AIRPLANE MAINTENANCE MANUAL

PA-32R-301

Saratoga II HP

(S/N'S 3246001 & UP)

PA-32R-301T

Saratoga II TC

(S/N'S 3257001 & UP)

PIPER AIRCRAFT, INC.

PART NUMBER 761-879 **AUGUST 31, 2019**

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2926 Piper Drive
Vero Beach, Florida 32960
U.S.A.

GAMA

Member
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Manufacturers Association

REVISION STATUS

1. Definitions

A. Revision

The data in the revision column is comprised of two elements:

(1) A Type of Revision Code: ORG = Original, CR = Complete Revision, and PR = Partial Revision.

NOTE: Partial Revisions (PR) are listed only until the next Complete Revision (CR) is published. Then they are removed.

(2) The Revision Date in YYMMDD format.

NOTE: The Revision Date is the date placed on each revised page. It exists to separate one version of a page from another. Revision Date does not indicate the calendar date when the revision was actually published and available to the public. However, ***this is the date that appears in the Current Revision Checklist*** in the Customer Service Information File.

B. Publication Date

Publication Date usage has varied over the years. 1995–1996 is unknown. 1997–2013 it generally was synchronized with the revision date regardless of when the revision was published. In mid 2013 and later, the Publication Date is the calendar date when the revision was actually published and available to the public.

NOTE: ***This date does not appear in the Current Revision Checklist*** in the Customer Service Information File.

2. Revisions

Revisions to this Maintenance Manual (P/N 761-879), originally published June 24, 1996, are as follows:

Revision	Publication Date
ORG950712	June 24, 1996
CR970701	July 1, 1997
CR060930	September 30, 2006
CR070630	June 30, 2007
PR071126	November 26, 2007
PR080131	January 31, 2008
PR090228	February 28, 2009
PR091231	December 31, 2009
PR110131	January 31, 2011
PR120321	March 21, 2012
PR130731	October 23, 2013
PR190731	September 13, 2019

3. Availability

This maintenance manual, related inspection reports and manuals, service publications (SB, SL, etc.) and other Piper publications are available as described in the Owner Publications Catalog (part of the Customer Service Information File, see below).

Consult the “Customer Service Information File” (a free download from the Piper Aircraft, Inc. website at http://www.piper.com/technical-publications-documents/) to verify that you have the latest revision.

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INTRODUCTION

LIST OF EFFECTIVE PAGES

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INTRODUCTION

1. Instructions for Continued Airworthiness

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

The Piper PA-32R-301 Saratoga II HP / PA-32R-301T Saratoga II 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).

2. General

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

WARNING: USE ONLY GENUINE PIPER PARTS OR PIPER 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 ensure 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.

Piper Aircraft, Inc. expressly disclaims any responsibility for malfunctions, failures, damage or injury caused by use of non-PIPER approved parts.

NOTE: 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.

Also, Piper Aircraft, Inc. may possess manufacturer's data which defines minimum type design beyond what may be assumed by an authorized repair entity. When a repair is proposed, it is the responsibility of the repairer per AC 43.13-1 to determine that the proposed repair is not contrary to manufacturer's data. The repairer or aircraft owner or his agent should contact Piper directly to determine that a proposed repair is not in conflict with minimum type design capability.

If you have any question concerning the care of your airplane, be sure to include the airplane serial number in any correspondence to Piper.

CHART 1
MODEL YEARS

PA-32R-301 Saratoga II HP		PA-32R-301T Saratoga II TC	
Model Year	**Serial Numbers**	**Model Year**	**Serial Numbers**
1995	3246001 thru 3246017	Prototype	3257001
1996	3246018 thru 3246059	1998	3257002 thru 3257075
1997	3246060 thru 3246087	1999	3257076 thru 3257123
1998	3246088 thru 3246125	2000	3257124 thru 3257155; less 3257144
1999	3246126 thru 3246153	2000.5	3257156 thru 3257198; and 3257144
2000	3246154 thru 3246165	2001	3257199 thru 3257266
2000.5	3246166 thru 3246181	2002	3257267 thru 3257296
2001	3246182 thru 3246203	2003	3257297 thru 3257338
2002	3246204 thru 3246209	2004	3257339 thru 3257369
2003	3246210 thru 3246217	2005	3257370 thru 3257400
2004	3246218 thru 3246226	2006	3257401 thru 3257439
2005	3246227 thru 3246232	2007	3257440 thru 3257477
2006	3246233 thru 3246244	2008	3257478 thru 3257493

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

3. Effectivity

This maintenance manual is effective for PA-32R-301 Saratoga II HP airplane serial numbers 3246001 and up, and PA-32R-301T Saratoga II TC airplane serial numbers 3257001 and up. This encompasses the model years shown in Chart 1.

4. Serial Number Explanation

Example:

32 46 001

TYPE CERTIFICATE DESIGNATION

SEQUENCE NUMBER

MODEL CODE
46 = PA-32R-301 SARATOGA II HP
57 = PA-32R-301T SARATOGA II TC

5. Assignment of Subject Material

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

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

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

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

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

6. Pagination

The Chapter - Section (i.e. - 28-40-00) numbering system (explained above) forms the primary page numbering system for this manual. Within each Section, pages are numbered consecutively beginning with Page 1 (i.e. - 28-40-00, Page 1). Additionally, a modified legacy Aerofiche grid numbering system (explained below) will be used to indicate location within the manual until the next complete revision.

7. Aerofiche Grid Numbering

Piper has ceased production of all Aerofiche (i.e., microfiche) products. The Aerofiche grid numbers will be removed in the next complete revision. In the interim, as partial revisions occur, the Aerofiche grid numbering system may be modified, as explained below, to simplify production.

Deviations from the legacy Aerofiche grid numbering system will occur when it becomes necessary to add pages to the manual and will typically take two forms:

A. Inserting pages between two existing grids in the same row.

When inserting two pages between the existing grids 1A8 and 1A9, the two new pages will be numbered 1A8A and 1A8B.

B. Inserting pages at the end of an Aerofiche grid row.

The legacy Aerofiche grid numbering system limited page numbers in a row to a maximum of 24 (i.e., row 1A would be numbered 1A1–1A24). That limit no longer applies. Accordingly, if two pages need to be added between any existing grid row end and grid row start (i.e., 1A24 and 1B1), the new pages will simply be numbered 1A25 and 1A26.

8. Identifying Revised Material

A vertical line (i. e. - change bar) along the left-hand margin of the page (or text column) is used to identify revised text or illustrations.

Example.

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.

Change bars in the individual chapter Tables of Contents do not indicate a change to that page, but rather that the information in the actual paragraph has changed.

NOTE: Change bars are not used in the title pages, list of effective pages, or the Index. Likewise, when a publication is completely revised (i.e. - reissued), change bars will only appear in the Tables of Contents.

A. 2007 thru 2011

A revision to a page was defined as any change to the printed matter that existed previously. Revisions, additions and deletions are identified by a change bar opposite only that portion of the printed matter that was changed.

B. 2012 and up

A revision to a page is defined as a change to the text or illustrations that existed previously. Revisions, additions and deletions are identified by a change bar opposite only the text or illustration that was changed. Reformatted, but otherwise unchanged, text (i.e., paragraph numbering, etc.) is not identified by a change bar.

9. Indexing

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

10. List of Effective Pages

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

11. Warnings, Cautions and Notes

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

12. Accident/Incident Reporting

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

13. Supplementary Publications

The following publications/sources provide servicing, overhaul and parts information for the PA-32R-301 / PA-32R-301T airplanes and their various components. Use them to supplement this manual.

A. Piper Publications:

	Part Number
(1) Parts Catalog	761-880
(2) Progressive Inspection Manuals (50 hour):	
SARATOGA II HP (S/N's 3246001 & up)	767-016
SARATOGA II TC (S/N's 3257001 & up)	767-015
(3) Periodic Inspection Report Forms:	
SARATOGA II HP (S/N's 3246001 & up)	230-1047
SARATOGA II TC (S/N's 3257001 & up)	230-2047

B. Vendor Publications:

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

(1) AIR CONDITIONING COMPRESSOR:

Vendor: Climate Control Inc.
2120 N. 22nd Street
Decatur, Illinois 62526
(217) 422-0055
http://www.ccicompressor.com

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

(2) ALTERNATOR:

Vendor: Hartzell Engine Technologies
2900 Selma Highway
Montgomery, Alabama 36108
http://www.hartzellenginetech.com/
PH: (877) 359-5355
(334) 386-5400
FAX: (334) 386-5410

Overhaul Manual: Manual OE-A2

(3) 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

(4) BATTERY:

Vendor: Gill/Teledyne Battery Products
840 W. Brockton Ave.
Redlands, California 92374
http://www.gillbatteries.com/
PH: (800) 456-0070

(5) 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

(6) ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS)

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
Multifunction Display:	Document No. AVMFD-167
Data Acquisition Unit:	Document No. AVSIU-011

or,

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

(7) EMERGENCY LOCATOR TRANSMITTER:

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

(8) EMERGENCY BATTERY:

Vendor:	Concorde Battery Corporation 2009 San Bernardino Road West Covina, CA 91790 http://www.concordebattery.com/	PH: FAX:	(626) 813-1234 (626) 813-1235

Instructions for Continued Airworthiness:

Component Maintenance Manual:	Document No. 5-0167

(9) ENGINE:

Vendor:	Lycoming Engines 652 Oliver Street Williamsport, Pennsylvania 17701 http://www.lycoming.com/	PH: FAX:	(717) 323-6181 (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-315-10		
Operators Handbook:	O-540, IO-540 SERIES - P/N 60297-10 TIO-540 Series - P/N 60297-23		

(10) ENGINE FUEL CONTROL SYSTEMS:

Vendor:	Precision Airmotive LLC 14800 40th Ave NE Marysville, WA 98271 http://www.precisionairmotive.com/	PH: FAX:	(360) 651-8282 (360) 651-8080

(11) ELECTRIC FUEL PUMP:

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

(12) FUEL CELLS:

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

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

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

(14) HI-LOK FASTENERS AND TOOLS:

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

(15) INADVERTENT ICE PROTECTION SYSTEM (TKS):

Vendor:	Aerospace Systems and Technologies, Inc. 3213 Arnold Ave. Salina, Kansas 67401 http://www.weepingwings.com/	 PH: FAX:	 (785) 493-0946 (785) 493-0950

(16) LIGHTS - NAVIGATION/STROBE LIGHTS STANDBY/MAP:

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

(17) MAGNETOS:

Vendor:	Slick Aircraft Products Champion Aerospace P.O. Box 686 1230 Old Norris Road Liberty, SC 29657 http://www.championaerospace.com/	PH:	(904) 772-1909
Installation, Operation and Maintenance Instructions:	F1100 MASTER SERVICE MANUAL, 4300/6300 SERIES MAGNETO MAINTENANCE AND OVERHAUL MANUAL - L-1363		

(18) 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

(19) OXYGEN SYSTEM: (SARATOGA II TC ONLY)

Vendor:	Avox Systems 2225 Erie Street Lancaster, New York 14086 http://www.avoxsystems.com/	PH:	(716) 683-5100

(20) PROPELLER:

Vendor:	Hartzell Propeller Inc. One Propeller Place Piqua, OH 45356-2634 http://www.hartzellprop.com/index2.htm	PH: FAX:	(937) 778-4379 (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		

(21) PROPELLER GOVERNOR:

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

(22) 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: FAX:	(316) 630-0101 (316) 630-0723
Installation Manual and Operating Instructions:	Manual No. 9015762		

(23) STARTER:

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

(24) VACUUM PUMPS:

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

(25) 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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14. Chapter/Section Index Guide

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

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GRIDS 1B8 THRU 1B24
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CHAPTER

4

AIRWORTHINESS LIMITATIONS

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CHAPTER 4

LIST OF EFFECTIVE PAGES

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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. Approved Mandatory Replacement Times for Type Certification (PIR-TCDS-A3SO, Rev. 32.)

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. Approved Mandatory Structural Inspection Intervals

None.

3. Inspection Procedures for those Approved Mandatory Structural Inspection Items

None.

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CHAPTER

5

TIME LIMITS / MAINTENANCE CHECKS

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CHAPTER 5

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
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	2	Jun 30/07
5-Table of Contents	1	Jul 31/13
	2	Jul 31/13
5-00-00	1	Jul 31/13
	2	Jun 30/07
5-10-00	1	Jul 31/13
	2	Jun 30/07
5-20-00	1	Mar 21/12
	2	Dec 31/09
	3	Mar 21/12
	4	Mar 21/12
	5	Jun 30/07
	6	Jun 30/07
	7	Mar 21/12
	8	Jul 31/13
	9	Jul 31/13
	10	Jul 31/13
	11	Jul 31/13
	12	Mar 21/12
	13	Mar 21/12
	14	Mar 21/12
	15	Jul 31/13
	16	Jul 31/13
	17	Jul 31/13
	18	Jul 31/13
	19	Jul 31/13
	20	Jun 30/07
	21	Mar 21/12
	22	Jul 31/13
	23	Jul 31/13
	24	Jul 31/13
	25	Jul 31/13
	26	Jul 31/13
	27	Mar 21/12
	28	Mar 21/12
	29	Jul 31/13
	30	Jul 31/13
5-20-00 (cont.)	31	Jul 31/13
	32	Jul 31/13
	33	Jul 31/13
	34	Jun 30/07
5-30-00	1	Jul 31/13
	2	Jul 31/13
	3	Jul 31/13
	4	Jul 31/13
	5	Jul 31/13
	6	Jul 31/13
	7	Jul 31/13
	8	Jul 31/13
	9	Jul 31/13
	10	Jul 31/13
5-50-00	1	Jan 31/08
	2	Jan 31/08
	3	Jan 31/08
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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

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

A. The recurring maintenance schedule for the PA-32R-301/301T Saratoga II HP / TC is provided in 5-20-00.

B. Piper Service Bulletins are of special importance and Piper considers compliance mandatory.

C. Service Letters deal with product improvements and service hints pertaining to the affected aircraft. Owners should give careful attention to service letter information so they can ensure their airplane is properly serviced and kept up to date with the latest changes.

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

E. Service Bulletins, Service Letters and Service Spares Letters are emailed to Piper Dealers/Service Centers. Owners are encouraged to download these service publications from http://www.piper.com/.

NOTE: Piper mails flight manual (AFM / POH) 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 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 flight manual revisions during this interim period through their Piper Dealer/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 their service. The owner is solely responsible for being aware of and complying with airworthiness directives.

NOTE: A searchable database of AD's is available on the FAA website. See the "Airworthiness Directives" link at www.faa.gov.

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

Service Bulletins, Service Letters, and Service Spares Letters are also available by subscription. See the availability statement in Revision Status.

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TIME LIMITS

1. General

   A. 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.

   B. Refer to 5-20-00 for Piper's recommended Inspection Programs. They include the frequency and extent of the inspections required for the continued airworthiness of these airplanes.

   C. 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.

2. 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. As stated in 4-00-00, there are no life limited parts defined by Type Certificate (TC). Other parts which are replaced or rebuilt after having accumulated cycles, hours, or other replacement limit are specified in 5-20-00 or 5-30-00.

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

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

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SCHEDULED MAINTENANCE

This section provides instructions for conducting inspections. Repair or replacement instructions for those components found to be unserviceable during inspections will be found in the applicable airplane system chapter. (See Chapter/Section Index Guide, Introduction.)

WARNING: GROUND THE MAGNETO PRIMARY CIRCUIT (P LEAD), BEFORE PERFORMING ANY MAINTENANCE OPERATION ON THE 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 the PA-32R-301T Saratoga II TC are provided herein as Annual / 100 Hour Inspections. Progressive Inspection Programs are available in a separate manual form. See the availability statement in Revision Status.

Piper inspection programs comply with the F.A.A. 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 accomplished only by persons authorized by the FAA or appropriate National Aviation Authority who are qualified on these 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 test 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.

Inspections must be accomplished by persons authorized by the FAA or appropriate National Aviation Authority.

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.

B. Progressive Inspection.

The Progressive Inspection program is designed to permit the best utilization of the aircraft through the use of a planned inspection schedule. These schedules:

P/N 767-016 for the Saratoga II HP (S/N's 3246001 & up), and

P/N 767-015 for the Saratoga II TC (S/N's 3257001 & up).

are prepared in manual form. See the availability statement in Revision Status.

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

NOTE: The 50 Hour Progressive Inspection Manuals (P/N 767-015 and 767-016) referenced above are not stand-alone documents. They constitute a snapshot of the Airworthiness Limitations and Inspection sections of the Instructions for Continued Airworthiness (ICA) and are 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 and applicable vendor publications.

4. Annual / 100 Hour Inspection Procedure

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

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.

(1) The required periodic inspection procedures are listed in paragraph 5 (PA-32R-301), and 6 (PA-32R-301T). These inspection procedures are broken down into major groups which include Propeller, Engine, Turbocharger (where applicable), Cabin and Cockpit, Fuselage and Empennage, Wing, Landing Gear, Special Inspections, Operational Inspection, and General. The first column in each group lists the inspection or procedure to be performed. The second column is divided into two sub-columns indicating the required inspection interval of 50 hours or 100 hours. Each inspection or operation is required at each of the inspection intervals indicated by a circle (O). When a vendor publication specifies a time outside the 50 / 100 hour cycle, it will be listed as a special inspection in 5-30-00.

(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:

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).

are available. See the availability statement in Revision Status.

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

(4) In addition to inspection intervals required in scheduled maintenance (i.e. - paragraph 5 or 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, 12-20-00		O
5. Inspect spinner mounting brackets for cracks and security		O
6. Inspect propeller mounting bolts for condition and security. If safety is broken, re-torque and safety		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
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 cowling 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
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 fittings 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 cowling or in Lubrication Chart, 12-20-00	O	O
CAUTION: USE CAUTION NOT TO CONTAMINATE VACUUM PUMP WITH CLEANING FLUID.		
10. Clean engine with approved solvents		O

5. Scheduled Maintenance - Saratoga II HP (S/N's 3246001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
B. ENGINE GROUP (CONT.)		
11. Inspect condition of spark plugs. Clean and adjust gap as required; adjust per latest revision 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
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. Inspect magnetos for oil seal leakage		O
18. Inspect magnetos to engine timing		O
19. Remove air filter and clean per 12-20-00. Replace as required	O	O
20. Clean fuel injector inlet line screen	O	O
21. Inspect condition of alternate air valve and housing	O	O
22. Inspect intake seals for leaks and clamps for tightness. (Torque clamps 40–50 in.-lbs.)	O	O
23. Inspect all air inlet duct hoses. Replace as required	O	O
24. Inspect condition of flexible fuel lines		O
25. Inspect fuel system for leaks		O
26. Inspect engine-driven and electric fuel pumps for condition and operation. Replace as required		O
27. If installed, inspect and operationally test engine driven and auxiliary vacuum pumps and lines. (See Notes 10, 11, and 20.)		O
28. Inspect throttle, alternate air, mixture, and propeller governor controls for security, travel, and operation condition		O
29. Inspect exhaust stacks, connections and gaskets. Replace gaskets as required. (See 100 Hour Inspection, 78-00-00.)	O	O
30. Inspect muffler, heat exchange, and baffles. (See 100 Hour Inspection, 78-00-00.)	O	O
31. Inspect breather tube for obstructions and security		O
32. Inspect crankcase for cracks, leaks, and security of seam bolts		O
33. Inspect engine mounts for cracks and loose mounting. (See Note 22.)		O
34. Inspect all engine baffles.		O
35. Inspect rubber engine mount bushings for deterioration. (Replace as required.)		O
36. Inspect firewall seals		O
37. Inspect condition and tension of alternator drive belt. (Refer to 24-30-00; or 21-50-00, if air conditioning is installed.)	O	O
38. 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
39. Inspect condition of alternator and starter.		O
40. Inspect security of alternator and mounting		O
41. If installed, inspect Standby Alternator per 100 Hour Standby Alternator Inspection, 24-30-00		O
42. If installed, inspect air conditioning compressor oil level. (See Note 12.)		O

5. Scheduled Maintenance - Saratoga II HP (S/N's 3246001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
B. ENGINE GROUP (CONT.)		
43. If installed, inspect condition of compressor belt and tension. (Refer to 21-50-00.)	O	O
44. If installed, inspect compressor clutch security and wiring. (See Note 13.)		O
45. If installed, inspect compressor mounting for cracks, corrosion, and security		O
46. Check fluid in brake reservoir. Fill as required.	O	O
47. If installed, perform Inadvertent Ice Protection System (TKS) 50 Hour Inspection, 30-10-00	O	O
48. Inspect condition and security of all controls.		O
49. Lubricate per Lubrication Chart, 12-20-00	O	O
50. Install engine cowling	O	O
C. CABIN AND COCKPIT GROUP		
1. Inspect cabin doors and windows for damage, operation and security		O
2. Inspect windows for scratches, crazing and condition.		O
3. Inspect window and door seals for deterioration, cracks and voids. (Refer to Chapter 56.)		O
4. Inspect upholstery for tears		O
5. Inspect seats and attaching brackets and hardware for condition, security and operation		O
6. Inspect seat belts and shoulder harnesses per 25-10-00, Restraint System		O
7. Inspect trim operation		O
8. Inspect rudder pedals		O
9. Inspect parking brake valve and brake handle for operation and cylinder leaks		O
10. Inspect control wheels, column, pulleys, cables, turnbuckles, and fittings for condition, security, and full travel. Inspect cables per Control Cable Inspection, 27-00-00.		O
11. Cycle each circuit breaker with airplane power off	O	O
12. Check landing, navigation, strobe, cabin, and instrument lights	O	O
13. Inspect instruments, lines, and attachments		O
14. Inspect gyro operated instruments (if installed), and electric turn and bank. (Overhaul or replace as required.)		O
15. If installed, replace vacuum regulator filter element		O
16. Inspect static system, altimeter (and ADAHRS (in Avidyne PFD), if installed) and transponder for installation/certification per latest revision of AC43.13-1 and current test/inspection per FAR's 91.411 and 91.413, respectively		O
17. Inspect operation of fuel selector valve		O
18. Inspect fuel valve drain lever cover for security. Check that door opens and closes freely and prevents operation of lever when closed	O	O
19. Inspect condition of heater controls and ducts		O
20. Inspect condition and operation of air vents		O
21. Inspect condition of air conditioning ducts		O
22. If installed, remove and clean air conditioning evaporator filter.		O
23. If installed, inspect portable fire extinguisher minimum weight as specified on nameplate		O

5. Scheduled Maintenance - Saratoga II HP (S/N's 3246001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
D. FUSELAGE AND EMPENNAGE GROUP		
1. Remove inspection plates and panels. (See Figure 3, 6-00-00.)		O
2. Inspect aft wing attach fittings for corrosion per Aft Wing Attach Fittings 100 Hour Inspection, 53-20-00		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 24-30-00		O
5. Conduct a general visual inspection of electrical and electronic installations (mounting, wiring, harnesses, shields, connectors, etc.) for condition and security		O
6. Inspect skins, bulkheads, frames, and stringers for damage, irregularities, or structural defects (i.e. - skin cracks, distortion, dents, corrosion, and loose or missing rivets)		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. If installed, inspect air conditioning system for refrigerant leaks. (See Note 12.)		O
11. If installed, inspect refrigerant level in sight gauge of receiver-dehydrator. (Refer to 21-50-00.)	O	O
12. If installed, inspect air conditioner condenser air scoop for condition and rigging. (See Note 19.)	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. Flush selector valve		O
15. Inspect security of all lines		O
16. Inspect electric flap screw jack and attachments for condition and lubrication		O
17. Inspect vertical fin for surface damage or irregularities (i.e. - skin cracks, distortion, dents, and corrosion); structural defects (i.e. - loose or missing rivets); and attachment points for missing or worn hardware		O
18. Inspect vertical fin attachments for security		O
19. Inspect rudder for surface damage or irregularities (i.e. - skin cracks, distortion, dents, and corrosion); structural defects (i.e. - loose or missing rivets); misrigging; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware		O
20. Inspect rudder hinges, sector and attachments for damage, security and proper operation		O
21. Inspect rudder hinge bolts for excessive wear. Replace as required.		O
22. Inspect rudder control stops to ensure stops have not loosened and locknuts are tight		O
23. Inspect stabilator and tab for surface damage or irregularities (i.e. - skin cracks, distortion, dents, and corrosion); structural defects (i.e. - loose or missing rivets); misrigging; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware		O
24. Inspect stabilator tab hinges, horn, and attachments for damage, security, and operation		O
25. Inspect stabilator attachments and attach brackets per Stabilator Attach Brackets Corrosion Inspection, 55-20-00		O

5. Scheduled Maintenance - Saratoga II HP (S/N's 3246001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
D. FUSELAGE AND EMPENNAGE GROUP (CONT.)		
26. Inspect stabilator control stops to ensure stops are not loose. Ensure bolts and locknuts are tight		O
27. Inspect stabilator trim mechanism for safety, damage, and operation		O
28. Inspect rudder, stabilator, and stabilator trim cable tensions per 27-00-00, Chart 2. Use a tensiometer		O
29. Inspect aileron, rudder, stabilator, and stabilator trim cables; and cable terminals, turnbuckles, guides, fittings, and pulleys for safety, condition, and operation per Control Cable Inspection, 27-00-00		O
30. Lubricate per Lubrication Chart, 12-20-00	O	O
31. Inspect anti-collision light for security and operation	O	O
32. If installed, inspect security of Autopilot bridle cables and clamps. Inspect condition of cables per Control Cable Inspection, 27-00-00		O
33. Inspect air ducts, electrical leads, lines, radio antenna leads, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation. Perform 100 Hour Inspection, 51-80-00		O
34. Inspect ELT battery mount for condition and security		O
35. Inspect ELT antenna for condition, security, and operation (check operation per Antenna Test in 25-60-00). Replace antenna if bent or damaged		O
36. Install inspection plates and panels		O
37. Inspect static wicks per Static Wicks, Inspection, 23-60-00. (Replace as required.)		O
E. WING GROUP		
1. Remove inspection plates and fairings. (See Figure 3, 6-00-00.)		O
2. Inspect surfaces and tips for damage, loose rivets, and condition of walkway. (See Note 21.)		O
3. Inspect ailerons for surface damage or irregularities (i.e. - skin cracks, distortion, dents, and corrosion); structural defects (i.e. - loose or missing rivets); misrigging; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware. (See Note 8.)		O
4. Inspect aileron hinges and attachments		O
5. Inspect aileron control stops to ensure stops have not loosened and locknuts are tight.		O
6. Inspect aileron cables and cable terminals, turnbuckles, fittings, guides, pulleys, and bellcranks for safety, condition, and operation per Control Cable Inspection, 27-00-00		O
7. Inspect aileron cable tension per 27-00-00, Chart 2. Use a tensiometer		O
8. Inspect pitot tube for damage and condition		O
CAUTION: SEVERE BURNS CAN RESULT FROM COMING IN CONTACT WITH A HEATED PITOT TUBE.		
9. Check pitot heat		O
10. Inspect flaps for surface damage or irregularities (i.e. - skin cracks, distortion, dents, and corrosion); structural defects (i.e. - loose or missing rivets); misrigging; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware		O

5. Scheduled Maintenance - Saratoga II HP (S/N's 3246001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
E. WING GROUP (CONT.)		
11. Inspect condition of flap hinge bolts. Replace as required		O
12. Lubricate per Lubrication Chart, 12-20-00	O	O
13. Inspect wing attachment bolts and brackets for security and condition. (See Note 14.)		O
14. Inspect fuel tanks and lines for leaks and water. (See Note 15.)		O
15. Inspect fuel tanks for minimum octane markings		O
16. Inspect fuel caps, cap gaskets, fuel filler neck gaskets, sight gauge gaskets, fuel gauge transmitter gaskets, gauge transmitter access covers, and upper surface inspection covers for condition, proper sealing, security, alignment, etc. Ensure to service and clean these areas, replacing parts as necessary		O
17. Inspect the interior of metal fuel tanks for signs of corrosion, which may indicate water contamination. If signs of contamination are found, alert the owner and fuel supplier of your findings for corrective action		O
18. Inspect the interior of bladder tanks for wrinkles, broken or missing hangers, etc. If signs of contamination are found, alert the owner and fuel supplier of your findings for corrective action		O
19. Inspect fuel cell vents		O
20. Inspect air ducts, electrical leads, lines, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation		O
21. Install inspection plates and fairings		O
22. Inspect static wicks per Static Wicks, Inspection, 23-60-00. (Replace as required.)		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 per 7-10-00		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 condition and 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

5. Scheduled Maintenance - Saratoga II HP (S/N's 3246001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
F. LANDING GEAR GROUP (CONT.)		
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		O
25. Inspect hydraulic lines, electrical leads, and attaching parts for condition and security (i.e., routing, chafing, damage, wear, etc.)		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.		
H. OPERATIONAL INSPECTION		
NOTE: Refer to Note 16 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. If installed, check vacuum gauge	O	O
9. If installed, 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 17.)	O	O
20. If installed, check air conditioner compressor clutch operation	O	O
21. If installed, check air conditioner condenser scoop operation	O	O
22. Fly airplane, check Landing Gear System. (See Note 18.)	O	O

5. Scheduled Maintenance - Saratoga II HP (S/N's 3246001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
I. GENERAL		
1. Aircraft conforms to FAA Specifications	O	O
2. Latest revision of applicable FAA Airworthiness Directives complied with	O	O
3. Current and correct Pilot's Operating Handbook (POH) is in the airplane	O	O
4. Check airplane for required placards as specified in Section 2 of the POH		O
5. Appropriate entries made in the Aircraft and Engine Log books	O	O
6. Airworthiness & Registration Certificates in the aircraft and properly displayed	O	O
7. Aircraft Equipment List, Weight and Balance and FAA Form(s) 337 (if applicable) are in the aircraft and in proper order	O	O
8. Operational inspection and run-up completed	O	O
9. Aircraft cleaned and lubricated after wash (as required)	O	O

J. NOTES

1. Refer to Piper's Customer Service Information File P/N 1753-755 (available online at http://pubs.piper.com) for latest revision dates to Piper Inspection Reports/Manuals and this maintenance manual. References to Chapter/Section are to the appropriate Chapter/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 or appropriate National Aviation Authority.
   (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 (available online at http://pubs.piper.com) to verify latest revision. See also Chart 1.
4. Piper Service Letters are product improvements and service hints pertaining to servicing the airplane and should be given careful attention.

5. Scheduled Maintenance - Saratoga II HP (S/N's 3246001 & up) (continued)

J. NOTES (CONT.)

5. Inspections given for the power plant are based on the engine manufacturer's operator's manual (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. Should fuel other than the specified octane rating for the power plant be used, refer to the latest revision of Lycoming Service Letter No. L185 for additional information and recommended service procedures.
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 Lycoming Service Bulletin No. 480 and Service Instruction No. 1492.
8. In S/N's 3246001 thru 3246244, for those airplanes on which new left and right aileron assemblies are not installed, new outboard center nose rib assemblies P/N's 86398-008 (left hand side) and 86398-009 (right hand side) are not installed, and which have accumulated 500 or more hours time-in-service: perform Aileron Outboard Center Nose Rib Assembly 100 Hour Inspection, 57-50-00.
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. For airplanes equipped with Aero Accessories Inc. Tempest Dry Air Pumps, which have accumulated 500 hours time-in-service: each 100 hours, inspect vacuum pump vane wear per Vacuum Pump(s), Inspection, 37-10-00.
11. 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.

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

12. 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.
13. Clean any traces of oil from the clutch surface.
14. Verify torque at forward and aft spar attach per 57-40-00, Figure 1.
15. Sloshing of fuel tanks not approved.
16. Refer to Section 4 of the Pilot's Operating Handbook for preflight and flight check list.
17. Refer to Pilot's Operating Handbook Supplement for preflight and flight check and for intended function in all modes.
18. Fly airplane to check landing gear system in accordance with instructions given in 32-60-00, Operational Check of Retractable Landing Gear and Flap Warning Systems.
19. Refer to 21-50-00, Condenser Assembly Rigging, and verify/check microswitch adjustment.
20. For airplanes equipped with Parker Hannifin / Airborne vacuum pump(s), verify compliance with Parker Hannifin / Airborne Service Letter No. 72.

5. Scheduled Maintenance - Saratoga II HP (S/N's 3246001 & up) (continued)

J. NOTES (CONT.)

21. In S/N's 3246001 thru 3246236 only, in airplanes which have not installed Piper Kits No. 767-397 (LH) and 767-398 (RH) and do not have wing rib assemblies at W.S. 49.25 with date codes of 8313 or higher, conduct 100 Hour Wing Rib Inspection 57-10-00.
22. In S/N's 3246001 thru 3246204 only, in airplanes which have not repaired the original equipment engine mount per Piper Service Bulletin No. 1092B (or 71-20-00) and have not installed a replacement engine mount P/N 38729-21, inspect the engine mount per Engine Mount 100 Hour Inspection, 71-20-00.

CHART 1 (Sheet 1 of 3)
SERVICE PUBLICATIONS LIST - SARATOGA II HP

This chart is a cumulative list of Piper service publications (i.e. - Service Bulletins, Service Letters, and Vendor Service Publications) applicable to the airplane model covered by this manual, with the following exceptions:

A. The following service publications have been incorporated into this manual and are not listed below: Service Bulletins 856, 977, 990, 1006, 1011, 1048, 1092B, 1161, 1162B, 1216B, 1244A, and 1245A; Service Letters 609, 903A, 1032, 1041, 1052, 1069, 1074, 1106A, 1108, 1116, 1135, and 1165.

B. Nor are service publications which have become obsolete.

Kits are listed when installation of that single kit indicates compliance with the associated service publication. Kits listed may be no longer available or may have been replaced.

Effectivity is listed by airplane model and year. See the individual service publication for specific serial number applicability.

Model	Year	Pub No.	Kit No.	Subject
PA-32R-301	1995	SB 993		KLN-90B GPS Wiring Modification
		SB 996		Missing Rivet in Upper Door Frame, Forward and Aft
	1995–1997	SB 1005		Addition of Drain Holes to the Engine Induction Air Inlet Scoops
		SB 1015A		Replacement of the Ammeter Shunt Wire Fuse Assemblies
	1995–1998	SB 1009		Replacement of the Engine Induction Air Inlet Elbow at the Fuel Injector Servo
		SB 1022		Inspection of Induction Air Filter and Distribution of Purolator Service Bulletin, SB090298.01 (AD 99-05-09)
		SB 1023		Inspection of Landing Gear Cylinders and Distribution of Parker Hannifin Service Bulletin SB7063
		SB 1024		Replacement of Control System Spacers and Inspection of Aileron Cables
		SB 1026	753-910	Dry Air Pump Flexible Couplings, Inspection/Replacement Parker Hannifin Airborne S/L No. 48
	1995–1999	SB 1020		Artex 110-4 ELT and Attachment Bracket
	1995–2000	SB 1041		Airborne Air Filter Elements, Inspection and Cleaning Airborne S/L No. 56
	1995–2001	SB 1049	766-684	Engine Baffle Brace Installation
		SB 1081A		Horizon Aerospace Analog Instrument Pointer Calibration
		VSP 142		Garmin SB-0204 New GPS Software
	1995–2002	VSP 137A		Cleveland (Parker) Service Bulletin 7073A, Landing Gear Retract Cylinder
	1995–2003	SB 1134		Servo Metered Fuel Pressure Port Leakage (Lycoming SB 557; Precision Airmotive SB PRS-105)
		VSP 155		Cleveland (Parker) Service Bulletin 7076, Landing Gear Actuator
	1995–2004	VSP 163		S-Tec SB's 04-001, 04-002R1 System 55X AutoPilot

CHART 1 (Sheet 2 of 3)
SERVICE PUBLICATIONS LIST - SARATOGA II HP

Model	Year	Pub No.	Kit No.	Subject
PA-32R-301 (cont.)	1995–2006	SB 1197D		Control Wheel Shaft Inspection
		SB 1198A		Fuel Selector O-Ring
		SB 1251		Stabilator Trim Barrel Inspection
		SL 578B		Lycoming Service Bulletin No. 342F, Fuel Line & Support Clamp Inspection & Installation
		SL 1093	767-390	Electrical Contractor Replacement Kit
		SL 1105	88422-2	Automatic Baggage Door Light Switch Upgrade Kit
		VSP 116B		Piston Pin Plug Wear Inspection Lycoming Service Instruction No. 1492D
		VSP 148		Lycoming SB 554, Supp 1, Crankshaft Gear Retaining Bolt Replacement
		VSP 170A		Lycoming SB 566, Supp 1, IO-540-K1G5 Crankshaft Replacement
		VSP 174		Lycoming SB 569, IO-540 or TIO-540, 540 Crankshaft
		VSP 175		S-Tec SB 06-001 Pitch Servo Inspection
		VSP 184		Lycoming SB 577, Sky-Tec SB 07-01
		VSP 196		Lycoming SB 583A - Reprint of Mandatory Slick Service Bulletin No. SB2-08: Inspections on all Slick 4300/6300 and LASAR 4700/6700
		VSP 197A		Lycoming SB 584B - Reprint of Mandatory Slick Service Bulletin No. SB3-08: Inspections on all Slick 4200/6200/4300/6300 and LASAR 4700/6700
	1996–1999	SB 1039		Manifold Pressure Gauge (MAP) Wiring Modification
	1996–2001	SL 1049		Voltage Regulator Replacement
	1998	SB 1028		Inspection of the Aileron Control Rod Attach Fitting and the Addition of Safety Clips
		SB 1031		Horizon Engine Instruments Repair or Replacement
	1998–2004	SB 1139A		Control Wheel Attachment Inspection
	1998–2006	SB 1162B		European Requirements for Avidyne Entegra Equipped PA-32 Model Aircraft
	1999	SB 1036		Garmin Service Bulletin No. 9905 "GNS430 Mod. 1"
	1999–2000	SL 1033		Air Conditioning Hose Replacement
	1999–2002	SB 1135		GMA-340 Audio Panel Wiring
	2000–2001	SB 1083C	767-318	S-TEC System 55X Autopilot
	2000–2006	VSP 143		S-Tec SB 02-001 AutoPilot Flight Manual Supplement
	2003	SB 1137		Stabilator Balance Weight Tube Assembly
		SB 1141		Clip Nut Replacement
	2004	SB 1151E		4130N Steel Hardness Discrepancy
		SL 1126		Voltage Suppressor Advisory
	2004–2006	SL 1123		Avidyne EXP5000 Software Upgrade
		VSP 172		Avidyne PFD SA-05-001
		VSP 182		Avidyne PFD Mandatory SB 601-00006-067
		VSP 183		Avidyne PFD Mandatory SB 601-00006-075
		VSP 191		Avidyne PFD SA-08-001
	2005	SB 1171		Stormscope Erroneous Strike Indication

CHART 1 (Sheet 3 of 3)
SERVICE PUBLICATIONS LIST - SARATOGA II HP

Model	Year	Pub No.	Kit No.	Subject
	2005–2006	SL 1089		Aircraft Painting Requirement
	2006	SB 1178		Nose Gear Forging Inspection/ Replacement
		SB 1187		Voltage Suppressor Replacement

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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
5. Inspect spinner mounting brackets for cracks and security		O
6. Inspect propeller mounting bolts for condition and security. If safety is broken, re-torque and safety		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
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 cowling 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
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 fittings 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 cowling or in Lubrication Chart, 12-20-00 .	O	O
CAUTION: USE CAUTION NOT TO CONTAMINATE VACUUM PUMP WITH CLEANING FLUID.		
10. Clean engine with approved solvents		O

6. Scheduled Maintenance - Saratoga II TC (S/N's 3257001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
B. ENGINE GROUP (CONT.)		
11. Inspect condition of spark plugs. Clean and adjust gap as required; adjust per latest revision 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
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. Inspect magnetos for oil seal leakage		O
18. Inspect magnetos to engine timing		O
19. Remove air filter and clean per 12-20-00. Replace as required	O	O
20. Clean fuel injector inlet line screen	O	O
21. Inspect condition of alternate air valve and housing	O	O
22. Inspect intake seals for leaks and clamps for tightness. (Torque clamps 40–50 in.-lbs.)	O	O
23. Inspect all air inlet duct hoses. Replace as required	O	O
24. Inspect condition of flexible fuel lines		O
25. Inspect fuel system for leaks		O
26. Inspect engine-driven and electric fuel pumps for condition and operation. Replace as required (See Note 20.)		O
27. If installed, inspect and operationally test engine driven and auxiliary vacuum pumps and lines. (See Notes 10, 11 and 22.)		O
28. Inspect throttle, alternate air, mixture, and propeller governor controls for condition, security, travel, and operation		O
29. Inspect exhaust stacks, connections and gaskets. Replace gaskets as required. (See 100 Hour Inspection, 78-00-00.)	O	O
30. Inspect muffler, heat exchange, and baffles. (See 100 Hour Inspection, 78-00-00.)	O	O
31. Inspect breather tube for obstructions and security		O
32. Inspect crankcase for cracks, leaks, and security of seam bolts.		O
33. Inspect engine mounts for cracks and loose mounting. (See Note 24.)		O
34. Inspect all engine baffles.		O
35. Inspect rubber engine mount bushings for deterioration. (Replace as required.)		O
36. Inspect firewall seals		O
37. Inspect condition and tension of alternator drive belt. (Refer to 24-30-00; or 21-50-00, if air conditioning is installed.)	O	O
38. 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
39. Inspect condition of alternator and starter.		O
40. Inspect security of alternator and mounting		O
41. If installed, inspect Standby Alternator per 100 Hour Standby Alternator Inspection, 24-30-00		O
42. If installed, inspect air conditioning compressor oil level. (See Note 12.)		O

6. Scheduled Maintenance - Saratoga II TC (S/N's 3257001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
B. ENGINE GROUP (CONT.)		
43. If installed, inspect condition of compressor belt and tension. (Refer to 21-50-00.)	O	O
44. If installed, inspect compressor clutch security and wiring. (See Note 13.)		O
45. If installed, inspect compressor mounting for cracks, corrosion, and security		O
46. Check fluid in brake reservoir. Fill as required.	O	O
47. If installed, perform Inadvertent Ice Protection System (TKS) 50 Hour Inspection, 30-10-00	O	O
48. Inspect condition and security of all controls.		O
49. Lubricate per Lubrication Chart, 12-20-00	O	O
50. Install engine cowling	O	O
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.	O	O
3. Inspect exhaust ducting and exhaust stacks for tightness	O	O
4. Inspect exhaust heat exchanger		O
5. Perform V-Band Coupling 100 Hour Inspection, 81-20-00		O
6. Carefully inspect all turbo support brackets, struts, etc., for damage, sagging, and wear	O	O
7. Inspect all oil hoses, lines, and fittings for wear, leakage, heat damage, and fatigue	O	O
8. Inspect bypass valve for security and safety	O	O
9. Run up engine, and check all instruments for smooth, steady response	O	O
D. CABIN AND COCKPIT GROUP		
1. Inspect cabin doors and windows for damage, operation, and security		O
2. Inspect windows for scratches, crazing, and condition		O
3. Inspect window and door seals for deterioration, cracks, and voids. (Refer to Chapter 56.)		O
4. Inspect upholstery for tears.		O
5. Inspect seats and attaching brackets and hardware for condition, security, and operation		O
6. Inspect seat belts and shoulder harnesses per 25-10-00, Restraint System		O
7. Inspect trim operation		O
8. Inspect rudder pedals		O
9. Inspect parking brake valve and brake handle for operation and cylinder leaks		O
10. Inspect control wheels, column, pulleys, cables, turnbuckles, and fittings for condition, security and full travel. Inspect cables per Control Cable Inspection, 27-00-00		O

6. Scheduled Maintenance - Saratoga II TC (S/N's 3257001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
D. CABIN AND COCKPIT GROUP (CONT.)		
11. Cycle each circuit breaker with airplane power off	O	O
12. Check landing, navigation, strobe, cabin, and instrument lights	O	O
13. Inspect instruments, lines and attachments. (See Note 21.)		O
14. Inspect gyro operated instruments (if installed), and electric turn and bank. (Overhaul or replace as required.)		O
15. If installed, replace vacuum regulator filter element		O
16. Inspect static system, altimeter (and ADAHRS (in Avidyne PFD) or GDC 74A (Garmin), if installed) and transponder for installation/ certification per latest revision of AC43.13-1 and current test/inspection per FAR's 91.411 and 91.413, respectively		O
17. Inspect operation of fuel selector valve		O
18. Inspect fuel valve drain lever cover for security. Check that door opens and closes freely and prevents operation of lever when closed	O	O
19. Inspect condition of heater controls and ducts		O
20. Inspect condition and operation of air vents		O
21. Inspect condition of air conditioning ducts		O
22. If installed, remove and clean air conditioning evaporator filter		O
23. If installed, inspect portable fire extinguisher minimum weight as specified on nameplate		O
E. FUSELAGE AND EMPENNAGE GROUP		
1. Remove inspection plates and panels. (See Figure 3, 6-00-00.)		O
2. Inspect aft wing attach fittings for corrosion per Aft Wing Attach Fittings 100 Hour Inspection, 53-20-00		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 24-30-00.		O
5. Conduct a general visual inspection of electrical and electronic installations (mounting, wiring, harnesses, shields, connectors, etc.) for condition and security		O
6. Inspect skins, bulkheads, frames, and stringers for damage, irregularities, or structural defects (i.e. - skin cracks, distortion, dents, corrosion, and loose or missing rivets)		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. If installed, inspect air conditioning system for refrigerant leaks. (See Note 12.)		O
11. If installed, inspect refrigerant level in sight gauge of receiver-dehydrator. (Refer to 21-50-00.)	O	O
12. If installed, inspect air conditioner condenser air scoop for condition and rigging. (See Note 19.)	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. Flush selector valve		O
15. Inspect security of all lines		O
16. Inspect electric flap screw jack and attachments for condition and lubrication		O

6. Scheduled Maintenance - Saratoga II TC (S/N's 3257001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
E. FUSELAGE AND EMPENNAGE GROUP (CONT.)		
17. Inspect vertical fin for surface damage or irregularities (i.e. - skin cracks, distortion, dents, and corrosion); structural defects (i.e. - loose or missing rivets); and attachment points for missing or worn hardware		O
18. Inspect vertical fin attachments for security		O
19. Inspect rudder for surface damage or irregularities (i.e. - skin cracks, distortion, dents, and corrosion); structural defects (i.e. - loose or missing rivets); misrigging; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware		O
20. Inspect rudder hinges, sector and attachments for damage, security and proper operation		O
21. Inspect rudder hinge bolts for excessive wear. Replace as required.		O
22. Inspect rudder control stops to ensure stops have not loosened and locknuts are tight		O
23. Inspect stabilator and tab for surface damage or irregularities (i.e. - skin cracks, distortion, dents, and corrosion); structural defects (i.e. - loose or missing rivets); misrigging; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware		O
24. Inspect stabilator tab hinges, horn, and attachments for damage, security, and operation		O
25. Inspect stabilator attachments and attach brackets per Stabilator Attach Brackets Corrosion Inspection, 55-20-00.		O
26. Inspect stabilator control stops to ensure stops are not loose. Ensure bolts and locknuts are tight		O
27. Inspect stabilator trim mechanism for safety, damage, and operation		O
28. Inspect rudder, stabilator, and stabilator trim cable tensions per 27-00-00, Chart 2. Use a tensiometer.		O
29. Inspect aileron, rudder, stabilator, and stabilator trim cables; and cable terminals, turnbuckles, guides, fittings, and pulleys for safety, condition, and operation per Control Cable Inspection, 27-00-00.		O
30. Lubricate per Lubrication Chart, 12-20-00	O	O
31. Inspect anti-collision light for security and operation.	O	O
32. If installed, inspect security of Autopilot bridle cables and clamps. Inspect condition of cables per Control Cable Inspection, 27-00-00		O
33. Inspect air ducts, electrical leads, lines, radio antenna leads, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation. Perform 100 Hour Inspection, 51-80-00		O
34. Inspect ELT battery mount for condition and security		O
35. Inspect ELT antenna for condition, security, and operation (check operation per Antenna Test in 25-60-00). Replace antenna if bent or damaged		O
36. If installed, inspect oxygen system per 35-10-00		O
37. Install inspection plates and panels		O
38. Inspect static wicks per Static Wicks, Inspection, 23-60-00. (Replace as required.).		O

6. Scheduled Maintenance - Saratoga II TC (S/N's 3257001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
F. WING GROUP		
1. Remove inspection plates and fairings. (See Figure 3, 6-00-00.)		O
2. Inspect surfaces and tips for damage, loose rivets, and condition of walkway. (See Note 23.)		O
3. Inspect ailerons for surface damage or irregularities (i.e. - skin cracks, distortion, dents, and corrosion); structural defects (i.e. - loose or missing rivets); misrigging; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware. (See Note 8.)		O
4. Inspect aileron hinges and attachments		O
5. Inspect aileron control stops to ensure stops have not loosened and locknuts are tight		O
6. Inspect aileron cables and cable terminals, turnbuckles, fittings, guides, pulleys, and bellcranks for safety, condition, and operation per Control Cable Inspection, 27-00-00		O
7. Inspect aileron cable tension per 27-00-00, Chart 2. Use a tensiometer		O
8. Inspect pitot tube for damage and condition		O
CAUTION: SEVERE BURNS CAN RESULT FROM COMING IN CONTACT WITH A HEATED PITOT TUBE.		
9. Check pitot heat		O
10. Inspect flaps for surface damage or irregularities (i.e. - skin cracks, distortion, dents, and corrosion); structural defects (i.e. - loose or missing rivets); misrigging; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware		O
11. Inspect condition of flap hinge bolts. Replace as required		O
12. Lubricate per Lubrication Chart, 12-20-00	O	O
13. Inspect wing attachment bolts and brackets for security and condition. (See Note 14.)		O
14. Inspect fuel tanks and lines for leaks and water. (See Note 15.)		O
15. Inspect fuel tanks for minimum octane markings		O
16. Inspect fuel caps, cap gaskets, fuel filler neck gaskets, sight gauge gaskets, fuel gauge transmitter gaskets, gauge transmitter access covers, and upper surface inspection covers for condition, proper sealing, security, alignment, etc. Ensure to service and clean these areas, replacing parts as necessary		O
17. Inspect the interior of metal fuel tanks for signs of corrosion, which may indicate water contamination. If signs of contamination are found, alert the owner and fuel supplier of your findings for corrective action		O
18. Inspect the interior of bladder tanks for wrinkles, broken or missing hangers, etc. If signs of contamination are found, alert the owner and fuel supplier of your findings for corrective action		O
19. Inspect fuel cell vents		O
20. Inspect air ducts, electrical leads, lines, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation		O
21. Install inspection plates and fairings		O
22. Inspect static wicks per Static Wicks, Inspection, 23-60-00. (Replace as required.)		O

6. Scheduled Maintenance - Saratoga II TC (S/N's 3257001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
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 per 7-10-00		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 condition and 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
23. Inspect anti-retraction system		O
24. Inspect actuating cylinders for leaks and security		O
25. Inspect hydraulic lines, electrical leads, and attaching parts for condition and security (i.e. routing, chafing, damage, wear, etc.)		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.		
I. OPERATIONAL INSPECTION		
NOTE: Refer to Note 16 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. If installed, check vacuum gauge	O	O
9. If installed, check gyros for noise and roughness	O	O

6. Scheduled Maintenance - Saratoga II TC (S/N's 3257001 & up) (continued)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
I. OPERATIONAL INSPECTION (CONT.)		
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 17.)	O	O
20. If installed, check air conditioner compressor clutch operation	O	O
21. If installed, check air conditioner condenser scoop operation	O	O
22. Fly airplane, check Landing Gear System. (See Note 18.)	O	O
J. GENERAL		
1. Aircraft conforms to FAA Specifications	O	O
2. Latest revision of applicable FAA Airworthiness Directives complied with	O	O
3. Current and correct Pilot's Operating Handbook (POH) is in the airplane	O	O
4. Check airplane for required placards as specified in Section 2 of the POH		O
5. Appropriate entries made in the Aircraft and Engine Log books	O	O
6. Airworthiness & Registration Certificates in the aircraft and properly displayed	O	O
7. Aircraft Equipment List, Weight and Balance and FAA Form(s) 337 (if applicable) are in the aircraft and in proper order	O	O
8. Operational inspection and run-up completed	O	O
9. Aircraft cleaned and lubricated after wash (as required)	O	O

K. NOTES

1. Refer to Piper's Customer Service Information File P/N 1753-755 (available online at http://pubs.piper.com) for latest revision dates to Piper Inspection Reports/Manuals and this maintenance manual. References to Chapter/Section are to the appropriate Chapter/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.

6. Scheduled Maintenance - Saratoga II TC (S/N's 3257001 & up) (continued)

K. NOTES (CONT.)

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 or appropriate National Aviation Authority.
   (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 (available online at http://pubs.piper.com) to verify latest revision. See also Chart 2.
4. Piper Service Letters are product improvements and service hints pertaining to servicing the airplane and should be given careful attention.
5. Inspections given for the power plant are based on the engine manufacturer's operator's manual (Lycoming Part 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. Should fuel other than the specified octane rating for the power plant be used, refer to the latest revision of Lycoming Service Letter No. L185 for additional information and recommended service procedures.
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 Lycoming Service Bulletin No. 480 and Service Instruction No. 1492.
8. In S/N's 3257001 thru 3257493, for those airplanes on which new left and right aileron assemblies are not installed, new outboard center nose rib assemblies P/N's 86398-008 (left hand side) and 86398-009 (right hand side) are not installed, and which have accumulated 500 or more hours time-in-service: perform Aileron Outboard Center Nose Rib Assembly 100 Hour Inspection, 57-50-00.
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. For airplanes equipped with Aero Accessories Inc. Tempest Dry Air Pumps, which have accumulated 500 hours time-in-service; each 100 hours, inspect vacuum pump vane wear per Vacuum Pump(s), Inspection, 37-10-00.
11. 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.

6. Scheduled Maintenance - Saratoga II TC (S/N's 3257001 & up) (continued)

K. NOTES (CONT.)

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

12. 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.
13. Clean any traces of oil from the clutch surface.
14. Verify torque at forward and aft spar attach per 57-40-00, Figure 1.
15. Sloshing of fuel tanks not approved.
16. Refer to Section 4 of the Pilot's Operating Handbook for preflight and flight check list.
17. Refer to Pilot's Operating Handbook Supplement for preflight and flight check and for intended function in all modes.
18. Fly airplane to check landing gear system in accordance with instructions given in Chapter 32, Operational Check of Retractable Landing Gear and Flap Warning Systems.
19. Refer to 21-50-00, Condenser Assembly Rigging, and verify/check microswitch adjustment.
20. In S/N's 3257001 thru 3257102 only, for airplanes equipped with AN-type engine-driven fuel pump, Lear/Romec part no. RG9080J4A without a "/M" suffix following the Lear/Romec part number, verify compliance with Piper Service Bulletin No. 1035A. See also AD 2003-14-03.
21. For airplanes equipped with Garmin G1000 EFIS, conduct the 100 Hour inspection per 34-20-00, EFIS - Garmin, Inspections.
22. For airplanes equipped with Parker Hannifin / Airborne vacuum pump(s), verify compliance with Parker Hannifin / Airborne Service Letter No. 72.
23. In S/N's 3257001 thru 3257411 only, in airplanes which have not installed Piper Kits No. 767-397 (LH) and 767-398 (RH) and do not have wing rib assemblies at W.S. 49.25 with date codes of 8313 or higher, conduct 100 Hour Wing Rib Inspection 57-10-00.
24. In S/N's 3257001 thru 3257264 only, in airplanes which have not repaired the original equipment engine mount per Piper Service Bulletin No. 1092B (or 71-20-00) and have not installed a replacement engine mount P/N 38729-21, inspect the engine mount per Engine Mount 100 Hour Inspection, 71-20-00.

CHART 2 (Sheet 1 of 3)
SERVICE PUBLICATIONS LIST - SARATOGA II TC

This chart is a cumulative list of Piper service publications (i.e. - Service Bulletins, Service Letters, and Vendor Service Publications) applicable to the airplane model covered by this manual, with the following exceptions:

A. The following service publications have been incorporated into this manual and are not listed below: Service Bulletins 856, 884, 977, 1006, 1011, 1018A, 1035A, 1048, 1092B, 1161, 1162B, 1216B, 1244A, and 1245A; Service Letters 609, 903A, 1032, 1041, 1043, 1052, 1069, 1074, 1106A, 1108, 1116, 1135, and 1165.

B. Nor are service publications which have become obsolete.

Kits are listed when installation of that single kit indicates compliance with the associated service publication. Kits listed may be no longer available or may have been replaced.

Effectivity is listed by airplane model and year. See the individual service publication for specific serial number applicability.

Model	Year	Pub No.	Kit No.	Subject
PA-32R-301T	1998	SB 1020		Artex 110-4 ELT and Attachment Bracket
		SB 1023		Inspection of Landing Gear Cylinders and Distribution of Parker Hannifin Service Bulletin SB7063
		SB 1024		Replacement of Control System Spacers and Inspection of Aileron Cables
		SB 1025		Replacement of the Alternate Air Door
		SB 1026	753-910	Dry Air Pump Flexible Couplings, Inspection/Replacement Parker Hannifin Airborne S/L No. 48
		SB 1028		Inspection of the Aileron Control Rod Attach Fitting and the Addition of Safety Clips
		SB 1031		Horizon Engine Instruments Repair or Replacement
	1998–1999	SB 1030A		Distribution of Textron Lycoming Service Bulletin 538A, “Air Inlet tube Replacement” and Drain Improvement
		SB 1035A		Distribution of Textron Lycoming Service Bulletin 529B, “Reprint of Crane/Lear Romec Service Bulletin No. 101SB020, Rev. 3” (AD 2003-14-03)
		SB 1039		Manifold Pressure Gauge (MAP) Wiring Modification
	1998–2000	SB 1041		Airborne Air Filter Elements, Inspection and Cleaning Airborne S/L No. 56
	1998–2001	SB 1049	766-684	Engine Baffle Brace Installation
		SB 1081A		Horizon Aerospace Analog Instrument Pointer Calibration
	1998–2002	SL 1049		Voltage Regulator Replacement
		VSP 137A		Cleveland (Parker) Service Bulletin 7073A, Landing Gear Retract Cylinder
		VSP 142		Garmin SB-0204 New GPS Software
	1998–2003	SB 1134		Servo Metered Fuel Pressure Port Leakage (Lycoming SB 557; Precision Airmotive SB PRS-105)
		SB 1180A		V-Band Exhaust Couplings on Lycoming Turbocharged Engines
		VSP 155		Cleveland (Parker) Service Bulletin 7076, Landing Gear Actuator

CHART 2 (Sheet 2 of 3)
SERVICE PUBLICATIONS LIST - SARATOGA II TC

Model	Year	Pub No.	Kit No.	Subject
PA-32R-301T	1998–2004	SB 1139A		Control Wheel Attachment Inspection
(cont.)		SL 1084	767-333	Cabin Heater Improvement Kit
		VSP 163		S-Tec SB's 04-001, 04-002R1 System 55X AutoPilot
	1998–2006	SB 1162B		European Requirements for Avidyne Entegra Equipped PA-32 Model Aircraft
	1998–2007	SL 1105	88422-2	Automatic Baggage Door Light Switch Upgrade Kit
		VSP 184		Lycoming SB 577, Sky-Tec SB 07-01
	1998–2008	SB 1197D		Control Wheel Shaft Inspection
		SB 1198A		Fuel Selector O-Ring
		SB 1251		Stabilator Trim Barrel Inspection
		SL 578B		Lycoming Service Bulletin No. 342F, Fuel Line & Support Clamp Inspection & Installation
		SL 1093	767-390	Electrical Contractor Replacement Kit
		VSP 116B		Piston Pin Plug Wear Inspection Lycoming Service Instruction No. 1492D
		VSP 148		Lycoming SB 554, Supp 1, Crankshaft Gear Retaining Bolt Replacement
		VSP 174		Lycoming SB 569, IO-540 or TIO-540, 540 Crankshaft
		VSP 175		S-Tec SB 06-001 Pitch Servo Inspection
		VSP 196		Lycoming SB 583A - Reprint of Mandatory Slick Service Bulletin No. SB2-08: Inspections on all Slick 4300/6300 and LASAR 4700/6700
		VSP 197A		Lycoming SB 584B - Reprint of Mandatory Slick Service Bulletin No. SB3-08: Inspections on all Slick 4200/6200/4300/6300 and LASAR 4700/6700
		VSP 202		Lycoming SB 590A, Kelly Aerospace Fuel Pumps
	1999	SB 1036		Garmin Service Bulletin No. 9905 "GNS430 Mod. 1"
	1999–2000	SL 1033		Air Conditioning Hose Replacement
	1999–2002	SB 1135		GMA-340 Audio Panel Wiring
	2000–2001	SB 1083C	767-318	S-TEC System 55X Autopilot
	2000–2008	VSP 143		S-Tec SB 02-001 AutoPilot Flight Manual Supplement
	2001–2008	VSP 182		Avidyne PFD Mandatory SB 601-00006-067
	2003	SB 1137		Stabilator Balance Weight Tube Assembly
		SB 1141		Clip Nut Replacement
	2004	SB 1151E		4130N Steel Hardness Discrepancy
	2004–2006	SB 1171		Stormscope Erroneous Strike Indication
	2004–2008	SL 1089		Aircraft Painting Requirement
		SL 1123		Avidyne EXP5000 Software Upgrade
		SL 1126		Voltage Suppressor Advisory
		VSP 172		Avidyne PFD SA-05-001
		VSP 183		Avidyne PFD Mandatory SB 601-00006-075
		VSP 191		Avidyne PFD SA-08-001
	2005–2007	SB 1187		Voltage Suppressor Replacement

CHART 2 (Sheet 3 of 3)
SERVICE PUBLICATIONS LIST - SARATOGA II TC

Model	Year	Pub No.	Kit No.	Subject
	2006–2007	SB 1178		Nose Gear Forging Inspection/ Replacement
	2007–2008	SB 1247		Garmin SafeTaxi® Limitation
		VSP 193		Garmin SA-070801-01 PFD
		VSP 194		Garmin SB-0806-01 Transponder Data Box

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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:

✈ Flight hours;

✈ Calendar Year; or

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

Unless otherwise indicated, these inspections are to be repeated at each occurrence 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

A. Each 200 Hours

[ ] For airplanes with wing flap(s) which have accumulated ten (10) years time-in-service, conduct the following special inspection each 200 hours: Inspect the interior of the wing flap for evidence of dissimilar metal corrosion where aluminum sheet metal is in contact with steel flap brackets. Use a bore scope or other suitable tool. Installation of a new wing flap will relieve this inspection requirement until such time as the replacement wing flap reaches ten (10) years time-in-service.

B. 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 Lycoming Service Table of Limits SSP1776.

C. Each 500 Hours

[ ] (1) Remove propeller; remove sludge from crankshaft. Clean any residual sludge clinging to the exterior of propeller / crankshaft mating surfaces.

[ ] (2) In S/N's 3246001 thru 3246236 and 3257001 thru 3257411 only, for airplanes which have not installed Piper Kits No. 767-397 (LH) and 767-398 (RH) and do not have wing rib assemblies at W.S. 49.25 with date codes of 8313 or higher: conduct 500-Hour Wing Rib Inspection, 57-10-00.

[ ] (3) If installed, the auxiliary vacuum pump/motor assembly 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.

C. Each 500 Hours (continued)

[ ] (4) Inspect flap selector lever cable attachment for any signs of cable fraying per Control Cable Inspection, 27-00-00.

[ ] (5) Clean and lubricate stabilator trim drum screw.

[ ] (6) Inspect and clean magneto(s) per 500 Hour Inspection in the Slick F1100 Master Service Manual.

[ ] (7) If installed, replace the vacuum system inlet air filter (i.e., central air filter, gyro filter, etc.) element each 500 hours time-in-service, annually, or at vacuum pump replacement, whichever comes first.

D. Each 1000 Hours

[ ] (1) Replace engine compartment flexible fuel and oil hoses as required; but not to exceed 1,000 hours time-in-service, eight (8) years, or engine overhaul; whichever comes first; except for TSO-C53a - Type D hoses which are replaced on-condition.

[ ] (2) For TC only: 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.

[ ] (3) In airplanes equipped with Garmin G1000 and an emergency battery which has accumulated twelve (12) months or 2000 hours time-in-service: inspect the emergency battery each 1000 hours or every twelve (12) months, whichever comes first. See Concorde's Instructions for Continued Airworhtiness, Component Maintenance Manual, Document No. 5-0167, for detailed inspection requirements and procedures.

[ ] (4) For airplanes equipped with Garmin G1000: each 1000 hours time-in-service conduct the 1000 Hour Inspection as specified in 34-20-00, Integrated Avionics System (IAS) - Garmin, Inspections.

E. Each 1500 Hours

[ ] For airplanes equipped with the optional Inadvertent Ice Protection System (TKS): each three (3) years or each 1500 hours, whichever comes first, replace the filter.

F. Each 2000 Hours

[ ] (1) Each 2000 hours or seven (7) years, whichever occurs first, remove interior cabinets, 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 bore scope) without removing the headliner, providing access is obtained to all concealed areas and bore scope provides sufficient detail to adequately accomplish the inspection. At F.S. 73, examine the two steel Upper Forward Cockpit Fittings (one each side), P/N's 79553-000/-001 or 62522-000/68257-000, as applicable, for signs of corrosion.

[ ] (2) Overhaul or replace Hartzell propellers each 2000 or 2400 hours or each five or six years. (Refer to latest revision of Hartzell Service Letter No. 61 to find specific requirements for individual airplanes.)

[ ] (3) Complete overhaul of engine or replace with factory rebuilt as required by Lycoming Service Instruction No. 1009. See also Lycoming Service Bulletin No. 240.

F. Each 2000 Hours (continued)

[ ] (4) For airplanes equipped with the optional Inadvertent Ice Protection System (TKS): each 2000 hours, replace pump or rebuild pump motor and replace brushes.

[ ] (5) In II HP's S/N's 3246088 and up, and in all TC's: clean and lubricate the outboard needle bearing on the Sky-Tec 149-24PM starter. Use lithium-based grease.

[ ] (6) In airplanes equipped with Garmin G1000: upon the emergency battery completing its first 2000 hours or twelve (12) months time-in-service, whichever comes first, inspect the emergency battery. See Concorde's Instructions for Continued Airworthiness, Component Maintenance Manual, Document No. 5-0167, for detailed inspection requirements and procedures.

[ ] (7) If installed, each 2000 hours or at engine overhaul, whichever comes first, replace the Standby Alternator with a new or overhauled unit.

[ ] (8) Each 2000 operating hours or seven (7) calendar years time-in-service, whichever occurs first, inspect as specified in 57-40-00, Wing Aft Attach Fitting Inspection.

[ ] (9) In airplanes that have accumulated 15 calendar years time-in-service or more, each 2,000 hours or seven (7) calendar years time-in-service, whichever occurs first, perform the Stabilator Control System Special Inspection under Control Cable Inspection in 27-00-00.

G. Each 2400 Hours

[ ] (1) Overhaul or replace Hartzell propeller governors each 2400 hours or at engine overhaul. (Verify TBO in latest revision of Hartzell Service Letter No. 61.)

[ ] (2) 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.)

H. Each 2700 Hours

[ ] In II HP's S/N's 3246088 and up, and in all TC's: overhaul the Sky-Tec 149-24PM starter each 2700 hours time-in-service or at engine overhaul, whichever comes first.

2. Per Calendar Year

A. Each Thirty (30) Days

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.

[ ] (1) If equipped, at least every 30 days, visually check oxygen cylinder installation for leakage, corrosion, bulges, gouges, distortion, and security of mounting.

[ ] (2) Inspect battery, box/shelf, and cables. Flush box as required and fill battery per label on box or 24-30-00.

[ ] (3) If installed, check portable fire extinguisher for condition and charge. Verify nozzle is unobstructed and safety seal is intact. Determine charge by "hefting" extinguisher.

B. Each Ninety (90) Days

[ ] (1) For airplanes equipped with Avidyne Entegra: 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.

[ ] (2) Remove, drain, and clean fuel strainer bowl and screen located in bottom of fuel selector valve.

[ ] (3) Operationally test ELT per the Test procedure in 25-60-00 for the appropriate installed ELT at least every 90 days.

C. Each Four (4) Months

[ ] Change the engine oil and full-flow cartridge oil filter each four (4) months or every 50 hours time-in-service, whichever comes first.

D. Each Six (6) Months

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

E. Each Twelve (12) Months

[ ] (1) For airplanes equipped with Avidyne Entegra or Garmin G1000: each twelve (12) months perform a full capacity test of the Standby Attitude Indicator battery. See Standby Attitude Indicator, 34-20-00.

[ ] (2) For airplanes equipped with the optional Inadvertent Ice Protection System (TKS): each twelve months, perform Ice Protection System Annual Inspection, 30-10-00.

[ ] (3) If installed, replace the vacuum system inlet air filter (i.e., central air filter, gyro filter, etc.) element each 500 hours time-in-service, annually, or at vacuum pump replacement, whichever comes first.

[ ] (4) For vacuum system equipped airplanes, beginning at five years from date of check valve manifold manufacture and each 12 months thereafter, inspect the Airborne 1H5 series check valve manifolds per the latest revision of Airborne SL 39A.

[ ] (5) For airplanes equipped with Garmin G1000: each twelve (12) months conduct the Annual Inspection as specified in 34-20-00, Integrated Avionics System (IAS) - Garmin, Inspections.

[ ] (6) In airplanes equipped with Garmin G1000 and an emergency battery which has accumulated twelve (12) months or 2000 hours time-in-service: inspect the emergency battery every twelve (12) months or each 1000 hours , whichever comes first. See Concorde's Instructions for Continued Airworthiness, Component Maintenance Manual, Document No. 5-0167, for detailed inspection requirements and procedures.

[ ] (7) Lubricate Hartzell propeller every 100 Hours or annually, whichever comes first. If annual usage is significantly less than 100 Hours, lubricate each six (6) months. See Hartzell Standard Practices Manual No. 202A.

F. Each Two (2) Years

[ ] (1) Test and inspect the static pressure system and altimeters (including ADAHRS (in Avidyne PFD) or GDC 74A (Garmin), if installed). Ensure compliance with the requirements of FAR 43, Appendix E. (See FAR 91.411.)

NOTE: In airplanes equipped with Garmin G1000, see GDC 74A Testing under Integrated Avionics System (IAS) - Garmin, Post-Installation Set-up, System Testing and Checkout, in 34-20-00 before beginning the above test and inspection.

[ ] (2) Test and inspect the transponder. Ensure compliance with the requirements of FAR 43, Appendix F. (See FAR 91.413.)

[ ] (3) Swing the magnetic compass and, if equipped, recalibrate the magnetometer/flux detector every two (2) years. See Magnetic Heading Systems, 34-20-00.

G. Each Three (3) Years

[ ] (1) For airplanes equipped with Avidyne Entegra: replace the Standby Attitude Indicator battery as required, but at least every three (3) years. See Standby Attitude Indicator, 34-20-00.

[ ] (2) For airplanes equipped with the optional Inadvertent Ice Protection System (TKS): each three (3) years or each 1500 hours, whichever comes first, replace the filter.

H. Each Five (5) Years

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.

[ ] (1) In 3257001 and up only, if installed:

[ ] (a) For each oxygen system outlet, inspect outlet and especially rubber components for condition and operation. Replace rubber components or entire outlet on condition.

[ ] (b) Oxygen system external recharge valve replacement is required only “On Condition,” but is recommended each five (5) years time-in-service.

[ ] (c) Overhaul or replace oxygen system regulator each five (5) years time-in-service.

[ ] (d) Remove and hydrostatically test oxygen cylinder each five (5) years (lightweight composite cylinders marked DOT-E 8162 or DOT-SP 8162, or Transport Canada SU 4237-127 or SU 9209).

[ ] (e) Overhaul or replace oxygen system masks each five (5) years time-in-service.

[ ] (2) 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.)

[ ] (3) For airplanes equipped with Garmin G1000: update the GRS 77 AHRS’ “Earth magnetic field model” each five (5) calendar years beginning in 2010. The updated “Earth magnetic field model” is expected to be available from Garmin on July 1st of each fifth year - i.e. - 2010, 2015, 2020, etc.

I. Each Six (6) Years

[ ] (1) 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.)

[ ] (2) For airplanes equipped with Aero Accessories, Inc. vacuum pump(s), replace the shear coupling each six (6) years time-in-service.

J. Each Seven (7) Years

[ ] (1) 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).

[ ] (2) Replace fuel tank flexible hose interconnect couplings and fuel tank vent line flexible hose and hose couplings as required; but not to exceed seven (7) years, or fuel tank removal, whichever comes first.

[ ] (3) Each 2000 hours or seven (7) years, whichever occurs first, remove interior cabinets, 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 bore scope) without removing the headliner, providing access is obtained to all concealed areas and bore scope provides sufficient detail to adequately accomplish the inspection. At F.S. 73, examine the two steel Upper Forward Cockpit Fittings (one each side), P/N's 79553-000/-001 or 62522-000/68257-000, as applicable, for signs of corrosion.

[ ] (4) Each seven (7) calendar years or 2000 operating hours time-in-service, whichever occurs first, inspect as specified in 57-40-00, Wing Aft Attach Fitting Inspection.

[ ] (5) In airplanes that have accumulated 15 calendar years time-in-service or more, each seven (7) calendar years or 2,000 hours time-in-service, whichever occurs first, perform the Stabilator Control System Special Inspection under Control Cable Inspection in 27-00-00.

K. Each Eight (8) Years

[ ] Replace engine compartment flexible fuel and oil hoses as required; but not to exceed 1000 hours time-in-service, eight (8) years, or engine overhaul, whichever comes first; except for TSO-C53a - Type D hoses which are replaced on-condition.

L. Each Ten (10) Years

[ ] (1) If installed, the auxiliary vacuum pump/motor assembly 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.

[ ] (2) For vacuum system equipped airplanes, replace Airborne 1H5 series check valve manifolds at 10 years from check valve manifold date of manufacture. See latest revision of Airborne SL 39A.

[ ] (3) For airplanes equipped with the Avidyne Entegra EFIS: replace the CMOS battery in the multifunction display (MFD) as required, but at least each 10 years. See Multifunction Display (MFD), 34-20-00.

[ ] (4) 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.

M. Each Twelve (12) Years

[ ] Replace disposable-type (non-gauged) fire extinguishers at twelve (12) years from date of manufacture.

N. Each Fifteen (15) Years

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.

[ ] In S/N's 3257001 & up only, if installed: no lightweight composite oxygen cylinder (i.e., DOT-E 8162 or DOT-SP 8162, or Transport Canada SU 4237-127 or SU 9209) may exceed 15 years total time-in-service.

O. Each Twenty (20) Years

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

3. Specific Operation / Operating Environment

A. High Dust or Industrial Pollution

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

	Item	Inspection	Inspection Interval
☐	Engine Air Filter.	Clean and inspect.	Daily.
☐	Cabin Environmental and Instrument Air Filters.	Inspect and replace if necessary.	100 Hours.
☐	Pitot/Static system.	Check for obstruction. Reverse flow to lines.	100 Hours or as required.
☐	Landing Gear Down Lock Assemblies.	Clean, inspect and lubricate. (Refer to Lubrication Chart, 12-20-00.)	100 Hours.
☐	Landing Gear 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

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

	Item	Inspection	Inspection Interval
☐	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 S/N's 3257273 and up.
Not applicable in S/N's 3257001 thru 3257272 when Piper Kit P/N 767-332 installed.
In 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.

E. At Engine Overhaul

	Item	Inspection	Inspection Interval
☐	Oil Cooler.	Remove and overhaul at engine overhaul	Each occurance.

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.	Hartzell Propellers - refer to the inspection requirements in the. latest revision of Hartzell Owner's Manual No. 115N.	Each occurrence, before further flight.
☐	Engine.	See latest revisions of appropriate Lycoming Service Bulletins and Overhaul Manual.	Each occurrence, before further flight.
☐	Electrical and Avionics Systems.	Inspect and check harness, connections, and equipment for high voltage damage, burns and insulation degradation. Replace or overhaul as required. Consult with appropriate avionics vendor(s) for inspections and operational checks. Bench test alternator and voltage regulator(s), see 24-30-00.	Each occurrence, before further flight.
☐	If Garmin 1000 equipped.	Replace both Instrument Dimmer voltage suppressor units. Perform electrical bonding resistance check (see 51-80-00) for G1000 equipment.	Each occurrence, Before further flight.
☐	All exterior surfaces, skins, and structure.	Inspect for burns, evidence of arcing, and damage on surfaces and bearings. Check for correct material properties in the area of the strike path. Degauss engine mount. Replace or repair affected areas/parts.	Each occurrence, before further flight.
☐	System Components.	Inspect instrumentation, vacuum, pitot/static, and fuel systems, for damage and correct operation.	Each occurrence, before further flight.
☐	Static Wicks.	Replace.	Each occurrence, before further flight.
☐	Bearings.	Inspect all control surface hinges and bearings, and landing gear and wheel bearings for pitting and damage. Replace as required.	Each occurrence, before further flight.

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

Item	Inspection	Inspection Interval
☐ Engine.	See latest revisions of appropriate Lycoming Service Bulletins and Overhaul Manual.	Each occurrence, before further flight.
☐ Propeller.	Hartzell Propellers - refer to the inspection requirements in the. latest revision of Hartzell Owner's Manual No. 115N.	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 Lycoming Maintenance Manual procedures. If there are any questions regarding repairs or procedures, contact your Piper Dealer's Service Advisor (DSA).

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

Item	Inspection	Inspection Interval
☐ Landing Gear Struts. (Not required for severe turbulence.)	Cracks, signs of overstress deformation, loose or damaged 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 for damage and condition. Inspect landing gear attachment and drag link bolts (magnetic particle method).	Each occurrence, before further flight.

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

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

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

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

5. Flood Damage, Immersion in Water

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

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

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

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

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

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

5. Flood Damage, Immersion in Water (continued)

Item	Inspection	Inspection Interval
☐ Engine.	Remove, disassemble, and inspect. Examine all parts paying particular attention for evidence of corrosion, rust or contaminants imbedded on bearing surfaces, piston, mounting flanges or any aluminum, magnesium or bronze surface that may be porous. Remove evidence of rust, or corrosion. If pitting in stressed areas is found the part should not be reused. Silt imbedded in porous surfaces may be removed. Be certain oil passages, dowel holes and similar hidden openings and recesses are thoroughly free from contaminants. Test electrical components and fuel metering devices in accordance with manufacturer's instructions to determine fitness for future use. Reassemble engine using new seals, gaskets, stressed bolts nuts and crankshaft sludge tubes. All reused parts must conform with Lycoming Table of Limits No. SSP-1776 for fits and clearances. See latest revision of Lycoming Service Bulletin No. 357.	If immersed, each event, before further flight.
☐ Engine Accessories.	Inspect. Aircraft systems that supply either fuel or oil to the engine must be thoroughly cleaned, including oil cooler, lines, valves, etc. to prevent contamination of the engine after reinstallation.	If immersed, each event, before further flight.
☐ Propeller.	Inspect and repair as necessary in an authorized propeller shop.	If immersed, each event, before further flight.

5. Flood Damage, Immersion in Water (continued)

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

5. Flood Damage, Immersion in Water (continued)

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

5. Flood Damage, Immersion in Water (continued)

Item	Inspection	Inspection Interval
☐ Oxygen System. (If installed.)	Disconnect all lines from source and outlets; clean all fittings and lines per MIL-I-5585A. Remove and clean regulator valve per appropriate Scott publication. Replace pressure gauge.	If immersed, each event, before further flight.
☐ Avionics Systems.	Replace avionics. Clean and inspect antennas and connectors.	If immersed, each event, before further flight.
☐ Insulation and Upholstery.	Remove all wet insulation and upholstery. Thoroughly clean and dry (or replace) to ensure corrosion is not promoted in adjacent structures.	If immersed, each event, before further flight.

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CHAPTER

6

DIMENSIONS AND AREAS

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CHAPTER 6

LIST OF EFFECTIVE PAGES

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CHAPTER 6 - DIMENSIONS AND AREAS

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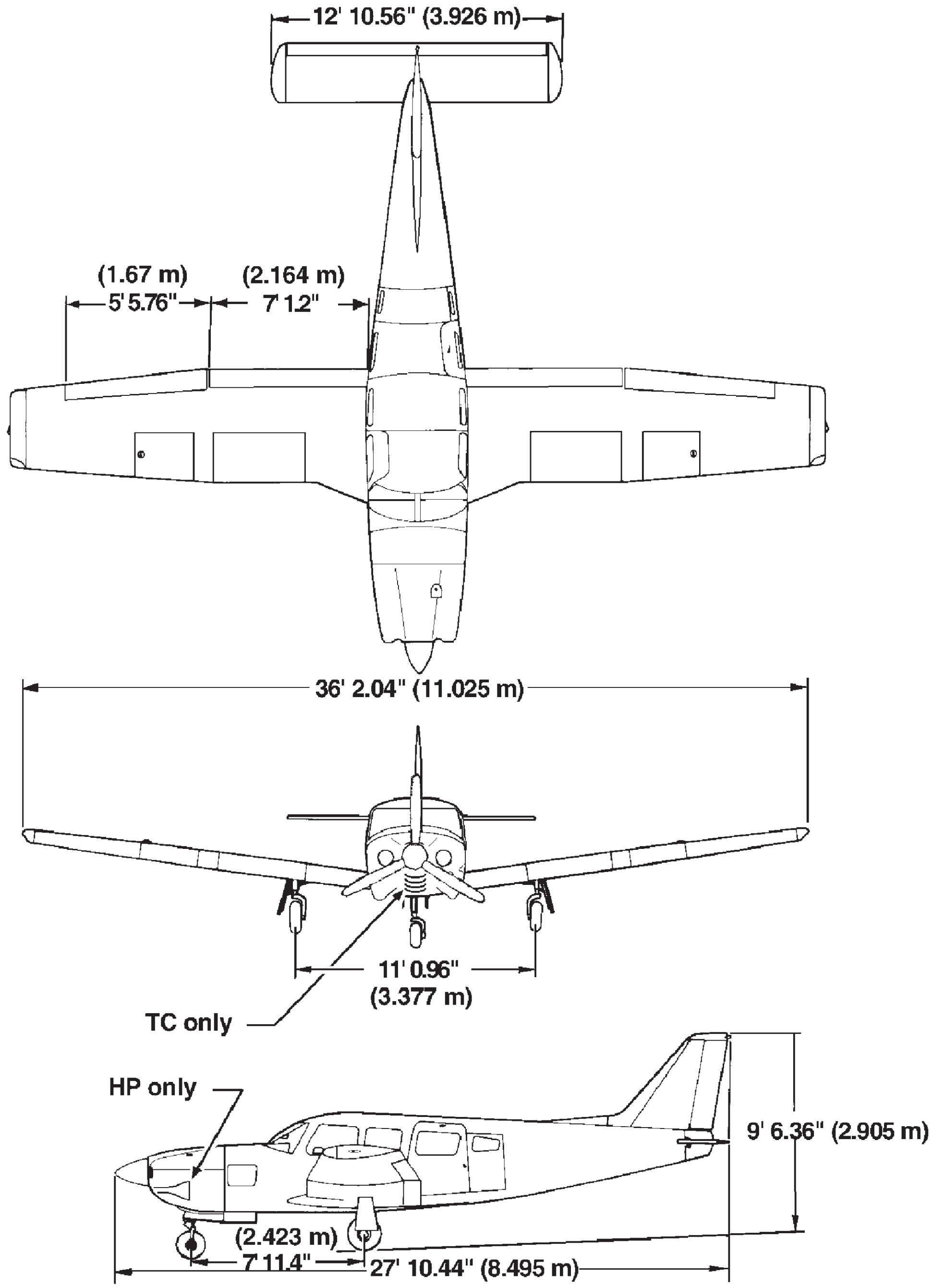
GENERAL

The principal airplane dimensions are shown in Figure 1, and the leading particulars/principal dimensions are listed in Chart 1. The airplane serial number is 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 right side of the engine oil sump just below cylinder number 5.



Three View
Figure 1

1. Leading Particulars and Principal Dimensions

See Chart 1.

CHART 1 (Sheet 1 of 3)
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 68804-005(4)	P/N 68804-005(4)
ESI VR320 (28 volt)	P/N 68804-007	P/N 68804-007

NOTES: (1) S/N's 3246001 thru 3246017 only.
(2) S/N's 3246017 thru 3246087 only.
(3) S/N's 3246088 and up.
(4) S/N's 3246018 thru 3246125 and S/N's 3257001 thru 3257074.

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

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.

MODEL (SARATOGA II)	PA-32R-301 (HP)	PA-32R-301T (TC)
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) SN's 3246001 thru 3246017 only.

MODEL (SARATOGA II)	PA-32R-301 (HP)	PA-32R-301T (TC)
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.	
Nose Wheel Travel	22.5° ± 2° Left and Right	
Turning Distance (Min.)	75 ft., 6 in.	
Turning Radius (Minimum):		
Nose Wheel	22 ft., 11 in.	
Wing Tip		

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

MODEL (SARATOGA II)	PA-32R-301 (HP)	PA-32R-301T (TC)
LANDING GEAR (cont.)		
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(2)		
Nose	35 psi	
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.

NOTE: (2) PIR-PPS50025, Rev. AB.

2. Station Reference Lines (See Figure 2.)

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

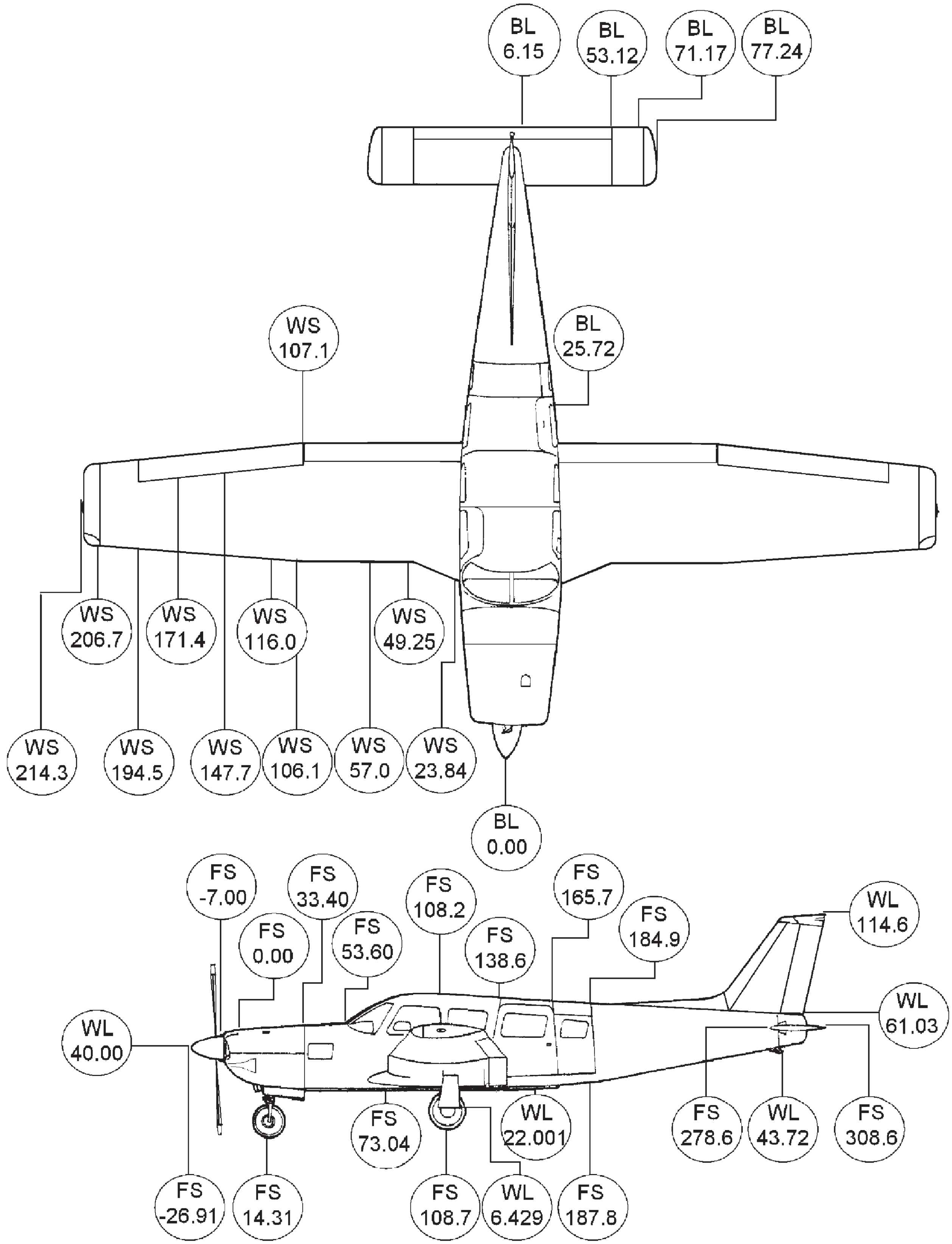
3. Access And Inspection Provisions

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

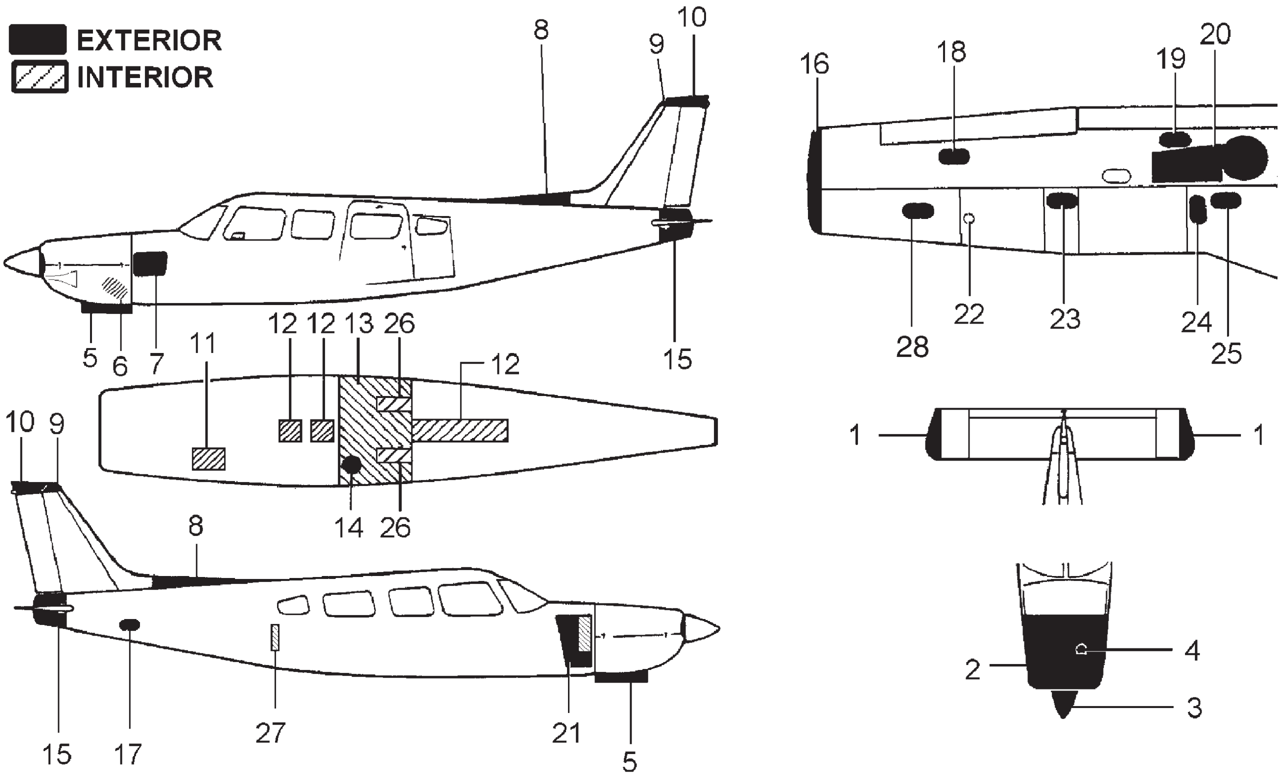
The access and inspection provisions for the airplane are shown in Figure 3. The component to be serviced or inspected through each opening is identified in the illustration. All access plates and panels are secured by either metal fasteners or screws.

“Access plates and panels” includes all forms of covers, cowlings, fairings, plates, panels, tips, etc. identified in Figure 3 which may be removed for access to any component or space.

To enter the aft section of the fuselage, remove the rear trim panel.



Station Reference Lines
Figure 2



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) & TKS MICROFILTER(2,3) SERVICE
8. FAIRING, ACCESS
9. TIP, VERTICAL STABILIZER
10. TIP, RUDDER
11. PANEL, BATTERY(1), HYDRAULIC, & TKS MICROFILTER(2,3) SERVICE
12. PLATES, TUNNEL ACCESS PANEL
13. PANEL, FLOOR
14. COVER, FUEL SELECTOR FILTER
15. TAIL CONE, CONTROL CABLES & TRIM SCREW
16. WINGTIP & LANDING LIGHT COVER, GARMIN 1000 MAGNETOMETER(2) ACCESS (LEFT WINGTIP)
17. COVER, E.L.T. ACCESS
18. COVER, AILERON BELLCRANK & TKS PROPORTIONING UNIT(2) (RIGHT AND LEFT WINGS) 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 &TKS FLUIDTANK AND STRAINER(2) ACCESS
24. COVER, FUEL AND BRAKE FITTINGS, &TKS MICRO FILTER(2,4) (RIGHT WING)
25. COVER, FUEL FITTINGS,TKS FLUID PUMP(2), &TKS MICRO FILTER(2,4) (RIGHT WING)
26. REAR WING ATTACH. & CONTROL CABLE INSPECT
27. COVER, AFT FUSELAGE, OXYGEN(2), BATTERY, &TKS PROPORTIONING UNIT(2) SERVICE
28. COVER, AVIDYNE ENTEGRA MAG/OAT(2) (LEFT WING)

NOTES: (1) S/N's 3246001 thru 3246087 only.
(2) If installed.
(3) II HP's & S/N's 3257404 thru 3257452, less 3257447.
(4) S/N's 3257447, and 3257453 & up.

Access Plates and Panels
Figure 3

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CHAPTER

7

LIFTING AND SHORING

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CHAPTER 7

LIST OF EFFECTIVE PAGES

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CHAPTER 7 - LIFTING AND SHORING

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JACKING

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

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

Jacking

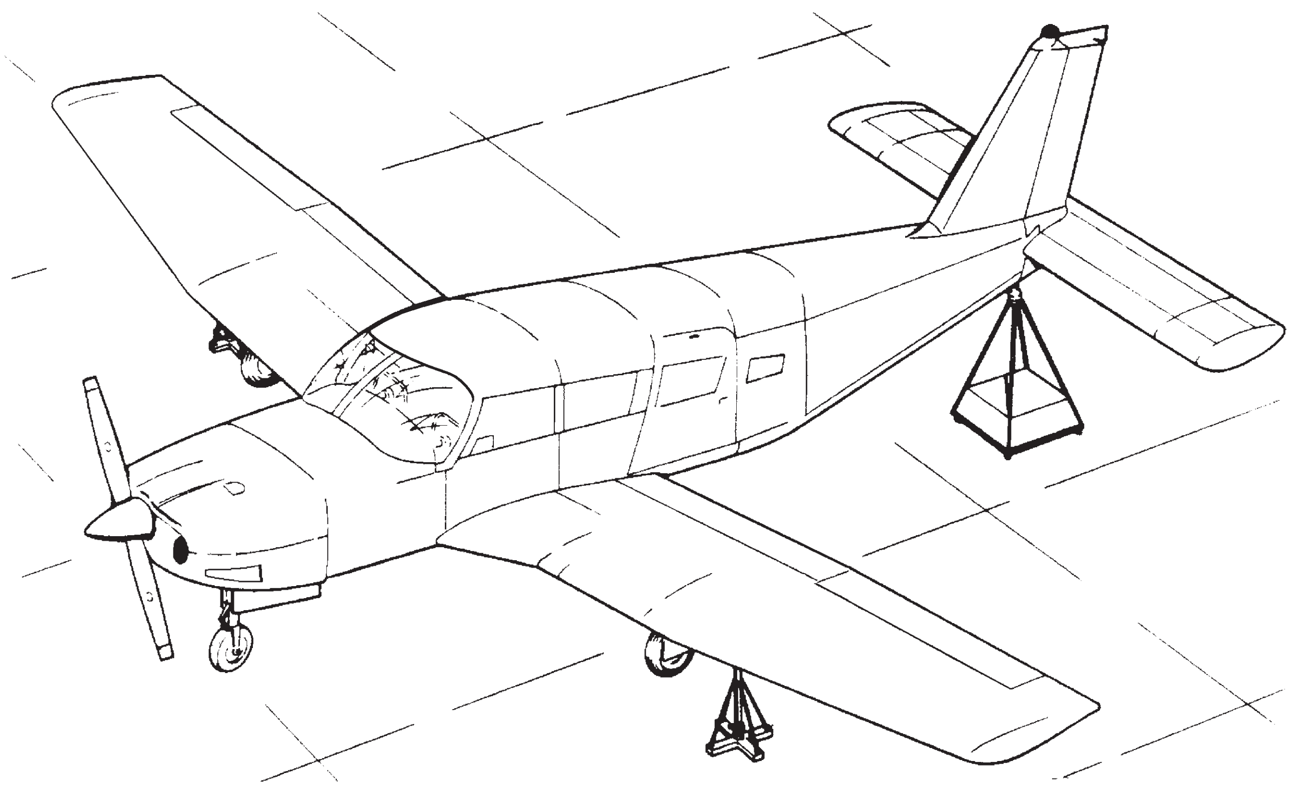
A. Align jacks under the wing respective pads on the wing front spar.

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

B. Attach a tail stand with approximately 250 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.

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



Jacking
Figure 1

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CHAPTER

8

LEVELING AND WEIGHING

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CHAPTER 8

LIST OF EFFECTIVE PAGES

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CHAPTER 8 - LEVELING AND WEIGHING

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WEIGHING

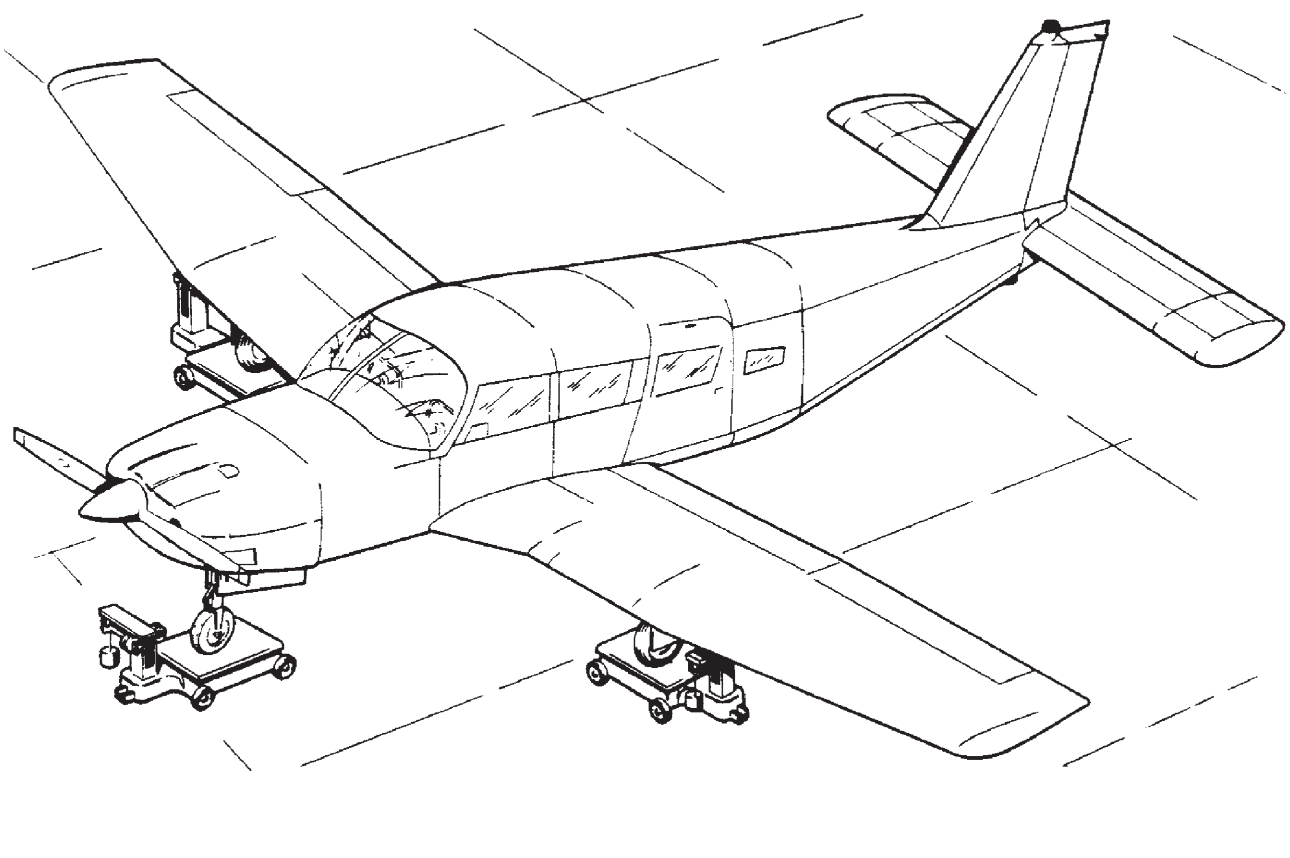
The airplane may be weighed by the following procedure (see Figure 1):

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

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

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

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



Weighing Airplane
Figure 1

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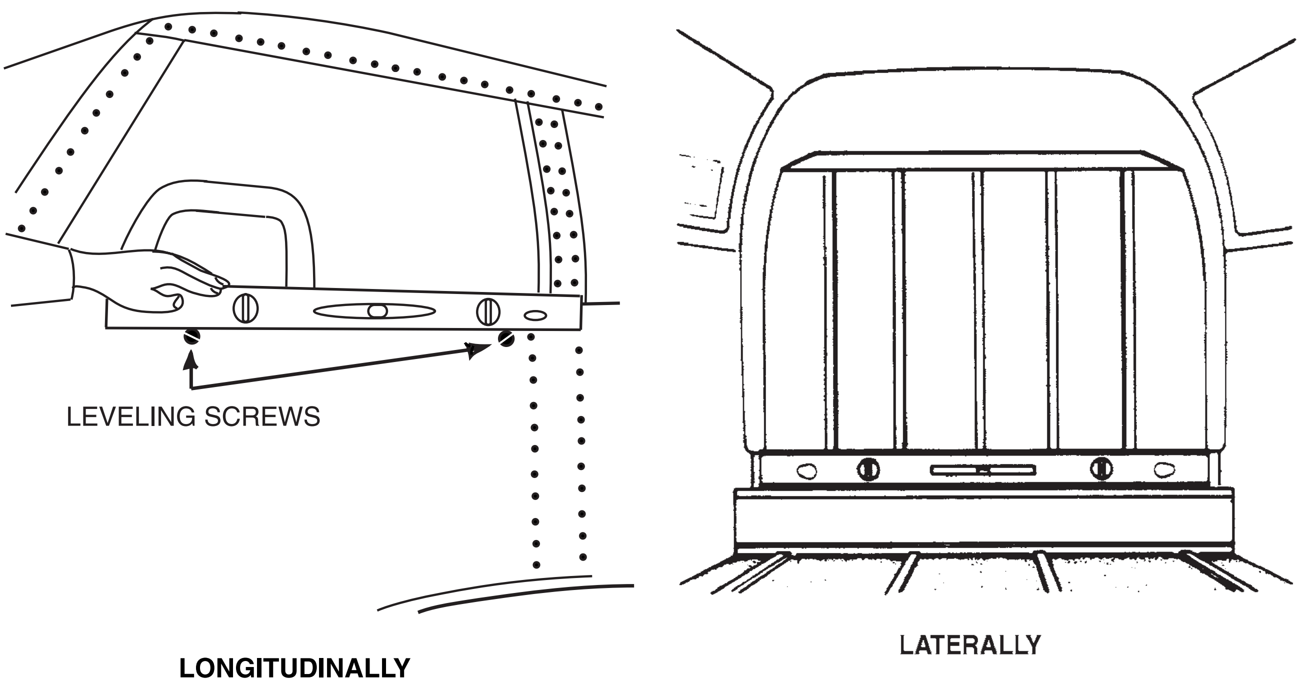
LEVELING

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

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

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

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



Leveling Airplane
Figure 1

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CHAPTER

9

TOWING AND TAXIING

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CHAPTER 9

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE	CHAPTER SECTION	PAGE	DATE
9-List of	1	Jun 30/07			
Effective Pages	2	Jun 30/07			
9-Table of Contents	1	Jun 30/07			
	2	Jun 30/07			
9-10-00	1	Jun 30/07			
	2	Jun 30/07			
9-20-00	1	Jun 30/07			
	2	Jun 30/07			

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CHAPTER 9 - TOWING AND TAXIING

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TOWING

CAUTION: DO NOT TURN THE NOSE GEAR BEYOND THE MARKED STEERING LIMITS. 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.

CAUTION: DO NOT PUSH ON THE TRAILING EDGE OF THE AILERONS. PUSHING ON THE AILERON TRAILING EDGES, 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 in the forward baggage compartment or by using power equipment that will not damage or cause excess strain to the nose gear steering assembly. Tow bar engages front axle inside fork.

In the event towing lines are necessary, lines (rope) should be attached to both main gear struts as high up on the tubes as possible. Lines should be long enough to clear the nose and/or tail by not less than 15 feet, and a qualified person to ride in the pilot's seat to maintain control by use of the brakes.

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TAXIING

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

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

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

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

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

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

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

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CHAPTER

10

PARKING AND MOORING

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CHAPTER 10

LIST OF EFFECTIVE PAGES

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CHAPTER 10 - PARKING AND MOORING

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PARKING

1. Parking

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

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

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

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

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

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

2. Locking Airplane

   The right front cabin door, left aft cabin door and the nose baggage compartment door are provided with a key lock on the outside. A locking gas cap is optional. All use the same key, except the locking gas caps, original equipment and service replacements in 2006 and up, which have a separate key.

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MOORING

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

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

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

B. Block the wheels.

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

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

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

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

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CHAPTER

11

PLACARDS AND MARKINGS

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CHAPTER 11

LIST OF EFFECTIVE PAGES

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CHAPTER 11 - PLACARDS AND MARKINGS

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GENERAL

1. Paper Decals

   A. Removal

   Remove paper decals by rubbing with cloth dampened with lacquer thinner. Use lacquer thinner sparingly if decals are applied over painted or doped surfaces.

   B. Installation

   Soak paper decals in water 1 to 3 minutes. Place one decal edge on receiving surface and slide decal off of paper backing. Blot water around decal with a soft absorbent cloth. Remove bubbles trapped beneath decal by wiping carefully towards nearest edge with a cloth. Coat decal with clear varnish to protect from deterioration and peeling.

2. Vinyl Film Decals

   A. Removal

   To remove a vinyl decal, place cloth saturated with cyclohexanone or methyl ethyl ketone on decal. Scrape with micarta scraper. Remove remaining adhesive with cloth dampened with dry cleaning solvent.

   B. Installation

   Separate paper backing from vinyl film. Remove paper adhering to film by rubbing with a clean water saturated cloth or a piece of masking tape. Apply cyclohexanone or equivalent, to adhesive side of film. Position and apply decal while adhesive is still tacky. Work a roller across decal until all air bubbles are removed.

3. Metal Decals

   A. Removal

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

   B. Installation

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

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

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

4. Meyercord / Ink Transfers

(PIR-PPS65104, Rev. J.)

Transfers installed on the instrument panel are Meyercord / Ink type. The following procedures should be followed in the event one or more of these transfers must be replaced.

A. Removal

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

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

CAUTION: BUTYL GLYCOL ETHER/ISOPROPYL ALCOHOL SOLVENT SOLUTION 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 Butyl Glycol Ether/ Isopropyl Alcohol Solvent Solution to remove placard to be replaced.

B. Installation

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

5. Placards, Nameplates, and Decals

(PIR-PPS65103, Rev. H.)

A. Self-Adhesive Installation

NOTE: For proper adhesion of decals, apply when the temperature is between 55° and 90° F.

(1) Wipe the area where the item is to be installed with a clean cloth soaked with isopropyl alcohol. Dry with a clean, dry cloth before the alcohol has time to evaporate from the surface.

NOTE: Dry area before liquid evaporates, to avoid deposits at edges of wetted area and discoloration.

(2) Lift a corner or an edge of backing from the item without touching adhesive.
(3) Position as specified by the applicable figure in 11-20-00 or 11-30-00 and secure a free corner or edge.
(4) Using squeegee to hold item to panel, draw the rest of the backing from the item.
(5) Press the item in place with the squeegee by wiping across it from end to end, around edges and corners, and into recesses with firm deliberate strokes and heavy pressure.

(6) Remove premask from face of item by using eraser or finger nail to lift a corner and then peeling back as parallel to item as possible.

NOTE: Any attempt to squeegee the item after the premask is removed will cause shiny marks, blemishing the background of the item.

(7) If any portion of item tends to lift off, remove item, discard, and replace, beginning with step (1), above.

B. Without Adhesive - Installation with Tape

(PIR-PPS50085, Rev. B.)

To bond to the aircraft any placards, etc., that do not have an adhesive backing, use 3M™ VHB™ pressure sensitive acrylic foam tape, as follows.

(1) Confirm the correct location to adhere the double-sided tape. Place location marks (using masking tape) on the aircraft surface to precisely position the tape.

(2) Clean the surface using acetone or a 50:50 mixture of isopropyl alcohol and water. Wipe the area dry with a clean, lint-free, dry cloth.

(3) Wipe both faying surfaces with a brush or swab saturated with 3M Tape Primer 94 (P/N 279-127, one quart). Use the minimum amount of primer that will coat the desired surface areas. Allow 10 minutes for it to dry.

NOTE: Use a minimum coating of the tape primer. More is not better.

CAUTION: THE ADHESION OF THE TAPE IS ALMOST IMMEDIATE, SO USE EXTREME CARE AND APPLY VERY LITTLE CONTACT PRESSURE. AVOID THE NEED TO REPOSITION THE TAPE.

(4) Handle the double-sided acrylic foam tape by its edges only; carefully position the tape using the location marks. Adhesion is almost immediate, so use extreme care and as little contact pressure as possible. Avoid the need to reposition the tape, but if necessary, move the tape immediately and cautiously.

(5) When the placement of the tape is completed, use a roller, squeegee, or other smoothing tool to apply even pressure against the tape. Pay close attention to the tape edges.

CAUTION: DO NOT TRY TO REPOSITION THE TAPE AFTER USING SMOOTHING TOOL. DO NOT PULL ON THE TAPE OR ATTEMPT TO LIFT OR PEEL ITS EDGES.

(6) Keep the outward liner intact on the tape and position the item to be bonded with the tape over the location. Remove the tape liner using the pull tabs, folding them back at an approximately 45-degree angle from under the item, exposing the tape to the item.

(7) Once bonded, if there is some bowing or deformation of the adhered item, apply pressure not exceeding 5 psi with a shot bag (approximately 6 inches wide, 36 lbs per foot is only 1 psi) for 30 minutes.

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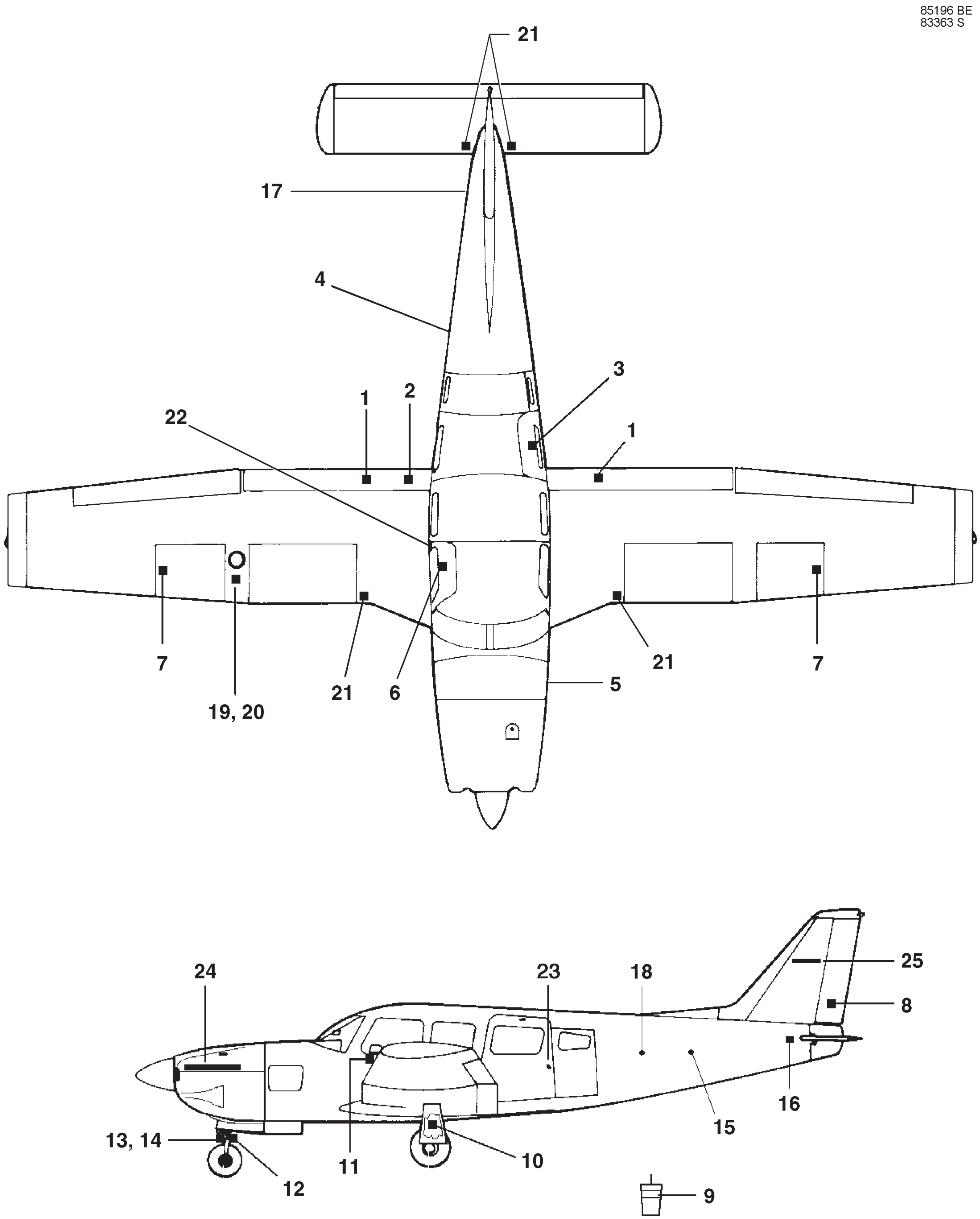
EXTERIOR PLACARDS AND MARKINGS

The airplane nameplate placard (Figure 1, Item 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 your Piper Dealer's Service Advisor (DSA).

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



Exterior Placards and Markings
Figure 1 (Sheet 1 of 2)

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)
19. PLACARD - NO FUEL (1)
20. PLACARD - TKS ICE PROTECTION TANK, USE ONLY THE FOLLOWING FLUIDS (1)
21. PLACARD - TKS ICE PROTECTION, CAUTION, POROUS DE-ICE PANELS (1)
22. PLACARD - PULL TO OPEN (HP S/N'S 3246182 & UP AND TC S/N'S 3257199 & UP)
23. PLACARD - RELEASE ABOVE HANDLE...
    (HP S/N'S 3246182 & UP AND TC S/N'S 3257199 & UP)
24. STENCIL - MODEL NAME
25. DECAL - PIPER LOGO

NOTES: (1) If equipped with the optional Inadvertent Ice Protection System (TKS).

Exterior Placards and Markings
Figure 1 (Sheet 2 of 2)

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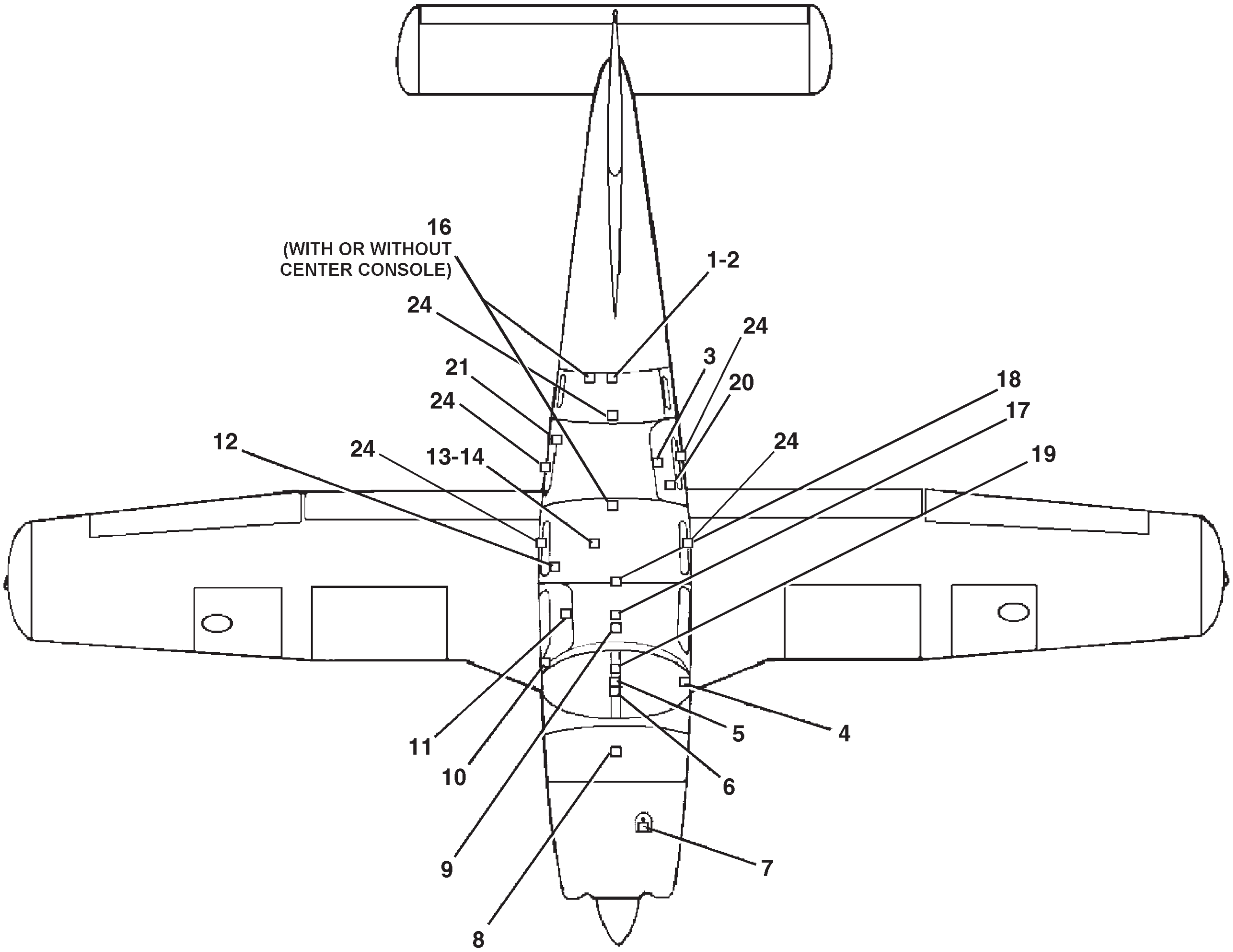
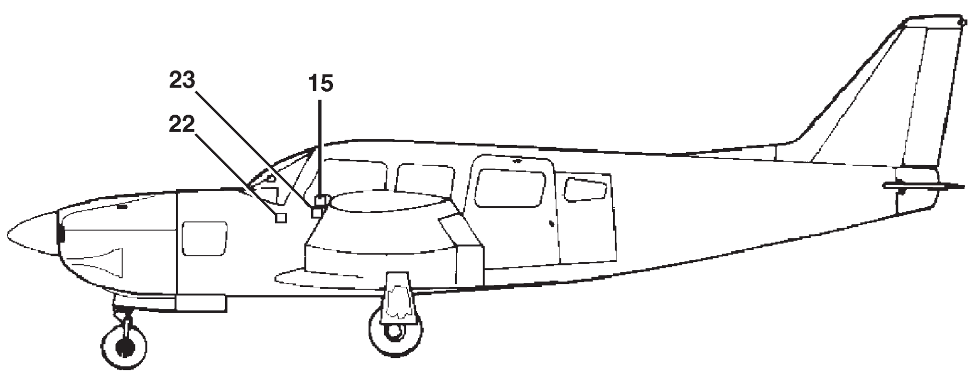
INTERIOR PLACARDS

See Figure 1 for interior placards, Figure 2 for instrument panel placards, and Figure 3 for entertainment console placards, if installed.

85196 BN
104814 E
101007 E



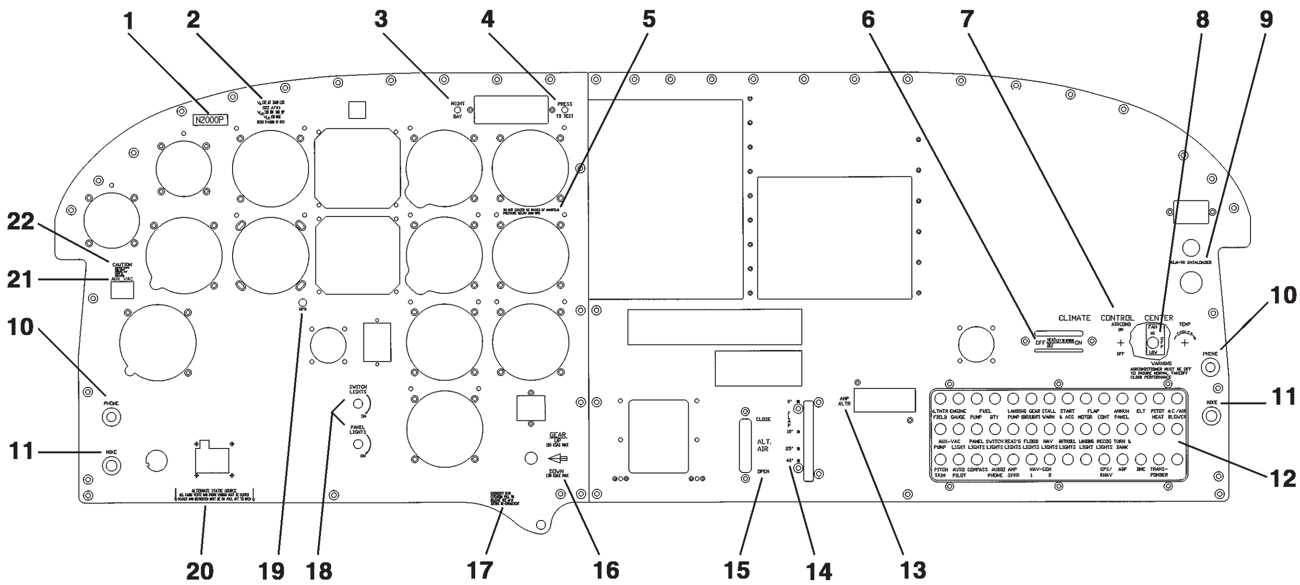


Interior Placards
Figure 1 (Sheet 1 of 2)

1. PLACARD - MAXIMUM BAGGAGE
2. PLACARD - SOFT WEAR ONLY
3. PLACARD - LATCH - OPEN
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 - LATCH
11. PLACARD - OPEN - LATCH (4)
12. PLACARD - FUEL SUMP DRAIN
13. PLACARD - STOW TABLE
    PLACARD - CONSOLE STOWAGE (2)
14. PLACARD - TABLE - MAX. WGT.
    PLACARDS - CONSOLE MAX. WGTS. AND AUX. POWER (2)
15. PLACARD - DO NOT OPEN ABOVE . . . . . .
16. PLACARD - MAX. ALLOWABLE WGT. (3)
17. PLATE - FORWARD HEAT OUTLET
18. PLACARD - CABIN AIR (6)
19. PLACARD - COMPASS DEVIATION CAUTION
20. PLACARD - OPEN ABOVE LATCH (5)
21. PLACARD - NO SMOKING (1)
22. PLACARD - CONTROL QUADRANT
23. PLACARD - ARM REST WARNING (7)
24. PLACARD - PHONE AND MIC JACK (8)

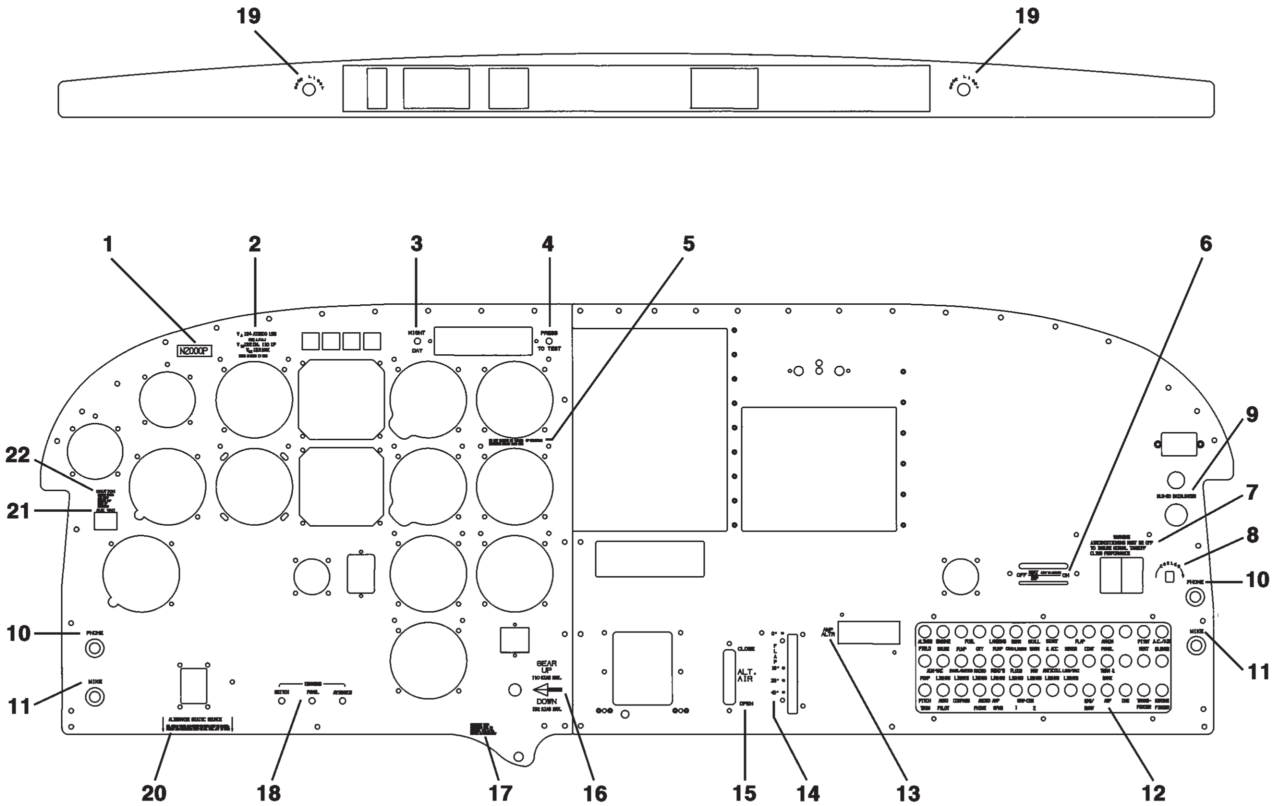
NOTES: (1) HP S/N's 3246088 and up; TC S/N's 3257001 and up.
(2) With entertainment console in S/N's 3246088 and up; TC S/N's 3257001 and up.
(3) HP S/N's 3246088 and up; TC S/N's 3257001 and up; as required by factory weight and balance.
(4) HP S/N's 3246001 thru 3246017 only.
(5) HP S/N's 3246182 and up; TC S/N's 3257199 and up.
(6) HP S/N's 3246018 thru 3246181; TC S/N's 3257001 thru 3257198 only.
(7) HP S/N's 3246018 and up; TC S/N's 3257001 and up.
(8) Three or four places only.

Interior Placards
Figure 1 (Sheet 2 of 2)



1. PLATE - REGISTRATION NUMBER
2. PLACARD - DEMONSTRATED X-WIND
3. PLACARD - DAY-NIGHT
4. PLACARD - PRESS TO TEST
5. PLACARD - DO NOT EXCEED - MANIFOLD PRESSURE
6. PLACARD - HEAT-DEF - ON OFF
7. PLACARD - CLIMATE CONTROL CENTER (WITH A/C OPTION)
8. PLACARD - FAN - HI LOW OFF
9. PLACARD - KLN 90 DATA LOADER
10. PLACARD - PHONE
11. PLACARD - MIKE
12. PLACARD - CIRCUIT BREAKER PANEL (3)
13. PLACARD - ALTERNATOR AMPS
14. PLACARD - FLAPS
15. PLACARD - ALT AIR - OPEN CLOSE
16. PLACARD - GEAR UP - DOWN SPEEDS
17. PLACARD - EMERGENCY GEAR EXTENSION
18. PLACARD - SWITCH LIGHTS - PANEL LIGHTS
19. PLACARD - GPS
20. PLACARD - ALTERNATE STATIC SOURCE
21. PLACARD - AUX VAC
22. PLACARD - CAUTION - BEFORE USING AUX PUMP

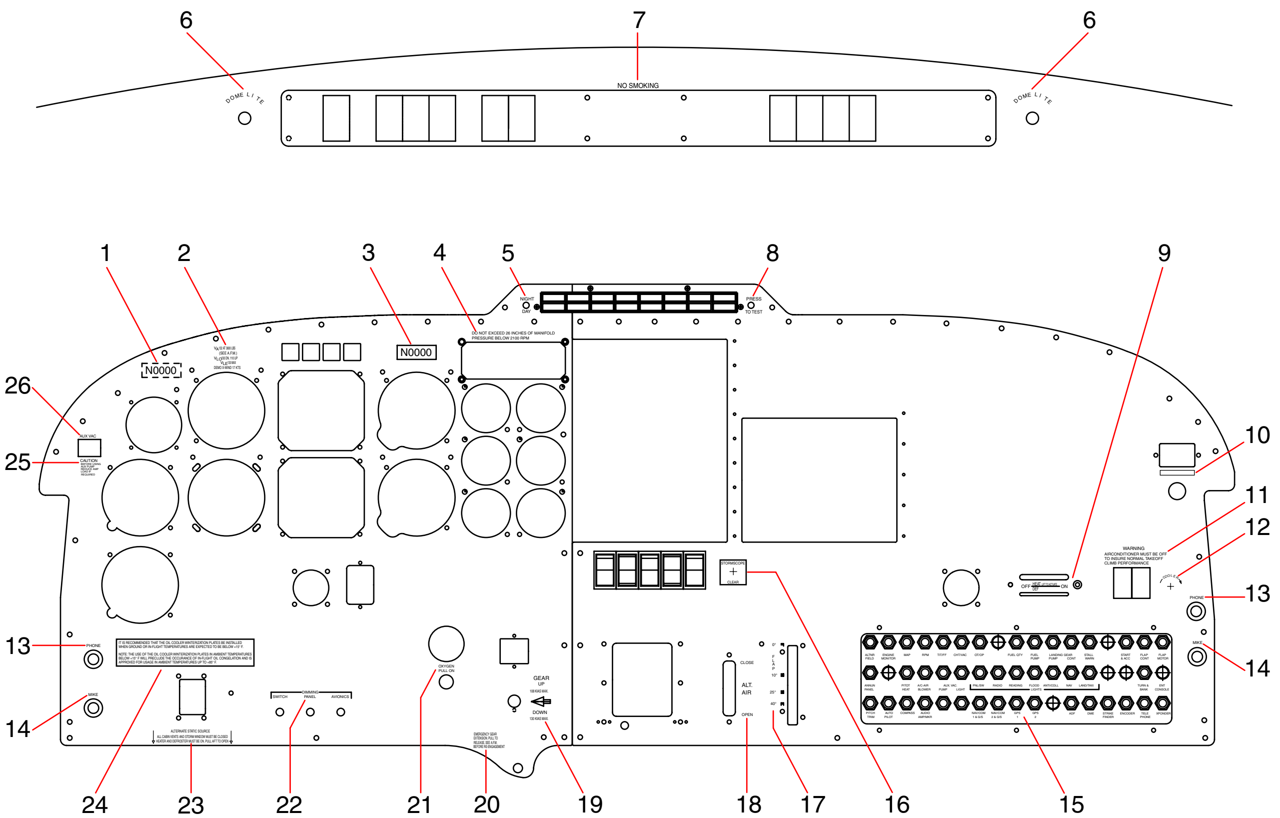
Instrument Panel Placards
Figure 2 (Sheet 1 of 5)



1. PLATE - REGISTRATION NUMBER
2. PLACARD - DEMONSTRATED X-WIND
3. PLACARD - DAY-NIGHT
4. PLACARD - PRESS TO TEST
5. PLACARD - DO NOT EXCEED - MANIFOLD PRESSURE
6. PLACARD - HEAT-DEF - ON OFF
7. PLACARD - WARNING: AIR CONDITIONING MUST BE OFF (OPTIONAL)
8. PLACARD - COOLER (OPTIONAL)
9. PLACARD - KLN 90 DATA LOADER
10. PLACARD - PHONE
11. PLACARD - MIKE
12. PLACARD - CIRCUIT BREAKER PANEL (3)
13. PLACARD - ALTERNATOR AMPS
14. PLACARD - FLAPS
15. PLACARD - ALT AIR - OPEN CLOSE
16. PLACARD - GEAR UP - DOWN SPEEDS
17. PLACARD - EMERGENCY GEAR EXTENSION
18. PLACARD - SWITCH LIGHTS - PANEL LIGHTS
19. PLACARD - DOME LIGHTS
20. PLACARD - ALTERNATE STATIC SOURCE
21. PLACARD - AUX VAC
22. PLACARD - CAUTION - BEFORE USING AUX PUMP

Instrument Panel Placards
Figure 2 (Sheet 2 of 5)

Effectivity
3246018 thru 3246087

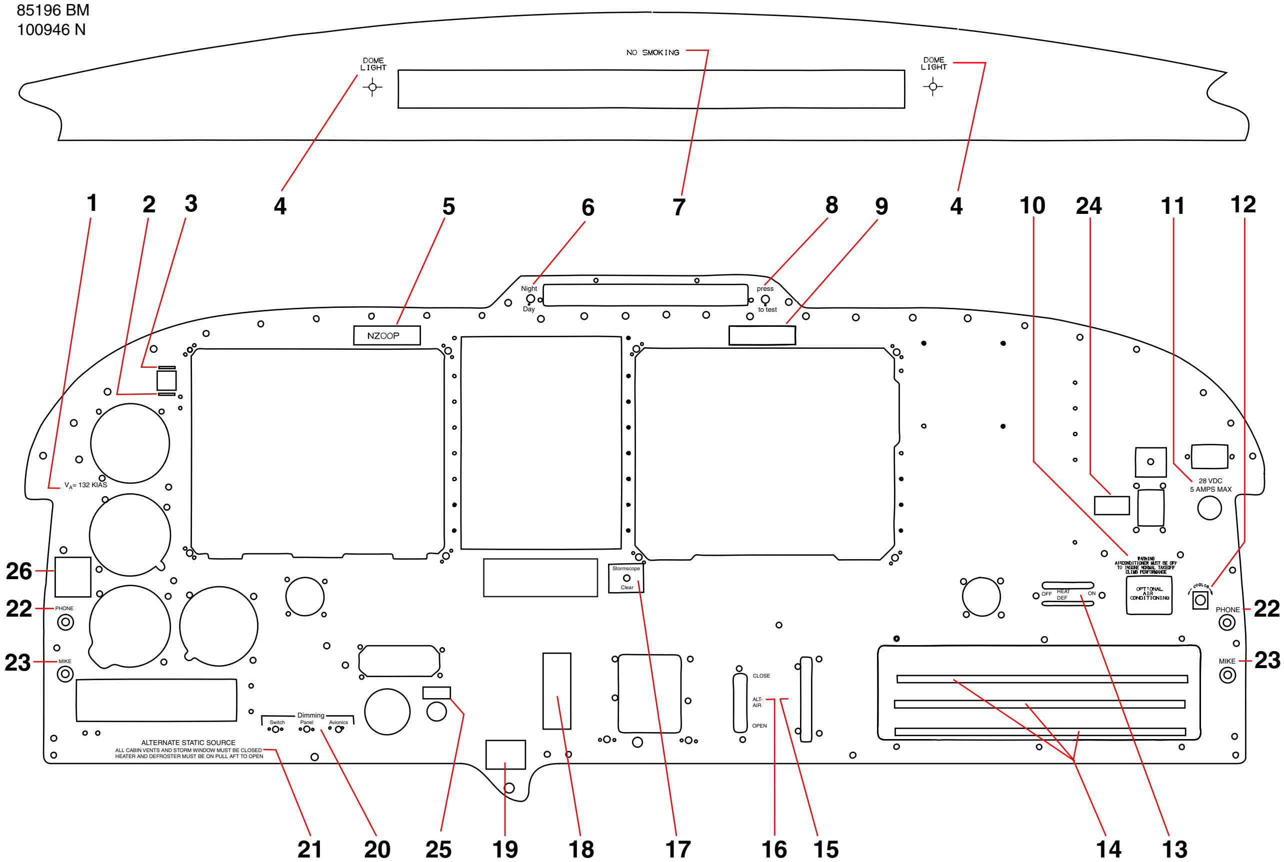


1. PLATE - REGISTRATION NUMBER (ALTERNATE LOCATION)
2. PLACARD - DEMONSTRATED X-WIND
3. PLATE - REGISTRATION NUMBER
4. PLACARD - PLACARD - DO NOT EXCEED - MANIFOLD PRESSURE
5. PLACARD - DAY-NIGHT
6. PLACARD - DOME LITE
7. PLACARD - NO SMOKING
8. PLACARD - PRESS TO TEST
9. PLACARD - HEAT-DEF - ON OFF
10. PLACARD - 28 VOLT, 5 AMPS MAX
11. PLACARD - WARNING: AIR CONDITIONING MUST BE OFF (OPTIONAL)
12. PLACARD - COOLER (OPTIONAL)
13. PLACARD - PHONE
14. PLACARD - MIKE
15. PLACARD - CIRCUIT BREAKER PANEL (3)
16. PLACARD - STORMSCOPE + CLEAR (OPTIONAL)
17. PLACARD - FLAPS
18. PLACARD - ALT AIR - OPEN CLOSE
19. PLACARD - GEAR UP - DOWN SPEEDS
20. PLACARD - EMERGENCY GEAR EXTENSION
21. PLACARD - OXYGEN - PULL ON (TC ONLY)
22. PLACARD - SWITCH LIGHTS - PANEL LIGHTS
23. PLACARD - ALTERNATE STATIC SOURCE
24. PLACARD - OIL COOLER WINTERIZATION PLATES
25. PLACARD - CAUTION - BEFORE USING AUX PUMP
26. PLACARD - AUX VAC

Effectivity
3246088 thru 3246217
3257001 thru 3257338

Instrument Panel Placards
Figure 2 (Sheet 3 of 5)

06327 W
85196 BM
100946 N

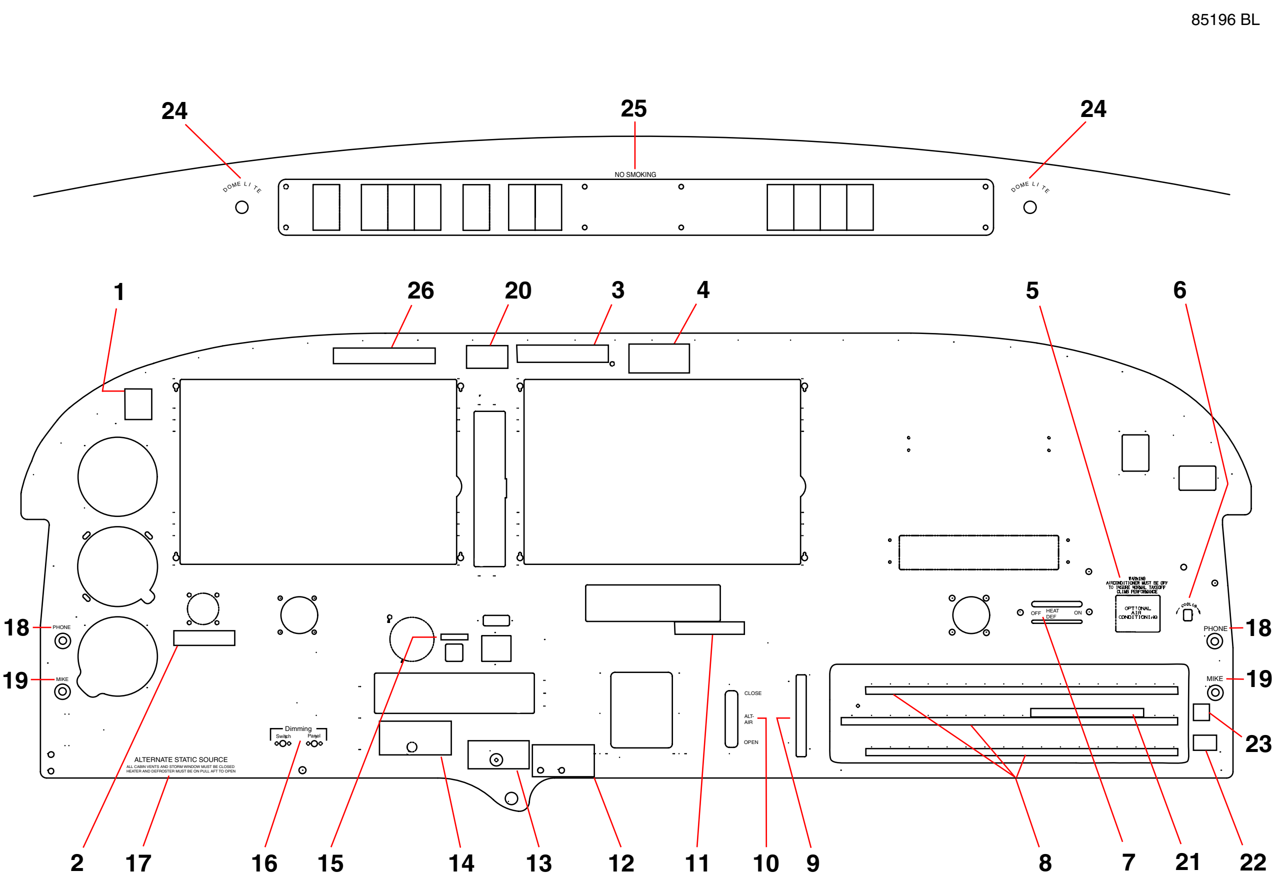


1. PLACARD - V_A SPEED / DEMO X-WIND
2. PLACARD - PUSH ON/OFF
3. PLACARD - ELEV. TRIM
4. PLACARD - DOME LIGHT
5. PLACARD - REGISTRATION NUMBER
6. PLACARD - DAY / NIGHT
7. PLACARD - NO SMOKING
8. PLACARD - PUSH TO TEST
9. PLACARD - MANIFOLD PRESSURE LIMIT
10. PLACARD - WARNING: AIR CONDITIONING MUST BE OFF... (OPTIONAL)
11. PLACARD - 28 VDC 5 AMPS MAX
12. PLACARD - COOLER (OPTIONAL)
13. PLACARD - HEAT - DEF. - ON/OFF
14. PLACARD - CIRCUIT BREAKER
15. PLACARD - FLAP POSITION
16. PLACARD - ALT AIR OPEN / CLOSED
17. PLACARD - STORMSCOPE CLEAR (OPTIONAL)
18. PLACARD - GEAR UP/DOWN
19. PLACARD - EMERGENCY GEAR EXTENSION
20. PLACARD - DIMMING (SWITCH, PANEL, AVIONICS)
21. PLACARD - ALTERNATE STATIC SOURCE
22. PLACARD - PHONE
23. PLACARD - MIKE
24. PLACARD - ELT CAUTION
25. DECAL - OXYGEN PULL ON (TC ONLY)
26. DECAL - STANDBY ATTITUDE INDICATOR (SEE NOTE)

NOTES: **HP S/N's 3246218, 3246220 thru 3246222, 3246224 thru 3246244, with Kit No. 88436; TC S/N's 3257339, 3257341 thru 3257446, 3257448 thru 3257487, with Kit No. 88436; TC S/N's 3257488 and up.**

Instrument Panel Placards
Figure 2 (Sheet 4 of 5)

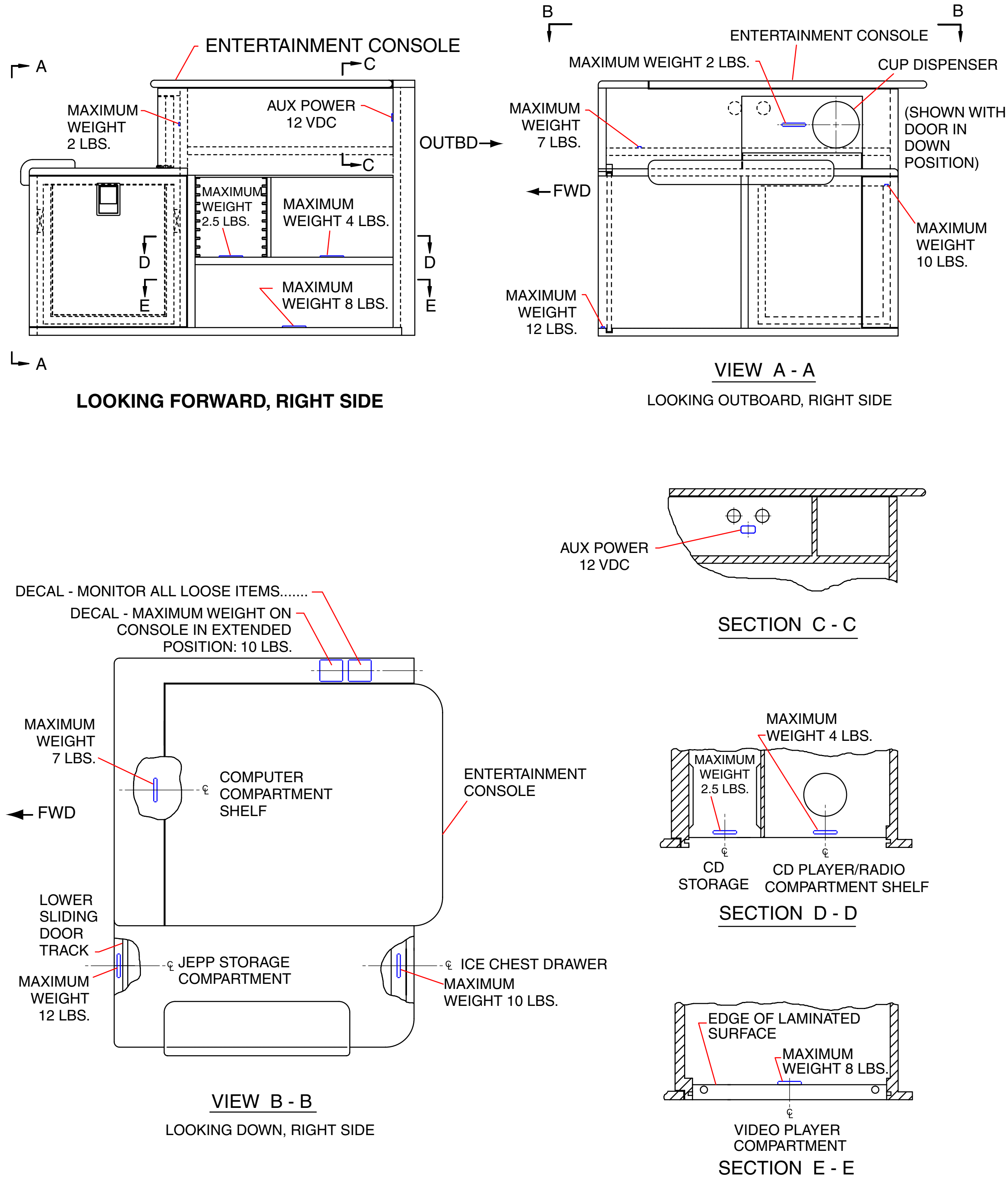
Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra



1. PLACARD - V_A SPEED / DEMO X-WIND
2. PLACARD - FLIGHT IN KNOWN ICING PROHIBITION (OPTIONAL)
3. PLACARD - MANIFOLD PRESSURE LIMIT
4. PLACARD - STORMSCOPE (OPTIONAL)
5. PLACARD - WARNING: AIR CONDITIONING MUST BE OFF... (OPTIONAL)
6. PLACARD - COOLER (OPTIONAL)
7. PLACARD - HEAT - DEF. - ON/OFF
8. PLACARD - CIRCUIT BREAKER
9. PLACARD - FLAP POSITION
10. PLACARD - ALT AIR OPEN / CLOSED
11. PLACARD - USE OF EMERGENCY BATTERY...
12. PLACARD - GEAR UP/DOWN
13. PLACARD - EMERGENCY GEAR EXTENSION
14. PLACARD - OXYGEN (OPTIONAL)
15. PLACARD - ELEV. TRIM (OPTIONAL)
16. PLACARD - DIMMING (SWITCH, PANEL)
17. PLACARD - ALTERNATE STATIC SOURCE
18. PLACARD - PHONE
19. PLACARD - MIKE
20. PLATE - AIRCRAFT REGISTRATION NUMBER
21. DECAL - CIRCUIT BREAKER - LIGHTS
22. DECAL - AVIONICS BUS
23. DECAL - ESS BUS
24. DECAL - DOME LIGHT
25. DECAL - NO SMOKING
26. DECAL - FLIGHT MANEUVER

Effectivity
with Garmin 1000

Instrument Panel Placards
Figure 2 (Sheet 5 of 5)



Optional Entertainment Console Placards
Figure 3

Effectivity
3246088 thru 3246217
3257001 thru 3257338

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CHAPTER

12

SERVICING

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CHAPTER 12

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
12-List of Effective Pages	1	Mar 21/12
	2	Jun 30/07
12-Table of Contents	1	Mar 21/12
	2	Mar 21/12
12-00-00	1	Jun 30/07
	2	Jun 30/07
	3	Dec 31/09
	4	Jun 30/07
	5	Jun 30/07
	6	Jun 30/07
	7	Jun 30/07
	8	Jun 30/07
12-10-00	1	Dec 31/09
	2	Mar 21/12
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	2B	Mar 21/12
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	4	Dec 31/09
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	5	Dec 31/09
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CHAPTER 12 - SERVICING

TABLE OF CONTENTS

CHAPTER 12 - SERVICING

TABLE OF CONTENTS (continued)

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.

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.)

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

C. Cleaning

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

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

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

(1) Flush away loose dirt with water.

(2) Apply cleaning solution with a rag, sponge or soft bristle brush.

(3) To remove stubborn oil and grease, use cloth dampened with naphtha.

(4) Where exhaust stains exist, allow solution to remain on the surface longer.

(5) Any good automotive wax may be used to preserve the painted surfaces. Soft cleaning cloths or a chamois should be used to prevent scratches when cleaning or polishing. A heavier coating of wax on the leading surfaces will reduce the abrasion problems in these areas.

2. Cleaning

A. Engine Compartment

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

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

CAUTION: DO NOT SPRAY SOLVENT INTO THE ALTERNATOR, STARTER, VACUUM PUMP(S), AIR INTAKE AND ALTERNATE AIR INLETS.

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

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

CAUTION: DO NOT OPERATE ENGINE UNTIL EXCESS SOLVENT HAS EVAPORATED OR OTHERWISE BEEN REMOVED.

(4) Remove the protective covers from the magnetos.

(5) Lubricate controls, bearing surfaces, etc., per Lubrication Charts,12-20-00.

B. Landing Gear

(1) Struts and Torque Links

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

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

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

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

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

(e) Lubricate gear per Lubrication Chart, 12-20-00.

(2) Wheels and Brakes

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

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

(b) Rinse with low-pressure spray.

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

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 91-10-00, Chart 10, List of Consumable Materials for Specifications and Manufacturer's address.)

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.

F. TKS Porous Panels (If Installed.)

CAUTION: USE ONLY APPROVED SOLVENTS, SEE BELOW, TO CLEAN ICE PROTECTION SYSTEM POROUS PANELS.

DO NOT APPLY POLISH OR WAX TO ICE PROTECTION SYSTEM POROUS PANELS.

DO NOT PAINT ICE PROTECTION SYSTEM POROUS PANELS.

MASK ICE PROTECTION SYSTEM POROUS PANELS WITH SOLVENT RESISTANT MATERIALS WHEN USING METHYL ETHYL KEYTONE (MEK), ACETONE, PAINT THINNERS AND STRIPPERS, AND ANY OTHER THINNERS, STRIPPERS, OR UNAPPROVED SOLVENTS ON ADJACENT SURFACES.

Inadvertent Ice Protection System (TKS) Porous Panels, if installed, are mounted to the wing and stabilator leading edges. These panels are functionally self-cleaning due to the flushing action of the deice fluid when the system is in use.

(1) Dirt and insect debris.

Use mild soap and water with a soft cloth, sponge, or soft bristle brush. Rinse thoroughly.

NOTE: Removal of heavy insect debris should be aided by operating the ice protection system for a sufficient period of time to wet the leading edges with deice fluid. Spread the deice fluid with a soft cloth or sponge to cover the insect encrusted area and wait ten (10) minutes for the fluid to soften the insect debris before proceeding with mild soap and water cleaning.

(2) Oil, grease, adhesives, paints, etc. may be removed by using the following approved solvents only:

WARNING: SOLVENT CLEANERS REQUIRE ADEQUATE VENTILATION. STODDARD SOLVENT, ISOPROPYL ALCOHOL, DENATURED ALCOHOL, AND AVIATION FUEL ARE FLAMMABLE. DO NOT USE NEAR OPEN FLAME.

Water, mild soap, approved deicing fluids (see Inadvertent Ice Protection System (TKS), 12-20-00), Stoddard Solvent, isopropyl alcohol, denatured alcohol, or aviation fuel (gasoline or kerosene).

(3) Polishing

CAUTION: DO NOT APPLY POLISH OR WAX TO ICE PROTECTION SYSTEM POROUS PANELS.

Porous panel finish may be restored to original condition by polishing with “Scotchbrite” pads. Polish in a chordwise direction to obtain a matching texture to the original. Use Very Fine grade only if required for initial cleaning and difficult deposits. Use Ultra Fine grade for normal cleaning and final polishing.

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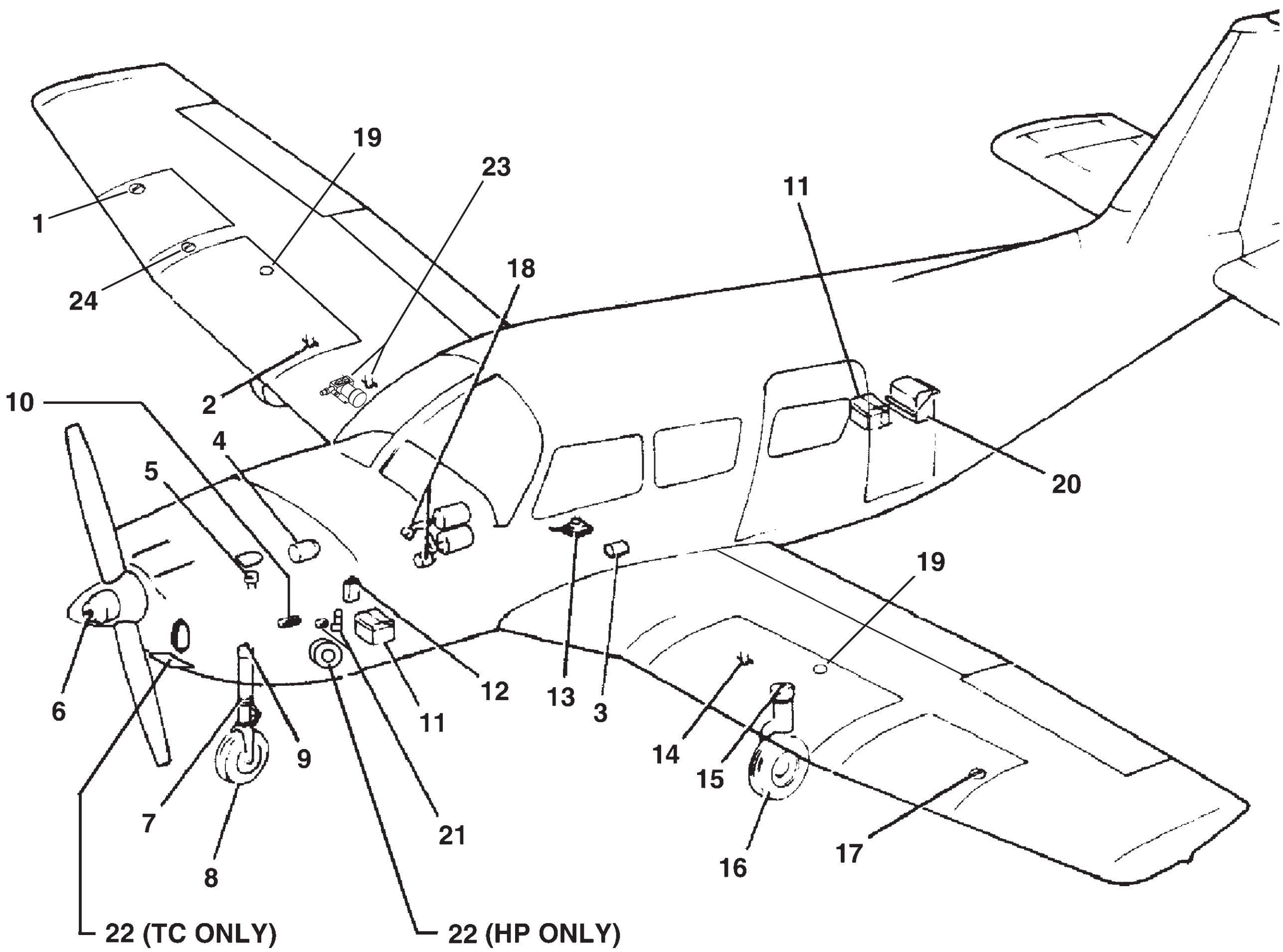
REPLENISHING

1. Service Points

   See Figure 1.



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 THRU 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. CENTRAL AIR FILTER (AIR CONDITIONER)
21. HYDRAULIC PUMP / RESERVOIR
    AND, IF INSTALLED, TKS FILTER
22. INDUCTION AIR FILTER
23. IF INSTALLED, TKS PUMP AND DRAIN
24. IF INSTALLED, TKS FLUID TANK FILLER

Service Points
Figure 1

2. Fuel System

A. Fuel Tanks

(1) Filling

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.

(2) Water Contamination

WARNING: PILOTS, OWNERS, OPERATORS, MAINTENANCE, AND SERVICE PERSONNEL SHOULD ASSUME SOME WATER EXISTS IN THE FUEL SYSTEM.

Water may enter the fuel tank system via any penetration in the wing fuel tank and from moisture condensation inside the tank. Water in the fuel may come out of solution, settle and make its way to a drain location in the form of a blob, pea, or BB-shaped translucent mass found at the bottom of the sampler cup. Water suspended in the fuel may lead to a cloudy or hazy appearance in the sampler cup. Water may have dissolved in the fuel, but conditions have not yet occurred to cause the water to come out of solution and perhaps adhere to the dry tank upper surface or walls (similar to condensation).

See FAA Special Airworthiness Information Bulletin (SAIB) No. CE-12-06 for additional information.

(3) Draining Moisture

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

The fuel system should be drained daily prior to first flight and after refueling to avoid the accumulation of water or sediment. Each aluminum fuel tank is equipped with an individual quick drain located at the lower inboard rear corner of the tank. This allows each wing to be drained individually. The fuel selector valve is provided with a quick drain valve located on the forward face of the spar box.

NOTE: There is no single point of drainage that can be used to check for all fuel system contaminants simultaneously.

Drain fuel tanks and selector valve per the following:

With the airplane in the normal ground attitude and starting at the highest drain location, check all drain locations for contaminants before every flight, whether or not refueling has occurred. Have fuel sample disposal provisions and proper lighting at your disposal to properly check for fuel tank system contamination.

(a) Drain at least one cup of fuel (using a clear sampler cup) from each drain location:

1) Drain each wing through its individual quick drain located at the lower inboard rear corner of the aluminum fuel tank.

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 strainer.

NOTE: The fuel selector should be positioned in the following sequence while draining the strainer: “OFF,” “LEFT” and “RIGHT.” This is done to ensure that the fuel in the lines between each tank outlet and the fuel strainer is drained, as well as the fuel in the fuel strainer. When the fuel tanks are full, it will take approximately six seconds to drain all the fuel in one of the lines from a tank to the fuel strainer. If the fuel tanks are less than full, it will take a few seconds longer.

(b) Check for water, clarity, cloudiness, haze, proper fuel type/grade (i.e.; 100LL is light blue in tint, jet fuel is clear or yellowish), odor, or other contaminants.

(c) Allow time between fueling and draining. It takes time for any contaminates to settle to sump area prior to draining tanks.

(d) If any contamination is detected in the fuel tank system, thoroughly drain all drain locations again.

(e) If contamination is observed, take further samples until the fuel appears clear, and gently rock the airplane in both the roll and pitch axis to move any additional contaminants to the drain points.

(f) Take repeated samples from all drain locations until all contamination has been removed.

(g) If contaminants are still present, do not fly the airplane. Have qualified maintenance personnel drain and purge the fuel tank system. Remove all evidence of contamination prior to further flight.

(4) Draining Entirely

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

Fuel may be drained from the system by opening the valve at the inboard end of each aluminum 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. Either wing may be drained by closing the selector valve and then draining as desired.

B. Flushing Tanks and Selector Valve

(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.

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3. 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.

A. Oil Sump

(1) Draining

To drain the oil sump, provide a suitable container with a minimum capacity of that required to fill the sump. Remove the 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 ensure complete draining of the old oil.

(2) Filling

The oil sump should normally be filled with oil to the mark on the engine dipstick. The quantity of oil required for the engine may be found in 6-00-00, Chart 1. The specified grade of oil may be found in 12-20-00, Lubrication Charts; 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 cowling, and remove the oil filler cap with dipstick.

(3) Recommendations for Changing Oil

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

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

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

1 Do not add additive oil to straight mineral oil. Drain the straight mineral oil from the engine and fill with additive oil.

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

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

4. Landing Gear

A. 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.

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

(1) Filling Nose Gear Oleo Strut

To fill the nose gear oleo strut with hydraulic fluid (MIL-PRF-5606H), 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:

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

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

(c) 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.

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

1 Method 1:

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

b 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.

c 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.

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

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

f 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.

2 Method II:

a Remove filler plug from top of strut housing.

b Raise strut piston until fully compressed.

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

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

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

f 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.

(e) 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.

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

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

(2) Filling Main Gear Oleo Strut

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

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

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

(c) 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.

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

1 Method I:

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

b 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.

c 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.

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

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

f 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.

2 Method II:

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

b Raise the strut to full compression.

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

d 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.

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

f Apply thread lubricant (Kopr-Kote or equivilent MIL-PRF-907E) to the threads of the filler plug. Reinstall the filler plug and torque to 45 foot-pounds.

(e) 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.

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

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

(3) 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. (See 7-10-00.)

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.

B. Brake System

The brake system incorporates a hydraulic fluid reservoir through which the brake system is periodically serviced. Fluid is drawn from the reservoir by the brake cylinders to maintain the volume of fluid required for maximum braking efficiency. Spongy brake pedal action is often an indication that the brake fluid reservoir is running low on fluid. Instructions for filling the reservoir are given in Filling Brake Cylinder Reservoir. When found necessary to accomplish repairs to any of the brake system components, or to bleed the system, these instructions may be found in 32-40-00.

(1) 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-PRF-5606H fluid to level marked on reservoir. No brake adjustment is necessary, though they should be checked periodically per instructions given in 32-40-00.

(2) Draining Brake System

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

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

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

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

5. Tires

Discounting tire growth after initial inflation, once the tire has been inflated, the maximum permissible pressure drop is 5% in any 24 hour period. When the loss rate exceeds 5% in 24 hours, check tires for damage.

Some aircraft tires are designed to permit air or nitrogen that is trapped in the cords or that diffuses through the liner or tube to escape through special sidewall vents. This venting prevents pressure build-up within the cord body which might cause tread, sidewall or ply separation. Tires requiring lower sidewall vents will have either a green or white paint dot applied to the area of each vent hole. Tires not needing lower sidewall vents will have no color dot in this zone.

When water or a soap solution is brushed over the outside of a vented 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 vented tire is inflated, there will be some diffusion from the vents. 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.

However, as stated above, any drop in pressure exceeding 5% in any 24 hour period is not acceptable.

A. Several basic characteristics of 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 tires to show a small amount of pressure leakage throughout the life of the tires.

B. Maintain tires at pressure specified in 6-00-00, Chart 1. When checking tire pressure, examine tires for wear, cuts, bruises, and slippage. 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) Re-apply as conditions dictate.

6. 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.

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-PRF-5606H, through the dipstick hole until full. Reinstall the dipstick.

NOTE: After tightening the dipstick, back it off 1 ½ turns to ensure proper venting of the reservoir.

7. 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.

8. Oxygen System

See 35-10-00.

9. Inadvertent Ice Protection System (TKS) (If Installed.)

WARNING: INTENTIONAL FLIGHT INTO KNOWN ICING IS PROHIBITED.
NO DETERMINATION HAS BEEN MADE AS TO THE CAPABILITY OF THIS SYSTEM TO REMOVE OR PREVENT ICE ACCUMULATION.

See Inadvertent Ice Protection System (TKS), 30-10-00, for a complete system description.

Ensure that the deicing fluid tank contains at least the minimum takeoff quantity of fluid (i. e. - 1/4 tank (1.125 US GAL)), and that all system components are filled with fluid. If necessary, operate the pump until all air is dispelled from components and pipelines (see Pump Priming, below). Recheck tank contents.

Run the system at least once a month during flight for at least 15 minutes. Running this system assures that it is operational, flushes any dirt or debris from the porous panels, and exercises the pump. This activity will assure the system is functional and available for use.

A. Deicing Fluid Tank

(1) Filling

Use only fluid meeting the following specifications: TKS 80, AL-5 (DTD 406B), or TKS R328. Fluids conforming to these specifications may be mixed in any proportion.

CAUTION: ALWAYS LOCK THE DEICING FLUID TANK FILLER CAP BETWEEN FLUID FILLS. MONITOR AIRCRAFT FUELING TO ASSURE NO FUEL IS PUMPED INTO THE DEICING FLUID TANK.

The filler cap is located on the right wing, inboard of the fuel filler. The tank has a capacity of 4.25 US gallons usable. To preclude the possibility of contaminated fluid, always clean the top of fluid containers before dispensing, and if required maintain a clean measuring vessel solely for deicing fluid. Secure the filler cap immediately after filling.

(2) Fuel Contamination

If fuel has been inadvertently pumped into the deicing fluid tank, the tank must be serviced. Do not operate the ice protection system with fuel in the tank. The contaminated fluid must be drained, see below, completely from the tank, and the tank should be flushed with clean water. At least two complete tanks of water (ten (10) US GAL) should be drained through the system. After the system has been thoroughly flushed, it must be filled and primed (see Pump Priming, below).

(3) Draining

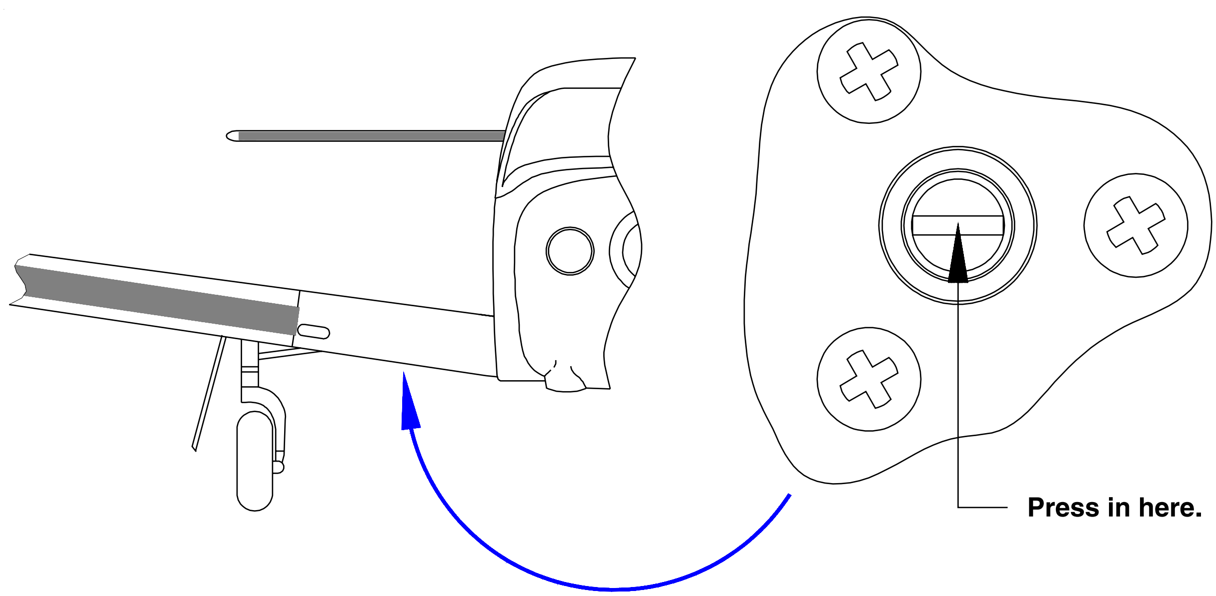
In the event that the deicing fluid tank must be drained, use the system drain valve located on the lower, right inboard surface of the wing, forward of the landing gear area and main spar. See Figure 2.

This valve can be locked open by pressing into the valve stem with a screwdriver, and turning the stem 1/4 turn. This action will allow the entire contents to be drained without holding the valve open.

After draining, return the valve to the closed position. When the tank has been drained, the pump must be primed. See Pump Priming below.

(4) Strainer

The deicing fluid strainer in the fluid tank outlet should not require cleaning unless there is a definite indication of foreign matter in the tank. If foreign matter is found in the tank, flush the tank with clean water if foreign materials are evident in the bottom of the tank.



TKS Drain Valve
Figure 2

B. Pump Priming

The metering pump is not self priming and may require priming in the event the deicing fluid tank is run dry or emptied completely. Once prime is established, the pump will maintain the prime unless air re-enters the pump. If priming is required, locate the system drain valve on the lower, right inboard wing, near the landing gear. The valve is forward of the main spar. Fill the deicing fluid tank completely. The valve is operated by pressing a screwdriver or center-pin cup into the valve, similar to fuel strainers. The pin may be held in momentarily to drain for priming.

For complete pump priming, one (1) quart of fluid must be drained. The fluid may be returned to the tank if kept clean. Assure that the drain valve is closed and not leaking fluid after use.

C. TKS Porous Leading Edge Panels

CAUTION: USE ONLY APPROVED SOLVENTS (SEE TKS POROUS PANELS, CLEANING, 12-00-00) TO CLEAN TKS POROUS LEADING EDGE PANELS.

DO NOT APPLY POLISH OR WAX TO TKS POROUS PANELS.

DO NOT PAINT TKS POROUS PANELS.

MASK TKS POROUS PANELS WITH SOLVENT RESISTANT MATERIALS WHEN USING METHYL ETHYL KEYTONE (MEK), ACETONE, PAINT THINNERS AND STRIPPERS, AND ANY OTHER THINNERS, STRIPPERS, OR UNAPPROVED SOLVENTS ON ADJACENT SURFACES.

SCHEDULED SERVICING

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

1. 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.

A. Removal

(1) Remove lower engine cowling.

(2) 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.

(3) Remove air filter.

B. Installation

After cleaning or replacing the filter, install the filter in the reverse order of removal.

(1) Position air filter on engine.

(2) Secure air filter using cover plate with wingnuts (HP) or retainer and screws (TC).

(3) Install lower engine cowling.

C. Cleaning

(1) HP only:

(a) Tap gently to remove dirt particles. Do not blow out with compressed air.

(b) 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.

(c) 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.

(d) Inspect filter medium for holes or tears and insure frame provides a good air seal. Replace defective filters.

(2) TC only:

(a) To clean filter, blow out with compressed air from gasket side; or,

(b) Wash in warm water and mild detergent and dry.

(c) Do not use oil.

2. 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:

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

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

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

D. Check the cockpit control cable for free travel.

3. 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.

4. Electrical System

Servicing the electrical system involves adding distilled water to the battery to maintain correct electrolyte level, and checking for any spilled electrolyte that would lead to corrosion. See Battery, 12-10-00. 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 24-30-00 of this manual.

5. Landing Gear

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

A. 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.

(1) Tire Balancer

An inexpensive balancing fixture that will balance almost any light aircraft tire can be made from the materials shown in Figure 1.

(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.

(2) Procedure

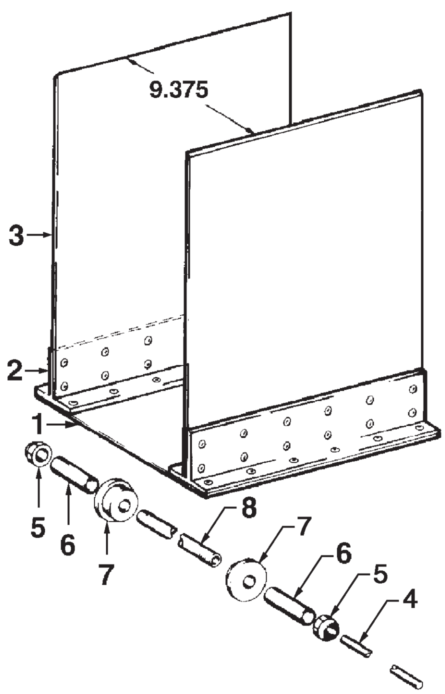
Balance tires as follows:

(a) Mount the tire and tube (if one is used) on the wheels, but do not install the securing bolts. Install the wheel bearings in the wheels; then, using the -7 bushings, -6 spacers, and -5 nuts, install the wheel/tire assembly on the -8 pipe. Secure the -5 nuts finger tight so that the wheel halves touch each other.. Be sure the bolt holes are aligned. Insert the -4 axle through the -8 pipe and place the wheel in the center of the balancer. Make sure the axle is only on the chamfered edges of the balancer and that it is at 90° to the sides of the balancer.

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

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

(d) When reassembling the wheel, powder the inside of the tire. Mount the tire on the valve side of the wheel in the same position it was in when it was balanced. Install the other wheel half, aligning the chalk marks. Install the bolts and tighten to required torque, then inflate the tire to the pressure specified in 6-00-00, Chart 1, and recheck the balance. The wheel should not be more than one ounce out of balance.



USE THE FOLLOWING LIST OF MATERIALS TO MAKE THE BALANCER

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

Wheel Balancer
Figure 1

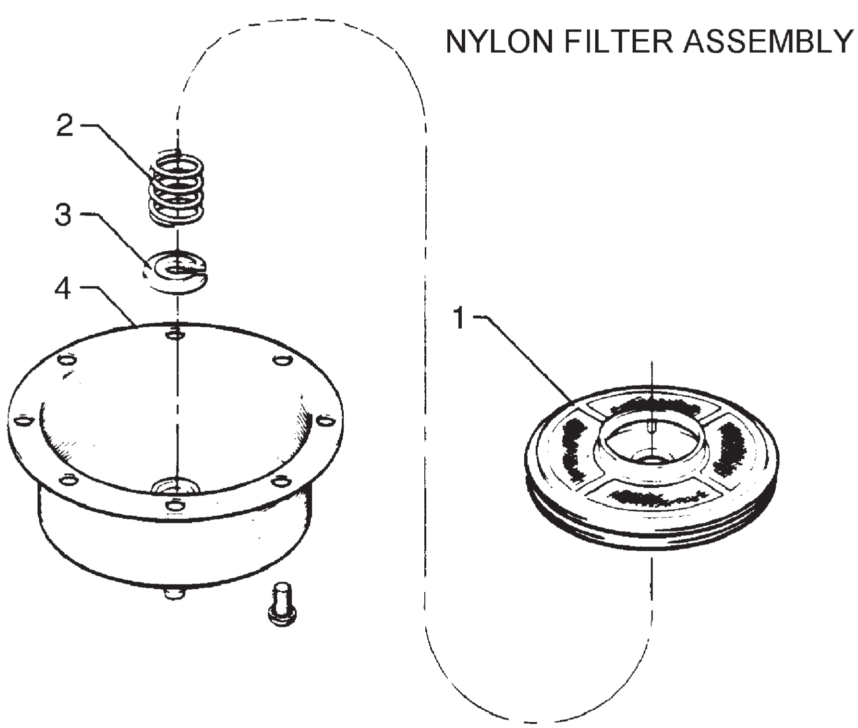
6. Fuel Filter

At intervals of 50 hours or 90 days, whichever comes first, clean the fuel screen/filter (i.e. - strainer). The filter in the bowl of the fuel selector valve (refer to Figure 2) is located under the floorboard aft of the main spar and accessed from below the airplane through an access plate.

7. Oil System

A. 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.



1. FILTER
2. SPRING
3. RETAINER WASHER
4. BOWL

Fuel Filter Bowl and Screen
Figure 2

B. Oil Filter

(1) The oil filter should be replaced after each 50 hours of engine operation or every four (4) months, whichever comes first. 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.

8. Lubrication

Proper lubrication procedures are valuable both as a means of prolonging the service life of the airplane and reducing the frequency of repairs. The periodic application of recommended lubricants to their relevant bearing surfaces, together with cleanliness, ensures the maximum efficiency and utmost service life of all moving parts. Instructions regarding the locations, time intervals, and types of lubricant used are found in the Lubrication Charts. See also 91-10-00, Chart 10, Consumable Materials.

NOTE: If the airplane is inactive for long periods of time, lubricate in accordance with Lubrication Charts at least every 90 days.

A. Precautions

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

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

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

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

(1) Use recommended lubricants. Where general purpose lubricating oil is specified, but unavailable, clean engine oil may be used.

(2) Check components to be lubricated for evidence of excessive wear and replace as required.

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

B. Application of Grease

Before using a grease gun, ensure that gun is filled with new, clean grease of the grade specified for the particular application.

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

(2) Remove wheel bearings from the wheel hub and clean thoroughly with a suitable solvent. When repacking with grease, be sure the lubricant enters the space between the rollers in the retainer ring. Do not pack the grease into the wheel hub.

(3) Use extra care when greasing the constant speed propeller hub to avoid blowing the clamp gaskets. Remove one grease fitting and apply grease to the other fitting until fresh grease appears at the hole of the removed fitting.

C. Application of Oil

Whenever specific lubrication instructions for individual components are not available, observe the following precautions:

(1) Apply oil sparingly, never more than enough to coat the bearing surfaces.

(2) Do not oil control cables.

D. Lubrication Charts

(PIR-38449-002, Rev NEW.)
(PIR-100768-002, Rev. A.)

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 are listed in Chart 2 before the lubrication charts.

NOTE: When the average ambient air temperature is approximately at the dividing line, use the lighter oil.

While the specified lubricant should be used if available, lubricants listed in the Lubrication Charts should all be considered “or equivalent.” Lubricant specifications become problematic over time. Where a specific product is called out, that manufacturer may go out of business, may be sold, or renamed. The named product may subsequently be no longer available, or renamed itself. Many lubricant military specifications have been superceded over the last several years. Accordingly, a cross-reference chart (Chart 1) is provided for lubricants where specification or product changes have been identified.

CHART 1 (Sheet 1 of 2)
LUBRICANT SPECIFICATION CROSS-REFERENCE

Old Spec / Product	superceded by	New Spec / Product	Product Type
MIL-A-907		MIL-PRF-907 (aka Kopr-Kote *)	Anti-Seize Thread Compound, High Temp. (up to 566 Degrees C) (up to 1050 Degrees F)
MIL-A-5092		MMM-A-1617	Adhesive, (Rubber Base) General Purpose.
MIL-C-16173		MIL-PRF-16173	Corrosion Preventative Compound, Solvent Cutback, Cold Application.
MIL-DTL-27686		See MIL-I-27686 below.	
MIL-G-3278		MIL-PRF-23827	Grease, Aircraft & Instrument, Gear and Actuator Screw.
MIL-G-3545		MIL-PRF-81322	Grease, Aircraft, General Purpose, Wide Temp. (-54 to 177 Degrees C) (-65 to 350 Degrees F).
MIL-G-6032		SAE-AMS-G-6032	Grease, Plug Valve, Gasoline & Oil Resistant.
MIL-G-7711		MIL-PRF-81322	See MIL-PRF-81322 above.
MIL-G-18709		DOD-G-24508	Grease, High Performance, Multipurpose.
MIL-G-23827		MIL-PRF-23827	See MIL-PRF-23827 above.
MIL-G-81322		MIL-PRF-81322	See MIL-PRF-81322 above.
MIL-H-5606		MIL-PRF-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance.
MIL-I-27686 and		MIL-DTL-85470	Inhibitor, Icing, Fuel System, High Flash, NATO Cold Number S-1745.
MIL-L-6082		SAE J 1966	Oil, Lubricating, Aircraft Piston Engine (Non-Dispersant Mineral Oil).
MIL-L-7870		MIL-PRF-7870	Oil, Lubricating, Low Temp.
MIL-L-22851		SAE J 1899	Oil, Lubricating, Aircraft Piston Engine (Ashless Dispersant).
MIL-L-25567		MIL-PRF-25567	Leak Detection Compound, Oxygen Systems.
MIL-L-60326		MS-122AD *	Dry-Lubricant.
MIL-M-7866		SAE-AMS-M-7866	Molybdenum Disulfide, Technical, Lubrication Grade.
MIL-S-11031B		A-A-59293	Adhesive (Curing), Sealing Compound (Polysulfide Base).
MIL-S-22473		ASTM-D-5363	Adhesive, Anaerobic Single-Component.

CHART 1 (Sheet 2 of 2)
LUBRICANT SPECIFICATION CROSS-REFERENCE

Old Spec / Product superceded by	**New Spec / Product**	**Product Type**
MIL-S-8660	SAE-AS-8660	Silicone Compound, Nato S-736, (-54 to 204 Degrees C) (-65 to 400 Degrees F)
MIL-T-5544	SAE-AMS-2518	Thread Compound, Anti-Seize, Graphite-Petrolatum
MIL-T-27730	A-A-58092	Tape, Anti-Seize, Polytetrafluoroethylene
MS-122 *	MS-122AD *	Dry-Lubricant
MS-122-6075 *	MS-122AD *	Dry-Lubricant
Parker O-Ring Lube *	Parker O-LUBE *	O-Ring Lubricant
Parker 6PB * or 6PB Parker *	MIL-PRF-907 (aka Kopr-Kote *)	See MIL-PRF-907 above.
TT-A-580 (JAN-A-669)	TT-A-580 (TT-S-1732)	Sealing Compound, Pipe Joint and Thread, Lead Free, General Purpose.

* Product Nomenclature

CHART 2
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.	WHEEL BEARINGS - For nose and main wheels, see bearing installation procedure in 32-40-00, under Main Wheel Assembly, Assembly and Installation, for grease requirements and packing instructions. Wheel bearings also require cleaning and repacking after exposure to any abnormal quantity of water.
4.	OLEO STRUTS, HYDRAULIC PUMP RESERVOIR AND BRAKE RESERVOIR - Fill per instructions on unit or container, or refer to applicable chapter in this manual.
5.	DOOR SEALS - Apply release agent/dry lubricant to door seals at least once a month to improve sealing characteristics and to prevent the seal from sticking.
6.	CONTROL CABLES - Do not oil control cables. Grease control cables where they pass over a pulley or through a fairlead.
7.	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.
7A.	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.
8.	OIL AND FILTER - Lycoming recommends changing the oil and filter every 50 hours or four months, whichever comes first.
9.	See the latest revision of Lycoming Service Instructions No. 1014 for use of detergent oil.
10	O-RING, CONTROL WHEEL SHAFT BUSHING - Disassemble the retainer plates and lubricate the O-ring around the control wheel shaft bushing as required.
11.	PROPELLER - For each blade: remove a grease fitting; apply grease through the remaining fitting until fresh grease appears at hole of removed fitting. If annual usage is significantly less than 100 hours, increase lubrication frequency to every six months.
12.	AIR CONDITIONING CONDENSER DOOR ACTUATING TRANSMISSION - Transmission to be 1/2 full of grease. Apply grease during assembly and lubricate transmission ball nut and screw with MIL-PRF-23827C grease.
13.	FUEL SELECTOR VALVE - Lubricate area where detent ball moves across cover plate (on external valve only).

CHART 3 (Sheet 1 of 2)
LUBRICATION - MAIN LANDING GEAR

COMPONENT	LUBRICANT	FREQUENCY
1. MAIN GEAR PIVOT POINTS (See Spec. Instr. 1 and 2)	MIL-PRF-23827	100 hrs
2. MAIN GEAR DOOR HINGE (See Spec. Instr. 2)	MIL-PRF-7870C	100 hrs
3. MAIN GEAR TORQUE LINKS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
4 EXPOSED MAIN OLEO STRUT (See Spec. Instr. 2)	Release Agent / Dry Lubricant MS-122AD	100 hrs
5. MAIN GEAR WHEEL BEARINGS (See Spec. Instr. 3)	Mobil Grease 28 MIL-PRF-81322E	100 hrs
6. MAIN GEAR DOOR CONTROL ROD ENDS (See Spec. Instr. 1)	MIL-PRF-7870	100 hrs
7. MAIN GEAR SIDE BRACE LINK ASSEMBLY (See Spec. Instr. 1 and 2)	MIL-PRF-23827	100 hrs
8. UPPER SIDE BRACE SWIVEL FITTING (See Spec. Instr. 1 and 2)	MIL-PRF-23827	100 hrs
9. MAIN GEAR DOWNLOCK ASSEMBLY RETRACTION FITTING AND CYLINDER attachment points (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
10. MAIN GEAR OLEO STRUT FILLER POINT (See Spec. Instr. 4 and Caution)	MIL-PRF-5606	As Required
11. HYDRAULIC PUMP RESERVOIR (See Spec. Instr. 4 and Caution)	MIL-PRF-5606	As Required
12. BRAKE RESERVOIR (See Spec. Instr. 4 and Caution)	MIL-PRF-5606	As Required

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

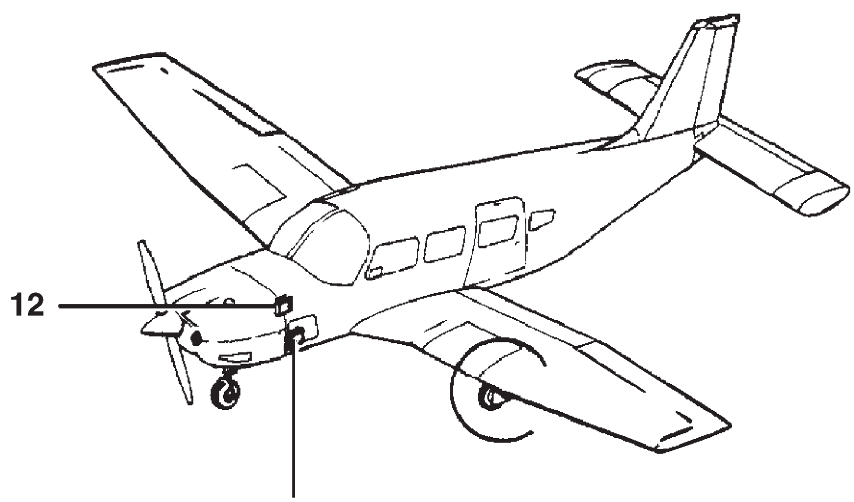


CHART 3 (Sheet 2 of 2)
LUBRICATION - MAIN LANDING GEAR

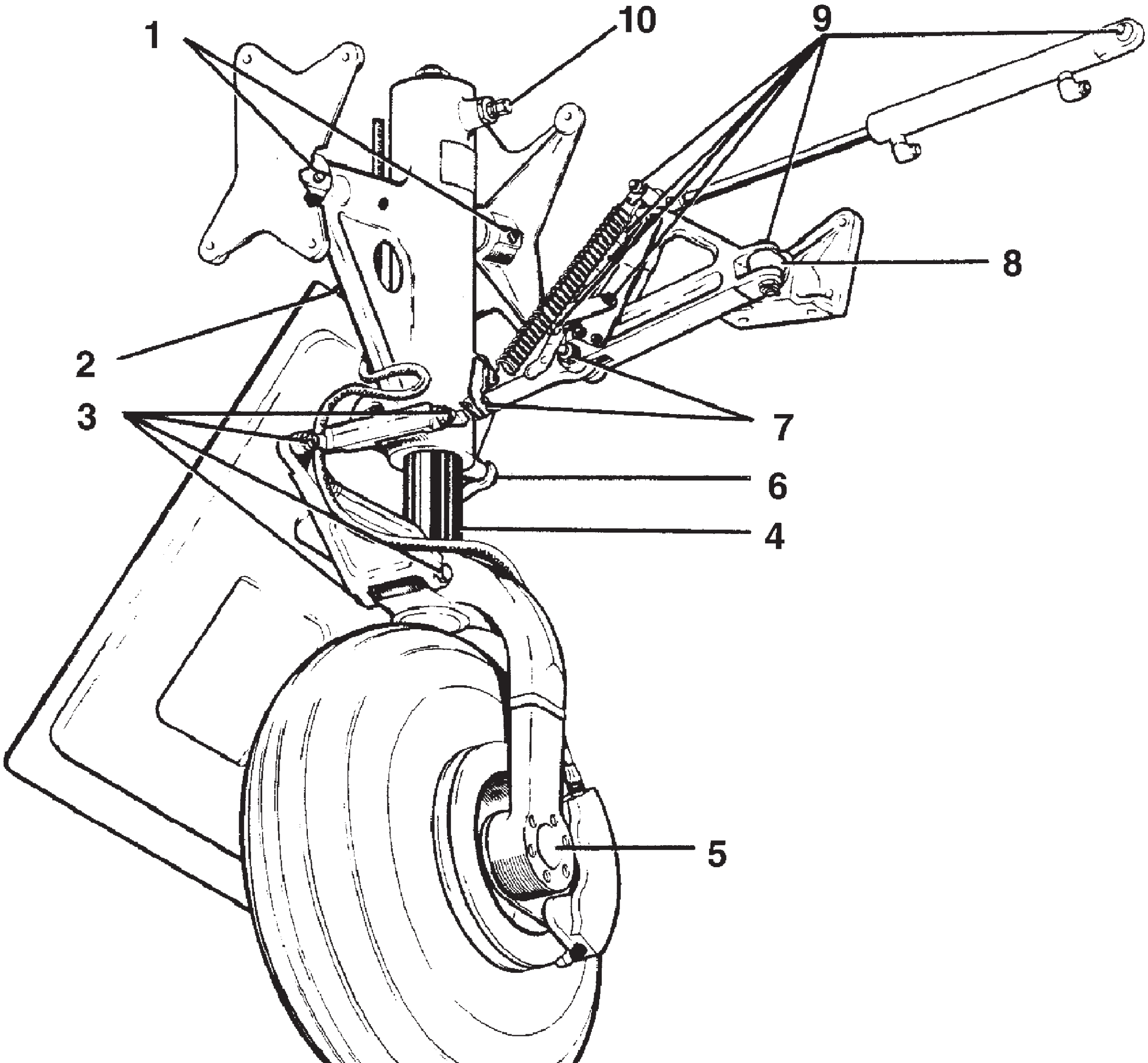


CHART 4 (Sheet 1 of 2)
LUBRICATION - NOSE LANDING GEAR

	COMPONENT	LUBRICANT	FREQUENCY
1.	NOSE GEAR STRUT HOUSING GREASE FITTING (See Spec. Instr. 2)	MIL-PRF-23827	100 hrs
2.	NOSE GEAR PIVOT POINT AND HYDRAULIC CYLINDER ROD END (See Spec. Instr. 2)	MIL-PRF-7870C	100 hrs
3.	NOSE GEAR DOOR RETRACTION MECHANISM (See Spec. Instr. 2)	MIL-PRF-7870C	100 hrs
4.	NOSE GEAR DOOR HINGES (See Spec. Instr. 2)	MiL-PRF-7870C	100 hrs
5.	EXPOSED OLEO STRUT (See Spec. Instr. 2)	Release Agent / Dry Lubricant MS-122AD	100 hrs
6.	NOSE WHEEL BEARINGS (See Spec. Instr. 3)	Mobil Grease 28 MIL-PRF-81322E	100 hrs
7.	NOSE GEAR DRAG LINK ASSEMBLIES (See Spec. Instr. 1)	MIL-PRF-7870	100 hrs
8.	NOSE GEAR TORQUE LINK ASSEMBLY AND STRUT HOUSING (See Spec. Instr. 2)	MIL-PRF-23827	100 hrs
9.	DOWNLOCK HOOK. TENSION SPRING ARMS.SHIMMY DAMPENER AND ALIGNING ROLLER PIVOT POINTS (See Spec. Instr. 1)	MIL-PRF-7870	100 hrs
10.	STEERING BELLCRANK PIVOT POINTS AND ROD ENDS (See Spec. Instr. 1)	MIL-PRF-7870	100 hrs
11.	NOSE GEAR OLEO STRUT FILLER POINT (See Spec. Instr. 4 and Caution)	MIL-PRF-5606	As Required

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

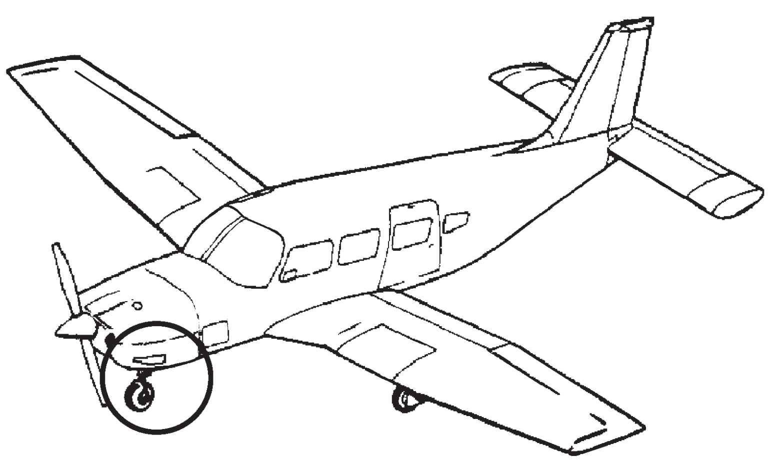


CHART 4 (Sheet 2 of 2)
LUBRICATION - NOSE LANDING GEAR

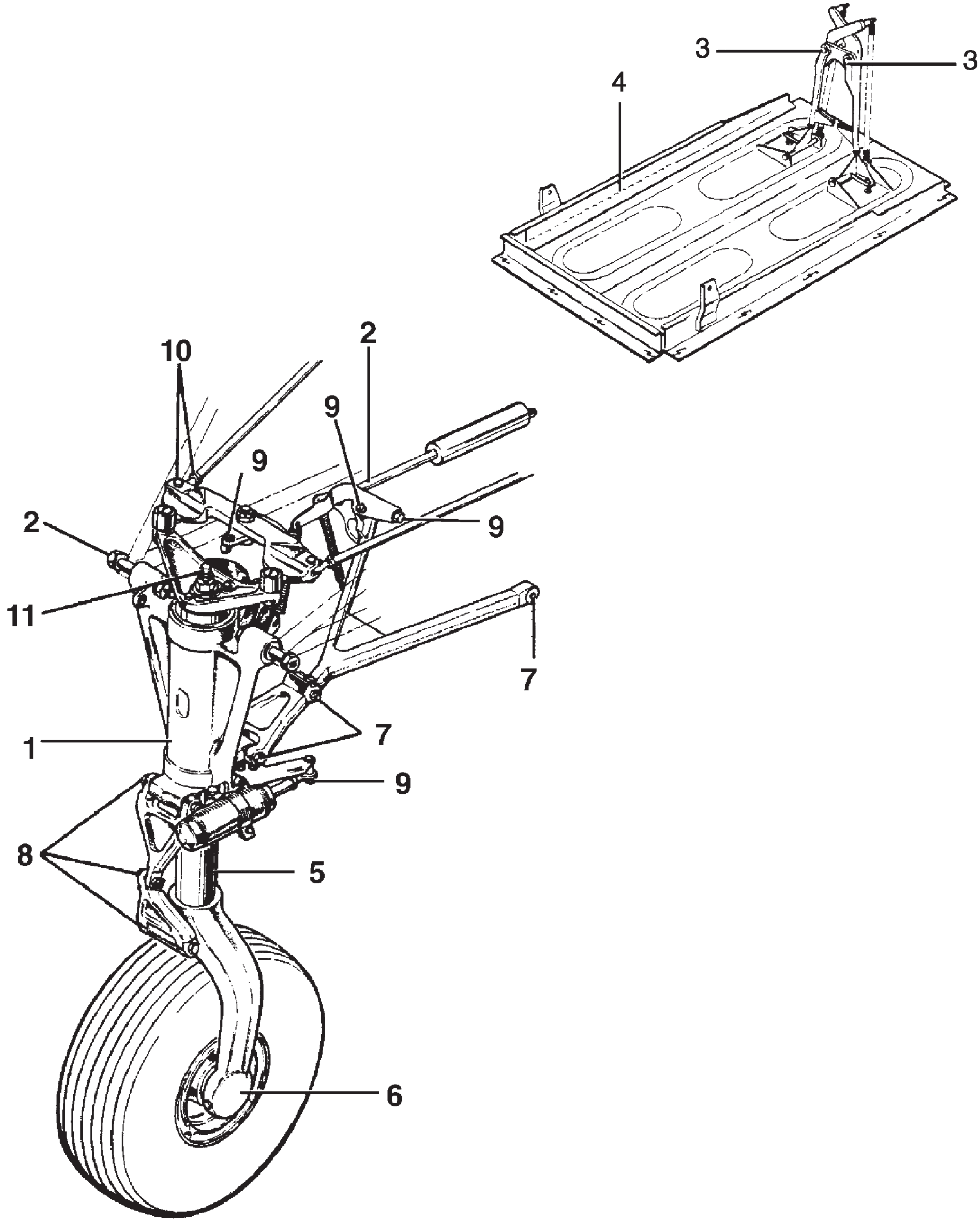


CHART 5 (Sheet 1 of 2)
LUBRICATION - CONTROL SYSTEM, PART 1

	COMPONENT	LUBRICANT	FREQUENCY
1.	AILERON HINGE BEARINGS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
2.	FLAP HINGE BEARINGS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
3.	STABILATOR HINGE PINS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
4.	RUDDER HINGE BEARINGS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
5.	CONTROL CABLE PULLEYS (See Spec. Instr. 1	MIL-PRF-787 0C	100 hrs
6.	STABILATOR TRIM CONTROL WHEEL (See Spec. Instr. 1 and Cautions)	MIL-PRF-7870C	100 hrs
7.	O-RING, CONTROL SHAFT BUSHING (See Spec. Instr. 2 and 10 and Cautions)	Parker O-Lube	As Required
8.	TEE BAR PIVOT POINT (See Spec. Instr. 1 and Cautions)	MIL-PRF-7870C	100 hrs
9.	CONTROL COLUMN CHAIN (See Spec. Instr. 2 and Cautions)	MIL-PRF-7870C	500 hrs
10.	CONTROL COLUMN FLEX JOINTS AND SPROCKET (See Spec. Instr. 2 and Cautions)	MIL-PRF-7870C	100 hrs
11.	STABILATOR CONTROL (See Spec. Instr. 1 and Cautions)	MIL-PRF-7870C	100 hrs
12.	AILERON, STABILATOR, AND RUDDER CONTROL CABLES AND TRIM CABLES (Not Shown.) (See Spec. Instr. 6 and Cautions)	AEROSHELL 33/ MIL-PRF-23827C	100 hrs

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

CAUTION: DO NOT OVER LUBRICATE COCKPIT CONTROLS.

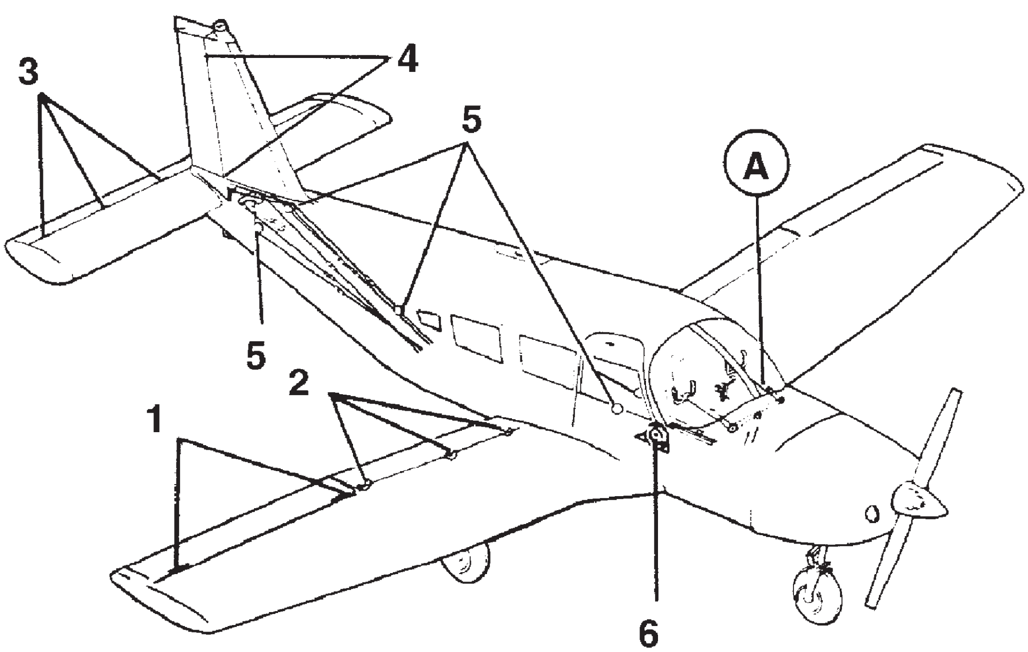
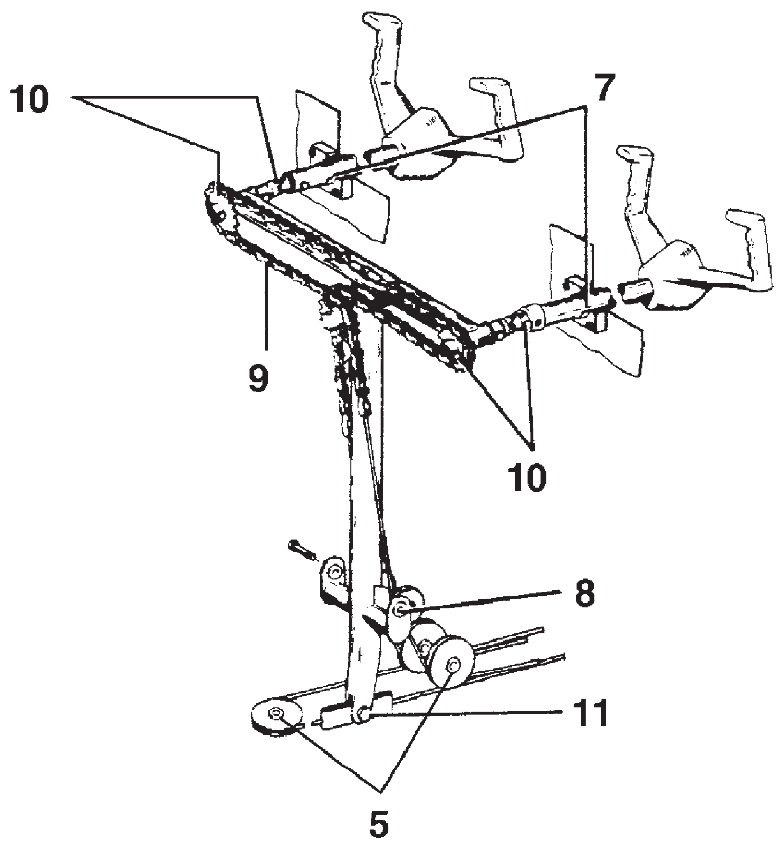


CHART 5 (Sheet 2 of 2)
LUBRICATION - CONTROL SYSTEM, PART 1



SKETCH A

CHART 6 (Sheet 1 of 2)
LUBRICATION - CONTROL SYSTEM, PART 2

	COMPONENT	LUBRICANT	FREQUENCY
1.	FLAP TORQUE TUBE BEARING BLOCKS (See Spec. Instr. 2)	MIL-PRF-7870C	100 hrs
2.	FLAP CONTROL ROD END BEARINGS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
3.	FLAP ACTUATOR SCREW JACK (See Spec. Instr. 2)	Lubriplate #907, or, MIL-G-7711	100 hrs
4.	FLAP ACTUATOR BELLCRANK (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
5.	FLAP TORQUE TUBE PULLEY (See Spec. Instr. 2)	MIL-PRF-7870C	100 hrs
6.	AILERON BELLCRANK PIVOT POINTS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
7.	AILERON CONTROL ROD END BEARINGS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
8.	AILERON BELLCRANK CABLE ENDS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs

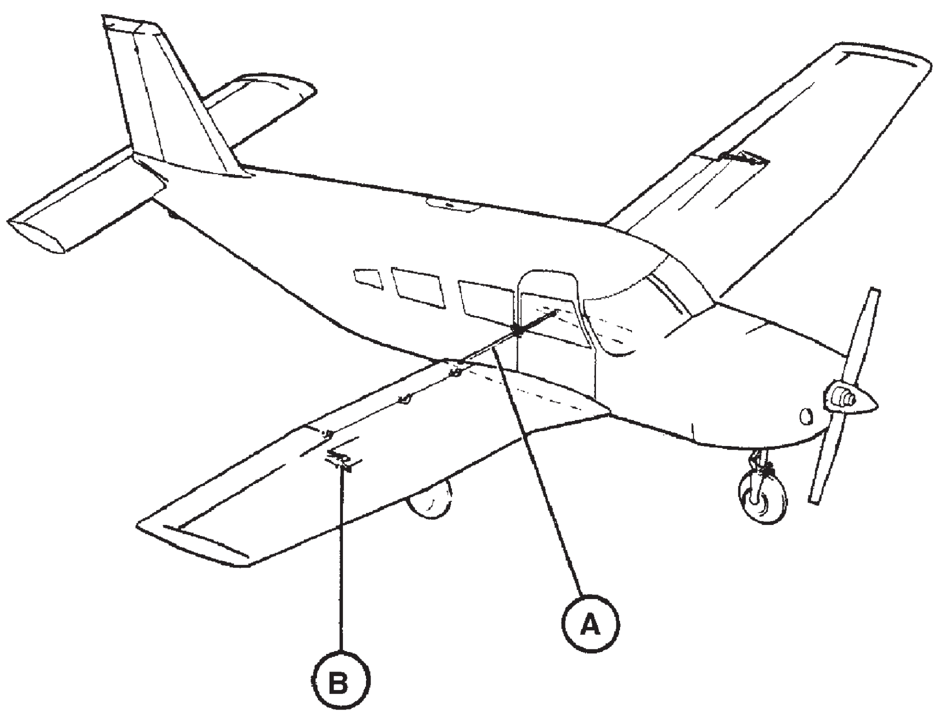
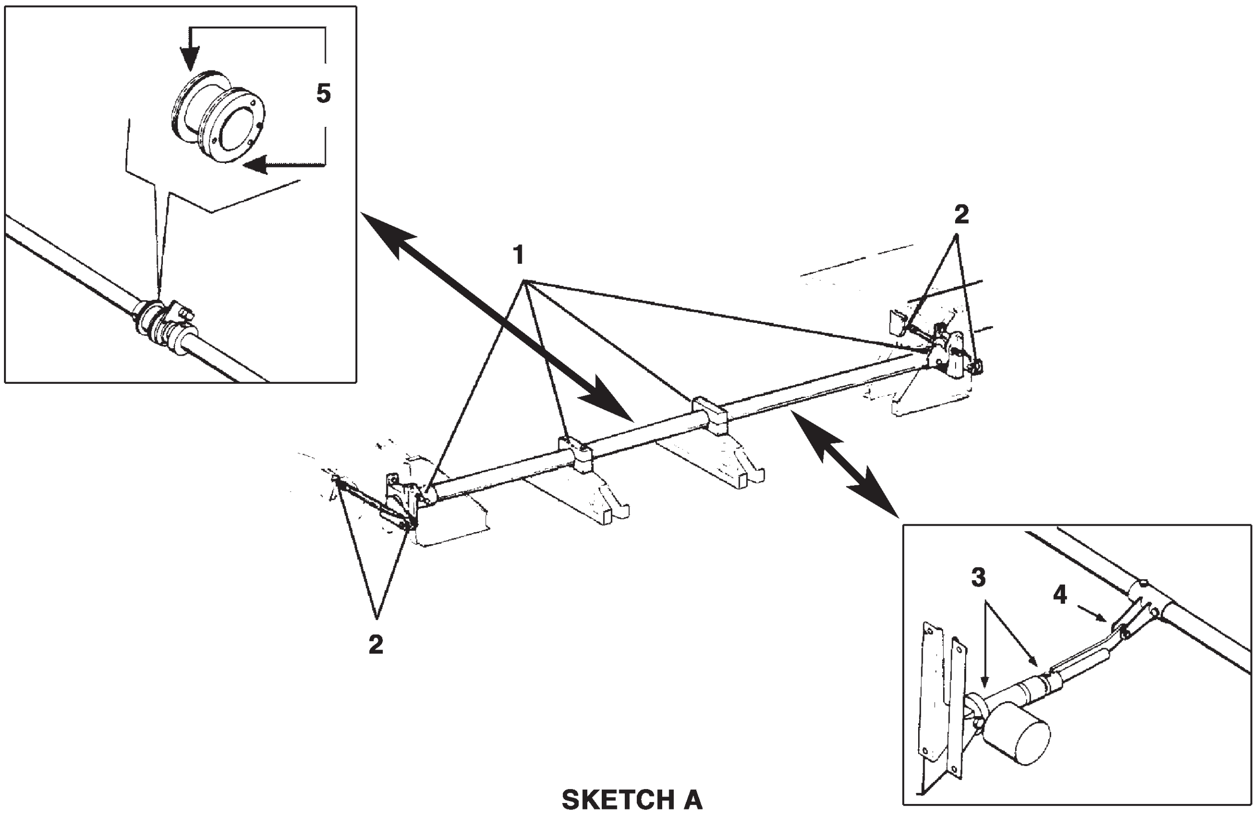


CHART 6 (Sheet 2 of 2)
LUBRICATION - CONTROL SYSTEM, PART 2



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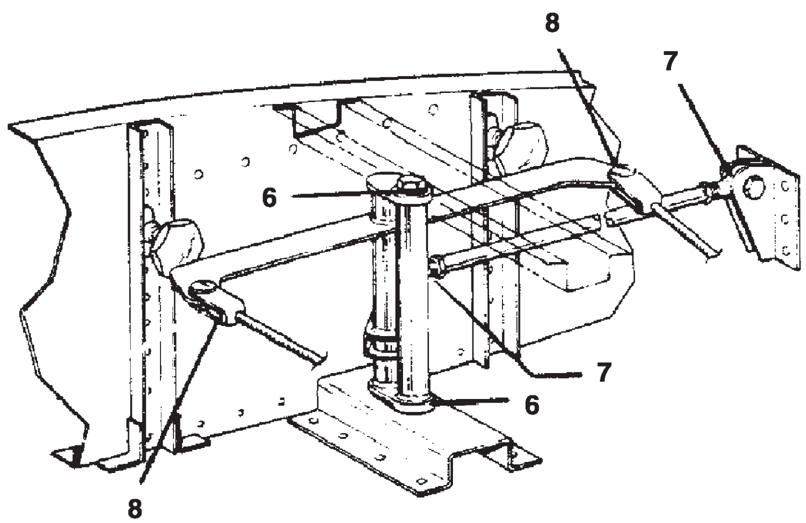


SKETCH B

CHART 7 (Sheet 1 of 2)
LUBRICATION - CONTROL SYSTEM, PART 3

COMPONENT	LUBRICANT	FREQUENCY
1. RUDDER TUBE BEARING BLOCKS (See Spec. Instr. 2 and Caution)	Release Agent / Dry Lubricant MS-122AD	100 hrs
2. TOE BRAKE CYLINDER ATTACHMENTS AND BRACES (See Spec. Instr. 1 and Caution)	MIL-PRF-7870C	100 hrs
3. RUDDER TUBE CONNECTIONS (See Spec. Instr. 1 and Caution)	MIL-PRF-7870C	100 hrs
4. BRAKE ROD ENDS (See Spec. Instr. 1 and Caution)	MIL-PRF-7870C	100 hrs
5. RUDDER TUBE CABLE ENDS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
6. NOSE GEAR STEERING ROD ENDS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
7. RUDDER ARM CABLE ENDS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
8. STABILATOR TRIM SCREW (See Spec. Instr. 2)	Lubriplate #907, or, MIL-G-7711	100 hrs
9. STABILATOR SCREW/TAB LINKS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
10. STABILATOR HINGE POINTS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
11. RUDDER TRIM ASSEMBLY (See Spec. Instr. 1 and Caution)	MIL-PRF-7870C	100 hrs

CAUTION: DO NOT OVER LUBRICATE COCKPIT CONTROLS.

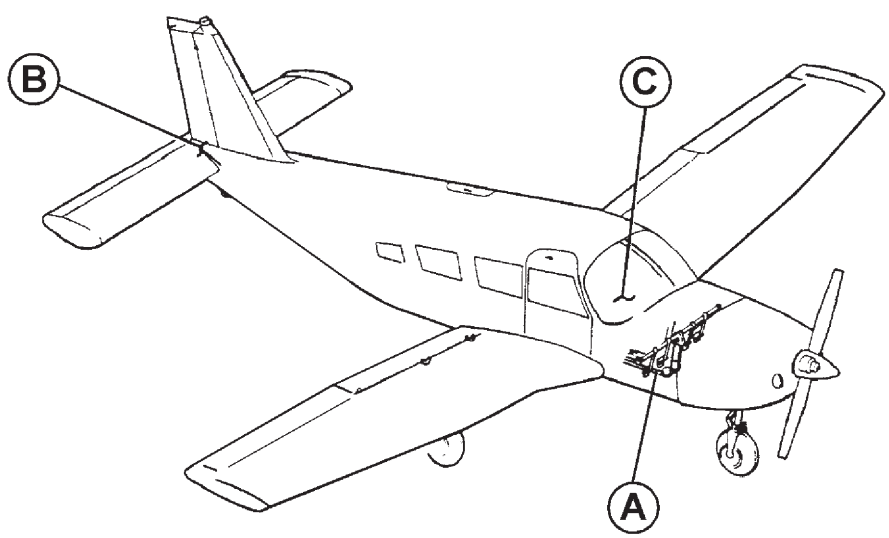
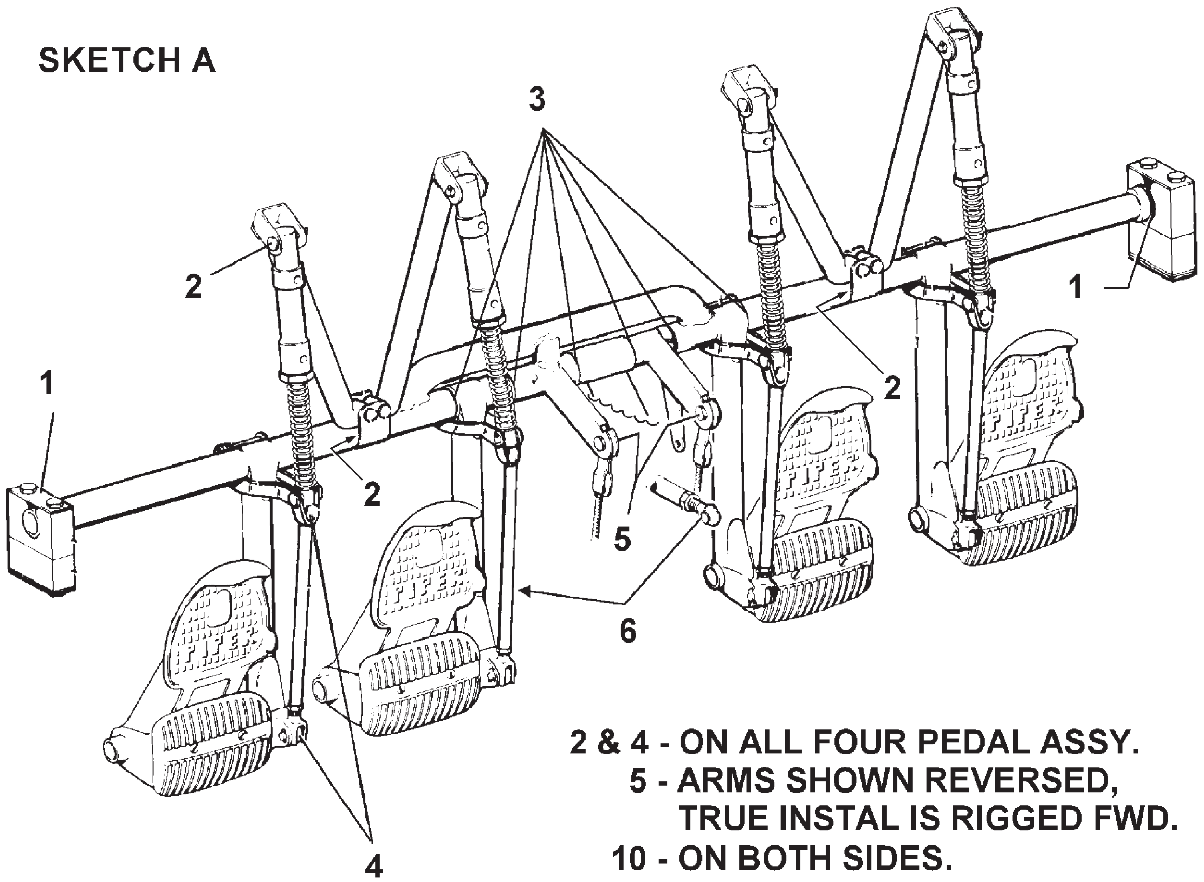
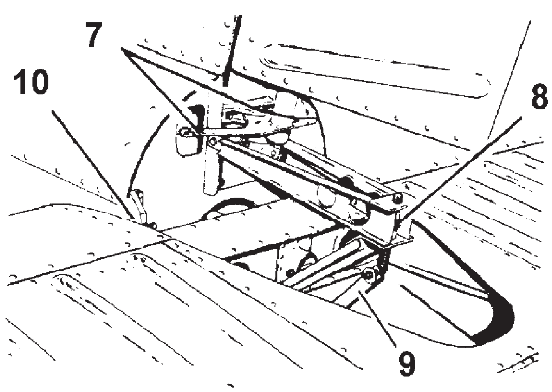


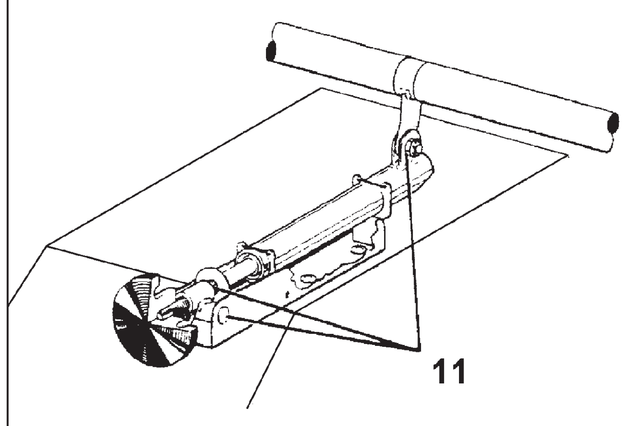
CHART 7 (Sheet 2 of 2)
LUBRICATION - CONTROL SYSTEM, PART 3

SKETCH A





SKETCH B



SKETCH C

CHART 8 (Sheet 1 of 2)
LUBRICATION - POWER PLANT AND PROPELLER

	COMPONENT		LUBRICANT		FREQUENCY
1.	ENGINE SUMP	Air Temperature	MIL-PRF-6082	MIL-PRF-22851	50 hrs
	LUBRICATING OIL,			(Ashless Dispersant)	
	AIRCRAFT RECIPROCATING	All		SAE 15W50 or 20W50	
	ENGINE (PISTON)	Above 80°F (26.67°c)	SAE 60	SAE 60	
	(See Spec. Instr. 8 and 9)	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. 8 and 9)				50 hrs
3.	AIR FILTER (HP Only) (See Spec. Instr. 7)				50 hrs
3A.	AIR FILTER (TC Only) (See Spec. Instr. 7A)				50 hrs
4.	PROPELLER ASSEMBLY (See Spec. Instr. 2 and 11)		AeroShell 6 Grease		100 hrs/ 12 Mo.
5.	ENGINE CONTROL AND ENVIRONMENTAL CONTROL PIVOT POINTS (See Spec. Instr. 1 and Caution)		MIL-PRF-7870C		100 hrs
6.	FRESH AIR VENT SHAFTS (See Spec. Instr. 2)		MIL-PRF-7711		500 hrs
7.	ALTERNATOR IDLER PULLEY BEARING (See Spec. Instr. 2)		Mobil Grease 28 MIL-PRF-81322E		100 hrs

CAUTION: DO NOT OVER LUBRICATE COCKPIT CONTROLS.

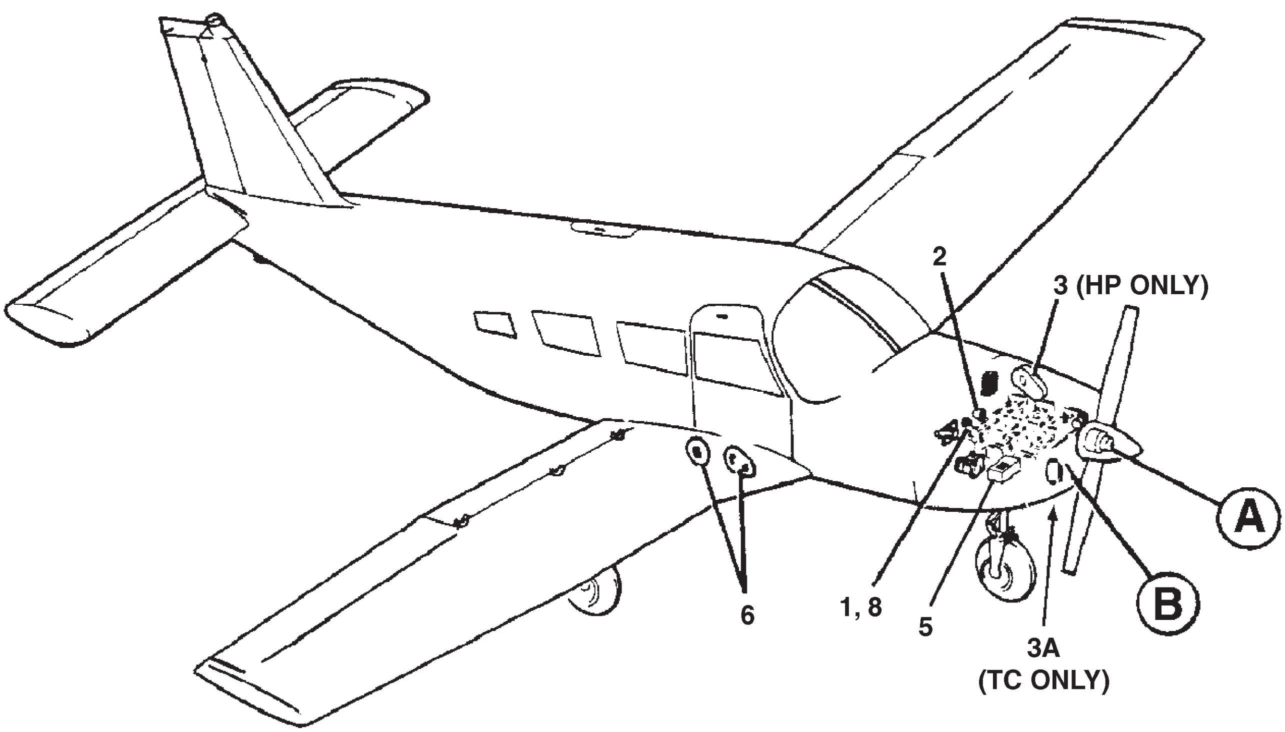
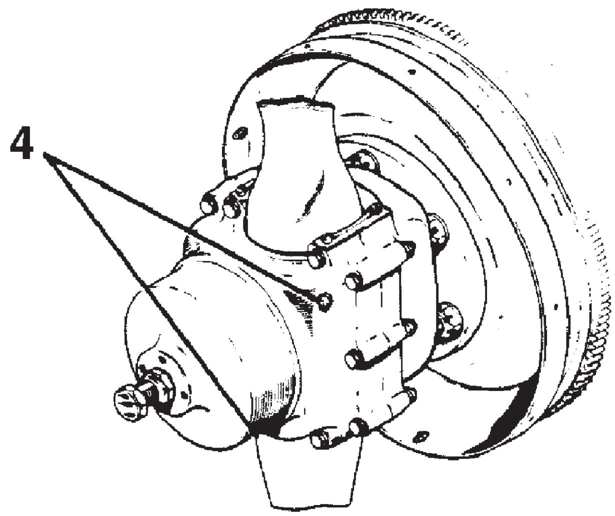
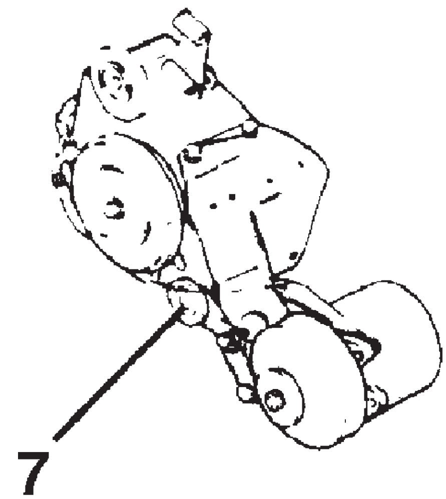


CHART 8 (Sheet 2 of 2)
LUBRICATION - POWER PLANT AND PROPELLER



SKETCH A



SKETCH B

CHART 9
LUBRICATION - FUEL SELECTOR

	COMPONENT	LUBRICANT	FREQUENCY
1.	FUEL SELECTOR LINKAGE (See Spec. Instr. 1 and Caution)	MIL-PRF-7870C	100 hrs
2.	FUEL SELECTOR VALVE COVER PLATE (See Spec. Instr. 13)	Release Agent / Dry Lubricant MS-122AD	100 hrs

CAUTION: DO NOT OVER LUBRICATE COCKPIT CONTROLS.

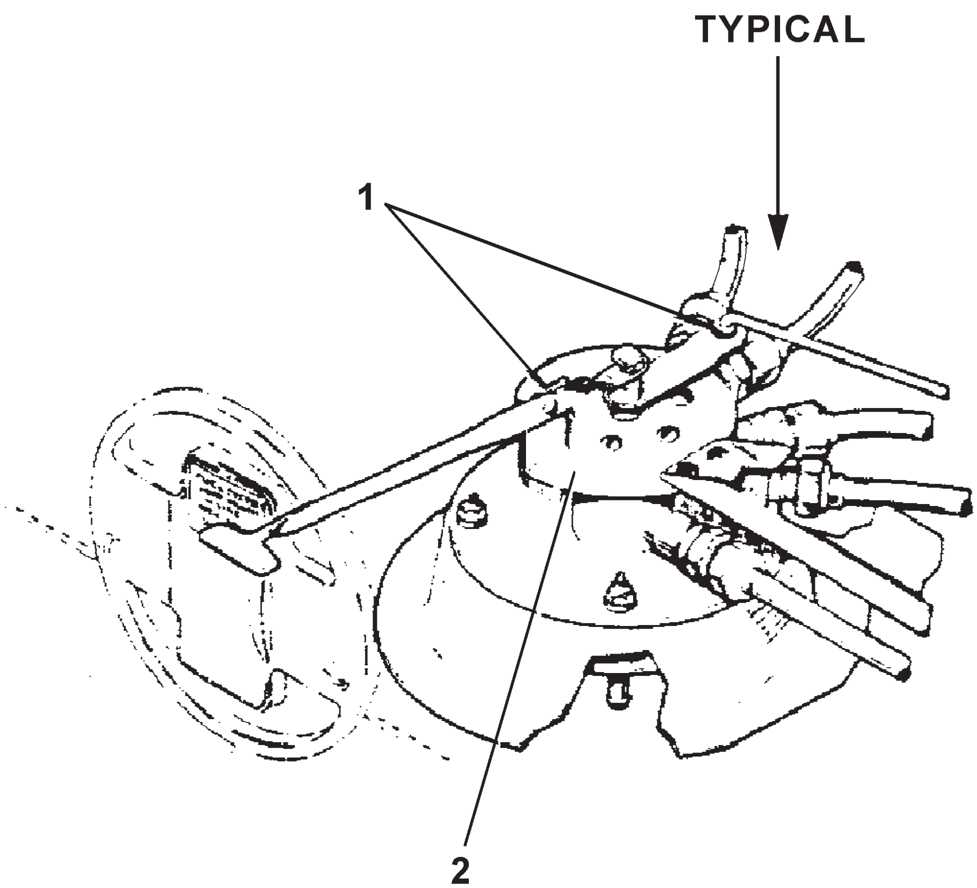


CHART 10
LUBRICATION - CABIN DOORS, BAGGAGE DOORS, AND SEATS

	COMPONENT	LUBRICANT	FREQUENCY
1.	DOOR HINGES (See Spec. Instr. 2)	MIL-PRF-7870C	100 hrs
2	DOOR SEALS (See Spec. Instr. 5)	Release Agent / Dry Lubricant MS-122AD	50 hrs
3	DOOR LATCH MECHANISMS (See Spec. Instr. 2)	MIL L-7870C	500 hrs
4	SEAT TRACK ROLLERS, STOP PINS AND REAR SEAT LEG RETAINER (CLIP AND CAM) (See Spec. Instr. 2)	Lubriplate #907 or, MIL-PRF-7711	100 hrs
5	SEAT LATCH STOP PIVOT POINT (COPILOT) (See Spec. Instr. 1)	MIL-L-7870C	100 hrs

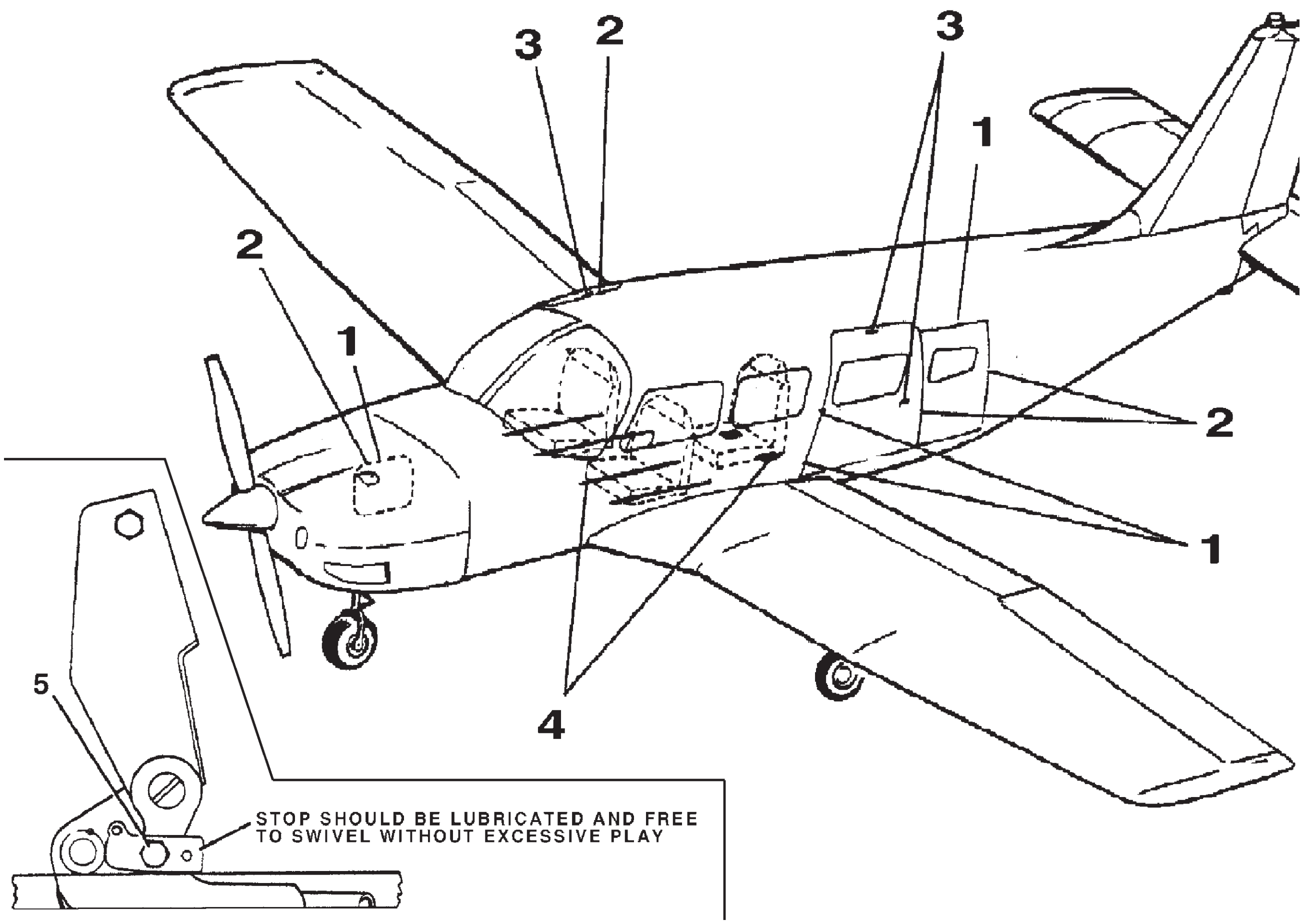
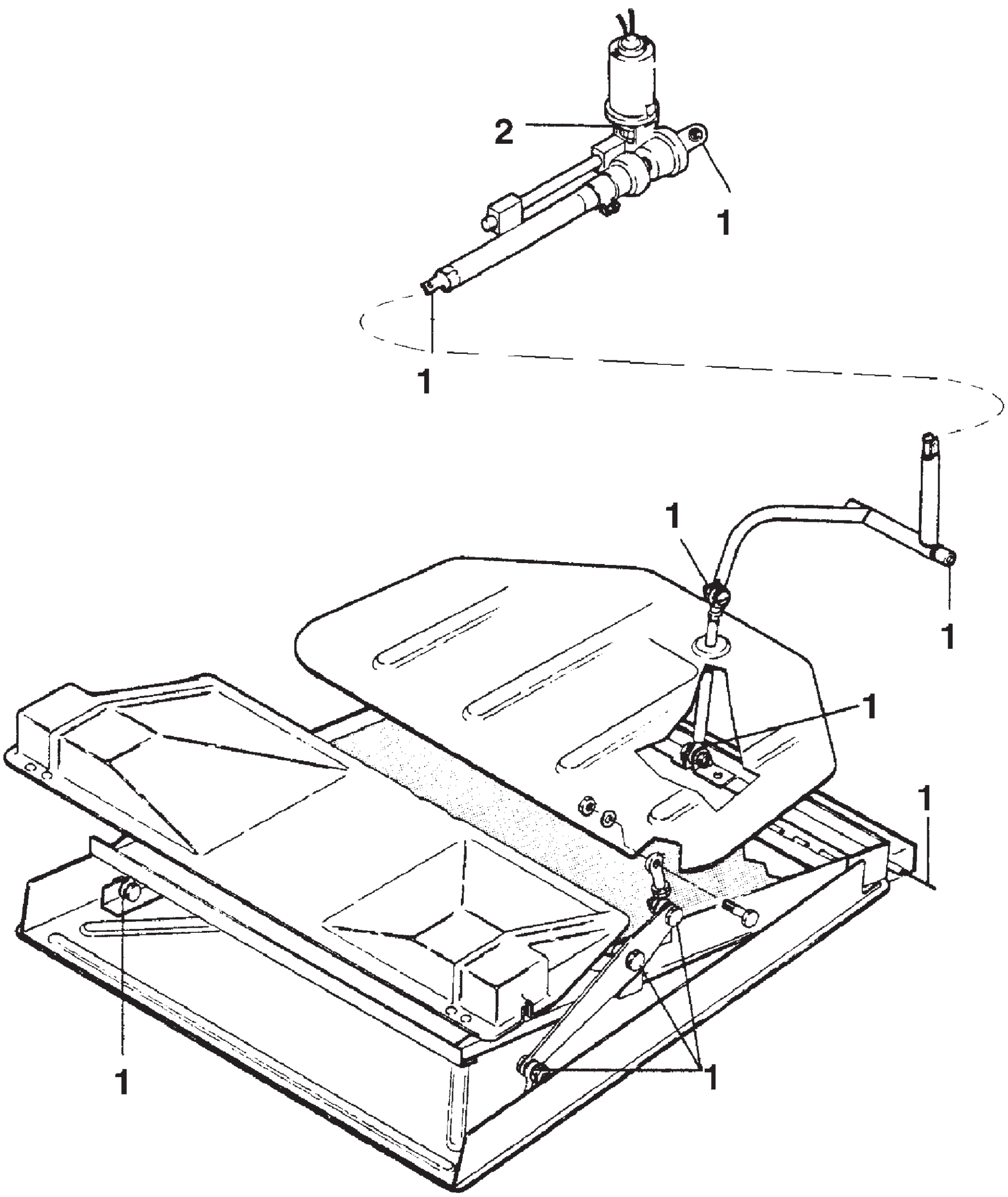


CHART 11
LUBRICATION - AIR CONDITIONING CONDENSER

	COMPONENT	LUBRICANT	FREQUENCY
1.	CONDENSER HINGE AND ACTUATORS (See Spec. Instr. 1)	MIL-PRF-7870C	100 hrs
2.	CONDENSER DOOR ACTUATING TRANSMISSION (See Spec. Instr. 2 and 12)	MIL-PRF-23827C	500 hrs



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CHAPTER

20

STANDARD PRACTICES - AIRFRAME

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CHAPTER 20

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE	CHAPTER SECTION	PAGE	DATE
20-List of	1	Mar 21/12			
Effective Pages	2	Jun 30/07			
20-Table of Contents	1	Mar 21/12			
	2	Jun 30/07			
20-00-00	1	Jun 30/07			
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	8	Jun 30/07			
	9	Jun 30/07			
	10	Jun 30/07			
	11	Mar 21/12			
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	13	Jan 31/11			
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CHAPTER 20 - STANDARD PRACTICES - AIRFRAME

TABLE OF CONTENTS

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GENERAL

1. Description

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

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

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

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

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

2. Torque Wrenches

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

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

T = Torque desired at the part.

A = Basic lever length from center of wrench shank to center of handle or stamped on wrench or listed for that model wrench.

B = Length of adapter extension, center of bolt to center of shank.

C = Scale reading needed to obtain desired torque (T).

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

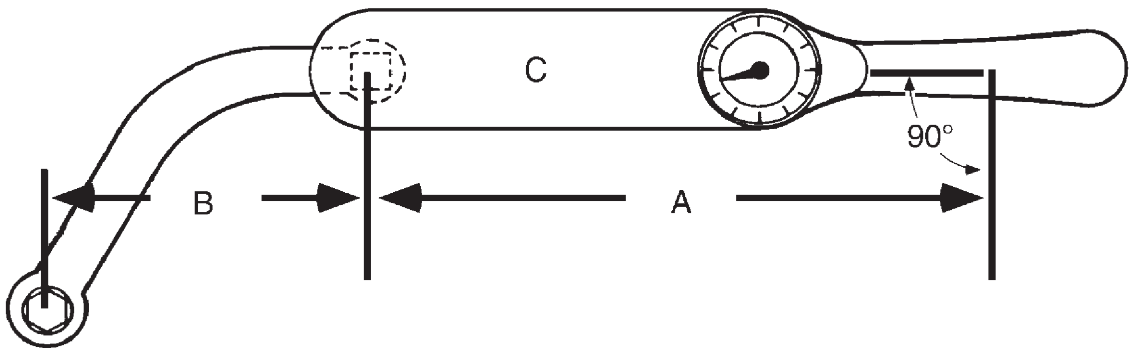
EXAMPLE: A bolt requires 30 foot pounds and a 3 inch adapter (one-quarter of a foot or 0.25') is needed to get at it. You want to know what scale reading it will take on a one-foot lever arm wrench to obtain the 30 foot pounds at the bolt.

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

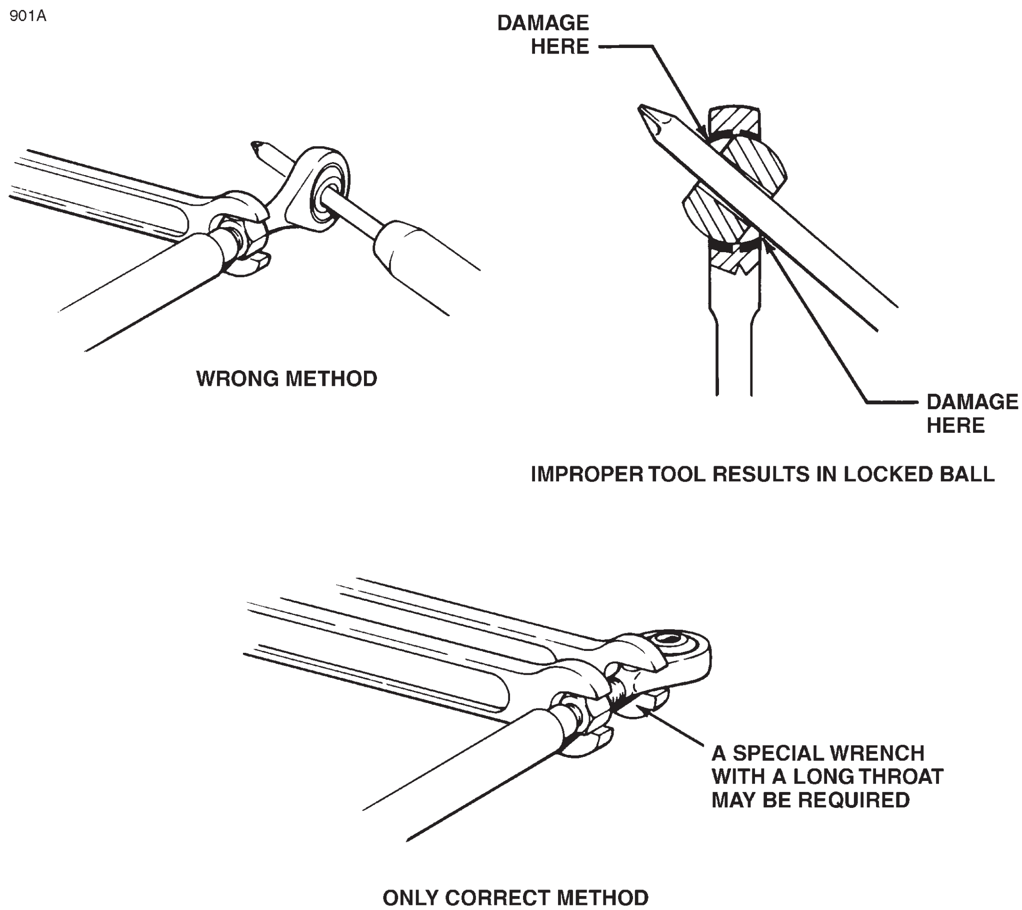
Remember, the 3 inch adapter must be projecting 3 inches straight along the wrench axis. In general, avoid all complex assemblages or adapters and extensions of flex joints.

3. Installing Rod End Bearings

Install rod end bearings as shown in Figure 2.



Torque Wrench Formula
Figure 1



Installing Rod End Bearings
Figure 2

4. Removing Cherrylock Rivets

Use following procedure to remove cherrylock rivets:

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

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

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

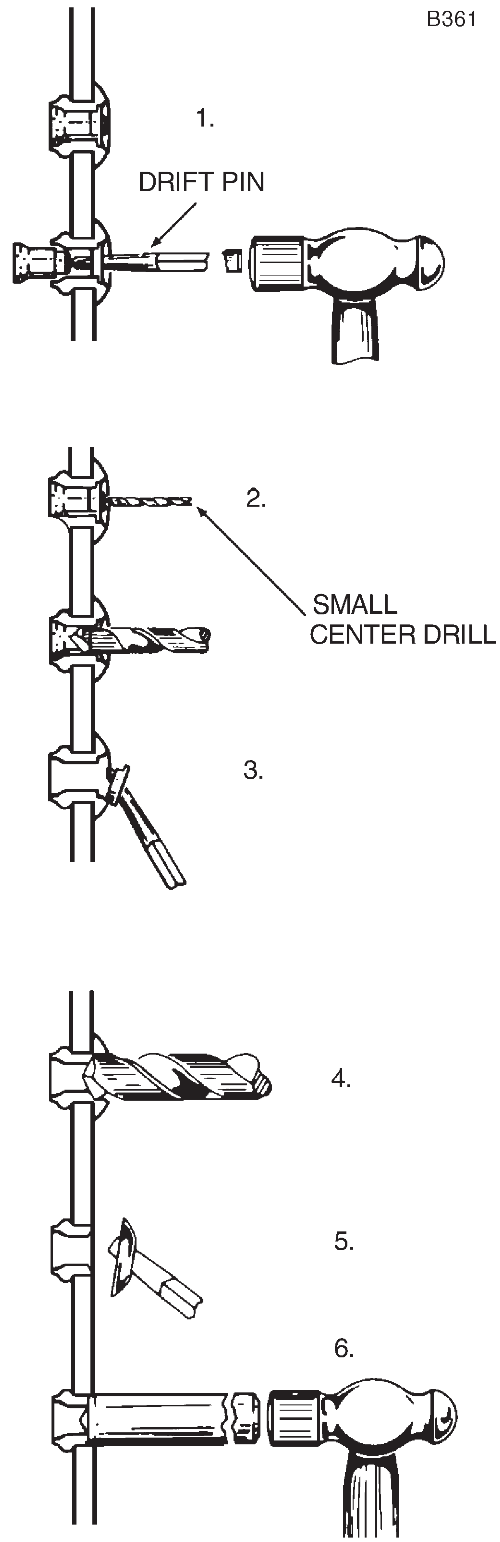
B. To remove from thin material, drill away tapered portion of stem to destroy the lock. Use a small center drill bit on top of the rivet stem to provide a guide for a larger bit. (See Figure 3, Views 2 and 3.)

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

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

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

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



Removing Cherrylock Rivets
Figure 3

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

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

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

Certain lines may also be identified as to the specific function within a system. For example: DRAIN, VENT, PRESSURE or RETURN.

Lines conveying fuel may be marked FLAM. Lines containing toxic materials are marked TOXIC. Line containing physically dangerous materials, such as oxygen, nitrogen, or freon, are marked PHDAN.

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

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

6. Inspection of Flexible Hoses

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

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

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

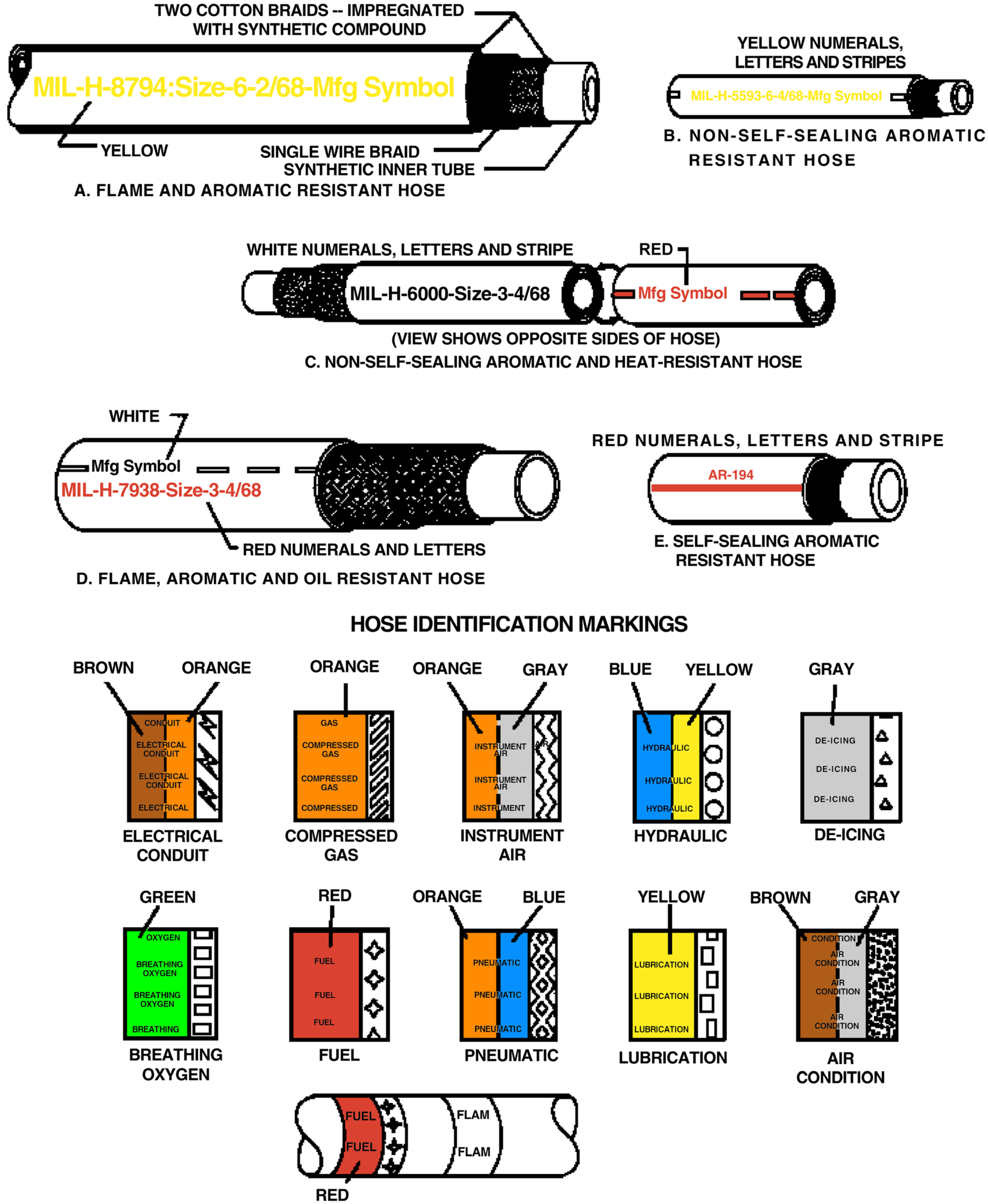
CAUTION: PUNCTURING THE OUTER COVER OF THE HOSE MAY CAUSE DAMAGE TO THE HOSE.

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

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

CHART 1
BALL DIAMETERS
FOR TESTING HOSE RESTRICTIONS

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



Hose, Tube, and Line Markings
Figure 4

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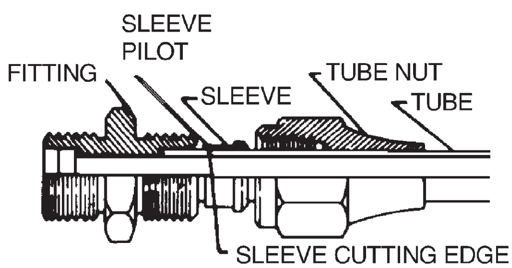
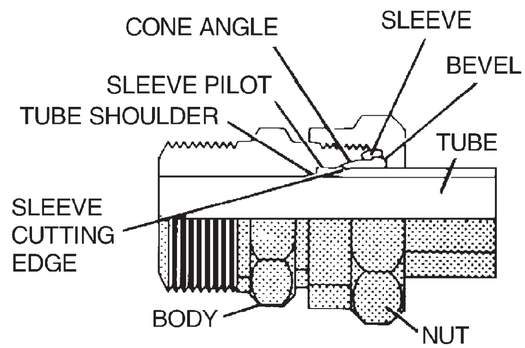
TUBING AND HOSE LUBRICANTS

TUBING SYSTEM	LUBRICANT
HYDRAULIC	MIL-H-5606
FUEL	MIL-H-5656
OIL	SYSTEM OIL
PNEUMATIC	MIL-L-4343
OXYGEN *	NONE

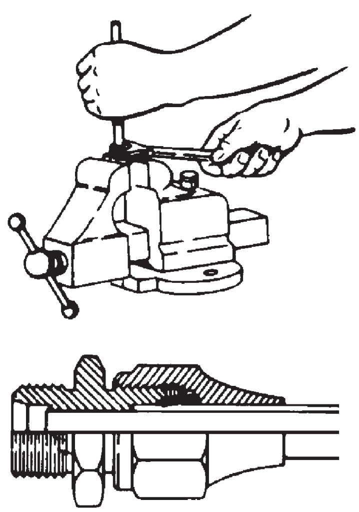
* SEE 35-10-00.



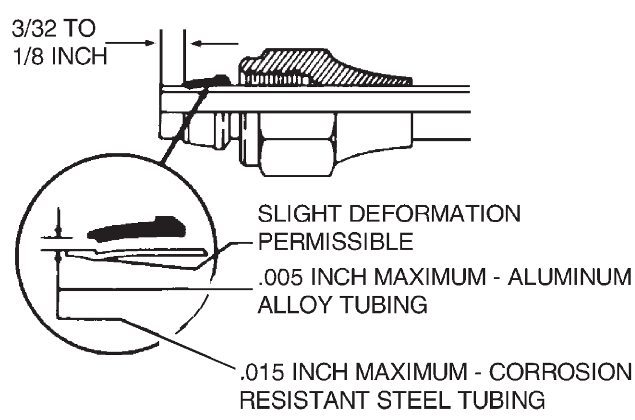
STEP 1



FLARELESS-TUBE FITTING



STEP 2



STEP 3

Flareless Tube Fittings
Figure 5

7. Flareless Tube Assemblies

NOTE: See 35-10-00 for installation of oxygen system tubing and fittings.

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:

A. 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 5, Step 1.)

B. Lubricate fitting and nut threads as specified in table contained in Figure 5.

C. Place fitting in a vise (refer to Figure 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.

D. 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.

E. After presetting the sleeve, disconnect tubing from fitting and check the following points (refer to Figure 5, Step 3):

(1) Tube extends 3/32 to 1/8 inch beyond sleeve pilot to prevent blow off.

(2) Sleeve pilot contacts tube. A maximum clearance of 0.005 inch for aluminum alloy tubing, or 0.015 inch for steel tubing, is acceptable.

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

8. Support Clamps

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

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

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

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

All plumbing lines must be secured at specified intervals. The maximum distance between supports for rigid fluid tubing is shown in Chart 2.

CHART 2
FLUID TUBING SUPPORT

	Distance Between Supports (IN.)	
Tube O.D. (IN.)	Aluminum Alloy	Steel
1/8	9.5	11.5
3/16	12	14
1/4	13.5	16
5/16	15	18
3/8	16.5	20
1/2	19	23
5/8	22	25.5
3/4	24	27.5
1	26-1/2	30

9. Dye Penetrant Inspections

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

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

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

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

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

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

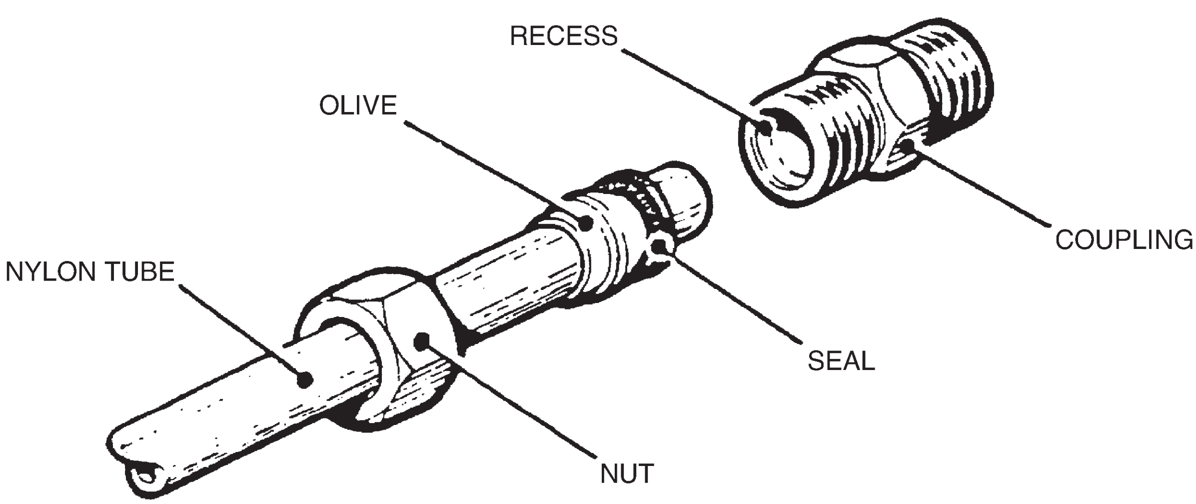
10. Nylon Tubing Couplings

A. Disassembly (See Figure 6.)

(1) Hold the coupling body, unscrew the coupling nut(s) and extract the tubing from the coupling. Remove and discard the sealing ring(s).

NOTE: When disassembling a coupling always hold the coupling body with a suitable wrench while unscrewing the coupling nut.

(2) In the case of a bulkhead coupling, remove the tubing as detailed above, then hold the coupling body using a suitable wrench and remove the locking nut from the extended thread of the coupling. Extract the coupling from the bulkhead.



Nylon Tubing Coupling (Typical)
Figure 6

B. Inspection

(1) Visually examine all component parts for damage, corrosion and wear with particular attention to corrosion and cracking of aluminum alloy components.

(2) Examine the anti-seize coating on all aluminum alloy external threads. If more than 20% of the total thread area is exposed renew the coating or reject the component.

(3) Check the olives for damage and overtightening. The olive may be capable of rotation by hand on the tube, but must not be obviously loose. Suspect olives should be removed and the joint reclenched as detailed in Remaking a Coupling, below.

(4) Check the nylon tube for cuts, cracks, abrasion and damage caused by crushing and kinking. Check that the tubing is not permanently deformed in the region of the olive in such a way as to make the olive loose (see Figure 7). Discoloration of the tubing is not detrimental and is therefore acceptable.

C. Remaking a Coupling.

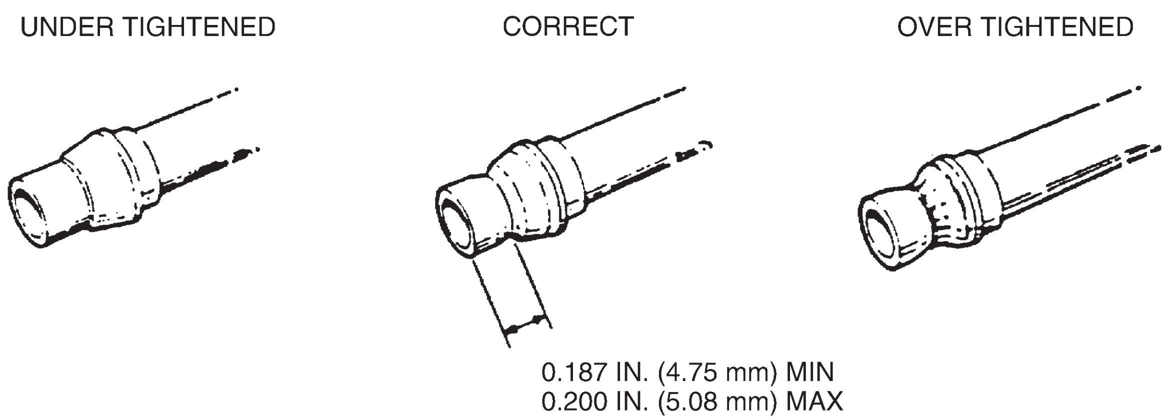
If a tubing end becomes damaged or a fluid line needs to be replaced, the coupling ends will need to be remade as follows:

CAUTION: TO PREVENT TENSION OCCURRING AT THE COUPLING, ENSURE THAT THE TUBING IS SUFFICIENTLY LONG TO ALLOW AT LEAST THREE PERCENT (3%) OR ONE (1) INCH SLACK PER THREE (3) FEET OF TUBING WHEN THE TUBING IS INSTALLED AND CLIPPED IN POSITION.

THE OLIVE MUST BE CLENCHED TO THE TUBING BEFORE THE INTRODUCTION OF THE SEALING RING. CLENCHING THE OLIVE WITH THE SEALING RING IN POSITION WILL PREVENT THE OLIVE FROM LOCKING CORRECTLY ON THE TUBING AND WILL DESTROY THE SEALING RING. ALWAYS USE A NEW SEALING RING WHEN ASSEMBLING ANY COUPLING.

(1) Slide the nut along the tubing away from the olive.

(2) Cut the tubing square as close as possible behind the olive to remove the damaged olive and tubing.



Olive Clenching
Figure 7

(3) Assemble a new olive onto the tubing and remake the coupling joint as detailed in the following paragraphs.

NOTE: The olive may be clenched to the tubing using the coupling components but to obtain maximum coupling security the use of a clenching tool is recommended.

(4) Clenching an Olive Using a Clenching Tool.

Clenching tools in various sizes are available from your Piper Dealer.

NOTE: The clenching tools for 3/16 inch and 5/16 inch O.D. tubing are fitted with a support spigot. Ensure that the spigot is correctly fitted in the tool before use.

(a) Cut the end of the tubing square and remove all fraze.
(b) Assemble the nut and love over the end of the tubing and press the end of the tubing fully home into the end of the clenching tool.
(c) Slide the nut and olive towards the end of the clenching tool, engage the nut and tighten finger tight. Ensure that the spigot on the outer end of the olive is correctly located in the bore of the nut.
(d) Tighten the nut until the torque begins to rise rapidly, approximately 315 degrees from finger tight. A correctly clenched olive should be obtained if tightening ceases just after the point where rapid torque increase begins.
(e) Unscrew the nut and remove the tubing from the clenching tool.
(f) Refer to Figure 7 and check that the olive is correctly clenched onto the tubing and the required length of tubing extends beyond the clenched end of the olive.

(5) Clenching an Olive Using a Coupling Body.

CAUTION: USE A COUPLING BODY ONLY ONCE TO CLENCH AN OLIVE. AFTER CLENCHING ENSURE THE COUPLING BODY IS PUT INTO SERVICE.

USING A COUPLING BODY FOR CLENCHING WILL CAUSE RAPID WEAR TO THE INTERNAL CONICAL BORE OF THE COUPLING LEADING TO INCORRECT CLENCHING OF THE OLIVE. THE SAME COUPLING BODY MUST NOT BE USED REPEATEDLY FOR CLENCHING OLIVES.

NOTE: The preferred method of clenching an olive to the tubing is by use of a clenching tool (see paragraph above). If required, a satisfactory but less strong joint may be obtained using a coupling body in place of a clenching tool.

(a) Cut the end of the tubing square and remove all fraze.
(b) Assemble the nut and olive over the end of the tubing and press the tubing fully home in the coupling body.
(c) Slide the nut and olive towards the coupling body, engage the nut and tighten finger tight. Ensure that the spigot on the outer end of the olive is correctly located in the bore of the nut.

CAUTION: IF THE COUPLING IS PART OF AN ASSEMBLED COMPONENT, DO NOT PERMIT THE COUPLING TO ROTATE DURING THE CLENCHING OPERATION.

(d) Tighten the nut until the torque begins to rise rapidly, approximately 315 degrees from finger tight. A correctly clenched olive should be obtained if tightening ceases just after the point where rapid torque increase begins.
(e) Unscrew the nut and remove the tubing from the coupling body.
(f) Refer to Figure 7 and check that the olive is correctly clenched onto the tubing and the required length of tubing extends beyond the clenched end of the olive.

D. Assembly

(1) If required, renew the anti-seize coating on aluminum alloy external threads as follows:

(a) Remove all traces of existing anti-seize compound using trichloroethane or a suitable chemical solvent.

(b) Mix the Moly-vi-Bond anti-seize compound in accordance with the manufacturers instructions, brush coat to cover the engaging parts of external thread.

CAUTION: WHEN FITTING A NEW SEALING RING ENSURE THAT IT IS CORRECTLY LOCATED AND NOT TRAPPED OR TWISTED.

(2) Place a new sealing ring over the end of the tubing, then insert the tubing into the coupling body and guide the sealing ring into the recess at the end of the coupling body.

(3) Push the tubing towards the coupling body so that the olive retains the sealing ring in position, engage the nut and tighten finger tight.

(4) Tighten the nut until the torque just begins to rise rapidly, approximately 180 degrees from finger tight.

(5) Safetywire the nut.

11. Threaded Fastener Installation

(PIR-PPS20015-1, Rev. AA.)

A. Fastener Lengths

Fastener shank lengths must be long enough to prevent bearing loads on threads. In addition, the fastener or screw must extend through the nut.

The specified fastener grip length can be varied by one size (longer or shorter) to meet requirements stated above.

B. Washer Usage

Add a maximum of two NAS1149 washers (of the correct diameter, material and finish that matches the fastener being installed) under fastener heads or nuts to correct for variations in material thickness within the tolerances permitted. Where needed, use a maximum of two standard filler washers (spacers) under the nut to adjust for fastener length or alignment of cotter key hole. Where nutplates are used, adjust for protruding head fastener length by using up to a maximum of two standard filler washers under the fastener head.

C. Self-locking Fasteners

The use of self-locking nuts, fasteners and screws, including fasteners with non-metallic inserts is subject to the following limitations:

(1) Fasteners incorporating self-locking devices must not be re-used if they can be run up using less than the required minimum torque values specified or as shown in Chart 2, 91-10-00. They may be reused, if hand tools are required to run them up, providing there is no obvious damage to the self-locking device prior to installation.

(2) Fasteners 5/16 inch diameter and over with cotter pin holes may be used with self-locking nuts.

(3) Self-locking nuts must not be used at joints which subject either the nut or the fastener to rotation.

(4) Self-locking fasteners shall never be tapped or rethreaded. Nuts, fasteners and screws with damaged threads or rough ends shall not be used, or rethreaded.

D. Torque

See Torque Requirements, 91-10-00.

12. Thread Lubrication

Lubricate all fittings on external lines, including attachment points at engine and other components, with proper lubricant as specified in Chart 3.

When applying thread lubricants, proceed as follows:

A. Thoroughly clean threads before applying lubricant.

B. Use thread lubricant sparingly.

C. Apply thread lubricant to male threads only.

D. Lubricate first three threads only on straight fittings.

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

F. Ensure lubricant does not enter fittings or flared areas.

G. Lubricate any fittings going to engine with same fluid going through lines.

CHART 3
THREAD LUBRICANTS

Line	Lubricant
WARNING: DO NOT PERMIT SAE-AMS-2518 ANTI-SEIZE COMPOUND TO ENTER SYSTEM. APPLY TO FITTING THREADS ONLY.	
Air Conditioning Refrigerant	SAE-AMS-2518, Anti-Seize Compound, Graphite Petrolatum
Brakes	MIL-PRF-5606, Hydraulic Fluid
Fuel	SAE-AMS-2518, Anti-Seize Compound, Graphite Petrolatum
Landing Gear Air Valve	MIL-PRF-907, Anti-Seize Thread Compound, High Temperature
Oil	SAE-AMS-G-6032, Grease (Gasoline and Oil Resistant)
Pitot and Static	TT-A-580 (TT-S-1732) Anti-Seize Compound
CAUTION: LUBRICATE ENGINE FITTINGS ONLY WITH THE FLUID CONTAINED IN THE PARTICULAR LINE.	

13. Airframe Water Leak Check

(PIR-PPS60047, Rev. C.)

Use the following procedures to verify watertight integrity of the fuselage.

A. Required Equipment

(1) Choice of one of the following size/length combinations of standard garden hose:

3/4 inch inside diameter, maximum length 150 feet, or

5/8 inch inside diameter, maximum length 75 feet, or

1/2 inch inside diameter, maximum length 25 feet.

(2) A hose nozzle capable of adjustment. (Green Garden Nozzle 1220-C or equivalent is acceptable.)

B. Procedure

(1) Attach hose with nozzle to water tap at city water pressure. Check to insure that there are no leaks in the hose or fittings which would impair the check or cause other damage, with the tap full open.

(2) The check (except for baggage compartments located apart from the cabin) shall be conducted with an observer inside the aircraft.

(3) All cabin and baggage compartment doors and other controllable external closures shall be closed and latched during rainfall simulation.

(4) The spray shall be aimed directly at the openings around doors and windows, and at any other cockpit/cabin/separate baggage compartment closures, for a period of one-half to one and one-half minutes for each door, window, and other closure(s). The nozzle shall be held three to ten feet from point of water contact.

(5) If a leak allowing water to enter the cockpit/cabin/separate baggage compartment is detected, the sealant or caulking (see 91-10-00, Chart 10) shall be repaired, as required, and the check shall be repeated in the area where the leak was noted.

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PAINTING

1. Painting Safety

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

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

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

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

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

2. Polyurethane Paint Safety

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

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

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

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

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

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

3. Paint Application

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

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

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

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

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

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

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

4. Painting Sequence

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

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

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

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

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

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

5. Color Matching

See aircraft logbooks for color codes.

6. Trim and Registration Numbers

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

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

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

7. Paint System Compatibility

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

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

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

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

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

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

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

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

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

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

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

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

8. Common Paint Troubles

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

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

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

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

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

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

9. Storage

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

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

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

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

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

10. Painting Facility

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

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

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

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

11. Aircraft Finish Care

See Aircraft Finish Care, 12-00-00.

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CHAPTER

21

ENVIRONMENTAL SYSTEMS

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CHAPTER 21

LIST OF EFFECTIVE PAGES

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CHAPTER 21 - ENVIRONMENTAL SYSTEMS

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CHAPTER 21 - ENVIRONMENTAL SYSTEMS

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GENERAL

Environmental control is available in a standard ram air configuration or one of two optional configurations.

1. Standard

   A. Ram Air Cabin Ventilation (See 21-20-00.)

      Fresh air from an inlet on the left rear fuselage is ducted into overhead cabin vents.

   B. Ram Air Heat and Defrost (See 21-40-00.)

      Fresh air from a heater inlet duct on the lower cowling passes through a shroud around a(the) muffler(s) and is ducted to the windshield and through the cabin.

2. Optional

   A. Fresh Air Blower (See 21-20-00.)

      Fresh air from an inlet on the left rear fuselage is ducted into overhead cabin vents by a two-speed blower mounted aft of the rear closeout panel.

   B. Air Conditioning (See 21-50-00.)

      If installed, the optional air conditioning system uses a two-speed blower to recirculate cabin air through an evaporator and filter located in the aft fuselage. The cooled air is then ducted back into the cabin through the overhead vents.

      A compressor mounted on the front of the engine takes heat-laden, vaporized, refrigerant from the evaporator and pumps it to a condenser mounted in the aft fuselage where it is cooled to a liquid state and pumped back into the evaporator.

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DISTRIBUTION

Overhead Vent System

When the optional air conditioning system is not installed cabin ventilation and cooling is provided solely by fresh air through the overhead vent system (see 21-40-00, Figure 1).

A. Ram Air Installation (Standard)

Air enters an inlet located on the rear left side of the fuselage and is ducted through the overhead vents 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.

B. Overhead Vent Blower (Optional)

An optional two-speed 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.

(1) Removal

(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.

(2) Disassembly

(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.

(3) Assembly

(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 (see 91-10-00, Consumable Materials Chart).

(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 (see 91-10-00, Consumable Materials Chart).

(4) Installation

(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 3M 390 Duct 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 1
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

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HEATING

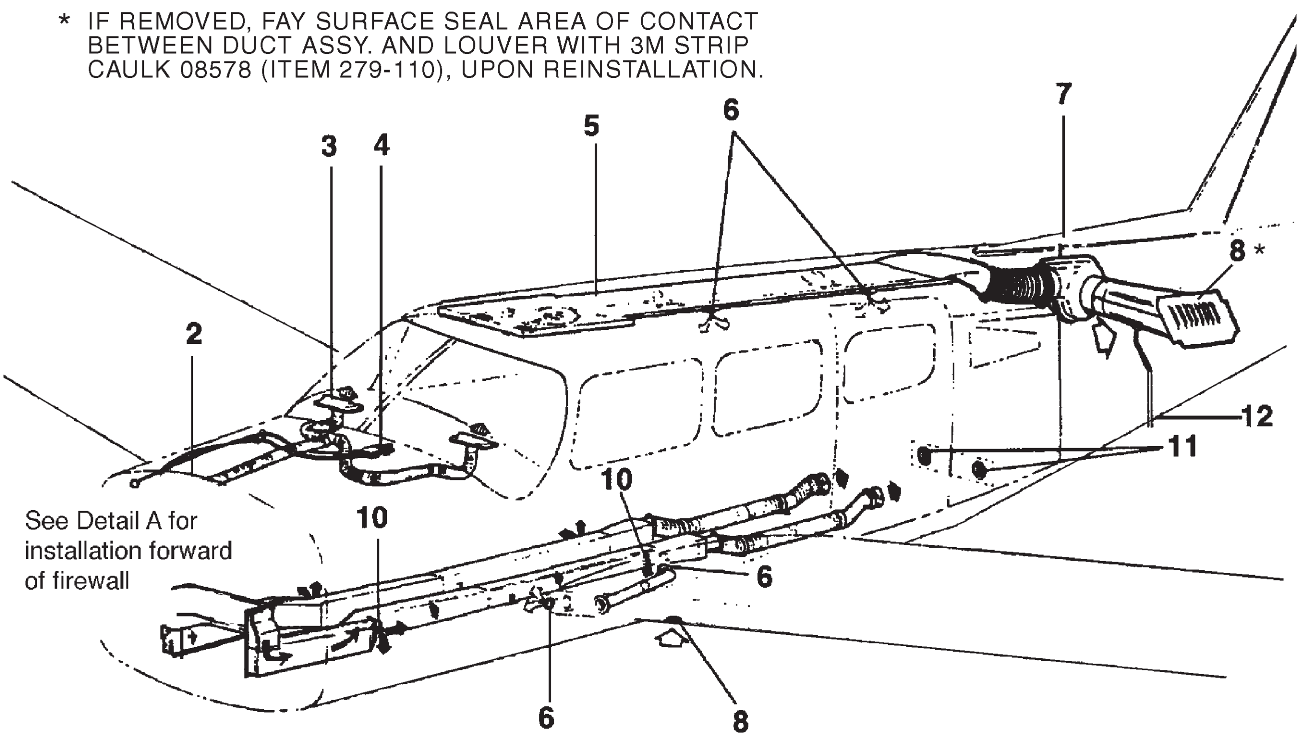
1. Description and Operation (See Figure 1.)

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

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.

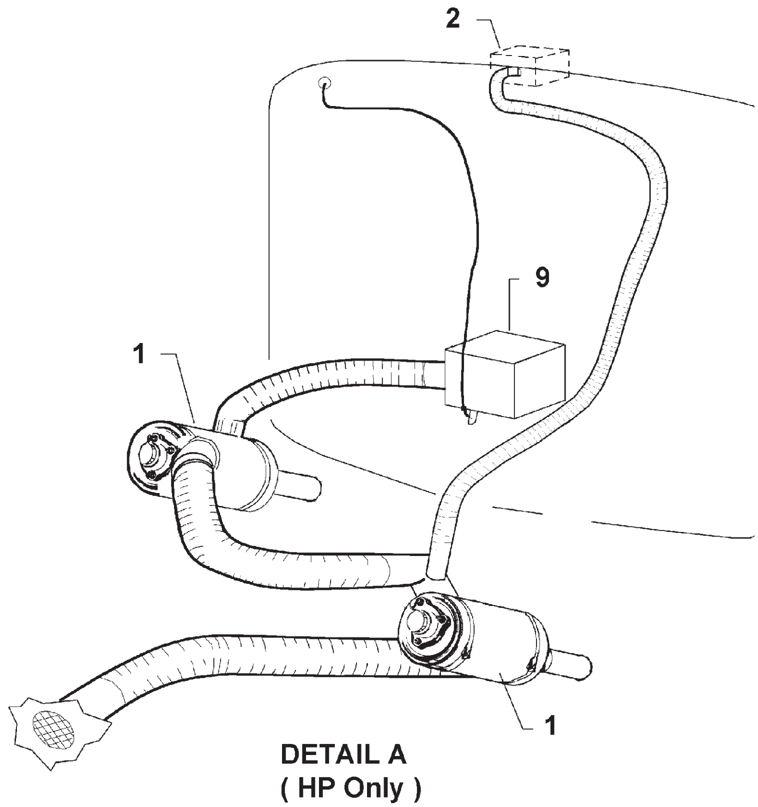
Defrosting is accomplished by heat outlets located on the right and left side of the cowl cover. Heated air is ducted directly from the heater valve box to the defroster shut-off valves at the firewall and then to the defroster outlets. The airflow is regulated by a defroster control located below the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

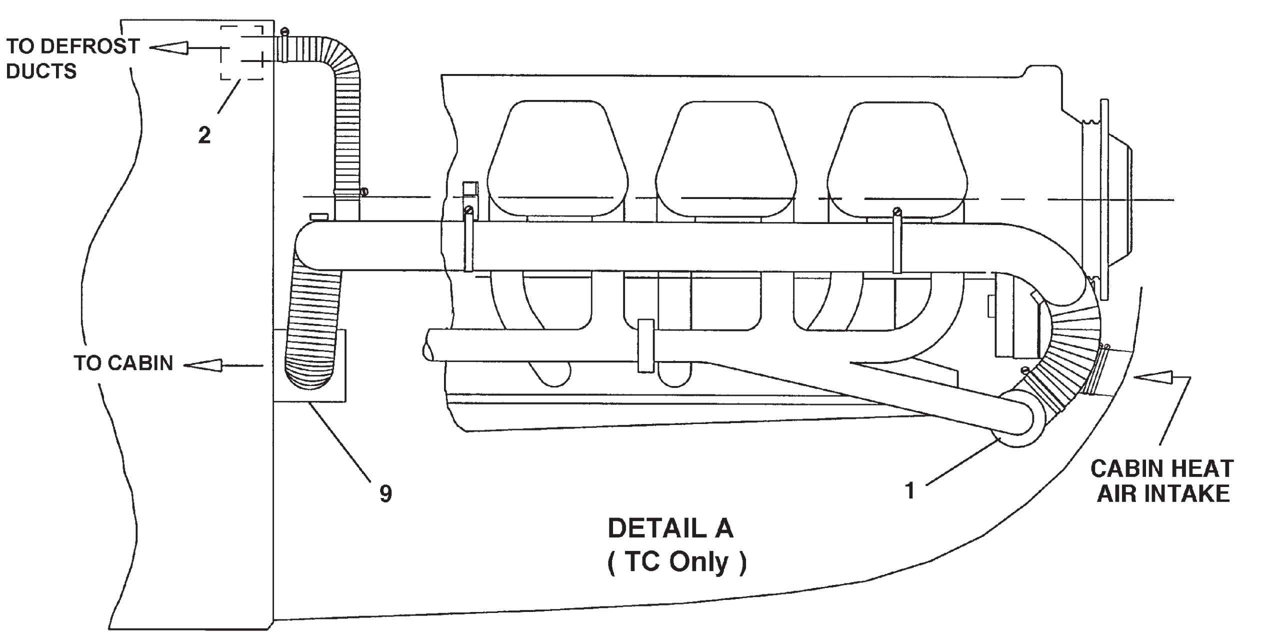
To aid air distribution, the cabin air is exhausted overboard by an outlet located on the bottom of the fuselage. Cabin exhaust outlets are located below and aft of the rear seats.



Cabin Heater, Defrosters and Overhead Vent System
Figure 1 (Sheet 1 of 2)

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





Cabin Heater, Defrosters, and Overhead Vent System
Figure 1 (Sheet 2 of 2)

2. 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 78-00-00 for the inspection procedure. 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 1 for an illustration of the heater system.

GRIDS 2D20 THRU 2D24
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COOLING

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 Fresh Air (Standard) (See 21-20-02.)

When the optional air conditioning system is not installed cabin ventilation and cooling is provided solely by fresh air through the overhead vent system.

2. Air Conditioning (Optional)

A. Description and Operation (Refer to Figure 1.)

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.

NOTE: "HFC-134a" means air conditioning refrigerant which is generically identified and documented as 1,1,1,2-Tetrafluoroethane and/or CAS# 811-97-2. Brand names and commercial designations which meet these requirements include (but are not limited to):

HFC134a, HFA134a, R134a, Dymel® 134a, Fluorocarbon 134a, Forane® 134a, Genetron® 134a, Halocarbon 134a, KLEA® 134a, Norfluane, Referon® 134a, and SUVA™ 134a.

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.

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 1, with probable causes, and suggested remedies. Correct trouble and check entire system for security and components operation. See definitions under Servicing Cooling System, below.

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

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

CHART 1 (Sheet 1 of 5)
TROUBLESHOOTING AIR CONDITIONING SYSTEM

Trouble	Cause	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 is 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. clogged. Inoperative expansion	Refrigerant undercharge. Moisture freezing in expansion valve. Valve shows frost.	Add refrigerant. Install new dryer. Evacuate and recharge.
	Expansion valve inlet screen solvent and replace.	Remove screen. Clean with
	valve. Valve stuck closed or capillary bulb has lost charge.	Warm capillary by holding in hand. If suction pressure does not change replace expansion valve.
	Restriction in liquid line. Restriction will show frost.	Locate restriction and repair.

CHART 1 (Sheet 2 of 5)
TROUBLESHOOTING AIR CONDITIONING SYSTEM

Trouble	Cause	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.
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.

CHART 1 (Sheet 3 of 5)
TROUBLESHOOTING AIR CONDITIONING SYSTEM

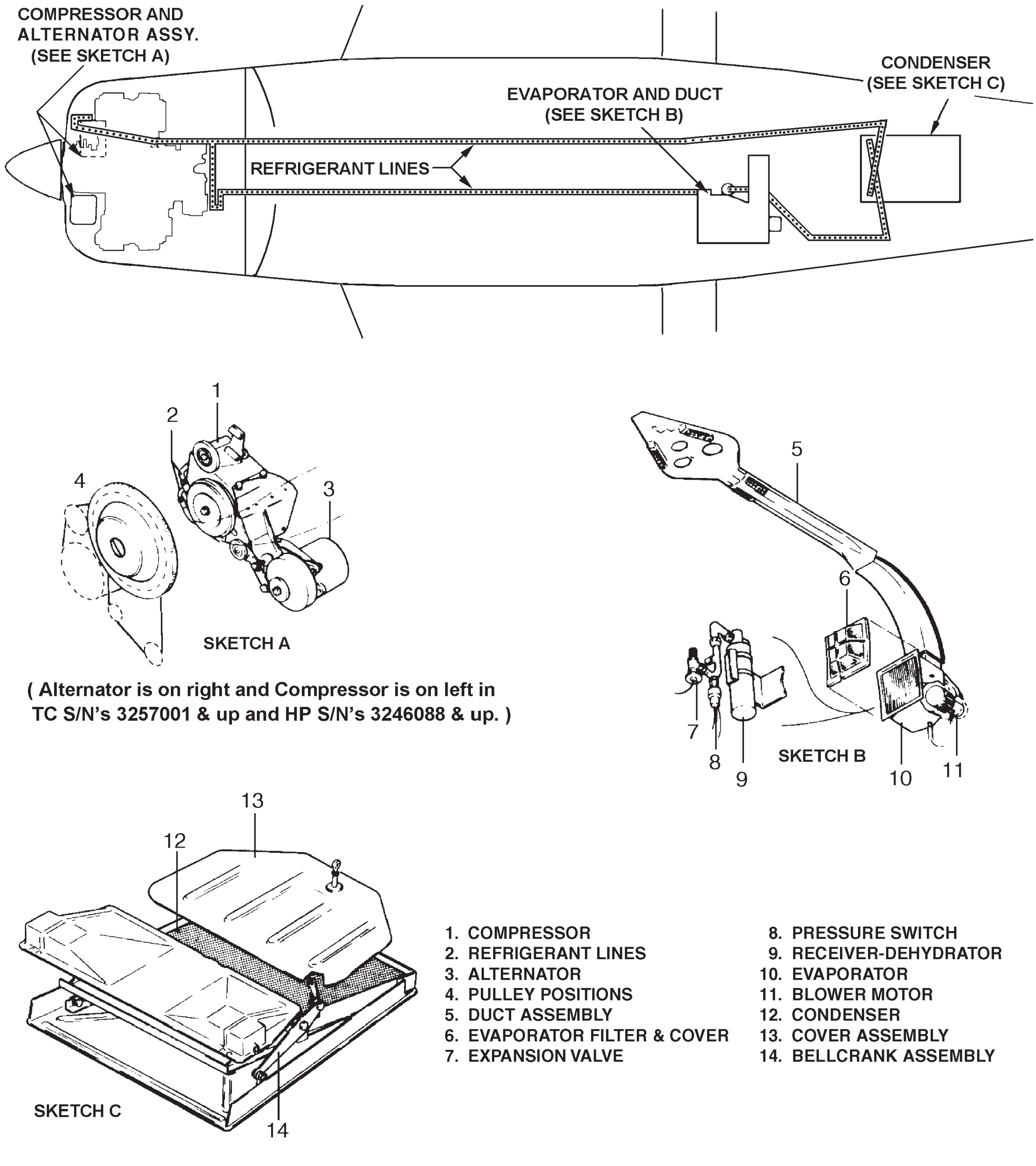
Trouble	Cause	Remedy
System does not cool. (cont.)	**If mechanical:**	
	Loose or broken drive belt.	Replace drive belts and tighten to specifications.
	Compressor partially or completely frozen.	Remove compressor. Service or replace.
	Expansion valve stuck in open position.	Replace expansion valve.
	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. 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.

CHART 1 (Sheet 4 of 5)
TROUBLESHOOTING AIR CONDITIONING SYSTEM

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.
	Magnetic clutch failure.	Check airgap, clutch pulley, front plate, coil, and bearing. Adjust, repair, or replace, as required.

CHART 1 (Sheet 5 of 5)
TROUBLESHOOTING AIR CONDITIONING SYSTEM

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



(Alternator is on right and Compressor is on left in TC S/N's 3257001 & up and HP S/N's 3246088 & up.)

1. COMPRESSOR
2. REFRIGERANT LINES
3. ALTERNATOR
4. PULLEY POSITIONS
5. DUCT ASSEMBLY
6. EVAPORATOR FILTER & COVER
7. EXPANSION VALVE
8. PRESSURE SWITCH
9. RECEIVER-DEHYDRATOR
10. EVAPORATOR
11. BLOWER MOTOR
12. CONDENSER
13. COVER ASSEMBLY
14. BELLCRANK ASSEMBLY

Air Conditioning Installation (Typical)
Figure 1

3. Servicing Cooling System (PIR-PPS50003, Rev. E/PPS50003-3, Rev. E.)

NOTE: The maximum refrigerant capacity is 2.25 pounds. The total refrigerant capacity required is determined separately for each system and is the amount that will result in bubble-free operation at the sight gauge, as specified in the post charging operational check.

A. Definitions:

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

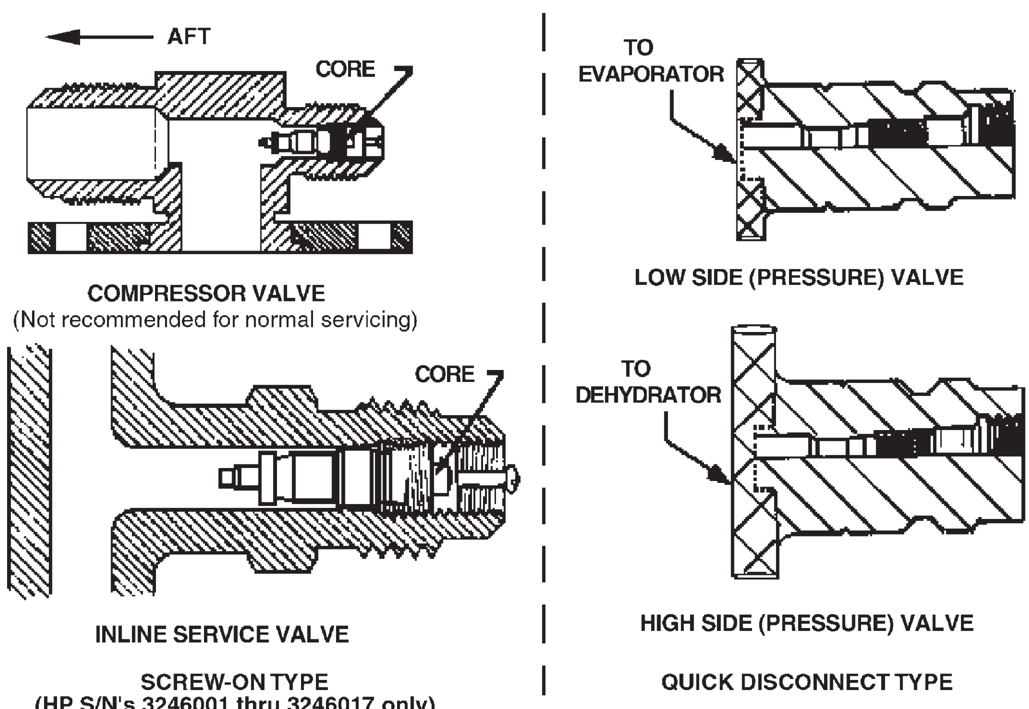
Low Side: Consists of all lines and components between the expansion valve and the compressor inlet. It includes the evaporator.

B. Service Valves (see Figure 2.)

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.)

The service valves are installed to Test, Bleed (Discharge), Evacuate and Charge the air conditioning system. The aircraft is equipped with inline service valves mounted in the suction and discharge lines of the evaporator assembly located behind the cabin rear closeout panel.

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.



Service Valves
Figure 2

These inline service valves are quick disconnect type Schrader valves (except in HP S/n's 3246001 thru 3246017 only, see note 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.

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

NOTE: 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.

C. Malfunction Detection

NOTE: If the cooling system has leaked refrigerant or is discharged, the compressor oil level must be checked.

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 2 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 3246018 & 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 2 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 2
REFRIGERANT TEMPERATURE VS. PRESSURE

Refrigerant R12 Evaporator Pressure Gauge Reading psi	Evaporator Temperature °F	**Refrigerant HFC134a** Evaporator Pressure Gauge Reading psi	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		

D. Special Servicing Procedures

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

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

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.

(1) Refrigerant Safety Precautions:

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 HFC-134A) 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.

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.

(2) System Servicing Precautions:

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.

NOTE: The term “Discharge”, as used throughout this section, in no sense implies or suggests discharging refrigerant into the atmosphere. In all cases when discharging, an environmentally approved refrigerant recovery station is to be used.

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.

IF ANY DOUBT EXISTS ABOUT THE CLEANLINESS OF THE COMPRESSOR OIL, REPLACE WITH NEW OIL.

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: NEVER REUSE OIL REMOVED FROM THE SYSTEM -- DISCARD IT.

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: WHEN LOCTITE REFRIGERANT SEALANT HAS BEEN USED ON A JOINT IT MUST BE HEATED TO 400°F PRIOR TO DISASSEMBLY. LOCTITE MUST BE USED TO SEAL ANY PIPE THREADS IN THE SYSTEM LINES.

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 3.)

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

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.

CHART 3
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

E. Servicing the System with a Charging Stand

CAUTION: MINERAL OIL AND PAG ARE NOT COMPATIBLE. USE A SEPARATE MANIFOLD TEST SET AND/OR TEST/CHARGING STAND AND RECOVERY SYSTEM FOR EACH REFRIGERANT TYPE.

CAUTION: USE RECOVERY UNIT SPECIFICALLY DESIGNED FOR THE TYPE OF REFRIGERANT USED IN THE AIRCRAFT

(1) Discharging (Bleeding/Purging) the System (with a Robinair 34700 or similar charging stand/ recovery station) (see Figures 3 and 6) (Required only if system contains refrigerant.)

CAUTION: APPLIES TO ROBINAIR 34700 OR SIMILAR CHARGING/RECOVERY STATION AS USED WITH HFC-134A REFRIGERANT. SEE OPERATOR'S MANUAL OF STATION BEING USED FOR DETAILED INSTRUCTIONS FOR DISCHARGING SYSTEM.

NOTE: The term “Discharge”, as used throughout this section, in no sense implies or suggests discharging refrigerant into the atmosphere. In all cases when discharging, an environmentally approved refrigerant recovery station is to be used.

(a) Gain access to service valves by removing rear closeout panel in cabin.

(b) Remove protective caps from service valves.

(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) valve and the blue LIQUID valve 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.

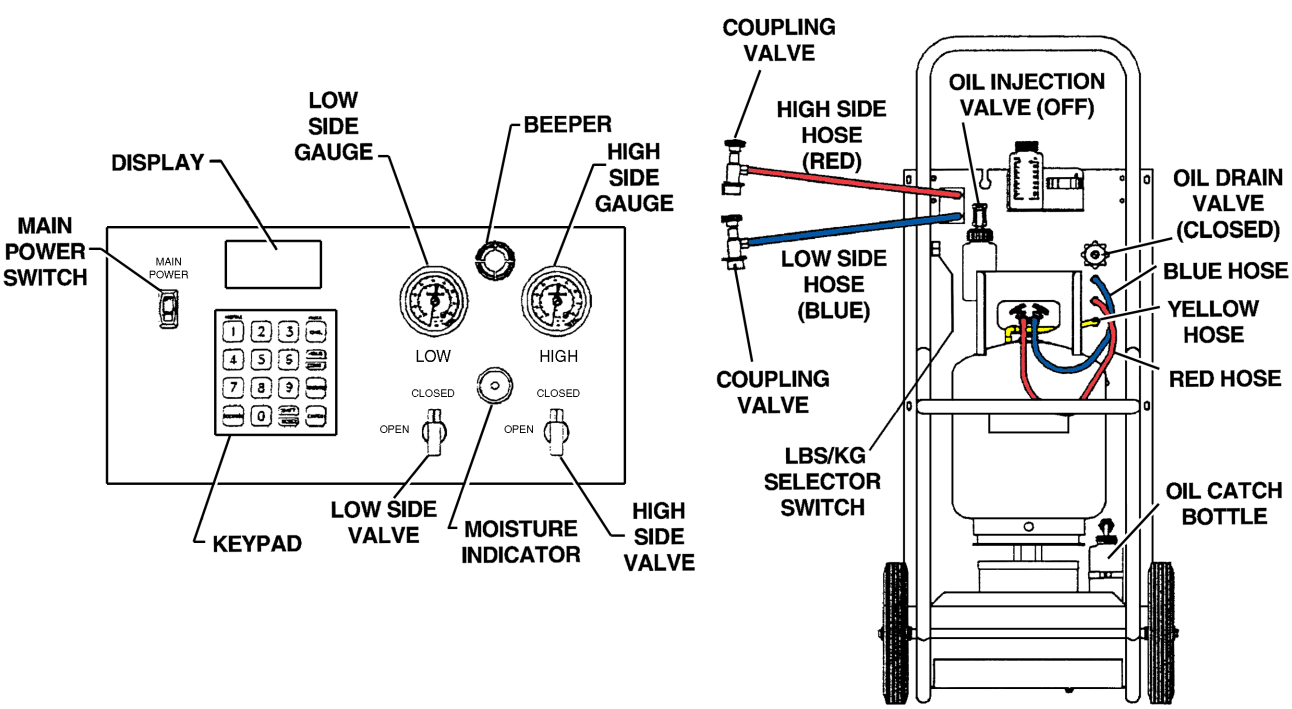
2 If a rise occurs, press the HOLD/CONT key.

3 Repeat as necessary until system maintains pressure for two minutes.

(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.

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

(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.



Robinair 34700 Charging Stand
Figure 3

(p) To enter diagnostic mode, simultaneously press the SHIFT/RESET and ENTER keys. To display 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.

(2) Leak Detection (refer to Figures 3 and 4).

When using a charging stand, a leak may be located as follows:

(a) Ensure that aircraft and/or ground power is OFF.

(b) Close all valves on the charging stand.

(c) Remove the protective caps from the high and low side service ports on the evaporator.

(d) Connect the blue and red hoses to the service ports as shown in Figure 6.

(e) Proceed following the instructions in either paragraph (f) or (g), below.

(f) Using gaseous dry nitrogen:

1 Remove the pressure switch located on the evaporator assembly.

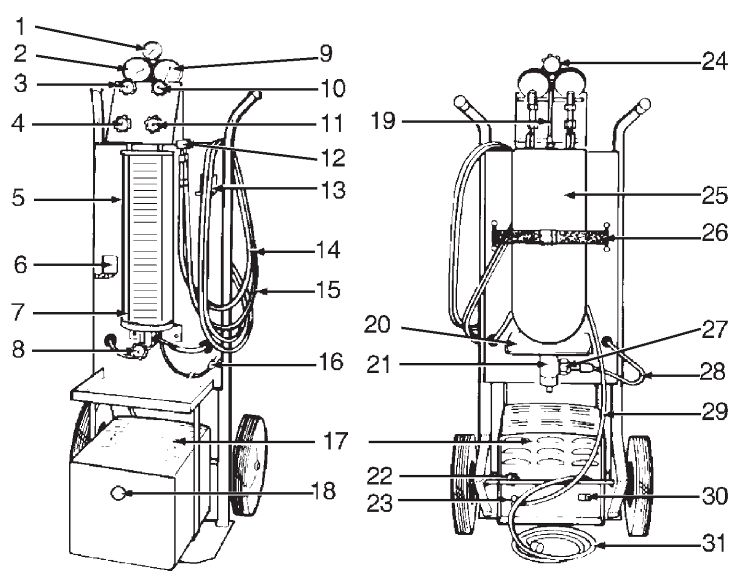
2 Connect a regulated (0-300 psig) gaseous dry nitrogen source to the pressure switch port on the evaporator assembly.

3 Slowly pressurize system with nitrogen to 200 psig max. Turn off the nitrogen source.

4 Monitor pressure on the charging station gauge for 20 minutes. A leak free system will maintain the 200 psig pressure for 20 minutes.

5 If there is no pressure drop for 20 minutes, slowly release nitrogen pressure and disconnect the nitrogen source from the evaporator assembly. Re-install the pressure switch, lubricating the threads with Retro-fix CCI ESTER-25065 oil (P/N 197-511). Proceed to step (i).

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



26. WEB STRAP
27. REFRIGERANT DRUM REDUCER
28. CHARGING CYLINDER HOSE
29. VACUUM PUMP INTAKE HOSE
30. VACUUM PUMP SWITCH
31. VACUUM PUMP POWER CORD

Kent Moore J23500 Charging Stand
Figure 4

6 If there is a pressure drop, find leak(s) by applying a soap solution to all connections.

7 Tighten/re-tighten fittings as necessary to stop leak(s). If leaks are due to damaged or worn components, proceed with refrigerant recovery/system discharge, perform repairs or component replacement and repeat leak detection procedure.

(g) Using HFC-134a refrigerant:

1 Ensure that there is at least one pound of refrigerant in the charging cylinder.

2 Open the high pressure control valve and the refrigerant control valve on the charging stand. Allow one pound of refrigerant to enter the system.

3 Close the high pressure control valve and the refrigerant control valve.

CAUTION: IT IS RECOMMENDED THAT A THICK SOLUTION OF SOAP AND WATER BE USED TO CHECK FOR LEAKS INSTEAD OF THE PROPANE LEAK DETECTOR THAT IS PROVIDED WITH SOME BRANDS OF CHARGING STANDS.

4 Locate leak(s) using an electronic leak detector designed to detect HFC134a refrigerant. Or, use soap and water in a thick solution.

5 If no leaks are found, proceed to step (h).

6 Tighten/re-tighten fittings as necessary to stop leak(s). If leaks are due to damaged or worn components, proceed with refrigerant recovery/system discharge, perform repairs or component replacement and repeat leak detection procedure.

(h) Recover remaining refrigerant from system using the Robinair 34700 (or other approved) charging station (see Discharging the System, above). Any quantity of oil recovered from aircraft must be measured and an equal amount of new oil (i.e. - PAG with HFC134a) must be added to system before recharging.

(i) Evacuate the system, and charge see below.

(3) Evacuating the System

NOTE: Perform a Leak Detection check, above, before evacuating the system.

If the system has been operated in a discharged condition or anytime the system has been open to atmospheric pressure, the receiver-dehydrator must be replaced and the system evacuated to remove any trapped air and moisture which has entered it. A vacuum pump capable of pulling 29 inches of mercury or better should be used. As the pressure in the air conditioning system is lowered, the boiling temperature of the water (moisture) that may be present is also lowered. This then forces any moisture, in the form of water vapor, out of the system. Chart 4 demonstrates the effectiveness of moisture removal under a given vacuum.

(a) Using a Kent Moore J23500 or similar charging stand: (See Figure 4)

1 Ensure that aircraft and/or ground power is OFF.

2 Close all valves on the charging stand.

3 Remove closeout panel at the rear of the cabin to gain access to the service valves.

4 Remove protective caps from the high and low side service ports on the evaporator.

5 Remove the protective cap from the vacuum pump outlet.

6 Connect the blue and red hoses to the service ports.

7 Start the vacuum pump.

8 Open the valve on the vacuum pump. Open the low pressure control valve and the vacuum control valve on the charging stand.

CHART 4
USING VACUUM TO EVACUATE MOISTURE

	System Vacuum	Boiling Point of Water (°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.

9 After five minutes of pump operation, the high pressure gauge should indicate slightly below zero.
   a If it doesn't, stop the pump and eliminate the blockage in the system replacing the faulty component, then repeat steps (1)-(9).
   b If it does, open the high pressure control valve on the charging stand and continue to evacuate the system.

10 Operate the vacuum pump for fifteen minutes, or until the compound gauge indicates 24 to 26 in. Hg. whichever occurs first.

11 Close the low pressure control valve and the high pressure control valve on the charging stand. Stop the vacuum pump and observe the compound gauge. If the gauge rises at a rate faster than 1 in. Hg. in 5 minutes, there is a leak in the system. Locate and fix the leak. Repeat the evacuation steps above.

12 Open the low pressure control valve and the high pressure control valve on the charging stand. Continue pumping and hold the system pressure below 26 in. Hg. for a minimum of 30 minutes. All the pumping time specified above may be included in the 30 minutes provided that no leaks or blockages are noted, and provided that the system is not opened by removal or disconnection of components.

13 Close the low pressure control valve, the high pressure control valve and the vacuum control valve. Stop the vacuum pump and perform the charging procedure immediately.

(b) Using a Robinair 34700 or similar charging/recovery stand: (See Figure 3)

1 Ensure that aircraft and/or ground power is OFF.

2 Close all valves on charging stand.

3 Remove closeout panel at rear of cabin to gain access to service valves.

4 Remove protective caps from the high and low side service ports on the evaporator.

5 Connect the blue and red hoses to the service ports (refer Figure 6), on systems equipped with quick disconnect connections, open coupler valves.

6 Open blue (low side) valve (1) on unit's control panel.

7 Open both the red GAS (vapor) valve and the blue LIQUID valve on the tank (ref. Figure 6).

8 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.

9 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.

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 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 (12).

13 If, after 5 minutes of pump operation, the RED gauge indicates a little below zero, open red (high side) valve (2), and continue evacuation.

- a System vacuum (i.e. - low side gauge (GAUGE 1)) should attain 24 to 26 inches of mercury (in. Hg.) in 10 to 15 minutes.
- b Allow pump to hold a vacuum of 26 in. Hg. (or below) for a minimum of 15 minutes.
- c Failure to achieve or hold a vacuum of 26 in. Hg. (or below) in either (a) or (b), above, indicates a leak in the system. Locate leak as described in Leak Detection, above.
- d Repair leak. Repeat steps (1) through (13).

14 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.

15 When panel display reads CPL (complete), close both the low side valve (1) and the high side (2) valves.

16 Perform charging procedure immediately, see Charging the System, below.

(4) Charging the System

NOTE: Always evacuate the system (see above), before charging.

(a) Using a Kent Moore J23500 or similar charging stand (refer to Figures 4 and 5)

1 Open the valve at the base of the charging cylinder and fill the charging cylinder with sufficient refrigerant to charge the system. If refrigerant stops filling the cylinder, open the bleed valve at the top of the charging cylinder to relieve head pressure and allow refrigerant to continue filling the charging cylinder.

2 Close the bleed valve and the valve at the base of the charging cylinder.

3 Turn the charging cylinder sight glass to match the pressure reading on the charging cylinder pressure gauge. Keep the sight glass in this position during the remainder of the charging operation.

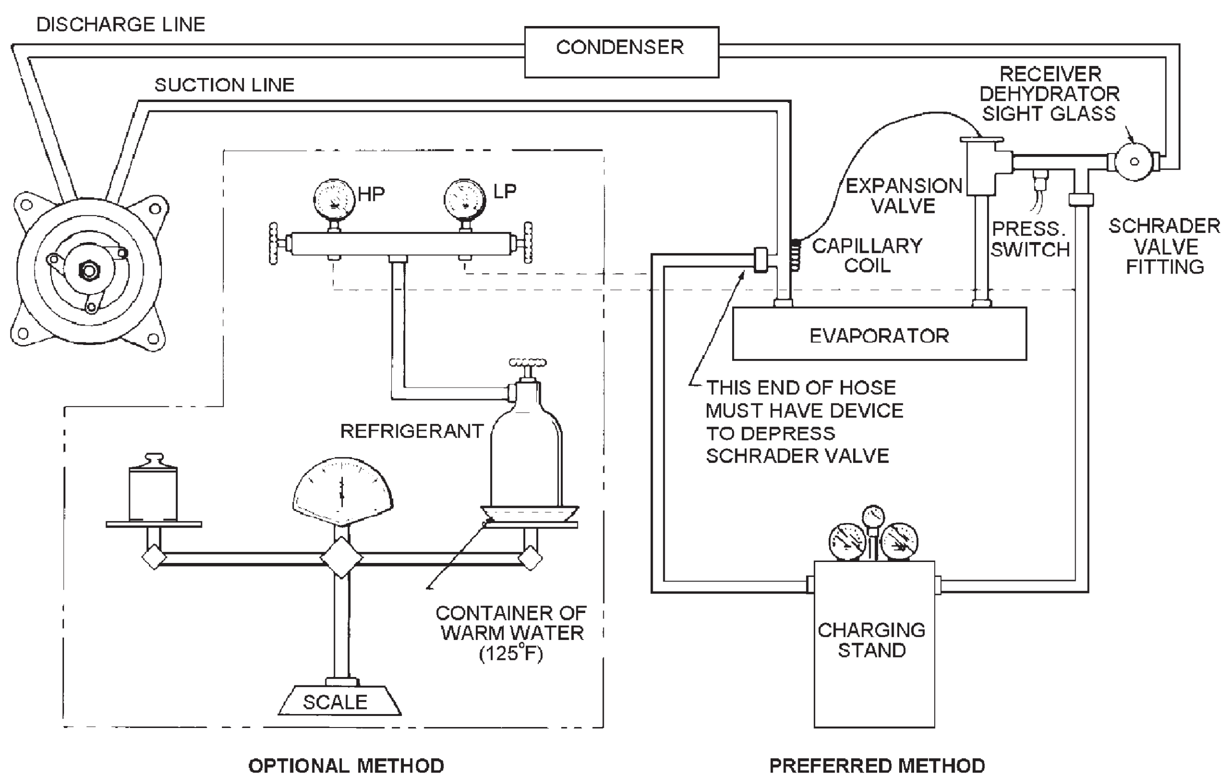
4 Connect the heating element plug to a 110 volt power outlet.

5 With the low pressure control valve (3) closed, open the refrigerant control valve (11) and the high pressure control valve (10).

6 Allow the correct amount of refrigerant to enter the high side of the system.

7 Close the high pressure control valve (10) and the refrigerant control valve (11).

8 Disconnect the hoses from the airplane's system.



Charging Hookup
Figure 5

(b) Using a Robinair 34700 charging station or equivalent (Refer to Figures 3 and 6)

CAUTION: THE FOLLOWING PROCEDURE APPLIES TO ROBINAIR 34700 OR SIMILAR CHARGING STATION. SEE OPERATOR'S MANUAL OF CHARGING STATION BEING USED, FOR DETAILED INSTRUCTIONS FOR CHARGING SYSTEM.

1 Check that main power switch and/or ground power is OFF.

2 Check that the LBS/KG selector switch on back of unit is in desired measurement mode. Be sure to turn OFF the main power switch before changing the 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.

3 Remove protective caps from the high and low side service ports on the evaporator.

4 Connect the blue and red hoses to the service ports (ref. Figure 6), on systems equipped with quick disconnect connections, open coupler valves.

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 INDIRECT TRANSFER OF REFRIGERANT.

CAUTION: ADD REFRIGERANT THROUGH THE LOW PRESSURE SIDE ONLY.

5 Open the low side (blue) valve on the unit's control panel.

6 If the messages PROGRAM and CHARGE 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. The PA-32R-301 II HP and PA-32R-301T II TC require approximately 2.25 LBS.

7 Enter amount of refrigerant required to charge the system by pressing the appropriate number keys and ENTER on keypad.

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.

8 To begin charging process, press CHG key on keypad.

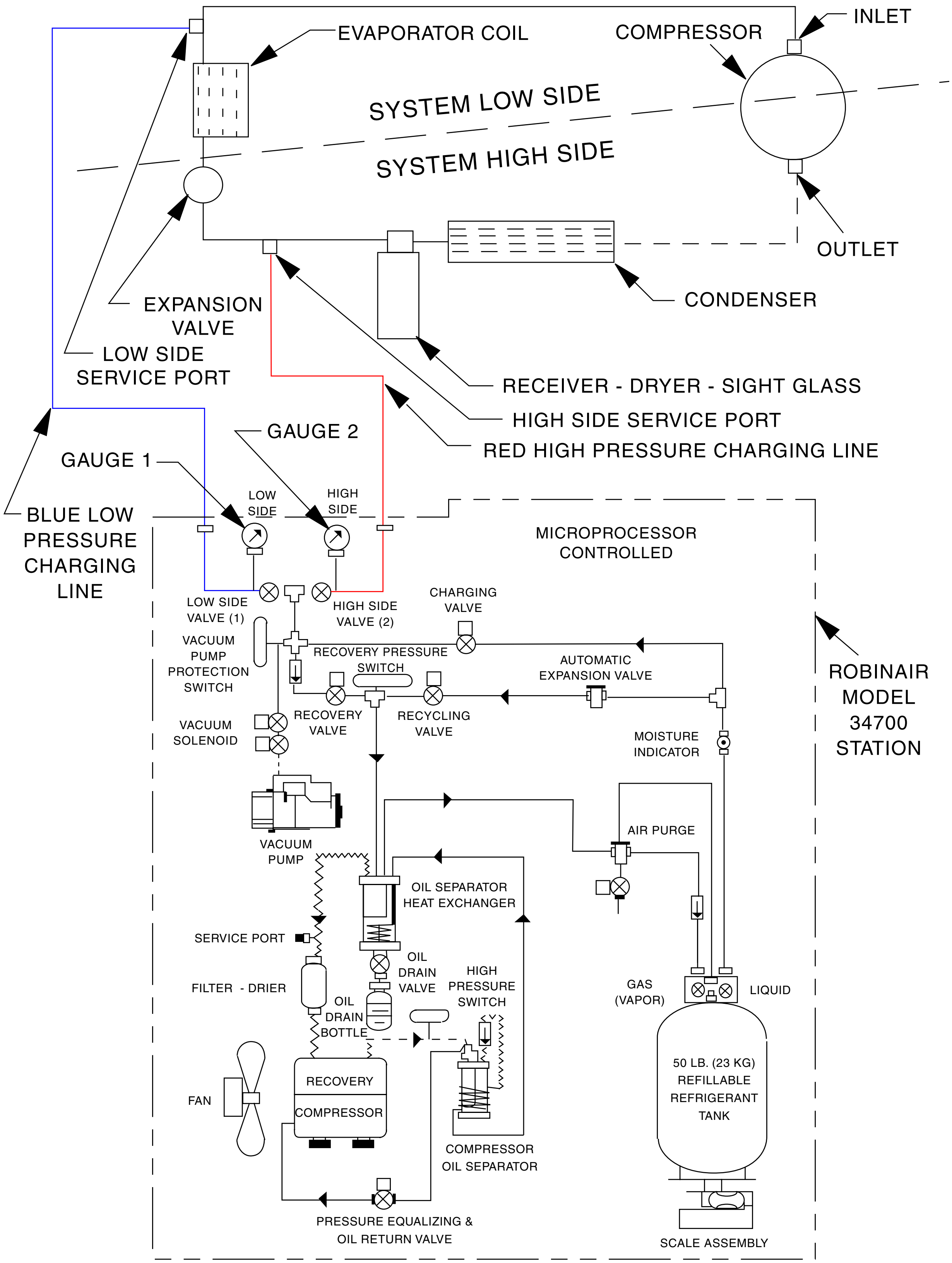
a The digital display will read AUTOMATIC and show the amount of refrigerant programmed for the charge.

b As the solenoid opens, it will make an audible sound.

c The display will count down to zero, and display message CPL, when charging is complete.

9 Close low side (blue) valve. Check that the high (red) valve is also closed. Also close coupler valves.

10 Perform Post Charging Operational Check, see below.



Robinair 34700 Charging Station Hose Hookup
Figure 6

(5) Post Charging Operational Check
(see Figures 3, 4, and 6 - numbers in parentheses refer to Figure 4, numbers in brackets refer to Figure 6)

(a) Ensure that the low pressure control valve (3) [1] and the high pressure control valve (10) [2] are closed. Hook up the charging stand to the system as shown in Figures 5 and 6.

(b) With Robinair 34700 style stands equipped with quick disconnect couplings only, ensure coupler valves are open.

CAUTION: ASCERTAIN THAT THE AREA AROUND THE AIRPLANE IS CLEAR AND THAT A QUALIFIED PERSON IS AT THE CONTROLS OF THE AIRPLANE.

CAUTION: ENSURE THE AIRPLANE IS HEADED INTO THE WIND.

(c) Activate the system and operate the engine at 1,000 rpm for 2 minutes. Then operate the engine at 2,000 rpm for 2 minutes.

(d) Check the sight gauge on the receiver-dehydrator during the engine operation at 1,000 and 2,000 rpm. Any indication of bubbles passing the sight gauge indicates that additional refrigerant is required.

(e) If additional refrigerant is required, add it slowly through the refrigerant control valve (11) (Kent Moore J23500 style stands only) and the low pressure control valve (3) [1] until the sight glass remains free of bubbles. Regulate the flow of refrigerant with the low pressure control valve. Do not allow the compound gauge (2) or the low side gauge [1] to exceed a reading of 40 psi.

(f) With the engine operating of 1,000-1,500 rpm, the low and high side gauges should indicate as shown in Chart 5.

(g) With the charge properly established, stop the engine and, with Robinair 34700 style stands equipped with quick disconnect couplings only, close the coupler valves.

(h) Close the low pressure control valve (3) [1] and, with Kent Moore J23500 style stands only, the refrigerant control valve (11).

(i) Remove the charging stand. Replace all protective caps and covers.

CHART 5
AMBIENT TEMPERATURE INDICATION

Gauge	Ambient Temperature	Indication
Low Pressure	All	10 to 35 psig
High Pressure	Up thru 75°F	125 psig min to 175 psig max
High Pressure	Over 75°F	150 psig min to 275 psig max

F. Servicing the System with a Manifold Set

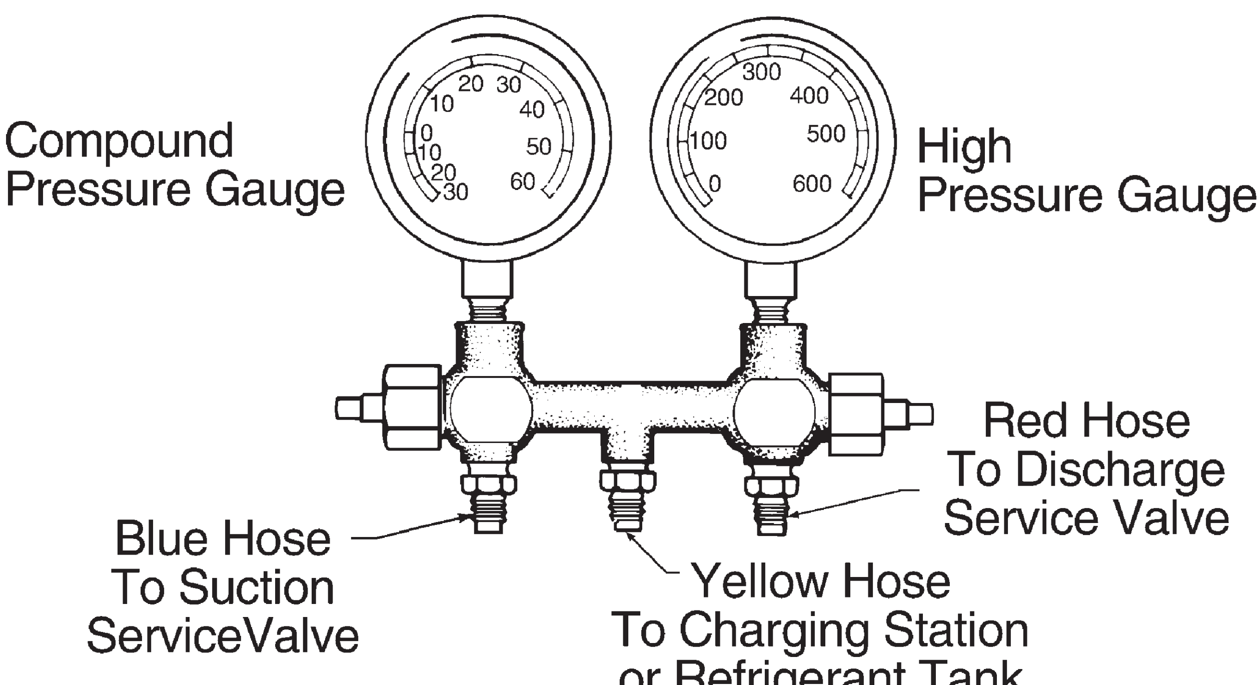
(1) Test Gauge and Manifold Set

The proper testing and diagnosis of the air conditioning system require that a manifold gauge set (or a charging stand) be attached to the system. This set consists of two gauges mounted to a manifold. One gauge is a high pressure gauge used in the discharge side of the system. The other is a low pressure gauge used in the suction side of the system. The manifold is a device having fittings for both gauges and connection hoses with provisions for controlling the flow of refrigerant through the manifold. (Refer to Figures 7 and 8.)

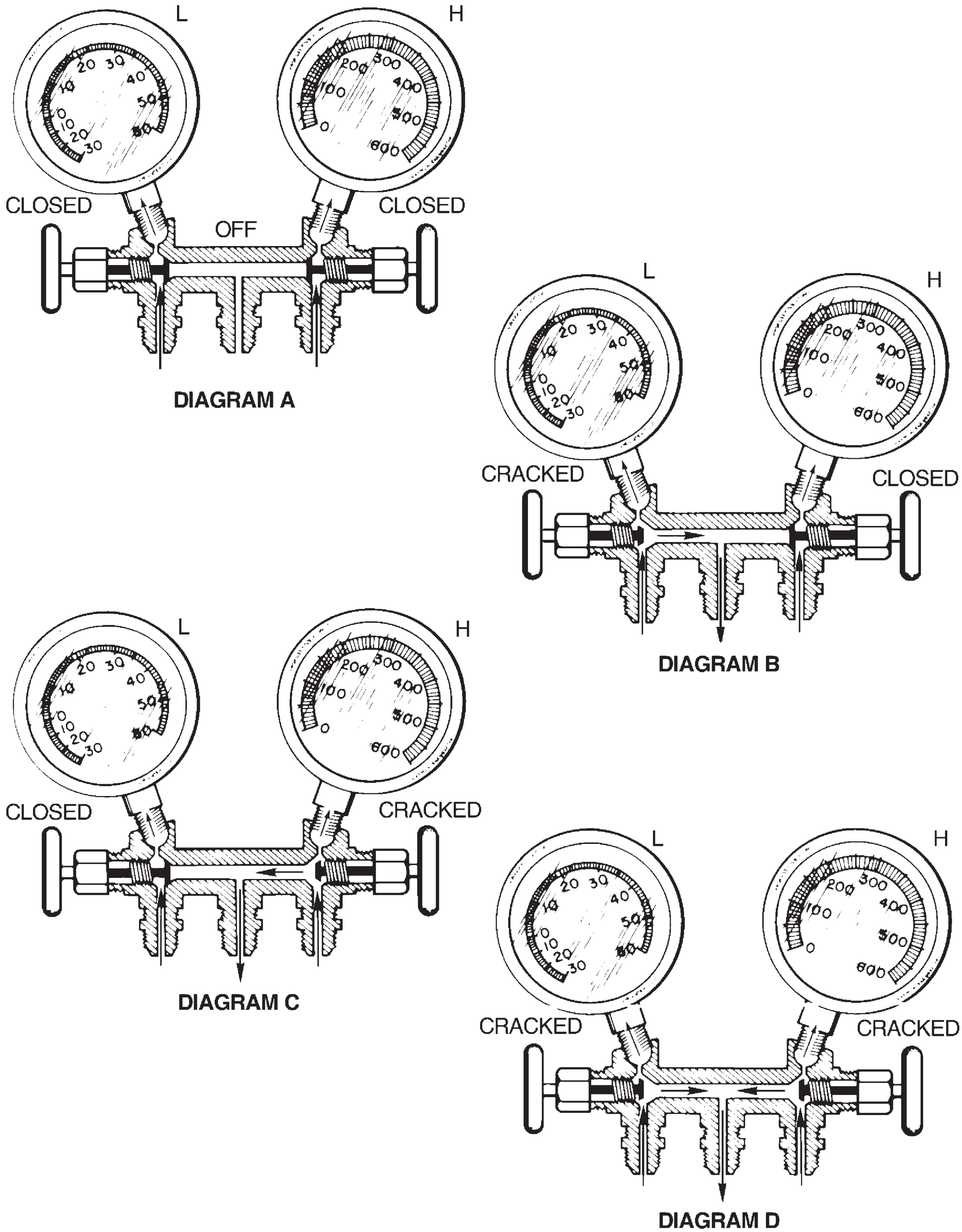
The center port of the manifold set is used for charging or evacuation procedures, or any other service that may be necessary.

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

Cracking the hand valve, in the counterclockwise direction, opens the systems to the middle service port of the manifold set. This is desirable only when it is necessary to let refrigerant out of or into the system. (Refer to Figures 7 and 8.)



Test Gauge and Manifold Set
Figure 7



Manifold Set Operation
Figure 8

(2) Leak Detection (refer to Figure 9.)

(a) Close both the low side and high side valves on manifold hand set.

(b) Connect manifold hand set middle port (yellow) hose to a regulated (0-300 psig) gaseous dry nitrogen source or a container of refrigerant.

(c) Open nitrogen source or refrigerant container service valve.

(d) Open the manifold hand set high side valve until a pressure of 50 psig is reached on low side gauge. Close high side valve.

(e) Locate leak(s) using soap and water in a thick solution; or, if using HFC-134a, an electronic leak detector designed to detect HFC134a refrigerant can also be used.

(f) Tighten/re-tighten fittings as necessary to stop leak(s). If leaks are due to damaged or worn components, proceed with refrigerant recovery/system discharge, perform repairs or component replacement and repeat leak detection procedure.

(g) Check that the both high side and low side valves on the manifold hand set are closed.

(h) Close service valve on nitrogen source or refrigerant container. Disconnect yellow manifold hand set center hose from nitrogen source or refrigerant container.

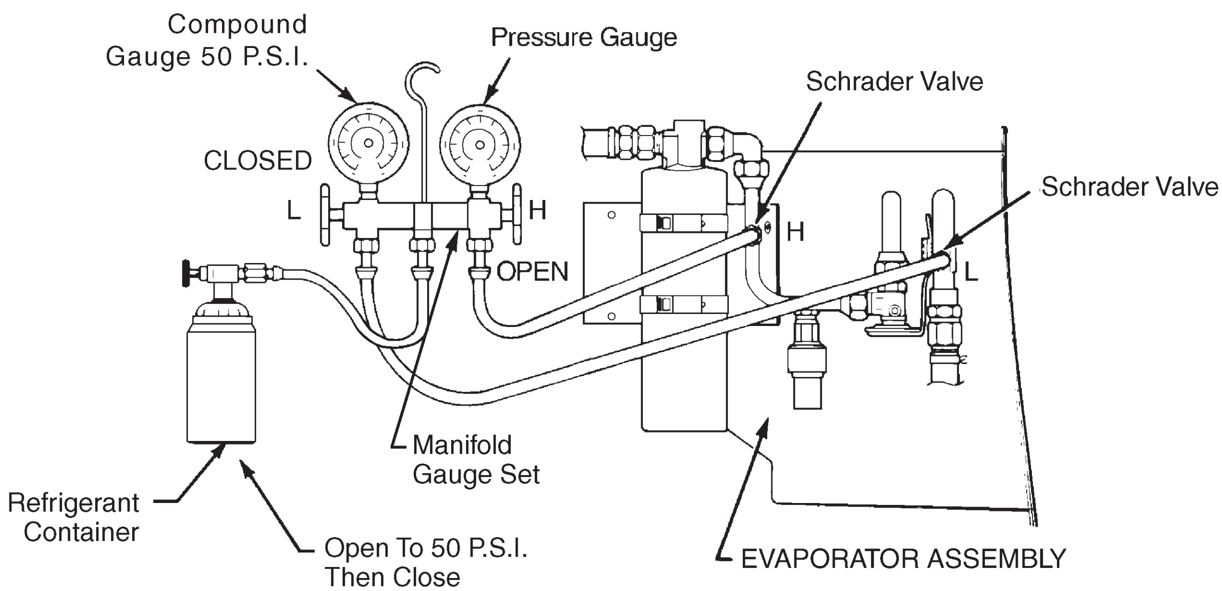
(i) On systems equipped with quick disconnect connections, close coupler valves. Disconnect manifold hand set red and blue hoses from airplane service ports. Remove manifold hand set.

(j) If refrigerant was used, recover remaining refrigerant from system using the Robinair 34700 (or other approved) charging station. Any quantity of oil recovered from aircraft must be measured and an equal amount of new oil (i.e. - PAG with HFC134a) must be added to system before recharging.

(k) When refrigerant recovery is complete, on systems equipped with quick disconnect connections, close coupler valves. Disconnect charging/test station from service ports.

(l) Evacuate the system, see below.

(m) Immediately charge the system, see below.



Leak Test Hookup
Figure 9

(3) Evacuating the System (refer to Figure 10)

NOTE: Perform a Leak Detection check, above, before evacuating the system.

If the system has been operated in a discharged condition or anytime the system has been open to atmospheric pressure, the receiver-dehydrator must be replaced and the system evacuated to remove any trapped air and moisture which has entered it. A vacuum pump capable of pulling 29 inches of mercury or better should be used. As the pressure in the air conditioning system is lowered, the boiling temperature of the water (moisture) that may be present is also lowered. This then forces any moisture, in the form of water vapor, out of the system. Chart 4 demonstrates the effectiveness of moisture removal under a given vacuum.

(a) Ascertain that all system pressure is released.

(b) Connect the manifold set hoses to the service ports and vacuum pump as shown in Figure 10.

(c) Close the high side (pressure) and low side (suction) hand valves on the manifold set.

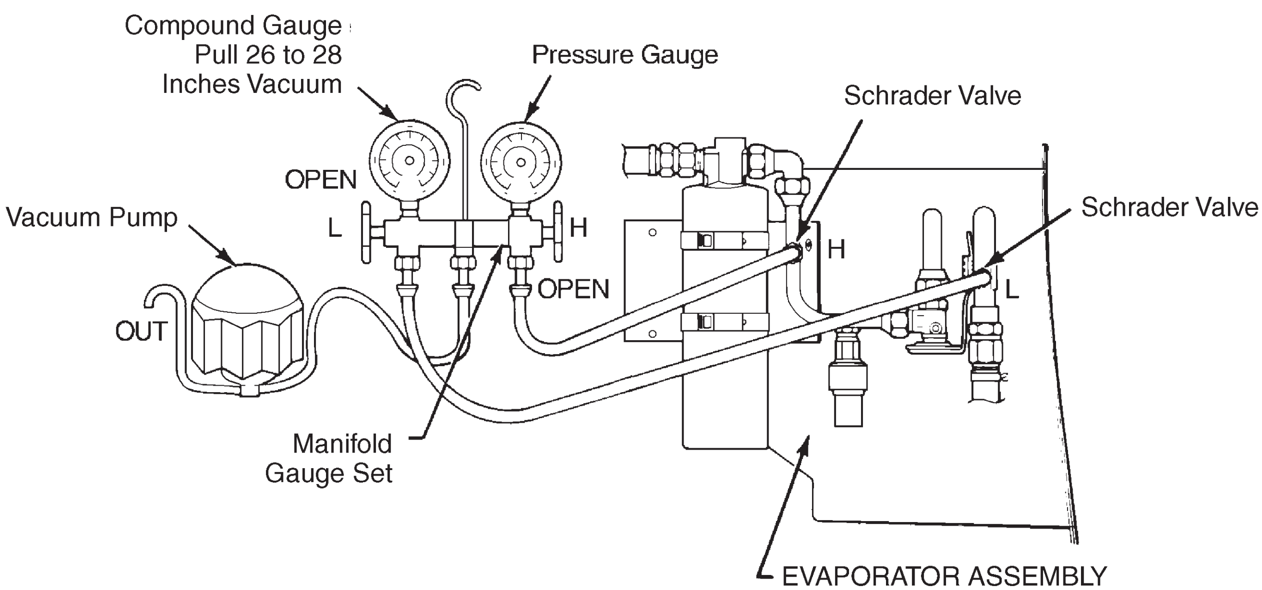
(d) Start the vacuum pump.

(e) Open the low side manifold set hand valve. The low side gauge should show a vacuum.

(f) After five minutes of pump operation the high side gauge should indicate slightly below zero. If it does not, stop the pump and eliminate the blockage in the system by replacing the faulty component, then repeat the previous evacuation steps.

(g) Operate the vacuum pump for fifteen minutes or until the low side gauge indicates 24 to 26 in. Hg. whichever occurs first.

(h) Close the low side hand valve, stop the vacuum pump and observe the low side gauge. If the gauge rises at a rate faster than 1 in. Hg. in 5 minutes, there is a leak in the system. Locate and repair the leak, then repeat the previous evacuation steps.



Evacuation Hookup
Figure 10

(i) With both the low and high side valves open, continue the pumping and hold the system below 26 in. Hg. for a minimum of 30 minutes. All the previous pumping time may be included in the 30 minutes provided that no leaks or blockages are noted, and provided that the system is not opened by removal or disconnection of components.

(j) Close the low and high side hand valves, stop the vacuum pump and perform the charging procedure immediately.

(4) Charging the System Using the Airplane Compressor

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

CAUTION: ASCERTAIN THAT THE AREA AROUND THE AIRPLANE IS CLEAR AND THAT A QUALIFIED PERSON IS AT THE CONTROLS OF THE AIRPLANE.

(a) Keep the system under the vacuum established during the evacuating procedure with both hand valves in the closed position.

(b) Attach a container of the refrigerant to the manifold set and open the container service valve.

(c) Loosen the center hose at the manifold set until a hiss can be heard. Allow the gas to escape for 2 to 3 seconds, then tighten the connection.

(d) Open the high side manifold set hand valve, observe the low side gauge, then close the high side hand valve. The low side gauge should immediately change from an indication of a vacuum to an indication of pressure. If it does not, the system is blocked, and the blockage must be corrected before proceeding.

(e) Start the engine and operate it at 1000 rpm.

(f) Adjust the airplane air conditioning controls for maximum cooling, high blower speed.

(g) Keep the refrigerant cylinder in an upright position. A slug of liquid refrigerant entering the system would damage the compressor.

(h) Open the low side manifold set hand valve and allow two pounds of refrigerant in the gas state to enter the system.

(i) Close the low side manifold set hand valve.

(j) Proceed with the Post Charging Operational Check, below.

(5) Post Charging Operational Check

CAUTION: ASCERTAIN THAT THE AREA AROUND THE AIRPLANE IS CLEAR AND THAT A QUALIFIED PERSON IS AT THE CONTROLS OF THE AIRPLANE.

NOTE: Head the airplane into the wind during these checks.

(a) With the manifold set installed, and both hand valves closed, actuate the system and operate the engine at 1,000 rpm for two minutes, then operate the system at 2,000 rpm for 2 minutes.

(b) Check the system sight gauge (on the receiver-dehydrator) during operation at 1,000 and 2,000 rpm. Any indication of bubbles passing the sight gauge indicates that additional refrigerant is required.

(c) Add additional refrigerant slowly through the low side manifold set hand valve until the sight glass remains free of bubbles.

(d) Close the low side hand valve and refrigerant container valve.

CHART 6
AMBIENT TEMPERATURE INDICATION

Gauge	Ambient Temperature	Indication
Low Pressure	All	10 to 35 psig
High Pressure	Up thru 75°F	125 psig min to 175 psig max
High Pressure	Over 75°F	150 psig min to 275 psig max

(e) With the engine operating at 1,000 to 1,500 rpm, the gauges should indicate as shown in Chart 6.

(f) Once the charge is properly established, stop the engine, close the refrigerant container service valve. Remove the manifold set and replace all protective caps and covers.

(6) Adding Partial Charge to System

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

(a) Remove the closeout panel at the rear of the cabin.

(b) Connect a charging hose to a refrigerant cylinder and also to the low pressure Schrader valve fitting on the manifold assembly.

(c) Purge the charging hose by allowing a small amount of refrigerant gas to escape at the Schrader valve fitting.

CAUTION: ASCERTAIN THAT THE AREA AROUND THE AIRPLANE IS CLEAR AND THAT A QUALIFIED PERSON IS AT THE CONTROLS OF THE AIRPLANE.

NOTE: Head the airplane into the wind during this procedure.

(d) Start the engine, operate at 1000 rpm and turn the air conditioner on maximum cool.

(e) Remove the plastic plug (if installed) from the sight glass in top of the receiver-dehydrator.

(f) With a low refrigerant charge in the system, bubbles will be seen passing through the sight glass when the system is operating.

(g) Open the valve on the refrigerant cylinder.

(h) Allow refrigerant to flow into the system until the bubbles disappear from the sight glass.

(i) Close the refrigerant valve and check to see that the sight glass remains clear during system operation.

(j) When the sight glass stays clear of bubbles, add an additional pound of refrigerant to the system. (Engine should be operating at 1,000 rpm.)

NOTE: This is done with OAT at 70°F, or higher, with the air conditioner operating.

(k) Shut off the air conditioner and engine. Remove the charging hose from the Schrader valve with care due to refrigerant remaining in the line.

(l) Reinstall closeout panel.

G. Compressor

(1) Servicing

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.)

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.

CAUTION: PREVENT DIRT OR FOREIGN MATERIAL FROM ENTERING THE 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.

(2) 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.

(a) Circuit protector for air conditioning system must be OFF.
(b) Remove engine cowling and left or right front baffles, as appropriate.
(c) Disconnect electrical leads to magnetic clutch on compressor.
(d) Using an approved refrigerant recovery system, completely discharge and depressurize air conditioning system. Refer to Servicing the System, Discharging, above.
(e) Remove suction and discharge lines from compressor.
(f) Loosen bolt securing compressor idler pulley to release belt tension and remove belt from compressor pulley. (Do not force belt over pulleys.)
(g) Support compressor and remove bolts securing compressor to engine mounting brackets and remove compressor from engine compartment.

(3) 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.

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

1 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.).

2 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 Drive Belt Service, Alignment, below.

NOTE: With the Sanden compressor only, after mounting attach a wench to the center nut of the compressor and slowly rotate in the direction of engine rotation 15 times. This step blows out any residual oil in the compressor head that could cause damage when the system is operated under engine power for the first time.

(b) Check oil level in the compressor as described in Checking Compressor Oil Level, below.

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

(c) Place drive belt over clutch pulley and adjust alignment of pulleys and belt as described in the following section: Compressor, Drive Belt Service, Alignment of Compressor Drive Belt.

(d) Connect discharge and suction lines to service valves on evaporator unit.

(e) Evacuate system per Servicing the System, Evacuating, above.

(f) Charge system per Servicing the System, Charging, above.

(g) Install engine baffle(s).

(h) Install engine cowling.

(4) Checking Compressor Oil Level

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:

(a) 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.

1 Discharge system (ref. discharging).

2 Make an oil dipstick (ref. Figure 11).

3 Remove 0.375 inch oil fill plug in top side of compressor crankcase.

4 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 11).

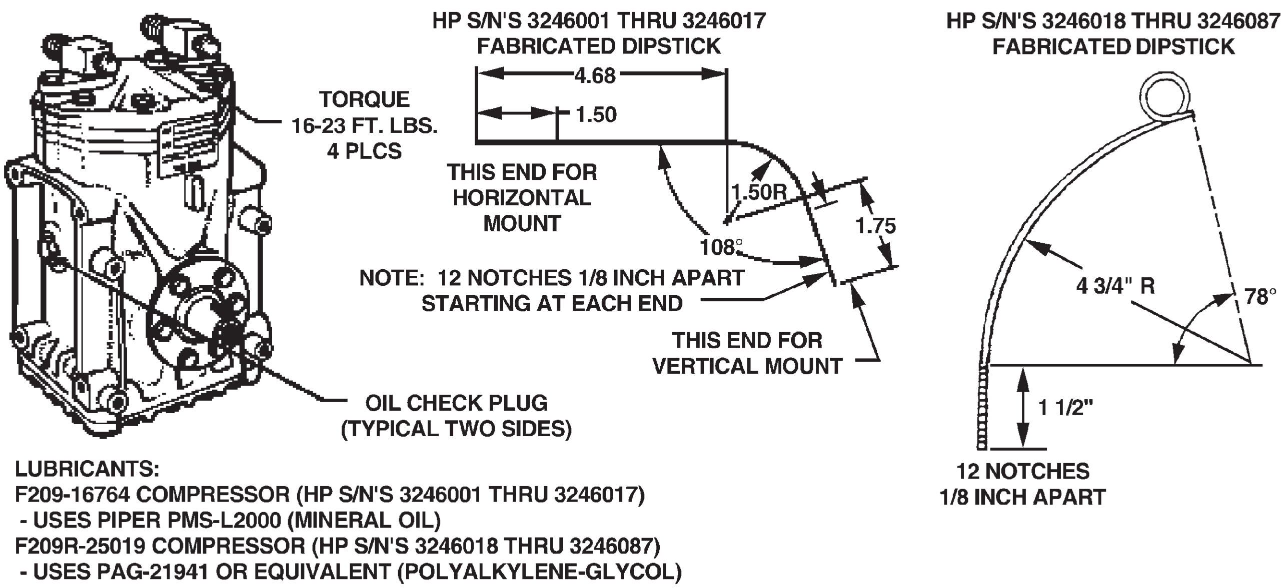
5 When compressor is installed, use Chart 7 to determine proper amount of oil to add to compressor.

6 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.

7 Evacuate and charge system. (Per evacuating the system and charging the system, above.)

CHART 7
YORK COMPRESSOR OIL CHARGE

Oil (Oz.)	6	8	10	16
Dipstick Reading (In.)	13/16	1	1 3/16	1 15/16



York Compressor and Fabricated Oil Dipstick
Figure 11

Effectivity
3246001 thru 3246087

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

1 Run the compressor for ten minutes at engine idle RPM.

2 Discharge system, recovering all refrigerant (refer to Servicing the System, Discharging). Be careful not to lose oil.

3 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.

4 Fabricate a dipstick as shown in Figure 12.

5 Remove oil filler plug. Referring to Figure 13, 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.

6 Insert the dipstick to its "Stop" (the bend near the top of the dipstick) as shown in Figure 12. Ensure the point of the bend is oriented appropriately for the cant of the compressor mount.

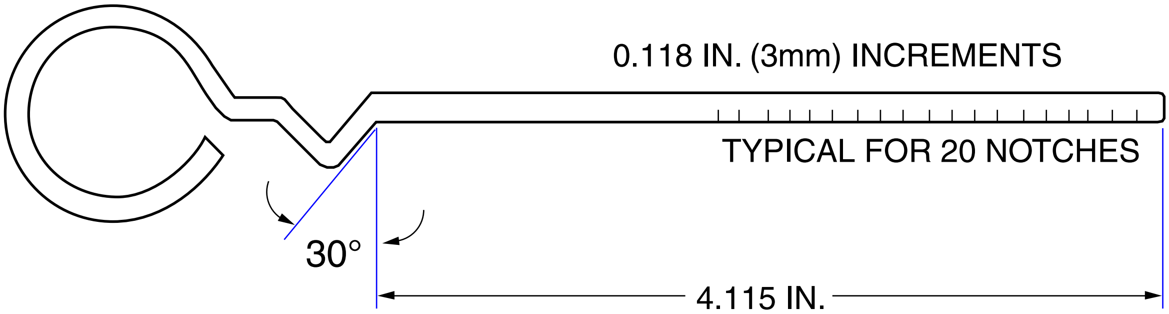
7 Remove dipstick, count notches of oil.

8 Using Chart 8, determine correct oil level.

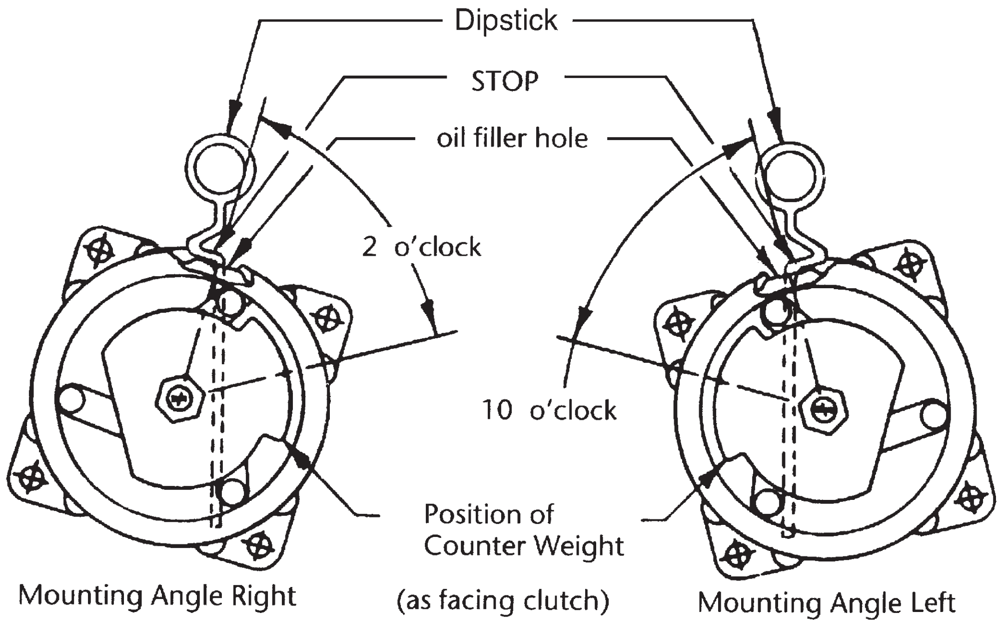
9 If the dipstick measured oil level is not within acceptable limits; add or subtract oil in one ounce increments until the correct level is achieved. Care should be taken to achleve the precise mid-range value. I.E. - if the angle is 20°, the desired oil level is 7.

CHART 8
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



Fabricated Oil Dipstick for Sanden Compressor
Figure 12



Sanden Compressor Oil Measurement
Figure 13

(5) Drive Belt Service.

(a) Replacement (refer to Figure 14).

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.

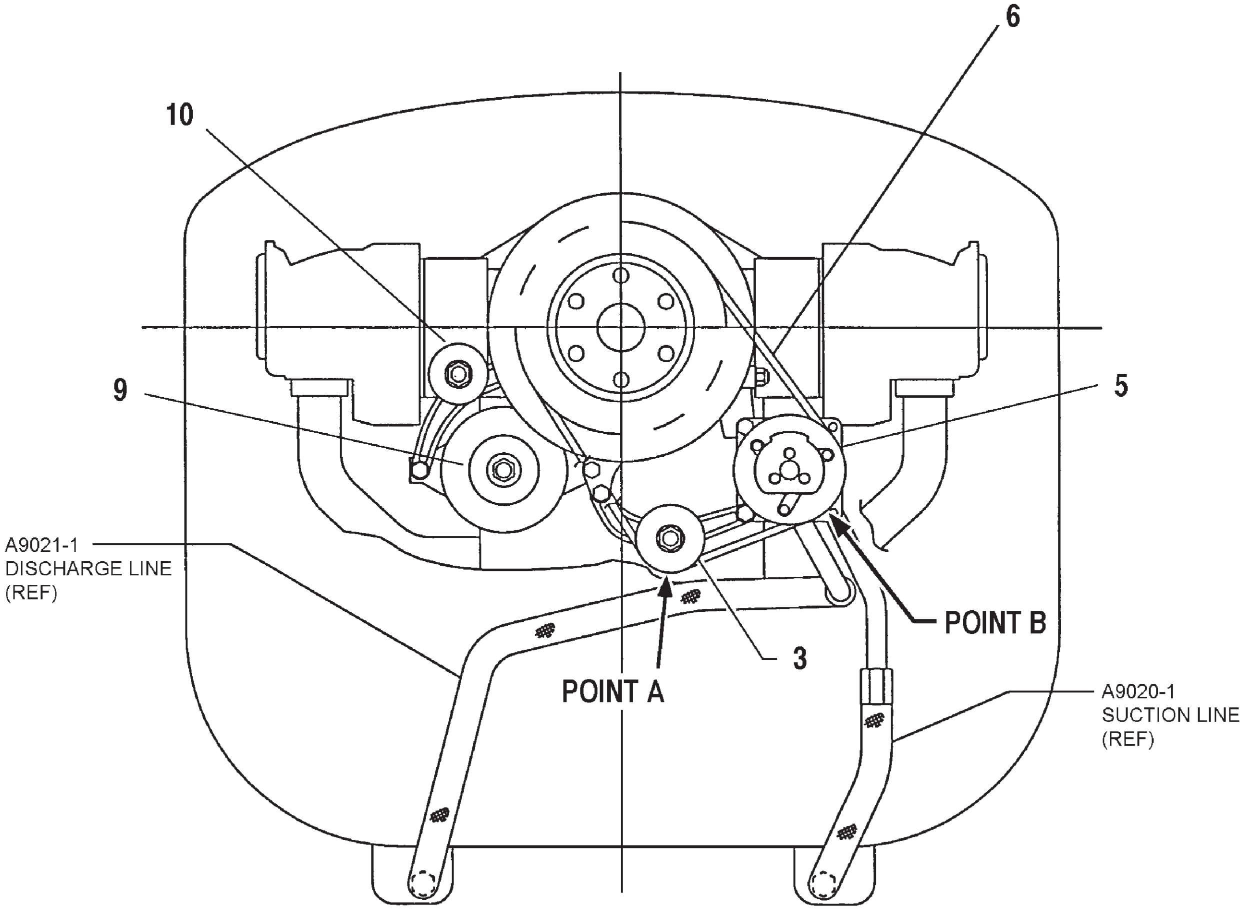
(b) Alignment (refer to Figure 14).

Check and adjust compressor belt and pulley alignment as follows:

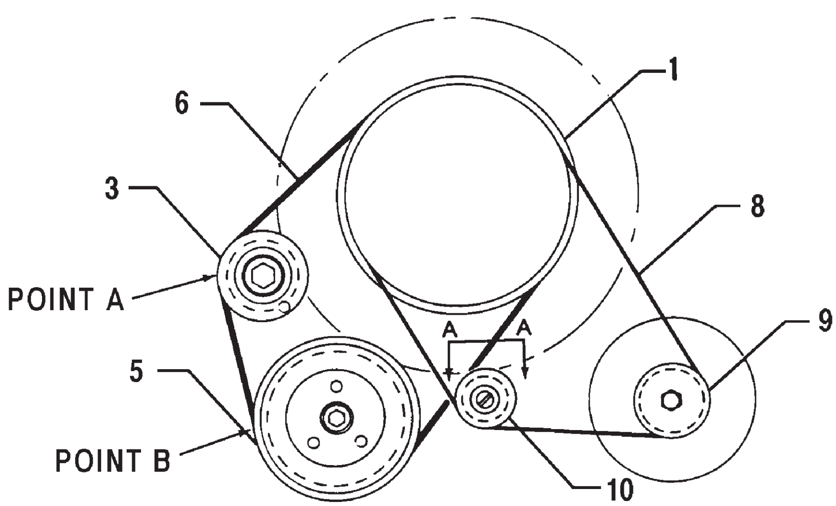
1 Establish a datum line for checking belt and pulley alignment by clamping a straightedge to the forward machined edge of the ring gear.

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.

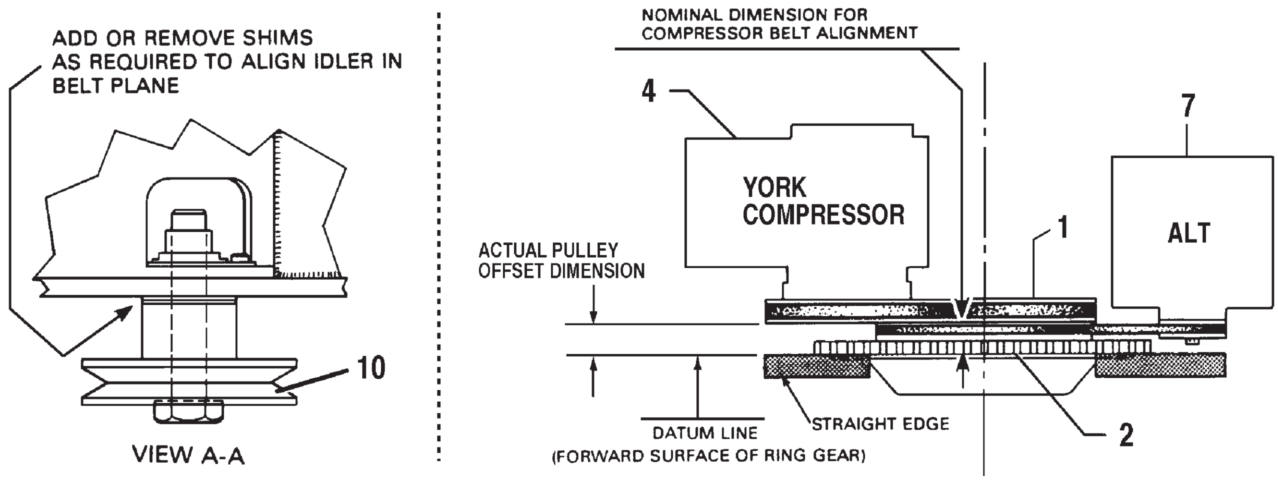


TC S/N's 3257001 & UP and HP S/N's 3246088 & UP

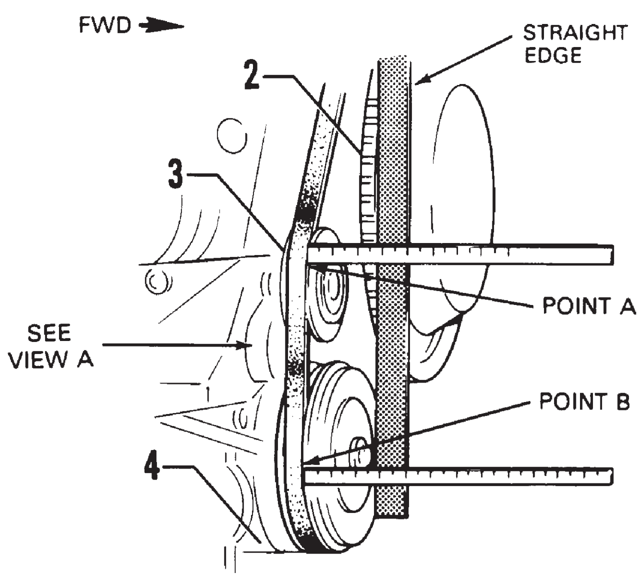


HP S/N's 3246001 THRU 3246087 ONLY

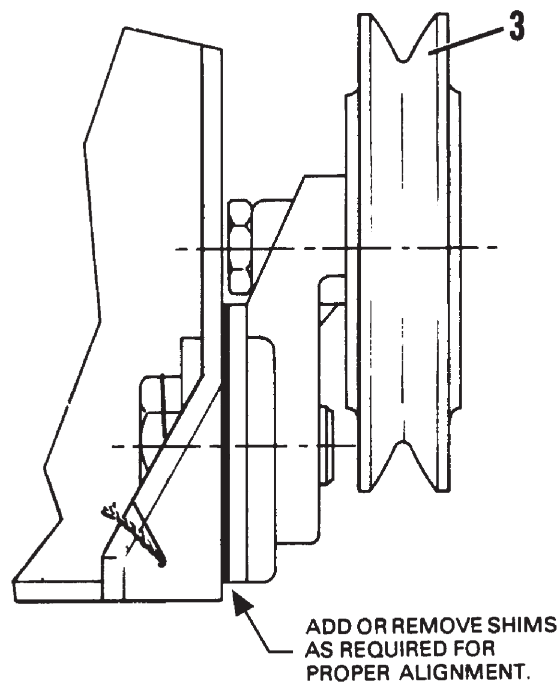
Compressor and Alternator Belt Installation
Figure 14 (Sheet 1 of 2)



HP S/N'S 3246001 THRU 3246087 SHOWN



HP S/N'S 3246001 THRU 3246087 SHOWN
(REPRESENTATIVE OF THE METHOD)



VIEW A
HP S/N'S 3246001 THRU 3246087 SHOWN

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

Compressor and Alternator Belt Installation
Figure 14 (Sheet 2 of 2)

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 Compressor, Installation, above. 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.

a In HP S/N's 3246001 thru 3246087 only: Point-A nominal offset is indicated in Chart 9, based on Point B measured offset. Add or remove shims (P/N 62833-33) as required (see View A, Figure 14 (Sheet 2 of 2)) 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.

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) Alternator Drive Belt Alignment (see Figure 14). 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.

CHART 9
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

(d) Tension Adjustment (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.

(6) Magnetic Clutch

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

1 Removal (ref. Figure 15)

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

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.)

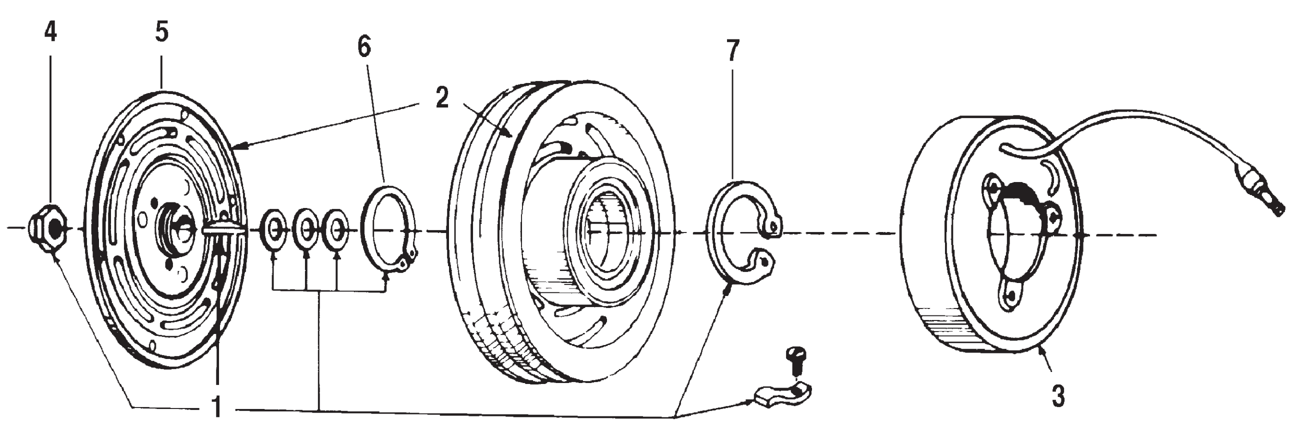
b Insert the two pins of the front plate spanner into any two threaded holes of the clutch front plate. Hold clutch plate stationary. Remove hex nut with 3/4 in. (19mm) socket.

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

Effectivity
3246088 and up;
3257001 and up

Sanden Magnetic Clutch
Figure 15

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 Installation (ref. Figure 15)

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 Magnetic Clutch (HP S/N's 3246001 thru 3246087 only).

1 Removal (ref. Figure 16).

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.

CAUTION: COMPRESSOR SHAFT MUST BE CLEAN AND FREE FROM BURRS.

2 Installation (ref. Figure 16)

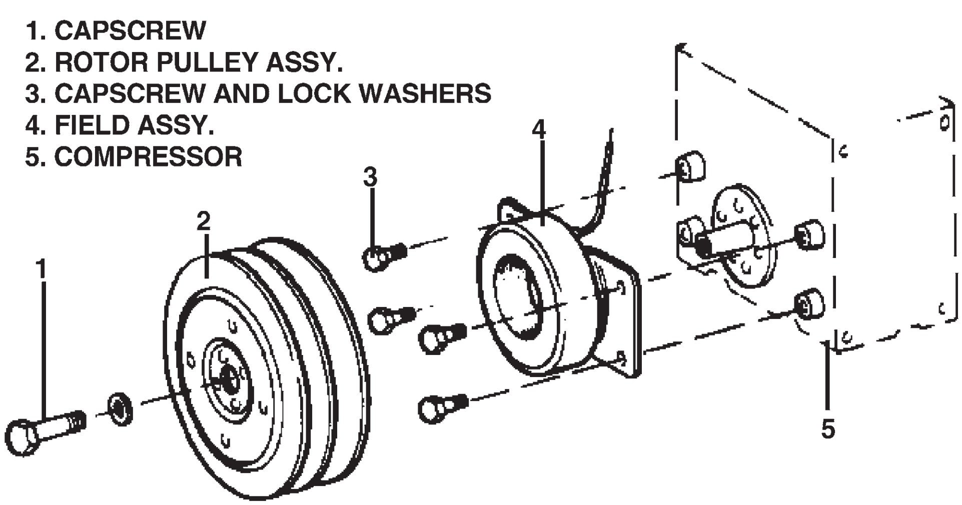
a Position field assembly against the compressor bosses, with electrical leads to cylinder side of compressor.

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.

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



Effectivity
3246001 thru 3246087

York Magnetic Clutch
Figure 16

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.

H. 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.

I. Receiver-Dehydrator

(1) Removal

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.

(a) Discharge system of all refrigerant. (refer to.Servicing the System with a Charging Stand, Discharging.)

(b) Uncouple refrigerant lines at receiver-dehydrator. (Servicing Cooling System, Special Servicing Procedures).

(c) Remove clamp attaching unit to evaporator housing.

(2) Installation

NOTE: On systems utilizing HFC-134a refrigerant, use only receiver-dehydrators marked with a GREEN arrow.

(a) 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.

(b) Replace O-rings on HFC-134a systems.

(c) Tighten fittings to torque listed in Chart 3.

(d) Evacuate and charge system per evacuating the system and charging the system.

J. Condenser

(1) Removal

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

(a) Discharge system (refer to.Servicing the System with a Charging Stand, Discharging).

(b) Remove access panel from aft bulkhead of cabin.

(c) Remove forward cover panel.

(d) Uncouple suction and discharge hoses at condenser fitting. (See special servicing procedures.) Remove hose clamps holding hoses to condenser frame.

(e) Remove AN-3 bolts from upper ends of side hinges and rod ends.

(f) Support condenser assembly and remove bolt attaching actuating rod to condenser assembly.

(g) Lower aft end of assembly on the piano hinge at assembly forward end.

(h) Remove eight screws attaching piano hinge to condenser frame assembly and remove.

(i) To remove condenser core from assembly, remove screws in the side mounting frame.

(2) Installation

(a) Install condenser core to frame assembly with hose fittings forward and RT fitting pointed inboard.

(b) Place condenser and frame assembly to fuselage frame mounting bracket and insert the eight screws into piano hinge.

(c) Attach side hinges, actuating rod, and rig per condenser assembly rigging instructions.

(d) Seal and couple hose fittings (seal with Loctite refrigerant sealant applied to flares only).

(e) 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.

(f) Seal around forward cover panel (and aft cover panel if removed) with Permagum Bead No. 576 purchased from Prestolite Engineering Company (refer Figure 17).

(3) 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,(refer Figure 17) for switch locations.

(4) Condenser Assembly Rigging (refer to Figure 17)

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:

(a) Adjust open limit switch to open condenser door 5.00 ± 0.50 inches measured from leading edge of door to fuselage skin.

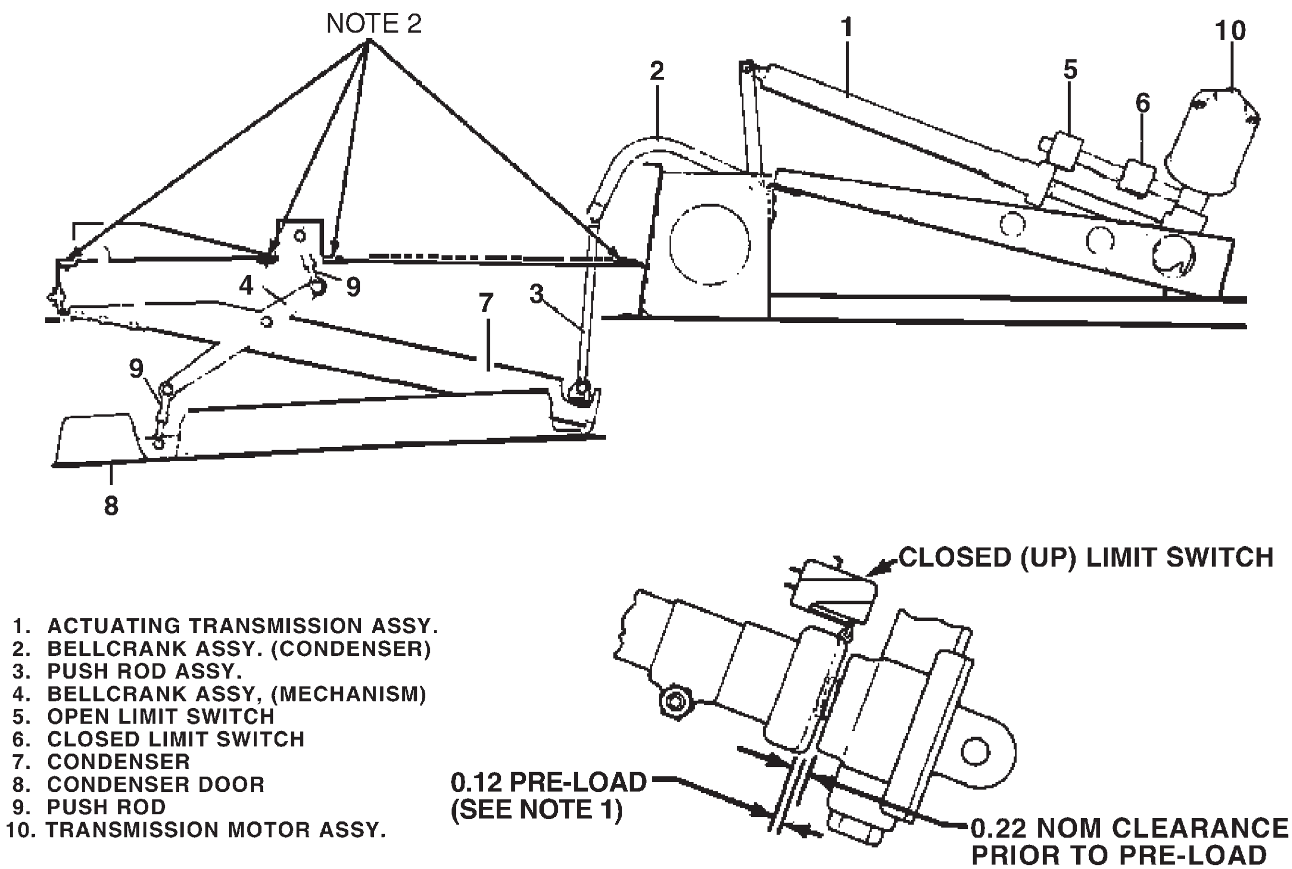
(b) Adjust side push rods so a vertically measured gap of 0.16 inch exists along trailing edge of door the instant forward edge of door is flush with fuselage skin.

(c) 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, refer Figure 17).

(d) Cycle assembly several times. Verify proper operation without binding.

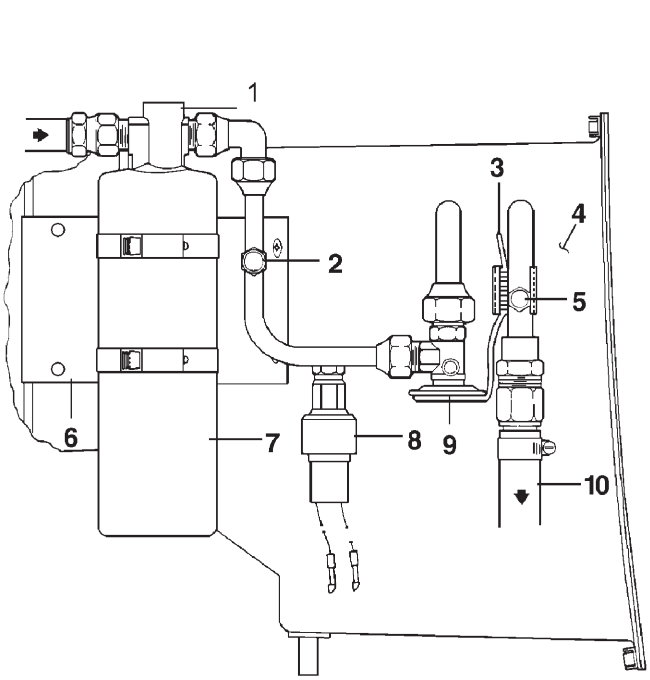
NOTES 99855 AB

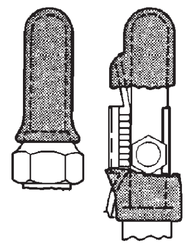
1. WITH DOOR FULLY CLOSED ADJUST "CLOSED" (UP) LIMIT SWITCH SO THAT THE ACTUATOR TRAVELS AN ADDITIONAL 0.12 INCH (PRE-LOAD) AFTER DOOR IS FULLY CLOSED. ADJUST "OPEN" LIMIT SWITCH TO PROVIDE DOOR OPENING OF 5.00 INCHES.
2. SEAL ALL AROUND FORWARD AND AFT COVERS WITH PERMAGUM BEAD NO. 576 PURCHASED FROM PRESTOLITE ENGINEERING COMPANY.



CLOSED LIMIT SWITCH ADJUSTMENT

Condenser Air Scoop Installation
Figure 17





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 4 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

Components Installation
Figure 18

K. Expansion Valve

(1) Removal (refer Figure 18)

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.

(a) Remove access panels, and discharge system (refer to Servicing the System with a Charging Stand, Discharging).

(b) Remove capillary coil from outlet line. (Do not kink capillary tube.)

(c) Uncouple all related tube fittings. (See special servicing procedures.)

(2) Installation

(a) 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 3.

(b) Secure capillary coil to evaporator outlet line.

(c) Evacuate and charge system (refer to Servicing the System with a Charging Stand, Evacuating the System).

(d) Check for leaks (refer to.Servicing the System with a Charging Stand, Leak Detection).

(e) Replace access panels.

L. Evaporator

(1) 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.

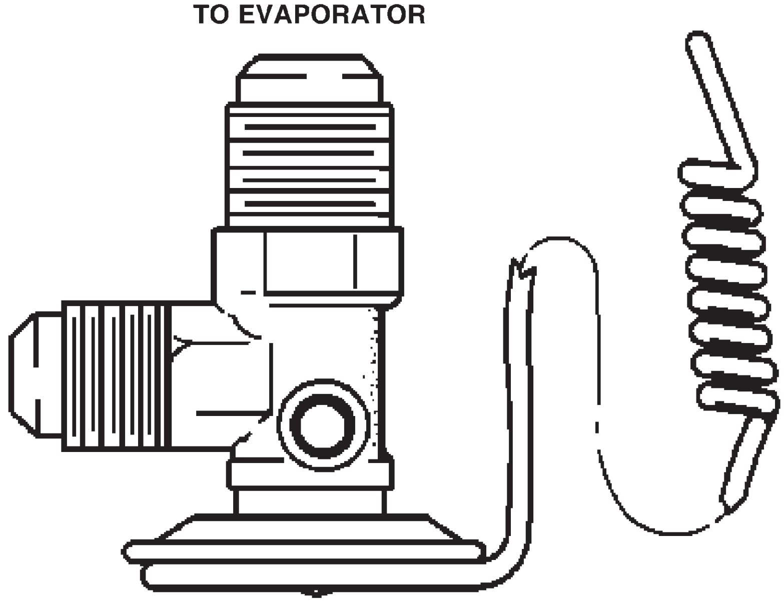
Evaporator assembly is behind cabin rear panel, attached to mounting panel with 12 screws, washers, and a bracket securing the back to mounting panel.

(a) Remove air conditioning filter cover, filter, and rear access panels.

(b) Uncouple the liquid line from inlet side of receiver-dehydrator and suction line from evaporator core outlet (See special servicing procedures).

(c) Disconnect related electrical wires.

(d) Remove flexible air duct from housing outlet and remove drain hose from housing.



Expansion Valve
Figure 19

(e) Remove temperature probe from evaporator housing.

(f) Remove screws attaching support bracket and evaporator housing to mounting panel.

(g) Remove assembly through access hole in bulkhead.

(2) Installation

(a) Cement gasket in place on flanges of evaporator housing and attach large end of mounting gasket to back of housing.

(b) 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).

(c) 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.

(d) Couple suction and discharge lines to their proper fittings (apply Loctite refrigerant sealant to tube flares only).

(e) Evacuate and charge system (refer to Servicing the System with a Charging Stand, Evacuating the System).

(f) Check for leaks (refer to.Servicing the System with a Charging Stand, Leak Detection), if no leaks are detected, seal, and install access panel on evaporator housing.

(g) Couple flexible air duct and drain tube.

(h) Make and check electrical connections (refer to Chapter 91-21-50, Figure 1)

(i) 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.

(j) Install and seal rear bulkhead panels.

M. 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 (Refer to.Servicing the System with a Charging Stand).

N. 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.

(1) 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.

(2) Fuse Replacement

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

(a) Open the fuse holder by applying a slight pushing,, counterclockwise twisting, pressure.

(b) Remove blown fuse and insert a new 5 amp fuse

(c) Close the fuse holder by applying a slight pushing and clockwise twisting pressure.

(3) Electrical Schematic

See 91-21-50, Figure 1.

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CHAPTER

22

AUTOFLIGHT

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CHAPTER 22

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CHAPTER 22 - AUTOFLIGHT

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AUTOPILOT

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

1. General

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 herein.

2. S-TEC System 55/55X

A. S-TEC System 55

This system was adopted in 1999 and is installed in:

(1) Saratoga II HP S/N's 3246126 thru 3246181 only.

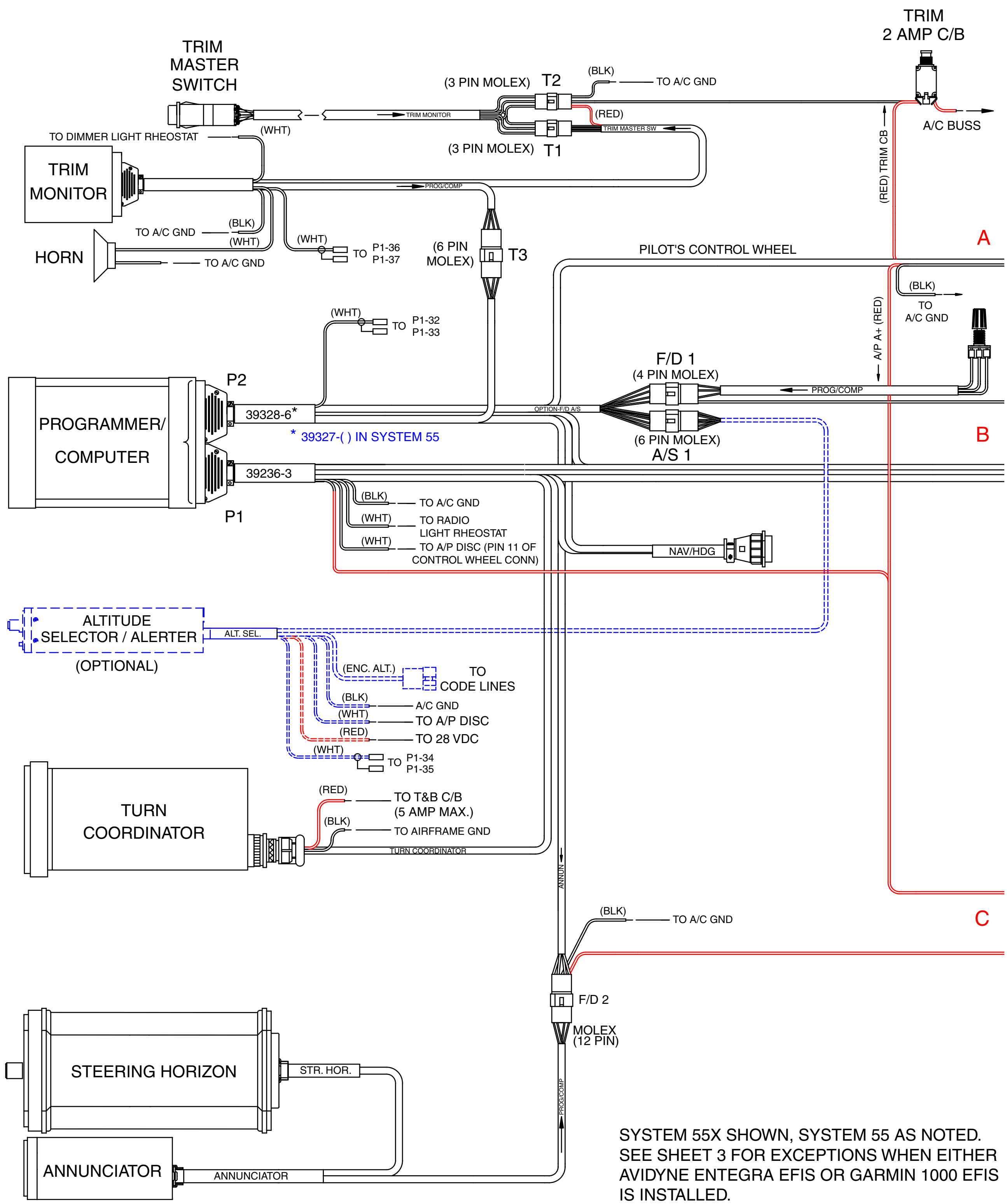
(2) Saratoga II TC S/N's 3257076 thru 3257198 only.

B. S-TEC System 55X

This system was adopted in 2001 is installed in:

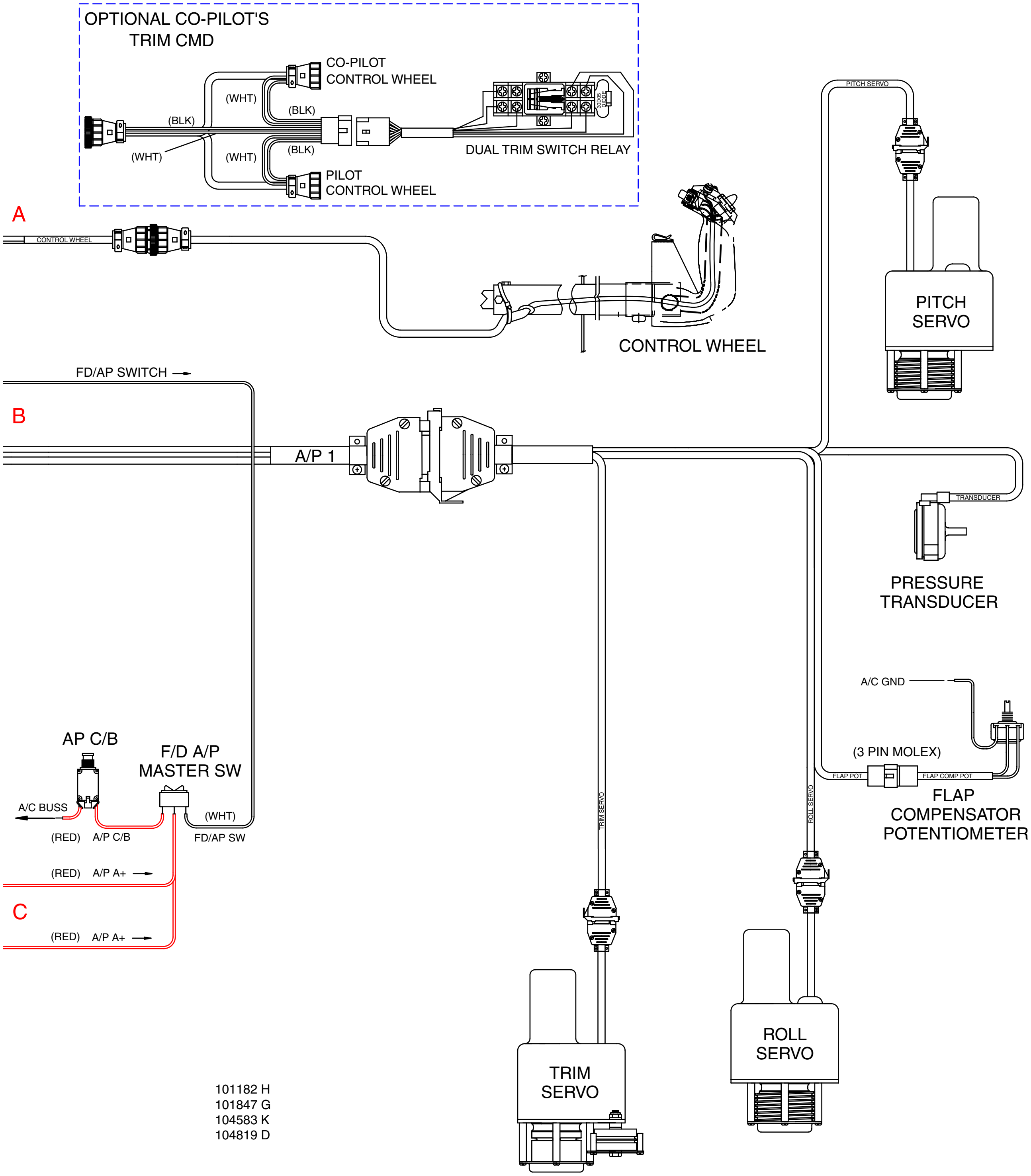
(1) Saratoga II HP S/N's 3246182 and up.

(2) Saratoga II TC S/N's 3257199 and up.



Effectivity
3246126 and up
3257076 and up

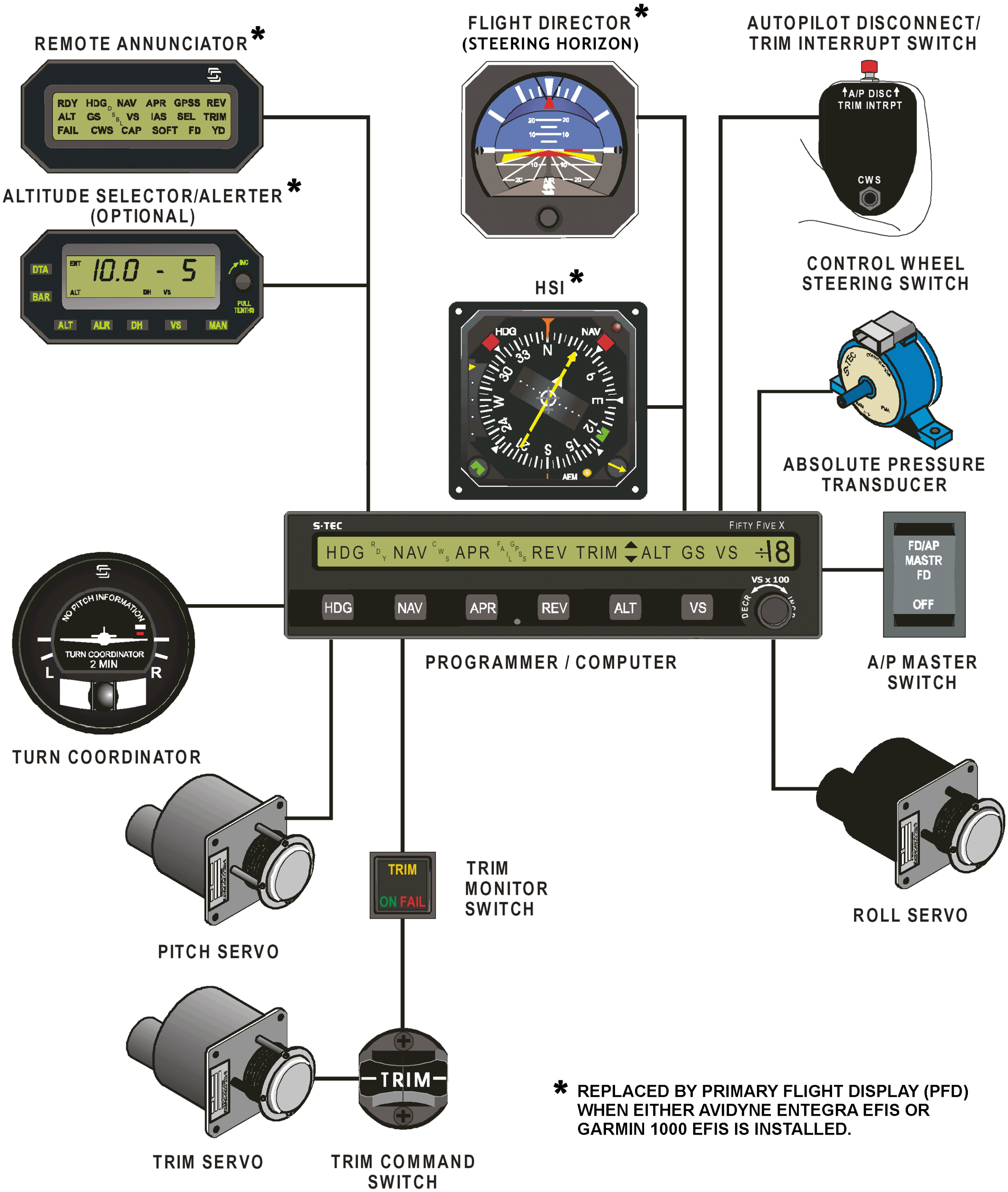
System 55/55X Autopilot Installation
Figure 1 (Sheet 1 of 3)



INTERNATIONAL AEROTECH ACADEMY FOR TRAINING PURPOSES ONLY

System 55/55X Autopilot Installation
Figure 1 (Sheet 2 of 3)

Effectivity
3246126 and up
3257076 and up



* REPLACED BY PRIMARY FLIGHT DISPLAY (PFD) WHEN EITHER AVIDYNE ENTEGRA EFIS OR GARMIN 1000 EFIS IS INSTALLED.

Effectivity
3246126 and up
3257076 and up

System 55/55X Autopilot Installation
Figure 1 (Sheet 3 of 3)

C. 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:

(1) Panel Mounted:

Programmer/Computer, Turn Coordinator, Annunciator, D.G. or HSI, and Steering Horizon.

(2) Remote Mounted:

Roll Servo, Pitch Servo, Trim Servo, Trim Monitor, A/P Disconnect switch, and Altitude (Pressure) Transducer.

Servo installations use aluminum brackets to secure the servos to the airframe. Attachment to the airplane's primary flight control and trim systems is accomplished with bridle cables and extension attachments.

D. Troubleshooting

System functionality can be determined using functional checks described in the AFM Supplement and autopilot Pilot's Operating Handbook. More detailed troubleshooting should be accomplished by authorized S-TEC Dealers, holding the appropriate FAA certification, with required test equipment and service data.

E. GPSS (System 55X only.)

The Global Positioning System Steering (GPSS) is a function of the 55X autopilot only. In the GPSS mode, the converter receives ground speed and bank angle digital signals that are calculated and converted to a commanded turn rate. The turn rate is then scaled and converted to a DC heading error signal that is compatible with S-TEC autopilots. The end result is an autopilot that can be directly coupled to the roll steering commands produced by the GPS Navigator, eliminating the need for the pilot to make any further adjustments to the HSI course arrow or the DG's heading bug.

F. System Operation

Operation of the autopilot and other systems is described in the FAA-approved Airplane Flight Manual Supplement (AFMS) - see airplane Pilot's Operating Handbook (POH), Section 9. Specialized controls, annunciation, operation and interpretation are covered in this supplement and in the S-TEC Autopilot POH that supplements the approved AFMS.

G. Maintenance

Except as provided in 5-20-00, servicing and/or maintenance of the autopilot system is On-Condition.

NOTE: Servicing of S-TEC System 55/55X Autopilot installations is best accomplished by approved S-TEC dealers holding the appropriate FAA-certification. Locations of and access to the components installed are described and depicted individually below. Removal and replacement of components is generally indicated by functional checks provided in the AFM Supplement,S-TEC Autopilot POH and/or below.

H. Post-Maintenance Operational Checkout (Ref. S-TEC Report No. 81191, Rev. 1.)

Standard and Avidyne Entegra EFIS equipped airplanes complete the following checkout procedure after any maintenance to the system is performed.

Airplanes equipped with the Garmin 1000 EFIS complete the “S-TEC 55X Interface” procedure in 34-20-00 under Electronic Flight Instrument System (EFIS) - Garmin 1000, Post-Installation Setup, System Testing and Checkout.

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 Avidyne Entegra EFIS, (see 34-20-00) references below to the remote annunciator, flight director and HSI are to those functions in the Primary Flight Display (PFD).

(1) Apply aircraft power.

(2) Avionics Master Switch — ON

(3) Autopilot Master Switch — Set to FD / AP

NOTE: Observe that all segments of the Programmer / Computer display and annunciators illuminate for five (5) seconds during test. Satisfactory completion of the SELF-TEST is indicated when the Ready (RDY) annunciator remains on at the end of the five (5) second self-test. Should a fault be detected, the FAIL annunciator will remain on at the conclusion of the self-test and the autopilot will not operate.

(4) Trim Master (ON / OFF) Switch — ON

(5) HDG and VS switches — PRESS / RELEASE

Ensure that HDG and VS illuminate on the Fifty Five X annunciator.

(6) VS Knob — ROTATE CW

Pitch control (i.e. - the control yoke) should move slowly out (pilot may have to assist a heavy yoke).

(7) VS Knob — ROTATE CCW

Pitch control should move slowly in.

(8) A/P DISC Trim Interrupt Switch (on control yoke) — PRESS

Verify the autopilot disconnects.

(9) HDG Mode — ENGAGE

(10) DG or HSI HDG bug MOVE LT / RT

Roll control should follow the HDG bug.

NOTE: If HSI equipped, center the course arrow under the lubber line and push the NAV button. Move the course arrow on the HSI left then right. Roll control should follow the course arrow. Channel a valid VOR signal and move course arrow just enough to deflect the left / right needle one (1) or two (2) dots. Roll control should follow the Course Deviation Indicator (CDI) left / right needle during the test. (This test is only valid if the left / right needle is centered with the course arrow under the lubber line.)

NOTE: If DG equipped, center the HDG bug under the lubber line. Channel a valid VOR signal. Move the OBS to cause left / right CDI needle deflection. The roll control should follow the left / right needle movement.

(11) REV Mode button PUSH

Roll control should respond opposite to the course arrow and CDI left / right needle inputs.

(12) Altitude Hold (ALT) button PUSH

Slowly pull out (nose up) on the pitch control (i.e. - control yoke). Autotrim should run nose down with TRIM flashing on the remote annunciator and the autopilot computer / programmer after approximately 3 seconds. Slowly move control yoke forward (nose down). After 3 seconds, autotrim should move nose up with TRIM flashing on the remote annunciator and the autopilot computer / programmer after approximately 3 seconds.

(13) Trim Master (ON / OFF) Switch OFF

(14) Manual Electric Trim Test:

(a) Trim Master (ON / OFF) switch ON

1 Move each segment of the Manual Electric Trim Command Switch FWD and AFT.
Trim should not run.

2 Move both segments of the Trim Command switch FWD.
Trim should run nose down.

3 Move both segments of the Trim Command switch AFT.
Trim should run nose up.

(b) Re-trim aircraft for takeoff and check controls for freedom of movement. Be sure the autopilot and trim servos are dis-engaged.

(15) Flight Director Test:

(a) 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.

(b) HDG Mode ENGAGE

MOVE HDG bug 45 degrees left. The roll steering bar should slowly indicate a left steering command. Repeat the same test for the right side.

(c) VS Mode ENGAGE

SELECT 1500 FPM rate of climb. Note the pitch steering bar moves slowly up. Repeat the same test for the down direction.

(d) Autopilot Master Switch SELECT FD / AP

The servos should re-engage.

(e) Trim Master ON / OFF Switch ON

(f) Manual Electric Trim Command Switch MOVE FWD or AFT

The autopilot should disconnect.

NOTE: The Manual Electric Trim Command Switch will disconnect the autopilot only if there is a Pitch Mode engaged.

I. 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.

J. Component Locator

See Figure 2.

K. Trim Monitor (See Figure 2.)

The trim monitor is mounted on the left side of the fuselage under the instrument panel.

(1) Removal

(a) Disconnect autopilot harness.

(b) Remove screws (4) holding trim monitor to mounting bracket and remove trim monitor.

(2) Installation

(a) Place trim monitor in position on mounting bracket and secure with screws (4).

(b) Connect autopilot harness.

(c) Perform Post-Maintenance Operational Checkout, above.

L. 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.

(1) Removal

(a) Remove the Ty-Rap and disconnect the transducer from the static-system by removing the flexible hose.

(b) Disconnect the autopilot harness.

(c) Remove screws and washers (2 ea.) and remove transducer.

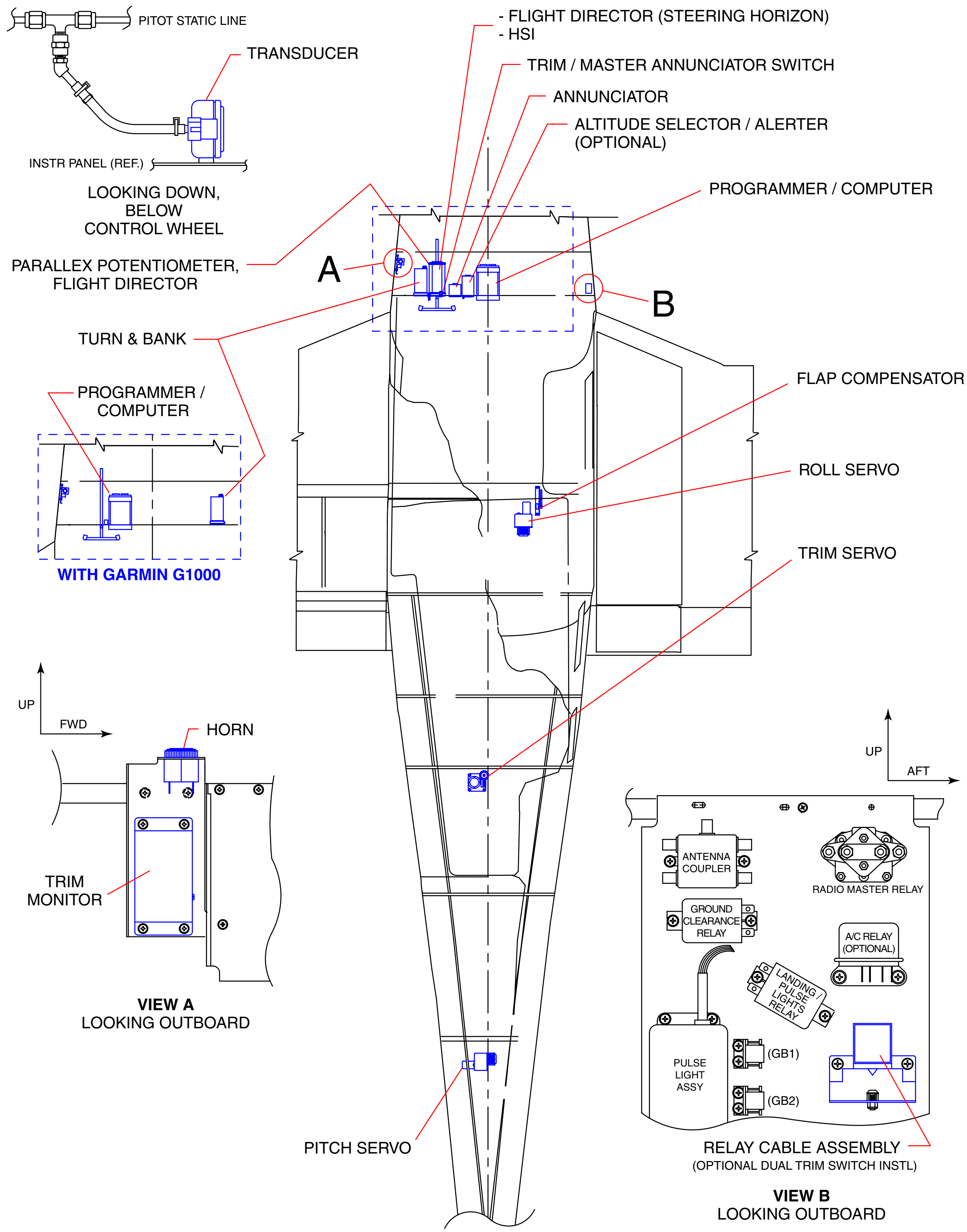
(2) Installation

(a) Place transducer in position. Secure transducer to instrument panel with screws and washers (2 ea.)

(b) Connect the transducer to the static system by sliding the flexible hose over the hose barb. Then position and tighten Ty-Rap.

(c) Connect the autopilot harness.

(d) Perform Post-Maintenance Operational Checkout, above.



Effectivity
3246126 and up
3257076 and up

Component Locator
Figure 2

M. 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.

(1) Removal

(a) Remove the aft facing passenger seat or entertainment cabinet, whichever is installed.

(b) Remove adjacent carpet.

(c) Remove screws securing floor panel and remove panel.

(d) Disconnect autopilot harness.

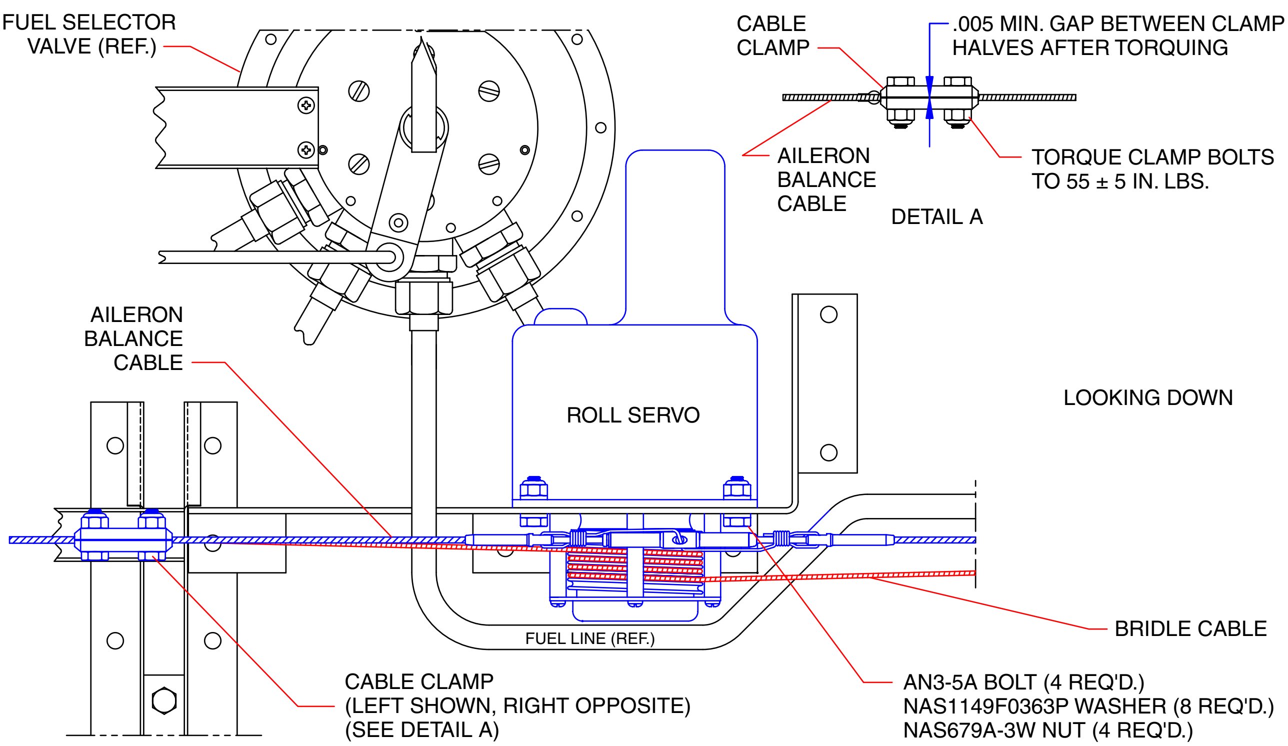
(e) Remove nuts and bolts (2 ea.) securing each cable clamp (2) and remove cable clamps from aileron balance cable and autopilot bridle cable.

(f) Remove nuts and bolts (4 ea.) and washers (8 ea.) securing roll servo to mounting bracket and remove roll servo with attached bridle cable.

(2) Installation

(a) Rig ailerons per Aileron Control Rigging and Adjustment, 27-10-00.

(b) 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.



Effectivity
3246126 and up
3257076 and up

Roll Servo Installation
Figure 3

(c) 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.

(d) Remove screws (4) and remove capstan cover and cable guards from servo.

(e) Adjust roll servo clutch torque per Servo Clutch Torque Adjustment, below.

(f) Wrap autopilot bridle cable, align capstan, and and tighten center-ball setscrew as shown in Figure 4.

(g) Replace cable guards and capstan cover, secure with screws (4).

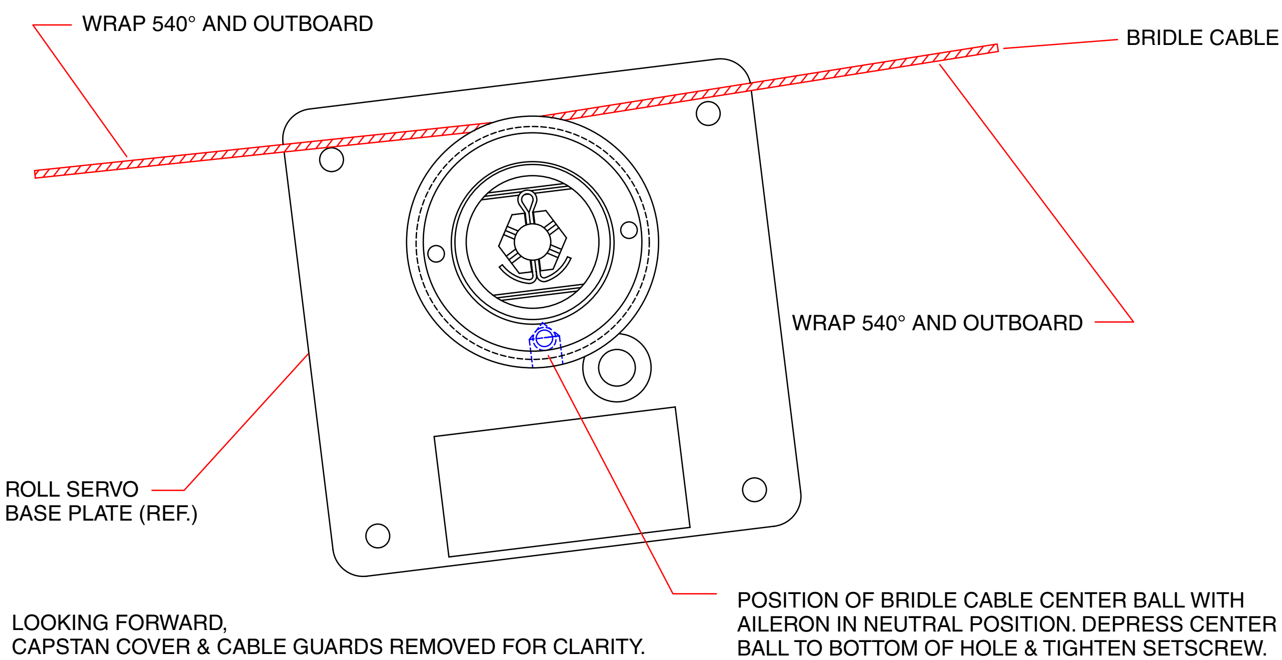
(h) Position servo as shown in Figure 3 and install and secure nuts (4 ea.) , washers (8 ea.) , and bolts (4 ea.) holding servo to mounting bracket.

(i) Position cable clamps (2) as shown in Figure 3 and tighten nuts and bolts (2 ea.). Adjust cable clamps in or out along the aileron 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.

(j) Remove the locking fixtures at the inboard ends of the ailerons. 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.

(k) 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.

(l) 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.



Effectivity
3246126 and up
3257076 and up

Roll Servo Capstan Wrapping
Figure 4

(m) 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:

1 Center bubble of a protractor over surface of aileron at neutral position. Note reading.

2 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.

(n) If steps (j) thru (m), above, reveal the aileron controls out of rig, repeat steps (a) thru (i).

(o) Connect autopilot harness.

(p) Check aileron controls for free and correct movement.

(q) Perform Post-Maintenance Operational Checkout, above.

(r) Replace floor panel and secure with screws.

(s) Replace carpeting.

(t) Replace the aft facing passenger seat or entertainment cabinet, whichever was installed.

N. 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.

(1) Removal

(a) Remove rear seats. Remove cabin rear closeout panel. Remove baggage compartment carpet and floor.

(b) Tie a pull rope to the left trim cable exposed beneath the baggage compartment floor and tie-off the pull rope to structure aft.

(c) 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.

(d) 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.

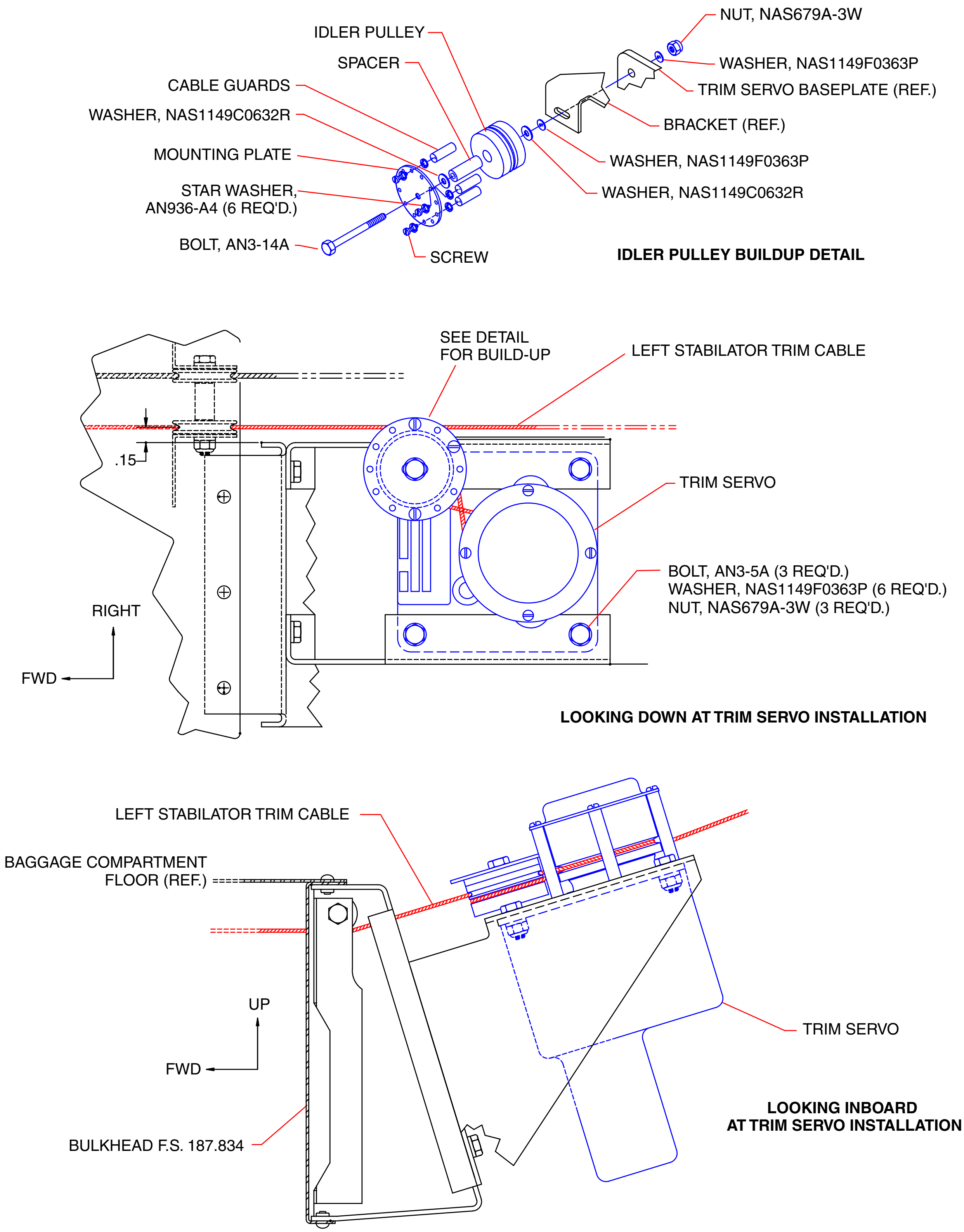
(e) Disconnect the autopilot harness.

(f) Remove the capstan cover and cable guards (4) by removing the retaining screws (4).

(g) 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.

(h) Remove the remaining bolts, nuts, and washers (3 ea.) securing the trim servo to its mounting bracket and remove the trim servo.



Effectivity
3246126 and up
3257076 and up

Trim Servo Installation
Figure 5

(2) Installation

(a) Adjust trim servo clutch torque per Servo Clutch Torque Adjustment, below.

(b) 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).

(c) 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.

(d) Drape the slack left trim cable over the servo capstan.

CAUTION: IN STEPS (e) THRU (i), 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.

(e) 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.

(f) Holding the trim cable in that position, install the capstan cover and cable guards as shown in Figure 5.

(g) Hold the idler pulley aft of the trim servo and to the right of the airplane'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.

(h) 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.

(i) 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.

(j) Place the spacer inside the idler pulley.

(k) Position the mounting plate/cable guard/bolt assembly as shown in Figure 5 and slide the bolt through the spacer inside the idler pulley.

(l) 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.

(m) Take up the slack in the left trim cable with the turnbuckle and remove the pull ropes.

(n) Rig stabilator trim per Stabilator Trim Rigging and Adjustment, 27-30-00.

(o) Connect the autopilot harness.

(p) Perform Post-Maintenance Operational Checkout, above.

(q) Check elevator trim controls for free and correct movement.

(r) Reinstall baggage compartment floor and carpet, and cabin rear closeout panel.

(s) Reinstall rear seats.

O. 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.

(1) Removal

(a) Attach a tail stand under the tail skid.

(b) Remove the cabin rear closeout panel.

(c) Crawl into the tailcone until the pitch servo is accessible.

(d) Disconnect autopilot harness.

(e) 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.

(f) Remove cotter pin from bridle cable pulley and pull upper portion of bridle cable free of the pulley.

(g) Remove nuts and bolts (4 ea.) and washers (8 ea.), securing pitch servo to mounting bracket and remove pitch servo with attached bridle cable.

(2) 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 enhanced accessibility, 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

(a) Rig stabilator controls per Stabilator Controls Rigging and Adjustment, 27-30-00.

(b) Remove screws (4) and remove capstan cover and cable guards from servo.

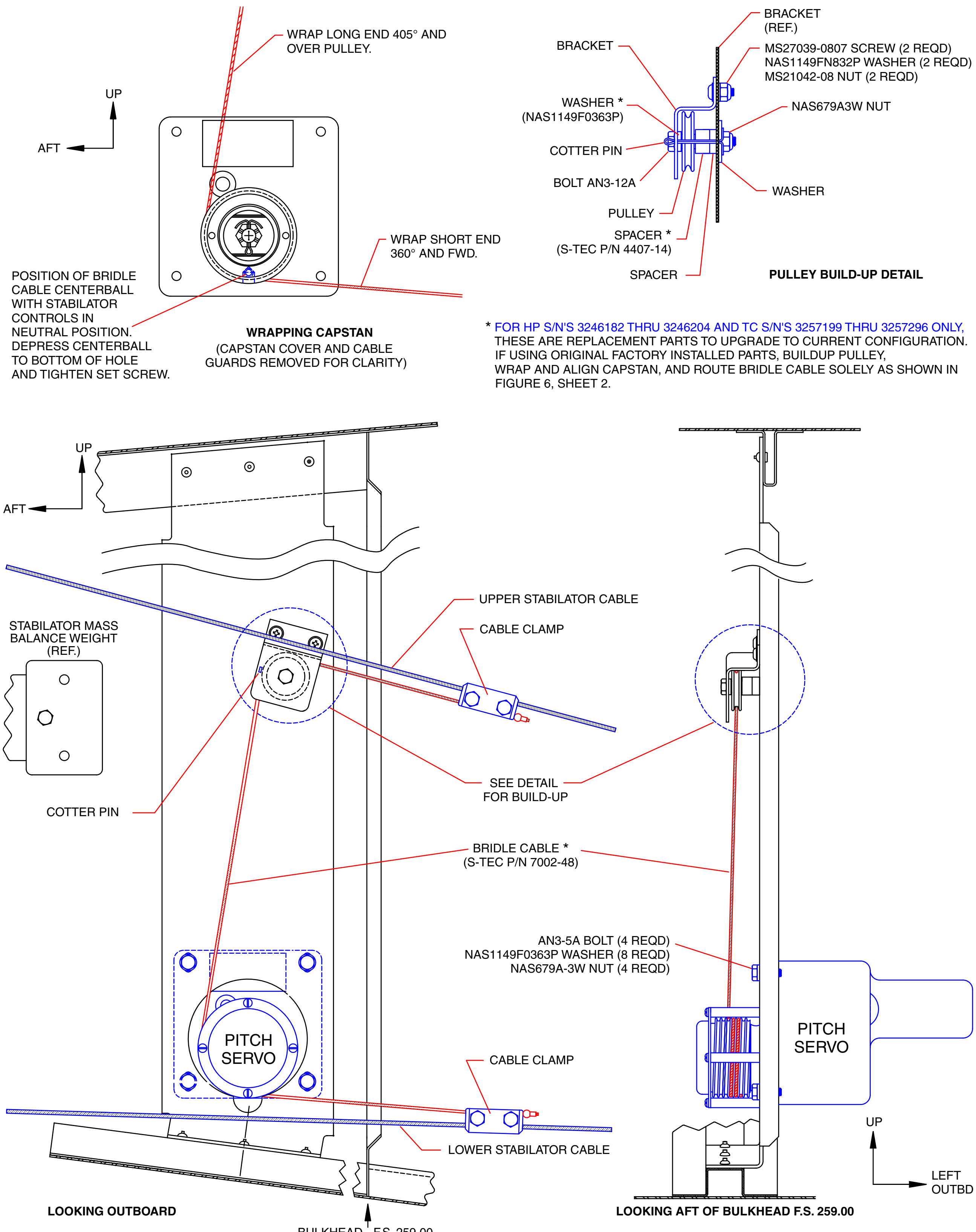
(c) Adjust pitch servo clutch torque per Servo Clutch Torque Adjustment, below.

(d) 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.

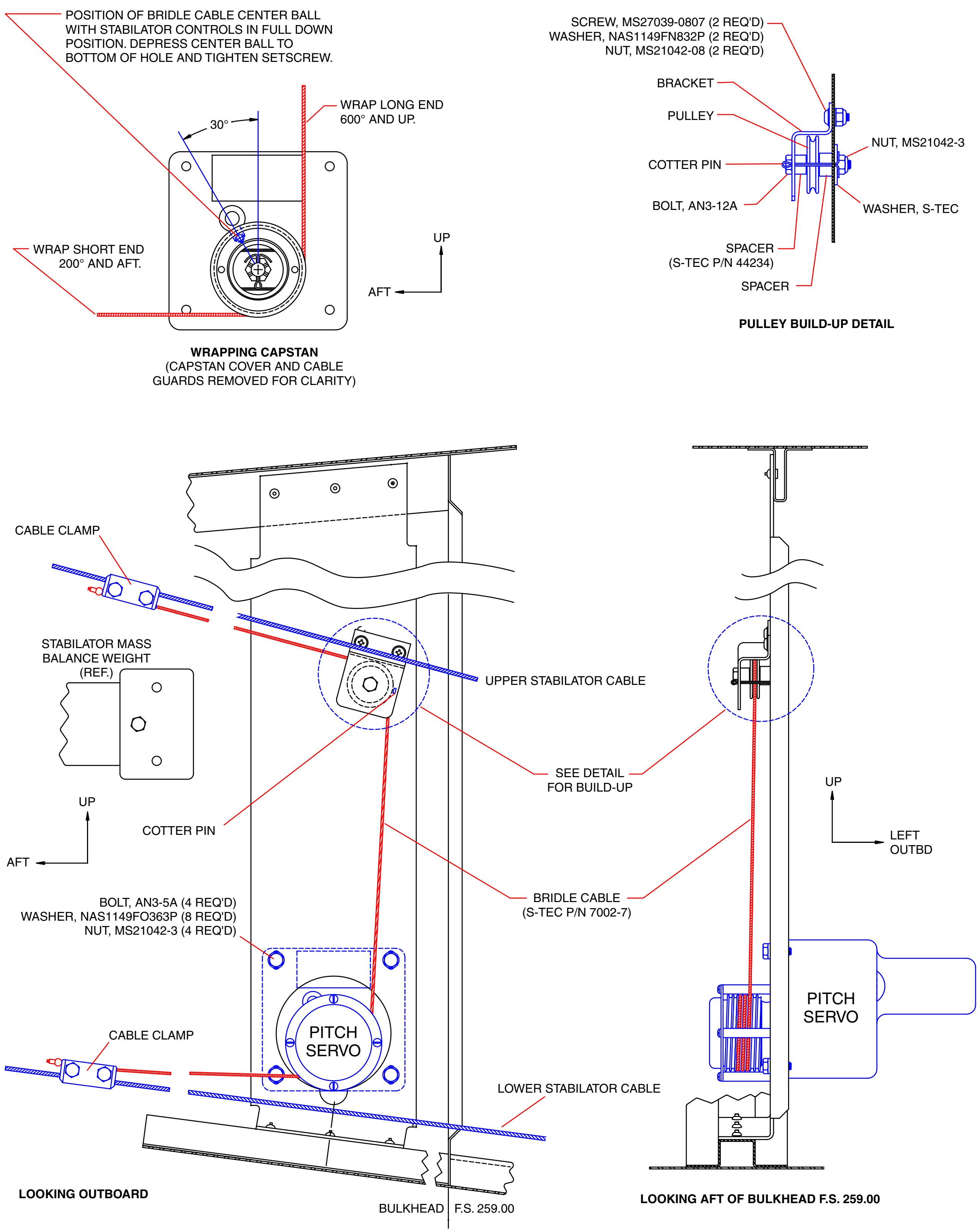
(e) Replace cable guards and capstan cover, secure with screws (4).

(f) Position pitch servo as shown in Figure 6 and secure with bolts, nuts, and washers (4 ea.)



Effectivity
3246182 and up
3257199 and up

Pitch Servo Installation
Figure 6 (Sheet 1 of 2)



Pitch Servo Installation
Figure 6 (Sheet 2 of 2)

Effectivity
3246126 thru 3246181
3257076 thru 3257198

(g) 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.

(h) 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.

(i) Connect autopilot harness.

(j) Perform Post-Maintenance Operational Checkout, above.

(k) Check stabilator controls for free and correct movement.

(l) Reinstall and secure the cabin rear closeout panel.

(m) Remove tail stand.

P. Servo Clutch Torque Adjustment (See Figure 7 and Chart 1.)

(1) Remove servo per instructions under specific servo, above.

(2) Place servo in a holding fixture (i.e. - vice) with capstan up.

(3) Remove capstan cover, cable guards, and cable.

(4) 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.

(a) Acceptable torque is specified in Chart 1.

(b) If adjustment is required, proceed as follows.

(5) Remove cotter pin from end of servo shaft and remove castle nut, shim washers, and tension washers.

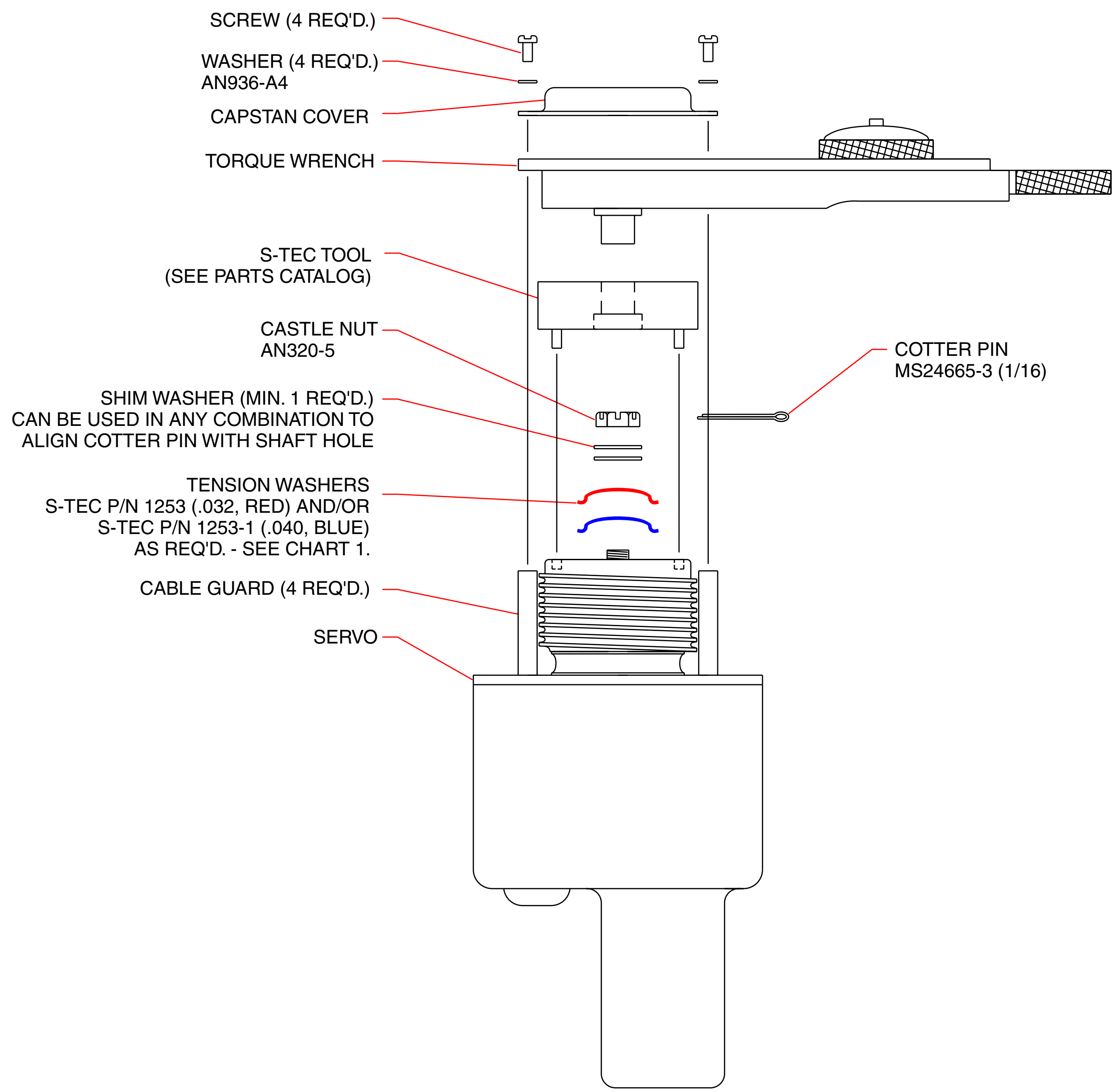
(6) Replace tension washers as required (see Chart 1).

(7) Replace shim washers and castle nut.

(8) 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



Servo Clutch Torque Adjustment
Figure 7

Effectivity
3246126 and up
3257076 and up

Q. 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 torque tube by a cable assembly.

(1) Adjustment

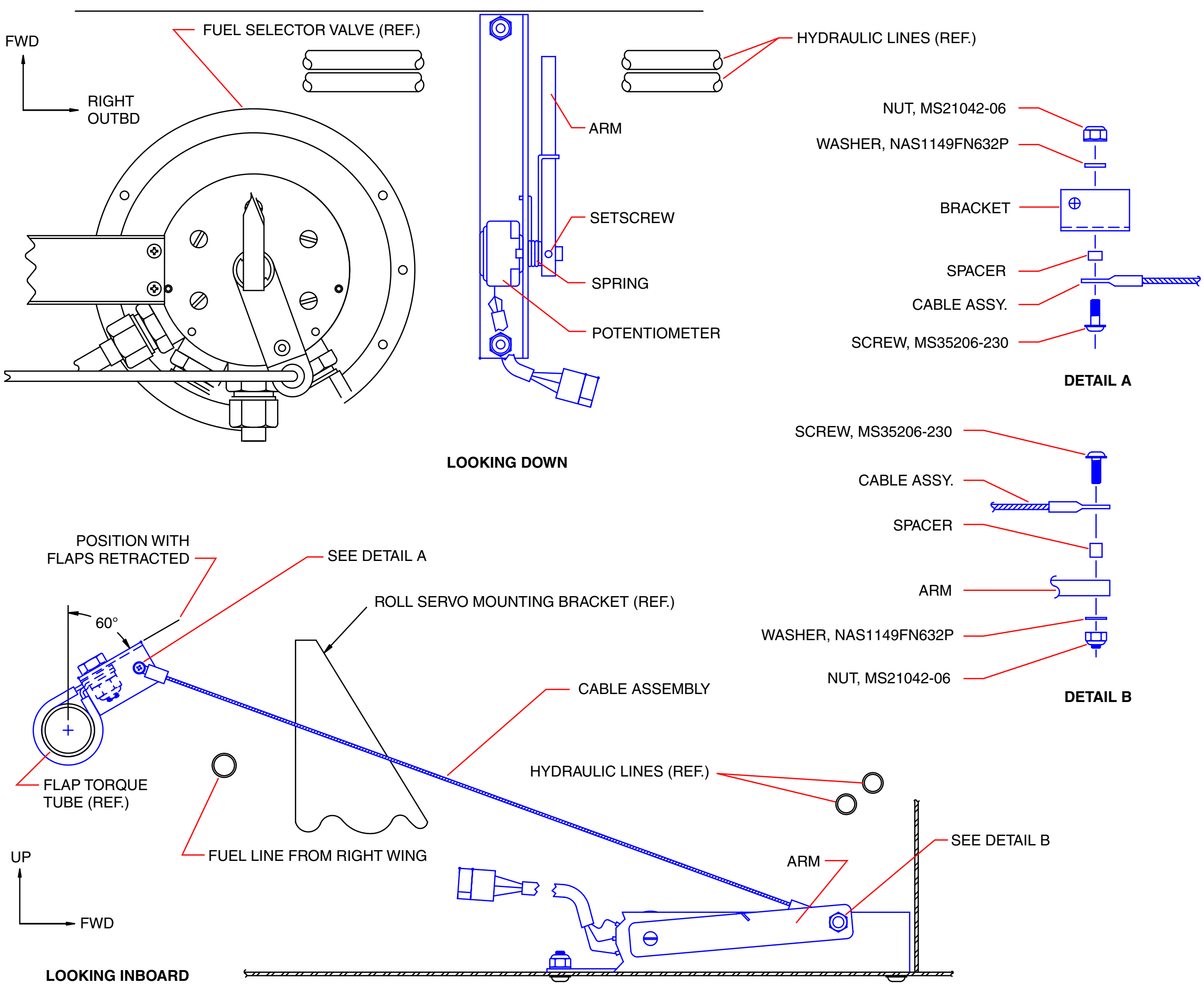
(a) With flaps in the full up position and set screw loose, turn A/P master switch ON.

(b) Connect a digital voltmeter (3 1/2 digit) between airframe ground and center terminal (wiper) of potentiometer (pot).

(c) Turn pot shaft clockwise to stop. Voltmeter should read 5.00 vdc.

(d) Turn pot shaft slowly counter-clockwise until voltage just starts to decrease from 5.00 volts.

(e) Tighten set screw and recheck wiper voltage for 4.95 to 5.00 vdc.



Effectivity
3246126 and up
3257076 and up

Flap Compensator Installation
Figure 8

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CHAPTER

23

COMMUNICATIONS

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CHAPTER 23

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CHAPTER 23 - COMMUNICATIONS

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GENERAL

Radio Master Switch (See 91-23-00, Figure 1.)

A separate master switch for the radios is located in the switch panel in the center of the instrument panel. Both this switch and the battery master switch must be “ON” for the radios to operate.

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AUDIO INTEGRATING

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. Garmin GMA-340 Audio Control Panel

The Garmin GMA-340 Audio Panel is installed as standard equipment in HP S/N's 3246182 and up; and TC S/N's 3257199 and up. It integrates the audio switching, amplifier, and intercom system with a marker beacon receiver. Maintenance of the GMA-340 is "on condition" only and, with the exception of swapping complete units, should be performed only by a qualified avionics shop in accordance with the GMA-340 Audio Panel Maintenance Manual (Garmin P/N 190-00149-02).

Information provided in this manual is intended to aid the removal and installation of the GMA-340 unit and its associated wiring and to permit basic system functional test and adjustment.

A. Removal and Installation (See Figure 2.)

See Rack-Mounted Avionics, Removal and Installation, 39-10-00.

B. System Functional Test (See Figure 1.)

(1) On Ground

The following known good equipment is required prior to performing this test: microphone, headset, speaker and avionics receivers.

(a) Lamp Test

1 Apply power to the unit by rotating the pilot intercom knob clockwise.

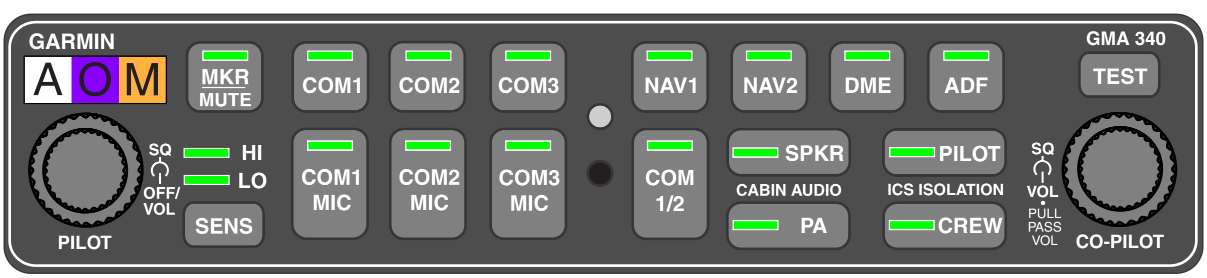
2 The test button checks the internal LED annunciator and marker beacon lamps. Press TEST to confirm operation of the LED's. Cover the photocell with a finger and observe that the LED annunciators dim automatically. Check the front panel back-lighting and dimming function. Each annunciator contains a lamp for illumination.

(b) Fail-safe Operation Check

1 Turn the unit off by rotating the pilot intercom knob counterclockwise.

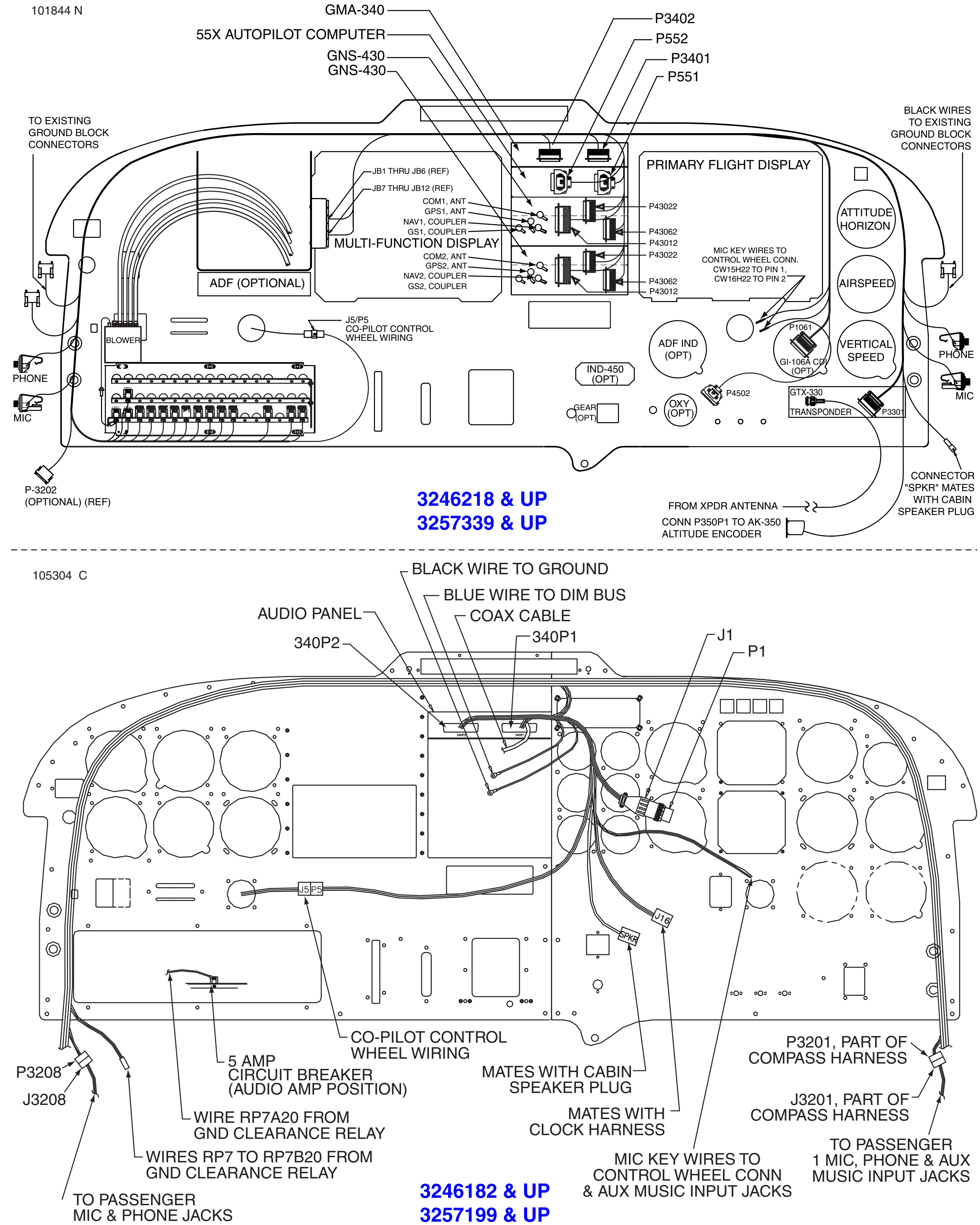
2 Check fail-safe operation by exercising the COM 1 microphone, microphone key and audio over the headphones.

3 Turn the unit back on to continue testing.



GMA-340 Audio Panel
Figure 1

Effectivity
3246182 and up
3257199 and up



Avionics Installation
Figure 2

(c) Transceiver Operational Check

1 Perform a ramp test radio check by exercising the installed transceivers, microphone, microphone key and audio over the headphones and speaker.

2 Verify that communications are loud and clear and push-to-talk (PTT) operation is correct.

(d) Intercom System (ICS) Check

1 Set the intercom to the ALL mode (Crew and Pilot LED's off).

2 Plug in headsets at each ICS position.

3 Adjust squelch and volume for each position and verify that the ICS is working properly.

4 Check Pilot and Copilot ICS positions for isolation and proper operation of volume and squelch controls.

5 Press the PA button. Verify that microphone audio is heard over the speaker.

(e) Aircraft Receivers Check

1 Select the audio source corresponding to each installed avionics unit and check for audio over the headsets.

2 Check for Pilot/Copilot audio isolation when pressing the COM 1/2 button.

3 Press the SPKR button and verify that any selected audio is heard over the speaker.

(f) Music System Check

Connect a stereo music source to MUSIC 2. Press the CREW button to set the ICS to the crew mode. Verify that stereo audio is heard in the passenger headsets only.

(2) In Flight

Verify proper operation of the marker lamps and marker audio, including the marker audio mute function. Check proper operation of the marker sensitivity selection (using the SENS button) by flying towards the outer marker position initially using HI sensitivity. When the OM audio is just barely audible in the headset, switching to LO sensitivity should reduce or eliminate the audio.

C. Adjustment (See Figure 3.)

CAUTION: USE ONLY A 2 MM (MAX BLADE WIDTH) FLAT-BLADE NON-CONDUCTIVE SCREW DRIVER AS AN ADJUSTMENT TOOL. BE CAREFUL WHEN INSERTING ADJUSTMENT TOOL THROUGH THE TOP COVER. THE UNIT MAY BE DAMAGED IF AN ADJUSTMENT TOOL IS ACCIDENTALLY FORCED AGAINST UNINTENDED COMPONENTS OR CIRCUIT BOARD PATHS.

The following adjustments can be made through access holes in the top cover of the GMA 340:

(1) Marker beacon audio level.

Counter-clockwise adjustment increases the marker audio level.

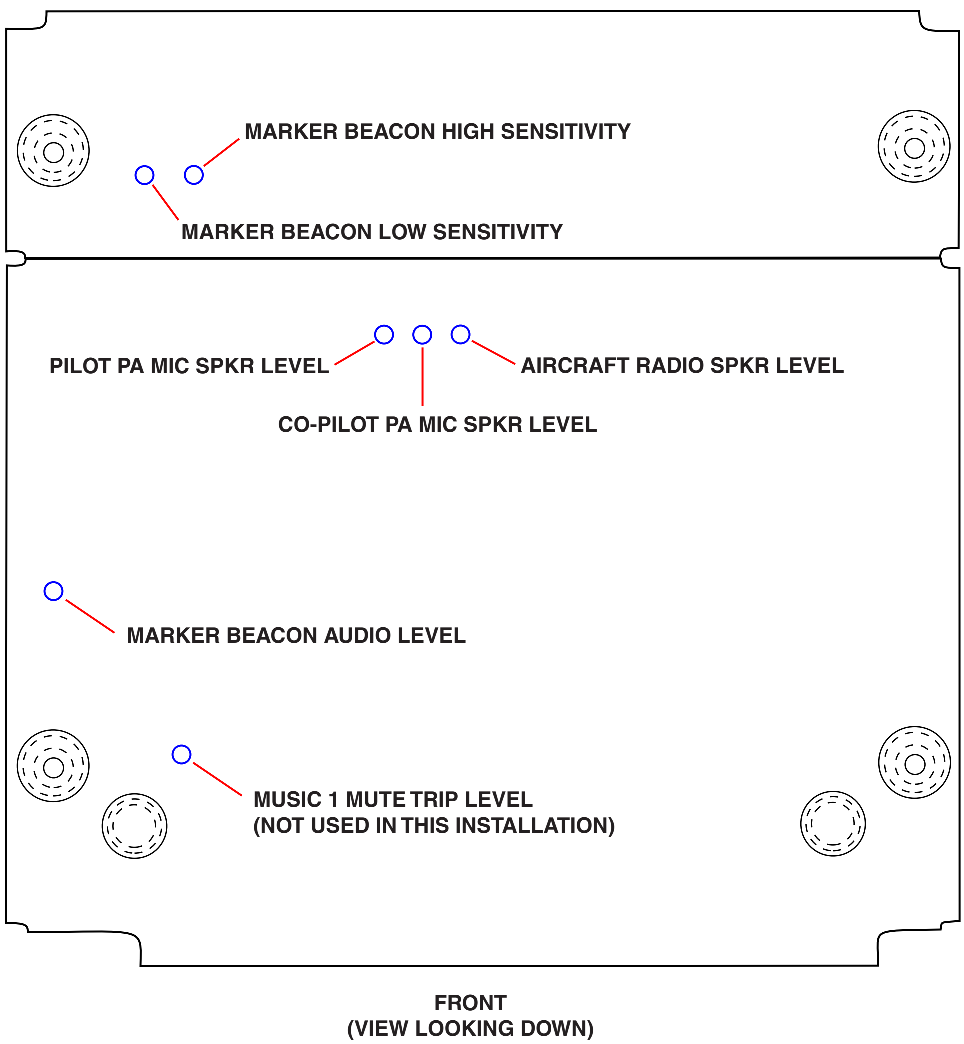
(2) Marker beacon sensitivity.

Clockwise (CW) adjustment increases the sensitivity. LOW sensitivity can be adjusted without affecting HIGH sensitivity setting. Adjusting HIGH sensitivity will, however, affect the LOW sensitivity. If the HIGH sensitivity setting is adjusted, then the LOW sensitivity setting should be checked and adjusted afterwards, as needed. If your GMA-340 top cover does not have the marker beacon sensitivity adjustment access holes as indicated in Figure 3, and you need to adjust the sensitivity, contact Garmin for instructions.

(3) Aircraft radio speaker output level.

(4) Pilot PA microphone speaker output level.

(5) Copilot PA microphone speaker output level.



Effectivity
3246182 and up
3257199 and up

GMA-340 Audio Panel Adjustments
Figure 3

2. M1091 Summing Amplifier (Optional) (PIR-PPS60205, Rev. A.)

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 Baker Electronics M1091 Summing Amplifier, if installed, is mounted on the under the instrument panel on the bulkhead at F.S. 49.50. The Summing Amp. is connected to the GMA-340 Audio Panel, the audio switching amplifier, and intercom system. It converts warning tones from up to six audio channels into one audio output. Maintenance is “on condition” only and, with the exception of swapping complete units, should be performed only by a qualified avionics shop.

Information provided herein is intended to aid the removal and installation of the M1091 Summing Amp. and its associated wiring and to permit basic system functional test and adjustment. In addition, an electrical schematic is provided in 91-23-50.

When replacing the Summing Amplifier Assy. the only adjustment required is to ensure that any unused channels are turned off. Proceed as follows:

A. Setup

(1) Remove the four #4-40 x 3/8 pan head phillips screws and four #4 lockwashers located on the sides of the M1091.

(2) Remove the two D-Subminiature connector male screw locks located on either side of the connector.

(3) Remove the case of the M1091.

(a) Remove the case by tilting the side of the case opposite the connector up at a 30 degree or greater angle.

(b) Slide the case toward the connector and remove it.

B. Adjustment (See Chart 1 and Figure 4.)

(1) Input channels not used on the M1091 will be turned OFF by adjusting the corresponding channel potentiometer fully counter clockwise.

(2) Input channels that are used on the M1091 will be turned on by adjusting the corresponding channel potentiometer fully clockwise.

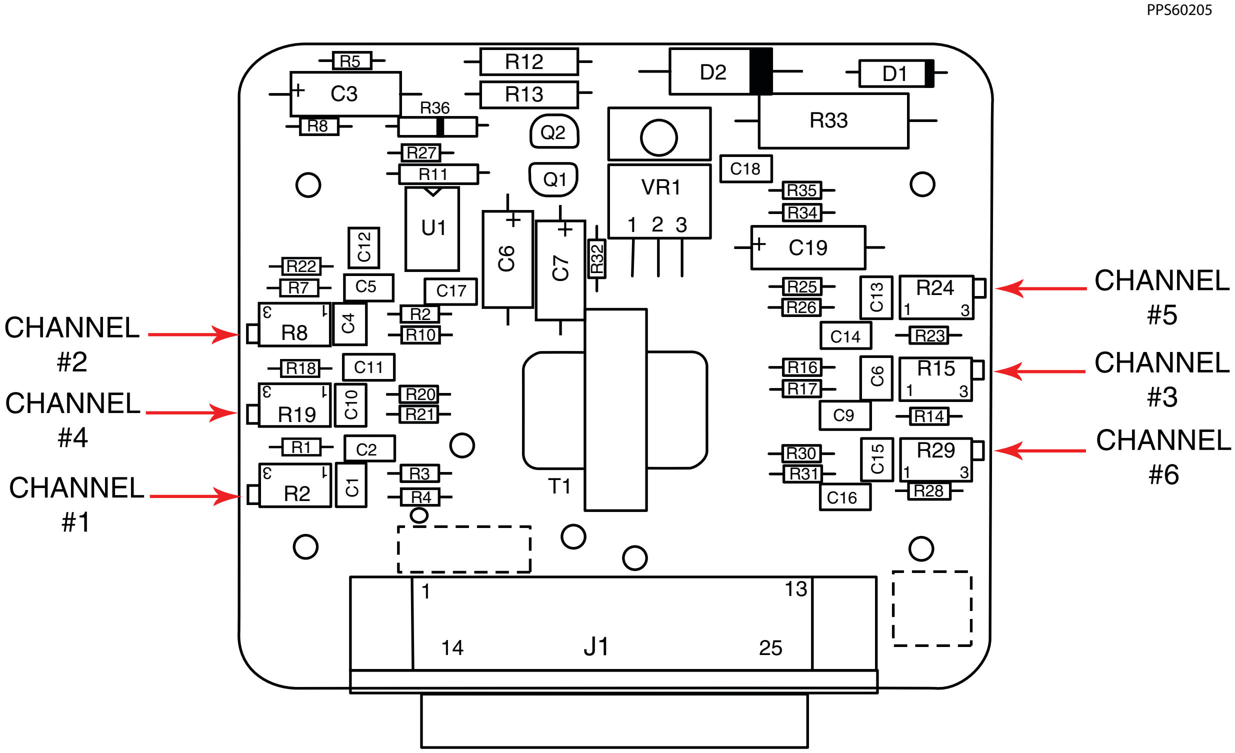
(3) After all channels have been adjusted, reinstall the unit case and the case and connector screws previously removed.

C. System Test

Activate each audio source and verify that the desired audio output is produced.

Chart 1
M1091 Summing Amplifier CONFIG Page

	AUDIO SOURCE	**AUDIO SOURCE**
MODEL	**PA-32R-301**	**PA-32R-301T**
CHANNEL 1	MODE S TRANSPONDER	MODE S TRANSPONDER
CHANNEL 2	SKYWATCH	SKYWATCH
CHANNEL 3	TAWS	TAWS
CHANNEL 4	UNUSED	UNUSED
CHANNEL 5	UNUSED	UNUSED
CHANNEL 6	UNUSED	UNUSED



[Effectivity](#)
Option with GMA-340

M1091 Summing Amplifier
Figure 4

STATIC DISCHARGING

1. Static Wicks

   A. Description

   This airplane is equipped with seven (7) static wicks: one (1) on the inboard end of each aileron; one (1) on each outboard end of the stabilator; one (1) on the left-hand side of the rudder at the bottom; and one (1) in the center of each flap.

   B. Inspection

   Each 100 hours or annually, whichever comes first, inspect static wicks as follows:

   (1) General appearance and physical condition.

   (2) Security of attachment to airframe.

   (3) Discharge points visible.

   (4) Resistance = 0.5 ±20% megohms (500 to 1,000 volt megohmmeter).

   (5) Base resistance to airframe (one (1) ohm maximum).

2. Bonding Straps (PIR-PPS55006, Rev. AG.)

   NOTE: Perform Electrical Bonding - On Condition Inspection, 51-80-00, whenever a bonding strap is installed/reinstalled.

   To aid in dissipating static electricity buildup the ailerons, stabilator, stabilator tab, and rudder are bonded to either the control's hinge or spar.

   When replacing the jumper assemblies (bonding straps), secure the end of the jumper that mounts to the control's hinge or spar as follows:

   A. Clean an area of 1 1/2 times the diameter of the jumper's washer down to bare metal.

   B. Attach the jumper and washer to the control's hinge or spar.

   C. Seal the cleaned area with a light coat of epoxy primer within 24 hours.

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CHAPTER

24

ELECTRICAL POWER

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CHAPTER 24

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CHAPTER 24 - ELECTRICAL POWER

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CHAPTER 24 - ELECTRICAL POWER

TABLE OF CONTENTS (continued)

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.

1. 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 Electrosystems, 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 landing lights.

2. Contactor Maintenance (See Figure 1.)

WARNING: A STARTER CONTACTOR THAT IS DAMAGED AS DESCRIBED BELOW CAN FAIL UNEXPECTEDLY IN THE CLOSED POSITION, CAUSING AN UNCOMMANDED ROTATION OF THE PROPELLER THE NEXT TIME THE MAIN POWER BUS IS ENERGIZED.

Contactor terminals may be damaged if correct procedure is not followed when loosening or tightening connections. Specifically, wrenching torque may be transmitted to components inside the contactor, causing damage that may go undetected.

Service spares replacement contactors are configured out-of-the-box as shown in Figure 1. The contactor is labeled with a note in red text that reads: "DO NOT REMOVE INNER NUT WHEN ASSEMBLING. USE WRENCH TO HOLD INNER NUT IN PLACE WHEN APPLYING OUTER NUT."

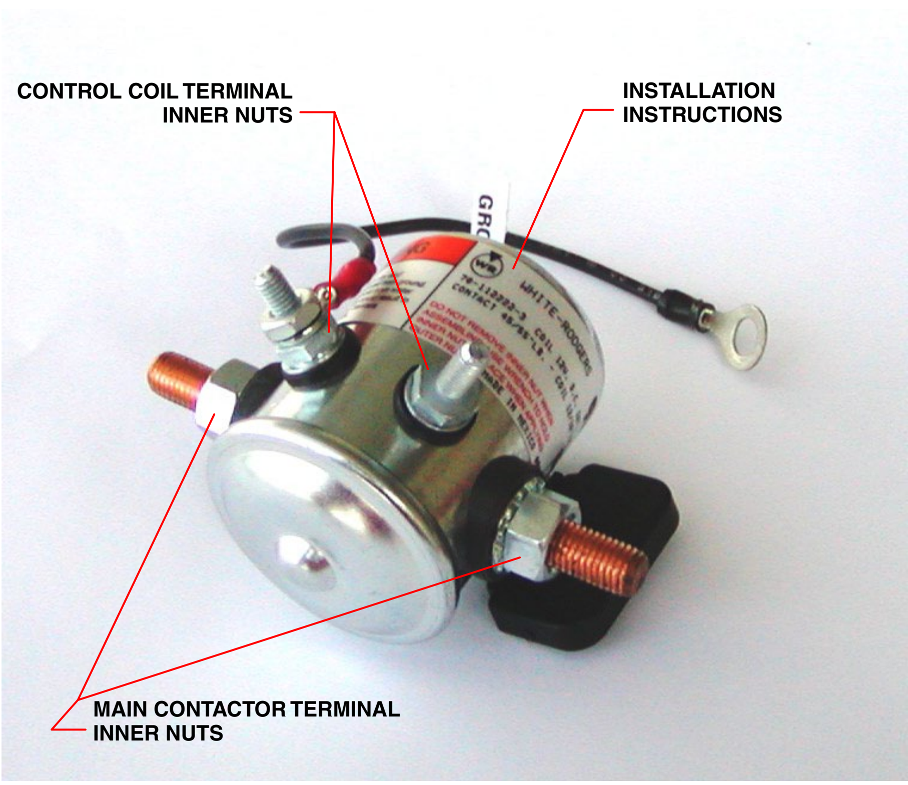
The "INNER NUT" referred to in this note is the nut(s) that are supplied with the contactor. When installing wire terminals onto the threaded posts, two wrenches must be used: One wrench (the back-up wrench) is placed on the inner nut to hold it stationary, while the other wrench turns and tightens the outer nut.

The proper installation torque for nuts installed on the threaded terminal posts is labeled on the contactor:

A. For nuts installed on the two large (5/16 - 24 thread) main contactor terminals, use 45 to 55 inch-pounds of torque.

B. For nuts installed on the two small (#10 - 32 thread) control coil terminals, use 12 to 18 inch-pounds of torque.

NOTE: Fastener torques shown above reflect the specifications of the contactor manufacturer at the time of publication, and are subject to change. Adhere to vendor installation instructions provided with any Piper-approved replacement contactor.



Typical Contactor
Figure 1

D.C. GENERATION

1. Alternator System (90 Amp Electrosystems)

A. Description (Keyed to Figure 1.)

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.

(1) The front housing 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.

(2) The rear housing 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 2 for Terminal identification.)

(3) The stator core and coil assembly 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 3.)

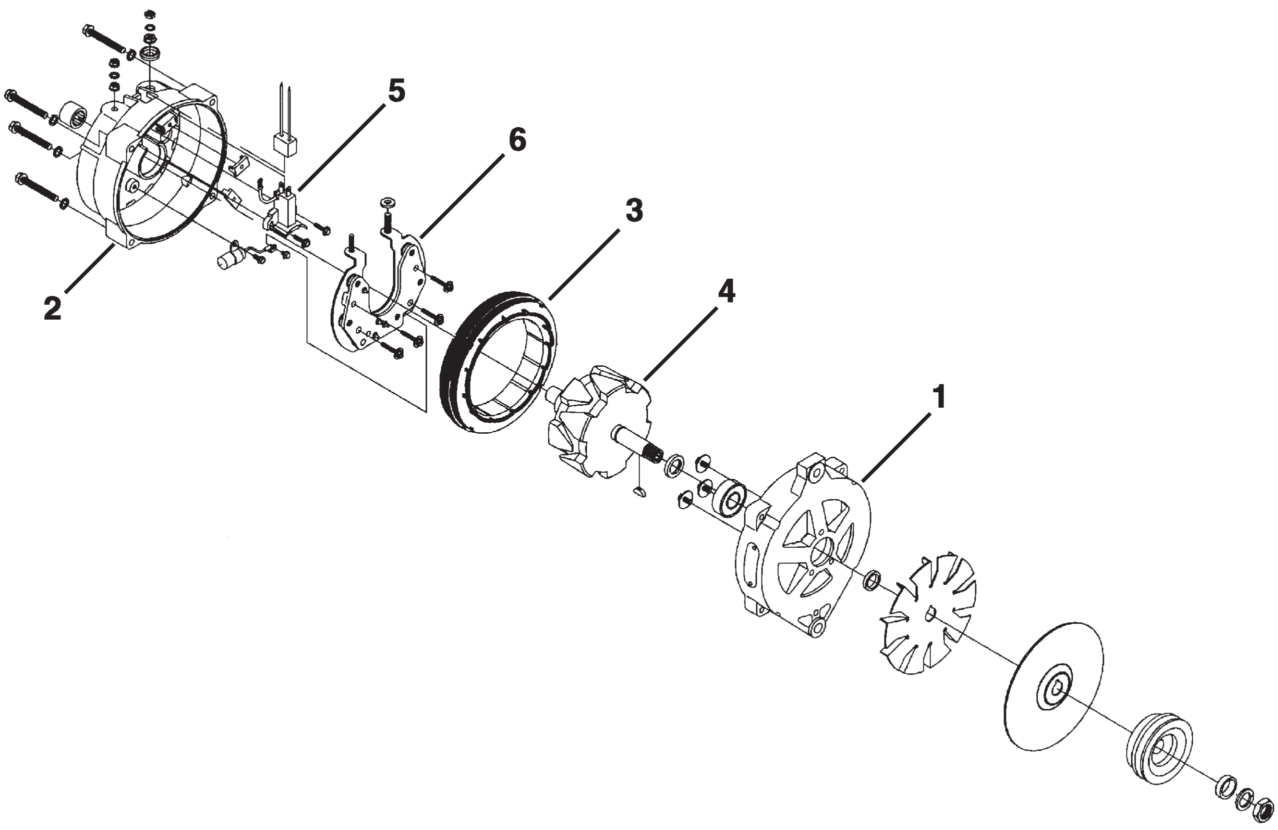
(4) The rotor core and coil assembly consists of the rotor shaft, two slip rings, two rotor halves and the coil assembly. The shaft is supported at each end by bearings. The front bearing (ball-type) is a slip fit on the shaft and is retained in the front housing with a retainer. The rear bearing (needle-type) 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.

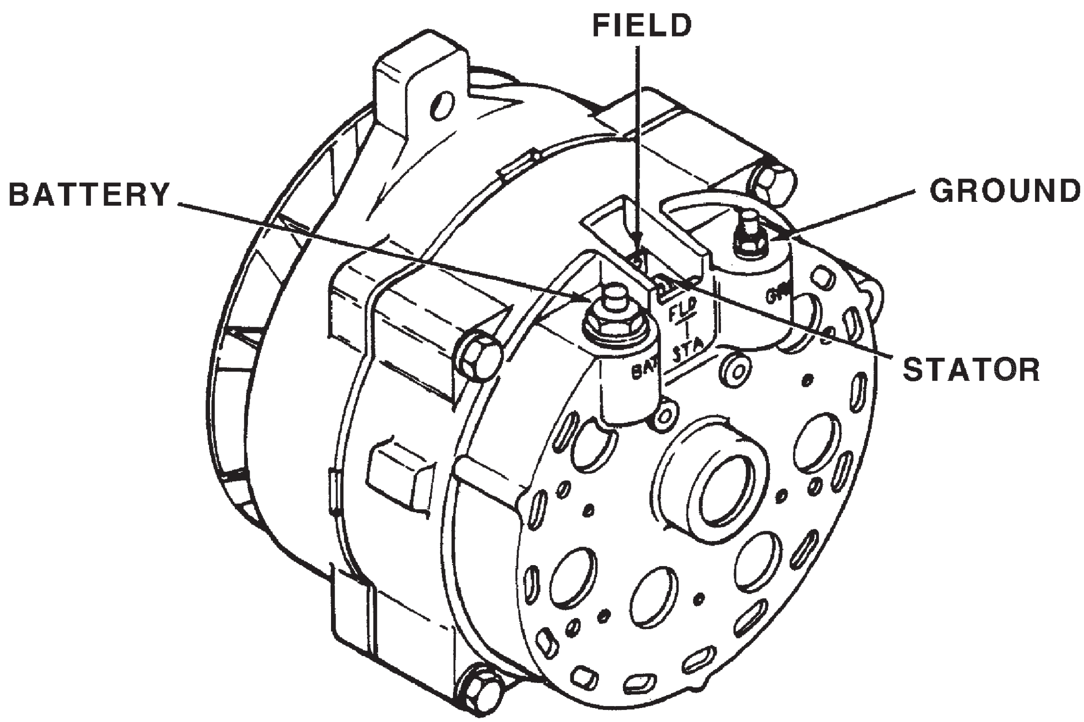
(5) The brush and holder assembly is installed in a cavity inside the rear housing. The brushes ride the surfaces of the slip rings on the rotor shaft under spring pressure and transmit field current through their circuit to ground. One brush or field terminal is, therefore, insulated from the housing.

(6) 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 3.)

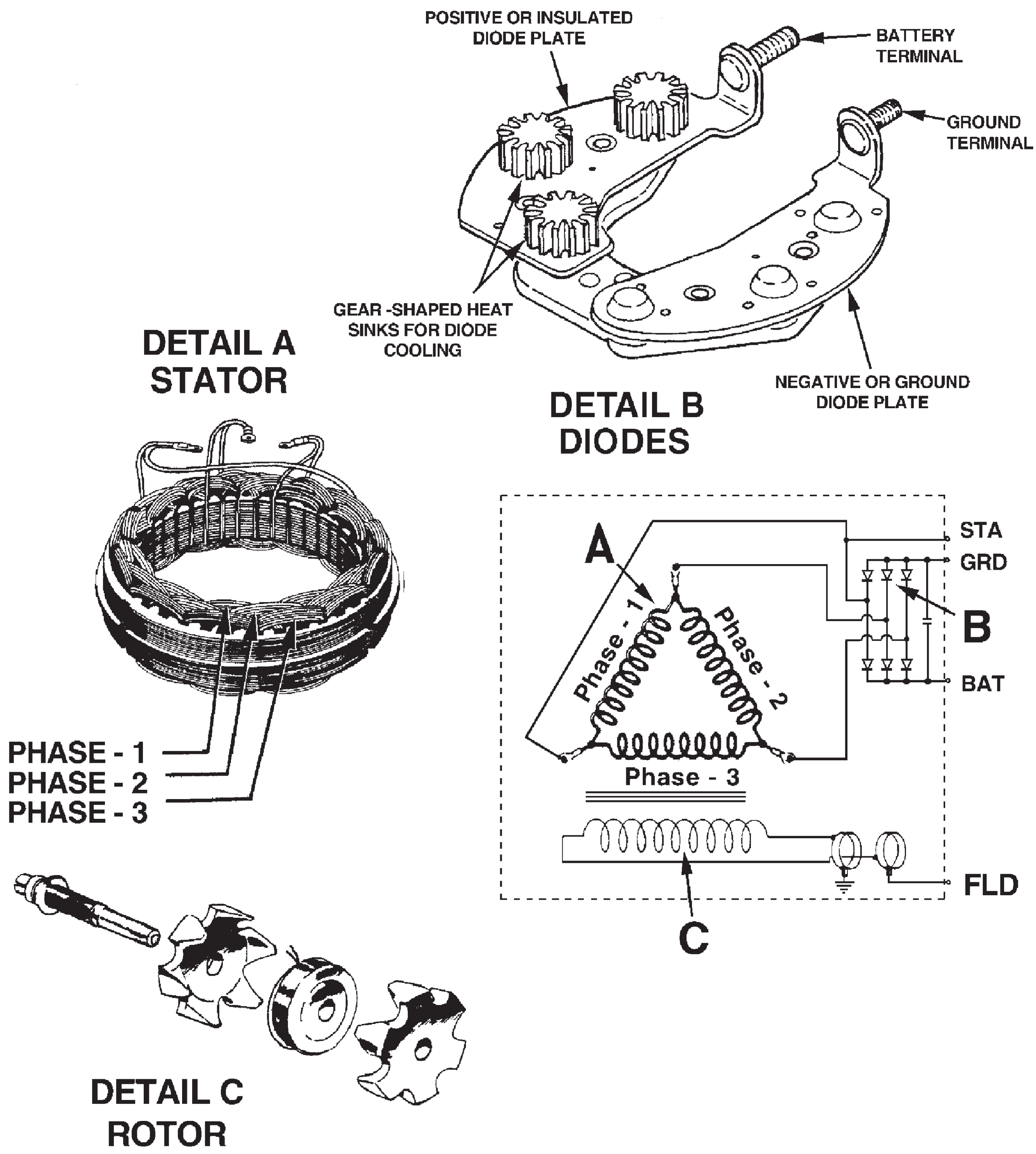
The stator winding leads are soldered to integral terminals on the back of the circuit board. The stator phase top is attached to the insulated stator terminal. The heat sinks are attached to the circuit board with insulated spacers and roll pins maintaining the necessary separation between the two assemblies. 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.



Exploded View of Electrosystems Alternator
Figure 1



Rear View and Terminal Identification
Figure 2



Internal Relationships of Alternator Components
Figure 3

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 3.)

B. Precautions

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

(1) Always disconnect the battery ground cable before disconnecting wiring or components of system.

(2) 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

(3) Never connect the battery ground cable until all system wiring connections and components are complete.

(4) 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.

(5) Never attempt to polarize the alternator. Polarizing is not applicable to alternator and could damage the regulator.

(6) Observe polarity when installing a battery in aircraft. Reverse polarity will destroy the diodes in alternator.

(7) Always connect a booster battery in parallel, negative to negative, positive to positive.

(8) 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.

(9) Disconnect the battery ground cable before connecting a charger to the battery.

C. 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 1 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 1 (Sheet 1 of 4)
TROUBLESHOOTING ALTERNATOR SYSTEM

Trouble	Cause	Remedy
Zero output indicated ammeter regardless of rpm (refer to alternator system test procedure)	Open field circuit	With the battery switch on 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 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.

CHART 1 (Sheet 2 of 4)
TROUBLESHOOTING ALTERNATOR SYSTEM

Trouble	Cause	Remedy
Zero output indicated on ammeter regardless of rpm (refer to alternator system test procedure). (continued)	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.
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 27.5 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.

CHART 1 (Sheet 3 of 4)
TROUBLESHOOTING ALTERNATOR SYSTEM

Trouble	Cause	Remedy
Output indicated on ammeter does not meet minimum values specified in alternator system test procedure. (continued)	Open rectifier.	If any of the six rectifiers pressed into the rear bell housing of the alternator open up internally, it will result in a definite limitation on the current that can be drawn from the alternator. After having checked the previous causes of low output it can be assumed that a faulty rectifier exists. See paragraph titled Inspection and Testing of Components.
Field circuit breaker trips.	Short circuit in field circuit.	Disconnect field wiring at terminal of alternator. Turn on master switch. If breaker continues to trip, 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.	

CHART 1 (Sheet 4 of 4)
TROUBLESHOOTING ALTERNATOR SYSTEM

Trouble	Cause	Remedy
CAUTION: TURN MAGNETO SWITCH TO OFF BEFORE TURNING PROP.		
Field circuit breaker trips. (continued)	Short circuit in field winding of alternator. (continued)	Pull propeller slowly by hand turning alternator rotor through 360 of travel. Observe circuit breaker for signs of tripping.
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.	Completely clean all corrosion from grounding points.

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D. On-Aircraft Checks

(1) 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.

(a) 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.

(b) Specific gravity of battery reading. A fully charged battery should read 1.275.

(c) Clean and tighten battery posts and cable clamps.

(d) Clean and tighten wiring connection at alternator.

(e) Clean and tighten wiring connections at regulator.

(2) 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:

(a) Check wiring connections at ammeter are tight and clean, or;

(b) Ammeter is defective. Replace ammeter.

(3) 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.

(a) Disconnect connector at voltage regulator.

(b) Connect voltmeter positive lead to pin 1 of disconnected plug (B lead of regulator) and negative lead to aircraft structure.

(c) Turn BATT MASTR and ALTR switches ON. Voltmeter should read battery voltage. If voltage is not present:

1 Check continuity of wiring harness from regulator plug to alternator circuit breaker.

2 Ensure that alternator regulator circuit breaker is closed and not defective.

(4) Voltage Output No-Load Test.

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

(a) Connect voltmeter positive lead to positive battery terminal and negative lead to negative battery terminal. Record Reading.

(b) Assure that all switches and lights are off, i. e., no load condition.

(c) Start engine and slowly increase speed to approximately 1500 rpm.

(d) Voltmeter reading should increase, but not more than 4 volts above voltage recorded in step 1.

(e) If the voltage does not increase, or if the increase is within the 4 volt limit, proceed to Voltage Output Load Test.

(f) If voltage increase exceeds 4 volts, stop engine, and isolate overvoltage problem as follows:

1 Disconnect regulator plug from regulator and repeat the test with plug disconnected.

2 Voltmeter should show no increase in voltage because excitation voltage to alternator is cut-off. Replace regulator.

3 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.

(5) Voltage Output Load Test

This test will determine if there is an undercharge condition.

(a) Connect regulator plug.

(b) Connect voltmeter to negative and positive post of battery. Record voltage reading.

(c) Turn off all accessory switches. Open circuit breakers where switches do not control circuits.

(d) Start the engine. Apply a load by turning on the landing light.

(e) Slowly increase engine speed to 1500 rpm.

(f) Voltage reading should increase a minimum of 0.5 volt above previous reading.

(g) Turn off landing light and shut down engine.

(h) 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.

1 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.

2 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.

3 Voltage reading at battery should increase above previous reading a minimum of 0.5.

4 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.

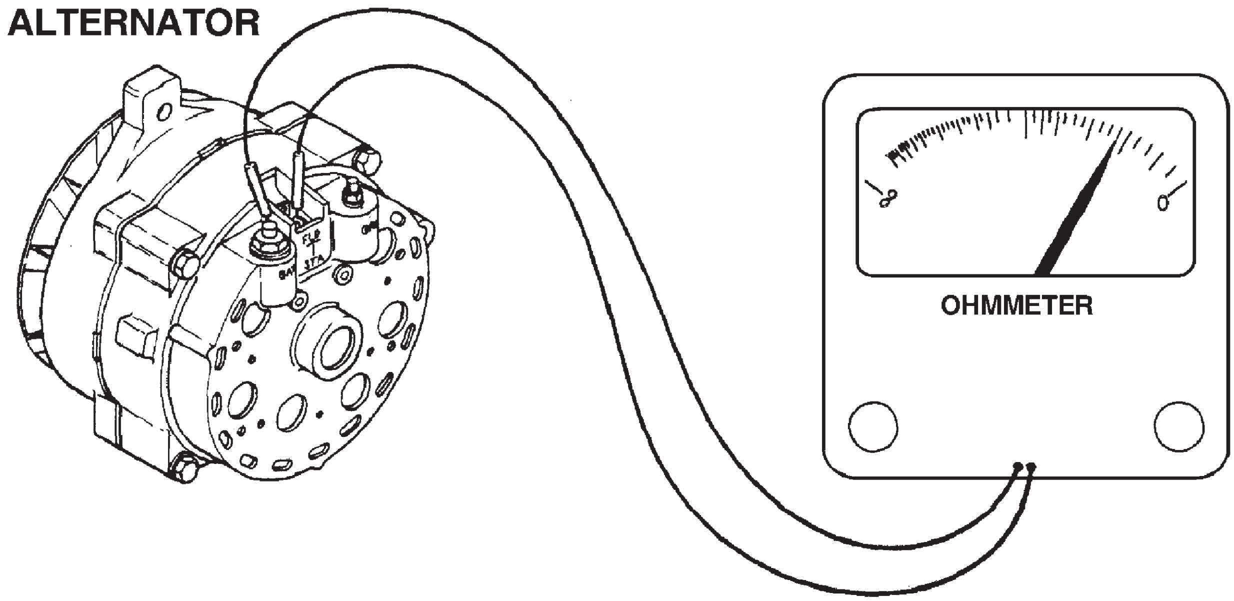
5 To isolate the wiring harness, remove jumper end from the voltage regulator plug and connect it to the FLD pin of the alternator (plug removed).

6 Leave alternator regulator plug disconnected.

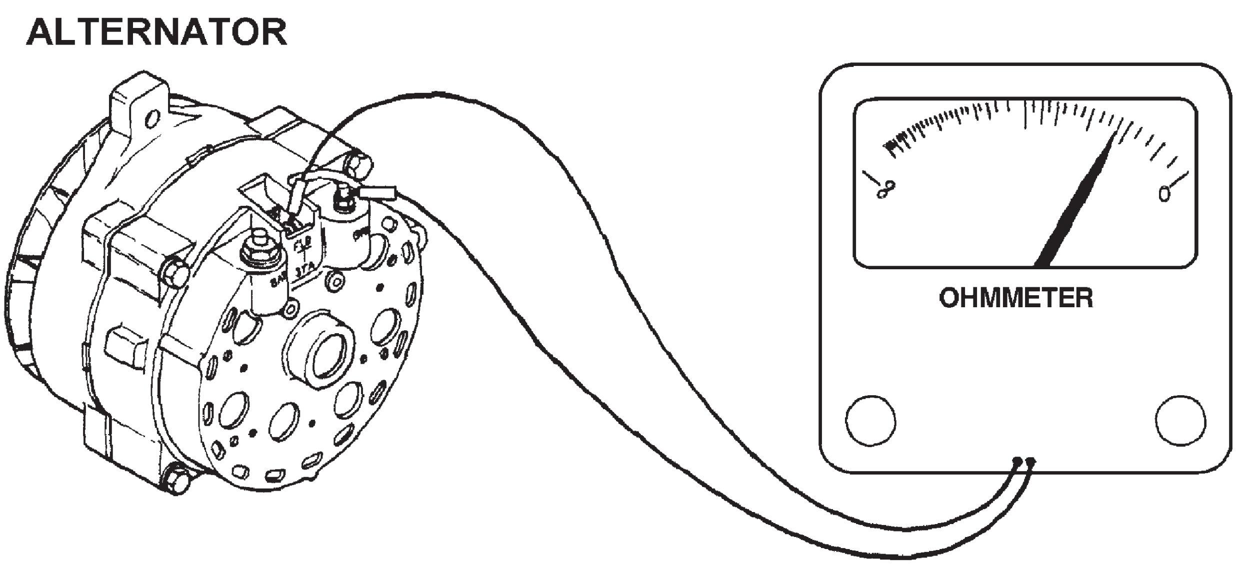
7 Start engine. Turn ALTR switch on. Apply electrical load by turning taxi and landing lights on. Slowly increase engine speed to determine that voltage of step (b) increases. Stop rpm increase when voltage measures 0.0 volts. Observe 2 minute operation caution.

a If the voltage increase is now a minimum 0.5 volt, fault is wiring harness. Repair or replace harness.

b If the voltage increase is still below 0.5 volt, fault is in alternator. Remove alternator from aircraft for bench test.



Rectifier Ground and Positive Diode Test
Figure 4



Stator Ground and Negative Diode Test
Figure 5

2. Alternator

A. Removal

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.

B. 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.

With a belt installed, align alternator idler pulley in the belt plane by adding or removing shims between the alternator mounting ears and the alternator mounting bracket. (See 21-50-00, Figure 14.)

C. Belt Tension Adjustment

(1) 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. 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.

(2) Run engine 15 minutes at 1200 rpm.

(3) Shut down engine, remove engine cowling, and check both belt tensions.

(4) 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.

(5) Install engine cowling.

(6) Re-check tension every 100 hours or annual inspection, whichever comes first.

D. Bench Tests

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.

(1) Rectifier Ground and Positive Diode Test (Refer to Figure 4.)

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

(a) Set the ohmmeter selector switch to resistance scale 10 and zero the meter.

(b) 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.

(c) A reading of 60 ohms or less in both directions indicates:

1 A defective positive diode.

2 A grounded positive diode plate.

3 A grounded alternator BAT terminal.

(d) Infinite reading (no needle movement) in both directions indicates an open STA terminal connection.

(2) Stator Ground and Negative Diode Test (Refer to Figure 5)

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

(a) Set the ohmmeter selector switch on resistance scale 10 and zero meter.

(b) 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.

(c) A reading of 60 ohms or less in both directions indicates:

1 A defective negative diode.

2 A grounded positive diode plate.

3 A grounded alternator BAT terminal.

4 A grounded STA terminal.

5 A grounded stator winding (laminations grounded or windings grounded to front or rear housing).

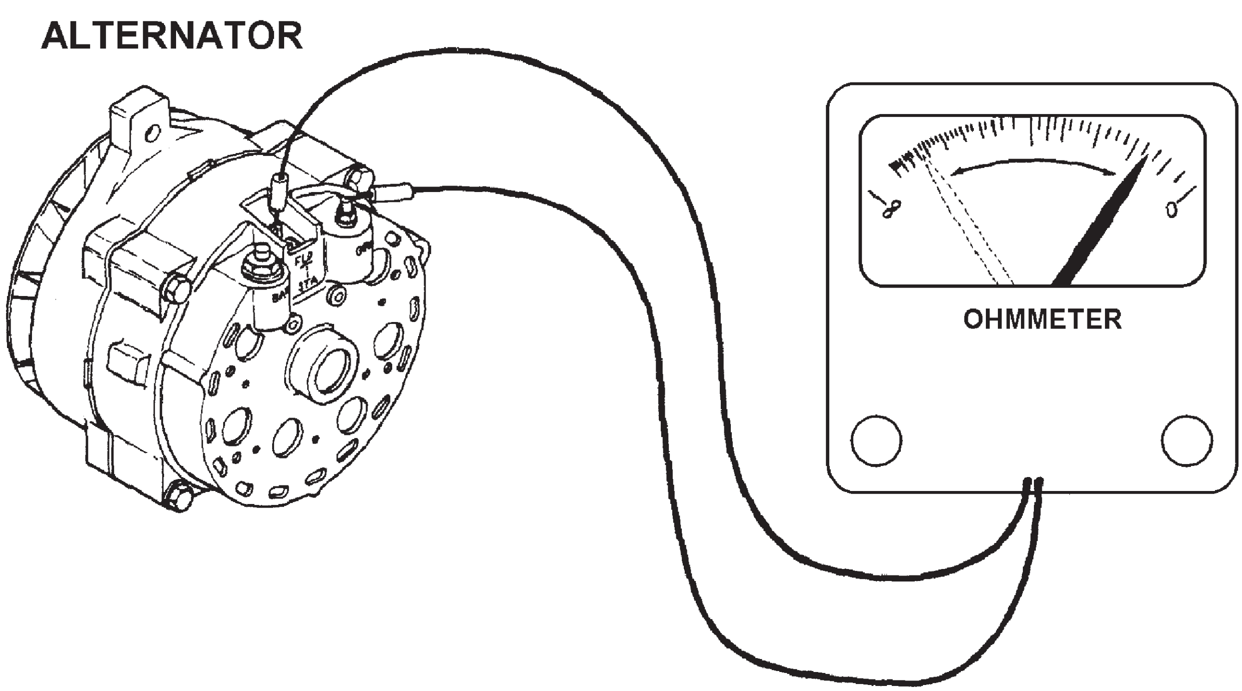
(d) Infinite readings (no needle movement) in both directions indicates an open STA terminal connection.

(3) Field Circuit Open or Ground Test (Refer to Figure 6)

(a) Set ohmmeter selector switch to resistance scale one and zero meter.

(b) Connect one lead to the FLD terminal and the other lead to the GRD terminal.

(c) Spin alternator pulley and note ohmmeter reading. Meter should read between 4 and 200 ohms and fluctuate while rotor is turning.



Field Circuit Open or Ground Test
Figure 6

(d) A reading lower than four ohms indicates:
   1 A grounded positive brush.
   2 A grounded field terminal.
   3 A defective rotor.

(e) A reading higher than 200 ohms indicates:
   1 Worn out or hung brushes.
   2 An open brush lead.
   3 A defective rotor.

E. Overhaul

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.)

See Kelly Aerospace Power Systems, Inc., OE-A2 Overhaul Manual (Starters & Alternators).

3. Standby Alternator (In HP S/N's 3246236 & up; and TC S/N's 3257256 and 3257410 & up: factory installed with Avidyne Entegra EFIS or with Garmin 1000 EFIS.)

A. Description

The standby system provides 20 amps of power to support continued flight in the event of primary alternator failure. It turns on automatically, annunciating its operation to the pilot through the panel mounted annunciator which doubles as a standby alternator load monitor.

If the primary alternator fails in flight, the standby regulator will sense the drop in system voltage and automatically activate the standby alternator. If the current requirement is over 20 amps when the standby alternator is activated, the STBY ALT ON annunciator light will flash. Reducing the current usage to 20 amps or less will cause the annunciator light to cease flashing and light steadily. The pilot may choose which equipment he needs for the given flight conditions by simply keeping the total load below the flashing point of the annunciator. This will reserve battery energy for transient loads (gear, flaps, landing lights, etc.) during approach. Loads may be beyond the flashing point of the annunciator light for up to five (5) minutes without damaging the standby alternator.

The standby alternator is mounted on the vacuum pump drive of the engine accessory case. Panel mounted equipment includes the addition of a STBY ALT ON light to the annunciator, a STBY ALT rocker switch and three standard pull type circuit breakers (1 amp, 5 amp and 40 amp). The regulator is mounted under the floor in the forward baggage compartment, right side.

See 39-20-00 for illustrated component locations and Chapter 91 for electrical schematics.

B. Troubleshooting

See Chart 2.

C. Inspection

100 Hour Standby Alternator Inspection

Each 100 Hours, or at each annual inspection, whichever comes first, inspect the standby alternator installation as follows:

(a) Standby Alternator (BC410)

1 Inspect security and condition of standby alternator mounting and wiring.

2 Perform a normal preflight inspection

3 Move the aircraft to an area safe for engine start.

4 Perform a normal engine start and allow the engine to reach proper temperature for runup RPM

5 Assure that the standby alternator “Field” and “Sense” circuit breakers and the “Standby Alt” master are in the on position.

6 Reduce system electrical loads to approx. 10-15 amps.

7 Set engine to 2000 RPM minimum.

8 Switch primary alternator field switch to OFF.

9 Check that the “Stby Alt On” annunciator lights.

10 Increase the electrical load to over 20 amps. The “Stby Alt On” annunciator should be blinking. Reduce the electrical load to less than 20 Amps. The “Stby Alt On” annunciator should be ON steadily.

11 Switch primary alternator field switch to ON and verify primary alternator operation. The “Stby Alt On” annunciator should be OFF.

12 Return the engine to idle RPM.

(b) Standby Alternator Regulator (BC203-3D)

1 Inspect security and condition of the case mounting bolts and wiring.

2 Inspect overvoltage protection by performing Overvoltage Test, below.

D. Set Point Voltage Check

Voltage adjustment of the BC203-2D is not normally required. Deviation from the factory set point of 26.0 volts by more than 0.2 volts may indicate the need for repair or replacement. This set point voltage can be checked as follows:

(1) Connect a calibrated digital voltmeter directly between terminals 1 and 7 of the regulator.

(2) Ensure the airplane is in a suitable area and start the engine.

(3) Running the engine at over 2000 RPM and with a total bus load of under 3 amps, the voltmeter should indicate 26.0 ± 0.2 volts.

CHART 2 (Sheet 1 of 3) (PIR-BC203-2D-trouble.wpd, Rev. C.)

TROUBLESHOOTING STANDBY ALTERNATOR REGULATOR (BC203-2D)

Following this procedure will locate the most common system problems encountered. When calling for additional factory support, the information gained from these checks should be readily available to aid your Piper Dealer's Service Advisor in narrowing the field of possibilities as quickly as possible. Record the various measurements in the spaces indicated.

Refer to the electrical schematics in 91-24-30 and a high impedance (preferably digital) volt/ohmmeter (DVM) to make the following checks.

1. Setup

   A. Ensure the engine is not running,

   B. The magnetos are OFF, and

   C. That no external power is applied to the aircraft electrical system.

2. Turn all switches off. Use the lowest resistance scale on the DVM. Check resistance between the battery negative (-) terminal and both Terminal 7 of the regulator and the engine case. Measurements over 0.5 Ohm to either would be cause for investigation. In this case, check the engine ground strap, battery ground strap, and regulator ground wire for loose or contaminated connections, broken conductors or bad crimp joints. If these measurements are less than 0.5 Ohm, any of these three points may be used as reference (-) for the following measurements.

   A. Resistance from battery to Terminal 7: _________Ohms.

   B. Resistance from battery to engine case: _________Ohms.

3. Turn on the battery master and alternator field switches. Measure the voltage on the battery bus and on Terminal 1 of the regulator. The voltages should be equal within 0.2 volts. A difference of greater than 0.2 volts may be caused by using a breaker as the source for Terminal 1 that supplies another device of considerable load. Change to a lightly loaded breaker or a breaker dedicated to Terminal 1 and the low voltage lamp. It is recommended that Terminal 1 not be jumped to Terminal 6. If Terminal 1 has no voltage, the regulator will not operate.

   A. Bus voltage: __________ volts.

   B. Terminal 1 voltage: ___________volts.

4. Measure the voltage on Terminal 6 of the regulator. It should be within 0.5 volts of the bus voltage. A difference of greater than 0.5 volts may be caused by poor contacts in the field breaker or field switch, poor crimp joints, or loose screw terminals in the wiring between the bus and Terminal 6. Absence of voltage on Terminal 6 will prevent the regulator from operating.

   Terminal 6 voltage:____________volts.

5. Check the voltage on Terminal 5 of the regulator. The voltage should be between 13 and 15 volts. A voltage outside this range may indicate a bad regulator.

   Terminal 5 voltage:___________volts.

CHART 2 (Sheet 2 of 3)
TROUBLESHOOTING STANDBY ALTERNATOR REGULATOR (BC203-2D)

6. Move to the engine compartment. Without disconnecting the field connector, measure the field voltage on the alternator. Use a thin probe or small gage wire wrapped around the probe to reach through the connector body and measure the voltage on the male blade coming out of the alternator. It should measure within 0.5 volts of the measurement on Terminal 5 of the regulator. A lack of voltage may indicate an open circuit between Terminal 5 of the regulator and the field terminal. If an open field circuit is suspected, the switches may be turned off, the alternator field connector removed, and a resistance measurement made between the connector and Terminal 5 of the regulator. Look for near 0 Ohms. Typically the field resistance of the alternator will be between 3 and 10 Ohms from the male field terminal blade to alternator case.

   A. Field terminal voltage:__________volts.

   B. Alternator field resistance:__________Ohms.

7. With the switches on, check the voltage between the alternator output post (or B lead) and ground. It should be battery voltage. If not, check the wiring between the alternator B lead and the battery positive (+) terminal. Look for loose or contaminated connections, broken wires, or an open breaker or fuse.

   Alternator B lead voltage:____________volts.

8. If all of the voltages in the first 6 steps are close to the value specified, the charging system should be operative. If not, check for a broken or loose alternator belt or, if the alternator is spline driven, check that the spline drive shear coupling is not sheared. Note that on spline drive alternators the engine speed must be at or above run-up RPM before checking for useable output.

   NOTE: During the following tests, if the annunciator is always ON or always OFF, check the annunciator circuit by removing the wire from terminal 2 of the regulator. The lamp should be OFF with the wire disconnected and should illuminate if the wire is connected to ground.

   If the lamp circuit works properly but the lamp still remains fixed either ON or OFF all the time with the lamp wire connected to Terminal 2, assume that the lamp driver is bad in the regulator. Have the regulator repaired or replaced.

9. If the charging system seems to be generating power, but the STBY ALT ON annunciator will not flash above 20 amps output, check the following:

   A. With the Battery and Standby Alternator Master switches ON but the engine not running, check the voltage between terminals 4 and 7 of the regulator. The voltage should be 10.0, “ 0.1 volts. If it is not within tolerance, remove the wire from Terminal 4 and re-check the voltage. If it is still not within tolerance the regulator may be bad. If the voltage is now in tolerance, suspect a bad current sensor or shorted sensor wire.

   B. If the voltage originally measured in step A was in tolerance, divide the measurement by 2. This value should be the voltage measured between terminals 3 and 7 of the regulator. If the voltage measured is not close to 5.0 Volts, suspect the current sensor in the standby alternator output lead.

CHART 2 (Sheet 3 of 3)
TROUBLESHOOTING STANDBY ALTERNATOR REGULATOR (BC203-2D)

C. If the measurements in Steps A and B are satisfactory, prepare to monitor the voltage between terminals 3 and 7 of the regulator with the engine running. Move the aircraft to a safe location for a 2000 RPM runup. Start the engine. Minimize the bus loads and bring the engine RPM up to approximately 2000. Switch OFF the primary alternator. Wait for the STBY ALT ON annunciator to illuminate. At light bus loads this could take a minute or two. Note the voltage between terminals 3 and 7 of the regulator and begin switching ON additional bus load. The monitored voltage should increase at the rate of 0.056 Volts for each Amp of standby alternator load.

(1) If the voltage does not change, verify standby alternator output with the ship's ammeter or a clamp-on ammeter probe. If the standby output is verified and there is still no change in the monitored voltage, suspect a bad current sensor.

(2) If the voltage decreases instead of increasing, the 10 Ga. current sensor wire is connected backward. Reverse the connection and re-run the test.

(3) If the voltage increases at approximately the correct rate, continue adding load until the voltage is greater than 6.2 volts. At or above this voltage, the lamp should be flashing. If not suspect a bad regulator.

10. Intermittent problems are the hardest to find. Temporarily bring small test wires into the cockpit from 2 or 3 points in question to allow monitoring them with the DVM during periods of system failure. Double check all screw terminals for security. Try a 5 pound pull test on all crimp joints and make sure that the terminal is crimped on the wire, not the insulation.

11. Noise problems are also difficult to find. A few tips to help with curing noise problems follow:

A. A unitized grounding system helps prevent noise problems by preventing voltage differences between different ground points.

B. The battery acts as a noise filter in the system. Poor connections to the battery or a battery that is going bad can add to or even cause noise problems.

C. Shielding of low level audio leads (especially microphone leads or headset leads) is required. Sometimes the shields in the cables can separate from repeated flexing. Try checking shield continuity with an ohmmeter or substituting another headset, microphone, etc.

D. Wire routing may be important in some installations. Separation of noise carrying conductors such as P leads from other wiring may help. Running noisy wiring parallel to other wiring in the same bundle is asking for trouble. Wires at 90 degrees to one another, however, do not couple noise.

E. Running transmitter feed lines close to and in parallel with other wiring can cause a problem. Normally, problems will only be encountered if there is a mismatch and therefore a high SWR in the antenna system. If noise or charging system breaker tripping occurs during Comm transmit only or when the transponder is ON only, check the corresponding antenna system carefully or separate the transmission line from other wiring.

F. The best plan is to stop the noise at its source. Once the noise is loose, it can be difficult to filter it out of all affected systems. Try to locate the offending item and correct the problem at that point. Switching off the alternator, the mags (first one then the other), or any other electrical equipment that generates noise should help to find the offender.

E. Overvoltage Test

The BC203-2D contains internal over-voltage protection. Grounding for both regulation and overvoltage protection is achieved through terminal 7 of the regulator, through the case mounting bolts and through the grounding stud provided under the terminal strip. Overvoltage protection may be tested for correct operation using either of the following two tests:

(1) Test 1

(a) Disconnect the aircraft wiring harness from terminal 6 of the regulator.

(b) Connect a current limited power supply with an output voltage adjustable between zero and 35 volts to terminals 6 and 7 with the positive lead on terminal 6.

(c) Connect a 10 ohm, 10 watt resistor from terminal 6 to terminal 5.

CAUTION: THE POWER SHOULD BE REMOVED FROM TERMINAL 6 WITHIN FIVE (5) SECONDS OF ACHIEVING THE SHORTED CONDITION.

(d) Limiting the output current to 5 amps or less, gradually raise the power supply voltage until the regulator shorts the output of the power supply. Remove power from terminal 6 as soon as the short occurs.

(e) The short should occur between 32.0 and 33.0 volts. No short indicates the failure of the overvoltage protection circuitry of the regulator and necessity for repair or replacement of the regulator.

(f) If the test is satisfactory, switch power OFF, disconnect the power supply, remove the 10 ohm resistor, and reconnect terminal 6 to the aircraft wiring harness.

(2) Test 2

(a) Disconnect the aircraft wiring harness from terminal 6 of the regulator.

(b) Connect a 5 amp in-line fuse from the aircraft bus to the negative terminal of a 12 volt lantern battery.

(c) Connect a 10 ohm, 10 watt resistor from terminal 6 to terminal 5.

(d) Energize the aircraft Bus and momentarily connect the positive terminal of the lantern battery to terminal 6 of the regulator.

(e) The fuse should blow immediately. If the fuse does not blow, the over-voltage protection circuit has failed and the regulator must be replaced or repaired.

(f) If the test is satisfactory, switch power off, reconnect terminal 6 to the aircraft wiring harness, and remove the 10 ohm resistor.

F. Repair

Failure due to broken wires or damaged connectors may be corrected in the field using repair procedures complying with the latest revision of AC43.13-1. All other repairs are by replacement only.

G. Removal

(1) Ensure the magnetos are OFF, and no external power is applied to the aircraft electrical system.

(2) Disconnect the battery cables: first the negative (ground), then the positive cable.

(3) Disconnect the wiring harness to the Standby Alternator.

(4) Remove nuts and washers (4 each), that mount the Standby Alternator to the engine block.

(5) Remove the Standby Alternator by sliding straight back from its original mounted position.

NOTE: Remove any gasket material present and take care to cover engine block opening in order to prevent foreign particles from falling in to the exposed cavity.

H. Installation

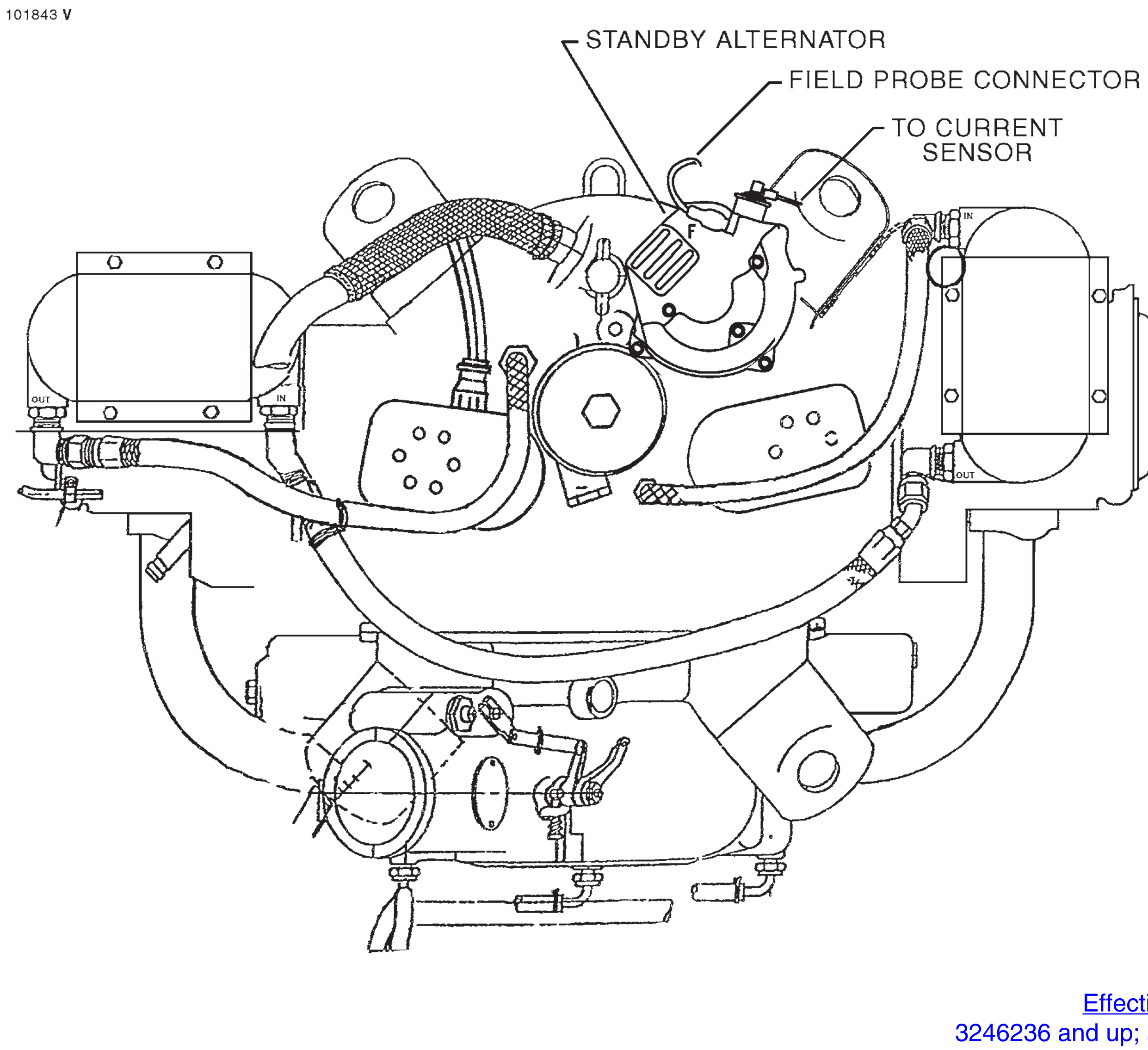
(1) Orientate standby alternator as shown in Figure 7.

(2) Locate new gasket and standby alternator on drive pad.

(3) Secure with washers and nuts (4 each).

(4) Torque nuts to 60-70 In/Lbs.

(5) Connect wiring harness.



Standby Alternator Installation
Figure 7

Effectivity
3246236 and up; and
3257256 & 3257410 and up
with Avidyne Entegra EFIS
or with Garmin 1000 EFIS

4. Battery (See also 12-10-00.)

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.

A. Removal

(1) Open the appropriate access panel(s).

(2) 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.

(3) Disconnect the battery cables: first the negative (ground), then the positive cable.

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

(a) Disconnect manifold overflow tube and positive vent line, in that order.

(b) Remove battery hold down bolts

(5) Remove battery.

B. Installation

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

(1) In HP S/N's 3246018 & up; 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.)

(2) Properly position battery on shelf or in box, as appropriate.

(3) In HP S/N's 3246018 & up; TC S/N's 3257001 & up: Connect positive vent line and manifold overflow tube.

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

(5) In HP S/N's 3246018 & up; TC S/N's 3257001 & up: install and secure battery hold down bolts.

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

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

C. Testing

Specific gravity values for checking battery charge using a hydrometer are listed in Chart 2.

If the alternator output is known to be correct, battery capability can be more accurately determined with a load type tester.

D. 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.

(1) Remove battery from airplane.

(2) Remove cell plugs and ensure that vents in plugs are open and that vent valves operate freely.

(3) Check that the electrolyte level in each cell is at the bottom of the split ring.

(4) A hydrometer check of each cell should be accomplished. (Refer to Chart 2)

(5) Place a wet cloth be over the vent caps within the manifold to prevent splashing of electrolyte.

(6) 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.

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.

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

(8) 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.

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

CHART 3
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

E. 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:

(1) Remove battery from airplane.

CAUTION: DO NOT ALLOW BAKING SODA SOLUTION TO ENTER BATTERY.

(2) In HP S/N's 3246001 thru 3246017 only,

(a) Remove the box drain cap from the under side of the fuselage. Drain off any electrolyte that may have overflowed into the box.

(b) 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.

(c) Rinse the battery and box with clean water and dry.

(d) Place cap over the battery box drain.

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

(a) 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.)

(b) Wash entire battery with clear water and dry thoroughly.

(c) 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.

(d) Removal of Battery Acid Recovery Jar

1 Remove battery.

2 Keeping the jar upright in a vertical position, remove the acid recovery jar by removing the two bracket screws that secure jar to bracket.

(e) Cleaning Acid Recovery Jar and Vent Lines

1 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.)

2 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.

3 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.

4 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.

5 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.

6 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.

7 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.

8 Screw jar back together and keep it in a vertical position.

9 Install jar in aircraft.

10 Install battery.

(4) Reinstall battery per Installation, above.

5. Emergency Battery (With Garmin G1000 EFIS only.)

The emergency battery is located in the forward baggage compartment, under the floor on the left side.

In the unlikely event of an entire electrical failure an emergency battery provides power to an emergency bus. The emergency battery bus powers a subset of the G1000, Standby Attitude gyro, illuminates the three standby instruments and illuminates the whiskey compass for a minimum of 30 minutes.

6. Checking Voltage Regulator

A. 14-Volt Regulator (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.

(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 100°F, 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.)

B. 28-Volt Regulator (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 8)

(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).

(4) Light Bulb Connections (refer to Figure 8)

(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.

7. Checking Overvoltage Relay

A. 14-Volt Overvoltage Relay (HP S/N's 3246001 thru 3246017 only)

(1) Required Equipment

(a) A good quality, accurate voltmeter, with a scale up to 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, there may be an audible "click" when the relay operates.

(4) Replace overvoltage control if it does not operate between 16.2 and 17.3 volts.

B. 28-Volt Overvoltage Relay (HP S/N's 3246018 & up; TC 3257001 & up)

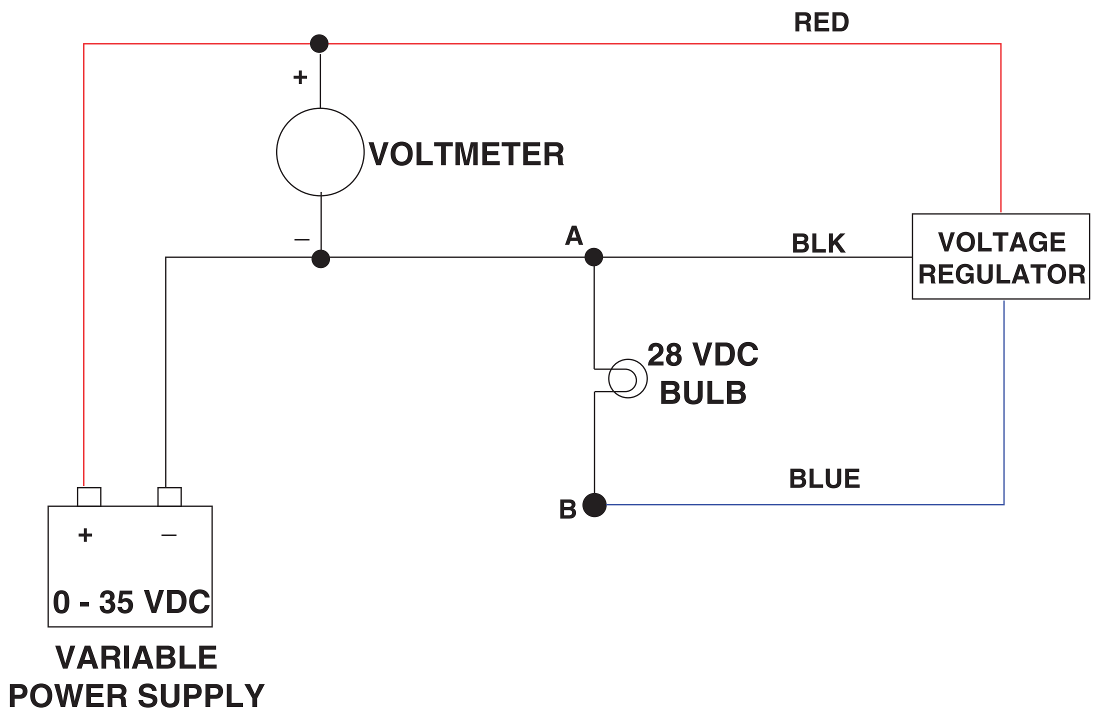
The Lamar regulator has an incorporated overvoltage relay. To check relay operation use the same test connections as testing the regulator, except connect the bulb across the RED and BLUE wires. (See Figure 9.)

Test as follows:

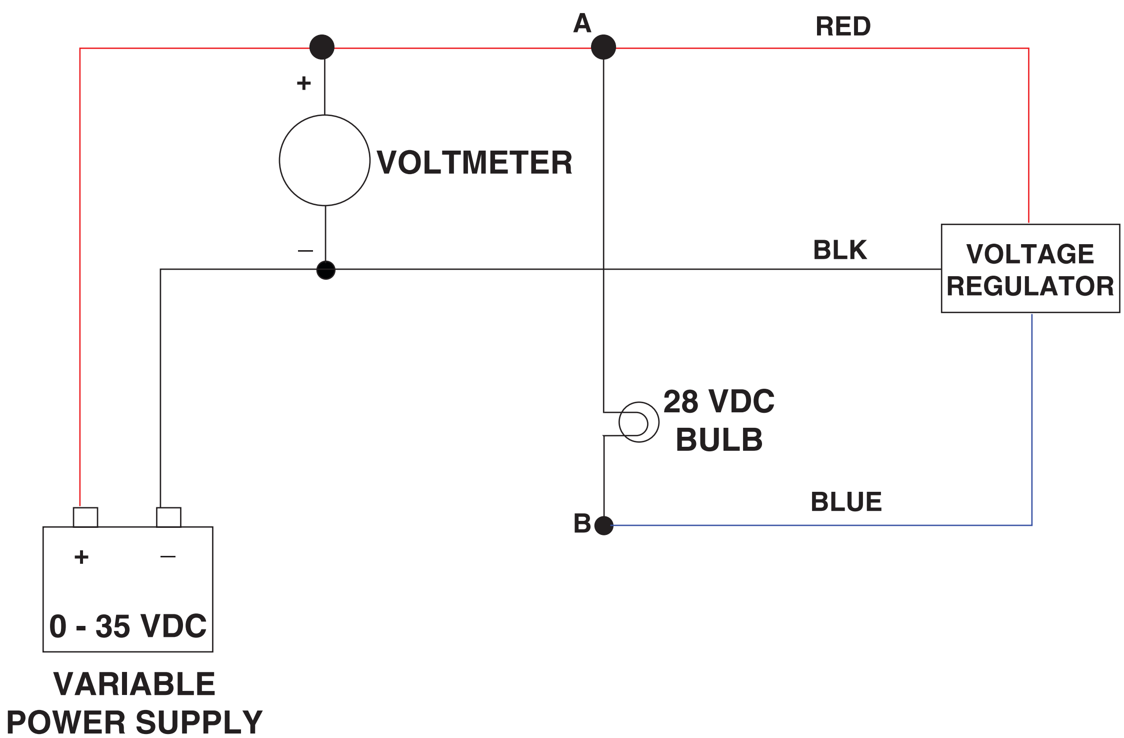
(1) While monitoring both the voltmeter and the light bulb, increase the voltage to circuit slowly to 32 volts.

(2) After a slight delay, the bulb will illuminate.

(3) If overvoltage control fails to operate at 32 Vdc, it must be replaced.



Lamar 28 Vdc Regulator Check
Figure 8



Lamar 28 Vdc Overvoltage Check
Figure 9

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EXTERNAL POWER

1. Description

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 early airplanes the battery is under the forward baggage compartment and the external power receptacle is located on the lower left side of that fuselage section, if installed. Further, in the 14-volt airplanes (HP S/N's 3246001 thru 3246017) the optional Piper External Power (PEP) uses a Piper-unique connector and is supplied with a special jumper cable.

2. Operation

CAUTION: ENSURE THE VOLTAGE AND POLARITY OF THE EXTERNAL POWER SOURCE CORRESPONDS TO THE AIRCRAFT SYSTEM VOLTAGE AND POLARITY. IF A GROUND POWER UNIT ENSURE IT IS SET CORRECTLY. IF A BATTERY VERIFY VOLTAGE IS CORRECT.

A. Ground Power

(1) Set the ground power unit to the proper voltage and polarity or, if using a single voltage ground power unit (or battery) ensure it is the proper voltage and polarity.

(2) Turn aircraft Master Switch and all electrical equipment OFF.

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

(a) Insert plug of a standard 28Vdc power source into the external power socket in the fuselage (see Description, above). Note that, after inserting plug, the electrical system is ON.

(b) Or, if using an external 28Vdc battery, connect 28Vdc aircraft jumper cables to the battery: RED cable to the POSITIVE (+) terminal and BLACK cable to the NEGATIVE (-) terminal and then plug jumper cable into external power socket located on fuselage (see Description, above). Note that, after inserting plug, the electrical system is ON.

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

(a) Insert plug of a Piper-specific 14Vdc power source into the external power socket in the fuselage (see Description, above). Note that, after inserting plug, the electrical system is ON.

(b) Or, if using an external 14Vdc battery, 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 (see Description, above). Note that, after inserting plug, the electrical system is ON.

(5) When using external power for operation of any of the airplane's equipment, the Master Switch must be ON.

B. Starting

CAUTION: ENSURE THE VOLTAGE AND POLARITY OF THE EXTERNAL POWER SOURCE CORRESPONDS TO THE AIRCRAFT SYSTEM VOLTAGE AND POLARITY. IF A GROUND POWER UNIT ENSURE IT IS SET CORRECTLY. IF A BATTERY VERIFY VOLTAGE IS CORRECT.

CAUTION: IF AIRCRAFT BATTERY IS WEAK, CHARGING CURRENT WILL BE HIGH. DO NOT TAKE OFF UNTIL CHARGING CURRENT FALLS BELOW 20 AMPS. DO NOT TAKE OFF WITH A COMPLETELY DISCHARGED BATTERY AS THREE VOLTS IS NEEDED TO EXCITE THE ALTERNATOR.

NOTE: Should the hydrometer reading indicate less than 1190, the aircraft battery should be removed and recharged or replaced.

NOTE: For all normal operations using an external battery and jumper cables, the master switch should be OFF, but the ship's battery can be used in parallel by turning the master switch ON. This will give longer cranking capabilities, but will not increase the amperage.

To start the engine with external power proceed as follows:

(1) Routine

(a) Turn aircraft Master Switch and all electrical equipment OFF.

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

1) 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.

2) Or, if using an external 24-volt battery, connect 28Vdc aircraft jumper cables to the battery: RED cable to the POSITIVE (+) terminal and BLACK cable to the NEGATIVE (-) terminal and then plug jumper cable into external power socket located on fuselage. Note that, after inserting plug, the electrical system is ON.

(c) In HP S/N's 3246001 thru 3246017 only:

1) Insert plug of a Piper-specific 14Vdc power source into the external power socket in the fuselage. Note that, after inserting plug, the electrical system is ON.

2) Or, if using an external 12-volt battery, 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.

(d) Leave Master Switch OFF and proceed with engine starting technique as follows:

CAUTION: SEE "CRANKING LIMITATIONS" IN 80-10-00.

1) Start engine with the standard technique.

2) After starting reduce power to the lowest possible RPM to reduce sparking when disconnecting external power cable.

(e) Turn all electrical equipment OFF and remove the jumper cable plug from the aircraft.

WARNING: DO NOT ATTEMPT ANY FLIGHT IF THERE IS NO INDICATION OF ALTERNATOR OUTPUT.

CAUTION: IF AIRCRAFT BATTERY IS WEAK, CHARGING CURRENT WILL BE HIGH. DO NOT TAKE OFF UNTIL CHARGING CURRENT FALLS BELOW 20 AMPS. DO NOT TAKE OFF WITH A COMPLETELY DISCHARGED BATTERY AS THREE VOLTS ARE NEEDED TO EXCITE THE ALTERNATOR.

(f) Turn the aircraft Master Switch to the ON position and check the alternator ammeter for an indication of output.

(g) 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.

(2) Emergency

When starting the airplane with a single external battery and the airplane's battery is nearly depleted, use the following procedure:

NOTE: Should the hydrometer reading indicate less than 1190, the aircraft battery should be removed and recharged or replaced.

(a) Disconnect the airplane's battery at the ground (negative) terminal to prevent excessive loading of the external starting battery.

(b) Check that all of the airplane's electrical equipment is turned OFF.

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

Connect 28Vdc aircraft jumper cables to the 24-volt battery: RED cable to the POSITIVE (+) terminal and BLACK cable to the NEGATIVE (-) terminal and then plug jumper cable into external power socket located on fuselage. Note that, after inserting plug, the electrical system is ON.

(d) In HP S/N's 3246001 thru 3246017 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.

CAUTION: SEE "CRANKING LIMITATIONS" IN 80-10-00.

(e) Turn master switch ON and start engine using normal starting procedure.

(f) After starting reduce power to the lowest possible RPM to reduce sparking when disconnecting external power cable.

(g) Turn master switch OFF; remove external battery and then reconnect the airplane's battery at the ground (negative) terminal.

WARNING: DO NOT ATTEMPT ANY FLIGHT IF THERE IS NO INDICATION OF ALTERNATOR OUTPUT.

CAUTION: IF AIRCRAFT BATTERY IS WEAK, CHARGING CURRENT WILL BE HIGH. DO NOT TAKE OFF UNTIL CHARGING CURRENT FALLS BELOW 20 AMPS. DO NOT TAKE OFF WITH A COMPLETELY DISCHARGED BATTERY AS THREE VOLTS ARE NEEDED TO EXCITE THE ALTERNATOR.

(h) Turn master switch ON and check ammeter for battery charging current.

(i) 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 LOAD DISTRIBUTION

Electrical System Component Loads

A. 14 Volt Systems

See Chart 1.

B. 28 Volt Systems

See Chart 2.

CHART 1
ELECTRICAL SYSTEM COMPONENT LOADS - 14 VOLT SYSTEM

Duty Cycle Cont.	Duty Cycle Inter.	Circuit Equipment	Circuit 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 Coordinator	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	

CHART 2
ELECTRICAL SYSTEM COMPONENT LOADS - 28 VOLT SYSTEM

Duty Cycle Cont.	Inter.	Circuit Equipment	Circuit 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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GRIDS 2J24 THRU 3B24
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CHAPTER

25

EQUIPMENT / FURNISHINGS

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CHAPTER 25

LIST OF EFFECTIVE PAGES

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CHAPTER 25 - EQUIPMENT / FURNISHINGS

TABLE OF CONTENTS

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FLIGHT COMPARTMENT

1. Pilots Seat Lock and Release Rigging (Refer to Figure 1)

   A. Loosen screws and loosen clamps to allow push-pull cable to move within the clamps.

   B. Place a straightedge along lower surface of seat back release bushing.

   C. Adjust push-pull cable by raising or lowering until lower surface of the stop assembly is parallel to straightedge.

   D. Secure push-pull cable in position by tightening screws on clamps. The stop must be lubricated and free to swivel without excessive play.

   E. Push on seat back to check stop assembly engagement. Rotate seat back release handle and check for seat back disengagement.

2. Lumbar Support (Refer to Figure 2.)

   A. Description

   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.

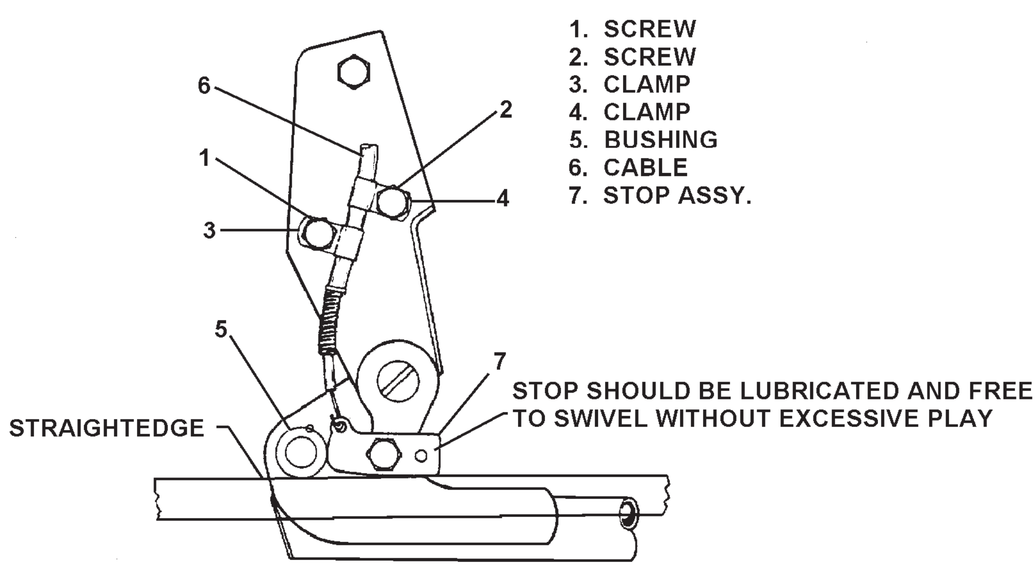
   B. Removal

   (1) Remove seat from airplane.

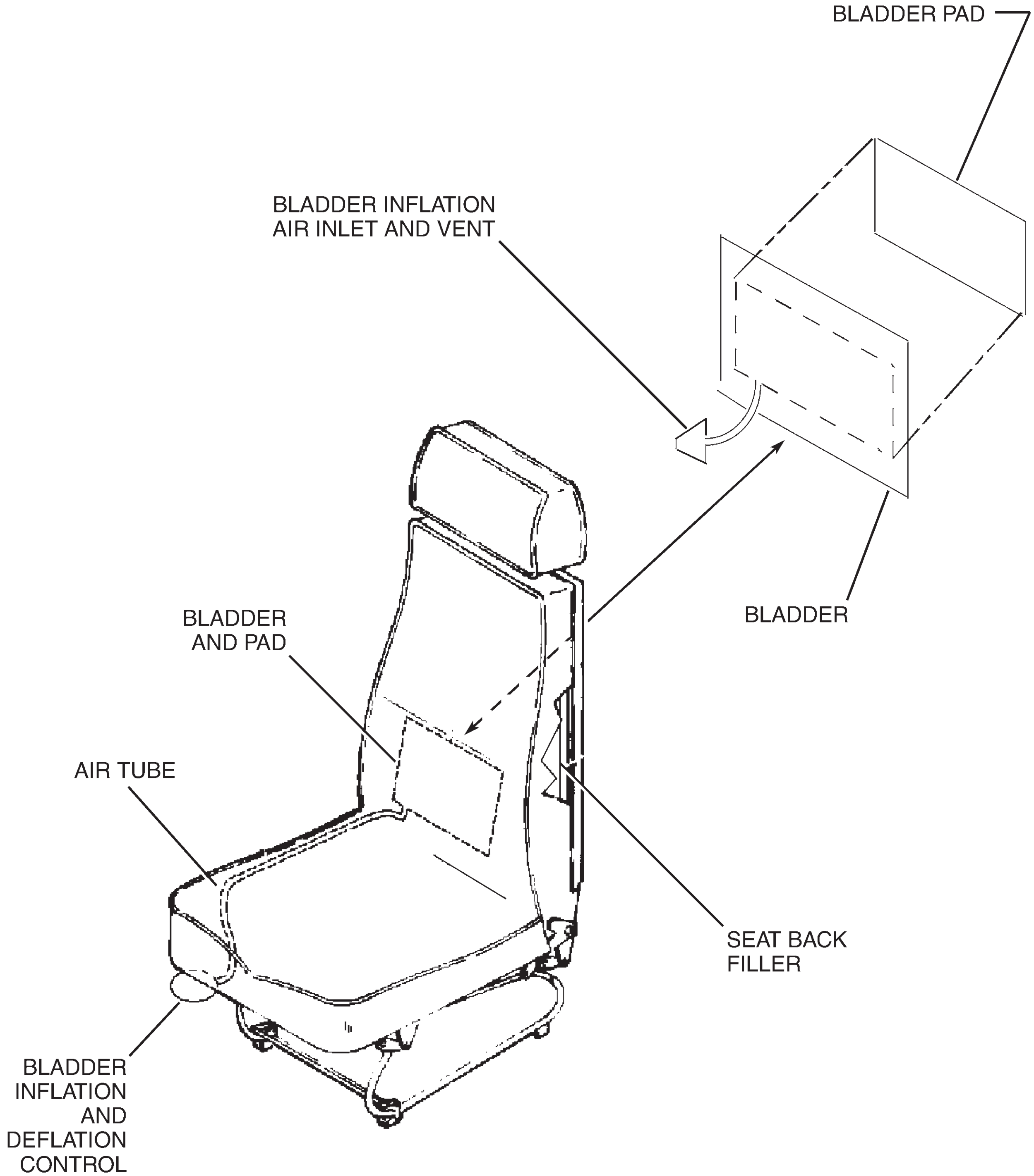
   (2) Loosen velcro securing seat back filler cover.

   (3) Remove only enough of seat back filer cover to expose lumbar bladder.

   NOTE: Inflation tube may be removed before or after bladder is removed from seat back filler. Tube is not glued to nipple attachment; it can be removed by carefully pulling on tube.



Seat Back Lock
Figure 1



Lumbar Seat Bladder Installation
Figure 2

(4) Remove inflation tube from bladder.

CAUTION: DO NOT USE A CHEMICAL SOLVENT TO REMOVE BLADDER. SOLVENT MAY DAMAGE SEAT BACK FILLER

CAUTION: TO AVOID OR MINIMIZE DAMAGE TO SEAT BACK FILLER DURING REMOVAL, USE ONE HAND TO RETAIN SEAT BACK FILLER IN PLACE, WHILE GENTLY REMOVING BLADDER WITH OTHER HAND.

(5) Starting at either right or left edge of bladder, carefully and slowly pull bladder and pad assembly from seat back filler.

C. Installation

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.

(1) If necessary to assemble pad and bladder:

(a) Apply a layer of 3M 847 cement to smooth side of bladder pad.

(b) Apply a layer of 3M 847 cement to back side of bladder (side away from inflation tube nipple).

(c) 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.

(2) Apply a layer of 3M 847 cement to rough side of bladder pad.

(3) Apply a layer of 3M 847 cement to seat back filler where bladder is to be located.

(4) 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.

(5) Install seat back filler cover and secure velcro fastenings.

(6) Install seat in airplane.

3. Carpets

The carpets are individually fastened to the floor with Velcro fasteners and adhesive (Hysol EA9309 NA).

4. Restraint System

An integrated shoulder harness / lap belt restraint system is installed in S/N's 3246159 & up; 3257140 & up. Earlier airplanes employ a traditional lap belt with a separate, detachable, shoulder harness.

A. Inspection

(1) S/N's 3246001 thru 3246158; 3257001 thru 3257139 only:

(a) Shoulder Harness

1 Inspect ends and attachment points for condition and security.

2 Inspect harness web material for condition and wear over its entire length. Particularly look for wear and fraying where harness web passes in and out of inertial reel. If excessively worn, replace.

3 Check inertia reel mechanism by pulling sharply on strap. Verify reel will lock in place under sudden stress.

(b) Lap Belt

1 Inspect ends and attachment points for condition and security.

2 Inspect harness web material for condition and wear over its entire length. Particularly look for wear and fraying where harness web passes in and out of adjustable buckle end. If excessively worn, replace.

3 Inspect shoulder harness keeper nylon bushing. If excessively worn or missing, replacement of that half of the lap belt is required.

(c) In S/N's 3246001 thru 3246009 only.

1 If Piper Service Bulletin No. 990 has been complied with, no further action is required. If not, then inspect seat belts at each position.

2 Replace all belts manufactured by Pacific Scientific and the seat belt has a date stamp of 6/94 thru 8/95, if the seat belt buckle end has an old Piper logo (large stylized “P”) or no logo, and if the seat belt fitting end I.D. tag has a date stamp of 6/94 thru 8/95.

3 Replacement belts, fitting end and buckle end, should be ordered under the same part number(s) found on the suspect seat belts as no new part numbers were issued. Order the appropriate quantity of: Seat Belt, Fitting End - P/N 564-867; Buckle End (short) - P/N 564-868; Buckle End (medium) - P/N 564-889; and/or, Buckle End (long) - P/N 564-862.

4 Check the new seat belts for operation and security, after installation.

5 Make an appropriate logbook entry of compliance with Service Bulletin No. 990.

6 Pending replacement of the suspect seat belts, the aircraft may be flown, provided the Pilot-In-Command inspects each seat belt being used for secure positive latching and that the seat belts are free of any anomalies prior to each flight and during each use.

(2) S/N's 3246159 and up; 3257140 and up:

Integrated Shoulder Harness / Lap Belt (Schroth)

(a) Inspect ends and attachment points for condition and security.

(b) Inspect harness web material for condition and wear over its entire length. Particularly look for wear and fraying where harness web passes in and out of inertial reel and in and out of the adjusting buckle. If excessively worn, replace.

(c) Check inertia reel mechanism by pulling sharply on strap. Verify reel will lock in place under sudden stress.

B. Inertial Reel Adjustment

The inertial reel locking feature prevents the shoulder strap from extending and holds occupant in place. For normal movement strap will extend and retract as required. If required, adust inertial reel as follows:

(1) Allow harness to wind up on reel as much as possible.

(2) On end of reel, pry off plastic cover over spring. Make sure spring does not come out of plastic cover. Set aside plastic cover.

(3) Unwind the harness completely. Measure and mark the harness 24 inches from the reel center.

(4) Wind harness onto reel until the 24 inch mark is reached. Hold reel and place cap with spring over reel shaft end.

(5) Align slot in shaft with spring tang. Wind spring 6 1/2 turns and snap plastic cover into holes in reel end shaft.

(6) Release harness and allow harness to wind up. Extend harness several times to check reel for smooth operation.

(7) Hold inertia reel with reel completely wound and inertia mechanism end up. Pry off plastic cover over mechanism and set reel aside.

(8) Install nut in plastic cover so that stud in cover is flush with nut surface. Position cover over reel and snap cover into place. Extend harness several times to ensure reel operates smoothly.

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PASSENGER COMPARTMENT

Entertainment/Executive Console

(HP S/N's 32460088 & up and TC S/N's 3257001 & up only.) (See Figure 1.)

The Entertainment/Executive Console is optional 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.

A. Removal (Refer to Figure 2.)

WARNING: REMOVE ALL ELECTRICAL POWER FROM THE AIRPLANE BEFORE REMOVING CONSOLE.

(1) Remove fire extinguisher from forward side of console (behind copilot seat).

(2) Disconnect electrical connections from console. (Electrical connections are standard connections, no special tools are necessary.)

(3) Remove four mounting bolts from aft side, bottom of console (the side facing the forward facing passenger seats). (Bolts may be hidden behind carpet.)

Entertainment / Executive Console
Figure 1

Console Mounting Bolts
Figure 2

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.

(4) Slide console aft until back legs are clear of retainers.

CAUTION: SET CONSOLE DOWN ON TO SURFACE GENTLY TO PREVENT BENDING ANGLE BRACKET.

(5) 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.

B. Installation (Refer to Figure 2.)

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.

(1) Align console into position, engaging back legs into retainers.

(2) 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.

(3) Connect electrical connections to console. (Electrical connections are standard connections, no special tools are necessary.)

(4) Install fire extinguisher to front of console (behind copilot seat).

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EMERGENCY

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

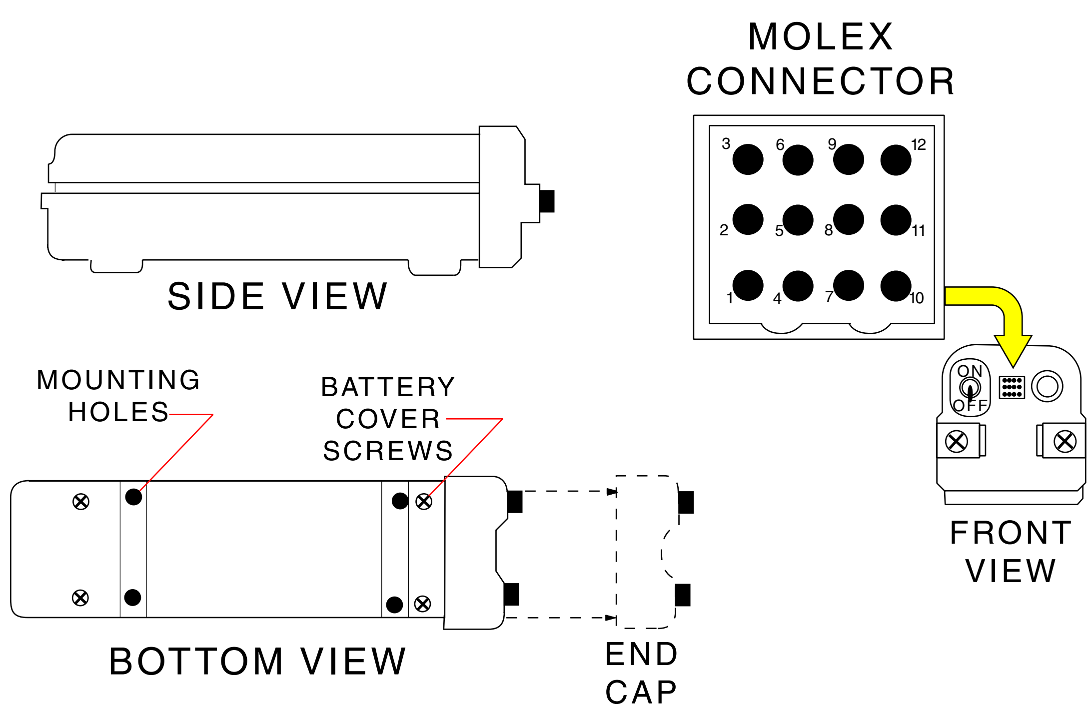
This section contains information necessary to perform operational checks of the Emergency Locator Transmitter (ELT), with and without a pilot's remote switch. Included are the appropriate removal and installation instructions to facilitate battery replacement.

1. Artex ELT 110-4 Emergency Locator Transmitter (ELT)

A. Description

The Artex ELT 110-4 was installed as standard equipment in S/N's 3246001–3246244 and 3257001–3257463. It transmits on 121.5 mHz and 243.0 mHz, and is designed to meet or exceed the requirements of TSO C91a and FAR Part 91. Electrical power for ELT transmissions is totally supplied by its own self-contained battery. The battery must be replaced if the transmitter has been used in an emergency situation, if accumulated test time exceeds one hour, or no later than the replacement date marked on the transmitter label, whichever comes first.

(1) The ELT 110-4 cannot be accidentally activated by dropping the unit, handling it roughly, or during shipping. However, when properly mounted, and locked into its mounting tray, the ELT will activate in a crash, regardless of the cockpit remote switch and ELT switch position. The normal position of the ELT switch is in the down or OFF position. The normal position of the remote cockpit switch is in down or ARM position.



Artex ELT 110-4
Figure 1

(2) Whenever the ELT is activated, a red light located just above the remote cockpit switch will blink to alert the pilot or maintenance personnel. Should the ELT be activated accidentally, it must be reset. To reset:

(a) Position the remote cockpit switch to ON, then immediately reposition it to ARM, or;

(b) position the switch on the ELT to ON, then immediately reposition it to OFF.

B. Inspections

(1) 100 Hour

Inspect per the 100 hour inspection (including the Antenna Test) under Artex ME406 ELT, below.

(2) Annual

Every 12 months, inspect the ELT installation as follows:

NOTE: The following inspection satisfies the requirements of FAR 91.207.

(a) Remove ELT from the airplane per Removal, below. While doing so:

CAUTION: DO NOT USE CONTACT CLEANER ON ELT COMPONENTS. SUCH CHEMICAL AGENTS CAN BE HIGHLY DESTRUCTIVE TO THE MOUNTING HARDWARE AND ELT HOUSING.

1) Visually inspect and confirm proper seating of all connector pins. Special attention should be given to coaxial center conductor pins which are prone to retracting into the connector housing.

2) Inspect the mounting hardware. Ensure the hardware is free of cracks or other obvious damage.

(b) Battery Inspection

1) Remove the four (4) securing screws from the bottom of the ELT.

2) Position the ELT product label (arrow) side down, and carefully lift the battery pack away from the ELT and lay it alongside the ELT.

3) Carefully disconnect the harness from the connnector in the black plastic housing. Use a flat-bladed screwdriver to pry the connector out of its mating plug.

4) Inspect the battery pack and ELT chassis. The battery cells, components and connectors should be free of corrosion.

5) Inspect for broken wires, connections, or damage.

6) Ensure the battery housing is free of cracks or other visible damage.

7) Verify the battery expiration date. If the battery pack has not expired it may be reinstalled. The battery pack must be replaced with a new one:

a) After use in an emergency;

b) After an inadvertent activation of unknown duration;

c) When the total of all known transmissions exceeds one (1) hour; or

d) On or before the battery replacement (expiration) date.

(c) Perform G-switch Check under Testing, below.

(d) Reinstall ELT into airplane per Installation, below.

(e) Perform Antenna Test per the procedure under Artex ME406 ELT, below.

(f) Reset ELT by turning ELT switch to “ON” then to ‘OFF/ARM” position.

(g) Make an appropriate logbook entry documenting completion of this inspection and whether or not the ELT passed or failed.

C. Removal

See “Figure 1”.

The ELT is located in the aft fuselage (tail cone), on the right hand side just forward of the stabilizer leading edge. Access is through a removable panel on the right side of the fuselage.

NOTE: Removing and installing the ELT requires disoonnnecting the aircraft main battery. In S/N’s 3246001–3246087 only the main battery is under the floor of the foward baggage compartment and accessed via a panel on the left side of the fuselage. In S/N’s 3246088 and up, and 3257001 and up; the main battery is in the aft fuselage behind the cabin rear closeout panel.

(1) Remove appropriate access panels/closeouts to access the airplane main battery.

(2) Disconnect the ground (negative) cable from airplane’s battery.

(3) At the right side of the empennage, remove four (4) screws and remove the ELT access panel.

(4) Remove the ELT from the airplane:

(a) Loosen the two screws on the front of the mounting tray and pull mounting tray cap off.

(b) Disconnect coax (antenna) cable.

(c) Disconnect the Molex cable from the ELT unit.

(d) Remove unit from airplane. Lift unit from the connector end. Careful use of a flat-bladed screwdriver as a lever makes this step easier.

D. Installation

(1) 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.

(2) Replace ELT access panel and secure with four (4) screws.

(3) Reconnect the negative (ground) cable to the airplane main battery.

(4) Install appropriate access panels/closeouts.

(5) Perform Installed Transmitter Self-Test under Testing, below.

E. Battery Replacement

(1) Removal

(a) If required, remove the ELT from the airplane per Removal, above.

(b) Remove the four (4) screws on the bottom of the ELT securing the battery pack.

(c) Disconnect battery pack connector from main unit. Use a flat-bladed screwdriver to pry the connector out of its mating plug.

(d) Remove battery pack from unit.

(2) Installation

(a) Securely plug in new battery pack connector to main unit.

(b) Immediately reset unit by positioning unit switch to ON, then to OFF.

(c) Fit new battery pack into place. Ensure all gaskets are properly aligned.

(d) Replace the four screws. Dress wires away from standoffs to avoid pinching wires between standoffs and the battery pack.

(e) Install ELT into airplane per Installation, above.

F. Testing

CAUTION: ALL ELT "ON" TESTS SHOULD BE PERFORMED WITHIN THE FIRST FIVE (5) MINUTES AFTER THE HOUR UTC OR AS REQUIRED BY LOCAL OR NATIONAL AUTHORITIES. NOTIFY ANY NEARBY CONTROL TOWER OF YOUR INTENTIONS.

CAUTION: DO NOT ALLOW TEST DURATION TO EXCEED FIVE (5) SECONDS.

CAUTION: CONSULT FAA ADVISORY CIRCULAR AC 91-44A, LATEST REVISION, FOR DETAILED INFORMATION CONCERNING UNSHIELDED TESTING.

Always perform the tests within the first five (5) minutes of the hour. Notify any nearby control tower of your intentions. If outside of the US, always follow all local or national regulations for testing ELTs. Do not allow test duration to exceed five (5) seconds. Any time the ELT is activated it is transmitting a 121.5 MHz distress signal.

The transmitter operates on the emergency frequencies of 121.5 and 243.0 MHz; both of these frequencies are monitored by the various FAA installations. Before performing any operational test of the ELT, the following precautions should be observed:

- Test should be no longer than three audio sweeps.
- Test should be conducted only within the time period made up of the first five minutes after any hour.
- If the operational tests must be made at a time not included within the first five minutes after the hour, the test should be coordinated with the closest FAA Tower or Flight Service Station.

(1) Installed Transmitter Test (Self-Test) (Every 90 Days)

(a) Turn both the airplane master switch and the radio master switch ON.

(b) Tune airplane communications receiver to 121.5 mHz and select SPKR on the audio panel.

(c) Turn the ELT aircraft panel switch to "ON", wait for three (3) sweeps on the receiver, which takes about one (1) second, and then turn the switch back to the "ARM" position.

(d) To pass the test, you must hear the three (3) sweeps and see the front panel light immediately begin to flash continuously until the unit is switched to "ARM".

1) During the "ON" to "ARM" transition, the microprocessor in the ELT checks the "G-Switch" (automatic activation switch) latching circuit, pins 5 and 8 on the tray connector.

2) If there is a problem, the processor will not immediately turn on the cockpit light during those first few sweeps. For example, if the jumper between pins 5 and 8 was not installed or was open, the cockpit light would flash momentarily upon ELT activation and the stay off for approximately three (3) seconds before beginning to flash continuously.

3) Repairs should be done only by a licensed aviation radio repair shop.

(2) Antenna Test (Each 100 Hours)

Use the procedure under Artex ME406 ELT, below.

(3) G-switch Check (Annually)

CAUTION: AS WITH ALL BEACON-TESTING, THIS TEST SHOULD BE PERFORMED WITHIN THE FIRST FIVE (5) MINUTES OF THE HOUR, AND ANY LOCAL CONTROL TOWER SHOULD BE ADVISED OF THE TEST.

A basic test of G-switch operation can be performed as follows:

(a) Setup

1) Remove the ELT from the airplane per Removal, above.

2) Fabricate a “shorting plug” by obtaining an appropriate connector and installing a jumper (i.e. - short) between Pins 5 and 8. (Artex sells a test plug for this purpose under part number 151-2012.)

NOTE: Be sure the correct pins are shorted. Some connections will force the ELT to activate. Others will keep the unit from activating in any circumstance. No combination of shorts will cause permanent damage to the ELT, however all wrong pin combinations erroneously indicate a faulty ELT.

If the ELT activates without any pins shorted it is defective and should be returned for repair.

3) Install the “shorting plug” on the ELT.

4) For a more thorough test, monitor the transmission with an AM receiver tuned to 121.5 MHz, as described in Transmitter Test, below.

(b) Procedure

The ELT should remain OFF until an acceleration of three (3) Gs or more is applied axially, in the rearward direction. This action should activate the unit, transmitting immediately on 121.5 MHz.

CAUTION: MAINTAIN A FIRM GRIP ON THE ELT.

1) Apply acceleration greater than three (3) Gs to the ELT, in the rearward direction. This can be achieved by using a rapid forward (throwing) motion in the direction of the label arrow, then rapidly reversing the direction.

2) Monitor ELT activation by observing the ELT LED (and AM receiver, if desired).

3) Allow ELT to transmit only long enough to verify operation.

4) Reset ELT by turning ELT switch to “ON” then to ‘OFF” position.

G. Electrical Schematic

See 91-25-60.

2. Artex ME406 ELT

A. Description and Operation

The Artex ME406 ELT is installed as standard equipment in Saratoga II TC airplanes, S/N's 3257464 and up. It is a fully TSO-C126 / ETSO-2C126 certified, type AF (automatic fixed) beacon 406 MHz ELT. All functions of the ME406 are under microprocessor control. A self-test routine checks ELT operation and installation, then presents the results as visual and auditory "error codes" to aid in troubleshooting and to indicate status. The ME406 is pre-programmed at the factory using a short message format. These user protocols are supported: Serial Number, Tail Number, 24-Bit Aircraft Address, and Aircraft Operator Designator/Serial Number.

The battery pack consists of two (2) D-size lithium cells mounted in a cover assembly; it is field replaceable. The rated life of the pack is five (5) years or one hour of use, whichever comes first, as specified by FAR 91.207(c).

In the event of a crash, the ME406 activates automatically, and transmits the standard swept tone on 121.5 MHz lasting until battery power is gone. In addition, for the first 24 hours of operation, a 406 MHz signal is transmitted at 50-second intervals. This transmission lasts 440 ms and contains identification data programmed into the beacon and is received by Cospas-Sarsat satellites. Position accuracy of the 121.5 MHz signal is approximately 15-20 km radius about the transmitter. Accuracy of the 406 MHz signal is within about a 3 km radius.

In a crash, an acceleration-activated crash sensor (G-switch) turns the ELT "ON" automatically when the ELT experiences a change in velocity (or deceleration) of 4.5 fps ± 0.5 fps. Activation is also accomplished by means of the cockpit-mounted remote switch or the local switch on the ELT. To deactivate the ELT, set either switch to the "ON" position, then back to 'ARM'.

The ELT does not have an "OFF" position. Instead, a jumper between two pins on the front D-sub connector must be in place for the G-switch to activate the unit. The jumper is installed on the mating half of the connector so that when the connector is installed, the beacon is armed. This allows the beacon to be handled or shipped without "nuisance" activation (i.e. - front connector removed).

NOTE: The ELT can still be manually activated using the local switch on the front of the ELT. Care should be taken when transporting or shipping the ELT not to move the switch or allow packing material to become lodged such as to toggle the switch.

If the ELT is inadvertently activated, deactivate it by setting either switch to the "ON" position and then back to "ARM".

B. Troubleshooting

See Chart 1.

CHART 1 (Sheet 1 of 2)
TROUBLESHOOTING ME406 ELT

Trouble	Cause	Remedy
3 Flash Error after performing Self Test.	Bad load detect. Detects open or short condition on the antenna output or cable.	Check that the RF cable is connected and in good condition. Perform continuity check of center conductor and shield. Check for a shorted cable. Check for intermittent connection in the RF cable. If this error code persists there may be a problem with the antenna installation. Check this with a VSWR meter. Check the antenna for opens, shorts, resistive ground plane connection.
4 Flash Error after performing Self Test.	Low power detected. Occurs if output power is below about 33 dBm (2 watts) for the 406 signal or 17 dBm (50 mW) for the 121.5 MHz output. Also may indicate that 406 signal is off frequency.	Verify battery voltage. Replace battery if low voltage (~5.6 VDC) or if 7 Flash error is also present. Verify 406 MHz frequency. If bad, return for repair / replacement.
5 Flash Error after performinq Self Test.	Indicates that the ELT has not been proqrammed.	Read ELT 406 MHz signal to verify programming.
6 Flash Error after performing Self Test.	Indicates that G-switch loop between pins 5 and 12 at the D- sub connector is not installed. ELT will not activate during a crash.	Check that the harness D-sub jumper is installed iby verifying less thant one (1) ohm of resistance between pins 5 and 12. If missing, install jumper wire.
7 Flash Error after performing Self Test.	Indicates that the ELT battery has too much accumulated operation time (more than one hour) per regulation. May also indicate damage to the battery circuit.	Replace battery. If error does not clear after battery replacement, check continuity of battery circuit and correct function of circuit components.

CHART 1 (Sheet 2 of 2)
TROUBLESHOOTING ME406 ELT

Trouble	Cause	Remedy
Remote Switch LED always ON (steady).	Wiring error or frayed wires shorting out pins on back of Remote Switch.	Verify wiring. Verify integrity of all crimp or solder connections on harness.

C. Inspections

(1) 100 Hour

Each 100 hours time-in-service, inspect the ELT installation as follows:

(a) Inspect the ELT unit and mount for proper installation and secure mounting.

(b) Inspect wiring and conduits for proper routing, secure mounting, and obvious defects.

(c) Inspect bonding and shielding for proper installation and condition.

(d) Inspect antenna for condition, secure mounting, and proper operation (per Antenna Test under Testing, below).

(2) Annual

Every 12 months, inspect the ELT installation as follows:

NOTE: The following inspection satisfies the requirements of FAR 91.207.

(a) Remove ELT from airplane per Removal, below. While doing so:

1) Visually inspect and confirm proper seating of all connector pins. Special attention should be given to coaxial center conductor pins which are prone to retracting into the connector housing.

2) Inspect mounting hardware. Ensure the hardware is free of cracks or other obvious damage.

(b) Battery Inspection

NOTE: The battery pack has static-sensitive parts. Take ESD precautions before handling.

1) Remove the eight (8) securing screws from the battery-side-cover.

NOTE: Battery pack is identified by the embossed text: “BATTERY ACCESS ON THIS SIDE”.

CAUTION: DO NOT PULL ON THE FLEXIBLE PART OF THE CABLE - USE THE RIGID SECTION OF THE FLEX CIRCUIT AT THE CONNECTOR AS A HANDLE.

2) Carefully lift the battery cover (battery pack) away from the ELT and unplug the flex-cable connected to the pack.

3) Inspect the battery pack and ELT chassis. The battery cells, components and connectors should be free of corrosion.

4) Inspect flex-circuit for broken connections or damage.

5) Ensure the battery housing is free of cracks or other visible damage.

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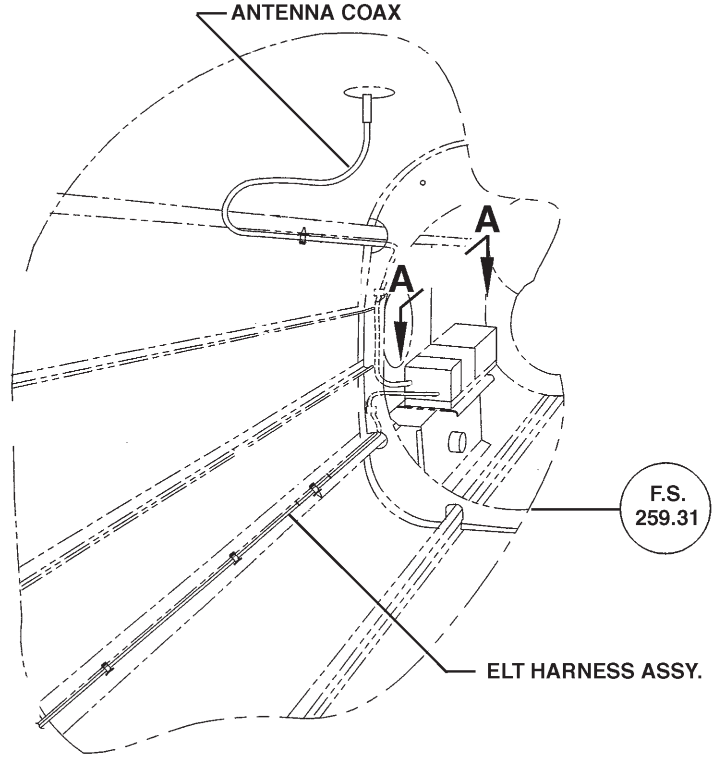
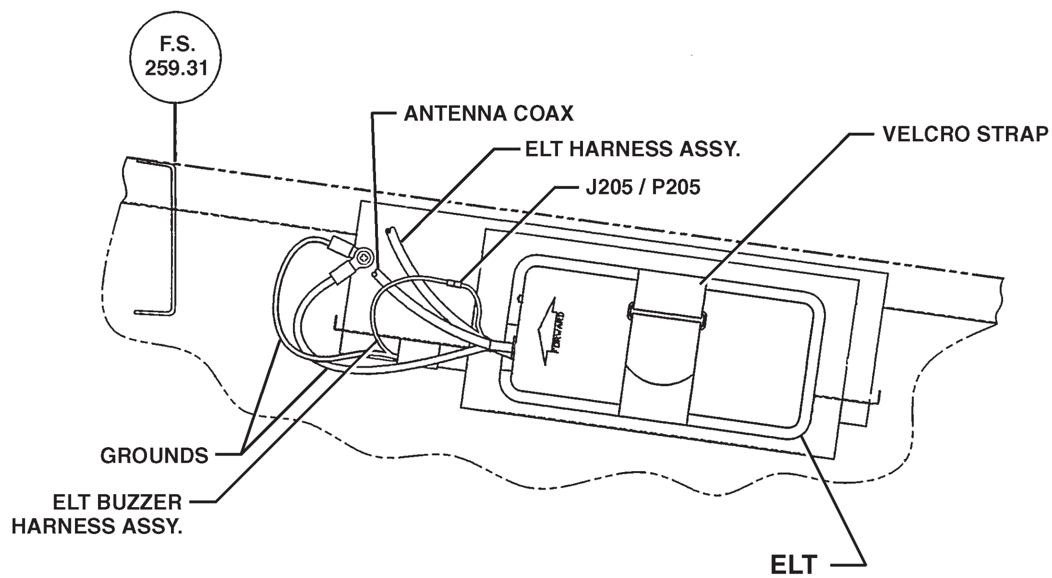


LOOKING AFT, RIGHT SIDE



VIEW A - A

Artex ME406 ELT
Figure 2

Effectivity
3257464 and up

6) Verify the battery expiration date. If the battery pack has not expired it may be reinstalled. The battery pack must be replaced with a new one:
   a) After use in an emergency;
   b) When the transmitter has been in use for more than one (1) cumulative hour (i.e. - 7 flash error);
   c) After an inadvertent activation of unknown duration; or
   d) On or before the battery replacement (expiration) date.

(c) Perform G-Switch Check under Testing, below.
(d) Reinstall ELT into airplane per Installation, below.
(e) Perform Antenna Test under Testing, below.
(f) Perform Digital Message Verification under Testing, below.
(g) Reset ELT by turning ELT switch to “ON” then to ‘ARM” position.
(h) Check ELT for signs of registration. In the US, NOAA supplies a beacon registration label that is applied to the ELT when it is registered.
(i) Make an appropriate logbook entry documenting completion of this inspection and whether or not the ELT passed or failed.

D. Removal

See “Figure 2”.

(1) In the cabin, remove the rear closeout panel.
(2) Disconnect and remove the ground (negative) cable from battery.
(3) At right side of empennage, remove four (4) screws and remove ELT access panel.
(4) Loosen the thumbscrews and remove the D-sub and RF connectors.
(5) Loosen the velcro strap and remove the ELT from its mounting tray.

E. Installation

See “Figure 2”.

(1) Insert the ELT into the mounting tray at an angle so that the locking ears at the end fit into the mounting tray locking slots.
(2) Fasten the Velcro strap around the ELT so that it is firmly held in place.
(3) Insert the D-sub and RF connectors ensuring that they are seated properly.
(4) Tighten the thumbscrews.
(5) At right side of empennage, place ELT access panel in position and secure with four (4) screws.
(6) In the rear cabin, connect the negative (ground) cable to battery.
(7) Reinstall the rear closeout panel.
(8) Perform Installed Transmitter Test (Self Test), under Testing, below.

F. Battery Replacement

NOTE: When replacing the battery pack, a replacement kit containing the battery pack, replacement gasket, hardware and labels is available.

(1) Remove ELT per Removal, above.

(2) Remove the battery pack as follows:

NOTE: The battery pack contains static-sensitive parts, so take ESD precautions before handling.

(a) Remove the eight (8) securing screws from the battery-side-cover.

NOTE: Battery pack is identified by the embossed text: “BATTERY ACCESS ON THIS SIDE”.

CAUTION: DO NOT PULL ON THE FLEXIBLE PORTION OF THE CABLE - USE THE RIGID SECTION OF THE FLEX CIRCUIT AT THE CONNECTOR AS A HANDLE.

(b) Carefully lift the battery cover (battery pack) away from the ELT and unplug the flex-cable connected to the pack.

(c) Discard/recycle the old battery pack.

(3) Lay the new battery pack on the work surface with the batteries facing up.

(4) Install a replacement seal in the slot along the perimeter of the housing.

(5) Leaving the battery as it is, position the ELT over the battery pack with one hand and plug the flex-cable connector into the battery assembly using the other. The cable should not be twisted and the connector should ‘click’ into place.

NOTE: The battery connector is keyed to prevent incorrect installation.

(6) Mate the ELT to the battery, making sure the seal is positioned correctly during the process.

(7) Replace the eight (8) securing screws and torque to 10–12 inch-lbs.

(8) Install ELT per Installation, above.

(9) Enter pertinent battery replacement information in the aircraft log book and fill out any other documentation required by local authority.

G. Testing

CAUTION: ALL ELT "ON" TESTS SHOULD BE PERFORMED WITHIN THE FIRST FIVE (5) MINUTES AFTER THE HOUR UTC OR AS REQUIRED BY LOCAL OR NATIONAL AUTHORITIES. NOTIFY ANY NEARBY CONTROL TOWER OF YOUR INTENTIONS.

CAUTION: DO NOT ALLOW TEST DURATION TO EXCEED FIVE (5) SECONDS.

Always perform the tests within the first five (5) minutes of the hour. Notify any nearby control tower of your intentions. If outside of the US, always follow all local or national regulations for testing ELTs. Do not allow test duration to exceed five (5) seconds. Any time the ELT is activated it is transmitting a 121.5 MHz distress signal. If the unit operates for approximately 50 seconds, a 406 MHz distress signal is transmitted and is considered valid by the satellite system.

(1) Installed Transmitter Test (Self Test) (Every 90 Days)

(a) Turn both the airplane master switch and the radio master switch ON.

(b) Tune a receiver (usually the aircraft radio) to 121.5 MHz.

(c) Turn the ELT aircraft panel switch to "ON", wait for three (3) sweeps on the receiver, which takes about one (1) second, and then turn the switch back to the "ARM" position while paying special attention to the LED activity upon entering the 'ARM" condition.

(d) To pass the test, you must hear the three (3) sweeps and see the front panel light immediately begin to flash continuously until the unit is switched to "ARM".

1) During the "ON" to "ARM" transition, the microprocessor in the ELT checks the "G-Switch" (automatic activation switch) latching circuit, pins 5 & 12 on the D-sub connector at the ELT; the 406 MHz transmitter for proper RF output and a battery check.

2) If the ELT is working properly, the sequence following entry to the "ARM" condition will result in the panel LED staying illuminated for approximately one (1) second (one pulse), and then extinguishing. The buzzer should also sound once.

(e) If the panel LED and buzzer present more than one (1) pulse when switched to "ARM", determine the problem from the list in Chart 1, above.

(2) Antenna Test

Use a low-quality AM broadcast receiver to determine if energy is being transmitted from the antenna.

(a) Hold the antenna of the radio (tuning dial on any setting) about six (6) inches from the activated ELT antenna. The ELT aural tone should be heard on the AM broadcast receiver.

(b) This is not a measured check, but it does provide confidence that the antenna is radiating sufficient power to aid search and rescue.

NOTE: Use of the aircraft's VHF receiver, tuned to 121.5 MHz, is not recommended. This receiver is more sensitive and could pick up a weak signal even if the radiating ELT antenna is disconnected. While it will confirm the ELT is active, it does not check the integrity of the ELT system

(3) G-switch Check

A basic test of G-switch operation can be performed as follows:

CAUTION: EVEN WITHOUT AN ANTENNA CONNECTED, THE SIGNAL CAN BE RECEIVED BY A SATELLITE. AS WITH ALL BEACON-TESTING, THIS TEST SHOULD BE PERFORMED WITHIN THE FIRST FIVE (5) MINUTES OF THE HOUR, AND ANY LOCAL CONTROL TOWER SHOULD BE ADVISED OF THE TEST.

(a) Setup

1) The ELT must be removed from the airplane. See Removal, above.

2) Fabricate a “shorting plug” by obtaining a standard 15-pin D-sub connector and installing a jumper (i.e. - short) between Pins 5 and 12. (Artex sells a test plug for this purpose under part number 150-1130.)

NOTE: Be sure the correct pins are shorted. Some connections will force the ELT to activate. Others will keep the unit from activating in any circumstance. No combination of shorts will cause permanent damage to the ELT, however all wrong pin combinations erroneously indicate a faulty ELT.

If the ELT activates without any pins shorted it is defective and should be returned for repair.

3) Install the “shorting plug” on the ELT.

4) For a more thorough test, monitor the transmission with an AM receiver tuned to 121.5 MHz, as described in Transmitter Test, below.

(b) Procedure

The ELT should remain OFF until an acceleration of three (3) Gs or more is applied axially, in the rearward direction. This action should activate the unit, transmitting immediately on 121.5 MHz.

CAUTION: MAINTAIN A FIRM GRIP ON THE ELT.

1) Apply acceleration greater than three (3) Gs to the ELT, in the rearward direction. This can be achieved by using a rapid forward (throwing) motion in the direction of the label arrow, then rapidly reversing the direction.

2) Monitor ELT activation by observing the ELT LED (and AM receiver, if desired).

3) Allow ELT to transmit only long enough to verify operation.

4) Reset ELT by turning ELT switch to “ON” then to ‘ARM” position.

(4) Digital Message Verification (Annually)

The ARTEX 406 MHz ELT transmits a 406 MHz message upon reset, which is encoded such that it will be ignored by the SAR satellite system. The 15-digit number contained in this transmission is used to register the ELT with the appropriate 406 MHz ELT registration authority. In the US, the National Oceanic and Atmospheric Administration (NOAA) maintains the database of registered ELT's. The information in this database provides the Search and Rescue system with aircraft identification data in the event an actual distress signal is transmitted.

Verify the 406 MHz digital message as follows:

(a) Required Equipment

A test set capable of receiving and decoding the message - i.e., the Artex ELT Test Set P/N 453-1000 or equivilent.

(b) Procedure

1) At right side of empennage, remove four (4) screws and remove ELT access panel.
2) Disconnect the antenna coax cable at the ELT, connect test set or terminate as applicable.
3) Perform all necessary steps to prepare Test Set to receive 406 MHz signal including (but not limited to) turning on power, activating program or any other steps required for the particular Test Set being used.
4) Perform the Installed Transmitter Test (Self Test) as described above.
5) Watch the screen on the Test Set to ensure that a message has been received. Repeat "Self Test" if necessary.
6) View message, and ensure that all applicable information is correct (country code, aircraft ID, etc.).
7) The 15-digit hex ID (for example "ADC6492640D3411F1') should match what is shown on the ELT product label. This is the 15-digit hex ID (Unique Identification Number or "UIN") that is used to register the ELT.
8) At the right side of the empennage, place the ELT access panel in position and secure with four (4) screws.

H. Electrical Schematic

See 91-25-60.

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CHAPTER

26

FIRE PROTECTION

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CHAPTER 26
LIST OF EFFECTIVE PAGES

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CHAPTER 26 - FIRE PROTECTION

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EXTINGUISHING

Portable Fire Extinguisher (See Figure 1.)

WARNING: AFTER DISCHARGE OF EXTINGUISHER AVOID EXPOSURE TO SMOKE, VAPORS AND OTHER BY-PRODUCTS OF FIRE. DO NOT INCINERATE EXTINGUISHER.

CAUTION: EXTINGUISHER IS A PRESSURE VESSEL. PROTECT FROM CORROSIVE CONDITIONS. IF THERE IS ANY CORROSION OR DAMAGE, EXTINGUISHER SHOULD BE CAREFULLY EMPTIED AND DISCARDED. USE ONLY AS DIRECTED.

A. Description

A portable, disposable, Class 2B:C fire extinguisher (Model No. A600) is installed as standard equipment. Containing 1.2 lbs. (550 grams) of Halon 1211/1301 blend, the extinguisher is located on the bottom of the right-hand, rear-facing seat. The extinguisher is secured by a quick-release bracket.

To operate the extinguisher, remove it from the quick-release bracket, hold it upright in either hand by the handgrip, with the spray nozzle pointing forward. Remove the safety pin, direct the nozzle towards the base of the fire source, depress the lever. Maximum extinguishing effect is obtained if the fire fighter uses side to side motion and keeps moving in towards the base of the fire source as it is extinguished. Releasing the lever closes a secondary seal inside the operating head. This interrupts the flow of extinguishant, thus retaining part of the charge, for dealing with a flash back or re-ignition should they occur, without waste or leakage. A partly or totally discharged extinguisher should be replaced immediately after use.

B. Inspection

Disposable-type fire extinguishers should be maintained and inspected in accordance with the nameplate instructions.

(1) Monthly

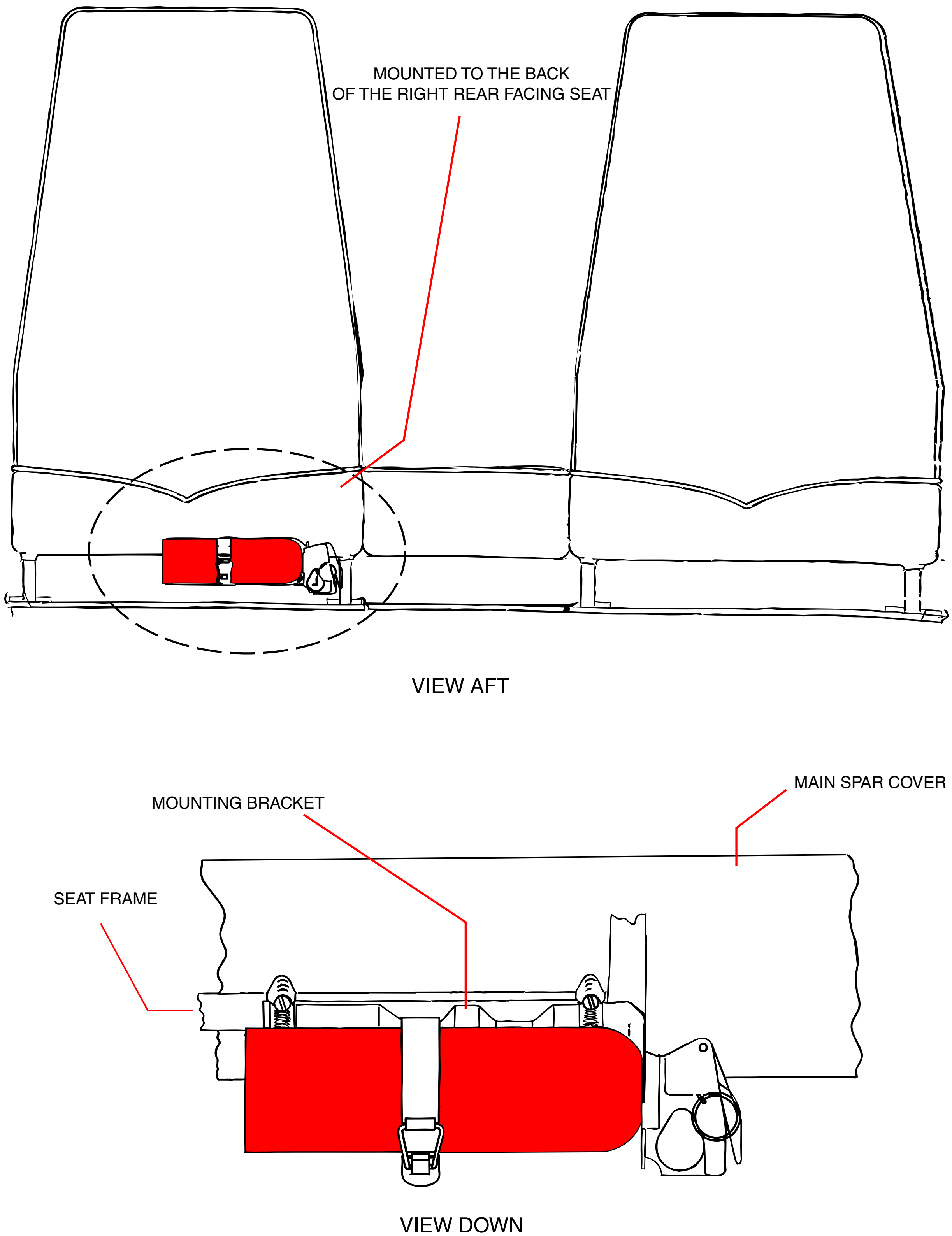
Inspect monthly or more frequently. Ensure nozzle is not obstructed and safety seal is intact. Inspection is a “quick check” that an extinguisher is available and will operate. It is intended to give reasonable assurance that the extinguisher is fully charged and operable. This is done by seeing that it is in its designated place, that it has not been actuated (discharged) or tampered with, and that there is no obvious physical damage or condition to prevent operation. Determine fullness by weighing or “hefting.”

(2) 100 Hour / Annual

Each 100 hours or annually, whichever comes first, weigh the extinguisher. Replace and return to manufacturer if gross weight is below the minimum specified on the nameplate.

C. Replacement Interval

Replace disposable-type (non-gauged) fire extinguishers at 12 years from the date of manufacture.



Handheld Fire Extinguisher
Figure 1

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CHAPTER

27

FLIGHT CONTROLS

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CHAPTER 27

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	9	Jun 30/07
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CHAPTER 27 - FLIGHT CONTROLS

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CHAPTER 27 - FLIGHT CONTROLS

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GENERAL

1. 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.

2. 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 the latest revision of AC 43.13-1 or to torques specified within this manual.

D. After completion of adjustment, each jam nut must be tightened securely and inspected.

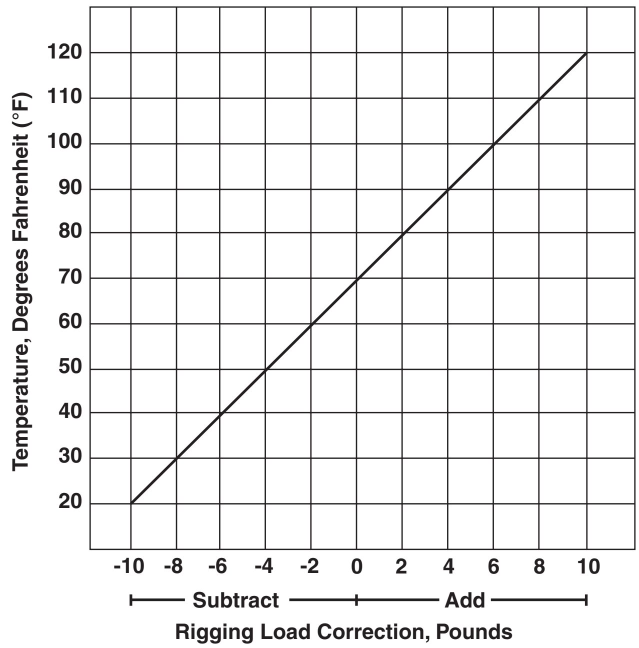
E. On push rods or rod ends provided with an inspection hole, screws must be screwed in sufficiently far to pass the hole. This can be determined visually or, by feel, by inserting a piece of wire into the inspection hole. If no inspection hole is provided, a minimum of 0.375 of an inch thread engagement 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 1.

G. See Figure 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.

CHART 1
CABLE TENSION VS AMBIENT TEMPERATURE



3. Flight Control Surface Travel

   See Chart 2 for specifications, see appropriate section for rigging instructions.

4. Flight Control Cable Tension

   CAUTION: CABLE TENSIONS GIVEN IN CHART 2 APPLY ONLY TO AIRPLANES WITHOUT AUTOPILOT BRIDLE CABLE INSTALLATIONS. IF AN AUTOPILOT USING BRIDLE CABLES HAS BEEN INSTALLED, CONSULT THE APPROPRIATE AUTOPILOT VENDOR PUBLICATION FOR CORRECT CABLE TENSIONS WITH AUTOPILOT BRIDLE CABLES ATTACHED.

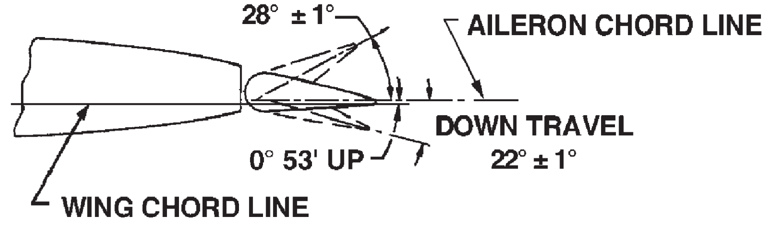
   A. See Chart 2 for specifications, see appropriate section for rigging instructions.

   B. When a new cable is installed, cable tension must be rechecked after flight test.

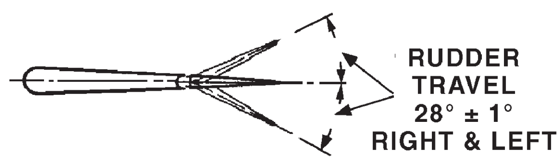
CHART 2 (Sheet 1 of 2)
FLIGHT CONTROL SURFACES RIGGING LIMITS

NOTES

1. Maximum free play for aileron is 0.120 of an inch, measured at trailing edge.
2. Maximum end play (inboard/ outboard must not exceed 0.035 of an inch).

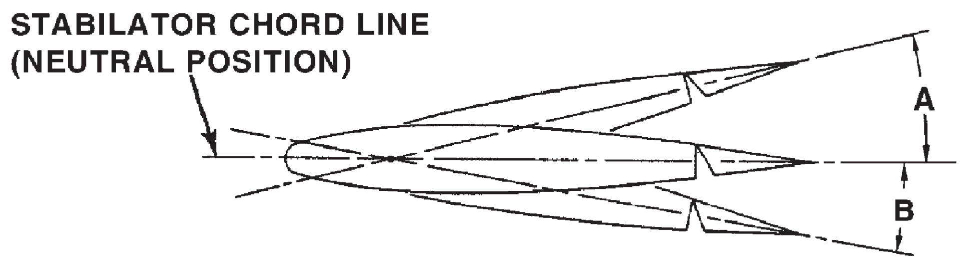


CABLE TENSION
40 LBS. ± 5 LBS



CABLE TENSION
65 LBS. ± 5 LBS.

CHART 2 (Sheet 2 of 2)
FLIGHT CONTROL SURFACES RIGGING LIMITS

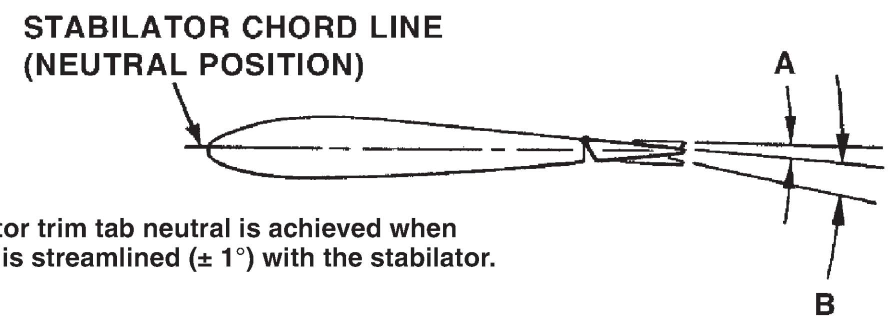


Neutral position of stabilator is when the stabilator chord line is parallel with the top of the front seat tracks. See Rigging and Adjustment, 27-30-00.

Stabilator

CABLE TENSION
40 LBS. ± 5 LBS

A - STABILATOR TRAILING EDGE UP TRAVEL FROM NEUTRAL = 14.5° ± 0.5°
B - STABILATOR TRAILING EDGE DOWN TRAVEL FROM NEUTRAL = 5.5° ± 0.5°



Stabilator trim tab neutral is achieved when the tab is streamlined (± 1°) with the stabilator.

Maximum free play for stabilator trim tab is 0.06 inch measured at tab trailing edge.

Stabilator Trim Tab

CABLE TENSION
14 LBS. ± 1 LB

A - STABILATOR TAB TRAILING EDGE UP TRAVEL FROM NEUTRAL = 5° ± 1°
B - STABILATOR TAB TRAILING EDGE DOWN TRAVEL FROM NEUTRAL = 8° ± 1°

5. Control Cable Inspection

Aircraft control cable systems are subject to a variety of environmental conditions and forms of deterioration that, with time, may be easy to recognize as wire/strand breakage or the not-so-readily visible types of wear, corrosion, and/or distortion. The following data may help in detecting the presence of these conditions:

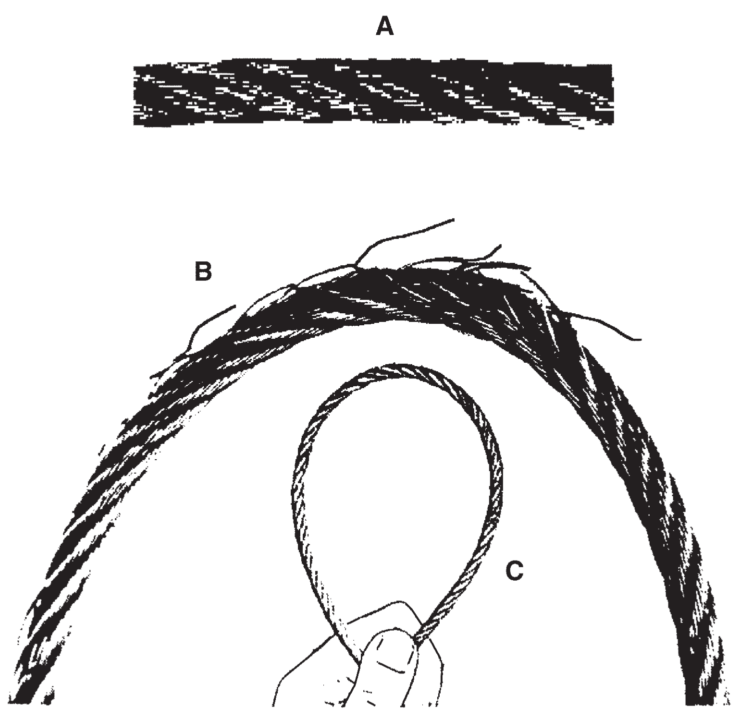
A. Cable Damage

Critical areas for wire breakage are sections of the cable which pass through fairleads and around pulleys. To inspect each section which passes over a pulley or through a fairlead, remove cable from aircraft to the extent necessary to expose that particular section. Examine cables for broken wires by passing a cloth along length of cable. This will clean the cable for a visual inspection, and detect broken wires, if the cloth snags on cable. When snags are found, closely examine cable to determine full extent of damage.

The absence of snags is not positive evidence that broken wires do not exist. Figure 2, View A, shows a cable with broken wires that were not detected by wiping, but were found during a visual inspection. The damage became readily apparent (View B) when the cable was removed and bent using the techniques depicted in View C.

B. External Wear Patterns

Wear will normally extend along cable equal to the distance cable moves at that location. Wear may occur on one side of the cable only or on its entire circumference. Replace flexible and non-flexible cables when individual wires in each strand appear to blend together (outer wires worn 40-50 percent) as depicted in Figure 3.



Control Cable Inspection Technique
Figure 2

C. Internal Cable Wear

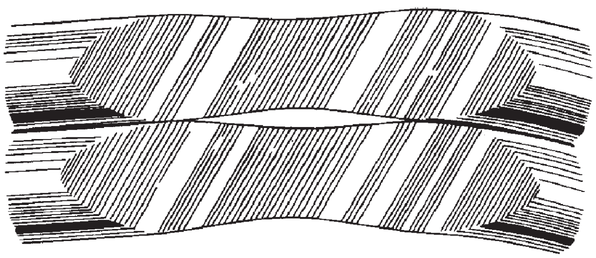
As wear is taking place on the exterior surface of a cable, the same condition is taking place internally, particularly in the sections of the cable which pass over pulleys and quadrants. This condition, shown in Figure 4, is not easily detected unless the strands of the cable are separated. Wear of this type is a result of the relative motion between inner wire surfaces. Under certain conditions the rate of this type wear can be greater than that occurring on the surface.

D. Corrosion

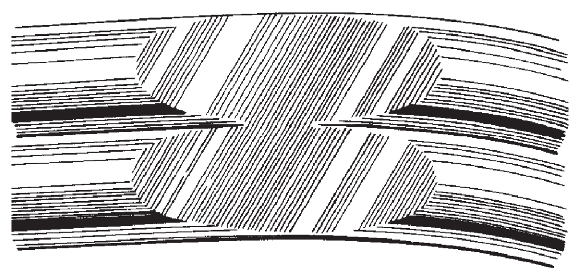
Carefully examine any cable for corrosion that has a broken wire in a section not in contact with wear producing airframe components such as pulleys, fairleads, etc. It may be necessary to remove and bend the cable to properly inspect it for internal strand corrosion as this condition is usually not evident on the outer surface of the cable. Replace cable segments if internal strand rust or corrosion is found.

Areas especially conducive to cable corrosion are battery compartments, lavatories, wheel wells, etc., where concentrations of corrosive fumes, vapors, and liquids can accumulate.

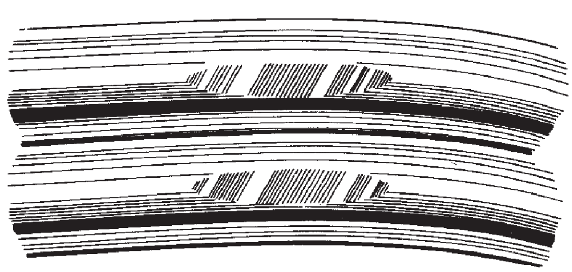
NOTE: Check all exposed sections of cable for corrosion after a cleaning and/or metal-brightening operation has been accomplished in that area.



INDIVIDUAL OUTER WIRES
WORN MORE THAN 50%



INDIVIDUAL OUTER WIRES WORN
MORE THAN 40 - 50 %
(NOTE BLENDING OF WORN AREAS)



INDIVIDUAL OUTER WIRES WORN LESS THAN 40%
(WORN AREAS INDIVIDUALLY DISTINGUISHABLE)

Cable Wear Patterns
Figure 3

E. Cable Maintenance

CAUTION: TO AVOID REMOVAL OF CORROSION-PREVENTATIVE COMPOUNDS AND CABLE INTERNAL LUBRICANT, DO NOT USE VAPOR DEGREASING, STEAM CLEANING, METHYLETHYLKETONE (MEK) OR OTHER SOLVENTS.

CAUTION: DO NOT OIL CONTROL CABLES.

Frequent inspections and preservation measures such as rust prevention treatments for bare cable areas will help to extend cable service life. Where cables pass through fairleads, pressure seals, or over pulleys, remove accumulated heavy coatings of corrosion prevention compound. Provide corrosion protection for these cable sections by lubricating as specified in the Lubrication Chart, 12-20-00.

F. Cable Fittings (Terminals, turnbuckles, etc.)

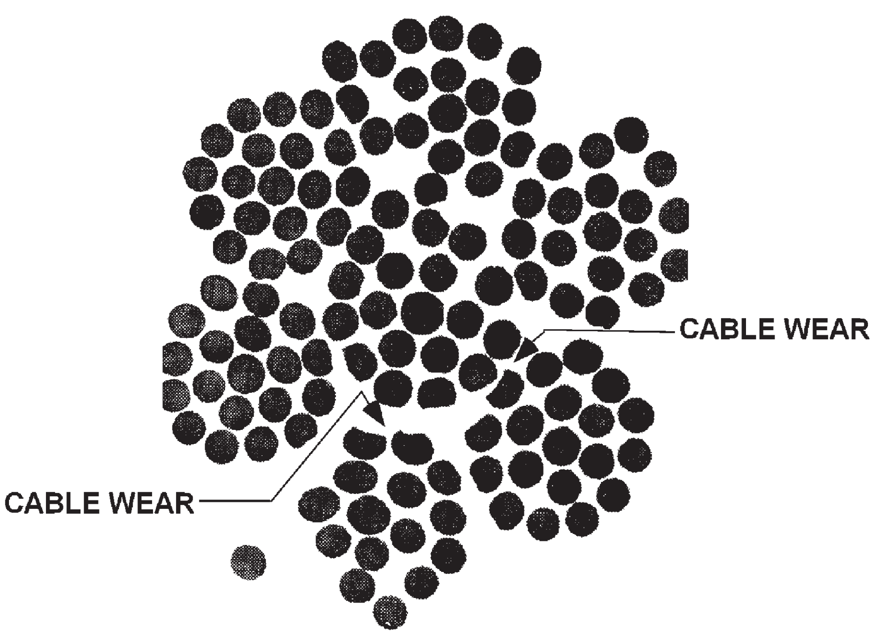
Clean the fittings thoroughly with a suitable solvent prior to inspection.

NOTE: Most control cables feature strands made of galvanized steel. By design, the galvanized coating corrodes sacrificially, protecting the steel strands underneath. This normal corrosion process creates zinc oxide powder, which can migrate along the length of the control cable, covering the surface of the fittings with an inert white speckled coating. This coating, along with any other contaminants such as dirt, oil or grease, must be removed in order to properly examine the fittings.

(1) 100 Hour Standard Inspection

Check swaged terminal reference marks for any indication of cable slippage within fitting. Inspect fitting assembly for distortion and/or broken strands at the terminal. Check that all bearings and swivel fittings (bolted or pinned) pivot freely to prevent binding and subsequent failure. Check turnbuckles for proper thread exposure and broken or missing safety wires/clips.

Pay particular attention to corrosion and “pitting” on cable terminals, turnbuckles and cable fittings. Any corrosion or pitting found requires replacement of the corroded fitting and/or cable.



Internal Cable Wear
Figure 4

(2) 100 Hour Special Inspection

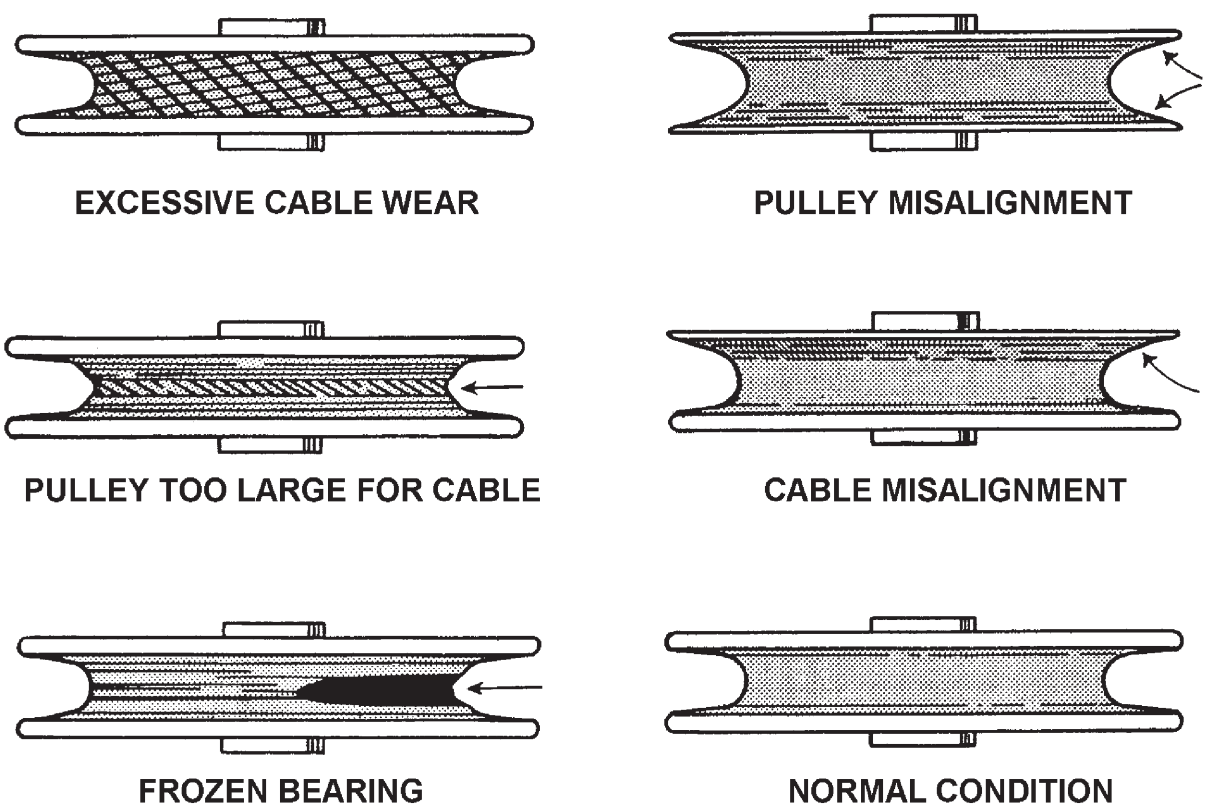
For airplanes 15 years old or older, using a 10X magnifier, visually inspect the entire surface of each cable terminal, turnbuckle, or other cable fitting for corrosion or cracking. Inspect under safety wire or clips wrapped around the cable or fitting. Any evidence of corrosion or cracking, however minute, is cause for replacement. A logbook entry documenting the replacement of a cable terminal, turnbuckle, or other cable fitting relieves the inspection requirement for that fitting only, until such time as that fitting has been in service for 15 years.

G. Pulleys

Inspect pulleys for roughness, sharp edges, and presence of foreign material embedded in the grooves. Examine pulley bearings to assure proper lubrication, smooth rotation, freedom from flat spots, dirt, and paint spray. Periodically rotate pulleys, which turn through a small arc, to provide a new bearing surface for the cable. Maintain pulley alignment to prevent the cable from riding on flanges and chafing against guards, covers, or adjacent structure. Check all pulley brackets and guards for damage, alignment, and security.

H. Pulley Wear Patterns

Various cable system malfunctions may be detected by analyzing pulley conditions. These include such discrepancies as too much tension, misalignment, pulley bearing problems, and size mismatches between cables and pulleys. Examples of these conditions are shown in Figure 5.



Pulley Wear Patterns
Figure 5

I. Stabilator Control System Special Inspection

NOTE: This inspection incorporates the requirements of Piper Service Bulletin No. 1245A.

Beginning at the first regularly scheduled maintenance event after reaching 15 calendar years time-in-service and each 2,000 hours or seven (7) calendar years time-in-service thereafter, whichever occurs first, perform the following inspection.

NOTE: Documented replacement of a control cable or cable fitting (i.e., turnbuckle, terminal, etc.) relieves this inspection requirement for that component only until it reaches 15 calendar years time-in-service.

(1) Secure a jack stand to the tail skid (tie down).

(2) Remove the access panel at the aft section of the cabin to gain access to the aft fuselage.

NOTE: Remove seats and/or other interior components as desired to ease accomplishment of this inspection.

(3) Visually inspect the entire length of the stabilator flight control cable system (see Figure 1, 27-30-00), with special emphasis on the turnbuckle area, as described in the steps that follow.

(4) Identify the two (2) stabilator flight control cable turnbuckles (Item 16 in Figure 1, 27-30-00) in the aft section of the fuselage.

(5) Disassemble the turnbuckle bodies to facilitate a complete inspection of the parts and the associated cable terminals.

NOTE: See Standard Practices and Procedures in 27-00-00; and Stabilator Control Cables, Removal, in 27-30-00.

(6) Clean the turnbuckle bodies and associated cable terminals thoroughly per the instructions provided in Cable Fittings, above.

(7) Using a 10X magnifier, a mirror and a suitable light source, carefully examine the entire surface of each turnbuckle, cable terminal, and adjacent portion of the flight control cable, inspecting for cracks, corrosion, or broken cable strands. Any evidence of cracks or cable fraying, however minute, is cause for replacement. Any evidence of corrosion that remains after accomplishing the cleaning instructions above is cause for replacement.

(8) Reassemble the turnbuckle bodies and associated cable terminals. Rig and adjust stabilator travel and stabilator control cable tension.

NOTE: See Standard Practices and Procedures in 27-00-00; and Stabilator Control Cables, Installation, as well as Rigging and Adjustment, in 27-30-00.

(9) Reinstall the rear cabin bulkhead access cover.

NOTE: Reinstall seats and/or other interior components that were removed in Step (2).

(10) Remove the jack stand from the aircraft.

(11) Make a logbook entry indicating compliance with this inspection and documenting any components that were replaced.

AILERON AND TAB

1. Troubleshooting

   See Chart 1.

2. Control Column

   A. Removal (Refer to Figure 1.)

      (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.

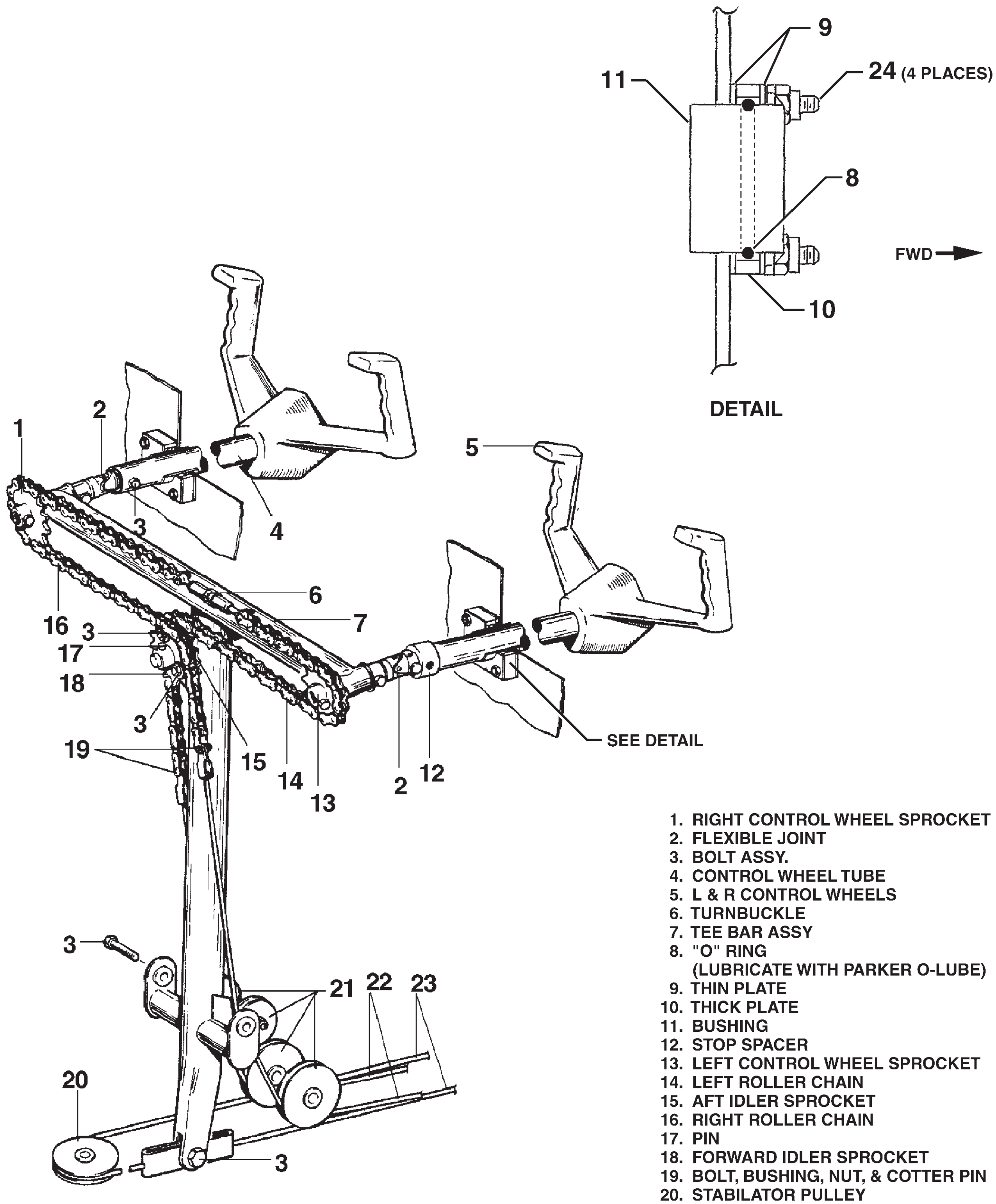
   B. Installation

      (1) To install tee bar assembly (Refer to Figure 1.)

         (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.

CHART 1
TROUBLESHOOTING AILERON CONTROL SYSTEM

Trouble	Cause	Remedy
Lost motion between control wheel and aileron.	Cable tension too low.	Adjust cable tension.
	Linkage loose or worn.	Check linkage and tighten or replace.
	Broken pulley.	Replace pulley.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
Resistance to control wheel rotation.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust cable tension.
	Control column horizontal chain improperly adjusted.	Adjust chain tension.
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
	Bent aileron and/ or hinge.	Repair or replace aileron and/or hinge.
	Cables crossed or routed incorrectly.	Check routing of control cables.
Control wheels not synchronized.	Incorrect control column rigging.	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.



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 (LUBRICATE WITH PARKER O-LUBE)
9. THIN PLATE
10. THICK PLATE
11. BUSHING
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
24. SCREW, WASHER, & NUT

Control Column Assembly
Figure 1

(e) Place the control wheels in neutral (centered) position and install the aileron control chains on the control wheel sprockets and idler cross-over sprockets. The turnbuckle must be centered between the two control wheel sprockets.

(f) Loosen the connecting bolts of the idler sprockets to allow the chain to fit snug around the control wheel sprockets and over the idler sprockets.

(g) Connect the aileron control cables to the ends of the chains with bolts, bushings, nuts and cotter pins.

(h) Adjust the chain turnbuckle between the two control wheel sprockets to allow the control wheels to be neutral and obtain proper cable tension as given in Figure 3. 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. Torque 45 ± 5 in. lbs.

(k) Install the floor tunnel plate and secure with screws. Fasten the tunnel carpet in place.

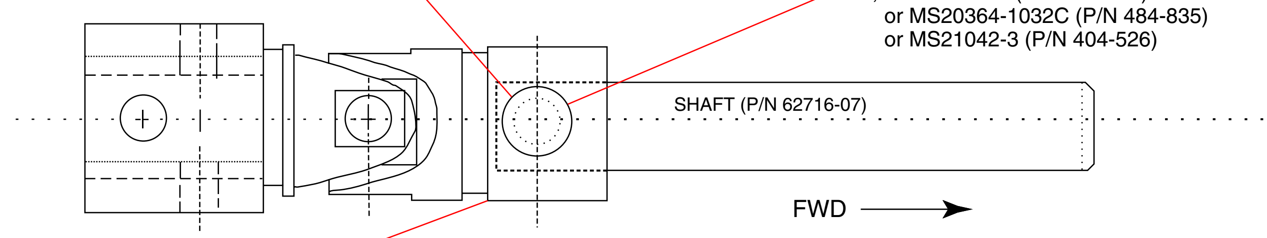
(2) To install either control wheel assembly (Refer to Figure 1.)

(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.



Flex (Universal) Joint Assembly
Figure 2

C. Flex Joint Replacement (Refer to Figures 1 and 2)

Install a replacement control column flex joint as follows:

(1) Carefully lay out location for hole to be drilled in flex joint tube to match hole in control column shaft.

(2) Using a #5 (0.2055) drill bit, drill hole through flex joint tube at location determined in paragraph (1).

(3) Ream drilled hole, in steps, with a #1 reamer, checking to ensure proper depth for taper pin and sufficient pin thread protrusion for proper installation.

NOTE: Reamer may be purchased from your Piper Dealer as P/N 906-713.

(4) Install pin through tube and shaft.

(a) If pin shoulder does not protrude past sprocket hub, install an AN960-10 washer.

(b) If pin shoulder protrudes past sprocket hub, install an AN975-3 washer.

(5) Install nut. Torque 35–40 inch-pounds.

3. Control Wheel

A. HP S/N's 3246001 thru 3246097 and TC S/N's 3257001 thru 3257027 only.

NOTE: In these airplanes, the control wheel and tube can be removed as a unit, see Control Column below. Disassembly of the control wheel from the tube is not normally required.

(1) Removal

(a) Remove two screws from bottom of control wheel and remove cover/pad assembly to gain access to locknut.

(b) Remove control wheel attachment bolt, spacer, washer, and locknut. Note build up to facilitate reinstallation.

(c) Slide control wheel off of tube.

(d) If not already done, disconnect control wheel switches wiring harness.

(2) Installation

(a) Connect control wheel switches wiring harness.

(b) Slide control wheel onto tube.

(c) Position and secure control wheel attachment bolt, spacer, washer, and locknut.

(d) Position cover/pad assembly and secure with two screws from bottom of control wheel.

B. HP S/N's 3246098 and up, TC S/N's 3257028 and up. (See Figure 3.)

The retainer clip (P/N 104687-002) and MS24693-S40 screws (2 ea.) are factory installed in HP S/N's 3246215 and up, TC S/N's 3257328 and up. HP S/N's 3246098 thru 3246214 and TC S/N's 3257028 thru 3257327 must individually procure and retrofit the retainer clip and screws.

(1) Removal

(a) Remove two (2) screws and retainer clip.

(b) Remove control wheel attachment screw and spacer.

(c) Slide control wheel off of tube.

(d) Disconnect control wheel switches wiring harness.

(2) Installation

(a) Degrease aft end of tube and inside of control wheel using acetone or naptha. Allow to dry.

(b) Degrease control wheel attachment screw, the spacer, and the nutplate (inside the tube) using acetone or naptha. Allow to dry.

(c) Prime inside of control wheel with Loctite 7649 (Piper P/N 279-073). Allow to dry.

(d) Connect control wheel switches wiring harness.

(e) Install control wheel onto tube using Loctite 271 (Piper P/N 279-128). Take care to ensure screw hole in control wheel aligns with screw hole in tube.

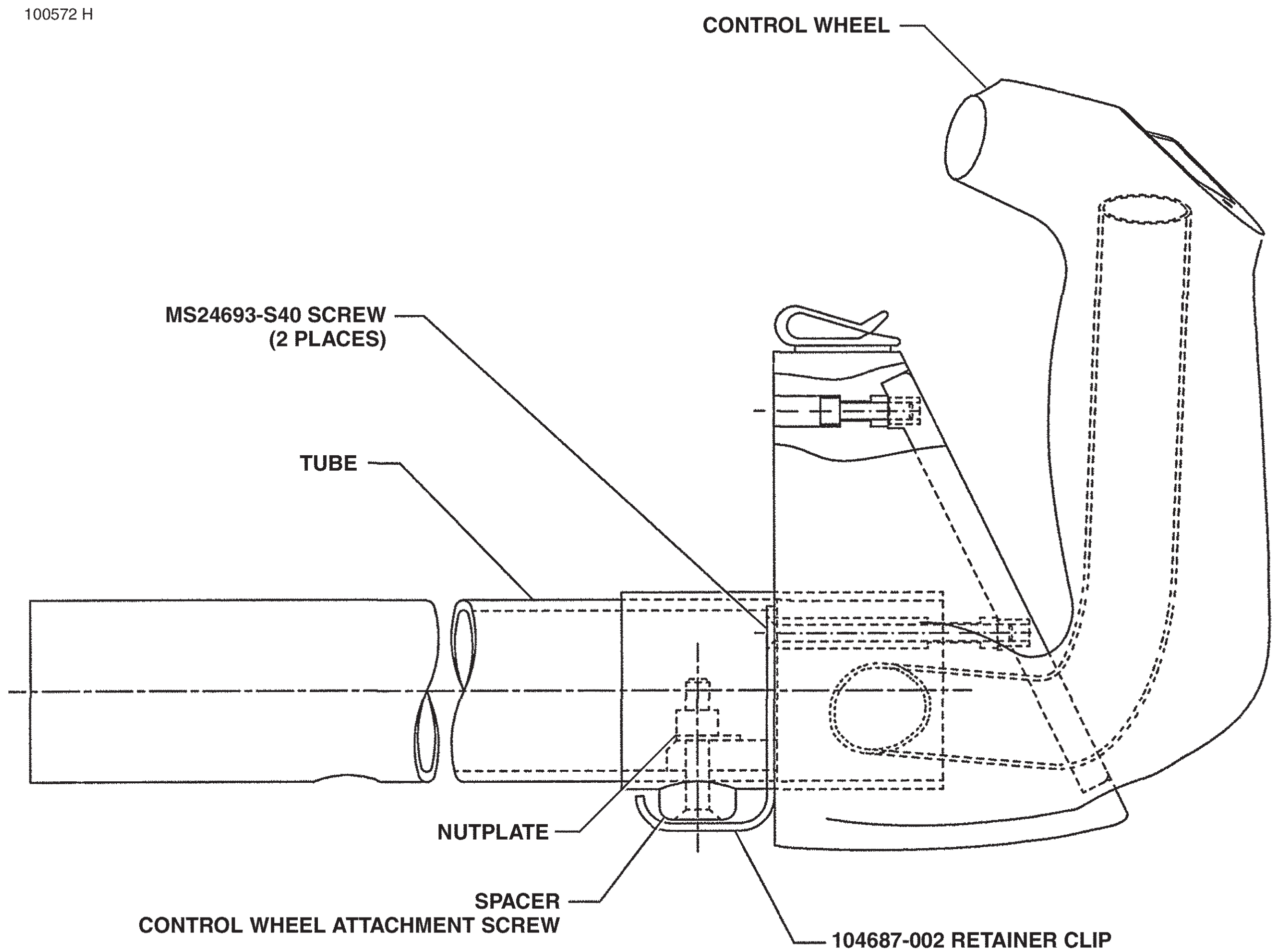
NOTE: This step must be accomplished promptly due to short cure time.

(f) Prime threads of control wheel attachment screw with Loctite 7649 (Piper P/N 279-073). Allow to dry.

(g) Install control wheel attachment screw (with spacer) into nutplate using Loctite 271 (Piper P/N 279-128).

NOTE: This step must be accomplished promptly due to short cure time.

(h) Position retainer clip to capture spacer and control wheel attachment screw. Secure with screws (2), being careful not to over tighten the screws and damage the logo medallion.



Control Wheel Installation
Figure 3

4. Aileron Control Cables

A. Removal (Refer to Figure 4.)

(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.

(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.

(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.

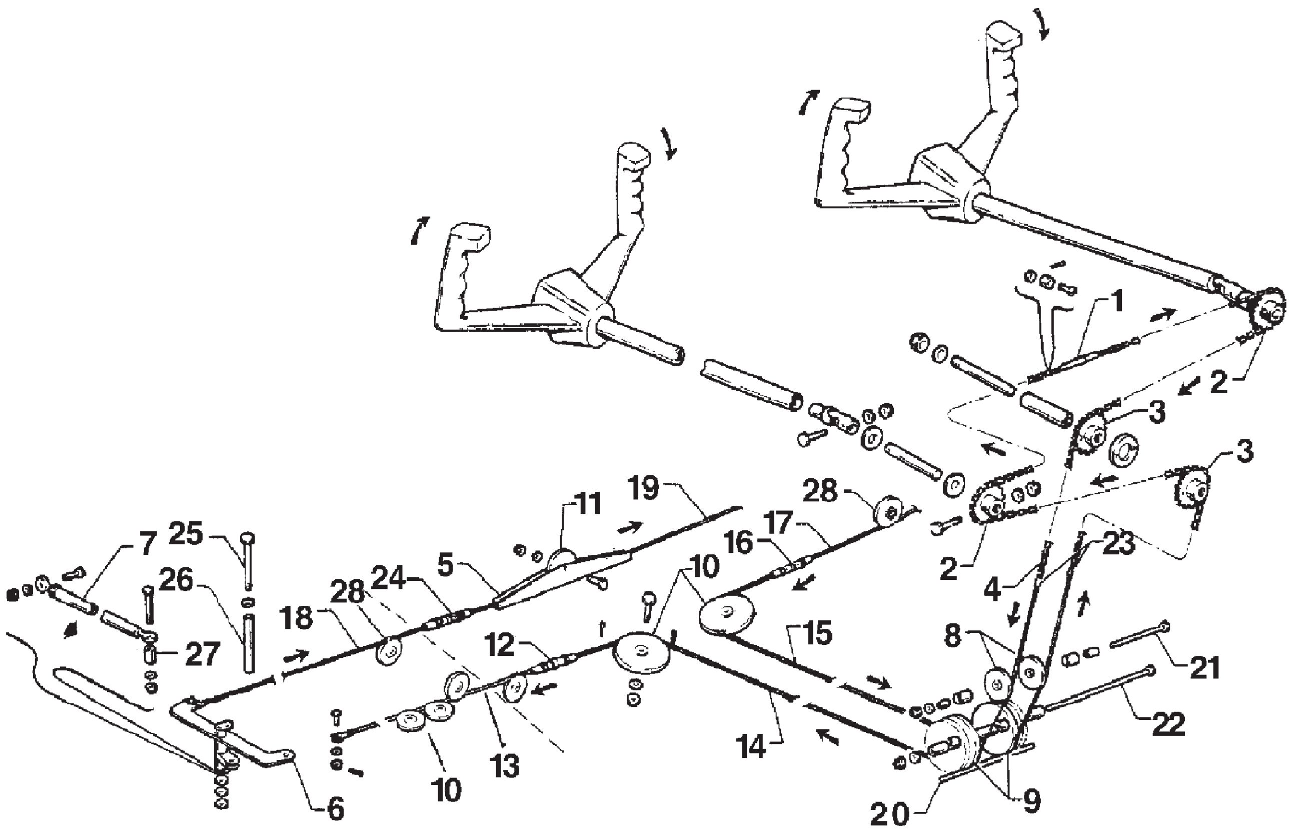
B. Installation (Refer to Figure 4.)

(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.



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

Aileron Controls
Figure 4

(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 below.

(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 below.

(e) Install access plate on underside of wing.

(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 below.

(f) Install access plate on the underside of wing.

(4) Install floor panel, seat belt attachments, rear seat and two front seats.

5. Aileron Bellcrank Assembly (Refer to Figures 4 and 5.)

A. Removal

(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.

B. Installation

(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 and ensure that bellcrank rotates freely with little up-down play.

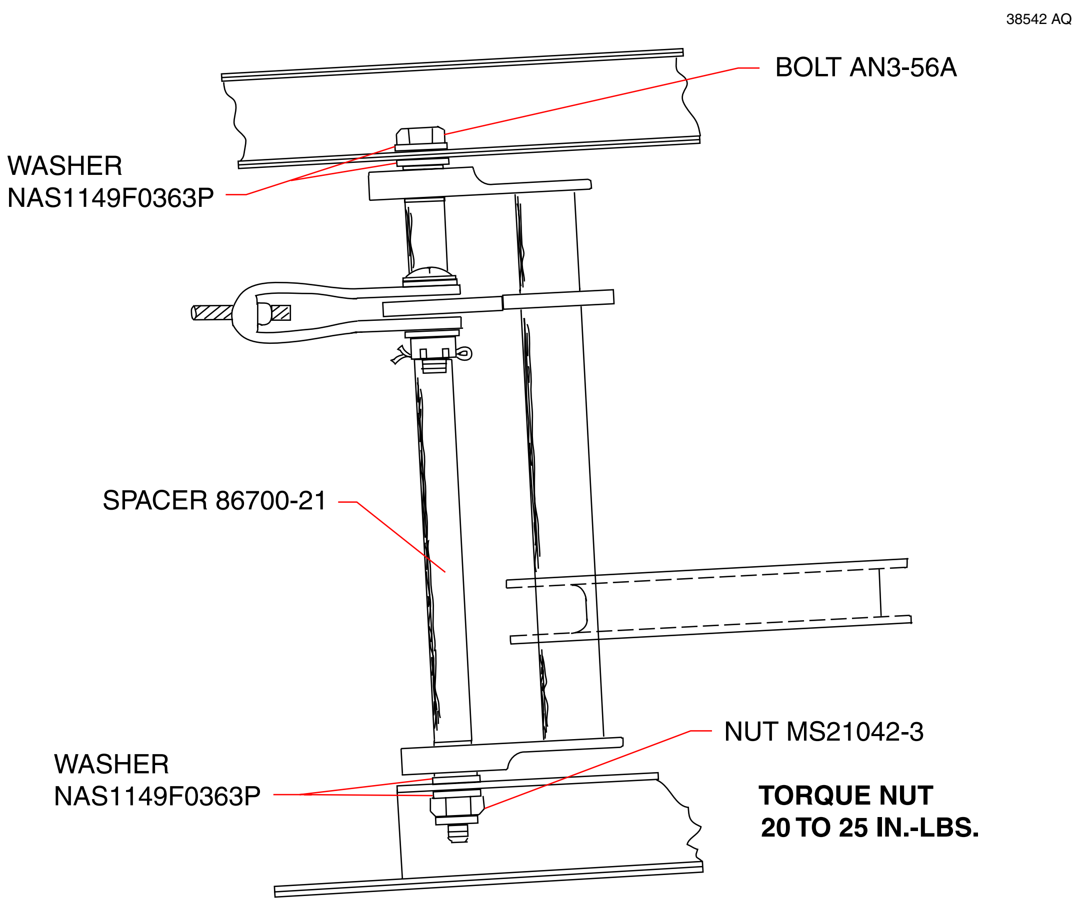
(4) Install and adjust control rod. Check aileron travel per Rigging and Adjustment below.

(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 below.

(7) Install access plate on underside of wing.

(8) Install floor panel, seat belt attachments and seats.



Aileron Bellcrank Installation
Figure 5

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6. Rigging and Adjustment

(PIR-PPS50005-9, Rev. N.)

(Refer to “Figure 4” on page 3E21, “Figure 6” and “Figure 7” on page 3F2, and “Figure 8” on page 3F4.)

WARNING: 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, VISUALLY CONFIRM THAT THE RIGHT AILERON TRAILING EDGE MOVES UP AND THE LEFT AILERON TRAILING EDGE MOVES DOWN WHEN THE CONTROL WHEEL IS TURNED RIGHT; AND THAT THE LEFT AILERON TRAILING EDGE MOVES UP AND THE RIGHT AILERON TRAILING EDGE MOVES DOWN WHEN THE CONTROL WHEEL IS TURNED LEFT.

NOTE: Flap rigging and adjustment must be completed before starting aileron rigging and adjustment. See 27-50-00.

A. To check and adjust rigging of the aileron controls:

(1) Determine that control chains have been rigged per Control Column Assembly Installation.

(2) Set the right and left aileron bellcranks at neutral position by:

(a) Removing access plate to each aileron bellcrank located on underside of wing, forward of inboard end of aileron, by removing plate attaching screws.

(b) Affix a bellcrank rigging tool between the forward arm of each bellcrank and the adjacent rib as shown in Figure 6. (Tool may be fabricated from dimensions given in Figure 7.)

1) Slotted end of the tool fits on bellcrank arm forward of and adjacent to the primary control cable end.

2) 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.

3) Neutral position of bellcrank is position at which forward and aft cable connection holes are an equal distance from adjacent outboard wing rib.

(3) With each bellcrank set at neutral, the ailerons may be checked and adjusted for neutral as follows:

(a) Ensure that bellcrank rigging tool fits snug between bellcrank and rib.

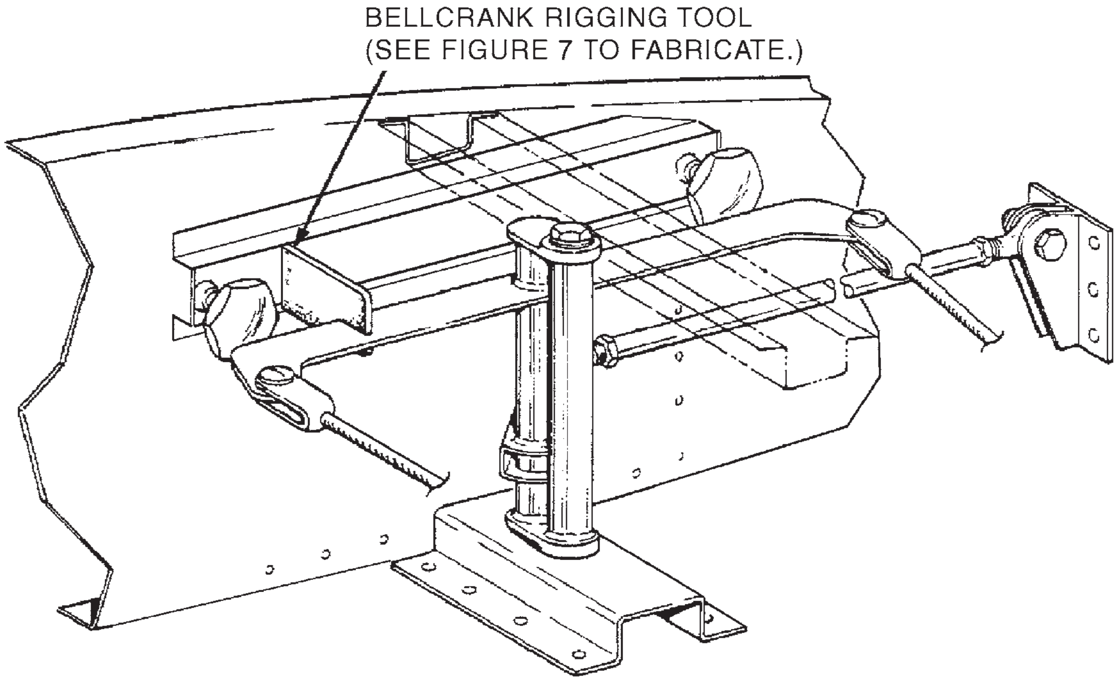
(b) Place an aileron rigging tool, as shown in Figure 8, against underside of the wing and aileron as close as possible to inboard end of aileron without contacting any rivets. Tool must be positioned parallel with wing ribs, with aft end of the tool even with trailing edge of the aileron. (Tool may be fabricated from dimensions given in Figure 9.)

(c) With aileron control rod connected between bellcrank and aileron:

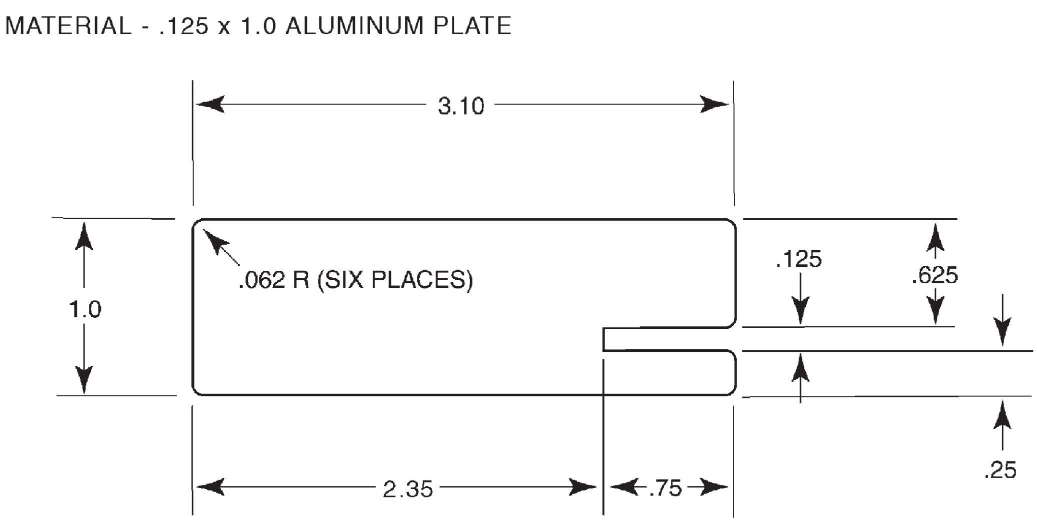
1) Check that surface of the wing contacts tool at its forward surface and at spacer.

2) Check that trailing edge of flap contacts aft end of the tool. The aileron is neutral at this position.

(d) 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.



Bellcrank Rigging
Figure 6



Bellcrank Rigging Tool
Figure 7

B. To adjust primary and balance cable tension, as given in Chart 2, 27-00-00.

(1) Remove the two front seats if desired, the rear seat and floor panel to facilitate in the necessary operation.

(2) 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.

(3) Ensure both bellcranks are at neutral position.

(4) 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.

(5) When adjustment is complete there should be even tension on all cables.

(6) Tighten the bolts to secure the idler cross-over sprockets.

(7) Remove the aileron bellcrank rigging tool from each wing.

C. Aileron Tab.

In early Saratoga II HP's, an aileron tab is located on the left aileron and is ground adjustable only.

NOTE: The aileron tab is installed only in Saratoga II HP's (1995 thru mid-1998), as originally delivered (i.e. - no tab is installed on service replacement ailerons).

D. Check ailerons for correct travel from neutral per limits given in Chart 2, 27-00-00. by the following procedure:

(1) Center bubble of a protractor over surface of either aileron at neutral position. Note reading.

(2) 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.

(3) If travel is not correct, set by rotating bellcrank stops in or out. Stops are attached to wing rib adjacent to aileron bellcrank.

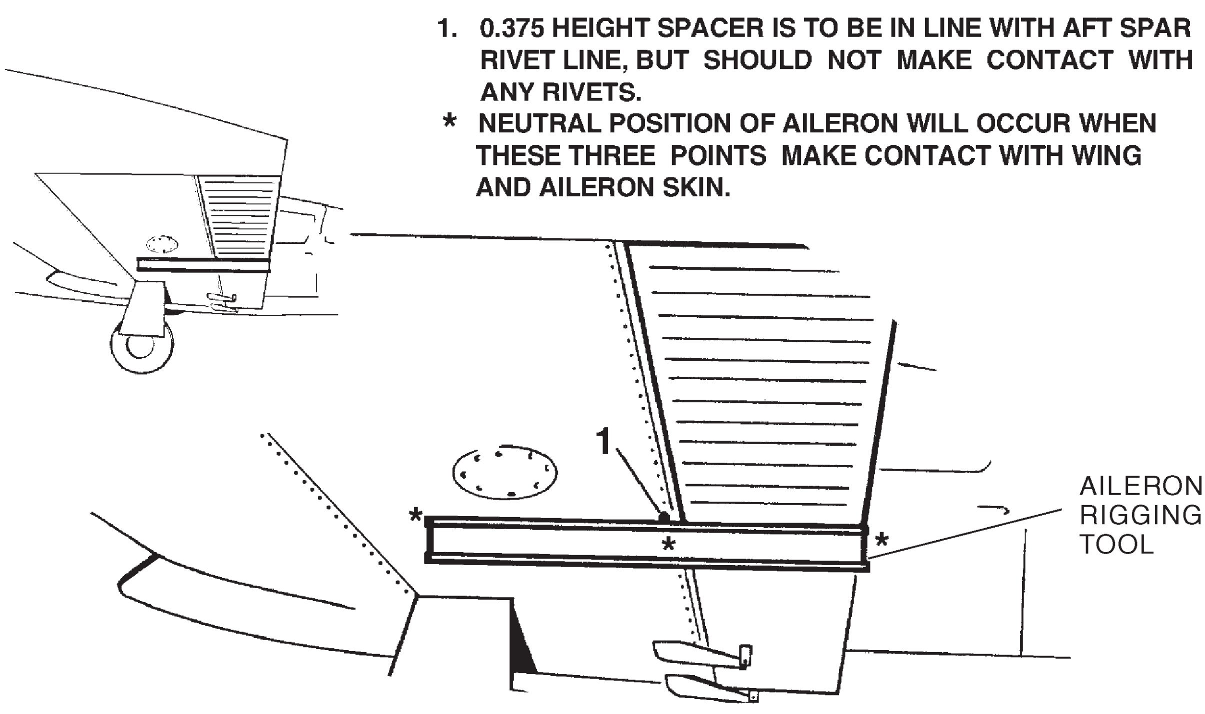
(4) Repeat procedure for other aileron.

(5) 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.

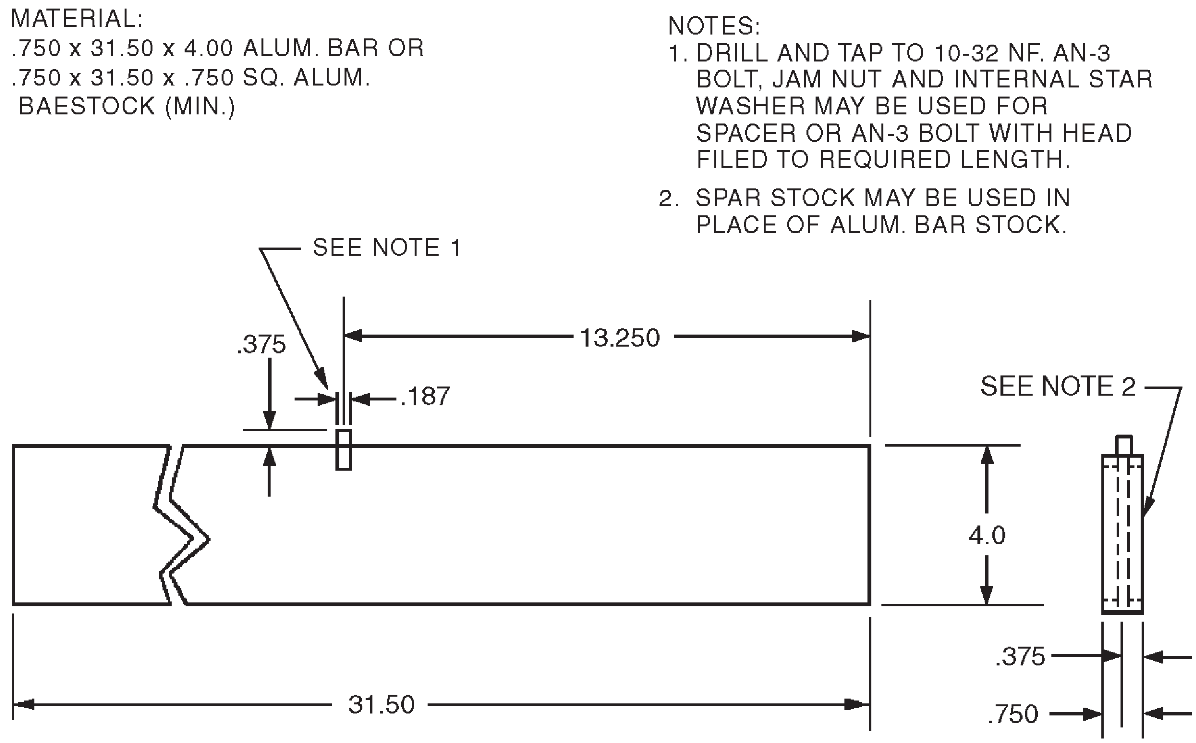
(6) Check complete system for operation and safety for turnbuckles, bolts, etc., install all pulley guard pins.

(7) 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.



Aileron Rigging
Figure 8



Fabricated Aileron and Flap Rigging Tool
Figure 9

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RUDDER AND TAB

1. Troubleshooting

   See Chart 1

CHART 1
TROUBLESHOOTING RUDDER CONTROL SYSTEM

Trouble	Cause	Remedy
Lost motion between rudder pedals and rudder.	Cable tension too low.	Adjust cable tension.
	Linkage loose or worn.	Check linkage and tighten or replace.
	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.

2. Rudder Control Cables

A. Removal (Refer to Figure 1.)

(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:

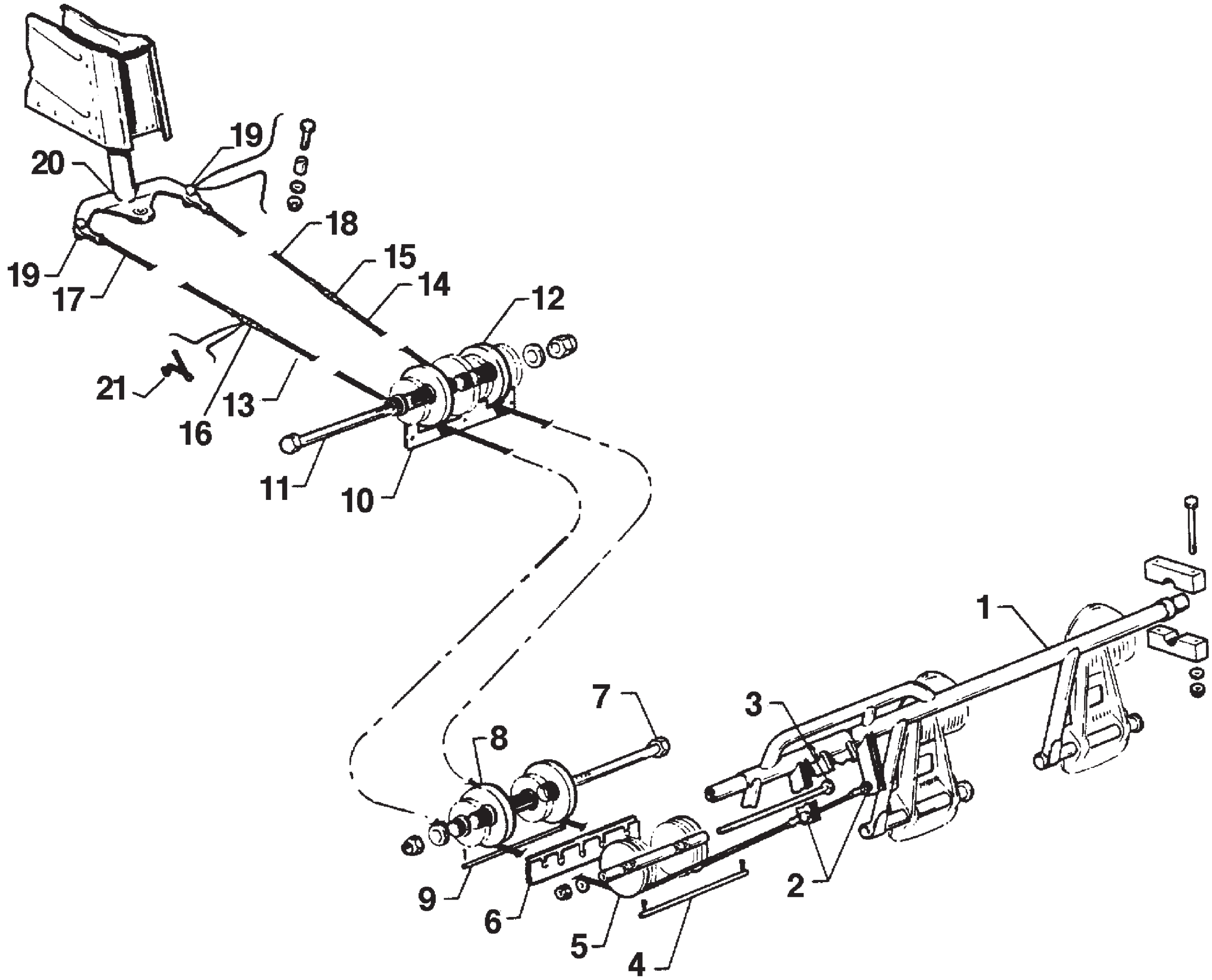
(a) Remove access panel to aft section of fuselage.

(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.



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)

Rudder Controls
Figure 1

B. Installation (Refer to Figure 1.)

(1) To install aft rudder control cable:

(a) Position control cable(s).(Refer to Figure 1)

(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, below.

(e) Install tail cone and secure with screws.

(f) Install the access panel to the aft section of the fuselage.

(2) To install forward rudder control cables:

NOTE: Aft control cable(s) must be installed before installing forward cable(s), see above.

(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, below.

(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.

C. Rigging and Adjustment

WARNING: 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, VISUALLY CONFIRM THAT THE RUDDER TRAILING EDGE MOVES RIGHT WHEN THE RIGHT PEDAL IS DEPRESSED; AND, THAT THE RUDDER TRAILING EDGE MOVES LEFT WHEN THE LEFT PEDAL IS DEPRESSED.

(1) To check and set correct degree of rudder travel per Chart 2, 27-00-00:

(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 (refer to Figure 7 for fabrication details of this tool), against side of the rudder and vertical stabilizer as shown in Figure 2. 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.

(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 (see Figure 3 per Chart 2, 27-00-00.

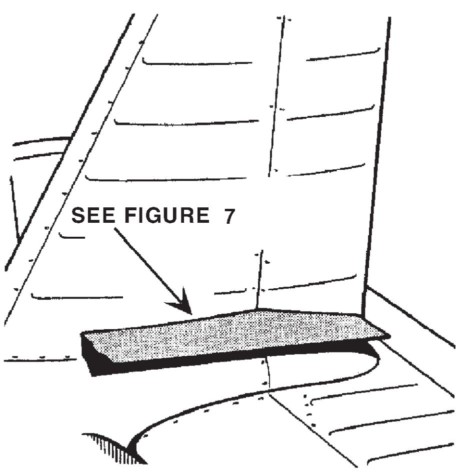
(2) To set cable tension and align rudder:

(a) Remove tail cone and fuselage aft access panel.

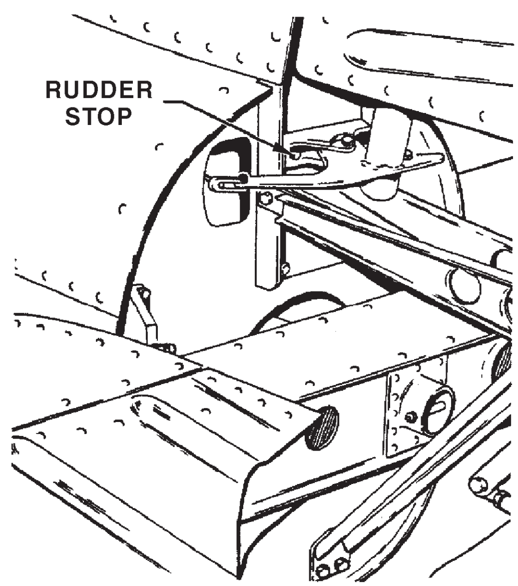
(b) Check that nose gear steering has been aligned.

(c) Clamp rudder pedals together in neutral position. (Refer to Figure 4 and Alignment of Nose Landing Gear, 32-20-00.)

(d) Adjust turnbuckles in aft section of fuselage to obtain proper cable tension and to allow rudder to align at neutral position.



Rudder Rigging
Figure 2



Rudder Travel Adjustments
Figure 3

(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.

3. Rudder Trim Control

A. Removal (Refer to Figure 4.)

(1) Remove fuel selector panel cover by removing rudder trim knob and cover attachment screws.

(2) Place trim knob on assembly and rotate to extreme left (counterclockwise) trim position.

(3) Disconnect housing lug from arm on rudder pedal torque tube by removing cotter pin, nut, washer and bolt.

(4) Remove threaded bushing from aft end of mounting channel by removing cotter pin and clevis pin.

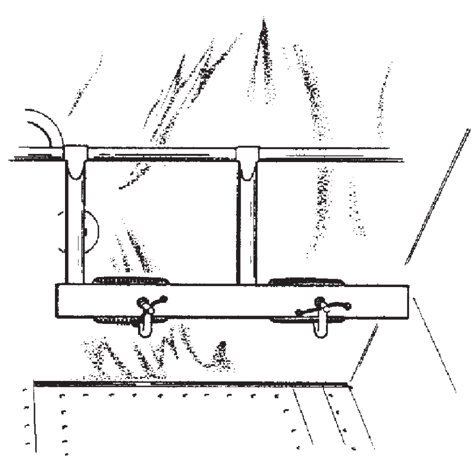
(5) Remove mounting channel may by removing channel attachment screws inside of channel.

(a) Middle and aft screws need only be turned out.

(b) Forward screw is secured by a nut on underside of tunnel. To remove forward screw

1 Lift floor carpet on right side of tunnel adjacent to channel and remove access plate on side of tunnel.

2 Secure nut and turn out screw.



Clamping Rudder Pedals
Figure 4

B. Installation (Refer to Figure 5.)

(1) Install trim control mounting channel on upper side of floor tunnel. Install a spacer plate between the channel and tunnel.

(a) Install the middle and aft attachment screws. Secure screws and with anchor nuts.

(b) Install forward screw. Forward screw is secured with a nut that must be held from within the tunnel.

(2) Install the access plate on the side of the tunnel and secure carpet in place.

(3) Before attaching assembly to mounting channel, check that:

(a) Clips are installed so safety wire will be on top.

(b) Threaded bushing is installed on assembly shaft with welded attachment bushing forward or toward housing.

(4) 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.

(5) Clamp rudder pedals in neutral. Position threaded bushing and shaft extension in mounting channel.

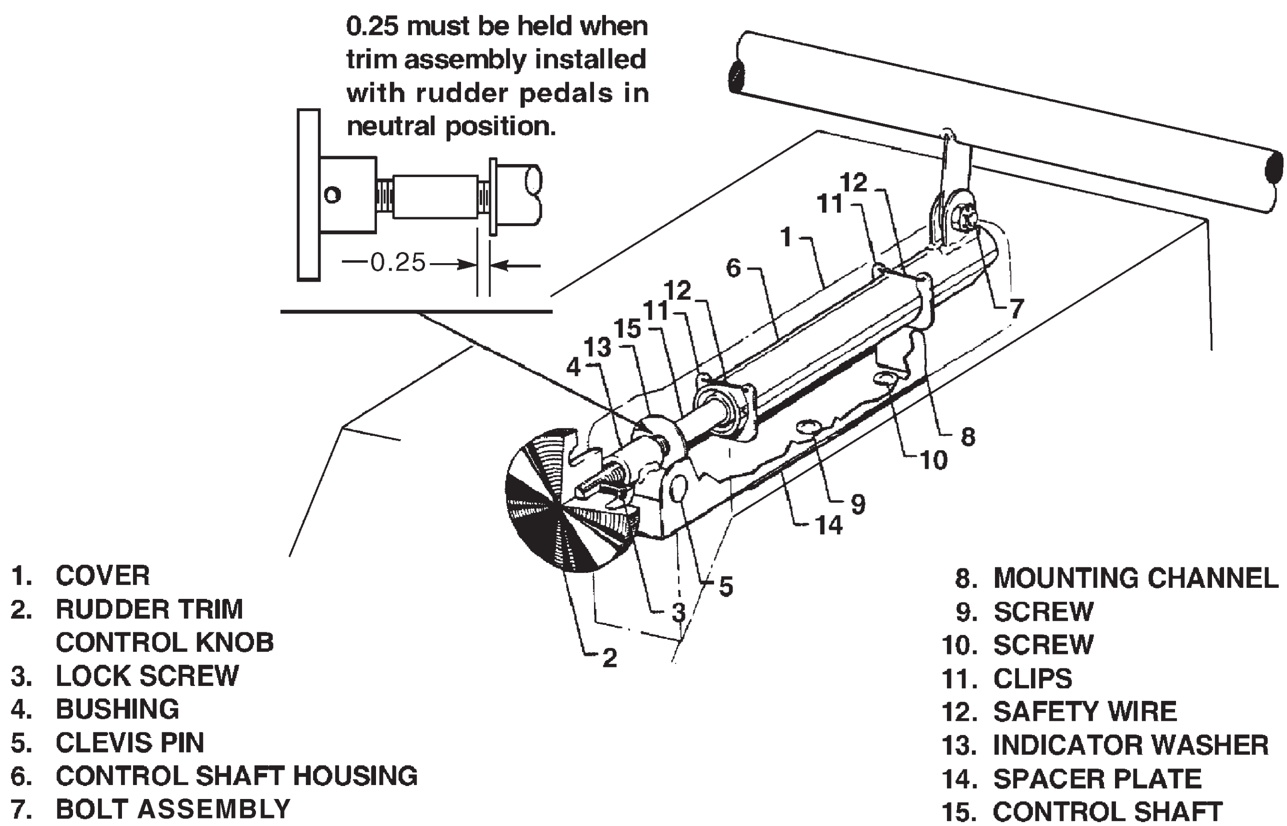
(a) Install the clevis pin and cotter pin.

(b) Check that dimensions noted in Figure 5 are maintained.

(6) Install fuel selector panel cover and cover attachment screws.

(7) Install rudder trim knob

(8) Ensure that neutral indicator aligns with neutral position on cover placard.



Rudder Trim Control
Figure 5

C. Rigging and Adjustment

WARNING: 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, VISUALLY CONFIRM THAT THE RUDDER TRAILING EDGE MOVES LEFT WHEN THE RUDDER TRIM KNOB IS TRIMMED LEFT; AND, THAT THE RUDDER TRAILING EDGE MOVES RIGHT WHEN THE RUDDER TRIM KNOB IS TRIMMED RIGHT.

No adjustments are necessary, other than those required during installation of assembly in the airplane. See Installation, above).

4. Rudder and Steering Pedal Assembly

A. Removal (Refer to Figure 6.)

(1) Remove access panel to aft section of fuselage.

(2) Relieve rudder and stabilator cable tension by loosening one rudder and one stabilator cable turnbuckle in aft section of fuselage.

(3) Remove fuel selector panel cover by removing rudder trim knob and cover attachment screws.

(4) Remove lower selector cover. Disconnect fuel selector control lever from selector torque tube by removing attachment pin located at bottom of the lever.

(5) Remove tunnel plate just aft of tee bar by laying back enough tunnel carpet to remove plate attachment screws.

(6) Disconnect stabilator control cable from lower end of tee bar assembly.

(7) 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.

(8) Disconnect control cable ends from arms of torque tube by removing cotter pins, washers, nuts and bolts.

(9) Disconnect rudder trim from torque tube assembly by removing cotter pin, washers and bolt.

(10) Disconnect steering rods at the rudder pedals by removing nuts and bolts.

(11) Disconnect brake cylinders at lower end of each cylinder rod by removing cotter pins, washers, nuts and bolts.

(12) Disconnect vee braces from torque tube by removing nuts, washers and bolts that secure strap bracket to vee brace.

(13) 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.

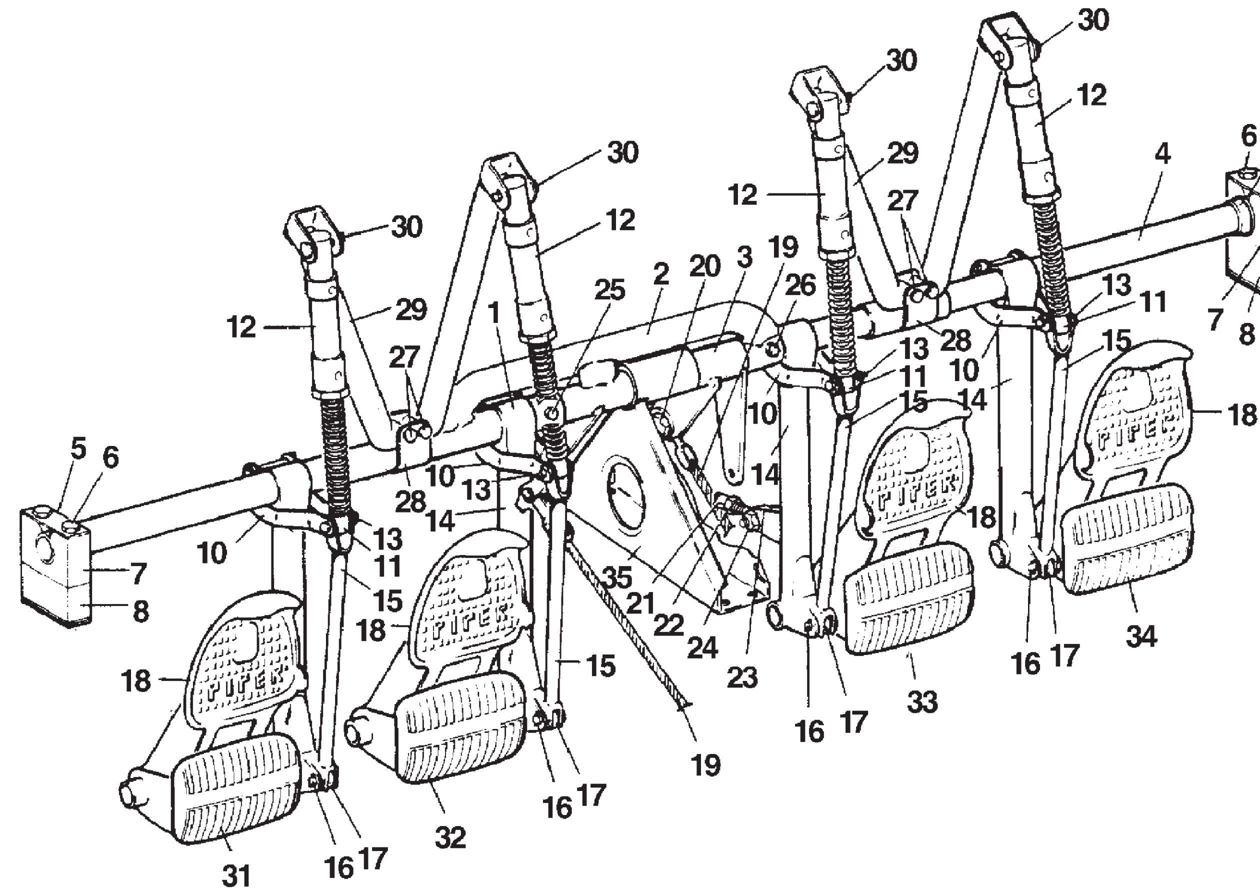
(14) Disconnect torque tube support bracket where it attaches to floor tunnel by removing its attachment bolts.

(15) Remove two bolts located at the center of the torque tube assembly over the floor tunnel that extend through torque tube. Compress the tubes.

(16) Disconnect torque tube support blocks from their support brackets on each side of fuselage by removing attachment nuts, washers and bolts.

(17) Remove trim side panels, if desired.

(18) Remove assembly from airplane. Note the spacer washer on each end between support blocks.



1. LEFT OUTER TUBE
2. LEFT CENTER TUBE
3. RIGHT CENTER TUBE
4. RIGHT OUTER TUBE
5. PLATE
6. BOLT AND 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 AND COTTER PIN
14. RUDDER CONTROL TUBE
15. CLEVIS ROD
16. CLEVIS PIN AND 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 AND NUT
25. BOLT, WASHER, AND NUT
26. BOLT, WASHER, AND NUT
27. BOLT, WASHER, AND NUT
28. BRACKET
29. VEE BRACE
30. CLEVIS PIN AND COTTER PIN
31. LEFT OUTER RUDDER PEDAL
32. LEFT INNER RUDDER PEDAL
33. RIGHT INNER RUDDER PEDAL
34. RIGHT OUTER RUDDER PEDAL
35. TUBE SUPPORT BRACKET

Rudder and Steering Pedal Assembly
Figure 6

B. Installation (Refer to Figure 6.)

(1) Assemble torque tube assembly as shown in Figure 6. Do not install the two bolts through the center of the tube assembly at this time.

(2) Place upper support blocks on the ends of the torque tube assembly. Note that a washer is required on each end of tube.

(3) Position support blocks on their mounting brackets at each side of fuselage and secure with bolts, washers and nuts.

(a) A bushing is required in bolt holes of upper support block.

(b) A plate is required on top of upper block, between upper and lower blocks and under block mounting bracket.

(4) Align bolt holes in center area of torque tube assembly. Install bolts, washers and nuts and tighten.

(5) Position torque tube support bracket on floor tunnel and secure with bolts.

(6) Position vee braces on torque tube. Install strap bracket around torque tube and brace. Secure with bolts, washers and nuts.

(7) Connect ends of brake cylinder rods and clevis rods to idler arms. Secure with clevis and cotter pins.

(8) Connect steering rods to rudder pedals and secure with bolts and nuts. Check steering rod adjustment per Alignment/Steering Adjustment, Nose Landing Gear, 32-20-00.

(9) 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.

(10) 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.

(11) Swing tee bar into place. Insert attachment bolts through each side of the floor tunnel. Secure with washers and nuts.

(12) 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.

(13) Set rudder cable tension and check rigging and adjustment per Rigging and Adjustment in Rudder Control Cables, above.

(14) Set stabilator cable tension. Check rigging and adjustment per Rigging and Adjustment in Stabilator Controls, 27-30-00.

(15) Check aileron cable tension.

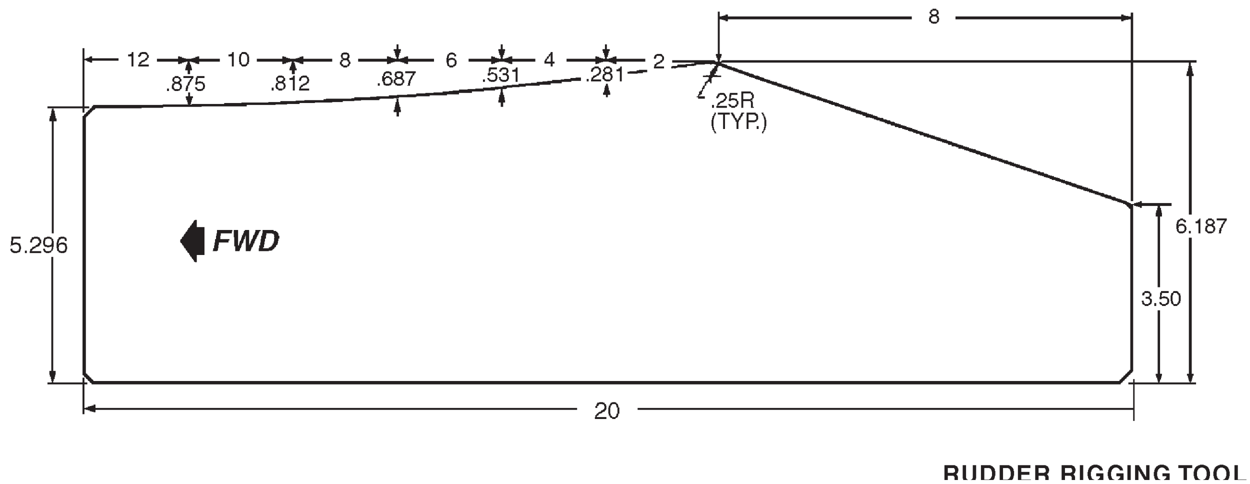
(16) Check safety of bolt and turnbuckles.

(17) Install floor tunnel plate and secure with screws. Fasten tunnel carpet in place.

(18) Install fuel selector lever on selector torque tube. Secure with clevis pin and safety with cotter pin.

(19) Install fuel selector covers and rudder trim control knob.

(20) Install access panel to aft section of the fuselage.



Fabricated Rudder Rigging Tool
Figure 7

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STABILATOR AND TAB

1. Troubleshooting

   See Chart 1.

CHART 1 (Sheet 1 of 2)
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.
	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.

CHART 1 (Sheet 2 of 2)
TROUBLESHOOTING STABILATOR CONTROL SYSTEM

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.

2. Stabilator Control Cables

A. Removal (Refer to Figure 1.)

(1) 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) Aft Stabilator Control Cable - either side:

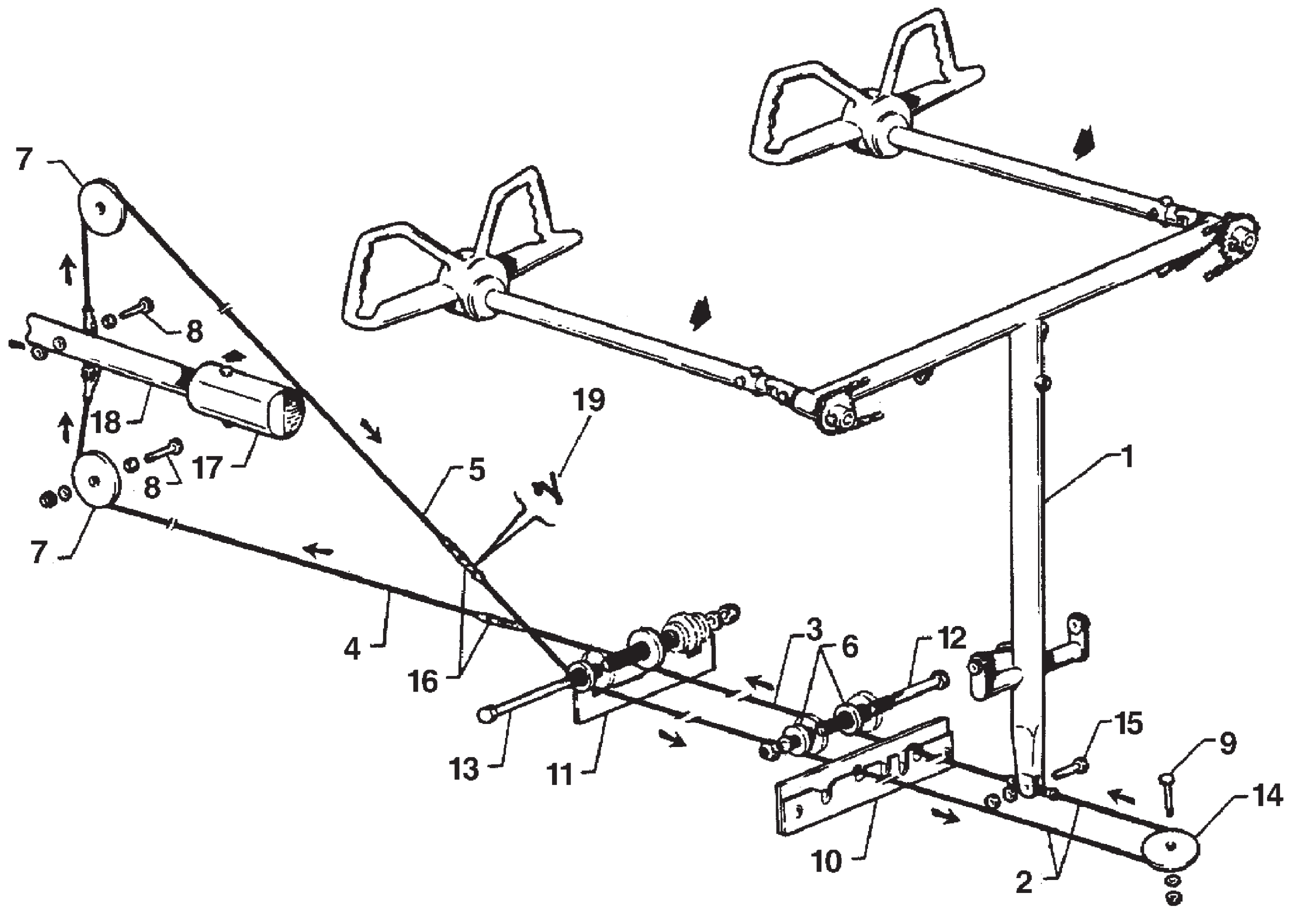
(a) Remove access panel to aft section of the fuselage.

(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.



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, AND COITER PIN
9. BOLT, WASHER, AND NUT
10. CABLE RUB BLOCK
11. CABLE GUARD
12. BOLT, WASHER (7), AND NUT
13. BOLT, WASHER (1 1), AND NUT
14. FORWARD PULLEY
15. BOLT, WASHER, NUT, AND COITER PIN
16. TURNBUCKLE
17. BALANCE ARM WEIGHT
18. STABILATOR BALANCE ARM
19. LOCKING CLIP

Stabilator Controls
Figure 1

B. Installation (Refer to Figure 1.)

(1) Aft Stabilator Control Cable - either side:

(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, below.

(f) Install access panels to aft section of the fuselage.

(2) Forward Stabilator Control Cables:

NOTE: Aft control cable(s) must be installed before installing forward cable(s). See above.

(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 to lower end of control column tee bar with bolt, washer, nut and cotter pin. Ensure that cable is free to rotate.

(c) Connect control cable to aft cable at turn buckle in aft section of fuselage.

(d) If installing right cable, install cotter pin cable guard at pulley in forward area of tunnel

(e) Install the cable rub blocks to the spar housing located in forward 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 Rigging and Adjustment, below.

(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.

C. Rigging and Adjustment

WARNING: 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, VISUALLY CONFIRM THAT THE STABILATOR TRAILING EDGE MOVES UP WHEN THE WHEEL IS PULLED BACK; AND, THAT THE STABILATOR TRAILING EDGE MOVES DOWN WHEN THE WHEEL IS PUSHED FORWARD.

(1) To check and set the correct degree of stabilator travel per Chart 2, 27-00-00.

(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 2), indicates that stabilator is parallel (bubble centered) with leveling holes noted in Chapter 8, Figure 1. (Rigging tool may be fabricated from dimensions given in Figure 7.)

(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 2, on a bubble protractor

3 Place protractor on rigging tool.

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 2 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.

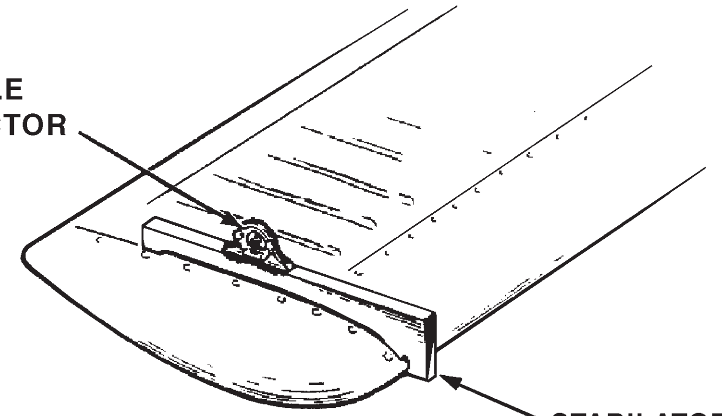
(d) If stabilator travel is not correct in either the up or down position:

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 3.)

3 Check that locknuts of stop screws are secure.

4 Install the tail cone.



Stabilator Rigging
Figure 2

(2) Stabilator Control Cable Tension:

(a) Check that the stabilator travel is correct according to Chart 2, 27-00-00.

(b) Remove access panel to aft section of fuselage and tail cone.

(c) Position control wheel by adjusting the turnbuckles on the stabilator control cables to obtain 3/8 ± 1/8 inch of control shaft travel between contact with the primary up stop on the stabilator and secondary stop on the left hand control column shaft.

(d) With the tee bar (control column) positioned 1/2 ± 1/4 inch off the forward tee bar stop in the cockpit, adjust the stabilator cable turnbuckles to the tension shown in Chart 2, 27-00-00.

(e) Recheck free travel per steps (c) and (d). With the control wheel forward and the stabilator on primary down stop, check for 1/4 inch minimum clearance between tee bar and secondary forward stop.

(f) With the stabilator and trim in all extremes of travel, check to insure that there is no interference between turnbuckles and pulleys.

(g) Check to insure that stabilator up and down stops are contacted before the tee bar stops are contacted.

(h) Install locking clips and check for proper proper installation by trying to remove the clips using only your fingers.

(i) Install access panels and tail cone.

3. Stabilator Trim Controls

A. Forward Assembly (Refer to Figure 5.)

(1) Removal:

(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 4.)

(d) To remove trim control wheel, loosen cables at trim cables turnbuckles in aft section of fuselage.

(e) To remove trim cables, disconnect cables at trim cables turnbuckles in aft section of fuselage.

(f) Control wheel with drum:

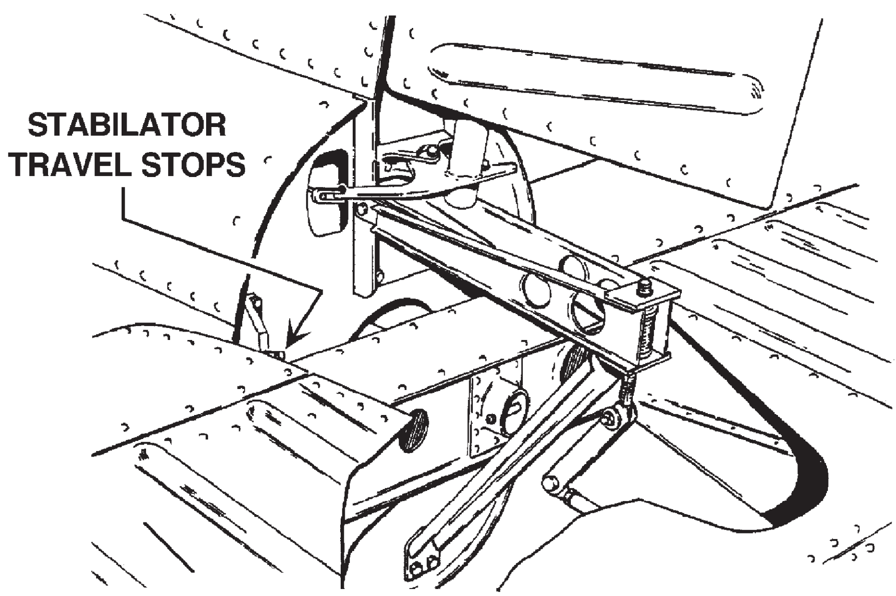
1 Remove control wheel cover by removing cover attaching screws.

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 Rigging
Figure 3

(g) 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.

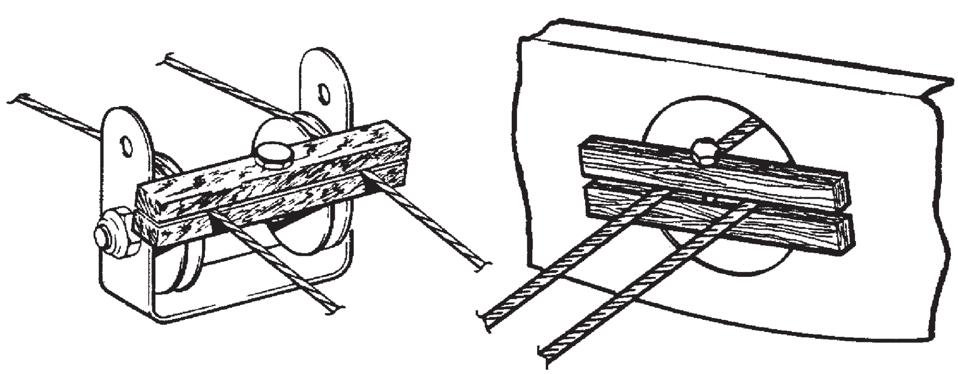
11 Remove cover plate from top of aft floor tunnel by removing attachment screws.

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.

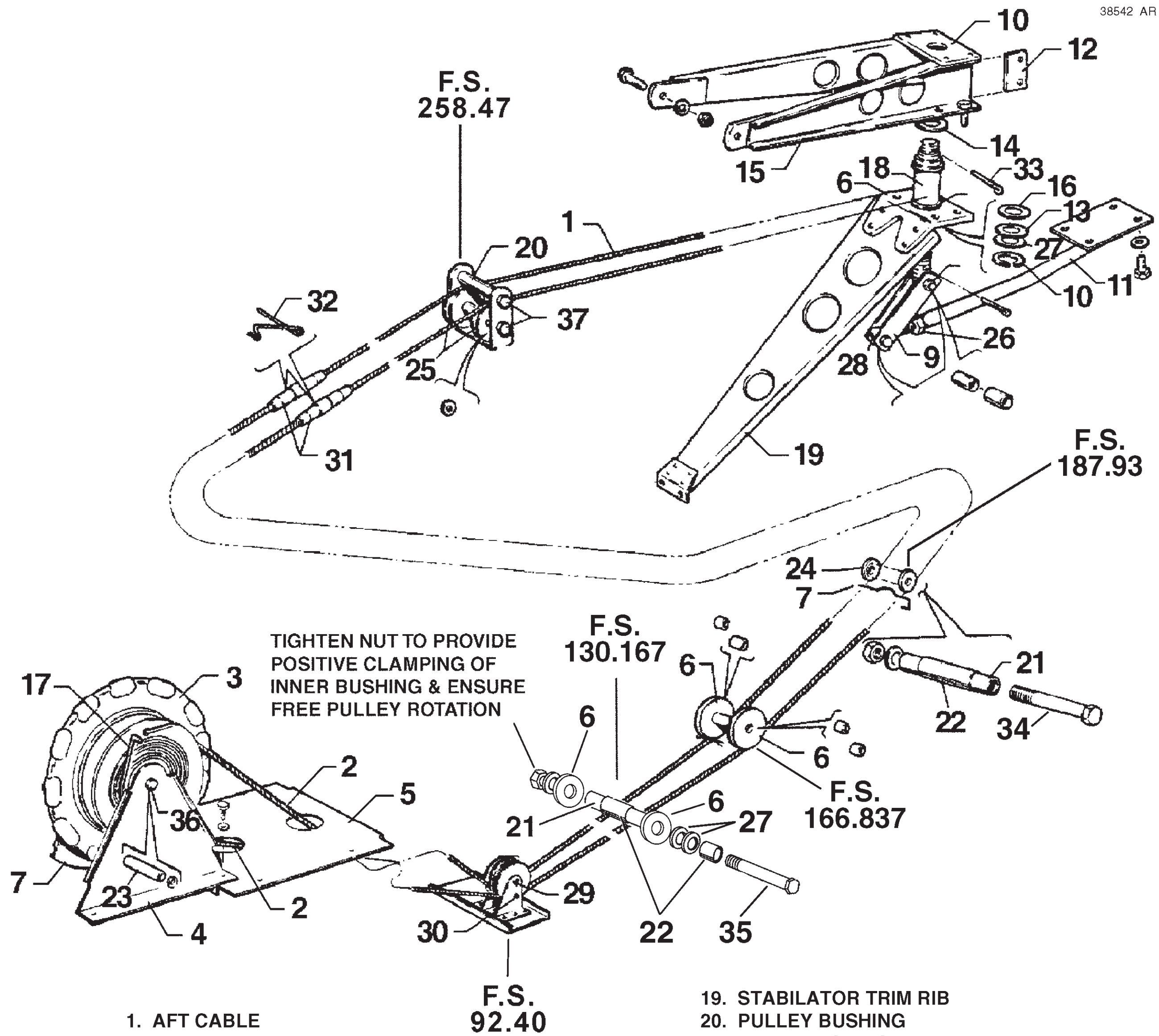
13 Remove cable guard plate from underside of pulley cluster located in aft area of floor tunnel by removing plate attachment screws.

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.



Methods of Securing Trim Cables
Figure 4



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, COTTER PIN
36. BOLT, WASHER, NUT
37. BOLT, WASHER, NUT

Stabilator Trim Controls
Figure 5

(2) Installation

(a) 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.

(b) 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 Aft Assembly, Installation, below.

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 per Rigging and Adjustment, below. 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.

B. Aft Assembly

(1) Removal (Refer to Figure 5.)

(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 (i.e., FS 187.93), by method shown in Figure 4.

(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.

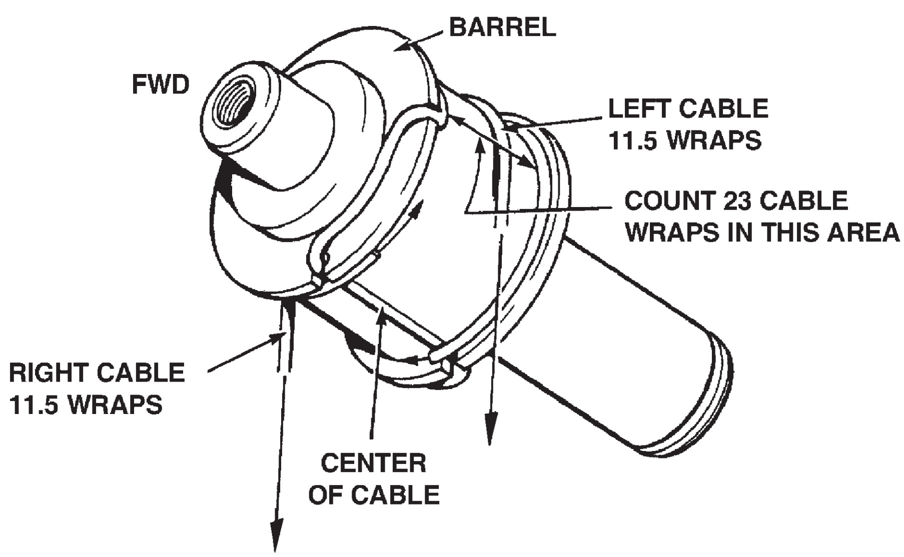
(f) Disconnect link between trim screw and trim control arm by removing nut, washer and bolt connecting link to screw.

(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.



Wrapping Trim Barrels
Figure 6

(2) Installation

(a) Wrap the trim barrel by: (Refer to Figure 6.)

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 6.)

(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, below. Check safety of all turnbuckles.

(k) Install tail cone and secure with screws.

(l) Install aft fuselage access panel.

C. Rigging and Adjustment

WARNING: 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, VISUALLY CONFIRM THAT THE STABILATOR TAB TRAILING EDGE MOVES UP WHEN THE TRIM WHEEL IS TRIMMED DOWN; AND, THAT THE STABILATOR TAB TRAILING EDGE 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 Chart 2, 27-00-00. If cables were disconnected, rotate trim control wheel several times to allow cables to seat and recheck tension.

(3) Secure stabilator in neutral position. See Figure 3.

(4) Turn trim control wheel until aft end of turnbuckle 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.

(9) Check bubble of protractor over neutral tab; then check tab travels specified in Chart 2, 27-00-00. 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.

4. Stall Warning System

A. 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 inboard lift detector will activate the stall warning horn when flaps are set 0° and 10°; the outboard lift detector will activate the stall warning horn when flaps are set 25° and 40°. Perform the following tests to determine that the lift detectors are functioning properly.

B. Functional Tests

(1) Ground Check

The following ground check will determine if the lift detectors are correctly connected and functioning properly. It also verifies the correct adjustment of the flap position switch. This ground check does not test the proper adjustment of the lift detectors.

(a) Apply electrical power to the airplane.

(b) Extend flaps to the 10° position. The 0° and 10° flap position activates the inboard lift detector only. Gently lifting the inboard lift detector vane should activate the stall warning horn. Gently lifting the outboard lift detector vane should not activate the stall warning horn.

(c) Position the flap to 25° or 40°. Gently lifting on the outboard lift detector vane should activate the stall warning horn. Lifting on the inboard lift detector vane should not activate the stall warning horn.

NOTE: In steps (b) and (c), above, if the stall warning horn sounds when it should not, or does not sound when it should, the fault may be the flap position switch being out of adjustment. See Wing Flap Controls, Rigging and Adjustment, 27-50-00.

(d) Remove electrical power from the airplane.

(2) Flight Test Procedure

(PIR-See PPS/FTP Index.)

WARNING: A QUALIFIED PILOT EXPERIENCED IN THIS MAKE AND MODEL AIRPLANE MUST FLY ALL FLIGHT TESTS.

NOTE: Typically performed whenever a lift detector(s) is removed and installed or a wing is removed and installed.

At a suitable altitude, configure the airplane power OFF, gear DOWN, and flying at a rate of 1 KT/SEC maximum; record the following warning and stall speeds:

	TRIM KIAS	RECORD:	WARNING KIAS	STALL KIAS
0° FLAPS = (Inboard lift detector)	96		______	______
FULL FLAPS = (Outboard lift detector)	88		______	______

(a) Verify that the stall warning system performs within the following limits:

1) Maximum: stall warning begins at 5 to 10 KIAS prior to stall and continues until stall occurs.

2) Desired: stall warning begins at 7 to 9 KIAS prior to stall and continues until stall occurs.

(b) If the stall warning system fails to perform within the limits above, adjust the system and refly the test.

(c) If not able to adjust the stall warning system sufficient to achieve the limits above, recheck the "replacement" wing installation to ensure it is installed and rigged correctly.

C. Lift Detectors.

(1) Removal

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.

(2) Installation

(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.

(d) Perform “Flight Test Procedure”, under Functional Tests, above.

(3) Adjustment

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.

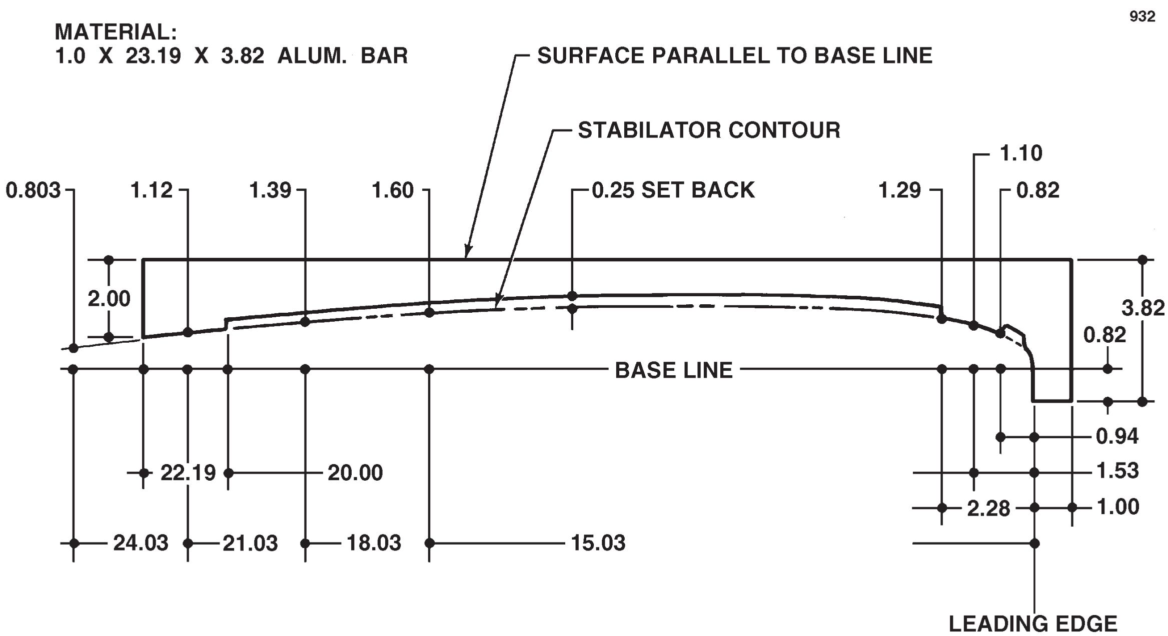
(a) Fly the airplane per Functional Tests, Flight Test Procedure, above.

(b) Loosen the two phillips 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.

(c) Tighten the screws after making any adjustments.



Stabilator Rigging Tool
Figure 7

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FLAPS

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, left of the co-pilot's control wheel. 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°.

1. Troubleshooting

   See Chart 1.

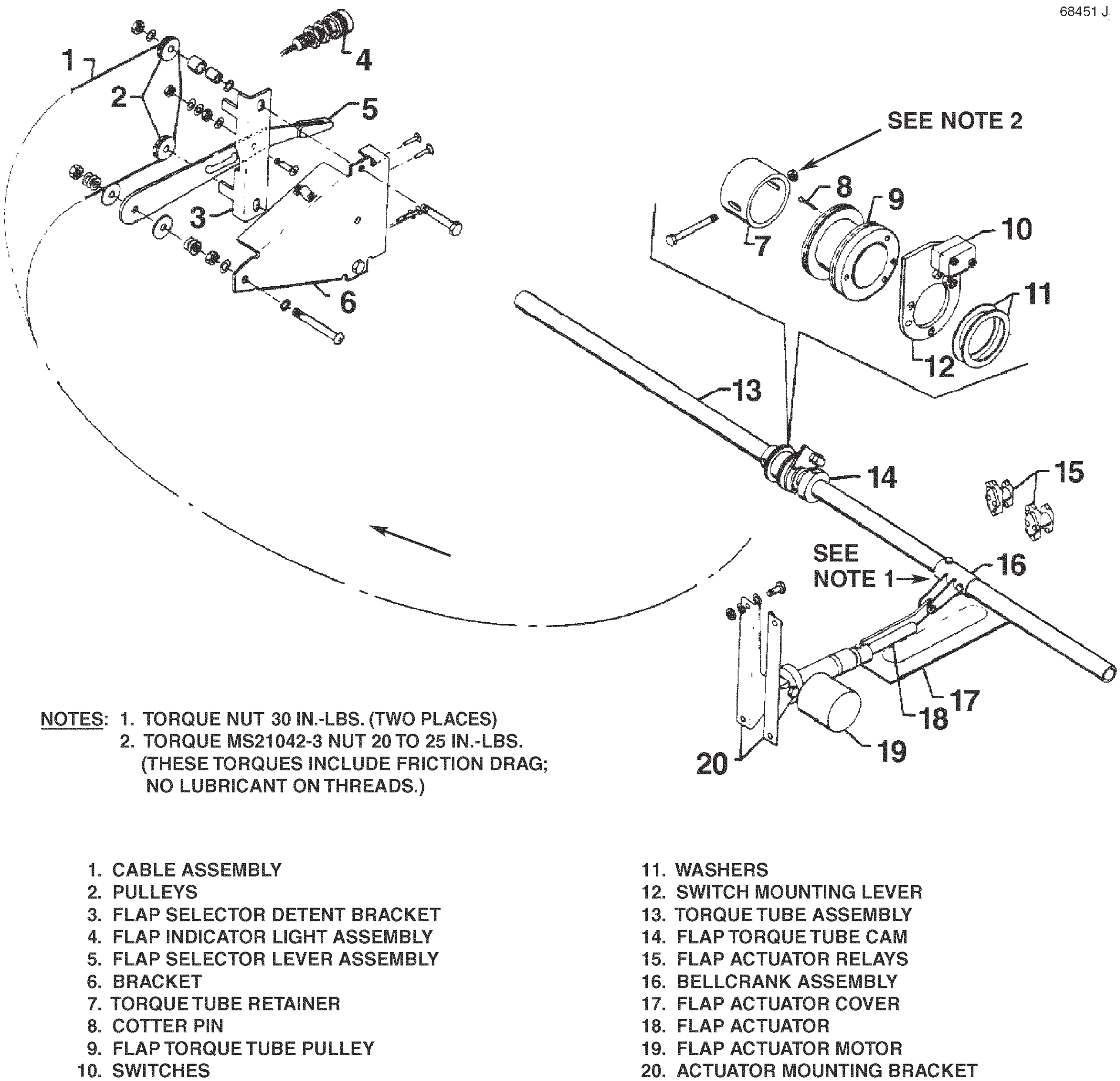
2. Wing Flap Controls (Refer to Figure 1.)

   A. Removal

   (1) Flap Torque Tube Assembly:
   (a) Extend flaps to 40° position.
   (b 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.
   (c) Remove access plate located between underside of aft section of each wing and fuselage by removing attaching screws.
   (d) Disconnect left and right flap control tubes (rods) either:
   1 At the flaps by removing nuts, washers and bolts at the torque tube cranks (arms) or by;
   2 Removing bolts and washers from inner side of each crank. Remove bolt through a hole in the fuselage side skin located over torque tube .
   (e) Disconnect electrical connections from limit switches mounted to torque tube switch plate.
   (f) Disconnect cable ends from torque tube pulley assembly by removing the cotter pins.
   (g) Disconnect jack screw actuator from torque tube bellcrank by removing nut, washers and bolt.
   (h) Remove tube support bearing blocks by removing block attachment bolts.
   (i) Remove nuts, washers and bolts securing right and left cranks, and stop fittings on torque tube.
   (j) From between each wing and fuselage, remove cranks from torque tube.
   (k) Disconnect one bearing block from its mounting brackets by removing nuts, washers and bolts.
   (l) Slide tube from bearing block still attached to its brackets. Raise end and lift it from floor opening.

CHART 1
TROUBLESHOOTING FLAP CONTROL SYSTEM

Trouble	Cause	Remedy
Flaps fail to extend or retract.	Control cable broken or disconnected.	Replace or reconnect control cable.
Flaps not synchronized or fail to move evenly when retracted.	Incorrect rigging of system.	Adjust flaps.



Electrically Operated Flap System
Figure 1

(2) To remove flap control cable:

(a) Remove center seats. Remove center floor panel by removing screws securing panel.

(b) Remove aft heat deflectors on each forward floor tunnel by sliding them far enough to release spring fasteners.

(c) Lift aft section of tunnel carpet far enough to remove screws securing tunnel cover. Remove cover.

(d) Remove cotter pins securing cable ends to pulley assembly on torque tube.

(e) Remove clamps securing cable housings to support bracket.

(f) Disconnect flap selector lever and cable from flap selector lever support bracket mounted on aft side of instrument panel.

(g) Remove cable assembly from tunnel.

(3) To remove flap actuator jack screw and motor assembly:

(a) Remove center seats. Remove center floor panel by removing screws securing panel.

(b) Disconnect electrical leads to flap actuator motor.

(c) Remove nut, washers and bolt securing flap actuator jack screw to torque tube bellcrank.

(d) Remove nut, washers and bolt securing flap actuator jack screw to its mounting bracket. Do not drop bushing in jack screw mounting end.

(e) Remove flap actuator jack screw and motor assembly through center floor opening

B. Installation (Refer to Figure 1)

(1) To install flap actuator jack screw and motor assembly:

(a) Position flap actuator jack screw and motor assembly through center floor opening. Do not drop bushing in jack screw mounting end.

(b) Install nut, washers and bolt securing flap actuator jack screw to its mounting bracket.

(c) Install nut, washers and bolt securing flap actuator jack screw to torque tube bellcrank.

(d) Connect electrical leads to flap actuator motor.

(2) To install flap control cable:

(a) Position cable assembly in tunnel.

(b) Connect cable to flap selector lever and flap selector lever support bracket mounted on aft side of instrument panel.

(c) Attach cable ends to pulley assembly on torque tube by installing cotter pins.

(d) Install clamps securing cable housings to support bracket.

(e) Install aft section tunnel cover and secure with screws.

(f) Install tunnel carpet and heat deflectors.

(g) Install center seats.

(3) To install flap torque tube assembly:

(a) Check that one end bearing block fitting is installed between its attachment brackets.

(b) Slide the other end bearing block over its respective end of torque tube.

(c) 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.

(d) Between each wing and fuselage, attach cranks to torque tube.

(e) Install nuts, washers and bolts securing right and left cranks, and stop fittings on torque tube.

(f) Install tube support bearing blocks. Secure by installing block attachment bolts.

(g) Connect jack screw actuator to torque tube bellcrank and secure with nut, washers and bolt.

(h) Connect cable ends to torque tube pulley assembly and secure with cotter pins.

(i) Connect electrical connections to limit switches mounted to torque tube switch plate.

(j) Connect left and right flap control tubes (rods) either:

1 At flaps by installing nuts, washers and bolts at torque tube cranks (arms) or by;

2 Installing bolts and washers to inner side of each crank. Install bolt through a hole in the fuselage side skin located over torque tube.

(k) Install access plate located between underside of aft section of each wing and fuselage by installing attaching screws.

(l) Install floor panel located aft of main spar and secure with screws

(m) Install center seats and seat belt attachments.

(n) Retract flaps.

C. Rigging and Adjustment

NOTE: Flap rigging and adjustment must be completed before starting aileron rigging and adjustment.

WARNING: 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, VISUALLY CONFIRM THAT THE FLAP TRAILING EDGES MOVE UP WHEN THE SELECTOR LEVER IS UP; AND, THAT THE FLAP TRAILING EDGES MOVE DOWN WHEN THE SELECTOR LEVER IS DOWN.

(1) To Rig Control Cable:

(a) Loosen lever cable clamp nut so that cable can move freely through cable clamp. Secure lever in the full down position. (Refer to Figure 2).

(b) Position the swash plate assembly on torque tube and secure in place. (Refer to Figure 3.)

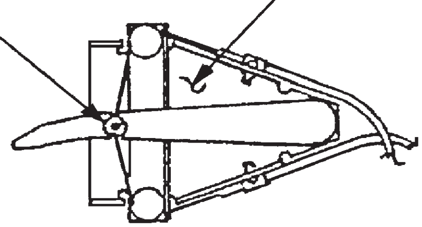
(c) Loosen cable housing clamps at pulley support channel. Adjust cable tension so that a 5 ± 0.5 pound pull midway between cable housing clamps and swash plate assembly will deflect the cable 0.38 inch from relaxed position. Tighten cable housing clamp. (Refer to Figure 3.)

(d) Tighten lever cable clamp nut so that cable is compressed to 1/2 its full diameter. (Refer to Figure 2.)

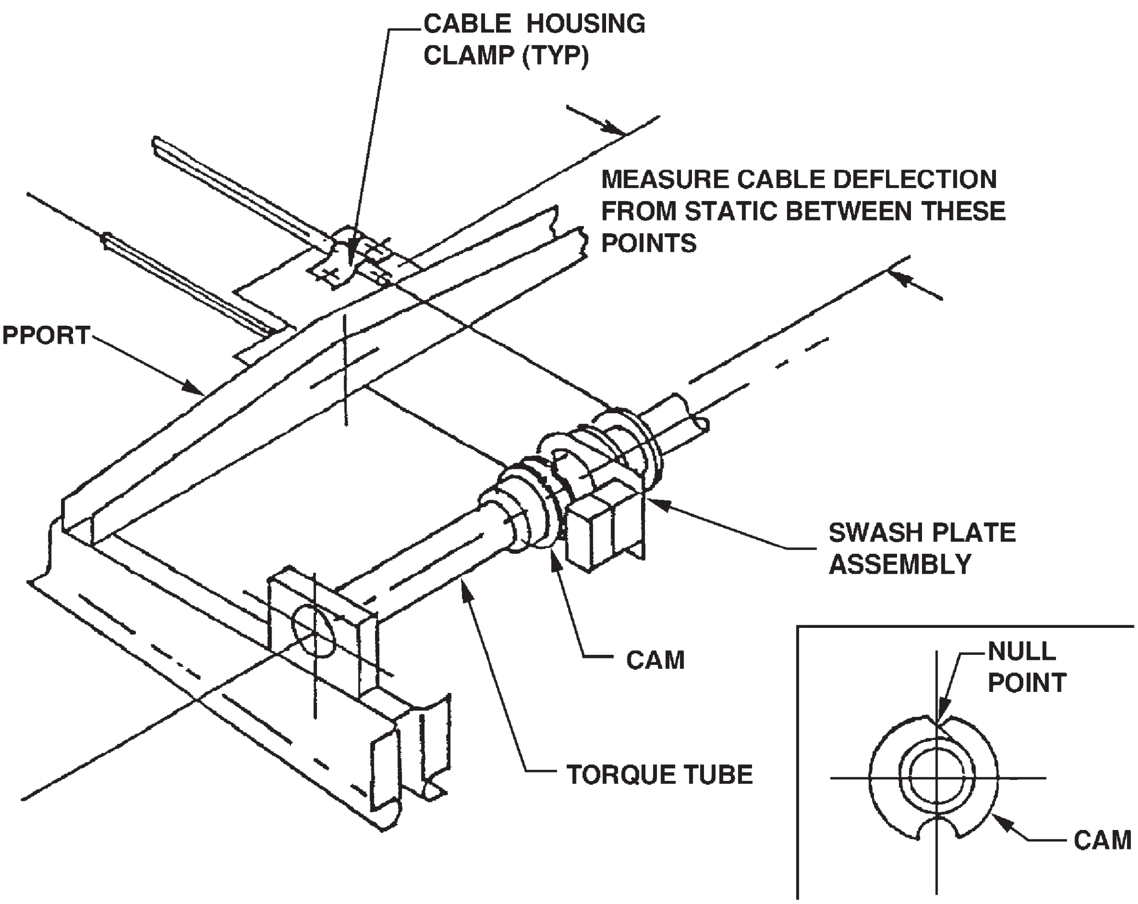
(2) To Adjust Cam:

(a) Pull the electric flap circuit breaker.

(b) 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.



Flap Selector and Cable Assembly
Figure 2



Electrically Operated Flap Torque Tube Assembly
Figure 3

(c) Run actuator out so that there is 0.10 inch clearance between torque tube and the actuator push rod. (Refer to Figure 4)

(d) Connect aircraft wires to actuator motor and secure.

(e) 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 3 inset, and not 180 degrees off.

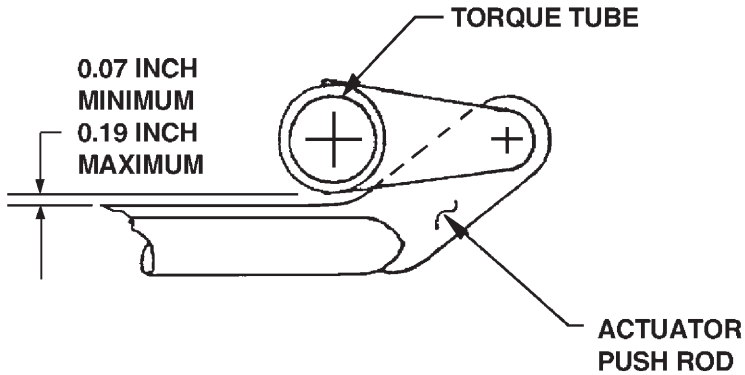
(f) Loosen set screw in cam and rotate until flap in-transit light is out (Refer to Figure 3). Tighten the cam set screws.

(g) Push in electric flap circuit breaker and verify that flap motor does not run.

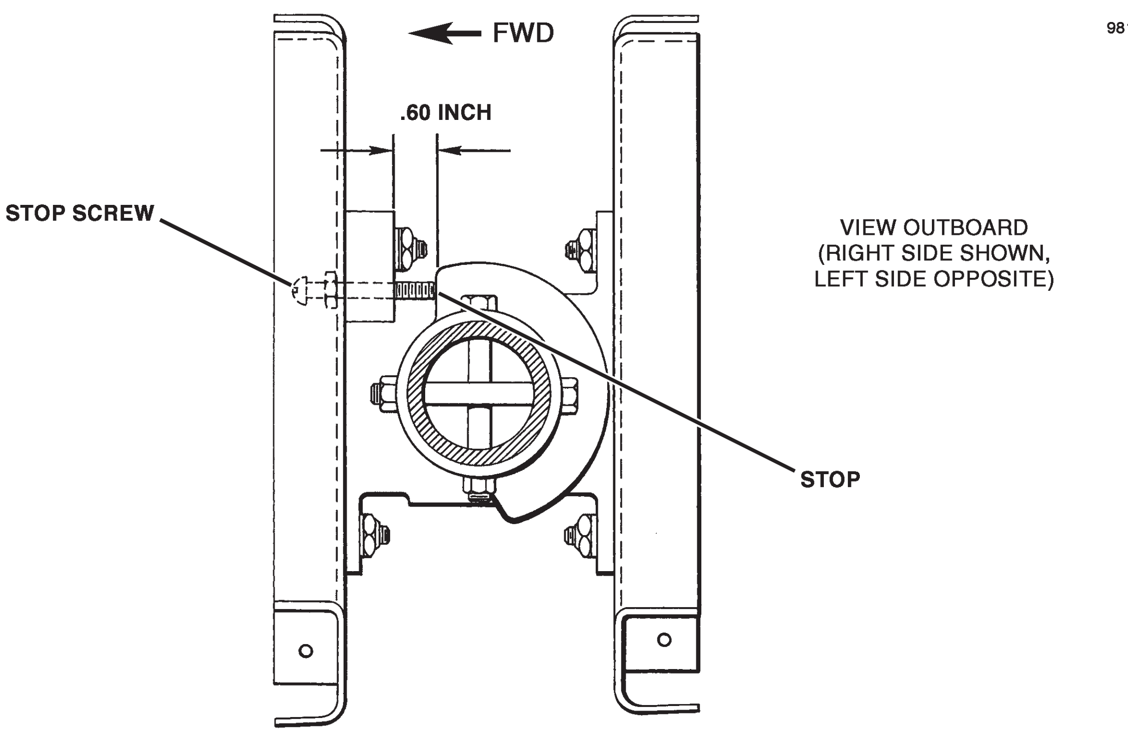
(h) Move selector lever to full DOWN position. Verify that actuator retracts and stops about 0.4 inch short of bottoming out.

(i) 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 4).

(j) Adjust left and right stop screws so that contact is just made with stop. Tighten jam nuts. (Refer to Figure 5).



Electrically Operated Flap Cam Adjustment
Figure 4



Stop Screws Adjustment
Figure 5

(3) To Set Flap Angle

(a) 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.

(b) Adjust each flap push rod so that chord line of flap forms a 0° ± 1° angle with wing chord at outboard end of flap.

(4) 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°.

3. Flap Torque Tube/Pushrod Distortion Inspection

If flaps have been extended at or above V_{FE}, inspect the flap torque tube arms and pushrods for evidence of distortion.

A. If the paint is cracked or peeling anywhere along the torque tube arm or pushrod, torsional movement has occurred.

B. Remove the paint and inspect for cracks:

(1) In the welds at the arm on the torque tube end.

(2) In the rod ends and pushrod tube.

(3) Use a dye penetrant method of inspection.

C. If cracks are not found, repaint the part(s) and reinstall.

D. If cracked, replace the affected part(s).

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CHAPTER

28

FUEL

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CHAPTER 28

LIST OF EFFECTIVE PAGES

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CHAPTER 28 - FUEL

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CHAPTER 28 - FUEL

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GENERAL

1. Description

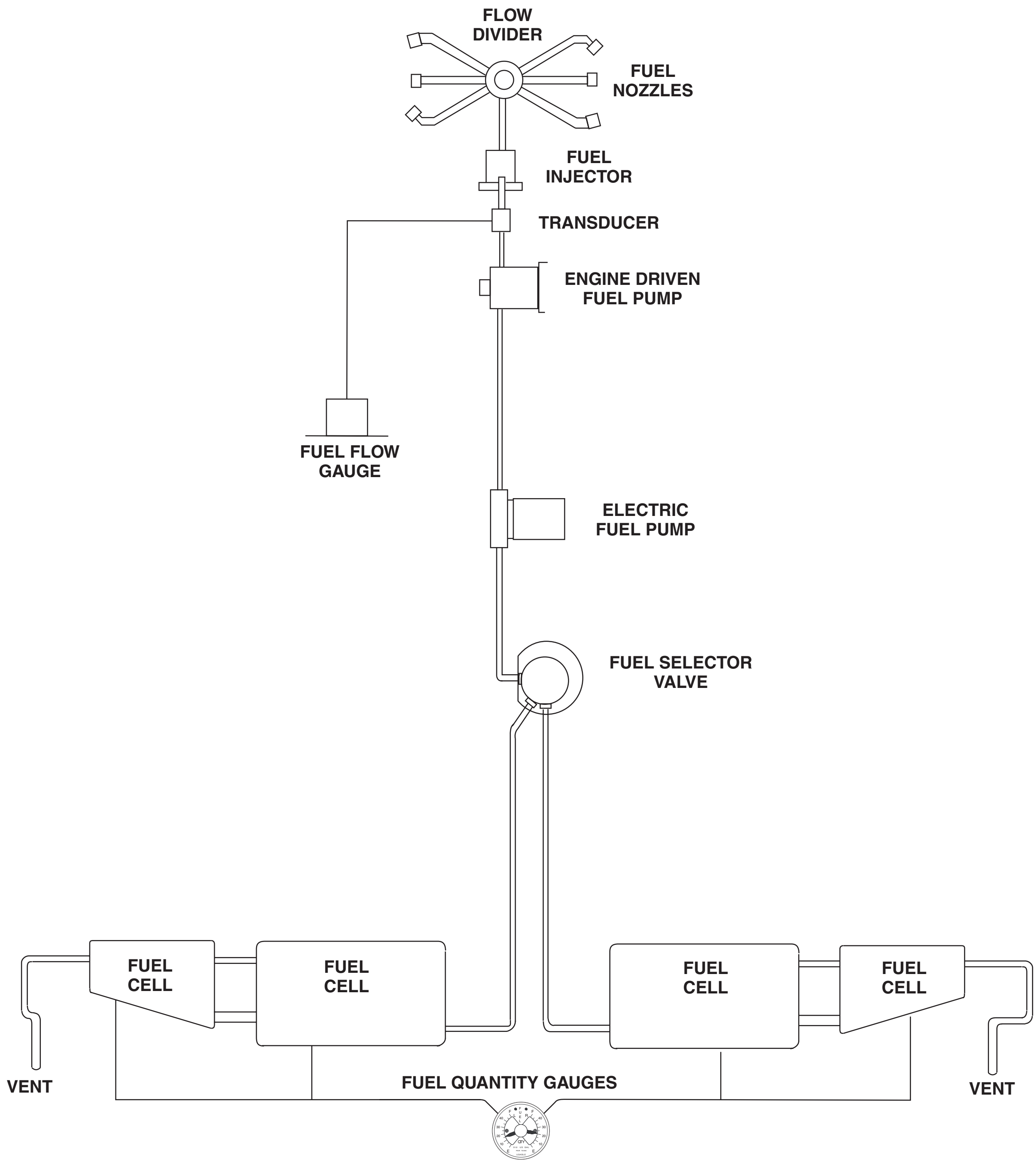
The fuel system consists of two interconnected tanks in each wing, having a combined capacity of 53.5 U.S. gallons per wing, for a total capacity of 107.0 U.S. gallons. The inboard tank is an integral part of the wing surface. Fuel flow is indicated on the gauge located in the instrument panel. A fuel 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 1 for layout and relationship of the fuel system and components.

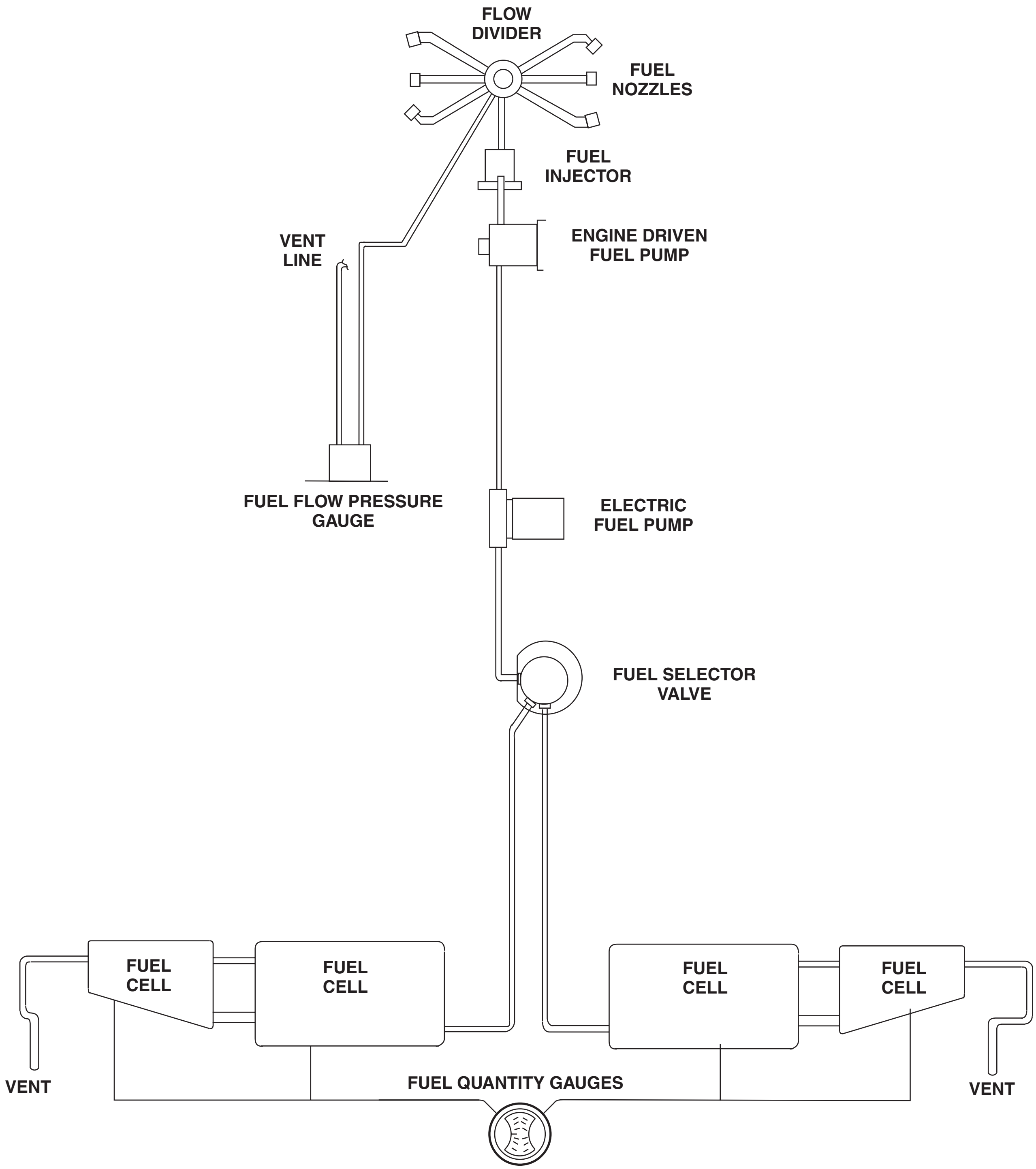
2. Troubleshooting

Electrical and mechanical troubles of the system are found in Chart 1. 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.



Effectivity
3246088 & up
3257001 & up

Fuel System
Figure 1 (Sheet 1 of 2)



Fuel System
Figure 1 (Sheet 2 of 2)

Effectivity
3246001 thru 3246087 only

CHART 1
TROUBLESHOOTING FUEL SYSTEM

Trouble	Cause	Remedy
Failure of fuel to flow.	Fuel line blocked.	Flush fuel system.
	Fuel vent cap blocked.	Check and clean vent hole in cap.
	Mechanical or electrical fuel pump failure.	Check and replace if necessary.
	Fuel selector valve in improper position.	Reposition as required.
		Check for obstructions in the fuel selector leverage mechanism.
	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

1. Fuel System Inspection

Fill tanks with fuel. Inspect tanks and fuel line connections for leaks. Leaks will be indicated by telltale stains.

A. If inboard fuel tanks leak, see Fuel Tanks - Inboard (Aluminum), below.

B. If outboard fuel cells leak, see Fuel Cells - Outboard (Bladder-type) - Repair, below.

C. If fuel line connections leak, tighten clamps.

D. If fuel line connections continue to leak:

(1) Drain tanks (see Fuel Tanks - Draining, 12-10-00).

(2) Replace hose connections.

2. Fuel Tanks - Inboard (Aluminum) (See Figure 1.)

WARNING: IF DRAIN VALVES ARE REMOVED TO DRAIN TANKS, APPLY LOCTITE 242, P/N 279-154, 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 per Repair, below.

A. Removal

(1) Completely drain fuel from tank (Refer to Draining Fuel Systems, Chapter 12-10-00).

(2) Remove access cover located on underside of wing between wing stations 88.75 and 115.95 and aft of the fuel tank.

(3) Loosen clamps at hose connections on fuel line and fuel vent line. Slide hose connections away from fuel tank.

(4) Disconnect fuel line on inboard side of tank.

(5) Remove screws from around perimeter of the tank.

(a) In standard airplanes (without Inadvertent Ice Protection System (TKS)).

1 Carefully pull tank away from wing far enough to gain access to/and remove sender wire.

2 Remove tank.

(b) In airplanes with the optional Inadvertent Ice Protection System (TKS).

1 Remove access cover in wing bottom between W.S. 49.25 and 57.00.

2 Remove the four (4) screws, washers (2 ea.), and nuts on the inboard end of the TKS porous panel.

CAUTION: TAKE CARE NOT TO DAMAGE THE TKS PANEL, FLUID FEED LINE, OR FLUID INLET PORT INBOARD OF THE FUEL TANK.

3 Carefully loosen the TKS panel from the leading edge of the inboard wing surface.

NOTE: The TKS panel inboard of the fuel tank is attached to the wing leading edge by low adhesion sealant. A tool fabricated by grinding down a hacksaw blade can be slipped between the TKS panel and the leading edge and used to cut the sealant.

4 Disconnect and cap the fluid feed line from the inlet port on the panel.

5 Carefully pull tank away from wing far enough to gain access to/and remove sender wire.

6 Remove tank.

B. Installation

NOTE: In airplanes with the optional Inadvertant Ice Protection System (TKS) clean and degrease rear surfaces of TKS panel and the wing leading edge where the panel is to be attached using alcohol. Do not touch these surfaces after this operation.

(1) Position fuel tank in wing recess. Connect fuel sender wires.

(a) In standard airplanes (without TKS) slide tank completely into position. Secure with screws around its perimeter.

(b) In airplanes with TKS:

1 Uncap and connect the fluid feed line to the fluid inlet port on the porous panel. Be sure to install O-ring seal as described in Nylon Tubing Couplings, 20-00-00.

2 Apply a sealant bead (approx. 0.2 inch diameter) of Type 2 sealant (see 30-10-00, Chart 5) along the edges of the panel (along backplate joggle) and around the feed inlet/nylon tubing coupling and each air bleed valve. Also apply a sealant bead around each screw hole in the wing leading edge skin (see 30-10-00, Figure 4).

3 Apply sealant to cover the fluid inlet and coupling. Cover exposed connector threads, nut and feed line for at least 1/2 inch beyond the nut.

4 Slide fuel tank into place and quickly secure tank in position with two perimieter screws top and bottom.

5 Press TKS panel firmly to wing and hold with sufficient force to help sealant flow into place.

6 Replace and tighten the four (4) screws, washers (2 ea.), and nuts in the inboard end of the TKS panel.

7 Finish securing the fuel tank in place with the remaining perimeter screws.

8 Remove any surplus sealant from edges using alcohol.

9 Allow sealant to cure as specified in 30-10-00, Chart 5.

10 Prime pump per Pump Priming, Inadvertent Ice Protection System, 12-10-00.

11 Perform 50 Hour Inspection as outlined in 30-10-00.

(2) Through access hole located on underside of wing aft of fuel tank:

(a) Slide hose on interconnecting fuel line.

(b) Slide fuel vent line into position.

(c) Tighten clamps on both lines.

(3) Connect fuel line on inboard side of tank.

(4) Fill fuel tanks and check for:

(a) Leaks.

(b) Unrestricted fuel flow.

(c) Accurate sender indications on fuel quantity gauge.

(d) Ground wire is securely attached to interconnecting fuel line, fuel vent line, and wing rib at wing station 88.75.

(e) Replace access covers.

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C. Fuel Tank / Wing Spar Corrosion Inspection. (see Figure 1.)

NOTE: Paragraphs (1) and (2), below, are keyed to Figure 1.

(1) 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 for 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 serviceability.

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.

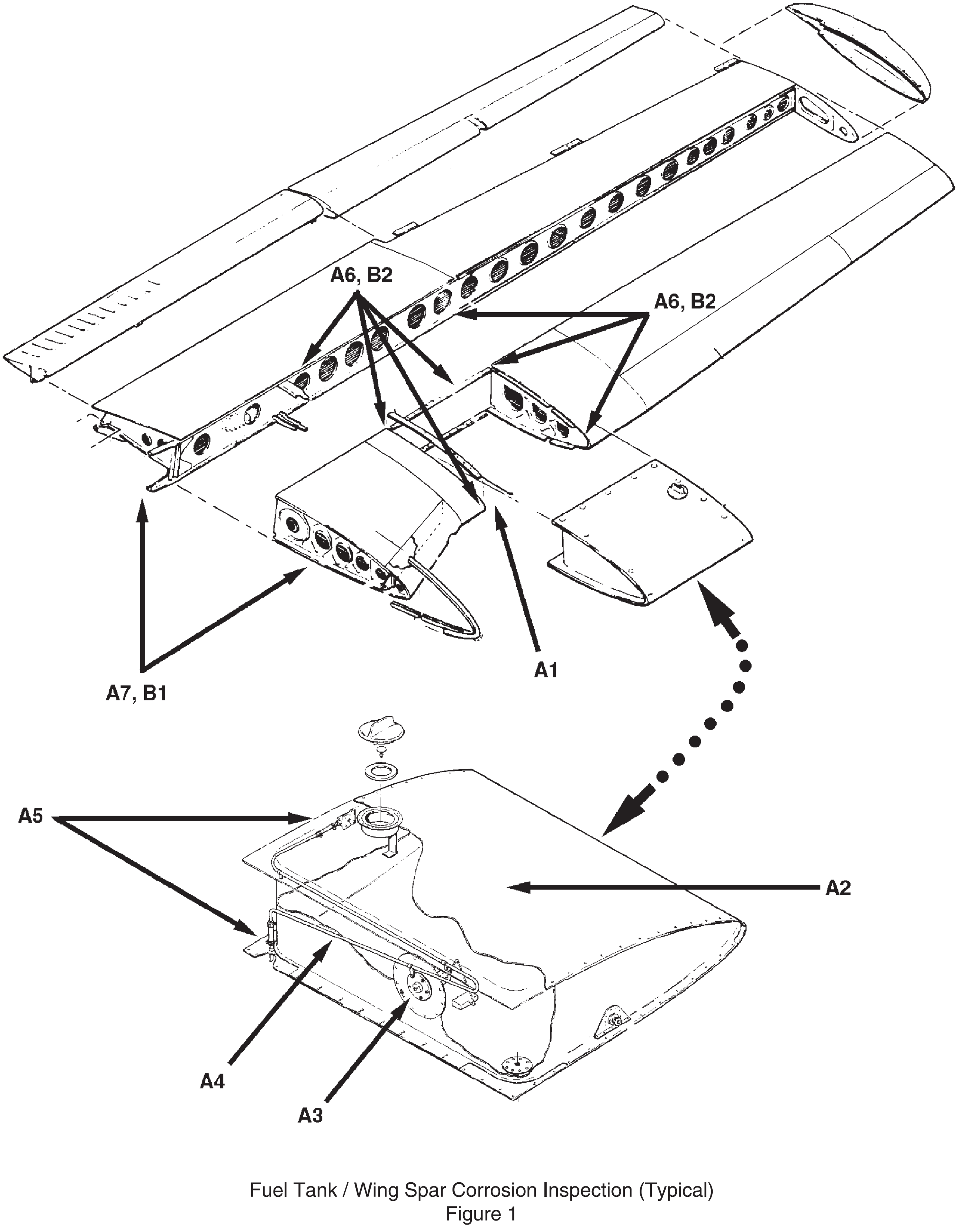
(2) Treat the following areas with Dinotrol AV 8 before reassembly.

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.

D. Repair

Seal leaks with Products Research Corporation PR 1422A series or PR1433G series sealant. For example: PR1422A1



Fuel Tank / Wing Spar Corrosion Inspection (Typical)
Figure 1

3. Fuel Cells - Outboard (Bladder-type)

A. Removal (Refer to Figure 2.)

NOTE: Prior to removal, a used cell should be drained, purged with fresh air and swabbed out to remove all traces of fuel.

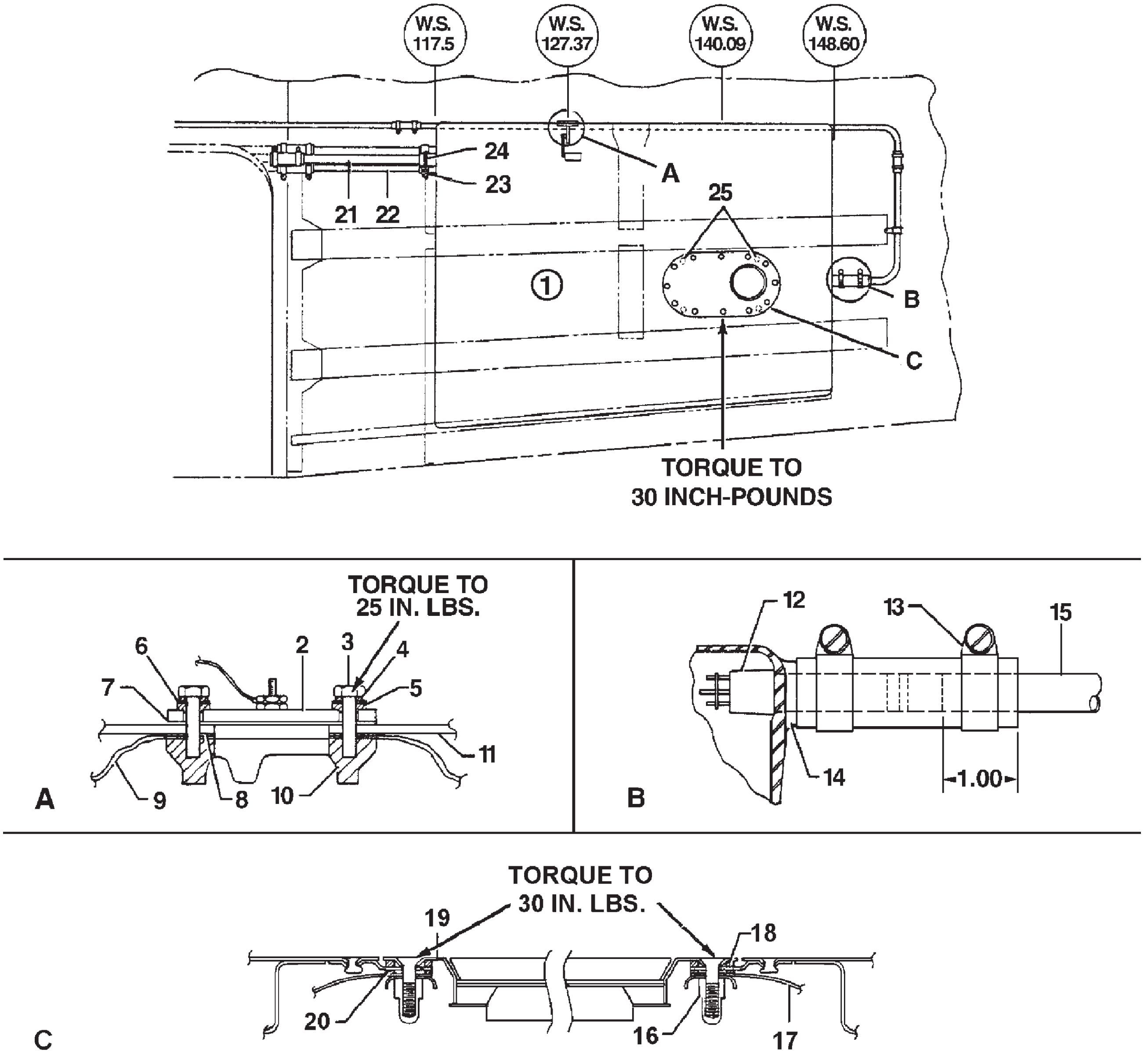
(1) Drain fuel cell (see Fuel Tanks - Draining, 12-10-00).
(2) Remove the access covers located on bottom of wing at wing stations 111.8, 165.5, and 129.3.
(3) Remove the twelve screws securing fuel cap adapter assembly to upper wing surface (wing station 140.09). Remove adapter assembly.
(4) Remove four screws securing fuel cell and nut ring and gasket to the top of wing. Remove nut ring and gasket.
(5) 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.
(6) Carefully separate \fuel vent line from fuel cell nipple.
(7) Reach in fuel cell and remove fuel vent valve assembly from fuel cell nipple.
(8) 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.
(9) 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.
(10) Inserting arm between fuel cell and top of wing, separate velcro strips which hold fuel cell in place.
(11) Fold fuel cell into a manageable form and withdraw it through the access opening at top of wing.

B. Cleaning

(1) 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.
(2) 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.

C. Inspection

(1) Inspect fuel cells during regularly scheduled airplane maintenance inspections.
(2) Inspect interior of each cell for cracking, porosity or other signs of deterioration.
(3) Inspect nipple as follows:
    (a) 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.
    (b) 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.
(4) Replace any cell found seeping or with soft nipples.



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. FUEL VENT VALVE ASSEMBLY
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)

Fuel Cell Components
Figure 2

D. Installation

(1) Inspect fuel cell compartment for cleanliness and condition. Ensure that:

(a) All sharp edges have been rounded off. Where this is not possible tape over all sharp edges or rough rivets;

(b) All filings, trimmings, loose washers, nuts, bolts, etc. have been removed from the compartment.

(2) Do not use sharp tools such as screwdrivers, files, etc. for installation purposes.

(3) Roll cell into a shape and size which can be inserted through access opening of the cell compartment.

(4) Place cell within cell compartment. Unroll and establish correct relationship of cell to compartment.

(5) Secure cell by pressing velcro strips of fuel cell against velcro strips of cell compartment.

(6) Using appropriate access opening in bottom of wing, install fuel sender unit as shown in Figure 2, View “A”.

(7) 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.

(8) Insert fuel vent line one inch into fuel cell vent nipple and secure with clamp. Torque clamp 12-16 inch - pounds.

(9) 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.

(10) Align holes of cork gasket, fuel cell, and nut plate. Secure with four screws. Torque to 12-15 inch - pounds.

(11) Using a clean soft lint-free cloth, wipe inside of cell clean of all dirt and foreign material. Inspect for cleanliness.

(12) 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.

(13) Fill fuel tanks and check for leaks, unrestricted fuel flow, and proper fuel level indication.

(14) Install access covers.

E. Handling and Storage

(1) Do not remove fuel cells from shipping container until time of installation.

(2) After removing fuel cell from its shipping container, inspect cell for damage due to crating or removal from crate.

(3) Do not use fuel cell nipple fittings as handholds. Do not drag fuel cells.

(4) Stack fuel cells only in original shipping containers.

(5) Prior to storing used fuel cells, clean with soap and warm water.

(6) 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.

(7) Store fuel cells in a dry area protected from sunlight. Recommended storage temperature is 70° F.

CHART 1
FUEL CELL REPAIR EQUIPMENT

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.

F. Repair (Refer to Chart 1.)

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.

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.

(1) Handling of Repair Materials

(a) 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.

(b) 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).

CAUTION: ALL CONTAINERS FOR CEMENTS AND SOLVENTS SHOULD BE PROPERLY IDENTIFIED.

(c) 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.

(2) Limitations

NOTE: Fuel cells sustaining damage exceeding the limitations listed below should be returned for evaluation to: Engineered Fabrics Corporation, 669 Goodyear Street, Rockmart, Georgia 30153.

(a) FT-192 repair fabric is for repair of simple contours only. Patches referred to in this text are of this material.

(b) Inside patches are to lap defect edges a minimum of 1.0 inches in each direction.

(c) Outside patches are to lap defect edges 0.25 to 0.50 inches inside patches.

(d) Outside patches are to be applied and cured prior to applying an inside patch.

(e) Blisters between inner liner and fabric larger than 0.25 of an inch in diameter require an outside and an inside patch.

(f) 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.

(g) Slits or tears up to 6.0 inches maximum length require an outside and inside patch.

(h) External abraded or scuffed areas without fabric damage require an outside patch only.

(i) 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.

(j) Air cure repair patches are to remain clamped and undisturbed for 72 hours at a room temperature of approximately 75°F.

(k) All heat cured patches are ready for use when cool.

(l) Fitting repairs are confined to loose flange edges, seal surface rework and coat stock.

(m) The maximum number of heat cure repairs in the same area is four.

(3) Heat Cure Repair Patch Method

The exterior patch is applied to the exterior cell wall and cured, first; then, the interior patch is applied to the interior cell wall.

(a) Preparation

1 Cut a repair patch from FT-192 material to size required to insure a proper lap over injury in all directions. (See Limitations, above.)

a 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.)

b Round corners of patch.

2 Wash one square foot of cell wall surrounding injury with a clean cloth soaked with Methylethylketone solvent.

3 Wash repair patch contact side with a clean cloth soaked with Methylethylketone solvent.

4 Abrade cell wall surface about the injury and on the contact side of patch with fine emery cloth to remove the shine.

5 Repeat Methylethylketone washings two more times, for a total of three washings for each surface.

6 Tape a 8'' x 8'' piece of cellophane inside the cell over the injury.

(b) Position cell for patch application on repair table.

(c) 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.

(d) 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.

(e) 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.

(f) After cement has dried approximately five minutes, center patch over injury.

1 Lay patch by rolling it down on surface from center to edge without trapping air.

2 Hold unrolled portion of repair patch off cemented surface until roller contact insures an air-free union.

3 The patch may now be moved by hand on the wet surface to improve lap. Do not lift repair patch, slide it.

(g) Using two aluminum plates larger than patch:

1 Cover one smooth surface of each plate with fabric-backed air foam, fabric side out. Foam must cover edges of plate for protection.

2 Tape air foam in place.

(h) Using a cellophane separator to prevent cement from sticking in the wrong place:

1 Fold cell adjacent to patch and place one prepared plate over repair patch.

2 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.

(i) 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.

(j) Connect repair iron into 110-volt current and cure repair for two hours.

(k) 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.

(l) After outside patch has been cured, apply inside patch using same procedure as above, except for side of repair patch (see Limitations, above.)

(4) Air Cure Repair Patch Method

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.

Follow procedure for heat cure method, above, except omit repair iron. Cure each patch for a minimum of 72 hours, undisturbed at 75°F.

(5) Fuel Cell Defect Repairs

(1) Blisters:

1 Remove loose material by trimming.

2 Apply an outside and inside repair patch.

(2) Holes, Punctures, Cuts, Tears and Deep Abraded Areas:

1 Trim away any ragged material

2 Apply an outside and inside repair patch.

(3) Loose Seams:

1 Buff loose edges and contact surfaces with emery cloth.

2 Wash three times with Methylethylketone.

3 Apply 80C27 mixed cement in two coats as with a repair patch.

4 Clamp and cure. Cure by either heat cure or air cure method.

5 Loose seams may be trimmed if a minimum lap remains.

(4) Loose Fitting Flange - Inside:

1 Buff the edge of the flange and the contact surface under the flange.

2 Apply 80C27 mixed repair cement, cellophane, padded plates and clamp.

3 Follow procedure as outlined for repair patch.

(5) Looseness Against Metal:

1 Prepare metal as per metal fitting - sealing surfaces.

2 Apply 80C27 mixed cement and cure.

G. 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.

(1) Unless otherwise specified, insert tubing into fitting until end is flush with inside edge of nipple.

(2) Hose clamp must clear end of fitting by 1/4 inch where possible.

(3) Locate hose clamp on fabric reinforced area of nipple.

(4) Do not use sealing paste or gasket compound.

(5) Use lightweight motor oil to facilitate insertion of tubing into nipple.

H. 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.

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 G, 4, (a), 2 and 3.)

(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 G, 4, (g) and (h)].

(9) Cure by either heat cure or air cure method.

I. Testing

Use either of the following procedures detect leaks in bladder cells:

(1) Soap Suds Test:

(a) Attach test plates to all fittings.

(b) Inflate the cell with air to a pressure of 1/4 psi maximum.

(c) Apply a soap and water solution to all repaired areas suspected of leakage. Bubbles will appear at any point where leakage occurs.

(d) After testing, remove all plates and wipe soap residue from the exterior of the cell.

(2) Chemical Test:

NOTE: The chemical test is the more sensitive and preferred test.

(a) Attach a test plate to all fitting openings except one.

(b) Make up a Phenolphthalein solution as follows:

1 Add 40 grams Phenolphthalein crystals in 1/2 gallon of Ethyl Alcohol and mix, then;

2 Add 1/2 gallon of water.

(c) Pour ammonia on an absorbent cloth in the ratio of 3 ml per cubic foot of cell capacity. Place ammonia saturated cloth inside the cell.

(d) Install remaining test plate to opening used to insert ammonia saturated cloth.

(f) Inflate cell with air to a pressure of 1/4 psi maximum. Cap and maintain pressure for fifteen minutes.

(g) 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.

(h) 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.

(i) 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.

(j) After test, remove all plates and test equipment. Allow cell to air out.

(3) 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.

4. Locking Fuel Cap (Refer to Figure 3)

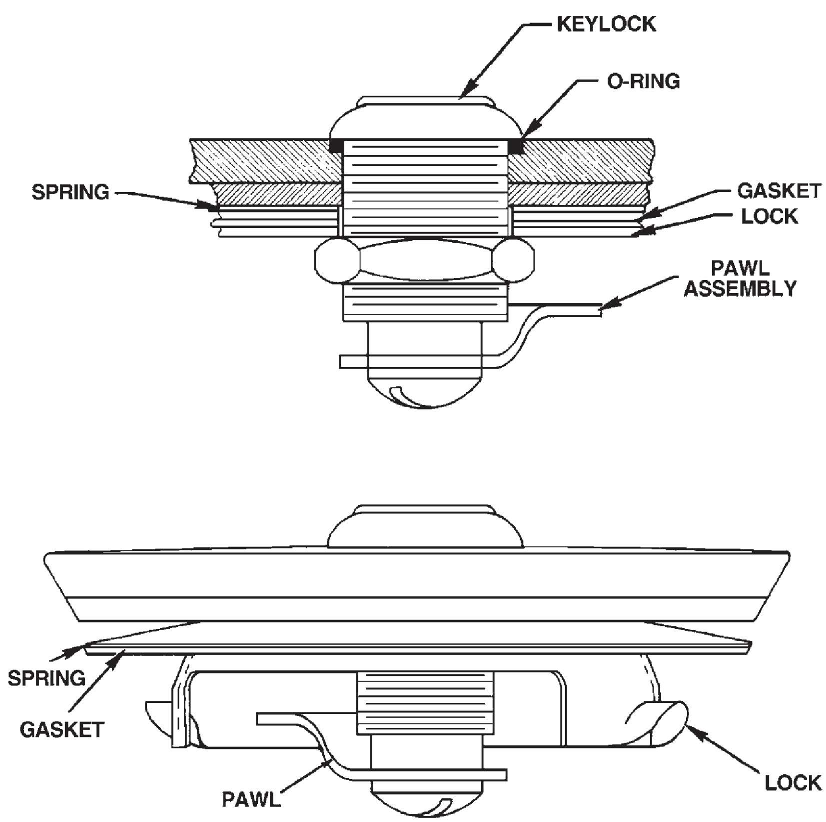
NOTE: These instructions do not apply to “new style” fuel caps, P/N 654-556, installed 2006 and later.

A. Disassembly

(1) Remove the two screws from top of fuel cap.
(2) Remove screw and lock washer that secures pawl to bottom of key lock. Remove pawl.
(3) Remove nut that secures key lock to cover.
(4) Slide lock, gaskets, and spring over back of key lock.
(5) Remove key lock by pushing key lock through cover. Ensure that the O–ring is not lost.

B. Assembly

(1) Insert key lock through cover. Make sure that O–ring gasket is installed under head of key lock.
(2) Slide spring, gaskets, and lock over back of key lock.
(3) Install nut that secures key lock to cover.
(4) 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.
(5) 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.



Old Style Locking Fuel Cap Assembly
Figure 3

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DISTRIBUTION

1. Cleaning Fuel System

A. Remove all fuel from tanks (see Fuel Tanks - Draining, 12-10-00). Drain fuel through a chamois or other straining equipment to inspect for presence of foreign matter.

B. 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.

C. Cleaning Filter Assembly (Refer to Figure 1.)

NOTE: Cleaning the filter assembly can also be performed alone, with fuel in the system. Set the fuel selector to OFF and proceed as indicated below.

(1) Remove access panel to filter bowl on bottom of fuselage.

(2) Remove fuel strainer bowl.

(3) Remove filter disc assembly from center stem by compressing filter retainer spring and removing filter retainer washer.

(4) Inspect bowl gasket. Replace if necessary.

(5) Filter discs may be cleaned as follows:

(a) 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.

(b) Wash metallic filter disc in acetone, gasoline, carbon tetrachloride, trichlorethylene (permachor) or Bendix cleaner. Wash nylon filter disc with soap and water.

(c) Remove stubborn deposits from filter disc with a soft bristle brush.

(d) Rinse all traces of soap solution. Drain or blow dry. Remove stoppers.

(6) Replace the filter disc if damage is evident.

(7) Reinstall filter disc assembly and strainer bowl.

D. After the aircraft is refueled:

(1) Disconnect fuel inlet line to injector.

(2) Turn electric fuel pump ON to flush lines.

(3) While flushing, move fuel selector back and forth from one tank to another.

2. Fuel Selector Valve and Filter Assembly

CAUTION: NO FIELD DISASSEMBLY OR REPAIR OF FUEL SELECTOR VALVES IS AUTHORIZED. MAINTENANCE IS LIMITED TO REMOVAL AND REPLACEMENT OF THE WHOLE UNIT.

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.

A. Removal

(1) Drain fuel from tanks. (Refer to Draining Fuel System, Chapter 12.)

(2) Remove center seats, seat belt attachments and floor panel just aft of main spar by removing floor attachment screws. Lift panel and remove.

(3) Remove plate from bottom of fuselage that covers fuel selector valve.

(4) Disconnect fuel lines and selector control linkage from selector valve assembly.

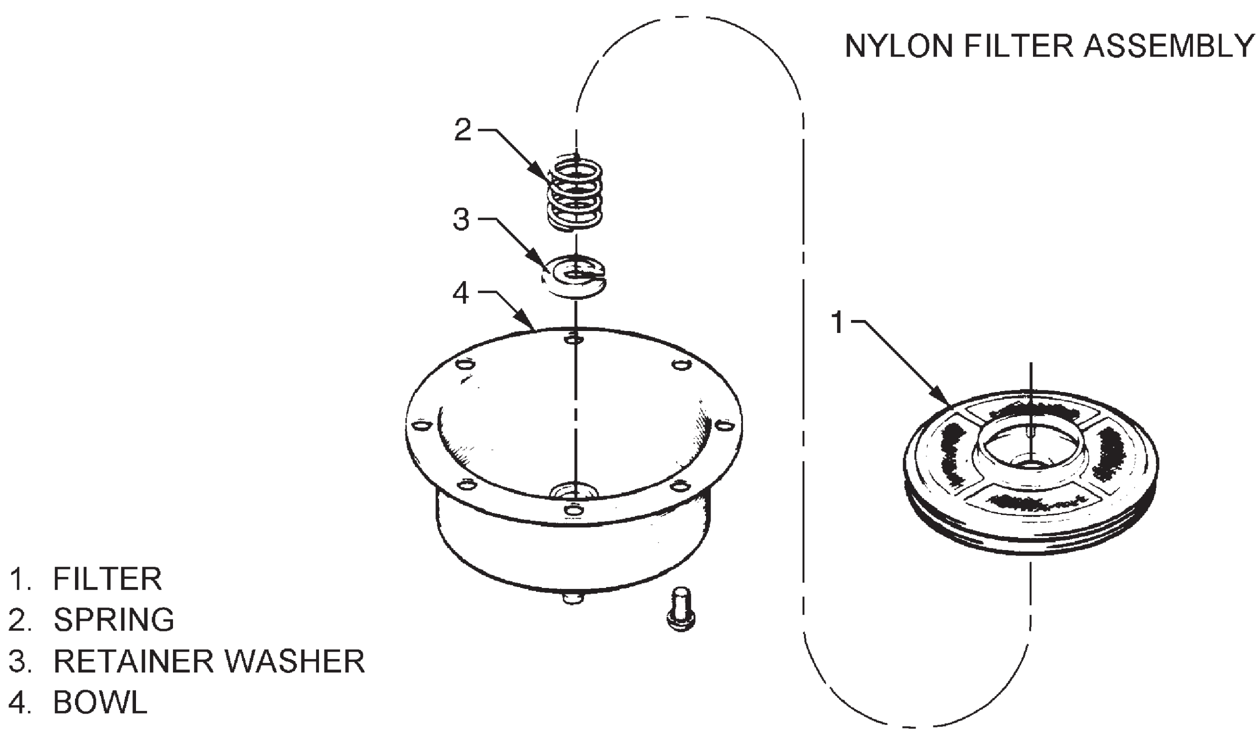
(5) Remove the four mounting screws that hold the fuel selector valve in place. Remove selector valve assembly.

B. Installation

NOTE: When installing fuel selector valve, drain and flush complete fuel system and tanks to ensure no contamination is present. (See Cleaning Fuel System, above.)

(1) Position the selector valve inside the airplane just aft of the main spar.

(2) Secure the selector valve with machine screws, washers and self-locking nuts.



Fuel Filter Assembly
Figure 1

(3) Connect the fuel lines.

(4) Connect fuel selector control linkage to insure that selector handle engages the left indent position when it is against the safety stop on the console cover.

(5) Fill the fuel tanks and check all connections for leaks.

(6) Install the rear seat and fuel drain placard cover.

(7) Install the access plate to the bottom of the fuselage with attaching screws.

C. Flush Lines

After fuel selector valve is installed and the aircraft is refueled:

(1) Disconnect fuel inlet line to injector.

(2) Turn electric fuel pump ON to flush lines.

(3) While flushing, move fuel selector back and forth from one tank to another.

(4) 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.

(5) Fill the fuel tanks and check all connections for leaks.

(6) Install the rear seat and fuel drain placard cover.

(7) Install the access plate to the bottom of the fuselage with attaching screws.

3. Fuel System Leakage Inspection (PIR-PPS60049-4, Rev. B.)

CAUTION: THE FUEL CELLS AND/OR TANKS MAY BE DAMAGED IF MORE THAN 1.5 PSI PRESSURE IS INTRODUCED INTO THE SYSTEM.

A. Setup

(1) Ensure the fuel lines and components of the fuel system are readily accessible.

(2) Defuel the airplane prior to performing any of the following tests.

(3) A test fixture containing the following features is required to perform this test: (See Figure 2 to fabricate.)

- Two air filters
- Pressure Regulator
- Two fuel filler test caps each incorporating a 5 psi gauge and a shut-off valve
- Main pressure gauge (0 - 5 psi; marked red above 1.5 psi)
- Two main air supply needle valve
- Manometer
- Manometer needle valve
- Flow meter (0.0 - 0.5 SCFH)
- Two flow meter shut-off valves

(4) Ensure appropriate caps are available for closing open lines and vents.

(5) Apply bubble testing liquid (P/N 279-246) to surfaces being checked for leaks.

B. Fuel System Leak Test

(1) Cap all fuel vent outlets on the left and right wings.

(2) Verify fuel sump drain valves are in the closed position.

(3) On the test fixture ensure that the following valves are selected to the OFF position:

(a) #1 and #2 main air supply shut-off valves

(b) Manometer needle valve, valve #3

(c) Main air supply needle valve, valve #4

(d) Shut-off valve on each fuel test cap

(e) Both flow meter shut-off valves

(4) Disconnect the main fuel line forward of the firewall.

(5) Connect the test fixture's left flow-meter hose to the main fuel line at the firewall.

(6) Select the Fuel Selector Valve to "LEFT TANK."

(7) Install test unit fuel caps at the fuel filler port in each wing.

(8) Connect shop air to the test fixture.

CAUTION: DO NOT EXCEED THE 1.5 PSI LIMIT OR FUEL CELL DAMAGE MAY OCCUR.

(9) Select the test fixture "Valve 2" and "Valve 3" to the "ON" position, and using "Valve 1," slowly pressurize the line to 1.0 psi minimum; 1.5 psi maximum.

NOTE: Monitor pressure on the main pressure gauge so as not to exceed 1.5 psi.

(10) Open both test cap shut-off valves. Slowly open "Valve 4" and monitor pressure on the main pressure gauge. Monitor, and close "Valve 1" immediately if pressure exceeds 1.5 psi. Open flow meter valves to bleed excess pressure.

(11) Select the test fixture "Valve 1" to the "OFF" position, then "Valve 3" to the "OFF" position, and then "Valve 2" to the "OFF" position.

(12) Disconnect shop air from the test fixture and monitor the leakage rate.

NOTE: No leakage should occur over a 5-minute period.

If leaks are found in fuel tanks or cells, repair per the appropriate Repair procedure in 28-10-00. For leaks in other areas, if upon inspection and tightening the leak cannot be stopped, component replacement is required.

(13) Remove all test equipment and reconfigure aircraft fuel system to production configuration.

C. Fuel System Flow Test

(1) Close test-cap valves and open "Valve 3" and "Valve 2" on the test machine. With the Fuel Selector Valve to "LEFT TANK" (inside fuselage), open the flow meter valve that's connected to the firewall. Monitor that the flow meter gauge reads at least "0.5" SCFH.

(2) Select the Fuel Selector Valve to "OFF" (inside fuselage) and verify flow meter gauge drops to "0" SCFH.

(3) Select the Fuel Selector Valve to "RIGHT TANK" (inside fuselage) and verify flow meter gauge reads at least "0.5" SCFH.

(4) Select the Fuel Selector Valve to "OFF" (inside fuselage) and verify flow meter gauge drops to "0" SCFH.

(5) Select the left flow-meter valve to the "OFF" position.

(6) Select the Fuel Selector Valve to "LEFT TANK" (inside fuselage). Press down on the Fuel Selector drain lever and verify pressure inside left tank is decreasing. Release lever.

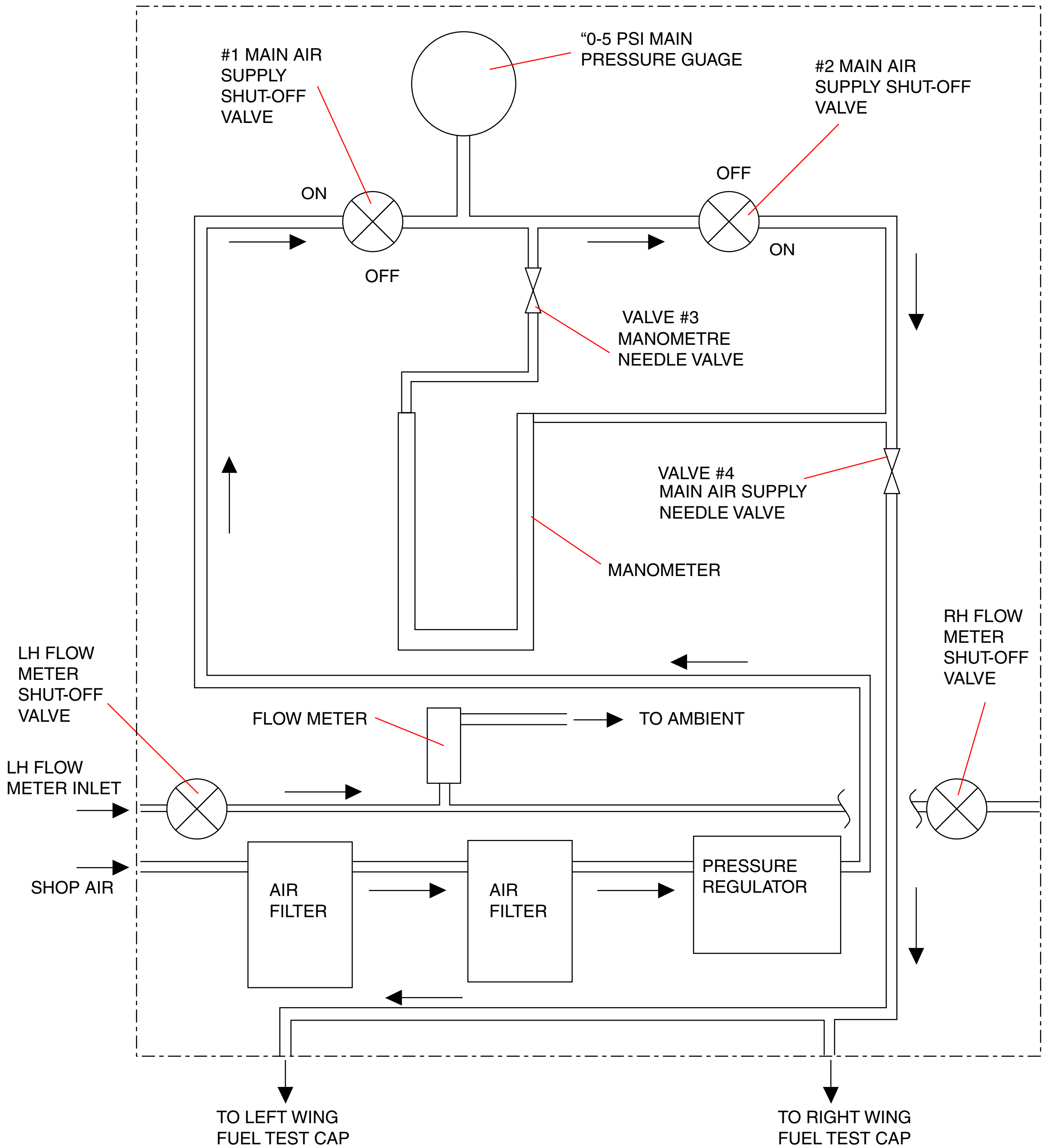
(7) Select the Fuel Selector Valve to "RIGHT TANK" (inside fuselage). Press down on the Fuel Selector drain lever and verify pressure inside right tank is decreasing. Release lever.

(8) Select the Fuel Selector Valves to "OFF" (inside fuselage).

(9) Push open each fuel sump drain valve (located underneath the LH and RH wings), and verify that air flows outside the fuel tanks. Close the fuel sump drain valves.

(10) Remove all fuel vent caps (LH and RH wings) and verify that the remaining fuel cell pressure bleeds off through each vent.

(11) Remove all test equipment and reconfigure aircraft fuel system to production configuration.



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Fuel System Leakage Test Fixture
Figure 2

4. Electric Fuel Pump

A. Inspection

Each 50 hours, visually inspect the fuel pump overboard drain line outlet (i.e. - underside of aircraft, on the left side, opposite the fuel selector filter access plate) for evidence of fuel discharge. Fuel discharge through this drain line is indicative of internal seal failure and cause for fuel pump replacement.

B. Removal

(1) Turn fuel selector to off position.
(2) 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.
(3) Disconnect electrical lead from pump.
(4) Disconnect pump inlet and outlet lines.
(5) Remove pump by removing pump attachment hardware.

C. Installation

(1) Position pump in airplane. Secure with attachment hardware.
(2) Connect pump inlet and outlet lines.
(3) Attach electrical leads to pump.
(4) Install floor panel in airplane and secure with screws. Install center seats and seat belt attachments.
(5) Set fuel selector to desired position.

INDICATING

1. Cockpit

A. Standard Installation

In the standard installation, these airplanes 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 3). 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 Figure 1). 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.

(1) Fuel Quantity Sender and Gauge Check (PIR-PPS 60032-10, Rev. D.)
(HP S/N's 3246001 thru 3246087 only)

NOTE: For S/N's 3246088 thru 3246176 and 3257001 thru 3257183, as required, ensure replacement sender is Piper part number 686-202 (left outboard) and 686-203 (right outboard). These senders, when installed, will alleviate erratic fuel quantity indications.

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).

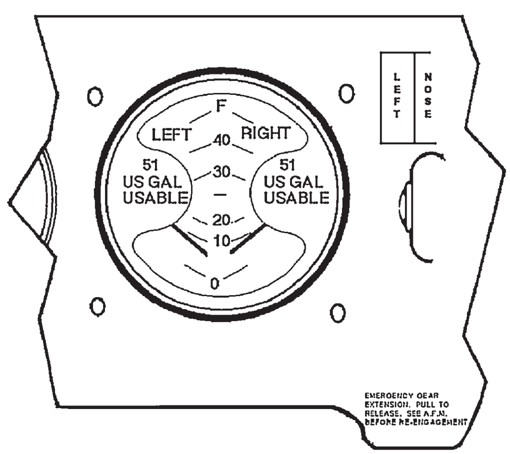
(b) Place battery switch in OFF position.

(c) Connect external power supply to airplane using APU connector. Adjust to provide 28 ± 1 Vdc; or, for HP S/N's 3246001 thru 3246017 only, 14 ± .5 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 1; or,

2 With tanks completely full, defueling each tank 10 gallons at a time.



Fuel Quantity Dual Gauge
Figure 1

Effectivity
3246001 thru 3246087

3 After measured amount has been added or drained, vibrate tank by bumping lower wing surface. Vibrate gauge by tapping gauge glass with fingers.

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 1, verify sender's resistance is as specified in Chart 1.

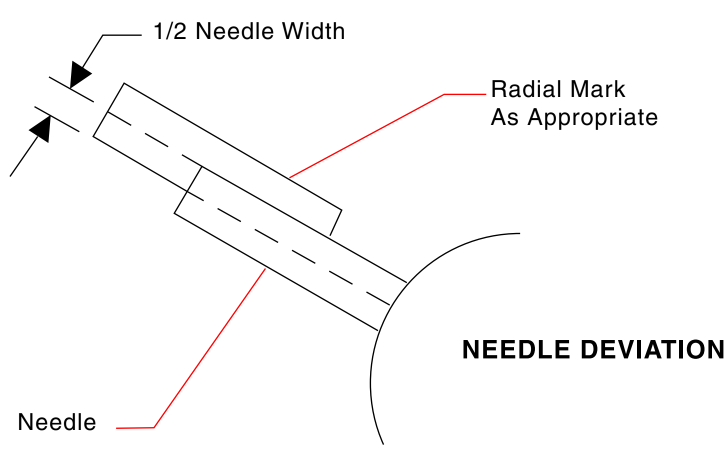
(f) If sender checks out OK, remove gauge and bench test/adjust as specified, below.

(g) If gauge or sender fails to meet accuracy requirements in Chart 1, replace gauge or sender, as applicable.

CHART 1
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 2



Needle Deviation
Figure 2

(2) Fuel Quantity Gauge Bench Test/Adjustment (PIR-PPS60032-10, Rev. D.)
(HP S/N's 3246001 thru 3246087 only.) (See Figure 3.)

(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 28 ± 1 Vdc; or, for HP S/N's 3246001 thru 3246017 only, 14 ± .5 Vdc.

(d) Low End Adjustment

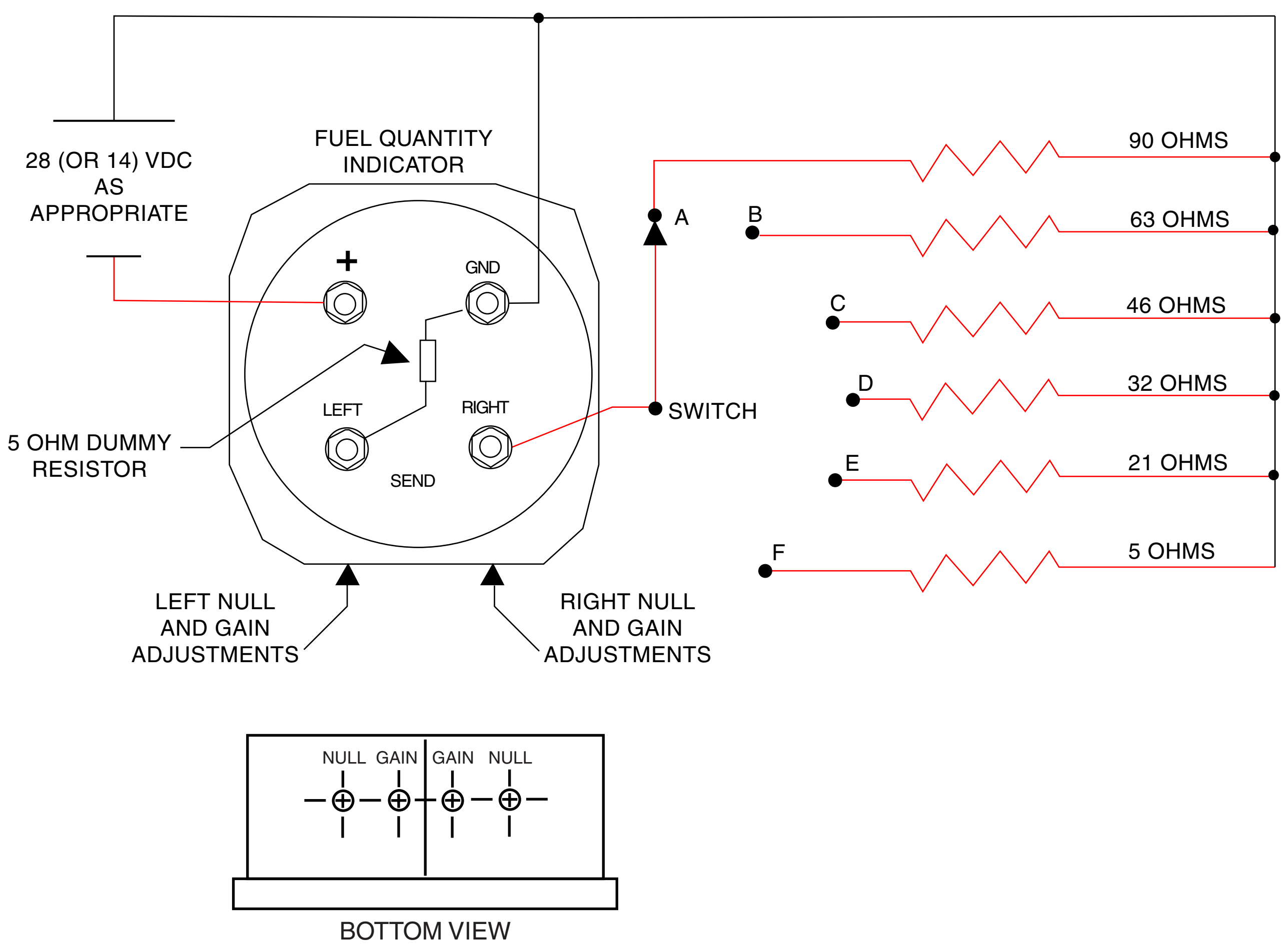
Select position "F" on resistance decade. Verify that instrument needle points to "0". If not, adjust respective "NULL" potentiometer to center needle on "0" radial.

(e) High End Adjustment

Select position "A" on resistance decade. Verify that instrument needle points to "F". If not, adjust respective "GAIN" potentiometer to center needle on "F" radial.

(f) Full Range Check

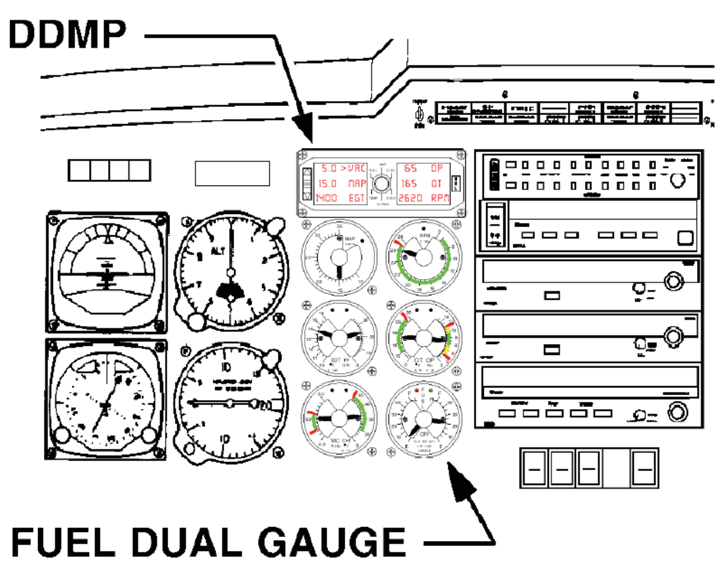
After low and high end adjustments have been made, verify that for each resistance value, the gauge indication is as shown in Chart 2.



Fuel Quantity Gauge Bench Test/Adjust Set-Up
Figure 3

CHART 2
FUEL QUANTITY GAUGE BENCH TEST TOLERANCES

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 3		* See Figure 2	



Effectivity
3246088 and up
3257001 and up

DDMP and Fuel Dual Gauge
Figure 4

(3) Fuel Quantity Gauge Calibration (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 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 28 ± 1 Vdc.

5 Record test results in logbook.

(b) Calibration Procedure (PIR-PPS60032-15, Rev. B.)

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 5 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.

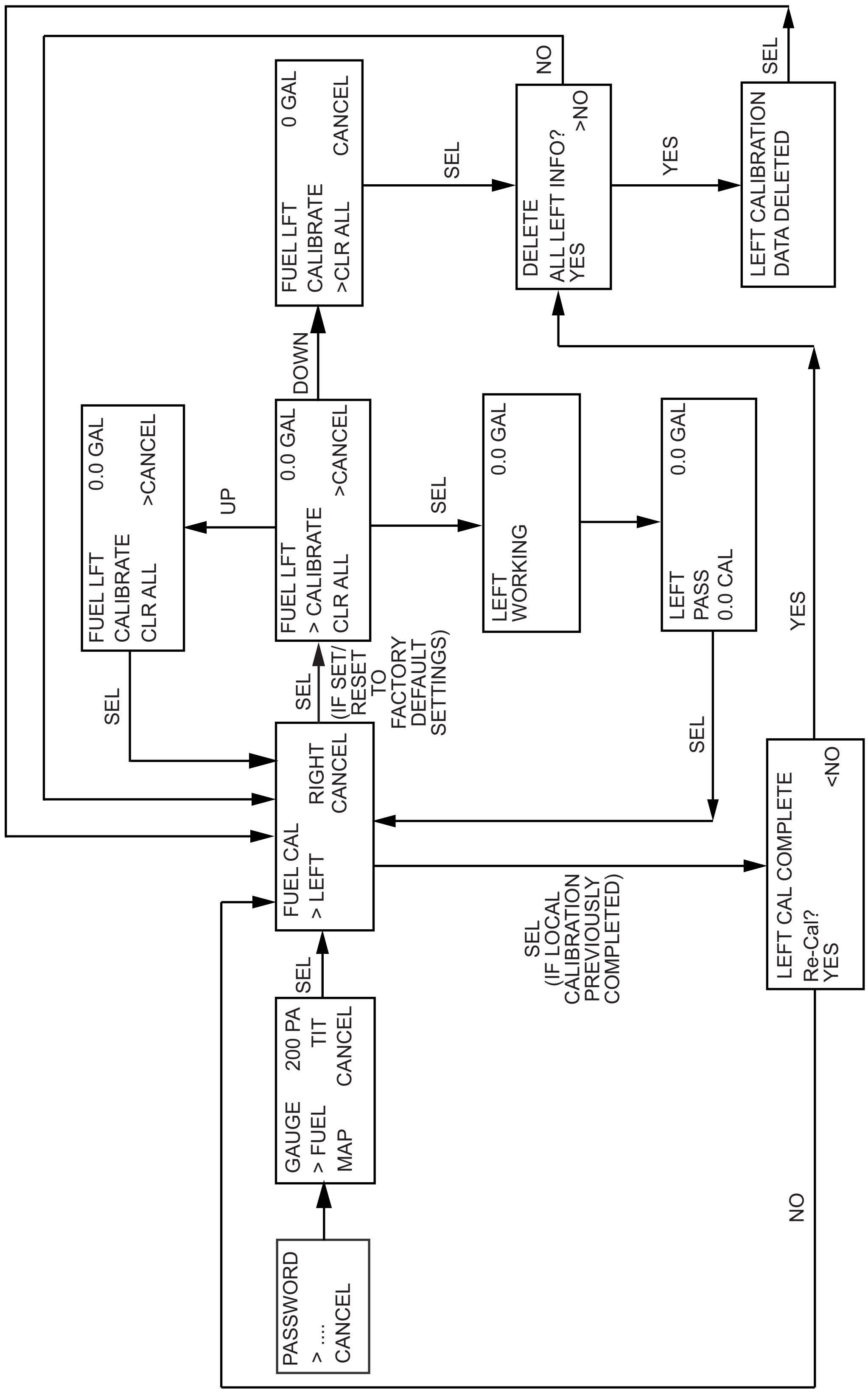
b If "FUEL LFT; CALIBRATE, CLR ALL, CANCEL" appears, jump to paragraph 10, below.

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.



DDMP Fuel Calibration Menu Flow Chart
Figure 5

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.

CHART 3
FUEL QUANTITY GAUGE TOLERANCES
(HP S/N’s 3246088 & up and TC S/N’s 3257001 & up)

FUEL CALIBRATION (PIR-100930, Rev. W.)

TANK CAPACITY (EITHER SIDE) (GALLONS)	CALIBRATION POINTS [1] (OHMS [2])	GAUGE READINGS [3]		TOLERANCE (GALS) (ON GAUGE READING)
		ANALOG	DIGITAL	
0.0 (E)	2.5 (+2.5, -2.5)			± 0
(2.5) Gal. Unusable	2.5 (+2.5, -2.5)			± 0
10	20.0			± 2
20	31.8			± 2
30	45.5			± 2
40	63.0			± 2
51 (F)	88.3			+ 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.

13 Repeat step (l) 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.

14 When “COMPLETE” message is displayed, depress “SEL” key and use cursor to select right tank and hit “SEL” to accept.

15 Repeat steps (j), (k), (l), (m), and (n), 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.

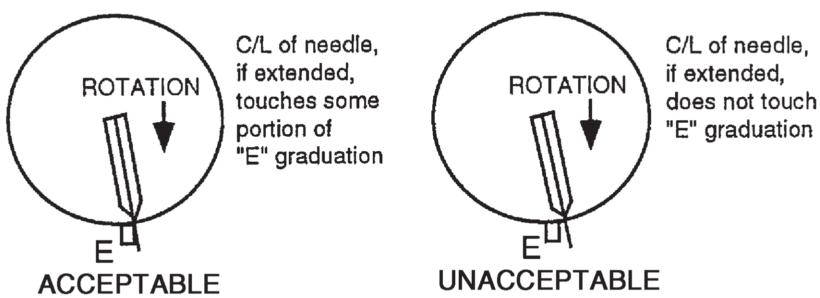
2 Add 2.5 gallons of fuel to each tank (unusable).

3 Verify that fuel gauges indicate “O” or “E”. (See Figure 6)

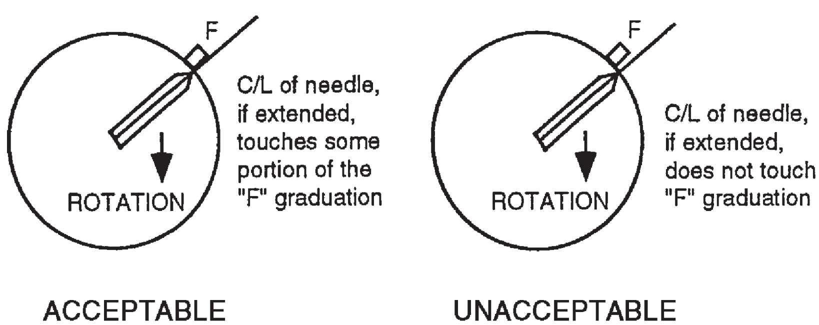
4 Add 10 gallons of fuel to each tank and again observe analog and digital gauge readings. When adding fuel, wait one (1) minute after each filling before recording digital and analog gauge readings.

5 Repeat step (d) for 20, 30, and 40 gallon, and “F” increments for both left and right tanks. See Figure 7 for analog needle display limits at “F”.

6 Gauge reading tolerances are given in Chart 3, which can also be used to record the data.



Analog Needle Display Limits at “E”
Figure 6



Analog Needle Display Limits at “F”
Figure 7

B. Avidyne Entegra EFIS Installation - Fuel Quantity Indicator Calibration (PIR-PPS60208, Rev. B / PPS60208-1, Rev. New.)

In HP S/N's 3246218 & up and TC S/N's 3257339 & up, with the Avidyne FlightMax Entegra EFIS installed, fuel quantity information is collected by the DAU and displayed on the MFD (Multifunction Display). Whenever the MFD, DAU, or any fuel sender is replaced, calibrate the Fuel Quantity Indicator as follows:

(1) Level the airplane per 8-20-00.

(2) Drain the fuel tank(s) per 12-10-00.

(3) Connect ground power per 24-40-00.

(4) From the maintenance page, depress LSK (L4) to access the Engine setup page.

(5) Depress the Fuel Cal button (L1) to enter the fuel calibration page.

(6) Depress "Begin Cal" button (R3) and follow the on-screen calibration Procedure for left & right tank zero fuel (2.5 +.1-0 gal. unusable) and full fuel calibration (51 +0;-1gal. usable) points.

(7) Use the Left Knob to select the current calibration point. The selected calibration point is highlighted and the value displayed is the current reported fuel quantity from the DAU. A message at the bottom of the screen prompts the operator to add the appropriate amount of fuel and then to select "Accept Value" once the value reported from the DAU has stabilized.

If the DAU reported value is not within 2 gallons of the test point value, a message "DAU Reported Fuel Quantity Out of Tolerance" will be presented and the value will not be accepted.

(8) Once all points have been calibrated, the operator presses "Calibration Complete" to cause the calibration factors to be computed and applied to the DAU reported fuel quantity.

(9) Other options from the Calibration Underway state are to "Restore Last Cal" and "Clear Cal".

(a) Pressing "Restore Last Cal" causes the calibration values from the last completed calibration to be restored and the state to change to Calibrated.

(b) Pressing "Clear Cal" causes all calibration values to be cleared and the state to change to "Not Calibrated". An "Are Your Sure?" prompt will give the operator a chance to reconsider the decision to either "Restore Last Cal" or "Clear Cal".

(10) When the calibration procedure has been completed, press the Save button. If you decide not to save the changes, pressing the Cancel button from the Underway state causes the current calibration session to be aborted with any unsaved interim calibration values being discarded. Changes will not take effect until the MFD has been restarted.

NOTE: The "empty" and "full" fuel readings on this set-up page will NOT display zero (0) or 51 gallons usable fuel for the respective empty and full calibration points. However, the appropriate zero and full (51 U.S. gallons) will be displayed on the MFD in normal operation mode (not maintenance set-up).

(11) For airplanes with MFD Software 530-00180-002 (latest revision) installed, two additional steps are necessary:

(a) Verify DAU Status box reads: "DAU(s) configured for Piper PA-32 (correct model)."

(b) Verify Calibration Status box reads: "Fuel Tank Calibration Status: Calibrated."

C. Garmin 1000 EFIS Installation

(1) Initial Fuel Tank Calibration

(a) Level the airplane per 8-20-00 to within +/- .25 degrees of zero pitch and roll.

(b) Drain the fuel tank(s) per 12-10-00.

(c) Connect ground power per 24-40-00.

(d) Enter the Configuration Mode by pulling MFD and PFD circuit breakers, then holding ENT until "INITIALIZING SYSTEM" appears in the upper left corner of the MFD and PFD.

NOTE: The G1000 must be powered for three minutes before proceeding. After adding any fuel, wait five minutes for the fuel level to stabalize.

(e) Fill each fuel tank with 2.5 gallons of fuel (unusable) and wait 5 minutes for fuel level to stabalize.

(f) Go to the CAL Page Group on the PFD.

(g) Select the Fuel Calibration page (1st page in CAL group).

(h) To perform the fuel calibration press the following softkeys:

1 12 (far right softkey)

2 11

3 10

4 9

(i) Ensure that the CALIBRATION VALUE indication for the left tank is stable.

(j) Press the EMPTY softkey.

NOTE: If the EMPTY key is not active, .5 gallons (3.0 gallons unusable) may be added to activate EMPTY softkey. If required, note in airplane logbook.

(k) Observe the CALIBRATION VALUE indication for the Left 1 Sub-Tank. The CAL VAL values should fall between -1 and 0.

(l) Press the TNK SEL softkey.

(m) Turn cursor knob to select the right fuel tank.

(n) Ensure that the CALIBRATION VALU indication for the Right Tank is stable.

(o) Press the EMPTY softkey.

NOTE: If the EMPTY key is not active, .5 gallons (3.0 gallons unusable) may be added to activate EMPTY softkey. If required, note in airplane logbook.

(p) Observe the CALIBRATION VALUE indication for the Right 1 Sub-Tank. The CAL VAL values should fall between -1 and 0.

(2) Full Tank Calibration

(a) Fill each tank with 51 gallons +0/-1 gallon and wait 5 minutes for fuel level to stabilize.

(b) Select the Left tank and press the FULL softkey. Press Enter.

(c) Select the Right tank and press the FULL softkey. Press Enter.

(d) Restart the PFD and MFD in the normal mode.

(e) Verify that the fuel values are Full.

(3) If either calibration procedure fails, then the quantity system requires service.

(4) Calibration Table Delete/Edit

NOTE: This procedure can be used to edit or delete an existing calibration point within the calibration table.

(a) Press the CAL TBL softkey.

(b) Scroll down to the entry to be edited or deleted.

(c) To edit the entry press the EDIT softkey. Fill the selected tank to the level of the selected entry. Allow CALIBRATION VALUE to stabalize.

(d) Press enter and confirm you want to overwrite the existing calibration point.

(e) To delete the entry press the DELETE softkey.

(f) Press and confirm you want to delete the calibration point.

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2. Wing

Fuel Sight-Gauge (Refer to Figure 12.)

These airplanes are equipped with wing-mounted fuel sight-gauges, providing a secondary means of indicating fuel quantity. Because the fuel tanks in each wing are interconnected, one sight-gauge indicates the cumulative quantity of fuel in either wing. Two sight-gauges are used (one per wing), and each is located on the upper wing surface, in the inboard fuel tank (right and left wings). A dial assembly on the gauge indicates a wing's fuel quantity.

Dial Assembly

(a) Removal

1 Pry the gauge's dial assembly from its pocket in the wing skin.

2 Clean the old silicone rubber adhesive from the wing skin pocket.

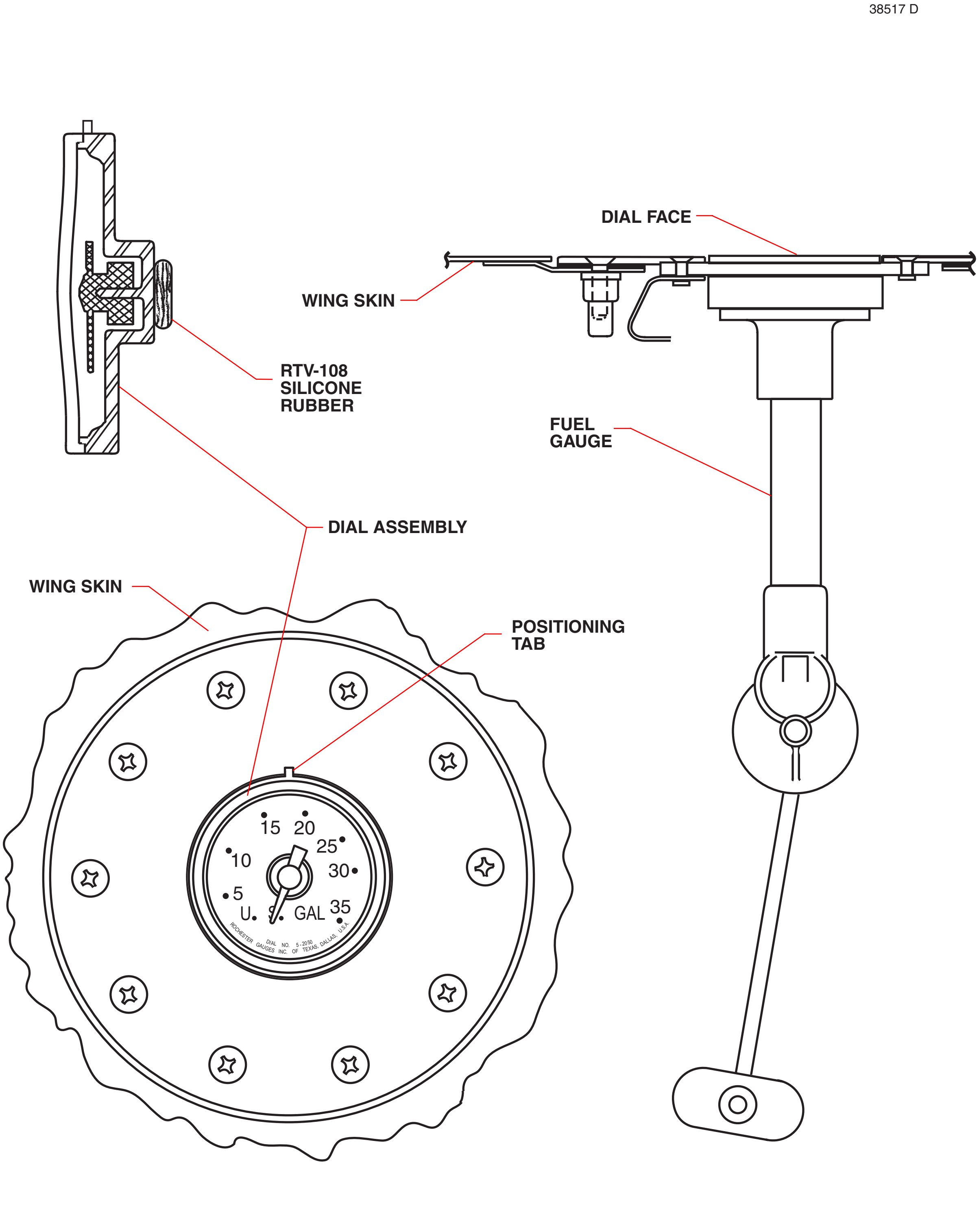
(b) Installation

1 Apply a 1/2-inch blob of RTV-108 silicone rubber adhesive to the dial assembly's stem (see Figure 12).

2 Set the dial assembly into the wing skin pocket, placing the assembly's positioning tab into the notch in the pocket.

3 Press on the dial's face to adhere the dial assembly to the wing skin pocket.

NOTE: The sight-gauge's dial is self-calibrating.



Fuel Sight-Gauge Dial Assembly Installation
Figure 12

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CHAPTER

29

HYDRAULIC POWER

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CHAPTER 29

LIST OF EFFECTIVE PAGES

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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 32-40-00.

WARNING: PRIOR TO STARTING ANY INVESTIGATION OF THE HYDRAULIC SYSTEM, PLACE THE AIRPLANE ON JACKS. (REFER TO JACKING, CHAPTER 7.)

1. 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 1.)

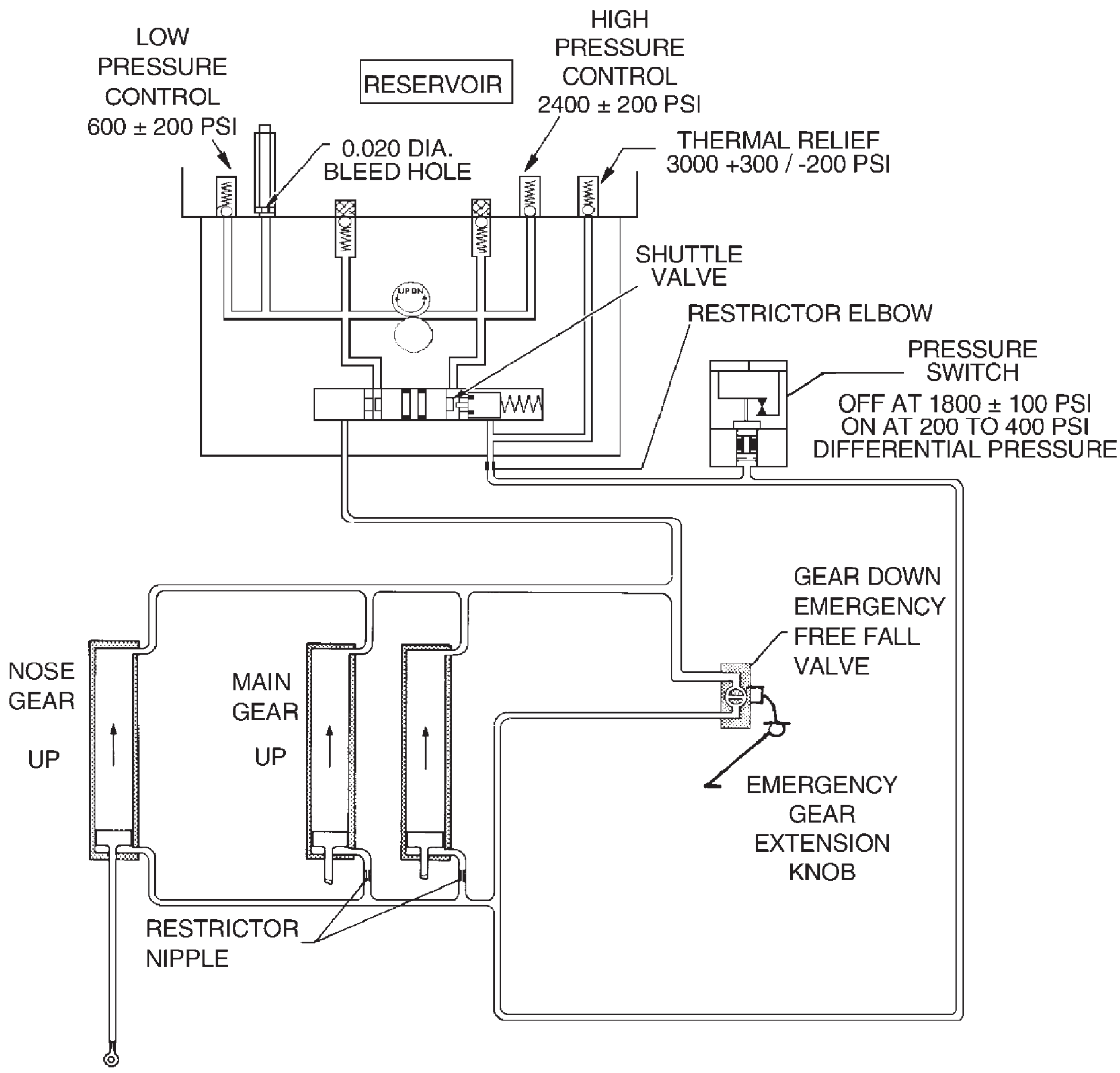
A pressure switch is installed on a cross fitting connected to the pump mount assembly. During landing gear retraction the pressure switch is the primary means to shut down the pump. This switch opens the electrical circuit to the pump solenoid when the gear fully retracts and the pressure in the system 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 1 and Chart 1 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.

Refer to Chapter 32, Landing Gear, for a description of the landing gear and associated electrical switches.



Hydraulic System Schematic Diagram
Figure 1

2. 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, 7-10-00), in order to determine the extent of the problem. 32-30-00, Chart 1, 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 1 or 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.

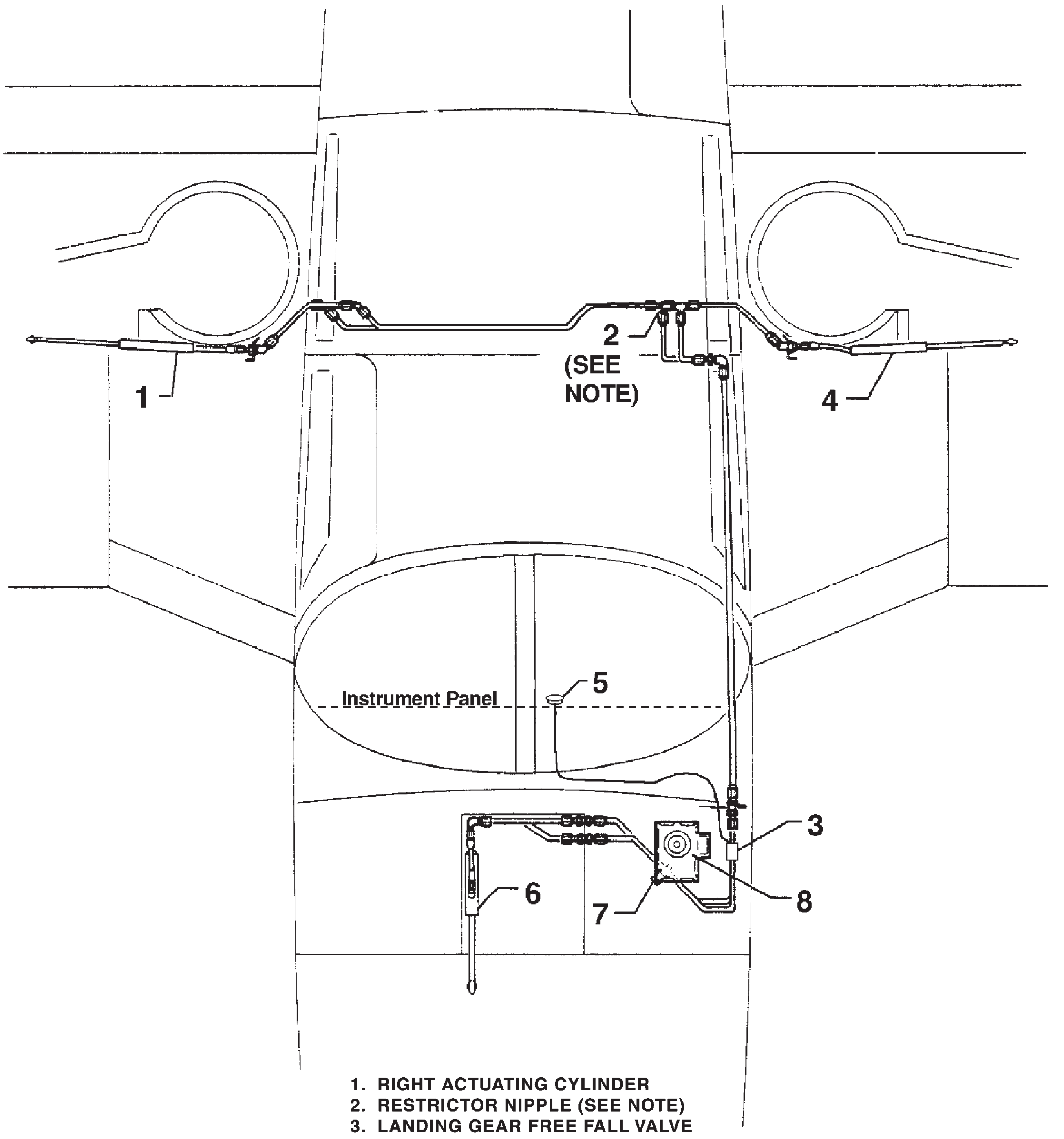
NOTE: No field repair of Oildyne hydraulic pumps is authorized. Any faulty hydraulic pump must be replaced; or, returned to Piper, via the local Piper distributor, for repairs.

CHART 1
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 thru 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 2
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)



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

NOTE: A SPECIAL RESTRICTOR NIPPLE (2) IS INSTALLED ON THE MAIN GEAR RETRACTION LINE. DO NOT MISTAKE THIS FOR A STANDARD NIPPLE.

Hydraulic System Installation
Figure 2

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MAIN

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.

1. Hydraulic Pump

NOTE: No field repair of Oildyne hydraulic pumps is authorized. Any faulty hydraulic pump must be replaced or returned to Piper for repairs via the local Piper Distributor.

NOTE: The appropriate source for identifying the correct part number of a component used on these airplanes is the applicable Piper parts catalog.

A. Removal (Refer to Figure 1.)

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:

(1) Disconnect the pump electrical leads from the pump solenoid relays and the ground wire from the battery shelf.

(2) Disconnect the hydraulic lines from the pump. Cap the line ends to prevent contamination.

(3) Remove pump by removing pump attaching bolts.

(4) Cap or plug all ports.

(5) Clean exterior of pump using a dry cleaning solvent to remove accumulated dirt and dust.

B. Installation (Refer to Figure 1.)

(1) Position assembled pump, bracket, and pump mount on pump deck in airplane.

(2) Secure pump assembly to deck by installing the three AN3-10 bolts with one MS35489-64 washer under each bolt head and three No. 5712-45 (Piper P/N 494-192) washers between Piper mount assembly and pump deck.

NOTE: Before positioning the complete hydraulic pump assembly on the mounting bracket, ensure that the cushion pad is secured in place on the reservoir base.

(3) Install the UP and DOWN pressure hydraulic lines to pump mount.

(4) Connect the three knife connectors that attach the black, blue, and green forward and reverse harness wires.

(5) Install nose baggage compartment access panel.

C. Field Service (Refer to Figure 1.)

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.

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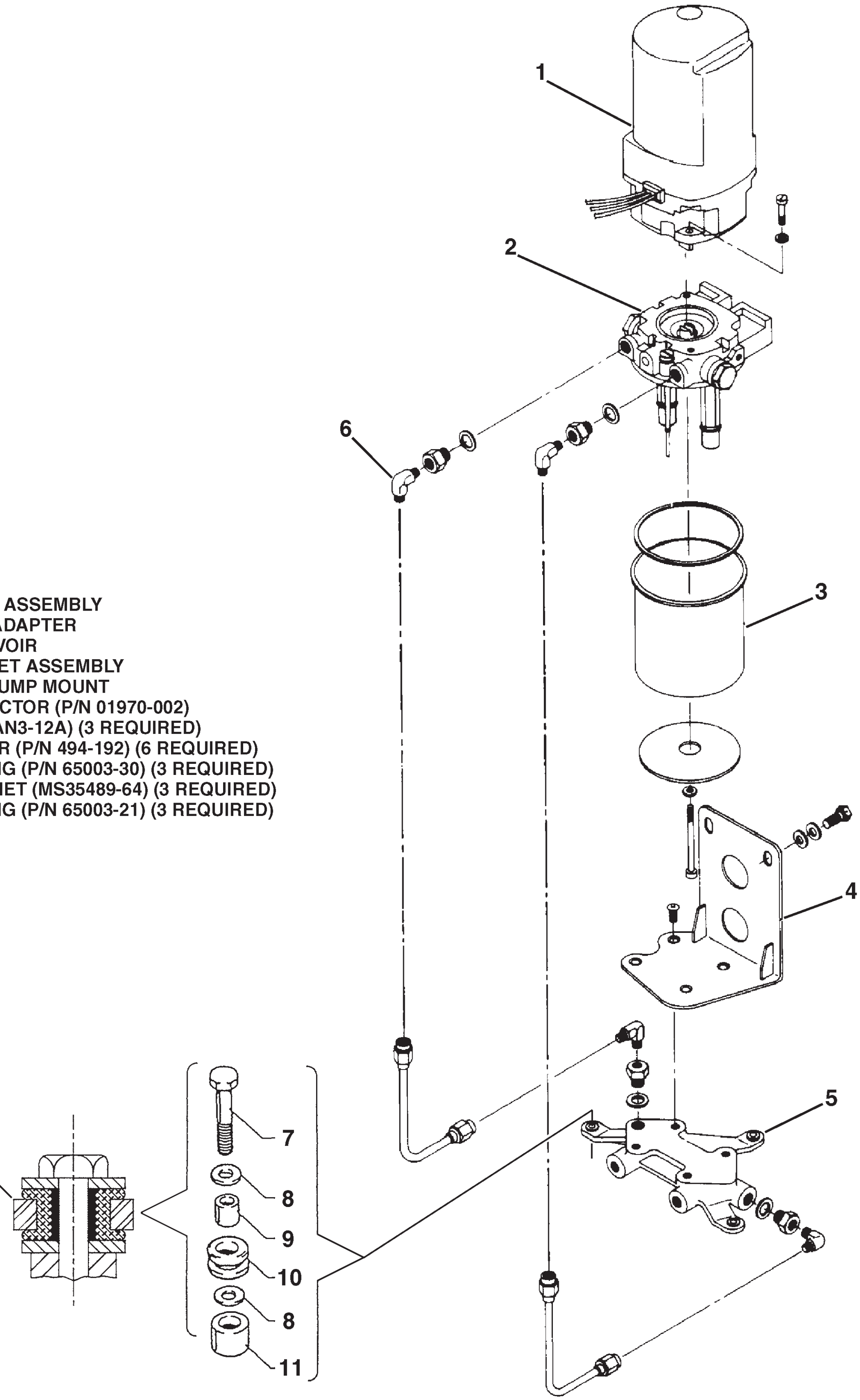
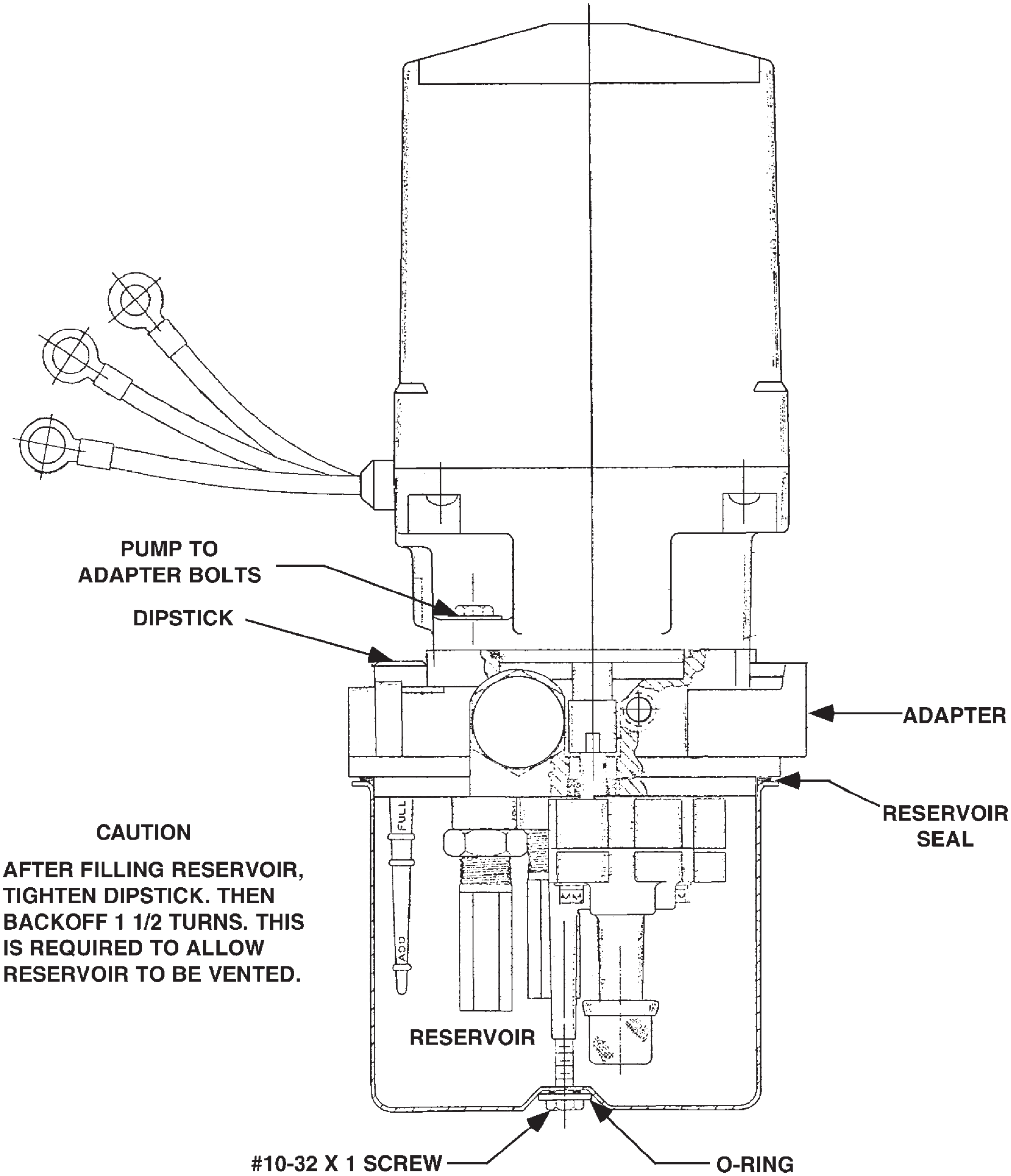


1. MOTOR ASSEMBLY
2. PUMP ADAPTER
3. RESERVOIR
4. BRACKET ASSEMBLY
5. PAD - PUMP MOUNT
6. RESTRICTOR (P/N 01970-002)
7. BOLT (AN3-12A) (3 REQUIRED)
8. WASHER (P/N 494-192) (6 REQUIRED)
9. BUSHING (P/N 65003-30) (3 REQUIRED)
10. GROMMET (MS35489-64) (3 REQUIRED)
11. BUSHING (P/N 65003-21) (3 REQUIRED)

Oildyne Hydraulic Pump
Figure 1 (Sheet 1 of 2)



Oildyne Hydraulic Pump
Figure 1 (Sheet 2 of 2)

D. Disassembly (Refer to Figure 1)

(1) Hydraulic Pump from Bracket

(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.

(2) Motor Assembly from Pump-Adapter

(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.

(3) Reservoir Assembly from Pump-Adapter

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.

E. Assembly (Refer to Figure 1)

(1) Reservoir to Pump-Adapter Assembly

(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.

(2) Motor Assembly to Pump-Adapter Assembly

(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.

(3) Bracket to Hydraulic Pump Assembly

(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.

2. Hydraulic Lines

Removal and Installation

Remove a damaged hydraulic line by disconnecting fitting at each end and by disconnecting where secured by brackets. Refer to 29-00-00, Figure 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.

3. Servicing Hydraulic Pump/Reservoir

NOTE: Hydraulic pump/reservoir fluid level must be checked with landing gear down and locked.

A. Check fluid level in reservoir of combination pump and reservoir at least every 50 hours.

B. To check fluid level:

(1) Using a screwdriver, remove dipstick/filler plug located on right front of pump. (See Figure 1.)

(2) If fluid level is between the ADD zone and FULL mark, fluid level is satisfactory.

(3) 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.

4. Testing Hydraulic System

Test hydraulic system after performing any service or repairs to determine that it functions properly. See 32-30-00 for a complete functional test of the landing gear extension and retraction system.

A. Place airplane on jacks per 7-10-00.

CAUTION: TURN MASTER SWITCH OFF BEFORE INSERTING OR REMOVING EXTERNAL POWER SUPPLY PLUG.

B. Connect airplane to an outside power source. (Refer to 24-40-00.)

C. 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.

D. 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.

E. 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.

F. Confirm that the three (3) green gear down lights are illuminated.

G. Turn master switch OFF.

H. Disconnect external power from airplane.

I. Remove airplane from jacks.

GRIDS 3J22 THRU 4B24
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CHAPTER

30

ICE AND RAIN PROTECTION

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CHAPTER 30

LIST OF EFFECTIVE PAGES

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	6	Jun 30/07

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CHAPTER 30 - ICE AND RAIN PROTECTION

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GENERAL

WARNING: INTENTIONAL FLIGHT INTO KNOWN ICING IS PROHIBITED.

The Saratoga II HP and TC are not approved for operation in known icing conditions.

1. Standard

The only ice and rain protection provided is a heated pitot-static mast.

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 91-30-30 for pitot heat wiring schematic.

2. Optional (Inadvertent Ice Protection System (TKS))

WARNING: INTENTIONAL FLIGHT INTO KNOWN ICING IS PROHIBITED.

NO DETERMINATION HAS BEEN MADE AS TO THE CAPABILITY OF THIS SYSTEM TO REMOVE OR PREVENT ICE ACCUMULATION.

The Piper Inadvertent Ice Protection System (PIIPS) is optional in HP S/N's 3246234 thru 3246244; and, TC S/N's 3257404 and up. PIIPS is a TKS "weeping wings" system which pumps a glycol-based deicing fluid out the wing and stabilator leading edges and along the propeller blades to reduce ice formation and adherence. This is intended to allow a pilot inadvertently encountering icing conditions additional time to find non-icing conditions safely.

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AIRFOIL

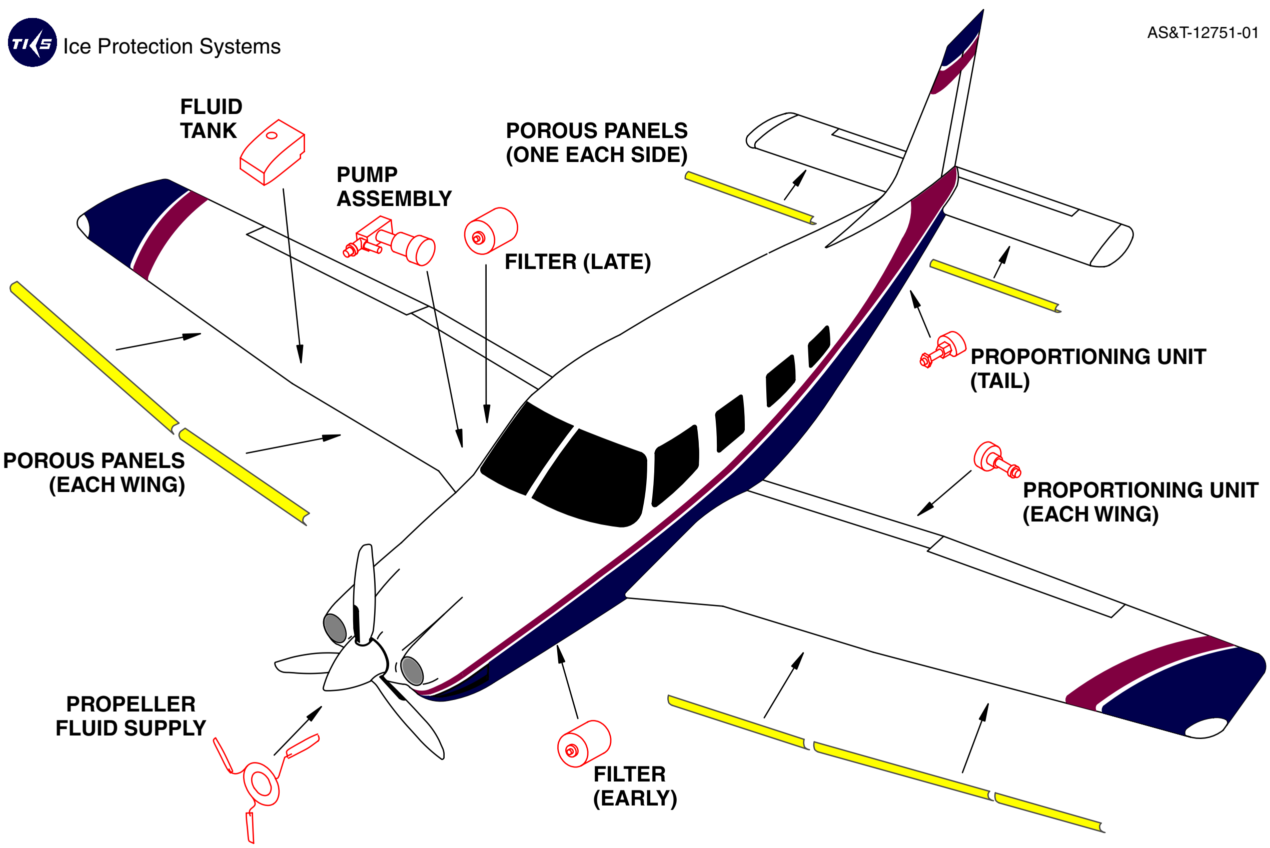
Inadvertent Ice Protection System (TKS) (Optional)

WARNING: INTENTIONAL FLIGHT INTO KNOWN ICING IS PROHIBITED. NO DETERMINATION HAS BEEN MADE AS TO THE CAPABILITY OF THIS SYSTEM TO REMOVE OR PREVENT ICE ACCUMULATION.

The optional Inadvertent Ice Protection System (TKS) is a "weeping wings" system which pumps a glycol-based deicing fluid out the wing and stabilator leading edges and along the propeller blades to reduce ice formation and adherence. This is intended to allow a pilot inadvertently encountering icing conditions additional time to find non-icing conditions safely.

A. Description

The TKS system consists of laser-drilled titanium porous panels attached to the leading edges of the wings and stabilator. Grooved rubber boots are attached to the inner leading edge of each propeller blade. Nylon and stainless steel tubing feed these panels and boots from a deice fluid tank mounted in the right wing. A two-speed pump and four proportioning units meter the fluid flow. A micro-filter ensures contaminants are removed from the deice fluid and not allowed to clog the porous panels. A deice fluid quantity indicator and a control switch are mounted in the instrument panel.



Inadvertent Ice Protection System (TKS)
Figure 1

B. Troubleshooting

See Charts 1 and 7. See also Figure 14 and Chart 6 to identify specific components.

NOTE: A common occurance with all TKS porous panels is "leaking" when not in use. Specifically, panels will stream very small quantities of fluid in flight or drip while parked. This fluid comes from the porous panel reservoirs only, typically in 60 to 70 °F temperatures. This is a normal characteristic of the design and not a maintenance issue.

It is, however; an operational issue. If panel reservoirs are drained it can take 5 to 10 minutes of system operation to refill them. Proper observation of TKS pre-flight procedures assures that the system will be ready and fully operational when activated.

C. 50 Hour Inspection

Each 50 hours time-in-service and as part of the annual inspection:

(1) Remove engine cowling, if not already removed.

(2) Check security and condition of visible components. Pay particular attention to those components attached to the engine and propeller.

(3) Switch ON electrical power. Check that deice fluid quantity indicator illuminates and stabilizes at a sensible value within 1.5 minutes. Replenish tank contents if required.

CAUTION: FLOOR/GROUND MAY BECOME SLIPPERY IN THE VICINITY OF THE AIRPLANE WHEN FLOW TESTING THE TKS SYSTEM.

NOTE: Placing trays under the wing leading edges and propeller to catch deice fluid is recommended.

(4) Set TKS Switch to "MAX", check that deicing fluid flows evenly from the active zone of each porous panel and that fluid is discharged into the propeller slinger ring from the nozzle fitted at the front of the engine.

NOTE: Fluid should be exuded evenly over the active zone of the porous panels. At high ambient temperatures a "waterline" may be observed at the top of some panels due to insufficient pressure being developed to expel entrained air. This is acceptable unless performance of the panel in icing conditions indicates that this is other than of a temporary nature.

NOTE: It can take as long as 15 minutes for fluid to begin flowing from one or more porous panels.

(5) Set TKS Switch from "MAX" to "NORM", check that pump speed reduces (audible check) and that deicing fluid continues to flow evenly from the active zone of each porous panel and that fluid continues to be discharged into the propeller slinger ring from the nozzle fitted at the front of the engine.

(6) Switch OFF electrical power.

D. Annual Inspection

Each 12 months:

(1) Remove floor and wing access panels; and, tailcone fairing. Check security and condition of components, pipelines, and wiring paying particular attention to those components close to control cables and other moving parts, etc.

(2) Remove deicing fluid tank per Components, Fluid Tank, Removal, below.

(3) Clean Fluid Tank Strainer.

(4) Install deicing fluid tank per Components, Fluid Tank, Installation, below. While refilling tank, check accuracy of fluid quantity indicator.

CHART 1
TROUBLESHOOTING INADVERTENT ICE PROTECTION SYSTEM (TKS)

Trouble	Cause	Remedy
No deicing fluid flow from entire airframe/propeller system.	Various	See Chart 2.
No deicing fluid flow from individual parts of airframe/propeller system.	Various	See Chart 3.

CHART 2
TKS FAULT ISOLATION - ENTIRE SYSTEM INOPERATIVE

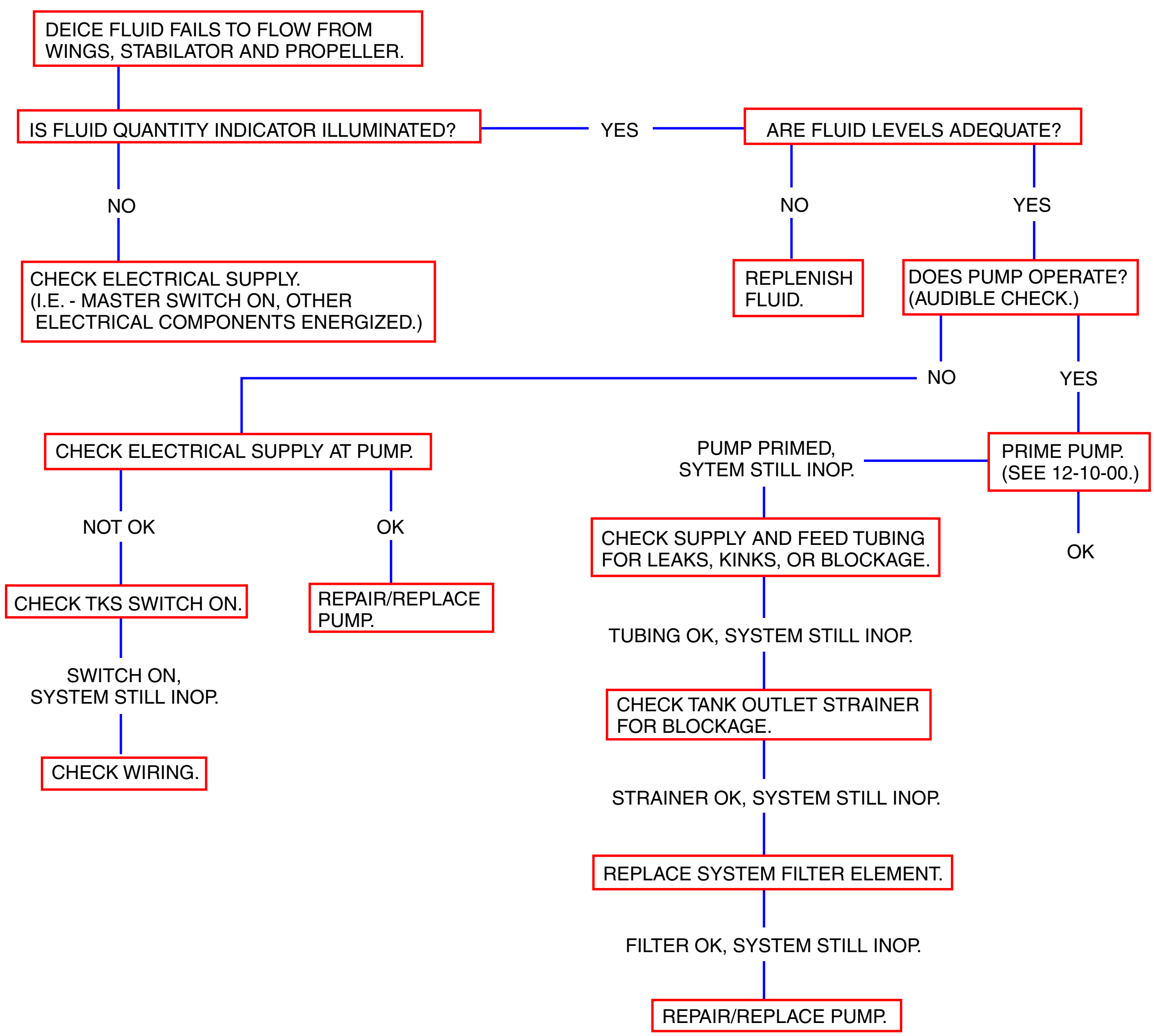


CHART 3
TKS FAULT ISOLATION - SYSTEM PARTLY INOPERATIVE

NO FLUID FLOW AT PROPELLER BOOTS. → CHECK SUPPLY AND FEED TUBING AND HOSE FOR LEAKS, KINKS, OR BLOCKAGE.

SUPPLY AND FEED TUBING AND HOSE OK, STILL NO FLOW.

CHECK NOZZLE AND SLINGER RING FOR CORRECT MOUNTING AND ALIGNMENT.

NOZZLE AND SLINGER RING OK, STILL NO FLOW.

REPLACE PROPELLER PROPORTIONING UNIT.

NO FLUID FLOW FROM LEFT WING PANELS. → FROM TEE IN FUSELAGE, CHECK LEFT WING SUPPLY AND FEED TUBING FOR LEAKS, KINKS, OR BLOCKAGE.

SUPPLY AND FEED TUBING OK, STILL NO FLOW.

REPLACE LEFT WING PROPORTIONING UNIT.

NO FLUID FLOW FROM RIGHT WING PANELS. → FROM TEE IN FUSELAGE, CHECK RIGHT WING SUPPLY AND FEED TUBING FOR LEAKS, KINKS, OR BLOCKAGE.

SUPPLY AND FEED TUBING OK, STILL NO FLOW.

REPLACE RIGHT WING PROPORTIONING UNIT.

NO FLUID FLOW FROM STABILATOR PANELS. → FROM TEE IN FUSELAGE, CHECK EMPENAGE SUPPLY AND FEED TUBING FOR LEAKS, KINKS, OR BLOCKAGE.

SUPPLY AND FEED TUBING OK, STILL NO FLOW.

REPLACE TAIL PROPORTIONING UNIT.

NO FLUID FLOW FROM AN INDIVIDUAL PANEL. → CHECK APPROPRIATE FEED TUBING FOR LEAKS, KINKS, OR BLOCKAGE.

FEED TUBING OK, STILL NO FLOW.

CHECK APPROPRIATE PROPORTIONING UNIT OUTLET(S) FOR BLOCKAGE.

PROPORTIONING UNIT OK, STILL NO FLOW.

CHECK PANEL, REPLACE IF REQUIRED.

(5) Conduct 50 Hour Inspection, above.

(6) Reinstall wing and floor access panels; and, tailcone fairing.

E. Testing (PIR-PPS60220-1, Rev. New.)

(1) System Functional Test - Use 50 Hour Inspection, above.

(2) Component Tests - Porous panel, pump, fluid quantity indicator/sender, and proportioning unit tests are listed under the individual component, below.

(3) System Flow Test - The following test validates fluid distribution from the test port (adjacent to the system filter) through the proportioning units and the porous panels. It can also be used to overcome the “waterline” effect encountered when testing porous panels on a hot day. (See Porous Panels, Testing, under Components, below.)

CAUTION: FLOOR/GROUND MAY BECOME SLIPPERY IN THE VICINITY OF THE AIRPLANE WHEN FLOW TESTING THE TKS SYSTEM.

NOTE: Placing trays under the wing leading edges and propeller to catch deice fluid is recommended.

(a) Access the test port (see Figure 12 for location). Remove 5/16 nut and nylon ball plug from the test port (i.e. - bulkhead tee). See Figure 14.

(b) Connect the supply line from the TKS Test Apparatus to the test port.

(c) Test Apparatus Set-up (See Figure 2.)

CAUTION: RESERVOIR MAY BE UNDER PRESSURE. ADJUST PRESSURE REGULATOR TO ZERO AND BLEED PRESSURE FROM RESERVOIR BY PULLING THE POP-OFF VALVE, BEFORE ATTEMPTING TO REFILL.

1 Check which pop-off (i.e. - pressure relief) valve is installed. If required, install the 75 PSI relief valve on the test apparatus fluid reservoir (i.e. - pressure vessel).

2 Open the top of the test apparatus fluid reservoir. Fill reservoir ¾ full with approved TKS deice fluid. Close top.

3 Adjust pressure regulator to zero.

4 Connect shop air to pressure regulator.

5 Remove fluid tank filler cap and leave the fluid tank filler open throughout the test.

(d) Slowly increase pressure downstream of the pressure regulator to 60 PSI.

(e) Inspect flow distribution along porous panels (wings and stabilator). Wipe leading edges as flow becomes evident.

NOTE: It can take as long as 15 minutes for fluid to begin flowing from one or more porous panels.

(f) Allow flow to continue up to 30 minutes, if required, to determine if panel flow is consistent and even along the entire leading edge between rivet rows on each porous panel.

(g) Inspect flow at the propeller nozzle tube and verify that flow is directed inside propeller slinger ring groove.

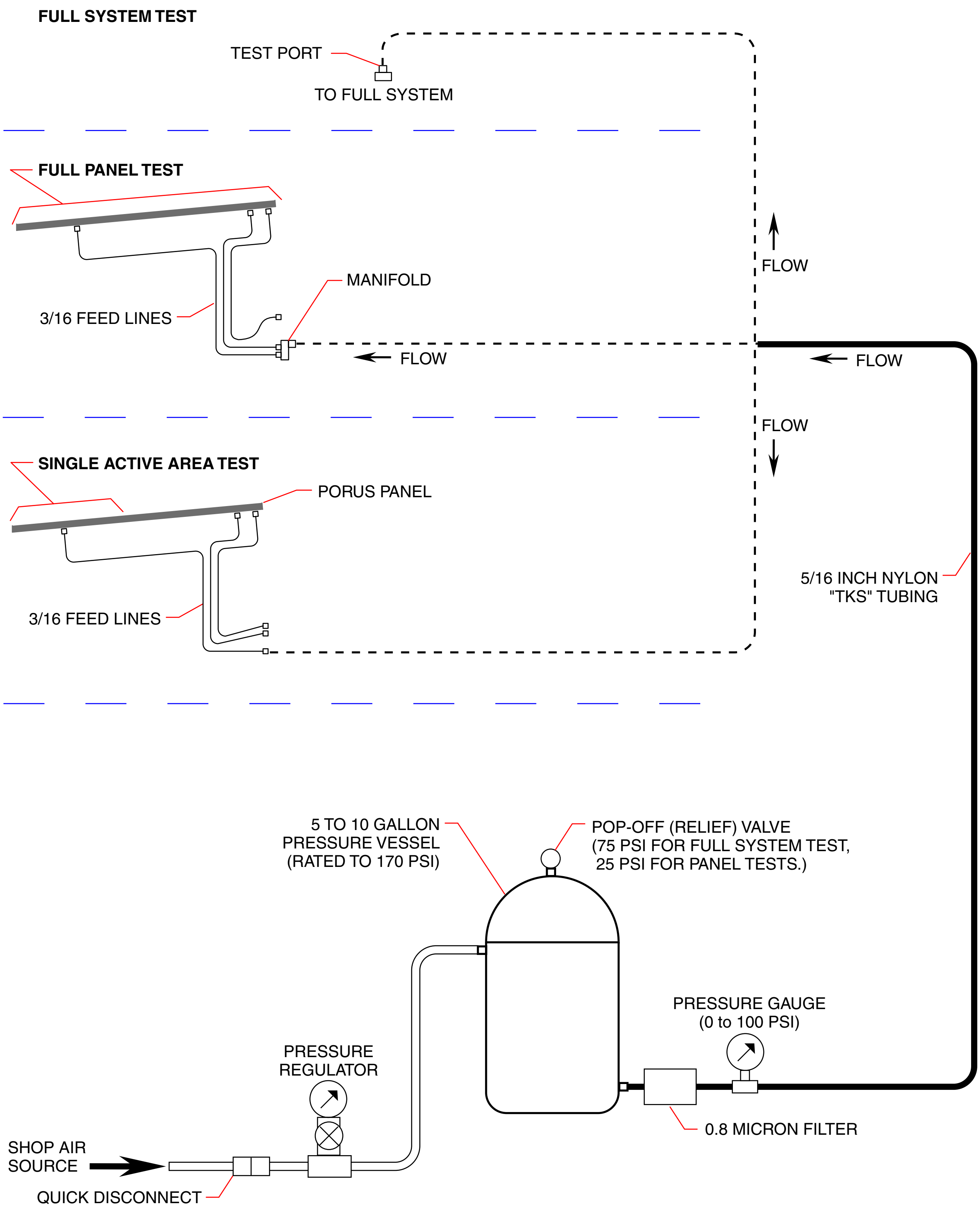
(h) Reduce air pressure at pressure regulator until appropriate pressure for the ambient temperature is reached as defined in Chart 4.

(i) Verify that flow of propeller nozzle tube is adequate and directed inside the propeller slinger ring groove.

(j) If flow is adequate on all panels and propeller nozzle, the flow test is completed.

(k) Disconnect shop air and close pressure regulator.

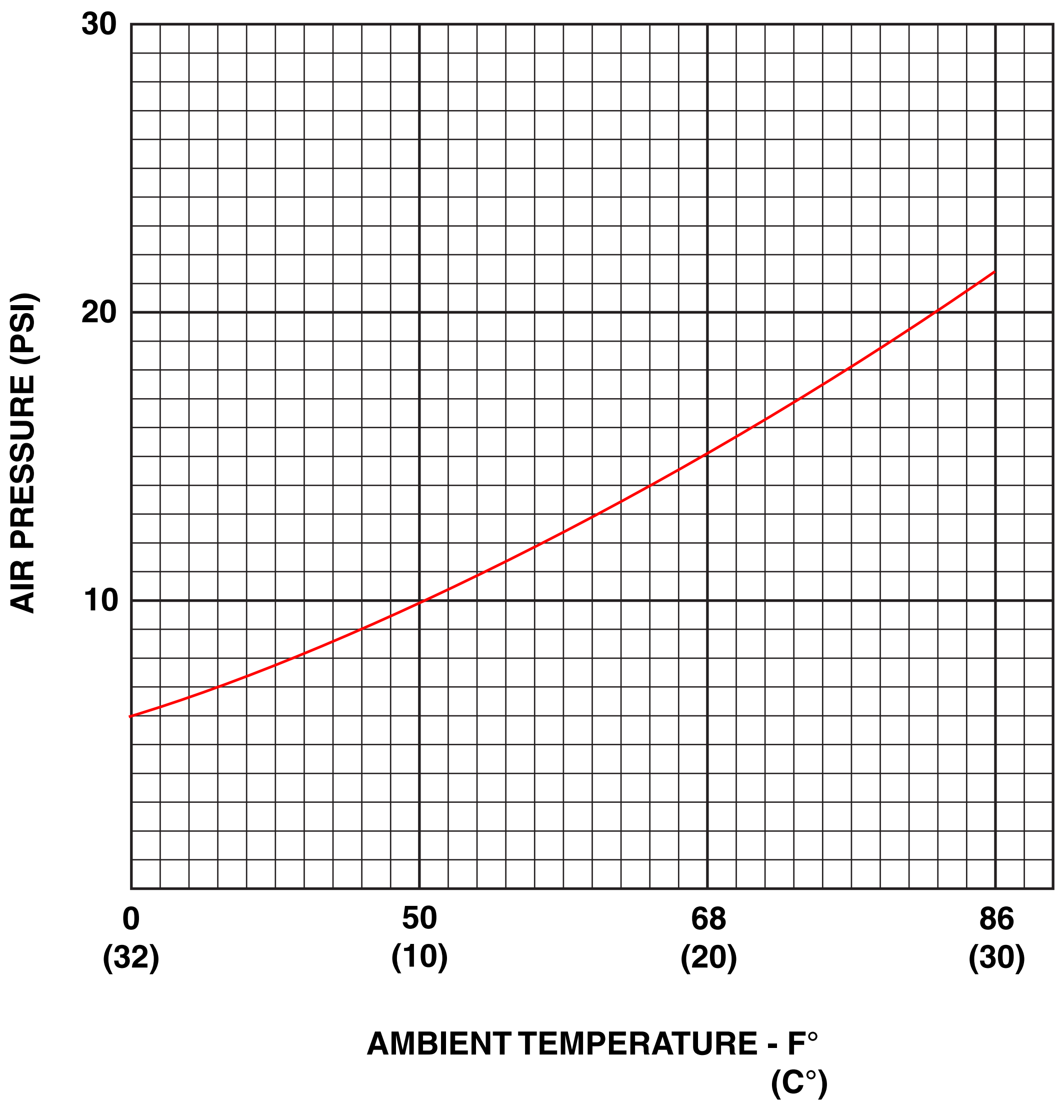
(l) Pull pop-off valve to depressurize the test apparatus fluid reservoir.



TKS Test Apparatus
Figure 2

CHART 4
PROPELLER NOZZLE FLOW TEST PRESSURE VS. TEMPERATURE

(PIR-PPS60220-1, Rev. New.)



(m) Disconnect supply line at the test port and re-install nylon ball plug and 5/16 nut on test port.

(n) Replace fluid tank filler cap.

(o) For any porous panels which did not demonstrate adequate flow evenly over the active zone, proceed with Proportioning Units, Testing; and, Porous Panel, Testing; under Components, below.

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F. Components

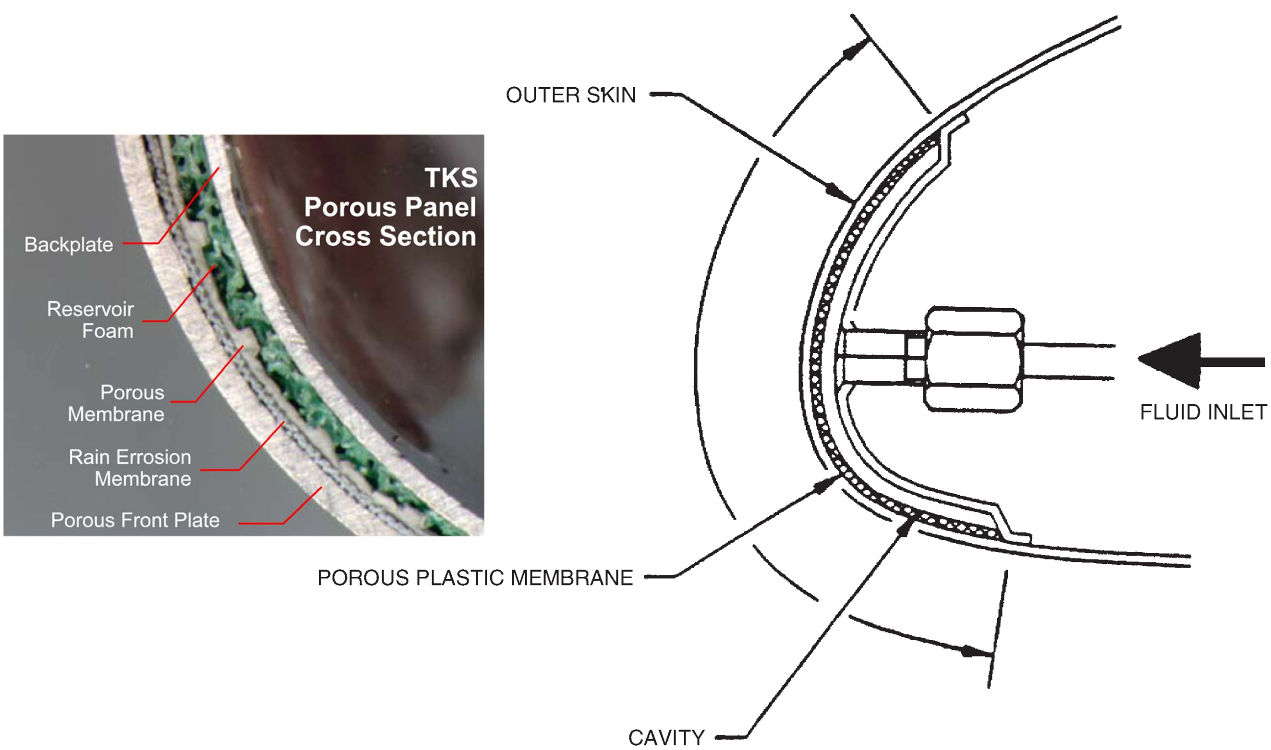
(1) Porous Panels

Ice protection with a TKS system is achieved by mounting laser drilled titanium panels to the leading edges of the wings and horizontal stabilizer.

The outer skin of the ice protection panels is manufactured with 0.9 mm thick titanium. Titanium provides excellent strength, durability, light weight, and corrosion resistance. The panel skin is perforated by laser drilling holes, 0.0025 inches in diameter, 800 per square inch. The porous area of the titanium panels is designed to assure fluid coverage from best rate of climb speed to maximum operational speed.

The back plate of a typical panel is manufactured from titanium. It is formed to create a reservoir for the ice protection fluid, allowing fluid supply to the entire porous area. A porous membrane between the outer skin and the reservoir assure even flow and distribution through the entire porous area of the panel.

The porous panels are bonded to the leading edges of the protected surfaces with a two-part adhesive. Porous panels cover a majority of the leading edges of the wings. Likewise, the horizontal stabilizer is completely protected with porous panels.



TKS Porous Panel Cross-Section
Figure 3

(a) Testing

Perform when a blockage or uneven flow is suspected in an individual panel.

CAUTION: FLOOR/GROUND MAY BECOME SLIPPERY IN THE VICINITY OF THE AIRPLANE WHEN FLOW TESTING THE TKS SYSTEM.

NOTE: Placing trays under the wing leading edges and propeller to catch deice fluid is recommended.

NOTE: The following procedure describes the "Full Panel Test" as shown in Figure 2. If desired, individual "active areas" can be tested by connecting the appropriate 3/16 inch single feed line directly to the TKS Test Apparatus 5/16 inch supply line using a male/male straight or bulkhead coupling, as available.

1 Gain access to the proportioning unit feeding the suspect porous panel.

2 Disconnect suspect panel's feed lines from proportioning unit outlet ports. Mark the feed lines to facilitate reconnecting them to the correct proportioning unit outlet ports. See also Chart 6 and Figure 14.

3 Using a locally produced manifold, connect the 5/16 inch supply line from the TKS Test Apparatus to the 3/16 inch feed lines to the suspect porous panel.

4 Test Apparatus Set-up (See Figure 2.)

CAUTION: RESERVOIR MAY BE UNDER PRESSURE. ADJUST PRESSURE REGULATOR TO ZERO AND BLEED PRESSURE FROM RESERVOIR BY PULLING THE POP-OFF VALVE, BEFORE ATTEMPTING TO REFILL.

a Check which pop-off (i.e. - pressure relief) valve is installed. If required, install the 25 PSI relief valve on the test apparatus fluid reservoir (i.e. - pressure vessel).

b Open top of test apparatus fluid reservoir (i.e. - pressure vessel). Drain and rinse reservoir with water. Fill reservoir ¾ full with water. Close top.

c Adjust pressure regulator to zero.

d Connect shop air to pressure regulator.

CAUTION: ENSURE PRESSURE DOES NOT EXCEED 20 PSI.

5 Slowly increase pressure downstream of the pressure regulator to 20 PSI.

6 Inspect porous panel to ensure deice fluid is being purged from the system.

CAUTION: RESERVOIR MAY BE UNDER PRESSURE. ADJUST PRESSURE REGULATOR TO ZERO AND BLEED PRESSURE FROM RESERVOIR BY PULLING THE POP-OFF VALVE, BEFORE ATTEMPTING TO REFILL.

7 Refill reservoir with water as required to maintain 30 minutes of water flow.

8 After the system has been flushed with water for 30 minutes, allow reservoir to empty and purge system with air, adjusting pressure regulator to maintain 15 PSI.

NOTE: When water empties from the reservoir, the pressure will drop.

9 Purge system with air for 10 minutes.

10 Adjust pressure regulator to zero and depressurize fluid reservoir by pulling pop-off valve.

11 Open top of test apparatus fluid reservoir. Fill reservoir ¾ full with approved TKS deice fluid. Close top.

CAUTION: ENSURE PRESSURE DOES NOT EXCEED 20 PSI.

12 Slowly increase pressure downstream of the pressure regulator to 20 PSI.

13 Inspect flow distribution along porous panel being checked. Wipe leading edge as flow becomes evident. Let fluid flow for 5 to 15 minutes after first evidence of flow through panel. Determine if panel flow is consistent and even along its entire length between rivet rows.

14 If flow is adequate, the panel is good.

a Disconnect shop air and adjust pressure regulator to zero. Depressurize fluid reservoir by pulling pop-off valve.

b Disconnect panel feed lines and the test apparatus supply line from the manifold. Reconnect the panel feed lines to the proportioning unit outlet ports per the markings made during disconnection. See also Chart 6 and Figure 14. Use new seals, if required.

c If desired, a full system test can now be conducted per Testing - System Flow Test, above.

15 If fluid fails to flow evenly from each active zone of the porous panel:

a first, inspect the appropriate 3/16 inch feed line(s) for blockage or kinks;

b if feed line(s) is(are) good, replace panel.

NOTE: Fluid should be exuded evenly over the active zone of the porous panels. At high ambient temperatures a "waterline" may be observed at the top of some panels due to insufficient pressure being developed to expel entrained air. This is acceptable unless performance of the panel in icing conditions indicates that this is other than of a temporary nature.

(b) Removal

Porous panels are bonded to the wing and stabilator leading edges using polysulfide rubber sealant material. Rivets are inserted through the corners of all but the inboard wing panels (see Note), primarily for electrical bonding purposes. Removal of these panels without causing a significant amount of damage to them is extremely difficult. In most cases reuse of a removed panel is impractical.

NOTE: Inboard wing panels are electrically bonded with screws, washers, and nuts on the inboard end.

NOTE: If the porous panel being replaced has a stall strip installed, the location of the stall strip must be marked and the stall strip removed before panel removal. Likewise, the stall strip must be reinstalled after panel installation. See Stall Strips, below.

1 Observe the porous panel to be removed and compare it to the new panel to be installed. Note any cutouts or trimming on the panel to be removed.

2 Protect wing and/or stabilator skins behind the edges of the porous panel to be removed. Use masking tape or other suitable material.

3 Drill out rivets (or remove screws, washers, and nuts) attaching panel to skin.

4 If the panel is unserviceable and not repairable, the most expedient means of removal is to peel the panel from the wing by tearing the outer panel skin and winding the edges of the panel around a pair of pliers to peel them from the skin. With the edges removed the central part of the panel can be pulled away from the skin by working inwards from the ends.

5 If the panel is serviceable and/or repairable it may be possible with care to remove it in a relatively undamaged condition by progressively cutting and parting the sealant which attaches the panel to the skin using a thin flexible blade. (A suitable blade can be made by grinding a hacksaw blade.)

6 Withdraw the panel and disconnect the nylon feed tubing. Cap the end of each line to prevent contamination/blockage. Mark each line to facilitate reconnecting to the correct inlet port.

(c) Installation (See Figure 4.) (PPS-PIR50074, Rev. C.)

CAUTION: IF INSTALLING A POROUS PANEL ON EITHER OR BOTH SIDES OF THE STABILATOR, BE SURE TO REBALANCE THE STABILATOR AFTER POROUS PANEL INSTALLATION IS COMPLETE. SEE BALANCING, 55-20-00.

1 Dry fit the panel as follows:

a Using notes made during removal of the old panel, trim the new panel to fit. Avoid trimming closer than .05 inch to the ends of the inner skin or to the air bleed tube where it is routed across the end of the panel.

b Position panels and adjust edges by hand, bending panel to achieve a snug fit at the top and bottom trailing edge of the panels. With panels held firmly in place, the panel edges should be in continuous contact with the wing skin.

NOTE: Align top edge and roll panel down by hand, applying pressure sufficient to form panel to wing contour.

c Inboard corners of the inboard wing panels only can be rounded up to 0.125 inch radius maximum to prevent interference with skin.

d With porous panels fitted in place, drill holes to match those in the leading edge skin.

NOTE: For all but the inboard wing panels, use a #30 drill bit and allow a minimum of two-diameter edge distance from the porous panel edge. On the inboard wing panels only, drill 0.156 inch holes as shown in Figure 4, Sheet 2.

e Secure panel in place with clecos at each rivet or screw hole.

f Review fit of panel and adjust as required.

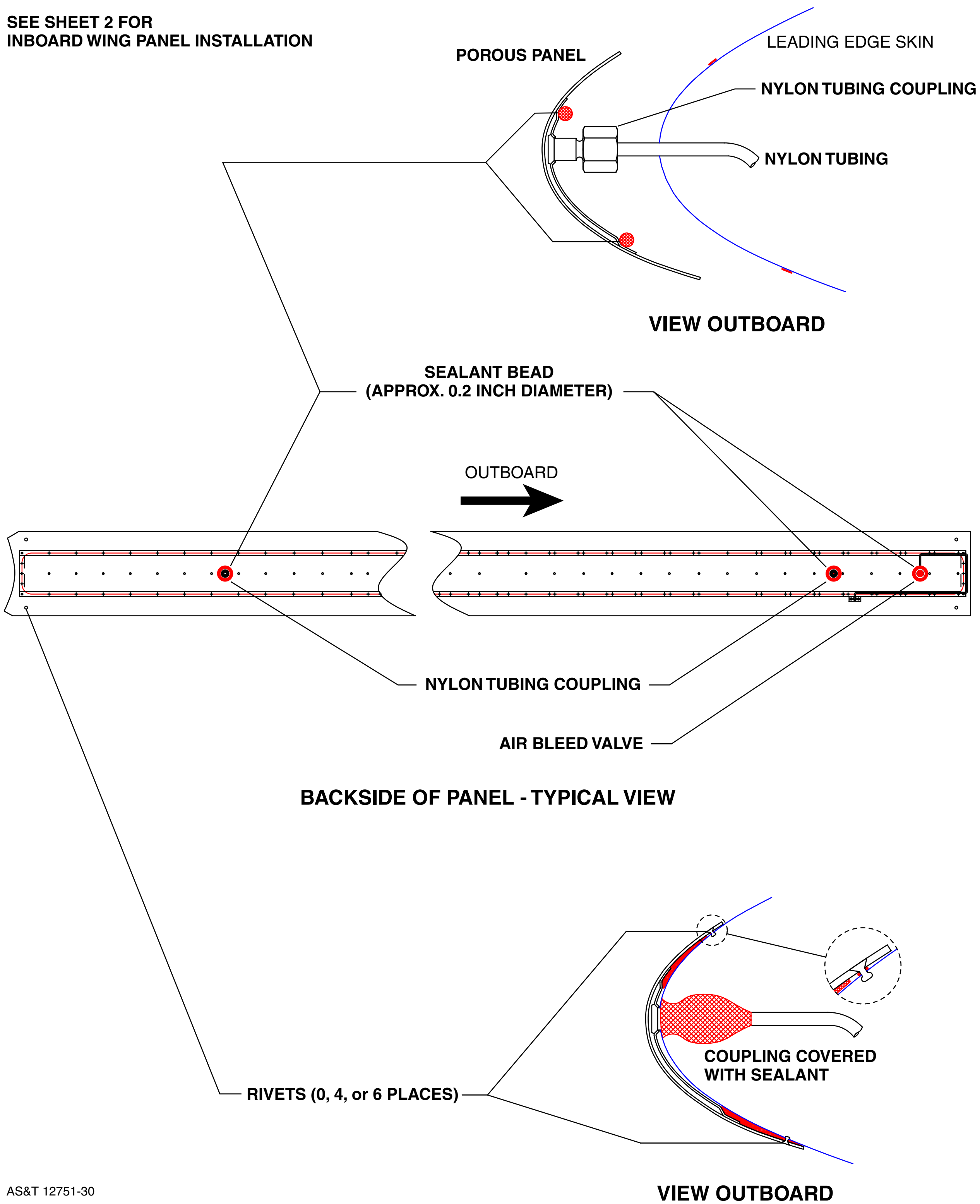
g When installing the center and outboard panels (P/N’s 680-886 and 680-876, respectively) on the left wing, trim panels to have positive clearance around stall vane plates (maximum acceptable gap is 0.14 inch).

h When installing the center panel on the left wing (P/N 680-886) and the outboard panel on the right wing (P/N 680-878), notch the inboard end of the panel 0.078 inch radius for the stall strip feed line.

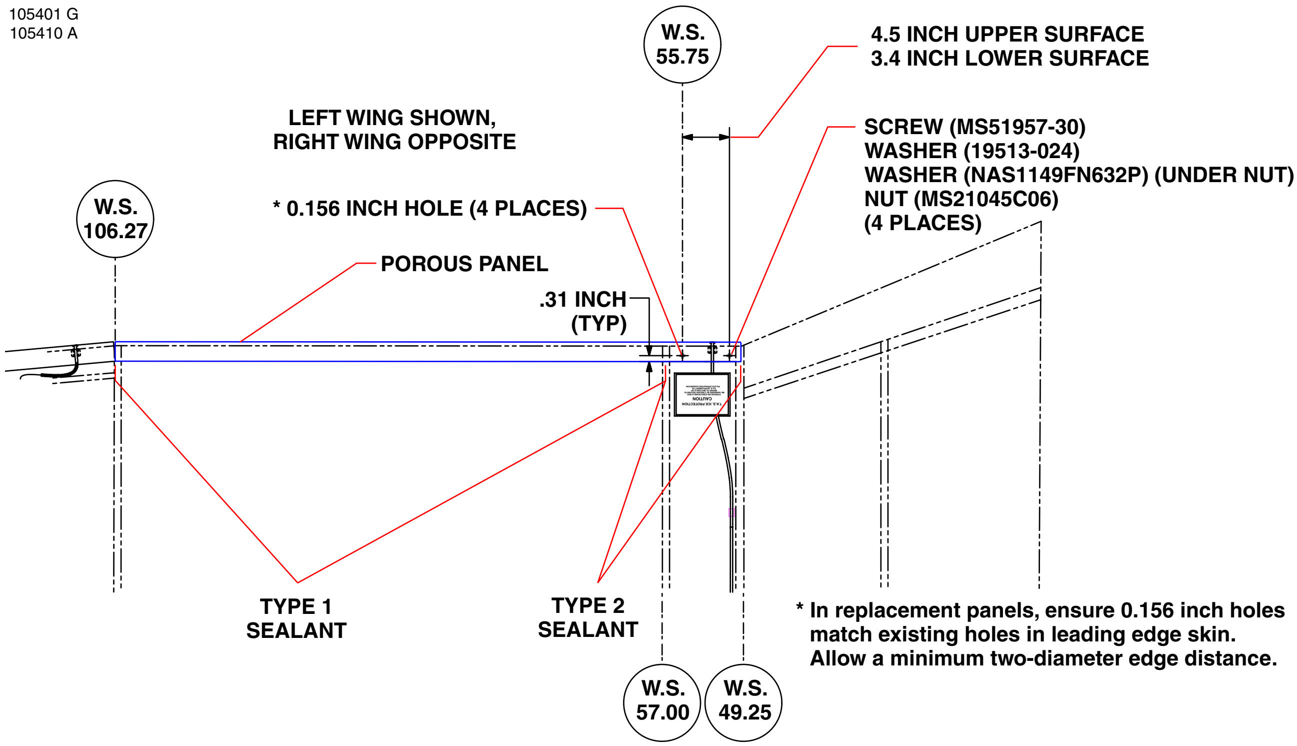
2 Clean and degrease rear surfaces of panel using alcohol. Do not touch rear surfaces after this operation.

3 Clean and degrease leading edge where panel is to be attached. Do not touch leading edge surface after this operation.

4 Connect fluid feed lines to fluid inlet ports on the panel. See Chart 6 and Figure 14, as well as markings on the lines made during disassembly to ensure connecting the correct feed line to the correct inlet port. Be sure to install O-ring seal as described in Nylon Tubing Couplings, 20-00-00.



TKS Porous Panel Installation
Figure 4 (Sheet 1 of 2)



INBOARD WING PANEL INSTALLATION

TKS Porous Panel Installation
Figure 4 (Sheet 2 of 2)

5 Apply a sealant bead (approx. 0.2 inch diameter) (see Note) along the edges of the panel (along backplate joggle) and around each feed inlet/nylon tubing coupling and each air bleed valve. Also apply a sealant bead around each drilled rivet (or screw) hole in the aircraft leading edge skin (see Figure 4).

NOTE: For all but the inboard wing panels, use Type 1 sealant (see Chart 5). On the inboard wing panels only, apply Type 1 sealant along the portion of the panel which will cover the fuel tank and Type 2 sealant (see Chart 5) along the small portion of the panel inboard of the fuel tank. (See Figure 4, Sheet 2.)

6 Apply sealant to cover each fluid inlet and coupling. Cover exposed connector threads, nut and feed line for at least 1/2 inch beyond the nut.

7 Press panel into place, and hold with sufficient force to help sealant flow into place. Insert clecos in rivet or screw holes to ensure panel is properly located on aircraft.

8 Wrap panel and wing or stabilator with load straps. Cinch tight ensuring that panel is pressed onto leading edge.

9 Remove any surplus sealant from edges using alcohol.

10 Allow sealant to cure as specified in Chart 5, then remove load straps.

11 Countersink holes and install rivets wet.

CHART 5
APPROVED SEALANTS

Vendor	Vendor Part Number	Piper Part Number (Quantity)
Type 1 (High Adhesion)		
PRC DeSoto (PPG Aerospace)	PR-1422-B2	179-754 (One Gallon)
	PR-1440-B2	279-192 (One Tube)
Advanced Chemistry and Technology	AC-350B-2	279-187 (One Gallon)
JDL Industries Inc.	CS-3204B-2	279-212 (One Kit)
Type 2 (Low Adhesion)		
PRC DeSoto (PPG Aerospace)	PR-1428-B2	TBD
Advanced Chemistry and Technology	AC-215B-2	279-184 (One Quart)

Application and Curing Properties at 77 °F / 50% Relative Humidity			
Sealant	**Work Life (Hrs)**	**Tack-Free Time (Hrs)**	**Cure Time (Hrs)**
PR-1422-B2	2	20	36
PR-1440-B2	2	36	48
AC-350B-2	2	7	7
CS-3204B-2	2	24	72
PR-1428-B2	2	8	24
AC-215B-2	2	24	48

12 If the panel installed replaces a panel which had a stall strip installed, reinstall the stall strip per Stall Strips, Installation, below.

13 Finish installation as shown in Figure 5 using Type 1 sealant. Allow sealant to cure as specified in Chart 5.

14 Prime pump per Pump Priming, Inadvertent Ice Protection System, 12-10-00.

15 Perform 50 Hour Inspection, above. Check for leaks while pump is running.

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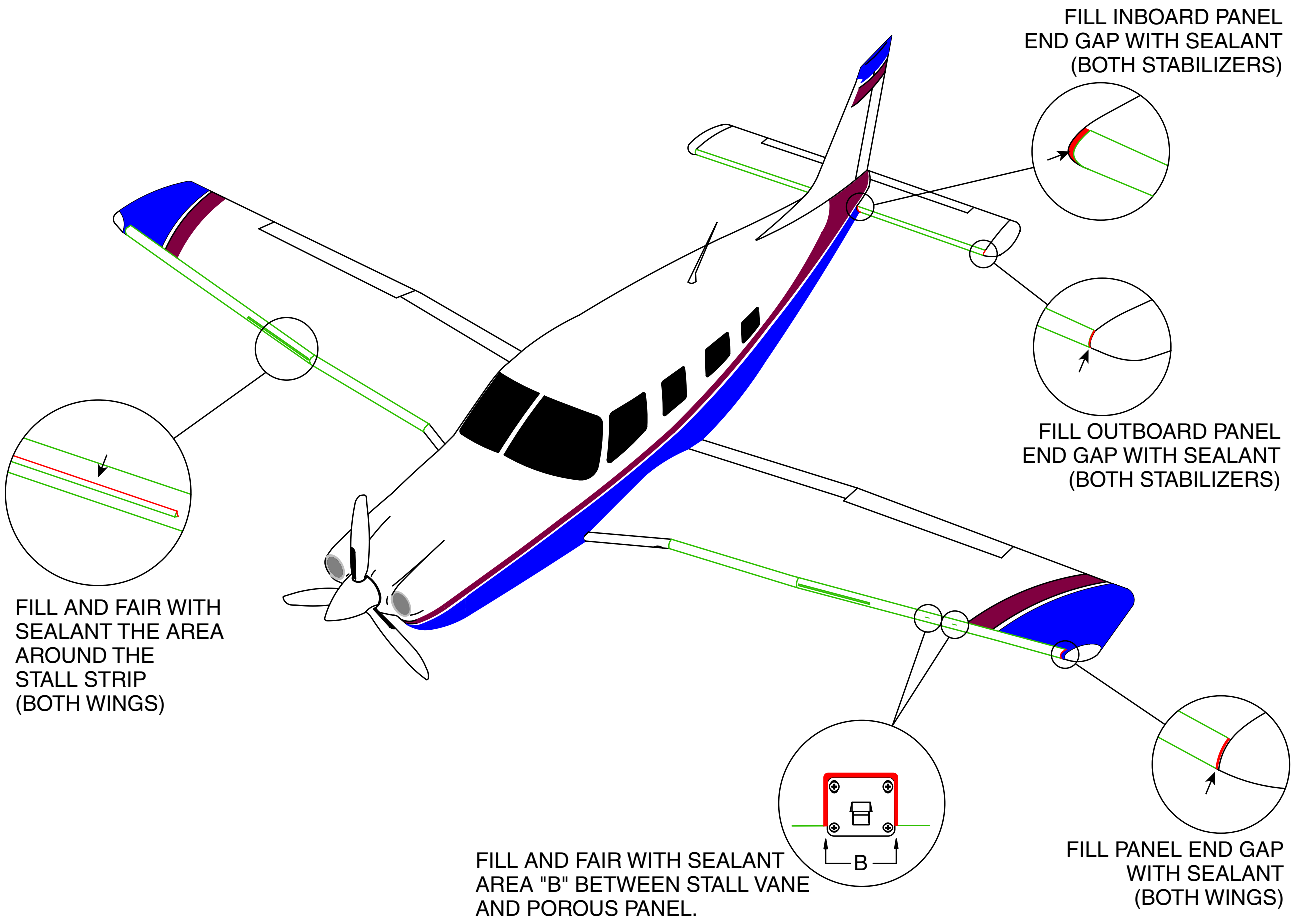


Finishing Panel Installation with Sealant
Figure 5

(d) Stall Strips

If a porous panel being replaced has a stall strip installed, the location of the stall strip must be marked prior to panel removal. With care, the stall strip can be removed from the existing porous panel and reused, but installation of a new stall strip is always recommended. In either case, a new or serviceable stall strip must be installed after installation of the new porous panel.

1 Marking and Removal (See Figure 6.)

a Measure horizontally from a reference point to either the inboard or outboard edge of the stall strip. Record the measurement and which edge it was from.

b Place a piece of masking tape on the top surface of the wing, approximately nine (9) inches aft of the the inboard and outboard apex of stall strip. Write the number “10” on each strip of masking tape.

c Place the measuring tape’s 10-inch mark on the inboard apex of the stall strip.

d With the measuring tape taut, mark where the end of the measuring tape falls on the masking tape.

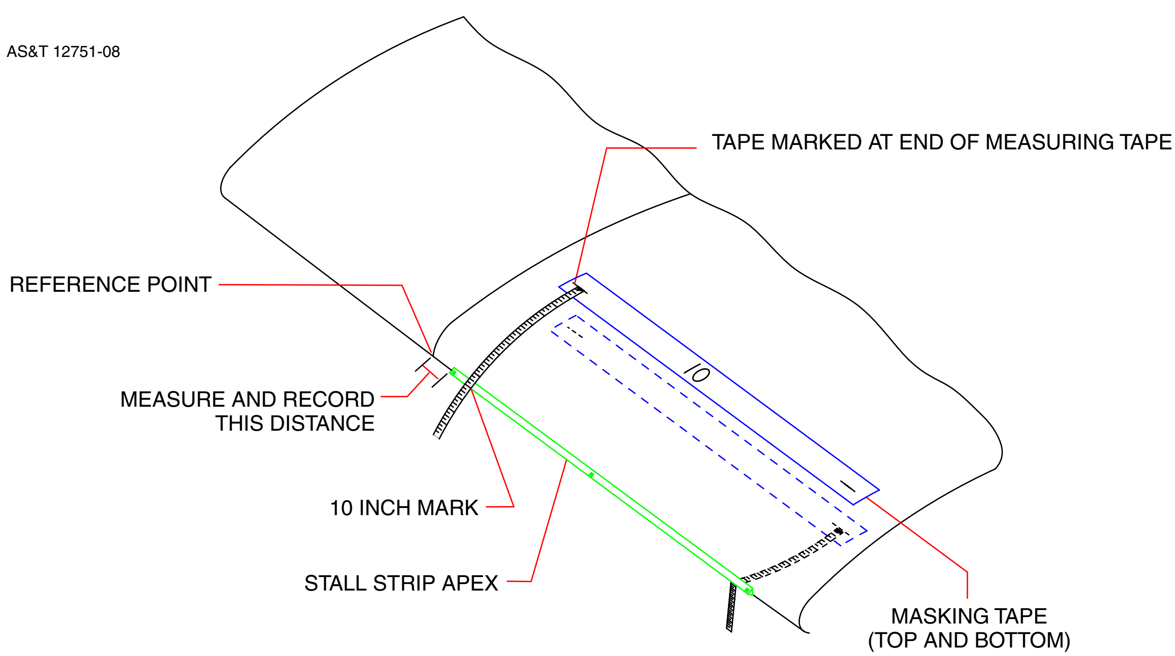
e Repeat steps c and d for the outboard apex of the same stall strip.

f Repeat steps a thru e on the underside of that wing.

g Repeat steps a thru f for the opposite wing.

h Remove stall strip only if you intend to reuse it on another porous panel.

i Stall strips are installed with adhesive sealant and can be removed by progressively cutting and parting the sealant which attaches the stall strip to the panel by using a thin flexible blade. (A suitable blade can be made by grinding a hacksaw blade.)



Marking and Removing Stall Strips
Figure 6

2 Installation (See Figure 7.) (PPS-PIR50074, Rev. C.)

Install only the TKS stall strip. Standard stall strips will not work on porous panels.

a Attach the stall strip to the leading edge of the titanium panel with masking tape at the approximate location it was removed from.

b Measure from either mark on the masking tape on the top of the wing over the apex of the stall strip to the corresponding mark on the masking tape on the underside of the wing. Keep measuring tape taut.

c Take the measurement and divide it by two. This is the index value.

d Measure from the inboard mark on the top of the wing to the inboard apex of the stall strip. Adjust the stall strip to match the index value.

e Repeat step 4 for the outboard mark and apex of the stall strip.

f Verify steps d and e by repeating and measuring from the marks on the tape on the underside of the wing.

g After the stall strip has been positioned correctly, outline the stall strip with masking tape. This will keep excess adhesive off of the panel.

h Mark the masking tape outline with alignment marks to show the exact location of the stall strip.

i Remove the stall strip and cover the face of the stall strip completely with masking tape to prevent any sealant from covering the holes.

j If not already present, notch the stall strip at inboard end 0.078 inch radius to allow the air bleed line to fit behind.

k Pull the stainless steel line from the wing porous panel through the notch in panel end and then feed it through the notch in the stall strip.

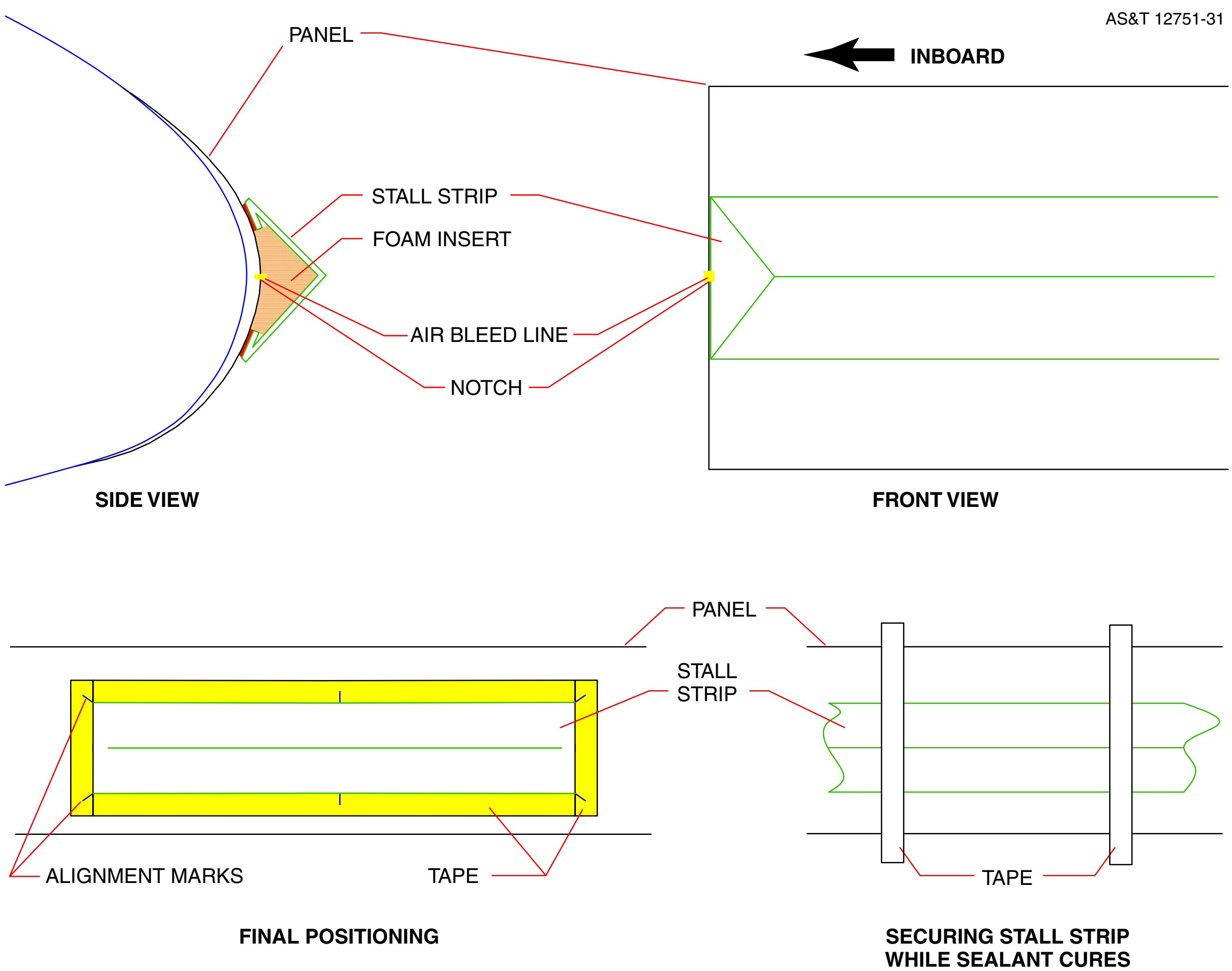
l Degrease the mating surfaces of the porous panel and stall strip with alcohol.

m Re-wet the TKS stall strip foam inserts. Remove excess water and install the foam inserts inside the stall strip.

n Apply Type 1 sealant (see Chart 5) to the mating surfaces of the stall strip using a brush.

o Align the stall strip with the marks on the masking tape outline and press into place. Put tape across the stall strip to hold it against the panel. Re-measure and adjust if necessary (see steps d, e, and f, above).

p Allow adhesive to cure as specified in Chart 5, then remove tape.



Installing Stall Strips
Figure 7

(2) Pump (See Figure 8.)

Fluid is supplied to the panels and propeller by a positive displacement, constant volume metering pump located in the right wing just inboard of W.S. 49.25 and forward of the main spar. The two-speed pump provides two flow rates to the panels and propeller and operates at a nominal system pressure of 50 PSI. The low speed (NORM) supplies fluid for the design point of anti-icing during a typical icing conditions. The high speed (MAX) doubles the flow rate for removing accumulated ice or providing ice protection for more severe conditions.

If the pump is run dry, it must be primed. See Pump Priming, Inadvertent Ice Protection System, 12-10-00.

(a) Testing

1 Fill tank to top of filler tube.

2 Operate pump at NORM for a timed period.

3 Refill tank, measuring the quantity necessary to replenish to the original level.

4 Operate pump at MAX for a timed period.

5 Refill tank, measuring the quantity necessary to replenish to the original level.

6 Using the quantities required to refill the tank, above, versus the time of pump operation at each pump speed, calculate flow rate.

Permitted limits are:

NORM = 140 to 150 ml/minute

MAX = 280 to 300 ml/minute

7 If pump fails to meet the above specifications, replace or rebuild.

(b) Removal

1 Drain TKS system. See Draining, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

2 Remove wing access plate adjacent to system drain valve.

3 Disconnect and cap the deice fluid tubing from the pump inlet, outlet, and drain ports.

4 Disconnect pump electrical harness.

5 Remove four (4) bolts, washers, and nuts securing pump to wing.

6 Remove pump.

(c) Installation

1 Position pump in wing and secure with four (4) bolts, washers, and nuts.

2 Connect pump electrical harness.

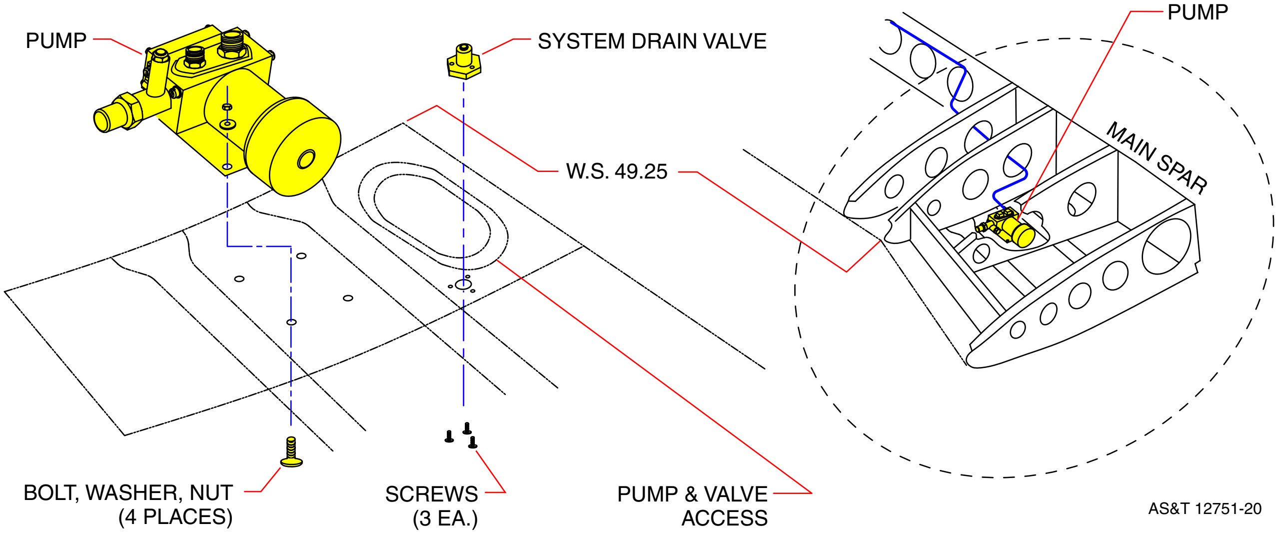
3 Uncap and connect the appropriate deice fluid tubing to the pump inlet, outlet, and drain ports.

4 Refill TKS system. See Filling, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

5 Prime pump. See Pump Priming, Inadvertent Ice Protection System, 12-10-00.

6 Perform 50 Hour Inspection, above. Check for leaks while pump is running.

7 Replace and secure wing access plate.



TKS Pump and Drain Valve Installation
Figure 8

(3) Fluid Tank (See Figure 9.) (PPS-PIR50074, Rev. C.)

The TKS deice fluid tank is located in the right wing between the ribs at W.S. 106.19 and 117.50 and forward of the main spar. This tank is serviced through a single filler located on the right wing, inboard of the fuel filler. The tank has a capacity of 4.25 US gallons useable. A minimum indication of ¼ tank is required before takeoff if the system is to be considered operational.

Fluid quantity is measured by a sender (see below) which transmits an electrical signal to the fluid quantity indicator (see below).

A strainer (see Figure 10) is fitted inside the tank outlet nipple.

(a) Removal

1 Drain TKS system. See Draining, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

2 Remove filler cap.

3 Remove wing access plate aft of tank and inboard W. S. 117.50.

4 Loosen and remove six (6) screws securing filler throat to wing skin and tank bladder nutplate.

5 Loosen and remove two (2) bolts and washers securing fluid quantity sender mounting bracket to stringer.

6 Pull the top, sides, and bottom of the tank away from the “Dual Lock” (i.e. - hook and loop) strips securing it to the wing skin and ribs.

CAUTION: TAKE CARE NOT TO CRUSH OR DEFORM THE STRAINER OR FLUID QUANTITY SENDER.

7 Collapse tank bladder sufficient to fit through the access plate opening and pull it through.

8 Disconnect fluid quantity sender electrical leads.

9 Loosen two (2) hose clamps and remove fluid tank vent tubing from fluid tank vent nipple. Cap vent tubing.

10 Loosen two (2) hose clamps and remove strainer from tank outlet nipple.

11 Remove fluid tank from airplane.

(b) Installation

1 Apply sealant to strainer as shown in Figure 10.

2 Place two (2) hose clamps over the fluid tank outlet nipple and insert strainer, ensuring strainer outlet elbow faces aft and strainer retaining loop captures strainer inside tank bladder.

3 Tighten both hose clamps.

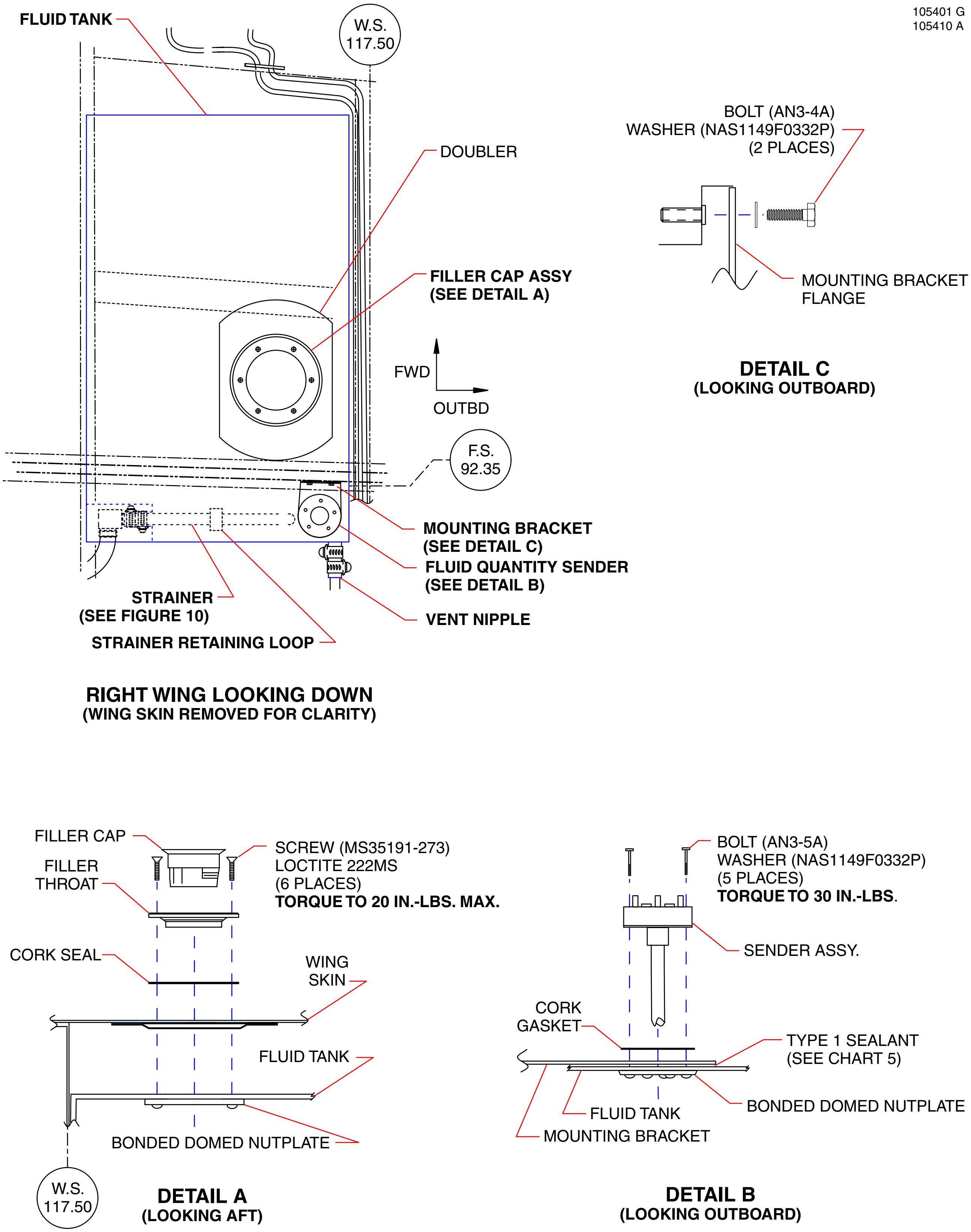
4 Place two (2) hose clamps over the fluid tank vent nipple. Uncap fluid tank vent tubing and insert tubing into nipple.

5 Tighten both hose clamps.

CAUTION: TAKE CARE NOT TO CRUSH OR DEFORM THE STRAINER OR FLUID QUANTITY SENDER.

6 Connect fluid quantity sender electrical leads.

7 Collapse tank bladder sufficient to fit through the access plate opening and place it in the wing.



TKS Fluid Tank Installation
Figure 9

8 Ensure it completely fills the space forward of the access plate and that the "Dual Lock" (i.e. - hook and loop) strips on the tank bladder top, bottom, and sides fully engage the corresponding "Dual Lock" (i.e. - hook and loop) strips on the wing skins and ribs.

9 Position filler throat through cork seal into wing skin filler opening and into tank bladder filler opening. Secure filler throat to wing skin and tank bladder nutplate with six (6) screws. Apply Loctite and torque as specifed in Figure 9.

10 Put fluid quantity sender mounting bracket in position and secure to stringer with bolts and washers.

11 Refill TKS system. See Filling, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

12 Reinstall filler cap.

13 Prime pump. See Pump Priming, Inadvertent Ice Protection System, 12-10-00.

14 Perform 50 Hour Inspection, above. Check for leaks while pump is running.

15 Replace and secure wing access plate.

(4) Fluid Tank Strainer (See Figure 10.)

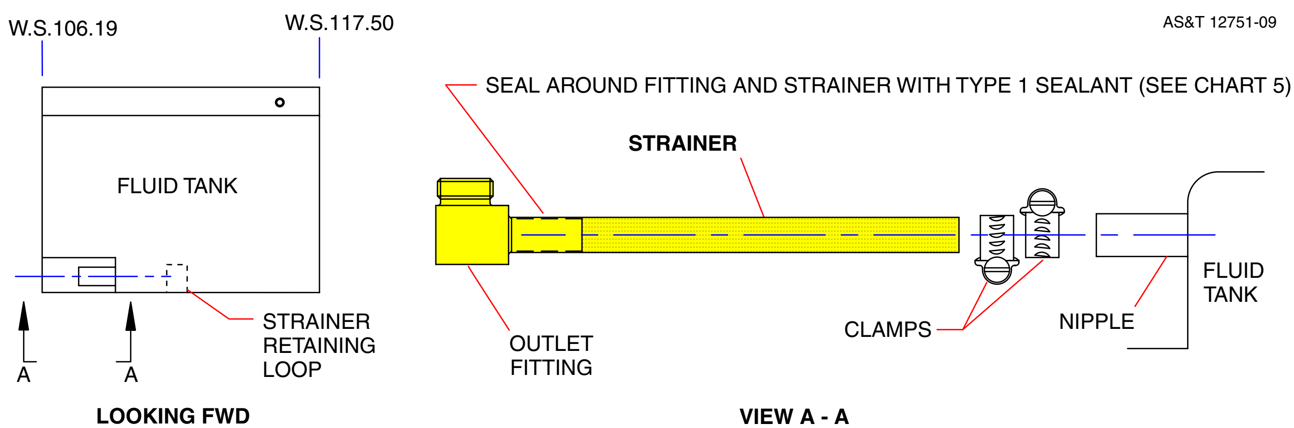
A strainer is fitted inside the fluid tank (see above) outlet.

(a) Inspection

Remove and clean the fluid tank strainer each 100 hours.

(b) Removal and Installation

See Fluid Tank: Removal; and Installation, above.



TKS Fluid Tank Strainer Installation
Figure 10

(5) Fluid Quantity Sender (See Figures 9 and 11.)

Fluid quantity is measured by a sender in the fluid tank (see above) which transmits an electrical signal to the fluid quantity indicator (see Figure 11).

(a) Testing / Calibration

The fluid quantity sender can be bench tested and calibrated as follows:

1 Remove sender from airplane per removal, below.

2 Connect the sender to a 28 Vdc regulated power supply and a voltmeter as shown in Figure 11.

3 Apply power to the sender and verify that the voltmeter shows zero Vdc for EMPTY. Turn power OFF.

4 Submerge the sender in TKS-approved deicing fluid in a container sufficiently deep to cover the full length of the sender as if it were installed in the fluid tank. See Figure 11.

5 Apply power to the sender and verify that the voltmeter shows five (5) Vdc for FULL. If not, adjust the gain potentiometer on the top of the sender until the voltmeter shows five (5) Vdc.

6 Turn power OFF. Calibration is complete.

(b) Removal

1 Remove fluid tank per Fluid Tank, Removal, above.

2 Remove five (5) bolts and washers securing fluid quantity sender to mounting bracket and tank bladder nutplate.

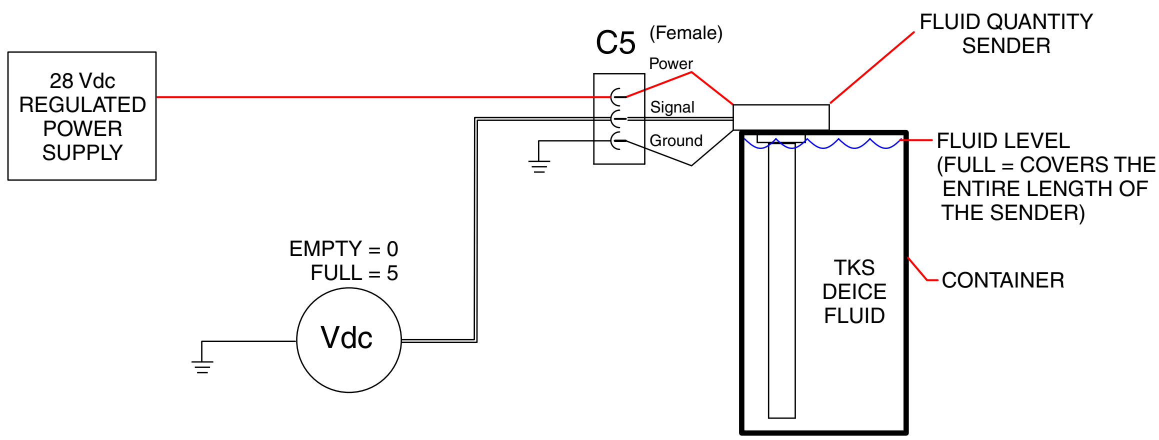
3 Remove sender.

(c) Installation

1 Position fluid quantity sender into fluid tank bladder.

2 Secure fluid quantity sender to mounting bracket and tank bladder nutplate with five (5) bolts and washers. Torque as specified in Figure 9.

3 Install fluid tank per Fluid Tank, Installation, above.



TKS Fluid Quantity Sender Calibration
Figure 11

(6) Fluid Quantity Indicator

Fluid quantity is measured by a sender (see above) in the fluid tank (see above) which transmits an electrical signal to the lighted fluid quantity indicator. The fluid quantity indicator is an analog gauge. This display dims for night operation.

(a) Removal and Installation

See Removal and Installation, Face-Mounted Instruments, 39-10-00.

(b) Full Range Check

To verify fluid quantity indication accuracy:

1 Drain the system per Deicing Fluid Tank, Draining, under Inadvertant Ice Protection System (TKS), in 12-10-00.

2 Turn ON the master switch.

3 Confirm that the Fluid Quantity Indicator reads “E”.

4 Add 2.125 gallons per Filling, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

5 Confirm that the Fluid Quantity Indicator reads “$^1/_2$” ± $^1/_8$.

6 Add an additional 2.125 gallons per Filling, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

7 Confirm that the Fluid Quantity Indicator reads “F”.

8 If the Fluid Quantity Indicator reads as required above, replace the fluid tank filler cap.

9 If the Fluid Quantity Indicator fails to read as required above:

a first, recalibrate the fluid quantity sender per Fluid Quantity Sender, Testing/Calibration, above;

b if sender recalibration fails to correct the problem, replace the Fluid Quantity Indicator.

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(7) Filter (See Figure 12.)

The deicing fluid passes through a microfilter (located under the forward baggage compartment floor - left side, or in later airplanes, in the right wing root) prior to distribution to the porous panels and propeller. The filter assures all contaminants are removed from the fluid and prevents panel blockage.

(a) Removal

1 Drain TKS system. See Draining, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

2 Remove the forward baggage compartment floor and the access panel on the left side of the nose, or in later airplanes, the right wing access panels.

3 Disconnect and cap the deice fluid tubing from the filter inlet and outlet.

4 Remove four (4) nuts and washers and remove filter.

(b) Installation

1 Place filter into position, sliding its mounting lugs over the four (4) studs.

2 Secure with four (4) nuts and washers.

3 Uncap and connect the deice fluid tubing to the filter inlet and outlet.

4 Refill TKS system. See Filling, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

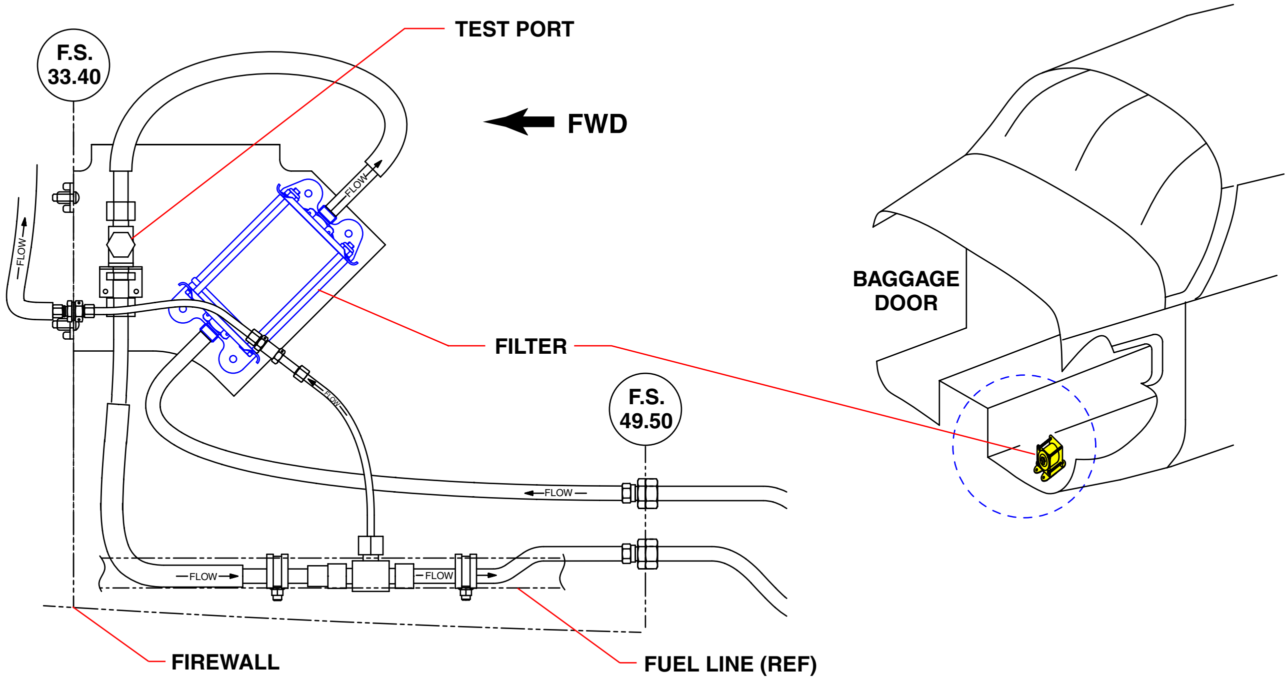
5 Prime pump. See Pump Priming, Inadvertent Ice Protection System, 12-10-00.

6 Perform 50 Hour Inspection, above. Check for leaks while pump is running.

7 Replace and secure either the forward baggage compartment floor and the access panel on the left side of the nose, or in later airplanes, the right wing access panels.

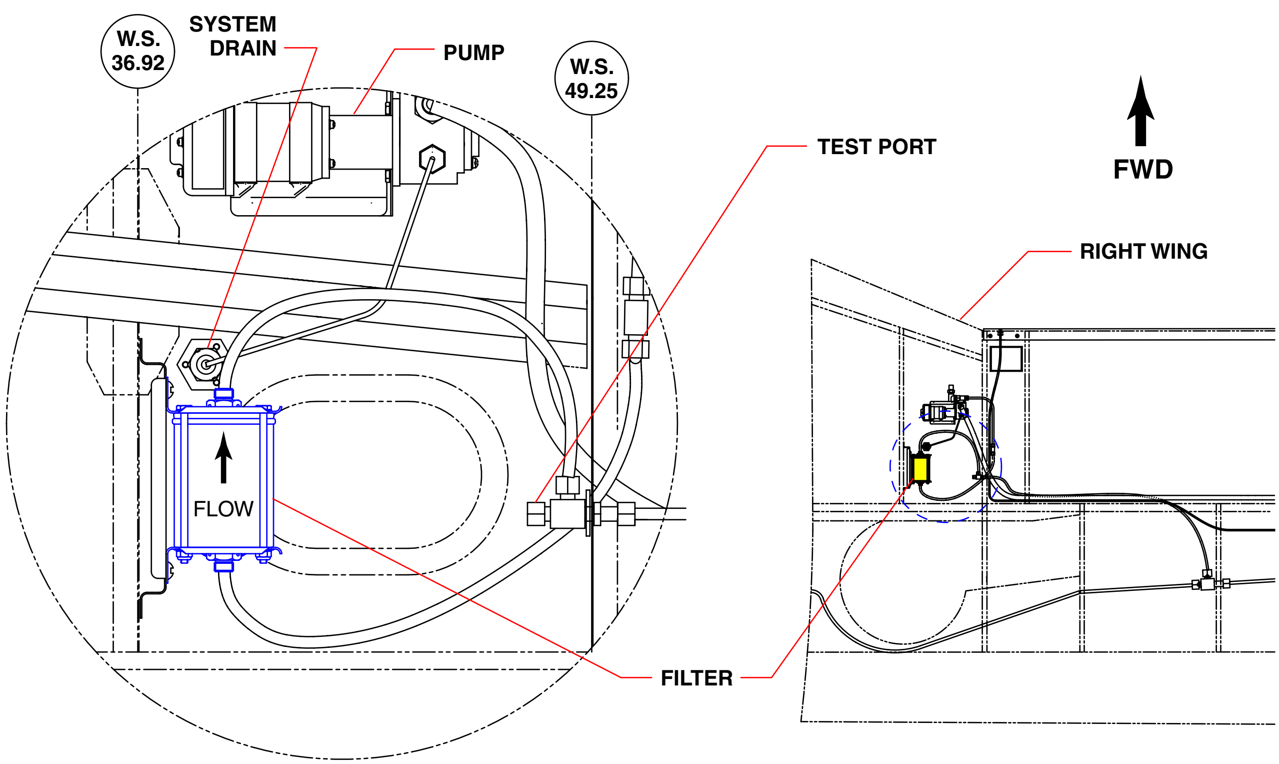
S/N'S 3246234 THRU 3246444; AND,
3257404 THRU 3257452, LESS 3257447

105401 G



S/N'S 3257453 AND UP, AND 3257447

105410 NEW



TKS System Filter Installation
Figure 12

(8) Proportioning Units

The proportioning units divide the flow into the volumetric requirements of each panel or device supplied through the unit. Four units are installed: one in each wing, one in the tail, and one under the forward baggage compartment floor. See Figure 13 for specific locations.

(a) Testing

The following test provides a simple flow / no-flow check and can be used when a blockage is suspected.

1 Gain access to the specific unit.

2 For wing or stabilator, consult Chart 6 and Figure 14 to determine which port feeds the suspect area of the panel in question.

3 Disconnect the installed feed line from the outlet port feeding the suspect panel area.

NOTE: If desired, a length of nylon tubing with the appropriate coupling can be fashioned and installed to route fluid to a collection jar.

4 Turn ON the master switch and then set the TKS switch to NORM. Observe (or have an assistant observe) the suspect port (or tubing routed to a collection jar from the suspect port). If fluid flow is observed from the outlet port, the proportioning unit is OK. If no flow observed, replace proportioning unit.

5 Turn OFF TKS switch and turn OFF master switch.

6 If used, disconnect the nylon test tubing from the suspect port. Remove it and the collection jar.

7 Reconnect the nylon feed line from the porous panel or propeller to the outlet port just tested. Clean up any split fluid.

8 Replace and secure any access plates or panels previously removed.

CHART 6
PROPORTIONING UNIT PORT USAGE

Unit	Port	Panel No./Feed Location
Left Wing	1	680-886 / Center (Outboard)
	2	680-876 / Outboard
	3 & 6	Blank
	4	680-886 / Center (Inboard)
	5	680-875 / Inboard
	7	690-929 / Stall Strip
Right Wing	1	680-877 / Inboard
	2	Blank
	3 & 6	Blank
	4	680-878 / Outboard (Inboard)
	5	680-878 / Outboard (Outboard)
	7	690-929 / Stall Strip
Tail	1	Blank
	2 (Aft)	680-884 / Right Stabilator
	3 (Fwd)	680-883 / Left Stabilator
Propeller	1	Slinger Ring

(b) Removal

1 Wing unit

The wing units are outboard the rib at W. S. 140.090 and just forward of the rear spar. Access is via the adjacent access plates on the underside of the wing.

a Drain TKS system. See Draining, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

b Remove wing access plates inboard and outboard of W. S. 140.090.

c Via the outboard access: disconnect four (4) (right wing) or five (5) (left wing) nylon feed tubes from the outlet ports.

NOTE: Refer to Figure 13 to identify outlet Port 1 and label each feed tube with its corresponding port number as it is disconnected. Outlet ports are numbered clockwise from Port 1.

d Via the inboard access: disconnect the nylon supply tubing from the inlet port.

e Via the outboard access: loosen and remove two (2) bolts, washers, and spacers.

f Remove proportioning unit.

2 Tail unit

The tail unit is aft of the cabin rear closeout panel (i.e. - aft of the bulkhead at F. S. 187.837).

a Drain TKS system. See Draining, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

b Remove cabin rear closeout panel.

c Disconnect two (2) nylon feed tubes from the outlet ports.

NOTE: Refer to Figure 13 to identify the outlet ports and label each feed tube with its corresponding port number as it is disconnected.

d Disconnect the nylon supply tubing from the inlet port.

e Loosen and remove two (2) screws, lockwashers, and washers.

f Remove proportioning unit.

3 Propeller unit

The propeller unit is clamped to a fuel line aft of the firewall and under the forward baggage compartment floor. It is on the left side, near F.S. 41.45. (See Figure 13.)

a Drain TKS system. See Draining, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

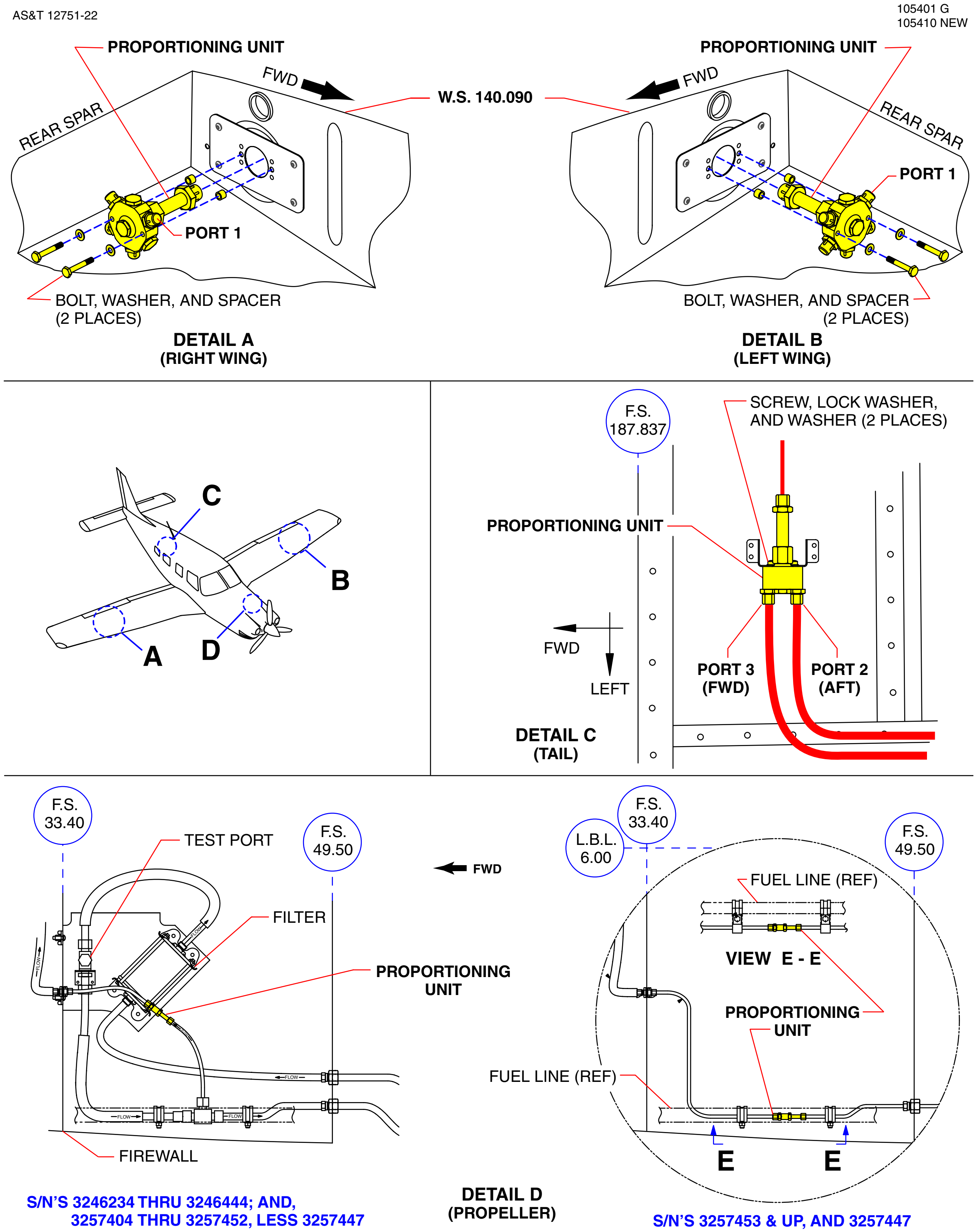
b Remove forward baggage compartment floor.

c Disconnect nylon feed tubing from the outlet port.

d Disconnect the nylon supply tubing from the inlet port.

e Loosen and remove bolt, washer, and nut from clamp.

f Remove proportioning unit.



TKS Proportioning Unit Installation
Figure 13

(c) Installation

1 Wing unit

The wing units are outboard the rib at W. S. 140.090 and just forward of the rear spar. Access is via the adjacent access plates on the underside of the wing.

a Place proportioning unit in position and secure with two (2) bolts, washers, and spacers.

b Via the inboard access: connect the nylon supply tubing to the inlet port.

c Via the outboard access: connect four (4) (right wing) or five (5) (left wing) nylon feed tubes to the appropriate outlet ports as marked on each tube during removal.

d Refill TKS system. See Filling, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

e Prime pump. See Pump Priming, Inadvertent Ice Protection System, 12-10-00.

f Perform 50 Hour Inspection, above. Check for leaks while pump is running.

g Reinstall wing access plates inboard and outboard of W. S. 140.090.

2 Tail unit

The tail unit is aft of the cabin rear closeout panel (i.e. - aft of the bulkhead at F. S. 187.837).

a Place proportioning unit in position and secure with two (2) screws, lockwashers, and washers.

b Connect the nylon supply tubing to the inlet port.

c Connect the two (2) nylon feed tubes to the appropriate outlet ports as marked on each tube during removal.

d Refill TKS system. See Filling, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

e Prime pump. See Pump Priming, Inadvertent Ice Protection System, 12-10-00.

f Perform 50 Hour Inspection, above. Check for leaks while pump is running.

g Replace and secure cabin rear closeout panel.

3 Propeller unit

The propeller unit is clamped to a fuel line aft of the firewall and under the forward baggage compartment floor. It is on the left side, near F.S. 41.45. (See Figure 13.)

a Place proportioning unit in position at clamp.

b Secure with bolt, washer, and nut.

c Connect the nylon supply tubing to the inlet port.

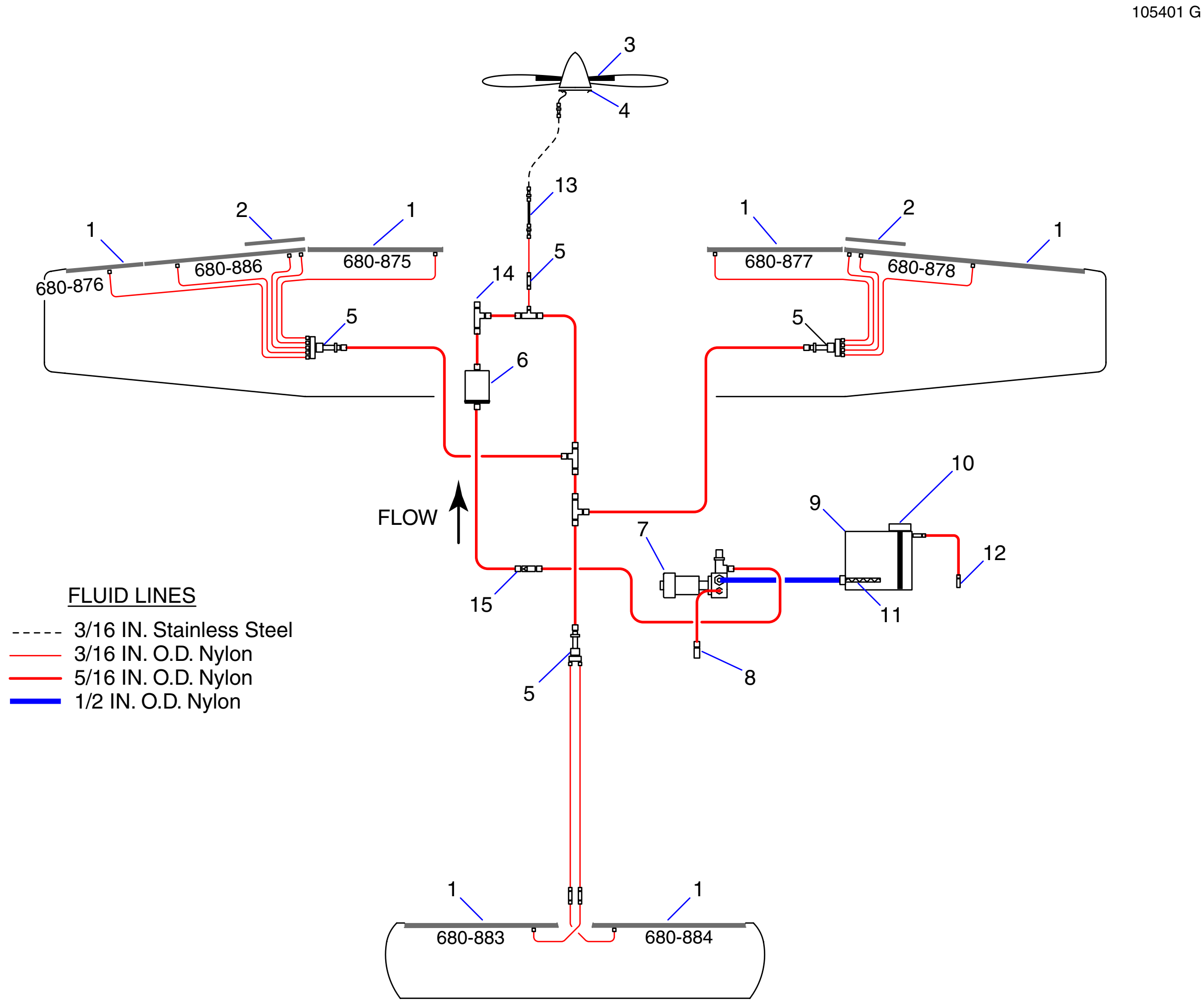
d Connect nylon feed tubing to the outlet port.

e Refill TKS system. See Filling, Deicing Fluid Tank, Inadvertent Ice Protection System, 12-10-00.

f Prime pump. See Pump Priming, Inadvertent Ice Protection System, 12-10-00.

g Perform 50 Hour Inspection, above. Check for leaks while pump is running.

h Reinstall forward baggage compartment floor.



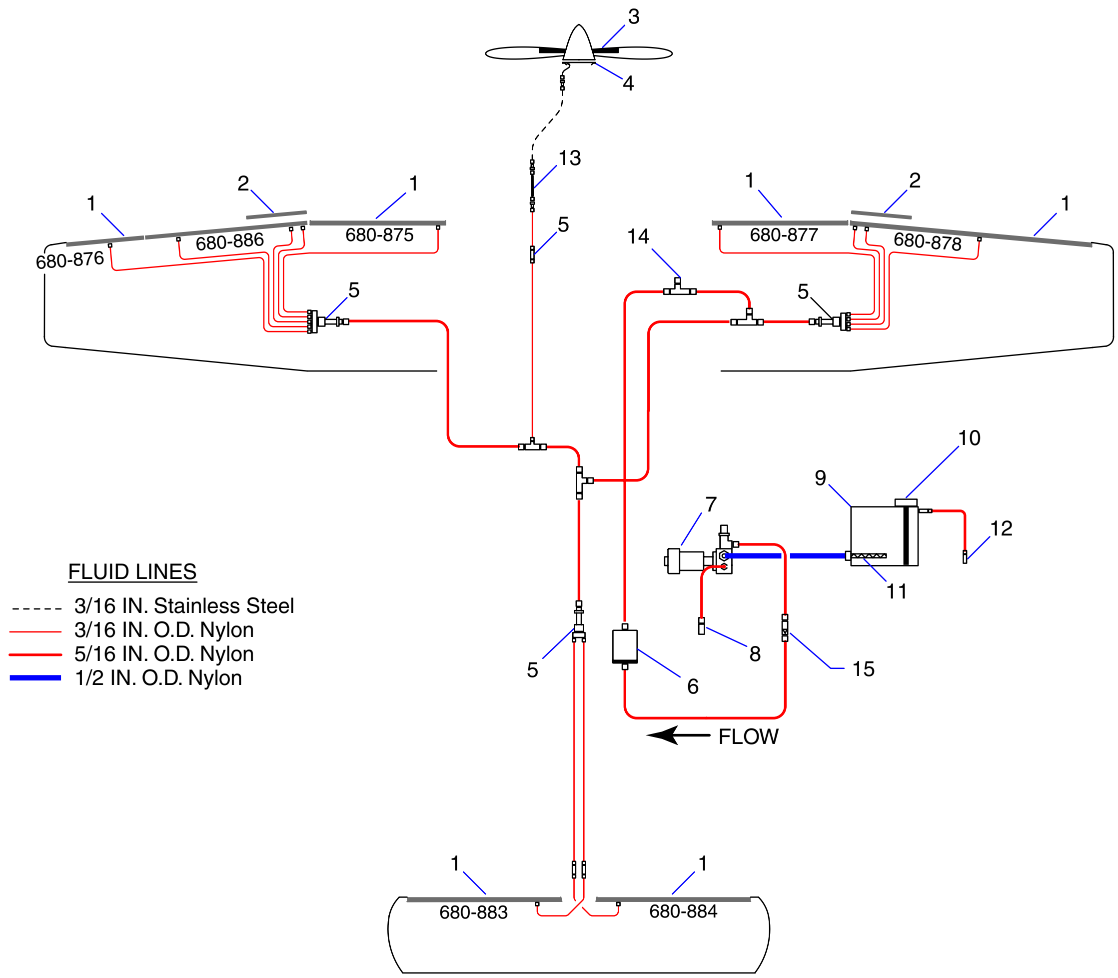
1. POROUS PANEL
2. STALL STRIP (P/N 690-929)
3. PROPELLER BOOT
4. PROPELLER SLINGER
5. PROPORTIONING UNIT
6. SYSTEM FILTER
7. FLUID PUMP
8. SYSTEM DRAIN
9. FLUID TANK
10. FLUID QUANTITY SENDER
11. STRAINER
12. FLUID TANK VENT
13. FLEXIBLE HOSE
14. TEST PORT
15. CHECK VALVE

Note: Part numbers shown are reference only. See Parts Catalog before ordering.

Effectivity
3246234 thru 3246244;
and, 3257404 thru 3257452,
less 3257447

TKS Fluid Schematic
Figure 14 (Sheet 1 of 2)

105410 NEW



1. POROUS PANEL
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12. FLUID TANK VENT
13. FLEXIBLE HOSE
14. TEST PORT
15. CHECK VALVE

Note: Part numbers shown are reference only. See Parts Catalog before ordering.

TKS Fluid Schematic
Figure 14 (Sheet 2 of 2)

Effectivity
3257453 and up,
and 3257447

(9) Tubing

A system of nylon and stainless steel tubing distributes the deice fluid from the fluid tank to proportioning units (supply tubing). And from the proportioning units to the porous panels and propeller blades (feed tubing). See Figure 14.

(a) Troubleshooting

See Chart 7.

(b) Inspection

See Inspection, Nylon Tubing Couplings, 20-00-00.

(c) Removal and Installation

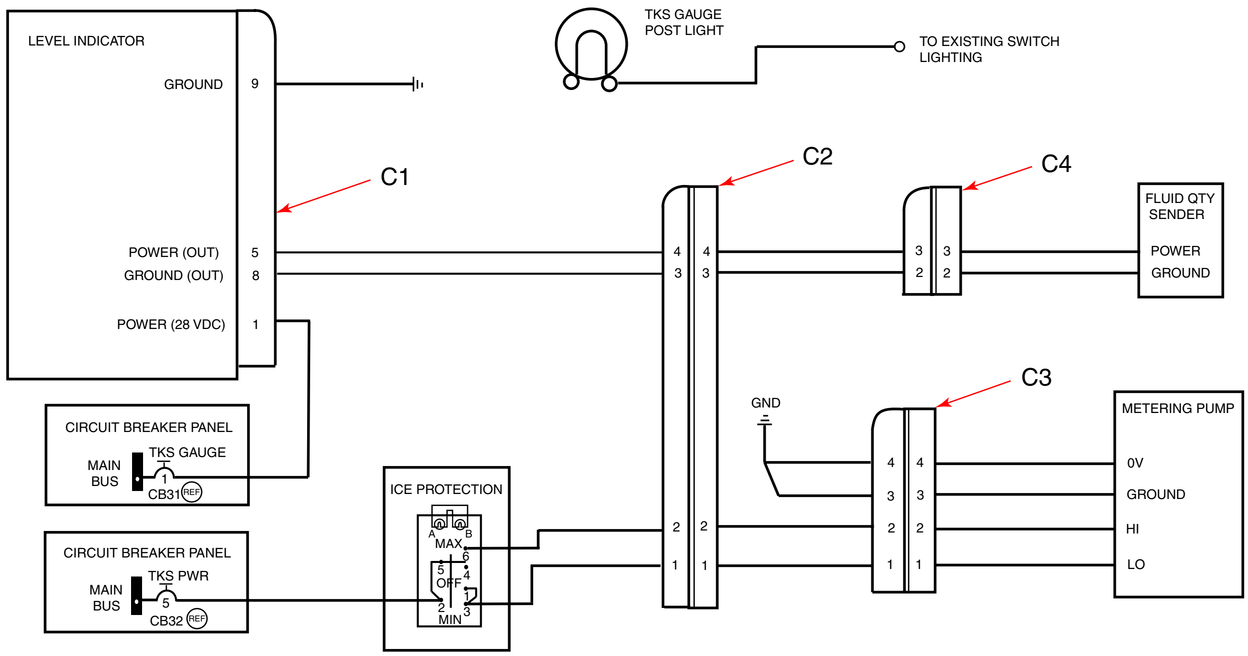
See Nylon Tubing Couplings, 20-00-00.

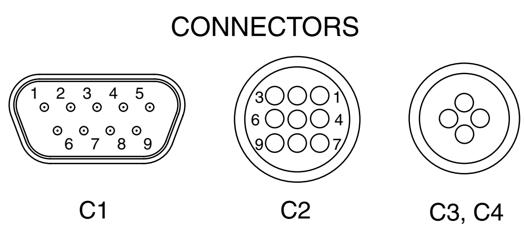
G. Electrical

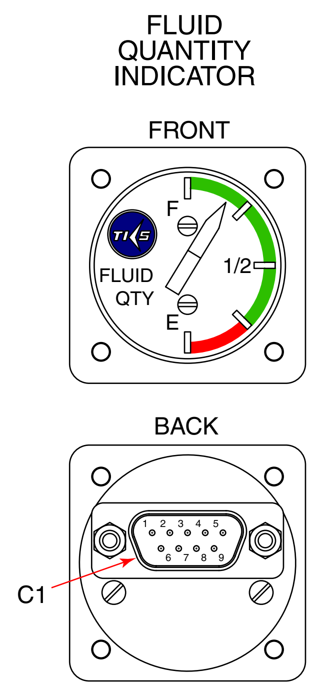
See Figure 15.

CHART 7
TROUBLESHOOTING TKS TUBING

Trouble	Cause	Remedy
Loose olive.	Insufficient clenching torque applied.	Apply additional tightening action.
	Clenching tool or coupling body worn.	Renew clenching tool or coupling body and reclench olive.
Distorted olive.	Overtightening during clenching operation.	Discard tubing with distorted olives, remake joints with new components using less torque.
Leakage from coupling joint.	Sealing damaged, omitted or incorrectly fitted.	Reassemble joint as detailed in 20-00-00.
	Olive loose, damaged or incorrectly fitted.	Renew olive and tubing as necessary.
	Coupling body worn or damaged.	Renew coupling body as necessary.
	Coupling nut loose.	Tighten coupling nut as detailed in 20-00-00.







Electrical Load Schedule

Component	Type of Load	Current - Ampere		Power Watts (Nominal)
		Normal Operating	Starting Peak	
Metering Pump	D.C. Motor MAX NORM	1.5 1.3	12 approx 12 approx	42 36
Fluid Quantity Indicator	Resistive	0.1	-	2.8
Fluid Qty Indicator E.L. Light	Lamp	.01	-	.28

TKS Electrical Schematic
Figure 15

**GRIDS 4D22 THRU 4D24
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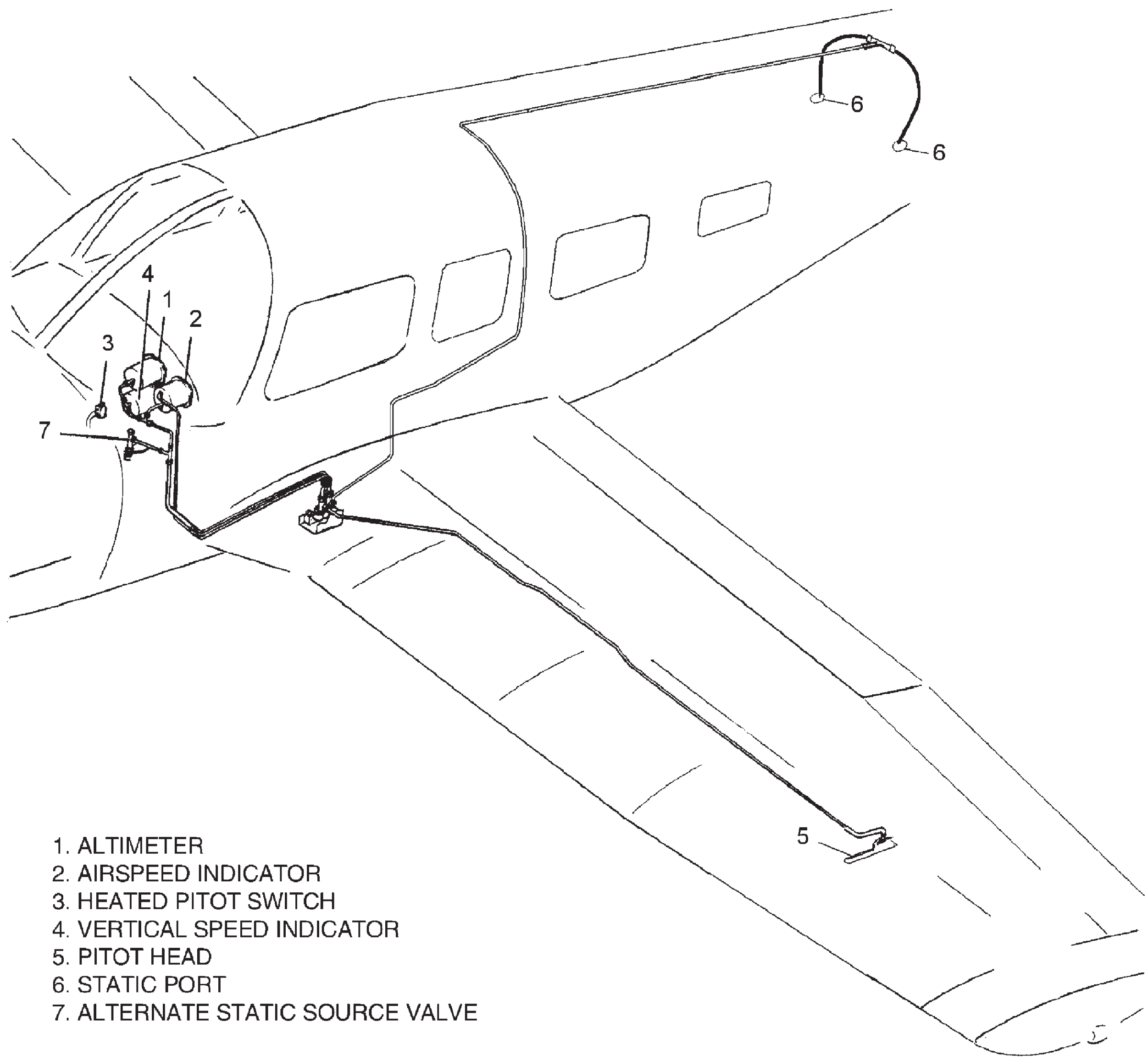
PITOT AND STATIC

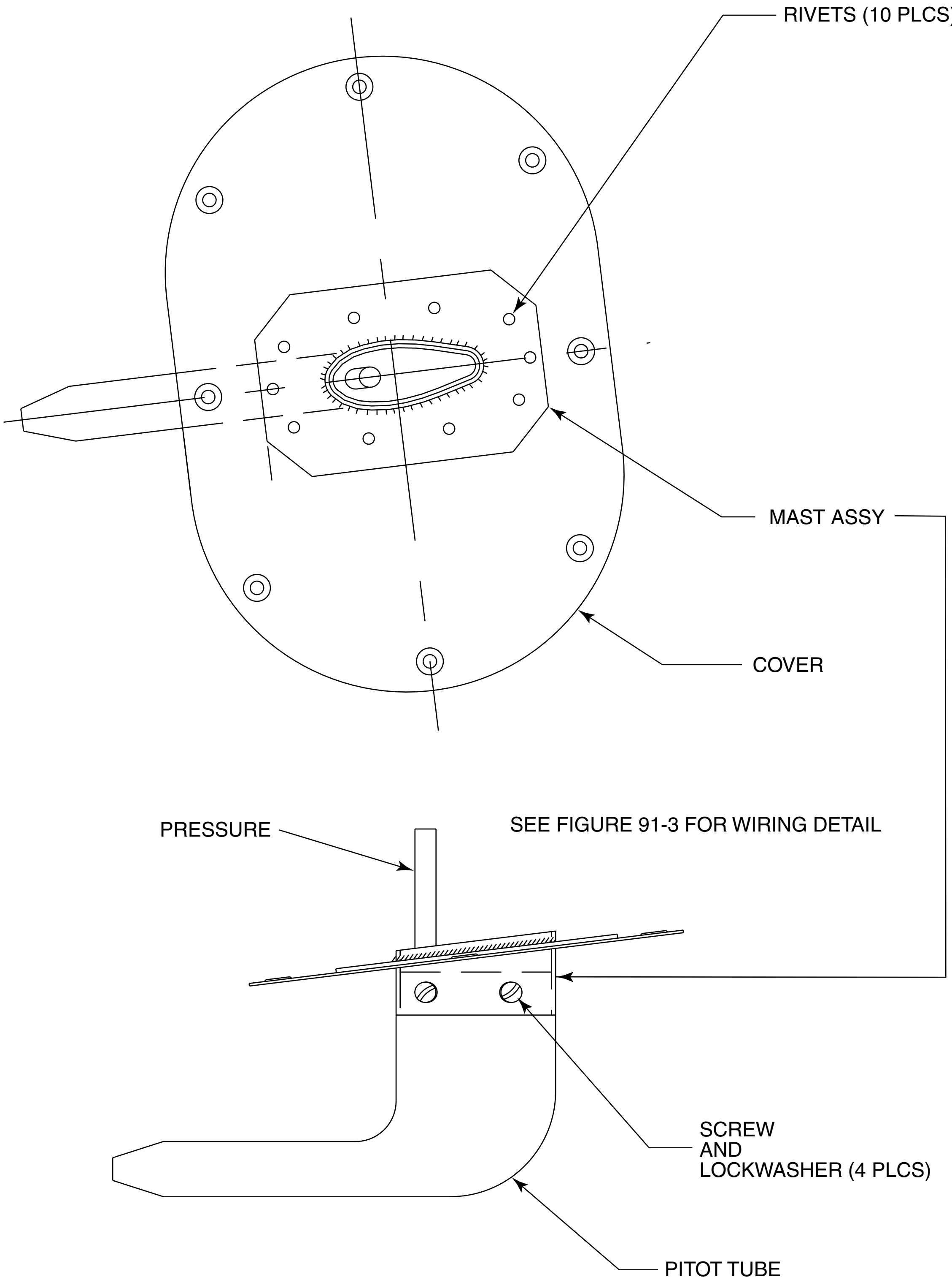
The heated pitot-static mast installed in these airplanes is controlled by a single switch in the center of the instrument panel.

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.



Pitot Static System Installation
Figure 1 (Sheet 1 of 3)

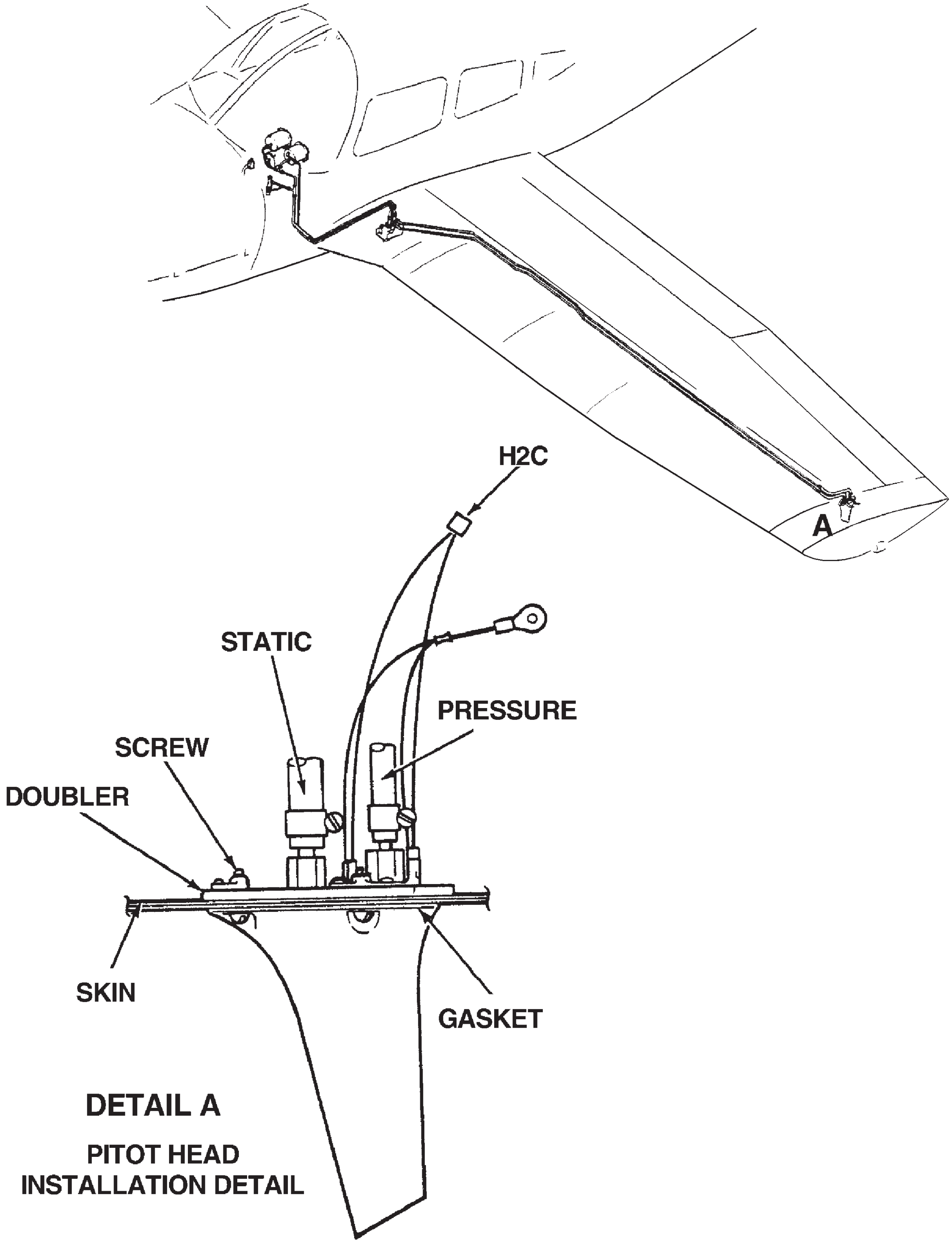
Effectivity
HP S/N's 3246018 & up
TC S/N's 3257001 & up



DETAIL - 5

Effectivity
HP S/N's 3246018 & up
TC S/N's 3257001 & up

Pitot Static System Installation
Figure 1 (Sheet 2 of 3)



Pitot Static System Installation
Figure 1 (Sheet 3 of 3)

Effectivity
HP S/N's 3246001 thru
3246017 only

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PROPELLER

Inadvertent Ice Protection System (TKS) (Optional)

WARNING: INTENTIONAL FLIGHT INTO KNOWN ICING IS PROHIBITED. NO DETERMINATION HAS BEEN MADE AS TO THE CAPABILITY OF THIS SYSTEM TO REMOVE OR PREVENT ICE ACCUMULATION.

The optional Inadvertent Ice Protection System (TKS) is a “weeping wings” system which pumps a glycol-based deicing fluid out the wing and stabilator leading edges and along the propeller blades to reduce ice formation and adherence. This is intended to allow a pilot inadvertently encountering icing conditions additional time to find non-icing conditions safely.

A. Description

(1) General

The TKS system consists of laser-drilled titanium porous panels attached to the leading edges of the wings and stabilator. Grooved rubber boots are attached to the inner leading edge of each propeller blade. Nylon and stainless steel tubing feed these panels and boots from a deice fluid tank mounted in the right wing. A two-speed pump and four proportioning units meter the fluid flow. A micro-filter ensures contaminants are removed from the deice fluid and not allowed to clog the porous panels. A deice fluid quantity indicator and a control switch are mounted in the instrument panel.

See 30-10-00 for details of the fluid storage and distribution system.

(2) Propeller

The feed to the propeller consists of nylon tubing from the system filter to the proportioning unit and then to the firewall. A flexible hose runs from the firewall to the rear engine baffle and stainless steel tubing is used from the rear engine baffle to the front of the engine. There a nozzle is fitted to direct fluid into the slinger ring which is attached to the spinner backplate. The slinger ring has three outlets which feed fluid through a tube to the root of each propeller blade. Grooved rubber boots attached to the inner leading edge of each propeller blade aid the even distribution of deicing fluid over the propeller blades.

B. Troubleshooting

See Chart 1, 30-10-00.

C. Components

(1) Slinger Ring (See Figure 1.)

The slinger ring is mounted on the aft side of the spinner bulkhead. Deice fluid is caught in the inner lip of the slinger ring and routed through the slinger ring and spinner bulkhead to a stainless steel feed tube mounted at the root of each propeller blade via three hollow feed bolts.

(a) Removal

1 Remove propeller per 61-10-00.

2 Loosen the propeller blade feed tube connector nut at each of the three slinger ring feed bolts.

3 Cut safetywire at each of the three slinger ring feed bolts.

4 Remove three (3) feed bolts, bonded seals, O-rings, spacers, washers, and nuts; and remove slinger ring.

(b) Installation

1 Install spinner bulkhead, if not already.

2 Assemble three (3) feed bolts, bonded seals, O-rings, and spacers on slinger ring and position slinger ring on spinner bulkhead.

3 Secure feed bolts with washers and nuts; and tighten.

4 Safetywire feed bolt nuts to adjacent safetywire screws.

5 Connect each of the three (3) feed tube nuts to the corresponding slinger ring feed bolt and tighten.

6 Install propeller per 61-10-00.

(2) Propeller Blade Feed Tubes (See Figure 1.)

A stainless steel feed tube mounted at the root of each propeller blade routes deice fluid from the slinger ring feed bolt to the grooved rubber boot on the blade.

(a) Removal

1 Loosen the connector nut at the slinger ring feed bolt.

2 Loosen the propeller hub bolt securing the P-clip and slide the feed tube inboard until the tube end clears the P-clip.

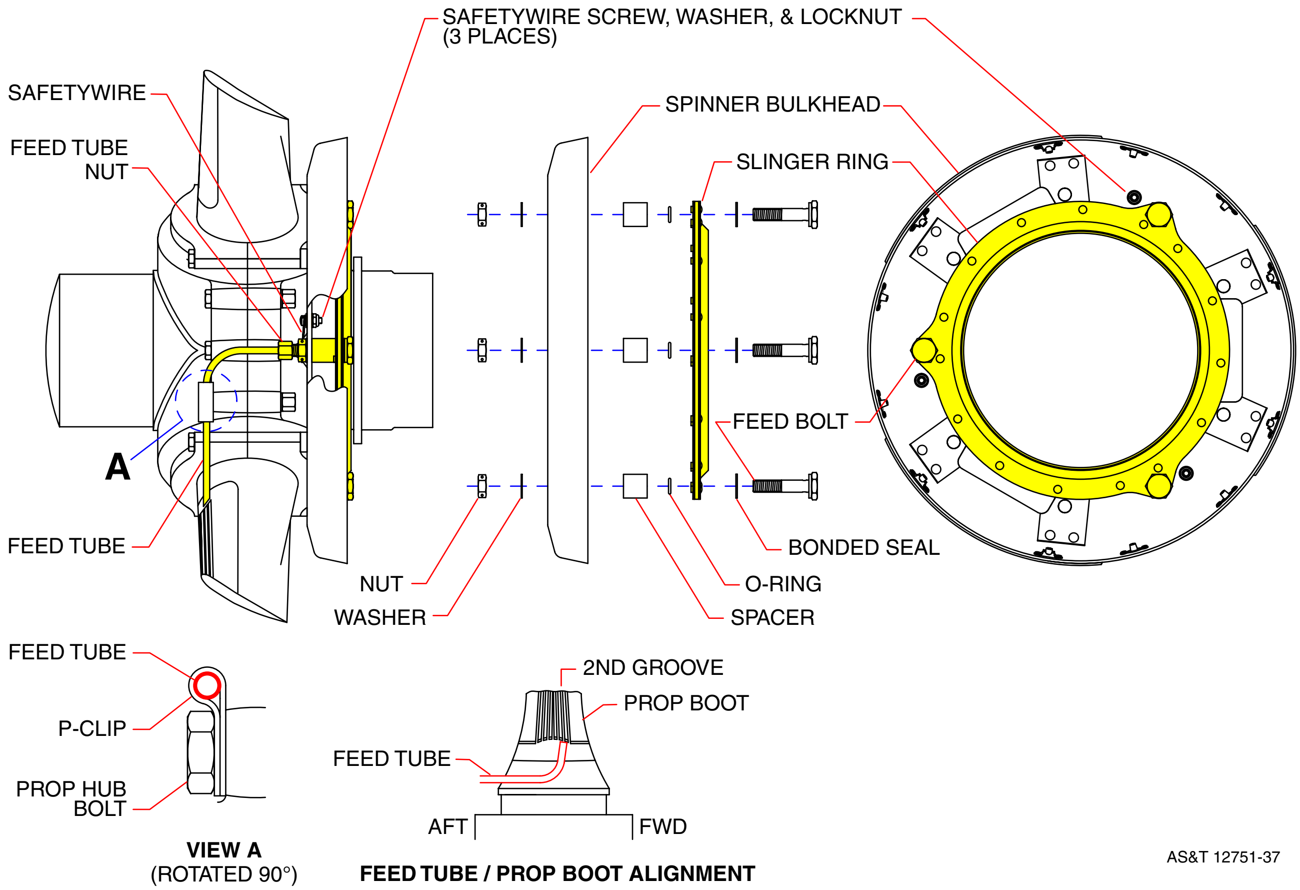
(b) Installation

1 Insert the outlet end of the feed tube into the inboard side of the P-clip and slide the feed tube outboard until the inlet tube end aligns with the slinger ring feed bolt.

2 Connect the feed tube nut to the slinger ring feed bolt and tighten.

3 If not already, set the propeller fully in fine pitch.

4 Position the outlet end of the feed tube approximately .25 inch above the second groove (from forward edge) of the propeller boot and tighten propeller hub bolt to hold P-clip and feed tube in that position.



TKS Propeller Installation
Figure 1

(3) Grooved Rubber Boots

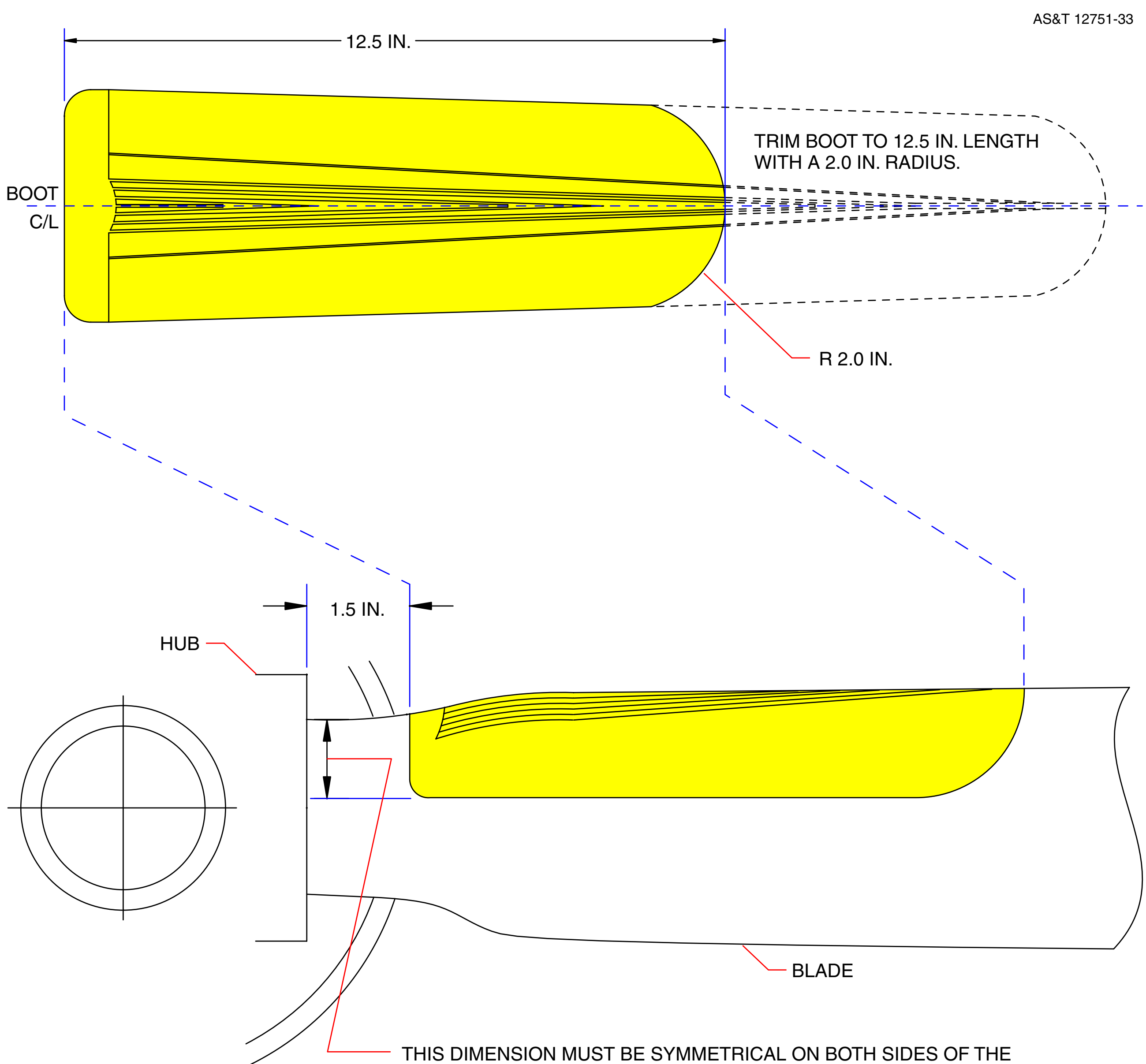
Grooved rubber boots are attached to the inner leading edge of each propeller blade to aid the even distribution of deicing fluid over the propeller blades.

(a) Removal

See Hartzell Manual No. 133C, Revision 17 or later.

(b) Installation

Trim and locate the new boot as shown in Figure 2. Install per Hartzell Manual No. 133C, Revision 17 or later.



TKS Propeller Boot Trimming and Alignment
Figure 2

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CHAPTER

31

INDICATING / RECORDING SYSTEMS

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CHAPTER 31

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CHAPTER 31 - INDICATING / RECORDING SYSTEMS

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CENTRAL WARNING SYSTEMS

1. Description and Operation

A. Standard and Avidyne Entegra EFIS-equipped

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. Garmin 1000 EFIS-equipped

Annunciation in airplanes equipped with Garmin 1000 EFIS is integrated into the PFD with the exception of landing gear warning. See Chart 2 for an explanation of the Garmin 1000 annunciation and alerts.

Landing gear warning is provided by a single red GEAR WARN annunciator light on the instrument panel above the landing gear selector and the three landing gear green lights. It functions the same as the standard and Avidyne EFIS-equipped GEAR WARN annunciator.

2. Troubleshooting

See Chart 1 for standard and Avidyne EFIS-equipped airplanes. See Chart 2 for Garmin 1000 EFIS-equipped airplanes. 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 1
TROUBLESHOOTING ANNUNCIATOR (Sheet 1 of 4)

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 annunciator panel.
All the warning lights fail to extinguish after engine is running	Test switch grounded out.	Check terminals and replace switch if necessary.
OIL 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.
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.

CHART 1
TROUBLESHOOTING ANNUNCIATOR (Sheet 2 of 4)

Trouble	Cause	Remedy
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.
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.
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.

CHART 1
TROUBLESHOOTING ANNUNCIATOR (Sheet 3 of 4)

Trouble	Cause	Remedy
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.
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. and connections.	Check all wire segments
	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.

CHART 1
TROUBLESHOOTING ANNUNCIATOR (Sheet 4 of 4)

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.

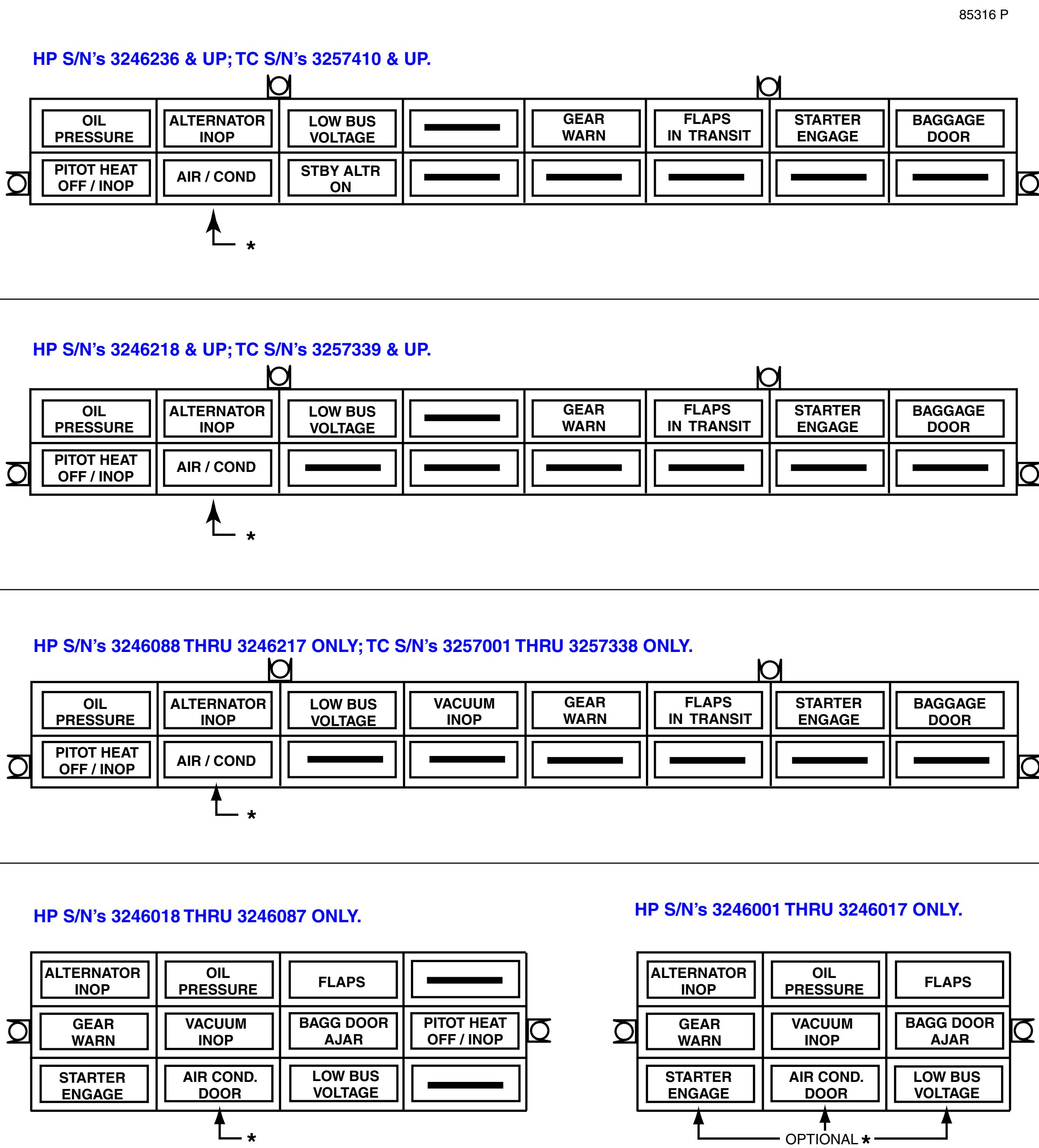
3. Annunciator Panel - Standard and Avidyne Entegra EFIS-equipped only (See Figure 1.)

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 circuit breaker. The annunciator lights function as follows:

AIR/COND - AIR COND. DOOR (optional)	Illuminates when air conditioner door is not properly closed.
ALTERNATOR INOP	On 14-volt systems (HP S/N's 3246001 thru 3246017 only) the 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 warning light comes from the alternator winding through a fuse to an alternator out switch which controls the annunciator light.
BAGGAGE DOOR / BAGG DOOR AJAR	Illuminates when baggage door is not properly closed
FLAPS IN TRANSIT / FLAPS	Illuminates whenever a new flap position is selected and remains on while the flaps are moving.

GEAR WARN	Illuminates whenever: A. Power is reduced below approximately 14 inches of manifold pressure with the landing gear up. B. Gear selector switch is in UP position while airplane is on ground with weight on wheels C. Flaps are extended beyond approach position (10°) and landing gear is retracted.
LOW BUS VOLTAGE	Illuminates to indicate low voltage supply to the bus.
OIL PRESSURE	Illuminates when oil pressure is below 35 psi. The warning light is controlled by an oil pressure switch in oil line, located at bulkhead.
PITOT HEAT OFF/INOP (S/N's in Figure 1)	Illuminates when pitot heat fails or is selected off.
STARTER ENGAGE	Illuminates to indicate when the starter is engaged.
STBY ALTR ON (S/N's in Figure 1)	If the primary alternator fails in flight, the standby regulator will sense the drop in system voltage and automatically activate the standby alternator. If the current requirement is over 20 amps when the standby alternator is activated, the STBY ALT ON annunciator light will flash. Reducing the current usage to 20 amps or less will cause the annunciator light to cease flashing and light steadily.
VACUUM INOP	Illuminates when differential pressure is below 3.5 in. hg. The warning light is controlled by a vacuum sensor switch located at bulkhead and is attached to vacuum regulator.

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.



* INDICATES OPTIONAL LIGHT POSITIONS.
POSITIONS NOT USED ARE REPLACED WITH GREEN CAP WITH BLACK BAR.

Annunciator Panel
Figure 1

CHART 2 (Sheet 1 of 6)
TROUBLESHOOTING GARMIN 1000 ANNUNCIATION

Annunciation Window (Color)	Alert Message	Solution
ALTNTR INOP (Red)	No output from alternator.	Ensure that ALTNR FIELD circuit breaker is closed and engine is running. Ensure that the ALTERNATOR SWITCH is ON. Ensure that the EMER BATT SWITCH is OFF. Check the fuse between the alternator and the ALT OUT SWITCH. Check wiring between ALT OUT SWITCH and the GEA 71. Troubleshoot alternator and aircraft electrical system per 24-30-00.
STARTER ENGD (Red)	Starter is engaged.	Start engine and turn engine off to see if the annunciation extinguishes. Check the fuse between the starter contactor and the GEA 71. Check wiring between the starter contactor and the GEA 71. Troubleshoot starter system per 81-10-00.
ESS BUS LOW (Red)	Essential bus voltage is less than 24.5V.	Start engine to engage alternator. Ensure that ALTNR FIELD circuit breaker is closed. Check for ALTNTR INOP annunciation. Check ALT LOAD gauge to verify that alternator is outputting current. Replace voltage regulator.

CHART 2 (Sheet 2 of 6)
TROUBLESHOOTING GARMIN 1000 ANNUNCIATION

Annunciation Window	Alert Message	Solution
EMER BATT LOW (Red)	Emergency battery voltage is less than 24V. or Emergency battery state of charge is less than 75%.	Ensure that the emergency battery is fully charged (refer to Concorde Owner / Operator manual). Ensure that EMER BAT circuit breaker is closed. Plug in Ground Power Unit or start engine to engage alternator. Ensure that ALTNR FIELD circuit breaker is closed. Check for ALTNTR INOP annunciation. Check ALT LOAD gauge to verify that alternator is outputting current. Ensure that the EMER BATT switch is in the ‘Off’ position. If the EMER BAT voltage is shown as zero, check the EMER BAT VOLT fuse. Check the wiring between the emergency battery and the GEA 71. Check wiring between the emergency battery and the GEA 71.
NO STBY ALT (Red)	No output from standby alternator.	Ensure that the STBY ALTNR circuit breaker is closed. Ensure that the STBY ALTR SWITCH is ON. Check the fuses connecting the standby alternator shunt to the GEA. Check wiring between the standby alternator shunt and the GEA. Check wiring between the standby alternator and the Essential Bus.

CHART 2 (Sheet 3 of 6)
TROUBLESHOOTING GARMIN 1000 ANNUNCIATION

Annunciation Window	Alert Message	Solution
NO STBY ALT (Red) (cont.)	No output from standby alternator. (cont.)	Troubleshoot the voltage regulator and standby alternator per 24-30-00.
OIL PRES LOW (Red)	Oil pressure is below 25 psi.	Check aircraft oil level. Sometimes caused by high temperatures and low engine RPM. Raise engine RPM above idle to see if oil pressure increases. Troubleshoot oil pressure sensor for proper operation. See also 79-30-00. If oil pressure sensor is OK, troubleshoot engine oil system.
OIL PRES HI (Red)	Oil pressure is above 115 psi.	Check to see if the oil pressure drops as the engine oil warms up. Troubleshoot oil pressure sensor for proper operation. If the oil pressure remains high, troubleshoot engine oil system.
BAGGAGE DOOR (Yellow)	Baggage door is open.	Close baggage door. If annunciation does not extinguish, check door switch for proper operation. Check wiring between baggage door switch and GEA 71.
AIR COND DR (Yellow)	Air conditioning door is open.	Ensure that the A/C-AIR BLOWER circuit breaker is closed. Ensure that the EMER BATT switch is in the 'Off' position. Close air conditioning door. If annunciation does not extinguish, check door switches for proper operation. Check wiring between the switches and the GEA 71.

CHART 2 (Sheet 4 of 6)
TROUBLESHOOTING GARMIN 1000 ANNUNCIATION

Annunciation Window	Alert Message	Solution
EMER BAT NC (Yellow)	The emergency battery is not charging.	Plug in Ground Power Unit or start engine to engage alternator. The voltage of the GPU or the alternator needs to be at least 27 V. Check to see that EMER BAT circuit breaker is closed. Ensure that ALTNR FIELD circuit breaker is closed. Check for ALTNTR INOP annunciation. Check ALT LOAD gauge to verify that alternator is outputting current. Check to see that the EMER BATT switch is in the 'Off' position. Check wiring between the circuit breaker panel and the emergency battery.
PITOT FAIL (Yellow)	Pitot heat is inoperative.	Ensure that PITOT HEAT circuit breaker is closed. Cycle pitot heat switch to see if the annunciation extinguishes. Check both of the discrete inputs to the GEA 71 and the associated wiring. Troubleshoot pitot heat system.
PITOT OFF (Yellow)	Pitot heat is off.	Turn on pitot heat. Ensure that PITOT HEAT circuit breaker is closed. Carefully feel the pitot tube to see if it is warm. Check both of the discrete inputs to the GEA 71 and the associated wiring. Troubleshoot pitot heat system.

CHART 2 (Sheet 5 of 6)
TROUBLESHOOTING GARMIN 1000 ANNUNCIATION

Annunciation Window	Alert Message	Solution
FLAPS (Yellow)	Flap position and flap setting do not agree.	Ensure that the FLAP MOTOR circuit breaker is closed. Move flaps. Check the wiring between the flap relays and the GEA 71. Troubleshoot flap system.
SHED LOAD (Yellow)	Shed electrical load.	The SHED LOAD annunciation is only active when the main alternator is offline, causing the standby alternator to supply more than 20 amps. Troubleshoot the loss of the main alternator per the instructions for the ALTNTR INOP warning, above. Shed non-essential loads by turning OFF switches or opening circuit breakers.
NOTE: The SHED LOAD annunciation begins as a white advisory message, see below, then after five (5) minutes it transitions to a CAUTION alert.		
None	DISPLAY FAN – The cooling fan for the display is inoperative.	This advisory applies to both the PFD and MFD fan. Ensure that the AVIONICS COOLING circuit breaker is closed. Check cooling fan wiring. Replace cooling fan.
None	AVIONICS FAN – The cooling fan for the remote avionics is inop.	Ensure that the AVIONICS COOLING circuit breaker is closed. Check cooling fan wiring. Replace cooling fan.

CHART 2 (Sheet 6 of 6)
TROUBLESHOOTING GARMIN 1000 ANNUNCIATION

Annunciation Window	Alert Message	Solution
None	STBY ALT ON - Standby alternator is ON.	Normal when main alternator is offline. If this message is present at other times, check the voltage regulator setting for the main alternator and the standby alternator. The standby alternator voltage should be set to 27.0 VDC.
None	SHED LOAD - Shed electrical load.	The SHED LOAD annunciation is only active when the main alternator is offline, causing the standby alternator to supply more than 20 amps. Troubleshoot the loss of the main alternator per the instructions for the ALTNTR INOP warning, above. Shed non-essential loads by turning OFF switches or opening circuit breakers.
NOTE: The SHED LOAD annunciation begins as a white advisory message, then after 5 minutes it transitions to a CAUTION alert.		
None	Air COND DR - Air conditioning	Normal when the air conditioning door is open. Ensure that the A/C-AIR BLOWER circuit breaker is closed. If annunciation does not extinguish when the door is closed, check the K3 logic relay for proper operation. Measure the voltage at pin 66 of P701. 28 VDC should be present when the air conditioning door is open, and zero volts (open) should be measured at the pin when the air conditioning door is closed.

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CHAPTER

32

LANDING GEAR

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CHAPTER 32

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CHAPTER 32 - LANDING GEAR

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CHAPTER 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.

1. Description and Operation

The Saratoga II HP and Saratoga II TC airplanes are equipped with retractable tricycle air-oil strut type landing gear that are hydraulically raised and lowered by an electrically powered reversible pump. A selector handle on the instrument panel to the left of the control quadrant is used to select the gear UP or DOWN position.

When the gear is down and locked, gear positions are indicated by three lighted green lights located above the selector lever. When the gear is unsafe, a red warning light on the instrument panel illuminates (in the annunciator panel except for Garmin G1000 equipped airplane where it is directly above the three green gear lights). There are no indications that the landing gear has fully retracted other than all lights are out. When all three down lock switches are activated the hydraulic pump shuts off. The green lights and the red warning light that indicate the gear is unsafe are dimmed when the DAY – NIGHT toggle switch is in the NIGHT position.

As the landing gear begins to extend, the up limit switches will again move to their NC position. The down limit switches are already in their NC position. Accordingly, the unsafe light will illuminate and gear warning horn will sound until the downlock hooks engage, moving the down limit switches to their normally open (NO) position. The engagement of all three downlock switches will shut off the hydraulic pump.

When the gear begins to retract and the downlock hooks disengage, each down limit switch actuates to the normally closed (NC) position and is in series with the NC circuit of the up limit switch engaging the gear unsafe light. The gear unsafe light remains on until the gear is up and all up limit switches are actuated to their NO position.

If power drops below approximately 14 inches of manifold pressure and the landing gear has not reached the down and locked position, the warning horn is activated. The warning horn will continue to sound until the landing gear is down and locked, at which time the three green lights will illuminate. This circuit is controlled by three paralleling down limit switches connected in series with the throttle switch.

The red warning light and horn will warn if the gear selector handle is UP when the airplane is on the ground. In addition, the gear warning light and warning horn will activate when the flaps are extended more than 10 degrees if the landing gear is not down and locked. A microswitch 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 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 schematics.)

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.

If the gear fails to extend when the gear selector switch is DOWN, an emergency gear extension (i.e., free fall) valve allows the landing gear to extend. The valve is operated with a push pull cable knob which is just below the primary gear selector switch on the instrument panel. The valve itself is located under the floorboard on the left side of the forward baggage compartment.

To help the nose gear 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 downlock hooks engage, a spring maintains each hook in a locked position until hydraulic pressure releases it. See Chapter 29 for a further description of the hydraulic system.

The nose gear is steerable through a 45-degree arc by use of the rudder pedals. Nose gear steering/ alignment is controlled by a bellcrank which bears on the steering arm when the gear is extended. 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 the pilot and copilot 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.

2. Troubleshooting

Mechanical and electrical switch troubles peculiar to the landing gear system are listed in Chart 1. When troubleshooting, first eliminate hydraulic malfunctions as listed in 29-00-00 Chart 3. 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 1 (Sheet 1 of 4)
TROUBLESHOOTING LANDING GEAR

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.
Red GEAR WARN annunciator light on though gear has retracted.	One or more limit switches failed. *	Isolate and replace switch(es).
	Nose gear up limit switch out of adjustment. *	Check gear up adjustment and readjust up limit switch.
	Main gear not retracting enough to actuate switch.	Check gear up adjustment.
Red GEAR WARN annunciator on though gear is down and locked.	One or more down limit switches failed. *	Isolate and replace switch(es).
	Nose gear down limit switch out of adjustment. *	Readjust down limit switch.
	Main gear down limit switch out of adjustment. *	Readjust down limit switch.
Red GEAR WARN annunciator light operates on and off after gear has retracted.	Light circuit wire loose.	Check wiring.
	Hydraulic system losing pressure.	Refer to Hydraulic System, Chapter 29.
	Gear up switch out of adjustment. *	Check gear up adjustment and then switch adjustment.
Red GEAR WARN annunciator and one green gear down light out though gear is down and locked.	Lamp burned out.	Replace lamp.
	Gear down limit switch failed. *	Replace switch.
	Light circuit wire broken.	Check wiring.
* The out of adjustment or failed switch may be determined by noting which down light is not lit.		
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.

CHART 1 (Sheet 2 of 4)
TROUBLESHOOTING LANDING GEAR

Trouble	Cause	Remedy
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.
	Microswitch “A” at throttle out of adjustment.	Adjust microswitch “A”
	Microswitch “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.
Hydraulic pump shuts off after gear retraction, but Red GEAR WARN annunciator remains on.	Gear not fully retracted.	Check gear retraction adjustments.
	Gear not contacting up micro switches.	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.
Green gear down lights blink momentarily before the down lock is engaged on roller.	Microswitch out of adjustment.	Adjust microswitch.

CHART 1 (Sheet 3 of 4)
TROUBLESHOOTING LANDING GEAR

Trouble	Cause	Remedy
Nose landing gear shimmies during fast taxi, take-off or landing.	Internal wear in shimmy dampener.	Replace shimmy dampener.
	Shimmy dampener or bracket loose at mounting.	Replace necessary parts and bolts.
	Tire out of balance.	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.
Excessive or uneven wear on nose tire.	Incorrect operating pressure.	Inflate tire to correct pressure.
	Wear resulting from shimmy.	Refer to preceding for correction; then replace tire.
Nose gear fails to steer properly.	Oleo cylinder bindings in strut housing.	Lubricate strut housing (see Lubrication Chart, 12-20-00).
		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.

CHART 1 (Sheet 4 of 4)
TROUBLESHOOTING LANDING GEAR

Trouble	Cause	Remedy
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.
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

1. Main Gear Oleo

A. Disassembly (See Figure 1.)

The main gear oleo assembly may be removed and disassembled from the gear oleo housing with the gear removed from or installed in the airplane.

(1) Place airplane on jacks. (See 7-10-00.)

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

(3) 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.

(4) Disconnect brake line at joint located in wheel well.

(5) To remove piston tube assembly from oleo housing:

(a) Remove cotter pin, nut, washers and bolt that connects upper and lower torque links.

(b) Note number and thickness of spacer washer(s) between two links.

(6) Compress piston tube. Reach up into the lower end of the oleo housing and release snap ring from annular slot at the bottom of the oleo housing.

(7) Pull piston tube with component parts from cylinder housing.

(8) 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.

(9) Remove orifice tube from oleo housing by removing locknut and washer from top of housing. Draw tube with O-ring and retainer from housing.

(10) Removed orifice plate from bottom of orifice tube by releasing snap ring holding plate in position.

(11) 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.

B. Cleaning, Inspection and Repair

(1) Clean all parts with a suitable dry type cleaning solvent.

(2) Inspect landing gear oleo assembly components for following:

(a) Bearings and bushings for excess wear, corrosion, scratches and overall damage.

(b) Retaining pins for wear and damage.

(c) Lock rings for cracks, burrs, etc.

(d) Cylinder and orifice tube for corrosion, scratches, nicks and excess wear.

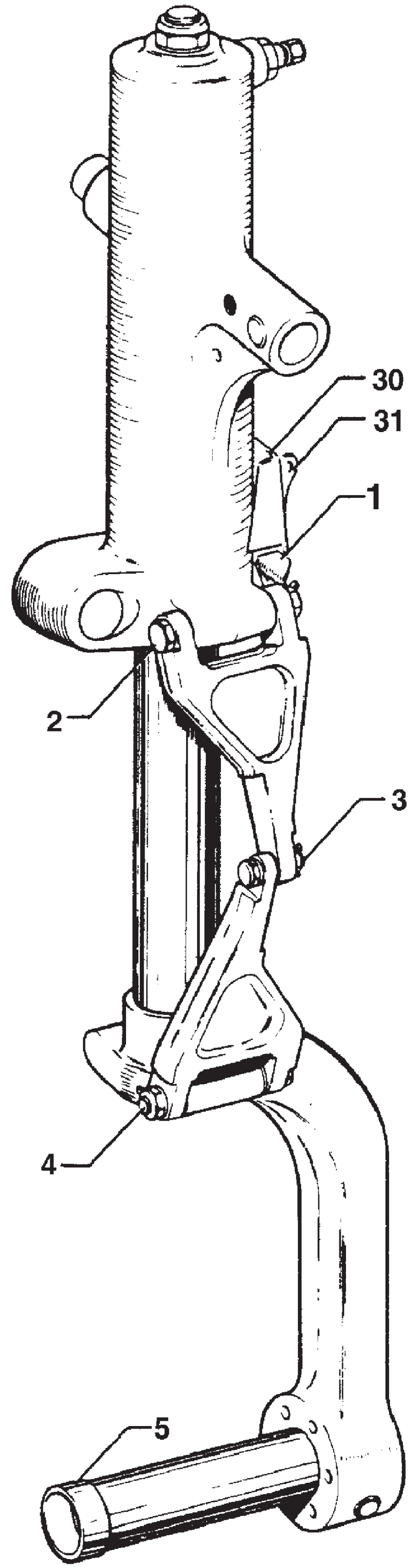
(e) Orifice plate for hole restriction.

(f) Fork tube for corrosion, scratches, nicks, dents and misalignment.

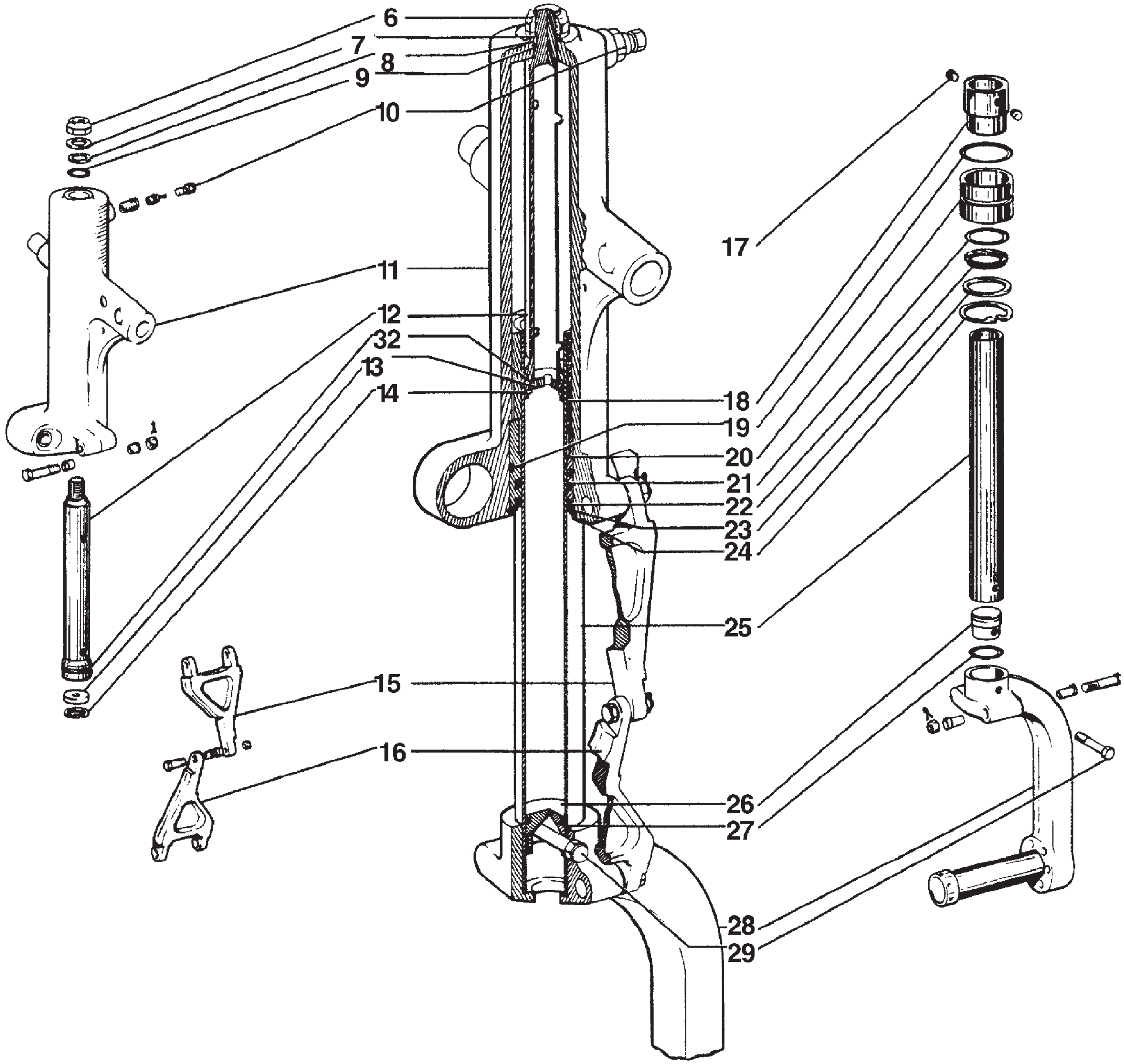
(g) Air valve general condition.

(3) Repair of oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts.

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



Main Gear Oleo Strut Assembly
Figure 1 (Sheet 1 of 2)



Main Gear Oleo Strut Assembly
Figure 1 (Sheet 2 of 2)

C. Assembly (See Figure 1.)

(1) Determine that all parts are cleaned and inspected.

(2) To install piston tube plug, first lubricate plug O-ring with hydraulic fluid (MIL-PRF-5606) 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.

(3) If desired, cement a cork in hole in bottom of fork body to prevent dirt from entering between fork and tube.

(4) To assemble components of orifice tube, insert orifice plate into bottom of tube and secure with snap ring.

(5) 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.

(6) 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.

(7) 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.

(8) Tighten locknut at top of housing.

(9) Ascertain that bushings are installed in upper and lower torque link connection holes and then connect the upper and lower torque links by installing the bolt, washers, and nut. (Use same thickness of spacer washers between two links as those removed to maintain correct wheel alignment.) Tighten nut enough to permit no side play in the links, yet still allow bolt rotation. Secure nut with cotter pin.

(10) On left oleo strut assemblies only: 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.

(11) Attach spring attachment plate to mounting lug on base of housing immediately above upper link.

(12) Connect brake line and bleed brakes.

(13) Lubricate gear assembly. (Refer to Lubrication Chart, 12-20-00.)

(14) Compress and extend strut several times to ascertain strut will operate freely. Weight of gear wheel and fork should allow strut to extend.

(15) Service oleo strut with fluid and air. (Refer to Oleo Struts, 12-10-00.)

(16) Check main gear alignment (refer to Alignment of Main Landing Gear) and gear operation. Ascertain that gear is down and locked.

(17) Remove airplane from jacks.

2. Main Landing Gear

A. Removal (See Figure 2.)

(1) Place airplane on jacks. (See 7-10-00.)

(2) Side brace link assembly may be removed by following procedure:

(a) With gear in extended position, disconnect gear downlock spring.

(b) Disconnect rod end of actuating cylinder from retraction fitting on upper side brace removing nut, washer and bolt, and bushing and spring swivel.

(c) Disconnect lower side brace link from gear housing by removing attachment nut, washer and bolt. Note bushings on each side of end bearing.

(d) Disconnect upper side brace link from side brace support fitting stud by removing cotter pin, nut, washer and attachment bolt.

(e) Remove side brace support fitting by removing cap bolts securing fitting to web of spar.

(f) Remove assembly and further disassemble and inspect as needed.

(3) Strut housing with components may be removed by following procedure:

(a) Disconnect brake line at its upper end in wheel well.

(b) Disconnect gear door actuating rod at gear housing.

(c) Remove access plate located on underside of wing, aft of landing gear.

(d) If not previously disconnected, disconnect lower side brace link from gear housing.

(e) Disconnect forward support fitting of housing from web of main spar by removing fitting attachment bolts.

(f) 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.

(g) Allow gear to drop free from wing.

(h) Aft support fitting may be removed by holding nuts in position, reaching through access opening, and removing fitting attachment bolts.

(i) 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.

(4) Either bearing installed in support fittings may be removed by removing snap rings that hold bearing in housing. Push bearing from housing.

B. Cleaning, Inspection and Repair

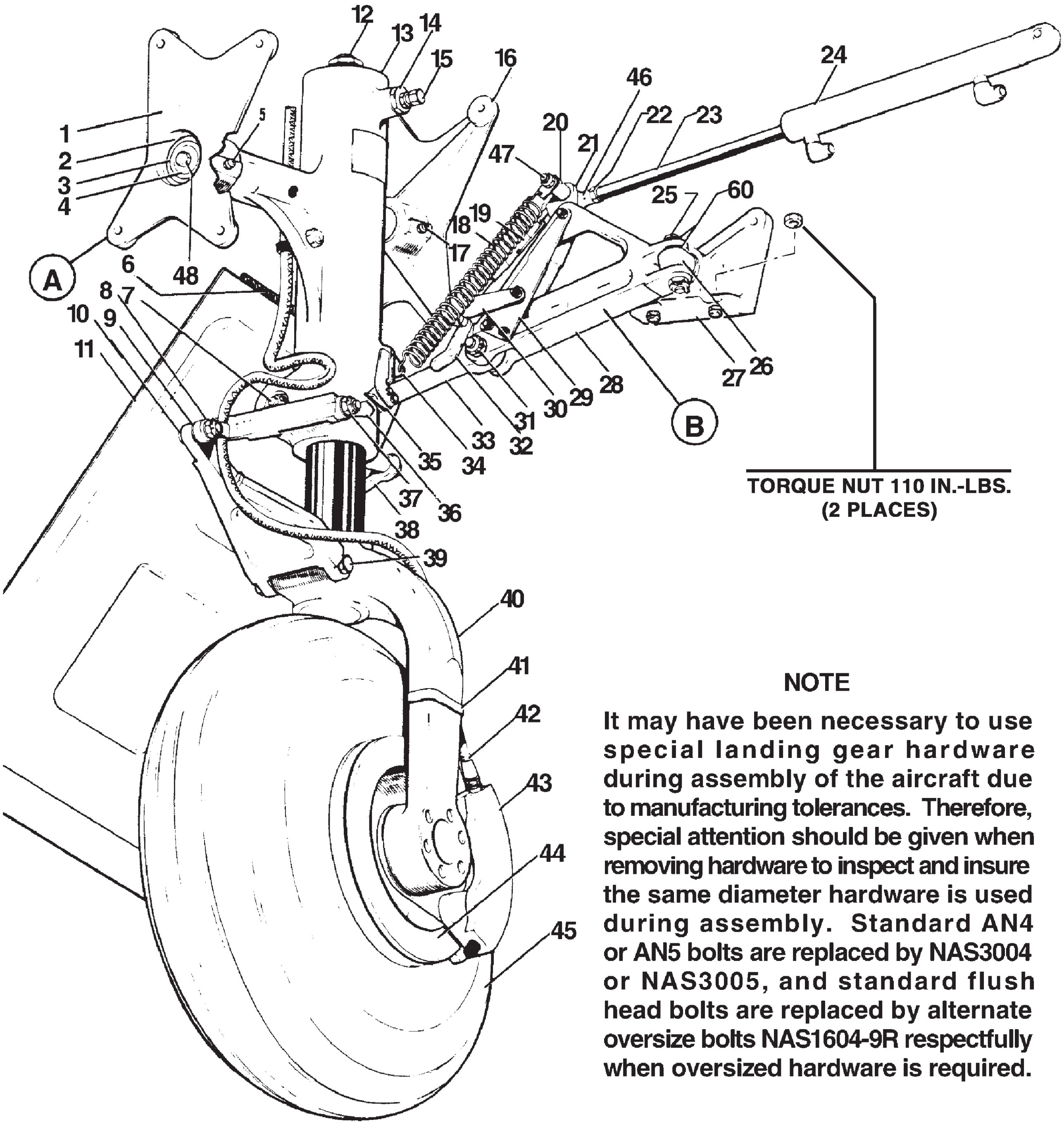
(1) Clean all parts with suitable dry type cleaning solvent.

(2) Inspect gear components for the following unfavorable conditions:

(a) Bolts, bearing and bushing for excess wear, corrosion and damage. (See Figure 4.)

(b) Gear housing, side brace links, torque links and attachment plates for cracks, bends or misalignment.

(c) downlock hook for excessive wear of bearing surfaces.

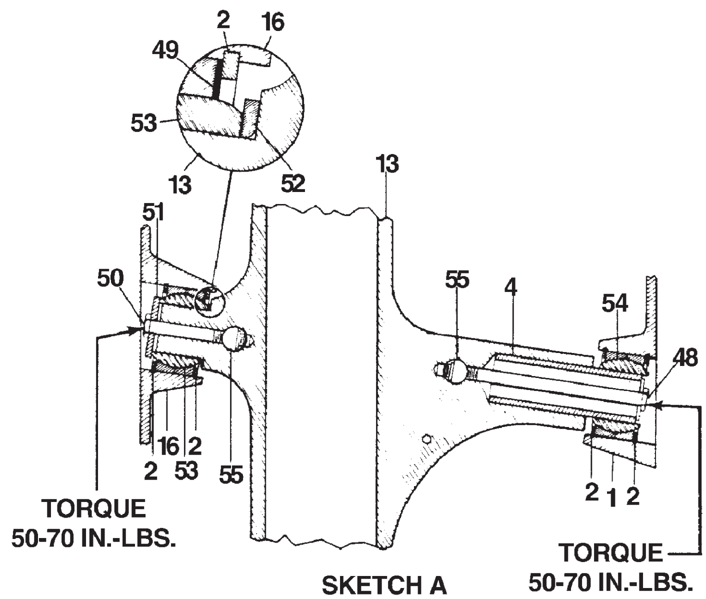


NOTE

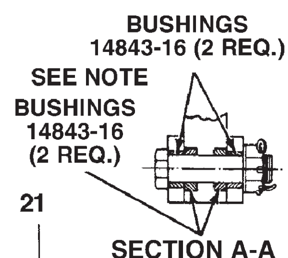
It may have been necessary to use special landing gear hardware during assembly of the aircraft due to manufacturing tolerances. Therefore, special attention should be given when removing hardware to inspect and insure the same diameter hardware is used during assembly. Standard AN4 or AN5 bolts are replaced by NAS3004 or NAS3005, and standard flush head bolts are replaced by alternate oversize bolts NAS1604-9R respectfully when oversized hardware is required.

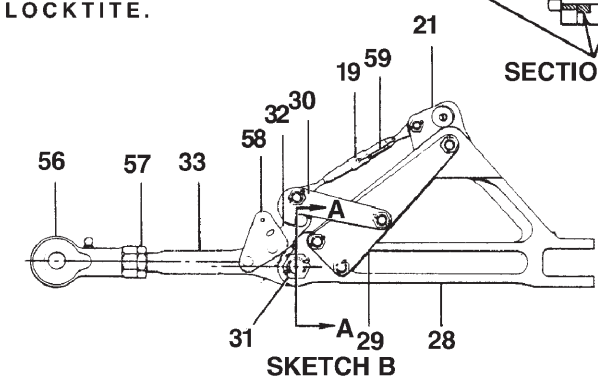
Main Gear Installation
Figure 2 (Sheet 1 of 2)

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



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.





Main Gear Installation
Figure 2 (Sheet 2 of 2)

(3) Inspect gear downlock spring for the following:

(a) 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.

(b) 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.

(4) Check general condition of each limit switch and its actuator, and wiring for fraying, poor connections or conditions that may lead to failures.

(5) Check side brace link through center travel by attaching 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.

(6) With side brace links assembled and checked, ensure that when stop surfaces of the two links contact, clearance between each downlock hook and flat of downlock 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 downlock 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.

(7) 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.

C. Installation (See Figure 2.)

NOTE: When assembling components of landing gear, lubricate bearings, bushings and friction surfaces with proper lubricant as described in 12-20-00.

(1) Insert a gear support bearing in each support fitting and secure with snap rings. Check bearing for excess end play, shim as necessary with shim washers (P/N 62833-44).

(2) Gear housing may be installed in wheel well of wing by the following procedure:

(a) 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.

(b) 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.

(c) 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.

(d) 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.)

(e) Push retainer tube into arm of housing and secure with bolt.

(f) Check that gear rotates freely in its support fittings and recheck thrust.

(g) Connect brake line to its mating line in wheel well and bleed brakes.

(3) Gear side brace link assembly may be installed by the following procedure:

(a) Position link support bracket with swivel stud installed at its attachment point on 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.

(b) Check that upper and lower links are assembled with downlock hook retraction fitting, etc, attached, and through travel of links and downlock hook clearance checked according to cleaning inspection and repair of main landing gear.

(c) Attach upper link to swivel stud of support fitting and secure with bolt, bushing, washer, nut and copper pin.

(d) 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.

(4) Ensure that the landing gear is lubricated per Lubrication Chart, 12-20-00.

(5) Check adjustment of landing gear per Adjustment, below.

(6) Check alignment of wheel per Alignment, below.

(7) Install access plate on underside of wing and remove airplane from jacks. (See 7-10-00.)

D. Adjustment

(1) Place airplane on jacks.

(2) Level airplane laterally and longitudinally. (Refer to 8-20-00.)

(3) Disconnect gear door actuating rods at either door or housing, as desired, by removing rod attachment bolt. Secure door out of way.

(4) Adjust rod end on upper side brace link with no load on wheels, to obtain 90 degree angle between wheel centerline and level floor line on outboard side of gear.

(5) Check that rod end has sufficient thread engagement in end bearing, align flat sides of bearing casting with flat side of bearing and tighten jam nut.

(6) Adjust turnbuckle of downlock 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 downlock hooks make contact with lock pin. Safety the turnbuckle.

(7) For easier adjustment of downlock limit switch, set it at this time as explained in Adjustment of Main Gear Down Limit Switch.

(8) Retract and extend gear manually several times to ensure that side brace link falls through center; downlock hook falls into position and there is no binding of gear assembly.

(9) 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 (c), (d), and (e) below, may be skipped.

(a) Check that rod end bearing of actuating cylinder is disconnected from retraction fitting.

(b) 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.

(c) 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.

(d) 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.

(e) Install with attachment bolt, bushing, spring swivel, and secure with washer and nut. Install gear downlock spring.

(f) 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.

(g) Check rod end bearing for adequate thread engagement and tighten jam nut.

(h) If downlock limit switch is properly adjusted, retract and extend gear to ensure that the gear operates properly.

E. Alignment (See Figure 3.)

(1) 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.

(2) 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 ± 1/2 degree.

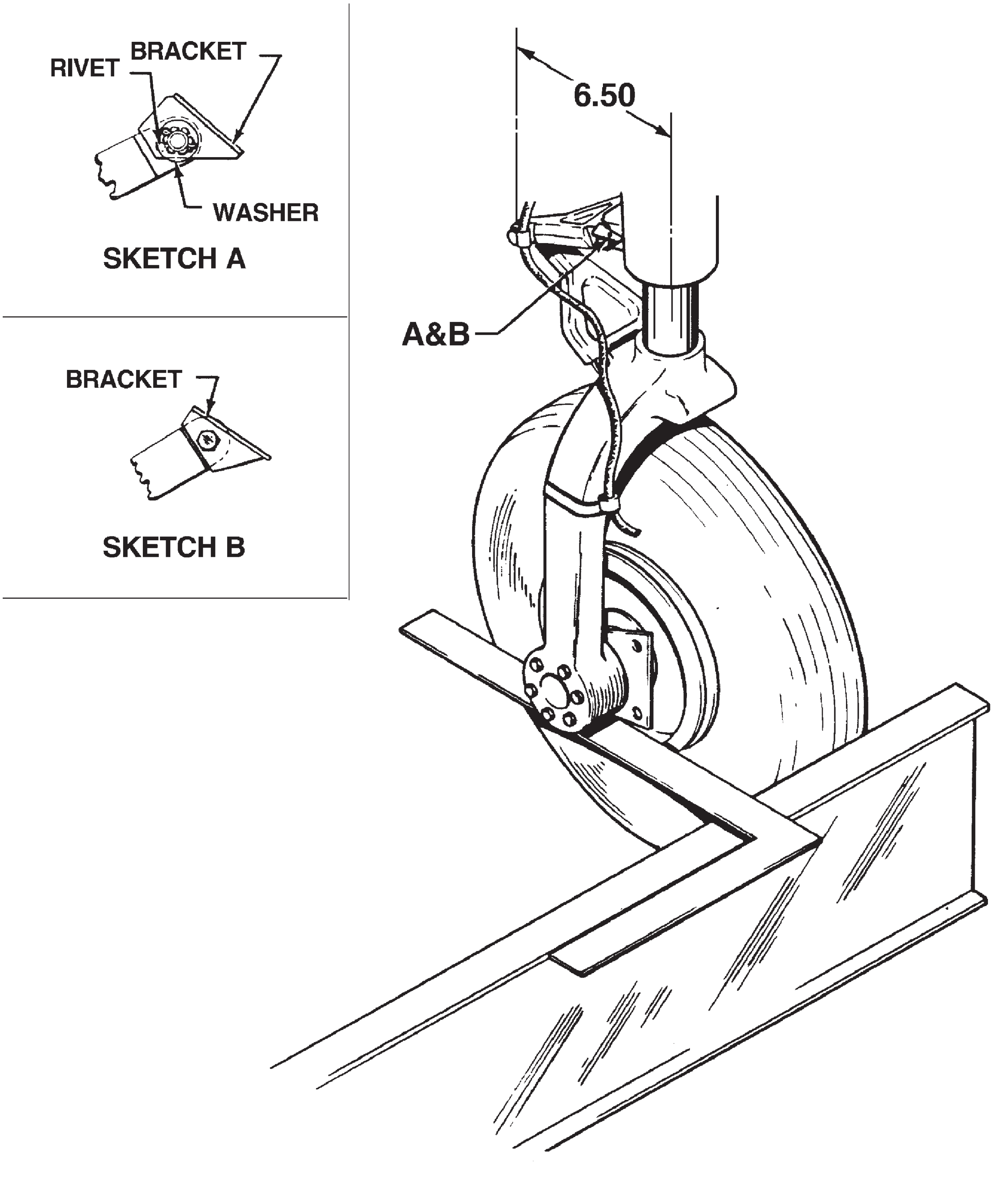
NOTE: A carpenter's square, because of its especially long legs, is recommended for checking main landing gear wheel alignment.

(3) 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.

(4) 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 Chart 2.

(5) 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.

(6) Recheck wheel alignment. If alignment is correct, safety castellated nut with cotter pin.



Aligning Main Gear
Figure 3

(7) 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 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 3.)

(8) Check adjustment of landing gear safety switch (squat switch).

CHART 2
TOE-IN AND 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

3. Main Gear Door Assembly

A. Removal

(1) With landing gear extended, disconnect door retraction rod from door by removing nut, washers, and bolt.

(2) Remove door from wing panel by bending door hinge pin straight and from other end pulling out pin.

(3) 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.

B. Cleaning, Inspection and Repair

(1) Clean door and retraction rod with a suitable cleaning solvent.

(2) Inspect door for cracks or damage, loose or damaged hinges and brackets.

(3) Inspect door retraction rod and end bearing for damage and corrosion.

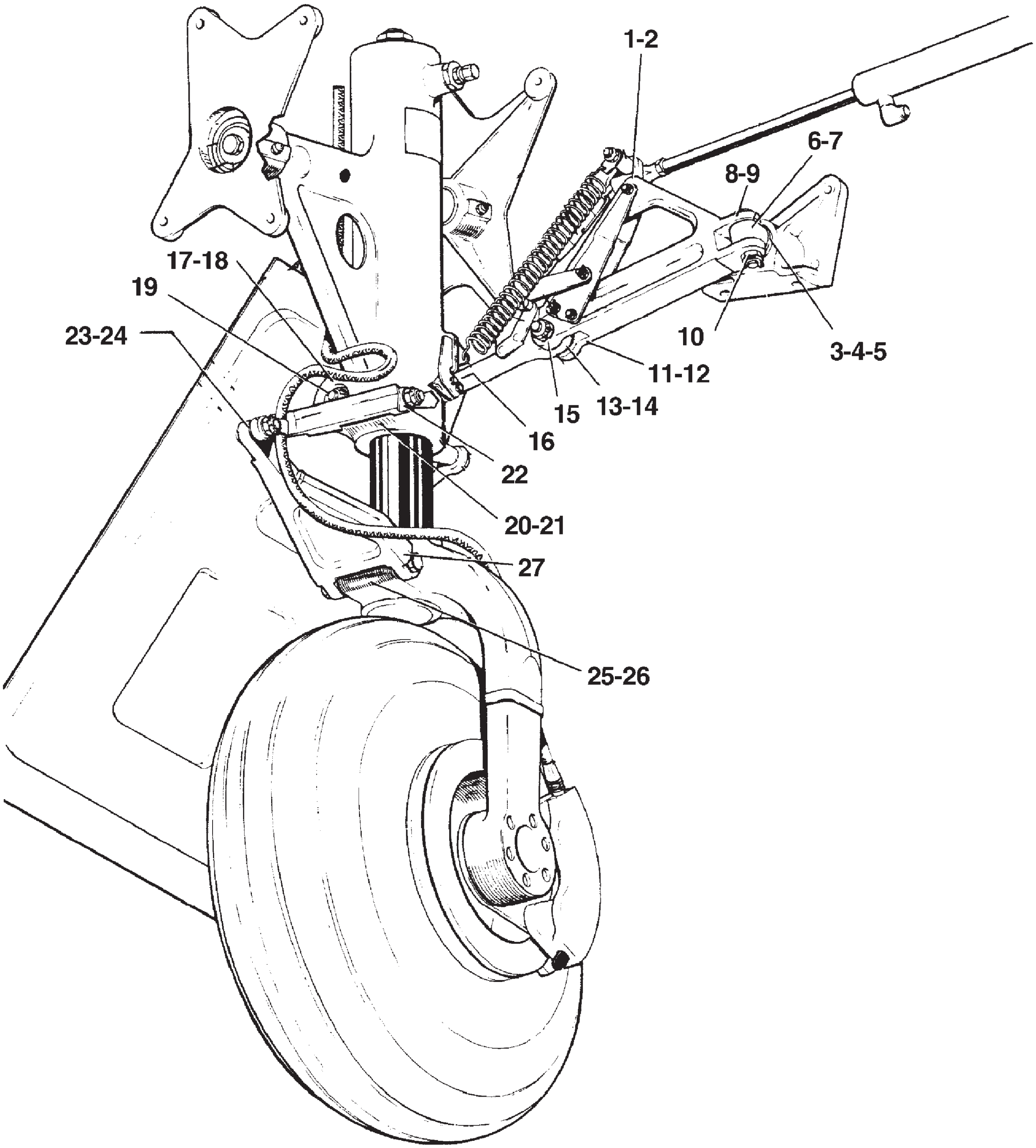
(4) Repairs to a door may be replacement of hinge, repair of fiberglass and painting.

C. Installation

(1) 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.

(2) 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.

(3) Check that all around clearance between door and wing skin is not less than .032 of an inch.



Main Gear Tolerances
Figure 4 (Sheet 1 of 3)

Item No.	Part No.	Nomenclature	Manufacturers Dimension (1)	Service Dimension (1)	Service Tolerance	Remarks
1	67514-002	Link, Upper Side Brace	0.3645 0.3625			No Rotation
2	63900-089	Bushing, Upper Side Brace Link	0.249 0.251	0.248 0.252	0.004	SEE NOTES 2 AND 5
3	95643-006 95643-007	Support Bracket, Side Brace	0.7465 0.7470			
4	67026-012	Bushing, Support Bracket	0.624 0.625	0.624 0.626	0.002	SEE NOTE 2
5	78717-002	Stud, Side Brace Support	OD 0.6235 0.6225	OD 0.6220		
6	78717-002	Stud, Side Brace Support	0.4365 0.4385	0.4355 0.4395	0.004	
7	67514-002	Link, Upper Side Brace	0.4945 0.4935	0.4925		
8	14843-016 (2)	Bushings, Side Brace Link	0.376 0.375	0.374		SEE NOTES 2 AND 5
9	67514-002	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	67514-002	Link, Upper . Side Brace	0.4945 0.4935	0.4925		
12	14843-016 (2)	Bushings, Side Brace Link	0.3745 0.3755	0.374		SEE NOTE 2
13	67797-003	Link, Lower Side Brace	0.4925 0.4905	0.500		
14	65003-044 (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	67926-024 67926-025 or 67926-034 67926-035	Trunnion Housing, Side Brace Attachment Trunnion Housing, Side Brace Attachment	0.7530 0.7550 0.7530 0.7550	0.7530 0.7550 0.7530 0.7550		

Main Gear Tolerances
Figure 4 (Sheet 2 of 3)

Item No.	Part No.	Nomenclature	Manufacturers Dimension (1)	Service Dimension (1)	Service Tolerance	Remarks
18	67026-005	Trunnion Bushing	0.4995 0.5010	0.498 0.502	0.004	SEE NOTES 3 AND 4
	or					
	67026-017 (2)	Trunnion Bushing	0.4975 0.4990	0.4995 0.5010		SEE NOTES 2, 3, 4 AND 5
19	402-960 (NAS-464-P8A-44)	Bolt, Trunnion Side Brace Attachment	OD 0.04991+.00 -0.0009	0.4972		
20	67926-024 67926-025	Trunnion Housing, Torque Link Attachment	0.4410 0.4430	0.4410 0.4440		
	or					
	67926-034 67926-035	Trunnion Housing, Torque Link Attachment	0.4410 0.4430	0.4410 0.4440		
21	67026-007 (2)	Trunnion Bearing	0.313 0.314	0.315		SEE NOTES 3, 4 AND 5
22	67012-000 (105041-002)	Torque Link	0.312 +0.001 -0.0	0.312 +0.00 -0.0		SEE NOTE 6
23	67012-000 (105041-002)	Torque Link	0.3760 0.3745	0.3770 0.3745	0.0025	SEE NOTE 6
24	31796-000	Bushing, Torque Link	0.252 0.251	0.253 0.251	0.002	SEE NOTES 2 AND 5
25	67037-004	Strut Assembly	0.4385 0.4370	0.4395 0.4370	0.0025	
26	67026-007	Strut Bearing	0.313 0.314	0.313 0.315	0.002	SEE NOTES 2 AND 5
27	67012-000 (105041-002)	Torque Link	0.312 +0.001 -0.0	0.312 +0.002 -0.0		SEE NOTE 6

NOTES:
1. All dimensions are inside dimensions (ID), unless specified otherwise.
2. Line ream to Manufacturer's Dimension after installation of new part.
3. Degrease mating surfaces using commercial degreaser or solvent.
4. Install using Loctite 601. rotate part while inserting, if possible, to ensure complete coverage.
5. Press fit.
6. Install wet using fluid resistant epoxy primer

Main Gear Tolerances
Figure 4 (Sheet 3 of 3)

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NOSE GEAR

1. Nose Gear Oleo

A. Disassembly (see Figure 1)

Nose gear oleo assembly may be removed and disassembled from gear oleo housing with gear either removed from or installed on the airplane.

(1) Place airplane on jacks. (Refer to Jacking, Chapter 7.)

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

(3) 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.

(4) Remove complete cylinder and fork assembly from oleo housing:

(a) Cut safety wire at top of unit.

(b) Remove cap bolts that attach steering arm and aligner guide bracket to top of oleo cylinder.

(5) Disconnect shimmy dampener by removing each cotter pin, nut, washer and bolt that connects dampener to oleo cylinder and housing.

(6) 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.

(7) To remove piston tube and fork from cylinder:

(a) Separate the upper and lower torque links by removing the cotter pin, nut, washers, and bolt connecting the links.

(b) Separate the two links. Note number of spacer washers between the two links.

(8) Compress piston tube; reach up along tube and release snap ring from annular slot at bottom of oleo housing.

(9) Pull piston tube with component parts from cylinder.

(10) 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.

(11) To remove orifice tube

(a) Remove large locknut and lock washer from top of cylinder.

(b) Pull tube from cylinder.

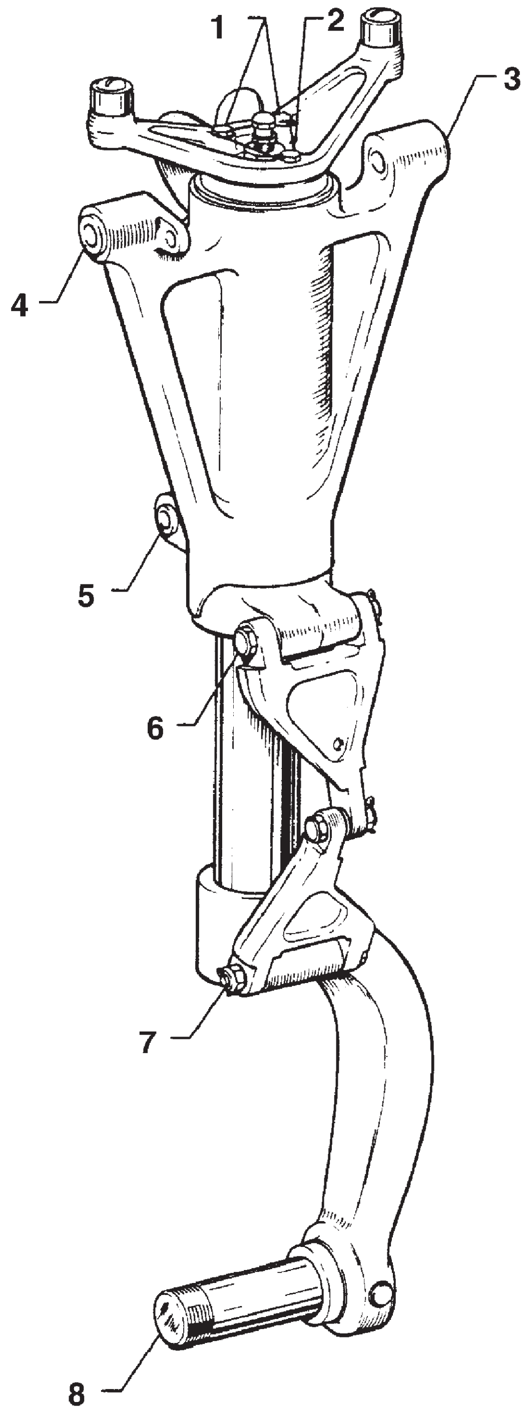
(12) Remove orifice plate from bottom of orifice tube by releasing snap ring that holds plate in position.

(13) To remove piston tube plug with o-ring located in lower end of tube:

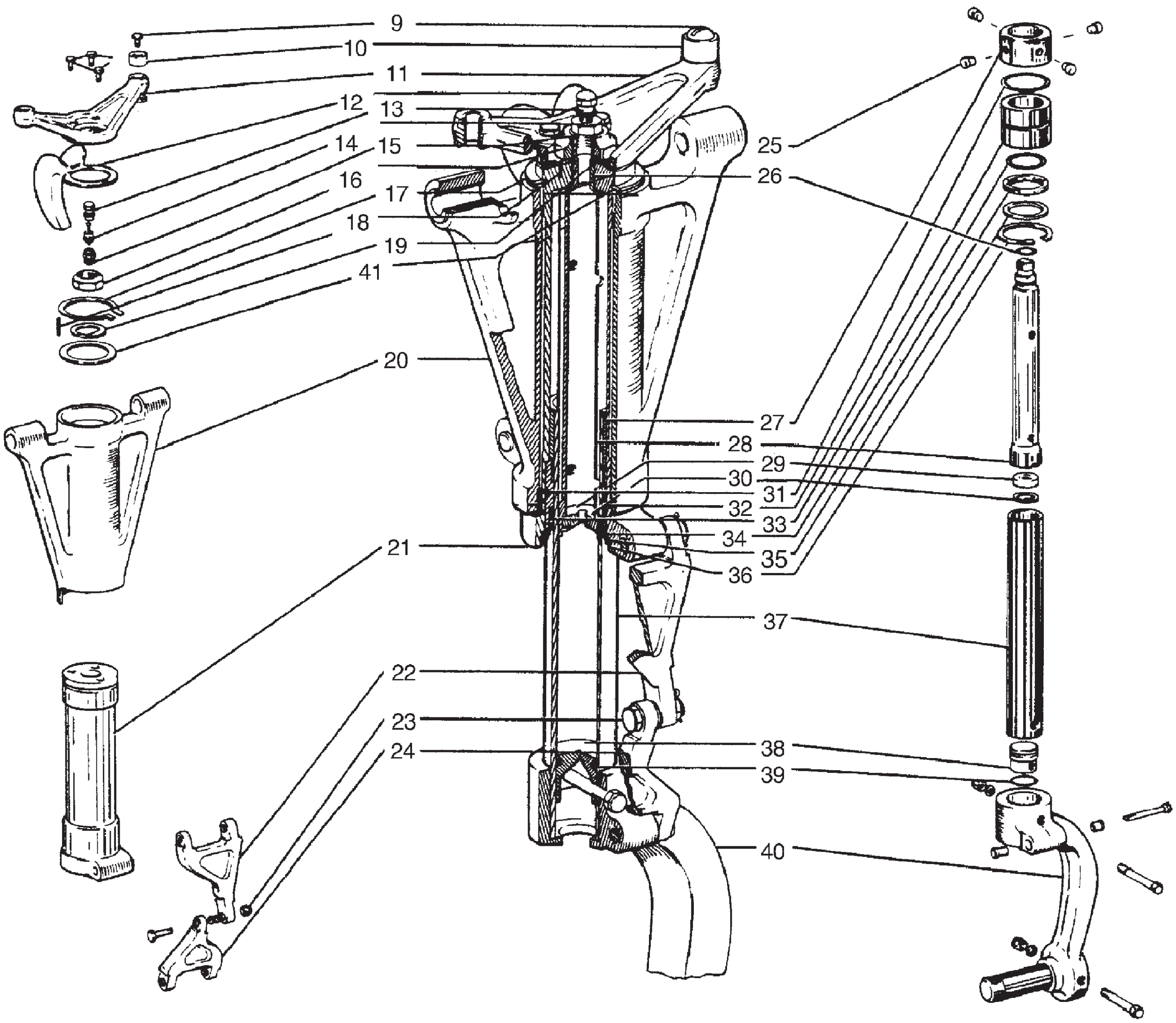
(a) Remove bolt assembly.

(b) Insert a rod up through hole in body of fork and push plug out through top of tube.

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



Nose Gear Oleo Strut Assembly
Figure 1 (Sheet 1 of 2)



Nose Gear Oleo Strut Assembly
Figure 1 (Sheet 2 of 2)

B. Cleaning, Inspection and Repair

(1) Clean all parts with a suitable dry type cleaning solvent.

(2) Inspect landing gear oleo assembly component for the following:

(a) Bearings and bushings for excess wear, corrosion, scratches and overall damage.

(b) Retaining pins for wear and damage.

(c) Lock rings for cracks, burrs, etc.

(d) Cylinder and orifice tube for corrosion, scratches, nicks and excess wear.

(e) Upper and lower cylinder bushings loose or turning in cylinder.

(f) Orifice plate for hole restriction.

(g) Fork tube for corrosion, scratches, nicks, dents and misalignment.

(h) Air valve general condition.

(3) Repair of oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts.

C. Assembly (see Figure 1)

(1) Check that parts are cleaned and inspected.

(2) To install piston tube plug:

(a) Lubricate tube plug and O-ring with hydraulic fluid (MIL-PRF-5606).

(b) Install O-ring on plug.

(c) Lubricate inside wall of tube.

(d) Insert plug into top of tube and push it to fork end.

(e) Align bolt holes of fork, tube and plug.

(f) Install bolt assembly.

(3) Cement a cork in hole in bottom of fork body to prevent dirt from entering between fork and tube.

(4) To assemble components of orifice tube:

(a) With countersunk side of orifice hole exposed, insert orifice plate into bottom of tube.

(b) Secure plate with snap ring.

(c) Lubricate and install O-ring on upper end of tube.

(5) 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.

(6) Assemble fork and tube assembly by:

NOTE: Install tube components on tube in the order shown.

(a) Slide snap ring, washer, lower bearing (with outer and inner o-rings) and upper bearing onto tube.

(b) Align lock pin holes in upper bearing with pin holes in piston tube

(c) Install pins.

(7) 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.

(8) Tighten (torque) orifice tube locknut at top of cylinder.

(9) Check that bushings are installed in upper and lower torque link connection holes and then connect the upper and lower torque links by installing the bolt, washers, and nut. Be sure to use the same number of spacer washers noted during disassembly. Tighten nuts enough to allow no side play in link, yet be free enough to rotate. Secure nut with cotter pin.

(10) 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.

(11) At top of oleo housing, install cylinder aligner guide bracket and steering arm. Install cap bolts, tighten 20 to 25 inch-pounds torque and safety with MS20995C40 wire.

(12) Install shimmy dampener and safety.

(13) Lubricate gear assembly. (Refer to Lubrication Chart, 12-20-00.)

(14) Compress and extend strut several times to ascertain that strut will operate freely. Weight of gear wheel and fork should allow strut to extend.

(15) Service oleo strut with fluid and air. (Refer to Oleo Struts, 12-10-00.)

(16) Check nose gear for alignment (refer to Alignment of Nose Landing Gear) and gear operation.

2. <u>Nose Landing Gear</u>

A. Removal (See Figure 2.)

(1) Remove engine cowling by:

(a) Release quarter-turn fasteners (5 on each side, 2 on top aft).

(b) Remove machine screws from around intake (2 each side).

(c) Pull slightly aft and then up, and remove upper cowling.

(d) Remove the screws securing the bottom cowling at its aft end and fuselage firewall flange.

(e) Remove screws which support bottom cowling to the nose gear doors support brackets and fuselage firewall flange.

(f) Remove screws securing induction filter housing to lower cowling (8 places) and disengage housing from NACA duct.

(g) Remove clamps securing fresh air inlet.

(h) Remove clamps securing alternator cooling air.

(i) Push nose gear doors inward against spring pressure and remove bottom cowling.

(2) Place airplane on jacks. (Refer to 7-10-00.)

(3) Disconnect gear tension springs from forward spring arm that is attached to right side of strut housing.

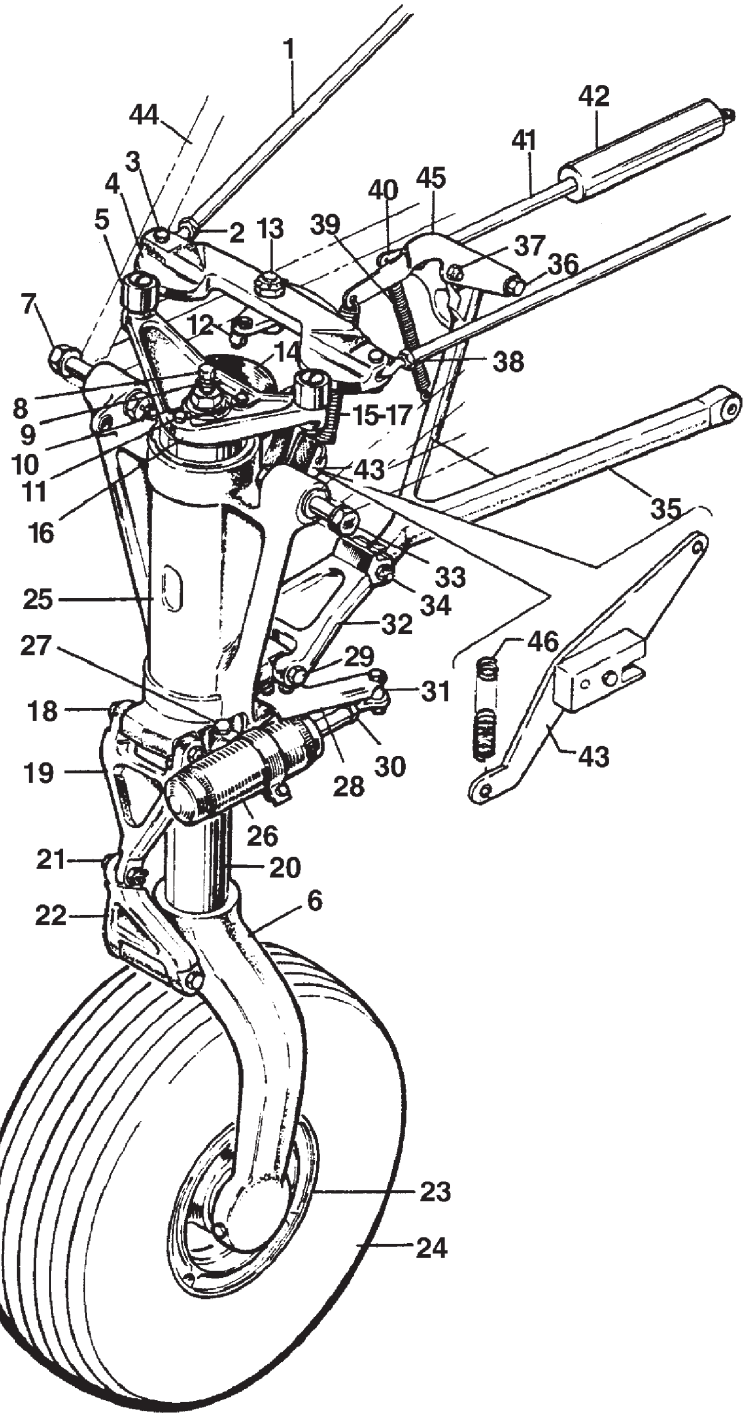
(4) Retract nose gear slightly to remove gear from its downlocked position.

(5) To remove upper and lower drag links, the following procedure may be used:

(a) 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.

<u>CAUTION</u>: BEFORE MANUALLY RETRACTING NOSE GEAR ASSEMBLY, WITH AIRPLANE ON JACKS, ENSURE NOSE GEAR DOWNLOCK IS FULLY DISENGAGED BEFORE RELEASING NOSE GEAR DRAG LINKS. DAMAGE COULD OCCUR TO DOWNLOCK IF NOT DISENGAGED FULLY.

(b) Retract gear and disconnect gear downlock spring from upper drag link.



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

Nose Gear Installation
Figure 2

(c) Remove cotter pins, washers and nuts from bolts that secure upper drag link and lower drag link.

(d) Remove lower and upper gear tension spring arms.

(e) Slide attachment bolts from upper and lower drag links and remove links.

(6) 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.

(7) Steering bellcrank may be removed by removing nut and bolt at steering rod, and nut and bolt with bushing at bellcrank pivot point.

B. Cleaning, Inspection and Repair

(1) Clean all parts with a suitable dry type cleaning solvent.

(2) Inspect gear components for following unfavorable conditions:

(a) Bolts, bearings and bushings for excess wear, corrosion and damage. (See Figure 8.)

(b) Gear housing, drag links, torque links, and tension spring arm for cracks, bends or misalignment.

(c) Downlock hook for excess wear of the hook and bearing surfaces.

(d) Downlock pin to ensure no looseness is present.

(3) Inspect gear tension and downlock hook springs for the following:

(a) 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.

(b) 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.

(c) 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.

(4) Check general condition of each limit switch and its actuator, and wiring for fraying, poor connections or conditions that may lead to failures.

(5) Check drag link through center travel by attaching 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.

(6) Shimmy dampener requires no service other than routine inspection. In case of damage or malfunction, dampener should be replaced rather than repaired.

(7) 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.

C. Installation (see Figure 2)

NOTE: When assembling any units of landing gear, lubricate bearings, bushings, and friction surfaces with proper lubricant as described in 12-20-00.

(1) 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.

(2) 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.

(3) Drag links and gear tension spring arms may be installed by following procedure:

(a) 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, above.

(b) Position link assembly to allow bolt holes in links to align with holes in gear housing and engine mount.

(c) Add upper gear tension spring arm, bushings and washers on upper link attachment bolt.

(d) Install bolt and tighten nut to allow link to rotate freely and safety.

(e) 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.

(4) Connect gear downlock spring between downlock and upper drag link.

(5) Connect two gear tension springs.

(6) 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 3).

(7) Retract gear and tighten with eccentric bushing in its adjusted position. Cycle gear a minimum of three times to ensure proper operation and engagement.

(8) Ensure that landing gear is lubricated per Lubrication Chart, 12-20-00.

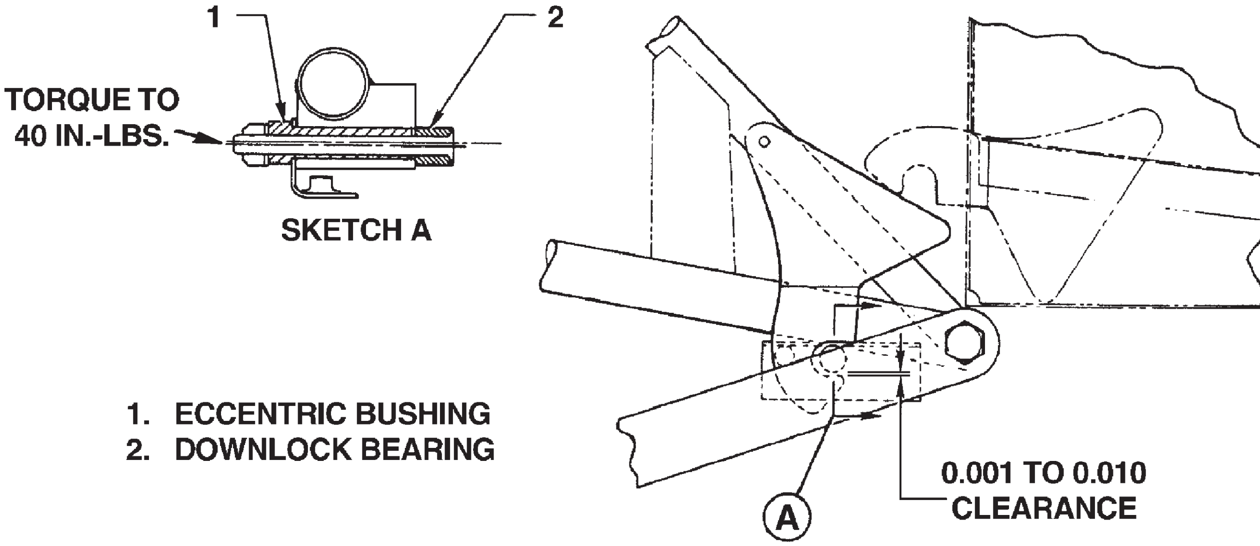
(9) Check adjustment of gear per Adjustment / Gear Up Stop and Shimmy Dampener, below.

(10) Install engine cowling.

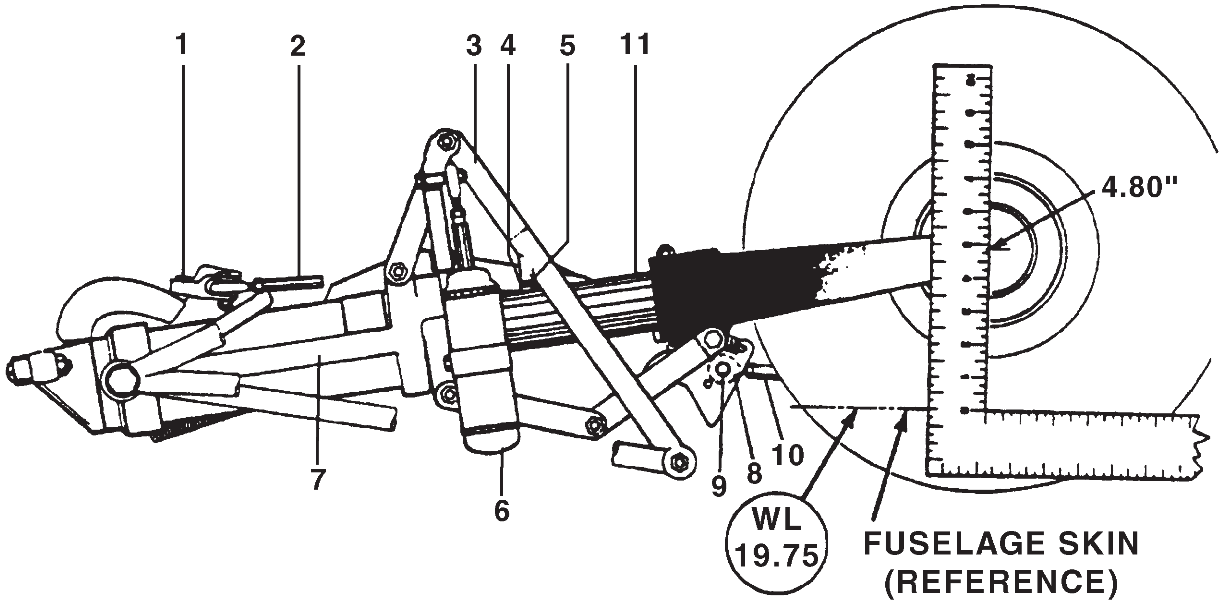
(11) Retract landing gear and check door operation as per Adjustment of Nose Gear Doors.

(12) Check alignment of nose gear per Alignment / Steering Adjustment, below.

(13) Remove airplane from jacks. (See 7-10-00.)



Adjustment of Eccentric Bushing
Figure 3



1. STEERING BELLCRANK
2. STEERING ROD
3. UPPER DRAG LINK
4. GEAR UP STOP
5. JAM NUT
6. SHIMMY DAMPENER
7. STRUT HOUSING
8. ROD END BEARING
9. BOLT ASSEMBLY
10. CYLINDER ACTUATOR ROD
11. STRUT TUBE

Nose Gear Adjustment
Figure 4

D. Adjustment / Gear Up Stop and Shimmy Dampener (Refer to Figure 4)

The gear up stop is located on under side of upper drag link.

(1) Remove engine cowl.

(2) Place airplane on jacks. (Refer to Jacking, 7-10-00.)

(3) Retract landing gear hydraulically by turning master switch on and moving gear selector switch to up position.

(4) 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 measurement. If this measurement is incorrect, extend gear, loosen jam nut on gear up stop, and make required adjustment by turning stop.

(5) 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.

(6) 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.

(7) Adjust shimmy dampener by turning nose wheel against stops and adjusting rod end of dampener for adequate travel to both extremes.

(8) Install engine cowling.

(9) Confirm that downlocks are engaged and that the three green gear down lights are on.

(10) Remove airplane from jacks.

E. Alignment / Steering Adjustment

(1) Place airplane on a smooth level floor that will accommodate striking of a chalk line.

(2) Check that nose gear is properly adjusted as given in Adjustment / Gear Up Stop and Shimmy Dampener, above.

(3) 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 bellcrank fore and aft until it clears each steering arm rollers by 0.03 of an inch. Retighten attachment bolt.

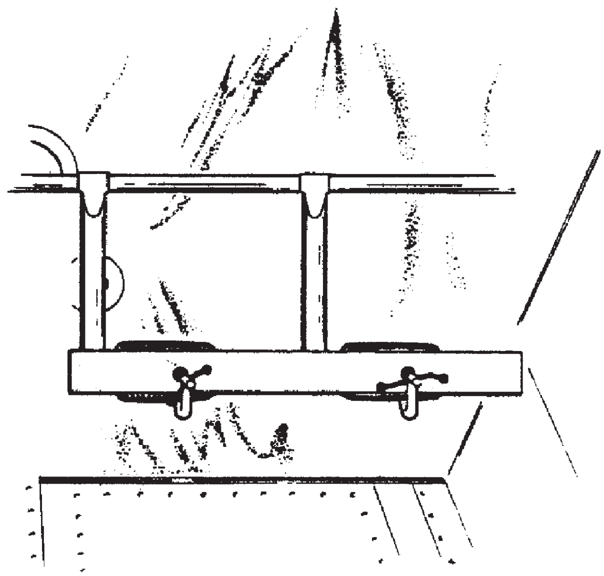
(4) Place airplane on jacks. (Refer to Jacking, 7-10-00.)

(5) Level airplane laterally and longitudinally. (Refer to Leveling, 8-20-00.)

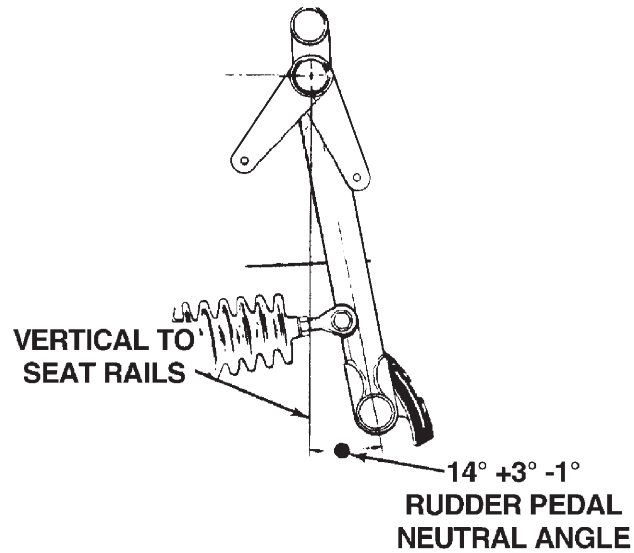
(6) From center point of tail skid, extend a plumb bob and mark contact point on floor.

(7) 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.

(8) Clamp rudder pedals to align them in a lateral position. Ensure that rudder pedals are in their neutral position. (Refer to Figure 5 and Figure 6)



Clamping Rudder Pedals in Neutral
Figure 5



Rudder Pedals at Neutral Angle
Figure 6

(9) 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.

(10) Install steering push rods on rudder pedals. Adjust rods so lengths are both same and rudder pedals are at their neutral position.

(11) 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.

(12) Place a bubble protractor against a rudder pedal steering tube to check the neutral angle. (Refer to Figure 6).

(13) 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.

(14) 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.

3. Nose Gear Doors

A. Removal (See Figure 7.)

(1) With nose gear extended, disconnect spring from door arms by removing upper attachment hardware.

(2) Disconnect link assemblies from doors and remove mechanism.

(3) To remove doors from cowl, bend end of hinge pin straight and pull out pin.

B. Cleaning, Inspection and Repair

(1) Clean all parts with a suitable cleaning solvent.

(2) Inspect doors for damage, loose or damaged hinges and brackets.

(3) Inspect door retraction link assemblies and arms for damage and wear.

(4) Check door tension springs for wear and tension. Reject springs if tension does not maintain doors in full open position.

(5) Repairs to doors may be replacement of hinges and painting.

(6) Repairs to retraction mechanism is limited to replacement of parts, and sanding and painting.

C. Installation (See Figure 7.)

(1) 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.

(2) Assemble door mechanism to doors and attach springs.

D. Adjustment

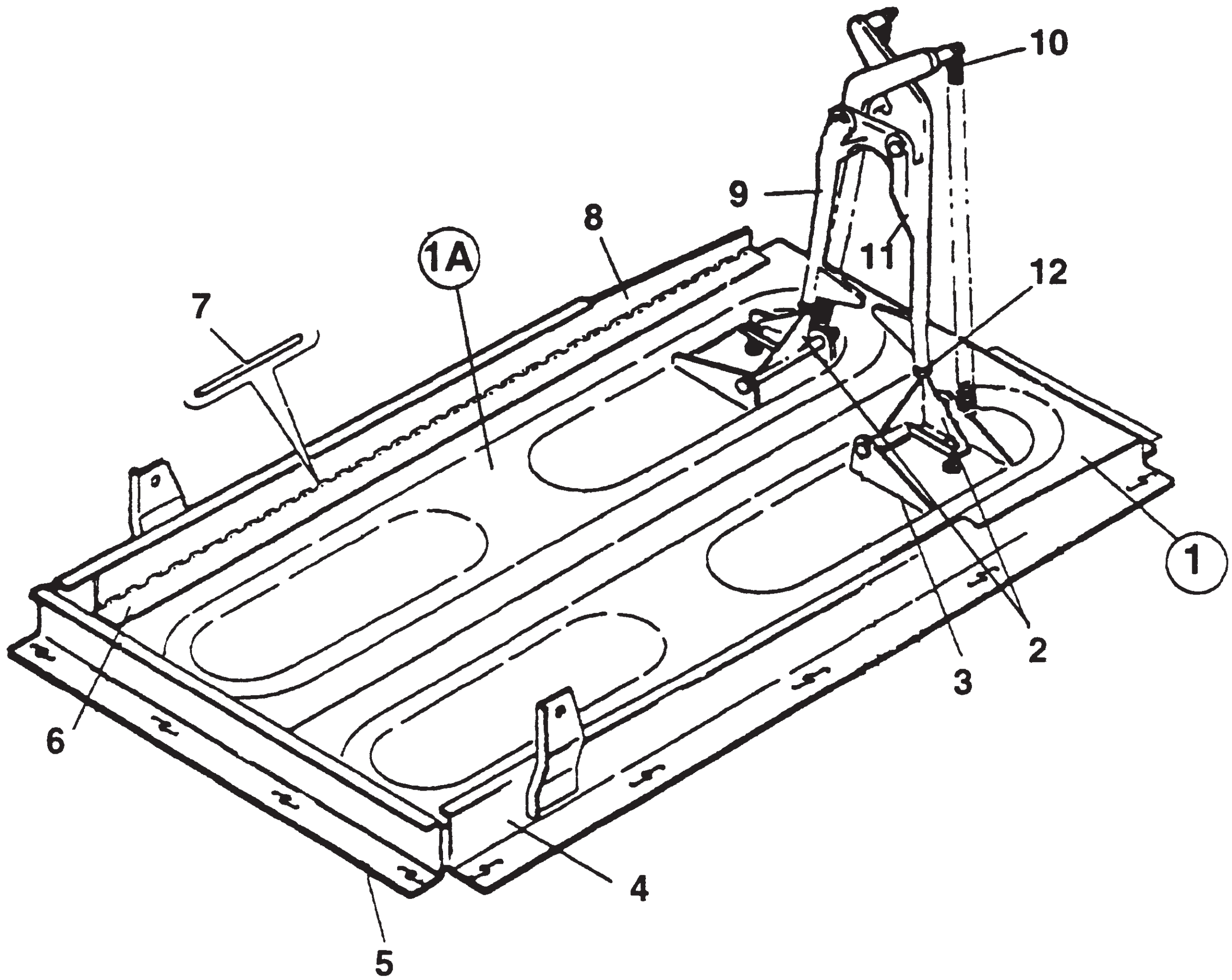
(1) Place airplane on jacks. (Refer to Jacking, 7-10-00.)

(2) Adjust door retraction links to align doors with lower cowl in closed position.

(3) Door down adjustment bolts should be positioned to limit doors travel to 90 degrees from closed position.

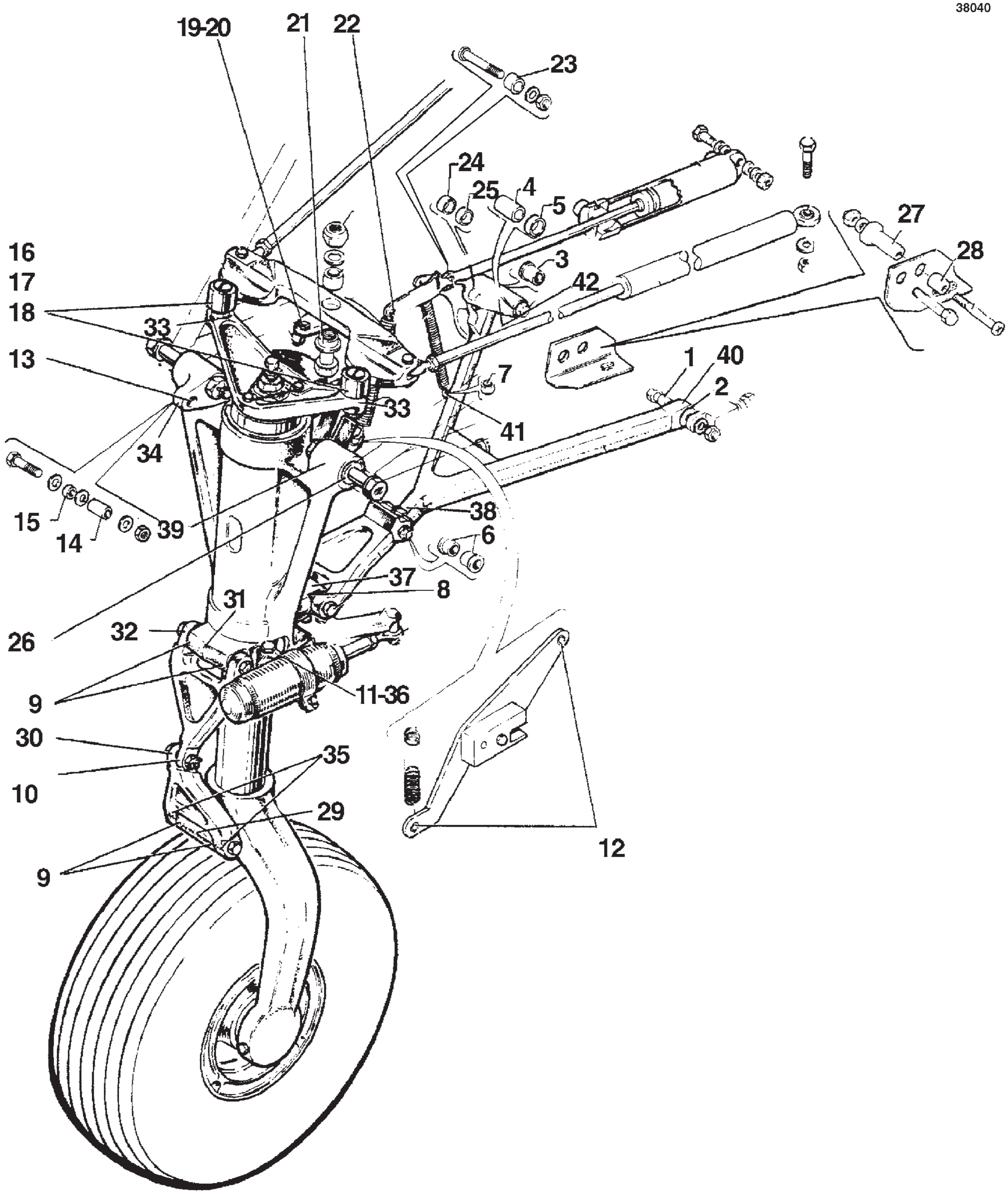
(4) Check attaching hardware and jam nuts for safety and tightness.

(5) Remove airplane from jacks.



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

Nose Gear Doors
Figure 7



Nose Gear Tolerances
Figure 8 (Sheet 1 of 4)

Item No.	Part No.	Nomenclature	Manufacturers Dimension (1)	Service Dimension (1)	Service Tolerance	Remarks
1	65003-045	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	Upper 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 (FF310-5)	Upper Drag Brace Bearing	.2505 .2495	.2515 .2495	.002	
7	61402-093	Upper Drag Brace Bushing	.189 .191	.193 .189	.004	
8	67026-007	Drag link Trunnion Bearing	.313 .314	.3130 .3165	.0025	SEE NOTE 4
9	67026-007	Bearing	.313 .314	.313 .315	.002	SEE NOTES 2, 3 AND 5
10	452-450 (FF310-5)	Link Assembly Bearing	.2505 .2495	.2515 .2495	.002	SEE NOTES 5 AND 6
11	21831-004	Nose Gear Strut Tube Bearing	.247 .248	.247 .250	.003	SEE NOTE 3
12	82732-099	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	82732-095	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	14976-015	Bushing	.385 .390	.385 .395	.010	
20	14976-016	Bushing	.260 .265	.270 .260	.010	
21	452-445	Steering Cam Bearing	.502	.512 .502	.020	
22	82732-099	Nose Gear Arm Bushing	.241 .246	.241 .251	.010	SEE NOTE 5

Nose Gear Tolerances
Figure 8 (Sheet 2 of 4)

Item No.	Part No.	Nomenclature	Manufacturers Dimension (1)	Service Dimension (1)	Service Tolerance	Remarks
23	65003-030	Downlock Bushing	.193 .195	.196 .193	.003	
24	96061-135	Bushing	.2495 .2505	.2515 .2495	.002	
25	95061-136		.2495 .2505	.2515 .2495	.002	
26	67026-011	Bearing				SEE NOTE 4
27	35662-002	Eccentric Bushing	.189 .191			
28	38068-002	Downlock Bearing	.191 .189			
29	67050-002	Lower Strut Assy. Torque Link Fitting				
30	20735-005 (106680-002)	Torque Link	.377 .3785	.377 .3790	.002	SEE NOTE 5
31	67148-000	Trunnion Torque Link Fitting	.4385 .4370	.4385 .4370	.0015	
32	20735-005 (106680-002)	Torque Link	.312 .313	.312 .314	.002	
33	44386-003	Steering Arm	.4370 .4385	.0015	.0015	
34	67054-003	Trunnion Assy. Assist Spring Fitting	.302 .303	.302 .3035	.0015	
35	20735-005 (106680-002)	Torque Link	.312 .313	.312 .314	.002	SEE NOTE 2
36	67148-000	Shimmy Dampener Fitting	.3745 .3760	.3745 .3760	.001	
37	67054-003	Trunnion Housing Drag Link Attachment	.4415 .4425	.4415 .4424	.0010	
38	38043-000	Upper Drag Link	.378	.3775 .379	.002 .3795	
39	67054-003	Trunnion Assy. Main Attachment Fitting	.6285 .6295	.6285 .6295	.001	
40	38043-000	Upper Drag Link	.4385 .4375	.4385 .4405	.002	
41	38043-000	Downlock Spring Attachment Fitting	.247 .248			
42	38043-000	Upper Drag Link	.6235	.6230 .6245	.002 .6250	

Nose Gear Tolerances
Figure 8 (Sheet 3 of 4)

NOTES:
1. All dimensions are inside dimensions (ID), unless otherwise noted.
2. Line ream to Manufacturer's Dimension after installation of part.
3. Install wet using fluid resistant epoxy primer.
4. Install new bushing by coating O.D. of bushing with Loctite 601, rotating bushing while inserting it to ensure coverage.
5. Press fit.
6. Install using Loctite 290.

Nose Gear Tolerances
Figure 8 (Sheet 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 1 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 1 (Sheet 1 of 5)
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 (upper solenoid).	Replace solenoid.
	Gear selector switch ground incomplete.	Check ground.
	Gear selector switch inoperative.	Replace switch.
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.		
	Hydraulic pump ground incomplete.	Check ground.

CHART 1 (Sheet 2 of 5)
TROUBLESHOOTING EXTENSION AND RETRACTION

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 (lower solenoid).	Replace solenoid.
	Gear selector switch ground incomplete.	Check ground.
	Gear selector switch inoperative.	Replace switch.
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.		
	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.
Landing gear retraction extremely slow.	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Restriction in hydraulic lines.	Isolate and check hydraulic lines.
	Shuttle valve sticking in pump base.	Check cause.

CHART 1 (Sheet 3 of 5)
TROUBLESHOOTING EXTENSION AND RETRACTION

Trouble	Cause	Remedy
Pump stops during gear retraction.	Landing gear actuator circuit breaker opens.	Reset circuit breaker and determine overload cause.
	Landing gear selector circuit breaker opens.	Reset circuit breaker and determine overload cause.
	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 overload cause.
	Landing gear selector circuit breaker opens.	Reset circuit breaker and determine overload cause.
Pump fails to shut off though gear has fully retracted.	Pressure switch inoperative. *	Replace switch.
	Pressure switch out of adjustment. *	Replace switch.
* The out of adjustment or failed switch may be determined by noting which down light is not ON.		
	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.

CHART 1 (Sheet 4 of 5)
TROUBLESHOOTING EXTENSION AND RETRACTION

Trouble	Cause	Remedy
Pump fails to shut off though gear has fully retracted.	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.
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)
	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.
* The out of adjustment or failed switch may be determined by noting which down light is not ON.		
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.

CHART 1 (Sheet 5 of 5)
TROUBLESHOOTING EXTENSION AND RETRACTION

Trouble	Cause	Remedy
Gear stops part way up, but pump continues to run.	Pump high pressure relief valve out of adjustment.	Replace pump.
	Internal leakage of system.	Check gear actuating cylinders for internal leakage.
		Check for broken or damaged hydraulic lines.
	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
All gears fail to free fall.	Free-fall valve fails to open.	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 (PIR-PPS60033-1, Rev. P / PIR-PPS60033-8, Rev. G.)

A. Set-Up

(1) Verify that nose and main gears are properly adjusted (see 32-10-00 and 32-20-00) and tires and struts are properly inflated (see 12-10-00).

(2) Place the airplane on jacks. (See 7-10-00.)

(3) 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.

B. Procedure

CAUTION: PRIOR TO AND THROUGHOUT THESE TESTS, 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.

(1) Gear Lights.

(a) All switches OFF and gear selector in the DOWN position.

(b) Throttle in MID position.

(c) Master switch ON. (Remains ON through all tests.)

Check: Three green safe lights ON.
Red warning light OFF.
Gear warning horn does not sound.

(2) Gear Down Microswitches.

(a) Throttle in mid position.

(b) Gear selector switch up.

(c) When nose gear is approximately half retracted, pull the landing gear pump circuit breaker. Pull the Emergency Gear Extension Knob (gear free fall control). Manually restrain nose gear from failing. Main gear shall fall to the extended position. Push in the Emergency Gear Extension Knob (gear free fall control) to the "NORMAL" position.

(d) 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.

(e) 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.

(f) "Unlock" left gear downlock manually.

Check: Pump operates.
Correct green safe light OFF.
Red warning light ON.
Gear warning horn does not sound.

(g) Repeat step (f) for the right main gear.

(h) Repeat step (f) for the nose gear.

(3) Squat Switch.

(a) Deactivate squat switch on left main gear by one of the following methods:

1 Loosen the squat switch adjustment screws and rotate the switch until the tang is free.

2 Partially compress the left main gear shock absorber so that the squat switch operating tang is free.

(b) Gear selector switch UP.

Check: Pump does not operate.
Three green gear safe lights remain ON.
Red warning light ON.

(c) Open throttle fully.

Check: Pump does not operate.
Red warning light remains ON.
Three green lights remain ON.

(d) Close throttle.

Check: Pump does not operate.
Red warning light remains ON.
Three green lights remain ON.
Horn sounds (intermittently).

(e) Gear selector switch DOWN.

(f) Re-activate squat switch.

NOTE: Do Not perform steps (g) thru (k) if airplane is equipped with Avidyne Entegra EFIS or Garmin 1000 EFIS.

(g) Locate connector R2 on left side of Instrument Panel harness on far outboard side. It may be necessary to cut tywraps to access connector.

(h) With aircraft on ground and right squat switch mated (weight-on-wheels), check for ground at pin 3 of connector R2.

(i) Repeat step (a) to ensure that gear microswitch is operating properly. With switch OPEN, check that pin 3 from previous step is now open to ground

(j) With switch still in weight-off-wheels position, check for ground at pin 15 of connector P2 or R2 depending on aircraft configuration. This ground is for the transponder.

(k) Return right hand squat switch to original configuration.

NOTE: If discrepancies are found, refer to applicable Schematic Wiring diagram for troubleshooting purposes.

(4) Retraction and Extension.

NOTE: The Emergency Gear Extension Knob (gear free-fall control) must be in the normal position throughout (4), (5), (6), and (7) until instructed otherwise.

(a) Throttle in MID position.

(b) If equipped with nose gear mounted taxi light/landing light, move landing light switch from OFF to ON position and verify landing light is illuminated.

(c) 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.
Taxi light/Landing light is extinguished
(applicable only to aircraft equipped with nose gear taxi light/landing light).

(d) 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
(applicable only to aircraft equipped with nose gear taxi light/landing light).

(e) Wait eight seconds, then move gear selector switch UP.

Check: Gear retracts in less than ten seconds.
Red warning light OFF.

(5) Second Retraction Test.

The second retraction check (see (4) (d) and (e), above) after an eight second wait, tests the functioning of the pump base shuttle valve. Retraction time will be prolonged beyond the time specified if the shuttle valve is sticking.

(6) Throttle Closed Microswitch.

(a) With gear still up, close throttle.

Check: Red warning light ON.
Gear warning horn sounds.

(b) Open throttle to MID position.

Check: Red warning light OFF.
Gear warning horn stops sounding.

(c) Leave the gear up for five (5) minutes.

Check: Pump motor does not operate at any time.

(If the pump motor operates at any time during the five minute period, there is a leak in the "UP" line of a malfunctioning component in the system.

NOTE: One momentary pump operation is allowable during this five minute period, provided that the gear unsafe light is not lit and there is no repeated pump operation for a subsequent fifteen (15) minute period.

(7) Free-fall.
   (a) Pull out 25 amp landing gear pump circuit breaker.
   (b) Pull the Emergency Gear Extension Knob (gear free fall control).
      Check: All gear return to the “down and locked” position, with down latches engaged. Three green gear safe lights ON. (Within 10 seconds max)
   (c) Push in the Emergency Gear Extension Knob (gear free fall control) to the normal position.
   (d) Gear selector switch DOWN.
   (e) 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.
(8) Flap Position Warning Check (Throttle to be in Middle Position)
   (a) Flap rigging complete.
   (b) Gear selector switch UP.
      Check: Gear retracts.
      Pump stops.
      Red warning light OUT.
   (c) Flap selector in first down (10°) position.
      Check: Flaps operate to first position.
      Warning horn does not sound.
   (d) Flap selector in second down (25°) position.
      Check: Flaps operate to second position.
      Warning horn sounds.
   (e) Flap selector in full down position.
      Check: Flaps operate to full down position.
      Warning horn continues to sound.
   (f) Flap selector back to first down (10°) position.
      Check: Flaps operate to first position.
      Warning horn stops sounding.
   (g) Flap selector to full up (0°) position.
      Check: Flaps retract.
      Warning horn does not sound.
   (h) Gear selector switch down.
      Check: Gear extends.
      Three green safe lights ON.
      Pump stops.
   (i) Flap selector to full DOWN position.
      Check: Flaps operate to full DOWN position.
      Warning horn does not sound.
   (j) Flap selector to full UP position.
      Check: Flaps operate to full UP position.
      Warning horn does not sound.
   (k) Master switch OFF.
(9) Disconnect the ground power unit.
(10) 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

(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.

CAUTION: WHENEVER AIRCRAFT IS PLACED ON JACKS FOR PURPOSE OF MANUALLY RETRACTING NOSE GEAR ASSEMBLY, ENSURE NOSE GEAR DOWNLOCK IS FULLY DISENGAGED BEFORE RELEASING NOSE GEAR DRAG LINKS. DAMAGE COULD OCCUR TO DOWNLOCK IF NOT FULLY DISENGAGED.

(c) Disconnect cylinder operating rod end. Manually unlock nose gear to allow clearance from engine mount for removal of attachment bolt.

(d) Disconnect aft end of cylinder from its attachment fitting. Remove cylinder from the wheel well.

(2) Installation

(a) Attach cylinder to its attachment fitting using bolt and nut.

(b) Attach operating rod end to downlock. 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.

(3) Disassembly (Refer to Figure 1.)

(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 .

(4) Cleaning, Inspection, and Repair

(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.

(5) Assembly (Refer to Figure 1)

(a) Install O-ring on the exterior of end gland.

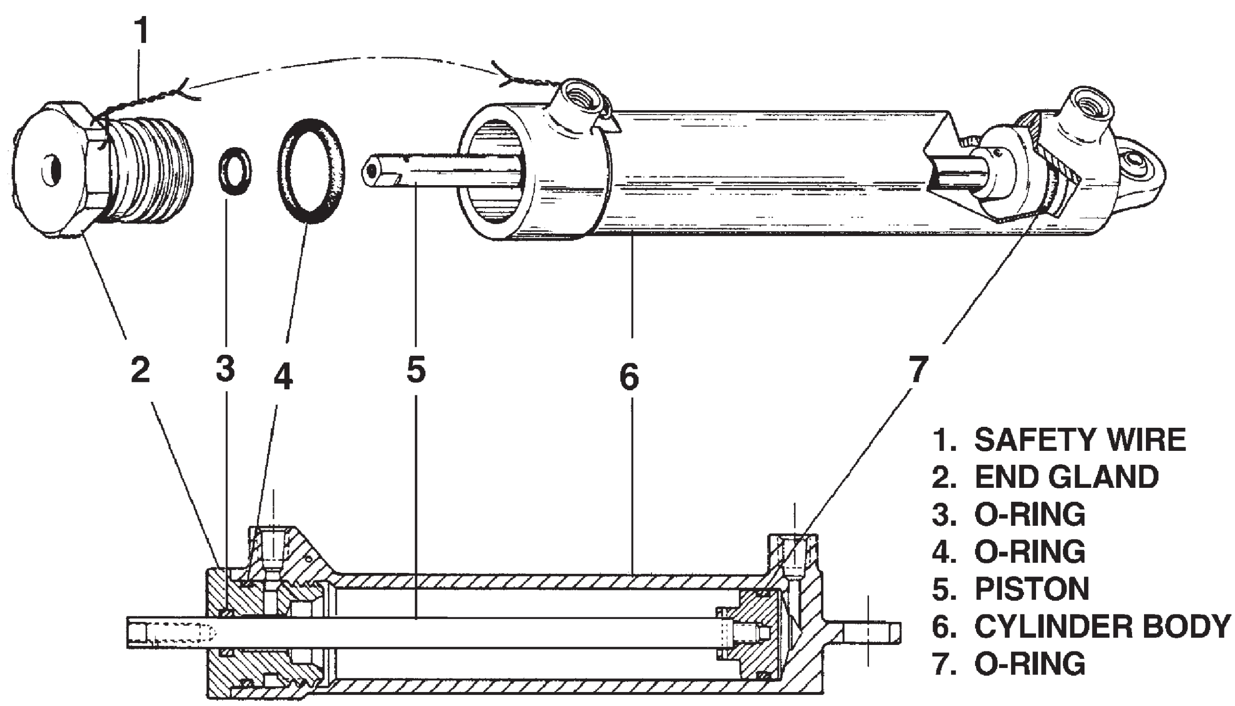
(b) Install O-ring in the interior of end gland.

(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.



Nose Gear Actuating Cylinder
Figure 1

B. Main Gear Actuating Cylinder

NOTE: Disassembly, Assembly, and Cleaning, Inspection and Repair instructions for actuators P/N 96860-002 and 96860-003 (i.e. - SFA232-5) are found in Cleveland Wheel and Brakes publication: Component Maintenance Manual - CMSFA232-5 (011-00504) available from the vendor. See Vendor Publications in the Introduction.

(1) Removal

(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 downlock spring from swivel fitting at upper end of spring.

(d) Remove downlock 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) Installation

(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.

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 (Refer to Figure 2.)

(1) Loosen screw securing cable to valve arm.

(2) Loosen clamp securing cable in position. Withdraw cable.

(3) Loosen (do not disconnect) hydraulic lines connected to the valve. Place a rag in position to absorb any hydraulic fluid spillage that may result.

(4) Remove clamps nuts and bolts securing the valve to bracket.

(5) Disconnect and remove hydraulic lines connected to valve. Cap the lines to avoid contamination.

(6) Remove the assembly from the airplane.

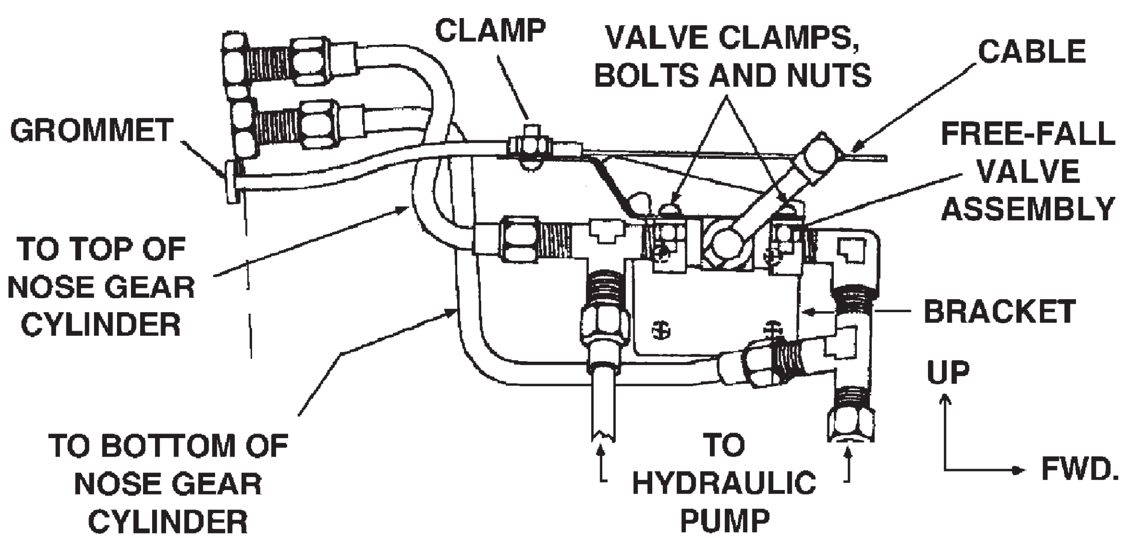
(7) Note direction of tees and elbows connected to valve. Remove tees and elbows.

B. Installation (Refer to Figure 2.)

(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.
(2) Insert tees and elbows. Tighten to same direction noted during removal.
(3) Connect hydraulic lines to tee and elbow fittings in valve; finger tighten only
(4) Install valve on bracket and secure in position with clamp bolts and nuts..
(5) Push arm assembly fully forward.
(6) Pull cable full forward. Insert loose end of cable through the hole in the bushing of the arm assembly
(7) Place clamp over reinforced portion of cable and tighten screws.
(8) Tighten arm lock screw on cable
(9) Tighten all hydraulic lines.
(10) Check for leaks. (Refer to Testing Hydraulic System, 29-10-00).
(11) 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.



Free-Fall Valve Assembly
Figure 2

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WHEELS AND BRAKES

1. Wheels

A. Nose Wheel Assembly

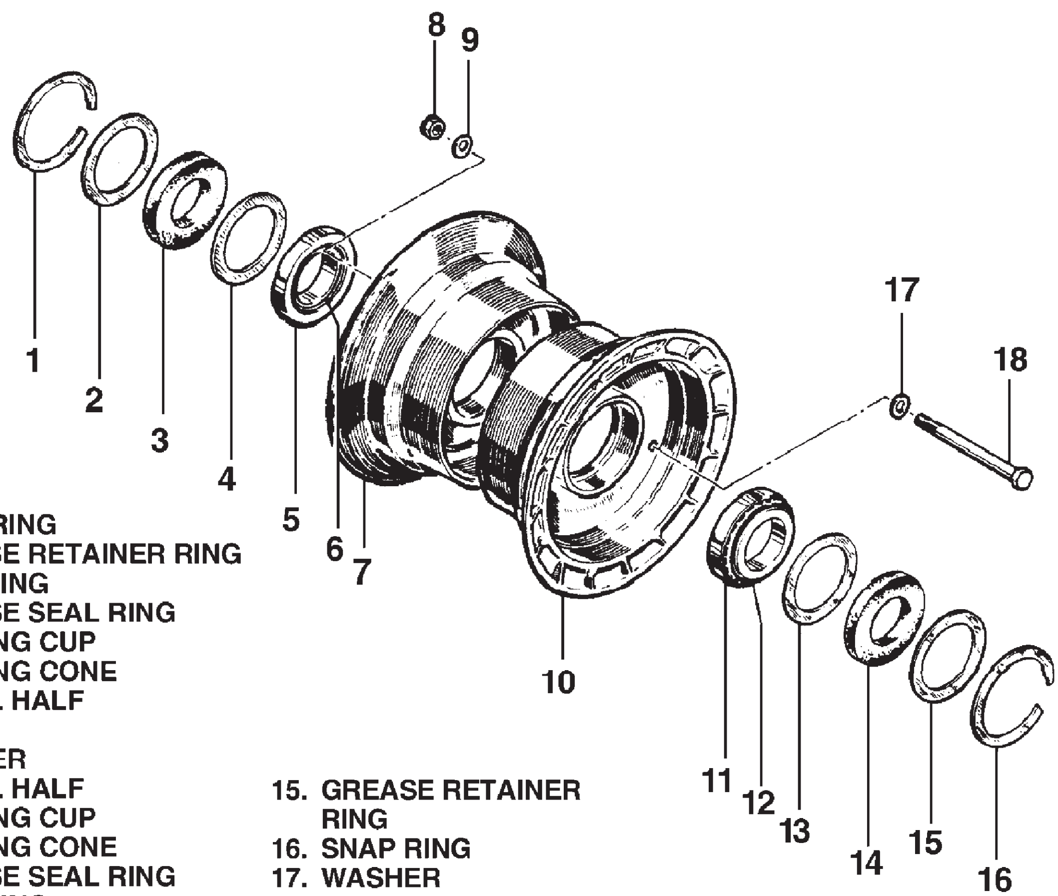
(1) Removal and Disassembly (See Figure 1.)

(a) Jack airplane enough to raise nose wheel clear of ground. (Refer to Jacking, 7-10-00.)

(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 (7 and 10) may be separated by first deflating tire. With tire sufficiently deflated, remove wheel through bolts (18). 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 (1 or 16) that secure grease seal retainers, and then retainers, grease seals (4 or 13) and bearing cones (6 or 12). Bearing cups (5 or 11) should only be removed for replacement. See Bearing Cup Replacement, below.



1. SNAP RING
2. GREASE RETAINER RING
3. FELT RING
4. GREASE SEAL RING
5. BEARING CUP
6. BEARING CONE
7. WHEEL HALF
8. NUT
9. WASHER
10. WHEEL HALF
11. BEARING CUP
12. BEARING CONE
13. GREASE SEAL RING
14. FELT RING
15. GREASE RETAINER RING
16. SNAP RING
17. WASHER
18. BOLT

Nose Wheel Assembly
Figure 1

(2) Inspection

(a) Visually check all parts for cracks, distortion, defects and excess wear.

(b) Check tie bolts for looseness or failure.

(c) Check internal diameter of felt grease seals. 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 (See Figure 1.) (PIR-PPS50025, Rev. AE.)

(a) If required, install bearing cup (5 or 11) into each wheel half (7 and 10) per Bearing Cup Replacement, below.

(b) Install the inner tube in the tire, making certain to align the index marking on the tire with the index marking on the tube to ensure proper wheel balance.

(c) Install the tire and tube on the wheel half with the valve stem hole (7), inserting the valve stem through the valve hole.

(d) Place the opposite wheel half inside the tire.

(e) Align the wheel bolt holes and join the two wheel halves.

(f) Install through bolts (18) with washers (9 and 17) and nuts (8) to valve stem side. Both plain and countersunk washers may be used. Some designs use bolts that have a radius between the head and shank, which requires the countersunk washers. Inspect bolts and washers prior to assembly. Properly oriented washers with countersunk surfaces to sit flush against the bolt head. Install washers and nuts on bolts.

(g) Tighten the bolts in a criss-cross pattern to about 20 inch-pounds.

(h) Remove all pressure in the tire. Torque each nut again in a criss-cross pattern to about 45 inch-pounds before setting the final torque specified on the wheel placard. Do not use power tools to torque nuts.

(i) Inflate the tire to the specified pressure per Chart 1, 6-00-00.

(j) Install wheel bearings per Bearing Installation under Main Wheel Assembly, Assembly and Installation, below.

(k) 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.

(l) Ensure nose gear is down and locked. Remove jack.

B. Main Wheel Assembly

(1) Removal and Disassembly (See Figure 2.)

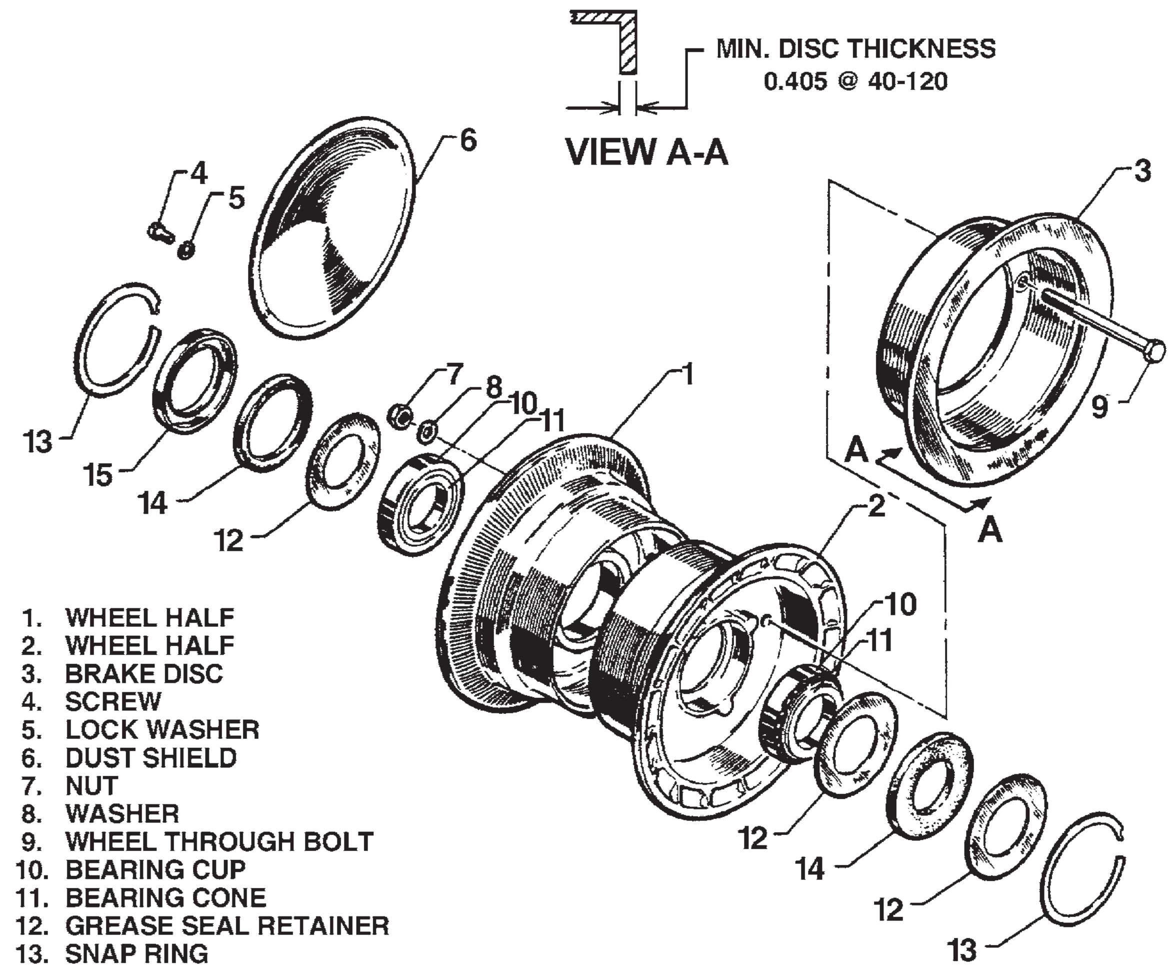
(a) Place the airplane on jacks. (Refer to Jacking, 7-10-00.)

(b) To remove main wheel, remove cap bolts that join brake cylinder housing and lining back plate assemblies. Remove back plate from between brake disc (3) and wheel.

(c) Remove dust cover (6), cotter pin and flat head pin that safeties wheel nut, and slide wheel from axle.

(d) Wheel halves (1 and 2) may be separated by first deflating tire. With tire sufficiently deflated, remove wheel through bolts (9). 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 (13) that secure grease seal retainers (12 and 15), and then retainers, grease seals (14) and bearing cone (11). Bearing cups (10) should only be removed for replacement. See Bearing Cup Replacement, below.



1. WHEEL HALF
2. WHEEL HALF
3. BRAKE DISC
4. SCREW
5. LOCK WASHER
6. DUST SHIELD
7. NUT
8. WASHER
9. WHEEL THROUGH BOLT
10. BEARING CUP
11. BEARING CONE
12. GREASE SEAL RETAINER
13. SNAP RING
14. GREASE SEAL
15. GREASE SEAL RETAINER

Main Wheel Assembly
Figure 2

(2) Inspection

(a) Inspect the brake disc for cracks, excessive wear or scoring, rust, corrosion, and warpage. Remove rust and blend out nicks, using fine 400 grit sandpaper. Replace disc if it is cracked or worn below minimum acceptable thickness. (Refer to Cleaning, Inspection and Repair, under Brakes, Wheel Brake Assembly, below.)

(b) Inspect the main wheel assembly per Inspection under Nose Wheel Assembly, above.

(3) Assembly and Installation (See Figure 2.)

(a) If required, install the bearing cup (10) into each wheel half (1 and 2) per Bearing Cup Replacement, below.

(b) Install the inner tube in the tire, making certain to align the index marking on the tire with the index marking on the tube, to ensure proper wheel balance.

(c) Install the tire and tube on the wheel half with the valve stem hole (1), inserting the valve stem through the valve hole.

(d) Place the opposite wheel half (2) inside the tire.

(e) Align the wheel bolt holes and join the two wheel halves. Position brake disc (3) in inner wheel half. Both plain and countersunk washers may be used. Some designs use bolts that have a radius between the head and shank, which requires the countersunk washers. Inspect bolts and washers prior to assembly. Properly oriented washers with countersunk surfaces to sit flush against the bolt head. Install washers and nuts on the bolts (bolt heads are to be on brake disc side of wheel).

(f) Tighten the bolts in a criss-cross pattern to about 20 inch-pounds. Remove all pressure in the tire. Torque each nut again in a criss-cross pattern to about 45 inch-pounds before setting the final torque specified on the wheel placard. Do not use power tools to torque nuts.

(g) Inflate the tire to the specified pressure per Chart 1, 6-00-00.

(h) Bearing Installation

CAUTION: DO NOT MIX AVIATION WHEEL BEARING GREASES WITH EACH OTHER.

NOTE: Mobil Aviation Grease SHC 100 has been used by the wheel manufacturer since March 2007 and is the preferred grease. If not available, greases meeting MIL-PRF-81322 or DOD-G-24508A are suitable alternatives. If old grease is unknown, thoroughly clean bearing components before packing with new grease.

CAUTION: HANDLE BEARING CONES WITH EXTREME CARE TO PREVENT CONTAMINATION OR DAMAGE.

1) Pack the bearing cones (11) as follows:

NOTE: Pack the bearing cones just before installation to prevent contamination.

NOTE: Bearing cones can be packed by hand or by using a mechanical bearing greaser. The mechanical bearing greaser will do a more thorough job of packing the grease.

a) Clean the bearing cones.

b) Push and force the grease up and out between the rollers, cone and cage.

c) The bearing is properly greased when no voids or daylight can be observed between the rollers and inner and outer races.

d) Disperse excess grease around each end and the tapered sides of each cone.

NOTE: Shaded area in Figure 2a shows the recommended quantity of grease.

2) Liberally swab the bearing cup, bearing bore hub, and grease seal and snap ring areas with bearing grease.

3) If felt seals are used, lightly coat all surfaces of the felt with the wheel bearing grease. If rubber lip seals are used, lightly coat the rubber surfaces with bearing grease.

4) Install the bearing cones, grease seals (felts and rings or rubber lip seals) and snap rings.

Excess grease will squeeze out. Remove the excess grease with an inward rotating movement against the bearing cone ID. Disperse any small amounts of grease on the exterior surface of the grease seal and snap ring and remove any grease from the hub outside surface.

5) Use care that bearing grease does not become contaminated.

(d) 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.

(e) Position brake lining back plates between wheel and brake disc and brake cylinder on torque plate. Insert spacer blocks between back plates and cylinder, and secure assembly by installing four bolts. If brake was disconnected, connect line and bleed brakes.

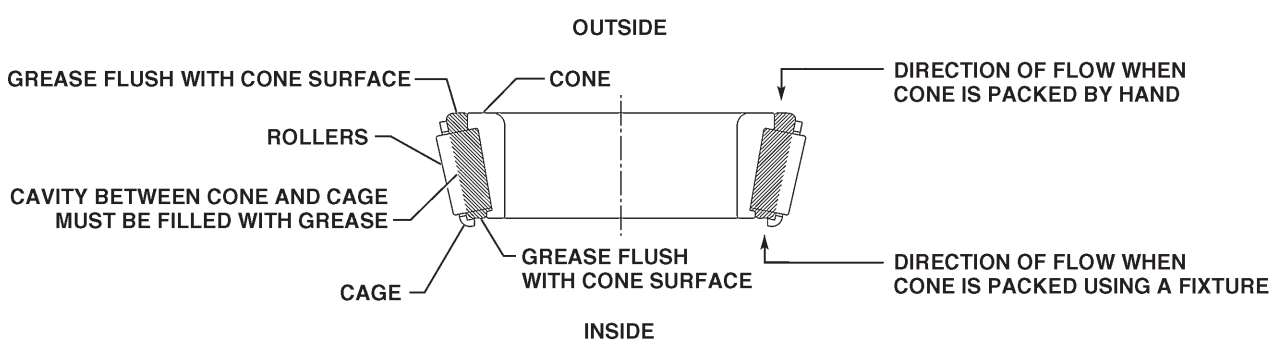
C. Repair

NOTE: Remove rust and blend out small nicks using fine 400 grit sandpaper.

The repair of nose and main wheel assemblies is limited to blending out small nicks, scratches, gouges and areas of slight corrosion, and the replacement of parts that are cracked or badly corroded.

NOTE: Never paint the working surfaces of bearing cups.

Wheels may be repainted if parts have been repaired and thoroughly cleaned. Paint exposed areas with one coat of fluid resistant epoxy primer and one coat of aluminum lacquer.



Wheel Bearing Packing
Figure 2a

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 install a new cup, apply one coat of fluid resistant epoxy 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.

2. <u>Brakes</u>

A. 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.

B. Wheel Brake Assembly

(1) Removal and Disassembly (See Figure 3.)

(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 the brake disc 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.

(g) Remove anchor bolt by the following procedure (see Figure 4):

1) Position cylinder assembly on a holding fixture.

2) Use a suitable arbor press to remove anchor bolt from cylinder body.

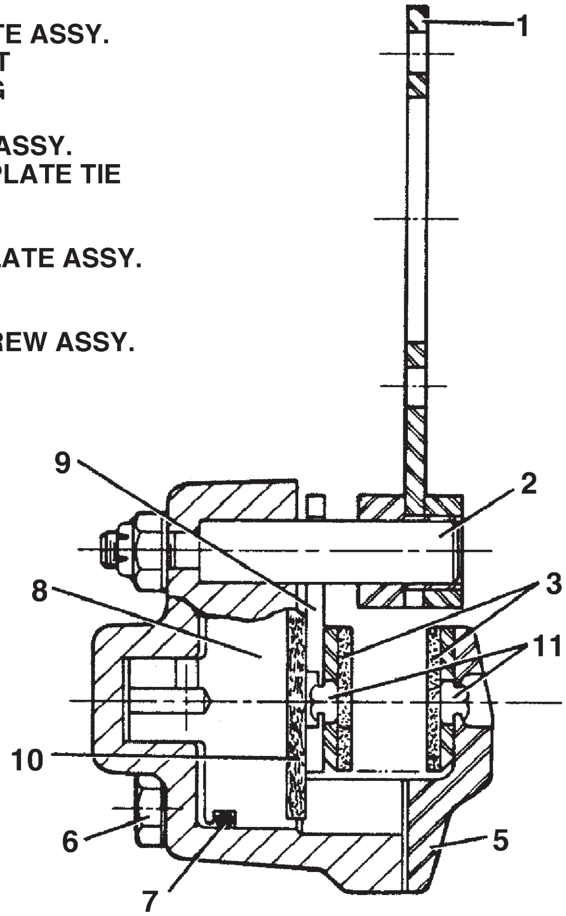
(h) Install anchor bolt by the following procedure:

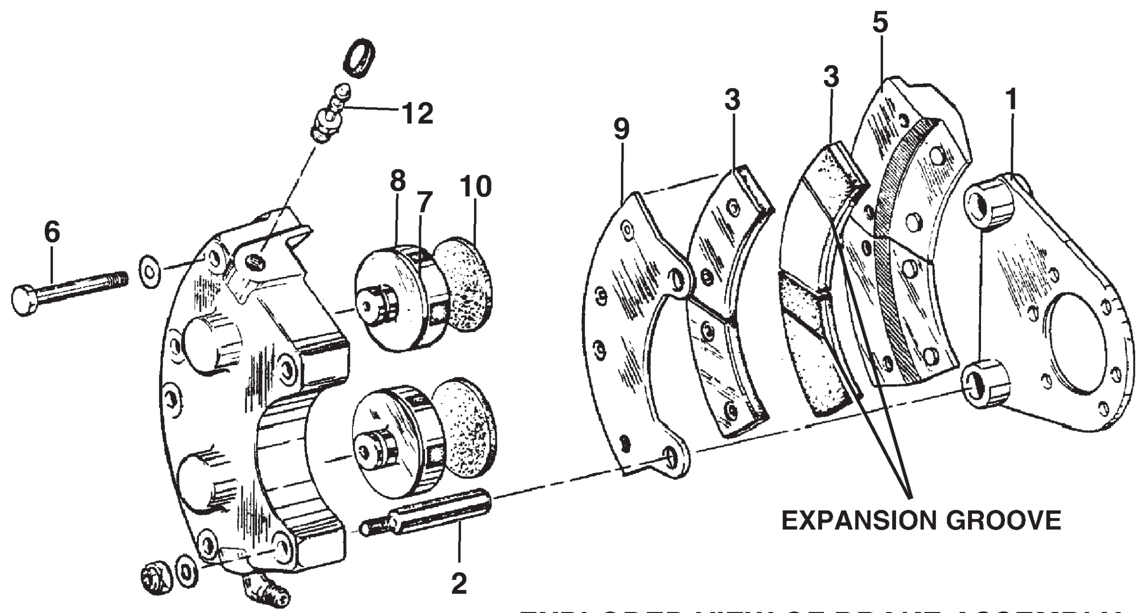
1) Support anchor bolt in a holding fixture. (Figure 4, Step A.)

2) Align cylinder body over anchor bolt. (Figure 4, Step B.)

3) Use a suitable arbor press and apply pressure on spot face directly over anchor bolt hole. (Figure 4, Step C.)

1. TORQUE PLATE ASSY.
2. ANCHOR BOLT
3. BRAKE LINING
4. RIVET
5. BACK PLATE ASSY.
6. BOLT, BACK PLATE TIE
7. O-RING
8. PISTON ASSY.
9. PRESSURE PLATE ASSY.
10. INSULATOR
11. SNAP
12. BLEEDER SCREW ASSY.

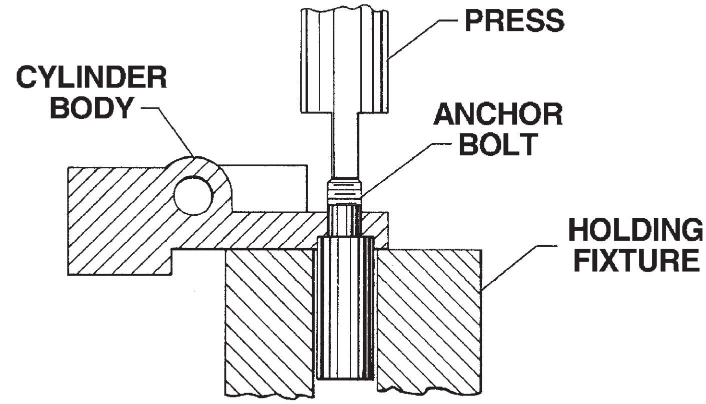




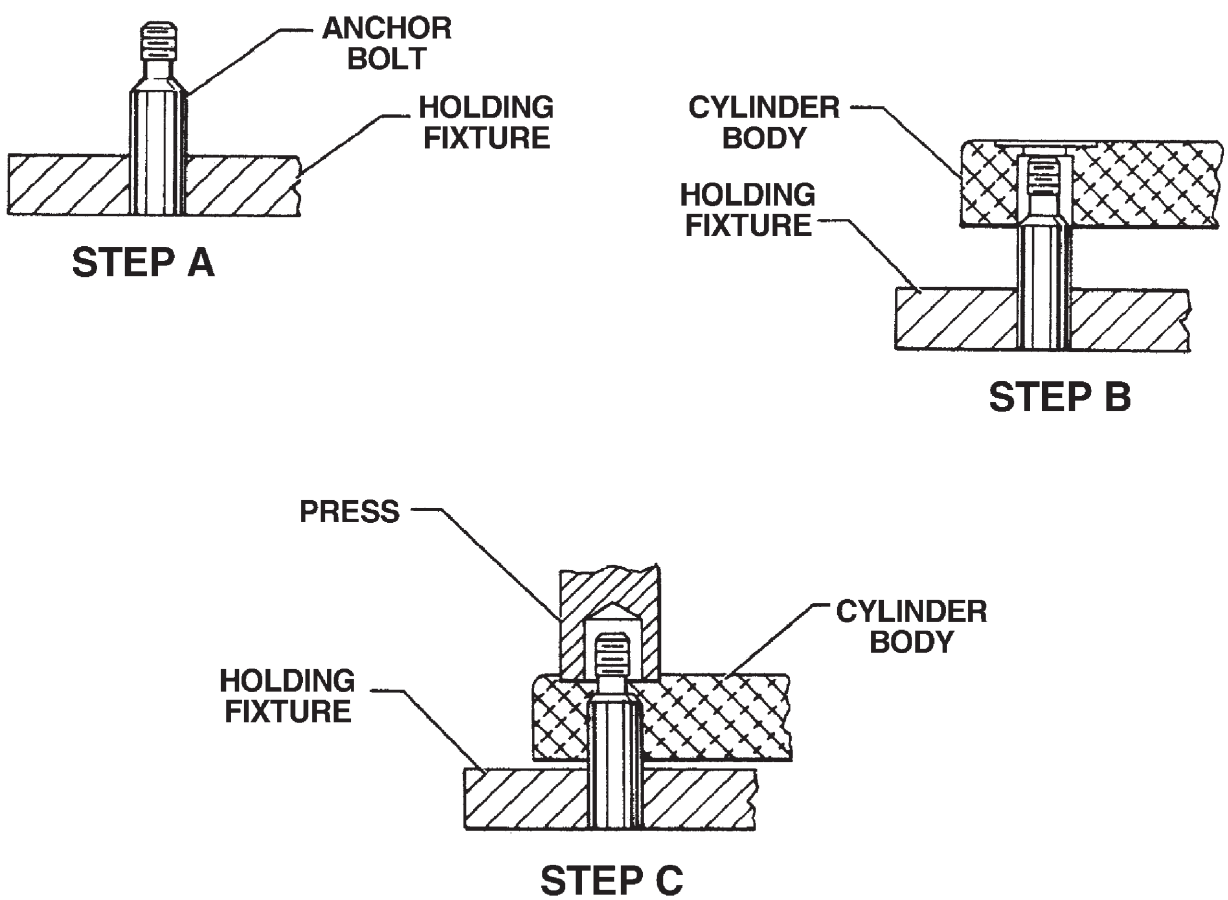
EXPLODED VIEW OF BRAKE ASSEMBLY

30-83 Wheel Brake Assembly
Figure 3

REMOVAL



INSTALLATION



Removal and Installation of Anchor Bolt
Figure 4

(2) Cleaning, Inspection and Repair

(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 the general condition of brake bleeder screw and lines.

(d) Check the brake disc for wear, grooves, scratches or pits. Minimum disc thickness of Disc 164-46 used on Wheel Assembly 40-120 is 0.405 inches. A single groove or isolated grooves up to 0.030 inch deep would not necessitate disc replacement. A grooving of entire disc surface would reduce lining life and should be replaced. If necessary to remove wheel disc, refer to Removal and Disassembly, under Main Wheel Assembly, above.

(e) Check the brake lining expansion groove. If groove is not showing, then replace the linings. Remove linings by prying loose with a flat-bladed 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.

(3) Assembly and Installation (See Figure 3.)

(a) Lubricate piston O-ring(s) with fluid MIL-PRF-5606 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 the bolts and dry torque to 90 inch-pounds to secure assembly.

(e) Connect brake line to brake cylinder housing.

(f) Bleed brake system as described in Bleeding Brakes, below.

C. Hand/Parking Brake Master Cylinder

(1) Removal (See Figure 5.)

(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) Installation (See Figure 5.)

(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.

(d) Connect pressure line to fitting at the bottom of the cylinder.

(e) Connect inlet supply line to fitting at the top of the cylinder. Secure with spring clamp.

(f) Bleed brake system per Bleeding Brakes, below.

(3) Disassembly (See Figure 6.)

(a) Remove cylinder from its mounting bracket per Removal, above.

(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.

(4) Cleaning, Inspection and Repair

(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.

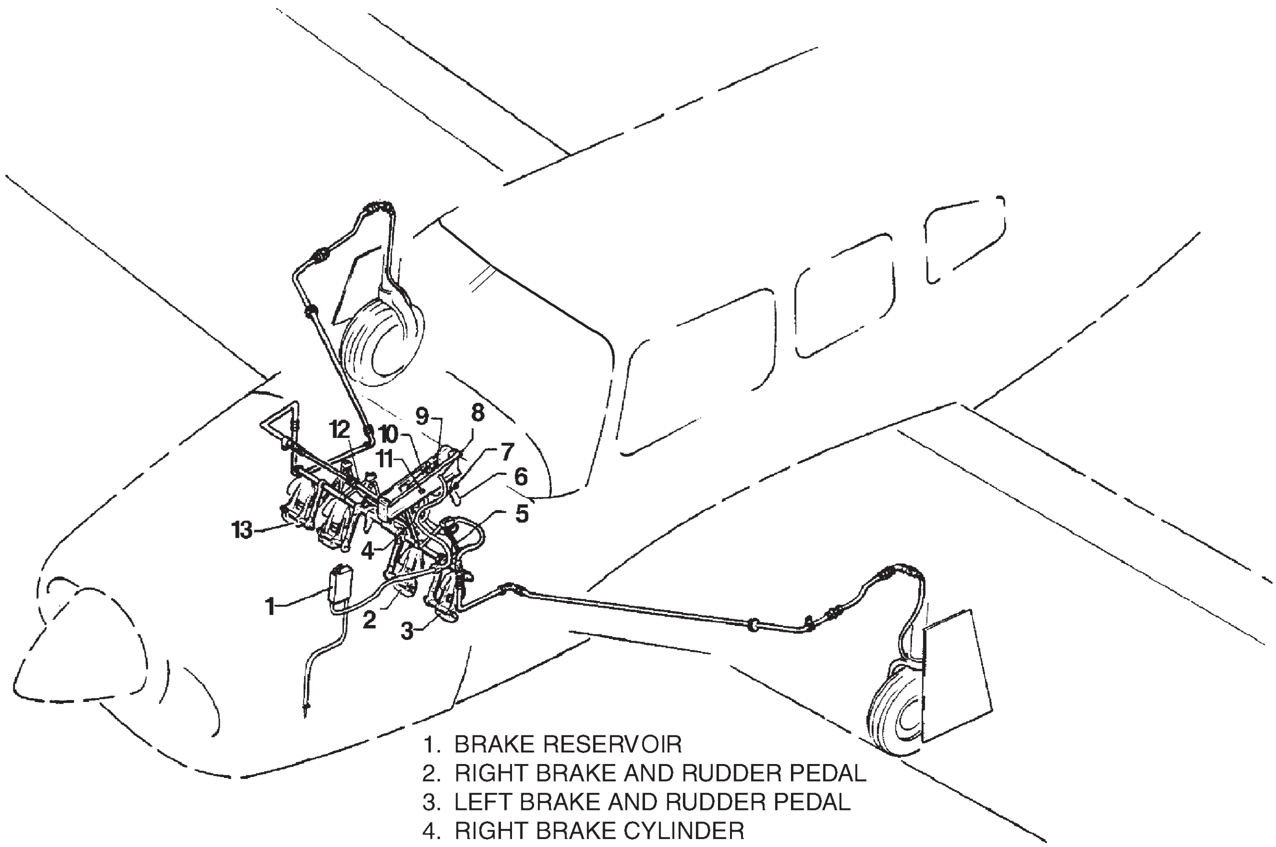
(d) Check piston for scratches, burrs, corrosion, etc.

(e) Repair of the brake cylinder is limited to polishing out small scratches, burrs, etc., and replacement of the O-rings.

(5) Assembly (See Figure 6.)

NOTE: Use a small amount of hydraulic fluid (MIL-PRF-5606) on O-ring and component parts to prevent damage and ease of handling during assembly.

(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 6.)



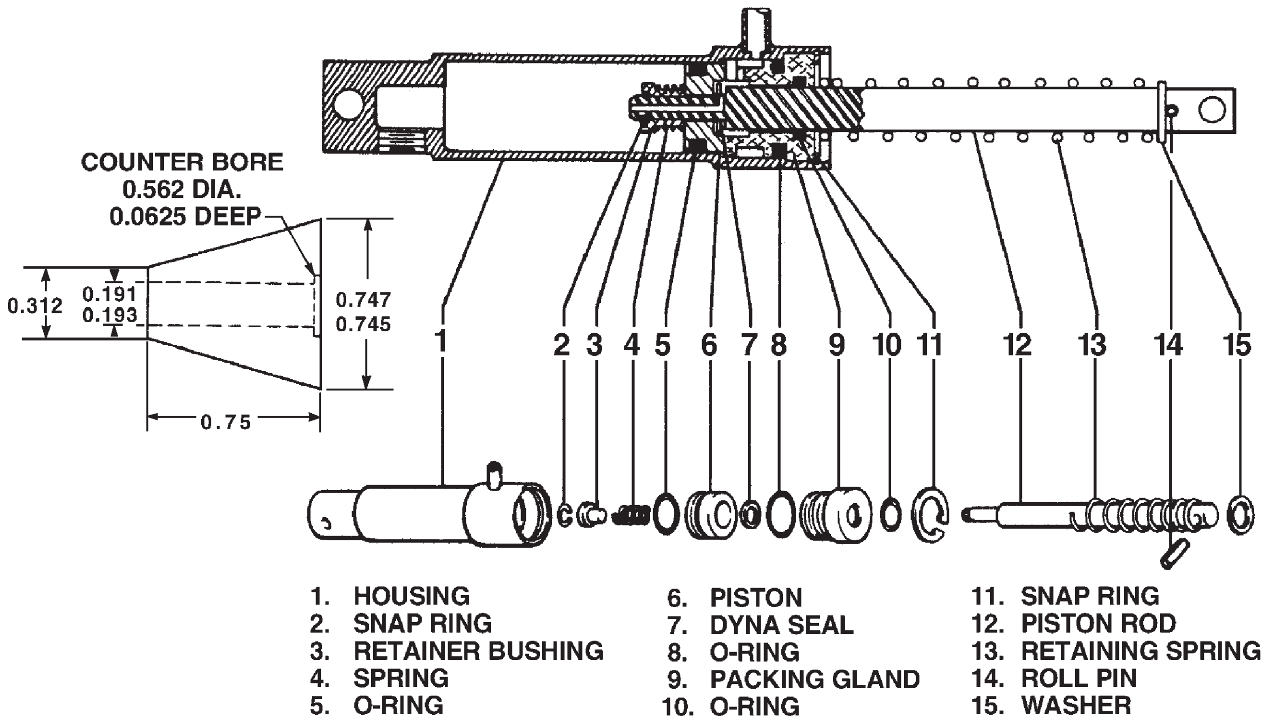
1. BRAKE RESERVOIR
2. RIGHT BRAKE AND RUDDER PEDAL
3. LEFT BRAKE AND RUDDER PEDAL
4. RIGHT BRAKE CYLINDER
5. LEFT BRAKE CYLINDER
6. HAND BRAKE HANDLE
7. HAND BRAKE HANDLE RELEASE BUTTON
8. MASTER CYLINDER ASSEMBLY
9. TORQUE TUBE
10. RUDDER PEDAL PADS
11. BOLT ASSEMBLY
12. CLEVIS PIN
13. INLET LINE

Brake System Installation
Figure 5

(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 master brake cylinder. (See Installation, above.)



Hand/Parking Brake Master Cylinder
Figure 6

D. Toe Brake Cylinder(s) (10-30)

(1) Removal (See Figure 7.)

(a) Disconnect the upper and lower lines from cylinder to be removed. Cap the lines to prevent fluid leakage, or drain the fluid from brake reservoir and master cylinder.

(b) To remove brake cylinder from its attachment fittings: Remove the cotter pins that safety the cylinder attachment pins, then remove the attachment pins.

(2) Disassembly (See Figure 8.)

(a) Remove cylinder from its mounting bracket per Removal, above.

(b) Remove piston rod assembly: Remove the retaining ring from annular slot in cylinder housing. Draw piston rod assembly out 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

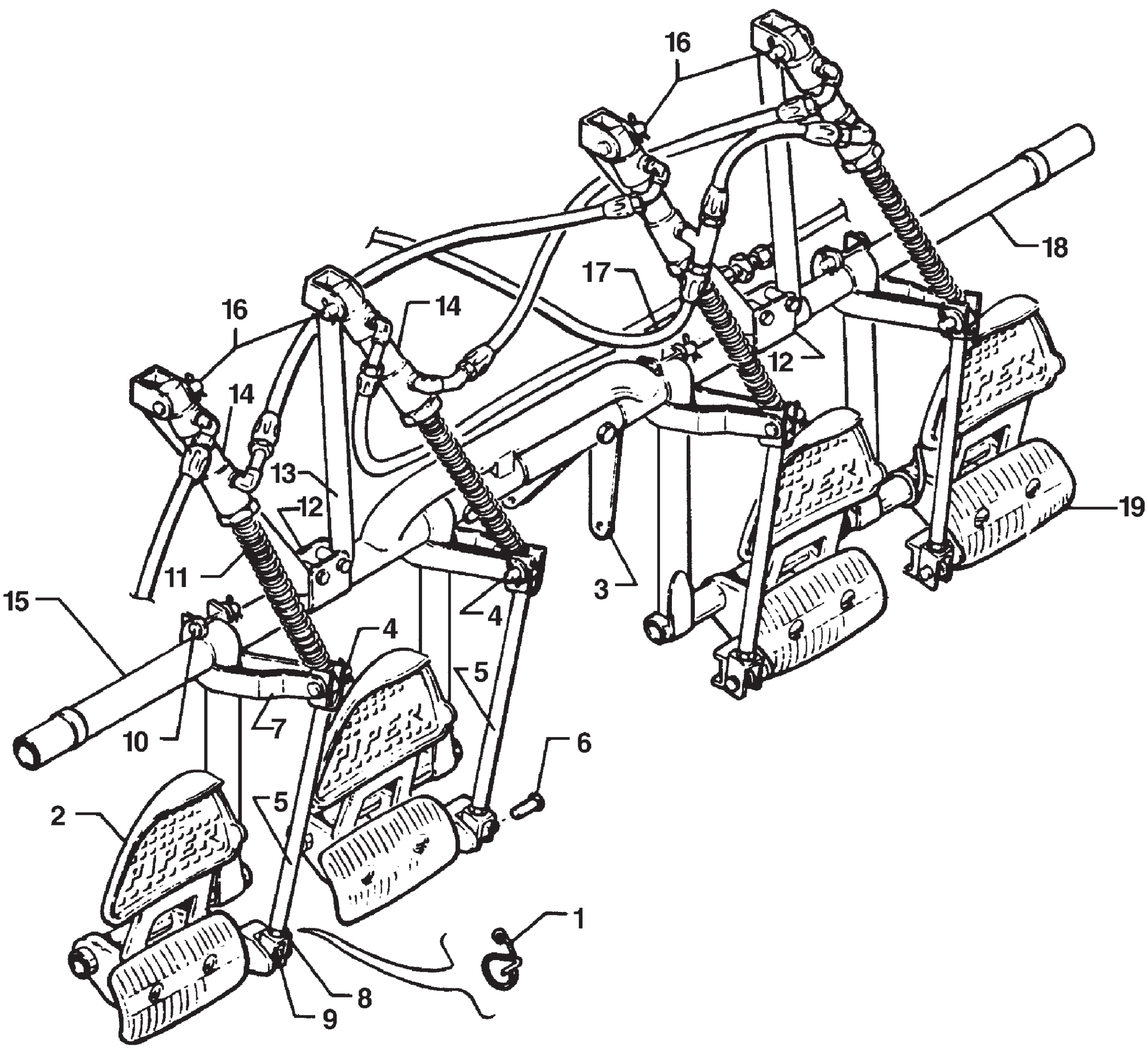
(a) Clean cylinder components with a suitable solvent and dry thoroughly.

(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) Repair of the brake cylinder is limited to polishing out small scratches and burrs and replacing the seal and O-rings.



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

Toe Brake Installation
Figure 7

(4) Assembly (See Figures 8.)

NOTE: Rub a small amount of hydraulic fluid (MIL-PRF-5606) 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, below.

(5) Installation (See Figure 8.)

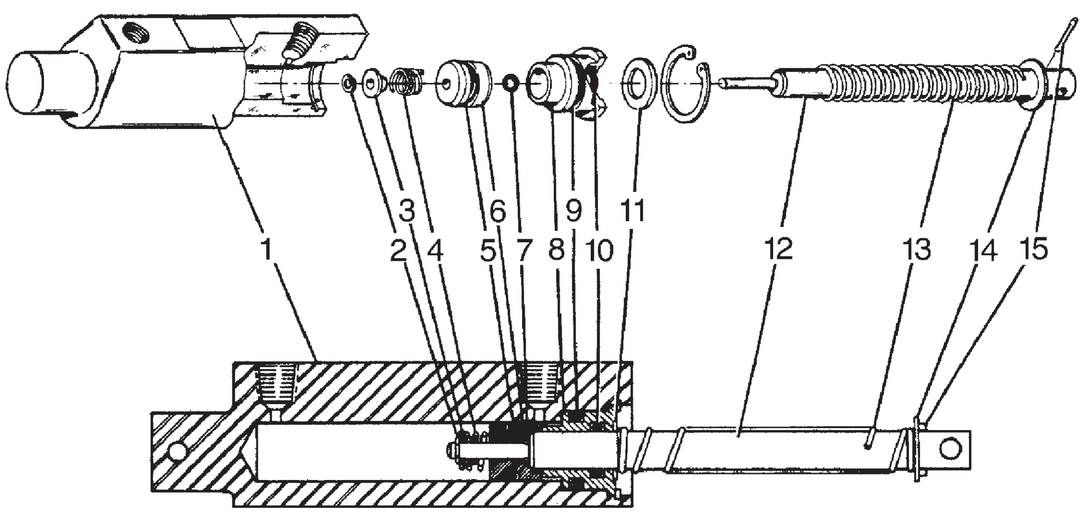
(a) Position the cylinder at its mounting points and attach with clevis pins. Safety the clevis pins with cotter pins.

(b) Connect brake lines to cylinder fittings.

(c) Bleed brakes per Bleeding Brakes, below.

E. 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.



1. HOUSING
2. RETAINING RING
3. SLEEVE
4. SPRING
5. O-RING
6. PISTON
7. O-RING
8. GLAND
9. O-RING
10. O-RING
11. WASHER WIPER
12. ROD
13. SPRING
14. WASHER
15. ROLL PIN

Toe Brake Cylinder (10-30)
Figure 8

F. Bleeding Brakes

(1) Gravity 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-PRF-5606.

(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 ensure 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: Maintain 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.

(2) Pressure 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 hydraulic fluid, MIL-PRF-5606.

(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) 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

1. Landing Gear Limit Switches

NOTE: Make all adjustments of limit switches with airplane on jacks. Do not bend actuator springs mounted on limit switches.

A. 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 1.)

(1) Raise airplane on jacks. (Refer to Jacking, 7-10-00.)

(2) Disconnect gear doors or remove bottom cowl, as desired.

(3) Retract landing gear hydraulically by turning master switch on and moving gear selector switch to UP position.

(4) Block nose gear in up position. Turn master switch off.

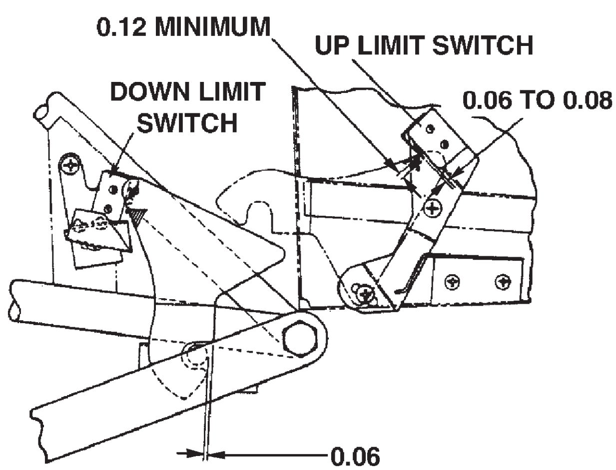
(5) Push gear up tight and block.

(6) Loosen lower attachment screw of switch bracket and rotate switch toward actuator tang until 0.06 to 0.08 inch measurement (noted in Figure 1) is obtained. Switch tang should be actuated a minimum of 0.12 inches in from lower end of tang.

(7) 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.

(8) 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.

(9) Confirm gear is down and locked. Remove airplane from jacks.



Adjustment of Nose Gear Limit Switches
Figure 1

B. 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.

(1) Check that gear is down and locked. Check the master switch is OFF.

(2) Raise airplane on jacks. (Refer to Jacking, 7-10-00)

(3) Down limit switch should actuate only after leading edge of downlock hook, when moving to locked position, has passed downlock roller by 0.06 of an inch. (Refer to Figure 1.) Position hook at this location in relation to roller by moving actuator piston manually toward up position. If necessary, disconnect downlock spring

(4) Loosen lower attachment screw of switch mounting bracket. Move bracket toward downlock hook until it is heard to actuate (click). Retighten bracket attachment screw.

(5) Manually move hook from locked to unlocked position and determine that switch actuates (clicks) at correct location of hook.

(6) 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.

(7) Select master switch OFF

(8) Confirm gear is down and locked. Remove airplane from jacks.

C. 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.

D. 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 downlock hook has entered locked position, and is within 0.025 and 0.035 of an inch of contacting downlock pinto, it actuates and illuminates the appropriate green indicator light in cockpit . (Refer Figure 2.) Adjust switch as follows:

(1) Check that main gear downlock is properly adjusted as described in 32-10-00, Main Landing Gear, Adjustment.

(2) Raise airplane on jacks. (Refer to Jacking, 7-10-00)

(3) Check that master switch is OFF.

(4) Confirm that landing gear is down and pressure is relieved from hydraulic system. To relieve pressure, pull out the emergency extender knob

(5) Raise downlock 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 downlock pin) and rounded surface of pin. Lower hook and allow it to rest on feeler gauge.

(6) 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.

(7) 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.

(8) Push emergency extender knob IN.

(9) 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.

(10) Select master switch OFF.

(11) Confirm gear is down and locked. Remove airplane from jacks.

E. Adjustment of Landing Gear Safety Switch (Squat Switch)

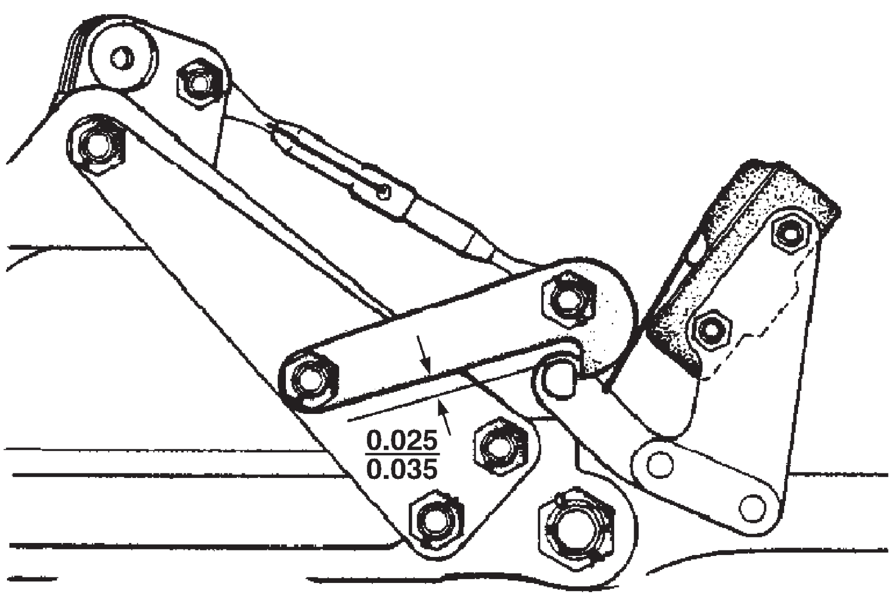
CAUTION: BEFORE BEGINNING THE FOLLOWING PROCEDURES, CHECK THAT THE LEFT GEAR OLEO HAS BEEN SERVICED PER SECTION 32-10-00, PARAGRAPH A, 3.

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.

(1) Compress strut until 7.875 inches is obtained between top of gear fork and bottom of gear housing. Maintain gear at this measurement.

(2) Adjust switch down until it actuates at this point. Secure switch.

(3) Extend and then compress strut to ascertain that switch will actuate within last quarter of an inch of oleo extension.



NOTE: IT MAY BE NECESSARY TO BEND OR ADJUST THE GEAR DOWN MICROSWITCH BRACKET TO CLEAR THE TRUNNION AND ENSURE ENGAGEMENT OF THE MICROSWITCH TANG WHEN THE GEAR IS EXTENDED.

Adjustment of Main Gear Down Limit Switch
Figure 2

2. Landing Gear Up/Power Reduced Warning Switch (PIR-See PPS/FTP Index.)

The gear up/power reduced warning switch (refer to Figure 3, 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 ± 2 inches of manifold pressure.

A. Removal

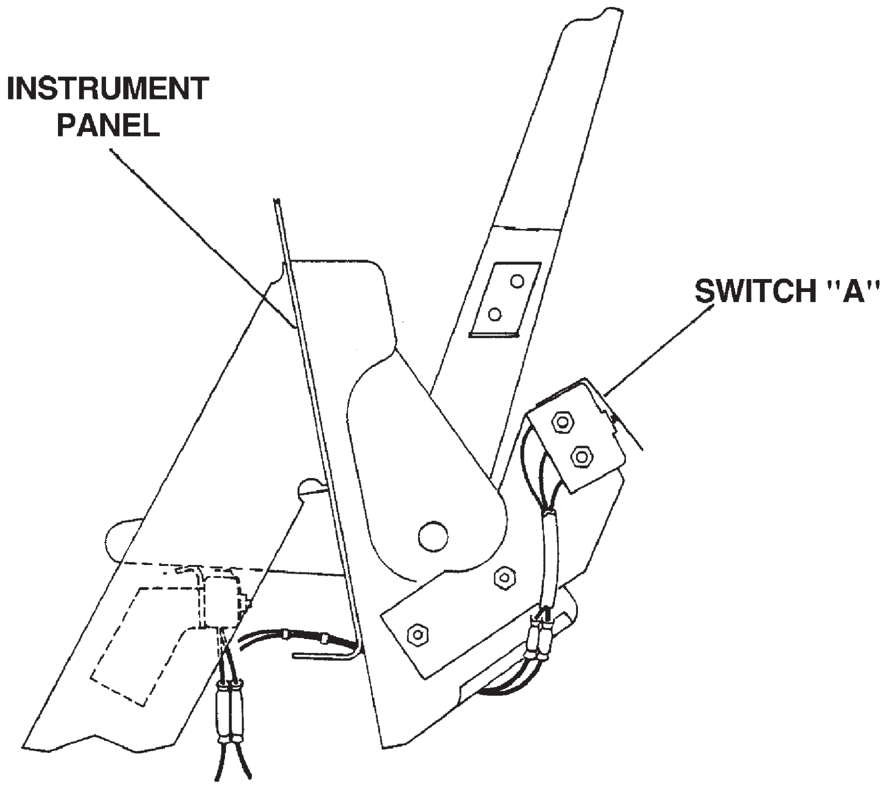
(1) Loosen quadrant cover by removing cover attaching screws from each side and at bottom of cover.
(2) Pull cover aft enough to remove screws that secure reinforcing clip to top underside of cover. Remove cover.
(3) Remove switch from its mounting bracket by removing switch attaching screws.
(4) Disconnect electrical leads from switch.

B. Installation

(1) Connect electrical leads to switch.
(2) Position switch with actuator follower against its mounting bracket and secure with screws.
(3) Switch may be adjusted at this time per instructions in Adjustment of Landing Gear Up/Power Reduced Warning Switch.
(4) 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.
(5) Install cover and secure with screws.

C. Adjustment

(1) Remove control quadrant cover as given in Removal of Landing Gear Up/Power Reduced Warning Switch.
(2) Flight test airplane and at a safe altitude, establish a normal descent with gear up and propeller control at a desired low pitch setting.
(3) Retard throttle to a manifold pressure of approximately 14 inches.
(4) In some manner, mark throttle lever in relation to its position next to mounting bracket.
(5) 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.
(6) Advance and retard throttle to check that switch actuates at desired throttle lever setting.
(7) Flight test airplane to determine that horn and light will actuate when throttle is reduced below 14 ± 2 inches of manifold pressure with gear up.
(8) Install quadrant cover as given in Installation of Landing Gear Up/Power Reduced Warning Switch.



Throttle Warning Switch
Figure 3

3. 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

A. Normal Landing Gear Extension and Retraction

(1) 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.

(2) 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.

B. Emergency Gear Extension:

(1) Establish level flight cruise condition at **90 KIAS**.

(2) Pull 25 amp hydraulic pump circuit breaker.

(3) Place landing gear selector handle in down position and note hydraulic pump does not operate.

(a) While fishtailing airplane, pull emergency landing gear extension control.

(b) Landing gear should extend, and three green locked down position lights should come ON, within 10 seconds.

(c) 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.

(d) Retract gear, system should operate normally.

C. 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.

D. Flap / Landing Gear Position Warning Horn:

Reduce to appropriate flap extended airspeed. With landing gear retracted:

(1) Extend flaps to 10°. Check that horn does not sound.

(2) 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

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CHAPTER 33 - LIGHTS

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GENERAL

1. 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 rheostats. 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.

2. 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

1. 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.

2. Dimmer Control Assembly

A. Removal

(1) Access to Dimmer Control Assembly is from beneath instrument panel.

(2) Disconnect electrical connection from assembly.

(3) Remove two screws securing assembly to instrument panel.

(4) Remove assembly from airplane.

B. Installation

(1) Position assembly in instrument panel with control knobs inserted into appropriate slots.

(2) Secure assembly to instrument panel with two screws previously removed.

(3) Connect electrical connection to assembly.

(4) Check operation of Dimmer Control Assembly.

3. 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.

NOTE: In airplanes equipped with the Garmin 1000 EFIS, annunciation is incorporated into the PFD and MFD.

Lamp Replacement

(1) 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.

(2) 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

1. Description

The landing lights consist of two wing tip lights and one nose gear light, except in HP S/N's 3246001 thru 3246017 and HP S/N's 3246227 thru 3246231 and TC S/N's 3257370 thru 3257385 only (see below).

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 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.

HP S/N's 3246126 thru 3246226, 3246232 & up and TC S/N's 3257076 thru 3257369, 3257386 & 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.

HP S/N's 3246227 thru 3246231 and TC S/N's 3257370 thru 3257385 only incorporate a pulse relay to allow flashing the wing leading edge landing lights for recognition purposes. One three-position Landing/ Pulse lights rocker-type switch in the overhead switch panel (wired through the 15 amp LANDING / TAXI LIGHT circuit breaker) controls these two lights. When the switch is in the up (landing) position, both lights in each wing leading edge illuminate. When the switch is in the center (off) position, all lights are off. When the switch is in the down (pulse) position, the wing leading edge lights will illuminate alternately (i.e. - pulse) at 55 pulses-per-minute.

If installed, 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.

2. Nose Gear Landing/Taxi Light

A. Removal

(1) Remove screws (4) securing retainer ring/bezel and remove retainer ring/bezel.

(2) Pull lamp out and remove electrical leads connected to it. (Make note of wire placement on lamp to facilitate installation.)

B. Installation

(1) To install lamp, reconnect electrical leads and insert lamp into position

(2) Position retainer ring/bezel and secure with screws (4).

3. Wing Tip Landing / Taxi Lights (See Figure 1.)

In HP S/N's 3246018 thru 3246226, 3246232 & up and TC S/N's 3257001 thru 3257369, 3257386 & up

A. Removal

(1) Remove screws/washers (9) securing the appropriate Plexiglas lens and remove lens.

NOTE: Use care not to disturb adjustment bolts when removing landing light bulb(s). Should adjustment bolt settings be disturbed, check light alignment after installing new bulb.

(2) Remove the three lamp retaining screws. Remove retaining ring. (Refer to Figure 1.)

(3) Pull lamp forward far enough to gain access to the electrical connection tabs on back of the lamp.

(4) Remove the two brass screws connecting the electrical leads to the lamp.

(5) Remove and discard defective bulb.

B. Installation

(1) Connect electrical leads to replacement bulb using two brass screws.

(2) Position lamp in place and install retainer ring.

(3) Install the three lamp retaining screws.

(4) Check lamp function by turning BATT MAST switch on and selecting LND LIGHT switch on.

(5) Place BATT MAST and landing light switch in OFF position.

(6) Install Plexiglas lens and secure with screws/washers (9).

C. Adjustment (Alignment) (See Figures 1 and 2.) (PIR-PPS50047-1, Rev. B.)

(1) Locate airplane 20 feet from a target wall as shown in Figure 2.

(2) Level airplane both vertically and horizontally. (Refer to 8-20-00.)

(3) Remove the appropriate Plexiglas cover lens.

(4) Connect airplane to a 28 Vdc external power supply.

(5) Position the BATT MAST and LDG LIGHT switches ON.

(6) Adjust the three (3) landing light adjustment bolts (see Figure 1) as necessary to move the landing light housing so that the center of the light beam illuminates the target wall at the following locations. (Refer to Figure 2.):

(a) Left light beam is centered at a point 32 ± 1 inches up from the floor and 15 feet ± 3 inches outboard to the left from the airplane's centerline.

(b) Right light beam is centered at a point 32 ± 1 inches up from the floor and 15 feet ± 3 inches outboard to the right from the airplane's centerline.

(7) Position the BATT MAST and LDG LIGHT switches OFF.

(8) Disconnect 28 Vdc external power supply.

(9) Install Plexiglas cover lens.

(10) Remove devices used to level airplanes. (Refer to 8-20-00.)

4. Wing Leading Edge Landing / Taxi Lights (See Figure 3.)

HP S/N's 3246227 thru 3246231 and TC S/N's 3257370 thru 3257385

A. Removal

(1) Remove screws/washers (18) securing the appropriate Acrylic lens. Remove lens.

NOTE: Should adjustment screw settings be disturbed, check light alignment after installing new bulb.

(2) Remove the four (4) lamp retaining screws and coil springs. Remove retainer bezel. (Refer to Figure 3.)

(3) Pull lamp forward far enough to gain access to the electrical connection tabs on back of the lamp.

(4) Remove the two brass screws connecting the electrical leads to the lamp.

(5) Remove and discard defective bulb.

B. Installation

(1) Connect electrical leads to replacement bulb using two brass screws.

(2) Position lamp in place and install retainer bezel.

(3) Install the four (4) lamp retaining screws and coil springs.

(4) Check lamp function by turning BATT MAST switch on and selecting LND LIGHT switch on.

(5) Place BATT MAST and landing light switch in OFF position.

(6) Install Acrylic lens and secure with screws/washers (18).

C. Adjustment (Alignment) (See Figures 3 and 4.) (PIR-PPS50047-3, Rev. NEW.)

(1) Locate airplane 20 feet from a target wall as shown in Figure 4.

(2) Level airplane both vertically and horizontally. (Refer to 8-20-00.)

(3) Remove the appropriate Acrylic cover lens.

(4) Connect airplane to a 28 Vdc external power supply.

(5) Position the BATT MAST and LDG LIGHT switches ON.

(6) Adjust the four (4) landing light adjustment screws (see Figure 3) as necessary to move the landing light housing so that the center of the light beam illuminates the target wall at the following locations. (Refer to Figure 4.):

(a) Left light beam is centered at a point 30 ± 1 inches up from the floor and 12 feet ± 3 inches outboard to the left from the airplane's centerline.

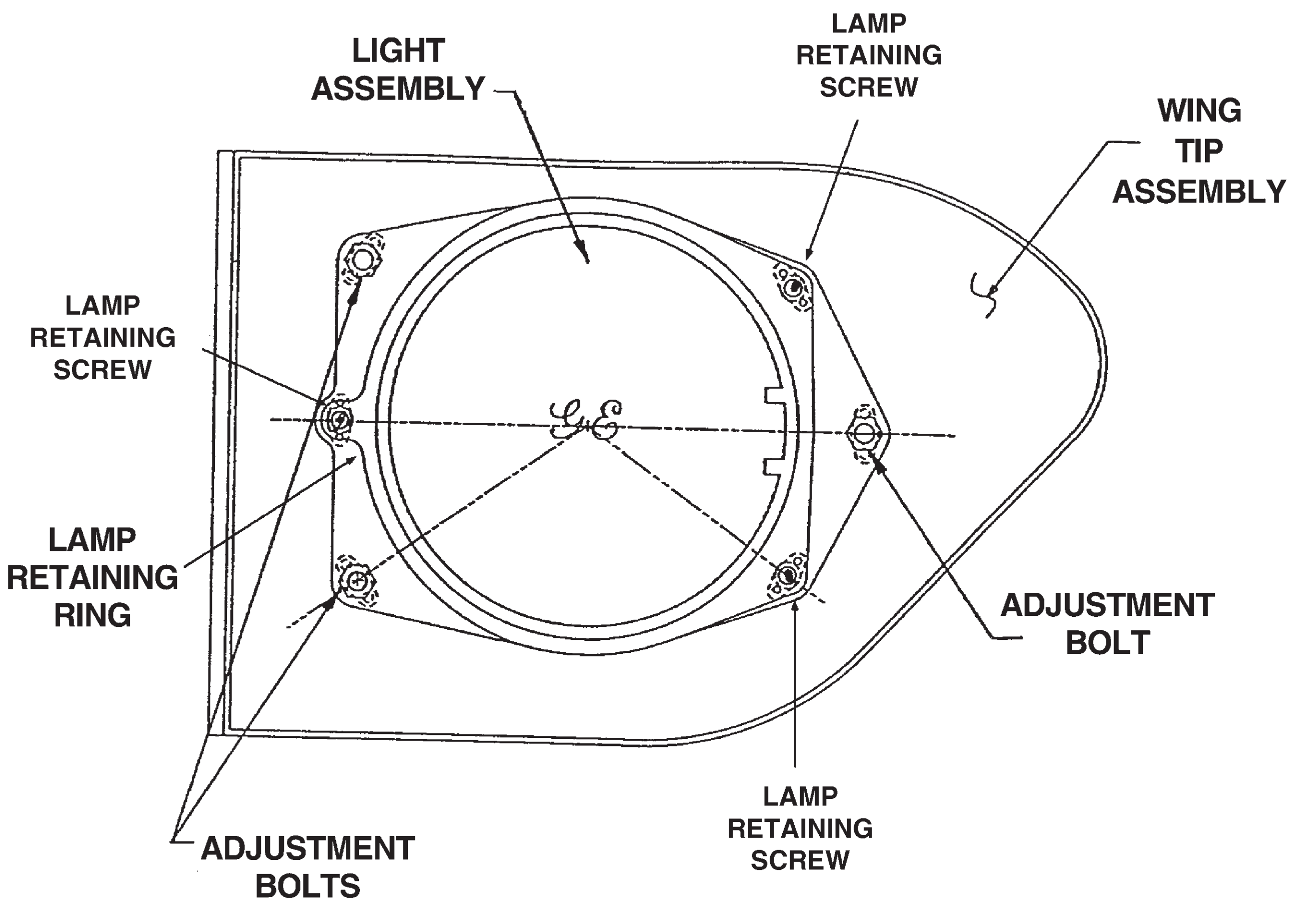
(b) Right light beam is centered at a point 30 ± 1 inches up from the floor and 13 feet ± 3 inches outboard to the right from the airplane's centerline.

(7) Position the BATT MAST and LDG LIGHT switches OFF.

(8) Disconnect 28 Vdc external power supply.

(9) Install Acrylic cover lens.

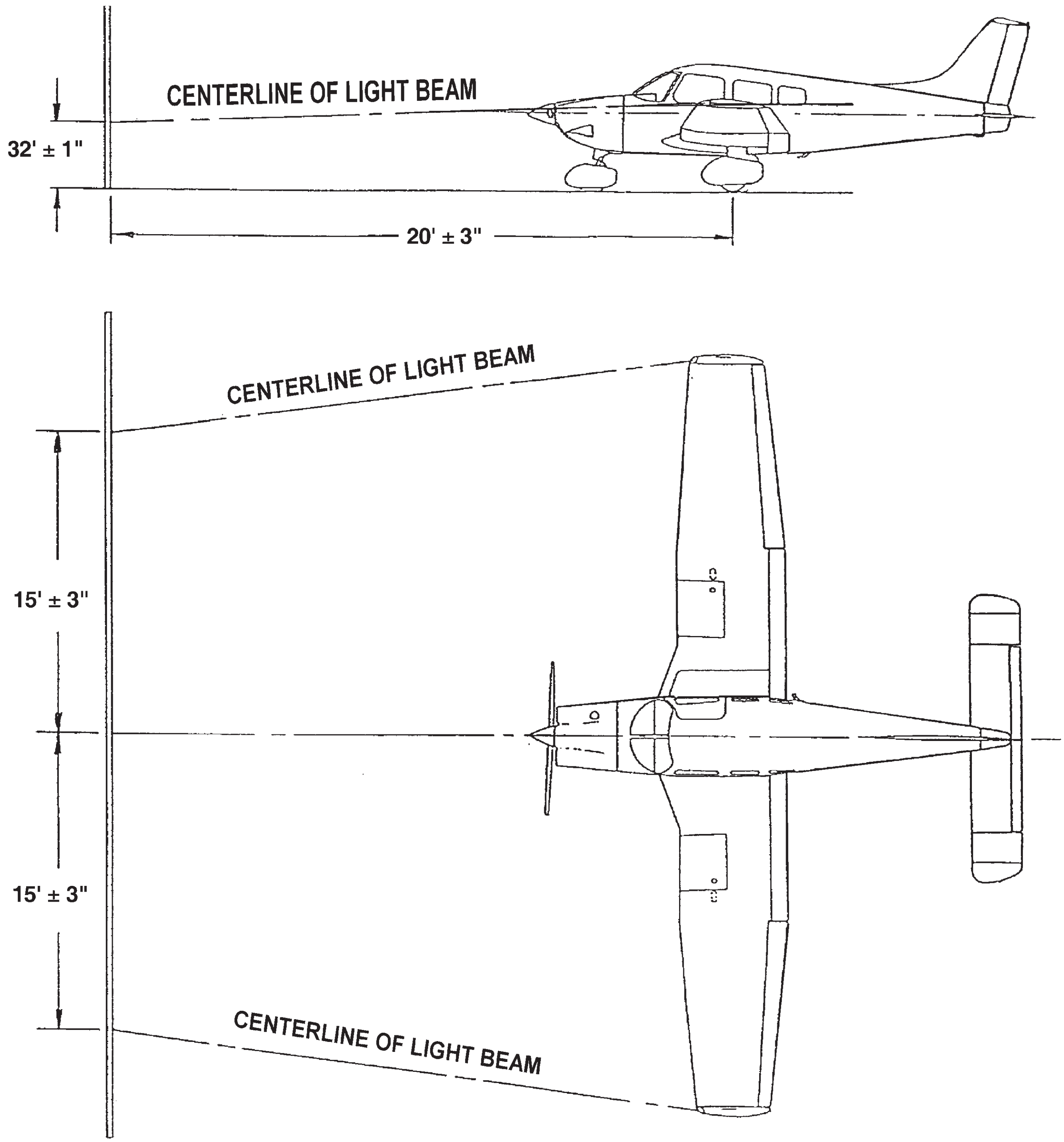
(10) Remove devices used to level airplanes. (Refer to 8-20-00.)



Effectivity
3246018 thru 3246226,
3246232 and up
3257001 thru 3257369,
3257386 and up

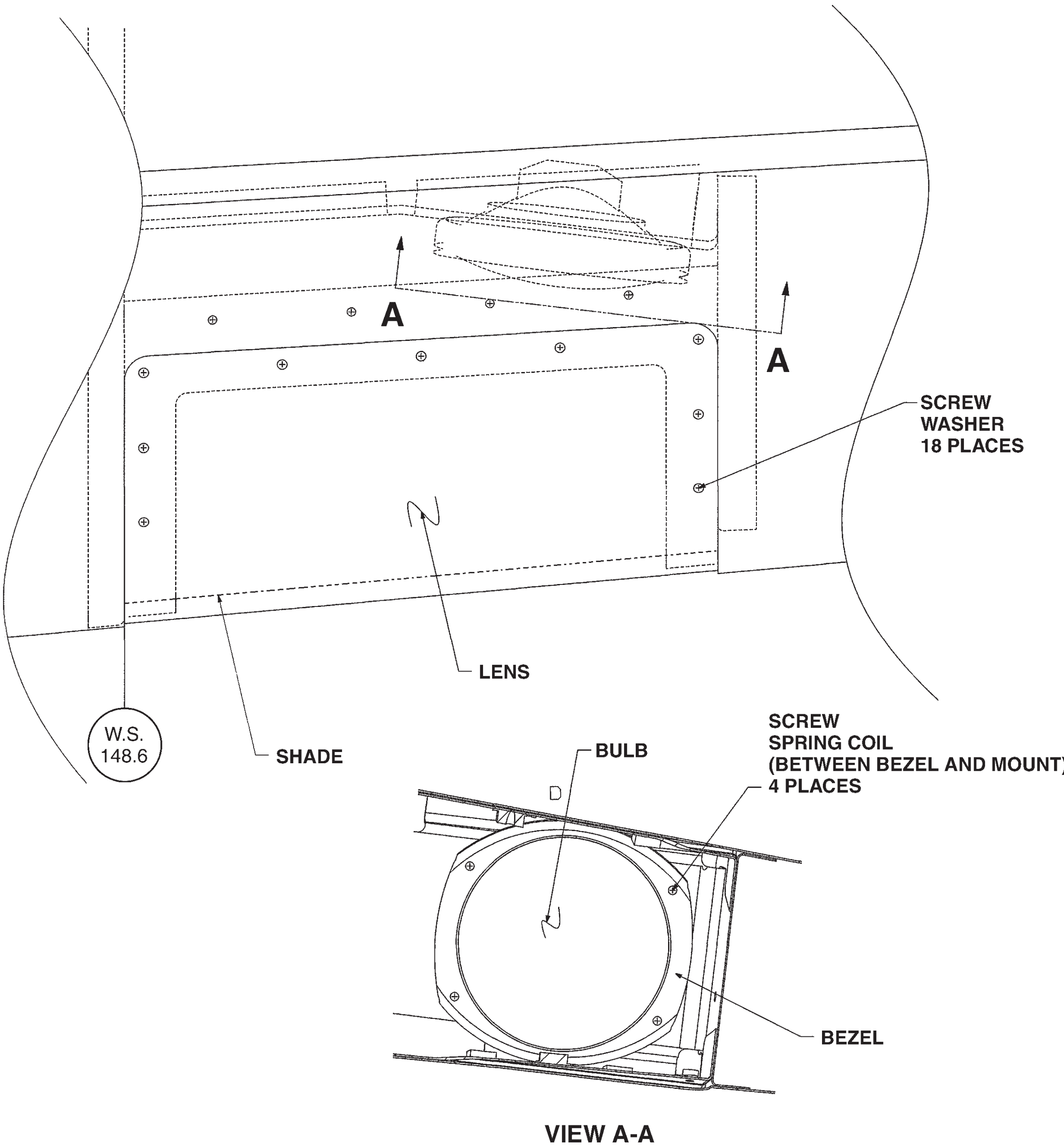
Wing Tip Landing Light Installation
Figure 1

(PIR-PPS50047-1, REV. B)



Effectivity
3246018 thru 3246226,
3246232 and up
3257001 thru 3257369,
3257386 and up

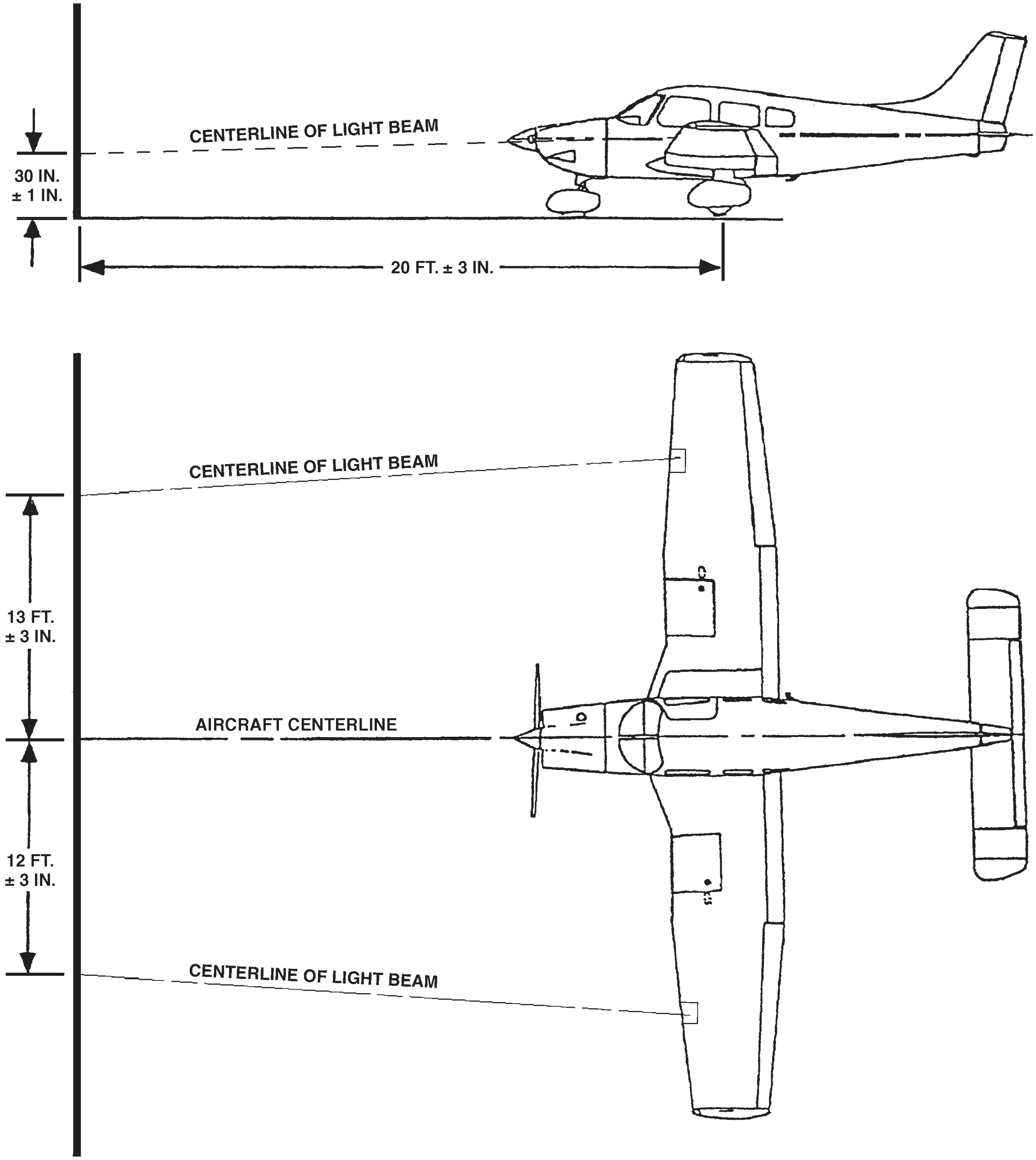
Wing Tip Landing Light Aiming
Figure 2



Effectivity
3246227 thru 3246231
3257370 thru 3257385

Wing Leading Edge Landing Light Installation
Figure 3

(PIR-PPS50047-3, REV. NEW)



Wing Leading Edge Landing Light Aiming
Figure 4

Effectivity
3246227 thru 3246231
3257370 thru 3257385

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5. 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 Wing Tip Landing / Taxi Lights above.

6. 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.

7. 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.

A. Removal

(1) Remove screw securing navigation light cover and remove cover.

(2) Remove the three screws securing navigation light bracket assembly and pull out.

(3) Remove strobe lamp by cutting wires on lamp beneath mounting bracket.

(4) Remove defective lamp.

(5) Remove and discard plug with cut wires from its electrical socket.

B. Installation

(1) Route wires from new lamp down through hole in navigation light bracket.

(2) 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.

(3) Position strobe lamp on navigation light bracket.

(4) Secure navigation light assembly and bracket with appropriate screw.

C. Strobe Power Supply (See Figure 5).

Strobe power supply is in aft section of fuselage.

(1) Removal

(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.

(2) Installation(see Figure 5)

(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.

D. 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 normally 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.

(1) 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.

(2) 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.

(a) Ascertain pins 1 and 3 of interconnecting cables are not reversed.

(b) 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.

(3) Check interconnecting cables for shorts.

(a) Disconnect output cables from power supply outlets.

(b) The following continuity checks can be made with an ohmmeter.

(c) 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.

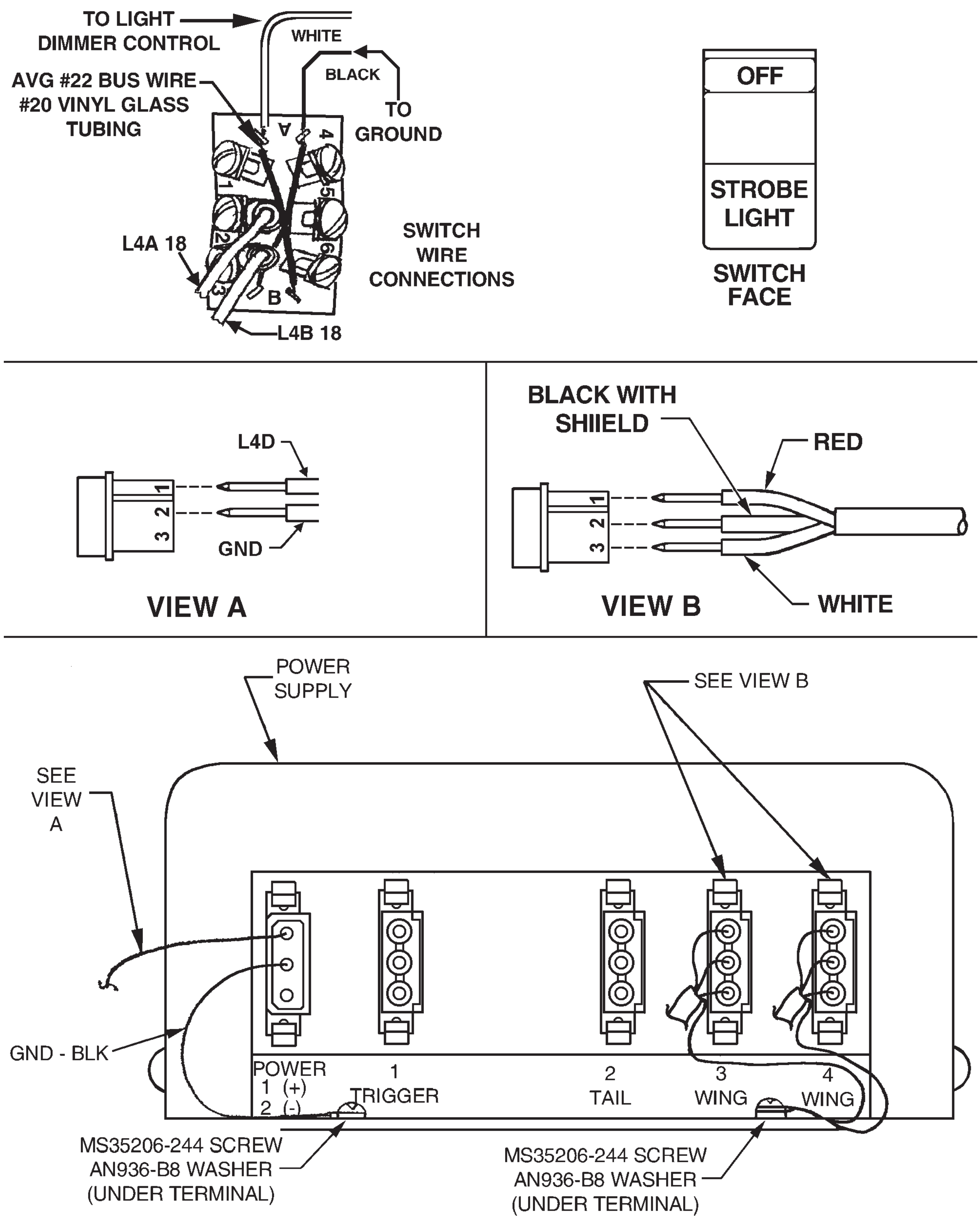
(d) Check continuity between pins 1 and 2, 1 and 3, 2 and 3 of interconnecting cable. If continuity exists between any of these connections, cable is shorted and should be replaced.

(4) Check tube socket assembly for shorts.

(a) Disconnect tube socket assembly of anti-collision light from interconnecting cable.

(b) The following continuity checks can be made with an ohmmeter.

(c) Check for continuity between pin 1 of AMP connector to pin 1 of tube socket. Pin 2 of AMP connector to 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.



Strobe Light Connections
Figure 6

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CHAPTER

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NAVIGATION

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CHAPTER 34

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	123	Jan 31/08
	124	Jan 31/08
	125	Jan 31/08
	126	Jan 31/08
	127	Jan 31/08
	128	Dec 31/09
	129	Jan 31/08
	130	Jan 31/08
	131	Jan 31/08
	132	Jan 31/08
	133	Feb 28/09
	134	Feb 28/09
	135	Feb 28/09
	136	Feb 28/09
	137	Jan 31/08
	138	Jan 31/08
	139	Jan 31/08
	140	Jan 31/08
	142	Jan 31/08
	142	Jan 31/08
	143	Jan 31/11
	144	Jan 31/08
	145	Jul 31/13
	146	Jan 31/08
	147	Jan 31/08
	148	Jan 31/08

CHAPTER 34

LIST OF EFFECTIVE PAGES (continued)

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CHAPTER 34 - NAVIGATION

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CHAPTER 34 - NAVIGATION

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CHAPTER 34 - NAVIGATION

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CHAPTER 34 - NAVIGATION

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GENERAL

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

1. 1995 thru 2003 (HP S/N's 3246001 thru 3246217 and TC S/N's 3257001 thru 3257338.)

   Traditional 3.25 inch flight instruments are installed as standard equipment. These instruments are face mounted, see 39-10-00 for removal and installation.

2. 2004 and up (HP S/N's 3246218 and up and TC S/N's 3257339 and up.)

   A. In early airplanes, traditional 3.25 inch flight instruments are installed as standard equipment. These instruments are face mounted, see 39-10-00 for removal and installation.

   B. Available initially as an option, and then as later as standard equipment (HP S/N's 3246218, 3246220 thru 3246222, 3246224 thru 3246244 and TC S/N's 3257339, 3257341 thru 3257446, 3257448 thru 3257454, 3257460, 3257475, 3257480, 3257485, and 3257487), the Avidyne FlightMax Entegra Electronic Flight Instrument System (EFIS) may be installed.

   This system uses two large 10.4-inch diagonal, high-resolution, sunlight-readable full color displays (PFD and MFD), to provide standard flight instrumentation including attitude direction indicator (EADI), horizontal situation indicator (EHSI), altitude, airspeed, vertical speed, moving map, weather, terrain and traffic data, as well as all engine instrumentation. Standard primary flight instruments (i.e. - airspeed, electric attitude indicator, and altimeter) provide redundancy. (See 34-20-00, Figure 1.)

   The EFIS installation consists of the following components: Primary Flight Display (PFD); Multi-function Display (MFD); Data Acquisition Unit (DAU), and associated sensors; and a Magnetometer/OAT Sensor Assembly.

   Line maintenance of this system is limited to basic troubleshooting and that is addressed in 34-20-00.

   C. Beginning in 2007 models, the Garmin G1000 Integrated Avionics System (IAS) is available as an option.

   The G1000 avionics system consists of two displays, one dedicated as a Primary Flight Display (PFD) and the other as a Multi-function Display (MFD). Functions provided by the system include display of attitude, heading, navigation, traffic (future option), air data, engine and airframe status, and situational awareness of a moving map display with position derived by GPS. In addition to display functions, GPS navigation, VHF/Com, VOR/ILS and transponder functions are provided by the system and controlled by knobs and buttons located on the PFD and MFD bezels.

   Standard altitude and airspeed indicators and a magnetic compass are also installed as secondary, independent sources of altitude, airspeed, and (non-stabilized) heading information. An electric attitude indicator is installed to provide an independent source for attitude information.

   Line maintenance of this system is limited to basic troubleshooting and that is addressed in 34-20-00.

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FLIGHT ENVIRONMENT DATA

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 Instrument System is also available 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.

1. Pitot / Static System

NOTE: If any connection in the pitot / static system is opened for maintenance, the entire system must be rechecked per Pitot / Static System, Test, below.

A. Description and Operation

See Figure 1.

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 on the instrument panel or, if Avidyne Entegra or Garmin G1000 is installed, to the Primary Flight Display (PFD) or GDC 74A Air Data Computer (ADC), respectively. 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 on most airplanes. The exceptions are HP S/N's 3246001 thru 3246017, which have a single static port located on the bottom of a 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 and, if Avidyne Entegra is installed, to the PFD. If Garmin G1000 is installed, the static system is connected to the GDC 74A ADC which then feeds the PFD.

An alternate static air source is located below the instrument panel in front of the pilot. The alternate static source is part of the standard system and has a shutoff valve which closes the port when it is not needed. A placard giving instructions for use is located on instrument panel.

Pitot and static lines can be drained through separate drain valves located on the lower left side of the fuselage interior.

B. Pitot Head

See 30-30-00 for detailed removal and installation diagrams.

(1) Removal

The pitot head is located on the lower side of the left wing.

(a) Remove the four screws which secure the pitot tube to the mast assembly.

(b) Carefully pull the pitot tube from the mast assembly.

(c) Remove the hose from the elbow on top of the pitot tube.

(d) Disconnect the electrical leads at the connector.

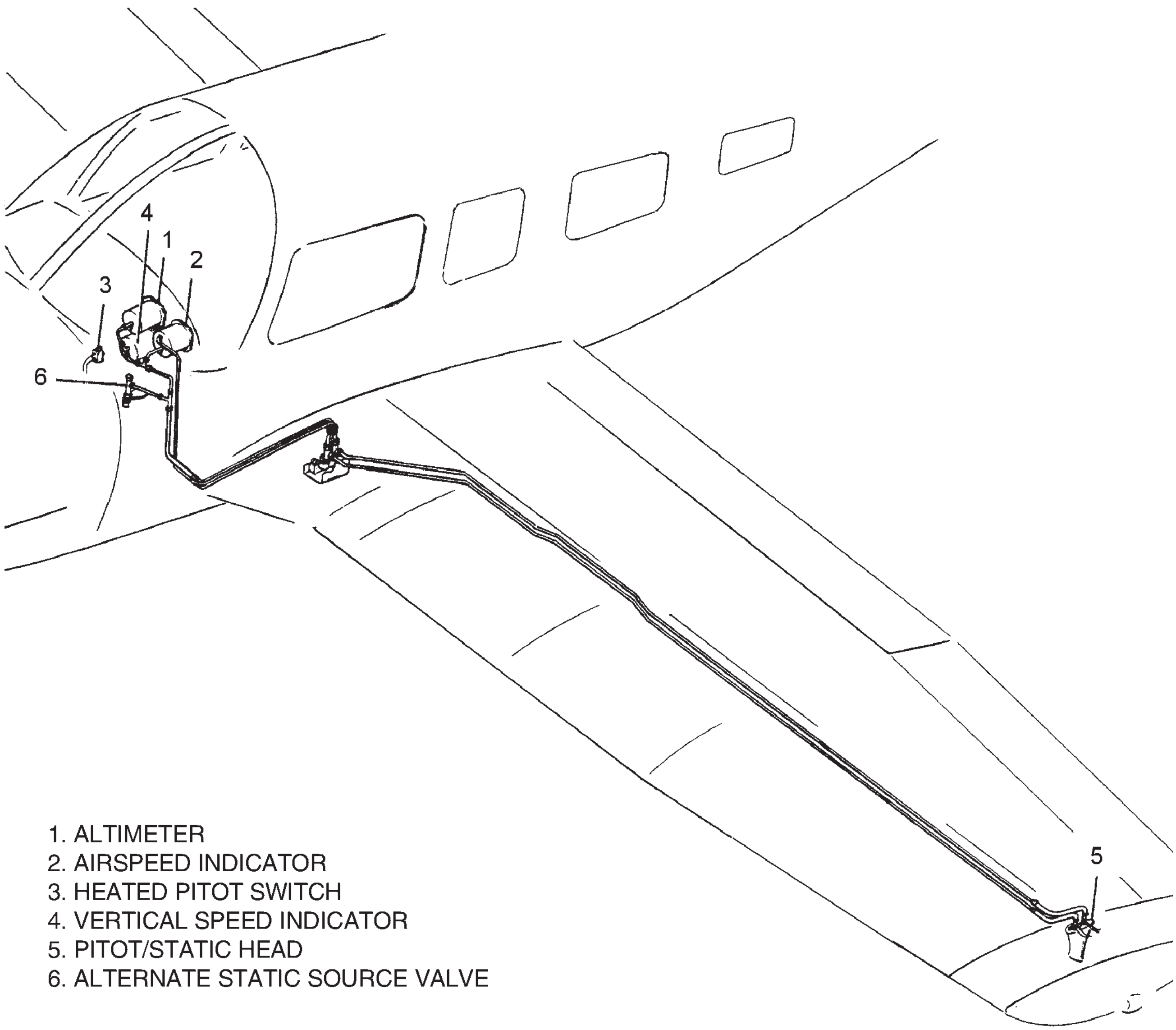
(2) Installation

(a) Reconnect the electrical leads to the heating elements.

(b) Install the pitot tube into the mast assembly.

(c) Secure the pitot tube to the mast assembly with the four screws.

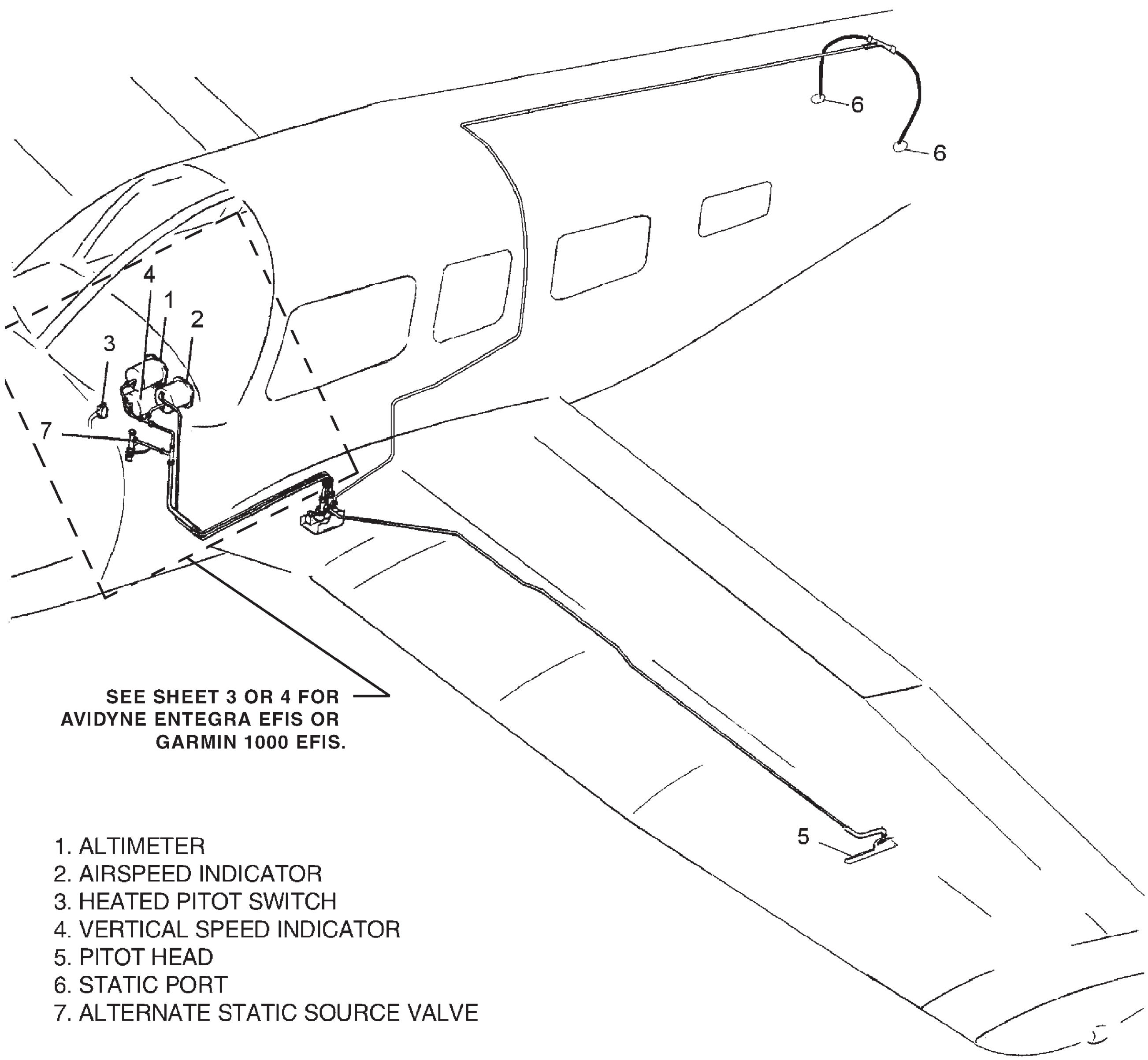
(d) Reconnect the electrical leads to the gauge.



1. ALTIMETER
2. AIRSPEED INDICATOR
3. HEATED PITOT SWITCH
4. VERTICAL SPEED INDICATOR
5. PITOT/STATIC HEAD
6. ALTERNATE STATIC SOURCE VALVE

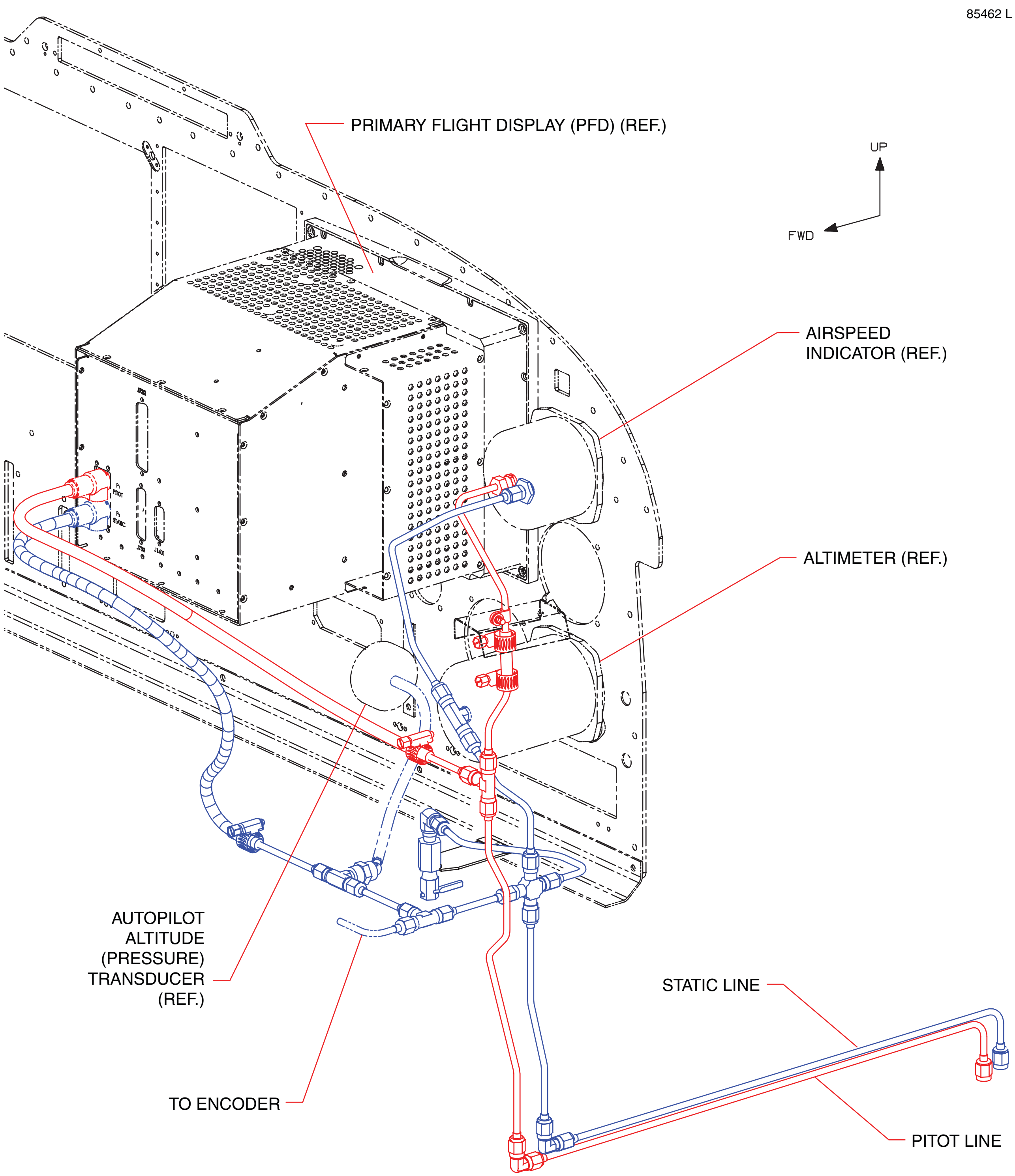
Effectivity
3246001 thru 3246017

Pitot-Static System Installation
Figure 1 (Sheet 1 of 4)



Pitot-Static System Installation
Figure 1 (Sheet 2 of 4)

Effectivity
3246018 and up
3257001 and up

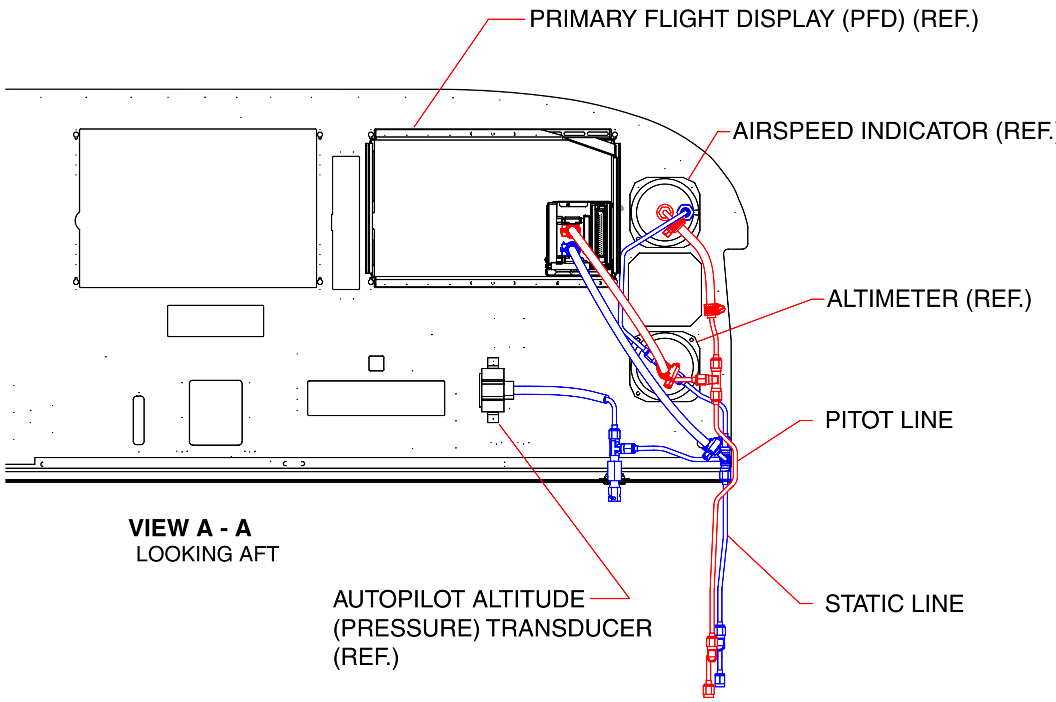


AVIDYNE ENTEGRA INSTALLATION

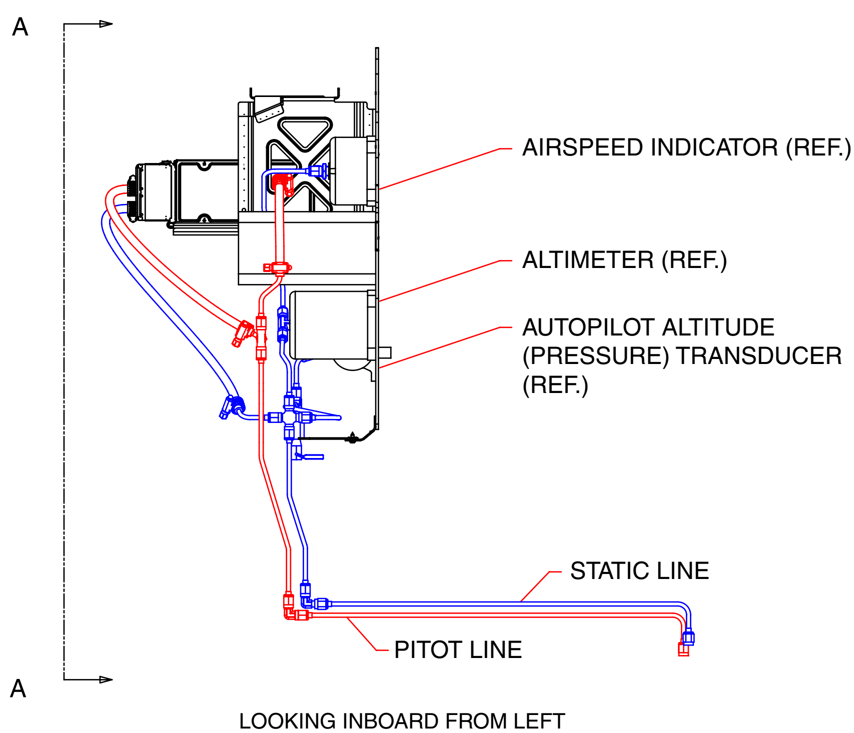
Effectivity
with Avidyne Entegra

Pitot-Static System Installation
Figure 1 (Sheet 3 of 4)

85462 W



GARMIN 1000 INSTALLATION



INTERNATIONAL AEROTECH ACADEMY FOR TRAINING PURPOSES ONLY

Pitot-Static System Installation
Figure 1 (Sheet 4 of 4)

Effectivity
with Garmin 1000

C. Test

(PIR-PPS60035, Rev. V.)

This test requires a pitot/static test fixture (i.e. - Aerosonic Air Data Test Set - Model 90000-0168 or equivalent) and calibrated air source (i.e. - airspeed simulator) and should be performed at any time an instrument, fitting, line, pitot head, or static button is disconnected. The test should be performed prior to the next flight.

NOTE: In airplanes equipped with Garmin G1000, see GDC 74A Testing under Integrated Avionics System - Garmin, Post-Installation Set-up, System Testing and Checkout, in 34-20-00, before beginning this test.

NOTE: In airplanes equipped with Avidyne Entegra or Garmin G1000, supply ground power per 24-40-00.

NOTE: Ensure the lines and fittings are free of any entrapped moisture or restrictions.

(1) Attach the test fixture to the pitot head. Align the holes in the fixture with the holes in the head.

(2) Attach the airspeed simulator hose to the pitot (pressure) port of the fixture.

(3) When equipped with Avidyne Entegra or Garmin G1000, turn ON the PFD.

(4) Operate the simulator to obtain a reading of 75 knots on the airplane airspeed indicator(s).

(5) Check that the airspeed indicator needles (or PFD airspeed indication, if installed) follow in the same direction as the simulator airspeed indicator needle.

(6) Raise airspeed to 191 knots and wait 15 seconds to allow the airplane airspeed indicators to stabilize.

(7) Observe the simulator and airplane airspeed indicators for 15 seconds. If a leak is present, the indicator needles (or PFD indication, if installed) will move toward zero. Maximum acceptable leak rate is 1 knot in 15 seconds.

(8) If a leak rate of greater than 1 knot in 15 seconds is present, check the fixture installation, hose connections, and pitot system lines and fittings. Repair the leak when found, then repeat steps (1) - (7), above.

(9) When equipped with Avidyne Entegra or Garmin G1000 only:

Operate the simulator to indicate 140 knots on the airspeed indicator in the PFD. Verify that the airspeed indicator shows within three (3) knots of the simulator indication.

(10) When equipped with Avidyne Entegra or Garmin G1000: turn OFF the PFD.

(11) Remove the test fixture from the pitot head.

(12) Attach static test fixture to the static port and pitot test port of the aircraft. Tape over the other static button.

(13) When equipped with Avidyne Entegra or Garmin G1000, turn ON the PFD.

(14) Set the aircraft altimeter needles to read zero altitude. Operate the static simulator to cause the aircraft altimeter needles to read 1,000 feet altitude. Momentarily open the alternate static port. There should be a decrease in altimeter indication. If no change occurs the system is blocked and must be repaired prior to further testing.

(15) Increase altitude to 1,050 feet.

(16) Check that the aircraft altimeter shows an increase.

(17) Observe the aircraft altimeter. Loss of indicated altitude shall not exceed 100 feet in one minute.

(18) If a leak exceeds the tolerances in step (17), check the fixture installation, plumbing and fittings. Repair the leak when found and repeat the static system checks above.

(19) When equipped with Avidyne Entegra or Garmin G1000, turn OFF the PFD.

(20) Remove the test fixture and tape from the static button.

2. Vertical Speed Indicator

NOTE: In airplanes equipped with Avidyne Entegra or Garmin G1000, this function is performed soley by the Primary Flight Display (PFD).

A. Description

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: If any connection in the pitot / static system is opened for maintenance, the entire system must be rechecked per Pitot / Static System, Test, above.

B. Troubleshooting

See Chart 1.

CHART 1
TROUBLESHOOTING VERTICAL SPEED INDICATOR

Trouble	Cause	Remedy
Pointer does not set on zero.	Aging of diaphragm.	Reset pointer to zero by means of setting screw. Tap instrument while resetting.
Pointer fails to respond.	Obstruction in static line.	Disconnect all instruments connected to the static line. Clear line.
Pitot head frozen over.	Water in static line.	Check individual instruments for obstruction in lines.
	Obstruction in pitot head.	Clean lines and head.
Pointer oscillates.	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.

C. Removal and Installation

See 39-10-00.

3. <u>Altimeter</u>

<u>NOTE</u>: In airplanes equipped with Avidyne Entegra or Garmin G1000, the primary altimeter is the Primary Flight Display (PFD).

A. Description

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.

<u>NOTE</u>: If any connection in the pitot / static system is opened for maintenance, the entire system must be rechecked per Pitot / Static System, Test, above.

B. Troubleshooting

See Chart 2.

C. Removal and Installation

See 39-10-00.

CHART 2
TROUBLESHOOTING ALTIMETER

Trouble	Cause	Remedy
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Defective mechanism.	Replace instrument.
High or low reading.	Improper venting.	Eliminate leak in static pressure system and check alignment of 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.	Replace instrument.
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.
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.

4. Airspeed Indicator

NOTE: In airplanes equipped with Avidyne Entegra or Garmin G1000, the primary airspeed indicator is the Primary Flight Display (PFD).

A. Description

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: If any connection in the pitot / static system is opened for maintenance, the entire system must be rechecked per Pitot / Static System, Test, above.

B. Troubleshooting

See Chart 3.

C. Removal and Installation

See 39-10-00.

CHART 3
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.	Replace instrument.
	Leaking static system.	Find leak and correct.
Instrument reads low.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
	Pitot head not aligned correctly.	Realign pitot head.
Airspeed changes as aircraft is banked.	Water in pitot line.	Remove lines from static instruments and blow out lines from cockpit to pitot head.

5. Outside Air Temperature (OAT)

A. In HP S/N's 3246001 thru 3246087, OAT is provided by a direct reading thermometer mounted in the lower forward corner of the pilot's side window.

B. In HP S/N's 3246088 thru 3246217, 3246219, & 3246223; and TC S/N's 3257001 thru 3257338 & 3257340, 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 91-77-20, Sheet 1 for additional information.

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C. In HP S/N's 3246218 thru 3246244 and TC S/N's 3257339 thru 3257487 with Avidyne Entegra installed, OAT is provided by the Magnetometer / OAT Sensor Assembly (Mag/OAT) mounted in the underside of the outboard left wing, which feeds temperature data to the Primary Flight Display (PFD) and Multifunction Display (MFD).

See Electronic Flight Instrument System (EFIS) - Avidyne in 34-20-00 for additional information.

D. In TC S/N's 3257447, 3257455 and up, equipped with Garmin G1000, OAT is provided by the GTP 59 OAT Probe mounted to the bottom of the right wing, which feeds temperature data to the PFD and MFD.

See Integrated Avionics System (IAS) - Garmin in 34-20-00 for additional information.

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ATTITUDE AND DIRECTION

1. Attitude Indicator

NOTE: In airplanes equipped with Avidyne Entegra or Garmin G1000, no air-driven attitude indicator is installed. In those installations, this function is provided by the Primary Flight Display (PFD).

A. Description

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 alignment of airplane to actual horizon. Any deviation simulates deviation of airplane from true horizon. Attitude Indicator is marked for different degrees of bank.

B. Troubleshooting

See Chart 1.

C. Removal and Installation

See 39-10-00.

CHART 1
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.

2. Standby Attitude Indicator

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NOTE: In airplanes equipped with Avidyne Entegra or Garmin G1000, the primary attitude indicator is the Primary Flight Display (PFD).

A. Description

In HP S/N's 3246218 thru 3246244 and TC S/N's 3257339 and up for airplanes equipped with Avidyne Entegra or Garmin G1000, 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 (Avidyne) or under the floor of the forward baggage compartment (Garmin).

Required periodic maintenance is listed in 5-20-00 and 5-30-00. Checkout and test procedures and Instructions for Continued Airworthiness are provided in Mid-Continent Instruments Manual No. 9015762.

B. Removal and Installation

See 39-10-00.

3. Electronic Flight Instrument System (EFIS) - Avidyne

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

The Avidyne Entegra Electronic Flight Instrument System (EFIS) was initially available as an option, and was offered later as standard equipment (HP S/N's 3246218, 3246220 thru 3246222, 3246224 thru 3246244 and TC S/N's 3257339, 3257341 thru 3257446, 3257448 thru 3257454, 3257460, 3257475, 3257480, 3257485, and 3257487).

A. Description

Avidyne Entegra 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.)

This installation consists of these components: Primary Flight Display (PFD), Multifunction Display (MFD), Data Acquisition Unit (DAU) and associated sensors, and Magnetometer/OAT Sensor Assembly.

Avidyne Entegra Instrument Panel
Figure 1

Effectivity
with Avidyne Entegra

B. Maintenance

The Instructions for Continued Airworthiness (ICA) published by Avidyne provide the necessary information for maintaining this system as installed in Piper airplanes, except as noted below.

(1) Primary Flight Display (PFD)

(PIR-PPS60209-2, Rev. NEW.)

Use 700-00006-0XX PFD & 700-00011-0XX Mag/OAT ICA, Avidyne Document No. AVPFD-174, Revision 03, or later, with the following exceptions:

NOTE: If any connection in the pitot / static system is opened for maintenance, the entire system must be rechecked per Pitot / Static System, Test in 34-10-00.

NOTE: Before attempting to set-up the PFD, ensure the GNS-430(s) / GNS-430W(s) have been configured per the Post-Installation Set-up Procedure under COM/NAV/GPS in 34-50-00.

NOTE: In HP S/N's 3246218 thru 3246244, and; TC S/N's 3257339 thru 3257487, before attempting to set-up the PFD, ensure the GTX-330 is configured per the Post-Installation Set-up Procedure under Transponder, GTX-330, in 34-50-00.

NOTE: Whenever the PFD is replaced perform the setup / calibration procedures specified in Avidyne Document No. AVPFD-174 as modified below.

NOTE: The following PFD software part numbers were factory installed in these airplanes: (earlier versions may have been upgraded in the field)

530-00138-000

530-00177-000 (i.e., Release 6.1)

530-00183-000 (i.e., Release 6.2, EASA only)

530-00194-000 (i.e., Release 7.0)

(a) In para 5.1, for airplanes equipped with PFD Software 530-00194-000 or later, the "ADU Calibration" referenced in conjunction with the bi-annual altimeter check can be performed by following the prompts from the ADU Calibration page.

(b) In para 6, "Troubleshooting Information," in the chart where it says "OAT (Option)," cross out "option." The OAT is standard in the Piper installation.

(c) In para 7.2, "Primary Flight Display Installation," and Figure 7, the standard Avidyne installation describes alignment and mating pins and retaining clips on the sides of the PFD. For the Piper installation, however, there is only a single alignment pin on the top of the PFD engaging a slot in the upper rear cross bracket. (See Figure 3, Sheet 1.)

(d) In para 7.5.1, apply power by turning the Battery Master Switch ON or by applying external power and turning the Radio Master Switch ON.

In airplanes equipped with PFD Software 530-00194-000 or later, when the countdown is finished and the system setup page appears, select the "System Info" tab and verify checksums have no "FAILED" or "PENDING" messages.

(e) In airplanes equipped with PFD Software 530-00194-000 or later, at the end of para 7.5.2.1, add the following:

With 32R-301T selected verify the following:

PFD Serial Number:	XXXXXXXXXXX
S/W Version ID:	XXXXXXXXXXX
Aircraft Make:	Piper
Model:	PA-32R-301T
Pitch Offset:	0.0
Avionics:	
GPS 1:	Garmin GNS-430/530
GPS 2:	Garmin GNS-430/530
VHF 1:	Garmin GNS-430/530
VHF 2:	Garmin GNS-430/530
Autopilot:	S-TEC System 55x OR Not Installed
Engine DAU1:	“Moritz DAU”
Engine DAU2:	Not Installed
ADF:	Not Installed
Radar Altimeter:	Not Installed
Copilot PFD:	Not Installed
Dimming Bus:	28 VDC

NOTE: If GPS 1, GPS2, VHF 1, or VHF 2 do not display the correct Garmin unit, proceed to para 7.7 in Avidyne Document No. AVPFD-174 as modified by step (h), below, and update the display. Then repeat step (e).

(f) Following para 7.5.3, add the following:

1 Rotate the lower left control knob to select the Display Set-up Page by highlighting the “Display” tab at the bottom of the screen.

2 Press the “Trim Ann” Line Select Key (L1) until “SHOW” is displayed.

3 Press the “A/P Annun” Line Select Key (L2) until “SHOW” is displayed.

4 Press the “V-Speeds” Line Select Key (L3) until “SHOW” is displayed.

5 Press the “Horiz Marks” Line Select Key (R3) until “SHOW” is displayed.

6 Depress the “ARS” (Aircraft Reference Symbol) Line Select Key (R4) until “DELTA” is displayed.

(g) If using para 7.6, add the following:
Verify that the Avionics Page Display indicates:

Aircraft Make:	Piper
Model:	PA-32R-301T
Sensor Suite:	
GPS 1:	GARMIN 430/530 on ARINC 1
GPS 2:	GARMIN 430/530 on ARINC 3
VHF 1:	GARMIN 430/530 on ARINC 2
VHF 2:	GARMIN 430/530 on ARINC 4
AutoPilot:	STEC 55X or Not Installed
Engine DAU:	INSTALLED
ADF:	NOT INSTALLED (even if an ADF is installed)
Copilot PFD:	NOT INSTALLED

(h) If using para 7.7, add the following:
Verify that the Avionics Page Display indicates:

GPS 1:	Garmin GNS-430/530
Inputs:	ARINC Rx1
Outputs:	ARINC Tx0
GPS 2:	Garmin GNS-430/530
Inputs:	ARINC Rx3
Outputs:	ARNC Tx0
VHF 1:	Garmin GNS-430/530
Inputs:	ARINC Rx2
VHF 2:	Garmin GNS-430-530
Inputs:	ARINC Rx4
Autopilot:	S-TEC System 55X
Attitude Rate Source:	External
Attitude Selector:	Emulating STEC ST-360
Annunciators:	Emulating STEC ST-645
Horizontal NAS Data:	Emulating Bendix/King KCS 55A
Flight Director:	Analog
GPS Roll Steering:	Retransmitting on ARINC Tx0
Engine DAU 1:	Moritz DAU
Engine DAU 2:	Not Installed
ADF:	Not Installed
Radar Altitude:	Not Installed
Copilot PFD:	Not Installed
Dimming Bus:	28 V DC

(i) In para 7.7.1 in the “Main RS232 Configuration Page” table, for CHNL 3 under GNS-430 in slot # 2, both Input and Output should read “Crossfill” instead of “Off.”

(j) In para 7.7.3, add the following note: “An airfield compass rose may be used to align the airplane in lieu of a handheld sight compass.”

(2) Multifunction Display (MFD)

Use 700-00004-0XX-() Multifunction Display ICA, Avidyne Document No. AVMFD-167, with the following exceptions:

NOTE: The following is written for airplanes with MFD Software 530-00180-002 (latest revision); exceptions or differences for airplanes equipped with earlier software versions are noted as required.

NOTE: Whenever the MFD is replaced, calibrate the Fuel Quantity Indicator as described under Cockpit - Avidyne Entegra EFIS Installation - Fuel Quantity Indicator Calibration in 28-40-00.

(a) In paragraph 2, items 7 and 8 are standard in the Piper installation.

(b) Engine Setup (PIR-PPS60208, Rev. B / PIR-PPS60208-1, Rev. New.)

Use the following to supplement the instructions in paragraph 7.3.10.1:

1 From the MFD maintenance page, depress LSK (L4) to access the Engine Instruments Setup page.

2 Using the right knob to select the configuration field and the left knob to change the desired configuration; configure the Engine Setup page for the following conditions:

a Aircraft Model: PA32 (Select Correct Model)

b Serial Port: RS232 4

c Vacuum System Installed: Box NOT Checked d DAU Status Box should indicate proper engine for above selection. (Earlier software versions only.)

e Depress Save button (R1).

3 When configuring a MFD for the first time only, the following set-up box appears: “Select ACFT Model and Port(s)”
“Then Press “Resync” to connect to DAU”

1 Press “Resync”

2 Press “Save”

(c) Aircraft Setup

1 From the maintenance page, depress LSK (R2) to access the Aircraft setup page.

2 Using the right knob to select the configuration field and the left knob to change the desired configuration; configure the Aircraft Setup page for the following conditions:

a NarrowCast: Quake SC (If Data Link option installed, otherwise “Not Installed”).

b Port: RS232 6 (Data Link Default)

c Broadcast: XM Radio (Not available in earlier software version)

d Port: RS232 1 (Not available in earlier software version)

e Aux Data: Entegra PFD (Avidyne PFD in earlier software version)

f Port: ARINC 429 4

g Dimming Bus Voltage: Shows current voltage - No Setting Required (0.0 volts when annunciator day/night switch in “DAY” position. Dimming bus voltage shown when day/night switch in “NIGHT” position).

h Brightest Dimming Voltage: 24 volts

i Darkest Dimming Voltage: 5 volts

j When the Aircraft Setup has been configured correctly, press the Save button. If you decide not to save the changes, press the Cancel button. Changes will not take effect until the MFD has been restarted

(d) In paragraph 7.3.10.1, replace “Fuel Quantity Calibration” with “Cockpit - Avidyne Entegra EFIS Installation - Fuel Quantity Indicator Calibration” in 28-40-00, above.

(3) Data Acquisition Unit (DAU)

Use 200-00041-000 DAU ICA, Avidyne Document No. AVSIU-011, with the following exceptions:

NOTE: Whenever the DAU is replaced, calibrate the Fuel Quantity Indicator as described under Cockpit - Avidyne Entegra EFIS Installation - Fuel Quantity Indicator Calibration in 28-40-00.

(a) In paragraph 6, in “Table 2 - DAU Pinout,” pins J1-2 and J1-21 have “No Connection” in the Piper installation.

(b) In paragraph 6, in “Table 4 - DAU Sensor Compatibility,” parameter “VAC” is not used in the Piper installation.

(4) Magnetometer/OAT Sensor Assembly

NOTE: See reference to Avidyne ICA under Primary Flight Display, above.

In HP S/N's 3246218 and up, and TC S/N's 3257339 and up with the Avidyne Entegra EFIS installed, the Magnetometer / OAT Sensor Assembly (Mag/OAT) mounted on a wing access cover plate in the underside of the outboard left wing, 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

NOTE: Whenever the Mag/OAT is replaced perform the PFD setup / calibration procedures specified in Avidyne Document No. AVPFD-174 as modified by Primary Flight Display (PFD), above.

(1) Prior to installation, the arrow on the magnetometer must be aligned as shown in Figure 2.

(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.

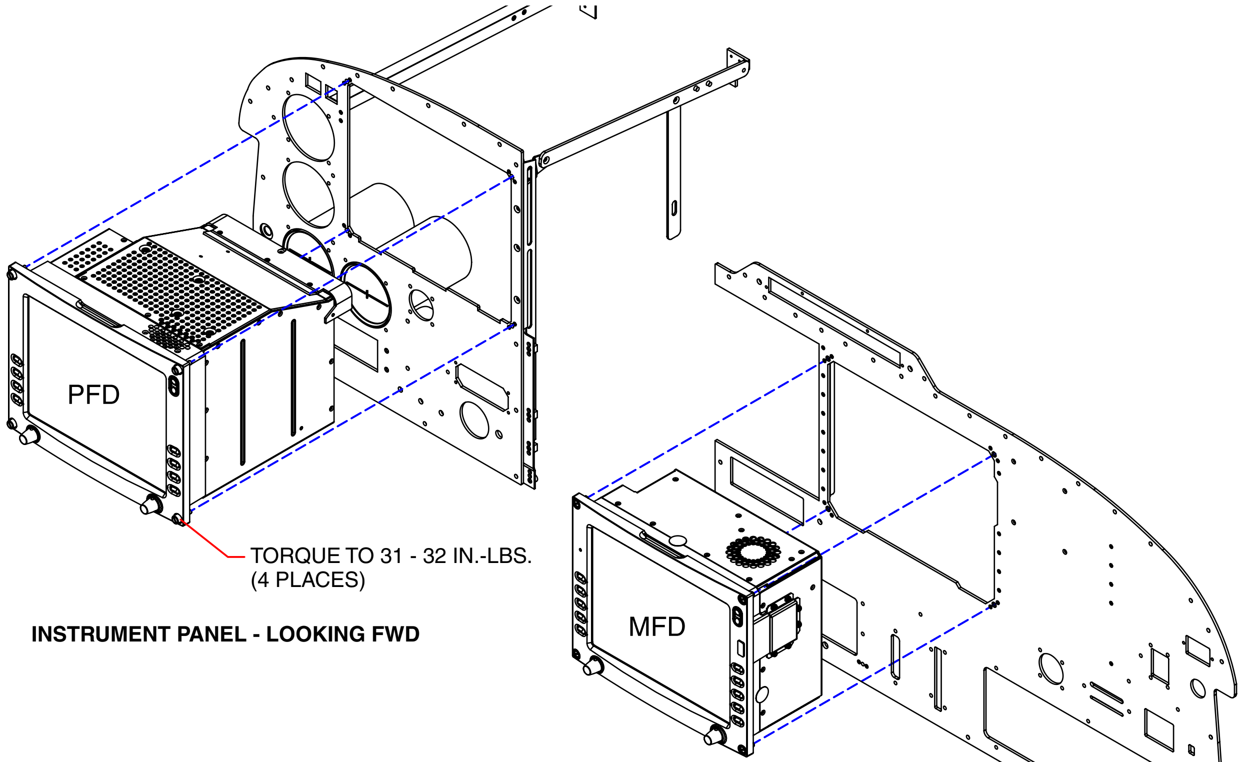
(4) Secure with screws (8).

C. Component Locator

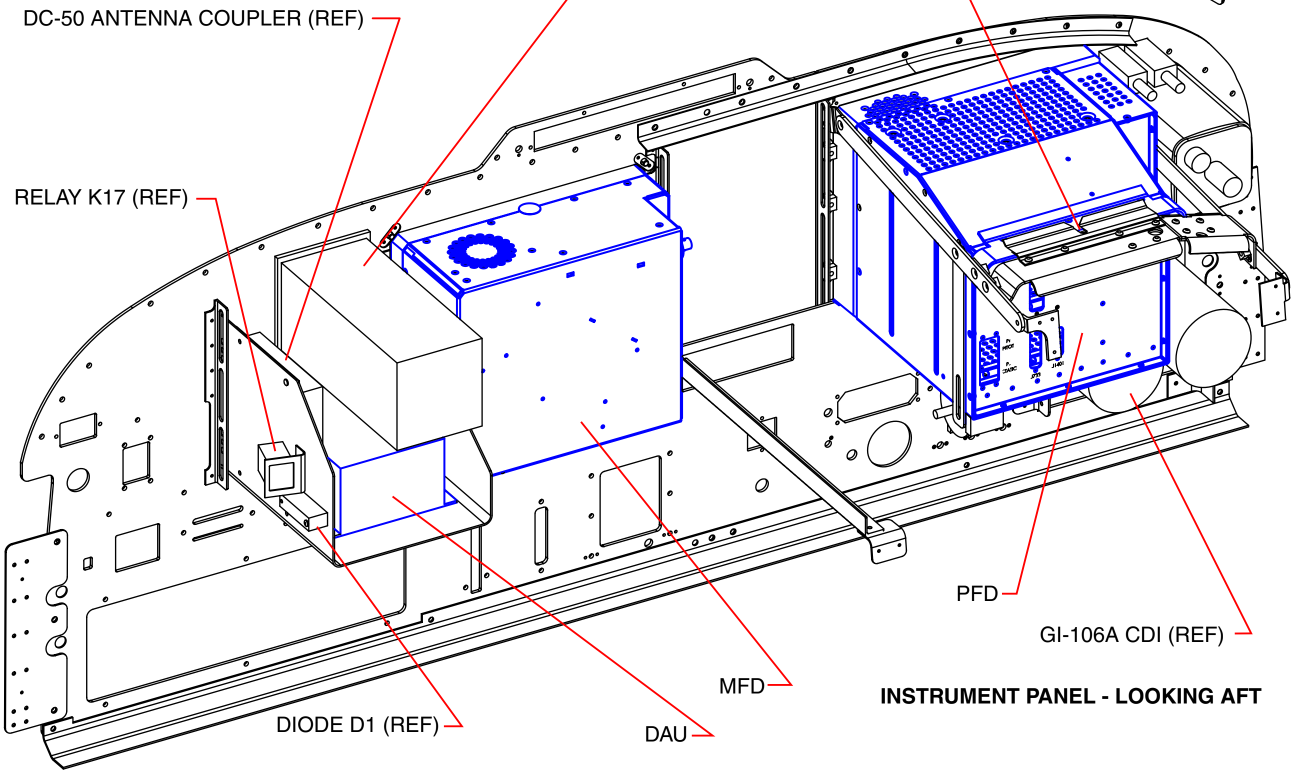
See Figure 2.

D. Standby Attitude Indicator

See Standby Attitude Indicator, above.



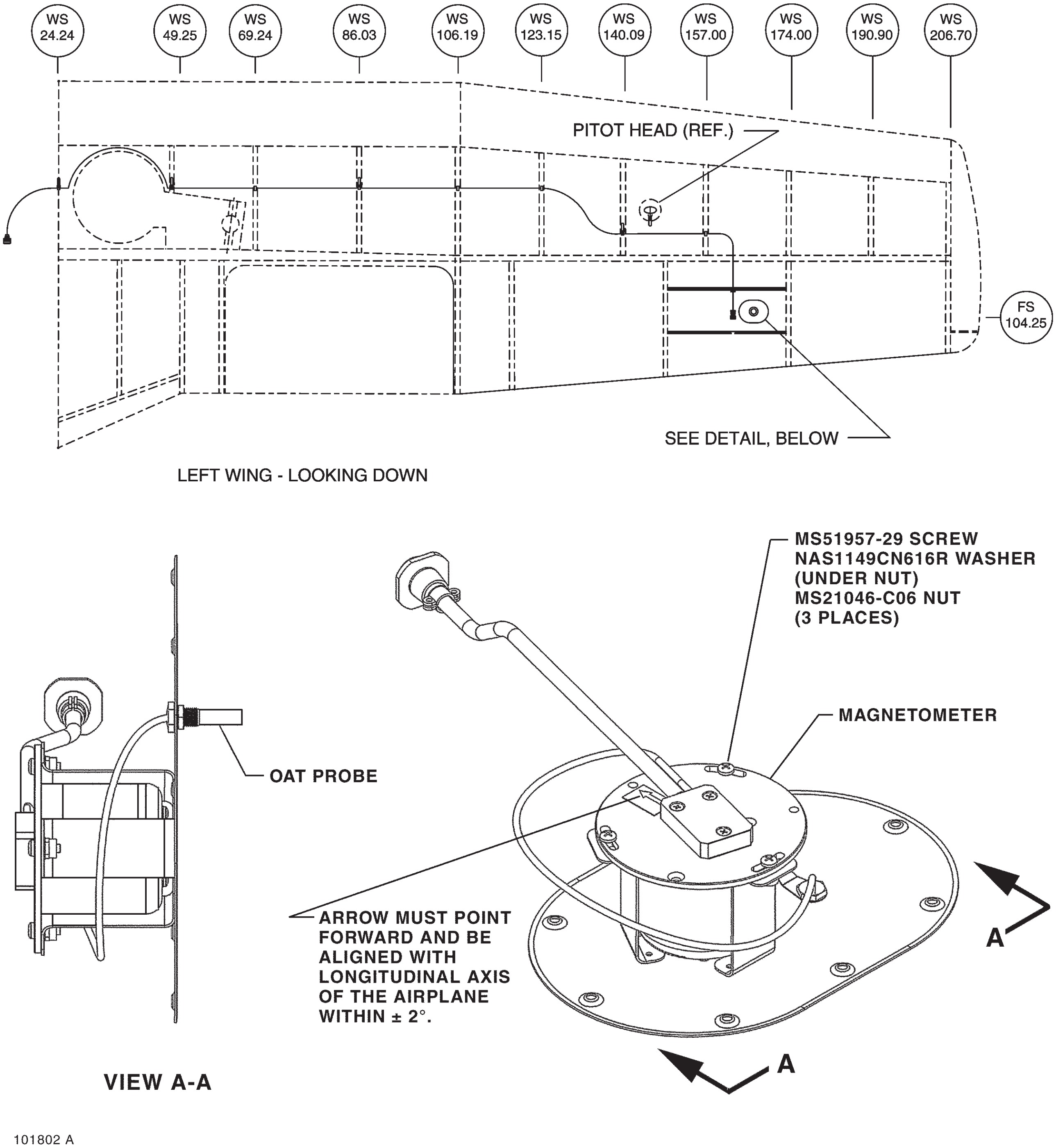
INSTRUMENT PANEL - LOOKING FWD



INSTRUMENT PANEL - LOOKING AFT

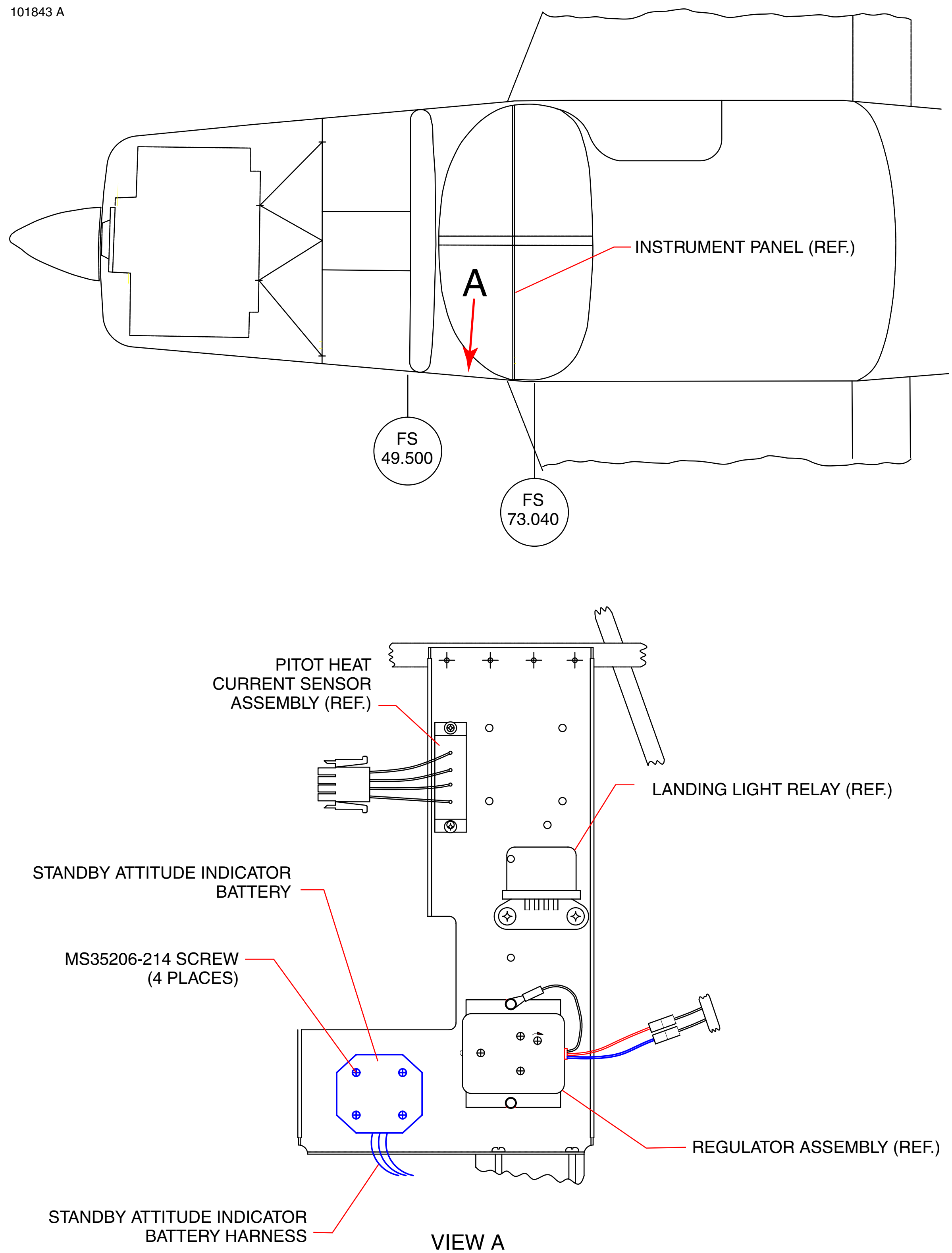
Avidyne Entegra Component Locator
Figure 2 (Sheet 1 of 3)

Effectivity
with Avidyne Entegra



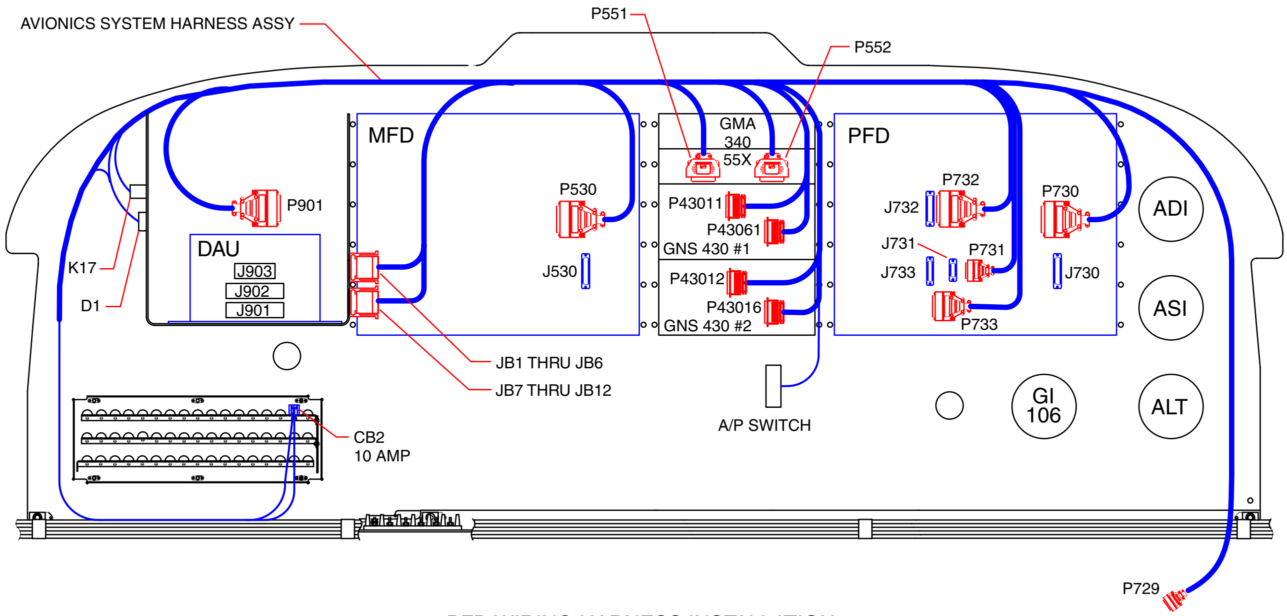
Effectivity
with Avidyne Entegra

Avidyne Entegra Component Locator
Figure 2 (Sheet 2 of 3)

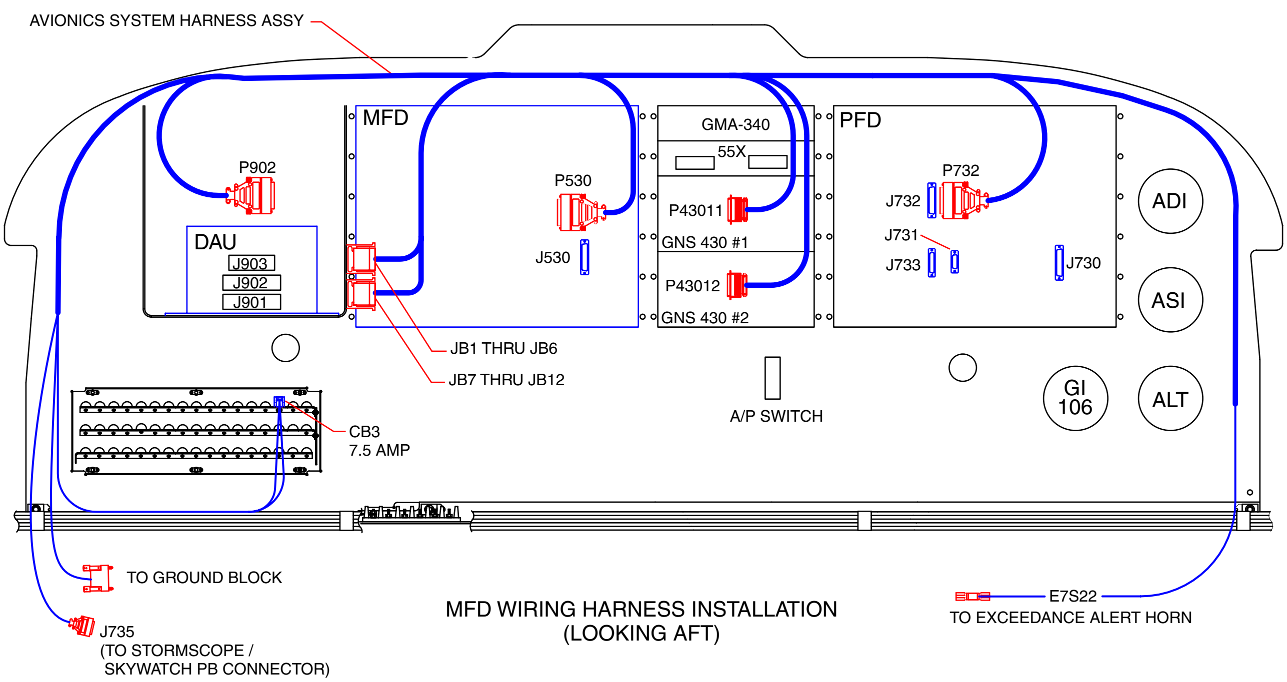


Avidyne Entegra Component Locator
Figure 2 (Sheet 3 of 3)

Effectivity
with Avidyne Entegra



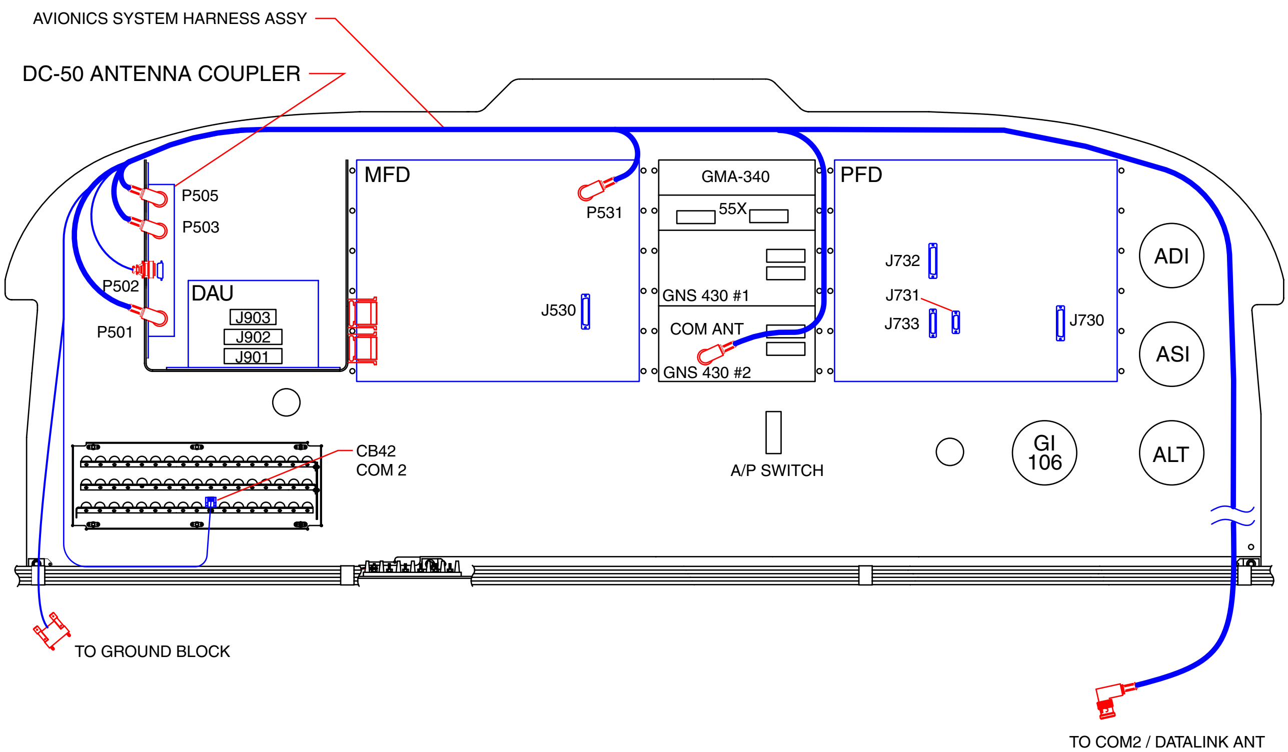
PFD WIRING HARNESS INSTALLATION
(LOOKING AFT)



MFD WIRING HARNESS INSTALLATION
(LOOKING AFT)

Effectivity
with Avidyne Entegra

Wiring Harness Installation
Figure 3 (Sheet 1 of 2)



ANTENNA COUPLER WIRING HARNESS INSTALLATION
(LOOKING AFT)

Wiring Harness Installation
Figure 3 (Sheet 2 of 2)

Effectivity
with Avidyne Entegra

4. Integrated Avionics System - Garmin G1000

(PIR-190-00343-03, Rev. C.)

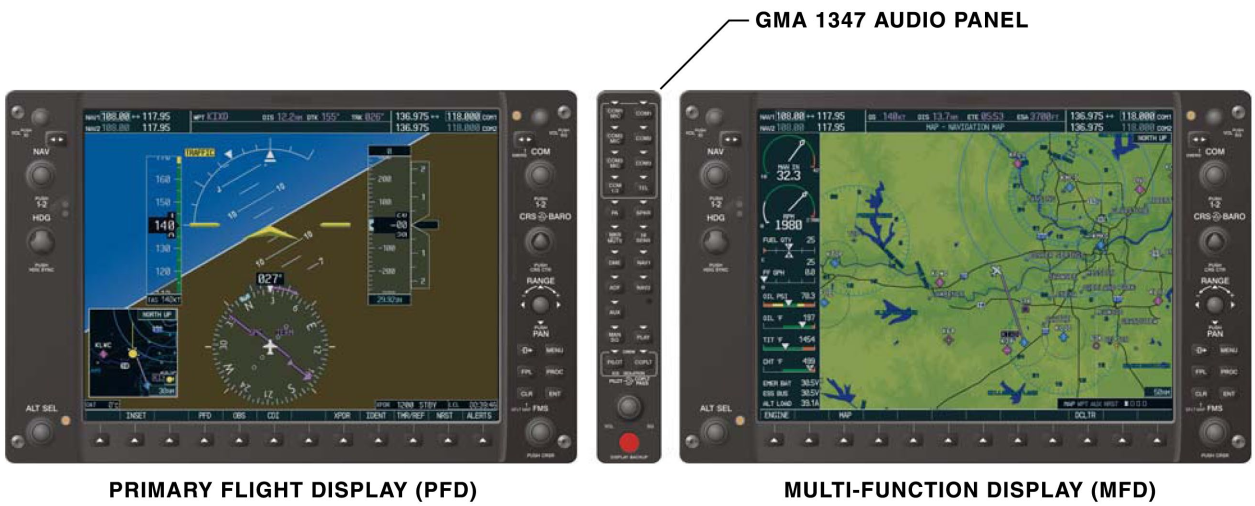
WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

A. Description (See Figure 4.)

The Garmin G1000 Integrated Avionics System (IAS) installation provides a fully integrated avionics suite that interfaces with an S-Tec System 55X Autopilot. Standard altitude and airspeed indicators and a magnetic compass are also installed as secondary, independent sources of altitude, airspeed, and (non-stabilized) heading information. An electric attitude indicator is installed to provide an independent source for attitude information.

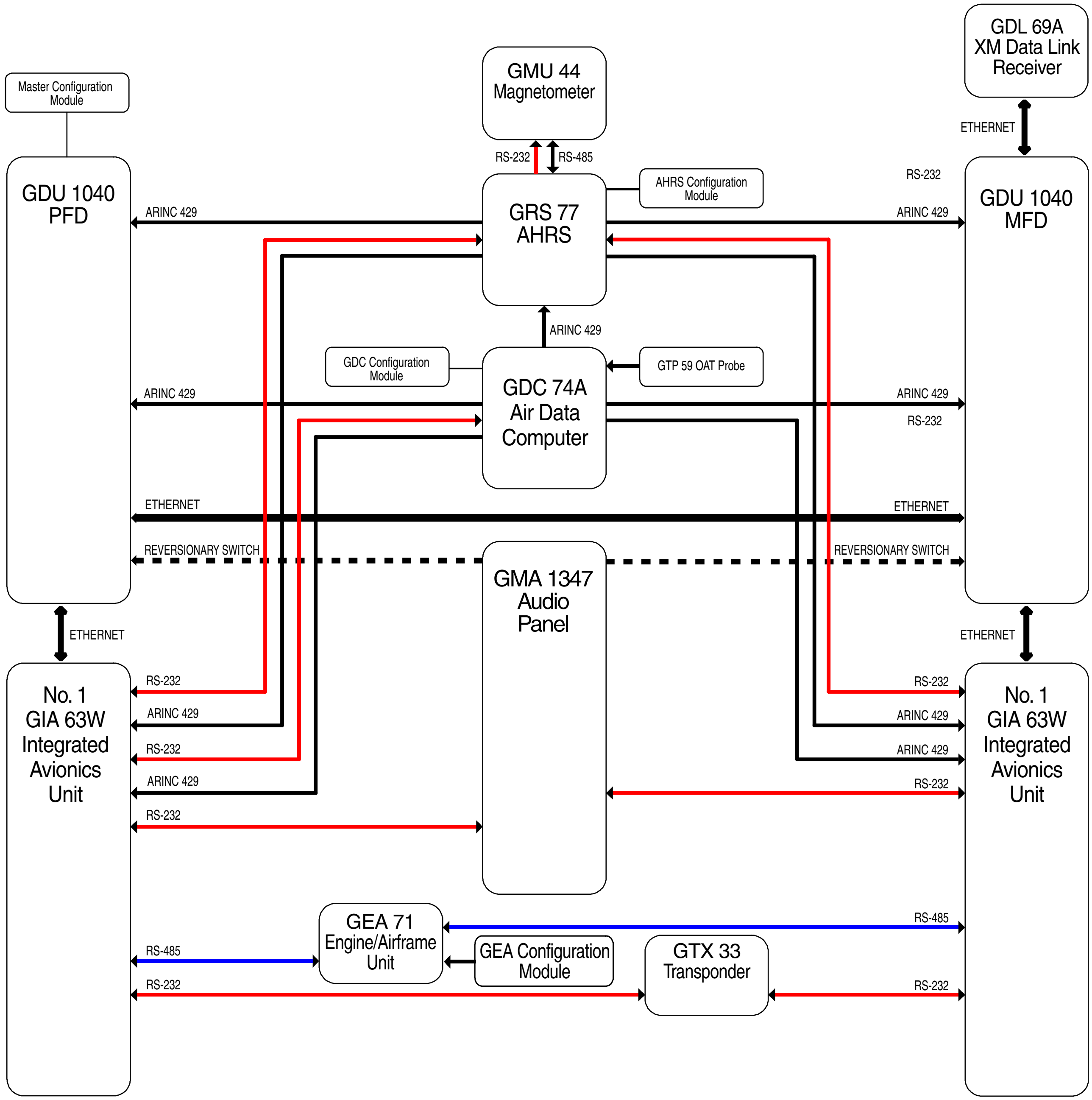
The G1000 avionics system consists of two displays, one dedicated as a primary flight display (PFD) and the other as a multi-function display (MFD). Functions provided by the system include display of attitude, heading, navigation, traffic (future option), air data, engine and airframe status, and situational awareness of a moving map display with position derived by GPS. In addition to display functions, GPS navigation, VHF/Com, VOR/ILS and transponder functions are provided by the system and controlled by knobs and buttons located on the PFD and MFD bezels.

See the Garmin Cockpit Reference Guide and Garmin Airplane Flight Manual Supplement for system control and operation.



Effectivity
with Garmin G1000

Garmin G1000 Displays
Figure 4



Garmin 1000 System Communications
Figure 5

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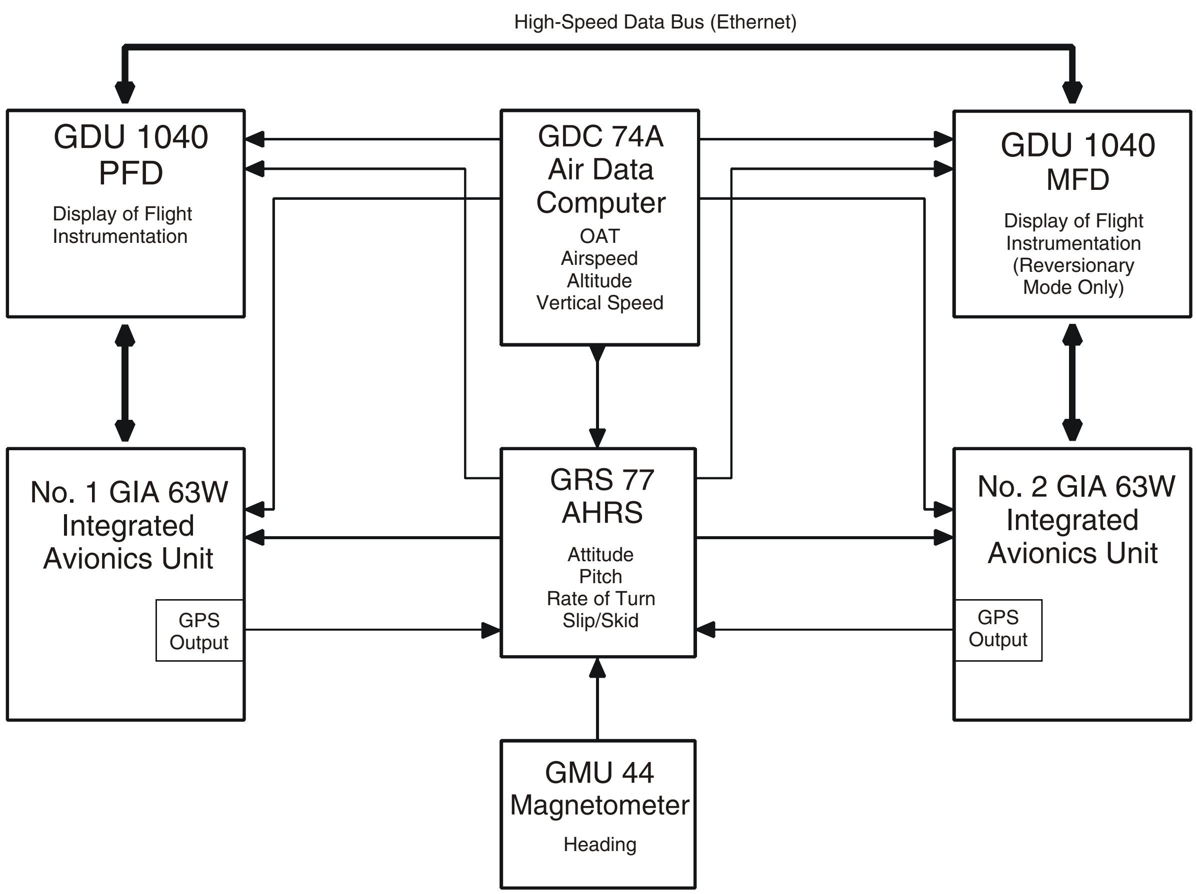
(1) Flight Instrumentation (See Figure 6.)

The GRS 77 AHRS, GDC 74A Air Data Computer, and GMU 44 Magnetometer are responsible for providing the G1000/PA32 system with flight instrumentation. Data consists of aircraft attitude, heading, altitude, airspeed, vertical speed, and outside air temperature information, all displayed on the PFD (data is displayed on the MFD in reversionary mode only).

Primary data outputs from the GRS and GDC are sent directly to the PFD via ARINC 429. Secondary data paths connect the GRS and GDC to the MFD. Additional communications paths connect the GRS and GDC to both GIA 63W units, providing quadruple redundant interface.

The GRS 77 receives GPS data from both GIAs, airspeed data from the GDC, and magnetic heading from the GMU. Using these three external sources, combined with internal sensor data, the GRS accurately calculates aircraft attitude and heading.

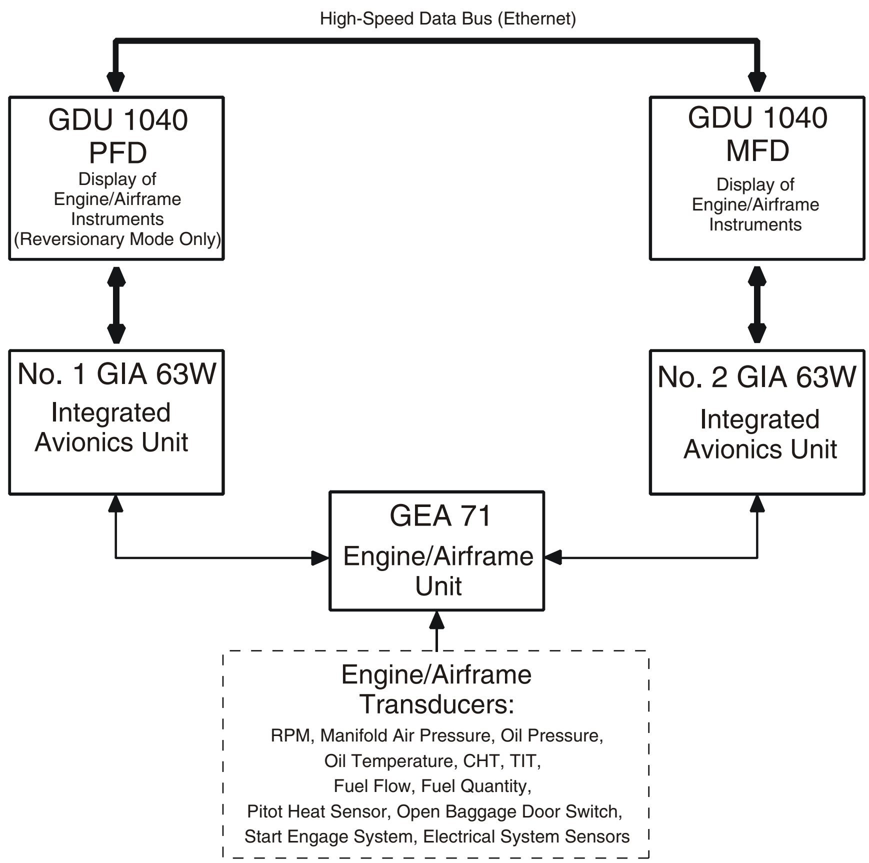


Flight Instrumentation Interface
Figure 6

Effectivity
with Garmin 1000

(2) Engine Indicator System (See Figure 7.)

The GEA 71 provides engine/airframe data to the G1000 system. The unit interfaces to transducers shown in Figure 6. Analog data is received from the transducers and is converted to a digital signal by the GEA 71. Digital information is then sent through the primary RS-485 serial path to the #1 GIA 63W. From the GIA, data is sent through the HSDB connection to the PFD, then on to the MFD for display. A backup data path from the GEA to the #2 GIA 63W, then on to the MFD, exists in the event the primary path fails.



Effectivity
with Garmin 1000

Engine / Airframe Interface
Figure 7

(3) Communications/Navigation Systems (See Figure 8.)

The GIA 63W IAUs contain VHF COM, VHF NAV, and GPS receivers. COM and NAV audio is sent via digital audio to the GMA 1347 Audio Panel.

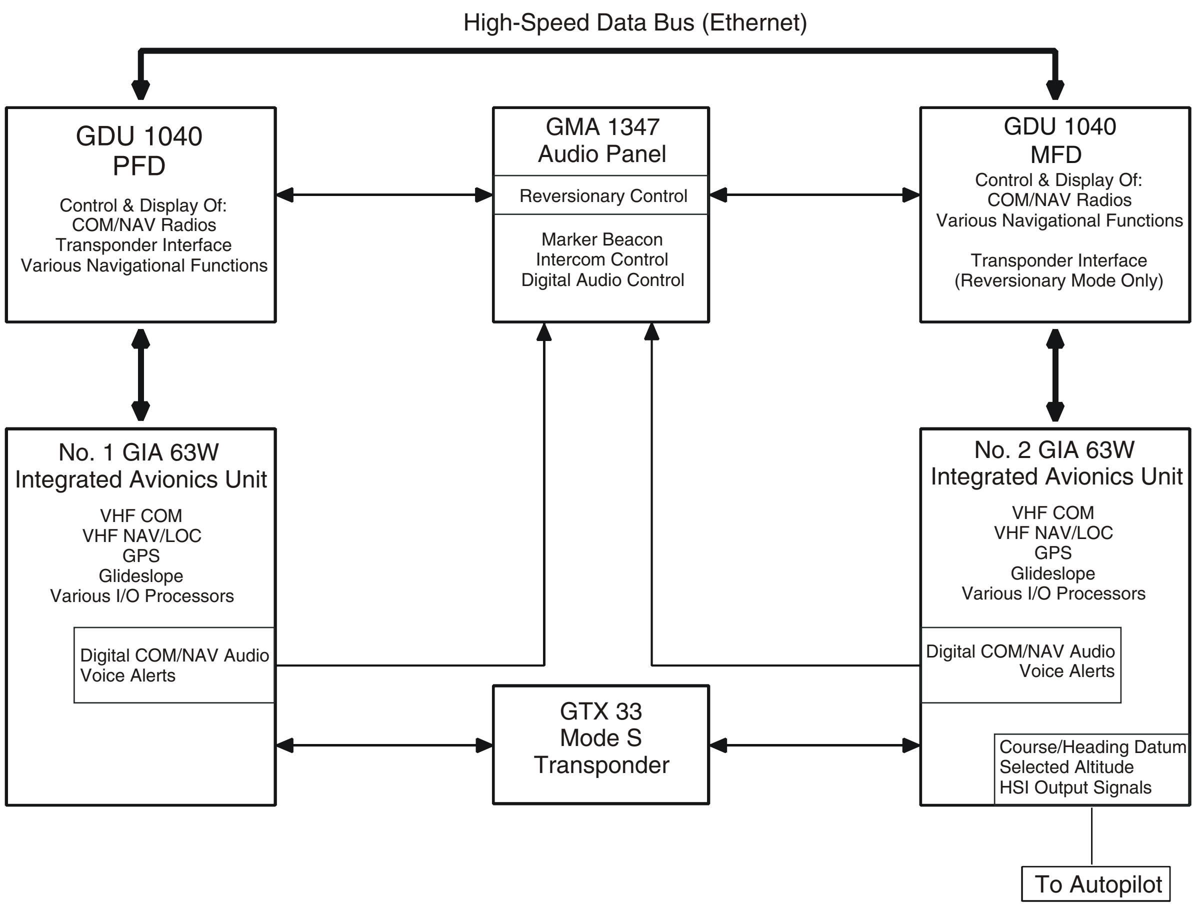
GPS information is sent to the GRS 77 AHRS and to both displays for processing.

The GTX 33 Mode S Transponder communicates with both GIAs. Transponder data is sent from the GIAs to the PFD where control and operation occurs.

The #2 GIA outputs analog HSI signals to the S-TEC 55X, along with ARINC 429 roll steering, and altitude data, and digital selected altitude data.

The GMA 1347 Audio Panel controls the display reversionary mode.

(4) See Components, below, for detailed descriptions of the individual G1000 components/Line Replaceable Units (LRU's).



Navigation / Communications Interface
Figure 8

Effectivity
with Garmin 1000

B. Power Distribution

Distribution of power to the G1000 system occurs on four aircraft electrical busses.

Essential Bus: The Essential bus is tied directly to the main aircraft battery via the battery master switch. When the master switch is turned on, power is immediately supplied to the Essential bus. The Essential bus is tied via a bus contactor to the Main bus. The emergency battery (EMER BAT) switch is connected to this bus contactor, and when turned on, the connection between the Main and Essential busses is broken and the alternator field current is interrupted. In case of a failure of the main alternator, the standby alternator supplies power to the Essential bus.

Main Bus: The Main bus receives power from the aircraft battery when tied to the Essential bus. After the aircraft engine is started, the alternator supplies power to the Main bus and to the rest of the system.

Emergency Bus: The Emergency bus exists as a backup power bus to the G1000 system. When the emergency battery switch is turned on, power is removed from the Main bus. At the same time, the relay connecting the Emergency bus to the emergency battery is closed, providing emergency power to the connected equipment.

Avionics Bus: The Avionics bus is tied to the Main aircraft bus via the Radio Master switch and switch relay.

C. Troubleshooting

Troubleshoot the G1000 system by first identifying, then isolating the specific failure to the responsible LRU. There are several indications that the G1000 presents to the pilot or technician, showing overall system condition. A course of action should be determined based on the information presented on the display.

The 5th AUX group page on the MFD (see Figure 9) provides LRU health status by means of a green check or a red ‘X’. Also, LRU software versions are shown along with other database versions and dates. If a red ‘X’ is shown for an LRU, see the appropriate LRU troubleshooting chart for guidance.

Typically, the G1000 Alerting System provides alerts/annunciations in conjunction with the information presented at the 5th AUX page. (See Figure 10.)

CAUTION: “POST INSTALLATION SET-UP,” BELOW, PROVIDES DETAILED INSTRUCTIONS ON EQUIPMENT CONFIGURATION AND RETURN-TO-SERVICE TESTING. ANYTIME A G1000 COMPONENT OR LRU IS REMOVED, SWAPPED, OR REPLACED, THE TECHNICIAN MUST FOLLOW THE PROCEDURES GIVEN IN “POST INSTALLATION SET-UP” TO ENSURE PROPER OPERATION OF THE SYSTEM.

Troubleshooting information is provided as follows:

(1) Line Replaceable Unit (LRU) Failures - see Chart 2.
(2) Engine / Airframe Sensor Failures - see Chart 3.
(3) GDU 1040 - see Chart 6.
(4) GMA 1347 - see Chart 7.
(5) GIA 63W - see Chart 8.
(6) GEA 71 - see Chart 9.
(7) GTX 33 - see Chart 10.
(8) GDC 74A - see Chart 11.
(9) GRS 77 - see Chart 12.
(10) GMU 44 - see Chart 13.
(11) GDL 69/69A - see Chart 14.

D. Recommended Tools

The following tools (or equivalent) are recommended to perform various maintenance tasks on the G1000 EFIS.

(1) Voltmeter capable of measuring 0-32 Volts DC.

(2) #2 Phillips Screwdriver.

(3) 3/32nd inch Hex Tool.

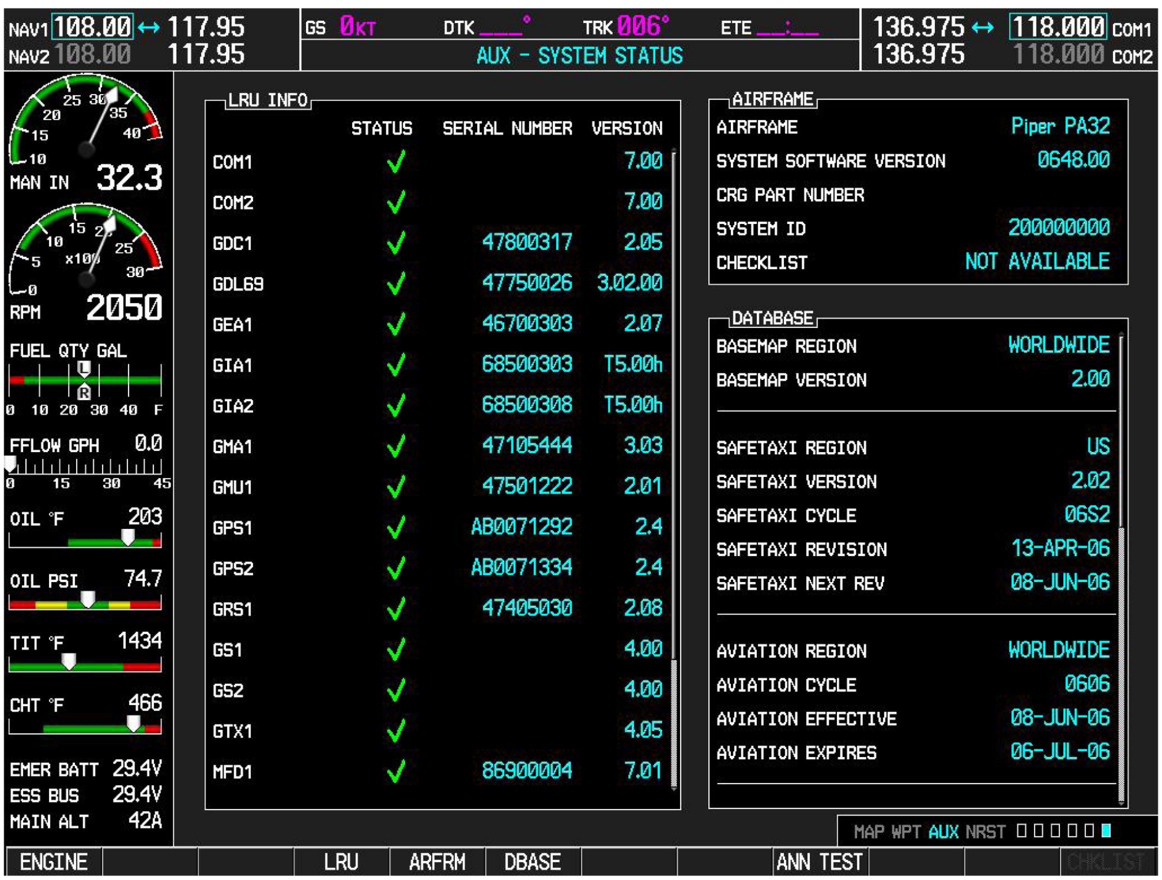
(4) Digital Level with 0.25 degrees of accuracy capability.

(5) VHF NAV/COM/ILS ramp tester.

(6) Transponder ramp tester including Mode S capability for Mode S transponder equipped aircraft.

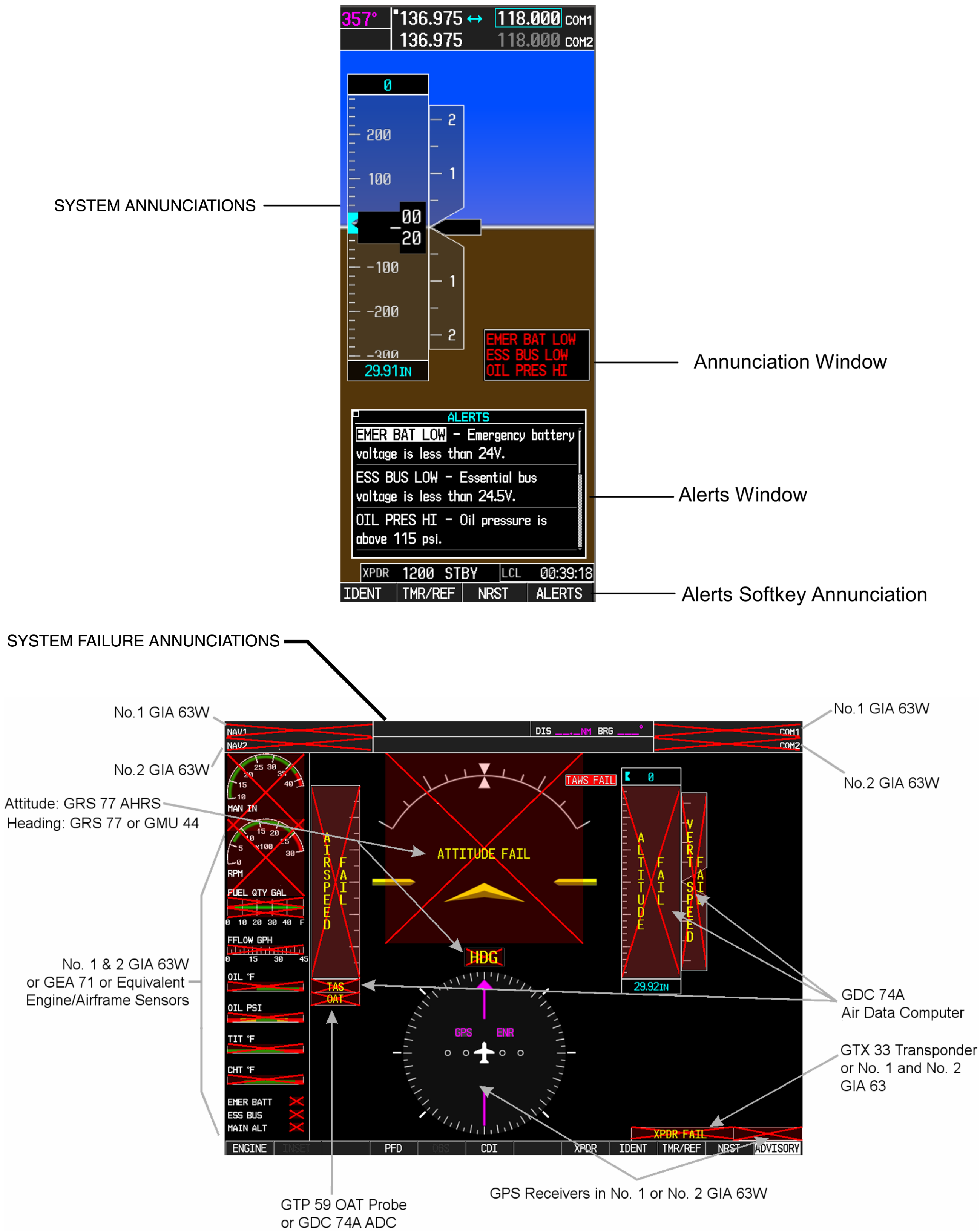
(7) Air Data Test Set (ADTS) capable of simulating altitude up to the aircraft's service ceiling.

(8) Headset/Microphone.



System Status Page (AUX Group Normal Mode)
Figure 9

Effectivity
with Garmin 1000

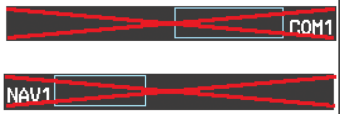


Effectivity
with Garmin 1000

Alerts and Annunciations
Figure 10

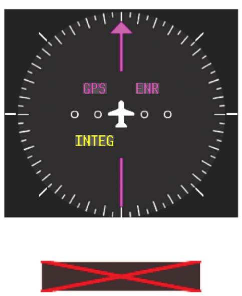
CHART 2 (Sheet 1 of 2)
TROUBLESHOOTING LRU FAILURES

Invalid Data Field	Associated LRU(s)	Solution

NAV1 & COM1

	GIA1	• Verify that there are no GIA1 configuration or manifest errors.
		• Check Ethernet connection from GIA1 to the PFD.
		• Switch GIA1 and GIA2 to verify location of problem.
		  • If problem follows unit, replace defective unit.
		  • If problem persists, replace defective PFD.

NAV2 & COM2

	GIA2	• Verify that there are no GIA2 configuration or manifest errors.
		• Check Ethernet connection from GIA2 to the MFD.
		• Switch GIA1 and GIA2 to verify location of problem:
		  • If problem follows unit, replace defective unit.
		  • If problem persists, replace defective MFD.

GPS INTEG & Time

	GIA1 or GIA2	• Verify that there are no GIA1 and GIA2 configuration or manifest errors.
		• Check GPS1 and GPS2 signal strength on the 3rd AUX page.
		• Check corresponding GPS antenna and cable.
		• Check Ethernet interconnect from PFD to GIA1 or MFD to GIA2.
		• Switch GIA1 and GIA2, to verify location of problem:
		  • If problem follows unit, replace defective unit.
		  • If problem persists, replace defective MFD or PFD.

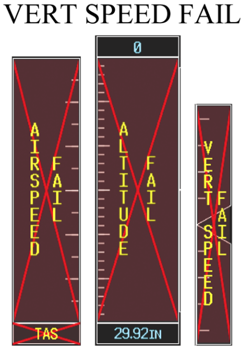
XPDR FAIL 	GTX 33	• Verify that there are no XPDR configuration or manifest errors. • Check GIA1 – GTX and GIA2 – GTX wiring. • Replace defective GTX 33.
TAS FAIL AIRSPEED FAIL ALTITUDE FAIL VERT SPEED FAIL 	GDC 74A	• Verify that there is no GDC manifest error. • Inspect GDC 74A pitot/static plumbing integrity. • Inspect pitot/static ports and associated equipment. • For TAS failure, also check GTP 59 OAT probe as stated below. • Replace defective GDC configuration module according to Section 5.11. • If problem persists, replace defective GDC 74A.
OAT 	GTP 59	• See above guidance for GDC 74A troubleshooting. • Replace GTP 59 probe. • If problem persists replace GDC 74A with a known good unit.

CHART 2 (Sheet 2 of 2)
TROUBLESHOOTING LRU FAILURES

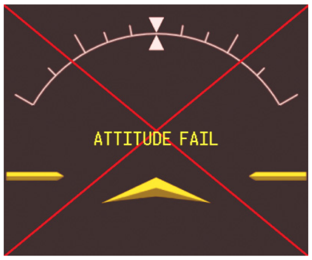
Invalid Data Field	Associated LRU(s)	Solution
ATTITUDE FAIL 	GRS 77	*Note: AHRS requires valid ADC and GPS position.* • Verify that there is no GRS manifest error. • Check AHRS wiring. • Replace GRS 77.
HDG FAIL 	GRS 77 & GMU 44	• Check GRS – GMU wiring. • Replace the GMU 44. • If problem persists, replace GRS 77.
	GRS 77 & GMU 44	• If this message persists, perform AHRS calibration procedures as described in Section 6.9.
Engine/Airframe Sensors (All Invalid) 	GEA 71	• Verify that there are no GEA configuration or manifest errors. • Reconfigure the GEA 71 per Section 6.2. • Check GEA – GIA1 and GEA – GIA2 Wiring. • Replace defective GEA 71.

CHART 3 (Sheet 1 of 3)
TROUBLESHOOTING ENGINE / AIRFRAME SENSOR FAILURES

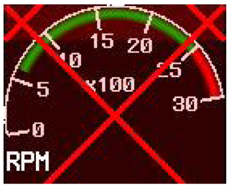
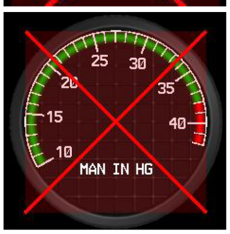
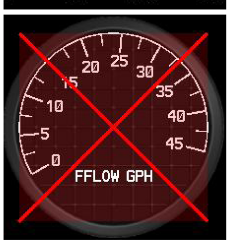
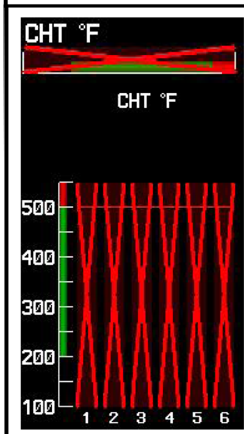
Invalid Field	Sensor	Solution
 	Tachometer	• Check tachometer – GEA wiring. • Replace tachometer sensor. • Replace defective GEA 71.
 	MAP Sensor	• Check MAP sensor – GEA wiring. • Replace MAP sensor. • Replace defective GEA 71.
 	Fuel Flow	• Check fuel flow sensor – GEA wiring. • Replace fuel flow sensor. • Replace defective GEA 71.
	CHT Probes (6)	• Check CHT probe – GEA wiring. • Replace CHT probe. *If all 6 CHT indicators are flagged, check the following:* • Replace backshell thermocouple and/or configuration module in GEA connector. • Replace defective GEA 71.

CHART 3 (Sheet 2 of 3)
TROUBLESHOOTING ENGINE / AIRFRAME SENSOR FAILURES

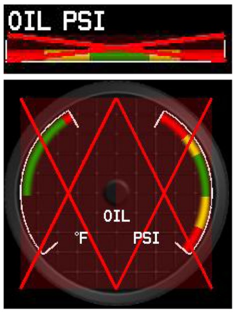
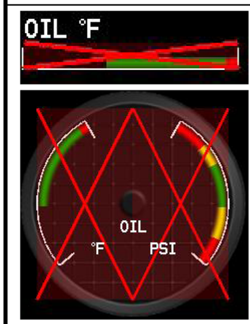
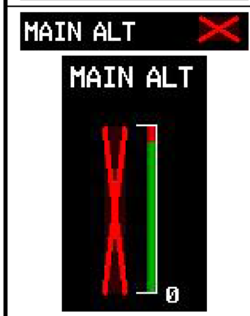
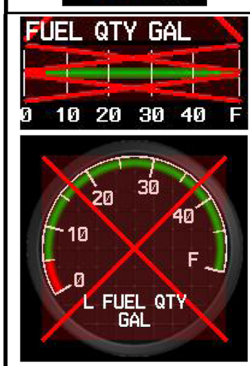
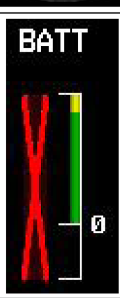
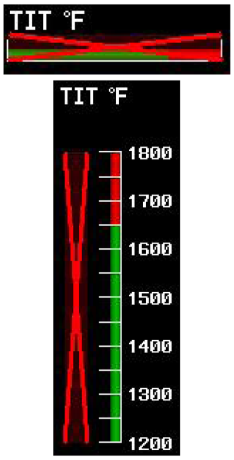
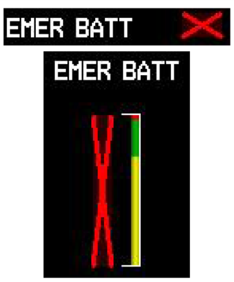
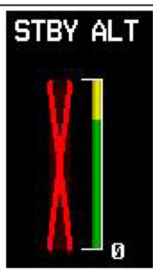
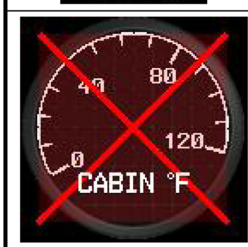
Invalid Field	Sensor	Solution
	Oil Pressure Sensor	• Check oil pressure sensor – GEA wiring. • Replace oil pressure sensor. • Replace defective GEA 71.
	Oil Temperature Sensor	• Check oil temperature sensor – GEA wiring. • Replace oil temperature sensor. • Replace defective GEA 71.
	Main Alternator Current Shunt	• Check current sensor – GEA wiring. • Replace current sensor. • Replace defective GEA 71.
	Fuel Quantity Sensors (2 per side)	• Check fuel quantity sensor – GEA wiring. • Replace fuel quantity sensor. • Replace defective GEA 71.
	Battery Current Shunt	• Check current sensor – GEA wiring. • Replace current sensor. • Replace defective GEA 71.

CHART 3 (Sheet 3 of 3)
TROUBLESHOOTING ENGINE / AIRFRAME SENSOR FAILURES

Invalid Field	Sensor	Solution
	TIT Probe	• Check TIT Probe – GEA wiring. • Replace temperature probe. • Replace defective GEA 71.
	Emergency Battery Voltage	• Replace defective GEA.
	Standby Alternator Current	• Check current sensor – GEA wiring. Check for swapped wires. • Replace defective GEA.
	Cabin Temperature	• Check temperature sensor – GEA wiring. • Replace cabin temperature sensor. • Replace defective GEA.

E. Inspections (PIR-190-00343-01, Rev. C.)

(1) Annual / 100 Hour Inspection

Each 12 months or 100 hours time-in-service, whichever comes first, inspect the emergency power system for proper operation per the following procedure.

NOTE: Additional information on the emergency power system can be found in 24-30-00.

(a) Ensure no ground power is connected to the aircraft.

(b) Power up the G1000 system by turning ON the Battery Master and Radio Master switches.

(c) Open the EMER BAT circuit breaker and verify that the EMER BAT voltage on the MFD reads at least 25.4 V. If the voltage is below this level, service the battery in accordance with the Concorde Aircraft Battery Owner/Operator Manual.

(d) Close the EMER BAT circuit breaker.

(e) Start the engine in accordance with the Pilot's Operating Handbook (POH).

(f) Verify the Radio Master switch is ON.

(g) Wait approximately one minute for the system to initialize.

(h) Verify that the EMER BAT NC annunciation is not displayed.

(i) Verify that the battery master, main alternator and standby alternator switches are ON.

(j) Set engine at 2000 RPM.

(k) Turn the main alternator OFF.

(l) Verify that the ALTNTR INOP and STBY ALT ON annunciations are displayed on the PFD.

(m) Verify on the MFD that the standby alternator is generating current.

(n) Turn the standby alternator OFF.

(o) Verify the NO STBY ALT is annunciated on the PFD.

(p) Turn the EMER BAT switch ON. See Chart 4.

(q) Verify that the MFD turns off and that the PFD enters reversionary mode (engine instruments displayed). Since the audio panel is off, the intercom will not function and Com1 will be tied directly to the pilot's headset

(r) Turn the battery master switch OFF. See Chart 5.

(s) Verify that each of the following components is receiving power:

1 GDU 1040 PFD – should be on and in reversionary mode.

2 GRS 77 AHRS – Attitude and heading should be displayed.

3 GDC 74A Air Data – Altitude, Vertical Speed, Airspeed, and True Airspeed displayed.

4 GEA 71 Engine Airframe – Engine instruments should be displayed.

5 GIA 63W #1 Integrated Avionics – Com1 and Nav1 should be displayed. GPS position should still function.

6 Backup ADI – The backup attitude indicator should not be flagged. The gyro should be powered.

7 Compass – The compass light should be illuminated.

8 Post lights – The post lights for the attitude, airspeed, and altitude indicators should be illuminated.

(t) Shut down the engine.

(u) Turn the EMER BAT switch OFF.

(v) Verify that all equipment turns off.

(w) Turn the Radio Master switch OFF.

CHART 4
NORMAL ANNUNCIATION WITH EMER BAT SWITCH ON AND BATTERY MASTER SWITCH ON

Annunciation / Flag	Reason
ALTNTR INOP annunciation	EMER BAT switch has interrupted the alternator field current.
DISPLAY FAN annunciation	Avionics bus is unpowered.
AVIONICS FAN annunciation	Avionics bus is unpowered.
EMER BAT NC or EMER BAT LOW annunciation	EMER BAT switch has interrupted the alternator field current. The emergency battery is now powering the emergency bus.
COM2/NAV2 fields flagged	Avionics bus is unpowered.
ESS BUS LOW annunciation (see Note)	The essential bus is not receiving power from the alternator or battery.
NOTE: ESS BUS LOW may or may not annunciate, depending on the state of charge of the aircraft battery.	

CHART 5
NORMAL ANNUNCIATION WITH EMER BAT SWITCH ON AND BATTERY MASTER SWITCH OFF

Annunciation / Flag	Reason
In addition to the Annunciations/Flags shown in Chart 4, when the Battery Master switch is turned OFF, the following additional annunciations / flags are normal:	
ESS BUS LOW annunciation	The essential bus is not receiving power from the alternator or battery.

(2) 1000 Hour Inspection

Each 1000 hours time-in-service visually inspect each unit listed below for corrosion, damage, or other defects. Replace any damaged parts as required. Inspection may require the temporary removal of a unit or units to gain access to connectors.

(a) GDU 1040 PFD & MFD

Remove the PFD & MFD. Inspect the mounting surface and connector for corrosion, heavy oxidation, or other damage.

(b) GMA 1347 Audio Panel

Inspect the GMA 1347 unit, rack, and connectors for corrosion or other defects.

(c) GIA 63W Integrated Avionics Unit (2 ea.)

Inspect the GIA 63W #1 and #2 unit, rack, and connectors for corrosion or other defects.

(d) GEA 71 Engine/Airframe Unit

Inspect the GEA 71 unit, rack, and connectors for corrosion or other defects.

(e) GTX 33 Mode S Transponder (if installed)

Inspect the GTX 33 unit, rack, and connectors for corrosion or other defects.

(f) GDL 69/69A - Datalink (if installed)

Inspect the GDL 69/69A unit, rack, and connectors for corrosion or other defects.

(g) PFD & MFD Cooling Fan

Inspect both PFD & MFD cooling fans for accumulation of dust or other damage. Remove excess dust as required. Close the AVIONICS COOLING circuit breaker and verify that the PFD and MFD cooling fans are functional.

(h) Avionics Cooling Fan

Inspect the avionics cooling fan for accumulation of dust or other damage. Remove excess dust as required. Close the AVIONICS COOLING circuit breaker and verify that the avionics cooling fan is functional.

(i) GRS 77 AHRS

Inspect the GRS 77 unit, rack, and connector for corrosion or other defects.

(j) GMU 44 Magnetometer

Remove the GMU 44 and inspect the mounting hardware and GMU 44 for corrosion or other damage.

(k) Perform electrical bond tests on all G1000 equipment per Garmin 1000 Electrical Bonding Inspection, 51-80-00.

(l) Perform visual checks on the shield terminations for any degradation.

F. Components

(1) General

Maintenance of Garmin 1000 system components is “On Condition” only. The following provides basic information regarding unit removal, installation, and troubleshooting. Basic guidance on loading and configuring software is provided under Post Installation Set-up, below. When removing and/or replacing any G1000 component, always ensure that aircraft power is off. Unplug any auxiliary power supplies.

Before removing any G1000 LRU, it is required that the technician verify the LRU software part number and version against the Required Equipment List, Chart 36.

To check an LRU software part number and/or version:

(a) Start the G1000 system in configuration mode as described in Configuration Mode Overview under Post Installation Set-up, below.

(b) The System Status page shows a list of LRUs in the LRU window. Activate the cursor and highlight the LRU window.

(c) Use the FMS knob to scroll through the list in the window and select the desired LRU.

(d) The software part number and version is displayed in the DATA window. Compare this to the data in the Required Equipment List, Chart 36.

NOTE: If a faulty LRU is not reporting its software version and part number, check aircraft maintenance logs for last software version loaded and verify against the Required Equipment List, Chart 36. The Software Manifest page may also be used to check part numbers and versions.

(2) GDU 1040 MFD and PFD (See Figure 4.)

CAUTION: THE GDU 1040S USE A LENS COATED WITH A SPECIAL ANTI-REFLECTIVE COATING THAT IS VERY SENSITIVE TO SKIN OILS, WAXES AND ABRASIVE CLEANERS. CLEANERS CONTAINING AMMONIA WILL HARM THE ANTI-REFLECTIVE COATING. IT IS VERY IMPORTANT TO CLEAN THE LENS USING A CLEAN, LINT-FREE CLOTH AND AN EYEGLASS LENS CLEANER THAT IS SPECIFIED AS SAFE FOR ANTI-REFLECTIVE COATINGS.

(a) Description

Two Garmin GDU 1040 CDUs are installed in the instrument panel. One is configured as a PFD and the other as an MFD (Configuration is determined by wiring harness and configuration files). Both displays provide control and display of nearly all functions of the G1000 integrated cockpit system.

The displays are located side-by-side, with the GMA 1347 Audio Panel located in the middle.

Both displays are installed in the instrument panel using built-in ¼-turn fasteners. Each display uses a single Garmin 62-pin connector. Electrical power to the PFD is from the ‘Essential’ power bus, whereas the MFD receives power from the ‘Avionics’ bus.

On the panel, traditional attitude, altitude, and airspeed indicators are retained as backup instruments. These are mounted in a vertical configuration to the left of the PFD.

(b) Troubleshooting

See Chart 6.

CHART 6 (Sheet 1 of 4)
TROUBLESHOOTING GDU 1040

Common Problems	
Symptom	**Recommended Action**
Display will not track photocell	Ensure that the panel dimming potentiometer is set to minimum level. Check display lighting settings on the Main Lighting page. If problem persists, replace defective unit.
Keypad/bezel will not track photocell	Ensure that the panel dimming potentiometer is set to minimum level. Check keyboard lighting settings on the Main Lighting page. If problem persists, replace defective unit.
Display will not track dimmer bus	Check display lighting settings on the Main Lighting page. Check wiring. Switch MFD and PFD: If problem follows unit, replace defective unit.
Keypad/bezel will not track dimmer bus	Check keyboard lighting settings on the Main Lighting page. Check wiring. Switch MFD and PFD: If problem follows unit, replace defective unit.

Software/Configuration Alerts		
Failure Message	**Cause**	**Solution**
FAILED PATH – A data path has failed.	A data path(s) connected to the GDU or GIA has failed.	Check wiring to the failed LRU.
SW MISMATCH – GDU software version mismatch. Xtalk is off.	The system has found the PFD and MFD software versions do not match.	Load correct software version.
MANIFEST – PFD1 software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in the PFD.	Load correct software version.
MANIFEST – MFD software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in MFD.	Load correct software version.
MFD1 CONFIG – configuration error. Config service req'd.	A configuration mismatch has occurred between the display and the Master Configuration Module.	Reconfigure MFD and/or PFD. If unable to reconfigure, replace defective master configuration module.

CHART 6 (Sheet 2 of 4)
TROUBLESHOOTING GDU 1040

Software/Configuration Alerts (cont.)		
Failure Message	**Cause**	**Solution**
PFD1 CONFIG – configuration error. Config service req'd.	A configuration mismatch has occurred between the display and the Master Configuration Module.	Reconfigure MFD and/or PFD. If unable to reconfigure, replace defective master configuration module.
CNFG MODULE – PFD1 configuration module is inoperative.	The PFD1 configuration module is inoperative.	Replace the configuration module.
Database Alerts		
Failure Message	**Cause**	**Solution**
MFD1 DB ERR – MFD1 aviation database error exists.	The MFD has encountered an error in the Jeppesen aviation database.	Reload Jeppesen database. Replace the MFD.
PFD1 DB ERR – PFD1 aviation database error exists.	The PFD has encountered an error in the Jeppesen database.	Reload Jeppesen database. Replace the PFD.
MFD1 DB ERR – MFD1 basemap database error exists.	The MFD has encountered an error in the basemap database.	Replace the MFD.
PFD1 DB ERR – PFD1 basemap database error exists.	The PFD has encountered an error in the basemap database.	Replace the PFD.
MFD1 DB ERR – MFD1 terrain database error exists.	The MFD has encountered an error in the terrain database.	Confirm terrain datacard is inserted properly. Replace terrain datacard. Replace the MFD.
PFD1 DB ERR – PFD1 terrain database error exists.	The PFD has encountered an error in the terrain database.	Confirm terrain datacard is inserted properly. Replace terrain datacard. Replace the PFD.
DB MISMATCH – Aviation database version mismatch. Xtalk is off.	The system has found the aviation database cycles in the PFD and MFD do not match.	Load current database versions.
DB MISMATCH – Aviation database type mismatch. Xtalk is off.	The system has found the aviation database types in the PFD and MFD do not match.	Load current database versions.
DB MISMATCH – Airport Terrain database version mismatch. Xtalk is off.	The system has found the airport database cycles in the PFD and MFD do not match.	Load current database versions.
DB MISMATCH – Obstacle database version mismatch. Xtalk is off.	The system has found the obstacle database versions in the PFD and MFD do not match.	Load current database versions.

CHART 6 (Sheet 3 of 4)
TROUBLESHOOTING GDU 1040

Database Alerts (cont.)		
Failure Message	**Cause**	**Solution**
DB MISMATCH – Terrain database version mismatch. Xtalk is off.	The system has found the terrain database versions in the PFD and MFD do not match.	Confirm terrain datacard is inserted properly. Replace terrain datacard. Replace the PFD or MFD.
DB MISMATCH – Terrain database type mismatch. Xtalk is off.	The system has found the terrain database types in the PFD and MFD do not match.	Confirm terrain datacard is inserted properly. Replace terrain datacard. Replace the PFD or MFD.
Cooling Alerts		
Failure Message	**Cause**	**Solution**
MFD1 COOLING – has poor cooling. Reducing power usage.	MFD1 has exceeded its operating temperature range.	Check MFD Fan for proper operation. Replace the MFD. If problem persists contact Garmin.
PFD1 COOLING – has poor cooling. Reducing power usage.	The PFD has exceeded its operating temperature range.	Check PFD Fan for proper operation. Replace the PFD. If problem persists contact Garmin.
Key Alerts		
Failure Message	**Cause**	**Solution**
MFD1 “key” KEYSTK – key is stuck.	The SYSTEM has determined a key is stuck on MFD1.	Exercise stuck key. Replace the MFD.
PFD “key” KEYSTK – key is stuck.	The SYSTEM has determined a key is stuck on PFD.	Exercise stuck key. Replace the PFD.

CHART 6 (Sheet 4 of 4)
TROUBLESHOOTING GDU 1040

Miscellaneous Alerts		
Failure Message	**Cause**	**Solution**
XTALK ERROR – A flight display cross talk error has occurred.	A communication error has occurred between the MFD and PFD.	Check the System Configuration page: - Ensure that MFD1 and PFD1 are green; - If configuration is not correct, reconfigure the PFD and MFD. Check Ethernet interconnect. Replace PFD with a known good unit to verify location of problem: - If problem persists, replace MFD; - If problem does not persist, replace PFD.
DATA LOST – Pilot stored data lost. Recheck settings.	Pilot stored data has been lost.	Cycle power to PFD. If problem persists, replace PFD.
MFD1 SERVICE – needs service. Return unit for repair.	The system has determined MFD1 needs service.	Replace MFD.
PFD1 SERVICE – needs service. Return unit for repair.	The system has determined PFD needs service.	Replace PFD.

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(c) Removal

1 Using a 3/32nd hex tool, rotate all four ¼-turn fasteners counter-clockwise until they reach their stops.

2 Carefully remove the display from the panel.

3 While supporting the display, disconnect the connector.

(d) Installation

1 Visually inspect the connector and pins for signs of damage. Repair any damage. While supporting the display, connect the connector to the rear of the unit.

2 Carefully insert the display into the panel cutout, ensuring that all 4 ¼-turn fasteners align with the corresponding holes.

3 Seat the display in the panel cutout. Do not use excessive force while inserting the display.

4 Once seated, rotate all four ¼-turn fasteners clockwise to lock the display to the panel.

5 Configure and test the MFD and/or PFD according to Post-Installation Setup, below.

(3) GMA 1347 Audio Panel (See Figure 4.)

(a) Description

The Garmin GMA 1347 Audio Panel is a digital audio panel with integrated marker beacon receiver. The GMA 1347 provides control of all cockpit intercom/mic systems as well as NAV/COM/ILS audio. The unit also provides display reversion mode control through a large red button. Power is received from the ‘Avionics’ bus; consequently the unit only powers up when the radio master switch is turned on. The GMA 1347 interfaces with the marker beacon antenna as well as mic and phone jacks.

(b) Troubleshooting

See Chart 7.

(c) Removal

1 Using a 3/32nd hex tool, turn the hex nut counter-clockwise until the GMA 1347 is unlocked from its location.

2 Carefully remove the GMA 1347 from its rack.

(d) Installation

1 Visually inspect the connectors using a flashlight to ensure there are no bent or damaged pins. Repair any damage.

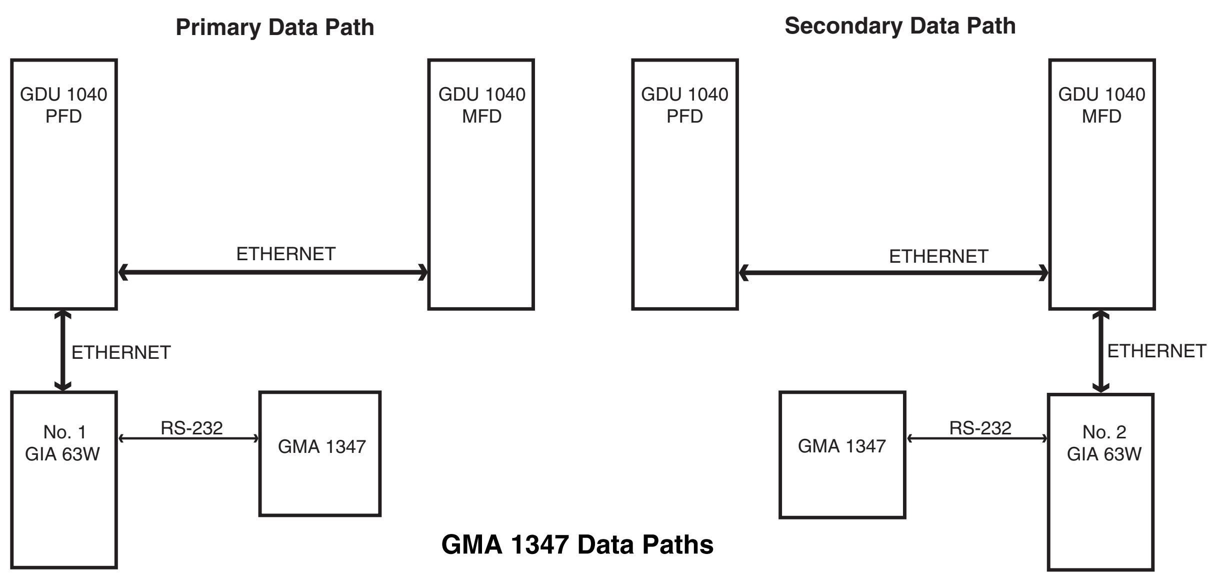
3 Gently insert the GMA 1347 into the rack until the locking tab engages the rack.

4 Begin to turn the hex nut clockwise. This draws the unit into the rack until seated. Do not overtighten the nut.

5 Configure and test the GMA 1347 according to Post-Installation Setup, below.

CHART 7
TROUBLESHOOTING GMA 1347

Alerts		
Failure Message	**Cause**	**Solution**
GMA1 SERVICE – GMA1 needs service. Return unit for repair.	A failure has been detected in audio panel. It may still be usable.	Replace GMA 1347.
GMA1 FAIL – GMA1 in inoperative.	A failure has been detected in audio panel. It is not available.	Replace GMA 1347.
MANIFEST – GMA1 software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in GMA 1347.	Load correct software version.
GMA1 CONFIG – GMA1 configuration error. Config service req'd.	The system has detected a GMA 1347 configuration mismatch.	Reconfigure GMA 1347.



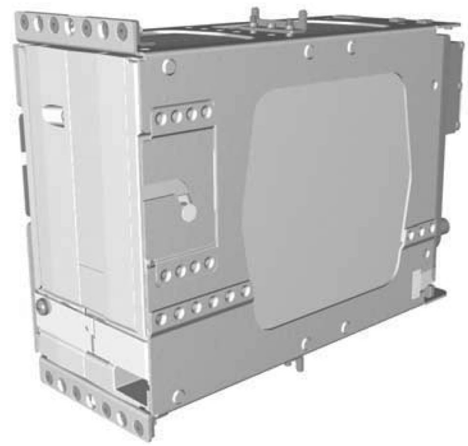
GMA 1347 Data Paths

(4) GIA 63W Integrated Avionics Unit (See Figure 11.)

(a) Description

Two Garmin GIA 63W IAUs provide VHF COM, VHF NAV, GPS NAV and other various navigation functions. GIAs provide communication interface to all other G1000/PA32 LRUs in the system. Both GIAs are located directly behind the MFD, installed into their respective LRU racks. The #1 GIA is powered through the 'Essential' power bus and immediately powers up when the battery master switch is turned on. The #2 GIA receives power through the 'Avionics' bus and powers up when the radio master switch is turned on. Both GIA 63Ws interface to the following equipment:

- S-TEC 55X Autopilot (GIA 2 Only)
- VOR/LOC/Glideslope Antenna System
- VHF COM 1 & 2 Antennas
- GPS 1 & 2 Antennas
- GDL 69/69A (GIA2 Only)
- Skywatch 497 TAS (GIA2 Only)
- WX500 StormScope (GIA2 Only)



GIA 63W Integrated Avionics Unit
Figure 11

NOTE: The GIA 63W is compatible only with the antennas listed in the GIA 63W Installation Manual, Garmin P/N 190-00303-05.

(b) Troubleshooting

See Chart 8.

(c) Removal

1 Remove the MFD as described above.

2 Unlock the GIA 63W handle by loosening the Phillips screw on the handle.

3 Pull the handle upward to unlock the GIA 63W. Gently remove the unit from the rack.

(d) Installation

1 Visually inspect the connectors to ensure there are no bent or damaged pins. Repair any damage.

2 Gently insert the GIA 63W into its rack. The handle should engage the dogleg track.

3 Press down on the GIA 63W hand to lock the unit into the rack.

4 Lock the handle to the GIA 63W body using the Phillips screw.

5 Reinstall the MFD as described above.

6 Configure and test the GIA 63W(s) according to Post-Installation Setup, below.

CHART 8 (Sheet 1 of 7)
TROUBLESHOOTING GIA 63W

General Alerts		
Failure Message	**Cause**	**Solution**
FAILED PATH – A data path has failed.	A data path(s) connected to the GDU or GIA has failed.	Check wiring to the failed LRU.
GIA1 SERVICE – GIA1 needs service. Return unit for repair.	A failure has been detected in GIA1. It may still be usable.	Replace GIA1.
GIA2 SERVICE – GIA1 needs service. Return unit for repair.	A failure has been detected in GIA2. It may still be usable.	Replace GIA2.
HW MISMATCH – GIA hardware mismatch, GIA1 communication halted.	A GIA mismatch has been detected in which only one is WAAS capable.	Replace non-WAAS GIA 63 with a WAAS capable GIA 63W.
HW MISMATCH – GIA hardware mismatch, GIA2 communication halted.	A GIA mismatch has been detected in which only one is WAAS capable.	Replace non-WAAS GIA 63 with a WAAS capable GIA 63W.

COM	
Symptom	**Recommended Action**
Weak COM transmit power	Check COM antenna and cabling. Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault. (Both GIAs must be configured when swapped. If problem follows unit, replace defective unit.
Weak COM receiver	Check COM antenna and cabling. Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault. (Both GIAs must be configured when swapped.). If problem follows unit, replace defective unit.
No COM sidetone	Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault. (Both GIAs must be configured when swapped.): - If problem follows GIA, replace defective GIA. - If problem persists, replace defective GMA 1347.

COM Alerts		
Failure Message	**Cause**	**Solution**
COM1 SERVICE – COM1 needs service. Return unit for repair.	The system has determined COM1 needs service.	Replace GIA1.
COM2 SERVICE – COM2 needs service. Return unit for repair.	The system has determined COM1 needs service.	Replace GIA2.

CHART 8 (Sheet 2 of 7)
TROUBLESHOOTING GIA 63W

COM Alerts (cont.)		
Failure Message	**Cause**	**Solution**
COM1 TEMP – COM1 over temp. Reducing transmitter power.	COM1 is reporting high temperature. Transmitter power is reduced.	Ensure that the avionics fan is functioning properly. Ensure that the scat tubing from the avionics fan is connected to GIA1.
COM2 TEMP – COM2 over temp. Reducing transmitter power.	COM2 is reporting high temperature. Transmitter power is reduced.	Ensure that the avionics fan is functioning properly. Ensure that the scat tubing from the avionics fan is connected to GIA2.
COM1 PTT – COM1 push-to-talk key is stuck.	The COM1 external push-to-talk (PTT) switch is stuck in the enabled (or “pressed”) state.	Press the push-to-talk switch(s) again to cycle its operation. Check push-to-talk switch(s) and wiring. Check GIA1/GMA 1347 interconnect. Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault. (Both GIAs must be configured when swapped.): - If problem follows the unit, replace GIA1; - If problem persists replace defective GMA 1347.

CHART 8 (Sheet 3 of 7)
TROUBLESHOOTING GIA 63W

COM Alerts (cont.)		
Failure Message	**Cause**	**Solution**
COM2 PTT – COM2 push-to-talk key is stuck.	The COM2 external push-to-talk (PTT) switch is stuck in the enabled (or “pressed”) state.	Press the push-to-talk switch(s) again to cycle its operation. Check push-to-talk switch(s) and wiring. Check GIA2/GMA 1347 interconnect. Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault. (Both GIAs must be configured when swapped.): - If problem follows the unit, replace GIA2; - If problem persists replace defective GMA 1347.
COM1 RMT XFR – COM1 remote transfer key is stuck.	The COM1 external remote transfer switch is stuck in the enabled (or “pressed”) state.	Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault. (Both GIAs must be configured when swapped.) - If problem follows the unit, replace GIA1; - If problem persists, continue to troubleshoot remote transfer switch & wiring.
COM2 RMT XFR – COM1 remote transfer key is stuck.	The COM2 external remote transfer switch is stuck in the enabled (or “pressed”) state.	Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault. (Both GIAs must be configured when swapped.) - If problem follows the unit, replace GIA2; - If problem persists, continue to troubleshoot remote transfer switch & wiring.

CHART 8 (Sheet 4 of 7)
TROUBLESHOOTING GIA 63W

NAV	
Symptom	**Recommended Action**
Weak NAV receiver	Check NAV antenna, coupler, and cabling. Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault (Both GIAs must be configured when swapped. If problem follows unit, replace defective unit.

NAV Alerts		
Failure Message	**Cause**	**Solution**
NAV1 SERVICE – NAV1 needs service. Return unit for repair.	The system has detected a failure in NAV1 receiver. It may still be usable.	Replace GIA1.
NAV2 SERVICE – NAV2 needs service. Return unit for repair.	The system has detected a failure in NAV2 receiver. It may still be usable.	Replace GIA2.
NAV1 RMT XFR – NAV1 remote transfer key is stuck.	The NAV1 external remote transfer switch is stuck in the enabled (or “pressed”) state.	Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault. (Both GIAs must be configured when swapped.): - If problem follows unit, replace GIA1; - If problem persists, continue to troubleshoot remote transfer switch & wiring.
NAV2 RMT XFR – NAV2 remote transfer key is stuck.	The NAV2 external remote transfer switch is stuck in the enabled (or “pressed”) state.	Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault. (Both GIAs must be configured when swapped.): - If problem follows unit, replace GIA2; - If problem persists, continue to troubleshoot remote transfer switch & wiring.

CHART 8 (Sheet 5 of 7)
TROUBLESHOOTING GIA 63W

Glideslope (G/S)		
Symptom	**Recommended Action**	
Weak G/S receiver	Check G/S antenna, coupler, and cabling. Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault. (Both GIAs must be configured when swapped.) If problem follows unit, replace defective unit.	
Glideslope Alerts		
Failure Message	**Cause**	**Solution**
G/S1 SERVICE – G/S1 needs service. Return unit for repair.	The system has detected a failure in G/S1 receiver. It may still be usable.	Replace GIA1.
G/S2 SERVICE – G/S2 needs service. Return unit for repair.	The system has detected a failure in G/S2 receiver. It may still be usable.	Replace GIA2.
G/S1 FAIL – G/S1 is inoperative.	The system has detected a failure in G/S1 system. The receiver is not available.	Check G/S1 antenna and cabling. Replace GIA1 if problem persists.
G/S2 FAIL – G/S2 is inoperative.	The system has detected a failure in G/S2 system. The receiver is not available.	Check G/S2 antenna and cabling. Replace GIA2 if problem persists.
GPS		
Symptom	**Recommended Action**	
Will Not Acquire Satellites	Go to AUX 3 Page on MFD and confirm which GPS receiver is inoperative (GPS 1 or GPS 2). Check appropriate GPS Antenna and Cabling. Switch GIA1 and GIA2, to identify whether the unit or connectors/wiring is at fault. (Both GIAs must be configured when swapped.) If problem follows unit, replace defective unit.	
GPS Alerts		
Failure Message	**Cause**	**Solution**
MANIFEST – GPS1 software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in GIA1.	Load correct software version.
MANIFEST – GPS2 software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in GIA2.	Load correct software version.

CHART 8 (Sheet 6 of 7)
TROUBLESHOOTING GIA 63W

GPS Alerts (cont.)		
Failure Message	**Cause**	**Solution**
GPS1 SERVICE – GPS1 needs service. Return unit for repair.	The system has detected a failure in GPS1 receiver. It may still be usable.	Replace GIA1.
GPS2 SERVICE – GPS2 needs service. Return unit for repair.	The system has detected a failure in GPS2 receiver. It may still be usable.	Replace GIA2.
GPS1 FAIL – GPS1 is inoperative.	The system has detected a failure in GPS1 system.	Check GPS1 antenna and cabling. Replace GIA1 if problem persists.
GPS2 FAIL – GPS2 is inoperative.	The system has detected a failure in GPS2 system.	Check GPS2 antenna and cabling. Replace GIA2 if problem persists.
LOI – GPS integrity lost. Crosscheck with other NAVS.	The GPS position is degraded.	This message may clear as GPS coverage improves. Check GPS1 and GPS2 antennas and cabling.
GPS NAV LOST - Loss of GPS navigation. Insufficient satellites.	The GPS position has been lost.	This message may clear as GPS position integrity improves. Check GPS1 and GPS2 antennas and cabling.
GPS NAV LOST - Loss of GPS navigation. Position error.	The GPS position has been lost.	Message may clear as GPS position integrity improves. Check GPS1 and GPS2 antennas and cabling.
GPS NAV LOST - Loss of GPS navigation. GPS fail.	The GPS position has been lost.	Message may clear as GPS position integrity improves. Check GPS1 and GPS2 antennas and cabling.
ABORT APR - Loss of GPS navigation. Abort approach.	The GPS position has been lost.	Message may clear as GPS position integrity improves. Check GPS1 and GPS2 antennas and cabling.
APR DWNGRADE - Approach downgraded.	The GPS position has been lost.	Message may clear as GPS position integrity improves. Check GPS1 and GPS2 antennas and cabling.

CHART 8 (Sheet 7 of 7)
TROUBLESHOOTING GIA 63W

GIA Cooling Alerts		
Failure Message	**Cause**	**Solution**
GIA1 COOLING – GIA1 temperature too low.	GIA1 operating temperature is too low.	Allow unit to warm up.
GIA2 COOLING – GIA2 temperature too low.	GIA2 operating temperature is too low.	Allow unit to warm up.
GIA1 COOLING – GIA1 over temperature.	GIA1 has exceeded its operating temperature range.	Check Avionics Fan for proper operation. Replace GIA1. If problem persists contact Garmin.
GIA2 COOLING – GIA2 over temperature.	GIA2 has exceeded its operating temperature range.	Check Avionics Fan for proper operation. Replace GIA2. If problem persists contact Garmin.
GIA Configuration Alerts		
Failure Message	**Cause**	**Solution**
MANIFEST – GIA1 software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in GIA1.	Load correct software version.
MANIFEST – GIA2 software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in GIA2.	Load correct software version.
GIA1 CONFIG – GIA1 configuration error. Config service req'd.	The system has detected a GIA1 configuration mismatch. If GIAs are not properly configured after being swapped/replaced, this message appears.	Configure GIA1 correctly.
GIA2 CONFIG – GIA2 configuration error. Config service req'd.	The system has detected a GIA2 configuration mismatch. If GIAs are not properly configured after being swapped/replaced, this message appears.	Configure GIA2 correctly.
GIA1 CONFIG – GIA1 audio config error. Config service req'd.	The system has detected an error in the audio configuration of GIA1.	Configure GIA1 correctly.
GIA2 CONFIG – GIA2 audio config error. Config service req'd.	The system has detected an error in the audio configuration of GIA2.	Configure GIA2 correctly.

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(5) GEA 71 Engine/Airframe Unit (See Figure 12.)

(a) Description

The Garmin GEA 71 Engine/Airframe Unit provides engine/airframe data to the G1000/PA32 system. Data received from transducers/sensors is processed, then sent via RS-485 to a GIA 63W, and subsequently to the GDU 1040 MFD. The GEA 71 is connected to both GIA 63Ws for redundant communications. In display reversionary mode, engine instrumentation is displayed on the PFD as well. The GEA is located directly behind the PFD in its LRU rack. Power is received from the 'Essential' power bus.

GEA 71 Engine / Airframe Unit
Figure 12

The GEA interfaces to the following:

- Manifold Pressure Sensor (MAP)
- Oil Pressure Sensor
- Tachometer Sensor
- Oil Temperature Sensor
- Fuel Flow Sensor
- Six Cylinder Head Temperature (CHT) Sensors
- TIT Sensor
- Alternator & Battery Current Monitor Shunts
- Fuel Senders
- Pitot Heat System
- Cabin Air Temp Sensor
- Baggage Door Detection Switch
- Landing Gear Position Switch
- Starter Engage System Monitor
- Flaps In Transit System Monitor

(b) Troubleshooting

See Chart 9.

(c) Removal

1 Remove the PFD as described above.

2 Unlock the GEA 71 handle by unscrewing the Phillips screw.

3 Pull the handle upward to unlock the GEA 71.

4 Gently remove the GEA 71 from its rack.

(d) Installation

1 Visually inspect the connectors to ensure there are no bent or damaged pins. Repair any damage.

2 Gently insert the GEA 71 into the rack. The handle should engage the dogleg track.

3 Press down on the handle to lock the unit into place.

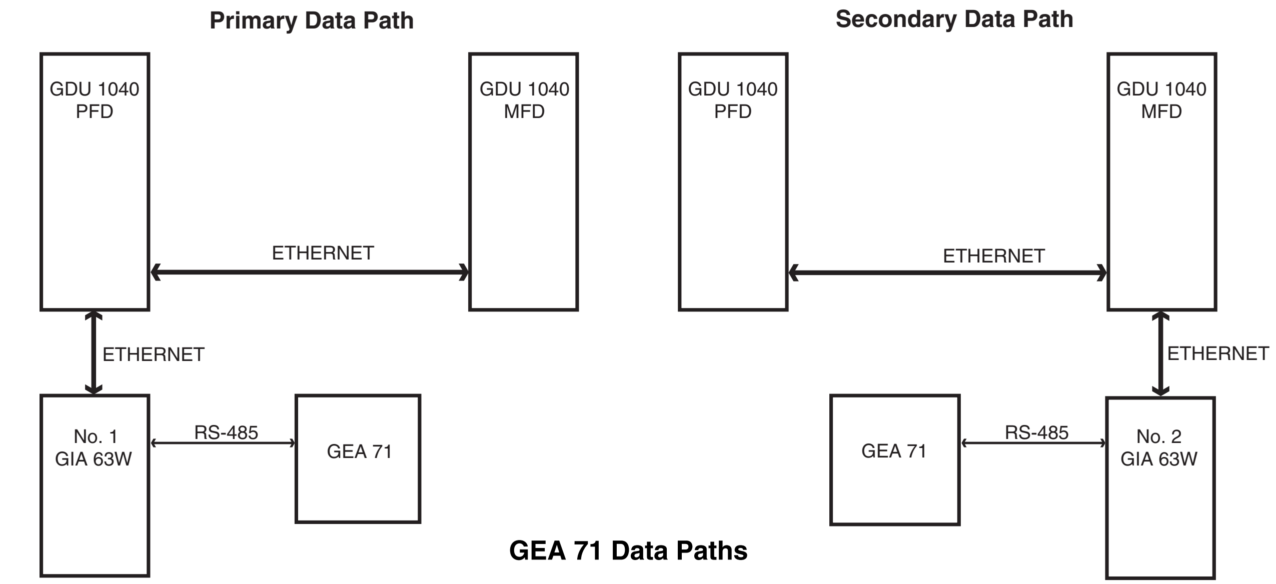
4 Lock the handle to the GEA 71 body using the Phillips screw.

5 Reinstall the PFD as described above.

6 Configure and test the GEA 71 according to Post-Installation Setup, below.

CHART 9
TROUBLESHOOTING GEA 71

GEA Alerts		
Failure Message	**Cause**	**Solution**
MANIFEST – GEA1 software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in GEA 71.	Load correct software version.
GEA1 CONFIG – GEA1 configuration error. Config service req'd.	The system has detected a GEA 71 configuration mismatch.	Configure GEA 71 correctly.



GEA 71 Data Paths

(6) GTX 33 Mode S Transponder (See Figure 13.)

(a) Description

The Garmin GTX 33 provides Mode A, C, and S altitude and position reporting information from the G1000/PA32 system. The unit is mounted directly behind the PFD in its LRU rack. Power is received from the ‘Essential’ bus. Similarly to the GEA 71, the GTX 33 sends data via RS-232 directly to a GIA 63W. Information is then sent to the PFD, where the pilot can control the transponder. The GTX 33 is connected to both GIA 63Ws for redundant communications. The GTX 33 interfaces with the transponder antenna. A remote Indent switch is also installed on the pilot’s control yoke.

GTX 33 Mode S Transponder
Figure 13

(b) Troubleshooting

See Chart 10.

(c) Removal

1 Remove the PFD as described above.

2 Unlock the GTX 33 handle by loosening the Phillips screw on the handle.

3 Pull the handle upward to unlock the GTX 33. Gently remove the unit from the rack.

(d) Installation

1 Visually inspect the connectors to ensure there are no bent or damaged pins. Repair any damage.

2 Gently insert the GTX 33 into its rack. The handle should engage the dogleg track.

3 Press down on the GTX 33 hand to lock the unit into the rack.

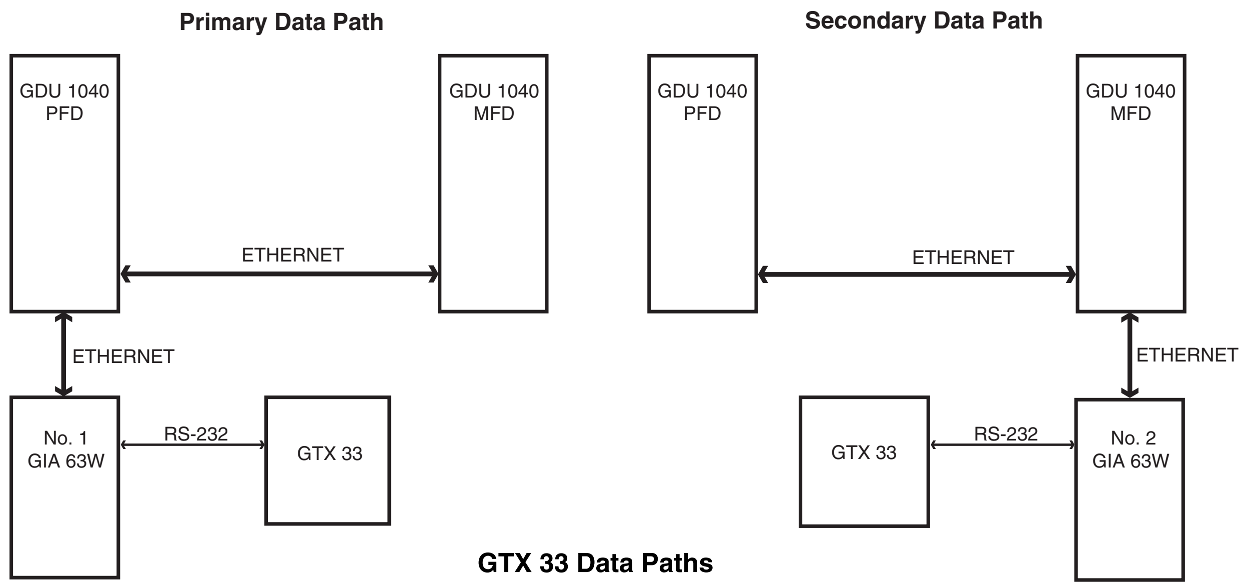
4 Lock the handle to the GTX 33 body using the Phillips screw.

5 Reinstall the PFD as described above.

6 Configure and test the GTX 33 according to Post-Installation Setup, below.

CHART 10
TROUBLESHOOTING GTX 33

GTX Alerts		
Failure Message	**Cause**	**Solution**
MANIFEST – GTX1 software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in GTX 33.	Load correct software version.
XPDR1 CONFIG – XPDR1 configuration error. Config service req'd.	The system has detected a GTX 33 configuration mismatch.	Configure GTX 33 correctly.
XPDR1 SRVC – XPDR1 needs service. Return unit for repair.	A failure has been detected in transponder1. The transponder may still be usable.	Replace GTX1.
XPDR1 FAIL – XPDR1 is inoperative.	The system cannot communicate with transponder1.	Reload configuration file. Check wiring. Replace GIA1 with a known good unit, to verify location of problem: - If problem persists, replace the GTX 33. - If problem does not persist, replaced GIA1.



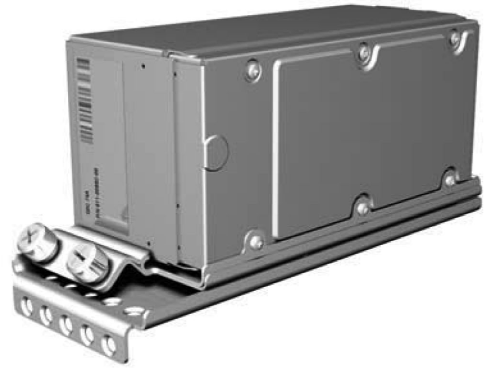
GTX 33 Data Paths

(7) GDC 74A Digital Air Computer (See Figure 14.)

(a) Description

The Garmin GDC 74A provides digital air data computations to the G1000/PA32 system. The unit is mounted to its rack directly behind the PFD. Power is received from the ‘Essential’ bus. The GDC 74A connects to pitot/static ports. Air data is sent to the PFD for display. Four redundant data paths exist to the PFD, MFD, and both GIAs.

NOTE: If any connection in the pitot / static system is opened for maintenance, the entire system must be rechecked per Pitot / Static System, Test in 34-10-00.



GDC 74A Digital Air Computer
Figure 14

(b) Troubleshooting

See Chart 11.

(c) Removal

1 Remove the PFD as described above.

2 Disconnect the pitot/static plumbing from the rear of the unit. Disconnect the single connector.

3 Loosen each thumbscrew on the hold-down clamp and remove the clamp.

4 Carefully remove the unit from its mount.

(d) Installation

1 Place the unit in the mounting tray.

2 Position the locking clamp and fasten using the thumbscrews.

3 Connect the pitot/static plumbing.

4 Inspect the connector and pins for damage. Repair any damage. Connect the connector to the unit.

5 Reinstall the PFD as described above.

6 Configure and test the GDC 74A according to Post-Installation Setup, below.

(8) GTP 59 OAT Probe (See Figure 14a.)

(a) Description

The Garmin GTP 59 OAT Probe provides the GDC 74A with air temperature data. The OAT probe is mounted to the bottom side of the right wing.

(b) Removal

1 Remove the OAT probe cover assembly from the underside of the right wing by removing the Phillips screws.

2 Disconnect the connector.

3 Use an open-end wrench to hold the probe in place on the inside of the cover. On the outside of the cover, loosen the GTP 59 mounting nut and remove the GTP 59.

(c) Installation

1 Place the GTP-59 grounding strap O-ring connector over the OAT probe end and insert the probe through the cover from the inside side. Secure with nut and washer on the outside of the cover. Use an open-end wrench to hold the GTP-59 on the inside and torque the nut on the outside to 50 ± 5 in. lbs.

2 Reconnect the connector to the airplanes wiring harness.

3 Position th OAT probe cover assembly on the underside of the right wing and secure with phillips screws.

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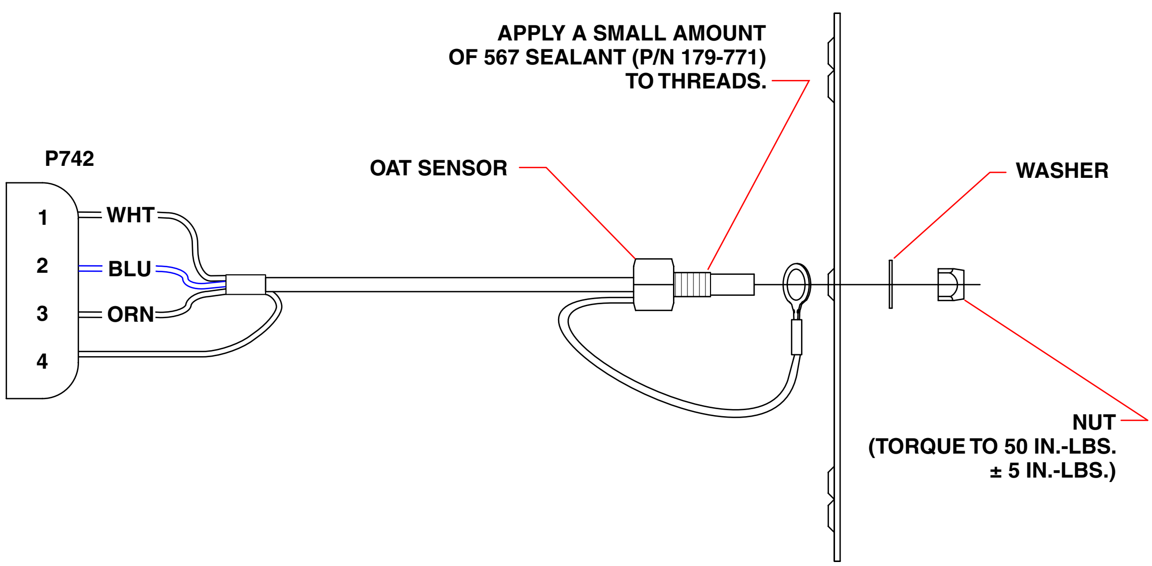

GTP 59 OAT Probe
Figure 14a

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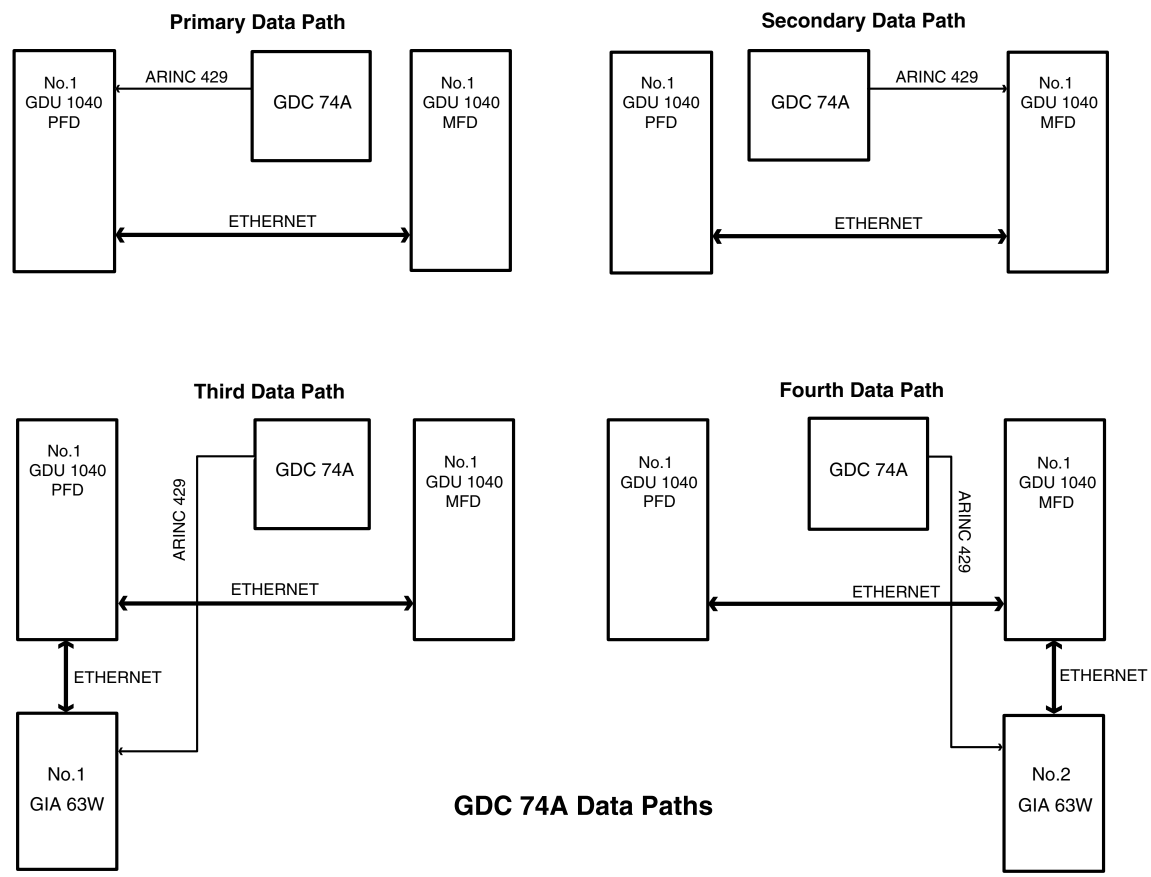
CHART 11
TROUBLESHOOTING GDC 74A

GDC 74A Alerts		
Failure Message	**Cause**	**Solution**
MANIFEST – GDC1 software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in GDC 74A.	Reload software.
GDC1 SERVICE – GDC1 needs service. Return unit for repair.	The system has detected a failure in GDC1.	Replace GDC1.
GDC1 FAIL – GDC1 has failed.	The system has detected a failure in GDC1.	Replace GDC1.



GDC 74A Data Paths

(9) GRS 77 Attitude and Heading Reference System (See Figure 15.)

(a) Description

The Garmin GRS 77 AHRS provides attitude and heading information to the G1000/PA32 system. The unit is mounted below the forward baggage compartment. Power is received from the ‘Essential’ bus. The GRS 77 interfaces with and provides power to the GMU 44 Magnetometer. The GRS 77 supplies attitude and heading information directly to the PFD, MFD, and to both GIAs.

GRS 77 AHRS
Figure 15

(b) Troubleshooting

See Chart 12.

(c) Removal

1 Remove forward baggage compartment floor.

2 Disconnect the AHRS connector.

3 Remove the four Phillips thumbscrews with a screwdriver and set them aside.

4 Gently lift the GRS 77 from the mounting plate. (If the mounting plate is removed, the GRS 77 must be re-calibrated. See Post-Installation Setup, below.)

(d) Installation

1 Place the GRS 77 on the mounting plate, ensuring the orientation is correct.

2 Fasten the unit to the plate using the Phillips thumbscrews.

3 Visually inspect the connectors to ensure there are no bent or damaged pins. Repair any damage. Connect the connector to the GRS 77.

4 Calibrate and test the GRS 77 according to Post-Installation Setup, below.

5 Reinstall forward baggage compartment floor.

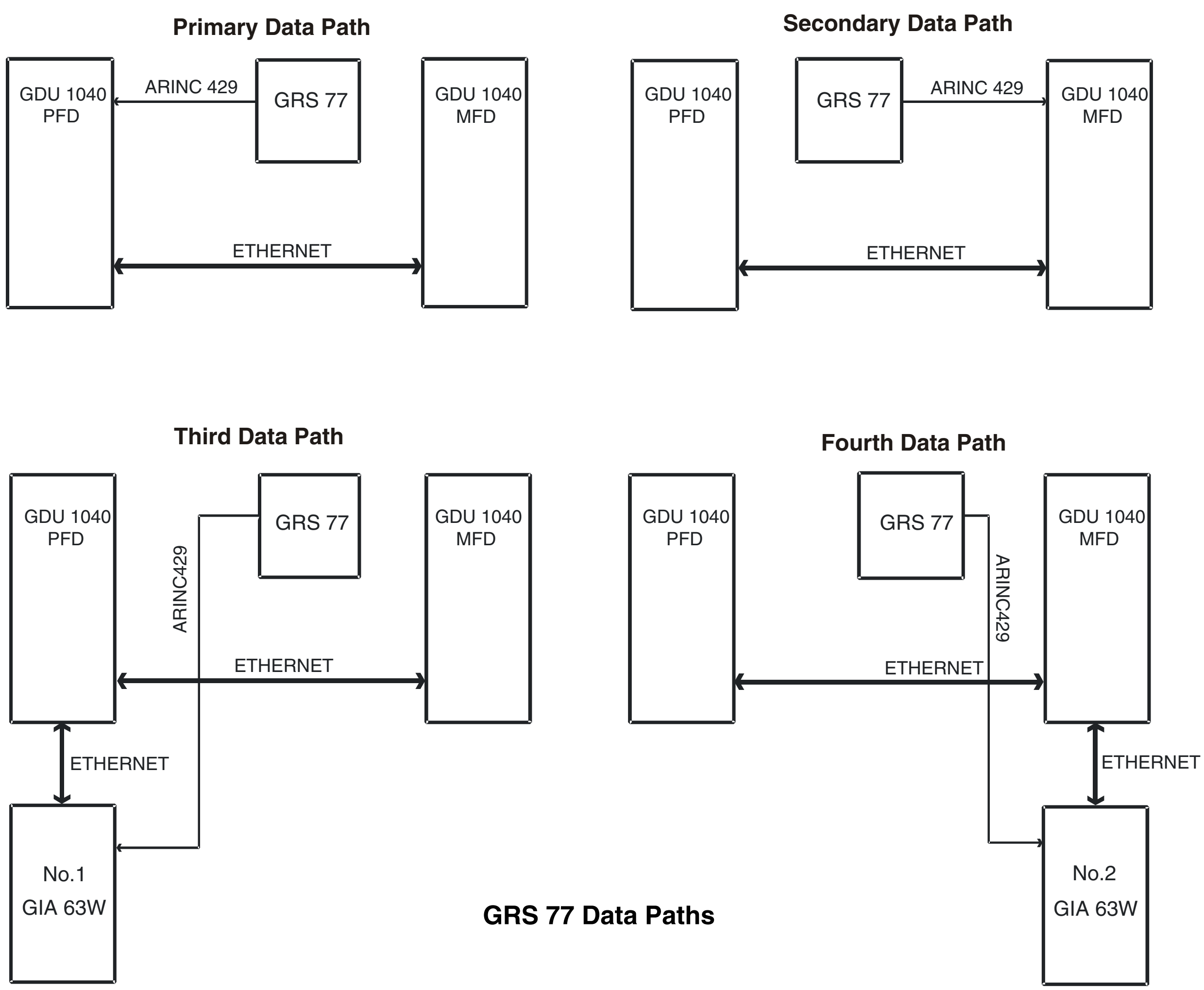
CHART 12 (Sheet 1 of 2)
TROUBLESHOOTING GRS 77

GRS 77 Alerts		
Failure Message	**Cause**	**Solution**
MANIFEST – GRS1 software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in GRS 77.	Reload software.
AHRS SERVICE – AHRS1 Magnetic-field model needs update.	The AHRS magnetic field model should be updated. Appears on ground only.	Required in 2010 and each five (5) years thereafter. Contact Garmin for procedure.
GEO LIMITS – AHRS1 too far North/South, no magnetic compass.	The aircraft is outside of its operating limits; i.e., too far North or South. Heading will be flagged invalid.	Operate the aircraft only within the limits as specified in the G1000 Flight Manual Suppl.
AHRS1 TAS – AHRS1 not receiving airspeed.	The GRS 77 is not receiving airspeed from the GDC 74A.	Check GRS/GDC interconnect.
AHRS1 GPS – AHRS1 not receiving GPS information.	The GRS 77 is not receiving GPS data from the GPS receivers.	Ensure that both GPS1 and GPS2 can lock on to GPS signals: - If GPS receivers are faulty, replace GIA unit(s); - If GPS receivers operate correctly, check GRS/GIA interconnects; - If interconnects operate correctly, replace GRS 77.
AHRS1 GPS – AHRS1 using backup GPS source.	The GRS 77 is using the backup GPS data path.	Ensure that both GPS1 and GPS2 can lock on to GPS signals: - If GPS receivers are faulty, replace GIA unit(s); - If GPS receivers operate correctly, check GRS/GIA interconnects; - If interconnects operate correctly, replace GRS 77.
AHRS1 GPS – AHRS1 not receiving backup GPS information.	The GRS 77 is not receiving data from the backup GPS data path.	Ensure that both GPS1 and GPS2 can lock on to GPS signals: - If GPS receivers are faulty, replace GIA unit(s); - If GPS receivers operate correctly, check GRS/GIA interconnects; - If interconnects operate correctly, replace GRS 77.

CHART 12 (Sheet 2 of 2)
TROUBLESHOOTING GRS 77

GRS 77 Redundant Paths

Failure Message	Cause	Solution
AHRS1 GPS – AHRS1 operating exclusively in no-GPS mode.	The GRS 77 is operating in reversionary mode because it is not receiving any GPS information.	Ensure that both GPS1 and GPS2 can lock on to GPS signals: - If GPS receivers are faulty, replace GIA unit(s); - If GPS receivers operate correctly, check GRS/GIA interconnects; - If interconnects operate correctly, replace GRS 77.



GRS 77 Data Paths

(10) GMU 44 Magnetometer (See Figure 16.)

(a) Description

The GMU 44 provides horizontal and vertical magnetic field information to the GRS 77 AHRS. This allows heading to be calculated and provides assistance during AHRS alignment. The GMU 44 is mounted in the left wingtip.

GMU 44 Magnetometer
Figure 16

(b) Troubleshooting

See Chart 13.

(c) Removal

1 Remove left wingtip cover by unscrewing the Phillips screws.

2 Unscrew the three screws that hold the GMU 44 to its mounting rack.

3 Carefully lift the GMU 44 from the rack.

4 Disconnect the wiring harness.

(d) Installation

1 Visually inspect the connectors to ensure there are no bent or damaged pins. Repair any damage. Connect the wiring harness to the GMU 44.

2 Lower the GMU 44 into the rack and secure the plate with the three Phillips screws.

3 Reinstall left wingtip cover.

4 Calibrate and test the GMU 44 according to Post-Installation Setup, below.

CHART 13
TROUBLESHOOTING GMU 44

GMU 44 Alerts		
Failure Message	**Cause**	**Solution**
MANIFEST – GMU1 software mismatch. Communication Halted.	The system has detected an incorrect software version loaded in GMU 44.	Reload software.
HDG FAULT – A magnetometer fault has occurred.	A fault has occurred in the magnetometer; heading will be flagged invalid.	Replace GMU 44.

(11) GDL 69/69A Data Link Unit (See Figure 17.)

(a) Description

The Garmin GDL 69 Data Link Unit provides NEXRAD weather information to the G1000 system. The GDL 69A Data Link Unit provides NEXRAD weather information and XMTM audio entertainment channels to the G1000 system. Data received from the GDL 69 or 69A is sent directly to the MFD via High Speed Data Bus (Ethernet). The GDL 69 or 69A is located directly behind the PFD in its LRU rack and receives power from the Avionics bus.

GDL 69/69A Data Link Unit
Figure 17

(b) Troubleshooting

See Chart 14.

(c) Removal

1 Remove the PFD as described above.

2 Unlock the GDL 69A handle by unscrewing the Phillips screw.

3 Pull the handle upward to unlock the GDL 69A.

4 Gently remove the GDL 69A from its rack.

(d) Installation

1 Visually inspect the connectors to ensure there are no bent or damaged pins. Repair any damage.

2 Gently insert the GDL 69A into the rack. The handle should engage the dogleg track.

3 Press down on the handle to lock the unit into place.

4 Lock the handle to the GDL 69A body using the Phillips screw.

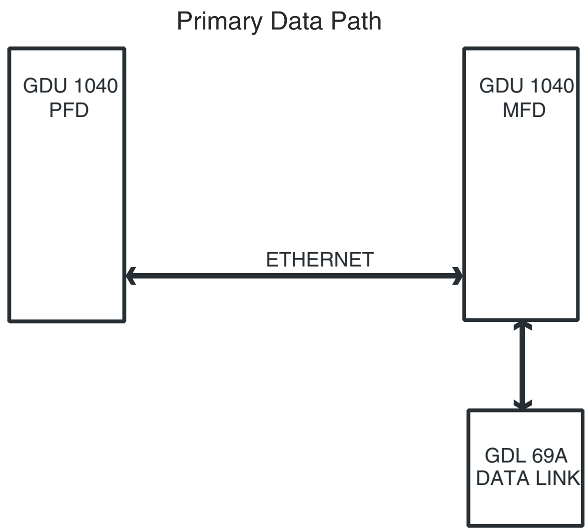
5 Reinstall the PFD as described above.

6 Configure and test the GDL 69A according to Post-Installation Setup, below.

CHART 14
TROUBLESHOOTING GDL 69/69A

GDL Alerts

Failure Message	Cause	Solution
GDL69 CONFIG – GDL 69 config error. Config service req'd.	The system has detected an error in the configuration of the GDL69.	Reload software.
GDL69 FAIL – GDL 69 has failed.	A failure has been detected in the GDL 69/69A. The unit is unavailable.	Replace GDL 69 or 69A.



GDL 69/69A Data Path

(12) Configuration Module

The configuration module is located in the backshell of the connector it is terminated to.

(a) Removal

1 Disconnect connector from LRU.

2 Remove 2 screws (8) from cover (7) and remove cover.

3 Unplug connector from configuration module (1).

4 Remove configuration module.

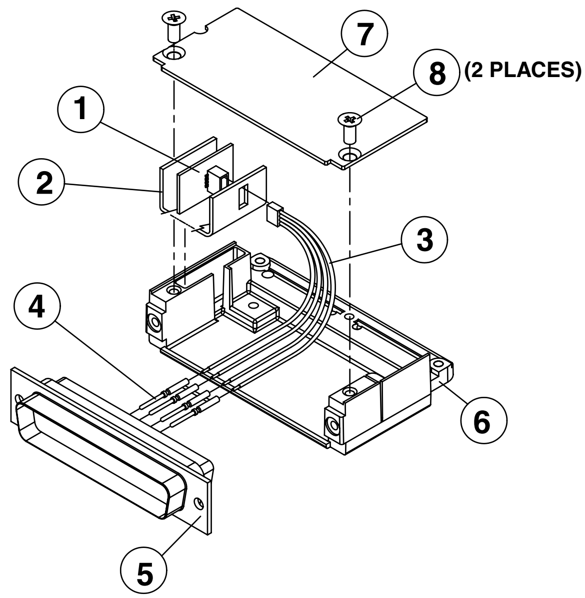
(b) Installation

1 Inspect connector for damaged pins (4).

2 Place configuration module (1) in position.

3 Insert connector into configuration module (1).

4 Assembly of the connector is the reverse of disassembly.



Configuration Module Installation
Figure 18

NOTE: If the GRS 77 AHRS Configuration Module is replaced:

All three GRS 77/GMU 44 calibration procedures must be performed. Proceed to Post-Installation Setup, below.

NOTE: If GDC 74 Configuration Module is replaced:

Configuration settings must be reloaded to the GDC 74A. Proceed to Post-Installation Setup, below.

NOTE: If the Master Configuration Module is replaced:

1. Start the G1000 system in configuration mode.
2. Go to the Configuration Upload Page on the PFD.
3. Press the UPDT CFG softkey.

NOTE: If both the PFD and Master Configuration Module is replaced:

The G1000 system (except GRS 77/GMU 44 and GDC 74A) must be reconfigured. Proceed to Post-Installation Setup, below.

(13) GEA 71 Backshell Thermocouple

(a) Removal

1 Remove GEA 71 as described above.

2 Remove GEA connector backplate.

3 Remove connector J701 (5) from the backplate.

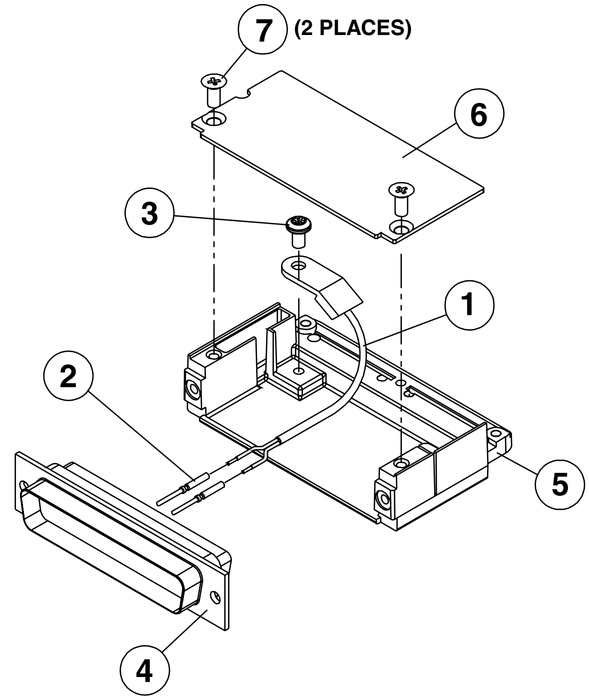
4 Remove cover (6) from the backshell.

5 Unscrew thermocouple from boss on backshell. Extract the thermocouple pins from the connector.

(b) Installation

1 Crimp pins (2) onto each of the thermocouple wires (1). Ensure that pre-stripped wire length is 1/8” prior to crimping.

2 Insert newly crimped pins and wires into the appropriate connector housing location (4) as specified in the electrical schematic.



GEA 71 Backshell Thermocouple
Figure 19

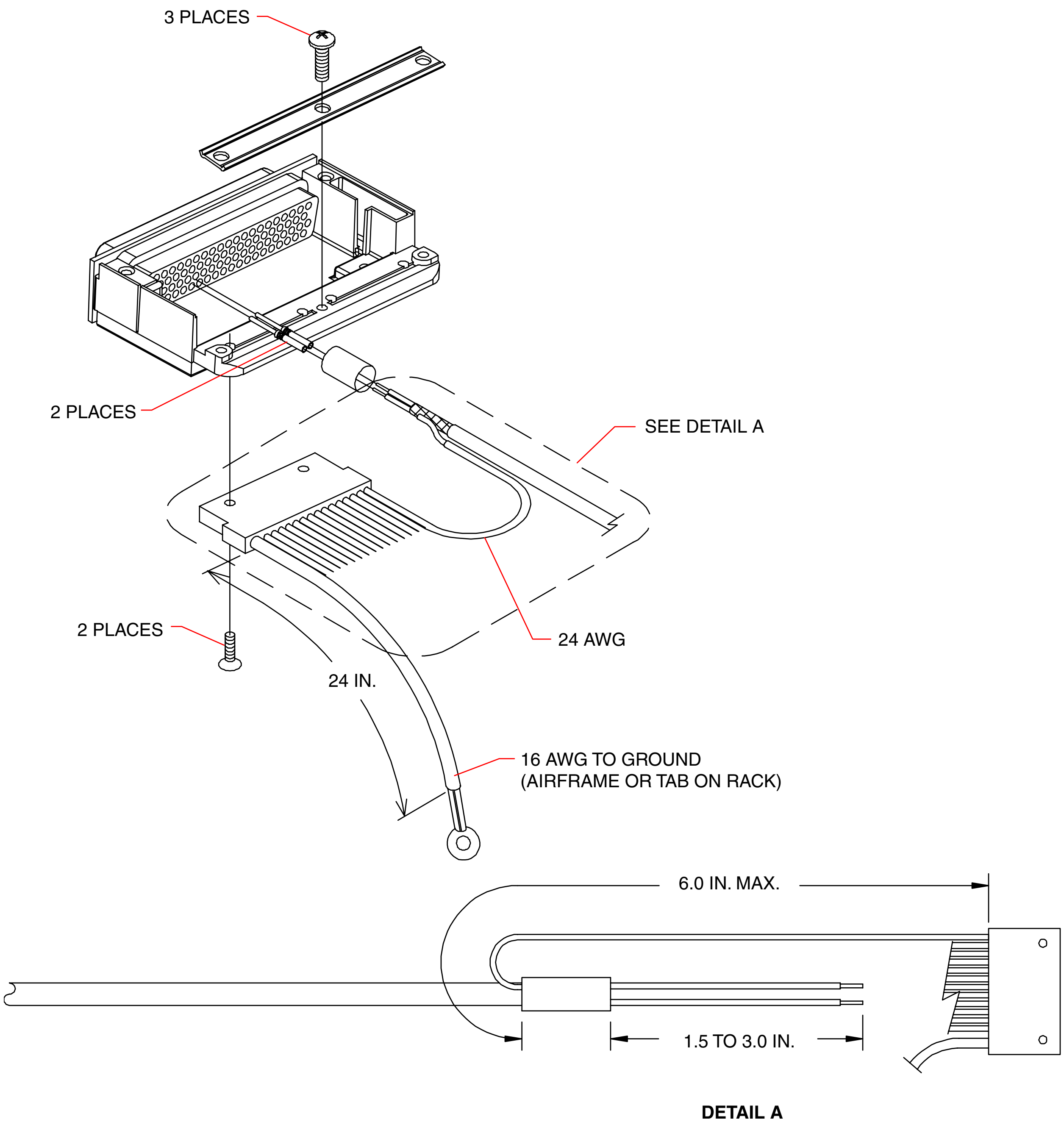
3 Place thermocouple body (1) onto the backshell boss (5). Place the thermocouple as shown in Figure 19 so that the wires exit towards the bottom of the backshell.

4 Fasten thermocouple tightly to backshell using the provided screw (3).

5 Fasten cover (6) to backshell using the provided screws (7).

(14) Spider Grounds

Most G1000 connectors employ a SPIDER grounding system to provide necessary ground reference to shielding and/or transducers. A single 16-gauge wire is connected locally to the airframe. Additional SPIDER wires, 24-gauge, are used to connect shield grounds. The assembly is fastened directly to the backshell housing with two screws. Figure 18 shows an example SPIDER installation.

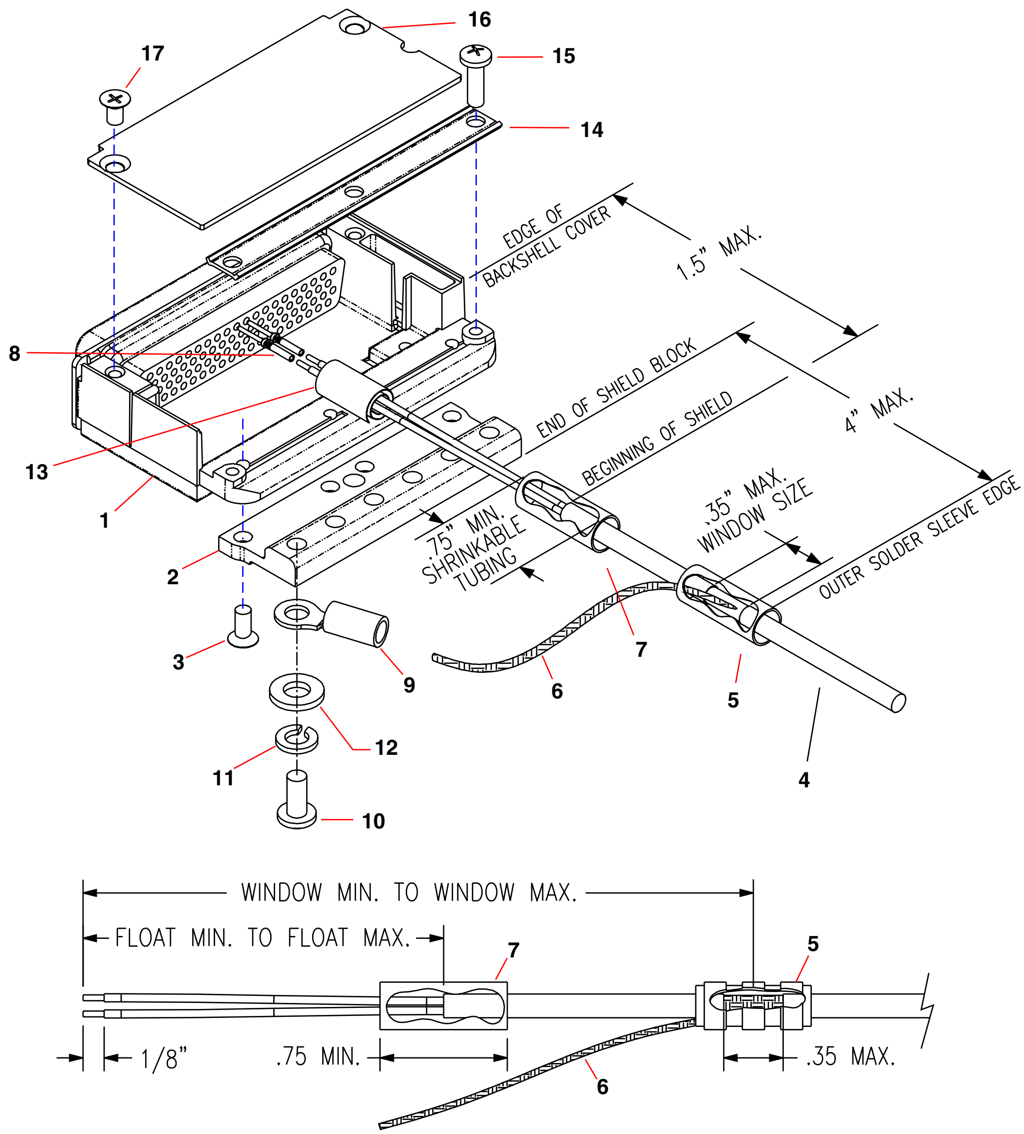


Effectivity
with Garmin 1000

Spider Grounds
Figure 20

(15) Shield Block Installation

Most G1000 connectors employ a shield block grounding system to provide necessary ground reference to shielding and/or transducers.



1. CAST HOUSING
2. SHIELD BLOCK(S)
3. SCREW
4. MULTIPLE CONDUCTOR SHIELDED CABLE (2–CONDUCTOR DEMONSTRATED HERE)
5. DRAIN WIRE SHIELD TERMINATION (METHOD OPTIONAL)
6. BRAID, FLAT
7. FLOATING SHIELD TERMINATION (METHOD OPTIONAL)
8. PINS
9. RING TERMINAL, #8, INSULATED
10. SCREW
11. SPLIT WASHER
12. FLAT WASHER
13. SILICON FUSION TAPE
14. STRAIN RELIEF
15. SCREW
16. LID
17. SCREW

Shield Block Installation to Backshell
Figure 21

Effectivity
with Garmin 1000

G. Post-Installation Setup (PIR-PPS55014, Rev. B/PIR-Garmin Doc. No. 190-00343-02, Rev. B.)

This section covers the procedures that must be performed after accomplishing the mechanical and electrical installations. The person performing the post-installation checks is assumed to be familiar with the aircraft, have a working knowledge of typical avionics systems, and have experience using the test equipment defined in this section. All installation work must be completed before beginning any of the following procedures.

(1) Required Test Equipment

The following test equipment is required to conduct and complete all post installation checkout procedures: (All test equipment should have current calibration records.)

- A VHF NAV/COM/ILS ramp tester or equivalent.
- A transponder ramp tester or equivalent.
- A pitot/static ramp tester.
- A Digital Multi-Meter (DMM).
- A ground power unit capable of supplying 28 Vdc power to the aircraft systems and avionics.
- Outdoor line-of-site to GPS satellite signals or GPS indoor repeater.
- IBM-compatible PC computer.
- Headset/Microphone.
- Digital Level or equivalent.

(2) Operation

See the Garmin Cockpit Reference Guide and the Pilot's Operating Handbook (POH) for system control and operation.

(3) Configuration Mode Overview

CAUTION: THE CONFIGURATION MODE CONTAINS CERTAIN PAGES AND SETTINGS THAT ARE CRITICAL TO AIRCRAFT OPERATION AND SAFETY. SUCH PAGES ARE PROTECTED AND CANNOT BE MODIFIED, UNLESS THE TECHNICIAN IS PROPERLY AUTHORIZED AND EQUIPPED. HOWEVER, MOST PROTECTED PAGES ARE VIEWABLE TO ALLOW SYSTEM AWARENESS FOR TROUBLESHOOTING.

The Configuration Mode exists to provide the technician with a means of configuring, checking, and calibrating various G1000 sub-systems. Troubleshooting and diagnostics information can also be viewed in this mode.

(a) To start the system in Configuration Mode:

1 Start the system in normal mode as described in the POH.

2 Remove power to the PFD and MFD by pulling the circuit breakers labeled PFD and MFD.

3 Press and hold the ENT key on the PFD while applying power using the PFD circuit breaker.

4 Release the ENT key after 'INITIALIZING SYSTEM' appears in the upper left corner of the PFD.

5 Power on the MFD in the same manner. It is best to have both displays in Configuration Mode whenever performing post-installation practices.

NOTE: For a complete description and breakdown of each Configuration Mode page, see the G1000 Configuration Manual, Garmin P/N 190-00303-04.

(b) Loader Card Interface

CAUTION: ALWAYS USE CAUTION WHEN USING CODE LOADER CARDS DURING MAINTENANCE. THE G1000 SYSTEM IS DESIGNED TO IMMEDIATELY INITIALIZE THE CARD UPON POWER-UP. ON-SCREEN PROMPTS MUST BE GIVEN CAREFUL ATTENTION IN ORDER TO AVOID POTENTIAL LOSS OF DATA. ALWAYS READ THROUGH PROCEDURES GIVEN IN HEREIN, AND/OR THE REQUIRED EQUIPMENT LIST, CHART 36, BEFORE ATTEMPTING TO USE THE CODE LOADER CARDS.

The G1000/PA32 Config/Loader Card interface exists to provide a means of loading software and configuration files to the system and LRUs. The G1000/PA32 Config/Loader Card uses a 128 MB Secure Digital (SD) data card that contains:

- All G1000 LRU Software Files
- All G1000 Configuration Files

All software and configuration files were pre-determined by Garmin and/or Piper during design of the system. During removal and replacement of LRUs, software and configuration files may need to be reloaded, see below. To satisfy TC/STC requirements, the technician must use the correct G1000/PA32 Config/Loader Card part number when servicing the G1000 system.

The G1000/PA32 Config/Loader Card part number defines all files specific to the G1000 system as installed in the PA32. Approved Loader Card part numbers for the PA-32 can be found in the Required Equipment List, Chart 36.

(c) Configuration Files

A G1000/PA32 Config/Loader Card typically contains the following configuration files:

- AIRFRAME: Contains data such as airspeed parameters, engine/airframe sensor limitations, fuel tank parameters and alerting system settings that tailor a G1000 PFD or MFD to the PA-32.
- SYSTEM: Configures the G1000 Ethernet to expect a PFD, MFD, and two GIAs.
- MANIFEST: Loads a manifest of all software part numbers and versions associated with an approved system configuration.
- MFD1: Configures MFD serial/discrete communication and alert system settings.
- PFD1: Configures PFD serial/discrete communication and alert system settings.
- GIA1/GIA2: Configure GIA1/GIA2 serial/discrete communication settings.
- GMA1: Configures GMA 1347 audio and serial communication settings.
- GTX1: Configures GTX 33 transponder and serial communications settings.
- GEA1: Configures GEA 71 engine/airframe parameters.
- GDC1: Configures GDC 74A air data values for the PA-32.
- CAL: Configures the fuel quantity calibration settings.
- AUDIO: Configures the audio messages played by the GIAs.

The above files are loaded during the configuration processes listed in Post Installation Procedures, below, and Required Equipment List, Chart 36. Each file is sent directly to the applicable LRU. The same file is also stored in PFD internal configuration memory. The PFD also sends a copy of all configuration files to its connector configuration module. If the PFD is replaced, the configuration module retains all configuration files in the aircraft.

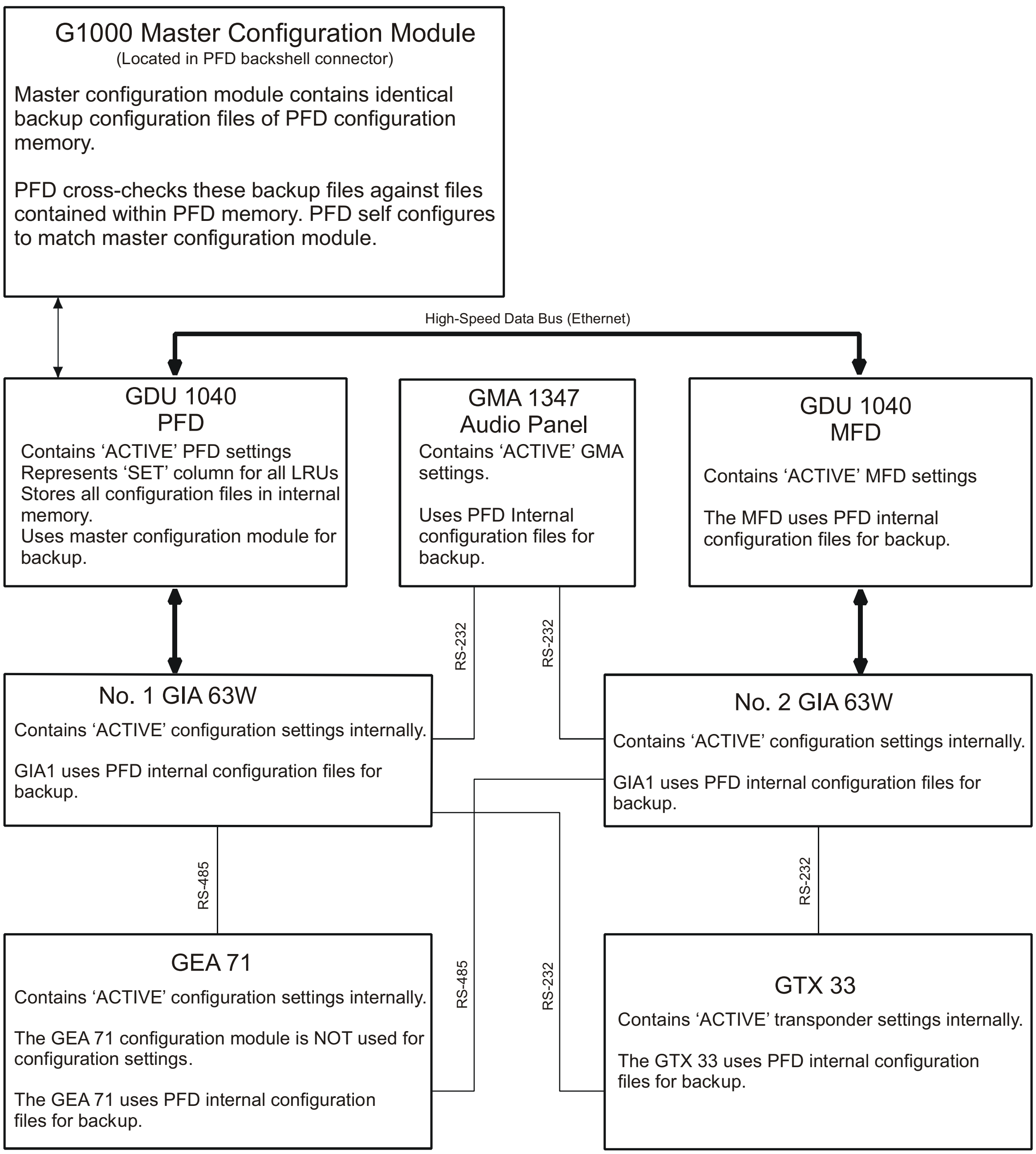
NOTE: The GRS 77 AHRS and GMU 44 Magnetometer do not use a configuration file. However, these LRUs do require several calibrations during installation checkout to tailor sensor characteristics to a specific PA32 airframe. While performing maintenance on these units, re-calibration may be required. See below.

(d) Configuration File Storage

The G1000 system is designed to store all configuration settings in various places so that the configuration is retained in the aircraft during unit maintenance. See Figures 22 and 23.

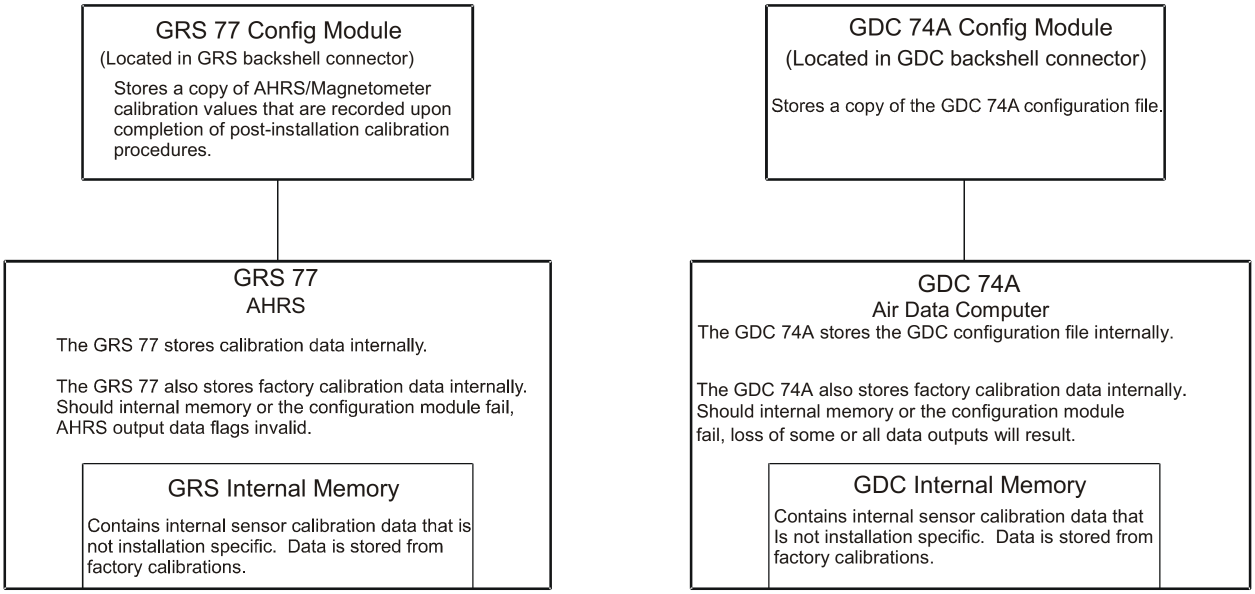
The GRS 77 and GDC 74A configuration modules function differently than the rest of the system. The GDC 74A's configuration file is loaded directly to GDC internal memory. A copy of the file is stored in the GDC configuration module.

The GRS 77 configuration module does not store any configuration settings. Rather, it stores calibration data recorded during installation calibration procedures.



Effectivity
with Garmin 1000

LRU Configuration File Storage
Figure 22



GRS / GDC Configuration Settings Storage
Figure 23

Effectivity
with Garmin 1000

(e) SET>ACTV Interface

CAUTION: THE ACTV>SET SOFTKEY MUST BE USED WITH CAUTION! IF AN IMPROPERLY CONFIGURED UNIT IS INSTALLED, THIS SOFTKEY CAUSES THE WRONG CONFIGURATION TO REPLACE THE CORRECT AIRCRAFT CONFIGURATION!

1 Throughout various Configuration Mode pages, there are SET and ACTIVE columns for input/output settings and other parameters.

SET: Refers to a setting or group of settings that reside in PFD Internal Memory and/or the Master Configuration Module.

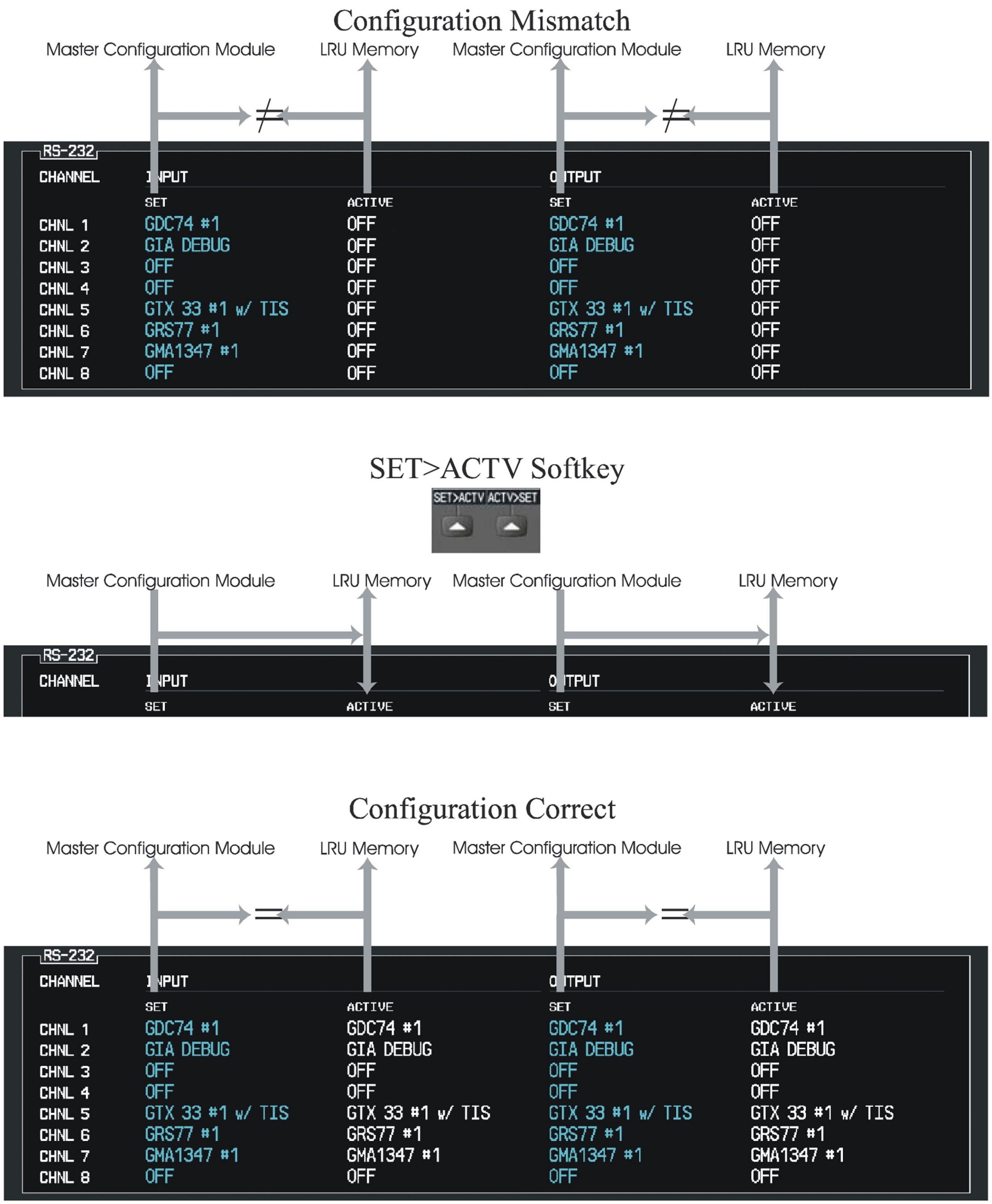
ACTIVE: Refers to an ‘active’ setting or parameter currently being used by the LRU. LRUs store the ‘active’ settings within internal memory.

2 Data can be manually copied from one column to the other by using the following two softkeys, when available:

- SET>ACTV (read ‘Set to Active’) softkey: Allows the installer to send the information in the SET column (data stored in the master config module) to the ACTV column (data used by LRU).

- ACTV>SET (read ‘Active to Set’) softkey: Causes the LRUs current settings to be copied to the master configuration module as SET items.

3 In the first example shown in Figure 24, the SET columns do not match the ACTIVE columns. The inequality between SET and ACTIVE indicates a configuration mismatch. By pressing the SET>ACTV softkey, this copies the SET column to the LRU unit’s configuration memory. The settings then become the ACTIVE settings for the LRU being configured.



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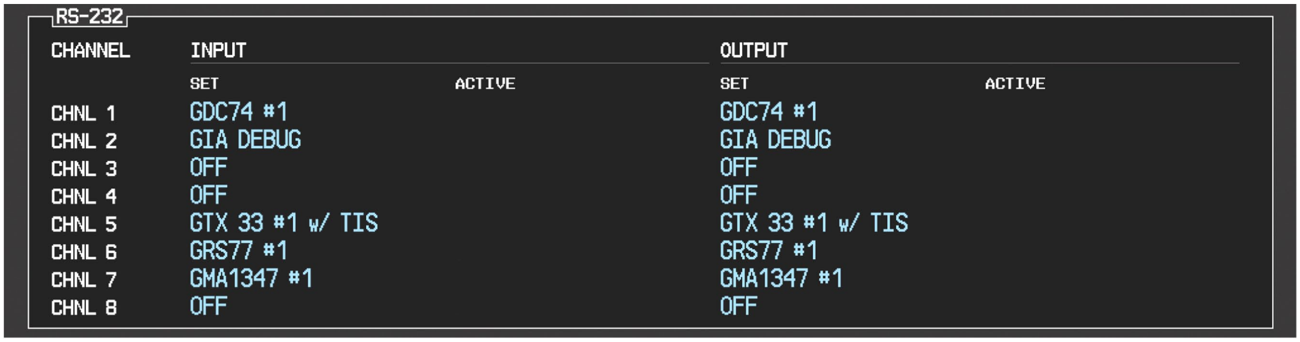
Set > Active Example
Figure 24



Set > Active - Loss of Communications
Figure 25

Effectivity
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4 When troubleshooting the system, technicians can look for inequalities between SET and ACTIVE columns. Certain problems can be resolved simply by pressing the SET>ACTV softkey, which reloads settings to the specific LRU from the PFD.

NOTE: This can also be accomplished by reloading the configuration files for the LRU using the G1000/PA32 Config/Loader Card. See below.

5 A blank active column, as shown in Figure 25, represents loss of communication between the display and the particular unit. See above.

(f) Configuration Prompts

When configuration settings are changed, the technician receives on-screen prompts and/or confirmations such as those shown in old Figures 27 and 28.

(g) Data Transmission Indicators (See Figure 26.)

Several configuration screens utilize an indicator light system to show discrete (ON/OFF) data and/or hardware component status. Unless otherwise noted, the following applies to all such status indicators:

- Green Light: Expected data is successfully received and is ON. A green light could also indicate that the parameter/component is working correctly.

- Red Light: Expected data is not received. A red light could also indicate that a parameter/component is invalid.

- No Light (Black): Expected data is successfully received and is OFF, no data is expected. A black light could also indicate that the parameter/component is not responding.

Data Transmission Indicators
Figure 26

Effectivity
with Garmin 1000

(4) Configuration Mode Navigator

Figure 28 lists the various page groups and pages shown in the G1000 configuration mode. Pages that are bold are used during post-installation setup. Pages that are grayed-out are either not used for setup or are protected so that information cannot be changed.

Using the FMS knob, a user can navigate through different pages and page groups in the Configuration Mode.

Figure 27 shows the typical layout and organization of Configuration Mode Navigator. Specifically, it shows the "SYSTEM" configuration mode page group selected, and the third page of that grouping being selected.

Effectivity
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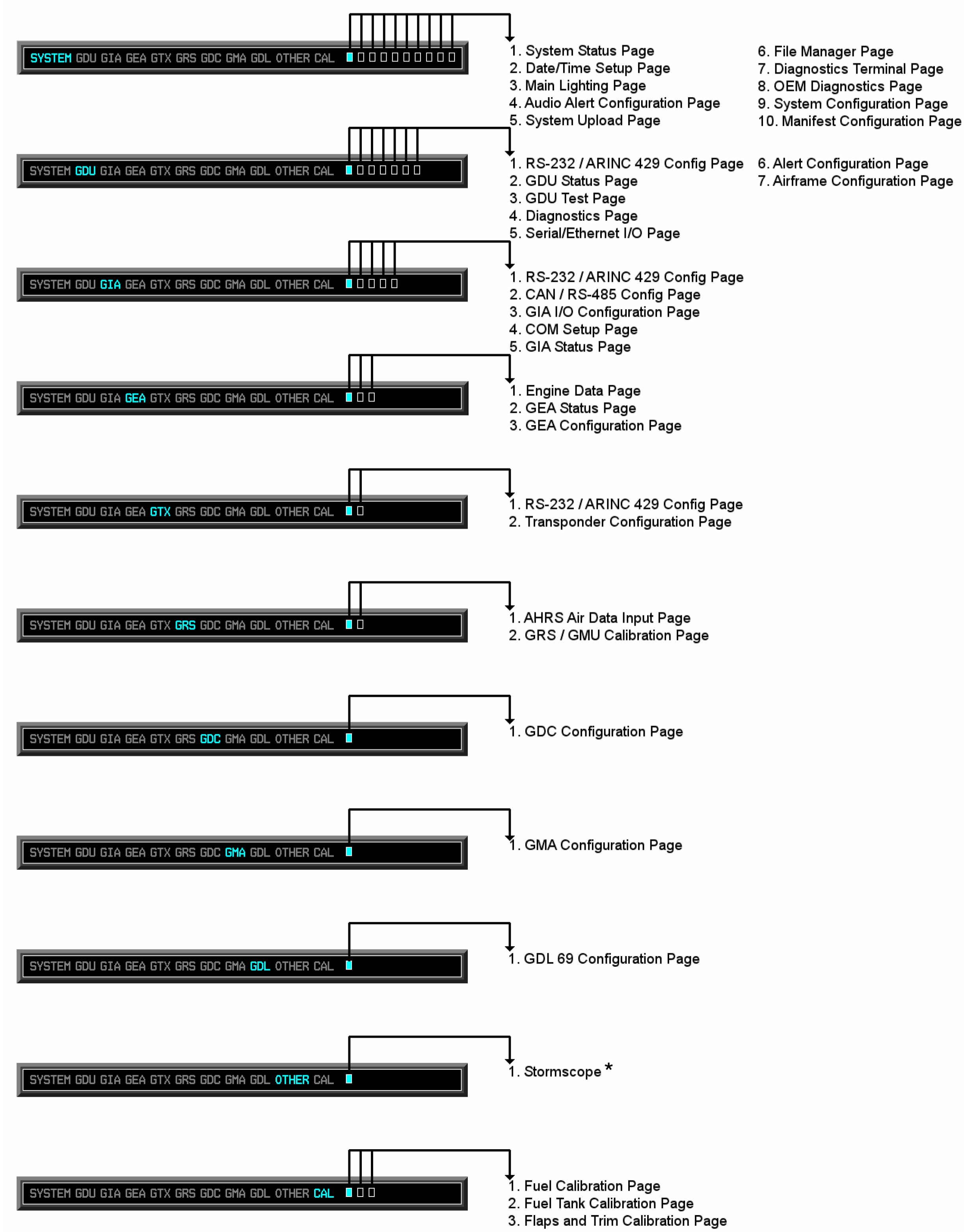
Configuration Page Navigator
Figure 27



* The OTHER page group will only be displayed if the G1000 is configured for the WX-500 Stormscope.

Configuration Pages and Groups
Figure 28

Effectivity
with Garmin 1000

(5) Post Installation Procedures

NOTE: This entire procedure must be successfully accomplished in order for the G1000 system to be airworthy in your airplane.

(a) Bus Power Check

1 Do not apply power to the aircraft.

2 Verify all Circuit Breakers are pulled.

3 Turn ON Battery Master switch with the Emergency Power Switch in the "OFF" position.

Verify the Essential Bus and Main Bus are powered.

4 Turn on the Avionics Master switch.

Verify the Avionics Bus is powered

5 Turn on the Emergency Batt switch.

a Verify the Main Bus is not powered.

b Verify the Avionics Bus is not powered.

c Verify the Emergency Bus is powered.

(b) Wiring Harness Checkout

The following is required only when a harness has been repaired, modified, or replaced, but is recommended when troubleshooting.

Prior to installing any LRUs, the wiring harness should be checked for proper connections to the aircraft systems and other avionics systems. Point to point continuity should be checked to expose any faults such as shorting to ground. Any faults or discrepancies found should be corrected before proceeding.

After accomplishing a continuity check, perform the following power and ground checks to verify power distribution to the LRUs. Any faults or discrepancies should be corrected at this time. Remove power to the aircraft upon completion of harness checkout.

1 Ensure all G1000 LRU's are removed and the cooling fans are disconnected.

2 Verify that the pins indicated in Chart 15 are connected to aircraft ground.

3 Ensure all circuit breakers are closed.

4 Apply external power to aircraft. Ensure that the Emergency Power switch is OFF. Set the Radio Master switch to ON to energize the avionics bus.

5 For the first pin listed in Chart 16 verify that the indicated pin has the appropriate voltage. Open the associated circuit breaker and verify that the voltage is removed from the pin. Close the associated circuit breaker.

6 Repeat step 5 for the remainder of the pins listed in Chart 16.

7 Turn Radio Master switch OFF.

8 Turn off Battery Master

9 Remove External power

10 Remove all Emergency Bus fuses

11 Turn on the Emergency Batt switch

12 Using a voltmeter add and remove fuses individually to verify proper fuse and unit interconnect per Chart 17.

13 Turn Emergency Batt switch OFF.

CHART 15 (Sheet 1 of 2)
GROUND CHECKS

Connector	Pin	Function	Unit	Comments	Verified ?
P3472	14	Pwr Gnd	GMA 1347 Audio		________
1P10001	27	Pwr Gnd	GDU 1040 PFD		________
2P10001	27	Pwr Gnd	GDU 1040 MFD		________
2P10001	57	Program Gnd	GDU 1040 MFD		________
*P771	22	Pwr Gnd	GRS 77 AHRS		________
P741	17	Pwr Gnd	GDC 74 AIR DATA		________
1P601	30	Pwr Gnd	#1 GIA 63W		________
1P601	31	Pwr Gnd	#1 GIA 63W		________
1P605	76	Pwr Gnd	#1 GIA 63W		________
2P601	30	Pwr Gnd	#2 GIA 63W		________
2P601	31	Pwr Gnd	#2 GIA 63W		________
2P604	22	Program Gnd	#2 GIA 63W		________
2P605	76	Pwr Gnd	#2 GIA 63W		________
P551	35	Pwr Gnd	AP Computer		________
P554	3	Pwr Gnd	Control Wheel		________
P558	B	Pwr Gnd	Turn Coordinator		________
P555	10	Pwr Gnd	Trim Monitor		________
P555	13	Pwr Gnd	Trim Monitor		________
P565	3	Pwr Gnd	Trim Master Switch		________
P3301	27	Pwr Gnd	GTX 33 XP		________
1P328	3	Pwr Gnd	Cooling Fan		________
2P328	3	Pwr Gnd	Cooling Fan		________
3P328	3	Pwr Gnd	Cooling Fan		________
P4978	B	Pwr Gnd	Skywatch		________
P5001	5	Pwr Gnd	Stormscope		________
P5001	9	Pwr Gnd	Stormscope		________
P872	S	Pwr Gnd	KR 87 ADF		________
P872	E	Lighting Gnd	KR 87 ADF		________
P872	H	Gnd	KR 87ADF		________
P872	P	Gnd	KR 87 ADF		________
P872	R	Gnd	KR 87 ADF		________
P632	1	Pwr Gnd	KN 63 DME		________

*Located in the baggage compartment. All other connectors located in the cockpit.

CHART 15 (Sheet 2 of 2)
GROUND CHECKS

Connector	Pin	Function	Unit	Comments	Verified ?
P632	A	Pwr Gnd	KN 63 DME		________
P691	20	Pwr Gnd	GDL 69A		________
P347	A	Pwr Gnd	Standby ADI		________
P347	D	Lighting Gnd	Standby ADI		________
P701	20	Pwr Gnd	GEA71		________
P701	43		GEA71	Logic Ess Bus V Lo	________
P701	47		GEA71	Logic Emer Bus V Lo	________
P702	55		GEA71	Left Fuel Quantity Sender Ground	________
P702	57		GEA71	Right Fuel Quantity Sender Ground	________
P702	61		GEA71	Baggage Door Ground	________
P702	63		GEA71	Grounded with Pitot Heat Switch OFF	________
P702	64		GEA71	Gnd with Emer Sw in NORMAL MODE	________

CHART 16
POWER CHECKS (28 VDC)

Connector	Pin	Equipment	Unit		Verified?
AVIONICS BUS					
P3472	53	AUDIO AMP/MKR	GMA 1347 Audio		________
2P10001	35	MFD	GDU 1040 MFD		________
2P601	17	COM 2	#2 GIA 63W		________
2P601	19	COM 2	#2 GIA 63W		________
2P605	29	NAV 2/GPS 2	#2 GIA 63W		________
P558	A	TURN & BANK	Turn Coordinator		________
P551	34	AUTO PILOT	AP Computer	AP/FD switch	________
P554	7	AUTO PILOT	Control Wheel	AP/FD switch	________
P565	2	PITCH TRIM	Trim Master Switch		________
P554	4	PITCH TRIM	Control Wheel		________
1P328	1	AVIONICS COOLING	Cooling Fan		________
2P328	1	AVIONICS COOLING	Cooling Fan		________
3P328	1	AVIONICS COOLING	Cooling Fan		________
P691	35	DATA LINK	GDL 69A	Optional	________
P4978	A	SKYWATCH	Skywatch	Optional	________
P5001	1	WEATHER SYSTEM	Stormscope	Optional	________
P5001	6	WEATHER SYSTEM	Stormscope	Optional	________
P872	13	ADF	KR 87 ADF	Optional	________
P632	2	DME	KN 63 DME	Optional	________
P632	3	DME	KN 63 DME	Optional	________
ESSENTIAL BUS					
1P10001	35	PFD	GDU 1040 PFD		________
*P771	18	AHRS	GRS 77 AHRS		________
P741	55	AIR DATA	GDC 74 AIR DATA		________
1P601	17	COM 1	#1 GIA 63W		________
1P601	19	COM 1	#1 GIA 63W		________
1P605	29	NAV 1/GPS 1	#1 GIA 63W		________
P3301	21	XPNDR	GTX 33 XP		________
P347	C	STBY ADI	Standby ADI		________
P701	35	ENGINE INSTR	GEA 71		________
P701	42	ENGINE INSTR	GEA 71		________

*Located in the baggage compartment. All other connectors located in the cockpit.

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CHART 17
EMERGENCY POWER CHECKS (24 VDC)

Connector	Pin	Fuse	Unit	Verified ?
1P601	23	COM 1A	#1 GIA 63W	________
1P601	25	COM 1B	#1 GIA 63W	________
1P10001	39	PFD	GDU 1040 PFD	________
P771	20	AHRS	GRS 77 AHRS*	________
P741	58	AIR DATA	GDC 74 Air Data	________
P347	B	EMER LIGHTING	Standby ADI	________
Stby A/S post light		EMER LIGHTING		________
Stby altimeter post light		EMER LIGHTING		________
Compass	1	EMER LIGHTING		________
P347	C	ADI	Standby ADI	________
P701	37	ENG INSTR	GEA 71	________
1P605	33	NAV 1 / GPS 1	#1 GIA 63W	________
P701	46	EMER BATT VOLT	GEA 71	________

*Located in the baggage compartment. All other connectors located in the cockpit.

(c) G1000 Hardware/Software Compatibility Check

Before installing replacement hardware, the technician must first ensure that hardware part numbers are compatible with the G1000/PA32 Config/Loader Card that is to be used. A G1000/PA32 Config/Loader Card is required to install software and configuration settings to a new G1000 components. The part number of this card is directly associated with the particular PA-32/32R model, and with the combination of software file part numbers and version levels that are defined on the card. Should software part numbers or versions change, a new Loader Card part number is issued.

The Required Equipment List, Chart 36, shows all available combinations of hardware and Loader Cards. Using the REL, the technician must verify that the PA-32/32R model and all hardware part numbers are compatible with the Loader Card to be used. The REL allows the technician to correlate each LRU hardware part number to a compatible Loader Card.

NOTE: After verifying hardware/Loader Card compatibility, it's important to record the Loader Card part number and all LRU hardware part numbers in the appropriate aircraft logbook before proceeding.

(d) System Installation

Upon completion of continuity, power, and compatibility checks, the LRUs can be installed as described for the individual component under Components, above. Each LRU must be installed into its respective rack and secured. The units and accessories must be connected to the wiring harness. Any additional connections, such as pitot/static plumbing, must also be accomplished at this time.

NOTE: The remainder of this section uses many screen shot examples to illustrate the software loading and configuration process. Considering the fluid nature of software development, you may notice slight differences in the screens appearing in your airplane. Always refer to the Required Equipment List, Chart 36, for the correct software file names, versions and part numbers.

(e) G1000 Software/Configuration Procedure

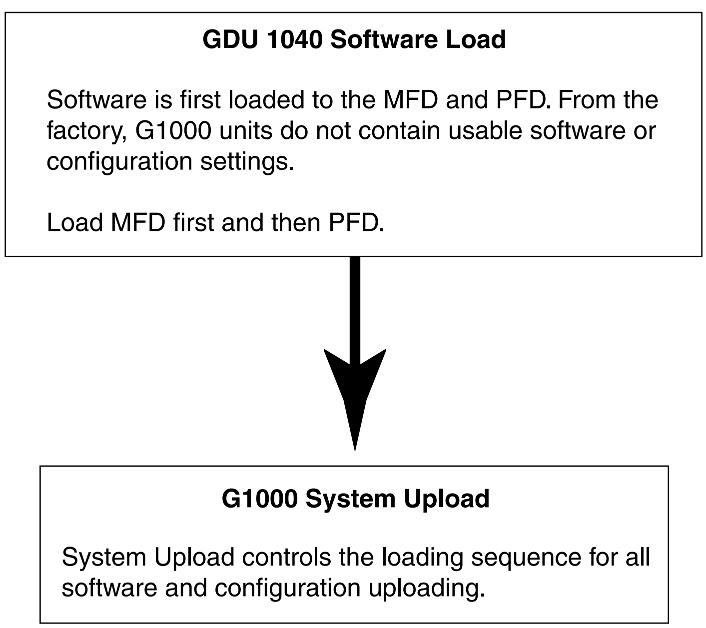
The G1000 is not airworthy unless software and configuration are accomplished successfully as described in these procedures. The system upload controls the sequence of software and configuration loaded in to the system. Figure 29 depicts an overview of the software/configuration upload for the G1000 system. If any problems are encountered during the loading process, see Chart 18. It is extremely important that each LRU software load be completed successfully.

(f) System Power Up

Apply power to the G1000 by doing the following

1 Connect a ground power unit to the external power receptacle and turn on the ground power unit.

2 Turn on the RADIO MASTER switch. At this moment, all G1000 equipment is receiving power.



Software Load / Configuration Overview
Figure 29

CHART 18
TROUBLESHOOTING SOFTWARE LOAD / CONFIGURATION

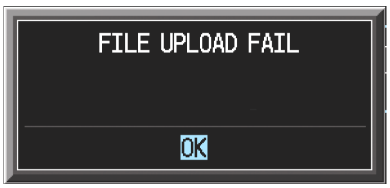
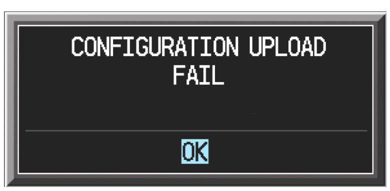
Problem	Solutions
GDU 1040 MFD or PFD display does not power up	Ensure that the criteria listed in Chart 18 are fulfilled for the applicable situation. Ensure power is present at display backshell connector. Replace display.
Software file load fails: 	Ensure that criteria listed in Chart 18 are fulfilled for the applicable situation. Ensure that the LRUs report being online on the System Status page. Check data path wiring as needed. Retry software file load or try using a different card. Ensure that the MFD is not touched during the loading process. Ensure that LRU part number is compatible with software version and Loader Card. Refer to the Required Equipment List, Chart 36, and to Software Load Confirmation, below. Replace LRU.
Configuration file load fails: 	Ensure that criteria listed in Chart 18 are fulfilled for the applicable situation. Ensure that LRU is reporting data on System Status page. Check data path wiring as required. Retry configuration file load or try using a different card. Ensure that the MFD is not touched during the loading process. Ensure that LRU part number is compatible with Loader Card. Refer to the Required Equipment List, Chart 36, and to Software Load Confirmation, below. Replace LRU.
GIA1 to LRU serial data path not working.	Ensure that the criteria listed in Chart 18 are fulfilled for the applicable situation. Ensure GIA1 and GIA2 are configured correctly. Check wiring, connectors and pins as required.
Software File Mismatch Alert appears in lower corner of PFD when started in normal mode: 	Ensure that proper software file part number and version were loaded to LRU. Refer to the Required Equipment List, Chart 33, Software Load Confirmation, below, and Chart 18. Check and ensure that correct Loader Card was used during load process. Refer to the Required Equipment List, Chart 33. Reload software to LRU.

CHART 19
SYSTEM COMMUNICATION HIERARCHY

Desired Operation	Criteria for Success
Load Software to GDU 1040 MFD or PFD Displays.	G1000/PA32 Config/Loader Card card must be inserted in top slot for each display to be loaded. CLR & ENT keys must be held during power up of display. Power only one display on at a time during software loading.
Load Software/Configuration files to GIA 63Ws.	G1000 system must be powered on. PFD and MFD must have correct software. PFD and MFD must be successfully configured with AIRFRAME, SYSTEM, MFD1, and PFD1 configuration files.
Load Software/Configuration files to: GMA 1347, GDC 74A, GEA 71, GRS 77 (software only), GTX 33, and GDL 69A.	G1000 must be powered on. G1000/PA32 Config/Loader Card must be inserted into PFD top slot. PFD and MFD must have correct software and configuration settings. GIA 63Ws must have correct software. GIA 63Ws must be successfully configured with GIA1 and GIA2 configuration files. Serial data path from GIA1 to each LRU must be operational.

(g) MFD & PFD Software Load

CAUTION: DO NOT INTERRUPT POWER TO THE AIRCRAFT AT ANY TIME DURING THESE PROCEDURES. INTERRUPTION OF POWER COULD RESULT IN DAMAGE TO THE EQUIPMENT.

Perform “System Power Up”, above.

1 Pull the MFD and PFD circuit breaker.

2 Insert Piper P/N PS50207-2 G1000/PA32 Config/Loader Card into the MFD top card slot.

3 While holding the ENT and CLR keys on the MFD, restore power by closing the MFD circuit breaker.

4 When the words **INITIALIZING SYSTEM** appear in the upper left corner of the MFD, release the ENT and CLR keys.

5 Press the YES key to acknowledge the following prompt:

“DO YOU WANT TO CLEAR USER SETTINGS?”

“YES WILL BE ASSUMED IN 10 SECONDS”

6 Press the YES key to acknowledge the following prompt:

DO YOU WANT TO UPDATE SYSTEM FILES?
NO WILL BE ASSUMED IN 30 SECONDS.

UPDATING SYSTEM FILES, PLEASE WAIT.

....

7 The following screen is displayed.

89 FILES SUCCESSFULLY UPDATED
PRESS ANY KEY TO CONTINUE.
CONTINUING IN 10 SECONDS.

8 New software is loaded to the MFD. When complete, the MFD starts in configuration mode.

9 Remove power to the MFD by pulling the MFD circuit breaker.

10 Remove the G1000/PA32 Config/Loader Card from the MFD and insert it into the top card slot on the PFD. Repeat Steps 3 through 6 for the PFD.

11 When PFD update is complete, it starts in the configuration mode. Do not remove power.

12 While holding the ENT key on the MFD, restore power to the MFD by closing the MFD circuit breaker.

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Selecting Airframe Type
Figure 30

CAUTION: FOR THE REST OF THE SOFTWARE/CONFIGURATION PROCEDURE, DO NOT OPERATE THE MFD WHILE LOADING SOFTWARE OR CONFIGURATION FILES UNLESS SPECIFICALLY INSTRUCTED TO DO SO. A FAILED OR CANCELLED LOAD MAY RESULT.

(h) System Upload

Go to the System Upload page (Figure 30) using the small FMS knob.

1 Activate the cursor and use the small FMS knob to highlight the airframe type in the AIRFRAME field. Press the ENT key to select the appropriate airframe type.

CAUTION: ENSURE THAT THE CORRECT AIRFRAME TYPE IS SELECTED BEFORE PROCEEDING; OTHERWISE, INCORRECT CONFIGURATION INFORMATION WILL BE LOADED.

2 Once an airframe type is selected, the cursor moves to the FILE field. Rotate the small FMS knob to generate a pick list. Move the cursor to highlight the appropriate aircraft model. Press ENT.

3 Press “CHK ALL” softkey. Product page will be filled with data pertaining to each LRU. The LRU and CARD VERS columns show their respective software versions. The Software and Configuration columns have all the check boxes checked. Any file with a checked box will be loaded into the respective LRU.

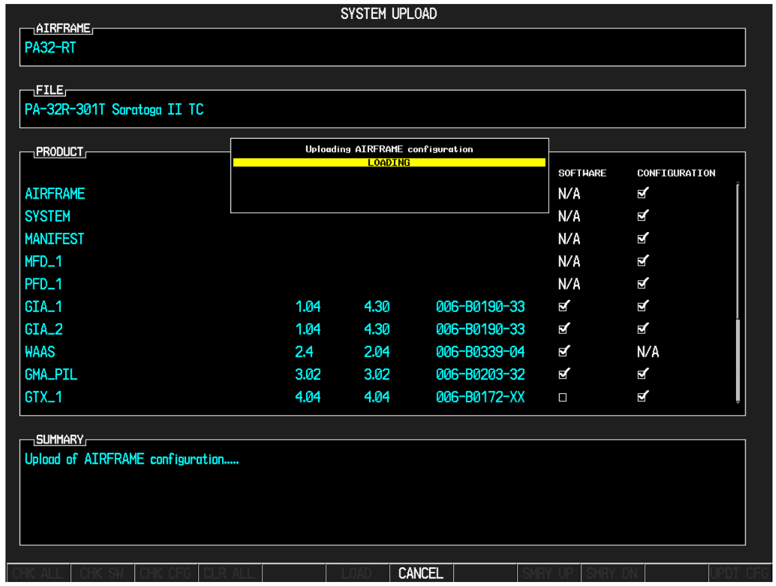
4 Press the LOAD softkey.

5 Load may take up to 45 Min.

6 Monitor the status of the upload by observing the SUMMARY window in the lower portion of the display (see Figure 31). The bottom line will show the active load with the lines above scrolling off the screen. Each successful upload will show PASS next to the check box as completed.

7 When the upload is finished (Figure 32), press the ENT key to acknowledge the following confirmation.

8 De-activate cursor by pressing the small FMS knob.



Monitoring Upload Status
Figure 31

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System Upload Complete
Figure 32

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(i) Software Load Confirmation

1 Go to the System Status page using the FMS knob. Activate the cursor and toggle to the LRU window (Figure 33).

2 Highlight each of the following items in the LRU window and verify that the software part number and version matches the information in the Required Equipment List, Chart 36.

NOTE: PS50207-2 PA32 Loader card contains software image 006-B0648-05. Verify the PA32 Software image on initial power-up of the MFD. The last six digits of the software image part number are displayed as "Piper PA32 System 0648.05" in the upper right corner of the MFD.

CAUTION: IF ANY SOFTWARE VERSION AND/OR PART NUMBER DOES NOT MATCH, OR IS NOT SUCCESSFULLY LOADED, DO NOT CONTINUE WITH POST-INSTALLATION PROCEDURES. TROUBLESHOOT AND RESOLVE THE ISSUE BEFORE CONTINUING, SEE CHART 18.

3 De-activate the cursor.

LRU Window - System Status Page
Figure 33

(6) Final Configuration and Setup Items

(a) Optional System Configuration

CAUTION: IF THE CONFIGURATION FOR AN OPTIONAL SYSTEM IS INADVERTENTLY LOADED FOR A SYSTEM THAT IS NOT INSTALLED, THE BASIC PIPER PA-32 CONFIGURATION FOR AIRFRAME, GIA 1, GIA 2 AND THE GMA MUST BE RELOADED. FOLLOWING THIS, CONFIGURATION OF THE OPTIONAL SYSTEMS MUST BE REPEATED.

This section describes the steps that must be completed in order to configure the G1000 for optional systems. Configure only those systems which are installed.

1 - WX-500
- GDL 69A
- SKY497 Sky Watch
- KR 87 ADF
- KN 63 DME

a Go to the System Upload page and activate cursor. Create a pick list by rotating the small FMS knob and select PA32 Options.

b Press ENT.

c Create a pick list by rotating the small FMS knob and select the desired option, press ENT.

d Verify both Software and Configuration boxes are checked for Garmin options. Verify Configuration boxes checked for all other options.

e Press LOAD softkey.

f Verify the summary field lists the software and configuration are complete as required and PASS is displayed next to both appropriate boxes.

g Press ENT to accept.

h For other installed options repeat steps 3 thru 7 by rotating the large FMS knob and highlighting the File Field.

i De-activate the cursor.

j Remove the PS50207-2 PA32 Loader card and return to controller.

2 XM Activation Procedure

The following is required only when installing a replacement GDL 69A Datalink unit.

a Required Data Elements

1) Customer's XM account billing information

a) Account number

b) XM Service Package (i.e., subscription level)

2) Old GDL 69A unit eight (8) digit XM radio ID number

3) New GDL 69A unit eight (8) digit XM radio ID number

b Procedure

Call 1-800-985-9200 and provide the Required Data Elements, explaining that you are transfering the service from one unit to another.

(b) Aircraft Registration Number Entry

1 Select the GTX page group, then select the TRANSPONDER CONFIGURATION page (Figure 34) on the PFD.

2 Ensure that the ‘ADDRESS TYPE’ is ‘US TAIL’ under the ‘SET’ and ‘ACTIVE’ columns.

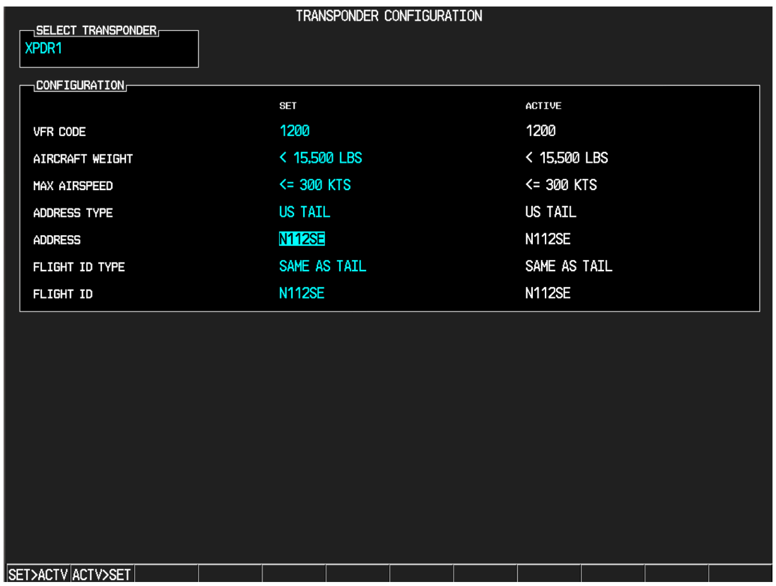
3 Ensure that the FLIGHT ID TYPE is PFD ENTRY under the SET and ACTIVE columns.

4 Activate the cursor and highlight the ‘ADDRESS’ field. Use the small/large FMS knobs to enter the aircraft registration number.

5 Once the correct registration number is entered, press the ENT key. Transponder configuration is in process as shown in Figure 35.

6 When complete the transponder alerts the technician as shown in Figure 36.

7 Deactivate the cursor.



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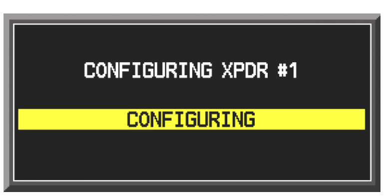
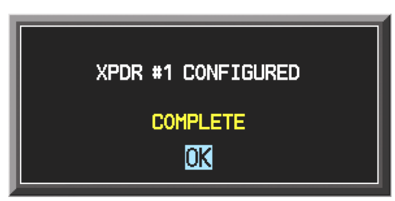
Transponder Configuration Page
Figure 34



Transponder Configuration in Progress
Figure 35



Transponder Configuration Complete
Figure 36

(c) GMA 1347 Configuration Check (PIR-PPS55014, Rev. C.)

1 Apply power to the aircraft and all avionics.

2 Pull the MFD and PFD circuit breakers.

3 While holding the “ENT” keys on the PFD and MFD, restore power by resetting the circuit breakers.

4 When the works “INITIALIZING SYSTEM” appear in the upper left corner of the displays, release the “ENT” key.

NOTE: The following steps are all accomplished using the PFD only.

5 Using the outer (large) FMS knob, rotate until the cursor highlights the “GMA” field on the menu.

6 Select “GMA” by pressing the “ENT” key. The PFD display should now show the GMA Configuration Page.

7 Verify that configuration label “UNSWITCHED IN #2” displays a value “15” in both the SET and ACTIVE columns.

8 If “15” is displayed, jump to step 17.

9 If other than “15” proceed to next step.

10 Activate the Curser by depressing the inner (small) FMS knob.

11 Select configuration label “UNSWITCHED IN #2” by rotating the outer FMS knob until the value is highlighted.

12 With the current value highlighted, rotate the inner FMS knob until the desired value (15) is delayed.

13 Set the new value (15) by depressing the “ENT” key.

14 Wait intil the message “GMA #1 Configured Complete….. OK” appears.

15 Acknowledge this message by depressing the “ENT” key and verify that both the SET and ACTIVE column values indicate the new value (15).

16 De-select the cursor by pressing the inner FMS knob.

17 Power down to save changes & re-apply power to continue with the GMA 1347 Audio and Communications verification.

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(d) GDC 74A Configuration Check

1 Select the GDC page group on the PFD. The GDC Configuration page (Figure 37) is shown by default.

2 Verify:

OAT PROBE =	GTP 59
AIRCRAFT =	MANUAL ENTRY
ALTITUDE ERROR CORRECTION =	OFF
AIRSPEED ERROR CORRECTION =	OFF

(e) ADF Fan Fail Configuration (Optional)

1 Select the GEA group on the PFD, then select the GEA CONFIGURATION page.

2 To perform the ADF FAN FAIL configuration press the following softkeys:

a 1 Far left softkey)

b 2

c 3

d 4

3 Select the DSCRT softkey.

4 Activate the cursor and select GEA BOARD and create a pick list.

5 Select GEA I/O A and press ENT.

6 Select SELECT CHANNEL and create a pick list.

7 Select CHANNEL 7A and press ENT.

8 Select DATA field and “Input Type SET Column”.

9 Create a pick list and select “OFF”. Press ENT.

10 Press ENT to acknowledge.

11 Deactivate cursor and press VERIFY softkey.

12 Press ENT to acknowledge the GEA configuration is complete.

GDC Configuration Page
Figure 37

Effectivity
with Garmin 1000

Effectivity
with Garmin 1000

System Upload Page
Figure 38

(f) TAWS

1 Installation / Unlock

a Remove power from the PFD and MFD by opening the PFD and MFD circuit breakers.

b A special TAWS Enable card, referenced in the Required Equipment List, Chart 36, is required to enable TAWS. Insert this card in the upper slot of the PFD.

NOTE: The TAWS Enable card can only enable TAWS on one system (one aircraft). A new TAWS Enable card must be used for each aircraft.

c While holding the ENT key on the PFD and MFD, restore power by closing the PFD and MFD circuit breakers.

d When the words **INITIALIZING SYSTEM** appear in the upper left corner of the PFD and MFD, release the ENT key.

e On the PFD, go to the System Upload page (Figure 38) using the FMS knob.

f Activate the cursor and use the small FMS knob to highlight Configuration Files in the AIRFRAME field. Press ENT.

g Activate the cursor and use the small FMS knob to highlight Enable TAWS in the FILE field. Press ENT.

h Verify there is a check mark in the box in the configuration column for Airframe.

i Press the LOAD softkey.

j Monitor the status of the upload. When the upload is finished, press the ENT key to acknowledge the confirmation shown in Figure 39.

k View the SUMMARY field and ensure that the item is “PASS” as shown in Figure 40.

Load Confirmation
Figure 39

l De-activate the cursor.

m Power down the system and remove the TAWS Enable card from the PFD.

n Load Garmin GDU 10XX Terrain Data Card per Aviation Database Loading, below.

2 TIS Inhibit

a While pressing the ENT key on the PFD and MFD restore power to the system.

b Select the GIA group on the PFD, then select the GIA I/O CONFIGURATION page.

c Activate the cursor and use the small FMS knob to create a pick list and select Discrete Out in the Input/Output field.

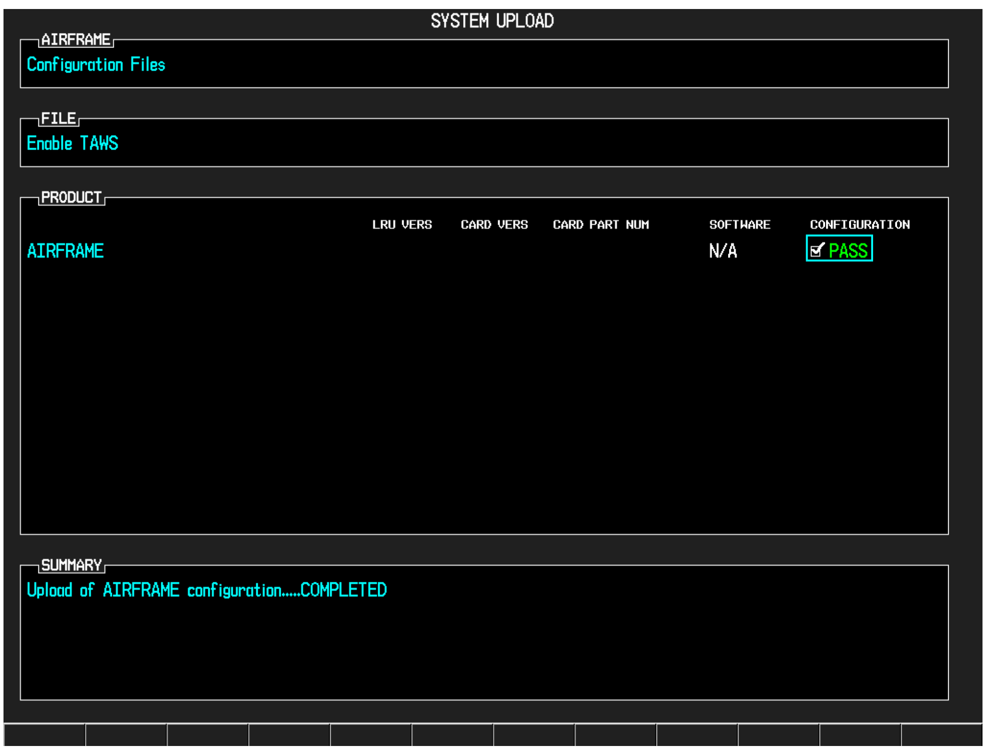
d Using the large FMS knob scroll to ANNU* 15 and use the small FMS knob to create a pick list and select Audio Inhibit 1. Press ENT.

e Press ENT again to except configuration then rotate the large FMS knob to move cursor to the Select GIA Unit field.

f Using the small FMS knob generate a pick list and select GIA 2.

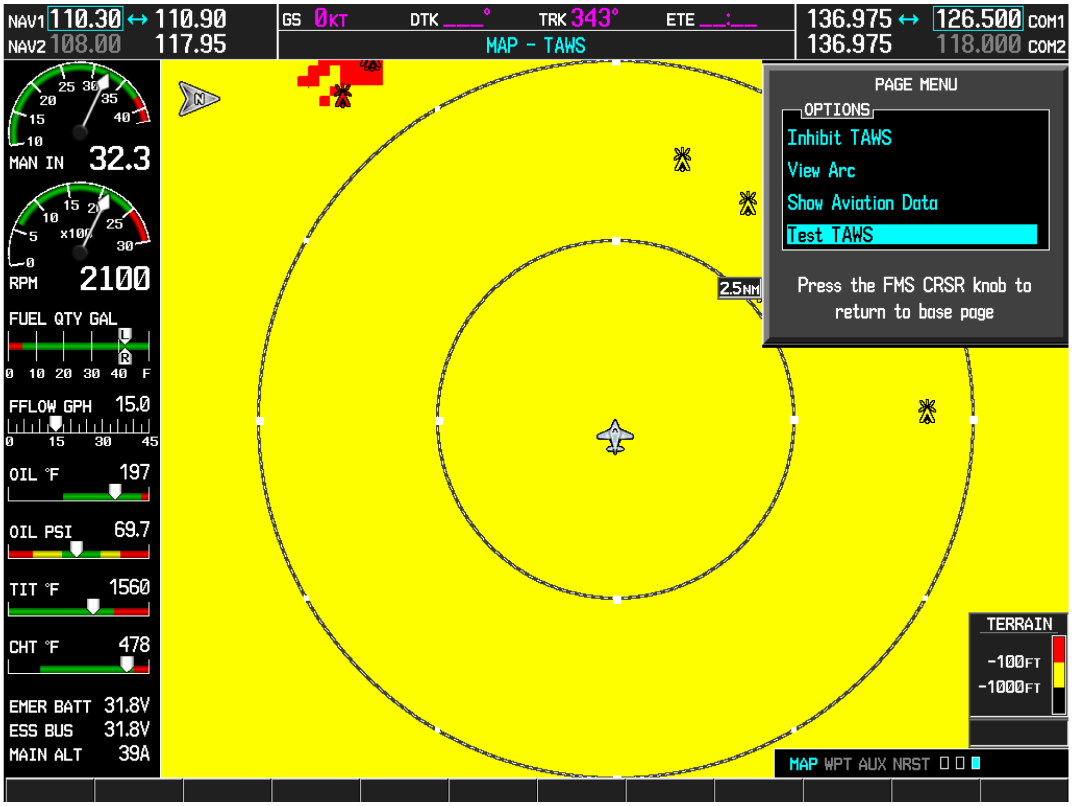
g Repeat steps c thru e.

h De-activate the cursor.



Summary Field Shows “PASS”
Figure 40

Effectivity
with Garmin 1000



Effectivity with Garmin 1000

TAWS Page
Figure 41

3 TAWS Check

a Ensure that matching terrain data base cards are installed in the bottom card slots in the PFD and MFD and the aircraft has a GPS position.

b Select the TAWS page (last page in the MAP group) (Figure 41)

c Verify that the title at the top of the page reads “MAP – TAWS”. If TAWS has not been enabled, the title will read “MAP – TERRAIN PROXIMITY” or “MAP - TERRAIN”.

d Press the MENU button and select “Test TAWS” from the pop-up menu and press ENT.

e After the TAWS test has completed, verify that “TAWS System Test Okay” is heard over the cockpit speaker.

(g) Chartview / Unlock

1 Installation

a Remove power from the PFD and MFD by opening the PFD and MFD circuit breakers.

b A special Chartview Enable card, referenced in the Required Equipment List, Chart 36, is required to enable Chartview. Insert this card in the upper slot of the PFD.

NOTE: The Chartview enable card can only enable Chartview on one system (one aircraft). A new chartview enable card must be used for each aircraft.

System Upload Page
Figure 42

Effectivity
with Garmin 1000

c While holding the ENT keys on the PFD and MFD, restore power by closing the PFD and MFD circuit breakers.

d When the words **INITIALIZING SYSTEM** appear in the upper left corner of the PFD and MFD, release the ENT key.

e On the PFD, go to the System Upload page (Figure 42) using the FMS knob.

f Activate the cursor and use the small FMS knob to highlight Configuration Files in the AIRFRAME field. Press ENT.

g Activate the cursor and use the small FMS knob to highlight Enable Chartview in the FILE field. Press ENT.

h Verify there is a check mark in the box in the configuration column for Airframe.

i Press the LOAD softkey.

j Monitor the status of the upload. When the upload is finished, press the ENT key to acknowledge the confirmation (see Figure 39).

k View the SUMMARY field and ensure that the item is ‘PASS’ as shown in Figure 43.

l De-activate the cursor.

m Power down the system and remove the Chartview Enable card from the PFD.

n Load GarminChartview, Jeppesen NavData U.S. Database per Aviation Database Loading, below.

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Summary Field Shows "PASS"
Figure 43

2 Check

a Ensure that a Chartview/Jeppesen NavData U.S. database card is installed in the top card slot of the MFD.

b Select the Airport Information page (first page in the WPT group) (Figure 44).

c Verify that the title at the top of the page reads "WPT - Airport Information".

d Enter KVRB as the waypoint and verify that the CHRT softkey is available.

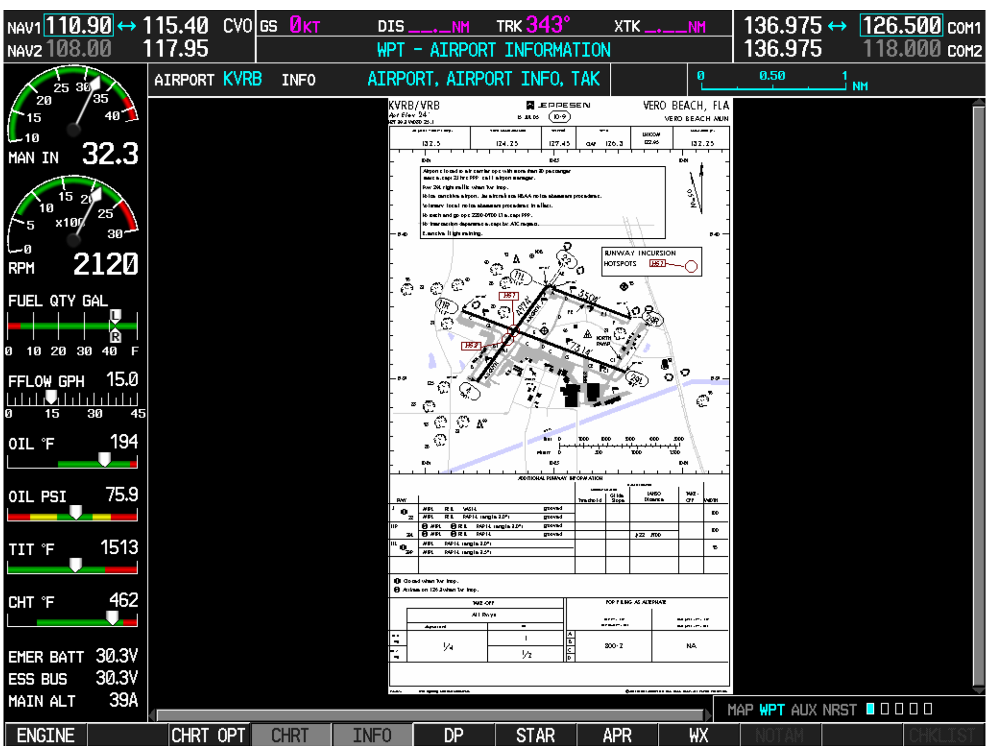
e Press the CHRT softkey and verify the electronic chart is viewable (Figure 45).

(h) Fuel Quantity Transducer Calibration and Full Tank Calibration

See 28-40-00.

Airport Information Page
Figure 44

[Effectivity
with Garmin 1000]



Airport Chart is Viewable
Figure 45

[Effectivity
with Garmin 1000]

(i) Aviation Database Loading Procedures

1 Garmin GDU 10XX Terrain Data Card Loading Procedure:

a Remove power from the PFD and MFD by pulling the PFD and MFD circuit breakers.

b Install a GDU 10XX Terrain Database Card PS50207-3 in the bottom slot of the PFD and MFD.

c This completes the installation of the Terrain Data Card.

2 JEPPS NAV Database Downloading Procedure:

a Using PS50207-7 Data Card, download the Jepps NavData G1000 Full U.S. database, using the following procedure.

b Using an approved computer, enter the Jeppesen Services program and enter the username and password.

c The update manager will appear and the available services will be displayed.

d Load the PS50207-7 card into an approved Scan Disk reader.

e Highlight the “NavData Garmin G1000 Full U.S.”

f Click the Start Button

g the load screen will appear and ask you to browse to the current location of your load card.

h Press continue and the load will begin.

i After the card loads, proceed to the JEPPS NAV Database Aircraft Loading Procedure, below. One PS50207-7 download will load one G1000 System (one PFD and one MFD).

3 JEPPS NAV Database Aircraft Loading Procedure:

a Remove power from the PFD and MFD by pulling the PFD and MFD circuit breakers.

b Install the PS50207-7 in the top slot of the PFD.

c Restore power to the PFD by closing the PFD circuit breaker.

The following screen is displayed.

DO YOU WANT TO UPDATE THE AVIATION DATABASE?
PRESS CLR FOR NO AND ENT FOR YES
YOU HAVE 30 SECONDS BEFORE NO IS RETURNED

d Press the ENT key to confirm the database update. The following prompt is displayed.

DO YOU WANT TO UPDATE THE AVIATION DATABASE?
PRESS CLR FOR NO AND ENT FOR YES
YOU HAVE 30 SECONDS BEFORE NO IS RETURNED
UPDATING AVIATION DATABASE

UPDATED 1 FILES SUCCESSFULLY!

e When the update is complete, the PFD starts in normal mode.

f The PFD aviation database is now updated.

g Remove the PS50207-7 from the top slot of the PFD and place it in the top slot of the MFD.

h Restore power to the MFD by closing the MFD circuit breaker.

The following prompt is displayed in the upper left corner of the MFD.

DO YOU WANT TO UPDATE THE AVIATION DATABASE?
PRESS CLR FOR NO AND ENT FOR YES
YOU HAVE 30 SECONDS BEFORE NO IS RETURNED

i Press the ENT key to confirm the database update. The following prompt is displayed.

DO YOU WANT TO UPDATE THE AVIATION DATABASE?
PRESS CLR FOR NO AND ENT FOR YES
YOU HAVE 30 SECONDS BEFORE NO IS RETURNED
UPDATING AVIATION DATABASE

UPDATED 1 FILES SUCCESSFULLY!

j When the update is complete, the MFD starts in normal mode.

k The MFD aviation database is now updated.

l Leave the PS50207-7 in the top slot of the MFD, for delivery with the airplane.

4 JEPPS CHARTS Downloading Procedure

a Remove the PS50207-7 Data Card from the top slot of the MFD. Download the Jepps Charts database using the following procedure.

b Using an approved computer enter the Jeppesen Services program and Enter the username and password.

c The update manager will appear and the available services will show.

d Load the PS50207-7 card into an approved Scan Disk reader.

e Highlight the "G1000 Electronic Chart Service."

f Click the Start Button

g The load screen will pop up and ask you to browse to the current location of your load card.

h Hit continue and the load will begin

i After the card is loaded proceed to JEPPS Charts Aircraft Loading Procedure, below.

5 JEPPS CHARTS Aircraft Loading Procedure

a Remove power from the MFD by pulling the MFD circuit breaker.

b Install Jepps Charts Card PS50207-7 in the top slot of the MFD.

c Restore power to the MFD by closing the MFD circuit breaker.

The following prompt is displayed in the upper left corner of the MFD.

**DO YOU WANT TO UPDATE THE AVIATION DATABASE?
PRESS CLR FOR NO AND ENT FOR YES
YOU HAVE 30 SECONDS BEFORE NO IS RETURNED**

d Press the ENT key to confirm the database update. The following prompt is displayed:

**DO YOU WANT TO UPDATE THE AVIATION DATABASE?
PRESS CLR FOR NO AND ENT FOR YES
YOU HAVE 30 SECONDS BEFORE NO IS RETURNED
UPDATING AVIATION DATABASE**

UPDATED 1 FILES SUCCESSFULLY!

e After the update completes, the MFD starts in normal mode.

f The Jepps Charts are now loaded in there MFD and do not need to be loaded in the PFD.

g The Jepps Charts Card PS50207-7 remains in the top slot of the MFD.

(j) Software Image Verification

1 Remove power from the MFD by pulling the MFD circuit breakers.

2 Restore power to the MFD.

3 On initial power-up of the MFD, “(Aircraft Model) System 0648.05” will appear in the upper right corner of the MFD to verify the PA32 Software Image.

(7) System Testing and Checkout

For the remainder of the system checkout procedures, the G1000 system is tested while operating in the normal mode unless otherwise specified. Restart the PFD by cycling the PFD circuit breaker to start the display in the normal mode. Cycle power to the MFD in the same manner. Press the ENT key to acknowledge the agreement on the MFD.

In the normal operating mode, data fields that are invalid have large red X’s through them (see Figure 10). A valid field does not display a red X. Allow the displays to initialize for approximately one minute. The GDC 74A requires a longer initialization period than do the other LRUs. During normal operation, this causes the airspeed, altitude, vertical speed, and OAT fields to be invalid during the first 40 to 60 seconds after PFD power up.

NOTE: Outputs from the GRS 77 AHRS and GMU 44 are invalid until the units have been calibrated as described below.

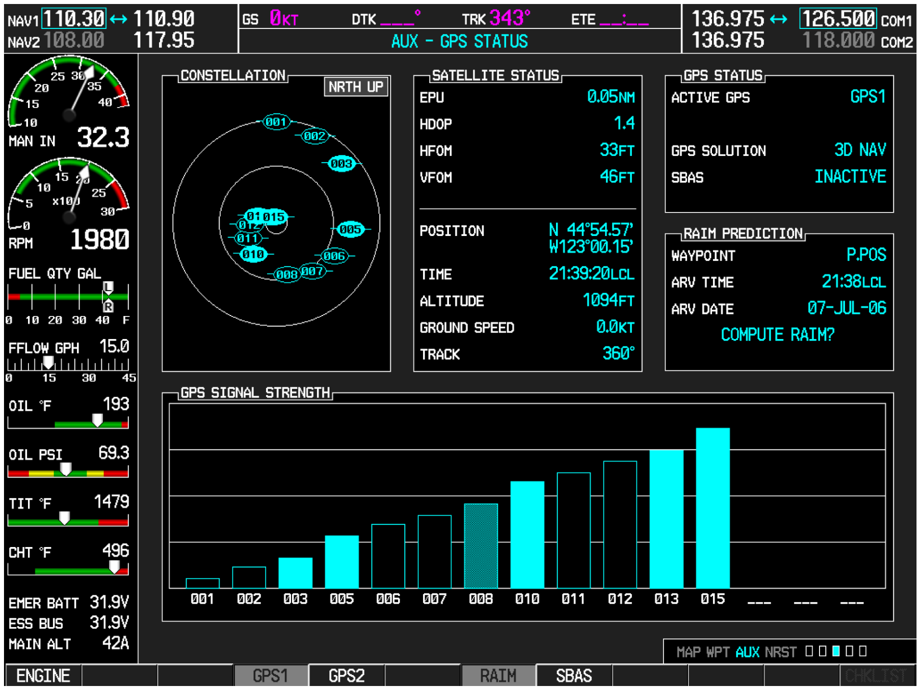
(a) Initial Display Testing

Check the PFD and MFD displays for the following:

1 Verify that all COM/NAV fields are valid in the top corners of the PFD and MFD.

2 Verify that altitude, airspeed, vertical speed and OAT fields are valid on the PFD.

3 Verify that there are no BACKUP PATH alerts on the PFD. If and LRU is not communicating over its primary path, the BACKUP PATH alert will identify which LRU is having the problem. Correct the problem before proceeding any further.



Satellite Status Page
Figure 46

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with Garmin 1000

4 GEA/GIA interface test.

This checks the Primary and secondary paths from the GEA 71 to each GIA.

a Verify “ESS BUS” voltage is displayed on the MFD.

b Pull the NAV 1/GPS 1 and NAV 2/GPS 2 circuit breakers and verify that “ESS BUS” voltage is failed.

c Reset the NAV 1/GPS 1 circuit breaker, “ESS BUS” voltage should become valid.

d Pull the NAV 1/GPS 1 circuit breaker and reset the NAV 2/GPS 2 circuit breaker, “ESS BUS” voltage should become valid.

5 Push the red display backup button on the GMA 1347. Verify both displays enter reversionary mode: both should have valid altitude, airspeed, vertical speed, and engine instruments.

6 De-activate reversionary mode by pushing the GMA 1347 display backup button again.

7 GPS Signal Acquisition

The GIA 63W units should normally acquire a 3D GPS navigation solution within 2 minutes of startup, provided the aircraft is outside (or indoors with a GPS repeater). Select the satellite status page on the MFD (3rd page in AUX group - see Figure 46). Two softkeys on the bottom of the display allow the user to toggle between GPS 1 and GPS 2. Verify that both receivers show 3D Navigation on the MFD.

8 Configuration and Status Checks

a Enter the configuration mode on the PFD and the MFD.

b Verify on the “SYSTEM CONFIGURATION PAGE” that the following are valid, as indicated with green annunciations.

1) MFD 1
2) PFD 1
3) GIA 1
4) GIA 2
5) GDL 69A

c Verify on the “SYSTEM STATUS PAGE” that the following are valid indicated with green annunciation.

1) MFD 1
2) PFD 1
3) GIA 1
4) GIA 2
5) GDL 69A

9 Bus Activity Checks

a Enter the configuration mode on the PFD and the MFD.

b Chart 20, below, identifies the unit, the busses that are to be active (indicated by a green annunciation), and the associated interface between units.

CHART 20
BUS ACTIVITY CHECKS

Unit	Bus Activity	Interface
GDU PFD	ARINC 429 in 1 active hi-speed GRS 77 #1	1P10001-18/19 to P771-12/27
	ARINC 429 in 2 active lo-speed GDC 74	1P10001-16/17 to P741-32/33
GDU MFD	ARINC 429 in 1 active hi-speed GRS 77 #1	2P10001-18/19 to P771-33/19
	ARINC 429 in 2 active lo-speed GDC 74	2P10001-16/17 to P741-47/48
GIA 1	RS 232 Ch 1 GDC 74A	1P603-43/41/42 to P741-10/11/12
	RS 232 Ch 5 in/out GTX 33	1P603-55/53/54 to P3301-22/23/51
	RS 232 Ch 6 in/out GRS 77	1P603-58/56/57 to P771-11/26/41
	RS 232 Ch 7 GMA 1347	1P603-59/62 to P3472-6/7
	ARINC 429 in Ch 5 GDC 74A	1P603-12/13 to P771-26/27
	ARINC 429 in Ch 6 GRS 77	1P603-14/15 to P771-14/29
GIA 2	RS 232 Ch 3 in/out WX 500	2P603-47/49/48 to P5003-20/8-5002-5
	RS 232 Ch 5 in/out GTX 33	2P603-55/53/54 to P3301-24/25/58
	RS 232 Ch 6 in/out GRS 77	2P603-58/56/57 to P771-6/21/35
	RS 232 Ch 7 GMA 1347	2P603-59/62 to P3472-38/39
	ARINC 429 Ch 4 in SKY 497	2P603-10/11 to P4971-34/33
	ARINC 429 Ch 5 in GDC 74A	2P603-12/13 to P771-29/30
	ARINC 429 Ch 6 in GRS 77	2P603-14/15 to P 771-13/28
	ARINC 429 Ch 1 out 55X/SKY 497	2P603-70/71 to P552-36/37 to P4971-45/44
GIA 1	RS 485 Ch 1 in GEA 71	1P603-23/24 to P701-5/6
GIA 2	RS 485 Ch 1 in GEA 71	2P603-23/24 to P701-7/8
	RS 485 in 55X	2P603-4/6 to P552-21/20

(b) Aircraft Interface Testing

1 CHT Probes

Verify the CHT interfaces as follows:

a Go to the LEAN page in the MFD by pressing the ENGINE softkey, followed by the LEAN softkey.

b Verify that all six cylinders have a valid cylinder head temperature display, showing ambient temperature

NOTE: An invalid CHT display will have a red ‘X’ through it.

c Apply heat to the area around the #1 CHT probe using a heat gun. Verify that the #1 cylinder CHT display shows the temperature increasing when the area around the sensor is heated.

d Repeat step 3 for the remaining CHT sensors, and verify that the corresponding CHT display on the MFD shows the temperature increasing when the area around the sensor is heated.

2 TIT Probes

Verify the TIT interface as follows:

While on the LEAN page, verify that the TIT display is valid and shows ambient temperature.

NOTE: An invalid TIT display will have a red ‘X’ through it.

3 Flaps

Verify the interface to the flaps system as follows:

a Open the FLAP MOTOR circuit breaker.

b Set the flaps handle to a setting at least 10 degrees from the current setting.

c Verify that the amber FLAPS annunciation is displayed on the PFD approximately 9 seconds after the flaps handle is moved.

d Return the flaps handle to its original zero degree setting and close the FLAP MOTOR circuit breaker.

e Verify that the amber FLAPS annunciation extinguishes.

4 Landing Gear Position Discrete

Check this during the next available flight. Verify that the Vy speed displayed on the PFD airspeed tape changes depending upon whether the gear is up or down.

5 Air Conditioner Door (Option)

Verify the two air conditioner door open discrete as follows:

a Set the FAN switch to LOW and the AIR COND switch to ON. Ensure that the throttle is not wide open.

b Verify that the ‘AIR COND DR’ annunciation is displayed.

c Ensure that the air conditioning door is not closed, and then open the A/C AIR BLOWER circuit breaker.

d Verify that the ‘AIR COND DR’ annunciation goes to amber.

e Close the A/C AIR BLOWER circuit breaker and verify that the ‘AIR COND DR’ annunciation is white.

f Set the FAN switch and AIR COND switch to OFF.

g After the air conditioning door closes, verify that the ‘AIR COND DR’ annunciation is removed.

6 Baggage Door

Verify the baggage door open annunciation as follows:

a Open the forward baggage door. Observe the PFD and verify that ‘BAGGAGE DOOR’ is displayed.

b Close the baggage door and verify that the BAGGAGE DOOR annunciation is removed.

7 Pitot Heat

Verify the pitot heat annunciation as follows:

a Cycle the PITOT HEAT switch. Observe that the PITOT OFF annunciation on the PFD disappears when the switch is ON and a tone is heard when switched “OFF”. Do not leave pitot heat on for more than 20 seconds.

b Pull the Pitot Heat circuit breaker and turn the Pitot Heat switch ON, PITOT FAIL should be annunciated and an associated audio alert should be heard.

8 Battery Voltage / Current

Verify the battery voltage and current displays as follows:

a Go to the SYSTEM page on the MFD by pressing the SYSTEM softkey.

b Verify that the ESS BUS display shows approximately the same as the external power cart.

c Verify that the EMER BATT display shows approximately 0.7V less than the ESS BUS display.

d Open the EMER BATT circuit breaker and verify that the EMER BATT display drops to approximately 24V or lower (the actual voltage displayed will depend upon the charge on the emergency battery).

e Close the EMER BATT circuit breaker.

f Verify that the BATT LOAD display is negative and less than -5A.

9 Cabin Temperature

Verify that the CAT (cabin temperature) display shows the ambient temperature.

10 Cooling Fans

Verify the operation of the cooling fans as follows:

a Open the AVIONICS COOLING circuit breaker and verify that ‘DISPLAY FAN’ and ‘AVIONICS FAN’ annunciations are displayed on the PFD.

b Close the AVIONICS COOLING circuit breaker and verify that ‘DISPLAY FAN’ and ‘AVIONICS FAN’ annunciations are removed.

11 OAT

OAT reads ambient.

12 Panel and Switch Lighting

Verify the following:

a Switch Dimmer potentiometer controls all Overhead Switch Panel and Instrument Panel switches excluding the Trim Master Switch.

b Panel Dimmer potentiometer controls the following:

1) All post lights
2) Standby ADI internal lights
3) Compass light
4) AP Computer
5) Trim switch
6) ADF
7) PFD and MFD Displays, Bezel, and Buttons.

c Emergency lighting

Select Emergency Power and verify the following:

1) These items remain lit: Internal lights for the Standby ADI, internal lights for the whiskey compass, Standby Airspeed post light and Standby Altimeter post light.
2) All other post lights and equipment lights extinguish.
3) All Overhead Switch Panel and Instrument Panel switch lights extinguish.

NOTE: If it is desired to further adjust the G1000 lighting characteristics, refer to Cockpit Lighting Setup under Final System Checkout, below.

(c) Emergency Bus Operation

1 Verfiy that the following items work when EMERGENCY BATTERY is selected:

a STANDBY ADI
b GEA 71 (All engine parameters)
c GIA #1
d AIR DATA
e AHRS
f PFD
g COM 1 (headset, pilot side only)

2 AVIONICS BUS equipment should be unavailable:

a MFD is blank
b NAV 2/GPS 2 is unavailable
c COM 2 is unavailable

(d) GMA 1347 Testing

Except for marker beacon operation, an in-aircraft checkout may be performed in the aircraft on the ramp with known good microphone, headset, and speaker.

1 Intercom System (ICS) Check

a Plug in headsets at each ICS position.

b Ensure that the MAN SQ key is off (no light).

c Adjust volume for each position and verify that the ICS is working properly.

d Check Pilot and Copilot ICS positions for isolation and proper operation of volume and squelch controls.

e Press the PA key. Verify that microphone audio is heard over the speaker when the Push-To-Talk (PTT) key is pressed.

f Verify operation of COM 1 and COM 2 per COM Antenna VSWR Checks under GIA 63W Testing, below.

2 Transceiver Operational Check

Perform a ramp test radio check by exercising the installed transceivers, microphone, microphone key and audio over the headphones and speaker. Verify that communications are clear and PTT operation is correct for each pilot position.

a Select the audio source corresponding to each installed avionics unit (i.e. NAV1, NAV2, COM1, COM2) and check for audio over the headsets.

b Press the SPKR key and verify that the selected audio is heard over the speaker.

3 Failsafe Operation Check

a Turn the GMA 1347 off by pulling the AUDIO circuit breaker. This directs all COM 1 phone audio, MIC audio and MIC key to the pilot's position.

b Check the failsafe operation by exercising the COM 1 microphone, microphone key and audio over the headphones. All volume control for the COM audio should be through the PFD/MFD volume control. Verify proper operation of COM 1 using the failsafe operation.

c Close the AUDIO circuit breaker to continue testing.

4 Marker Beacon Test

Using a ramp tester, simulate the outer marker, middle marker and inner marker signals by following the test equipment manufacturer's instructions. Verify that each marker audio signal is present over the headphones and speaker.

Verify that the outer, middle, and inner annunciations appear on the PFD when the corresponding signal is applied. Marker beacon annunciations appear at the upper left corner of the altitude indicator on the PFD (Figure 47). Operate the MKR MUTE key on the GMA 1347 and ensure that the audio signal is muted.

(e) GIA 63W Testing

The following section applies to both GIA 63W units. Any differences in testing will be noted.

1 VHF COM Interference Test

This test must be conducted outside. Use of a GPS repeater inside a hangar may result in a failed test. This procedure assumes that the system is currently set to 25 kHz COM channel spacing. Once the signal acquisition test under Initial Display Testing, above, has been completed successfully, perform the following steps:

a On the MFD, monitor GPS signal strength bars on the 3rd AUX page (Figure 46).

b On the PFD, ensure that the CDI is set to GPS. If it is not, press the ‘CDI’ softkey until GPS ENR is displayed.

c Verify that the GPS “INTEG” flag is out of view.

d Select 121.150 MHz on the No. 1 COM transceiver.

e Transmit for a period of 35 seconds while monitoring GPS 1 signal strength levels.

f During the transmit period, verify that the GPS “INTEG” flag does not come into view on the PFD and verify that GPS 1 does not lose a 3-D navigation solution on the MFD.

g Repeat steps e and f and re-transmit while monitoring GPS 2 signal levels on the MFD.

h Repeat steps d through g for each of the following frequencies:

- 121.175 MHz
- 121.200 MHz
- 131.250 MHz
- 131.275 MHz
- 131.300 MHz

i Repeat steps d through h for the No. 2 COM transceiver (GIA2).

j On the MFD, select the 4th AUX page.

k Under the COM CONFIG field, change the COM channel spacing from 25 kHz to 8.33 kHz.

l Go back to the 3rd AUX page.

m Select 121.185 MHz on the No. 1 COM transceiver.

n Transmit for a period of 35 seconds while monitoring GPS 1 signal strength levels.

o During the transmit period, verify that the GPS “INTEG” flag does not come into view on the PFD and verify that GPS 1 does not lose a 3-D navigation solution on the MFD.

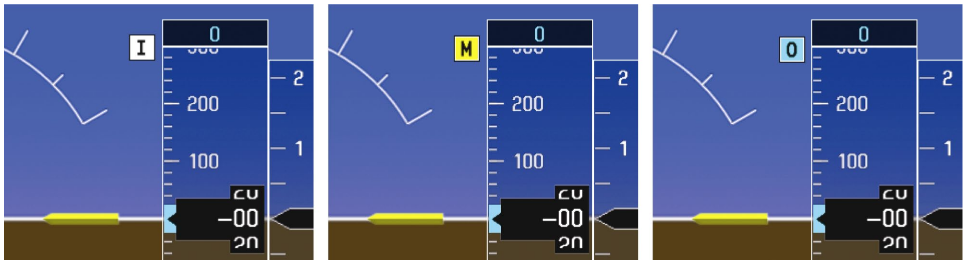
p Repeat steps n and o and re-transmit while monitoring GPS 2 signal levels on the MFD.

q Repeat steps n through p for each of the following frequencies:

- 121.190 MHz
- 130.285 MHz
- 131.290 MHz

r Repeat steps n through q for the No. 2 COM transceiver (GIA2).

s On the MFD, select the 4th AUX page and change the COM channel spacing back to 25 kHz



Marker Beacon Symbology
Figure 47

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2 VOR/LOC/GS Test

Check the VOR, ILS, and Glideslope functions for NAV1, NAV2, and GS1 and GS2 with ramp test equipment. Operate the equipment according to the test equipment manufacturer's instructions. Adjust the RF signal to a level adequate to perform the test. Select the appropriate HSI source by using the CDI softkey.

NOTE: The PFD HSI does not show a course deviation bar unless a valid VHF nav frequency is tuned.

Simulate a VOR signal on radial 000° with a course-width of 20°. Verify full scale deflection of the CDI while applying a 10° deviation signal. Exercise the CDI with both right and left deviations for both NAV 1 and 2. Exercise the Glideslope deviation indicator with up and down deviation indications.

3 COM Antenna VSWR Checks

Check for insertion loss and VSWR (Voltage Standing Wave Ratio) for COM1 and COM2. VSWR should be checked with an in-line type VSWR/wattmeter inserted in the coaxial transmission line between the transceiver and the antenna. The VSWR should be inserted as close to the transceiver as possible. Any problem with the antenna installation is most likely seen as high reflected power. A VSWR of 3:1 may result in up to a 50% loss in transmit power. Ideally, the VSWR should be 2.5:1 or less.

(f) GTX 33 Testing

Operation of the GTX 33 Mode-S transponder is accomplished using the G1000 PFD. Refer to the Garmin Cockpit Reference Guide, for basic operation. Perform a basic operational check on the transponder. Any discrepancies or anomalies should be corrected before proceeding. The integrated transponder/altitude reporting system must be verified in accordance with §§ 91.411 and 91.413 of the Federal Aviation Regulations (FARs).

See Mode S Transponder Ground Test, 34-50-00.

(g) GDC 74A Testing

NOTE: Allow the unit to warm up for 15 minutes before performing the following tests.

Verification of the altimeter and airspeed must be performed using an air data test set. The static port and altimeter must be verified in accordance with FAR § 91.411 and Part 43 Appendix E. The PFD must be in Configuration mode and the MFD must be in Reversionary mode for performing the tests as outlined in Part 43 Appendix E.

1 To prepare the G1000 system for Part 43 Appendix E testing:

a Start the G1000 system in normal mode.

b Remove power to the PFD.

CAUTION: CONFIGURATION MODE CONTAINS CERTAIN PAGES AND SETTINGS THAT ARE CRITICAL TO AIRCRAFT OPERATION AND SAFETY. THESE PAGES ARE PROTECTED AND CANNOT BE MODIFIED, UNLESS THE TECHNICIAN IS PROPERLY AUTHORIZED AND EQUIPPED. HOWEVER, MOST PROTECTED PAGES ARE VIEWABLE TO ALLOW SYSTEM AWARENESS FOR TROUBLESHOOTING.

c Turn the PFD on in Configuration mode by pressing and holding the ENT key on the PFD while applying power.

d Release the ENT key after “INITIALING SYSTEM” appears in the upper left corner of the PFD.

e Using the FMS knob on the PFD turn to the GRS page group. Use the B ALT field for all CFR Part 43 Appendix E tests for G1000 altitude.

f Place the MFD in Reversionary mode by pressing the red “Display Backup” button on the GMA 1347 Audio Panel. Baro settings can then be read from the MFD for the CFR Part 43 Appendix E tests.

After completing the test specified by § 91.411 and Part 43 Appendix E, return both the MFD and PFD to normal mode.

NOTE: The following tests are above and beyond the requirements set forth in Appendix E, and are required only when Appendix E tests are required.

2 Pitot/Static Airspeed Test

a Command the pitot/static ramp tester to simulate air speeds shown in Chart 21.

b Wait for the ramp tester to report that target values have been achieved.

c Verify that computed airspeeds shown on the PFD are within the tolerances specified in Chart 21.

3 Static Port Vertical Speed (Rate of Climb) Test

a Command ramp tester to change the altitude at the rates shown in Chart 22.

b Wait for ramp tester to report that target rates have been achieved.

c Verify that the Rate of Climb reported by the Vertical Speed field on the PFD is within the tolerances specified in Chart 22.

4 OAT Probe Check

a Check the outside temperature (OAT) measurement shown on the PFD to ensure it reads ambient temperature.

5 Press the ENT key on the PFD to conclude this Procedure.

CHART 21
AIRSPEED TEST TOLERANCES

Calibrated Air Speed (Knots)	Allowed tolerance (± Knots)
50	5.0
80	3.5
100	2.0
120	2.0
150	2.0

CHART 22
VERTICAL SPEED TEST TOLERANCES

Vertical Speed (Feet/Minute)	Allowed tolerance (± Feet/Minute)
2000	100
0	45
-2000	100

(h) GRS 77/GMU 44 Initial Alignment

The GRS 77 AHRS unit and the GMU 44 magnetometer unit are calibrated in three stages. Whenever either or both units are replaced, all three calibration procedures must be completed before first flight.

There are three procedures to be carried out. The aircraft engine must be started after the first procedure is complete. When ready to perform the procedures, shut the PFD and MFD off by pulling the PFD and MFD circuit breakers. Restart both displays in configuration mode.

1 GRS 77 Pitch/Roll Offset Calibration

This procedure must be carried out with the engine off.

a Level the aircraft to within +0.25 of zero pitch and zero roll per 8-20-00.

b Rotate the large FMS knob to select the GRS page group on the PFD. Rotate the small FMS knob clockwise to access the GRS/GMU calibration page (Figure 48) on the PFD.

c Enter the following softkey password:

1) 9
2) 10
3) 11
4) 12 (Far Right softkey)

d Initiate the AHRS Ground Pitch/Roll Aircraft Level compensation mode by performing the following steps:

1) Ensure that the No. 1 GRS 77 is selected.
2) Select PITCH/ROLL OFFSET, then press the ENT key.
3) Follow the checklist items displayed on the PFD and press the ENT key as each one is completed or confirmed. When the CALIBRATE field is blinking, press the ENT key to begin the procedure.
4) After several seconds, a new checklist appears in the lower half of the PFD. Press the ENT key as each item is confirmed. When the CONFIRM AIRCRAFT IS LEVEL field is blinking, press the ENT key to continue.

e The result of the pitch/roll offset compensation is displayed on the PFD. If successful, the AHRS records the required pitch and roll offsets, informs the operator of a successful conclusion and returns to normal operation.

f Press the ENT key on the PFD to conclude this procedure.

g Restart both displays in normal mode and proceed to step (h), below.

(i) Engine / Airframe Transducer Checks

To carry out the two remaining GRS/GMU procedures, the aircraft engine must be started. In order to start the engine, all engine/airframe transducers must have been checked to ensure proper operation.

1 Engine off Checks

On the MFD, check the indication for each of the sensor or monitor inputs with the aircraft engine off. Observe the 'Engine' page (Figure 49) by using the ENGINE softkey on the MFD. While in reversionary mode observe the 'Engine' 'Lean' page, and 'System' page by using the ENGINE, LEAN, and SYSTEM softkeys on the MFD.

At the appropriate EIS section, observe and verify the sensor indications against those shown in Chart 23.

2 Engine On Checks

The aircraft engine can now be started as needed to carry out the remaining GRS/GMU calibrations listed in Final GRS 77 / GMU 44 Calibration Procedures, below. Follow the procedures in the POH, and start the engine. Monitor engine instruments during startup for proper operation.

When engine is running, verify the sensor indications at the appropriate EIS section against those shown in Chart 24.

Verify the starter engaged annunciation as follows:

a Engage the starter and verify that the STARTER ENGD annunciation is displayed.

b Disengage the starter and verify that STARTER ENGD annunciation is removed.

(j) Final GRS 77/GMU 44 Calibration Procedures

1 GRS 77/GMU 44 Magnetic Calibration

Perform calibration procedure under "Magnetic Heading Systems," "Garmin 1000 - EFIS," below.

GRS / GMU Calibration Page - Pitch / Roll Offset
Figure 48

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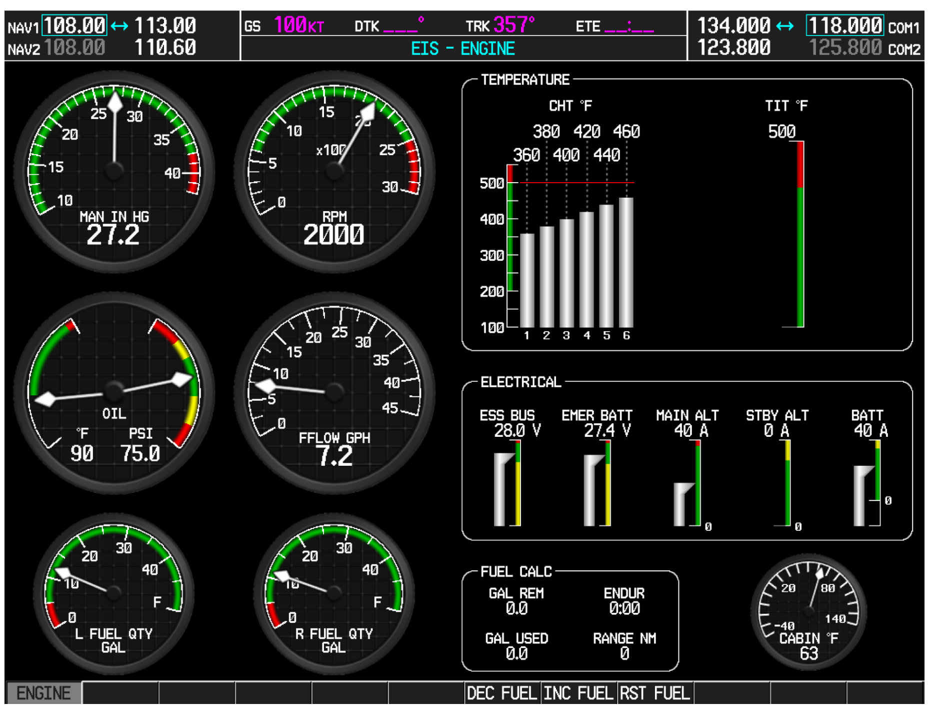

Engine Page
Figure 49

Effectivity
with Garmin 1000

(k) Emergency Power

Verify the operation of the emergency power system as follows:

1 Start the aircraft engine following the procedures referenced in the POH.

2 Ensure that both the PFD and MFD are operating in normal mode and ensure that the ALTR switch is in the ON position.

3 Set the EMER BAT switch to the ON position.

4 Verify that the MFD is automatically switched off, and the PFD goes into reversionary mode.

5 Set the BATT MASTR switch OFF to ensure that a reduced subset of the G1000 is running on the emergency battery.

6 Verify that the COM1/NAV1 fields remain valid in the top corners of the PFD.

7 Verify that altitude, airspeed, vertical speed and OAT fields remain valid on the PFD.

8 Verify that there are no BACKUP PATH alerts on the PFD. If an LRU is not communicating over its primary path, the BACKUP PATH alert will identify which LRU is having the problem. Correct the problem before proceeding any further.

9 Verify that all engine instrument fields remain valid on the PFD.

10 Set the BATT MASTR switch back to ON.

11 Set the EMER BATT switch to OFF.

12 Verify that the system recovers and returns to the normal operating mode.

13 Shut the engine down.

(l) S-TEC 55X Interface

The S-TEC 55X (55X computer) autopilot system interface to the G1000 must be verified, and the S-TEC55X must be adjusted for roll centering for optimum system performance. See also S-TEC 55X General Installation Information Bulletin, S-TEC bulletin number 600.

CAUTION: WHEN THE AUTOPILOT IS ENGAGED, FLIGHT CONTROL SURFACE MOVEMENT CAN OCCUR.

1 Power up the aircraft and set the Radio Master switch to ON. Turn on the cockpit speaker and set the AP Master switch to ON. Verify that after approximately five seconds the RDY annunciation is annunciated on the 55X computer.

2 Verify that a green RDY is annunciated on the PFD above the compass rose.

3 Set the Trim Master switch to ON

4 Press the Heading Select knob on the PFD to center the heading bug, and center the course pointer using the Course Select knob.

5 Press the HDG and VS button on the 55X computer to engage the heading and vertical speed modes (HDG and VS will be displayed on both the 55X computer and on the PFD).

6 Rotate the Heading Select knob on the PFD to move the heading bug left of center and right of center. Verify that the control wheel movement follows the direction of the commanded input. Center the heading bug.

7 Using the ALT SEL knob on the PFD, select an altitude approximately 1000 ft above the current elevation. Simultaneously press the ALT and VS keys on the 55X. Verify that ALT and VS are displayed on the 55X. Adjust VS down and up via the VS control on the 55X and verify that the pitch servo runs up and down accordingly.

CHART 23
ENGINE OFF CHECKS

Indicator	Desired Reading	Check
MAP	Atmospheric Pressure	______
Tachometer	‘0’ RPM	______
Fuel Qty Gal	‘Full’ on MFD with fully fuelled tanks	______
Fuel Flow	‘0’	______
Oil Pressure	Approximately 0	______
Oil Temperature	Ambient temperature	______
TIT	Ambient Temperature	______
CHT (qty 6)	Ambient Temperature	______
EMER BAT Volts	(GPU voltage -0.7) or Emergency battery volts *EMER Bat NC annunciation may appear if GPU is disconnected.	______
ESS Bus Volts	GPU voltage (Battery volts when GPU disconnected)	______
MAIN ALT	Approx ‘0’ amps	______
BAT LOAD	Negative value (indicating battery is discharging)	______
STBY ALT	Approx ‘0’ amps	______

CHART 24
ENGINE ON CHECKS

Indicator	Desired Reading	Check
MAIN ALT	Positive	______
BAT LOAD	Positive value (indicating battery is charging) *BAT AMPS may still indicate a negative value if the engine RPM is too low	______
STBY ALT	Turn off the MAIN ALT switch and ALTNTR INOP and STBY ALT ON annunciation appear. Positive value (indicating battery is charging) MAIN ALT says STBY ALT on the Engine strip *May indicate a ‘0’ value if the engine RPM is too low.	______
SHED LOAD	Turn on equipment until the current draw from the STBY ALT increases above 20. Verify that the SHED LOAD annunciation appears. Decrease the current draw and verify the SHED LOAD annunciation is removed.	______
ESS Bus Volts	Approximately 28 volts	______
EMER BAT Volts	Approximately 27.3 volts	______

8 Press the AP Disconnect switch on the control wheel. Verify the Autopilot disconnects and that an audible tone is heard over the speaker indicating the autopilot disconnection.

9 On the PFD press the CDI softkey to select the CDI to ‘GPS’.

10 On the 55X computer press the NAV button twice and verify that GPSS FAIL is annunciated. Press the NAV button once more to return to the normal NAV mode.

11 On the PFD press the CDI softkey to select the CDI to ‘VOR1’. On the 55X computer press the NAV button once and verify that GPSS is NOT annunciated (the NAV annunciation will remain unchanged).

NOTE: GPSS cannot be completely checked out on the ground due to a groundspeed limitation in the 55X. Consequently, the interfaces related to GPSS must be checked during a flight test by verifying that GPSS FAIL is not annunciated when GPSS is selected.

12 With the 55X in NAV mode, rotate the Course Select knob on the PFD to move the course pointer left of center and right of center. Verify that the control wheel movement follows the direction of the commanded input. Center the course pointer. Adjust VS down and up via the VS knob on the 55X and verify that the control wheel moves forward and aft, respectively.

13 Select VOR1 on the PFD for selected CDI

14 Using a VOR/ILS ramp generator, create a valid VOR signal and adjust the deviation signal until the deviation bar on the PFD is centered.

15 With the CDI needle centered, adjust the S-TEC 55X roll centering (three-turn pot accessible through the 55X face plate between the ALT and REV mode select buttons). Adjust for zero roll servo activity with the CDI needle centered.

16 Adjust the VOR/ILS ramp generator so that the course deviation bar on the PFD moves to the left of center and right of center. Verify that the control wheel movement follows the direction of the needle deflection.

17 Generate a valid ILS signal, center the lateral deviation and adjust the vertical deviation to 1 dot UP. Press the ALT and APR buttons on the 55X (the ALT, APR and NAV modes should now be selected). Slowly adjust the vertical deviation from 1 dot UP to centered. ALT should extinguish and the GS annunciation should appear green.

18 Generate a valid ILS signal, center the lateral deviation and adjust the vertical deviation to 1 dot DN. Press the ALT and APR buttons on the 55X (the ALT, APR and NAV modes should now be selected). Press the ALT button again to arm the glideslope, and the GS annunciation should appear and the ALT annunciation should extinguish.

(m) Optional System Checkouts

This section describes the checks that must be completed in order to verify the system interface to the G1000. The checks must be completed only for those systems that are installed. Following the interface verification with the G1000, additional system checks may be required – refer to the appropriate system installation manual for additional details.

1 WX-500 Stormscope (if installed)

a Restart the G1000 in configuration mode by opening the PFD and MFD circuit breakers. While holding the ENT keys on the PFD and MFD, restore power by closing the PFD and MFD circuit breakers.

b Select the OTHER page group on the PFD. The STORMSCOPE page (Figure 50) is shown by default.

c Activate the cursor and highlight the DATA field. Use the small FMS knob to select ‘Config’ and press the ENT key on the PFD.

d Verify that the DATA window shows the following:

Hdg: None:	J3-1	Open
	J3-2	Open
Hdg Valid Flag		N/A
Flag Sense		N/A
Hdg Value		N/A
Inhibit Line		Off
Antenna Mount		Bottom
	J3-3	Open

e Deactivate the cursor.

Stormscope Page
Figure 50

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2 GDL 69A Datalink (if installed)

NOTE: This section verifies correct installation in the aircraft. It does not activate the GDL 69 XM data link radio. If the XM Radio is activated, the channel list will contain more channels than the three that are shown for a radio that has not been activated. Complete instructions for activating the XM data link can be found in Garmin Document No. 190-00355-04.

a Select the AUX – XM RADIO page (Figure 51) on the MFD.

b Using the channel control located in the cabin, verify that you can increment and decrement the channels (the white arrow to the left of the channel list indicates the currently selected channel). Select channel 1 when complete.

c Using the volume control located in the cabin, verify that you can increase and decrease the XM radio volume (the volume bar at the bottom of the screen will show changes to the volume level). Set the volume to the mid position when done.

d Plug a set of headphones into one of the passenger stations and verify that you can hear the XM radio playing in both left and right channels. The volume level may be adjusted to a comfortable level at this point.

e Plug a set of headphones into one of the pilot stations and verify that you can hear the XM radio playing in both left and right channels.

f Plug an external audio source into the AUX input and verify audio can be heard in the passenger headsets and not in the pilot/co-pilot headsets.

g Gently lift the stall vane on the left wing to set off the stall horn. Verify that the GDL 69 audio is muted as long as the stall vane is lifted and the stall horn is heard.

h Activate the gear warning. Verify that the GDL 69 audio is muted as long as the gear horn is heard.

AUX - XM Radio Page
Figure 51

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3 SKY497 Skywatch (if installed)

a Antenna Calibration

NOTE: If the TRC has not been calibrated to the directional antenna , the display may show a FAIL message. If so calibrate the system as follows:

1) Connect a laptop to J7 TEST port on the TRC 497.
2) Ensure the aircraft's transponder is in STBY and the DME is turned off.
3) Verify heading is valid.
4) Turn on the SKY 497.
5) On the laptop type “Cal” and hit “Enter”.
6) Verify that Re-Calibration Successful! is displayed

b Checkout Procedure

NOTE: Configuration settings must be saved in the SKY497 unit prior to doing this test. Refer to the SKY497 installation manual.

1) Select the TRAFFIC MAP map page (Figure 52) on the MFD.
2) Verify that the STANDBY, OPERATE, TEST (only when in Standby mode) and ALT MODE soft keys are available on the bottom of the display. Verify that a TAS mode (and not TAS FAIL) is displayed in the upper left corner of the traffic map. Verify that NO DATA is not displayed in yellow in the center of the display (in place of the ownship symbol)

   NOTE: If TIS is displayed instead of TAS, the G1000 has not been properly configured for Skywatch.

3) Press the OPERATE soft key and verify that TAS OPERATING is displayed in the upper left corner of the traffic map.
4) Press the STANDBY soft key and verify that TAS STANDBY is displayed in the upper left corner of the traffic map.
5) Press the TEST soft key and verify that TAS TEST is displayed in the upper left corner of the traffic map and a traffic test pattern is displayed. Upon completion of the test, verify that “TRAFFIC ADVISORY SYSTEM TEST PASSED” is heard over the cockpit speaker.
6) Using a pitot/static ramp tester set the airspeed to 60 KIAS. Verify that the Skywatch mode changes from TAS STANDBY to TAS OPERATING within 15 seconds of exceeding 50 KIAS.
7) Return the airspeed on the pitot/static ramp tester to 0 KIAS and disconnect the test set if it is no longer required. Verify that the Skywatch mode changes from TAS OPERATING to TAS STANDBY within 30 seconds of decreasing below 50 KIAS.
8) Open the SKYWATCH circuit breaker on the avionics circuit breaker panel. On the MFD, verify that NO DATA is displayed in yellow after several seconds.
9) Close the SKYWATCH circuit breaker on the avionics circuit breaker panel and verify that NO DATA is removed after several seconds.
10) Using two people cover the #2 GPS antenna with your hands till you loose signal.
11) Press the TEST soft key and wait to hear the message “TRAFFIC ADVISORY SYSTEM TEST PASSED”.

12) The instant you hear audio have the other person cover the #1 GPS antenna. You should get the message “TAWS SYSTEM NOT FUNCTIONING”. This message will mute the traffic advisory message.

13) If message is not muted check set up in TIS Inhibit

14) Repeat steps 10-13 by covering the #1 GPS antenna first.

4 KR 87 ADF Checkout (Optional)

Tune the ADF to a known, local NDB and verify the bearing is accurate to +/- 15° and the Morse Code Identifier is clear and accurate.

5 KN 63 DME Checkout (Optional)

a Perform systems check with the ATC 600 and verify the DME is tuned by NAV 1 and NAV 2

b Verify the distance is accurate.

c Verify the DME audio is available.

(8) Final System Checkout

The final checkout tests various secondary communications paths to ensure that the desired backup paths are in place. Restart the PFD and MFD by cycling the PFD and MFD circuit breakers to start the displays in the normal mode. Press the ENT key to acknowledge the agreement on the MFD. Perform the following steps and verify the results of each test.

(a) LRU Failure Tests

1 GPS Failure Test - see Chart 25.

Start this test with all avionics powered and valid GPS reception.

2 GIA Failure Test - see Chart 26.

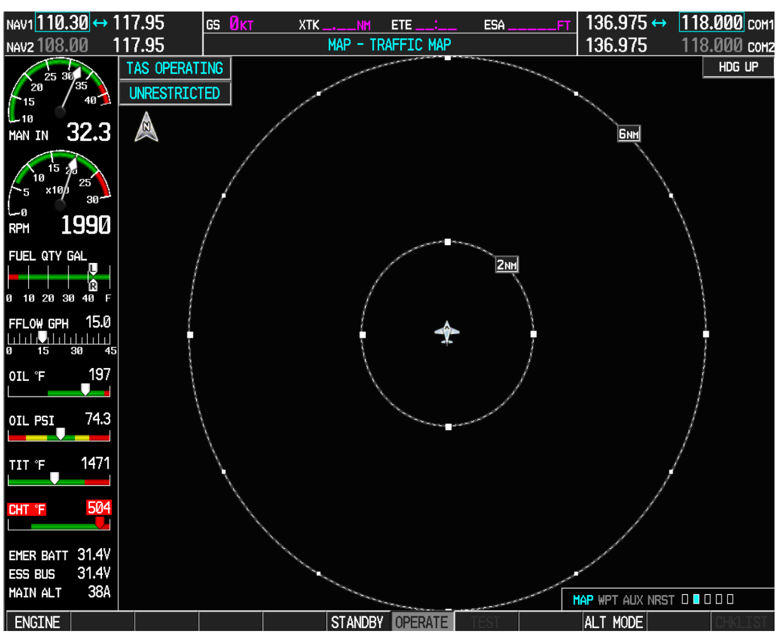
Start this test with all avionics powered, valid GPS reception, and valid NAV signal.

3 Display Failure Test - see Chart 27.

Start this test with all avionics powered.

4 AHRS/ADC Backup Failure Test - see Chart 28.

Start this test with all avionics powered.



Traffic Map Page
Figure 52

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CHART 25
GPS FAILURE TEST

Step	Desired Result
Single GPS Failure Conditions: 1. Place a shroud over the GPS antenna for GIA 1 to prevent signal reception. Verify loss of signal on MFD AUX page 3. 2. Remove shroud from the GIA 1 GPS antenna. 3. Place a shroud over the GPS antenna for GIA 2 to prevent signal reception. Verify loss of signal on MFD AUX page 3. 4. Remove shroud from the GIA 2 GPS antenna.	GPS Failure - For each of the specified GPS failure conditions, the following shall remain valid on the PFD throughout the procedure: Altitude and Heading from AHRS. Airspeed, Altitude, Vertical Speed, and OAT from Air Data Computer. GPS CDI remains valid on PFD.
Dual GPS Failure Conditions: 1. Cover both GPS antennas. Verify loss of signal on MFD AUX page 3. 2. Remove shrouds from GPS antennas.	Dual GPS Failure - For a dual GPS failure, the following shall occur: GPS CDI flags INTEG on PFD. Attitude and Heading remain valid from AHRS. Airspeed, Altitude, Vertical Speed, and OAT remain valid from Air Data Computer.

CHART 26
GIA FAILURE TEST

Step	Desired Result
Single GIA Failure Conditions: 1. Remove power from GIA 1 by pulling NAV/GPS1 and COM1 breakers 2. Restore power to GIA 1. Allow to reacquire satellites. 3. Remove power from GIA 2 by pulling NAV/GPS2 and COM2 breakers 4. Restore power to GIA 2.	GIA 1 Failure - For a GIA 1 failure, only the following shall flag invalid: COM/NAV 1 field. NAV 1 CDI loses deviation bar. GIA 2 Power Failure - For a GIA 2 failure, only the following shall flag invalid: COM/NAV 2 field. NAV 2 CDI loses deviation bar.
Dual GIA Failure Conditions: 1. Remove power from both GIA units 2. Restore power to both GIA units	Dual GIA Failure - For a dual GIA failure, only the following shall occur: COM/NAV 1 & COM/NAV 2 fields flag invalid. GPS CDI flags INTEG on PFD. NAV 1, 2 CDI loses deviation bar. XPDR field flags invalid on PFD. Engine Instrument field flags invalid on MFD. All AHRS & ADC fields remain valid.

CHART 27
DISPLAY FAILURE TEST

Step	Desired Result
MFD Display Failure Conditions:	The following shall occur when power is removed from the MFD:
1. Remove power from MFD.	PFD switches to reversion mode.
	Attitude and Heading remain valid from AHRS.
2. Restore power to MFD.	Airspeed, Altitude, Vertical Speed, and OAT remain valid from Air Data Computer.
	Engine Instrumentation appears on PFD.
	COM/NAV 2 fields flag invalid.
PFD Display Failure Conditions:	The following shall occur when power is removed from the PFD:
1. Remove power from PFD.	MFD switches to reversion mode.
	Attitude and Heading remain valid from AHRS.
2. Replace power to PFD.	Airspeed, Altitude, Vertical Speed, and OAT remain valid from Air Data Computer.
	MFD retains engine instrumentation.
	COM/NAV 1 fields flag invalid.

CHART 28
AHRS / ADC BACKUP PATH TEST

Step	Desired Result
Secondary AHRS/ADC path check:	The following shall occur on the MFD when power is removed from the PFD and GIA2:
1. Remove power from PFD. (Pull PFD breaker.)	MFD switches to reversion mode.
2. Remove power from GIA2. (Pull NAV/GPS2 and COM2 breakers.)	Attitude and Heading remain valid from AHRS.
3. Check for desired results.	Airspeed, Altitude, Vertical Speed, and OAT remain valid from Air Data Computer.
4. Restore power to the PFD and GIA2.	Engine Instrumentation flags invalid.
	All COM & NAV fields flag invalid.

(b) Lighting Setup

The lighting control system offers excellent configuration capability. During G1000 configuration, default lighting values are loaded. The following is provided to allow for further refinement of the lighting system as determined by the technician.

1 Main Lighting Page

Through configuration settings on this main lighting page (Figure 53), G1000 lighting can be setup and adjusted to suit each installation/cockpit environment. Each GDU must be configured for individual performance. The GMA 1347 lighting is also controlled from this page. Audio panel lighting is directly tied to display configuration, normally to the PFD (if the PFD fails, the MFD supplies lighting information to the GMA).

a Display/Key Parameters

The following parameters apply to both display lighting and key/bezel lighting. The two are divided into separate windows on screen as shown in Figure 53.

INPUT: Input level is provided from two photocell on the display (ambient light) or an external avionics dimmer bus voltage. Range is between 0 and 99.99. The higher number indicates a corresponding demand for a brighter display. Input level is shown on the graph as the ‘x’ (horizontal) axis, with a vertical magenta line showing the current input value. The input value is only adjustable by varying the amount of light reaching the photocell or by manipulating the appropriate aircraft dimmer bus, if equipped.

BRIGHTNESS: Depicts actual brightness level of the display, shown on the graph as the ‘y’ (vertical) axis with a horizontal yellow line. For any given condition, the brightness is determined by the intersection of the input level and the lighting curve. Range is between 0.0 and 99.99.

EDIT CURVE VERTEX: (See Figure 54 and Chart 29.) Selects which point (vertex) on the lighting curve to adjust. By adjusting the vertices, the lighting curve slope(s) can be adjusted as functions of a single curve. This sets the brightness level for any given input level. When a point is selected for adjustment, the map-panning joystick on the PFD/MFD is used to manipulate the point.

b GMA ANNUNCIATOR PARAMETERS (arrow lights above keys)

BRIGHTNESS: Depicts actual brightness level of the arrow lights beneath the keys on the GMA. Range is between 0.0 and 99.99.

GAIN: Controls the brightness level of the arrow lights beneath the keys on the GMA. Range is between 0 and 2. Gain is a brightness multiplier and is best suited for small adjustments.

OFFSET: Allows an offset control of the brightness level for the arrow lights beneath the keys on the GMA. Range is between -100 and 100. Offset allows for the largest change in brightness in efforts to match other cockpit lighting.

c GMA KEY PARAMETERS

BRIGHTNESS: Depicts actual brightness level of the keys on the GMA. Range is between 0.0 and 99.99.

GAIN: Controls the brightness level of the keys on the GMA. Range is between 0 and 2. The gain is a multiplier that lends itself best to small adjustments, mainly used for tweaking the brightness.

OFFSET: Allows an offset control of the brightness level for the keys on the GMA. Range is between -100 and 100. Offset allows for the largest change in brightness in efforts to match other cockpit lighting.

When the lighting input source is set to use dimmer bus voltage (14 Vdc, 28 Vdc, 5 Vdc, 5 V AC), installers can set a transition point where the display switches from using dimmer bus voltage to using the photocell (see Figure 55). The light green curve represents the selected input. If something other than photo input is used, the light-green curve will represent that input, while the dark-green input will represent the photo input.

PHOTO TRANSITION %: Sets the input level point at which the display transitions from using the photocell to dimmer bus. At input levels greater than the transition point, the display uses the dimmer bus. At input levels less than the transition point, the display uses the photocell. Should the installer desire to completely operate the display entirely on dimmer bus voltage, the transition point should be set to 0.0. This allows the brightness to track the full range of the dimmer bus voltage from the maximum input value to the minimum value.

EDIT PHOTO CURVE VERTEX: Controls the slopes of the lighting curve used by the photocell when the dimmer bus input level falls below the set transition point. Operation is identical to that of the normal vertex adjustment described above.

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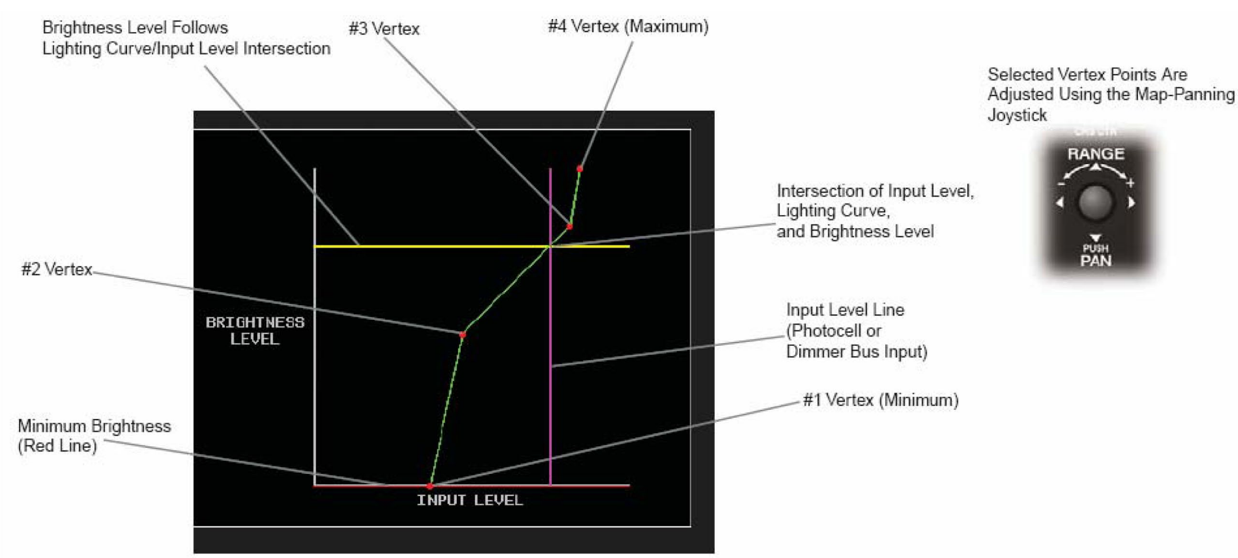
with Garmin 1000

Main Lighting Page
Figure 53

CHART 29
LIGHTING CURVE VERTICES ADJUSTMENT

Selection	Description
NONE	No vertex point is selected.
1.	The #1 vertex (bottom endpoint of curve) is selected for adjustment. This point cannot be moved in the vertical (y) direction. It is only adjustable in the horizontal (right/left) direction.
2.	The #2 vertex is selected for adjustment.
3.	The #3 vertex is selected for adjustment.
4.	The #4 vertex (top endpoint of curve) is selected for adjustment. This point cannot be moved in the vertical (y) direction. It is only adjustable in the horizontal (right/left) direction.
ALL	All vertex points are selected for adjustment. Movement is only allowed within each respective bound of a vertex (vertex #1 and #2, the curve endpoints, can not move vertically). The most pronounced resultant movements would be a step or trough shaped curve.



Lighting Curve Vertices
Figure 54

Effectivity
with Garmin 1000

2 Cockpit Lighting Setup

The following guidance is recommended to help the installer determine a suitable setup. A test flight is recommended upon completion of the setup.

NOTE: To accurately configure the lighting, the ability to adjust ambient light conditions is required. The installer should be prepared to simulating complete darkness in the cockpit. Simply covering the photocell may not allow the installer's eye to properly judge whether the display brightness is too bright, or too dim, for night use.

a Photocell Configuration:

1) Start configuration with a linear lighting curve slope (45° Straight Line).

2) Minimize photocell input levels by simulating night conditions in the cockpit. Any other instrument panel or cockpit lighting should be turned on for this adjustment. Seek uniform consistency between display lighting, bezel/key lighting, and any other illuminated objects.

a) If a display/keypad is too bright, lower the minimum setting and/or adjust the lighting curve to achieve the desired brightness.

b) If the display is not bright enough, raise the minimum setting to the desired brightness.

c) In the case of the GMA, adjust gain and offset settings to achieve the desired brightness relative to other lighting.

3) Simulate direct maximum sunlight in the cockpit (best if done outside).

Verify that the display produces maximum brightness on the graph.

4) Simulate average sunlight conditions in the cockpit (between ~50-75% input level).

a) If the display is too bright or too dim, use a combination of lighting curve changes to achieve desired brightness at mid-range lighting input levels.

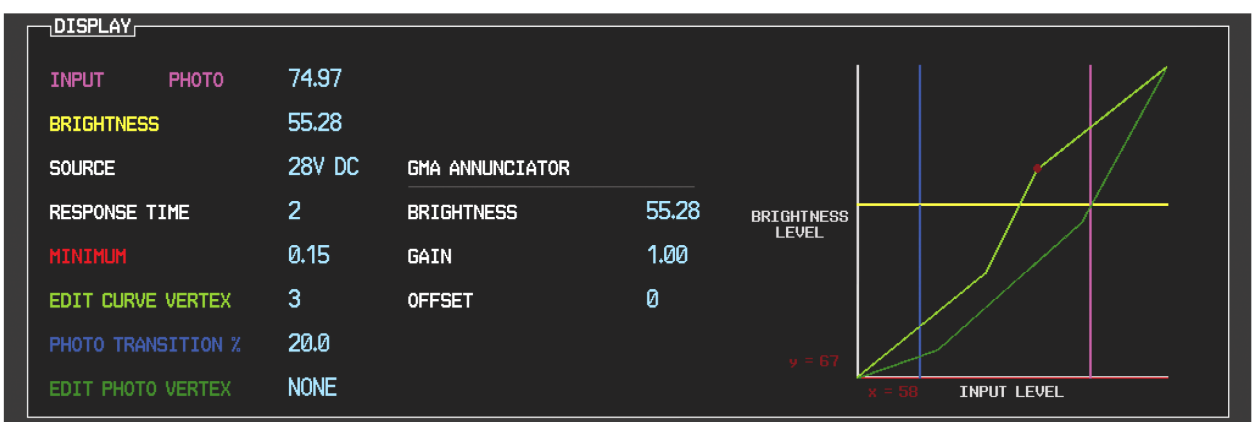
b) Ensure that the lighting curve and minimum setting still maintain the low-light configuration achieved in Step 2. Repeat Step 2 if necessary to re-adjust night lighting settings.

c) Adjust the response time to smooth changes to brightness as required.

b Dimmer Bus Configuration:

1) Select the appropriate source voltage for the dimmer bus. Set the Photo Transition point to 0.0 for initial dimmer knob calibration.
2) Simulate night conditions in the cockpit. Turn the dimmer bus knob to its minimum setting and observe the graph for corresponding change to the input level. Attempt to seek uniform consistency between display lighting, bezel key lighting, and any other cockpit illuminated information.
   a) If a display/keypad is too bright, lower the minimum setting and/or adjust the lighting curve to achieve the desired brightness.
   b) If the display is too dim, increase the minimum setting to achieve desired levels.
   c) In the case of the GMA, adjust gain and offset settings to achieve the desired brightness relative to other lighting.
3) Simulate direct sunlight conditions in the cockpit. Turn the dimmer bus knob to its maximum setting and observe the graph for a corresponding change to the input level.
   a) If the brightness is below maximum on the graph, adjust the lighting curve settings to achieve maximum brightness.
   b) Check for smoothness in the transition from dark to light and adjust the lighting curve and response time settings to achieve desired results.

If desired, set the photocell transition point and associated photo lighting curve to achieve desired display performance over a variety of lighting conditions.



Main Lighting Page
Figure 55

Effectivity
with Garmin 1000

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5. Directional Gyro

NOTE: In airplanes equipped with either the Avidyne Entegra EFIS or the Garmin G1000 EFIS, no air-driven directional gyro is installed. In those installations, this function is provided by the Primary Flight Display (PFD).

A. Description

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.

B. Troubleshooting

See Chart 29.

CHART 30
TROUBLESHOOTING DIRECTIONAL GYRO

Trouble	Cause	Remedy
Excess drift in either direction.	Setting error.	Review paragraph titled “Description” 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. 2. Incorrect gauge reading. 3. Pump failure. 4. Vacuum line kinked or leaking.	 1. Adjust relief valve. 2. Replace gauge. 3. Repair or replace. 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.

6. Magnetic Heading Systems (1995-1998)
S/N's 3246001 thru 3246125 (1995-1998), and 3257001 thru 3257074 (1998):

Slaving compasses (i.e. - KCS 55A) installed in these airplanes are part of the installed King/Allied Signal (now Honeywell) Autopilot System. Follow the service literature published by the autopilot equipment manufacturer. See also 22-10-00.

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/

7. Magnetic Heading Systems (1999-2003)
S/N's 3246126 thru 3246217 (1999 - 2003), and 3257075 thru 3257338 (1999 - 2003):

The S-TEC ST-180 HSI Slaved Compass System may be installed as optional equipment.

A. Flux Detector (See Figure 56.)

A flux detector installed in the wing tip of the left wing is used to provide heading data to the HSI.

(1) Removal

CAUTION: PERFORM MAGNETIC HEADING COMPENSATION / CALIBRATION, BELOW, WHENEVER THE FLUX DETECTOR IS CHANGED.

(a) Remove the left wing tip fairing to expose the flux detector.
(b) Disconnect the wiring harness from the top of the flux detector to be removed.
(c) Unscrew and remove the three brass screws and washers and remove the flux detector.

(2) Installation

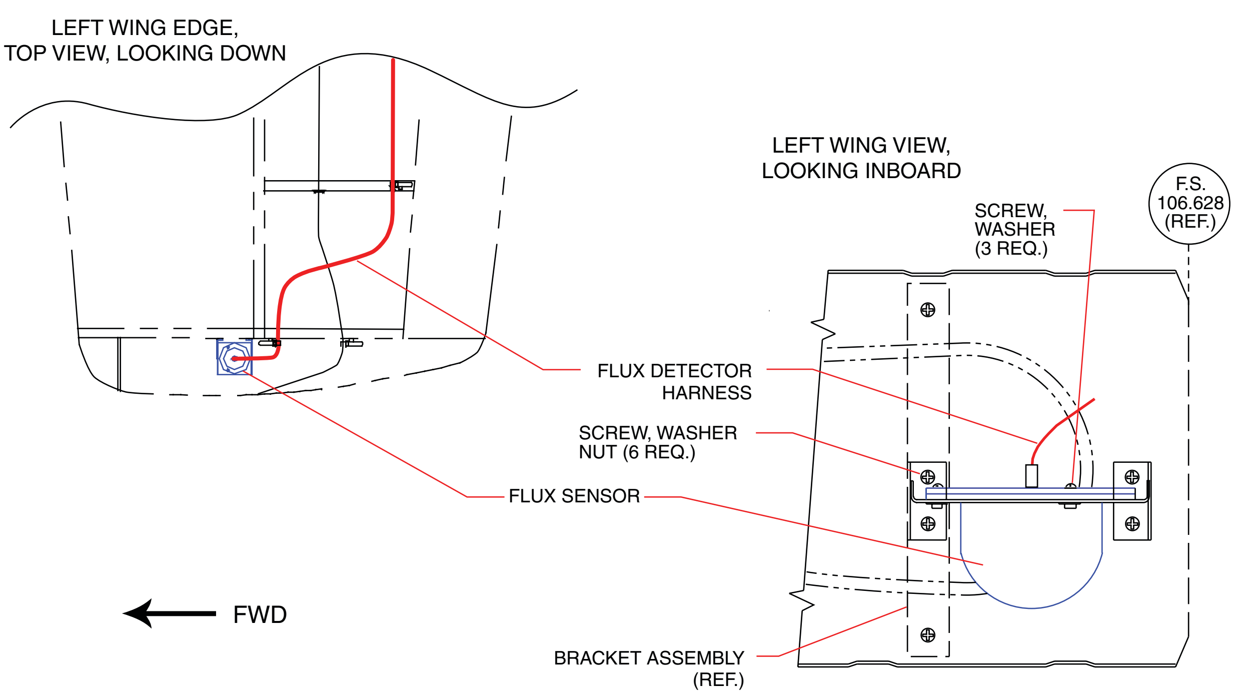
CAUTION: THE FLUX DETECTOR IS SECURED TO THE MOUNTING BRACKET WITH BRASS SCREWS. ENSURE ONLY BRASS SCREWS ARE USED WHEN REINSTALLING.

(a) Place the flux detector into position on its mounting bracket and secure with brass screws and washers (3 ea.)
(b) Connect wiring harness to the connector on top of the flux detector.
(c) Reinstall the Left wing tip.

NOTE: Ensure correct hardware is used when reinstalling wing tip over flux detector.

104391G

MAGNETIC FLUX SENSOR



Effectivity
3246126 thru 3246217,
3257075 thru 3257338

Flux Detector Installation
Figure 56

B. Magnetic Heading Compensation / Calibration (PIR-PPS60191, Rev. New.)

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.)

Accuracy of the entire heading system is dependent on the location of the flux detector and proper calibration. Accuracies of plus or minus one degree are possible when care is taken during installation and calibration. To obtain such results:

The flux detector must be positioned so that it points in the direction of aircraft flight; and, The north-south and east-west correctors must be adjusted to compensate for extraneous magnetic fields near the location of the flux detector.

(1) Required Equipment

Instrument Flight Research Corp. RF signal generator NAV-40IL or equivalent. Characteristics of the signal generator include: Frequency ranges 108 to 118 MHz, 117 to 136 Mhz, 328 to 336 MHz; +1/-0.01% accuracy, output level continuously adjustable from 1 .0uV to 0.1V into a 50 ohm load; 50 ohm output impedance; and internal adjustable or stepped VOR, LOC, and GS modulation. The RF signal generator should be portable and convenient for use while sitting in the aircraft cockpit.

(2) Procedure

(a) Apply power to the Model ST-180 HSI System. Allow at least three (3) minutes for the gyro to erect and synchronize.

(b) Prior to actual alignment of the flux sensor, turn the aircraft to both north and east headings. Apply power to electrical equipment such as navigation and beacon lights and verify that the compass system is not affected.

(c) Align the aircraft to an approximate magnetic north heading. On Chart 30, record the actual magnetic heading and the HSI heading card reading.

(d) Determine and record on Chart 30 the deviation between the actual magnetic heading and the heading card heading. If the heading card reads high, the deviation is a plus.

(e) Repeat steps (c) and (d) for east, south, and west headings. Record actual magnetic headings, heading card readings, and deviations on Chart 30.

(f) Plot deviations on the initial deviation graph in Figure 57.

(g) Realign the aircraft to north. Adjust the north-south corrector on the Slaving Panel, for one half of the difference between the north and south deviations. Record the new deviation for north and south on the initial deviation graph in Figure 57.

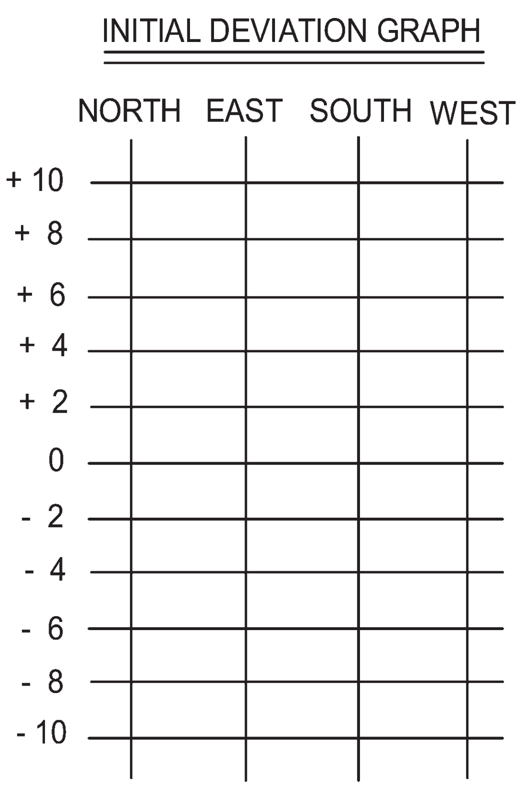
(h) Realign the aircraft to east. Adjust the east-west corrector on the Slaving Panel, for one half the difference between the east and west deviations. Record the new deviation for east and west on the initial deviation graph in Figure 57.

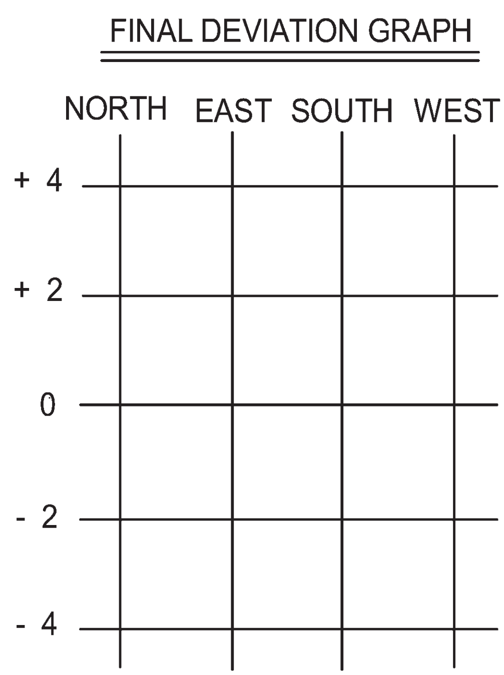
(i) If the pattern is not centered around zero, rotate the flux sensor clockwise to correct for minus deviations or counterclockwise for plus deviations. Plot final deviations on the final deviation graph in Figure 57.

(j) The deviations should now center around the zero reference line of the graph. If the error exceeds the specified system error limits (± 3°), repeat the complete procedure.

CHART 31
DEVIATION CHART

Approx. Magnetic Heading	Actual Magnetic Heading	Heading Card Reading	Deviation
North			
East			
South			
West			





ST-180 Deviation Graphs
Figure 57

8. Magnetic Heading Systems (Avidyne EFIS - 2004 and up)

See Electronic Flight Instrument System (EFIS), Maintenance, Primary Flight Display (PFD), above.

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9. Magnetic Heading Systems (Garmin EFIS - 2007 and up)

A. Description

In airplanes equipped with the Garmin 1000 EFIS, magnetic heading information is provided by the GRS 77 Attitude and Heading Reference System (AHRS). The GRS 77 interfaces with and provides power to the GMU 44 Magnetometer. The GRS 77 supplies attitude and heading information directly to the PFD, MFD, and to both GIAs. Location, removal, and installation information is provided under Electronic Flight Instrument System (EFIS) - Garmin, Components, above.

B. GRS 77/GMU 44 Magnetic Calibration

CAUTION: THIS PROCEDURE MUST BE CARRIED OUT ON A COMPASS ROSE IN ORDER TO GUARANTEE MEASUREMENTS FREE OF ENVIRONMENTAL MAGNETIC DISTURBANCES. ATTEMPTING TO CARRY OUR THIS MANEUVER ON ATYPICAL RAMP AREA MAY NOT YIELD A SUCCESSFUL CALIBRATION. THE ACCURACY OF THE AHRS CANNOT BE GUARANTEED IF THIS CALIBRATION IS NOT PERFORMED ON A MAGNETICALLY CLEAN COMPASS ROSE OR EQUIVALENT.

(1) Start the aircraft engine following the procedures referenced in the POH.

(2) After aircraft engine startup, taxi the aircraft to a properly calibrated compass rose. At the compass rose, align the aircraft to a heading of magnetic north (±5°)

(3) Restart the PFD and MFD in configuration mode.

NOTE: The engine performance can be monitored on the GRS/GMU calibration pages during the procedure.

(4) Go to the GRS Page Group on the PFD.

(5) Select the GRS/GMU Calibration page (Figure 58) and enter the following softkey password:

(a) 9

(b) 10

(c) 11

(d) 12 (Far Right softkey)

(6) Activate the cursor and highlight the SELECT PROCEDURE window and select MAGNETOMETER.

(7) Press the ENT button.

(8) Use the cursor to highlight the BEFORE CALIBRATION window.

(9) Follow the checklist items displayed on the PFD and press the ENT key as each one is completed or confirmed. When the CALIBRATE field is blinking, press the ENT key to begin the procedure.

(10) The PFD display advises the operator when to turn the aircraft, when to stop, and when to turn again.

(11) Upon instruction to turn, taxi the aircraft in a right turn. After approximately 25° to 30° of turn from the last heading, the PFD display advises the operator to stop the aircraft.

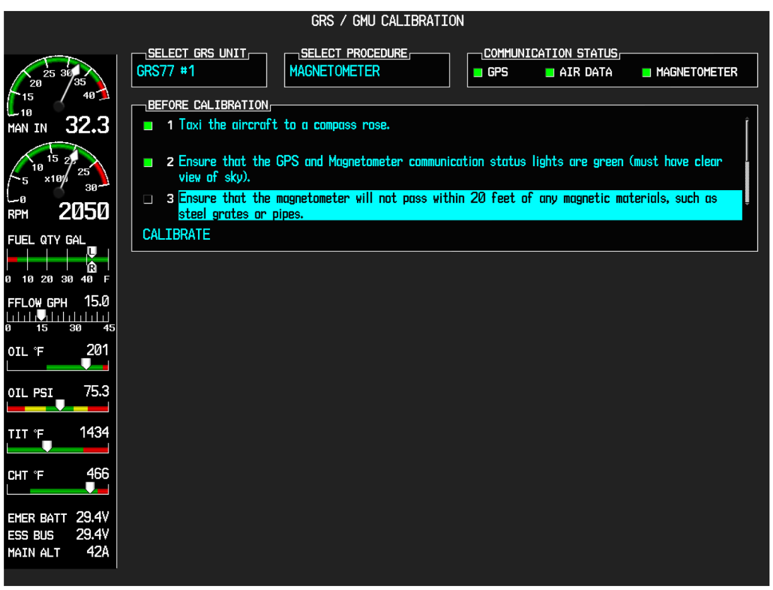
NOTE: Due to the difficulties in executing smooth, accurate turns the PFD may incorrectly interpret a station and instruct to “HOLD POSITION” prior to full completion of a 30° turn. If this scenario is encountered, it is best for the operator to ignore the “HOLD POSITION” command and instead use outside references to complete the approximate 30° turn. Instead of using the PFD instruction to turn as a real-time indication of when to turn, simply judge the 30° (±5°) turn increments of the aircraft by using the compass rose radials, Dwelling at these 30° increments for the time recommended by the PFD should result in successful calibration.

(12) The PFD guides the operator to dwell at multiple headings around a complete circle.

NOTE: Due to high winds or excessive airframe vibration, the operator may encounter a condition where the PFD restarts the 18-second countdown without full completion of the previous countdown. If this is encountered more than once for a given station, the operator should begin turning to the next station (approximately 30°). A minimum of 2 successful stations per quadrant is required, where a successful station is a full 18-second countdown followed by instruction to move. Ensure that at least 2 stations per quadrant are completed. Thus, it may sometimes be required to dwell at a station after a countdown restart. A maximum of 20 stations is allowed for the entire calibration procedure. If too many countdown restarts are encountered, the calibration will fail with the message, “TOO MANY STATIONS.”

(13) Repeat the turn-and-stop process until the PFD advises that a successful calibration is complete. The GRS 77 AHRS then enters its normal operational mode. Press the ENT button on the PFD to conclude this procedure.

(14) Perform the adjustment of the magnetic compass as specified below.



Effectivity
with Garmin 1000

GRS/GMU Calibration Page
Figure 58

C. Engine Run-Up

(1) Start the PFD and MFD in the configuration mode by holding ENT on each display while closing the circuit breaker.

(2) Go to the GRS Page Group on the PFD.

(3) Activate the cursor by pushing the small FMS knob and use the large FMS knob to go to SELECT PROCEDURE. Rotate the small FMS knob to generate the pick list and use the large FMS knob to select ENGINE RUN-UP TEST and press the ENT key to select ENGINE RUN-UP TEST.

(4) Press ENT again to select the first checklist item displayed. As each command is complied with and ENT is hit the associated box will turn green to confirm the selection has been complied with. When the CALIBRATE field is blinking (Figure 59), press the ENT key to begin the procedure.

a The PFD display instructs the operator to gradually increase power from idle to full throttle and back to idle over a period of 2-4 minutes.

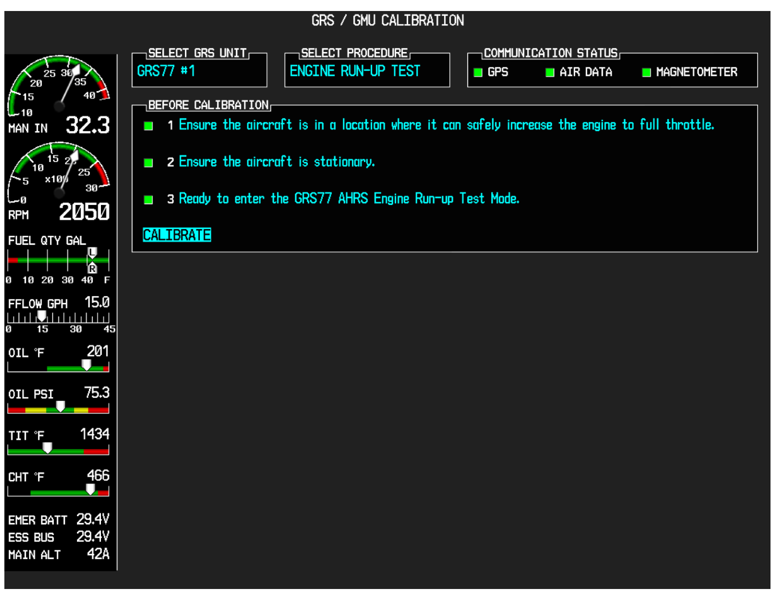
b When the operator has completed the engine run-up and the engine is back to an idle setting, press the ENT key to indicate that the process is complete. When this is done, the TEST COMPLETE field stops blinking.

c The PFD informs the operator if the installation has passed or failed the vibration test. If the test fails, the specific measurements causing the failure are identified and numeric values are displayed on the PFD.

d Press the ENT key on the PFD to conclude this procedure.

NOTE: Complete the Emergency Power Check, below, before shutting down the engine.

The aircraft can now be taxied back and the engine can be shut down for final testing. Restart both displays in normal mode to conduct emergency power, lighting, autopilot and final system checks. When the PFD powers up in normal mode, the AHRS attitude and heading information displayed should become valid within one (1) minute of power-up.



GRS / GMU Calibration Page - Engine Run-Up
Figure 59

Effectivity
with Garmin 1000

D. Magnetometer Interference Test

NOTE: External power cart and other aircraft need to be as far away from the test aircraft as possible. Turn the Battery Master ON, AV BUS Master ON, AP Master ON, Trim Master ON and all circuit breakers in.

NOTE: If TKS equipped, this test is performed twice: first for the units/systems listed in Chart 32; and, then for the TKS system as shown in Chart 33.

(1) Place the aircraft on jacks per 7-10-00.

(2) Start the PFD and MFD in the configuration mode by holding ENT on each display while closing the circuit breaker.

(3) Go to the GRS Page Group on the PFD.

(4) To perform the Magnetometer Interference Test press the following softkeys:

(a) 9

(b) 10

(c) 11

(d) 12 (Far Right softkey)

(5) Activate the cursor by pushing the small FMS knob and use the large FMS knob to go to SELECT PROCEDURE. Rotate the small FMS knob to generate the pick-list and use the large FMS knob to select MAGNETOMETER INTERFERENCE TEST and press the ENT key to select MAGNETOMETER INTERFERENCE TEST.

(6) Press ENT again to select the first checklist item displayed (see appropriate chart - i.e., Chart 32 or Chart 33). As each command is complied with and ENT is hit, the associated box will turn green to confirm the selection has been complied with.

NOTE: Use a stopwatch to accurately time the tests. All actions are to be carried out in the order and at the precise elapsed time as specified in the prepared test sequence.

(7) When the CALIBRATE field is blinking, press the ENT key to begin the procedure.

(8) When the test is complete, press the ENT key to indicate the process is complete. The TEST COMPLETE annunciation stops blinking.

(9) The PFD will display whether the installation has passed or failed the Magnetometer Interference Test. If the installation does not pass, troubleshoot all grounds and shielded wires from the failed component and then perform the Magnetometer Interference Test again.

(10) Press ENT on the PFD to conclude the test.

CAUTION: VERIFY LANDING GEAR ARE DOWN AND LOCKED BEFORE REMOVING AIRPLANE FROM JACKS.

(11) Remove the aircraft from jacks per 7-10-00.

CHART 32 (Sheet 1 of 2)
MAGNETOMETER INTERFERENCE TEST

Elapsed Time	**Action**
Since start of test (minutes:seconds)	
0:00	Test Begins
0:10	Alternator on
0:20	Alternator off
0:30	Standby Alternator on
0:40	Standby Alternator off
0:50	Fuel Pump on
1:00	Fuel Pump off
1:10	Navigation Lights on
1:20	Navigation Lights off
1:30	Strobe Light on
1:40	Strobe Light off
1:50	Fin Strobe on
2:00	Fin Strobe off
2:10	Taxi Lights on
2:20	Taxi Lights off
2:30	Landing Lights on
2:40	Landing Lights off
2:50	Pulse Light on
3:00	Pulse Light off
3:10	Switch Dimmer Pot full ccw to full cw
3:20	Instrument Dimmer Pot full ccw to full cw
3:30	Manual electric trim neutral to full up
3:40	Manual electric trim return to neutral
3:50	Manual electric trim neutral to full down
4:00	Manual electric trim return to neutral
4:10	Engage AP by selecting HDG and VS and run HDG bug from center to left (roll servo to respond)
4:20	Run HDG bug from left to center
4:30	Run HDG bug from center to right

CHART 32 (Sheet 2 of 2)
MAGNETOMETER INTERFERENCE TEST

Elapsed Time	Action
4:40	Run HDG bug from right to center
4:50	Select a positive VS (pitch servo to respond)
5:00	Return VS selection to 0
5:10	Select a negative VS
5:20	Return VS selection to 0 and disconnect AP
5:30	Pitot Heat on
5:40	Pitot Heat off
5:50	Vent Fan Hi on
6:00	Vent fan Hi off
6:10	Vent Fan Lo on
6:20	Vent Fan Lo off
6:30	Aileron full right
6:40	Aileron full left
6:50	Aileron level
7:10	Landing Gear up
7:30	Landing Gear down
7:40	Flaps down
7:50	Flaps up
8:00	Air Condition on
8:10	Air Condition off

CHART 33
MAGNETOMETER INTERFERENCE TEST (WITH TKS SYSTEM OPERATION ONLY)

Elapsed Time	Action
Since start of test (minutes:seconds)	
0:00	Test Begins
0:10	TKS Max
0:20	TKS off
0:30	TKS Norm
0:40	TKS off

10. Magnetic Compass

A. Description

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. Swing the compass as described under Adjustment, below, as follows:

(1) When the accuracy of the compass is suspected.
(2) After any cockpit modification or major replacement involving ferrous metal.
(3) Whenever a compass has been subjected to a shock; e.g., after a hard landing or turbulence.
(4) After aircraft has passed through a severe electrical storm.
(5) After lighting strike.
(6) Whenever a change is made to the electrical system.
(7) Whenever a change of cargo is likely to affect the compass.
(8) When aircraft's area of operation is changed to a different geographic location with a major change in magnetic deviation. (e.g., from Miami, Florida to Fairbanks, Alaska.)
(9) After aircraft has been parked on one heading for over a year.
(10) When flux valves / magnetometers are replaced.

B. Troubleshooting

See Chart 34.

C. Adjustment

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.

CHART 34
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.	

11. Turn and Bank Indicator

NOTE: In airplanes equipped with Avidyne Entegra or Garmin G1000, this function is provided solely by the Primary Flight Display (PFD).

A. Description

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 presence of side forces on the aircraft.

B. Troubleshooting

See Chart 35.

C. Removal and Installation

See 39-10-00.

CHART 35
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.	Replace instrument.
	Aircraft not in coordinated turn.	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.	Check circuit and repair.
	Instrument malfunction.	Replace instrument.

(PIR-PPS55014, Rev. B. / PIR-PS50207, Rev. C.)

CHART 36
REQUIRED EQUIPMENT LIST - GARMIN 1000 EFIS

Description	LRU Part Number	Code Loader Part Number	Software Part Number	Software Version
GTX 33 Mode S Transponder	011-00779-10	010-00605-05 (1)	006-B0172-XX	4.05
GEA 71 Engine Airframe Unit	011-00831-00	“	006-B0193-05	2.07
GDC 74a Air Data Computer	011-00882-00	“ “	006-B0261-03 006-C0055-00	2.05 1.05
GMU 44 Magnetometer	011-00870-00	“ “	006-B0224-00 006-C0048-00	2.01 2.00
GDU 1040 Display Unit, PFD	011-00972-03	“ “	006-B0319-62 006-C0036-03	8.02 1.03
GDU 1040 Display Unit, MFD	011-00972-03	“ “	006-B0319-62 006-C0036-03	8.02 1.03
GIA 63W Avionics Integration Unit No. 1	011-01105-00	“ “ “	006-B0544-24 006-B0339-04 006-D0425-02	5.31 2.4 2.02
GIA 63W Avionics Integration Unit No. 2	011-01105-00	“ “ “	006-B0544-24 006-B0339-04 006-D0425-02	5.31 2.4 2.02
GRS 77 Attitude Heading Reference Unit	011-00868-10	“ “	006-B0223-07 006-C0049-00	2.09 2.00
GMA 1347 Audio Panel	011-00809-00	“	006-B0203-33	3.03
PA-32 Config / Loader Card	PS50207-2 (4)	“	006-D0717-05 (2)	3.05
GDL69 Satellite Datalink	011-00986-00	N/A	006-B0317-12	3.02.00
GDL69A Satellite Datalink with Audio	011-00987-00	N/A	006-B0317-12	3.02.00
GDU 10XX Terrain Data Base Card (3)	PS50207-3 (4)	N/A	010-00330-42	
GDU 10XX Chartview/Jeppesen NavData U.S. Data Card	PS50207-7 (4)	N/A	010-00330-70	
GDU 10XX Chart Unlock	PS50207-4 (4)	N/A	010-00330-53	
GDU 10XX TAWS Unlock	PS50207-5 (4)	N/A	010-00330-51	

Notes:
1. 010-00605-05 contains software image 006-B0648-05. Upon initial power-up, this appears in the upper right corner of the MFD as “Piper PA32 System 0648.05”.
2. Enable Flight Director Option.
3. Two (2) terrain/obstacle/airport cards are required, one (1) for each GDU 1040 display unit.
4. Piper part number.

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DEPENDENT POSITION DETERMINING

1. COM/NAV/GPS - GNS 430/530

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

A. Maintenance

In TC S/N's 3257491 and up, with Entegra EFIS, dual Garmin GNS-430W COM/NAV/GPS systems may be installed as standard equipment. Each installation consists of the GNS-430W transceiver/display units, associated wiring, and antennas.

In HP S/N's 3246126 thru 3246165, and; TC S/N's 3257076 thru 3257155 excluding 3257144, as well as HP S/N's 3246218 and up, and; TC S/N's 3257339 and up, with Entegra EFIS, dual Garmin GNS-430 COM/NAV/GPS systems are installed as standard equipment. Each installation consists of the GNS-430 transceiver/display units, associated wiring, and antennas.

In HP S/N's 3246166 thru 3246217, and; TC S/N's 3257144, 3257156 thru 3257338 Garmin GNS-430/530 COM/NAV/GPS systems are installed as standard equipment. The installation consists of the GNS-430/530 transceiver/display units, associated wiring, and antennas.

Maintenance of the GNS-430/530 series units is "on condition" only and, with the exception of swapping complete units, should be performed only by a qualified avionics shop in accordance with the appropriate GARMIN maintenance manual.

Information provided in this manual is intended solely to aid the removal and installation of the GNS-430/530 transceiver/display units, their associated wiring and antennas.

B. Removal and Installation

See 39-10-00.

C. Post Installation Setup Procedure (PIR-PPS60199, Rev. New / PIR-PPS60199-2, Rev. K / PIR-PPS60199-9,Rev. NEW)

(1) Aircraft Preparation and Configuration

Setup and preliminary checks may be made using the aircraft battery or external power supplied by an external power source. Final checks (CDI/HSI accuracy) should be made with the engine running and the aircraft configured as in Chart 1.

CHART 1
FINAL CHECK CONFIGURATION (PIR-PPS60199, Rev. New / PIR-PPS60199-2, Rev. K.)

Engine running, alternators	On	Avionics	On
Instrument Panel Lights	Full Bright	Day/Night Switch	Day
Navigation Lights	On	Strobe Lights	On
Pitot Heat	Off	Air Conditioning	Off
Cabin Blower Fan	Low	Vent Blower	Off

(2) Configuration Setup Procedure

Access the Configuration Mode of the unit by depressing and holding the ENT key while applying power to the unit. Release the ENT key when the display activates. After the data base pages, press the ENT key twice to display the MAIN ARINC 429 CONFIG page. Pages may be selected by ensuring the cursor is off and rotating the inner concentric knob on the right side of the unit.

To change data on the displayed Configuration Page, the cursor must be selected. Press the inner concentric knob on the right side of the unit to activate the cursor. Rotating the outer concentric knob on the right side of the unit changes the selected data field. Rotating the inner concentric knob changes the data within the selected field. To accept entry of the desired selection, press the ENT key.

(a) Press the ENT key twice to display the MAIN ARINC 429 CONFIG page. Setup per Chart 2, 3, or 4, as applicable.

CHART 2
MAIN ARINC 429 CONFIG PAGE
- WITH DUAL 430 AND MECHANICAL INDICATORS (PIR-PPS60199, Rev. New.)

MAIN ARINC 429 CONFIG Page	**#1 GNS 430**		**#2 GNS 430**	
BUS	SPEED	DATA	SPEED	DATA
GPS ARINC IN 1	HIGH	OFF	HIGH	OFF
	HIGH	“TRAFFIC ADVISORY” W/SKYWATCH	HIGH	“TRAFFIC ADVISORY” W/SKYWATCH
GPS ARINC IN 2	HIGH	OFF	HIGH	OFF
GPS ARINC OUT	HIGH	GAMA 429 GRAPHICS W/INT	HIGH	GAMA 429 GRAPHICS W/INT
SDI	LNAV 1		LNAV 2	

CHART 3
MAIN ARINC 429 CONFIG PAGE
- WITH 530 / 430 AND MECHANICAL INDICATORS

(PIR-PPS60199-2, Rev. K.)

MAIN ARINC 429 CONFIG Page	#1 GNS 530		#2 GNS 430	
BUS	SPEED	DATA	SPEED	DATA
GPS ARINC IN 1	HIGH	GARMIN GTX 330	HIGH	GARMIN GTX 330
	HIGH	"AIRDATA" W/SKYWATCH	HIGH	"AIRDATA" W/SKYWATCH
GPS ARINC IN 2	HIGH	OFF	HIGH	OFF
	HIGH	"TRAFFIC ADVISORY" W/SKYWATCH	HIGH	"TRAFFIC ADVISORY" W/SKYWATCH
GPS ARINC OUT	HIGH	GAMA 429 GRAPHICS W/INT	HIGH	OFF
SDI	LNAV 1		LNAV 2	

CHART 4

(PIR-PPS60199-2, Rev. K / PIR-PPS60199-9, Rev. New.)

MAIN ARINC 429 CONFIG PAGE - WITH AVIDYNE ENTEGRA

MAIN ARINC 429 CONFIG Page	#1 GNS 430		#2 GNS 430	
BUS	SPEED	DATA	SPEED	DATA
GPS ARINC IN 1	LOW	SANDEL EHSI	LOW	SANDEL EHSI
GPS ARINC IN 2	HIGH	"AIRDATA"	HIGH	"AIRDATA"
GPS ARINC OUT	LOW	GAMA 429 GRAPHICS W/INT	LOW	GAMA 429 GRAPHICS W/INT
SDI	LNAV 1		LNAV 2	
VNAV*	ENABLE LABELS		ENABLE LABELS	
* 430 W only.				

(b) Deselect the cursor and rotate the inner concentric knob on the right side of the unit to display the MAIN RS232 CONFIG page. Configure per Chart 5

(c) Deselect the cursor and rotate the inner concentric knob on the right side of the unit to display the MAIN System Config page. Configure per Chart 6.

(d) Deselect the cursor and rotate the inner concentric knob on the right side of the unit to display the MAIN LIGHTING page. Configure per Chart 7.

(e) Deselect the cursor and rotate the inner concentric knob on the right side of the unit to display the MAIN CDI/OBS CONFIG page. Setup is only required for selected course calibration.

On the CDI/HSI connected to the GNS unit being configured, adjust the OBS or HSI course needle to indicate a selected course of 150 degrees. The SELECTED COURSE field on the GNS unit should indicate very close to 150 degrees. Select the “Calibrate to 150?” field and press ENT. Verify the OBS (or HSI course) operation by checking that the course displayed on the GNS unit is within 2° of the selected course. Verify the accuracy at cardinal headings around the OBS card.

(f) Deselect the cursor and rotate the inner concentric knob on the right side of the unit to display the COM SETUP page. Change only the “SPACING” setting to display “Select 25.0 KHz”.

(g) Deselect the cursor and rotate the inner concentric knob on the right side of the unit to display the VOR/LOC/GS/CDI page. Change only the “DME CHNL MODE” setting to display “Parallel 2x5”.

(h) VOR/LOC/GS ARINC 429 CONFIG Page Setup per Chart 8 or 9.

CHART 5
MAIN RS-232 CONFIG PAGE (PIR-PPS60199, REV. NEW / PIR-PPS60199-2, Rev. K.)

MAIN RS232 CONFIG page	**#1 GNS 530/430**		**#2 GNS 430**	
	INPUT	OUTPUT	INPUT	OUTPUT
CHNL 1	OFF	AVIATION NO ALT**	OFF	OFF *
CHNL 2	OFF	OFF	OFF	OFF
CHNL 3	CROSSFILL	CROSSFILL	CROSSFILL	CROSSFILL
CHNL 4	OFF **	OFF	OFF	OFF
	“WX-500” W/STORMSCOPE OFF	“WX-500” W/STORMSCOPE	“WX-500” W/STORMSCOPE	
CHNL 5***	OFF	OFF	OFF	OFF
CHNL 6***	OFF	OFF	OFF	OFF
* “AVIATION NO ALT” with Horizon DDMP / ** “OFF” with Avidyne Entegra / *** Not used 430W				

CHART 6
FUEL AND TERRAIN CONFIG PAGE (PIR-PPS60199-9, Rev. New.)

MAIN SYSTEM CONFIG PAGE	**#1 GNS 430W**	**#2 GNS 430W**
CONFIGURE	FUEL	FUEL
FUEL TYPE	AV GAS	AV GAS
TERRAIN		
CONFIGURE	TERRAIN	
TERRAIN TYPE	TERRAIN	TERRAIN
TEST CARD?	PASS	PASS
HW CONFIGURE		

CHART 7
MAIN LIGHTING PAGE

(PIR-PPS60199, Rev. New / PIR-PPS60199-2, Rev. K.)

MAIN LIGHTING PAGE	DISPLAY		KEY	
LIGHTING	NO SETTING		NO SETTING	
SOURCE	PHOTO		PHOTO *	
RESP TIME/MIN	4 **	80 **	4 **	40 **
SLOPE/OFFSET	50 **	50 **	50 **	50 **
Prior to EFIS: * “28V DC” / ** retain factory setting				

CHART 8
VOR/LOC/GS ARINC 429 CONFIG PAGE
- WITHOUT AVIDYNE ENTEGRA

(PIR-PPS60199-2, Rev. K.)

#1 GNS	RX	TX
SPEED	HIGH	HIGH
SDI	VOR/ILS 1	
DME MODE	DIRECTED FREQ 1	
#2 GNS	**RX**	**TX**
SPEED	HIGH	HIGH
SDI	VOR/ILS 2	
DME MODE	DIRECTED FREQ 2	

CHART 9
VOR/LOC/GS ARINC 429 CONFIG PAGE
- WITH AVIDYNE ENTEGRA

(PIR-PPS60199-2, Rev. K.)

#1 GNS	RX	TX
SPEED	LOW	LOW
SDI	VOR/ILS 1	
DME MODE	DIRECTED FREQ 1	
#2 GNS	**RX**	**TX**
SPEED	LOW	LOW
SDI	VOR/ILS 2	
DME MODE	DIRECTED FREQ 2	

D. VOR / LOC / GS Ramp Checks

Once the GNS units have been configured, proper navigation receiver and indicator operation (VOR / LOC / GS) should be verified using the IFR NAV-401L ramp test set or equivalent. This procedure assumes familiarity with proper operation of the test equipment and is not intended to be a tutorial on test set use. Refer to the appropriate test set operating instructions for proper operation of the ramp test equipment.

(1) OBS / CDI Checks:

(a) Check that the proper OBS indicator is connected to the appropriate VOR receiver; the #1 OBS is connected to GNS #1; and, the #2 OBS is connected to GNS #2.

(b) Check the lateral and vertical deviation needles and/or lateral and vertical flags for deflection while keying the communication transmitter on a representative sampling of frequencies (118.00 MHz to 136.975 MHz).

(c) Tune the navigation receiver and the adjust test set to 108.0 MHz. Using the ramp test set, check the accuracy of the OBS or Course Selector needle (HSI) at 30° increments (30°, 60°,....,330°, 360°).

(2) Localizer Indicators Checks

(a) Tune the navigator receiver and adjust the test set to 108.1 MHz. Using the ramp test set, check that the course deviation needle (CDI) centers within 1/2 dot with 0 DDM applied at the test set.

(b) Check GNS #1 and #2 left and right deviation of the CDI per Chart 10

CHART 10
LOCALIZER TEST POINTS (PIR-PPS60199-2, Rev. K. / PIR-PPS60199-9, Rev. New)

CDI (LOC)	DDM	DEFLECTION
Centered	0	0% F.S.
Standard Deviation	.093	60% F.S.
Full Scale Deflection	.155	100% F.S.
More than F.S.	.200	100% + F.S.
Full Tone (single mod)	.400	FLAG

(3) Glide Slope Indicator Checks

(a) Set navigation receiver and the test set to 108.1 MHz. Glide Slpoe generator defaults to proper G/S frequency (334.7 MHz.). Using the ramp test set, check that the needle (G/S) centers within 1/2 dot with 0 DDM applied at the test set.

(b) Check GNS #1 and #2 up and down deviation of the glide slope indicator per Chart 11.

CHART 11
GLIDE SLOPE TEST POINTS (PIR-PPS60199-2, Rev. K. / PIR-PPS60199-9, Rev. New)

G / S	DDM	DEFLECTION
Centered	0	0% F.S.
Standard Deviation	.091	52% F.S.
Full Scale Deflection	.175	100% F.S.
More than F.S.	.400	100% + F.S.
Full Tone (single mod)	.800	FLAG

2. Transponder

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

A. GTX-327 (HP S/N's 3246166 thru 3246181, and; TC S/N's 3257144, 3257156 thru 3257198)

(1) Maintenance

A Garmin GTX-327 Transponder is installed as standard equipment. Maintenance of the GTX-327 is "on condition" only and, with the exception of swapping complete units, should be performed only by a qualified avionics shop in accordance with the GTX-327 maintenance manual (Garmin P/N 190-00187-05, latest revision).

Information provided in this manual is intended solely to aid the removal and installation of the GTX-327 transceiver/display unit, its associated wiring and antenna.

(2) Removal and Installation

See 39-10-00.

B. GTX-330 (HP S/N's 3246182 and up, and; TC S/N's 3257199 and up)

(1) Maintenance

A Garmin GTX-330 Transponder is installed as standard equipment. Maintenance of the GTX-330 is "on condition" only and, with the exception of swapping complete units, should be performed only by a qualified avionics shop in accordance with the GTX-330 maintenance manual (Garmin P/N 190-00207-05, latest revision).

Information provided in this manual is intended solely to aid the removal and installation of the GTX-330 transceiver/display unit, its associated wiring and antenna.

(2) Removal and Installation

See 39-10-00.

(3) Post Installation Setup Procedure (PIR-PPS60206, Rev. O.)

Access the Configuration Mode of the unit by depressing and holding the FUNC key while applying power to the unit. Release the FUNC key when the display activates. The FUNC key sequences forward through the configuration pages. The START/STOP key reverses through the pages, stopping at the Menu page. The CRSR key highlights selectable fields on each page. When a field is highlighted, the 0-9 keys enter numeric data and the 8 or 9 keys move through list selections. Press the CRSR key to accept changes. When a field is highlighted, pressing the FUNC key moves to the next configuration page without saving the changes. To exit the configuration pages, turn the power off and then turn the unit on again without holding the FUNC key for normal operation.

NOTE: When the unit it turned on for the first time, or an invalid address is recognized, the unit will prompt the user to enter a valid aircraft address. See Mode S Address (ICAO Aircraft Address Code) and FLIGHT ID Entry Page paragraph, below.

(a) Configuration Menu

The JUMP TO menu page provides the capability to select a configuration mode starting page without having to step through all of the pages. Press the CRSR key and sequence through to the desired section with the 8 and 9 keys. Jump to the selection by pressing the CRSR key again with the desired selection highlighted. The FUNC key steps to the next configuration page, after which the START/STOP key reverses until stopping at the JUMP TO menu page. Following is a list of selections and their descriptions

SELECTION	DESCRIPTION
DIAGNOSTICS	Jumps to Gray Code Input Page
DISPLAY/AUDIO	Jumps to Audio Volume Page
I/O CONFIG	Jumps to ARINC INPUT #1 Page
ACFT CONFIG	Jumps to Operation Configuration #1 Page

(b) Refer to Charts 12-16 for required settings on the configuration pages.

(c) On the TEMPERATURE Page, select “NO” for SENSOR INSTALLED.

(d) MODE S Address (ICAO Aircraft Address Code) and FLIGHT ID Entry Page

When the unit is turned on for the first time, or an invalid address is recognized, the unit will prompt the user to enter a valid aircraft address.

NOTE: U.S. registered aircraft ICAO Aircraft Address Code (ADDRESS HEX) is the “N number” and is displayed as such on the ATC-601. On Non-U.S. registered aircraft, verify only that the hexadecimal code displayed on ATC-601 matches the “ADDRESS HEX” code programmed on the GTX-330.

1 U.S. Registered Aircraft

a To highlight the “U.S. Tail #” address field, press the CRSR key one time.

b Enter the registration number using the number keys. Press a key repeatedly to scroll through the digit/alpha characters for that entry field.

c Press the CRSR key to select the numeric entry field. Enter the next character as stated in step b , then move onto the next one, repeating the process until the complete number is entered.

d When finished, press the CRSR key to accept the number entry.

e For entering the Flight ID number, press the CRSR key one time.

f Repeat steps b and c.

g When finished, press the CRSR key to accept the number entry.

2 Non-US Registered Aircraft

a For entering Non-U.S. Aircraft Registration, press the CRSR key one time, then 8 or 9 to select ADDRESS HEX.

b Non-U.S. Aircraft Registry normally supplies a 24 bit binary code, known as the ICAO Aircraft Code for the Mode S address in lieu of directly entering the N# for U.S. registered aircraft.

c The GTX 330 only accepts a hexadecimal format for the Non-U.S. Registered Aircraft, so the 24 bit binary code must be converted to a hexadecimal format.

d Convert the 24 bit binary code to hexadecimal as follows:

1) 24 bit binary code: 111001000111111101101101

2) Separate for hex conversion: 1110 / 0100 / 0111 / 1110 / 1110 / 1101

3) Apply the hexadecimal values found in Chart 17.

E	4	7	E	E	D
1110/	0100/	0111/	1110/	1110/	1101

4) “ADDRESS HEX” = E47EED

e Enter the hexadecimal address using the number keys. Press a key repeatedly to scroll through the digit/alpha characters for that entry field.

f Press the CRSR key to select the numeric entry field. Enter the next character as stated in step e , then move onto the next one, repeating the process until the complete number is entered.

g For FLIGHT ID select “CONFIG ENTRY” and enter the Hex code or select “POWER UP ENTRY”.

h When finished, press the CRSR key to accept the number entry.

(e) On the “MODE S Aircraft Type” Page:

1 Select “<15.5k Lb” for AC TYPE, “<= 300 kt” for MAX AIRSPEED, and “1E-5” for GPS INTEGRITY.

2 Select “<15 MT” for AC LENGTH TYPE LENGTH, and <=11.5 MT. FOR AC WIDTH TYPE WIDTH.

3 Select “ENABLE” for EHS (ENHANCED SURVEILLANCE).

NOTE: Advance through remaining display screens that cannot be changed.

4 When entries are complete, cycle unit power and check for entries.

CHART 12
VOICE AND VOLUME (TIS Installation Only - No Other Traffic System Installed.)

Function	Selection	Description
VOLUME	MAX	
VOICE	MALE	
MESSAGE (0-5)		Selected Audio Tones and Messages 0= Toggle a continuous tone on and off 1= Attention Tone, precedes voice messages to attract the pilot's attention. 2= "Leaving Altitude", when altitude monitor is active and the altitude deviation is exceeded. 3= "Traffic", when a TIS traffic alert is received. 4= "Time Expired", when the countdown expires. 5= "Traffic Not Available", when TIS service is not available or out or range of an operating TIS MODE S site. 6-9 are not used.
ALTITUDE MONITOR	OFF TONE	When Altitude Pre-Select is installed. When Altitude Pre-Select is not installed.
PAGE CHANGE	ENABLE	
COUNTDOWN TIMER	TONE	

CHART 13
DISPLAY MODE AND KEY LIGHTING

DISPLAY MODE	AUTO
LEVEL	75
BKLT	AUTO
LVL	Not Selectable
RSP TIME	4
MIN	8
BKLT SRCE	PHOTO
SLOPE	50
OFFSET	50
KEY	AUTO
LVL	Not Selectable
RSP TIME	4
MIN	5
KEY SRCE	28V
SLOPE	20
OFFSET	30
CONTRAST MODE	AUTO
VFR KEY	ENABLE

CHART 14
ARINC 429 CONFIGURATION PAGE

GTX 330		
429 INPUT	SPEED	DATA
CHANNEL 1	HIGH	GPS/FMS
CHANNEL 2	HIGH	OFF
CHANNEL 3	LOW	OFF
CHANNEL 4		OFF
429 OUTPUT		DATA
CHANNEL 1		OFF
CHANNEL 2		GARMIN W/TIS “GARMIN” W/SKYWATCH

CHART 15
RS-232 INPUT AND OUTPUT

RS-232 CONFIG	GTX	
232 INPUT	INPUT	OUTPUT
CHANNEL 1	OFF	OFF
CHANNEL 2	OFF	OFF

CHART 16
OPERATION CONFIGURATION

VS RATE	500
FORMAT	FEET
VFR ID	1200
ALTITUDE ALERT DEVIATION	200
SQUAT SWITCH	NO
SENSE	LOW
DELAY TIME	24
AUTO FLIGHT TIMER	MANUAL

CHART 17
HEXADECIMAL CONVERSION

Binary	Hexadecimal	Decimal	Binary	Hexadecimal	Decimal
/0000	0	0	/1000	8	8
/0001	1	1	/1001	9	9
/0010	2	2	/1010	A	10
/0011	3	3	/1011	B	11
/0100	4	4	/1100	C	12
/0101	5	5	/1101	D	13
/0110	6	6	/1110	E	14
/0111	7	7	/1111	F	15

(4) Mode S Transponder Ground Test (PIR-PPS60207, Rev. E.)

NOTE: Provides compliance with FAR Part 43 Appendix F and Part 91.413, and also tests for accuracy, correlation requirements for altitude encoders to provide compliance with FAR Part 43 Appendix E.

(a) Required Equipment:

IFR ATC-601-2 Ramp Test Set or equivalent.

Perform these test in conjunction with Post Installation Setup Procedure, above.

Set altimeter to 29.92 inches of mercury. Altitude encoders shall be tested up to and including the maximum operating altitude for the aircraft.

(b) Auto Test Requirements

Perform the AUTO TEST and verify that MODES A, C, & S pass.

Record the following results:

FREQ: 1090 +/-1 MHZ (1089.0 MHZ to 1091.0 MHZ)

ERP: 125 Watts minimum to 500 Watts maximum

MTL: -73 dBm +/-4 (-69 dBm to -77 dBm)

(c) Individual Test Requirements

U.S. registered aircraft ICAO aircraft address codes (address hex) is actually the “N number” and is displayed as such on the ATC-601. On foreign registered aircraft verify that the hexadecimal code displayed on the ATC-601 matches the “address hex” code programmed on the transponder.

NOTE: In the following tests (using the ATC 601-2 Ramp Test Set) invalid parameters are displayed in **BOLD** type.

1 SLS Level (ATC 601 Test 4)

Test Set interrogates UUT with ATCRBS Modes A and C. A reply is verified when SLS pulse is -9dB and no reply is received when SLS pulse is 0dB. Transponder response to Mode 3/A interrogations not to exceed three replies per second when amplitude of the P2 pulse = P1 pulse and the transponder is interrogated at a pulse repetition rate of 235 per second. Test Set results are as follows:

a SLS Level Test - Passed

-9 dB: REPLY

0.dB: NO REPLY

Press RUN to start

b SLS Level Test - Failed

-9 dB: REPLY

0.dB: **REPLY**

Press RUN to start

2 ATCRBS Only ALL-CALL (ATC 601 Test 5)

Test Set interrogates UUT with ATCRBS Only ALL-CALL (0.8 microsecond P4 pulse) and verifies that Mode S transponders do not reply. Test set results are as follows:

a ATC ONLY ALL-CALL TEST - PASSED

PASSED TEST

Press RUN to start

b ATC ONLY ALL-CALL TEST - FAILED

MODE S XPDR REPLIED WITH MODE S

Press RUN to start

3 Mode S ALL-CALL Interrogations (ATC 601 Test 6)

Test Set interrogates UUT with Mode A/S ALL-CALL (1.6 microsecond P4 pulse). Address received from Mode S reply is sent in UF4 interrogation and verified with DF4 address. Test Set results are as follows:

NOTE: All address codes shown herein as replies from the transponder are based on an input of N12345 into the GTX 330 Mode S Address Entry Page for U.S. tail#. Insure that the reply address is the same throughout the test when the aircraft tail number is entered into the GTX 330 instead of N12345. It is suggested that all test be run with N12345 entered and then run again with the actual U.S. Tail# entered. At this time the proper tail number can be left in the Address Entry page. See Post-Installation Setup Procedures, above, for Addresses associated with Foreign registered aircraft.

a MODE S ALL-CALL TEST - PASSED
ALL CALL ADDRESS = 3AC421 [16542041]
TAIL NUMBER = N12345
Press RUN to start

b MODE S ALL-CALL TEST - FAILED
ALL CALL ADDRESS = 3BD532 [16752462]
TAIL NUMBER = N12345
DF4 REPLY ADDRESS = 3AC421
Press RUN to start

4 Invalid Address: Mode S Address (ATC 601 Test 7):

Test Set interrogates UUT with MODE S interrogations using correct address and two incorrect addresses (Nominal rate of 50 interrogations per second). These addresses are different from the addresses determined from the Mode S ALL-CALL. The Test Set verifies that no reply is received. Test Set results are as follows:

a INVALID ADDRESS TEST - PASSED
PASSED TEST
Press RUN to start

5 SPR On/Off (ATC 601 TEST 8):

Test Set interrogates UUT with Mode S interrogation (SPR On) and verifies that correct reply is received. Test Set then transmits the same interrogation again with (SPR Off) and verifies that no reply is received. Test Set results are as follows:

a SPR ON/OFF TEST - PASSED
SPR ON: REPLY
SPR OFF: NO REPLY
Press RUN to start

b SPR ON/OFF TEST - FAILED
SPR ON: REPLY
SPR OFF: **REPLY**
Press RUN to start

6 Mode S UFO (ATC 601 Test 9:)

Test Set interrogates UUT with Mode S UFO and verifies that reply has correct altitude (Compared to ATCRBS Mode C), correct address (Compared to DF11) and correct format. UFO AQ bit is “1” for requesting airspeed information in DFO RI field.

a MODE S UFO TEST - PASSED

DF 0 VS = 1 RI = 0 AC = 10,700 FT

ADDRESS = 3AC421

Press RUN to start

b MODE S UFO TEST - FAILED

DF 0 VS = 1 RI = 0 AC = 10,800 FT

ADDRESS = 3AC421

MODE C ALT = 10,700

Press RUN to start

7 Mode S UF4 (ATC601 Test 10)

Test Set interrogates UUT with Mode S UF4 and verifies reply has correct altitude (Compared to ATCRBS Mode C), correct address (Compared to DF11) and correct format.

a MODE S UF4 TEST - PASSED

DF 5 FS = 1 DR = 00 AC = 10,700

ADDRESS = 3AC421

Press RUN to start

b MODE S UF 4 TEST - FAILED

DF 0 FS = 1 DR = 00 **UM = 00** AC = 10,700

ADDRESS = 3AC421

Press RUN to start

8 Mode S UF5 (ATC 601 Test 11):

Test Set interrogates UUT with Mode S UF5 and verifies that reply has correct ID Code (Compared to ATCRBS Mode A), correct address (Compared to DF11) and correct format.

a MODE UF5 TEST - PASSED

DF 5 FS = 1 DR = 00 UM = 00 ID = 7777

ADDRESS = 3AC421

Press RUN to start

b MODE S UF5 TEST - FAILED

DF 5 FS = 1 DR = 00 UM = 00 ID = 7377

ADDRESS = 3AC421

Press RUN to start

9 Mode S UF11 (ATC 601 Test 12):

Test Set interrogates UUT with Mode S UF16 and verifies that reply has correct address and format.

a MODE S UF11 TEST - PASSED

DF 11 CA = 1 AA = 3AC421 PI = 000000

Press RUN to start

b MODE UF11 TEST - FAILED

DF 16 CA = 1 **AA = 33E35B** PI = 000000

Press RUN to start

10 Mode S UF16 (ATC 601 Test 13):

Test set interrogates UUT with UF16 and verifies that reply has correct altitude (Compared to ATCRBS Mode C), correct address (Compared to DF11) and correct format. UF16 AQ bit is “0” for requesting TCAS capability information in DF16 RI field.

a MODE S UF16 TEST - PASSED

DF 16 VS = 00 RI = 0 AC = 10,700 FT

MV = 0000000000000 ADDRESS = 543212

Press RUN to start

b MODE S UF16 TEST - FAILED

DF 16 VS = 00 RI = 0 AC = 10,700 FT

MV = 000000000000 ADDRESS = 543212

DF 11 ADDR = 3AC421

Press RUN to start

11 Mode S UF20 (ATC 601 Test 14):

Test Set interrogates UUT with Mode S UF20 and verifies that reply (if received) has correct ID code (Compared to ATCRBS Mode A), correct address (Compared to DF11) and correct format.

a MODE S UF20 TEST - PASSED

DF 20 FS = 0 DR = 00 UM = 00 AC = 10,700 FT

MB = 00000000000000 ADDRESS =3AC421

Press RUN to start

b MODE S UF20 TEST - FAILED

DF 20 FS = 0 UM = 00 AC = 10,700 FT

MB = 00000000000000 ADDRESS = 3AC421

MODE C ALT = 10,000 FT

Press RUN to start

12 Mode S UF21 (ATC 601 Test 15):

Test Set interrogates UUT with Mode S UF21 and verifies that reply (if received) has correct ID code (Compared to ATCRBS Mode A), correct address (Compared to DF11) and correct format.

a MODE S UF21 TEST - PASSED

DF 21 FS = 0 DR = 00 UM = 00 ID = 777

MB = 0000000000000 ADDRESS = 3AC421

Press RUN to start

b MODE S UF21 TEST - FAILED

DF5 FS = 0 DR = 00 UM = 00 **ID = 7777**

MB = 0000000000000 ADDRESS = 3AC421

Press RUN to start

13 Squitter (ATC 601 Test 16):

Test Set verifies that squitters are received from UUT every 0.8 to 2.4 seconds.

a SQUITTER TEST - PASSED
PERIOD = 1.00 SECONDS
TAIL NUMBER = N13245
SQUITTER ADDRESS = 3AC421 [16542041]
Press RUN to start

b SQUITTER TEST - FAILED
PERIOD = **2.64 SECONDS**
TAIL NUMBER = N13245
SQUITTER ADDRESS = 3AC421 [16542041]
Press RUN to start

14 Radio Reply Frequency (ATC 601 Test 17):

Test Set verifies that UUT transmit frequency is 1090 MHz (+/- 3 MHz).

a FREQUENCY TEST - PASSED
FREQUENCY = 1092.30 MHz
Press RUN to start

b FREQUENCY TEST - FAILED
FREQUENCY = **1086.80 MHz**
Press RUN to start

15 MTL Difference (Receiver Sensitivity) (ATC 601 Test 19):

Test Set verifies that receiver sensitivity difference between Mode A and Mode C is less than or equal to 1.0 dB.

a MTL DIFFERENCE TEST - PASSED
MODE A MTL - MODE C MTL = 0.2dB
Press RUN to start

b MTL DIFFERENCE - FAILED
MODE A MTL - MODE C MTL = 1.1 dB
Press RUN to start

16 Power and MTL (ATC 601 Power Test):

Test Set verifies that UUT power output is between the following parameters:

48.5 dBm less than UUT ERP less than 57.0 dBm

UUT MTL = -73.0 dBm (+/- 4.0 dB) Test Set results are as follows:

NOTE: Power Test must be run at a distance established in Setup procedure. The minimum RF peak output power (ERP on Test Set) is at least 125 watts and maximum RF peak output power does not exceed 500 watts.

a POWER TEST

ERP (WATTS)	MTL (DbM)	STATUS
TOP AVG = 156	-73.4	PASSED
BOT AVG = 135	-74.3	PASSED
INSTANT = 146	-73.4	

Press RUN to start

b POWER TEST - BOTTOM ANTENNA

ANTENNA	ERP (dBm)	MTL (dBm)	STATUS
Bottom	53.0	-73.4	PASSED

Press RUN to start

(5) Accuracy Test

(a) Apply power to the Altitude Reporter, and the ATC Transponder Test Set. Set primary flight altimeter to 29.92 in hg.

(b) Allow a minimum of 15 minutes warm up time.

(c) The Transponder Test Set reading should match with flight altimeter reading, not with the static pressure system tester.

(6) Testing

Select ten or more evenly spaced altitude test points between sea level and the altitude designated in 3.6. Increase the vacuum, casuing the aircraft altimeter indicated altitude to increase. Approach each test point slowly. Tap the altimeter lightly before each reading to minimize friction effects. If a check point is missed, do not go back, go to the next point. For each test point check the aircraft altimeter dial reading at the encoding altimeter/digitizer transition point. (The transition point is the point at which the altimeter encoder readout displayed on the ATC-600A or equivalent test set, changes to the proper code for the test point).

(7) Accuracy Requirements

Accuracy requirements shall be as follows:

The altitude encoder shall transition to the selected test point within ±125 ft. at each test point, and within ±87 ft. at no less than 70 percent of the test points.

Example: Approaching the 6,000 foot transition point, the aircraft altimeter dial shall read 6,000 ±125 ft. (5,875 to 6,125 ft.) when the transition to the ±87 ft. (5,913 to 6,087 ft.) if the 6,000 foot transition point is one of 70% noted above.

If either the aircraft altimeter or the encoder fails the accuracy tests, replace the out-of-limits device and repeat the test.

(8) Post Test Cleanup

After testing is completed, the aircraft transponder switch and battery switch shall be placed in the off position and the Test Set disconnected. Reconnect the static system and test for leaks.

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GRIDS 5J24 THRU 6B24
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CHAPTER

35

OXYGEN

(SARATOGA II TC ONLY)

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CHAPTER 35

LIST OF EFFECTIVE PAGES

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CHAPTER 35 - OXYGEN

TABLE OF CONTENTS

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CREW / PASSENGER

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.)

CAUTION: 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.).

The following provides supplemental information for the servicing of the oxygen system. Major repairs to the oxygen system should be accomplished by an approved shop.

1. Description and Operation (See Figure 1.)

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.).

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 Avox Systems (previously Scott Aviation). Accordingly, Avox Systems, as well as your Piper Dealer's Service Advisor (DSA), should be contacted for information / procedures not covered herein.

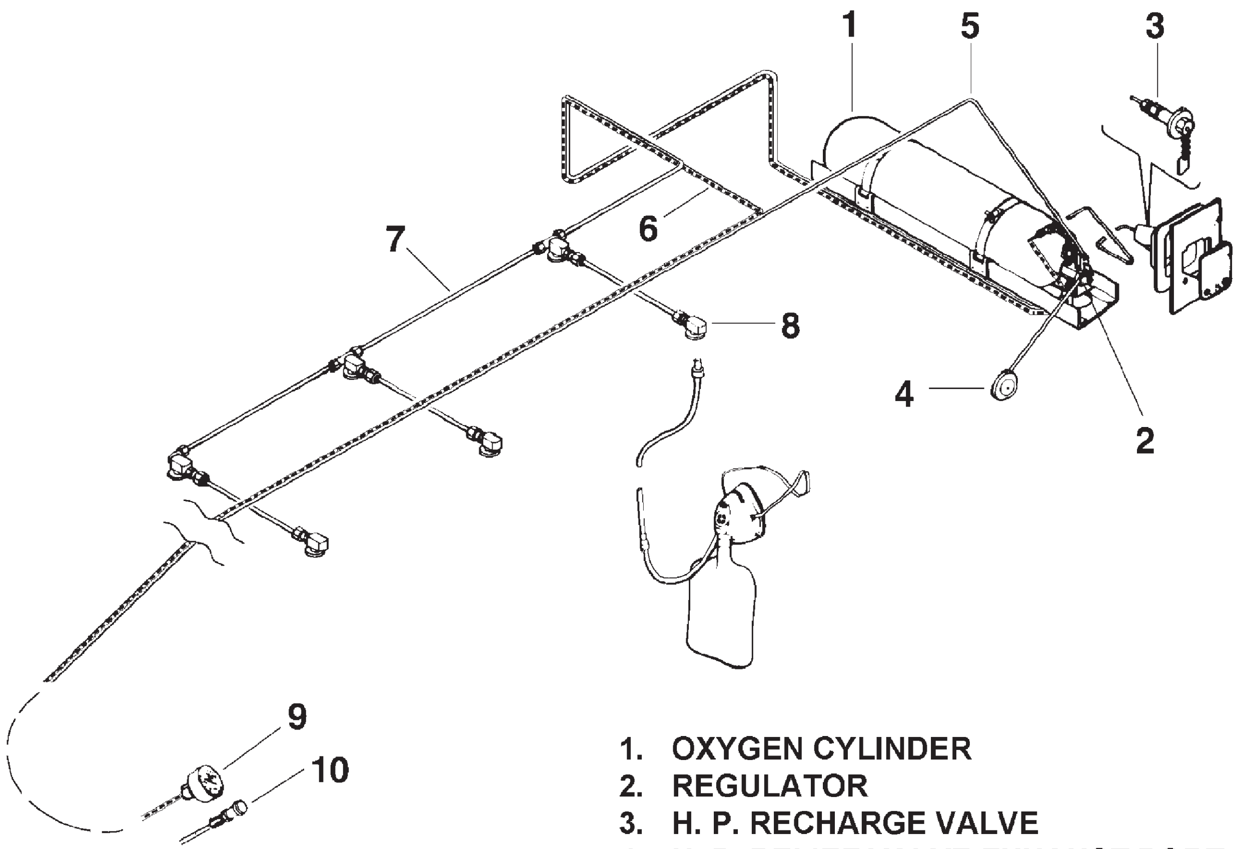
The oxygen system cylinder is installed in the tailcone, behind the baggage compartment, and is connected to an external recharge valve mounted to the left side of the fuselage, aft of FS 222.437. The low pressure (L.P.) feed line for the outlets is routed to the right side of the fuselage and then up 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-E 8162 or DOT-SP 8162, or Transport Canada SU 4237-127 or SU 9209) installed in these airplanes must be hydrostatically tested every five (5) 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.

2. Troubleshooting

See Chart 1.



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)

Fixed Oxygen System Installation
Figure 1

CHART 1
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.

3. Precautions

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.)

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 TEFLON TAPE THREAD SEALANT, BELOW.

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.

4. Inspection and Maintenance

(PIR-PPS60087, Rev. V.)

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 (Avox Systems) approved shop. The following material gives recommended inspection and maintenance information for the various parts of the oxygen systems.

NOTE: Oxygen cylinders are identified by the ICC or DOT identification stamped on the cylinder. The lightweight cylinder of composite construction (DOT-E 8162 or DOT-SP 8162, or Transport Canada SU 4237-127 or SU 9209) installed in these airplanes must be hydrostatically tested every five (5) 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.

A. Check the outlets for leakage both in the use and non-use condition and for leakage around an inserted connector. See Leak Tests, below.

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. System Flow Check

WARNING: THE FOLLOWING FLOW CHECK ALLOWS EXCESS OXYGEN TO FLOW INTO THE AIRFRAME. AVOID THE POTENTIAL FOR SPARK IGNITION BY NOT OPERATING ANY ELECTRICAL EQUIPMENT DURING THE TEST AND OBSERVE ALL SAFETY PRECAUTIONS RELATED TO OXYGEN HANDLING.

An operational check of the regulator can be accomplished as follows: (Refer to Figures 1 and 2.)

(1) Using the test pressure gauge (or equivalent) shown in Figure 2, connect the apparatus to the pilot's outlet in the overhead panel.

(2) Using the flow test apparatus (or equivalent) shown in Figure 2, connect the flow apparatus to the copilot's outlet.

(3) Connect additional flow test apparatus (or equivalent) to 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.

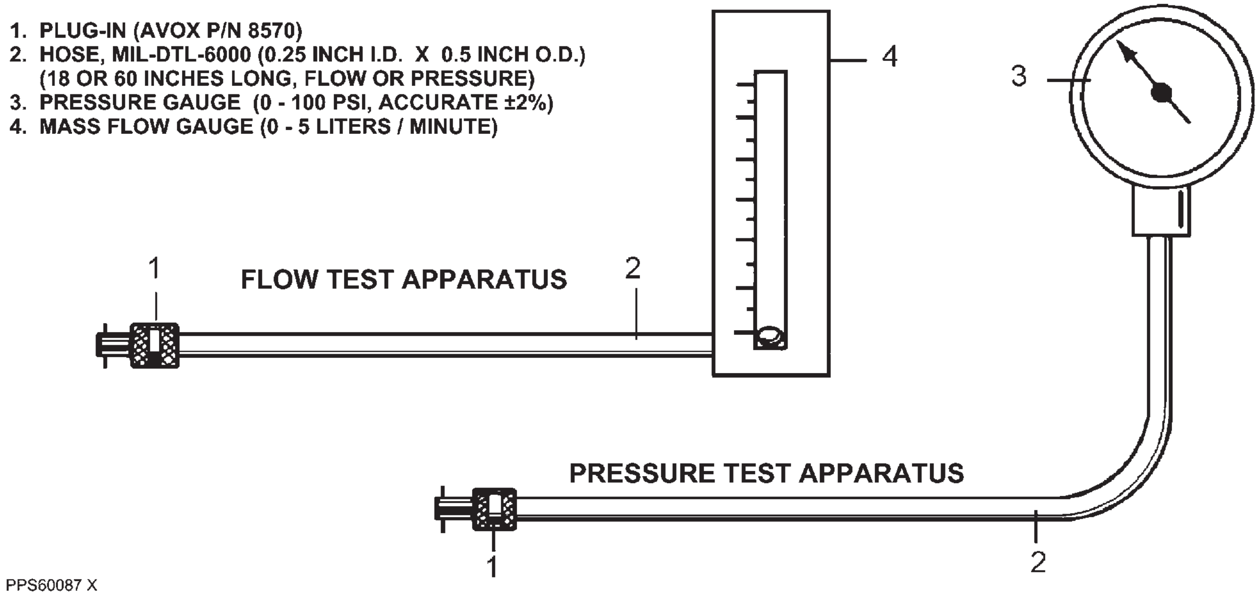
(4) Replace the test pressure gauge (or equivalent) at the pilot's outlet with a flow test apparatus (or equivalent) and check the pilot's outlet for flow. Similarly, exchange the flow test apparatus (or equivalent) at each of the other outlets with the pressure test apparatus (or equivalent) and check pressure at each outlet.

E. Check airframe logbook for last maintenance on oxygen system and perform as required per Chart 2.

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.

G. Any fittings, connectors, and tubes which have imperfect threads, pitted or disfigured cones, or other damage should be replaced.

H. Check plumbing for kinking, cracks, gouges, dents, deep scratches, or other damage. Replace as necessary.



Oxygen System Test Apparatus
Figure 2

CHART 2
FIXED OXYGEN SYSTEM COMPONENT LIMITS

Component	Inspection	Overhaul
Cylinder	Monthly [1]	Each 5 Years
Regulator	On Condition / Each Use [2]	Every 5 Years
Pressure Gauge	On Condition / Each Use [2]	Replace On Condition
High Pressure Lines	On Condition / Each Use [2]	Replace On Condition
Low Pressure Lines	On Condition / Each Use [2]	Replace On Condition
Outlets	On Condition / Each Use [2]	Replace On Condition
External Recharge Valve	On Condition / Each Use [2]	Replace On Condition [3]
Masks	On Condition / Each Use [2]	Every 5 Years

1. Visual inspection for dents, bulges, corrosion, or chafing.
2. Visual inspection in the normal course of use.
3. If the screen in front of valve is dirty, replace valve.

(PIR-Avox SIL-35-114)

I. Oxygen Lines Clearance Check

CAUTION: OXYGEN TUBES MUST NOT BE CLAMPED TO, OR SUPPORTED BY ELECTRICAL WIRE BUNDLES, HYDRAULIC, PNEUMATIC OR OTHER LINES.

Make sure to check the oxygen lines for proper clearance as follows: (Refer to Figure 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. (See Figure 3, Sketch C.)

(4) A minimum of 1/8 inch between tubing and structure adjoining the supporting clamp as shown in Figure 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 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 3, Sketch B.)

J. Perform any other oxygen system maintenance as required by AC43.13-1, latest revision.

K. Clean components as necessary per Cleaning and Purging under Oxygen System Components, below.

L. Leak Tests

Solution recommended for leak testing is Leak-Tec Formula #16-OX. Refer to the List of Consumable Materials for consumer information.

(1) 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.

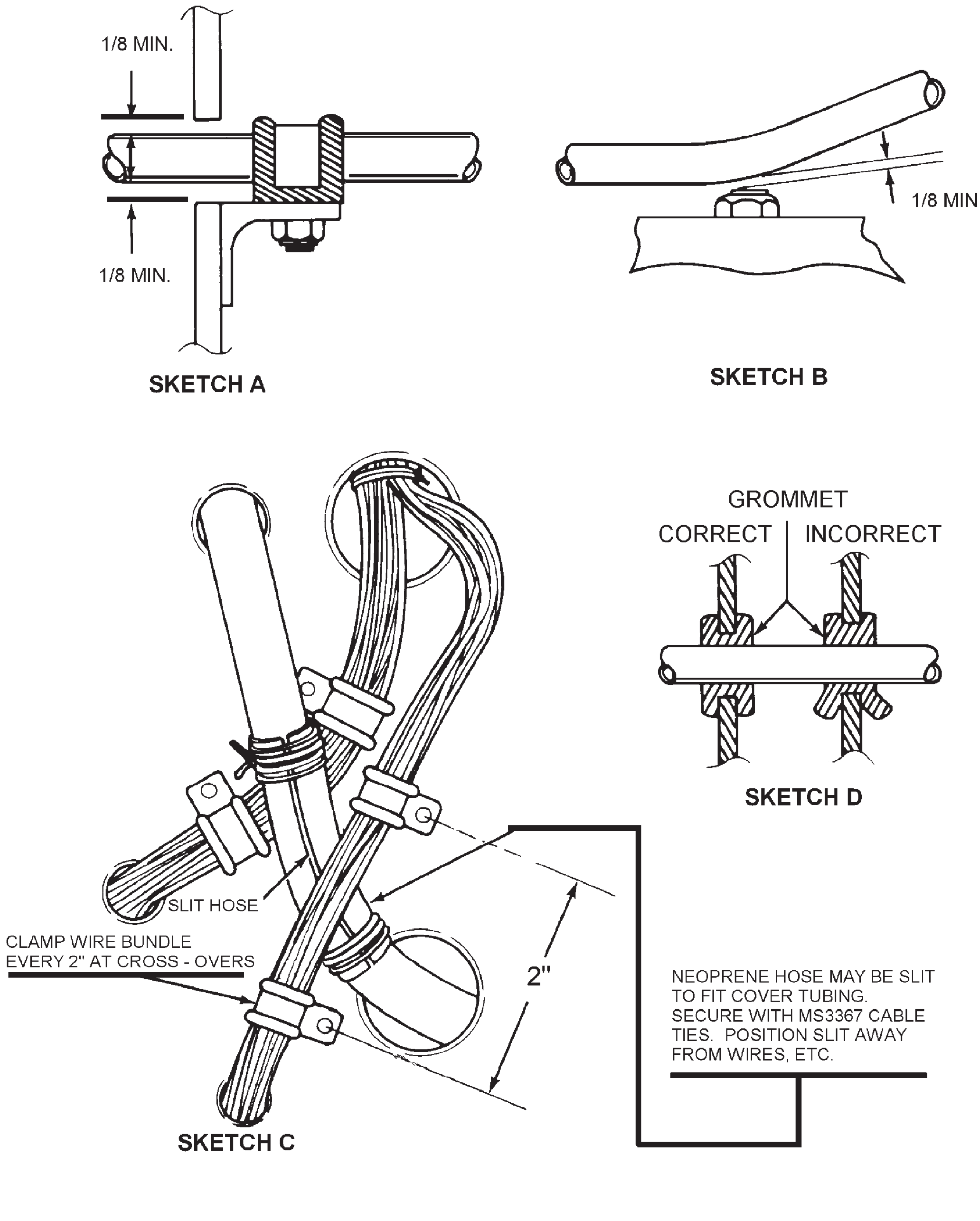
NOTE: Whenever a leak check is performed, all fitting connections as well as other questionable areas, should be inspected.

(2) Apply the leak detector solution to the test surface and watch for indication of leakage.

(3) Large leaks will produce bubbles immediately, but small leaks will form a white foam in 5 to 60 seconds.

(4) With outlets vacated of masks, connect a test pressure gauge to the copilot's outlet as described in System Flow Check, above.

(5) Adjust the regulator on the dry nitrogen cylinder for 100 psi and check for leakage at the outlets.



Oxygen Tubing Installation
Figure 3

(6) Correct any leaks and wipe off excess leak detector solution.

(7) Close the valve on the nitrogen gas tank and insert a plug-in (see Figure 2, Item 1) to relieve system pressure.

(8) Disconnect test gauge, plug-in, and nitrogen tank.

(9) If the oxygen cylinder is not to be hooked up or installed immediately, cap and cover the exposed fittings with new clean plastic bags. Temporarily support lines as needed to prevent damage. Make sure caps and coverings are as clean as possible.

5. Swageloc Fitting Installation (Refer to Figure 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.

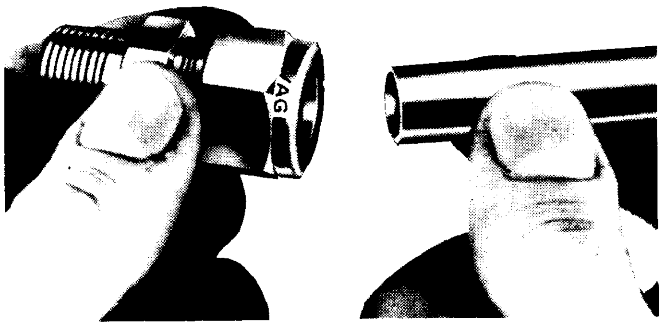
(b) Snug slightly with wrench.

6. Teflon Tape Thread Sealant

All male pipe (tapered) threads of the oxygen system should be sealed with 3M No. 547 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.

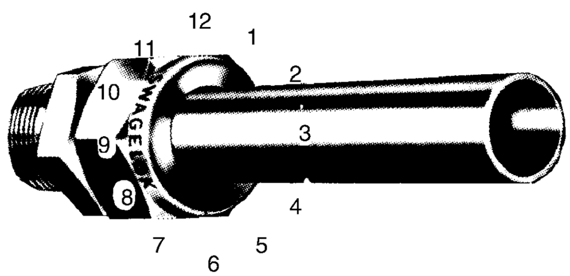


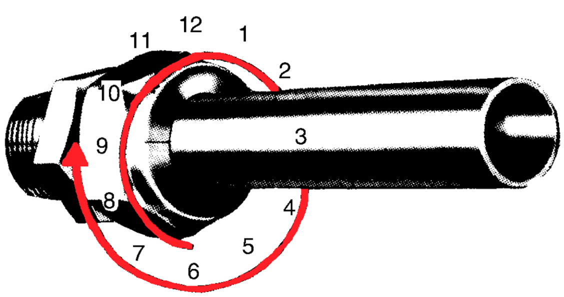
STEP 1

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.

Installation of Swageloc Fittings
Figure 4

7. Oxygen System Components

Keeping in mind the effect of compressed oxygen on materials, oxygen system components must be handled carefully. Ports on regulators, indicators, and other opened components must also be kept capped or plugged to prevent ingestion of foreign material. Adjustments or modifications should only be initiated under the auspices of the FAA, Piper, or Avox Systems (previously Scott Aviation).

NOTE: Replacement times for oxygen system components are shown in “Chart 2”.

A. Cleaning and Purging

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.

(1) 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.

(2) After cleaning, all tubing must be protected by caps, plugs and/or plastic bags.

(3) Before installation, make sure fitting, tube, and fixture threads are in good condition and that the cones do not exhibit pitting or disfigurement.

B. Oxygen Cylinder (Refer to Figure 5.)

(1) Removal

CAUTION: BEFORE ENTERING THE TAIL CONE, FIRST SUPPORT THE AIRCRAFT TAIL WITH A SUITABLE TAILSTAND.

From inside the aft cabin:

(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 feed/recharge line at regulator until pressure decreases and then remove line. Cap line immediately after removal.

(e) Disconnect high pressure relief line from regulator. Cap line immediately after removal.

(f) Disconnect low pressure line from regulator. Cap line immediately after removal.

(g) Loosen and open clamps securing oxygen cylinder to its shelf.

(h) 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.

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.

(i) Safety valve on cylinder in the OFF position.

(j) Remove cylinder from airplane.

(2) Installation

(a) If cylinder mounting shelf has been removed, reinstall it first.

(b) Position cylinder in airplane as shown in Figures 1 and 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.

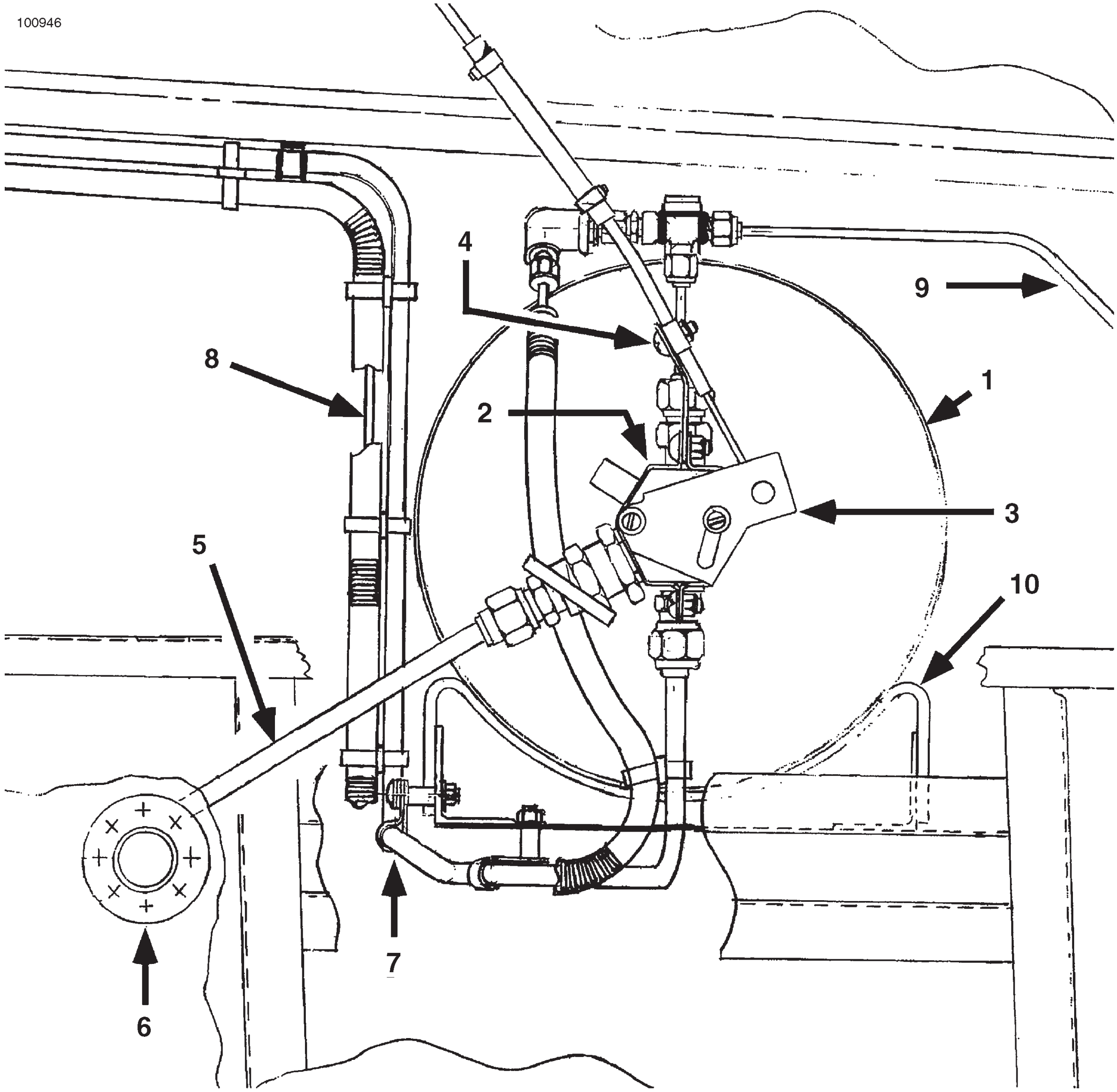
(d) Install and secure two cylinder hold down clamps.

(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.

NOTE: Apply teflon tape to all tapered male threads as advised above.

(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.



1. OXYGEN CYLINDER
2. REGULATOR VALVE
3. REGULATOR VALVE CONTROL ARM
4. RETAINING SCREW, REGULATOR VALVE CONTROL CABLE (PULL ON)
5. H. P. RELIEF LINE
6. H. P. RELIEF VALVE EXHAUST PORT
7. L. P. OUTLET FEEDER LINE
8. H. P. GAUGE FEEDER LINE
9. H. P. RECHARGE LINE
10. OXYGEN CYLINDER MOUNTING BRACKET

Oxygen Cylinder and Regulator Valve
Figure 5

(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.

C. Recharge Valve (See Figure 6.)

(1) Removal

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 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.

(2) Installation

NOTE: Apply teflon tape to all tapered male threads as described above.

(a) Insert valve assembly into hole in mounting dish.

(b) Align screw holes in valve mounting plate with those in mounting dish.

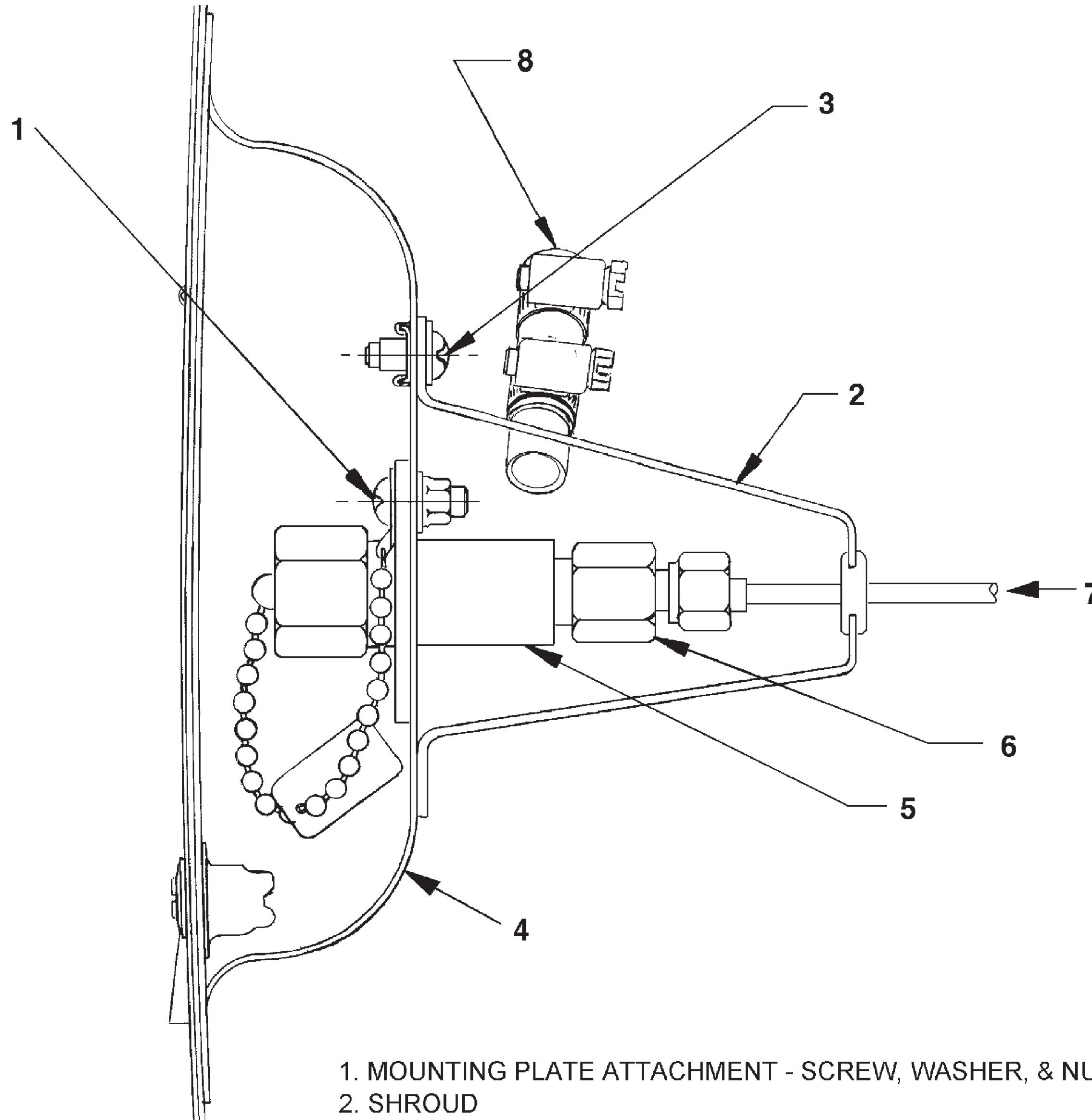
(c) Install the three mounting screws. Attach cap chain, with information plate attached, with one of the screws.

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 Oxygen Cylinder, Installation, above.



1. MOUNTING PLATE ATTACHMENT - SCREW, WASHER, & NUT (3 EA.)
2. SHROUD
3. SHROUD ATTACHMENT - SCREW, WASHER, & NUT (3 EA.)
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

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Oxygen System Recharge Valve Installation
Figure 6

D. 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.

(1) Removal

CAUTION: BEFORE ENTERING THE TAIL CONE. FIRST SUPPORT THE AIRCRAFT TAIL WITH A SUITABLE TAILSTAND.

(a) At the oxygen cylinder:

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.

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.

4 Carefully unscrew high pressure line until pressure decreases and then remove line. Cap line immediately after removal.

(b) At the instrument panel:

1 Disconnect high pressure line from gauge and cap immediately.

2 Remove two nuts from brass studs securing gauge to panel.

3 Remove gauge from pilot's side of instrument panel.

(2) Installation

(a) Insert pressure gauge into instrument panel.

(b) 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.

(c) Connect H. P. line to gauge.

(d) Connect H. P. line to cylinder.

(e) Inspect fittings that have been separated for leaks.

(f) Reinstall finished bulkhead in aft cabin, secure with screws.

(g) If used, remove tailstand from airplane.

E. Outlets

(1) Removal

(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.

(2) Installation

(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.

F. 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.

(1) Removal

CAUTION: BEFORE ENTERING THE TAIL CONE, FIRST SUPPORT THE AIRCRAFT TAIL WITH A SUITABLE TAILSTAND.

(a) Disconnect cable from regulator-control mechanism on cylinder:

1 Remove screws attaching finished bulkhead to fuselage bulkhead.

2 Remove finished bulkhead.

3 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.

4 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.

(b) Remove or drop overhead panel sufficiently to gain access to the control cable running the entire length of the cabin.

(c) 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.

(d) Remove retaining nut from rear of control knob.

(e) Pull cable from airplane through instrument panel. Retrieve retainer nut as cable bitter end pulls through the instrument panel.

(2) Installation:

(a) Insert cable through instrument panel. Slide retainer nut onto cable and secure control knob to instrument panel.

(b) Feed cable up through windshield centerpost and along H.P. Gauge feed line to cylinder.

(c) 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.

(d) 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.

(e) Bend core wire end for 1 1/2 to 2 turns with 0.188 (0.478 cm) inside diameter.

(f) 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

(g) Check operation, adjust as required.

(h) Replace and secure overhead panels in the cabin.

(i) Replace and secure finished bulkhead in aft cabin. If used, remove tailstand.

8. Refilling

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 3. The following are parameters to be followed for filling.

A. Only aviators breathing oxygen (MIL-0-27210) and appropriate filling equipment should be used to fill the system.

B. 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.

C. 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.

D. Attach service cart hose to recharge port. Fill the system at a rate not exceeding 200 psig per minute proceeding as follows:

(1) 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 3.

(2) When using a recharge unit consisting of one supply cylinder, slowly open the valve of the supply unit and allow the oxygen to transfer.

CHART 3
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.

(3) When using a recharge unit consisting of two or more supply cylinders (cascade storage system), it is recommended that the following procedure be used:

(a) Before opening any valves, check the pressure remaining in the airplane's oxygen cylinder. If it is still partly charged, note the pressure indicated on the cylinder gauge. Then open and close each valve on the cascade storage system and determine which cylinder has the lowest pressure. When found, if this cylinder has a pressure lower than the oxygen cylinder in the aircraft, do not attempt using it for filling; use the storage cylinder that has a pressure higher than the aircraft's cylinder but lower than the others.

(b) Open the valve on only the one storage cylinder with the lowest pressure. When the pressure indicated on the aircraft's oxygen gauge and charging gauge has become equal, close the valve of the storage cylinder, then go to the storage cylinder with the next higher pressure and repeat the procedure.

(c) If after using the last storage cylinder the aircraft's oxygen system is still not fully charged, a full storage cylinder should be put in place of a cylinder with the lowest pressure and used in the same manner.

(d) A good 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.

(e) It is not economical, even on a three or four cylinder cascade system, to begin recharging with oxygen at less than 300 psi pressure in the 300 cubic foot bank of cylinders. So use 300 cubic foot cylinders down to approximately 300 psi; then return for refilling. In two cylinder systems use to approximately 100 psi; then return for filling.

(4) 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 3 after the cylinder temperature stabilizes.

E. After detaching the service cart, cap hose and fittings to prevent contamination.

F. Perform a leak check of the high pressure lines and clean off solution afterwards. If solution is not properly cleaned off, corrosion may result.

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CHAPTER

37

VACUUM

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CHAPTER 37

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CHAPTER 37 - VACUUM

TABLE OF CONTENTS

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GENERAL

1. Description and Operation

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

NOTE: In HP S/N's 3246218 & up and TC S/N's 3257339 & up, when equipped with either the Avidyne Entegra EFIS or the Garmin 1000 EFIS, no vacuum system is installed.

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.

2. Troubleshooting

See Chart 1.

CHART 1 (Sheet 1 of 2)
TROUBLESHOOTING VACUUM SYSTEM

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 per instructions in 37-10-00.
	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.
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.
* HP S/N's 3246088 & up, TC S/N's 3257001 & up.		

CHART 1 (Sheet 2 of 2)
TROUBLESHOOTING VACUUM SYSTEM

Trouble	Cause	Remedy
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.
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 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 operation. 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.

* HP S/N's 3246088 & up, TC S/N's 3257001 & up.

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DISTRIBUTION

The following information is intended to aid in diagnosing vacuum system service symptoms on those components which are serviced by removal and replacement - I.E. - hoses, clamps, gyro filters, vacuum pumps, and vacuum regulators.

1. Hoses and Clamps

A. These items should be examined periodically and inspected carefully whenever maintenance activities cause hose disconnections to be made at the pumps, manifold, regulators, tube assemblies, 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, the vacuum pump(s) will suck in the loose particles and eventually ingest them. This can cause pump failure.

C. Replace old, hard, cracked or brittle hose. Sections of the inner layers may separate, causing pump failure.

D. Ensure hoses are clear and clean by blowing them out with shop air. Remove from aircraft as required.

CAUTION: DO NOT WIGGLE HOSE FROM SIDE TO SIDE DURING INSTALLATION. WIGGLING COULD CAUSE PARTICLES TO BE CUT FROM INNER WALL OF HOSE WHICH WOULD DAMAGE THE PUMP.

E. Where hose clearance is tight, making it difficult to reinstall it onto a fitting or barb, spray the fitting or barb with silicone. Let dry, then install hose by pushing it straight on.

CAUTION: WHEN REPLACING ANY OF THE THREADED FITTINGS, DO NOT USE PIPE DOPE, THREADLUBE, OR TAPE. PIPE DOPE / TAPE PARTICLES INGESTED BY THE VACUUM PUMP COULD CAUSE THE PUMP TO FAIL. USE ONLY SILICONE SPRAY, LETTING IT DRY BEFORE ASSEMBLY.

F. Hose clamps and fittings should be replaced when broken, damaged or corroded.

2. Gyro Filter

A. Gyro filters must be serviced on a scheduled basis, not to exceed 100 hours, and on condition.

B. The system installation employs a large central filter and differential vacuum gauge that continuously monitors filter condition while indicating vacuum readings.

NOTE: A decline in panel gauge reading indicates the filter is becoming clogged. Filters should be replaced when gauge reading declines; DO NOT adjust regulator(s).

3. Vacuum Pump

NOTE: In HP S/N's 3246218 & up and TC S/N's 3257339 & up, when equipped with either the Avidyne Entegra EFIS or the Garmin 1000 EFIS, no vacuum system is installed.

The 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.

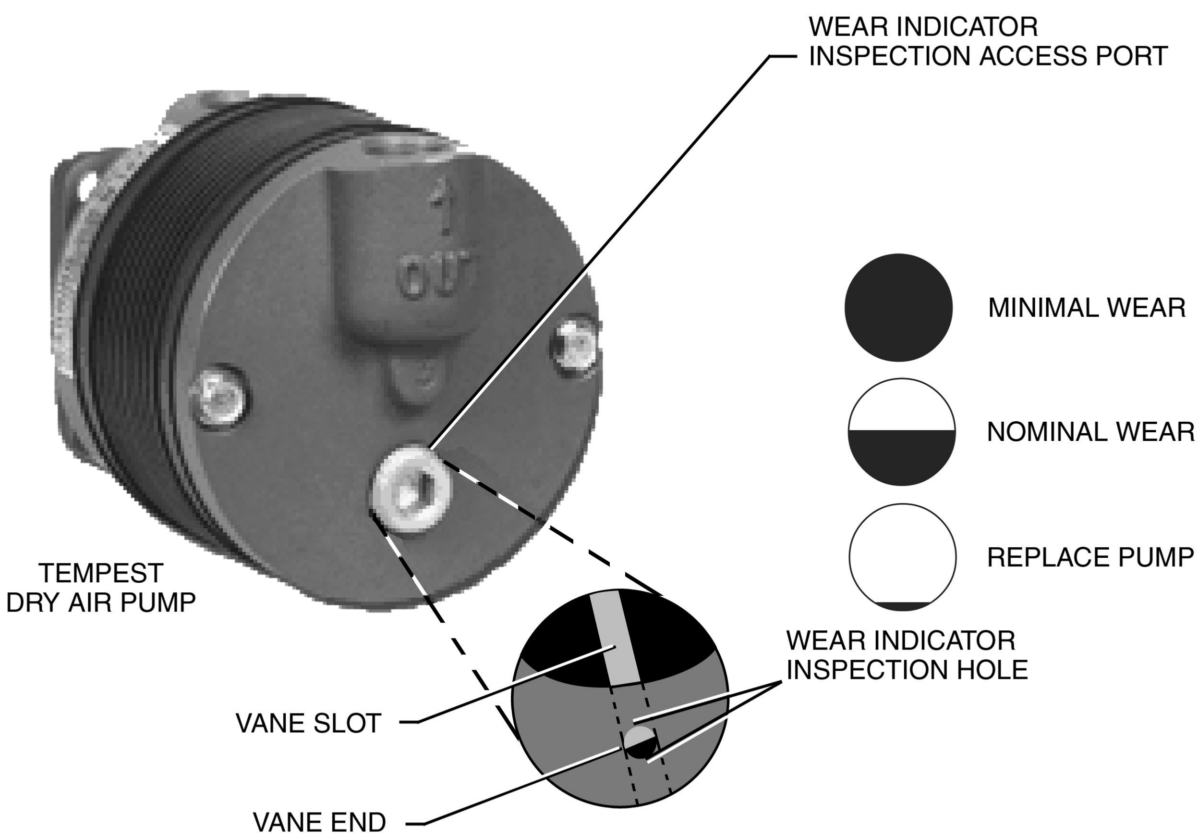
A. Inspection (See Figure 1.)

NOTE: Aero Accessories (Tempest) Dry Air (Vacuum) Pumps are installed in HP S/N's 3246205 & up and TC S/N's 3257298 & up, and as service replacements. The following inspection applies only to those pumps.

The Aero Accessories (Tempest) vacuum pumps feature a wear indicator inspection port on the back cover which allows direct observation of pump vane wear. Beginning at 500 hours time-in-service, and each 100 hours thereafter, remove the inspection port plug and observe vane wear as shown in Figure 1.

(1) As the vanes wear, they slide outboard in the vane slots in the rotor.

(2) When the portion of the vane that can be observed in the inspection hole covers approximately 1/8 TH of inspection hole, replace the pump.



Effectivity
3246205 and up
3257298 and up

Vacuum Pump Vane Wear Inspection
Figure 1

B. Removal

(1) Remove top portion of engine cowling, (Refer to Chapter 71.)

(2) Loosen hose clamp and remove hose from pump fitting.

(3) Remove four retaining nuts, lock washers and plain washers used to secure pump to engine; then remove pump.

C. Installation

NOTE: Change the vacuum system filter when installing a new pump.

(1) If required, install fittings on pump per Replacing Pump Fittings, below.

CAUTION: ONLY PUMP MOUNTING GASKET AUTHORIZED AND APPROVED FOR USE ON AIRBORNE VACUUM PUMP IS AIRBORNE GASKET B3-1-2, PIPER PART NUMBER 751-859. USE OF ANY OTHER GASKET MAY RESULT IN OIL SEEPAGE OR LEAKAGE AT MOUNTING SURFACE.

(2) Place pump gasket in its proper place and align spline on pump drive with spline on engine drive assembly.

(3) Secure pump to engine with four plain washers, lock washers and retaining nuts. Torque nuts 50 to 70 inch-pounds.

(4) Connect hoses to pump and secure with hose clamps.

(5) Reinstall engine cowling.

D. Replacing Pump Fittings

CAUTION: WHEN REPLACING ANY OF THE THREADED FITTINGS, DO NOT USE PIPE DOPE, THREADLUBE, OR TAPE. PIPE DOPE / TAPE PARTICLES INGESTED BY THE VACUUM PUMP COULD CAUSE THE PUMP TO FAIL. USE ONLY SILICONE SPRAY, LETTING IT DRY BEFORE ASSEMBLY.

(1) Before installing any fittings on pump, check for any external damage. A pump that has been damaged or dropped should not be installed.

CAUTION: DO NOT APPLY VISE PRESSURE TO OUTSIDE DIAMETER OR OVERALL LENGTH OF PUMP.

(2) When a vise is used to hold pump while installing fittings, suitable caution must be exercised to avoid pump damage. Square mounting flange must be held between soft wood blocks and only at right angles to vise jaws. Use only enough vise pressure to hold pump firmly.

(3) The ports of AIRBORNE pumps have been treated with a dry film lubricant and AIRBORNE fittings are cadmium plated thus eliminating any need for thread lubricants. If thread lubricant is required, use only a silicone spray. Apply sparingly to external threads of fittings only and let dry before assembly.

4. Vacuum Regulator (Refer to 39-20-00 Figure 1 Sheet 14)

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.

A. Service Tips

(1) Vacuum regulators seldom needs replacement. Symptoms that suggest replacement are:

(a) Chatter as indicated by rapid fluctuation of vacuum gauge needle or an audible sound.

(b) Non-repeatability of vacuum gauge reading when panel gauge is not suspect or has been checked against a known test gauge (cruise RPM only).

(2) 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.

(3) 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 the vacuum regulator should be changed. Observe usual precautions for maintaining system cleanliness to avoid pump failure from ingested debris.

B. Adjustment

(1) 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.

(2) Start engine, after allowing time for warm-up, run engine at 2000 rpm

(3) 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.

(4) Restart engine and repeat check.

(5) After system pressure has been adjusted to these recommended settings, replace protective cap or retighten locknut, whichever applies to type of valve installed.

C. Removal

(1) Disconnect and cap the three (3) lines and remove mounting nut.

(2) Remove valve from airplane.

D. Installation

(1) Position regulator in airplane and secure with mounting nut. Uncap and connect the three (3) lines.

(2) Check complete vacuum system for proper operation.

5. Auxiliary Vacuum Pump (Optional) (Refer to 37-10-00 Figure 2, and 91-37-20 Figure 2.)

The auxiliary vacuum pump installation has a 28 Vdc pump motor and relay. The VAC OFF AUX ON switch is located on the instrument panel in the Saratoga II HP/TC.

CAUTION: REPLACE AUXILIARY VACUUM PUMP/MOTOR ASSEMBLY WITH A NEW, WORKING UNIT, OR SEND UNIT TO VENDOR FOR REPAIR. FOR PROPER OPERATION, IT IS IMPORTANT THAT THE PUMP/MOTOR ASSEMBLY BE REPAIRED BY TRAINED PERSONNEL.

The auxiliary vacuum pump mounted, on the firewall, is a backup source to operate the gyro flight instruments if the engine driven pump fails. A 20 amp circuit breaker in the system protects the pump motor circuit. A 5 amp circuit breaker protects the annunciator light switch.

A. Operational Check, Engine Off

CAUTION: VERIFY ALL ELECTRICAL EQUIPMENT IS OFF BEFORE BEGINNING ENGINE OFF OPERATIONAL CHECK.

CAUTION: RUN AUXILIARY PUMP FOR ONLY A SHORT PERIOD OF TIME. EXCESSIVE TIME OF OPERATION WEAKENS BATTERY TO AN UNRELIABLE CHARGE LEVEL.

(1) Select battery master switch on. Check that VAC OFF annunciator illuminates.
(2) Press VAC OFF/AUX ON annunciator switch. Check that AUX ON annunciator lights, and VAC OFF annunciator extinguishes. Check that the vacuum gauge reads between 4.8 and 5.2 in. hg.
(3) Press VAC OFF/AUX ON annunciator switch to cycle it to the off position. Check that AUX ON annunciator goes out, and VAC OFF annunciator illuminates.
(4) Select battery master switch off.

B. Removal

WARNING: VERIFY BATTERY MASTER SWITCH IS OFF.

WARNING: COVER AUXILIARY VACUUM PUMP SWITCH ON THE INSTRUMENT PANEL WITH AN INOP PLACARD, IF A REPLACEMENT AUXILIARY PUMP/MOTOR ASSEMBLY IS NOT INSTALLED BEFORE NEXT FLIGHT.

CAUTION: THE AUXILIARY VACUUM PUMP AND MOTOR COMPRISE A SEALED ASSEMBLY AND MUST BE REMOVED AS ONE ASSEMBLY.

CAUTION: THE ELAPSED TIME INDICATOR IS MATCHED TO THE PUMP/MOTOR ASSEMBLY AND MUST BE REMOVED AND REPLACED WITH THE PUMP/MOTOR ASSEMBLY.

(1) Remove top engine cowling.
(2) Disconnect and mark hoses from pump/motor assembly.
(3) Disconnect and mark electrical leads at terminals on pump/motor assembly.
(4) Loosen band clamps and remove pump/motor assembly from airplane.
(5) Locate elapsed time indicator under instrument panel; disconnect and mark electrical leads.

CAUTION: INSULATE AND SECURE LEADS REMAINING IN AIRPLANE IF A REPLACEMENT ELAPSED TIME INDICATOR IS NOT INSTALLED IMMEDIATELY.

(6) Remove elapsed time indicator.
(7) If auxiliary vacuum pump will not be installed immediately, place protective covers over open end of vacuum lines, insulate all electrical leads relative to the auxiliary vacuum system, and install top engine cowling.

C. Installation

WARNING: BE SURE BATTERY MASTER SWITCH IS OFF.

CAUTION: NEVER INSTALL A PUMP THAT HAS BEEN DAMAGED OR DROPPED.

CAUTION: THE ELAPSED TIME INDICATOR IS MATCHED TO THE PUMP/MOTOR ASSEMBLY AND MUST BE REMOVED AND REPLACED WITH THE PUMP/MOTOR ASSEMBLY.

(1) Connect elapsed time indicator to two-pin connector on the leads coming from the back of the switch.

CAUTION: DO NOT LOCATE ELAPSED TIME INDICATOR ON OR NEAR AVIONICS OR OTHER EQUIPMENT THAT GENERATES A SIGNIFICANT AMOUNT OF HEAT.

(2) Secure elapsed time indicator to wire harness with a strap; check elapsed time indicator can be easily inspected.

(3) Secure excess lead wire.

(4) Remove top engine cowling.

(5) Mount pump motor assembly to bracket with band clamps. Do not tighten clamps.

NOTE: Rotate pump/motor assembly within clamps for easier installation.

(6) Attach and secure electrical leads to terminals on pump motor assembly.

(7) Measure hoses to obtain proper length. Cut hoses if necessary.

(8) Attach and secure hoses to ports on pump/ motor assembly.

(9) Position pump/motor assembly per Figure 2.

(10) Tighten clamps.

(11) Install top engine cowling.

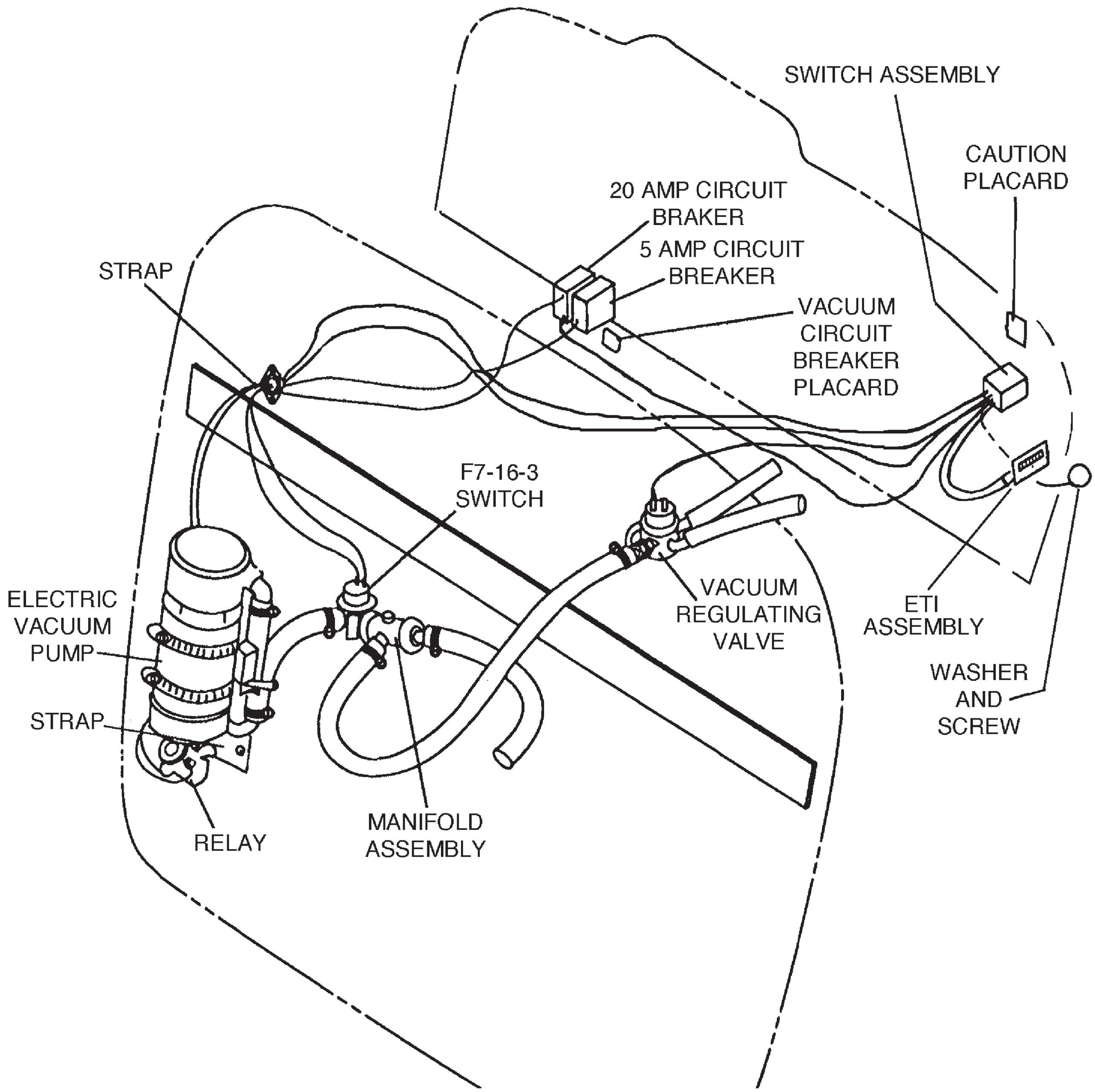
D. Replacing Auxiliary Pump Fittings

CAUTION: DO NOT PLACE PUMP OR MOTOR HOUSING IN VISE. HOLD BY HAND WHEN REMOVING OR TIGHTENING FITTINGS.

CAUTION: DO NOT USE PIPE TAPE, THREAD DOPE, HYDROCARBON OIL, OR GREASE, AS THESE COULD CONTAMINATE THE PUMP AND CAUSE MALFUNCTION.

CAUTION: DO NOT OVER TIGHTEN FITTINGS. PUMP CASE AND PORT DAMAGE COULD RESULT.

CAUTION: CHECK FOR EXTERNAL DAMAGE BEFORE INSTALLING ANY FITTINGS ON PUMP.



Auxiliary Vacuum Pump Installation (Optional)
Figure 2

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INDICATING

The following information is intended to aid in diagnosing vacuum system service symptoms on those components which are serviced by removal and replacement - I.E. - vacuum gauges and switches.

1. Vacuum Gauge

   A. Service Tips

      (1) 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.

      (2) 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.

      (3) Visual examination of gauge performance should cover the following steps:

         (a) 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.

         (b) A slight overshoot during engine startup, not to exceed half an inch of mercury, is normal and is not cause to replace gauge.

         (c) 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.

         (d) At 1200 rpm, vacuum gauge reading should be more than four inches of mercury.

   B. HP S/N's 3246001 thru 3246087 only.

      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.

   C. HP S/N's 3246088 & up and TC S/N's 3257001 & up.

      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.

   D. Removal and Installation

      See Face-Mounted Instruments, 39-10-00.

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

39

ELECTRICAL / ELECTRONIC PANELS

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CHAPTER 39

LIST OF EFFECTIVE PAGES

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CHAPTER 39 - ELECTRICAL / ELECTRONIC PANELS

TABLE OF CONTENTS

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INSTRUMENT AND CONTROL PANELS

1. General

A. Face-Mounted Instruments

Most instruments are face-mounted and secured to the instrument panel by screws from the front of the panel. 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 (PIR-PPS60237, Rev. New.)

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.

2. Circuit Breaker Panel

Circuit breakers are installed in the lower right instrument panel and are of the single hole mounting, pushbutton type, with manual reset.

Should a circuit breaker be replaced or added, exercise extreme caution ensuring the breakers are in proper mechanical alignment, any insulators that are called out are installed correctly, and all electrical wiring and connections meet aviation standards. Do not deviate from the parts manual requirements when replacing circuit breakers.

NOTE: This type of circuit breaker can be used as a method of turning a system on and off.

A. Removal

(1) Disconnect negative (ground) battery cable.

(2) Remove knurled nut from circuit breaker face plate on front of instrument panel.

(3) From behind instrument panel, disconnect electric bus bar from circuit breaker.

(4) From behind instrument panel, remove circuit protector from instrument panel.

NOTE: Record placement of electrical leads to aid installation.

(5) Disconnect electrical connections fastened with screws to circuit breaker.

B. Installation

(1) Check circuit breaker amperage is correct.

(2) Connect electrical leads to their proper screws on new breaker and secure.

(3) From behind instrument panel, insert circuit protector into its proper hole on instrument panel.

(4) From behind instrument panel, install electric bus bar to circuit breakers.

(5) Reconnect negative (ground) battery cable.

3. 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 are used in the instrument panel.

(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.

4. Linear Modular Connectors (LMD/LMS)

Linear Modular Connectors (LMD/LMS) are used in some instrumentation and avionics installations to simplify assembly and reduce production costs. Special tools are needed to remove some modules in some installations. See Amphenol / Pyle publication LM-300 (LM-300-1) available from:

http://www.amphenol-aerospace.com/ServiceInstructions.asp

5. EMI and RFI Check (PIR-PPS65119, Rev A.)

A. Background

ElectroMagnetic Interference (EMI) and Radio Frequency Interference (RFI) are a growing concern with the installation of advanced digital avionics. The following test procedure is recommended before return-to-service each time any electrical / avionics work is performed.

B. Procedure

(1) Position the aircraft at least 50 yards from buildings or any other large structures.
(2) Ensure all aircraft closeout panels (excluding interior trim panels) and engine cowling are installed on the aircraft being tested.
(3) With the aircraft running and all avionics, exterior lights and equipment ON, verify that:
 (a) There are no unusual needle or display fluctuations on any display or gauge;
 (b) There is no objectionable background noise in the headsets.
 (c) For troubleshooting purposes, if either is present, systematically turn OFF equipment until the offending system is identified.
(4) RFI interference is typically generated by energy from the aircraft communication radios bouncing around the airframe. Verify that transmitting on the communication system does not cause RFI interference by performing the following test on each communication system.
 (a) On each of the following frequencies key the microphone for 3 to 5 seconds:

121.150 MHZ	127.000 MHZ
131.250 MHZ	121.175 MHZ
121.200 MHZ	131.275 MHZ
123.000 MHZ	131.300 MHZ

 (b) Verify that this does not cause any unusual needle or display fluctuations on any display or gauge.

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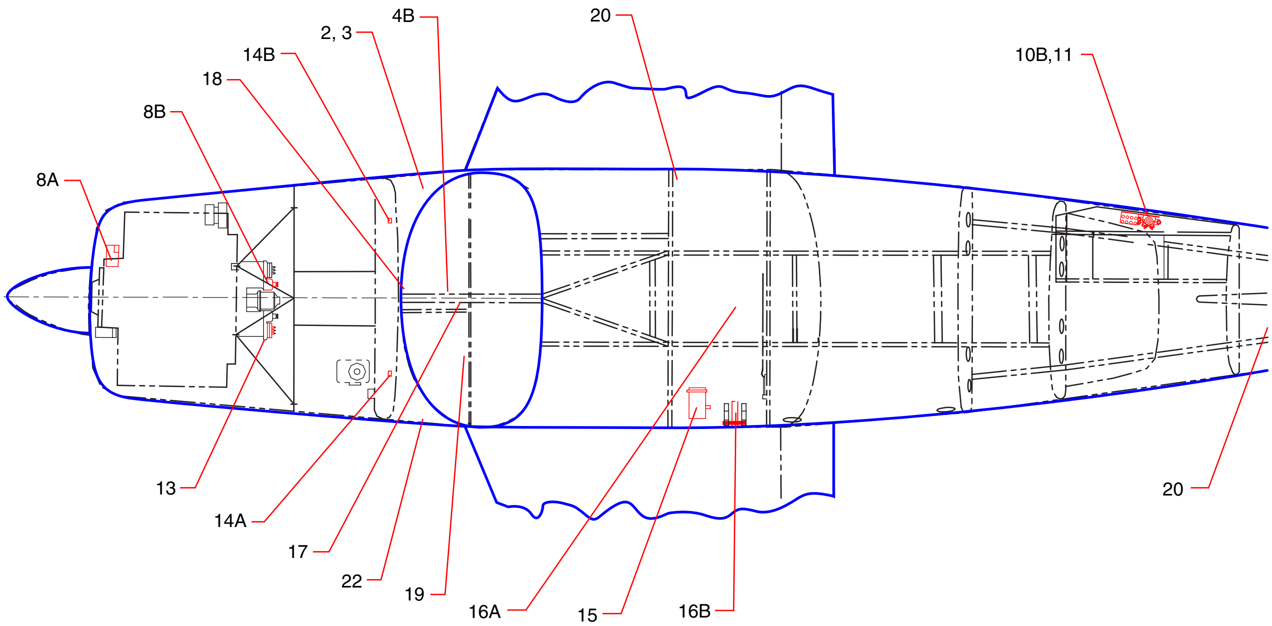
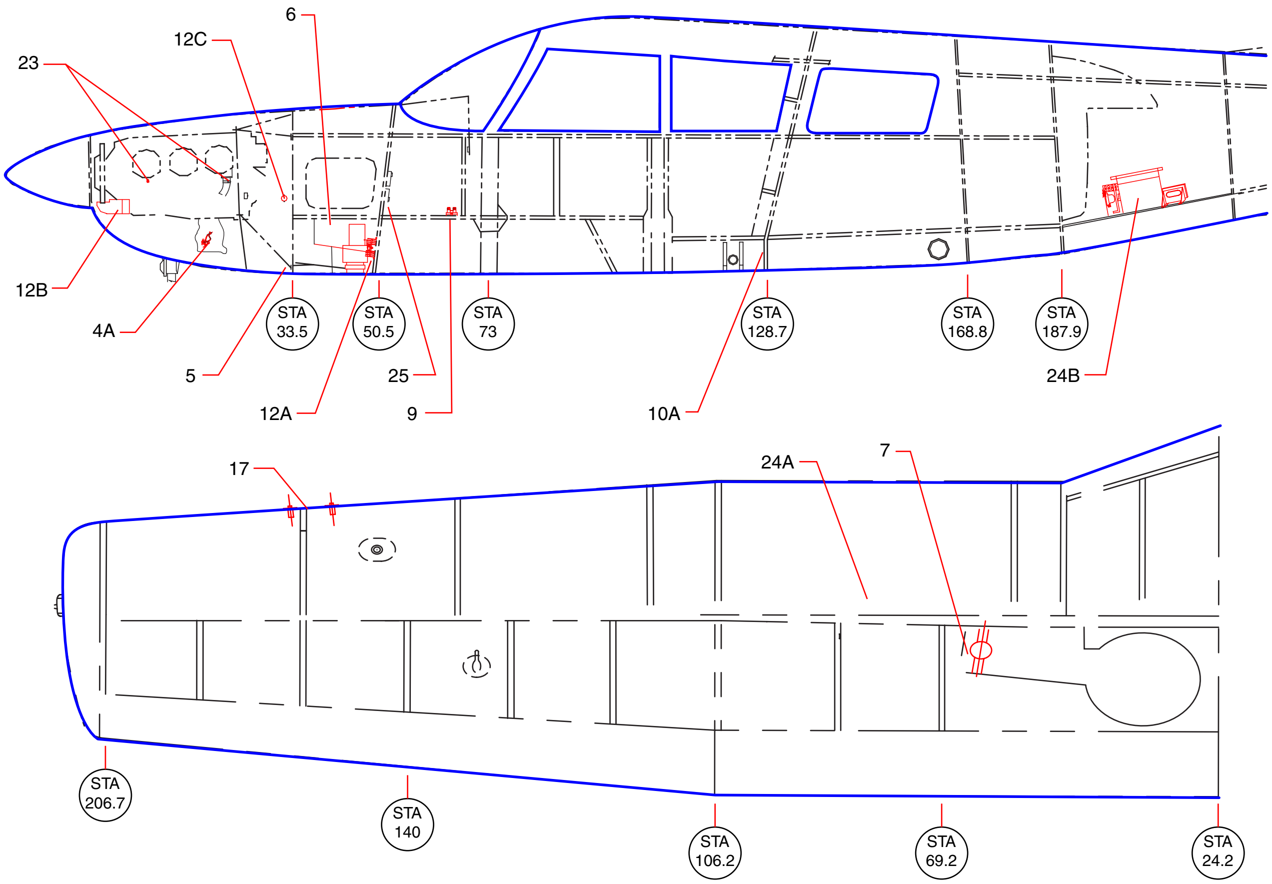
ELECTRICAL & ELECTRONIC EQUIPMENT

The following illustrations depict the location and installations of various electrical/electronic components. Refer to Figure 1, Sheet 1 on the following page for Fuselage and Wing Location Guide.

Index

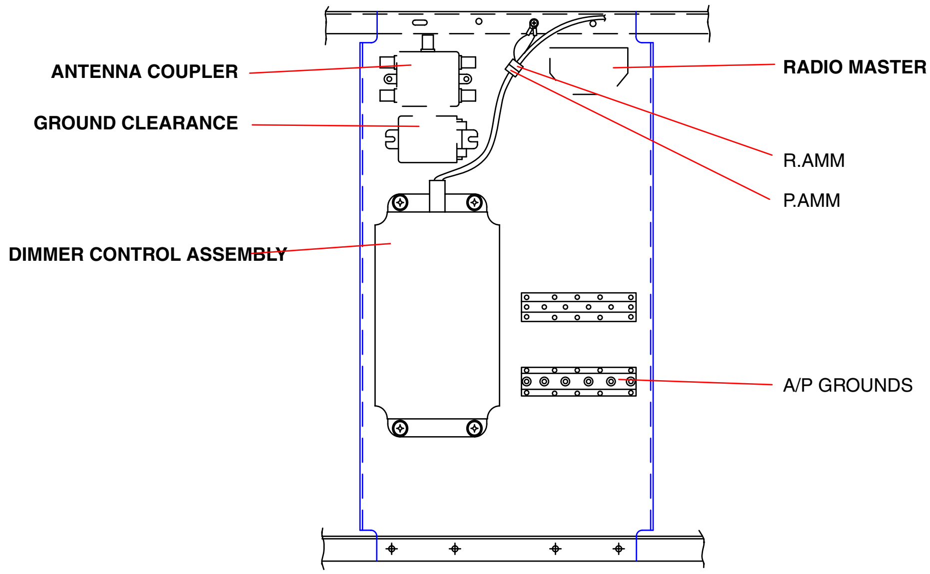


NOTE: ITEM NUMBERS REFER TO THE SHEET NUMBER OF FIGURE 1. LETTERS REFER TO VIEW.



Electrical/Electronic Component Locator
Figure 1 (Sheet 1 of 25)

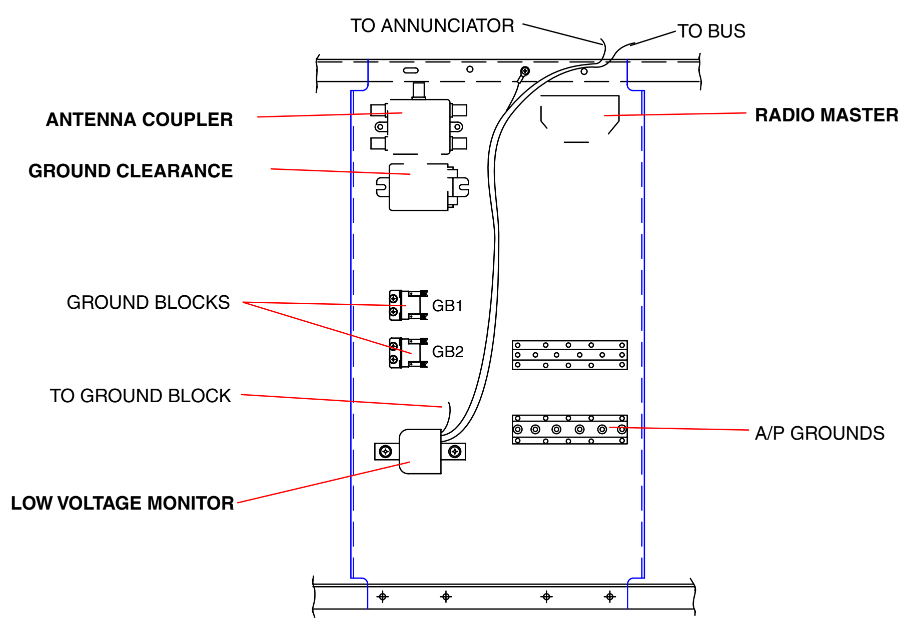
85295 2.0 F
85455 2.0 G



S/N'S 3246001 thru 3246087

UNDER INSTRUMENT PANEL
RIGHT SIDE, LOOKING OUTBOARD

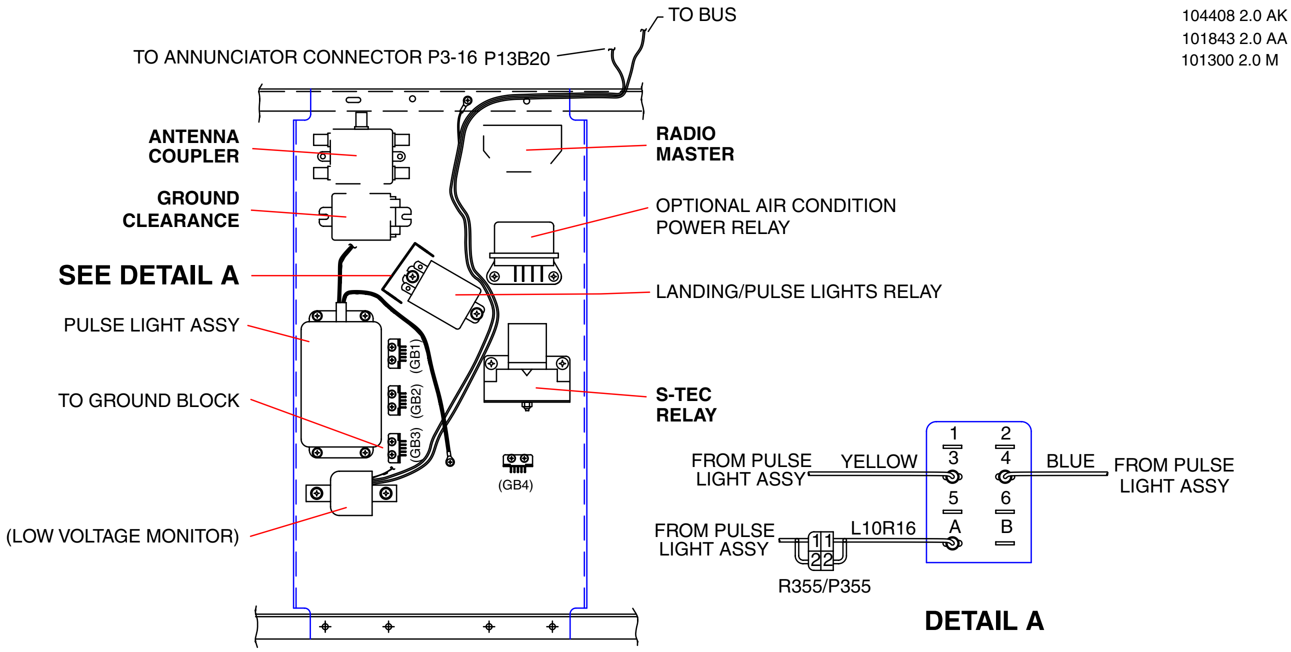
100838 2.0 P



**S/N'S 3246088 thru 3246125;
AND, 3257001 thru 3257075**

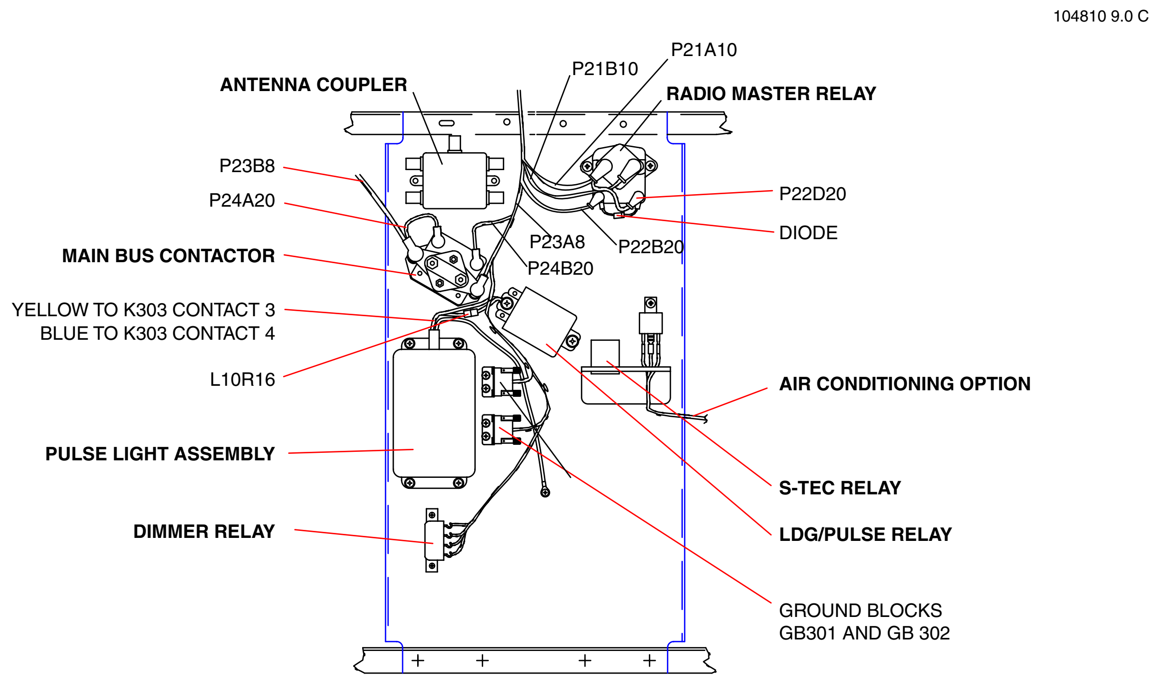
UNDER INSTRUMENT PANEL
RIGHT SIDE, LOOKING OUTBOARD

Electrical/Electronic Component Locator
Figure 1 (Sheet 2 of 25)



S/N'S 3246126 THRU 3246244;
AND, 3257076 THRU 3257454 LESS 3257447

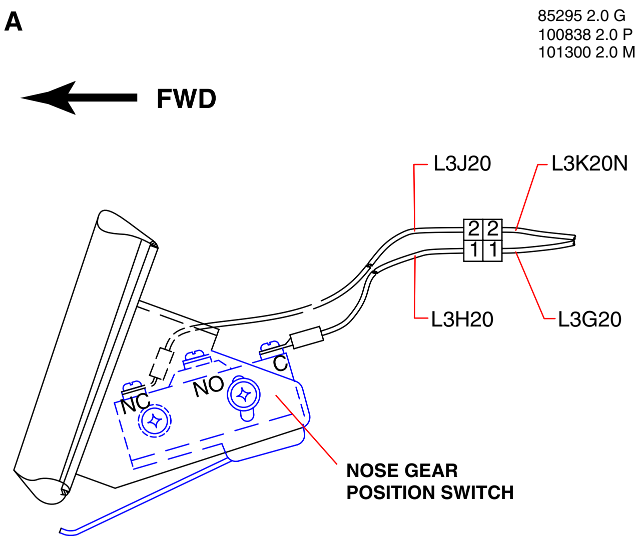
UNDER INSTRUMENT PANEL
RIGHT SIDE, LOOKING OUTBOARD



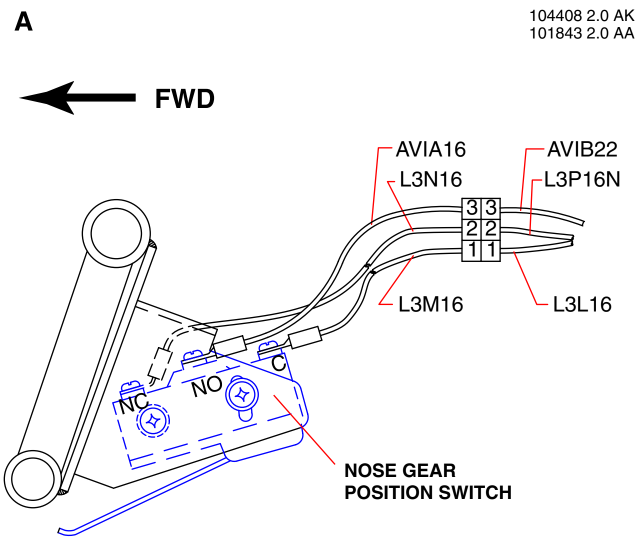
S/N'S 3257447, AND 3257455 AND UP

UNDER INSTRUMENT PANEL
RIGHT SIDE, LOOKING OUTBOARD

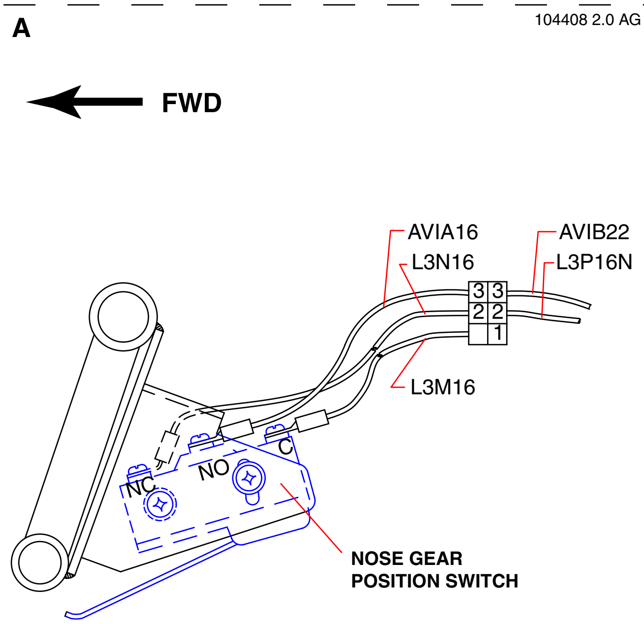
Electrical/Electronic Component Locator
Figure 1 (Sheet 3 of 25)



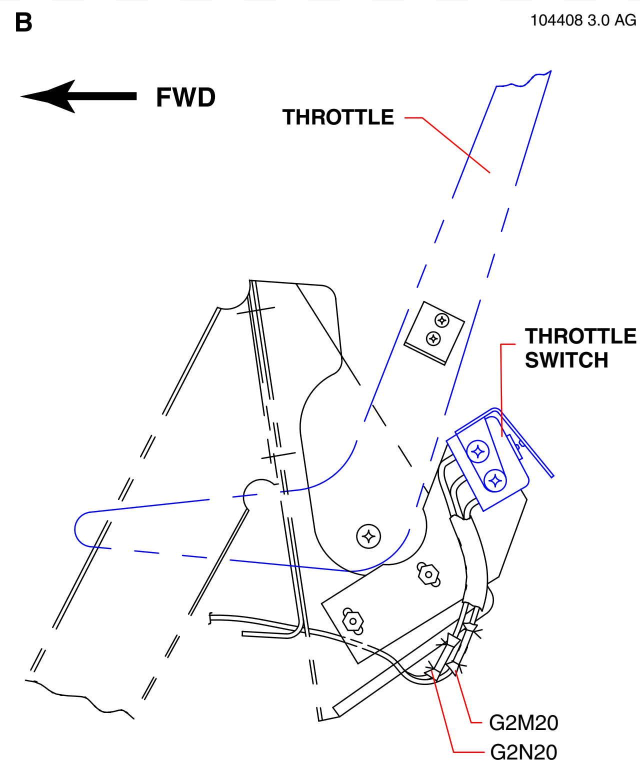
S/N'S 3246001 thru 3246181;
AND, 3257001 thru 3257198



S/N'S 3246182 THRU 3246224,
3246225 THRU 3246231 WITH AVIDYNE ENTEGRA,
AND, 3246232 THRU 3246244; AND,
3257199 THRU 3257365,
3257366 THRU 3257385 WITH AVIDYNE ENTEGRA,
AND, 3257386 THRU 3257454, LESS 3257447

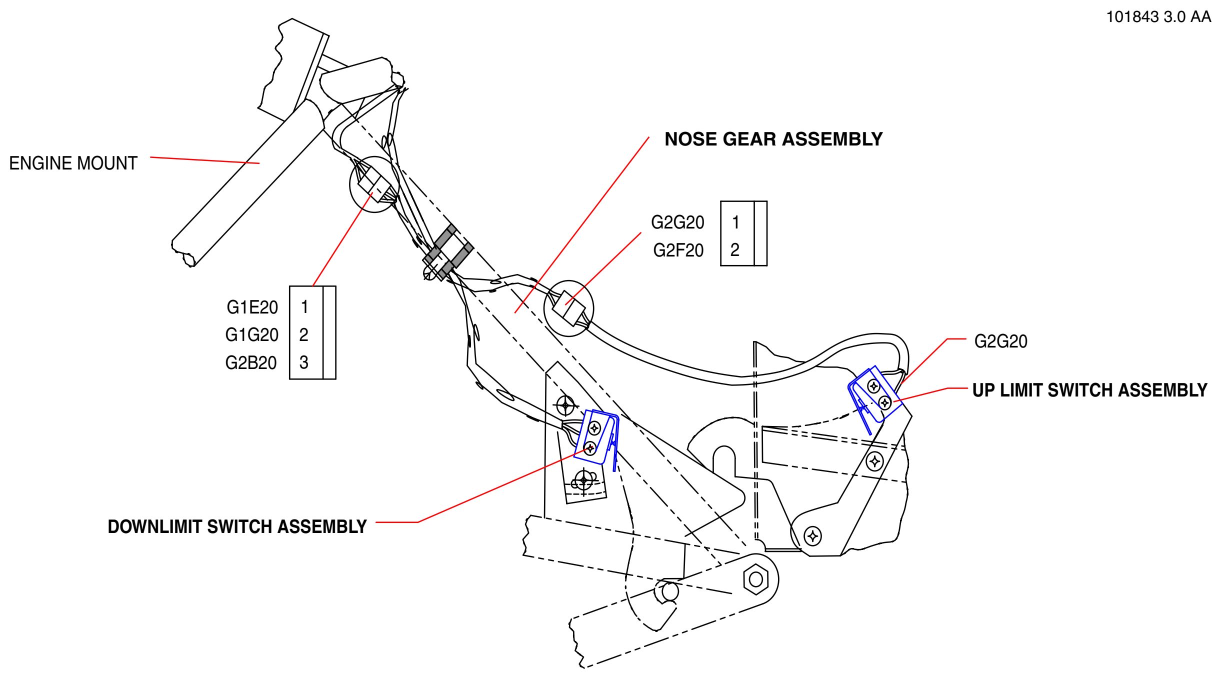


S/N'S 3246225 THRU 3246231 WITHOUT AVIDYNE ENTEGRA;
AND, 3257366 THRU 3257385 WITHOUT AVIDYNE ENTEGRA ONLY



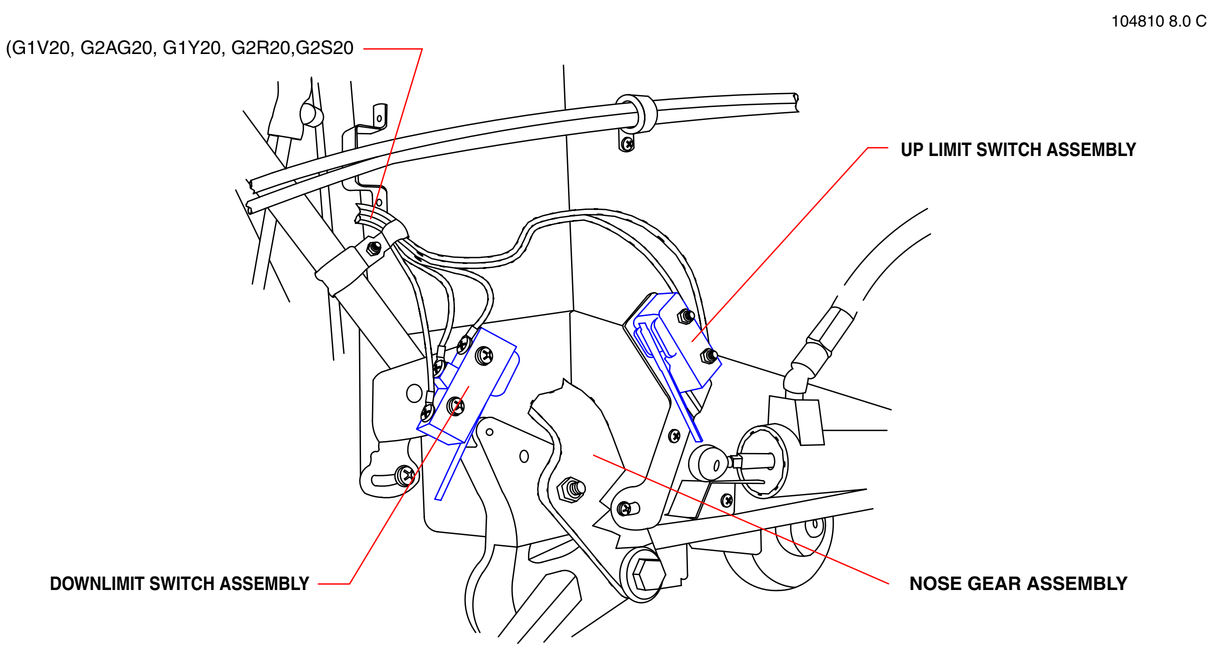
S/N'S 3246001 AND UP;
AND, 3257001 thru 3257454, LESS 3257447

Electrical/Electronic Component Locator
Figure 1 (Sheet 4 of 25)



S/N'S 3246001 THRU 324644; AND, 3257001 THRU 3257447 LESS 3257256

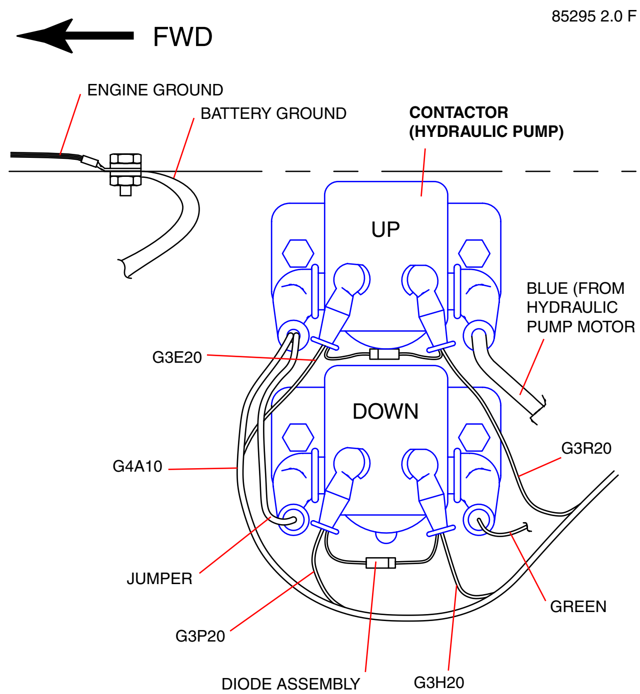
RIGHT SIDE OF WHEEL WELL LOOKING OUTBOARD



S/N'S 3257447, 3257455 AND UP

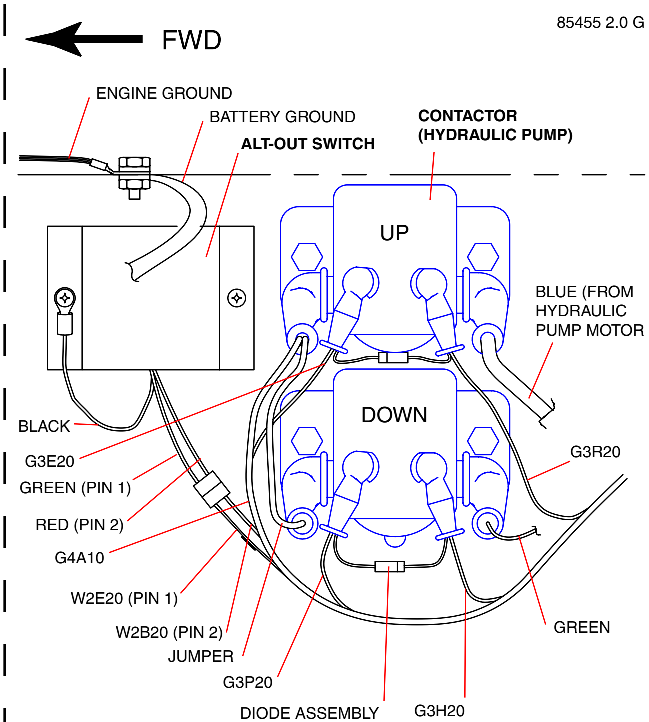
LEFT SIDE LOOKING INBOARD

Electrical/Electronic Component Locator
Figure 1 (Sheet 5 of 25)



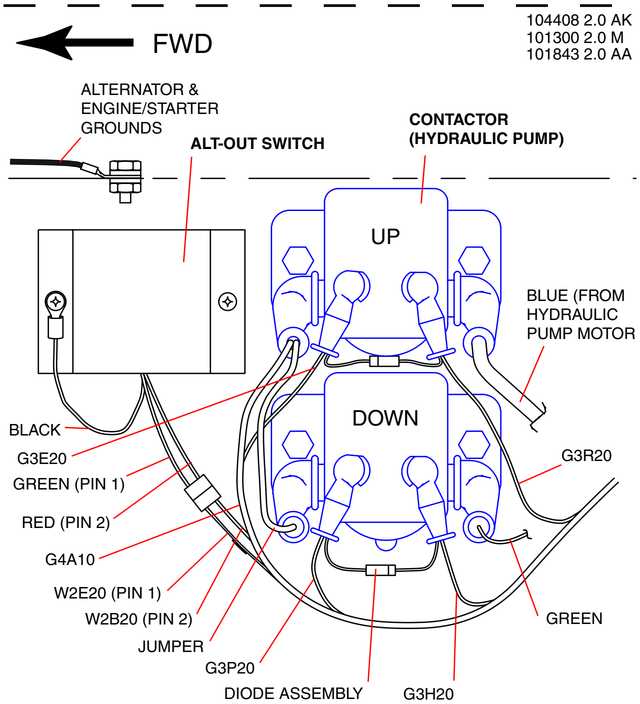
S/N'S 3246001 THRU 3246017

LEFT SIDE LOOKING INBOARD



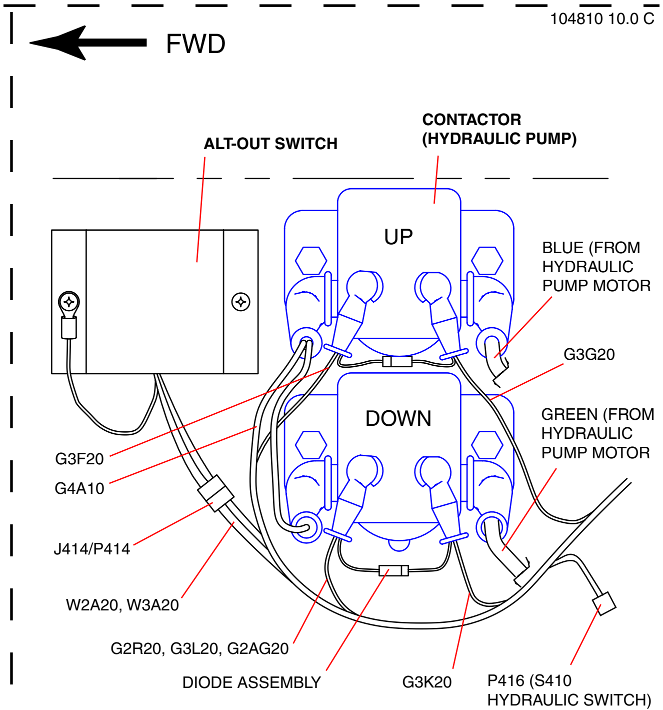
S/N'S 3246018 THRU 3246087

LEFT SIDE LOOKING INBOARD



S/N'S 3246088 THRU 3246244; AND, 3257001 THRU 3257454, LESS 3257447

LEFT SIDE LOOKING INBOARD

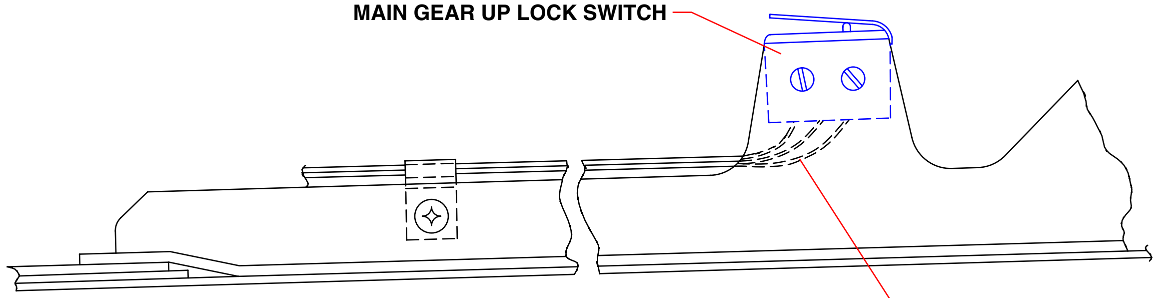


S/N'S 3257455 AND UP; AND, 3257447

LEFT SIDE LOOKING INBOARD

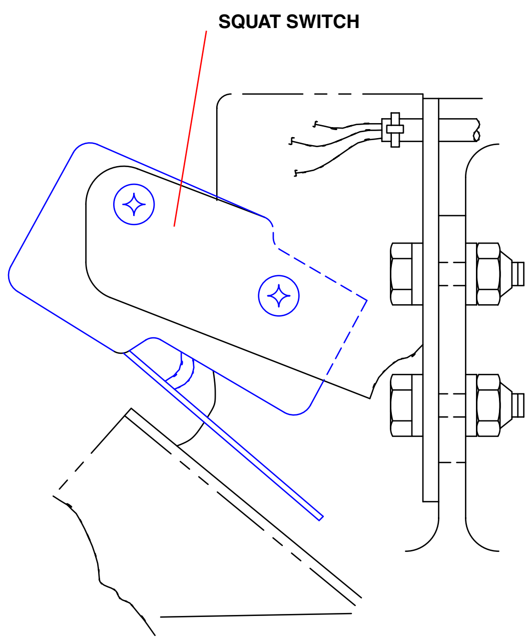
Electrical/Electronic Component Locator
Figure 1 (Sheet 6 of 25)

101843 4.0 AA



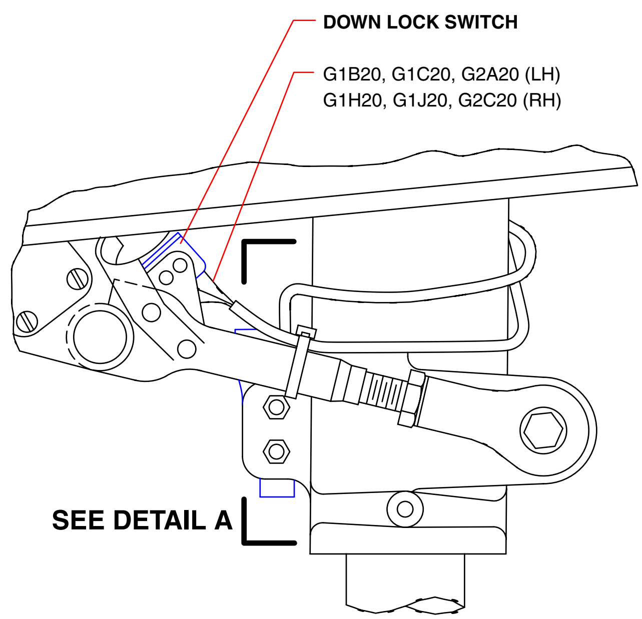
TYPICAL LEFT & RIGHT GEAR

101843 4.0 AA



DETAIL A

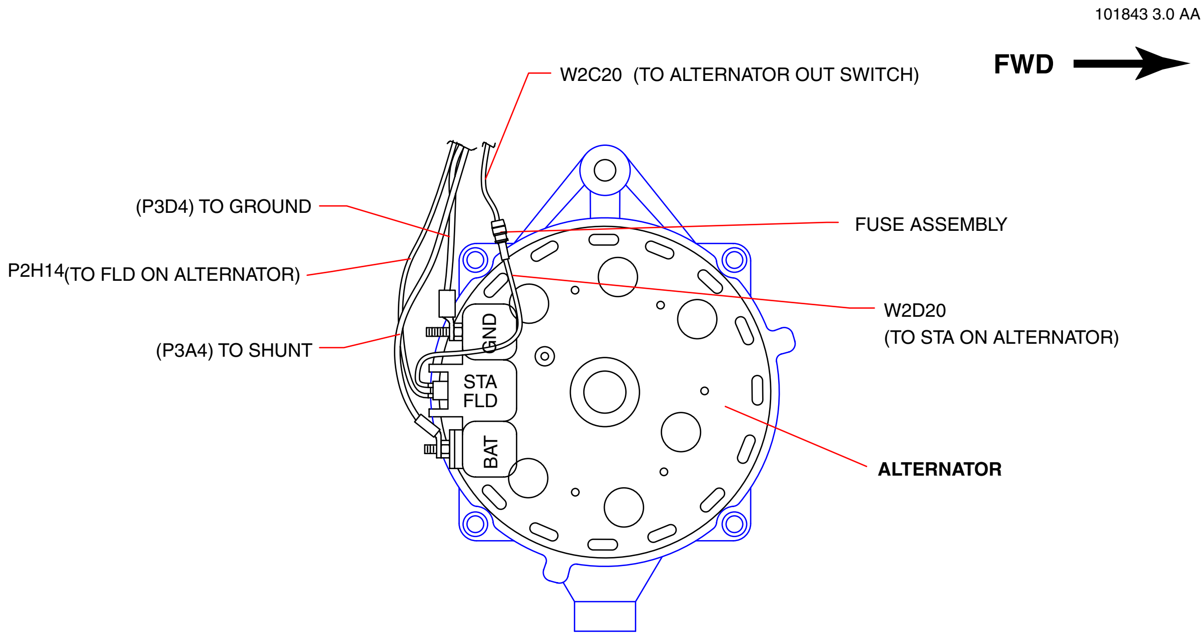
LEFT WING SHOWN



TYPICAL LEFT & RIGHT

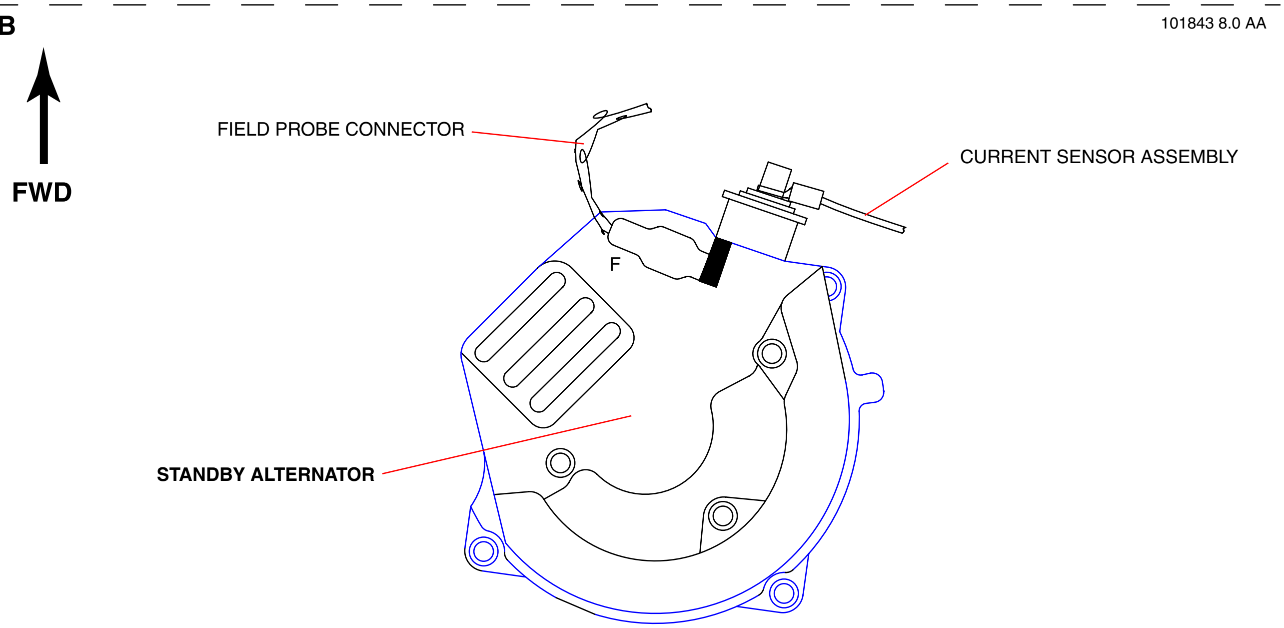
Electrical/Electronic Component Locator
Figure 1 (Sheet 7 of 25)

A



RIGHT SIDE LOOKING INBOARD

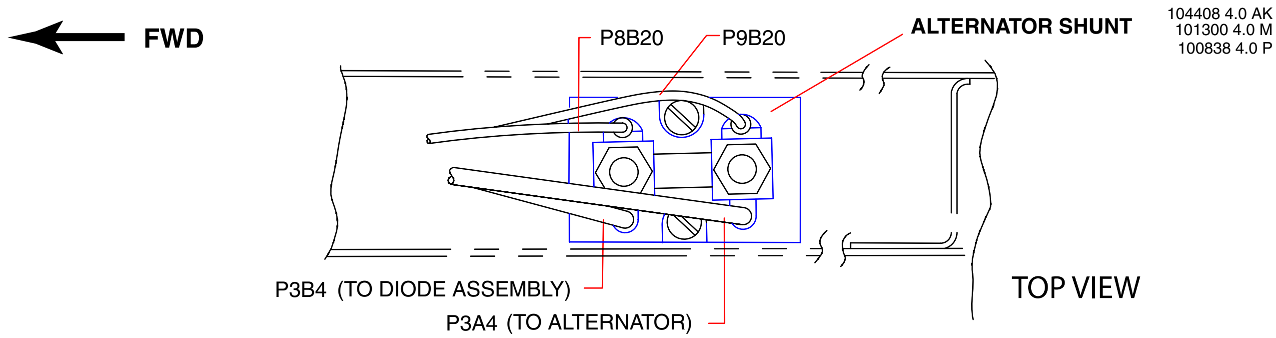
B



S/N'S 3246236 THRU 3246244; AND, 3257256, 3257410 THRU 3257454 WITH AVIDYNE ENTEGRA, LESS 3257447

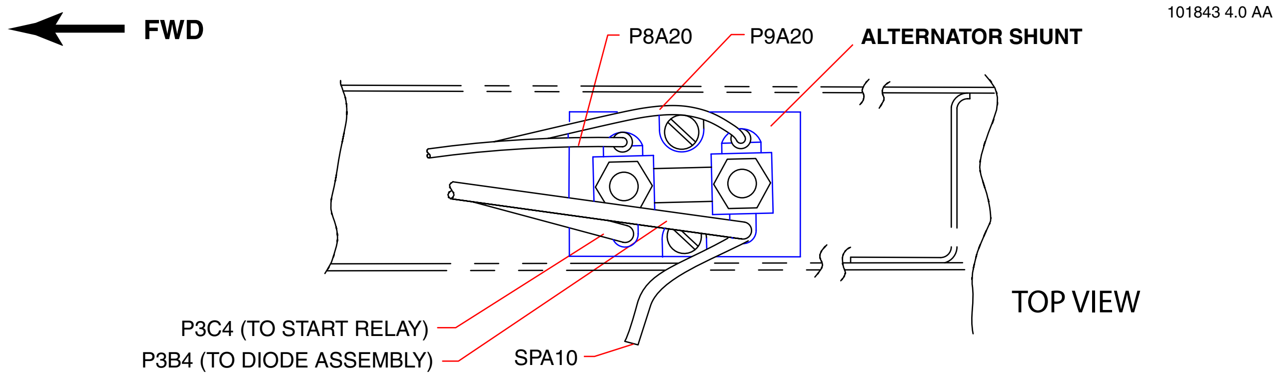
AFT SIDE OF ENGINE LOOKING FORWARD

Electrical/Electronic Component Locator
Figure 1 (Sheet 8 of 25)



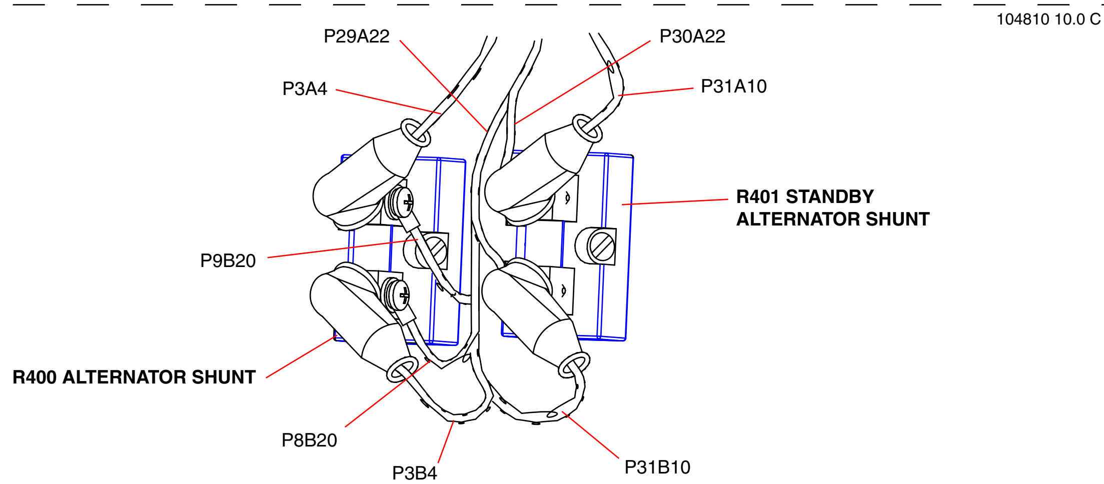
S/N'S 3246088 THRU 3246235;
AND, 3257001 THRU 3257409, LESS 3257256

LEFT SIDE LOOKING INBOARD



S/N'S 3246218 THRU 3246244;
AND, 3257339 THRU 3257454, WITH AVIDYNE ENTEGRA LESS 3257447

LEFT SIDE LOOKING INBOARD

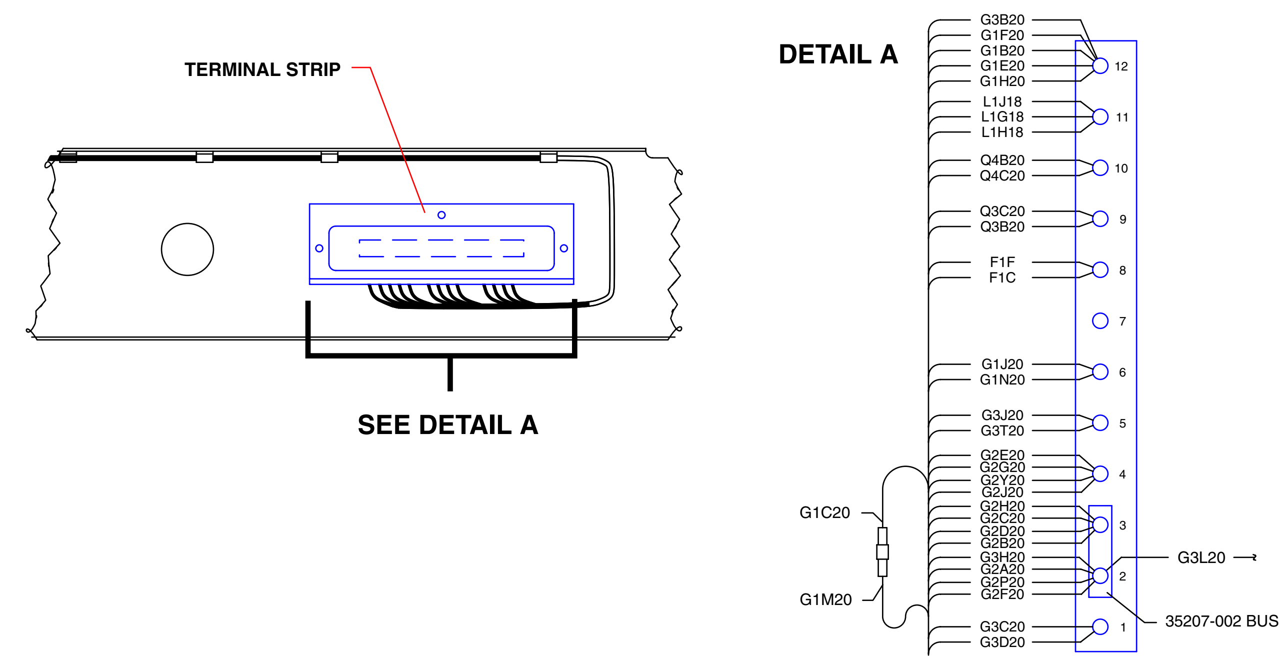


3257447, AND 3257455 AND UP

LOOKING AFT

Electrical/Electronic Component Locator
Figure 1 (Sheet 9 of 25)

A



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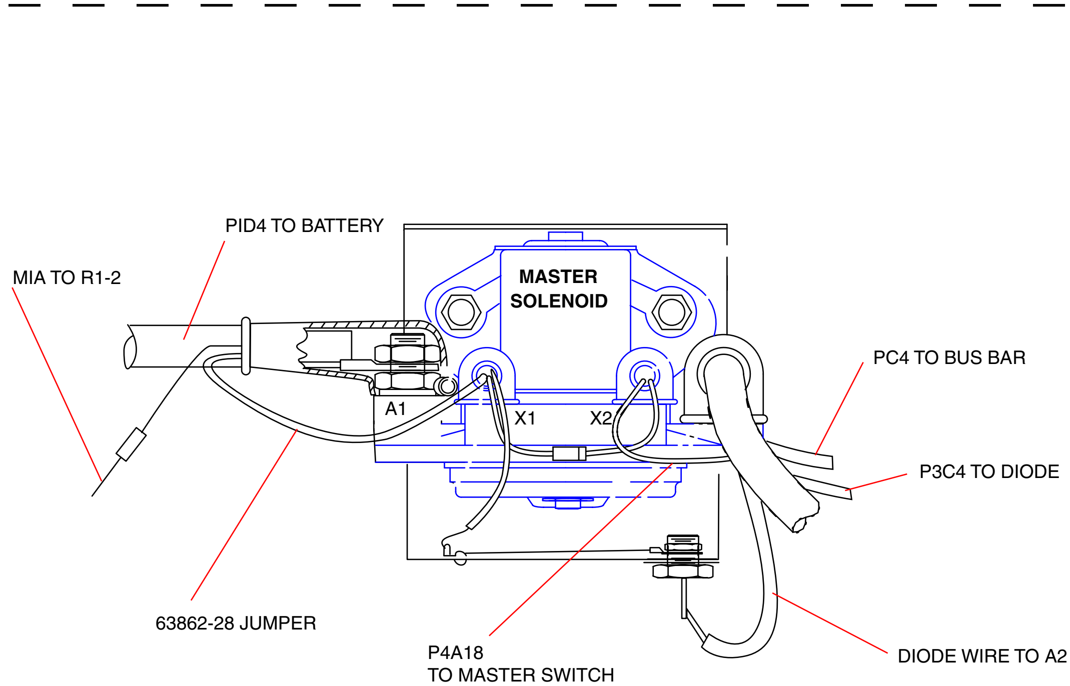
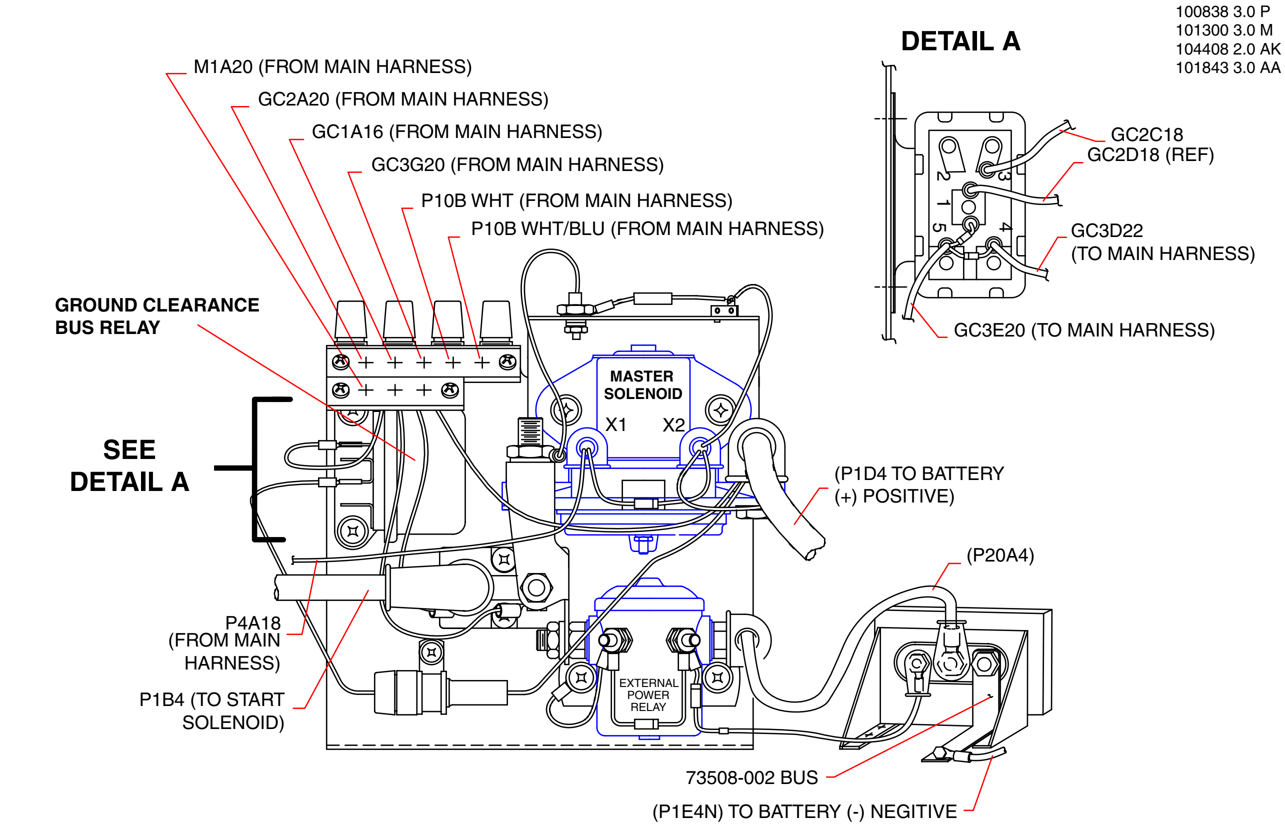


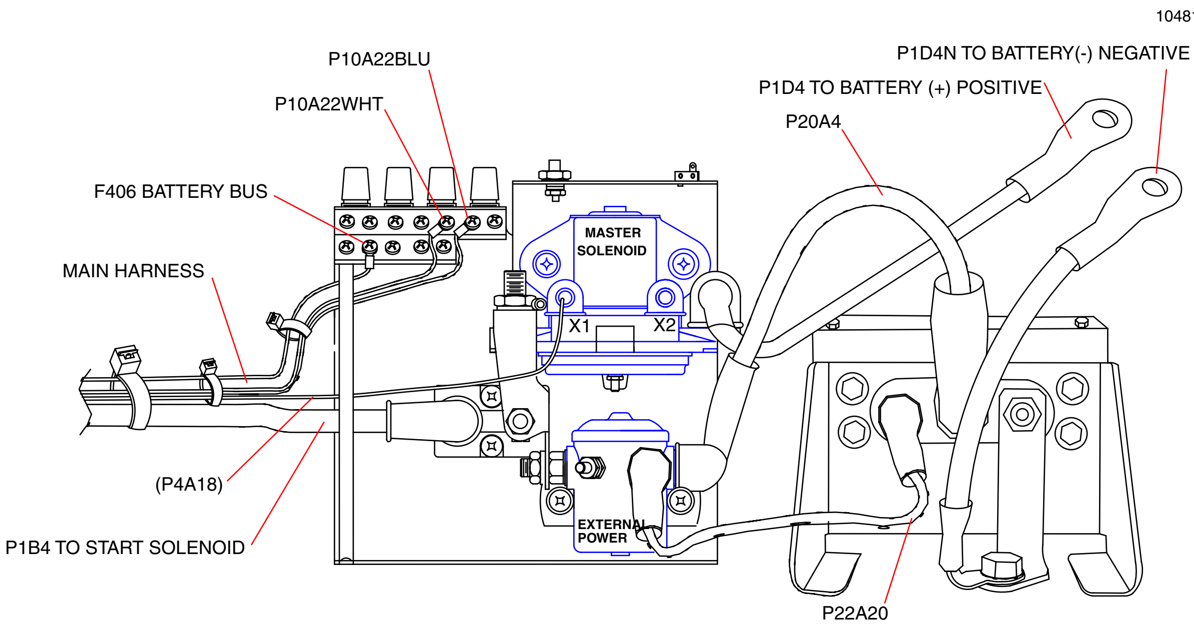
S/N'S 3246001 THRU 3246087

Electrical/Electronic Component Locator
Figure 1 (Sheet 10 of 25)



S/N'S 3246088 thru 3246244;
AND, 3257001 thru 3257454, LESS 3257447

LOOKING OUTBOARD

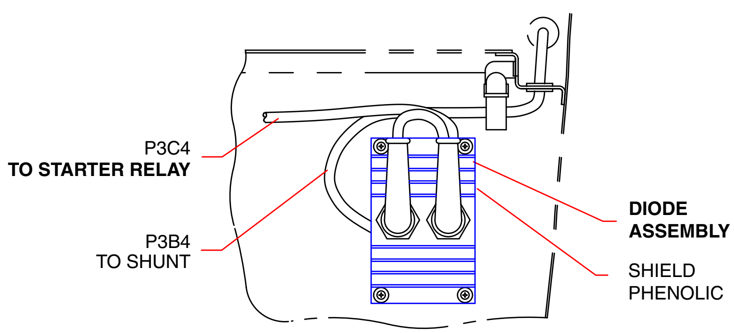


S/N'S 3257447, AND 3257455 AND UP

Electrical/Electronic Component Locator
Figure 1 (Sheet 11 of 25)

A

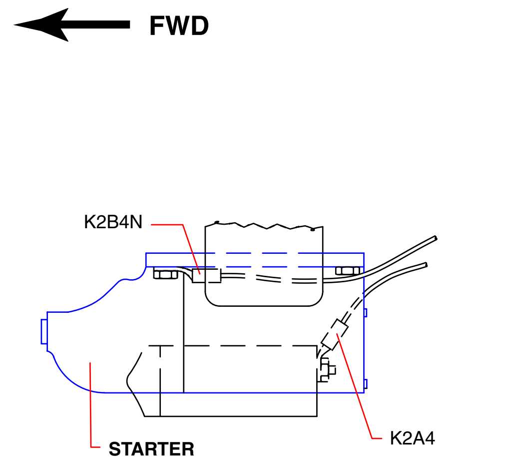
101843 4.0 AA



LOOKING AFT

B

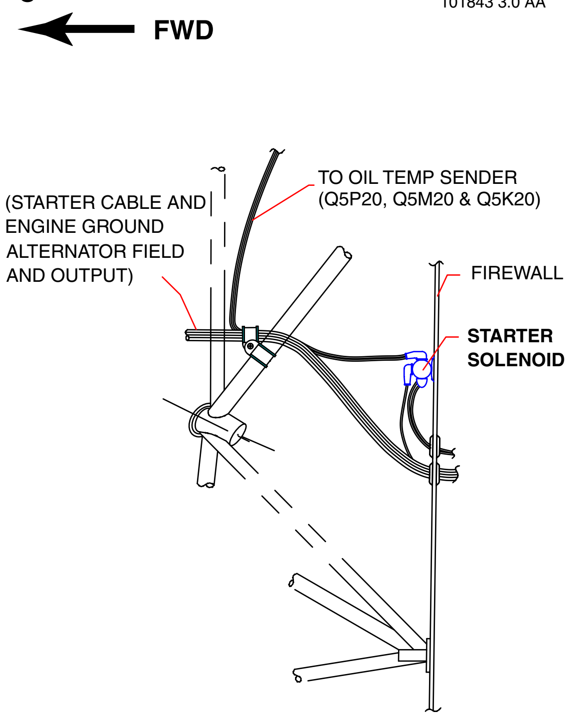
101843 4.0 AA



LEFT SIDE LOOKING INBOARD

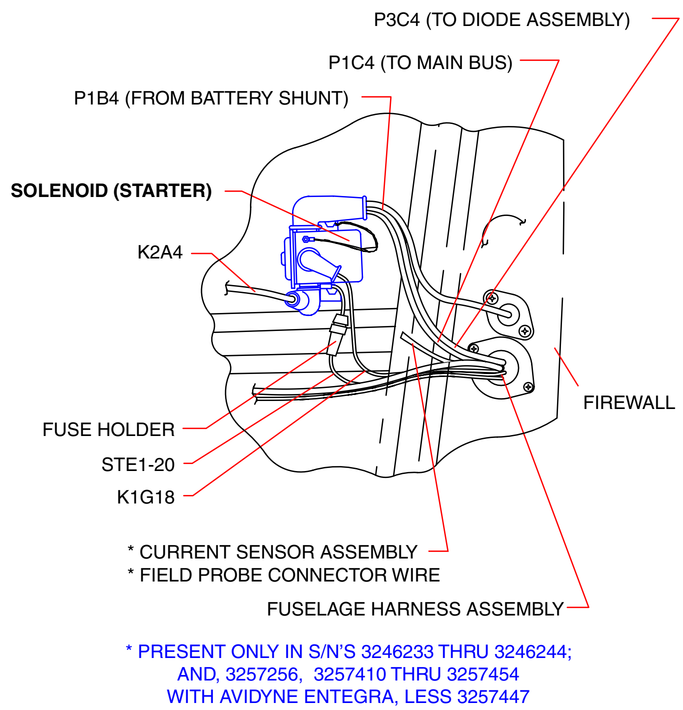
C

101843 3.0 AA



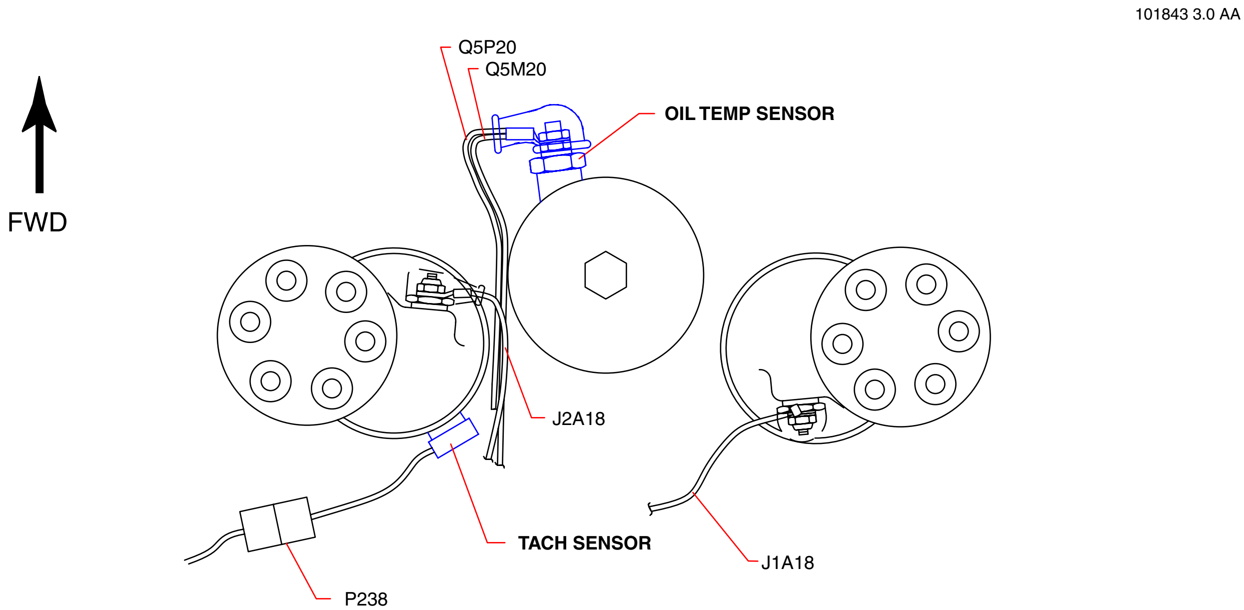
LEFT SIDE LOOKING INBOARD

104408 3.0 AK

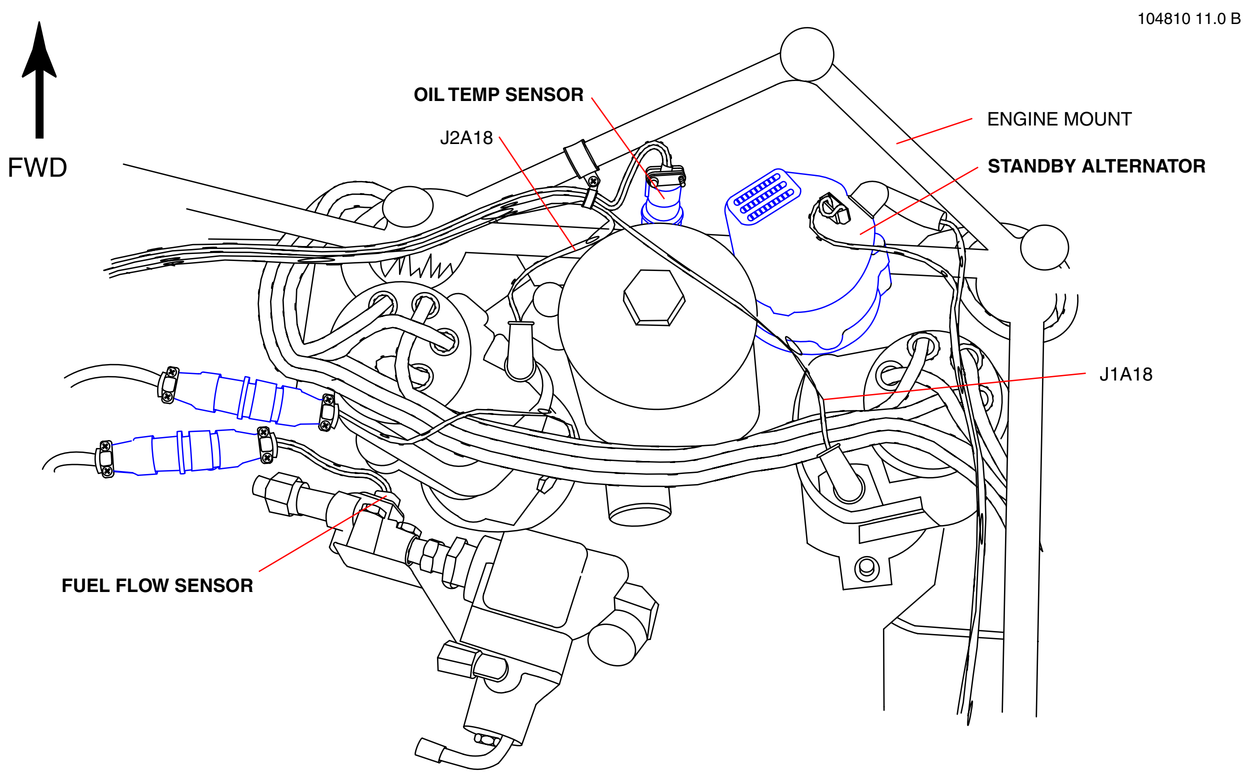


LOOKING AFT

Electrical/Electronic Component Locator
Figure 1 (Sheet 12 of 25)



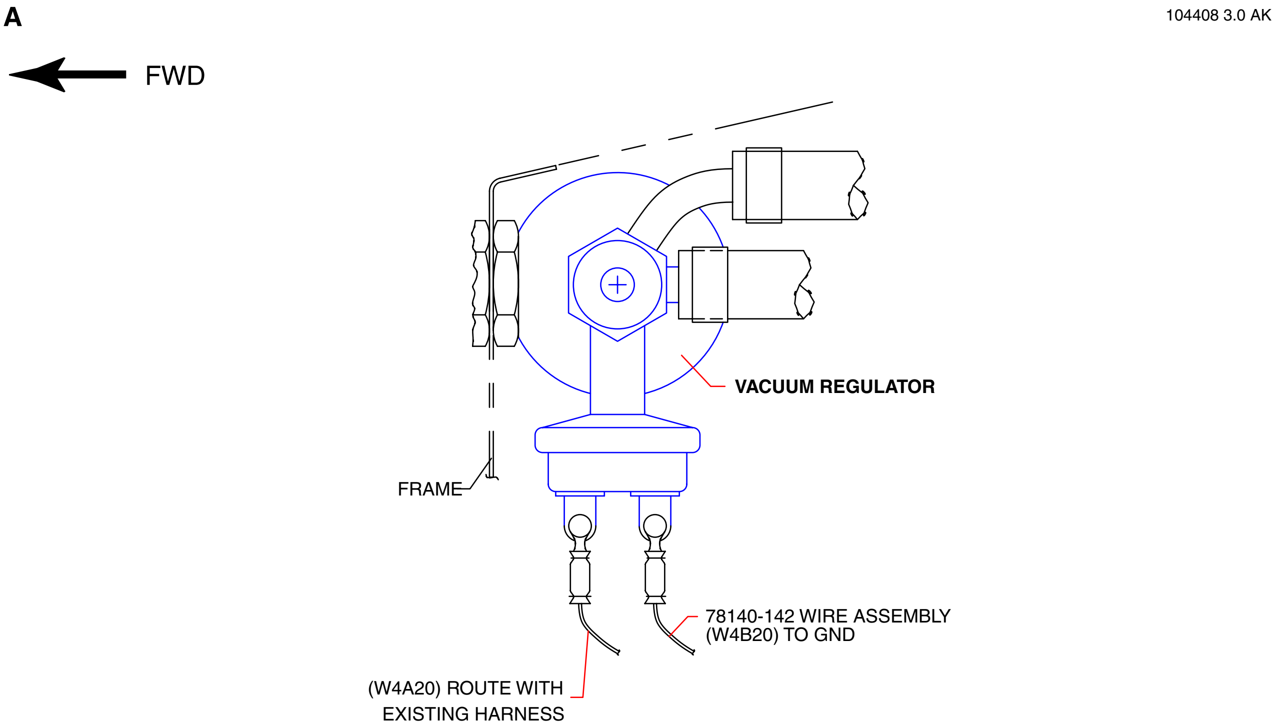
S/N'S 3246001 AND UP
3257001 THRU 3257454, LESS 3257447



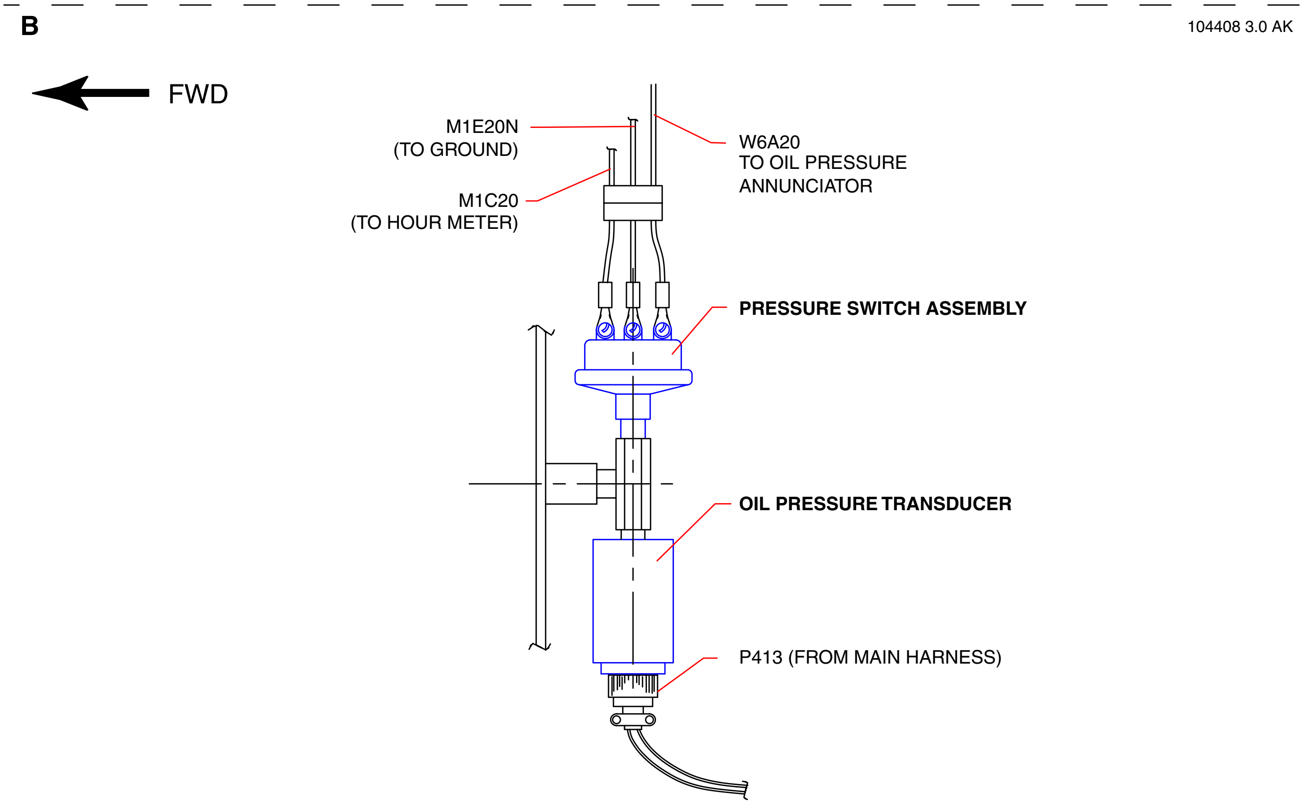
S/N'S 3257455 AND UP, AND 3257447

Electrical/Electronic Component Locator
Figure 1 (Sheet 13 of 25)

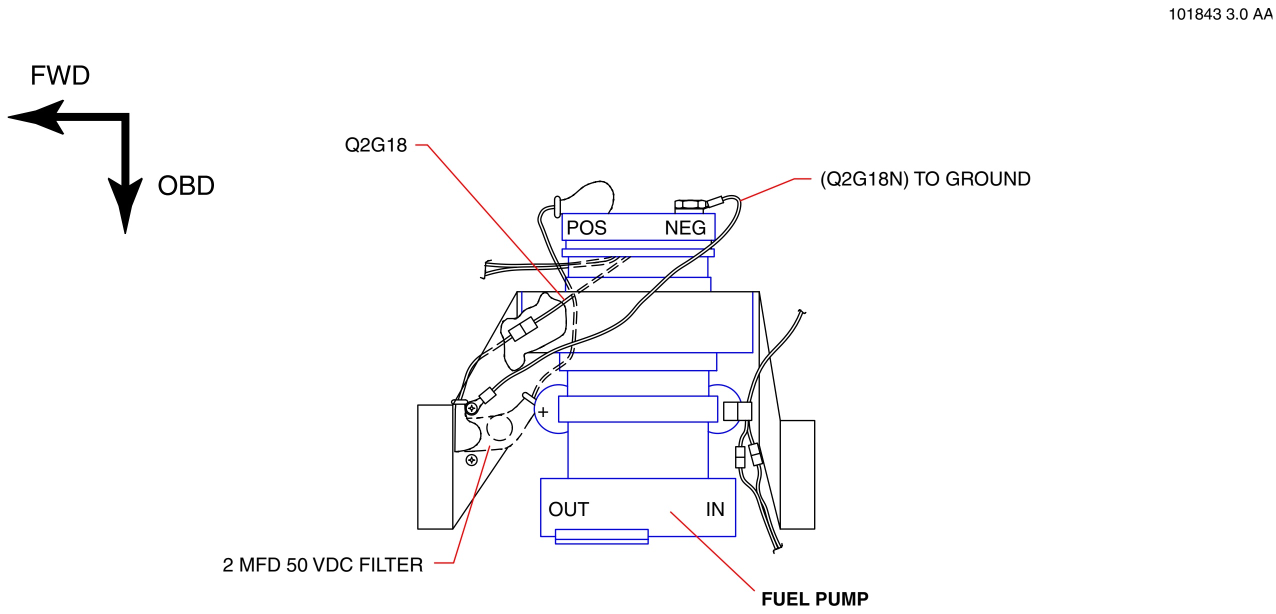
A



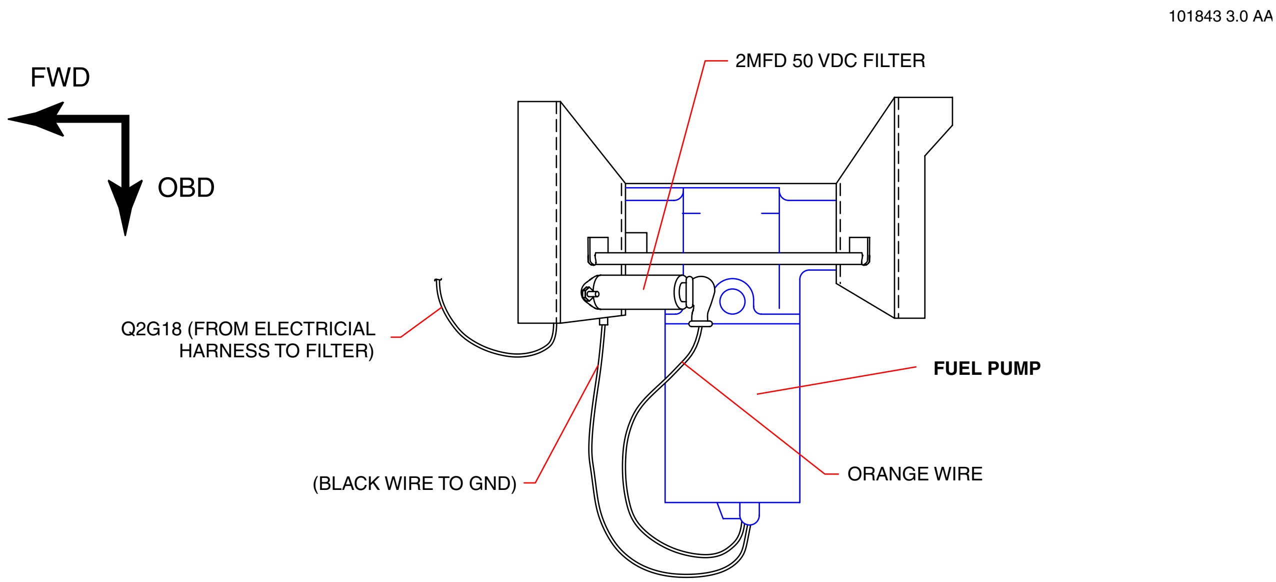
B



Electrical/Electronic Component Locator
Figure 1 (Sheet 14 of 25)



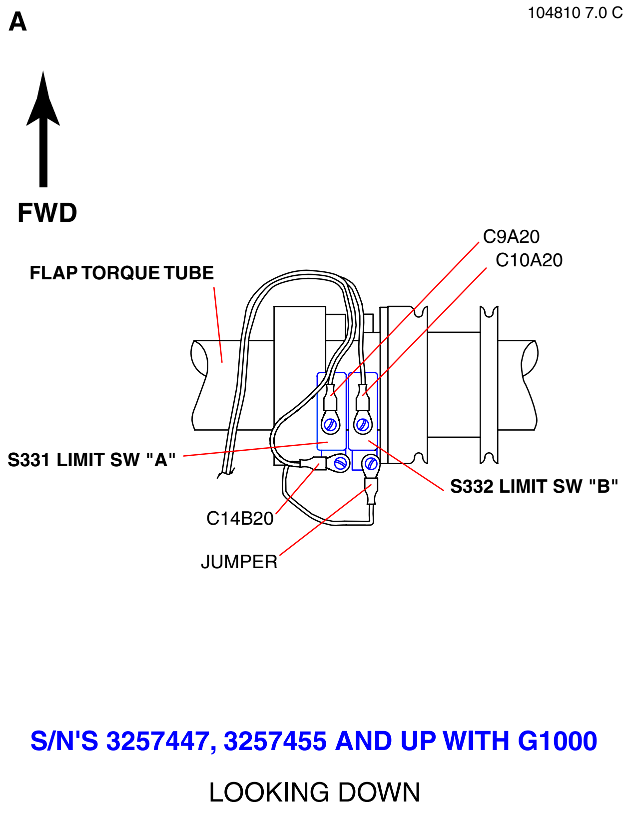
S/N'S 3246001 THRU 3246244
LOOKING DOWN

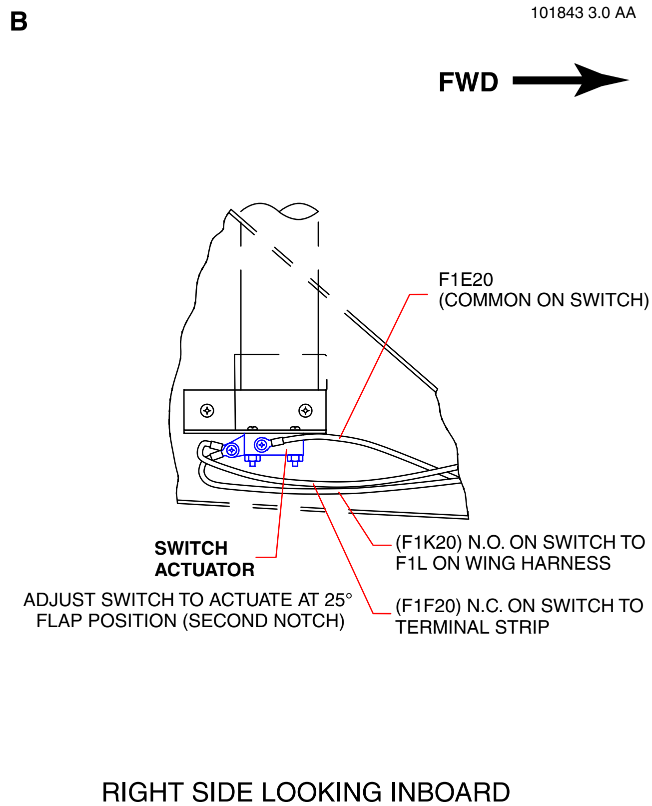


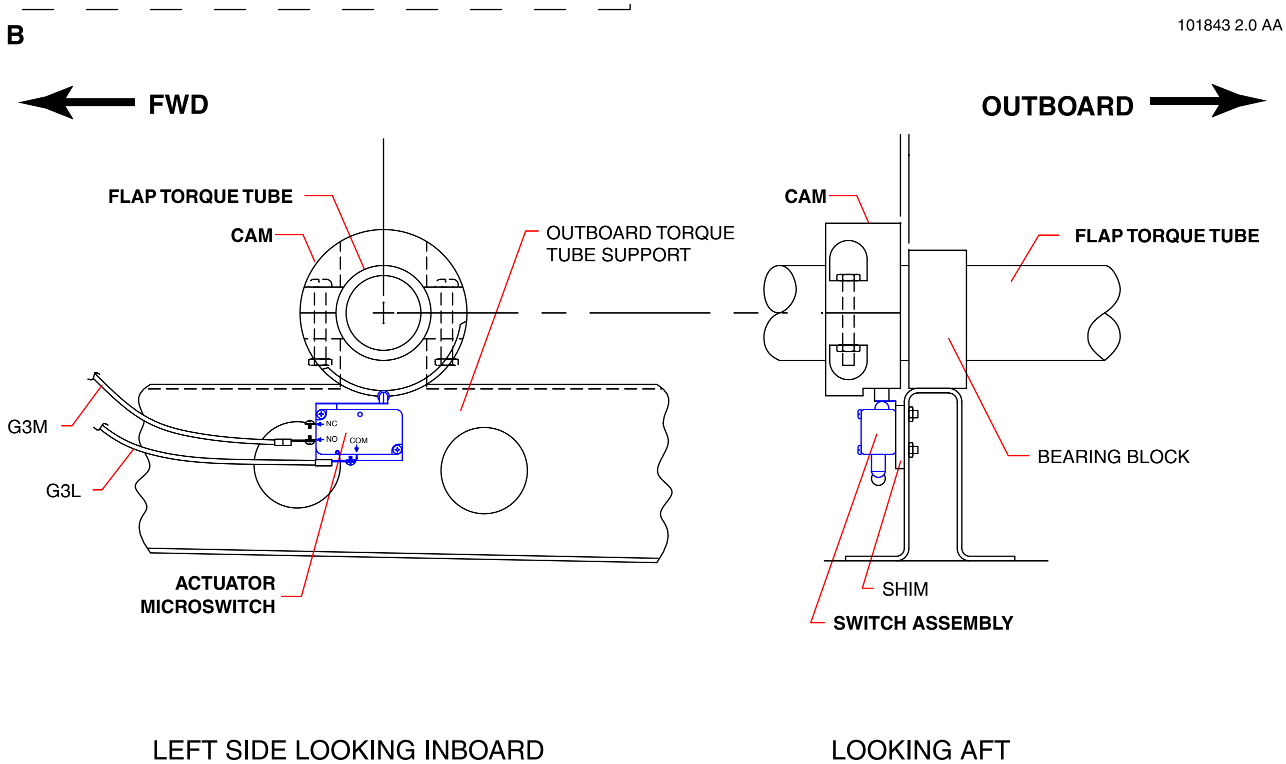
S/N'S 3257001 AND UP

LOOKING DOWN

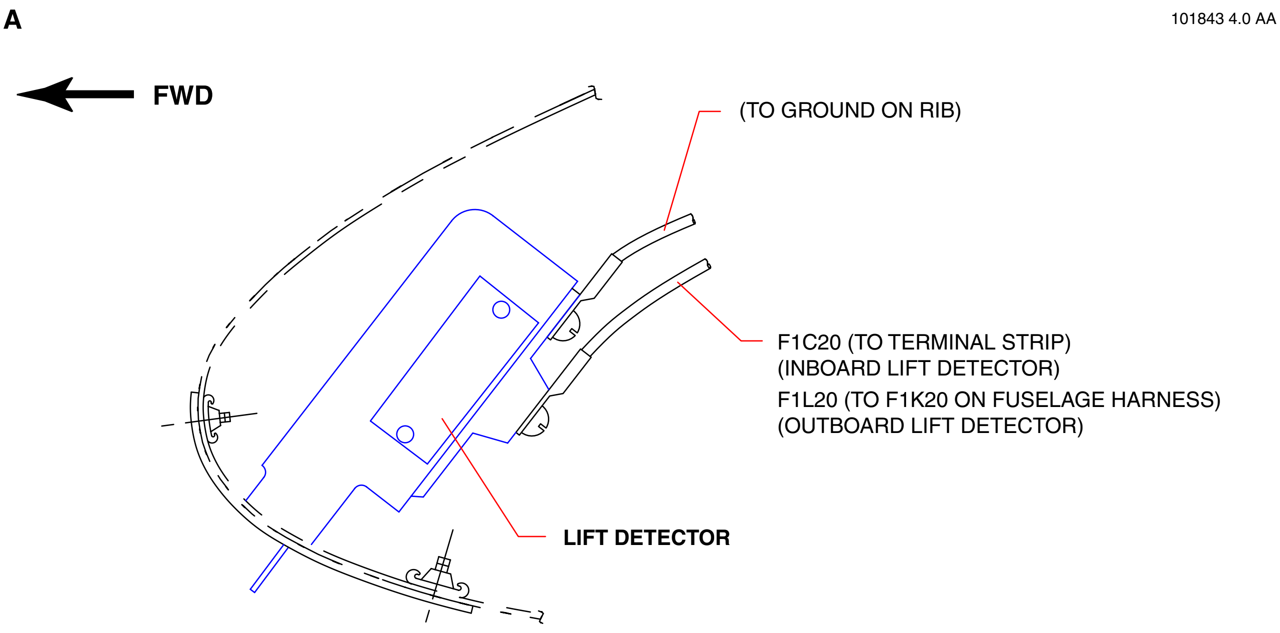
Electrical/Electronic Component Locator
Figure 1 (Sheet 15 of 25)



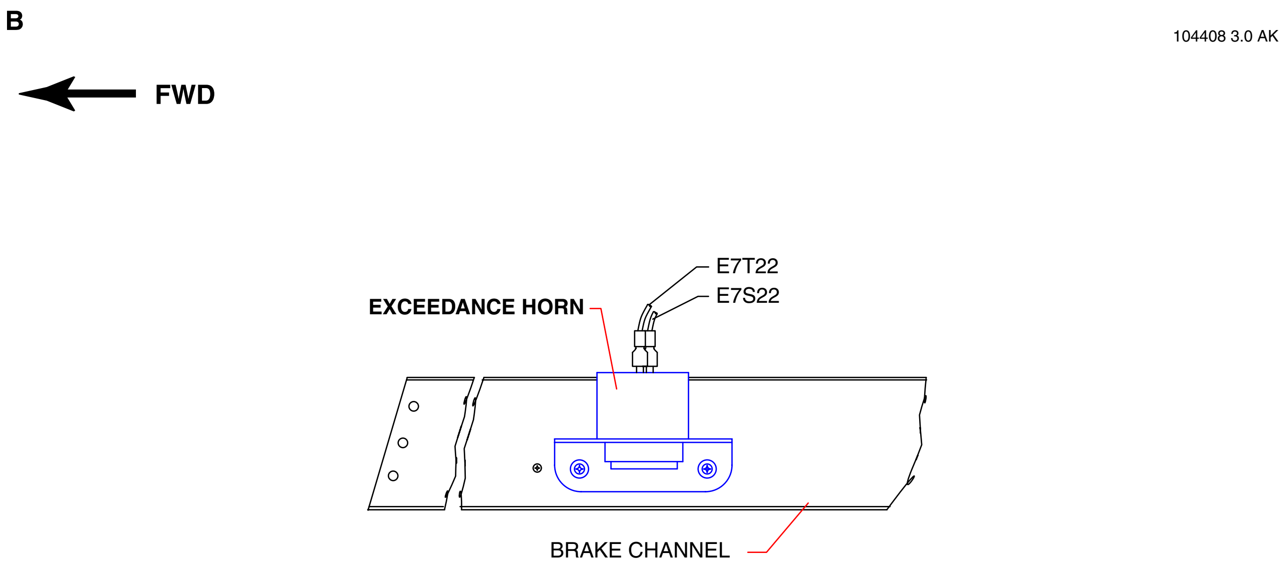




Electrical/Electronic Component Locator
Figure 1 (Sheet 16 of 25)

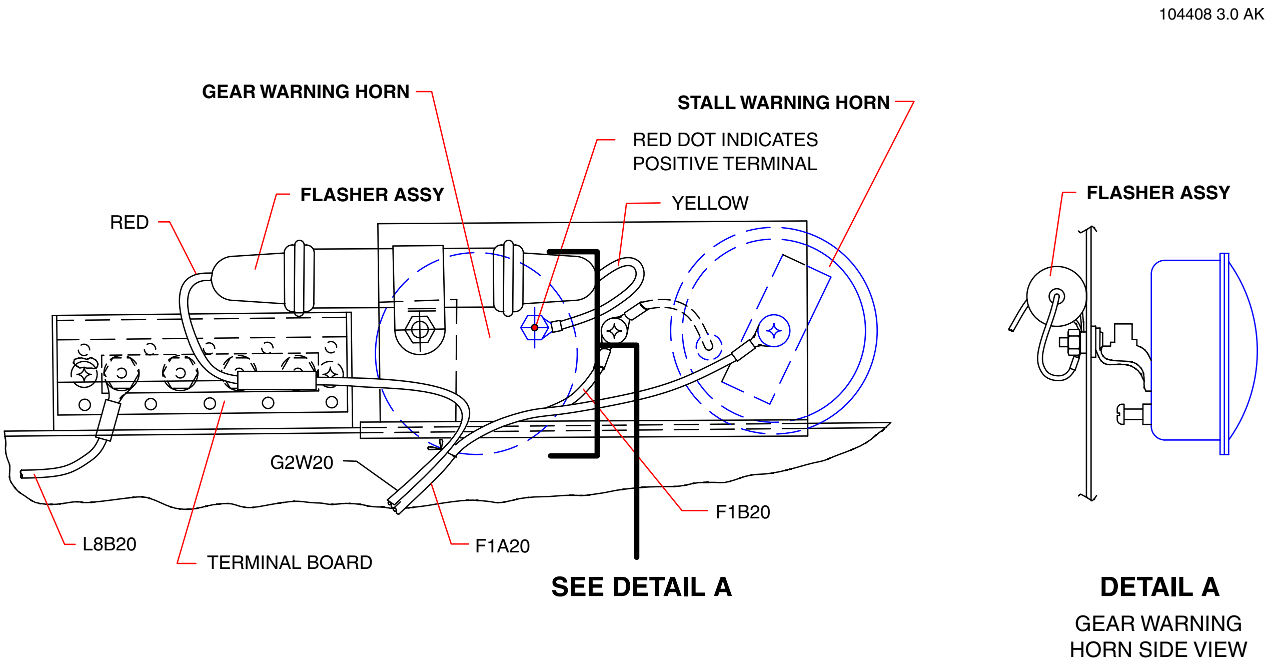


TWO (2) EACH
LEFT WING ONLY
LEFT SIDE LOOKING INBOARD

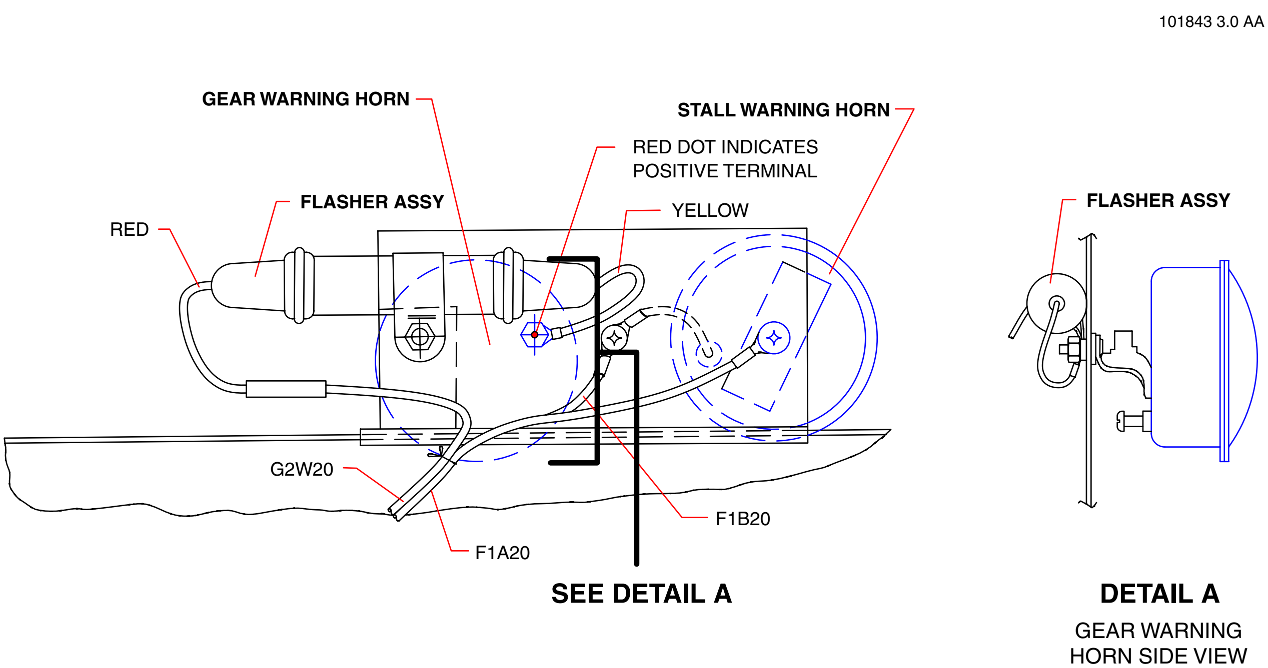


LEFT SIDE LOOKING INBOARD

Electrical/Electronic Component Locator
Figure 1 (Sheet 17 of 25)

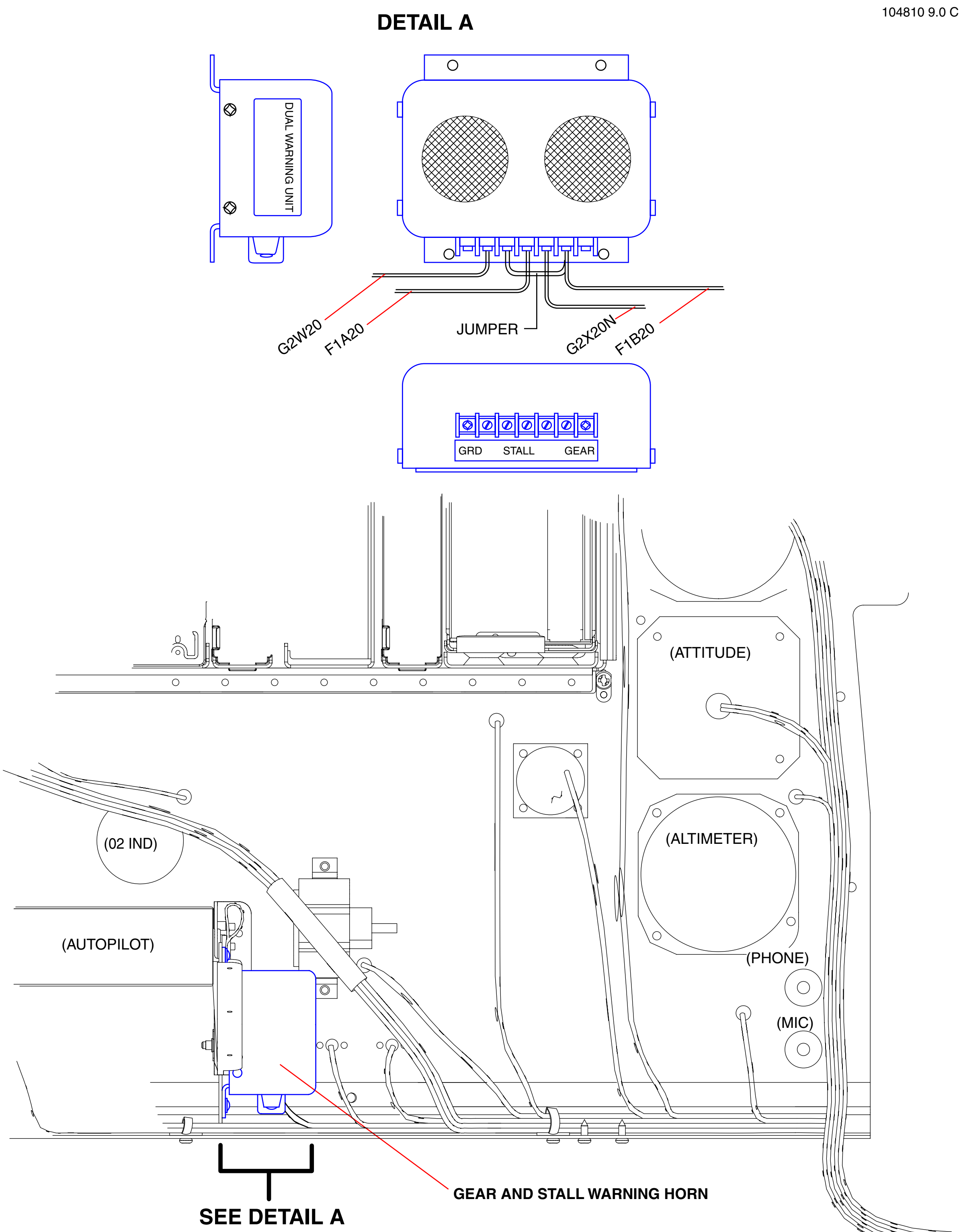


**S/N'S 3246001 THRU 3246235; AND,
3257001 THRU 325740 WITHOUT AVIDYNE ENTEGRA, LESS 3257256**



**3246218 THRU 3246235; AND,
3257339 THRU 3257409 WITH AVIDYNE ENTEGRA, LESS 3257256**

Electrical/Electronic Component Locator
Figure 1 (Sheet 18 of 25)

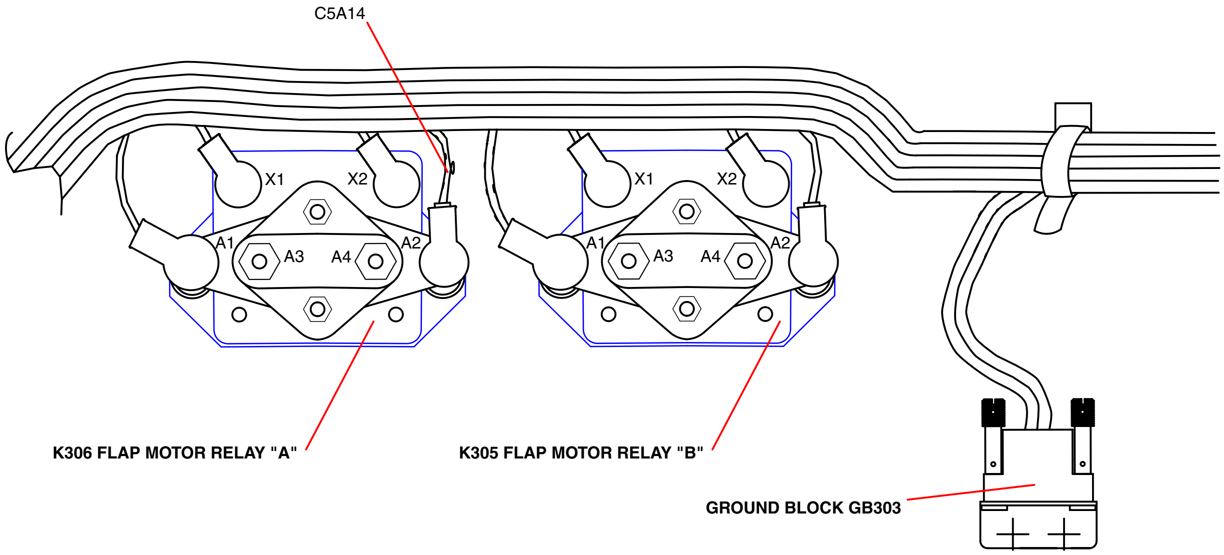


S/N'S 3257447, 3257455 AND UP ONLY

BACK OF INSTRUMENT PANEL, LEFT SIDE LOOKING AFT

Electrical/Electronic Component Locator
Figure 1 (Sheet 19 of 25)

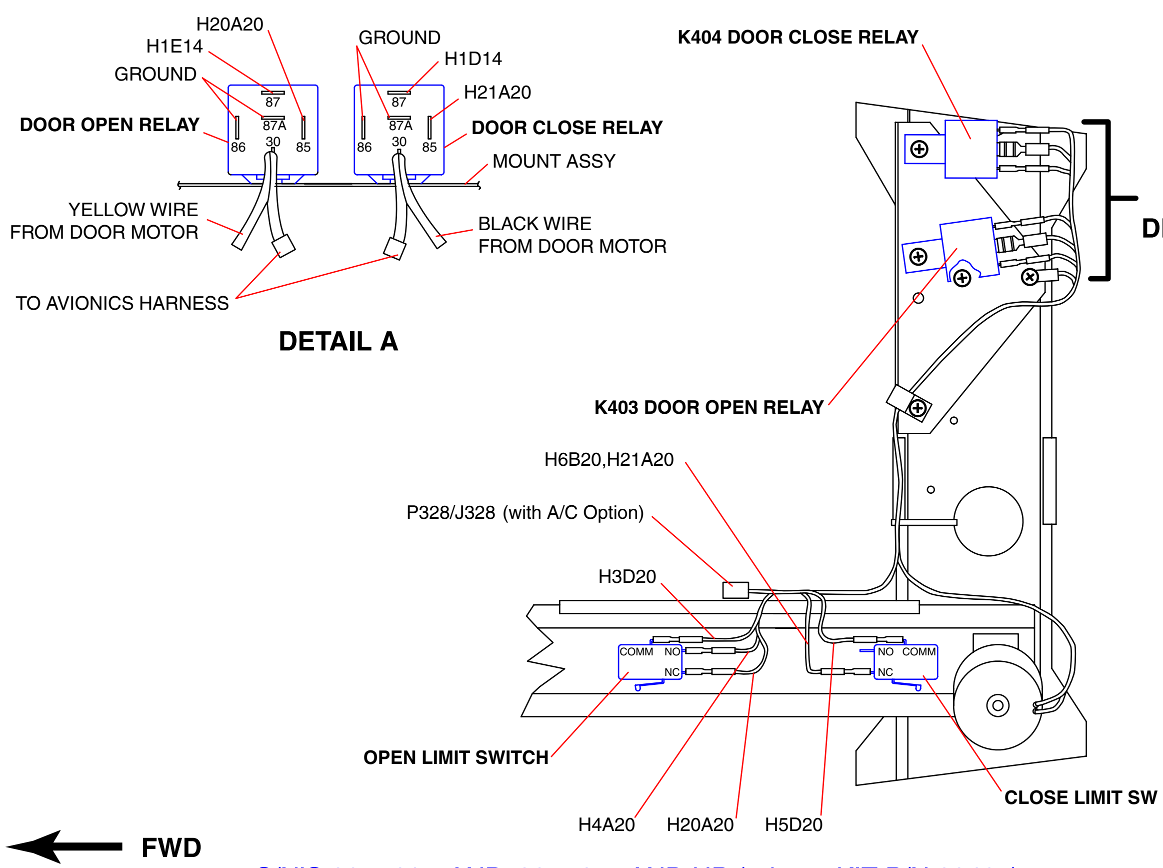
104810 13.0 C



S/N'S 3257447; AND, 3257455 AND UP

LOOKING AFT

104810 14.0 C

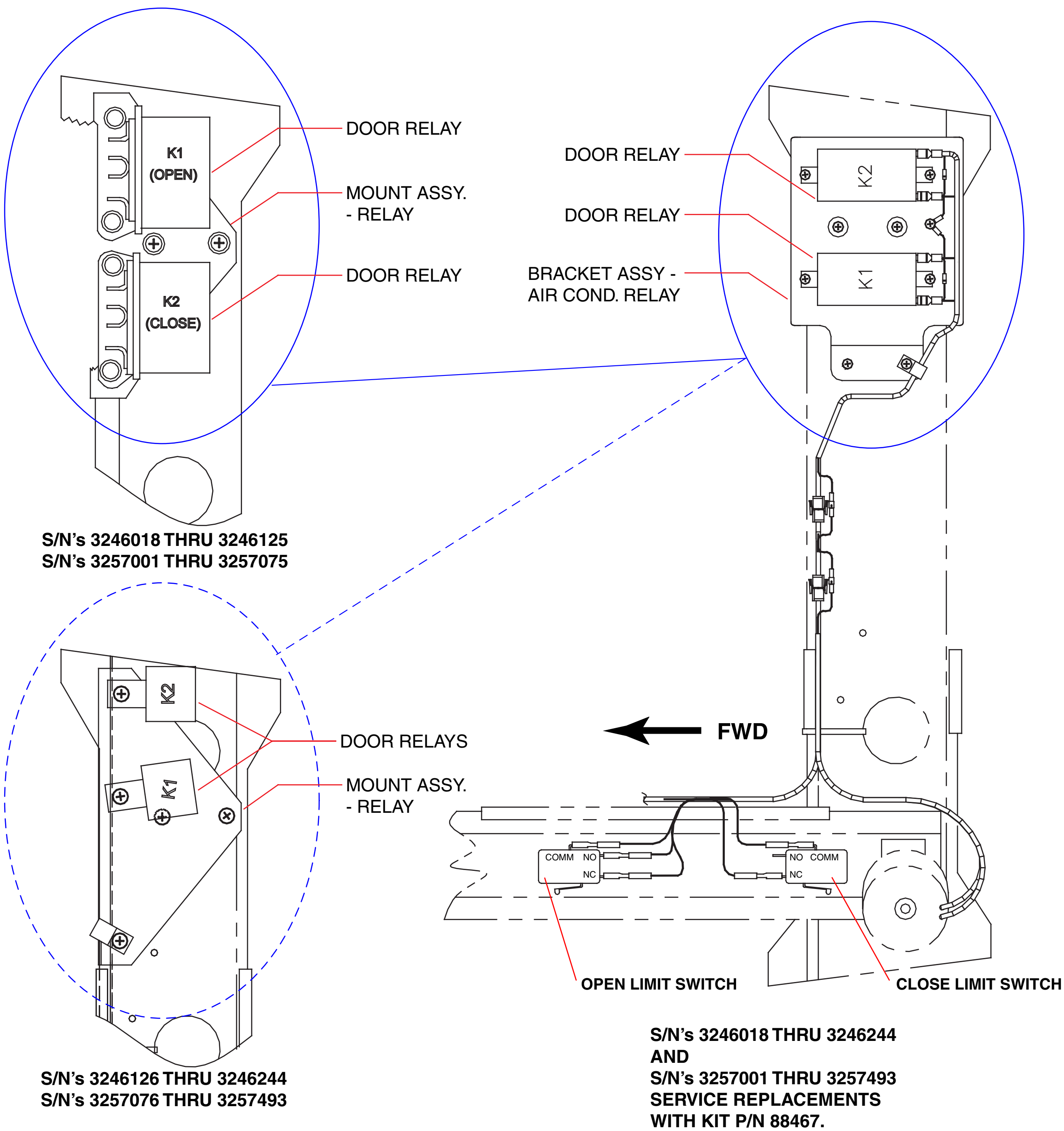


S/N'S 3257447; AND, 3257455 AND UP (prior to KIT P/N 88467)

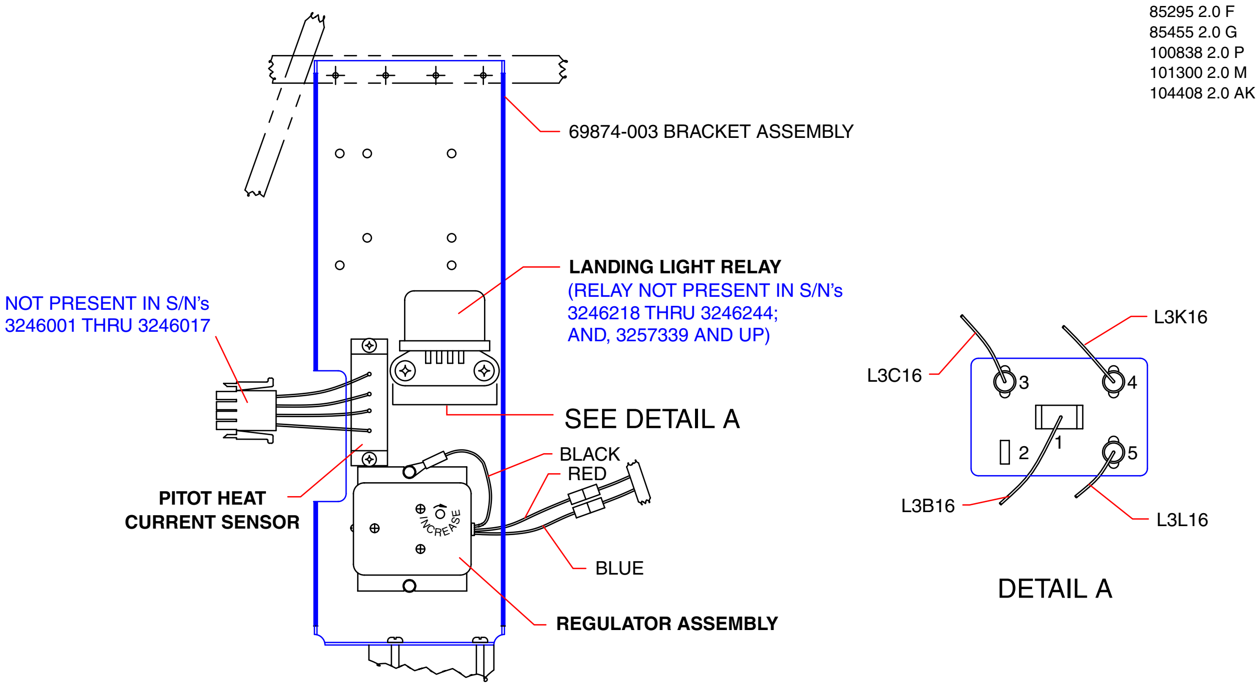
LOOKING DOWN

Electrical/Electronic Component Locator
Figure 1 (Sheet 20 of 25)

99980 1.0 AI
101294 2.0 D
104810 14.0 H
106869 C

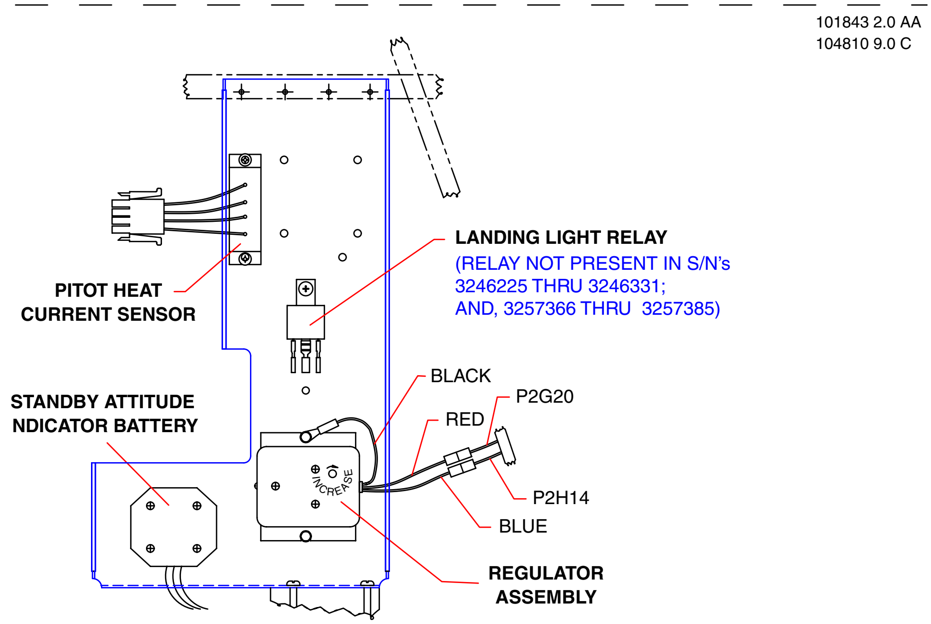


Electrical/Electronic Component Locator
Figure 1 (Sheet 21 of 25)



S/N'S 3246001 THRU 3246224, AND 3246232 THRU 3246244 AND, 3257001 THRU 3257365; AND 3257386 AND UP

LOOKING OUTBOARD L.H. SIDE

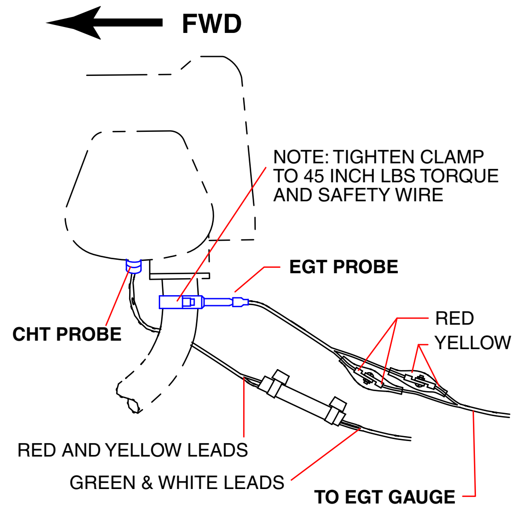


S/N'S 3246218 AND UP; AND, 3257339 AND UP WITH AVIDYNE ENTEGRA

LOOKING OUTBOARD L.H. SIDE

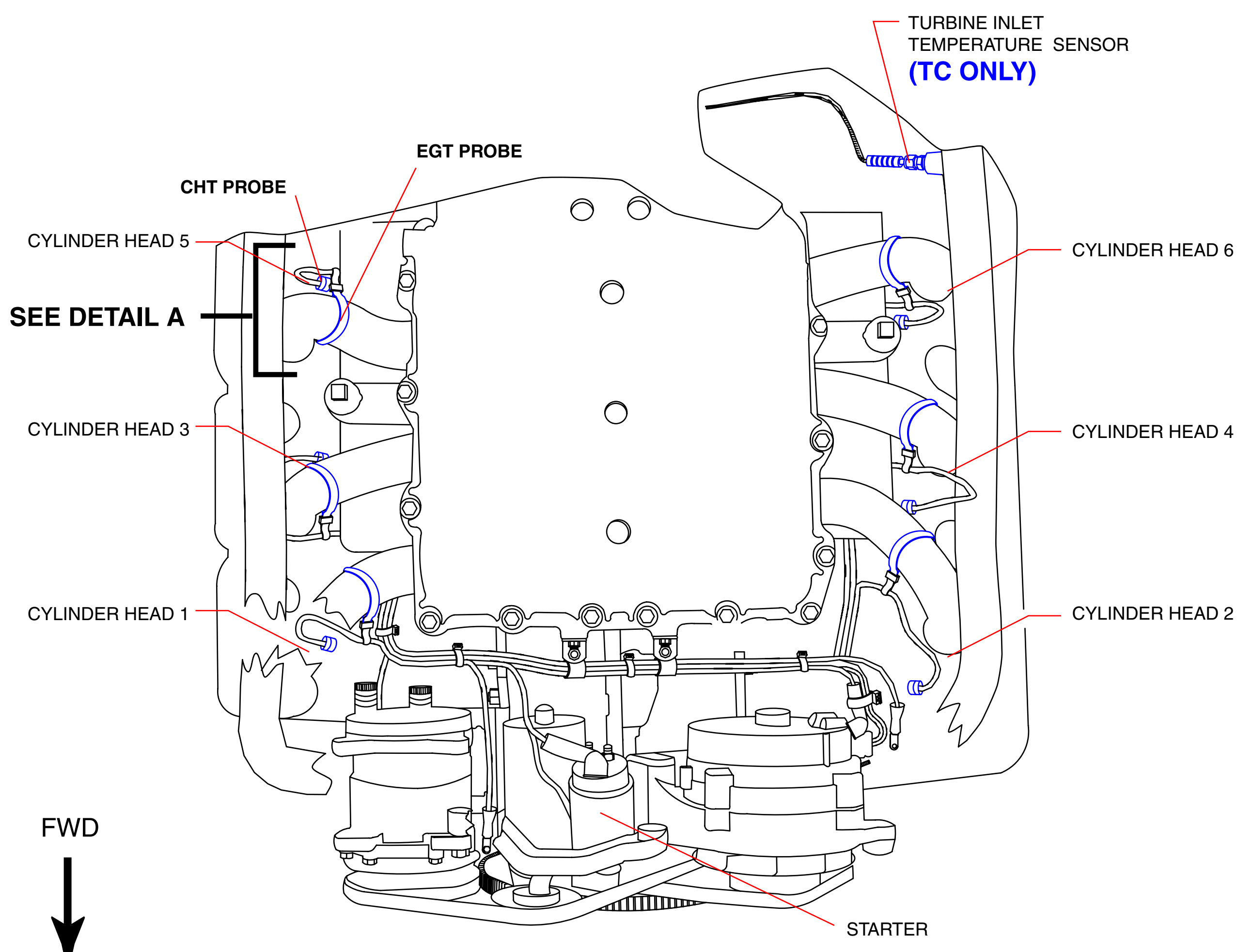
Electrical/Electronic Component Locator
Figure 1 (Sheet 22 of 25)

104810 11.0 C



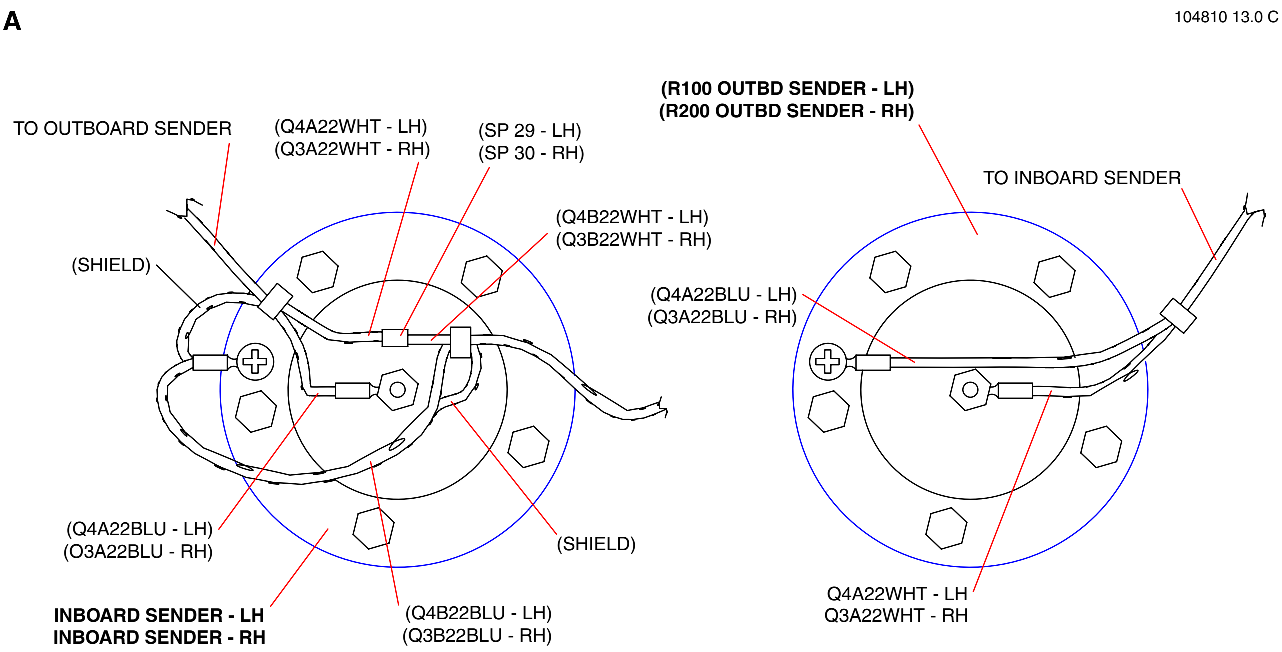
DETAIL A

CYLINDER HEAD TEMPERATURE PROBE (CHT)	
CYL #	SERIAL NUMBER RANGE
2	3246088 THRU 3246235 WITHOUT AVIDYNE ENTEGRA
3	3257001 THRU 3257409 LESS 3257256
ALL	3246218 THRU 3246244 WITH AVIDYNE ENTEGRA
ALL	3257339 AND UP WITH AVIDYNE OR GARMIN EFIS
EXHAUST GAS TEMPERATURE PROBE (EGT)	
CYL #	SERIAL NUMBER RANGE
6	3246126 THRU 3246235 WITHOUT AVIDYNE ENTEGRA
ALL	3246218 AND UP WITH AVIDYNE ENTEGRA



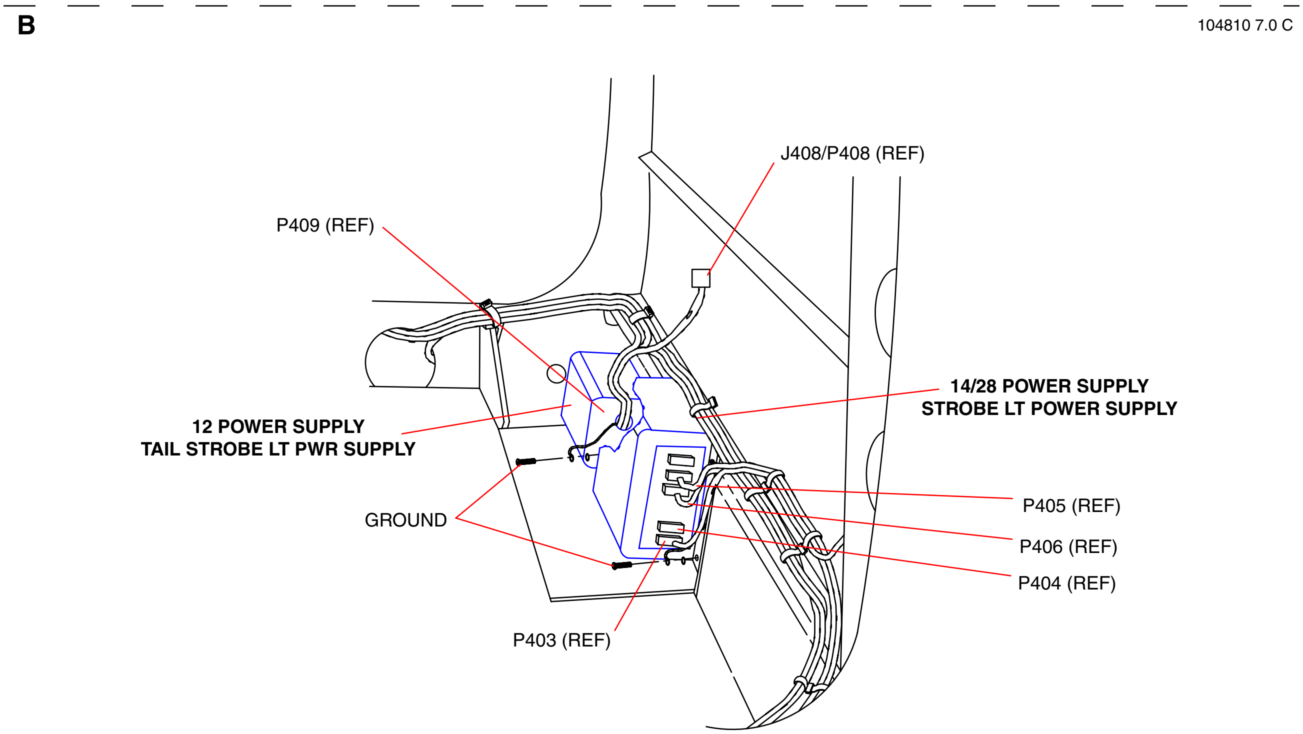
UNDERNEATH LOOKING UP

Electrical/Electronic Component Locator
Figure 1 (Sheet 23 of 25)



S/N'S 3257447; AND, 3257455 AND UP

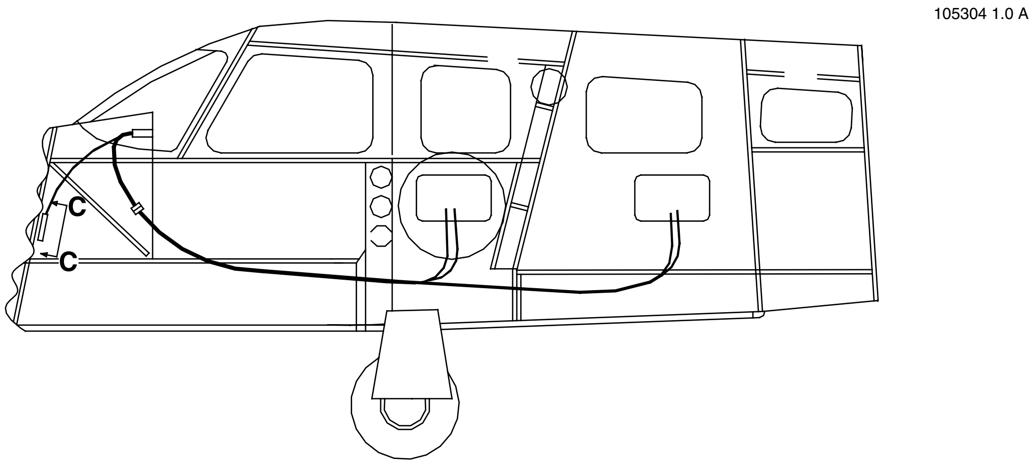
LOOKING FORWARD (RIGHT SHOWN, LEFT OPPOSITE)



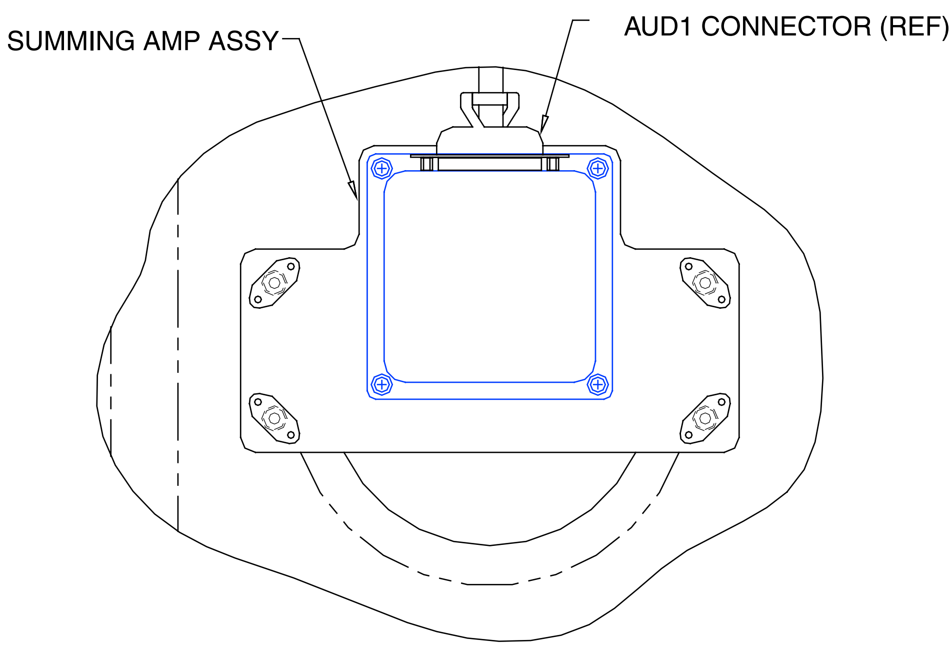
S/N'S 3257447; AND, 3257455 AND UP

LOOKING AFT

Electrical/Electronic Component Locator
Figure 1 (Sheet 24 of 25)



AUDIO/INTERCOM INSTALLATION PLAN VIEW



VIEW C-C
SUMMING AMP ASSY INSTALLATION
LOOKING FORWARD

Electrical/Electronic Component Locator
Figure 1 (Sheet 25 of 25)

CHAPTER

51

STRUCTURES

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CHAPTER 51

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE	CHAPTER SECTION	PAGE	DATE
51-List of Effective Pages	1	Jul 31/13			
	2	Jun 30/07			
51-Table of Contents	1	Jul 31/13			
	2	Jun 30/07			
51-00-00	1	Jun 30/07			
	2	Jun 30/07			
	3	Jun 30/07			
	4	Jun 30/07			
51-10-00	1	Jun 30/07			
	2	Jun 30/07			
	3	Jun 30/07			
	4	Dec 31/09			
	5	Jun 30/07			
	6	Jun 30/07			
	7	Jun 30/07			
	8	Jun 30/07			
51-70-00	1	Jul 31/13			
	2	Dec 31/09			
	3	Jun 30/07			
	4	Jun 30/07			
	5	Jun 30/07			
	6	Jun 30/07			
	7	Jun 30/07			
	8	Jun 30/07			
	9	Jun 30/07			
	10	Jun 30/07			
	11	Jun 30/07			
	12	Jun 30/07			
	13	Jun 30/07			
	14	Jun 30/07			
51-80-00	1	Jun 30/07			
	2	Jun 30/07			
	3	Mar 21/12			
	4	Mar 21/12			
	5	Mar 21/12			
	6	Mar 21/12			
	7	Jun 30/07			
	8	Jun 30/07			

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CHAPTER 51 - STRUCTURES

TABLE OF CONTENTS

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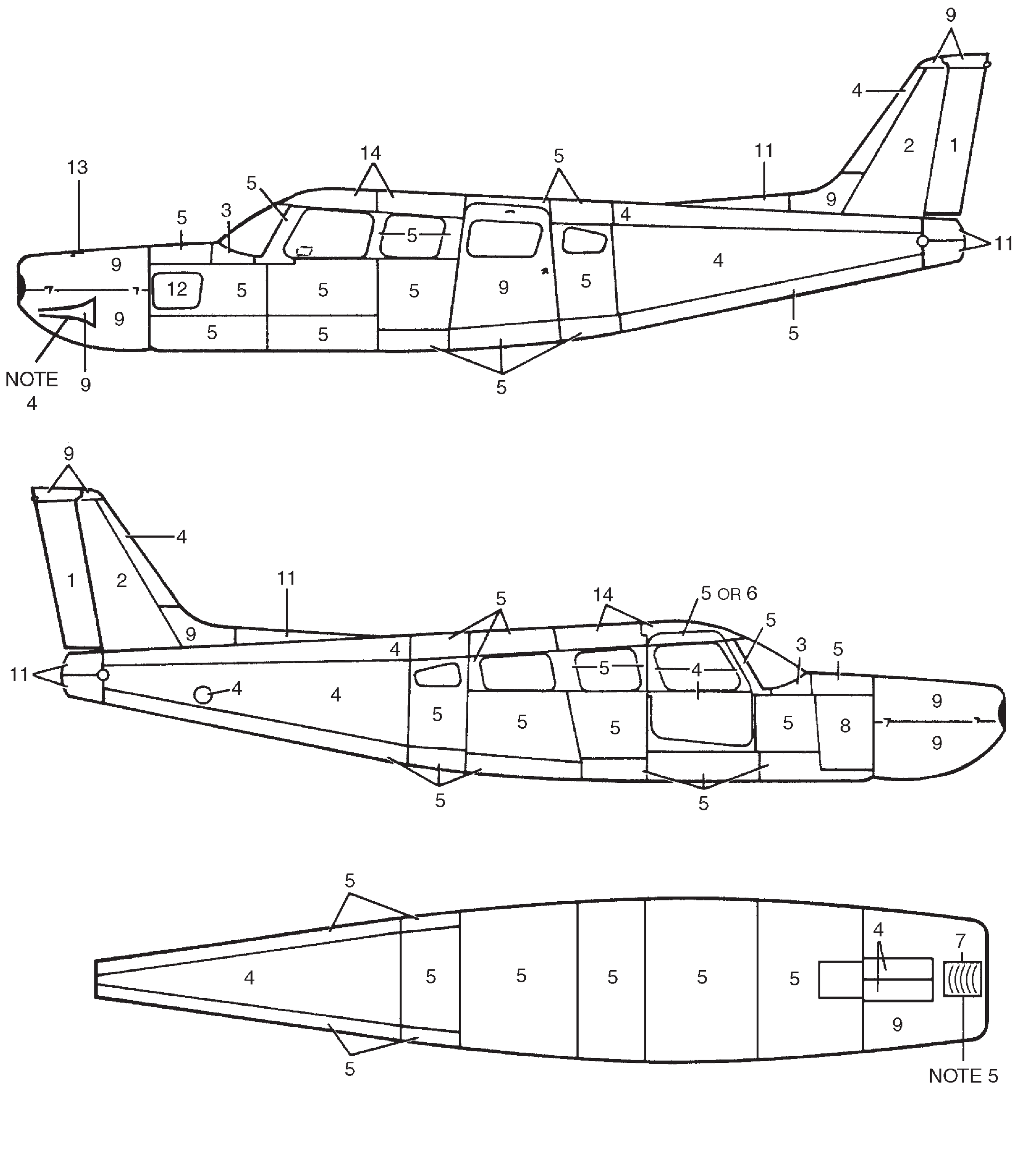
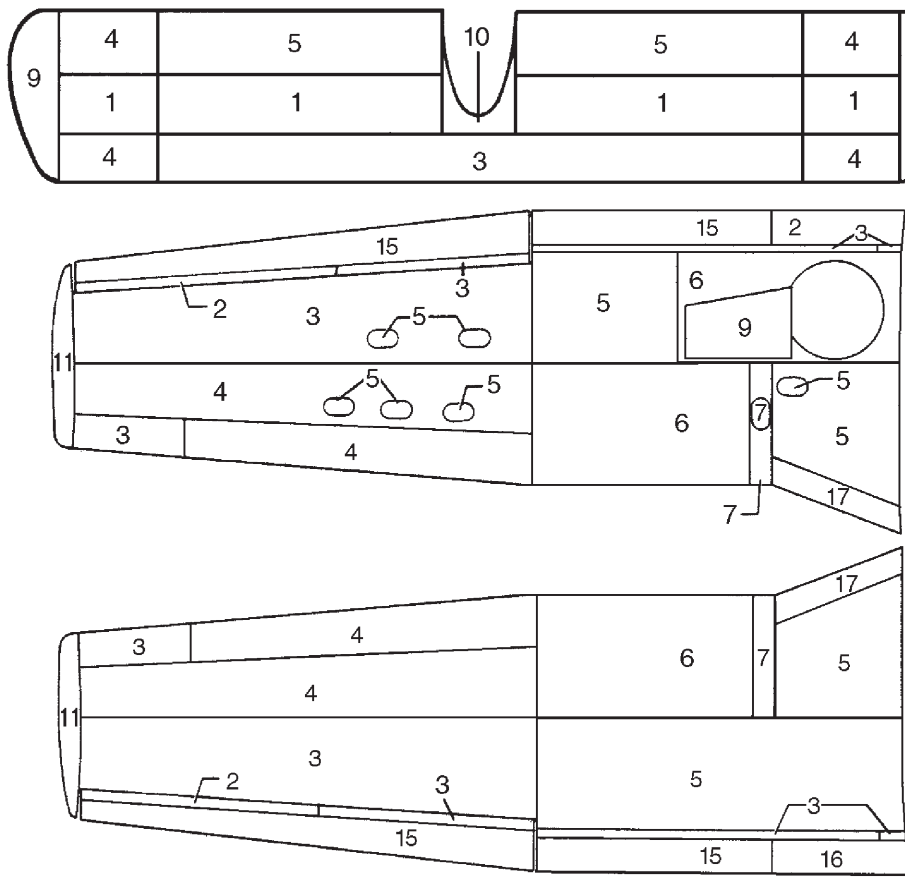
GENERAL

These airplanes have 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.



Skin Material Thickness
Figure 1 (Sheet 1 of 2)



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.

Skin Material Thickness
Figure 1 (Sheet 2 of 2)

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INVESTIGATION, CLEANUP AND AERODYNAMIC SMOOTHNESS

1. Corrosion Control

Corrosion is the deterioration of metal by chemical or electrochemical attack. Water which is allowed to remain on the aircraft and industrial pollution are the major causes of corrosion in aircraft. The two general types of corrosion are:

-- Direct chemical attack (i.e. spilled battery acid).

-- Electrochemical attack which requires a medium (usually water).

The latter is the most common and is responsible for most forms of aircraft corrosion.

Since corrosion is a constant threat, the only effective method to control it is a routine of regular inspection, cleaning, and surface refinishing.

A. Forms of Corrosion (See Chart 1.)

The following are the most common forms of corrosion:

(1) Surface Corrosion appears as a general roughening or pitting on the surface usually accompanied by a powdery deposit of corrosion products. It may spread under the surface and not be recognized until the paint or plating is lifted off the surface in small blisters.

(2) Dissimilar Metal Corrosion may occur when two dissimilar metals are contacting each other. This type may be serious because it usually takes place out of sight. The only way to find it before structural failure is by disassembly and inspection. Insulating is necessary between two contacting dissimilar surfaces (2 to 3 coats of zinc chromate on each surface; plus, if one of the surfaces is magnesium, a 0.003 inch thick piece of vinyl tape).

(3) Intergranular Corrosion is difficult to detect in its early stages. When severe, it causes the surface of the metal to exfoliate (flake or lift).

(4) Stress Corrosion is the result of sustained tensile stresses and corrosive environment. It usually occurs in assemblies such as aluminum alloy bellcranks with pressed in bushings; landing gear shock struts with pipe thread grease fittings, clevis pin joints and shrink-fit parts.

(5) Fretting Corrosion takes place when two parts rub together, constantly exposing fresh active metal to the corrosive effects of the atmosphere.

(6) Filiform Corrosion is the appearance of numerous meandering thread-like filaments of corrosion on the surface of various types of metal.

B. Conditions Affecting Corrosion

Some conditions which affect the occurrence of corrosion are:

(1) Heat and humidity increase corrosion.

(2) Different (i.e. - dissimilar) metals and their relative sizes affect resistance or susceptibility to corrosion.

(3) Frequent contributing factors to corrosion:

(a) Soil and atmospheric dust.

(b) Oil, grease, and exhaust residues.

(c) Salt water and salt moisture condensation.

(d) Spilled battery acids and caustic cleaning solution.

(e) Welding, brazing, and soldering flux residue.

CHART 1
TYPES OF METAL CORROSION

Type of Material	Type of Corrosion	Remedy [(2)]
Steel.	Rust [(1)].	Complete removal of corrosion by mechanical means.
Aluminum.	White to grey powdery material.	Mechanical polishing or brushing with material softer than aluminum.
Magnesium (highly susceptible to corrosion).	White powdery snow-like mounds and white spots.	Mechanical polishing or brushing for a smooth finish.
Cadmium (plating).	White to brown to black mottling of surface (plating is still protecting until iron appears).	Mechanical removal of corrosion is limited to metal surfaces from which cadmium has been depleted.
Chromium (plating).	May pit in chloride environment.	Polishing and buffing.

NOTES:

(1) Red rust generally shows on bolts, nuts, and other aircraft hardware. Rust in these areas is generally not dangerous, however, it shows a need for maintenance and the possibility of corrosive attack in more critical areas. Any surface corrosion on highly stressed steel parts is potentially dangerous. A careful removal of corrosion using mild abrasives (rouge or fine grit aluminum oxide paper) is necessary. Do not overheat metal when removing corrosion.

(2) For abrasion, do not use dissimilar material (for example steel wool on aluminum). Remove only material required to clean affected area.

(4) A clean aircraft will resist corrosion better than a dirty one. Cleaning frequency depends on several factors, including geographical location, type of operation, etc. Remove soil as soon as possible, especially when in a high-temperature area.

(5) After cleaning, verify that no cleaning solution remains in any holes, crevices, or joints, as it may lead to increased corrosion. All exposed areas (landing gear, flap tracks, control surfaces, hinge parts, etc.) must be lubricated after cleaning.

C. Inspection

CAUTION: INSPECTION FOR CORROSION MUST BE PERFORMED BY PERSONS FAMILIAR WITH CORROSIVE PROBLEMS AND REMEDIES.

NOTE: Some areas of the airplane have been treated with a corrosion inhibiting compound which requires re-treatment at five (5) year intervals. See Each Five (5) Years, Per Calendar Year, 5-30-00.

Check for corrosion at every inspection. In trouble areas, inspection frequency must be increased. In addition to routine inspections:

(1) Aircraft operating around a marine environment must be given special inspections on a weekly basis. See Per Specific Operation / Operating Environment, 5-30-00.

(2) Aircraft operating in semi-acid conditions must be inspected monthly. Semi-acid conditions are likely to occur in industrialized areas where sulphur-bearing particles in dust, smoke, and smog will attack painted surfaces. See Per Specific Operation / Operating Environment, 5-30-00.

(3) Inspection for corrosion must be performed by personnel familiar with corrosive problems and remedies.

(a) Daily and preflight inspection must include engine frontal areas, all intake vents, engine compartments, gaps, seams, and faying surfaces in exterior skins, wheel and wheel well areas, battery compartment, fuel cell, all other drains, and any bilge areas not requiring extensive removal of inspection access covers.

(b) Detailed inspection must include above-referenced areas, along with areas requiring removal of inspection plates and panels, to thoroughly inspect internal cavities of aircraft.

(4) Paint tends to hide corrosion in its initial stages. The results of corrosion can sometimes be seen as blisters, flakes, chips, and other irregularities in paint.

D. Corrosion Removal and Control

CAUTION: THE DEPTH OF MATERIAL REMOVED MUST NOT EXCEED SAFE LIMITS.

CAUTION: REMOVAL OF SEVERE CORROSION MAY BE CONSIDERED A MAJOR REPAIR. ANY REPAIR OF THIS TYPE MUST BE APPROVED BY THE FAA BEFORE THE AIRPLANE CAN BE RETURNED TO SERVICE.

Corrosion cannot be prevented or eliminated on aircraft; it can only be reduced to an acceptable level by proper control methods.

All corrosion products must be removed prior to refinishing. If not removed, corrosion will begin again, even though affected area is refinished.

(1) Before beginning any rework:

(a) Position airplane in a wash rack or provide some type of washing apparatus for rapid rinsing of all surfaces.

(b) Connect static ground line to airplane.

(c) Remove airplane battery if required.

(d) Protect pitot-static ports, engine openings, airscoops, louvers, wheels, tires, and other portions of airplane from moisture and chemical brightening agents.

(e) Protect surfaces next to rework areas from chemical paint strippers, corrosion removal agents, and surface treatment materials.

(2) Evaluate corrosion damage to determine type and extent of repairs required. Proceed as follows:

(a) Light Corrosion: discoloration or pitting. Remove by light hand sanding or a small amount of chemical treatment.

(b) Moderate Corrosion: similar to light corrosion except there is blistering or evidence of scaling and flaking. Remove by extensive hand or mechanical sanding.

(c) Severe Corrosion: similar to moderate corrosion with severe blistering, exfoliation, scaling, or flaking. Remove by extensive mechanical sanding or grinding.

E. Corrosion-Prone Areas

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

(1) Areas around steel fasteners are susceptible to corrosion. The paint on these areas cracks, which allows moisture to seep in and corrode the underlying metal. Each time the fastener is removed, it should be coated with fluid resistant epoxy primer (or equivalent) before reinstallation. The paint should be wet when the fastener is installed.

(2) Fluids tend to seep into faying surfaces, seams and joints due to capillary action. The effect of this type of intrusion is usually detectable by irregularities in the skin's surface.

(3) Spot-welded assemblies are particularly prone to corrosion. The only means to prevent this type of corrosion is by keeping potential moisture entry points in the spot-weld filled with a sealant or preservative compound. On an aluminum spot-welded assembly, a chromate conversion coating before paint is applied will help prevent corrosion.

(4) Areas exposed to exhaust gases may have their finish damaged by deposits. These deposits may result in an aggressive attack on the metal by corrosion. Heat from the exhaust may also blister or otherwise damage the paint. Gaps, seams, hinges and fairings are some places where exhaust gas deposits may be trapped and not reached by normal cleaning methods.

(5) The wheel well and landing gear are the most exposed parts of the aircraft. Due to the complexity of its shape, assemblies and fittings, maintaining a protective coverage is difficult. The especially troublesome areas are:

(a) Magnesium wheels: around bolt heads, lugs and wheel well areas:

(b) Exposed rigid tubing, B-nuts, ferrules, under clamps and tubing identification tape:

(c) Exposed position indicator switches and other electrical equipment:

(d) Crevices between stiffeners, ribs and lower skin surfaces.

(6) Flaps, flight control slots and equipment installed in these areas may corrode unnoticed unless a careful surveillance is maintained.

(7) Engine frontal areas, air inlet ducts and the leading edge of wings, because they are constantly exposed to abrasion by dirt, dust, gravel and rain, should be checked frequently for the beginning of corrosion.

(8) Hinges (piano hinges especially) are extremely vulnerable to corrosion. Their protective coatings wear away and they naturally trap dirt, salt and moisture.

(9) Control cables may have bare spots in their preservative coating which will lead to corrosion. Cables having external corrosion must be checked for internal corrosion. If internal corrosion is present, replace the cable. If only external corrosion is present, remove corrosion with wire brush and recoat cable with preservative.

(10) Check and clean drain holes regularly.

(11) Battery compartment and vent openings are especially prone to corrosion due to spilled electrolyte. Fumes from overheated battery electrolyte will spread to adjacent areas and cause rapid corrosion of unprotected surfaces. Frequent cleaning and neutralization of deposits will minimize corrosion in this area.

(12) Magnesium parts are prone to corrosion. Special attention must be given to their surface treatment, proper insulation (due to dissimilar metal corrosion), and paint coatings.

(13) Electrical components and connectors must be checked. Inspection frequency is based on operational environment and past trouble.

(14) Skin joints and lap-overs are two areas that can trap and hold moisture. Corrosion in these areas may go unnoticed unless particular attention is paid to them during inspection.

(15) Hoses, having an internal wire braid, which are located in a position where they are frequently water soaked, need a protective treatment.

(16) Drilled holes and trimmed ends of sandwich panels must be protected. Use an inhibitor solution or sealant application. Any gaps or cavities which allow dirt or moisture to enter must be filled with sealant.

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REPAIRS

WARNING: NO ACCESS HOLES ARE PERMITTED IN ANY CONTROL SURFACE.

WARNING: USE OF PATCH PLATES FOR REPAIRS OF ALL MOVABLE CONTROL 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 CONTROL SURFACES.

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

Structural repair methods used for minor repairs must be in accordance with FAA Advisory Circular 43.13-1, latest revision. To assist in making repairs, Figure 1, 51-00-00, identifies type and thickness of various skin material used.

Repairs to areas defined in FAR Part 43, Appendix A, must be shown (using approved engineering data) to not diminish strength or the Fatigue Life of the component, if a life limit is stated herein (see 4-00-00) or in the aircraft type certificate data sheet (TCDS).

When a repair is proposed, it is the responsibility of the repairer per AC 43.13-1 to determine that the proposed repair is not contrary to manufacturer's data. The repairer or aircraft owner or his agent should contact Piper directly to determine that a proposed repair is not in conflict with minimum type design capability.

Temporary repairs, when required, must add Instructions for Continued Airworthiness (ICA) to the maintenance record. Any such ICA must be based on approved data.

1. Fiberglass Repairs

The repair procedure in this section will describe the methods for the repair of fiberglass-reinforced structures. This section describes Touch-up and Surface Repairs of problems such as blisters, open seams, delaminations, cavities, small holes and minor damages that have not harmed the fiberglass cloth material. Also covered are Fracture and Patch Repairs such as puncture, breaks and holes that have penetrated through the structure and damaged the fiberglass cloth. A repair kit, Piper P/N 766-222, that contains the necessary material for such repairs, is available through Piper Distributors.

NOTE: Very carefully follow resin and catalyst mixing instructions furnished with repair kit.

A. Touch-up and Surface Repairs

(1) Remove wax, oil and dirt from around the damaged area (using acetone, methylethylketone or equivalent) and remove paint to gel coat.

(2) The damaged area may be scraped with a fine blade knife or a power drill with a burr attachment to roughen the bottom and sides of the damaged area. Feather the edge surrounding the scratch or cavity. Do not undercut the edge. (If the scratch or cavity is shallow and penetrates only the surface coat, continue to step (8)

(3) Pour a small amount of resin into a jar lid or on a piece of cardboard, just enough to fill the area being worked on. Mix an equal amount of milled fiberglass with the resin, using a putty knife or stick. Add catalyst, according to kit instruction, to the resin and mix thoroughly. A hypodermic needle may be used to inject gel into small cavities not requiring fiberglass millings mixed with the gel.

(4) Work the mixture of resin, fibers and catalyst into the damaged area, using the sharp point of a putty knife or stick to press it into the bottom of the hole and to puncture any air bubbles which may be present. Fill the scratch or hole above the surrounding undamaged area about .062 of an inch.

(5) Lay a piece of cellophane or waxed paper over the repair to cut off air and start the cure of gel mixture.

(6) Allow the gel to cure 10 to 15 minutes until it feels rubbery to the touch. Remove the cellophane and trim flush with the surface, using a sharp razor blade or knife. Replace the cellophane and allow to cure completely for 30 minutes to an hour. The patch will shrink slightly below the structure surface as it cures. (If wax paper is used, make sure the wax is removed from surface.)

(7) Roughen the bottom and edges of the hole, using the electric burr attachment or rough sandpaper. Feather hole into surrounding gel coat; do not undercut.

(8) Pour a small amount of resin, add catalyst, and mix thoroughly, using a cutting motion rather than stirring. Use no fibers.

(9) Using the tip of a putty knife or fingertips, fill the hole to about .062 of an inch above the surrounding surface with the gel coat mixture.

(10) Lay a piece of cellophane over the patch to start the curing process. Repeat step (6), trimming patch when partially cured.

(11) After trimming the patch, immediately place another small amount of gel coat on one edge of the patch and cover with cellophane. Then, using a squeegee or the back of a razor blade, level with area surrounding the patch; leave the cellophane on patch for one to two hours or overnight, for complete cure.

(12) After repair has cured for 24 hours, sand patched area, using a sanding block with fine wet sandpaper. Finish by priming, again sanding and applying color coat.

B. Fracture and Patch Repairs

(1) Remove wax, oil and dirt from around the damaged area (using acetone, methylethylketone or equivalent).

(2) Using a key hole saw, electric saber saw, or sharp knife, cut away ragged edges. Cut back to sound material.

(3) Remove paint three inches back from around damaged area.

(4) Working inside the structure, bevel the edges to approximately a 30-degree angle and rough-sand the hole and the area around it, using 80-grit dry paper. Feather back for about two inches all around the hole. This roughens the surface for strong bond with patch.

(5) Cover a piece of cardboard or metal with cellophane. Tape it to the outside of the structure, covering the hole completely. The cellophane should face toward the inside of the structure. If the repair is on a sharp contour or shaped area, a sheet of aluminum formed to a similar contour may be placed over the area. The aluminum should also be covered with cellophane.

(6) Prepare a patch of fiberglass mat and cloth to cover an area two inches larger than the hole.

(7) Mix a small amount of resin and catalyst; enough to be used for one step at a time, according to kit instructions.

(8) Thoroughly wet mat and cloth with catalyzed resin. Daub resin on mat first, and then on cloth. Mat should be applied against structures surface with cloth on top. Both pieces may be wet out on cellophane and applied as a sandwich. Enough fiberglass cloth and mat reinforcements should be used to at least replace the amount of reinforcements removed in order to maintain the original strength. If damage occurred as a stress crack, an extra layer or two of cloth may be used to strengthen area.

(9) Lay patch over hole on inside of structure, cover with cellophane, and squeegee from center to edges to remove all air bubbles and assure adhesion around edge of hole. Air bubbles will show white in the patch and they should all be worked out to the edge. Remove excess resin before it gels on the part. Allow patch to cure completely.

(10) Remove cardboard or aluminum sheet from outside of hole and rough-sand the patch and edge of hole. Feather edge of hole about two inches into undamaged area.

(11) Mask area around hole with tape and paper to protect surface. Cut a piece of fiberglass mat about one inch larger than the hole and one or more pieces of fiberglass cloth two inches larger than the hole. Brush catalyzed resin over hole, lay mat over hole and wet out with catalyzed resin. Use a daubing action with brush. Then apply additional layer or layers of fiberglass cloth to build up patch to the surface of structure. Wet out each layer thoroughly with resin.

(12) With a squeegee or broad knife, work out all air bubbles in the patch. Work from center to edge pressing patch firmly against the structure. Allow patch to cure for 15 to 20 minutes.

(13) As soon as the patch begins to set up, but while still rubbery, take a sharp knife and cut away extra cloth and mat. Cut on outside edge of feathering. Strip cut edges of structure. Do this before cure is complete, to save extra sanding. Allow patch to cure overnight.

(14) Using dry 80 grit sandpaper on a power sander or sanding block, smooth patch and blend with surrounding surface. Should air pockets appear while sanding, puncture and fill with catalyzed resin. A hypodermic needle may be used to fill cavities. Let cure and resand.

(15) Mix catalyzed resin and work into patch with fingers. Smooth carefully and work into any crevices.

(16) Cover with cellophane and squeegee smooth. Allow to cure completely before removing cellophane. Let cure and resand.

(17) Brush or spray a coat of catalyzed resin to seal patch. Sand patch, finish by priming, again sanding and applying color coat.

NOTE: Brush and hands may be cleaned in solvents such as acetone or methylethylketone. If solvents are not available, a strong solution of detergent and water may be used.

2. Thermoplastic Repairs

The following procedure will assist in making field repairs to items made of thermoplastic which are used throughout the airplane. Chart 1 lists materials needed to perform these repairs along with suggested suppliers. Common safety precautions should be observed when handling some of the materials and tools used while making these repairs. Refer to Vendor Information, Chapter 91, for supplier addresses.

A. Surface Preparation

(1) Surface dirt and paint if applied must be removed from the item being repaired. Household cleaners have proven most effective in removing surface dirt.

(2) Preliminary cleaning of the damaged area with perchlorethylene or V M & P Naphtha will generally ensure a good bond between epoxy compounds and thermoplastic.

B. Surface Scratches, Abrasion or Ground-in-Dirt (See Figure 1.)

(1) Shallow scratches and abraded surfaces are usually repaired by following directions on containers of conventional automotive buffing and rubbing compounds.

(2) If large dirt particles are embedded in thermoplastic parts they can be removed with a hot air gun capable of supplying heat in the temperature range of 300° to 400° F. Use care not to overheat the material. Hold the nozzle of the gun about 1/4 of an inch away from the surface and apply heat with a circular motion until the area is sufficiently soft to remove the dirt particles.

(3) The thermoplastic will return to its original shape upon cooling.

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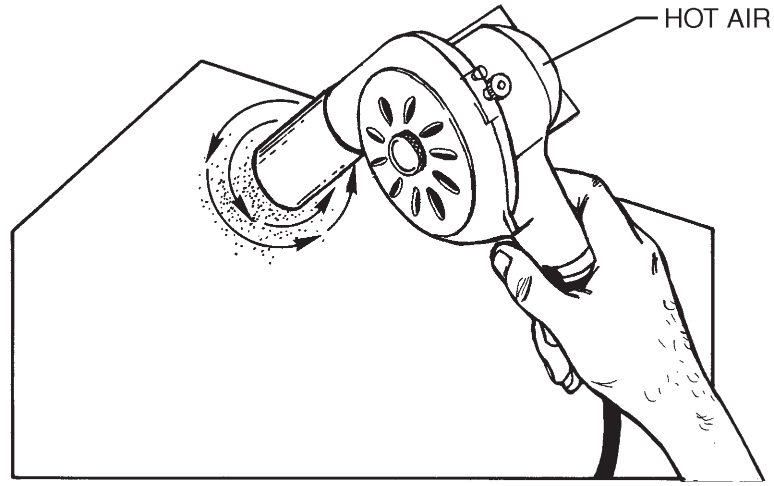

Surface Scratches - Abrasions or Ground in Dirt
Figure 1

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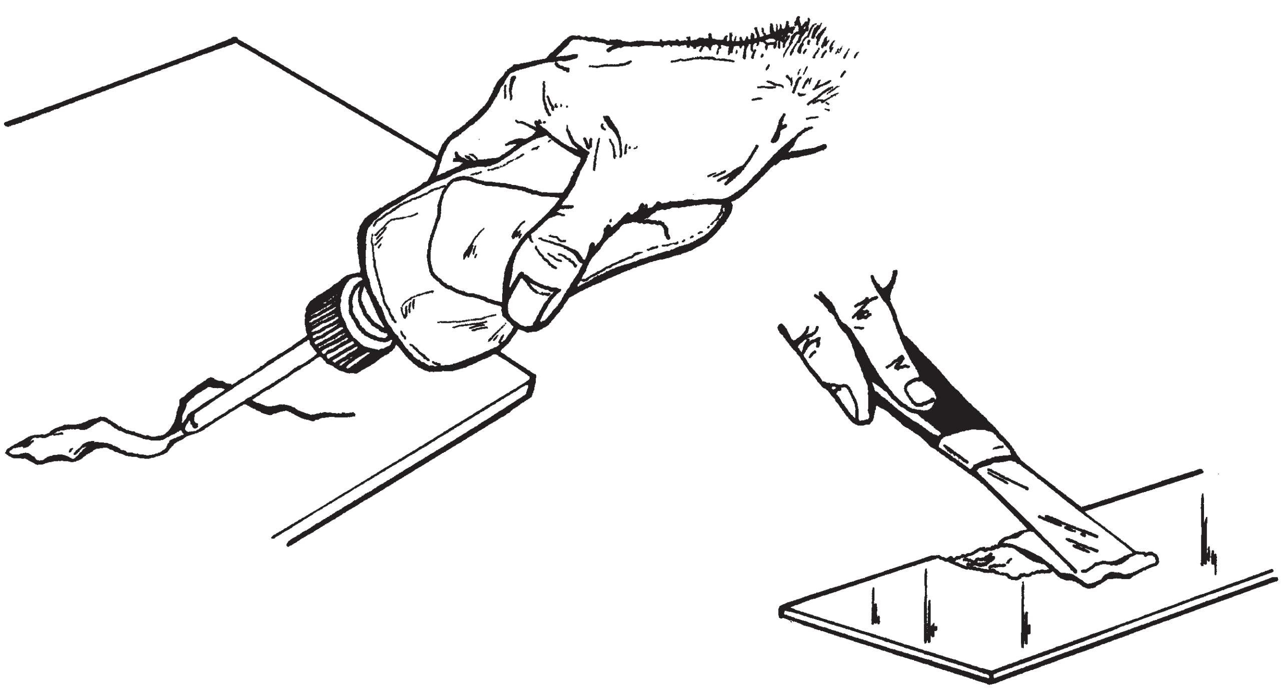

Deep Scratches, Shallow Nicks and Small Holes
Figure 2

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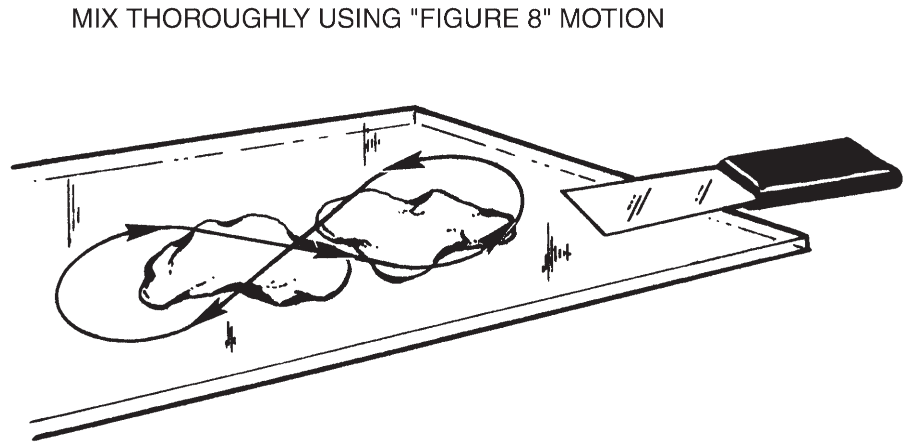

Mixing of Epoxy Patching Compound
Figure 3

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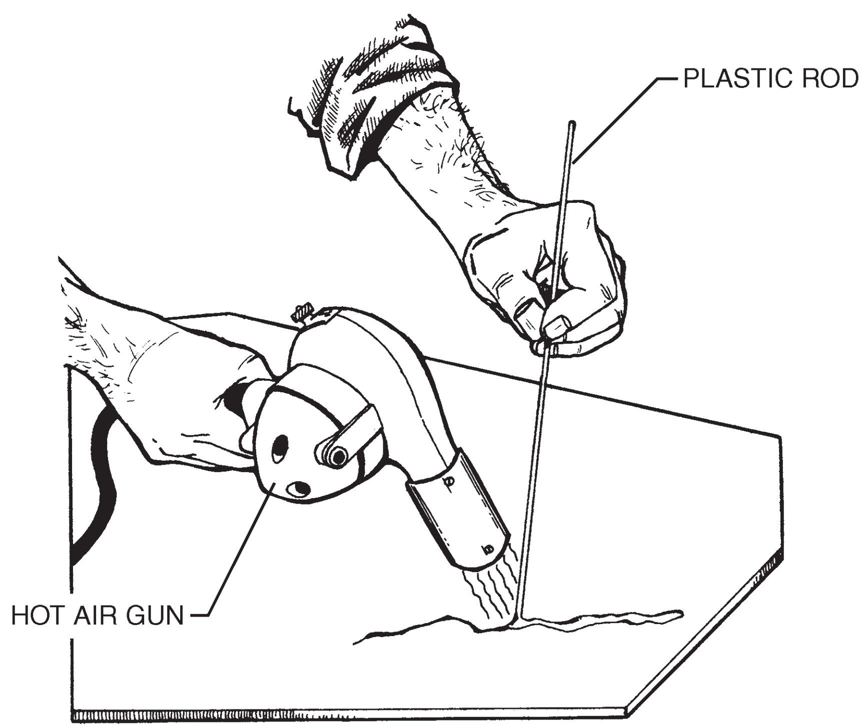

Welding Repair Method
Figure 4

CHART 1
LIST OF MATERIALS (THERMOPLASTIC REPAIRS)

Items	Descriptions	Suppliers
Buffing and Rubbing Compounds	Automotive Type - DuPont #7	DuPont Company
	Ram Chemical #69 x 1	Ram Chemicals
	Mirror Glaze #1	Mirror Bright Polish Co., Inc.
Cleaners	Fantastic Spray	Obtain From Local Suppliers
	Perchlorethylene	
	V M & P Naphtha (Lighter Fluid)	
ABS-Solvent Cements	Solarite #11 Series	Solar Compounds Corp.
Solvents	Methylethylketone	Obtain From Local Suppliers
	Methylene Chloride	
	Acetone	
Epoxy Patching Compound	Solarite #400	Solar Compounds Corp.
Hot Melt Adhesives	Stick Form 1/2 in. dia.	Sears Roebuck & Co. or
Polyamids and Hot Melt Gun	3 in. long	Most Hardware Stores
Hot Air Gun	Temp. Range 300° to 400° F	Local Suppliers

C. Deep Scratches, Shallow Nicks and Small Holes - Less than 1 inch in diameter (See Figure 2.)

(1) Solvent cements will fit virtually any of these applications. If the area to be repaired is very small, it may be quicker to make a satisfactory cement by dissolving thermoplastic material of the same type being repaired in solvent until the desired paste like consistency is achieved.

(2) This mixture is then applied to the damaged area. Upon solvent evaporation, the hard durable solids remaining can easily be shaped to the desired contour by filing or sanding.

(3) Solvent adhesives are not recommended for highly stressed areas, or thin walled parts or for patching holes greater than 1/4 inch in diameter.

(4) For larger damages, an epoxy patching compound is recommended. This type material is a two part, fast curing, easy sanding commercially available compound.

(5) Adhesion can be increased by roughing the bonding surface with sandpaper and by utilizing as much surface area for the bond as possible.

(6) The patching compound is mixed in equal portions on a hard flat surface using a figure eight motion. The damaged area is cleaned with perchlorethylene or V M & P Naphtha prior to applying the compound (see Figure 3).

(7) A mechanical sander can be used after the compound is cured, providing the sander is kept in constant motion to prevent heat buildup.

(8) For repairs in areas involving little or no shear stress, the hot melt adhesives, polyamids which are supplied in stick form, may be used. This type of repair has a low cohesive strength factor.

(9) For repairs in areas involving small holes, indentations or cracks in the material where high stress is apparent or where thin walled sections are used, the welding method is suggested.

(10) This welding method requires a hot air gun and ABS rods. To weld, the gun should be held to direct the flow of hot air into the fusion (repair) zone, heating the damaged area and rod simultaneously. The gun should be moved continuously in a fanning motion to prevent discoloration of the material. Pressure must be maintained on the rod to ensure good adhesion (see Figure 4).

(11) After the repair is completed, sanding is allowed to obtain a surface finish of acceptable appearance.

D. Cracks (See Figure 5.)

(1) Before repairing a crack in the thermoplastic part, first determine what caused the crack and alleviate that condition to prevent it from recurring after the repair is made.

(2) Drill small stop holes at each end of the crack.

(3) If possible, a double plate should be bonded to the reverse side of the crack to provide extra strength to the part.

(4) The crack should be "V" grooved and filled with repair material, such as solvent cement, hot melt adhesive, epoxy patching compound or it should be hot air welded, whichever is preferred.

(5) After the repair has cured, it may be sanded to match the surrounding finish.

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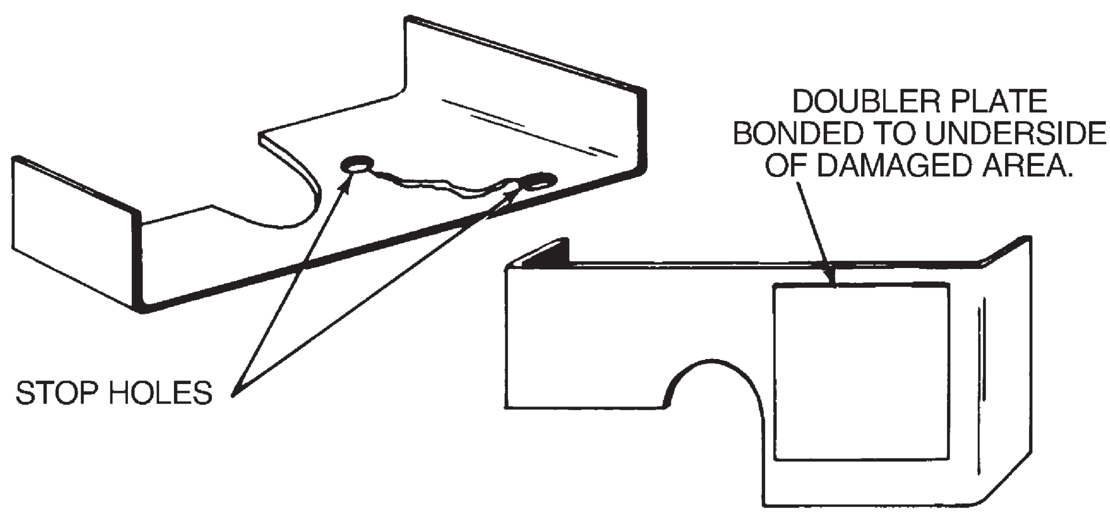
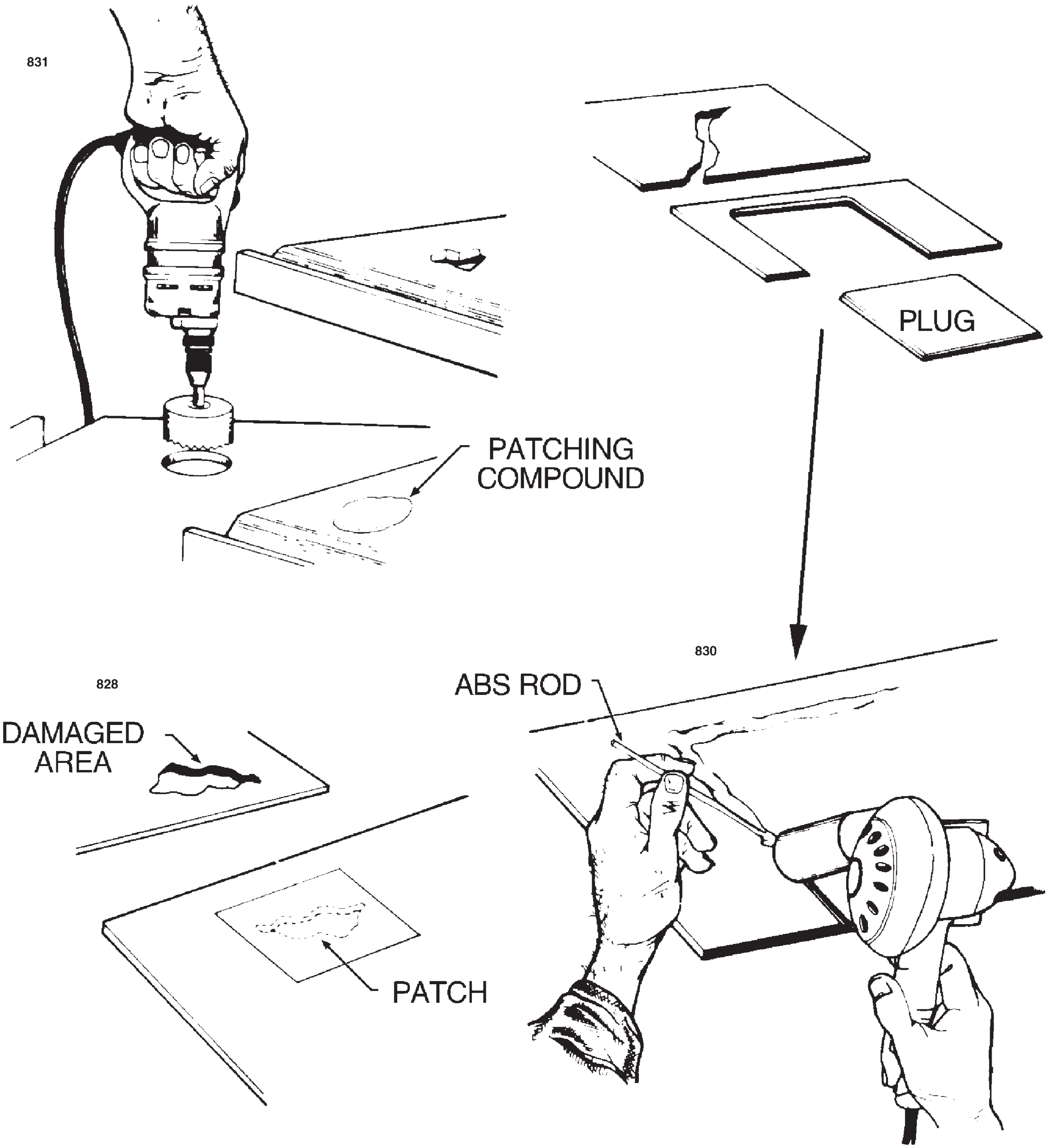


Repairing of Cracks
Figure 5



Various Repairs
Figure 6

E. Repairing Major Damage - Larger than 1 inch in diameter (See Figure 6.)

(1) If possible, a patch should be made of the same material, and cut slightly larger than the section being repaired.

(2) When appearances are important, large holes, cracks, tears, etc, should be repaired by cutting out the damaged area and replacing it with a piece of similar material.

(3) When cutting away the damaged area, under cut the perimeter and maintain a smooth edge. The patch and/or plug should also have a smooth edge to ensure a good fit.

(4) Coat the patch with solvent adhesive and firmly attach it over the damaged area.

(5) Let the patch dry for approximately one hour before any additional work is performed.

(6) The hole, etc, is then filled with the repair material. A slight overfill of the repair material is suggested to allow for sanding and finishing after the repair has cured. If patching compound is used, the repair should be made in layers, not exceeding a 1/2 inch thickness at a time. This will allow the compound to cure and ensure a good solid buildup of successive layers as required.

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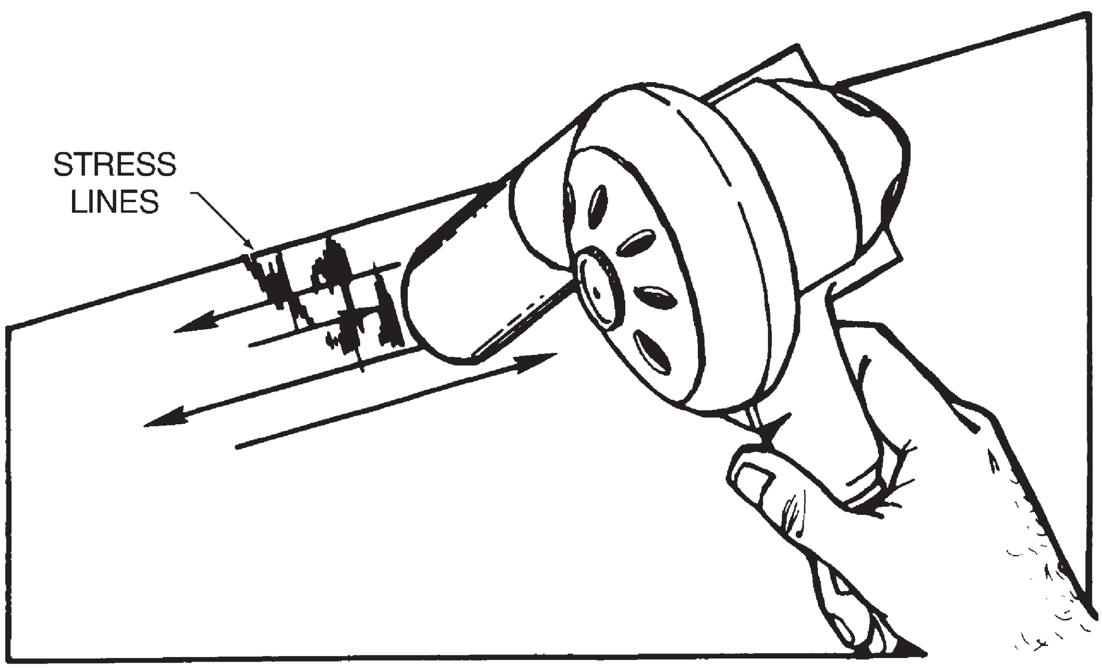
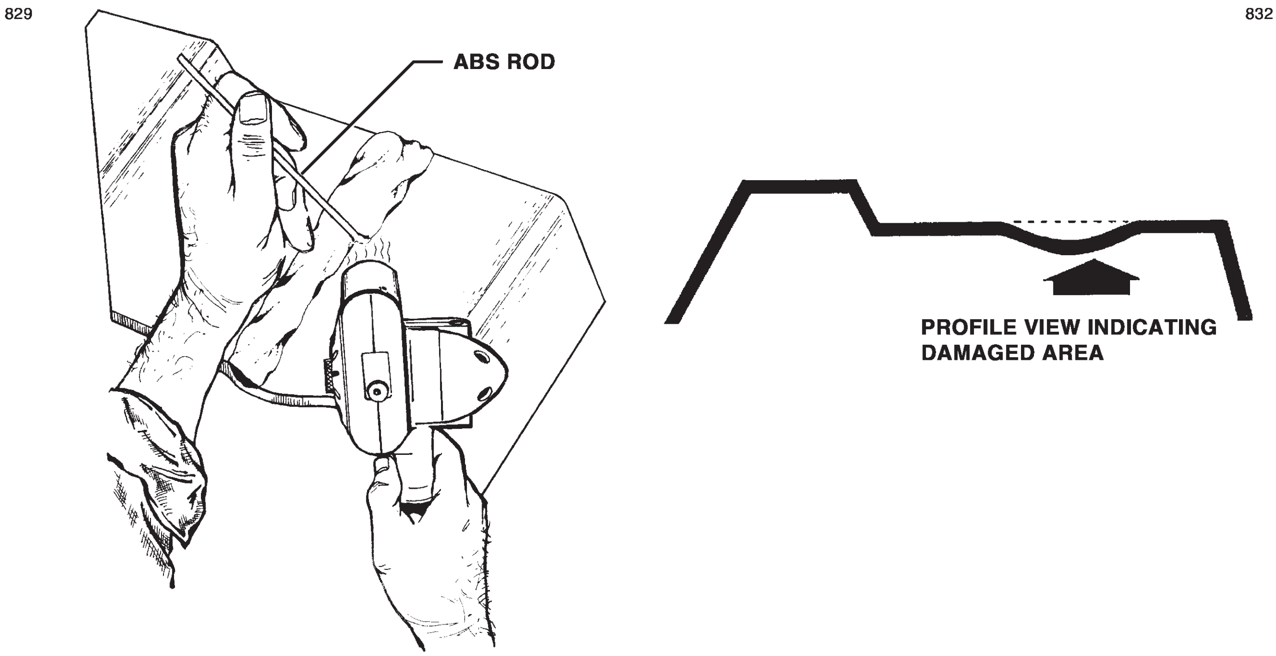


Repair of Stress Lines
Figure 7



Repair of Impacted Damage
Figure 8

F. Stress Lines (See Figure 7.)

(1) Stress lines produce a whitened appearance in a localized area and generally emanate from the severe bending or impacting of the material (see Figure 8).

(2) To restore the material to its original condition and color, use a hot air gun or similar heating device and carefully apply heat to the affected area. Do not overheat the material.

G. Painting the Repair

(1) An important factor in obtaining a quality paint finish is the proper preparation of the repair and surrounding area before applying any paint.

(2) It is recommended that parts be cleaned prior to painting with a commercial cleaner or a solution made from one-fourth cup of detergent mixed with one gallon of water.

(3) The paint used for coating thermoplastic can be either lacquers or enamels, depending on which is preferred by the repair facility or customer.

NOTE: It is extremely important that solvent formulations be considered when selecting a paint, because not an lacquers or enamels can be used satisfactorily on thermoplastic. Some solvents used in the paints can significantly affect and degrade the plastic properties

(4) Another important matter to consider is that hard, brittle coatings that are usually best for abrasion resistance should not be used in areas which incur high stress, flexing or impact. Such coating may crack, thus creating a weak area.

3. Pressure Sensitive Safety Walk Installation

(PIR-PPS45010, Rev. G.)

Pressure sensitive safety walk (i.e. - non-skid) is installed on the right wing root, right inboard flap end, and the top of the boarding step to provide a secure non-slip path to the cabin door.

A. Surface Preparation

(1) Allow newly painted surfaces to dry a minimum of 2 hours prior to applying the safety walk.

(2) If the paint becomes contaminated, remove the contamination with clean dry rags or paper wipers moistened with MIL-S-18718 Safety Solvent.

(3) Prior to applying the safety walk, wipe the applicable surface with a clean dry cloth, ensuring that no moisture remains on the surface.

B. Application Procedure

(1) Do not apply when surface temperature is below 50°F.

(2) Peel back the full width of the protective liner leading edge approximately two inches.

(3) Adhere the leading edge of the safety walk to the forward edge of the area being covered.

(4) Remove the remaining protective liner as the safety walk is being adhered from front to back.

(5) Roll firmly with a long handled cylindrical brush in both lengthwise directions.

(6) Seal all edges of the safety walk with “3M Company Safety Walk Edge Sealing Compound” (P/N 914-055) or “Flex-Tred Edge Sealer” (P/N 688-440). Position the bead with half the bead on the safety walk and half on the surface on which the safety walk is mounted.

4. Metal / Wire Stitching Repair (See Figure 9.)

(PIR-PPS20024, Rev. A.)

CAUTION: METAL/WIRE STITCHING (AND THE ALTERNATE METHOD OF JOINING DESCRIBED BELOW) SHALL ONLY BE USED FOR NON-STRUCTURAL, NON-LOAD CARRYING APPLICATIONS.

A metal/wire stitching process is used to staple fabric and rubber seal materials to engine baffles and some composite materials. The following alternate method of joining is approved for field use when replacing these fabric and rubber seal materials.

Alternate (Rivet) Method of Joining.

(1) Substitute two rivets in lieu of each staple where stitching was previously used or is specified. Maintain a minimum of .75 inch spacing between rivets.

(2) When materials being joined include Stainless Steel, Galvanized Steel or Steel, use:

(a) MS20615M4 Rivet (Monel) and NAS1149CN432R Washer (See Figure 9.)

(b) Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.

(3) When materials being joined include only aluminum and nonmetallic materials use:

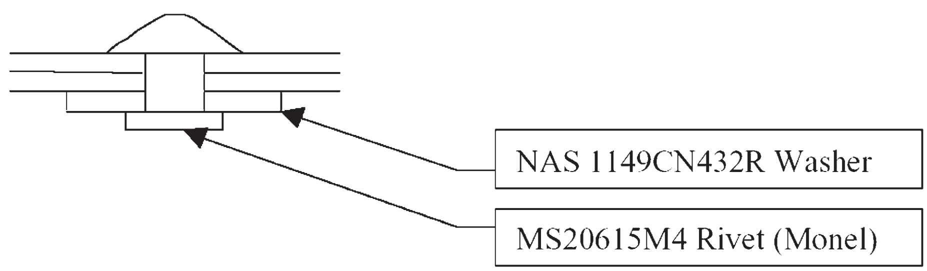
(a) MS20470A4 Rivet and NAS1149DN432H Washer (See Figure 9.)

(b) Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.

When materials being joined include Stainless Steel, Galvanized Steel or Steel, use:

MS20615M4 Rivet (Monel)
NAS1149CN432R Washer

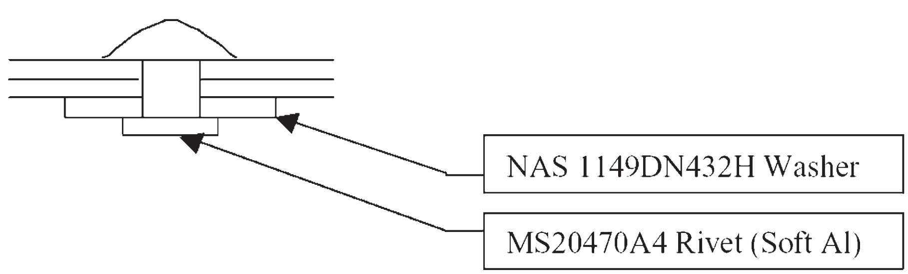
Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.



When materials being joined include only aluminum and nonmetallic materials use:

MS20470A4 Rivet
NAS1149DN432H Washer

Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.



Metal / Wire Stitching Repair
Figure 9

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ELECTRICAL BONDING

1. General (See also 23-60-00.) (PIR-PPS55006, Rev. T.)

All electrical and electronic equipment and specified components shall be installed in such a manner as to provide a continuous low resistance path (bonds) from the equipment enclosure/component to the airplane structure. Bonds must be installed to ensure that the structure and equipment are electrically stable and free from the hazards of lightning, static discharge, electrical shock, etc.

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

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

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

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

2. 100 Hour Inspection (PIR-AC 43.13-1, Rev. B.)

Each 100 hours, visually inspect shield and shield terminations of each electrical harness for integrity, condition, and security. If electrical arcing is evident, check for intermittent contact between conducting surfaces. Arcing can be prevented by bonding or insulation, as appropriate.

Inspect the components listed in Chart 1 as follows:

A. Bond connections shall be secure and free from corrosion.

B. Bonding jumpers installed so as not to interfere in any way with the operation of moveable components of the aircraft.

C. No self-tapping screws used for bonding purposes.

D. Exposed conducting frames or parts of electrical or electronic equipment should have a low resistance bond of less than 2.5 millohms to structure. If the equipment design includes a ground terminal or pin, which is internally connected to such exposed parts, a ground wire connection to such terminal will satisfy this requirement.

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

F. Where aluminum or copper is bonded to dissimilar metallic structures, ensure installed hardware (typically washers) is as called out in the parts catalog to minimize electrolytic corrosion and ensure the hardware should corrode first.

3. On Condition Inspection

Whenever any electrically bonded component (see Chart 1) is removed and reinstalled, or visual inspection reveals the electrical bonding to be suspect, measure resistance between component and aircraft structure.

To ensure proper operation and suppression of radio interference from hazards, electrical bonding of equipment must not exceed the maximum allowable resistance values specified in Chart 1.

A. Measurements should be performed after the grounding and bonding mechanical connections are complete to determine if the measured resistance values meet the basic requirements.

B. A high quality test instrument (an AN/USM-21A or equivalent) will accurately measure the very low resistance values specified.

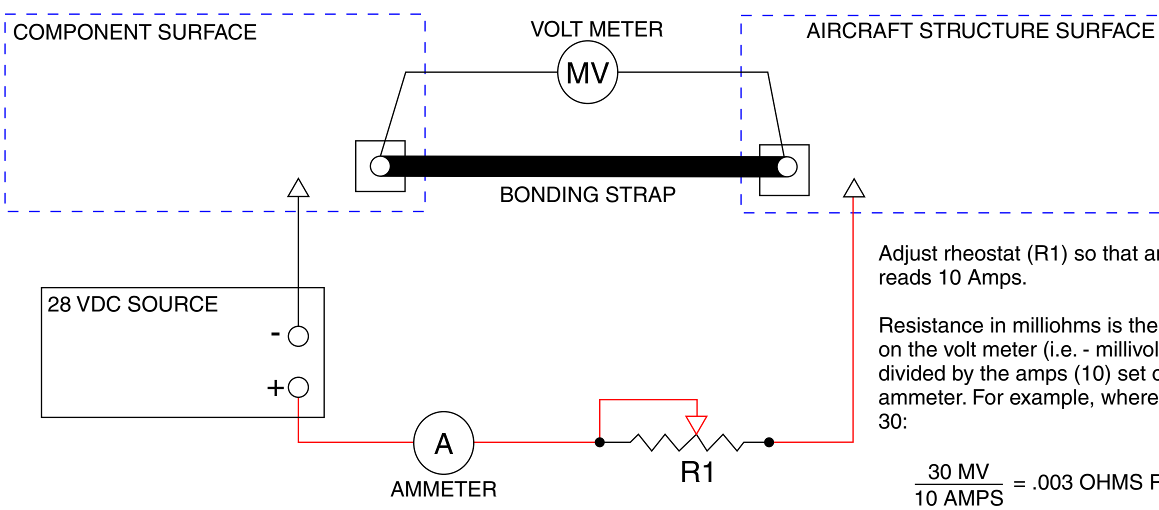
C. Another method of measurement is the millivolt drop test as shown in Figure 1.

CHART 1
ELECTRICAL BONDING RESISTANCE INDEX

Component	Maximum Allowable Resistance Value in Ohms
Engine Mount(s)	.003
Generator(s)	.010
Ailerons	.003
Elevator / Stabilator	.003
Rudder	.003
Alternator(s)	.010
Trim Tab(s)	
Conventional Hinge	.003
Piano Hinge	.010
Instrument Panel Inserts	.010
Exterior Lights Mounted on Non-Conductive Material	.003
Avionics 'Black Boxes'	.003
NOTE: Harnesses should be installed and connected for this check, internal chassis wiring through the connector to ground is permissible for this grounding.	
Battery Ground Point	.010
Static wick mounting plates (TCO Model B-4) P/N 452-094	1.00

NOTE: Where jumper wires or cables are used to accomplish a proper bond, resistance between the jumper terminal and the component or structure shall not exceed .001 ohms. The controlling points for measuring resistance will be within the limits of the cleaned area to be bonded and within 1/4 inch of the exterior limits of the bonding jumper terminal or material called for in the bill of materials of the drawing.

Resistance to ground will be measured from wire terminal to structure for electrical / electronic equipment not internally grounded and from mounting flange to structure for equipment that is internally grounded.



Adjust rheostat (R1) so that ammeter (A) reads 10 Amps.

Resistance in milliohms is then the reading on the volt meter (i.e. - millivolts (MV)) divided by the amps (10) set on the ammeter. For example, where MV equals 30:

$$\frac{30\ \text{MV}}{10\ \text{AMPS}} = .003\ \text{OHMS RESISTANCE}$$

Millivolt Drop Test
Figure 1

4. Garmin G1000 Electrical Bonding Inspection (PIR-PPS55014, Rev. D)

The following procedures test the GRS 77, the accessory bracket, both GPS antennas, the Mag and bracket assembly, the PFD and MFD Rack, GDU 1040's and the OAT Probe for proper bonding.

A milliohmmeter or equivilent will be needed to complete the procedure.

NOTE: Any area that fails shall be re-bonded and re-tested per AC 43.13-1 latest revision.

A. GRS 77 Test. (Refer to Figure 2.)

(1) Test betwen the two probe points shown in Figure 2.

(2) Make sure the unit is not connected or is removed from the rack for this test.

(3) PASS: **= or < 2.5 mohms**

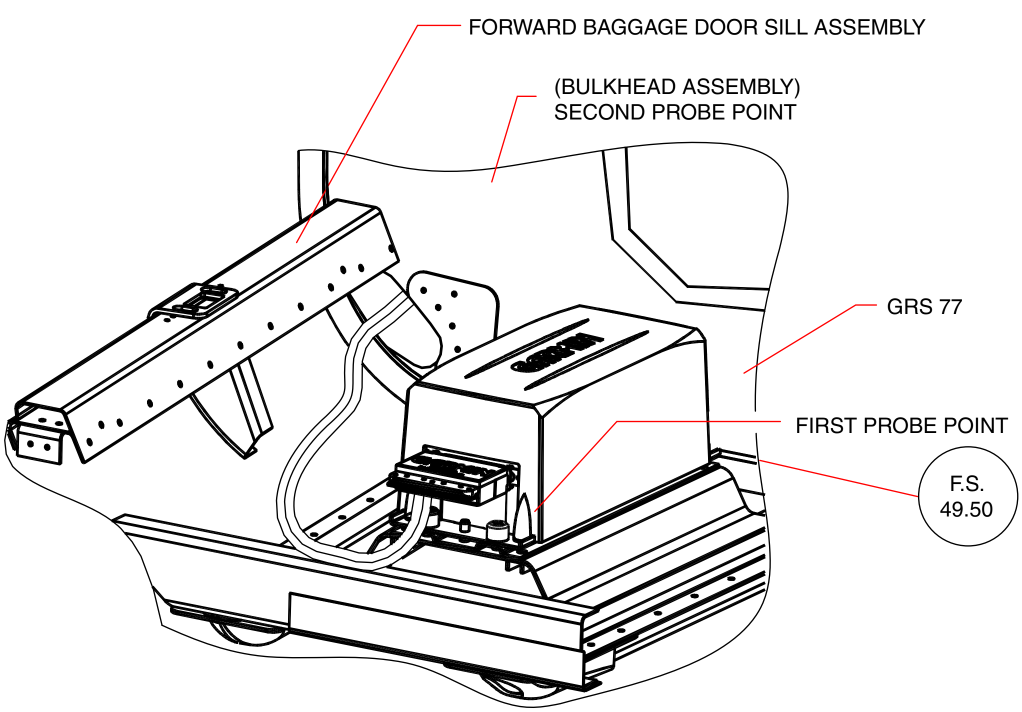
B. Accessory Bracket Test. (Refer to Figure 3.)

(1) Test from Bracket as shown to the aircraft floor.

(2) Do not use screws as test point, it must be to the bracket.

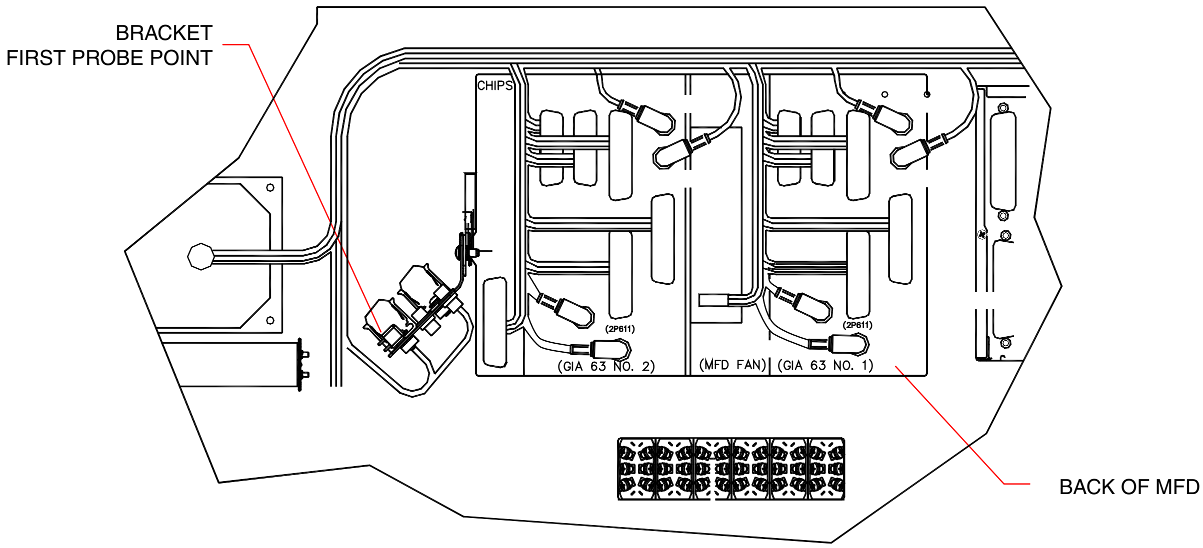
(3) Do not use the instrument panel a second test point, it must be the floor of the aircraft.

(4) PASS: **= or < 2.5 mohms**



GRS 77
Figure 2

Effectivity
with Garmin G1000



Effectivity
with Garmin G1000

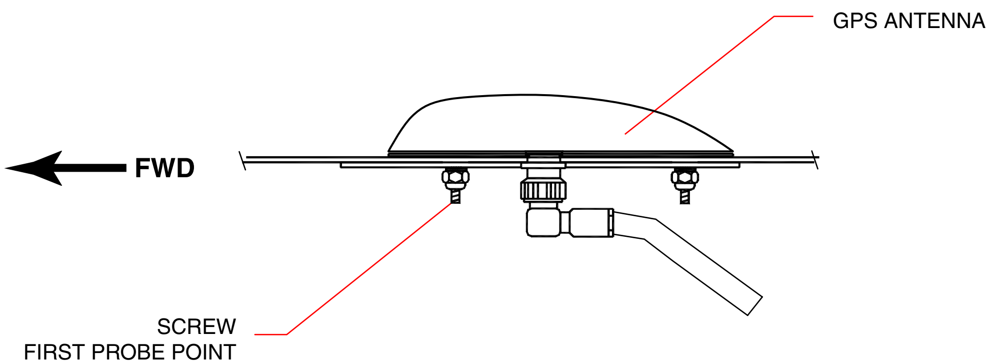
Accessory Bracket
Figure 3

C. GPS Antennas (both) Test. (Refer to Figure 4.)

(1) Test from the screws to a point on the aircraft frame that is two (2) feet away.

(2) Coax cable must be removed for this test.

(3) PASS: **= or < 2.5 mohms**



Effectivity
with Garmin G1000

GPS Antenna
Figure 4

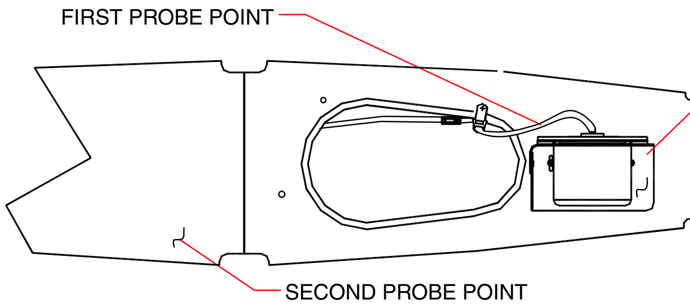
D. GMU 44 MAG Test. (Refer to Figure 5.)

(1) Test between the two (2) points shown.

(2) This test verifies that the bracket mount is bonded to the bracket and to the airframe.

(3) Make sure unit is unplugged or removed from bracket for his test.

(4) PASS: **= or < 2.5 mohms**



GMU 44 MAG
Figure 5

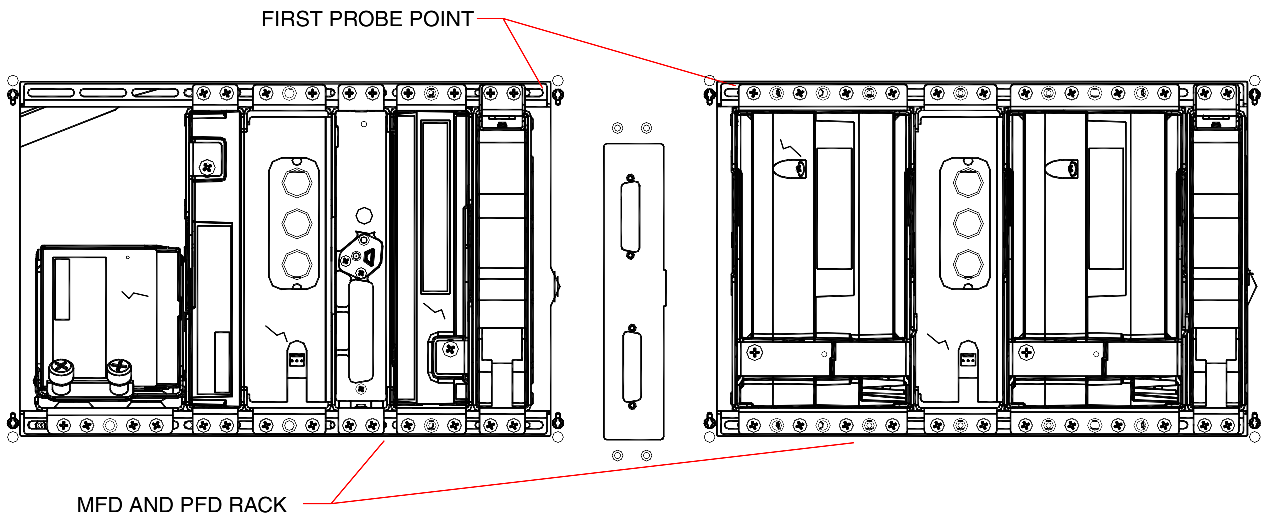
Effectivity
with Garmin G1000

E. MFD and PFD Rack. (Refer to Figure 5.)

(1) Test between the rack and aircraft floor as in the Accessory Bracket Test.

(2) This is the main rack that holds all other equipment.

(3) PASS: **= or < 2.5 mohms**



MFD and PFD Rack
Figure 6

Effectivity
with Garmin G1000

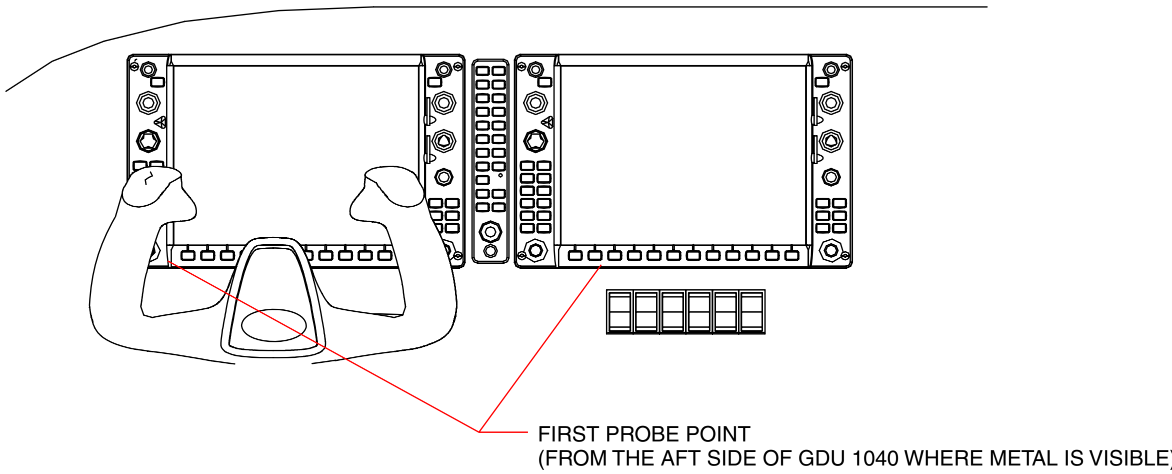
F. MFD and PFD GDU 1040's Test. (Refer to Figure 7.)

(1) Test on a clean metal spot on aft side of GDU while unit is installed to a location on the aircraft floor same as in the Accessory Bracket Test.

(2) The unit must be installed for this test. Test from the back side of the panel while it is installed.

(3) Firgure 7 shows the front side of the unit just to show approximate location to test on aft side.

(4) PASS: **= or < 20 mohms**



Effectivity
with Garmin G1000

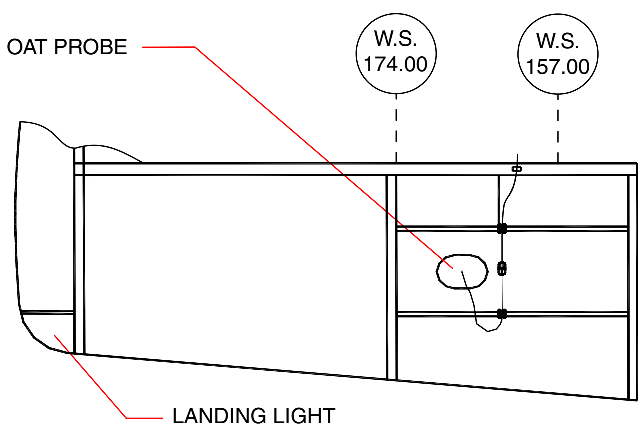
MFD and PFD
Figure 7

G. OAT Probe Test (Refer to Figure 8).

(1) Test between the cover and two (2) feet away on aircraft frame.

(2) Do not use the screws that mount the cover plate as a test point, use the outside of the OAT Probe while installed.

(3) PASS: **= or < 2.5 mohms**



Effectivity
with Garmin G1000

OAT Probe
Figure 8

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CHAPTER

52

DOORS

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CHAPTER 52

LIST OF EFFECTIVE PAGES

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Effective Pages	2	Jun 30/07			
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	2	Jun 30/07			
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	2	Jun 30/07			
	3	Jun 30/07			
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	5	Jun 30/07			
	6	Jun 30/07			
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	2	Jun 30/07			

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CHAPTER 52 - DOORS

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GENERAL

1. 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.

2. Door Snubber Seals - Replacement

Door snubber seals are incorporated in the door jambs to improve door sealing in all doors except the forward cabin door of HP S/N's 3246018 & up and TC S/N's 3257001 & up. On those airplanes, the latching mechanism used in the forward cabin door has improved sealing characteristics sufficient 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

A. To replace door snubber seal, proceed with the following steps:

(1) Remove windlace retainers, “roll” back windlace (tape to secure) out of way, remove all scuff plates and disconnect door holder.

(2) Remove all striker plates except where shown in Figure 1, Section A-A.

(3) With a plastic scraper or other appropriate instrument, scrape off snubber while applying mineral spirits as necessary to loosen strip and wipe off excess adhesive with a clean cloth.

B. Install snubber as follows:

(1) If door jamb is flaking or excessively scuffed, rub down with wet and dry emery cloth. Clean surface using Prep-Sol or equivalent cleaner which will not leave an oily residue.

(2) Mask jamb as shown in View E of Figure 1.

(3) Apply adhesive to door jamb as shown in View E of Figure 1.

(4) Apply adhesive to inside surface of snubber.

(5) Position snubber with protruding leg facing outboard beginning at lower center of door jamb and work progressively around jamb applying pressure to snubber to remove any trapped air and to ensure a proper bond. Do not prestretch snubber as this can induce cracks.

NOTE: Normal tack time for 3M EC 1300L is 30-45 minutes at 75°F. However, adhesive that has “set” may be reactivated by a clean rag moistened with Toluol or MEK.

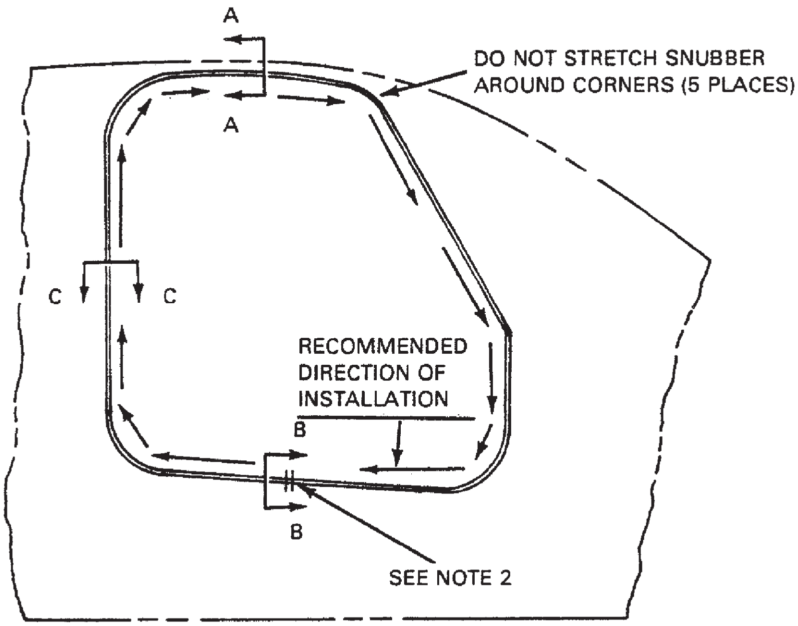
(6) It takes approximately 1 day for bond to cure. Do Not allow door to close during this period. It is recommended that door be left open as long as possible to effect curing.

(7) Remove masking tape if used and clean off excessive adhesive smears using Mineral Spirits or Toluol and a clean cloth. Install striker plates and windlacing. Cut snubber for aft cabin door as shown in Figure 1.

(8) Check that doors close properly and readjust as necessary to achieve a flush fit. Latching effort must not have increased.

(9) With all hardware and plates installed, coat snubbers with silicone.

FORWARD CABIN
DOOR INSTALLATION

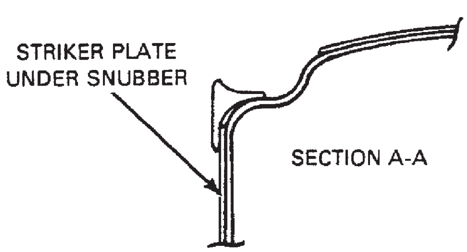


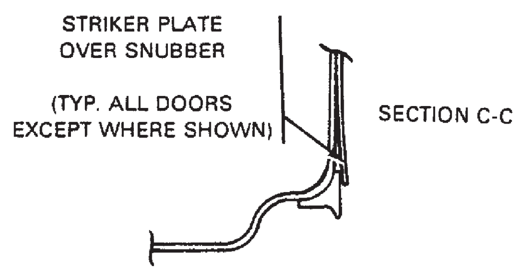
VIEW LOOKING INBOARD RIGHT HAND SIDE

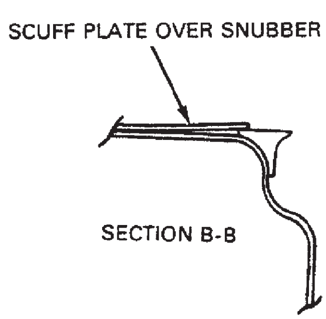
NOTES

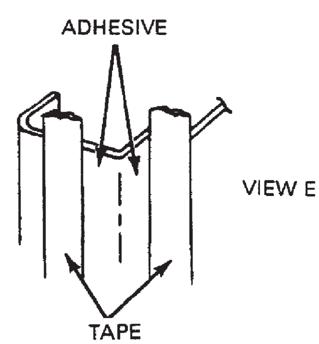
1. ORIENT SNUBBER FLAT WITH THIS SURFACE.
2. BUTT JOINT SHALL BE AT CENTER OF DOOR JAMB ±2.0 INS.
3. TRIM SNUBBER TO CLEAR DOOR LATCH PINS WHEN APPLICABLE.

HP S/N'S 3246001 THRU 3246017 ONLY

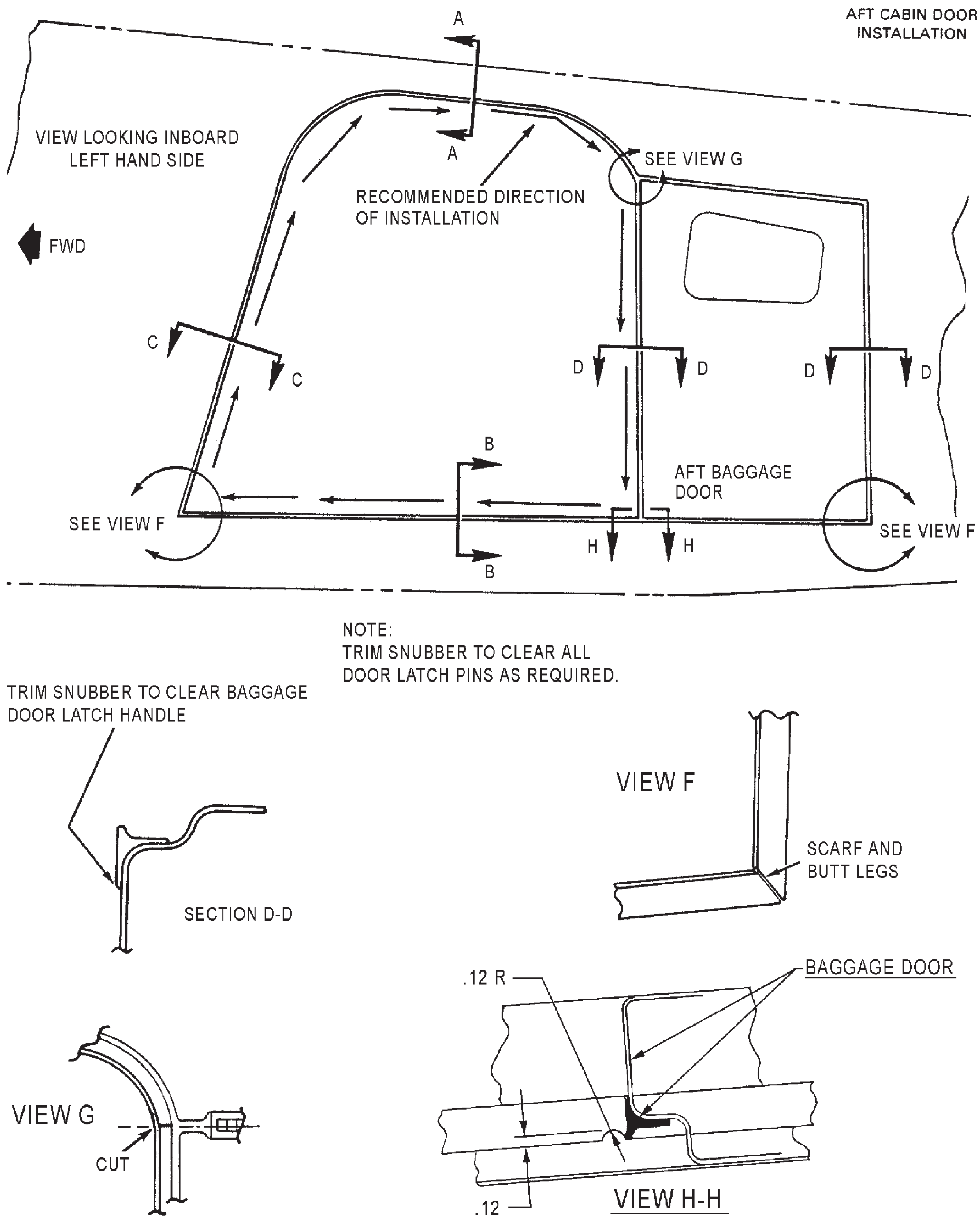




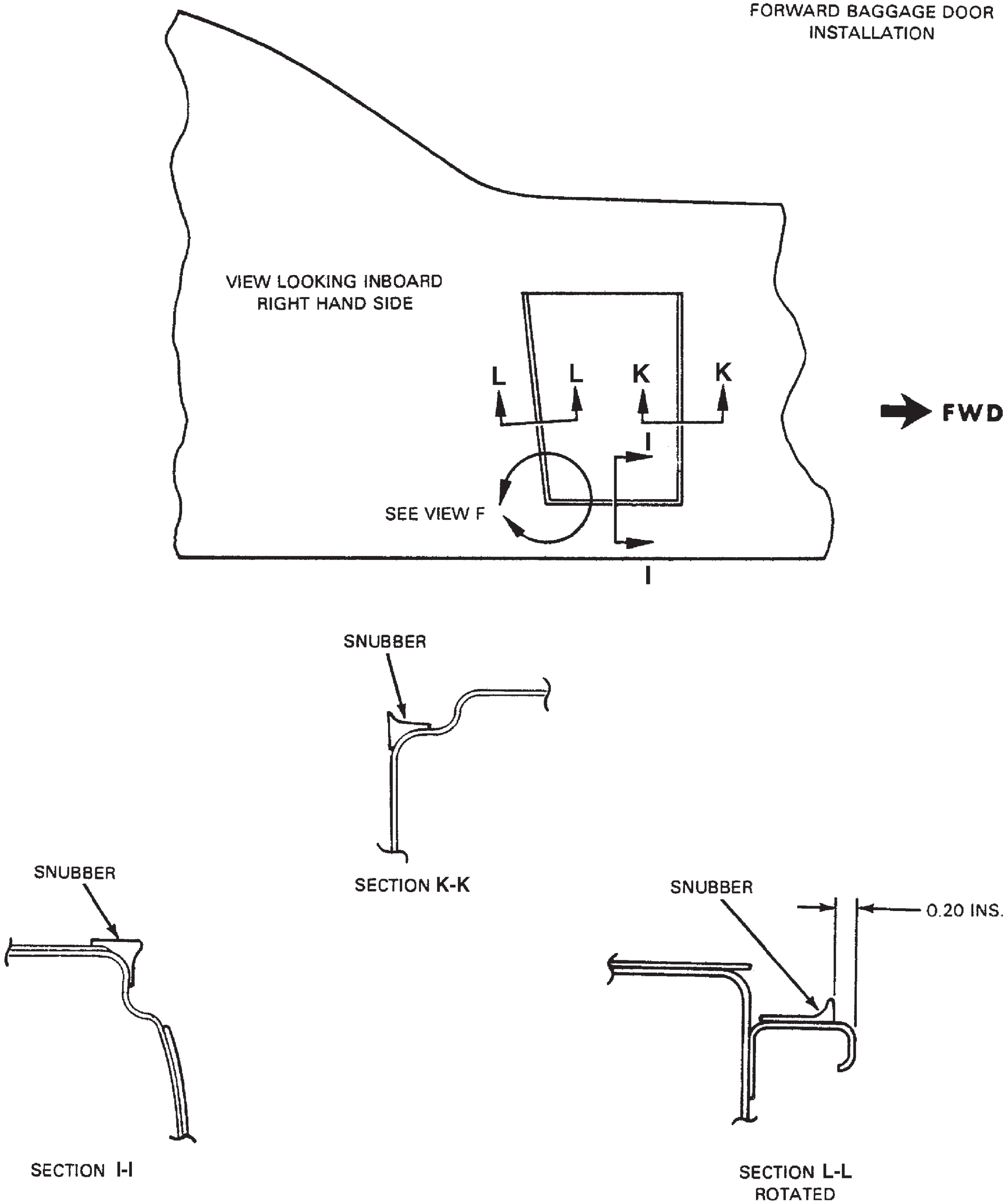




Door Snubber Seal Installation
Figure 1 (Sheet 1 of 3)



Door Snubber Seal Installation
Figure 1 (Sheet 2 of 3)



Door Snubber Seal Installation
Figure 1 (Sheet 3 of 3)

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PASSENGER / CREW

1. Cabin Doors

A. Removal

(1) Remove the clevis bolt, washer and bushing from the door holder assembly.

(2) Remove cotter pins, clevis pins and washers from door hinges.

(3) Remove the door from the airplane.

B. Installation

(1) Insert the door into position and install the washers, clevis bolts and cotter pins on the door hinges.

(2) For adjustment of door, refer to Adjustment, below.

(3) Hook up and install the clevis bolt, bushing and washer into the door holder assembly.

C. Adjustment

(1) To achieve the proper vertical adjustment of the door, insert the necessary washer combination between the cabin door hinge and fuselage eyebolt.

NOTE: To ensure long life of door seals and improve sealing characteristics, lubricate with a dry lubricant in a spray can.

2. Door Locks

A. Removal

(1) Remove the door trim upholstery by removing the attachment screws.

(2) Loosen the nut on the lock assembly and remove the lock by turning it sideways.

B. Installation

(1) Install the lock in the door by turning it sideways and placing it through the opening provided.

(2) Replace the nut on the back of the lock assembly and tighten.

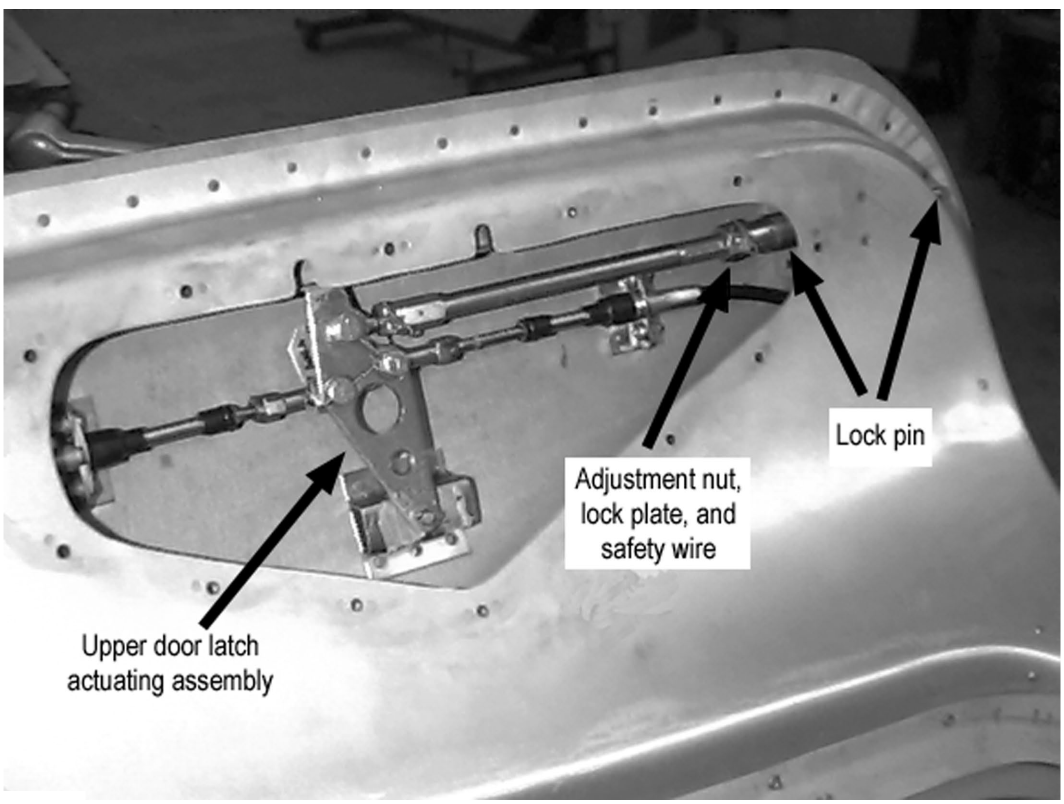
(3) Replace the door trim upholstery and secure with the attachment screws.

3. Door Latch Mechanisms

A. Forward Cabin Door - Upper - Adjustment (see Figure 1)
(TC S/N's 3257001 & up and HP S/N's 3246018 & up)

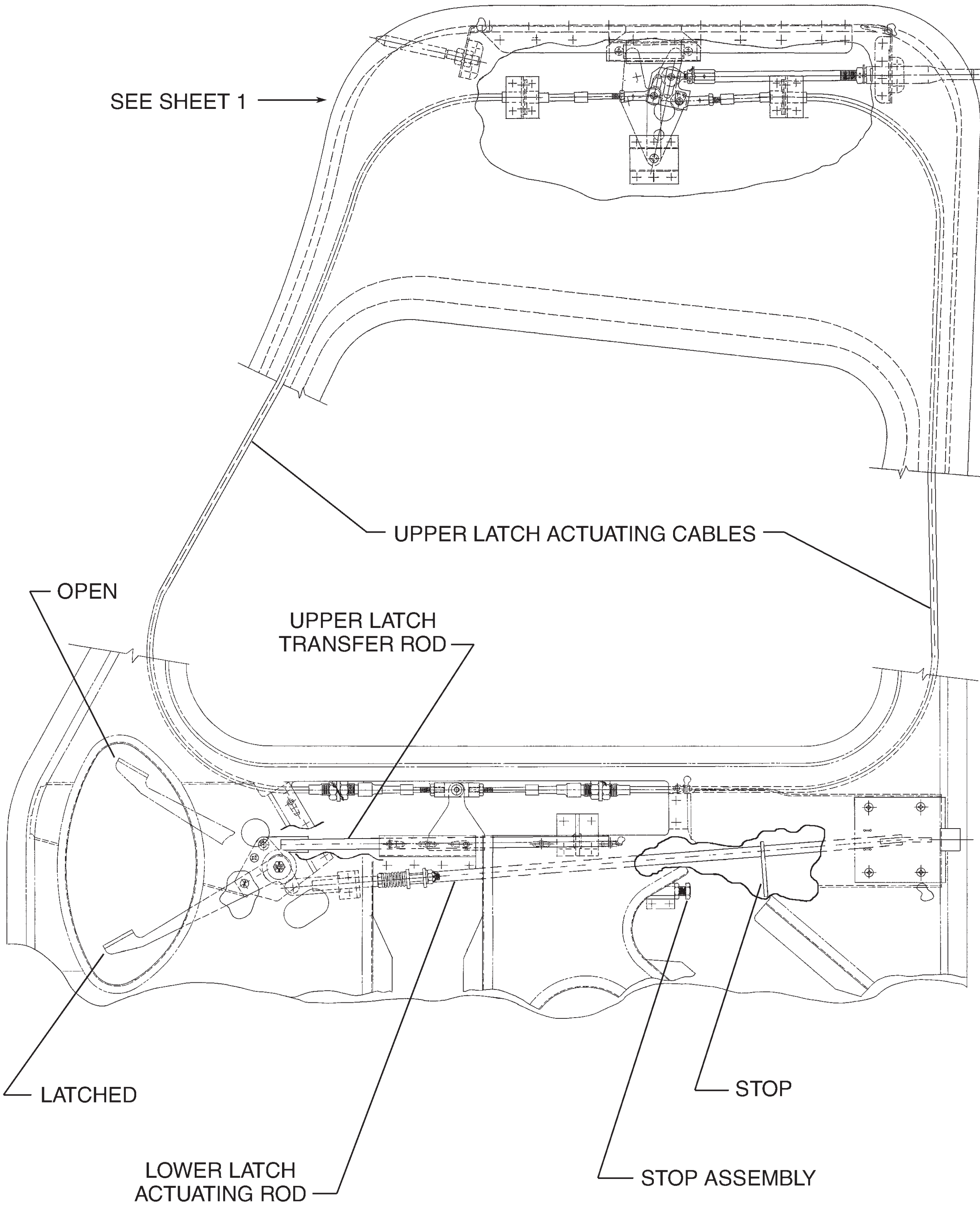
CAUTION: DO NOT LUBRICATE LOCK PIN / LOCK PIN TEFLON GUIDE BEARING.

(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.



Effectivity
3246018 and up
3257001 and up

Adjustment of Upper Door Latch on Forward Cabin Door
Figure 1 (Sheet 1 of 2)



VIEW OUTBOARD, SHOWN LATCHED

Adjustment of Upper Door Latch on Forward Cabin Door
Figure 1 (Sheet 2 of 2)

Effectivity
3246018 and up
3257001 and up

B. Aft Cabin Door

(1) Lower Latch

(a) Removal

1 Remove the door latch mechanism by removing the door trim upholstery and the screws that attach the latch plate and latch mechanism to the door.

2 Disconnect the latch pull rod from the inside door handle.

3 Remove the complete latch mechanism.

(b) Installation

1 Place the latch assembly into position on the door.

2 Connect the latch pull rod to the inside door handle.

3 Replace the screws that attach the latch plate and mechanism to the door. Install the door trim upholstery and secure with screws.

(c) Adjustment

To adjust the door latch, loosen the screws on the striker plate, make necessary adjustment, and retighten the screws.

(2) Upper Latch (and, in HP S/N's 3246001 thru 3246017 only, Upper Fwd Door Latch)

(a) Removal

1 Remove the inside and outside handles and the screws holding the pan on the inside of the door.

2 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.

(b) Installation

1 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.

2 Replace the pan and install the screws and handles.

3 Check the latch assembly for operation and be certain that it is free of rubbing on the trim panels.

(c) Adjustment

1 To adjust the door safety latch, remove the two screws from latch plate found at the top of the door opening.

2 Remove the plate and turn the loop assembly in or out to make necessary adjustments.

3 Replace the latch plate and secure with the two attachment screws.

4 In the aft door only, the locking pin may be adjusted through the opening near the locking pin receptacle.

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CARGO

1. Baggage Doors

   A. Removal

   With door open remove hinge pin from hinge and remove the door.

   B. 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.

2. Baggage Door Locks

   A. Removal

   (1) 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 1.)

   (2) Remove lock assembly through front of door.

   B. Installation

   (1) Place lock into position for installation.

   (2) Install nut on lock assembly and tighten with use of a special wrench.

3. Baggage Door Hinges

   A. Removal

   (1) Remove door from airplane as described in Removal of Baggage Door.

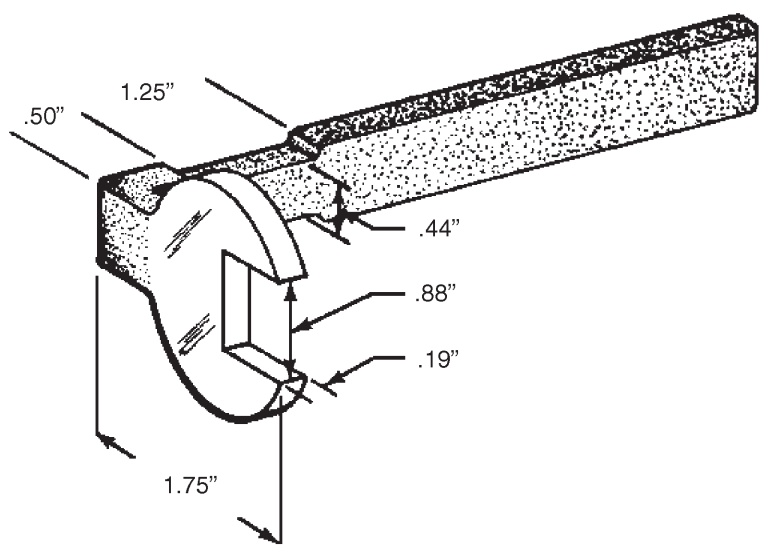
   (2) Remove hinge half from airplane or door by drilling out rivets and removing hinge.

   B. Installation

   (1) Place hinge halves together and install hinge pin.

   (2) Install door into closed position and drill two end rivet holes and install rivets.

   (3) Operate door and check for proper fit and installation. Drill remaining holes and install rivets.



Baggage Door Lock Tool
Figure 1

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CHAPTER

53

FUSELAGE

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CHAPTER 53

LIST OF EFFECTIVE PAGES

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CHAPTER 53 - FUSELAGE

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MAIN

1. Aft Wing Attach Fittings 100 Hour Inspection

A. Background

Should the seals for the windows and doors not be maintained, leaks may develop which, if not corrected, will allow an ingress of water. This water contamination will wet the insulation around the aft wing attach fittings creating a highly corrosive environment.

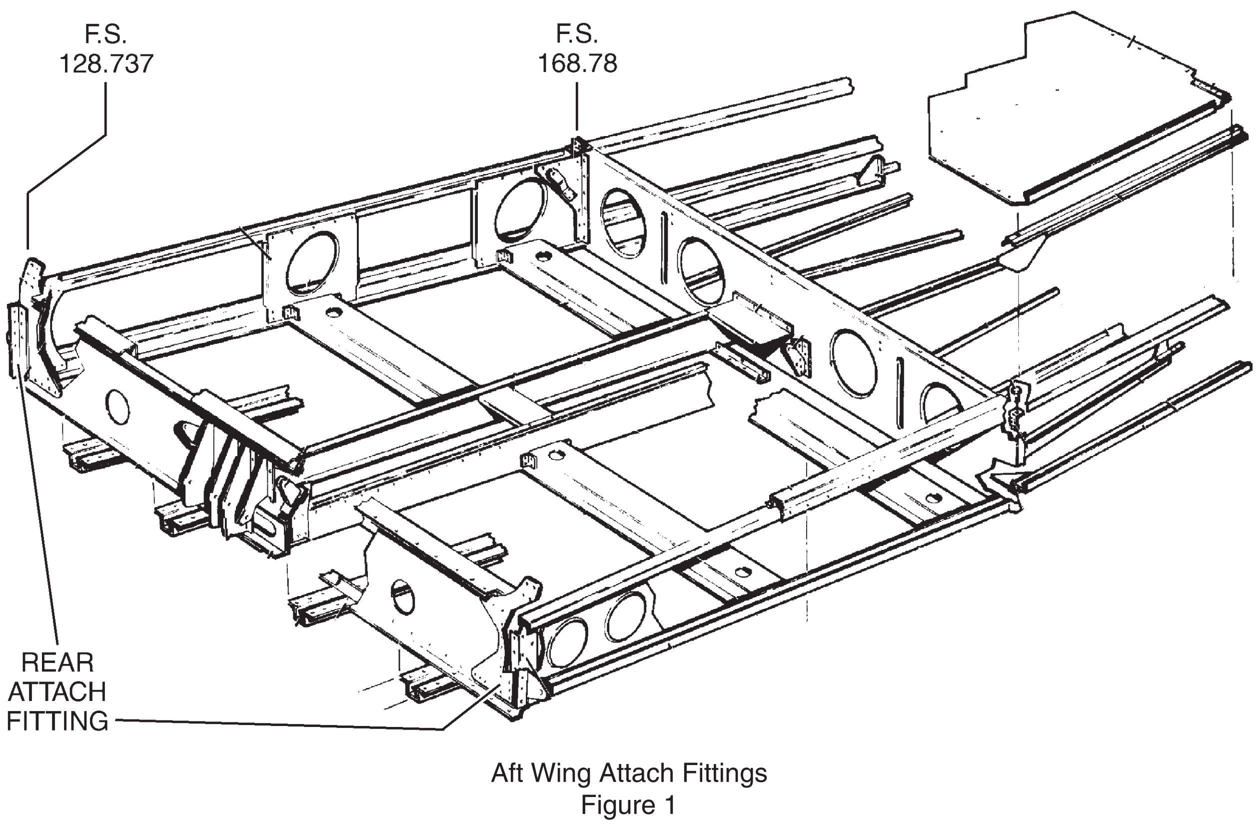
B. Procedure

Each 100 hours, inspect to determine condition of the aircraft window and door seals, the condition of the aft wing attach fittings, the insulation material around the affected area, and the drain holes in the bottom fuselage skin at the aft attach fittings area.

(1) Gain access to the left and right aft wing attach fittings.(See Figure 1.)

(a) Remove center seats and the center floorboard.

(b) Remove interior mouldings and carpet as necessary.



Aft Wing Attach Fittings
Figure 1

(2) Inspect thoroughly the left and right aft wing attach fittings for evidence of flaking paint and/or corrosion. (Flaking paint may be a symptom of hidden corrosion.)

(a) If no corrosion exists, continue with these instructions.

(b) If corrosion is superficial and there is no metal flaking and/or pitting, clean and paint fittings, using a good quality aircraft primer.

(c) If serious corrosion is found, consult the Piper Illustrated Parts Catalog (P/N 761-880) for replacement part numbers and obtain and install new parts before next flight.

(3) Upon completion of the inspection and after replacement or refurbishment of fittings, treat the aft attach fittings area using DINOL AV 8 corrosion compound (P/N 89500-800). The treatment may be brushed or sprayed.

(4) Inspect insulation in and around the rear fittings.

(a) If insulation is wet or matted down where it has been wet, it will be necessary to replace this insulation and it will be necessary to inspect all windows, doors, and exterior panels leading to the cabin.

1 Check door seals for deterioration, cracks, and voids in adhesive.

2 Check window seals for voids, cracks, and deterioration.

3 Perform a leak check with water to determine where the water is entering. Cure all leak paths before continuing these instructions.

4 Consult the Piper Illustrated Parts Catalog (P/N 761-880) for replacement part numbers and obtain and install new parts before continued operation.

5 If sealing windows, use P/N 279-058 Sealant (Bostik 1100 FS) or equivalent.

6 If using insulation other than Piper original material, be sure that the insulation is flame resistant and conforms to FAR part 23.853.

(b) If the insulation material has not been wet, or if new material is being installed, ensure a six (6) inch clearance in the insulation has been cut out in all directions around each attach fitting.

(5) Locate the two 0.191 inch drain holes, one beneath each rear attach fitting, in the bottom fuselage skin and ensure each is clean and free of obstruction.

(6) Re-install floorboards, seats, interior panels, and other articles previously removed. Perform a functional test of any system or component that may have been interrupted or removed.

2. Aft Wing Attach Fitting Replacement

NOTE: The following is basic guidance. More extensive disassembly may be required to remove the rear attach fitting(s). Thoroughly access the job before beginning to determine if additional steps or parts may be required. Consult the Piper Illustrated Parts Catalog (P/N 761-880) for additional parts as required.

A. Removal

(1) Remove electrical power from aircraft by disconnecting the battery.

(2) Place jacks under wings and tail - tie down to stabilize aircraft. Provide support for fuselage in affected area.

(3) Remove seats, interior panels and center floorboard to gain access to rear wing attach fittings.

(4) Remove or relocate systems components to gain access to the attach fittings.

(5) Remove bolt that attaches fuselage to wing spar.

(6) Carefully remove rivets, screws, inner panels, channels and brackets as necessary to remove attach fitting.

NOTE: In order to remove some channels, it may be necessary to remove the wings.

(7) Clean and inspect the areas that were under bracket for any signs of corrosion.

(a) If corrosion is found, repair or replace parts as necessary. Coat the area with primer and allow to dry.

(b) If no corrosion is found, coat the area with primer. Allow time to dry.

B. Installation

(1) Install new wing attach fitting and align rivet holes. It may be necessary to ream open the bolt hole to proper size. The hole is close tolerance and should be .3745 / .3765 (3/8) (see 57-40-00, Figure 1).

(2) Re-rivet wing attach fitting into place with appropriate fasteners.

NOTE: For hard to reach areas. it is permissible to replace the existing MS20470AD-5 rivets with Hi Lok fasteners. Use HL30-5 with HL-94 Hi Lok collars. Torque to 15 to 25 in.-lbs. Observe standard practices for use of Hi Lok fasteners.

(3) Install wing spar and fuselage attach fitting bolt per 57-40-00, Figure 1.

NOTE: Replace attach fitting bolt should there be any sign of wear or corrosion.

(4) Seal the edges of the attach fittings with PRC PR1422 (or equivalent) before installing interior.

(5) Complete the same process to the opposite side.

(6) Reinstall center floorboard, interior panels, and seats.

(7) Connect battery and check for operation.

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CHAPTER

55

STABILIZERS

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CHAPTER 55 - STABILIZERS

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GENERAL

This chapter describes removal and installation procedures for the empennage component parts (i.e., stabilator and tab, vertical stabilizer (fin), and rudder). The overall structure of the airplane and general repair procedures are described in Chapter 51.

NOTE: When torquing structural assemblies, standard torque values are to be used as found in Chart 2, 91-10-00, unless otherwise stated in this section.

1. Description (See Figure 1.)

The all metal empennage group is a full cantilever design consisting of a stabilator, vertical stabilizer (fin), and rudder, all with removable thermoplastic tips. The stabilator has a trim tab attached that is controllable from the cockpit. The stabilator also incorporates a one channel main spar that runs the full length of the stabilator and hinges to the aft bulkhead assembly of the fuselage.

NOTE: The Saratoga II Parts Catalog, P/N 761-880, provides detailed views of the individual structural components.

All exterior surfaces are coated with enamel or acrylic lacquer. As an option the airplane may be completely primed with zinc chromate or equivalent.

2. Repairs

WARNING: NO ACCESS HOLES ARE PERMITTED IN ANY CONTROL SURFACES.

WARNING: THE USE OF PATCH PLATES FOR REPAIRS OF ALL MOVABLE CONTROL SURFACES IS PROHIBITED. THE USE OF ANY FILLER MATERIAL NORMALLY USED FOR REPAIR OF MINOR DENTS AND/OR MATERIALS USED FOR FILLING THE INSIDE OF SURFACES IS ALSO PROHIBITED ON ALL MOVABLE CONTROL SURFACES.

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

Structural repairs must be made in accordance with procedures and practices described in the latest revision of FAA Advisory Circular 43.13-1. See 51-70-00.

3. Control Surface Balancing

A. Checking Balance

The movable control surfaces have been statically balanced at the time of installation at the factory and normally should not require rebalancing. Where possible the control surfaces were set with the balance weight on the heavy side of the limits, to permit paint touch-up without adjusting the balance weight. It should be noted however, that spare control surfaces are delivered unpainted and the static balance will not necessarily fall within the limits provided, especially on stabilators and rudders. All replacement control surfaces, or surfaces that have been repainted, should be rebalanced when completed according to the procedures and limits given in 55-20-00 (Stabilator) or 55-40-00 (Rudder), as applicable.

Before balancing any control surface, it must be complete and in its final flight configuration as specified under Balancing Equipment, below.

If optional equipment is added or removed after balancing, the control surface must be rebalanced. During balancing, trim/servo tabs must be maintained in their neutral positions.

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B. Balancing Equipment (Refer to Figure 2.) (PIR-PPS50015, Rev. AG)

Balancing must be done using a suitable tool capable of measuring unbalance in inch-pounds from the centerline of the control surface hinge pin. A suggested configuration is shown in Figure 2. Other tools may be used if accuracy is maintained and recalibration capability is provided.

To use this tool:

(1) Ensure that the control surface is in its final flight configuration (i.e., including tips, trim/servo tabs as applicable, surface and tab actuating arms or pushrods with bearings as applicable, and all optional equipment which will be mounted on or in the surface when it is flown, including position lights and wiring, static wicks, etc.). The surface should be painted, decals applied, and trim/servo tabs should be in the neutral position.

NOTE: Because paint is a considerable balance factor, remove existing paint prior to repainting a control surface.

(2) Place hinge bolts through control surfaces and place control surface on a holding fixture.

(3) Calibrate the tool:

(a) 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.

(b) Adjust the movable trailing edge support to fit the width of the control surface. Tighten the set screw on the trailing edge support.

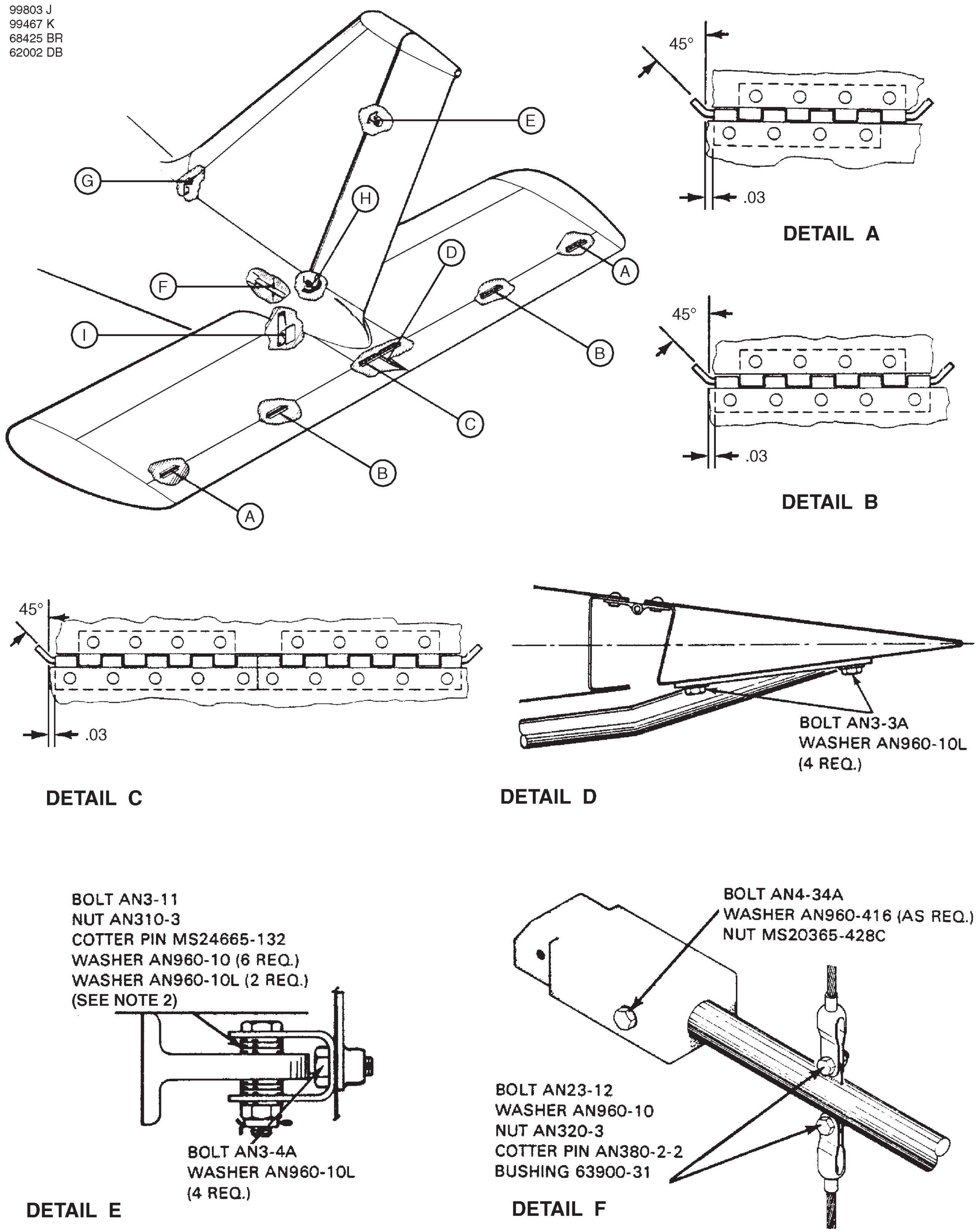
(c) Adjust the trailing edge support vertically until the beam is parallel with the control surface chord line.

(d) Remove the tool from the control surface and balance the tool itself by adding or removing nuts or washers from the beam balancing bolt. When balancing the tool, the movable weight must be at the bar's hinge centerline.

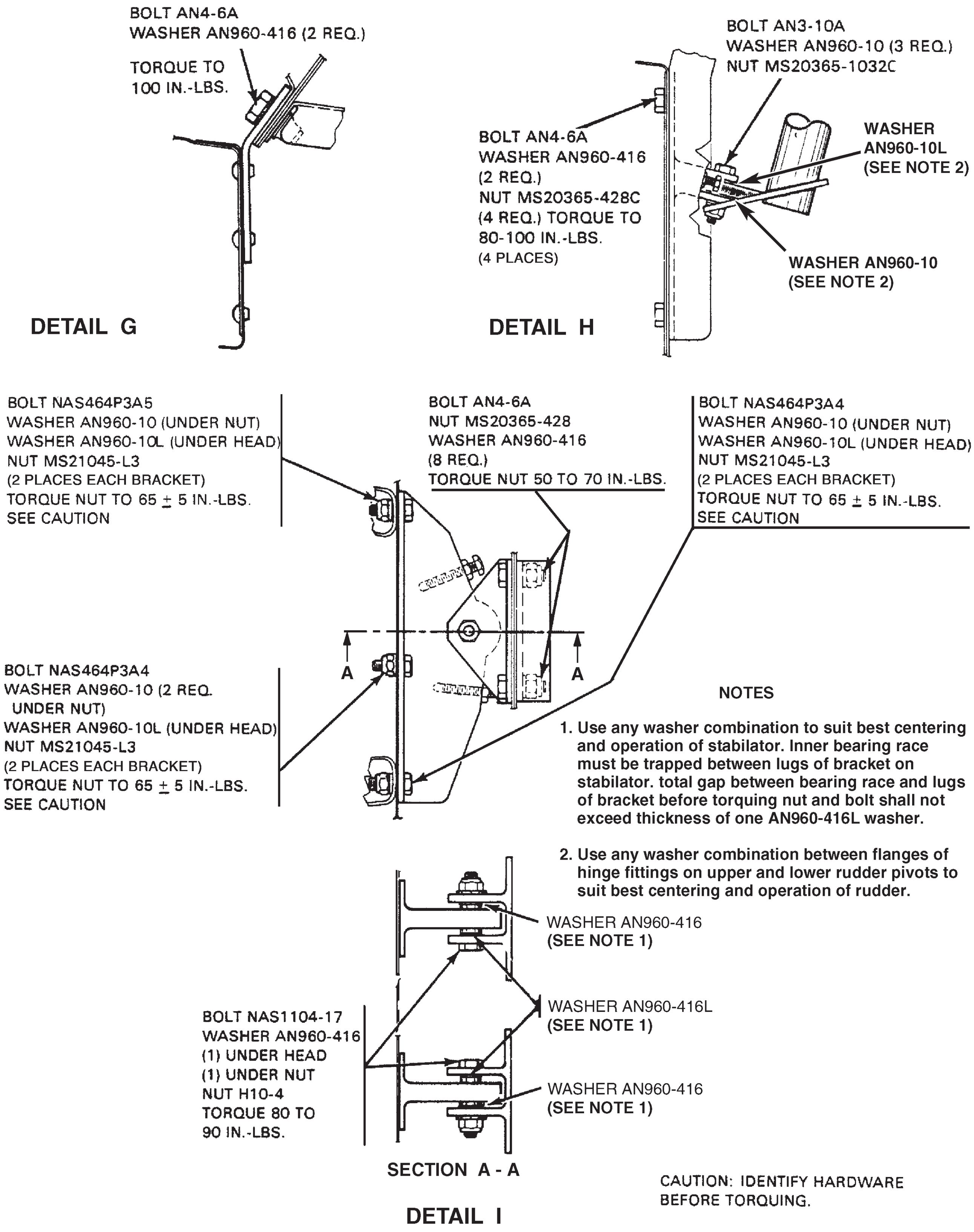
(4) After balancing the tool, reattach it to the control surface. Keep the beam positioned 90° from the control surface hinge line.

(5) Determine balance of control surface by sliding movable weight along the balance beam.

(6) Read the scale when the bubble in the level has been centered. Multiply by three (3) to determine inch-pounds (i.e. - since the movable weight weighs three pounds, every inch it is moved from the center of the beam equals three (3) inch-pounds of force).



Empennage Group
Figure 1 (Sheet 1 of 2)



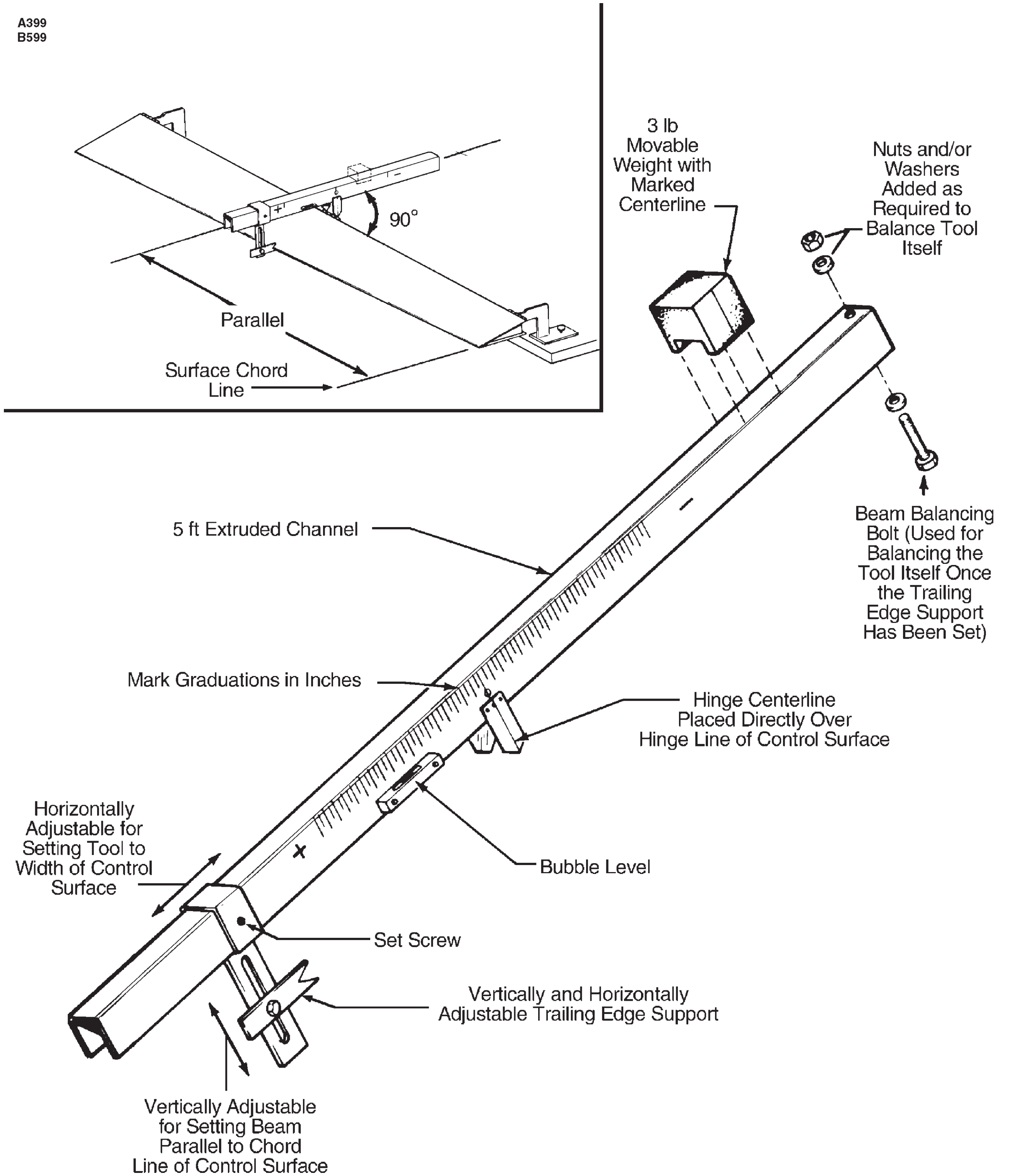
NOTES

1. Use any washer combination to suit best centering and operation of stabilator. Inner bearing race must be trapped between lugs of bracket on stabilator. total gap between bearing race and lugs of bracket before torquing nut and bolt shall not exceed thickness of one AN960-416L washer.

2. Use any washer combination between flanges of hinge fittings on upper and lower rudder pivots to suit best centering and operation of rudder.

CAUTION: IDENTIFY HARDWARE BEFORE TORQUING.

Empennage Group
Figure 1 (Sheet 2 of 2)



Control Surface Balancing Tool
Figure 2

STABILATOR

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

1. Checking Free Play

   A. 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.

   B. Stabilator Trim Tab: Set the stabilator trim tab in neutral position. Neutral position is determined with the airplane properly rigged per 27-30-00, Stabilator Trim Controls, Rigging and Adjustment; and the trim indicator set 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.

2. Stabilator (Refer to 55-00-00, Figure 1.)

   A. Removal

   CAUTION: AT EACH REMOVAL OF THE STABILATOR, CONDUCT ATTACH BRACKETS CORROSION CONTROL INSPECTION, 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.

   B. Installation (Refer to 55-00-00, Figure 1.)

   WARNING: IF THE STABILATOR HAS BEEN REPLACED OR REPAINTED, OR THE TRIM TAB HAS BEEN REPLACED OR REPAINTED; THE STABILATOR MUST BE BALANCED BEFORE INSTALLATION. SEE BALANCING, BELOW.

   (1) Reinstall the stabilator in reverse of removal instructions, above.

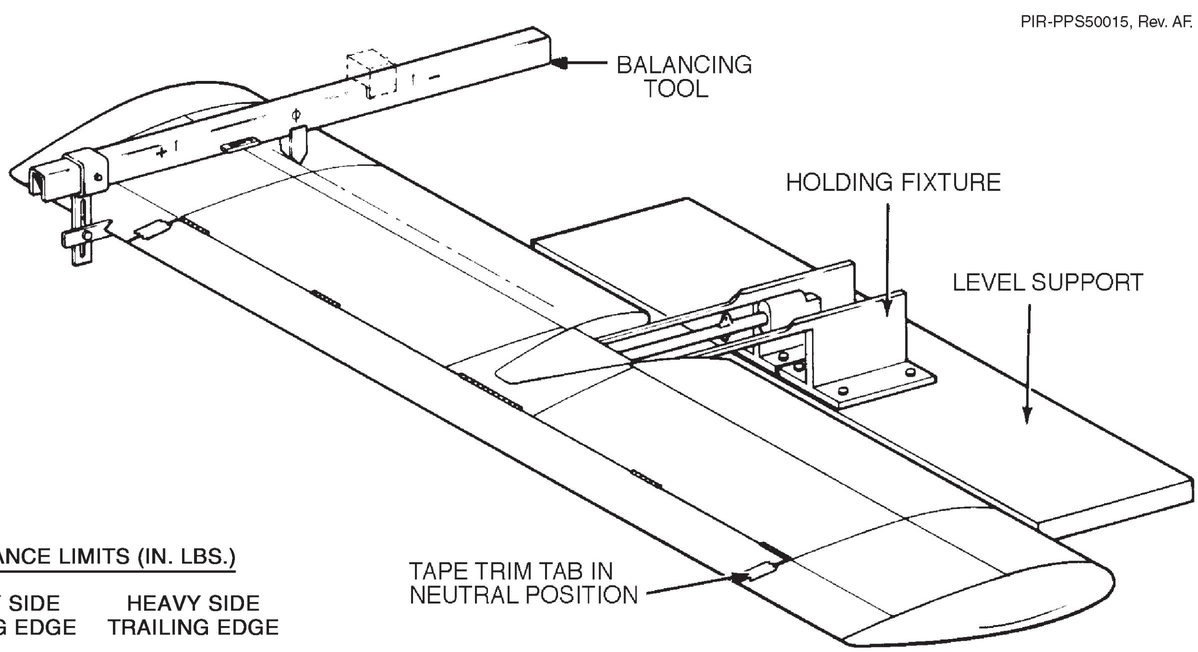
   (2) Tension trim cable and stabilator control cables to specifications given in 27-30-00, Figure 2.

C. Balancing

To balance stabilator, assembly must be complete and in its final flight configuration as specified in Balancing Equipment, under Control Surface Balancing, 55-00-00, 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, 55-00-00. 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:

(1) 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.

(2) 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.



BALANCE LIMITS (IN. LBS.)

HEAVY SIDE LEADING EDGE	HEAVY SIDE TRAILING EDGE	
0	-40.00	STANDARD
+8.4	-11.30	WITH OPTIONAL INADVERTENT ICE PROTECTION SYSTEM (TKS)

Stabilator Balancing
Figure 1

3. Attach Brackets Corrosion Control Inspection (Refer to Figure 2.)

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.

A. Remove upper and lower tail cone fairing assembly.

B. Remove the aft fuselage closeout plate assembly on the applicable models.

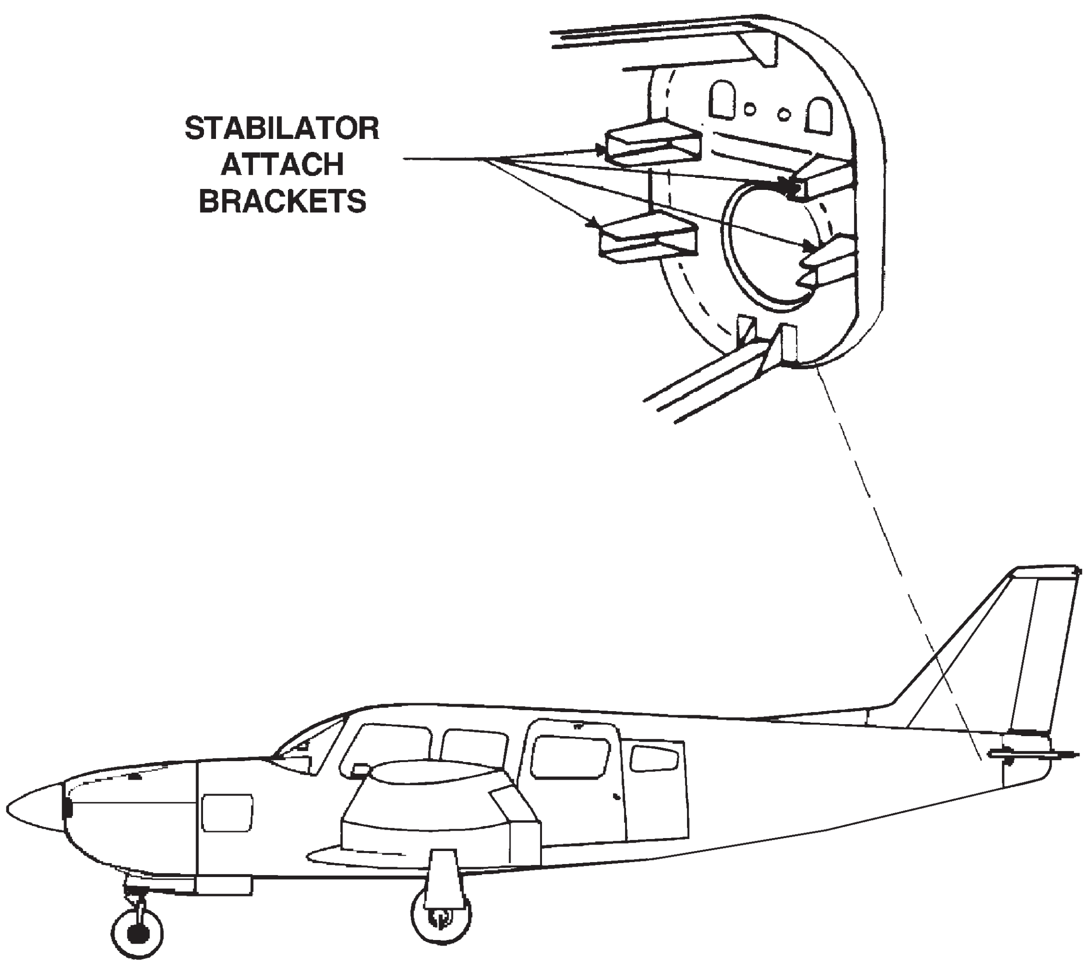
C. Inspect the steel stabilator attach fittings (4 places) and adjacent fuselage structure for the presence of rust and/or corrosion. (Refer to Figure 2.)

NOTE: Refer to F.A.A. Advisory Circular AC43-4A, Corrosion. Control for Aircraft.

D. If rust and/or corrosion is present, repair or replace as required. Add corrosion protection per AC43-4A.

E. Install aft fuselage closeout plate assembly. Verify integrity of rubber seals; replace if required

F. Install upper and lower tail cone fairing assembly.



Stabilator Attach Brackets (Typical)
Figure 2

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VERTICAL STABILIZER

Vertical Fin (Refer to 55-00-00, Figure 1.)

A. Removal

(1) 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.

B. Installation

(1) Install fin in reverse of removal instructions, above.

(2) Torque per 55-00-00, Figure 1.

(3) Check all bolts for safety.

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RUDDER

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

Rudder

A. Removal (Refer to 55-00-00, Figure 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.

(5) Disconnect tail light electrical wire and remove rudder.

B. Installation

WARNING: IF THE RUDDER HAS BEEN REPLACED OR REPAINTED, THE RUDDER MUST BE BALANCED BEFORE INSTALLATION. SEE BALANCING, BELOW.

(1) Position the rudder in place and install the upper hinge bolt, washers, nut, and cotter pin.

(2) Connect tail light electrical wire.

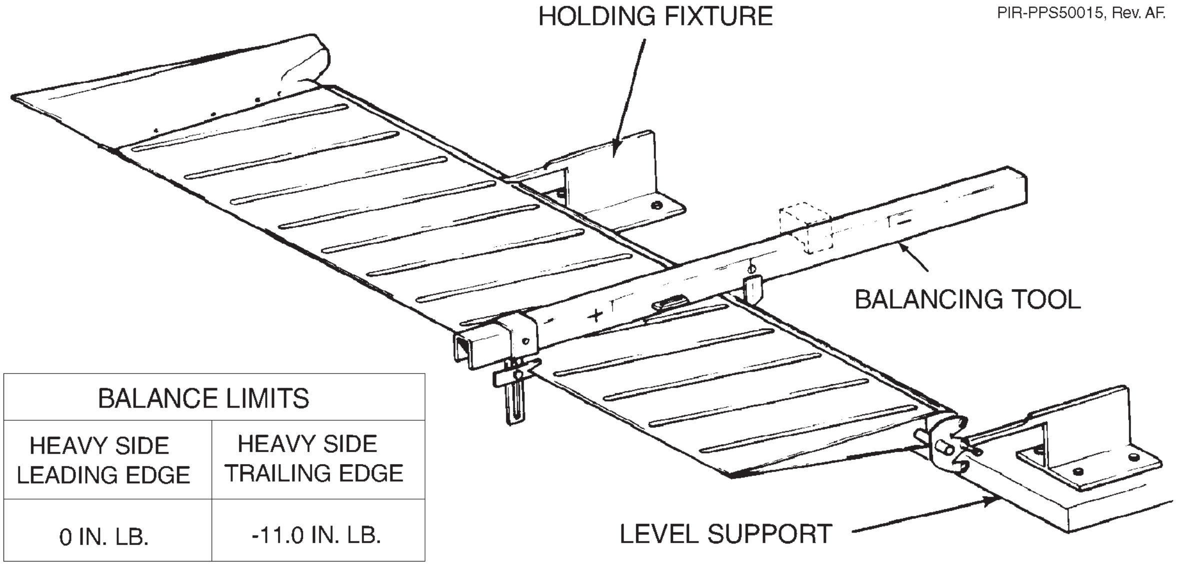
(3) Install bolt, washer, and nut in lower rudder hinge bracket.

(4) Torque per 55-00-00, Figure 1.

(5) Connect the two control cables to the rudder horn.

(6) Check all bolts and pins for safety.

(7) Install tail cone fairing.



BALANCE LIMITS	
HEAVY SIDE LEADING EDGE	HEAVY SIDE TRAILING EDGE
0 IN. LB.	-11.0 IN. LB.

Rudder Balancing
Figure 1

C. Balancing (Refer to Figure 1.)

To balance rudder, assembly must be complete including sector assembly, and in its final Flight configuration as described in Balancing Equipment under Control Surface Balancing, 55-00-00. 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, 55-00-00. 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.

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CHAPTER

56

WINDOWS

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CHAPTER 56

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE	CHAPTER SECTION	PAGE	DATE
56-List of Effective Pages	1	Jul 31/13			
	2	Jun 30/07			
56-Table of Contents	1	Jul 31/13			
	2	Jun 30/07			
56-10-00	1	Jul 31/13			
	2	Jun 30/07			
	3	Jul 31/13			
	4	Jul 31/13			
56-20-00	1	Jun 30/07			
	2	Feb 28/09			

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CHAPTER 56 - WINDOWS

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FLIGHT COMPARTMENT

1. Windshield (Refer to Figure 1.)

   A. Removal

      (1) Remove the collars from around the bottom of the windshield and the trim strip from between the windshield halves by removing the attaching screws.

      (2) Remove the windshield by raising the lower portion of the windshield and carefully pulling it out and down to release the top and side edges.

      NOTE: A damaged windshield should be saved to provide a pattern for shaping the new windshield.

      (3) Clean old tape and sealer off the affected mating surfaces.

   B. Installation

      (1) Match new windshield to old. If necessary, cut or grind the new windshield to matching dimensions.

      (2) Apply 1/8 in. by 1 in. vinyl foam tape, Norton V510 or equivalent (i.e. - Tape - Vinyl Foam, Type 2; 91-10-00, Consumable Materials), around entire edge of windshield.

      (3) Place windshield into position, sliding aft and up into place. Take care not to dislocate vinyl foam tape. Allow clearance for expansion between the two windshield sections at the center post.

      (4) Apply 1.5 in., 9 mil, black vinyl tape covering the previously applied vinyl foam tape and sealing the joint between the windshield and airframe as indicated in Figure 1.

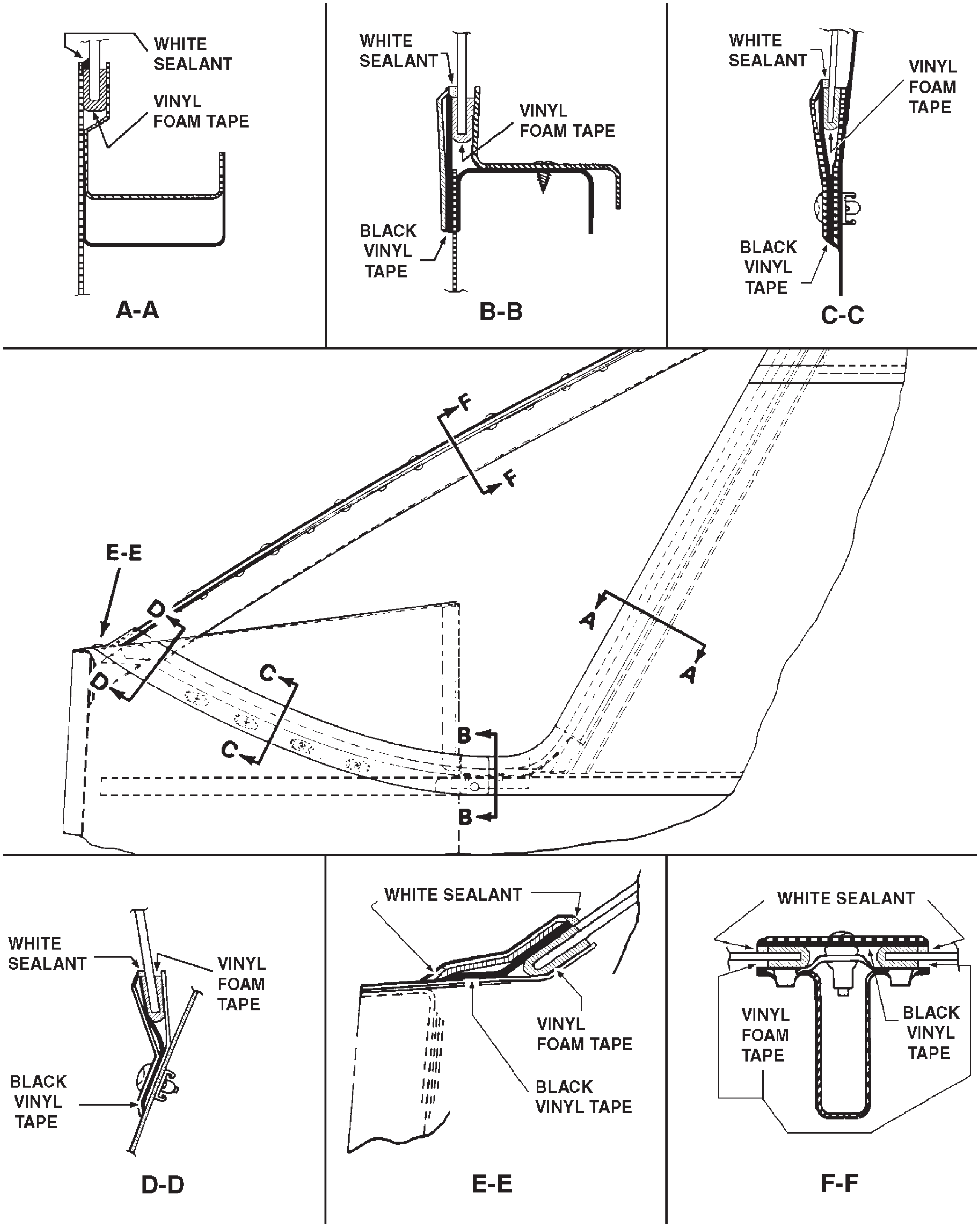
      (5) Apply polyurethane, urethane, acrylic, or polysulfide sealant (i.e. - Sealant - Window and Airframe; 91-10-00, Consumable Materials), to seal the forward edge of the vinyl tape at the bottom of the center post, as indicated in Figure 1, View E-E.

      (6) Reinstall collars and trim strip. Apply sealant as indicated in Figure 1 by forcing the sealant between the mating parts. Mating parts may be separated slightly using a soft wooden wedge or a tongue depressor. Force sealant deep into the gap. Take care to avoid bending or scratching aluminum or windshield surfaces. Joints should be completely filled, and blended smoothly with adjacent surfaces after clean-up.

      (7) Remove excess sealant and exposed tape. Sealant may be cleaned from window areas using rags, disposable wipers or plastic scrapers. A tool made of acrylic sheet with a wedged end (.25 in. thick and 1.5 in. wide) can be fabricated and used. Tirpolene solvent or Apperson solvent No. 120 may be used to clean polysulfide sealants.

2. Windows

   See Side Windows, 56-20-00.



Windshield Installation (Typical)
Figure 1

3. Storm Window

Refer to Figure 2.

The pilot side window assembly includes a storm window, which is a small, openable window. The storm window has a hinge attached with five (5) rivets along its bottom edge. The lower plate of the hinge is attached to the side window assembly with five (5) rivets. The storm window is held closed by a latch that fastens at its top. The latch assembly is attached to the side window assembly with screws, washers and a nut.

A. Removal

(1) Unlatch the storm window.

(2) Hold the storm window in place. Remove the pin which links the two plates of the storm window hinge.

(3) To remove the storm window assembly, lean the top toward you, then grip it along its edges and slide the upper hinge plate away from the lower plate.

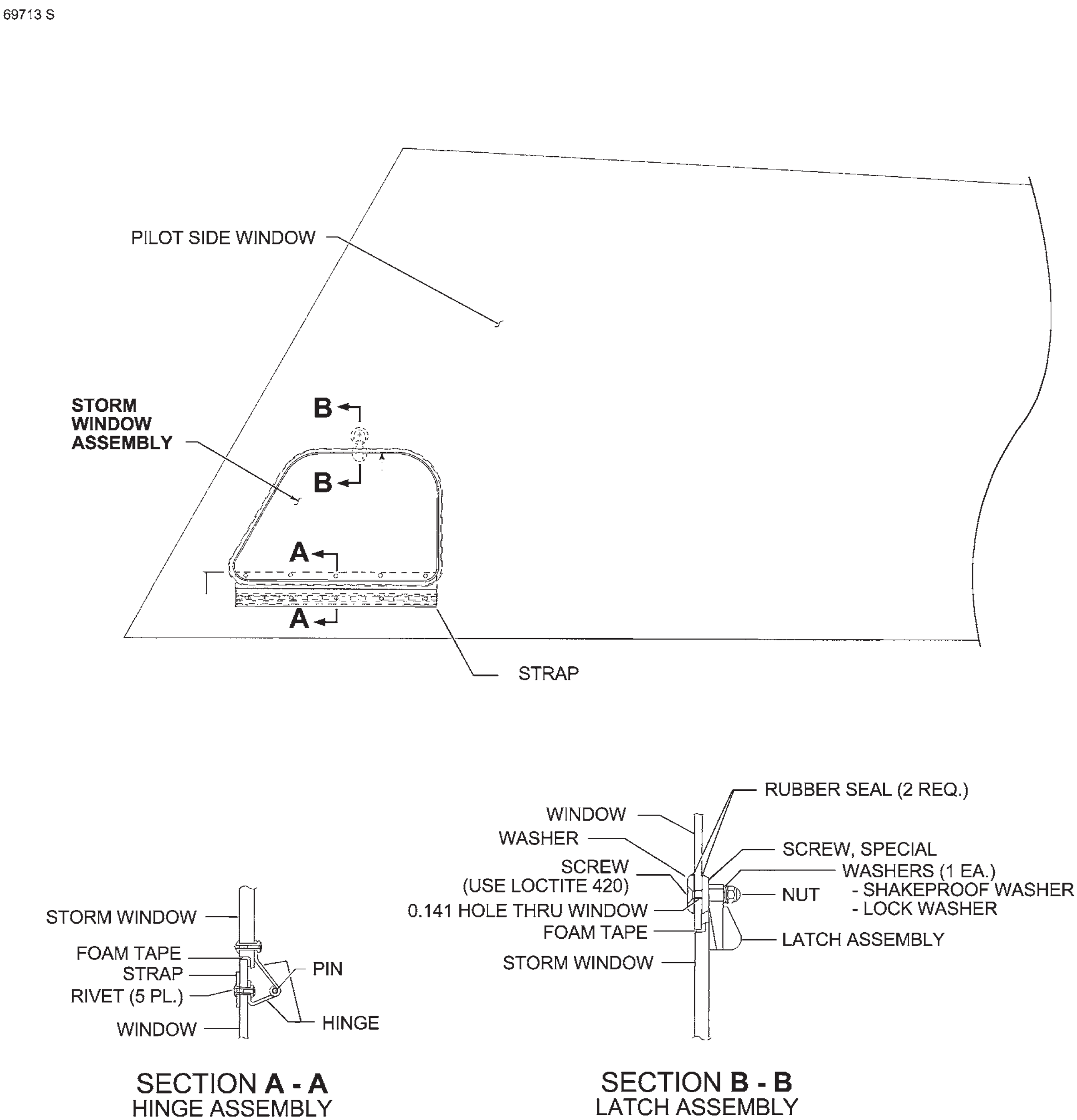
B. Installation

(1) Place the storm window over its opening in the side window and hold it in place.

(2) Adjust the storm window and the upper hinge plate so the plate meets the lower hinge plate correctly.

(3) Push the top of the storm window into place and close the latch over it.

(4) Insert the pin which links the two hinge plates.



Storm Window
Figure 2

PASSENGER COMPARTMENT

Side Windows

These airplanes are equipped with single pane side windows.

A. Removal (Refer to Figure 1.)

(1) Remove the molding and retainer from around the window by removing attaching screws.

(2) Carefully remove the damaged window from the frame.

(3) Remove old tape and sealer from window frame and molding.

NOTE: A damaged window should be saved to provide a pattern for shaping the new window.

B. Installation (Refer to Figure 1.)

(1) Match new window to old. If necessary, cut or grind the new window to the same dimensions.

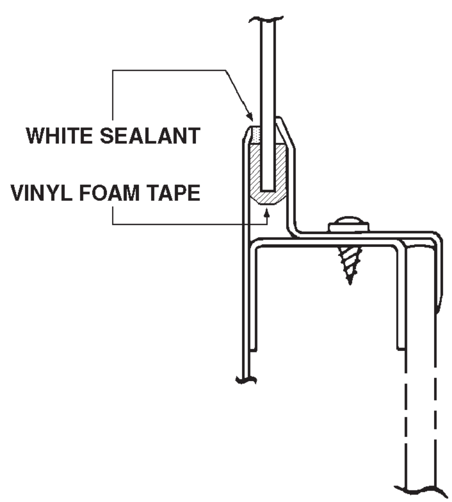
(2) Apply 1/8 in. by 1 in. vinyl foam tape, Norton V510 or equivalent (i.e. - Tape - Vinyl Foam, Type 2; 91-10-00, Consumable Materials), around entire edge of window.

(3) Insert the window into the frame, install the retainer moldings and attachment screws, but do not tighten. Take care not to damage or dislocate the vinyl foam tape.

(4) Apply polyurethane, urethane, acrylic, or polysulfide sealant (i.e. - Sealant - Window and Airframe; 91-10-00, Consumable Materials), completely around the outer surface of the window at all attachment flanges as indicated in Figure 1. Force the sealant between the mating parts, which may be separated slightly using a soft wooden wedge or a tongue depressor. Force sealant deep into the gap. Take care to avoid bending or scratching aluminum or window surfaces. Joints should be completely filled, and blended smoothly with adjacent surfaces after clean-up.

(5) Tighten attachment screws until vinyl foam tape is compressed approximately 25 percent.

(6) Remove excess sealant from window areas using rags, disposable wipers or plastic scrapers. A tool made of acrylic sheet with a wedged end (.25 inch thick and 1.5 inch wide) can be fabricated and used. Tirpolene solvent or Apperson solvent No. 120 may be used.to clean polysulfide sealants.



Side Window Installation
Figure 1

GRIDS 6K2 THRU 7B24
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CHAPTER

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WINGS

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CHAPTER 57

LIST OF EFFECTIVE PAGES

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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.

1. Description

   Each wing is an all metal, full cantilever, semi-monocoque type structure with removable tips and access panels. Attached to each wing are the aileron, flap, main landing gear and 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.

2. Repairs

   WARNING: NO ACCESS HOLES ARE PERMITTED IN ANY CONTROL SURFACES.

   WARNING: THE USE OF PATCH PLATES FOR REPAIRS OF ALL MOVABLE CONTROL SURFACES IS PROHIBITED. THE USE OF ANY FILLER MATERIAL NORMALLY USED FOR REPAIR OF MINOR DENTS AND/OR MATERIALS USED FOR FILLING THE INSIDE OF SURFACES IS ALSO PROHIBITED ON ALL MOVABLE CONTROL SURFACES.

   CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

   Structural repairs must be made in accordance with procedures and practices described in the latest revision of FAA Advisory Circular 43.13-1. See 51-70-00.

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MAIN FRAME

Wing Rib Assembly W.S. 49.25

The left and right rib assemblies, factory installed in S/N's 3246001 thru 3246236 and 3257001 thru 3257411 only, aft of the main spar at W.S. 49.25 can, under certain conditions, crack. The cracking is typically observed vertically along the bend radius of the flange common to the main spar and the main landing gear side brace attach fitting. Accordingly, in S/N's 3246001 thru 3246236 and 3257001 thru 3257411 only, perform the following inspections at the intervals indicated:

NOTE: Installation of Kits No. 767-397 (LH) and 767-398 (RH), confirmation of existing rib assemblies stamped with Date Code 8313 or higher, installation of new rib assemblies with Date Code 8313 or higher, or any combination of the above will eliminate the following 100 hour and 500 hour repetitive inspection requirements.

A. 100 Hour Wing Rib Inspection

In S/N's 3246001 thru 3246236 and 3257001 thru 3257411 only, for airplanes which have not installed Kits No. 767-397 (LH) and 767-398 (RH), and do not have rib assemblies at W.S. 49.25 stamped with Date Code 8313 (see Figure 2) or higher, each 100 hours time-in-service:

(1) Place the airplane on jacks per 7-10-00.

(2) In both the right and left wings:

(a) Inspect the Aft Rib Assembly at W.S. 49.25 for any evidence of cracks (see Figure 1).

(b) Inspection shall be limited to a visual examination.

(c) Inspect the exposed (upper half) portion of the bend radius of the flange common to the Aft Rib Assembly and the Main Spar Web.

(3) If any crack is detected visually, proceed to a more detailed examination.

(a) Remove the Main Landing Gear Side Brace, by removing the five (5) bolts that fasten it to the wing structure. Retain hardware for reassembly.

(b) Inspect the cracked Rib Assembly in the bend radius of the flange common to the Main Spar Web, using dye penetrant inspection techniques, to determine the full extent of crack propagation.

(c) Determine if trimming, as shown in Figure 1, will remove all the material affected by the crack.

1) If so, install the appropriate kit (see above).

2) If this cannot be accomplished, replace the cracked Rib Assembly.

(4) If no cracks are detected, reassemble/reinstall any parts or components previously removed.

(5) Verify proper functioning of landing gear.

(6) Verify gear are down and locked and remove airplane from jacks.

(7) Make an appropriate logbook entry.

B. 500 Hour Wing Rib Inspection

In S/N's 3246001 thru 3246236 and 3257001 thru 3257411 only, for airplanes which have not installed Kits No. 767-397 (LH) and 767-398 (RH), or do not have rib assemblies at W.S. 49.25 stamped with Date Code 8313 (see Figure 2) or higher, each 500 hours time-in-service:

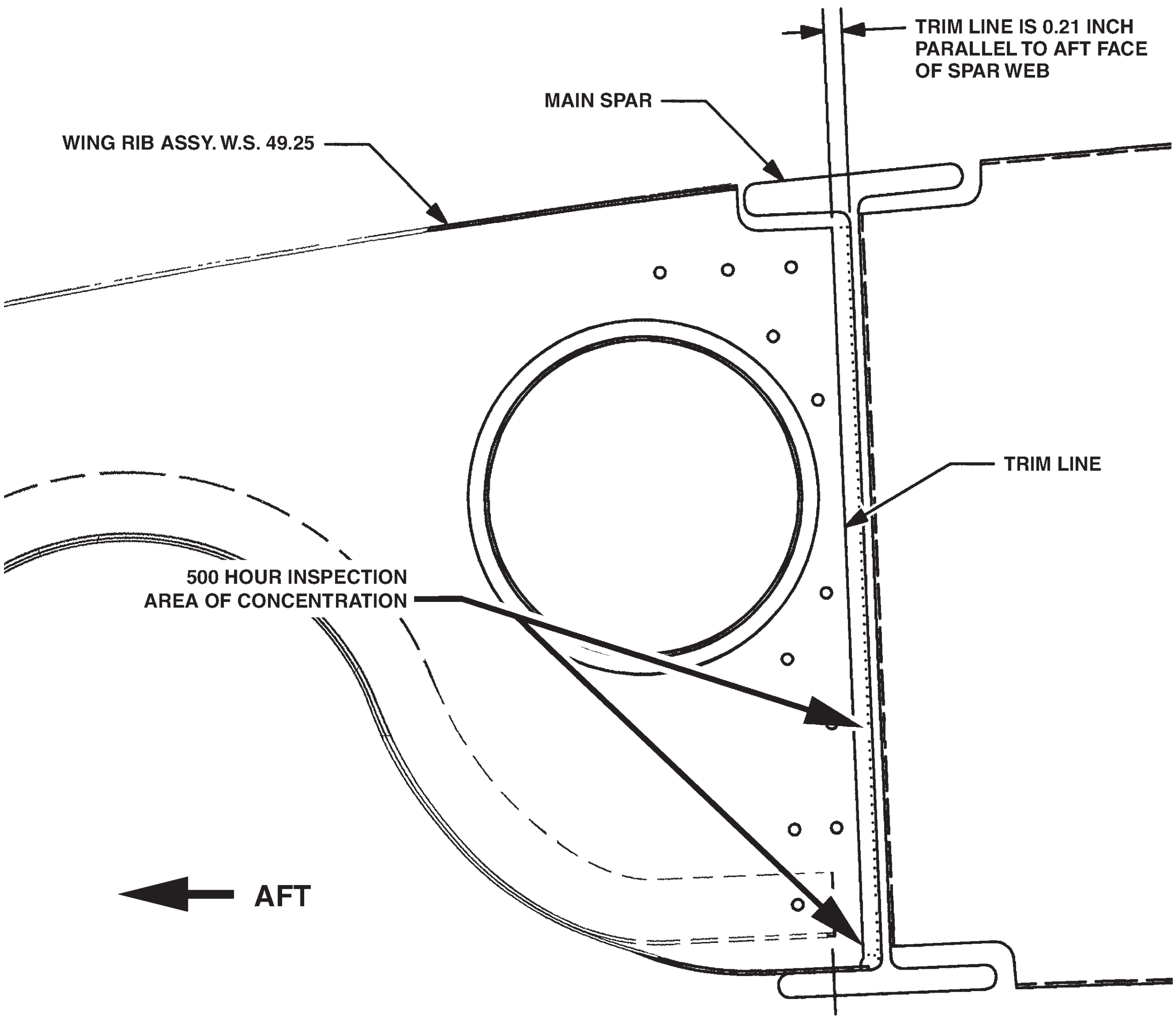
(1) Place the airplane on jacks per 7-10-00.

(2) In both the right and left wings:

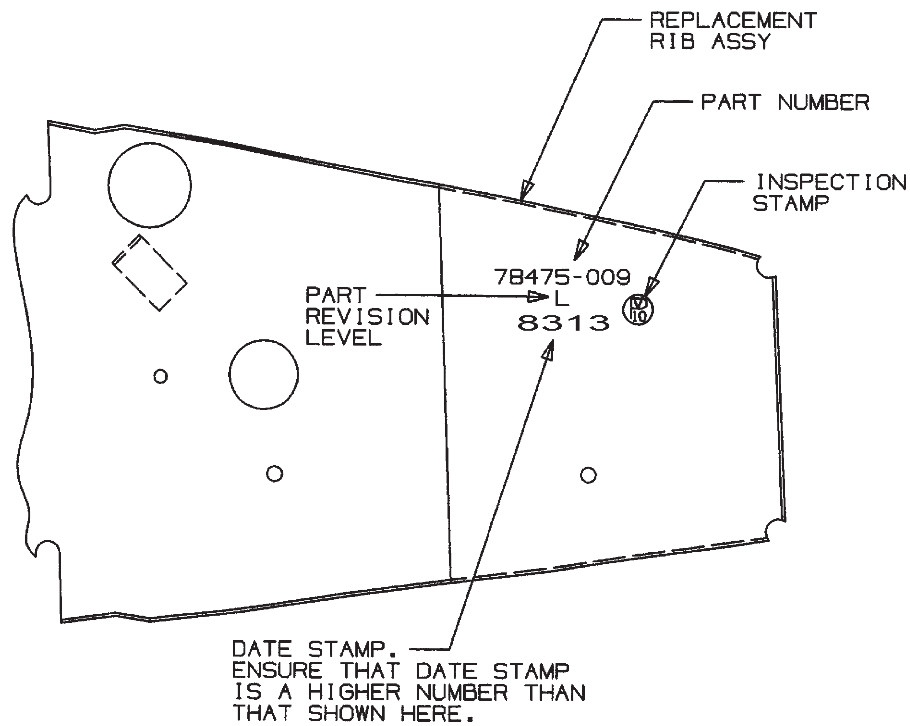
(a) Remove the Main Landing Gear Side Brace, by removing the five (5) bolts that fasten it to the wing structure. Retain hardware for reassembly.

(b) Inspect the Rib Assembly for evidence of cracks in the bend radius of the flange common to the Main Spar Web (as show in Figure 1), using dye penetrant inspection techniques.

(3) If a crack is detected, identify the path of the propagation, and determine if trimming, as shown in Figure 2, will remove all the material affected by the crack.
    (a) If so, install the appropriate kit.
    (b) If this cannot be accomplished, replace the cracked Rib Assembly.
(4) If no cracks are detected, reassemble/reinstall any parts or components previously removed.
(5) Verify proper functioning of landing gear.
(6) Verify gear are down and locked and remove airplane from jacks.
(7) Make an appropriate logbook entry.



Wing Rib Inspection
Figure 1



Wing Rib Date Stamp
Figure 2

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AUXILIARY STRUCTURE

Wing Tip

A. Removal

(1) Remove the screws holding the wing tip to the wing, being careful not to damage the wing or wing tip.

(2) Pull off the wing tip far enough to disconnect the landing light and navigation and strobe light wire assemblies. Be sure to unscrew the ground lead at the wing rib.

(3) Inspect the wing tip to ascertain that it is free of cracks, severe nicks and minor damage. If repair is required, refer to Repair, below.

B. Installation

(1) 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 ensure a good connection.

(2) Insert the wing tip into position and install the screws round the tip. Take care to refrain from damaging the wing tip or wing. Check operation of the lights.

C. Repair

Limited thermoplastic repairs are provided in 51-70-00. Badly damaged thermoplastic tips should be replaced with new parts.

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ATTACH FITTINGS

1. Wing to Fuselage Fittings

A. Removal

See Figure 1.

(1) Close the fuel valve and drain the fuel from the wing to be removed. (Refer to Draining Fuel System, 12-10-00.)

(2) Drain the brake line and reservoir. (Refer to Draining Brake System, 12-10-00.)

(3) Remove the access plate at the wing butt rib and wing inspection panels. (See Figure 3, 6-00-00.)

(4) Remove the front and back seats from the airplane.

(5) Expose the spar box and remove the cockpit side trim panel assembly that corresponds with the wing being removed.

(6) 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.

(7) Disconnect the aileron balance and control cables at the turnbuckles that are located within the fuselage aft of the spar.

(8) 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.

(9) 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.

(10) 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.

(11) 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.

(12) 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.

(13) 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.

(14) Arrange a suitable fuselage cradle and supports for both wings.

(15) Remove the jacks.

(16) Remove the front and rear spar nuts, washers and bolts.

CAUTION: DO NOT DRIVE BOLTS OUT. 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 FROM WHICH IT WAS REMOVED. REPLACEMENT OF ALL (18) NUTS IS RECOMMENDED.

(17) 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 recommended.

(18) Slowly remove the wing being certain that all electrical leads, cables and lines are disconnected.

	BOLT LEGEND		WASHER	
POSITION	BOLT	NUT	UNDER HEAD	UNDER NUT
A1	NAS464P6LA17	MS21042-6	NAS1149F0663P	NAS1149F0663P *
A2	NAS464P6LA16	MS21042-6	NAS1149F0663P	NAS1149F0663P **
A3	NAS464P6LA16	MS21042-6	NAS1149F0663P	NAS1149F0663P *
A4	NAS464P6LA16	MS21042-6	NAS1149F0663P	NAS1149F0663P *
A5	NAS464P6LA16	MS21042-6	NAS1149F0663P	NAS1149F0663P *
B1	NAS464P6LA15	H19300-6	NAS1149F0632P	K19301-6 ***
B2	NAS464P6LA14	H19300-6	NAS1149F0663P	K19301-6 ***
B3	NAS464P6LA14	H19300-6	NAS1149F0663P	K19301-6 ***
B4	NAS464P6LA14	H19300-6	NAS1149F0663P	K19301-6 ***
B5	NAS464P6LA14	H19300-6	NAS1149F0663P	K19301-6 ***
C1	NAS464P5LA20	MS21042-5	NAS1149F0532P	NAS1149F0563P *
C2	NAS464P6LA20	MS21042-6	NAS1149F0632P	NAS1149F0663P *
C3	NAS464P6LA20	MS21042-6	NAS1149F0632P	NAS1149F0663P *
C4	NAS464P6LA20	MS21042-6	NAS1149F0632P	NAS1149F0663P *
C5	NAS464P6LA21	MS21042-6	NAS1149F0632P	96352-3 ***
C6	NAS464P5LA21	MS21042-5	NAS1149F0532P	96352-2 ***
D1	NAS464P5LA20	MS21042-5	NAS1149F0532P	NAS1149F0563P *
D2	NAS464P6LA20	MS21042-6	NAS1149F0632P	NAS1149F0663P *
D3	NAS464P6LA20	MS21042-6	NAS1149F0632P	NAS1149F0663P *
D4	NAS464P6LA20	MS21042-6	NAS1149F0632P	NAS1149F0663P *
D5	NAS464P6LA21	MS21042-6	NAS1149F0632P	96352-3 ***
D6	NAS464P5LA21	MS21042-5	NAS1149F0532P	96352-2 ***

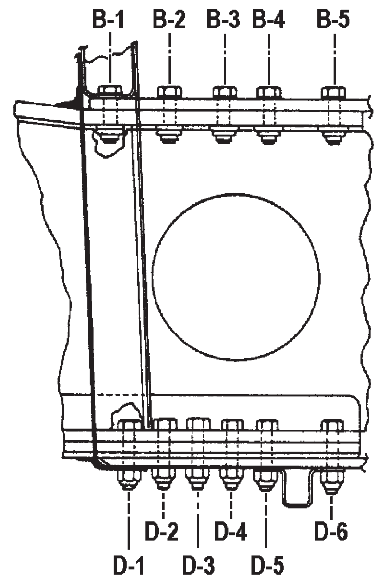
TORQUE BOLT HEADS ON UPPER SPAR CAP & NUTS ON LOWER SPAR CAP AS FOLLOWS:

5/16 INCH BOLT = 205-225 IN-LBS or 3/8 INCH BOLT = 360-390 IN-LBS.

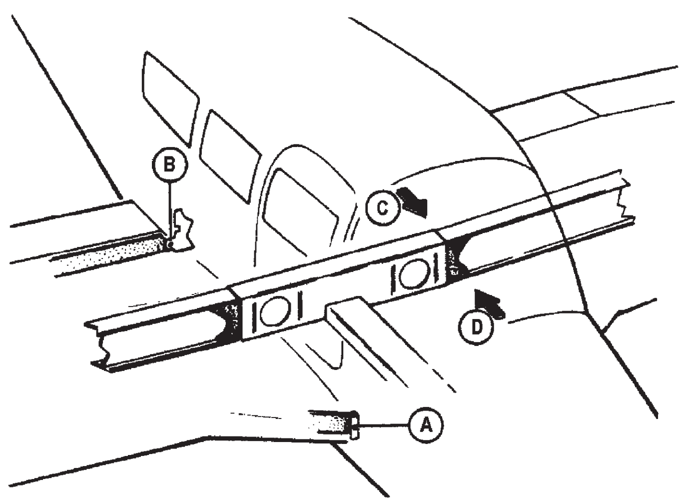
* - Maximum of two (2).

** - In addition to the one (1) washer specified under nut, use one (1) additional NAS1149F0632P or one (1) additional NAS1149F0663P as required to accomodate manufacturing tolerances. Place the additional washer between the specified washer and the nut. Total washers under nut shall not exceed two (2).

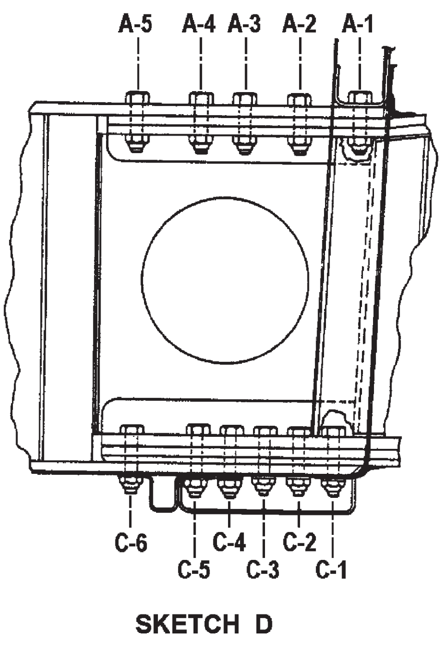
*** - A maximum of two (2) NAS1149F0563P or NAS1149F0663P washers may also be used under the special washer.



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.

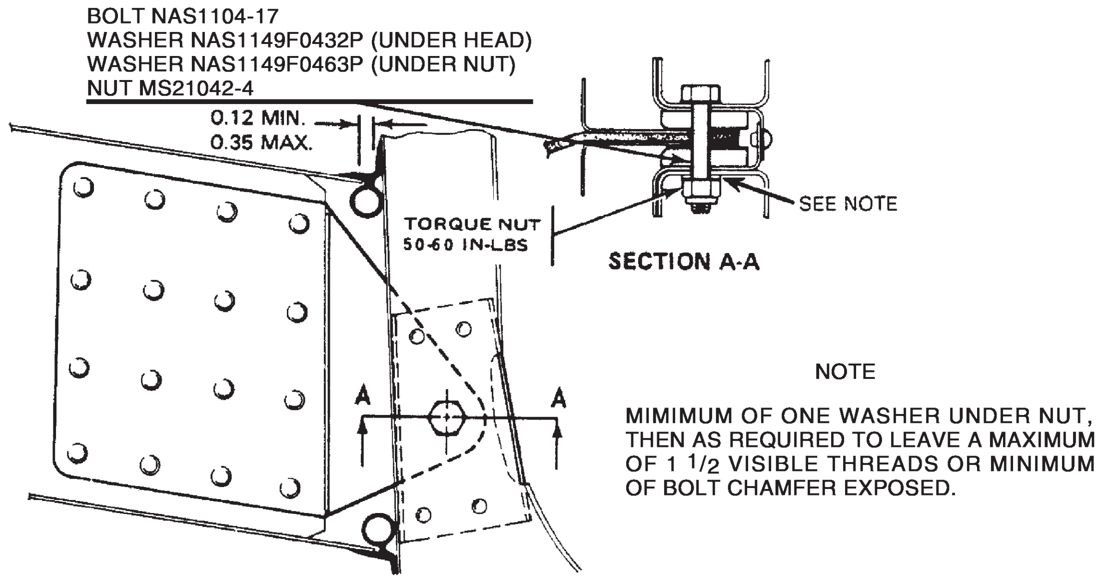


SKETCH D

Wing Installation
Figure 1 (Sheet 1 of 2)

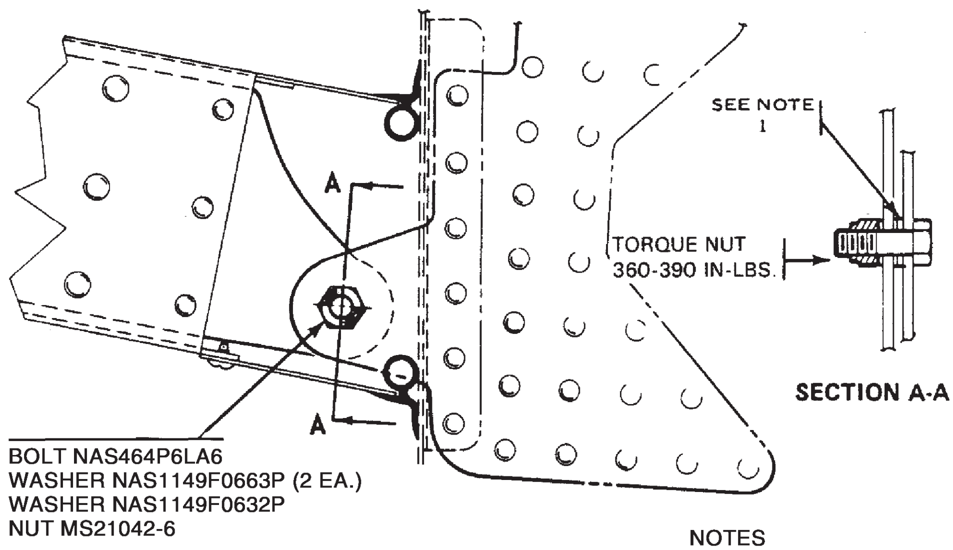
FORWARD SPAR ATTACHMENT

38500 CB



SKETCH A

REAR SPAR ATTACHMENT (LOOKING AFT, RIGHT SIDE)



NOTES

1. MAXIMUM NUMBER OF WASHERS ALLOWED BETWEEN FORWARD FACE OF WING FITTING AND AFT FACE OF FUSELAGE FITTING IS ONE NAS1149F0632P AND TWO NAS1149F0633P. (ALL THREE WASHERS ALWAYS REQUIRED WITH ONLY THE NAS1149F0632P WASHER ALLOWED UNDER THE BOLT HEAD.)
2. NEW SERVICE WINGS ARE NOT DRILLED FOR THE REAR SPAR ATTACHMENT BOLT. ACCORDINGLY, WHEN INSTALLING A NEW SERVICE WING, DRILL A .3745-.3765 HOLE IN THE REAR SPAR ATTACHMENT POINT.

SKETCH B

Wing Installation
Figure 1 (Sheet 2 of 2)

B. Installation

See Figure 1.

NOTE: When installing a "replacement" wing, perform the Flight Test Procedure under Stall Warning System, Functional Tests, in 27-30-00, upon completion of wing installation.

(1) Ascertain that the fuselage is positioned solidly on a support cradle.

(2) Place the wing in position for installation, with the spar end a few inches from the side of the fuselage and set on trestles.

(3) Prepare the various lines, control cables, etc., for inserting into the wing or fuselage when the wing is slid into place.

(4) Slide the wing into position on the fuselage.

CAUTION: DO NOT DRIVE BOLTS IN. TAKE CARE NOT TO DAMAGE BOLT HOLES. ENSURE THAT, IF REUSED, EACH BOLT IS REINSTALLED IN THE SAME HOLE FROM WHICH IT WAS REMOVED. REPLACEMENT OF ALL (18) NUTS IS RECOMMENDED.

(5) 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 1.)

(6) 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.

(7) 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 ensure 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.

(8) Torque the eighteen main spar bolt nuts or bolt heads as specified in Figure 1. Be certain that the bolts, nuts and washers are installed in accordance with the bolt legend. The forward spar attachment bolt should be torqued as specified in Figure 1. Torque the rear spar attachment bolt as specified in Figure 1.

(9) 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.

(10) 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.

(11) Connect the hydraulic brake line onto the fitting located within the cockpit at the leading edge of the wing.

(12) 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.

(13) Remove the cap from the fuel line and connect it at the fitting located forward of the spar at the wing butt line.

(14) Connect the aileron balance and control cables at the turnbuckles that are located within the fuselage aft of the spar. After the left balance cable has been inserted through the bracket assembly and connected, install a cotter pin cable guard into the hole that is provided in the bracket assembly.

(15) Connect the 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.

(16) Check the rigging and control cable tension of the ailerons and flaps. (Refer to Rigging and Adjustment, 27-10-00; and Wing Flap Controls, Rigging and Adjustment, 27-50-00.)

(17) Service and refill the brake system with hydraulic fluid in accordance with Servicing Brake System, 12-10-00. Bleed the system as given in 32-40-00 and check for fluid leaks.

(18) Service and fill the fuel system in accordance with Servicing Fuel System, 12-10-00. Open the fuel valve and check for leaks and flow.

(19) Check the operation of all electrical equipment, and pitot system.

(20) Remove the airplane from the jacks.

(21) Install the cockpit trim panel assembly, spar box carpet, the front and back seats, and wing butt rubber molding.

(22) Replace all the access plates and panels on the wing involved.

2. Wing Aft Attach Fitting Inspection

NOTE: This inspection incorporates the requirements of Piper Service Bulletin No. 1244A.

A. Inspection

Each 2,000 operating hours or seven (7) calendar years time-in-service, inspect the aft wing attach fitting hardware for both the right and left wings as follows:

(1) Remove wing inspection plates and fairings, as required to gain visual access to the aft wing attach fittings. See Access and Inspection Provisions in 6-00-00.

(2) Identify the aft wing attach fittings which are riveted to the aft wing spars. See Figure 2. Using a solvent-based degreaser spray that conforms to SAE AMS 1525 (such as LPS Presolve Orange Degreaser) and/or an alkaline cleaner that complies with SAE AMS 1526 (such as Chemetall Ardrox 6333A), thoroughly clean the aft wing attach fittings and the adjacent wing spar structure (fore and aft sides of each wing spar), removing surface oil, grease, loose paint, and soil, followed by a clean water rinse and dry.

(3) Carefully inspect for evidence of corrosion. The initial stages of corrosion are often masked by paint coatings and hidden under faying surfaces such as riveted lap joints. Since corrosion products occupy more volume than the original metal, carefully inspect these areas for irregularities such as blisters, flakes, chips, lumps, bulging skins and missing rivets.

(a) If no corrosion is present proceed to Corrosion Protection, below.

(b) If superficial corrosion is detected, remove per FAA Advisory Circular AC 43.13-1B, Chapter 6, Section 7 and treat corrosion in affected areas using guidance from FAA Advisory Circular AC 43.13-1B, Chapter 6, Section 8 or 10. Upon completion of procedure, verify that all affected areas meet or exceed the minimum thicknesses shown in Chart 1. Paint affected areas using a good quality aircraft primer that complies with MIL-PRF-23377 (such as Akzo-Nobel 10P30-5). Proceed to Corrosion Protection, below.

(c) If corrosion is detected and removal of corrosion in the affected areas will result in a part thickness in any location that is less than the minimum values shown in Chart 1, structural repair is required. Proceed to Structural Repair, below.

CHART 1
CORROSION LIMITS

Part Description	Minimum Thickness
Aft wing spar (aluminum)	0.060 inches
Aft wing attach fitting (steel)	0.117 inches

NOTE: Measure thickness using a nondestructive inspection method, such as ultrasound, eddy current, or equivalent, with a measurement accuracy of ± 0.005 inches or better.

B. Structural Repair

Order and install Kit, Corrosion - Aft Spar Rework, Piper P/N 764-998. This kit provides parts and instructions to replace (via a splicing operation) the aft spar fitting, as well as the inboard 10.80 inches of the aft wing spar on both left and right hand sides. Corrosion damage beyond these areas may require additional and/or different repairs. If that is the case, contact Piper Aircraft at (772) 299-2141. Piper normal business hours are 7:30 AM to 4:30 PM EST, Monday through Friday.

NOTE: Kit 764-998 as originally offered did not include the PA-32R-301 / PA-32R-301T. When ordering specify the kit must be revision B or higher to be effective for the PA-32R-301 / PA-32R-301T. The kits instructions will be marked drawing number 87584, revision B or higher.

Upon completion of structural repair, make a logbook entry documenting installation of Piper Kit No. 764-998 and proceed to Corrosion Protection, below.

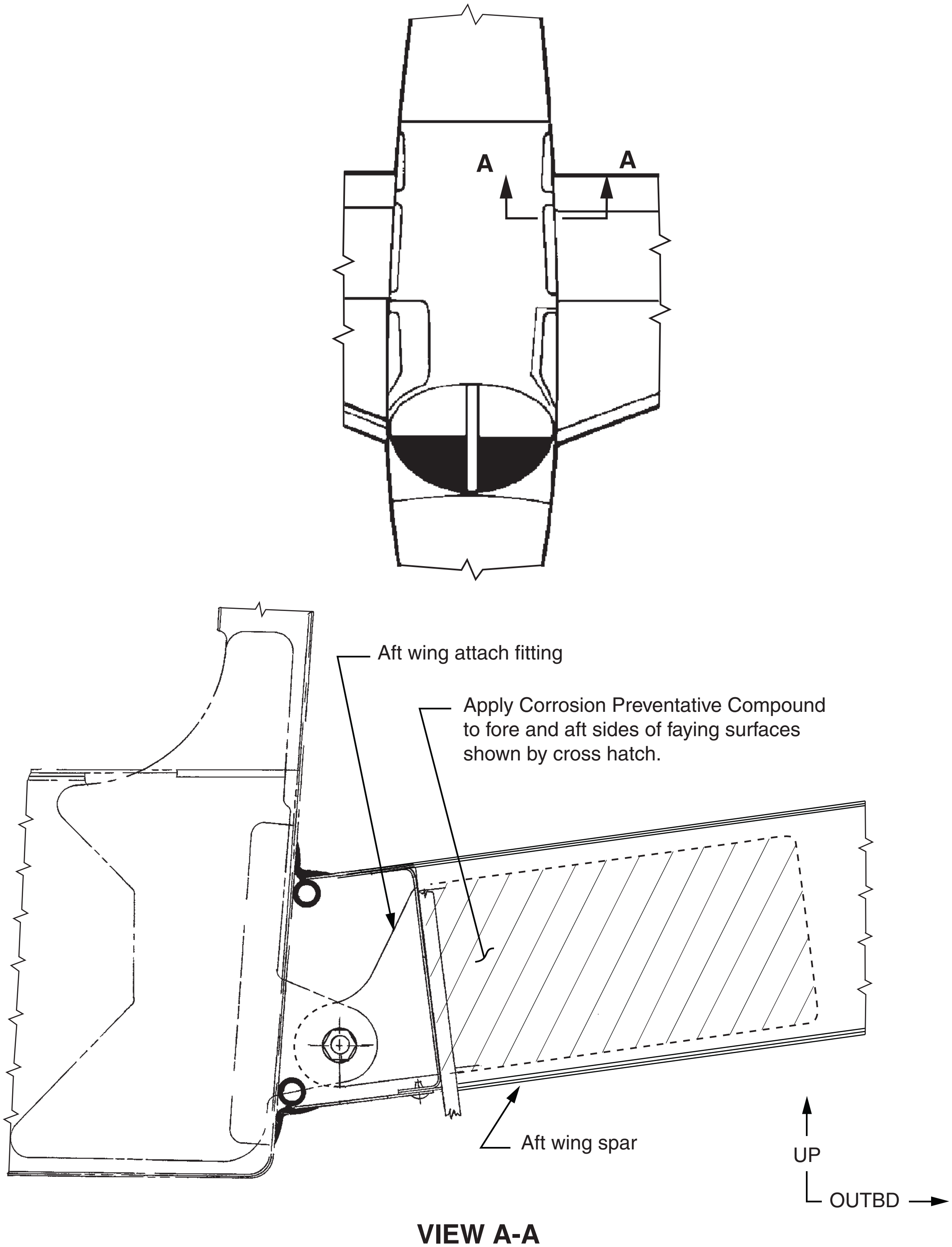
C. Corrosion Protection

Treat the area identified in Figure 2, View A-A, with Ardrox (Dinitrol) AV8, or other MIL-PRF-16173 Class I or II, Grade 1 or 4 compliant Corrosion Preventive Compound (procure locally, or order Piper P/N 89500-800). The treatment may be brushed or sprayed.

NOTE: After applying Corrosion Preventive Compound verify that all drain holes and drain passages are clear before proceeding.

D. Reinstall inspection plates and fairings. Perform a functional test of any system or component that may have been disconnected or removed.

E. Make a logbook entry documenting compliance with this inspection.



VIEW A-A
LOOKING AFT AT LEFT HAND SIDE

Wing Aft Attach Fitting
Figure 2

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FLIGHT SURFACES

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

1. Aileron (Refer to Figure 1.)

A. Checking Free Play

(1) Set the aileron in its neutral position and secure.

(2) 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.

(3) 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.

(4) Grasp the aileron and move it spanwise (inboard/outboard) to ensure maximum end play of 0.035 of an inch is not exceeded.

B. Removal

(1) Disconnect the aileron control rod at the aileron attachment point by removing the nut, washers and bolt from the rod end bearing. To simplify installation note location of washers removed.

(2) Remove the attaching nuts, bolts and washers from the hinges at the leading edge of the aileron, and remove the aileron.

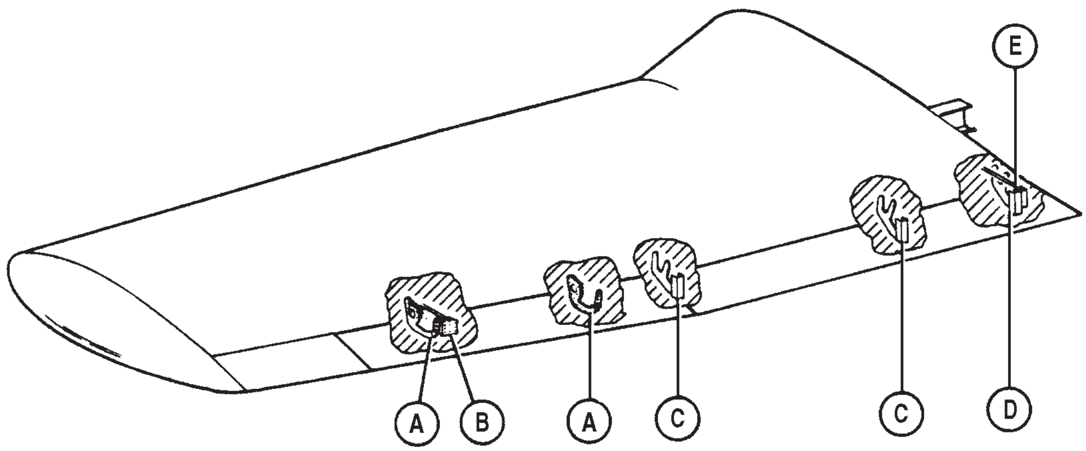
C. Installation

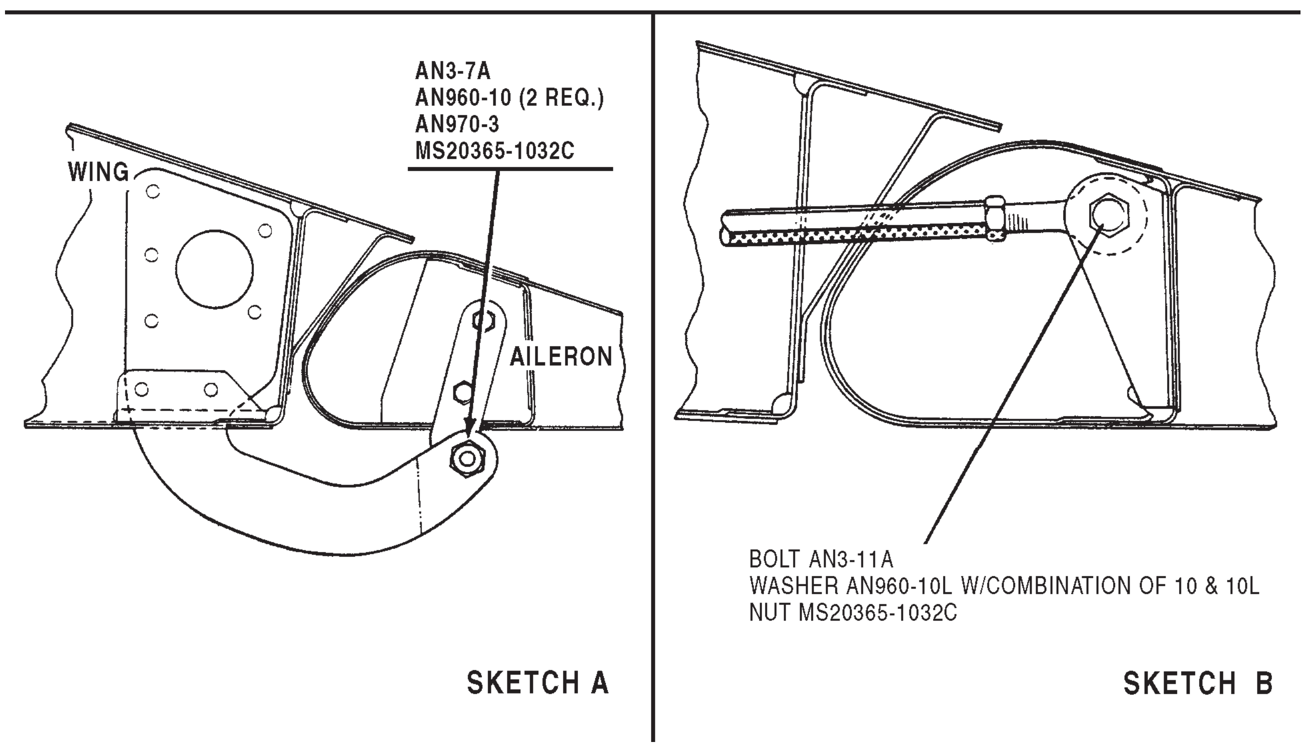
WARNING: AILERONS THAT HAVE BEEN REPLACED OR REPAINTED MUST BE BALANCED BEFORE INSTALLATION. SEE BALANCING, BELOW.

(1) Move the aileron into place and install attaching bolts, washers and nuts. Ascertain that the aileron is free to move with no interference.

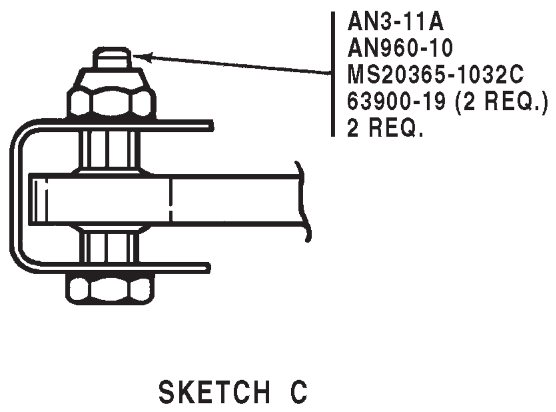
(2) Attach the aileron control rod with bolts, washers and nut, dividing the washers so that the aileron is free to rotate from stop to stop without the control rod binding or rubbing on the opening in the aft spar. Be certain that the rod end bearing has no side play when tightening the bolt and that the rod does not contact the side of the bracket.

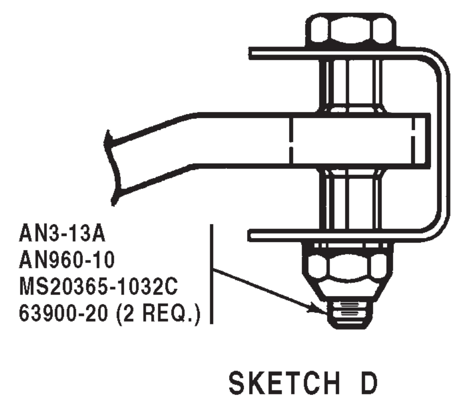
(3) Actuate the aileron controls to ensure freedom of movement.

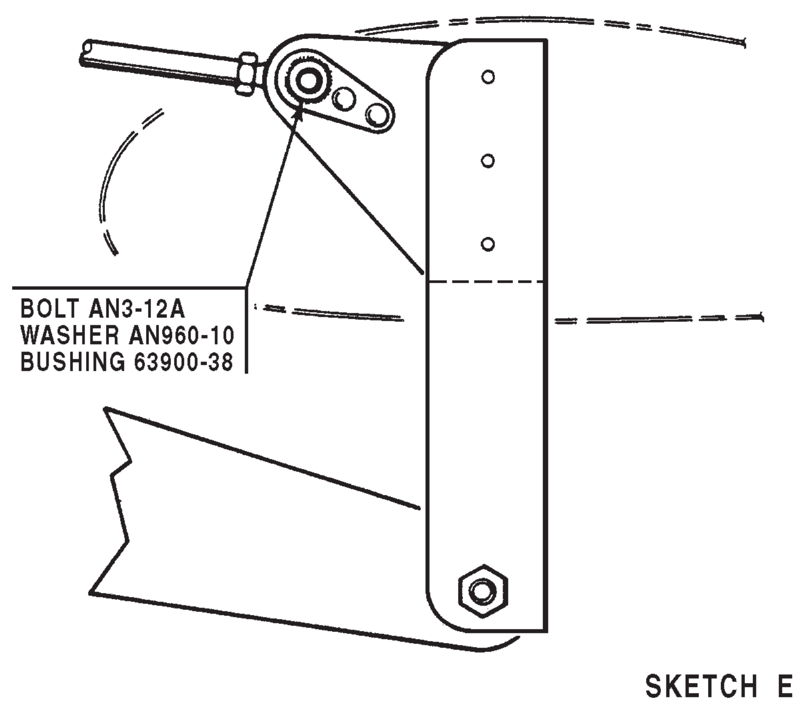




Aileron and Flap Installation
Figure 1 (Sheet 1 of 2)







Aileron and Flap Installation
Figure 1 (Sheet 2 of 2)

D. Balancing

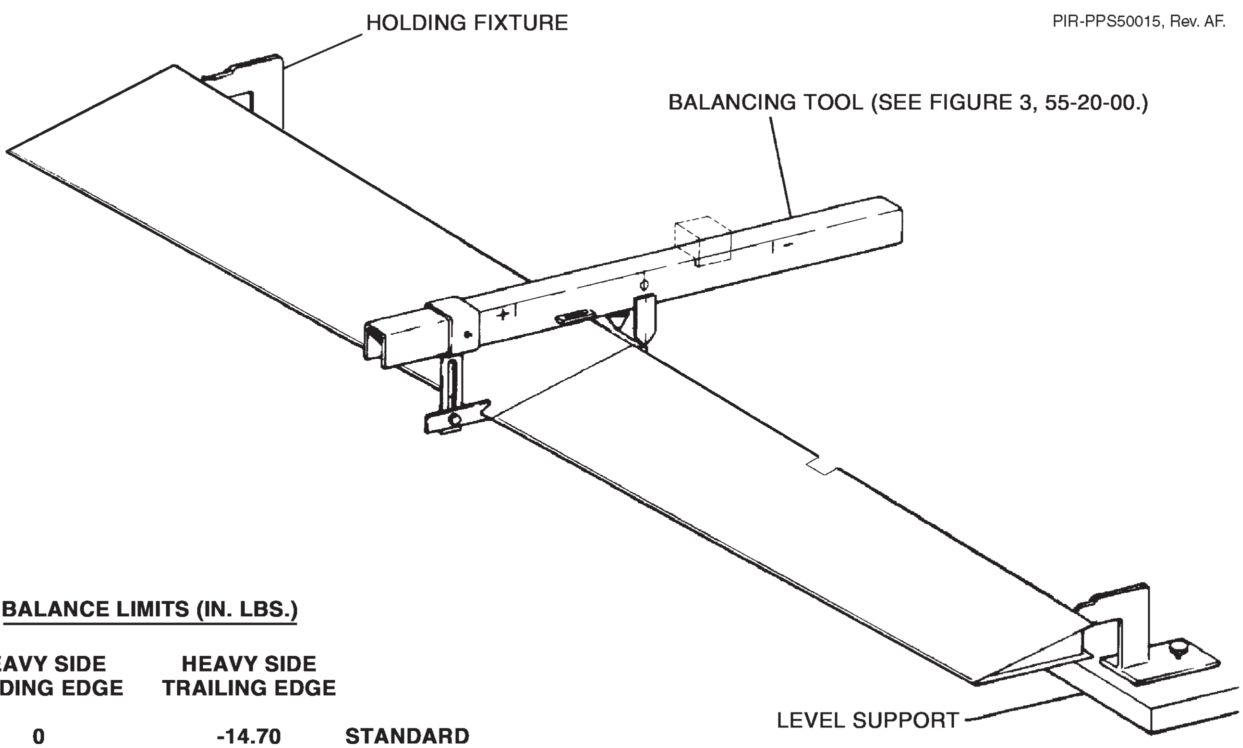
Refer to Figure 2.

To balance aileron, assembly must be complete and in its final flight configuration as described under Control Surface Balancing, Balancing Equipment, in 55-00-00.

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 (see 55-00-00, Figure 2) 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 2, proceed as follows:

(1) Leading edge heavy: This condition is highly improbable; recheck measurements and calculations.

(2) Trailing edge heavy: There are no provisions for adding weight to balance weight to counteract a trailing edge heavy condition. Therefore, it will be necessary to determine the exact cause of the unbalance. If the aileron is too heavy because of painting over old paint, it will be necessary to strip all paint from the aileron and repaint. If the aileron is too heavy resulting from repair to the skin or ribs, it will be necessary to replace all damaged parts and recheck the balance.



BALANCE LIMITS (IN. LBS.)

HEAVY SIDE LEADING EDGE	HEAVY SIDE TRAILING EDGE	
0	-14.70	STANDARD
0	-12.50	WITH OPTIONAL INADVERTENT ICE PROTECTION SYSTEM (TKS)

Balancing Aileron
Figure 2

2. Aileron Outboard Center Nose Rib Assembly 100 Hour Inspection

NOTE: This inspection incorporates the requirements of Piper Service Bulletin No. 1216B.

In HP S/N's 3246001–3246244 and TC S/N's 3257001–3257493, for those airplanes which have not installed new left and right aileron assemblies, and have not installed new outboard center nose rib assemblies P/N's 86398-008 (left hand side) and 86398-009 (right hand side), and have accumulated 500 or more hours time-in-service: each 100 hours time-in-service, inspect the outboard center nose rib assembly in each aileron at W.S. 156.3 for cracking as follows:

NOTE: This repetitive inspection requirement may be relieved by installing new replacement aileron assemblies P/N's 38650-007 (right hand side) and 38650-008 (left hand side) per paragraph "E. Aileron Replacement", below. It may also be relieved by installing new replacement nose rib assemblies P/N's 86398-008 (left hand side) and 86398-009 (right hand side) per paragraph "F. Nose Rib Assembly Replacement", below.

Verify aileron assemblies P/N's 38650-007 and 38650-008 are marked wiht revision level Y or later. Some affected aircraft were delivered with ailerons marked revision level W or earlier. Such ailerons do not contain Nose Rib Assembly P/N's 86398-008 and 86398-009 and therefore do not relieve the repetitive inspection requirement.

Likewise, this inspection is not required if steps A, B, and/or C, below, have previously confirmed that the aileron hinge fitting is attached using a nut and bolt combination (i.e., nut and locknuts visible or bolt head and no countersunk rivets visible).

A. Inspect the left and right ailerons at the outboard hinge attachment. (See Figure 3.) Referring to Figure 4, determine if the aileron hinge fitting at W.S. 156.3 is attached using a nut and bolt combination (nut and locknuts visible) or a bolt and nutplate combination (bolt head and nutplate rivets visible).

B. If nuts are visible, along with a threaded portion of the bolts as shown in Figure 4, no further action is required. Proceed to step G, Documentation of Compliance.

C. If bolt heads are visible as shown in Figure 5, look just forward of the hinge fitting for countersunk rivets indicating a nutplate installation (remove paint if necessary). (See Figures 6 and 7.)

(1) If the hardware that fastens the outboard aileron hinge fitting to the web of the aileron nose rib consists exclusively of bolts, washers and nuts (as determined by borescope inspection), nutplates are not installed and no further action is required. Proceed to step G, Documentation of Compliance.

(2) If rivets are visible, then nutplates are installed, so proceed to step D.

NOTE: Nutplate configurations have varied over time. Existence of any nutplates at this location, regardless of type, requires a recurring inspection until such time as the ailerons are replaced in accordance with "E. Aileron Replacement" or the the Nose Rib Assemblies are replaced in accordance with "F. Nose Rib Assembly Replacement".

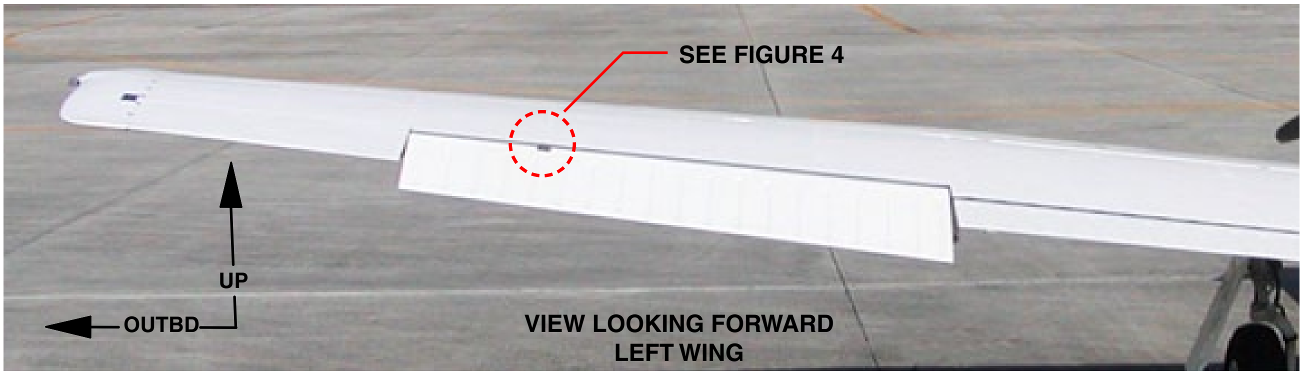
D. Recurring Inspection for cracks.

(1) Remove the left and/or right aileron(s) per Removal under Aileron, above.

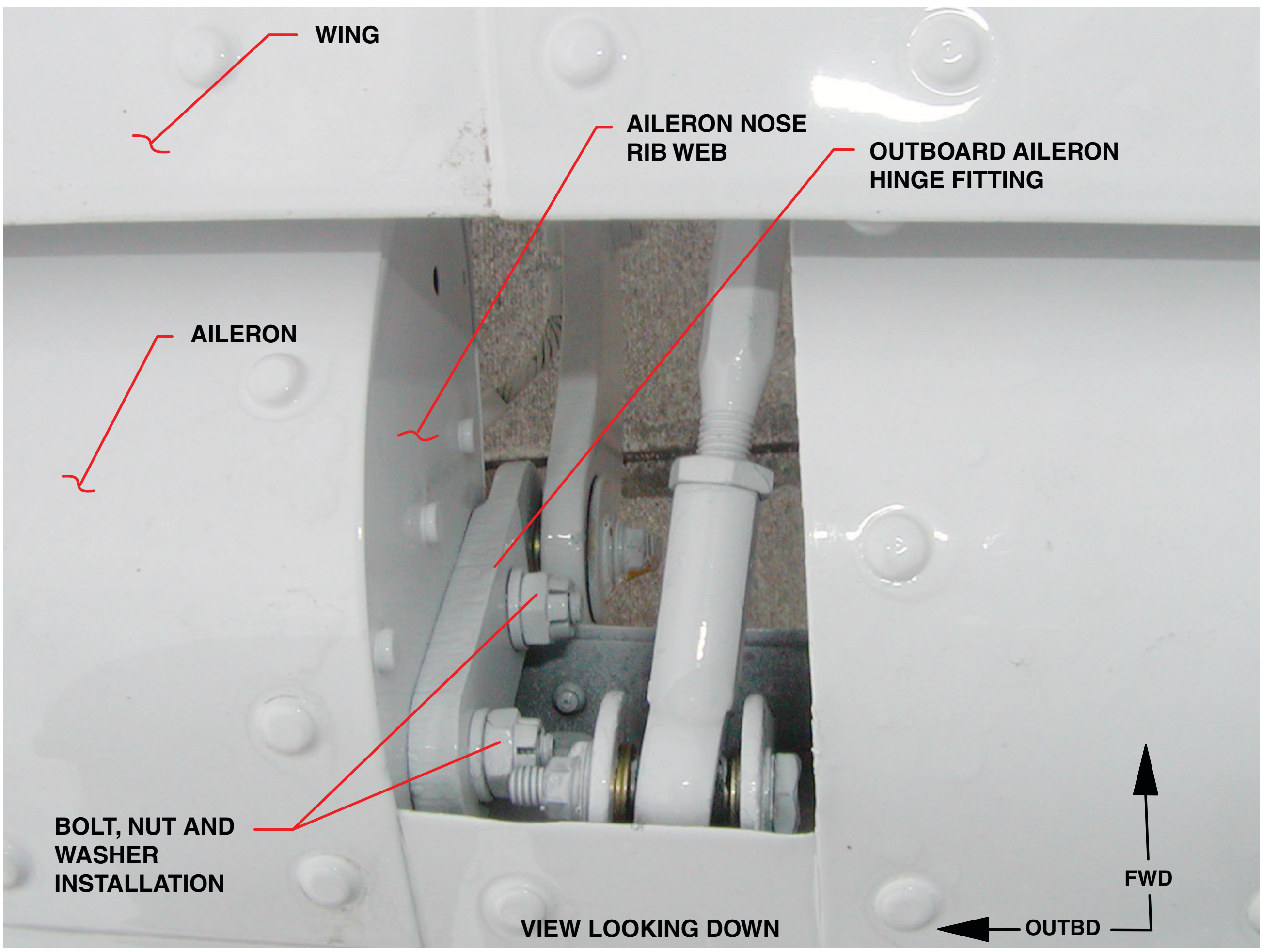
(2) Remove the outboard aileron hinge fitting from each nose rib. Hardware in good condition may be reused.

(3) Remove paint from the nose rib, in the areas identified in Figure 7. (Use Cee-Bee A-202 paint stripper or equivalent).

NOTE: Remove paint using chemical processes only. The use of abrasives or other mechanical methods to remove paint will hide the existence of any cracks, making an accurate inspection impossible. Use isopropyl alcohol to wipe clean the area of the nose rib where paint was removed. See Figure 7.

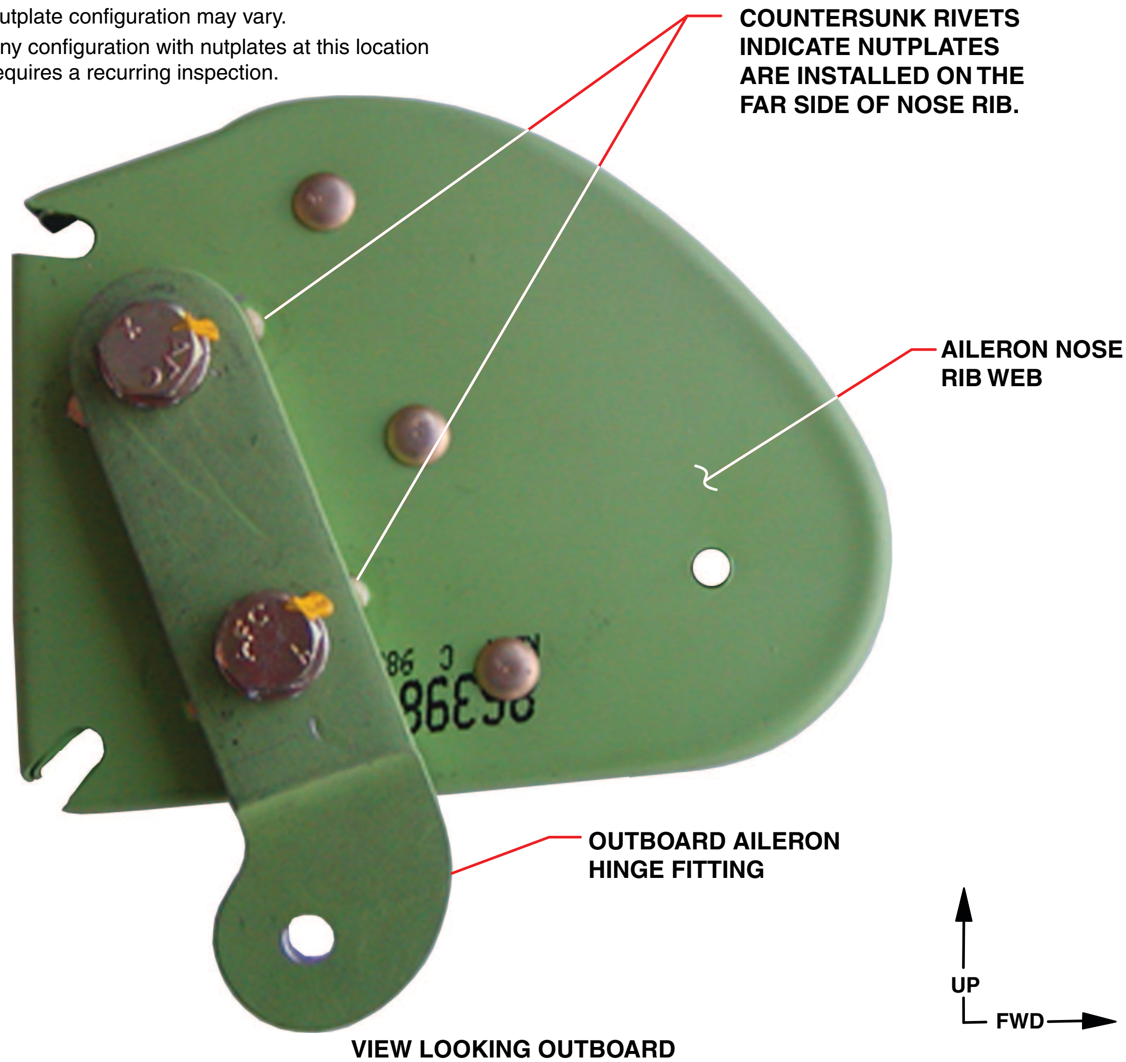


Outboard Aileron Hinge Location
Figure 3



Outboard Aileron Hinge Nose Rib Installed With Nuts, Bolts and Washers
Figure 4

NOTE: Nutplate configuration may vary.
Any configuration with nutplates at this location requires a recurring inspection.



Outboard Aileron Hinge Nose Rib Installed With Nutplate
Figure 5

(4) Perform fluorescent penetrant inspection on the area identified in Figure 7, using procedures described in FAA Advisory Circular AC 43.13-1B.

(a) If any cracks are detected, proceed to “E. Aileron Replacement” or “F. Nose Rib Assembly Replacement”, below.

(b) If no crack is detected, wipe area of inspection clean with isopropyl alcohol. Apply primer to nose rib in area where paint was removed for inspection using MIL-PRF-85582D Type I Class C2 primer, ANAC 10P8-10 Fluid Resistant Epoxy primer, or any compatible epoxy primer. Apply a compatible top coat of paint such as DuPont Imron, color to match adjacent paint.

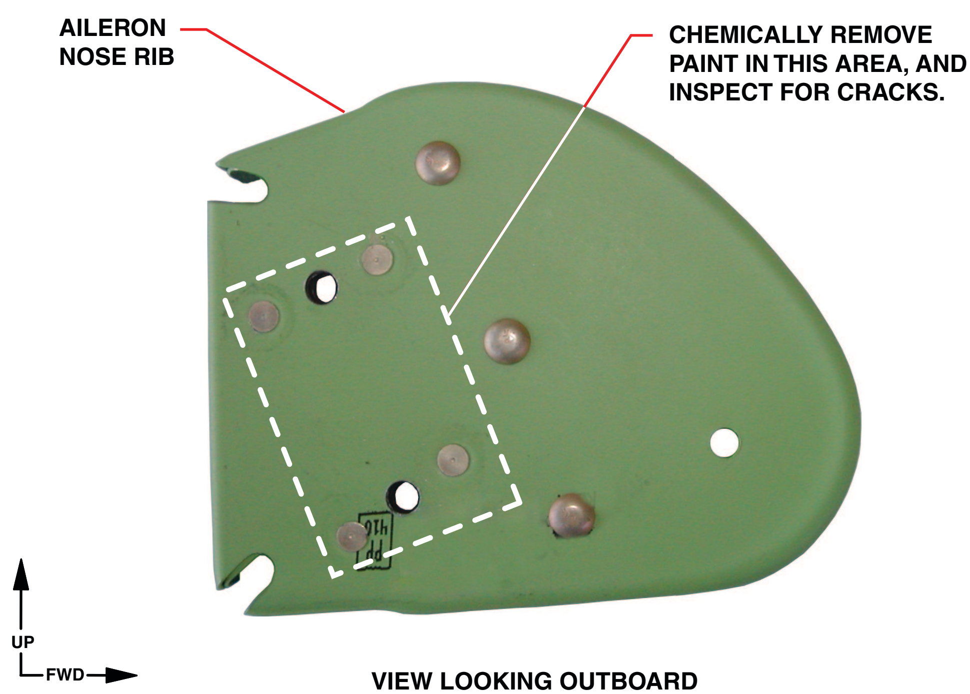
(5) Reinstall hinge fitting.

(6) Reinstall aileron per Installation under Aileron, above.

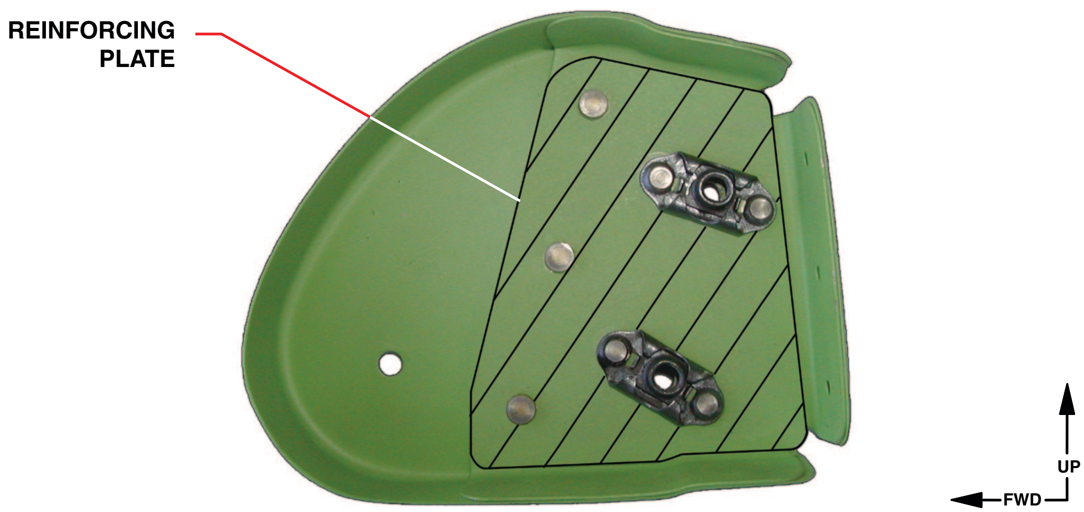
(7) Proceed to step G, Documentation of Compliance.

NOTE: The nutplate configuration may vary.

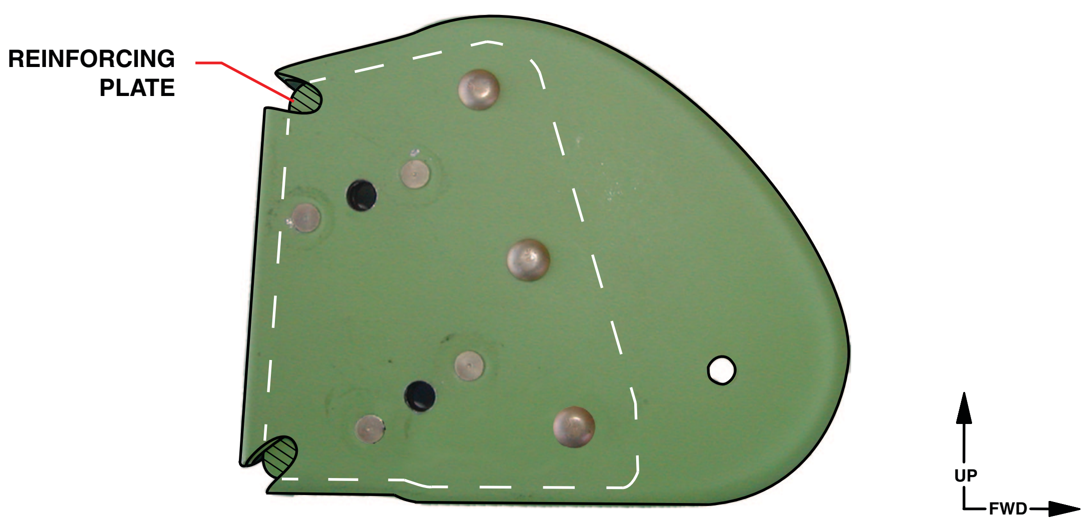
Aileron Hinge Nose Rib Nutplates
Figure 6



Aileron Hinge Nose Rib Nutplate Inspection Area
Figure 7



VIEW LOOKING INBOARD FROM INSIDE AILERON



VIEW LOOKING OUTBOARD

P/N 86398-009 (RIGHT SIDE) AND P/N 86398-008 (LEFT SIDE)

NOTE: The nutplate configuration may vary.

Aileron Hinge Nose Rib with Reinforcing Plate
Figure 8

E. Aileron Replacement

(1) Order new ailerons, Piper P/N's 38650-007 (right hand side) and 38650-008 (left hand side), one each per aircraft. Verify ailerons are marked with revision level Y or later prior to installation.

NOTE: Any ailerons (Piper P/N's 38650-007 and 38650-008) marked revision level W or earlier do not relieve the repetitive inspection requirement. Such ailerons do not contain the new Nose Rib Assemblies, P/N's 86398-008 and 86398-009.

(2) Ailerons are supplied with metal surfaces primed. Apply a compatible top coat of paint such as DuPont Imron, color to match adjacent paint.

(3) Balance new ailerons per Balancing, under Aileron, above.

(4) Remove existing ailerons from aircraft per Removal, under Aileron, above.

(5) Install new ailerons per Installation, under Aileron, above.

(6) Proceed to step G, Documentation of Compliance.

F. Nose Rib Assembly Replacement

CAUTION: REWORKED AILERONS MUST CONFORM TO TYPE DESIGN. THEREFORE, THE FOLLOWING REQUIREMENTS MUST BE MET DURING THE NOSE RIB ASSEMBLY REPLACEMENT DESCRIBED HEREIN:

- A HOLDING FIXTURE MUST BE USED DURING REWORK TO ENSURE THAT THE AILERON MAINTAINS CONTOUR.
- REPLACEMENT FASTENERS MUST MATCH TYPE AND SIZE OF REMOVED FASTENERS.

(1) Order Nose Rib Assemblies Piper P/N's 86398-008 (left hand side) and 86398-009 (right hand side), one each per aircraft. (See Figure 8.)

(2) Nose rib assemblies are supplied with metal surfaces primed. Apply a compatible top coat of paint such as DuPont Imron, color to match adjacent paint.

(3) Remove aileron from aircraft per Removal, under Aileron, above. Upon removing the outboard aileron hinge fitting from each nose rib, determine if attaching hardware is in good condition and may be reused.

(4) Remove and discard the existing nose rib assembly.

(5) Rework existing ailerons by installing new nose rib assemblies, Piper P/N's 86398-008 (left hand side) and 86398-009 (right hand side). Secure with replacement rivets of same size and type; NAS1738B series rivets (qty 7) through nose rib flange common to Aileron skin, and MS20470AD rivets (qty 3) through nose rib flange common to the web of the aileron spar.

(6) Balance Ailerons per Balancing, under Aileron, above.

(7) Install Ailerons per Installation, under Aileron, above.

(8) Proceed to step G, Documentation of Compliance.

G. Make an appropriate logbook entry documenting compliance with this inspection / modification, as appropriate.

3. Wing Flap (Refer to Figure 1.)

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

A. Removal

(1) Extend the flaps to their fullest degree and remove the bolt and bushing from the rod end bearing.

(2) Remove the nuts, washers, bushing and hinge bolts that hold the flap to the wing assembly.

(3) Pull the flap straight back off the wing.

B. Installation

(1) Replace the wing flap by placing the flap onto its proper position and inserting the hinge bolts, bushings, washers and nuts.

(2) With the flap control in the full flap position, place the bushing on the outboard side of the rod end bearing and insert and tighten the bolt.

(3) Operate the flap several times to be certain it is operating freely. (Refer to 27-50-00, Wing Flap Controls, Rigging and Adjustment.)

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CHAPTER

61

PROPELLER

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CHAPTER 61

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE	CHAPTER SECTION	PAGE	DATE
61-List of Effective Pages	1	Jul 31/13			
	2	Jun 30/07			
61-Table of Contents	1	Jul 31/13			
	2	Jun 30/07			
61-10-00	1	Jul 31/13			
	2	Jul 31/13			
	3	Jun 30/07			
	4	Jun 30/07			
	5	Jun 30/07			
	6	Jun 30/07			
	7	Jun 30/07			
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61-20-00	1	Jun 30/07			
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	6	Jun 30/07			

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CHAPTER 61 - PROPELLER

TABLE OF CONTENTS

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PROPELLER ASSEMBLY

Propeller

This section lists procedures for the removal, cleaning, inspection, repair, and installation of the propeller assembly. Servicing information may be found in 12-20-00.

A. Removal

(1) Ensure that the master and magneto switches are off.

(2) Move fuel selector to off position.

(3) Place the mixture control in idle cut-off.

(4) Note position of each component to facilitate reinstallation.

(5) Remove the screws from around the spinner assembly and remove spinner.

(6) Remove the safety wire from the six propeller mounting nuts on studs and remove studs.

(7) Place a drip pan under the propeller to catch oil spillage, then remove the propeller.

B. Installation

Refer to Figure 1.

(1) Ensure master and magneto switches are off.

(2) Place fuel selector to off position.

(3) Place mixture control in idle cut-off.

(4) Observe the starter ring gear to make sure it is mounted properly on the engine crankshaft flange. One of the bushings on the crankshaft is stamped with an “O” mark and it must be inserted in the starter ring gear hole, likewise identified with an “O” mark.

(5) Wipe crankshaft and propeller pilot to assure that no chips or foreign matter enter the propeller mechanism.

(6) Check interior of propeller hub for proper seating of “O” ring. Wipe inside of hub to remove any traces of dirt. Check to see that “O” ring is covered with grease.

(7) Install spinner bulkhead. Torque bulkhead attachment nuts per Chart 1.

(8) Slide propeller carefully over pilot, taking care that “O” ring is not damaged.

(9) Install the six hexagon head propeller hub mounting nuts and torque per Chart 1, or as specified in the appropriate Hartzell Propeller Owner’s Manual.

(10) Check blade track, per Checking Propeller Blade Track, below.

(11) Safety the propeller mounting nuts with MS20995-C41 safety wire.

(12) 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.

(13) Install spinner. Torque all attachment screws per Chart 1.

CHART 1
PROPELLER TORQUE LIMITS

Description	Required Torque (Dry)
Propeller Mounting Nuts	60–70 foot-pounds *
Spinner Bulkhead Attachment Nuts	20–24 foot-pounds *
Spinner Attachment Screws	20–22 inch-pounds *
* Or as specified in the appropriate Hartzell Propeller Owners Manual.	

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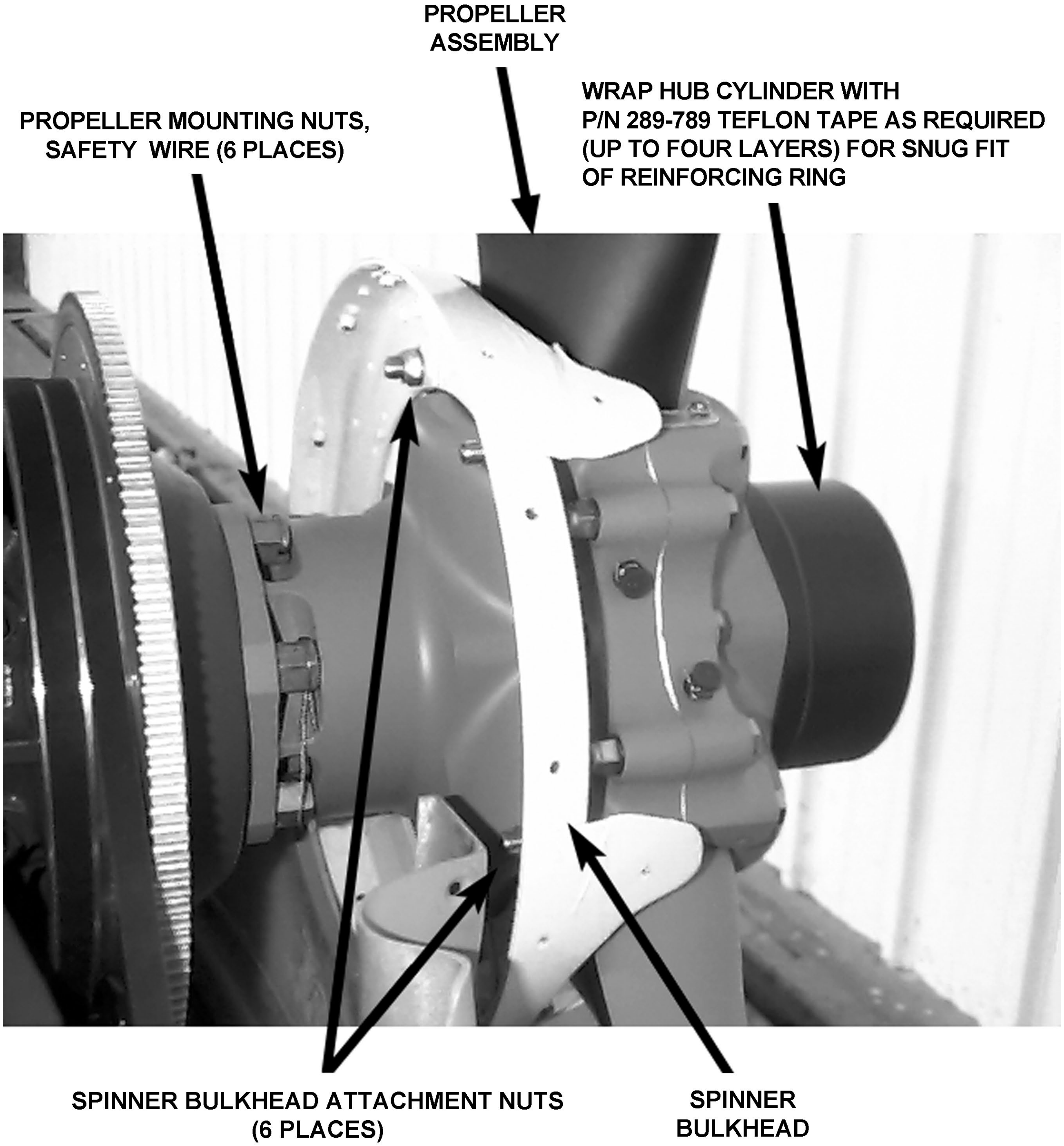
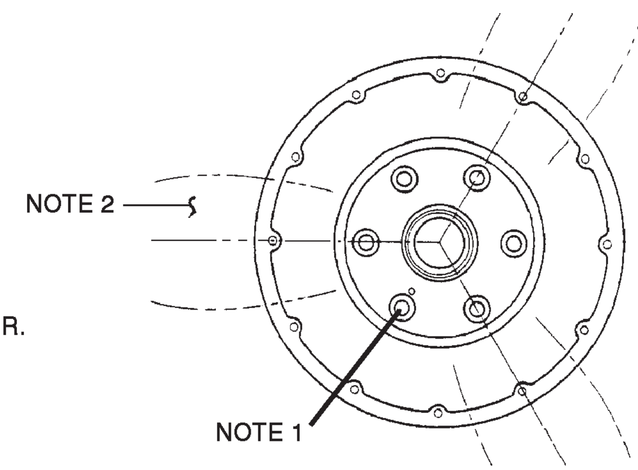
100920 AO



Propeller Installation
Figure 1 (Sheet 1 of 2)



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.

Propeller Installation
Figure 1 (Sheet 2 of 2)

C. Cleaning, Inspection, and Repair

(1) Check for oil and grease leaks.

(2) Clean the spinner, propeller hub interior and exterior, and blades with a non-corrosive solvent.

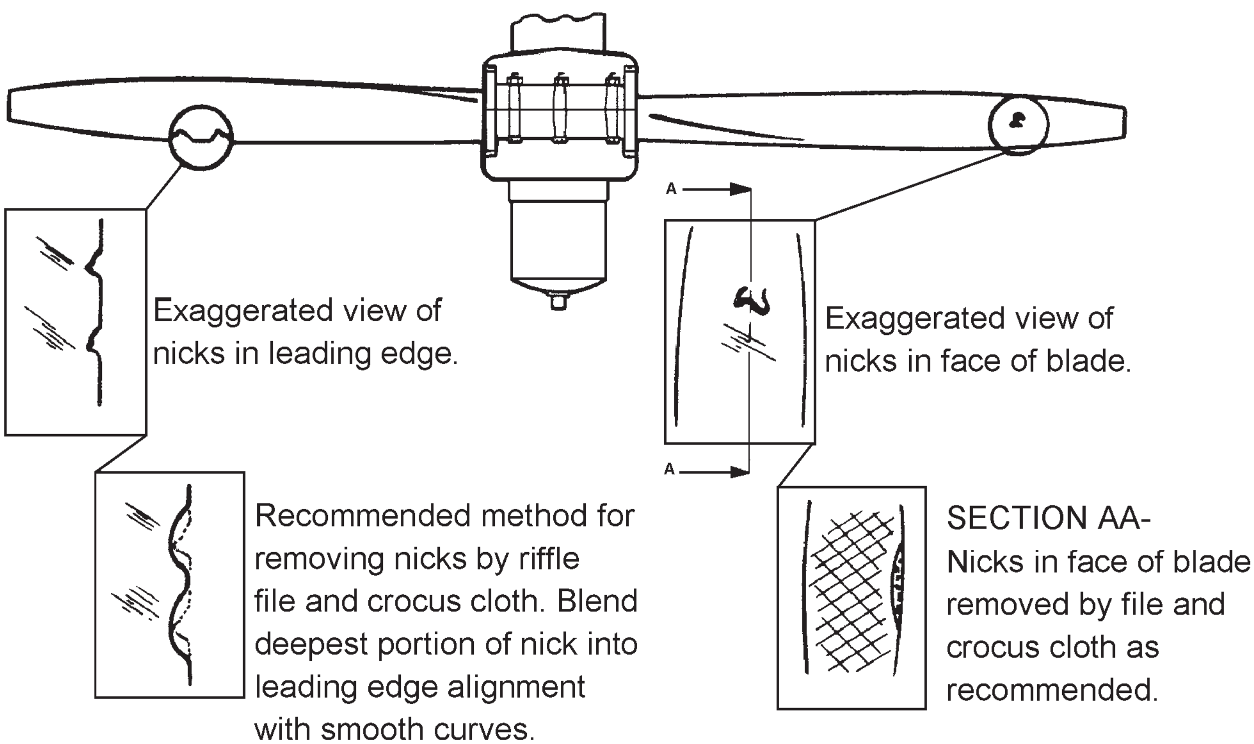
(3) Inspect the hub parts for cracks.

(4) Steel hub parts should not be permitted to rust. Use aluminum paint to touch up if necessary, or replate during overhaul.

(5) Check all visible parts for wear and safety.

(6) Check blades to determine whether they turn freely on the hub pivot tube. This can be done by rocking the blades back and forth through the slight freedom allowed by the pitch change mechanism. If they appear tight and are properly lubricated, the pitch change mechanism should be removed so that each blade can be checked individually. If blades are tight, the propeller should be disassembled.

(7) Inspect blades for damage or cracks. Nicks in leading edges of blades should be filed out and all edges rounded, as cracks sometimes start from such places. Use fine emery cloth for finishing. Refer to Figure 2 for propeller blade care.



Typical Nicks and Removal Methods
Figure 2

D. Checking Propeller 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 0.0625 inch – may be an indication of bent blades or improper propeller installation. Check blade track as follows:

(1) With the engine shut down and blades vertical, secure to the aircraft a smooth board just under the tip of the lower blade. Move the tip fore and aft through its full “blade-shake” travel, making small marks with a pencil at each position. Then center the tip between these marks and scribe a line on the board for the full width of the tip.

(2) Carefully rotate propeller by hand to bring the opposite (or next) blade down. Center the tip and scribe a pencil line as before and check that lines are not separated more than 0.0625 inch.

(3) Propellers having excess blade track should be removed and inspected for bent blades, or for parts of sheared “O” ring, or foreign particles, which have lodged between hub and crankshaft mounting faces. Bent blades will require repair and overhaul of assembly.

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CONTROLLING

Propeller Governor

A. Removal

(1) Remove the upper engine cowl.

(2) Disconnect the control cable end from the governor control arm.

(3) Remove the governor mounting stud nuts. It will be necessary to raise the governor as the nuts are being removed before they can be completely removed.

(4) Remove the mounting gasket. If the governor is to be removed for a considerable length of time and another unit not substituted, it is advisable to cover the mounting pad to prevent damage caused by foreign matter.

B. Installation

(1) Clean the mounting pad thoroughly, making very certain that there are no foreign particles in the recess around the drive shaft.

(2) Place the governor mounting gasket in position with the raised portion of the screen facing away from the engine.

(3) Align the splines on the governor shaft with the engine drive and slide the governor into position.

(4) With the governor in position, raise the governor enough to install washers and start mounting nuts. Torque nuts even.

(5) Connect the control cable end to the governor control arm. The ball stud is installed in the inner hole of the control arm.

(6) Adjust governor control per Rigging and Adjustment of Propeller Governor.

(7) Install engine cowl.

C. Rigging and Adjustment (Refer to Figure 1.)

(PIR-See PPS/FTP Index.)

(1) 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.

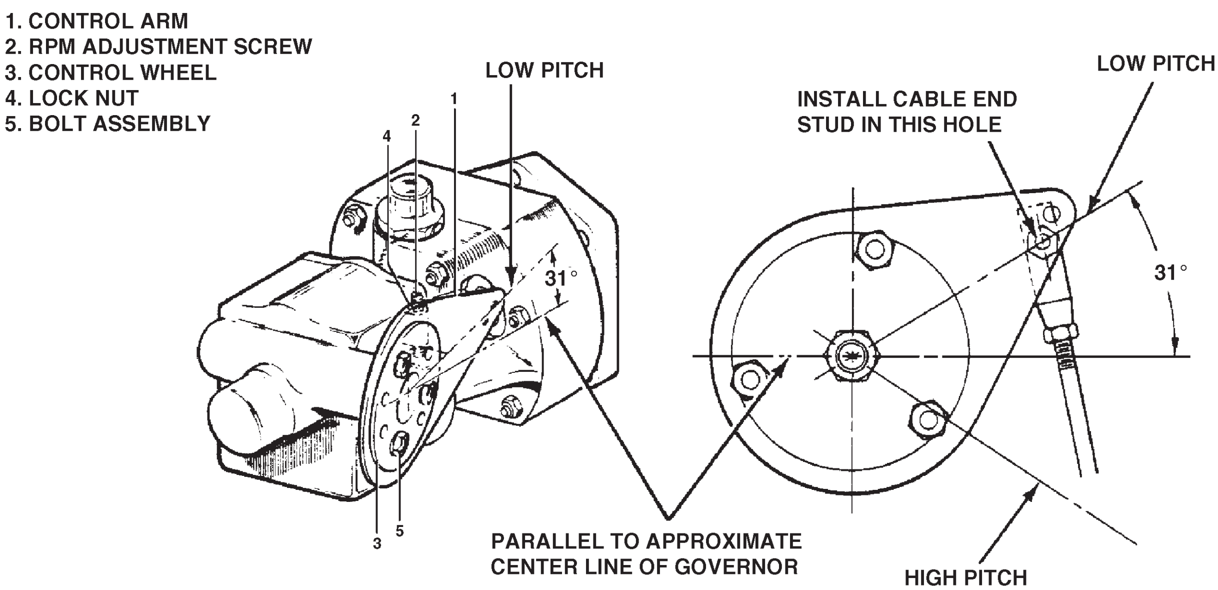
(2) If adjustment is required complete the following steps.

(a) Ensure that the governor control arm is located approximately as shown on Figure 1.

(b) Adjust control cable end hardware to obtain cockpit control cushion. Ensure there is adequate thread engagement of clevis end and rod end bearing (witness holes) after adjustment.

(c) Ensure that the control cable assembly is not bottoming internally.

(3) Start engine, park 90° to wind direction and warm in normal manner.



Propeller Governor
Figure 1

(4) 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:

(a) Shut down the engine and remove the upper engine cowl.

(b) Adjust the governor by means of the fine adjustment screw to: 2650 - 2700 RPM for HP S/N's 3246001 & up; 2460 - 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.

(c) Reinstall upper engine cowl and repeat step b to ascertain proper rpm setting.

(d) After setting the proper high rpm adjustment, run the self-locking nut on the fine adjustment screw against the base projection to lock.

(e) Ascertain that the governor control arm is adjusted to the proper angle on the control wheel as shown in Figure 1.

(5) 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.

(6) 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.

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CHAPTER

70

STANDARD PRACTICES - ENGINE

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CHAPTER 70

LIST OF EFFECTIVE PAGES

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CHAPTER 70 - STANDARD PRACTICES - ENGINES

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GENERAL

Review the following suggestions before working on the power plant.

1. To ensure proper reinstallation and/or assembly, tag and mark all parts, clips, and brackets as to their location prior to their removal and/or disassembly.

   NOTE: Use tags or temporary marking methods which are durable enough to ensure identification during ordinary handling, storage and final assembly of parts.

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. Ensure that all parts are thoroughly clean before assembling.

5. Never reuse any lockwire, lockwashers, tablocks, tabwashers or cotter pins. All lockwire and cotter pins must fit snugly in holes drilled in studs and bolts for locking purposes. Cotter pins should be installed so the head fits into the castellation of the nut, and unless otherwise specified, bend one end of the pin back over the stud or bolt and the other end down flat against the nut. Use only corrosion resistant steel lockwire and/or cotter pins. Bushing plugs shall be lockwired to the assembly base or case. Do not lockwire the plug to the bushing.

6. All gaskets, packings and rubber parts must be replaced with new items of the same type at reassembly. Ensure 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.

   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.

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.

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CHAPTER

71

POWER PLANT

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CHAPTER 71

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
71-List of Effective Pages	1	Jul 31/13
	2	Jun 30/07
71-Table of Contents	1	Jul 31/13
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71-00-00	1	Jun 30/07
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	4	Jul 31/13
	5	Jul 31/13
	6	Jun 30/07
	7	Jun 30/07
	8	Jun 30/07
	9	Jun 30/07
	10	Jun 30/07
	11	Jun 30/07
	12	Jun 30/07
71-10-00	1	Jul 31/13
	2	Jun 30/07
71-20-00	1	Jul 31/13
	2	Jun 30/07
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	4	Jun 30/07
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	7	Mar 21/12
	8	Mar 21/12

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CHAPTER 71 - POWER PLANT

TABLE OF CONTENTS

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GENERAL

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

1. Description

A. SARATOGA II HP (S/N's 3246001 and 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.

B. SARATOGA II TC (S/N's 3257001 and 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.

2. Troubleshooting

WARNING: GROUND THE MAGNETO PRIMARY CIRCUIT BEFORE PERFORMING ANY CHECKS OF THE ENGINE.

Troubles peculiar to the power plant are listed in Chart 1 along with their probable causes and suggested remedies.

CHART 1 (Sheet 1 of 4)
TROUBLESHOOTING ENGINE

Trouble	Cause	Remedy
Failure of engine to start.	Lack of fuel.	Check fuel system for leaks.
		Fill Fuel tank.
		Clean dirty lines, strainers or fuel valves.
		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 1 (Sheet 2 of 4)
TROUBLESHOOTING ENGINE

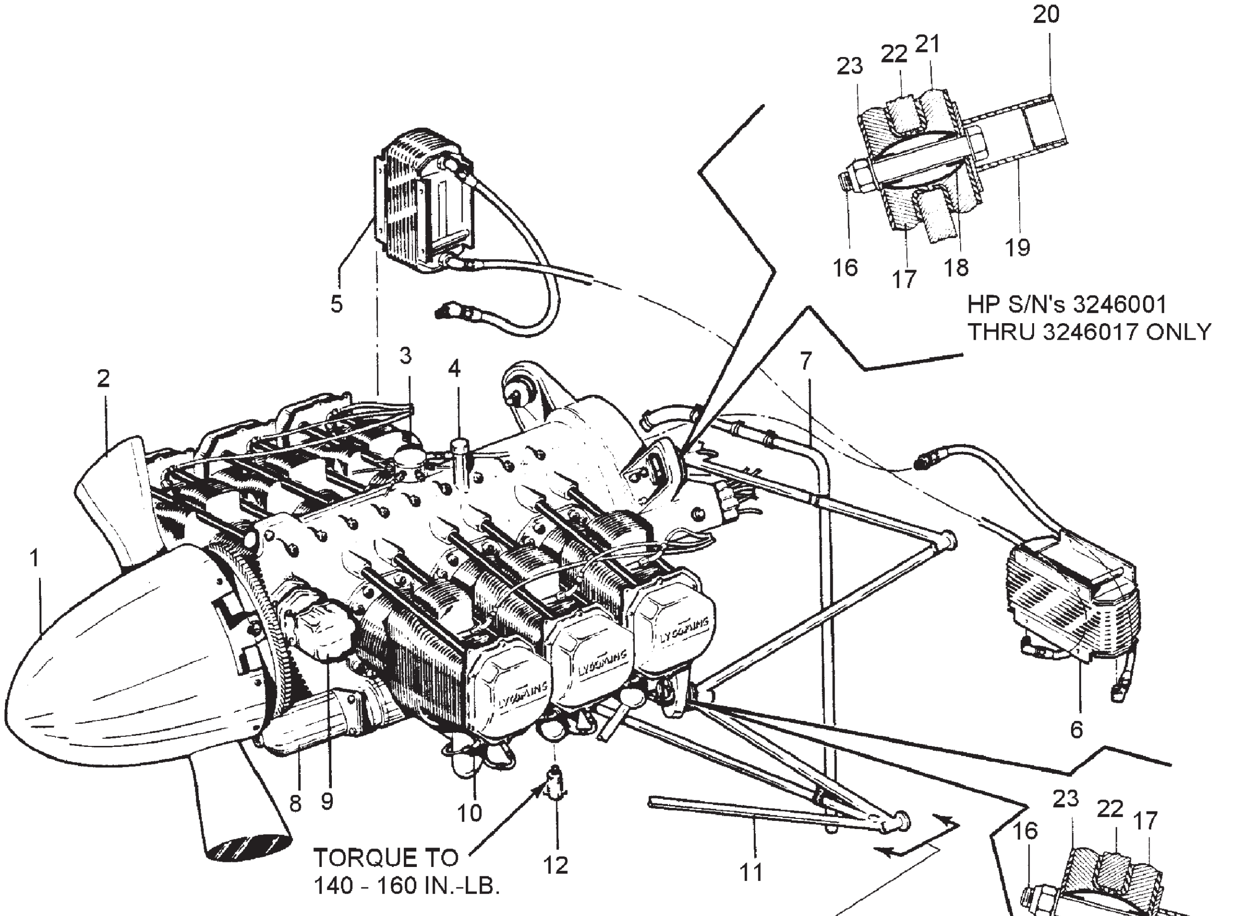
Trouble	Cause	Remedy
Failure of engine to idle properly.	Incorrect idle mixture.	Adjust mixture.
	Leak in the induction system.	Tighten all connections in the induction system. Replace any parts that are defective.
	Incorrect idle adjustment.	Adjust throttle stop to obtain correct idle.
	Uneven cylinder 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 1 (Sheet 3 of 4)
TROUBLESHOOTING ENGINE

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 screens.	Remove and clean oil screens.
	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 1 (Sheet 4 of 4)
TROUBLESHOOTING ENGINE

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, screens or oil cooler.	Remove and clean oil screens. Replace or overhaul oil cooler.
	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.



SEE 71-20-00, FIGURE 2

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

Engine Installation
Figure 1

3. Engine

A. Removal (Refer to Figure 1.)

(1) Turn off all electrical switches in the cockpit and then disconnect the battery ground wire at the battery.

(2) Ascertain that the fuel selector lever is in the “OFF” position.

(3) Remove the cowling and propeller. (See 71-10-00 and 61-10-00.)

NOTE: Tag hoses, lines and wires at separation to facilitate reinstallation. Open fuel, oil, vacuum lines and fittings should be covered to prevent contamination.

(4) Disconnect the following electrical systems/components:

(a) Starter positive and ground leads at the injector. (The injector may be removed if desired.)

(b) Alternator leads and the cable attachment clamps.

(c) Magneto “P” leads at the magnetos.

(d) Tachometer magnetic sensor lead at the left magneto. (HP S/N’s 3246088 & up and TC S/N’s 3257001 & up.)

(e) Oil temperature, cylinder head temperature (CHT), and exhaust gas temperature (EGT) (or turbine inlet temperature (TIT) in TC S/N’s 3257001 & up) leads.

(5) Disconnect the following mechanical systems/components:

(a) Governor control cable at the governor and cable attachment clamps.

(b) Throttle and mixture cables at the injector. (The injector may be removed if desired.)

(c) Tachometer drive cable at the engine. (HP S/N’s 3246001 thru 3246087 only.)

(d) Induction air intake duct hose.

(e) Cooling ducts to vacuum pump, if installed, and fuel pump shroud.

(f) In TC S/N’s 3257001 & up only, the injector intake ducting and associated lines.

(6) Disconnect the following environmental systems/components:

(a) Heater and defroster hoses.

(b) Air conditioning compressor lines (if installed).

(7) The following engine lines should also be disconnected:

(a) Fuel pump supply line at the left side of the pump. Disconnect pump vent line.

(b) Both lines from each oil cooler at the coolers.

(c) Engine vent tube at the engine.

(d) Untie the ignition harness hoses and lines at the aft of the engine.

(e) If installed, vacuum pump lines at pump and remove the fittings from pump.

(f) Oil pressure line at the engine.

(g) Deck pressure and fuel flow lines.

(h) Manifold pressure line.

(i) Injector line at the flow divider.

(8) 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.

(9) Check the engine for any attachments remaining to obstruct its removal.

(10) Drain the engine oil, if desired, and then close drain.

(11) Remove the four engine shock mount assemblies and swing the engine free, being careful not to damage any attaching parts.

B. Installation (Refer to Figure 1.)

(1) Attach a one-half ton (minimum) hoist to the engine hoisting straps and swing the engine into alignment with its attaching points.

(2) 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 1 or 71-20-00, Figure 1, as appropriate, for proper shock mount buildup.) Repeat this procedure for the other three attachment points.

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 metal face of the mount.

(3) Position the mounting lugs of the engine so that they align with the engine shock mount attaching points, then move the engine rearward onto the mounts.

(4) Slide onto each mounting bolt a spacer and the forward half of the shock mount. Install washers and nut, and torque the nuts to 550 to 600 inch-pounds.

(5) Turn off all electrical switches in the cockpit and, if not already done, disconnect the battery ground wire at the battery.

(6) Ascertain that the fuel selector lever is in the “OFF” position.

(7) Connect the following engine lines:

(a) Fuel pump supply line, at the left side of the pump, and pump vent line.

(b) Both lines from each oil cooler at the coolers.

(c) Engine vent tube at the engine.

(d) Resecure the ignition harness hoses and lines at the aft of the engine.

(e) If so equipped, vacuum pump lines at pump and remove the fittings from pump.

(f) Oil pressure line at the engine.

(g) Deck pressure and fuel flow lines.

(h) Manifold pressure line.

(i) Injector line at the flow divider.

(8) Connect the following environmental systems/components:

(a) Heater and defroster hoses.

(b) Air conditioning compressor lines (if installed).

(9) Connect the following mechanical systems/components:

(a) Governor control cable at the governor and cable attachment clamps.

(b) Throttle and mixture cables at the injector. (Reinstall the injector if previously removed.)

(c) Tachometer drive cable at the engine. (HP S/N's 3246001 thru 3246087 only.)

(d) Induction air intake duct hose.

(e) Cooling ducts to vacuum pump, if installed, and fuel pump shroud.

(f) In TC S/N's 3257001 & up only, the injector intake ducting and associated lines.

(10) Connect the following electrical systems/components:

(a) Starter positive and ground leads at the injector.

(b) Alternator leads and the cable attachment clamps.

(c) Magneto "P" leads at the magnetos.

(d) Tachometer magnetic sensor lead at the left magneto. (HP S/N's 3246088 & up and TC S/N's 3257001 & up.)

(e) Oil temperature, cylinder head temperature (CHT), and exhaust gas temperature (EGT) (or turbine inlet temperature (TIT) in TC S/N's 3257001 & up) leads.

(11) Secure the ignition harness, lines,and any hoses, wires, etc. that may be loose.

(12) Check the engine for any additional components/systems still disconnected.

(13) Fill engine oil, if previously drained.

(14) Install cowling and propeller. (Refer to 71-10-00 and 61-10-00.)

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.

(15) Reconnect the battery ground wire at the battery.

(16) Perform an engine operation check.

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COWLING

Cowling

A. Removal

(1) Release quarter-turn fasteners:

(a) In HP S/N's 3246001–3246216 and TC S/N's 3257001–3257333: (5 on each side, 2 on top aft).

(b) In HP S/N's 3246217 & up and TC S/N's 3257334 & up: (5 on each side, 6 on top aft) and one screw on top aft center.

(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. Secure with screws and quarter turn fasteners.

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MOUNTS

1. Engine Shock Mounts

Rubber vibration isolators are installed at each of the four engine mount to engine attachment points.

A. In S/N's 3246001 thru 3246017 only, see 71-00-00, Figure 1, for buildup.

B. In S/N's 3246018 and up; 3257001 and up: see Figure 1 for buildup.

2. Engine Mount

A. Removal

Remove bolts, washers and nuts at five locations as shown in View A, Figure 2.

B. Installation

(1) Install bolts, washers and nuts at five locations as shown in View A, Figure 2.

(2) Torque bolts as noted in View A.

3. Engine Mount 100 Hour Inspection

NOTE: This inspection incorporates the requirements of Piper Service Bulletin No. 1092B.

In S/N's 3246001 thru 3246204 and 3257001 thru 3257264, for those airplanes which do not have a new engine mount P/N 38729-21 installed and the original is not repaired per paragraph "4. Engine Mount Repair / Replacement" or SB 1092, SB 1092A, or SB 1092B: each 100 hours time-in-service, inspect the engine mount, per AC 43.13-1 (latest revision) in the area indicated in Figure 3 for cracks.

A. If a crack appears in the tube at any point, the engine mount must be repaired or replaced before further flight. Pay particular attention to the weld joint between the short, interconnecting vertical tube and the lower horizontal tube. The repair or the replacement of the engine mount with Piper P/N 38729-21 engine mount constitutes compliance.

B. If no cracks are found, continue with repetitive 100 hours time in service inspection.

NOTE: This repetitive inspection requirement may be relieved by installing a new engine mount P/N 38729-21 or repairing the original.

C. Make an appropriate logbook entry documenting compliance with this inspection.

4. Engine Mount Repair / Replacement

A. If cracks are found, and the area where the cracks are located has not been previously repaired, the following repair and modification can be performed. If the area was repaired previously, the engine mount must be replaced.

CAUTION: TAKE ALL NECESSARY FIRE PREVENTION ACTIONS WHEN PERFORMING THE WELD REPAIR. PIPER RECOMMENDS REMOVAL OF THE ENGINE MOUNT FROM THE AIRCRAFT PRIOR TO WELDING.

(1) After removal of the engine mount, per Engine Mount, Removal, above, remove the switch bracket and the gear-up switch from the engine mount. Discard the switch bracket. Retain the switch and the mounting hardware for re-installation.

(2) Repair the cracked tube by T.I.G. welding per AC43.13-1 (latest revision) procedures. All welding must be performed by a certified welder.

(3) Position the 104642-002 bracket assembly by aligning it on-center with the vertical interconnecting tube and centered between the horizontal tubes, as shown in Figure 4.

(4) Attach the bracket assembly to the engine mount by T.I.G. welding per AC43.13-1 (latest revision) along the top and bottom edges of the bracket as shown in Figure 4.

(5) Clean, prime, and paint the engine mount and bracket assembly.

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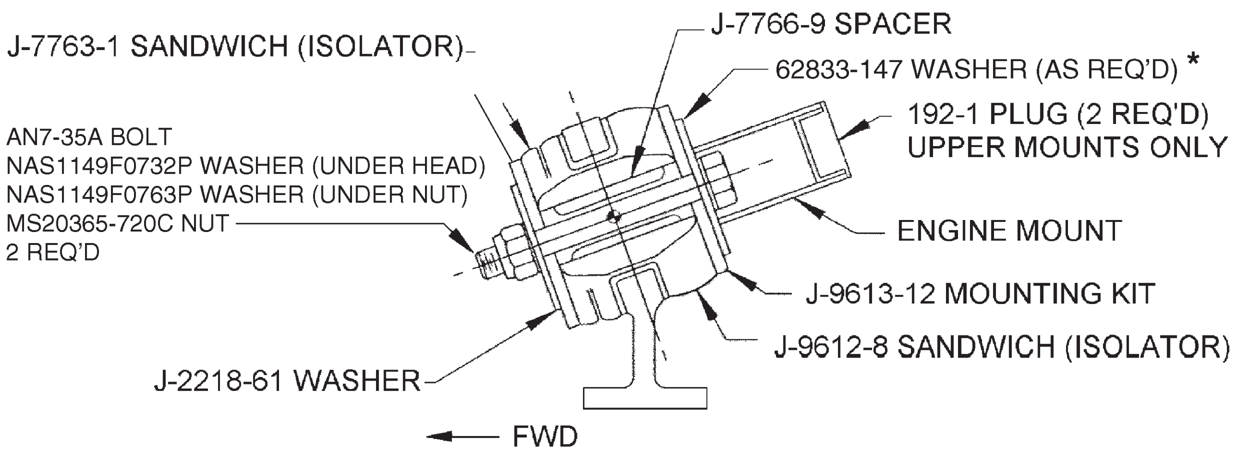
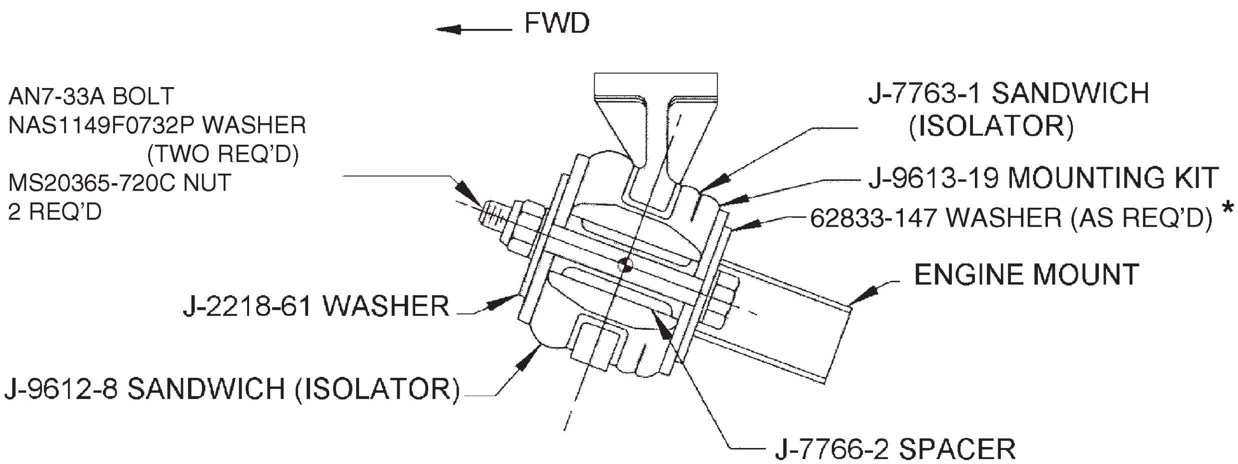


UPPER MOUNTS



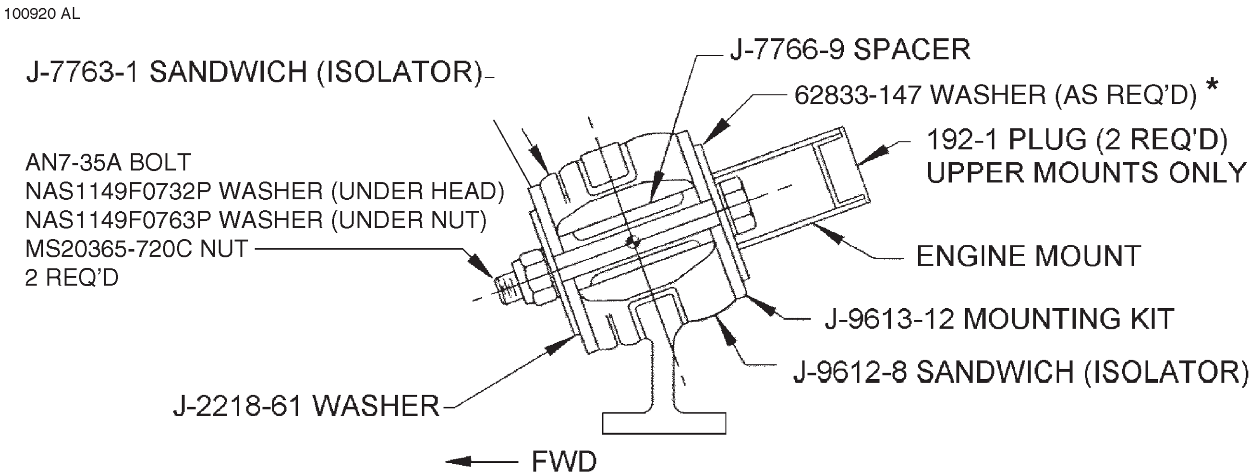
LOWER MOUNTS

* 62833-147 WASHERS ARE USED AS REQUIRED WHEN INSTALLING NEW SHOCK MOUNTS TO ELIMINATE CHAFING BETWEEN THE SHOCK MOUNTS AND ENGINE MOUNT.
WHEN USED, THE BOLT LENGTH MAY BE INCREASED TO ACCOMODATE THE WASHERS.

SEE 71-00-00, FIGURE 1, FOR S/N'S 3246001 THRU 3246017.

Effectivity
3246018 and up

Engine Shock Mounts
Figure 1 (Sheet 1 of 2)



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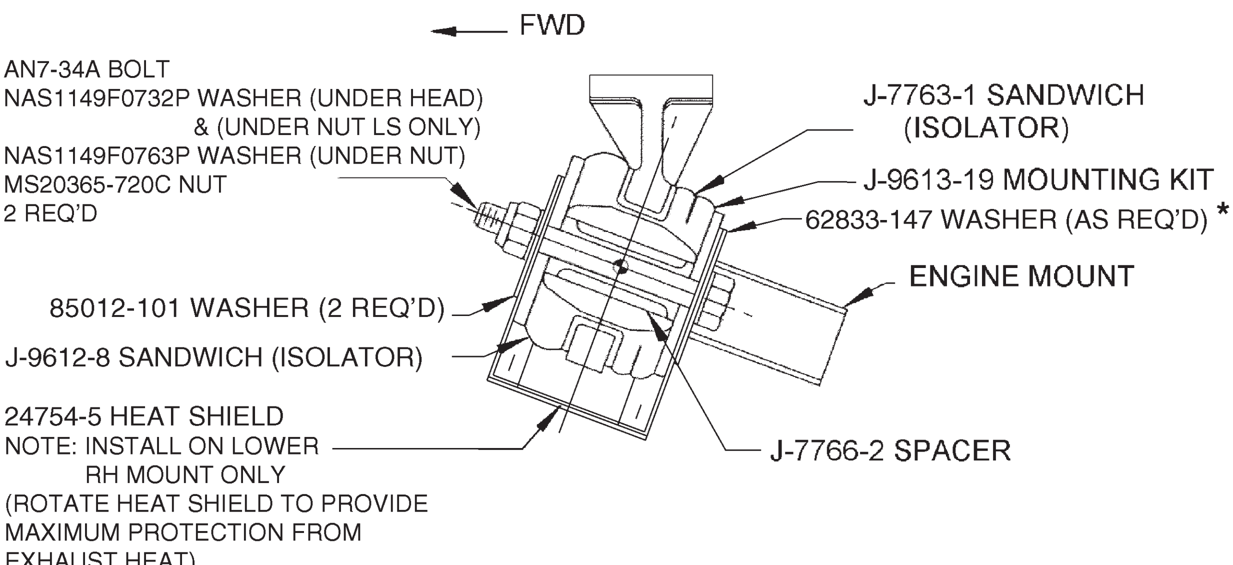
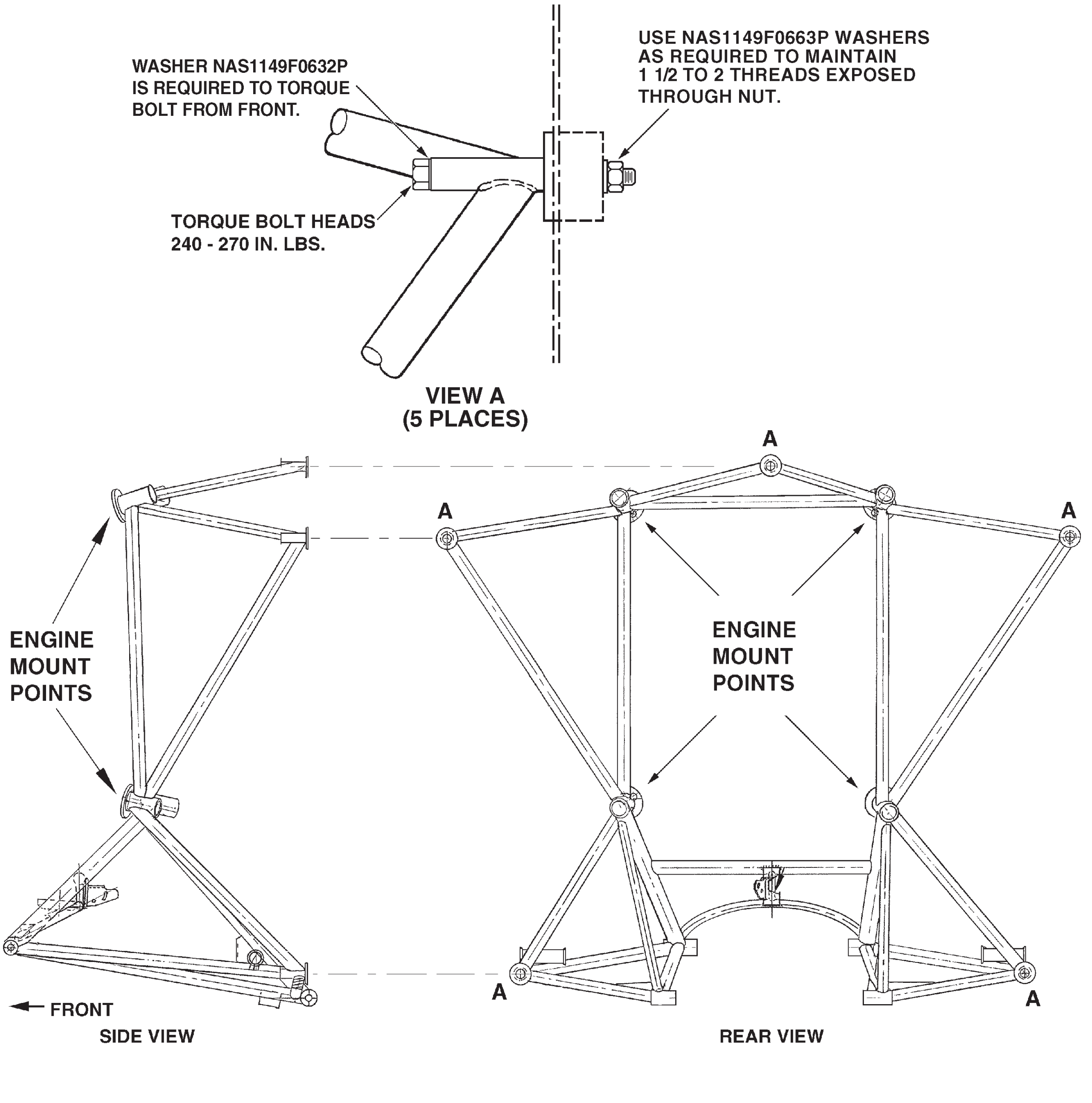


LOWER MOUNTS

* 62833-147 WASHERS ARE USED AS REQUIRED WHEN INSTALLING NEW SHOCK MOUNTS TO ELIMINATE CHAFING BETWEEN THE SHOCK MOUNTS AND ENGINE MOUNT.
WHEN USED, THE BOLT LENGTH MAY BE INCREASED TO ACCOMODATE THE WASHERS.

Engine Shock Mounts
Figure 1 (Sheet 2 of 2)

Effectivity
3257001 and up



Engine Mount Installation
Figure 2

(6) Re-install the engine mount per Engine Mount, Installation, above.

(7) Install the gear-up switch, adjust, and test per 32-60-00.

B. If cracks are found and the area where the cracks are located has been previously repaired, replace with the engine mount P/N 38729-21, per Engine Mount, Removal and Installation, above.

NOTE: As the engine may have been removed for a number of reasons, it is the responsibility of the installation agent to assure the proper re-installation, functional checks and operational suitability of the engine prior to returning the aircraft to service. Refer to the applicable engine manufacturers maintenance manuals as well as the Piper Maintenance Manual in the appropriate chapters as required.

C. Make an appropriate logbook entry documenting compliance with this modification.

5. Engine Mount Corrosion Inspection, Immersion in Water

The following guidance is general in nature and should be applied or varied to fit the individual situation based on water level during immersion, length of time immersed, length of time since exposure, etc. Proceed as follows:

A. Inspection

See Figure 2.

(1) Level the aircraft in accordance with 8-20-00.

(2) In the two lower tubes drill a 3/16 inch hole in each tube, at the approximate mid-point.

(3) Visually inspect the interior surface of each tube through the 3/16 inch hole for evidence of internal corrosion.

(4) Should evidence of corrosion be detected in step (3), above, replace the engine mount. If no corrosion is detected, proceed with corrosion prevention, below.

B. Corrosion Prevention

If no evidence of corrosion is detected in step (3), above, proceed as follows:

(1) Place a drip pan below the inspection holes in each engine mount tube.

(2) Insert a plastic tube through each inspection hole and feed it up to the high point of the engine mount tube.

(3) Using a syringe inserted into the end of the plastic tube, pump linseed oil into the upper end of the engine mount tube while rotating the syringe/plastic tube assembly to assure maximum coverage. Continue pumping until the lower end of the engine mount tube is filled with linseed oil to the level of the inspection hole.

(4) Now, draw the plastic tube out of the upper end of the engine mount tube and reinsert it in the opposite direction, feeding it to the lower end of the engine mount tube.

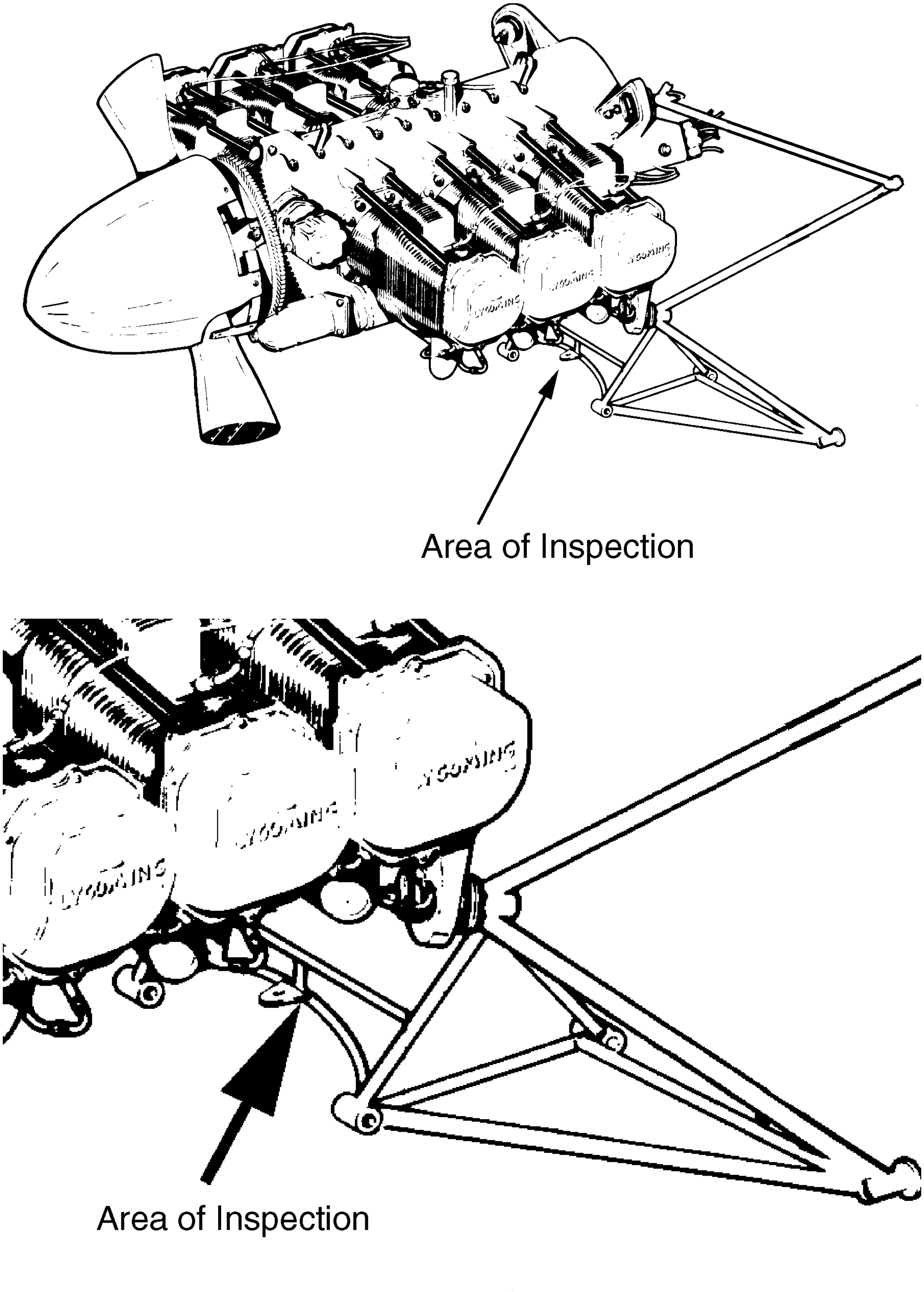
(5) Suck excess linseed oil out of the engine mount tube with the syringe/plastic tube assembly.

(6) When linseed oil can no longer be picked up by the syringe/plastic tube assembly, remove it and allow the engine mount tube to drain into drip pans for approximately two hours.

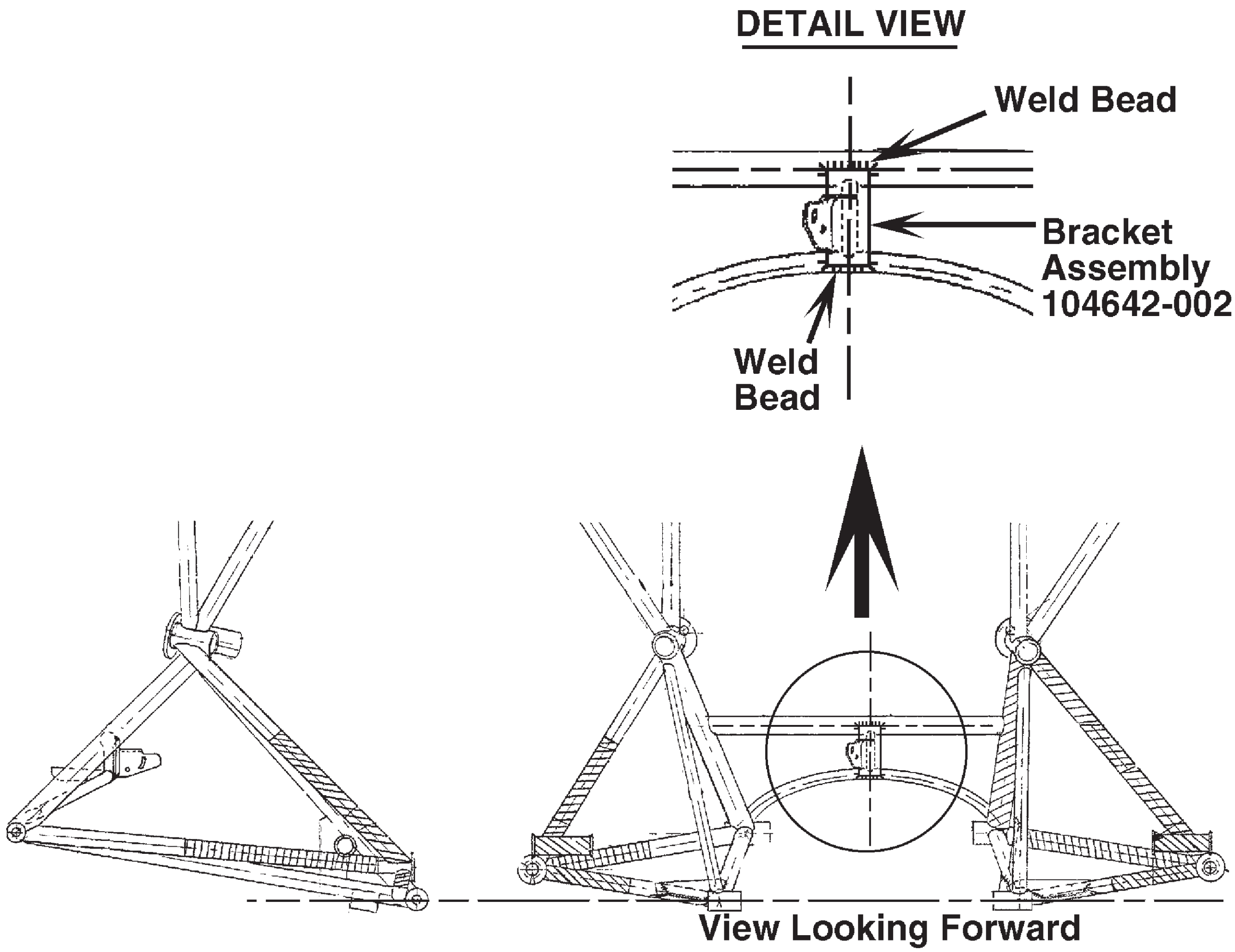
(7) Purge excess oil from tubes by applying air pressure to each 3/16 inch inspection hole, one at a time.

(8) Ensure that roughly the same amount of linseed oil that was pumped in is retrieved in the drip pans.

(9) Apply a liberal coating of an approved fuel tank sealant (see List of Consumables, 91-10-00) to each inspection hole and seal the hole with an appropriate blind rivet. After installing the rivet, apply a liberal coating of the approved fuel tank sealant over the head of the rivet.



Engine Mount Area of Inspection
Figure 3



Weld Repair Views
Figure 4

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CHAPTER

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ENGINE FUEL AND CONTROL

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CHAPTER 73

LIST OF EFFECTIVE PAGES

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CHAPTER 73 - ENGINE FUEL AND CONTROL

TABLE OF CONTENTS

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GENERAL

1. Description

These airplanes are equipped with fuel injected engines. The Precision Airmotive RSA fuel injection system (see Figure 1) is comprised of a fuel metering servo, a flow divider, and fuel nozzles (one per cylinder).

2. Troubleshooting

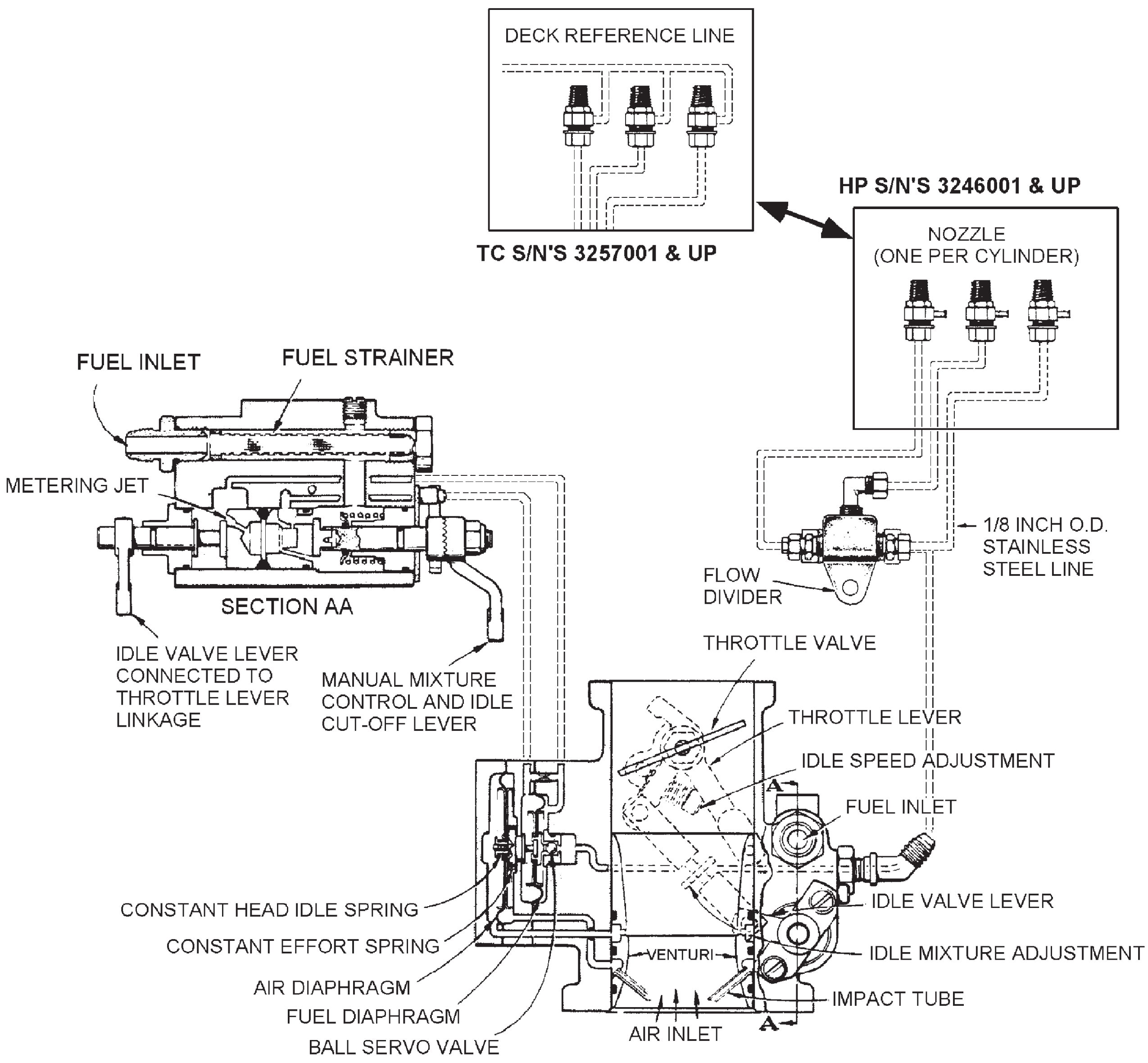
See Chart 1.

CHART 1 (Sheet 1 of 2)
TROUBLESHOOTING - RSA FUEL INJECTION SYSTEM

Trouble	Cause	Remedy
High fuel flow reading. is accompanied by loss of power	Plugged nozzle, if high fuel flow check system for source and roughness.	Remove and clean nozzles; of contamination.
	Faulty gauge.	Replace gauge.
Poor cut-off.	Improper rigging of mixture control linkage.	Adjust rigging.
Rough engine (charges) and poor cut-off.	Nozzle airbleed hole(s) clogged	Clean or replace turbo nozzles.
Engine won't accelerate past a given RPM.	Oil in air chamber.	See Precision Airmotive Service Information Letter No. RS-40.
Rough idle.	Slight induction leaks through loose pipes or bad O-rings. (Usually able to adjust inital idle but rough in 1000-1500 RPM range.)	Repair.
	Large induction leaks such as missing pipe plugs, etc. (Usually unable to throttle below 800-900 RPM.)	Repair.

CHART 1 (Sheet 2 of 2)
TROUBLESHOOTING - RSA FUEL INJECTION SYSTEM

Trouble	Cause	Remedy
Rough idle. (cont.)	Fuel vaporizing in lines or flow divider. (Encountered only under high ambient temperature conditions or following prolonged operation at low idle RPMs.)	Avoid excessive ground run. Keep RPMs as high as practical. Upon restart of hot engine, operate at 1200-1500 RPM for several minutes to reduce residual heat in engine compartment.
Low takeoff fuel flow.	Faulty gauge.	Replace gauge.
	Sticky flow divider.	Clean flow divider.
Rough engine.	Mixture too rich or too lean.	Confirm with mixture control. Rich will be corrected and roughness decreased during lean out while lean will be aggravated and roughness increased. Adjust idle to give a 25-50 RPM rise at 700 RPM.
	Plugged nozzle(s).	Usually accompanied by high takeoff fuel flow readings. Remove and clean nozzles for 20 min. in Hoppes #9 gun cleaning solvent, rinse with stoddard solvent and blow dry. Check system for source of contamination.
	Slight induction leak through manifold drain check valve. (Usually able to adjust initial idle but rough in 1000-1500 RPM range.)	Confirm by temporarily plugging drain line. Replace check valve if necessary.
	Air leak in fuel line from tank to servo.	Confirm by connecting clear tubing between servo and flow divider and watch for air bubbles. Locate and correct source of leakage.



Schematic Diagram of RSA Fuel Injection System
Figure 1

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DISTRIBUTION

1. General

   Comply with Lycoming Service Bulletin No. 342F every 100 hours, annual inspection, overhaul, and any time the engine fuel lines or clamps are serviced, removed or replaced.

2. Fuel Nozzles (Air Bleed) (Refer to Figure 1.)

   A. Removal

   CAUTION: THE FUEL NOZZLES MUST BE CAREFULLY REMOVED, OR THE CYLINDERS MAY BE DAMAGED.

   (1) Remove the upper engine cowling.

   (2) Disconnect the fuel line from the nozzle.

   (3) Carefully remove the nozzle, using the correct size deep socket.

   (4) Clean and inspect the nozzle per Cleaning and Inspection, below.

   B. Installation

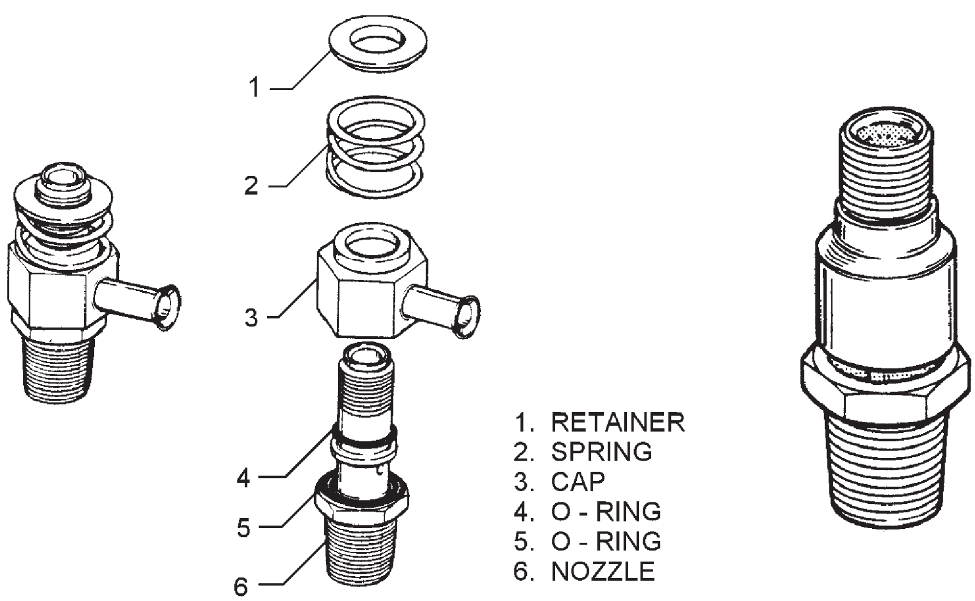
   CAUTION: WHEN INSTALLING THE FUEL NOZZLES, BE CAREFUL AS YOU APPROACH THE CYLINDERS TO AVOID DAMAGING THE CYLINDERS AND FUEL NOZZLES.

   (1) Installation and torque procedures for the fuel nozzles are per Lycoming Service Instruction No. 1275, rev. B or latest revision.

   (2) Carefully install the nozzle, using the correct size deep socket.

   (3) Connect the fuel line to the nozzle.

   (4) Install the upper engine cowling.



Fuel - Air Bleed Nozzle
Figure 1

C. Cleaning and Inspection

(1) 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.

(2) Inspect the nozzle and cylinder threads for nicks, stripping or cross-threading.

(3) Inspect for battered or rounded hexagons.

(4) A test procedure for air bleed nozzles is described in Lycoming Service Instruction No. 1275, rev. B or latest revision.

CONTROLLING

1. Fuel Metering Servo Maintenance (See Figure 1.)

   In general, little attention is required between servo 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.

| 2. Idle Speed and Mixture Adjustment (See Figure 1.)

   WARNING: USE EXTREME CAUTION WHILE WORKING AROUND RUNNING ENGINES. BE AWARE OF YOUR POSITION RELATIVE TO THE PROPELLER. PLACE THE AIRCRAFT IN AN AREA THAT IS SAFE FOR ENGINE RUN AND SECURE IT WITH TIE DOWNS. ENSURE A QUALIFIED PERSON IS IN THE COCKPIT AT THE CONTROLS DURING THIS ADJUSTMENT.

   DO NOT ATTEMPT THIS ADJUSTMENT ALONE.

   DO NOT LEAVE THE COCKPIT EMPTY OR RUNNING ENGINE UNATTENDED.

   A. Start the engine and warm up in the usual manner until oil and cylinder head temperatures are normal.

      NOTE: The relationship of the airplane to the prevailing wind will affect the propeller load and its RPM. Accordingly, place the airplane 90 degrees to the wind to reduce it's impact.

   B. Check magnetos. If the "mag-drop" is normal, proceed with idle adjustment.

   C. Set throttle stop screw or bolt 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.

   D. 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.

E. 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 (i.e. - shorten the linkage to Lean the mixture or lengthen the linkage to Richen the mixture), 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.

F. 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.

3. Full Power Performance (See Figure 1.)

(PIR-PPS50026-7, Rev. A.)

In Saratoga II TC S/N's 3257001 and up only, check and adjust full power performance:

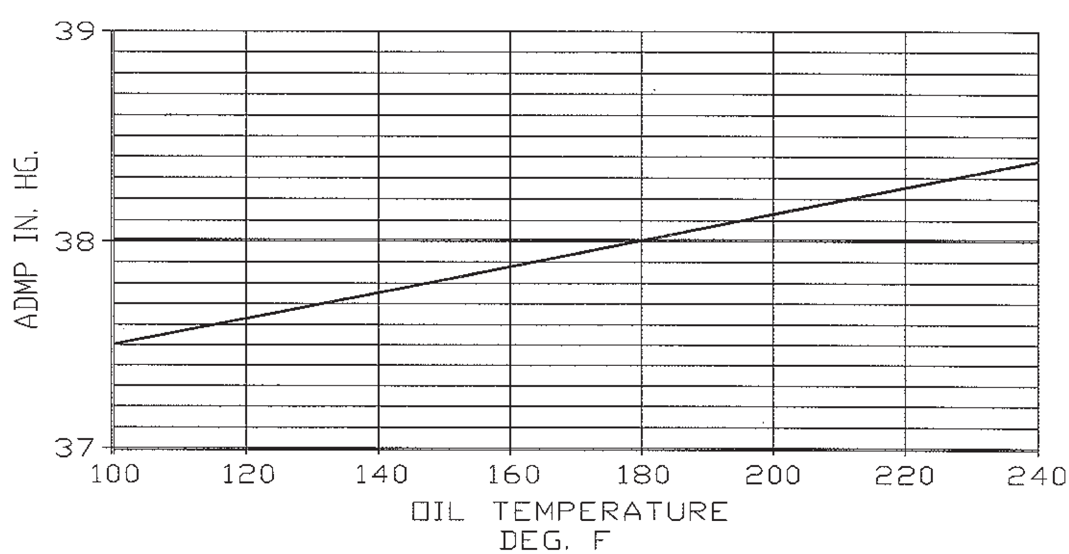
A. With the aircraft pointed in the direction of the prevailing wind, run engine at 1500 to 1800 rpm until the oil temperature is 160°F to 180°F.

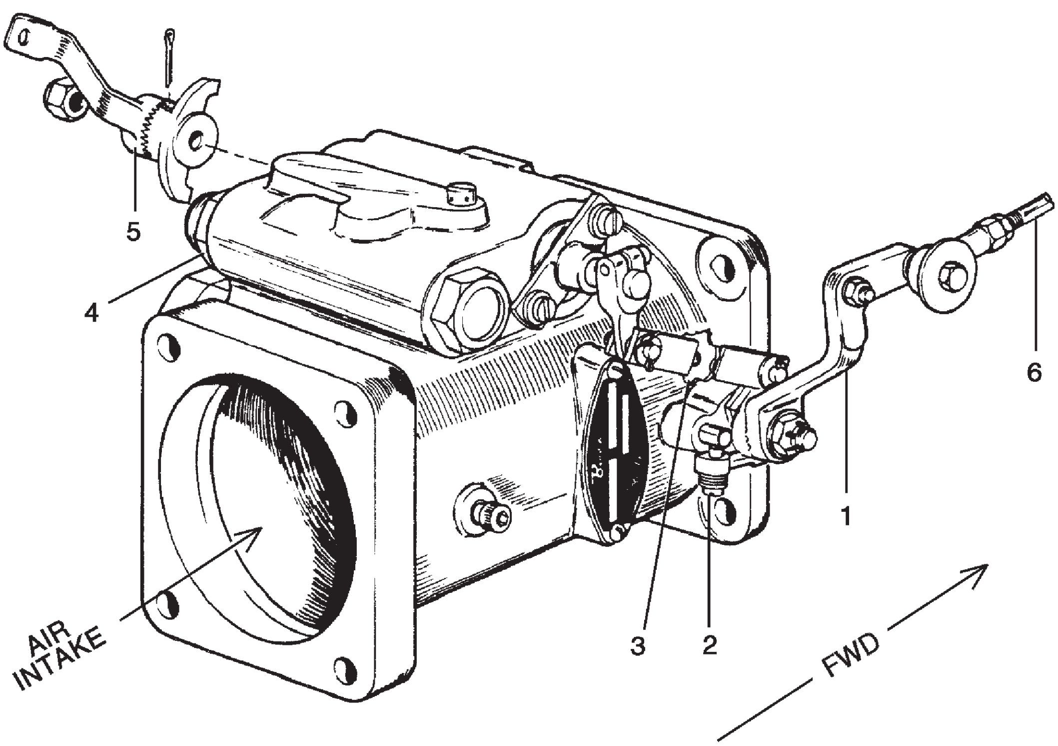
B. With the propeller control set to 2500 rpm (using a digital handheld tachometer) and fuel flow set between 33.2 and 37.3 gallons per hour, set the manifold pressure with the throttle in the full forward position to the value shown in Chart 1 (+0, -0.5 IN. HG.) by adjusting the screw on the end of the sloped controller (which is accessible thru the Nose Gear opening).

NOTE: Turning the adjustment screw in the clockwise direction will increase manifold pressure and in the counter-clockwise direction will decrease manifold pressure. A slight turn of the adjusting screw will result in a noticeable change in manifold pressure.

C. Set up the propeller governor as follows: with the manifold pressure set to 38 inches and the propeller control in the full forward position, adjust the stop screw on the governor, and associated rod end if necessary, to obtain 2500 rpm (+0, -25 rpm).

CHART 1
MANIFOLD PRESSURE VS OIL TEMPERATURE





1. THROTTLE ARM
2. IDLE SPEED ADJUSTMENT
3. IDLE MIXTURE ADJUSTMENT
4. FUEL SCREEN
5. MIXTURE ARM
6. THROTTLE CONTROL CABLE

Fuel Metering Servo (Precision)
Figure 1

GRIDS 7G2 THRU 7G6
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CHAPTER

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IGNITION

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CHAPTER 74

LIST OF EFFECTIVE PAGES

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				6	Jun 30/07
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CHAPTER 74 - IGNITION

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ELECTRICAL POWER SUPPLY

1. Ignition System

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

A. Description

Ignition of the fuel charge in each cylinder is accomplished by two spark plugs independently excited by one of two Slick 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 reaches the proper position for starting, the spring in the impulse coupling is released to spin the rotating magnet and produce the spark required to fire the engine. After the engine starts, the impulse coupling flyweights disengage the coupling due to centrifugal action. The coupling then acts as a straight drive and the magneto fires at the normal firing position of the engine.

NOTE: Check the magneto dataplate to verify the specific model number and series of the magneto being worked on.

B. Troubleshooting

See Chart 1.

C. Replacement Magnetos

An alternative to overhaul is complete magneto replacement with a new Slick magneto. New Slick magnetos incorporate all the latest design features and may be a cost effective alternative to overhaul.

D. 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.

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
(See Introduction, Supplementary Publications, Vendor Publications, Magnetos.)

CHART 1
TROUBLESHOOTING MAGNETOS

Trouble	Cause	Remedy
Failure of engine to start.	Defective spark plugs.	Clean and adjust or replace spark plugs.
	Defective ignition wire.	Check with electric tester and replace defective wires.
	Defective battery.	Replace with charged battery.
	Improper operation of magneto breaker.	Check points. Check internal timing of magnetos.
Failure of engine to idle properly.	Faulty ignition system.	Check entire ignition system.
Low power and uneven running.	Defective spark plugs.	Clean and gap or replace spark plugs.
	Magneto breaker points not working properly.	Clean points. Check internal timing of magnetos.
	Defective ignition wire.	Check wire with electric tester. Replace defective wire.
	Defective spark plug terminal connectors.	Replace connectors on spark plug wire.
Failure of engine to develop full power.	Faulty ignition.	Tighten all connections.
		Check system with tester.
		Check ignition timing.

2. Magnetos

A. 100 Hour Inspection

Every 100 hours or at annual inspection, whichever comes first, perform the following checks.

WARNING: BE SURE IGNITION SWITCH IS IN THE "OFF" POSITION AND THE CONDENSER P-LEAD IS GROUNDED.

(1) Adjust timing to engine. (See Figure 1.)

(a) Turn the engine crankshaft in the normal direction of rotation until the No. 1 cylinder is in the full-advance firing position.

1 Cover spark plug hole of number one cylinder with thumb. Rotate crankshaft until pressure is felt on thumb.

2 Rotate crankshaft slowly until the advance timing mark on the starter ring gear is in alignment with the small hole located at the two (2) o'clock position on the front face of the starter housing. When the 20° mark on the gear is aligned with the small hole, number one piston is at 20° BTC.

NOTE: Verify correct engine timing for the airplane being worked on by checking the engine dataplate.

(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.

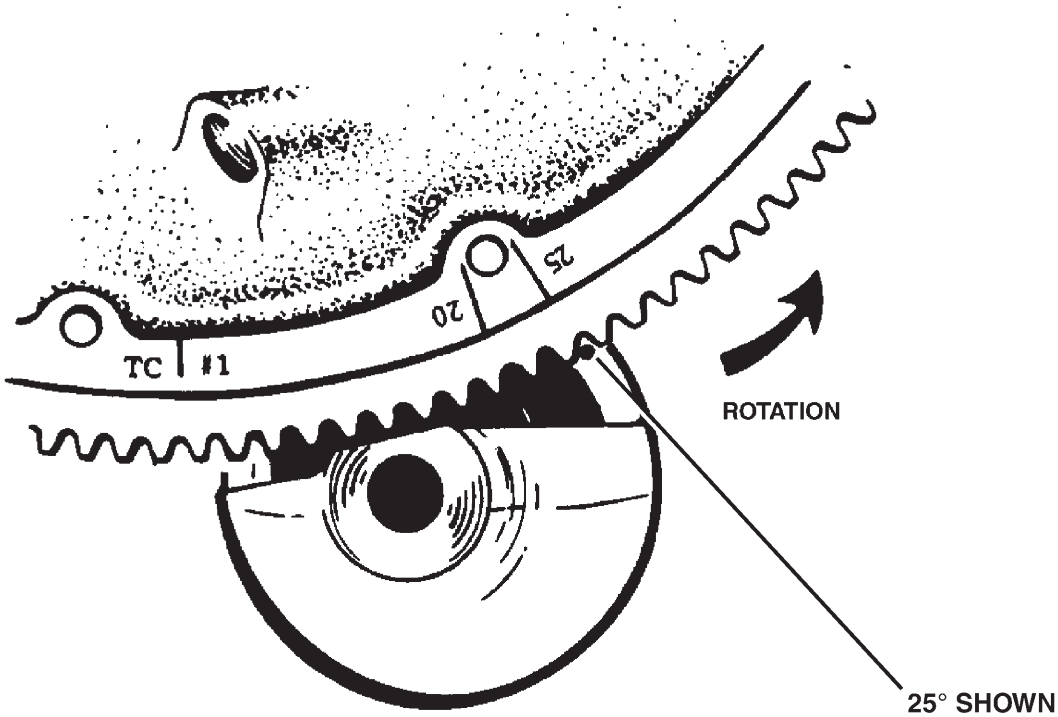
WARNING: DO NOT ROTATE PROPELLER WHEN IGNITION SWITCH IS IN THE "ON" POSITION. THE MAGNETOS WILL FIRE THE SPARK PLUGS IF THE PROPELLER IS ROTATED - FATAL INJURY IS POSSIBLE.

(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.



Engine Timing Marks (Typical)
Figure 1

(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 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 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.

(b) Inspect and clean orifice 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 2). If the heel of the pawl has struck the shaft and caused the shaft to dimple in excess of .006 inch per side, the rotor shaft must be replaced.

(3) In the left magnetos only (i.e. - impulse coupled), clean and inspect the impulse coupling:

(a) Clean to bare metal to ensure a reliable inspection. Use a suitable degreasing solvent to remove all oil or sludge buildups.

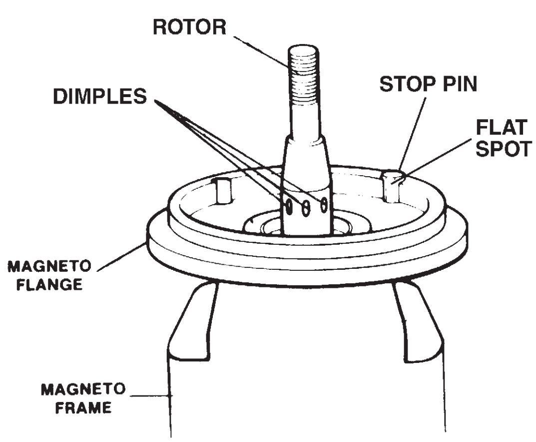
(b) Inspect impulse coupling shell and hub for cracks, rust or corrosion. Replace impulse coupling, if found.

(c) Inspect hub shaft and keyway for deformation or damage. Replace impulse coupling, if found.

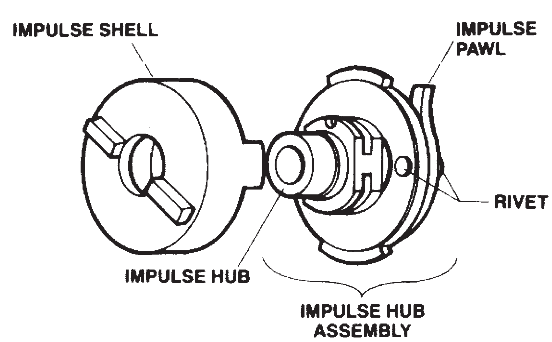
(d) Inspect impulse coupling pawl latching ends (see Figure 4). If rounded, peened, or excessively worn, replace impulse coupling.

NOTE: Stringers, inclusions, and heat checks may appear on the surfaces of impulse coupling components. These conditions are normal and, by themselves, generally do not require impulse coupling replacement.

(e) Inspect pawl retaining rivets. If loose or, if they show indications of movement, replace impulse coupling.



Rotor and Stop Pin
Figure 2



Impulse Coupling
Figure 3

(f) Measure the clearance between the boss on the underside of each impulse pawl and the pawl plate using a feeler gauge. Position the latching end of the impulse pawl over the pawl plate as shown in Figure 4.

(g) Maximum clearance for pawls with one boss is .150 inch (see Figure 5). Maximum clearance for pawls with two bosses is .150 inch for left-hand rotation couplings and .140 inch for right-hand rotation couplings. If the feeler gauge passes between the full width of the boss(es) and the pawl plate, replace the impulse coupling.

(4) In the left magnetos only (i.e. - impulse coupled), reassemble and install the impulse coupling:

(a) Lubricate the pawl assembly, hub and spring with aircraft engine oil. Verify that pawls move freely.

(b) Reassemble impulse coupling per paragraph E (5), below.

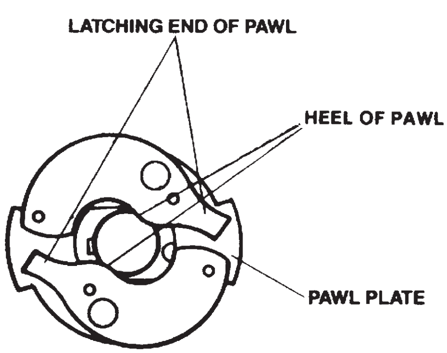
(c) Inspect stop pin for looseness, cracks or corrosion (see Figure 2). Replace magneto frame, if found.

(d) Inspect stop pin for flat spots. These are a normal sign of wear and do not, of themselves, mandate component replacement. However, if the flat spots allow the impulse coupling pawls to slip past the stop pin, then either or both the impulse coupling and the magneto frame must be replaced.

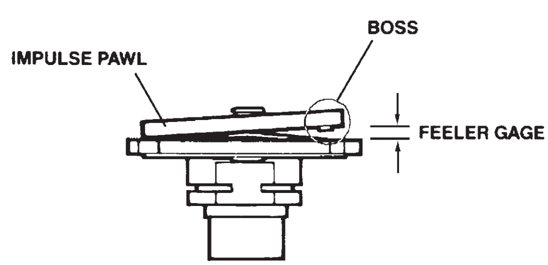
(e) Install impulse coupling per paragraph E (6), below.

(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.



Impulse Coupling Pawls
Figure 4



Measuring Pawl Clearance
Figure 5

(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

CAUTION: DO NOT PUT CLEANER IN EITHER BRONZE OILITE BUSHING. THESE BUSHINGS ARE IMPREGNATED AT THE FACTORY AND CLEANER WILL DRAW THE LUBRICANT OUT OF THE BUSHING.

(a) Disassemble and clean the distributor block bearing bar. Use standard non-filming non-conductive cleaner. Clean distributor gear with soapy water and rinse with clean water.

(b) Clean all surfaces free of dirt, oil, carbon dust and other contaminants using a cotton swab or “Q-Tip”.

(c) Inspect the distributor block for cracks or other physical damage. Replace, as required.

(d) Inspect the brass electrode posts for signs of physical wear. Replace block assembly, as required, but note that during normal operation, the post will experience an electrical-metal transfer with the distributor gear electrode.

(e) Inspect oilite bushing for gumming oil. The bushing should be free of contamination and the gear should turn freely in the distributor block with no appreciable drag. If the bushing is gummed, wipe the bushing with MEK and lubricate with one drop of Exxon Teresstic 100 or Slick P/N M-3306. No other oils should be placed in these bushings.

(f) Ensure the distributor block surfaces are free of all oil and carbon dust prior to reassembly.

(g) Inspect distributor gear teeth for wear and general integrity. Replace block assembly as required.

(h) Inspect the electrode finger for looseness. The electrode should be held securely to the shaft when tested with light finger pressure. If loose, replace block and gear.

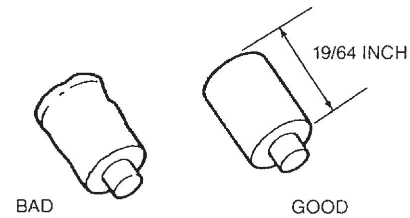
(i) Clean the end of the electrode to remove electrical deposits.

(j) Inspect bearing bar for cracks or other physical damage. Replace as required.

(k) Ensure the bearing bar is free of all and carbon dust prior to reassembly.

(9) Inspect the carbon brush. Overall length must be greater than 19/64 (.297) inch and the outside diameter must be uniform (see Figure 6). Replace as required.

(10) Inspect the loading spring. Overall free standing length should be greater than 19/32 (.594) inch. Springs that appear worn, that have flat spots or are too short must be replaced.



Carbon Brush Assembly
Figure 6

(11) In TC S/N's 3257001 & up only (i.e. - pressurized magnetos):

(a) 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.

(b) Inspect and clean orifice vent. Maximum orifice diameter is .025 inch.

(c) Inspect frame gasket for wear. Replace as required. Use only Slick replacement gaskets as gasket contains a metal mesh to ensure proper ground between magneto frame and housing. Inspect screw gaskets for wear. Replace as required.

(d) Inspect harness cap O-ring for wear. Replace as required.

D. Disassembly (see Figures 7 and 8.)

NOTE: Use of the Slick T-100 Assembly and Timing Kit (Figure 7) is strongly recommended. The tools contained in this kit will greatly facilitate magneto disassembly/assembly and help prevent damage to parts.

(1) Remove impulse coupling:

CAUTION: THE SHELL OF THE IMPULSE COUPLING ASSEMBLY IS UNDER CONSIDERABLE SPRING TENSION.

(a) Remove cotter pin, nut, washer, bushing and drive gear, where applicable.

(b) Firmly holding the shell of the impulse coupling assembly, gently pull shell of impulse coupling assembly out enough to clear the latching ears of the impulse hub assembly.

(c) Turn shell to release spring tension. Remove shell and attached impulse spring.

(d) Engage T-106 hub puller into grooves in the hub assembly. Tighten T-106 puller bolt to remove impulse coupling hub assembly.

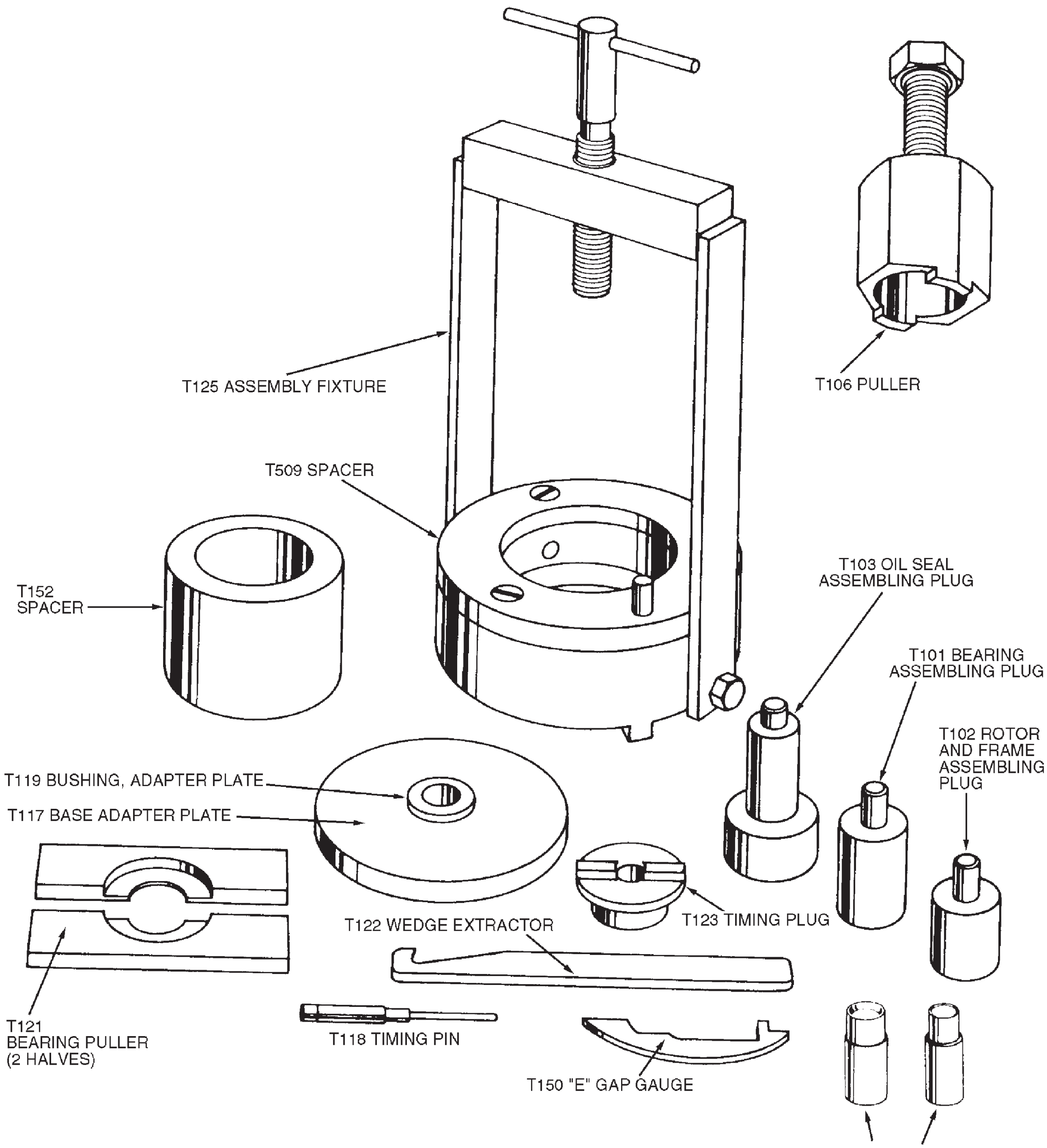
(2) Remove Woodruff key by prying key from rotor shaft using pliers.

(3) Remove distributor housing assembly

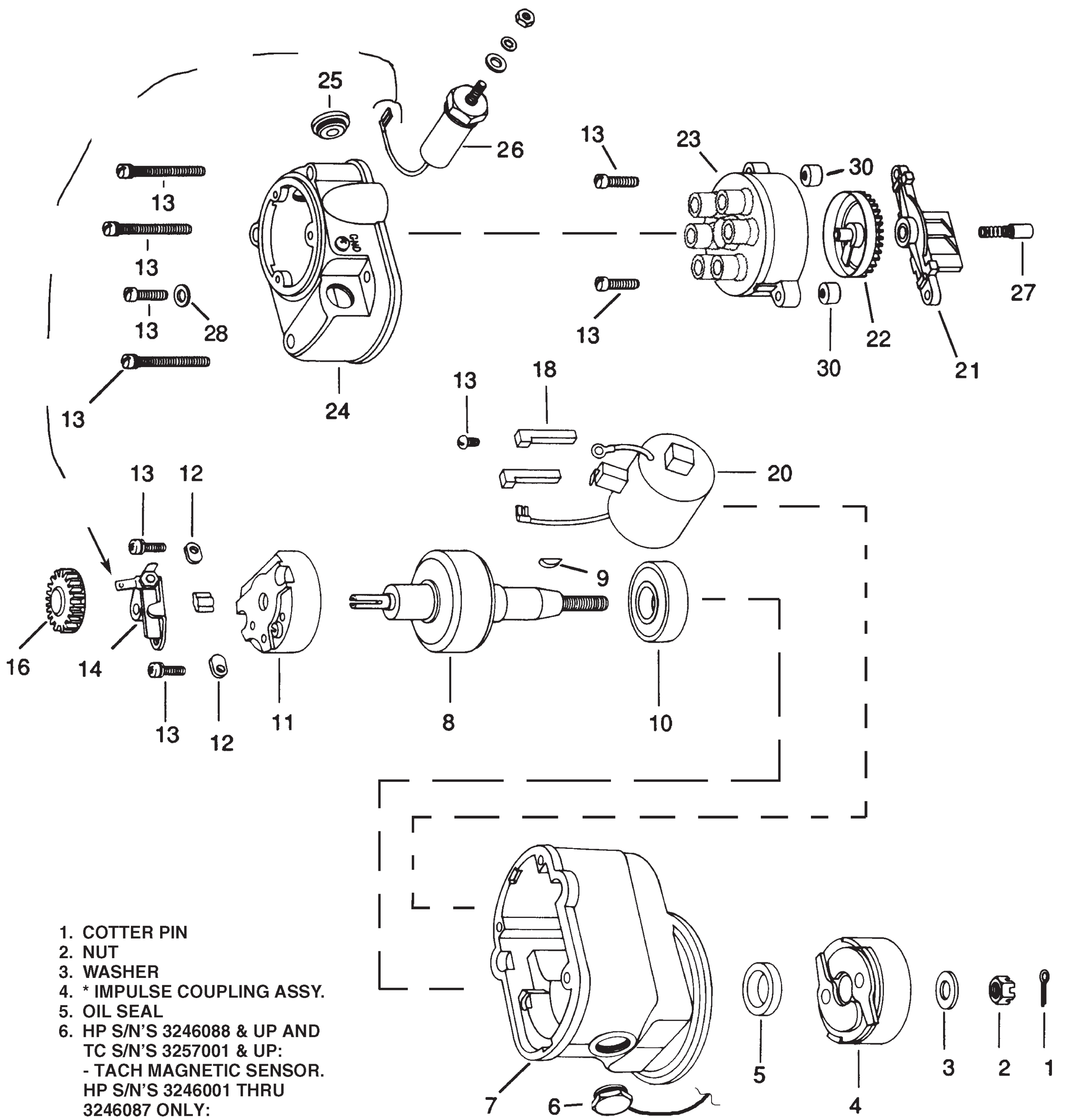
(a) Remove three long screws and single short screw from distributor housing.

(b) Separate distributor housing from magneto frame.

(c) Disconnect condenser lead from contact breaker assembly.



Slick T-100 Assembly and Timing Tool Kit
Figure 7



1. COTTER PIN
2. NUT
3. WASHER
4. * IMPULSE COUPLING ASSY.
5. OIL SEAL
6. 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)
7. MAGNETO FRAME
8. ROTOR
9. WOODRUFF KEY
10. BALL BEARING
11. BEARING CAP ASSEMBLY
12. BEARING CAP CLAMP
13. SCREW (VARIOUS)
14. CONTACT POINTS

* - LEFT MAGNETO ONLY.

15. NOT USED
16. ROTOR GEAR
17. NOT USED
18. COIL WEDGE
19. NOT USED
20. COIL
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
28. WASHER
29. NOT USED
30. SPACER

Exploded View of 6300 Series Magneto
Figure 8

(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

CAUTION: DO NOT ALLOW ROTOR TO COME INTO CONTACT WITH METAL CHIPS OR FILINGS. ROTOR IS MAGNETIZED.

(a) Remove two screws and two bearing plate clamps.

(b) Press against the drive end of the rotor shaft and withdraw the rotor and bearing cap assembly from the drive frame.

(9) Remove bearings from shaft and discard

CAUTION: DO NOT DISASSEMBLE BEARING CAP ASSEMBLY SLICK PART NUMBER M-3485. THIS ASSEMBLY HOLDS A DOUBLE-SHIELDED BEARING CAPTIVE IN THE BEARING CAP AND IS PRE-LUBRICATED AT THE FACTORY WITH SPECIAL GREASE THAT TOLERATES THE OZONE RICH ENVIRONMENT WITHIN THE MAGNETO.

CAUTION: DO NOT ALLOW ROTOR TO COME INTO CONTACT WITH METAL CHIPS OR FILINGS. ROTOR IS MAGNETIZED.

(a) Place rotor on T-152 spacer with drive end down. Using T-125 assembly fixture, press rotor shaft, removing bearing cap assembly.

(b) Reverse rotor shaft and insert T-121 bearing puller (both halves) between the drive end bearing and the rotor magnet head.

(c) Place rotor and T-121 on T-152 spacer.

(d) Press rotor shaft and remove drive end bearing.

(10) Remove coil (See Figure 9.)

(a) Remove coil primary ground screw.

(b) Using coil wedge extractor T-122, remove coil wedges and lift out coil.

(11) Remove air vent/pressure vent plug from magneto.

(12) Remove oil seal from magneto.

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 10.)

CAUTION: DO NOT ALLOW ROTOR TO COME INTO CONTACT WITH METAL CHIPS OR FILINGS. ROTOR IS MAGNETIZED.

(a) Insert the base plate (T-117) and adapter plate bushing (T-119) into T-125 assembly fixture.
(b) Place one drive-end bearing and one bearing cap assembly onto the rotor shaft.
(c) Insert the rotor shaft into the adapter plate bushing (threaded end down).
(d) Place the bearing assembly plug (T-101) onto the exposed end of the rotor shaft.
(e) Turn T-handle screw to seat the bearings against the bearing shoulders on the rotor shaft.
(f) Remove the rotor shaft, adapter bushing, adapter plate and bearing assembly plug from T-125 assembly fixture.

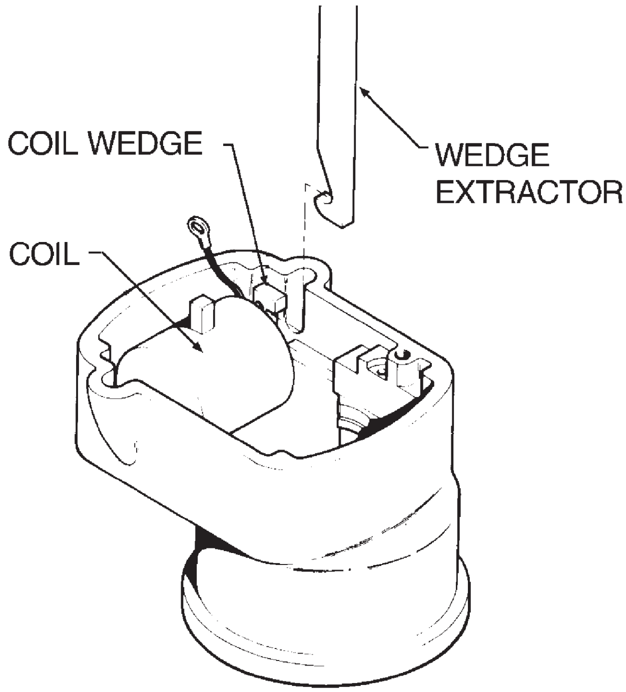
(2) Install rotor shaft assembly (see Figure 10.)

(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.
(d) Turn T-handle until the bearing cap bottoms in the frame. Place cap over end of rotor shaft 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.

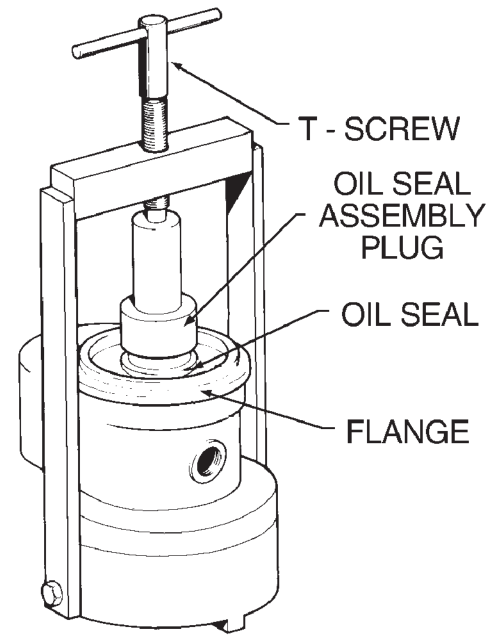
(3) Install oil seal (see Figure 11.)

(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.

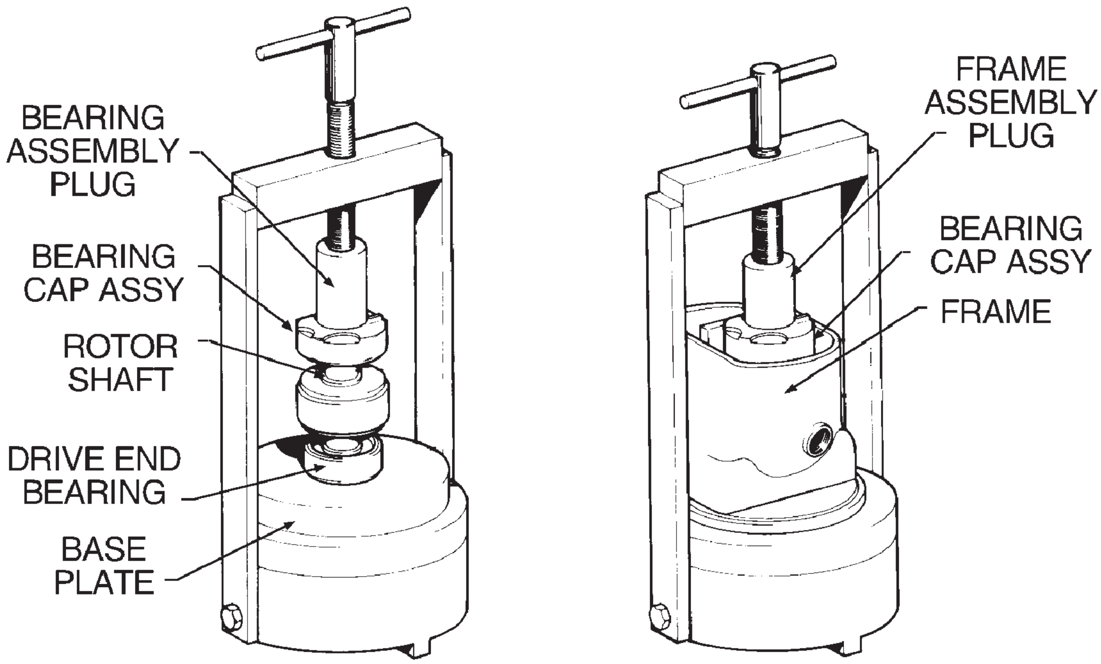
(4) Install Woodruff Key by pressing Woodruff Key into the key slot of the rotor shaft.



Coil Wedge Removal
Figure 9



Oil Seal Installation
Figure 11



Installing Bearings
Figure 10

(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.

CAUTION: IF THE HIGH TENSION LEAD PROTRUDES ABOVE THE MAGNETO FRAME, IT CAN MAKE DIRECT CONTACT WITH THE DISTRIBUTOR GEAR AND CAUSE THE MAGNETO TO MALFUNCTION.

(c) Position the coil high tension lead flush to 1/32 (.031) inch below the parting surface of the magneto frame.

(8) Install contact points - All magnetos

Attach contact point assembly on the bearing cap using appropriate screw.

(9) Install rotor cam

(a) Install cam using a light hammer and T-151 cam and rotor set.

(b) Drive the cam until it bottoms in the rotor cam slot.

(10) Time the magneto internally - Set primary points - All magnetos

(a) Place the magneto on the T-125 assembly fixture, flange down, with the T-509 timing base adapter removed.

(b) In the right magnetos only (i.e. - non-impulse coupled), install the T-123 timing plug on the rotor shaft before placing the magneto on the T-125 assembly fixture.

(c) Looking directly down on the magneto, align the magneto so that the coil is oriented in the 12 o'clock position.

(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 dataplate for magneto rotation.

1 For old style rotor (i.e. - no slots on the magnet head), insert flat end of T-150 "E" Gap Gauge. Insert the "E" Gap Gauge against the right lamination for right-hand rotation magnetos and against the left laminations for left-hand rotation magneto.

2 For new style rotors (with slots on magnet head), insert notched end of T-150 "E" Gap Gauge. Locate the appropriate "L" or "R" timing slot on the rotor magnet head and insert the notched end of the "E" gap gauge. Use the "L" slot for left-hand rotation magnetos and the "R" slot for right-hand rotation magnetos.

(e) Rotate the magneto frame on the T-125 assembly fixture until the T-150 "E" Gap Gauge rests against the pole lamination in the magneto frame. Rotate the magneto frame clockwise for left-hand rotation magnetos and counterclockwise for right-hand rotation magnetos. The magneto rotor shaft is now in "E" Gap position.

(f) Using a timing light (see Figure 12), adjust the contact points to be just opening when the frame is against the T-150 gauge. This will provide a point gap opening of .008-.012 inches.

(g) Secure the points in this position by tightening the screws. Torque adjusting screw to 18-20 in-lbs. Torque the pivot screw to 15-18 in-lbs.

(h) Apply cam grease sparingly to each lobe of the cam.

(i) Attach coil lead wire to the vertical bronze male terminal of the primary point assembly.

(11) Assemble the condenser into the distributor housing, being sure to rotate the condenser wire the same rotation as the condenser is tightened in the housing..

(12) Distributor gear assembly

(a) Install carbon brush into spring.

1 Insert small end of carbon brush 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.

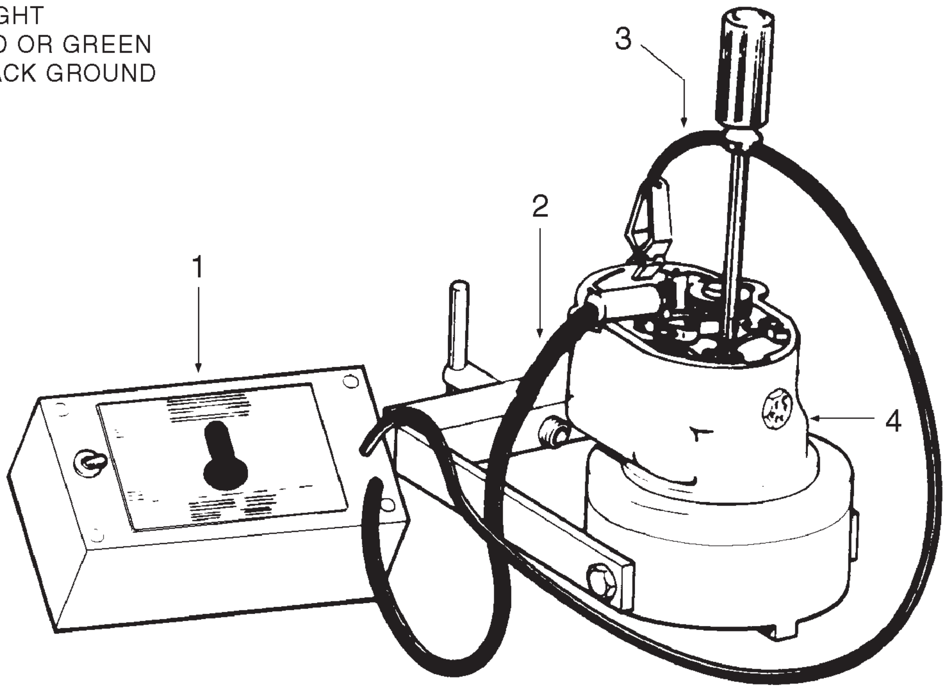
2 Gently press the carbon brush and spring assembly into the shaft until the spring seats on the bottom of the shaft. The top of the carbon brush should protrude from the top of the shaft approximately 1/4 inch.

(13) Install distributor block

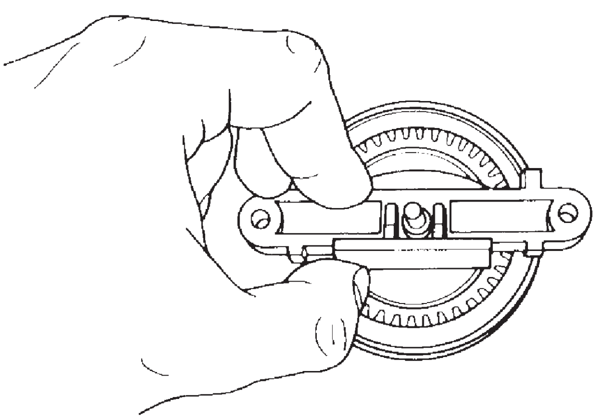
(a) Assemble the distributor gear in the distributor block with the L&R facing you.

(b) Assemble the bearing bar to the distributor block as shown in Figure 13.

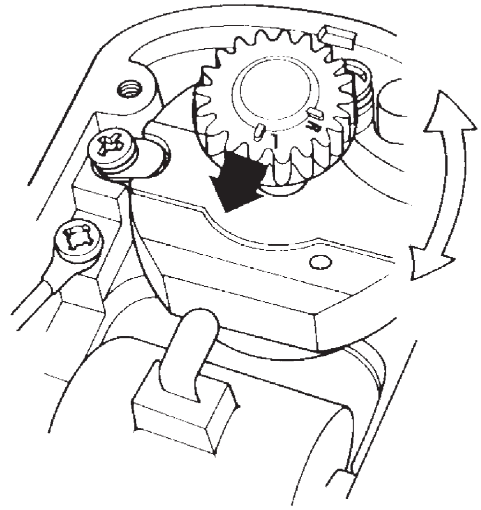
1. TIMING LIGHT
2. WIRE, RED OR GREEN
3. WIRE, BLACK GROUND
4. VENT



Magneto Internal Timing
Figure 12



Bearing Bar Assembly
Figure 13



Rotor Gear Alignment
Figure 14

(14) Install rotor gear onto end of rotor shaft.

(15) Align the “L” or “R” (depending on the rotation of the magneto—look at dataplate) on the rotor gear so that it points up, toward the high tension lead of the coil. Secure rotor shaft to prevent rotation during assembly. Alignment of rotor gear is critical. (See Figure 14.)

(16) Align the “L” or “R” hole in the distributor gear with the “L” or “R” in the distributor block. Use “L” for left-hand rotation and “R” for right-hand rotation magnetos.

CAUTION: DO NOT ROTATE MAGNETO ROTOR SHAFT WITH THE T-118 TIMING PIN INSERTED IN THE DISTRIBUTOR BLOCK. IF ROTOR SHAFT IS ROTATED WITH TIMING PIN INSERTED, THE MAGNETO MUST BE DISASSEMBLED AND INSPECTED FOR DISTRIBUTOR BLOCK AND GEAR DAMAGE.

(17) Lock the distributor gear in place with the T-118 timing pin through the appropriate hole in the block and gear. Then:

(a) Place distributor block spacers on magneto frame.

(b) Place distributor block on magneto frame. The distributor gear and rotor gear are properly meshed when the index mark on the rotor gear aligns with the index mark on the distributor block.

(c) Secure distributor block to frame with screws provided.

(18) Connect condenser wire

(a) Connect condenser wire to the remaining terminal of the contact assembly.

(b) Attach the terminal with the lead pointing left.

(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.

CAUTION: MAKE SURE THE CARBON BRUSH IS CONTAINED WITHIN THE DISTRIBUTOR SHAFT DURING ASSEMBLY. IF THE CARBON BRUSH CATCHES ON THE SIDE OF THE DISTRIBUTOR SHAFT, THE COIL STRAP WILL BE BENT INTO THE WRONG POSITION DURING ASSEMBLY.

(21) Gently rotate the distributor housing onto the magneto frame.

(22) Secure the housing with three long screws and one short screw. Torque all four to 24 in-lbs.

(23) Remove T-118 timing pin.

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 dataplate.

(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.

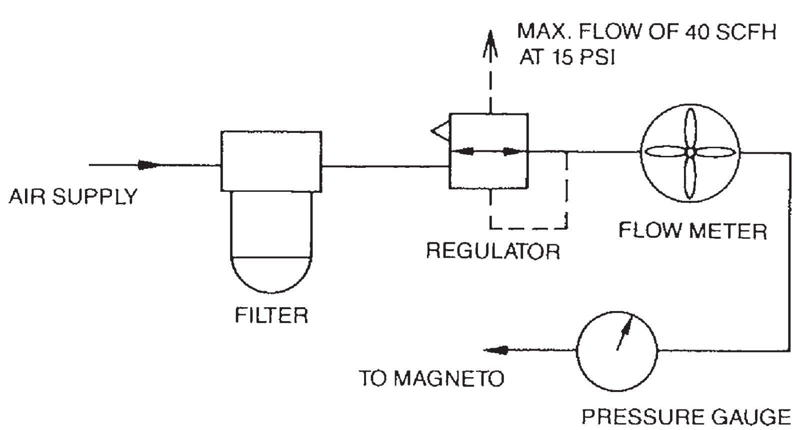
(4) Coming-in Speed

(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.

(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 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.



Pressurized Magneto Pressure Testing
Figure 15

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 1) is centered in the viewing hole, number one piston is at 20° BTC.

   NOTE: Verify correct engine timing for the airplane being worked on by checking the engine dataplate.

(6) Place a new gasket on magneto flange. Install magneto carefully so drive coupling lugs mate with slots of drive bushings. Install holding washers, lockwashers, and nuts.

NOTE: Do not tighten completely. Allow for turning magneto for final timing.

(7) After the magneto is installed on engine, remove the timing pin. The magneto is now ready to be timed to the engine.

(8) Complete magneto to engine timing procedure listed under 100 Hour Inspection, above.

WARNING: THE MAGNETO IS NOT INTERNALLY GROUNDED, WHEN THE GROUND LEAD IS DISCONNECTED THE MAGNETO IS HOT. REMOVING THE HARNESS ASSEMBLY FIRST AND INSTALLING IT LAST, MINIMIZES THE DANGER OF STARTING THE ENGINE ACCIDENTALLY WHEN THE GROUND LEAD IS REMOVED FROM THE MAGNETO.

(9) Replace the harness cap onto the magneto. Align the index marks made on the harness cap and distributor housing when removed.

(10) Connect the P-lead and pressurization tube to magneto. Connect the retard breaker lead to the starting circuit to the left magneto.

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DISTRIBUTION

1. Ignition Harness

A. Inspection

(1) Check lead assemblies for nicks, cuts, mutilated braiding, badly worn section or any other evidence of physical damage. Inspect spark plug sleeves for chafing or tears, and damage or stripped threads on coupling nuts. Check compression spring is not broken or distorted. Inspect grommet for tears. Check all mounting brackets and clamps to see that they are secure and not cracked.

(2) Use an ohmmeter, buzzer, or other suitable low voltage device, and check each lead for continuity. If continuity does not exist, wire is broken and must be replaced.

(3) For electrical test of harness assembly, use high voltage, direct current tester such as TAKK model 86 or 86A or equivalent direct current high voltage tester capable of delivering test potential of 10,000 volts. Connect ground lead to high voltage tester to outer shielding braid of a single lead. Connect plug terminal. Turn tester ON and apply 10,000 volts. Insulation resistance should be 100 megohms minimum. Check all other harness leads in same manner.

(4) Minor repair to harness assembly, such as replacement of contact springs, spring retainer assemblies, insulating sleeves, or of one lead assembly, is done with harness assembly mounted on engine. To replace more than one lead assembly or cable outlet plate, harness should be removed from engine and sent to an overhaul shop.

B. Removal

(1) Disconnect clamps holding wires to engine and accessories.

(2) Loosen coupling nuts at spark plugs and remove insulators from spark plug barrel well. Do not damage insulator spring when withdrawing insulator.

(3) Place a guard over harness insulators.

(4) Remove harness assembly terminal plate from magneto.

(5) Remove harness from airplane.

C. Disassembly

(1) To remove spring, Slick M-2929, from damaged lead, turn spring counterclockwise while pulling gently. This will remove spring and M-1498 electrode screw from end of coiled conductor.

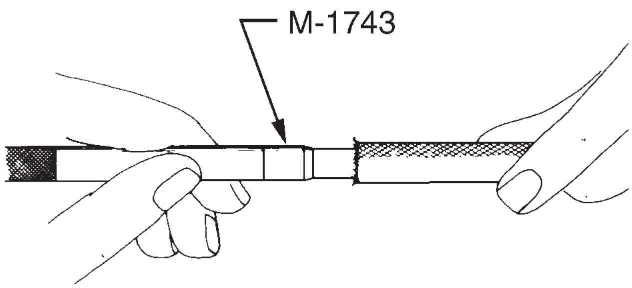
(2) To separate spring and screw, hold electrode screw with pliers and turn spring clockwise until it is through the threaded portion.

(3) Remove insulator sleeve from end of wire.

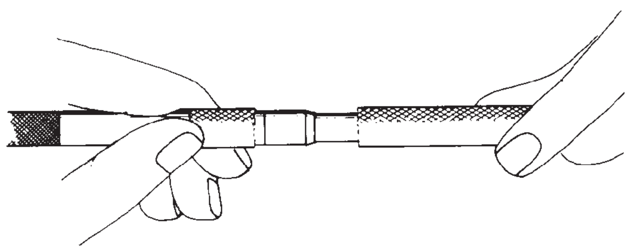
(4) To remove lead from M-1568 harness cap, use diagonals or cutting pliers and cut lead off close to cap. Use drift or punch to tap ferrule loose from harness cap.

NOTE: Further service on Slick harnesses will require the use of Slick T-200 or M-1495 Service Tool Kit, obtained from:

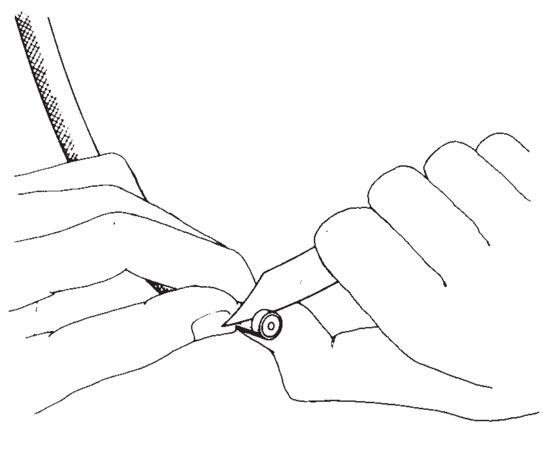
Slick Aircraft Products
(See Introduction, Supplementary Publications, Vendor Publications, Magnetos.)



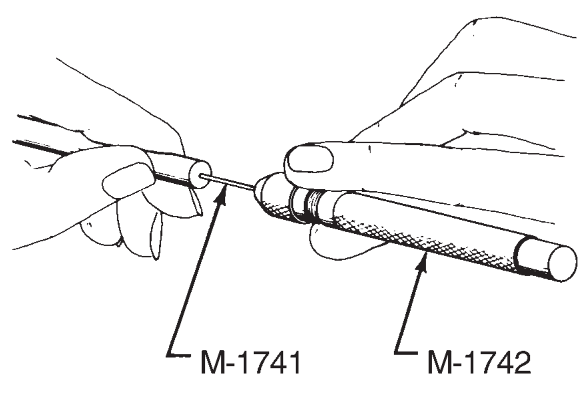
Stripping Tool
Figure 1



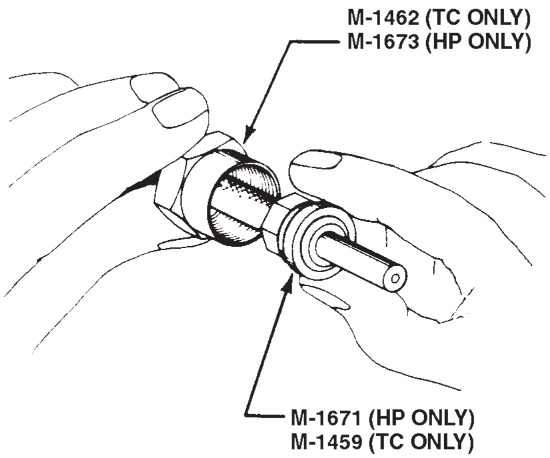
Inserting Stripping Tool
Figure 2



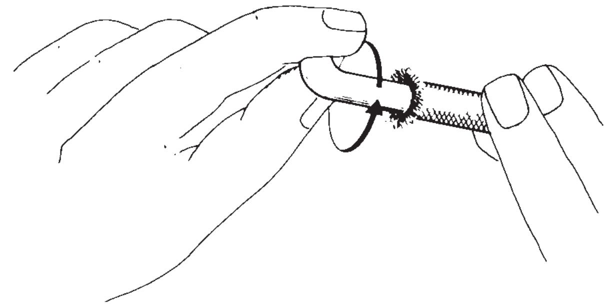
Cutting Insulation
Figure 3



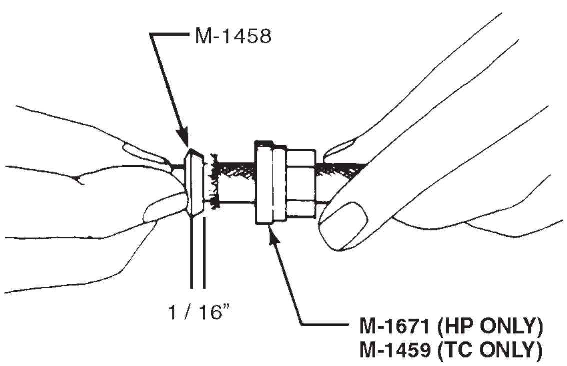
Removing Silicone Rubber from Wire
Figure 4



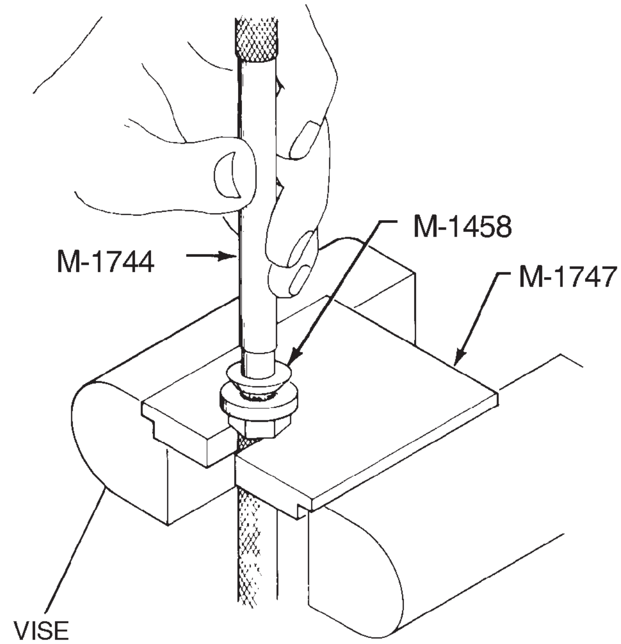
Installation of Plug Endnut
Figure 5



Flaring out the Shielding
Figure 6



Installation of Ferrule
Figure 7



Driving Tool
Figure 8

D. Assembly

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 1.)

(4) Make sure stripping tool is inserted past cutting mark, and cut shielding with a sharp knife using a rolling motion. Remove shielding and stripping tool. Do not cut silicone insulation. (Refer to Figure 2.)

(5) Cut exposed insulation 0.125 inch back from end and roll insulation clockwise to remove. Do not use a pulling motion when removing insulation. Trim end of coiled conductor to make a clear hole for inserting stud. (Refer to Figure 3.)

(6) Using T-111 or M-1742 pin vise, insert T-110 or M-1741 drill (#72 drill), drill out silicone rubber from inside coiled conductor approximately 0.5 inch deep. (Refer to Figure 4.)

(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 5.)

(8) After installation of nut and ferrule, bend and rotate silicone insulation as per Figure 6 to flare out shielding so drive ferrule can be inserted. Do not cut silicone insulation with sharp braiding while wire is being rotated.

CAUTION: DO NOT REUSE THE M-1458 DRIVE FERRULE.

(9) On spark plug end of wire install M-1458 male tapered drive ferrule over silicone insulation and under shielding to within 0.0625 inch from flange of ferrule. Make sure that shielding is away from ferrule flange then slide ferrule M-1671 (HP only) /M-1459 (TC only) over the M-1458 drive ferrule until tight. (Refer to Figure 7.)

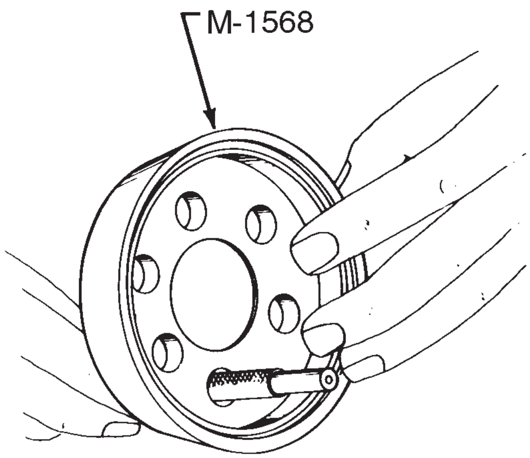
(10) For spark plug end, mount M-1747 drive plate in a bench vise. Set hex ferrule in drive plate slot. Drive M-1458 drive ferrule flush against the hex ferrule using the M-1744 drive tool. (Refer to Figure 8.) Or, press into place using T-109 pressing tool.

(11) For magneto end of wire, insert wire through hole in M-1568 harness cap so shielding is through hole as shown in Figure 9.

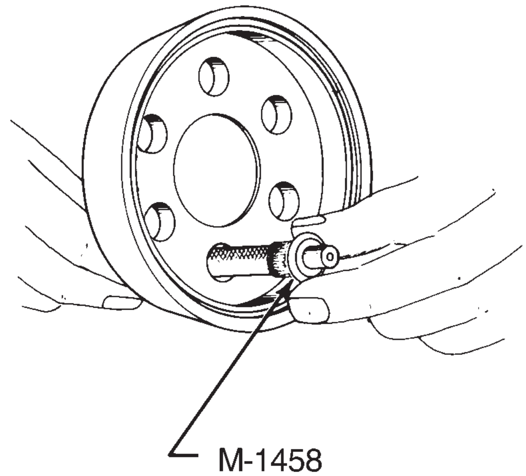
(12) Install an M-1458 male tapered drive ferrule over insulation and under shielding as in step 9, then drive ferrule into M-1568 harness cap using M-1744 drive tool, similar to step 10. (Refer to Figure 10.) Or, press into place using T-109 pressing tool.

(13) Clamp threaded end of M-1498 electrode screw in T-111 or M-1742 pin vise. Insert tapered pin of electrode screw into center of coiled conductor by turning pin vise counterclockwise and pushing at same time until screw is flush with insulation. This is done at both ends of the wire assembly. (Refer to Figure 11.)

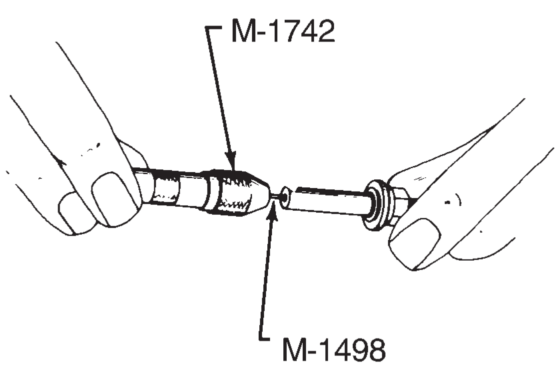
(14) On magneto end of wire, place M-3168 insulator sleeve over silicone insulation. On spark plug end of wire, use M-1677 insulator sleeve (HP only) or K-3300 insulator sleeve and washer (TC only). (Refer to Figure 12.)



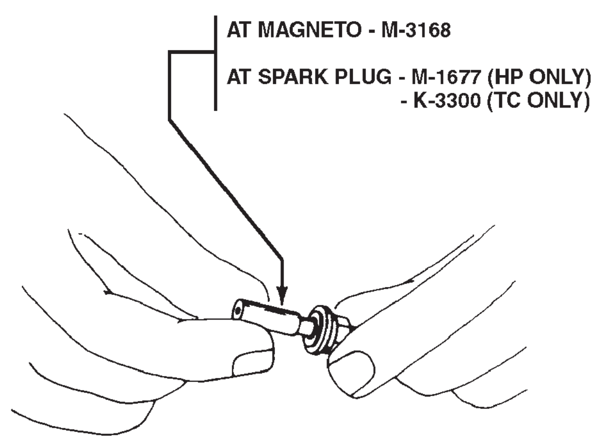
Installation of Harness Cap
Figure 9



Securing Wire in Harness Cap
Figure 10



Installation of Electrode Screw
Figure 11



Installation of Insulator Screw
Figure 12

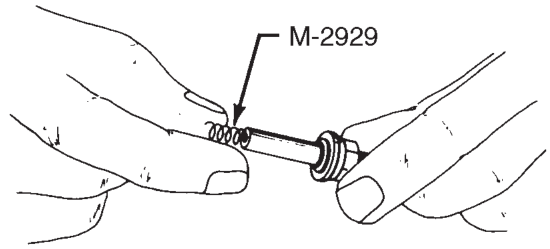
(15) Turn M-2929 spring clockwise on electrode screw three full turns until end is flush with first large coil of spring. This applies to both ends of wire. (Refer to Figure 13.)

E. Installation

(1) Before installing harness on magneto, check mating surfaces for cleanliness.

(2) Place harness terminal plate on magneto and tighten nuts around plate alternately to seat cover squarely on magneto.

NOTE: The left magneto is wired to fire all top spark plugs in this engine. The right magneto fires all bottom plugs.



Installation of Spring
Figure 13

(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.

2. Spark Plugs (Refer to Figure 14.)

A. Removal

CAUTION: WHEN WITHDRAWING IGNITION CABLES LEAD CONNECTION FROM PLUG, CAREFULLY PULL LEAD STRAIGHT OUT AND IN LINE WITH CENTER LINE OF PLUG BARREL; OTHERWISE, A SIDE LOAD WILL BE APPLIED WHICH FREQUENTLY RESULTS IN DAMAGE TO BARREL INSULATOR AND CONNECTOR. A LEAD CANNOT BE REMOVED EASILY IN THIS MANNER, RESISTING CONTACT BETWEEN NEOPRENE COLLAR AND BARREL INSULATOR WILL BE BROKEN BY A ROTARY TWISTING OF COLLAR. AVOID UNDUE DISTORTION OF COLLAR AND POSSIBLE SIDE LOADING OF BARREL INSULATOR.

(1) Loosen coupling nut on harness lead and remove terminal insulator from spark plug barrel well.

CAUTION: DUE TO GREATER TORQUE VALUE REQUIREMENTS, TORQUE WRENCHES SHOULD NOT BE USED TO REMOVE SPARK PLUG.

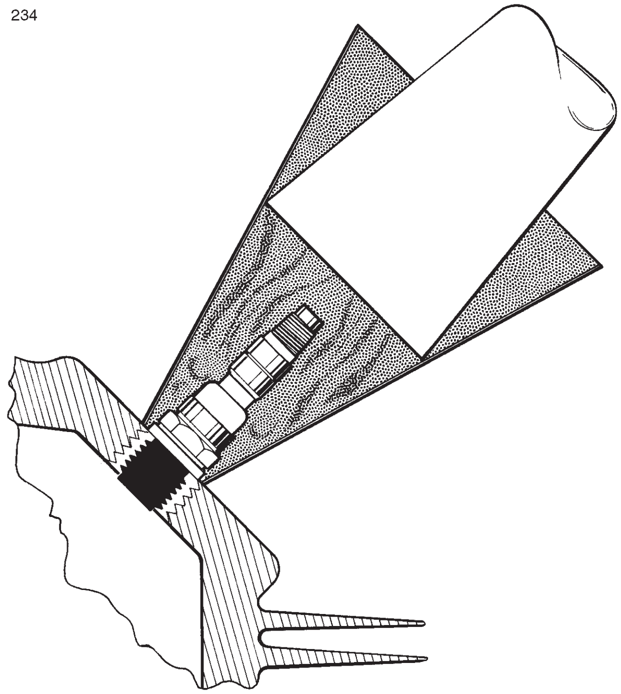
CAUTION: DO NOT ALLOW FOREIGN OBJECTS TO ENTER SPARK PLUG HOLE.

(2) Remove spark plug from engine.

(a) In the course of engine operation, carbon and other combustion products are deposited on the end of spark plugs and will penetrate lower threads to some degree. As a result, a greater torque is required for removing a plug than for installation. Torque limitations given do not apply to plug removal, as sufficient torque must be used to unscrew plug.

(b) The higher torque required to remove plugs is not as detrimental as in installation, since it cannot stretch the threaded section. It does, however, impose a shearing load on this section and may, if sufficiently severe, produce a failure in this location.

(3) Immediately upon removal, place spark plugs in a tray in a manner that will identify their position in the engine.



Removing Frozen Spark Plug
Figure 14

(4) Removal of seized spark plugs in cylinder is done by application of liquid carbon dioxide (CO_2) by a conical metal funnel adapter with a hole at the apex just large enough to accommodate the funnel of a 20 lb bottle. (Refer to Figure 14.) When a seized spark plug cannot be removed by normal means, funnel adapter is placed over and around spark plug. Place funnel of CO_2 bottle inside funnel adapter and release carbon dioxide to chill and contract spark plug. Break spark plug loose with a wrench. A warm cylinder head at the time carbon dioxide is applied will aid in removal of excessively seized plug.

B. Inspection And Cleaning

(1) Visually inspect each spark plug for the following non-repairable defects.

(a) Severely damaged shell or shield; threads nicked up, stripped, or crossthreaded.

(b) Badly battered or rounded shell hexagons.

(c) Out-of-round or damaged shielding barrel.

(d) Chipped, cracked, or broken ceramic insulator portions.

(e) Badly eroded electrodes worn to approximately 50 percent of original size.

(2) Clean spark plug as required; remove carbon and foreign deposits.

(3) Test spark plug both electrically and for resistance.

(4) Set electrode gap at 0.016 to 0.022 inch.

C. Installation

CAUTION: DO NOT INSTALL ANY SPARK PLUG THAT HAS BEEN DROPPED.

(1) Before installing spark plugs, make sure that threads within cylinder are clean and not damaged.

CAUTION: MAKE CERTAIN DEEP SOCKET IS PROPERLY SEATED ON SPARK PLUG HEXAGON AS DAMAGE TO PLUG WILL RESULT IF WRENCH IS COCKED TO ONE SIDE WHEN PRESSURE IS APPLIED.

(2) Apply anti-seize compound sparingly on threads; install gasket and spark plugs. Tighten to a torque of 420 inch-pounds.

(3) Carefully insert terminal insulator in spark plug and tighten coupling nut per Chart 1.

CHART 1
SPARK PLUG COUPLING TORQUE

Application	Spark Plug Coupling Threads	Torque (In. - lb.)
HP S/N's 3246001 & UP	5/8-24	90 - 95
TC S/N's 3257001 & UP	3/4-20	110 - 120

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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

The magneto switches and the starter switch are located in the overhead switch panel.See Switches, 39-10-00.

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CHAPTER

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ENGINE CONTROLS

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CHAPTER 76

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CHAPTER 76 - ENGINE CONTROLS

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POWER CONTROL

Throttle and Mixture Control Adjustment (Refer to Figure 1.)

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.

A. The throttle may be adjusted as follows:

(1) 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.

(2) 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.

(3) 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.

(4) Reconnect the clevis end to the control arm and safety.

B. The mixture may be adjusted as follows:

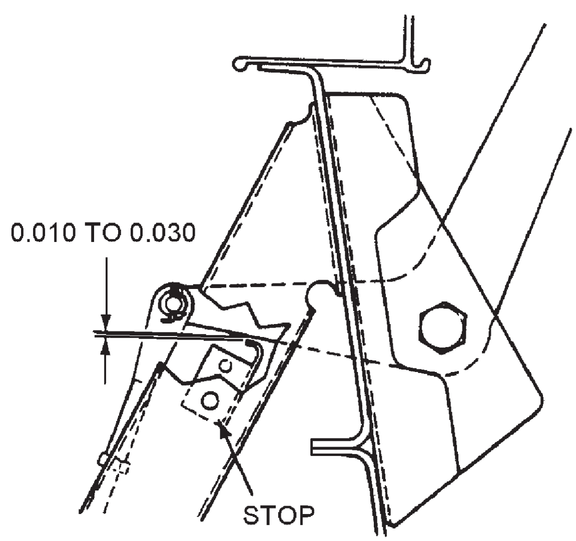
(1) At the fuel injector, disconnect the clevis end of the mixture control cable from the control arm. Loosen the jam nut that secures the clevis end.

(2) 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.

(3) Reconnect the clevis end to the control arm and safety.

C. Check security of cabling casing attachments.

D. Pull the throttle and mixture levers in the cockpit full aft to ascertain that the idle screw contacts it's stop and the mixture control arm contacts it's 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.



Engine Controls Adjustment
Figure 1

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CHAPTER

77

ENGINE INDICATING

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CHAPTER 77

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CHAPTER 77 - ENGINE INDICATING

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CHAPTER 77 - ENGINE INDICATING

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GENERAL

1. Description

Significantly different engine instrumentation packages are installed in these aircraft.

HP S/N's 3246001 thru 3246087 only use traditional three-inch analog display, electrically or mechanically actuated engine instruments. These instruments and their function are addressed in 77-10-00, 77-20-00 and 79-30-00.

HP S/N's 3246088 & up and TC S/N's 3257001 & up use an Integrated Engine Instrument System by Flightline/Horizon which incorporates two-inch analog display, electronically actuated engine instruments and a multifunction Digital Display Monitoring Panel (DDMP). This system's function and display is addressed in 77-40-00. Associated sensors and transducers are addressed in 77-10-00, 77-20-00, or 79-30-00.

In HP S/N's 3246218 & up and TC S/N's 3257339 & up, for airplanes equipped with Avidyne Entegra; engine data is also displayed via an Integrated Engine Instrument System. Engine data is collected by a Data Acquisition Unit (DAU) and displayed on the Multifunction Display (MFD) and Primary Flight Display (PFD)). The function and display of these systems is addressed in 34-20-00. Associated sensors and transducers are addressed in 77-10-00, 77-20-00, or 79-30-00.

In TC S/N's 3257447; 3257455 and up, for airplanes equipped with Garmin G1000; engine data is also displayed via an Integrated Engine Instrument System. Engine data is collected by the Engine/Airframe Unit (GEA 71), passed to an Integrated Avionics Unit (GIA 63W) and displayed on the Multifunction Display (MFD) and Primary Flight Display (PFD)). The function and display of these systems is addressed in 34-20-00. Associated sensors and transducers are addressed in 77-10-00, 77-20-00, or 79-30-00.

2. Removal and Installation

A. Engine Instruments

(1) Removal

(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) Installation

(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) Removal

(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) Installation

(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.

POWER

1. Saratoga II HP S/N's 3246001 thru 3246087

A. Manifold Pressure Gauge

(1) Description

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.

(2) Troubleshooting

Refer to Chart 1.

CHART 1
TROUBLESHOOTING MANIFOLD PRESSURE GAUGE

Trouble	Cause	Remedy
Excessive error at existing barometric pressure.	Pointer shifted.	Replace instrument.
Excessive error when engine is running.	Line leaking.	Tighten line connections.
Sluggish or jerky pointer movement.	Defective instrument.	Replace instrument.
Dull or discolored marking.	Age.	Replace instrument.
Incorrect reading.	Moisture or oil in line.	Disconnect lines and blow out.

B. Tachometer Indicator

(1) Description

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.

(2) Troubleshooting

Refer to Chart 2.

CHART 2
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.

2. Saratoga II HP (S/N's 3246088 and up) and Saratoga II TC

Manifold pressure and engine RPM information are displayed in one of three Integrated Engine Instrument Systems described in 77-00-00. Accordingly, information in this section describes only the sensors and transducers used to send the engine information to the installed Integrated Engine Instrument System.

A. Manifold Pressure Transducer

A manifold pressure transducer located above the forward baggage compartment provides manifold pressure data to the installed Integrated Engine Instrument System.

(1) Removal

(a) Disconnect battery ground cable.

(b) Remove ceiling liner from forward baggage compartment.

(c) Locate the transducer (on the left side of the channel assembly running fore and aft in the center of the forward baggage compartment overhead).

(d) Disconnect electrical leads from aft end of transducer.

(e) Loosen the P-clamp securing the transducer to the channel assembly.

(f) Loosen the fitting connecting the forward end of the transducer to the manifold pressure line and remove the transducer.

(2) Installation

(a) Place the transducer in the P-clamp and connect the forward end of the transducer to the manifold pressure line.

(b) Torque manifold pressure line fitting per label on transducer.

(c) Tighten the P-clamp to secure the transducer to the channel assembly.

(d) Reconnect electrical leads to aft end of transducer.

(e) Replace the ceiling liner in the forward baggage compartment.

(f) Reconnect battery ground cable.

(3) Test

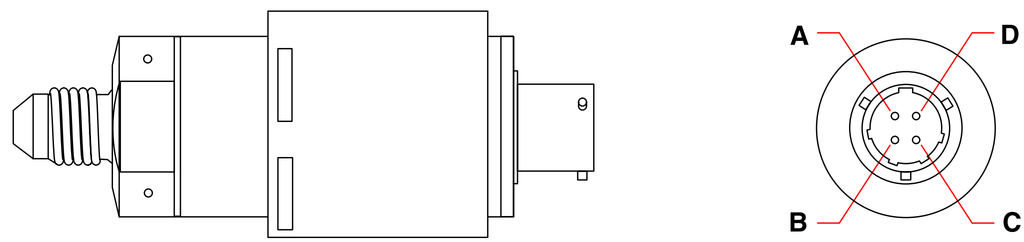
The manifold pressure transducer can be tested as follows:

(a) Basic

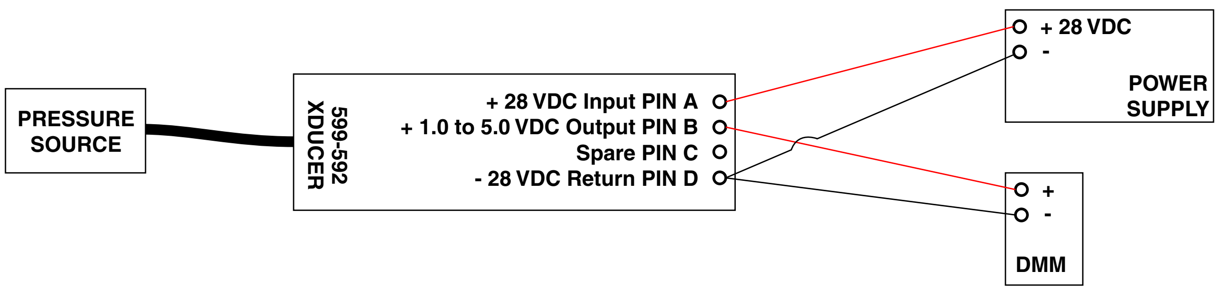
1 Turn aircraft electrical power on to energize cockpit instruments.

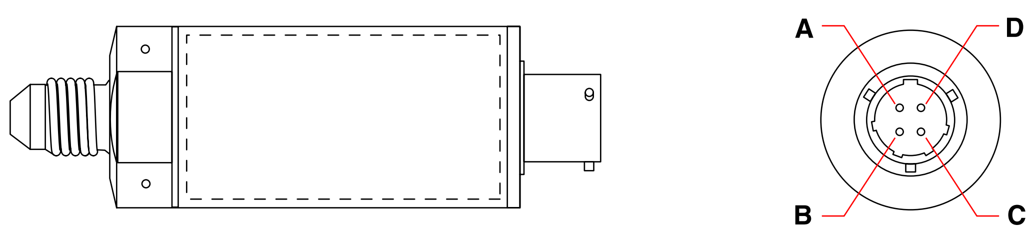
2 Prior to engine start, confirm the accuracy of the manifold pressure displayed by the cockpit instrumentation by comparing the indicated manifold pressure against the actual, current barometric pressure, as reported by the local airport authority, or another known good instrument.

3 With a properly functioning Manifold Pressure Transducer, the indicated manifold pressure should agree with the actual barometric pressure within 0.5 inHg (one-half inches of mercury). If an erroneous reading is suspected, continue with detailed test, below.

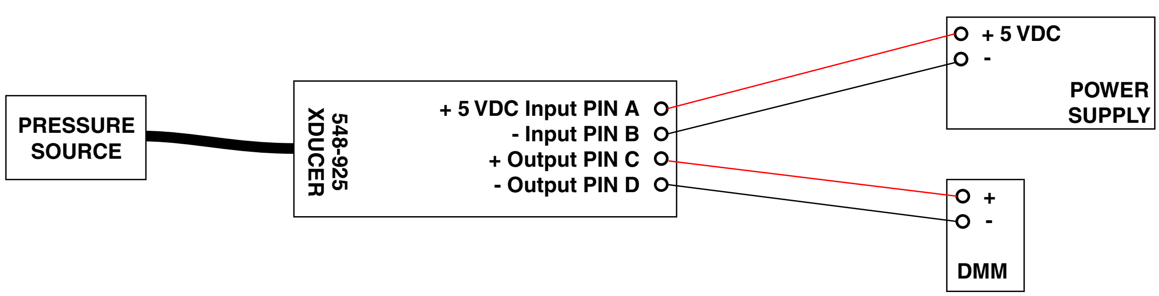


599-592 (WITH AVIDYNE ENTEGRA)





548-925 (WITH GARMIN G1000)



Effectivity
3246088 and up
3257001 and up

Manifold Pressure Transducer Test Set-up
Figure 1

CHART 3
MANIFOLD PRESSURE TRANSDUCER SERVICE TEST SPECIFICATIONS

Pressure Applied (PSI)		P/N 599-592 with Avidyne Entegra Nominal ± 2% (VDC)	P/N 548-925 with Garmin G1000 Nominal ± 2% (MVDC)
0		1.00	0
5		1.80	10
10		2.60	20
15		3.40	30
20		4.20	40
25	Maximum	5.00	50
20		4.20	40
15		3.40	30
10		2.60	20
5		1.80	10
0		1.00	0

(b) Detailed

1 Remove the transducer per Removal, above.

2 Using a calibrated regulated pressure source and a 28 VDC power source, setup the transducer for testing as shown in Figure 1.

3 Slowly applying regulated pressure, record the voltage shown on the digital multimeter (DMM) at each stage as shown in Chart 3, until a maximum pressure of 25 PSI is reached.

4 Then, slowly decrease the regulated pressure and, again, record the voltage shown on the digital multimeter (DMM) at each stage as shown in Chart 3, until zero (0) PSI is achieved.

5 The transducer is good if it meets the specifications shown in Chart 3 for the equipment installed. Any other result is cause for transducer replacement.

B. Tachometer Magnetic Sensor (See Item #6, Figure 8, 74-10-00.)

(1) Description

Engine RPM information is provided by a magnetic sensor on the left magneto of the engine. As the magneto rotates, a signal is generated and sent to the installed Integrated Engine Instrument System.

(2) Removal and Installation

Each magnetic sensor may be removed and installed as follows:

(a) Remove the upper cowling and upper support panel.

(b) Locate the left magneto and the magnetic sensor. Follow the sensor leads back to the connection and separate the connector.

(c) Unscrew the sensor from the magneto. Install using the reverse order.

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TEMPERATURE

1. Exhaust Gas Temperature (EGT) (Saratoga II HP only)

Exhaust Gas Temperature (EGT) is displayed on an analog gauge or in one of three Integrated Engine Instrument Systems described in 77-00-00. Information in this section describes only the analog gauge and the sensors used to send the engine information to the gauge or installed Integrated Engine Instrument System.

A. Gauge (HP S/N's 3246001 thru 3246087 only.)

(1) Description

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.

(2) Troubleshooting

See Chart 1.

(3) Removal

(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.

(4) Installation

(a) Install the EGT gauge into the instrument panel and secure with four bolts.

(b) Connect the thermocouple wires to the rear of the EGT gauge.

CHART 1
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.

(5) Cleaning and Inspection

Unless mechanical damage is evident, broken glass, bent or broken pointer, or broken case, the following checks should be performed before removing the instrument.

CAUTION: DO NOT CONNECT OHMMETER. IT WILL BURN OUT THE MOVEMENT OF THE METER.

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.

B. Probe(s) (See 39-20-00, Figure 1, Sheet 22.)

In S/N's 3246001 thru 3246087, one (1) EGT probe is installed on Cylinder No. 6. Later HP's have an EGT probe on all six (6) cylinders.

NOTE: If replacing EGT probe see Piper Service Spares Letter No. 428A.

(1) Removal

(a) Trace thermocouple leads to the connectors and disconnect from the wiring harness.

(b) Cut safety wire and loosen the clamp which secures the EGT probe to the exhaust system.

(c) Remove the probe.

(2) Installation

(a) Install the probe and secure with clamp. Torque per 39-20-00, Figure 1, Sheet 22 and safety.

(b) Route the thermocouple leads to the wiring harness and connect.

(3) Cleaning and Inspection

(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.

2. Cylinder Head Temperature (CHT)

Cylinder Head Temperature (CHT) is displayed on an analog gauge or in one of three Integrated Engine Instrument Systems described in 77-00-00. Information in this section describes only the analog gauge and the sensors used to send the engine information to the gauge or installed Integrated Engine Instrument System.

A. CHT Gauge (HP S/N's 3246001 thru 3246087 only.)

(1) Description

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 traditional three-inch 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.

(2) Troubleshooting

Refer to Chart 2.

CHART 2
TROUBLESHOOTING CYLINDER HEAD TEMPERATURE GAUGE

Trouble	Cause	Remedy
Gauge inoperative.	Defective gauge, probe, or wiring.	Check probe and lead wires for chafing, breaks or shorting between wires and / or metal structure.
	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.

B. CHT Probe(s) (See 39-20-00, Figure 1, Sheet 22.)

In HP S/N's 3246088 thru 3246244 without Avidyne Entegra, one (1) CHT probe is installed on Cylinder No. 2.

In HP S/N's 3246218 thru 3246244 with Avidyne Entegra, six (6) EGT probes are installed, one on each cylinder.

In TC S/N's 3257001 and up without Avidyne Entegra or Garmin G1000, one (1) CHT probe is installed on Cylinder No. 3.

In TC S/N's 3257339 and up with Avidyne Entegra or Garmin G1000, six (6) CHT probes are installed, one on each cylinder.

(1) Removal
   (a) Trace thermocouple leads to the connectors and disconnect from the wiring harness.
   (b) Unscrew CHT probe from cylinder.
   (c) Remove the probe.

(2) Installation
   (a) Install the probe into cylinder and tighten.
   (b) Route the thermocouple leads to the wiring harness and connect.

3. Turbine Inlet Temperature (TIT) (TC only.)

Turbine Inlet Temperature (TIT) is displayed in one of three Integrated Engine Instrument Systems described in 77-00-00. Information in this section describes only the sensor used to send the information to the installed Integrated Engine Instrument System.

Probe

A single TIT probe is installed just ahead of the wastegate as shown in Figure 3, 81-20-00.

(1) Removal
   (a) Trace thermocouple leads to the connectors and disconnect from the wiring harness.
   (b) Unscrew TIT probe from the exhaust system and remove probe.

(2) Installation
   (a) Install the probe into the exhaust system and tighten.
   (b) Route the thermocouple leads to the wiring harness and connect.

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INTEGRATED ENGINE INSTRUMENT SYSTEMS

This section applies only to HP S/N's 3246088 & up; TC S/N's 3257001 & up; for airplanes that are not equipped with Avidyne Entegra or Garmin G1000.

1. Introduction

The Engine Instrument and Digital Display Monitoring Panel (DDMP) forms 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.

2. Troubleshooting (Refer to Chart 1.)

A. 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 its 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.

B. 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 3.)

"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.

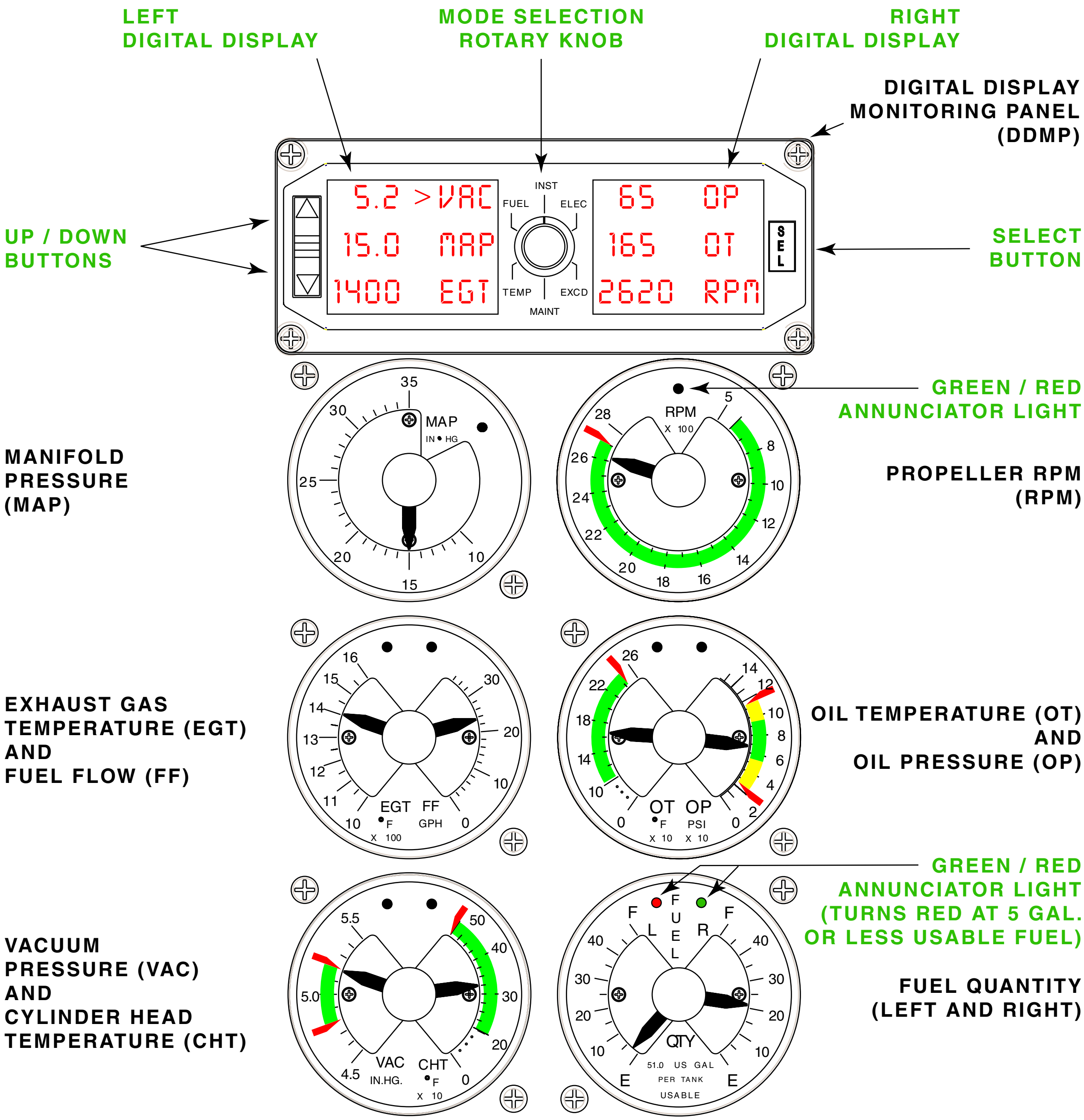
"DDMP FAIL OP SYS SHUTDOWN CODE 2"

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).

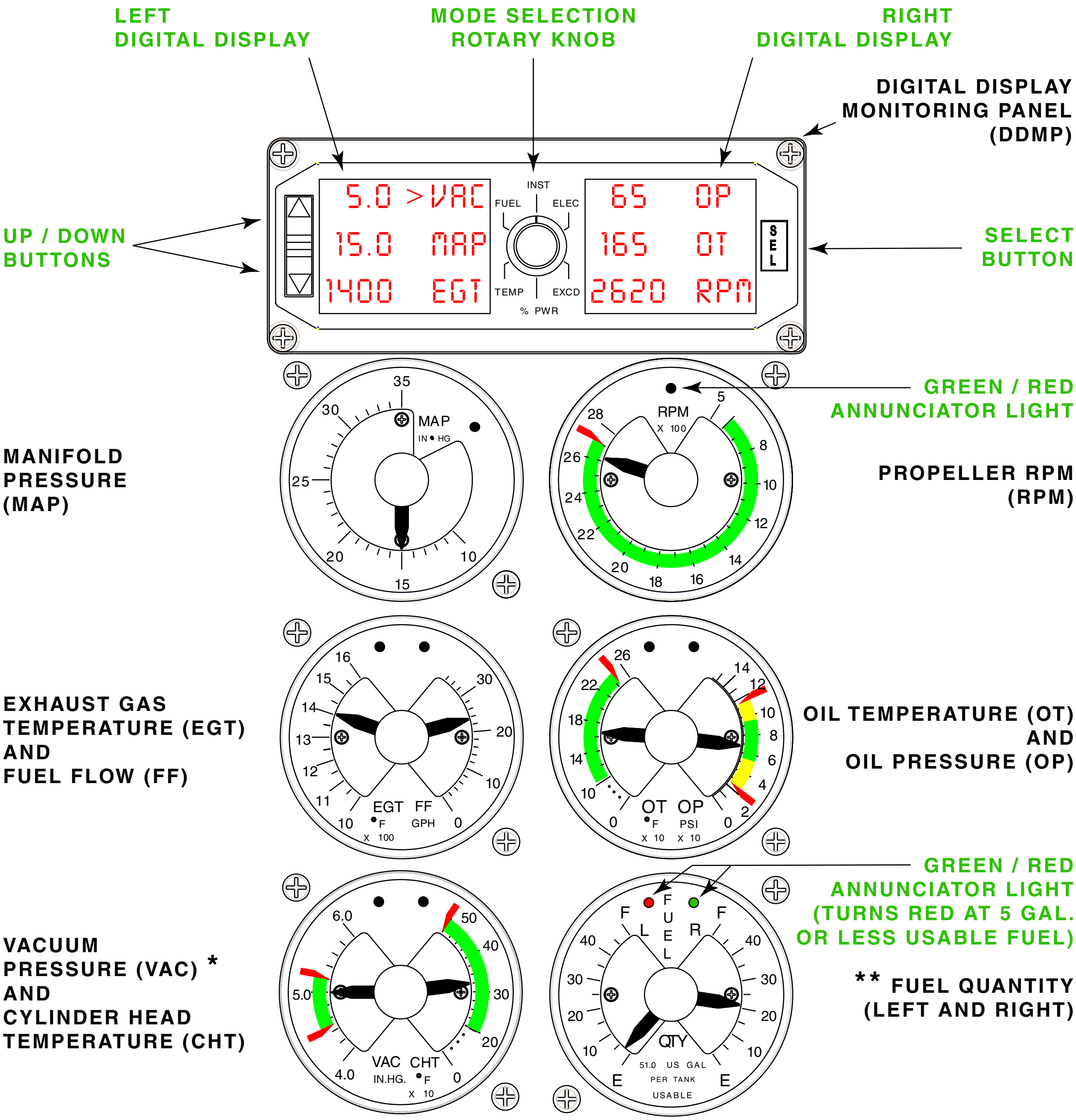
CHART 1
TROUBLESHOOTING ENGINE INSTRUMENT AND DIGITAL DISPLAY MONITORING PANEL
(HP S/N's 3246088 & up; TC S/N's 3257001 & up)

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



Engine Instruments and DDMP
Figure 1 (Sheet 1 of 4)

Effectivity
3246088 thru 3246125

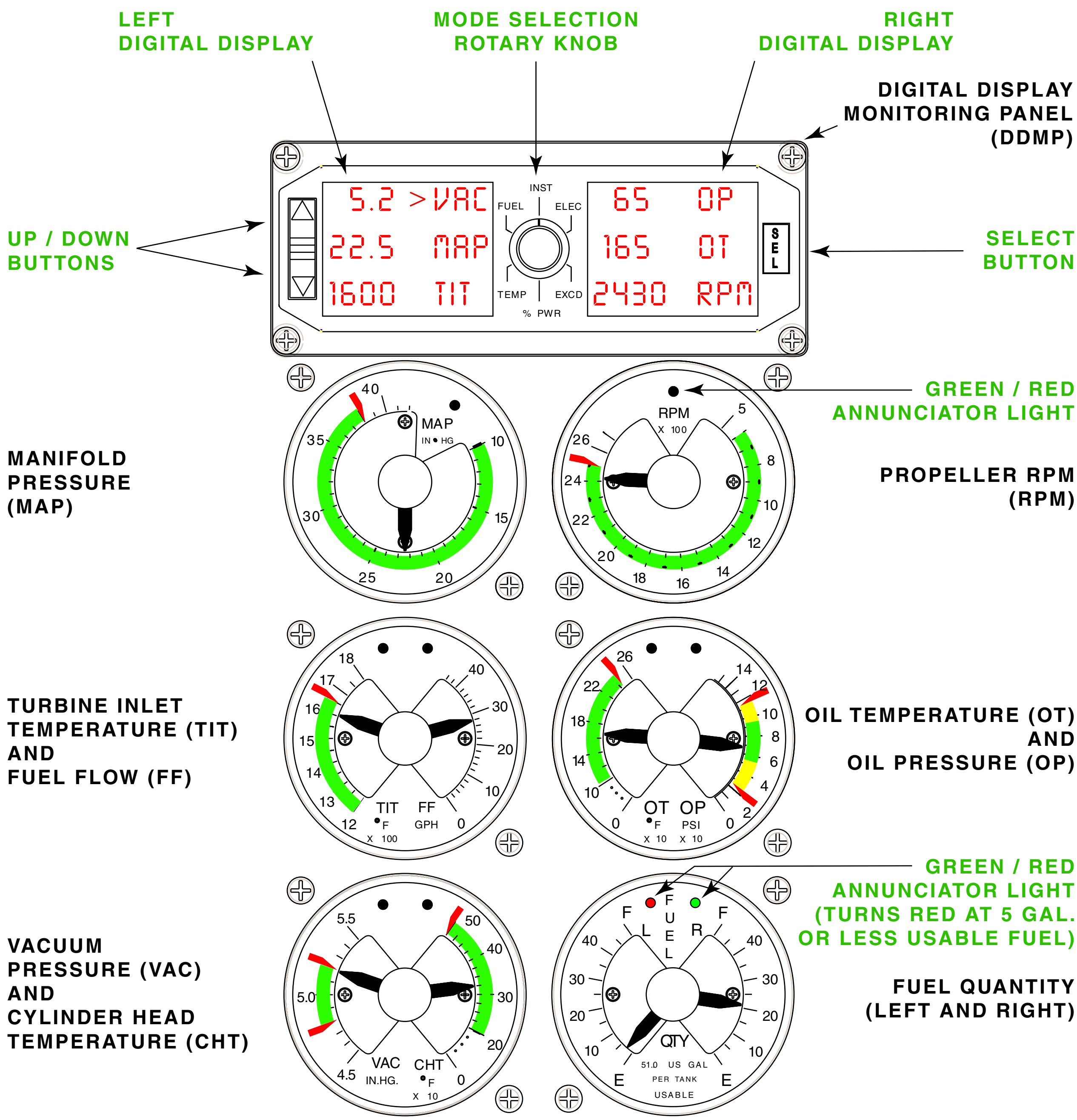


* HP S/N'S 3246126 THRU 3246129 HAVE VAC / CHT GAUGE AS IN SHEET 1.

** 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.

Effectivity
3246126 and up

Engine Instruments and DDMP
Figure 1 (Sheet 2 of 4)



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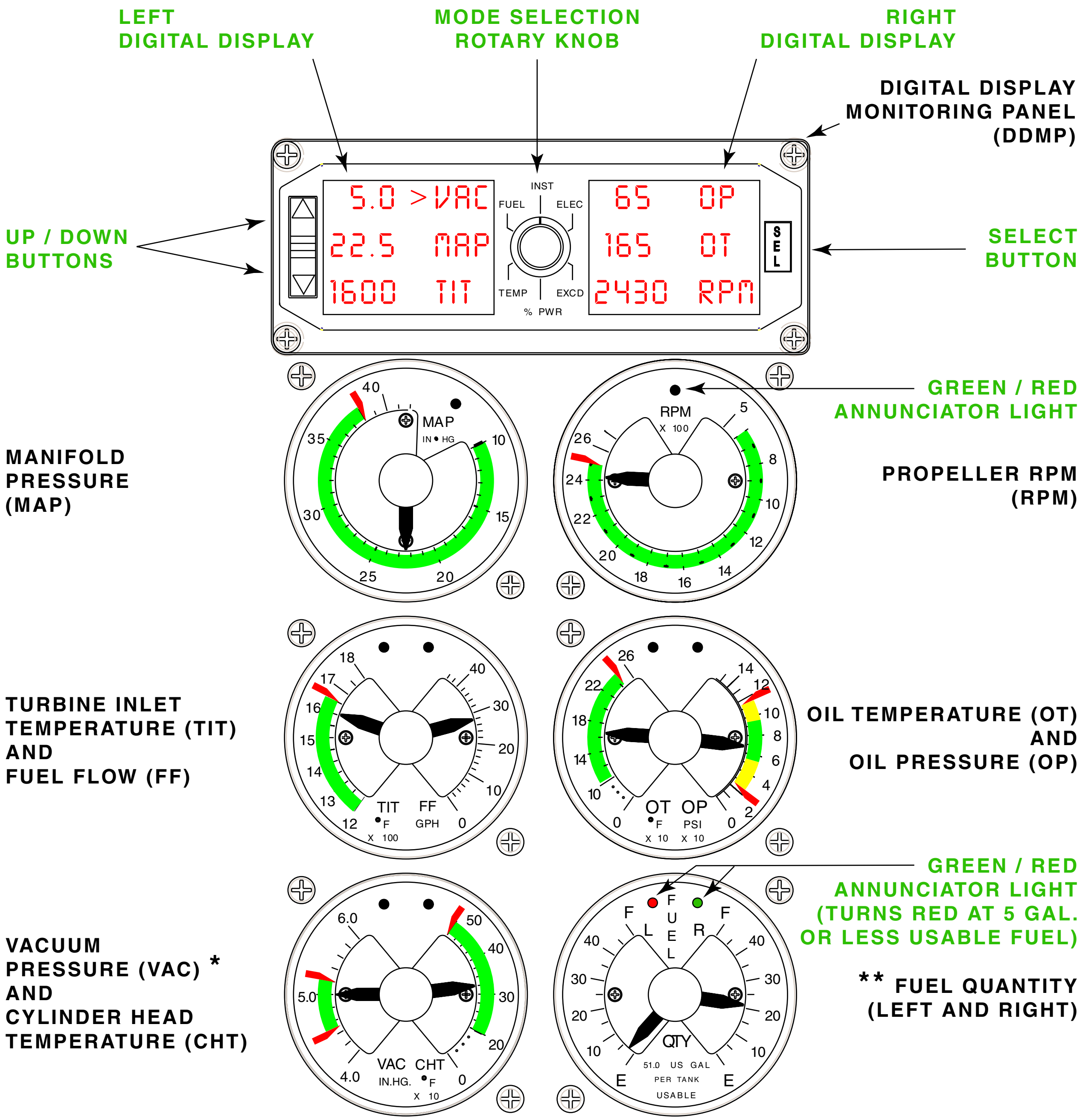
Engine Instruments and DDMP
Figure 1 (Sheet 3 of 4)



* 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.

Effectivity
3257076 and up

Engine Instruments and DDMP
Figure 1 (Sheet 4 of 4)

3. Analog Instruments

(HP S/N's 3246088 & up; TC S/N's 3257001 & up.)

The system uses two-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.

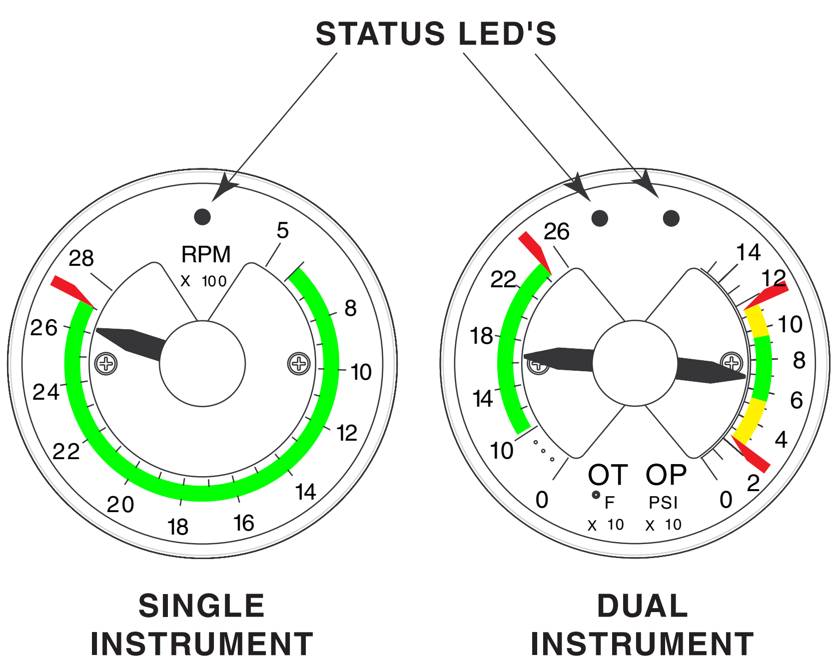
A. Instrument Self Test

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.

B. 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.

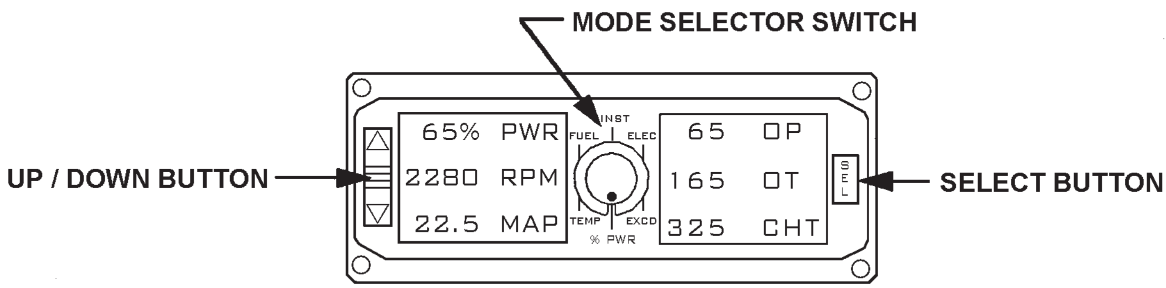


Single Instrument / Dual Instrument (Typical)
Figure 2

4. Digital Display Monitoring Panel (DDMP)

(HP S/N's 3246088 & up; 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.



Digital Display Monitoring Panel (DDMP) (Typical)
Figure 3

A. Self Test

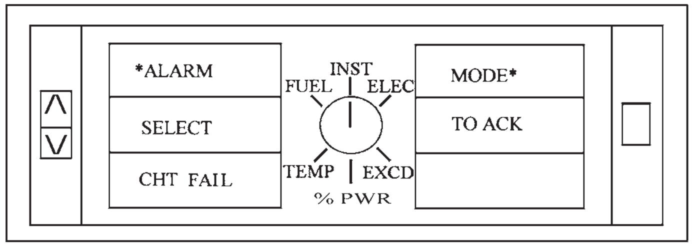
Upon power on, the DDMP will perform an internal self test, and will test communications with each of the instruments. If failure codes are displayed, or the system does not appear to be functioning properly, see the error codes, and instructions on initiating a self test from a power on state.

B. DDMP Controls

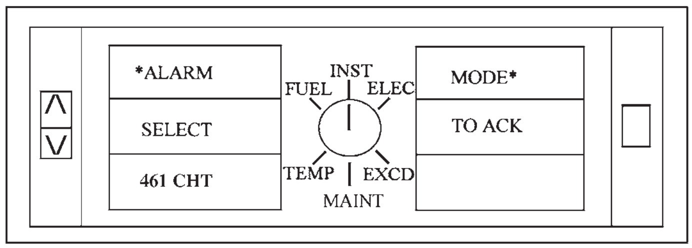
The operating mode of the DDMP is selected using the rotary Mode Selector Switch located at the center of the instrument. Within a given mode, a cursor ">" is moved throughout different display locations to provide an easy to understand user interface. The Up, Down and Select buttons are used in a multifunction manner as described in the following sections.

C. 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:



Instrument Failure Condition (Typical)
Figure 4A



Instrument Exceedance Condition (Typical)
Figure 4B

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 alarm conditions shown in Chart 2 may occur.

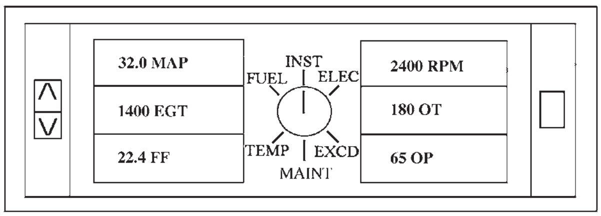
CHART 2
ALARM CONDITIONS

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 instrument.	Horn for 3 seconds.
Sensor failure.	DDMP Display. Red LED flashes four times per second on instrument.	Horn for 3 seconds

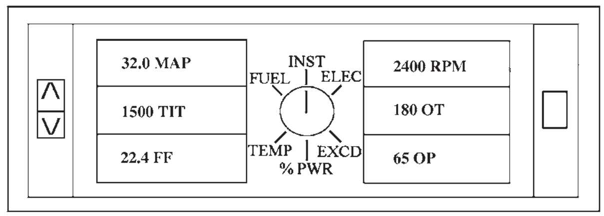
D. Instrument Mode

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

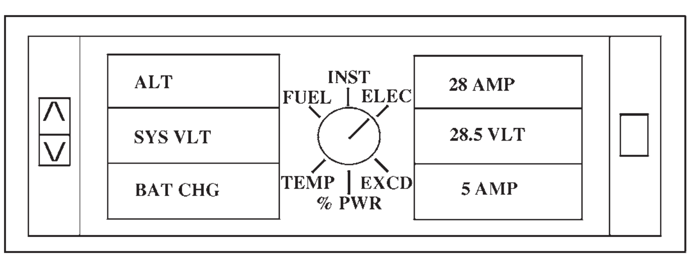
Instrument Mode
Figure 5

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.

E. 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 display shown in Figure 6 will appear.

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.



Electrical Mode
Figure 6

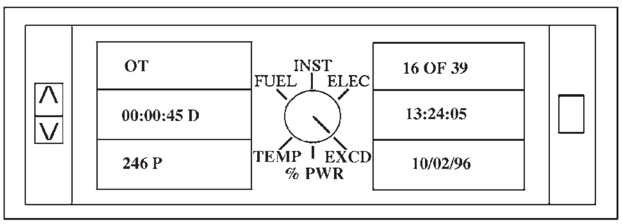
F. Exceedance Mode

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.

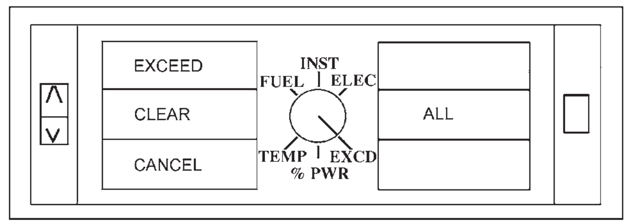
To view exceedances, turn the Mode Selector Switch to “EXCD.” The DDMP automatically defaults to the most recent or current exceedance. A display similar to that shown in Figure 7A will appear.

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 screen shown in Figure 7B will appear.



Exceedance Mode - Viewing (Typical)
Figure 7A



Exceedance Mode - Deleting (Typical)
Figure 7B

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.

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

G. 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 that shown in Figure 8A will appear.

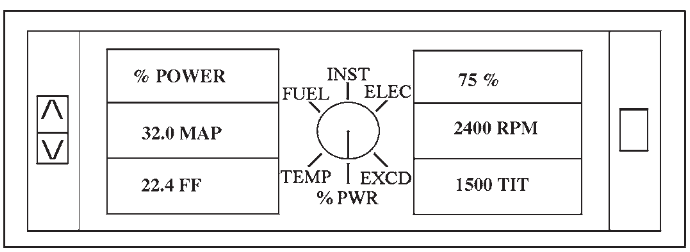
To estimate new engine settings for a given % Power, press the SELECT button. The DDMP rounds the current settings to the nearest 5% Power and produces a display similar to Figure 8B.

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.

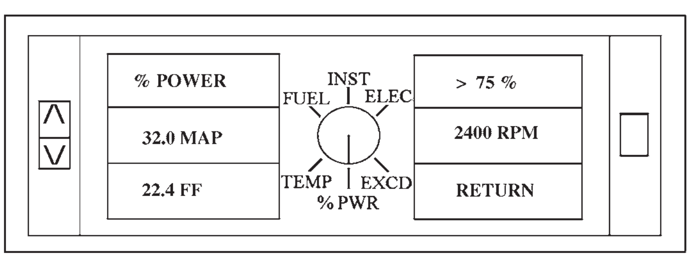
If the selected % Power is not obtainable at the current RPM setting, the DDMP will change the RPM to the nearest value within the range of the desired % Power. To select a new RPM value, press the SELECT button to move the cursor to the RPM position. Using the UP or DOWN button, select the desired value.

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.



Current Percent Power (Typical)
Figure 8A

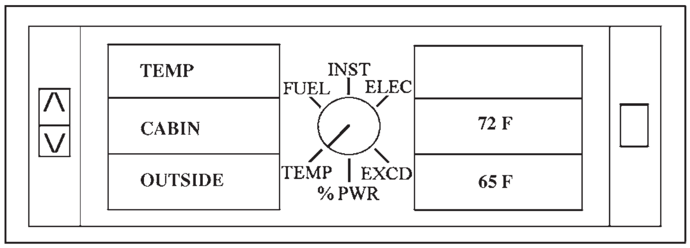


Calculating Percent Power
Figure 8B

H. 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 9):

Press the SELECT button to toggle between Degrees Fahrenheit and Degrees Celsius.



Temperature Mode (Typical)
Figure 9

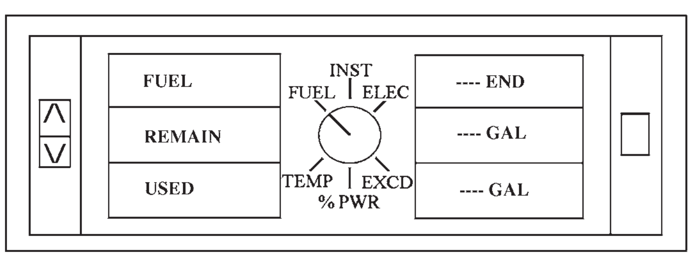
I. Fuel Mode

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.

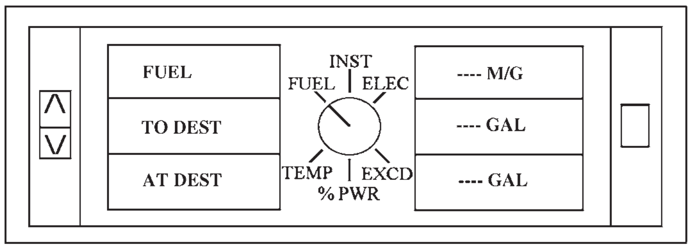
CAUTION: ALL OF THE FUEL CALCULATIONS ARE BASED ON THE MANUAL ENTRY OF THE PROPER FUEL LOAD AFTER REFUELING. FUEL LOAD MUST BE MANUALLY ENTERED INTO THE DDMP FOR IT TO FUNCTION PROPERLY. THERE IS NO CONSISTENCY CHECKING BETWEEN THE ENTERED FUEL LOAD AND THE ACTUAL FUEL QUANTITY.

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 10A):



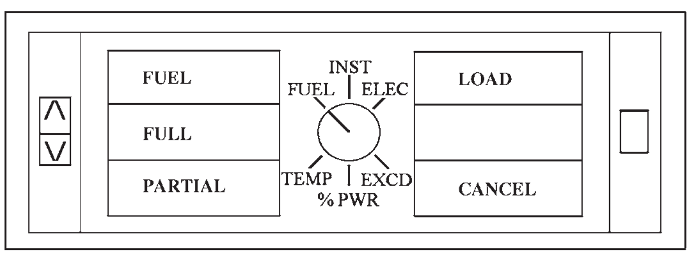
Fuel Remaining (Typical)
Figure 10A

Press SELECT to view the next screen (Figure 10B).



Fuel To Destination (Typical)
Figure 10B

Press SELECT to view the next screen (Figure 10C).



Fuel Load Entry (Typical)
Figure 10C

Press SELECT to return to the first screen (Figure 10A).

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.

5. RS-232 Interface (HP S/N’s 3246088 & up; 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.

To communicate/download information from the DDMP, proceed with the following:

A. Hyperterminal Setup:

The DDMP will communicate with any standard PC using the computer serial port, and any standard terminal emulation software such as MS Windows Hyperterminal, or Symantec ProComm.

The following procedure uses Windows Hyperterminal.

(1) Open the Windows Hyperterminal (normally located in the Start/Programs/Accessories Folder).
(2) Create a new connection titled “DDMP”.
(3) In the “Connect To” Window, change the “Connect Using” box the proper serial port (normally COM1).
(4) In the “COM1 Settings” Window establish the following settings:

9600 Baud
8 Data Bits
No Parity
1 Stop Bit
No Flow Control

(5) Under the File Drop-down Menu , select the “Properties” option.

(6) In the “DDMP Properties” Window, select the “Settings” Tab, and choose the “ASCII Setup” button.

(7) Under the “ASCII Receiving” section, check “Append Line Feeds to Incoming Line Ends”, and “Wrap Lines that Exceed Terminal Width”.

(8) Under the File Drop-down Menu , select the “Save” option.

B. Establishing Connection:

(1) Connect the Aircraft’s RS-232 port to the Computer’s Serial Port.

(2) Open the “DDMP” Connection in Hyperterminal.

(3) Apply Power to the DDMP.

(4) Press the Enter Key on the computer and the DDMP Menu should appear.

CHART 3 (Sheet 1 of 2)

INTEGRATED ENGINE INSTRUMENTATION CALIBRATION

NOTE: Fuel Quantity calibration specifications and procedures are in Section 28-40-00.

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	DEG C	-40	0	20	55		
		MAXIMUM OHMS		84.62	100.39	108.20	121.72		
		MINIMUM OHMS		83.84	99.61	107.42	120.93		
CAT	- 1.527 TO 2.229 mV (- 40 TO 55 °C)	TEST POINT	DEG C	-40	0	20	55		
		MAXIMUM DEG C		-37	3	23	58		
		MINIMUM DEG C		-43	-3	17	52		
VOLTS	10 TO 32 VDC	TEST POINT	VDC	10	16	22	28	32	
		MAXIMUM VDC		10.2	16.2	22.2	28.2	32.2	
		MINIMUM VDC		9.8	15.8	21.8	27.8	31.8	
AMPS	- 50 TO 50 mV	TEST POINT	AMPS	-99	-50	0	50	99	
		MAXIMUM mV		-48.5	-24	1	26	50.5	
		MINIMUM mV		-50.5	-26	-1	24	48.5	
MAP [1, 3]	1.0 TO 5.0 VDC (O TO 25 PSIA)	TEST POINT	IN HG(ABS)	10	20	30	38	42	
		MAXIMUM VDC		1.811	2.597	3.383	4.012	4.327	
		MINIMUM VDC		1.761	2.547	3.333	3.962	4.277	
RPM [1, 4]	12.50 HZ TO 67.50 HZ (500 TO 2700 RPM)	TEST POINT	RPM	500	1400	2000	2500	2700	
		MAXIMUM HZ		13.05	35.55	50.55	63.05	68.05	
		MINIMUM HZ		11.95	34.45	49.45	61.95	66.95	
TIT [1]	26.978 TO 40.581 mV (1200 - 1800 °F)	TEST POINT	DEC F	1200	1600	1650	1800		
		MAXIMUM DEG F		1216	1616	1666	1816		
		MINIMUM DEG F		1184	1584	1634	1784		
FUEL FLOW [1]	0 TO 285.745 HZ (0 TO 44 GPH)	TEST POINT	GPH	7.5	15	25	30	44	
		MAXIMUM HZ		56.138	107.538	173.148	204.700	288.605	
		MINIMUM HZ		50.418	101.818	167.428	198.980	282.885	
OIL TEMPERATURE	84.5 TO 140.86 OHMS (NON~LINEAR)	TEST POINT	DEG F	0	140	180	245	260	
		MAXIMUM OHMS		84.90	112.78	121.79	137.53	141.46	
		MINIMUM OHMS		84.10	111.78	120.79	136.53	140.26	
OIL PRESSURE	1.0 TO 4.867 VDC (0 TO 145 PSIG)	TEST POINT	PSI	0	25	55	95	115	145
		MAXIMUM VDC		1.039	1.706	2.506	3.572	4.106	4.906
		MINIMUM VDC		0.961	1.628	2.428	3.494	4.028	4.828
CHT	60.09 TO 143.8 OHMS (NON-LINEAR)	TEST POINT	DEG F	100	200	300	400	500	
		MAXIMUM OHMS		61.34	78.00	96.79	119.21	144.70	
		MINIMUM OHMS		59.59	76.27	95.39	117.61	142.90	

CHART 3 (Sheet 2 of 2)
INTEGRATED ENGINE INSTRUMENTATION CALIBRATION

INDICATOR TYPE	SENSOR FULL SCALE OUTPUT (UNLESS NOTED)	CALIBRATION POINTS EACH INDICATOR SHALL MEET THE CRITERIA SPECIFIED BELOW WITH ITS APPLICABLE SENDER UNIT							
VAC [5, 6]	4.000 TO 4.667 VDC (4.5 TO 5.5 IN HG)	TEST POINT	IN HG	4.5	4.8	5.0	5.2	5.5	
		MAXIMUM VDC		4.020	4.220	4.353	4.487	4.687	
		MINIMUM VDC		3.980	4.180	4.313	4.447	4.647	
VAC [5, 7]	3.667 TO 5.000 VDC (4.0 TO 6.0 IN HG)	TEST POINT	IN HG	4.0	4.4	5.0	5.4	6.0	
		MAXIMUM VDC		3.686	3.953	4.353	4.620	5.020	
		MINIMUM VDC		3.646	3.913	4.313	4.580	4.980	
MAP [2]	1.786 TO 3.752 VDC (10 TO 35 IN HG ABS)	TEST POINT	IN HG(ABS)	10	2.0	30	35		
		MAXIMUM VDC		1.806	2.592	3.378	3.772		
		MINIMUM VDC		1.766	2.552	3.338	3.732		
RPM [2, 8]	12.50 HZ TO 70.00 HZ (500 TO 2800 RPM)	TEST POINT	RPM	500	1400	2000	2500	2700	2800
		MAXIMUM HZ		13.08	35.58	50.58	63.08	68.08	70.58
		MINIMUM HZ		11.93	34.43	49.43	61.93	66.93	69.43
EGT [2]	22.255 TO 36.166 mV (1000 TO 1600 °F)	TEST POINT	DEG F	1000	1200	1400	1600		
		MAXIMUM DEG F		1016	1216	1416	1616		
		MINIMUM DEG F		984	1184	1384	1584		
FUEL FLOW [2]	0 TO 238.601 HZ (0 TO 36 GPH)	TEST POINT	GPH	7.5	15	25	30	36	
		MAXIMUM HZ		55.374	106.694	172.204	203.707	240.991	
		MINIMUM HZ		51.186	102.658	168.368	199.970	236.211	
FUEL QUANTITY		SEE SECTION 28-40-00							PIR-100930, Rev.W

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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GENERAL

100 Hour Inspection (See Figures 1 and 2.)

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.

NOTE: See the latest revision of AC 43.13-1 for additional information on inspecting exhaust systems and components.

The possibility of exhaust system failure increases with use. Check the system even more carefully as the number of hours increase; for example an inspection at the 700 hour period would be more critical than one in the 100 hour period. The system should also be checked carefully before winter operation when cabin heat will be used.

NOTE: Piper recommends that all airplanes be fitted with a new muffler at or near 1000 hours of service life.

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: When installing an exhaust clamp having an alignment pin be certain that the pin engages the mating holes in exhaust pipe and muffler to prevent separation of components.

A. Removal of the tail pipe and stacks are required for inspection of the muffler baffles.

B. Remove or loosen all exhaust shields, cabin heat shroud, heat blankets, etc., as required to permit inspection of the complete system.

C. Perform the necessary cleaning operations and inspect all external surfaces for dents, cracks and missing parts.

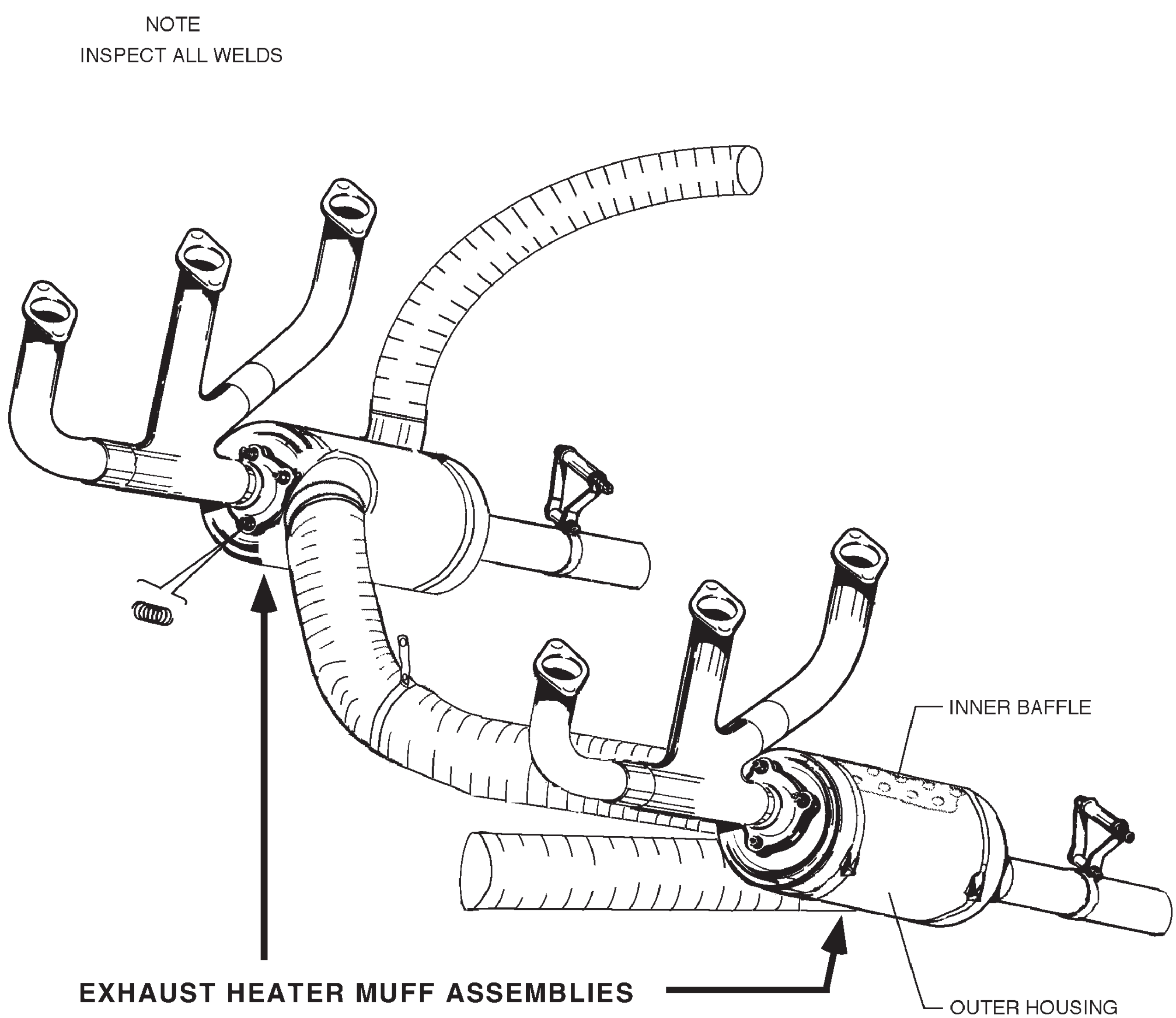
D. Pay particular attention to welds, clamps, supports and support attachment lugs, slip joints, stack flanges and gaskets.

E. Inspect internal baffles or diffusers. Any cracks, warpage or severe oxidation are cause for replacement of muffler or tail pipe assembly.

F. If any component is inaccessible for a thorough visual inspection, accomplish one of the following:

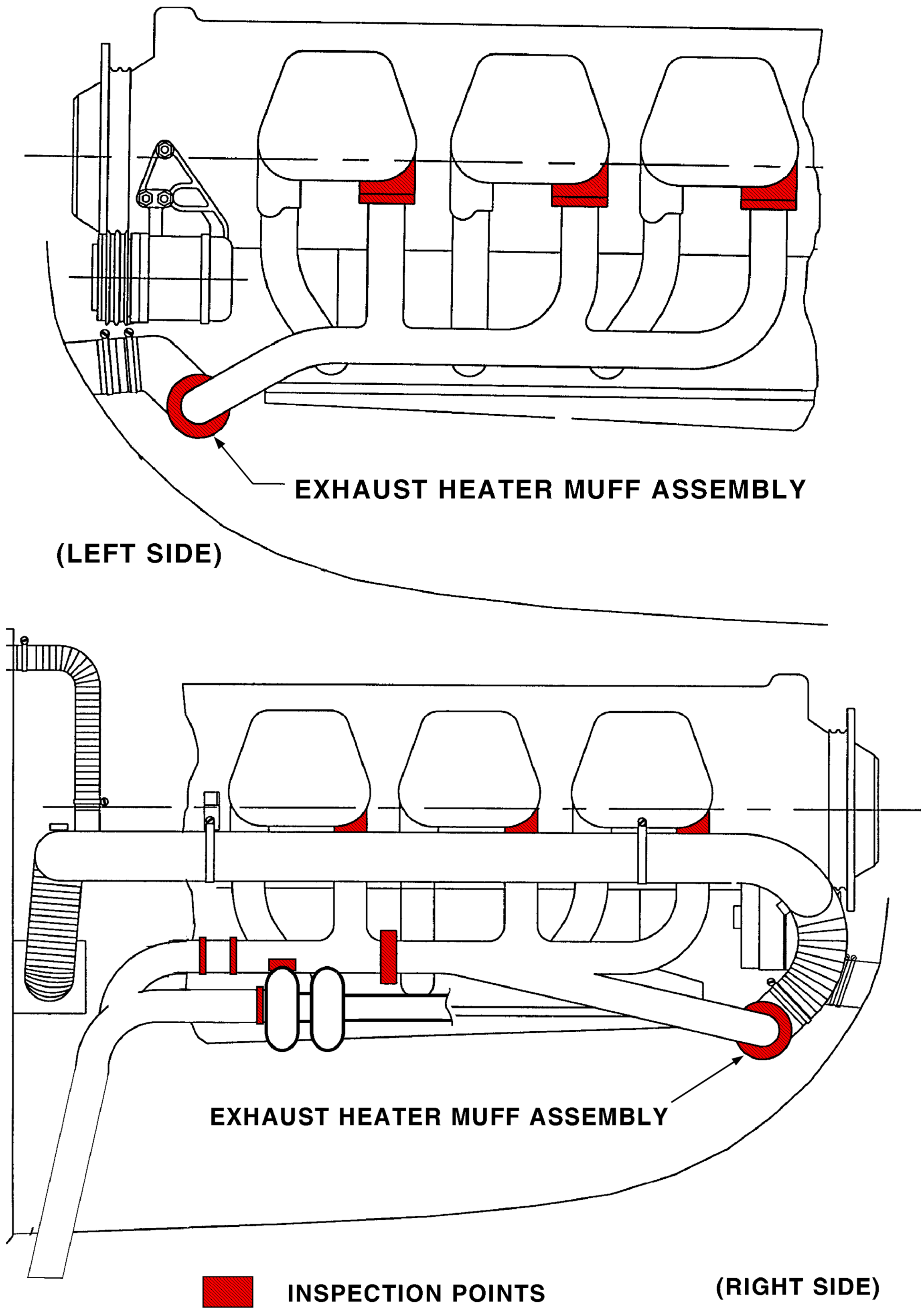
(1) Perform a submerged pressure check of the muffler and exhaust stack at 2 psi air pressure.

(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 must be replaced.



Effectivity
3246001 and up

Exhaust System Inspection Points
Figure 1 (Sheet 1 of 2)



Exhaust System Inspection Points
Figure 1 (Sheet 2 of 2)

Effectivity
3257001 and up

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OIL

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DISTRIBUTION

Oil Cooler

A. When installing fittings in the oil cooler, care should be used to prevent excessive torque being applied to the cooler. When a rectangular fitting boss is provided, backup wrench should be used, employing a scissor motion, so that no load is transmitted to the cooler. When the oil cooler has a round fitting boss. care should be taken not to permit excessive torque on the fittings.

B. If a pipe thread fitting is used, it should be installed only far enough to seal with sealing compound.

C. Apply Lubon No. 404 to all male pipe thread fittings; do not allow sealant to enter the system.

D. If fitting cannot be positioned correctly using a torque of 9 to 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

1. Oil Pressure

NOTE: In HP S/N's 3246088 & up and TC S/N's 3257001 & up, an electronic engine monitoring system is used. The Flightline/Horizon system incorporates 2-inch analog gauges, electronically actuated engine instruments, and a multi-function Digital Display Monitoring Panel (DDMP). This system is addressed in 77-40-00.

In HP S/N's 3246218 and up and TC S/N's 3257339 and up, for airplanes equipped with either the Avidyne Entegra EFIS or the Garmin 1000 EFIS, engine data is displayed on the Multi-Function Display (MFD) and Primary Flight Display (PFD). See the specific EFIS system in 34-20-00.

A. Gauge

(1) Description

In 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 and the cylinder head temperature gauges. This traditional 3-inch gauge will indicate the amount of oil pressure available at the oil pressure transducer (sensor).

(2) Troubleshooting

See Chart 1.

(3) Removal and Installation

See Face-mounted Instruments, 39-10-00.

CHART 1
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.

B. Transducer

In all installations, an oil line carries pressurized engine oil from the engine to the transducer which is mounted on the top right rear of the forward bulkhead, under the instrument panel.

(1) Removal

(a) Disconnect the two electrical leads.

(b) Unscrew the transducer from the T-fitting on the bulkhead.

(c) Catch spillage and cover hole to prevent foreign matter from entering oil line.

(2) Installation

(a) Seal transducer pipe threads with thread sealant tape.

(b) Screw the transducer into the bulkhead fitting.

(c) Reconnect the two electrical leads.

(d) Perform operational check.

2. Oil Temperature

NOTE: In HP S/N's 3246088 & up and TC S/N's 3257001 & up, an electronic engine monitoring system is used. The Flightline/Horizon system incorporates 2-inch analog gauges, electronically actuated engine instruments, and a multi-function Digital Display Monitoring Panel (DDMP). This system is addressed in 77-40-00.

In HP S/N's 3246218 and up and TC S/N's 3257339 and up, for airplanes equipped with either the Avidyne Entegra EFIS or the Garmin 1000 EFIS, engine data is displayed on the Multi-Function Display (MFD) and Primary Flight Display (PFD). See the specific EFIS system in 34-20-00.

A. Gauge

(1) Description

In 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 traditional 3-inch instrument will display a temperature indication of the engine oil in degrees Fahrenheit.

(2) Troubleshooting

See Chart 2.

(3) Removal and Installation

See Face-mounted Instruments, 39-10-00.

B. Bulb

A standard temperature bulb, located in the oil screen assembly on the engine accessory section, provides a signal to the gauge.

(1) Removal

(a) Remove safety wire from electrical connector and temperature bulb.

(b) Remove electrical connector.

(c) Unscrew and remove temperature bulb.

(2) Installation

(a) Screw in and tighten temperature bulb, then safety.

(b) Connect electrical connector and safety.

CHART 2
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.

GRIDS 7K18 THRU 8B24
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STARTING

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CRANKING

1. Cranking Limitations

Do not crank for more than ten (10) seconds. Allow twenty (20) seconds for cool-down between cranking attempts. Repeat no more than six (6) times. If start not achieved in the sixth attempt, let starter cool for thirty (30) minutes before reattempt.

2. Hartzell Engine Technologies (HET) Starter (aka Kelly Aerospace, Electrosystems, Prestolite)

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.)

Factory installed in HP S/N's 3246001 thru 3246087.

A. Description (See Figure 1.)

When the starting circuit is energized, battery current is applied to the starting motor terminal. Current flows through the field coils creating a strong magnetic field. At the same time, current also flows through the brushes and commutator, and finally through the armature to ground. The result is a high cranking torque, for a limited period of time, with a high current flow at a minimum loss of voltage.

The drive end gear of the armature mates with the reduction gear which drives the Bendix shaft. The Bendix drive is held in position on the shaft by a spiral pin. As the armature turns the reduction gear, the Bendix drive pinon meshes with the starter drive gear by inertia and action of the spiral grooves within the Bendix unit. A detent pin engages in a notch in the screw threads which prevents demeshing if the engine fails to start. When the engine does start and reaches a predetermined speed, centrifugal action forces the detent pin to release and allows the pinion to demesh from the starter drive gear.

B. Troubleshooting

See Chart 1.

NOTE: In Chart 1, for any remedy which requires disassembly and cleaning or repair of the starter; replacement with a new, or known good, unit is always an alternative solution.

NOTE: NEVER USE JUMPER CABLES to test voltage to the starter. The "toothed" jaws of jumper cables are meant to "bite" into soft, leaded terminals on car batteries, and simply WILL NOT provide enough contact with the starter terminal to supply the needed amperage to engage the starter properly.

NOTE: Use an analog voltage meter if you can. Digital meters take intermittent 'snap shots' of voltage. In situations where voltage is being supplied intermittently (even in rapid cycles), the digital meter will simply not provide the correct 'picture' of the aircraft's voltage situation.

C. Removal

CAUTION: TO PREVENT SHORT CIRCUITING, DISCONNECT THE GROUND CABLE FROM THE BATTERY BEFORE REMOVING THE STARTER FROM THE ENGINE.

(1) Disconnect ground (negative) cable from battery.

CAUTION: ROTATION OF THE STARTER POST WILL CAUSE INTERNAL DAMAGE TO THE STARTER. ALWAYS HOLD THE STARTER POST'S BOTTOM NUT IN PLACE WHEN TORQUING OR REMOVING THE TOP NUT.

(2) Disconnect the starter cable from the terminal post (or stud): Hold the bottom nut on the terminal (or starter) stud in place with a wrench to prevent the stud from rotating. Loosen the top nut.

(3) Remove one (1) each mounting bolt, internal tooth "star" lock washer, and flat washer; and three (3) each mounting nuts, internal tooth "star" lock washers, and flat washers.

(4) Lift off starter motor.

D. Installation

(1) Clean all traces of rust, corrosion, or dirt from all mounting surfaces and mounting hardware. All ground points or straps must be clean and tight.

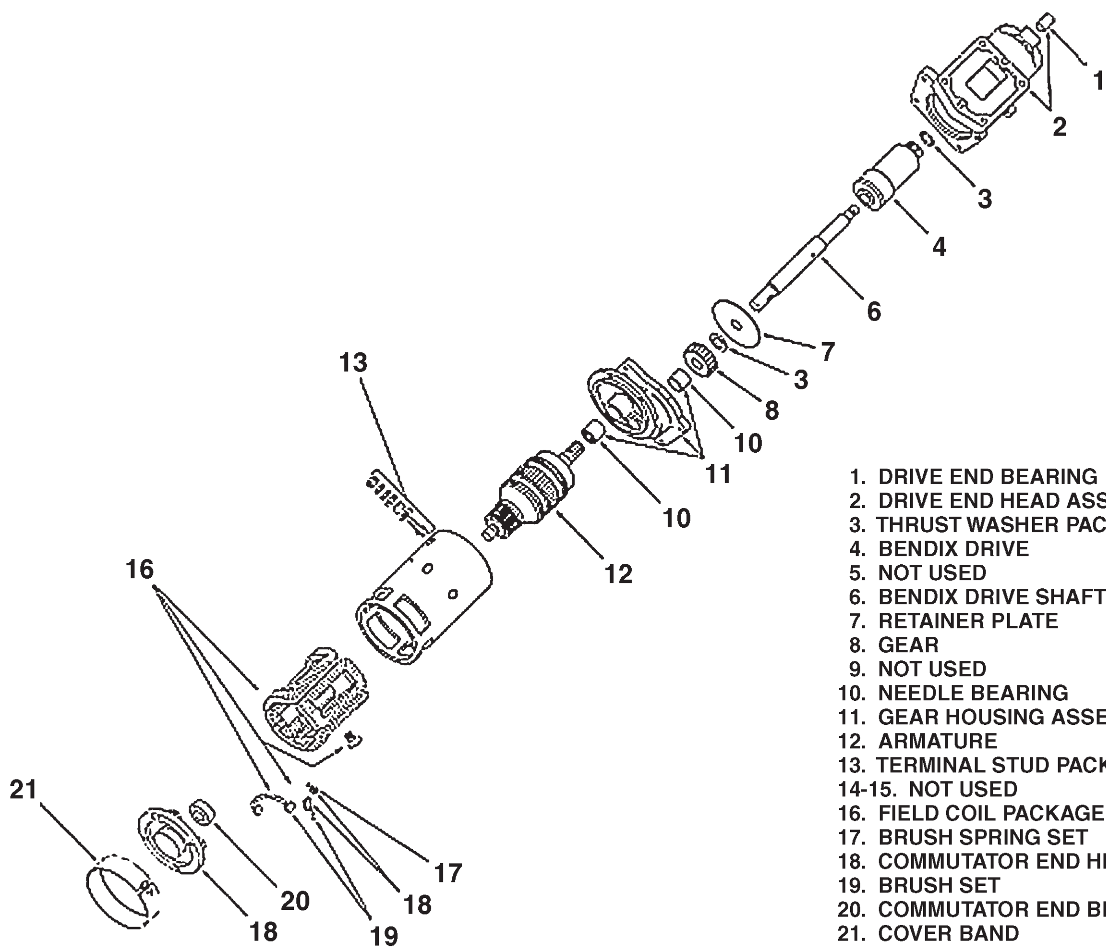
(2) Place starting motor in position with no stresses or binding forces being present and install three (3) each flat washers, internal tooth "star" lock washers, and mounting nuts; and one (1) each flat washer, internal tooth "star" lock washer, and mounting bolt. Torque bolt and nuts to 204 in.-lbs. or as specified in Lycoming SSP-1776.

CAUTION: ROTATION OF THE STARTER POST WILL CAUSE INTERNAL DAMAGE TO THE STARTER. ALWAYS HOLD THE STARTER POST'S BOTTOM NUT IN PLACE WHEN TORQUING OR REMOVING THE TOP NUT.

(3) Reinstall starter cable to starter terminal post (or stud): Hold the bottom nut on the terminal (or starter) stud in place with a wrench to prevent the stud from rotating. Tighten the top nut. Torque to 40 in.-lbs. or as specified in Lycoming SSP-1776.

(4) Reconnect negative (ground) cable to negative post of battery.

(5) Perform cranking tests, below.



1. DRIVE END BEARING
2. DRIVE END HEAD ASSEMBLY
3. THRUST WASHER PACKAGE
4. BENDIX DRIVE
5. NOT USED
6. BENDIX DRIVE SHAFT
7. RETAINER PLATE
8. GEAR
9. NOT USED
10. NEEDLE BEARING
11. GEAR HOUSING ASSEMBLY
12. ARMATURE
13. TERMINAL STUD PACKAGE
14-15. NOT USED
16. FIELD COIL PACKAGE
17. BRUSH SPRING SET
18. COMMUTATOR END HEAD ASSEMBLY
19. BRUSH SET
20. COMMUTATOR END BEARING
21. COVER BAND

Exploded View of Hartzell Engine Technologies (HET) Starting Motor
Figure 1

CHART 1 (Sheet 1 of 2)
TROUBLESHOOTING - HARTZELL ENGINE TECHNOLOGIES STARTER

Trouble	Cause	Remedy
Starter fails to operate.	Low battery charge.	Check and recharge if necessary.
	Defective or improper wiring or loose connections.	Refer to wiring diagram and check all wiring.
	Defective starter solenoid or control switch.	Replace faulty unit.
	Binding, worn, or improperly seated brush, or brushes with excessive side play.	Brushes should be a free fit in the brush boxes without excessive side play. Binding brushes and brush boxes should be wiped clean with a gasoline (undoped) moistened cloth. A new brush should be run in until at least 50% seated; however, if facilities are not available for running in brushes, then the brush should be properly seated by inserting a strip of No. 0000 sandpaper between the brush and commutator with the sanded side next to the brush.
	CAUTION: DO NOT USE COARSE SANDPAPER OR EMERY CLOTH.	
		Pull sandpaper in the direction of rotation, being careful to keep it in the same contour as the commutator.
	Binding, worn, or improperly seated brush, or brushes with excessive side play (continued).	After seating, clean thoroughly to remove all sand and metal particles to prevent excessive wear. Keep motor bearing free from sand or metal particles.
	Dirty commutator.	If commutator is rough or dirty, smooth and polish with No. 0000 sandpaper. If too rough and pitted, remove and turn down. Blow out all particles.

CHART 1 (Sheet 2 of 2)
TROUBLESHOOTING - HARTZELL ENGINE TECHNOLOGIES STARTER

Trouble	Cause	Remedy
Starter fails to operate. (continued)	Shorted, grounded, or open armature.	Remove and replace with an armature known to be in good condition.
	Grounded or open field circuit.	Test and then replace with new part.
Motor operates at proper speed but fails to crank.	Faulty Bendix drive.	Remove Bendix drive assembly. Clean and check engine. Reinstall.
Low motor and cranking speed.	Worn, rough, or improperly lubricated motor or starter gearing.	Disassemble, clean, inspect and relubricate, replacing ball bearings, if worn.
	See electrical causes listed under “Starter fails to operate,” above.	See remedies listed for “Starter fails to operate,” above.
Excessive arcing of motor brushes.	Binding, worn, or improperly seated brush or brushes, with excessive side play.	See information above dealing with this trouble.
	Dirty, rough, pitted or scored commutator.	Clean as outlined above.
Excessive wear and arcing of motor brushes.	Rough or scored commutator.	Remove and turn commutator down on the lathe.
	Armature assembly not concentric.	Reface commutator.

E. Cranking Tests

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

NOTE: NEVER USE JUMPER CABLES to test voltage to the starter. The “toothed” jaws of jumper cables are meant to “bite” into soft, leaded terminals on car batteries, and simply WILL NOT provide enough contact with the starter terminal to supply the needed amperage to engage the starter properly.

NOTE: Use an analog voltage meter if you can. Digital meters take intermittent ‘snap shots’ of voltage. In situations where voltage is being supplied intermittently (even in rapid cycles), the digital meter will simply not provide the correct ‘picture’ of the aircraft’s voltage situation.

The starting circuit should be inspected at regular intervals. The frequency should be determined by the type of starting conditions and the amount of starter usage. In any case, it is recommended that the following tests be conducted each six months or every 100 hours time-in-service.

(1) Check the battery with a hydrometer to make sure it is fully charged and filled to the proper level. A load test should be made on the battery to verify proper condition before proceeding.

(2) Check all starter circuit wiring, making sure all connections, including battery terminals, are clean and tight and that all insulation is sound and complete.

(3) A voltage loss test should be made to locate any high-resistance connections that would impair starting motor electrical efficiency. Using a low-reading voltmeter scale while cranking engine (or at approximately 100 amperes current flow) measure for the following limits:

   (a) Voltage loss from the insulated (positive) battery post to the starter motor terminal = 0.3 volt maximum.

   (b) Voltage loss from the battery negative (ground) terminal to the starter motor frame = 0.1 volt maximum.

   NOTE: If voltage loss exceeds the above limits, measure the voltage drops across all connections to discover the faulty connection. When within the maximum limits proceed to next step.

(4) The starter motor should be operated for several seconds with the ignition OFF. The starter motor engagement should be prompt and the motor should turn freely at a uniform speed without binding or producing unusual sounds.

(5) Re-engage the starter two or three times, listening for prompt engagement, without the clashing of gears, and to determine that the pinion disengages properly when the starter switch is released.

F. Bench Tests (See Figures 2 and 3.)

(1) No-Load Test

(a) Connect as shown in Figure 2.

(b) Current measured on voltmeter should be within specifications shown in Chart 2. If current is too high, the bearings may be mis-aligned or end play may be unacceptable. Two or three sharp raps on the frame with a rawhide hammer will often help to align the bearings and free the armature.

(c) If the starter passes the No-Load Test, proceed to the Stall-Torque Test, below.

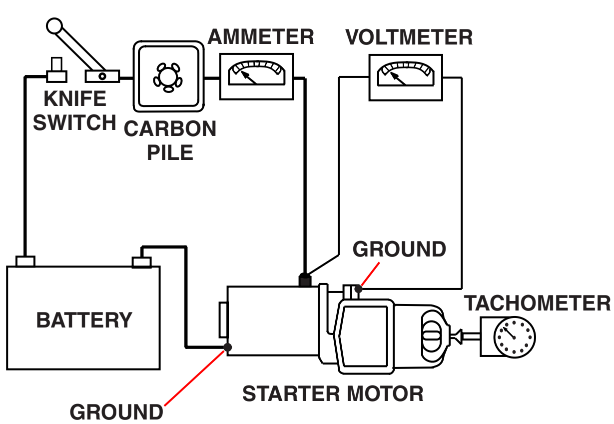
(2) Stall-Torque Test

To see if the starter is producing its rated cranking power:

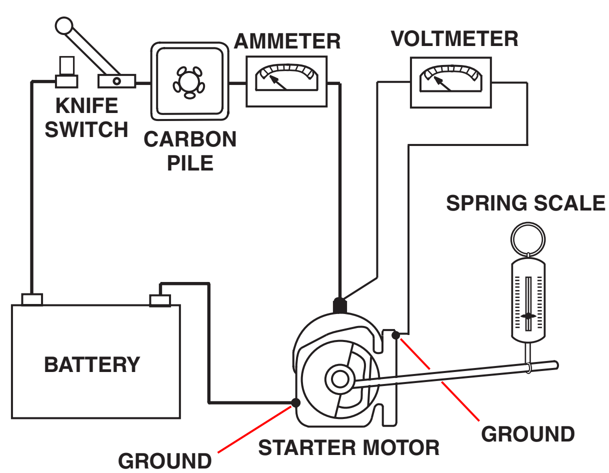
(a) Make test connections and set-up as shown in Figure 3.

(b) See specifications in Chart 2.

(3) If torque and current are not within specifications, overhaul or replace the starter.



No Load Current Test
Figure 2



Stall Torque Test
Figure 3

CHART 2
HARTZELL ENGINE TECHNOLOGIES STARTER SERVICE TEST SPECIFICATIONS

Motor Model	MZ-4206	MHB-4016
Min Brush Tension Max Brush Tension	32 oz 40 oz	32 oz 40 oz
No-Load Test (75° F:) Volt Max Amps Min rpm	 10 75 I600	 20 35 1300
Stall Torque Amps Min Torque, ft lbs Approx Volts	 560 37.5 4.0	 260 Maximum 27 14

3. Sky-Tec Starter (See Figure 4)

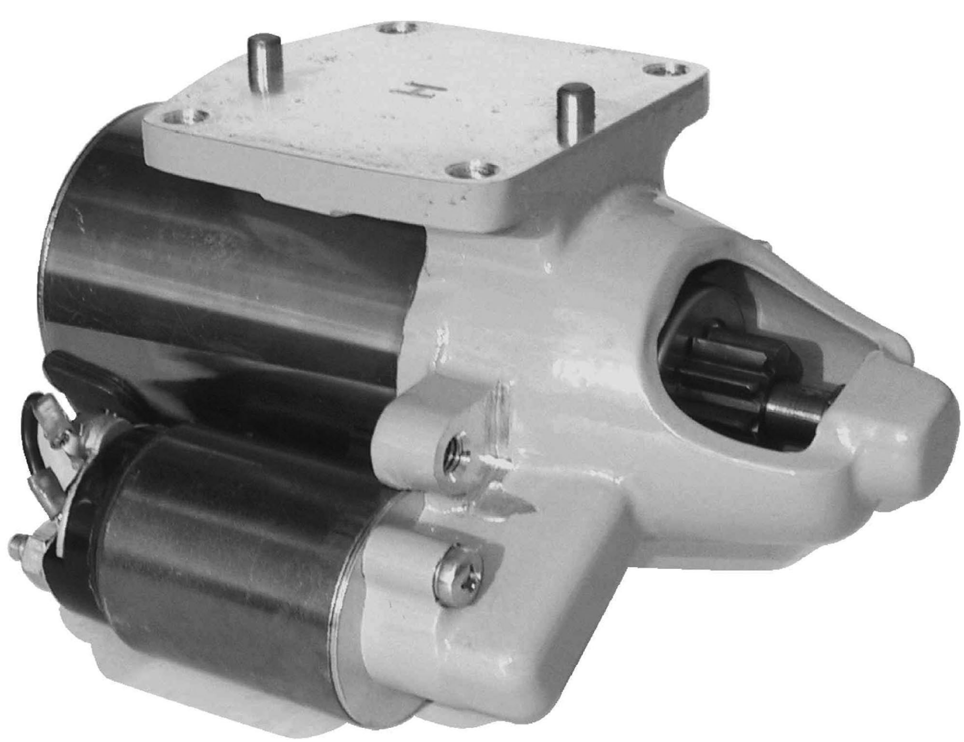
   Factory installed in HP S/N's 3246088 and up; and TC S/N's 3257001 and up.

   A. Description

      The Sky-Tec 149-24PM high-performance starters have significant differences from the earlier starters made by Kelly Aerospace, Electrosystems, and Prestolite. The Sky-Tec starters use a more modern, more reliable, bendix-free, design. The recommended TBO is 2700 hours. Engine cranking speed may be up to twice as fast as with previous starters. The lightweight of these starters does, however, provide less mass to extract heat from starter components. Accordingly, strict adherance to cranking limitations, above, is essential to prevent overheating.

   B. Troubleshooting

      See Chart 3.



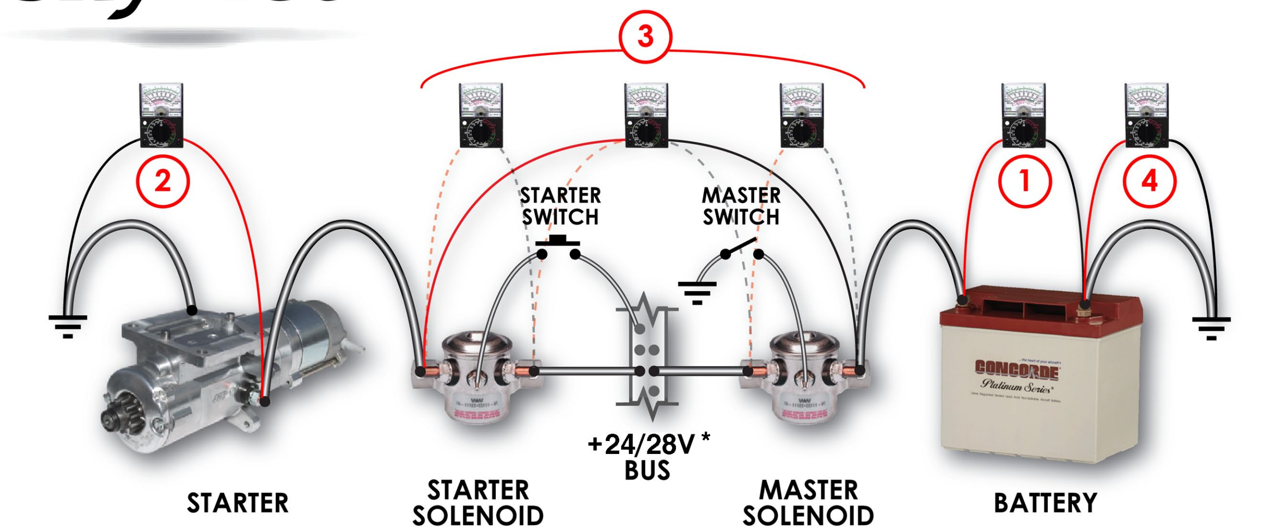
Sky-Tec High-Torque Starter
Figure 4

CHART 3
TROUBLESHOOTING - SKY-TEC STARTER

Sky Tec

AIRCRAFT STARTING SYSTEM TROUBLESHOOTING GUIDE

REV_3.0



IMPORTANT NOTES: DO NOT REMOVE THE STARTER FROM THE AIRCRAFT TO PERFORM TESTING! For accuracy and relevance, starter testing should be conducted in the aircraft while the starter is in its failure mode. Please do NOT use jumper cables to test starters - it will not provide useful information. Use an analog voltmeter if at all possible. An ohmmeter will not provide useful information - keep it simple & follow these easy steps:

Pretest Considerations: If possible, visually inspect the starter and/or interview pilot/operators for starting history. Indications of long cranking periods, burning odor or smoke from the starter, kickback(s), a cracked starter mount, a fast spinning starter w/no prop movement, oil in starter, grinding noise or a damaged ring gear are generally indications that the starter is in need of repair and the following tests will not be helpful. Remove the starter for repair or overhaul.

Testing Relevance: The following testing procedure is most relevant to starters that are low performing including slow cranking and/or failure to crank the engine over a compression stroke. If a starter is damaged by overcranking or a stuck firewall solenoid, voltage in step one may read below acceptable levels thus incorrectly indicating a potential battery problem. Therefore, in such cases some consideration must be to the pretest conditions noted above (if it smells burned...). If the only effect of energizing the starter results only in an audible "click" with no prop movement, confirm step 2 to isolate problem to starter or starter contactor.

	TEST	RECORD	RESULT	ANALYSIS
STEP 1	Record voltage at the battery while cranking the starter in its failure mode.	____ VOLTS	Below 20.0* volts? Above 20.0* volts? - Proceed to Step 2	Questionable battery. See Testing Relevance above as a shorted (cooked) starter will pull voltage down appreciably. However, if starter rotates at all, this is generally not a shorted starter condition.
STEP 2	Record voltage at the starter while cranking the starter in its failure mode.	____ VOLTS	No voltage recorded	Starter OK. Test Starter Solenoid or switch (Step 3)
			Above 18.0* volts?	Suspect Starter.
			Below 18.0* volts and: - Difference between Step 1 and Step 2 exceeds 4.0* volts	Suspect Cables, terminals and/or solenoids - proceed to Steps 3 & 4
			- Difference between Step 1 and Step 2 less than 4.0* volts	Borderline Condition - Call Sky-Tec with test results to discuss. If happens more when cold, suspect battery. When hot, suspect cables/terms/sols.

* Halve all voltages for 12/14 volt systems.

OPTIONAL:

	TEST	ANALYSIS
STEP 3	Record voltages between each and every cable terminal and across solenoids while cranking the starter in its failure mode.	Assuming the voltage difference noted in Step 2 exceeded 4.0* volts, flush out any appreciable loss in voltage in any cable or solenoid by placing the meter along each link in the diagram. A tight electrical system will lose no more than 0.5 volts between the battery and starter. Be sure to conduct these tests while cranking the starter in its failure mode.
STEP 4	Record voltages between battery & ground and starter & ground while cranking the starter in its failure mode.	If no appreciable loss of voltage is noted in Step 3, flush out the integrity of all electrical system grounds. Pay close attention to battery and engine grounds. Clean up or repair any questionable ground connections and re-test.

C. Installation as a Service Replacement

Engines with high-time magnetos and weak electrical systems should be thoroughly inspected prior to installing any lightweight, high-torque starter. Failure to do so may make your aircraft susceptible to poor starter performance or damage from kickbacks.

(1) Inspect the Magneto system thoroughly.

Make sure that the magnetos are in compliance with all service bulletins. Make sure that the magneto impulse coupling is within service specifications. Check the impulse couplers prior to attempting even a single start.

(2) Inspect the voltage supply system.

If the Sky-Tec starter fails to turn the engine significantly faster than the OEM starter, immediately inspect the aircraft's voltage supply system. Lightweight starters can require as much as 45% more output from the battery – or as many as 300 Amps during initial cranking.

(3) Troubleshoot the entire voltage system

All Sky-Tec starters are tested to verify power output before leaving the factory. If a new starter does not spin quickly or seems weak, see Chart 3. Do not return a "weak" starter without first completing the troubleshooting procedure in Chart 3.

(4) Replace hardware.

(a) Replace all washers with four (4) AN936-516 internal star lock washers or AN split-type lock washers. Do not use flat washers.

(b) In some cases, the stock 5/16 in. bolt may be too long. If so, replace with shorter bolt of same type and strength.

D. Removal

CAUTION: TO PREVENT SHORT CIRCUITING, DISCONNECT THE GROUND CABLE FROM THE BATTERY BEFORE REMOVING THE STARTER FROM THE ENGINE.

(1) Disconnect ground cable from battery.

(2) Disconnect starter cable from power terminal post.

(3) Remove one (1) each mounting bolt and internal tooth "star" lock washer, and three (3) each mounting nuts and internal tooth "star" lock washers.

(4) Lift off starter motor.

E. Installation

(1) Clean all traces of rust, corrosion, or dirt from all mounting surfaces and mounting hardware. All ground-points or straps must be clean and tight.

(2) Place starting motor in position with no stresses or binding forces being present and install three (3) each internal tooth "star" lock washers and mounting nuts, and one (1) each internal tooth "star" lock washer and mounting bolt. Torque bolt and nuts to 100 in.-lbs.

NOTE: Stock AN split-type lock washers may be used in place of the internal tooth "star" lock washers.

CAUTION: TAKE CARE NOT TO OVER-TORQUE THE POWER TERMINAL POST NUT. THE POWER TERMINAL POST IS COPPER AND CAN EASILY BE STRIPPED.

(3) Reinstall starter cable to power terminal post using an internal tooth "star" lock washer or split lock washer, as desired. Torque the power terminal post nut to 50 to 60 in.-lbs. and reinstall terminal nipple.

(4) Reconnect ground cable to negative post of battery.

4. Starter Control Circuit

   A. Inspect the control circuit wiring between the battery, solenoid and manual starting switches for breaks, poor connections and faulty insulation. Tighten all connections and make sure solenoid is firmly mounted and makes a good ground connection.

   B. Check the voltage loss across the switch contacts during normal starting. If loss is in excess of 0.2 volts per 100 amperes, the solenoid should be replaced.

   C. If solenoid fails to operate when the manual starting switch is turned on or if it fails to release when the manual starting switch is released, it should be removed and tested to specifications, if available. If either opening or closing voltages are not to specifications, or tests cannot be performed, replace the solenoid.

5. Starting with External Power

   See 24-40-00.

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CHAPTER

81

TURBINES

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CHAPTER 81

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CHAPTER 81 - TURBINES

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TURBO - SUPERCHARGER

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

1. Description

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, with the exception of routine inspections as specified in 5-20-00. Should trouble occur, refer to the Troubleshooting, below, and seek out the possible cause. Do not break the clamp seal joining the turbine and compressor units.

2. Troubleshooting

Troubles peculiar to the turbocharger are listed in Chart 1 along with their probable causes and suggested remedies.

CHART 1 (Sheet 1 of 2)
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 screen.
		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.
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.
	Wastegate butterfly not closing.	Butterfly shaft binding. Check bearings.
	Turbocharger impeller binding, frozen or fouling housing.	Check bearings. Replace turbocharger.

CHART 1 (Sheet 2 of 2)
TROUBLESHOOTING TURBOCHARGER

Trouble	Cause	Remedy
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.		
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: A 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.

3. Nomenclature

The following is a list of commonly used terms that apply to turbocharging.

Term	**Definition**
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.”
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.

NOTE: Refer to the latest revision of Lycoming Service Bulletin No. 369 for recommended engine inspections after any Overspeed or Overboost conditions.

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 cause the exhaust gas to change slightly, which causes the turbine speed to change slightly, which causes the compressor air to the engine to change slightly, which in turn again affects the exhaust gas, etc.
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.

4. Turbocharger (See Figures 1 and 3.)

A. Removal

(1) Remove the engine cowling. (Refer to 71-10-00.)

(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. 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

(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.

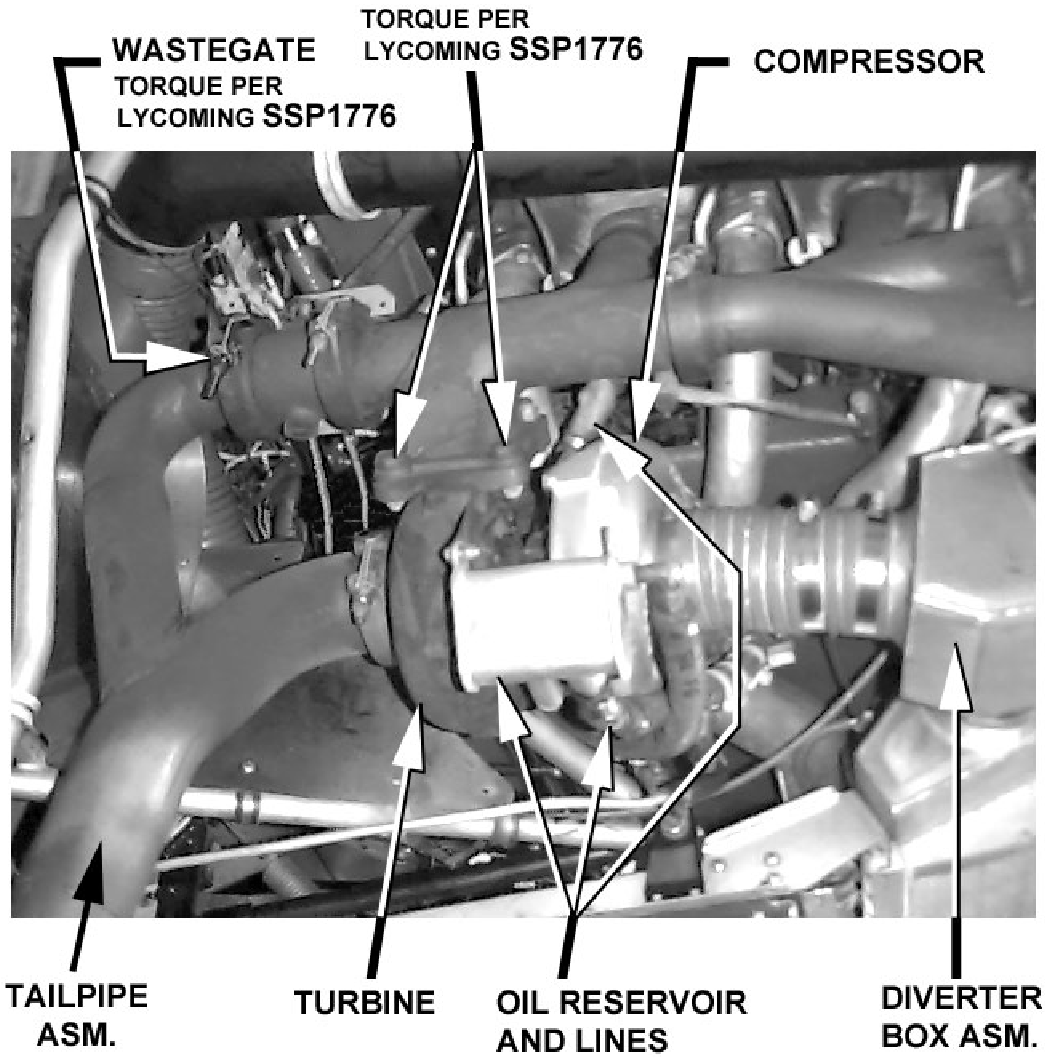
(7) Fill engine and oil inlet line with new, clean lubricating oil, and connect line.

(8) Connect the oil supply and return lines to the turbocharger center section.

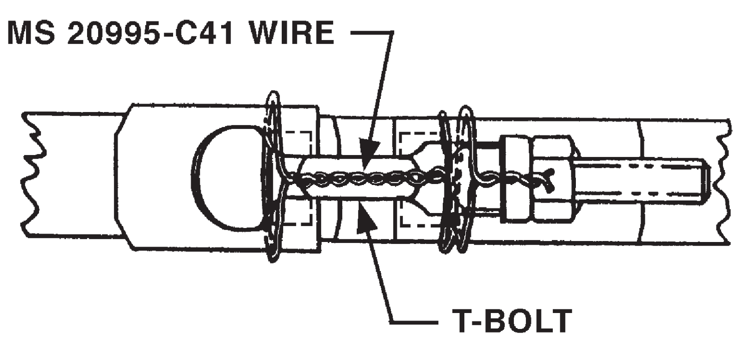
(9) Install the engine cowling. (Refer to 71-10-00.)

D. V-Band Coupling 100 Hour Inspection (See Figure 2.)

Each 100 hours, inspect lockwiring on V-band couplings for condition and security. If lockwiring is found broken, inspect T-bolt for stretching, cracking, or any other damage. Replace coupling as required.



Turbocharger Installation
Figure 1



Lockwiring V-Band Couplings
Figure 2

E. 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 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.

5. Exhaust Wastegate Assembly (See Figure 3.)

A. Removal

(1) Remove engine cowling. (Refer to 71-10-00.)

(2) Remove nut, bolt and washers securing wastegate actuator rod to wastegate control arm.

(3) Remove V-band clamps securing wastegate to exhaust transition and tailpipe.

B. Installation

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.

(1) Install wastegate assembly with gasket between exhaust transition and tailpipe.

(2) Secure wastegate with V-band clamps. Torque clamps to specifications given in Lycoming Special Service Publication (SSP) 1776, Table of Limits, and safety.

(3) Secure the wastegate actuator rod to the control arm with the appropriate washers, bolt and nut.

C. Adjustment (See Figures 3 and 4.)

The exhaust wastegate (butterfly) valve is mechanically linked to a hydraulically-driven servo by the wastegate actuator rod. The butterfly valve/actuator rod orientation is set at the factory, but may occasionally require adjustment in the field.

(1) Remove the engine cowling as described in 71-10-00.

(2) Remove the clamp securing the tailpipe assembly to the wastegate and separate wastegate and tailpipe assembly (separate sufficiently to access the butterfly valve within the wastegate).

(3) Place the shank end of a #20 drill bit between the inner wall of the wastegate assembly and the butterfly valve (Figure 4).

(4) 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.

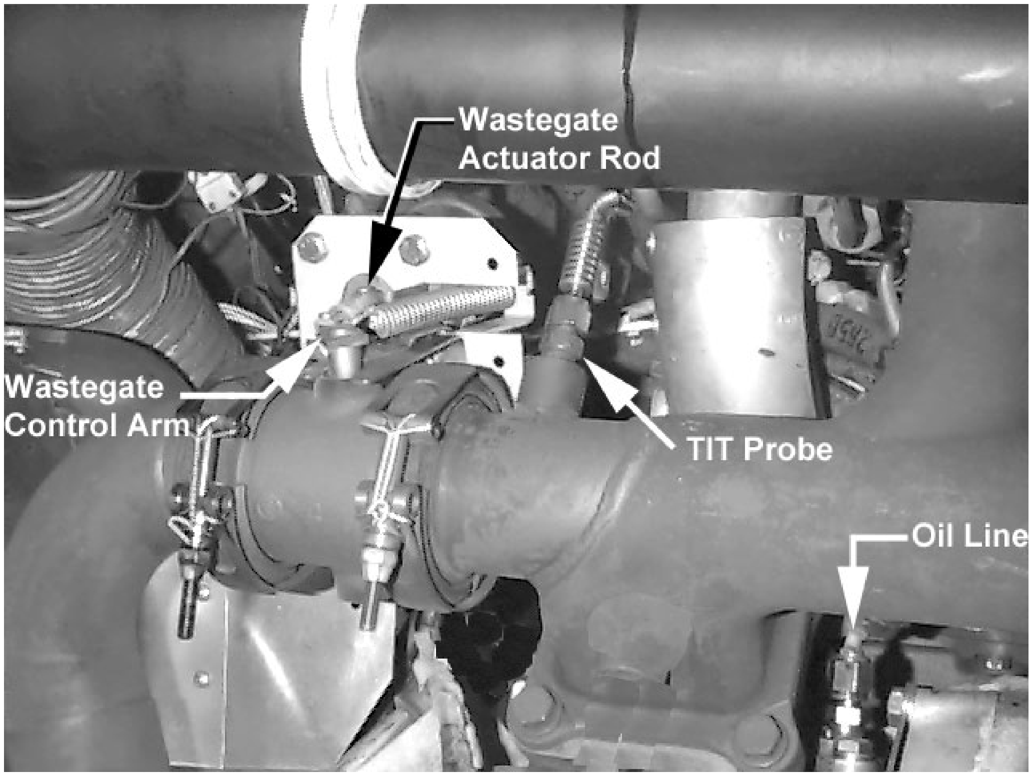
(5) Place the tailpipe assembly in position and secure with the appropriate clamps.

(6) Install upper and lower cowling as described in 71-10-00.

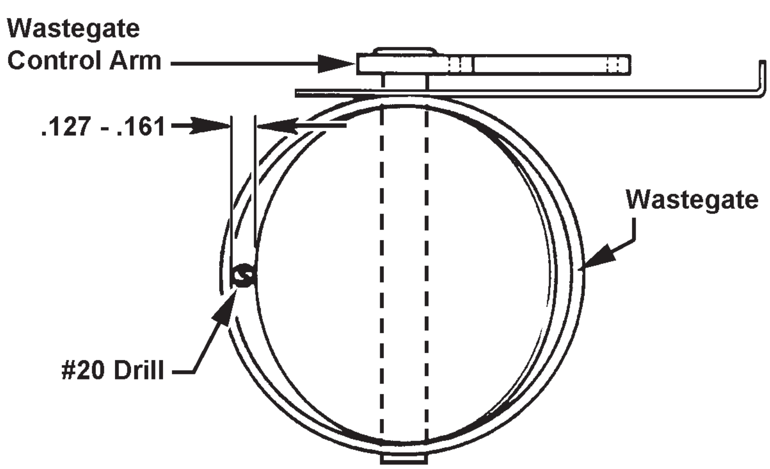
(7) Flight test the aircraft to determine critical altitude (12,000 feet minimum) at MAX power of 2500 RPM and 38 inches Hg.

NOTE: See also Full Power Performance, 73-20-00.

(8) If the above criteria is not met, further ground adjustment of the wastegate will be required.



Wastegate Installation
Figure 3



Wastegate Adjustment
Figure 4

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CHAPTER

91

CHARTS & WIRING DIAGRAMS

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	2	Jun 30/07		7	Jun 30/07
	3	Jun 30/07		8	Jun 30/07
	4	Jun 30/07		9	Jun 30/07
				10	Jun 30/07
91-24-60	1	Jun 30/07		11	Jun 30/07
	2	Jun 30/07		12	Jun 30/07
91-25-60	1	Jun 30/07	91-32-30	1	Jun 30/07
	2	Jul 31/13		2	Jun 30/07
	3	Jul 31/13			
	4	Jul 31/13	91-32-60	1	Jun 30/07
				2	Jun 30/07
91-27-30	1	Jun 30/07		3	Jun 30/07
	2	Jun 30/07		4	Feb 28/09
91-27-50	1	Jun 30/07			
	2	Jun 30/07			
	3	Jun 30/07			
	4	Jun 30/07			
91-28-20	1	Jun 30/07			
	2	Jun 30/07			

CHAPTER 91

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	2	Jun 30/07
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	13	Jun 30/07
	14	Jun 30/07
	15	Jun 30/07
	16	Jun 30/07
	17	Jun 30/07
	18	Jun 30/07
	19	Jun 30/07
	20	Jun 30/07
	21	Jun 30/07
	22	Jun 30/07
91-33-40	1	Jun 30/07
	2	Jun 30/07
	3	Jun 30/07
	4	Jun 30/07
	5	Jun 30/07
	6	Jun 30/07
	7	Jun 30/07
	8	Jun 30/07
	9	Jun 30/07
	10	Jun 30/07
	11	Jun 30/07
	12	Jun 30/07
91-34-10	1	Jun 30/07
	2	Jun 30/07
91-34-20	1	Jun 30/07
	2	Jun 30/07
	3	Jun 30/07
	4	Jun 30/07
	5	Jun 30/07
	6	Jun 30/07
	7	Jun 30/07
	8	Jun 30/07
	9	Jun 30/07
	10	Jun 30/07
	11	Jun 30/07
	12	Jun 30/07
	13	Jun 30/07
	14	Jun 30/07
91-34-40	1	Jun 30/07
	2	Jun 30/07
	3	Jun 30/07
	4	Jun 30/07
	5	Jun 30/07
	6	Jun 30/07
91-34-50	1	Jun 30/07
	2	Jun 30/07
	3	Jun 30/07
	4	Jun 30/07
	5	Jun 30/07
	6	Jun 30/07
	7	Jun 30/07
	8	Jun 30/07
	9	Jun 30/07
	10	Jun 30/07
	11	Jun 30/07
	12	Jun 30/07
	13	Jun 30/07
	14	Jun 30/07
	15	Jun 30/07
	16	Jun 30/07

CHAPTER 91

LIST OF EFFECTIVE PAGES (continued)

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	4	Jun 30/07			
91-74-30	1	Jun 30/07			
	2	Jun 30/07			
91-77-10	1	Jun 30/07			
	2	Jun 30/07			
	3	Jun 30/07			
	4	Jun 30/07			
91-77-20	1	Jun 30/07			
	2	Jun 30/07			
	3	Jun 30/07			
	4	Jun 30/07			
	5	Jun 30/07			
	6	Jun 30/07			
	7	Jun 30/07			
	8	Jun 30/07			
	9	Jun 30/07			
	10	Jun 30/07			
	11	Jun 30/07			
	12	Jun 30/07			
91-77-40	1	Jun 30/07			
	2	Jun 30/07			
91-79-30	1	Jun 30/07			
	2	Jun 30/07			
	3	Jun 30/07			
	4	Jun 30/07			
91-81-10	1	Jun 30/07			
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	4	Jun 30/07			
	5	Jun 30/07			
	6	Jun 30/07			

CHAPTER 91 - CHARTS AND WIRING DIAGRAMS

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CHAPTER 91 - CHARTS AND WIRING DIAGRAMS

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CHARTS

1. Torque Requirements

(PIR-PPS20015-1, Rev. AD.)

CAUTION: DO NOT OVERTORQUE FITTINGS.

Chart 1 lists the torque values for flared fittings of various sizes and material.

NOTE: When installing flared fittings, verify that male threads are properly lubricated.

The torque values given in Chart 2 are derived from oil-free cadmium-plated threads and are recommended for all airframe installation procedures where torquing is required, unless other values are specified in subject chapter/section. Engine torque values are found in the latest revision of Lycoming Service Table of Limits SSP-1776 and propeller torque values are found in 61-10-00.

NOTE: All torque values given are installation torques for installation purposes only and shall not be construed as retained torque.

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.

A. Calibrate the torque wrench periodically to assure accuracy, and recheck frequently.

B. If the fastener, screw, or nut is listed in Chart 2, but the mating fastener is not listed, tighten only to the low end of the torque range specified for the listed fastener. In addition, the following limitations shall apply:

(1) Fastener and nut threads shall be clean and dry (free of lubricants). If the subject chapter/section requires the fastener and/or nut to be lubricated prior to tightening and does not specify a torque requirement, use the Chart 2 torque range reduced 50 percent.

(2) Chart 2, Sheet 1, shall be used for free running nuts, provided minimal friction drag is determined as specified below.

CHART 1
FLARE FITTING TORQUE VALUES

(PIR-AC65-9A.)

Torque — Inch-Pounds						
Tubing OD Inches	Aluminum Alloy Tubing		Steel Tubing		Hose End Fitting and Hose Assemblies	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
1/8	20	30	———	———	———	———
3/16	30	40	90	100	70	120
1/4	40	65	135	150	100	250
5/16	60	85	180	200	210	420
3/8	75	125	270	300	300	480
1/2	150	250	450	500	500	850
5/8	200	350	650	700	700	1150
3/4	300	500	900	1000	———	———
7/8	500	600	1000	1100	———	———
1	500	700	1200	1400	———	———
1-1/4	600	900	———	———	———	———
1-1/2	600	900	———	———	———	———

(3) The friction drag torque can be determined as follows: Run the nut down to near contact (but not in contact) with the bearing surface and check the “friction drag torque” required to turn the nut.

NOTE: Check 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.)

(4) The friction drag torque (if any) shall be added to the desired torque specified in Chart 2, Sheet 1. This final torque should register on the indicator or be the setting for a snap-over torque limiting device.

(5) Torque requirements do not apply to cross recessed or slotted screws or to fasteners installed into rivnuts, pressnuts or other nuts not designed to rotate for wrenching at the fastener unless otherwise specified in the subject chapter/section.

(6) Fasteners listed in Chart 2 installed into nutplates, and which are accessible to be torqued at the fastener, must be tightened to the low end of the torque range specified in the appropriate “shear” column.

NOTE: When the fastener is stationary and the nut is torqued, use the lower side of the torque range.

When the nut is stationary and the fastener is torqued, use the higher side of the torque range. In this case, ensure one (1) washer is installed under the head as follows:

(a) If the subject chapter/section does not specify the use of a washer under the head, install one (1) NAS1149 .032 thick washer under the head. If additional washers are required under nut to adjust for grip length variation as described under Threaded Fastener Installation in 20-00-00: reduce them .032 to allow for the additional .032 washer now installed under head. Check to ensure threads are not bearing loads, due to the added .032 washer thickness.

(b) All added washers are to be of the correct diameter, material and finish that matches the fastener being installed.

(7) Apply a smooth even pull when applying torque pressure. If chattering or a jerking motion occurs during final torque, back off and re-torque.

(8) When installing a castellated nut, start alignment with the cotter pin hole at minimum recommended torque, and do not exceed maximum recommended torque. If the hole in the fastener shank and the nut castellation do not align within this range, change washers and try again. Do not exceed the maximum recommended torque. If self-locking castellated nuts are used, include friction drag torque.

(9) Unless otherwise specified in the subject chapter/section, when castellated nuts are used with a cotter pin on moving joints, the nut shall not be torqued to Chart 2 values. Nuts shall be tightened to remove looseness in the joint and then the cotter pin installed.

C. Gap Conditions Between Parts Attached with Threaded Fasteners

If a gap condition exists between mating parts where a threaded fastener is to be installed, install fasteners and associated hardware per subject chapter/section or to buildup noted during removal. Then, torque to a value 10% of the final torque required plus the friction drag torque.

For example, if Chart 2, Sheet 2, torque is 190 in.-lbs. and the friction drag torque of the nut is 80 in.-lbs. (i.e. - Chart 2, Sheet 2, torque minus Chart 2, Sheet 1, torque), torque to a value of:

Maximum Permissible
Gap Closing Torque = (Chart 2, Sheet 1, torque x .10) + (Sheet 2 - Sheet 1) torque

Example: 3/8-24 (190 x .10) + (270-190) = 19 + 80 = 99 in.-lbs.

NOTE: If the Chart 2, Sheet 1, torque requirement exceeds the final torque specified in the subject chapter or section (if any), use the torque specified in the subject chapter or section to calculate the maximum permissible gap closing torque.

Accomplish this for all fasteners common to the gapped interface. If no gap exists after accomplishing the above, finish torquing to final torque. If a gap remains consult your Piper Dealer's Service Advisor (DSA) for further assistance.

D. After the final torque, apply a slippage mark to the nut or bolt or screw head as applicable.

NOTE: For more details on torquing, refer to FAA AC 43.13-1, latest revision.

2. Conversion Tables

The following charts contain various conversion data that may be useful when figuring capacities, lengths, temperatures, and various weights and measures from the English system to the metric system or back again:

Chart 3, Torque Conversion

Chart 4, Decimal Conversions

Chart 5, Temperature Conversion

Chart 6, Weights and Measures Conversion

Chart 7, Metric Conversion

Chart 8, Drill Sizes

3. Hose Specifications

See Chart 9.

4. Consumable Materials

See Chart 10.

5. Vendor Contact Information

See Chart 11.

6. Electrical Wire Coding

See Chart 12.

7. Electrical Symbols

See Chart 13.

8. Electrical / Electronic Component Reference Designation Code

See Chart 14.

CHART 2 (Sheet 1 of 2)
RECOMMENDED NUT TORQUES

	Bolts - Steel								Bolts - Aluminum			
	AN 3 thru AN 20 AN 42 thru AN 49 AN 386 AN 525 MS 20033 thru MS 20046 MS 20073 MS 20074 MS 24694 MS 27039				MS 20004 NAS 333 thru NAS 340 NAS 464 NAS 624 thru NAS 644 NAS 1580 NAS 6203 thru NAS 6220 NAS 6603 thru NAS 6620 NAS 6703 thru NAS 6720				AN 3DD Series			
	Nuts - Steel								Nuts - Aluminum			
	Tension		Shear		Tension		Shear		Tension		Shear	
	AN 310 AN 315 MS 20365 MS 21042 MS 21044 MS 21045 NAS 679 NAS 1291		AN 320 MS 20364 MS 21083 MS 21245		AN 310 AN 315 MS 20365 MS 21042 MS 21044 MS 21045 NAS 679 NAS 1291		AN 320 MS 20364 MS 21083 MS 21245		AN 310D AN 315D		AN 320D	
FINE THREAD SERIES - ADD FRICTION DRAG												
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

COARSE THREAD SERIES - ADD FRICTION DRAG				
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

NOTE: MS21042, NAS 1291, and NAS 679 steel nuts may be used in tension only applications.

NOTE: Unless otherwise specified, torque size No. 6 screws used with self-locking nutplates to no greater than 4 to 5 in.-lbs.

Use an appropriately calibrated driver.

CHART 2 (Sheet 2 of 2)
RECOMMENDED NUT TORQUES

Bolts - Steel				Bolts - Aluminum	
AN 3 thru AN 20 AN 42 thru AN 49 AN 525 MS 20033 thru MS 20046 MS 20073 MS 20074 MS 24694 MS 27039		MS 20004 NAS 333 thru NAS 340 NAS 464 NAS 624 thru NAS 644 NAS 1580 NAS 6203 thru NAS 6220 NAS 6603 thru NAS 6620 NAS 6703 thru NAS 6720		AN 3DD Series	
Nuts - Steel				**Nuts - Aluminum**	
Tension	**Shear**	**Tension**	**Shear**	**Tension**	**Shear**
AN 310 AN 315 MS 20365 MS 21042 MS 21044 MS 21045 NAS 679 NAS 1291	AN 320 MS 20364 MS 21083 MS 21245	AN 310 AN 315 MS 20365 MS 21042 MS 21044 MS 21045 NAS 679 NAS 1291	AN 320 MS 20364 MS 21083 MS 21245	AN 310D AN 315D	AN 320D

FINE THREAD SERIES - INCLUDES FRICTION DRAG

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.
10-32	38	43	30	33	43	48	33	38	28	33	23	28
1/4-28	65	100	60	70	110	130	80	90	60	75	45	60
5/16-24	160	200	120	145	180	205	130	150	100	125	85	100
3/8-24	240	270	175	190	280	330	200	230	155	190	125	150
7/16-20	550	600	370	400	620	730	400	500	280	380	210	270

COARSE THREAD SERIES - INCLUDES FRICTION DRAG

Nut-Bolt Size	Torque Limits In.-Lbs.		Torque Limits In.-Lbs.	
	Min.	Max.	Min.	Max.
8-32	27	30	22	24
10-24	38	43	30	33
1/4-20	70	80	55	60
5/16-18	140	150	108	115
3/8-16	240	265	175	190
7/16-14	335	355	240	255

NOTE: MS21042, NAS 1291, and NAS 679 steel nuts may be used in tension only applications.

NOTE: Unless otherwise specified, torque size No. 6 screws used with self-locking nutplates to no greater than 4 to 5 in.-lbs.

Use an appropriately calibrated driver.

CHART 3
TORQUE CONVERSION

INCH POUNDS (IN.-LBS.) TO CENTIMETER KILOGRAMS (CMKG.)
CENTIMETER KILOGRAMS (CMKG.) TO INCH POUNDS (IN.-LBS.)
FOOT POUNDS (FT.-LBS.) TO METER KILOGRAMS (MKG.)
METER KILOGRAMS (MKG.) TO FOOT-POUNDS (FT.-LBS.)

IN.-LBS.	CMKG.
5	5.76
10	11.52
15	17.28
20	23.04
25	28.80
30	34.56
35	40.32
40	46.08
45	51.84
50	57.60
55	63.36
60	69.12
65	74.88
70	80.64
75	86.40
80	92.16
85	97.92
90	103.68
95	109.44
100	115.20
105	120.96
110	126.72
115	132.48
120	138.24

CMKG.	IN.-LBS.
50	43.4
100	86.8
150	130.2
200	173.6
250	217.0
300	260.4
350	303.8
400	347.2
450	390.6
500	434.0
550	477.4
600	520.8
650	564.2
700	607.6

FT.-LBS.	MKG.
2.5	.346
5	.691
7.5	1.037
10	1.383
12.5	1.728
15	2.074
17.5	2.419
20	2.765
22.5	3.111
25	3.456
27.5	3.802
30	4.148
32.5	4.493
35	4.839
37.5	5.185
40	5.530
42.5	5.876
45	6.222
47.5	6.567
50	6.913
52.5	7.258
55	7.604
57.5	7.950
60	8.295
62.5	8.641
65	8.987
67.5	9.332
70	9.678
72.5	10.024
75	10.369
77.5	10.715
80	11.060
82.5	11.406
85	11.752
87.5	12.097
90	12.443
92.5	12.789
95	13.134
97.5	13.480
100	13.826
105	14.517
110	15.208

FT.-LBS.	MKG.
115	15.900
120	16.591
125	17.282
130	17.974
135	18.665
140	19.356
145	10.047
150	20.739
155	21.430
160	22.121
165	22.813
170	23.504
175	24.195
180	24.887
185	25.578
190	26.269
195	26.960
200	27.652
105	28.343
210	29.034
215	29.726
220	30.417
225	31.108
230	31.800
235	32.491
240	33.182
245	33.873
250	34.565
255	35.256
260	35.947
265	36.639
270	37.330
275	38.021
280	38.713
285	39.404
290	40.095
295	40.786
300	41.478

MKG.	FT.-LBS.
1	7.23
2	14.46
3	21.69
4	28.98
5	36.16
6	43.39
7	50.63
8	57.86
9	65.09
10	72.32
11	79.56
12	86.79
13	94.02
14	101.26
15	108.49
16	115.72
17	122.95
18	130.19
19	137.42
20	144.65
21	151.89
22	159.12

CHART 4
DECIMAL CONVERSIONS

4ths	8ths	16ths	32nds	64ths	TO 3 PLACES	TO 2 PLACES	M.M. EQUIV
				1/64	.016	.02	.397
			1/32		.031	.03	.794
				3/64	.047	.05	1.191
		1/16			.062	.06	1.587
				5/64	.078	.08	1.984
			3/32		.094	.09	2.381
				7/64	.109	.11	2.778
	1/8				.125	.12	3.175
				9/64	.141	.14	3.572
			5/32		.156	.16	3.969
				11/64	.172	.17	4.366
		3/16			.188	.19	4.762
				13/64	.203	.20	5.159
			7/32		.219	.22	5.556
				15/64	.234	.23	5.593
1/4					.250	.25	6.350
				17/64	.266	.27	6.747
			9/32		.281	.28	7.144
				19/64	.297	.30	7.540
		5/16			.312	.31	7.937
				21/64	.328	.33	8.334
			11/32		.344	.34	8.731
				23/64	.359	.36	9.128
	3/8				.375	.38	9.525
				25/64	.391	.39	9.922
			13/32		.406	.41	10.319
				27/64	.422	.42	10.716
		7/16			.438	.44	11.112
				29/64	.453	.45	11.509
			15/32		.469	.47	11.906
				31/64	.484	.48	12.303
					.500	.50	12.700

4ths	8ths	16ths	32nds	64ths	TO 3 PLACES	TO 2 PLACES	M.M. EQUIV
				33/64	.516	.52	13.097
			17/32		.531	.53	13.494
				35/64	.547	.55	13.891
		9/16			.562	.56	14.288
				37/64	.578	.58	14.684
			19/32		.594	.59	15.081
				39/64	.609	.61	15.478
	5/8				.625	.62	15.875
				41/64	.641	.64	16.272
			21/32		.656	.66	16.669
				43/64	.672	.67	17.065
		11/16			.688	.69	17.462
				45/64	.703	.70	17.859
			23/32		.719	.72	18.256
				47/64	.734	.73	18.653
3/4					.750	.75	19.050
				49/64	.766	.77	19.447
			25/32		.781	.78	19.844
				51/64	.797	.80	20.241
		13/16			.812	.81	20.637
				53/64	.828	.83	21.034
			27/32		.844	.84	21.431
				55/64	.859	.86	21.828
	7/8				.875	.88	22.225
				57/64	.891	.89	22.622
			29/32		.906	.91	23.019
				59/64	.922	.92	23.416
		15/16			.938	.94	23.812
				61/64	.953	.95	24.209
			31/32		.969	.97	24.606
				63/64	.984	.98	25.003
					1.000	1.00	25.400

CHART 5
TEMPERATURE CONVERSION

CENTIGRADE - FAHRENHEIT

Example: To convert 20°C, to Fahrenheit, find 20 in the center column headed (°F - °C); then read 68.0°F, in the column (°F) to the right. To convert 20°F, to Centigrade; find 20 in the center column and read -6.67°C, in the (°C) column to the left.

°C	°F - °C	°F	°C	°F - °C	°F
-56.7	-70	-94.0	104.44	220	428.0
-51.1	-60	-76.0	110.00	230	446.0
- 45.6	-50	-58.0	115.56	240	464.0
- 40.0	-40	-40.0	121.11	250	482.0
- 34.0	-30	-22.0	126.67	260	500.0
- 38.9	-20	-4.0	132.22	270	518.0
- 23.3	-10	14.0	137.78	280	536.0
- 17.8	0	32.0	143.33	290	554.0
-12.22	10	50.0	148.89	300	572.0
-6.67	20	68.0	154.44	310	590.0
-1.11	30	86.0	160.00	320	608.0
4.44	40	104.0	165.56	330	626.0
10.00	50	122.0	171.11	340	644.0
15.56	60	140.0	176.67	350	662.0
21.11	70	158.0	182.22	360	680.0
26.67	80	176.0	187.78	370	698.0
32.22	90	194.0	193.33	380	716.0
27.78	100	212.0	198.89	390	734.0
43.33	110	230.0	204.44	400	752.0
38.89	120	248.0	210.00	410	770.0
54.44	130	266.0	215.56	420	788.0
60.00	140	284.0	221.11	430	806.0
65.56	150	302.0	226.67	440	824.0
71.00	160	320.0	232.22	450	842.0
76.67	170	338.0	257.78	460	860.0
82.22	180	356.0	243.33	470	878.0
87.78	190	374.0	248.89	480	896.0
93.33	200	392.0	254.44	490	914.0
98.89	210	410.0	260.00	500	932.0

CHART 6
WEIGHTS AND MEASURES CONVERSION

MULTIPLY	BY	TO OBTAIN
CENTIMETERS	0.3937	IN.
	0.03281	FT.
CU. CENTIMETERS	0.001	LITERS
	0.06102	CU. IN.
	0.0002642	U.S. GAL.
CU. FT.	28.320	CU. CM.
	1.728	CU. IN.
	7.481	U.S. GAL.
	28.32	LITERS
CU. IN.	16.39	CU. CM.
	0.01639	LITERS
	0.004329	U.S. GAL.
	0.01732	QUARTS
CU. METERS	1000000	CU. CM.
	35.314	CU. FT.
	61.023	CU. IN.
	264.17	GAL.
	999.97	LITERS
FEET	0.3048	METERS
	12.000	MILS
	304.8	MM.
	0.3333	YARDS
FT.-LB.	0.1383	M-KG
	0.001285	BTU
	0.000000376	KW-HR
FLUID OZ.	8	DRAM
	29.6	CU. CM.
GAL., IMPERIAL	277.4	CU. IN.
	1.201	U.S. GAL.
	4.546	LITERS
GAL., U.S. DRY	268.8	CU. IN.
	0.1556	CU. FT.
	1.164	U.S. GAL., LIQ.
	4.405	LITERS
GAL., U.S. LIQ.	231.0	CU. IN.
	0.1337	CU. FT.
	3.785	LITERS
	0.8327	IMPERIAL GAL.
	128	FLUID OZ.
IN.	2.540	CM.
	.08333	FT.
JOULES	0.000948	BTU
	0.7376	FT.-LB.
KILOGRAMS	2.205	LB.
	35.27	OZ.
	1000	GRAMS
LITERS	1000	CU. CM.
	61.03	CU. IN.
	0.03532	CU. FT.
	0.2642	U.S. GAL.
	0.22	IMPERIAL GAL.
	1.057	QUARTS
METERS	39.37	IN.
	3.281	FT.
	1000	MM.
METER-KILOGRAM	7.233	FT.-LB.
	9.807	JOULES
OUNCES, AVDP	0.0625	LB., AVDP
	28.35	GRAMS
	437.5	GRAINS
OUNCES, FLUID	29.57	CU. CM.
	1.805	CU. IN.
LB., AVDP	453.6	GRAMS
	7000	GRAINS
	16.0	OUNCES
SQUARE INCH	6.4516	SQ. CM.
POUND PER SQUARE INCH (PSI)	0.0703	KG.-CM SQUARED
STATUTE MILE	1.609	KILOMETER
	0.8684	NAUTICAL MILE
NAUTICAL MILE	1.151	STATUTE MILE
QUART	.9463	LITER
MILLIMETER	1000	MICRON
MICRON	0.001	MILLIMETER
	0.000039	INCH
INCH POUNDS	11.521	METER GRAMS
INCH OUNCES	0.72	METER GRAMS
POUNDS	0.453	KILOGRAMS

CHART 7
METRIC CONVERSION

Example: Convert 1.5 inches to millimeters.

(1) Read down inches column to 1. inches.
(2) Read across top inch column to 0.5.
(3) Read down and across to find millimeters (1.5 inches is 38.10 millimeters).

INCHES TO MILLIMETER

INCHES	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009
	MILLIMETER									
0.000		0.0025	0.0050	0.0076	0.0101	0.0127	0.0152	0.0177	0.0203	0.0228
0.001	0.0254	0.0279	0.0304	0.0330	0.0355	0.0381	0.0406	0.0431	0.0457	0.0482
0.002	0.0508	0.0533	0.0558	0.0584	0.0609	0.0635	0.0660	0.0685	0.0711	0.0736
0.003	0.0762	0.0812	0.0838	0.0863	0.0889	0.0914	0.0939	0.0965	0.0965	0.0990
0.004	0.1016	0.1041	0.1066	0.1092	0.1117	0.1143	0.1168	0.1193	0.1219	0.1244
0.005	0.1270	0.1295	0.1320	0.1346	0.1371	0.1397	0.1422	0.1447	0.1447	0.1498
0.006	0.1524	0.1549	0.1574	0.1600	0.1625	0.1651	0.1676	0.1701	0.1727	0.1752
0.007	0.1778	0.1803	0.1828	0.1854	0.1879	0.1905	0.1930	0.1955	0.1981	0.2006
0.008	0.2032	0.2057	0.2082	0.2108	0.2133	0.2159	0.2184	0.2209	0.2235	0.2260
0.009	0.2286	0.2311	0.2336	0.2362	0.2387	0.2413	0.2438	0.2463	0.2489	0.2514

INCHES	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
	MILLIMETER									
0.00		0.025	0.050	0.076	0.101	0.127	0.152	0.177	0.203	0.228
0.01	0.254	0.279	0.304	0.330	0.355	0.381	0.406	0.431	0.457	0.482
0.02	0.508	0.533	0.558	0.584	0.609	0.635	0.660	0.685	0.711	0.736
0.03	0.762	0.787	0.812	0.838	0.863	0.889	0.914	0.939	0.965	0.990
0.04	1.016	1.041	1.066	1.092	1.117	1.143	1.168	1.193	1.219	1.244
0.05	1.270	1.295	1.320	1.346	1.371	1.397	1.422	1.447	1.473	1.498
0.06	1.524	1.549	1.574	1.600	1.625	1.651	1.676	1.701	1.727	1.752
0.07	1.778	1.803	1.828	1.854	1.879	1.905	1.930	1.955	1.981	2.006
0.08	2.032	2.057	2.082	2.108	2.133	2.159	2.184	2.209	2.235	2.260
0.09	2.286	2.311	2.336	2.362	2.387	2.413	2.438	2.463	2.489	2.514

INCHES	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
	MILLIMETER									
0.0		0.254	0.508	0.762	0.016	1.270	1.524	1.778	2.032	2.286
0.1	2.540	2.794	3.048	3.302	3.556	3.810	4.064	4.318	4.572	4.826
0.2	5.080	5.334	5.558	5.842	6.096	6.350	6.604	6.858	7.112	7.366
0.3	7.620	7.874	8.128	8.382	8.636	8.890	9.144	9.398	9.652	9.906
0.4	10.160	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
0.5	12.700	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
0.6	15.240	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
0.7	17.780	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
0.8	20.320	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
0.9	22.860	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146

INCHES	0.00	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	MILLIMETER									
0.0		2.54	5.08	7.62	10.16	12.70	15.24	17.78	20.32	22.86
1.0	25.40	27.94	30.48	33.02	35.56	38.10	40.64	43.18	45.72	48.26
2.0	50.80	53.34	55.88	58.42	60.96	63.50	66.04	68.58	71.12	73.66
3.0	76.20	78.74	81.28	83.82	86.36	88.90	91.44	93.98	96.52	99.06
4.0	101.60	104.14	106.68	109.22	111.76	114.30	116.84	119.38	121.92	124.46
5.0	127.00	129.54	132.08	134.62	137.16	139.70	142.24	144.78	147.32	149.86
6.0	152.40	154.94	157.48	160.02	162.56	165.10	167.64	170.18	172.72	175.26
7.0	177.80	180.34	182.88	185.42	187.96	190.50	193.04	195.58	198.12	200.66
8.0	203.20	205.74	208.28	210.82	213.36	215.90	218.44	220.98	223.52	226.06
9.0	228.60	231.14	233.68	236.22	238.76	241.30	243.84	246.38	248.92	251.46

CHART 8
DRILL SIZES

Decimal/Millimeter Equivalents of Drill Sizes From 1/2" to No. 80

Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.
1/2	0.500	12.7000	G	0.261	6.6294	5/32	0.1562	3.9687	51	0.067	1.7018
31/64	0.4843	12.3031	F	0.257	6.5278	23	0.154	3.9116	52	0.0635	1.6129
15/32	0.4687	11.9062	E-1/4	0.250	6.3500	24	0.152	3.8608	1/16	0.0625	1.5875
29/64	0.4531	11.5094	D	0.246	6.2484	25	0.1495	3.7973	53	0.0595	1.5113
7/16	0.4375	11.1125	C	0.242	6.1468	26	0.147	3.7338	54	0.055	1.397
27/64	0.4218	10.7156	B	0.238	6.0452	27	0.144	3.6576	55	0.052	1.3208
Z	0.413	10.4902	15/64	0.2343	5.9531	9/64	0.1406	3.5719	3/64	0.0468	1.1906
13/32	0.4062	10.3187	A	0.234	5.9436	28	0.1405	3.5687	56	0.0465	1.1811
Y	0.404	10.2616	1	0.228	5.7912	29	0.136	3.4544	57	0.043	1.0922
X	0.397	10.0838	2	0.221	5.6134	30	0.1285	3.2639	58	0.042	1.0668
25/64	0.3906	9.9212	7/32	0.2187	5.5562	1/8	0.125	3.1750	59	0.041	1.0414
W	0.386	9.8044	3	0.213	5.4102	31	0.120	3.048	60	0.040	1.016
V	0.377	9.5758	4	0.209	5.3086	32	0.116	2.9464	61	0.039	0.9906
3/8	0.375	9.5250	5	0.2055	5.2197	33	0.113	2.8702	62	0.038	0.9652
U	0.368	9.3472	6	0.204	5.1816	34	0.111	2.8194	63	0.037	0.9398
23/64	0.3593	9.1262	13/64	0.2031	5.1594	35	0.110	2.794	64	0.036	0.9144
T	0.358	9.1281	7	0.201	5.1054	7/64	0.1093	2.7781	65	0.035	0.899
S	0.346	8.7884	8	0.199	5.0546	36	0.1065	2.7051	66	0.033	0.8382
11/32	0.3437	8.7300	9	0.196	4.9784	37	0.104	2.6416	1/32	0.0312	0.7937
R	0.339	8.6106	10	0.1935	4.9149	38	0.1015	2.5781	67	0.032	0.8128
Q	0.332	8.4328	11	0.191	4.8514	39	0.0995	2.5273	68	0.031	0.7874
21/64	0.3281	8.3337	12	0.189	4.8006	40	0.098	2.4892	69	0.029	0.7366
P	0.323	8.2042	3/16	0.1875	4.7625	41	0.096	2.4384	70	0.028	0.7112
O	0.316	8.0264	13	0.185	4.699	3/32	0.0937	2.3812	71	0.026	0.6604
5/16	0.3125	7.9375	14	0.182	4.6228	42	0.0935	2.3749	72	0.025	0.635
N	0.302	7.6708	15	0.180	4.572	43	0.089	2.2606	73	0.024	0.0696
19/64	0.2968	7.5387	16	0.177	4.4958	44	0.086	2.1844	74	0.0229	0.58166
M	0.295	7.4930	17	0.173	4.3942	45	0.082	2.0828	75	0.021	0.5334
L	0.290	7.3660	11/64	0.1718	4.3656	46	0.081	2.0574	76	0.020	0.508
9/32	0.2812	7.1425	18	0.1695	4.3053	47	0.0785	1.9939	77	0.018	0.4572
K	0.281	7.1374	19	0.166	4.2164	5/64	0.0781	1.9844	1/64	0.0156	0.3969
J	0.277	7.0358	20	0.161	4.0894	48	0.076	1.9304	78	0.016	0.4064
I	0.272	6.9088	21	0.159	4.0386	49	0.073	1.8542	79	0.0145	0.3683
H	0.266	6.7564	22	0.157	3.9878	50	0.070	1.778	80	0.0135	0.3429
17/64	0.2656	6.7462									

DRILL SIZES AVAILABLE

Drill may be obtained in regular sizes to a 4 inch diameter, and increase in 64ths of an inch. The regular metric drills vary from 2 to 76mm and increase in 0.5mm variations.

CHART 9
HOSE SPECIFICATIONS

SINGLE WIRE BRAID FABRIC COVERED

MIL PART NO.	TUBE SIZE O.D.	HOSE SIZE I.D.	HOSE SIZE O.D.	RECOMMENDED OPER. PRESS	MIN BURST PRESS	MAX PROOF PRESS	MIN BEND RADIUS
MIL-H-8794- 3-L	3/16	1/8	.45	3,000	12,000	6,000	3.00
MIL-H-8794- 4-L	1/16	3/16	.52	3,000	12,000	6,000	3.00
MIL-H-8794- 5-L	5/16	1/4	.58	3,000	10,000	5,000	3.38
MIL-H-8794- 6-L	3/8	5/16	.67	2,000	9,000	4,500	4.00
MIL-H-8794- 8-L	1/2	13/32	.77	2,000	8,000	4,000	4.63
MIL-H-8794-10-L	5/8	1/2	.92	1,750	7,000	3,500	5.50
MIL-H-8794-12-L	3/4	5/8	1.08	1,500	6,000	3,000	6.50
MIL-H-8794-16-L	1	7/8	1.23	800	3,200	1,600	7.38
MIL-H-8794-20-L	1 1/4	1 1/8	1.50	600	2,500	1,250	9.00
MIL-H-8794-24-L	1 1/2	1 3/8	1.75	500	2,000	1,000	11.00
MIL-H-8794-32-L	2	1 13/16	2.22	300	1,400	700	13.25
MIL-H-8794-40-L	2 1/2	2 3/8	2.88	200	1,000	300	24.00
MIL-H-8794-48-L	3	3	3.56	200	800	300	33.00

Construction: Seamless synthetic rubber inner tube reinforced with one fiber braid, one braid of high tensile steel wire and covered with an oil resistant rubber impregnated fiber braid.

Identification: Hose is identified by specification number, size number, quarter year and year, hose manufacturer's identification.

Uses: Hose is approved for use in aircraft hydraulic, pneumatic, coolant, fuel and oil systems.

Operating Temperatures:

Sizes -3 thru -12: Minus 65°F. to plus 250°F.

Sizes -16 thru -48: Minus 40°F to plus 275°F.

NOTE: Maximum temperatures and pressures should not be used simultaneously.

MULTIPLE WIRE BRAID RUBBER COVERED

MIL PART NO.	TUBE SIZE O.D.	HOSE SIZE I.D.	HOSE SIZE O.D.	RECOMMENDED OPER. PRESS	MIN BURST PRESS	MAX PROOF PRESS	MIN BEND RADIUS
MIL-H-8788- 4-L	1/4	7/32	.63	3,000	16,000	8,000	3.00
MIL-H-8788- 5-L	5/16	9/32	.70	3,000	14,000	7,000	3.38
MIL-H-8788- 6-L	3/8	11/32	.77	3,000	14,000	7,000	5.00
MIL-H-8788- 8-L	1/2	7/16	.86	3,000	14,000	7,000	5.75
MIL-H-8788-10-L	5/8	9/16	1.03	3,000	12,000	6,000	6.50
MIL-H-8788-12-L	3/4	11/16	1.22	3,000	12,000	6,000	7.75
MIL-H-8788-16-L	1.00	7/8	1.50	3,000	10,000	5,000	9.63

Hose Construction: Seamless synthetic rubber inner tube reinforced with one fabric braid, two or more steel wire braids, and covered with a synthetic rubber cover (for gas applications, request perforated cover).

Identification: Hose is identified by specification number, size number, quarter year and year, hose manufacturer's identification.

Uses: High pressure hydraulic, pneumatic, coolant, fuel and oil.

Operating Temperature:

Minus 65°F to plus 200°F.

CHART 10 (Sheet 1 of 8)
CONSUMABLE MATERIALS

Material	Specification	Product	Vendor
ABS-Solvent/ Cements		Solarite, #11 Series	Solar Compounds Corp.
Adhesive		EC 801 EC 807 EC 1357 Scotch Grip 210 (Rubber Adhesive)	Minnesota Mining and Manufacturing Adhesive Coating and Sealers Division
Adhesive, Rudder Pedal Pads		3M EC 1300L	Local Supplier
Adhesive, Forward Cabin Door Seal		RTV 103 or 133	GE
Anti-Galling Solution	MIL-A-907	Ease-Off	Taxacone Company
Anti-Seize Compound	TT-A-580 (TT-S-1732)	Armite Product Anti-Seize Compound Royco 44	Armite Laboratories Exxon Oil Company Royal Lubricants Co.
Anti-Seize Thread Compound “HIGH TEMPERATURE”		Fel-Pro C5-A	Fel-Pro Incorporated
Buffing and Rubbing Compounds		Automotive Type DuPont #7 Ram Chemical #69	DuPont Company Ram Chemicals
Compound for Polishing		Mirror Glaze	Mirror Bright Polish Co., Incorporated
Plexiglas Polish and Cleaner	P-P-560	Part Number 403D	Permatex Co., Inc. Kansas City, Kansas 66115
Cleaners		Fantastic Spray Perchlorethylene VM&P Naphtha (Lighter Fluid)	Local Supplier
Corrosion Retardant Compounds	MIL-PRF-16173 (Piper P/N 197-508) (Piper P/N 197-509)	LPS-3 Heavy Duty Rust Inhibitor Metal Parts Protector Protector Flex	Holt Lloyd Corp. Chemi-Cap. Chemical Packaging Corp.
Deicer Boot Surface Coatings		Agemaster	B.F. Goodrich

CHART 10 (Sheet 2 of 8)
CONSUMABLE MATERIALS

Material	Specification	Product	Vendor
Deice Fluid, TKS	AL-5 / DTD 406B / NATO S-745	Kilfrost TKS 406B	Kilfrost, Inc.
	N/A	Kilfrost TKS R328	
	N/A	Kilfrost TKS 80	
Dry Lubricant		MS-122AD	Miller-Stephenson
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-PRF-23827 (See Note at end.)	Supermil Grease No. A72832	Amoco
		Royco 27A	Royal Lubricants Co.
		Shell 6249 Grease	Shell Oil Company
		RR-28	Socony Mobil Oil Co.
		Castrolease A1	Burmah-Castrol LTD.
		Low-Temp. Grease E.P.	Texaco Incorp.
		5114 E.P. Grease AV55	Standard Oil of Calif.
		Aeroshell Grease 7 Braycote 627S	Shell Oil Company
		Mobil Grease 27	Mobil Oil Corporation
		B.P. Aero Grease 31B	B.P. Trading Limited
Grease, Aircraft Instrumentation, Gear and Actuator Screw (Temp. Range - 65°F to +250°F)	MIL-G-3278	Unitemp E.P.	Texaco Incorporated
		RPM Aviation Grease 5, Supermil Grease No. 8723	Standard Oil of Calif.
		Aeroshell Grease 7A Royco 78	Shell Oil Corporation Royal Lubricants Company
		L-1212	Sinclair Refining Co.
		1916 Uni-Temp Grease	California Texas Oil Corporation
Grease Ball and Roller Bearing	DOD-G-24508	Regal ASB-2 Formula TG-10293	Texaco Incorporated
		Andok B	Exxon Company, U.S.A.

CHART 10 (Sheet 3 of 8)
CONSUMABLE MATERIALS

Material	Specification	Product	Vendor
Grease Ball and Roller Bearing (continued)		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-PRF-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-PRF-81322	High Temp. Grease, Marfak All Purpose	Texaco Incorporated
		Shellaire Grease HT Alvania E.P. Grease 2 Aeroshell Grease 5	Shell Oil Company
		Grease 77, Mobilux E.P. 2	Mobil Oil Corporation
		Royco 45A	Royal Lubricants Co.
		L-1231	Sinclair Refining Company
Grease, Aircraft General Purpose	MIL-PRF-81322	Regal AFB2 Regal Starfak Premium	Texaco Incorporated
		PED 3040	Standard Oil of Calif.
		Aeroshell Grease 6	Shell Oil Company
		Royco II	Royal Lubricants Co.
Grease, Lubricating, Molybdenum Disulfide, Low and High Temperature	MIL-G-21164	Aeroshell Grease No. 17	Shell Oil Company
		Royco 64C	Royal Lubricants Co.
		Castrolease MSA (c)	Burmah Castrol LTD.

CHART 10 (Sheet 4 of 8)
CONSUMABLE MATERIALS

Material	Specification	Product	Vendor
Grease, Plug Valve, Gasoline and Oil Resistant	SAE-AMS-G-6032	Royco 32	Royal Lubricant Co.
		Castrolease PV	Burmah Castrol LTD.
		Parker Fuel Lube 44	Parker Seal Company
		B.P. Aero Grease 32	B.P. Trading Limited
		L-237	Lehigh Tenneco Chemicals Co., Inc.
		Rockwell 950	Rockwell International
Grease, Waterproof, High and Low Temperature		Aero Lubriplate	LUBRIPLATE Lubricants Co.
"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-PRF-5606	Brayco 756D	Bray Oil Company
		TL-5874	Texaco Incorporated
		PED 3565	Standard Oil Company of California
		Aircraft Hydraulic Oil AA	Texaco Incorporated
		RPM Aviation Oil No. 2 Code PED 2585 PED 3337	Standard Oil Company of California
		3126 Hydraulic Oil (Univis 40)	Exxon Company U.S.A.
		Aeroshell Fluid 4, SL-7694	Shell Oil Company
		Aero HF	Mobil Oil Corporation
		Royco 756, 756A and 756B	Royal Lubricants Co.
Isopropyl Alcohol	Fed. Spec. TT-I-735		Local Supplier
Isocryl Tape	(PMS-C1012-2)		Schnee Moorehead Chemicals, Incorporated
Kevlar		Kevlar	Kevlar Special Products

CHART 10 (Sheet 5 of 8)
CONSUMABLE MATERIALS

Material	Specification	Product	Vendor
Leak Detector Solution for Oxygen Systems	MIL-PRF-25567	ALPHA 73 Oxygen Leak Detector Type 1	U.S. Gulf Corporation
		Leak Tec #16-OX	American Gas and Chemical Co. LTD.
Loctite	ASTM-D-5363 Grade AA	Loctite 290	Loctite Corporation
	ASTM-D-5363 Grade H and HV	Loctite 222	
	Piper P/N 279-128	Loctite 27121 (10 ml)	
Lubricant, O-Rings		Parker O-Lube	Parker Hannifin Corp.
Methylethylketone (MEK)	Fed. Spec. TT-M-261		Local Supplier
Molybdenum Disulfide	SAE-AMS-M-7866	Molykote-Type G (Paste)	Dow Corning Corp.
		Molykote - Type 2 (Powder)	
Oil, Air Conditioner, R12		Frigidaire #525	Virginia Chemical
		Suniso #5	Sun Oil Company of Pennsylvania
		Texaco Capilla “E”	Texaco Incorporated
Oil, Air Conditioner, HFC-134a, POE	Piper P/N 197-511	Ester-25065	
Oil Lubricating, General Purpose, Low Temperature	MIL-PRF-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.
Primer, Fluid Resistant Epoxy	Piper P/N 279-179	EWDE072A/B	PPG Aerospace PRC-DeSoto
	Piper P/N 279-506	10P8-10NF / EC-283	Akzo Nobel Aerospace Coatings
	Piper P/N 279-108	10P30-5 / EC-275	
		44GN036	Deft, Inc.
Rain Repellent	FSCM 50150	Repcon	Unelco Corporation

CHART 10 (Sheet 6 of 8)
CONSUMABLE MATERIALS

Material	Specification	Product	Vendor
Refrigerant, A/C HFC-134a	1,1,1,2-Tetrafluoroethane and/or CAS# 811-97-2		Procure locally.
Safety Walk Pressure Sensitive		Flextred 300	Wooster Products, Incorporated
Sealant, Adhesive (Polysulfide Base)	A-A-59293	PRC 5000 PRC 383	Products Research Company
Sealant, Fuel Tank Sealing		*RS-36b, Stripper (thin)	CEE BEE Chemical Co.
		*RS-24b, Stripper (thick)	
		*PR 1422 A-2 Sealant (Brushing Consistency)	Products Research Company
		*PR 1422 B-2 Sealant (Trowling Consistency)	
		*PR 1431G, Faying Surface Seal, Type 1	
		* PR 1321-B 1/2, Access Panel Sealant	
		* PR 1560 MK, Primer (Anti-Bacteriological Coating)	Products Research Company
		* BJO-0930, Phenolic Balloons	Union Carbide Plastics Division
		* ERL-2795, Epoxy Resin	
		* 22LA-0340 Polyamid Hardener	
	Class A-2	* Thiokol MC-236	
	* NOTE: Use of Equivalent Sealant Approved.		
Sealant, Fuselage Structure	Class A-1/2, A-2, B-2 B-4, B-6, B-8		H.S. Bancroft Corp.
		EC 1239	Minnesota Mining and Manufacturing Industrial Specialties Division
		EC 612 (Leak Marker or Weather Stripping, etc)	
		G.E.-SS-4004 (Primer) RTV-88 with RTV-9811	General Electric Silicone Products Department

CHART 10 (Sheet 7 of 8)
CONSUMABLE MATERIALS

Material	Specification	Product	Vendor
Sealant, Windshield & Windows	MIL-S-7502B B-1/4, B-1/2, B-2, B-4, B-8, B-12	PR 1221	Products Research Company
		PR 1425	
	Piper P/N 279-066	* Thiokol MC-236-B4	
Sealing Compound, Gasket and Joint		Tite-Seal	Radiator Specialty Co.
Sealer		PR 1321 B-1/2	Products Research Company
Silicone Compound	SAE-AS-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.
Toluol	TT-M-261		Local Supplier
Trichlorethylene	MIL-T-7003	Perm-A-Clor	Dextrex Chemical Industries, Inc.
		Turco 4217	Turco Products, Inc.
Teflon Tape	.003” x .5” wide/-1		Minnesota Mining and Manufacturing Company
			Shamban W.S. and Co.
	.003” x .25” wide/-2		Johnson & Johnson, Inc. Permacel Division
Thread Lubricant, Oleo Strut, Air Valve	MIL-PRF-907	Kopr-Kote	Jet Lube, Inc.

CHART 10 (Sheet 8 of 8)
CONSUMABLE MATERIALS

Material	Specification	Product	Vendor
Thread Sealant for High Pressure Oxygen System	A-A-58092	Permacel 412	Johnson & Johnson, Inc. Permacel Division
Vinyl Foam	1 in. x 1/8 in.	530 Series, Type I	Norton Tape Division
Vinyl, Foam Tape	1/8 in. x 1 in.	501 Series, Type II	Norton Tape Division
Vinyl, Black Plastic	2 in. x 9 mil. and/or 1 1/2 in. x 9 mil.		

NOTE: Take precautions when using MIL-PRF-23827 and engine oil. These lubricants contain chemicals harmful to painted surfaces.

CHART 11 (Sheet 1 of 2)
VENDOR CONTACT INFORMATION

A

American Gas and
Chemical Co. LTD
220 Pegasus Avenue
Northvale, NJ 07647
201-767-7300

Amoco Oil Co.
200 E. Randolph Drive
Chicago, IL 60601
312-856-5111

Armite Laboratories
1845-49 Randolph Street
Los Angeles, CA 90001
213-587-7744

Akzo Nobel Aerospace Coatings
East Water Street
Waukegan, IL 60085
847-625-3340
www.anac.com/

B

BP Trading Limited
Moore Lane
Brittanic House
London E.C. 2
England

Bray Oil Company
1925 N. Marianna Avenue
Los Angeles, CA 98103
213-268-6171

Burmah - Castrol Inc.
30 Executive Avenue
Edison, NJ 08817
201-287-3140

C

California Texas Oil Corp.,
380 Madison Avenue
New York, NY 10017

Caltex Oil Products Co.
New York, NY 10020

CEE BEE Chemical Co.
9520 E. CEE BEE Drive
Box 400
Downey, CA 92041

Chemi-cap
Chemical Packaging Corp.
1100 N.W. 70th Street
Ft. Lauderdale, FL 33309
305-665-9059

Corrosion Reaction
Consultants, Inc.
Limekin Pike
Dresher, PA 19025

D

Deft, Inc.
17451 Von Karman Ave.
Irvine, CA 92614
800-544-3338
www.deftfinishes.com/

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

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

J

Jet Lube, Inc.
P.O. Box 21258
Houston, TX 77226-1258
PH: 800-538-5823
www.jetlube.com

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

Kilfrost Incorporated
6250 Coral Ridge Drive
Suite 130
Coral Springs, Florida 33076
877-U-KILFROST
www.kilfrost.com

L

Lehigh - Tenneco Chemicals Co.,
Inc.
Chestertown, MD 21620
301-778-1991

Loctite Corporation
777 N. Mountain Road
Newington, CT 06111
800-243-8160
In CT 800-842-0225

LPS Laboratories
4647 Hugh Howell Rd.
Tucker, GA 30084
800-241-8334
www.lpslabs.com/

LUBRIPLATE Lubricants Co.
129 Lockwood St.
Newark, NJ 07105
PH: 800-733-4755
www.lubriplate.com

CHART 11 (Sheet 2 of 2)
VENDOR CONTACT INFORMATION

M

Miller-Stephenson
George Washington Hwy.
Danbury, CT 06810
PH: 203-743-4447
http://www.miller-stephenson.com

Minnesota Mining and MFG
3M Center
St. Paul, MN 55144
612-733-1110

Mirror Bright Polish Co., Inc.
Irvine Industrial Complex
P.O. Box 17177
Irvin, CA 92713
714-557-9200

Mobil Oil Corporation
150 E. 42nd Street
New York, NY 10017
212-883-4242

Morton Inc.
7341 Anacona Ave
Garden Grove, CA 92641
724-373-2837
Fax 724-373-1913

N

Norton Tape Division
Department 6610
Troy, NY 12181
518-273-0100

P

Parker Hannifin Corp.
O-Ring Division
2360 Palumbo Drive
Lexington, KY 40509
PH: 859-269-2351
http://www.parker.com

Permatex Co., Inc.
P.O. Box 11915
Newington, CT 06111
203-527-5211

PPG Aerospace PRC-DeSoto
11601 United Street
Mojave, California 93501
661-824-4532
818-549-7999
http://corporateportal.ppg.com/na/aerospace/

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

Shell Oil Company
One Shell Plaza
Houston, TX 77003
713-220-6697

Sinclair Refining Co.
600 Fifth Avenue
New York, NY 10020

Socony Mobil Oil Co.
Washington 5, DC 20005

Solar Compounds Corp.
1201 W. Blancke Street
Linden, NJ 07036
201-862-2813

Standard Oil of California
225 Bush Street
San Francisco, CA 94104
415-894-7700

Sun Oil Company of Penna
5 Penn Center Plaza
Philadelphia, PA 19103
215-972-2000

T

Taxacone Company
P.O. Box 10823 TR
Dallas, TX 75208

Texaco, Inc.
2000 Westchester Avenue
White Plains, NY 10650
914-253-4000

Turco Products Inc.
24600 S. Main Street
Box 6200
Carson, CA 90749
213-835-8211

U

U.S. Gulf Corp.
P.O. Box 233
Stoney Brook, NY 11790
212-683-9221

Unelko Corporation
727 E. 110th Street
Chicago, IL 60628

Union Carbide; Plastic Div.
270 Park Avenue
New York, NY 10017
212-551-3763

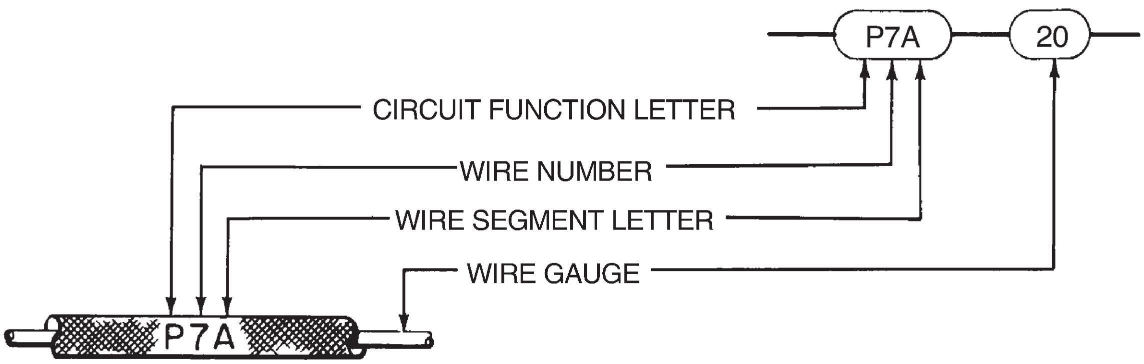
V

Virginia Chemical
3340 W. Norfolk Rd.
Portsmouth, VA 23703
703-484-5000

W

Wooster Products, Inc.
1000 Spruce Street
Wooster, OH 44691
800-321-4936
In OH 216-264-2844

CHART 12 (Sheet 1 of 3)
ELECTRICAL WIRE CODING



(PIR-PPS55006, Rev. AG.)

FUNCTION LETTER (Circa 2010 and Prior)	FUNCTION LETTER (Circa 2010 and Later)	CIRCUIT
AC	H	Air Conditioning
	F	Airspeed Indicator
PF		Alternator Field Control
	F	Altitude Indicator / Altimeter
	L	Anti-collision Lights
	F	Attitude Indicator
A	C	Autopilot
	H	Avionics Cooling
	L	Avionics Lights
	P	Battery
	H	Cabin Heating
	L	Cabin Lights
	H	Cabin Ventilation
	D	Clock
C		Control Surface
	E	DAU
	C	Electric Trim
	M	ELT Switch
K		Engine Control, Starter
	J	Engine Ignition
E		Engine Instrument
	Q	Engine Priming
	K	Engine Starting
	E	Engine Temperature
	M	Entertainment System
	W	Exceedance Horn
	C	Flap Position/Control
	F	Flight Display/ MFD
F		Flight Instruments
	E	Fuel Flow
	E	Fuel Pressure
	Q	Fuel Pumps

CHART 12 (Sheet 2 of 3)
ELECTRICAL WIRE CODING

(PIR-PPS55006, Rev. AG.)

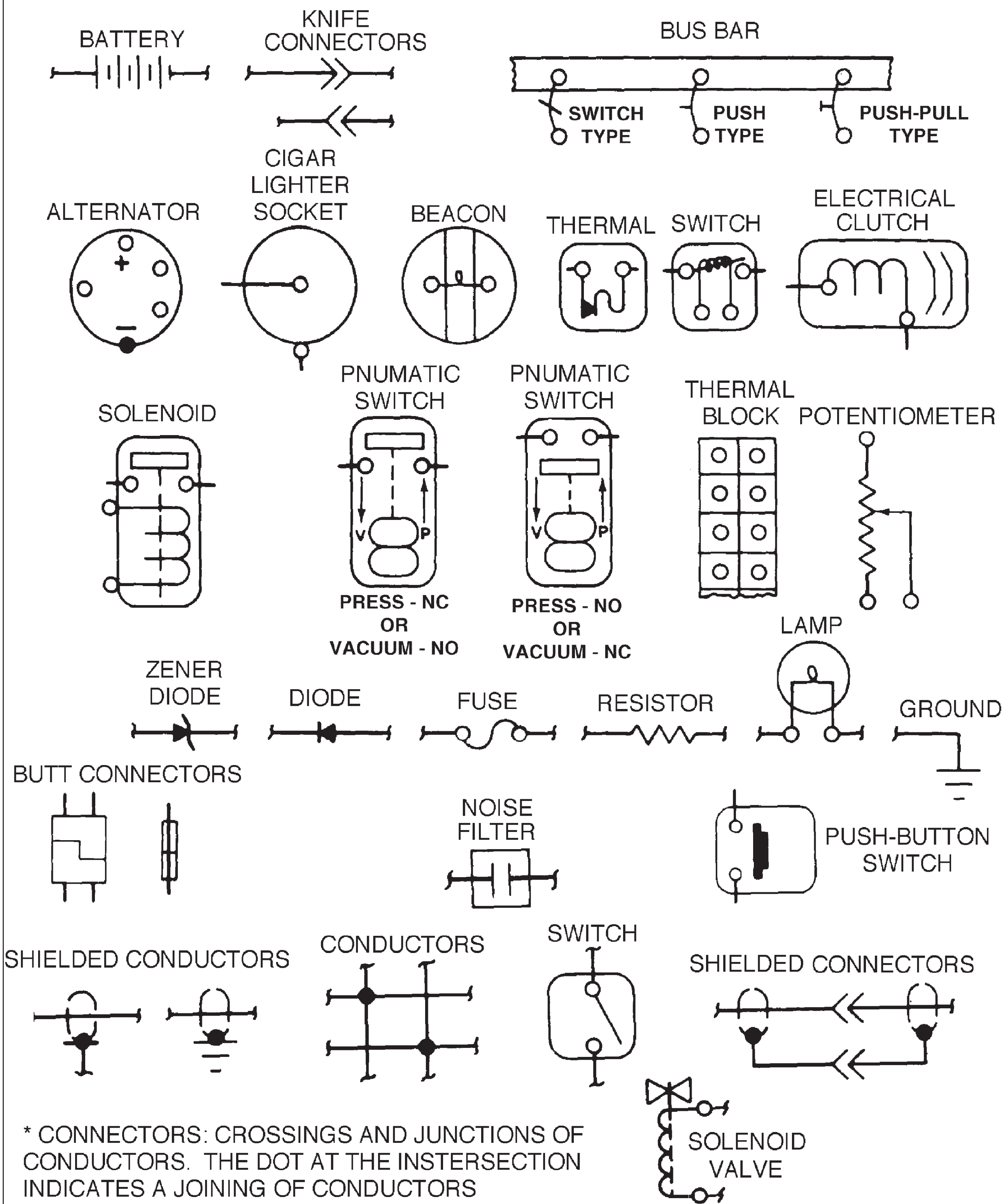
FUNCTION LETTER (Circa 2010 and Prior)	FUNCTION LETTER (Circa 2010 and Later)	CIRCUIT
Q	Q	Fuel Qty
	G	Gear Extension and Retraction
	G	Gear Position and Warning
GND		Ground
	T	Hazard Awareness (IHAS, Skywatch, etc.)
H		Heating, Ventilating
	D	Hours Meters
	G	Hydraulic Pump, Power, and Control “
J		Ignition
G		Landing Gear
	L	Landing Lights
L		Lighting
	E	Manifold Pressure
M		Misc. Equipment, Cigar Lighter, Hour Meter
	L	Navigation Lights
	E	Oil Pressure
Q		Oil Quantity
	E	Oil Temperature
OX		Oxygen
	W	Oxygen System
	L	Panel Lights
	H	Pitot Heat
	P	Power Distribution
	P	Power Generation
	P	Power Monitoring
X		Power, AC
P		Power, DC
	P	Power, External
PP		Propeller
	K	Propeller Control
	E	Propeller Overspeed Governor
RZ		Radio Audio
RC		Radio Cooling
RG		Radio Gnd
RP		Radio Power
	R	Radio, ADF
	R	Radio, Comm and Nav
	R	Radio, DME
	R	Radio, Headphone, Microphone and Speakers
	R	Radio, Transponder
	L	Recognition Lights
	W	Stall Detection and Warning
S		Stall Warning
	T	Stormscope
	L	Switch Lights

CHART 12 (Sheet 3 of 3)
ELECTRICAL WIRE CODING

(PIR-PPS55006, Rev. AG.)

FUNCTION LETTER (Circa 2010 and Prior)	FUNCTION LETTER (Circa 2010 and Later)	CIRCUIT
	E	Tachometer
	L	Taxi Lights
	D	Vacuum System
GB		Vent / Defogger
W		Warning
	H	Windshield Heat

CHART 13 (Sheet 1 of 3)
ELECTRICAL SYMBOLS (OLD STYLE)



* CONNECTORS: CROSSINGS AND JUNCTIONS OF CONDUCTORS. THE DOT AT THE INSTERSECTION INDICATES A JOINING OF CONDUCTORS

CHART 13 (Sheet 2 of 3)
ELECTRICAL SYMBOLS

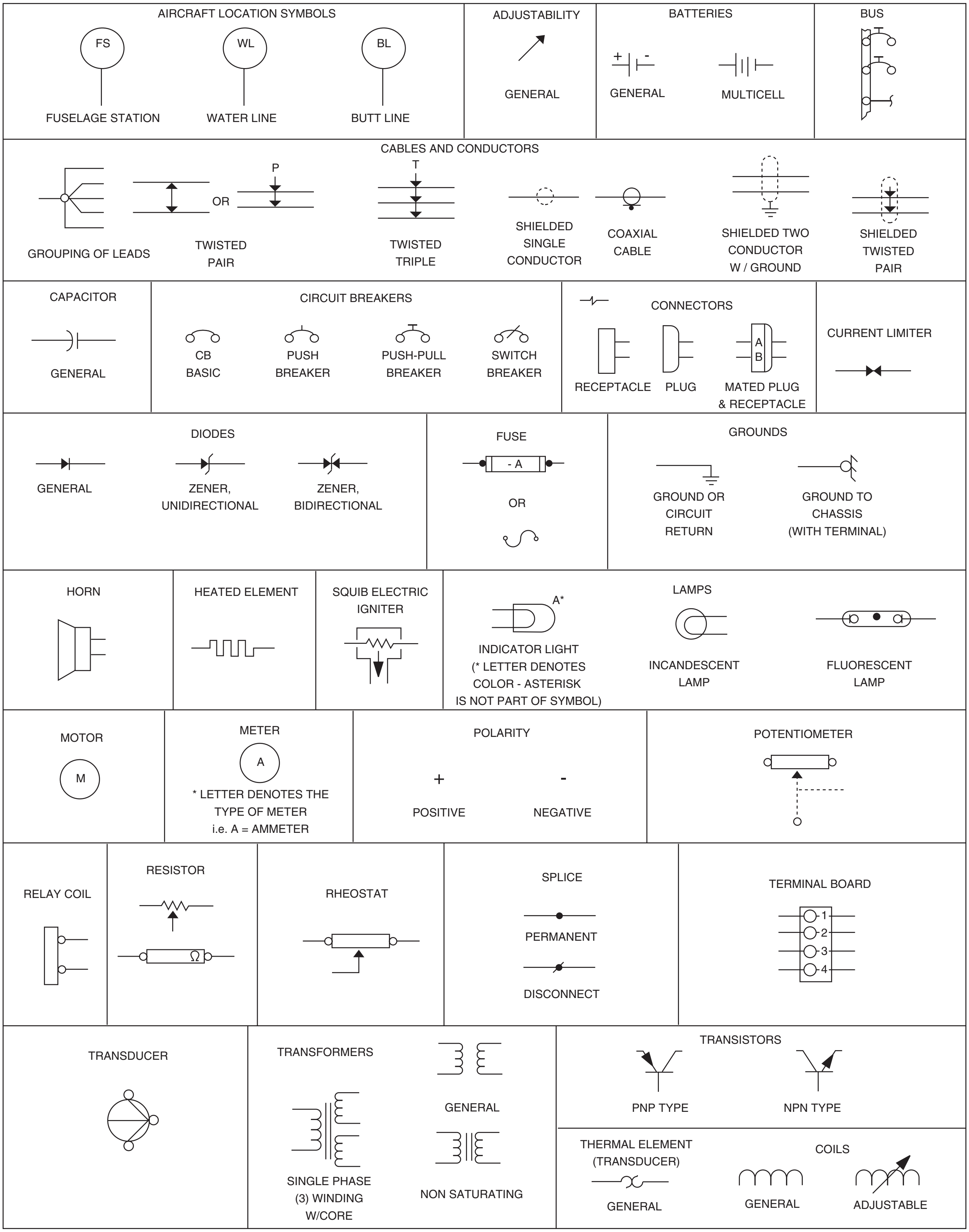


CHART 13 (Sheet 3 of 3)
ELECTRICAL SYMBOLS

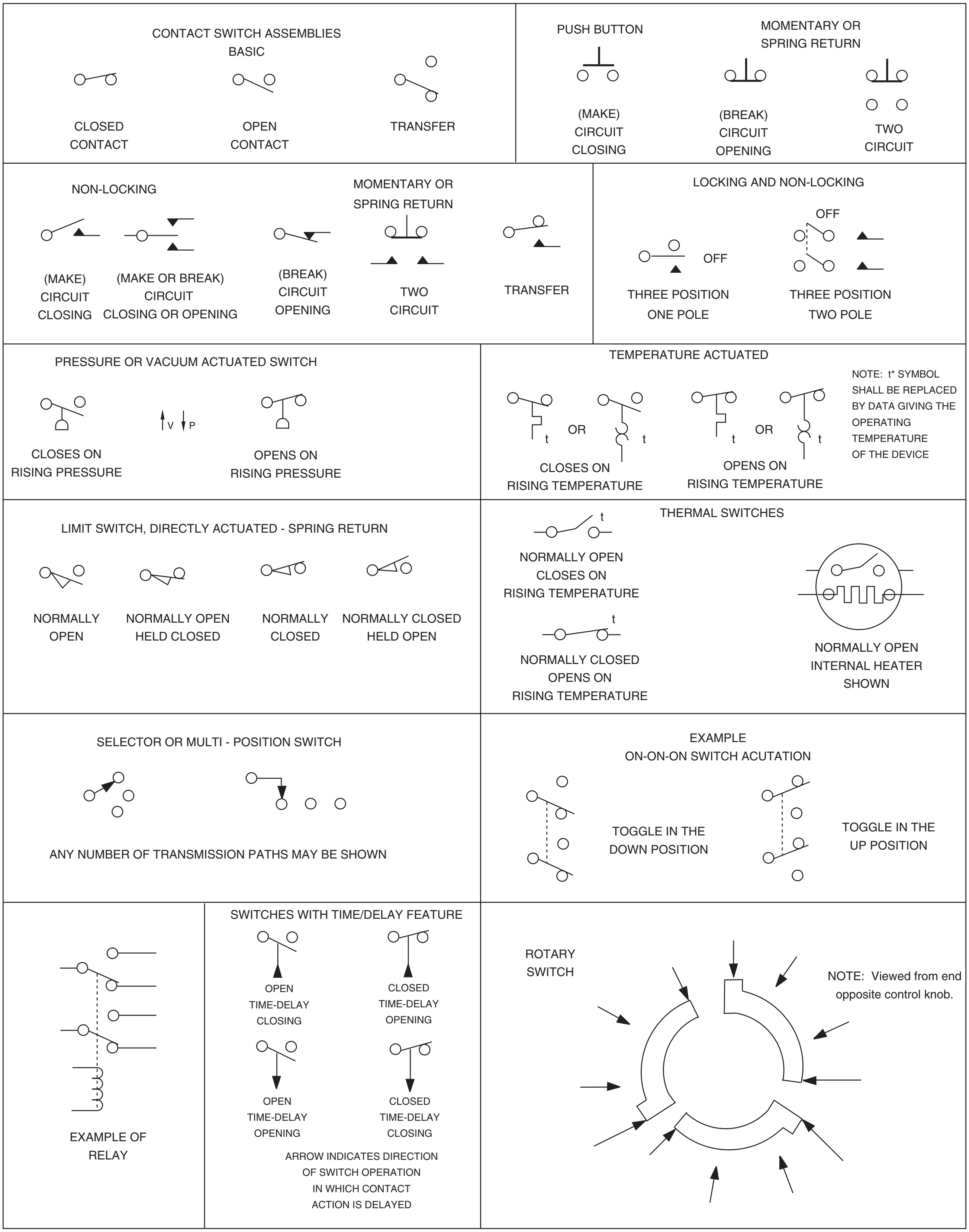


CHART 14
ELECTRICAL / ELECTRONIC COMPONENT REFERENCE DESIGNATION CODES

All electrical / electronic components are assigned a unique reference code which indicates component function and general location within the airplane.

S 301

Class Designation Letter (from list at right)

Component Number (location within airplane indicated by number ranges below:)

100 to 199 -- Electrical - Left Wing and Nacelle
200 to 299 -- Electrical - Right Wing and Nacelle
300 to 399 -- Electrical - Fuselage area (inside cabin)
400 to 499 -- Electrical - Fuselage area (outside cabin)
500 to 599 -- Avionics - Left Wing and Nacelle
600 to 699 -- Avionics - Right Wing and Nacelle
700 to 799 -- Avionics - Fuselage area (inside cabin)
800 to 899 -- Avionics - Fuselage area (outside cabin)

So, the example above, S301, represents either a flasher, switch, or thermostat located in the left fuselage area inside the cabin.

Component	Class Letter
Alternator	G
Annunciator	DS
Antenna	E
Battery	BT
Blower / Fan / Motor	B
Capacitor	C
Circuit Breaker	CB
Clock	M
Compass	M
Contactor	K
Diode	D or CR
Flasher	S
Fuse	F
Generator	G
Heater	HR
Horn	LS
Hour Meter	M
Indicator Lamp	DS
Instrument	M
Jack	J
Light	L
Magneto	G
Miscellaneous Electrical Part	E
Plug	P
Potentiometer	R
Power Supply	PS
Pump	B
Receptacle	J
Rectifier	CR or D
Relay / Solenoid	K
Resistor	R
Sensor	A or MT
Shunt	R
Speaker	LS
Splice	SP
Starter	B
Switch	S
Terminal	E
Terminal Board	TB
Thermocouple	TC
Thermostat	S
Transducer	A or MT
Transformer	T
Transistor	Q
Voltage Regulator	VR
Zener Diode	D

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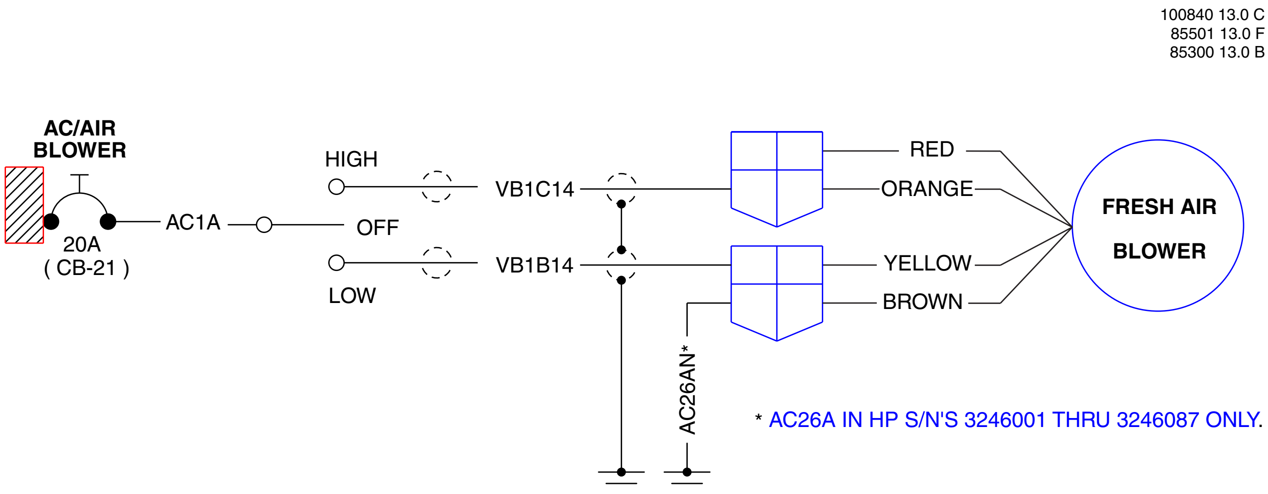
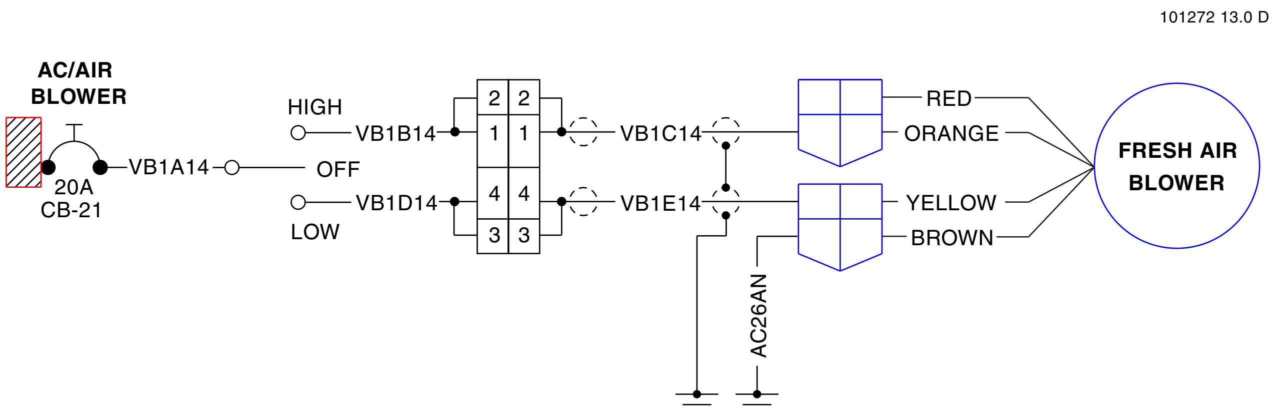
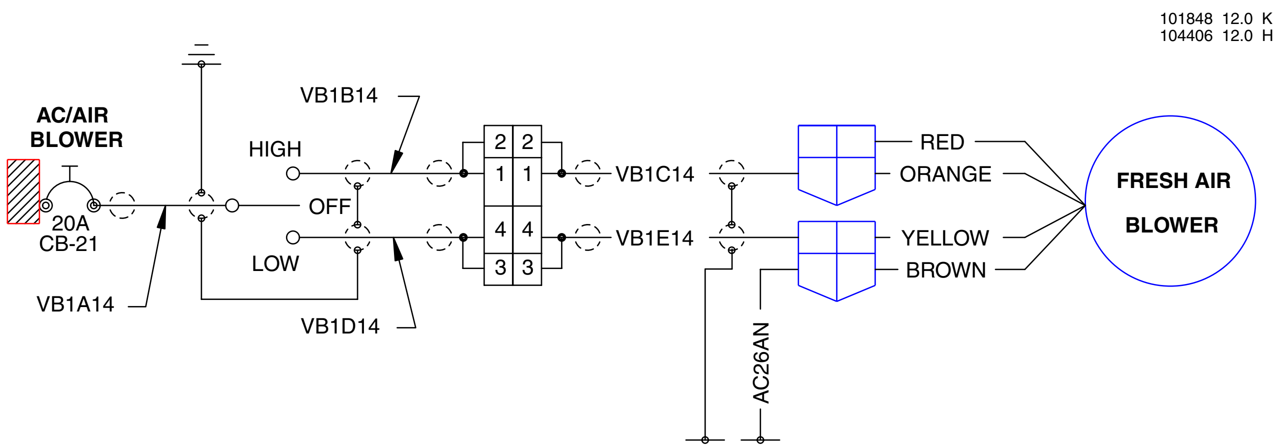


HP S/N'S 3246001 THRU 3246125 ONLY; TC S/N'S 3257001 THRU 3257074 ONLY

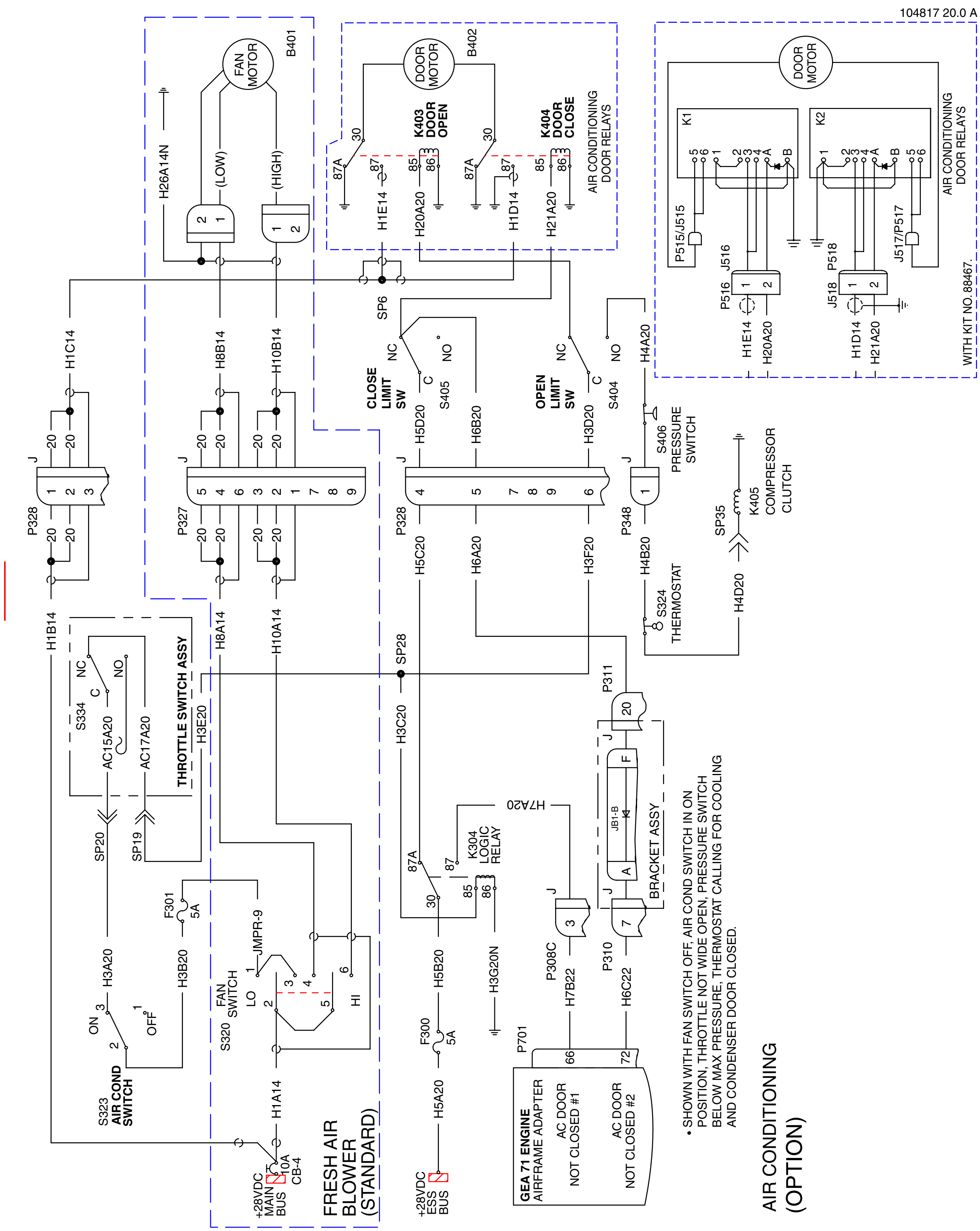


HP S/N'S 3246126 THRU 3246181 ONLY; TC S/N'S 3257075 THRU 3257198 ONLY



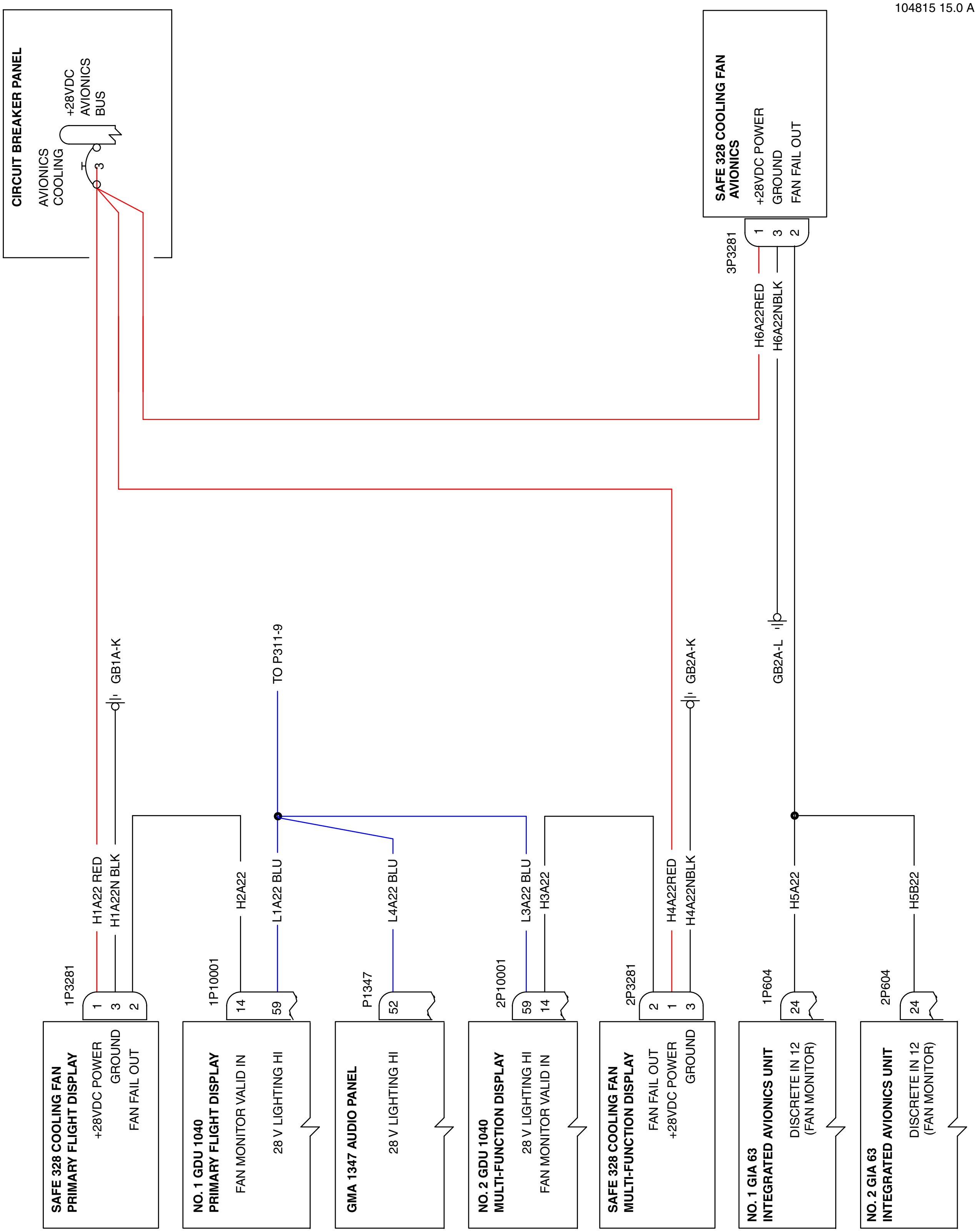
HP S/N'S 3246182 & UP; TC S/N'S 3257199 & UP

Fresh Air Blower
Figure 1 (Sheet 1 of 2)



Effectivity
with Garmin G1000

Fresh Air Blower
Figure 1 (Sheet 2 of 2)



Avionics Cooling and Lighting
Figure 2

Effectivity
with Garmin 1000

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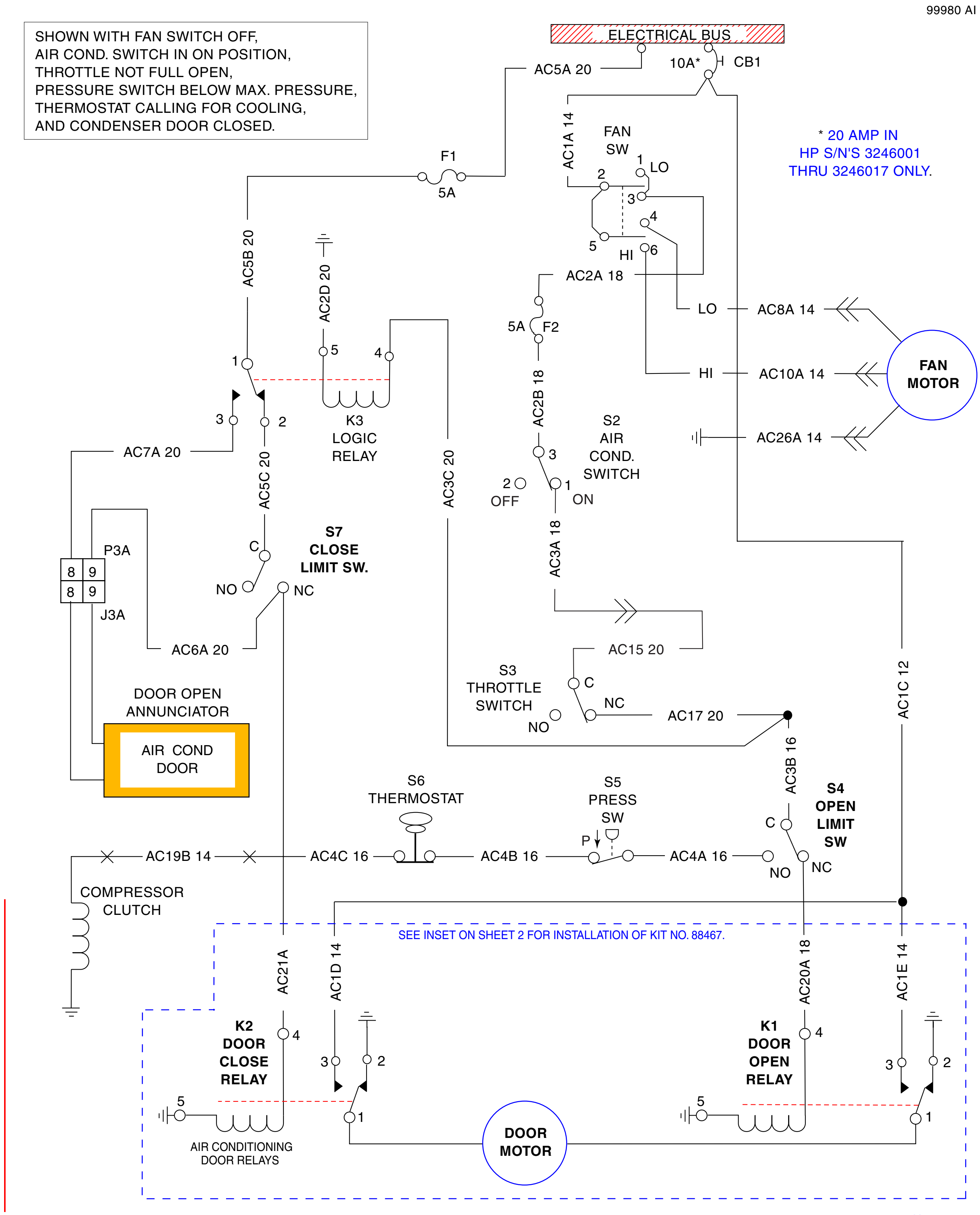
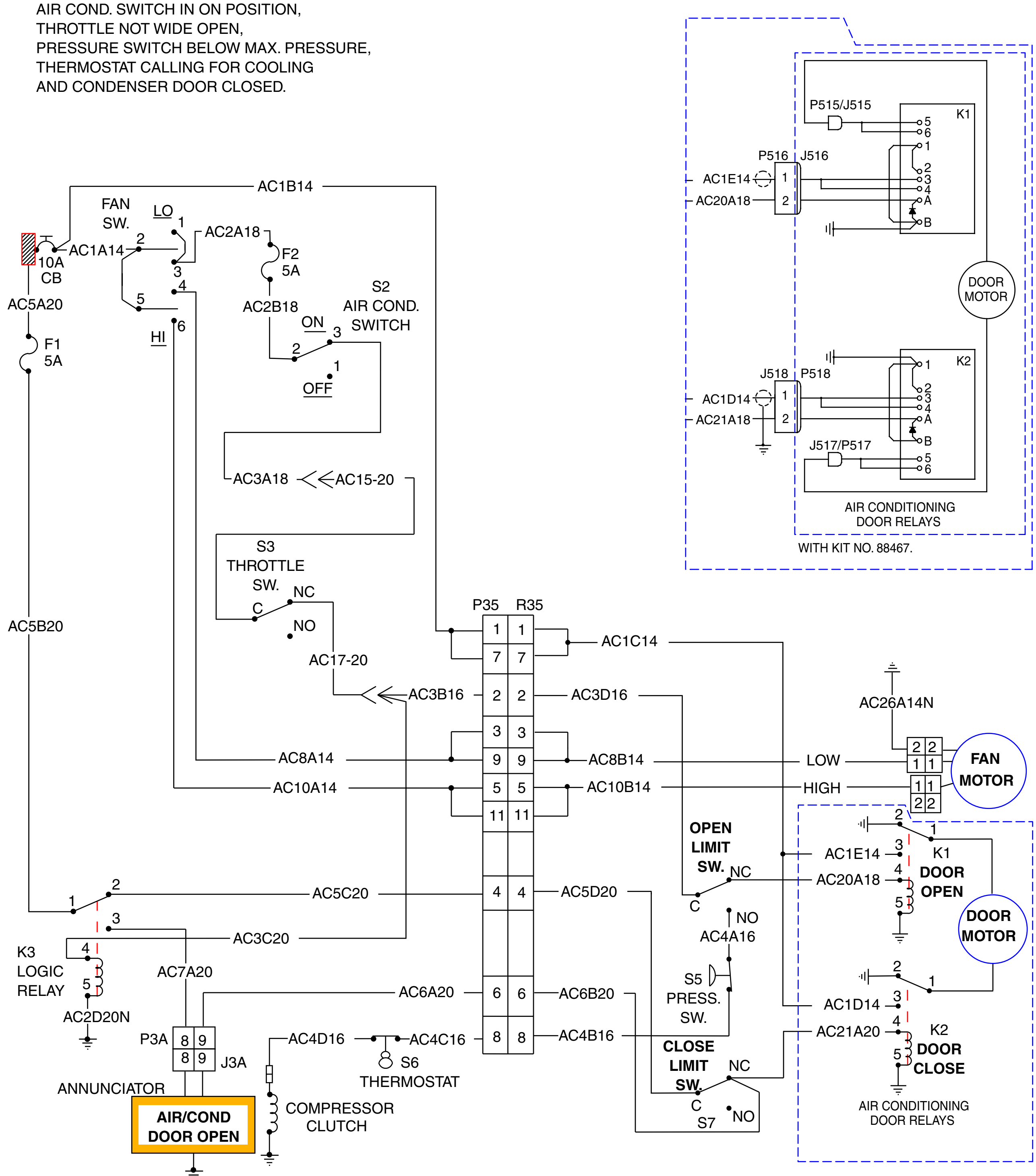


Air Conditioning
Figure 1 (Sheet 1 of 4)

Effectivity
3246001 thru 3246125
3257001 thru 3257075

101272 34.0 D
104141 33.0 C

SHOWN WITH FAN SWITCH OFF,
AIR COND. SWITCH IN ON POSITION,
THROTTLE NOT WIDE OPEN,
PRESSURE SWITCH BELOW MAX. PRESSURE,
THERMOSTAT CALLING FOR COOLING
AND CONDENSER DOOR CLOSED.



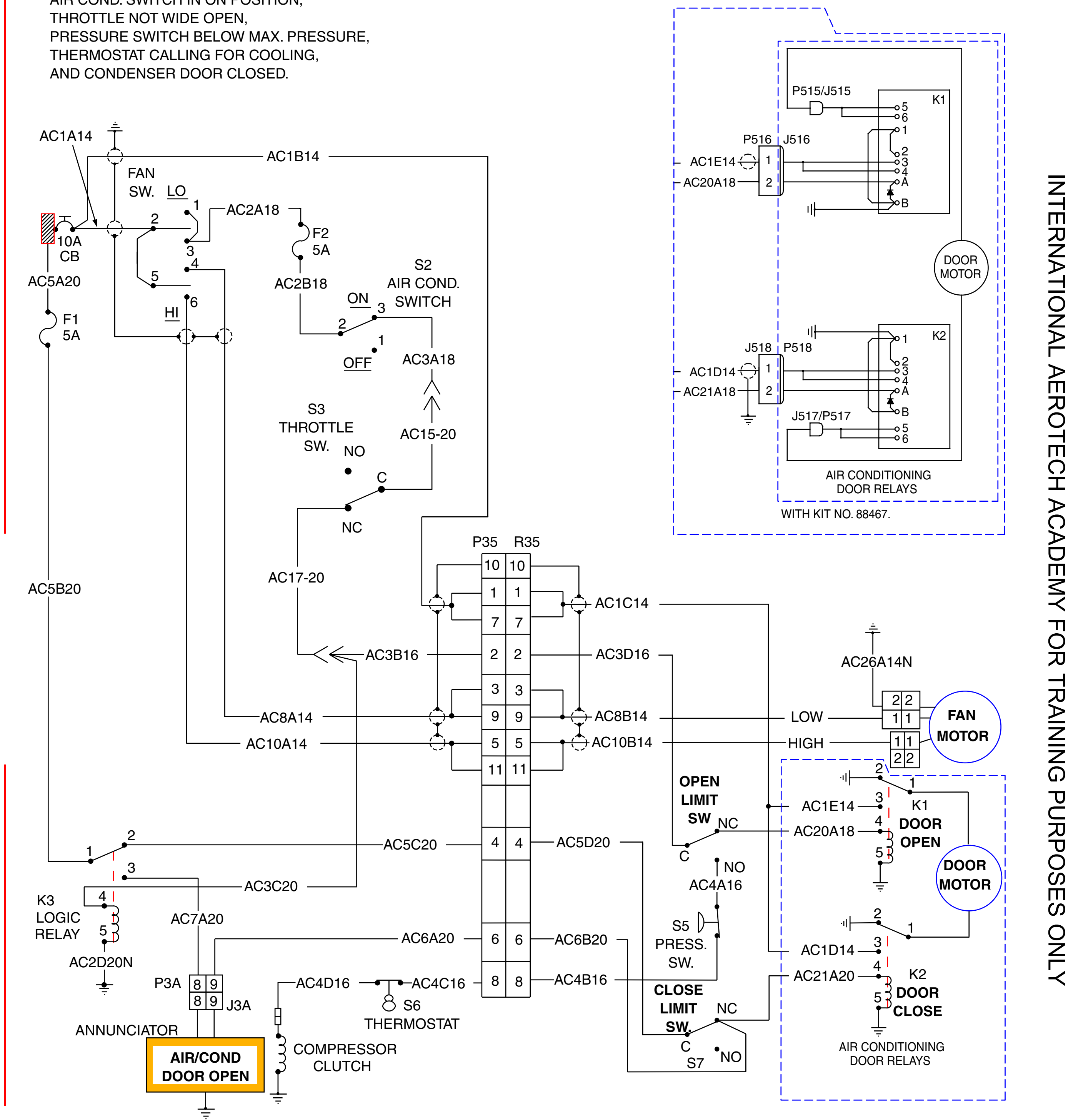
INTERNATIONAL AEROTECH ACADEMY FOR TRAINING PURPOSES ONLY

Effectivity
3246126 thru 3246181
3257076 thru 3257198

Air Conditioning
Figure 1 (Sheet 2 of 4)

101848 30.0 H
104406 33.0 E

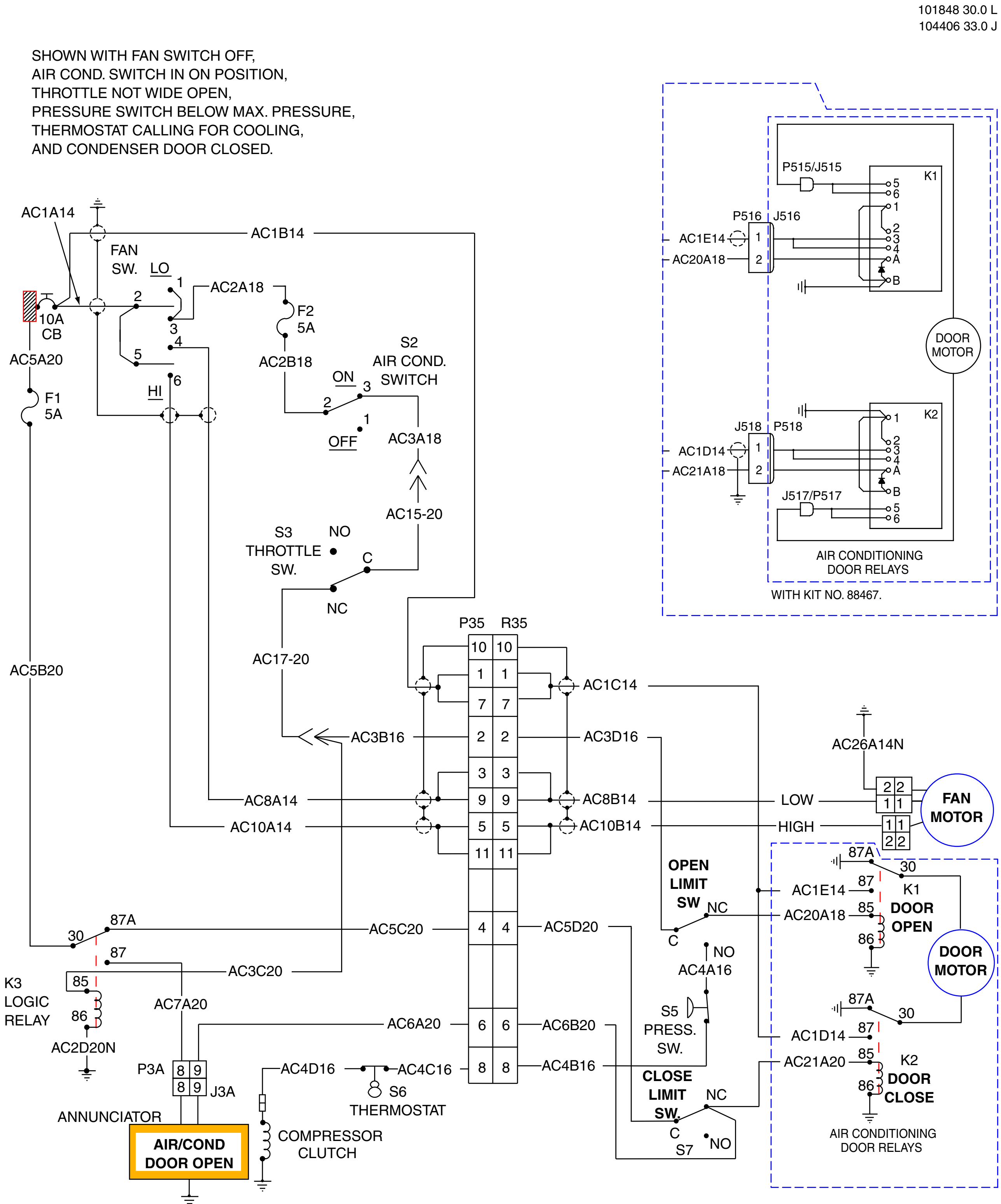
SHOWN WITH FAN SWITCH OFF,
AIR COND. SWITCH IN ON POSITION,
THROTTLE NOT WIDE OPEN,
PRESSURE SWITCH BELOW MAX. PRESSURE,
THERMOSTAT CALLING FOR COOLING,
AND CONDENSER DOOR CLOSED.



NOTE: FOR AIRPLANES EQUIPPED WITH GARMIN G1000 EFIS, SEE 91-21-20, FIGURE 1, SHEET 2.

Air Conditioning
Figure 1 (Sheet 3 of 4)

Effectivity
3246182 thru 3246244
3257199 thru 3257454



NOTE: FOR AIRPLANES EQUIPPED WITH GARMIN G1000 EFIS, SEE 91-21-20, FIGURE 1, SHEET 2.

Effectivity
3257455 and up

Air Conditioning
Figure 1 (Sheet 4 of 4)

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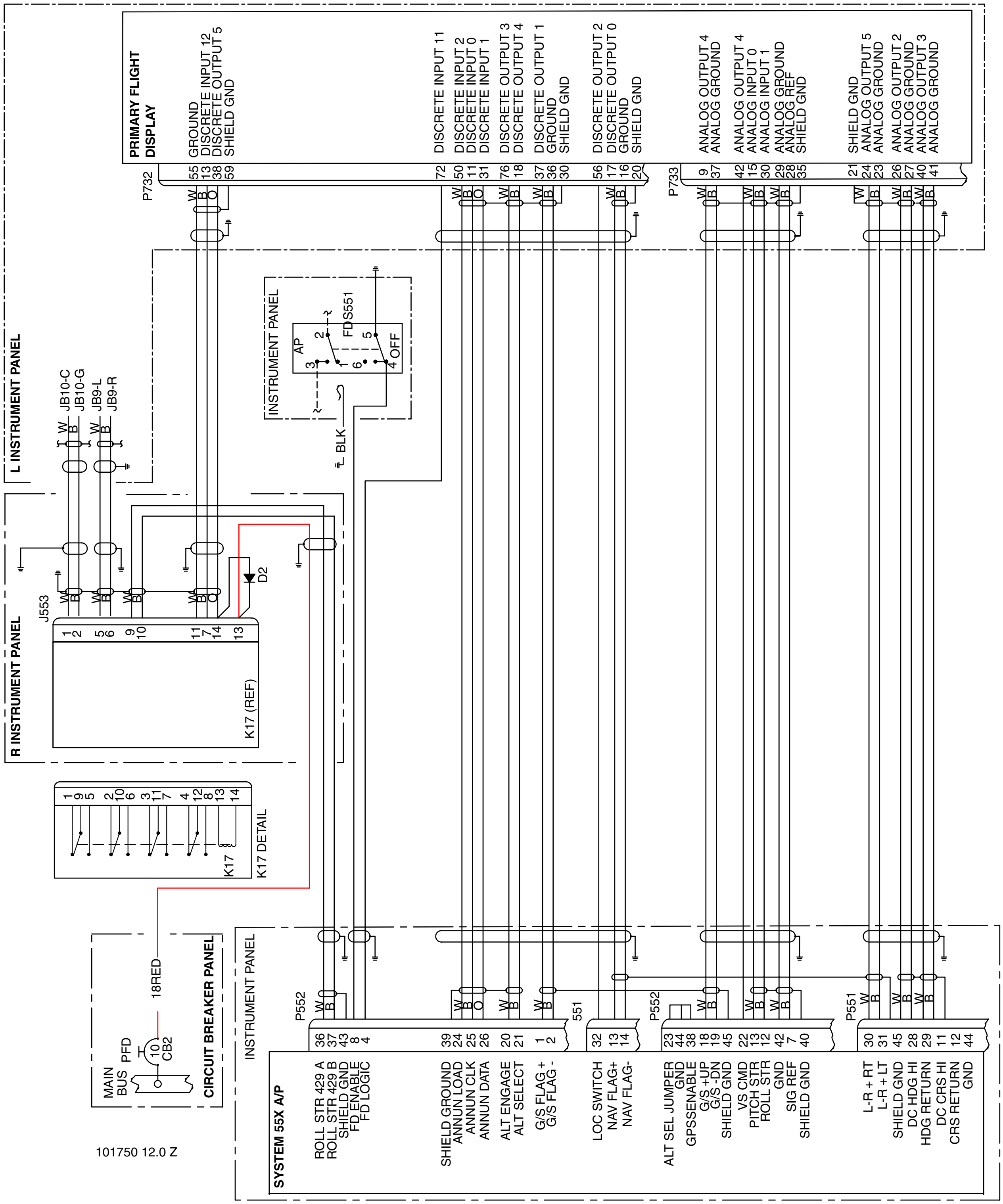
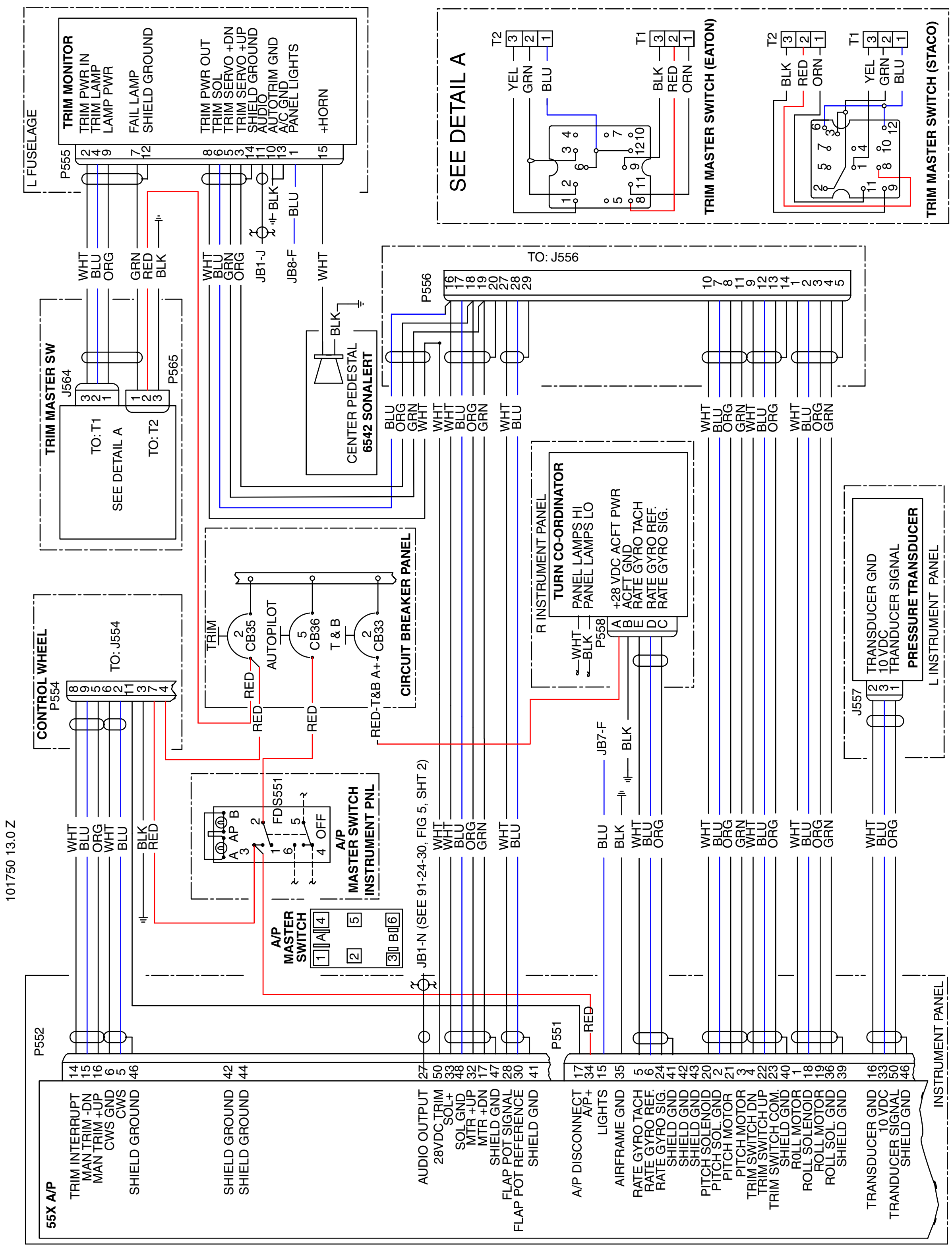


Autopilot
Figure 1 (Sheet 1 of 7)

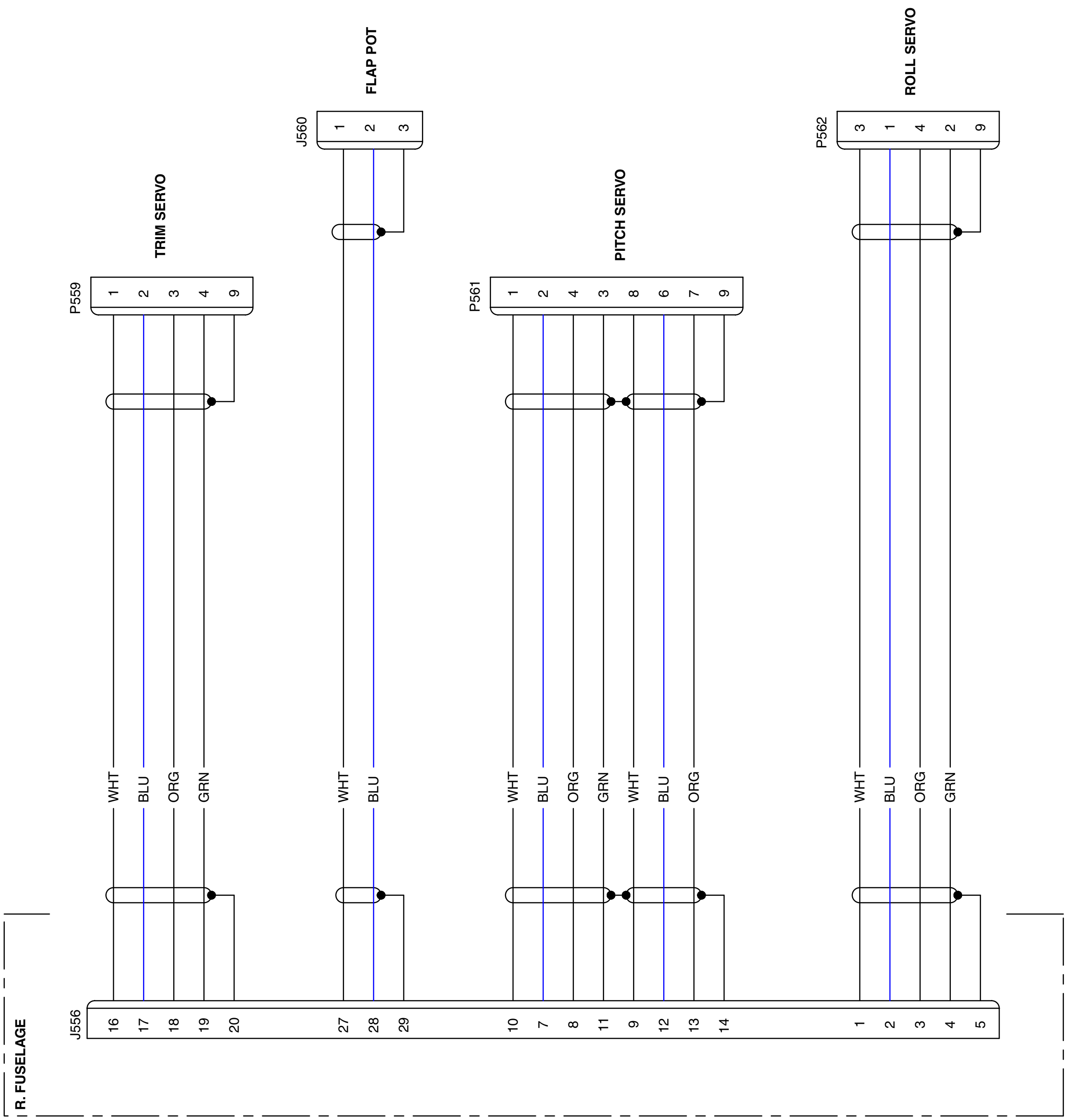
Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra



Autopilot
Figure 1 (Sheet 2 of 7)

Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

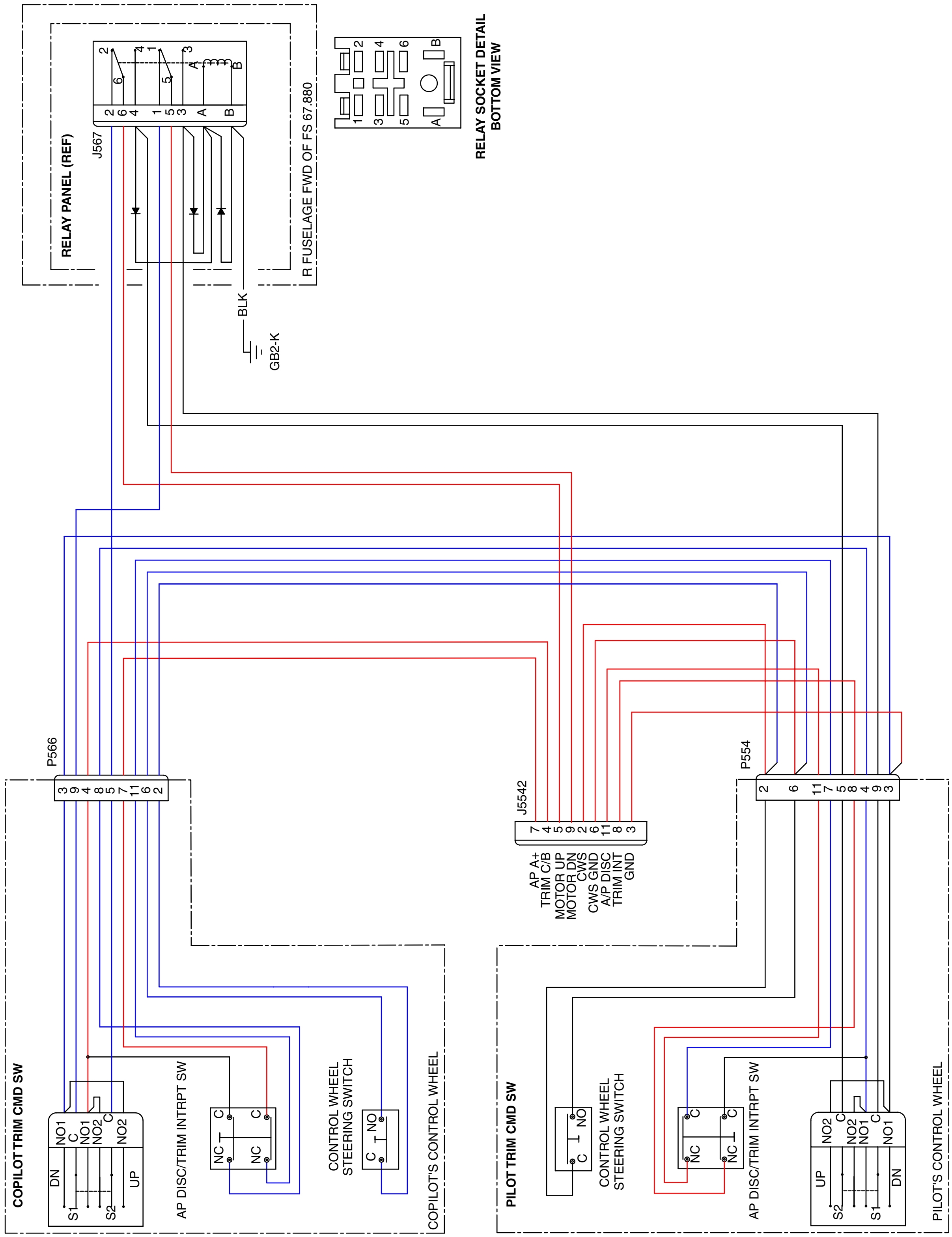
101750 20.0 Z



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

Autopilot
Figure 1 (Sheet 3 of 7)

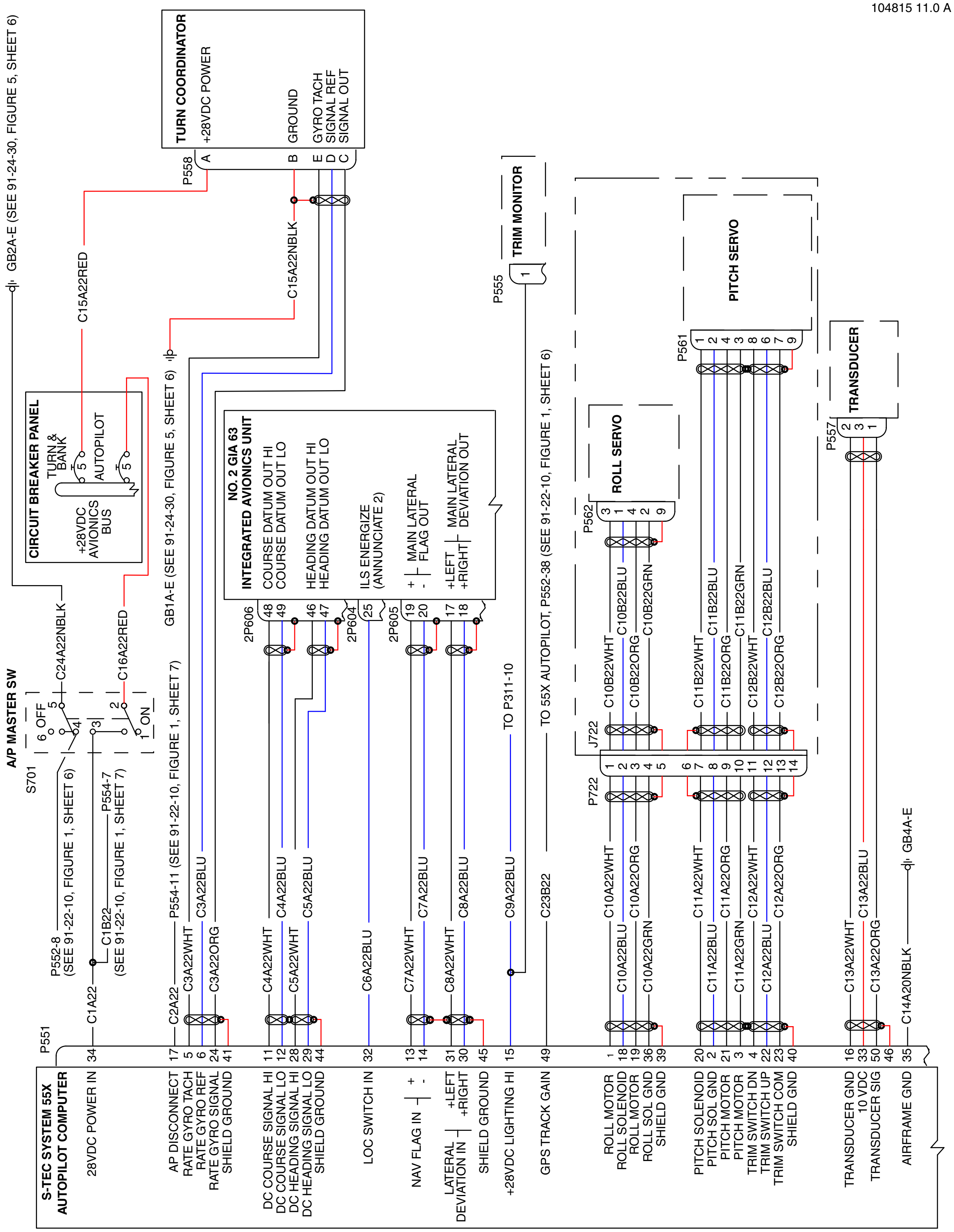
101750 21.0 Z



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

Autopilot
Figure 1 (Sheet 4 of 7)

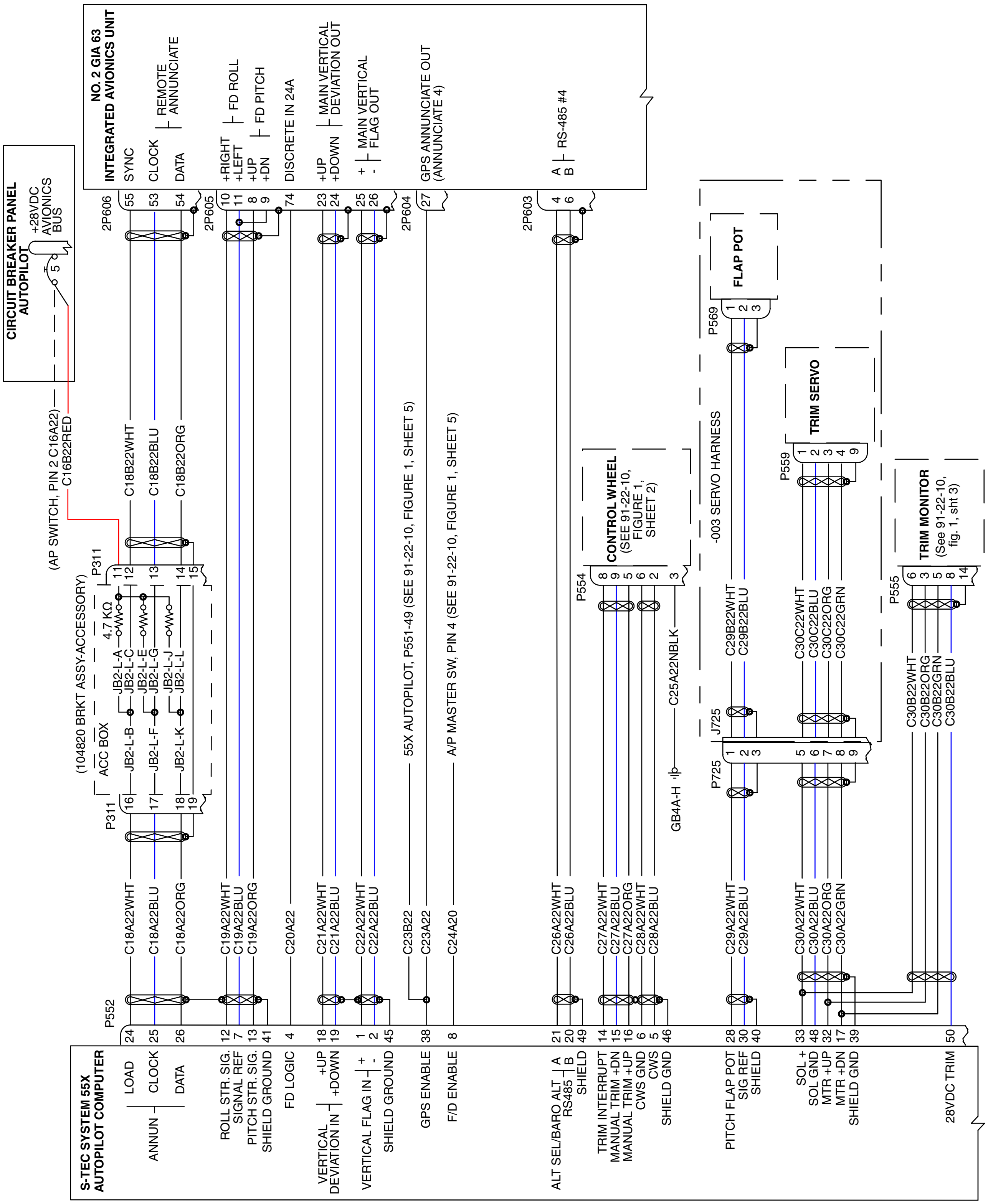
104815 11.0 A



Autopilot
Figure 1 (Sheet 5 of 7)

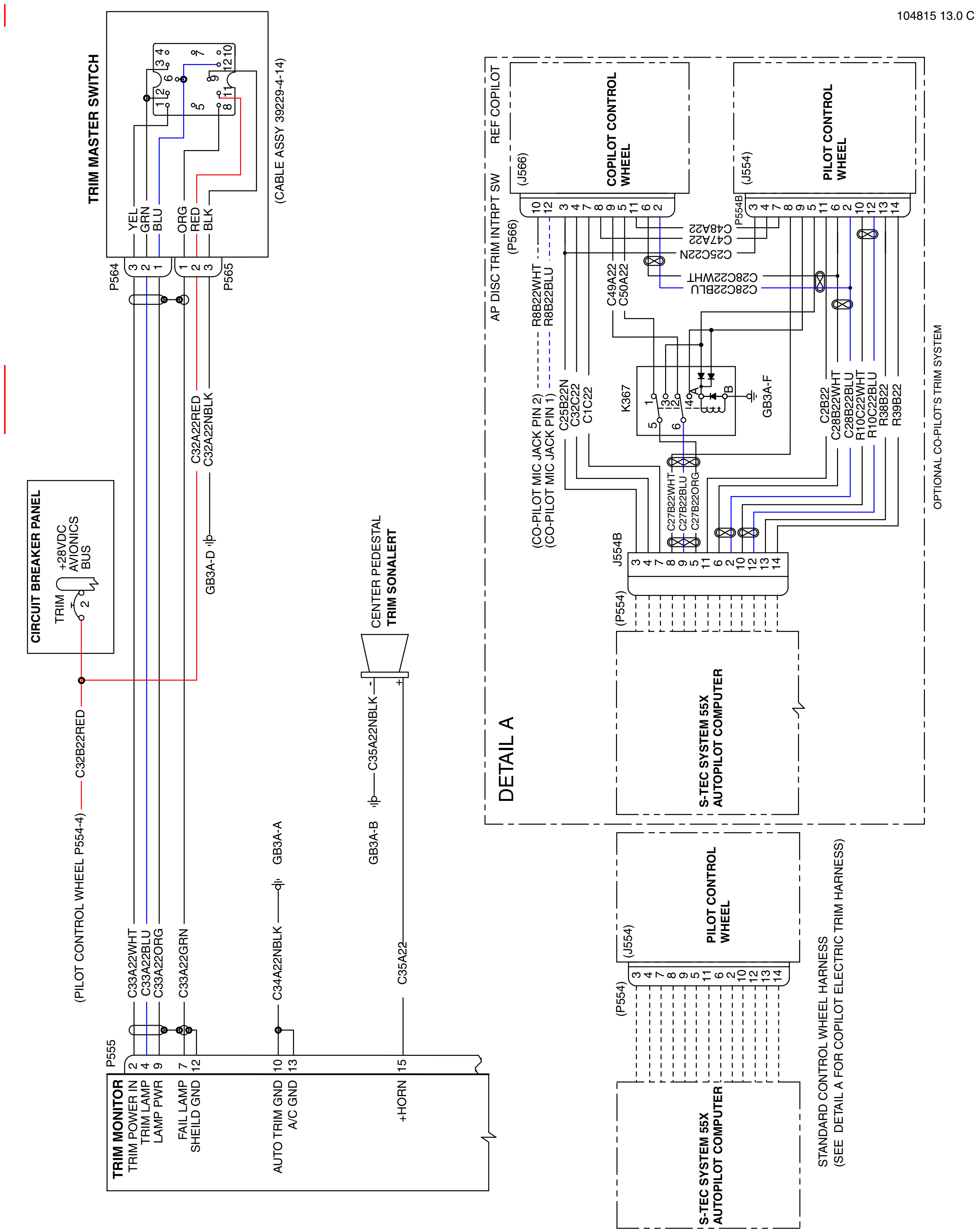
Effectivity
with Garmin 1000

104815 12.0 A



Effectivity
with Garmin 1000

Autopilot
Figure 1 (Sheet 6 of 7)



Autopilot
Figure 1 (Sheet 7 of 7)

Effectivity
with Garmin 1000

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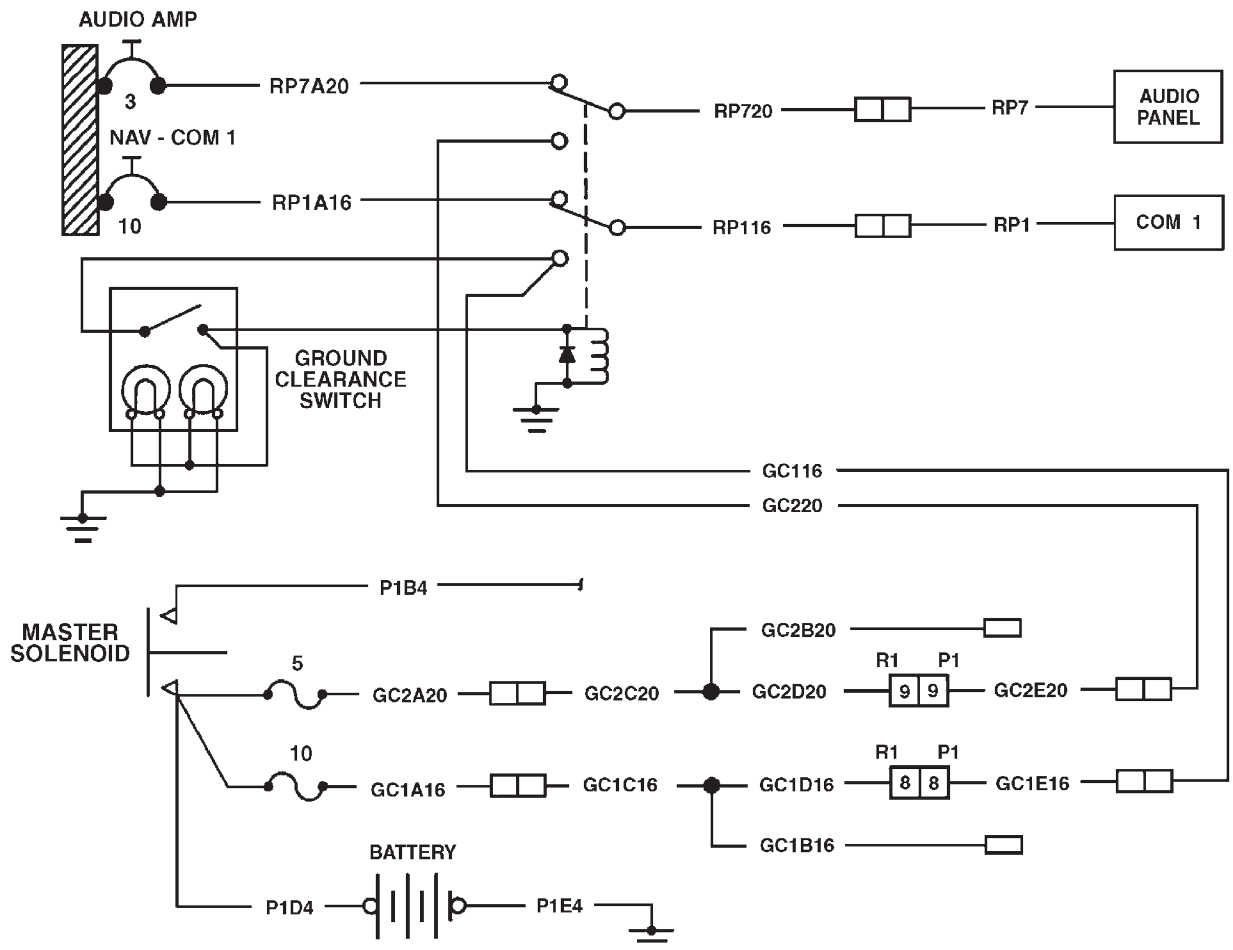
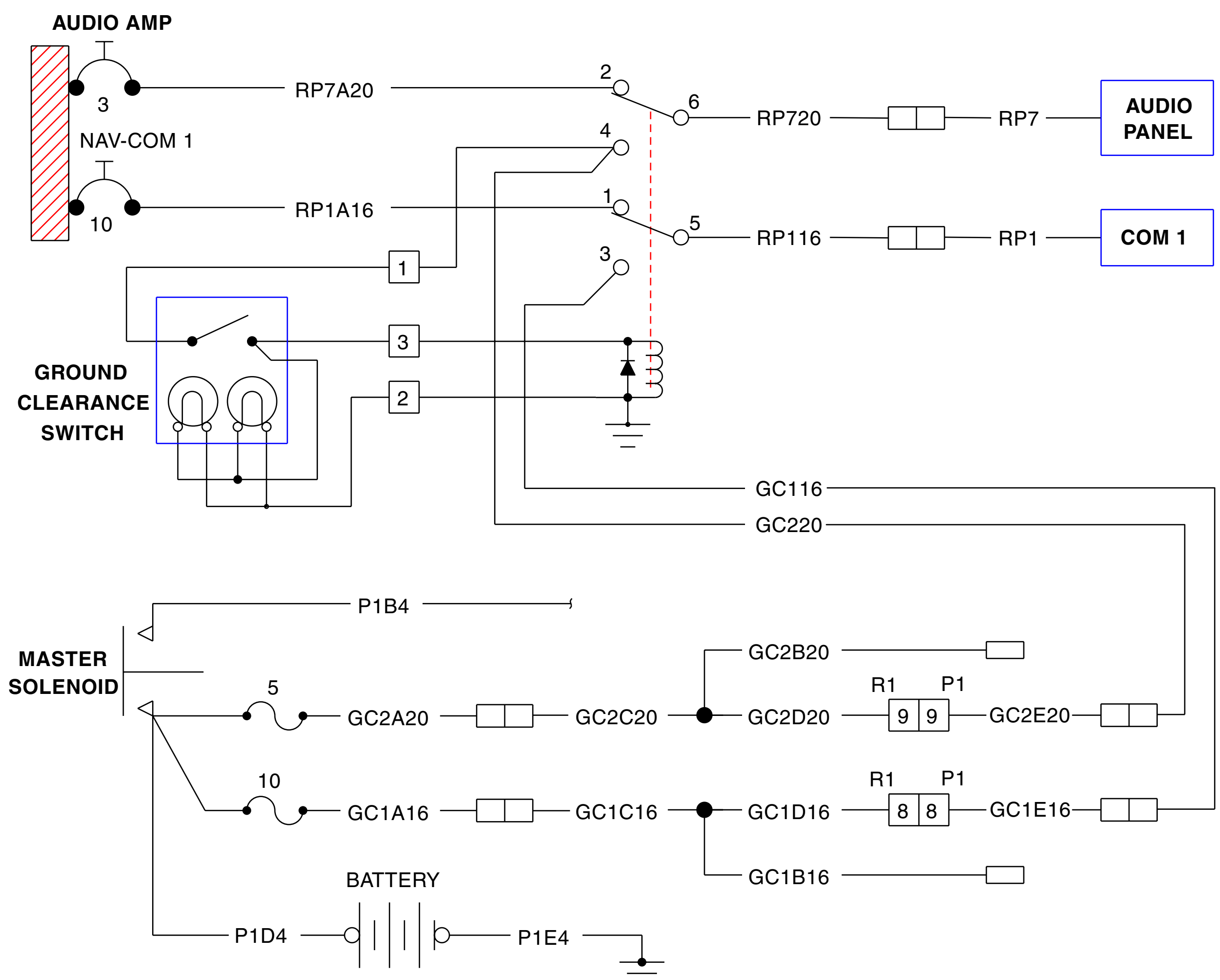
85300 16.0 NEW / B



Ground Clearance
Figure 1 (Sheet 1 of 4)

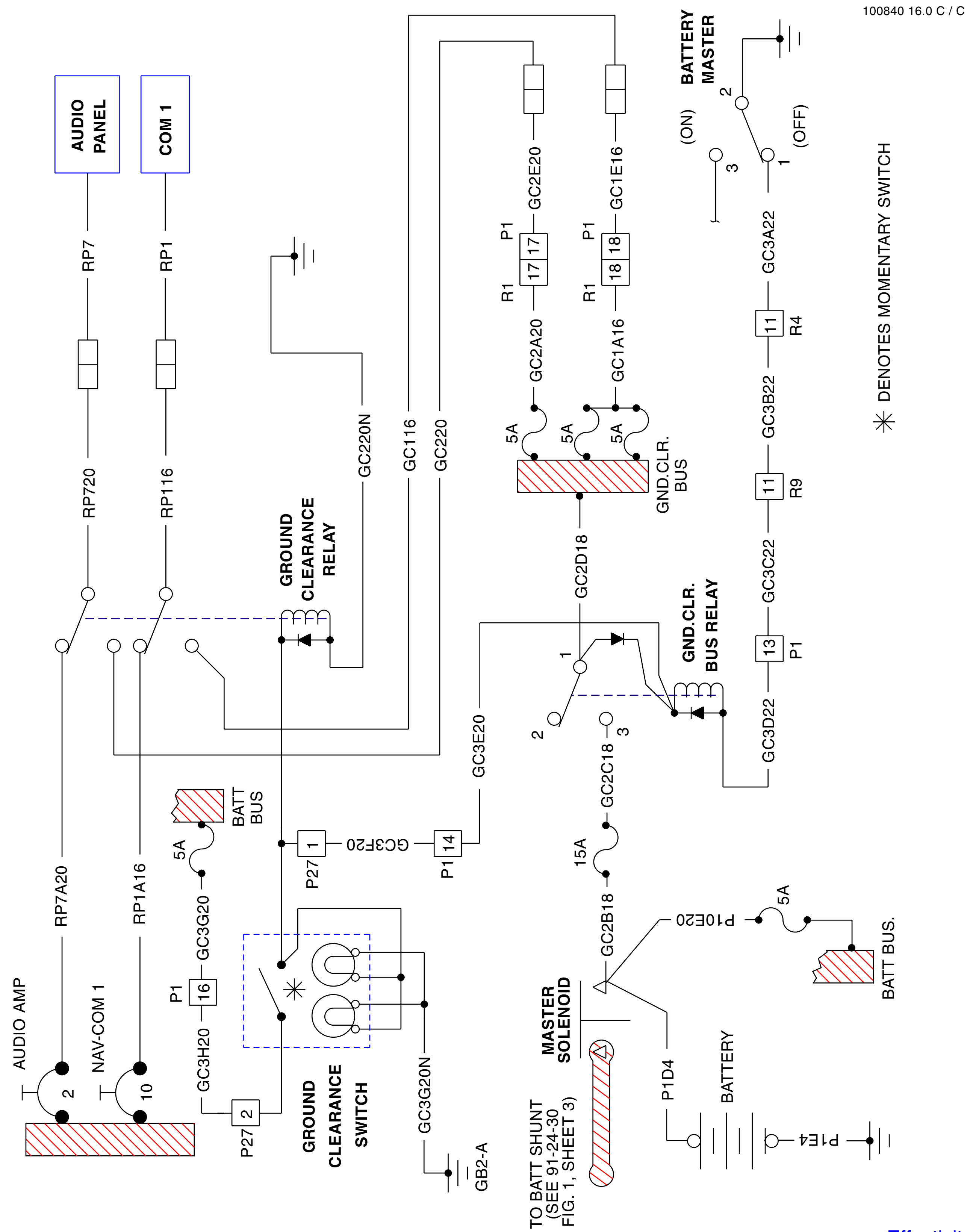
Effectivity
3246001 thru 3246017

85501 16.0 F / F



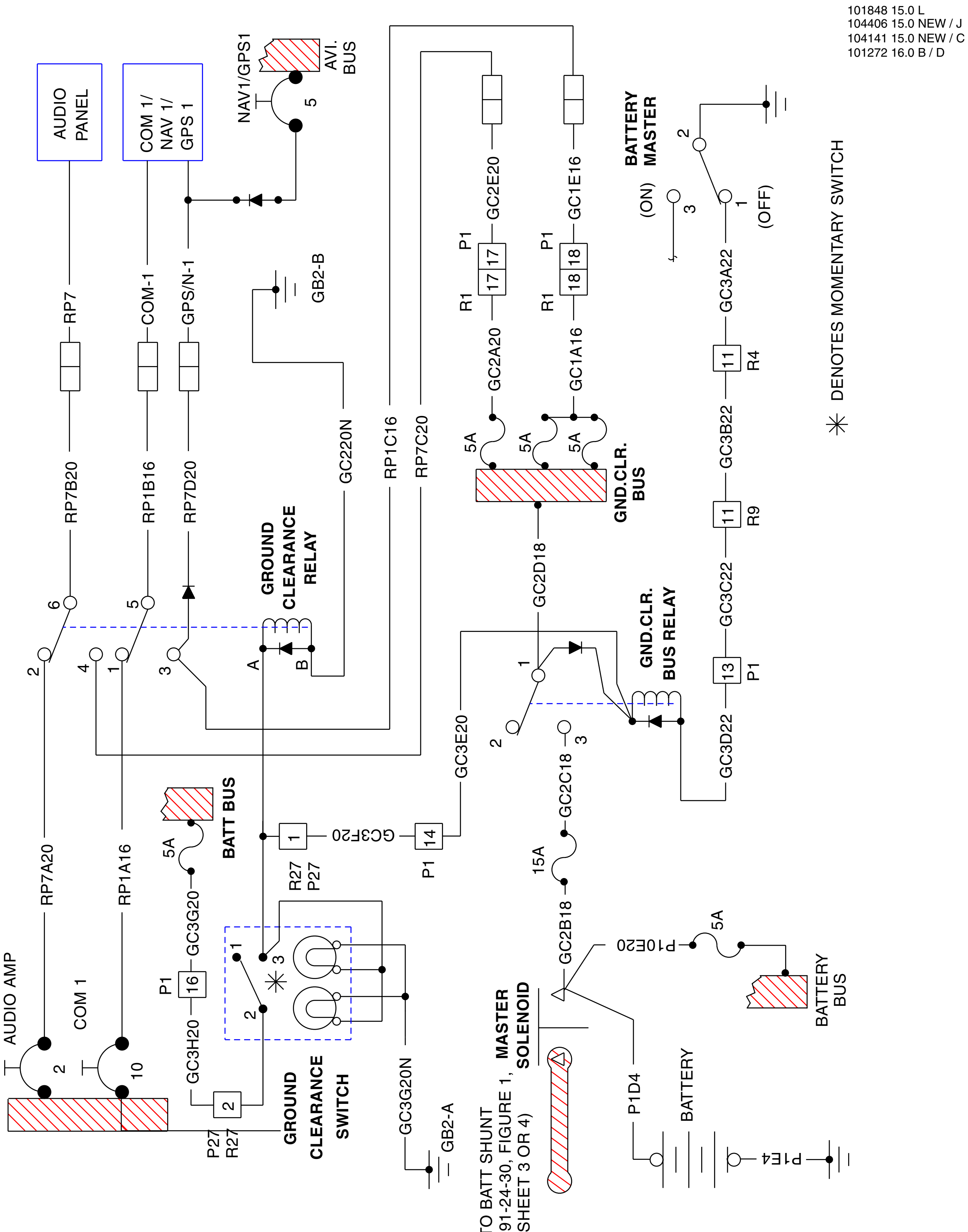
Effectivity
3246018 thru 3246087

Ground Clearance
Figure 1 (Sheet 2 of 4)



Ground Clearance
Figure 1 (Sheet 3 of 4)

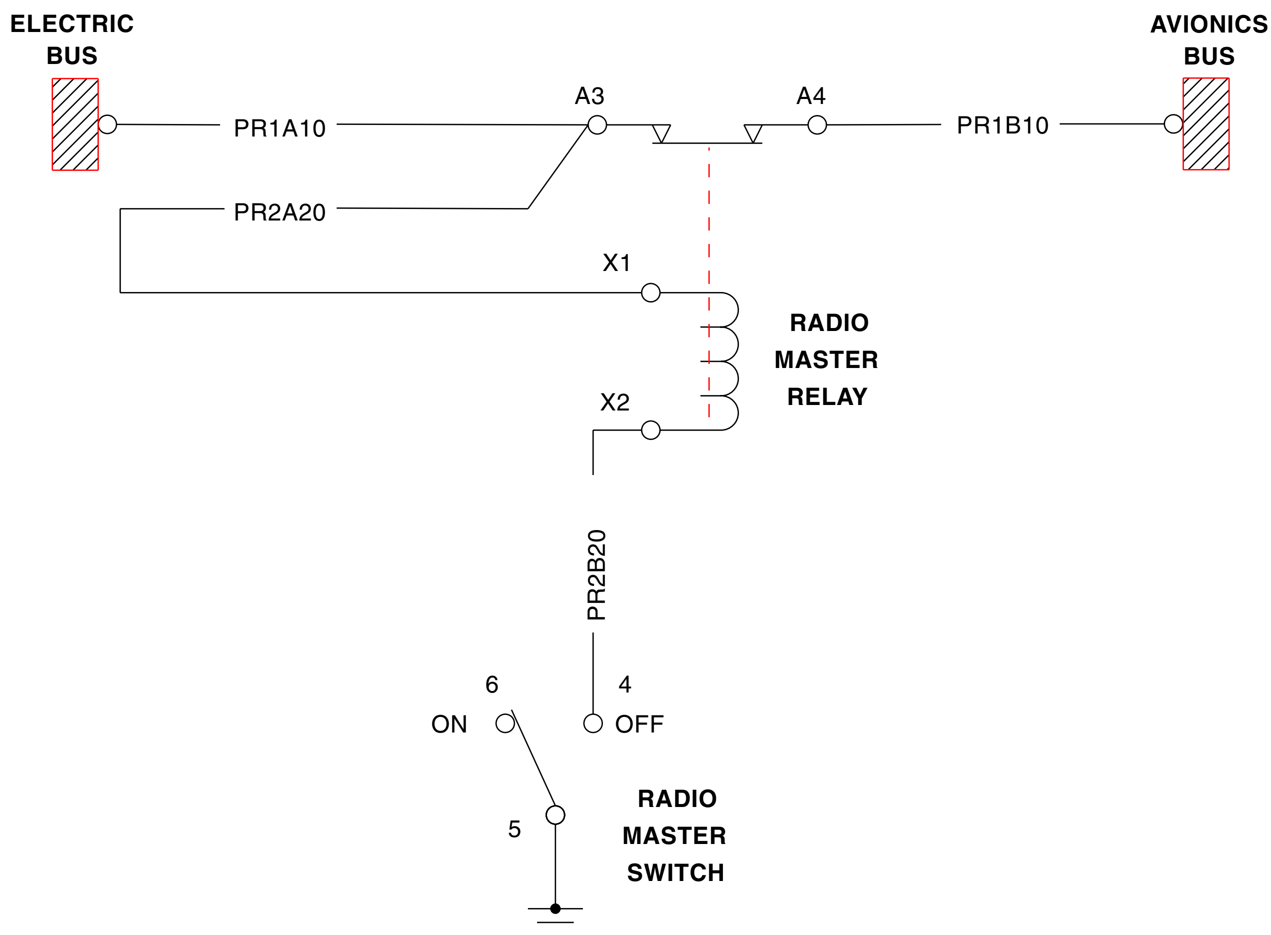
Effectivity
3246088 thru 3246125
3257001 thru 3257074



Effectivity
3246126 and up
3257075 and up

Ground Clearance
Figure 1 (Sheet 4 of 4)

101848 14.0 L
104406 14.0 NEW / J
104141 14.0 NEW / C
101272 15.0 NEW / D
100840 15.0 NEW / C
85501 15.0 NEW / F
85300 15.0 NEW / B



Radio Master Switch
Figure 2

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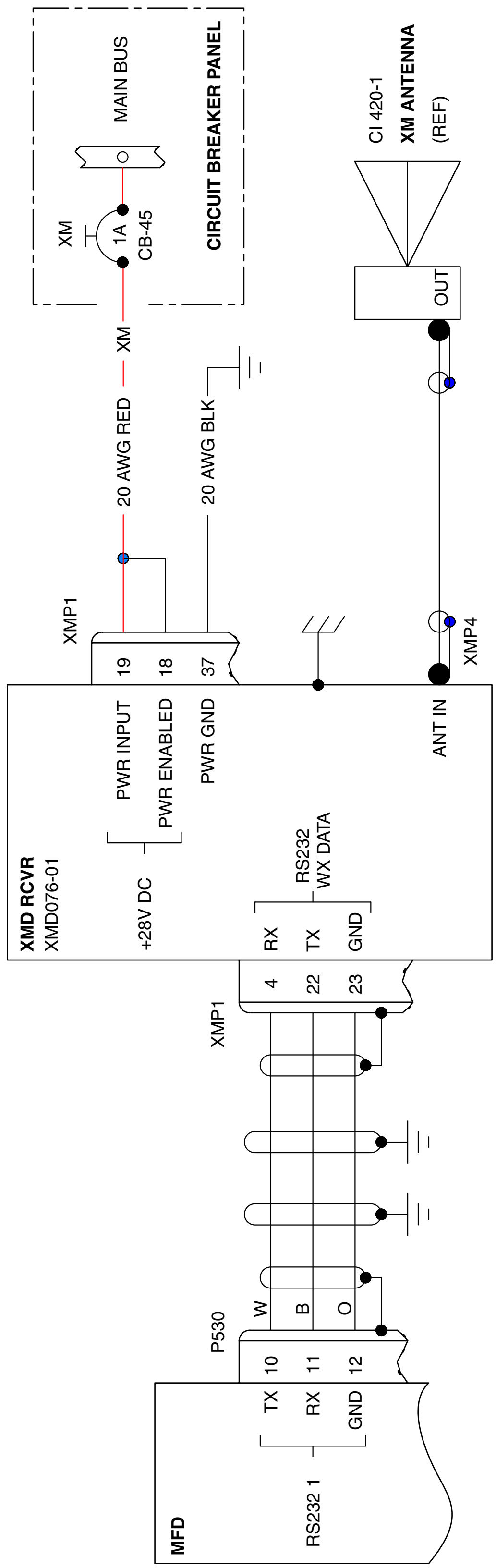
101750 25.0 Z



XM Receiver
Figure 1

Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

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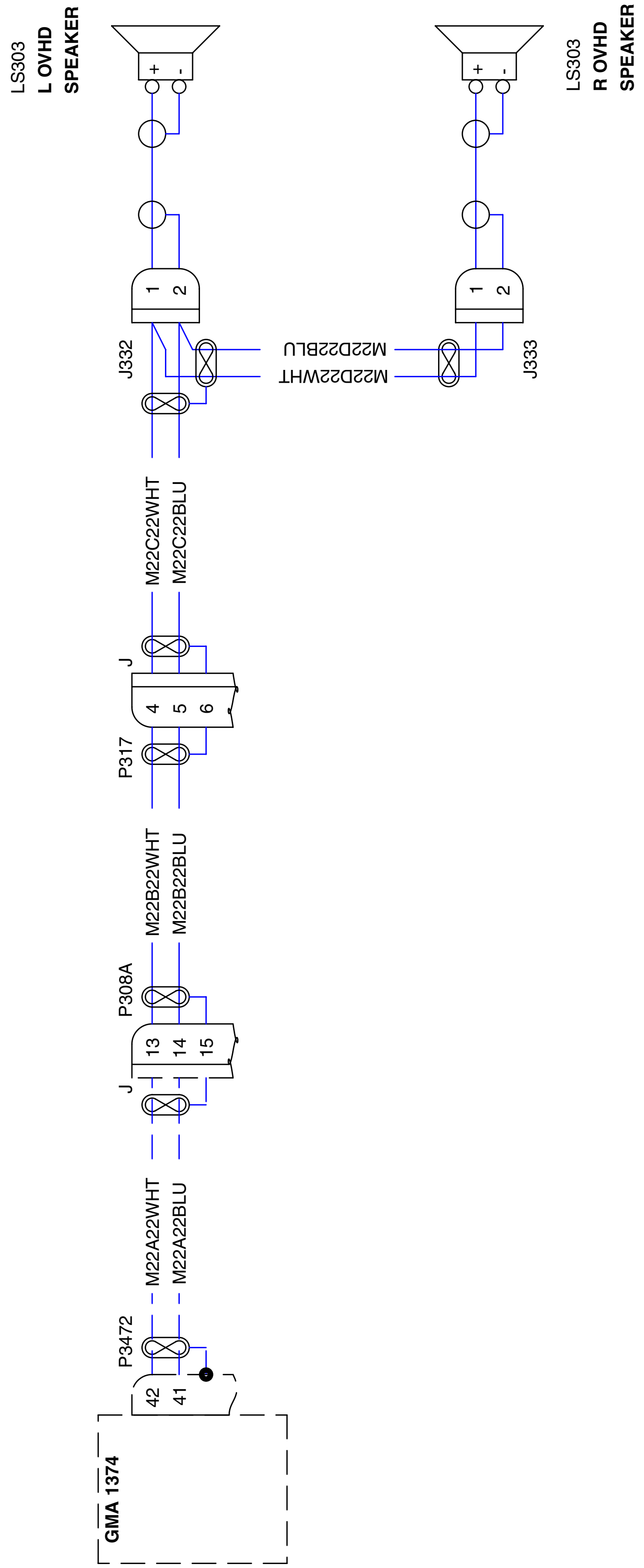
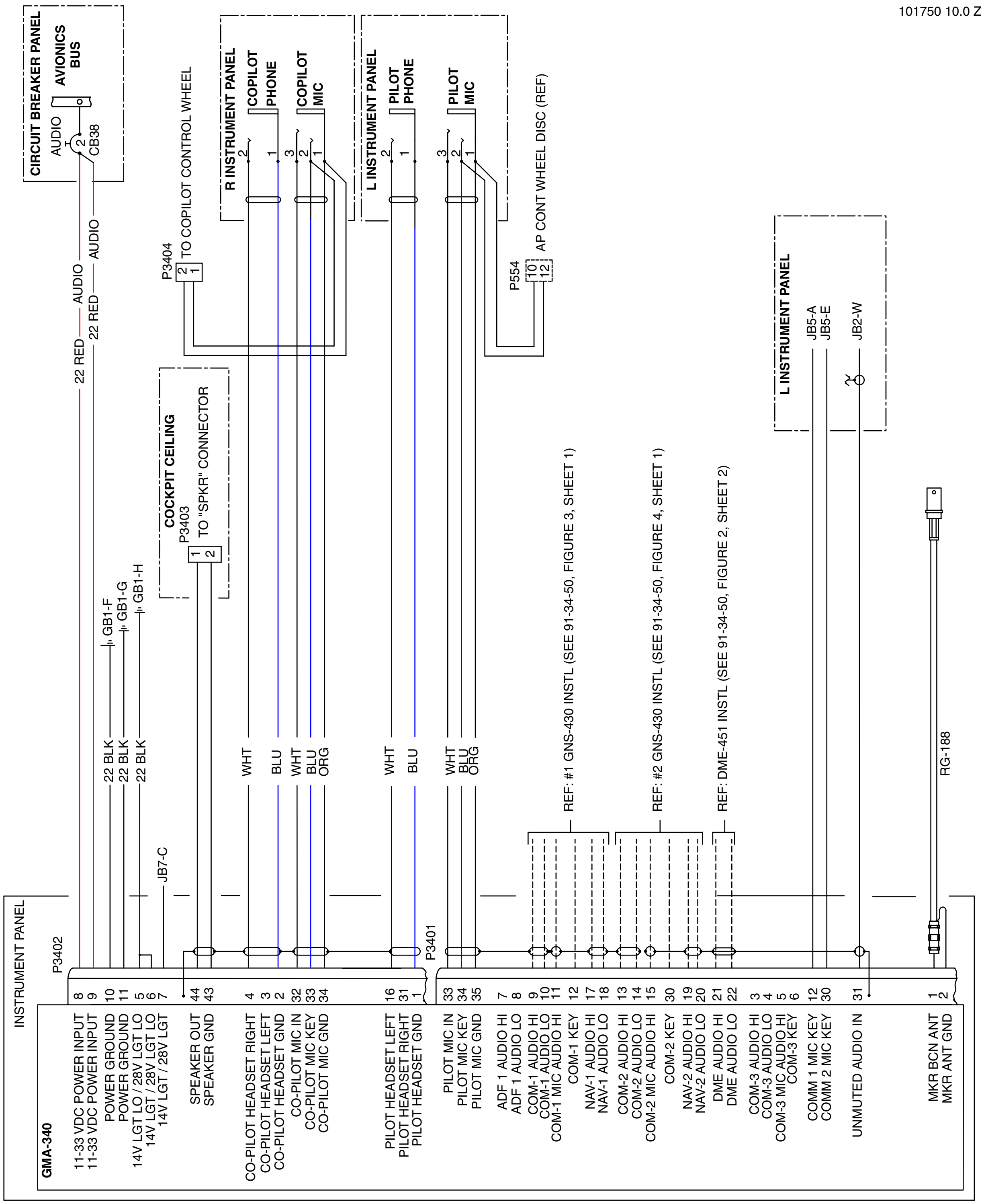
104817 11.0 A



Overhead Speakers
Figure 1

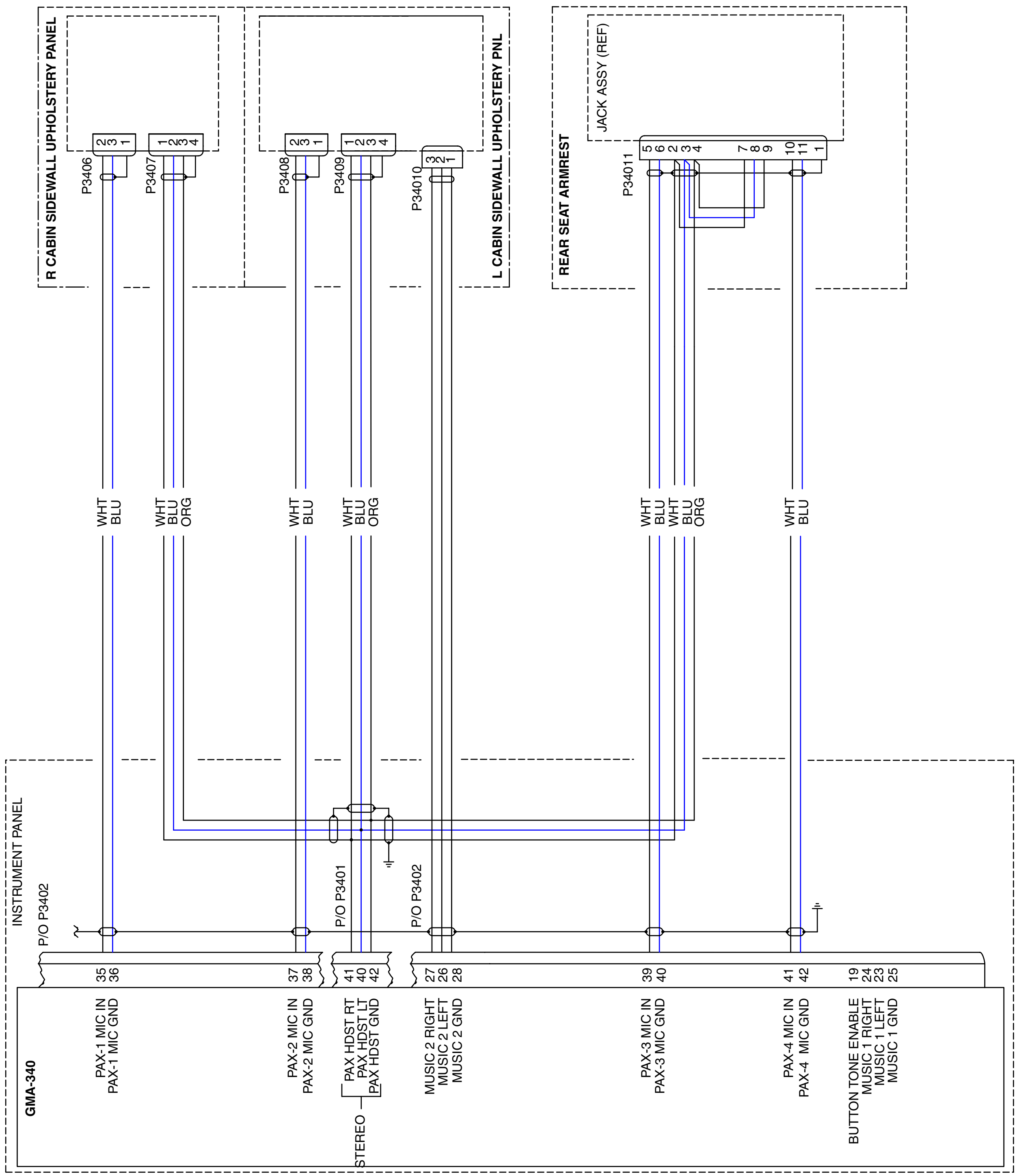
Effectivity
with Garmin 1000



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

GMA 340 Audio Panel
Figure 2 (Sheet 1 of 2)

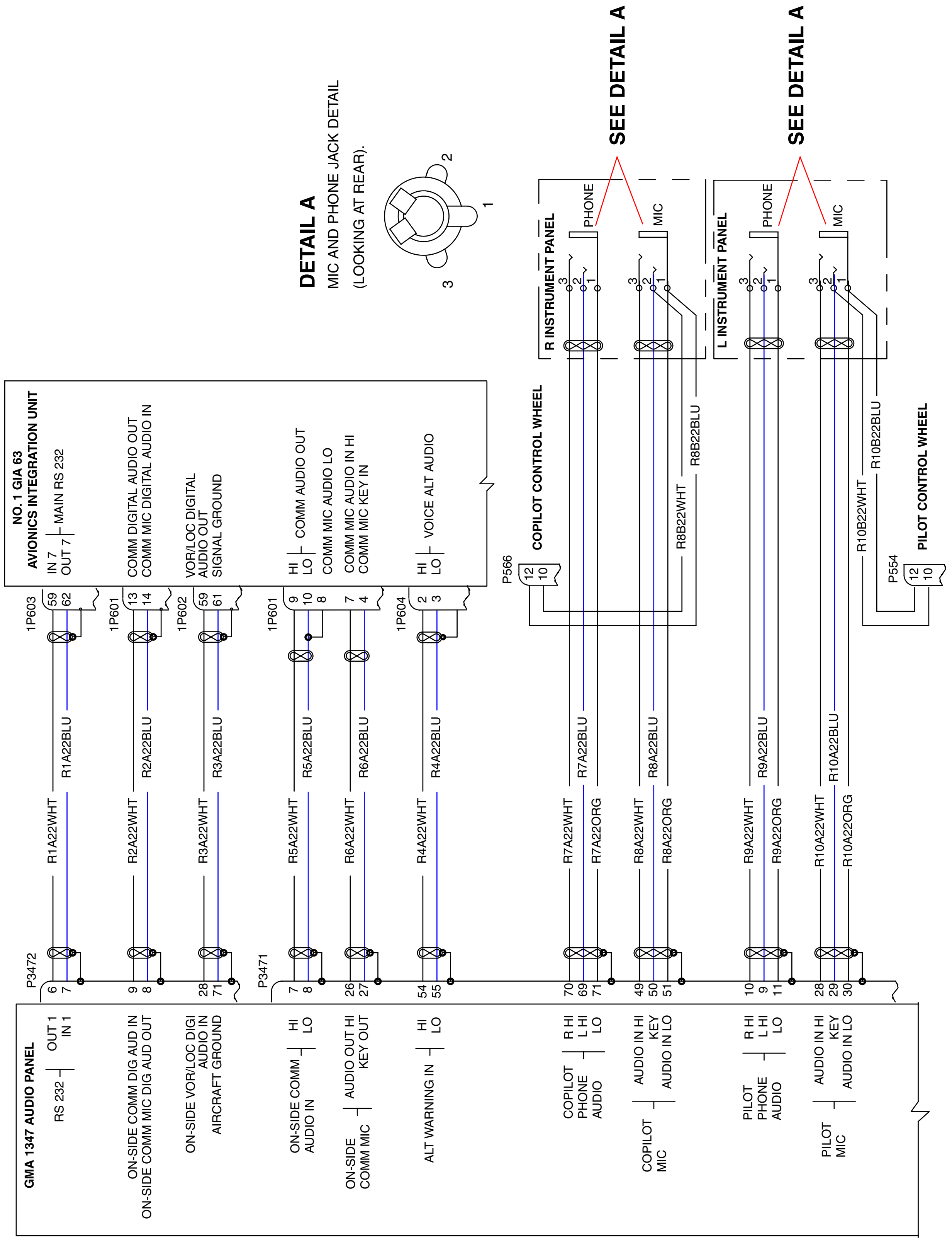
101750 19.0 Z



GMA 340 Audio Panel
Figure 2 (Sheet 2 of 2)

Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

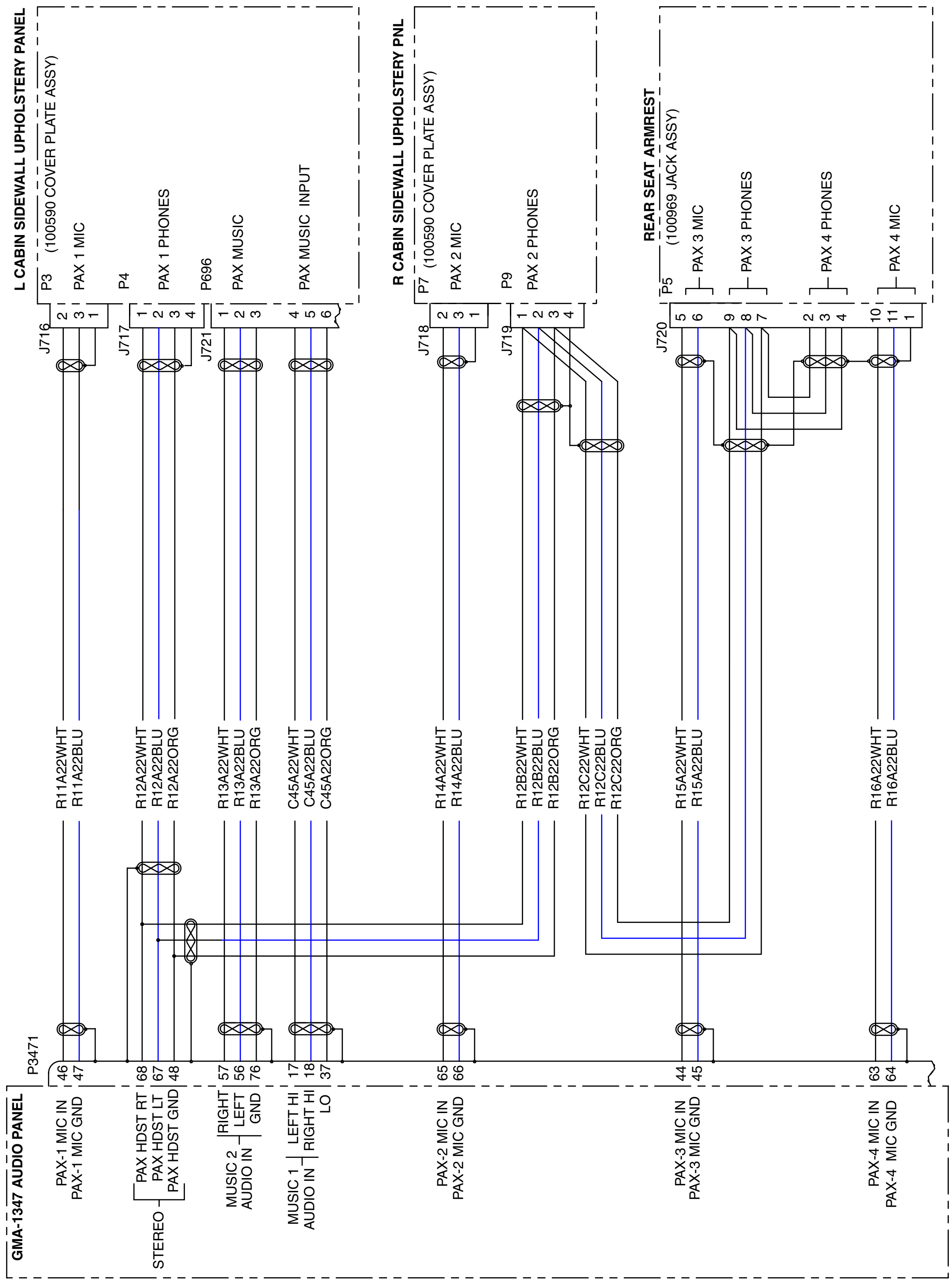
104815 4.0 A



GMA 1347 Audio Panel
Figure 3 (Sheet 1 of 3)

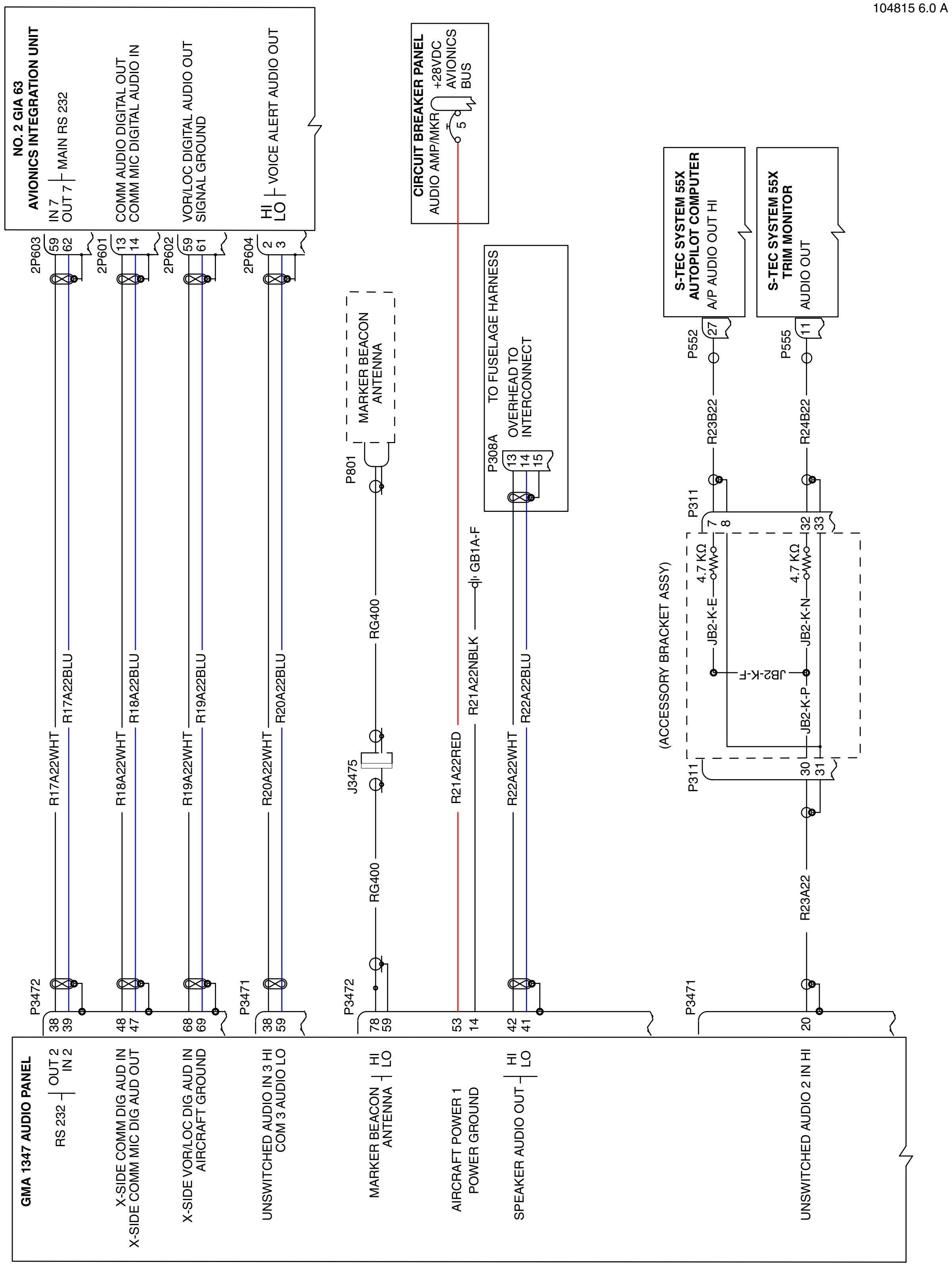
Effectivity
with Garmin 1000

104815 5.0 A



GMA 1347 Audio Panel
Figure 3 (Sheet 2 of 3)

Effectivity
with Garmin 1000



Effectivity
with Garmin 1000

GMA 1347 Audio Panel
Figure 3 (Sheet 3 of 3)

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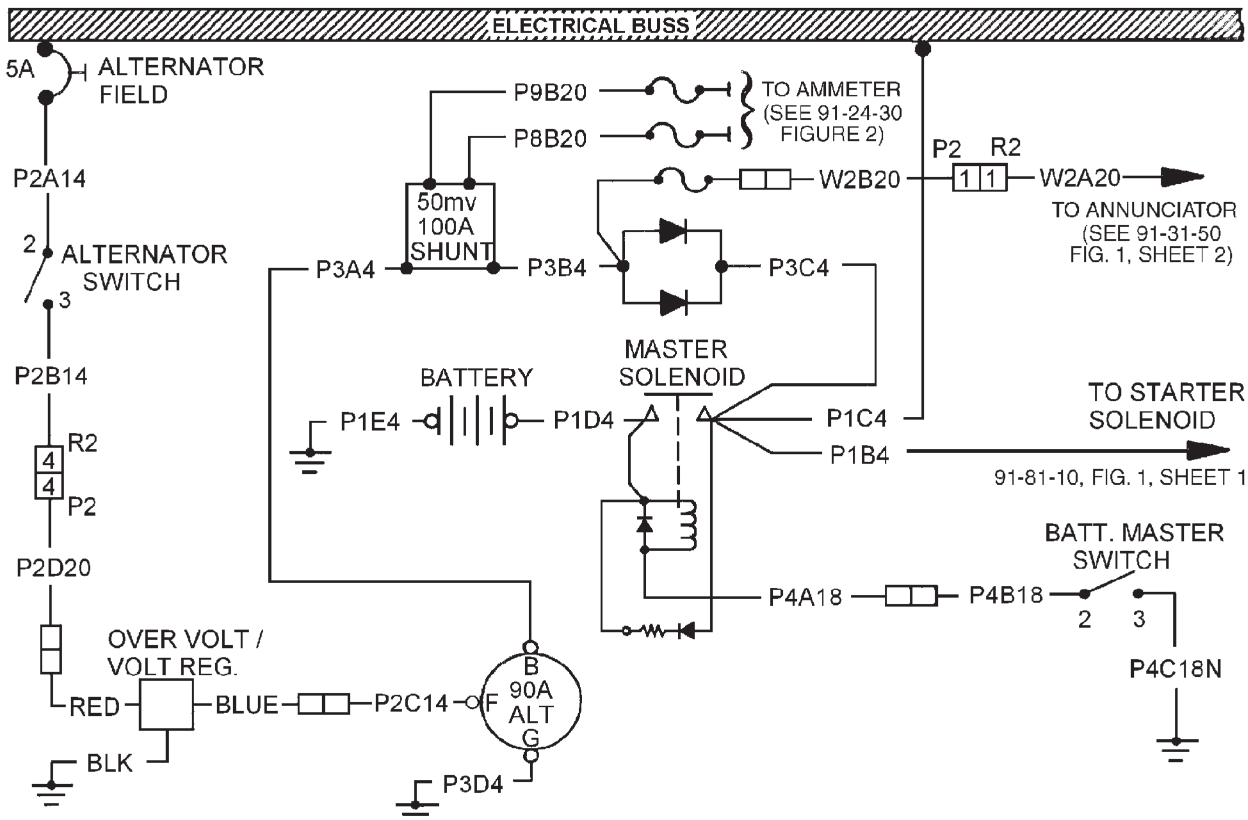
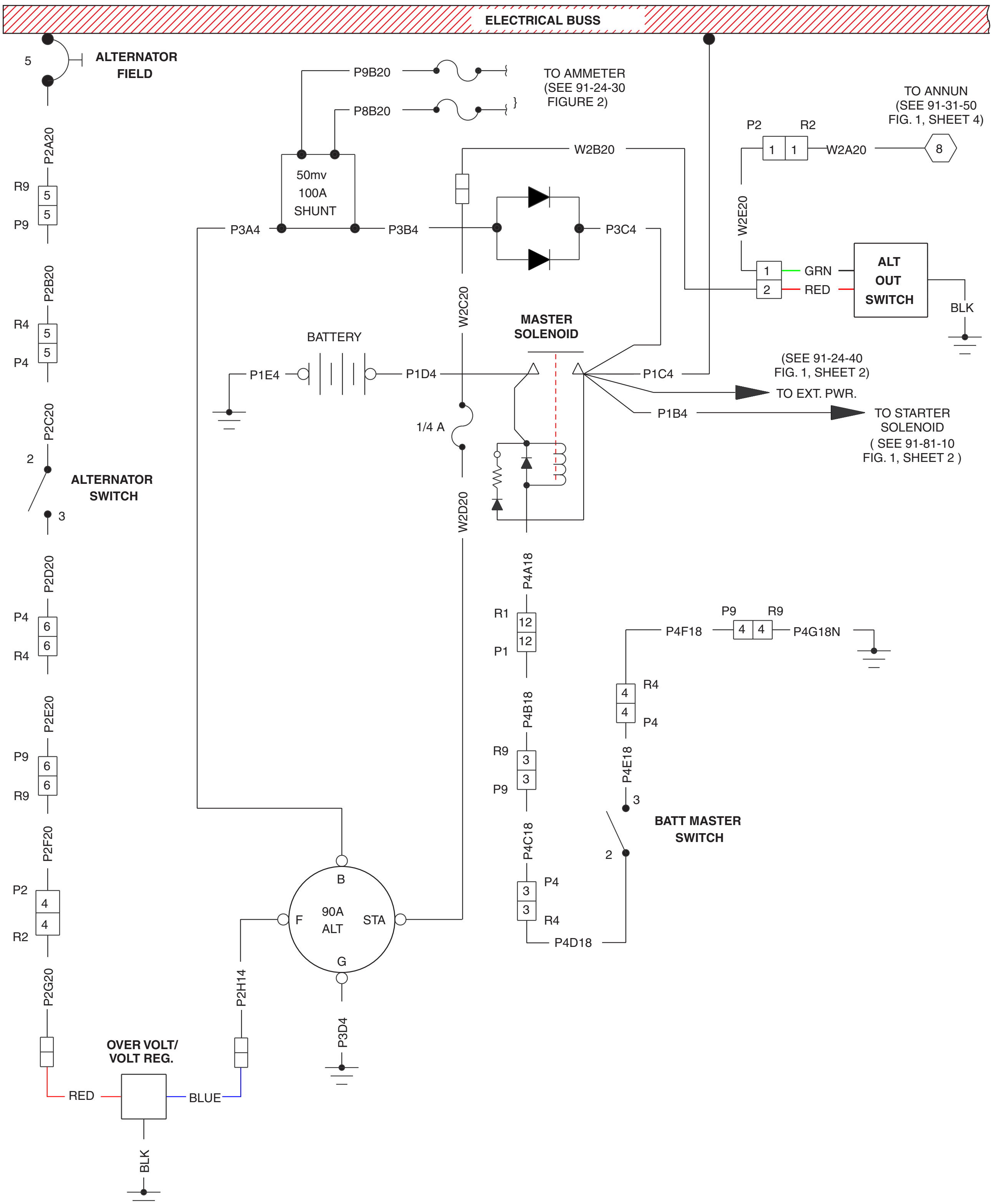
85300 2.0 NEW / B



Alternator Power
Figure 1 (Sheet 1 of 6)

Effectivity
3246001 thru 3246017

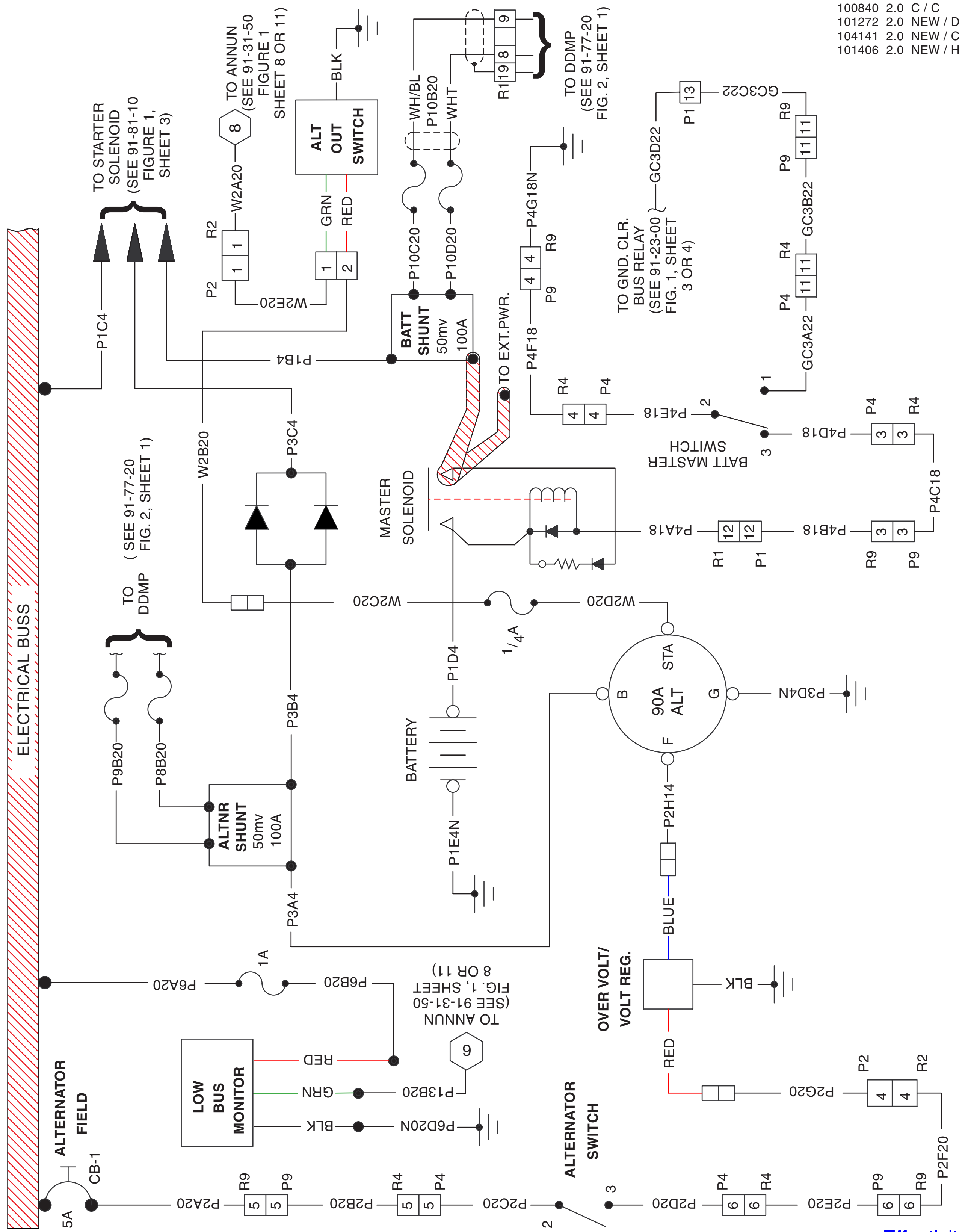
85501 2.0 F / F



Effectivity
3246018 thru 3246087

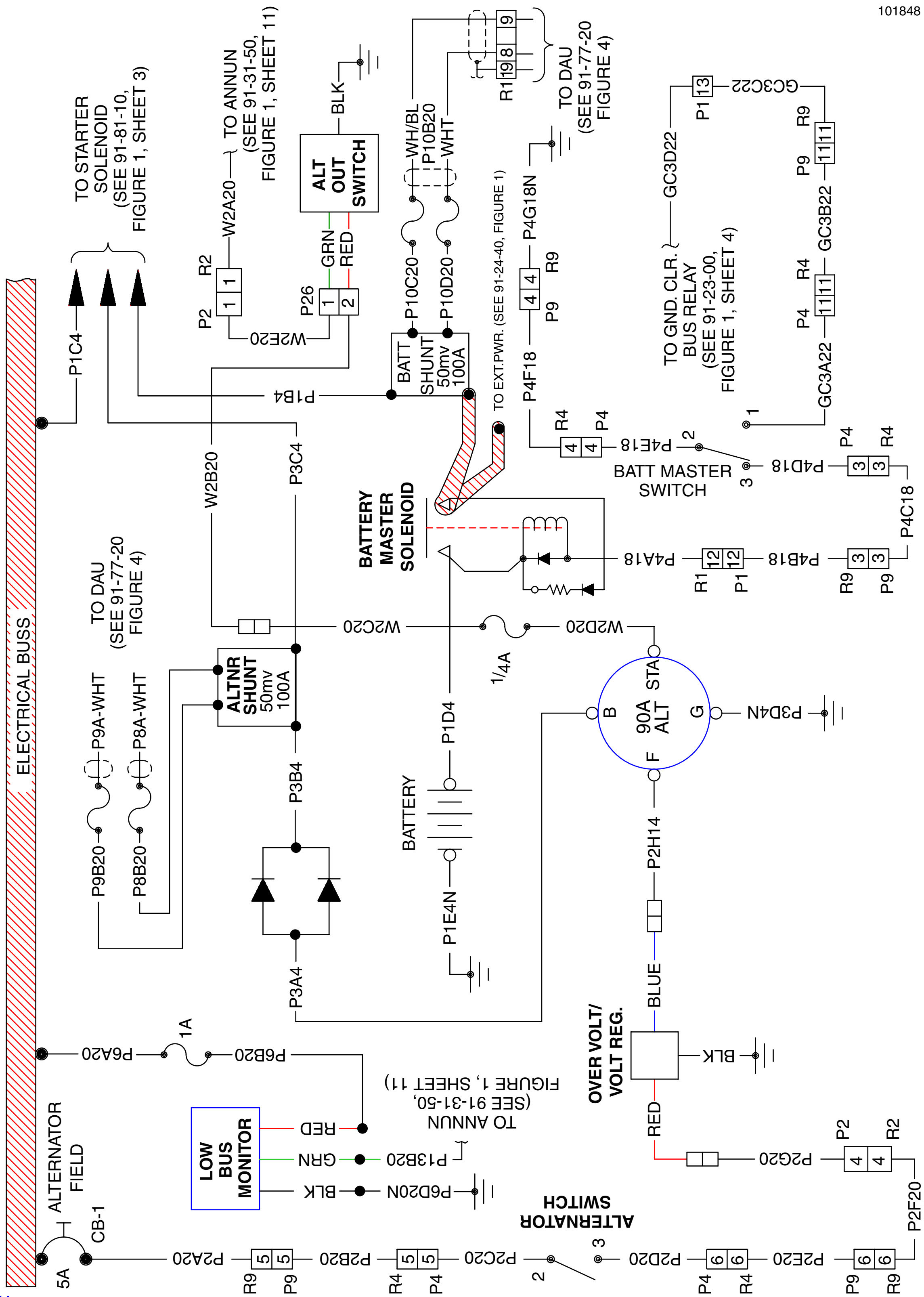
Alternator Power
Figure 1 (Sheet 2 of 6)

100840 2.0 C / C
101272 2.0 NEW / D
104141 2.0 NEW / C
101406 2.0 NEW / H



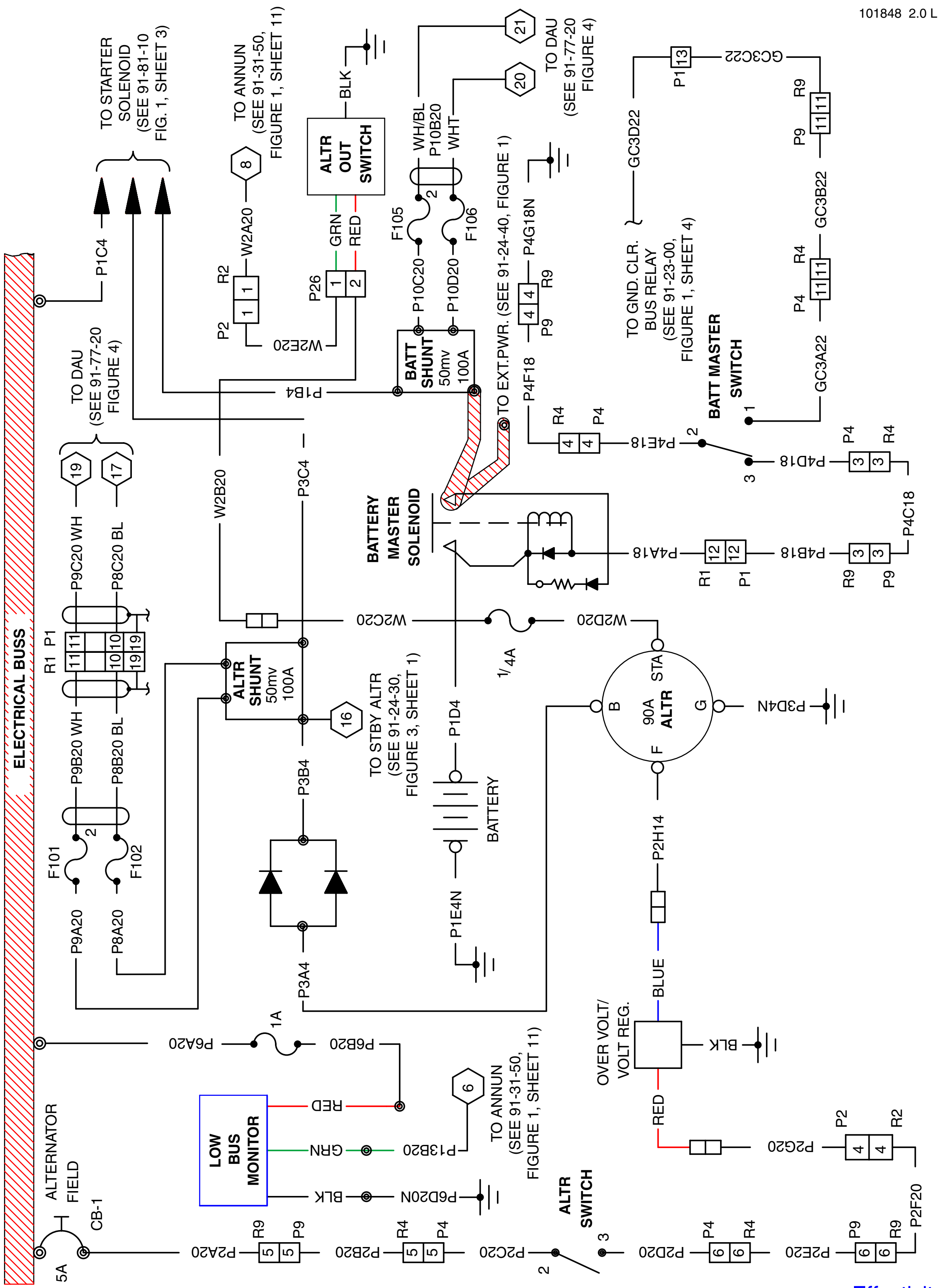
Alternator Power
Figure 1 (Sheet 3 of 6)

Effectivity
3246088 and up
3257001 and up



Effectivity
3246218 thru 3246235
3257339 thru 3257409
with Avidyne Entegra

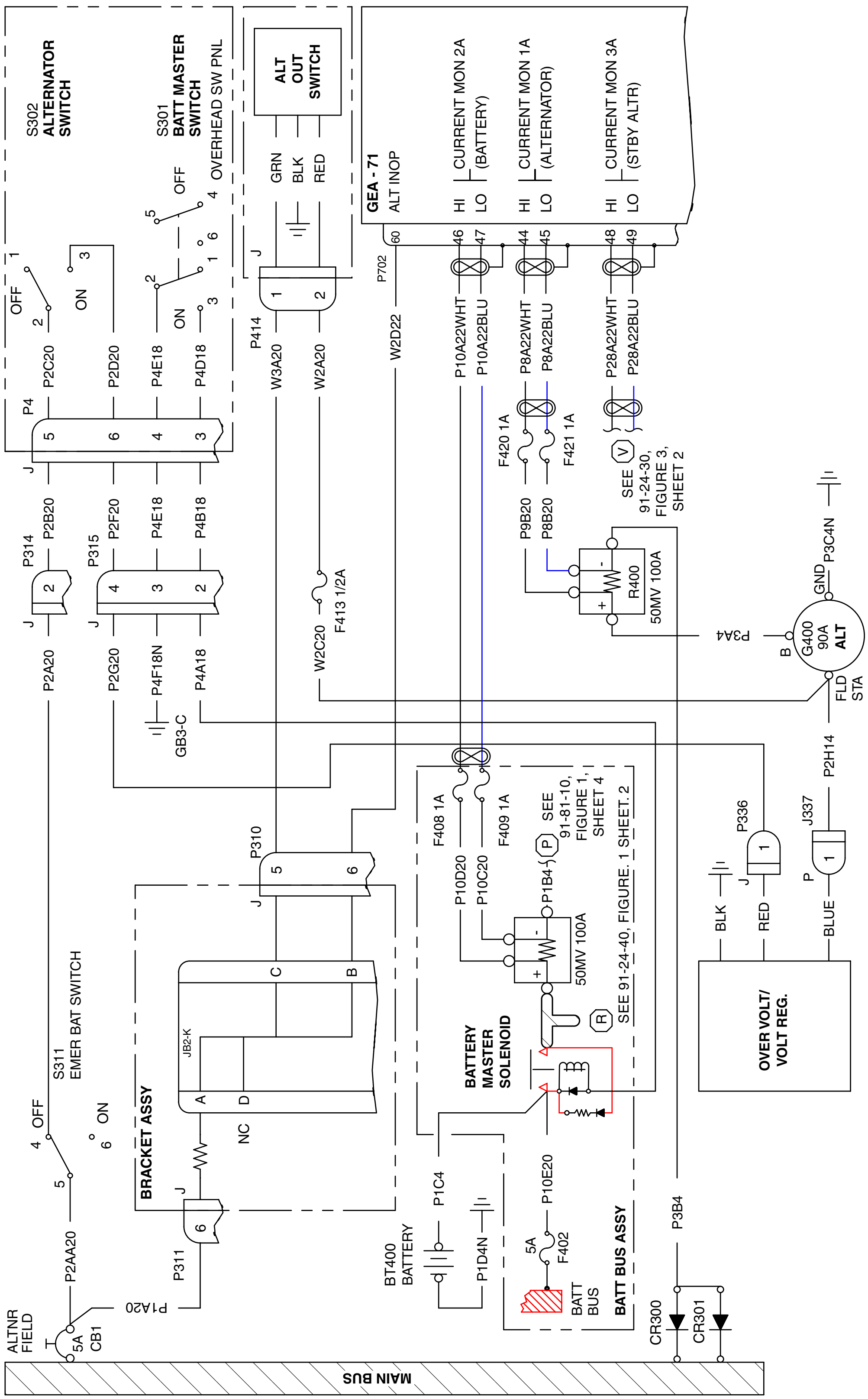
Alternator Power
Figure 1 (Sheet 4 of 6)



Effectivity
3246236 and up
3257256, 3257410 and up
with Avidyne Entegra

Alternator Power
Figure 1 (Sheet 5 of 6)

104817 2.0 A



Alternator Power
Figure 1 (Sheet 6 of 6)

Effectivity
with Garmin 1000

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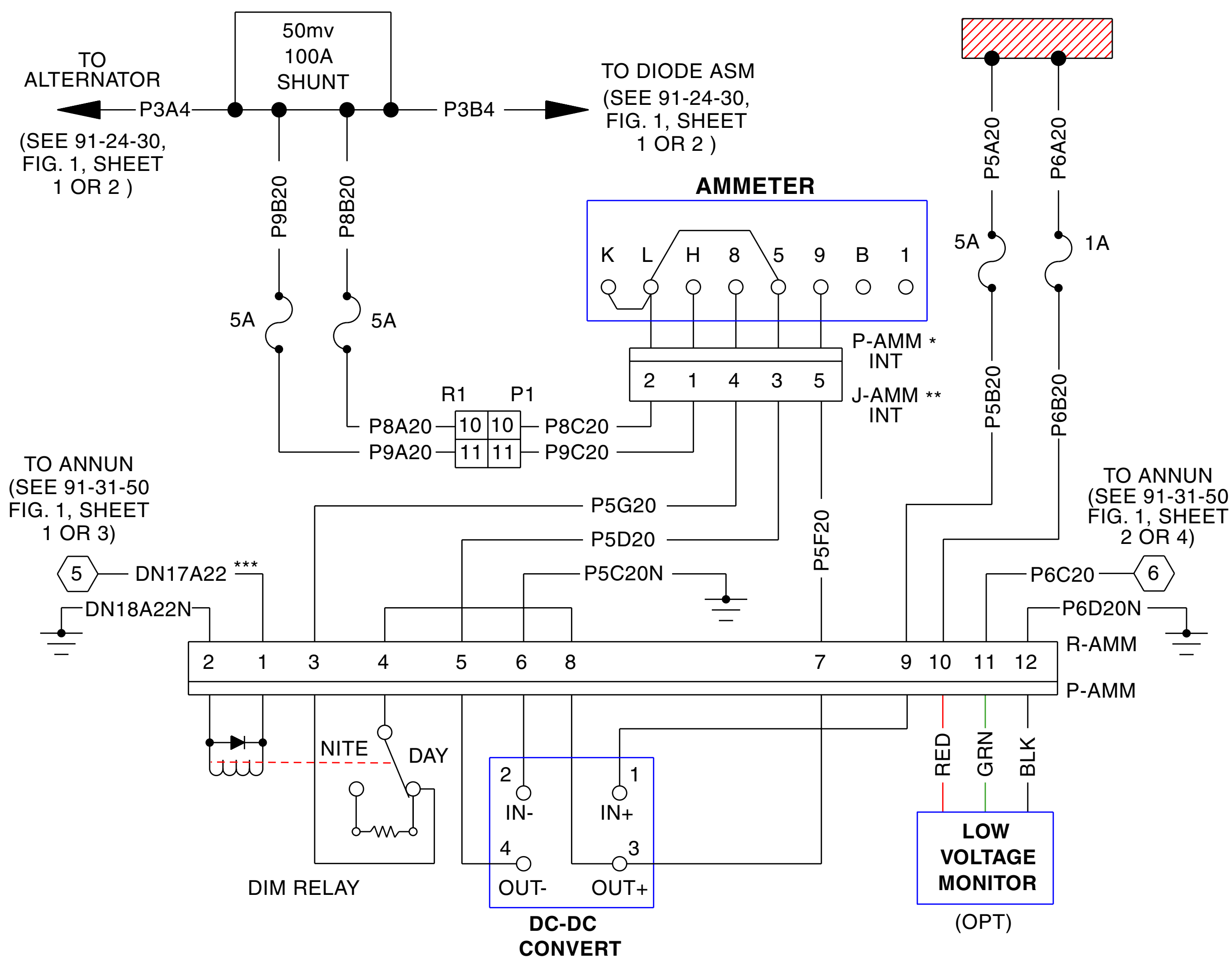
85501 3.0 C / F
85300 3.0 NEW / B

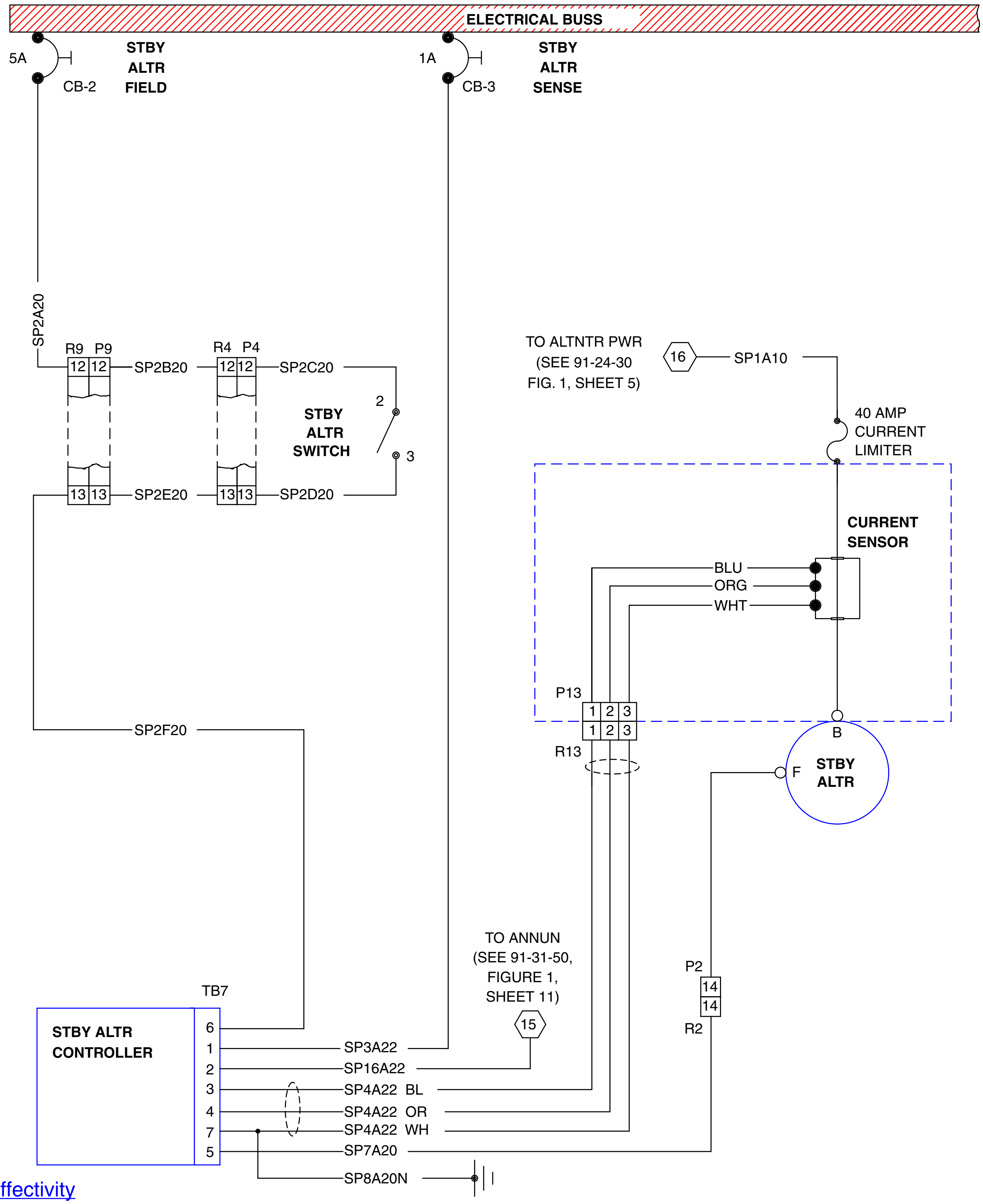


IN HP S/N'S 3246001 THRU 3246017 ONLY: * J-AMM
** P-AMM
*** DN17B22

Ammeter / Low Voltage Monitor
Figure 2

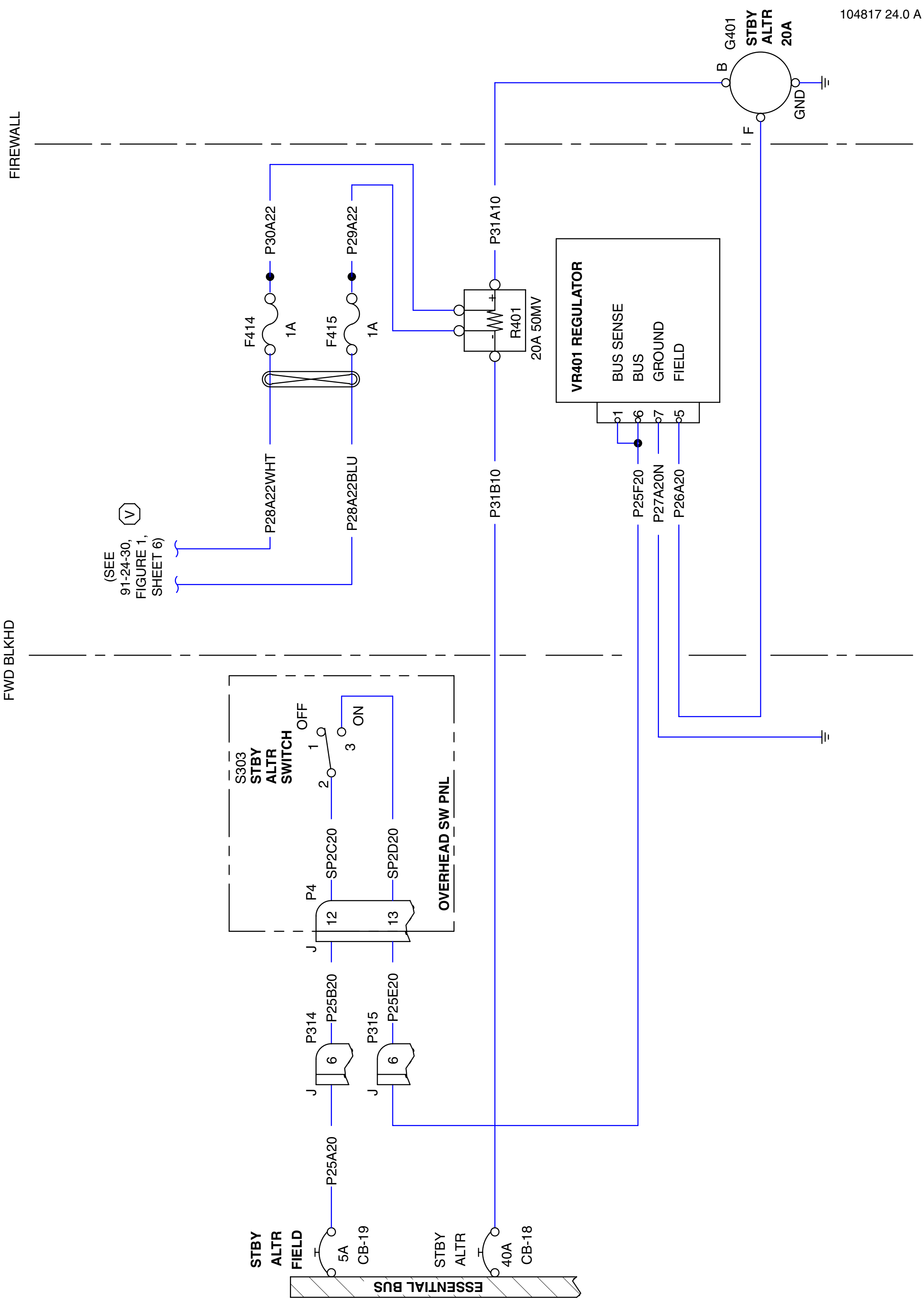
Effectivity
3246001 thru 3246087

101848 2.1 L



Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra

Standby Alternator
Figure 3 (Sheet 1 of 2)



Standby Alternator
Figure 3 (Sheet 2 of 2)

Effectivity
with Garmin 1000

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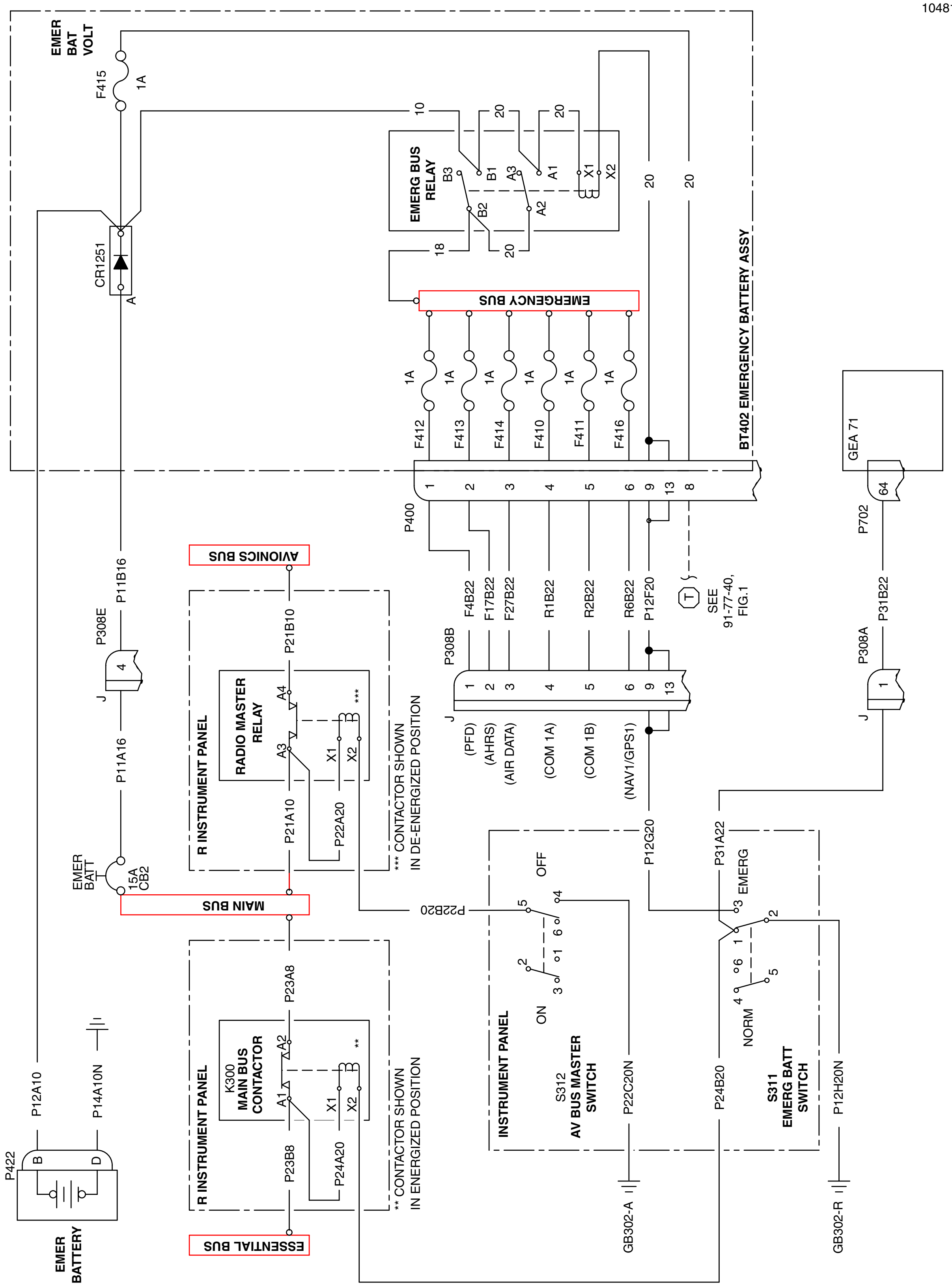
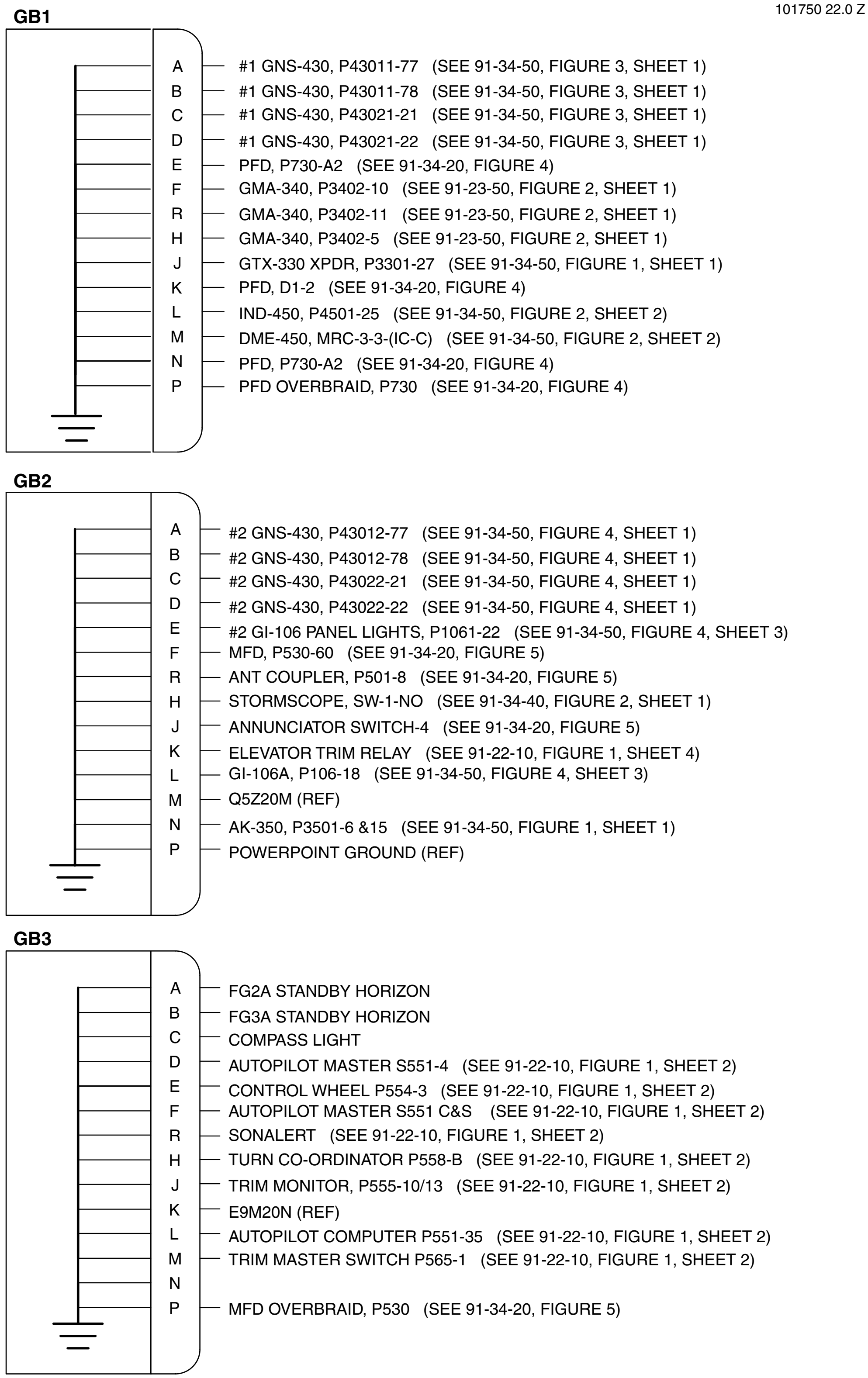
104817 4.0 A



Power Switching
Figure 4

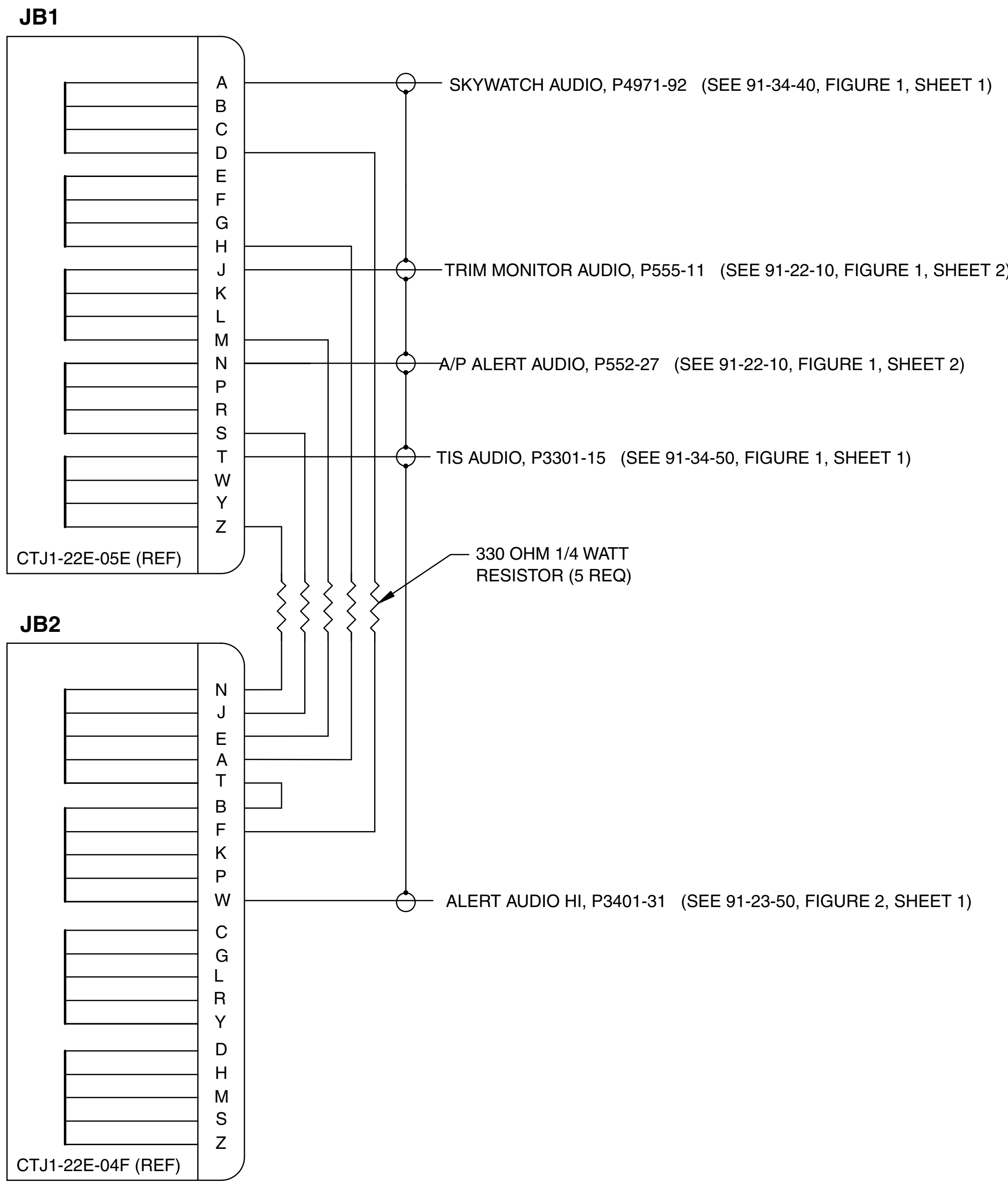
Effectivity
with Garmin 1000



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

Ground Blocks
Figure 5 (Sheet 1 of 6)

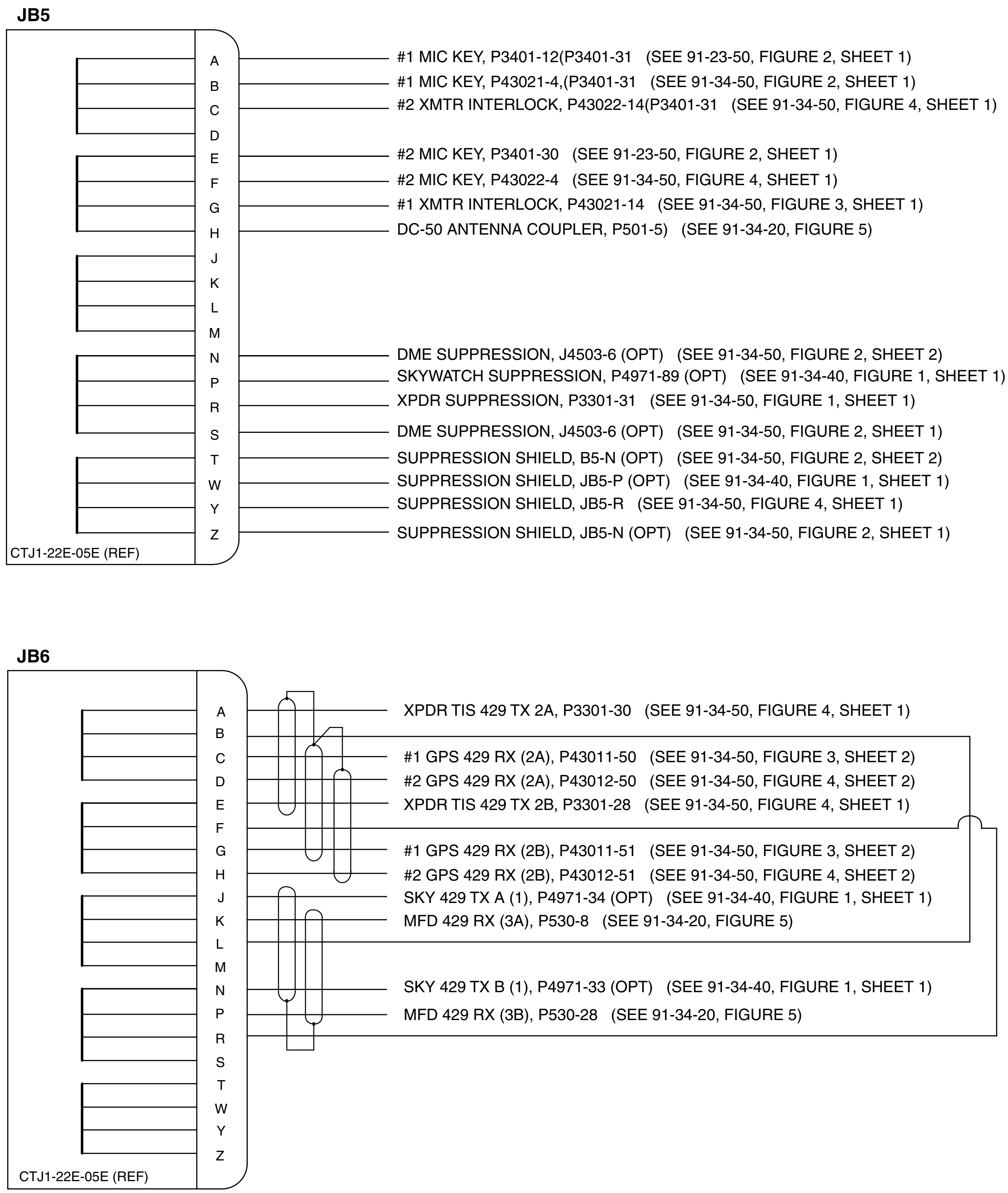
101750 22.0 Z



Ground Blocks
Figure 5 (Sheet 2 of 6)

Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

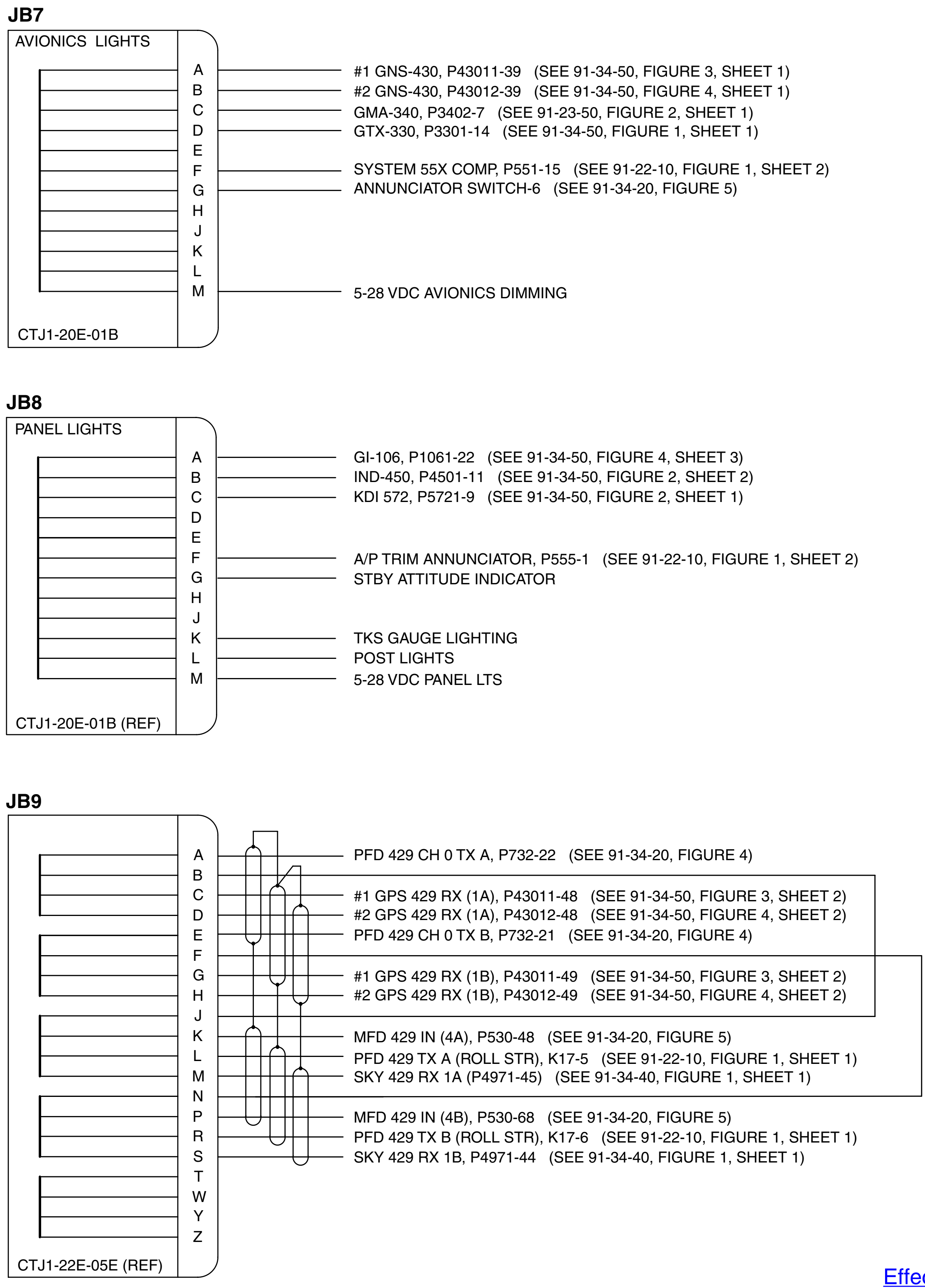
101750 22.0 Z



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

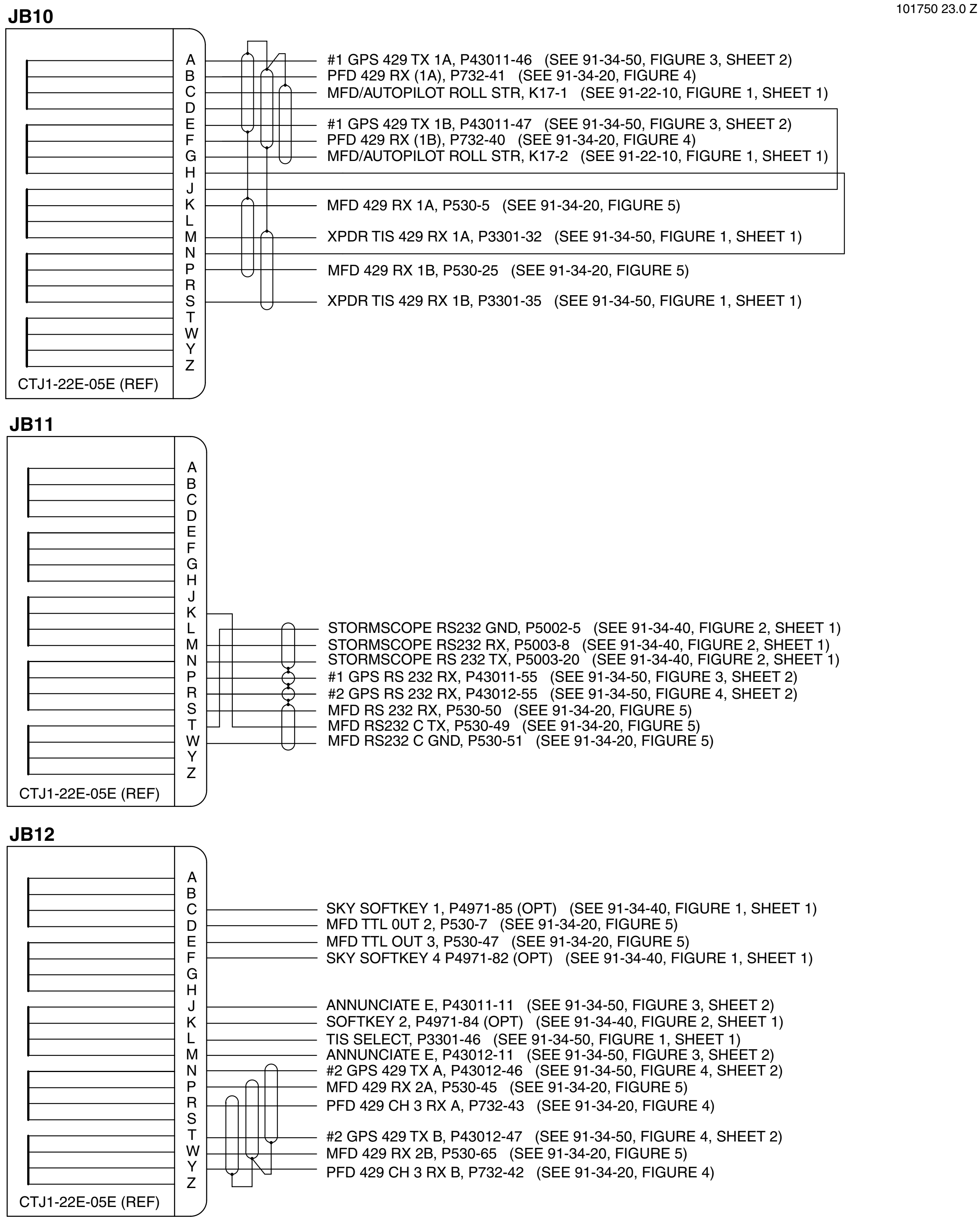
Ground Blocks
Figure 5 (Sheet 3 of 6)

101750 23.0 Z



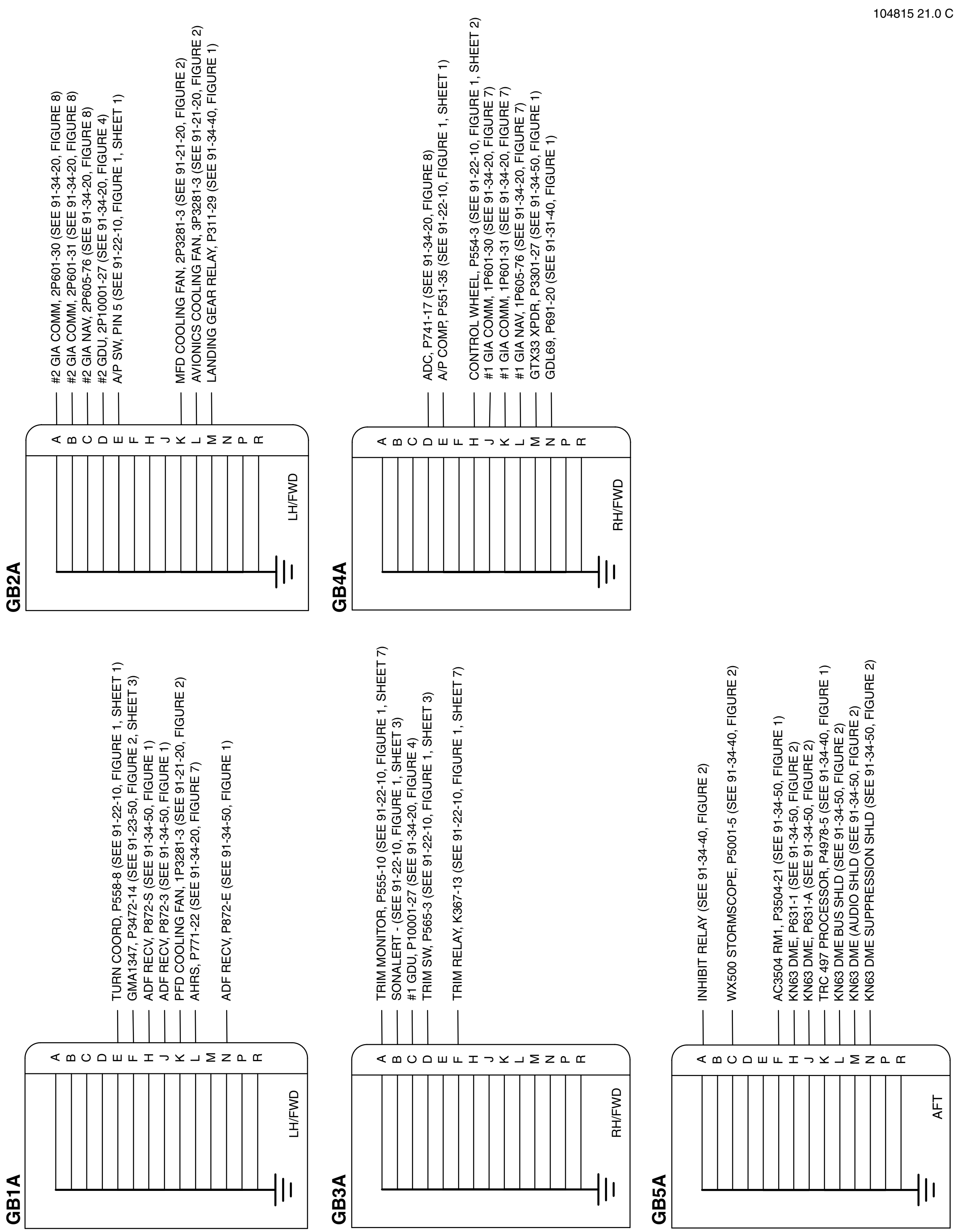
Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

Ground Blocks
Figure 5 (Sheet 4 of 6)



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

Ground Blocks
Figure 5 (Sheet 5 of 6)



Ground Blocks
Figure 5 (Sheet 6 of 6)

Effectivity
with Garmin 1000

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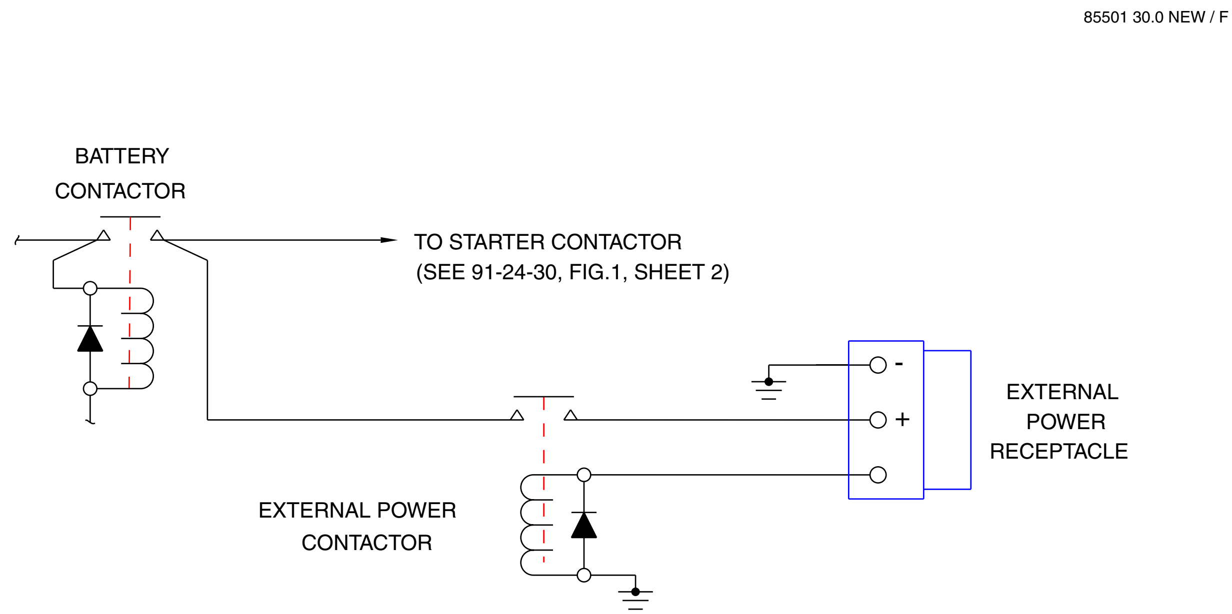
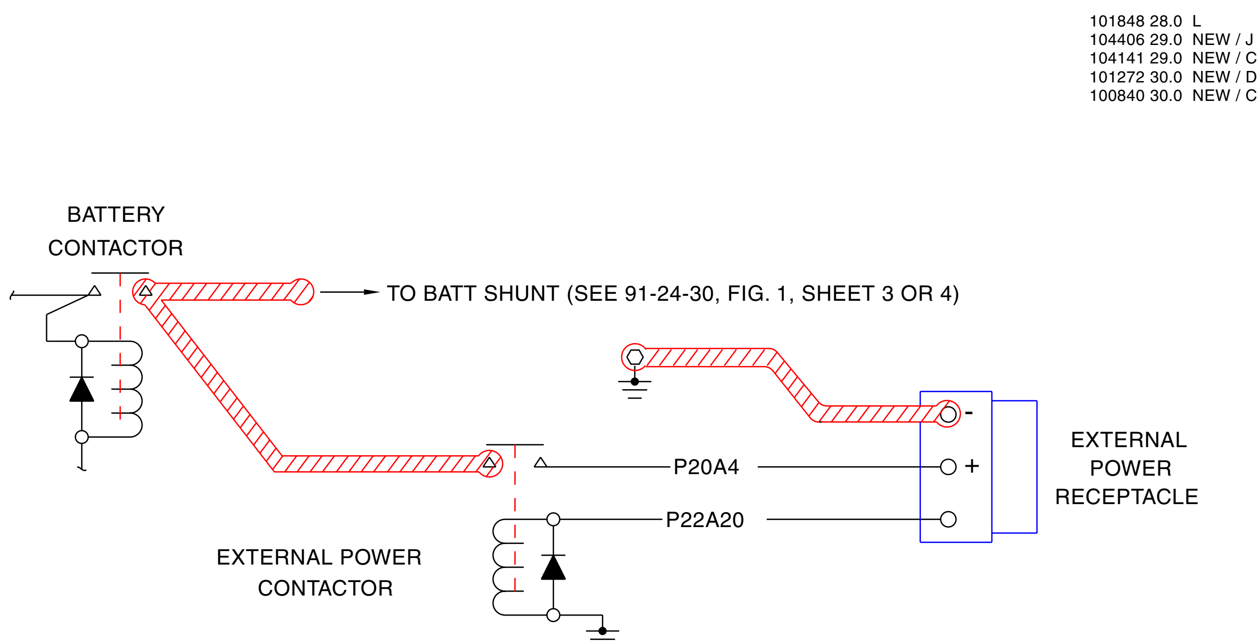


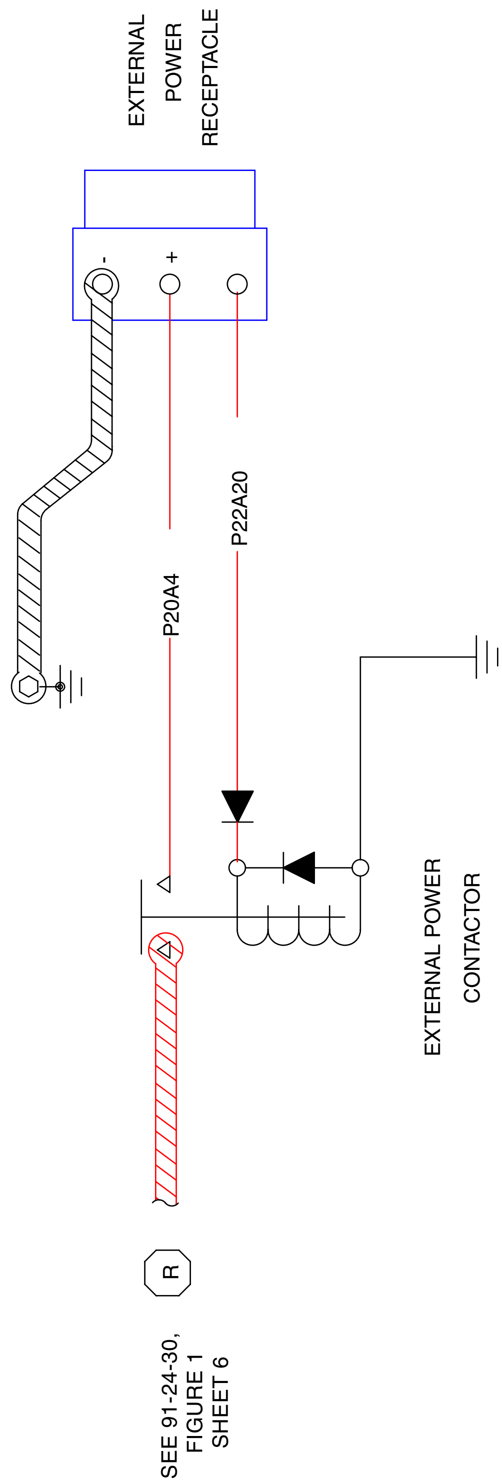
HP S/N'S 3246018 THRU 3246087 ONLY.



HP S/N'S 3246088 & UP; TC 3257001 & UP.

External Power
Figure 1 (Sheet 1 of 2)

104817 5.0 A



Effectivity
with Garmin 1000

External Power
Figure 1 (Sheet 2 of 2)

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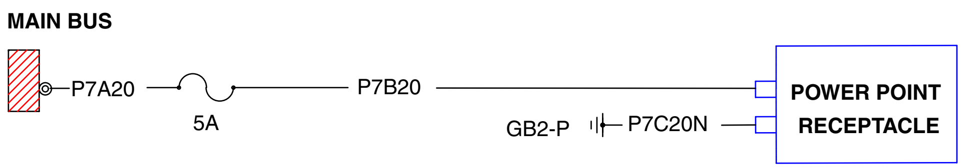
101848 31.0 L
104406 34.0 NEW/ J
104141 34.0 B / C



Power Point
Figure 1

Effectivity
3246154 and up
3257124 and up

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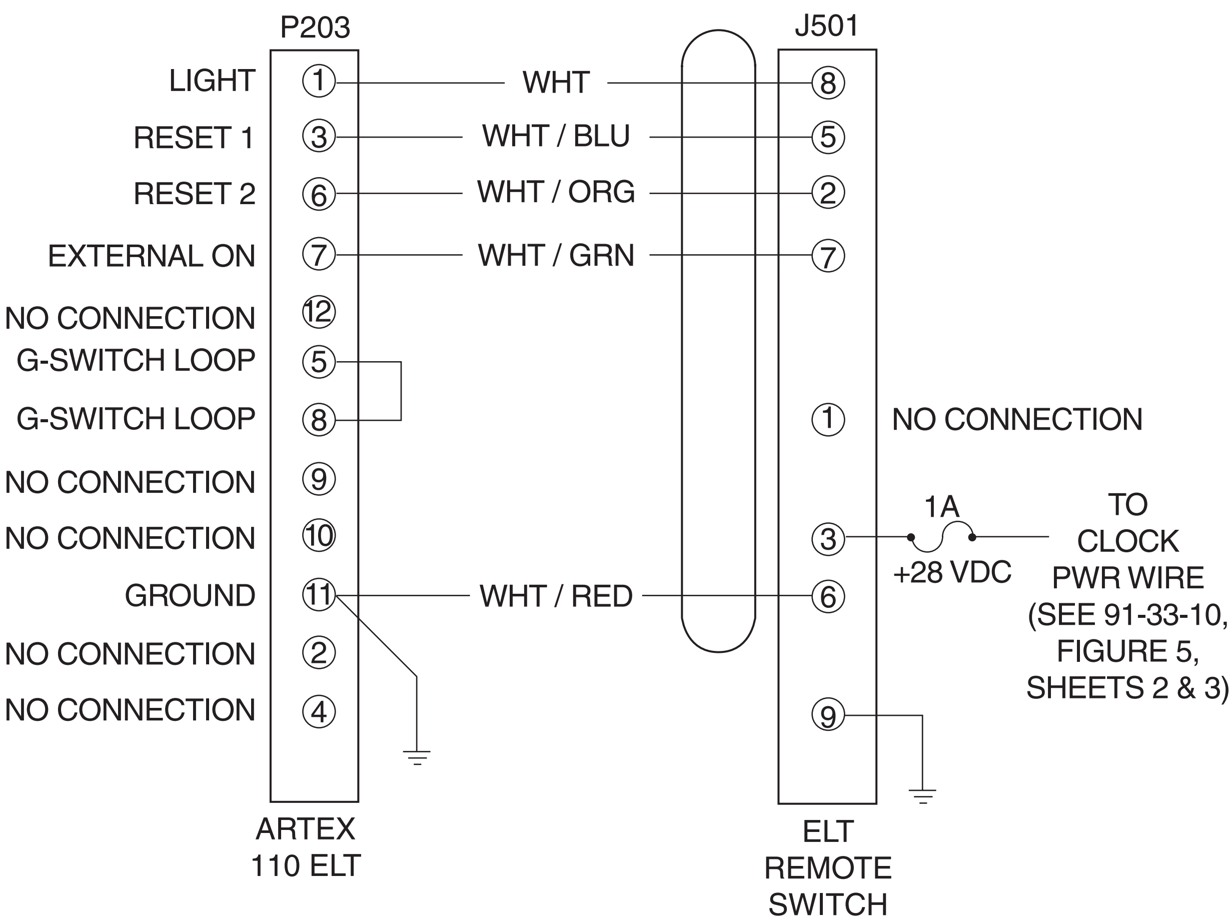
85501 11.0 NEW / F
85300 11.0 NEW / B

ELT
Figure 1

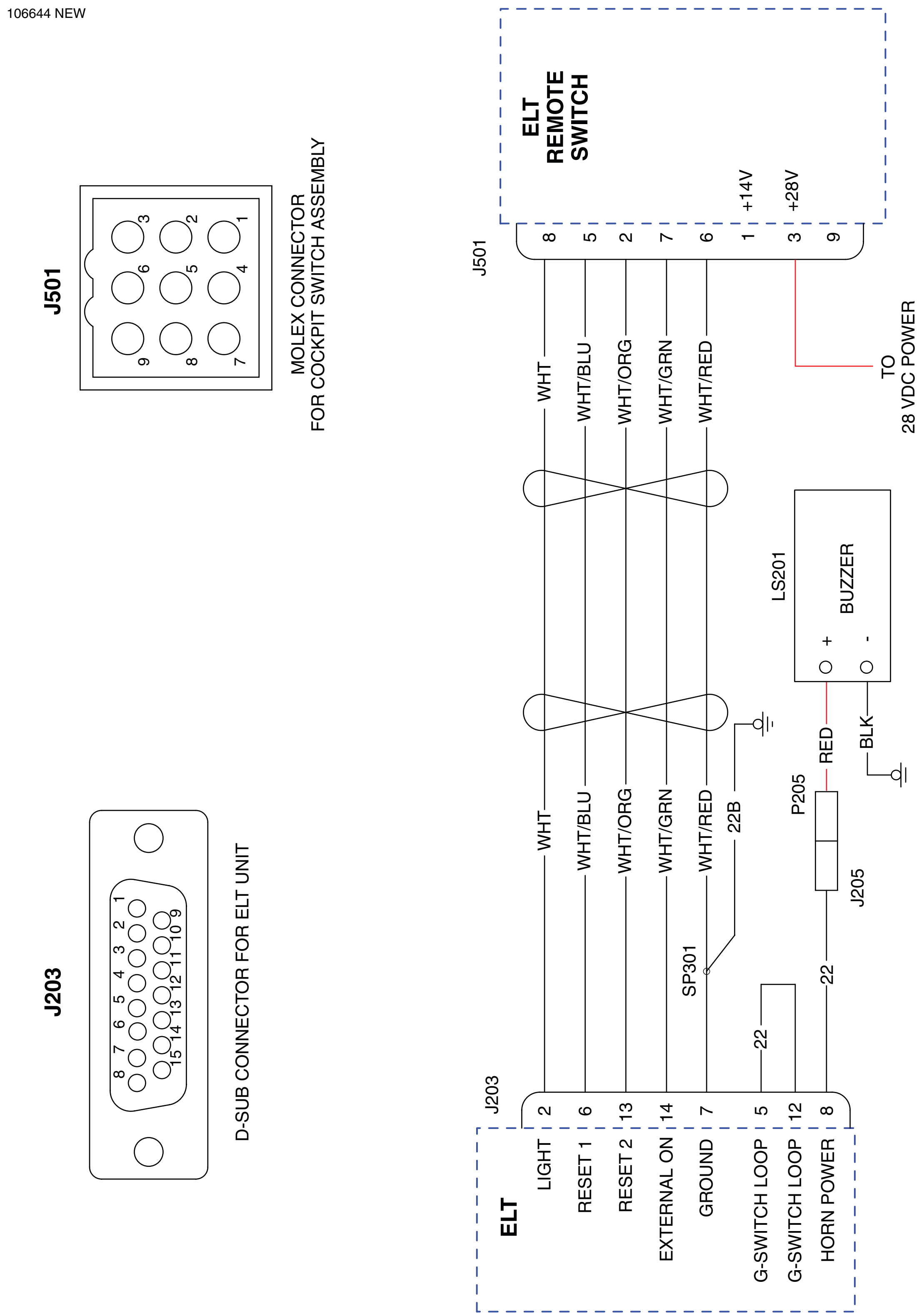
Effectivity
3246001 thru 3246087

06311 T



Effectivity
3246088–3246244
3257001–3257463

Artex ELT 110-4
Figure 2



Artex ME406 ELT
Figure 3

Effectivity
3257464 and up

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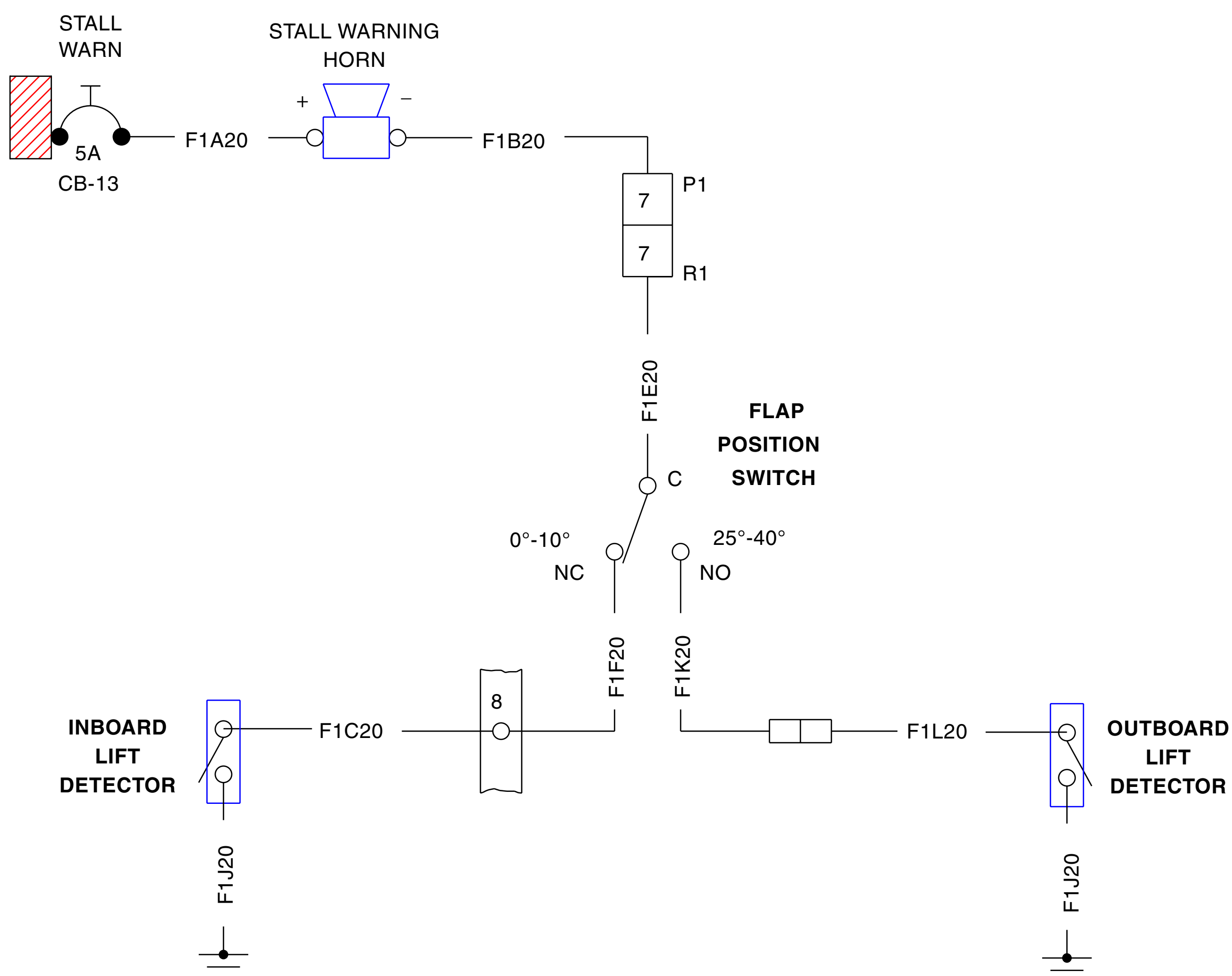
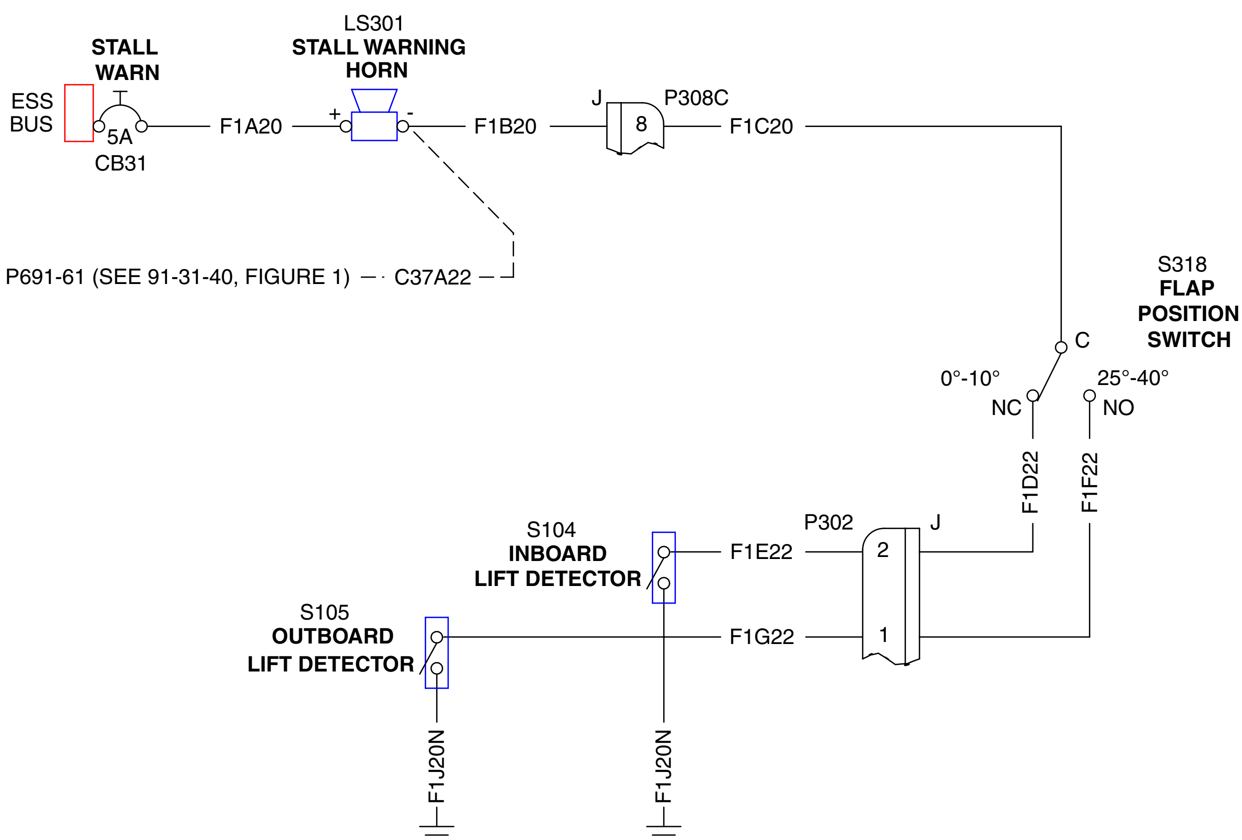
101848 9.0 L
104406 9.0 NEW / J
104141 9.0 NEW / C
101272 9.0 NEW / D
100840 9.0 B / C
85501 9.0 NEW / F
85300 9.0 NEW / B



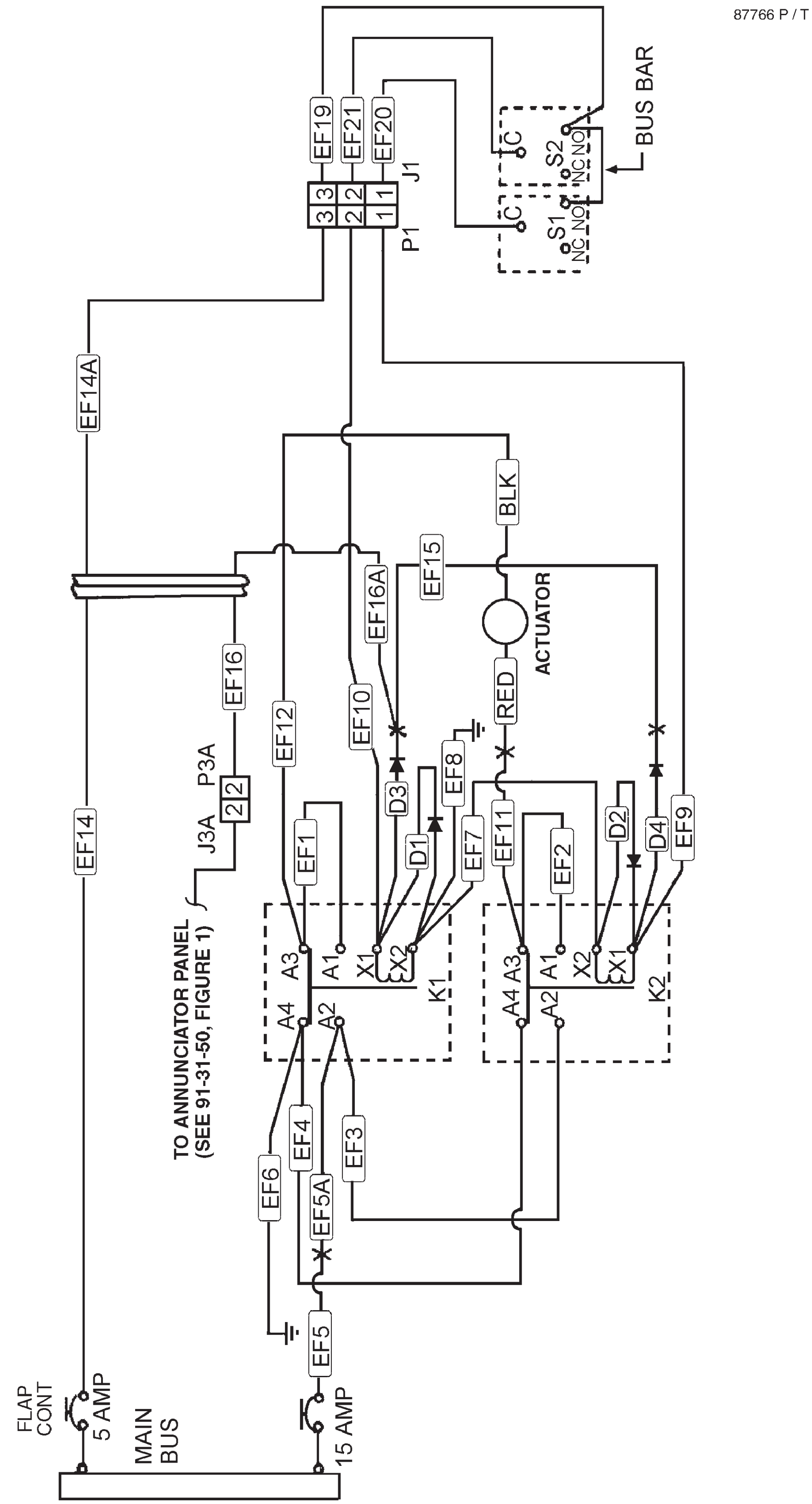
Stall Warning
Figure 1 (Sheet 1 of 2)

104817 9.0 A



Effectivity
with Garmin 1000

Stall Warning
Figure 1 (Sheet 2 of 2)



Electric Flaps
Figure 1 (Sheet 1 of 2)

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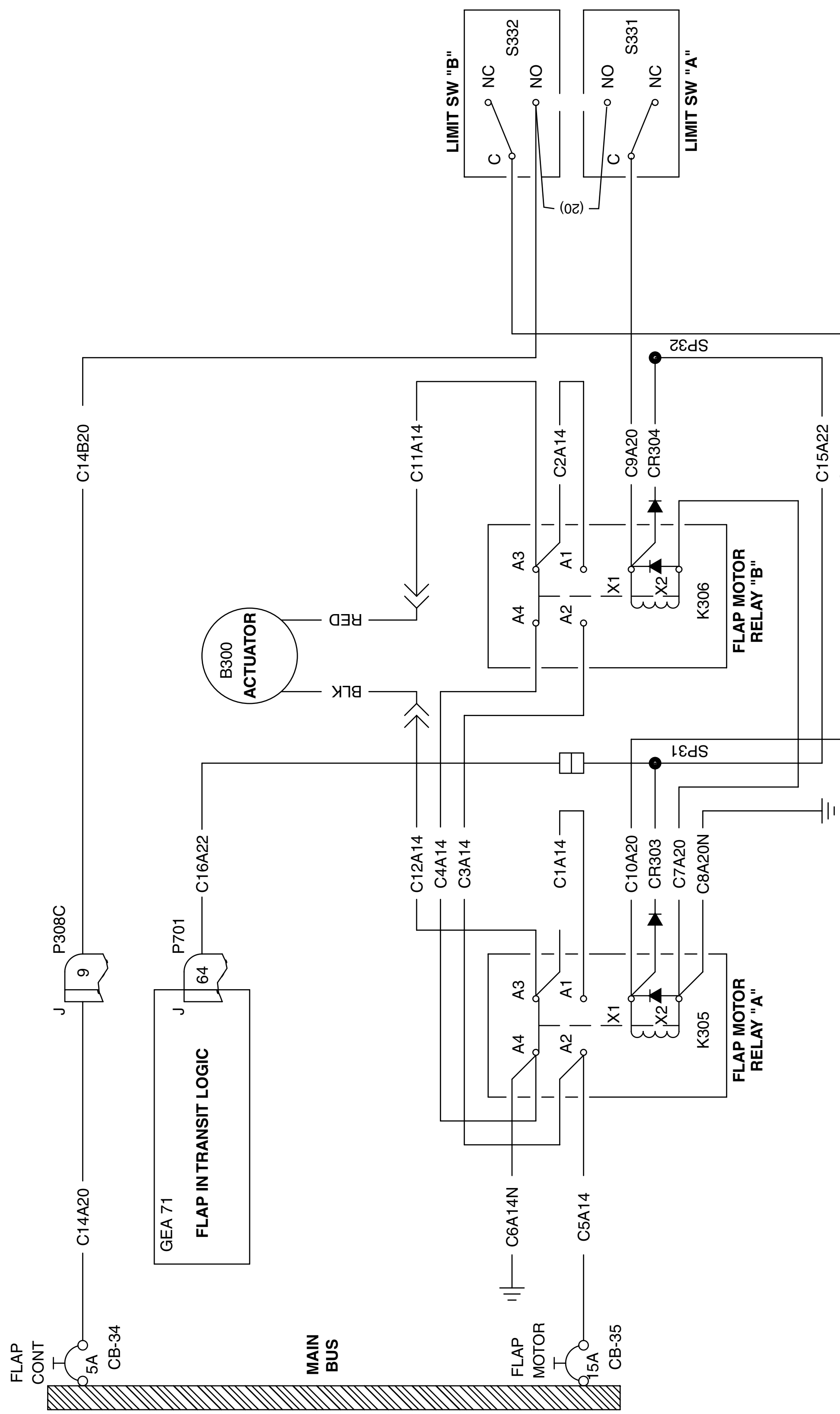
104817 23.0 A



Electric Flaps
Figure 1 (Sheet 2 of 2)

Effectivity
with Garmin 1000

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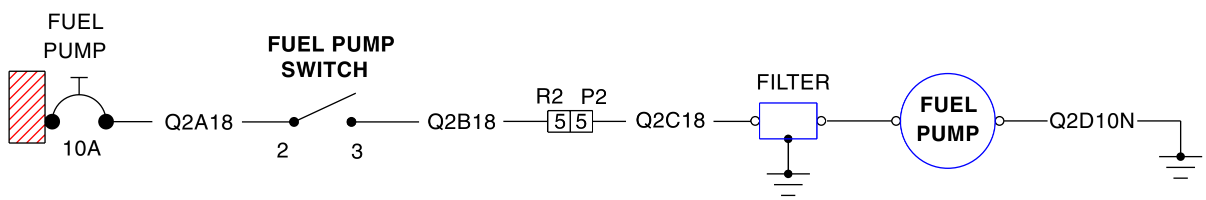
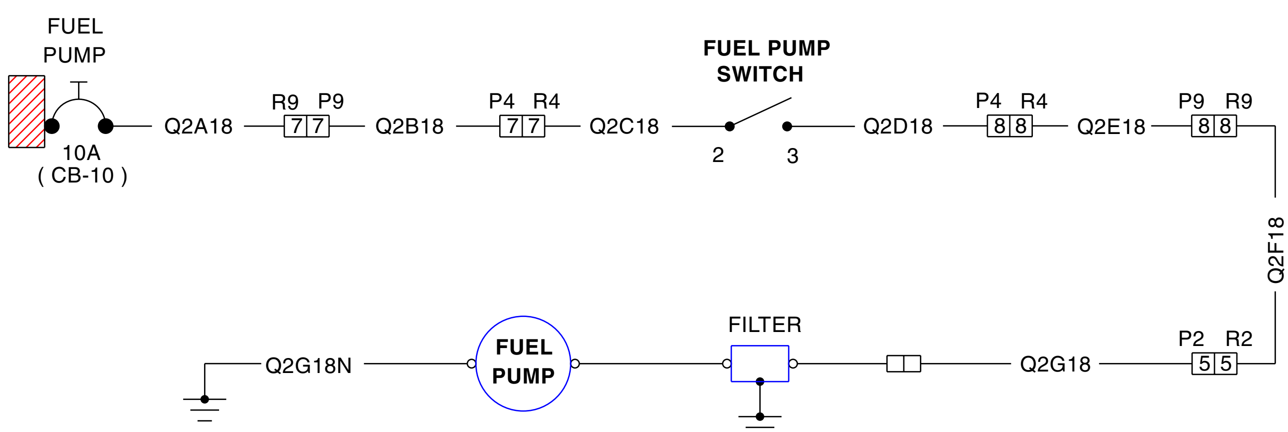
85300 8.0 NEW / B



HP S/N'S 3246001 THRU 3246017 ONLY

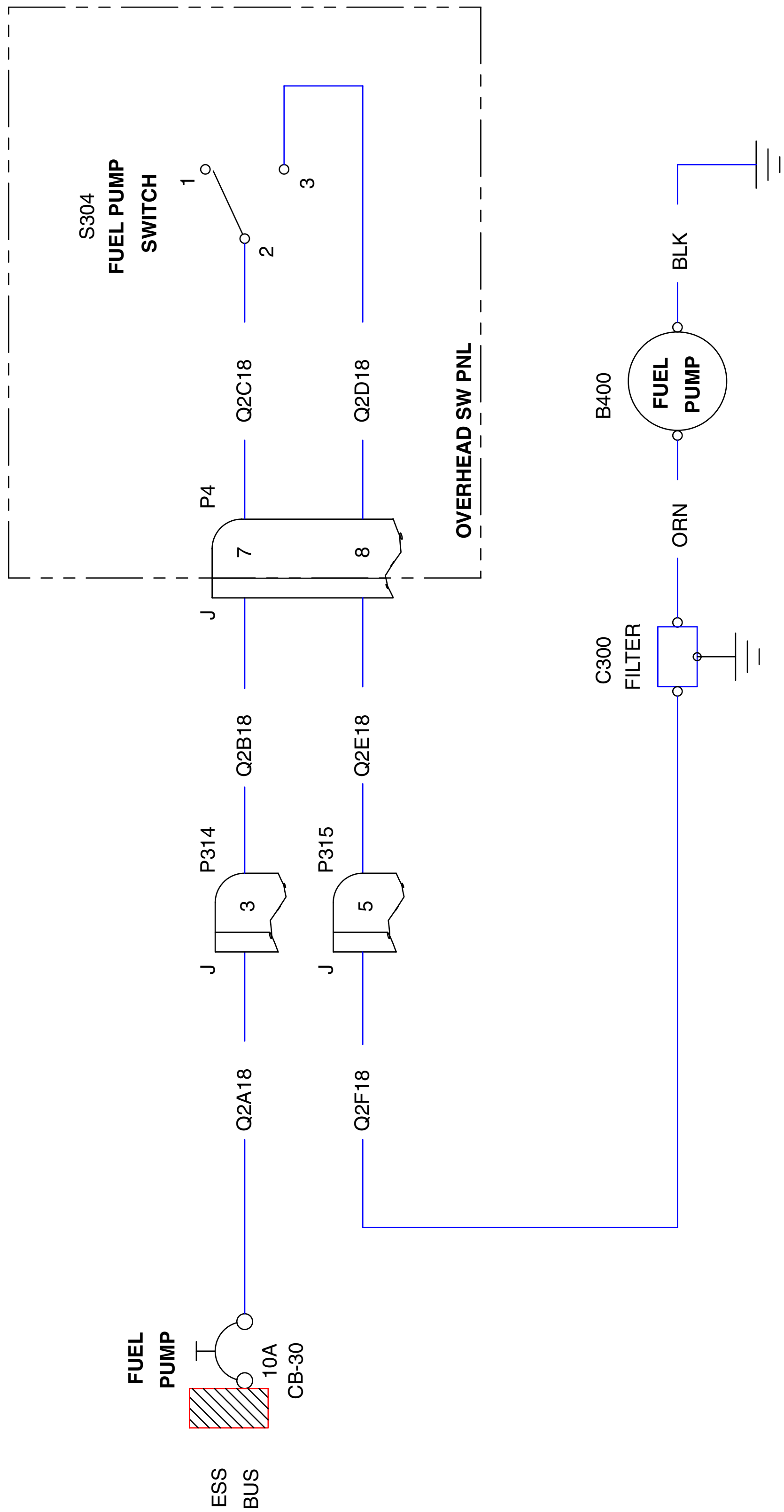
101848 8.0 L
104406 8.0 NEW / J
104141 8.0 NEW / C
101272 8.0 NEW / D
100840 8.0 NEW / C
85501 8.0 NEW / F



HP S/N'S 3246018 & UP; TC S/N'S 3257001 & UP

Fuel Pump
Figure 1 (Sheet 1 of 2)

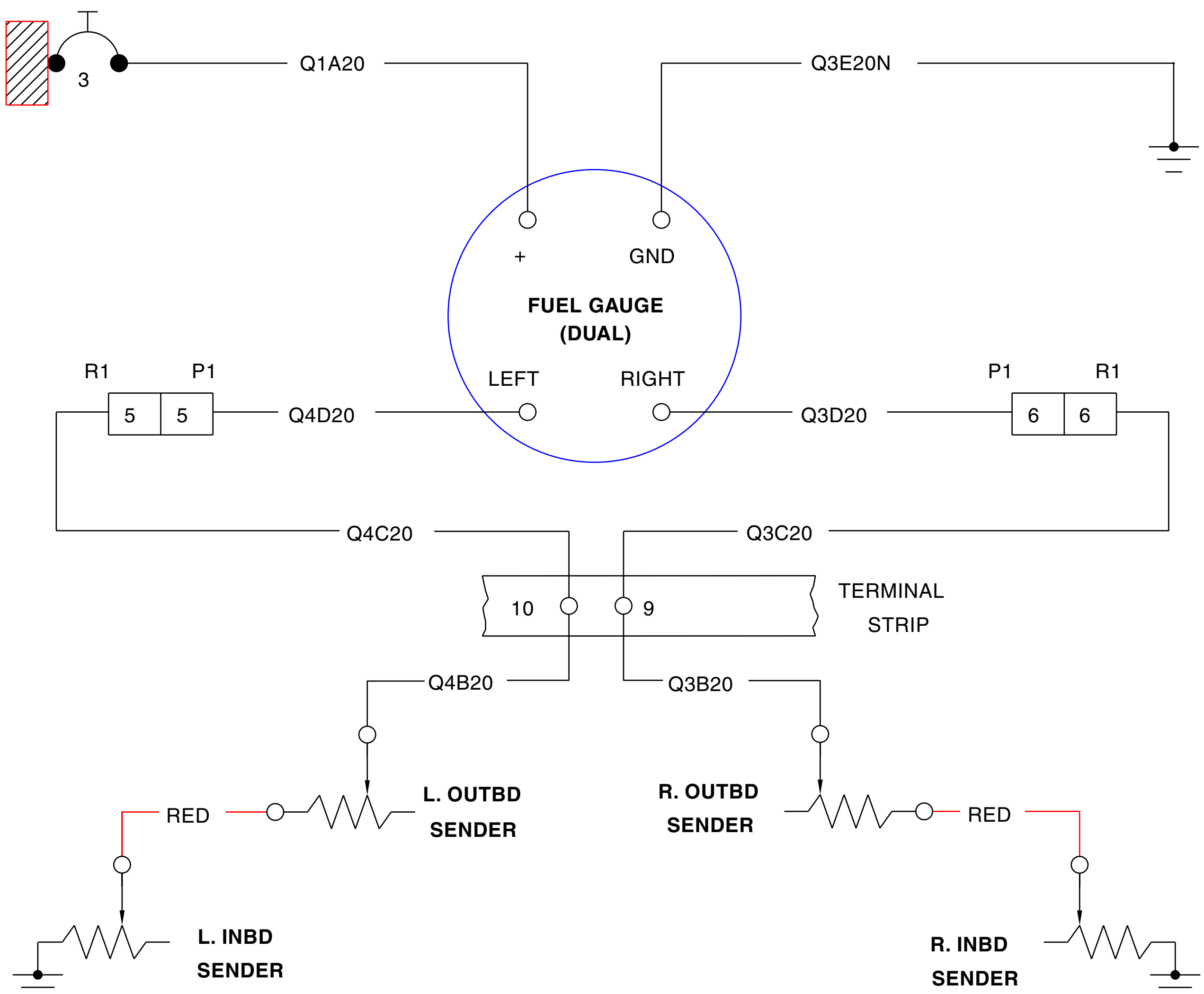
104817 8.0 A



Effectivity
with Garmin 1000

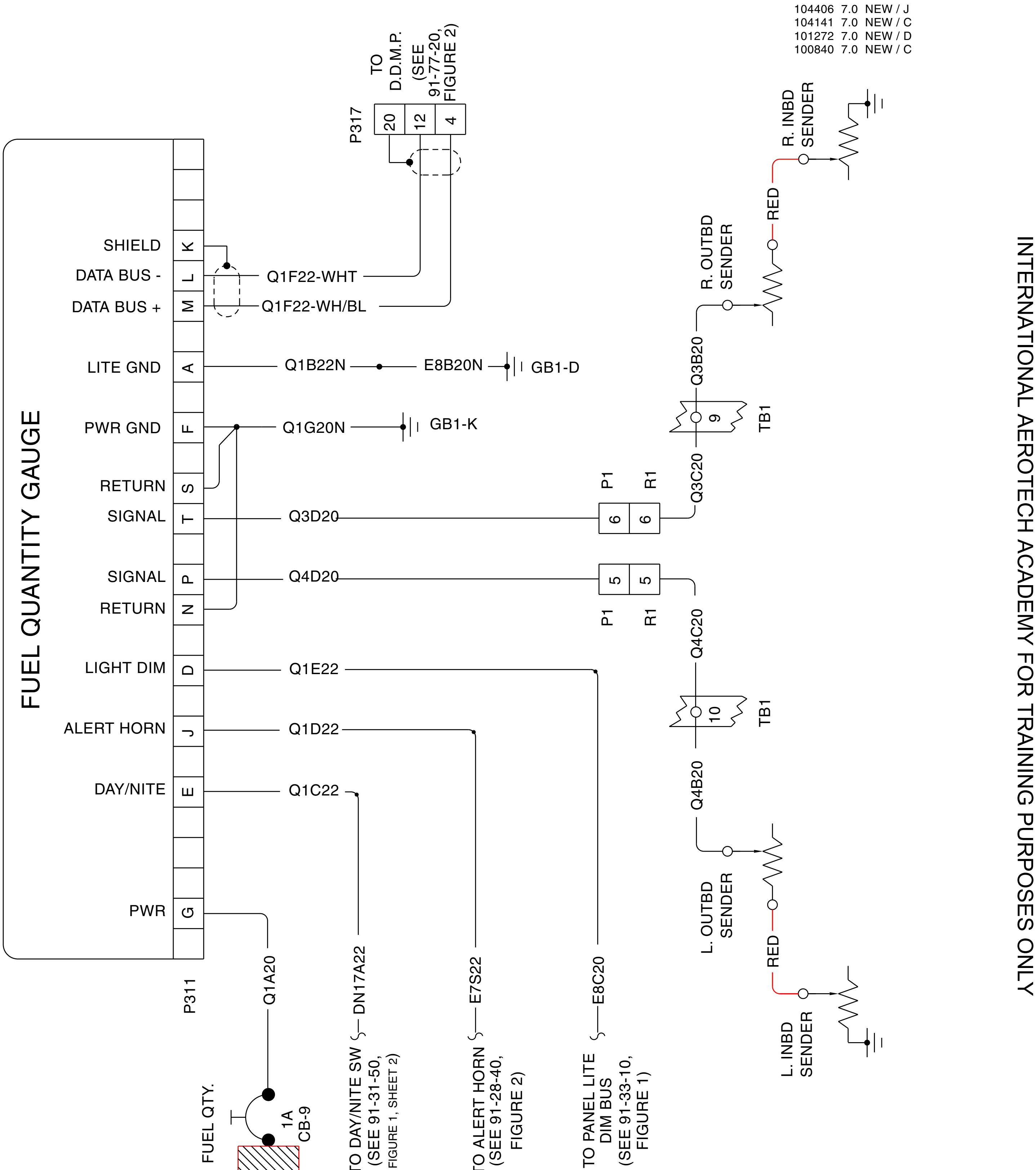
Fuel Pump
Figure 1 (Sheet 2 of 2)

85501 7.0 NEW / F
85300 7.0 NEW / B



Fuel Quantity
Figure 1 (Sheet 1 of 4)

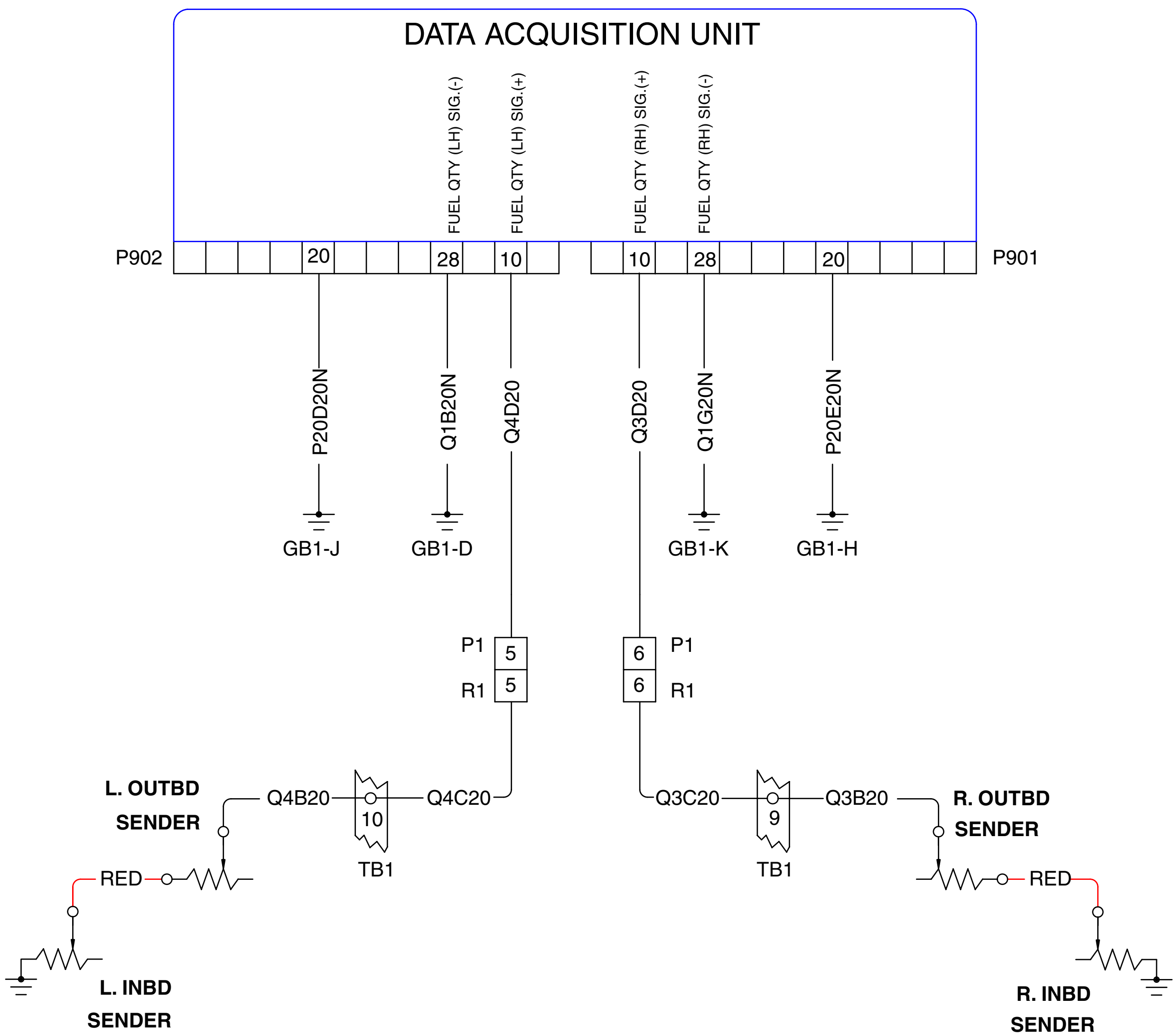
Effectivity
3246001 thru 3246087



Effectivity
3246088 and up
3257001 and up

Fuel Quantity
Figure 1 (Sheet 2 of 4)

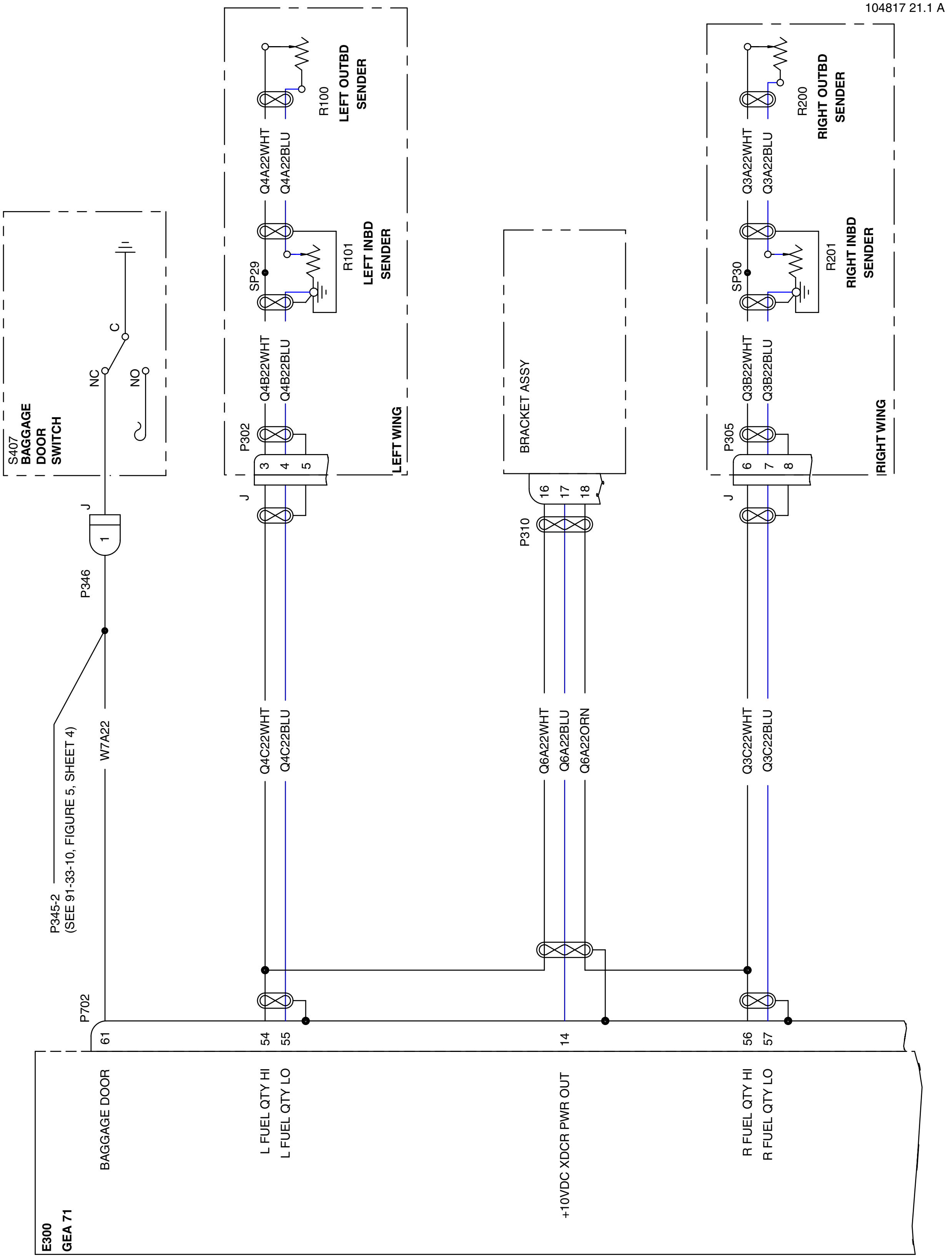
101848 7.0 L



Fuel Quantity
Figure 1 (Sheet 3 of 4)

Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra

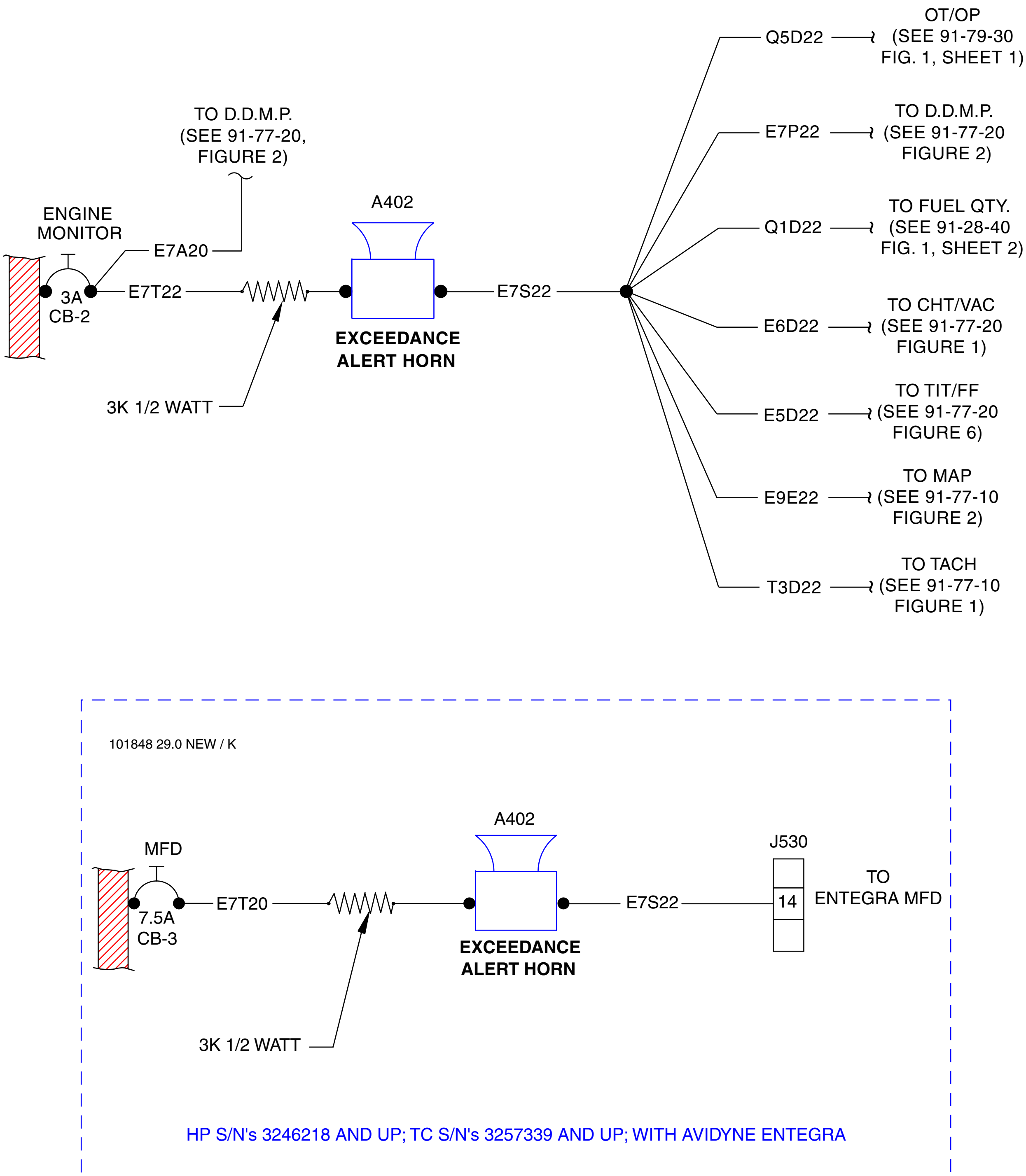
104817 21.1 A



Effectivity
with Garmin 1000

Fuel Quantity
Figure 1 (Sheet 4 of 4)

104406 31.0 NEW / J
104141 31.0 NEW / C
101272 32.0 NEW / D
100840 32.0 NEW / C



Effectivity
3246088 and up
3257001 and up

Exceedance Audio Alert
Figure 2

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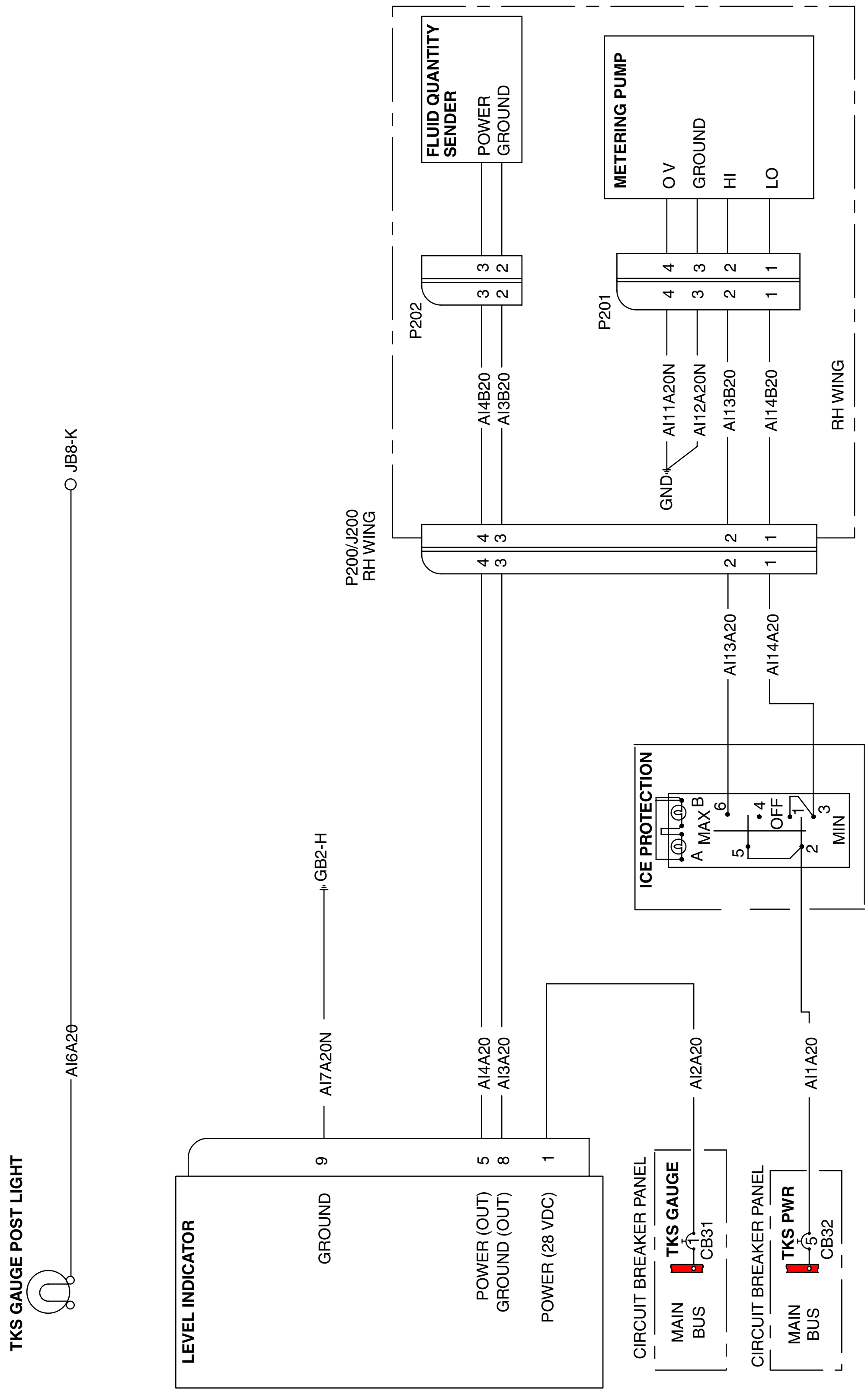
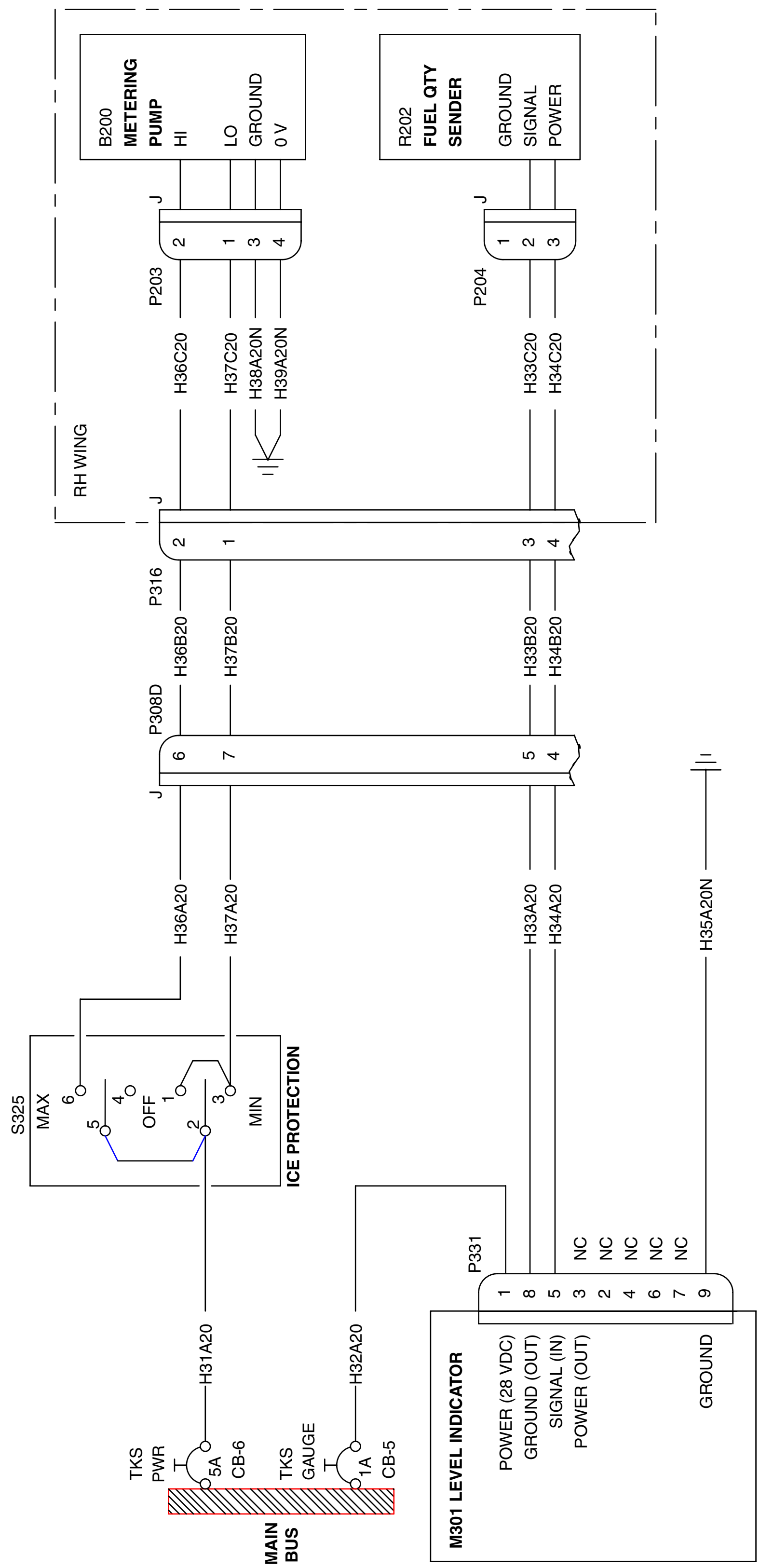
105403 2.0 D



TKS System (Optional)
Figure 1 (Sheet 1 of 2)

Effectivity
3246234 and up
3257404 and up

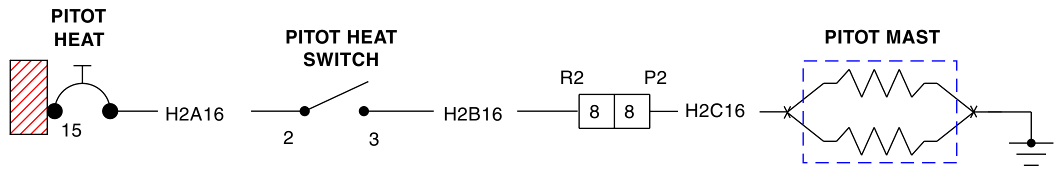
104817 25.0 A



[Effectivity with Garmin 1000]

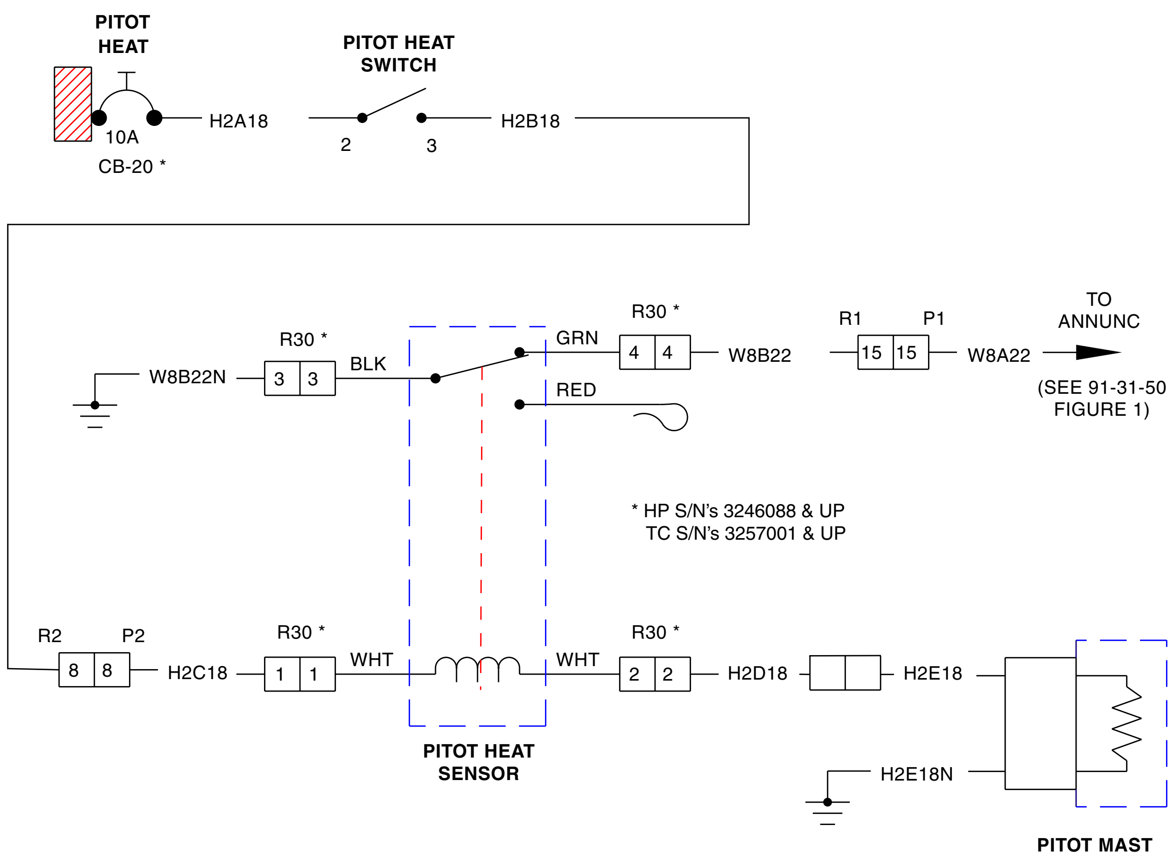
TKS System (Optional)
Figure 1 (Sheet 2 of 2)

85300 10.0 NEW/B



HP S/N's 3246001 THRU 3246017 ONLY

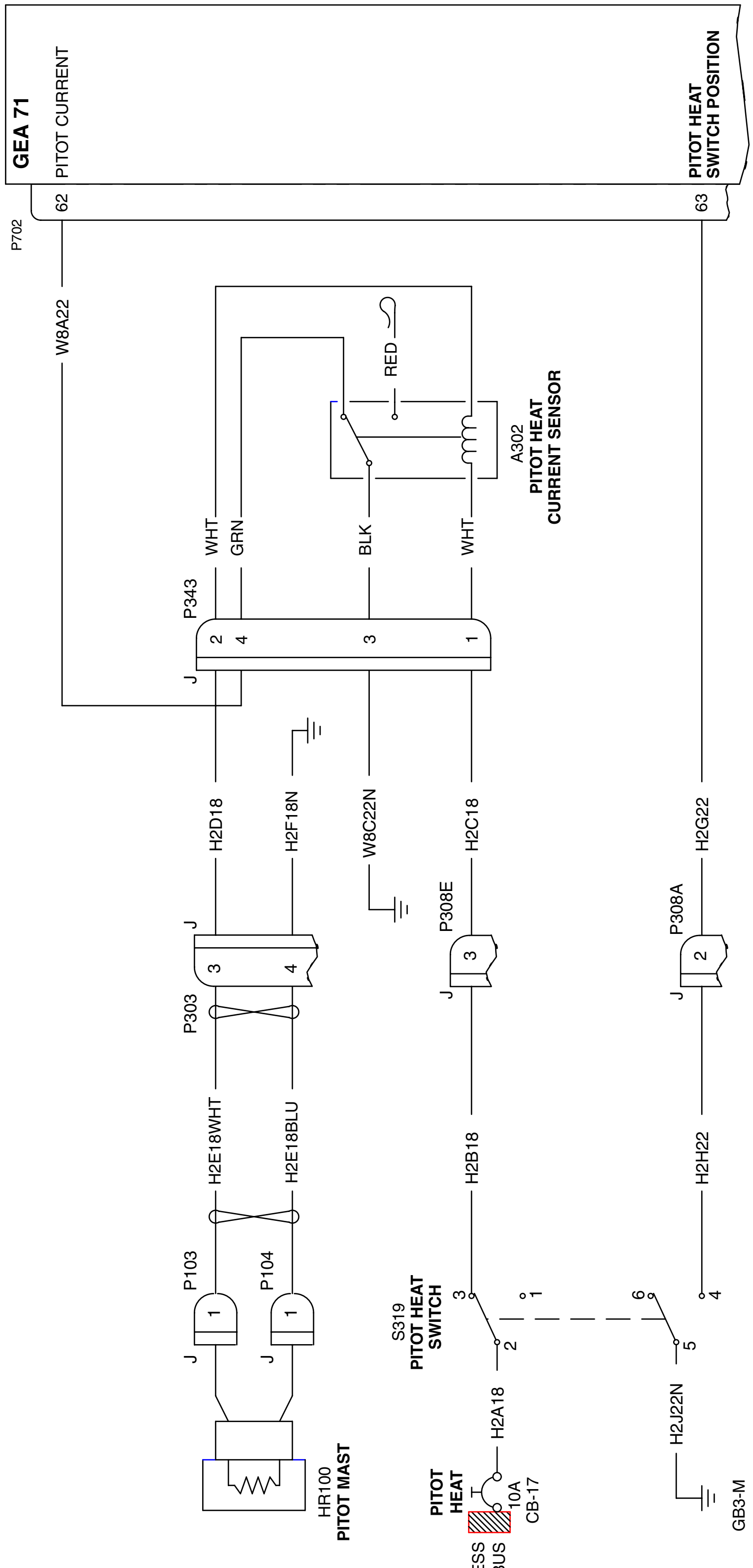
101848 10.0 L
104406 10.0 NEW / J
104141 10.0 NEW / C
101272 10.0 NEW / D
100840 10.0 NEW / C
85501 10.0 NEW / F



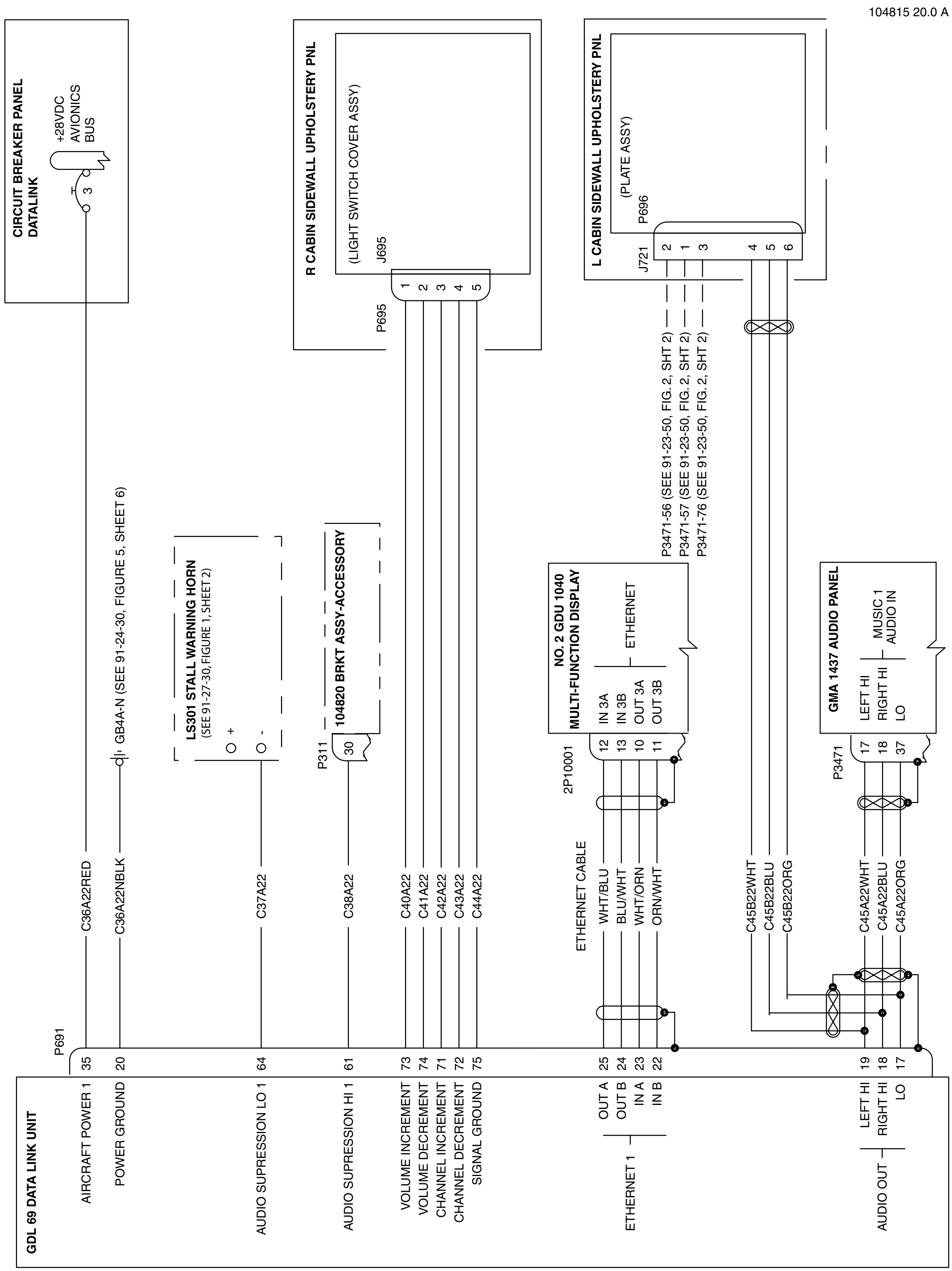
HP S/N's 3246018 & UP; TC S/N's 3257001 & UP

Pitot Heat
Figure 1 (Sheet 1 of 2)

104817 10.0 A



Pitot Heat
Figure 1 (Sheet 2 of 2)



Data Link
Figure 1

Effectivity
with Garmin 1000

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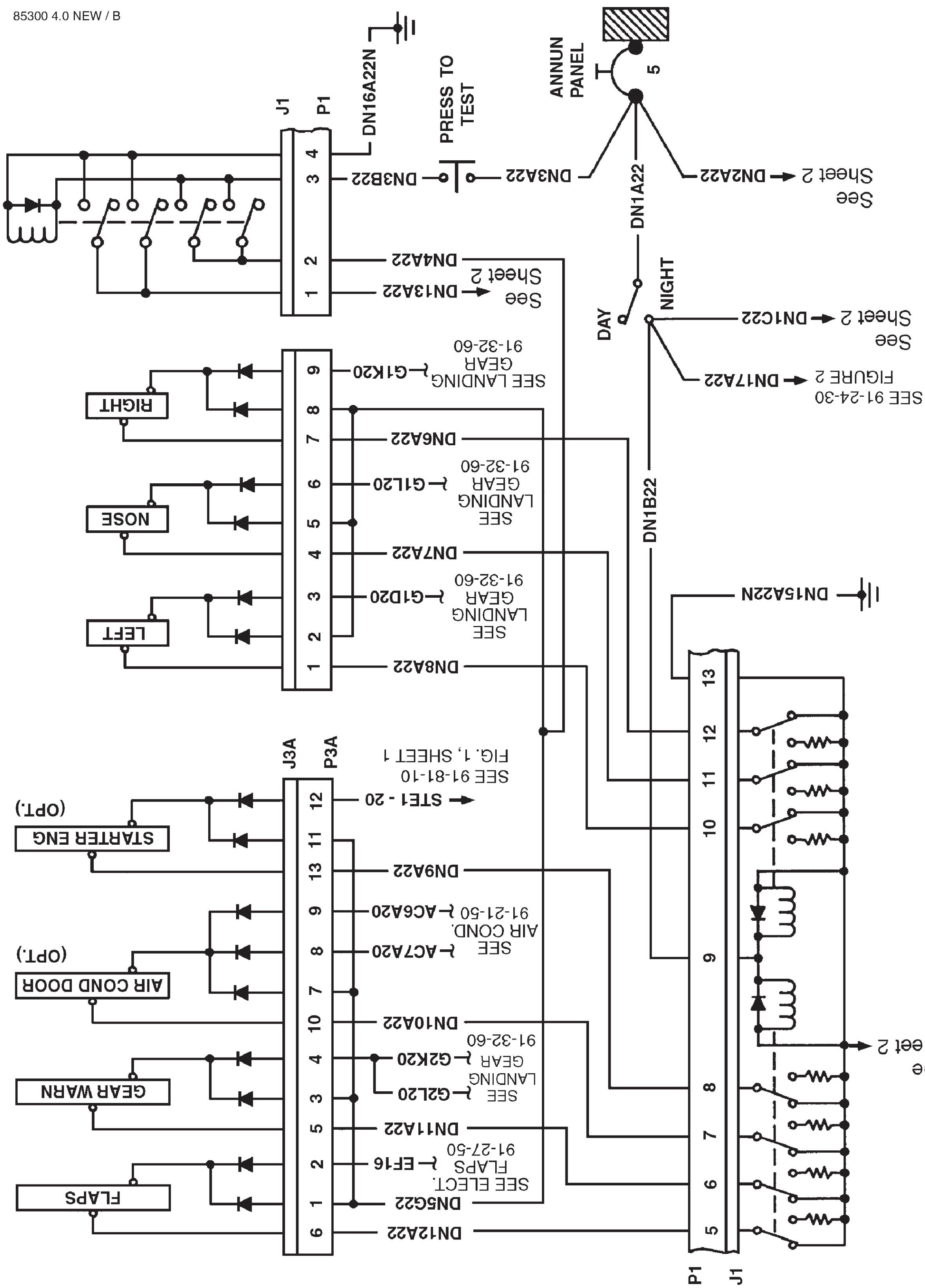
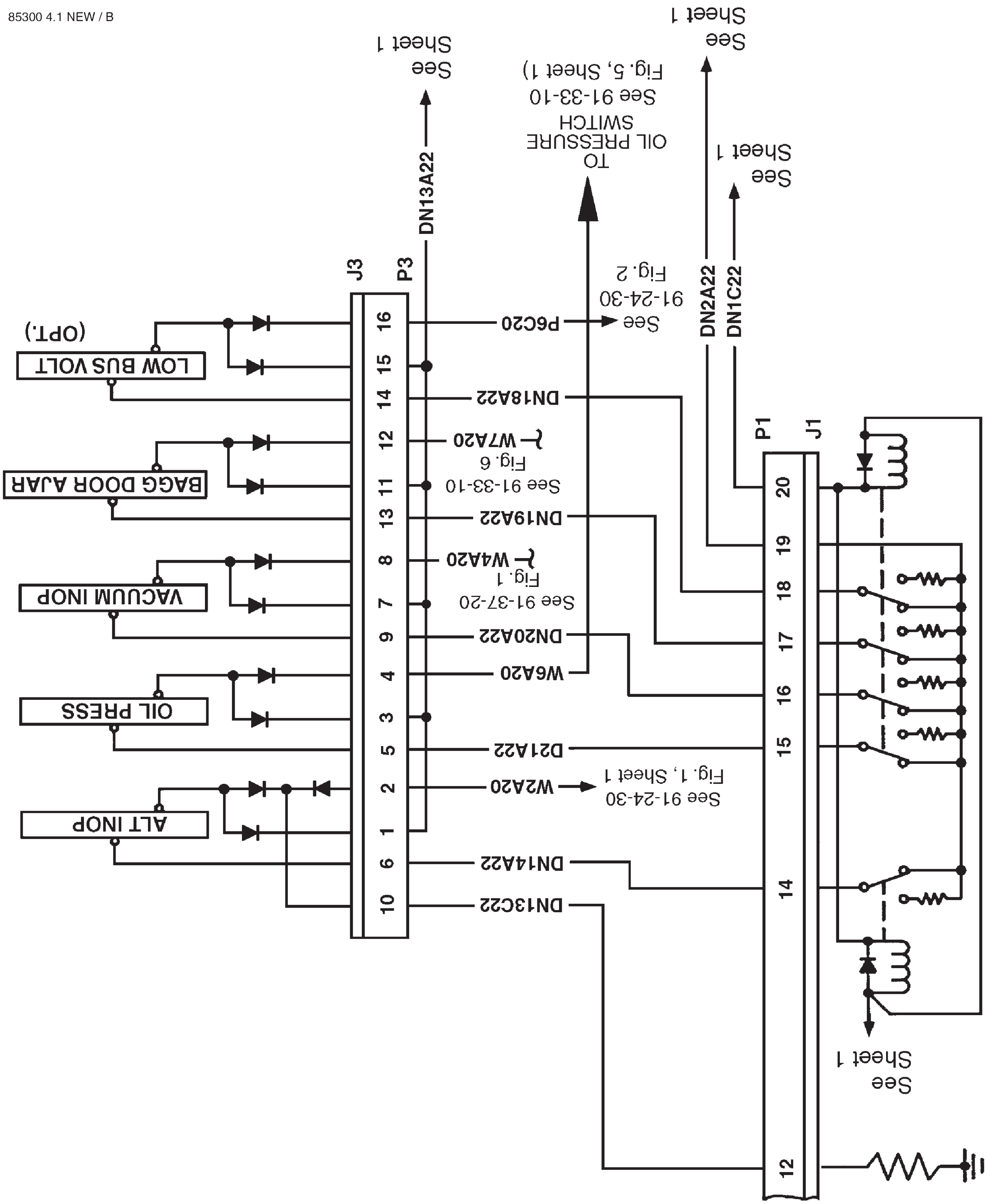
85300 4.0 NEW / B



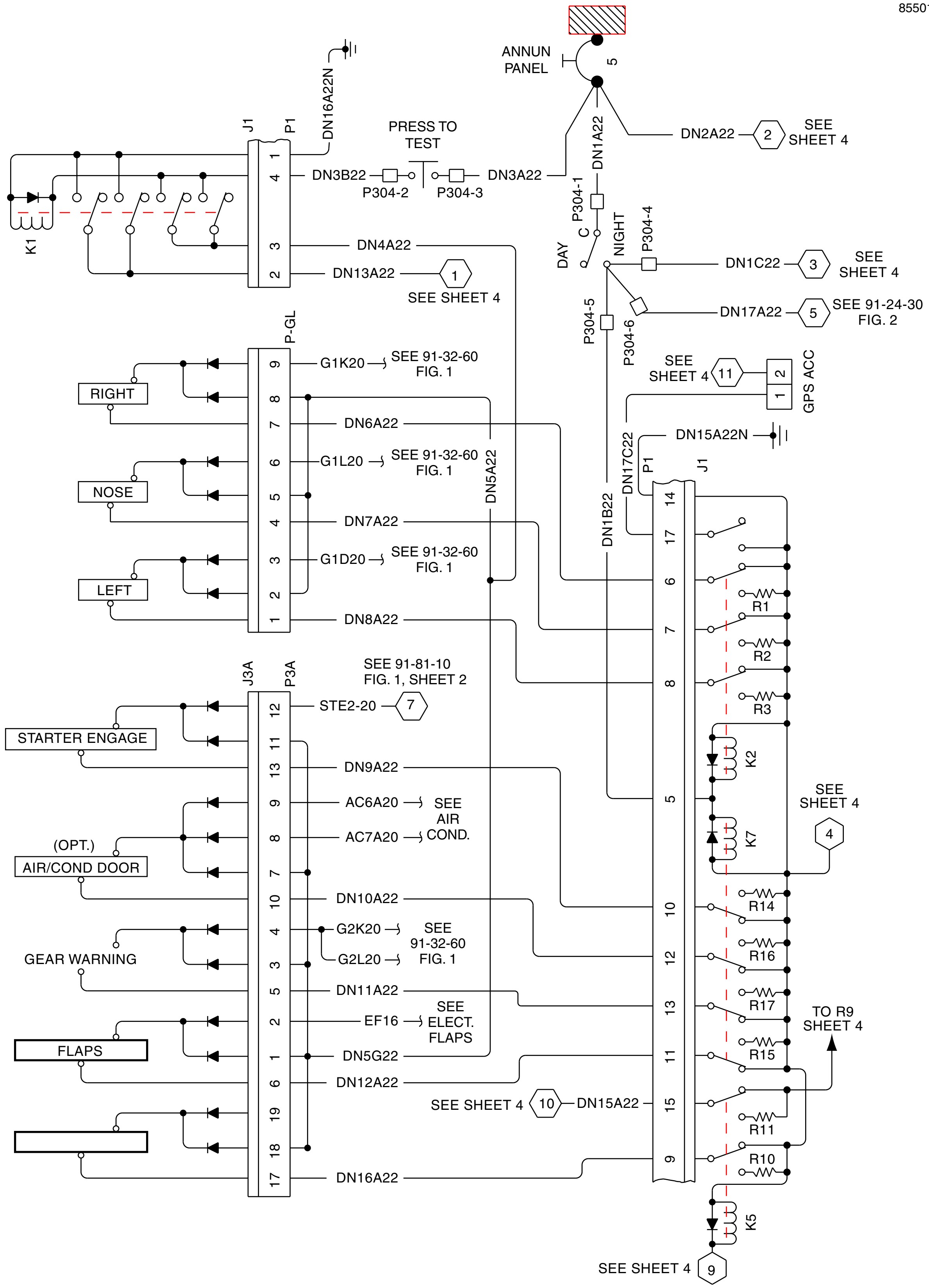
Annunciator
Figure 1 (Sheet 1 of 12)

Effectivity
3246001 thru 3246017



Annunciator
Figure 1 (Sheet 2 of 12)

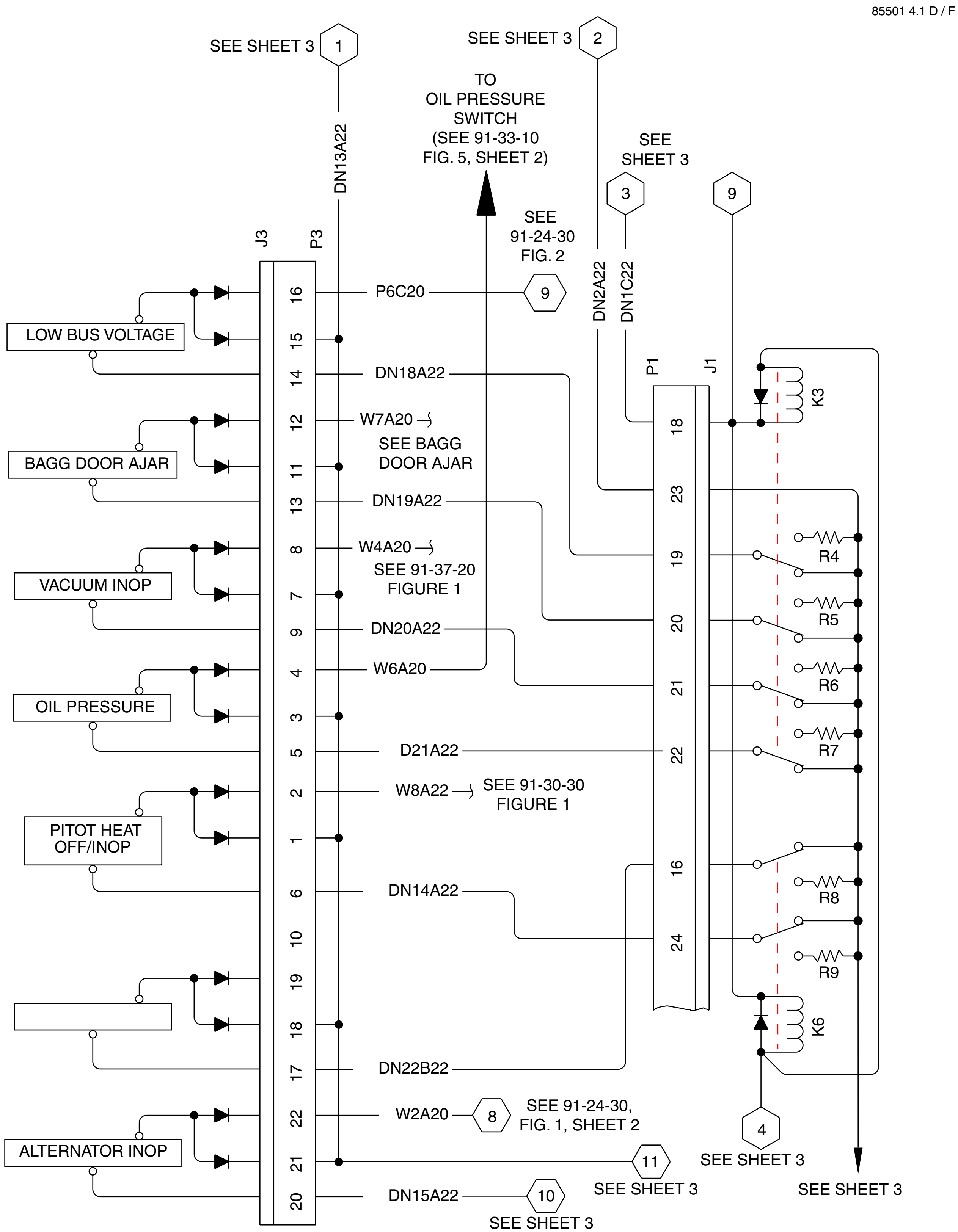
85501 4.0 E / F



INTERNATIONAL AEROTECH ACADEMY FOR TRAINING PURPOSES ONLY

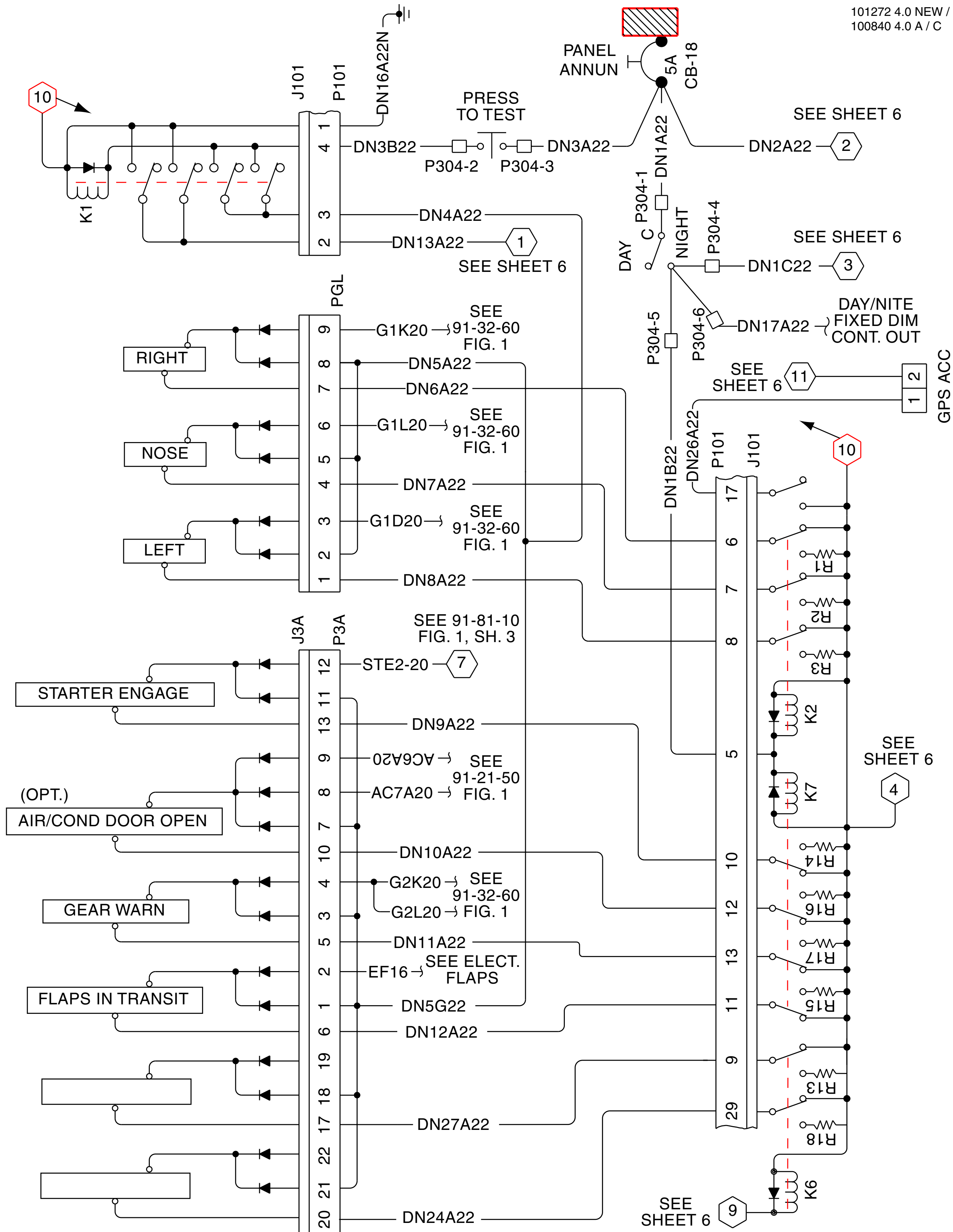
Annunciator
Figure 1 (Sheet 3 of 12)

Effectivity
3246018 thru 3246087



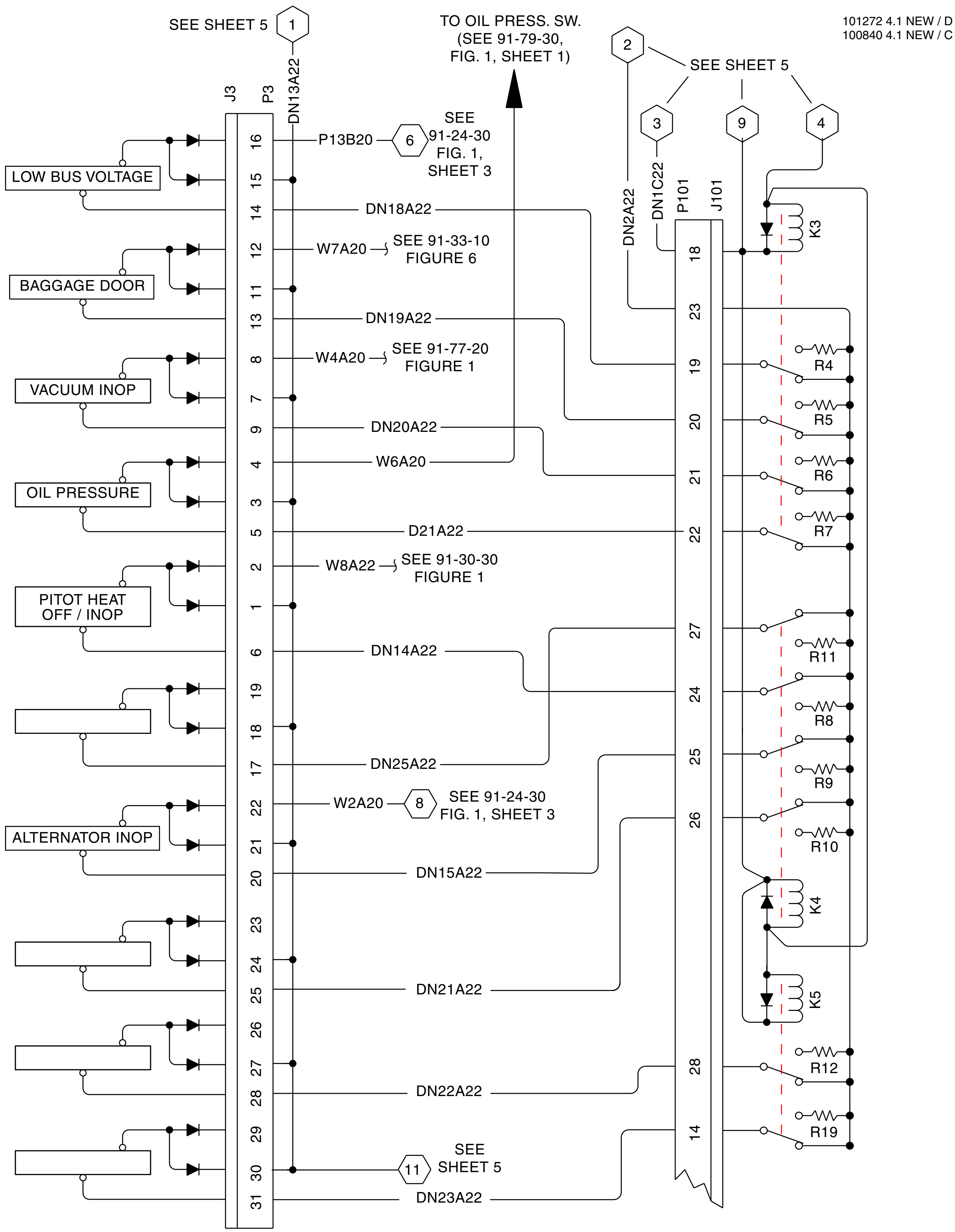
Effectivity
3246018 thru 3246087

Annunciator
Figure 1 (Sheet 4 of 12)



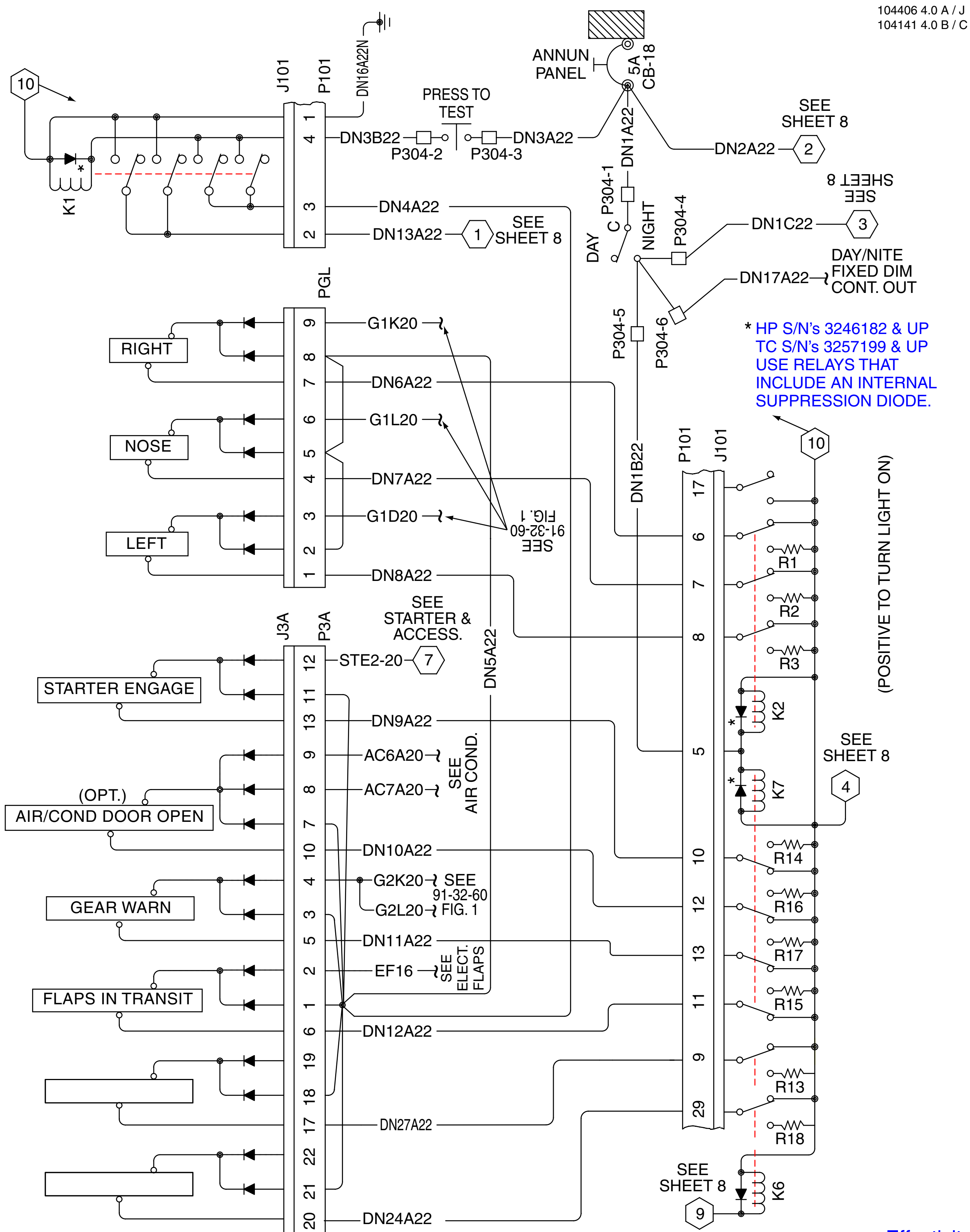
Annunciator
Figure 1 (Sheet 5 of 12)

Effectivity
3246088 thru 3246153
3257001 thru 3257123



Effectivity
3246088 thru 3246153
3257001 thru 3257123

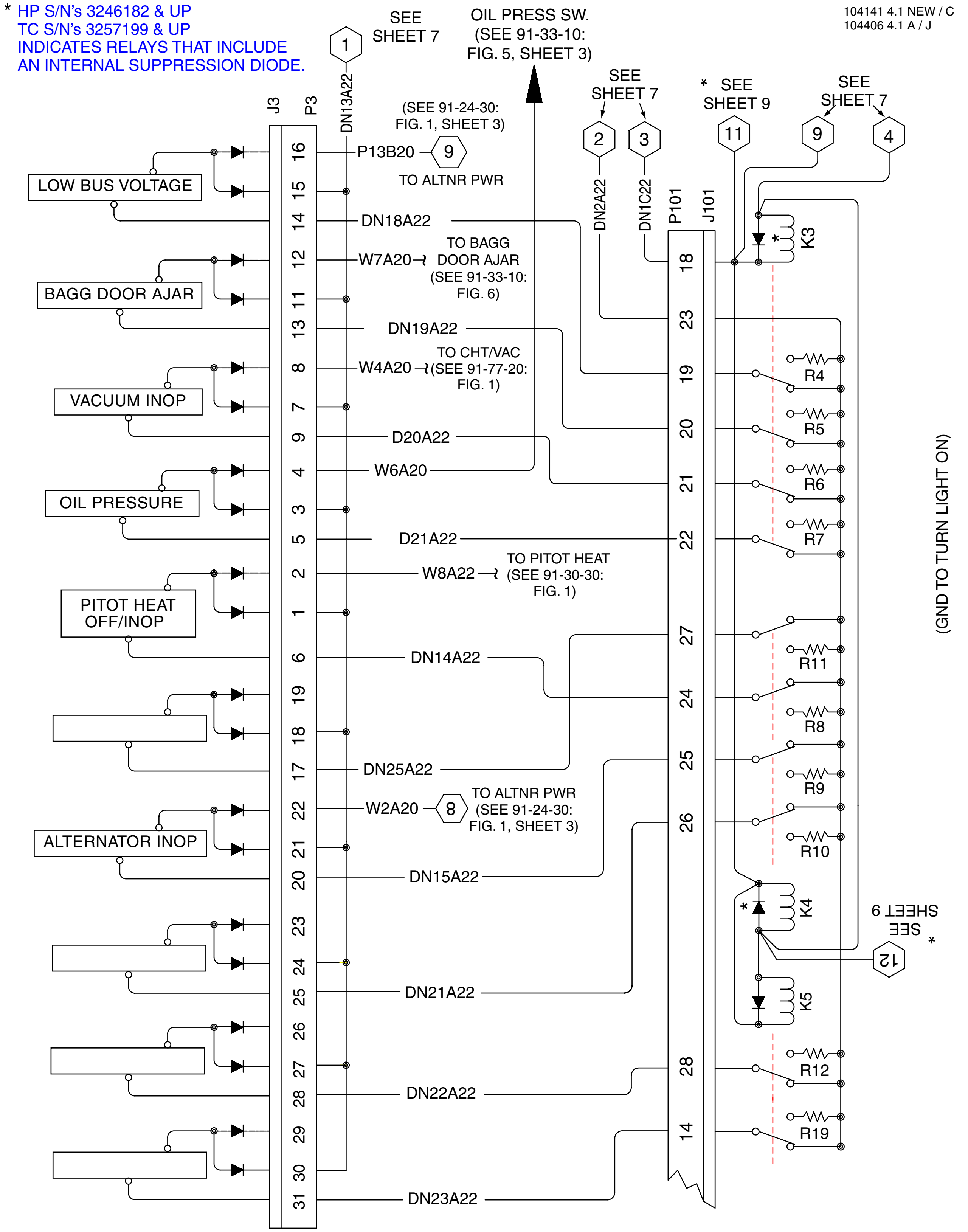
Annunciator
Figure 1 (Sheet 6 of 12)



Annunciator
Figure 1 (Sheet 7 of 12)

Effectivity
3246154 and up
3257124 and up

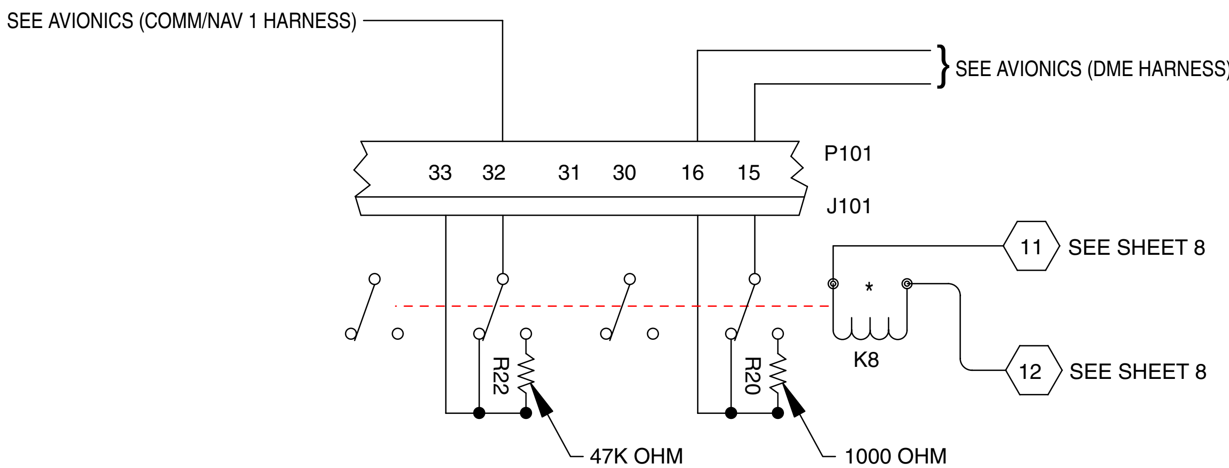
INTERNATIONAL AEROTECH ACADEMY FOR TRAINING PURPOSES ONLY



Annunciator
Figure 1 (Sheet 8 of 12)

Effectivity
3246154 and up
3257124 and up

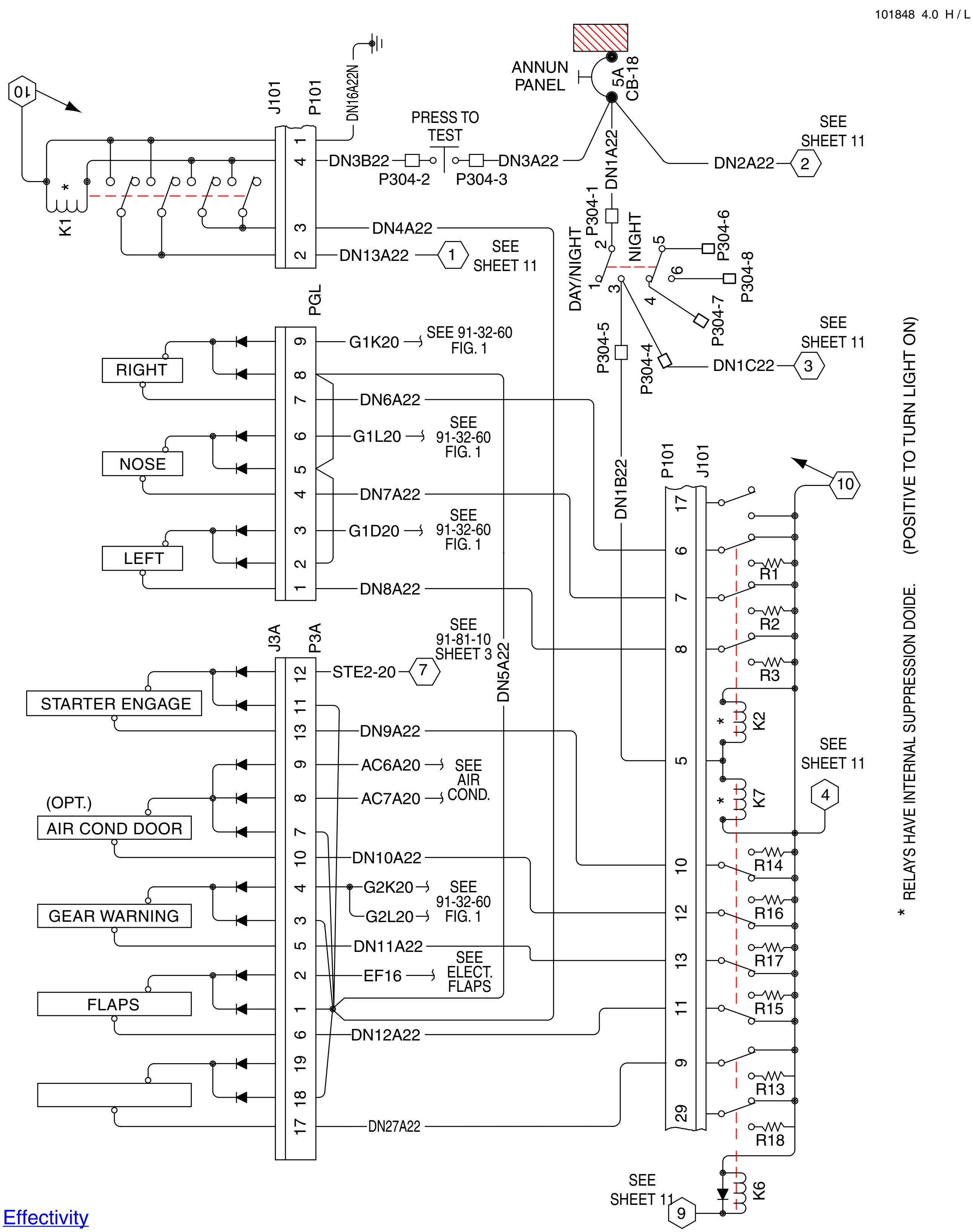
104406 4.2 D / J



* (HAS INTERNAL SUPPRESSION)

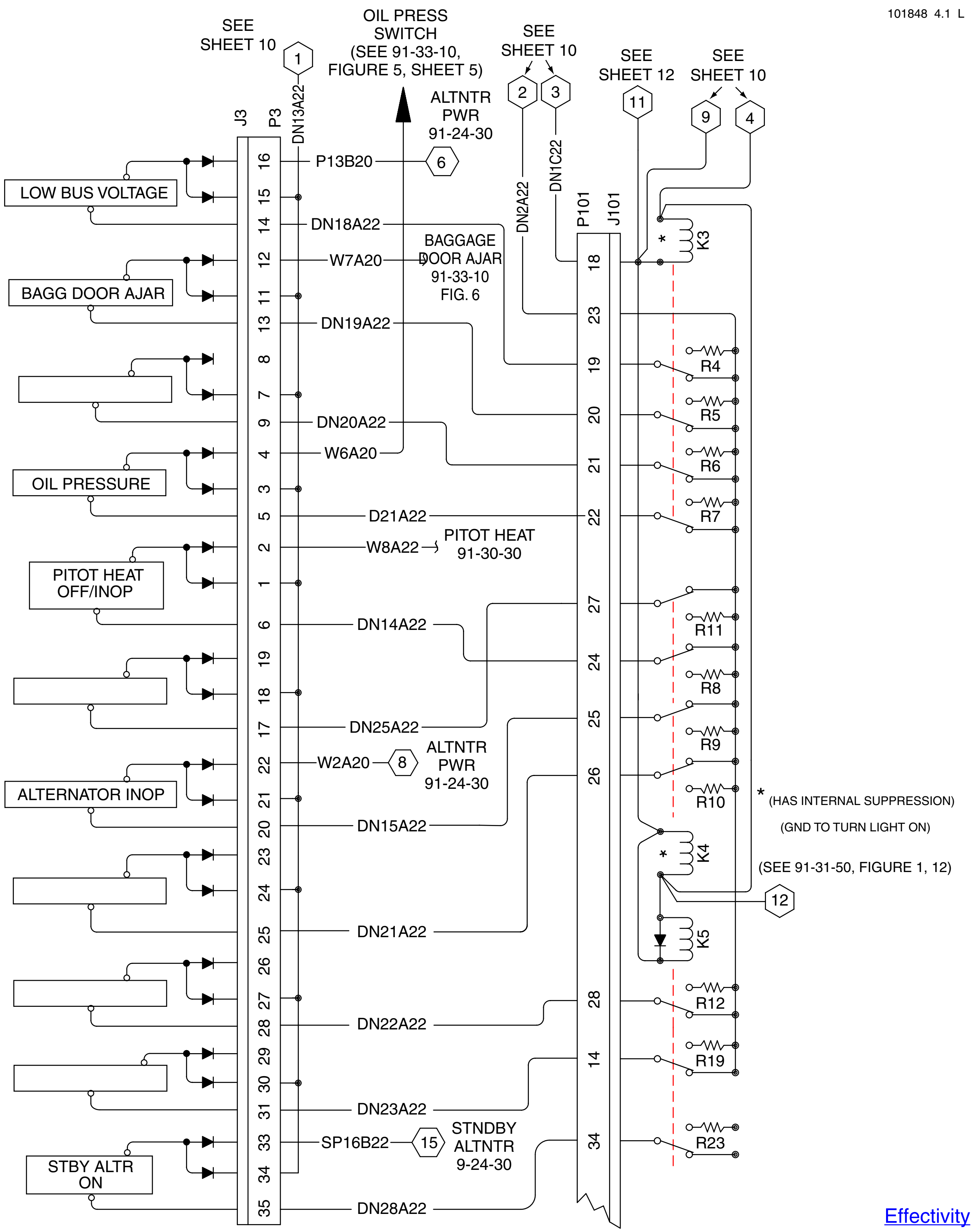
Annunciator
Figure 1 (Sheet 9 of 12)

Effectivity
3246182 and up
3257199 and up



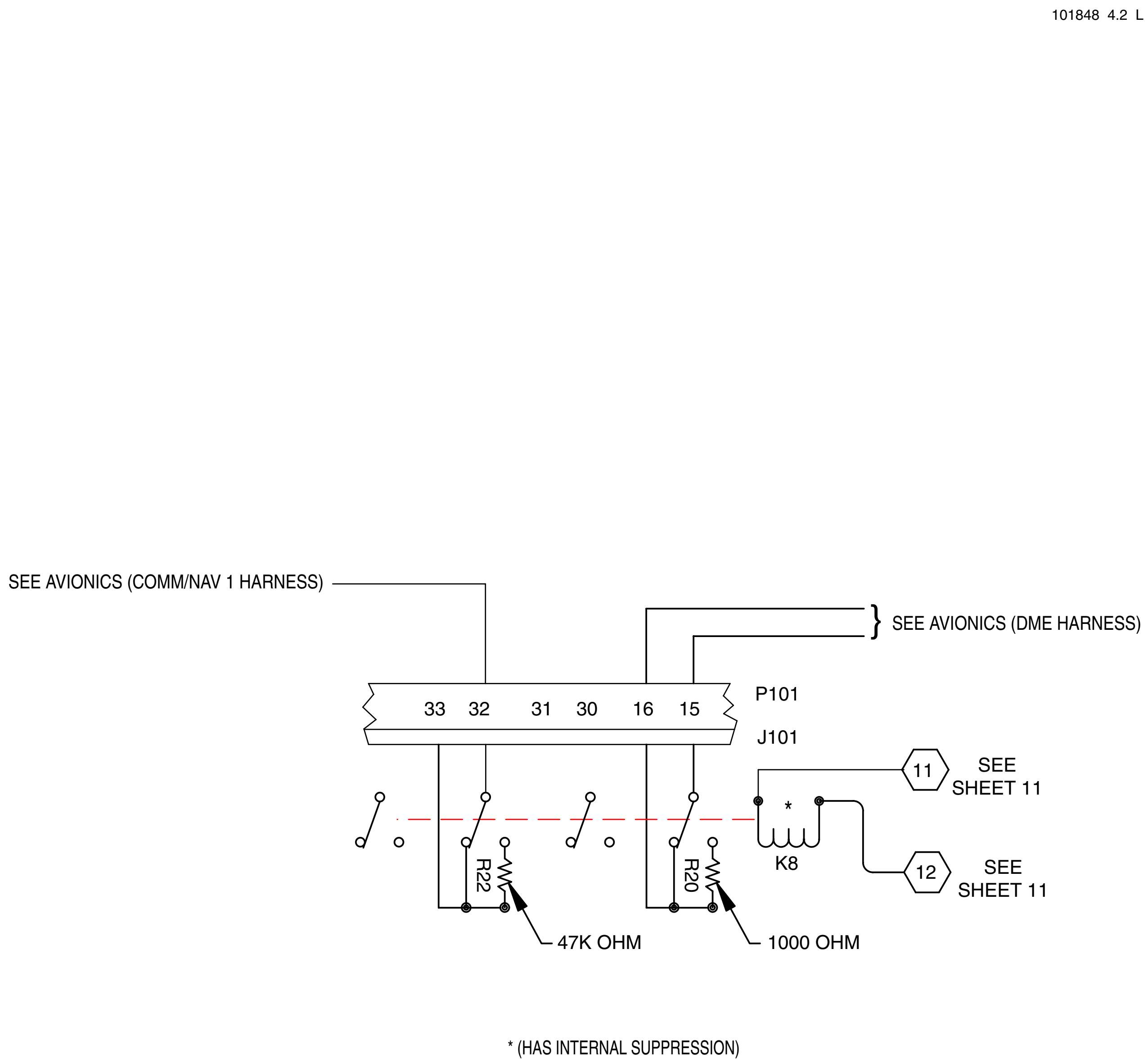
Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra

Annunciator
Figure 1 (Sheet 10 of 12)



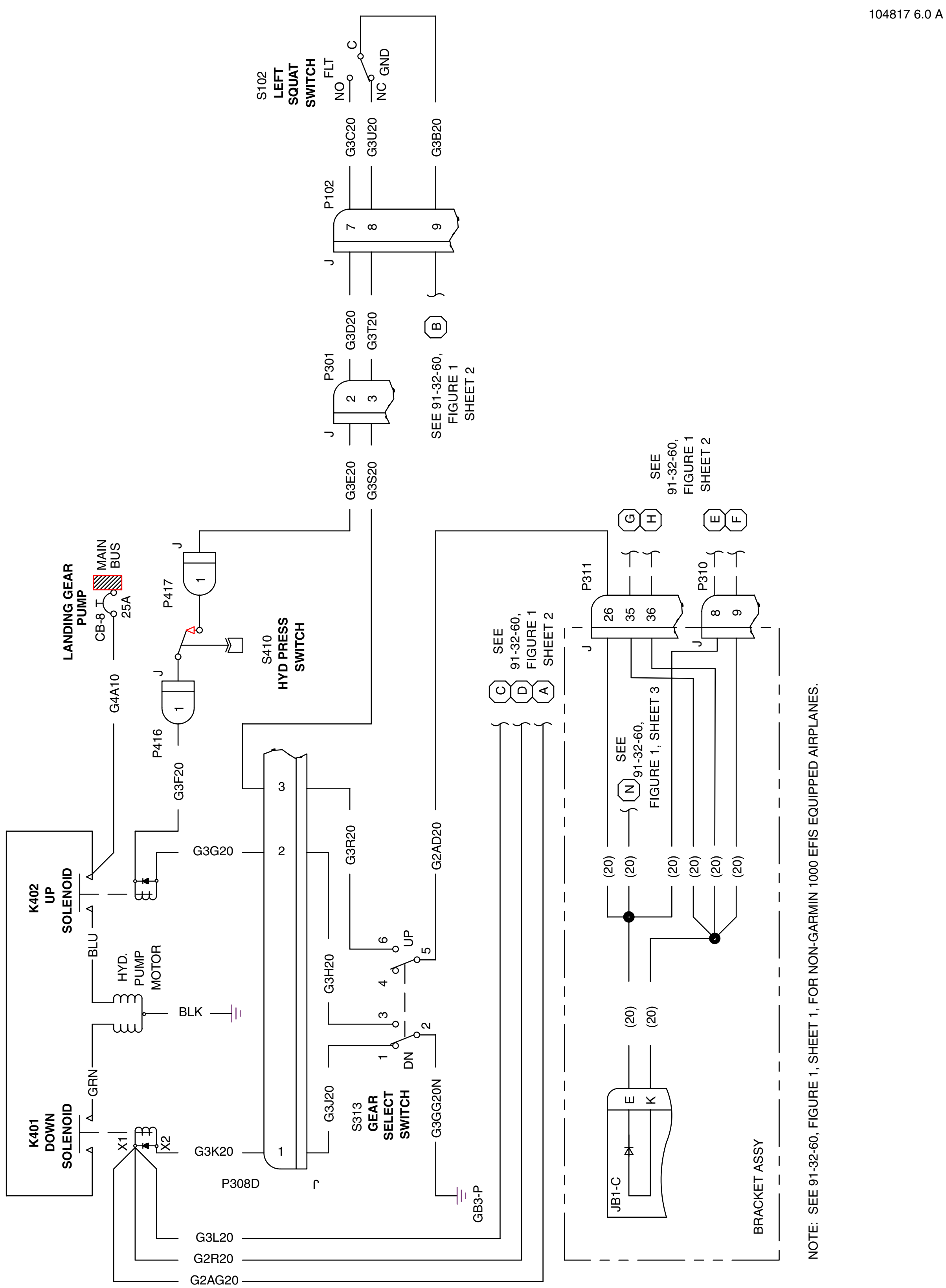
Annunciator
Figure 1 (Sheet 11 of 12)

Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra



Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra

Annunciator
Figure 1 (Sheet 12 of 12)



Landing Gear Control
Figure 1

Effectivity
with Garmin 1000

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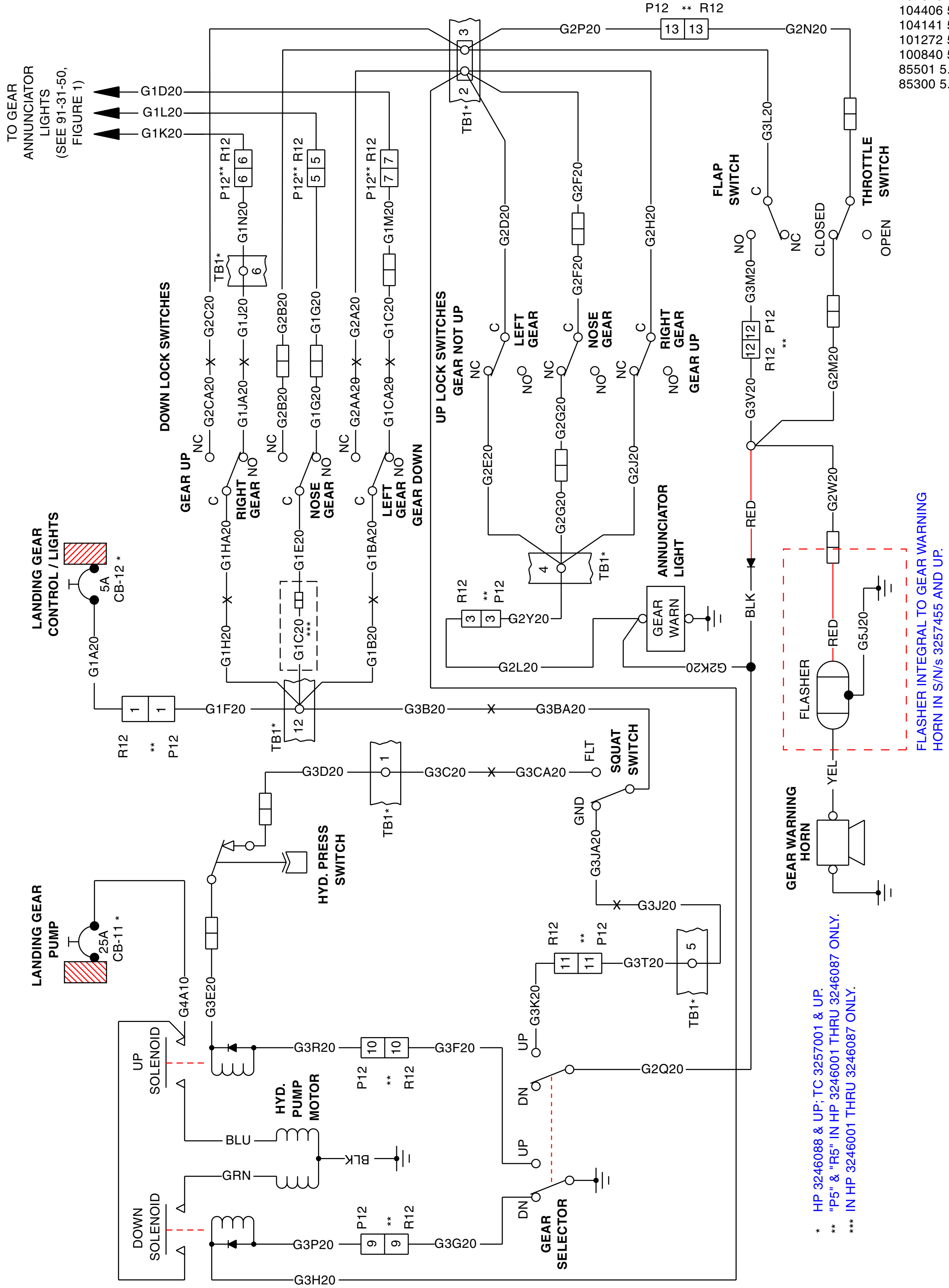
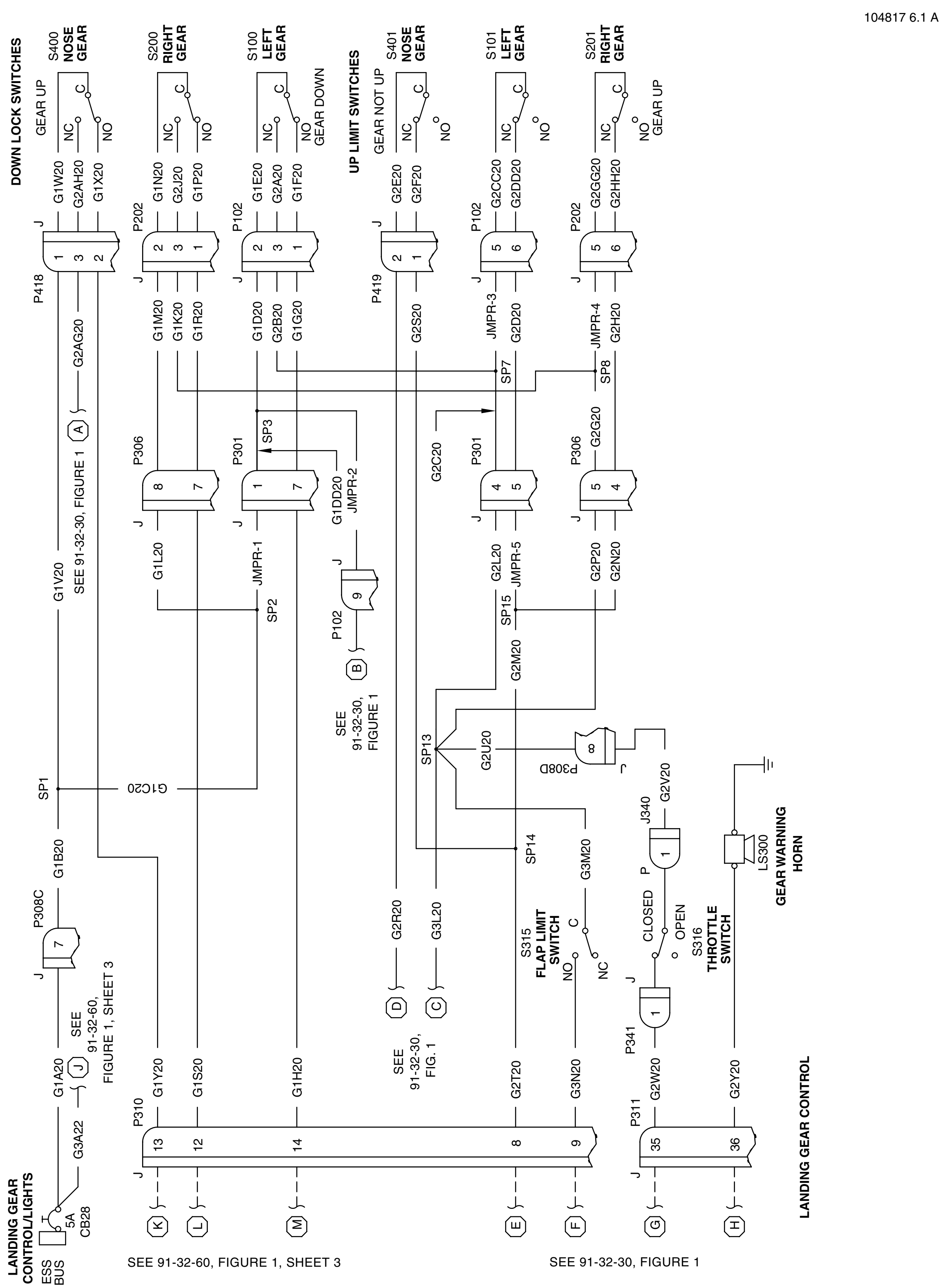
101848 5.0 L
104406 5.0 NEW / J
104141 5.0 NEW / C
101272 5.0 NEW / D
100840 5.0 B / C
85501 5.0 NEW / F
85300 5.0 NEW / B

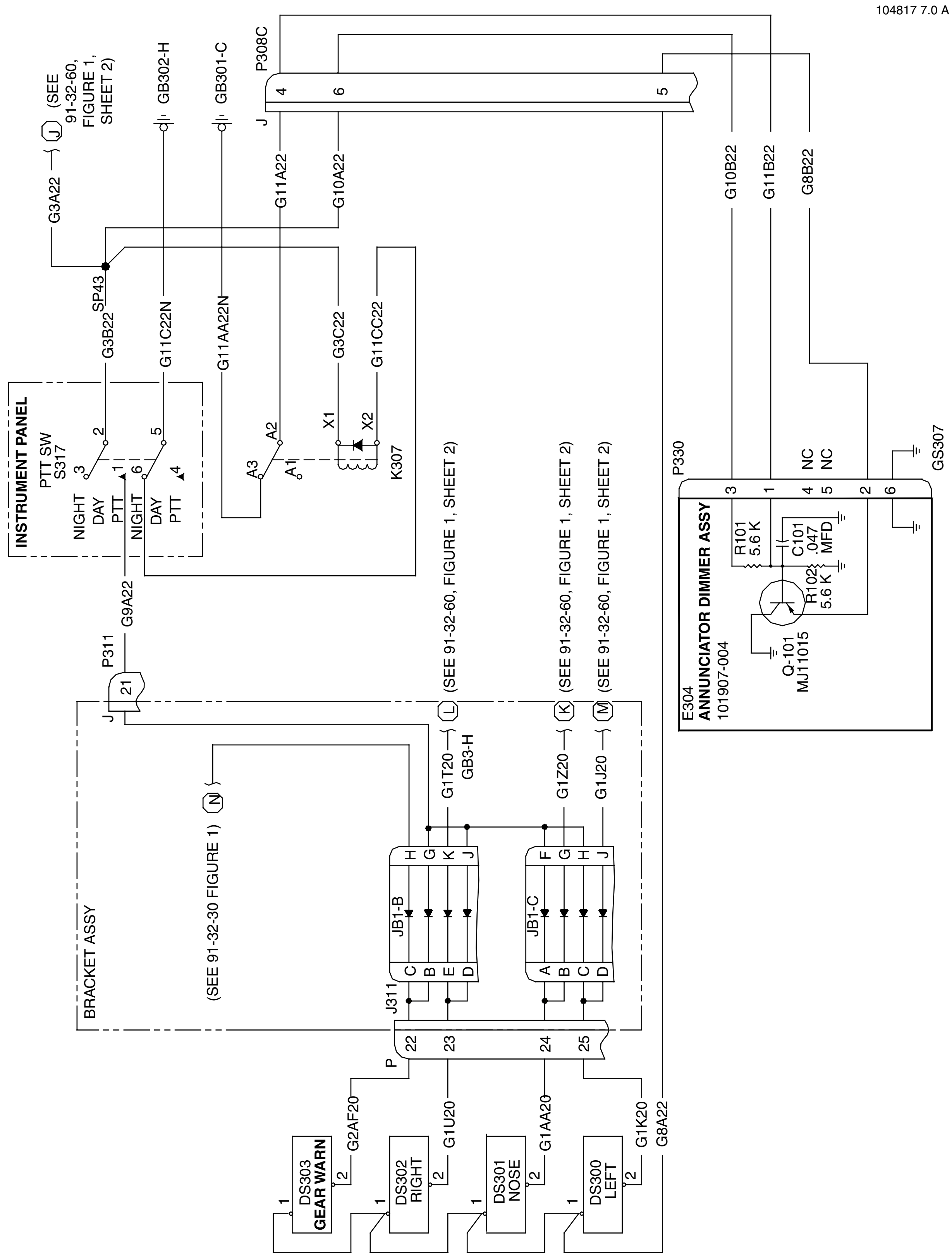


Landing Gear Position and Warning
Figure 1 (Sheet 1 of 3)



Effectivity
with Garmin 1000

Landing Gear Position and Warning
Figure 1 (Sheet 2 of 3)



Landing Gear Position and Warning
Figure 1 (Sheet 3 of 3)

Effectivity
with Garmin 1000

GRIDS 8J18 THRU 9C8
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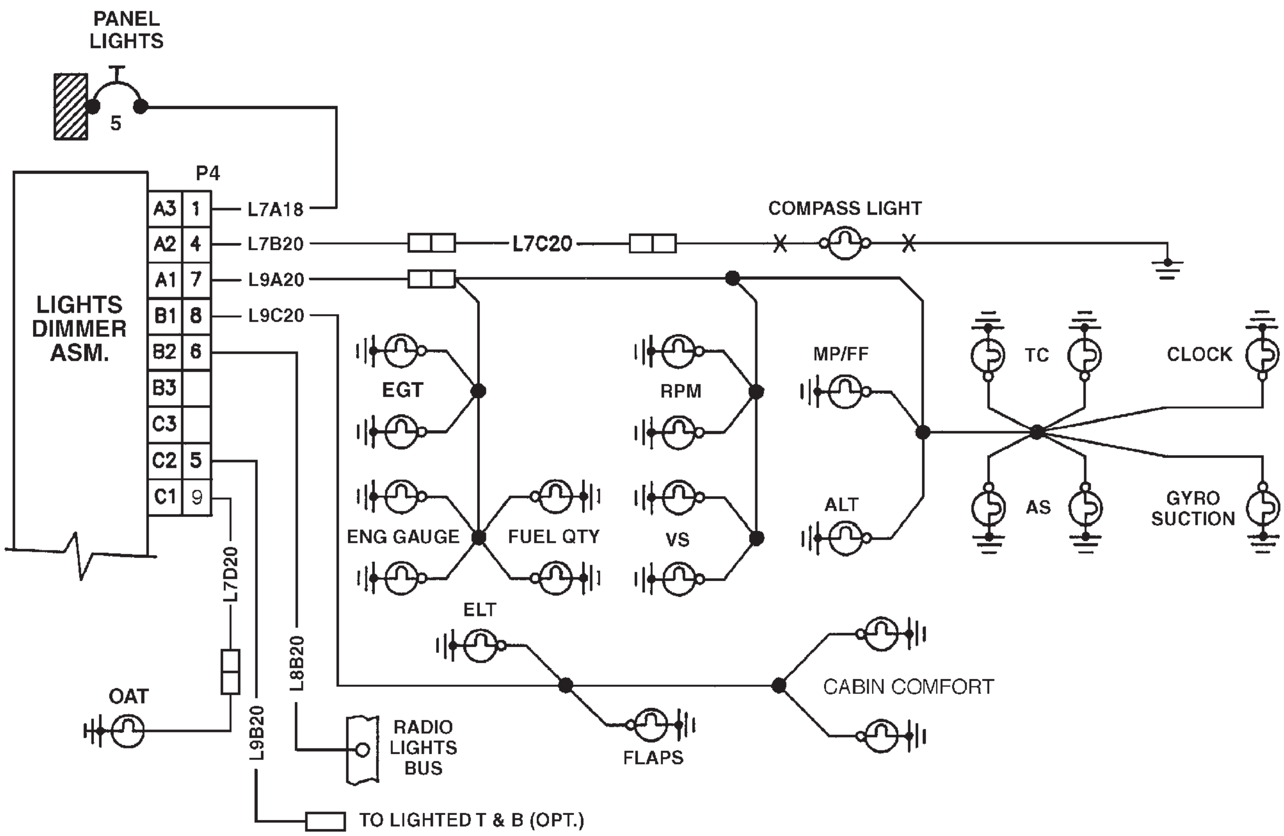
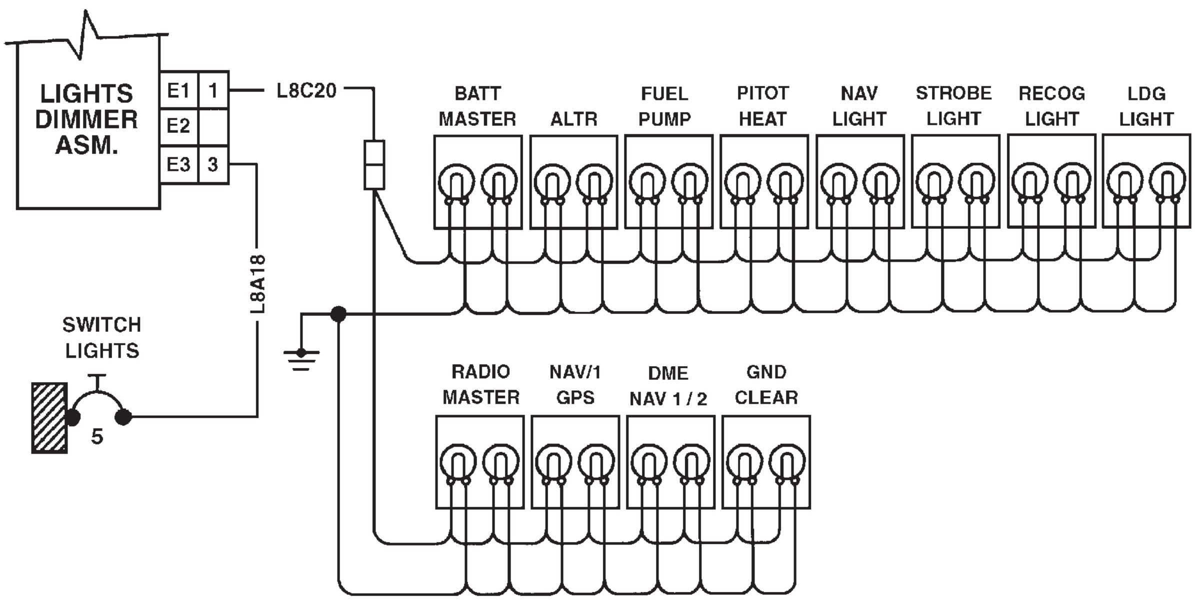
85300 24.0 A / B



Panel and Switch Lights
Figure 1 (Sheet 1 of 6)

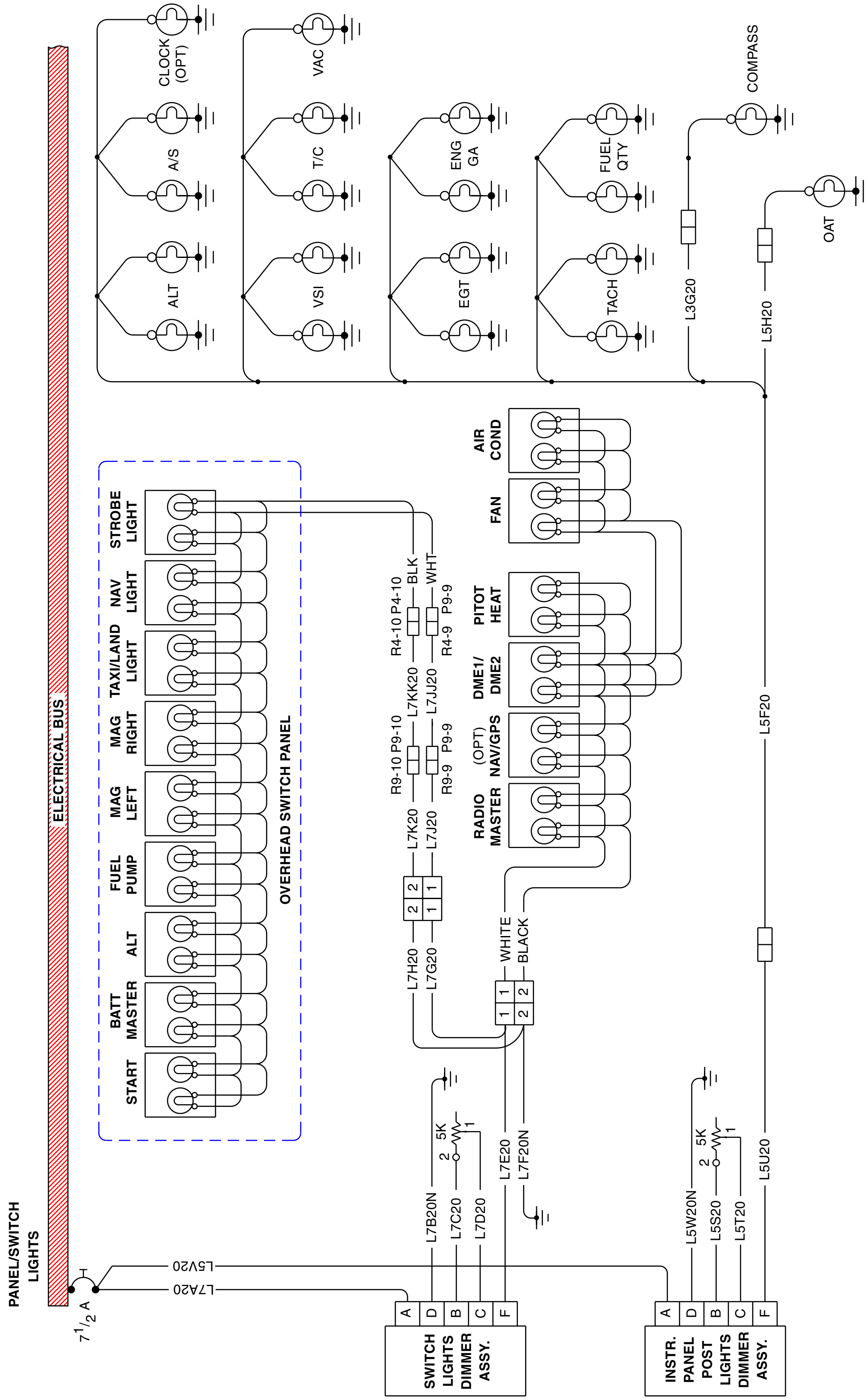
Effectivity
3246001 thru 3246017

85300 25.0 NEW / B



Effectivity
3246001 thru 3246017

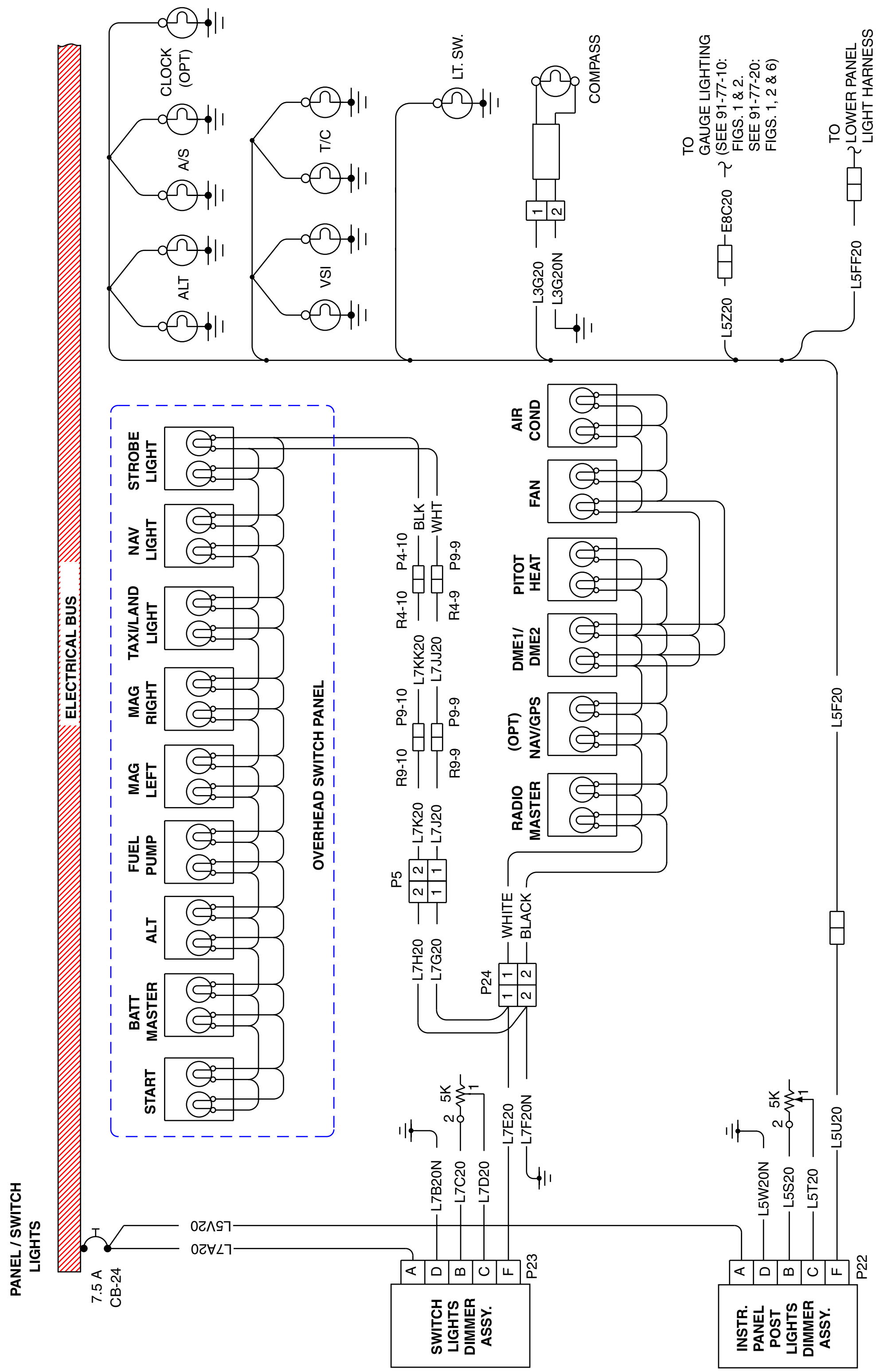
Panel and Switch Lights
Figure 1 (Sheet 2 of 6)



Panel and Switch Lights
Figure 1 (Sheet 3 of 6)

Effectivity
3246018 thru 3246087

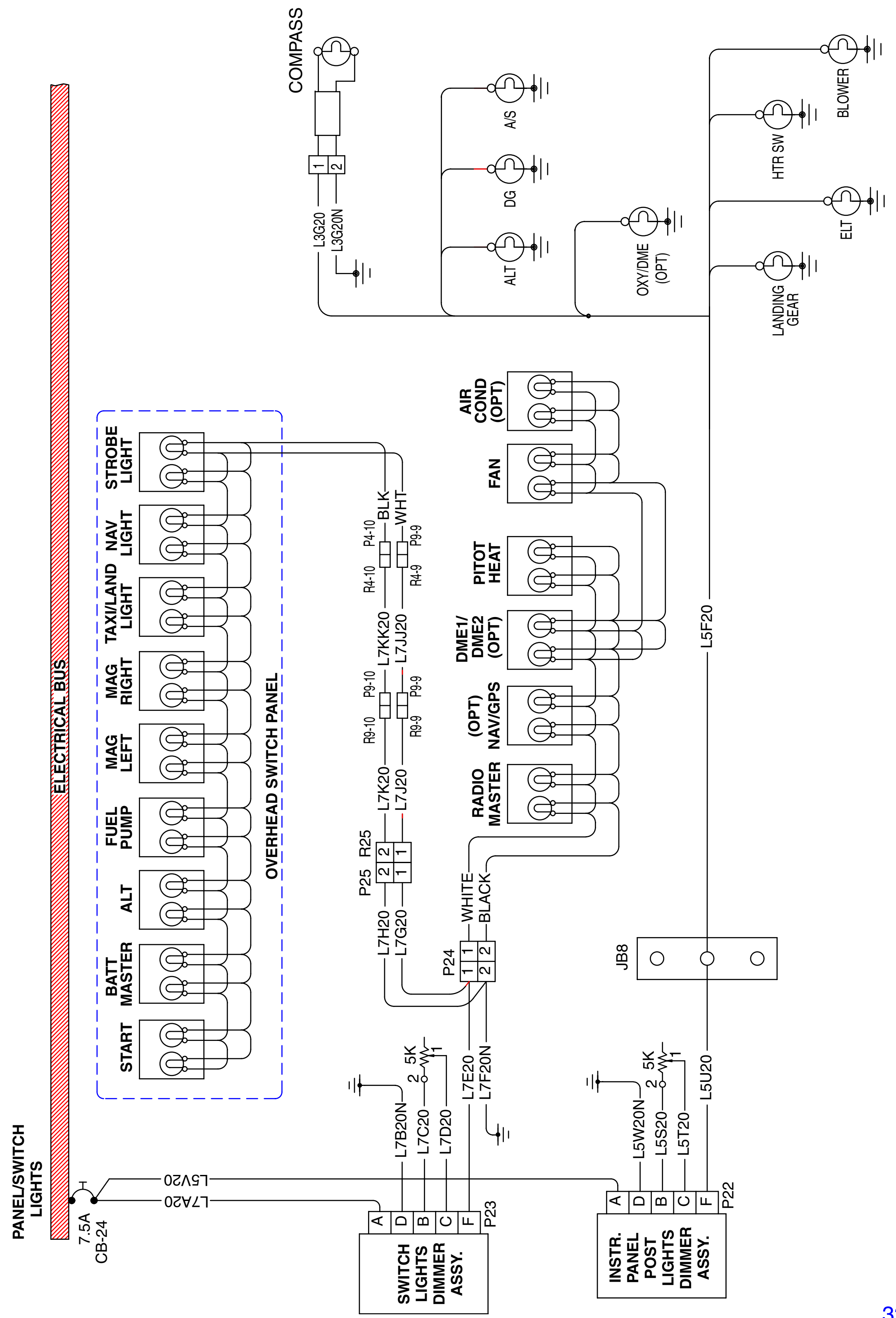
104406 24.0 NEW / J
104141 24.0 NEW / C
101272 25.0 NEW / D
100840 25.0 B / C



Effectivity
3246088 and up
3257001 and up

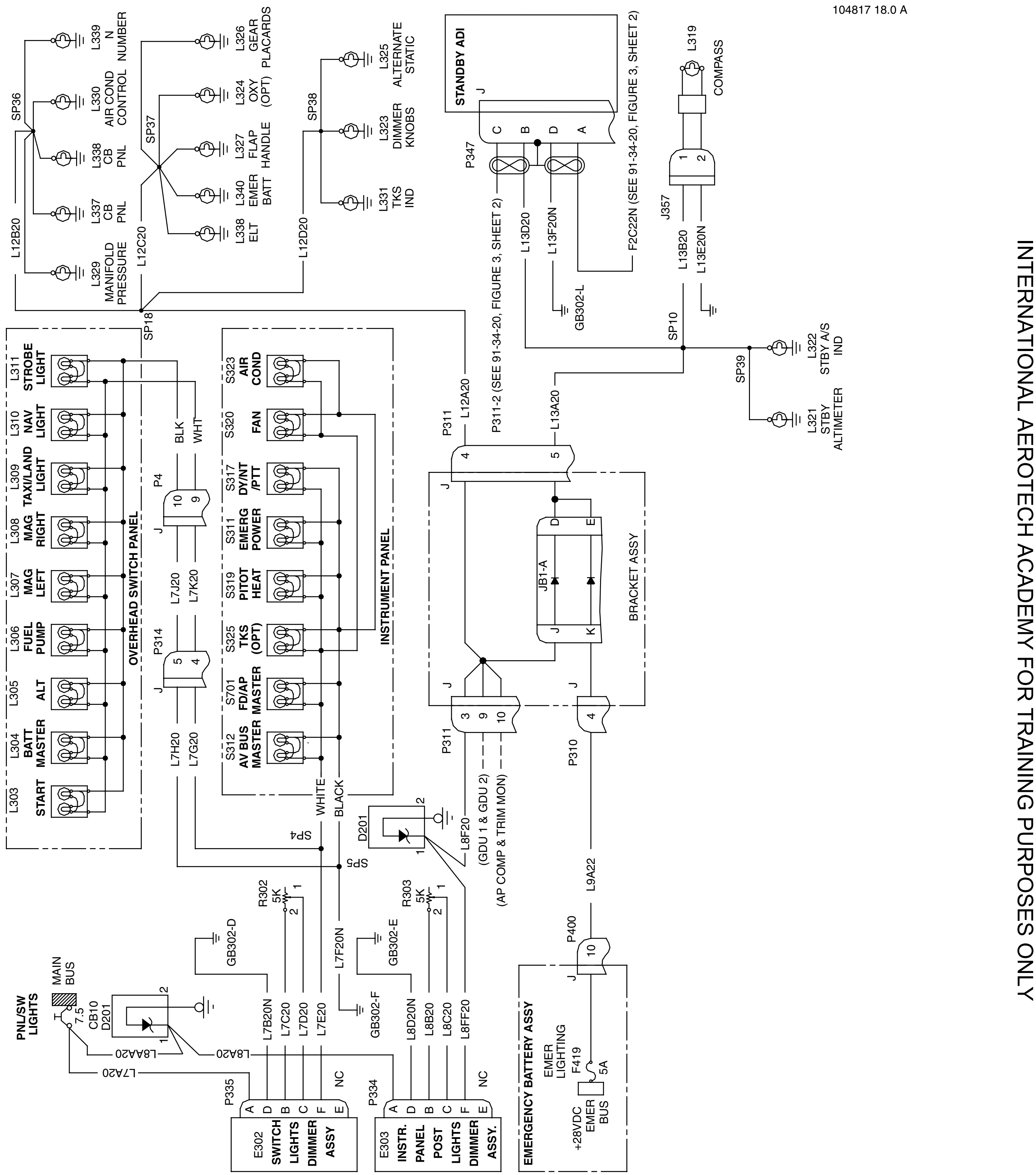
Panel and Switch Lights
Figure 1 (Sheet 4 of 6)

101848 24.0 L



Panel and Switch Lights
Figure 1 (Sheet 5 of 6)

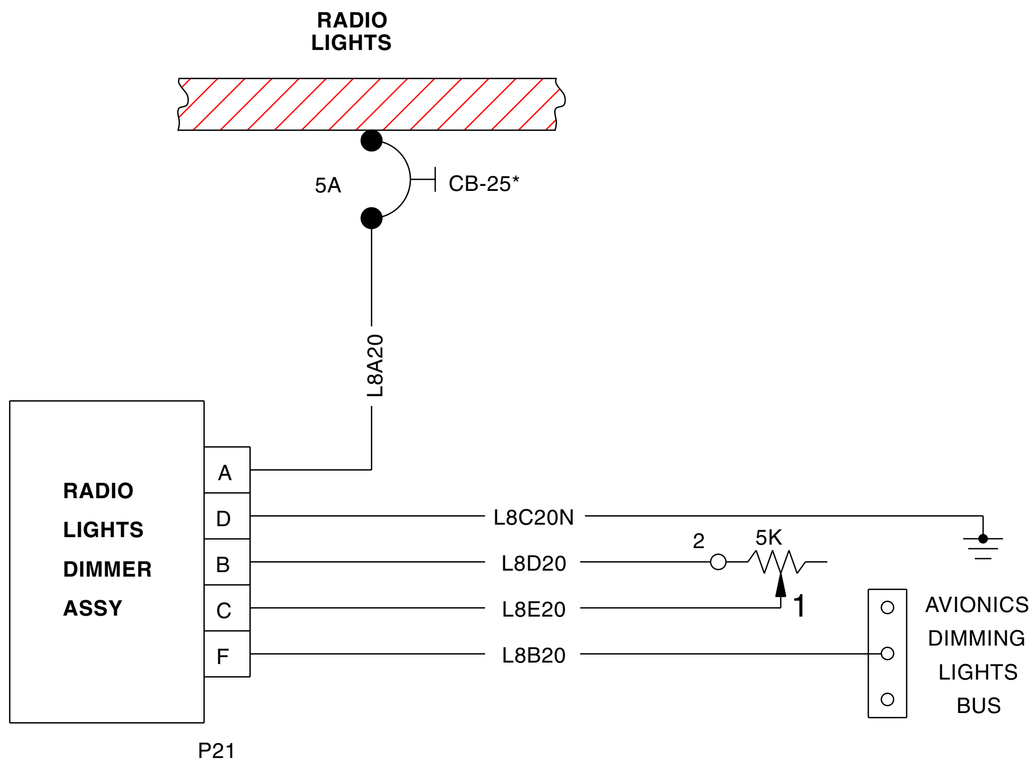
Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra



[Effectivity with Garmin 1000](#)

Panel and Switch Lights
Figure 1 (Sheet 6 of 6)

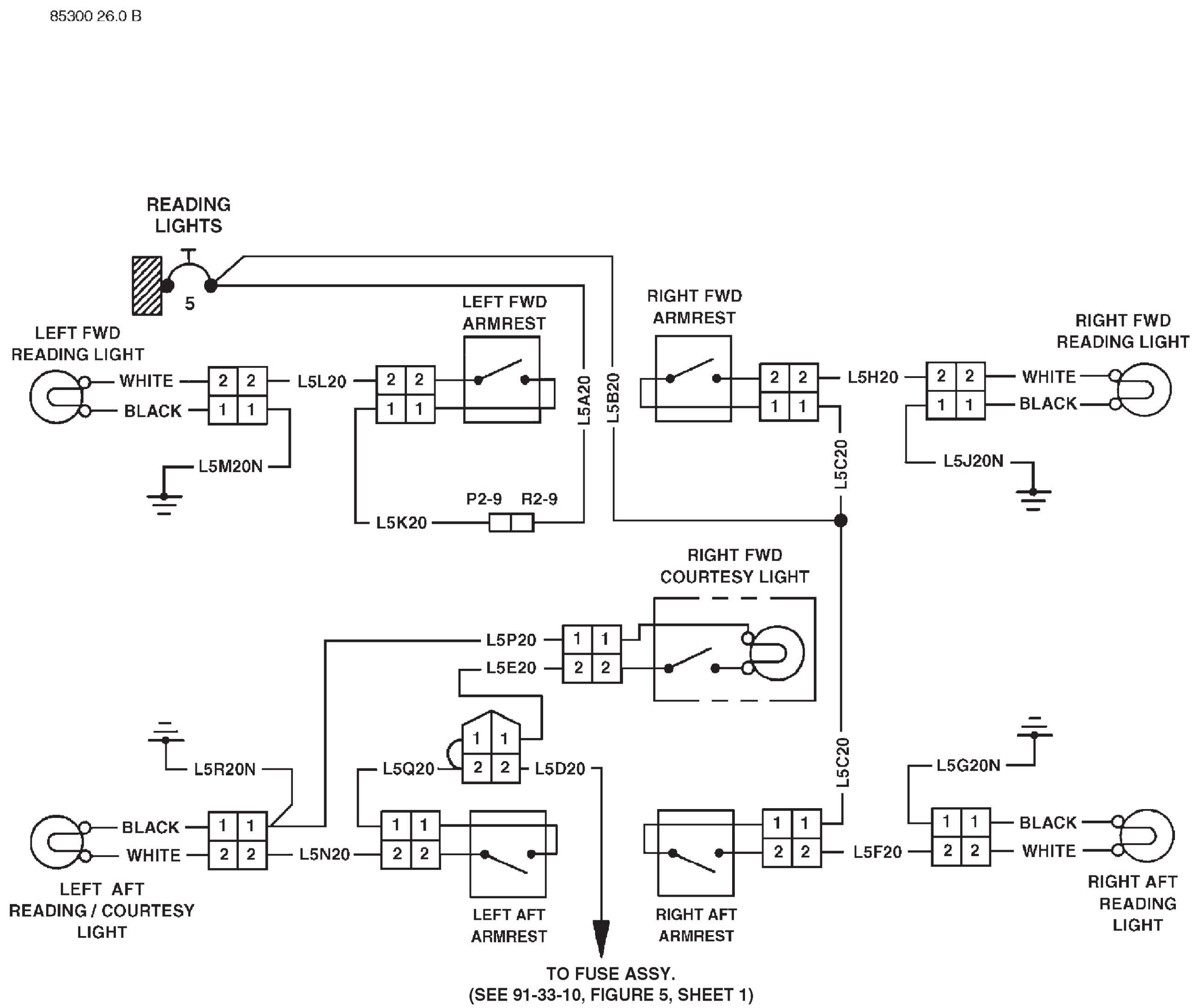
101848 27.0 L
104406 28.0 NEW / J
104141 28.0 NEW / C
101272 29.0 NEW / B
100840 29.0 A / C
85501 29.0 NEW / F



* LESS HP S/N'S 3246018 THRU 3246087.

Radio Lights
Figure 2

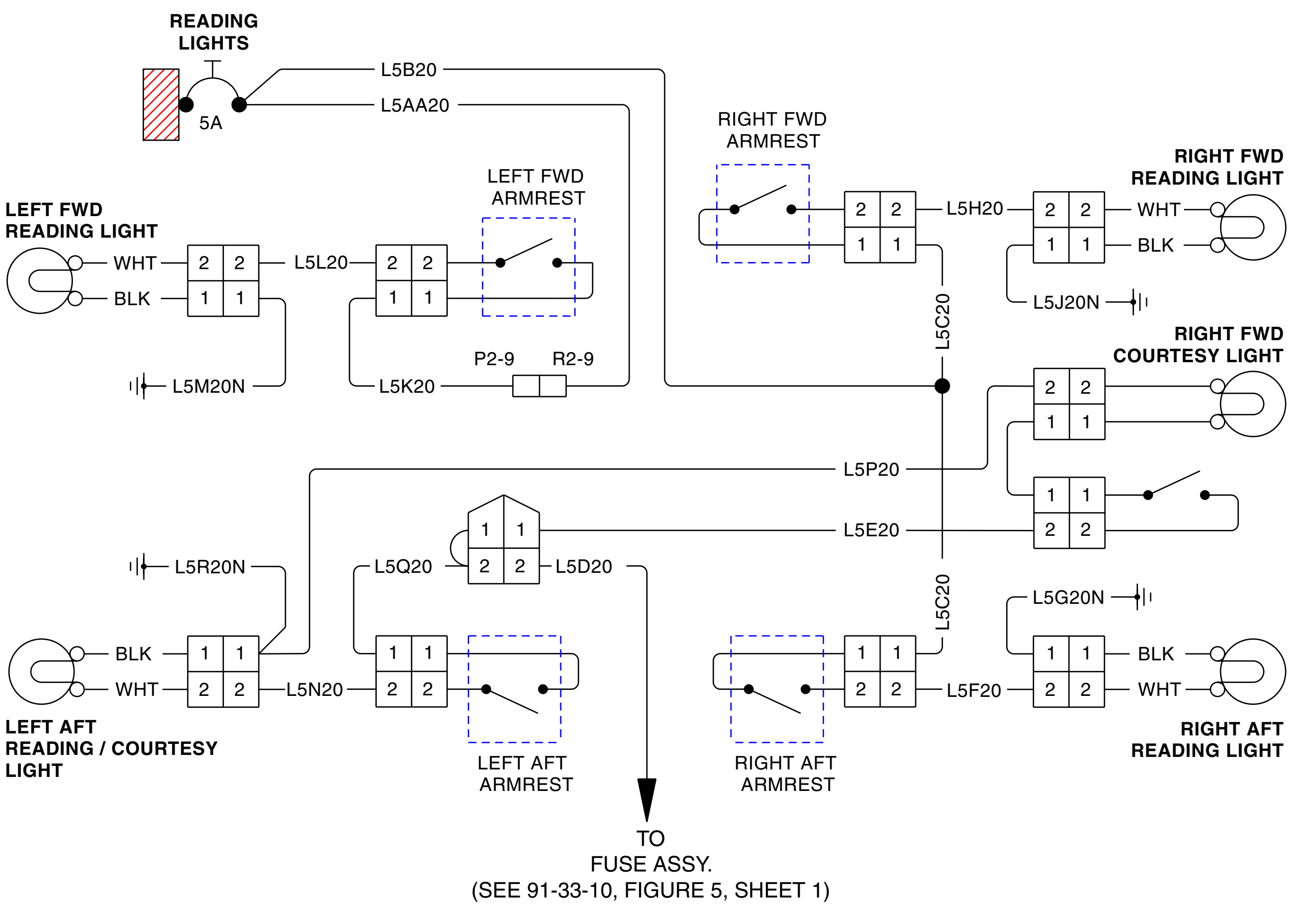
Effectivity
3246018 and up
3257001 and up



Effectivity
3246001 thru 3246017

Courtesy / Reading Lights
Figure 3 (Sheet 1 of 4)

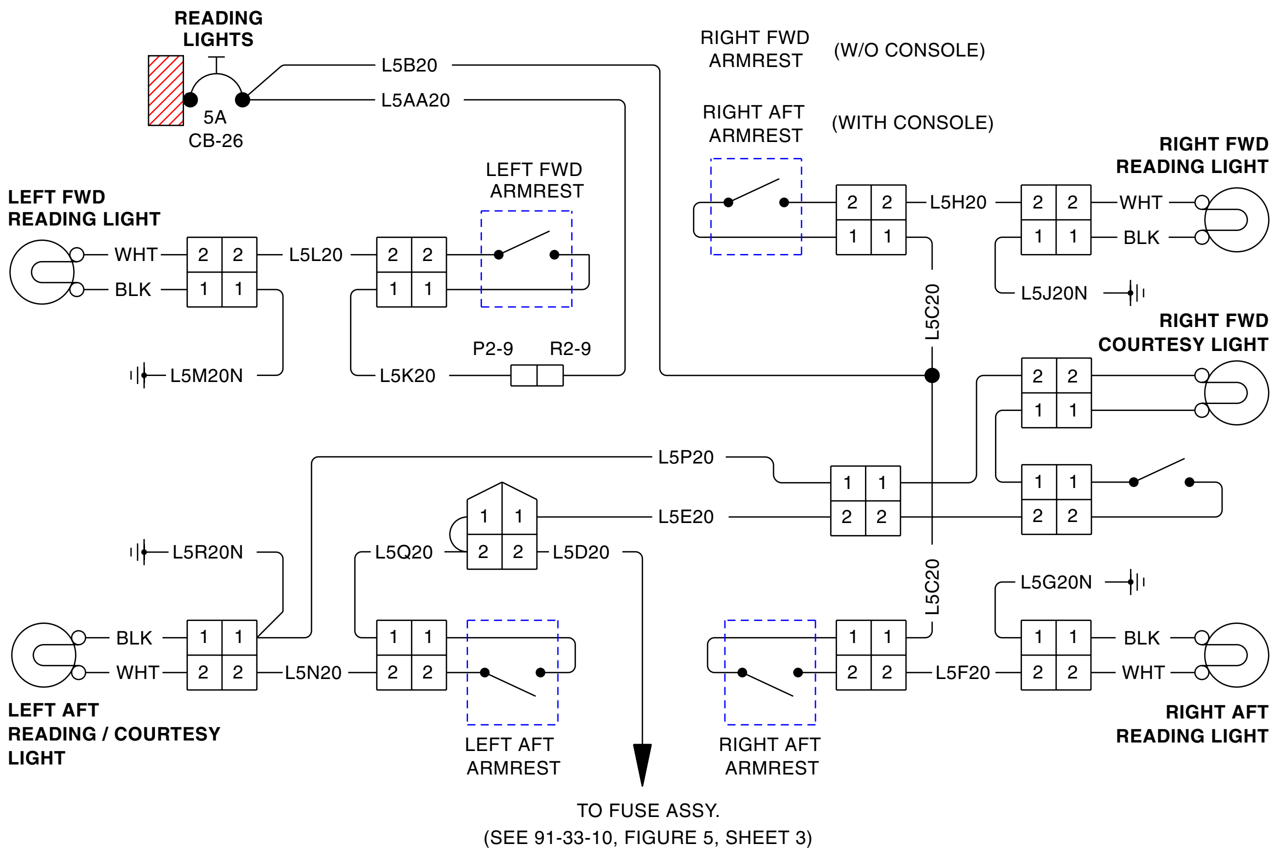
85501 26.0 C / F



Courtesy / Reading Lights
Figure 3 (Sheet 2 of 4)

Effectivity
3246018 thru 3246087

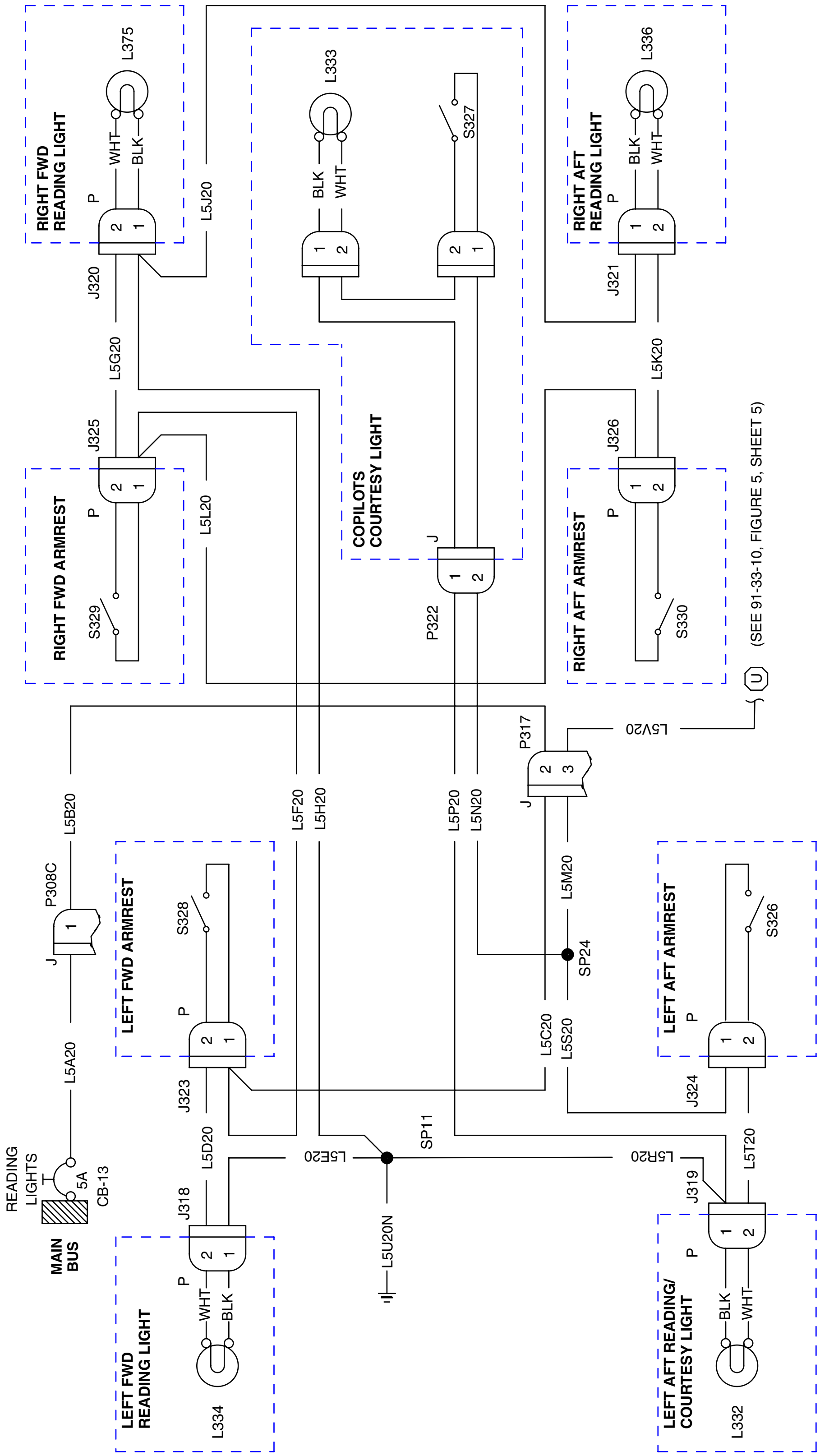
101848 25.0 L
104406 25.0 NEW / J
104141 25.0 NEW / C
101272 26.0 NEW / D
100840 26.0 A / C



Effectivity
3246088 and up
3257001 and up

Courtesy / Reading Lights
Figure 3 (Sheet 3 of 4)

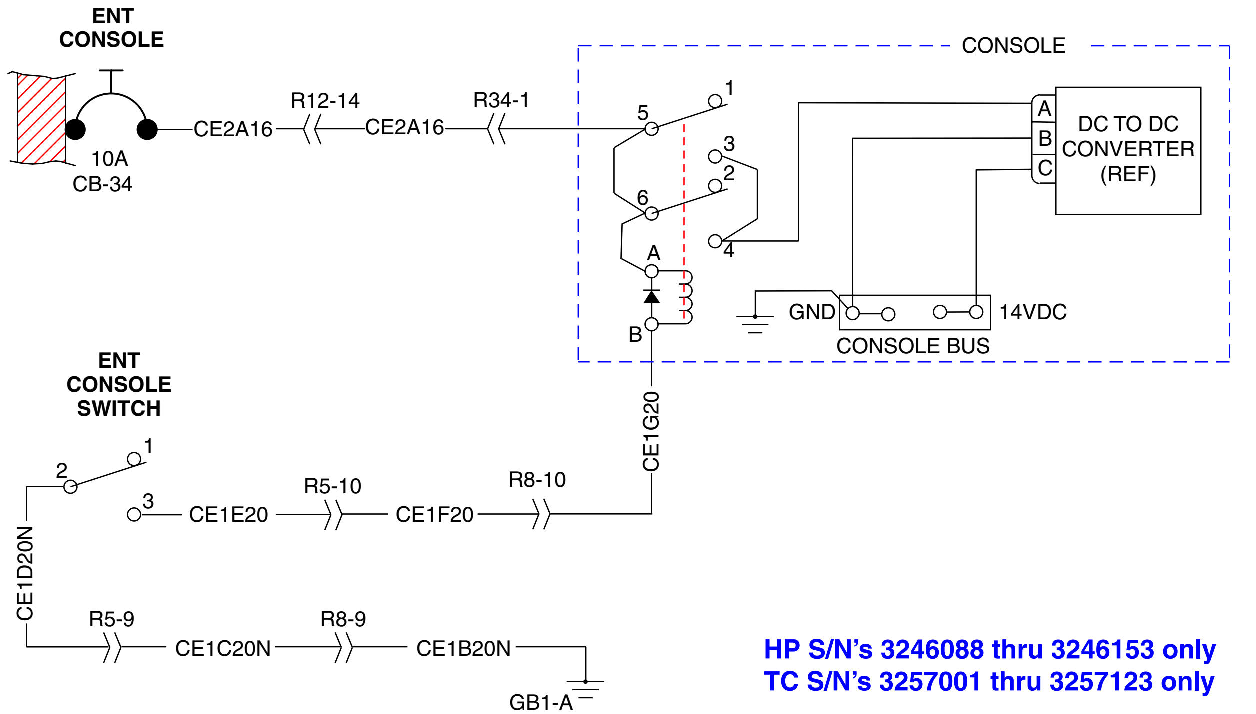
104817 19.0 A



Courtesy / Reading Lights
Figure 3 (Sheet 4 of 4)

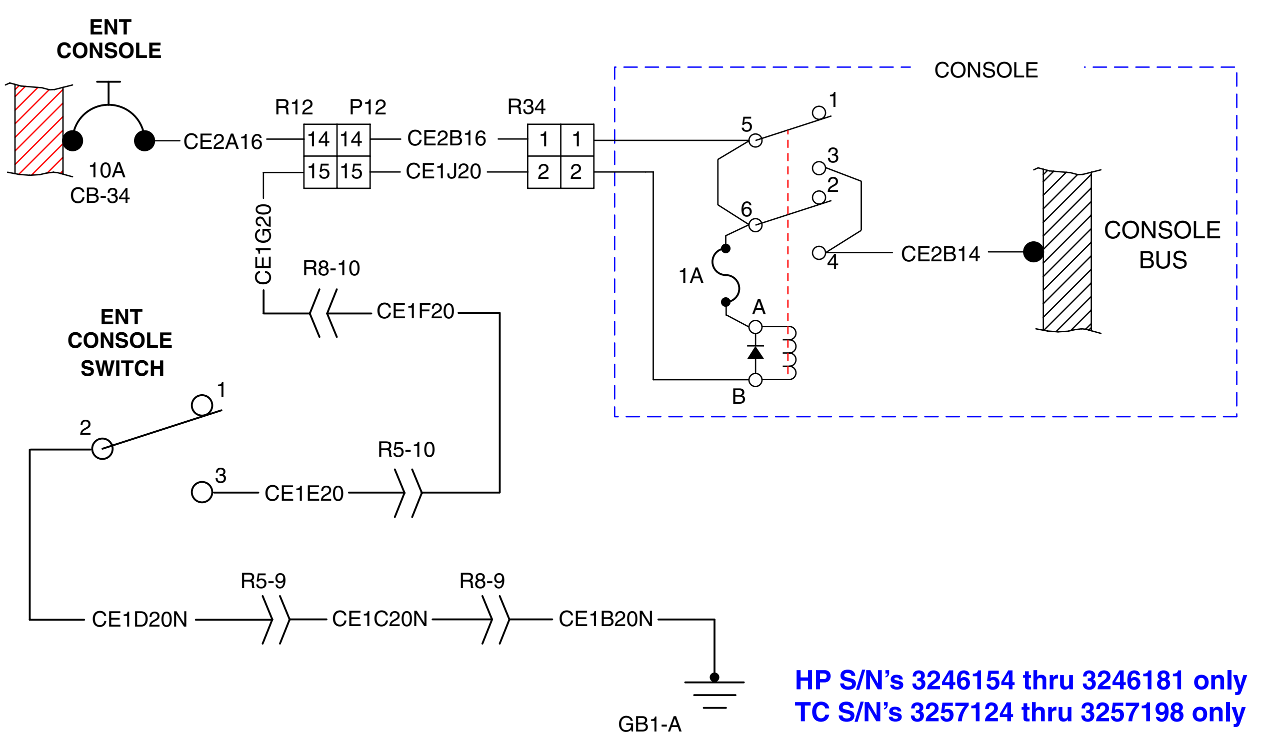
Effectivity
with Garmin 1000

101272 33.0 NEW / D
100840 33.0 NEW / C



HP S/N's 3246088 thru 3246153 only
TC S/N's 3257001 thru 3257123 only

104141 32.0 NEW

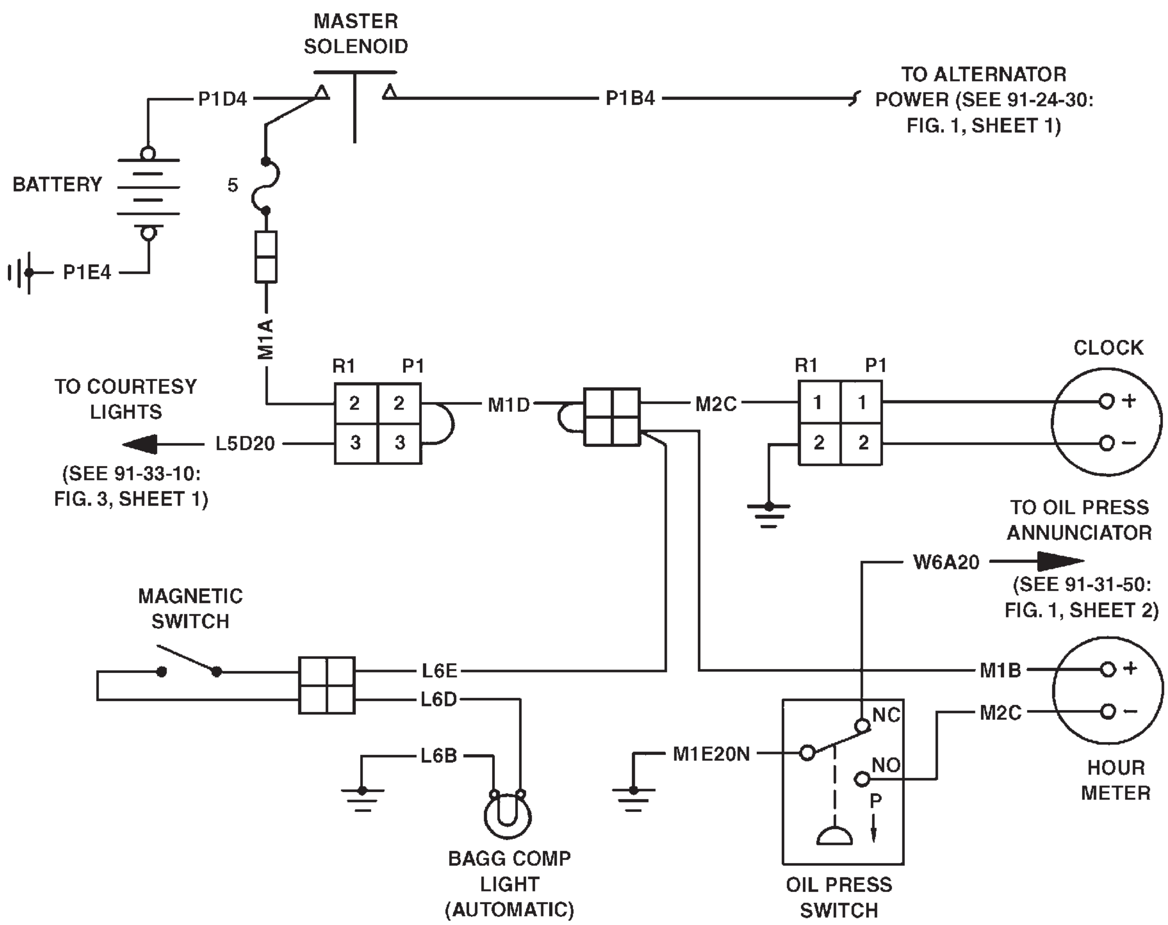


HP S/N's 3246154 thru 3246181 only
TC S/N's 3257124 thru 3257198 only

Effectivity
3246088 thru 3246181
3257001 thru 3257198

Entertainment Console
Figure 4

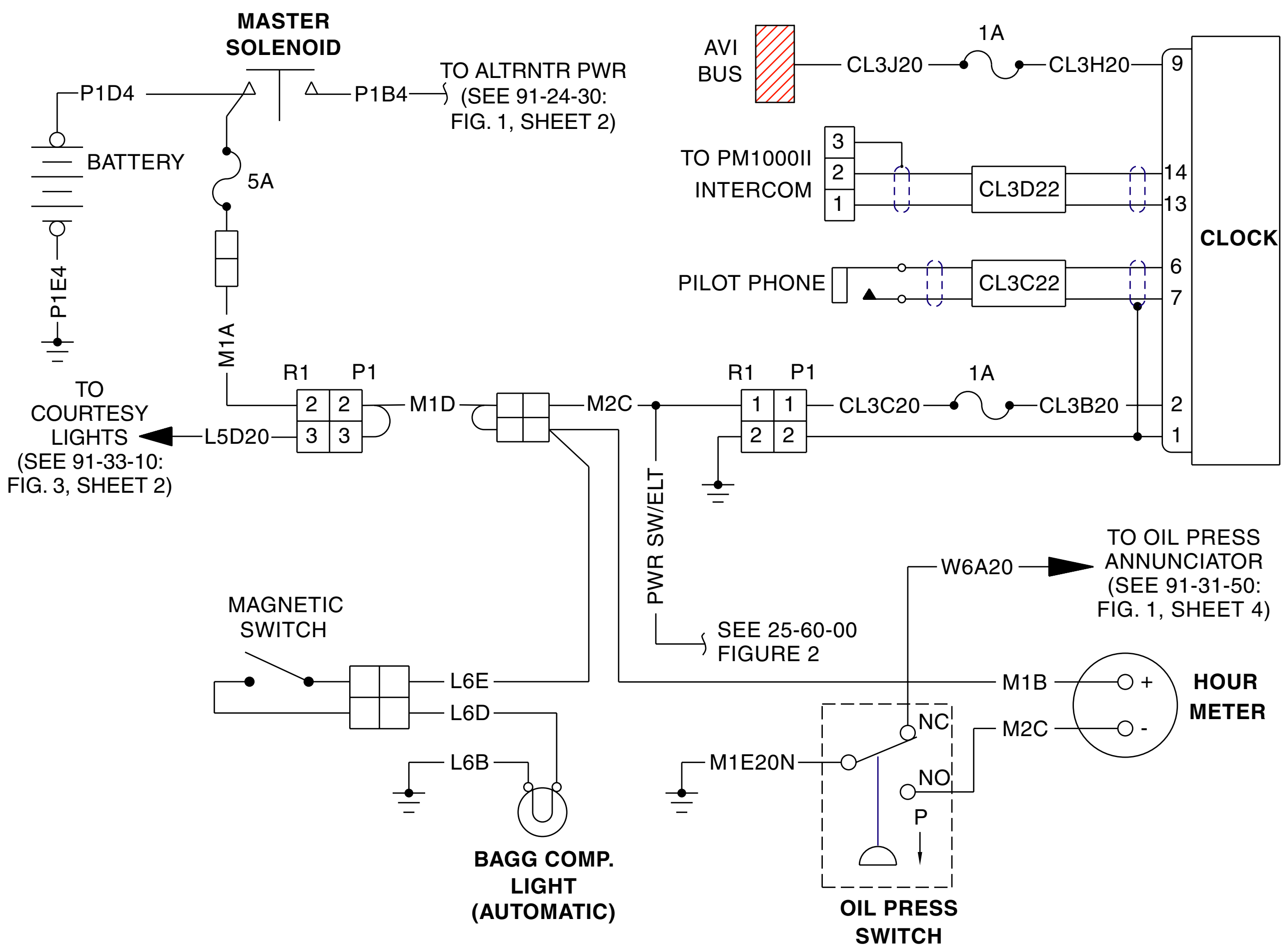
85300 17.0 NEW / B



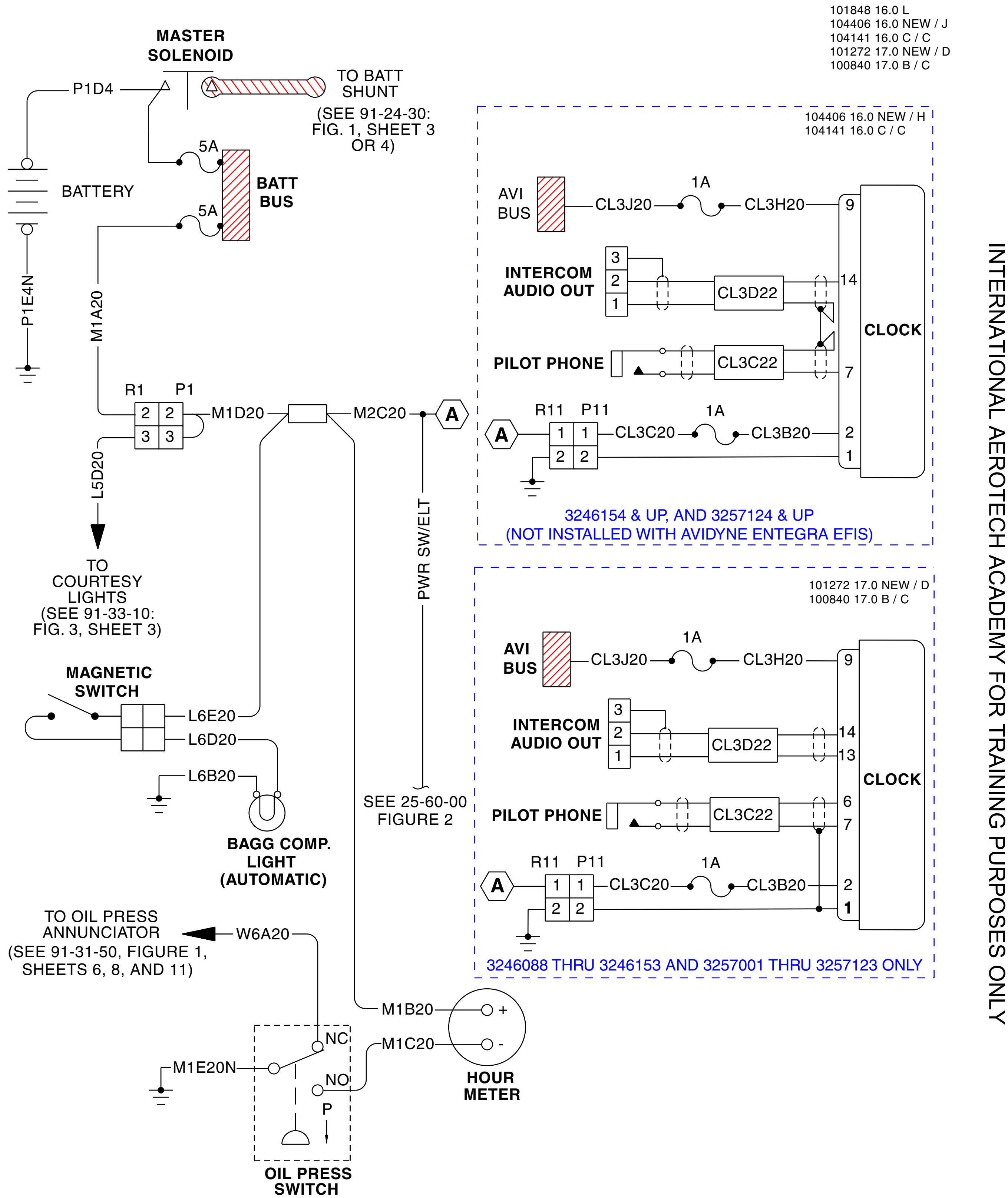
Clock, Hour Meter, and Baggage Light
Figure 5 (Sheet 1 of 5)

Effectivity
3246001 thru 3246017

85501 17.0 A / F



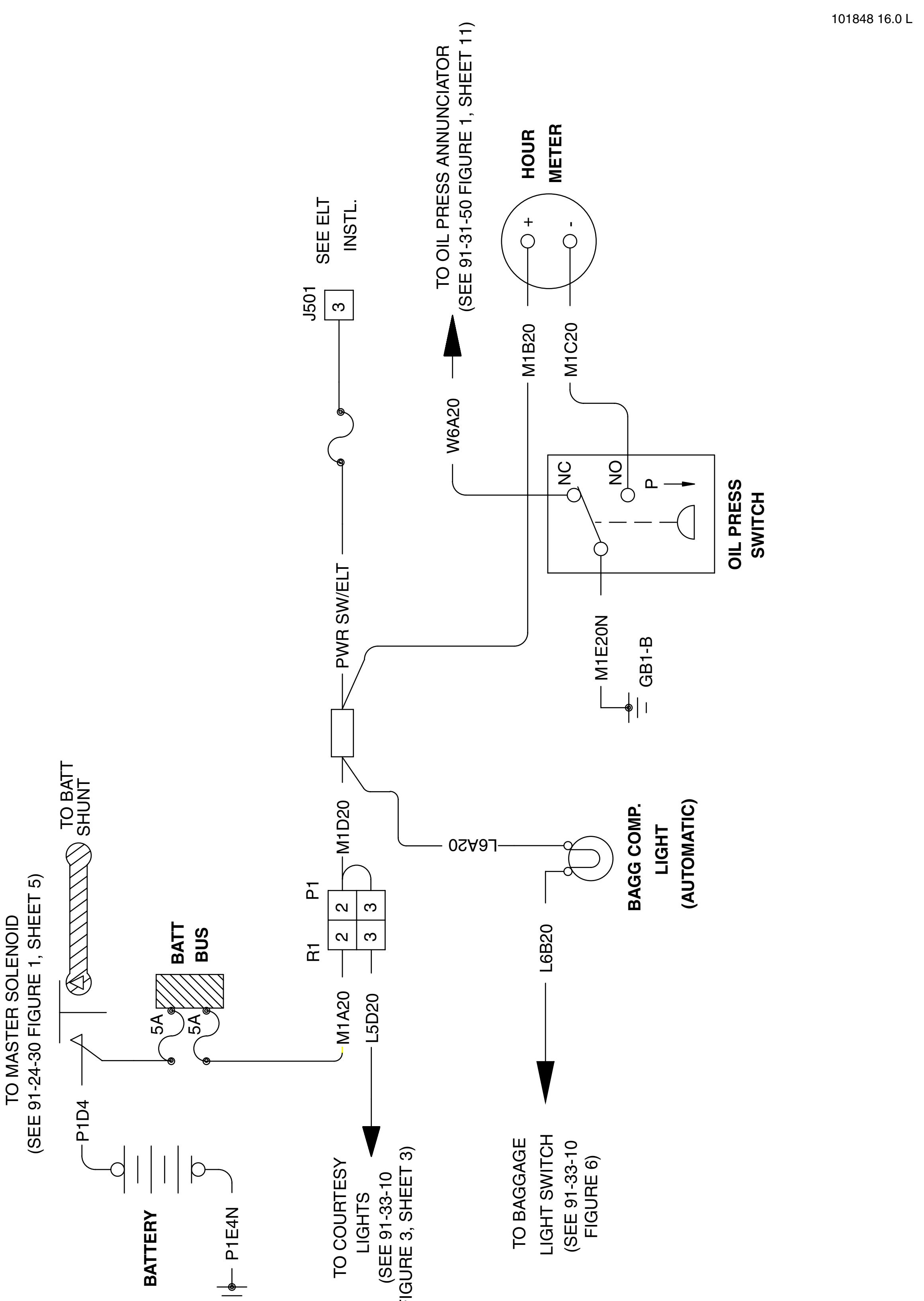
Clock, Hour Meter, and Baggage Light
Figure 5 (Sheet 2 of 5)



Clock, Hour Meter, and Baggage Light
Figure 5 (Sheet 3 of 5)

Effectivity
3246088 thru 3246244
3257001 thru 3257454

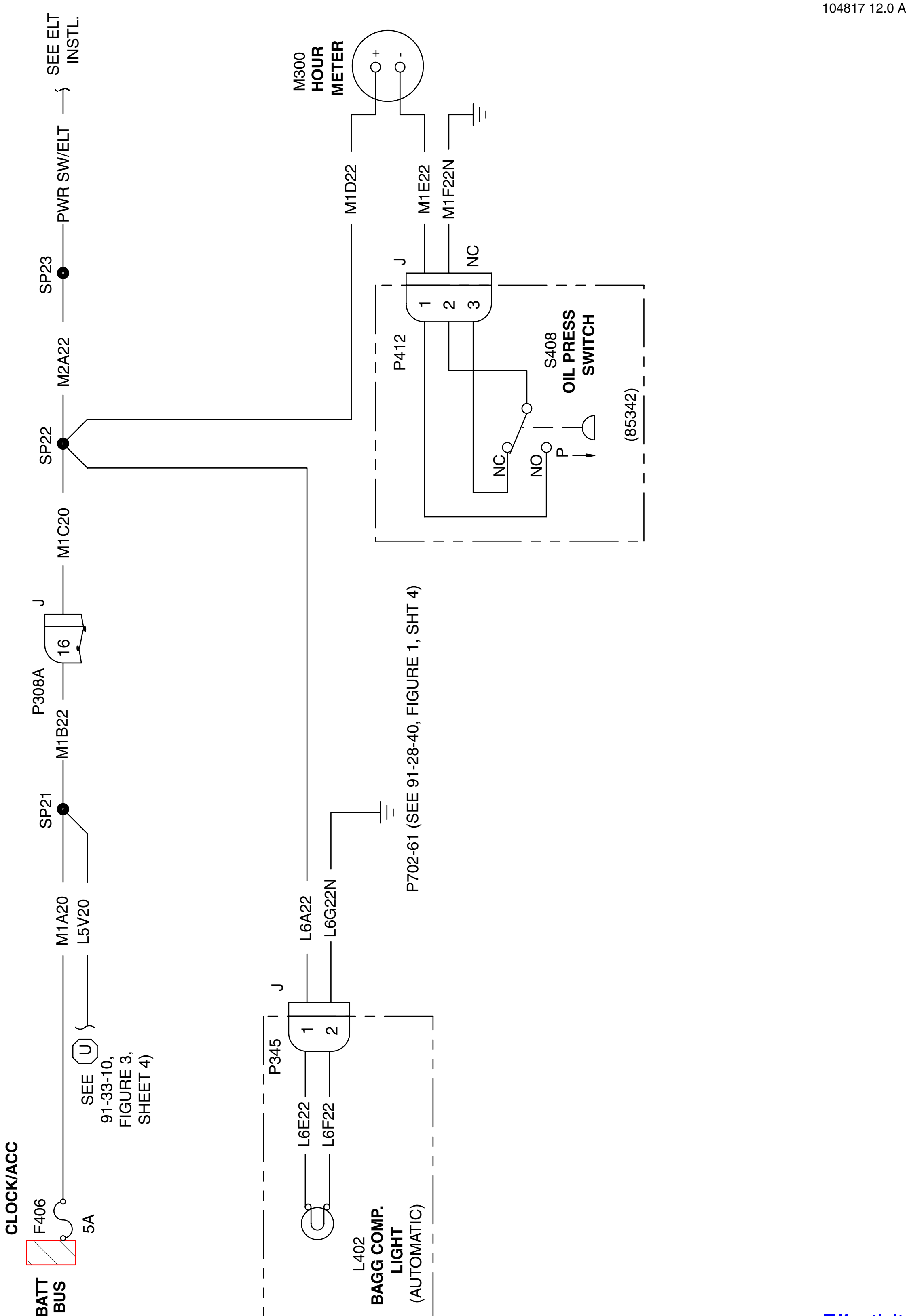
101848 16.0 L



Effectivity
3257455 and up
with Avidyne Entegra

Clock, Hour Meter, and Baggage Light
Figure 5 (Sheet 4 of 5)

104817 12.0 A



Clock, Hour Meter, and Baggage Light
Figure 5 (Sheet 5 of 6)

Effectivity
3246088 thru 3246244
3257001 thru 3257454

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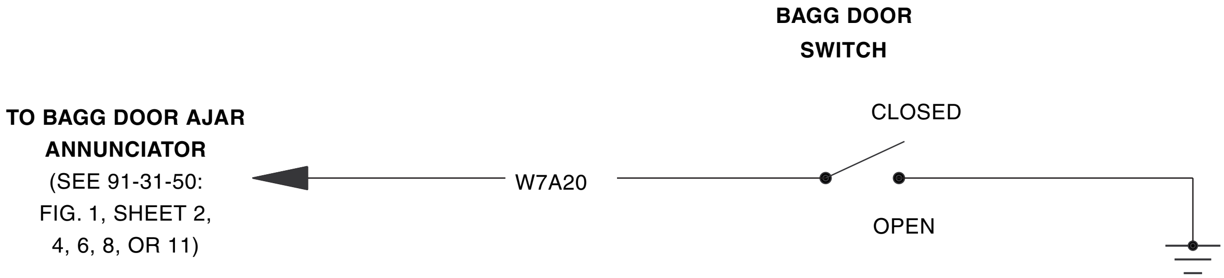
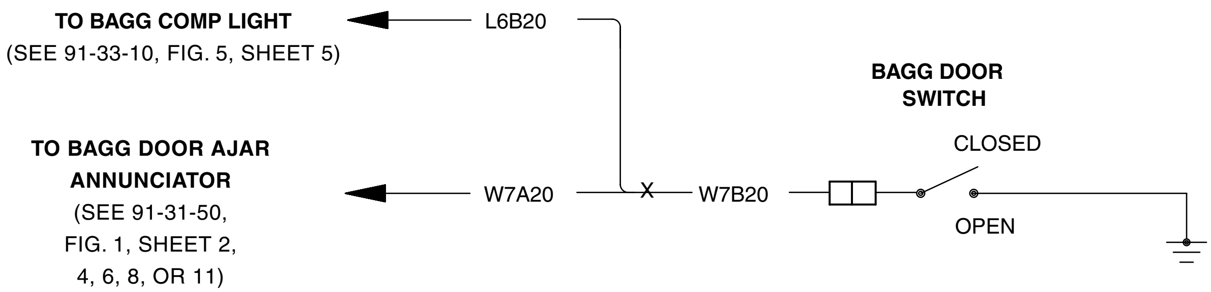
101848 17.0 L
104406 17.0 NEW / J
104141 17.0 NEW / C
101272 18.0 NEW / D
100840 18.0 NEW / C
85501 18.0 NEW / F
85300 18.0 NEW / B



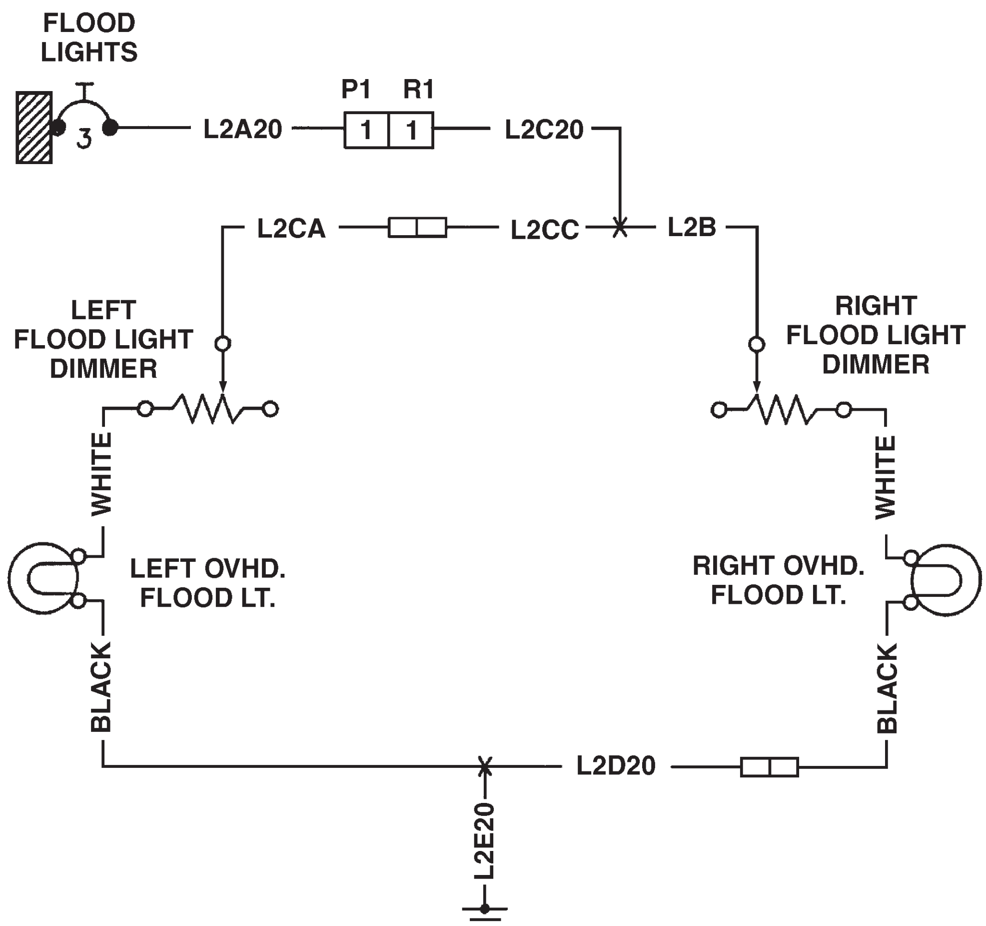
3246001 THROUGH 3246244, AND 3257001 THROUGH 3257454 ONLY



3257455 AND UP

Baggage Door Ajar
Figure 6

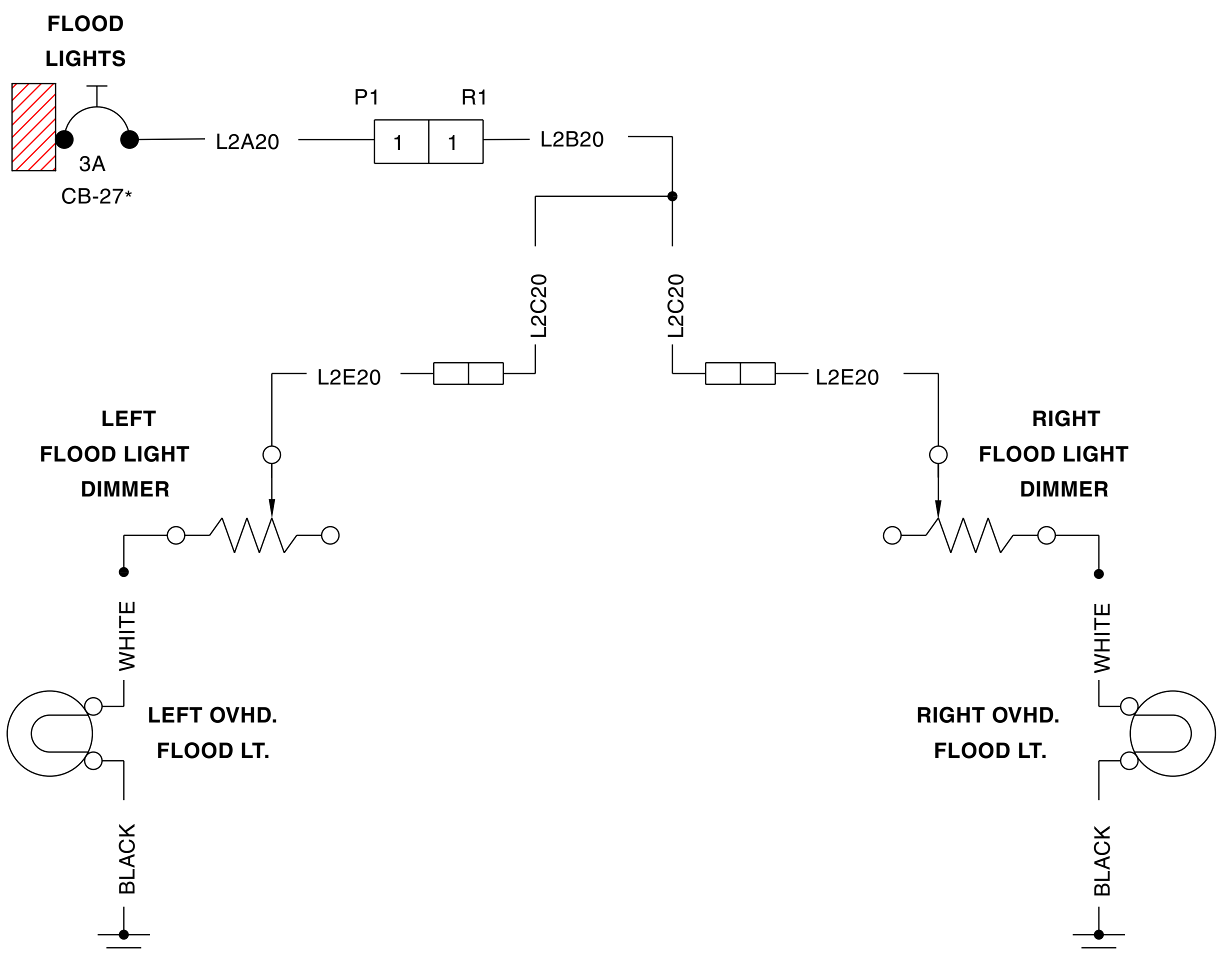
85300 22.0 NEW / B



Effectivity
3246001 thru 3246017

Flood Lights
Figure 7 (Sheet 1 of 3)

101848 21.0 L
104406 21.0 NEW / J
104141 21.0 NEW / C
101272 22.0 NEW / D
100840 22.0 NEW / C
85501 22.0 NEW / F

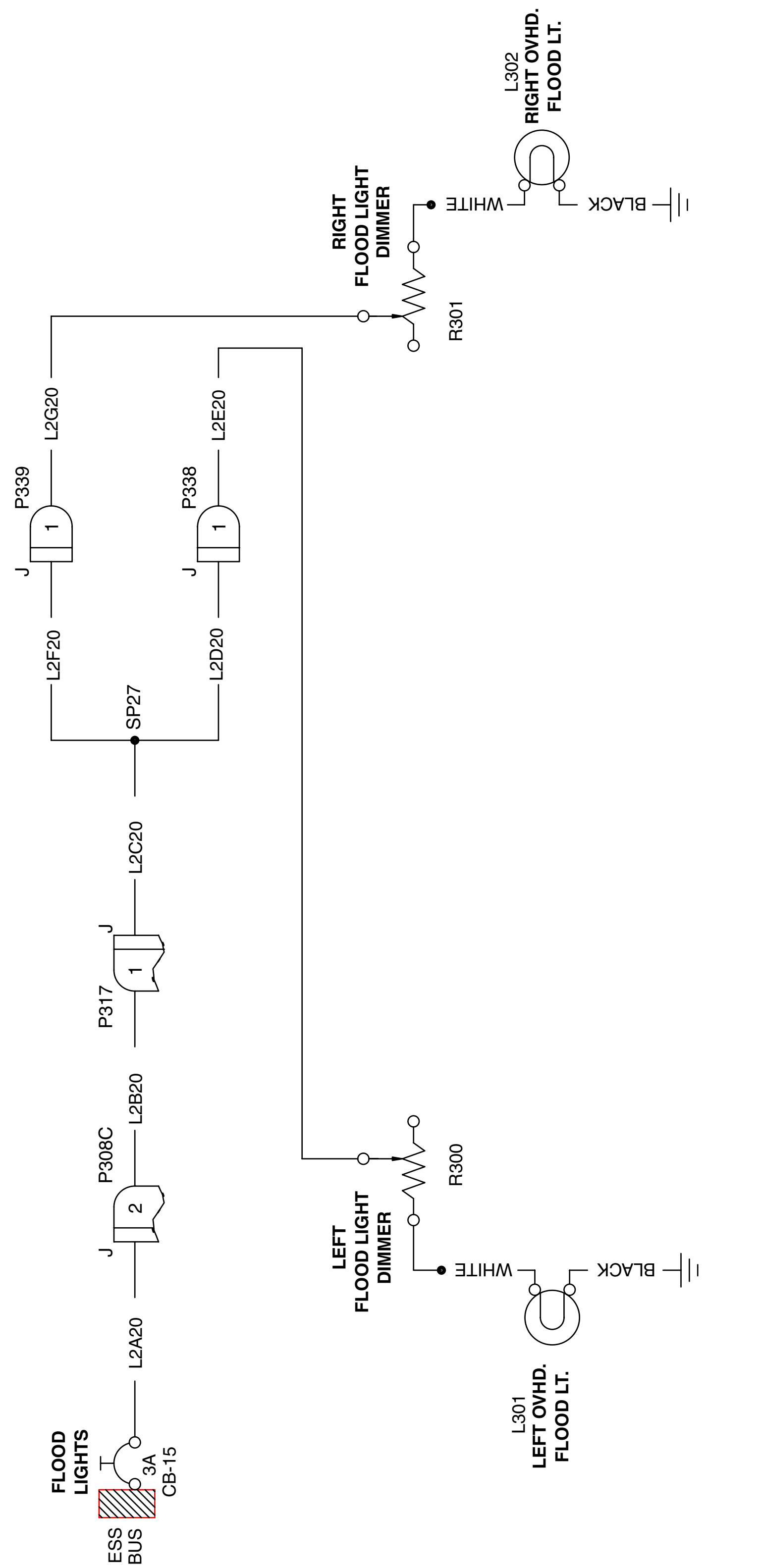


* HP S/N'S 3246088 & UP; TC 3257001 & UP.

Flood Lights
Figure 7 (Sheet 2 of 3)

Effectivity
3246018 and up
3257001 and up

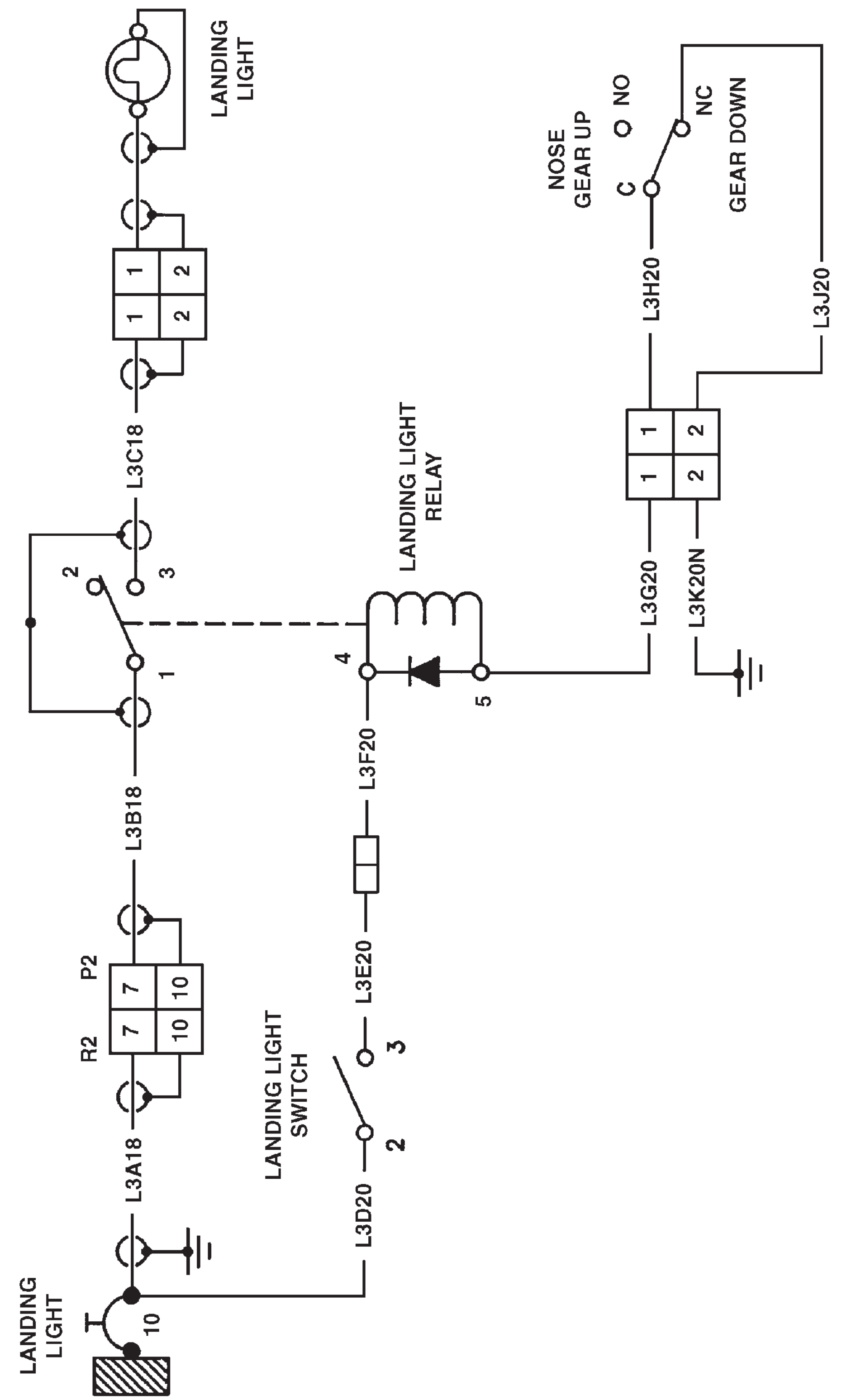
104817 16.0 A



Effectivity
with Garmin 1000

Flood Lights
Figure 7 (Sheet 3 of 3)

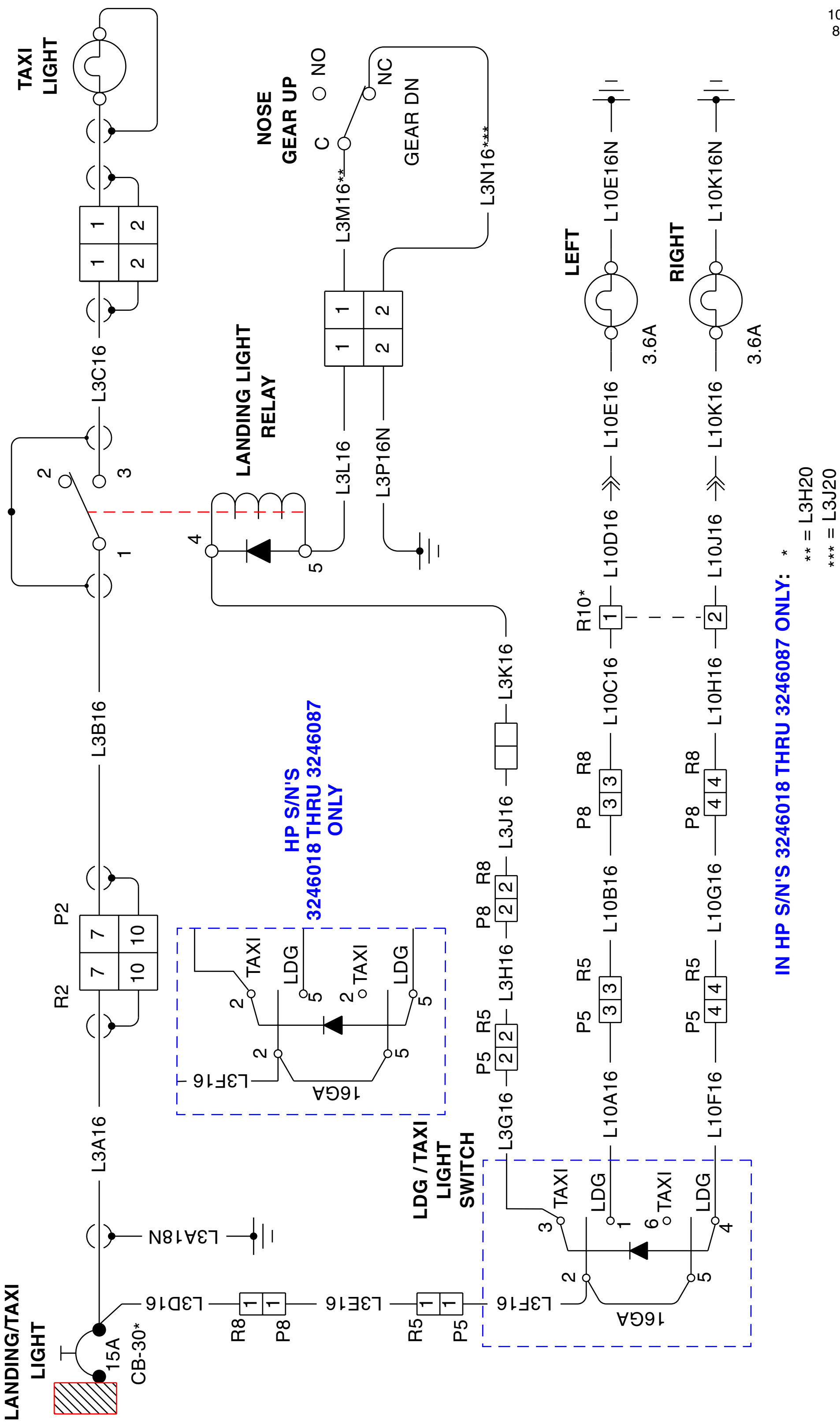
85300 21.0 B



Landing / Taxi Lights
Figure 1 (Sheet 1 of 5)

Effectivity
3246001 thru 3246017

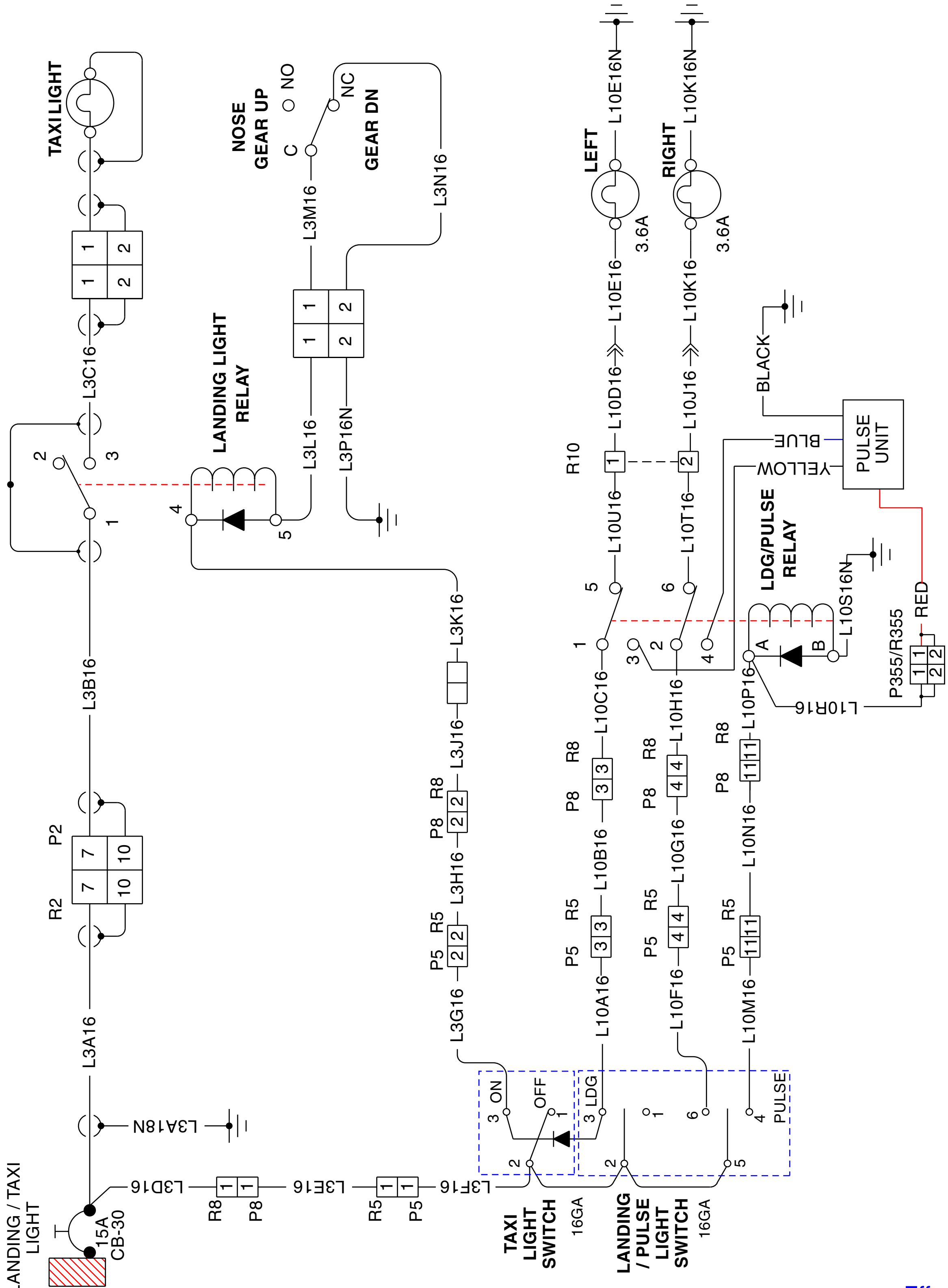
100840 21.0 C
85501 21.0 F



Effectivity
3246018 thru 3246125
3257001 thru 3257074

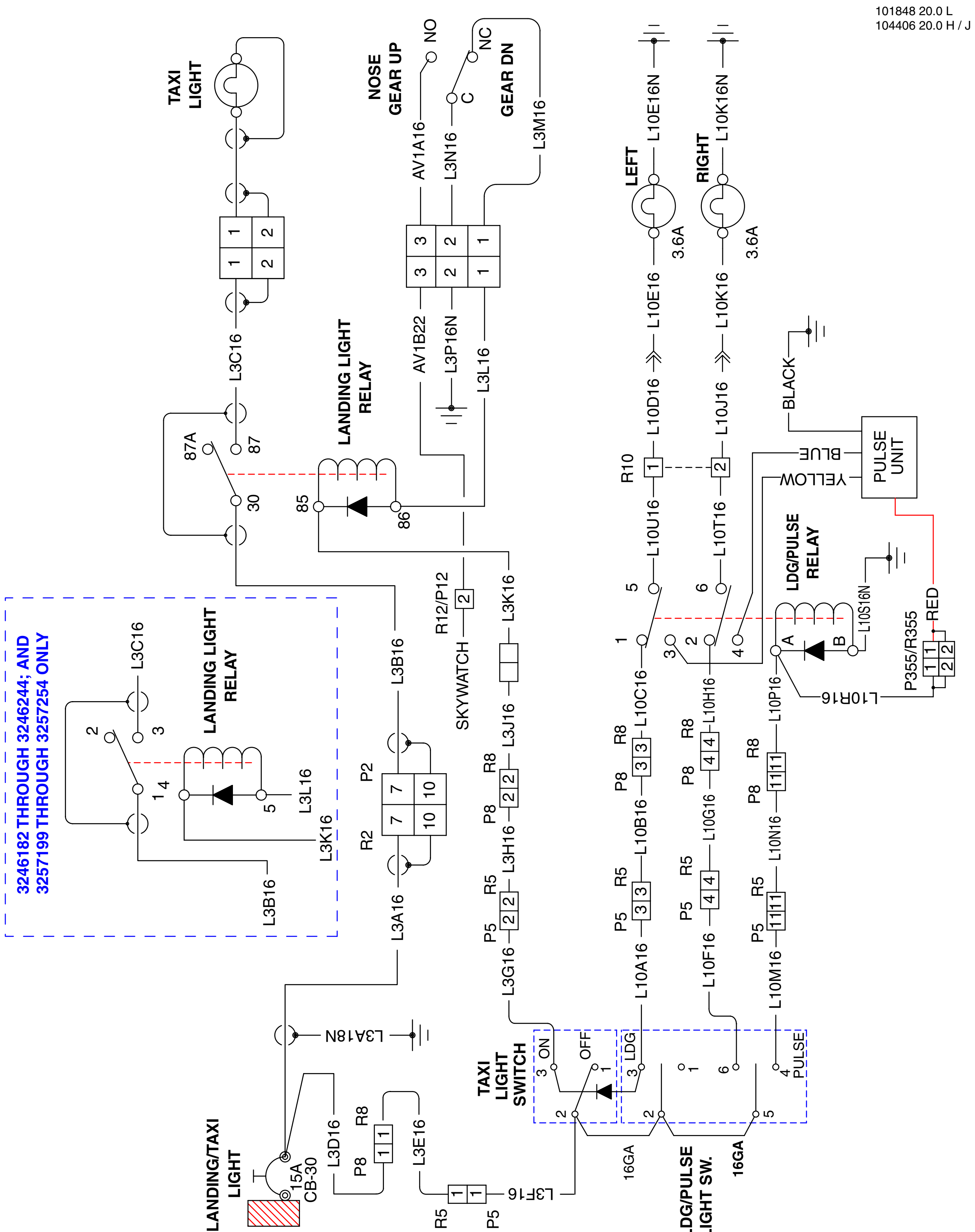
Landing / Taxi Lights
Figure 1 (Sheet 2 of 5)

104141 20.0 NEW / C
101272 21.0 NEW / D



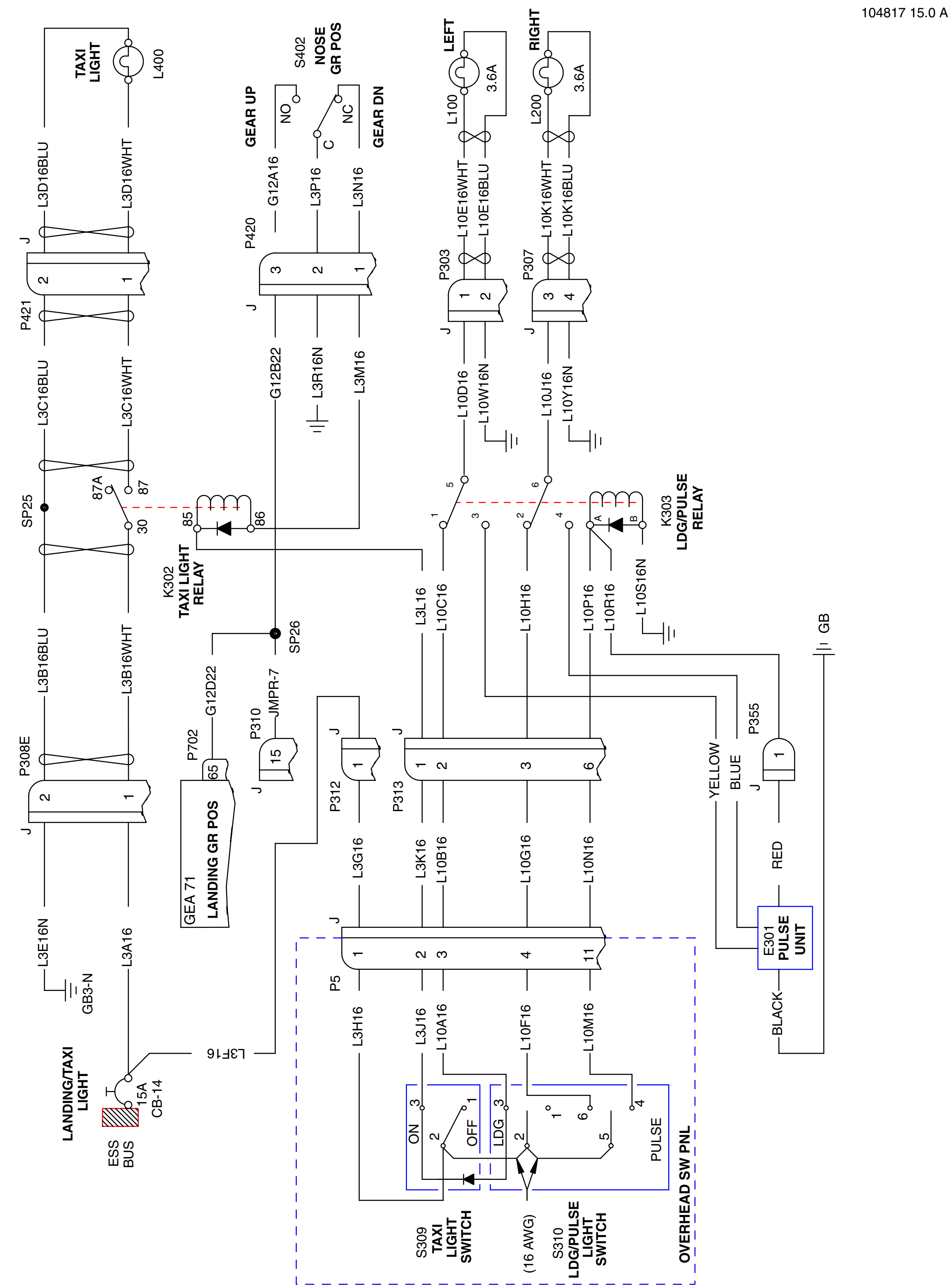
Landing / Taxi Lights
Figure 1 (Sheet 3 of 5)

Effectivity
3246126 thru 3246181
3257075 thru 3257198



Effectivity
3246182 and up
3257199 and up

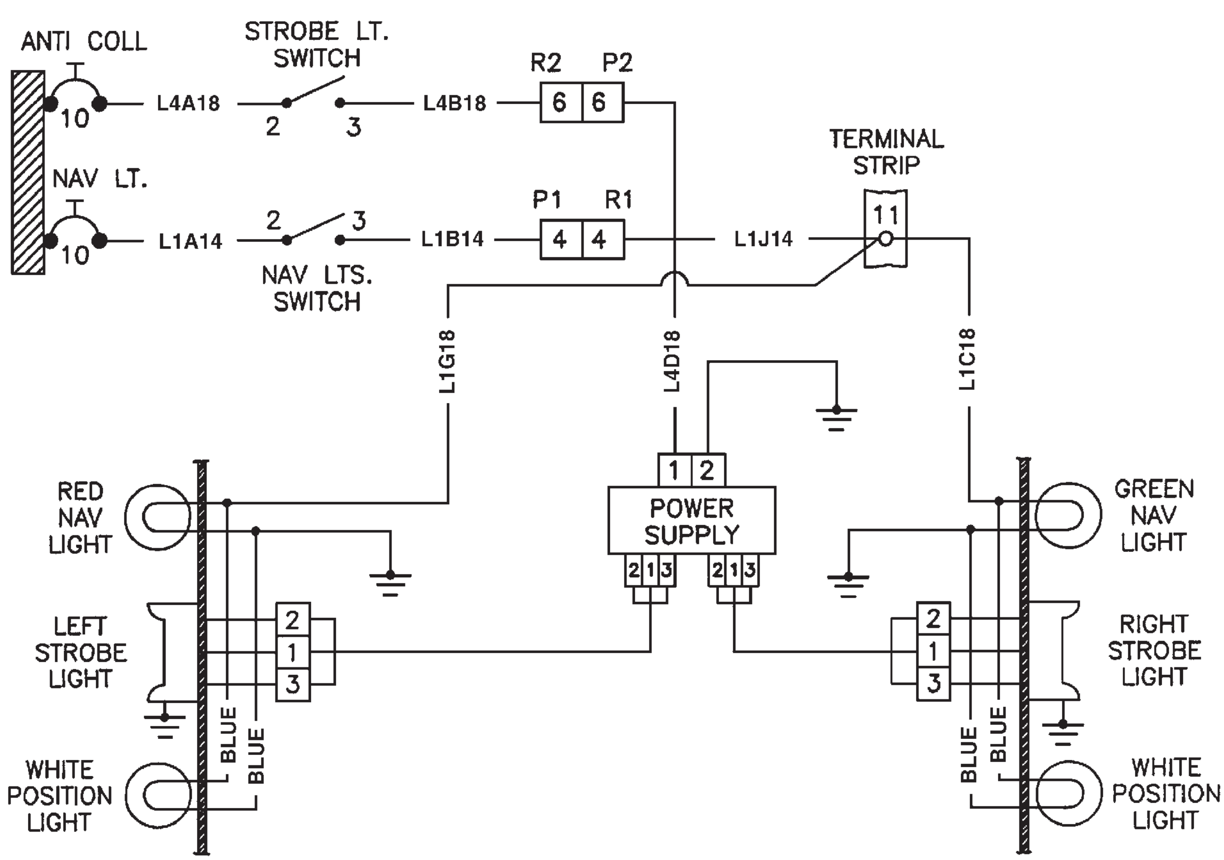
Landing / Taxi Lights
Figure 1 (Sheet 4 of 5)



Landing / Taxi Lights
Figure 1 (Sheet 5 of 5)

Effectivity
with Garmin 1000

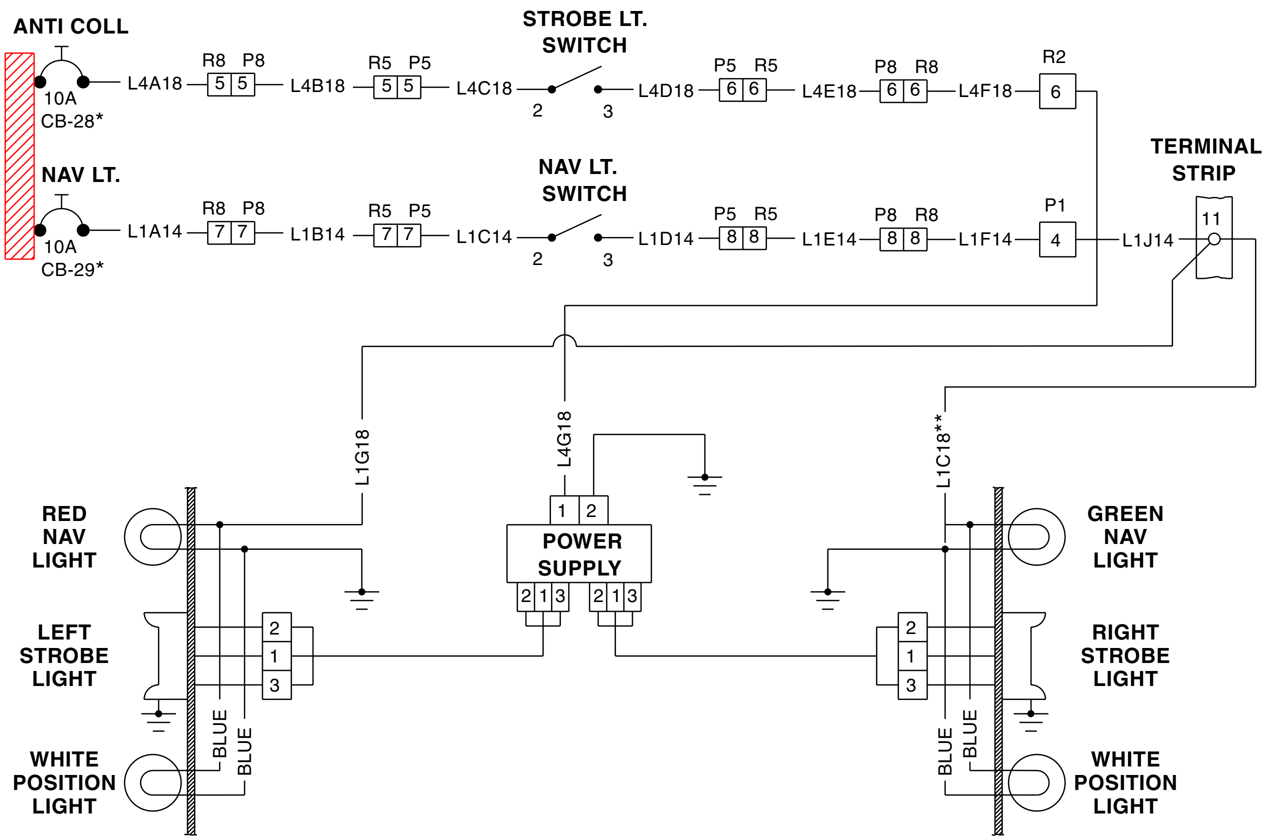
85300 23.0 NEW / B



Effectivity
3246001 thru 3246017

Navigation and Strobe Lights
Figure 2 (Sheet 1 of 4)

101272 23.0 NEW / D
100840 23.0 C / C
85501 23.0 NEW / F



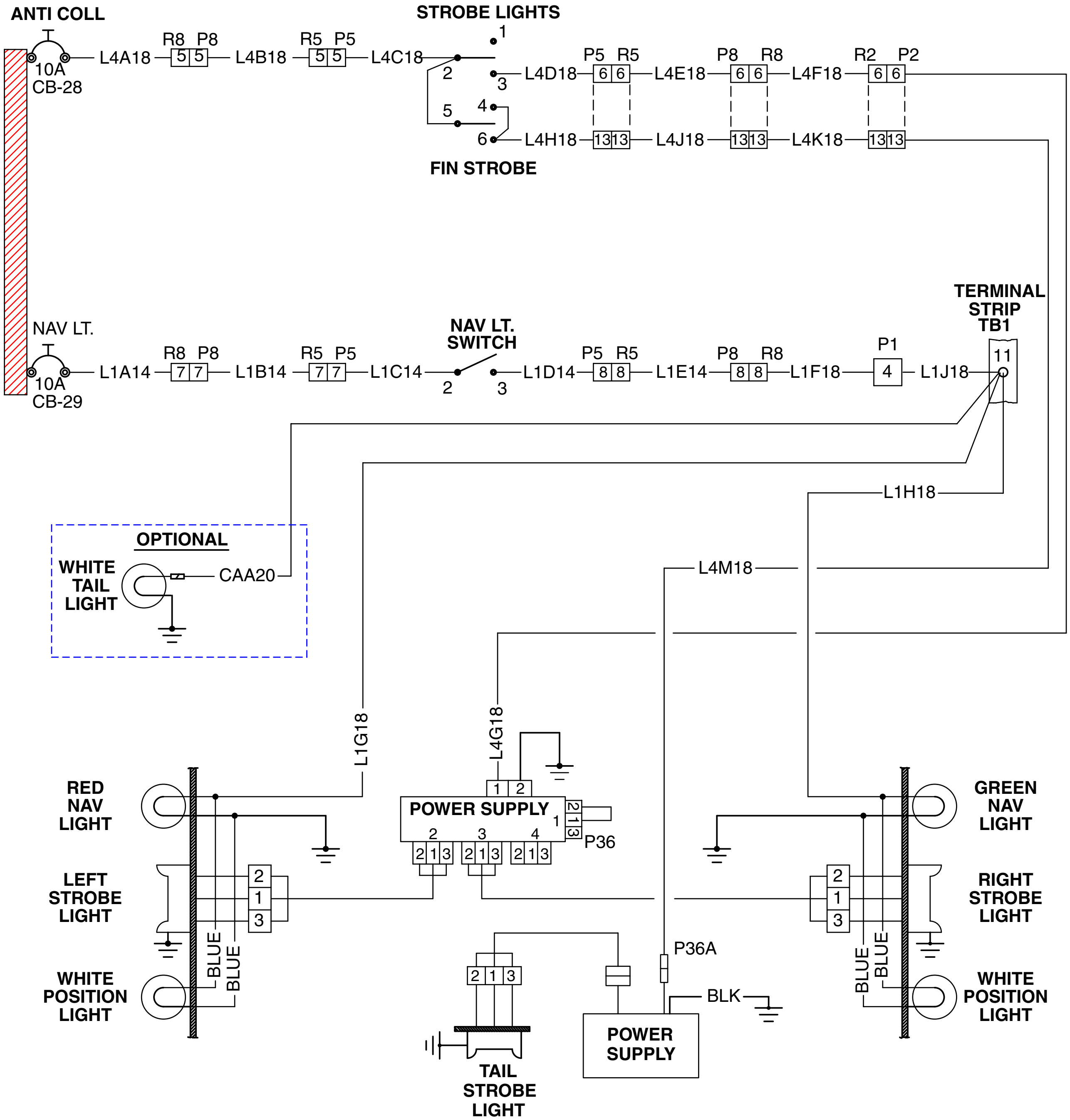
IN HP S/N'S 3246018 THRU 3246087 ONLY: *
** = L1H18

INTERNATIONAL AEROTECH ACADEMY FOR TRAINING PURPOSES ONLY

Navigation and Strobe Lights
Figure 2 (Sheet 2 of 4)

Effectivity
3246018 thru 3246153
3257001 thru 3257123

101848 22.0 L
104406 22.0 F / J
104141 22.0 A / C

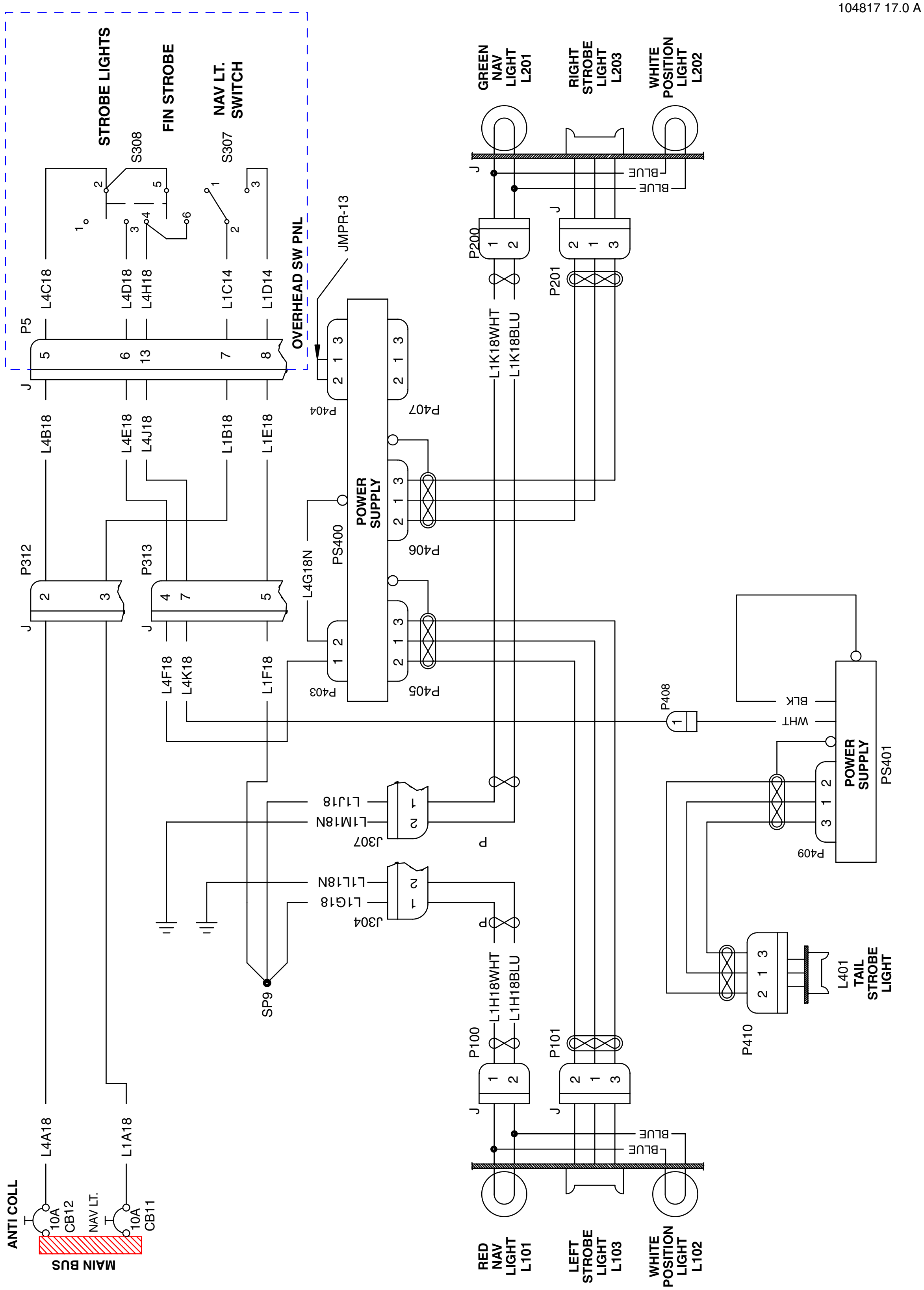


INTERNATIONAL AEROTECH ACADEMY FOR TRAINING PURPOSES ONLY

Effectivity
3246154 and up
3257124 and up

Navigation and Strobe Lights
Figure 2 (Sheet 3 of 4)

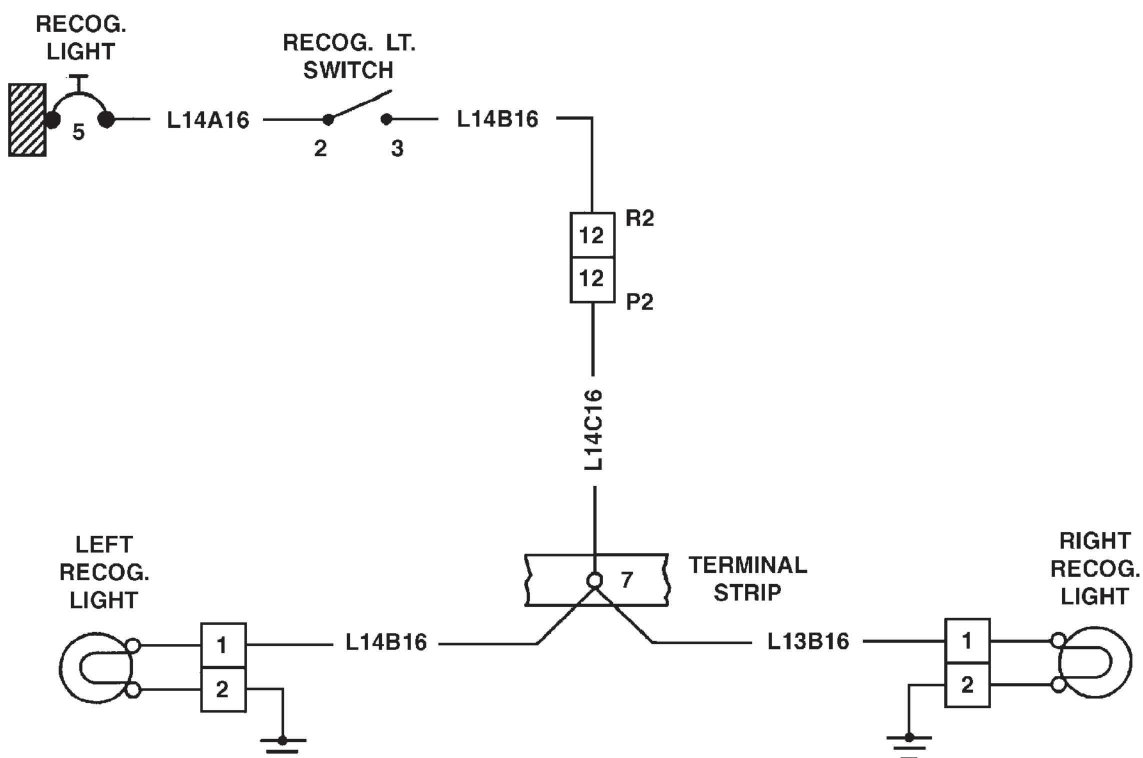
104817 17.0 A



Navigation and Strobe Lights
Figure 2 (Sheet 4 of 4)

Effectivity
with Garmin 1000

85300 20.0 NEW / B



Effectivity
3246001 thru 3246017

Recognition Lights
Figure 3

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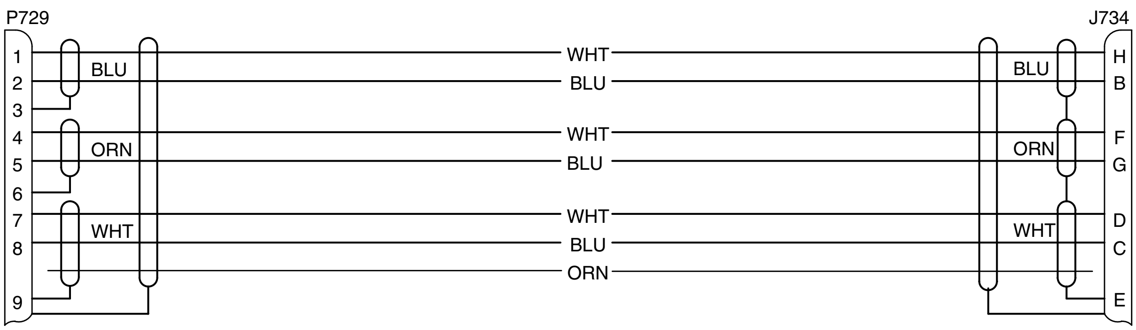
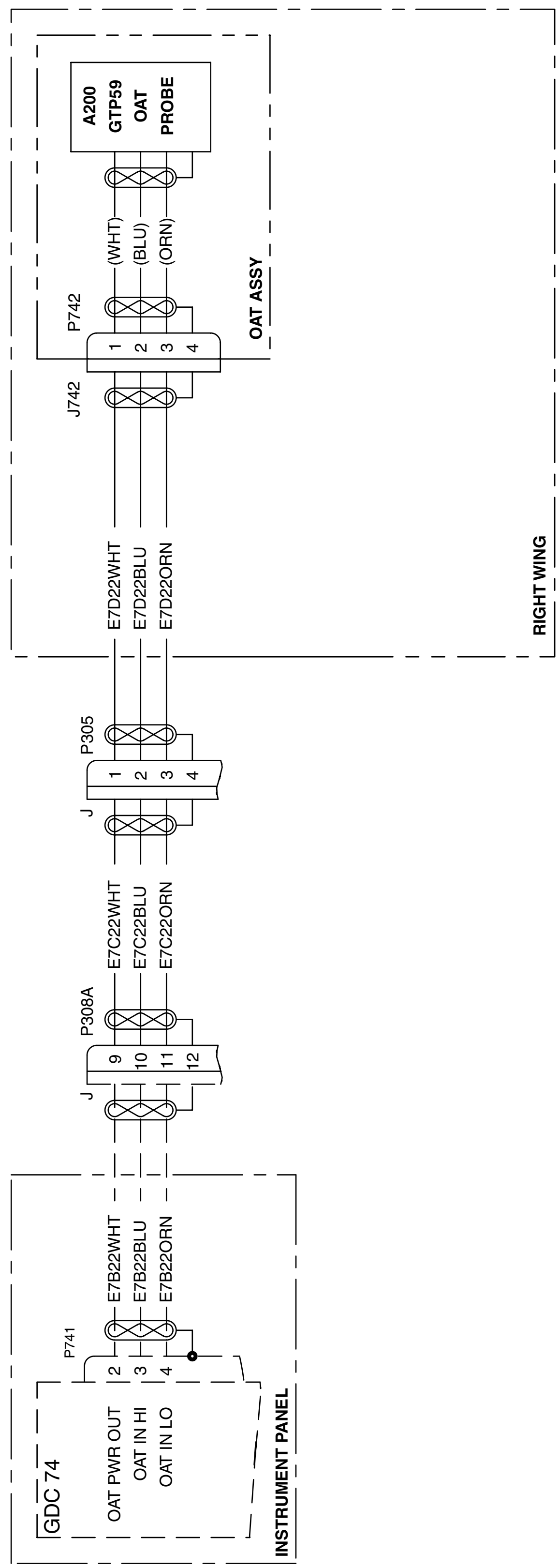
101753 D



OAT Probe
Figure 1 (Sheet 1 of 2)

Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

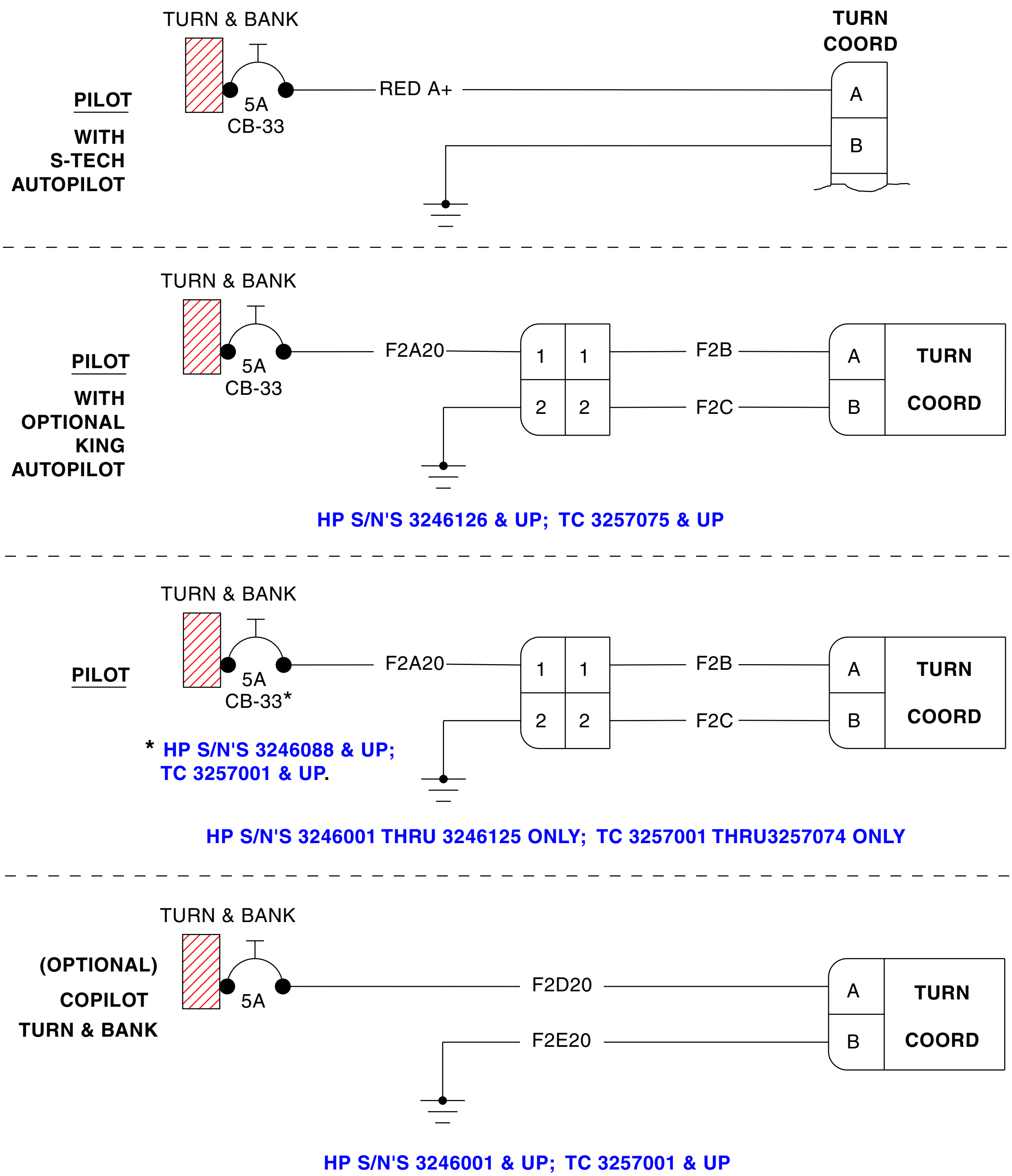
104817 22.0 A



[Effectivity
with Garmin 1000]

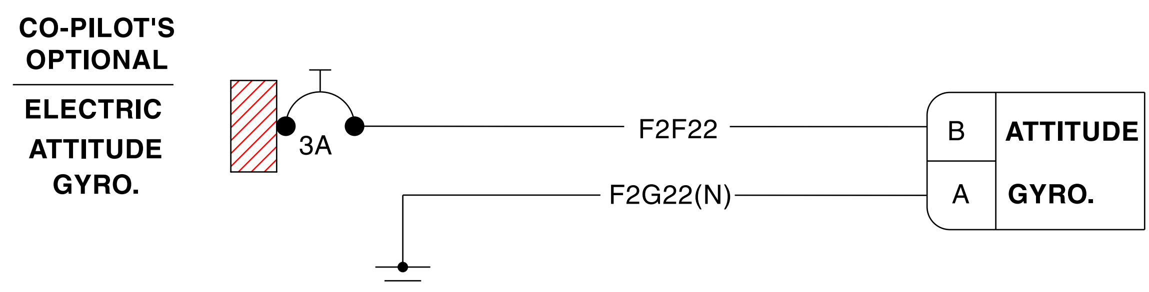
OAT Probe
Figure 1 (Sheet 2 of 2)

104406 11.0 NEW / J
104141 11.0 NEW / C
101272 12.0 NEW / D
100840 12.0 NEW / C
85501 12.0 NEW / F
85300 12.0 NEW / B



Turn and Bank Indicator
Figure 1

104406 26.0 J
104141 26.0 NEW / C
101272 27.0 NEW / D
100840 27.0 B / C
85501 27.0 NEW / F
85300 27.0 B / B



Electric Attitude Gyro (Co-Pilots's Optional)
Figure 2

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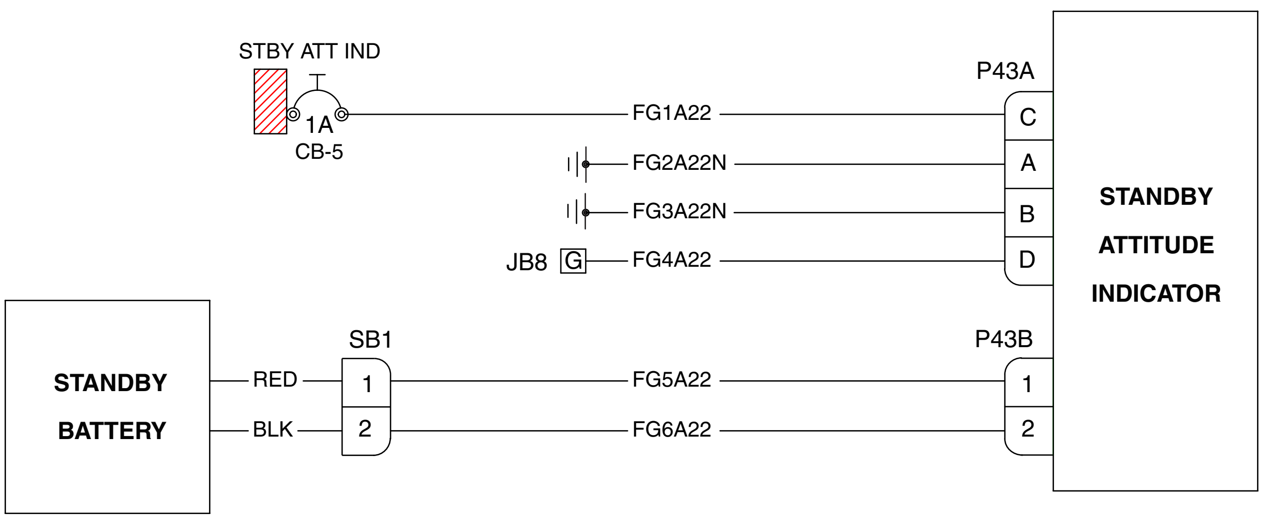
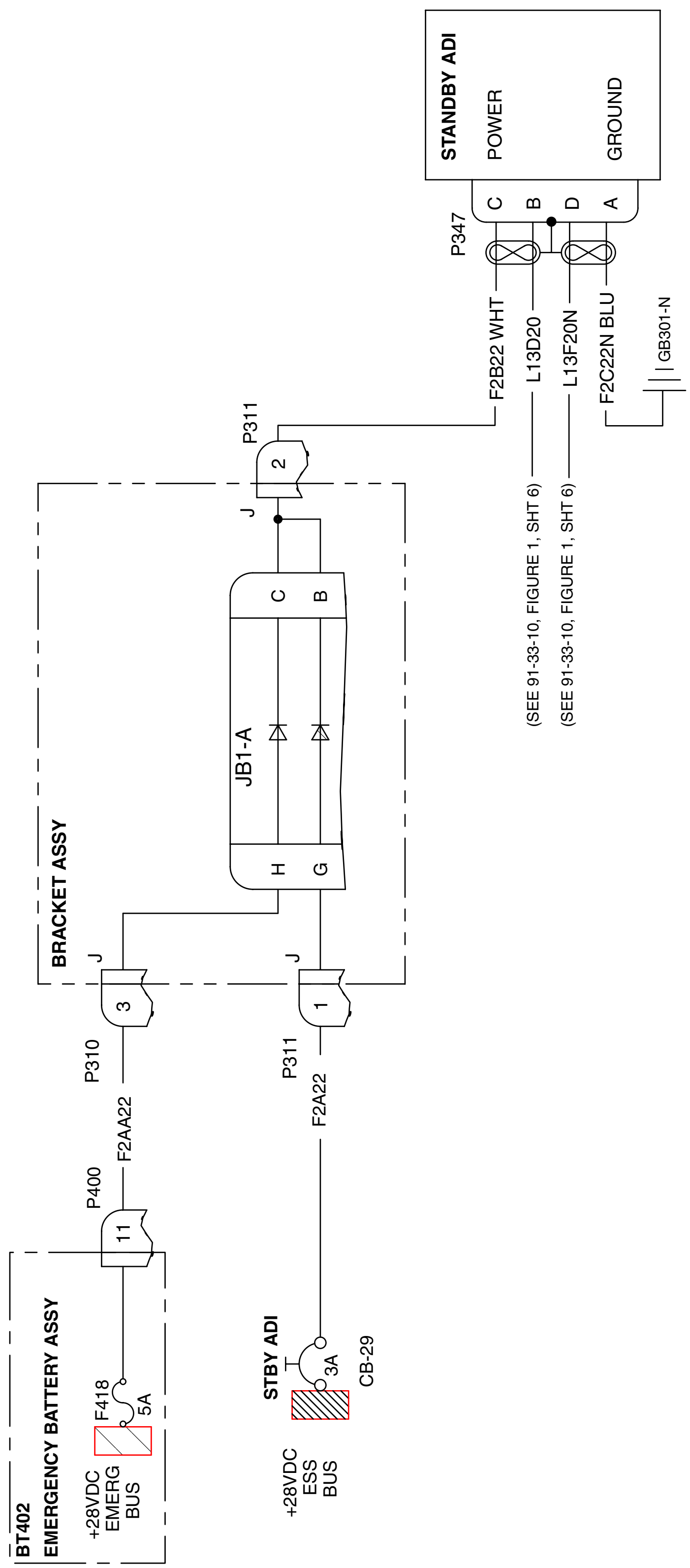
101848 11.0 L



Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra

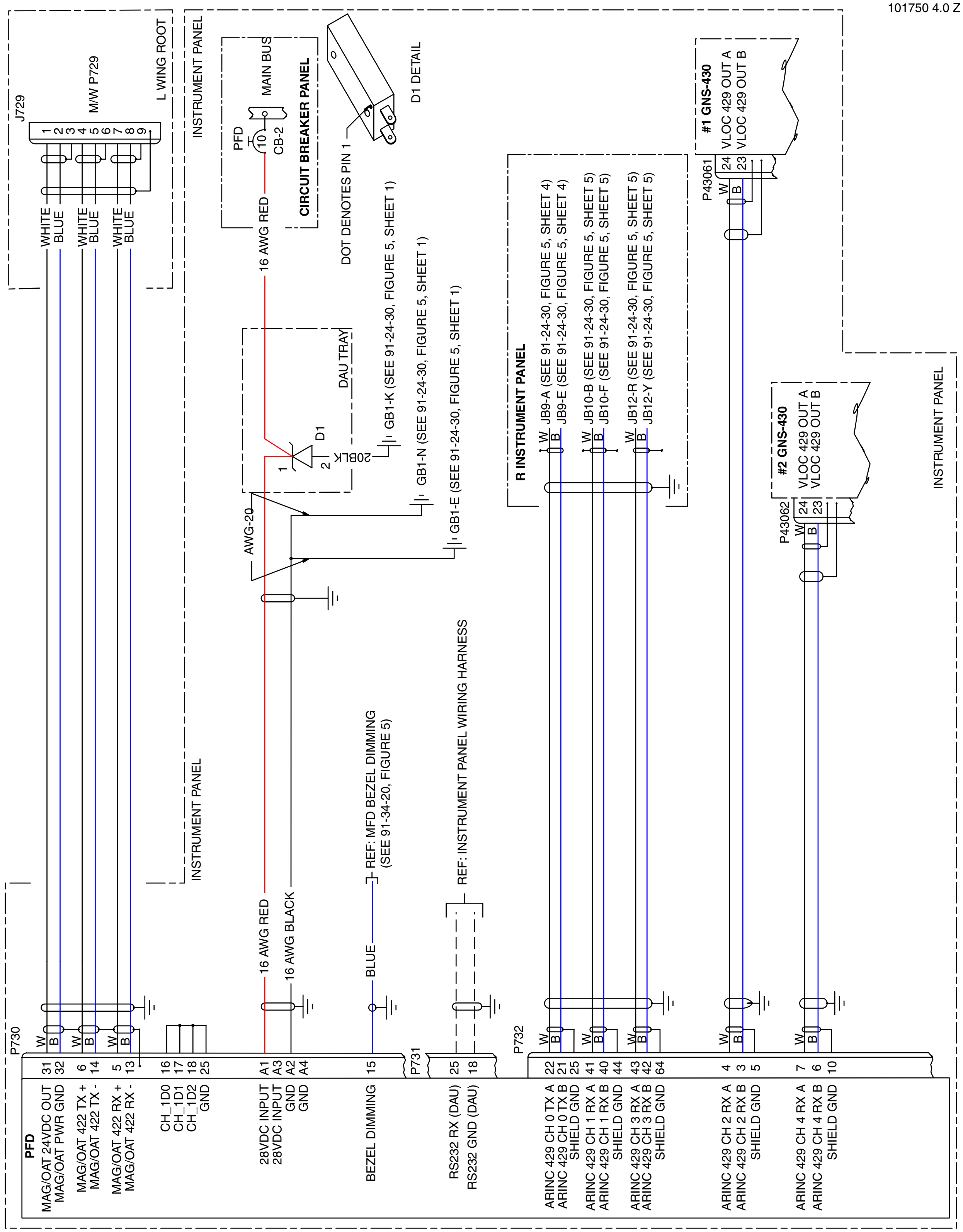
Standby Attitude Indicator
Figure 3 (Sheet 1 of 2)

104817 13.0 A



Standby Attitude Indicator
Figure 3 (Sheet 2 of 2)

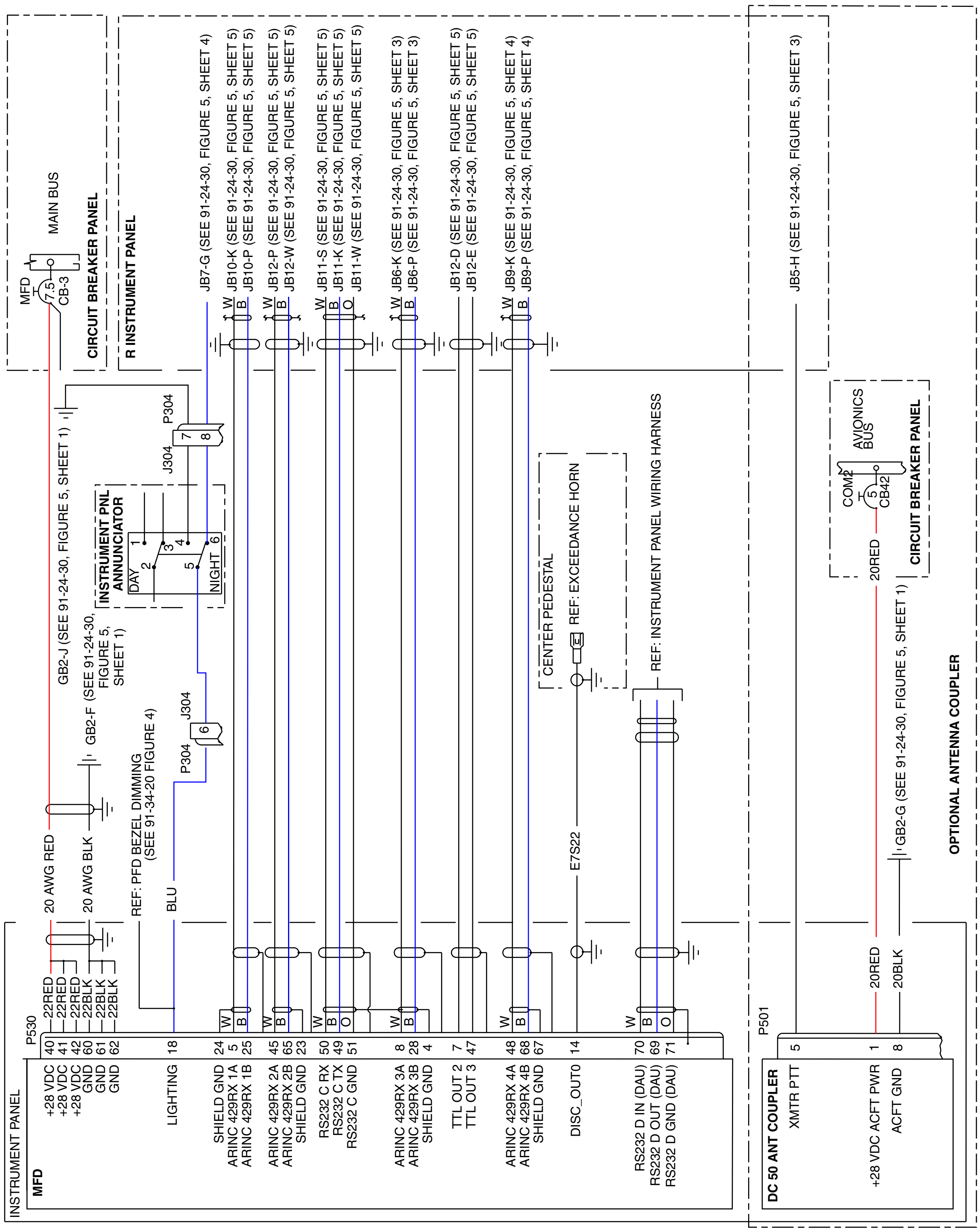
Effectivity
with Garmin 1000



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

Primary Flight Display (PFD)
Figure 4

101750 5.0 Z



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

Multifunction Display
Figure 5

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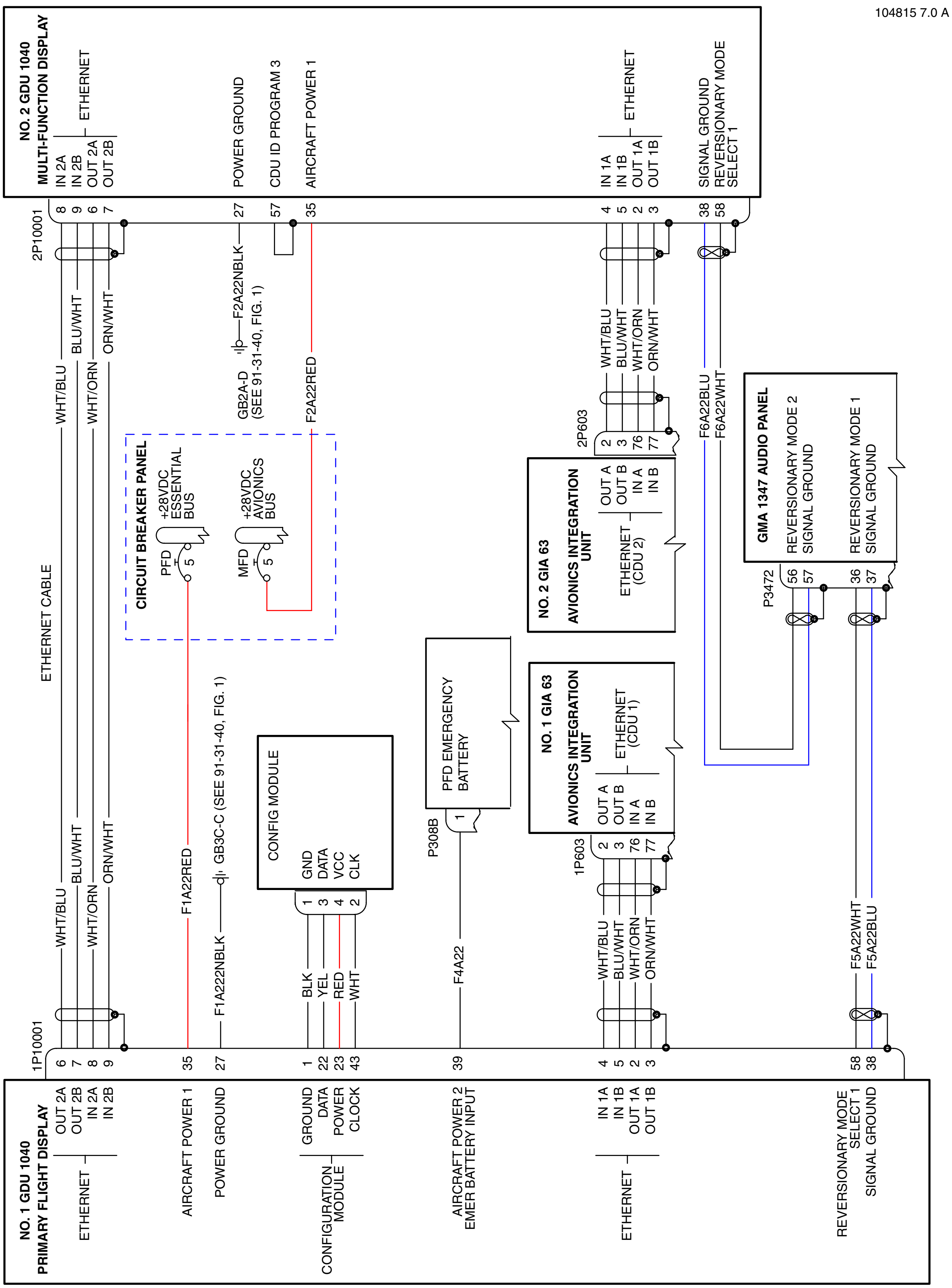
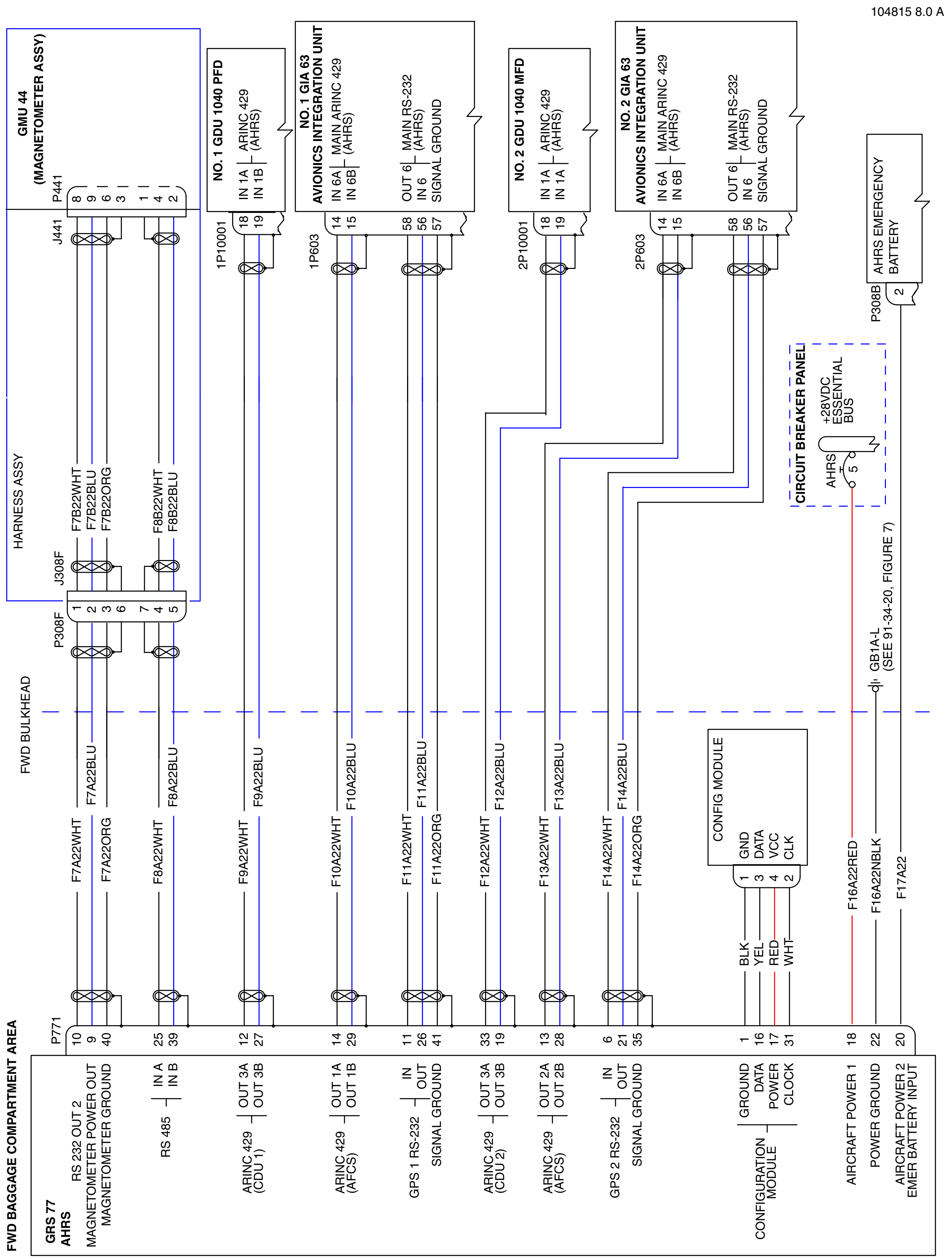


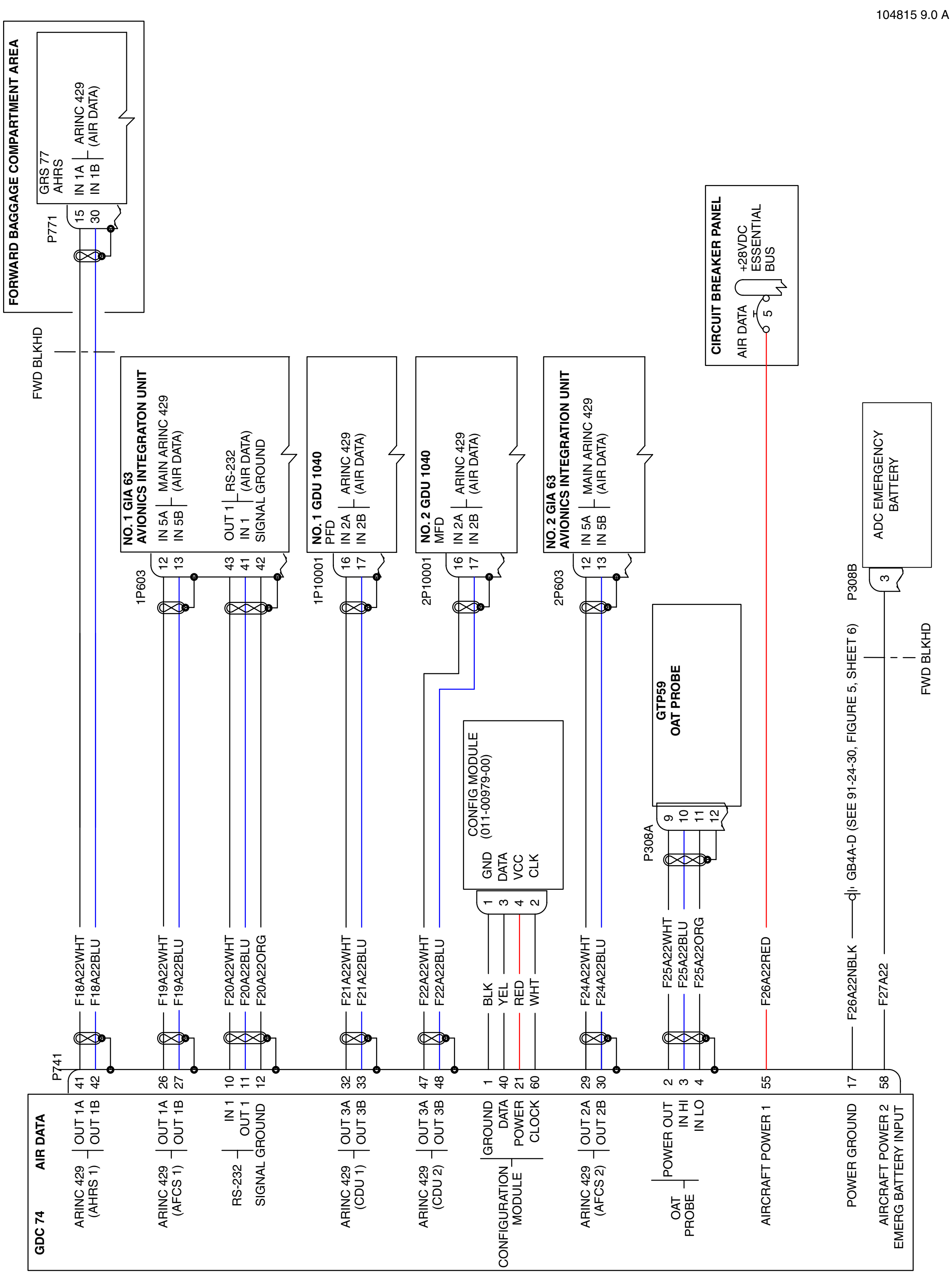
Primary Flight Display (PFD) / Multi-Function Display (MFD)
Figure 6

Effectivity
with Garmin 1000



Effectivity
with Garmin 1000

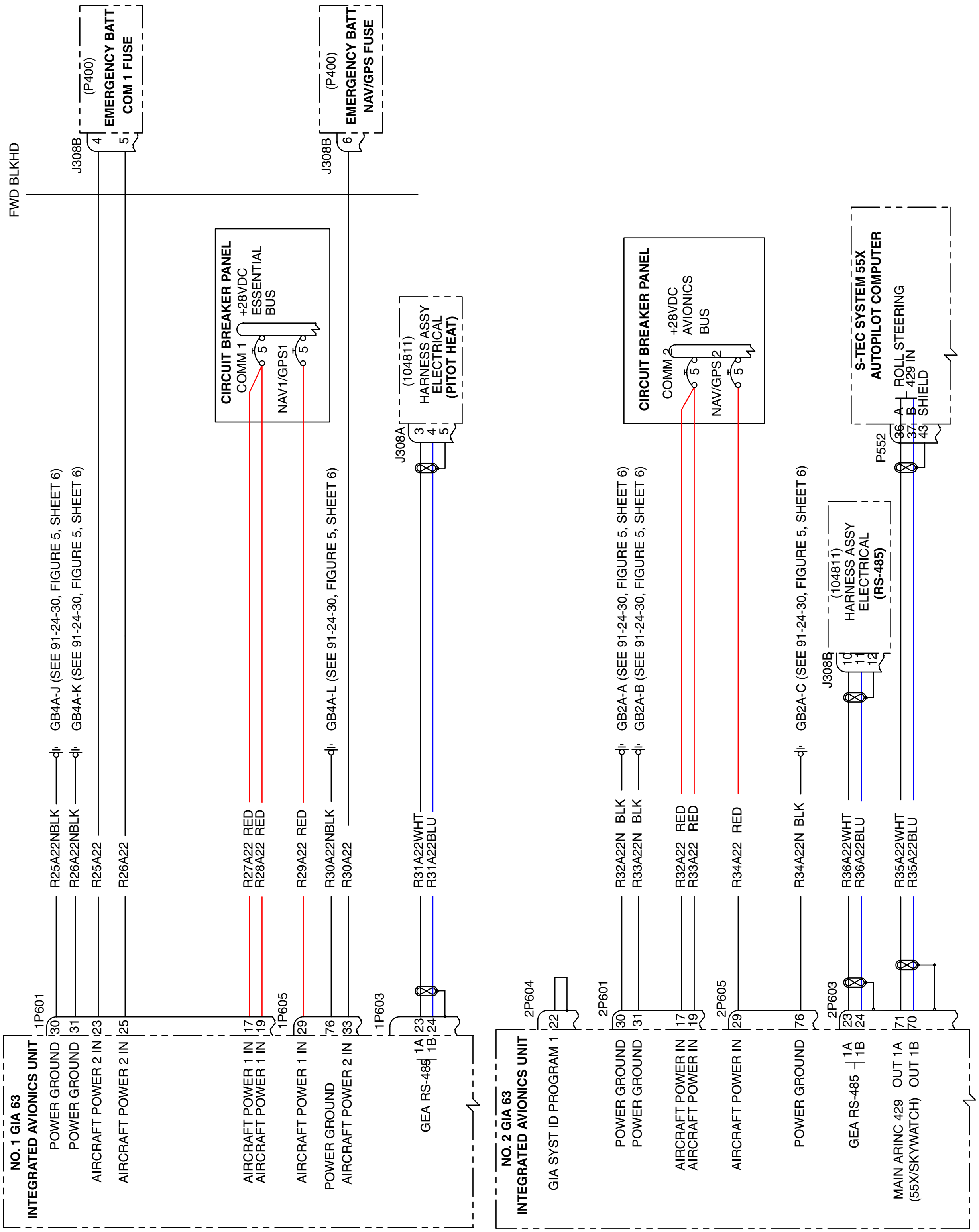
AHRS
Figure 7



Air Data Computer
Figure 8

Effectivity
with Garmin 1000

104815 10.0 A



Effectivity
with Garmin 1000

Integrated Avionics Unit No. 1
Figure 9

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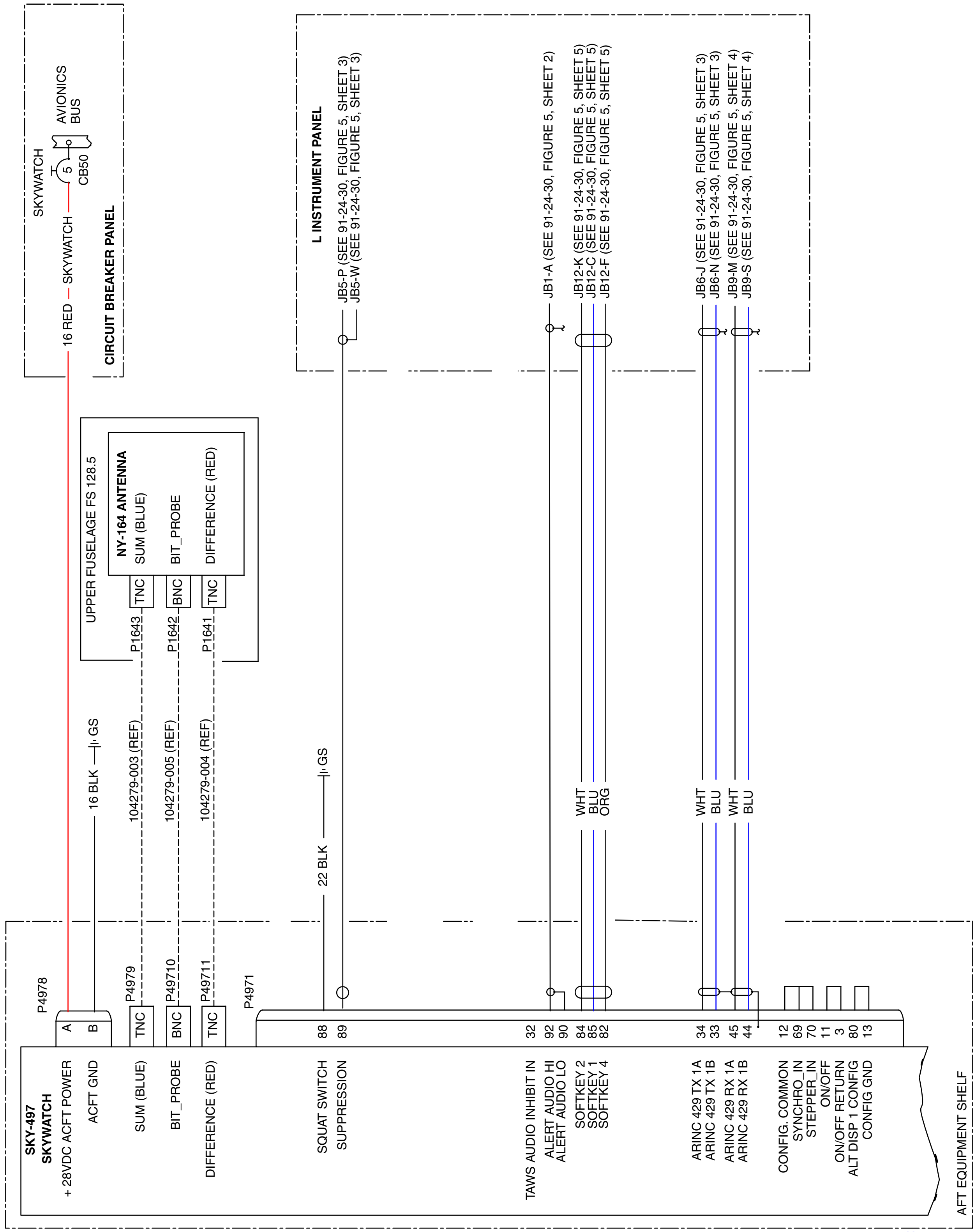
101750 16.0 Z



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

Skywatch
Figure 1 (Sheet 1 of 2)

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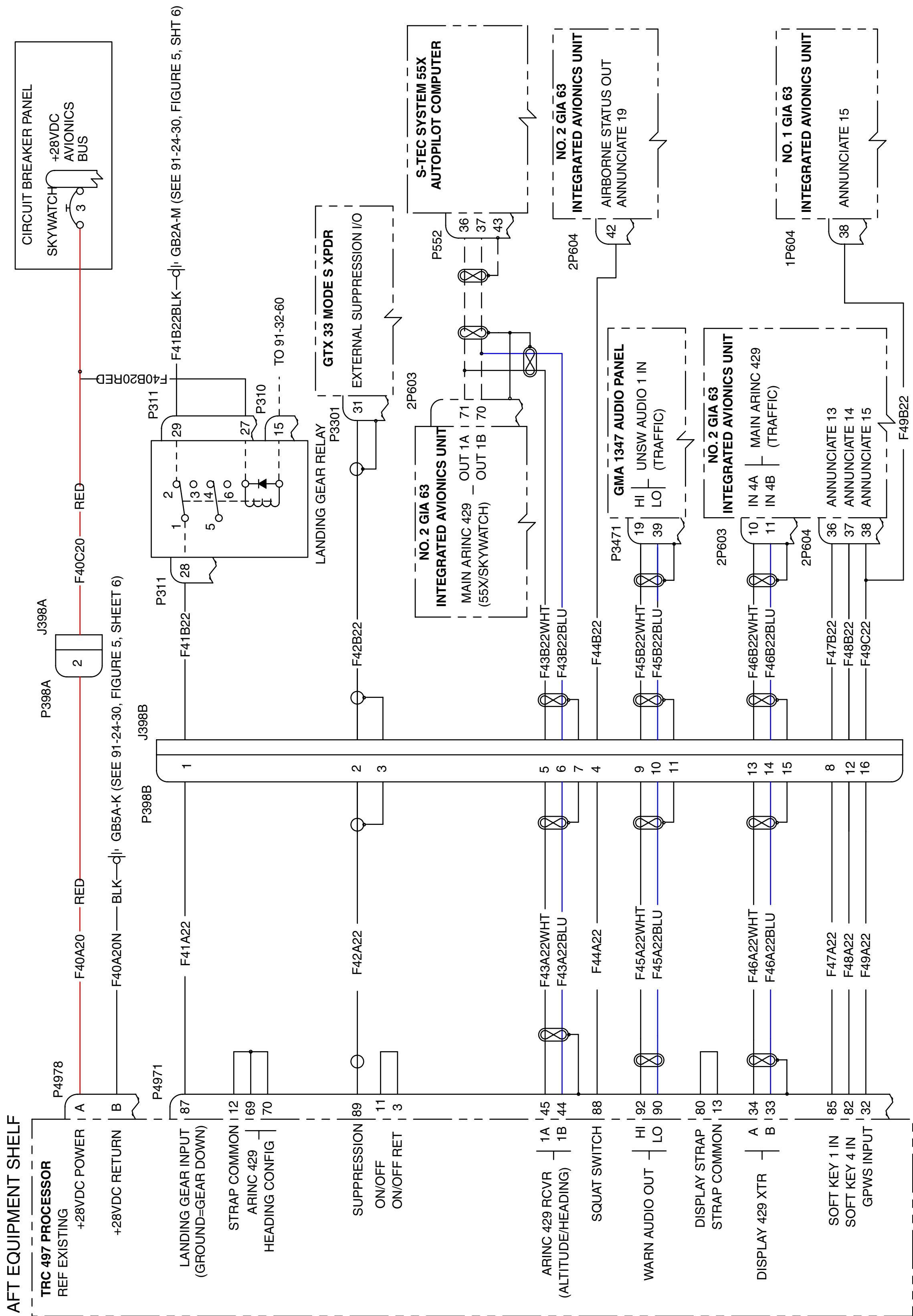
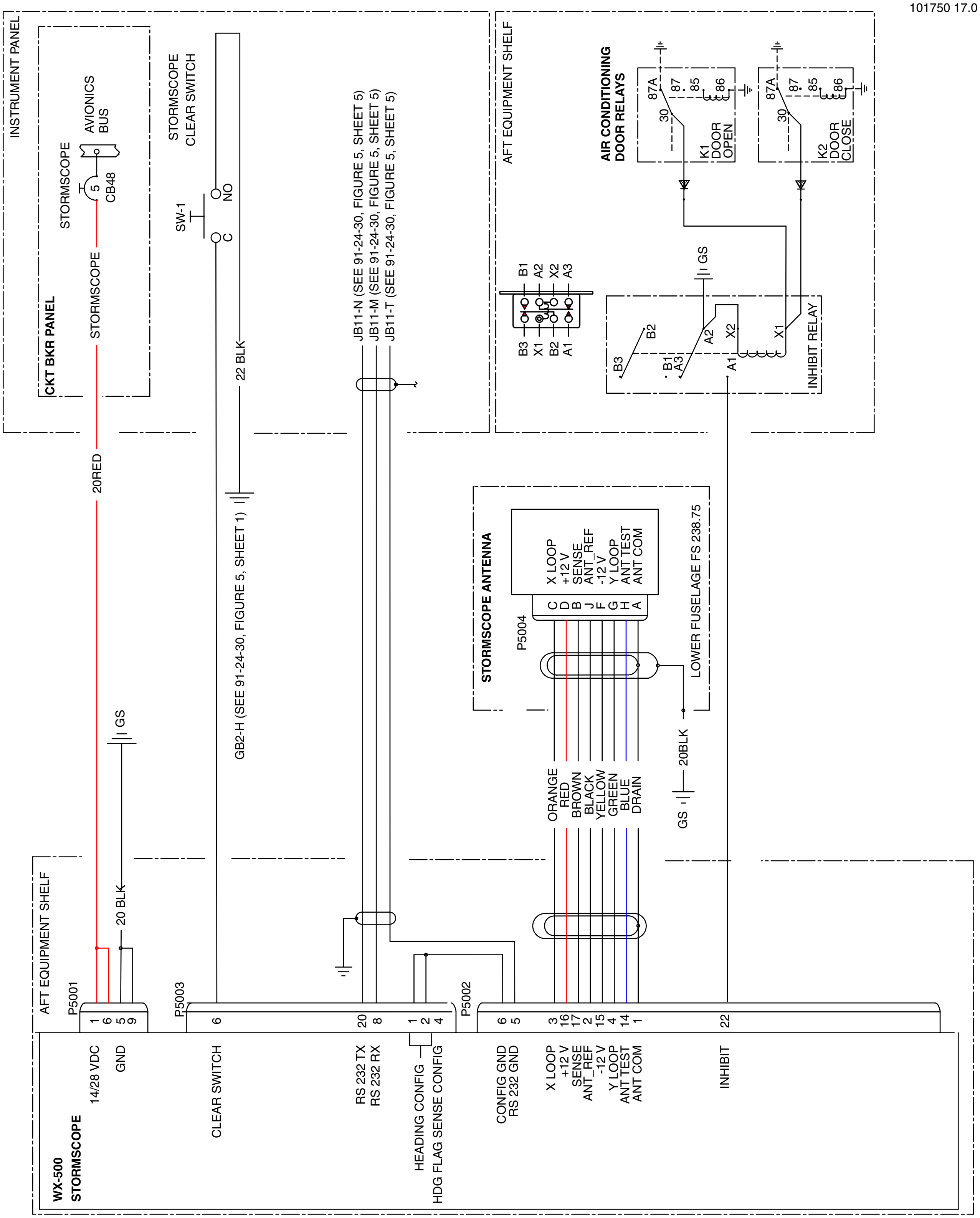
104815 16.0 A



Skywatch
Figure 1 (Sheet 2 of 2)

Effectivity
with Garmin 1000

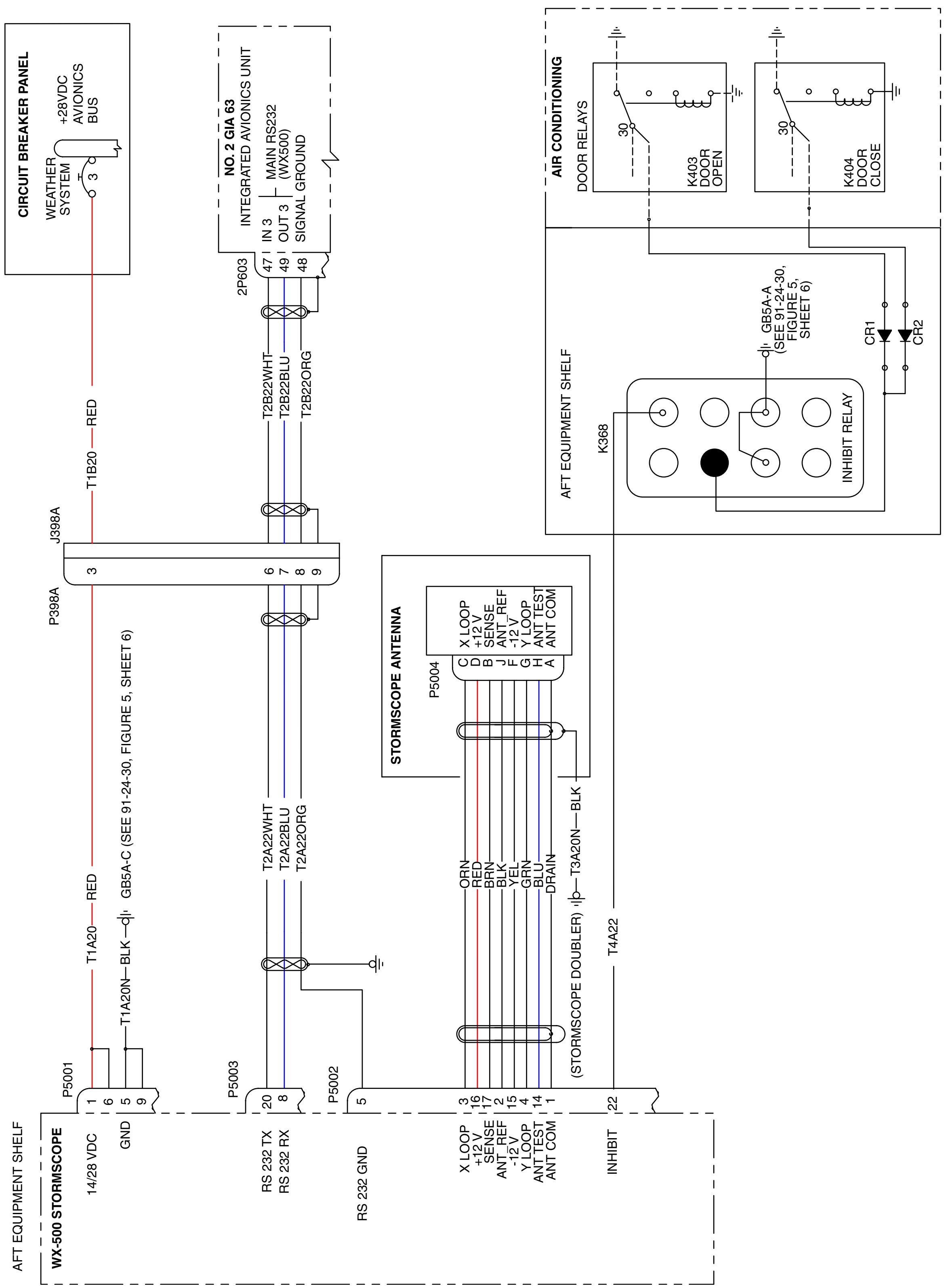
101750 17.0 Z



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

Stormscope
Figure 2 (Sheet 1 of 2)

104815 17.0 A



Stormscope
Figure 2 (Sheet 2 of 2)

Effectivity
with Garmin 1000

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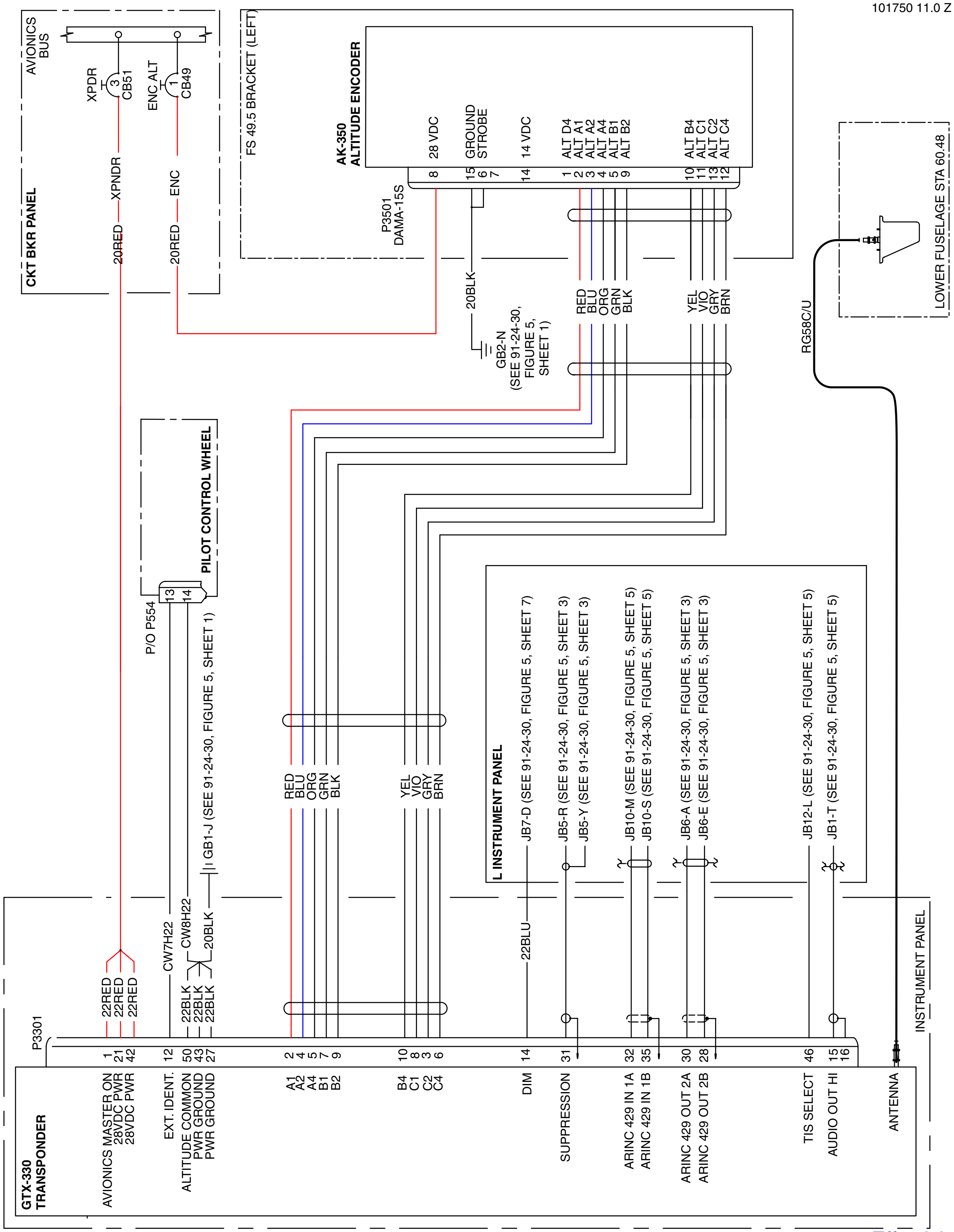
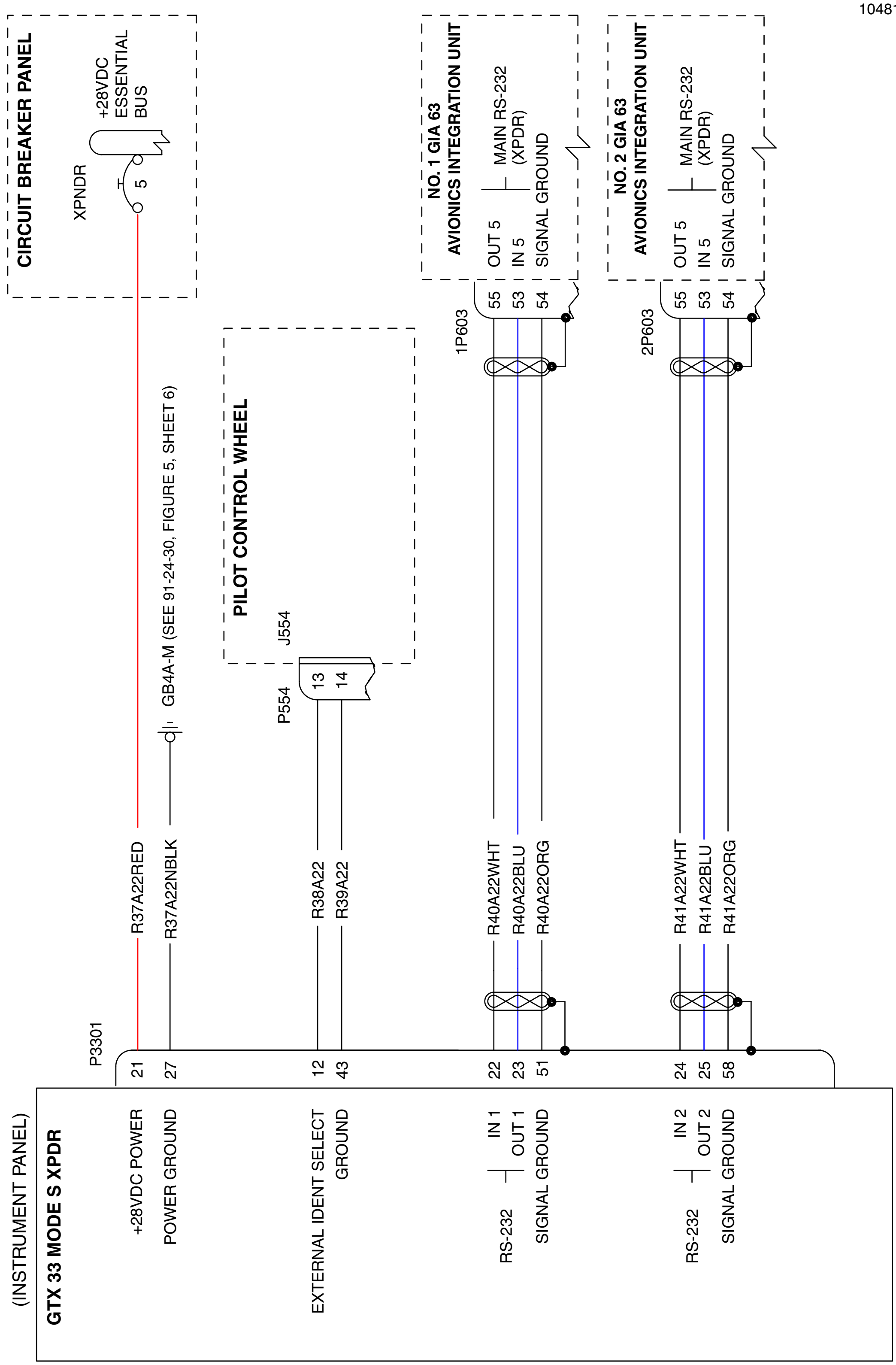


GTX-330 Transponder
Figure 1 (Sheet 1 of 2)

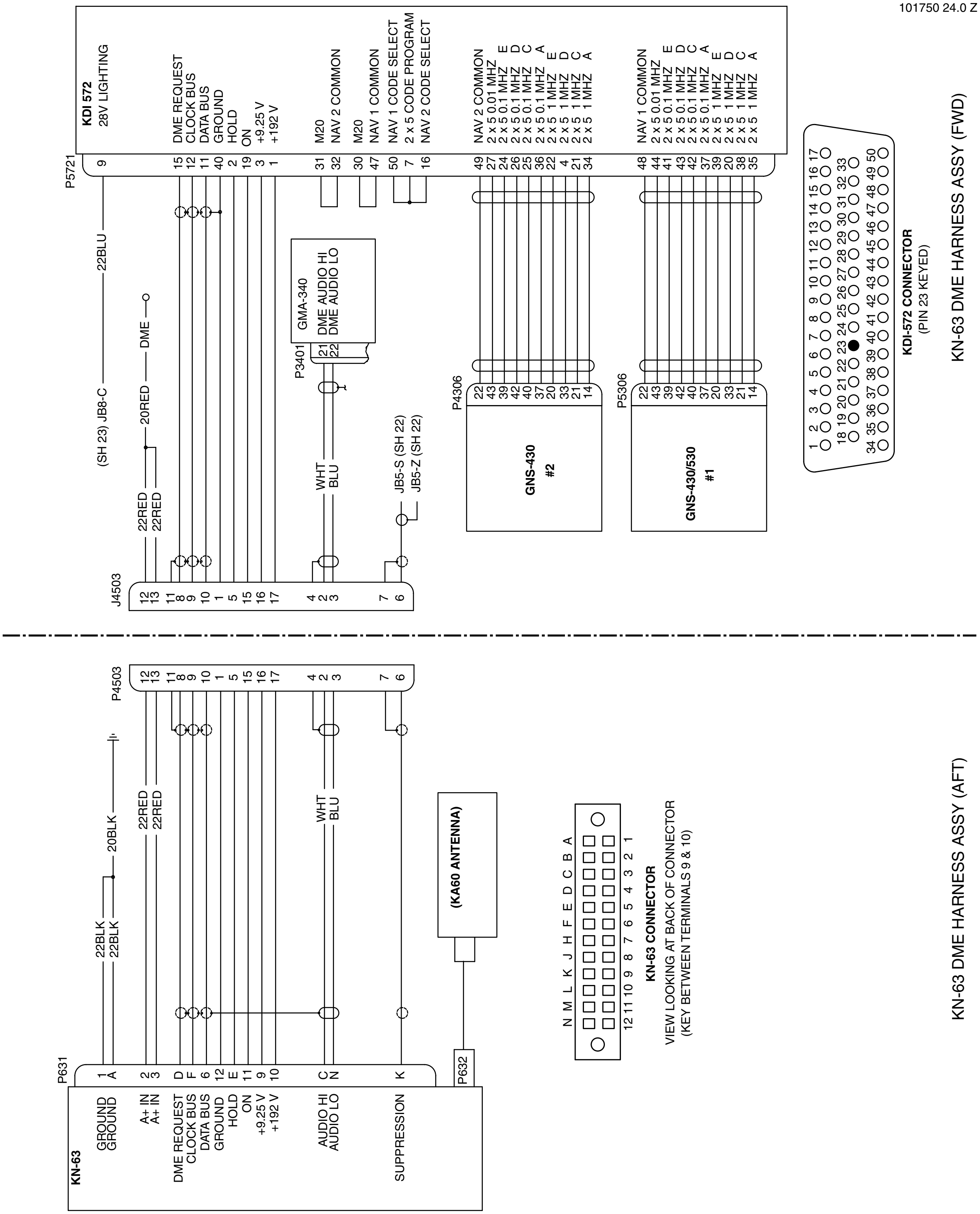
Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

104815 14.0 A



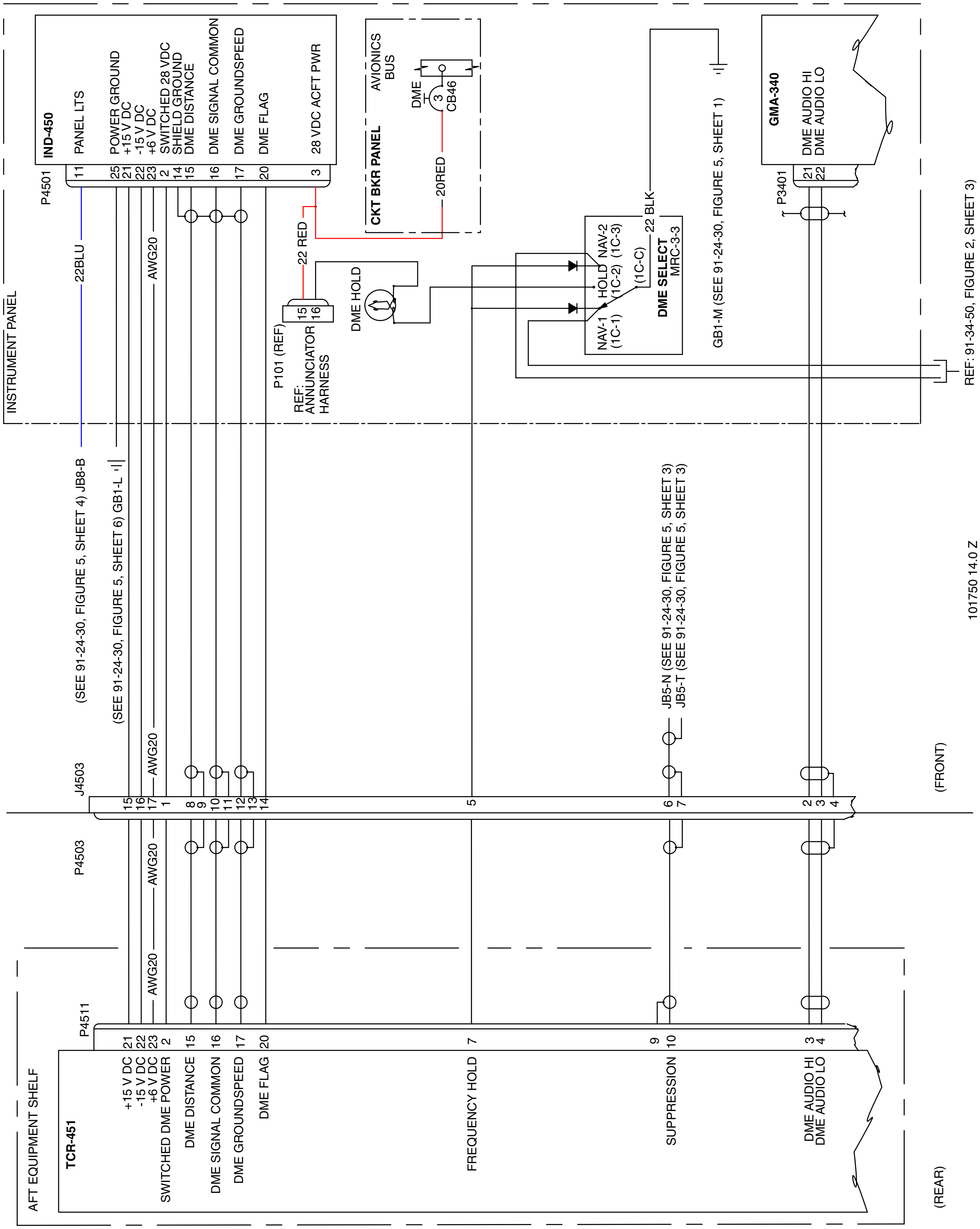
Effectivity
with Garmin 1000

GTX-33 Transponder
Figure 1 (Sheet 2 of 2)



KN-63 DME
Figure 2 (Sheet 1 of 4)

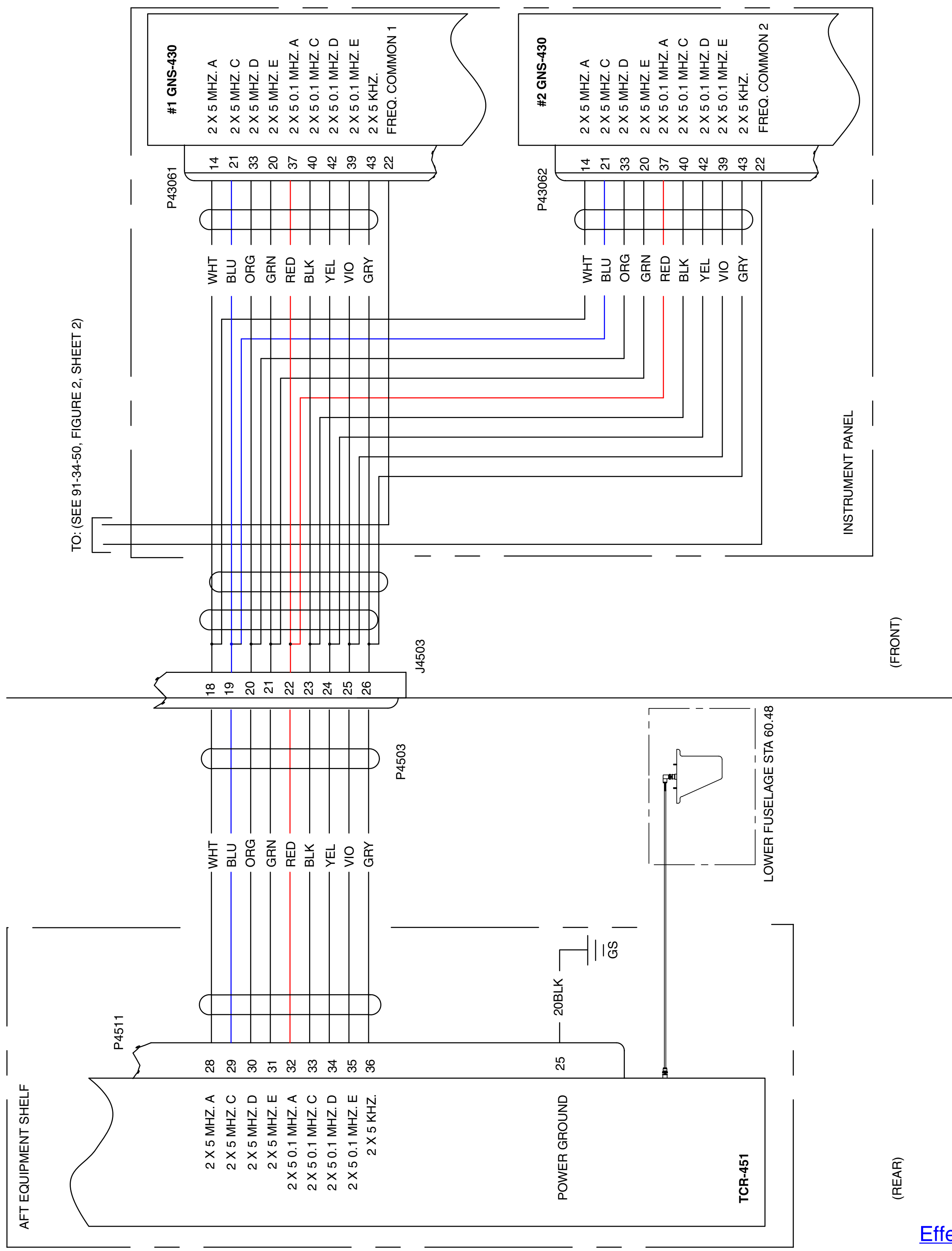
Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

TCR-451 DME
Figure 2 (Sheet 2 of 4)

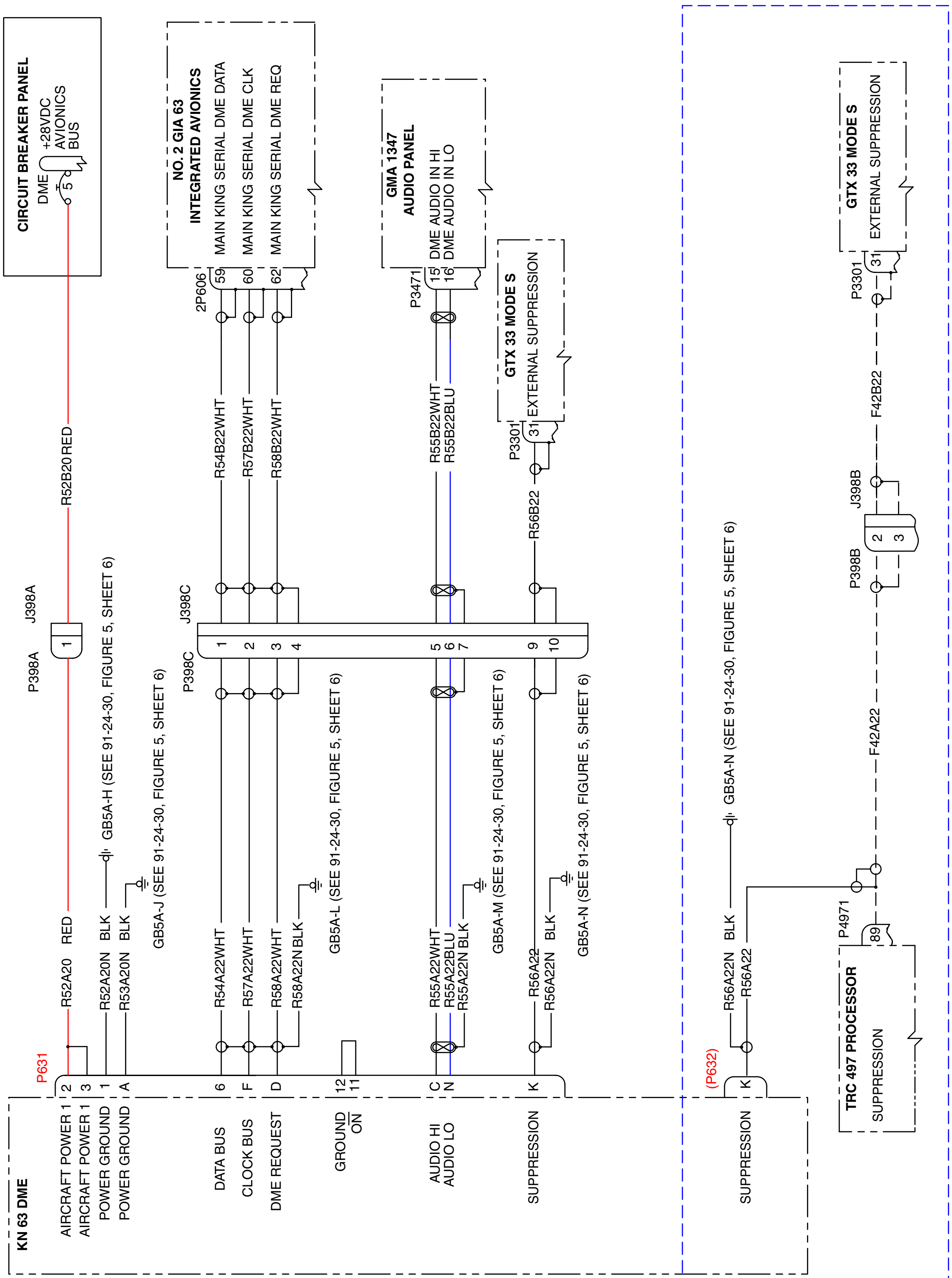
101750 15.0 Z



TCR-451 DME
Figure 2 (Sheet 3 of 4)

Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

104815 19.0 A



Effectivity
with Garmin 1000

KN-63 DME
Figure 2 (4 of 4)

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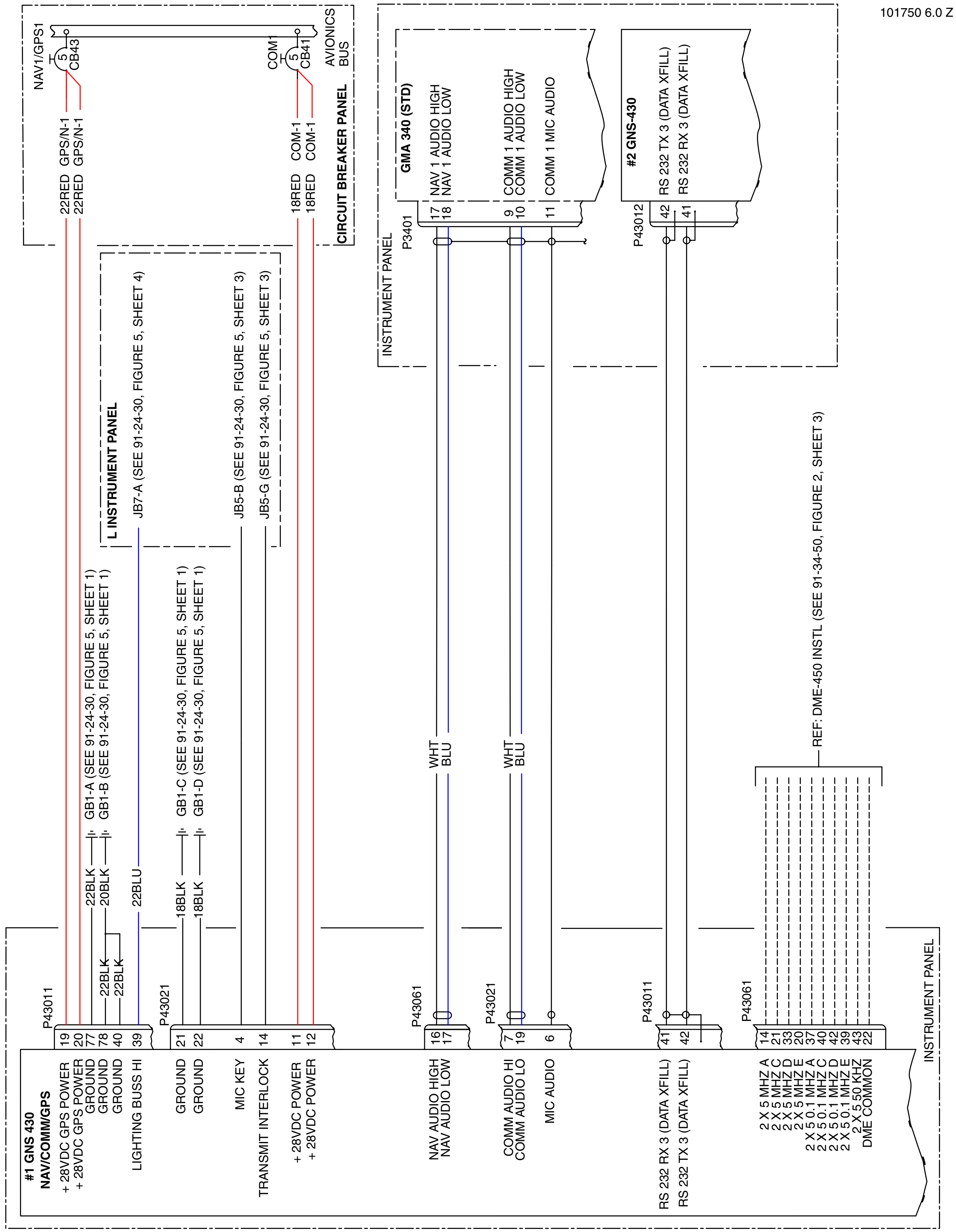
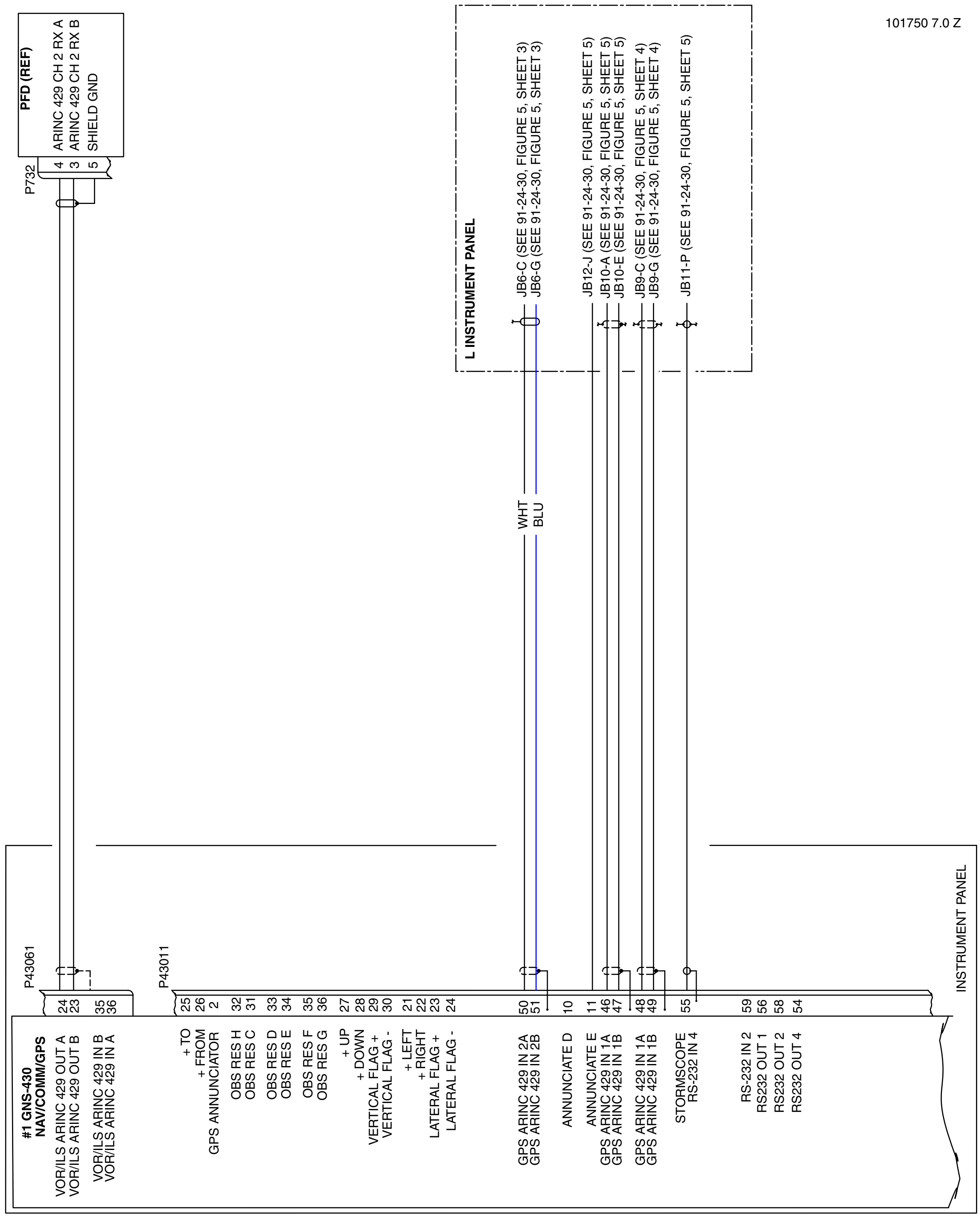


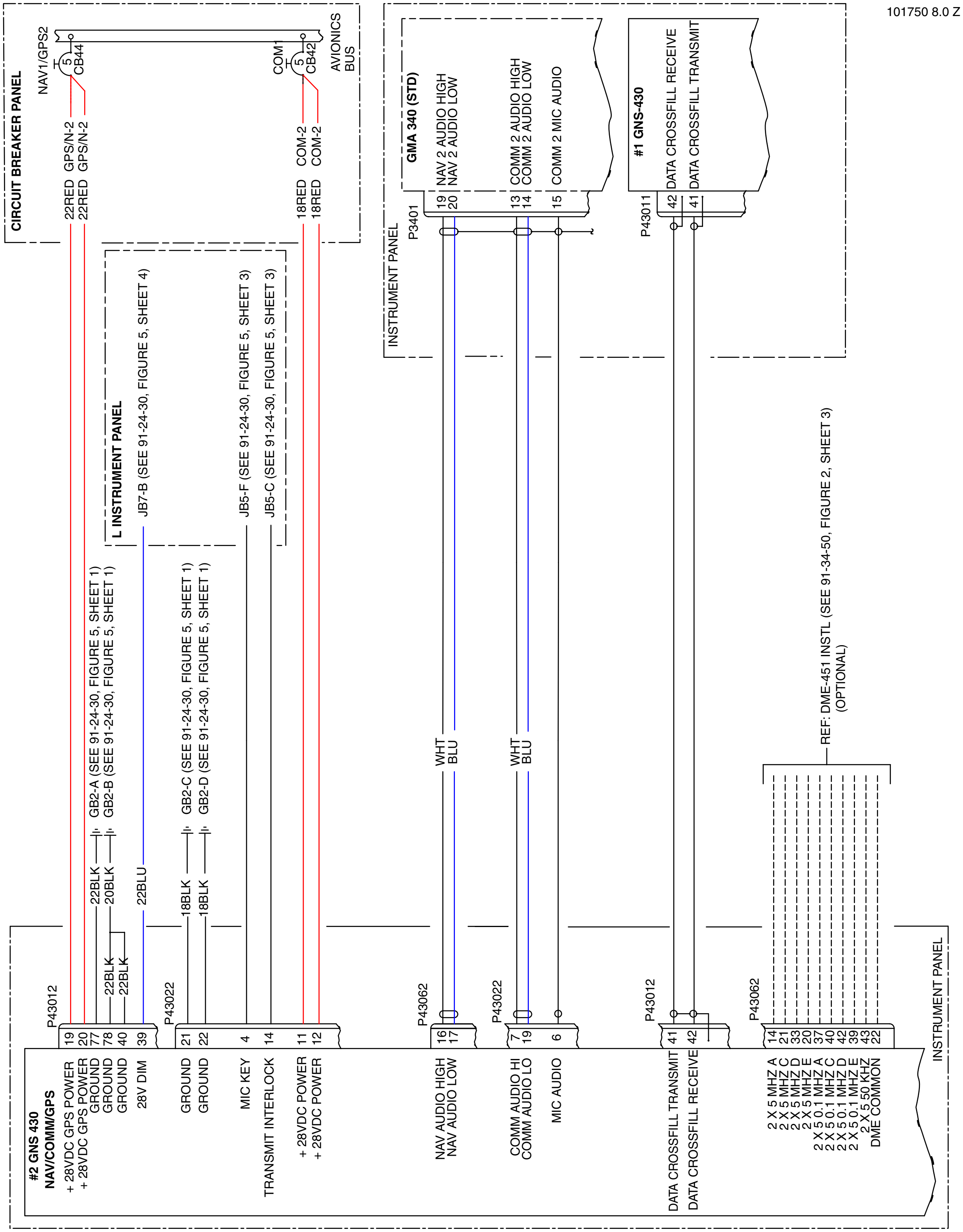
Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

#1 GNS NAV/COM/GPS
Figure 3 (Sheet 1 of 2)



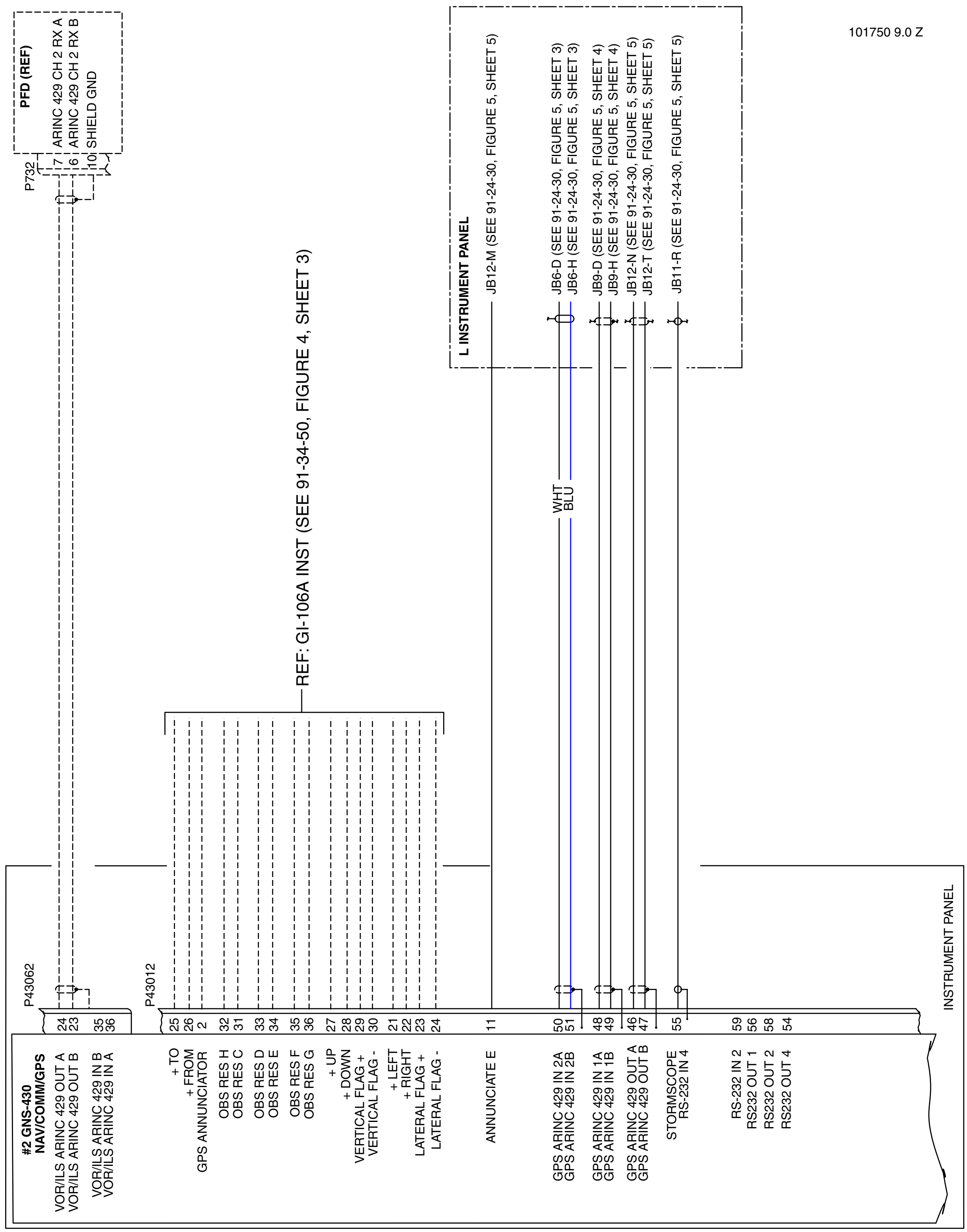
Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

#1 GNS NAV/COM/GPS
Figure 3 (Sheet 2 of 2)



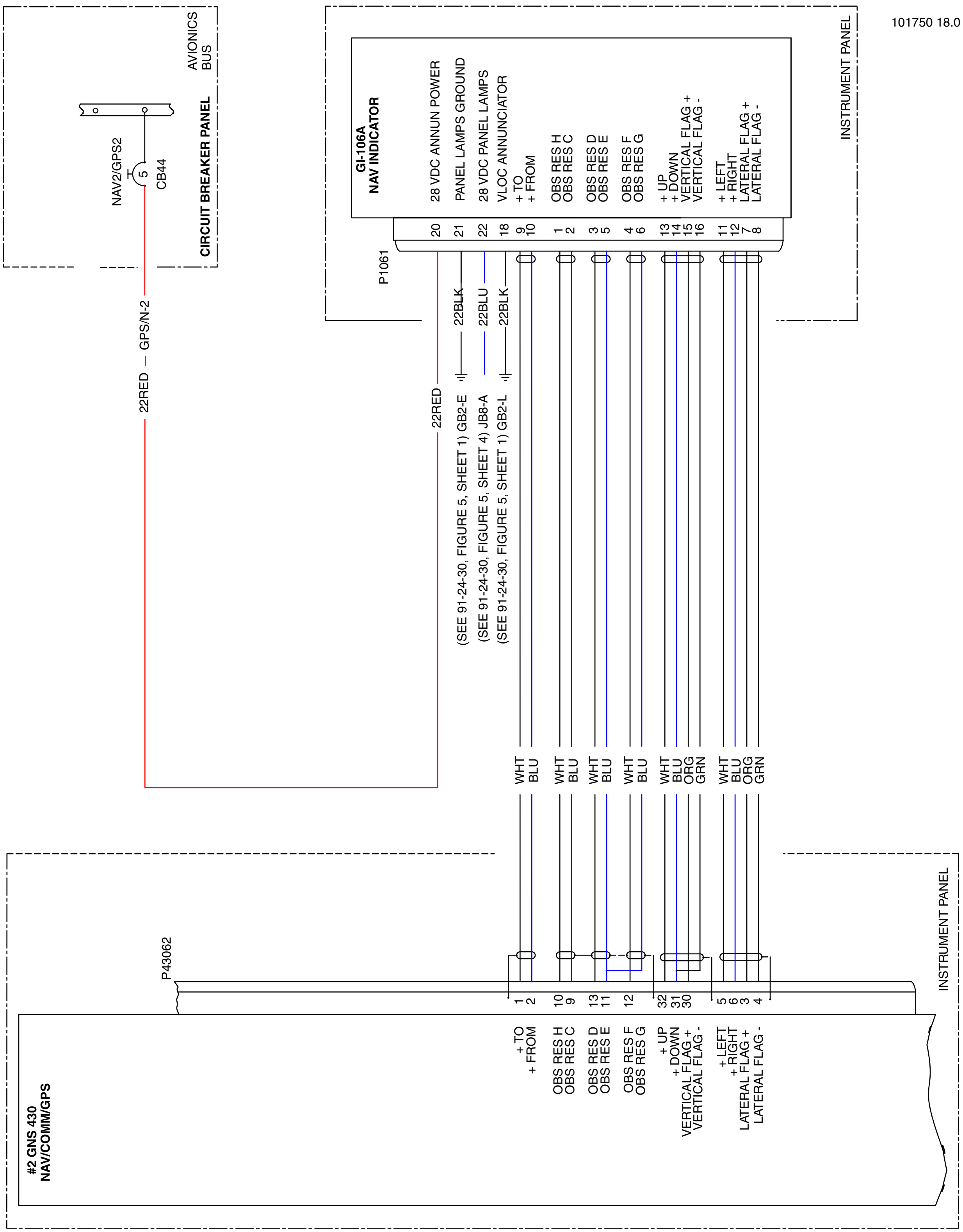
Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

#2 GNS NAV/COM/GPS
Figure 4 (Sheet 1 of 3)



#2 GNS NAV/COM/GPS
Figure 4 (Sheet 2 of 3)

Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra



Effectivity
3246218 and up;
3257339 and up,
with Avidyne Entegra

#2 GNS NAV/COM/GPS
Figure 4 (Sheet 3 of 3)

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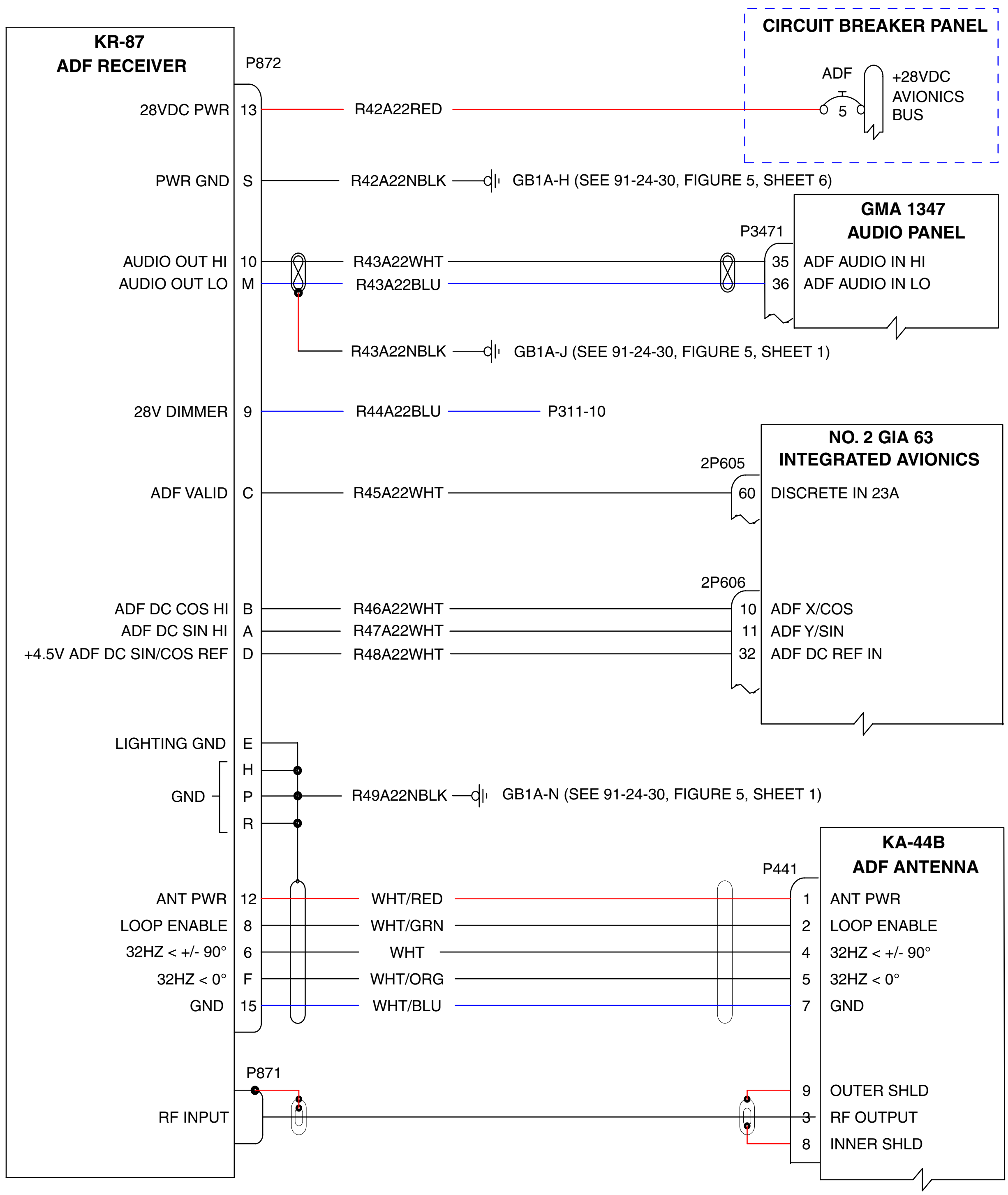
104815 18.0 A



Effectivity
with Garmin 1000

KR-87 ADF RECEIVER
Figure 5

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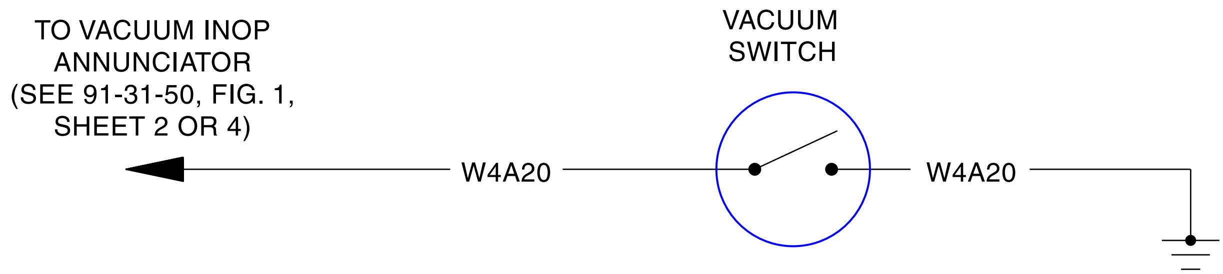
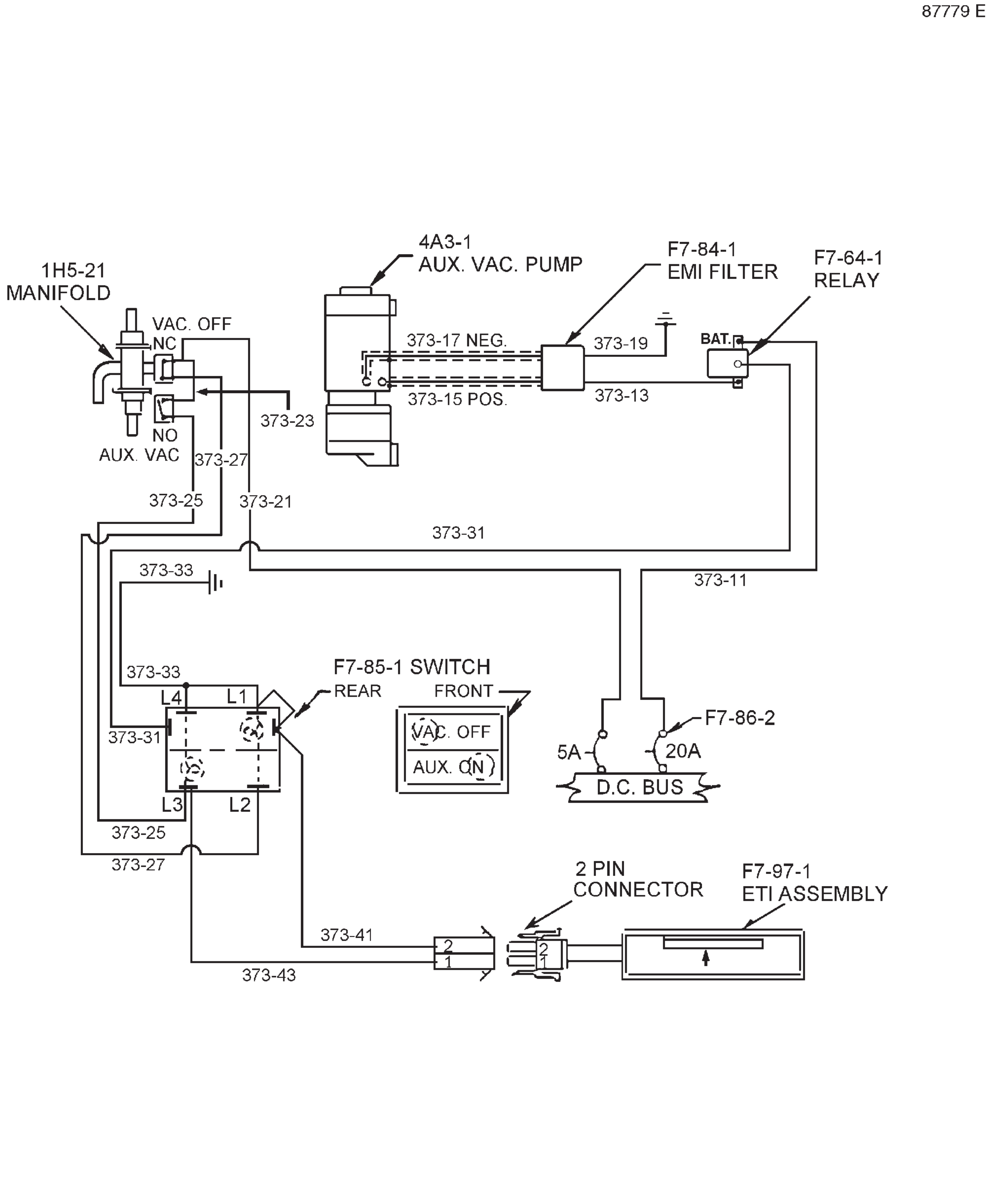
85501 19.0 NEW / F
85300 19.0 NEW / B



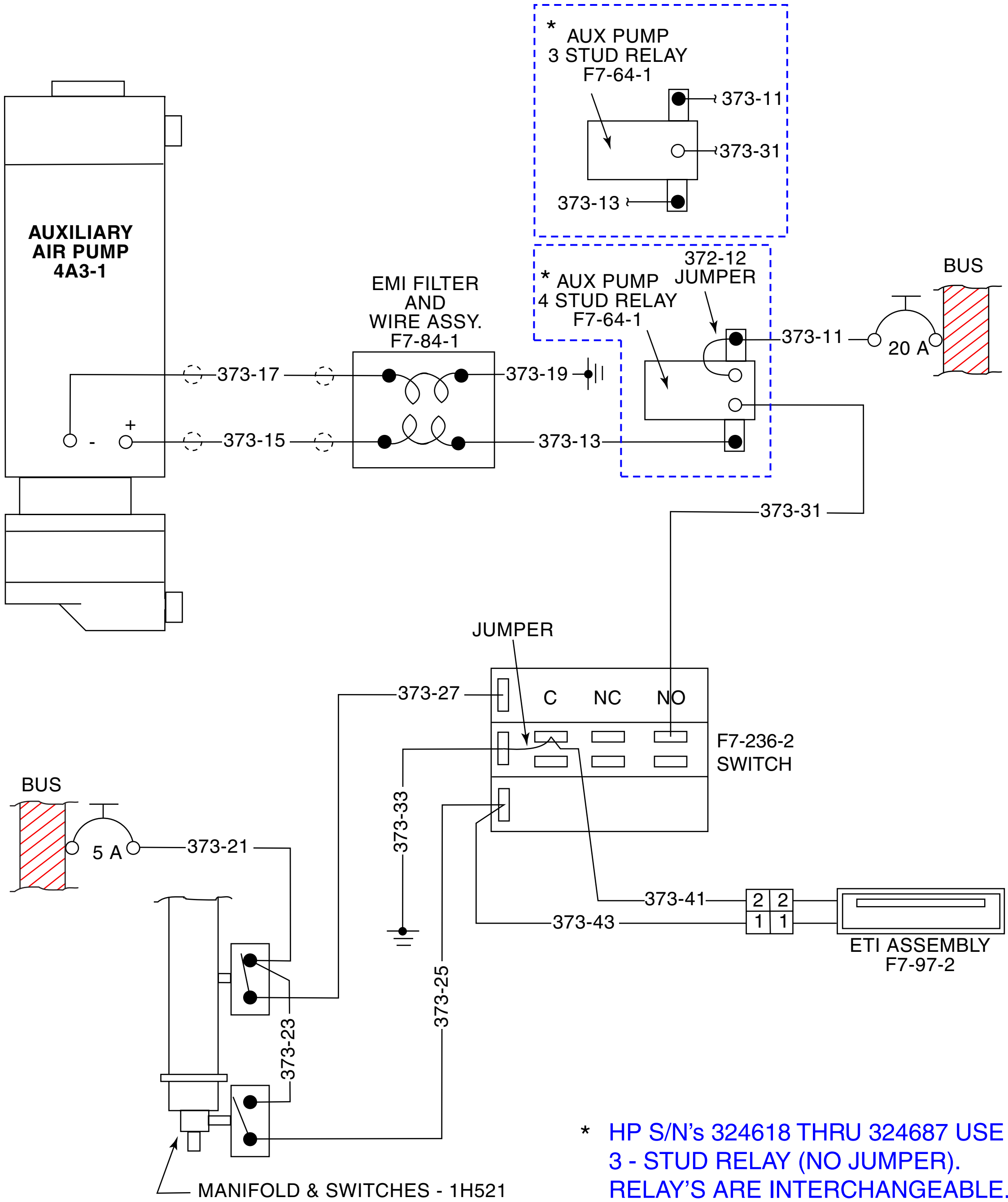
Vacuum Inop
Figure 1

Effectivity
3246001 thru 3246087



Auxiliary Vacuum System
Figure 2 (Sheet 1 of 2)

87779 J / J



* HP S/N's 324618 THRU 324687 USE
3 - STUD RELAY (NO JUMPER).
RELAY'S ARE INTERCHANGEABLE.

Auxiliary Vacuum System
Figure 2 (Sheet 2 of 2)

Effectivity
3246018 and up
3257001 and up

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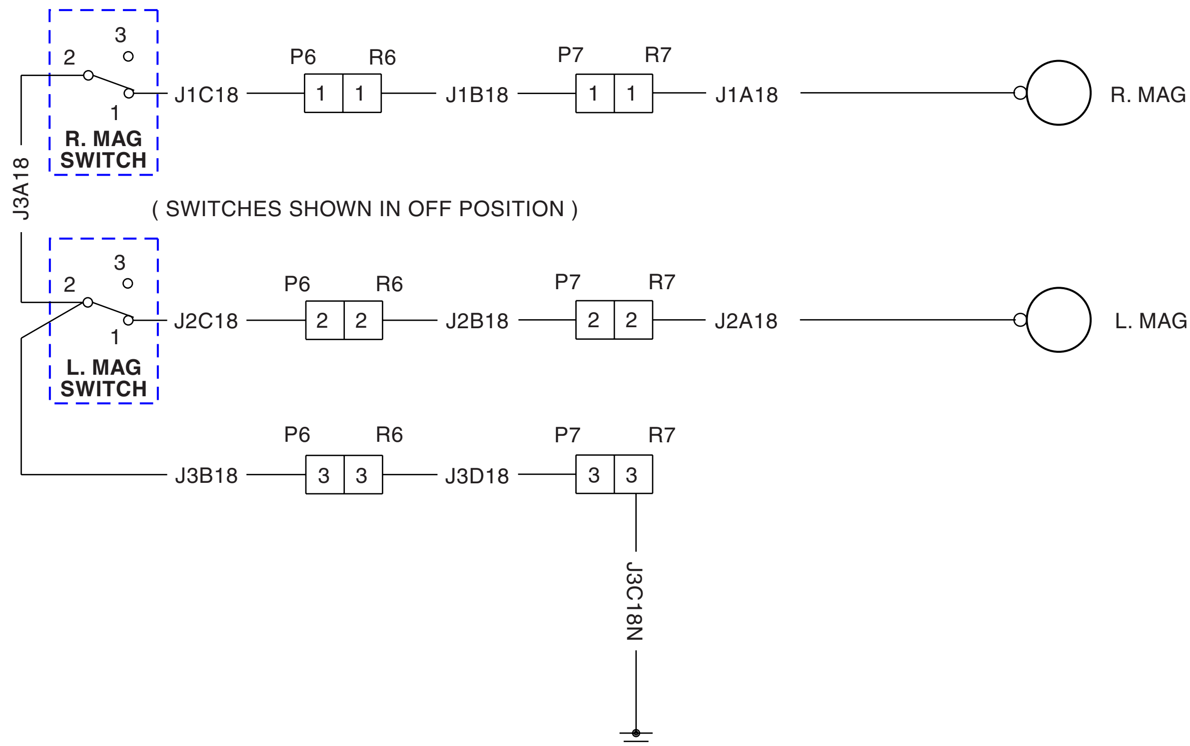
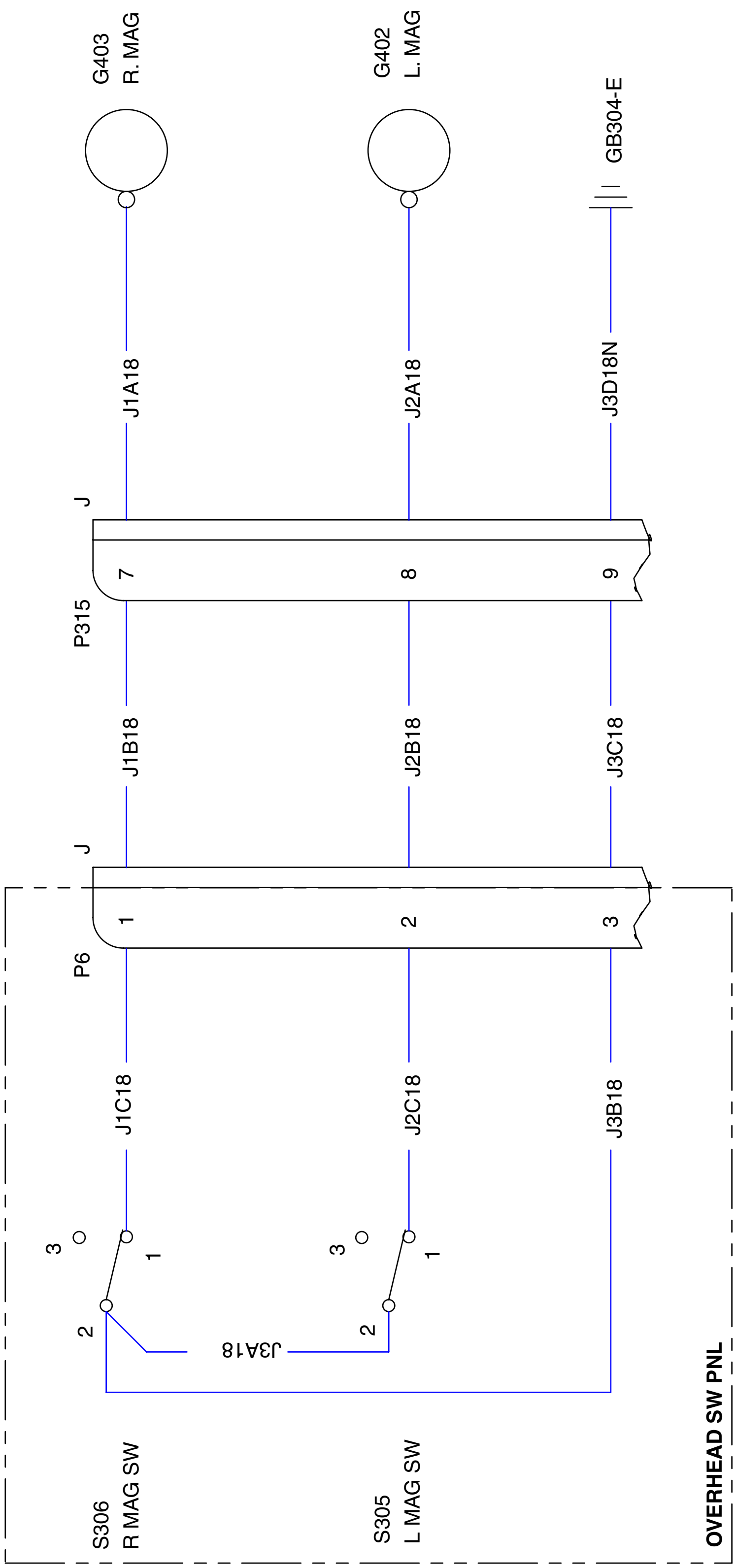
101848 26.0 L
104406 27.0 NEW / J
104141 27.0 NEW / C
101272 28.0 NEW / D
100840 28.0 NEW / C
85501 28.0 NEW / F



Magneto Switch
Figure 1 (Sheet 1 of 2)

Effectivity
3246018 and up
3257001 and up

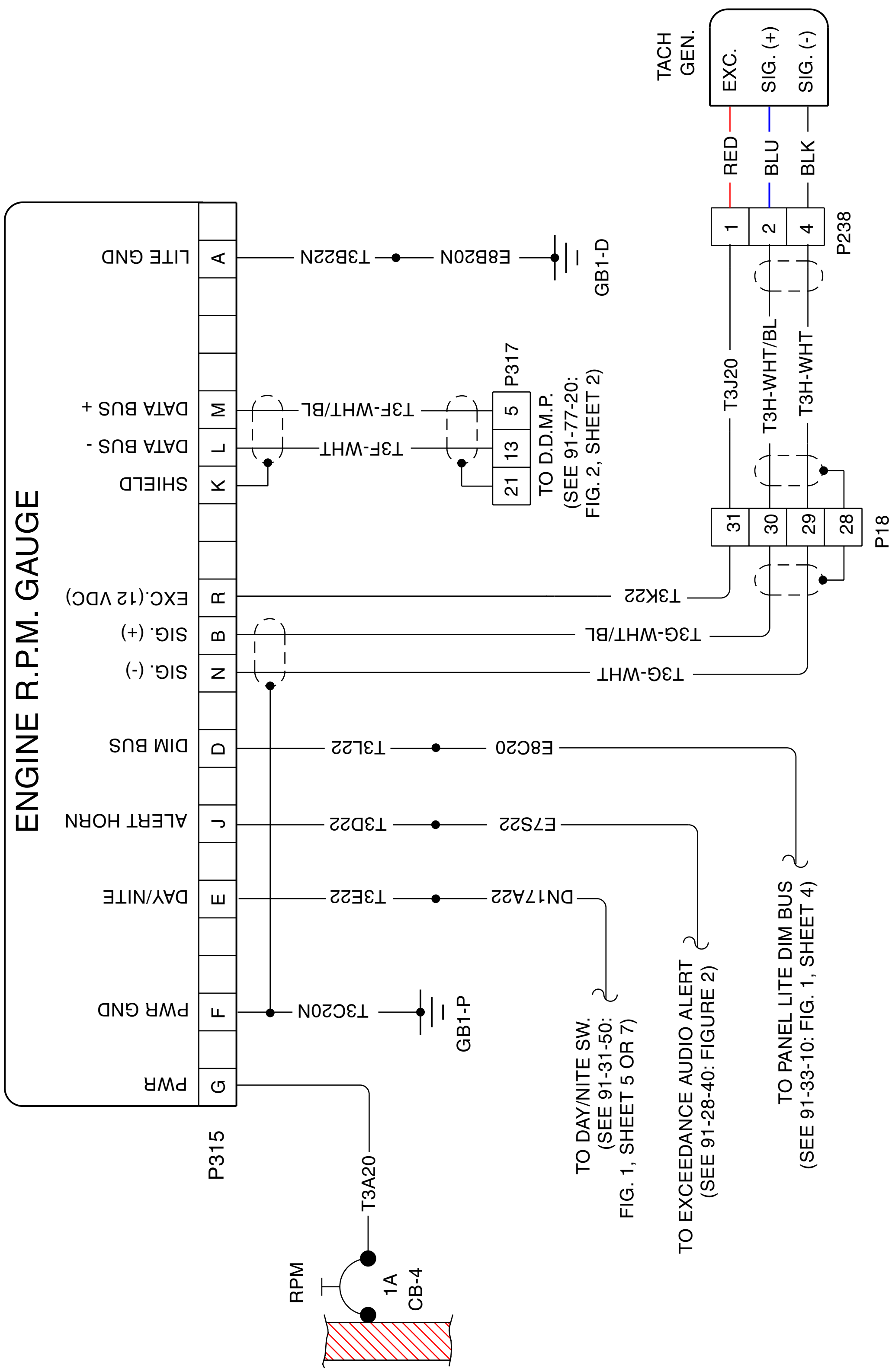
104817 14.0 A



Effectivity
with Garmin 1000

Magneto Switch
Figure 1 (Sheet 2 of 2)

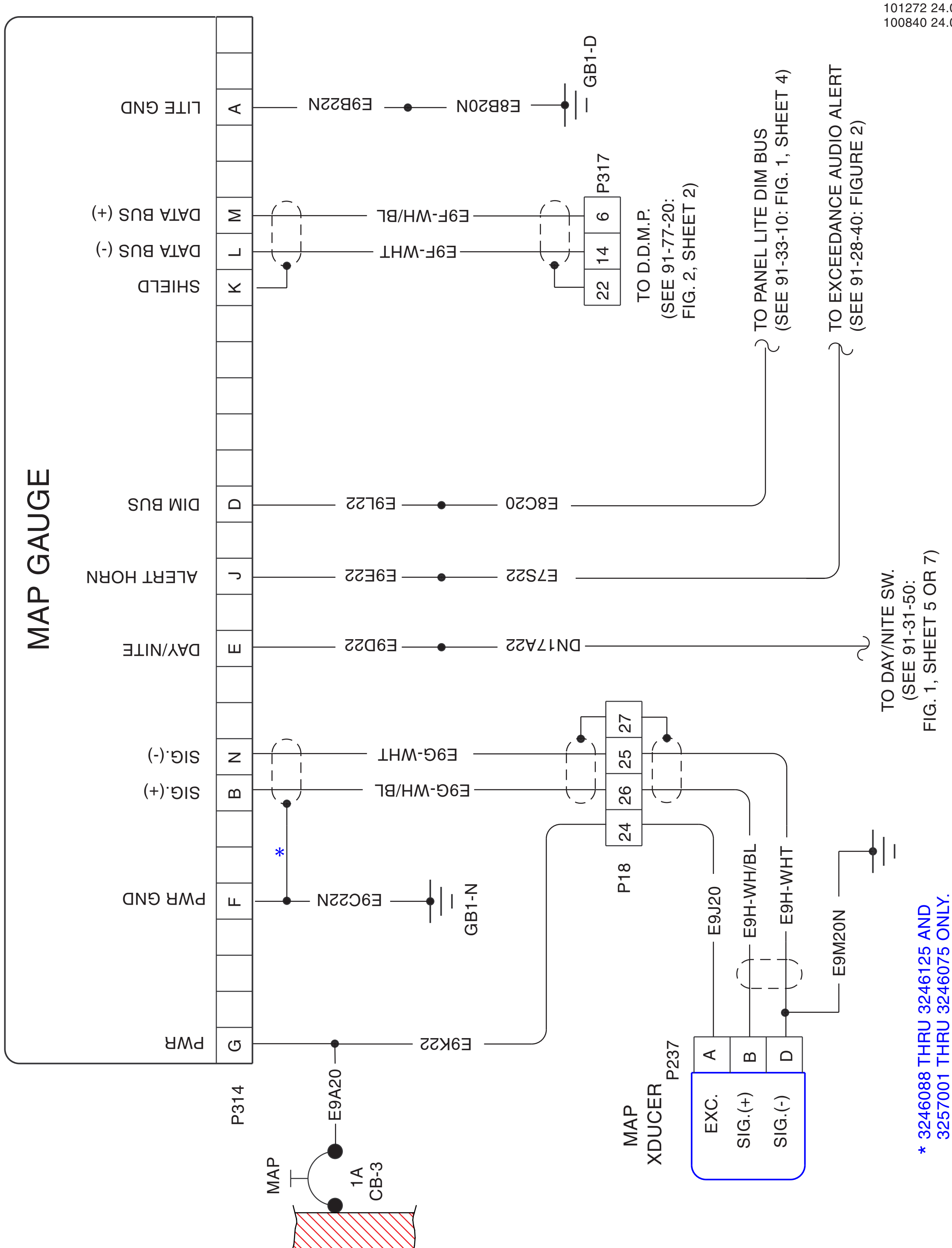
104406 30.0 NEW / J
104141 30.0 NEW / C
101272 31.0 NEW / D
100840 31.0 B / C



Engine RPM
Figure 1

Effectivity
3246088 and up
3257001 and up

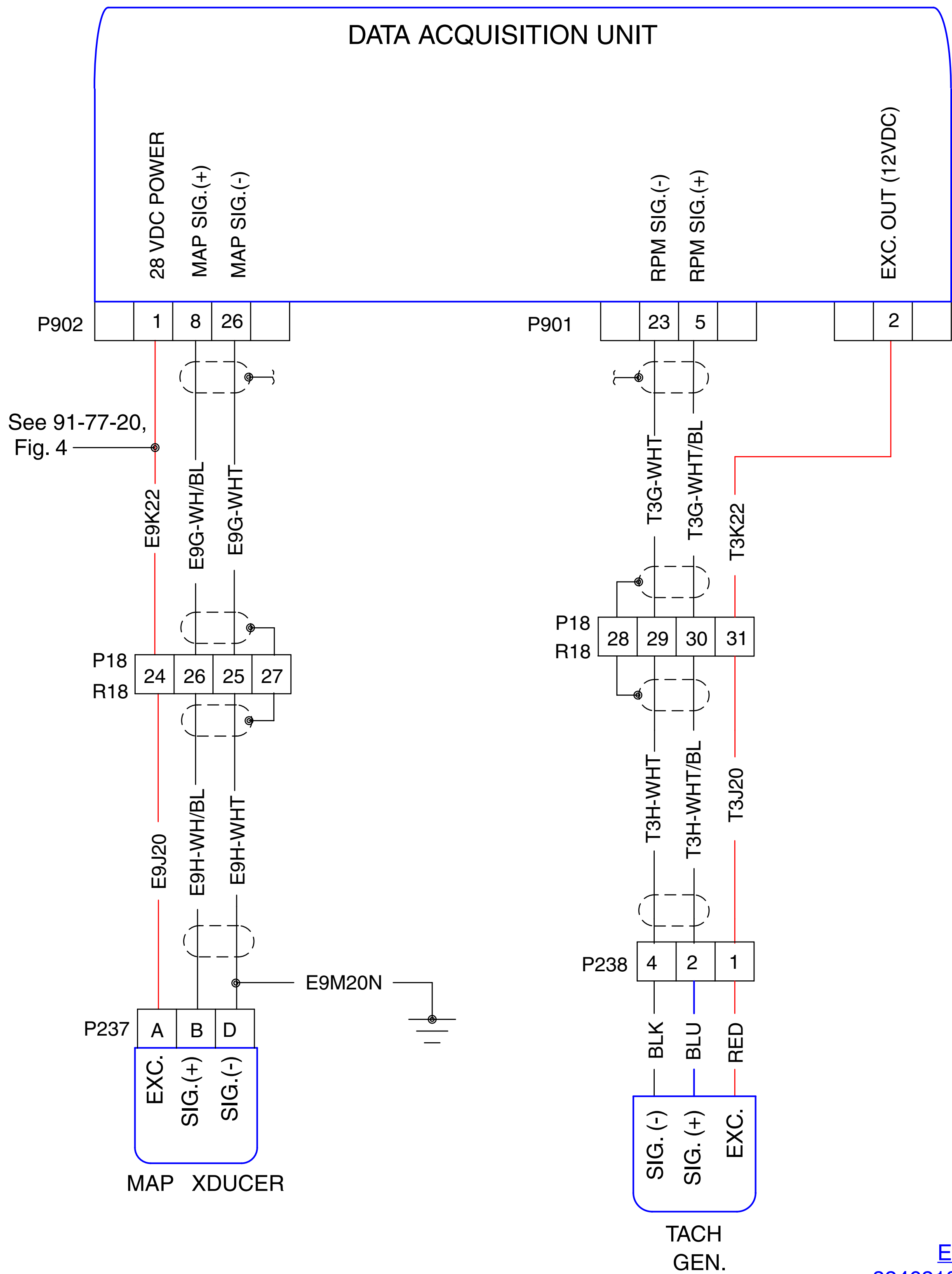
104406 23.0 NEW / J
104141 23.0 B / C
101272 24.0 C / D
100840 24.0 C



Effectivity
3246088 and up
3257001 and up

MAP Gauge
Figure 2

101848 23.0 L



MAP / RPM
Figure 3

Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra

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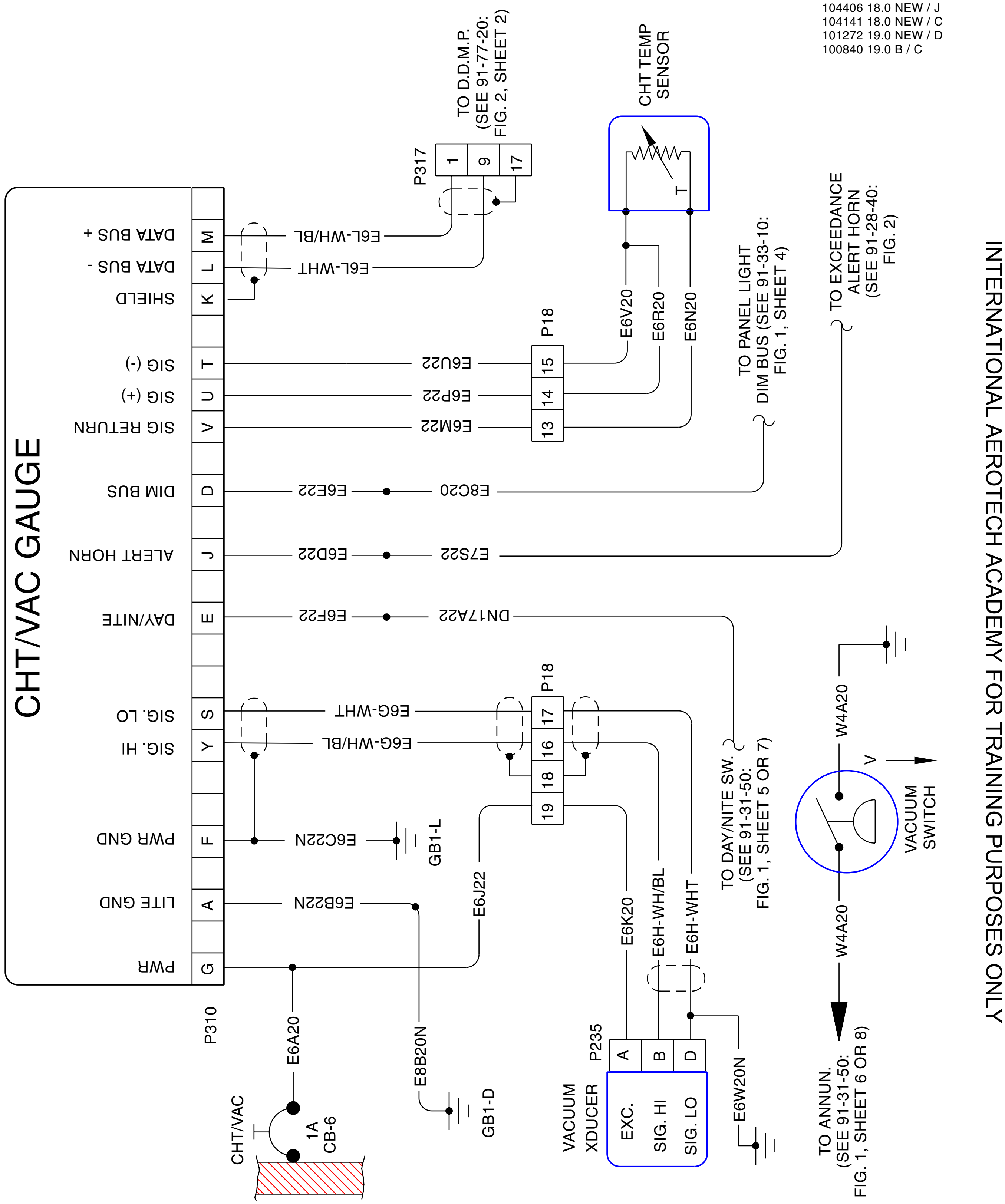
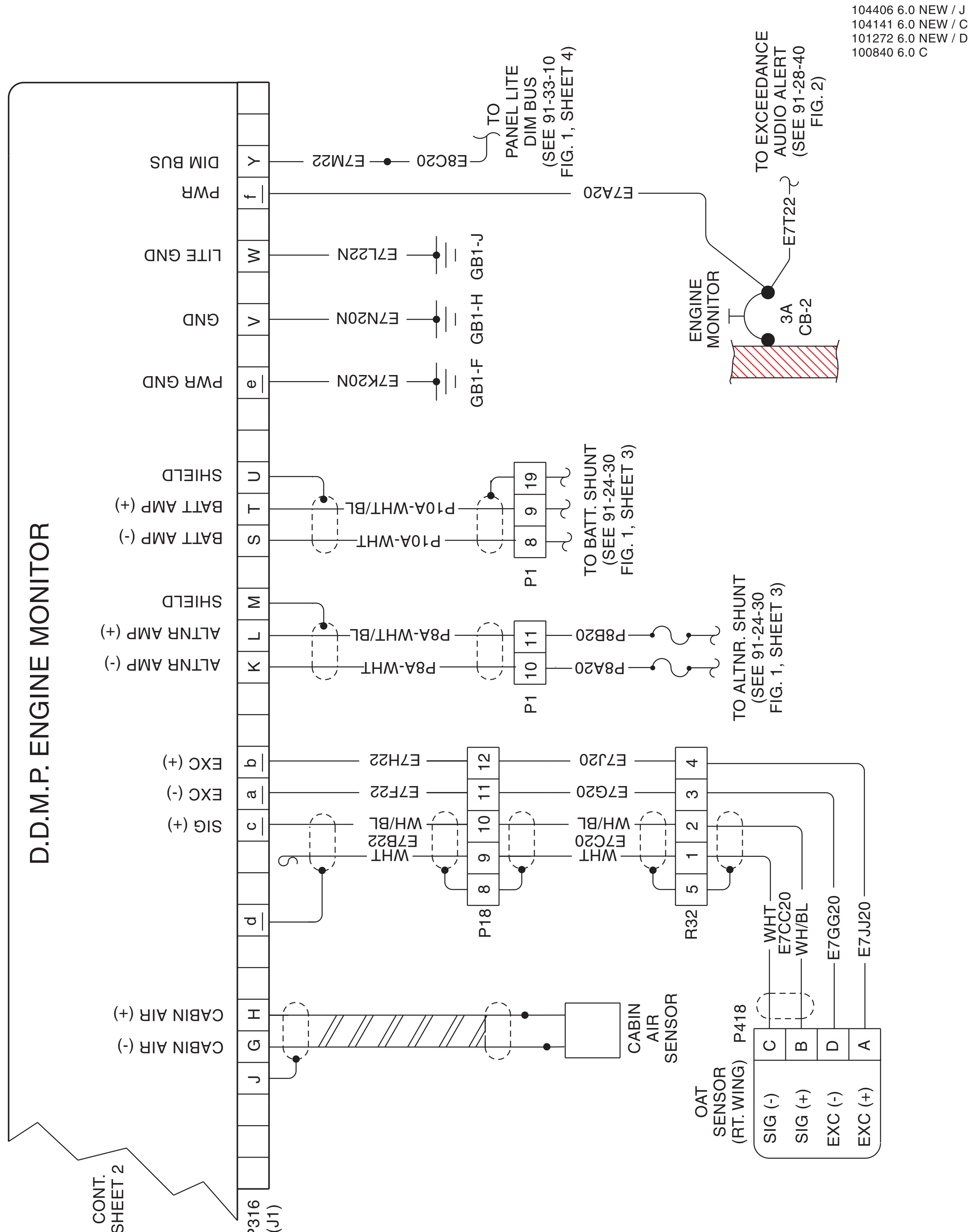
104406 18.0 NEW / J
104141 18.0 NEW / C
101272 19.0 NEW / D
100840 19.0 B / C



CHT / VAC
Figure 1

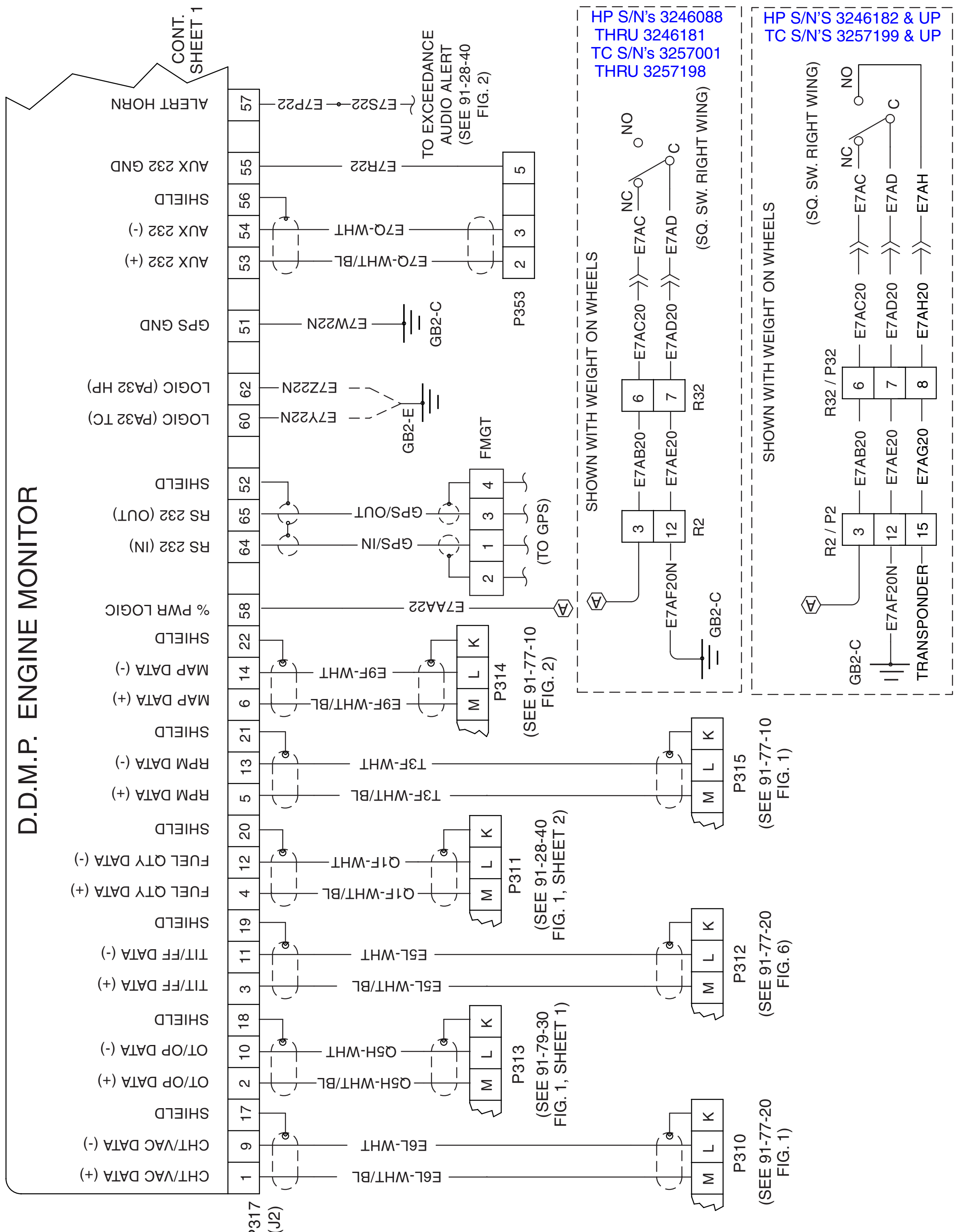
Effectivity
3246088 and up
3257001 and up



Effectivity
3246088 and up
3257001 and up

Engine Digital Display Monitoring Panel (DDMP)
Figure 2 (Sheet 1 of 2)

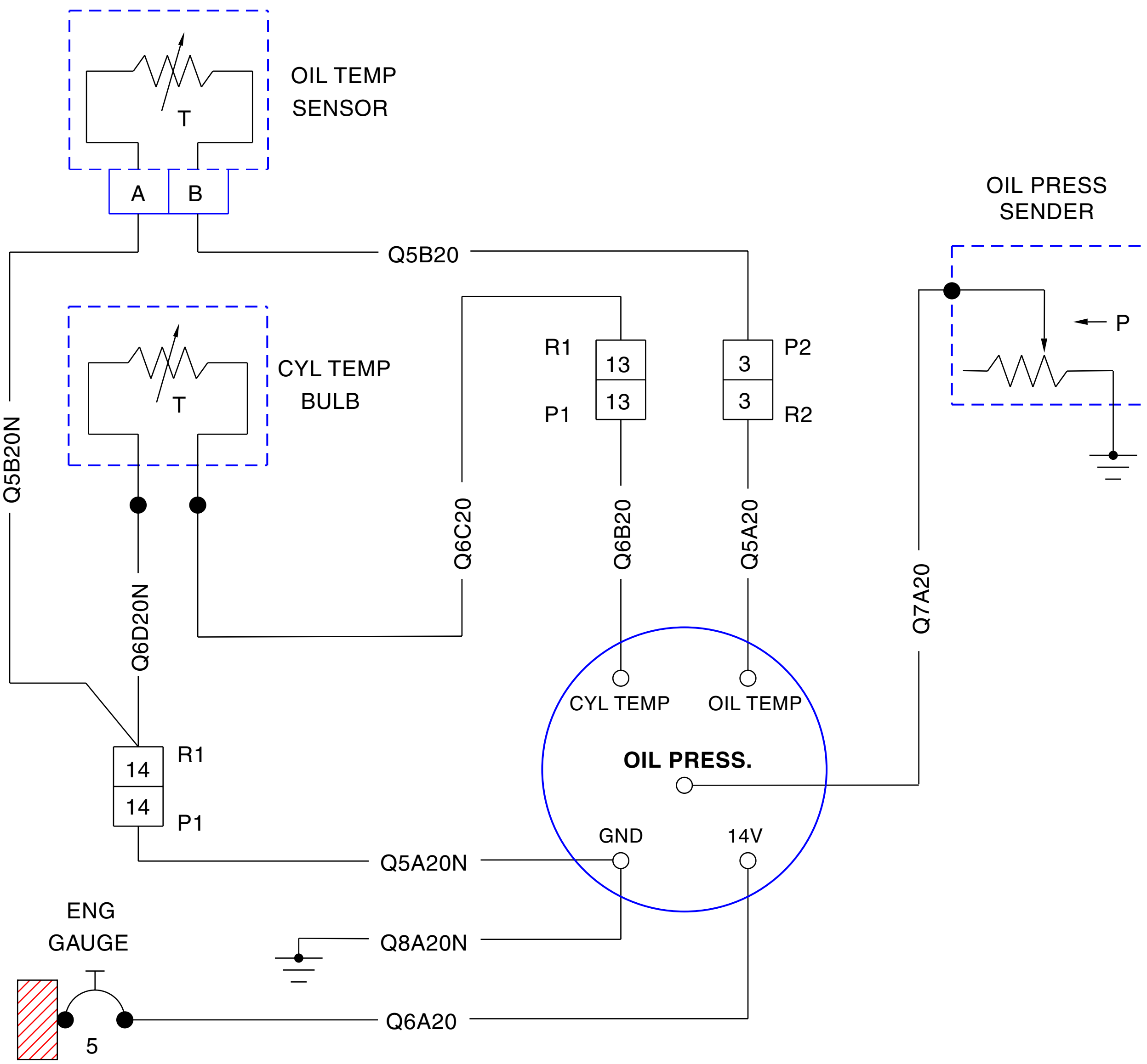
104406 6.1 C / J
104141 6.1 C / C
101272 6.1 NEW / D
100840 6.1 A / C



Engine Digital Display Monitoring Panel (DDMP)
Figure 2 (Sheet 2 of 2)

Effectivity
3246088 and up
3257001 and up

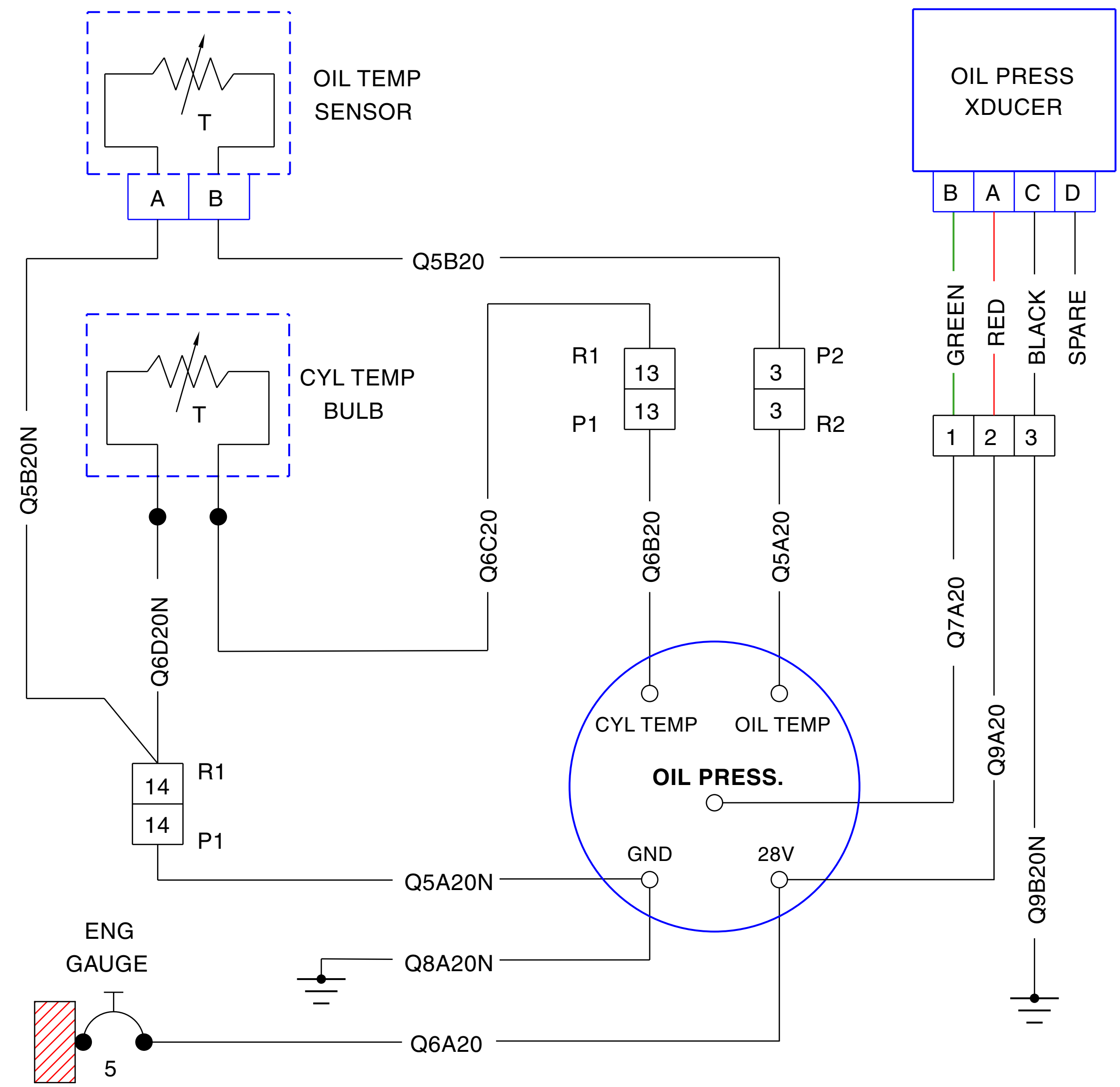
85300 6.0 NEW / B



Effectivity
3246001 thru 3246017

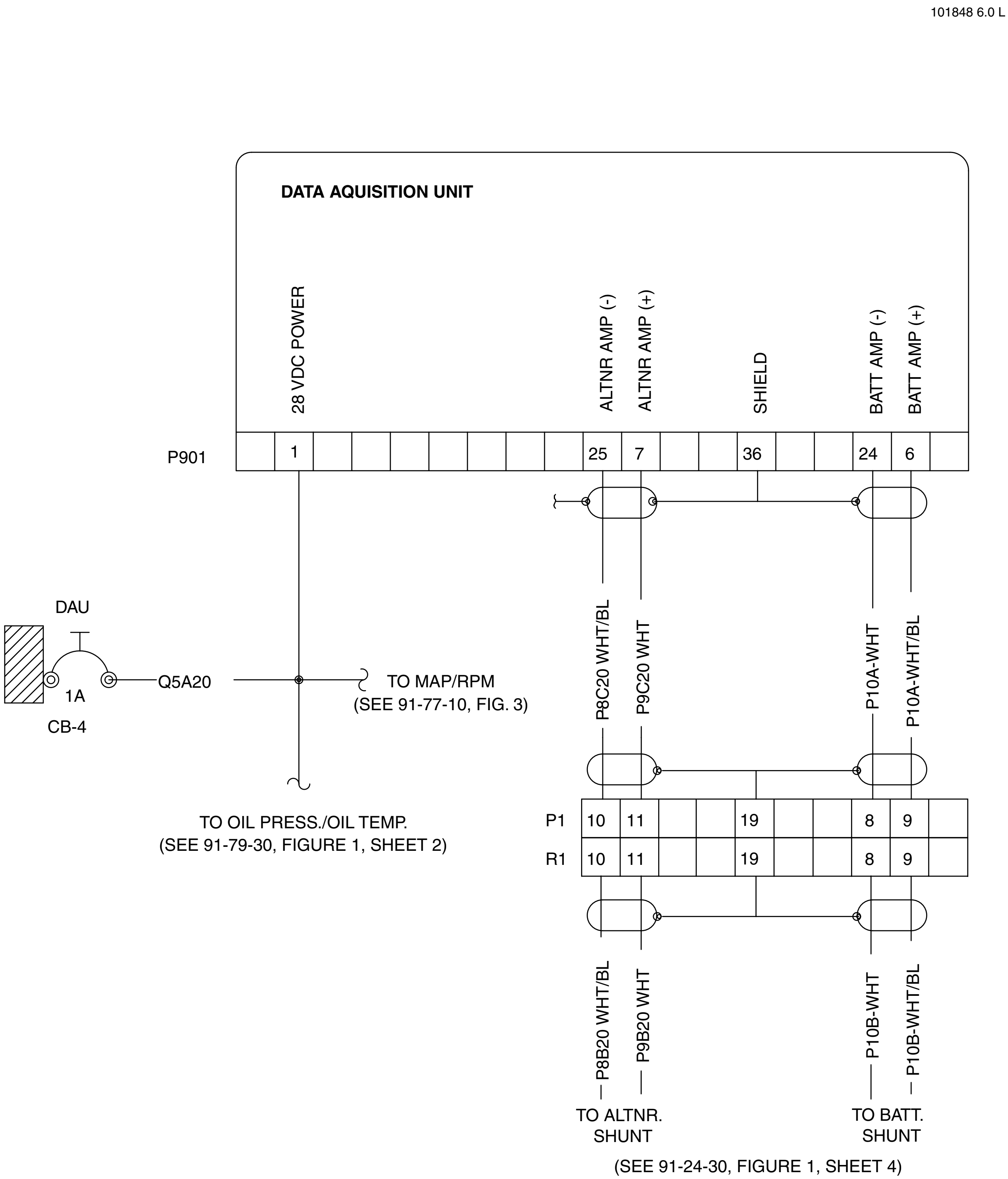
Engine Gauge
Figure 3 (Sheet 1 of 2)

85501 6.0 A / F



Engine Gauge
Figure 3 (Sheet 2 of 2)

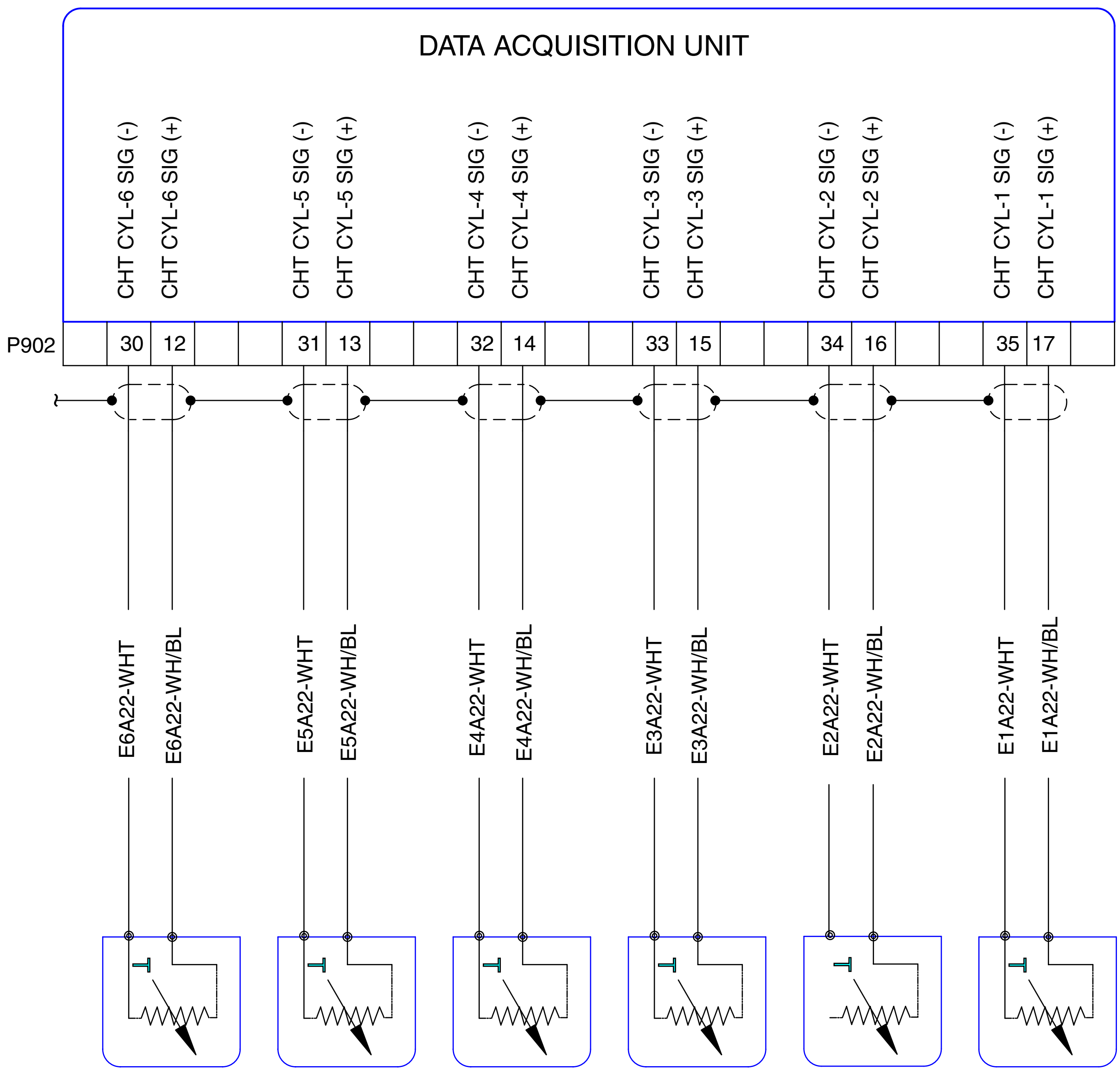
Effectivity
3246088 and up
3257001 and up



Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra

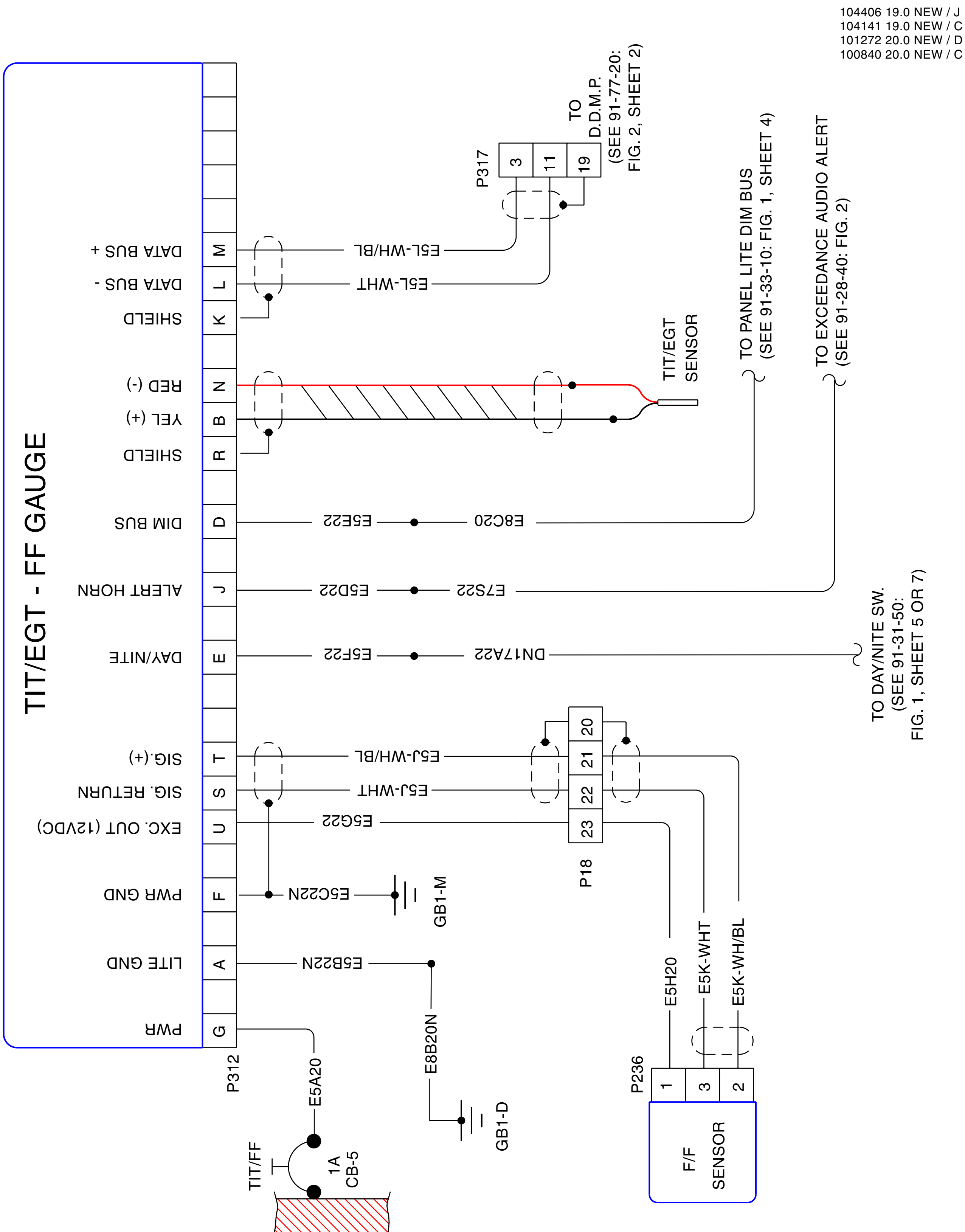
Data Acquisition Unit
Figure 4

101848 18.0 L



CHT
Figure 5

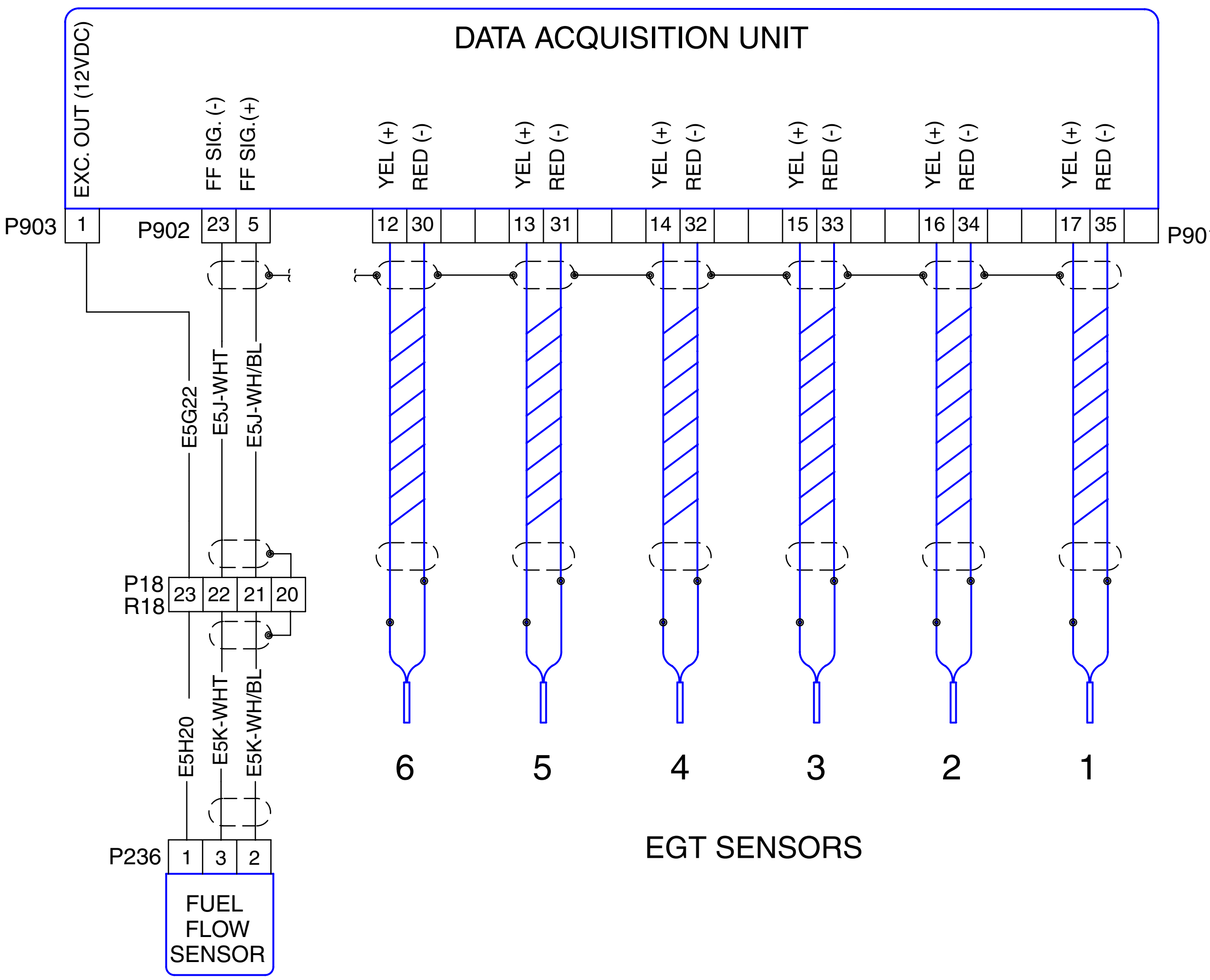
Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra



Effectivity
3246088 and up
3257001 and up

TIT / Fuel Flow or EGT / Fuel Flow
Figure 6

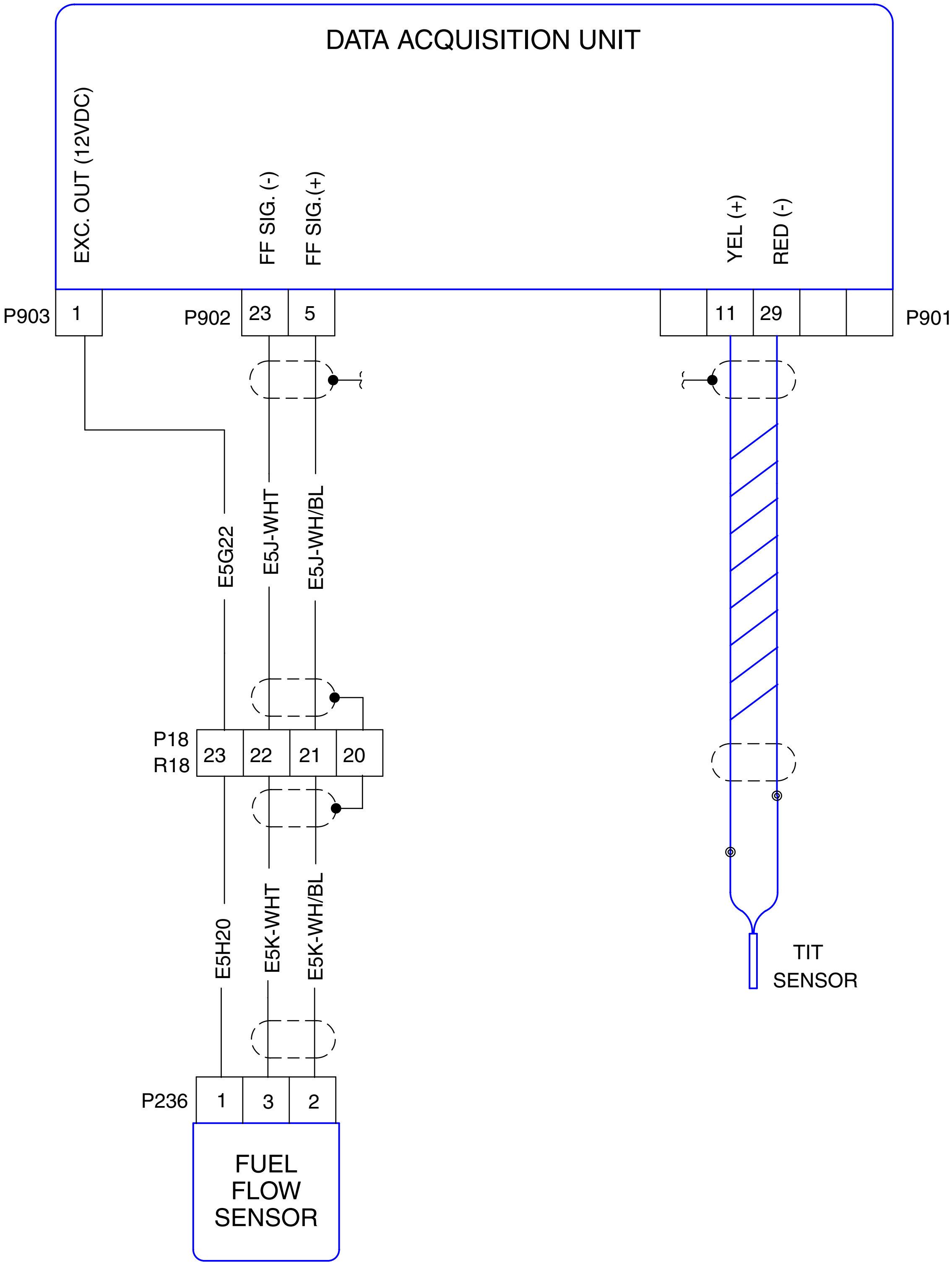
101848 19.0 L



EGT / Fuel Flow (HP only)
Figure 7

Effectivity
3246218 and up
with Avidyne Entegra

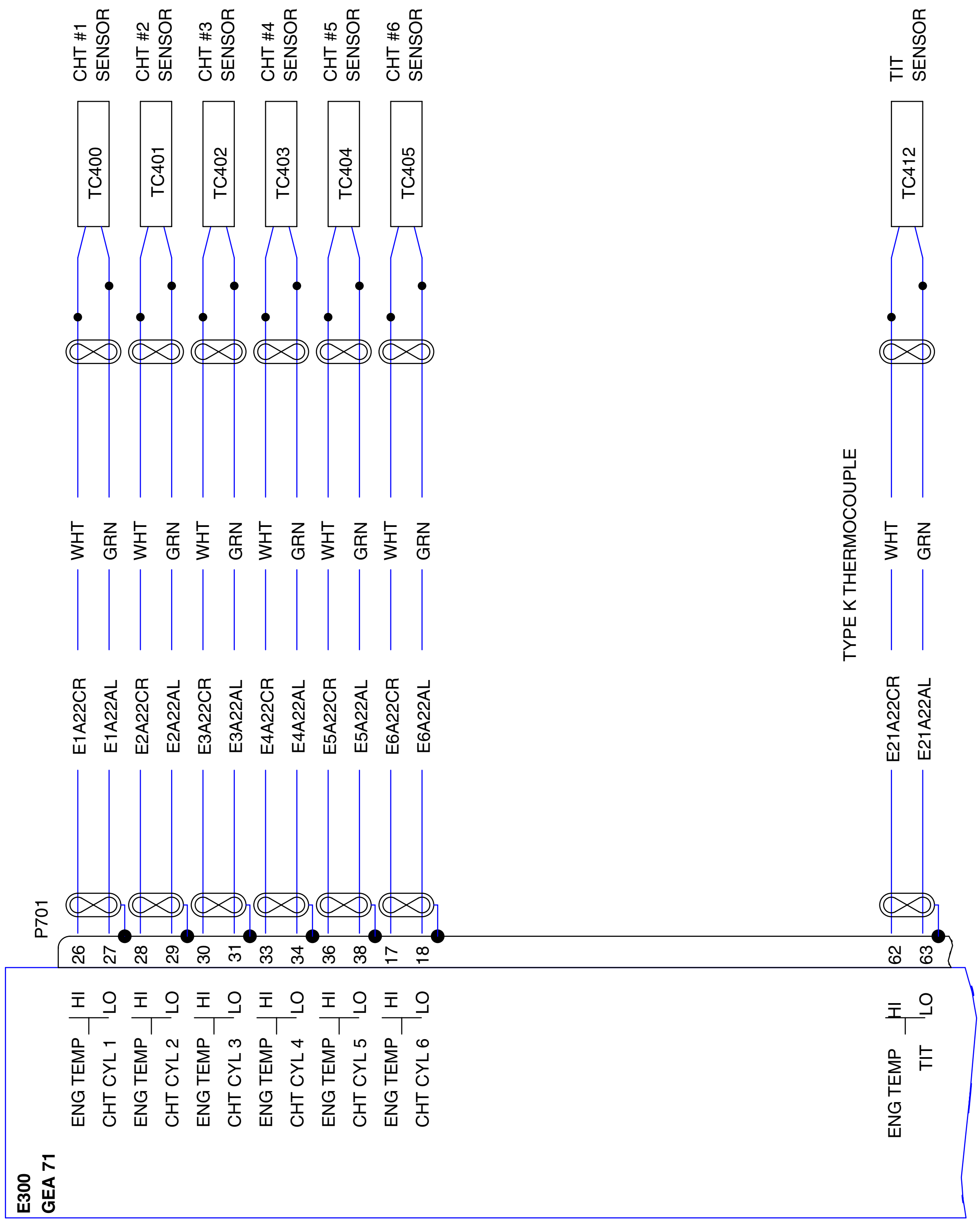
101848 19.1 L



Effectivity
3257339 and up
with Avidyne Entegra

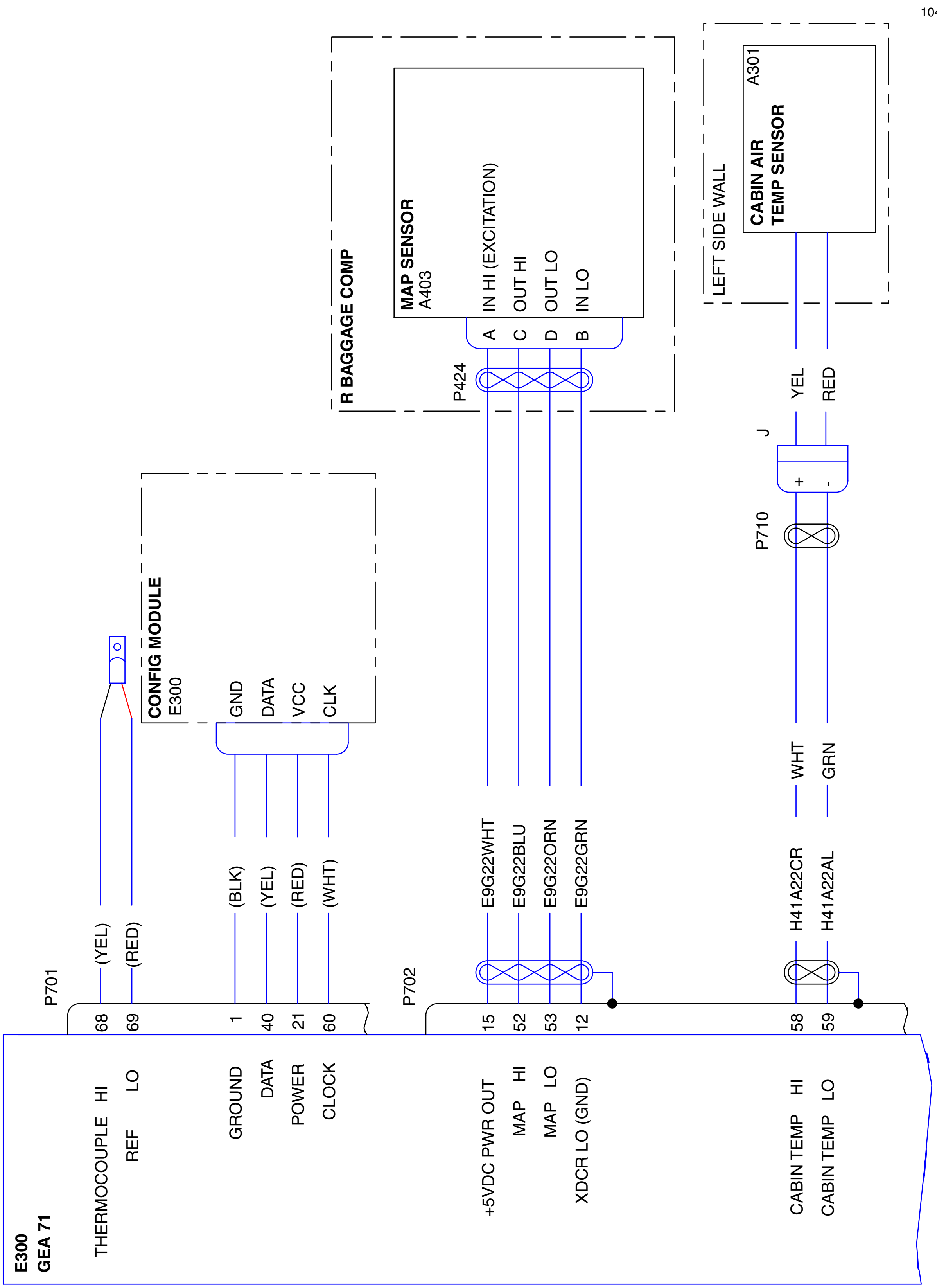
TIT / Fuel Flow (TC only)
Figure 8

104817 21.3 A



CHT / TIT
Figure 9

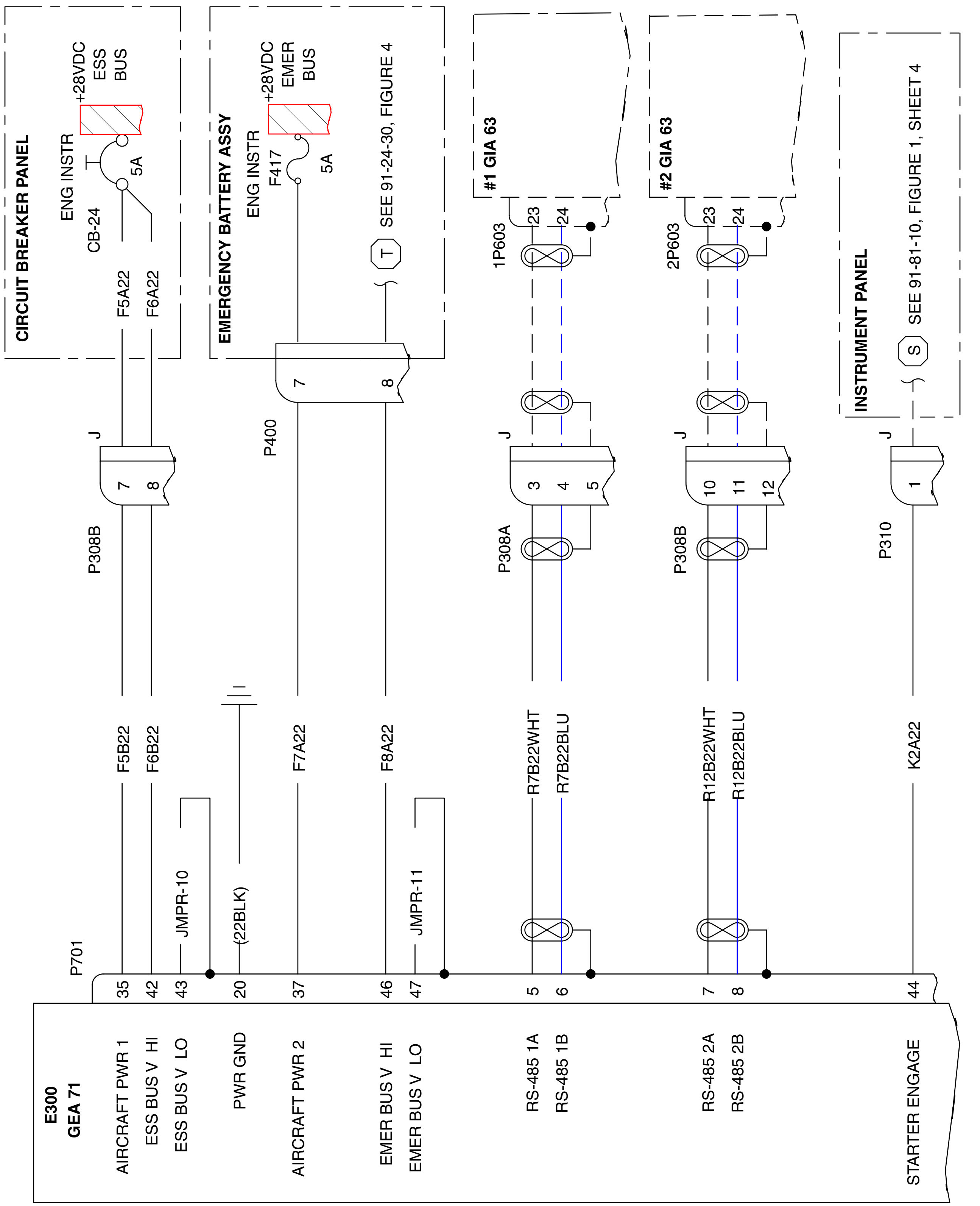
Effectivity
with Garmin 1000



Effectivity
with Garmin 1000

Configuration Module / Cabin Temp / MAP
Figure 10

104817 21.0 A



Engine / Airframe Unit
Figure 1

Effectivity
with Garmin 1000

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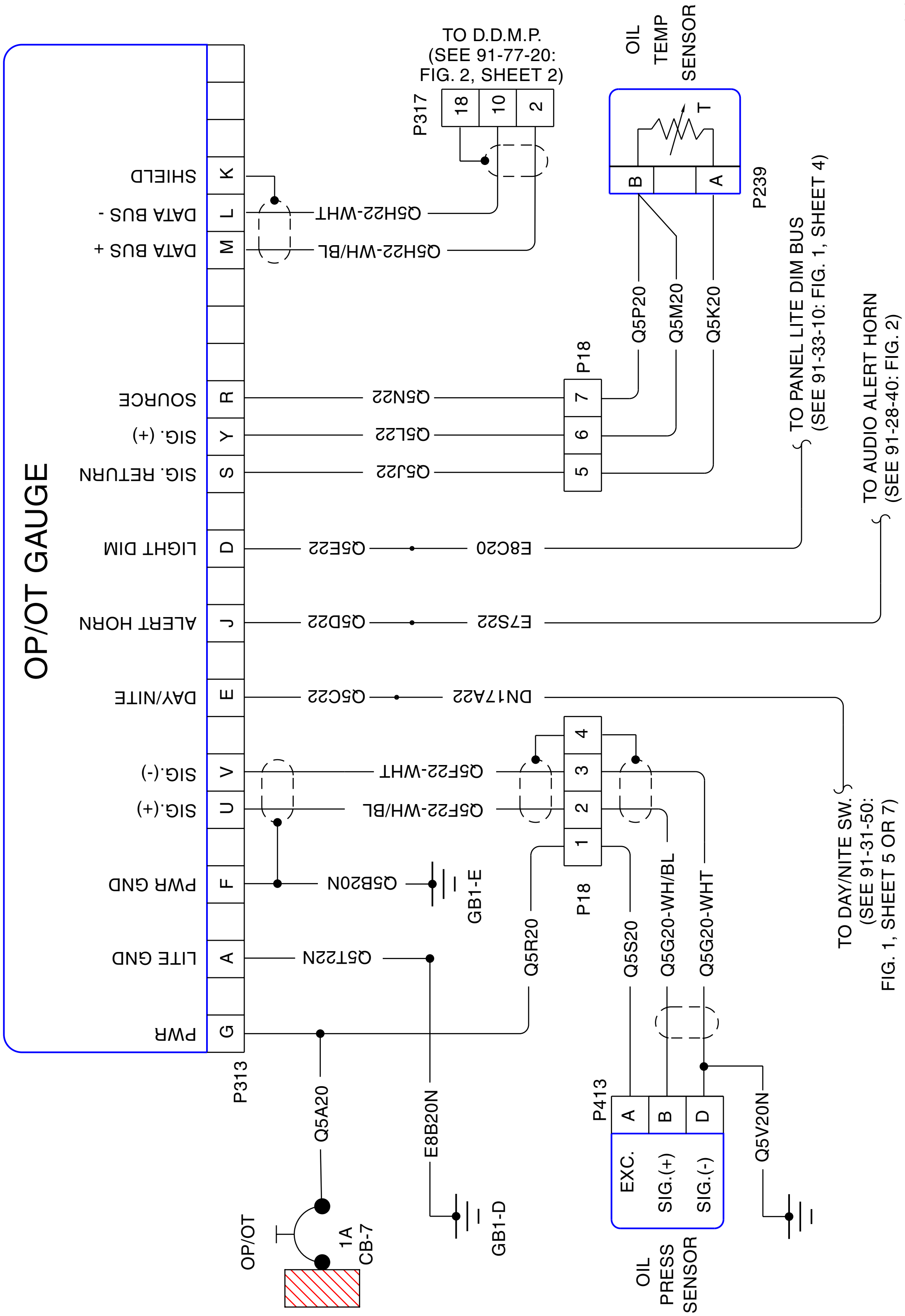
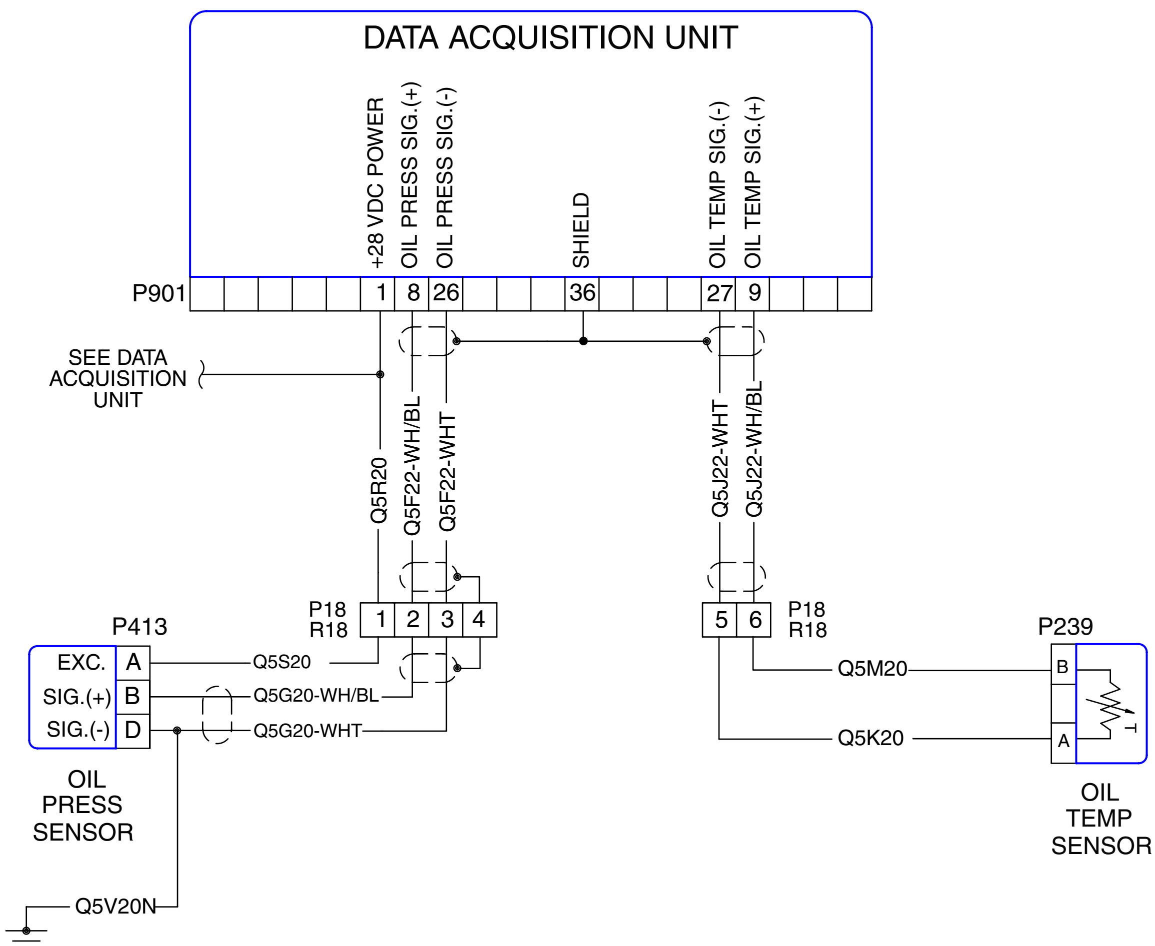
104406 3.0 NEW / J
104141 3.0 NEW / C
101272 3.0 NEW / D
100840 3.0 B / C



Oil Pressure / Oil Temperature
Figure 1 (Sheet 1 of 2)

Effectivity
3246088 and up
3257001 and up

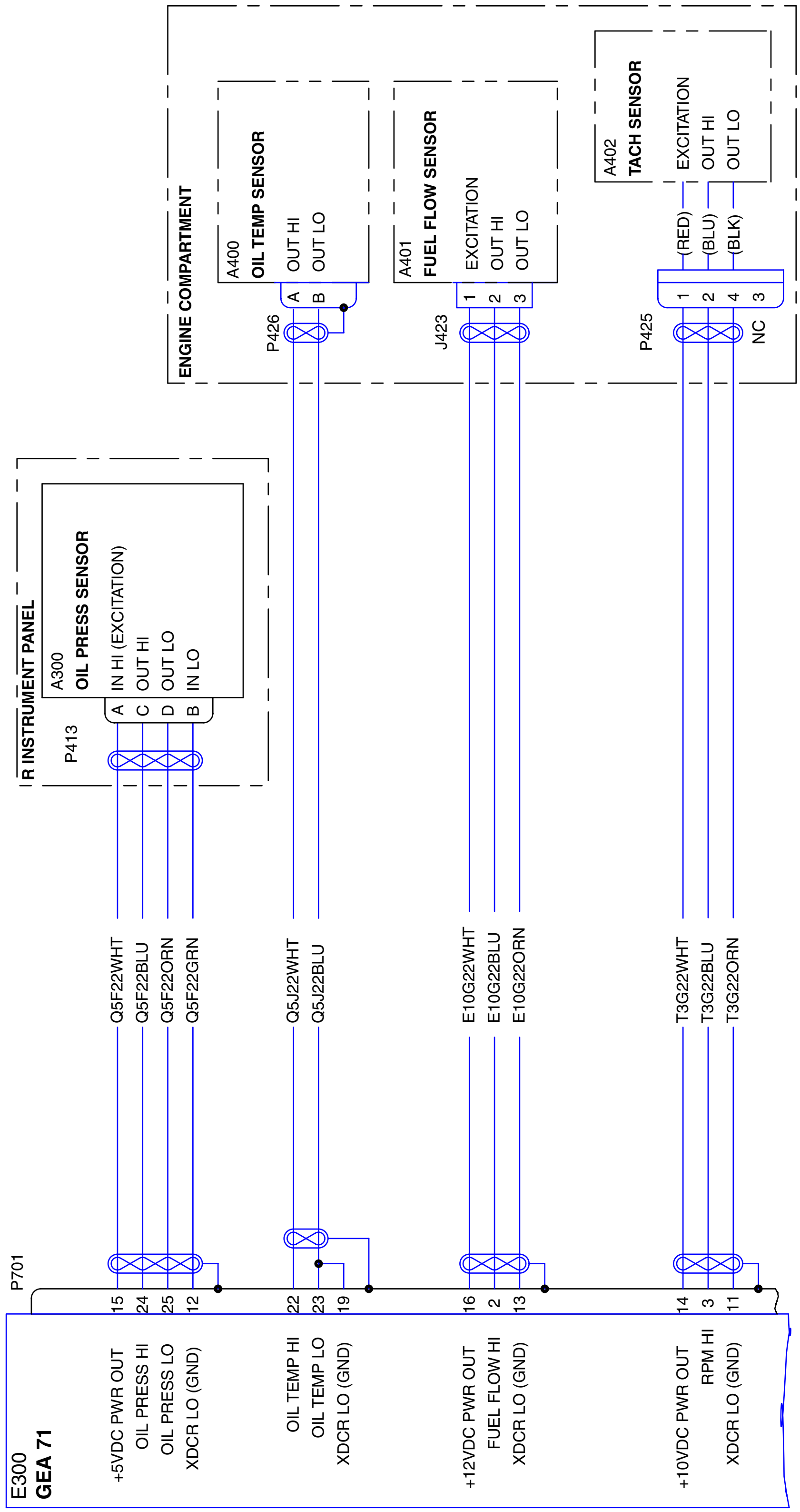
101848 3.0 L



Effectivity
3246218 and up
3257339 and up
with Avidyne Entegra

Oil Pressure / Oil Temperature
Figure 1 (Sheet 2 of 2)

104817 21.2 A



Oil Pressure / Oil Temperature / Fuel Flow / RPM
Figure 2

Effectivity
with Garmin 1000

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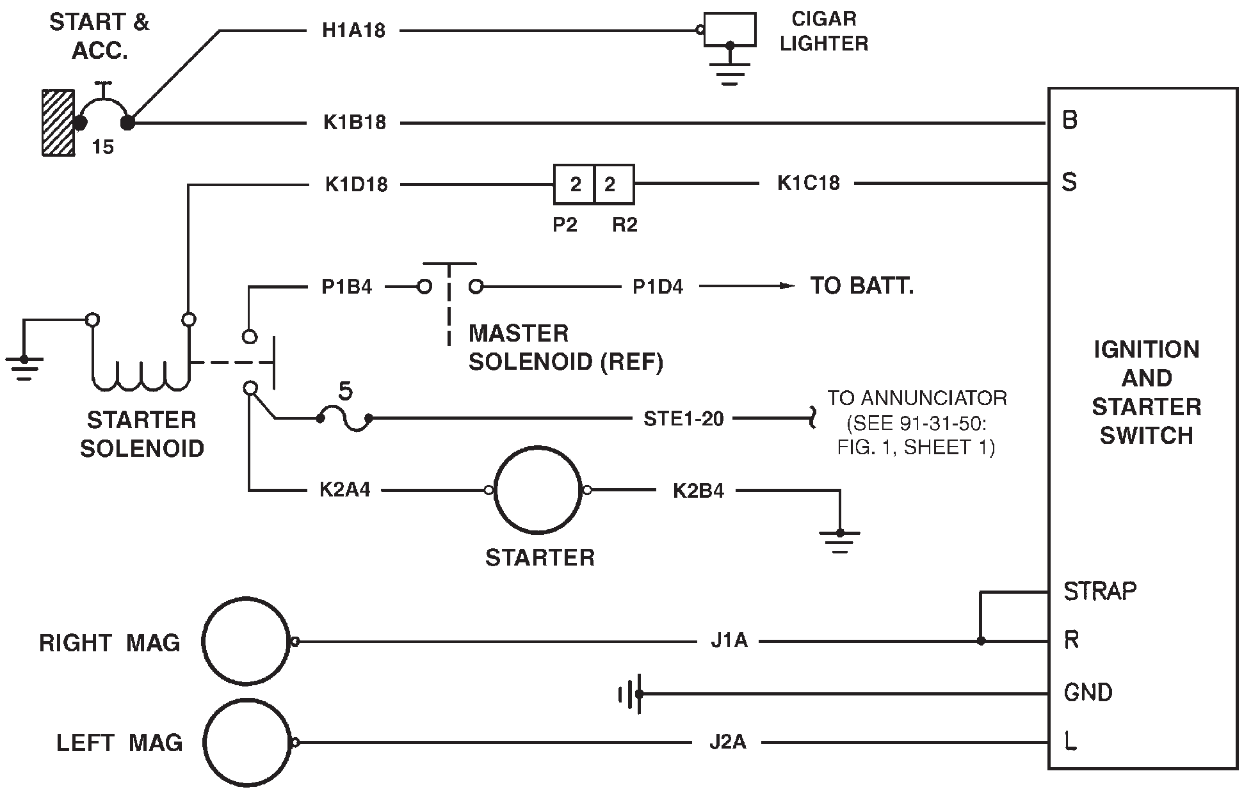
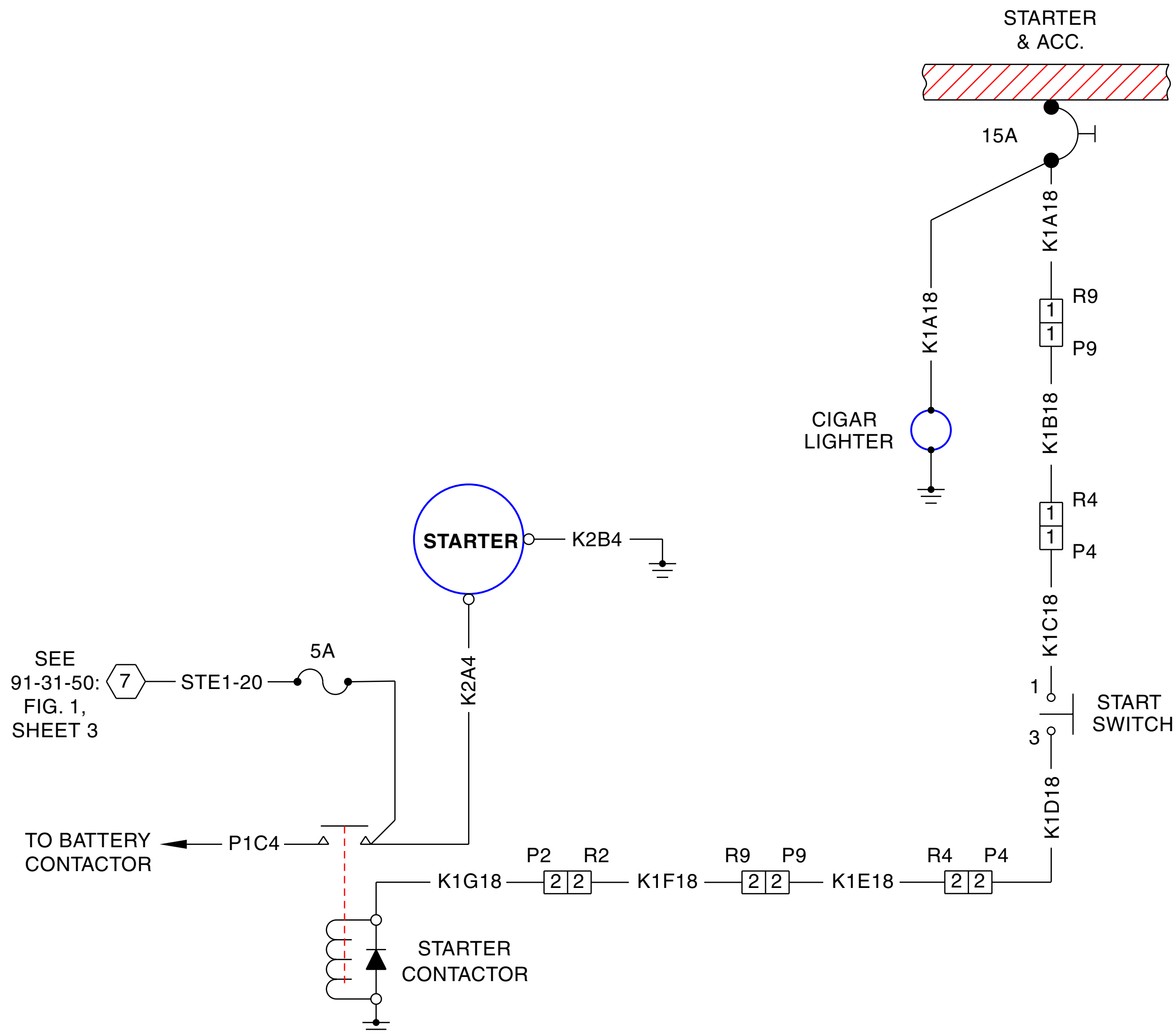
85300 14.0 NEW / B



Starter and Accessories
Figure 1 (Sheet 1 of 4)

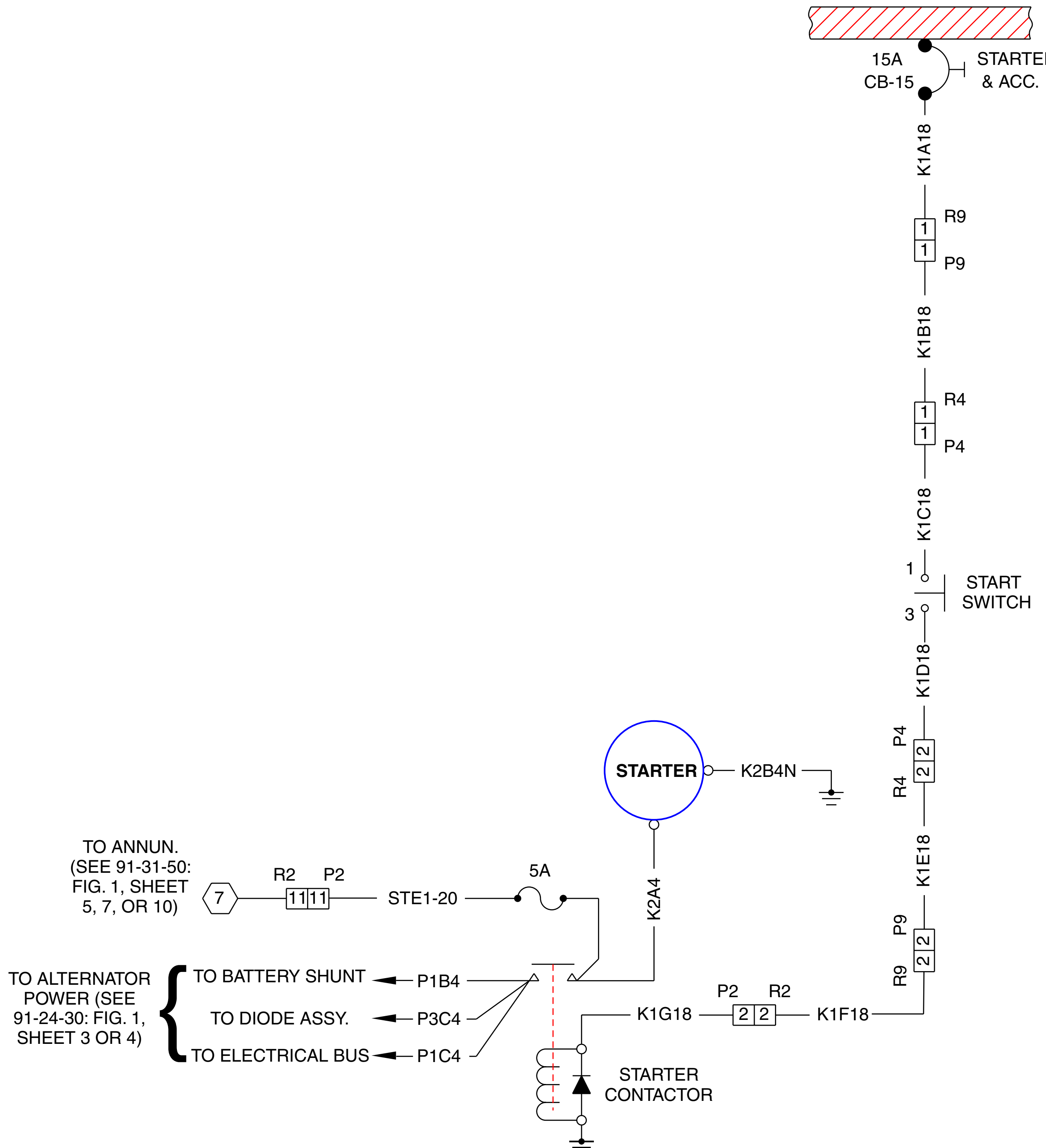
Effectivity
3246001 thru 3246017

85501 14.0 NEW / F



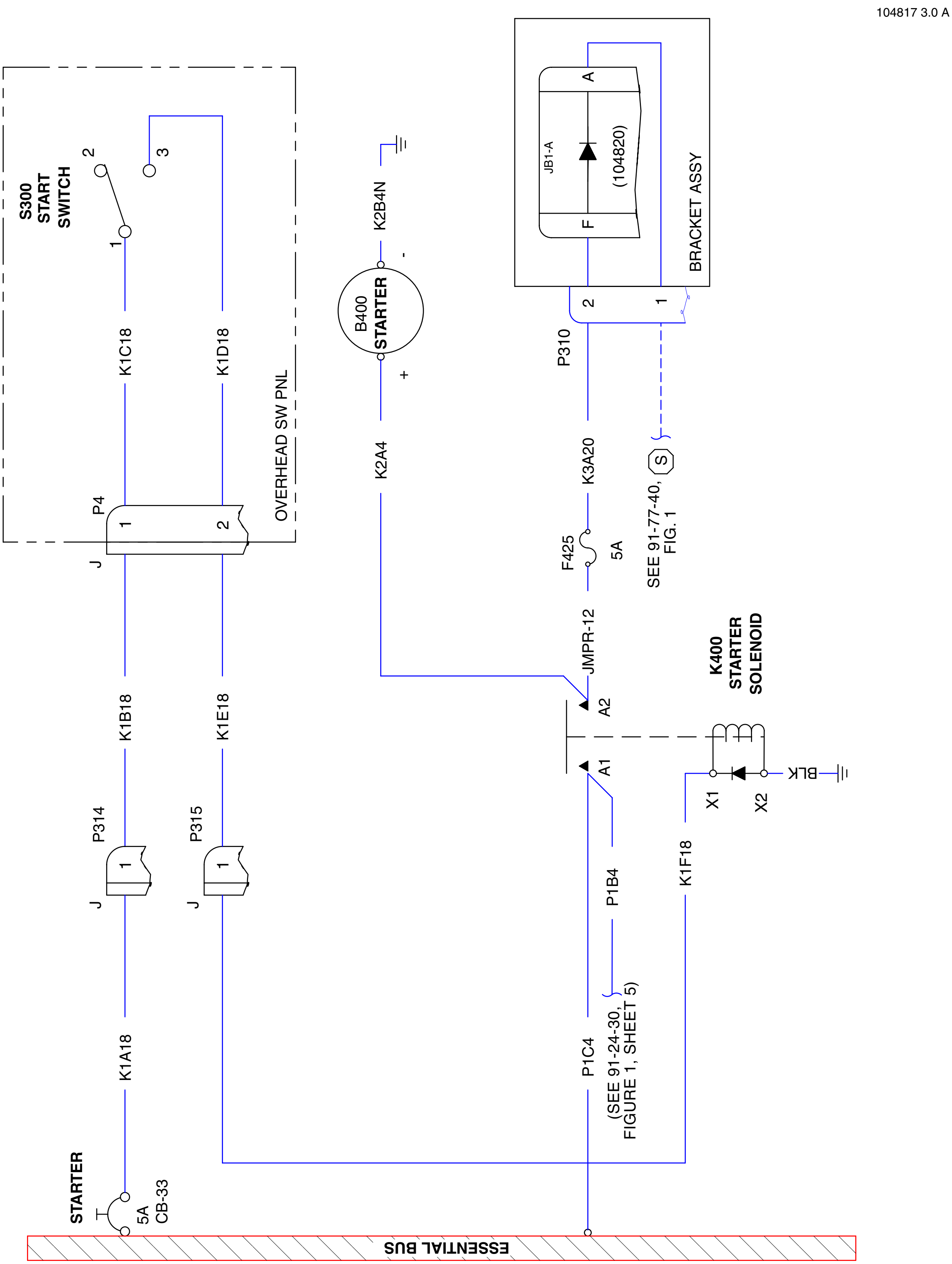
Starter and Accessories
Figure 1 (Sheet 2 of 4)

101848 13.0 L
104406 13.0 NEW / J
104141 13.0 NEW / C
101272 14.0 NEW / B
100840 14.0 C / C



Starter and Accessories
Figure 1 (Sheet 3 of 4)

Effectivity
3246088 and up
3257001 and up



Effectivity
with Garmin 1000

Starter and Accessories
Figure 1 (Sheet 4 of 4)

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GRIDS 9G18 THRU 9L24
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