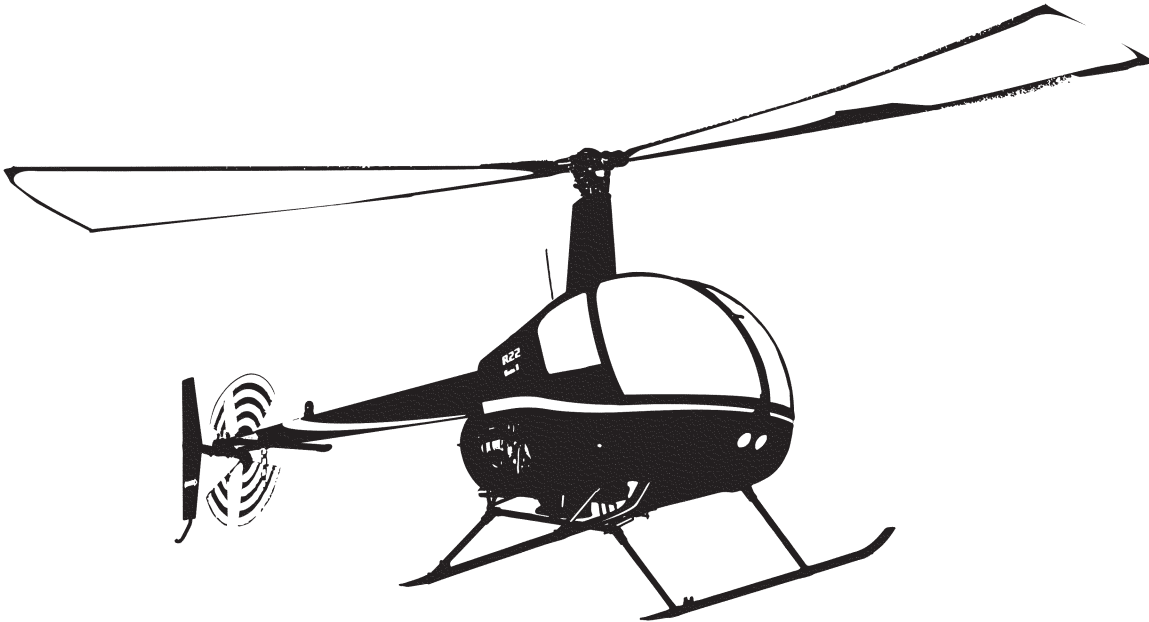


# ROBINSON HELICOPTER COMPANY

## R22 MAINTENANCE MANUAL AND INSTRUCTIONS FOR CONTINUED AIRWORTHINESS RTR 060 VOLUME I

Production Certificate Number 424WE

Type Certificate Number H10WE



Robinson Helicopter Company  
2901 Airport Drive  
Torrance, California 90505-6115  
United States of America

Phone: (310) 539-0508  
Fax: (310) 539-5198  
Web: <https://robinsonheli.com>

### OFFICE HOURS

Monday through Friday, 7:30 a.m. to 4:30 p.m., Pacific Time.  
Lunch hour is 11:30 a.m. to 12:30 p.m.

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### PUBLICATIONS

Viewing RHC Maintenance Manuals (MMs) and Illustrated Parts Catalogs (IPCs) online at <https://robinsonheli.com> is recommended to ensure use of current data. Viewing MMs and IPCs offline via paper or digital download requires verification that the data is current. Refer to the online MM or IPC Revision Log for the list of current pages.

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**WARRANTY INFORMATION**

Helicopter and parts warranty information is located at <https://robinsonheli.com>.



**CHAPTER LIST**

	Introduction
Chapter 1	General
Chapter 2	Inspection
Chapter 3	Life-Limited Components
Chapter 4	Airframe
Chapter 5	Landing Gear
Chapter 6	Powerplant
Chapter 7	Drive Train
Chapter 8	Flight Controls
Chapter 9	Rotor Systems
Chapter 10	Rigging, Track and Balance
Chapter 11	Environment Control
Chapter 12	Fuel System
Chapter 13	Instruments
Chapter 14	Electrical and Avionics Systems
Chapter 15	Furnishings
Chapter 16	Dimensions and Descriptions
Chapter 17	Jacking and Hoisting
Chapter 18	Weight and Balance
Chapter 19	Ground Handling
Chapter 20	Parking and Storage
Chapter 21	Placards and Markings
Chapter 22	Servicing
Chapter 23	Standard Practices
Chapter 24	Lights
Chapter 25	Doors and Windows
Chapter 26	Main Rotor
Chapter 27	Main Rotor Drive System
Chapter 28	Tail Rotor
Chapter 29	Tail Rotor Drive System
Chapter 30	Engine Controls
Chapter 31	Engine Oil System
Chapter 32	Police Version
Chapter 33	Electrical System
Chapter 34	Avionics
Chapter 35	Wiring Diagrams
Chapter 36	Special Tools
Chapter 37	Revision Log

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## TECHNICAL PUBLICATIONS

## RECOMMENDED CHANGE REPORT

Please direct recommended changes to RHC Technical Publications via the email address listed below, by phone, or by submitting a duplicate of this completed form by fax or mail. Please include or have available the information detailed in this form.

Recommended changes may include but are not limited to general comments, corrections, omitted information, or clarification of instructions.

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## COMMENTS:

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## CHAPTER 1

## GENERAL

<u>Section</u>	<u>Title</u>	<u>Page</u>
1.000	Introduction . . . . .	1.1
1.001	RHC Maintenance Manuals and Illustrated Parts Catalogs Updates . . . . .	1.1
1.002	R22 Maintenance Authorization . . . . .	1.2
1.003	Component Maintenance Authorization . . . . .	1.2
1.004	Maintenance Record . . . . .	1.2
1.005	Notations . . . . .	1.3
1.006	Maintenance Manual and Illustrated Parts Catalog References . . . . .	1.3
1.007	Definitions and Abbreviations . . . . .	1.4
1.008	Service Information . . . . .	1.6
1.009	Assembly Instructions for R22-series Helicopter Crated for Export . . . . .	1.7
1.100	Helicopter Servicing . . . . .	1.11
1.101	Scheduled Maintenance and Inspections . . . . .	1.11
1.102	Additional Component Maintenance . . . . .	1.12

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## CHAPTER 1

## GENERAL

1.000 Introduction

The R22 Maintenance Manual contains instructions necessary for proper maintenance, servicing, and handling of R22-series helicopters. The R22 Instructions for Continued Airworthiness (ICA) includes the R22 Maintenance Manual (MM), R22 Illustrated Parts Catalog (IPC), R22 Service Bulletins (SBs), R22 Service Letters (SLs), Lycoming O-320-series and O-360-series Operator's Manuals, applicable Lycoming technical publications, and applicable component manufacturer technical publications.

Service Bulletins are issued by Robinson Helicopter Company (RHC), Lycoming, and component manufacturers. RHC Service Bulletin compliance is mandatory; comply with other applicable Service Bulletins as directed. RHC technical publications are available online at [www.robinsonheli.com](http://www.robinsonheli.com). Recent technical publications are available from Lycoming at [www.lycoming.com](http://www.lycoming.com), and from Continental Motors, Inc. (CMI) at [www.continentalmotors.aero](http://www.continentalmotors.aero).

Kit instructions are issued for field installation of either optional or mandatory (due to Service Bulletin or parts obsolescence) equipment upgrades, or provisions for upgrades. Kit instruction issued by RHC either implement approved type design data, or are approved as type design data.

A list of chapters is located in the *Introduction*. Chapters are separated by tab dividers and chapter contents are listed in the chapter front pages.

**CAUTION**

Always read instructions completely before performing a task.

1.001 RHC Maintenance Manuals and Illustrated Parts Catalogs Updates

RHC Maintenance Manuals (MMs) and Illustrated Parts Catalogs (IPCs) are available digitally at [www.robinsonheli.com](http://www.robinsonheli.com), under the Publications tab. Access to these publications does not require an account and is free of charge.

Viewing MMs & IPCs online is recommended to ensure use of current data.

Viewing MMs & IPCs offline via paper or digital download requires verification that the data is current. Refer to the online MM or IPC Revision Log for the list of current pages.

Sign up for free email notification of revisions to MMs & IPCs by sending an email to [subscriptions@robinsonheli.com](mailto:subscriptions@robinsonheli.com) with "Subscribe email" in the subject line. Within the email, include name, email address, physical address, and helicopter model(s) of interest.

### 1.002 R22 Maintenance Authorization

Only appropriately certificated mechanics who have successfully completed an R22 factory-sponsored maintenance course, or are under direct supervision of the above-stated mechanic, may perform maintenance, repairs, or inspections on R22-series helicopters. Annual inspections of U.S.-registered light helicopters must be performed by holders of an Inspection Authorization (IA) certificate or by repair stations certificated by the Federal Aviation Administration (FAA). The daily preflight and some preventive maintenance may be performed by the above-stated mechanics, or by the pilot/owner after receiving appropriate instruction in accordance with the R22 Pilot's Operating Handbook and applicable aviation regulations.

### 1.003 Component Maintenance Authorization

Only appropriately certificated mechanics who have successfully completed both a factory-sponsored maintenance course and component maintenance course, and who possess technical data supplied by RHC, are authorized to perform maintenance specified in the Component Maintenance Manual (CMM). Component maintenance may only be performed at an RHC-authorized Service Center that has the Component Maintenance special tools (ref. R22 SL-81).

### 1.004 Maintenance Record

The Airframe Maintenance Record is available online at [www.robinsonheli.com](http://www.robinsonheli.com).

Airframe Maintenance Record blank PDF forms may be used for R22-series, R44-series, and R66-series helicopters. Component Record blank PDF forms may be used for life-limited or TBO components. Blank paper copies are available for purchase (P/N R8478 Airframe Maintenance Record and P/N R8479 Component Record [pack of 20]).

A Component Record is a maintenance record of the removals, installations, or maintenance performed on a life-limited or TBO component. When a life-limited or TBO component is installed in the helicopter, the Component Record card is inserted in the Airframe Maintenance Record. When a life-limited or TBO component is removed from the helicopter, remove the Component Record card and keep the card with the Component. Major assemblies may contain one or more life-limited or TBO component.

RHC encourages operators to utilize Component Record cards to assist in tracking time on interchangeable parts since service lives may be different between models.

RHC does not create Component Record cards for spares, however, operators may create their own.

RHCs Repair Station does not require a Component Record card in order to perform work on a component, unlike a Component/Return Authorization form.

RHC recommends using a toner-based laser, or a pigment-based inkjet, color printer and 65 lb white (96 bright) premium card stock for Maintenance Record or Component Record card production. Maintenance Record binders and tab sets are available separately (P/N R8656 Maintenance Record Binder and P/N R8650 Maintenance Record Tabs).



### 1.005 Notations

The following notations will be found throughout the manual:

<b>NOTE</b>
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A NOTE provides emphasis or supplementary explanation.
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<b>CAUTION</b>
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Equipment damage can result if a <b>CAUTION</b> is not followed.
--

<b>WARNING</b>
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Personal injury or death can result if a <b>WARNING</b> is not followed.
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### 1.006 Maintenance Manual and Illustrated Parts Catalog References

Maintenance Manual and Illustrated Parts Catalog Section and Figure references are subject to relocation and renumeration. Effort will be made at the time of RHC technical document revisions to correct superseded references, however, certain documents may not otherwise require revision and superseded references may remain. A keyword or part number search in online documents (Ctrl + F [PC] or Command + F [Mac]) may help to locate applicable data.

## 1.007 Definitions and Abbreviations

Refer to R22 Pilot's Operating Handbook (POH) Section 1 for additional definitions and abbreviations.

### A. Definitions

14 CFR § 27.602 Critical Part:	A016-x main rotor blades & A029-x tail rotor blades are critical parts as defined by 14 CFR § 27.602 and are subject to special inspection requirements & reporting described in chapters 26 & 28. Contact RHC Technical Support if questions arise concerning special inspection or reporting requirements.
12 years:	With respect to a 12 year inspection or life-limit, 12 years means 12 years from the date of the: <ul style="list-style-type: none"><li>– factory-issued airworthiness certificate,</li><li>– factory-issued authorized release certificate (FAA Form 8130-3, Airworthiness Approval Tag), or</li><li>– last 12-year inspection.</li></ul>
Annually:	With respect to an annual inspection, annually means within the preceding 12 calendar months.
Datum:	An imaginary vertical plane from which all horizontal measurements are taken for balance purposes with the aircraft in level flight attitude. Refer to § 16-20 for R22 datum location.
Empty Weight:	Standard empty weight of a standard helicopter including unusable fuel, full operating fluids, and full engine oil. Basic empty weight is standard empty weight plus weight of installed optional equipment. Refer to R22-series Type Certificate Data Sheet (TCDS) H10WE at: <a href="https://drs.faa.gov">https://drs.faa.gov</a> . Refer to Equipment List/Weight and Balance Data Sheet (RF 134) and Weight and Balance Record in R22 POH Section 6 for installed equipment.
Life-Limited Part:	Refer to Chapter 3. Any part for which a mandatory replacement limit is specified in the type design, the Instructions for Continued Airworthiness, or the maintenance manual.
Time in Service:	With respect to maintenance time records, time in service means the time from the moment an aircraft leaves the surface of the earth until it touches it at the next point of landing.

**1.007 Definitions and Abbreviations (continued)****B. Abbreviations**

14 CFR:	Title 14 of the Code of Federal Regulations. The Federal Aviation Regulations (FARs) are part of the CFR.
AOG:	Aircraft on Ground
Assy:	Assembly (component consisting of more than one part)
ATA-100:	Air Transport Association of America Specification No. 100
BL:	Butt Line Station locations
CO:	Carbon Monoxide
CRA:	Component Return/Authorization
ELT:	Emergency Locator Transmitter
EMU:	Engine Monitoring Unit
FS:	Fuselage Station locations
HID:	High Intensity Discharge
HS:	Horizontal Stabilizer Station locations
ICA:	Instructions for Continued Airworthiness
LBL:	Left Butt Line Station locations
LED:	Light Emitting Diode
LH:	Left-hand
LRU:	Line-Replaceable Unit
MR:	Main Rotor
MRB:	Main Rotor Blade
MRDS:	Main Rotor Drive Shaft
MRGB or MGB:	Main Rotor Gearbox or Main Gearbox
OEM:	Original Equipment Manufacturer
R22 IPC:	R22 Illustrated Parts Catalog
R22 MM:	R22 Maintenance Manual
R22 POH:	R22 Pilot's Operating Handbook
RBL:	Right Butt Line Station locations
RH:	Right-hand
RHC:	Robinson Helicopter Company
RS:	Rotor Station locations
SB:	Service Bulletin
SDS:	Safety Data Sheet
SL:	Service Letter
TBO:	Time Between Overhaul
TCDS:	Type Certificate Data Sheet
TIR:	Total Indicator Reading
TR:	Tail Rotor
TRB:	Tail Rotor Blade
TRDS:	Tail Rotor Drive Shaft
TRGB or TGB:	Tail Rotor Gearbox or Tail Gearbox
TS:	Tailcone Station locations
TSN:	Time Since New
TSO:	Time Since Overhaul
WL:	Water Line Station locations

## 1.008 Service Information

### **A. Part Designation**

RHC parts are designated with an alphanumeric part number beginning with letter "A", "B", "C", etc., followed by three digits and a dash number.

A revision letter or letters follow(s) the stamped or ink-marked part number. Revision progression is A thru Z, followed by AA thru AZ, followed by BA thru BZ, etc. Unless otherwise specified, any revision of the same part number is interchangeable, such as "A101-1 A" and "A101-1 D".

A change in dash number indicates a change in form, fit, and/or function (e.g. part number C339-1 is not interchangeable with part number C339-10 even though both are jackshaft weldments for [hydraulic] R44s). Similarly, part numbers F049-6 and F049-06 are not interchangeable because the dash numbers are different.

### **B. Returning Parts**

All parts shipped to RHC must include a signed Component Return/Authorization (CRA) Form available online at <https://robinsonheli.com>.

### **C. Ordering and Shipping**

Procure parts from any R22 Dealer or Service Center, or order directly from assigned RHC Customer Service Representative via email, fax, or phone.

### **D. Warranty Claims**

Complete CRA Form (refer to Part B) and, in the Warranty Claim section, indicate if rotorcraft or component is under warranty. If claim is for parts or for labor allowance due to a Service Bulletin issued against rotorcraft or component, write in "per SB-XX" adjacent to requested warranty action.

### **E. Customer Support**

Please visit <https://robinsonheli.com> for Customer Support contact information.

1.009 Assembly Instructions for R22-series Helicopter Crated for Export**NOTE**

Aircraft assembly to be performed by a certificated mechanic.

1. Remove all components from tailcone crate and all accessible components from cabin crate. Assemble landing gear per §§ 5.220 (float gear only) and 5.320.

**CAUTION**

Do not lift helicopter and attached crate using main rotor hub; damage to main rotor gearbox and frames could result.

2. Attach a hoist to main rotor hub per § 17-20. Lift aft end of crate while taking up slack in hoist. When main rotor shaft is vertical, remove bolts at landing gear attach points and remove crate. Install landing gear per § 5.120. Lower helicopter on ground.
3. Install front cross tube cover panel. For float landing gear, set float pressure per Mariner supplement of Pilot's Operating Handbook and verify float stabilizer is being used in place of tail skid.
4. Install tailcone per § 4.312. Install tail rotor visual warning guard.
5. Install empennage assembly per § 4.322.
6. Install exhaust system per § 6.520. Install lower half of cooling fan scroll.
7. Remove preservative plugs from engine cylinder upper spark plug holes. Install upper spark plugs and special torque per § 23-33. Connect ignition leads.
8. Fill engine oil to six quart mark on dipstick, as required.
9. Install main rotor blades per § 26-10. Match color coded markings on blades, hub bolts, hub, and pitch links. Attach upper end of pitch links to pitch horns.
10. Install tail rotor assembly per § 28-10.
11. If required, fill battery with electrolyte and charge.
12. Fill main and tail gearboxes to center of sight gage using correct gearbox oil (refer to § 22-10 Part C). For helicopters shipped "on-side": earlier main gearboxes that have a vent hole atop static mast tube require 6 ounces correct gearbox oil injected into vent hole (later helicopters with vent hole located at base of mast tube do not require 6 ounce injection).
13. Fuel helicopter and drain a small amount of fuel through gascolator.

1.009 Assembly Instructions for R22-series Helicopter Crated for Export (continued)

14. If ship is equipped with artificial horizon, directional gyro, or vertical card magnetic compass, install as follows:

Artificial Horizon and/or Directional Gyro:

- a. Remove amber ALT light and red OIL light from B050 console. Pull out A777-1, A981-1, or B197-1 instrument face by removing perimeter mounting screws. Place a pad under face to prevent scratches.
- b. Install required instrument(s) using screws provided.

**CAUTION**

Directional gyro mounting screws must not exceed 1 inch in length or unit will be damaged.

- c. Connect straight multi-pin connector to directional gyro and/or angled connector to artificial horizon ensuring that angled strain relief points down. Ensure that connectors lock in place. Ty-rap excess wiring.
- d. Install instrument face, ALT light, and OIL light.

Vertical Card Magnetic Compass:

Locate two wires extending from windshield bow. Slide one piece of heat-shrink tubing (provided) over each wire. Connect compass pins to wire sockets (polarity not critical). Position heat-shrink tubing over connections and apply heat. Install compass using two screws provided.

15. Install battery (Negative Ground System).

**NOTE**

This must be performed by a qualified pilot and a certificated mechanic.

16. Perform preflight inspection per Pilot's Operating Handbook and inspection per §§ 2.205 & 2.210.
17. Check tail rotor balance per § 10.240.
18. Perform hover checks in § 2.220.1. DO NOT proceed into forward flight at this time.
19. Track and balance main rotor per § 10.230.
20. While climbing at takeoff power per placard and 50 KIAS:
  - a. Evaluate roughness at maximum and minimum power-on RPM.
  - b. At minimum power-on RPM perform 30° left yaw to check for adequate directional control.

1.009 Assembly Instructions for R22-series Helicopter Crated for Export (continued)

21. During level flight typical cruise altitude (if possible, deviate as required for weather and regulations), MCP, with right trim and governor on:
  - a. Verify longitudinal and lateral cyclic control forces are neutralized (no tendency of cyclic to creep longitudinally or laterally).
  - b. Verify collective control forces are neutralized (no tendency of collective to creep up or down).
  - c. Verify throttle correlation. Set MAP to 22 inches and turn governor off. Without twisting throttle, lower collective to 12 inches MAP then raise it to 22.5 inches MAP. RPM must stay in green arc.
22. Evaluate roughness at minimum power-on RPM, takeoff power per placard, and  $V_{ne}$  per placard.
23. Check all instruments, gauges, and avionics for proper operation.
24. During autorotation at 50 KIAS and 90% rotor RPM, perform 30° right yaw to check for adequate directional control.

**TABLE 1 SCHEDULED INSPECTIONS**

Consult latest revision of listed publications for specific applicability.

	First 25 hours	First 100 hours	Every 50 hours	Every 100 hours	Every 300 hours	Every 500 hours	Every 800 hours	Every 2200 hours	Every 4 months	Every 12 months	Every 4 years	Every 5 years	Every 12 years
Perform inspection per Lycoming Operator's Manual.*	•		•	•	•								
Perform <b>Lycoming SB 480</b> <i>I. Oil &amp; Filter Change &amp; Screen Cleaning / II. Oil Filter/Screen Content Inspection.</i> <i>NOTE: Oil filters on D723-1 adapters do not require safety wire.</i>	•		•						•				
Perform <b>Lycoming SI 1129</b> <i>Methods of Checking DC Alternator and Generator Belt Tension.</i>	•			•									
Perform <b>Lycoming SB 301*</b> <i>Maintenance Procedures and Service Limitations for Valves.</i>		•			•								
Perform <b>Lycoming SB 388*</b> (also applies to replacement cylinders) <i>Procedure to Determine Exhaust Valve and Guide Condition.</i>		•			•								
Perform <b>Lycoming SB 366, as applicable</b> <i>Carburetor Throttle Body Screw Inspection.</i>			•										
Perform <b>Lycoming SI 1191</b> <i>Cylinder Compression.</i>				•									
Perform <b>CMI SB 643, as applicable</b> <i>Maintenance Intervals for All CMI/TCM/Bendix Magnetos &amp; Related Equipment.</i>				•		•						•	•
Perform 100-hour/annual inspection per § 2.400.				•						•			
Perform main rotor blade tip maintenance per § 26-60.				•						•			
Lubricate A181-4 Revision K, L, and M bearings per § 22-42.					•					•			
Lubricate A184 bearing per § 22-41.					•					•			
Clean gearbox chip detectors per §§ 22-11 & 22-21.						•				•			
Perform <b>CMI SB 663</b> <i>Two-Wire Magneto Tach. Breaker Contact (Points) Assy. P/N 10-400507.</i>						•							
Perform clutch assembly lubricant inspection & servicing per § 22-30.						•							
Drain and flush gearboxes per §§ 22-13 & 22-23.						•							
Perform FAA AD 88-26-01 R2 (A158-1 spindles only).						•							
Lubricate A181-4 Revision N and subsequent bearings per § 22-42.							•				•		
Perform 2200-hour/12-year inspection per § 2.600.								•					•

\* Gray square indicates a shorter interval than published on referenced document.



## 1.100 Helicopter Servicing

### 1.101 Scheduled Maintenance and Inspections

Required maintenance and inspection intervals are given in Table 1. Publications listed are subject to revision.

Also consult the following for specific applicability, as some aircraft may require maintenance and inspections in addition to the requirements in Table 1:

- Aircraft maintenance records
- Manufacturers' Service Bulletins (SBs)
- Aviation regulations
- Airworthiness Limitations
- Airworthiness Directives (ADs)

Preventive maintenance is required between scheduled inspections. Fluid leaks, discoloration, fretting, galling, chafing, nicks, scratches, dents, cracks, and corrosion all warrant further investigation. Unairworthy items must be replaced or repaired as allowed by RHC.

## 1.102 Additional Component Maintenance

## NOTE

RHC-manufactured parts not listed in § 1.102 as requiring additional component maintenance, or replacement per § 3.300, are "on condition".

## A. 12 YEARS

Remove the following components when they have accumulated 12 years time in service and less than 2200 hours time in service since new, since last overhaul, or since last 12-year maintenance, and perform action indicated:

Part Number	Description	Action
A005-4	A154-1 Main Rotor Hub & Bearing Assembly	Perform inspection and repair per MM § 2.610, return to RHC for inspection and repair, or replace with new.
A005-12	B370-1 Main Rotor Hub & Bearing Assembly	
A005-6	A016-4 Main Rotor Blade & A158-1 Spindle Assembly	Submit to RHC-authorized component maintenance facility for 12-year maintenance, or replace with new or overhaul exchange. 12-year maintenance includes blade replacement (as required), spindle bearing replacement (as required), pitch horn screw replacement, boot and O-ring replacement, and inspection.
A005-7	A016-6 Main Rotor Blade & A158-1 Spindle Assembly	
A005-14	A016-6 Main Rotor Blade & A158-3 Spindle Assembly	
A006-1 & -6	Main Rotor Gearbox Assembly	Submit to RHC-authorized component maintenance facility for 12-year maintenance, or replace with new or overhaul exchange. 12-year maintenance includes pinion seal replacement, O-ring replacement, sealed bearing replacement, rubber mount replacement, additional bearings replacement (as required), and inspection.
A007-3, -5 or -6	Fanshaft Assembly	Replace with new A007-6 fanshaft assembly.
A008-2 or -4	Tail Rotor Assembly	Disassemble. Replace hub and/or blades as required. Remove bushings and teeter hinge bearings. Inspect hub; verify no fretting or corrosion. Fluorescent penetrant inspect hub if corrosion found. Replace teeter hinge bearings. Or replace with new A008-4 tail rotor assembly.
A014-8	Landing Gear Assembly originally installed on R22 S/N 0002 thru 0487.	Replace with new.
A017-2	Swashplate Assembly	Submit to RHC-authorized component maintenance facility for 12-year maintenance, or replace with new or overhaul exchange. 12-year maintenance includes inspection and repair as necessary.

### 1.102 Additional Component Maintenance (continued)

#### A. 12 YEARS (continued)

Part Number	Description	Action
A018-1	Clutch Assembly (anodized)	Submit to RHC-authorized component maintenance facility for 12-year maintenance, or replace with new or overhaul exchange. 12-year maintenance includes seal and O-ring replacement, bearing replacement, and inspection.
A018-2	Clutch Assembly (metalized)	
A020-2	Upper Frame Assembly S/N 0399 and prior (originally installed on R22 S/N 0002 thru 0311).	Replace with new. Note: Frame replacement may require tailcone forward bay replacement.
A021-1	Tail Rotor Gearbox Assembly	Replace with new or overhaul exchange B021-1 tail rotor gearbox assembly.
A031-1	Tail Rotor Pitch Control	Replace with new.
A041-11 or -12	Tail Rotor Drive Shaft Damper Bearing Assembly	Replace with new A041-11 or -12 damper bearing assembly or replace with new B224-1 or -3 drive shaft.
A044-1	Horizontal Stabilizer Rev M and prior (originally installed on R22 S/N 0002 thru 0631).	Replace with new.
A051-1 or A051-3	Clutch Actuator Assembly (A051-1 includes gearmotor assembly)	Replace with new or overhaul exchange.
A120-1	Tail Rotor Bellcrank	Replace with new.
A169-1, -2, or -4	Muffler with Risers Rev J and prior (baffled muffler with straight tailpipe, originally installed on R22 S/N 0002 thru 0500).	Replace with new, revision K or subsequent muffler with risers.
A169-6 or -35	Muffler with Risers (O-320 engine)	Visually inspect muffler interior; verify no obvious loss of material.
A169-24 or -37	Muffler with Risers (O-360 engine)	Visually inspect muffler interior; verify no obvious loss of material.
A190-1 or -2	V-Belt Set	Replace with new A190-2 v-belt set.
A193-2	Flex Plate	Replace with new A947-2 flex plate assembly.
A193-3	Flex Plate	Replace with new A947-3 flex plate assembly.
A197-1 thru -7	Tail Rotor Drive Shaft Assembly originally installed on R22 S/N 0002 thru 0747.	Replace with B224-1 drive shaft & appropriate B223 yoke.
A258-1	Main Rotor Pitch Link Assemblies	Replace with new A258-1 or A258-5 link assembly.
A258-5	Main Rotor Pitch Link Assemblies	Disassemble. 10X visually inspect barrel; verify no corrosion.
A343-1	Strut – Jackshaft (vertical)	Record length and disassemble. Inspect interior and exterior for corrosion, replace if corrosion found.
A347-1	Strut – Jackshaft (Aft, horizontal; attaches to cabin. Originally installed on R22 S/N 0002 thru 0435)	

### 1.102 Additional Component Maintenance (continued)

#### A. 12 YEARS (continued)

Part Number	Description	Action
A347-5	Strut – Jackshaft (aft, diagonal)	Record length and disassemble. Inspect interior and exterior for corrosion, replace if corrosion found.
A480-1	Swashplate Boot	Replace with new.
A493-1	Lower Sheave Rev H and prior (anodized, originally installed on R22 S/N 0002 thru 0294).	Replace with new, revision I or subsequent (steel-sprayed) lower sheave.
A649-1, -2, or C649-1	Oil Cooler	Replace with new or overhaul exchange C649-1 oil cooler.
A650-1 or -3	Main Gearbox Mount Fittings	Visually inspect exterior and interior. Replace if worn or corroded.
A785-1	Hose – Air (intake)	Replace with new.
A785-2	Hose – Air (hot air inlet)	Replace with new.
A785-6	Hose – Air (engine cooling)	Replace with new.
A785-7	Hose – Air (alternator cooling)	Replace with new.
A785-26	Hose – Air (hot air inlet)	Replace with new.
A785-32	Hose	Replace with new.
A792-2, -4 or -5	Dual Tachometer	Replace with new A792-5 dual tachometer.
B021-1	Tail Rotor Gearbox Assembly	Perform 12-year maintenance per MM § 2.620, or replace with new or overhaul exchange.
B173-1	V-belt – Alternator	Replace with new.
B174-1	Fanwheel	Perform 12-year maintenance per MM § 2.630, or replace with new or overhaul exchange.
B283-1	Hose Assembly (fuel system) Revision A thru P	Replace with new.
B283-2	Hose Assembly (fuel system) Revision A thru P	Replace with new.
B283-6	Hose Assembly (fuel system) Revision A thru P	Replace with new.
B286-2	Governor Controller	Replace with new or overhaul exchange.
D270-1	Governor Controller	Replace with new or overhaul exchange.
D756-2 (or A011-2)	Bellcrank Assembly – Throttle	Replace with new.
F650-3	Main Gearbox Mount Bolt	Visually inspect exterior and interior. Verify no corrosion.

### 1.102 Additional Component Maintenance (continued)

#### B. 2200 Hours

Remove the following components when they have accumulated 2200 hours time in service since new or since last overhaul, and perform action indicated:

Part Number	Description	Action
A005-4	A154-1 Main Rotor Hub & Bearing Assembly	Perform inspection and repair per MM § 2.610, return to RHC for inspection and repair, or replace with new.
A005-12	B370-1 Main Rotor Hub & Bearing Assembly	
A005-6	A016-4 Main Rotor Blade & A158-1 Spindle Assembly	Replace with new or overhaul exchange A005-7 or A005-14 main rotor blade and spindle assembly.
A005-7	A016-6 Main Rotor Blade & A158-1 Spindle Assembly	
A005-14	A016-6 Main Rotor Blade & A158-3 Spindle Assembly	
A006-1 & -6	Main Rotor Gearbox Assembly	Replace with new or overhaul exchange A006-6 main rotor gearbox assembly.
A007-3, -5 or -6	Fanshaft Assembly	Replace with new A007-6 fanshaft assembly.
A008-2 or -4	Tail Rotor Assembly	Disassemble. Replace hub and/or blades as required. Remove bushings and teeter hinge bearings. Inspect hub; verify no fretting or corrosion. Fluorescent penetrant inspect hub. Replace teeter hinge bearings and blade attach bolts. Or replace with new A008-4 tail rotor assembly.
A014-8	Landing Gear Assembly originally installed on R22 S/N 0002 thru 0487.	Replace with new.
A017-2	Swashplate Assembly	Submit to RHC-authorized component maintenance facility for overhaul, or replace with new or overhaul exchange.
A018-1	Clutch Assembly (anodized sheave)	Replace with new or overhaul exchange.
A018-2	Clutch Assembly (metalized sheave)	
A020-2	Upper Frame Assembly S/N 0399 and prior (originally installed on R22 S/N 0002 thru 0311).	Replace with new. Note: Frame replacement may require tailcone forward bay replacement.
A021-1	Tail Rotor Gearbox Assembly	Replace with new or overhaul exchange B021-1 tail rotor gearbox assembly.
A031-1	Tail Rotor Pitch Control	Replace with new.
A041-11 or -12	Tail Rotor Drive Shaft Damper Bearing Assembly	Replace with new A041-11 or -12 damper bearing assembly or replace with new B224-1 or -3 drive shaft.
A044-1	Horizontal Stabilizer Rev M and prior (originally installed on R22 S/N 0002 thru 0631).	Replace with new.

### 1.102 Additional Component Maintenance (continued)

#### B. 2200 Hours (continued)

Part Number	Description	Action
A051-1 or A051-3	Clutch Actuator Assembly (A051-1 includes gearmotor assembly)	Replace with new or overhaul exchange.
A120-1	Tail Rotor Bellcrank	Replace with new.
A121-17	Push-Pull Tube Assembly	Replace with new.
A169-1, -2, or -4	Muffler with Risers Rev J and prior (baffled muffler with straight tailpipe, originally installed on R22 S/N 0002 thru 0500).	Replace with new, revision K or subsequent muffler with risers.
A169-6 or -35	Muffler with Risers (O-320 engine)	Replace with new A169-35 muffler.
A169-24 or -37	Muffler with Risers (O-360 engine)	Replace with new A169-37 muffler.
A189-10	Nut – Double Lock	Replace with new.
A190-1 or -2	V-Belt Set	Replace with new A190-2 v-belt set.
A193-2	Flex Plate	Replace with new A947-2 flex plate assembly.
A193-3	Flex Plate	Replace with new A947-3 flex plate assembly.
A197-1 thru -7	Tail Rotor Drive Shaft Assembly originally installed on R22 S/N 0002 thru 0747.	Replace with new B224-1 drive shaft & appropriate B223 yoke.
A258-1	Main Rotor Pitch Link Assembly	Replace with new A258-5 link assembly.
A258-5	Main Rotor Pitch Link Assembly	Replace with new, or perform inspection per § 2.650 and magnetic particle inspect barrel.
A347-1	Strut – Jackshaft (Aft, horizontal; attaches to cabin. Originally installed on R22 S/N 0002 thru 0435)	Replace with A347-5 strut (aft, diagonal).
A426-6	Cap – Collective Spring	Replace with new.
A480-1	Swashplate Boot	Replace with new.
A493-1	Lower Sheave Rev H and prior (anodized, originally installed on R22 S/N 0002 thru 0294).	Replace with new, revision I or subsequent (steel-sprayed) lower sheave.
A615-1	Gasket – Carburetor-to-Air Box	Replace with new.
A628-6	Connector Assembly – Harness	Replace with new.
A636-2	Support (O-320 engine)	Replace with new.
A649-1 or -2	Oil Cooler	Replace with new or overhaul exchange C649-1 oil cooler.
A650-1 or -3	Main Gearbox Mount Fittings	Visually inspect exterior and interior. Replace if worn or corroded. Magnetic particle inspect per § 23-41.
A723-1	Oil Line Assembly	Replace with new A723-5 oil line assembly.
A723-2	Oil Line Assembly	Replace with new A723-6 oil line assembly.
A780-33	Cable Assembly	Replace with new.
A785-1	Hose – Air (intake)	Replace with new.

### 1.102 Additional Component Maintenance (continued)

#### B. 2200 Hours (continued)

Part Number	Description	Action
A785-2	Hose – Air (hot air inlet)	Replace with new.
A785-6	Hose – Air (engine cooling)	Replace with new.
A785-7	Hose – Air (alternator cooling)	Replace with new.
A785-26	Hose – Air (hot air inlet)	Replace with new.
A785-32	Hose	Replace with new.
A792-2, -4 or -5	Dual Tachometer	Replace with new A792-5 dual tachometer.
A947-1	Flex Plate Assembly – Forward	Replace with new.
A947-2	Flex Plate Assembly – Intermediate	Replace with new.
A947-3	Flex Plate Assembly – Aft	Replace with new.
B021-1	Tail Rotor Gearbox Assembly	Replace with new or overhaul exchange.
B173-1	V-belt – Alternator	Replace with new.
B174-1	Fanwheel	Replace with new or overhaul exchange.
B224-1	Tail Rotor Drive Shaft	Replace with new.
B224-3	Tail Rotor Drive Shaft	Replace with new.
B283-1	Hose Assembly (fuel system)	Replace with new.
B283-2	Hose Assembly (fuel system)	Replace with new.
B283-6	Hose Assembly (fuel system)	Replace with new.
B286-2	Governor Controller	Replace with new or overhaul exchange.
B350-2	Pin – Spring (fanshaft nut)	Replace with new.
C636-2	Support (O-360 engine)	Replace with new.
C649-1	Oil Cooler	Replace with new or overhaul exchange.
D270-1	Governor Controller	Replace with new or overhaul exchange.
D756-2 (or A011-2)	Bellcrank Assembly – Throttle	Replace with new.
F628-8	Buckle Assembly	Replace with new.
KI-217-1	R22 Bladder Fuel Tank Installation Kit	Required for helicopter S/N 0002 thru 4620 per R22 SB-109, if not previously accomplished.
KI-2207	A017-1 Swashplate Installation Kit	Replace existing parts with kit parts.
KI-2208	R22 A057-2 Air box Assembly Installation Kit	Required for helicopter S/N 2571M thru 2664 if not previously accomplished.
AN320-18	Nut – Fanshaft	Replace with new.
MS16562-15	Pin – Spring	Replace with new.
MS20002-18	Washer	Replace with new.
NAS1149F1832P	Washer	Replace with new.
NAS630-80	Bolt	Replace with new.
NAS6604-38	Bolt	Replace with new.

**1.102 Additional Component Maintenance (continued)****C. Engine Maintenance**

Refer to latest revisions of Textron Lycoming Service Instruction No. 1009 and Lycoming Service Bulletin No. 240.

**D. Airframe and Engine Accessory Maintenance**

Refer to accessory manufacturer's instructions for continued airworthiness for accessory maintenance. Remove accessories per R22 Maintenance Manual or accessory manufacturer's instructions as required.



## CHAPTER 2

## INSPECTION

<i>Section</i>	<i>Title</i>	<i>Page</i>
2.000	Introduction . . . . .	2.1
2.100	General Procedures . . . . .	2.1
2.110	Ball and Roller Bearings . . . . .	2.1
2.120	Push-Pull Tubes, Rod Ends, and Spherical Bearings . . . . .	2.1
2.121	Push-Pull Tubes . . . . .	2.1
2.122	Rod Ends and Spherical Bearings . . . . .	2.2
2.125	Elastomeric Bearings . . . . .	2.3
2.130	Telatemp Indicators . . . . .	2.6
2.140	Torque Stripes . . . . .	2.6
2.200	Ground and Flight Check For 100-Hour/Annual Inspection . . . . .	2.7
2.205	Ground Check . . . . .	2.7
2.210	Run Up . . . . .	2.9
2.220	Flight Check . . . . .	2.10
2.300	Airframe Preparation For 100-Hour/Annual Inspection . . . . .	2.10
2.400	100-Hour/Annual Airframe Inspection . . . . .	2.11
2.410	Inspection Procedures and Checklist . . . . .	2.11
2.500	Special Inspections . . . . .	2.41
2.501	Clutch Actuator Upper and Lower Bearings . . . . .	2.41
2.502	A181-4 Actuator Lower Bearing Inspection and Lubrication . . . . .	2.41
2.503	A184 Actuator Upper Bearing Inspection and Lubrication . . . . .	2.42
2.507	V-Belt Inspection . . . . .	2.43
2.508	Lower Sheave V-Belt Wear Pattern Inspection . . . . .	2.45
2.510	Tail Skid Strike . . . . .	2.46
2.520	Tail Rotor Strike . . . . .	2.47
2.530	Main Rotor Strike . . . . .	2.48
2.540	Rotor/Engine Overspeed . . . . .	2.49
2.550	Hard Landing . . . . .	2.51
2.560	Steel Tube Frame Corrosion . . . . .	2.53
2.570	[Deleted] . . . . .	2.54
2.580	Float Inspection and Testing . . . . .	2.54
2.600	2200-Hour/12-Year Inspection . . . . .	2.56
2.610	Main Rotor Hub Inspection and Repair . . . . .	2.58
2.620	Tail Rotor Gearbox 12-Year Maintenance . . . . .	2.60
2.630	Fanwheel 12-Year Maintenance . . . . .	2.61
2.640	Main Rotor Blade Static Balance . . . . .	2.62

CHAPTER 2

INSPECTION (Continued)

<i>Section</i>	<i>Title</i>	<i>Page</i>
2.650	A258-5 Main Rotor Pitch Link Assembly Inspection . . . . .	2.65
2.700	Additional Special Inspections . . . . .	2.66
2.710	Volcanic Ash Recommendations . . . . .	2.66
2.720	Lightning Strike . . . . .	2.67
2.730	Inspection After Stabilizer Damage . . . . .	2.68

## CHAPTER 2

## INSPECTION

2.000 Introduction

The R22 helicopter must be inspected periodically to verify it is in airworthy condition. Required inspection intervals are maximum 100 hours time in service or 12 calendar months (annually), whichever occurs first; the inspection interval may be extended up to 10 hours, without accumulation, if allowed by local regulations. Fluid leaks, discoloration, dents, scratches, nicks, cracks, galling, chafing, fretting, and corrosion all warrant further investigation. Unairworthy items must be replaced or repaired as allowed by Robinson Helicopter Company. This section contains procedures for performing the required periodic airframe inspections.

2.100 General Procedures

Refer to U.S. FAA AC 43.13-1B Chapter 5 Section 2 for Visual Inspection guidance, and Chapter 11 Section 8 paragraph 11-97 for Wiring Replacement guidance. When required, magnetic particle inspection may be performed in accordance with ASTM E 1444 and MIL-STD-1907. Fluorescent penetrant inspection may be performed in accordance with ASTM E 1417 and MIL-STD-1907. For following components, use accompanying inspection criteria unless otherwise specified.

2.110 Ball and Roller Bearings

The first indication of bearing failure is usually an increase in bearing noise. Noise will almost always start several hours before bearing failure or any increase in bearing temperature. Listen to drive system during start-up and shutdown. A failing bearing will produce a loud whine, rumble, growl, or siren sound. Upon hearing an unusual noise, thoroughly inspect all bearings before further flight. A failing bearing may have a distorted seal or be exuding a large amount of grease. Do not rely on Telatemp to detect failing bearings as temperature increase may occur only seconds before bearing disintegrates. Refer to § 22-40.

The failure of either actuator bearing in flight could cause loss of power to the rotor system and could result in a serious accident. The actuator upper ball bearing is on the clutch shaft aft of the upper sheave; the actuator lower roller bearing is on the fanshaft aft of the lower sheave. Just before complete failure of an actuator bearing, the clutch light may flicker constantly (on and off in less than one second). This should not be confused with its normal on-off re-tensioning in flight (on for 1-8 seconds then off). Flight should not be resumed until cause of the flickering clutch light has been determined.

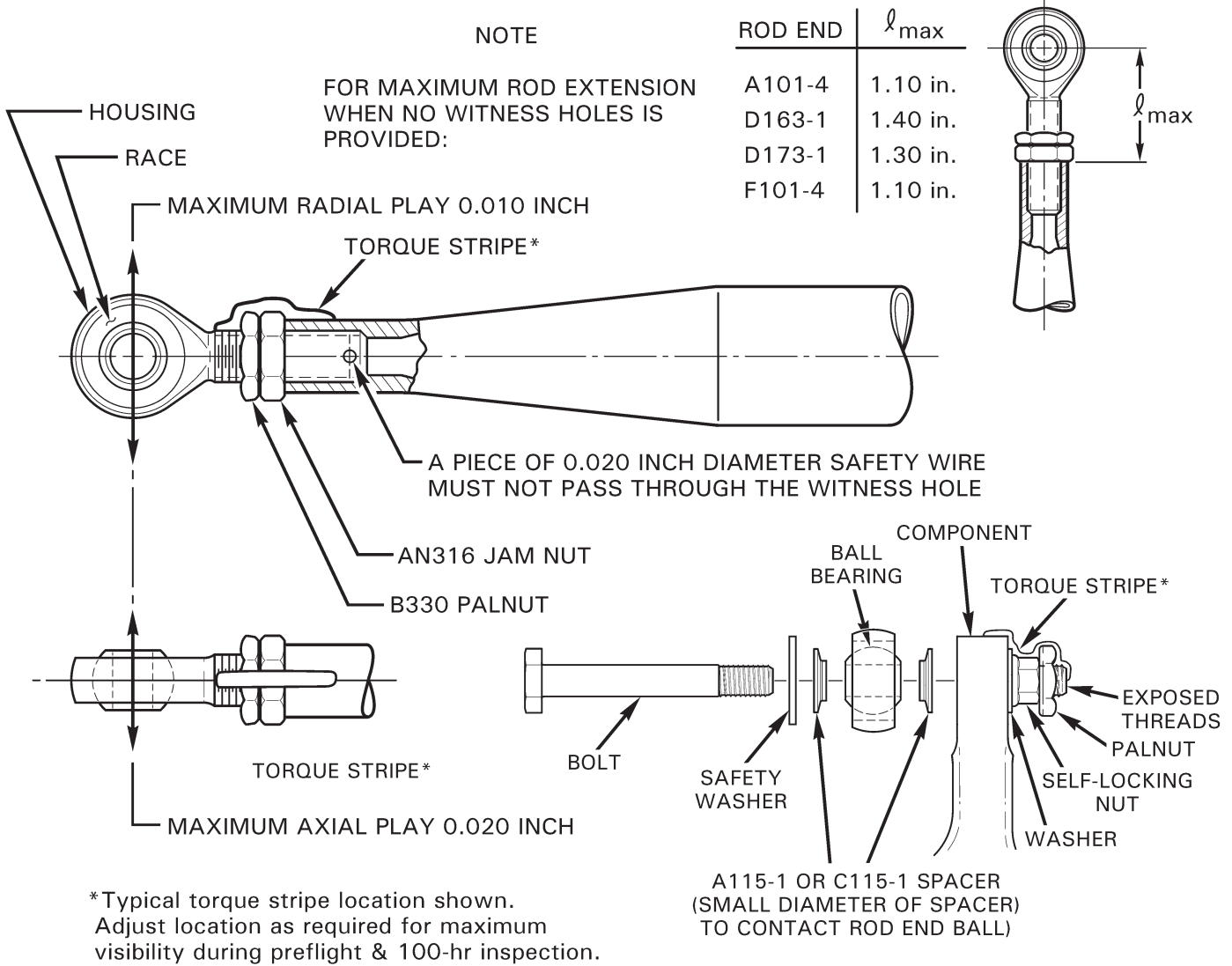


FIGURE 2-1 ROD END AND SPHERICAL BEARING PLAY LIMITS AND TORQUE STRIPE APPLICATION

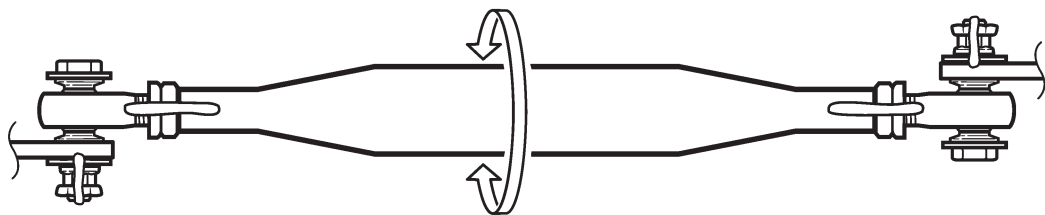


FIGURE 2-1A ROD END CENTERING  
(Position rod ends for maximum rotation)

## 2.120 Push-Pull Tubes, Rod Ends, and Spherical Bearings

### 2.121 Push-Pull Tubes

Nicks, cuts, or scratches in tube not more than 0.010 inch deep and not more than 1/4 of tube circumference may be polished out in lengthwise direction using 320-grit or finer wet-or-dry abrasive paper and 1-inch minimum blend radius. If depth exceeds these limits, tube must be replaced.

If tube is dented or flattened more than 5 percent of its diameter, it must be replaced.

### 2.122 Rod Ends and Spherical Bearings

Refer to Figure 2-1.

1. Maximum axial play: 0.020 inch  
Maximum radial play: 0.010 inch
2. Looseness between bearing outer race and rod end housing is not permitted.
3. Rod ends not riveted in place must block passage of 0.020 inch diameter wire through witness hole, if provided.
4. Rod end jam nuts and palnuts must be torqued per § 23-32 and torque striped, per Figure 2-1, at the most visible position for pre-flight inspection. Torque stripe must extend across nuts to both rod end shank and push-pull tube (or pitch link barrel, yoke, support, strut, etc.). Torque stripes are subject to deterioration and must be periodically renewed.
5. Rod ends must be centered, i.e., rod ends should be positioned to allow as much movement as possible without binding.

#### **WARNING**

**Assembly of flight controls is critical and requires inspection by a qualified person. If a second person is not available, the installer must take a 5-minute break prior to inspecting flight control connections he has assembled.**

#### **CAUTION**

**Teflon-lined bearings must not be lubricated or solvent cleaned.**

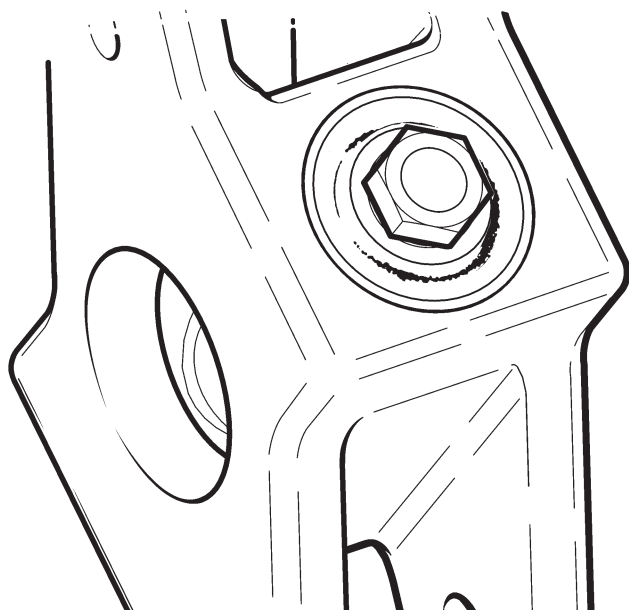


FIGURE 2-2A  
ELASTOMER FATIGUE

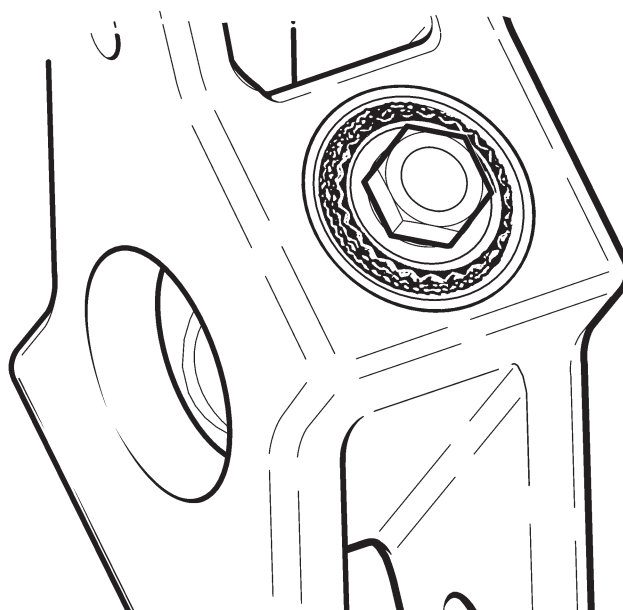


FIGURE 2-2B  
ELASTOMER OIL CONTAMINATION

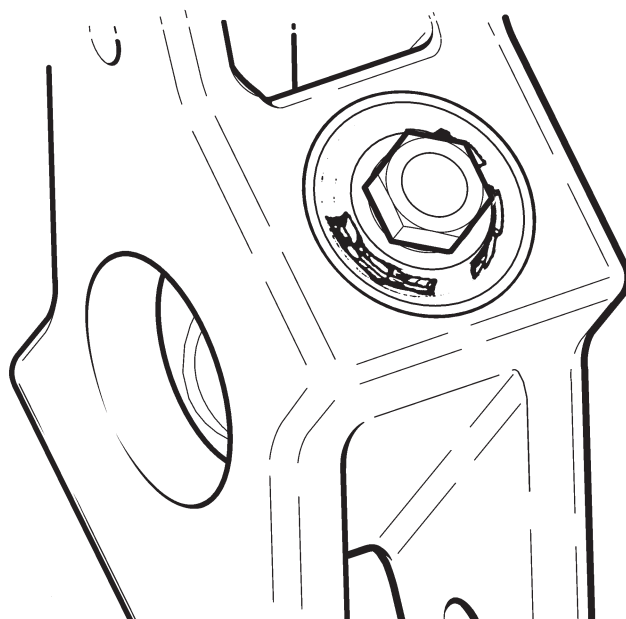


FIGURE 2-2C  
ELASTOMER OVERLOAD

### 2.125 Elastomeric Bearings

Elastomeric bearings are used in the A062-1 tail rotor hub. Fatigue, oil contamination, or overload can degrade the elastomer.

Small surface cracks (fatigue cracks) and elastomer dust or “eraser crumbs” (see Figure 2-2A) are normal and are not causes for replacement. As cracks grow, enough elastomer will be lost to cause reduced stiffness and increased vibration. If deep (greater than 0.10 inch) cracks are present over more than 25% of elastomer face, replace bearing.

Avoid exposure to oil, grease, hydraulic fluid, cleaning solvent, and rust-preventative fluids. Immediately wash off any such contaminants with detergent and water. Contaminated bearings exhibit swelling, wavy edges, or debonding (see Figure 2-2B) and must be replaced.

Overload occurs when elastomer’s tensile strength or rubber-to-metal bond strength is exceeded. This can occur when normal loads are applied to a bearing weakened by fatigue or oil contamination. Overload is indicated by large extrusions from and large clean cracks in elastomer as shown in Figure 2-2C.

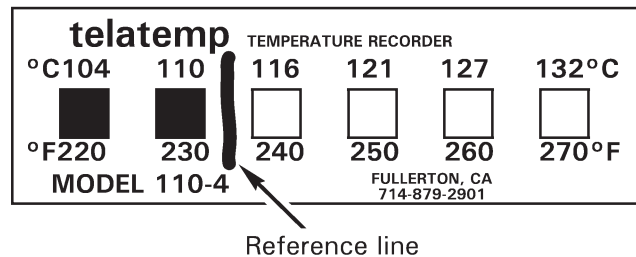
Elastomer may also separate (debond) from metal bushings. If separation occurs over more than 25% of bonded area, replace bearing.

### 2.130 Telatemp Indicators

Self-adhesive Telatemp indicators record changes in operating temperatures of bearings and gearboxes. To use a Telatemp, draw a reference line between the highest temperature square which has darkened during normal operation and the next undarkened square. During every check thereafter, determine if an additional square has blackened. If an indicated temperature increase cannot be accounted for by a change in operating conditions, carefully examine the component before further flight.

#### NOTE

Telatemps can indicate erroneously if contaminated by a petroleum product, typically appearing as white, unactivated square(s) between darkened squares at each end; replace any Telatemp indicating as such and clean area with acetone prior to installing.



Part Number	Temperature Range
F110-2	60°C / 140°F — 88°C / 190°F
F110-4	104°C / 220°F — 132°C / 270°F

#### Usage

F110-4 on A006-1 Main Rotor Gearbox

F110-2 on A184-3 Upper Actuator Bearing (just aft of upper sheave)

F110-2 on A181-4 Lower Actuator Bearing (just aft of lower sheave)

F110-2 on A021-1 or B021-1 Tail Rotor Gearbox

### 2.140 Torque Stripes

If, during inspection, the remaining torque stripe on a fastener is insufficient to determine joint integrity, then remove accompanying palnut as required and apply specified torque to fastener. If fastener moves, disassemble joint and inspect parts for damage such as fretting, thread deformation, hole elongation, etc.; replace damaged parts. If fastener does not move, install new palnut as required & standard torque per § 23-32. Torque stripe fastener per Figure 2-1.



## 2.200 Ground and Flight Check for 100-Hour/Annual Inspection

Complete the following checklists in conjunction with a 100-hour or annual inspection. Note and correct any discrepancies.

### 2.205 Ground Check

1. **Throttle Control:** Check for freedom of rotation with collective full down and full up. \_\_\_\_\_
2. **Throttle Overtravel Spring:** Check by twisting throttle past idle position to override stop. Release throttle and ensure it returns immediately to normal idle position. \_\_\_\_\_
3. **Mixture Control:** Check for smoothness of operation with no binding. Check press-to-unlock button for proper function. Verify 0.03 to 0.10 inch spring-back at full rich position. \_\_\_\_\_
4. **Carburetor Heat Control:** Check for smoothness of operation with no binding. Verify 0.03 to 0.10 inch spring-back at full off position. \_\_\_\_\_
5. **Cyclic Control:** Check freedom through full travel with friction and right trim off. Verify friction knob rotates 1/8 to 1 turn clockwise before adding friction. Check full travel with friction and right trim on. Verify 10 pounds maximum friction measured laterally at grip with right trim off, friction on, and MR blade pitch links fore and aft. \_\_\_\_\_
6. **Collective Control:** Check freedom through full travel with friction off. Check freedom through full travel with friction on; friction should be 12 to 20 pounds measured at grip. \_\_\_\_\_
7. **Carb Heat Assist (if installed):** With collective down and full carb heat, raise collective full up and verify carb heat off. Lower collective full down and verify carb heat full on. With collective friction off, push carb heat off and verify collective stays down. \_\_\_\_\_
8. **Tail Rotor Pedals:** Check for smooth operation with no binding. \_\_\_\_\_
9. **Removable Controls:** Verify security of attached fasteners. \_\_\_\_\_
10. **Lighting and Instruments:** Turn MASTER switch on and verify —
  - a. Carbon Monoxide caution light blinks twice \_\_\_\_\_
  - b. Carb Air Temp approximately same as Outside Air Temp \_\_\_\_\_
  - c. ALT caution light on \_\_\_\_\_
  - d. OIL pressure warning light on \_\_\_\_\_
  - e. Fuel quantity gages – indication of fuel level \_\_\_\_\_
  - f. Navigation and panel lights – check function \_\_\_\_\_
  - g. Strobe light – check function \_\_\_\_\_

2.205 Ground Check (continued)
**10. Lighting and Instruments:** Turn MASTER switch on and verify — (continued)

- h. Landing lights – check function  
(clutch switch must be Engaged to check landing lights) \_\_\_\_\_
- i. Map light – check function \_\_\_\_\_
- j. Ammeter – shows discharge \_\_\_\_\_
- k. Oil temperature gage – slight needle deflection with engine cold \_\_\_\_\_
- l. Cylinder head temp gage – slight needle deflection with engine cold \_\_\_\_\_
- m. MR CHIP light – on when sender shorted or test switch depressed \_\_\_\_\_
- n. MR TEMP light – on when sender shorted or test switch depressed \_\_\_\_\_
- o. TR CHIP light – on when sender shorted or test switch depressed \_\_\_\_\_
- p. LOW FUEL light – on after approximately 1 second delay when low  
fuel sender in tank is depressed or when test switch depressed \_\_\_\_\_

### 2.210 Run Up

1. Perform preflight inspection per POH. \_\_\_\_\_
2. Turn MASTER switch on. Apply rotor brake and verify BRAKE light on. With brake applied, verify starter does not activate when key is turned to START position. \_\_\_\_\_
3. Start engine and run up using POH checklist, except leave cyclic and collective frictions on and governor off before proceeding. After engaging clutch switch, verify blades turn within 5 seconds and CLUTCH light extinguishes within 100 seconds. \_\_\_\_\_
4. Ammeter indicates charge, ALT light off. \_\_\_\_\_
5. Both magnetos ground (momentarily off) at 60% RPM. \_\_\_\_\_
6. Select alternator and battery switches off and verify-
  - a. Engine and rotor tachometers operate. \_\_\_\_\_
  - b. All warning/caution lights extinguished, indicating proper function of tachometer bus isolation diode. \_\_\_\_\_
7. No unusual bearing noise when varying RPM through operating range. Mechanic to listen near V-belt drive for symptoms of failing bearing as described in Section 2.110. \_\_\_\_\_
8. Set RPM at 75%, governor on, Increase to 85%, release throttle and verify governor increases RPM to 104%  $\pm$  1.5%. Increase RPM to 106%, release throttle, and verify governor decreases RPM to 104%  $\pm$  1.5%. \_\_\_\_\_
9. Engine and rotor tachometer needles within 1% of each other at 104% RPM. \_\_\_\_\_
10. Verify alternator voltage as follows:
  - 13.4 to 13.9 vdc for A942-3 alternator control unit
  - 13.0 to 13.7 vdc for A942-1 or -2 alternator control unit
 \_\_\_\_\_
11. Heater operates properly (if installed). \_\_\_\_\_
12. Tachometer needles do not jump more than 2% when transmitting on 118.00, 125.00, and 136.975 MHz with governor on. \_\_\_\_\_
13. Raise collective control 0.5 inch at grip and slowly decrease RPM. Verify low rotor RPM warning horn and light activate at 97 to 96% RPM and remain on as RPM is decreased to idle. \_\_\_\_\_
14. Idle RPM with engine warm, clutch engaged, throttle closed: 53 to 57%. \_\_\_\_\_
15. Idle mixture with engine warm, clutch disengaged, throttle closed: 2 to 4% RPM rise as mixture is pulled slowly to idle cut-off. Adjust idle mixture screw as required. If unable to obtain rise, set idle mixture screw to nominal position of 1½ turns out from full-in then adjust as required for smooth idle. \_\_\_\_\_

## 2.220 Flight Check

### 1. Hover:

- a. All gages green \_\_\_\_\_
- b. Controllability in left and right pedal turns \_\_\_\_\_
- c. Vibration levels \_\_\_\_\_

### 2. Level flight: Approximately 3000 feet density altitude (if possible), maximum continuous power, governor on, right trim on, frictions off.

- a. Vibration levels \_\_\_\_\_
- b. Longitudinal cyclic trim - cyclic does not creep forward or aft \_\_\_\_\_
- c. Lateral cyclic trim - cyclic does not creep left or right \_\_\_\_\_
- d. Collective spring - collective does not creep up or down \_\_\_\_\_
- e. Tail rotor pedal position - 0.0 to 0.5 inch left \_\_\_\_\_

## 2.300 AIRFRAME PREPARATION FOR 100-HOUR/ANNUAL INSPECTION

The airframe must be thoroughly cleaned prior to inspection in accordance with U.S. FAR 43, Appendix D, paragraph (a). Cleaning should include a wipe down of main and tail rotor blades, hubs, and airframe exterior with a mild soap and water solution. Refer to R22 POH Section 8 for cleaning instruction. Note any fluid leakage before cleaning.

### CAUTION

Do not spray magnetos, main rotor hub, tail rotor gearbox vent, or swashplate area with high pressure water as water may enter and cause corrosion and breakdown of lubricants.

## 2.400 100-HOUR/ANNUAL AIRFRAME INSPECTION

Perform 100 hour or annual airframe inspections per Section 2.410. RHC recommends keeping a copy of the most recently performed checklist with the aircraft's maintenance records.

### 2.410 Inspection Procedures and Checklist

R22 Serial No.:	_____	Technician name:	_____
Registration No.:	_____	Technician	_____
Hourmeter Indication:	_____	Certificate number:	_____
Aircraft Total Time:	_____		

Numbers in parentheses indicate access location per Figures 2-3A and 2-3B.

#### 1. Remove Landing Light Retainer (1A)

##### NOTE

Do not remove pedal bearing block cover plates (1B) unless function check of pedals indicates a problem with bearing blocks.

**Landing Light Retainer and Support:** Inspect condition. Verify support security. \_\_\_\_\_

**Tail Rotor Pedal Bearing Blocks:** Use an inspection light and mirror to inspect bearing blocks. Maximum allowable play is 0.050 inch axially and 0.020 inch radially. Verify security. \_\_\_\_\_

**Tail Rotor Pedal Bearing Blocks Sheet Metal Supports:** Use an inspection light and mirror to verify no cracks or fretting in bearing block vertical sheet metal supports. \_\_\_\_\_

**Tail Rotor Pedals:** Inspect condition. Verify no cracks. Verify security and operating clearance. \_\_\_\_\_

**Push-Pull Tubes:** Inspect condition. Verify no cracks at ends. Inspect rod ends per Section 2.120. Verify security and operating clearance. \_\_\_\_\_

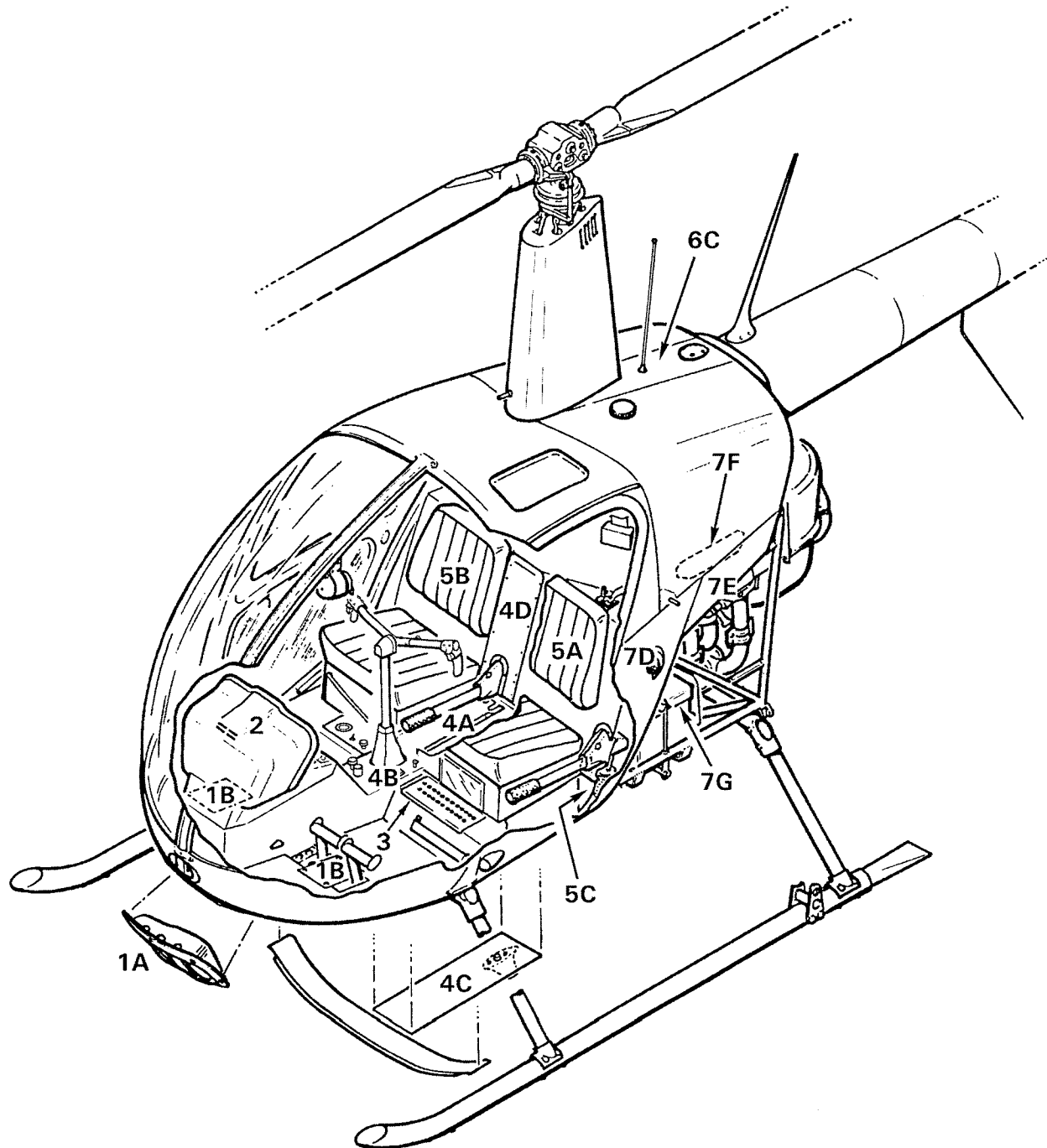
**Sheet Metal Structure:** Inspect condition. Verify no corrosion. No cracks. \_\_\_\_\_

**Battery Box (if installed in nose):** Inspect drain attachment to battery box. Verify no electrolyte leakage. \_\_\_\_\_

**Chin Area:** Verify no loose equipment or debris. \_\_\_\_\_

**Wiring:** Inspect condition. Verify no loose, broken, or chafed wires. Verify neatness and security. \_\_\_\_\_

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

**2.410 Inspection Procedures and Checklist (cont'd)**

**FIGURE 2-3A ACCESS COVERS AND INSPECTION PANELS**

## 2.410 Inspection Procedures and Checklist (continued)

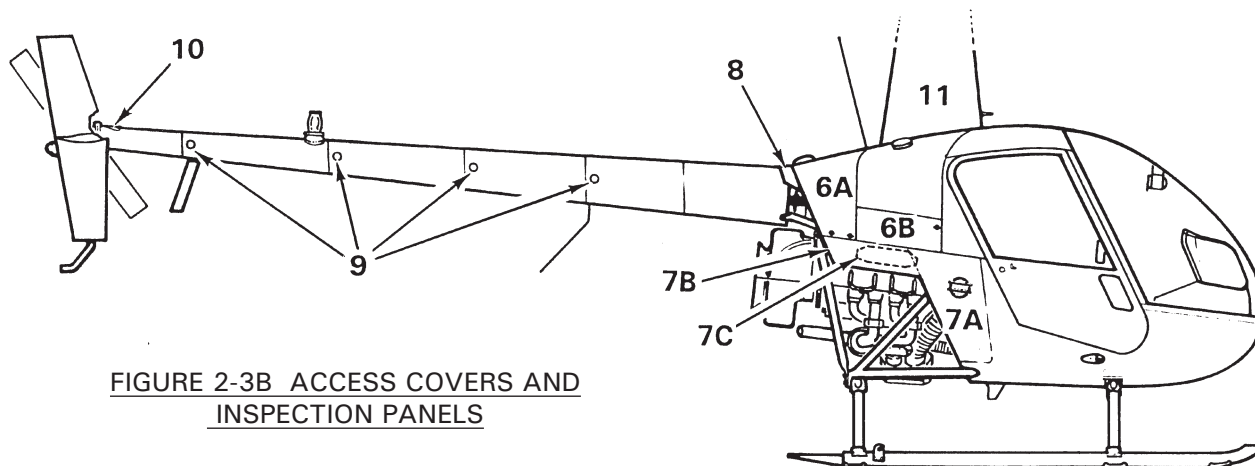


FIGURE 2-3B ACCESS COVERS AND INSPECTION PANELS

## 2. Remove or open upper console assembly per § 13-70:

**CAUTION**

Instrument console removal (§ 13-70) is not required for scheduled inspections. Sufficient access for inspection is gained by removing the landing light retainer and/or removal of installed avionics, as required (refer to Chapter 34).

**Upper Console Assembly:** Inspect condition. Verify hinge security. \_\_\_\_\_

**Instruments and Instrument connections:** Inspect condition. Verify security. \_\_\_\_\_

**Strobe Power Supply and Wiring (alternate locations – atop horizontal firewall or behind right seat back):** Inspect condition. Verify no cracks in mounting area. Verify security. \_\_\_\_\_

**B255-1 Bracket (10-hole instrument console only):** Inspect condition of grommet and bracket contacting brace assembly between windshields. \_\_\_\_\_

**Tail Rotor Push-Pull Tubes:** Inspect condition of visible portions. Verify operating clearance. \_\_\_\_\_

**Battery and Box (if installed in nose):** Inspect condition. Check battery cell fluid level and specific gravity (non-sealed battery only). Verify security of connections. Verify no corrosion in surrounding structure. \_\_\_\_\_

**Radio Tray(s):** Inspect condition. Verify security. Verify no loose or poor wire connections. \_\_\_\_\_

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

**Wiring:** Inspect condition. Verify neatness, security, and no chafing. \_\_\_\_\_

2.410 Inspection Procedures and Checklist (continued)**3. Open Circuit Breaker Panel (3)****WARNING**

**Ensure electrical system remains off while circuit breaker panel is open.**

**Wiring:** Inspect condition. Verify neatness, security, and no chafing. \_\_\_\_\_

**Connections:** Inspect condition. Verify security and no corrosion. \_\_\_\_\_

**Circuit Breakers:** Inspect condition. Verify security. Check airworthiness directive applicability. Verify red button (collar) on CLUTCH circuit breaker button. \_\_\_\_\_

**Copper Bus Bars:** Inspect condition. Verify no corrosion. Verify bus bars are not bent and will not contact surrounding structure. \_\_\_\_\_

**Circuit Breaker Box Interior:** Inspect condition. Verify cleanliness. \_\_\_\_\_

**Close and Secure:** Circuit breaker panel. \_\_\_\_\_

**4. Remove Horizontal Cover (4A), Cyclic Box Cover (4B), Belly Panel (4C) and Vertical Panel (4D)**

To remove cyclic box cover, unscrew trim adjustment knob, remove spring pin in cyclic friction knob, and, on ships equipped with carburetor heat assist, unscrew carburetor heat knob.

**Covers:** Inspect condition. Verify placard legibility. \_\_\_\_\_

**Cyclic Box Assembly:** Inspect condition. Verify no cracks, loose rivets, or corrosion. Verify security. \_\_\_\_\_

**Cyclic Stick Assembly:** Inspect condition. Verify no cracks in weld areas. Verify security and operating clearance. Verify no more than 0.015 inch wear in plates at bottom of stick from A121-1 push-pull tube's forward rod end housing. \_\_\_\_\_

**Cyclic Pivot (forward end of torque tube):** Inspect condition. Inspect bearings per § 2.120. Verify security and operating clearance. \_\_\_\_\_

**Cyclic Right Trim:** Rotate main rotor blades until pitch links are located fore and aft. Grip cyclic and activate right trim. Trim should produce a right cyclic stick force. Move cyclic stick fully left and verify right trim spring coils do not bind. Verify security and operating clearance. \_\_\_\_\_



## 2.410 Inspection Procedures and Checklist (cont'd)

### 4. Remove Horizontal Cover (4A), Cyclic Box Cover (4B), Belly Panel (4C) and Vertical Panel (4D) (cont'd)

**Cyclic Friction:** Inspect condition. Inspect rod ends per Section 2.120. \_\_\_\_\_

**Cyclic Horizontal Push-Pull Tube:** Inspect condition. Verify no cracks around reinforcement blocks at tube ends. Verify security and operating clearance. \_\_\_\_\_

**Tail Rotor Horizontal Push-Pull Tubes:** Inspect condition. Verify no cracks at ends. Inspect rod ends per Section 2.120. Verify security and operating clearance. \_\_\_\_\_

**Tail Rotor Push-Pull tube Lower Bellcrank:** Inspect condition. Verify security and operating clearance. \_\_\_\_\_

**Mixture Cable:** Verify security. \_\_\_\_\_

**Carburetor Heat Cable:** Verify security. \_\_\_\_\_

**Carburetor Heat Assist Bellcrank (if installed):** Inspect condition. Verify security and operating clearance. \_\_\_\_\_

**Carburetor Heat Assist Push-Pull Tube (if installed):** Inspect condition. Verify no cracks at ends. Inspect rod ends per Section 2.120. Verify security and operating clearance. \_\_\_\_\_

**Pitot and Static Lines and Drains:** Inspect condition. Verify no cracking, chafing, or kinking. Remove drain plugs from tee fittings in each line and drain any water. Install drain plugs. \_\_\_\_\_

**Elastic Trim Cord:** Remove trim cord assembly and stretch it. While stretched, check cord for voids which may indicate broken strands. Slide both hooks back and verify security of locking rings. Install cord. Verify operating clearance. \_\_\_\_\_

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

#### NOTE

Elastic trim cord is not required if cyclic does not need forward trim in cruise flight.

2.410 Inspection Procedures and Checklist (cont'd)**4. Remove Horizontal Cover (4A), Cyclic Box Cover (4B), Belly Panel (4C) and Vertical Panel (4D) (cont'd)**

**Electrical Wiring:** Inspect condition. Verify no loose, broken, or chafed wires. Verify neatness and security. \_\_\_\_\_

**Tail Rotor Vertical Push-Pull Tube:** Inspect condition. Verify no cracks at ends. Inspect rod ends per Section 2.120. Verify security and operating clearance. \_\_\_\_\_

**Cyclic Push-Pull Tubes:** Inspect condition. Verify no cracks at ends. Inspect rod ends per Section 2.120. Verify security and operating clearance. Contact between A121-3 & -7 push-pull tube lower ends is permitted when cyclic stick is in aft corners of cyclic box. \_\_\_\_\_

**Cyclic Bellcrank:** Inspect condition. Verify security and operating clearance. \_\_\_\_\_

**Cyclic Yoke (aft end of torque tube):** Inspect condition. Inspect bearings per Section 2.120. Verify security and operating clearance. \_\_\_\_\_

**Cyclic Fork (attaching bellcrank to collective stick):** Inspect condition. Inspect rod end per Section 2.120. Verify security. Verify operating clearance. \_\_\_\_\_

**Throttle Overtravel Spring:** Inspect condition. Inspect rod ends per Section 2.120. Verify security and operating clearance. Contact between overtravel spring and A121-1 push-pull tube is permitted when cyclic stick is in forward right corner of cyclic box. \_\_\_\_\_

**Collective Friction and Stop Assembly:** Inspect condition. Verify no nicks, cuts, or scratches. Move collective up and down and verify no bending or binding. Verify security and operating clearance. \_\_\_\_\_

**Collective Boot:** Inspect condition. Verify no tears. Ensure tie string ends are tucked into boot (if installed - current production aircraft use Ty-raps to secure boot around collective stick). \_\_\_\_\_

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

2.410 Inspection Procedures and Checklist (continued)**5. Remove Seat Backs (5A & 5B) & Collective Spring Guard (5C under left seat)**

**Seat Backs and Collective Spring Guard:** Inspect condition. Verify upholstery security. \_\_\_\_\_

**Upper Frame Assembly:** Inspect condition of visible portions. Verify security. \_\_\_\_\_

**Electrical and Antenna Wiring:** Inspect condition. Verify security. Verify no chafing. Check grommets for proper installation. \_\_\_\_\_

**Pitot and Static Lines:** Inspect condition. Verify no chafing or kinks. \_\_\_\_\_

**Collective Stick Assembly:** Inspect condition. Inspect bearings per § 2.120. Verify security and operating clearance. Verify no cracks in welds. Verify security of removable stick (if installed). If applicable, verify A783-1 retainer is secured to collective stick with ty-raps per Figure 2-4. \_\_\_\_\_

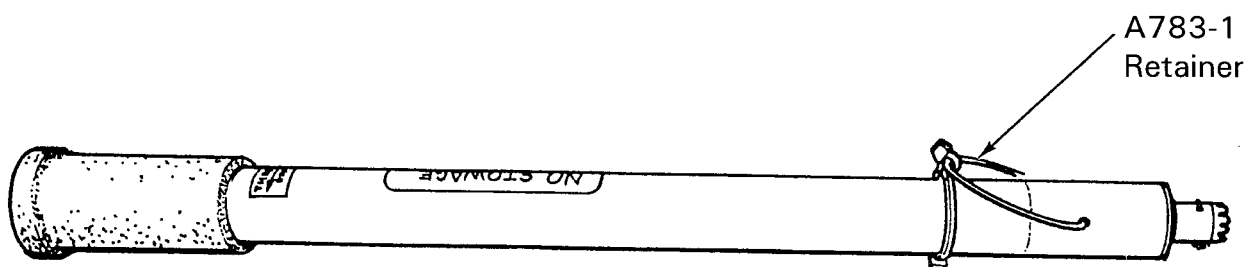


FIGURE 2-4 A783-1 RETAINER SECURITY

**Throttle Connecting Rod:** Inspect condition. Verify no cracks. Verify security and operating clearance. \_\_\_\_\_

**Governor:** Inspect condition. Inspect rod ends per § 2.120. Verify security and operating clearance. Verify sufficient wiring slack with full up collective. \_\_\_\_\_

**Collective Spring:** Inspect condition. Inspect rod ends per § 2.120. Verify no binding or roughness during operation. Verify lubrication of guide rods. Verify spring coils do not touch each other when collective is full down. Verify no elongation of lower cap guide rod holes. Verify security and operating clearance. \_\_\_\_\_

2.410 Inspection Procedures and Checklist (continued)**5. Remove Seat Backs (5A & 5B) & Collective Spring Guard (5C under left seat) (continued)**

**Firewall Drains:** Inspect condition. Verify drains are unobstructed. Verify tubing clamps are not cutting tubing. Verify security. \_\_\_\_\_

**Governor Controller/Engine Monitoring Unit (EMU; later helicopters) and Wiring:** Inspect condition. Refer to § 33-137 for EMU description; refer to EMU Technician's Guide and EMU User Guide online at [www.robinsonheli.com](http://www.robinsonheli.com) for data access. Verify security. \_\_\_\_\_

**Main Fuel Tank Outlet & Fuel Hose:** Inspect condition. Verify no leakage. Verify security. Verify smooth operation of fuel valve. \_\_\_\_\_

**Fuel Shut-Off Valve:** Inspect condition. Verify no leakage. Verify security. Verify smooth operation of fuel valve. \_\_\_\_\_

**Aux Fuel Tank Fuel Hose:** Inspect condition. Verify clearance to structure. Verify no leakage. Verify security. \_\_\_\_\_

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

**6. Open Cowling Door(s) (6A & 6B) & Remove aft Cowling (6C)**

**Cowling Doors:** Inspect condition. Verify proper operation of fasteners. \_\_\_\_\_

**Electrical Wiring:** Inspect condition. Verify no loose, broken, or chafed wires. Verify neatness and security. \_\_\_\_\_

**Actuator Fuse(s) and Holder(s):** Inspect condition. Verify no corrosion. Verify correct AGC-1 ½ fuse(s), twist-to-lock function, and security. \_\_\_\_\_

**Antennas and Connections:** Inspect condition. Verify security of antenna(s) and antenna connection(s). \_\_\_\_\_

**Emergency Locator Transmitter (ELT; if installed):** Inspect condition. Comply with U.S. 14 CFR 91.207 (d), if required. Verify proper installation, security, and clearance from drive train components. Verify D693-4 strap assembly is installed and buckled securely. \_\_\_\_\_

**Pitot Line and Static Vent:** Inspect condition. Verify no chafing, kinks, or tight bends. Verify static vent is clean and unobstructed. \_\_\_\_\_

**Fuel Tanks:** Inspect condition of visible portion. Verify no leaks. Verify security. Check interior for foreign objects and cracks in baffle. \_\_\_\_\_

**Aux Fuel Tank Fuel Hose:** Inspect condition. Verify clearance to structure. Verify no leakage. Verify security. If hose is C595-1 "breakaway" style (later helicopters), visually inspect coupling and verify no leakage, four rivets are installed and secure, and gap is not excessive (0.005 inch max.). \_\_\_\_\_

**Fuel Gage Sender(s) and Wiring:** Inspect condition. Verify no fuel leaks. \_\_\_\_\_

2.410 Inspection Procedures and Checklist (continued)**6. Open Cowling Door(s) (6A & 6B) & Remove Aft Cowling (6C) (continued)**

**Fuel Tank Sump Drain(s):** Inspect condition. Verify drain valve(s) open easily, drain fuel freely, spring closed, and seal completely. \_\_\_\_\_

**Low Fuel Warning:** Turn battery on. With a clean wooden dowel, gently depress low fuel sender float in main fuel tank and verify LOW FUEL warning light illuminates after approximately 1 second delay. Turn battery off. \_\_\_\_\_

**Fuel Cap(s):** Refer to Figure 2-4A. Verify A689-6 fuel cap is revision J or subsequent if bladder tanks are installed (revision J or subsequent caps may also be used on all-aluminum tanks). Inspect condition. Verify no deterioration of gasket(s). Verify security when closed. Refer to R22 SB-107; verify cap decal is legible and properly installed, and alignment marks on cap and tank align when cap is fully closed. \_\_\_\_\_

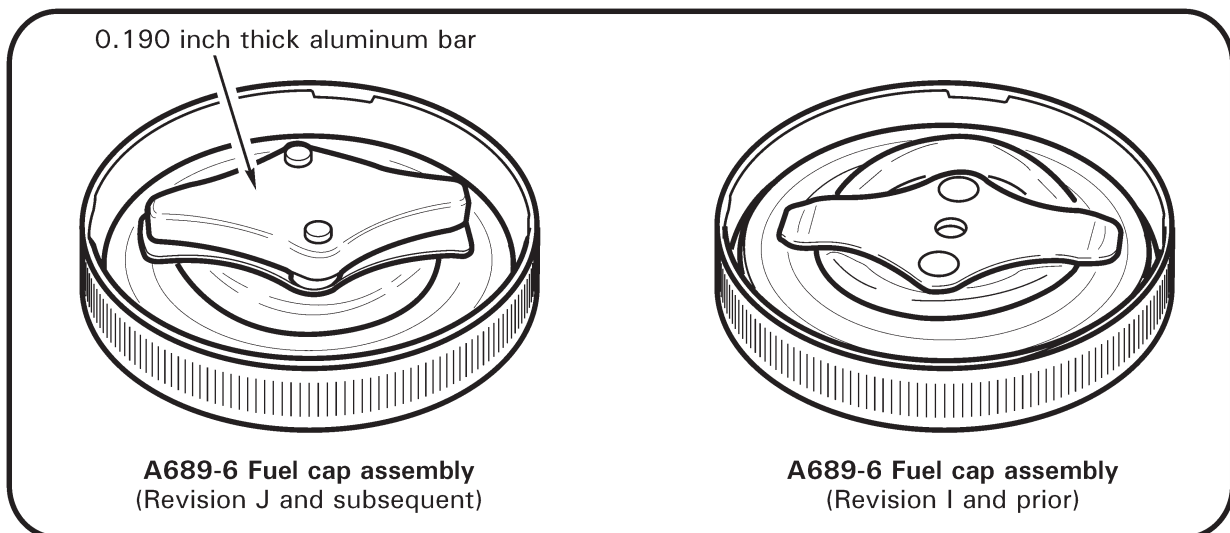


FIGURE 2-4A A689-6 FUEL CAPS

**Collective Jackshaft Supports:** Inspect condition. Inspect rod ends per § 2.120. Verify no cracks or corrosion. Verify strut ends are sealed. Verify security. \_\_\_\_\_

**Collective Jackshaft:** Inspect condition. Verify no cracks or corrosion. If open type, verify no internal corrosion. Verify security. Verify operating clearance. \_\_\_\_\_

**Swashplate Push-Pull Tubes:** Inspect condition of visible portions. Verify no cracks at ends. Inspect rod ends per § 2.120. Verify no tears in, or wear through, heat-shrink sleeves on forward push-pull tubes. Verify security and operating clearance. \_\_\_\_\_

**Push-Pull Tube Guides or Rollers:** Inspect condition. Verify cleanliness, no wear into metal, and free movement of rollers. Verify security. \_\_\_\_\_

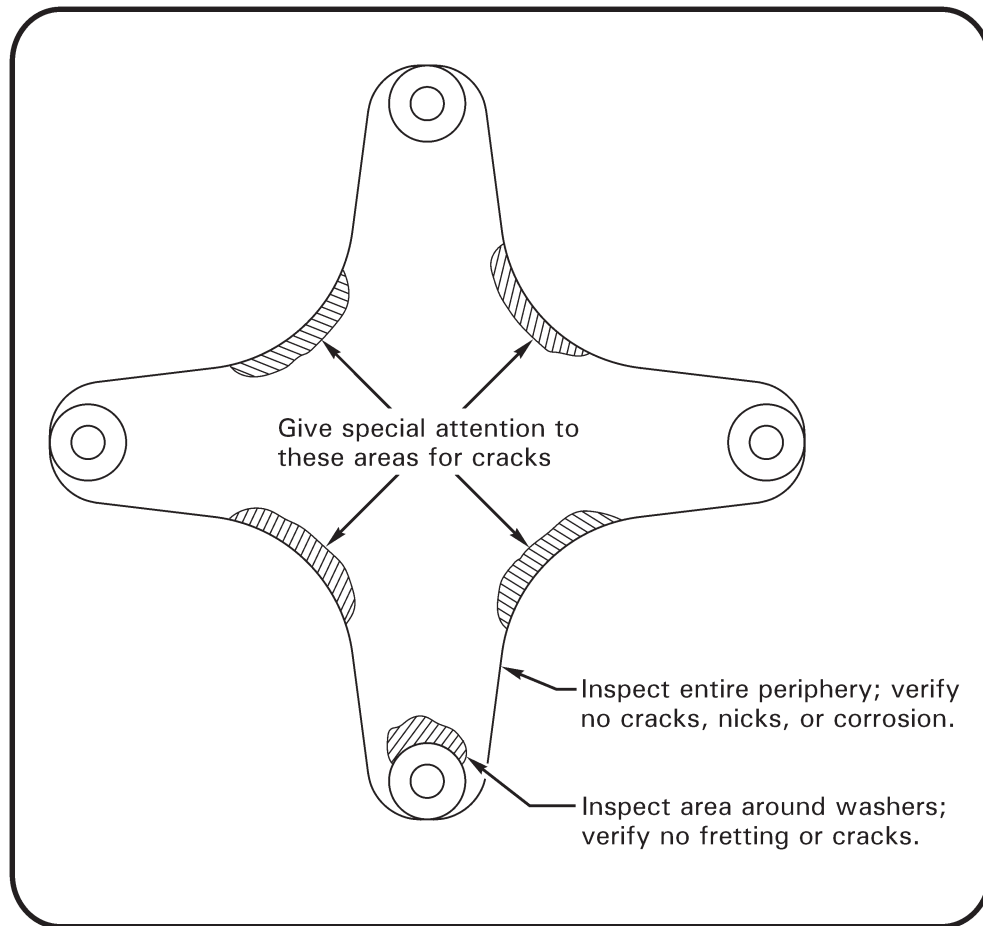


FIGURE 2-4B A947-1 FLEX PLATE INSPECTION

2.410 Inspection Procedures and Checklist (continued)

**6. Open Cowling Door(s) (6A & 6B) & Remove Aft Cowling (6C) (continued)**

**Tail Rotor Push-Pull Tube and Bellcrank (at forward end of A121-15 push-pull tube):** Inspect condition. Inspect rod ends per § 2.120. Verify no cracks in tube ends. Verify no cracks at bellcrank sheet metal mounting. Verify security and operating clearance.

**Main Rotor Gearbox Cooling Air Duct and Nozzle:** Inspect condition. Verify security. Verify no rips, holes, chafing, or obstructions. Inspect condition and verify security of horizontal firewall grommet around duct.

2.410 Inspection Procedures and Checklist (continued)**6. Open Cowling Door(s) (6A & 6B) & Remove Aft Cowling (6C) (continued)**

**Main Rotor Gearbox:** Inspect condition, especially gearbox mounts, static mast tube-to-gearbox attachment, and mast tube lower casting (if applicable). Inspect Telatemp per § 2.130. Verify proper oil level with no leakage. Verify security. Verify security of Hall Effect senders.

**NOTE**

At 500 hours time in service or annually, whichever occurs first, remove chip detector and clean any varnish accumulation from detector's magnetic probe and adjacent metal body using a toothbrush and approved solvent per § 22-11. Drain and flush gearbox at intervals not to exceed 500 hours time in service (refer to § 22-13).

**Rotor Brake:** Inspect condition, including activating cable & pulley and microswitch. Verify integrity of brake pads and 0.030 inch minimum pad thickness. Verify brake pad clearance to input yoke when brake is off. Verify security and operating clearance.

**MRGB Input Yoke:** Inspect condition. Verify security and operating clearance. Verify security of magnets.

**Forward Flex Plate:** Refer to Figure 2-4B. Inspect condition. Verify no distortion, nicks, scratches, cracks, corrosion, or fretting. If fretting is detected, contact RHC Technical Support. Verify bonded washers are installed on both sides of each flex plate ear. Verify proper installation, security, and operating clearance.

**WARNING**

**A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, flex plate is unairworthy and cannot be repaired. Ensure A947-1 forward flex plate is Rev E or subsequent (identified by letter, "E" or subsequent letter, on two adjacent arms of flex plate).**

**Clutch Shaft Forward Yoke:** Inspect condition. Verify no cracks, corrosion, or fretting. Verify security and operating clearance.

**Clutch Assembly:** Inspect condition. Verify no oil leakage. Verify no clutch shaft corrosion, especially at shaft-to-A966-1 seal junctures. Remove any light surface corrosion at shaft-to-seal junctures and apply wax or suitable corrosion preventative compound. Verify no cracks in seal retainer plates.

**NOTE**

Clutch assembly lubricant inspection and servicing (§ 7.214) is recommended every 500 hours time in service.

2.410 Inspection Procedures and Checklist (continued)**6. Open Cowling Door(s) (6A & 6B) & Remove Aft Cowling (6C) (continued)**

**Upper Sheave:** Inspect condition. Verify smoothness of drive belt contact surfaces. Replace any sheave having corrosion, pitting, flaking, roughness, sharp ridges, wear through anodized coating, or blistering of optional metalized coating.

**Upper Steel Tube Frame:** Inspect condition. Verify no cracks or corrosion. If corrosion is found, inspect and repair per § 2.560. Use an inspection light and mirror to inspect all parts of each weld.

**CAUTION**

Upper steel tube frame is fatigue loaded and therefore susceptible to fatigue cracks. Inspect all joints very thoroughly.

**Horizontal Firewall:** Inspect condition, especially where bolted to steel structure. Verify no cracks, buckling, or wrinkles.

**Cabin Aft Bulkhead:** Inspect condition. Verify no corrosion, loose rivets, deformation, or cracks.

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1.

**7. Remove Side Skirts (7A, 7B, 7D, & 7E), Spark Plug Access Covers (7C & 7F), and Battery Box Cover (7G, alternate location under upper console or left seat)**

**Engine:** Refer to Lycoming Operator's Manual (Lycoming P/N 60297-12 or 60297-16, as applicable) Sections 4 and 5 and Lycoming SI 1080 (current revision) for 100-hour or annual inspection and service procedure.

**Muffler:** Open heater shroud (if installed). Inspect muffler condition. Verify no cracks or ruptures. Pay particular attention to tail pipe and riser attachment areas, welds, clamps, riser flanges and gaskets. Verify no internal obstructions.

**Muffler Leak Check:** Pressurize muffler with low pressure air and inspect for leakage by applying soapy water to exterior and looking for air bubbles. Verify security.

**WARNING**

Exhaust system failure can result in carbon monoxide poisoning, partial loss of power, or fire.

**Heater Shroud (if installed):** Inspect condition. Close and secure shroud and connect hoses.

**Engine Cooling Panels:** Inspect condition. Pay particular attention to panel attached to oil cooler and panel attached to alternator cooling hose. Verify no cracks or missing or loose fasteners. Verify security.



2.410 Inspection Procedures and Checklist (continued)**7. Remove Side Skirts (7A, 7B, 7D, & 7E), Spark Plug Access Covers (7C & 7F), and Battery Box Cover (7G, alternate location under upper console or left seat) (continued)**

**Alternator & Pulley:** Inspect condition. Verify steel pulley (use magnet); aluminum pulley is not approved. Verify security. \_\_\_\_\_

**Alternator Wiring:** Inspect condition. Verify no evidence of arcing. Verify security of output, aux, and field terminal studs. Verify no damage to insulating spacer at output stud. Verify wiring security. \_\_\_\_\_

**Alternator Belt:** Inspect condition. Replace belt if there are any cracks, missing teeth or delamination. Check tension per Lycoming Service Instruction 1129 (current revision). Verify proper belt alignment. \_\_\_\_\_

**Emergency Spare Alternator Belt:** Remove if installed. \_\_\_\_\_

**Alternator Cooling Hose:** Inspect condition. Verify no obstructions or holes. Verify security. \_\_\_\_\_

**Vertical Firewall:** Inspect condition. Verify no cracks, buckling, or wrinkles, especially around structural attachment points. \_\_\_\_\_

**Lower Steel Tube Frames:** Inspect condition. Verify no corrosion or cracks, especially at welds. If corrosion is found, inspect and repair per § 2.560. Verify proper torque (see § 23-32) and safety wiring of drilled-head bolt at lower left frame-to-cabin-belly attachment. \_\_\_\_\_

**Engine Mounts:** Inspect condition. Verify security. Replace rubber mounts exhibiting significant deflection or other than superficial cracks. \_\_\_\_\_

**Throttle Control:** Verify carburetor butterfly bellcrank contacts idle rpm adjustment screw with collective full down and throttle grip at idle position. Verify bellcrank contacts full-open stop when throttle is opened with collective half-up. Inspect rod end per § 2.120. Verify operating clearance, especially at vertical firewall. \_\_\_\_\_

**Throttle Correlation Rigging:** Check per § 10.150 and adjust as required. \_\_\_\_\_

**Full Throttle Switch Rigging:** Check per § 33-60 and adjust as required. \_\_\_\_\_

**Carburetor Mixture Control:** Verify carburetor mixture control moves carburetor mixture control arm stop to stop. Inspect condition and verify security of mixture control cable clamp(s) on air box bracket; push and pull cable housing to ensure it does not slip in clamp(s). Inspect condition and verify security of mixture control cable inner wire attachment to carburetor mixture control arm. Ensure freedom of rotation between mixture control arm and inner wire retention fitting (bolt) when arm moves. Verify mixture control safety spring is properly installed (so spring force moves mixture control arm to full-rich position if inner wire breaks). \_\_\_\_\_

**Engine Electrical Wiring, Alternator Control Unit:** Inspect condition. Verify no wire chafing. Inspect connections. Verify security and no corrosion. \_\_\_\_\_

2.410 Inspection Procedures and Checklist (continued)**7. Remove Side Skirts (7A, 7B, 7D, & 7E), Spark Plug Access Covers (7C & 7F), and Battery Box Cover (7G, alternate location under upper console or left seat) (continued)**

**Oil Lines & Elbows:** Inspect condition. Verify clearance and no cracks or abrasions. Wires, ty-raps, and structure must not contact lines. \_\_\_\_\_

**Oil Line Clamps:** Inspect condition. Verify no broken clamps. \_\_\_\_\_

**Oil Cooler:** Inspect condition. Verify no cracks or leakage. Verify security. Verify airflow path through cooling fins is unobstructed. \_\_\_\_\_

**Gascolator:** Inspect condition. With fuel valve in OFF position, remove and clean gascolator bowl and filter screen. Reinstall bowl, turn fuel valve ON. Safety wire retainer after ensuring no leakage. Verify drain valve opens easily, drains fuel freely, springs closed, seals completely, and is torque-stripped per § 23-31. \_\_\_\_\_

**Fuel Hose:** Inspect condition, verify security, clearance, no cracks, abrasion or leakage. \_\_\_\_\_

**Carburetor Air Box:** Open air box. Inspect condition. Verify free movement of disk in drain valve (not applicable to Mariners). Verify security. If installed, verify free movement and full closure of spring-loaded alternate air door. \_\_\_\_\_

**Carburetor Heat Valve:** Verify carburetor heat control fully opens and closes slider valve. Inspect condition and verify security of carburetor heat cable clamp on air box. Inspect condition and verify security of carburetor heat control cable inner wire attachment to slider valve. \_\_\_\_\_

**Air Filter:** Clean B771-1 air filter per § 6.435. Close and secure air box. \_\_\_\_\_

**Carburetor Air Inlet Hose:** Inspect condition. Verify no obstructions, leakage, or chafing. Verify security. \_\_\_\_\_

**Carburetor Heat Scoop and Hose:** Inspect condition. Verify security. Verify no obstructions, leakage, chafing, or scoop cracks. \_\_\_\_\_

**Heater Hoses (if installed):** Inspect condition. Verify security and no obstructions, leakage, or chafing. Verify security. \_\_\_\_\_

**Battery, Battery Cables, and Battery Box (alternate locations under upper console or left seat):** Inspect condition. Check each battery cell electrolyte for quantity and specific gravity (non-sealed batteries only). As required, perform capacity test or replace battery per manufacturer's instructions. Verify battery cable security and no cracked or corroded terminals. Verify security of, and no obstructions in, battery box drain tube (if installed). \_\_\_\_\_

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

2.410 Inspection Procedures and Checklist (continued)**8. Remove Tailcone Fairing (8)**

**Tailcone Fairing:** Inspect condition. \_\_\_\_\_

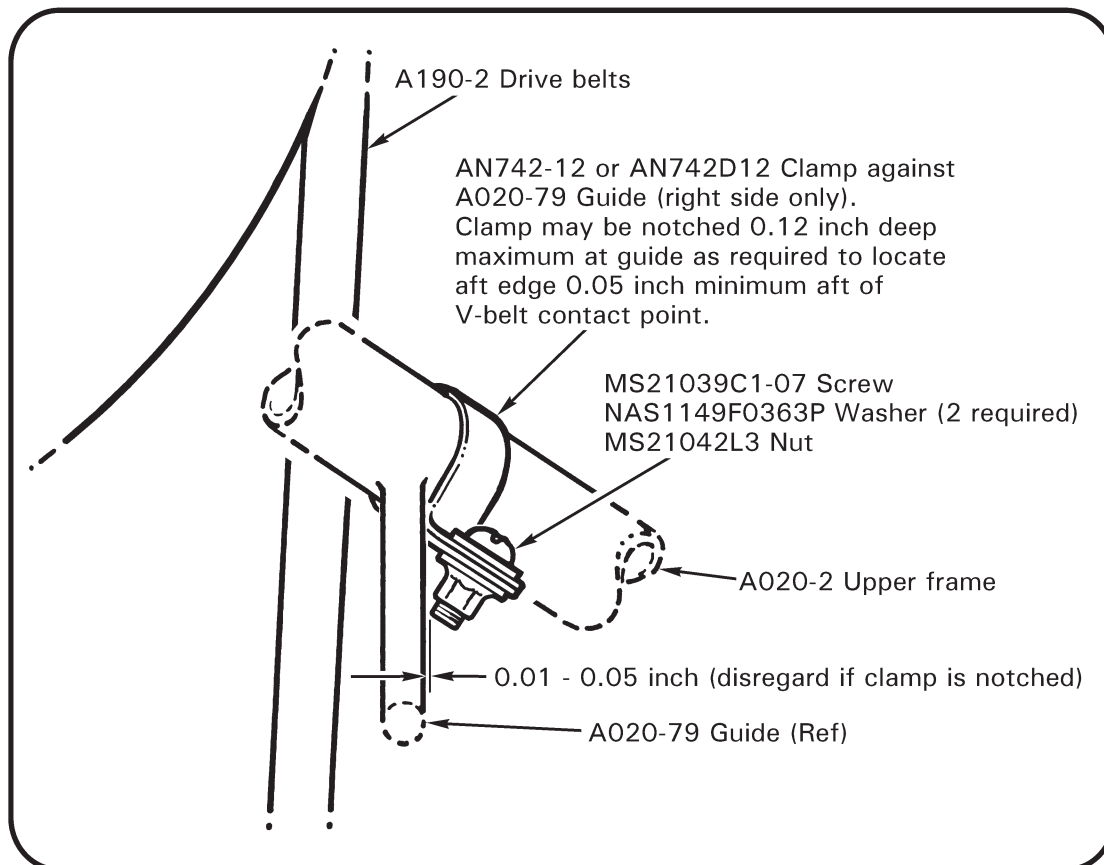
**Upper Steel Tube Frame:** Inspect condition. Verify no cracks or corrosion. If corrosion is found, inspect and repair per § 2.560. Use an inspection light & mirror to inspect all parts of each weld. \_\_\_\_\_

**CAUTION**

Upper steel tube frame is fatigue loaded and therefore susceptible to fatigue cracks. Inspect all joints thoroughly.

**Tailcone-to-Upper Frame Attachment:** Inspect condition. Verify security. \_\_\_\_\_

**Upper Frame Protective Clamp:** Inspect clamp protecting right side upper frame tube from drive belt contact; replace if wear has penetrated clamp. If clamp is not installed, verify no more than 0.0049 inch wear into frame tube due to drive belt rubbing. Protective clamp may be installed per Figure 2-4C on any R22 if desired. \_\_\_\_\_



**FIGURE 2-4C UPPER FRAME PROTECTIVE CLAMP INSTALLATION**  
(View looking forward)

2.410 Inspection Procedures and Checklist (continued)**8. Remove Tailcone Fairing (8) (continued)**

**Actuator Upper Bearing:** Inspect condition. Verify no more than 0.060 inch axial play. Verify no fretting between bearing inner race and clutch shaft. Verify bearing inner race has not slipped relative to clutch shaft. Inspect Telatemp per § 2.130. Perform § 22-41 bearing inspection if unexplainable Telatemp increase has occurred.

**CAUTION**

A184 bearing requires periodic lubrication per § 1.101.

**Actuator Upper Bearing Lubrication:** Perform as required.

**Clutch Lateral Centering Strut Assembly:** Inspect condition. Inspect rod ends per § 2.120. Verify security.

**Intermediate Flex Plate and Yokes:** Refer to Figure 2-4B. Inspect condition. Verify no distortion, nicks, scratches, cracks, corrosion, or fretting. If fretting is detected, contact RHC Technical Support. Verify bonded washers are installed on both sides of each flex plate ear. Verify proper installation, security, and operating clearance.

**WARNING**

**A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, flex plate is unairworthy and cannot be repaired.**

**Tail Rotor Push-Pull Tubes and A331-1 Bellcrank:** Inspect condition. Verify no cracks at tube ends. Inspect rod ends per § 2.120. Verify security and operating clearance.

**Drive V-Belts:** Inspect per § 2.507.

**Fanshaft:** Inspect condition. Perform 360° visual inspection of exposed fanshaft for cracks. Verify security and safety wiring of attaching bolts.

**Actuator Lower Bearing:** Inspect condition, verify bearing inner race has not slipped relative to fanshaft. Inspect Telatemps per § 2.130. Perform § 22-42 bearing inspection if unexplainable Telatemp increase has occurred.

**CAUTION**

A181-4 bearing requires periodic lubrication per § 1.101.

**Actuator Lower Bearing Lubrication:** Perform as required.

2.410 Inspection Procedures and Checklist (continued)**8. Remove Tailcone Fairing (8) (continued)**

**Actuator Lower Bearing Lubrication:** Perform as required.

**Lower Bearing Brackets:** Refer to Figure 2-4D. Visually inspect A185 brackets and attaching rivets for evidence of fretting or looseness. If evidence of looseness is found repair per R22 SL-74A. On lower A185 bracket, apply torque seal in a horizontal stripe across both outboard rivets to lower scroll to facilitate future inspections.

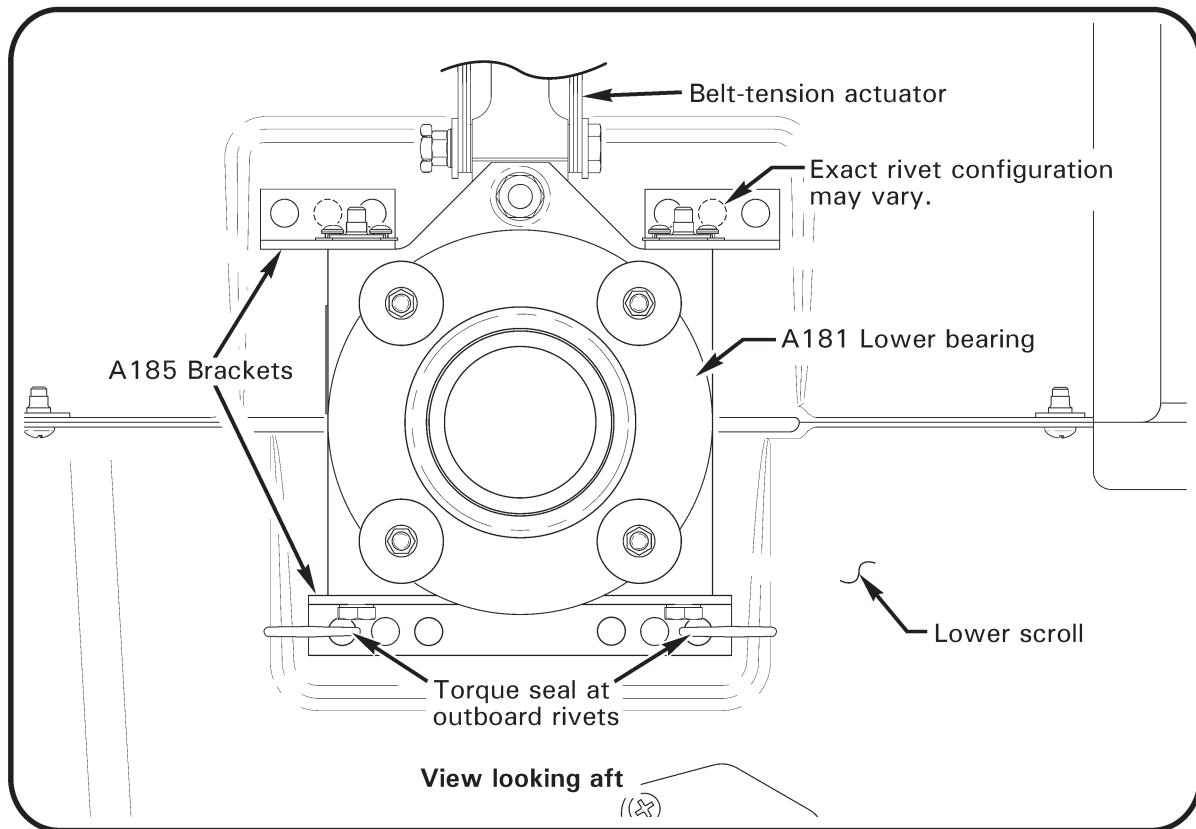


FIGURE 2-4D ACTUATOR LOWER BEARING A185 BRACKETS

**Fiberglass Scroll:** Inspect condition. Verify no damage to vane assembly in upper right scroll. Verify security. Verify drain hole is unobstructed.

**Scroll Metal Inlet Lips & Gap (if installed):** Inspect condition. Verify 0.020 to 0.100 inch gap between lips and fanwheel inlet. (Attach holes in lips may be elongated to facilitate gap adjustment.)

**Fanwheel Assembly:** Inspect condition. Verify no cracks or corrosion. Check leading edge of vanes for damage. Verify alignment of roll pin and slippage marks on fanwheel. If marks and roll pin do not align, remove fanwheel and inspect hub and shaft for damage. Verify security.

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2.410 Inspection Procedures and Checklist (continued)**8. Remove Tailcone Fairing (8) (continued)**

**Actuator (A051-1):** Turn master switch on and engage clutch switch. While actuator is engaging, depress extension limit switch lever and verify gear motor stops; release lever and verify gear motor resumes running. Use an inspection mirror to observe column springs at end of belt-tensioning cycle; springs should snap outward simultaneously. Verify maximum engaged extension limit per Figure 7-15 is not exceeded. Verify security of attachment to A181 and A184 bearings. Verify gear motor security and minimum 0.030 inch clearance to upper frame.

**Actuator Spring Switches:** Check using either of following two methods, as appropriate:

Method 1 – (actuator electrical harness must be equipped with “Test” plug)

**CAUTION**

When using MT558-1 plug assembly (see Figure 2-5), if gear motor does not shut off when column springs snap outward then spring switch has failed in closed position; immediately remove MT558-1 to prevent actuator damage.

- a. Disengage actuator. Connect one end of MT558-1 to actuator test plug. Engage actuator and verify gear motor shuts off when column springs snap outward.
- b. Disengage actuator. Connect opposite end of MT558-1 to actuator test plug. Engage actuator and verify gear motor shuts off when column springs snap outward.
- c. MT558-1 pins 1-2 jumper tests the wire 98 spring switch; the pins 2-3 jumper tests the wire 91 spring switch (see Figure 14-4A). If either switch does not function properly, replace switch section per § 7.551 before further flight.

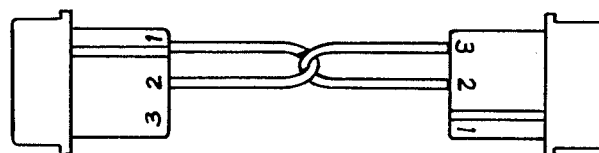


FIGURE 2-5 MT558-1

2.410 Inspection Procedures and Checklist (continued)**8. Remove Tailcone Fairing (8) (continued)****Actuator Spring Switches (continued):**

Method 2 – (use if actuator electrical harness is not equipped with “Test” plug)

- a. Refer to Figure 2-5A. Depress column springs on one side of actuator until springs snap inward (use large screwdriver or similar tool with several layers to tape over end to protect actuator). Hold springs inward for at least one second. Actuator motor should not run. If motor starts, allow motor to run approximately two seconds, then release pressure on column springs. Depress column springs again. If motor starts again, opposite spring switch does not function properly. \_\_\_\_\_
- b. Disengage and re-engage actuator. Repeat step a. on opposite-side column springs. \_\_\_\_\_
- c. If either switch does not function properly, replace switch per § 7.551 before further flight.

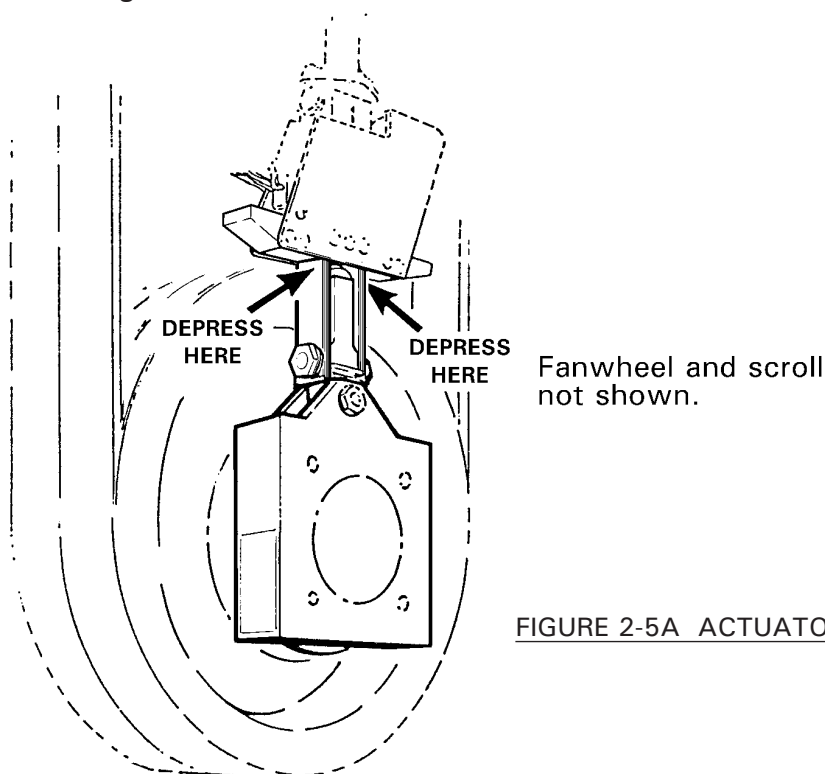


FIGURE 2-5A ACTUATOR FUNCTION TEST

**Lower Sheave:** Inspect condition. Verify smoothness of drive belt contact surfaces. Remove any surface corrosion and refinish with approved primer (chromate primer preferred; refer to § 23-75). Replace any sheave showing corrosion-pitting or flaking of metalized coating, roughness, or sharp ridges. \_\_\_\_\_



2.410 Inspection Procedures and Checklist (continued)**8. Remove Tailcone Fairing (8) (continued)**

**Engine Height:** Check per § 6.130 and adjust as required. \_\_\_\_\_

**Clutch Shaft Angle:** Check per § 7.240. Replace drive belts as required. \_\_\_\_\_

**Sheave Alignment:** Check per § 7.230 and adjust as required. \_\_\_\_\_

**Throttle Correlation Rigging:** Check per § 10.150 and adjust as required. \_\_\_\_\_

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

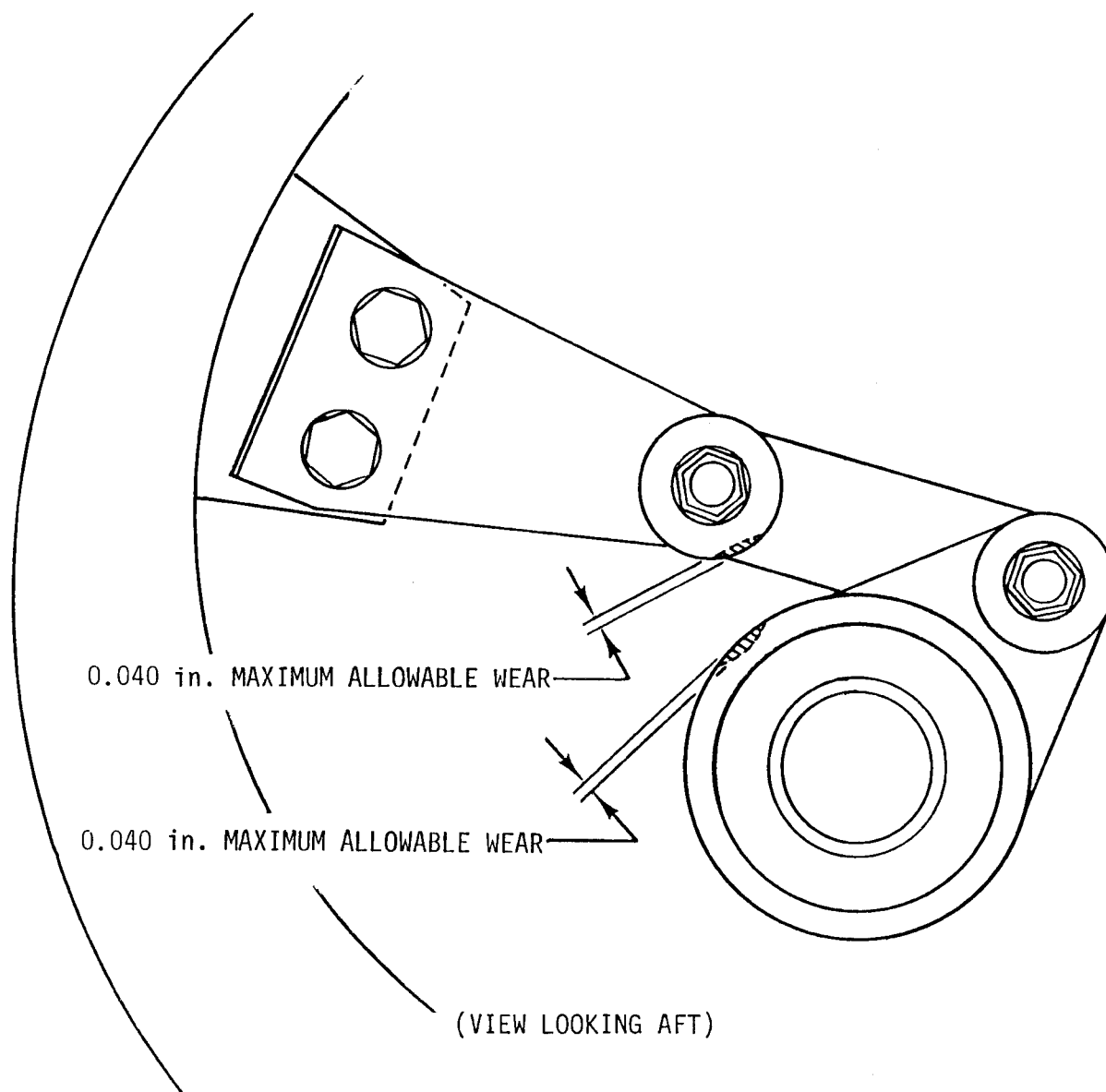


FIGURE 2-6 DAMPER BEARING HOUSING WEAR LIMITS

2.410 Inspection Procedures and Checklist (continued)

- 9. Remove 4 Tailcone Inspection Covers (9):** Verify nutplate self-locking feature when removing.

**Inspection Covers:** Inspect condition. \_\_\_\_\_

**Tail Rotor Drive Shaft:** Inspect condition. Verify no cracks, bends, or contact with inside of tailcone. Refer to Figure 7-12C for corrosion limitations. Check runout per § 7.340. \_\_\_\_\_

**Tail Rotor Push-Pull Tube:** Inspect condition. Inspect rod ends per § 2.120. Verify wear does not exceed § 2.120 limits. Verify no cracks in ends. Verify operating clearance. Verify tail rotor guard mounting screw shanks clear push-pull tube. \_\_\_\_\_

**Damper:** Inspect condition. Verify security. Verify bearing housing wear is within Figure 2-6 limits. \_\_\_\_\_

**Tailcone Interior:** Inspect condition. Verify no loose rivets or corrosion. Verify no excessive wear in tail rotor push-pull tube bushings. Verify no cracks, especially at damper-to-tailcone attachment. \_\_\_\_\_

**Lower, Whip Antenna (if installed):** Remove four screws securing antenna mounting plate to tailcone. Verify no cracks or corrosion on mounting plate or tailcone mount. Inspect antenna and wiring condition. Install antenna. Verify security. \_\_\_\_\_

**Upper Antenna(s) (if installed):** Inspect antenna and wiring condition. Verify security and no cracks at attachment to tailcone. \_\_\_\_\_

**Tailcone Exterior:** Inspect condition. Refer to § 4.310. Inspect tailcone exterior for nicks, scratches, dents, cracks, corrosion, fretting or loose rivets. Verify no obstructions in drain hole at forward edge of each bay (except forward bay). Inspect tailcone for cracks in vicinity of antenna mounts. \_\_\_\_\_

**B375-2 Horizontal Stabilizer:** Inspect condition. Verify no nicks, scratches, dents, cracks, corrosion, fretting, or loose rivets. Verify security. \_\_\_\_\_

**Tail Rotor Visual Warning Guard:** Inspect condition. Verify no cracks or corrosion, especially at tailcone attachment. Verify security. \_\_\_\_\_

**Strobe Light:** Inspect condition. Verify cleanliness and security. \_\_\_\_\_

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

2.410 Inspection Procedures and Checklist (continued)

10. Remove Plastic Cover (10)

**Plastic Cover:** Remove and clean. Inspect condition. Replace as required and install. Verify nutplate self-locking feature when installing. \_\_\_\_\_

**Empennage:** Inspect condition. Verify security. Verify no cracks or loose fasteners. Verify lower vertical stabilizer and tail skid drain holes are unobstructed. Refer to special inspection section for tail skid strike inspection criteria. \_\_\_\_\_

**Aft Navigation Light:** Inspect condition. Verify cleanliness, clear lens, and security. \_\_\_\_\_

**Aft Flex Plate:** Refer to Figure 2-4B. Inspect condition. Verify no distortion, nicks, scratches, cracks, corrosion, or fretting. If fretting is detected, contact RHC Technical Support. Verify bonded washers are installed on both sides of each flex plate ear. Verify proper installation, security, and operating clearance. \_\_\_\_\_

WARNING

A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from a A947 flex plate, flex plate is unairworthy and cannot be repaired.

**Tail Rotor Gearbox:** Inspect condition, including seals. Verify proper oil level and no leakage. Verify security and safety wire integrity. Verify output shaft cleanliness. \_\_\_\_\_

NOTE

At 500 hours time in service or annually, whichever occurs first, remove chip detector and clean any varnish accumulation from detector’s magnetic probe and adjacent metal body using a toothbrush and approved solvent per § 22-21. Drain and flush gearbox at intervals not to exceed 500 hours time in service (refer to § 22-23).

2.410 Inspection Procedures and Checklist (continued)**10. Remove Plastic Cover (10) (continued)**

**Tail Rotor Pitch Control Assembly and Aft Bellcrank:** Inspect condition. Inspect spherical bearing in underside of pitch control per § 2.120; it is permissible to have a single radial crack in this spherical bearing ball. Verify no excessive looseness on output shaft (0.25 inch maximum rotational play measured at pitch link attaching bolt head). Verify operating clearance and assembly slides freely on output shaft. Verify no leakage at bearing seals. Verify security.

**WARNING**

**A031-1 Rev. J or prior pitch control assemblies require repetitive inspection per R22 Service Bulletin SB-90A every 300 hours or annually, whichever occurs first.**

**Pitch Links:** Inspect condition. Inspect rod ends and spherical bearings per § 2.120. Remove and reinstall pitch links with outboard end inboard and inboard end outboard as required to obtain maximum service life; additionally, an optional A215-012 o-ring may be installed on A115-1 spacer under bolt head at pitch control. Reinstall chordwise weights at respective attachment points for balance purposes. Verify proper installation, security, and operating clearance.

**Tail Rotor Blades:** Refer to R22 SB-120. Inspect condition. Refer to § 28-30 for damage limits and repair. Verify no buckling. Verify no looseness between feather bearing outer races and root fittings. Inspect bearings per § 2.120. Verify no obstructions in blade tip drain holes. Verify proper installation, security, and pitch change operation.

**WARNING**

**Structural damage may occur if compressed air is applied to blade tip drain holes.**

**Tail Rotor Hub:** Inspect condition. Verify no nicks, scratches, gouges, dents, cracks, or corrosion. Inspect elastomeric teeter hinge bearings per § 2.125. Teeter the rotor hub and verify teeter bearing bolt, spacers, and nuts do not rotate. Verify hub teeters smoothly. Verify proper installation and security of blade bolts.

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1.

2.410 Inspection Procedures and Checklist (continued)**11. Open Mast Fairing (11)**

**Mast Fairing:** Inspect condition. Verify no cracks, dents, or corrosion. Verify no yielding or cracking of A665-1 restraint. Yielding can be caused by overtightening screws in restraint nutplates.

**Upper and Lower Ribs:** Inspect condition. Verify security, especially tightness of lower rib clamp.

**Three Vertical Push-Pull Tubes (Two A121-7 and One A121-5):** Inspect condition. Inspect rod ends per § 2.120. Verify no cracks at upper ends. With collective full up and cyclic full aft, verify no wear of A121-7 tubes or sleeves, especially where sleeves rub inside guide assembly. Verify security and operating clearance.

**Pitot Tube and Line:** Inspect condition. Verify no cracking, chafing, or kinking. Ensure drain hole on bottom of elbow behind pitot tube is clear. Verify security.

**Fuel Tank Vent Metal Lines and Plastic Tubes:** Inspect condition. Verify no kinking or obstructions. Verify security.

**Swashplate Upper Scissors:** Inspect condition. Inspect rod ends and spherical bearings per § 2.120. Measure scissors play per Figure 2-8. Observe scissor linkage while having someone raise and lower collective. Verify bolt, journals (or spherical bearing balls and spacers), and arm rotate together at each scissor linkage pivot. Verify operating clearance.

**Swashplate Lower Scissors:** Inspect condition. Inspect rod ends per § 2.120. Verify security.

**Swashplate Slider Tube:** Inspect condition. Verify no cracks at rivet holes or corrosion on base. Verify no damage to, or wear through, anodized tube surface. When viewed under 10X magnification, minute "checkerboarding" of anodized surface is normal.

**Remove Swashplate Boot Lower Ty-rap:** Lift boot from swashplate. Using an inspection mirror, inspect area between main rotor drive shaft and inside of slider tube. Verify no corrosion and no debris. Verify no boot damage.

**Swashplate:** Inspect condition. Verify 0.020 inch maximum radial play between swashplate ball and slider tube. Rotate rotor by hand and verify operating clearance and no rough or dry bearings.

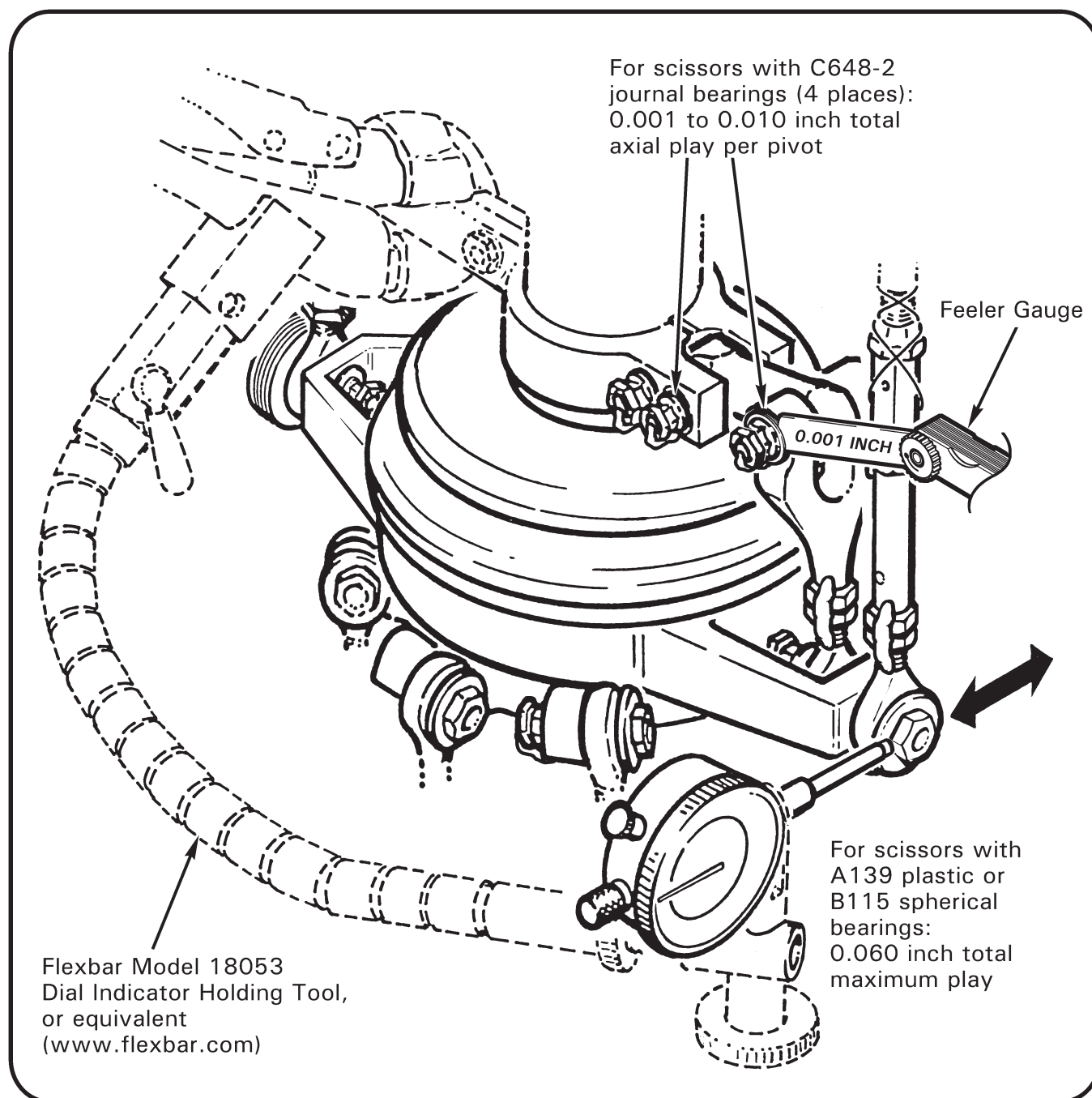
**Swashplate Shimming:** Observe swashplate ball from below and have someone move collective stick slowly up & down. Verify swashplate ball immediately moves with swashplate when swashplate reverses direction. Movement of swashplate without attendant ball movement indicates axial play between ball and swashplate; shim swashplate per § 8.416.

**Install Swashplate Boot Lower Ty-rap:** Verify correct boot position and security and no boot damage.

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1.

2.410 Inspection Procedures and Checklist (continued)**11. Open Mast Faring (11) (continued)**

**Main Rotor Drive Shaft:** Inspect condition of accessible portion. Verify no corrosion.



**FIGURE 2-8 MEASURING UPPER SWASHPLATE SCISSORS PLAY**  
(Identify scissors bearing type and measure as shown)

2.410 Inspection Procedures and Checklist (continued)**12. Rotor Hub and Hinge Bolts**

**Hub:** Inspect condition. Verify no nicks, scratches, gouges, or corrosion. If main rotor imbalance is suspected, check teeter and coning hinge friction per § 26-32. Verify no brown or black residue (indicates bearing wear). \_\_\_\_\_

**Hinge Bolts (three):** Inspect condition; corrosion is prohibited. Verify cotter pins are in place and secure. Verify bolt heads and nuts are torque striped to thrust washers. \_\_\_\_\_

**Pitch Links and Rod Ends:** Inspect condition. Inspect rod ends per § 2.120, including centering. Verify security, including jam nut tightness and proper safety wiring. \_\_\_\_\_

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

**13. Main Rotor Blades**

**Blade Boots:** Inspect condition. Verify no boot damage or oil leakage. Verify proper boot position and security. Verify sufficient clearance from hub assembly through full control travel. \_\_\_\_\_

**Blade Spindles & Root Fittings:** Inspect area for damage per § 26-43. Comply with FAA Airworthiness Directive 88-26-01 (current revision) as required (A158-1 spindles only). Verify proper installation and security of visible fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

**Main Rotor Blade Tip Maintenance:** Perform main rotor blade tip maintenance per § 26-60. \_\_\_\_\_

**Main Rotor Blade Inspection:** Inspect skins and doublers for scratches and corrosion per § 26-41. Inspect blades for dents and local deformations per § 26-42 and for voids per § 26-44. As required, wax blades with soft cleaning cloths using carnauba-type wax (such as SC Johnson® Paste Wax). Ensure tip cover and blade tip drain holes are unobstructed. \_\_\_\_\_

**WARNING**

Structural damage may occur if compressed air is applied to blade tip drain holes.



2.410 Inspection Procedures and Checklist (continued)**14. Cabin**

**General:** Verify no loose equipment that might interfere with controls. \_\_\_\_\_

**Seat Belts:** Inspect condition. Verify no fraying, broken stitching, holes, or rotting. Verify no significant discoloration due to UV damage. Check inertia reels for proper operation. Check buckles for proper operation. Verify security. \_\_\_\_\_

**NOTE**

TSO tag not required on factory-installed harnesses.

**Windows:** Inspect condition. Verify no significant UV damage (yellowing). Minor defects or imperfections that do not impair pilot's visibility are considered acceptable. Acceptable defects include:

One nick, no more than 0.010 inch deep and no larger than 0.25 by 0.50 inch per square foot. \_\_\_\_\_

Scratches no more than 0.010 inch deep and 5 inches long. \_\_\_\_\_

Any surface defect such as small spots or stains that can be removed with light polishing. \_\_\_\_\_

For cracks and crazing adjacent to windshield edges refer to § 25-20. \_\_\_\_\_

**Yaw String:** Inspect condition. Minimum 3 inches long each side. Verify security. \_\_\_\_\_

2.410 Inspection Procedures and Checklist (continued)**14. Cabin (continued)**

**Exterior:** Inspect condition. Verify no cracks, corrosion, or damage. Verify no loose rivets. Loose rivets may be indicated by cracked paint and/or black residue around heads. \_\_\_\_\_

**Left and Right Navigation Lights:** Inspect condition. Verify red left, green right, lens cleanliness, and security. \_\_\_\_\_

**Doors:** Inspect condition. Verify no structural cracks around hinges or door latches. Check door vents for operation. Ensure door hinge pins are secured with cotter pins. Check tightness of hinge mounting screws. Verify proper operation of door latching and locking mechanisms. \_\_\_\_\_

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

**15. Landing Gear**

**Skid Tubes and Shoes:** Inspect condition. Verify no more than 0.5 inch wide flat area on underside of skid tube due to wear. Verify longitudinal scratches are not more than 0.030 inch deep, and circumferential scratches are not more than 0.030 inch deep & are less than 0.50 inch long. Verify drain holes are open (not applicable to float landing gear). Verify security of rain caps. Verify minimum 0.05 inch shoe thickness. \_\_\_\_\_

**Struts and Elbows:** Inspect condition. Verify no cracks or corrosion, especially where joined and in weld areas at bottom of struts. Verify security. If helicopter routinely performs running landings, torque check strut-to-skid-tube bolts. \_\_\_\_\_

**Cross Tubes:** Inspect condition. Verify minimum tail skid height per § 5.210. Verify no corrosion. Verify security of rain caps. If a rain cap is loose, verify no internal corrosion. Verify no fretting at elbows. \_\_\_\_\_

**Landing Gear Attach Points:** Inspect condition. Verify no loose fasteners, cracks, buckling, or fretting. Inspect mounts and verify no loose swages or worn bearings. \_\_\_\_\_

**Floats (if installed):** Perform relief valve and bulkhead tests per § 2.580 (2) and (3). Verify proper inflation pressure per R22 POH. Inspect condition. Verify security. \_\_\_\_\_

**Float Skid Tubes (if installed):** Remove drain plugs at aft end of skid extensions. With ground handling wheels installed, pull down on tailcone to drain any trapped moisture. Install drain plugs. \_\_\_\_\_

**Fasteners & Torque Stripes:** Inspect condition and verify security of all fasteners. Renew deteriorated torque stripes per Figure 2-1. \_\_\_\_\_

2.410 Inspection Procedures and Checklist (continued)**16. Life-Limited Parts, Additional Limitations, ADs, & SBs**

**Life-Limited Parts:** Refer to helicopter maintenance records and § 3.300. Replace life-limited parts as required. Verify components installed have sufficient time remaining for projected operations. \_\_\_\_\_ |

**Airworthiness Directives:** Verify applicable airframe, engine, and accessory Airworthiness Directives (ADs) have been performed according to AD compliance procedures. Some aircraft may be affected by ADs that require recurring inspections at less than 100-hour or annual intervals. Recent U.S. Airworthiness Directives are available online at [www.faa.gov](http://www.faa.gov). \_\_\_\_\_ |

**Service Bulletins:** Verify applicable airframe, engine, and accessory Service Bulletins (SBs) have been complied with according to manufacturers' instructions. Some aircraft may be affected by SBs that require recurring inspections at less than 100-hour or annual intervals. RHC Service Bulletins are available online at <https://robinsonheli.com>, under the Publications tab. \_\_\_\_\_ |

**17. Required Documents and Placards**

**Documents:** Check that required documents (Airworthiness Certificate, Registration, applicable Radio Station License, Pilot's Operating Handbook, Equipment List/Weight & Balance Data) are on board, legible, and current. \_\_\_\_\_

**Placards:** Verify required placards are properly installed, legible, and current. Refer to Pilot's Operating Handbook Section 2 for placard requirements. \_\_\_\_\_

**18. Inspection and Access Covers**

**Foreign Objects Removed:** Verify all tools, loose hardware, rags, and other foreign objects are removed from helicopter. \_\_\_\_\_

**Covers Closed and Secure:** Install/close all inspection and access covers removed in preceding steps. Verify security of all access covers. \_\_\_\_\_

**Mariner Airbox Sealed:** Ensure air box cover perimeter is sealed with aluminum tape (Mariner models only). \_\_\_\_\_

2.410 Inspection Procedures and Checklist (continued)**19. Maintenance Records**

**Maintenance Records:** Verify maintenance records are accurate, legible, and complete. Enter maintenance performed (such as part replacement, equipment adjustments, servicing, and lubrication) and inspection data. Data must include a description of (or reference to data acceptable to the Administrator) the work performed, date, helicopter total time in service, signature, certificate type and certificate number of person approving aircraft for return to service. \_\_\_\_\_

**SHEAVE ALIGNMENT LEFT:** \_\_\_\_\_ **ENGINE HEIGHT:** \_\_\_\_\_

**SHEAVE ALIGNMENT RIGHT:** \_\_\_\_\_ **CLUTCH ANGLE:** \_\_\_\_\_

**TRDS RUNOUT:** \_\_\_\_\_

**CHECKLIST COMPLETE:**

Mechanic's signature: \_\_\_\_\_ Date: \_\_\_\_\_

## 2.500 Special Inspections

### 2.501 Clutch Actuator Upper and Lower Bearings Inspection and Lubrication

This section has been moved to § 22-40.

|

### 2.502 A181-4 Actuator Lower Bearing Inspection and Lubrication

This section has been moved to § 22-42.

|

### 2.503 A184 Actuator Upper Bearing Inspection and Lubrication

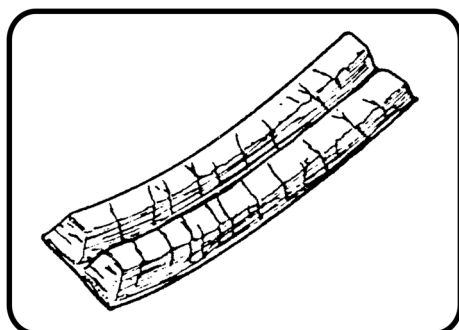
This section has been moved to § 22-41.

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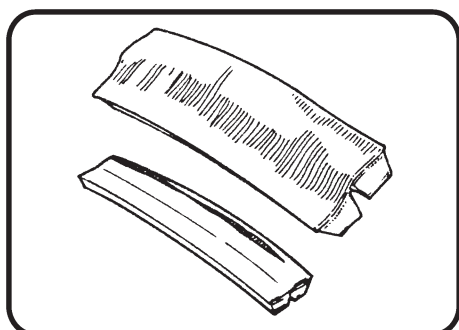
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2.507 V-Belt Inspection

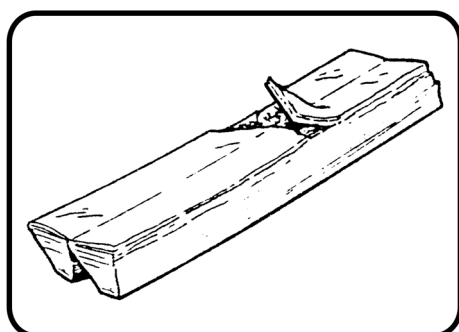
The most common V-belt discrepancies and courses of corrective action are given below.

1. Belts Cracking:

CAUSE	REMEDY
Belt is old.	Replace belts per § 7.280.
Belt slipping causing heat buildup and gradual hardening of undercord.	Replace belts per § 7.280. Replace actuator per § 7.500.

2. Top of Tie Band Frayed or Damaged:

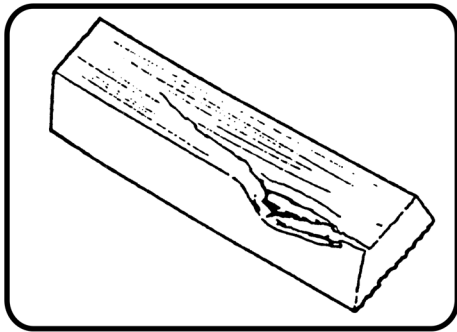
CAUSE	REMEDY
Obstruction interfering with normal belt operation.	Remove obstruction, and replace belts per § 7.280.

3. Top of Tie Band Blistered or Perforated:

CAUSE	REMEDY
Dirt or sand accumulating between belts and sheave.	Replace belts per § 7.280. Periodically wash inside of replacement belts.
Belts worn out.	Replace belts per § 7.280.

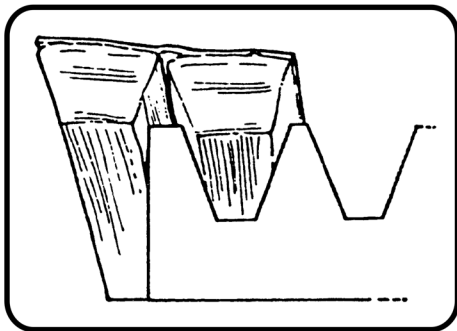
FIGURE 2-10 V-BELT DISCREPANCIES

### 2.507 V-Belt Inspection (continued)



#### 4. Belt Cut on Inside:

CAUSE	REMEDY
Belt forced over sheave flange during installation without proper slack.	Replace belts per § 7.280.
Foreign material fell into belt drive.	Replace foreign material and replace belts per § 7.280.



#### 5. Belt Riding Outside Sheave Groove:

CAUSE	REMEDY
Belt forced over sheave flange during installation without proper slack.	Replace belts per § 7.280.

FIGURE 2-10A V-BELT DISCREPANCIES



### 2.508 Lower Sheave V-Belt Wear Pattern Inspection

Observe wear patterns in paint primer in all four lower sheave grooves. The eight wear patterns (both sides of all four grooves) should appear very similar and be consistent around sheave circumference.

If wear pattern is noticeably different from groove to groove, measure width of narrowest and widest wear patterns. See Figure 2-11. If ratio exceeds 3:1, replace V-belts per § 7.280.

#### CAUTION

RHC does not recommend using A170-1 or -2 Revision N or prior upper sheaves with A493-1 Revision T or later lower sheaves. Such combinations may cause excessive drive belt vibration. Refer to Figure 7-3D.

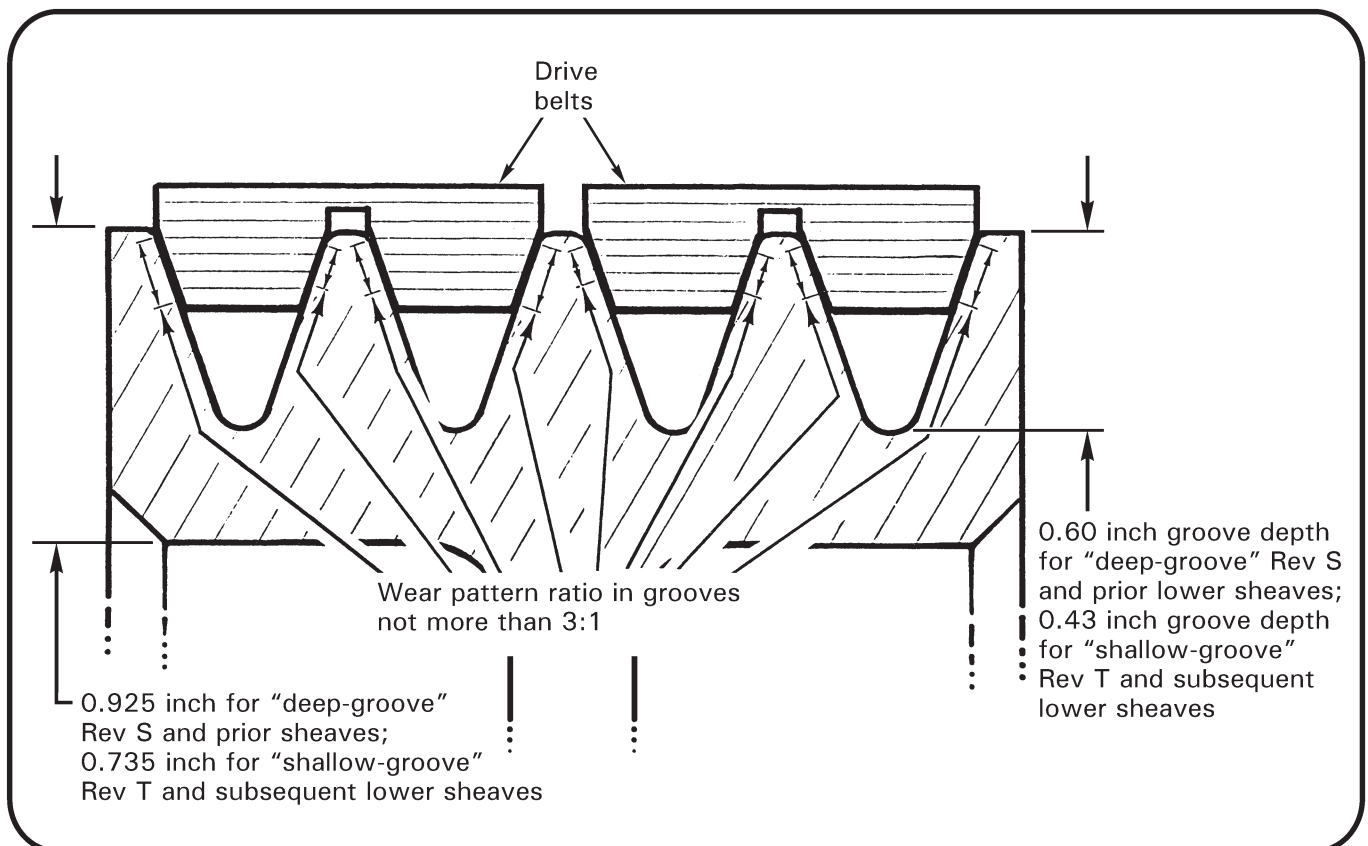


FIGURE 2-11 LOWER SHEAVE V-BELT WEAR PATTERN

### 2.510 Tail Skid Strike

#### **A. Scuffing or Slight Bending of Tail Skid**

1. Visually inspect tail rotor blades. Verify no evidence of solid object or ground contact. If tail rotor damage is found, inspect tail rotor per § 2.520.
2. Visually inspect lower vertical stabilizer. Verify no buckling, cracks, or loose rivets at tail skid and lower vertical to horizontal stabilizer attach points.
3. Visually inspect horizontal stabilizer to tailcone attach points. Verify no buckling, loose rivets, or cracking.
4. Visually inspect tailcone. Verify no damage. Also inspect tailcone-to-upper steel tube frame attach points and verify no buckling or loose attach bolts.

#### **B. Buckling or Breaking of Tail Skid and/or Lower Vertical Stabilizer**

1. Perform inspections per § 2.510.A.
2. Inspect tail rotor drive shaft run-out per § 7.340.
3. Remove tailcone and:
  - a. Visually inspect tailcone attach points. Verify any elongated holes are no greater than 0.265 inch across at widest point.
  - b. See Figure 2-12. Using an approved paint stripper (ref. § 23-71), remove paint from and within 2 inches of tailcone attach points on upper frame.
  - c. Fluorescent penetrant inspect (ref. § 23-42) upper steel tube frame at tailcone attach points.
4. Remove stabilizer assembly and:
  - a. Visually inspect horizontal stabilizer. Verify any elongated holes at attach points are no greater than 0.265 inch across at widest point. Verify no loose rivets or buckling.
  - b. Using an approved paint stripper (ref. § 23-71), remove paint from tailcone casting exterior surfaces.
  - c. Fluorescent penetrant inspect (ref. § 23-42) casting.
5. Remove lower vertical stabilizer from horizontal stabilizer and visually inspect. Verify no buckling, cracks, or loose rivets. Buckling or cracks require replacement of stabilizer. Loose rivets may be drilled out and replaced. Verify any elongated holes at attach points on either stabilizer are no greater than 0.200 inch across at widest point.

2.520 Tail Rotor Strike**A. Contact with Small Stone, Tall Grass, or Other Small Object in Free Air**

1. Inspect tail rotor blades per § 28-30.
2. Check tail rotor drive shaft run-out per § 7.340. If run-out exceeds 0.025 inch at any location, shaft must be replaced or repaired.

**B. Sudden Stoppage of Tail Rotor due to Ground or Solid Object Contact (Causing Bending or Shearing of Blade(s))**

1. Perform inspections per § 2.520.A.
2. Using an approved paint stripper (ref. § 23-71), strip paint surrounding and at least 2 inches from tail rotor drive shaft forward holes and aft weld. Fluorescent penetrant inspect (ref. § 23-42) stripped areas. If cracks are found, drive shaft must be replaced.
3. Visually inspect drive shaft. Verify no deformation, nicks, dents, or scratches. Nicks and scratches may be polished out per § 7.360. Deformation or dents require replacement of drive shaft.
4. Remove tail rotor and tail rotor gearbox and return to RHC for overhaul.
5. Replace aft and intermediate flex plates.
6. Visually verify tail rotor blades have not struck tailcone and empennage.
7. Visually inspect main rotor system. Verify no nicks, dents, or scratches.

### 2.530 Main Rotor Strike

#### **A. Contact with Small Objects in Free Air**

1. Inspect main rotor blades per § 26-40.
2. Verify no buckling or bending of trailing edge.

<p style="text-align: center;"><b>WARNING</b></p>
---

<p><b>Any main rotor blade buckling or spar bending is considered sudden stoppage and requires compliance with Part B.</b></p>
--

#### **B. Sudden stoppage of Main Rotor Due to Ground or Solid Object Contact**

1. Check tail rotor drive shaft run-out per § 7.340.
2. Remove following components and return to a RHC authorized overhaul facility for inspection and/or repair.
  - a. A005-2 Main Rotor Blade and Spindle Assemblies
  - b. A005-4 Main Rotor Hub and Bearings
  - c. A017-2 Swashplate Assembly
  - d. A018-1 or -2 Clutch Assembly
  - e. A106 Main Rotor Journals
  - f. A152-1 Thrust Washers
  - g. A907-4 or -5 Yoke
  - h. A908-4 or A006-5 Yoke
3. Replace A947-1 forward flex plate.
4. Return main rotor gearbox to RHC for overhaul.
5. Inspect engine per engine manufacturer's sudden stoppage instructions.

2.540 Rotor/Engine Overspeed**A. Rotor Overspeed Between 110 and 116%****NOTE**

Refer to Part C if a power-on overspeed occurs.

1. Check main rotor and tail rotor dynamic balance. Compare pre-overspeed and post-overspeed balance.

**CAUTION**

Any change in rotor dynamic balance greater than 0.3 ips requires inspection per Part B.

2. Remove main rotor blades. Drain pitch bearing housings. Remove outer blade boot clamps and fold boots away from pitch horns. Rotate spindles to verify no brinelling of pitch bearings.

**NOTE**

Bearings have a high preload; slight roughness is normal. If roughness is evident, return blade and spindle assembly to RHC-authorized overhaul facility for repair.

3. Visually inspect main and tail rotor blades.
4. Check tail rotor drive shaft run-out per § 7.340.

2.540 Rotor/Engine Overspeed (continued)**B. Rotor Overspeed at or Above 116%****NOTE**

For power-on overspeeds, Part C must also be performed.

1. Perform inspection per Part A steps 2, 3, and 4.
2. Return blades and hub to an RHC-authorized overhaul facility for NOT inspection of spindles and hub.
3. Replace any cracked or bent bolts, thrust washers, and journals. Magnetic particle inspect any parts not replaced.

**C. Engine overspeed**

Percent engine overspeed is determined from tachometer indication as follows:

$$\% \text{ Engine Overspeed} = \frac{\text{Engine Tach Indication (\%)} \times 2550}{2700} - 100$$

**NOTE**

104% Engine Tach Indication  
Engine is rated at 2700 RPM. = 2652 Actual Engine RPM.

Refer to Lycoming SB 369 (current revision) for engine overspeed inspection requirements.

2.550 Hard Landing**A. Yielding of Cross Tubes Due to Hard Landings Without Side Loads****NOTE**

Side loads are indicated by buckling and bending of steel tube frame or sheet metal.

1. Visually inspect steel tube frames. Verify no yielding or cracks. Pay particular attention to lower steel tube frame aft vertical struts.
2. Check tail rotor drive shaft run-out per § 7.340.
3. Visually inspect main rotor blades per § 26-40.
4. Place rotorcraft on level ground and measure from tail skid or bottom of float stabilizer to ground. Aft cross tube must be replaced if dimension is less than:  
24 inches for Standard or HP.  
34 inches for Alpha, Beta, Beta II, Mariner, or Mariner II measured from tail skid.  
37 inches for Mariner or Mariner II, measured from float stabilizer.

Replace forward cross tube if it contacts cross tube cover.

5. Check and adjust upper and lower sheave alignment per § 7.230.

**B. Hard Landings That May Impose Side Loads on Landing Gear****NOTE**

Side loads are indicated by buckling and bending of steel tube frame or sheet metal.

1. Perform inspection per Part A.
2. Visually inspect fuselage landing gear attach points, vertical firewall, and horizontal firewall. Verify no buckling or cracks. Pay attention to engine mount strut-to-vertical firewall attach points.
3. Remove tailcone per § 4.311.
4. See Figure 2-12. Using an approved paint stripper (ref. § 23-71), remove paint from and within 2 inches of tailcone attach points on upper frame. Fluorescent penetrant inspect (ref. § 23-42) upper steel tube frame at tailcone attach points.
5. Visually inspect tailcone. Verify no buckling or loose rivets.
6. Visually inspect landing gear elbows. Verify no yielding, nicks, or cracks.

## 2.550 Hard Landing (continued)

## B. Hard Landings That May Impose Side Loads on Landing Gear (continued)

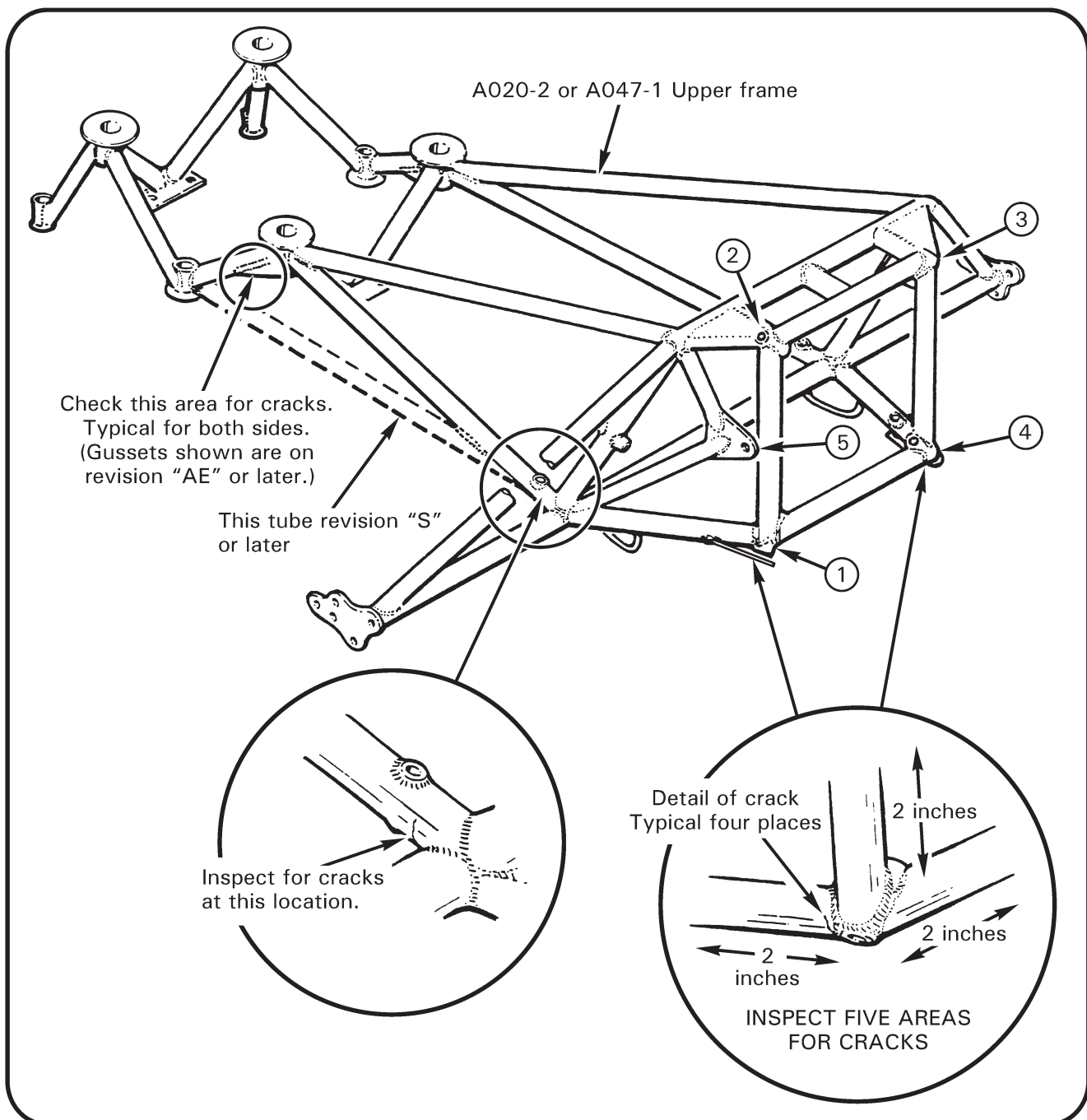


FIGURE 2-12 UPPER FRAME CRACK INSPECTION



### 2.560 Steel Tube Frame Corrosion

1. For large areas of corrosion, remove frame and strip paint using an approved paint stripper (ref. § 23-71) to determine full extent of corrosion. If corrosion exceeds Figure 2-13 limits, replace frame.
2. Measure and record diameter of frame member at corroded area(s).
3. Polish out corrosion with 320-grit or finer wet-or-dry sandpaper. Measure frame member diameter at polished area(s). Compare with measurement(s) from step 2, and verify polish depth is within Figure 2-13 limits.
4. Clean, prime, and paint frame (see § 23-71). Install frame if removed in step 1.

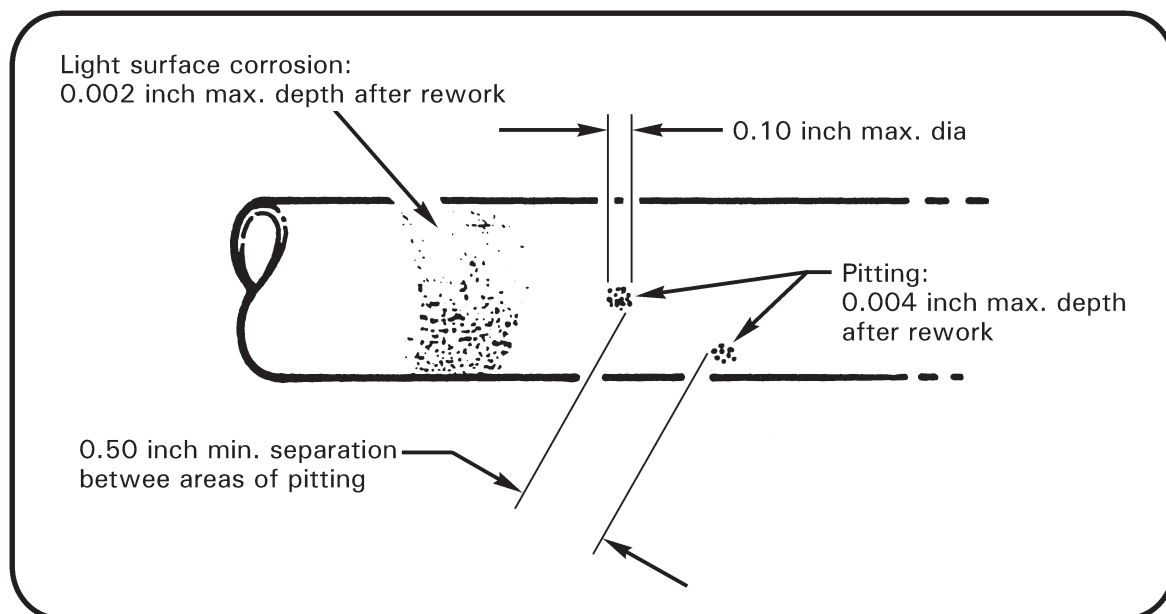


FIGURE 2-13 FRAME CORROSION AND REPAIR LIMITS

2.570 [Deleted]2.580 Float Inspection and Testing

## 1. Inspection Intervals and Float Replacement

Perform Relief Valve Test and Bulkhead Test during each 100-hour or annual inspection. Floats must be repaired or replaced on condition, or upon failure of Relief Valve or Bulkhead Test.

## 2. Relief Valve Test

**CAUTION**

When filling floats, open inflation valve prior to applying air pressure; do not apply air pressure against a closed valve.

**CAUTION**

Prior to test, inspect float bag uninflated and with each compartment individually inflated to 0.75 to 1.0 psig. Verify no cuts, tears, punctures, abrasion, delamination (blistering), or seam separation.

- a. Use filtered oil-free dry air to inflate float compartments to 5.0 psig. Inflate by using a manifold or inflate chambers individually in 0.5 psig increments.
- b. Fill relief valve apertures with clean water. Slowly increase pressure and observe relief valves; bubbles indicate opening. Record opening pressures, then reduce pressure until bubbles stop, indicating relief valves are closed. Record closing pressures.

**CAUTION**

Do not exceed 7 psig in float compartments.

- c. Replace any valve not meeting the following criteria:

Opening pressure: 5.5 to 6.5 psig  
Closing pressure: 5.5 psig minimum

## 3. Bulkhead Test

- a. Deflate all float chambers, then inflate forward chamber and second chamber from rear to 3 psig.
- b. Repair or replace floats if pressure in inflated chambers after 1 hour, at constant temperature, is less than 2.75 psig minimum.
- c. Deflate all float chambers, then inflate aft chamber and second chamber from front to 3 psig. Repeat step b.

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2.600 2200-Hour/12-Year Inspection

## NOTE

KI-2202 (for R22-series Helicopter S/N 2570 & prior) and KI-2203 (for R22-series Helicopter S/N 2571 & subsequent) 2200-Hour Inspection Kit contents are available online at [www.robinsonheli.com](http://www.robinsonheli.com) for review.

## NOTE

12-Year Inspection is only required for helicopters that have accumulated 12 years in service and less than 2200 hours time in service since new, since last 2200-hour inspection, or since last 12-year inspection.

1. Refer to helicopter maintenance records and § 3.300; replace life-limited parts, or next higher assemblies, as required.
2. Refer to helicopter maintenance records and § 1.102; perform additional component maintenance, as required.
3. Remove engine, engine cooling panels, fanwheel, scroll, air induction system, carburetor heat system, oil lines, and all hoses. Overhaul or inspect, as required, magnetos, alternator, and carburetor per appropriate manufacturer's maintenance publications and service bulletins.
4. Remove horizontal and vertical stabilizers per § 4.320, and replace as required. If replacement is not required, visually inspect stabilizers and verify no cracks, corrosion, loose rivets, dents, or deformation. Fluorescent penetrant inspect any suspect areas per § 23-42. Install stabilizers per § 4.320.
5. Remove landing gear assembly per § 5.100, and replace as required. If replacement is not required, completely disassemble gear and remove paint. Visually inspect parts and verify no cracks, corrosion, or deformation. Magnetic particle and fluorescent penetrant inspect per §§ 23-41 and 23-42. Clean, prime, and paint per § 23-60. Assemble gear if disassembled. Install landing gear assembly per § 5.100.
6. Remove steel tube frames per § 4.200, and replace as required. If replacement is not required, remove paint. Visually inspect frames and verify no cracks or corrosion. Magnetic particle inspect per § 23-41. Clean, prime, and paint per § 23-60. Install frames per § 4.200.
7. Remove cyclic stick per § 8.110. Remove wiring harness. Remove paint via dry media blasting. Visually inspect and verify no cracks or corrosion. Magnetic particle inspect per § 23-41. Clean, prime, and paint per § 23-60. Install wiring harness. Install cyclic stick per § 8.110.

2.600 2200-Hour/12-Year Inspection (continued)

8. Remove A121 push-pull tube assemblies per Chapter 8. Remove paint. Visually inspect and verify no cracks or corrosion. Fluorescent penetrant inspect per § 23-42. Clean, prime, and paint per § 23-60. Install push-pull tubes per Chapter 8.
9. Magnetic particle inspect A650 and F650-3 main gearbox mount fittings and bolt, and A337-1 jackshaft per § 23-41.
10. Inspect airframe wiring condition. Verify no corrosion, insulation deterioration, or other damage. Verify correct wires attached to correct circuit breakers.
11. Remove main and aux tank fuel bladders per § 12.110 and § 12.120. Visually inspect; verify no cracking or delamination of rubber and rubber-to-metal joints. Visually inspect threaded inserts and fittings for damage. Pressurize to 1 psi max and check for leaks with mild soap & water mixture. Visually inspect tank structures for evidence of bladder leakage. Install bladders per § 12.110 and § 12.120.
12. Perform clutch sheave alignment per § 7.230 and intermediate flex plate shimming per § 7.330.
13. Perform main rotor flight control and blade angle rigging per § 10.110 and § 10.120.
14. Perform tail rotor flight control and blade rigging per § 10.130 and § 10.140.
15. Perform 100-hour/annual inspection per § 2.400.
16. Weigh helicopter per § 18-20.

**NOTE**

Extended low-power operation with new piston rings may prevent proper piston ring seating.

17. Balance tail rotor per § 10.240. Track and balance main rotor per § 10.230. Perform ground check, run up, and flight checks per §§ 2.205, 2.210, and 2.220.
18. Drain and flush main and tail rotor gearboxes per § 22-13 and § 22-23.
19. Make appropriate maintenance record entries. Enter maintenance performed (such as part replacement, equipment adjustments, weighing, servicing, and lubrication) and inspection data. Data must include a description of (or reference to data acceptable to the Administrator) the work performed, date, helicopter total time in service, signature, certificate type and certificate number of person approving aircraft return to service.

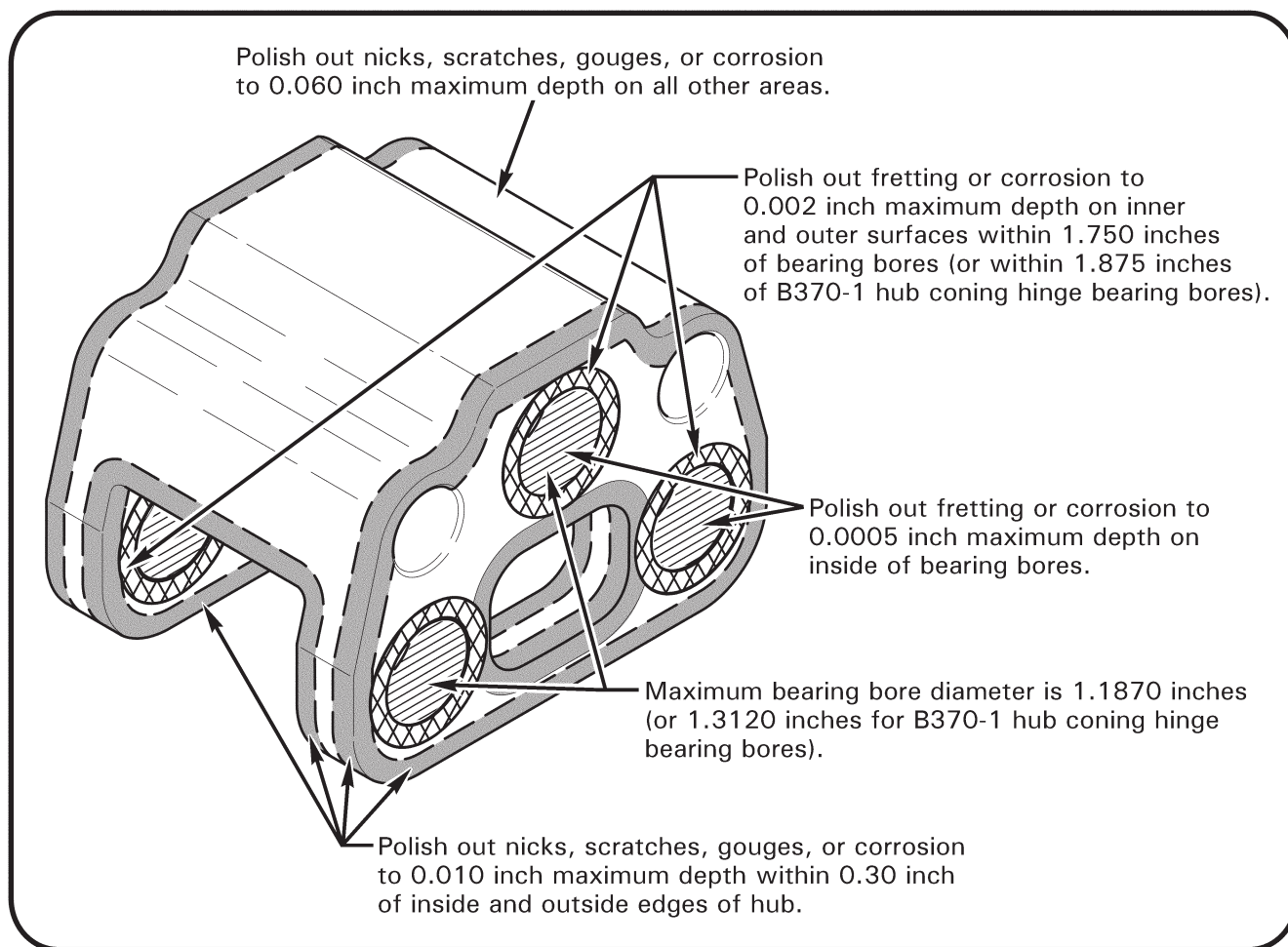


FIGURE 2-17 MAIN ROTOR HUB REPAIR LIMITS

### 2.610 Main Rotor Hub Inspection and Repair

1. Remove main rotor hub bearings per § 26-21 steps 1 and 2.
2. Remove hub paint by plastic or baking soda media blasting.
3. Refer to Figure 2-17. If required, polish surfaces using 320-grit or finer aluminum-oxide abrasive paper to 0.25 inch minimum blend radius.
  - a. Visually inspect hub bearing bores and verify no scoring, scratches, or other obvious damage. Polish out fretting or corrosion to 0.002 inch maximum depth on inner and outer surfaces within 1.750 inches of bearing bores (or within 1.875 inches of B370-1 hub coning hinge bearing bores). Polish out fretting or corrosion to 0.0005 inch maximum depth on inside of bearing bores; maximum bearing bore diameter is 1.1870 inches (or 1.3120 inches for B370-1 hub coning hinge bearing bores).
  - b. Visually inspect all other areas of hub for obvious damage. Polish out nicks, scratches, gouges, or corrosion to 0.010 inch maximum depth within 0.30 inch of inside and outside edges of hub. Polish out nicks, scratches, gouges, or corrosion to 0.060 inch maximum depth on all other areas.

2.610 Main Rotor Hub Inspection and Repair (continued)

4. Fluorescent penetrant inspect hub per § 23-42.
5. Prime hub per § 23-60.
6. Install bearings per § 26-21 steps 4 and 5.
7. Mask bearings and topcoat hub assembly per § 23-60.
8. When top coat has sufficiently cured, remove masking.

**2.620 Tail Rotor Gearbox 12-Year Maintenance**

1. If installed, drain and flush B021-1 tail rotor gearbox assembly per § 22-23 steps 1 thru 8.
2. If installed, remove tail rotor gearbox per § 7.410.
3. Remove hardware securing B546-1 yoke to B545 input gear. Visually inspect yoke and replace yoke if damaged. Visually inspect input gear splines; return gearbox to RHC if splines are damaged, including wear steps. Replace input shaft seal per § 7.470 steps 6 thru 17.
4. Remove sight gage and clean glass. Visually inspect gear set; return gearbox to RHC if corrosion or other damage is detected. Install sight gage and special torque gage per § 23-33.
5. Replace output shaft seal per § 7.460 steps 4 thru 9.
6. Install tail rotor gearbox per § 7.420 steps 1 thru 3.
7. Remove filler-plug. Fill gearbox to center of sight gage using correct gearbox oil (refer to § 22-10 Part C). Rotate rotor system by hand for several revolutions and pull down on tail rotor gearbox several times. Check gearbox oil level and adjust as required. Install filler-plug in gearbox and special torque plug per § 23-33.
8. Connect tail light and chip detector wiring to airframe harness at connectors. Turn battery on. Verify tail light illuminates with position lights turned on. Depress push-to-test TR CHIP button and verify TR CHIP caution light illuminates. Turn battery off.
- | 9. Install tail rotor assembly per § 28-10.



### 2.630 Fanwheel 12-Year Maintenance

1. If installed, remove B174-1 fanwheel assembly per § 6.210.
2. Mark fanwheel assembly parts, including balancing hardware, for identical reassembly.
3. Refer to Figure 2-19. Remove hardware securing A187-4 cone assembly, A186-2 hub, and A178-2 spacer(s) to fanwheel and remove parts, noting relative locations for identical reassembly.
4. Visually inspect all components for obvious damage. Verify no elongation of fastener holes. Replace parts as required.
5. Assemble fanwheel wet with approved primer (chromate primer preferred; refer to § 23-75) between all clamping surfaces; while primer is wet, special torque NAS6603 bolts to 70 in.-lb and NAS6605 bolts to 300 in.-lb.

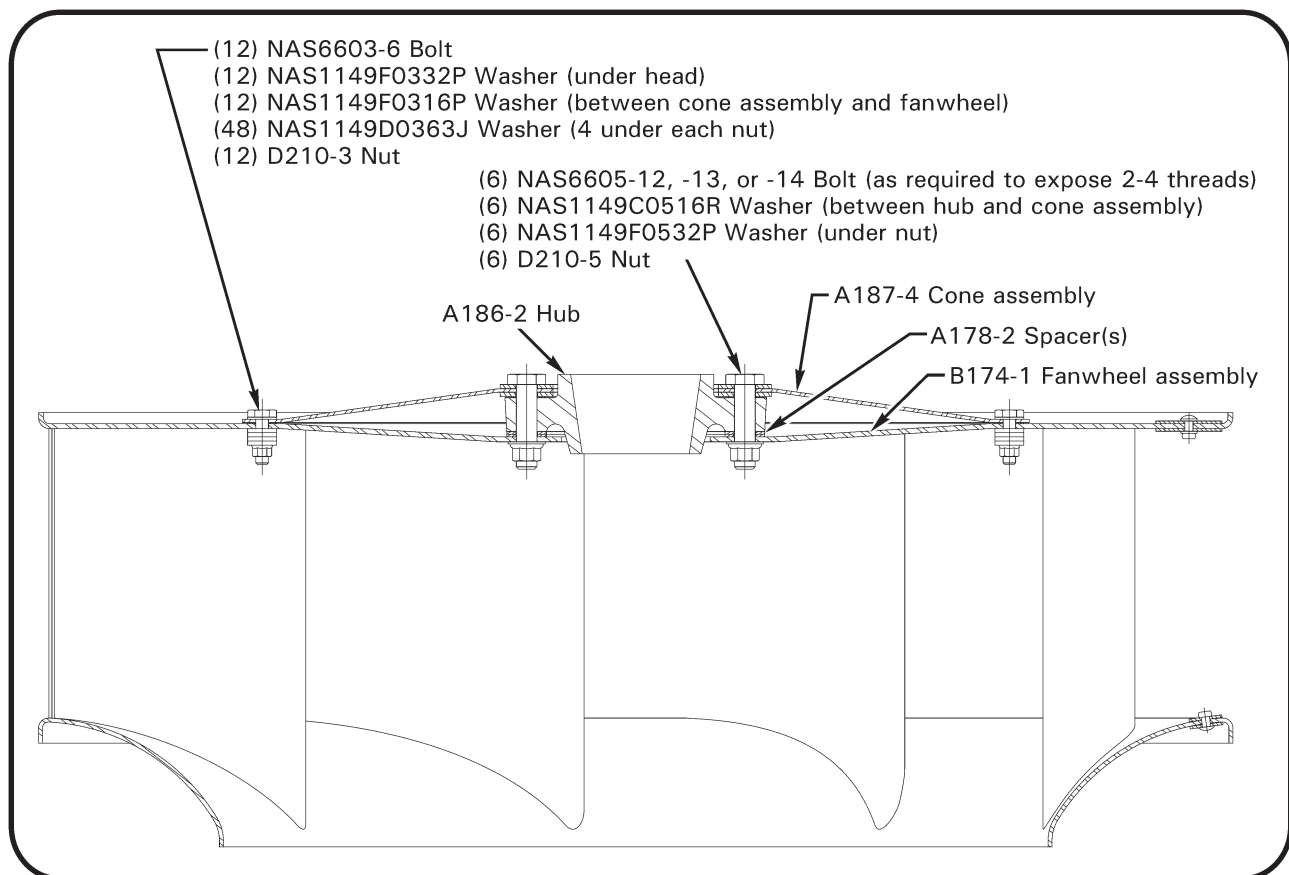


FIGURE 2-19 B174-1 FANWHEEL ASSEMBLY

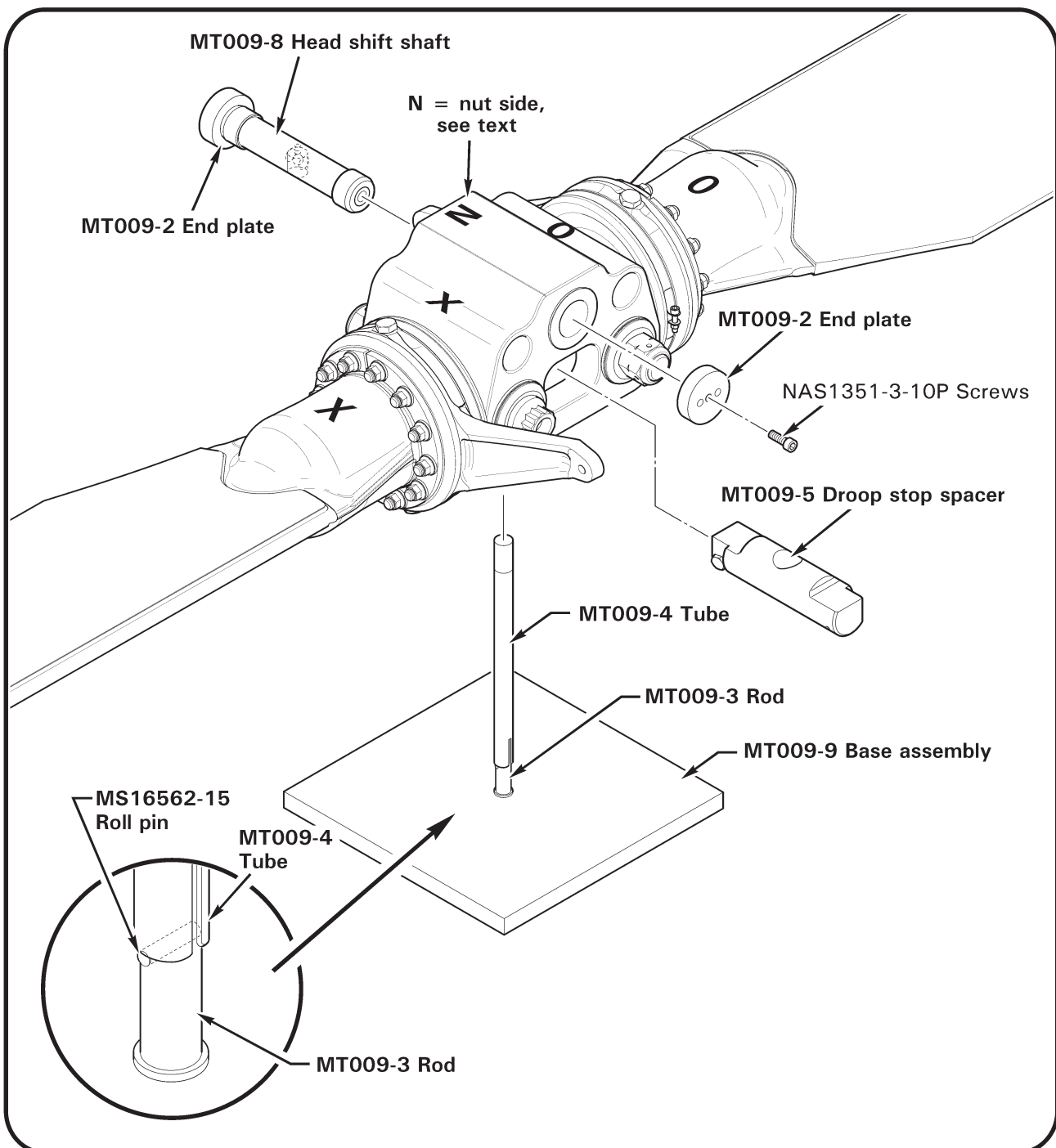


FIGURE 2-20 MT009-10 MAIN ROTOR STATIC BALANCE FIXTURE ASSEMBLY

2.640 Main Rotor Blade Static Balance**CAUTION**

Ensure surfaces contacting blade skins and trailing edges are sufficiently cushioned to prevent blade damage.

1. Refer to Table 26-1. Assemble main rotor blade & spindle assembly to main rotor hub by selecting a combination of A106 coning hinge journals and A117 coning hinge shims (if used) to obtain total axial clearance between 0.002–0.006 inch. Install same length journal (dash number) on leading edge side of both coning hinges.
2. Install nuts (dry); tighten nuts on hinge bolts until journals and thrust washers are firmly seated (snug). Measure gaps between thrust washers and hub bearing faces per Figure 26-8; verify total axial clearance at each hinge is between 0.002–0.006 inch.
3. Refer to Figure 2-20. Install MT009-10 main rotor static balancing fixture assembly in hub as shown. Hoist main rotor assembly and position on MT009-9 base assembly.
4. Refer to Figure 2-21. Verify blade pitch angles are approximately equal with pitch horns adjusted as shown. If blade pitch angles are not equal, then pitch horn(s) are not correctly installed.
5. Place a spirit level chordwise (parallel with teeter and coning hinges) atop main rotor hub. Level by adjusting NAS1351-3-10P screws.

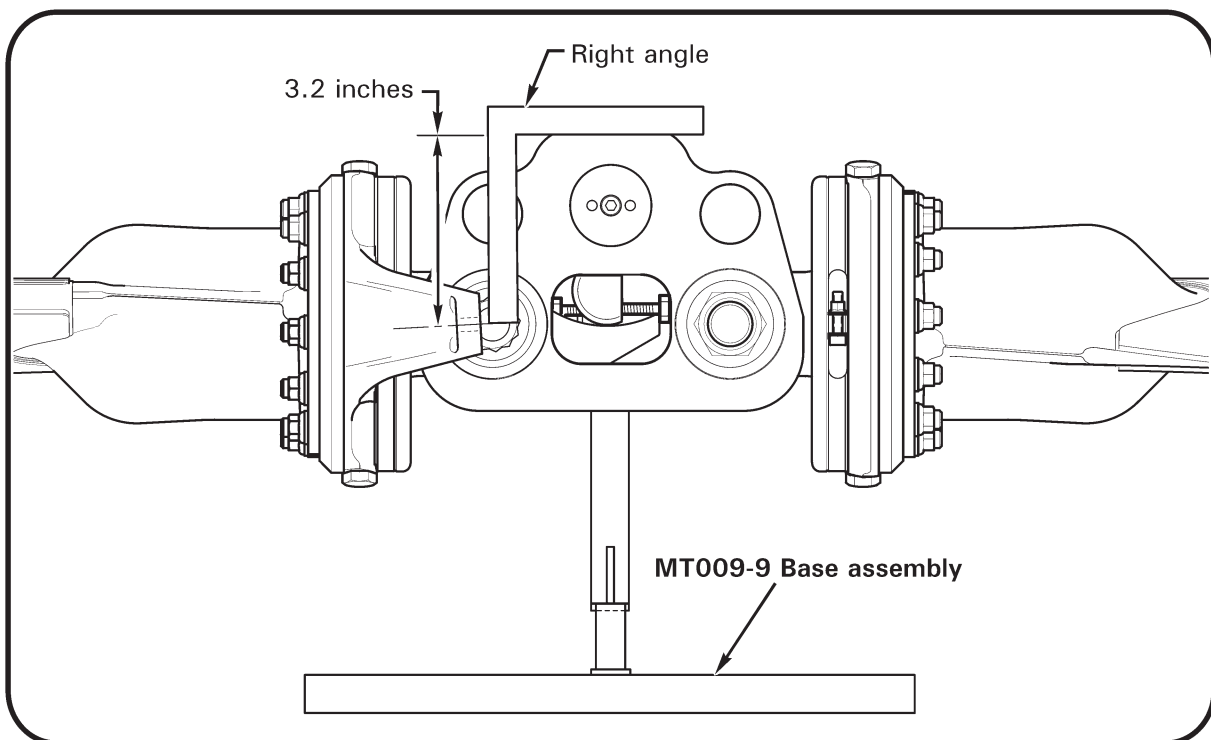


FIGURE 2-21 EQUALIZING BLADE PITCH

2.640 Main Rotor Blade Static Balance (continued)

6. Refer to Figure 2-22. Using a depth micrometer or calipers, measure distance between MT009-2 end plate and MT009-8 shaft thru (either) end plate hole on both sides of main rotor hub. On side of hub with smaller measured distance, mark top of hub with letter "N" to indicate nut-side of teeter hinge bolt.
7. Place a spirit level spanwise (perpendicular to teeter and coning hinges) atop main rotor hub. Place tip cover, tip cover attach screws, and two A722-4 screws as close to blade tip as possible. Level rotor system by adding A298 balance strips, NAS1149F0332P washers, and/or NAS1149F0363P washers as required. Final balance to be within one NAS1149F0332P washer.
8. Apply light coat A257-9 anti-seize to threads and install screws securing tip weights to blade; special torque screws to 40 in.-lb. Apply light coat A257-9 anti-seize to threads and install screws securing tip cover to blade; special torque screws to 40 in.-lb. Recheck spanwise and chordwise balance.
9. Conspicuously mark rotor assembly with colored "X" and "O" on hub, blade roots, and coning bolts (consistent marking on each side of hub) as reference for correct assembly on helicopter. Disassemble main rotor assembly.

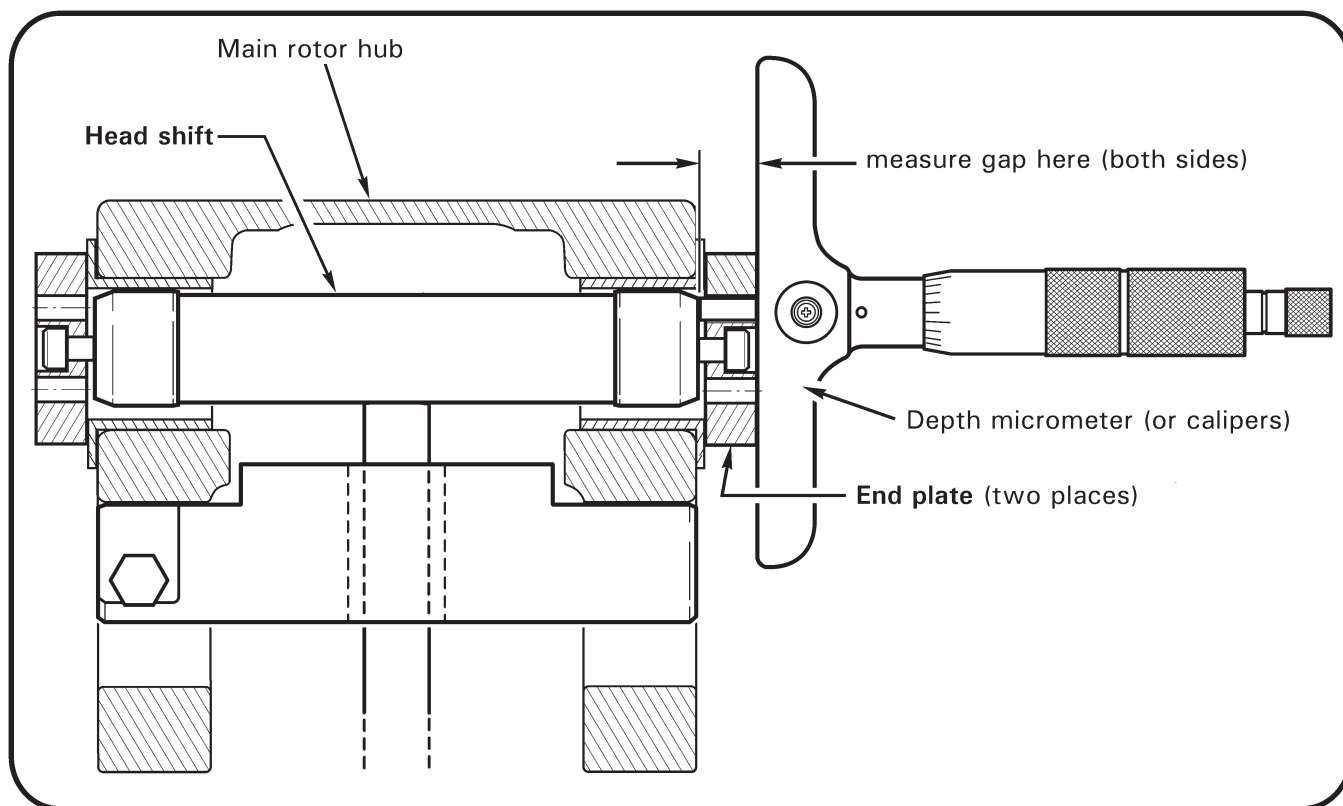


FIGURE 2-22 MEASURING GAP BETWEEN THRUST WASHER AND HUB BEARING

**2.650 A258-5 Main Rotor Pitch Link Assembly Inspection**

1. Temporarily mark each pitch link and associated swashplate ear with unique color. Record overall lengths of both links.
2. Remove pitch links.
3. Disassemble pitch links, keeping parts from each link separate from the other.
4. Evaluate rod ends per § 2.122 and replace as required.
5. Visually inspect parts with 10X magnification for obvious damage. Replace damaged parts.
6. Visually inspect interior of barrels with borescope for obvious damage. Replace damaged barrels.
7. Assemble pitch links and adjust to recorded lengths. Torque jam nut & adjacent palnut per § 23-32. Special torque self-locking jam nut per § 23-33.
8. Install pitch links to associated swashplate ear and, if installed, main rotor blade. Torque fasteners per § 23-32 and torque stripe per Figure 2-1.

## 2.700 Additional Special Inspections

### 2.710 Volcanic Ash Recommendations

Flight in visible volcanic ash conditions ("ash cloud") is detrimental to the helicopter and should be avoided. If helicopter has been operated in visible volcanic ash conditions:

1. Refer to Lycoming SI 1530. Wearing suitable protective equipment, use vacuum cleaner followed by compressed air to remove as much debris as possible. Do not use compressed air near main rotor blade drain holes.
2. Refer to R22 Pilot's Operating Handbook (POH) Section 8. Thoroughly clean, wash, and rinse helicopter, including inner circumference of drive belts.
3. Remove main rotor blade tip covers and clean blade tips.
4. Using 10X magnification, visually inspect any exposed main rotor blade skin-to-spar bond line (adhesive) for gaps (empty space between skin and spar). Blade is unairworthy if any gap, including "pin hole(s)", is detected in the bond line. Refinish blade as required.
5. Inspect condition of drive belt sheaves. Replace any sheave having corrosion pitting, flaking, wear thru metalized or anodized coatings, roughness, or sharp ridges. Replace drive belts if either sheave has sharp ridge(s) on drive belt contact surface.
6. Disconnect alternator drive belt from alternator. Spin alternator pulley by hand and verify rotor bearings and brushes operate smoothly; repair alternator as required if roughness or unusual noise is encountered (volcanic ash can enter via unfiltered cooling air). Inspect alternator and ring gear support pulleys and verify no wear steps; replace alternator belt and pulley(s) if wear steps exist. Perform Lycoming SI 1129 alternator belt tension check and adjust as required.
7. Clean airbox interior and:
  - a. Inspect air filter and clean or replace as required.
  - b. Inspect induction system downstream of air filter (a clean, white glove is beneficial). If volcanic ash is found then:
    - i. Clean induction system, disassembling as required.
    - ii. Disassemble carburetor or fuel injection servo, as applicable, inspect for internal contamination, and overhaul as required.
    - iii. Perform Lycoming SI 1191 Cylinder Compression check.
    - iv. Perform Lycoming SB 388 Procedure to Determine Exhaust Valve and Guide Condition.
    - v. Inspect spark plug condition; service as required.

### 2.710 Volcanic Ash Recommendations (continued)

8. Remove each magneto's distributor gear inspection plug and inspect visible internal portion for contamination; overhaul magnetos if volcanic ash is found inside (magneto vent plugs are unfiltered).
9. Inspect engine oil condition. Regardless of oil time-in-service if oil smells bad, is opaque (or is not obviously brown), or if particulates are detectable on the dipstick, change engine oil & oil filter, inspect suction screen and old oil filter, and perform Lycoming SI 1191 Cylinder Compression check if not previously accomplished in step 6.

### 2.720 Lightning Strike

Lightning strikes are extremely rare for helicopters operating in VFR conditions.

If a lightning strike does occur, RHC recommends performing a 100-hour inspection per § 2.400 and following recommendations for aircraft struck by lightning per Lycoming Service Bulletin No. 401.

High voltage that is well conducted through the aircraft structure will dissipate and cause minimal damage. High voltage that is not well conducted through the aircraft structure can result in excessive heat, which can bake, burn, char, or even melt certain materials. Heat damage may or may not be detectable by visual inspection. A component may not exhibit obvious damage, but temperatures above 300° F can alter the strength of some materials and thus affect a component's service life and airworthiness.

Visually inspect main rotor blades, landing gear, drive train, airframe, and flight controls thoroughly for obvious damage such as electrical arcing or burns, pitting, or cracking. Particular attention should be given to rod ends, journals, etc., where the conductive path is most susceptible. If obvious damage is detected in any of the above-mentioned systems, additional components may require replacement. Contact RHC Technical Support with detailed documentation for further guidance prior to approving aircraft for return to service.

### 2.730 Inspection After Stabilizer Damage

For damage to an installed A042-1 upper vertical stabilizer, A043-1 lower vertical stabilizer, and/or A044-1 horizontal stabilizer that results in denting, tearing, or cracking of stabilizer metal, or if a tail skid strike has occurred, perform the following:

1. On associated tailcone's A148 bulkhead, strip paint from cross-hatched surfaces shown in Figure 2-23 using § 23-71 approved materials.
2. Perform fluorescent penetrant inspection (FPI) per § 23-42 of stripped surfaces. Replace tailcone if crack is indicated.
3. Conversion coat bare aluminum per § 23-51, as required. Epoxy prime (chromated epoxy primer preferred) & topcoat stripped surfaces per § 23-60.

#### NOTE

Do not apply primer or topcoat to tail rotor gearbox attachment surfaces.

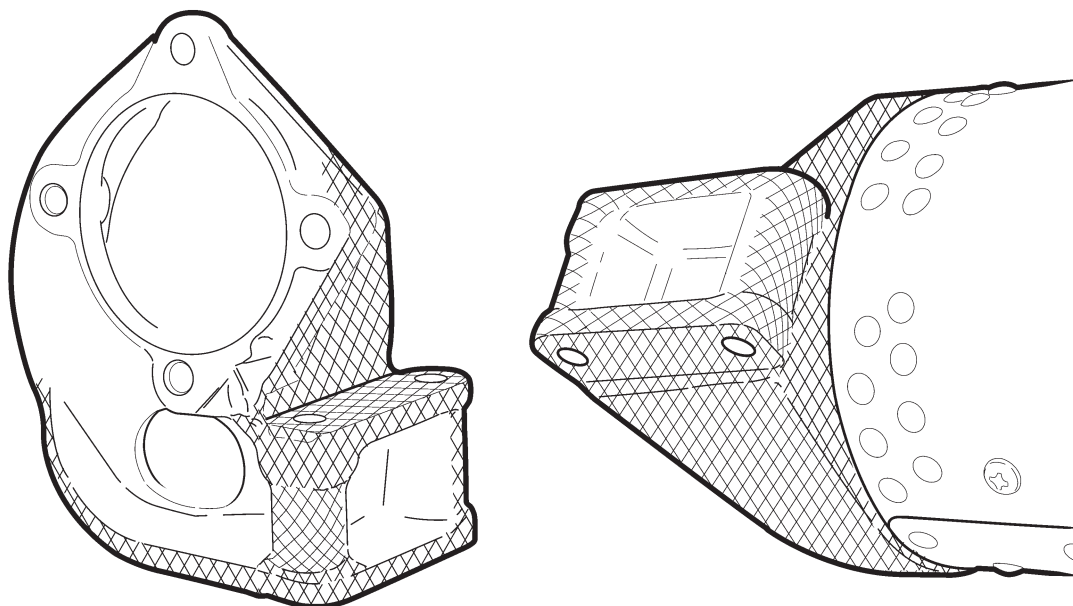


FIGURE 2-23 PENETRANT INSPECT CROSS-HATCHED SURFACES OF A148 BULKHEAD



CHAPTER 3

LIFE-LIMITED COMPONENTS

<i>Section</i>	<i>Title</i>	<i>Page</i>
3.100	Life-Limited Components . . . . .	3.1
3.110	Time-in-Service Records . . . . .	3.1
3.120	Fatigue Life-Limited Parts . . . . .	3.1
3.200	Type Certificate Data Sheet (TCDS) . . . . .	3.1
3.300	Airworthiness Limitations . . . . .	3.3

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## CHAPTER 3

## LIFE-LIMITED COMPONENTS

3.100 Life-Limited Components3.110 Time-In-Service Records

It is the operator's responsibility to maintain a record of time in service for the airframe, engine, and life-limited components. R22s are equipped with either an oil-pressure-activated hourmeter which records engine run time or a collective-activated hourmeter which records flight (collective up) time. Either method may be used to track time in service, however numerical values for service lives depend on the tracking method used (refer to § 3.300).

Calendar time in service for the airframe and engine begins on the date of the original RHC-issued Export (or Standard) Certificate of Airworthiness for the helicopter. For spares without a storage limit specified in § 23-85, calendar time in service begins on the date of the RHC-issued Airworthiness Approval Tag (Authorized Release Certificate) issued with the invoice.

If a component or an inspection is scheduled for hourly and calendar intervals, comply with whichever requirement comes first, then reset interval unless otherwise specified.

When installing a life-limited part or a part with an overhaul requirement, record in the helicopter maintenance record the installation date, part number, part name, serial number, helicopter total time, and time in service accumulated by part since new or since last overhaul, as applicable.

**WARNING**

**Components with mandatory overhaul times or life limits whose time in service is not reliably documented cannot be considered airworthy and must be removed from service.**

3.120 Fatigue Life-Limited Parts

The Airworthiness Limitations Section (ref. § 3.300) lists the mandatory replacement schedule for fatigue life-limited parts.

Listed items (ref. § 3.300) must be removed from the helicopter at the specified intervals and permanently retired from service, preferably by destroying or damaging each part so it cannot inadvertently be returned to service.

3.200 Type Certificate Data Sheet (TCDS)

TCDS is available at FAA Dynamic Regulatory System website: <https://drs.faa.gov>.

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### 3.300 Airworthiness Limitations

The Airworthiness Limitations Section is FAA approved and specifies inspections and other maintenance required under 14 CFR §§ 43.16 and 91.403, unless an alternative program has been FAA approved.

Time in service may be tracked based on engine run time or based on flight (collective up) time. Either method may be used, however numerical values for service lives depend on the tracking method used.

#### R22 Fatigue Life-Limited Parts

Use the following lives if time is tracked based on engine run time as recorded by an oil-pressure-activated hourmeter:

<u>Part Number</u>	<u>Description</u>	<u>Maximum Service Life</u>
A016-2 (Retired by AD 2004-19-09) . .	Main Rotor Blade . . . . .	2200 Hours or 10 years <sup>1</sup>
A016-4 (Retired by AD 2014-23-16) . .	Main Rotor Blade . . . . .	2200 Hours or 12 years <sup>1</sup>
A016-6 . . . . .	Main Rotor Blade, Rev AW & Prior . . . .	2200 Hours or 12 years <sup>1</sup>
A016-6 . . . . .	Main Rotor Blade, Rev AX & Subsequent	2200 Hours or 15 years <sup>1</sup>
A029-1 and -2 . . . . .	Tail Rotor Blade, Rev U & Prior . . . . .	2200 Hours or 12 years <sup>1</sup>
A029-2 . . . . .	Tail Rotor Blade, Rev V & Subsequent . .	2200 Hours or 15 years <sup>1</sup>
A146-1 . . . . .	Pinion, Main Gearbox . . . . . (O-360 Engine)	2200 Hours
A158-3 . . . . .	Main Rotor Spindle . . . . .	2200 Hours
B545-1 . . . . .	Gear Set, Tail Gearbox . . . . .	2200 Hours
B545-2 . . . . .	Pinion, Tail Gearbox . . . . .	2200 Hours
NAS630-80 (or MS21250-10080) . . .	Coning Hinge Bolt . . . . .	2200 Hours
NAS1351-4-20 (or A722-1 or -2) . . .	Pitch Horn Screws . . . . .	2200 Hours
NAS6604 (or NAS1304) . . . . .	Tail Rotor Blade-to-Hub Attach Bolt . . .	2200 Hours
A158-1 . . . . .	Main Rotor Spindle . . . . .	2415 Hours <sup>2</sup>
A020-2 . . . . .	Upper Frame, Rev R & Prior . . . . .	4200 Hours
A020-2 and -90 . . . . .	Upper Frame, Rev S & Subsequent . . . .	4400 Hours
A023-1, -20, -22, and -23 . . . . .	Tailcone Assembly . . . . .	4400 Hours
A047-1 and -6 . . . . .	Upper Frame . . . . .	4400 Hours
A154-1 . . . . .	Main Rotor Hub . . . . .	4400 Hours
B370-1 . . . . .	Main Rotor Hub . . . . .	4400 Hours
A020-84 . . . . .	Lower R.H. Frame . . . . .	5110 Hours
A046-2 . . . . .	Lower R.H. Frame . . . . .	5110 Hours
A062-2 . . . . .	Tail Rotor Hub . . . . .	6000 Hours
A030-1 . . . . .	Tail Rotor Hub Assembly . . . . .	6260 Hours

<sup>1</sup> Whichever limit occurs first. Calendar time starts on date of original RHC-issued Airworthiness Approval.

<sup>2</sup> Subject to AD 88-26-01 R2 compliance.

## 3.300 Airworthiness Limitations (continued)

**R22 Fatigue Life-Limited Parts (continued)**

Use the following lives if time is tracked based on flight (collective up) time as recorded by a collective-activated hourmeter:

<u>Part Number</u>	<u>Description</u>	<u>Maximum Service Life</u>
A016-2 (Retired by AD 2004-19-09) . .	Main Rotor Blade . . . . .	1964 Hours or 10 years <sup>1</sup>
A016-4 (Retired by AD 2014-23-16) . .	Main Rotor Blade . . . . .	1964 Hours or 12 years <sup>1</sup>
NAS630-80 (or MS21250-10080) . . .	Coning Hinge Bolt . . . . .	1964 Hours
NAS1351-4-20 (or A722-1 or -2) . . .	Pitch Horn Screws . . . . .	1964 Hours
A158-1 . . . . .	Main Rotor Spindle . . . . .	2156 Hours <sup>2</sup>
A016-6 . . . . .	Main Rotor Blade, Rev AW & Prior . . .	2200 Hours or 12 years <sup>1</sup>
A016-6 . . . . .	Main Rotor Blade, Rev AX & Subsequent	2200 Hours or 15 years <sup>1</sup>
A029-1 and -2 . . . . .	Tail Rotor Blade, Rev U & Prior . . . . .	2200 Hours or 12 years <sup>1</sup>
A029-2 . . . . .	Tail Rotor Blade, Rev V & Subsequent . .	2200 Hours or 15 years <sup>1</sup>
A146-1 . . . . .	Pinion, Main Gearbox . . . . .	2200 Hours
A158-3 . . . . .	Main Rotor Spindle . . . . .	2200 Hours
A188-2 . . . . .	Sprag Clutch Assembly . . . . .	2200 Hours
A647-1 . . . . .	Bearing, Main Rotor Shaft . . . . .	2200 Hours or 12 years <sup>1</sup>
A647-6 . . . . .	Bearing, Tail Rotor Pitch Control . . . . .	2200 Hours or 12 years <sup>1</sup>
A647-8 . . . . .	Bearing, Damper Assembly . . . . .	2200 Hours or 12 years <sup>1</sup>
B545-1 . . . . .	Gear Set, Tail Gearbox . . . . .	2200 Hours
B545-2 . . . . .	Pinion, Tail Gearbox . . . . .	2200 Hours
NAS6604 (or NAS1304) . . . . .	Tail Rotor Blade-to-Hub Attach Bolt . . .	2200 Hours
A020-2 . . . . .	Upper Frame, Rev R & Prior . . . . .	3750 Hours
A154-1 . . . . .	Main Rotor Hub . . . . .	3928 Hours
A020-2 and -90 . . . . .	Upper Frame, Rev S & Subsequent . . . .	4400 Hours
A020-84 . . . . .	Lower R.H. Frame . . . . .	4400 Hours
A023-1, -20, -22, and -23 . . . . .	Tailcone Assembly . . . . .	4400 Hours
A046-2 . . . . .	Lower R.H. Frame . . . . .	4400 Hours
A047-1 and -6 . . . . .	Upper Frame . . . . .	4400 Hours
A062-2 . . . . .	Tail Rotor Hub . . . . .	4400 Hours
B370-1 . . . . .	Main Rotor Hub . . . . .	4400 Hours
A030-1 . . . . .	Tail Rotor Hub Assembly . . . . .	5589 Hours

<sup>1</sup> Whichever limit occurs first. Calendar time starts on date of original RHC-issued Airworthiness Approval.

<sup>2</sup> Subject to AD 88-26-01 R2 compliance.

3.300 Airworthiness Limitations (continued)

Approved By: **ERIC D  
SCHRIEBER**      Digitally signed by ERIC D  
SCHRIEBER  
Date: 2024.12.10 08:56:49 -08'00'      Date: 10 Dec 2024

Federal Aviation Administration  
*for* Manager, West Certification Branch, AIR 770

**FAA Approved:** Pages 3.3, 3.4, and 3.5 constitute the Airworthiness Limitations Section in | its entirety, are considered segregated from the rest of the document, and set forth the FAA-approved mandatory replacement times for fatigue life-limited parts.

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## CHAPTER 4

## AIRFRAME

<u>Section</u>	<u>Title</u>	<u>Page</u>
4.000	Description . . . . .	4.1
4.100	Fuselage . . . . .	4.1
4.110	Cabin Assembly . . . . .	4.1
4.111	Repair . . . . .	4.1
4.120	Windshield Assembly . . . . .	4.4
4.130	Door Removal and Installation . . . . .	4.4
4.140	Fairing, Cowling, and Inspection Panels . . . . .	4.4
4.141	Side Skirts . . . . .	4.4
4.142	Mast Fairing . . . . .	4.6
4.143	Aft Cowling . . . . .	4.6
4.144	Cabin Inspection Panels . . . . .	4.6
4.200	Welded Steel Tube Frame Assemblies . . . . .	4.7
4.210	Left-Hand Frame Assembly . . . . .	4.8
4.211	Left-Hand Frame Removal . . . . .	4.8
4.212	Left-Hand Frame Installation . . . . .	4.8
4.220	Right-Hand Frame Assembly . . . . .	4.9
4.221	Right-Hand Frame Removal . . . . .	4.9
4.222	Right-Hand Frame Installation . . . . .	4.12
4.230	Upper Frame Assembly . . . . .	4.13
4.231	Upper Frame Removal . . . . .	4.13
4.232	Upper Frame Installation . . . . .	4.14
4.240	Vertical Strut Assembly Removal and Installation . . . . .	4.15
4.300	Tailcone . . . . .	4.16
4.310	Tailcone Replacement . . . . .	4.18
4.320	Tailcone Repair . . . . .	4.25
4.400	B375-2 Horizontal Stabilizer Assembly . . . . .	4.27
4.500	Empennage Assembly . . . . .	4.29
4.510	Upper Vertical Stabilizer Assembly . . . . .	4.32
4.520	Lower Vertical Stabilizer Assembly . . . . .	4.32
4.530	B902-1 or -2 Vertical Stabilizers Mount Assembly . . . . .	4.33
4.540	A044-1 Horizontal Stabilizer Assembly . . . . .	4.34
4.600	Tail Skid . . . . .	4.35

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## CHAPTER 4

## AIRFRAME

4.000 Description

The R22 is a two-place, single main rotor, single engine helicopter constructed primarily of metal and equipped with skid-type landing gear.

The primary fuselage structure is welded steel tubing and riveted aluminum sheet. The tailcone is a monocoque structure in which aluminum skins carry primary loads. Fiberglass and thermoplastics are used in secondary cabin structure, engine cooling shrouds, and various other ducts and fairings.

A right-side cowl door provides access to the main gearbox and drive system. Additional access to controls and other components for maintenance is provided by removable panels and cowlings.

Stainless steel firewalls are located forward of and above the engine.

4.100 Fuselage4.110 Cabin Assembly

The cabin assembly is a non-field-replaceable assembly.

4.111 Repair

1. Vertical firewall replacement must be performed at the factory in a jig. Firewall repairs may be accomplished in accordance with U.S. FAA Advisory Circular 43.13-1B Section 4-59. Firewall material is 0.016 inch, type 301, one-quarter hard corrosion-resistant (CRES) steel.
2. Keel panel replacement must be performed at the factory in a jig. Keel panel repairs may be accomplished in accordance with U.S. FAA Advisory Circular 43.13-1B Sections 4-58 and 4-59. Keel panel material is 0.025 inch, 2024-T3 clad aluminum-alloy sheet.
3. To preserve crashworthiness, repairs to seat structure are limited to replacement of damaged components only.

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#### 4.120 Windshield Assembly

|      This section has been moved to Chapter 25 Doors and Windows.

#### 4.130 Door Removal and Installation

|      This section has been moved to Chapter 25 Doors and Windows.

#### 4.140 Fairing, Cowling, and Inspection Panels

##### 4.141 Side Skirts

<p style="text-align: center;"><b>CAUTION</b></p>
---

<p>This is a structural panel assembly and must be installed for run up and flight.</p>
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#### 4.142 Mast Fairing

**CAUTION**

Mast fairing must be installed for flight.

The mast fairing upper rib is mounted to swashplate tube assembly. The lower rib is clamped to main rotor gearbox mast assembly.

The pitot tube is mounted on lower front of mast fairing.

The fuel tank vent is installed through lower rib of mast fairing. (Vent should have approximately 0.30 inch clearance from the aft cowling.)

#### 4.143 Aft Cowling

**CAUTION**

Aft cowling must be installed for flight.

The aft cowling is a two-piece, sheet-aluminum structure with a removable tailcone rain guard.

#### 4.144 Cabin Inspection Panels

**CAUTION**

All cabin inspection panels must be installed for flight. With the exception of side skirts, all panels may be left off for run-up.

1. Seat Backs: Left side seat back has fuel valve attached. Back cushions are installed using blind rivets.
2. Cyclic Control Inspection Panels – 4 panels:
  - a. Center belly panel
  - b. Inside center of cabin (2 each horizontal: 1 each vertical).
  - c. Instrument console (refer to Chapter 13 Instrument System).
  - d. Forward cross tube inspection panel.



4.200 WELDED STEEL TUBE FRAME ASSEMBLIES**WARNING**

All welded steel tube structures used in the rotorcraft are stress relieved. No weld repairs are permissible outside Robinson Helicopter Co.

1. Frames required on R22 Alpha & Beta Models

A020-2 Upper Frame Serial Number 0400 and subsequent.

A046-1 Lower Left Frame

A046-2 Lower Right Frame

A046-3 Right-Hand Strut

2. Frames required on R22 Standard & HP Models

A020-2 Upper Frame

A020-1 Lower Left Frame

A020-84 Lower Right Frame

A020-3 Right-Hand Strut

3. Optional frame on Mariner

A047-1 Upper Frame with Tie Downs

4.210 Left-Hand Frame Assembly

## 4.211 Removal

- a) Remove main rotor blades per Section 9.111.
- b) Remove clutch assembly per Section 7.210.
- c) Remove main rotor gearbox per Section 7.110.
- d) Remove tailcone assembly per Section 4.311.
- e) Remove power plant per Section 6.110.
- f) Remove seat backs and center panels per Section 4.144.
- g) Disconnect the three lower forward firewall and left-hand upper aft attach points on the left-hand frame.
- h) Disconnect the aft NAS1306 landing gear attach bolt from the left-hand landing gear support.
- i) Disconnect the two upper left-hand frame attach points at the vertical firewall.
- j) Remove the through bolts connecting the upper frame to the fuselage and lower left-hand frame assembly.
- k) Remove the left-hand frame.
- l) Remove the landing gear support from the left-hand frame assembly.

## 4.212 Left-Hand Frame Assembly Installation

- a) Install the landing gear support bearing.
- b) Position left-hand frame for installation.
- c) Install the bolt (internal wrenching) connecting the upper frame assembly to the left-hand frame assembly through the horizontal firewall. Torque bolt to 75 ft-lbs. (wet).

## 4.212 Left-Hand Frame Assembly (cont'd)

- d) Install the two NAS1304 bolts on upper support of the left-hand frame to the vertical firewall. Torque to 100 in-lbs. plus nut drag.
- e) Install fasteners at firewall forward attachment points. Torque the attaching screws and bolts per Fastener Torques, Section 1.300.

## NOTE

Lower support at fuselage has a large-area washer AN 970-4 under bolthead next to tab of frame.

## NOTE

The outboard support of the frame requires a washer between the frame and the fuselage skin.  
(See Fig. 4-1 View H)

- f) Install NAS1306 landing gear attach bolt from frame support to landing gear. Torque NAS1306 bolts to 300 in.-lb plus nut drag. Install palnuts.
- g) Install upper aft support of the left-hand frame arm. Torque NAS1304 bolt to 100 in-lbs. plus nut drag. Install palnut.
- h) Install power plant per Section 6.120.
- i) Install tailcone per Section 4.312.
- j) Install main rotor gearbox per Section 7.120.
- k) Install clutch assembly per Section 7.220.
- l) Install main rotor blades per Section 9.112.
- m) Install seat backs and panels after verifying all attaching nuts and screws are secure.

4.220 Right-Hand Frame Assembly

## 4.221 Right-Hand Frame Removal

- a) Remove main rotor blades per Section 9.111.
- b) Remove clutch assembly per Section 7.210.
- c) Remove main rotor gearbox per Section 7.110.

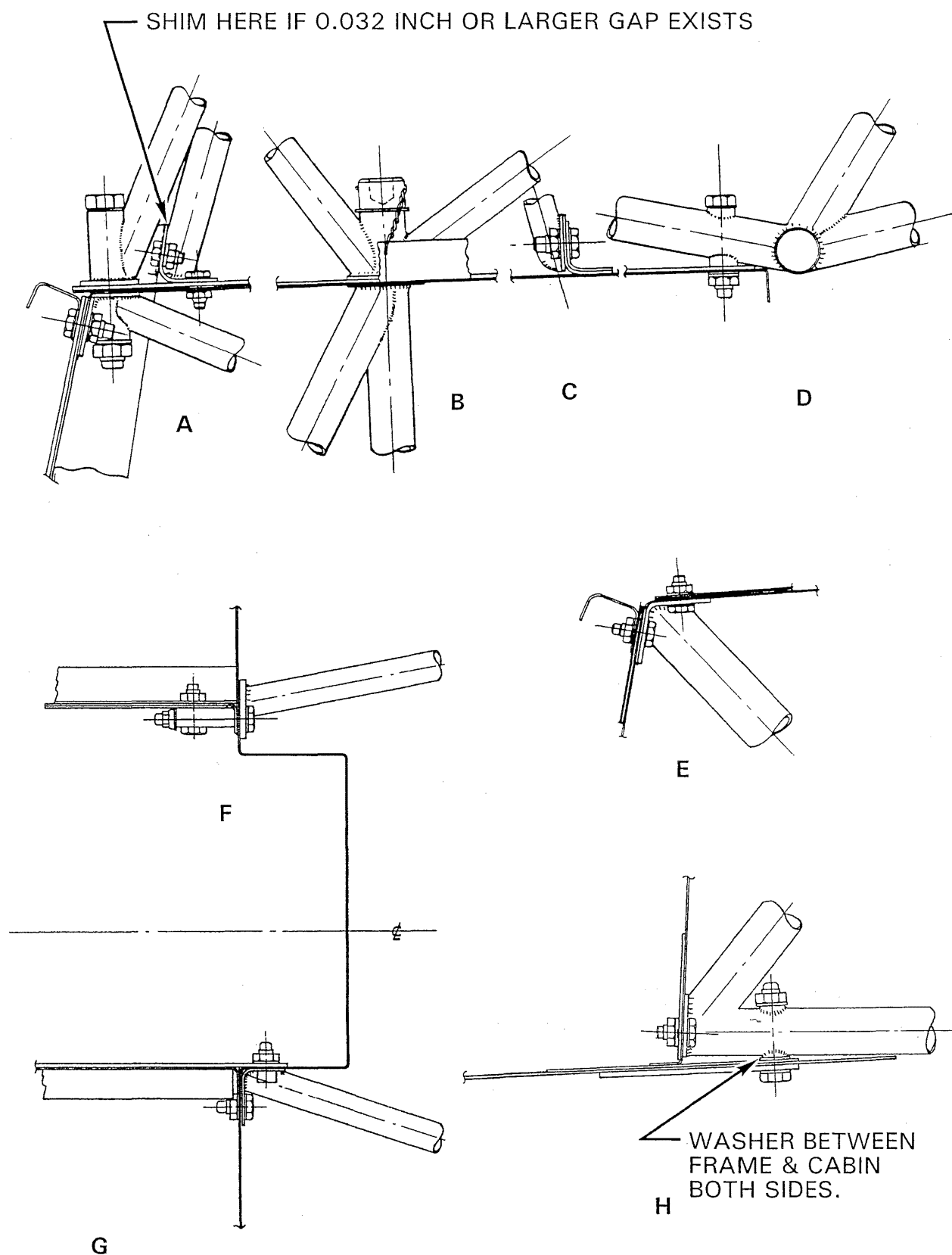
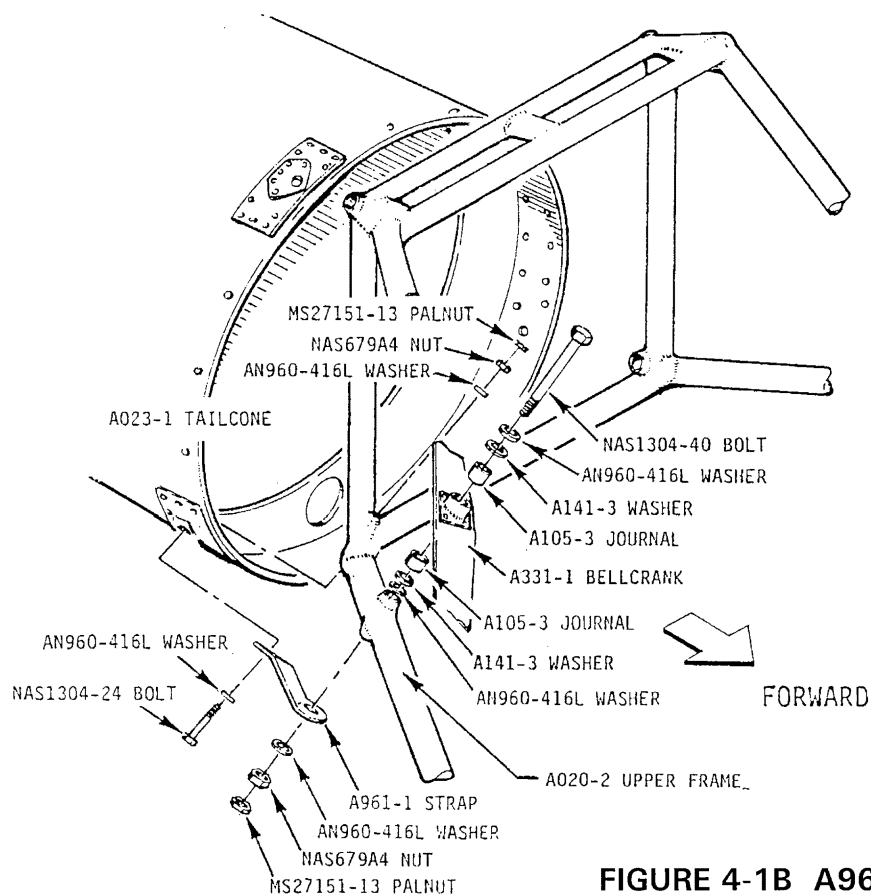
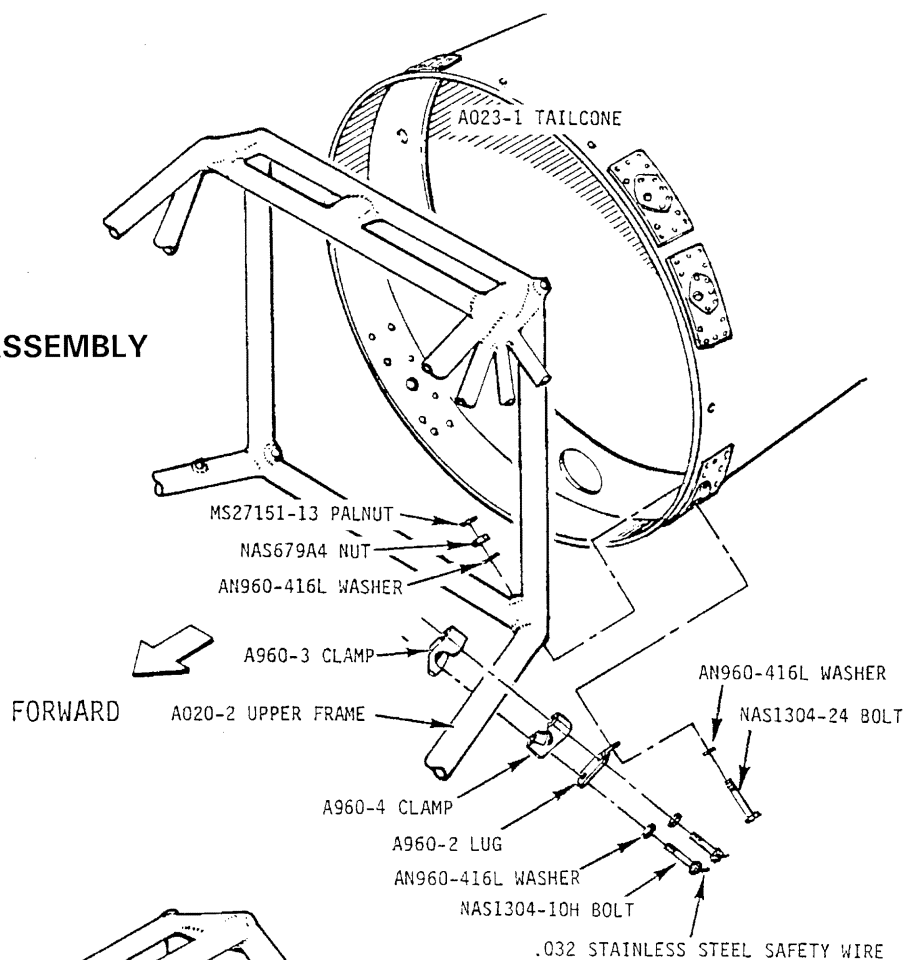


FIGURE 4-1 FRAME-TO-CABIN ATTACHMENTS

**FIGURE 4-1A A960 CLAMP ASSEMBLY**



**FIGURE 4-1B A961 STRAP ASSEMBLY**

**4.221 Right-Hand Frame Removal (cont'd)**

- d) Remove tailcone assembly per Section 4.311.
- e) Remove powerplant per Section 6.110.
- f) Disconnect aft landing gear attach bolt from right-hand landing gear support.
- g) Disconnect four forward firewall attach points.
- h) Remove (2) through bolts connecting right side of upper frame to fuselage.
- i) Remove right-hand frame from helicopter.
- j) Remove landing gear support from right frame assembly.

**4.222 Right-Hand Frame Installation**

- a). Install landing gear support bearing.
- b) Position right-hand frame for installation.
- c) Install attaching screw (internal wrenching) connecting upper frame assembly to right hand frame assembly through horizontal firewall. Torque screw per Section 1.330.
- d) Tighten lower inboard support attaching screws to the vertical firewall.
- e) Install fasteners at the forward firewall attachment points. Torque fasteners per Section 1.300.
- f) Install landing gear attach bolt from frame support to landing gear.
- g) Install powerplant per Section 6.120.
- h) Install aft strut assembly between right-hand lower frame and upper frame assemblies. Torque bolts per Section 1.320. Install palnuts.

**NOTE**

Seal around inner diameter of bolt holes in strut with B270-1 sealant. Verify no sealant on bolt threads.

- i) Install tailcone per Section 4.312.
- j) Install main rotor gearbox per Section 7.120.
- k) Install clutch assembly per Section 7.220.
- l) Install main rotor system per Section 9.112.

## 4.222 Right-Hand Frame Installation (cont'd)

- m) Install seat backs and panels after verifying all attaching nuts and screws are secure.

4.230 Upper Frame Assembly

## 4.231 Upper Frame Removal

Before the upper frame is disconnected and removed, the power plant must be either removed or supported.

**CAUTION**

Extensive damage to the firewall and lower welded tube structures will occur if power plant is not supported or if support is dislodged.

- a) Remove main rotor blades per Section 9.111.
- b) Remove clutch assembly per Section 7.210
- c) Remove the right and left seat back and center push-pull tube panel assemblies.
- d) Remove main rotor gearbox per Section 7.110.
- e) Remove tailcone assembly per Section 4.311.
- f) Support power plant or remove per Section 6.110.
- g) Disconnect right-hand aft vertical strut assembly at upper frame and lower right-hand attach points and remove.
- h) Disconnect the forward support at the horizontal and vertical firewall.

**NOTE**

If same upper frame is to be re-installed, any shims found at the forward support should be reinstalled in the same position.

- i) Disconnect the two forward through bolts attaching the upper frame to the two lower frames.
- j) Disconnect the two (internal wrenching) bolts attaching the upper frame to the two lower frames.

#### 4.231 Upper Frame Removal (cont'd)

- k) Disconnect the center upper frame mount point at the horizontal firewall stiffener.
- l) Disconnect the aft portion of the upper frame.
- m) Remove upper frame.

#### 4.232 Upper Frame Installation

- a) Clean upper frame and attach points of all old sealant, grease and oil.
- b) Position upper frame for installation.
- c) Install internal wrenching bolts with anti-seize. Do not tighten at this time.
- d) Install the two NAS1306(NAS6606) forward through bolts.
- e) Torque the four attach bolts in c & d above to:
 

NAS1306(NAS6606)	300 in-lb
NAS1351-8H40P	75 ft-lb (wet)
- f) Measure gap on the upper frame. Shim as required (see Fig. 4-1 View A)
- g) Install the four attaching bolts in forward support. Do not install washers under the two B238-1 bolt heads in the push-pull tube tunnel. Torque the four bolts to 40 in.-lb plus nut drag (see Fig. 4-1 View A).
- h) Install the center support bolts of the upper frame assembly. Torque the two NAS1304(NAS6604) bolts.
- i) Connect the upper frame to the aft end of the horizontal firewall.
- j) Connect the aft end of the upper frame to the lower frame assembly.
- k) Torque the NAS1304(NAS6604) attach bolts.
- l) Install the power plant, if removed.
- m) Seal firewalls at the upper and lower frame attach points to insure no seepage of fuel in the event of a fuel tank leak. Use Coast Pro-Seal 890B2.



#### 4.232 Upper Frame Installation (continued)

- n) Install main rotor gearbox per § 7.120.
- o) Install tailcone per § 4.312.

**NOTE**

A020-2 upper frames S/N 0002 thru 0399 require A960-1 clamp assembly and A961-1 strap assembly per R22 Service Bulletin SB-26.

- p) Install clutch assembly per § 7.220
- q) Install seat backs and panels after verifying all attaching nuts and screws and secure.

#### 4.240 Vertical Strut Assembly Removal and Installation

To remove strut:

- a. Remove upper and lower attaching bolts.
- b. Remove strut.

To install strut:

- a. Line up holes in strut with upper and lower frame tabs. Lower end of strut goes on aft face of lower frame tab.
- b. Install NAS6604-3 attaching bolts wet with B270-1 sealant on shanks.

**CAUTION**

Verify threads are clean and dry.

Special torque per § 23-33. Install palnuts and standard torque per § 23-32 and torque stripe per Figure 2-1.

#### 4.300 Tailcone

##### CAUTION

If tailcone has a B379-1 or -3 bracket then A958-1 bellcranks (original equipment on helicopter S/N 0357 and subsequent) must be installed or retrofitted. Figure 8-2A refers.

If tailcone has a B379-1 or -3 bracket then B375-2 horizontal stabilizer must be installed.

Tailcone equipped with B379-1 or -3 bracket may not be installed on R22 Mariner helicopters.

A044-1 horizontal stabilizer may not be installed on a tailcone that has a B379-1 or -3 bracket.

B902-1 or -2 vertical stabilizers mount assembly may only be installed on a tailcone that has a B379-1 or -3 bracket.

##### A. Removal

1. Pull open associated circuit breakers for lights and antennas installed on tailcone.
2. Remove A706-1 fairing.
3. Cut and discard ty-raps as required and disconnect tailcone wiring at connectors. Disconnect antenna cables at forward bulkhead, as applicable.
4. Remove hardware securing tail rotor drive shaft assembly forward yoke to A947-2 (intermediate) plate assembly. Support drive shaft using a conspicuous foam block or equivalent, while drive shaft is disconnected from drive train.

##### WARNING

**A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, flex plate is unairworthy and cannot be repaired. Ensure A947-1 forward flex plate is Rev E or subsequent (identified by letter "E" or subsequent letter on two adjacent arms of flex plate).**

5. Remove hardware securing A121-17 push-pull tube to A331-1 intermediate bellcrank assembly.
6. Support tailcone and remove hardware securing tailcone to upper frame. Remove tailcone from helicopter.
7. If replacing tailcone, refer to appropriate sections of this manual and remove installed components or assemblies as applicable.

4.300 Tailcone (continued)**B. Installation****NOTE**

Install tail rotor drive shaft, tail rotor gearbox, and A121-17 push-pull tube on tailcone prior to tailcone installation.

1. Inspect tailcone interior. Remove debris. At bulkheads, verify bushings prevent push-pull tube from contacting metal, and wiring is protected by grommets. Verify correct damper assembly orientation per Figure 7-11B.
2. Position A023 tailcone assembly on upper frame assembly; do not pinch wiring between tailcone forward bulkhead and frame. Install hardware securing tailcone to frame, standard torque bolts & palnuts per § 23-32, and torque stripe per Figure 2-1.

**NOTE**

All R22 helicopters with upper frame A020-2 S/N 0002 thru 0399 are required to install A960-1 clamp and A961-1 strap assemblies per R22 Service Bulletin 26.

3. Install hardware securing A121-17 push-pull tube to A331-1 bellcrank assembly. Standard torque bolt & palnut per § 23-32 and torque stripe per Figure 2-1.

**WARNING**

**A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, then flex plate is unairworthy and cannot be repaired.**

4. Inspect flex plate per Figure 2-4B. Perform intermediate flex plate installation and shimming per § 7.330.
5. Measure tail rotor drive shaft runout per § 7.340.
6. Connect tailcone wiring at connectors, connect antenna cables at forward bulkhead, as applicable. Individually test and verify correct function of tail position light, strobe, and TR chip light circuits.
7. Refer to Figure 4-2D. Verify clearance between tailcone edge and upper frame.
8. As required, install B375-2 stabilizer per § 4.400 and empennage assembly per § 4.500.

### 4.310 Tailcone Replacement

#### CAUTION

If tailcone has a B379-1 or -3 bracket then A958-1 bellcranks (original equipment on helicopter S/N 0357 and subsequent) must be installed or retrofitted. Figure 8-2A refers.

#### A. Tailcone Set-up

1. Level helicopter longitudinally and laterally per § 18-10.
2. Verify tailcone part number is correct for helicopter model. Slide forward end of tailcone over upper frame and support aft end of tailcone with a stand.
3. Refer to Figure 4-2A. Insert two bolts of sufficient length (to support a level) in A148 bulkhead's left & right gearbox-mounting holes and place level across bolt shanks. Rotate tailcone on upper frame as required until bolts are level.

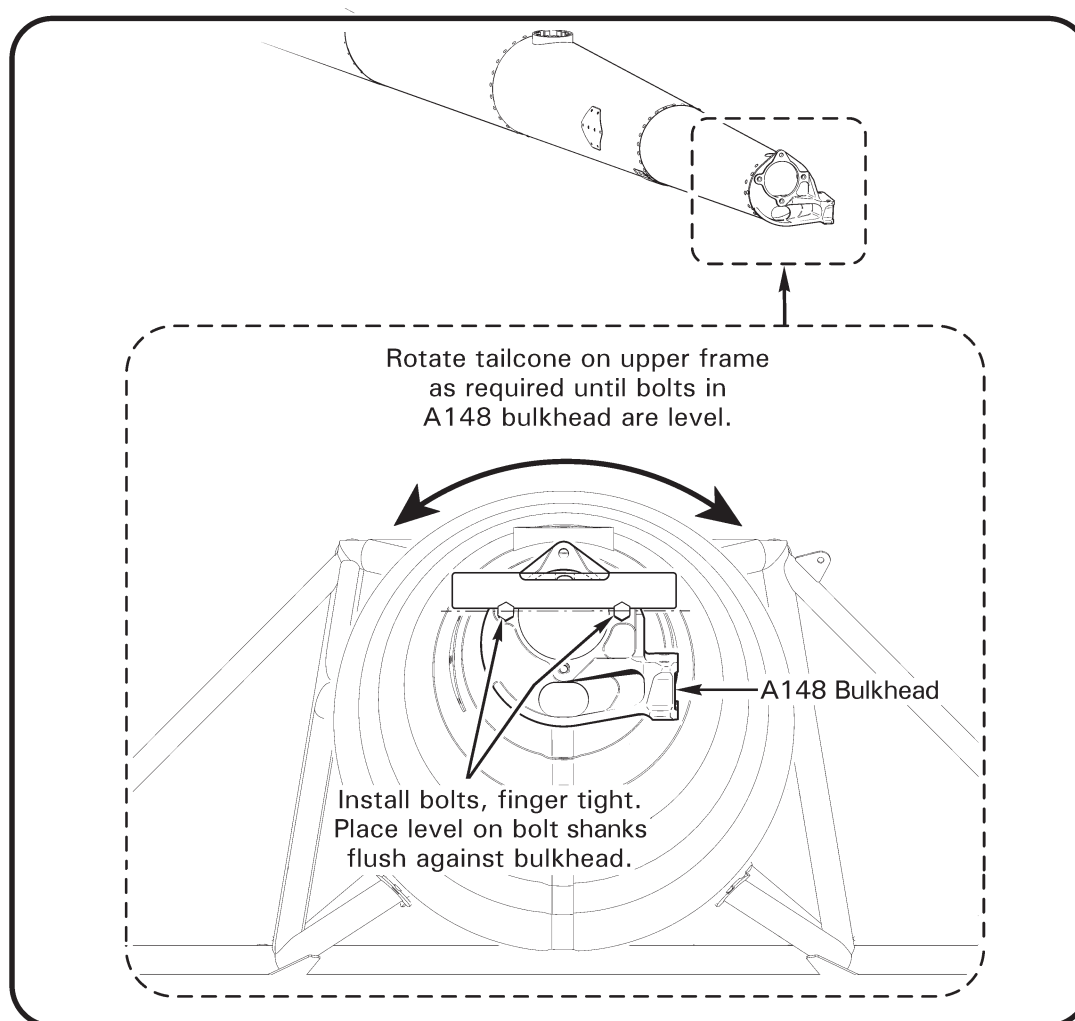


FIGURE 4-2A TAILCONE LATERAL LEVELING

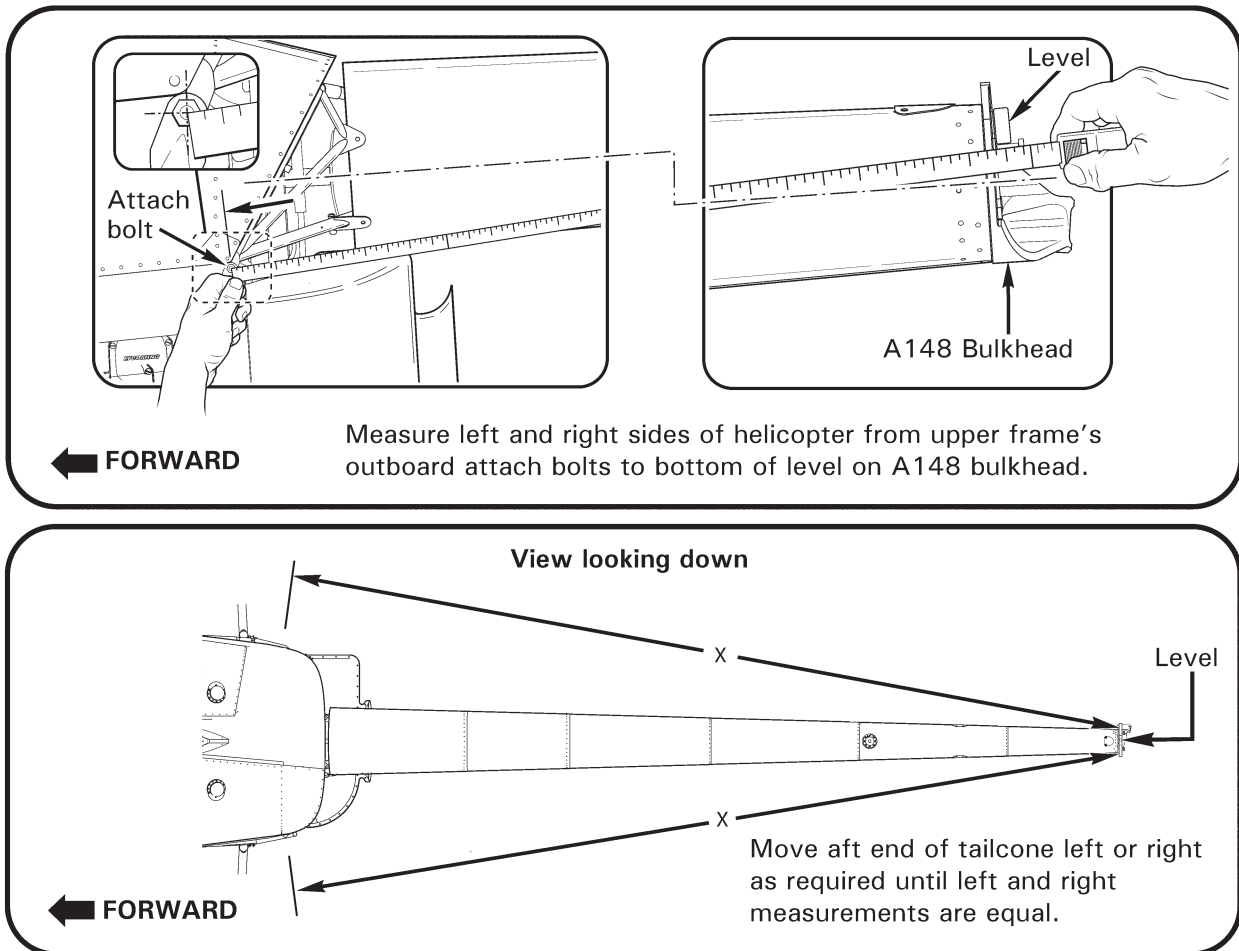


FIGURE 4-2B TAILCONE LATERAL ALIGNMENT

#### 4.310 Tailcone Replacement (continued)

##### A. Tailcone Set-up (continued)

4. Refer to Figure 4-2B. Measure left and right sides of helicopter from upper frame's outboard attach bolts to bottom of level on A148 bulkhead. Move aft end of tailcone left or right as required until left and right measurements are equal.

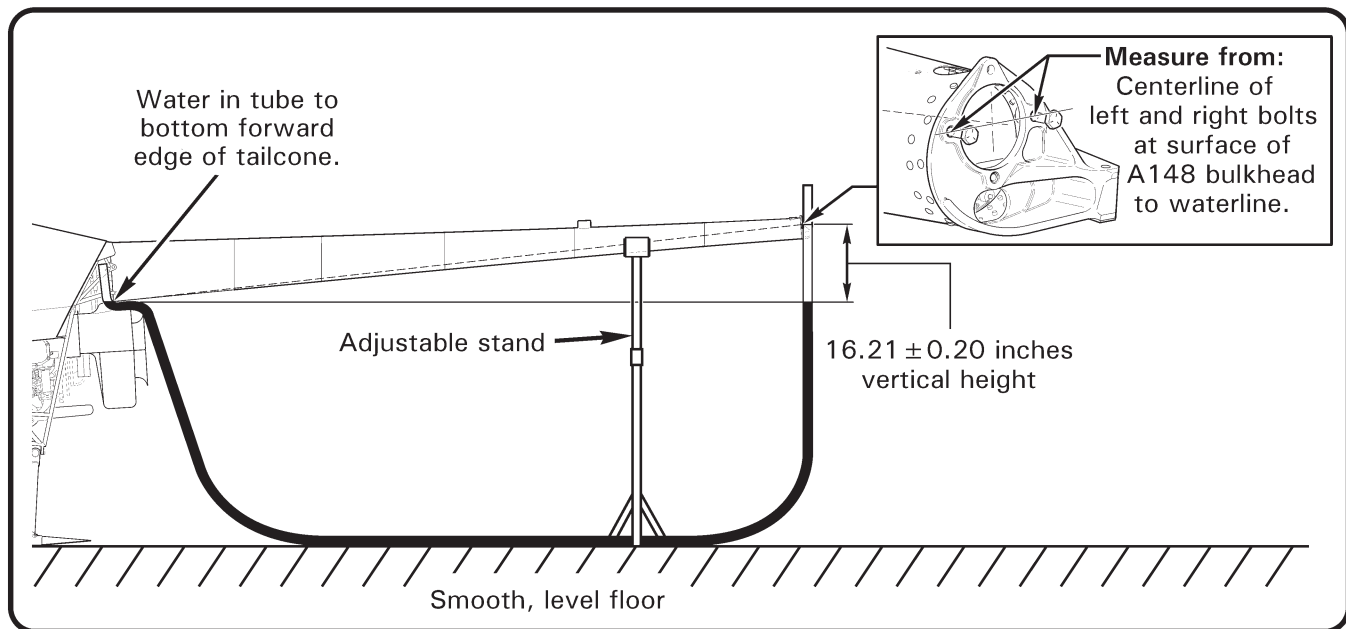


FIGURE 4-2C TAILCONE VERTICAL ALIGNMENT

#### 4.310 Tailcone Replacement (continued)

##### A. Tailcone Set-up (continued)

5. Refer to Figure 4-2C. Use a water level and measure the difference in vertical height between forward end of tailcone (at lowest point) and centerline of left & right bolts at surface of A148 bulkhead. Using stand, adjust height of tailcone to  $16.21 \pm 0.20$  inches.

##### NOTE

Due to bolt & hole tolerances, tailcone vertical height tends to decrease when supporting stand is removed.

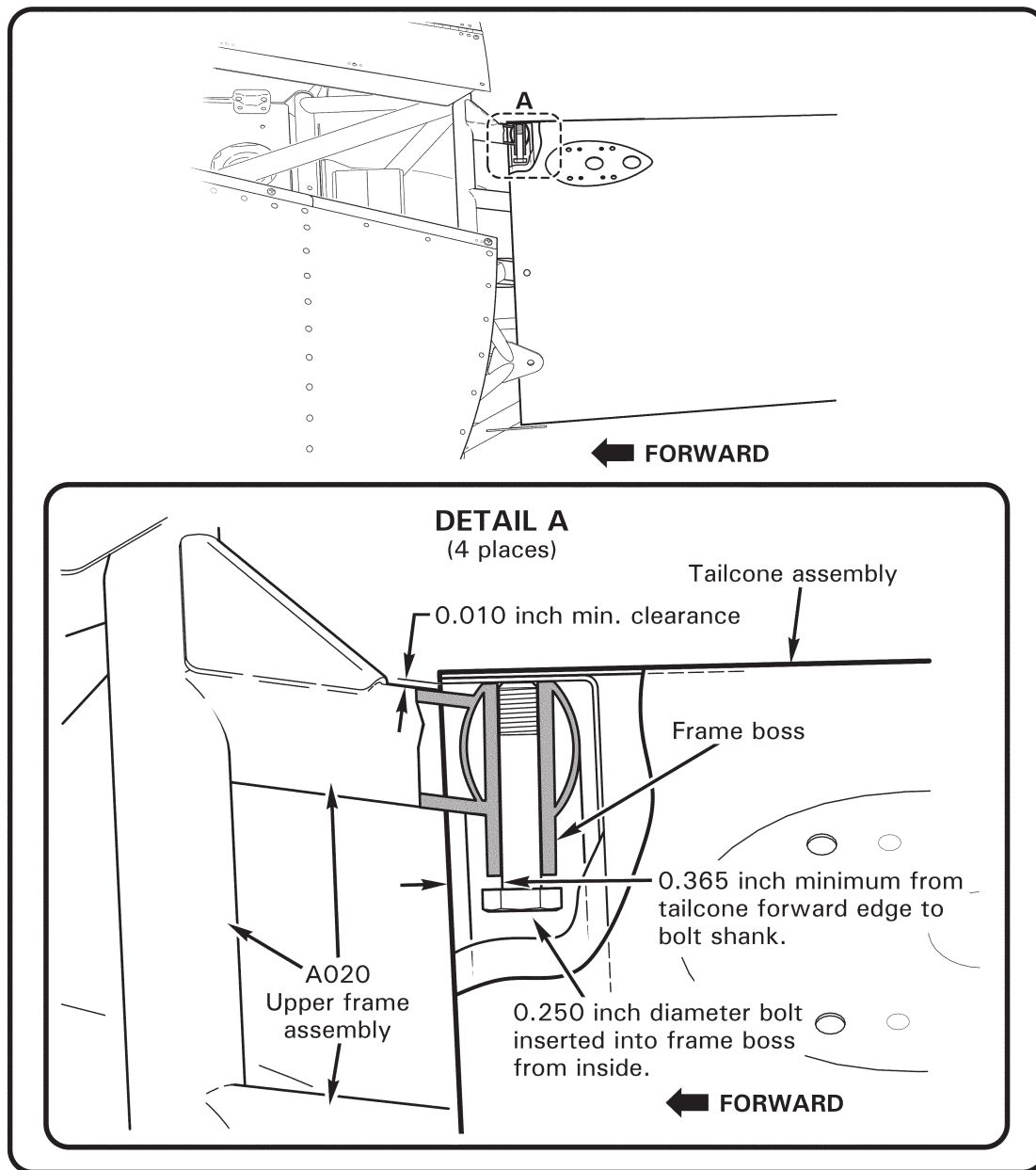


FIGURE 4-2D TAILCONE ATTACH HOLE EDGE DISTANCE

#### 4.310 Tailcone Replacement (continued)

##### A. Tailcone Set-up (continued)

6. Refer to Figure 4-2D. Verify 0.010 inch minimum clearance between upper frame tubes and tailcone forward edge (4 places). Place a straight edge across forward face of tailcone and verify 0.365 inch minimum between straight edge and mounting bolt shank inserted in frame boss (4 places). Push tailcone forward or pull aft as required to maintain dimensions.
7. Verify tailcone leveling, lateral & vertical alignments, clearances, and minimum edge distances are correct; adjust tailcone set-up as required per steps 3 thru 6. Drill tailcone per Part B.

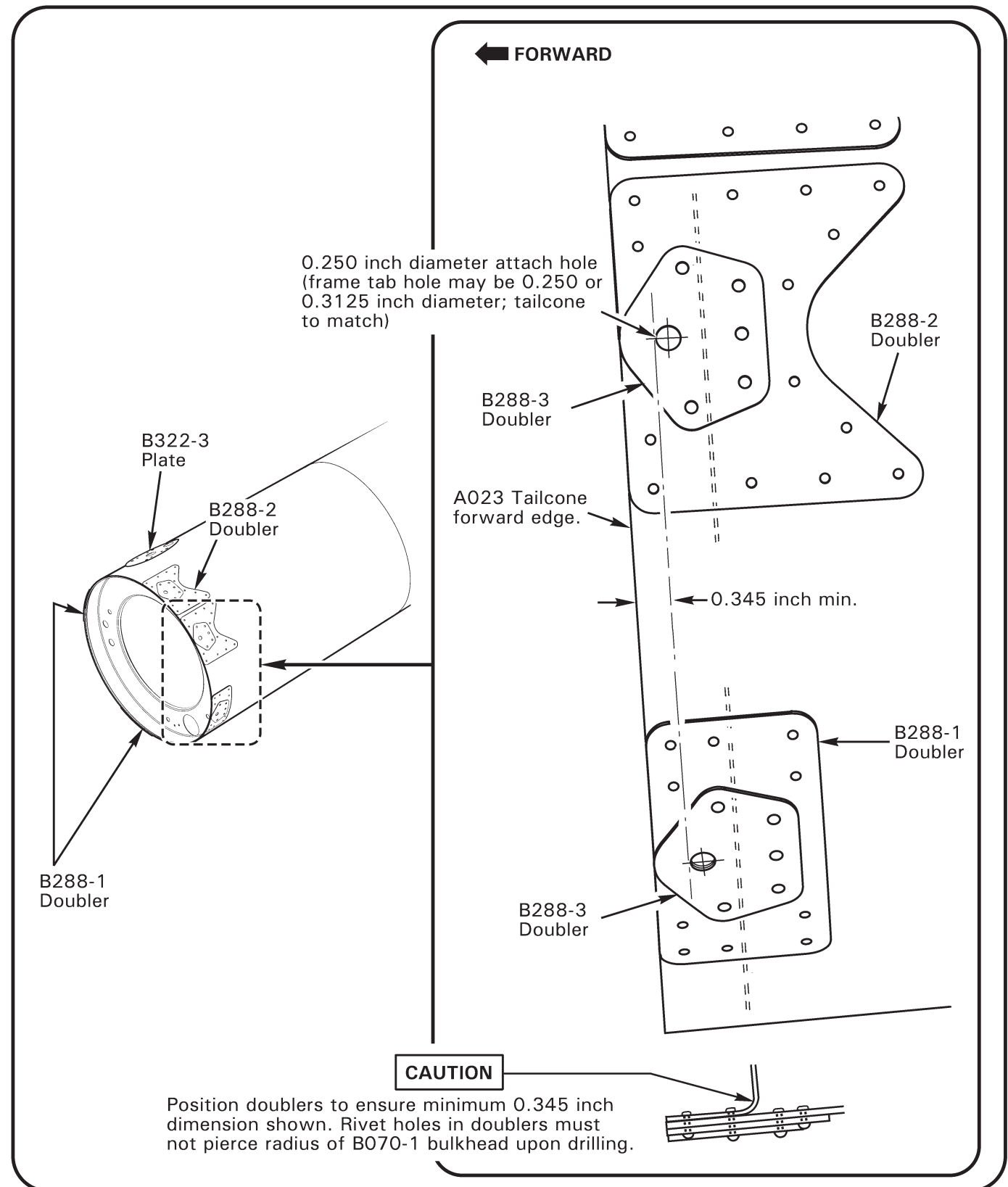


FIGURE 4-2E TAILCONE DOUBLER INSTALLATION



4.310 Tailcone Replacement (continued)**B. Tailcone Drilling****CAUTION**

Protect drive belts from drilling debris.

1. Perform tailcone set-up per Part A.
2. Clamp tailcone at (3) mounting locations to prevent tailcone movement during drilling, do not clamp tailcone at frame tab on left side of tailcone.
3. Back drill from inside of tailcone mounting hole (without clamp) using a center drill with a 0.250 inch diameter shank, then use a 0.250 inch diameter twist drill. After drilling hole, secure tailcone to frame with appropriate fastener.
4. Remove (1) clamp from next mounting location and back drill hole per step 3, repeat process for each clamped mounting hole.
5. Match drill left-side frame tab thru tailcone. Protect steel tube frame behind tailcone skin using a piece of scrap metal before drilling.
6. Remove tailcone. Deburr drilled holes.
7. Refer to Figure 4-2E and accompanying "CAUTION" statement. Center B288-1 or -2 doublers over each tailcone mounting hole and flush with tailcone forward edge. Mark doublers from inside tailcone for drilling 0.250 inch diameter hole.
8. Refer to Figure 4-2E. Drill B288-1 or -2 doubler with a 0.250 inch diameter twist drill at spot marked in step 7. Deburr hole and secure doubler to tailcone with a NAS1304-3 bolt. Drill through existing pilot holes in doubler with a #30 drill bit and secure with clecos.
9. Remove each NAS1304-3 bolt. Install B288-3 doubler atop B288-1 or -2 doubler and secure with NAS1304-3 bolt. Drill through existing pilot holes with a #30 drill bit.
10. Remove doublers and deburr holes. Install doublers with clecos then rivet with MS20470AD4 rivets.
11. If B288-3 doubler protrudes past forward edge of tailcone skin, file doubler flush with forward edge of tailcone, as required.
12. Apply B270-1 sealant all around doublers and forward edge of tailcone skin and B070-1 bulkhead.
13. Apply zinc chromate or epoxy primer (ref. § 23-75) per § 23-60 to doublers. Apply topcoat to tailcone, as required.
14. Install tailcone per § 4.300 Part B.

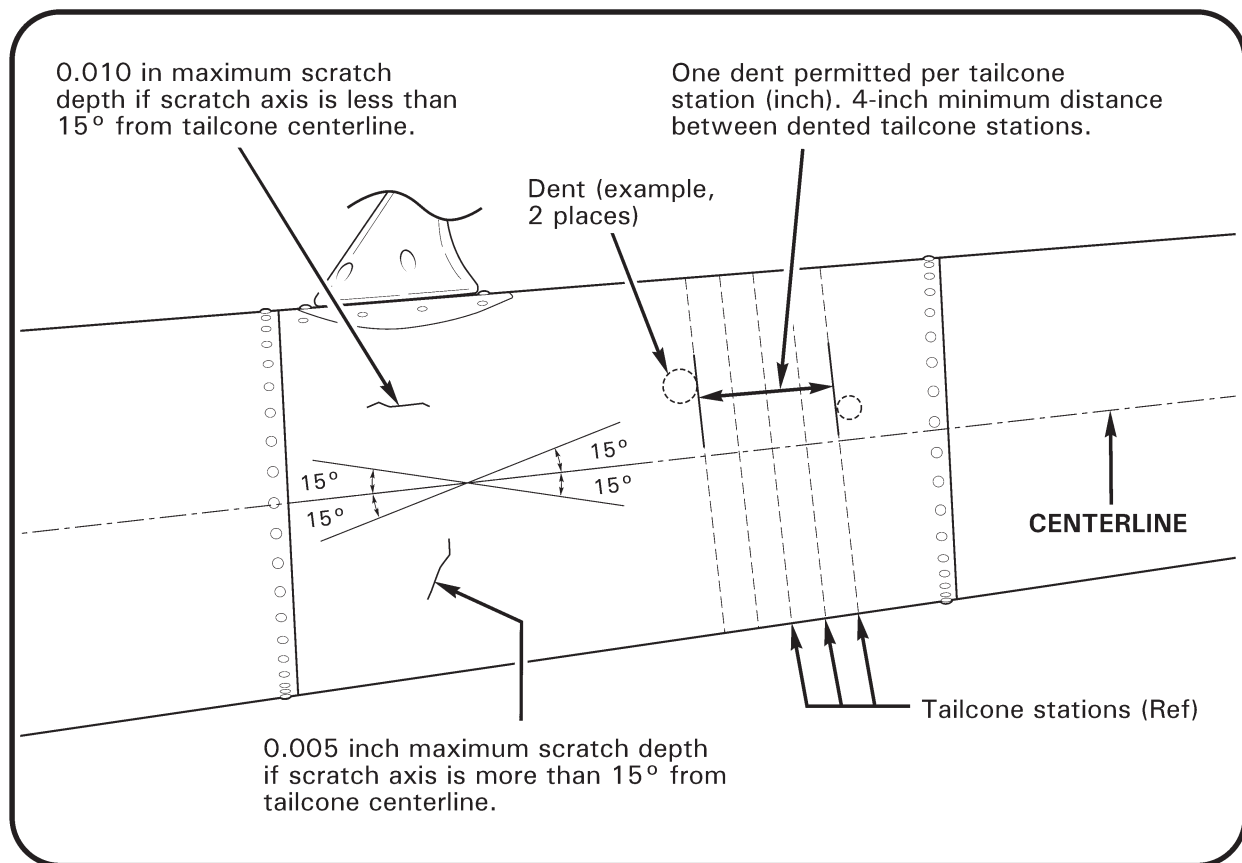
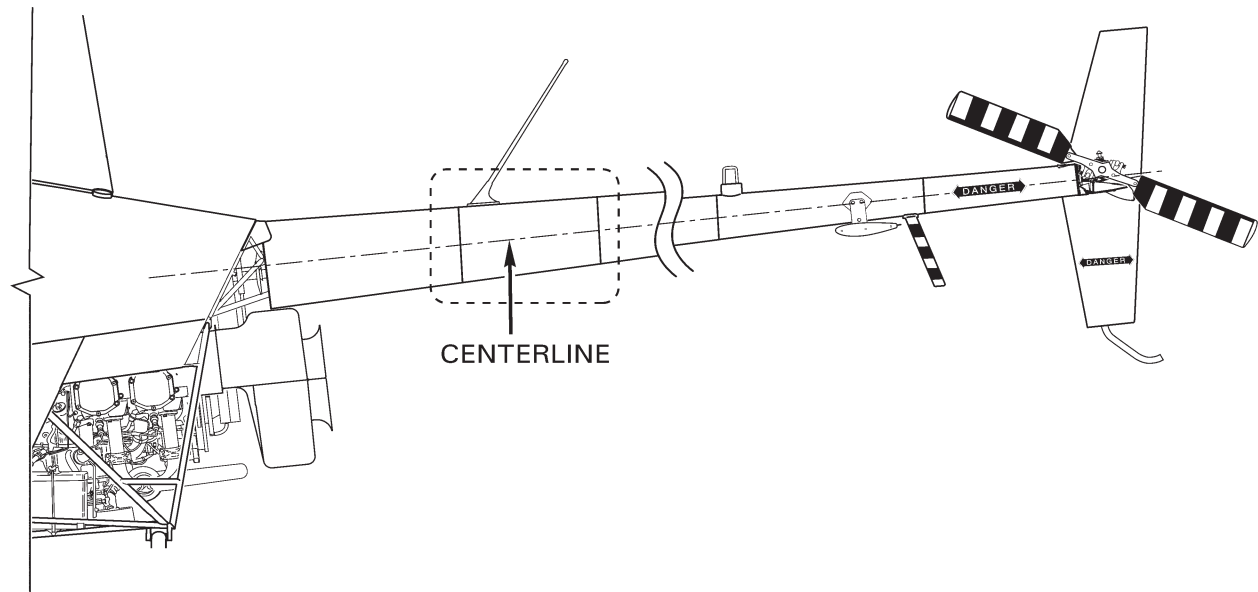


FIGURE 4-3 TAILCONE DAMAGE LIMITS

#### 4.320 Inspection and Repair

Repairs are limited to blending out scratches within limits and refinishing skins. If allowable damage is exceeded, replace tailcone, or submit tailcone to RHC for repair.

##### A. Scratches

1. Refer to Figure 4-3. Verify damage does not exceed the following limits:
  - a. 0.005 inch maximum scratch depth if scratch axis is more than 15° from tailcone centerline.
  - b. 0.010 inch maximum scratch depth if scratch axis is less than 15° from tailcone centerline.
2. If damage exceeds limits, return tailcone assembly to RHC for repair. If damage is within limits, blend out scratches with a 0.10 inch minimum blend radius. Refinish skins using approved materials per § 23-70.

##### B. Dents

###### NOTE

0.125 inch minimum radius can be verified with using a 0.250 inch diameter bearing ball: Place bearing ball within dent and back light with lamp; if light is visible between skin & ball (i.e. ball not contacting dent bottom) then dent radius is less than 0.125 inch.

1. Refer to Figure 4-3. Smooth, round bottom dents with 0.125 inch minimum radius without sharp nicks or cracks are acceptable when damage does not exceed the following limits:
  - a. 0.030 inch maximum dent depth.
  - b. 1.250 inches maximum dent diameter.
  - c. One dent permitted per tailcone station (inch).
  - d. 4.000 inches minimum distance between dented tailcone stations.
2. If damage exceeds limits, replace tailcone or return to RHC for repair.

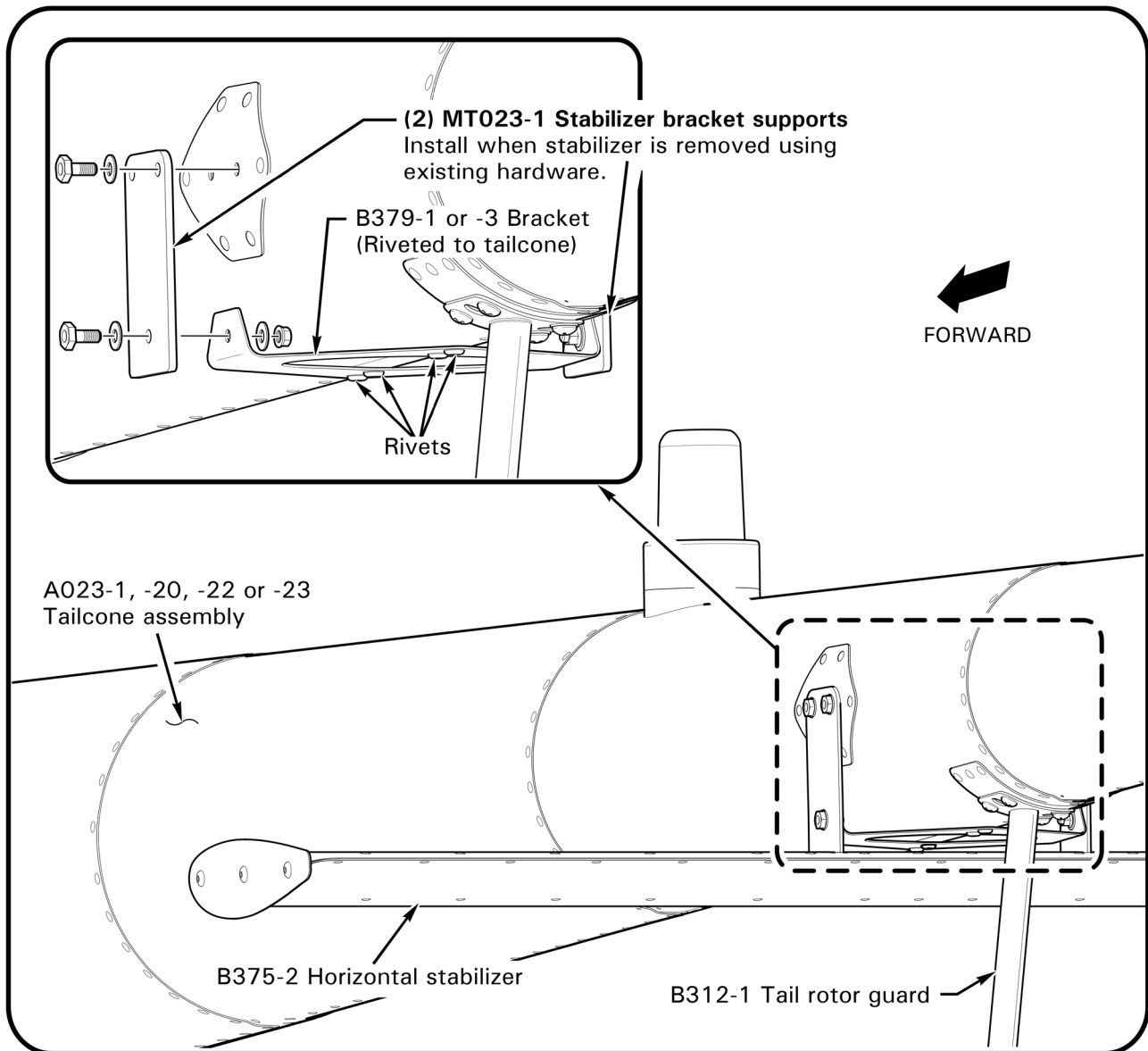


FIGURE 4-4 B375-2 HORIZONTAL STABILIZER ASSEMBLY

**4.400 B375-2 Horizontal Stabilizer Assembly****CAUTION**

If tailcone has a B379-1 or -3 bracket then A958-1 bellcranks (original equipment on helicopter S/N 0357 and subsequent) must be installed or retrofitted. Figure 8-2A refers.

If tailcone has a B379-1 or -3 bracket then B375-2 horizontal stabilizer must be installed.

B375-2 horizontal stabilizer may not be installed on R22 Mariner helicopters.

**CAUTION**

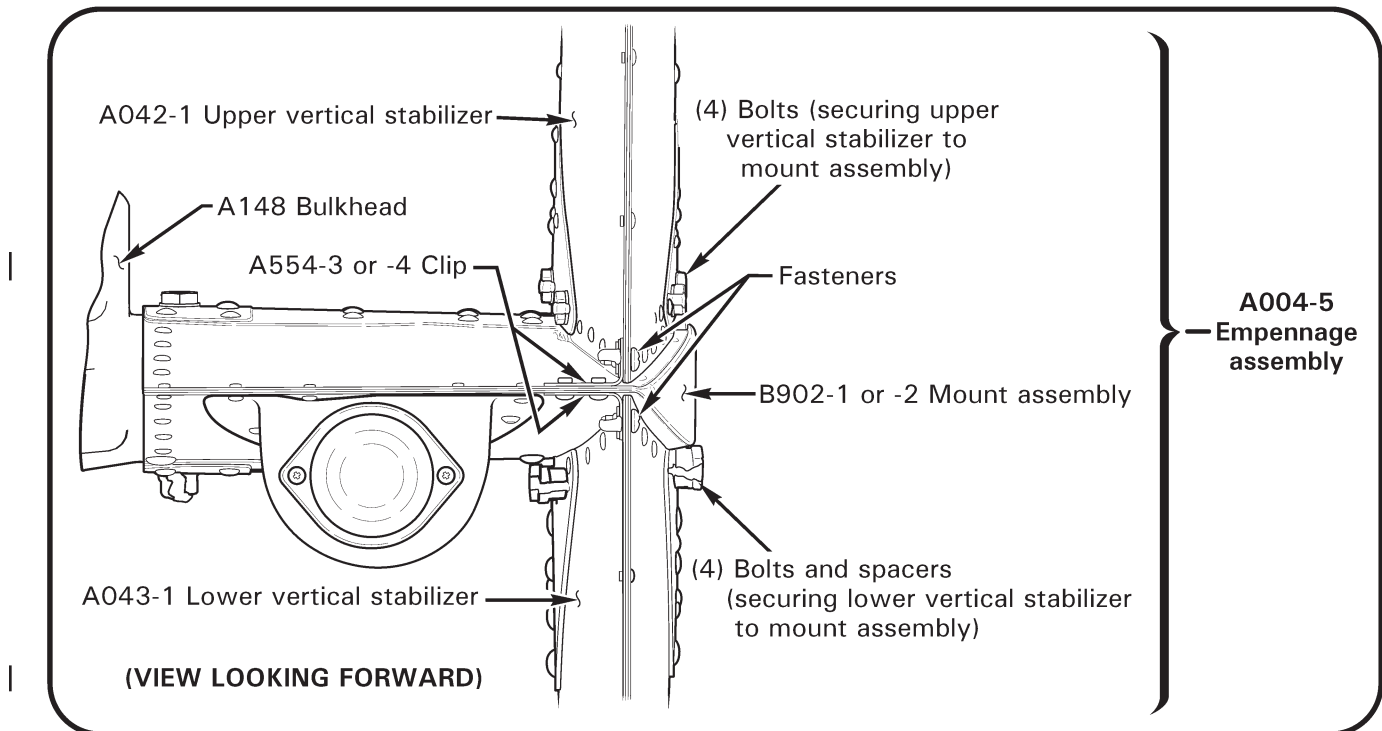
Support the B375-2 horizontal stabilizer assembly during removal & installation when upper bolts are removed to prevent bending B379-1 or -3 bracket that is riveted to tailcone.

**A. Removal**

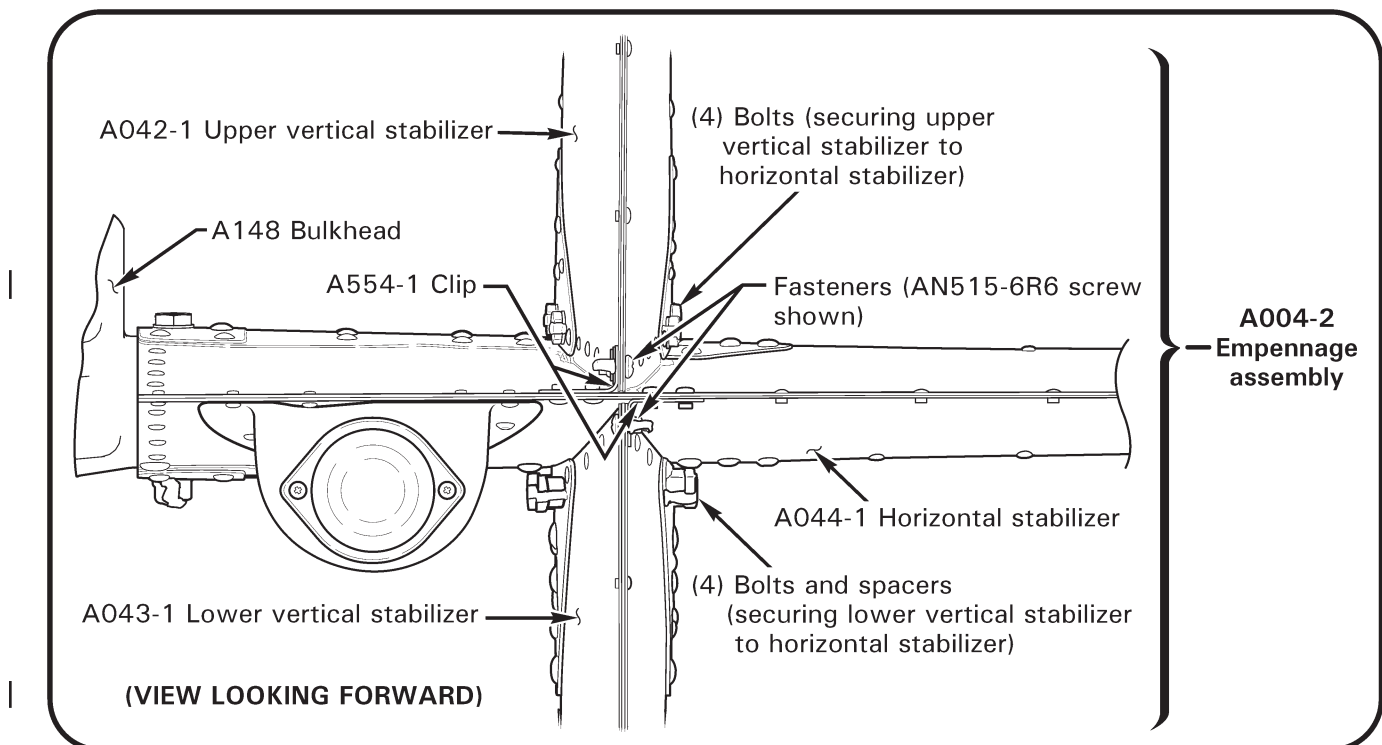
1. Refer to Figure 4-4. Remove hardware securing B375-2 horizontal stabilizer assembly to B379-1 or -3 bracket.
2. While supporting stabilizer, remove hardware securing stabilizer to tailcone assembly and remove stabilizer.
3. As required, install MT023-1 stabilizer bracket supports using removed hardware (recommended when stabilizer is removed).

**B. Installation**

1. If installed, remove hardware securing MT023-1 stabilizer bracket supports to B379-1 or -3 bracket & tailcone assembly and remove supports.
2. While supporting B375-2 horizontal stabilizer assembly, install hardware securing stabilizer to tailcone and bracket. Special torque bolts per § 23-33 and torque stripe per Figure 2-1.



**FIGURE 4-5 A004-5 EMPENNAGE ASSEMBLY INSTALLATION**  
(use with B375-2 horizontal stabilizer)



**FIGURE 4-5A A004-2 EMPENNAGE ASSEMBLY INSTALLATION**  
(includes A044-1 horizontal stabilizer)

#### 4.500 Empennage Assembly

##### CAUTION

If tailcone has a B379-1 or -3 bracket then A958-1 bellcranks (original equipment on helicopter S/N 0357 and subsequent) must be installed or retrofitted. Figure 8-2A refers.

If tailcone has a B379-1 or -3 bracket then B375-2 horizontal stabilizer must be installed.

A044-1 horizontal stabilizer may not be installed on a tailcone that has a B379-1 or -3 bracket.

B902-1 or -2 vertical stabilizers mount assembly may only be installed on a tailcone that has a B379-1 or -3 bracket.

##### A. Removal

1. Remove hardware securing MS21919WDG2 clamp to B902-1 (or -2) vertical stabilizers mount assembly (or A044-1 horizontal stabilizer, if installed). Cut and discard ty-raps securing position light and gearbox chip detector wires and connectors together. Disconnect position light at connectors.
2. Refer to Figure 4-5 or 4-5A. While supporting empennage assembly, remove hardware securing empennage to A148 bulkhead, and remove empennage.

##### B. Installation

1. Refer to Figure 4-5 or 4-5A. Position empennage assembly on A148 bulkhead.
  - a. **If A301-5 (empennage ballast; ref. § 18-32) weight will not be installed:** Install (2) NAS6604-28 bolts & associated hardware securing empennage to A148 bulkhead. Standard torque bolts and palnuts per § 23-32 and torque stripe per Figure 2-1.
  - b. **If A301-5 (empennage ballast; ref. § 18-32) weight will be installed:** Install (2) NAS6604-44 bolts & associated hardware securing empennage to A148 bulkhead. Standard torque bolts and palnuts per § 23-32 and torque stripe per Figure 2-1.
2. Connect position light wire connectors. Secure wires and install hardware securing MS21919WDG2 clamp to B902-1 (or -2) vertical stabilizers mount assembly (or A044-1 horizontal stabilizer, if installed). Install MS3367-4-9 ty-raps as required to secure wires and connectors together. Cinch ty-raps until snug without over-tightening, and trim tips flush with heads.
3. Test and verify correct function of position and TR chip light circuits.

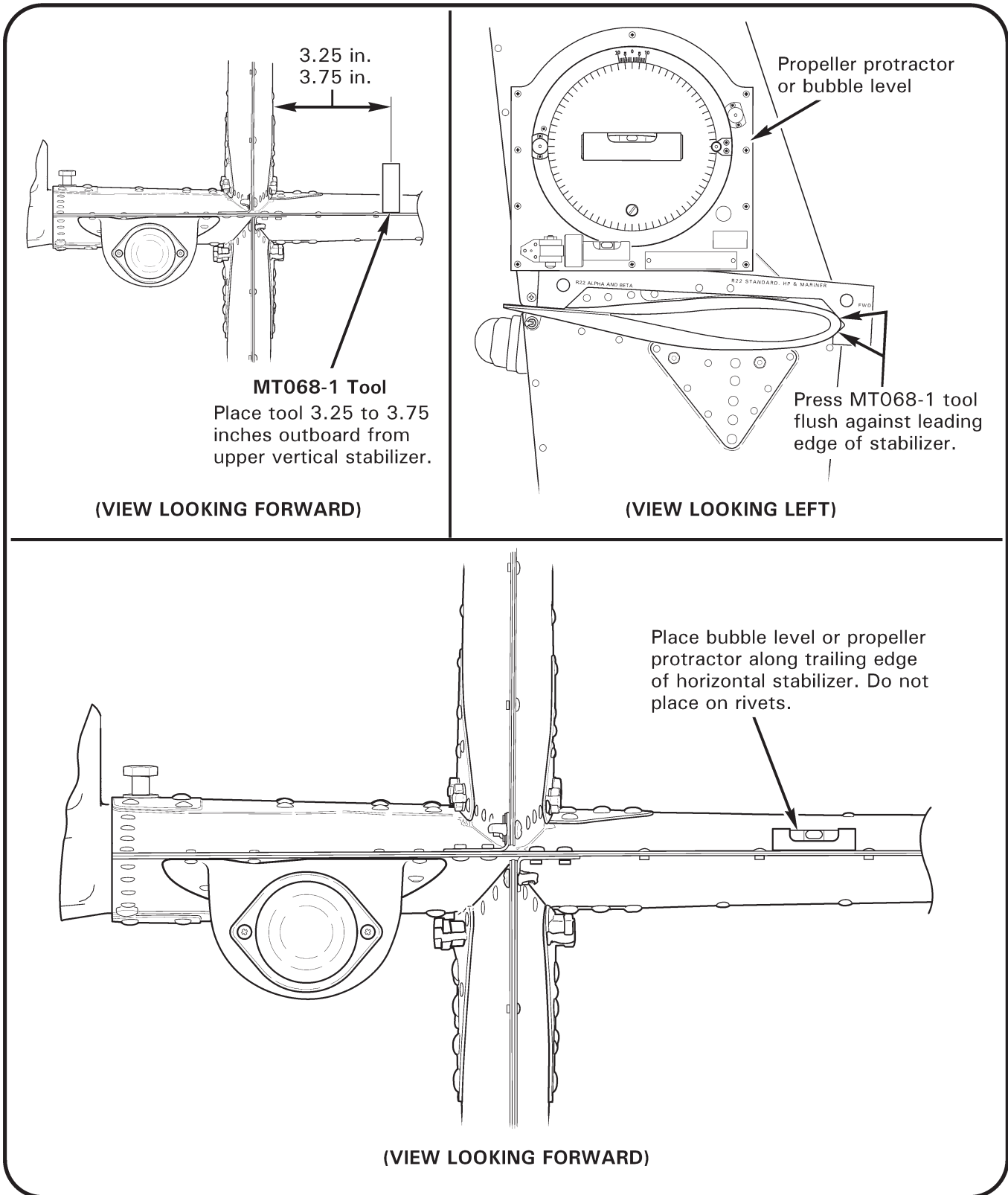


FIGURE 4-6 EMPENNAGE ASSEMBLY REPLACEMENT



4.500 Empennage Assembly (continued)**C. Replacement (A004-2 Empennage Only)**

1. Level aircraft per § 18-10.
2. Refer to Figure 4-6. Position empennage assembly on tailcone aft bulkhead. Insert (2) NAS1304-28 bolts thru top mounting holes in A044-1 horizontal stabilizer.

**NOTE**

A large C-clamp and wooden blocks may be used between NAS1304 bolts to prevent empennage moving prior to drilling.

3. Place MT068-1 horizontal stabilizer rigging tool on top of horizontal stabilizer 3.25–3.75 inches from outboard edge of vertical stabilizer.
4. Place propeller protractor or bubble level atop MT068-1 forward flat surface if tailcone is A023-1 or -22 (Standard, HP, & Mariner helicopters), or aft flat surface if tailcone is A023-20 or -23 (Alpha & Beta helicopters).
5. Push forward or pull aft slightly on tail skid to adjust horizontal stabilizer angle of incidence until correct flat of MT068-1 tool is level with helicopter.
6. Place propeller protractor or bubble level along trailing edge of horizontal stabilizer. Push up or pull down slightly at outboard end of horizontal stabilizer as required to obtain  $0^{\circ} \pm 0.5^{\circ}$  level laterally.
7. Verify angle of incidence performed in step 5. Adjust stabilizer per steps 5 & 6 as required.
8. Remove aft bolt from horizontal stabilizer top hole. Using existing hole as a drill guide, drill thru stabilizer's lower surface using 0.250 inch diameter drill bit. Temporarily secure stabilizer using NAS1304-28 bolt & D210-4 nut with washers in drilled hole.
9. Verify stabilizer angle of incidence and lateral level, adjust per steps 5 & 6 if required.
10. Remove forward bolt from horizontal stabilizer top hole. Using existing hole as a drill guide, drill thru stabilizer's lower surface using 0.250 inch diameter drill bit.
11. Remove aft bolt and C-clamp (if used), and remove empennage from tailcone. Deburr holes and install empennage per Part B.

#### 4.510 Upper Vertical Stabilizer Assembly

##### **A. Removal**

1. Refer to Figure 4-5 or 4-5A. Remove fastener securing A554 clip to A042-1 upper vertical stabilizer assembly.
2. While supporting A042-1 vertical stabilizer, remove bolts securing vertical stabilizer to B902-1 (or -2) vertical stabilizers mount assembly or A044-1 horizontal stabilizer, as applicable, and remove A042-1 vertical stabilizer.

##### **B. Installation**

1. Refer to Figure 4-5 or 4-5A. Position A042-1 upper vertical stabilizer assembly on B902-1 (or -2) vertical stabilizers mount assembly or A044-1 horizontal stabilizer, as applicable. Verify 0.030–0.120 inch gap between vertical stabilizer skin edges and mount assembly (or horizontal stabilizer) upper skin. File vertical stabilizer skin edge(s) as required. Conversion coat & prime bare aluminum edges per §§ 23-51 & 23-60.
2. Install bolts securing vertical stabilizer to mount assembly (or horizontal stabilizer). Special torque bolts per § 23-33 and torque stripe per Figure 2-1.
3. If replacing vertical stabilizer, match drill A554 clip to stabilizer using 0.144 inch diameter drill. Deburr holes as required, install fastener and torque stripe per Figure 2-1.

#### 4.520 Lower Vertical Stabilizer Assembly

##### **A. Removal**

1. Refer to Figure 4-5 or 4-5A. Remove fastener securing A554 clip to A043-1 vertical stabilizer.
2. While supporting A043-1 vertical stabilizer, remove bolts & spacers securing vertical stabilizer to B902-1 (or -2) vertical stabilizers mount assembly or A044-1 horizontal stabilizer, as applicable, and remove A043-1 vertical stabilizer.

##### **B. Installation**

1. Refer to Figure 4-5 or 4-5A. Position A043-1 lower vertical stabilizer assembly on B902-1 (or -2) vertical stabilizers mount assembly or A044-1 horizontal stabilizer, as applicable. Verify 0.030–0.120 inch gap between vertical stabilizer skin edges and mount assembly (or horizontal stabilizer) lower skin. File vertical stabilizer skin edge(s) as required. Conversion coat & prime bare aluminum edges per §§ 23-51 & 23-60.
2. Install bolts & spacers securing vertical stabilizer to mount assembly (or horizontal stabilizer). Special torque bolts per § 23-33 and torque stripe per Figure 2-1.
3. If replacing vertical stabilizer, match drill A554 clip to stabilizer using 0.144 inch diameter drill. Deburr holes as required, install fastener and torque stripe per Figure 2-1.

4.530 B902-1 or -2 Vertical Stabilizers Mount Assembly**A. Removal**

1. Remove A042-1 & A043-1 vertical stabilizer assemblies per §§ 4.510 & 4.520.
2. Remove hardware securing MS21919WGD2 clamp to B902-1 (or -2) vertical stabilizers mount assembly. Cut and discard ty-raps securing position light and gearbox chip detector wires and connectors together. Disconnect position light at connectors.
3. While supporting mount assembly, remove hardware securing mount to A148 bulkhead and remove mount.

**B. Installation****CAUTION**

If tailcone has a B379-1 or -3 bracket then A958-1 bellcranks (original equipment on helicopter S/N 0357 and subsequent) must be installed or retrofitted. Figure 8-2A refers.

B902-1 or -2 vertical stabilizers mount assembly may only be installed on a tailcone that has a B379-1 or -3 bracket.

1. Refer to Figure 4-5. Position B902-1 (or -2) vertical stabilizers mount assembly on A148 bulkhead.
  - a. **If A301-5 (empennage ballast; ref. § 18-32) weight will not be installed:** Install (2) NAS6604-28 bolts & associated hardware securing empennage to A148 bulkhead. Standard torque bolts and palnuts per § 23-32 and torque stripe per Figure 2-1.
  - b. **If A301-5 (empennage ballast; ref. § 18-32) weight will be installed:** Install (2) NAS6604-44 bolts & associated hardware securing empennage to A148 bulkhead. Standard torque bolts and palnuts per § 23-32 and torque stripe per Figure 2-1.
2. Install A042-1 & A043-1 vertical stabilizer assemblies per §§ 4.510 & 4.520. If installing B902-2 mount assembly, match drill vertical stabilizers to A554-4 clips using 0.144 inch diameter drill. Deburr holes, install fasteners and torque stripe per Figure 2-1.
3. Connect position light at connectors. Install hardware securing clamp to mount assembly. Install MS3367-4-9 ty-raps as required to secure position light and gearbox chip detector wires and connectors together. Cinch ty-raps until snug without over-tightening, and trim tips flush with heads.
4. Test and verify correct function of position and TR chip light circuits.

#### 4.540 A044-1 Horizontal Stabilizer Assembly

##### A. Removal

1. Remove A042-1 & A043-1 vertical stabilizer assemblies per §§ 4.510 & 4.520.
2. Remove hardware securing MS21919WGD2 clamp to A044-1 horizontal stabilizer assembly. Cut and discard ty-raps securing position light and gearbox chip detector wires and connectors together. Disconnect position light at connectors.
3. While supporting horizontal stabilizer, remove hardware securing stabilizer to A148 bulkhead and remove stabilizer.
4. If replacing horizontal stabilizer, A554-1 clips may be reused. Drill out two rivets securing each clip to stabilizer and retain clips.

##### B. Installation

###### CAUTION

A044-1 horizontal stabilizer may not be installed on a tailcone that has a B379 bracket.

1. Refer to Figure 4-5A. Position A044-1 horizontal stabilizer assembly on A148 bulkhead.
  - a. If A301-5 (empennage ballast; ref. § 18-32) weight will not be installed: Install (2) NAS6604-28 bolts & associated hardware securing empennage to A148 bulkhead. Standard torque bolts and palnuts per § 23-32 and torque stripe per Figure 2-1.
  - b. If A301-5 (empennage ballast; ref. § 18-32) weight will be installed: Install (2) NAS6604-44 bolts & associated hardware securing empennage to A148 bulkhead. Standard torque bolts and palnuts per § 23-32 and torque stripe per Figure 2-1.
2. Install A042-1 & A043-1 vertical stabilizer assemblies per §§ 4.510 & 4.520.
3. Connect position light at connectors. Install hardware securing clamp to stabilizer. Install MS3367-4-9 ty-raps as required to secure position light and gearbox chip detector wires and connectors together. Cinch ty-raps until snug without over-tightening, and trim tips flush with heads.
4. Test and verify correct function of position and TR chip light circuits.

**4.540 A044-1 Horizontal Stabilizer Assembly (continued)****C. Repair**

A single dent on A044-1 horizontal stabilizer leading edge outboard of vertical stabilizers is permitted provided:

1. Dent is no more than 0.050-inch deep.
2. Dent must have a smooth bottom, with minimum 0.125-inch radius, and no sharp nicks or cracks.
3. Dent must be less than 1.25 inches spanwise.
4. It is permissible to remove above dent via metalworking.

Skin replacement, damage to spars, and either forward or middle attachment for vertical stabilizers, is not field repairable.

To inspect spars, remove NAS1919B04S01 rivets securing B722-3 outboard rib. Only B722-3 outboard tip rib may be field replaced; all other parts require use of the factory jig.

**D. Replacement**

1. On a padded surface, install A042-1 & A043-1 vertical stabilizer assemblies on A044-1 horizontal stabilizer per §§ 4.510 & 4.520.
2. Refer to Figure 4-5A. Position A554-1 clips on horizontal stabilizer, install fastener securing each clip to upper or lower vertical stabilizer. With upper and lower vertical stabilizers in-line, match drill clips to horizontal stabilizer using #30 drill. Deburr holes and install rivets securing clips to horizontal stabilizer. Reinstall fasteners and torque stripe per Figure 2-1.
3. Perform empennage replacement per § 4.500 Part C.

**4.600 Tail Skid****A. Removal**

Remove hardware securing tail skid to A043-1 vertical stabilizer and remove skid.

**B. Installation**

Position tail skid in bottom of A043-1 vertical stabilizer. Install hardware securing skid. Standard torque bolts & palnuts per § 23-32 and torque stripe per Figure 2-1.

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## CHAPTER 5

## LANDING GEAR

<u>Section</u>	<u>Title</u>	<u>Page</u>
5.000	Landing Gear . . . . .	5.1
5.001	Introduction . . . . .	5.1
5.002	Description . . . . .	5.1
5.100	Landing Gear Assembly . . . . .	5.2
5.110	Landing Gear Removal . . . . .	5.2
5.120	Landing Gear Installation . . . . .	5.2
5.200	Cross Tubes . . . . .	5.3
5.210	Cross Tube Removal . . . . .	5.3
5.220	Cross Tube Installation . . . . .	5.4
5.300	Skid Tubes . . . . .	5.4
5.310	Skid Tube Removal . . . . .	5.4
5.320	Skid Tube Installation . . . . .	5.4
5.330	Skid Shoe Removal and Replacement . . . . .	5.4
5.340	Ground Handling Wheel Support Removal and Replacement . . . . .	5.8
5.400	Preventive Maintenance . . . . .	5.8
5.500	Float Ship Landing Gear . . . . .	5.9
5.510	Float Landing Gear Removal . . . . .	5.9
5.520	Float Landing Gear Installation . . . . .	5.10
5.530	Float Tube Removal . . . . .	5.11
5.540	Float Tube Installation . . . . .	5.11
5.550	Float Tube Repair . . . . .	5.13

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**CHAPTER 5****LANDING GEAR****5.000 Landing Gear****5.001 Introduction**

This section covers removal and reinstallation of the landing gear assembly, cross tubes, skid tubes, skid shoes, and ground handling wheel supports.

**5.002 Description**

A skid-type landing gear is used. Most hard landings will be absorbed elastically. However, in an extremely hard landing, the struts will hinge up and outward as the crosstube yields (becomes permanently bent) to absorb the impact. Slight crosstube yielding is acceptable. Replace forward crosstube when it contacts underlying cover. Yielding which allows the tail skid to be within 34 inches (24 inches for R22 Standard or HP, 37 inches for Mariner) of the ground when the helicopter is sitting empty on level, hard surface requires crosstube(s) replacement.

Abrasion-resistant wear shoes are mounted on the bottom of the skids. These shoes should be inspected periodically, particularly if autorotation landings with ground contact have been performed.

R22 Mariners have permanently inflated utility floats mounted to skid tubes and incorporate aft skid extensions to support the floats.

## 5.100 Landing Gear Assembly

### 5.110 Landing Gear Removal

1. Remove forward cross tube cover.
2. Jack or hoist helicopter per Chapter 17.
3. Disconnect A936 ground wire at aft-right elbow.
4. Remove four landing gear attach bolts. Slide landing gear clear of helicopter.

#### NOTE

If jacking helicopter using contour block under vertical firewall, remove one skid tube to move landing gear clear of helicopter.

### 5.120 Landing Gear Installation

1. Jack or hoist helicopter per Chapter 17.
2. Lift landing gear one side at a time, install mounting bolts, and standard torque per § 23-32.

#### NOTE

All mounting bolts are installed from aft side. Ensure large diameter washers are installed on both sides of strut elbows.

3. Attach ground wire to aft-right elbow lower bolt, standard torque per § 23-32, and torque stripe per Figure 2-1.
4. Install palnuts, standard torque per § 23-32, and torque stripe per Figure 2-1.

## 5.200 Cross Tubes

### 5.210 Cross Tube Removal

Replace cross tube(s) if yielding results in tail skid-to-level ground dimension of less than 24 inches for a Standard or HP, 34 inches for an Alpha/Beta/Beta II, or 37 inches for a Mariner/Mariner II with float stabilizer installed.

<p><b>NOTE</b></p>
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<p>See § 2.550 for hard landing inspection criteria.</p>
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1. Remove landing gear per § 5.110.
2. Using a soft brass or aluminum drift, carefully tap out spacers securing cross tube in strut elbow and tap elbows off cross tube.
3. If difficulty is encountered removing strut elbow from cross tube:
  - a. Install spacer securing opposite strut elbow to cross tube.
  - b. Disconnect stuck strut assembly from skid tube.
  - c. Place a rigid support under cross tube.
  - d. Using strut on stuck elbow as handle, rotate elbow on cross tube to break paint bond.
  - e. Remove spacer installed in step a. and remove cross tube.

### 5.220 Cross Tube Installation

1. Install cross tube in upper strut elbow. Place a wooden block against end of cross tube and tap as necessary to align mounting hole in cross tube with hole in elbow.
2. Install spacers by tapping them through elbows and cross tubes with a soft face hammer.

### 5.300 Skid Tubes

#### 5.310 Skid Tube Removal

Replace skid tubes worn beyond 0.030-inch maximum depth (no length limit) longitudinal scratch, 0.030-inch maximum depth and 0.50-inch maximum length circumferential scratch, or 0.50-inch maximum width flat spot.

1. Raise one side of helicopter by jacking under one end of the aft cross tube, one inch inboard of fitting.
2. Remove 4 bolts at each landing gear strut. Remove skid tube.

#### 5.320 Skid Tube Installation

Place skid tube under fore and aft gear struts and install attach bolts. Standard torque attach bolts per § 23-32 (self-locking nutplate installed inside skid tube).

#### 5.330 Skid Shoe Removal and Replacement

<p style="text-align: center;"><b>NOTE</b></p>
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<p>Replace A667-5 and -6 skid shoes less than 0.050 inch thick.</p>
---

1. Install ground handling wheels.
2. Push down on tail and place a wooden block approximately 4 inches ahead of intermediate skid shoes. (See Figure 5-3.)
3. Remove bolts attaching forward and intermediate shoes to skids. Discard worn shoes and screws.
4. Install new skid shoes and screws. Standard torque screws per § 23-32.

<p style="text-align: center;"><b>NOTE</b></p>
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<p>Some early R22's had forward skid shoes attached using aluminum blind rivets (MS20600AD6-4). These can be removed by drilling off head and punching out shank.</p>
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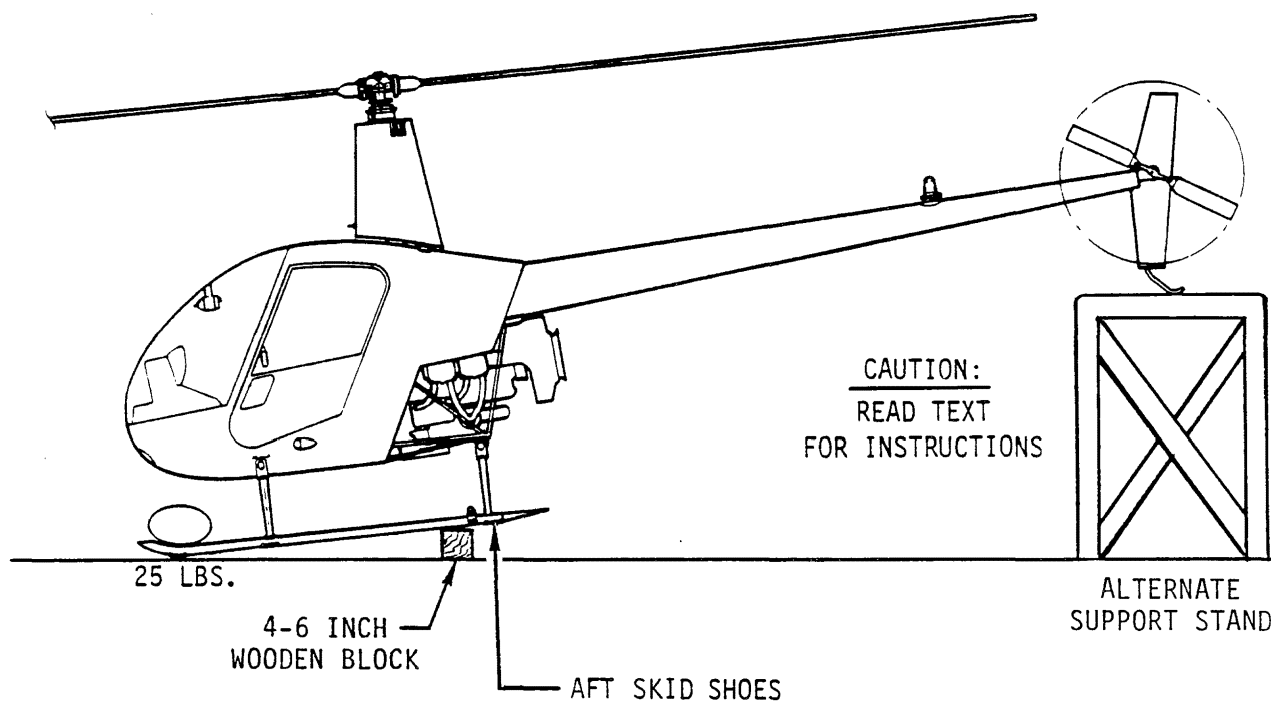
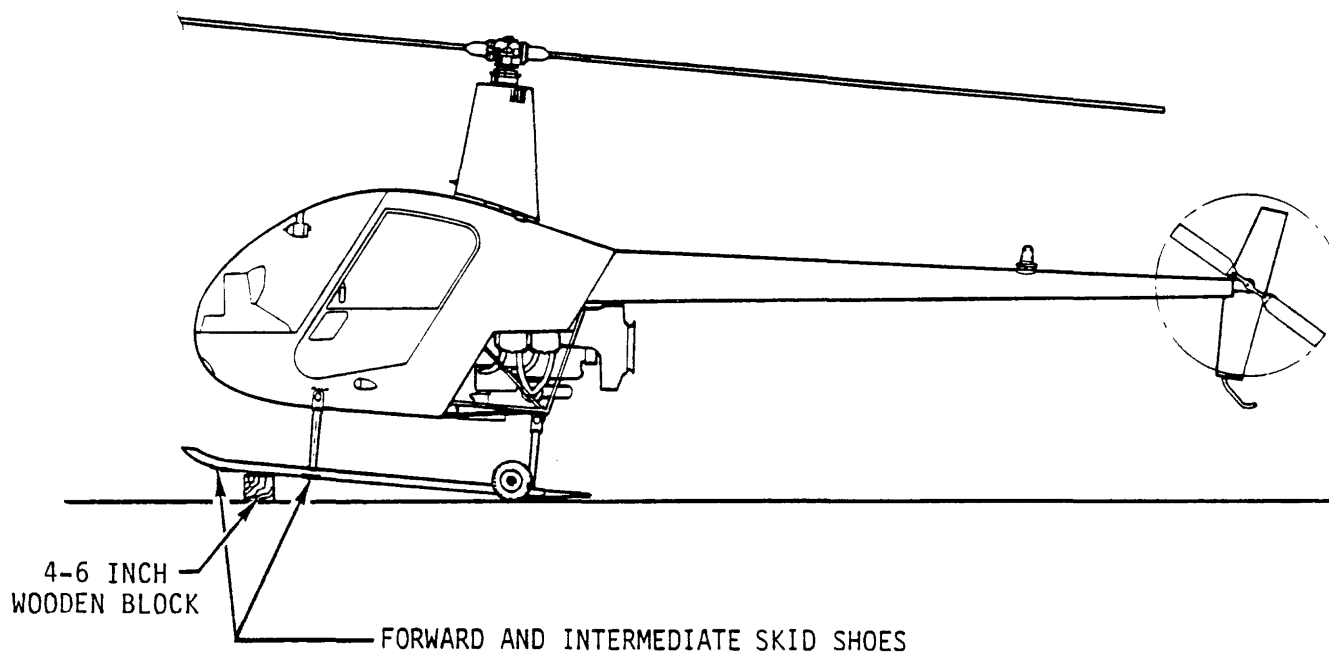


FIGURE 5-3 SKID SHOE REPLACEMENT

5.330 Removal and Replacement of Skid Shoes (cont'd)

- e) Tilt the helicopter until the tail skid touches the ground. Place a 4-6 inch wooden block as far aft as possible under each skid tube. (See Figure 5-3).
- f) Press down on each skid tip or lift on the tailcone until the helicopter tips forward. Ballast each skid at the tip with approximately 25 pounds, or place a support under the tail skid.
- g) Remove and replace the skid shoes per Steps c) and d) above.

5.340 Removal and Replacement of Ground Handling Wheel Support

- a) Remove the two attach bolts and pull the support free of the skid.
- b) Align the mounting holes of the support with the holes in skid tube. Install the mounting bolts and torque to 50 in.-lb plus nut drag.

5.400 PREVENTIVE MAINTENANCE

- 1. Ensure drain holes in bottoms of skid tubes are not plugged (two per skid), located just aft of forward two skid shoes.
- 2. Touch up skid tubes, cross tubes and struts to prevent corrosion. Use paints and primers obtained from approved materials list per Section 1.400.
- 3. Daily or preflight inspection of skid shoes (Rotorcraft heavy usage).
- 4. Install lost or loose raincaps with structural adhesive per the manufacturer's instructions. (See approved materials list, Section 1.400).



5.500 FLOAT SHIP LANDING GEAR

The Robinson R22 Mariner Helicopter may be flown with or without the float landing gear installed. If the floats are to be removed from the helicopter, it is necessary for a complete standard landing gear to be installed. Do not remove the float tubes from the landing gear skid tubes.

**CAUTION**

Float landing gear can only be installed on R22 Mariner helicopters. Mariner helicopters have a "M" suffix after the helicopter serial number stamped on the aircraft data plate.

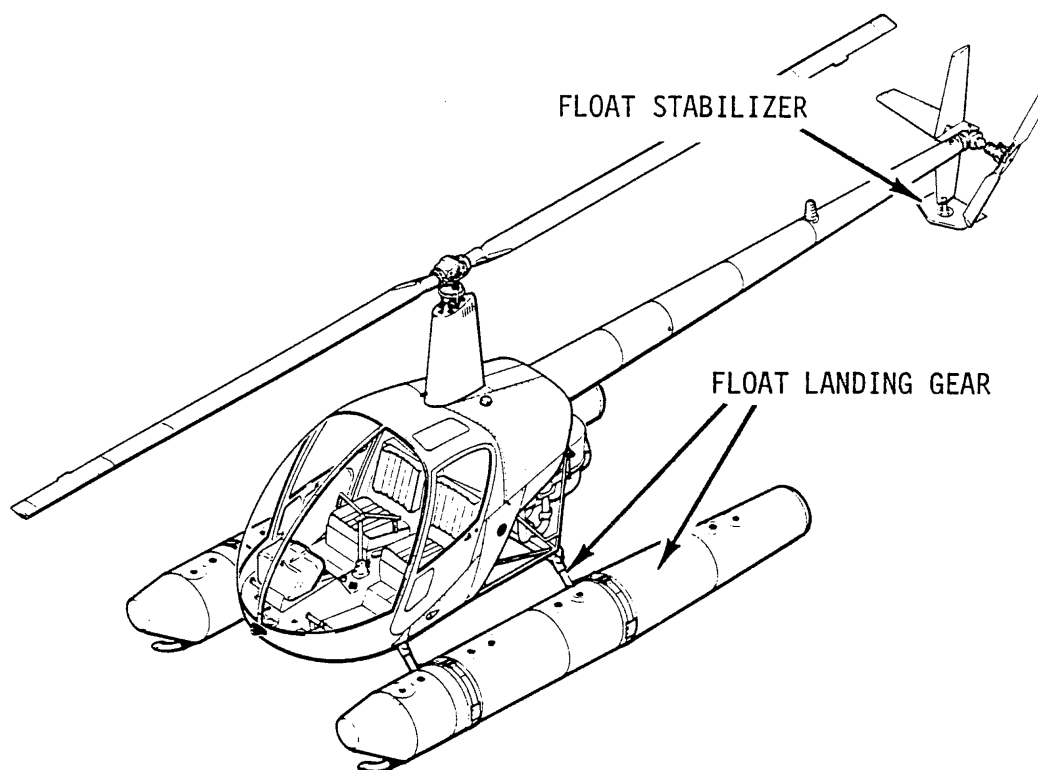
5.510 Float Landing Gear Removal

- a) Remove the complete float landing gear. Refer to Section 5.110 for landing gear removal.
- b) Install a complete standard landing gear. Refer to 5.120 for landing gear installation.
- c) Remove the float stabilizer on the lower vertical fin of the empennage. Install the standard skid tube and torque the bolts to 30 inch-pounds.
- d) Calculate the Weight and Balance using the following information and enter it into the aircraft records.

Part No.	Description	Weight (lb)	CG Arm (in)	Moment (in-lb)
A034-1	Landing Gear with Floats	+62.9	94.6	+5950
A014-1	Landing Gear without Floats	-32.5	85.5	-2779
A970 & A971	Float Stabilizer on Lower Tail Fin	+ 0.6	270	+ 162
A470-1	Standard Tail Skid	- 0.2	272.5	- 54

5.510 Float Landing Gear Removal (cont'd)

- e) Review the flight limitations of the R22 Mariner without floats installed in the Mariner Supplement 9-4 of the Pilot's Operating Handbook.
- f) Complete a Pre-flight Inspection and Run-up per the Pilot's Operating Handbook.
- g) Complete a Flight Check per Section 2.220.
- h) Check and adjust the autorotation RPM per Section 10.250 (It will usually require lengthening the pitch links approximately  $\frac{1}{2}$  to 1 full turn).

5.520 Float Gear Installation

- a) Remove the standard landing gear. Refer to Section 5.110 for landing gear removal.
- b) Install the complete float landing gear with float tubes attached to the skid tubes. Refer to Section 5.120 for landing gear installation. Use existing landing gear hardware to install the float landing gear except for the palnuts which must be replaced.
- c) Remove the lower vertical fin skid tube on the emmpenage.

5.520 Float Gear Installation (cont'd)

- d) Install the float stabilizer in place of the skid tube and torque the bolts to 30 in-lbs.
- e) Calculate the new helicopter Weight and Balance using the information given above and enter the change into the aircraft records.
- f) Check and adjust the autorotation RPM per Section 10.250 (It will usually require shortening the pitch links approximately  $\frac{1}{2}$  to 1 full turn).
- g) For float pressure information See Pilot's Operating Handbook Mariner Supplement page 9-4 Section 2.

5.530 Float Tube Removal

- a) Untie and remove the lacings at each landing gear strut. Unbuckle the restraint belts.
- b) Remove the bolts and nuts that attach the float tube to the skid tube and skid extension.

## NOTE

The bolts and nuts are sealed in place and may be difficult to remove.

- c) Remove the retainer strips from the girts. Carefully separate the girt from the skid tube extension.

## NOTE

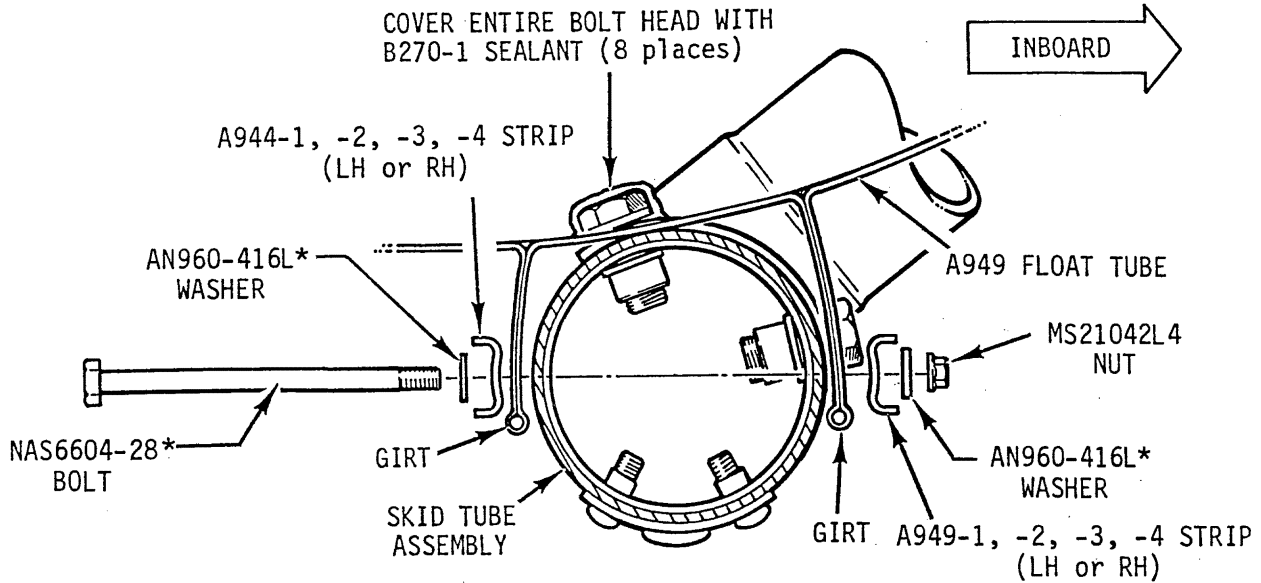
Sealant is installed between the girt and the skid tube at each bolt hole.

5.540 Float Tube Installation

## NOTE

Remove the old sealant from the skid tube, float tubes and reusable hardware before installation of the float tubes.

- a) Position the float tube over the landing gear skid tube and extension. Align the holes in the girt of the float tube and the skid tube.



\*BOLT LENGTH AND/OR WASHER THICKNESS MAY BE VARIED AS REQUIRED TO MAINTAIN 2-4 THREADS SHOWING BEYOND NUTS. SEAL UNDER HEAD AND NUT AND AROUND BOLT BETWEEN GIRTS AND SKID TUBE WITH B270-1 SEALANT.

FIGURE 5-4 FLOAT TUBE ATTACHMENT  
(LEFT SIDE SHOWN, VIEW LOOKING FORWARD)

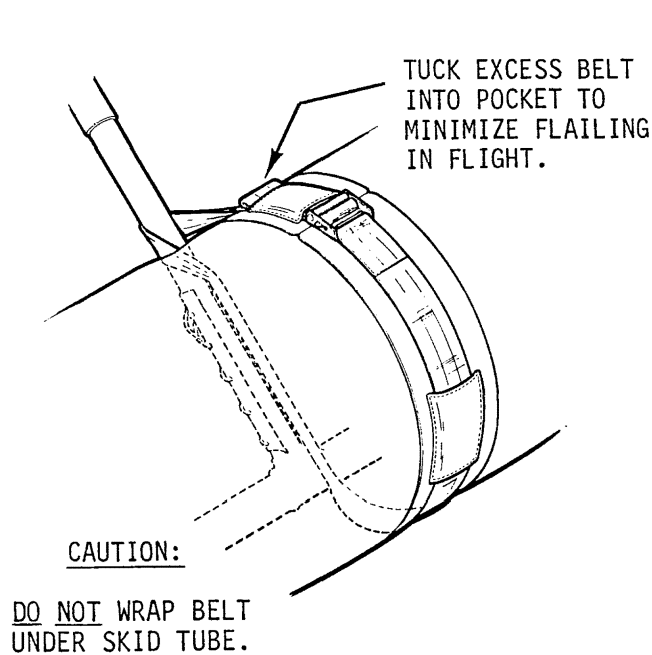


FIGURE 5-5 RESTRAINT BELT INSTALLATION

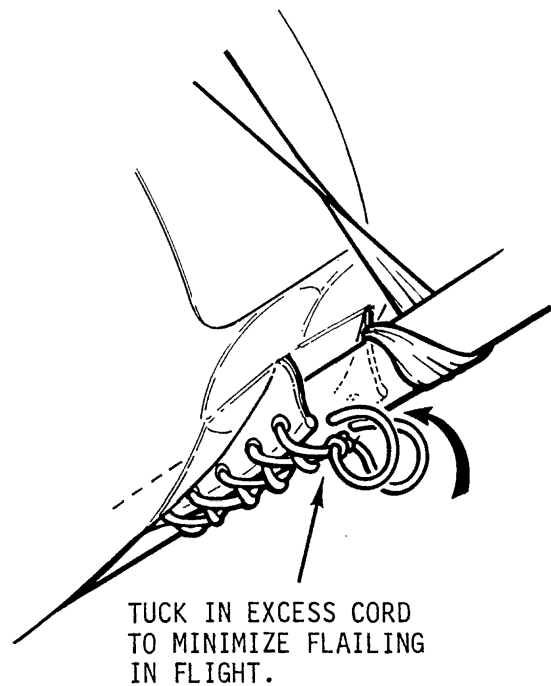


FIGURE 5-6 LACING INSTALLATION

5.540 Float Tube Installation (cont'd)

- b) Place the retainer strips in their proper positions. Temporarily install NAS6604-32 or NAS1304-32 bolts to hold the retainer strips and girts in place.
- c) Complete one girt section at a time. Using 890-B2 sealant, thoroughly seal all around the bolt holes between the girt and skid tube.
- d) Install the correct length bolts in their proper positions and seal under the bolt heads and nuts. Torque all the NAS6604 or NAS1304 bolt to 100 inch-pounds plus nut drag.
- e) After completing one girt section, move on to the next one and repeat the process. Prime all exposed bolts and nuts then paint black.
- f) Lace the float tube to the landing gear strut using a crossing pattern. Slide the restraint straps through the outside pockets. Wrap the restraint belt under the float tube making sure it passes over the skid tube. Make one wrap around the landing gear strut. Slide the strap through the pocket and into the buckle. Pull tight and tuck the excess strap material into the pocket.
- g) Slowly inflate the float tube to its proper operating pressure.

**CAUTION**

When inflating chambers individually (without the use of a manifold), increase pressure in each chamber in .5 psig increments.

5.550 Float Tube Repair

For float repair procedures refer to instructions included with the Float Repair Kit.



## CHAPTER 6

### POWERPLANT

<i>Section</i>	<i>Title</i>	<i>Page</i>
6.000	Powerplant And Related Systems . . . . .	6.1
6.001	Introduction . . . . .	6.1
6.002	Description . . . . .	6.1
6.100	Powerplant . . . . .	6.2
6.110	Engine Removal . . . . .	6.2
6.120	Engine Installation . . . . .	6.4
6.130	Engine Shimming . . . . .	6.6
6.200	Cooling System . . . . .	6.11
6.210	Fanwheel Removal . . . . .	6.11
6.220	Fanwheel Installation . . . . .	6.12
6.230	(Reserved)	
6.240	Balancing Fanwheel . . . . .	6.15
6.250	Cooling Scroll Replacement . . . . .	6.16A
6.300	Lubrication System . . . . .	6.18
6.310	Oil Cooler Removal . . . . .	6.18
6.320	Oil Cooler Installation . . . . .	6.18
6.400	Induction System . . . . .	6.18
6.410	Carburetor Removal . . . . .	6.18
6.420	Air Box Removal . . . . .	6.19
6.430	Air Box Installation . . . . .	6.19
6.435	Air Filter Cleaning . . . . .	6.21
6.440	Carburetor Installation . . . . .	6.22
6.450	Carburetor Heat Scoop Removal . . . . .	6.22
6.460	Carburetor Heat Scoop Installation . . . . .	6.22
6.500	Exhaust System . . . . .	6.22A
6.510	Exhaust System Removal . . . . .	6.22A
6.520	Exhaust System Installation . . . . .	6.22A
6.600	Troubleshooting . . . . .	6.23
6.610	Low-Power Checklist . . . . .	6.23
6.620	High Cylinder Head Temperature (CHT) Indication . . . . .	6.24A
6.700	Throttle Control And Carburetor Heat Assist . . . . .	6.25
6.710	Overtravel Spring . . . . .	6.25
6.711	Overtravel Spring Removal . . . . .	6.25
6.712	Overtravel Spring Installation . . . . .	6.25

CHAPTER 6

POWERPLANT (Continued)

<i>Section</i>	<i>Title</i>	<i>Page</i>
6.720	(Reserved)	
6.730	Throttle Push-Pull Tube Assembly . . . . .	6.26
6.731	Throttle Push-Pull Tube Assembly Removal . . . . .	6.26
6.732	Throttle Push-Pull Tube Assembly Installation . . . . .	6.26
6.740	Carburetor Heat Assist . . . . .	6.26
6.741	Carburetor Heat Control Cable Removal . . . . .	6.26
6.742	Carburetor Heat Control Cable Installation . . . . .	6.27
6.743	D334-5 Carburetor Heat Assist Bellcrank Removal . . . . .	6.27
6.744	D334-5 Carburetor Heat Assist Bellcrank Installation . . . . .	6.27
6.745	D334-5 Bellcrank Friction Adjustment . . . . .	6.29



## CHAPTER 6

### POWERPLANT

#### 6.000 Powerplant and Related Systems

##### 6.001 Introduction

This section includes instructions for removal and installation of engine and support systems. Support systems include induction, cooling and exhaust systems. Refer to engine and engine component manufacturer's maintenance publications for product specific inspection, repair, and maintenance procedures.

##### 6.002 Description

R22-series helicopters are powered by one of four different Lycoming engines. O-320-A2B or O-320-A2C engines are installed in standard model R22s and are normally rated at 150 horsepower. O-320-B2C engines are installed in R22 HP, R22 Alpha, and R22 Beta models and are normally rated at 160 horsepower. Beta II/Mariner II helicopters have an O-360-J2A engine capable of 180 horsepower, derated by Lycoming to 145 horsepower. All engines are derated to 124 maximum continuous horsepower (MCP) by limitation of manifold pressure and RPM. Beta, Mariner, and Beta II/Mariner II helicopters have a 5-minute takeoff rating of 131 HP (see Pilot's Operating Handbook). Starting assist for O-320-A2B engines is provided by an impulse coupling installed on the engine-left (helicopter-right) magneto. Starting assist for O-320-A2C, O-320-B2C, and O-360-J2A engines is provided by a starter vibrator system and retard points in the engine-left magneto. Tachometer points in the engine-right magneto supply engine RPM information to the governor controller and engine tachometer. At 104% engine tachometer indication the engine is turning 2652 RPM.

Induction is through an air filter located in a carburetor-mounted air box assembly. Carburetor heat is supplied by an exhaust-pipe-mounted scoop and duct. Carburetor heat is controlled through a cable-operated guillotine valve in air box. Carburetor inlet air is filtered, even with carburetor heat on. Provision for an obstructed air filter is provided by a spring loaded bypass valve mounted on the air box cover, or by air box flexing. On Beta II/Mariner II aircraft, application of carburetor heat is correlated with changes in collective setting through a friction clutch to reduce pilot work load. Lowering collective mechanically adds carburetor heat and raising collective reduces carburetor heat. The pilot may override the friction clutch and increase or decrease carburetor heat as desired. A latch is provided at the carburetor heat control knob to lock carburetor heat off when not required.

Cooling is supplied by an engine-mounted fanwheel enclosed by a fiberglass scroll. The scroll ducts cooling air to engine-mounted panels which in turn direct air to cylinders, external oil cooler, alternator, and main rotor gearbox.

Power is transmitted through a vertically mounted sheave-and-belt system which is engaged by an electric belt tension actuator.

Battery charging and electrical power is supplied by 60-amp belt-driven alternator. A 70-amp alternator is optional.

## 6.100 Powerplant

### NOTE

Refer to engine and engine component manufacturer maintenance publications for product specific inspection, repair, and maintenance procedures.

## 6.110 Engine Removal

### NOTE

If engine is to be removed to facilitate a lower frame replacement, engine mount change, or firewall repair, fanwheel can remain installed. However, if engine is to be disassembled, remove fanwheel per § 6.210.

1. Disconnect static line from and remove aft cowling, tailcone fairing, B429-5 frame.

### NOTE

If aux tank installed, defuel helicopter. Remove aux tank.

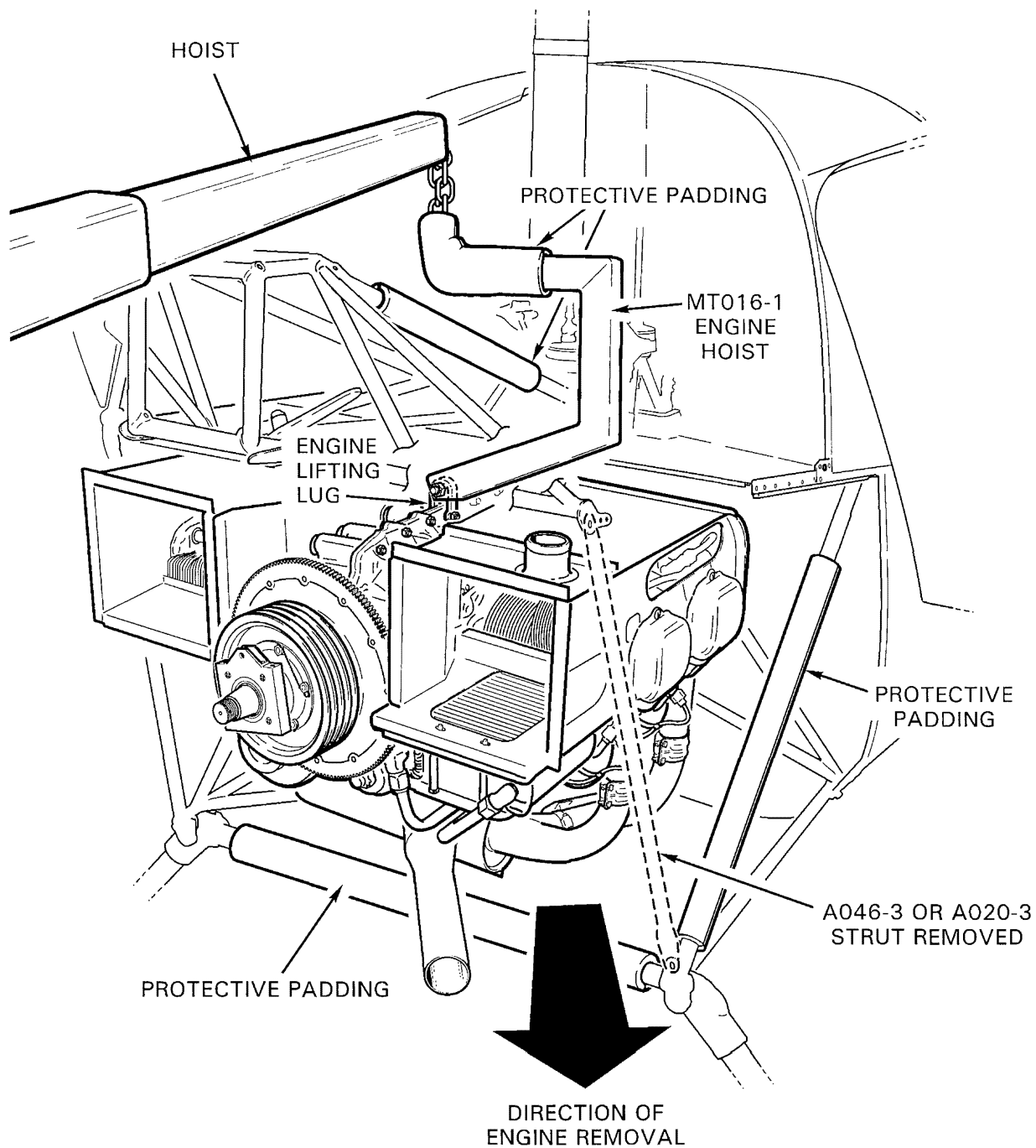
2. Disconnect main rotor gearbox cooling duct and remove horizontal firewall access panel (aft right-hand).
3. Remove clutch assembly per § 7.210.
4. Remove side skirts. Turn off fuel selector valve and disconnect fuel hose at carburetor. Cap fuel hose and carburetor inlet port.
5. Disconnect carburetor throttle linkage at carburetor bellcrank, mixture control cable at carburetor, carburetor heat control at air box, and carburetor air temperature probe at quick-disconnect, located approximately four inches from probe in a heat shrink sleeve. Remove carburetor and air box assembly.

### NOTE

Air box and carburetor may be removed as a unit.

6. Disconnect oil pressure hose from elbow on accessory housing and cap exposed connections.
7. Disconnect manifold pressure line from forward, left cylinder fitting and clamp and cap exposed connections.
8. Identify for reinstallation and disconnect engine ground straps, alternator leads, starter leads, oil pressure line, cylinder head temperature lead, and oil temperature lead. Disconnect all clamps attaching wiring to steel tubular frames. Disconnect belt tension actuator motor leads.
9. Disconnect cabin heater duct, if installed (optional equipment).
10. Disconnect primer line, if installed (optional equipment).

### 6.110 Engine Removal (cont'd)



**FIGURE 6-1 POWERPLANT REMOVAL**

### 6.110 Engine Removal (cont'd)

11. Install protective padding per Figure 6-1.
12. Connect MT016-1 "C" fitting to a minimum 500-pound capacity hoist and to engine lifting lug per Figure 6-1. Take up any slack in chain or cable of hoist. Engine mounting pads have shims placed between pads and engine mounts for proper engine alignment. Note shim stack for each mount and record for reinstallation.
13. Remove four engine mounting bolts. This will require removal of right-side (engine -left) spark plug access cover.
14. Place a support stand under tail skid or remove tailcone.
15. Remove tubular steel strut at right rear corner of steel tube structure. With a person on each side of engine, carefully remove engine. Vary height of engine as required to clear aft cross tube during removal. Swing engine clear of helicopter. Refer to Figure 6-1.

### 6.120 Engine Installation

- a) Connect MT016-1 "C" fitting to a minimum 500-pound capacity hoist and to engine lifting lug per Figure 6-1. Carefully hoist engine and swing it into alignment with engine mounting pads.
- b) Select appropriate shims as recorded during engine removal. If no record is available, install a 0.063-inch thick shim between both lower mounting pads and engine and install a 0.190-inch thick shim between both upper mounting pads and engine. Install engine mounting bolts, torque per Section 1.320. Torque stripe per Figure 2-1. Install right rear tubular strut per Section 4.222 h).

#### WARNING

**Damage or failure of drive line components may result from incorrect engine shimming.**

- c) Disconnect engine hoist, install horizontal firewall, right-hand spark plug access panel, and aft cowling. Reconnect main rotor gearbox cooling duct.
- d) Install carburetor using a new gasket and torque nuts per Section 1.330. Install palnuts, torque per Section 1.320, and torque stripe per Figure 2-1.

6.120 Engine Installation (cont'd)

- e) Reconnect throttle linkage to middle position of carburetor bellcrank. Refer to § 10.150 for throttle rigging. Reconnect mixture control and carburetor heat control and rig these controls for 1/16" springback at each end of the control travel (See Chapter 10 for rigging of throttle).
- f) Reconnect engine grounding strap and torque engine oil sump bolts per § 23-33. Connect oil line to oil pressure sender. Connect manifold pressure line to engine and firewall connections.
- g) Reconnect all electrical leads to oil temperature sender, cylinder head temperature sender, alternator, magnetos, etc.
- h) Install cabin heater ducting and all wire and oil line clamp connections.
- i) Connect fuel line to carburetor and inspect engine compartment for proper installation of all electrical connections, control attachment, ducting and routing.
- j) Reinstall clutch assembly. (See § 7.200).
- k) Reinstall engine access panels, compartment panels and aft cowling.
- l) Before running engine, check following components for proper alignment:
  - 1) Sheave alignment per § 7.230.
  - 2) Tail rotor drive shaft shimming per § 7.330.
  - 3) Cooling shroud-to-tailcone clearance 0.250 inch minimum.
  - 4) Intermediate flex plate to tail rotor bellcrank clearance 0.250 inch minimum with belts over 10 hours, 0.125 inch minimum with new belts.
  - 5) Clutch shaft angle per § 7.240.
  - 6) Upper sheave centering per § 7.250.

<b>NOTE</b>
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Fill engine to proper oil level.
----------------------------------

### 6.130 Engine Shimming

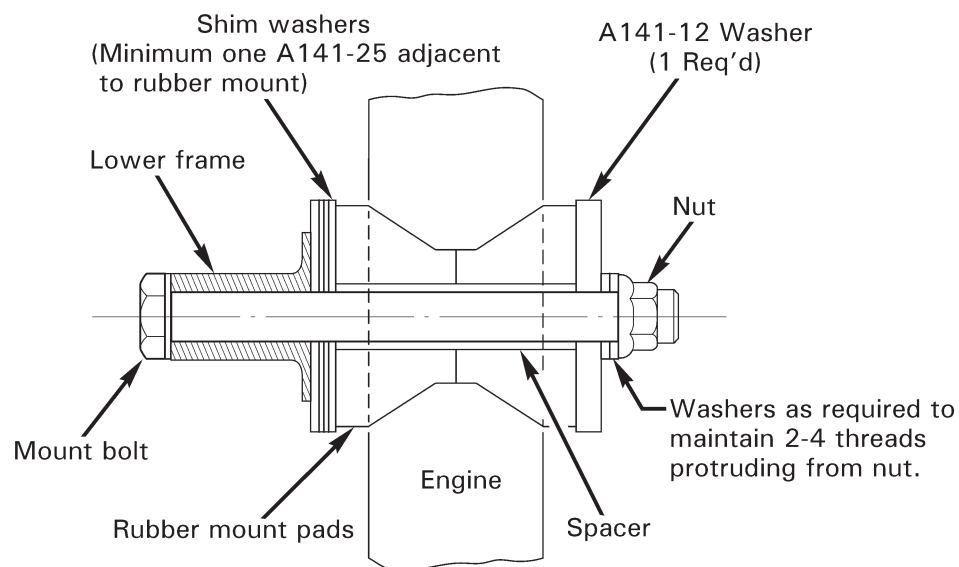
To facilitate sheave proper alignment, the engine must be shimmed to 3.55/3.75 inches, measured between ring gear top and bottom of upper frame's long cross tube with clutch engaged.

1. Engage clutch.
2. Measure ring gear-to-upper frame cross tube dimension as shown in Figure 6-2. If dimension exceeds 3.75 inches, an equal amount of shims must be added between lower frames and both the lower-left and the lower-right engine rubber mount pads. Use following formula to calculate required maximum shim thickness:

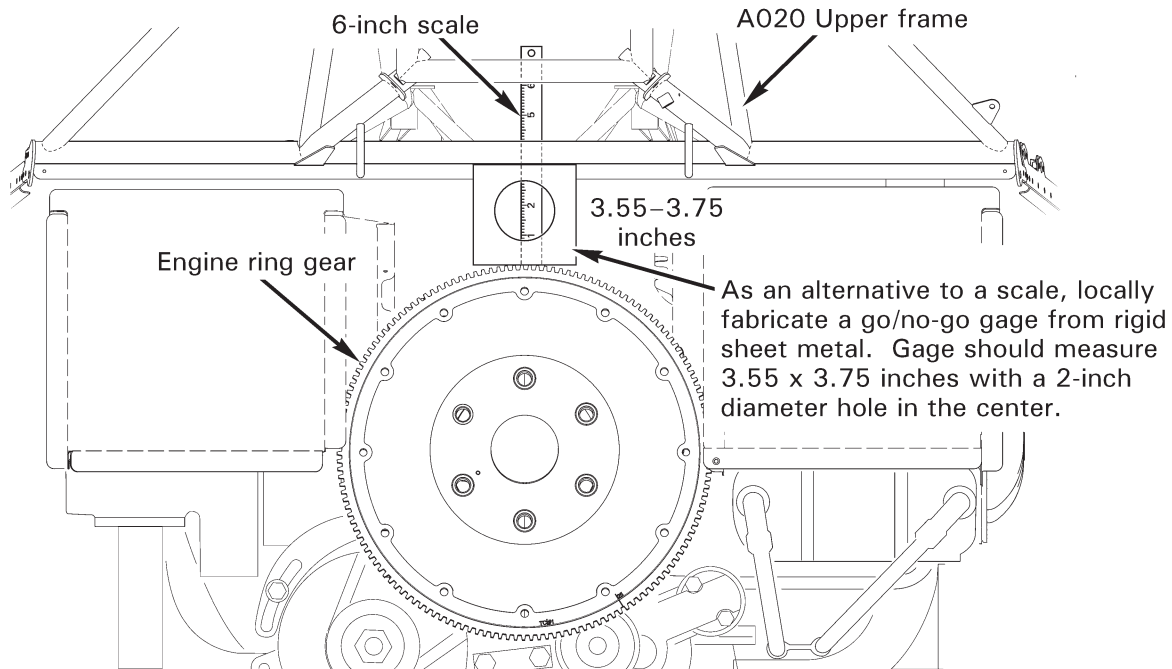
$$\frac{(\text{Measured ring gear-to-upper frame dimension}) - 3.55}{2} = \text{Calculated shim thickness}$$

Select shim(s) as required up to, but not exceeding, calculated shim thickness. Shims are available in thicknesses of 0.032 inch, 0.063 inch, and 0.190 inch. Removing an equal amount of shims from between both lower frames and the lower-left and the lower-right engine rubber mount pads will increase ring gear-to-upper frame cross tube dimension.

3. Disengage clutch.
4. Remove side skirts.
5. Loosen upper-left and lower-left engine mount bolts. Leaving right engine mounts torqued, install selected shim(s) between lower-left frame and lower-left engine mount pad. Slotted shims, if used, may be stacked together but must be installed between unslotted shims and safetied. See Figure 6-2A.
6. Torque engine-mount bolts per § 23-32.
7. Remove right-side spark plug inspection panel. Loosen upper-right and lower-right engine mount bolts. Leaving left engine mounts torqued, install selected shim(s) between lower-right frame and lower-right engine mount pad.
8. Torque engine-mount bolts per § 23-32.
9. Engage clutch. Verify ring gear-to-upper frame cross tube dimension as shown in Figure 6-2. Adjust as required.
10. Torque stripe nuts per Figure 2-1.



Add shim washers A141-12 (0.190 inch), A141-24 (0.032 inch), B155 (0.032 inch), A141-25 (0.063 inch) as required to shim engine. B155 shims, if used, shall be between A141 washers (ref. Figure 6-2A).



**FIGURE 6-2 ENGINE INSTALLATION**

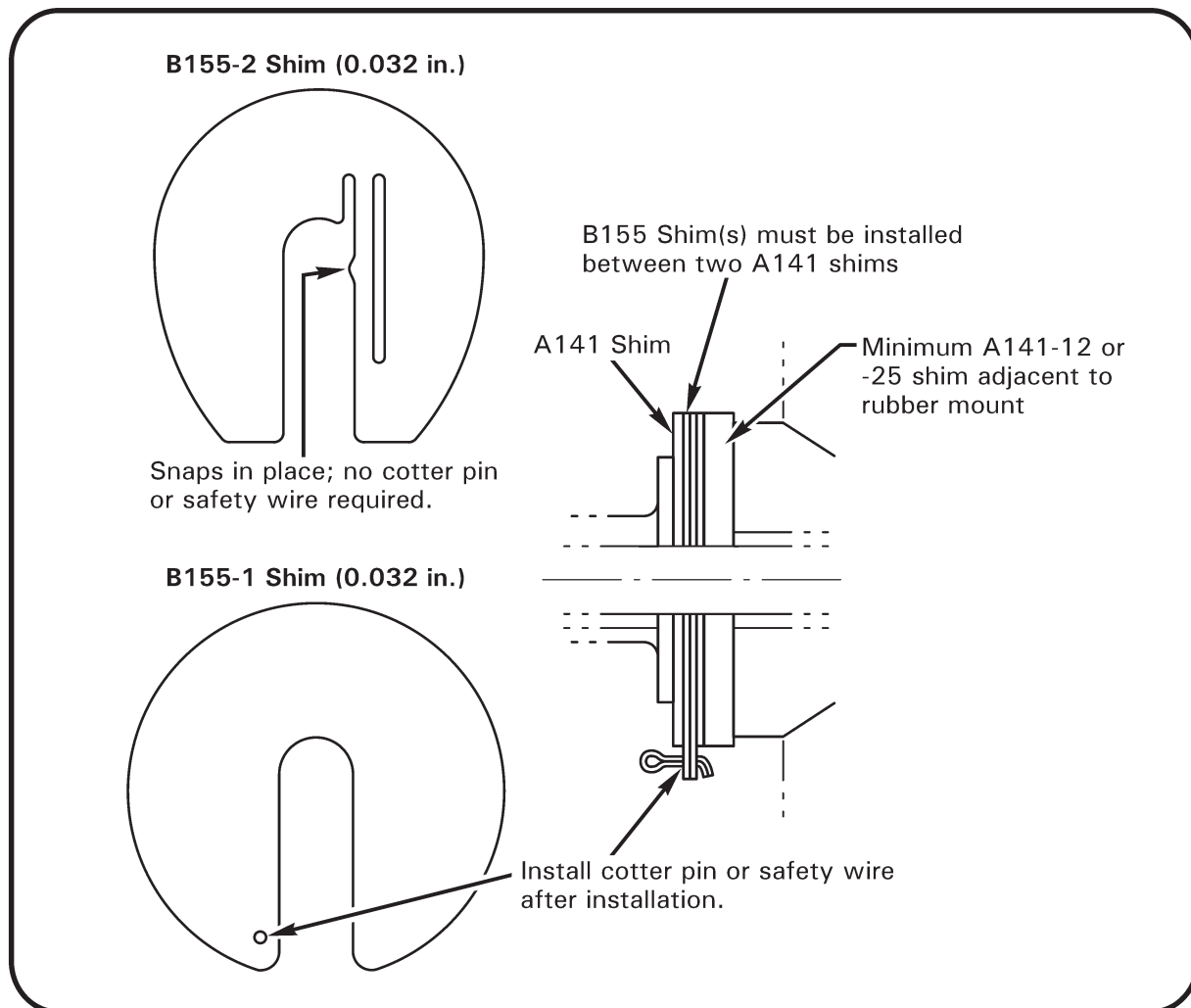


FIGURE 6-2A B155 ENGINE SHIM

**NOTE**

Engine mounting shims added or subtracted at two bottom engine mounts will change engine ring-gear-to-frame dimension by approximately twice the thickness of engine mount shim.

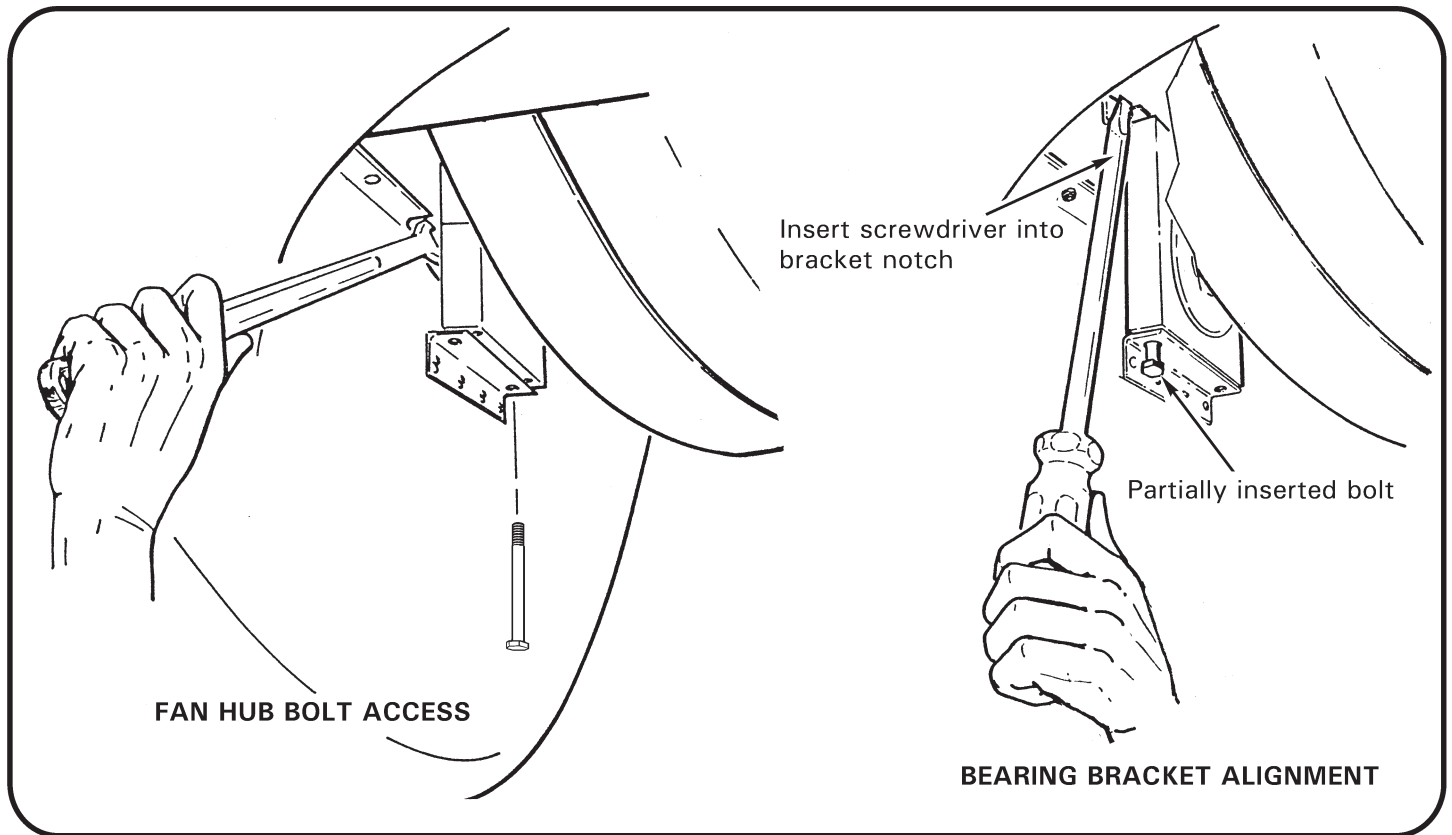
Example: Adding a 0.032-inch thick shim at each bottom engine mount will raise rear of engine approximately 0.064 inch.



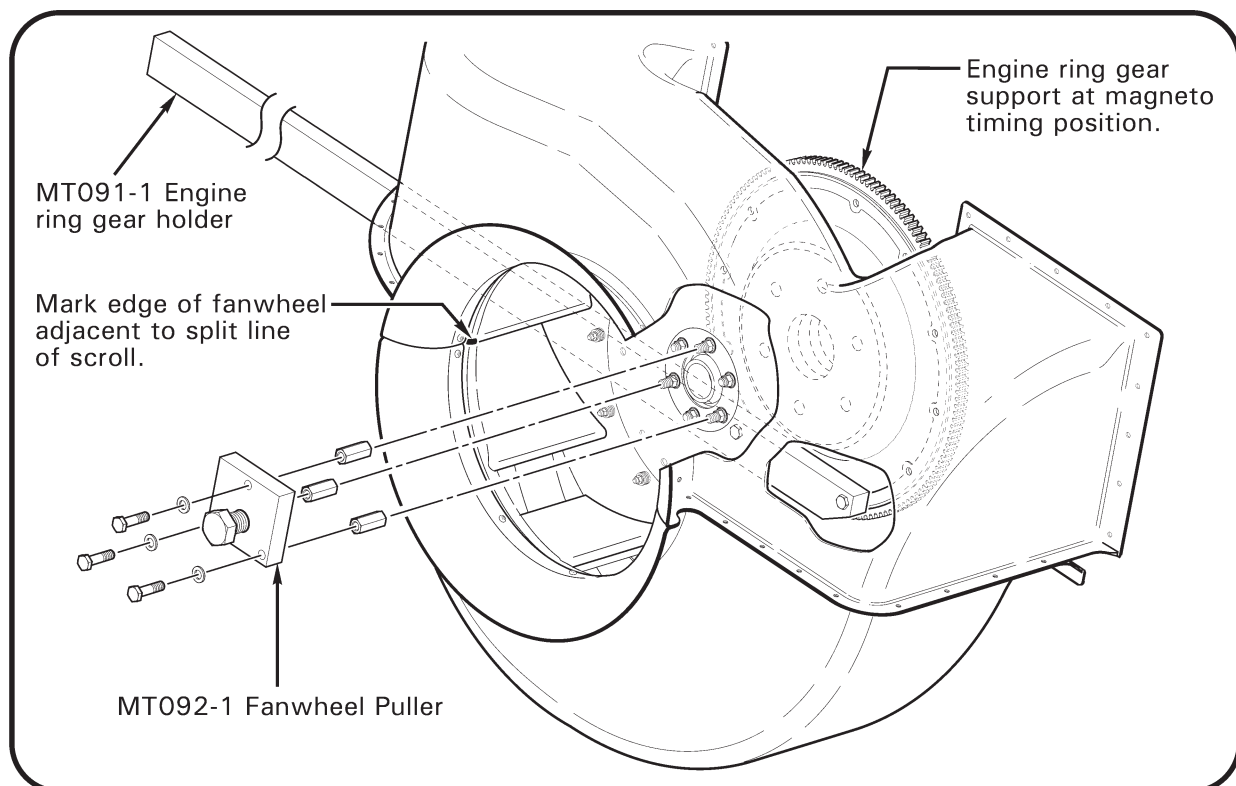
6.130 Engine Shimming (continued)**NOTE**

AN6- engine mount bolts are obsolete and must be replaced with NAS1306- or NAS6606- series bolts when shimming engine.

11. Check clutch sheave alignment per § 7.230.
12. Reinstall engine inspection covers and side skirts.
13. Adjust throttle correlation rigging per § 10.150.



**FIGURE 6-3A FAN HUB ACCESS AND LOWER BEARING BRACKET ALIGNMENT**



**FIGURE 6-3B PULLING FANWHEEL**

## 6.200 Cooling System

### 6.210 Fanwheel Removal

#### CAUTION

Do not engage clutch actuator without scroll installed.

#### NOTE

If same fanwheel is to be reinstalled then orient starter ring gear support to magneto timing position and mark fanwheel at split line of scroll; this will minimize need for new balance weights. See Figure 6-3B.

1. Ensure clutch actuator is fully disengaged. Pull out CLUTCH START (5 or 7.5 amp) circuit breaker and turn battery switch off.
2. If installed, loosen clamp securing cabin-heater hose to lower scroll half and disconnect hose.
3. Remove scroll-to-engine cooling panel perimeter screws and two bolts attaching scroll to A181-4 bearing.
4. Cut safety wire and remove spring pin from fanwheel retaining nut. Remove retaining nut. Remove washers. Install retaining nut 3 full turns to prevent fanwheel from dropping while being removed.
5. Refer to Figure 6-3B. Install MT092-3 spacers directly on each of (3) long B660-1 bolts (if installed; nuts remain in place). Alternately, remove scroll lower half then replace every other nut & washer (3 each) with MT092-3 spacers.
6. Back out MT092-1 fanwheel puller's center bolt, lubricate bolt tip & threads with A257-9 anti-seize, and attach puller to MT092-3 spacers.
7. Secure MT091-1 engine ring gear holding tool to ring gear support. Immobilize tool so ring gear remains stationary.

#### NOTE

Fanwheel may come off tapered shaft with a loud pop.

8. Tighten fanwheel puller's large center bolt against fanshaft until fanwheel is unseated.
9. Remove fanwheel puller. Apply B270-21 protectant to exposed B660-1 bolt threads. If nuts were removed, apply wet primer to mating surface of fanwheel and install washers & nuts on fanwheel hub bolts. While primer is wet, special torque nuts per § 23-33 and torque stripe per Figure 2-1.
10. Remove fanwheel retaining nut. Remove fanwheel and scroll.

### 6.220 Fanwheel Installation

#### CAUTION

Beta II/Mariner II helicopters must use B174-1 Rev F (12 NAS6603-6 cone-to-fanwheel attach bolts) or subsequent fanwheels and A007-5 or -6 (1<sup>11</sup>/<sub>16</sub> inch nut) or subsequent shaft assemblies.

1. Evaluate drive belts, alternator belt, and A181 bearing condition; replace as required. Clean tapered shaft and fanwheel hub mating surfaces with approved solvent and dry. Inspect shaft and hub for damage; replace as required.
2. If removed, place scroll upper half on fanwheel and install fanwheel on tapered shaft. Secure scroll upper half to engine cooling panels.
3. Using A257-9 anti-seize, coat threaded portion only of A007 shaft and clamping surfaces of MS20002-18 washer & NAS1149F1832P washers (as many as needed to install spring pin), and castellated nut. Install hardware with MS20002-18 washer against hub.

#### NOTE

If installing original fanwheel ensure starter ring gear support is at magneto timing position and align marks on fanwheel with scroll split line.

4. Secure MT091-1 ring gear holding tool to ring gear support and hold ring gear stationary. Special torque fanwheel retaining nut per § 23-33 until slot in castellated nut aligns with hole in fanshaft. Install spring pin and safety with 0.041-inch diameter stainless steel wire (may be installed after dynamic balance per § 6.240).

#### NOTE

If slot in castellated nut does not align with hole in fanshaft throughout torque range, remove or add NAS1149F1832P washers (or AN960 washers) under nut.

5. Verify (6) fanwheel hub bolts are properly torqued per § 23-33. Apply torque stripe per Figure 2-1 after dynamic balance per § 6.240.
6. Refer to Figure 6-3A. Install lower cooling scroll half (if removed). Insert two AN3 bolts through lower bracket and actuator bearing block until they enter upper bracket nut plates. If required, align upper bracket nutplate by inserting screwdriver in bracket notch. Standard torque bolts per § 23-32 and torque stripe per Figure 2-1.
7. If revision I or prior fanwheel was replaced by revision J or subsequent fanwheel, and lower scroll was not replaced, contact RHC Technical Support for D229-4 cover relocation instructions.

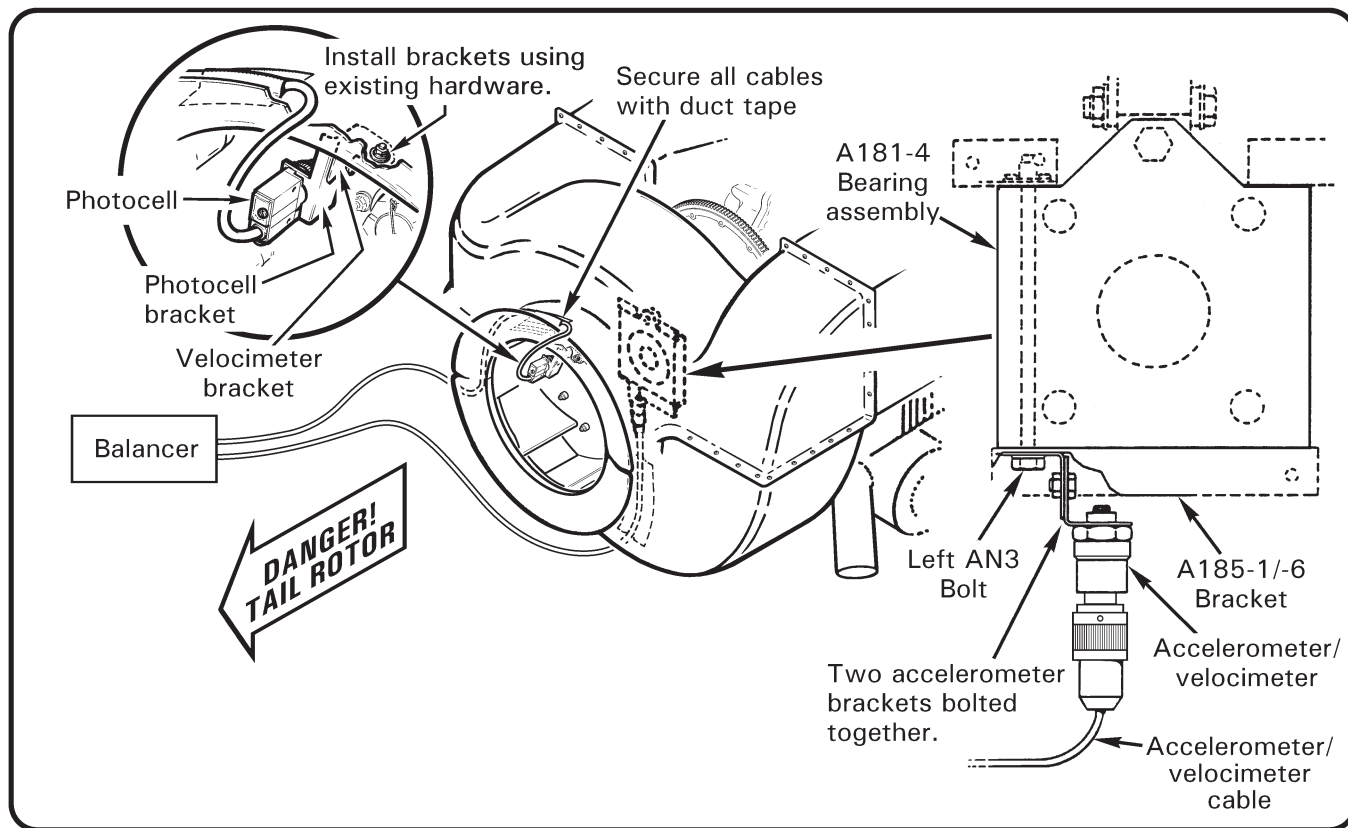
6.220 Fanwheel Installation (continued)

8. Install screws, nuts and washers around scroll perimeter, verify security. |
9. Mark fanwheel with torque seal directly opposite each end of fanwheel nut spring pin to allow detection of movement between fanwheel and fan shaft.
10. Pull fanwheel aft to take-up crankshaft and crankcase front end clearance (ref Lycoming SSP-1776). Verify B229 lip-to-fanwheel inlet clearance is  $0.060 \pm 0.030$  inch. If necessary, lip clearance may be adjusted by elongating lip mounting holes. |
11. Dynamic balance per § 6.240. |

**CAUTION**

Fanwheel balance must be checked upon installation; fanwheel imbalance can cause damage. Fanwheel retaining nut must be retorqued after first engine run.

6.230 Reserved



Add weight by increasing washer size opposite accelerometer/velocimeter. Alternatively, remove weight by decreasing washer size adjacent to accelerometer/velocimeter. Do Not Remove NAS6603-6 bolts.

NAS1149F0363P Washer = 0.03–0.05 IPS Change

A141-17 Washer = 0.08–0.10 IPS Change

AN970-3 Washer = 0.18–0.20 IPS Change

Mix above sizes as required for balance.  
Ensure 2-4 threads exposed beyond nut.

Radius R = 5.10 inches on revision "J" and subsequent fanwheels;  
R = 4.10 inches on revision "I" and prior fanwheels.

Rotate fan until target tape is at clock angle displayed on balancer.

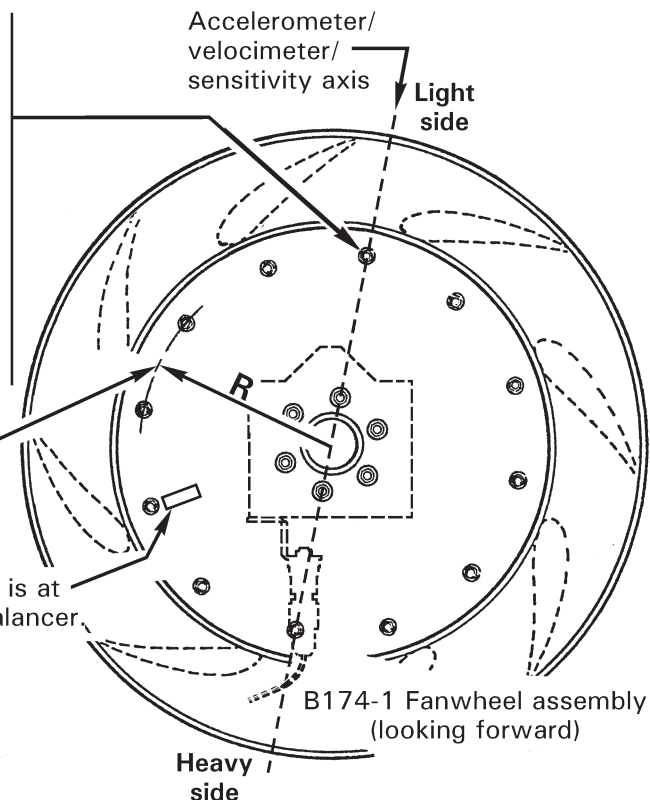


FIGURE 6-4 FANWHEEL DYNAMIC BALANCE

### 6.240 Fanwheel Dynamic Balance

**NOTE**

The following instructions pertain to Chadwick-Helmuth Vibrex™ 2000 series. When using MicroVib, Chadwick-Helmuth Model 177- or 8350- series, or equivalent equipment consult the equipment's specific operating instructions.

1. Clean fanwheel including fan vanes using mild soap (pH between 7 & 9) and warm water solution. Rinse thoroughly with potable water.
2. Refer to Figure 6-4. Install accelerometer on lower actuator bearing left bolt. Accelerometer wire should be pointed down. A suitable bracket may be assembled from two accelerometer brackets or may be fabricated.
3. Install photocell nearest to 12 o'clock position using existing hardware in upper scroll half. Secure cables to scroll assembly with duct tape.
4. Place C701-1 or 907-4270-1 target tape at one fan vane edge.
5. Connect cables to balancer, turn balancer power on.
6. Ground run helicopter at 104% with rotor system engaged.

**WARNING**

**Use extreme care near tail rotor.**

7. Select appropriate channel. Wait until engine stabilizes at approximately 2652 RPM, then press start.
8. Note vibration reading & clock angle displayed on balancer.
9. Shut down engine.

**CAUTION**

Ensure ignition switch is off and keys are out of switch whenever fanwheel is moved by hand.

10. As required, following first run-up after fanwheel installation, secure MT091-1 ring gear holding tool to engine ring gear support and hold stationary. Special torque AN320-18 nut per § 23-33 until spring pin can be installed in shaft. Install spring pin and safety with 0.041-inch diameter stainless steel wire.

**NOTE**

If spring pin cannot be installed within AN320-18 nut's torque range, remove or add NAS1149F1832P washers under nut. Large pliers may be used to squeeze spring pin into position.

6.240 Fanwheel Dynamic Balance (continued)

11. As required, following first run-up after fanwheel installation, verify (6) fanwheel hub bolts are properly torqued per § 23-33.
12. If IPS exceeds 0.2, balance weights must be changed. Rotate fanwheel until target tape is in position noted in step 8. Increase balance weight by changing washers under nut closest to 1 o'clock position or by splitting required weight change among two nearest nuts per Figure 6-4. Alternatively, weight may be decreased under nut closest to 7 o'clock position. Total washers under each nut must result in (2) to (4) threads protruding past nut to ensure proper clamp-up. Access balance weight bolt heads thru hole under D229-4 cover (if installed; cover may be retrofitted using P/N KI-111 Kit) on forward side of lower scroll or thru oil cooler access door (with a crowfoot on a flex handle) and rotating fanwheel as required. Ensure NAS1149F0316P washers (if installed) are not dislodged if NAS6603-6 bolts are removed. Special torque NAS6603 bolts per § 23-33. Install D229-4 cover.
13. Recheck fanwheel balance and adjust as required to obtain less than 0.2 IPS.
14. Remove balancing equipment from helicopter.
15. Torque stripe fasteners per Figure 2-1 as required.

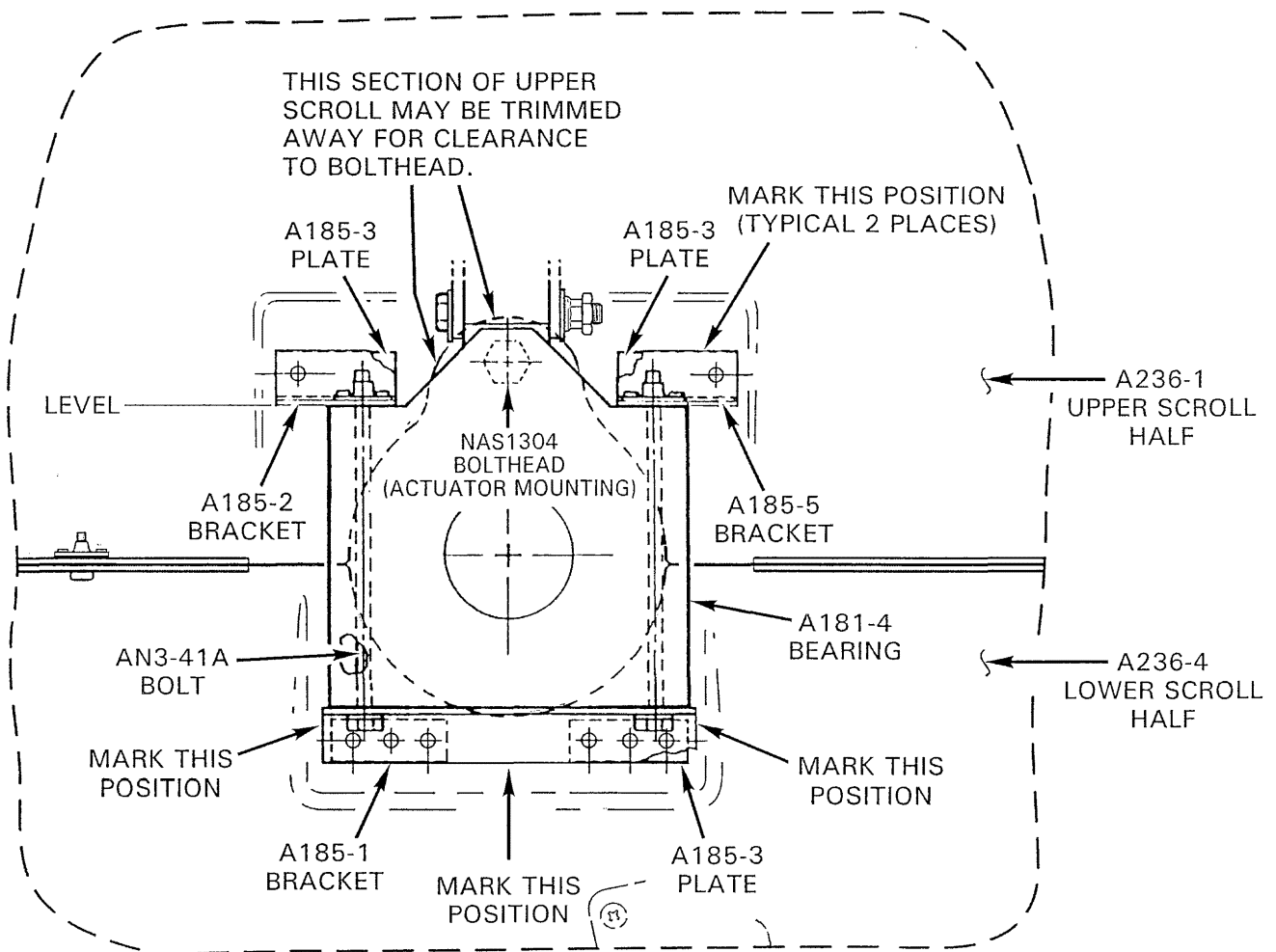


### 6.250 Cooling Scroll Replacement

- a) Remove the old scroll halves and actuator assembly, if installed.
- b) Level the airframe laterally per Section 1.210. Assemble the A185-1 bracket on the bottom of the bearing housing with the A185-2 on the upper left and the A185-5 on the upper right. Use two AN3-41A bolts to secure the brackets (See Figure 6-5A). Place a bubble level across the top surface of the lower actuator bearing. Rotate the housing to level the bearing.
- c) Place the upper scroll half (A236-1) and the engine cooling fan on the fanshaft. Do not disturb the position of the lower actuator bearing. Finger tighten the fanshaft nut. On Beta and Mariner ships with the larger oil coolers, the right-hand side of the upper scroll sits on the oil cooler ledge. Adjust the upper half laterally to center the lip of the fan and the edge of the inlet scoop, then clamp to the sheet metal shrouds (See Figure 6-5B).
- d) Install the lower scroll half (A236-3) to the upper. Check the clearance between the lip of the fan and the edge of the inlet scoop. The clearance should be concentric all the way around the lip of the fan. Adjust both the halves as required and clamp into position (See Figure 6-5B).
- e) Carefully mark the position of the lower actuator bearing and brackets on the scroll halves. Mark the mounting holes on the scroll halves through the sheet metal shrouds. Mark the top and sides of the scroll at the edge of the sheet metal shrouds. Using a 90 degree angle drill, with a #18 drill bit, match drill as many mounting holes as possible. Cleco clamp or install AN525-832 screws to secure the scroll as the holes are drilled. Match drill the two vertical mounting holes through the oil cooler ledge.
- f) Position the upper and lower B229-2 lips at the inlet of the scroll. Adjust the clearance to the edge of the cooling fan to 0.030-0.070 inch. Clamp into position and match drill the lips to the scroll.
- g) Remove the scroll and fan. Drill the remaining marked mounting holes, with a #18 drill bit. Assemble the A185 brackets on the drill fixture. Position the brackets on their alignment marks on the scroll. Drill through the brackets and scroll with a #40 drill bit. Position the reinforcing plates on the inside of the scroll. Enlarge the holes in the brackets, scroll and reinforcing plates with a #30 drill bit. Disassemble and deburr the holes. Reassemble and rivet the brackets and reinforcing plates using MS20470AD4 rivets.

### 6.250 Cooling Scroll Replacement (cont'd)

- h) Position one NAS679A08 nutplate on upper scroll half at vertical mounting hole on inboard right hand side. Drill and rivet nutplate in position with flush head rivets.
- i) Trim top and side edges of scroll upper half parallel with sheet metal cool panel flanges as required to maintain an edge distance of 0.01-0.02 inch
- j) Trim upper scroll at lower actuator mounting bolt as necessary. No contact with bolthead is permitted.
- k) Epoxy prime and paint grey.
- l) Install fanwheel per Section 6.220.



**FIGURE 6-5A LOWER ACTUATOR BEARING INSTALLATION**  
(VIEW LOOKING AFT)

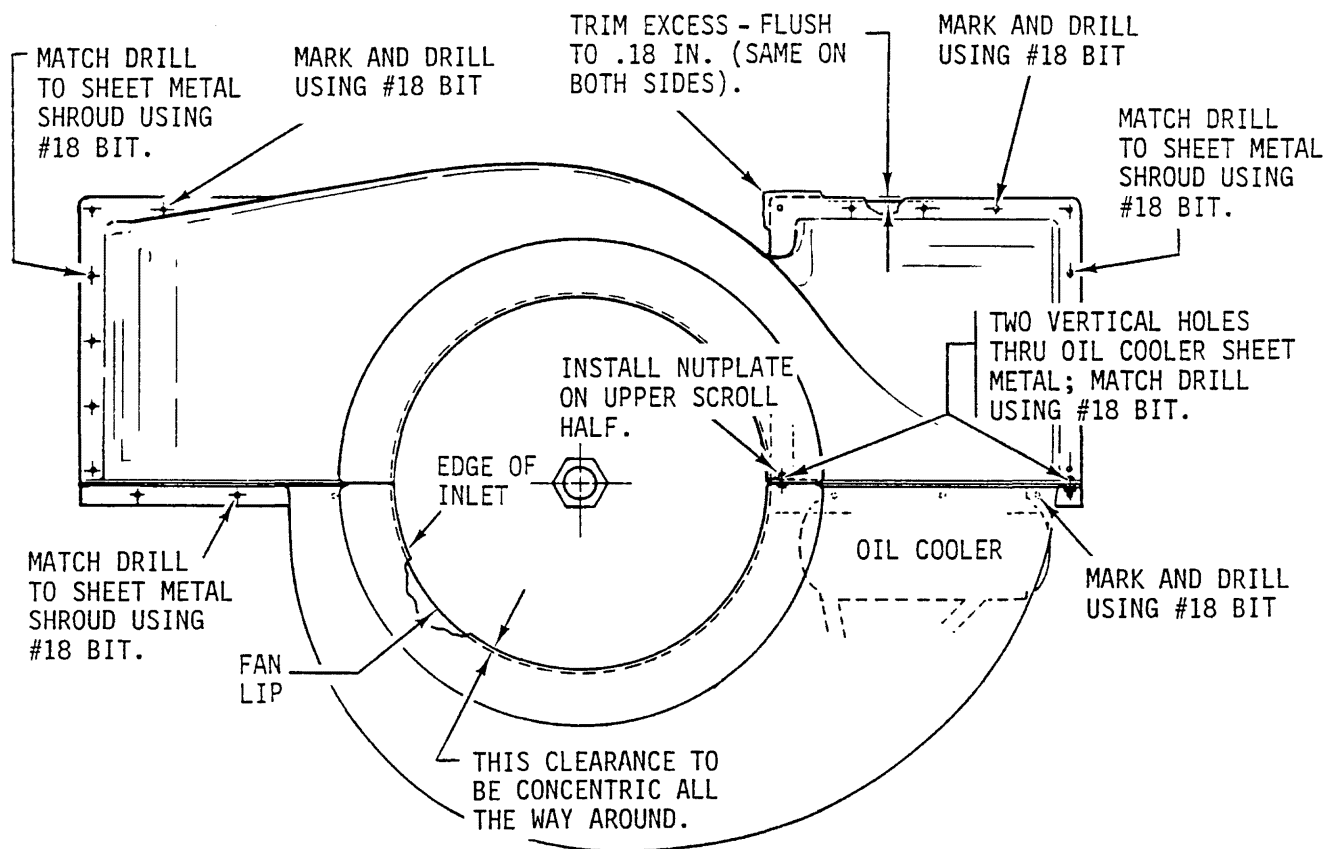


FIGURE 6-5B COOLING SCROLL REPLACEMENT

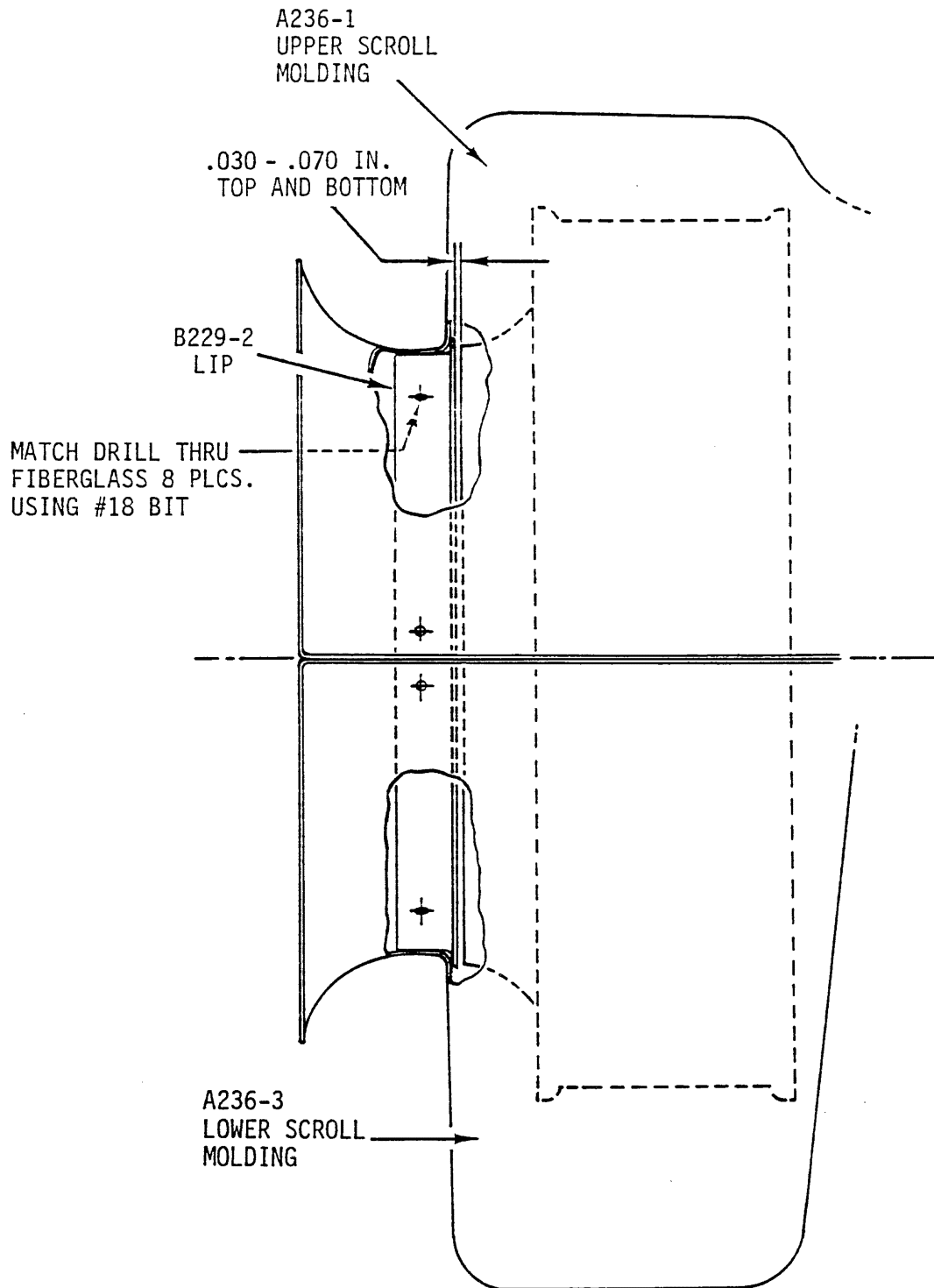
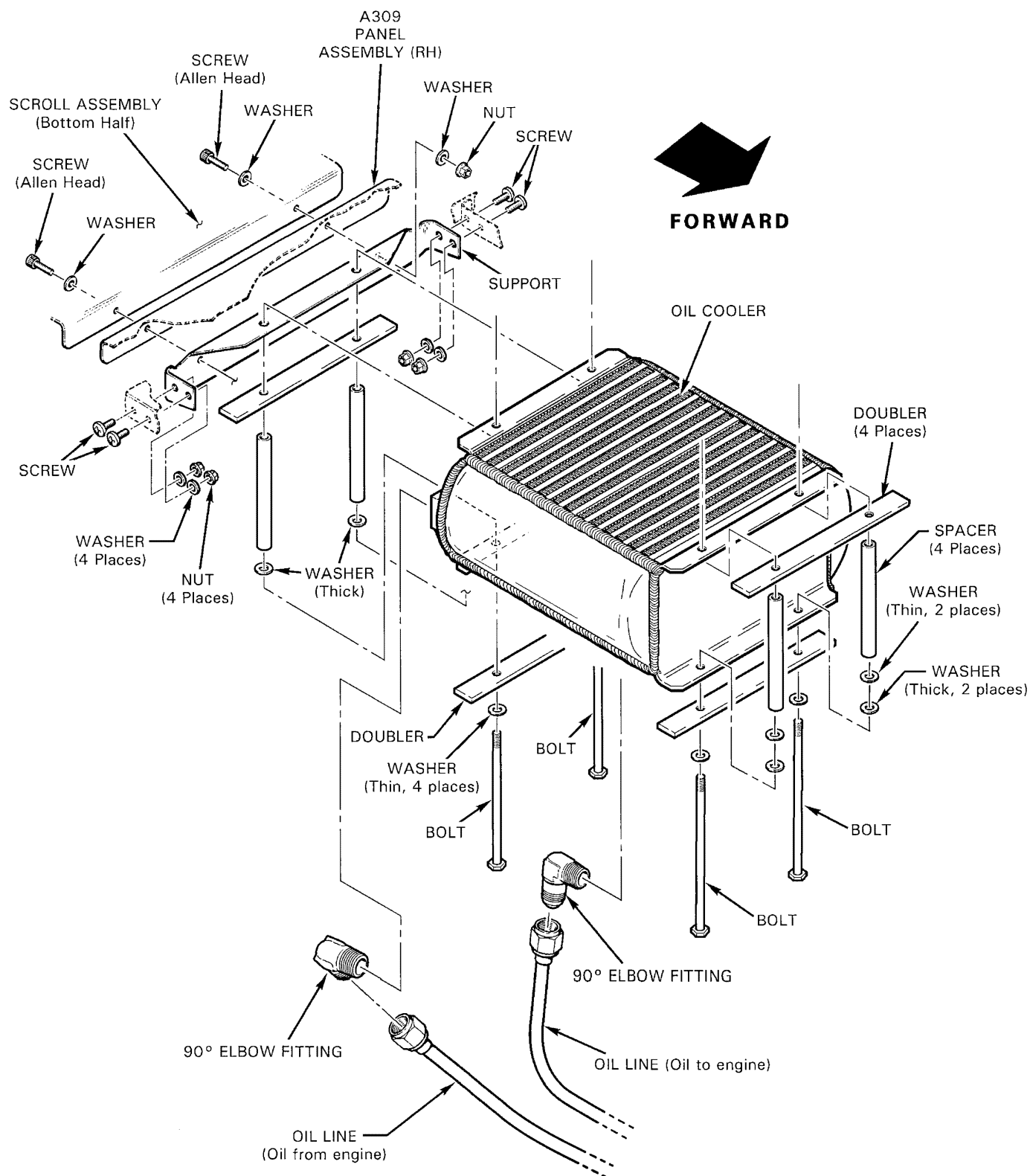


FIGURE 6-5C COOLING SCROLL REPLACEMENT  
(FAN LIP POSITIONING)



**FIGURE 6-6 OIL COOLER INSTALLATION**

## 6.300 LUBRICATION SYSTEM

### **NOTE**

Refer to Pilot's Operating Handbook for grade and quantity of oil required. Refer to the Textron-Lycoming Operator's Manual for adjustment and maintenance of the lubrication system.

### 6.310 Oil Cooler Removal

1. Disconnect oil lines at cooler.
2. Remove four screws and nuts connecting support to panels.
3. Disconnect four mounting bolts and remove oil cooler and attached support. If replacing cooler do NOT attempt to remove and transfer blue-anodized 90 degree elbow fittings (steel fittings may be removed).

### 6.320 Oil Cooler Installation

### **NOTE**

Seal elbows' pipe threads with B270-6 sealant prior to installing in oil cooler. Torque elbows per Section 1.320.

### **CAUTION**

Hold threaded fittings on oil cooler with wrench to react torque when tightening elbows.

1. Install oil cooler and attached support to engine cooling panels using four mounting bolts. Torque AN3 bolts per Section 1.320 and torque stripe per Figure 2-1.
2. Install four screws and nuts connecting support to cooling panels (See Figure 6-6).
3. Connect oil lines, torque nuts per Section 1.330, and and torque stripe per Figure 2-1.

## 6.400 INDUCTION SYSTEM

### 6.410 Carburetor Removal

1. Disconnect air intake and carburetor heat hoses from air box.
2. Disconnect throttle linkage from carburetor bellcrank, mixture control cable from carburetor and carburetor heat control cable from air box slider valve.
3. Disconnect carburetor air temperature probe wiring.
4. Remove palnuts and nuts securing carburetor to intake manifold and remove carburetor and attached air box assembly.

### 6.420 Air Box Removal

1. Disconnect air intake hoses from air box.
2. Disconnect mixture control cable clamp(s) from air box.
3. Disconnect mixture safety spring from carburetor mixture control arm.
4. Open air box cover and remove air filter.
5. Disconnect carburetor heat control cable from air box and slider valve.
6. Cut safety wire and remove four bolts (or cap screws) securing air box to carburetor and remove air box and rubber gasket.

### 6.430 Air Box Installation

1. With air inlets on right, install air box and rubber gasket on carburetor and secure with bolts and washers (or cap screws and spacers on R22 S/Ns 2571-2664 with C057 air box). Torque fasteners per Section 1.330 and safety with 0.032 inch diameter safety wire.
2. Connect mixture control safety spring to carburetor mixture control arm. Verify spring moves arm to full rich position.
3. See Figure 6-7. Connect mixture control cable housing to air box. Push and pull on cable housing and verify it does not slip in clamp(s).
4. See Figure 6-7. Connect mixture control cable inner wire to mixture control arm. Verify mixture control moves carburetor mixture control arm stop to stop. Verify 0.03/0.10 inch clearance (spring-back) under knob at full-rich position. If required, adjust position of inner wire in A462 fitting. Torque A462 fitting per Section 1.330. Install palnut, torque per Section 1.320, and torque stripe.
5. Connect carburetor heat control cable to air box. Connect carburetor heat control cable inner wire to slider valve and torque A462 fitting per Section 1.330. Verify carburetor heat control fully opens and closes slider valve. Bend free end of inner wire ninety degrees where it exits A462 fitting, then cut wire as required to leave 0.25/0.50 inch remaining. Install palnut, torque per Section 1.320, and torque stripe.
6. Install air filter, close cover, and secure. Tighten four long bolts only enough to secure cover and eliminate looseness, then torque stripe. On R22 Mariners, seal air box cover perimeter with aluminum tape. If installed, verify spring-loaded alternate air door fully closes when released.
7. Connect air intake hoses to air box.

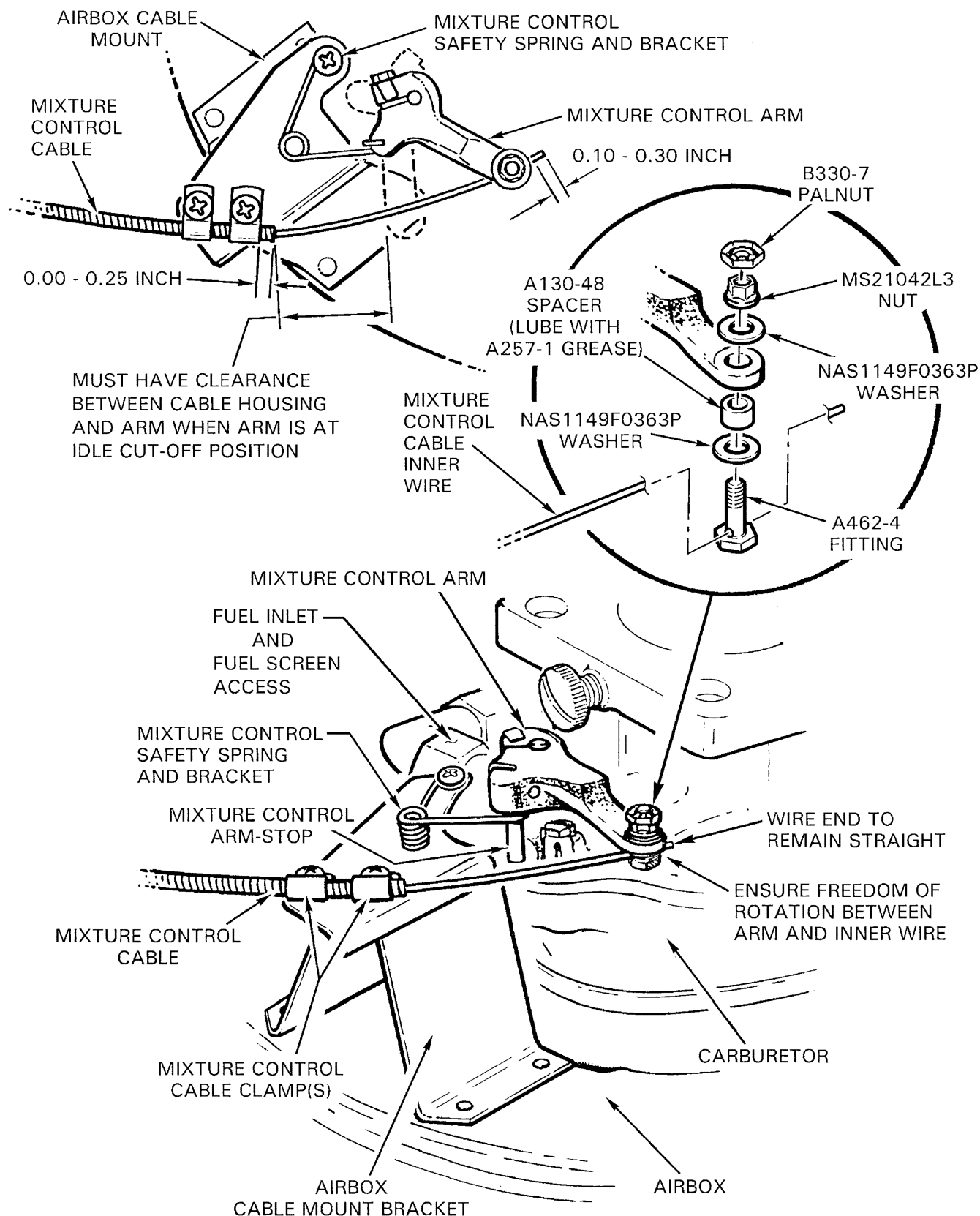


FIGURE 6-7 MIXTURE SAFETY SPRING INSTALLATION



### 6.435 Air Filter Cleaning

**NOTE**

Replace B771-1 air filters after 5 years or 600 flight hours, whichever occurs first.

1. Remove B771-1 air filter from airbox. Visually inspect filter and verify no obvious damage. Inspect filter's pleated media for cleanliness. If the media contains only dust, clean media using compressed air or water. Clean heavily soiled media using a mild soap & water solution.
  - a. Compressed air: Maintain at least one-inch distance between air nozzle and pleated media and apply less than 40 psi compressed air thru media opposite the normal direction of airflow.
  - b. Water: Apply less than 40 psi water stream thru media opposite the normal direction of airflow. Dry filter thoroughly using less than 160°F warm air.
  - c. Mild soap & water solution: Apply less than 40 psi water stream thru media opposite the normal direction of airflow. Soak filter in a mild soap and water solution for more than 15 minutes but less than 4 hours. Gently agitate filter in soap solution to help remove dirt. Apply less than 40 psi water stream thru media in both directions. Dry filter thoroughly using less than 160°F warm air.
2. Using a bright light, examine pleated media and verify no holes or tears.
3. Verify filter sealing surfaces are a smooth, continuous circle and flat.

**NOTE**

Do not install a wet air filter. Do not apply oil to filter media.

4. Install filter in airbox.

#### 6.440 Carburetor Installation

1. With carburetor butterfly bellcrank on left, install carburetor and new gasket on mounting studs of engine sump and secure with washers and nuts. Special torque nuts per § 23-33. Install palnuts, standard torque per § 23-32, and torque stripe.
2. Connect throttle push-pull tube to middle hole of carburetor butterfly bellcrank. Standard torque bolt per § 23-32. Install palnut, torque per § 23-32, and torque stripe.
3. See Figure 6-7. Connect mixture control cable inner wire to carburetor mixture control arm. Lightly tighten A462 fitting, but do not torque; fitting will be torqued in following step.
4. Install air box per § 6.430.
5. Verify idle RPM and idle mixture per § 2.210.
6. Check throttle correlation rigging per § 10.150.

#### 6.450 Carburetor Heat Scoop Removal

1. Disconnect hose from carburetor heat scoop.
2. 0-320 engine: Remove six screws securing curved sheet metal and remove sheet.  
0-360 engine: Remove two B277 clamps securing scoop assembly to exhaust manifold and remove scoop.
3. 0-320 engine: Remove four bolts securing scoop assembly to bead clamp on exhaust riser and remove scoop assembly. Remove additional clamp from exhaust riser above bead clamp.

#### 6.460 Carburetor Heat Scoop Installation

1. 0-320 engine: Install A694 clamp and angle on #4 cylinder exhaust riser and lightly tighten. Attach scoop assembly on bead clamp and lightly tighten.  
0-360 engine: Install scoop assembly, secure with B277 clamps, and lightly tighten.
2. Connect air inlet hose to scoop assembly.
3. 0-320 engine: Position sheet on mounts. Move A694 clamp and rotate bead clamp (with attached scoop assembly) as required to minimize preload and ensure clearance from surrounding structure. Tighten A694 clamp. Standard torque bolts per § 23-32. Install sheet with six screws.  
0-360 engine: Move scoop assembly as required to minimize preload and ensure clearance with surrounding structure. Special torque scoop attach clamps to 30 in.-lb.

## 6.500 Exhaust System

### 6.510 Exhaust System Removal

1. Remove carburetor heat hose and, if installed, disconnect heater hoses from muffler shroud.
2. Protect landing gear aft cross tube with suitable covering. Disconnect exhaust flanges at cylinder heads and remove exhaust system and gaskets.

### 6.520 Exhaust System Installation

<p style="text-align: center;"><b>NOTE</b></p> <p>Do not use stainless tape beneath exhaust bead clamps which incorporate integral barriers.</p>
--

1. Position a gasket on each exhaust port.
2. Protect landing gear aft cross tube with suitable covering. Position exhaust system on engine and connect riser exhaust flanges to cylinder heads with washers and nuts. Remove protective cover from cross tube.
3. Loosen bead clamp on each riser. If required, remove curved metal sheet from carb heat scoop assembly.
4. Special torque exhaust flange nuts per § 23-33. Install palnuts and standard torque per § 23-32.
5. Install carburetor heat hose and connect heater hoses, if installed.
6. Standard torque bead clamp AN3 bolts per § 23-32. If removed, install curved metal sheet on carburetor heat scoop assembly and reposition clamps as required to minimize preload and ensure clearance from surrounding structure.

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6.610 LOW-POWER CHECKLIST

When low engine power output is suspected, use the following checklist to verify:

1. Aircraft gross weight is not exceeded. Weigh aircraft if it was not weighed at last overhaul.
2. Engine oil pressure, oil temperature, and CHT are within limits.
3. MAP gage indicates ambient pressure (engine off).
4. Proper grade of fuel per Pilot's Operating Handbook.
5. Main rotor blades are clean and smooth (no rough paint).
6. Exhaust is unobstructed.
7. Main rotor blade trim tabs are not excessively bent.
8. Carburetor heat valve closes fully in OFF position.
9. Induction system is unobstructed. Air filter and both inlet hoses (ambient and carburetor heat) are clean, undamaged, unobstructed, and do not collapse in flight. Carburetor-to-engine gasket is correct size.
10. Engine tachometer indication is correct. Verify with digital tachometer (such as found in newer dynamic balancing equipment) or similar equipment.
11. Oil screens or filter do not exhibit metallic debris consistent with internal engine damage.
12. Proper cylinder compression (both leakage and direct) per Lycoming recommendations.
13. Mixture neither excessively lean nor rich. Compare fuel flow. Verify fuel filter cleanliness, check spark plug indications, check carburetor throttle body-to-float bowl screw security per Lycoming SB 366.
14. Proper spark plug type and condition.
15. Proper magneto-to-engine timing. Verify engine-left (helicopter-right) magneto is not operating in retard mode when ignition switch is in BOTH position (disconnect retard terminal after starting engine and compare hover MAP indications; lesser hover MAP with retard terminal disconnected indicates magneto was operating retarded).
16. Proper fuel flow and unobstructed carburetor fuel inlet screen. Perform fuel-flow check per Section 12.
17. If primer-equipped, verify fuel is not leaking past primer pump (ensure primer pump is locked) and air is not leaking past fittings in cylinder head.

**| 6.610 LOW-POWER CHECKLIST (cont'd)**

18. Carburetor or fuel control throttle lever contacts full-throttle stop (collective must be raised slightly).
19. Carburetor or fuel control mixture arm contacts stop when mixture control is in full-rich position and mixture arm does not exhibit springback at extremes of travel when disconnected from control cable/safety spring (due to internal binding).
20. No induction/MAP system leaks. To check MAP system, disconnect MAP line at cylinder head fitting and apply suction with syringe until MAP gage indicates 10 inches Hg. Monitor gage for one minute; indication should rise no more than 1 inch Hg. Verify carburetor throttle shaft bushings are not worn; check both axial and radial clearances. Intake leaks can also occur due to loose intake pipe connections in oil sump and/or cracked sump runner tubes. For O-320-B2C engines only, incorrect thin-flanged intake pipes P/Ns 61363, 61364, or 61365 used in place of correct P/Ns LW-16728, LS-16729, and LW-16730 can cause leaks in conjunction with deep-counterbore flange P/N 74360.
21. Proper exhaust valve guide clearance per Lycoming SB388B.
22. Proper dry-tappet clearance per Lycoming Overhaul Manual.
23. With lifters pumped up (valve lash removed), each intake valve should exhibit equal travel during opening when measured with a dial indicator. Similarly, each exhaust valve should exhibit equal travel during opening. Unequal travel indicates damaged cam lobe(s).
24. Proper magneto internal timing.
25. Carburetor float bowl fuel level correct.
26. Cylinder head intake port has radiused edge where inlet airflow turns 90 degrees toward valve. If no radius exists, contact Lycoming Technical Support.
27. Proper crankshaft-to-camshaft timing: As #1 piston passes TDC on compression stroke, the #2 intake valve should open while the #2 exhaust valve closes (valve overlap position).
28. If O-320/O-360/O-540 engine exhibits low-power immediately after overhaul, verify correct 8.5:1 compression ratio piston P/N 75089 has been installed (instead of 7.0:1 low compression piston P/N 75413).

6.620 High Cylinder Head Temperature (CHT) Indication

1. For any helicopter indicating unusually high CHTs, verify:
  - a. Proper fuel grade.
  - b. Cooling scroll inlet metal lips-to-fanwheel clearance is within 0.020–0.100 inch.
  - c. Mixture control at carburetor is at full-rich position when mixture knob is fully in.
  - d. Integrity of engine baffles and cooling panels.
  - e. Cooling hoses are properly routed, secured, and in good condition.
  - f. Correct spark plugs (Lycoming Service Instruction 1042 refers).
  - g. Magnetos are properly timed.
  - h. No excessive leakage from exhaust riser-to-cylinder head gaskets.

**NOTE**

Cylinder head temperatures may be higher during engine break-in until oil change and switch from mineral to ashless dispersant oil.

2. If preceding steps and corrective actions do not improve CHT indications, the CHT gage may be indicating erroneously high. Refer to § 33-131-2 Part E.

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## 6.700 THROTTLE CONTROL AND CARBURETOR HEAT ASSIST

The throttle control consists of a twist grip integral with the collective control, an overtravel spring, throttle bellcrank, throttle push-pull tube, a carburetor throttle lever, and carburetor heat assist factory installed on S/N 2571 and subsequent.

### 6.710 Overtravel Spring (Refer to Figures 8-6 and 10-8)

#### 6.711 Overtravel Spring Removal

1. Remove belly panel and vertical panel between seat backs.
2. Disconnect A327-1 overtravel spring's upper rod end from collective throttle arm.
3. Disconnect A327-1 overtravel spring's lower rod end from bellcrank.
4. Remove overtravel spring.

#### 6.712 Overtravel Spring Installation

1. Connect overtravel spring's lower rod end to bellcrank and torque per Section 1.32. Install palnut, torque per Section 1.320, and torque stripe per Figure 2-1.
2. Connect overtravel spring's upper rod end to collective throttle arm. Raise collective fully, and with throttle twist grip rotated full closed, verify dimension shown in Figure 10-8; adjust upper rod position as required. Torque screw per Section 1.330. Install palnut, torque per Section 1.320, and torque stripe per Figure 2-1.
3. Install belly panel and vertical panel between seatbacks.

### 6.720 (Reserved)

### 6.730 Throttle Push-Pull Tube Assembly

#### 6.731 Throttle Push-Pull Tube Assembly Removal

1. Remove cover enclosing bellcrank beneath left seat baggage compartment. Disconnect throttle push-pull tube assembly from bellcrank.
2. Disconnect throttle push-pull tube assembly from carburetor and remove.

#### 6.732 Throttle Push-Pull Tube Assembly Installation (Refer to Figure 10-8)

1. Insert throttle push-pull tube assembly forward thru firewall seal. Attach aft end to middle hole of carburetor throttle lever and tighten bolt.
2. Attach throttle push-pull tube assembly to bellcrank and tighten bolt.
3. Adjust throttle correlation rigging per section 10.150. Torque push-pull tube jam nuts(s) and palnut(s) (if installed), per Section 1.320 and torque stripe per Figure 2-1.

### 6.740 Carburetor Heat Assist

A carburetor heat assist device is installed on R22s with O-360 engines. The carb heat assist correlates application of carburetor heat with changes in collective setting to reduce pilot work load. Lowering the collective mechanically adds heat and raising the collective reduces heat. Collective input is transmitted through a friction clutch which allows the pilot to override the system and increase or decrease heat as required. A latch is provided at the control knob to lock carburetor heat off when not required.

#### 6.741 Carburetor Heat Control Removal

1. Open air box.
2. Remove horizontal cover between seats.
3. Drive out spring pin on cyclic friction knob using a pin punch. Remove cyclic friction knob. Unscrew knob and collar from carb heat assist stem.
4. Raise cyclic cover and secure out of the way.
5. Remove and discard palnuts from carburetor heat slider valve fittings. Discard palnuts.
6. Loosen nut(s) securing carburetor heat control inner wire to valve.
7. Remove cotter pin and washer securing forward end of control to D334 bellcrank assembly.
8. Pull center wire out of conduit.
9. Remove B270-5 sealant surrounding conduit at vertical firewall. Remove screws securing conduit to keel panel and airbox.
10. Remove outer conduit.

**6.740 Carburetor Heat Assist (Cont'd)****6.742 Carburetor Heat Control Cable Installation**

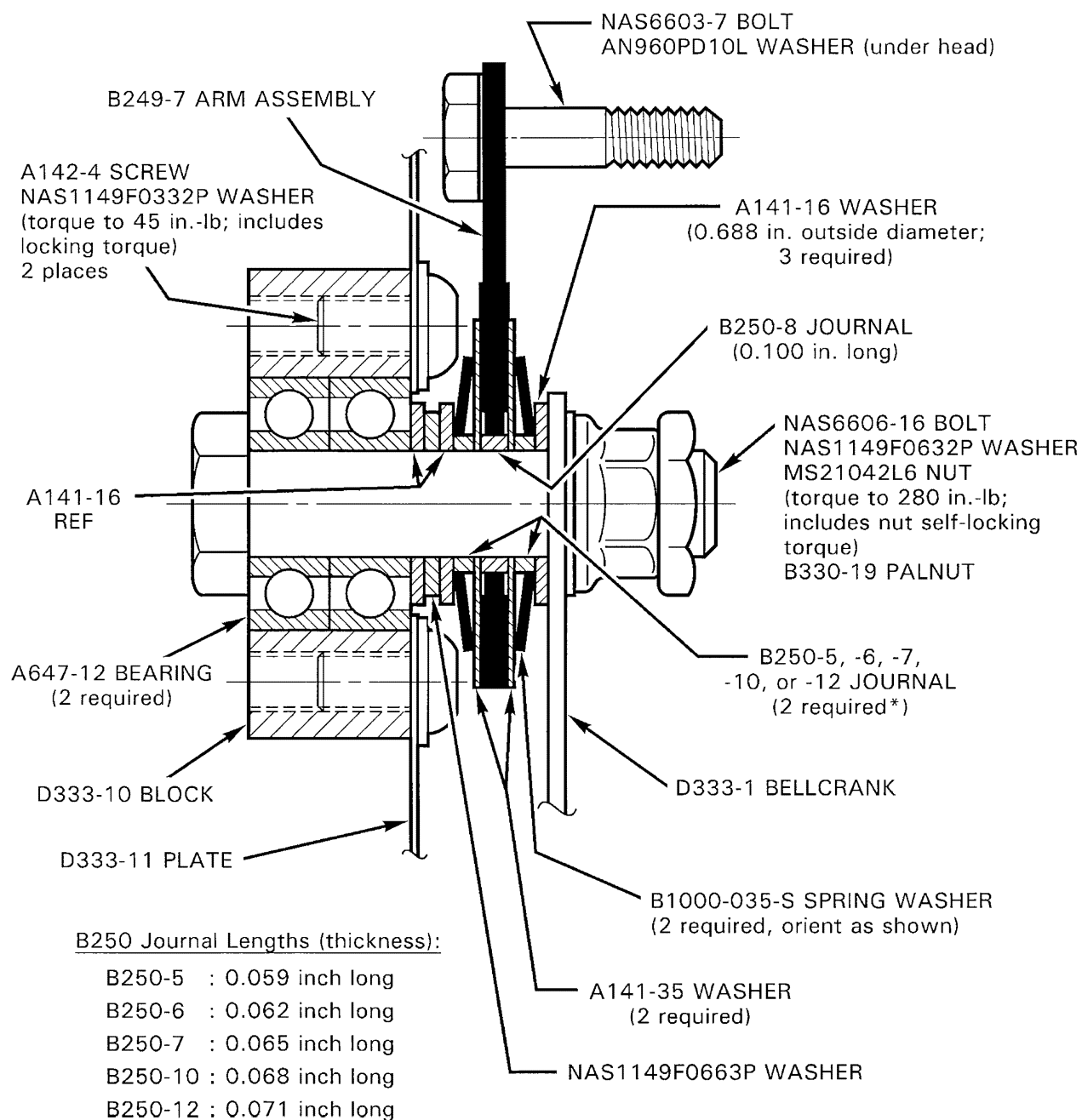
1. Pull inner wire from new control. Route and secure conduit along keel panel, thru vertical firewall, and into air box with retained hardware.
2. Replace B270-5 sealant around cable at firewall pass-through.
3. Lubricate inner wire with A257-1 grease, insert into conduit. Connect forward end to bellcrank, install washer, and temporarily install cotter pin.
4. Secure cyclic cover in place, install collar and knob on stem. Verify 0.10 to 0.25 inch clearance between fitting on inner wire and forward end of conduit with control knob fully down. Reposition conduit as required.
5. Verify aft end of conduit has 0.00 to 0.15 inch protrusion into air box. As required, remove inner wire and trim conduit. Install inner wire, connect forward end to D334 bellcrank, install washer and secure with cotter pin.
6. Connect inner wire thru fitting(s) in carb heat slider valve. With knob fully down and slider valve fully aft, trim inner wire 0.10 to 0.03 inch beyond aft edge of fitting. Torque nuts on fittings per Section 1.330. Torque stripe per Figure 2-1.
7. Install air filter, close cover, and secure. Tighten four long bolts only enough to secure cover and eliminate looseness, then torque stripe. On R22 Mariners, seal air box cover perimeter with aluminum tape. If installed, verify spring-loaded alternate air door fully closes when released.

**6.743 D334-5 Carburetor Heat Assist Bellcrank Assembly Removal**

1. Remove belly panel and horizontal panel between seats.
2. Disconnect carburetor heat assist control inner wire from bellcrank.
3. Disconnect carb heat assist push-pull tube from B249 arm assembly. Remove six screws securing bellcrank assembly to keel panel and B368 stiffener.
4. Remove bellcrank assembly.

**6.744 D334-5 Carburetor Heat Assist Bellcrank Assembly Installation**

1. Position bellcrank assembly against, and with bearing block protruding thru, right keel panel.
2. Secure plate to keel panel with screws.
3. Install A142 screws thru stiffener into bearing block. Torque to 45 in.-lb and torque stripe.
4. Attach A336 push-pull tube to B249 arm assembly and torque bolt per Section 1.320. Install palnut, torque per Section 1.320 and torque stripe per Figure 2-1.
5. Lubricate D333-3 fitting at forward end of carb heat control with A257-1 grease and secure to bellcrank with washer and cotter pin.



\*Install B250-5, -6, -7, -10, or -12 journals as required to produce a rotational friction of 10-12 inch-pounds. Journal dash numbers may be mixed. Measure rotational friction by clamping long side of D333-11 plate in padded vise w/B249-7 arm assembly against vice jaws and rotating bolt head with dial-indicating torque wrench.

**FIGURE 6-8 D334 BELLCRANK ASSEMBLY**  
**CARB HEAT ASSIST FRICTION ADJUSTMENT**  
 (View looking aft)

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6.745 D334-5 Bellcrank Friction Adjustment (Refer to Figure 6-8)

NOTE
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Verify bolt head between arm and plate.
---

1. Measure rotational friction per Figure 6-8.
2. Adjust friction as required by exchanging B250 journals per Figure 6-8 (dash numbers may be mixed). Decreasing journal thickness increases friction. Torque NAS6606 bolt per Figure 6-8.
3. Install palnut, torque per Section 1.320, and torque stripe per Figure 2-1.

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## CHAPTER 7

## DRIVE TRAIN

<u>Section</u>	<u>Title</u>	<u>Page</u>
7.000	Drive Train . . . . .	7.1
7.001	Introduction . . . . .	7.1
7.002	Description . . . . .	7.1
7.100	Main Rotor Gearbox . . . . .	7.1
7.110	Main Rotor Gearbox Removal . . . . .	7.1
7.120	Main Rotor Gearbox Installation . . . . .	7.3
7.130	Leveling Main Rotor Gearbox . . . . .	7.5
7.140	A006-5 or A908-4 Yoke Removal and Installation . . . . .	7.7
7.141	Setting Hall Effect Sender Gap . . . . .	7.7
7.150	Replacement of Main Rotor Gearbox Pinion Seal . . . . .	7.7
7.155	Replacement of Main Rotor Gearbox Sump O-Ring . . . . .	7.9
7.160	Main Rotor Gearbox Overtemp Inspection . . . . .	7.9A
7.170	Main Rotor Gearbox Chip Light Indicator . . . . .	7.9B
7.180	(Reserved)	
7.200	Clutch Assembly . . . . .	7.10
7.210	Clutch Assembly Removal . . . . .	7.10
7.211	A184 Bearing Removal . . . . .	7.12
7.212	A184 Bearing Installation . . . . .	7.14
7.213	Clutch Assembly Seal Replacement . . . . .	7.15
7.214	Clutch Assembly Lubricant Inspection and Servicing . . . . .	7.16
7.220	Clutch Assembly Installation . . . . .	7.19
7.230	Clutch Sheave Alignment . . . . .	7.20
7.240	Clutch Shaft Angle . . . . .	7.23
7.250	Clutch Lateral Centering . . . . .	7.23
7.260	A907 Yoke Removal and Installation . . . . .	7.25
7.270	A195 Yoke Removal and Installation . . . . .	7.29
7.280	V-Belts . . . . .	7.29B
7.281	V-Belt Removal . . . . .	7.29B
7.282	V-Belt Installation . . . . .	7.29B
7.290	A007 Fanshaft and Bearing Assembly, Starter Ring Gear Support, Lower Sheave and Alternator Belt Replacement . . . . .	7.33A
7.291	Removal . . . . .	7.33A
7.292	Installation . . . . .	7.33A
7.300	Tail Rotor Drive Shaft . . . . .	7.34

## CHAPTER 7

## DRIVE TRAIN (Continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
7.310	Tail Rotor Drive Shaft Removal . . . . .	7.34
7.320	Tail Rotor Drive Shaft Installation . . . . .	7.35
7.321	Adjustment of Damper Friction . . . . .	7.37
7.330	Intermediate Flex Plate Installation and Shimming . . . . .	7.40
7.340	Checking Tail Rotor Drive Shaft Runout . . . . .	7.40
7.350	Two-Piece Tail Rotor Drive Shaft . . . . .	7.44A
7.360	B224-1 Tail Rotor Drive Shaft Corrosion Removal . . . . .	7.44D
7.400	Tail Rotor Gearbox . . . . .	7.45
7.410	Tail Rotor Gearbox Removal . . . . .	7.45
7.420	Tail Rotor Gearbox Installation . . . . .	7.45
7.430	Tail Rotor Gearbox Shimming . . . . .	7.46
7.440	Tail Rotor Gearbox Chip Indicator . . . . .	7.46
7.450	A021 Tail Rotor Gearbox Output Shaft Seal Replacement . . . . .	7.47
7.460	B021 Tail Rotor Gearbox Output Shaft Seal Replacement . . . . .	7.48
7.470	B021 Tail Rotor Gearbox Input Shaft Seal Replacement . . . . .	7.48B
7.500	Actuator Assembly . . . . .	7.49
7.510	Actuator Removal . . . . .	7.49
7.520	Actuator Installation . . . . .	7.49
7.530	Actuator Gearmotor Replacement . . . . .	7.49
7.540	Actuator Adjustment . . . . .	7.50
7.550	Switch and Fuse Replacement . . . . .	7.53
7.551	Switch Replacement . . . . .	7.53
7.552	Fuse Replacement . . . . .	7.53
7.600	Rotor Brake . . . . .	7.54
7.610	Rotor Brake Removal . . . . .	7.54
7.620	Rotor Brake Installation . . . . .	7.54
7.630	Rotor Brake Pad Replacement . . . . .	7.55



## CHAPTER 7

## DRIVE TRAIN

7.000 Drive Train7.001 Introduction

This section contains procedures for removal, installation, replacement, and maintenance of drive train components.

7.002 Description (See Figure 7-1)

A steel-coated multiple-grooved aluminum pulley, known as the lower sheave, is bolted directly to the crankshaft. Two banded-pair V-belts transmit power to the anodized aluminum upper sheave; a steel-coated upper sheave is optional. The upper sheave has an overrunning sprag clutch, also known as a freewheeling unit, in its hub through which passes the clutch shaft. The clutch shaft receives power from the sprag clutch and transmits power forward to the main rotor gearbox and aft to the tail rotor driveshaft. Flexible couplings are located at input to the main rotor gearbox and at each end of the long tail rotor driveshaft. The main rotor gearbox contains a single-stage spiral-bevel gear set which is splash-lubricated. The tail rotor driveshaft has no hanger bearings but has a lightly-loaded damper bearing. The tail rotor gearbox also contains a splash-lubricated spiral-bevel gear set. Tail rotor gearbox input and output shafts are made of stainless steel to resist corrosion. Other shafts throughout drive system are made of alloy steel.

7.100 Main Rotor Gearbox7.110 Main Rotor Gearbox Removal

1. Remove main rotor per §§ 9.111 & 9.121.
2. Remove swashplate per § 8.411.
3. Remove mast fairing and aft cowl.
4. Disconnect rotor brake cable from brake lever.
5. Remove fuel tank(s) per § 12.100. Mark all wires for reassembly.
6. Remove jackshaft and support struts per §§ 8.311 & 8.321.
7. Remove clutch assembly per § 7.210.
8. Disconnect chip detector, Hall Effect senders, rotor brake switch and overtemp sender at quick disconnects. Disconnect ground wire. Mark all wires for reassembly.
9. Remove gearbox cooling hose and nozzle.
10. Remove four main rotor gearbox mounting bolts. Carefully lift gearbox up to clear forward push-pull tubes and remove gearbox (see Figure 7-2).

**WARNING**

**Leveling shims may be installed between gearbox mounts and frame mounting pads. Shims should remain attached to frame, or mark mounting pads with shim thickness for reinstallation.**

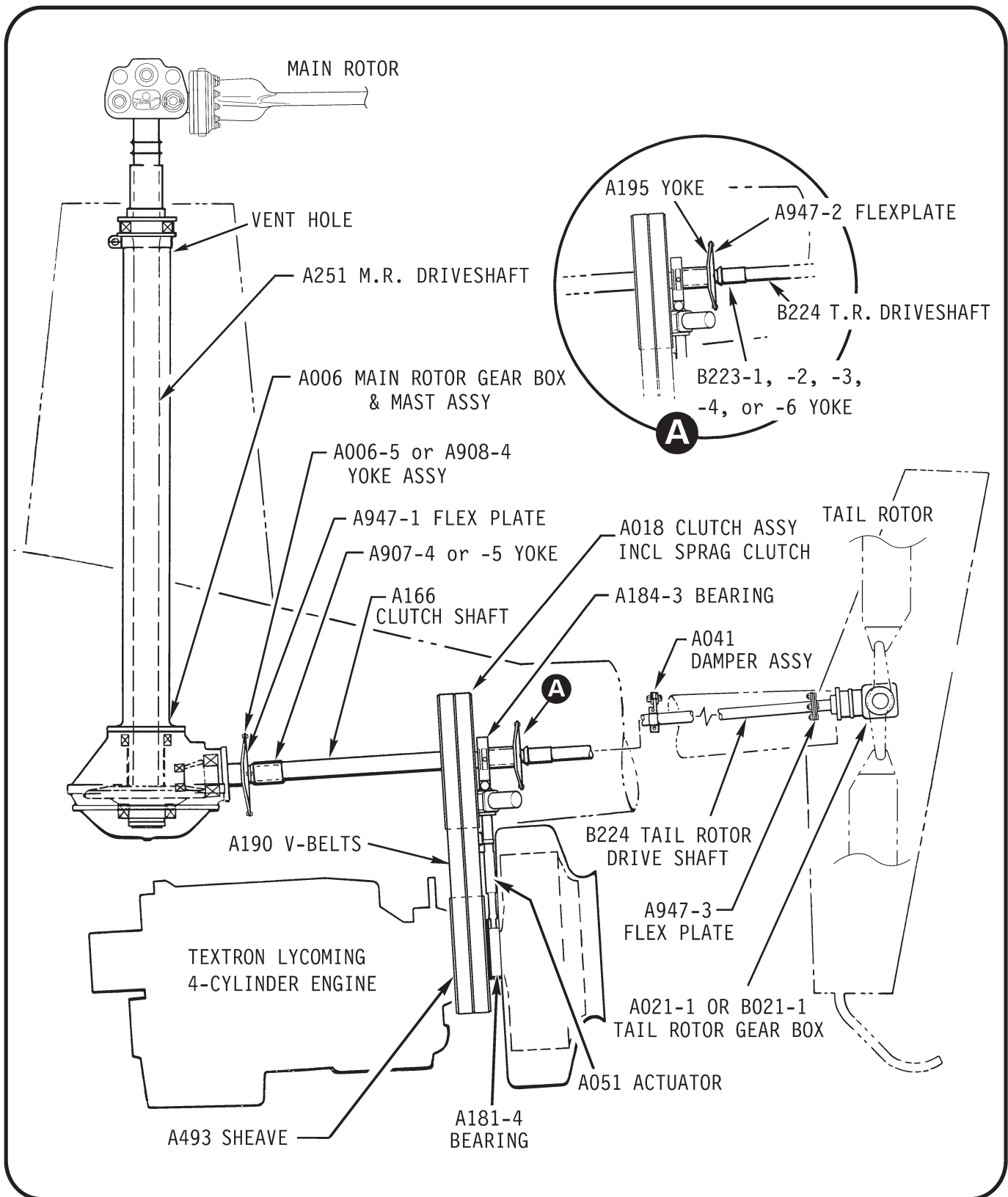


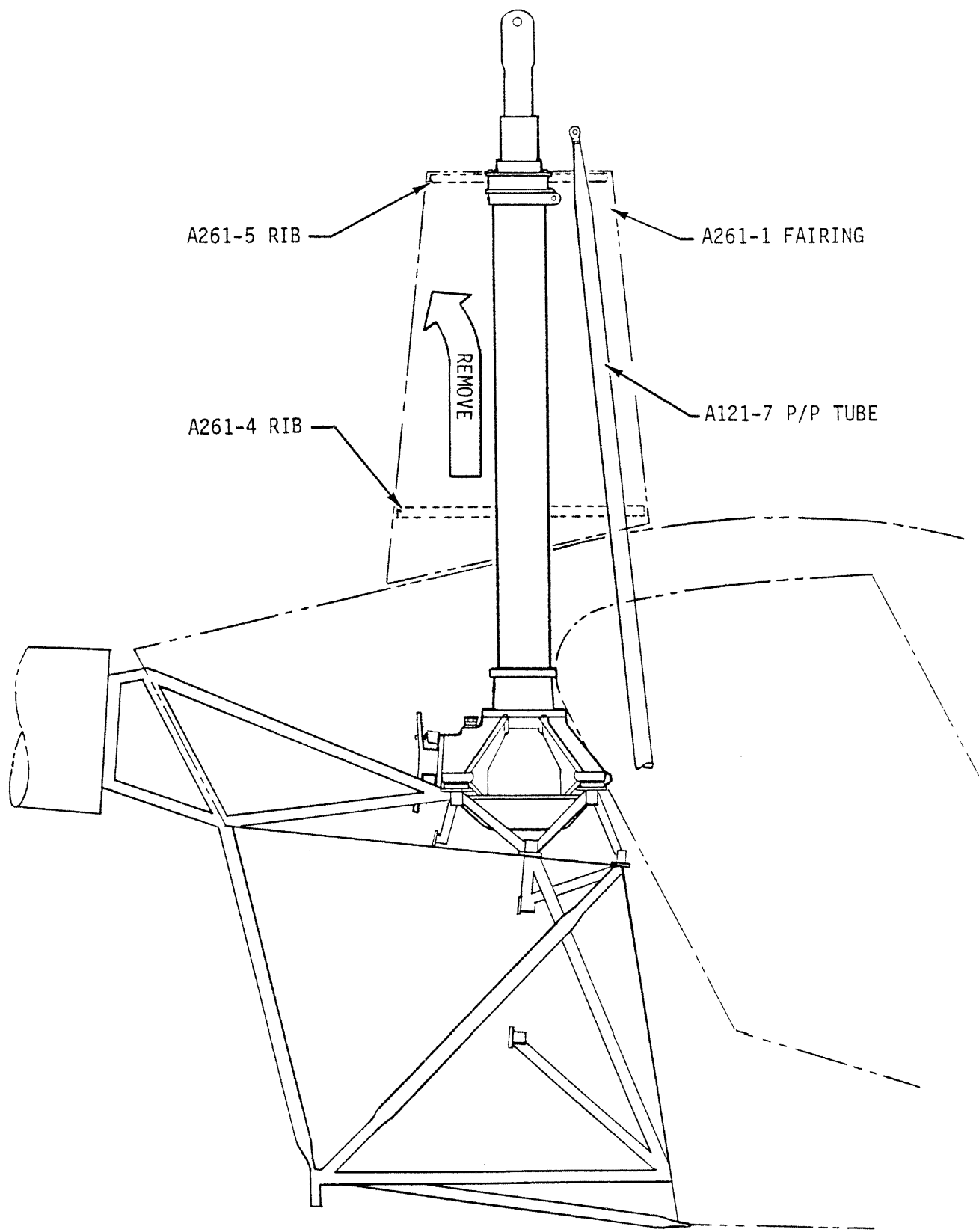
FIGURE 7-1 DRIVE TRAIN

### 7.120 Main Rotor Gearbox Installation

1. Ensure area is clear for installation of gearbox. One or two other people are needed to help position gearbox.
2. If original shims unknown or a new upper frame has been installed, Level main rotor gearbox mounting pads per Section 7.130. Install proper shims on main rotor gearbox mount pads before gearbox installation. Install main rotor gearbox attach bolts and A650 fittings and torque per Section 1.330.
3. Install clutch assembly per Section 7.220.
4. Install jackshaft support and jackshaft per Sections 8.312 and 8.322.
5. Install main rotor gearbox cooling hose and nozzle.
6. Install fuel tank(s) per Section 12.130 and 12.170.
7. Connect rotor brake cable to brake lever. Torque bolt per Section 1.320 and torque stripe per Figure 2-1. Verify rotor brake switch activates per Figure 7-16A dimension.
8. Connect electrical leads at fuel tank(s) and main rotor gearbox.
9. Install aft cowling and clamp static line.
10. Install fairing lower rib and ensure it is aligned with helicopter's longitudinal axis. Connect pitot tube to pitot line and install mast fairing.
11. Install swashplate assembly per Section 8.412.
12. Install main rotor system per Sections 9.112 and 9.122
13. Refer to Section 1.110 for new or overhauled gearbox servicing instructions.

#### **CAUTION**

Prior to operation of a new, overhauled, or repaired gearbox, or if gearbox has ever been laid horizontally, 6 ounces of A257-2 gear oil must be injected into vent hole (see Figure 7-1) on top aft side of mast tube. Gearbox must remain vertical during and after injecting oil. Fill gearbox with oil, via fill port, to level indicated on sight glass decal.



**FIGURE 7-2 MAIN ROTOR GEARBOX REMOVAL**

### 7.130 Leveling Main Rotor Gearbox

1. Level aircraft per § 18-13.
2. Place A796 shims as required on upper frame MRGB mounting pads such that a level laid laterally or longitudinally between any two pads indicates  $\pm 0.20^\circ$  or less. If unable to obtain  $\pm 0.20^\circ$ , level to within one 0.020 inch thick shim. Maximum six shims per pad.

<p style="text-align: center;"><b>NOTE</b></p> <p>Ensure at least one pad has no shims. As required after leveling, remove equal number of shims from each pad.</p>
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3. Install main rotor gearbox per § 7.120.

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### 7.140 A006-5 or A908-4 Yoke Removal and Installation

#### Yoke Removal:

- a) Remove A947-1 flex plate and remove clutch per § 7.210 or support clutch shaft per Figure 7-8.
- b) Place a wooden block between horizontal firewall and yoke flange to counteract torque when loosening nut.
- c) Remove cotter pin and nut from main rotor gearbox pinion shaft and remove yoke.

#### Yoke Installation:

- a) Install A006-5 or A908-4 yoke on main rotor gearbox pinion shaft. Install A141-10 washer and AN320-8 castellated nut.
- b) Special torque nut per § 23-33 and install cotter pin. Place a wood block between yoke flange and horizontal firewall to counteract torque.
- c) Install clutch assembly, if removed, and connect forward flex plate per § 7.220.

#### **WARNING**

**A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, flex plate is unairworthy and cannot be repaired. Ensure A947-1 forward flex plate is Rev E or subsequent (identified by letter "E" or subsequent letter on two arms of flex plate).**

- d) Check Hall Effect sender-to-yoke magnet gap per § 7.141 before run-up or turning blades.

### 7.141 Setting Hall Effect Sender Gap

Hall Effect sender-to-magnet gap is 0.020 inch  $\pm$  0.005 inch. Gap is adjustable by loosening sender jam nuts. Check gaps between bolt magnets at each sender. After setting gap, tighten jam nuts and torque-stripe.

### 7.150 Replacement of Main Rotor Gearbox Pinion Seal

- a) Ensure belt tension actuator is fully disengaged. Disconnect A947-2 intermediate flex plate at tail rotor drive shaft. Note shim location(s) for reinstallation.
- b) Remove A947-1 forward flex plate. Note shim location(s) for reinstallation.

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### 7.150 Replacement of Main Rotor Gearbox Pinion Seal (continued)

- c) Rest forward end of clutch shaft on firewall. Remove yoke from pinion shaft per § 7.140.
- d) Cut safety wire securing pinion bearing end cover bolts and remove bolts.
- e) Remove Hall Effect sender bracket(s) and gearbox overtemp sender bracket.
- f) Carefully slide pinion bearing end cover off pinion shaft.

#### **CAUTION**

Do not remove shims under pinion bearing end cover as they control bearing preload and gear backlash.

- g) Press seal out of bearing end cover and press in new seal until it seats.

#### **NOTE**

Open face of seal lip must point toward gearbox.

- h) Position bearing end cover on pinion shaft. Install Hall Effect and overtemp sender brackets and remaining end cover bolts.
- i) Torque bolts per § 23-33 and safety wire.
- j) Adjust Hall Effect sender gap per § 7.141.
- k) Install A947-1 forward flex plate and connect A947-2 intermediate flex plate, ensuring correct ship placement.

### 7.155 Replacement of Main Rotor Gearbox (MRGB) Sump O-Ring

- a) Drain MRGB.
- b) Remove MRGB per § 7.110.
- c) Check and record MRGB gear backlash at and tangential to a gear tooth, accessible via sight gage or filler-plug hole.
- d) Carefully note and record position of each fastener, washer and shim stack-up at all A263-1 sump-to-A264-1 housing attach points (an equal number of shims is installed between sump and housing at each attach point). Remove, identify and retain fasteners, washers and shims.
- e) Remove sump and o-ring.
- f) Prelubricate new A214-172 o-ring with correct gearbox oil (refer to § 22-10 Part C) | and install on sump. Ensure o-ring is not twisted in sump groove.

7.155 Replacement of Main Rotor Gearbox (MRGB) Sump O-Ring (continued)

- g) Carefully assemble sump to housing and secure finger-tight with fasteners, washers and shims installed in same positions recorded in step d).

**NOTE**

Install ground wires under nut located aft of forward right mount.

**CAUTION**

Verify all sump bolts have same shim stack as noted during removal.

- h) Torque fasteners as follows:

Eight nuts on AN4 bolts:	90 in.-lb (incl nut self-lock torque)
Two MS20074 cap screws:	60 in.-lb and safety wire
A7260 chip detector housing:	150 in.-lb and safety wire
A7260 chip detector:	75 in.-lb and safety wire

- i) Check MRGB gear backlash exactly as performed in step c). Backlash should be within 0.001 inch of value recorded in step c).
- j) Install MRGB per § 7.120.
- k) Fill MRGB with correct gearbox oil (refer to § 22-10 Part C).

7.160 Main Rotor Gearbox Overtemp Inspection

- a) If "MR TEMP" warning light illuminates AND Telatemp indicates abnormally high operating temperature:
1. Inspect gearbox cooling duct for obstructions and conditions. Clear obstructions or replace duct as required.
  2. Remove chip detector and inspect for chips. Return gearbox to RHC if chips are found.
  3. Drain gearbox oil and remove sight gage and filler-plug. Observe gear tooth surfaces thru filler-plug and sight gage holes while rotating gearbox pinion and inspect for damage. Return gearbox to RHC if damage is detected or if gearbox does not rotate smoothly. If no damage is noted, refill gearbox.
  4. Replace Telatemp. Ensure old Telatemp adhesive is removed and new Telatemp makes good contact with gearbox.
  5. If gearbox overtemp indications continue, return gearbox to RHC.

7.160 Main Rotor Gearbox Overtemp Inspection (cont'd)

- b) If "MR TEMP" warning light illuminates but Telatemp indicates normal operating temperature, replace gearbox overtemp sender and perform steps a) 1, 2, & 5 above.
- c) If Telatemp indicates 240°F/116°C but "MR TEMP" warning light does not illuminate, test "MR TEMP" warning circuit and perform steps a) 1, 2, 4, & 5 above.

NOTE

Light illuminates at  $240 \pm 5^{\circ}\text{F}$ .

7.170 Main Rotor Gearbox Chip Light Indicator

If "MR CHIP" light illuminates:

- a) Drain and flush gearbox per Section 1.120 except strain oil (a paint filter works well) while draining and examine any particles found in oil or on chip detector.
- b) Particles larger than 0.12 inch long or 0.02 inch wide are cause for concern and should be identified as ferrous or non-ferrous with a magnet. If particles are ferrous return main rotor gearbox to RHC for repair along with particles. If particles are non-ferrous, drain and flush gearbox per Section 1.120.
- c) If "MR CHIP" illuminates again within next 100 hours time-in-service a gearbox failure may be imminent. Return gearbox to RHC for repair.

7.180 (Reserved)

## 7.200 CLUTCH ASSEMBLY

### 7.210 Clutch Assembly Removal

1. Remove A947-2 intermediate flex plate.
2. Turn Master Battery switch on and disengage clutch switch. Adjust actuator down-limit stop screw (see Figure 7-15) for maximum drive belt slack. Turn Master Battery switch off.

#### **CAUTION**

Belt tension actuator must be fully disengaged prior to removing clutch assembly.

3. Disconnect A947-1 forward flex plate.

#### **WARNING**

A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, flex plate is unairworthy and cannot be repaired.

4. Disconnect A184 upper actuator bearing assembly from actuator.
5. Disconnect clutch lateral centering strut from upper frame.
6. Disconnect actuator wiring.
7. Pivot actuator to right. Lower clutch to allow drive belt removal.

#### **CAUTION**

Mark drive belt fore and aft positions and direction of rotation per Figure 7-8 if reinstalling drive belts.

8. Remove drive belts from clutch and remove clutch per Figure 7-3.
9. When returning clutch to RHC, remove and retain both yokes, centering strut, and attaching hardware.

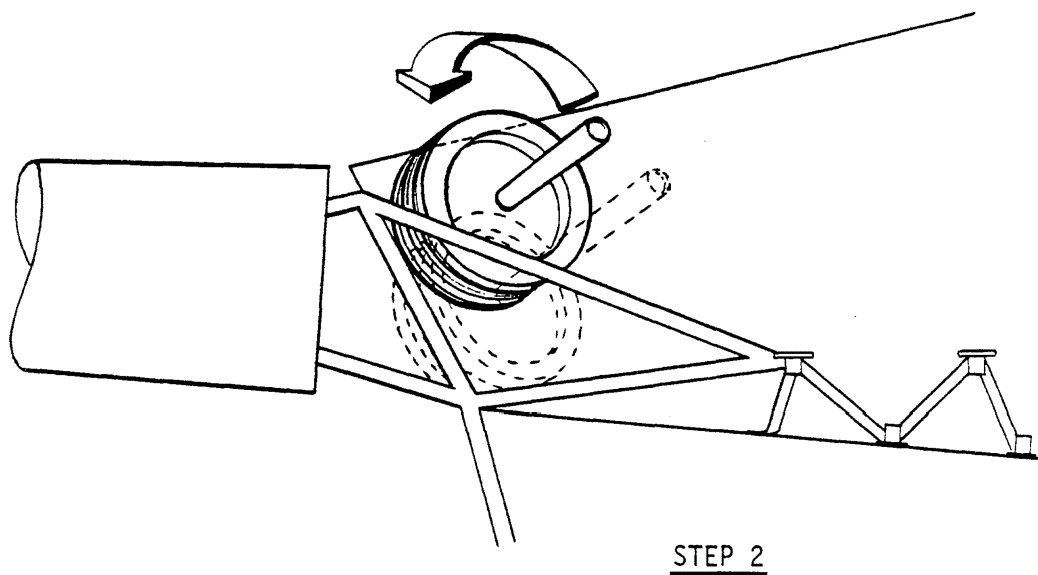
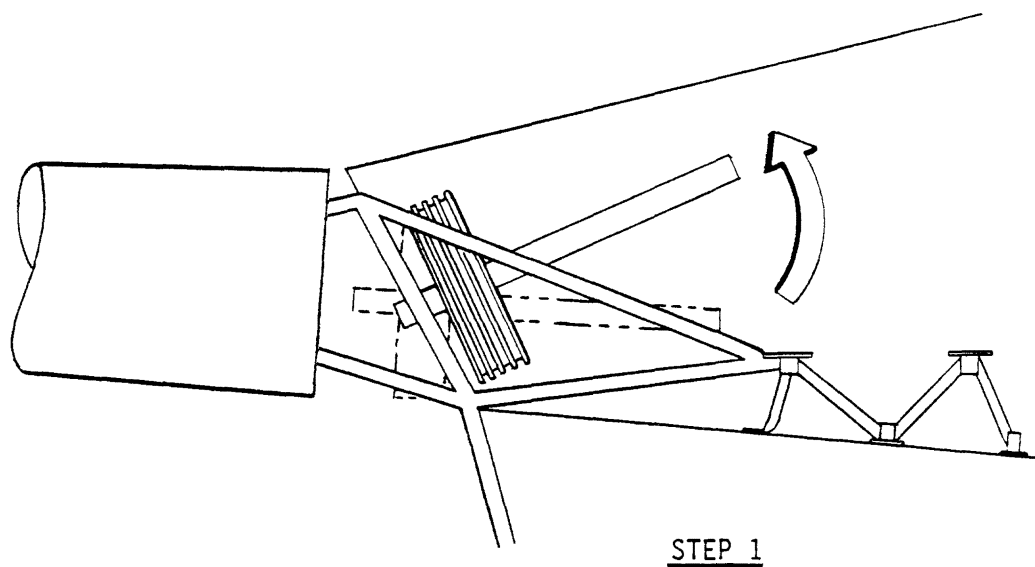


FIGURE 7-3 CLUTCH REMOVAL

**7.211 A184 Bearing Removal**

- a. Refer to Figures 7-3A and 7-3B. Remove A184 bearing:
  1. If a press is available, assemble MT303-5 lower puller assembly between A184 bearing and upper sheave per Figure 7-3A. Press clutch shaft out of bearing.

**CAUTION**

Ensure A018 assembly does not fall when bearing is removed.

2. If press is not available, assemble MT303-2 upper puller assembly with MT303-5 lower puller assembly on clutch per Figure 7-3B. Install MT303-16 plug in short end of clutch shaft and secure with MT303-13 pin. Ensure extractor bolt threads are lubricated with anti-seize. Remove bearing by holding handle and tightening extractor bolt.

**WARNING**

A647-4 bearing in A184-3 upper bearing assembly has internal clearance modified by RHC. **DO NOT SUBSTITUTE.**

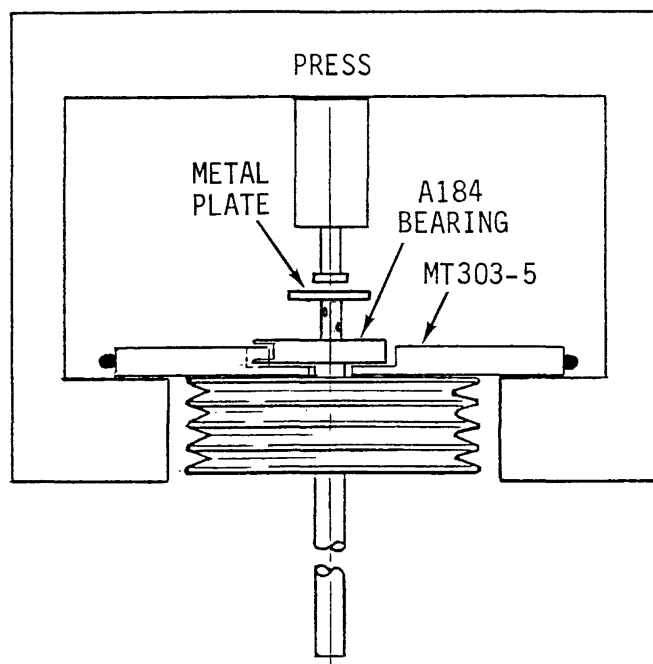


FIGURE 7-3A

Removing A184 Bearing in shop using hydraulic press and MT303-5 Lower Puller Assembly.

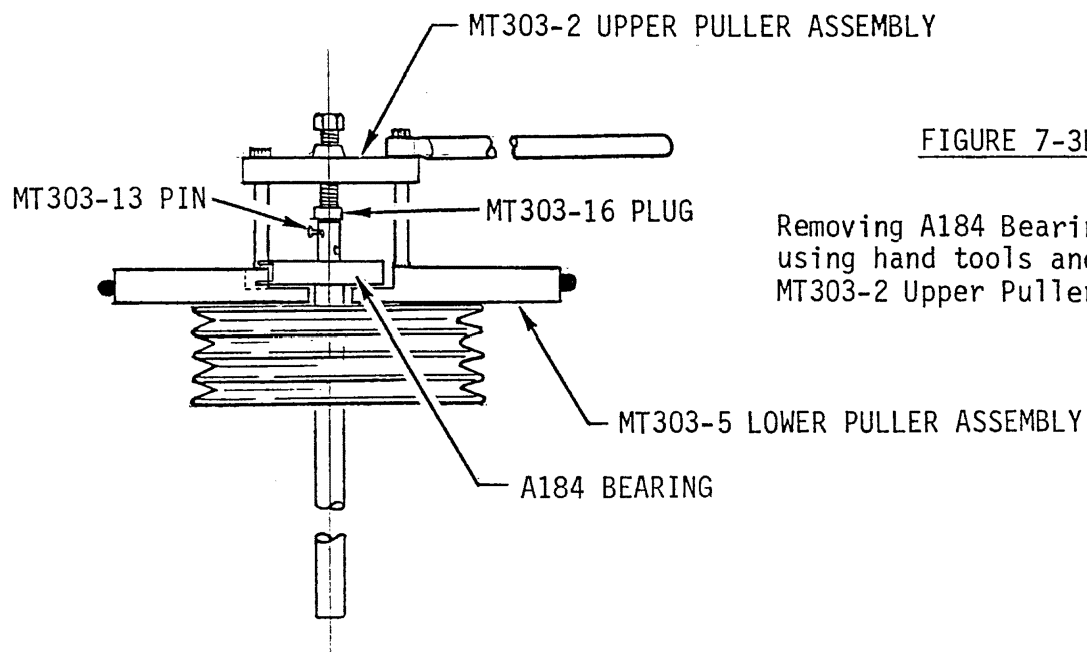


FIGURE 7-3B

Removing A184 Bearing in field using hand tools and MT303-5 and MT303-2 Upper Puller Assembly.

## 7.212 A184 Bearing Installation

1. Remove loose paint and clean mating area on shaft.
2. Heat A184 bearing assembly. A heat lamp placed one foot from bearing may be used. Ensure temperature of bearing does not exceed 180° F by monitoring Telatemp installed on bearing.
3. Apply zinc-chromate or epoxy primer, or B270-10 adhesive, to bearing mating area of shaft. While primer or adhesive is still wet, install bearing on clutch shaft:

## NOTE

Ensure bearing is installed with lateral centering strut attachment ear to left side and actuator attachment on bottom per Figure 7-3F.

- I. If press is available: If installed, remove A907 forward yoke. Position MT303-19 tube against A184 bearing assembly inner race and press assembly onto clutch shaft per Figure 7-3E until bearing is at dimension shown in Figure 7-3D.

## CAUTION

Do **NOT** support clutch assembly by sheave while pressing or internal bearing will be damaged.

Do **NOT** press bearing beyond dimension shown in Figure 7-3D.

- II. If press is not available: Install MT303-4 bearing press assembly and handle from MT303-2 upper puller assembly per Figure 7-3G. Lubricate threaded shaft portion of MT303-4 bearing press assembly with anti-seize compound then insert drilled end into clutch shaft. Align clutch shaft holes with threaded shaft hole and insert MT303-13 pin. Hold handle and tighten nut on MT303-4 bearing press assembly until bearing is at dimension shown in Figure 7-3D.
4. Remove bearing press tooling.
  5. Check bearing for smooth operation.
  6. Seal bearing inner race-to-shaft juncture with primer to minimize corrosion.
  7. Torque stripe inner race of bearing to clutch shaft two places, 180° apart.
  8. Install new Telatemp on A184 bearing housing if original was altered by heating.



### 7.213 Clutch Assembly Seal Replacement

1. Remove clutch assembly per § 7.210.
2. If replacing aft seal, remove A184-3 bearing assembly from clutch shaft per § 7.211. Remove loose paint and clean shaft.

**NOTE**

Orient clutch assembly vertically with leaking seal up.

3. Remove inner circle of six (6) bolts from leaking seal retainer.
  - a. If seal retainer is circular with two opposing half-moon-shaped cutouts: Remove four (4) bolts in outer row, but not two (2) bolts with large-area washers (which holds inner clutch assembly together).

**NOTE**

DO NOT REMOVE two bolts holding the inner clutch assembly together. Further disassembly is not approved.

- b. If seal retainer has two socket-head cap screws: Remove six bolts in outer row, and two socket-head cap screws.
4. Lift retainer plate with seal off shaft per Figure 7-3C. Remove exposed O-ring from clutch housing and discard.
5. Press damaged seal out of retainer.
6. Measure retainer seal bore. If bore measures over 1.687 inches, retainer must be replaced.
7. For "National" brand seals coat seal bore of retainer with B270-3 sealant and press seal in at room temperature. For "CR" brand seal with green coating on seal outer diameter, heat retainer to 150°F and press seal in dry. Press new seal into retainer flush with outside lip.
8. Fill sprag and bearing cavity with A257-4 oil until oil level is flush with top of bearing races (see Figure 7-3D). Rotate shaft while filling to ensure complete filling of inner shaft and sprag assembly.
9. Lightly lubricate new O-ring with A257-4 oil and place it in clutch housing groove.
10. Lightly lubricate seal inner lip with A257-4 oil and slide retainer over shaft.

### 7.213 Clutch Assembly Seal Replacement (continued)

11. a. If seal retainer is circular with two opposing half-moon shaped cutouts: Position retainer so cut outs fit over two (2) A141-14 washers holding clutch assembly together. Install six (6) inner and remaining four (4) outer bolts in retainers with heads toward shorter end of clutch shaft.  
  
b. If seal retainer has provisions for two socket-head cap screws: Install cap screws with washers and tighten only enough to clamp retainer to o-ring. Install six inner and six outer bolts with heads toward shorter end of clutch shaft.
12. Using a criss-cross pattern, standard torque nuts per § 23-32 and torque stripe.
13. If installed, fully tighten cap screws and torque stripe.
14. If removed, install A184-3 bearing assembly per § 7.212.
15. Install clutch assembly per § 7.220.

### 7.214 Clutch Assembly Lubricant Inspection and Servicing

|      This section has been moved to § 22-30.

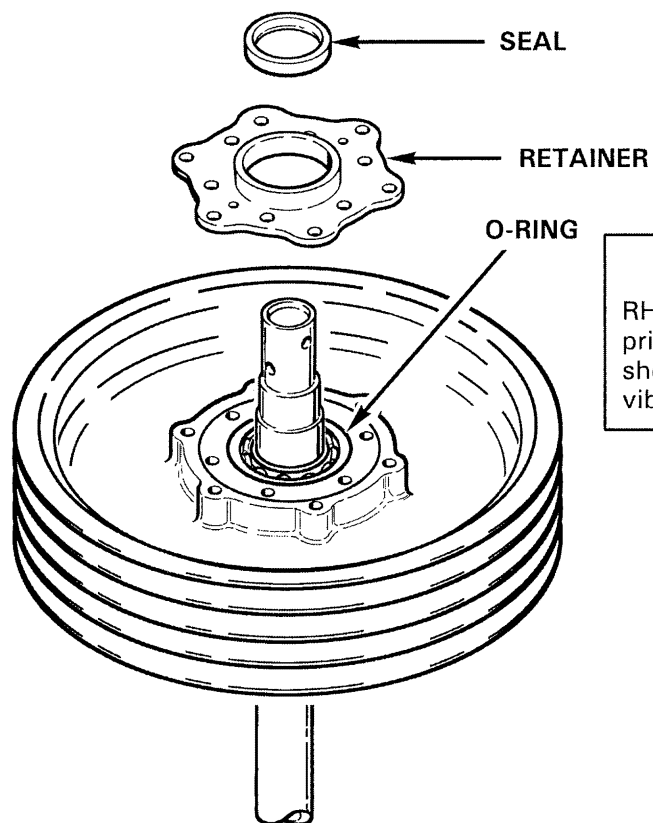


FIGURE 7-3C

**CAUTION**

RHC does not recommend using A170-1 or -2 Revision N or prior upper sheaves with A493-1 Revision T or later lower sheaves. Such combinations may cause excessive drive belt vibration. Refer to Figure 2-9.

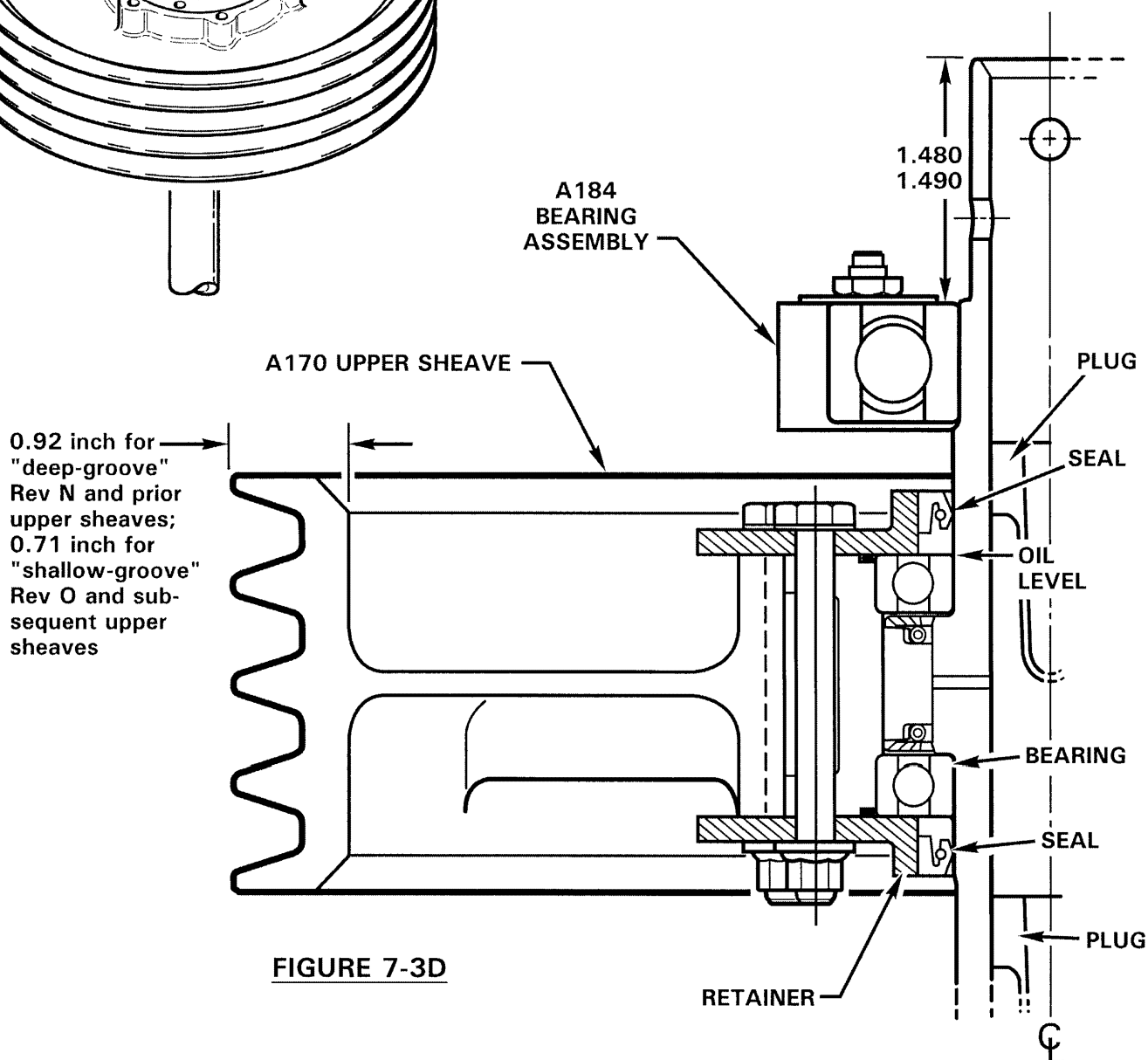
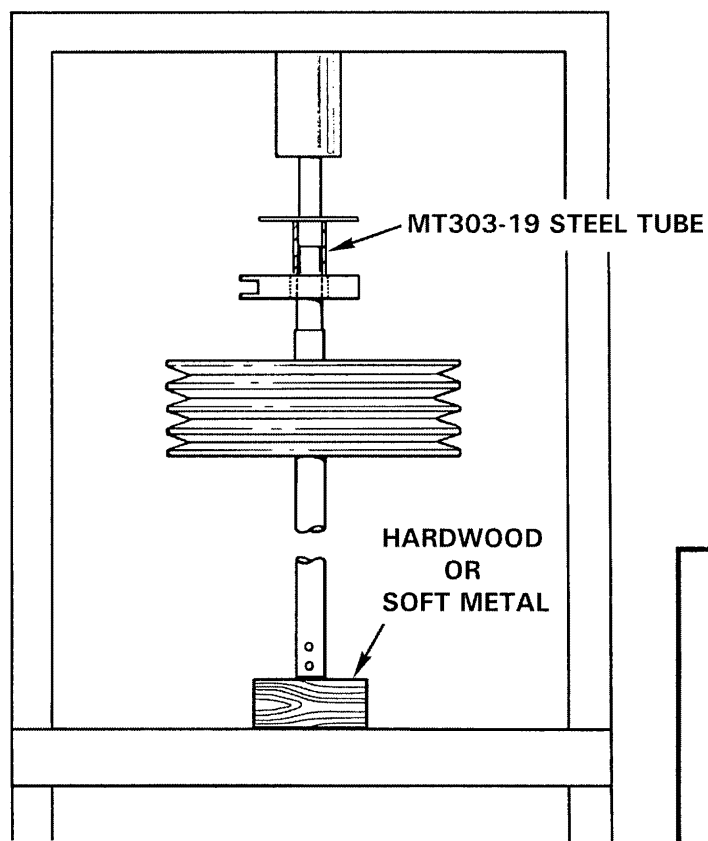


FIGURE 7-3D

**FIGURE 7-3E**

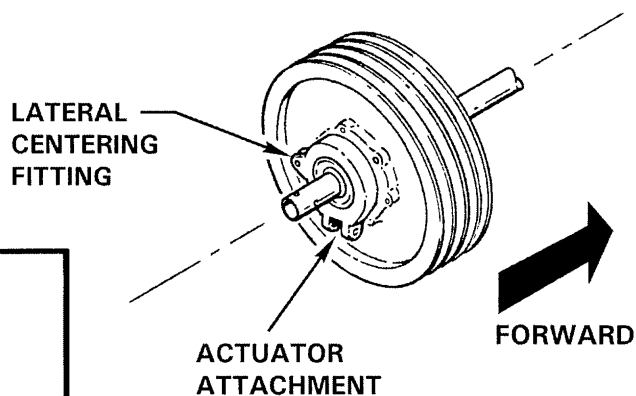
**INSTALLING A184 BEARING USING  
MT303-19 BEARING PRESSING TOOL**



**WARNING**

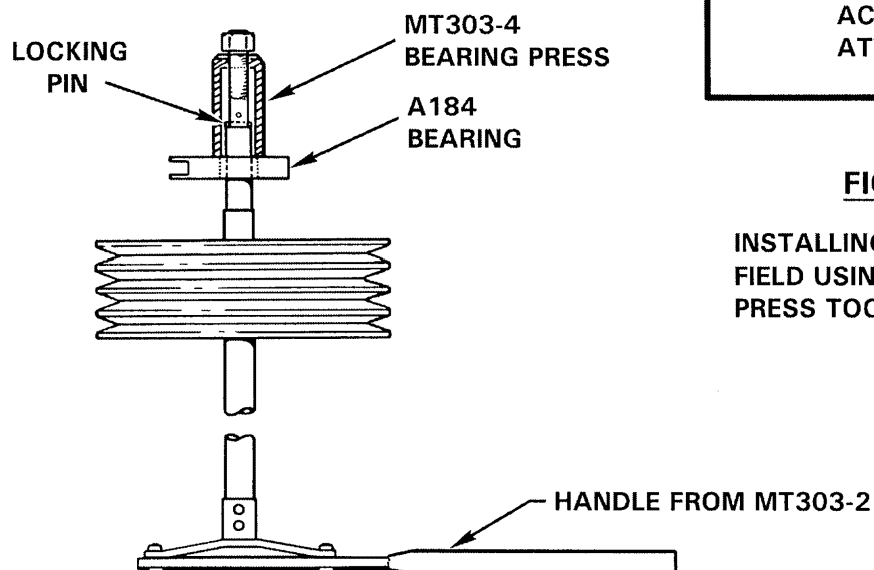
Do not press across sheave or  
bearings will be damaged.

**FIGURE 7-3F**



**FIGURE 7-3G**

**INSTALLING A184 BEARING IN THE  
FIELD USING MT303-4 BEARING  
PRESS TOOL**



### 7.220 Clutch Assembly Installation

1. If removed, install A195 and/or A907 yokes per §§ 7.260 & 7.270.
2. If removed, connect clutch lateral centering strut to A184 bearing assembly and standard torque fasteners per § 23-32.
3. Ensure actuator is fully disengaged.
4. Identify type (deep-groove or shallow-groove) of upper and lower sheaves. Refer to Figures 7-3D & 2-11.

#### **CAUTION**

RHC does not recommend using A170-1 or -2 Revision N or prior upper sheaves with A493-1 Revision T or later lower sheaves. Such combinations may cause excessive drive belt vibration.

5. Install clutch assembly and pull belts over clutch aft yoke. Install belts in proper fore/aft order with proper direction of rotation.
6. Attach clutch assembly to clutch actuator. Standard torque fasteners per § 23-32.
7. Install A947-1 flex plate. Standard torque fasteners per § 23-32.

#### **WARNING**

**A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, flex plate is unairworthy and cannot be repaired. A947-1 flex plate must be marked with letter "E" (or subsequent letter) on two adjacent arms.**

8. Connect clutch lateral centering strut from clutch assembly to upper frame. Standard torque fasteners per § 23-32.
9. Check clutch sheave alignment per § 7.230 and adjust as required.
10. Install A947-2 intermediate flex plate per § 7.330.
11. Adjust actuator down-limit stop screw (see Figure 7-15) for V-belt deflection shown in Figure 7-7A.
12. Perform run-up per § 2.210. Adjust actuator down-limit stop screw as required and tighten down-limit stop screw jam nut.
13. Torque stripe fasteners per Figure 2-1.

### 7.230 Clutch Sheave Alignment

1. Check engine shimming installation limits per § 6.130. Ring-gear-to-frame dimension must be within specified limits before sheave alignment is checked.
2. Engage clutch (fan and scroll must be installed).
3. Check clutch shaft angle per § 7.240.
4. Hold MT331-4 sheave alignment bar against aft face of lower sheave extending bar upward to horizontal center line of clutch assembly upper sheave.
5. Measure left and right gaps per Figure 7-5. Both gaps must be within noted limits and left gap must be 0.010–0.030 inch larger than right gap. If left gap is not 0.010–0.030 inch larger than right gap, adjust clutch lateral centering per § 7.250 or adjust engine shims.

If either gap exceeds maximum limit, clutch assembly is too far forward or engine is too far aft. Engine may be moved forward by removing an equal amount of shims from each engine mount, subject to § 6.130 minimum shim requirement. Alternatively, the clutch assembly may be moved aft by shimming at forward flex plate and/or adjusting A907 yoke length. Shimming is accomplished by installing a maximum of one AN960-516L washer between A947-1 flex plate and both arms of A907 and/or A908 yoke; AN960-516L washers installed on either yoke will decrease right and left gaps an amount equal to the washer's thickness. A907-4 and -5 yokes each have two sets of mounting holes which change effective yoke length by 0.120 inch. A907-5 yoke is 0.120 inch or 0.240 inch longer than long position of A907-4 yoke, depending on mounting holes used. Right and left gaps will decrease by 0.120 inch with each 0.120 inch increase in A907 yoke length.

If either gap is smaller than minimum limit, clutch assembly is too far aft or engine is too far forward. Engine may be moved aft by adding an equal amount of shims to each engine mount, subject to § 6.130 maximum shim allowance. Alternatively, clutch assembly may be moved forward by removing shims (if installed) at forward flex plate and/or adjusting A907 yoke length. Removing AN960-516L washers from between A947-1 flex plate and both arms of A907 and/or A908 yoke will increase both gaps an amount equal to washer's thickness. A907-4 and -5 yokes each have two sets of mounting holes which change effective yoke length by 0.120 inch. A907-4 yoke is 0.120 inch or 0.240 inch shorter than short position of A907-5 yoke, depending on mounting holes used. Right and left gaps will each increase by 0.120 inch with each 0.120 inch decrease in A907 yoke length.

#### **CAUTION**

Disengage clutch prior to shimming A947-1 flex plate.

A907-4 yoke replaces A907-1 and -2 yokes. A907-5 yoke replaces A907-3 yoke and includes an additional set of mounting holes.

## 7.230 Clutch Sheave Alignment (continued)

6. Check intermediate flex plate shimming per § 7.330 if shims were added or removed at A947-1 flex plate or if A907 yoke position changed.
7. Adjust V-belt guide per Figure 7-8A.
8. Check throttle correlation rigging per § 10.150 and adjust as required.

## NOTE

Shortening clutch lateral centering strut simultaneously increases left gap and decreases right gap. Lengthening clutch lateral centering strut decreases left gap and increases right gap.

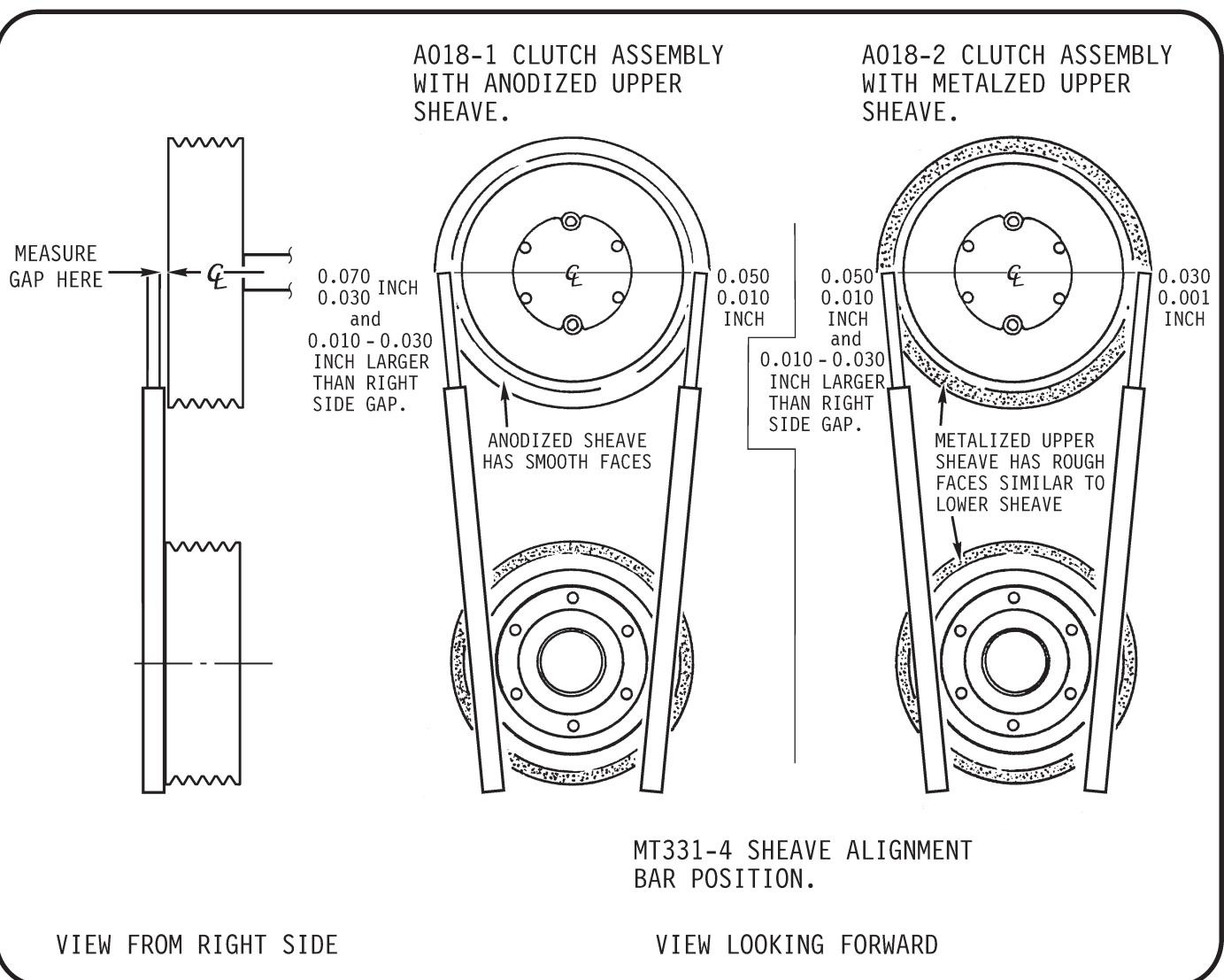


FIGURE 7-5 SHEAVE ALIGNMENT

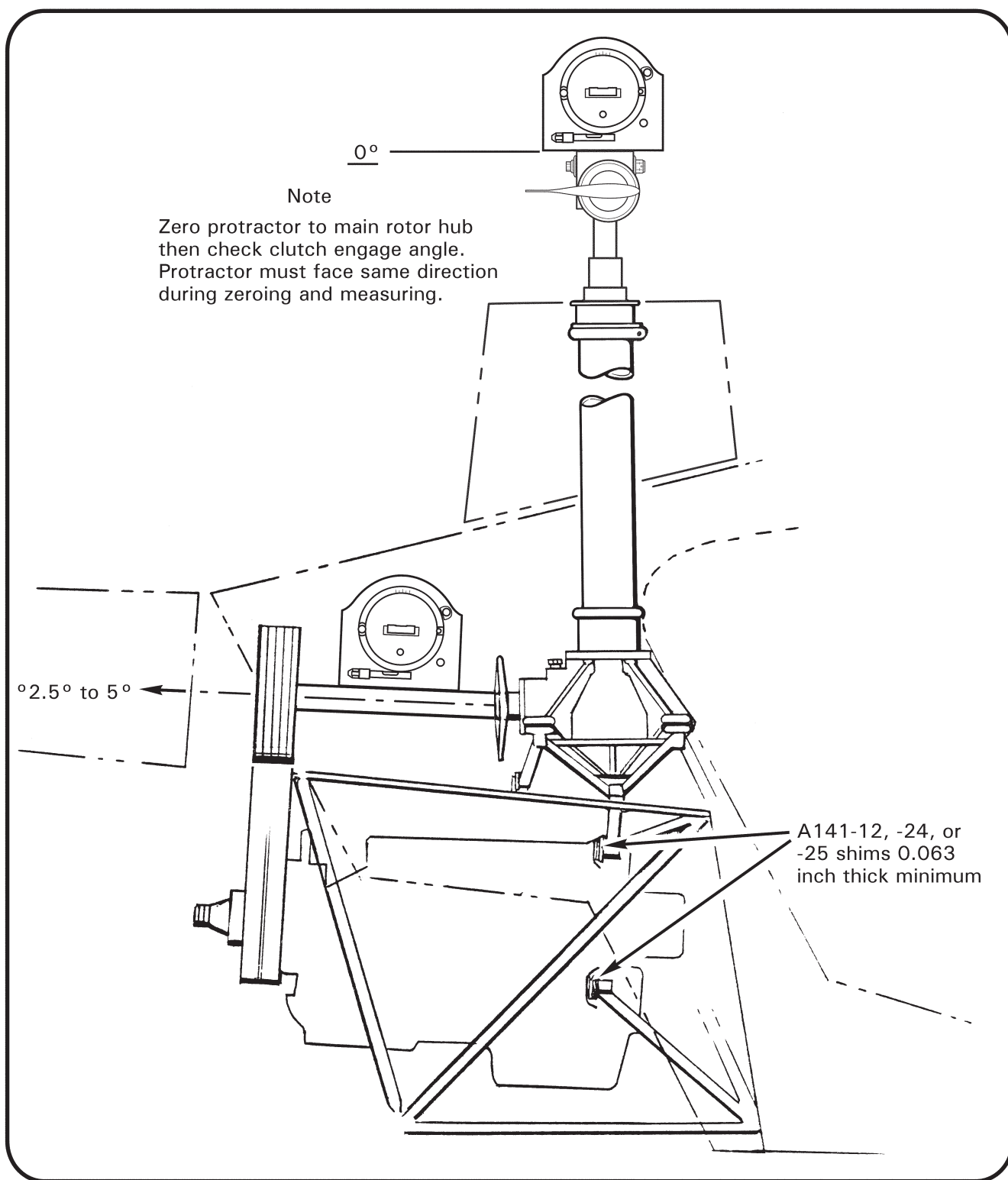


FIGURE 7-6 MEASURING CLUTCH SHAFT ANGLE



### 7.240 Clutch Shaft Angle

Verify correct engine shimming per § 6.130 prior to checking clutch shaft angle.

1. See Figure 7-6. Orient main rotor blades perpendicular to centerline of helicopter. Position protractor atop main rotor hub facing right side of helicopter as shown. Zero protractor to main rotor hub.
2. Turn master switch on and engage clutch. Check angle of clutch shaft per Figure 7-6.
3. Clutch shaft angle limits with clutch engaged are 2.5 to 5.0 degrees.

Flex plate has zero vertical misalignment when angle is 3.5 degrees. If clutch shaft angle is not within limits, drive V-belts must be replaced.

### 7.250 Clutch Lateral Centering

1. Clutch actuator fully engaged.
2. Check sheave alignment on left and right side per Figure 7-5.
3. To facilitate sheave alignment, left gap should be 0.010 to 0.030 inch larger than right gap. Clutch lateral centering strut may be adjusted (with clutch engaged) to obtain gap differential provided following clearances are met:
  - a. Minimum 0.030 inch between clutch actuator motor and upper frame tube.
  - b. Minimum 0.150 inch between V-belts and right side frame guard (actuator engaged).
4. If alignment cannot be adjusted within required measurements, contact Robinson Helicopter Company Technical Support.
5. Standard torque attach bolts and jam nuts per § 23-32.

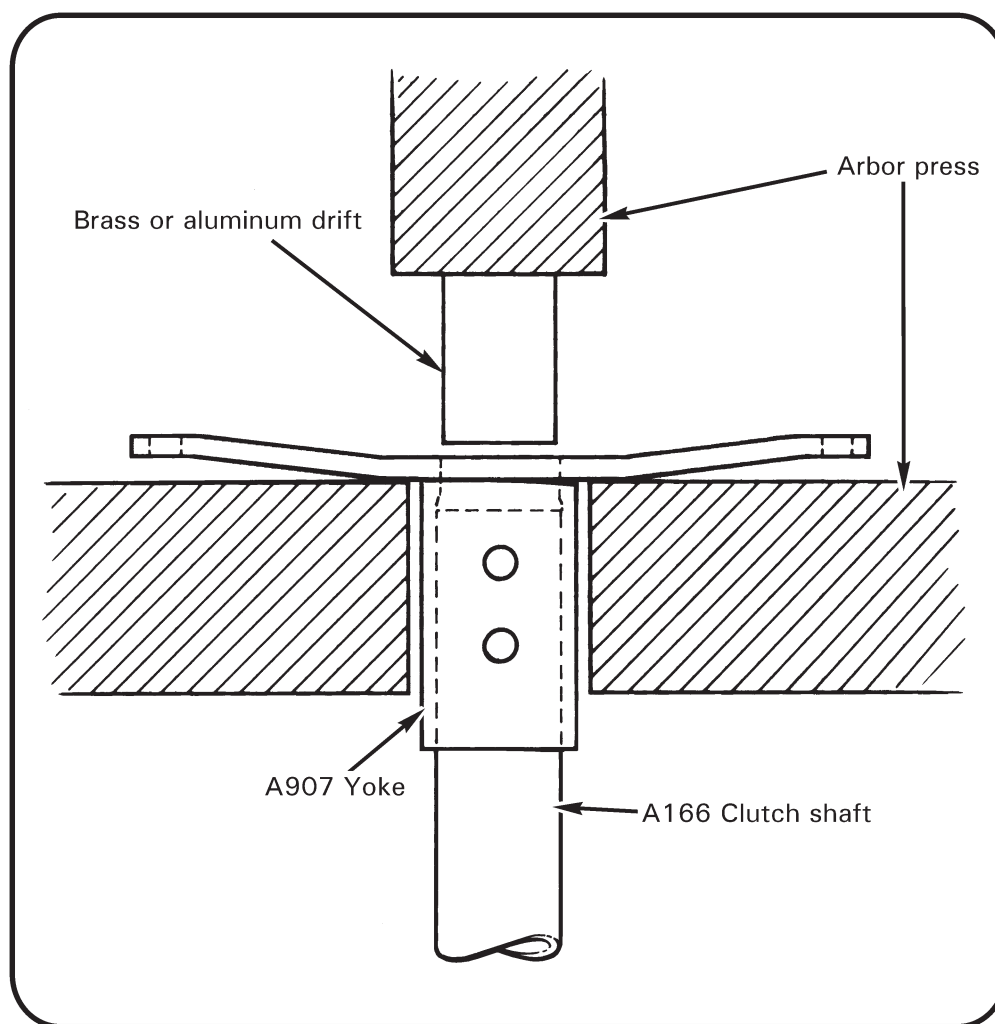


FIGURE 7-6A A907 YOKE REMOVAL

### 7.260 A907 Yoke Removal and Installation

To remove yoke:

1. Remove clutch assembly per § 7.210.
2. Remove bolts and clamping blocks securing A907 yoke to clutch shaft. Mark which set of yoke attachment holes are used.
3. Remove A907 yoke:
  - a. (Preferred method) If a press is available, position clutch assembly in press per Figure 7-6A. Ensure brass or aluminum drift fits against outer rim of clutch shaft and not against inner spacer. Press clutch shaft out of yoke.

**CAUTION**

Ensure clutch assembly does not fall when yoke is removed.

- b. If a press is not available, apply penetrating oil to yoke-shaft juncture. Gently clamp A907 yoke in a padded vise per Figure 7-6B. Twist clutch shaft out of yoke by turning upper sheave. If difficulty is encountered, discontinue attempt and arrange use of press as described in preceding step.

**CAUTION**

Avoid bending loads on clutch shaft when A907 yoke is clamped in vise as yoke can be damaged.

To install yoke:

1. Remove paint from and clean mating area on clutch shaft.
2. Remove paint from A907 yoke bore, from A907 yoke exterior at clamping block attachment areas, and from clamping surfaces of clamping blocks.
3. Coat A907 yoke bore and mating portion of clutch shaft with approved primer (chromate primer preferred; refer to § 23-75). While primer is still wet, install yoke on clutch shaft and align marked holes on yoke (if applicable) with clutch shaft holes.

**CAUTION**

Use only specified primers to install yoke; do not use any other lubricants.

4. While yoke primer is still wet, secure yoke to shaft with clamping blocks coated with approved primer and bolts. Standard torque bolts per § 23-32. Install palnuts and standard torque per § 23-32.
  5. Clean all exposed bare metal fasteners and joints, and prime with approved primer. Ensure formation of primer fillets at all joints for sealing out moisture.
  6. Torque stripe fasteners.

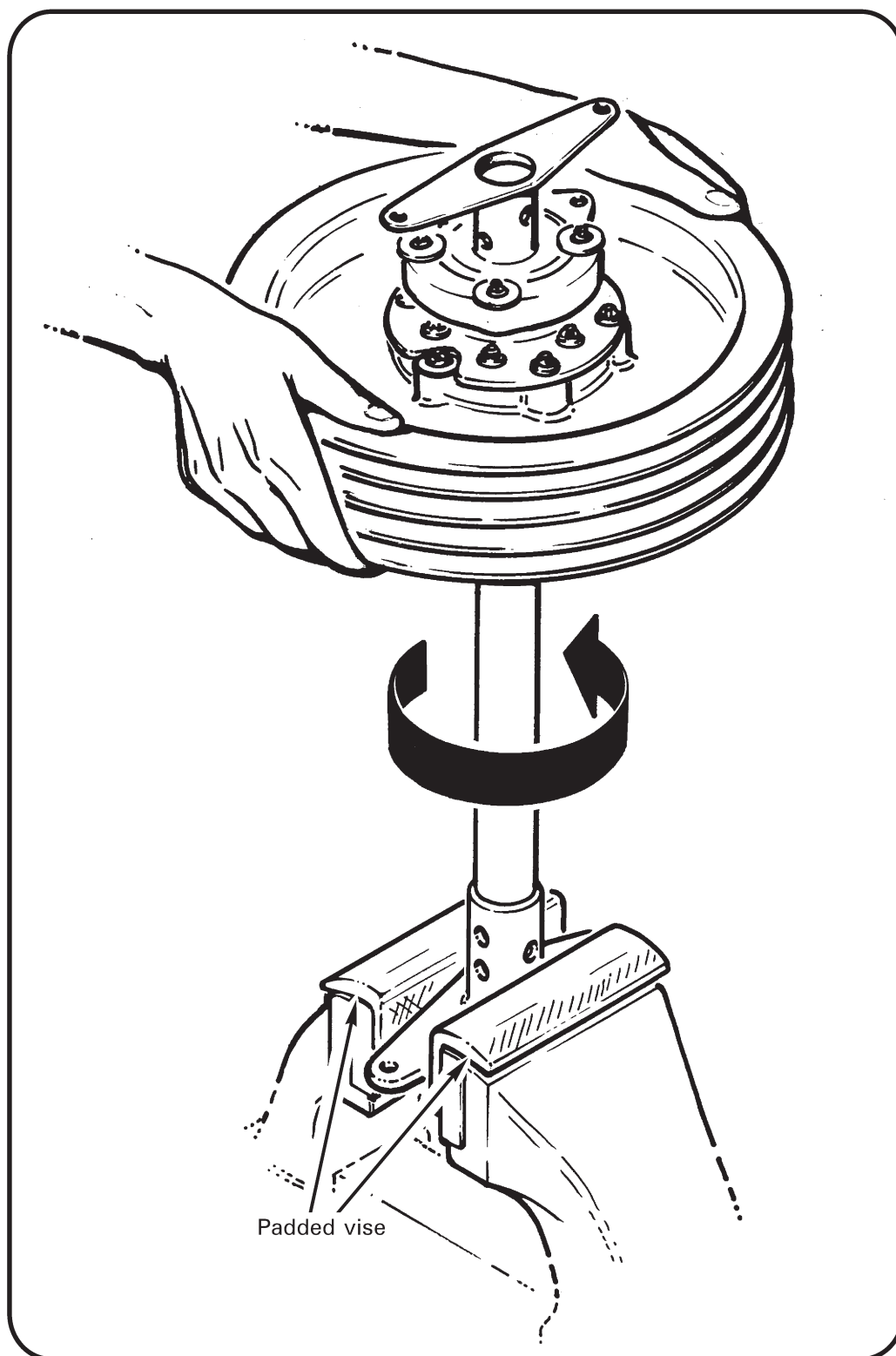


FIGURE 7-6B A907 YOKE REMOVAL

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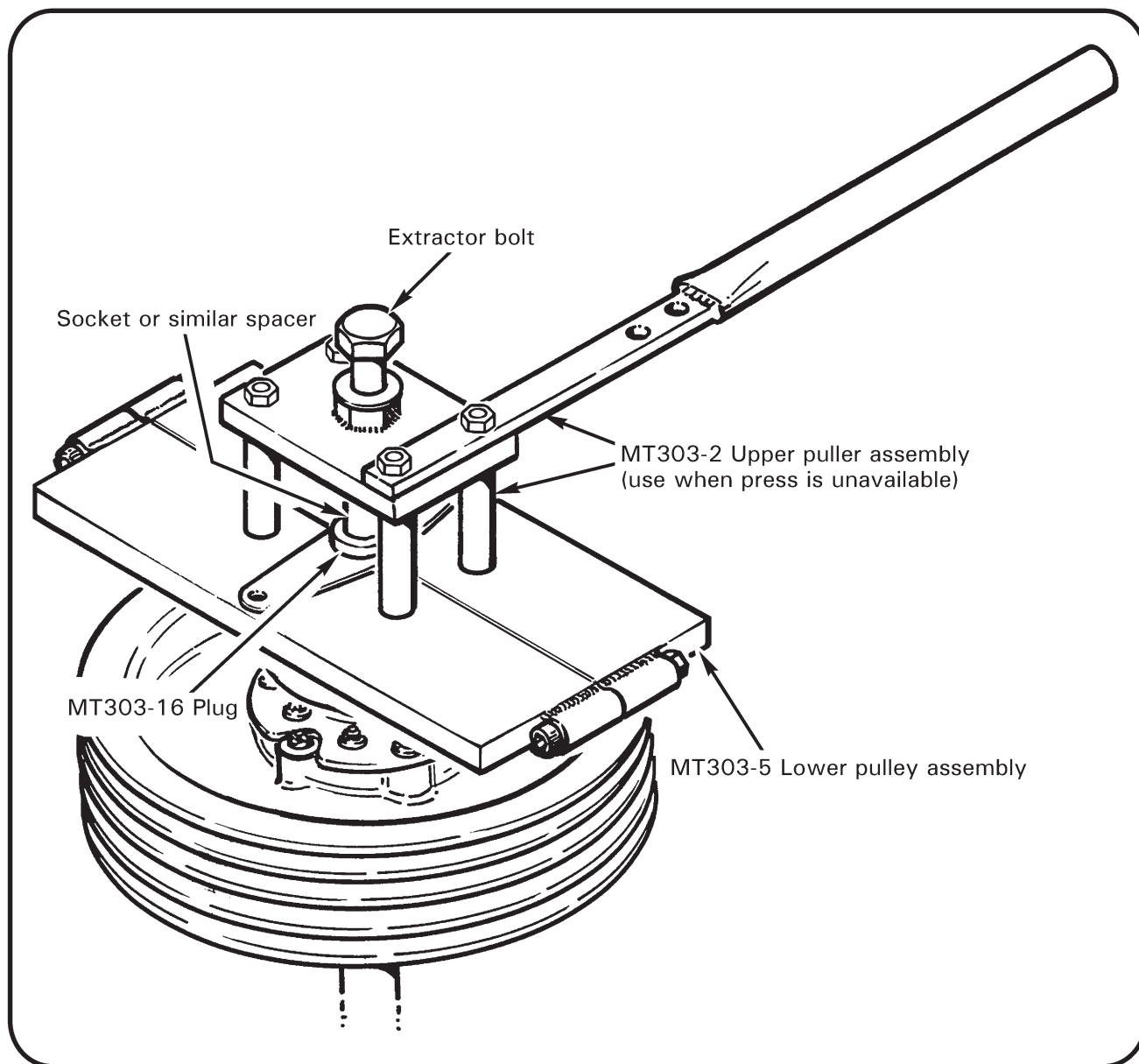


FIGURE 7-6C A195 YOKE REMOVAL

### 7.270 A195 Yoke Removal and Installation

1. Remove clutch assembly per § 7.210.
2. Remove bolts and clamping blocks securing A195 yoke to clutch shaft.

**CAUTION**

A195 yoke arms are easily bent. Exercise care when removing or installing yoke. Always remove A195 yoke when shipping or transporting clutch assembly.

3. Remove A195 yoke:
  - a. If a press is available, assemble MT303-5 lower puller assembly around clutch shaft between A184 bearing and A195 yoke. Flat face of puller must be towards yoke. Refer to Figure 7-6C. Insert MT303-16 plug thru A195 yoke bore into clutch shaft and press shaft out of yoke.
  - b. If a press is not available, assemble MT303-5 lower puller assembly with MT303-2 upper puller assembly per Figure 7-6C. Flat face of puller must be towards yoke. Insert MT303-16 plug thru A195 yoke bore into clutch shaft. Place a deep socket (or similar) between MT303-16 plug and extractor bolt. Tighten bolt and remove A195 yoke.

To install yoke:

1. Remove paint from and clean mating area on shaft.
2. Remove paint from A195 yoke bore, from A195 yoke exterior at clamping block attachment areas, and clamping surfaces of clamping blocks.
3. Coat inside of A195 yoke and mating portion of clutch shaft with approved primer (chromate primer preferred; refer to § 23-75). While primer is still wet, slide A195 yoke onto clutch shaft and align mounting holes.
4. While yoke primer is still wet, secure yoke to shaft with clamping blocks coated with approved primer (chromate primer preferred) and bolts. Standard torque bolts per § 23-32. Install palnuts and standard torque per § 23-32.
5. Clean all exposed bare metal fasteners and joints, and prime with approved primer (chromate primer preferred). Ensure formation of primer fillets at all joints for sealing out moisture.
6. Torque stripe fasteners.

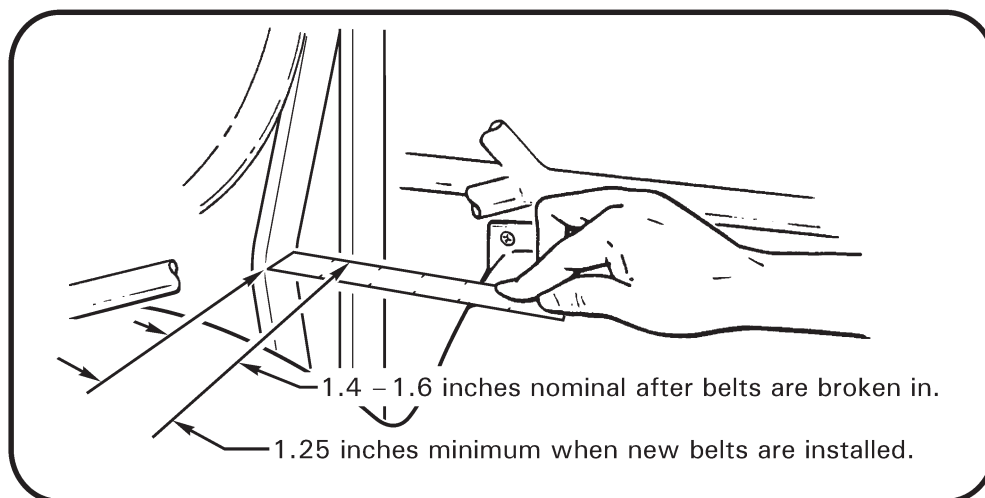


FIGURE 7-7A V-BELT DEFLECTION (ACTUATOR DISENGAGED)

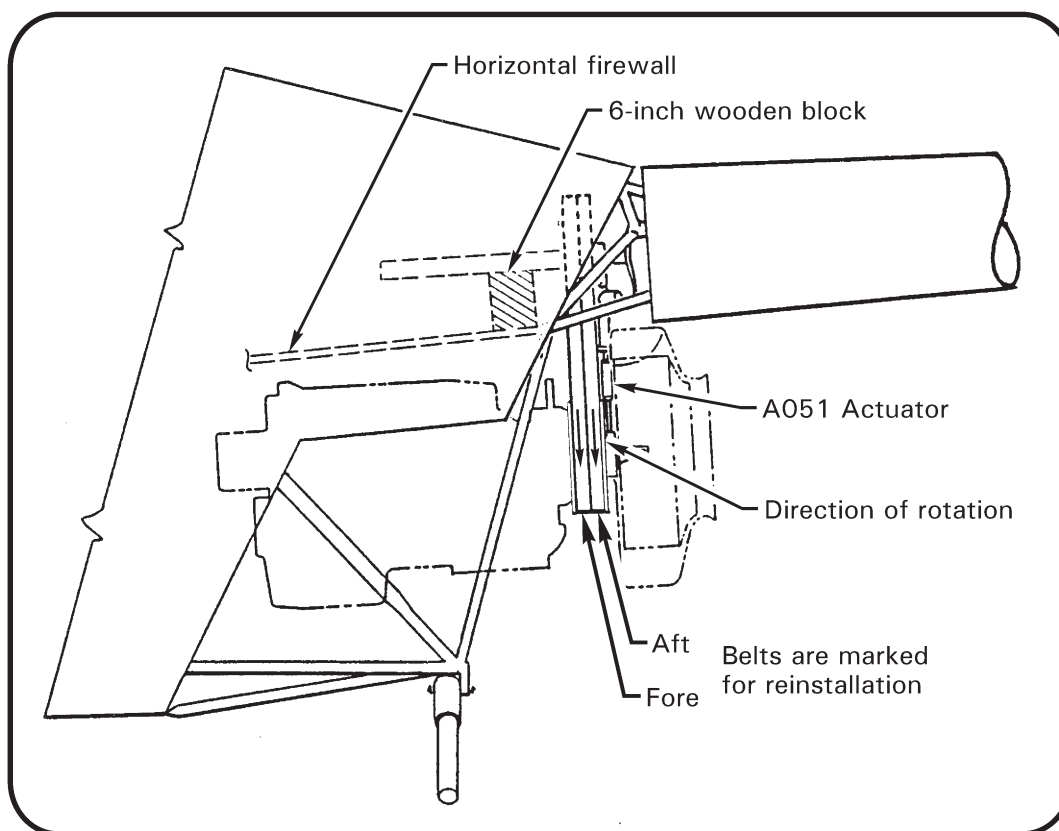


FIGURE 7-8 V-BELT AND ACTUATOR REMOVAL



## 7.280 V-Belts

### 7.281 V-Belt Removal

- a. Remove fanwheel per § 6.210.
- b. Fully disengage belt tension actuator. Place a six-inch wooden block between clutch shaft and horizontal firewall per Figure 7-8. Block will prevent excessive sheave drop and protect forward flex plate.
- c. Disconnect clutch lateral centering strut from upper frame and remove intermediate flex plate.
- d. Mark drive belts for “fore” and “aft” position and direction of rotation if they will be reinstalled.

#### **CAUTION**

Used belts must be reinstalled in proper order due to individual differences in belt stretch.

- e. Loosen belt guide and position guide to remove v-belts.
- f. Disconnect actuator wiring.
- g. Remove belts from sheave and pull over aft yoke.

### 7.282 V-Belt Installation

1. Evaluate alternator belt(s) condition and replace as required.
2. Inspect upper and lower actuator bearings per §§ 2.502 & 2.503 (lubricate as required).
3. Identify type (deep-groove or shallow-groove) of upper and lower sheaves. Refer to Figures 7-3D & 2-11.

#### **CAUTION**

RHC does not recommend using A170-1 or -2 Revision N or prior upper sheaves with A493-1 Revision T or later lower sheaves. Such combinations may cause excessive drive belt vibration.

4. Inspect both sheaves. Replace any sheave showing corrosion, pitting or flaking of the metalized or anodized coatings, wear through anodized coating, grooves, roughness, or sharp ridges.

#### **CAUTION**

Rough or corroded grooves in the upper or lower sheave can cause V-belts to roll, break, or come off.

7.282 V-Belt Installation (continued)

5. Paint lower sheave grooves with a thin coating of approved primer (chromate primer preferred; refer to § 23-75). Sheave may be primed without removal by using an aerosol can or air brush.
6. Inspect belts per § 2.507.
7. Install belts on sheaves. Ensure belts are installed in proper fore/aft order with proper direction of rotation.

**WARNING**

**V-belts are a matched set. Only install V -belts as matched set.**

8. Connect actuator wiring.
9. Connect lateral centering strut bolts and standard torque per § 23-32.
10. Install fanwheel and scroll per § 6.220.
11. Measure belt deflection with actuator disengaged. Using a scale and finger pressure, belts must deflect inward 1.4–1.6 inches per Figure 7-7A. Adjust actuator down-limit stop screw (see Figure 7-15) as required to obtain correct dimension. Tighten down-limit stop screw jam nut.

**CAUTION**

Belts which are too tight can damage flex plates during start and belts which are too loose can jump out of grooves during engagement.

**NOTE**

A delay of more than 5 seconds between clutch switch engagement and rotor turning indicates excessive slack. If rotor rotates when cranking engine, belts may not have enough slack. Actuator down limit screw adjustments are required more frequently with new belts.

12. Check clutch sheave alignment per § 7.230.
13. Shim and connect intermediate flex coupling per § 7.330.
14. Rotate drive train by hand with actuator disengaged. Verify minimum 0.125 inch clearance with new belts (0.25 inch after approximately 10 hours) between intermediate flex coupling and A331-1 tail rotor bellcrank-to-A121-17 push-pull tube attach bolt. If clearance less than minimum, shim engine per § 6.130.
15. Position V-belt guide to maintain clearance specified in Figure 7-8A. Standard torque attach hardware per § 23-32.

7.282 V-Belt Installation (continued)

16. If required, install protective clamp on upper frame per Figure 2-4C. |
17. Ground run or hover helicopter for at least one-half hour.
18. At end of half-hour run, inspect primer wear pattern in lower sheave grooves. A similar wear pattern in all four grooves indicates compatible belt/sheave combination. A noticeably different wear pattern from groove to groove indicates combination is not compatible. Refer to § 2.508 for allowable wear pattern limits.
19. If belt/sheave combination is not compatible, re-check sheave alignment, replace belts, and repeat installation procedure. If belt/sheave combination is still not compatible, it may be necessary to replace lower sheave. Wear pattern in all four grooves must be similar before aircraft is released for flight.
20. Check clutch shaft angle per § 7.240.

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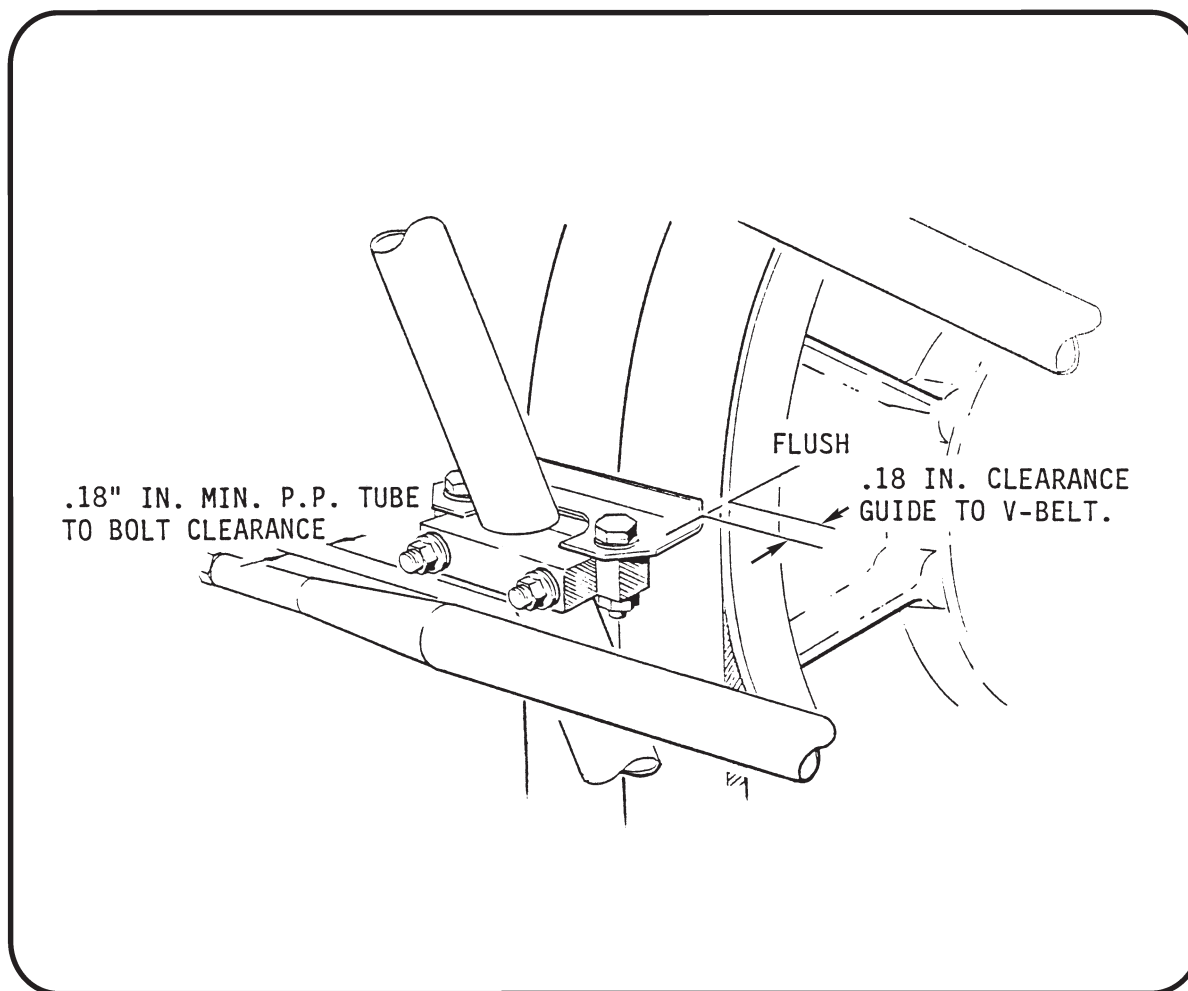


FIGURE 7-8A V-BELT GUIDE

7.282 V-Belt Installation (continued)

**CAUTION**

Position guide to 0.18 inch clearance with clutch engaged. Guide to be flushed with front face of sheave. Maintain 0.18 inch clearance between P/P tube and guide attach bolts.

**NOTE**

A020-2 upper frame S/N 0501 and subsequent have guide bracket welded to frame.

### 7.290 A007-3 & -5 Fanshaft and Bearing Assembly, Starter Ring Gear Support, Lower Sheave and Alternator Belt Replacement

#### 7.291 Removal

- a. Remove fanwheel and fiberglass scroll per § 6.210.

#### NOTE

Fanwheel and fiberglass scroll may be removed without splitting scroll.

- b. Support clutch shaft assembly at horizontal firewall with a wooden block. Remove lower bolt connecting belt tension actuator to A181-4 lower bearing assembly.
- c. Label drive belts (forward & aft) for reinstallation.
- d. Cut safety wire and remove bolts and washers.
- e. Remove A007-3 or -5 fanshaft and bearing assembly. Temporarily secure lower sheave if it is not to be removed.
- f. To remove lower sheave, tap it with a soft mallet while pulling.
- g. Removal of starter ring gear support is required to change alternator belt or gain access to engine nose section.
  1. Loosen alternator belt tension.
  2. Note "O" mark on the starter ring gear support at one crankshaft flange bushing. Mark this bushing to ease reinstallation.
  3. Remove starter ring gear support.

#### 7.292 Installation

- a. Install new and spare alternator belts if required. Install starter ring gear support. Align "O" mark on ring gear support with marked bushing. Bushing and hole marked "O" are slightly larger than other five holes.
- b. Install lower sheave and fanshaft assembly. Install (6) NAS6606H23 bolts and (6) NAS1149F0632P washers, or (6) NAS6606H24 bolts, (6) NAS1149F0632P washers, and (6) NAS1149F0663P washers (washer positions optional), as required. Special torque bolts per § 23-33 in a crossing pattern. Safety wire bolts in pairs with 0.041 inch diameter stainless steel safety wire.

7.290 A007-3 & -5 Fanshaft and Bearing Assembly, Starter Ring Gear Support,  
Lower Sheave and Alternator Belt Replacement (cont'd)

7.292 Installation (cont'd)

**CAUTION**

RHC does not recommend using A170-1 or -2 Revision N or prior upper sheaves with A493-1 Revision T or later lower sheaves. Such combinations may cause excessive drive belt vibration. Refer to Figures 2-9 and 7-38.

- c) Place drive belts in correct forward and aft order on upper and lower sheaves. Install lower bolt connecting belt tension actuator to lower actuator bearing assembly, and torque per Section 1.320.
- d) Install fanwheel per Section 6.220.
- e) Remove wooden block supporting clutch assembly. Adjust alternator belt tension per Lycoming Service Instruction 1129 (current revision).

**WARNING**

Bearings in A007-3 and A007-5 fanshaft bearing assemblies have internal clearance modified by RHC. **DO NOT** **SUBSTITUTE** any other bearing.

### 7.300 TAIL ROTOR DRIVESHAFT

#### 7.310 Tail Rotor Driveshaft Removal

- a) Disconnect the tail rotor shaft at the intermediate flexplate. Leave the flexplate connected to the aft clutch yoke. Use 4-inch block under the driveshaft near the forward end to support the driveshaft in the tailcone. This prevents damage to the aft flexplate.
- b) Remove the tailcone per Section 4.311.
- c) Use a 3-foot socket extension with a 3/8-inch socket to disconnect the two NAS1303 bolts which hold the driveshaft to its mounting bracket.
- d) Disconnect tail rotor push-pull tube from tail rotor gearbox bellcrank arm. If push-pull tube length is not changed, rerigging is not required.
- e) Remove the four bolts (one NAS1304-8, three MS20074-04-06) that hold the tail rotor gearbox to the tailcone casting. Hold the forward end of the driveshaft while the gearbox is pulled out of the tailcone casting far enough to allow removal of the flex coupling bolts.
- f) Mark aft end of driveshaft and flexplate for reassembly. Disconnect driveshaft from flexplate, leaving flexplate connected to gearbox. Reinstall bolts, spacers and nuts on flexplate so none will be lost or misplaced.
- g) The driveshaft can now be pulled out of the forward end of the tailcone.



### 7.320 Tail Rotor Drive Shaft Installation

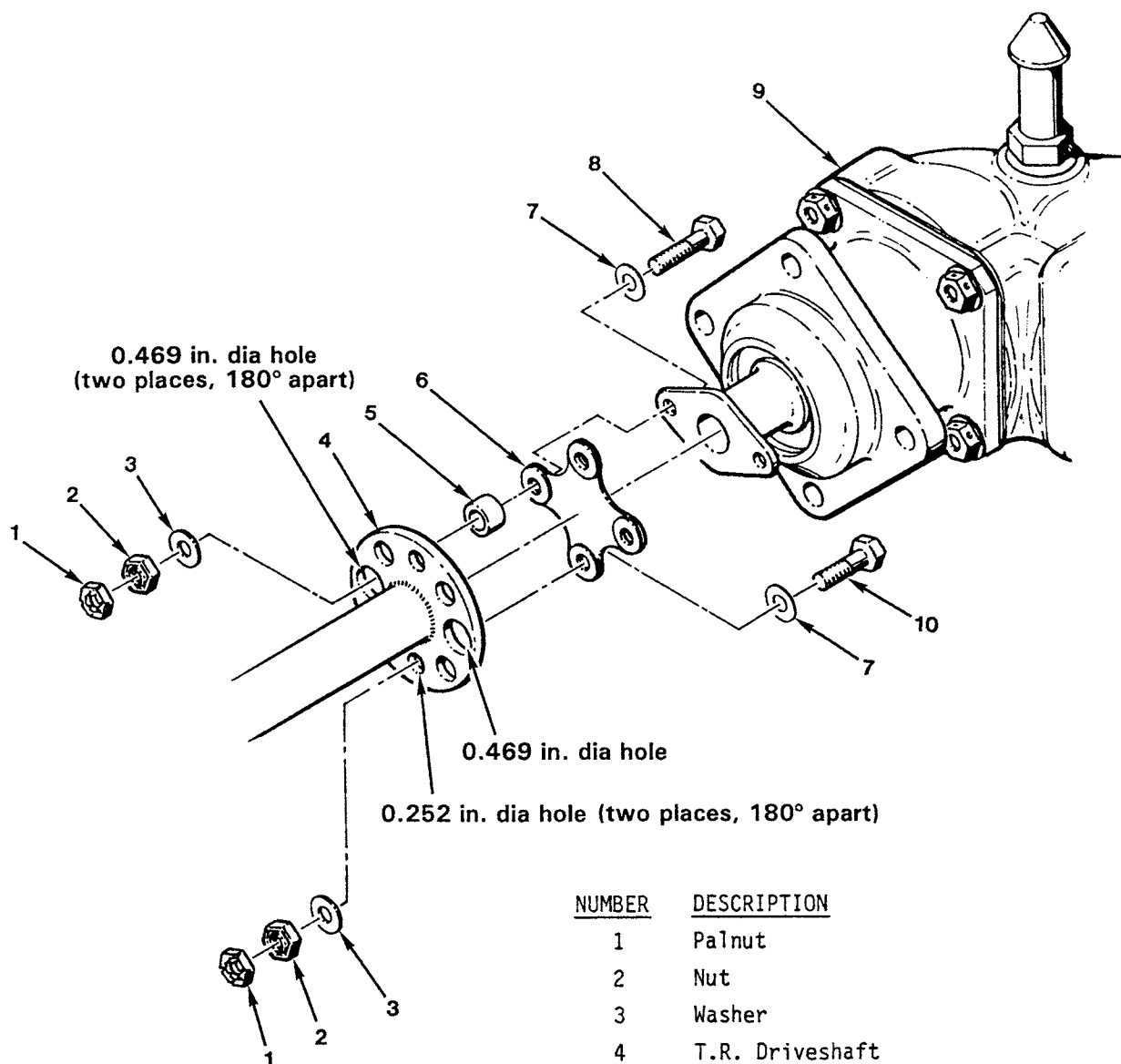
Also applies to Tail Rotor Gearbox Installation to Tailcone.

- a) Insert tail rotor drive shaft into tailcone and pull aft end of shaft through tailcone's aft casting.
- b) Reconnect flex plate to tail rotor gearbox. Bonded washers on flex plate must be directly against flange of gearbox input shaft. Torque NAS1304 bolts per Section 1.320. (See Figure 7-9)

#### **CAUTION**

Improper installation of flex plate can damage tail rotor drive shaft and gearbox.

- c) Support forward end of drive shaft and push flex coupling forward through aft casting.
- d) Reconnect the four bolts that hold the gearbox to the casting. Torque NAS1304 bolt per Section 1.320. Torque the MS20074-04-06 bolts per Section 1.330 and safety with 0.032 inch diameter safety wire.
- e) Connect damper assembly to tailcone frame and torque attach bolts per Section 1.320. Through inspection holes on side of tailcone, determine longitudinal alignment of damper clip (or arm) with tailcone's attachment bracket. If clearance or interference between clip (or arm) and bracket is greater than 0.12 inch, contact RHC Technical Support. Ensure damper is oriented per Figure 7-11B.
- f) Install tailcone per Section 4.312.
- g) Connect the A121-17 aft push-pull tube and torque fastener per Section 1.320.
- h) Install and shim intermediate flex plate per Section 7.330.
- i) Perform tail rotor drive shaft run-out check per Section 7.340.



**FIGURE 7-9**  
**AFT FLEXPLATE INSTALLATION**

NUMBER	DESCRIPTION
1	Pin nut
2	Nut
3	Washer
4	T.R. Driveshaft
5	Spacer
6	Flexplate
7	Washer
8	Bolt
9	T.R. Gearbox Assy.
10	Bolt

\*A197 T.R. Driveshaft no longer available. See R22 Parts Catalog for replacement with proper B224-1 T.R. Driveshaft and B223 Yoke combination.

## 7.321 Adjustment of Damper Friction

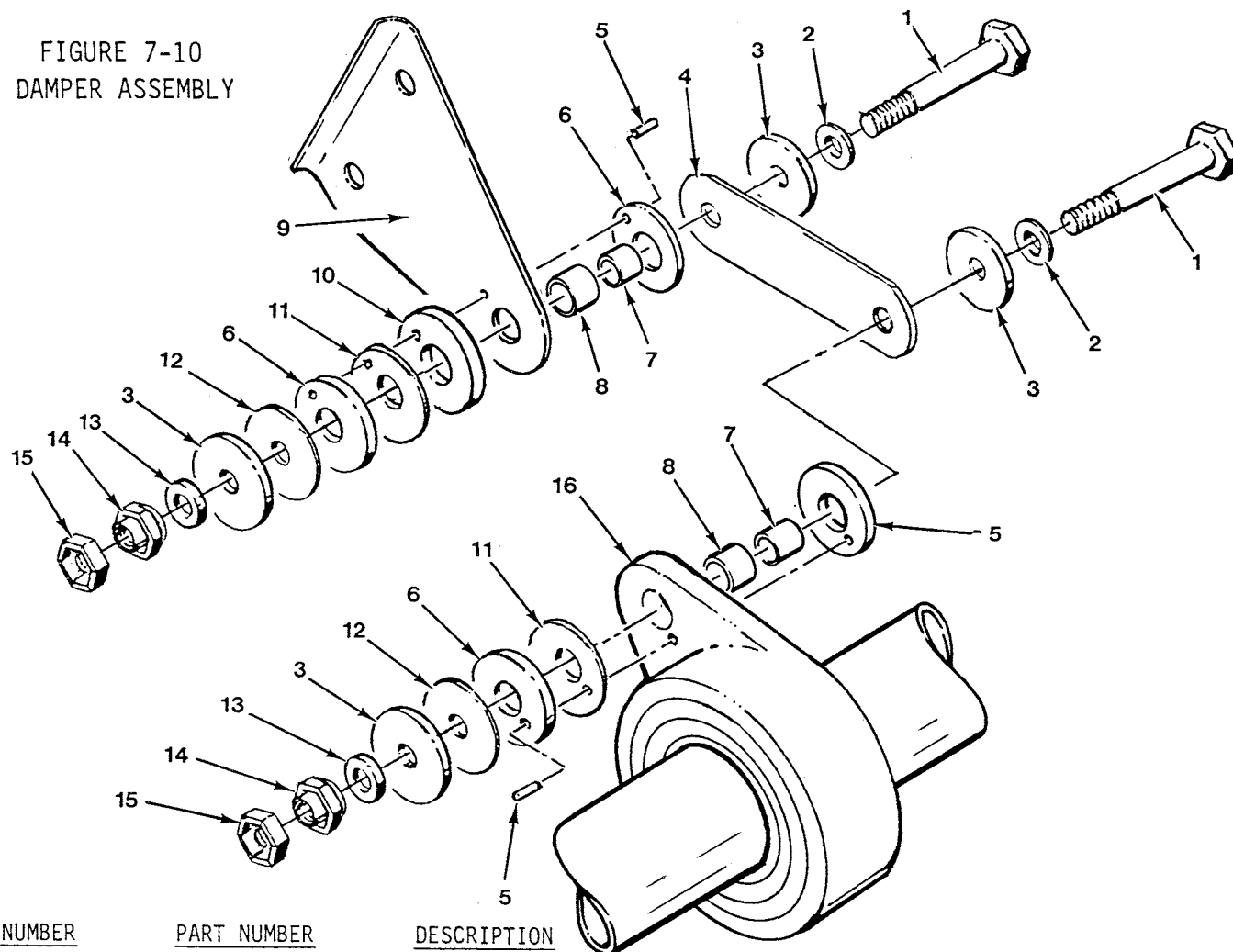
- a) Remove tail rotor drive shaft from tailcone per Section 7.310.
- b) Disassemble damper per Figure 7-10 or Figure 7-10A, as applicable.
- c) Inspect the following parts for wear and replace worn parts:
  1. Inspect A041-5 DU washers for worn Teflon® coating (dark gray face).
  2. Inspect A141-15 washers and A041-3 arm for indications of wear or grooving.
- d) Assemble damper per Figure 7-10 or Figure 7-10A, as applicable. Install spring washers with concave face toward A041-5 DU washers.

## CAUTION

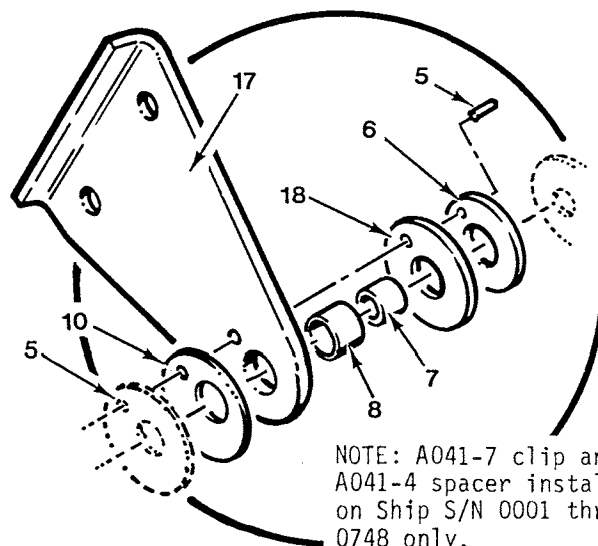
The Teflon® (dark gray) face of the A041-5 DU washer must be placed against the A141-36 washer or A041-3 arm. Remove plastic or tape coating, if installed.

- e) Torque nuts per Section 1.320.
- f) Using a spring scale or dead weight, measure pivot frictions per Figure 7-11A. If friction is less than specified, bend A041-6 spring washer until it has a  $0.070 \pm 0.010$  inch total height. If spring washer height is within limits but friction is still too low, lap metal from end of A105-9 journal. If friction is greater than specified, flatten A041-6 spring washer slightly or replace A105-9 journal.

FIGURE 7-10  
DAMPER ASSEMBLY



NUMBER	PART NUMBER	DESCRIPTION
1	NAS6603-8	Bolt
2	AN960-10L	Washer
3	A141-18	Washer
4	A041-3	Arm
5	A041-10	Dowel Pin
6	A041-5	DU Washer
7	A105-9	Journal
8	04DU04	Bushing
9	A041-8	Clip
10	A041-9	Spacer
11	A041-6	Spring Washer
12	A041-15	Washer
13	AN960-10	Washer
14	NAS679A3	Nut
15	B330-7	Palnut
16	A041-11	Bearing Assembly
17	A041-7*	Clip
18	A041-4*	Spacer



NOTE: A041-7 clip and A041-4 spacer installed on Ship S/N 0001 thru 0748 only.

\*No longer available. Order A041-9 spacer along with A041-8 clip for replacement.

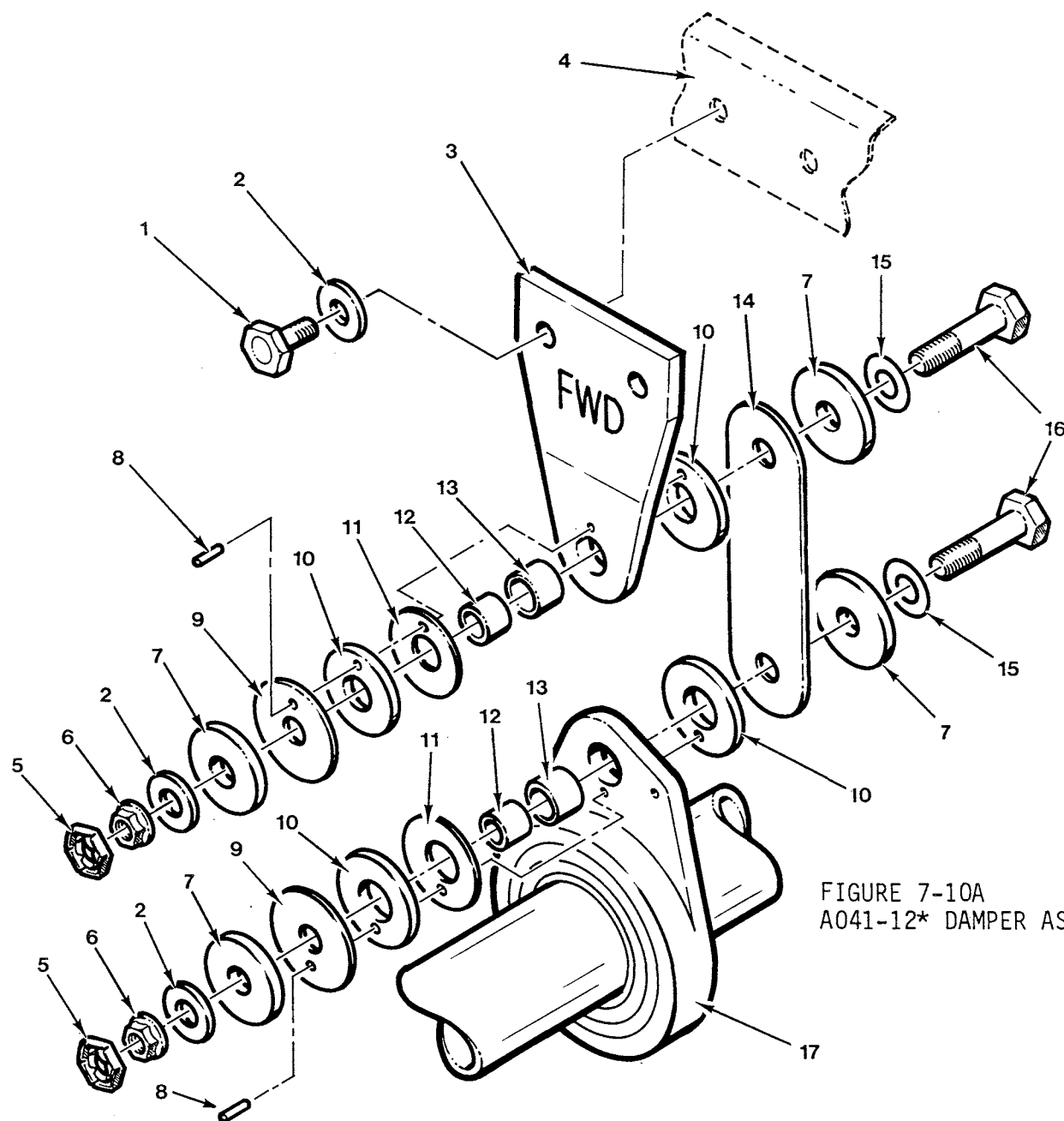


FIGURE 7-10A  
A041-12\* DAMPER ASSEMBLY

NUMBER	PART NUMBER	DESCRIPTION	NUMBER	PART NUMBER	DESCRIPTION
1.	NAS6603-3	Bolt	11	A041-6	Spring Washer
2	AN960-10	Washer	12	A105-9	Journal
3	A041-13	Arm	13	04DU04	Bushing
4	B288-8	Support (Ref)	14	A041-3	Arm
5	B330-7	Palnut	15	AN960-10L	Washer
6	MS21042L3	Nut	16	NAS6603-8	Bolt
7	A141-18	Washer	17	A041-11	Bearing Assembly
8	A041-10	Dowel Pin	18	A041-12*	Damper Assembly (Includes items 3, and 5-17)
9	A141-15	Washer			
10	A041-5	DU Washer			

\*Ship S/N 2571 and on, and ships equipped with A023-22 or A023-23 tailcones.

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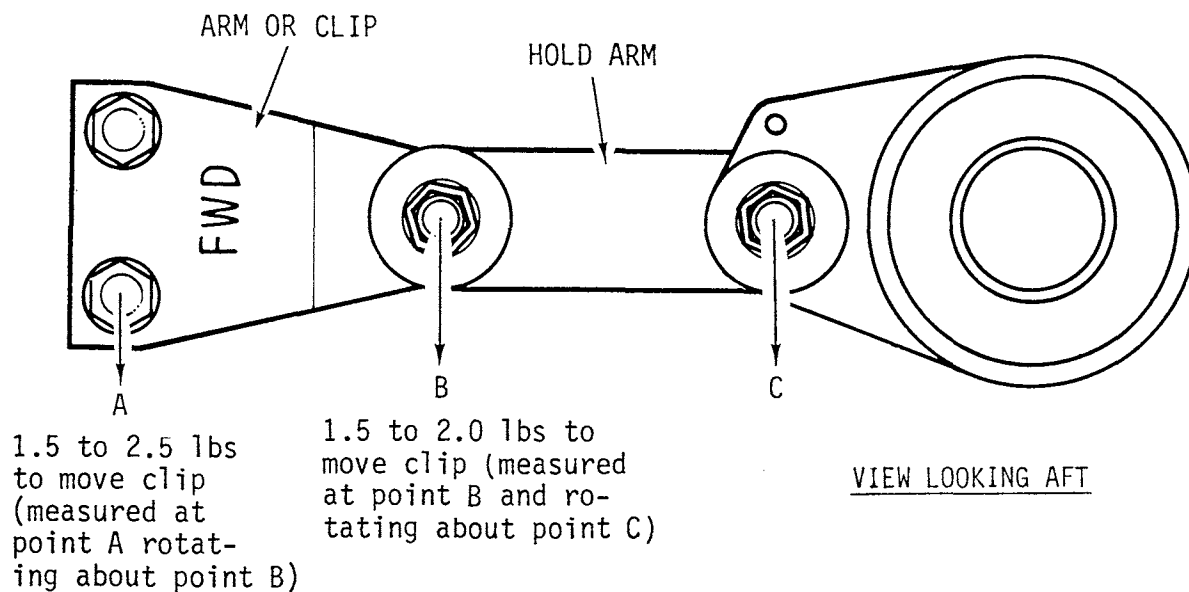


FIGURE 7-11A

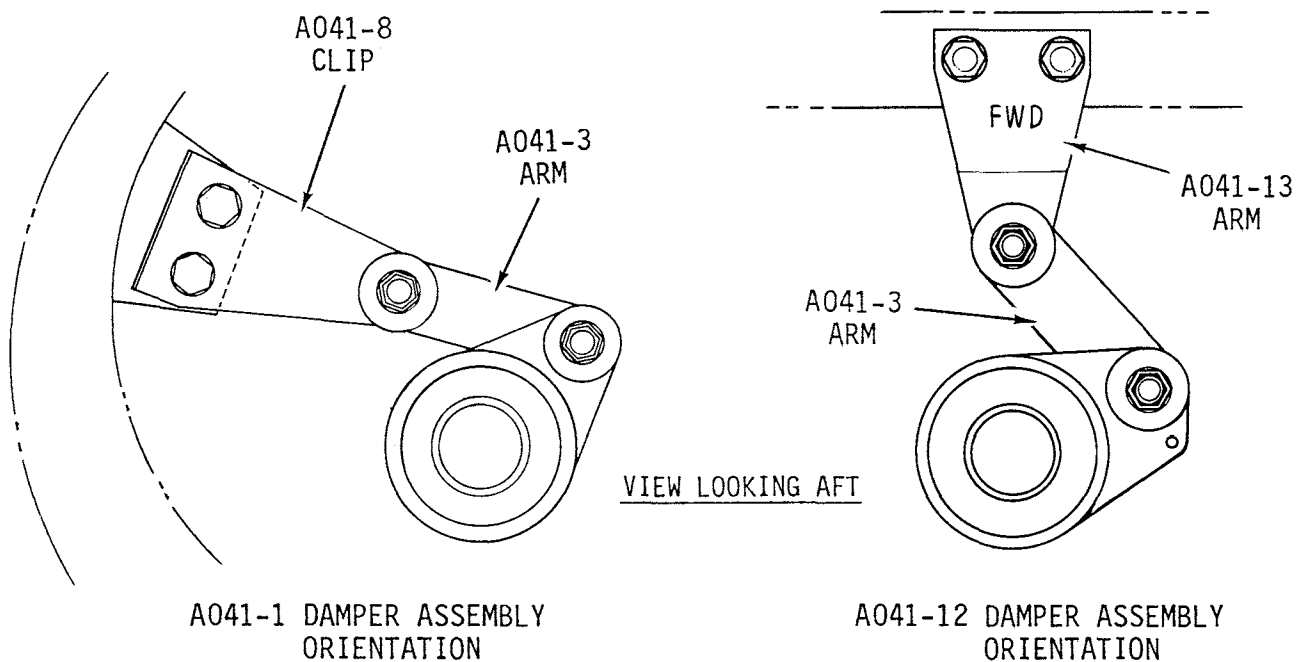


FIGURE 7-11B

**7.321 Adjustment of Damper Friction (cont'd)****CAUTION**

Do not adjust damper drag by changing bolt torque.

- f) Torque MS21042L4 nut per Section 1.320 and recheck damper drag. Install B330-13 palnut and torque stripe.
- g) Install tail rotor drive shaft per Section 7.320.

**7.330 Intermediate Flex Plate Installation and Shimming**

Measurements taken with intermediate flex plate removed.

- a) Engage clutch actuator.
- b) Rotate tail rotor drive shaft yoke and A195 yoke so yoke arms are horizontal.
- c) Insert NAS1304 bolt through tail rotor shaft yoke and A195 yoke at 9 o'clock position. Measure gap between yoke arms at 3 o'clock position.
- d) Insert bolt at 3 o'clock, remove bolt at 9 o'clock, and measure gap at 9 o'clock. Measurements in sequence c and d are measurement 1.
- e) Remove bolt and rotate tail rotor drive shaft 180 degrees. Repeat steps c) and d). This will be measurement 2.

**NOTE**

Measurement 1 and 2 should be similar. If measurements are not similar one or both yokes are bent.

- f) Record difference between 3 o'clock and 9 o'clock gaps in measurement 1 and in measurement 2. Difference between 3 o'clock and 9 o'clock gap must not exceed 0.050 inch in either measurement 1 or measurement 2. If difference exceeds 0.050 inch adjust clutch lateral centering strut length as required and align sheaves per Section 7.230.
- g) Use following formula to obtain calculated dimensions for proper intermediate flex plate shimming.



**TABLE 7-1**  
**INTERMEDIATE FLEX PLATE SHIM TABLE**

	CLUTCH SIDE	TR DRIVE SHAFT SIDE
Calculated dimension in inches from Section 7.330(g)	Shim required between A947-2 flex plate and A195-1 yoke 2 places.	Shim required between A947-2 flex plate and B223-X yoke 2 places.
0.135 or more	Remove TRGB shims or shim A947-1 flex plate** or change A907 yoke length** or install longer B223 yoke	
0.134 to 0.105	AN960-416 washer	AN960-416 washer
0.104 to 0.075	AN960-416 washer	AN960-416L washer
0.074 to 0.045	AN960-416L washer	AN960-416L washer
0.044 to 0.015	AN960-416L washer	None
0.014 to -0.015	None	None
-0.016 or greater negative number	Shim TRGB aft (max. 0.080 inch*) or remove shims at A947-1 flex plate** or change A907 yoke length** or install shorter B223 yoke	

\*When shimming tail rotor gearbox, replace MS20074-04-04 bolts with MS20074-04-06 bolts. If over 0.040 inch shims used, change washers under bolt heads to AN960-416L. Total shims must not exceed 0.080 inch. Torque bolts per Section 1.330.

\*\*Requires clutch sheave alignment check per Section 7.230.

### 7.330 Intermediate Flex Plate Installation and Shimming (cont'd)

#### NOTE

Use measurement with smaller difference between 3 and 9 o'clock gaps.

9 o'clock reading + 3 o'clock reading	=	
Divide by 2	=	
Subtract	-	*
Calculated Dimension	=	

\*Measure A947-2 flex plate thickness across bonded washers four places and average.

Shim as required per Table 7-1.

#### NOTE

When shims are installed or removed between tail rotor gearbox and tailcone casting, lengthen A121-17 push-pull tube by 1/2 turn of rod end for each 0.018 inch that tail rotor gearbox is shimmed aft; shorten A121-17 push-pull tube by 1/2 turn of rod end for each 0.018 inch of shims removed.

- h) Install A947-2 flex plate using shims determined above. Torque attach bolts per Section 1.320. Install palnut and torque stripe.

#### NOTE

Use AN960-416L or AN960-416 washers under nuts as required to expose two to four threads beyond nut.

#### WARNING

A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, flex plate is unairworthy and cannot be repaired.

- i) Check clearance between A331 bellcrank-to-A121-17 push-pull tube forward rod end attach bolt and flex plate (0.250 inch minimum) with actuator disengaged.

### 7.340 Checking Tail Rotor Drive Shaft Runout

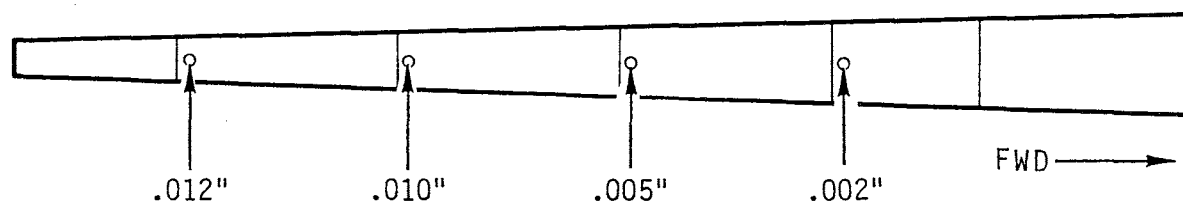
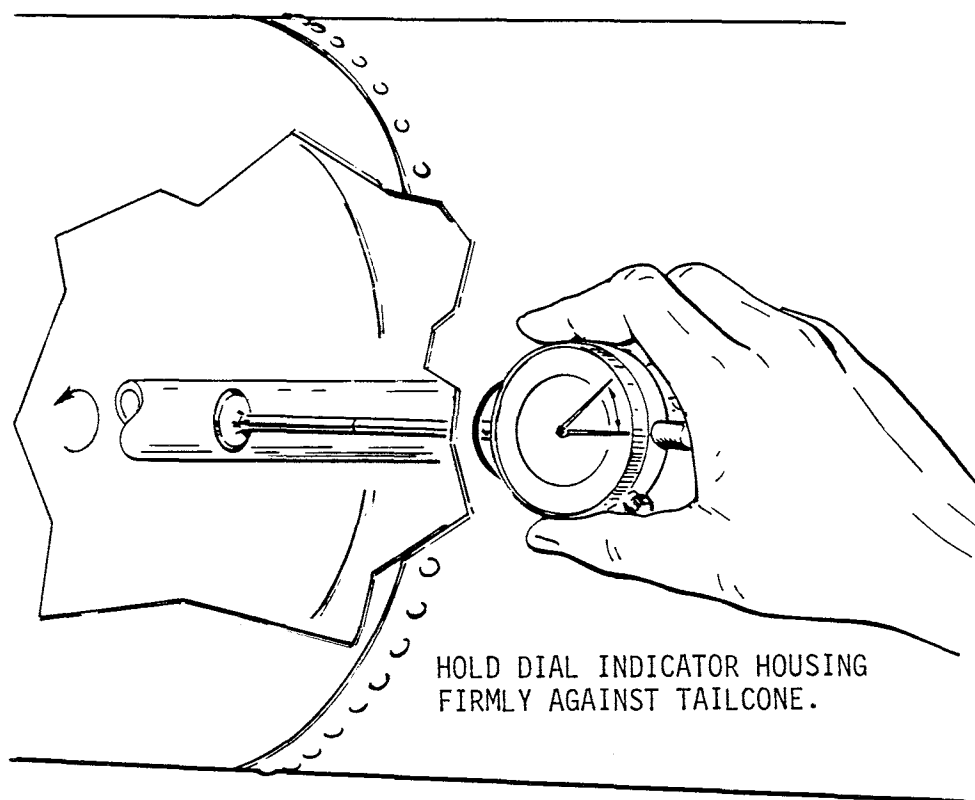
Excessive tail rotor drive shaft runout can cause intermediate flex coupling or damper assembly failure. To check runout:

- a) Remove tailcone inspection covers on tailcone right side. Engage clutch.
- b) Assemble MT260-6 tool and suitable dial indicator.

#### NOTE

The dial indicator included in the Robinson MT122 bolt stretch gauge can be used.

- c) Insert dial indicator through farthest aft inspection hole on right side of tailcone. Press dial indicator firmly against tailcone with extension riding on drive shaft.
- d) Have someone rotate drive train at A166 clutch shaft at least three full revolutions. Dial indicator may vary somewhat with each revolution so it will be necessary to take an average.
- e) Repeat procedure in steps c) and d) at next inspection hole forward.
- f) Remove extension from MT260 tool and, using longer extensions, check drive shaft at remaining inspection holes.
- g) Maximum runout at any location must not exceed 0.025 inch. If runout is excessive, drive shaft must be repaired or replaced.



Sample of measurements taken.

FIGURE 7-12 TAIL ROTOR DRIVESHAFT RUNOUT CHECK

### 7.350 Two-Piece Tail Rotor Driveshaft

- a) The two-piece tail rotor driveshaft consists of a B224-1 driveshaft, B223-1, -2, -3, or -4 yoke assembly, A041-1 damper bearing assembly, A553-2 block and two A207-4 blocks. See Figure 7-12A.
- b) The A041-1 damper bearing assembly is field replaceable only with the two-piece tail rotor driveshaft.
- c) The B224-1 driveshaft is produced in one length only. The overall length of the driveshaft assembly may be adjusted with various length B223 yokes. The yokes are produced in .150 inch length increments. See Figure 7-12B.
- d) A197-1 one-piece driveshaft assemblies may be replaced with the two-piece driveshaft per the table below:

<u>One-Piece Driveshaft</u>	<u>Overall Length (inches)</u>	<u>B223 Yoke Req. w/ B224 D.S.</u>
A197-7	140.25	-1
A197-4	140.40	-2
A197-5	140.55	-3
A197-6	140.70	-4
A197-1	Varies	As Required

- e) If the length of the driveshaft cannot be measured or is unknown, use the following procedure to determine the correct B223 yoke to use:
  1. Install the intermediate flexplate onto the A195-1 yoke on the clutch shaft. For this measurement procedure, no shims should be installed between the beveled washers or the bonded washers on the flexplate and the A195-1 yoke.
  2. Install the A553-2 block into the forward end of the driveshaft. Align the two bolt holes in the block and the driveshaft.
  3. Consult the appropriate section of this manual for the following installation steps. Connect the B224-1 driveshaft to the aft flexplate and the tail rotor gearbox input yoke. Install the gearbox on the tailcone. Connect the damper assembly to the clip on the inside of the tailcone. Install the tailcone on the upper steel tube frame. Engage the actuator.

7.350 Two-Piece Tail Rotor Driveshaft (cont'd)

4. Hold the driveshaft centered on the intermediate flexplate. Measure the distance from the flexplate to the center of the forward hole on the driveshaft. Subtract .032 inches from this measurement, which is the thickness of the beveled washer or the bonded washer. This will be the Calculated Dimension. Select the B223 yoke which is closest to but does not exceed the Calculated Dimension. Shims may be added or subtracted between the tail rotor gearbox and the tailcone aft casting to adjust the driveshaft-to-flexplate dimension. See Figure 7-12B. The difference between the Calculated Dimension and the length of the B223 yoke will be taken up with shims per Section 7.330 of this manual.
5. Install A553-2 block in yoke end of T.R. driveshaft. Removal of primer to install block is allowed. If primer is removed, swab wet primer inside the T.R. driveshaft before installing block. After installation, prime inside of T.R. driveshaft to cover tube and seal edges of block.
6. Install the correct length B223 yoke onto the forward end of the driveshaft. Align the two bolt holes. Install two NAS1304-21 bolts with a washer and a B207-4 block under the bolt heads and the nuts. Torque the nuts to 100 inch-pounds plus nut drag (add 10% for the total torque-110 inch-pounds). Install and tighten the palnuts.
7. Use Zinc Chromate or epoxy primer to form fillets at all joints for sealing moisture out. Paint as required.

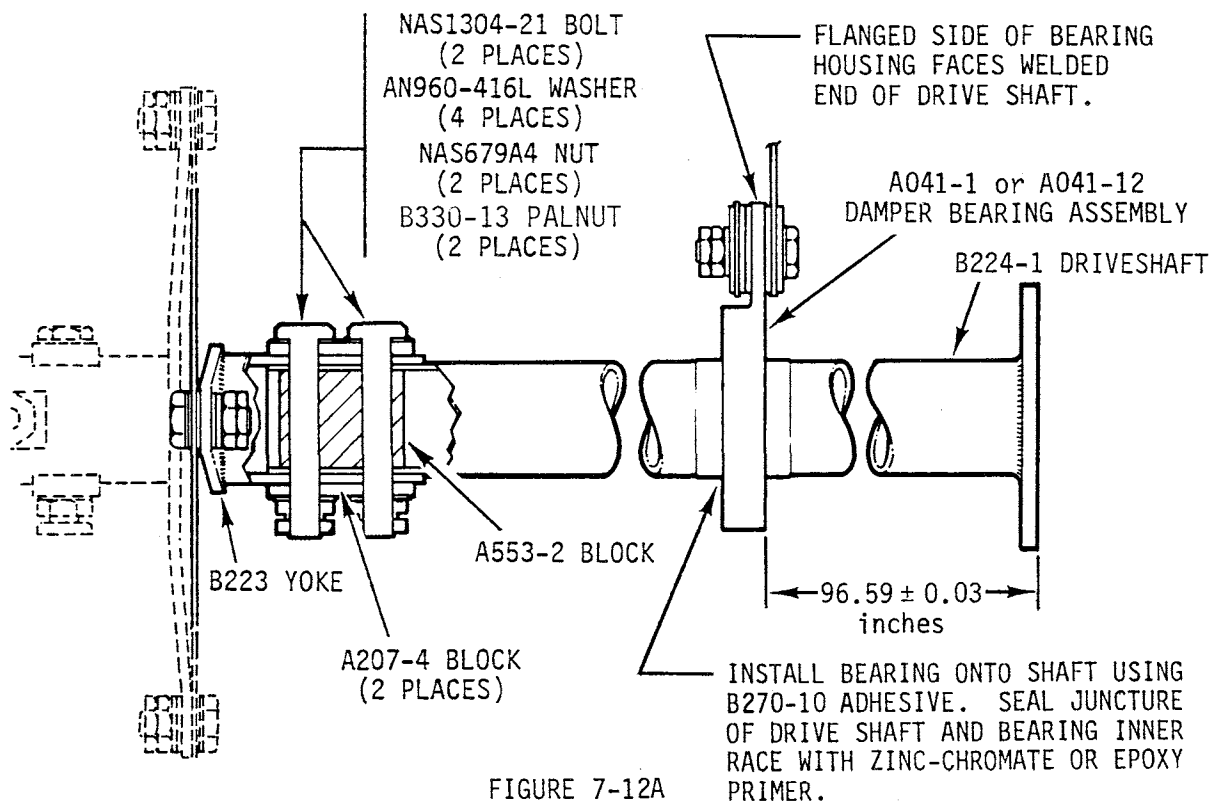


FIGURE 7-12A

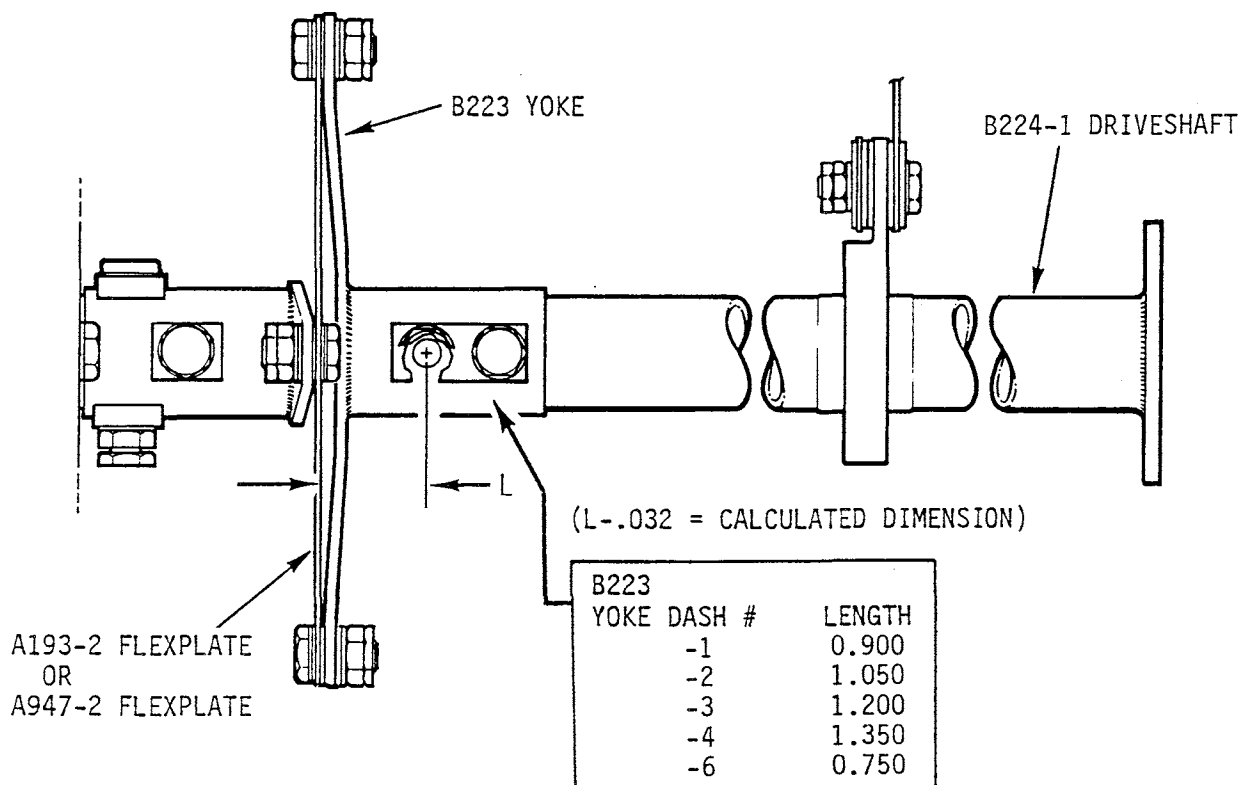
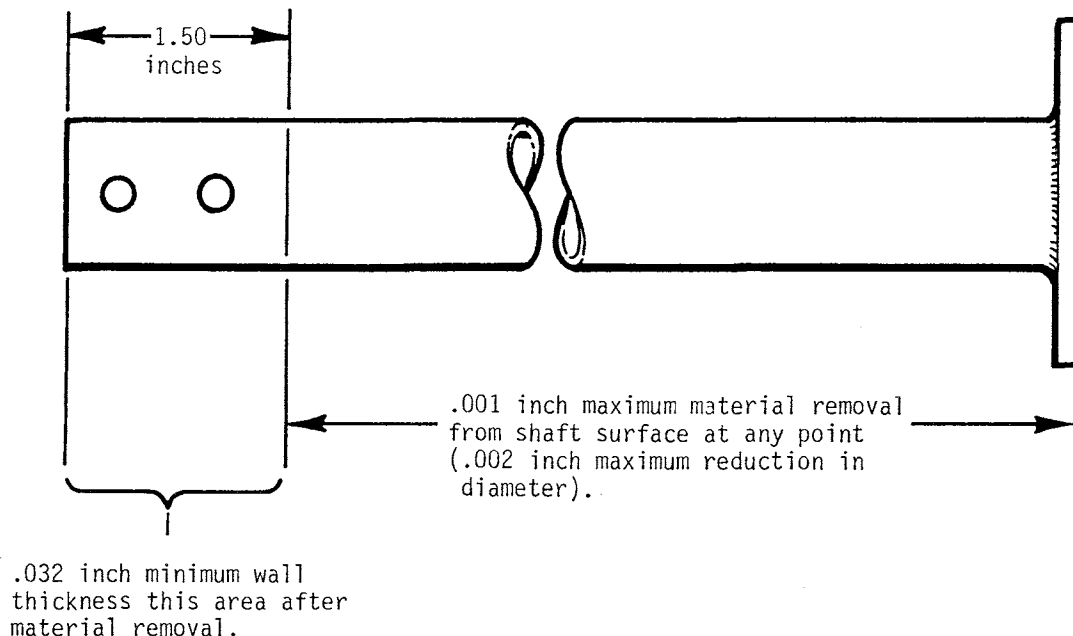


FIGURE 7-12B

7.360 B224-1 Tail Rotor Driveshaft Corrosion Removal

- a) No power tools allowed.
- b) Remove only the minimum amount of material necessary to clean up damage; do not exceed limitations shown.
- c) Sand or polish parallel to the shaft's long axis.
- d) Polish reworked areas with 400 grit or finer wet-or-dry sandpaper.
- e) Zinc chromate or epoxy prime bare metal surfaces.



## 7.400 Tail Rotor Gearbox

### 7.410 Tail Rotor Gearbox Removal

1. Mark tail rotor hub and blades and tail rotor pitch links to their respective pitch control arms before disassembly. This will facilitate reinstallation and eliminate re-rigging tail rotor if push-pull tube lengths are not altered.
2. Remove tail rotor assembly. Leave pitch control links attached to tail rotor blades.
3. Disconnect A120-1 bellcrank from push-pull tube.
4. Disconnect A120 bellcrank from gearbox and reassemble bellcrank hardware to bellcrank. Slide pitch control, with bellcrank attached, off gearbox output shaft.
5. Disconnect gearbox chip detector wire at quick disconnect.
6. Remove tail rotor driveshaft per § 7.310.
7. Remove aft flex plate from gearbox. Reinstall bolts, spacers, and nuts on flex plate to prevent loss.

### 7.420 Tail Rotor Gearbox Installation

1. Install tail rotor drive shaft per § 7.320. |

<p><b>WARNING</b></p>
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<p><b>A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, flex plate is unairworthy and cannot be repaired.</b></p>
--

2. Install tail rotor pitch control and bellcrank. Check bellcrank to pitch control shimming per § 8.562. |
3. Connect A121-17 push-pull tube to aft bellcrank.
4. Install tail rotor assembly per § 9.213.

#### 7.430 Tail Rotor Gearbox Shimming

Shimming of gearbox at mounting flange is only required when intermediate flexplate gap between clutch shaft yoke and tail rotor drive shaft forward yoke is too small to allow installation of flexplate. Gearbox may be shimmed aft a maximum of 0.080 inch. If shims are installed (3) MS20074-04-06 and (1) NAS1304-8 bolts must be used for gearbox-to-casting installation. If more than 0.040 inch shims are used, change NAS1149F0463P washers under bolt heads to NAS1149F0432P. If tail rotor system is rigged and shims are subsequently installed, extend A121-17 push-pull tube aft rod end 1/2 turn for each 0.018 inch the gearbox is shimmed aft; retract rod end 1/2 turn for each 0.018 inch of shims removed.

#### 7.440 Tail Rotor Gearbox Chip Indicator

If "TR CHIP" light illuminates:

1. Drain and flush gearbox per § 22-23 except strain oil (a paint filter works well) while draining and examine any particles found in oil or on chip detector.
2. Particles larger than 0.09 inch long or 0.02 inch wide are cause for concern and should be identified as ferrous or non-ferrous with a magnet. If particles are ferrous return gearbox to RHC for repair along with particles. If particles are non-ferrous, drain and flush gearbox per § 22-23.
3. If "TR CHIP" illuminates again within next 100 hours time-in-service a gearbox failure may be imminent. Return gearbox to RHC for repair.

**7.450 A021 Tail Rotor Gearbox Output Shaft Seal Replacement**

1. Drain gearbox oil. Clean and inspect chip detector. Clean sight gage as required. Reinstall chip detector and sight gage, torque per § 23-33 and safety wire.
2. Remove tail rotor assembly per § 28-10.
3. Remove pitch control per § 8.561 and clean gearbox output shaft.
4. Verify tailcone-to-upper frame attach bolts are torqued per § 23-32.
5. See Figures 7-13A and 7-13B. Slide MT295-10 mandrel on output shaft until it contacts seal. Tape mandrel to gearbox to maintain position when punching holes in seal.
6. Using small holes in MT295-10 mandrel as a guide, punch four holes in output shaft seal with MT295-3 punch.

**CAUTION**

MT295-10 mandrel is designed to guide and limit MT295-3 punch protrusion into gearbox. Punching seal using other tools may damage gearbox case, output shaft, and/or bearings.

7. Remove tape holding MT295-10 mandrel. Rotate mandrel to align large holes in flange with punched holes in output shaft seal. Install a 92470A113 screw thru each large hole in flange into matching hole in seal. Tighten screws until heads contact mandrel flange; do not overtighten screws.

**CAUTION**

Do not use screws longer than 0.75 inch; longer screws may damage bearing.

8. See Figure 7-13C. Lubricate MT295-6 screw threads with anti-seize and install in end of MT295-10 mandrel. Tighten screw to remove seal. Remove mandrel and seal.
9. Carefully clean seal seating surfaces in gearbox and on output shaft with a solvent dampened cloth, dry, and inspect for damage. Verify output shaft shoulder has a smooth edge and will not damage seal lip. Do not polish or alter seal seating surfaces. Return gearbox to RHC for repair if damage is noted.
10. See Figure 7-13D. Lubricate new A966-2 seal inner lip and output shaft seal seat area with correct gearbox oil (refer to § 22-10 Part C). Do not lubricate seal outside edge and its mating surface in gearbox; they must remain clean and dry. Slide seal on output shaft with cupped face toward gearbox until seal contacts gearbox.

7.450 A021 Tail Rotor Gearbox Output Shaft Seal Replacement (continued)

11. Remove MT295-6 screw and old seal from MT295-10 mandrel and slide mandrel on output shaft until it contacts seal.
12. See Figures 7-13A and 7-13B. Determine if gearbox output shaft seal installation is recessed type or flush type. Install flush-type seal until it is flush with seal bore; install recessed-type seal until MT295-10 mandrel contacts gearbox face. Lightly tap end of mandrel with soft-face hammer until seal is properly positioned.
13. Remove mandrel.
14. Fill gearbox to center of sight gage using correct gearbox oil (refer to § 22-10 Part C). Verify filler-plug vent holes are clear. Install filler-plug and torque per § 23-33.
15. Install pitch control per § 8.562.
16. Install tail rotor assembly per § 28-10.
17. Inspect seal for leaks after dynamic balancing tail rotor.

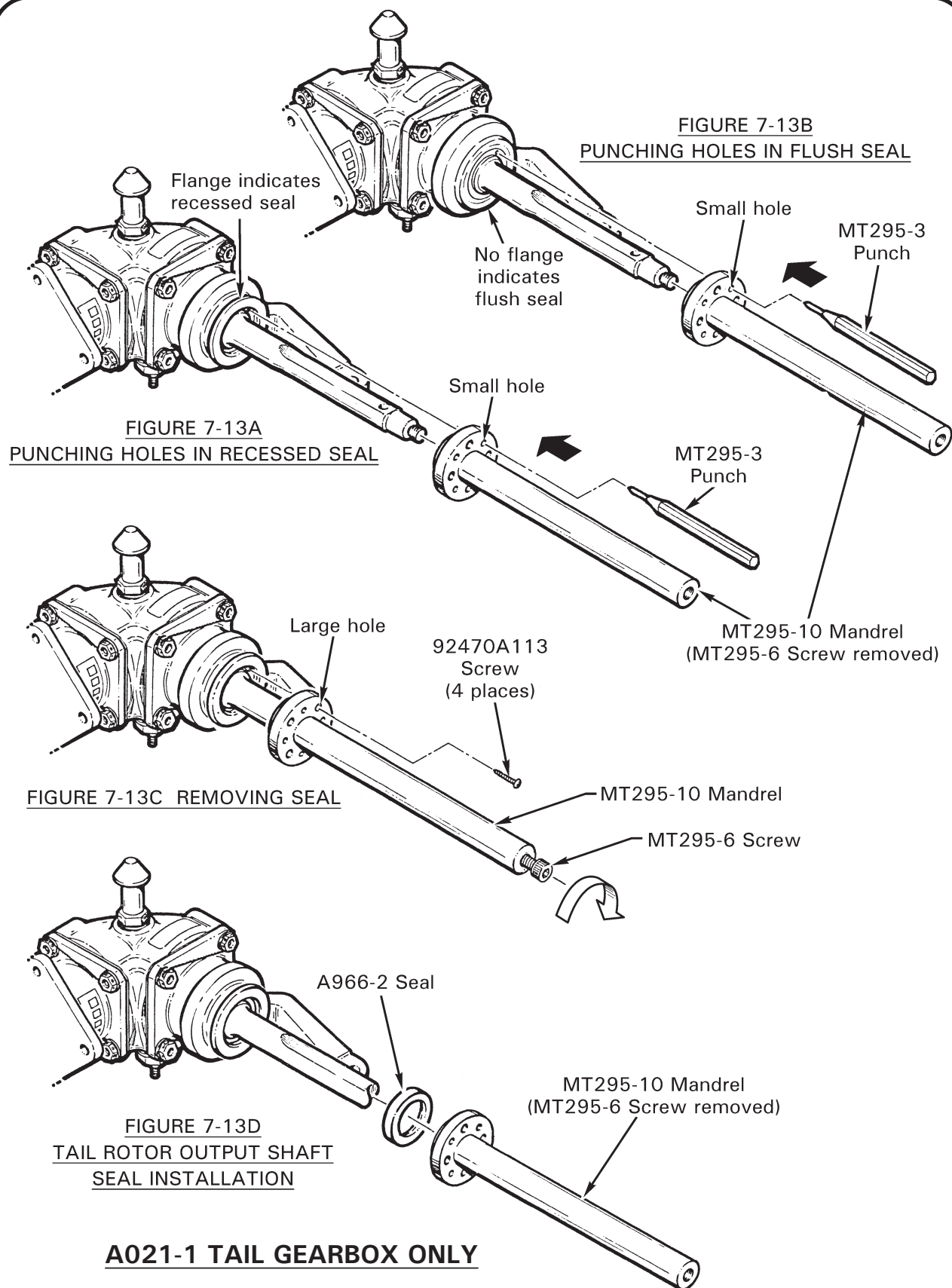
7.460 B021 Tail Rotor Gearbox Output Shaft Seal Replacement

1. Drain gearbox oil. Clean and inspect chip detector. Clean sight gage as required. Using new o-ring(s) install chip detector and sight gage, torque per § 23-33, and safety wire.
2. Remove tail rotor assembly per § 28-10.
3. Remove pitch control per § 8.561 and clean gearbox output shaft.
4. Cut safety wire and remove four drilled-head bolts securing B552-1 retainer and slide retainer off output shaft.

**CAUTION**

Do not alter shim stack-up between retainer and bearing or bearing preload may be adversely affected.

5. Remove seal and o-ring from B552-1 retainer.
6. Carefully clean and dry retainer seal seating surface and O-ring groove.
7. With seal lip toward gearbox, press new A966-4 seal into retainer bore 0.140/0.160 inch below external flat surface. Lubricate new o-ring with correct gearbox oil (refer to § 22-10 Part C) and install in retainer groove without twisting.
8. Lubricate seal seating area of output shaft with correct gearbox oil (refer to § 22-10 Part C).
9. Carefully slide retainer over output shaft. Align retainer and gearbox bolt holes and press retainer into gearbox. Install four drilled-head bolts, torque per § 23-33, and safety wire.



7.460 B021 Tail Rotor Gearbox Output Shaft Seal Replacement (continued)

10. Install pitch control per § 8.562.
11. Install tail rotor per §§ 9.212 or 9.213, as applicable.
12. Inspect for leaks after dynamically balancing tail rotor.

7.470 B021 Tail Rotor Gearbox Input Shaft Seal Replacement

1. Drain tail rotor gearbox lubricant.
2. Remove tailcone per § 4.311.
3. Remove tail rotor driveshaft per § 7.310.
4. Remove aft flex plate from gearbox.
5. Remove nut & washer securing splined B546 input yoke on gearbox input shaft. Remove yoke.
6. Cut safety wire from B549 retainer and remove retainer and adjacent A117 shim from gearbox.
7. Remove and discard seal and o-ring from retainer.
8. Remove A266 spacer and underlying o-ring from input shaft. Discard o-ring.
9. Clean parts and inspect. Verify no grooves in A266 spacer, no scoring on A117 shim (such as from rotating), and no wear steps on input yoke & shaft splines.
10. Coat input shaft splines with B270-21 protectant and allow to dry.
11. Press new A966 seal 0.030 inch deep beyond flush into chamfered inner end of B549 retainer, with solid side of seal toward opposite hexagonal end.
12. Prelubricate new o-ring with correct gearbox oil (refer to § 22-10 Part C) and install in groove around B549 retainer.
13. Slide A117 shim over input shaft until it contacts input bearing outer race.
14. Prelubricate new o-ring with correct gearbox oil and slide over input shaft until it contacts input bearing inner race.
15. Lubricate outside diameter of A266 spacer with correct gearbox oil and slide it, inner-chamfered end first, over input shaft until spacer inner chamfer seats on o-ring.
16. Coat threads of B549 retainer with A257-9 anti-seize and install on gearbox. Torque retainer per § 23-33 and safety wire.
17. Install input yoke on input shaft. Apply B270-11 adhesive to input shaft threads and install washer and nut. While adhesive is still wet, torque nut per § 23-33 and torque stripe.

### 7.500 Actuator Assembly

#### 7.510 Actuator Removal

1. Remove tailcone fairing.
2. Full disengage clutch.
3. Remove fanwheel per § 6.210.
4. Put a four-inch wood block under clutch shaft just forward of upper sheave on horizontal firewall. This keeps sheave from drooping and prevents damage to forward flex plate per Figure 7-8.
5. Disconnect two wiring connections to actuator.
6. Remove upper and lower NAS6604 bolts connecting actuator to bearings and remove actuator.

#### 7.520 Actuator Installation

1. Connect actuator to A184 bearing and standard torque bolt per § 23-32. Install | palnut, standard torque per § 23-32, and torque stripe per Figure 2-1.
2. Install lower attach bolt with head facing aft. Use one NAS1149F0432P washer under bolt head and one NAS1149F0463P washer under nut. Standard torque bolt per § 23-32. Install palnut, standard torque per § 23-32, and torque stripe per Figure 2-1. Remove wooden block.
3. Install fanwheel per § 6.220.
4. Connect motor and switch assembly electrical leads.

<b>CAUTION</b>
----------------

Do not engage actuator without scroll installed.
--

#### 7.530 Actuator Gearmotor Replacement

Actuator Gearmotor can be replaced with actuator on helicopter.

1. Disconnect gearmotor electrical leads.
2. Cut safety wire from and remove four gearmotor attaching screws. Exercise care not to drop either safety wire or screws in V-belt sheaves.
3. Slowly slide gearmotor assembly from housing. An unscrewing motion may be necessary.
4. Lightly lubricate worm gear on new gearmotor assembly with A257-1 grease before installing. Install o-ring onto gearmotor nose piece.

### 7.530 Actuator Gearmotor Replacement (continued)

5. Install new gearmotor into housing with wire leads pointing down. Verify no gap exists between housing and gearmotor mounting flange before installing screws; do not use screws to draw gearmotor into housing as motor flange can break.
6. Secure gearmotor to housing with four mounting screws and safety wire with 0.020-inch diameter wire using single strand method.
7. Connect gearmotor electrical leads. Engage clutch, listen for binding, and verify actuator fully tensions drive belts.
8. Seal all fasteners, seams and openings around gearmotor with B270-8 sealant.
9. Ty-rap gearmotor electrical leads as required.

#### **CAUTION**

Severe damage to actuator and drive belts can occur if gearmotor electrical leads are installed incorrectly in wiring connector (gearmotor will operate backwards and down-limit switch and spring switches will not shut off gearmotor current).

### 7.540 Actuator Adjustment

#### 1. Engaged Limit

The actuator engaged limit is determined by column springs which control drive belt tension. Column springs may only be adjusted by the factory.

#### 2. Disengaged Down-Limit Adjustment (see Figure 7-15)

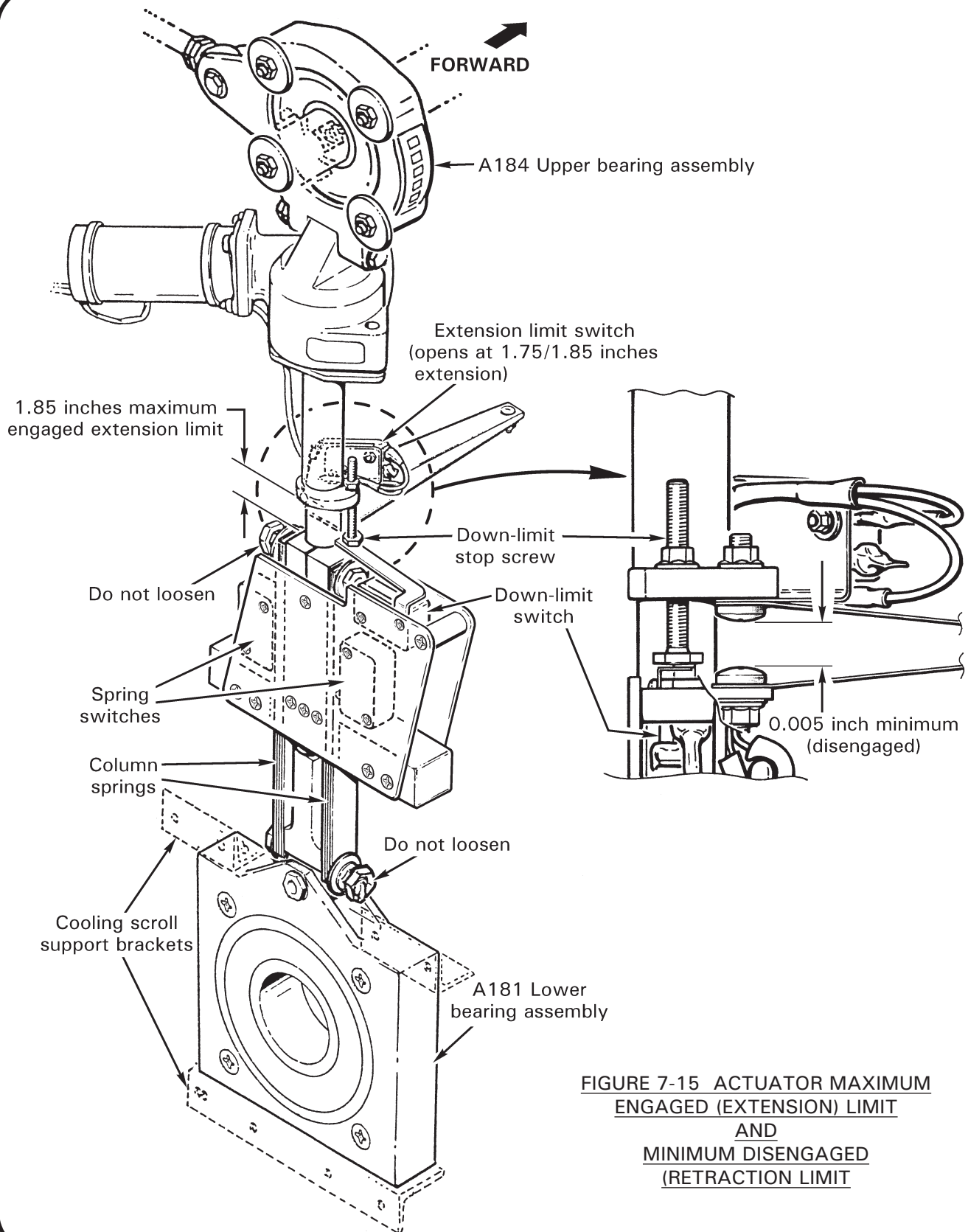
The down-limit switch is activated by the down-limit stop screw which can be adjusted using long 3/8-inch open-end and 1/4-inch box-end wrenches. Adjust down-limit stop screw to maintain proper belt deflection per § 7.282 with actuator fully disengaged. Minimum clearance between screw heads at scissors is 0.005 inch.

#### 3. Maximum Extension (see Figure 7-15)

Maximum engaged extension is 1.85 inches measured between top of column spring block and bottom of screw housing. Drive V-belts must be replaced when maximum extension is encountered.



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## 7.550 Switch and Fuse Replacement

### 7.551 Switch Replacement

1. Remove actuator from helicopter per § 7.510.

**NOTE**

Switches may be replaced as a complete harness assembly or replaced individually by soldering wire connection and installing heat shrink.

2. Remove each switch by removing attaching screw, nut, washer, and spacing washers between switch and plate.

**NOTE**

Bond the four spacing washers to the new switch(es), if necessary, to ease reassembly.

3. Replace complete switch and wire harness assembly or, if installing a single switch, cut faulty switch from harness wiring. Cut wires as close to switches as possible.
4. Slide heat shrink over each cut wire. Solder wires to switch and install heat shrink over solder connection.
5. Reassemble switch(es) to plate. Two spacing washers are installed between switch and plate at each attach screw and one under nut. Do not over tighten screws or plastic switch housing may crack.
6. Reinstall actuator on helicopter per § 7.520.

### 7.552 Fuse Replacement

An in-line fuse holder is installed in clutch actuator motor power circuit. Fuse holder is mounted on test switch panel. Replace fuse with 1.5 amp (AGC 1.5) fuse.

## 7.600 Rotor Brake

### 7.610 Rotor Brake Removal

1. Remove tailcone cowling. Remove forward flex plate. Mark and record any shim washers installed between flex plate and main rotor gearbox input yoke and/or clutch shaft yoke.

#### **WARNING**

**A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, flex plate is unairworthy and cannot be repaired. Ensure A947-1 forward flex plate is Rev E or subsequent (identified by letter "E" or subsequent letter on two adjacent arms of flex plate both sides).**

2. Remove cotter pin and nut securing input yoke on main rotor gearbox. Remove yoke. Disconnect brake spring from firewall angle.
3. Disconnect cable from lever. Disconnect wiring to micro switch at three-pin connector.
4. Cut and remove safety wire, then remove three bolts securing rotor brake. Remove rotor brake assembly.

### 7.620 Rotor Brake Installation

1. Place rotor brake assembly over splined input pinion shaft of main rotor gearbox.
2. Place one each of two small (A130-41) spacers in place between rotor brake assembly and pinion end cover. Install one each NAS1149F0432P washer on three NAS1352-4H30P bolts. Insert first bolt through rotor brake assembly and A130-41 spacer. Insert second bolt through Hall Effect sender plate, rotor brake assembly and A130-41 spacer.
3. Insert third bolt through Hall Effect sender plate and long A130-41 spacer. Finger tighten three bolts into gearbox, then special torque bolts per § 23-33 and safety with 0.032 inch diameter safety wire. Attach spring to the firewall angle.
4. Coat splines of pinion shaft with B270-21 protectant before installing yoke. Place A908-4 yoke on pinion shaft. Install one each A141-10 washer and AN320-8 nut on pinion shaft. Special torque nut per § 23-33 as required to align castellations on nut with hole through pinion shaft. Do not exceed 410 in.-lbs. Install one MS24665-210 cotter pin.
5. Set Hall Effect sender-to-magnets gap per § 7.141.
6. Attach cable to lever. Reconnect wiring to micro switch at three-pin connector.

### 7.620 Rotor Brake Installation (continued)

7. With brake engaged, adjust gap between NAS428-3-12 bolthead on B109-1 arm and A130-43 spacer to 0.030–0.035 inch. Lock adjustment by tightening MS21042L3 nut.
8. With brake in the released position, measure gap between B112-1 lever and B110-1 arm assembly. The gap measurement should be 0.030–0.170 inch. Adjust length of bead chain as required to obtain proper gap. One bead is approximately 0.150 inch.
9. Adjust micro switch to open and close at a gap of 0.20–0.30 inch between B112-1 lever and B110-1 arm.
10. Install forward flex plate.
11. Check clutch sheave alignment per § 7.230.
12. Install intermediate flex plate per § 7.330.

### 7.630 Rotor Brake Pad Replacement

1. Minimum pad thickness is 0.030 inch.
2. Brake pad replacement is accomplished by replacing B110-1 and B109-1 arm assemblies.

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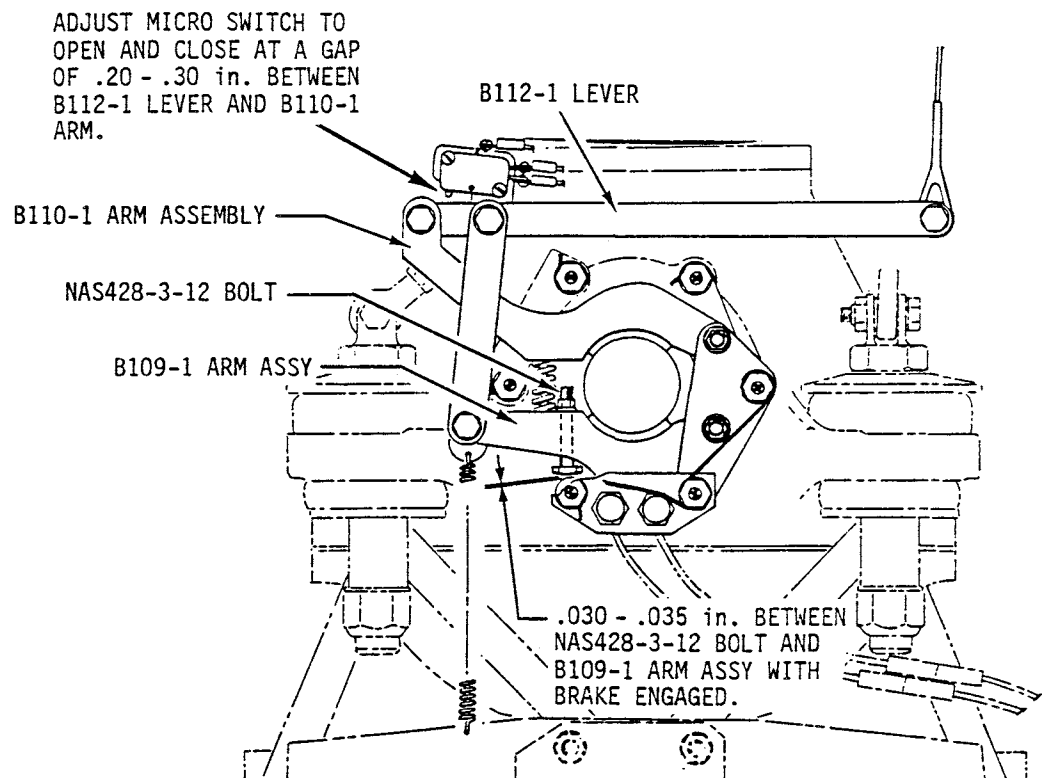
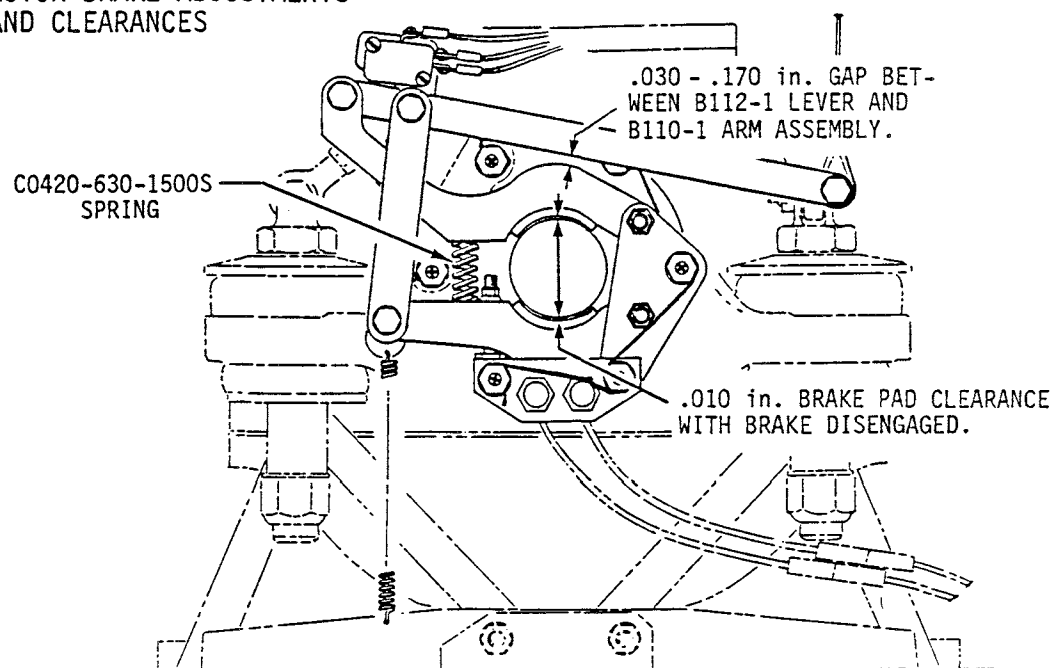


FIGURE 7-16A ROTOR BRAKE ADJUSTMENTS AND CLEARANCES







## CHAPTER 8

## FLIGHT CONTROLS

<u>Section</u>	<u>Title</u>	<u>Page</u>
8.000	Flight Controls . . . . .	8.1
8.100	Cyclic Controls . . . . .	8.1
8.110	Cyclic Assembly . . . . .	8.1
8.111	A958-1 or A175-1 Bellcranks . . . . .	8.7
8.120	Cyclic Grip Assembly . . . . .	8.9
8.130	Cyclic Spring (Right-Trim) . . . . .	8.11
8.140	Elastic Cord (Forward-Trim) . . . . .	8.15
8.150	Cyclic Friction Assembly . . . . .	8.19
8.160	A121-7 Push-Pull Tube . . . . .	8.21
8.161	A121-7 Push-Pull Tube Removal . . . . .	8.21
8.162	A121-7 Push-Pull Tube Inspection/Repair . . . . .	8.21
8.163	A121-7 Push-Pull Tube Sleeve Installation . . . . .	8.22
8.164	A121-7 Push-Pull Tube Sleeve Inspection . . . . .	8.22
8.165	A121-7 Push-Pull Tube Installation . . . . .	8.23
8.200	Collective Control . . . . .	8.25
8.210	Collective Stick Assembly . . . . .	8.25
8.220	Collective Spring Assembly . . . . .	8.28
8.230	Collective Friction Assembly . . . . .	8.32
8.240	RPM Governor System . . . . .	8.33
8.300	Jackshaft and Support Struts . . . . .	8.35
8.310	Jackshaft . . . . .	8.35
8.311	Jackshaft Removal . . . . .	8.35
8.312	Jackshaft Installation . . . . .	8.35
8.320	Strut Assembly (Jackshaft Support) . . . . .	8.35
8.321	Strut Removal . . . . .	8.35
8.322	Strut Installation . . . . .	8.38
8.400	Swashplate and Main Rotor Pitch Links . . . . .	8.39
8.410	Swashplate . . . . .	8.39
8.411	Swashplate Removal . . . . .	8.39
8.412	Swashplate Installation . . . . .	8.40
8.413	(Reserved)	
8.414	(Reserved)	
8.415	(Reserved)	
8.416	Shimming Upper (Unflanged) Spherical Sleeve with Aluminum Ball . . . .	8.48

## CHAPTER 8

## FLIGHT CONTROLS (Continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
8.500	Tail Rotor Controls . . . . .	8.48
8.510	Tail Rotor Pedals . . . . .	8.48
8.511	Tail Rotor Pedal Removal . . . . .	8.48
8.512	Tail Rotor Pedal Installation . . . . .	8.52
8.520	A317-1 Lower Bellcrank . . . . .	8.52
8.521	A317-1 Lower Forward Bellcrank Removal . . . . .	8.52
8.522	A317-1 Lower Forward Bellcrank Installation . . . . .	8.53
8.530	A316-1 Upper Bellcrank . . . . .	8.55
8.531	Bellcrank Removal . . . . .	8.55
8.532	Bellcrank Installation . . . . .	8.55
8.540	A331-1 Intermediate Bellcrank . . . . .	8.56
8.541	Bellcrank Removal . . . . .	8.56
8.542	Bellcrank Installation . . . . .	8.57
8.550	A120-1 Aft Bellcrank . . . . .	8.57
8.551	Bellcrank Removal . . . . .	8.57
8.552	Bellcrank Installation . . . . .	8.57
8.560	A031-1 Pitch Control . . . . .	8.57
8.561	Pitch Control Removal . . . . .	8.57
8.562	Pitch Control Installation . . . . .	8.57
8.570	Tail Rotor Pitch Links . . . . .	8.58
8.571	Tail Rotor Pitch Link Removal . . . . .	8.58
8.572	Tail Rotor Pitch Link Installation . . . . .	8.58
8.600	A203 Yoke and A205 Fork Assemblies . . . . .	8.60
8.610	Bearing Removal . . . . .	8.60
8.615	C648-2 Bearing Installation . . . . .	8.60
8.620	A139-1 Bearing Installation . . . . .	8.60
8.630	B115-1 Bearing Installation . . . . .	8.62
8.640	Yoke and Fork Assembly Installation . . . . .	8.63

## CHAPTER 8

## FLIGHT CONTROLS

8.000 Description

Dual controls are standard equipment and all primary controls are actuated through push-pull tubes and bellcranks. Bearings used throughout the control system are either sealed ball bearings or have self-lubricated liners.

R22 Flight controls operate conventionally. The cyclic is center-mounted with the left and right control grips mounted to a cross tube which pivots on the center cyclic stick. On later aircraft, the pilot's cyclic grip angle can be adjusted fore and aft relative to the cross tube by a mechanic to achieve the most comfortable hand position.

The collective stick is also conventional with a twist grip throttle control. When the collective is raised, the throttle is opened by an interconnecting linkage. An electronic governor makes minor throttle adjustments required to maintain RPM. On later aircraft, a fixed (plastic) grip aft of the twist grip allows the pilot to rest their hand on the collective without inadvertently interfering with governor operation.

**WARNING**

**Assembly of flight controls is critical and requires inspection by a qualified person. If a second person is not available, RHC recommends the installer take a 5-minute break prior to inspecting flight control connections the installer has assembled.**

8.100 Cyclic Controls8.110 Cyclic Assembly**A. Removal**

1. Remove collective stick assembly per § 8.210.
2. If installed, remove C683 damper(s).
3. Remove screws securing mixture and carburetor heat control cable covers to cyclic box cover. If equipped with carb heat assist, unscrew carb heat knob from shaft.
4. Remove spring pin & knob from cyclic friction and right trim adjustment (if equipped); temporarily install spring pins to retain spacers. Unscrew & remove right trim actuation knob from shaft.
5. Remove screws securing cyclic box cover to cyclic box and vertical panels. Lift cyclic box cover and disconnect wiring at connectors. Temporarily secure cover up and clear of keel panels using ty-rap(s), as required.
6. Remove elastic cord per § 8.140.

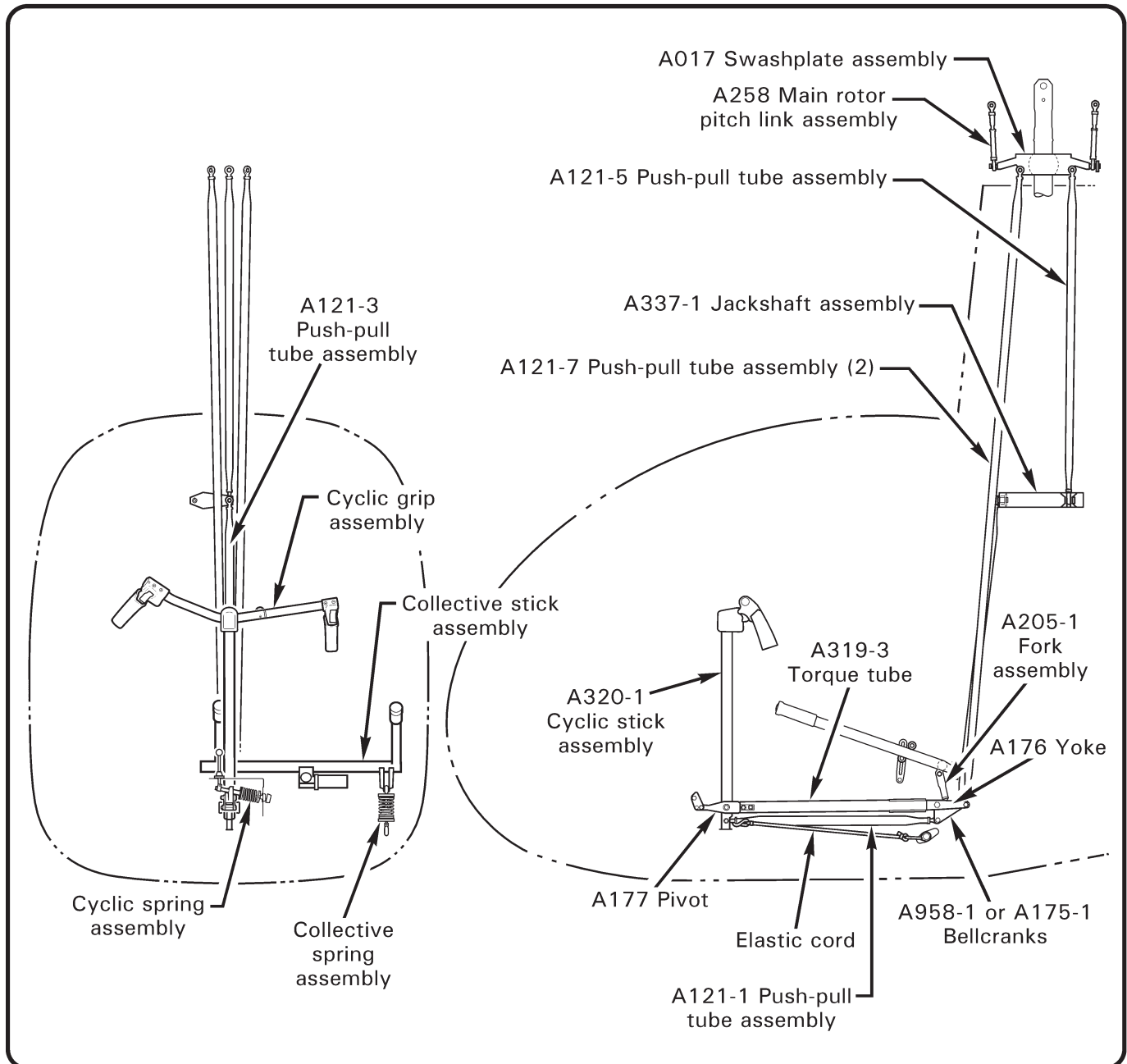


FIGURE 8-1 MAIN ROTOR FLIGHT CONTROLS

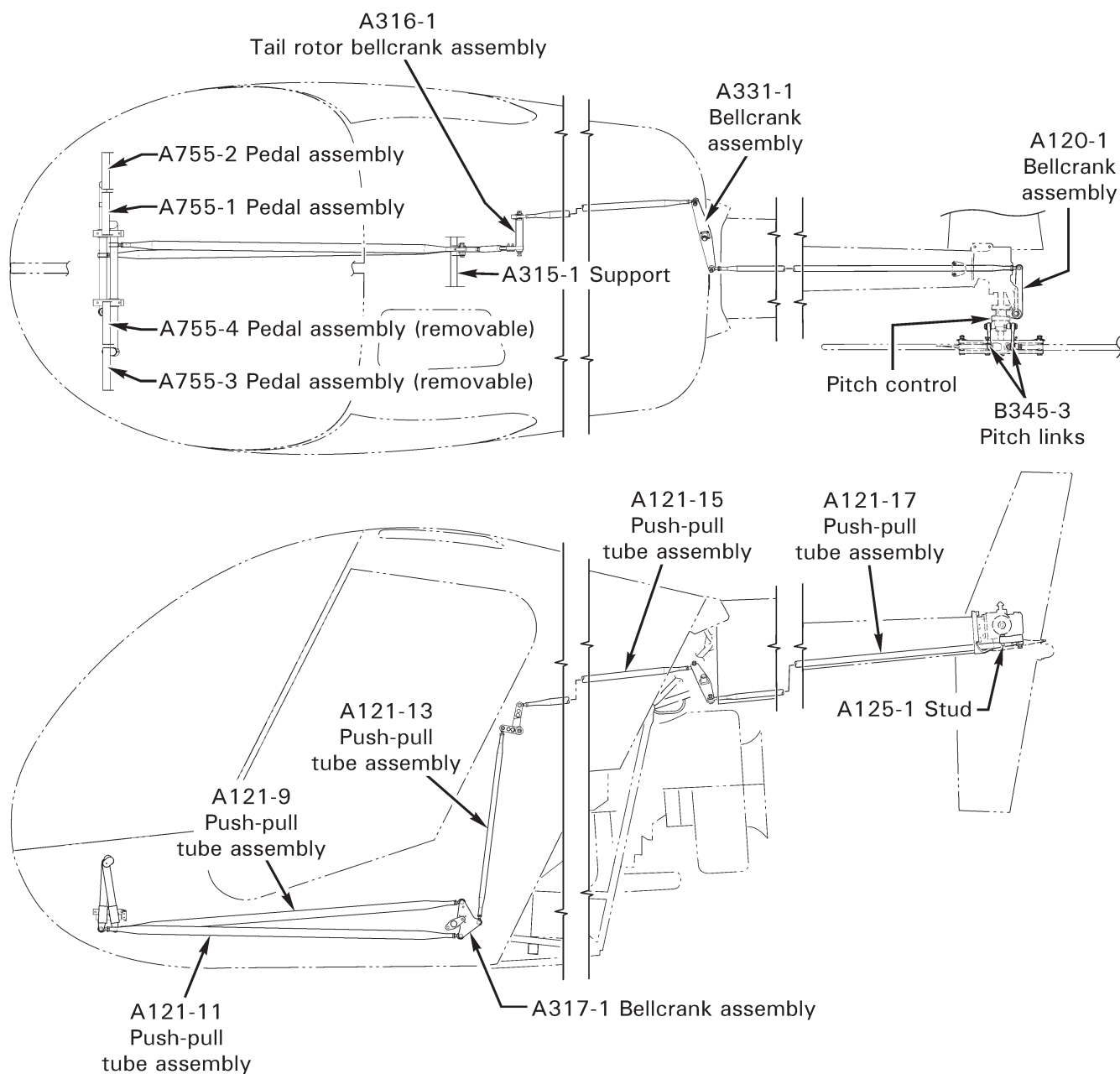


FIGURE 8-2 TAIL ROTOR FLIGHT CONTROLS

### 8.110 Cyclic Assembly (continued)

#### A. Removal (continued)

7. Position cyclic stick full forward. Remove bolt securing A121-3 push-pull tube to A958-1 (or A175-1) bellcranks.
8. Remove A231-9 plug assemblies from vertical firewall tunnel. Remove bolt securing left & right A121-7 push-pull tubes to cyclic pivot assembly.
9. Disconnect cyclic stick wiring at connectors.
10. Unscrew, but do not remove, bolts securing cyclic friction assembly to A500-1 plate (bolts will retain spacers between friction plates).
11. Remove screws securing cyclic box assembly to keel panels.
12. Move cyclic stick full right to relieve right trim spring compression and apply cyclic friction to hold friction assembly stackup in place. Pull cyclic box straight up from keel panels and remove cyclic assembly from helicopter.

#### B. Installation

##### CAUTION

Rigging must be checked if any of the following has occurred:

1. Replacement of cyclic assembly.
2. Replacement of A338-1 cyclic box or A320-1 cyclic stick.
3. Replacement or change of A205-1 fork assembly (connecting collective assembly to cyclic pivot assembly).
4. If A121-1, -3, -5, or -7 push-pull tube assembly rod end center-to-center dimension changes.
5. Jackshaft support length is changed.

##### NOTE

During cyclic installation, properly align cyclic friction stackup and apply friction to hold stackup in place.

1. Position cyclic assembly between keel panels. Ensure cyclic friction assembly and right-trim spring assembly are properly located.
2. Install screws securing cyclic box to keel panels except (4) screws that secure cyclic cover. Standard torque bolts securing cyclic friction assembly and torque stripe per Figure 2-1.
3. Assemble A121-7 push-pull tubes, A115-1 spacers, and A130-10 spacer to A176 yoke. Standard torque bolt & palnut per § 23-32 and torque stripe per Figure 2-1.
4. Position cyclic stick full forward. Assemble A121-3 push-pull tube and A115-1 spacers to A958-1 (or A175-1) bellcranks. Standard torque bolt per § 23-32 and torque stripe per Figure 2-1 (1 thread exposed minimum beyond nut is permissible).

8.110 Cyclic Assembly (continued)**B. Installation (continued)**

5. Install elastic cord per § 8.140.
6. Attach cyclic stick electrical connector(s) to airframe harness. With cyclic friction off, move cyclic throughout full travel and verify wiring is clear of friction assembly.
7. Refer to Figure 8-3. If A205-1 fork was removed from A101-4 rod end, screw fork onto rod end between 3.50–3.60 inches from center of rod end hole to centerline of attach bolt hole. Standard torque jamnut per § 23-32 and torque stripe per Figure 2-1.

**NOTE**

Dimension of A205-1 fork should be 3.50–3.60 inches from center of rod end bearing to center of attaching bolt hole (no palnut required on this rod end). Verify autorotational RPM per § 10.250 if A205-1 fork dimension has changed.

8. Install collective stick per § 8.210 but do not install horizontal cover, vertical panel, or seat backs.
9. Cut and discard ty-rap(s) temporarily securing cyclic box cover. Connect post light wire & ELT connector as applicable and ty-rap clear of controls. Cinch ty-raps until snug without over-tightening and trim tips flush with heads.
10. Position cyclic box cover over keel panels, inserting right trim shaft, friction assembly shaft, fuel mixture control, and carb heat control through cover, as applicable. Install screws securing cover to keel panels.
11. Install knobs and control cover attach screws.
12. Move flight controls throughout complete travel. Verify 0.12 inch minimum clearance & no binding or interference with control movement, except the following:
  - a. 0.030 inch minimum clearance permissible between A121-7 push-pull tubes and upper frame forward attach bolts & nearby surrounding cabin structure.
  - b. Contact permissible between A121-3 & -7 push-pull tubes near lower ends when cyclic stick is positioned in aft corners of stop plate.
  - c. Contact permissible between A121-1 push-pull tube and A327-1 overtravel spring when cyclic is positioned in forward right corner of stop plate.
  - d. Contact permissible between A121-3 push-pull tube and B328-1 collective connecting rod when collective is positioned full up & cyclic is full aft.
13. Adjust friction assembly per § 8.150, as required.
14. Rig main rotor flight controls per §§ 10.110 & 10.120.
15. Install seat backs per § 15-22.
16. Install center horizontal cover & vertical panel.

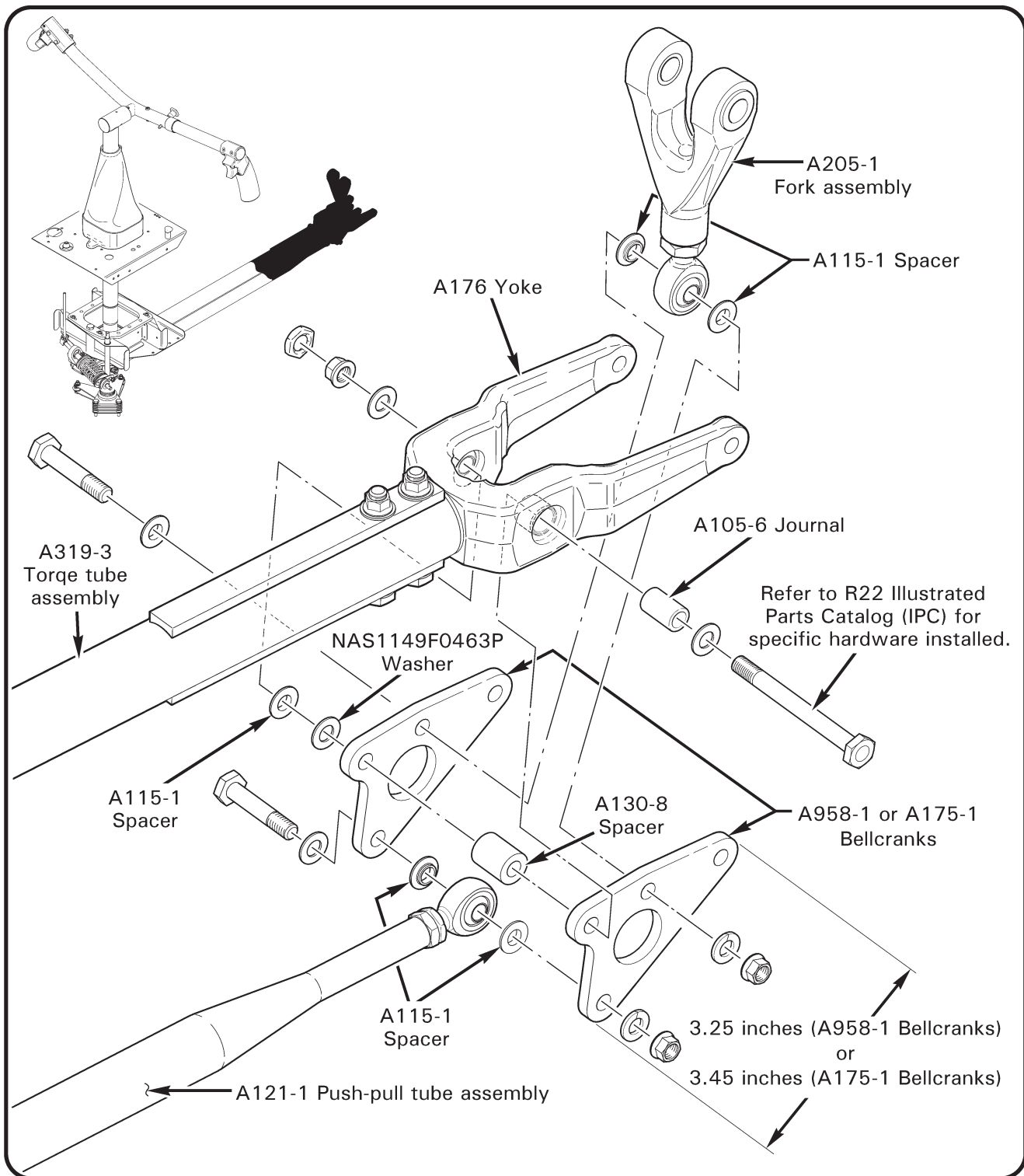


FIGURE 8-2A CYCLIC PIVOT ASSEMBLY AFT BELLCRANK



8.111 A958-1 or A175-1 Bellcranks**NOTE**

A175-1 bellcranks are original equipment on helicopter S/N 0001 thru 0356 except S/N 0256, 0301, 0350, and 0351. A958-1 bellcranks are original equipment on helicopter S/N 0256, 0301, 0350, 0351, and 0357 and subsequent.

**CAUTION**

A958-1 bellcranks are required equipment if tailcone has B379-1 or -3 bracket installed.

**A. Removal**

1. Remove cyclic assembly per § 8.110.
2. Refer to Figure 8-2A. Remove hardware securing A121-1 push-pull tube to A958-1 (or A175-1) bellcranks.
3. Remove hardware securing bellcranks to A176 yoke and remove bellcranks.
4. Remove hardware securing A205-1 fork assembly's rod end to bellcranks.
5. As required for upgrade, earlier A175-1 bellcranks may be directly replaced with A958-1 bellcranks per Part B.

**B. Installation**

1. Refer to Figure 8-2A. Position A130-8 spacer between A958-1 (or A175-1) bellcranks and insert temporary bolt for alignment.
2. Install hardware securing A205-1 fork assembly's rod end and A121-1 push-pull tube to bellcranks. Standard torque bolts & palnuts per § 23-32 and torque stripe per Figure 2-1.
3. Remove temporary bolt and install hardware securing A958-1 (or A175-1) bellcranks and spacer in A176 yoke. Standard torque bolt & palnut per § 23-32 and torque stripe per Figure 2-1.
4. Install cyclic assembly per § 8.110, as required.
5. Perform main rotor rigging per § 10.120 and track and balance per § 10.230.

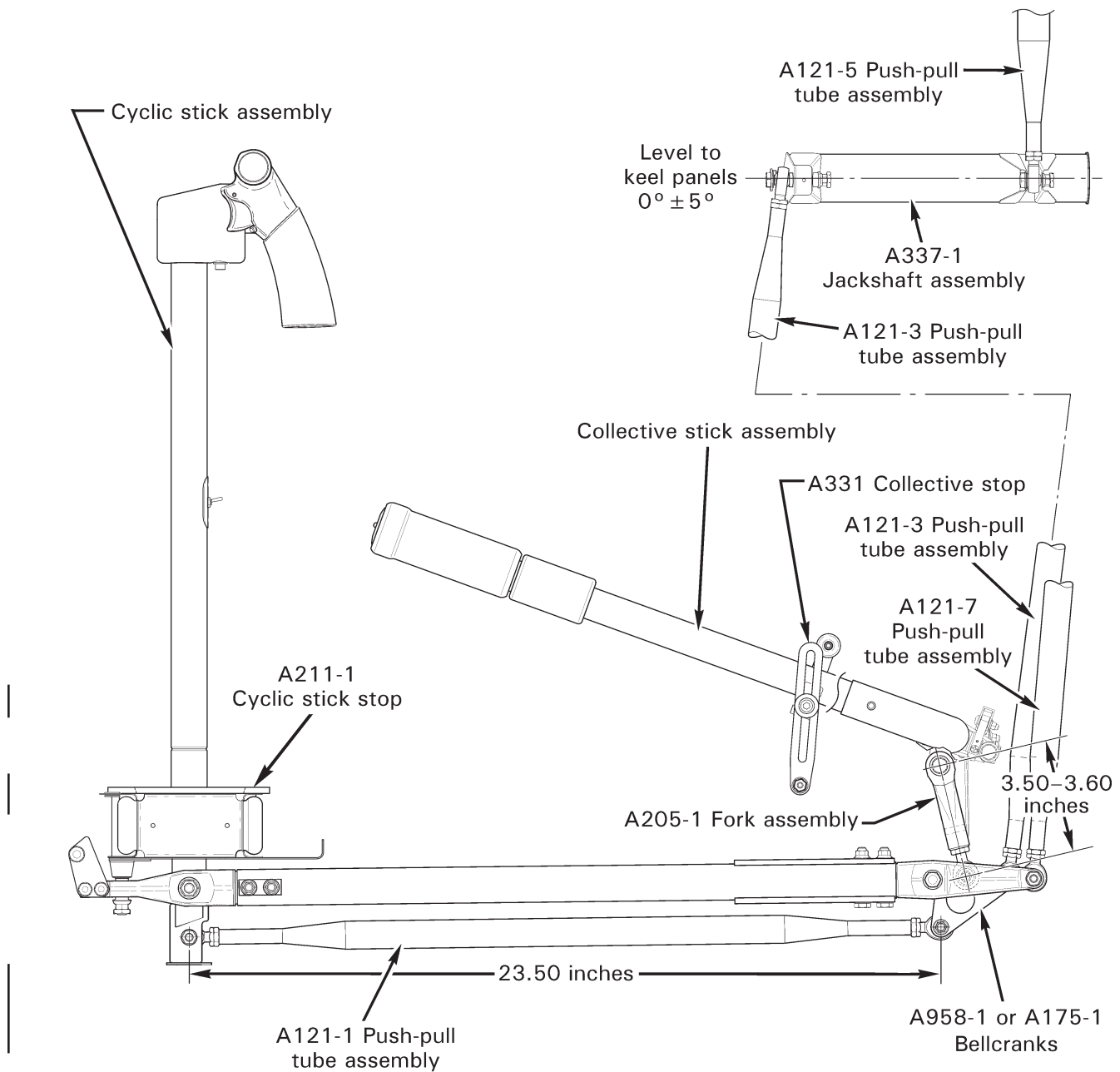


FIGURE 8-3 CYCLIC AND COLLECTIVE CONTROL

### 8.120 Cyclic Grip Assembly

#### A. Removal

##### NOTE

This may be accomplished without removal of complete cyclic assembly from helicopter.

1. Remove bottom center inspection panel.
2. Disconnect cyclic stick electrical connectors. Using pin extractor, remove pins from housing(s), retain housing(s). Wires -112, -138, and -355 may remain installed.
3. Remove heat shrink & sleeving from wires. Attach one piece of safety wire or lace tape to each group of wires near pins.
4. Remove grommet from upper aft side of stick assembly and pull each wire group out of stick leaving safety wires or lace tapes protruding from each end of stick.

##### NOTE

Wires are separated into two groups of wires at bottom-right forward & aft side of cyclic stick.

5. Remove C683-9 damper assembly (if installed), B209-4 plug, cotter pin, castellated nut and A141-14 washer from cyclic grip pivot.
6. With a soft-faced hammer, gently tap cyclic grip shaft and remove cyclic grip assembly from A320-1 stick. Ensure bearings remain inside stick.

##### NOTE

Do not damage bearings during removal.

#### B. Installation

1. Ensure B350-1 spring pin is installed in grip assembly. Ensure heat shrink, sleeving, and grommets (as applicable) are installed over grip assembly wiring.
2. Slide grip assembly thru bearings in stick assembly. Install A141-14 washer and castellated nut, tighten castellated nut until there is no axial movement of bearings and cyclic grip assembly. Install cotter pin.

##### CAUTION

Over-tightening nut will damage bearings.

3. Install B209-4 plug and C683-9 damper (as required).

### 8.120 Cyclic Grip Assembly (continued)

#### B. Installation (continued)

4. Separate wires into (2) groups. Attach lace tape or safety wire protruding from cyclic stick to each group of wires and pull wires thru cyclic stick. Install grommet in cyclic stick.

#### NOTE

One wire group will extend thru forward right side of cyclic stick;  
one wire group will extend thru aft right side of cyclic stick.

5. Install sleeving and heat shrink around all wires and slide heat shrink into cyclic stick as far as possible to prevent chafing of wires. Secure sleeving ends with lacing tape.
6. Refer to Figures 14-39A, 14-39B, and 14-39C for A024 electrical system schematic. Install wires in housing(s) per schematic.
7. Connect cyclic wiring at connectors and lock connectors using MS3367-4-9 ty-raps, as required. Cinch ty-raps until snug without over tightening and trim tips flush with heads. Move cyclic throughout complete travel and verify electrical wiring clearance & no binding.
8. Turn battery switch ON and verify correct function of all switches on cyclic grip and stick assemblies.
9. Install belly panel.

#### C. Adjustment (D379-1 Grip)

1. Loosen (2) 91251A194 (or NAS1352-08-8) cap screws securing pilot's grip to A756-18 weldment.
2. Rotate grip to desired position, special torque cap screws to 40 in.-lb.

#### NOTE

Verify full control travel prior to flight when changing grip angle.

### 8.130 Cyclic Spring (Right-Trim)

#### A. Description

The function of the cyclic spring is to balance the left-stick force in cruise conditions. It is actuated by pulling up on the black knob located forward of the cyclic stick. The trim spring (two forces available) may be changed or shimmed to create the force necessary to balance the cyclic control laterally. This usually is required after a main rotor blade change.

#### B. Removal

1. Remove screws securing mixture and carburetor heat control cable covers to cyclic box cover. If equipped with carb heat assist, unscrew carb heat knob from shaft.
2. Remove spring pin & knob from cyclic friction and right trim adjustment; temporarily install spring pins to retain spacers. Unscrew & remove right trim activation knob from shaft.
3. Remove screws securing cyclic box cover to cyclic box and keel panels. Lift cyclic box cover and disconnect wiring at connectors. Temporarily secure cover up and clear of keel panels using ty-rap(s), as required.
4. Remove right-trim assembly attach bolt. Firmly grasping spring assembly; tip cyclic stick right to relieve pressure from spring, pull spring up & right to remove assembly.

#### C. Spring Replacement & Shimming

##### B056 Assemblies (in-flight adjustable)

##### NOTE

Changing trim spring will create a large change in trim forces. Shimming A618-1 spring (primer colored) may be required to obtain desired trim force.

1. Remove right-trim assembly per Part B.
2. Remove A584-1 bearing support and A130-46 spacer from A585-2 shaft. Unscrew A583-2 cap from shaft and remove A618 spring.
3. Adjust shims as required between A583-1 cap and A588-1 spacer. A618-1 spring (primer colored) may be shimmed a maximum thickness of (3) NAS1149F0463P washers. A618-2 spring (black colored) must not be shimmed.

##### CAUTION

Do not shim beyond allowable thickness. Trim spring may bottom preventing full left cyclic travel.

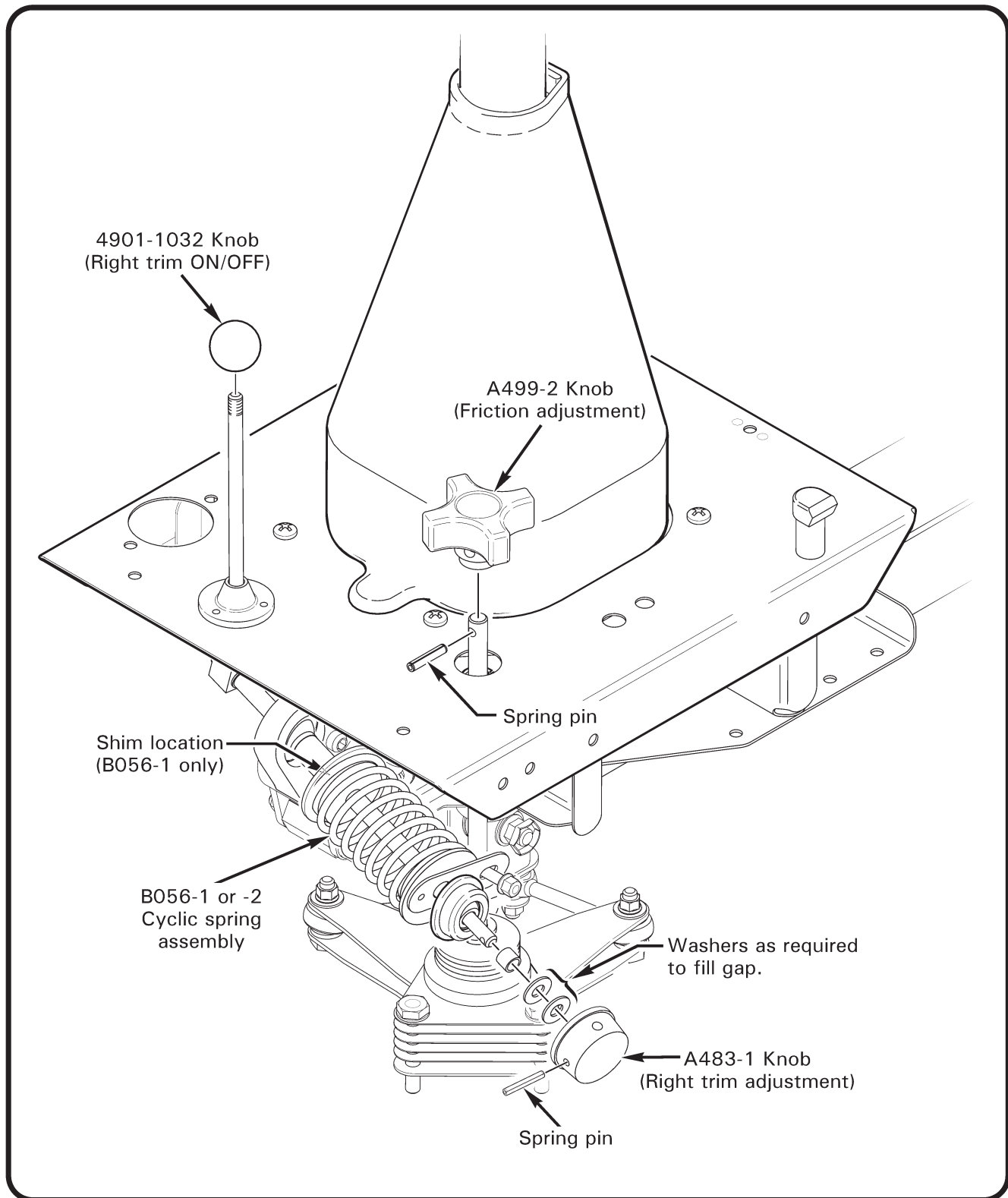


FIGURE 8-4 CYCLIC SPRING (RIGHT-TRIM)

8.130 Cyclic Spring (Right-Trim) (continued)**C. Spring Replacement & Shimming (continued)**B056 Assemblies (in-flight adjustable) (continued)

4. Install A618-1 (10.7 lb/in.) or A618-2 (14.5 lb/in.) spring to obtain desired trim force. Ensure light coat of A257-1 grease is applied to shaft at caps and A588-1 spacer. Thread A583-2 cap on shaft. Reinstall A130-46 spacer and A584-1 bearing support.
5. Install right-trim assembly per Part D.

A056 Assemblies (non-adjustable)**NOTE**

If A056 cyclic spring assembly (originally installed on R22 helicopters S/N 0002 thru 0549) requires shimming, contact RHC Technical Support.

**D. Installation**

1. Move cyclic stick full right to minimize spring compression during installation. Insert bearing support flush into left vertical panel; ensure B160-1 pin is inserted through A594-1 tab, as required. Firmly grasp spring assembly and insert A581-1 arm in cyclic pivot assembly. Install hardware and standard torque per § 23-32.
2. For in-flight adjustable trim assemblies, install A483-1 knob and set to full trim. Verify spring does not limit full cyclic travel, or cause spring binding. Adjust shims as required per Part C.
3. Cut and discard ty-rap(s) temporarily securing cyclic box cover. Connect post light wire & ELT connector as applicable and ty-rap clear of controls. Cinch ty-raps until snug without over-tightening and trim tips flush with heads.
4. Position cyclic box cover over keel panels, inserting right trim shaft, friction assembly shaft, fuel mixture control, and carb heat control through cover, as applicable. Install screws securing cover to keel panels.
5. Install knobs and control cover attach screws.
6. Move flight controls throughout complete travel and verify no binding or interference with control movement. Adjust friction assembly per § 8.150, as required.

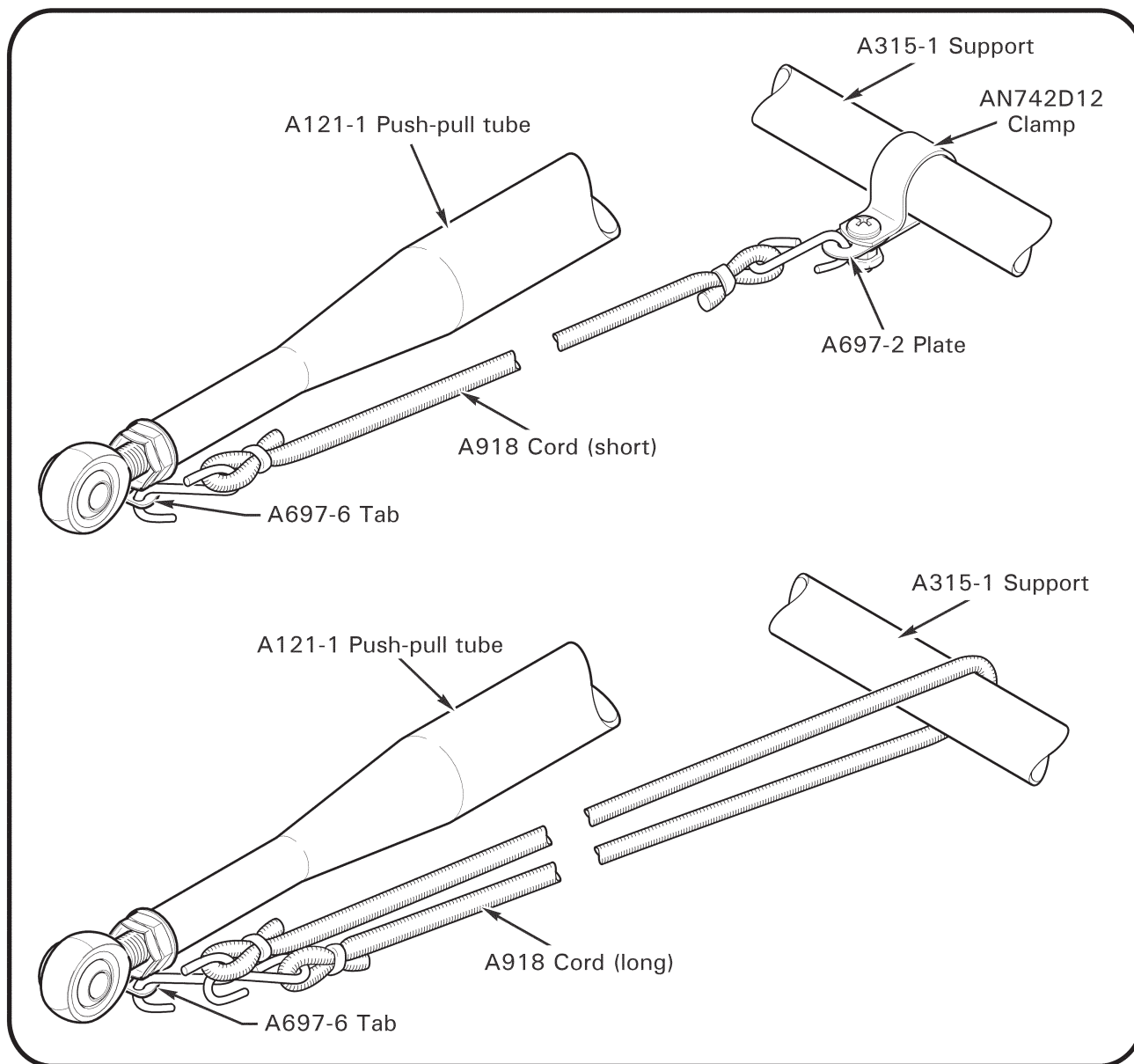


FIGURE 8-4A ELASTIC CORD (FORWARD-TRIM)



### 8.140 Elastic Cord (Forward-Trim)

#### A. Description

The elastic cord is used to balance most longitudinal (fore-aft) stick forces during cruise flight. If the cyclic grip moves forward in cruise flight, a weaker elastic cord is required. If the cyclic stick grip moves aft in cruise flight, a stronger elastic cord is required. Elastic cords can be identified by an I.D. tag, or by measuring the diameter and length of the cord. Refer to R22 Illustrated Parts Catalog (IPC) for available elastic cords. Test fly helicopter after elastic cord change to evaluate trim forces in level cruise flight, repeat until desired trim forces are obtained.

#### B. Removal

1. Remove A794-2 center belly panel. If transponder antenna installed in panel, pull XPDR (refer to electrical schematic) circuit breaker and disconnect antenna.
2. Position cyclic stick full forward.
3.
  - a. Refer to Figure 8-4A. Unhook short elastic cord from forward end of A121-1 push-pull tube then unhook at A315-1 support and remove elastic cord, or
  - b. Separate long elastic cord hooks from each other, then unhook from forward end of A121-1 push-pull tube and remove long elastic cord.
4. Inspect elastic cord. Stretch cord, while stretched look for voids which may indicate broken strands. Slide hooks back and verify security of locking rings.

#### C. Installation

##### NOTE

Select A918-1 thru -13 elastic cord as determined by flight test evaluation.

1. As required for short elastic cord installation, install hardware securing A697-2 plate and AN742D12 clamp to A315-1 support.
2. Position cyclic stick full forward.
3.
  - a. Refer to Figure 8-4A. Attach short elastic cord to A697-2 plate then attach elastic cord to A697-6 tab at forward end of A121-1 push-pull tube, or
  - b. Attach long elastic cord to A697-6 tab at forward end of A121-1 push-pull tube then route over A315-1 support and attach hooks together.
4. Move cyclic throughout full travel and verify clearance of elastic cord hooks to push-pull tube, wire bundle, and cyclic stick assembly wires.
5. Connect transponder antenna (as required) and install belly panel. Push in XPDR (refer to electrical schematic) circuit breaker.

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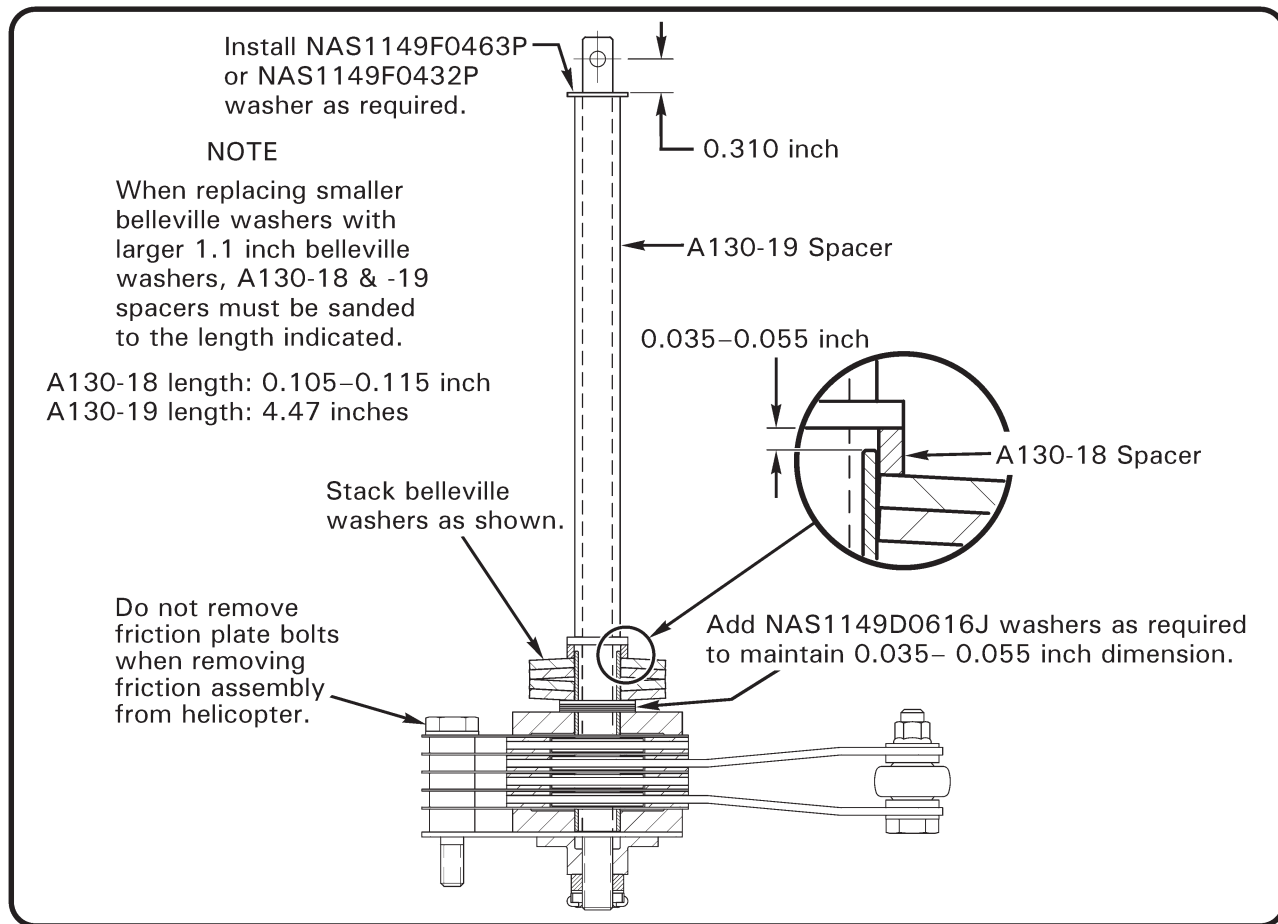


FIGURE 8-4B CYCLIC FRICTION ADJUSTMENT

### 8.150 Cyclic Friction Assembly

#### A. Description

Cyclic Friction knob is located at front left corner of cyclic box cover. Turning knob clockwise applies friction to both longitudinal and lateral cyclic. If friction cannot be applied by turning knob clockwise, adjustment of friction may be required.

#### B. Adjustment

1. Turn friction knob counter-clockwise until it stops. Verify knob rotates  $\frac{1}{8}$  to 1 full turn before adding friction.
2. Remove elastic cord per § 8.140.
3. Rotate blades until pitch links are in right & left position to eliminate pitch link movement when measuring longitudinal cyclic friction.
4. Select right trim off. Using spring scale measure force required to move cyclic stick forward & aft. Average force required must not exceed 3 lb.
5. Rotate blades until pitch links are in forward & aft position to eliminate pitch link movement when measuring lateral cyclic friction.
6. Using spring scale measure force required to move cyclic stick left & right. Average force required must not exceed 2 lb.
7. Apply full cyclic friction and measure force required to move cyclic stick left & right. Force required must not exceed 10 lb.
8. Refer to Figure 8-4B. To adjust friction remove spring pin from friction knob and lift knob off shaft. Install NAS1149F0463P or NAS1149F0432P washer as required. Install friction knob & spring pin. Verify proper friction per preceding steps.

#### NOTE

If friction assembly will not tighten and does not have larger (1.1 inch) belleville washers installed (4 ea.), replace with A478-1 spring washer and change length of spacers per Figure 8-4A. Replace circular knob with A499-2, as required.

9. Move flight controls throughout complete travel. Verify operating clearance with no binding.
10. Install elastic cord per § 8.140.

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8.160 Al21-7 Push Pull (P-P) Tube

## 8.161 Al21-7 Push-Pull Tube Removal

- a) Remove belly panel, vertical panel between seat backs and mast fairing, disconnecting pitot line at pitot fitting.
- b) Remove vertical firewall maintenance hole plug to remove Al21-7 P-P tubes.

## NOTE

IF HOLES NOT PRESENT, INSTALL USING  
RHC KIT KI-21.

- c) Remove NAS1304-44 bolt attaching -7 P-P tube rod ends to cyclic fork.
- d) Disconnect bolts holding Al21-7 P-P tubes at swashplate.
- e) Tape sheet metal edges to prevent P-P tube removal damage.
- f) Position swashplate and rotor to slide Al21-7 P-P tube up and clear. Mark right and left tubes if they are to be reinstalled.
- g) Inspect P-P tubes and sleeves for damage.
- h) Inspect P-P tube guide for wear. The guide should be replaced if excessively worn or if fretting evident between guide material and riveted aluminum support.

## NOTE

If P-P tube replaced, adjust rod ends to obtain same center-to-center length or M.R. Flight Controls will require rigging per R22 Maintenance Manual Section 10.

## 8.162 Al21-7 Push-Pull Tube Inspection/Repair

1. Nicks, cuts or scratches in the tube which are longitudinal not more than 0.010 inches deep, or across the tube and not more than 0.005 inches deep may be polished out.
2. Dented or flattened tube of more than five percent of its diameter must be replaced.
3. Maximum tube wear at guide 0.015 inch per wall after smoothing wear ridges. Epoxy primer repair surfaces before sleeve installation. Any tube wear requires sleeve installation.
4. Replace tube worn in excess of 0.015 inch after polishing.

## 8.163 Sleeve Installation Onto A121-7 Push-Pull Tube

## NOTE

Repair any wear damage on A121-7  
P-P tube per Section 8.162 prior to  
the P-P tube sleeve installation.

- a) Clean P-P tube by lightly using MEK or acetone.
- b) Apply tape to restrict adhesive to 6.5 inch area located 31 inches from end of P-P tube (not end of rod end).
- c) Test paint for paint bubbling; apply 1-inch band of adhesive to one end of 6.5 inch area. If paint bubbles, remove paint and apply epoxy primer to area before applying adhesive to whole 6.5 inch area.

**WARNING**

Adhesive to be applied to complete  
area under P-P tube sleeve.

- d) Apply adhesive supplied in kit to whole 6.5 inch area. (It will set and become stringy very quickly. Brush thin coat of adhesive without large lumps as rapidly as possible).

## NOTE

Sleeve must be installed within two  
minutes after adhesive applied.

- e) Slide sleeve onto tube and center of adhesive.
- f) Rotate tube and apply heat using up to 1200-watt heat gun to evenly shrink sleeve producing smooth surface.

**CAUTION**

DO NOT APPLY HEAT CONTINUOUSLY TO  
SAME AREA.

- g) Allow to cool and apply adhesive to seal end of sleeve. Do not have adhesive at ends above surface of sleeve or sleeve will be damaged or will not enter guide during installation.

## 8.164 Push-Pull Tube Sleeve Inspection

- a) Visually inspect sleeve for wrinkles, pin holes, bubbles, gouges, torn areas, etc. Replace sleeve if any damaged or suspect areas are found.



## 8.165 Al21-7 Push-Pull Tube Installation

- a) Inspect P-P tube guide for wear. The guide should be replaced if excessively worn or if fretting evident between guide material and moveable guide plate.

## NOTE

Old-style guide bushings which are riveted to fuselage must be replaced with moveable guide kit (RHC Kit KI-19A) if Al21-7 Push-Pull tubes are worn. Reference RHC Service Bulletin #36.

- b) Loosely (snug) install moveable guide on underside of airframe support A439-1 per Figure 8-4E.

## CAUTION

Extreme care must be taken when installing Al21-7 P-P tube into guide to prevent damage to P-P tube sleeve.

- c) Install Al21-7 P-P tube, ensure spacers installed properly. Reference Figure 8.4E. Torque attach bolt 100 in.-lb. plus nut drag.
- d) Attach Al21-7 P-P tubes to swashplate. Torque attach bolts 100 in.-lb. plus nut drag.
- e) Raise collective approximately seven (7) inches (measured from pilot throttle handle to center panel) with cyclic neutral.
- f) Tighten guides three attach bolts to slight friction and verify Al21-7 P-P tubes are centered in guide bore. Torque guide attach bolts 40 in.-lb. and torque stripe nuts.
- g) Remove protective tape from sheet metal edges used to protect P-P tubes during installation.
- h) Check full travel clearances of flight controls.
  - 1) Upper frame forward two boltheads at horizontal firewall to Al21-7 P-P tubes minimum clearance .010 inch.
  - 2) Fuel tank top inboard flange to left Al21-7 P-P tube minimum clearance .10 inch.

# 8.165 A121-7 Push-Pull Tube Installation (cont'd)

- i) Verify fasteners disconnected are retorqued per R22 Maintenance Manual Section 1.300.
- j) Reinstall panels, fairings and firewall plugs.
- k) If rod ends were unscrewed from P-P tubes, main rotor rigging must be re-checked per Section 10.

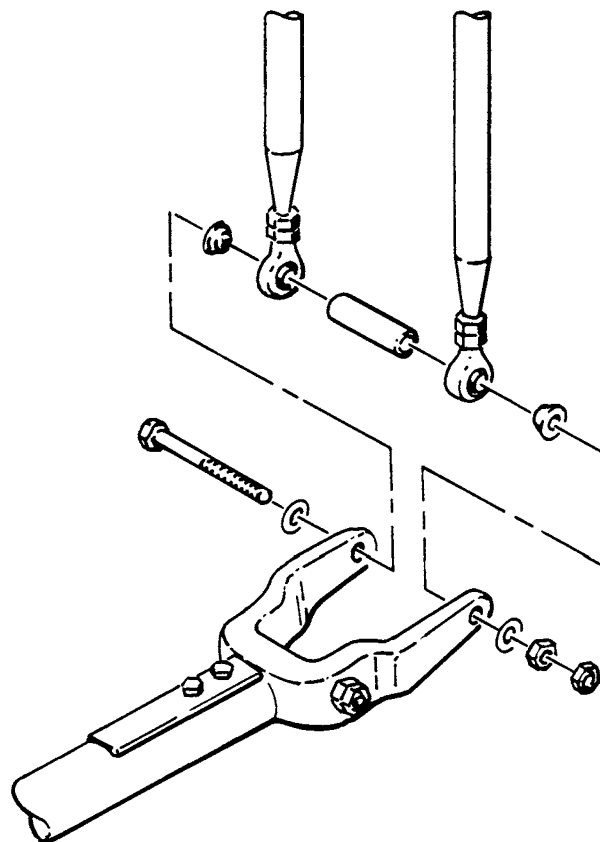
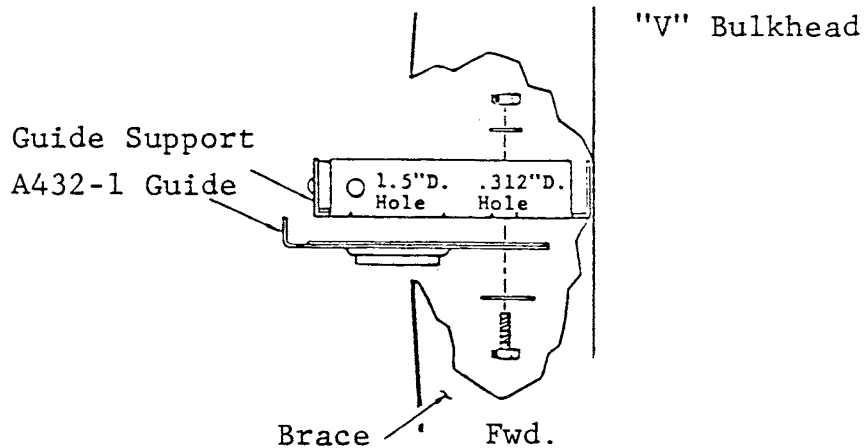


FIGURE 8-4E PUSH-PULL TUBES AND GUIDE

## 8.200 Collective Control

### 8.210 Collective Stick Assembly

#### **A. Removal**

1. Remove seat backs per § 15-22.
2. Remove center cover & vertical panel (cyclic control inspection panels).
3. Remove screws securing collective spring cover and remove cover. If spring cover aft mounting hole is slotted, screw may be loosened and left installed in vertical firewall stiffener.
4. Place collective in full down position. Install MT294-1 collective spring retainer or use 0.032 inch diameter safety wire to secure collective spring in compressed state. If safety wire is used, twist wire around rod end to rod end several times to ensure spring assembly can be removed safely.

#### **WARNING**

**Spring is under compression and failure to comply with above procedure can cause bodily harm and/or damage to helicopter.**

5. Remove spring lower attach bolt slowly while moving collective slightly to transfer spring compression onto restraining safety wire or MT294-1. When bolt is removed, position spring assembly forward for more clearance during removal.
6. Remove hardware securing A333-1 collective stop to A348-1 seat belt anchor, retain all hardware.

#### **NOTE**

To prevent damage, rotate collective stop slider in line with collective handle and tape in place.

7. Remove bolt and associated hardware securing A205-1 fork to collective stick.
8. Remove A486-4 (or -1) screw securing A327-1 overtravel spring to C341-3 (or C342-1) throttle arm.
9. If installed, disconnect aft end of carb heat assist push-pull tube from collective stick.
10. Cut and discard ty-raps securing electrical wiring and disconnect collective stick assembly wiring from main harness.
11. Remove (2) attach bolts and associated hardware securing collective stick and remove collective stick assembly from helicopter.

8.210 Collective Stick Assembly (continued)**B. Installation**

1. If removed, assemble A332-2 (or-1) friction lever onto collective stick per § 8.230. Tape A333-1 collective stop in line with stick to prevent damage during installation.
2. Refer to Figure 8-3. If A205-1 fork was removed from A101-4 rod end, screw fork onto rod end between 3.50–3.60 inches from center of rod end hole to centerline of attach bolt hole. Standard torque jamnut per § 23-32 and torque stripe per Figure 2-1.

**NOTE**

Dimension of A205-1 fork should be 3.50–3.60 inches from center of rod end bearing to center of attaching bolt hole (no palnut required on this rod end). Verify autorotational RPM per § 10.250 if A205-1 fork dimension has changed.

**NOTE**

Replace A139-1 bearings in A205-1 fork per § 8.600 if bearings are damaged or worn.

3. Position collective stick in helicopter and install hardware, ensure smaller diameter of A115-1 spacer installed against A329-1 bearing block assembly. Standard torque per § 23-32 and torque stripe per Figure 2-1.
4. Install hardware securing A205-1 fork to collective stick, standard torque per § 23-32 and torque stripe per Figure 2-1. Verify smooth operation of fork pivot.
5. Assemble hardware securing lower end of A333-1 collective stop to A348-1 seat belt anchor using combination of NAS1149F0432P or NAS1149F0463P washers (as required) on A130-4 spacer to align stop and collective with 0.001 to 0.035 inch axial play. Standard torque hardware per § 23-32 and torque stripe per Figure 2-1. Verify correct axial play and no binding.
6. Raise or lower collective to align collective spring lower rod end in A476-1 support assembly and install hardware. Standard torque bolt per § 23-32 and torque stripe per Figure 2-1.
7. Lower collective stick to relieve spring tension from MT294-1 or safety wire, remove tool or cut and discard safety wire. Verify smooth operation and spring does not bind with collective full down.

**WARNING**

**Failure to remove restraining safety wire after collective spring is installed can limit control travel creating a safety-of-flight hazard.**

8.210 Collective Stick Assembly (continued)**B. Installation (continued)**

8. Install collective spring guard.
9. Install hardware securing A327-1 overtravel spring upper rod end to throttle arm weldment. Ensure smaller diameter of A341-1 spacer is against rod end. Standard torque per § 23-32 and torque stripe per Figure 2-1.

**NOTE**

Use A486-1 screw for installation with C342-1 throttle arm.  
Use A486-4 screw for installation with C341-3 throttle arm.  
Screw head and smaller diameter of A341-1 spacer must be installed against rod end.

**WARNING**

**Improper installation can cause binding, rod end damage or rod end separation with subsequent loss of engine throttle control**

10. If installed, connect aft end of carb heat assist push-pull tube to flat side of collective arm. Standard torque per § 23-32 and torque stripe per Figure 2-1.
11. Attach collective stick assembly electrical connectors and ty-rap connectors to harness. Cinch ty-raps until snug without over-tightening and trim tips flush with heads.
12. Adjust throttle correlation rigging per § 10.150.
13. Install seat backs per § 15-22.
14. Install center cover & vertical panel (cyclic control inspection panels).
15. Verify autorotational RPM per § 10.250 if A205-1 fork assembly center-to-center dimension has changed.
16. Adjust collective spring per § 8.220 Part D, as determined by test flight.

## 8.220 Collective Spring Assembly

### A. Description

The collective spring assembly is installed to balance in-flight main rotor collective control forces. A038-1 thru -7 spring assemblies may be adjusted and A429 springs may be changed to obtain desired collective control forces in Part D. Test fly helicopter after collective spring adjustment to evaluate collective control forces in level cruise flight, repeat until desired forces are obtained.

#### WARNING

**Exercise extreme care when working with compressed collective springs. Always relieve spring compression slowly.**

#### NOTE

A038-5 spring assembly replaces A038-2 assembly. A038-6 assembly replaces A038-1, -3, & -4 assemblies.

Assembly P/N	Spring P/N	Spring Color	Spring Constant
A038-1	A429-1 (old)	Silver	89 lb/in.
A038-2	A429-2 (old)	Primer	35 lb/in.
A038-3 or -5	A429-3	Grey	50 lb/in. (weak)
A038-4	A429-4 (old)	Black	70 lb/in.
A038-6	A429-5	Gold	50 lb/in. (standard)
A038-7	A429-8	White	71 lb/in. (strongest)

### B. Removal

1. Remove left seat back per § 15-22.
2. Remove screws securing collective spring cover and remove cover. If spring cover aft mounting hole is slotted, screw may be loosened and left installed in vertical firewall stiffener.
3. Place collective in full down position. Install MT294-1 collective spring retainer or use 0.032 inch diameter safety wire to secure spring in compressed state. If safety wire is used, twist wire around rod end to rod end several times to ensure spring assembly can be removed safely.

#### WARNING

**Spring is under compression and failure to comply with above procedure can cause bodily harm and/ or damage to helicopter.**

4. Remove spring lower attach bolt slowly while moving collective slightly to transfer spring compression onto restraining safety wire or MT294-1 collective spring retainer.
5. Remove spring assembly upper attach bolt and remove spring assembly.

8.220 Collective Spring Assembly (continued)**C. Installation****NOTE**

Spring assembly must be compressed for installation to between 4.30 and 4.00 inches from center-to-center of rod ends. Orient assembly with nut end of rod guides pointing up.

**WARNING**

**When installing the A038-5, -6, or -7 spring assembly, both rod ends must be bottomed (B292-3 rod end has left-hand thread). Failure to bottom both rod ends can cause either one to run out of threads during adjustment and can cause bodily harm.**

1. Position collective spring assembly upper rod end in collective arm and install hardware. Standard torque hardware per § 23-32.
2. Raise or lower collective to align collective spring lower rod end in A476-1 support assembly and install hardware. Standard torque hardware per § 23-32.
3. Lower collective stick to relieve spring compression from MT294-1 collective spring retainer or safety wire, remove tool or cut and discard safety wire.
4. Verify smooth operation & spring does not bind with collective full down.

**WARNING**

**Failure to remove restraining safety wire after collective spring installation can limit collective control travel creating a safety-of-flight hazard.**

5. Install collective spring guard.
6. Install left seat back per § 15-22.

8.220 Collective Spring Assembly (continued)**D. Adjustment****WARNING**

Ensure that spring coils are not binding with collective stick full down after making adjustment. Binding spring coils can limit flight control travel.

A038-1 thru -4 Spring Assemblies

1. Remove left seat back per § 15-22, as required. Remove collective spring guard.
2. Place collective in full down position. Install MT294-1 collective spring retainer or use 0.032 inch diameter safety wire to secure collective spring in compressed state. If safety wire is used, twist wire around rod end to rod end several times to ensure spring assembly can be removed safely.
3. Remove spring lower attach bolt slowly while moving collective slightly to transfer spring compression onto restraining safety wire or MT294-1 collective spring retainer.
4. Loosen palnut and jamnut on lower rod end. Screw rod end into A426-4 cap to decrease collective-up force; extend rod end to increase collective-up force. Maximum extension for bottom rod end is 1.1 inches from cap to rod end center, provided spring does not bind.
5. Standard torque jamnut and palnut per § 23-32.
6. Raise or lower collective to align collective spring lower rod end in A476-1 support assembly and install hardware. Standard torque hardware per § 23-32.
7. Lower collective stick to relieve spring compression from MT294-1 collective spring retainer or safety wire, remove tool or cut and discard safety wire.
8. Verify smooth operation & spring does not bind with collective full down.
9. Install collective spring guard.
10. Install left seat back per § 15-22, as required
11. Evaluate collective trim forces per Part A. Adjust or replace spring as required.

A038-5, -6, or -7 Spring Assemblies

1. Remove collective spring guard.
2. Loosen palnut and jamnut on lower rod end.
3. With collective up, rotate spring by hand to screw rod ends in or out of caps (lower rod end is right-hand thread; upper rod end is left-hand thread). Screwing rod ends into caps decreases collective-up force; extending rod ends increases collective-up force.



8.220 Collective Spring Assembly (continued)**D. Adjustment (continued)**A038-5, -6, or -7 Spring Assemblies (continued)

4. Standard torque jamnut and palnut per § 23-32.
5. Install collective spring guard.
6. Evaluate collective trim forces per Part A. Adjust or replace spring as required.

**E. A429 Spring Replacement**

1. Remove collective spring per Part B.
2. Position spring assembly in a soft-jawed vise to compress spring, ensure rod ends will not slip during disassembly. Compress spring assembly slightly to relieve spring compression from MT294-1 collective spring retainer or safety wire, remove tool or cut safety wire and discard.
3. Carefully open vise to decompress spring and remove assembly from vice. Remove spring from assembly.
4. Inspect A428-1 guide rods for scratches or nicks; if damage found, replace rods. Apply light coat of A257-1 grease to guide rods, as required.

**NOTE**

If replacing B292-3 or A127-3 rod ends, apply light coat of A257-1 grease to threads.

5. Refer to table in Part A. Assemble collective spring using spring required to obtain desired collective control forces as determined by test flight.
6. Place collective spring assembly in a soft-jawed vise, ensure rod ends will not slip during spring compression. While guiding A428-1 rods into A426-4 or -6 cap, slowly compress spring assembly to between 4.30 and 4.00 inches from center-to-center of rod ends. Install MT294-1 collective spring retainer or secure spring assembly in a compressed state using 0.032 inch diameter safety wire. If safety wire is used, twist wire around rod end to rod end several times. Open vise slowly and remove spring assembly.
7. Reinstall collective spring assembly per Part C.

### 8.230 Collective Friction Assembly

#### A. Removal

1. Remove center horizontal cover (cyclic control inspection panel).
2. Remove hardware securing A333-1 stop to A348-1 anchor, retain hardware.
3. Loosen NAS1352-08LE8P (or -08-12P) screw in A332-2 (or -1) lever. Remove NAS1352-4-24P screw from lever and collective stick, retain washers.

#### B. Installation

1. Place (2) A478-2 (or B0500-022-S) washers on NAS1352-4-24P screw with concave side of washers facing each other.
2. Insert NAS1352-4-24P screw through (1) A141-20 washer, A333-1 stop (slotted hole), then second A141-20 washer, ensure gray Teflon®-coated surface of A141-20 washers are against A333-1 stop.
3. Thread NAS1352-4-24P screw into collective stick, as screw exits collective, thread screw into A332-2 (or -1) lever. Snug screw finger tight.
4. Assemble hardware securing lower end of A333-1 stop to A348-1 seat belt anchor using combination of NAS1149F0432P or NAS1149F0463P washers (as required) on A130-4 spacer to align stop and collective with 0.001 to 0.035 inch axial play. Standard torque hardware per § 23-32 and torque stripe per Figure 2-1. Verify correct axial play and no binding.
5. Set collective friction per Part C.
6. Install center horizontal cover (cyclic control inspection panel).

#### C. Adjustment

1. As required, loosen NAS1352-08LE8P (or -08-12P) screw in A332-2 (or -1) lever. Rotate friction lever aft to friction locked position.
2. Tighten NAS1352-4-24P screw to increase friction, or loosen screw to decrease friction as required to produce 12 to 20 pounds resistance measured at collective grip, using a spring scale pulling up from bottom of travel.
3. Tighten NAS1352-08LE8P (or -08-12P) screw. Verify 12 to 20 pounds of force required to raise collective measured at grip with friction locked; verify 6-10 pounds of force to raise collective with friction unlocked. Repeat steps 1 and 2 as required.

#### WARNING

Collective friction greater than 20 pounds may prevent aircraft from entering autorotation.

## 8.240 RPM Governor System

### A. Description

The governor maintains engine RPM by sensing changes and applying corrective throttle inputs through a friction clutch which can be easily overridden by the pilot. The governor is active only above 80% engine RPM and can be switched on or off using the toggle switch on the end of the right seat collective.

The governor is designed to assist in controlling RPM under normal conditions. It may not prevent over- or under-speed conditions generated by aggressive flight maneuvers.

#### CAUTION

When operating at high density altitudes, governor response rate may be too slow to prevent overspeed during gusts, pull-ups, or when lowering collective.

### B. Governor Controller Removal

Refer to § 33-137 for D270-1 Governor Controller and Engine Monitoring Unit (EMU) description. Refer to the EMU Technician's Guide and EMU User Guide online at <https://robinsonheli.com> for data access.

#### WARNING

**No external adjustment of controller is available. If controller fails to operate correctly, remove and return it to RHC.**

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Remove right seat back assembly to access D270-1 governor controller, or left seat back assembly to access B286-2 governor controller per § 15-22.
  - a. D270-1 Governor controller: Loosen screws and disconnect airframe harness connector from governor controller; disconnect 1598-01C cable from governor controller. Cut and discard ty-raps as required and disconnect MAP line from governor controller.
  - b. B286-2 Governor controller: Disconnect airframe harness connector from B286-2 governor controller.
3. Remove hardware securing governor controller to right side bulkhead (D270-1 governor controller) or left seat back assembly (B286-2 governor controller) and remove governor controller.

## 8.240 RPM Governor System (continued)

### C. Governor Controller Installation

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Install hardware securing governor controller to right side bulkhead (D270-1 governor controller) or left seat back assembly (B286-2 governor controller). Verify security.
  - a. D270-1 Governor controller: Connect airframe harness connector to governor controller and tighten screws; connect 1598-01C cable to governor controller. Connect MAP line to governor controller and install ty-raps. Cinch ty-raps until snug without over-tightening and trim tips flush with heads.
  - b. B286-2 Governor controller: Connect airframe harness connector to B286-2 governor controller.
4. Push in GOV (2 amp) circuit breaker on circuit breaker panel.
5. Install seat back assembly per § 15-22.

### D. Governor Assembly Removal

1. Remove collective stick per § 8.210.
2. Remove three screws securing governor assembly to collective stick.
3. Remove NAS6603-7 bolt securing governor assembly output arm to A498-1 rod end.

#### WARNING

Adjustment of the friction clutch is **NOT** permitted. Field replacement of the gearmotor is **NOT** permitted. If friction setting is incorrect, or gearmotor operates incorrectly, remove governor assembly from collective stick and return to RHC.

### E. Governor Assembly Installation

1. Install hardware securing governor assembly output arm to A498-1 rod end, ensure bolt head is aligned to clear washers on arm. Standard torque bolt and palnut per § 23-32 and torque stripe per Figure 2-1.

#### NOTE

Link assembly length must be 2.47-2.53 inches from rod end center-to-center.

8.240 RPM Governor System (continued)**E. Governor Assembly Installation (continued)**

2. Ensure governor assembly output arm points up toward B328-1 connecting rod. Install NAS1351-4-28P screw, (2) NAS1352N08-4 screws, and associated hardware securing governor assembly to collective stick. Standard torque screws per § 23-32.
  - a. If installing (2) AN503-8-4 screws; torque to 27 in.-lb and safety wire with 0.020 inch diameter safety wire.
3. Rotate throttle grips, verify smooth operation and no interference.
4. Install collective stick per § 8.210.

**F. Governor System Troubleshooting**

The majority of governor problems are caused by the engine's right (helicopter left side) magneto tachometer contact assembly (points) being out of adjustment or faulty. Refer to TCM Master Service Manual for tachometer contact assembly installation and adjustment.

When operating in the 80% – 115% active range, the R22 governor will attempt to maintain engine rpm at 104%  $\pm$  1.5% (102.5% – 105.5%). The edges of this governed 3%-rpm wide window, called a "deadband", may be detected as follows:

1. With an appropriately rated person at controls, start engine and run-up helicopter per R22 Pilot's Operating Handbook (POH) Section 4. Collective must remain fully down during this and following steps.
2. Gently hold throttle and very slowly increase rpm (do not exceed 107%). Note and record engine rpm indication when governor input (subtle throttle resistance) is encountered.
3. Gently hold throttle and very slowly decrease rpm (do not go below 97%). Note and record engine rpm indication when governor input (subtle throttle resistance) is encountered.
4. After shutdown, subtract Step 3 indication from Step 2 indication. Result should be approximately 3%.

A result of 3% but centered beyond 104%  $\pm$  0.5% is indicative of a governor controller problem.

Results greater than 3% but still centered on 104% are usually indicative of excessive throttle linkage friction or insufficient governor friction.

**8.240 RPM Governor System (continued)****F. Governor System Troubleshooting (continued)**

Check throttle friction by disconnecting overtravel spring assembly upper rod end from C342 arm and attaching a spring scale to the rod end. With carburetor throttle arm in idle position, slowly pull up overtravel spring assembly with spring scale and note maximum 4 pounds moving friction prior to full-open throttle at carburetor. Excessive throttle linkage friction can be caused by binding rod ends, control interference, carburetor throttle shaft bushing elongation, or binding carburetor accelerator pump (typically binds in one direction only).

Check governor friction with collective down, collective friction on, overtravel spring assembly upper rod end disconnected from C342 arm, and C342 arm positioned horizontally. Attach a spring scale to hole in C342 arm and, with scale held tangential to arm, slowly pull on scale and note both the breakaway and the moving frictions. Breakaway friction is typically 0 – 0.5 pound greater than moving friction. Breakaway friction 1 pound or greater than moving friction may indicate damaged or contaminated governor friction clutch. Moving friction must be minimum 8 pounds until arm stops moving. Insufficient moving friction can be caused by wear, contamination, or loss of spring rate.

Proper governor operation requires a minimum 2:1 ratio of governor friction-to-throttle linkage friction.

Erratic operation is usually indicative of tachometer contact assembly problems or wiring damage. Wiring damage may be evidenced by crushing, pinching, or abrasion, all of which can result in grounding of one or both center wire conductor(s) to the shielding or to structure. Tachometer contact assembly problems may be caused by contamination, oxidation, or loose contact(s), in addition to installation or assembly errors.

Contamination can be caused by over-lubrication of cam follower felt, engine oil leaking past oil seal, or moisture intrusion thru vent plug. Oxidation can be caused by an obstructed vent plug or by engine oil leaking past the oil seal.

When flying in turbulence, or if the engine is lightly “loaded” (drive train almost freewheeling), a fluctuating MAP indication is expected.

Any loose connection in throttle linkage (including worn carburetor throttle shaft bushings) will result in both RPM & MAP oscillations.

### 8.300 JACKSHAFT AND SUPPORT STRUTS

#### 8.310 Jackshaft (See Figure 8-9)

##### 8.311 Jackshaft Removal

###### NOTE

Rigging check should not be necessary if jackshaft support strut rod ends or push-pull tube rod ends are not loosened or removed.

- a) Disconnect the push-pull tubes from the jackshaft.
- b) Disconnect the two (2) jackshaft support bolts at the upper support strut rod ends.
- c) Remove jackshaft.

##### 8.312 Jackshaft Installation

Install jackshaft to strut rod ends. Aft support rod end requires a safety washer A214-3 between the rod end and bolthead. Both upper strut attach boltheads point aft. Torque nut to 100 in.-lbs plus nut drag. Install palnut.

Connect the A121-3 and -5 push-pull tubes to jackshaft. Both push-pull tube attach boltheads point forward. The forward A121-3 push-pull tube rod end requires a safety washer A214-3 and A115 spacer between the rod end and bolthead. Torque nuts to 100 in.-lbs plus nut drag. Install palnut.

Verify no binding or interference with control movement throughout flight control travel.

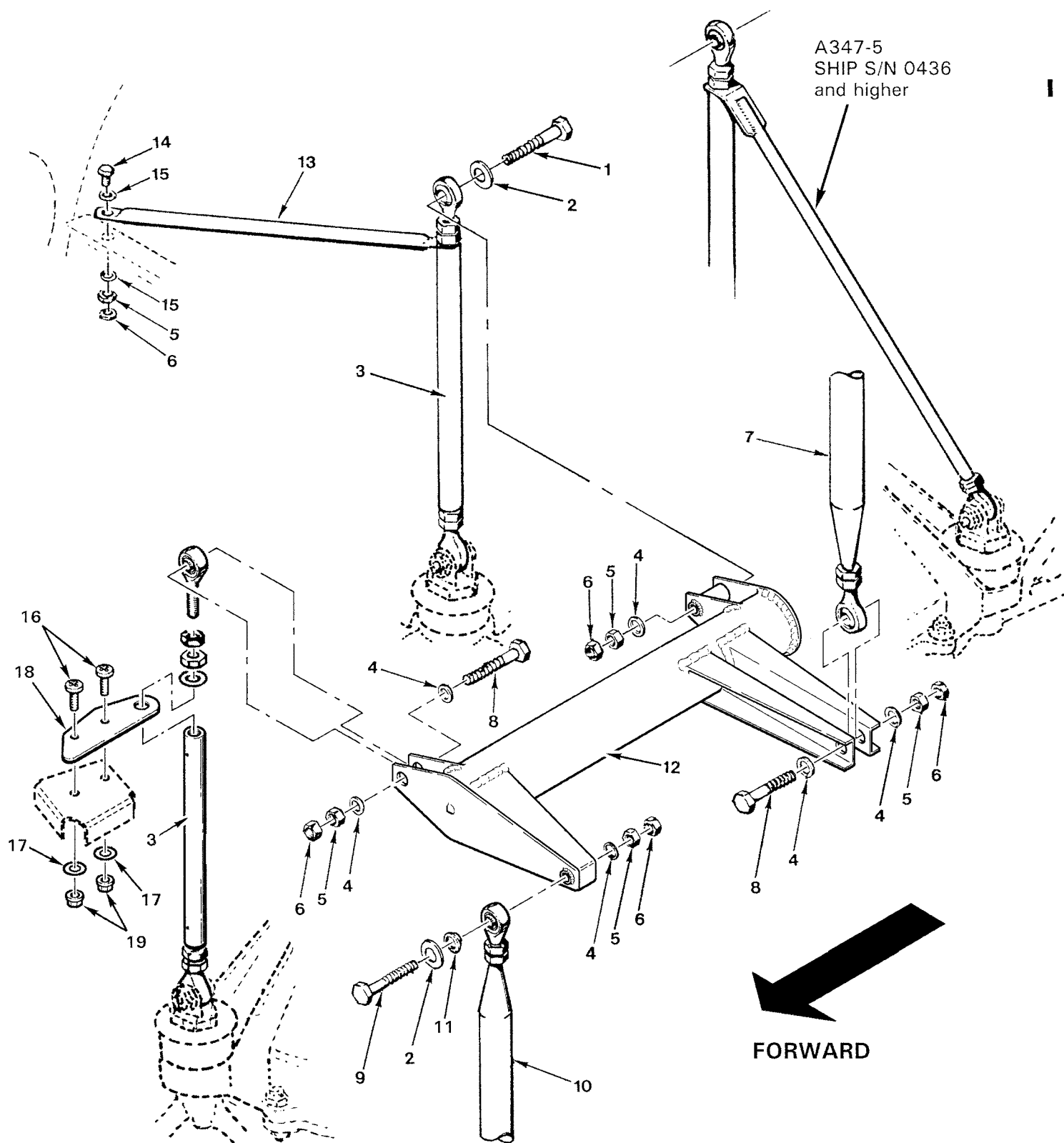
#### 8.320 Strut Assembly (Jackshaft Support)

##### 8.321 Jackshaft Strut Removal

- a) Remove jackshaft per Section 8.311
- b) Remove the aft support strut. Disconnect horizontal strut assembly at the 'V' bulkhead. Disconnect the lower strut rod end at the aft main rotor gearbox fitting.

<u>NUMBER</u>	<u>PART NUMBER</u>	<u>DESCRIPTION</u>
1	NAS1304-23	Bolt
2	A214-3	Washer
3	A343-1	Strut
4	AN960-416L	Washer
5	NAS679A4	Nut
6	MS27151-13	Palnut
7	A121-5	Push-Pull Tube
8	NAS1304-7	Bolt
9	NAS1304-21	Bolt
10	A121-3	Push-Pull Tube
11	A115-1	Spacer
12	A337-1	Jackshaft
13	A347-1	Brace
14	NAS1304-2	Bolt
15	AN960-416	Washer
16	AN525-832R6	Screw
17	AN960-8L	Washer
18	A437-2	Tab
19	NAS679A08	Nut





**FIGURE 8-9 JACK SHAFT INSTALLATION**

### 8.321 Jackshaft Strut Removal (cont'd)

#### NOTE

For ease of installation later, DO NOT disassemble the long horizontal strut from the vertical strut.

- c. Forward support strut removal: To remove, it will be necessary to disconnect upper rod end installed through a fuselage tab, DO NOT remove lower rod end from support if possible.

#### NOTE

For ease of installation later, measure length of strut from center of rod ends and tag strut with length for later reference.

### 8.322 Jackshaft Strut Installation

#### NOTE

Two (2) AN960-516L washers are installed on forward supports; one between upper forward rod end jamnut and fuselage tab, other between upper aft jamnut and A347 horizontal strut.

1. Install forward support strut.
  - a. Connect forward vertical support strut lower rod end to forward-right gearbox fitting. Verify minimum preload between bulkhead-mounted jackshaft brace tab and top of strut; adjust strut height as required. Verify proper rod end engagement via strut witness hole.
  - b. Install strut upper rod end , with palnut and jam nut installed, thru brace tab into top of strut. Adjust rod end center-to-center dimension to previously recorded measurement, if applicable. Verify proper rod end engagement via strut witness hole.
2. Connect aft-vertical strut lower rod end to aft-right main rotor gearbox fitting. Connect vertical diagonal strut to aft-left gearbox fitting, or connect horizontal diagonal strut to Vee-bulkhead, as applicable.
3. Torque bolts per Section 1.320. Install palnuts, and torque per Section 1.320. Torque stripe per Figure 2-1.
4. Install jackshaft and push-pull tubes per Section 8.312.
5. If aft-vertical strut was disassembled or length changed, adjust aft strut and/or forward strut to achieve jackshaft level to helicopter keel panel within  $\pm 0.5^\circ$ . Verify proper rod end engagement through witness hole in strut.
6. Verify proper rod end centering and all bolts, jamnuts, and palnuts are torqued per Section 1.320 and torque striped per Figure 2-1.

## 8.400 Swashplate and Main Rotor Pitch Links

### 8.410 Swashplate

#### 8.411 Swashplate Removal

**NOTE**

Rigging check is not required if push-pull tube rod end bearing center-to-center dimension has not changed.

1. Remove main rotor hub and blade assembly per §§ 26-20 and 26-10. |
2. Disconnect and remove A203 yoke halves.
3. Remove droop stops and elastic teeter stops.
4. Remove swashplate boot.
5. Disconnect three push-pull tubes and rod end of lower A205 fork assembly from lower, non-rotating swashplate.
6. Lift swashplate off slider tube.

| 8.412 Swashplate Installation**CAUTION**

Swashplate plastic balls are obsolete and must be replaced.

1. Verify swashplate rotates freely.
2. On swashplate ear opposite interrupter, attach pitch link's lower rod end with five AN970-4 washers and two AN960-416L washers under bolt head, one A115-1 spacer on each side of rod end, with the small washers between spacer and large washers. Install additional AN960-416L washer on bolt inboard of inner A115-1 spacer and insert bolt into swashplate ear. Washer stack-up must be located on outside of ear. Install washers under nut as required to expose two to four threads after torquing. Standard torque nut per § 23-32. Install palnut, standard torque per § 23-32, and torque stripe per Figure 2-1.
3. On interrupter-side swashplate ear, attach pitch link with an A214-3 washer under bolthead, one A115-1 spacer on each side of pitch link rod end, and one AN960-416L washer between A115-1 spacer and swashplate ear.
4. On interrupter-side swashplate ear, install A115-1 spacer on protruding length of bolt, then A205 fork assembly rod end (rod end shank pointing up), another A115-1 spacer, one A214-3 washer, and the nut. Standard torque nut per § 23-32. Install palnut, standard torque per § 23-32, and torque stripe per Figure 2-1.
5. Attach A204 arm to A205 fork installed in previous step. If fork has plastic A139-1 bearings, line ream and spot face bearings for correct fit per § 8.600. If fork has C648-2 bearings (dark-brown colored face & bore), install a combination of A117-45, -46, and/or -47 shims between A105-17 journal and A141-43 washer on nut side to provide 0.010/0.001 inch axial play in joint. Refer to Figure 2-8. Verify 2.5 in.-lb maximum pivot friction.
6. Install swashplate and attached pitch links, fork, and arm onto slider tube assembly atop main rotor gearbox.
7. Slide boot over A251 main rotor shaft and set in place.
8. Install A203 yoke assembly onto A251 shaft using A210-1 key to position yoke on shaft. Radiused edge of A210-1 key goes into flange slot in A251 shaft. Standard torque nut per § 23-32. Install palnut, standard torque per § 23-32, and torque stripe per Figure 2-1.

**CAUTION**

Tighten and torque bolt through A210-1 key first.

#### 8.412 Swashplate Installation (continued)

9. Install opposite clamping bolt in chord-arm side of yoke. As applicable, special torque NAS1305 or NAS6605 bolt per § 23-33, or standard torque NAS1304 or NAS6604 bolt per § 23-32. Install palnut, standard torque per § 23-32, and torque stripe per Figure 2-1.

#### NOTE

A small space between chord-arm side yoke halves adjacent to driveshaft is normal. Do not exceed bolt torque limits.

10. Connect A204-1 arm to A203 yoke assembly. If yoke has plastic A139-1 bearings, line ream and spot face bearings for correct fit per § 8.600. If yoke has C648-2 bearings (dark-brown colored face & bore), install a combination of A117-45, -46, and/or -47 shims between A105-17 journal and A141-43 washer on nut side to provide 0.010/0.001 inch axial play in joint. Refer to Figure 2-8. Verify 2.5 in.-lb maximum pivot friction.
11. Install A255 counterweights and AN970-4 washers on A203 yoke arm as required for balance.
12. Attach lower A205 fork's rod end to left side of middle of three lugs grouped together on lower swashplate. Connect forward push-pull tube rod ends to left side of remaining two forward lugs. Aft push-pull tube rod end attaches to right side of lower swashplate aft lug. A214-3 safety washer required between bolthead and A115-1 spacer. A115-1 spacers are required on each side of all rod end balls. Standard torque bolts per § 23-32. Install palnuts, standard torque per § 23-32, and torque stripe per Figure 2-1.
13. Position boot on upper swashplate and ty-rap in place. Ensure upper portion of boot clamps on shaft between upper flange and A203 yoke halves.
14. Temporarily install teeter hinge bolt and journals. Install droop stops and elastic teeter stops. Ensure teeter stop brackets are oriented per Figure 26-5. Standard torque bolts per § 23-32. Install palnut, standard torque per § 23-32, and torque stripe per Figure 2-1. Remove teeter hinge bolt and journals.
15. Verify no binding or interference with control movement throughout flight control travel.
16. Install main rotor hub and blades per §§ 26-20 and 26-10.
17. Track and balance main rotor per § 10.200.

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#### 8.416 Shimming Upper (Unflanged) Spherical Sleeve with Aluminum Ball

Measure space between top of upper spherical sleeve to top surface of lower swashplate. Determine required A209 spacer thickness by installing a spacer that will completely fill the space. (A209 spacers are available in increments of 0.005 inch.)

- a) Install shield plate. Torque screws to 17 in-lbs.
- b) Use a spring scale (MT359-1 or equivalent) to pull down at bolt hole in upper swashplate arm as shown in Figure 8-12A. The force required to tilt the swashplate must be free-without-looseness to five pounds maximum, measured while moving; do not use breakaway reading.
- c) Use a thicker or thinner A209 spacer to adjust swashplate tilting force. Increase spacer thickness to increase force required to tilt swashplate.

### 8.500 TAIL ROTOR CONTROLS

#### 8.510 Tail Rotor Pedals (Standard or Removable)

##### 8.511 Tail Rotor Pedal Removal

- a) Remove the landing light cover, belly cover and cabin cover between the seats (horizontal).

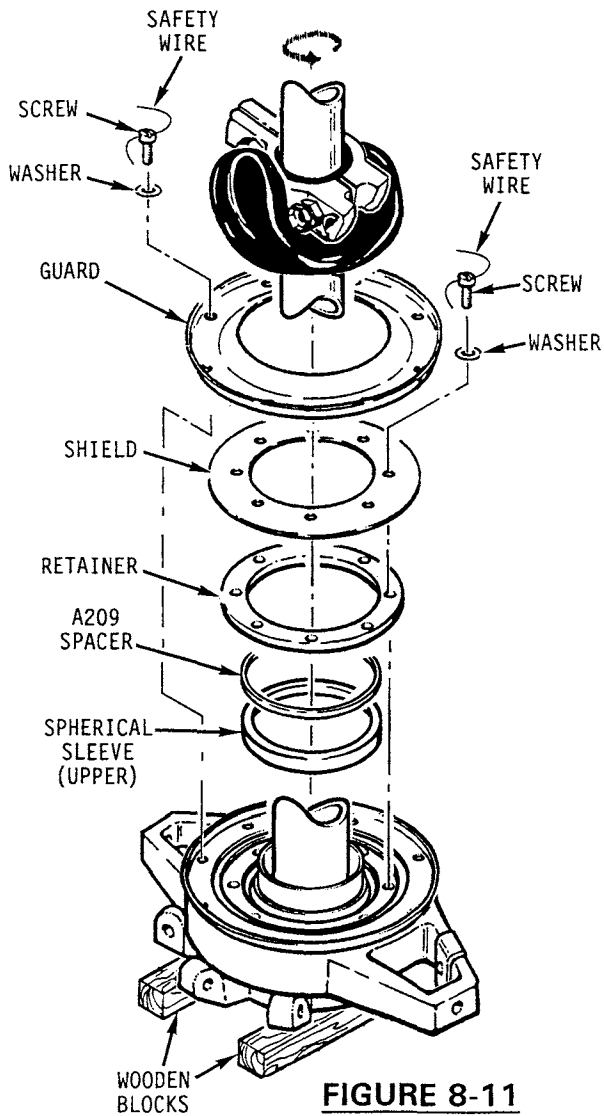
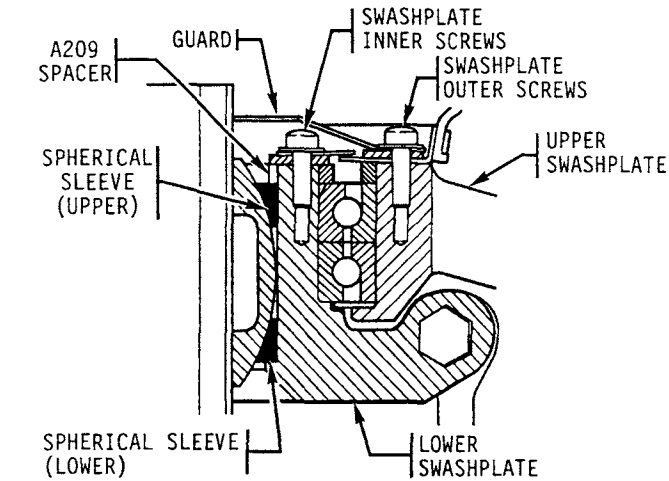
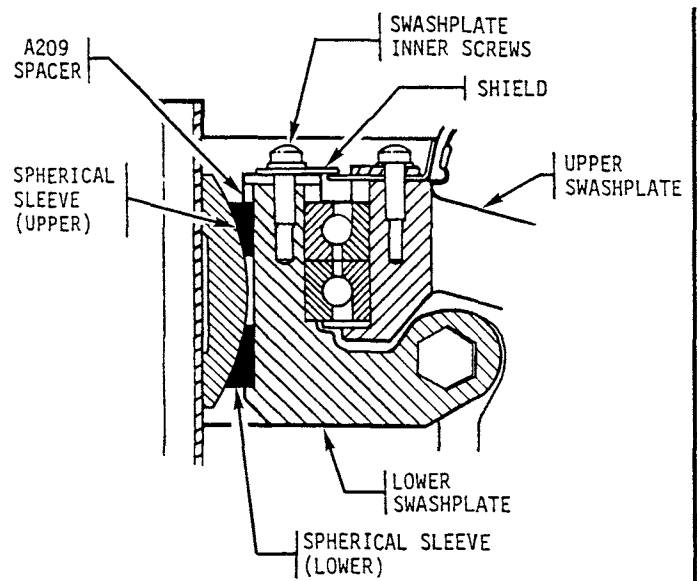


FIGURE 8-11



SWASHPLATE CUTAWAY  
A209 SPACER (SHIM)  
UNFLANGED SLEEVE

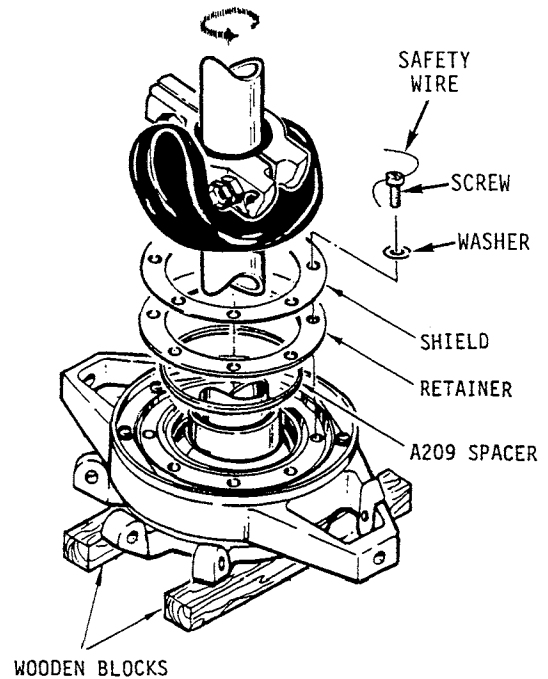
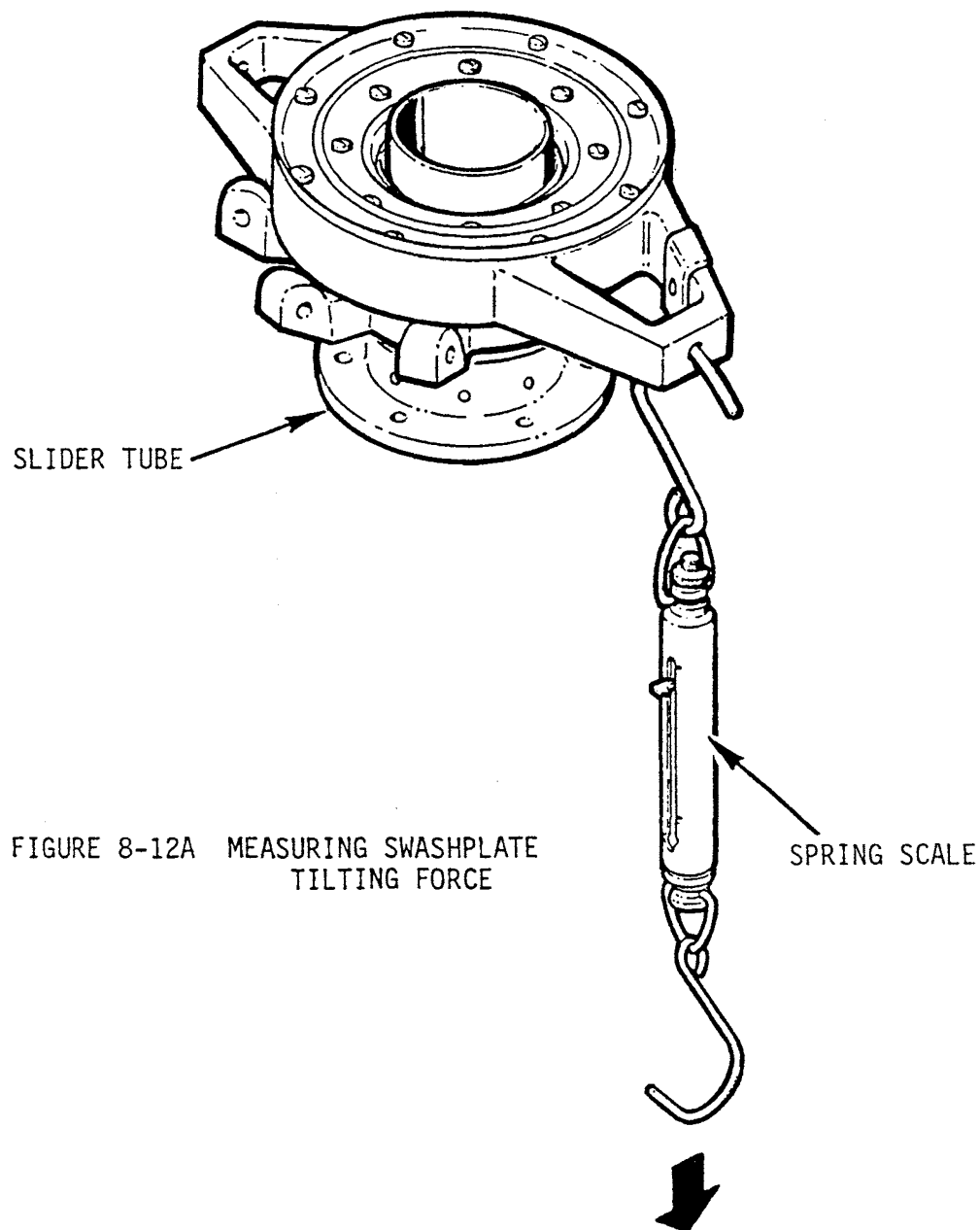


FIGURE 8-12

SWASHPLATE SHIMMING WITH A209 SPACER



## 8.511 Tail Rotor Pedal Removal (cont'd)

- b) Drill out the pop rivets holding the landing light bracket to the fiberglass chin with a #30 drill bit and remove.
- c) Remove the two NAS1304-9 bolts holding the tail rotor push-pull tubes to the A317-1 tail rotor bellcrank (lower).
- d) Pull the left tail rotor pedal aft, then working through the landing light access in the chin, disconnect the NAS1304-9 bolt that holds the A121-11 push-pull tube to the left pedal assembly.
- e) Leaving the left pedal in the full aft position, pull the right pedal fully aft and disconnect the NAS1304-9 bolt that holds the A121-9 tube to the right pedal assembly.
- f) Remove both push-pull tubes from the aircraft through the chin access.
- g) Lift carpet carefully from the floor on both sides and remove from the cabin.
- h) Remove the eight (8) screws that hold the access plates between the pedal assemblies and remove the plates.
- i) The next step will require two (2) people. With someone holding the NAS1303-20 bolts from above that hold the A318-1 bearing block halves together, reach through the chin access and remove the NAS679-A3 nuts.
- j) Remove the lower bearing block halves.
- k) Remove the tail rotor pedals one at a time by lifting one end and allowing the other to drop into the chin. They can be removed from either the right or the left side.

## NOTE

On reassembly the right pedal assembly is mounted forward in the bearing blocks and the left is mounted aft.

## 8.511 Tail Rotor Pedal Removal (cont'd)

## NOTE

Pedal blocks (upper and lower) are machined matched set as indicated by matching letter or number on the upper and lower portion of blocks. DO NOT MIX THEM or alignment problems may develop on installation.

## 8.512 Tail Rotor Pedal Installation

- a) Fill the grooves in the pedal bearing blocks with A257-1 grease.
- b) Install the pedal assemblies into the bearing blocks and torque the bearing block attach bolts to 40 in.-lb plus nut drag.

## NOTE

If a force greater than 5 lbs is required to move pedals, check the bearing blocks to ensure they are matched correctly.

- c) Install the A121-9 and 11 push-pull tubes. The A121-9 will connect to the upper A317-1 bellcrank attach point and the left pedal assembly. The A121-11 will connect to the lower A317-1 bellcrank attach point and the right pedal assembly. Torque the attach bolts to 100 in.-lb plus nut drag. Install palnuts.

## NOTE

The bolts attaching the push-pull tubes to the pedal assemblies must have their head toward each other for clearance.

- d) Install the pedal cover plates and carpeting.
- e) Pop rivet the landing light bracket to the chin and install the landing lights.

8.520 A317-1 Lower Bellcrank

## 8.521 A317-1 Lower Bellcrank Removal

- a) Remove lower belly panel.
- b) Disconnect the attaching hardware to the A121-9 and -11 push-pull tubes at the A317-1 bellcrank.



## 8.521 A317-1 Lower Bellcrank Removal (cont'd)

- c) Disconnect the A315 support holding the A317 bellcrank by removing the 4 attach bolts and swing assembly forward.
- d) Remove bolt attaching A317 bellcrank to the A315 support.

## 8.522 A317-1 Lower Bellcrank Installation

This procedure also covers rigging of the lower push-pull tubes and pedal assemblies. If re-checking of rigging is not required, disregard rigging portions and follow installation sequences.

- a) Install A130-12 spacers and two A105-3 journals inside A316 bellcrank, A141-3 washers are installed against the A105-3 journals upon assembly to the A315 support outside of aircraft. Excess gap between A315 support attaching flanges and the A141-3 washers next to the assembled bellcrank may be filled with either A214-3 or A141-3 washers.

## NOTE

When A317 bellcrank is installed, the 3/16" dia. rigging pin hole will be above the pivot point and the bellcrank itself will be aft of the bellcrank support.

Tighten pivot nut and check for smooth and free operation. Maximum spring scale drag of 2 lb is acceptable to move the bellcrank. Torque to 100 in-lb plus drag torque if acceptable.

If a force in excess of 2 lbs. is required to move the bellcrank, see Section 8.600 for A139-1 bearing reaming and spotface procedure.

- b) Temporarily attach the A315-1 and A317-1 into aircraft to check for proper push-pull tube rigging length. Insert rigging pin thru the cabin assembly into the A317-1 bellcrank for rigging. Temporarily attach A121-9, 11 and 13 push-pull tubes to the A317.

Place the left and right pedals together at the mid (neutral) travel position. Place a 2.90 inch spacer between each inside pedal and stop. Adjust the rod ends on the A121-9 and A121-11 push-pull tubes as required to insert a bolt through the rod end and the A317-1 bellcrank. Check push-pull tube rod end and the A317-1 bellcrank. Check push-pull tube rod end witness holes for engagement.

## 8.522 A317-1 Lower Bellcrank Installation (cont'd)

- c) After adjusting pedal travel, remove the rigging pin and apply full left pedal and adjust A121-13 push-pull tube to obtain .06" minimum clearance of the A013-3 bellcrank and the vertical firewall. Adjust push-pull tube as required.

## NOTE

It is permissible for the bellcrank arm to touch and deflect acoustical foam, as long as it does not interfere with free movement and full travel of the controls.

- d) With the A315 support and A317 bellcrank attachment, disconnected from the keel panels (A121-9 and -11 push-pull tubes disconnected) slide bellcrank forward.

## NOTE

The A121-13 push-pull tube attach bolt must be installed with bolthead to the right side for clearance in vertical tunnel.

## NOTE

On installation to the A317 bellcrank, an AN960-416 washer is installed to fill gap between rod end and the left plate of the A317 bellcrank (washer on left side of rod end).

- e) Attach A315 bellcrank support to keel panels.
- f) Attach the A121-9 and -11 push-pull tubes to the A317 bellcrank.
- g) Torque all attaching NAS1304 bolts to 100 in.-lb plus nut drag. Install palnuts and torque stripe fasteners.
- h) Check for smoothness and ease of operation. Move pedals full travel. Check for any interference between tubes, wires and structures.

**8.522 C317-2 Lower Forward Bell Crank Installation (cont'd)**

- i) If required, check complete Tail Rotor rigging if changes to A121-9, -11, or -13 push-pull lengths have been made.
- j) Verify all attach bolts and jamnuts torqued per Fastener Torques Section 1.300.
- k) Install panels.

**8.530 A013-3 Upper Bellcrank****8.531 Bellcrank Removal**

- 1. Remove A121-15 push-pull tube.
- 2. Remove belly inspection panel.
- 3. Disconnect A121-9 and -11 at A317 bellcrank.
- 4. Disconnect A315 and A317 bellcrank with A317 bellcrank attached.
- 5. Slide A315 and A317 bellcranks with A121-13 push-pull tube attached up to disconnect -13 push-pull tube at upper bellcrank.

**NOTE**

Upper bellcrank needs to be rotated as far aft as possible to remove A121-13 push-pull tube attach bolt.

- 6. Remove upper bellcrank attach bolt. Catch all A214-2 and A141-3 washers installed as bolt is remove.
- 7. Remove upper bellcrank from structure.

**8.532 Bellcrank Installation**

- 1. Install A130-12 spacer and two A105-3 journals inside A013-3 bellcrank. Ream A139 bearing with 0.375/0.376 inch dead sharp reamer if required for journal's smooth installation.
- 2. Install bellcrank with A141-3 washers bellcrank with A141-3 washers next to blue Turcite A139-1 bearings. If gap exists between A141-3 washers and outboard support, fill either with A214-3 or A141-3 washers.
- 3. Torque attach bolt per Section 1.320. Install palnut.

### 8.532 A013-3 Upper Bellcrank Installation (cont'd)

4. Check for smoothness and ease of operation.
5. Attach A121-9, -11 and -13 push-pull tubes along with A315 and A317 bellcrank assemblies, following procedure in Section 8.522.

#### **CAUTION**

A121-13 push-pull tube to A013-3 upper bellcrank attach bolt head must point to right side of helicopter for clearance.

6. Install the A121-15 push-pull tube.
7. Check rigging if necessary.
8. Torque all attaching bolts and jamnuts per Section 1.300.
9. Check for smoothness and ease of operation. Move pedal full travel, check for any interference between tubes, wires and structures.
10. Install panels.

### 8.540 A331-1 Intermediate Bellcrank

#### 8.541 A331-1 Intermediate Bellcrank Removal

1. Disconnect A121-15 and -17 push-pull tubes from A331-1 bellcrank.
2. Disconnect A331-1 attach bolt and remove bellcrank.

#### 8.542 A331-1 Intermediate Bellcrank Installation

Install two A105-3 journals into bellcrank bearings. An A141-3 washer is required on each side of bellcrank to A139-1 bearings. (Ream A139-1 bearing with 0.375/0.376 inch dead sharp ream if required for journal's smooth installation).

#### **NOTE**

If required for A121-17 attach bolt clearance with the scroll two AN960-416 washers may be installed between the bell crank and the frame to raise the bellcrank. This will require use of NAS1304-40 bolt, to attach bellcrank to frame.

## 8.542 A331-1 Intermediate Bellcrank Installation (cont'd)

- a) Torque to 100 in-lb plus nut drag. Install palnuts.
- b) Check for smoothness and ease of operation.
- c) Connect A121-15 and -17 push-pull tubes. A214-3 safety washers are required under the boltheads.
- d) Re-rig if push-pull tube lengths were altered.
- e) Move pedals full travel, check for any interference between tubes, wires, components or structures.

8.550 A120-1 Aft Bellcrank

## 8.551 A120-1 Aft Bellcrank Removal

- a) Disconnect A121-17 push-pull tube from A120 aft bellcrank.
- b) Disconnect bellcrank pivot from attach bolt connected to tail rotor gearbox.
- c) Remove nut holding bellcrank to the pitch control. Remove bellcrank and reinstall nut and shims found between bellcrank and pitch control for bellcrank installation.

## 8.552 A120-1 Aft Bellcrank Installation

See A031 Pitch Control Installation (See Section 8.562).

8.560 A031 Pitch Control

## 8.561 Pitch Control Removal

- a) Remove tail rotor hub and blade assembly. Mark corresponding tail rotor blade grips, tail rotor pitch change to each of the pitch control ears, for later reinstallation so re-rigging is not required.
- b) Disconnect and remove aft bellcrank per Section 8.551.
- c) Remove pitch control from tail rotor output shaft.

## 8.562 Pitch Control Installation

- a) Slide A031-1 pitch control assembly onto output shaft.
- b) Position A120-1 bellcrank assembly on the tail rotor gearbox and install NAS1304-25 bolt, one AN960-416 washer under bolt head, two MS20002-4 washers, one on each side of the bearing and NAS679-A4 nut.

## 8.562 Pitch Control Installation (cont'd)

- b) Measure the gap existing between the A120-1 bellcrank ear and the flats on the A125-1 pitch control stud. Install sufficient A117-20, -21 and -22 washers between bellcrank and stud to completely fill the gap but not apply any axial preload on the spherical bearing after all the nuts are tightened. The clearance tolerance is plus or minus .003". Install one AN960-416L washer and NAS679-A4 nut on protruding end of stud. Torque nut to 70 in.-lbs plus nut drag while holding stud from rotating. Install palnut.
- c) Torque nut on A120-1 bellcrank pivot to 100 in.-lbs plus nut drag. Install palnut.
- d) Attach aft end of A121-17 push-pull tube to the A120-1 bellcrank and A214-3 safety washer under nut next to rod end. Torque nut to 100 in.-lb. plus nut drag. Install palnut.
- e) Install pitch control links per Section 8.572.
- f) Install tail rotor hub and blade assembly (See Section 9.212).
- g) Ensure all bolts, jamnut and palnuts torques per Fastener torques, Section 1.300.

8.570 Tail Rotor Pitch Links

## 8.571 Tail Rotor Pitch Link Removal

## NOTE

To ensure proper rigging upon re-installation of pitch links, mark pitch links to corresponding blade grip and pitch control ear.

- a) Disconnect the two attach bolts on either rod end of the pitch link.
- b) Remove pitch link.

## 8.572 Tail Rotor Pitch Link Installation

**WARNING**

A214-3 safety washers are to be installed next to rod end.

8.572 Tail Rotor Pitch Link Installation (cont'd)**WARNING**

**Both pitch links must be same part number (same type and material). Mixing one-piece with adjustable-length pitch links is prohibited. Mixing steel one-piece with aluminum one-piece pitch links is prohibited.**

Refer to Figure 9-11.

1. If installing one-piece pitch link(s); connect pitch link to pitch link control arm and blade pitch horn.
2. If installing new, adjustable-length pitch link(s) based on old pitch link length:
  - a. Match pitch link to proper blade pitch horn and pitch control arm and connect pitch link. Torque attach bolts per Section 1.320. Install palnuts, torque per Section 1.320, and torque stripe per Figure 2-1. Repeat for opposite blade.
  - b. Torque attach bolts per Section 1.320. Verify proper rod end centering and adjust as required. Install palnut, torque per Section 1.320, and torque stripe per Figure 2-1. Repeat for opposite blade.
  - c. Check tail rotor control rigging per Section 10.140.
3. If installing new, adjustable-length pitch links (nominal length setting):
  - a. Assemble male rod end, with jam nut and palnut installed, into female rod end. Adjust rod ends until a dimension of 2.360 inches, measured between rod end bearing centers.
  - b. Attach pitch link female rod end to outboard side of pitch control arm. Torque bolt per Section 1.320. Install palnut, torque per Section 1.320, and torque stripe per Figure 2-1.
  - c. Connect pitch link male rod end to blade pitch horn. AN960-416, AN960-416L, or A141-14 washers may be under nut for chordwise balance. Torque bolt per Section 1.320. Install palnut, torque per Section 1.320, and torque stripe per Figure 2-1.
  - d. Torque pitch link jam nut and palnut per Section 1.320 and torque stripe per Figure 2-1. Repeat steps a. thru d. for opposite blade.
  - e. Check tail rotor control rigging per Section 10.240.

### 8.572 Tail Rotor Pitch Link Installation (cont'd)

4. Operate the tail rotor controls thru their entire operating range and verify no binding or abnormality exists.
- I 5. Dynamically balance tail rotor per Section 10.240.

### 8.600 A203 YOKE AND A205 FORK ASSEMBLY (Figure 8-10)

Three different bearing types have been used in A203 yoke and A205 fork assemblies: A139-1 blue-plastic Turcite journal bearings, B115-1 spherical bearings, and C648-2 Teflon-lined journal bearings. More than one type bearing may be used in an installation, but each pivot axis must have same type bearings.

#### 8.610 Bearing Removal

Care must be taken not to damage yoke or fork assemblies during bearing removal.

A139-1 Turcite bearings may be removed from A203 yoke or A205 fork assemblies with a broken-screw extractor or by pressing or tapping them out with a small brass or aluminum drift.

B115-1 Spherical bearings and C648-2 journal bearings may be removed with a press. Press from inner side of bearings while supporting outboard side of yoke or fork. Use a socket or other suitable pressing tool to apply the force.

#### 8.615 C648-2 Bearing Installation (0.5625/0.5630 inch diameter bearing bores)

1. Clean mating surfaces of A205 fork or A203 yoke where C648 bearing is installed. Deburr any sharp edges that may damage bearings during installation.
2. Coat yoke or fork bearing bores with zinc chromate or epoxy primer. While primer is still wet, press in C648 bearing while supporting backside of fork or yoke.

#### 8.620 A139-1 Bearing Installation (0.499/0.501 inch diameter bearing bores)

- a) Clean mating surfaces of A205 fork or A203 yoke where A139 bearing is installed. Deburr any sharp edges that may damage bearings during pressing operation.
- b) Coat yoke or fork bearing bores with zinc chromate or epoxy primer. While primer is still wet, press in A139 bearing.
- c) With both A139 bearings installed, ream inner bearing bores with a 0.375 inch dead sharp reamer. Using A105-11 journals as a gauge, continue to ream bores until a very light drag fit is achieved. It may be necessary to use a 0.376 or 0.377 inch reamer to obtain correct fit.
- d) Place one A141-3 washer and one A105-11 journal on NAS6604 bolt. Insert bolt into A204-1 arm. Place second A105-11 journal and second A141-3 washer on bolt.



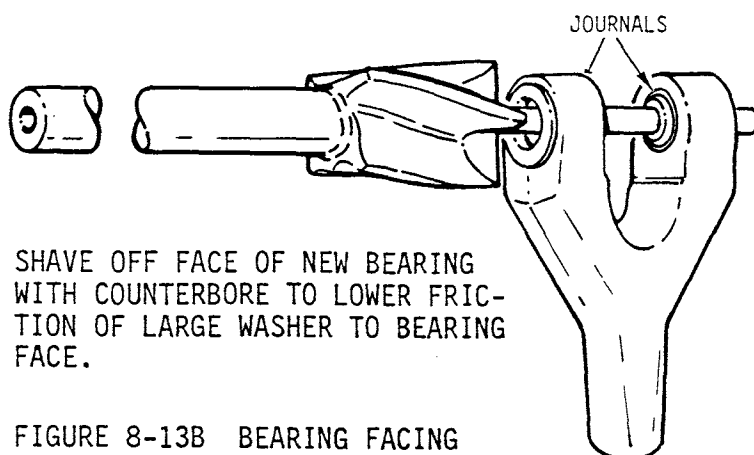
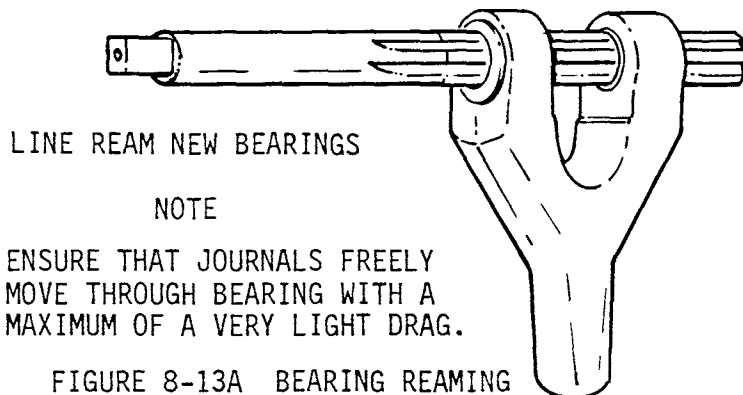


FIGURE 8-13C BEARING FACING WIDTH MEASUREMENT

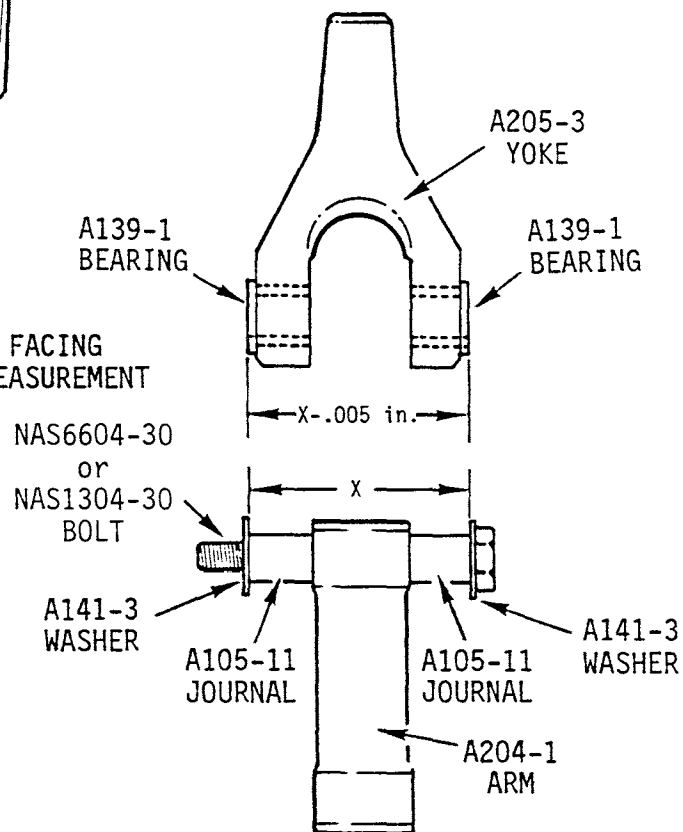


FIGURE 8-13 BEARING REAMING, FACING, & WIDTH MEASUREMENT

8.620 A139-1 Bearing Installation (cont'd)

- e) Measure the distance between the A141-3 washers with the washers held tightly against the journals. Using a one-inch spotface tool with a 0.25 inch pilot, lightly shave the face of each bearing until the measurement across the bearing faces is 0.005 inch less than the measurement between the A141-3 washers. When this dimension is achieved, do not shave any more material off the bearing faces (See Figure 8-13C).
- f) Reassemble the yoke or fork assembly and torque the NAS6604 (or NAS1304) bolt to 100 in.-lb plus nut drag. Check for freedom of movement with no play or drag.

8.630 B115-1 Bearing Installation

The B115-1 Bearing may be either interference-fit or Loctite®-secured slip-fit in the A203 yoke or A205 fork, depending on the diameter of the bearing bores.

8.631 Interference-Fit Bearings (0.6239/0.6244 inch diameter bearing bores)

- a) Clean the bearing bores of the yoke or fork assembly. Deburr any sharp edges and inspect and remove any metal shavings in the bearing bores.
- b) Heat the yoke or fork assembly to approximately 180 degrees Fahrenheit.
- c) Coat one bearing bore with zinc chromate primer. While the primer is still wet, press in the B115-1 bearing to the bottom of the bore.
- d) Coat the other bearing bore with a graphite solution (Lubri-Kote Type A or equivalent). Press in the B115-1 bearing until it is 0.010 to 0.020 inch above the top of the bearing bore.

8.632 Loctite®-Secured Slip-Fit Bearings (0.6255/0.6260 inch diameter bearing bores)

- a) Clean the yoke or fork assembly bearing bores of old Loctite®.
- b) Measure the bearing bores; maximum allowable diameter is 0.6260 inch.
- c) Lightly coat the B115-1 bearing outer races with Loctite® 271 compound and install the B115-1 bearings into the bearing bores. Wipe off excess Loctite®. Do not allow Loctite® to enter the B115-1 bearing.

**8.630 B115-1 Bearing Installation (cont'd)**

- d) While the sealant is still wet, assemble yoke or fork assembly per Section 8.640. Wait until sealant has been allowed to cure per manufacturer's instructions prior to checking bearing pivot force.

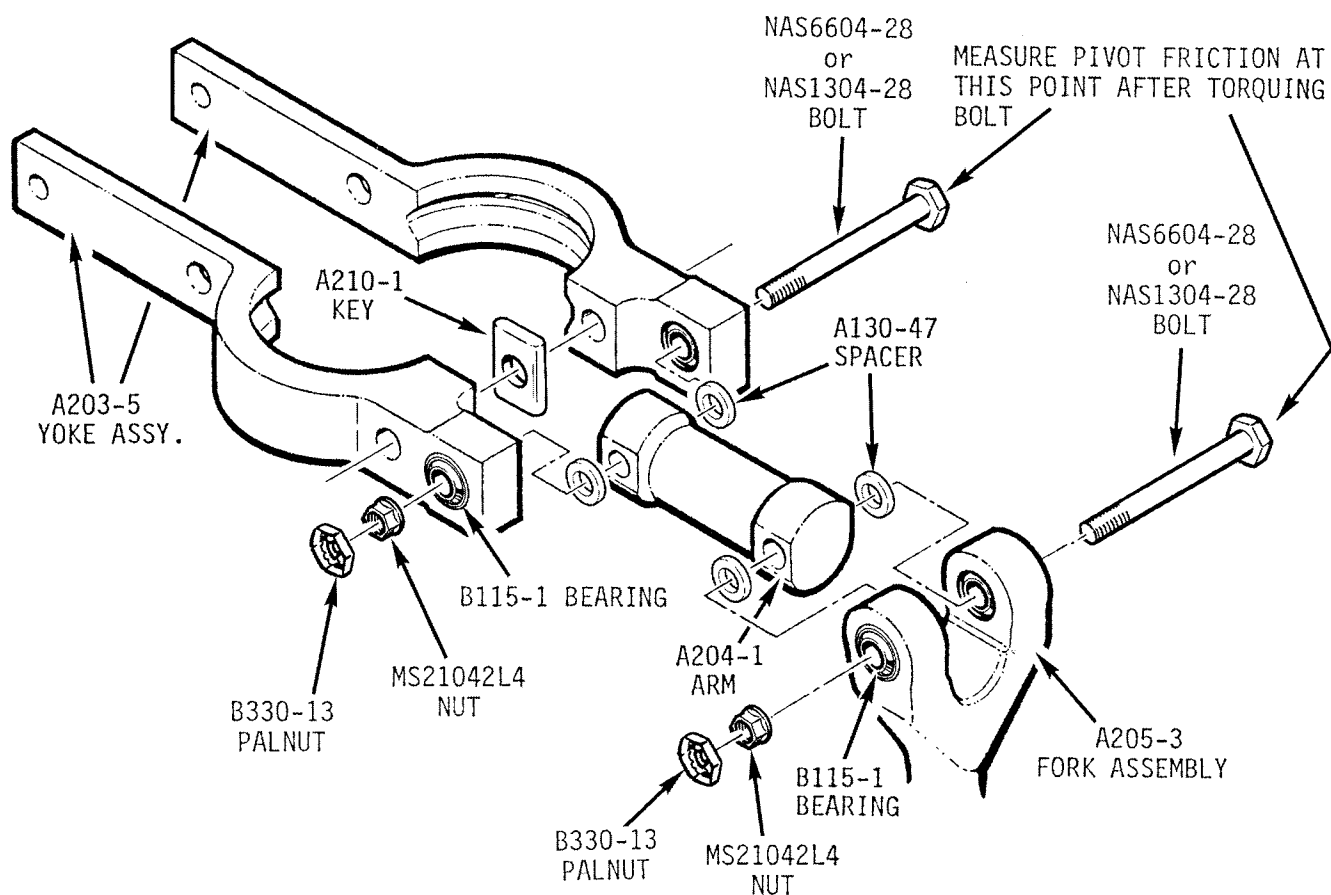
**8.640 Yoke and Fork Assembly Installation**

1. Assemble fork or yoke assembly. Torque NAS6604 (or NAS1304) bolt per Section 1.320.
2. Place a torque wrench on bolt head at fork or yoke pivot point. The force required to pivot assembly must be 5 in-lbs or less.
3. To reduce pivot force for A139-1 bearings:
  - a. Disassemble fork or yoke assembly.
  - b. Ream inner bores of A139-1 bearings; a very slight oversized bore may be required.
  - c. Reassemble yoke or fork assembly. Recheck pivot force.
4. To reduce pivot force for interference-fit B115-1 bearings:

**CAUTION**

Do not rotate bearing with a drill motor to reduce pre-load as this may damage Teflon® liner and cause premature failure.

- a. Place a 7/16 inch socket against outer race of the bearing installed with graphite solution. Tap bearing lightly to relieve axial preload caused by torquing bolt. The pivot force should drop with this slight movement of bearing race. If outer bearing race is moved too far inward, bearing will be preloaded in opposite direction and pivot assembly will have to be disassembled so that bearing can be pressed back into its original position. The pivot assembly will have to be reassembled and retorqued as described above.
- b. If pivot force is still too high, replace interference-fit bearing yoke or fork assembly with a adhesive-secured slip-fit bearing yoke or fork assembly.
- c. Reassemble yoke or fork assembly per Figure 8-10. Recheck pivot force.



**FIGURE 8-14 B115-1 BEARING INSTALLATION**

**CHAPTER 9**

**ROTOR SYSTEMS**

<u>Section</u>	<u>Title</u>	<u>Page</u>
9-00	Description . . . . .	9.1

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**CHAPTER 9****ROTOR SYSTEMS**9-00 Description

Main Rotor information has been moved to Chapter 26.

Tail Rotor information has been moved to Chapter 28.

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## CHAPTER 10

## RIGGING, TRACK AND BALANCE

<u>Section</u>	<u>Title</u>	<u>Page</u>
10.000	Rigging, Track and Balance . . . . .	10.1
10.001	Introduction . . . . .	10.1
10.002	Rod End Adjustment Procedure for Rigging . . . . .	10.1
10.100	Rigging . . . . .	10.2
10.110	Main Rotor Flight Controls . . . . .	10.2
10.111	Cyclic Controls . . . . .	10.2
10.112	Swashplate . . . . .	10.3
10.113	Collective Control . . . . .	10.3
10.120	Main Rotor . . . . .	10.3
10.121	Cyclic Travel Rigging . . . . .	10.8
10.122	Collective Travel Rigging . . . . .	10.11
10.130	Tail Rotor Flight Controls . . . . .	10.12
10.131	Pedals . . . . .	10.12
10.132	A316 Bellcrank . . . . .	10.12
10.133	A331 Bellcrank . . . . .	10.12
10.134	A120-1 Bellcrank . . . . .	10.15
10.135	Tail Rotor Pitch Links . . . . .	10.15
10.140	Tail Rotor Rigging . . . . .	10.15
10.150	Throttle Correlation Rigging . . . . .	10.19
10.200	Track and Balance . . . . .	10.21
10.210	Equipment Requirements . . . . .	10.21
10.220	Equipment Installation . . . . .	10.21
10.221	Main Rotor Equipment Installation . . . . .	10.21
10.222	Tail Rotor Equipment Installation . . . . .	10.23
10.230	Main Rotor Track and Balance Procedure . . . . .	10.29
10.231	Main Rotor Balance Adjustments . . . . .	10.31
10.232	Main Rotor Pitch Link Adjustment . . . . .	10.32A
10.233	Main Rotor Trim Tab Adjustment . . . . .	10.32G
10.234	Main Rotor Track and Balance Trouble Shooting . . . . .	10.33
10.240	Tail Rotor Balance Procedure . . . . .	10.35
10.250	Autorotational RPM Adjustment . . . . .	10.38

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**CHAPTER 10****RIGGING, TRACK AND BALANCE**10.000 Rigging, Track and Balance10.001 Introduction

This section contains the procedures necessary to rig the main rotor flight controls, tail rotor flight controls and throttle correlation. The track and balance procedures in this section are to be used in conjunction with Chadwick-Helmuth balancing equipment instructions.

10.002 Rod End Adjustment Procedures For Rigging

Refer to § 23-34 Push-Pull Tube Rod End Adjustment.

## 10.100 Rigging

### 10.110 Main Rotor Flight Controls

#### 10.111 Cyclic Controls

The cyclic control travel is non-adjustable and is controlled by A211-1 stop plate attached to the cyclic box assembly.

**NOTE**

If the A121-1 push-pull tube length has been changed or the length of the A205 fork was changed, they must be readjusted to the dimensions shown in Figure 8-3.

- a. Place the cyclic stick against the aft stop and the collective control full down.
- b. Adjust the A121-3 push-pull tube to obtain a clearance of .130 inch between the aft arm of the jack shaft and the main rotor gearbox upper cap flange.

### 10.111 Cyclic controls (cont'd)

- c) Check for clearance between the forward jackshaft arm and the A121-7 push-pull tube guide with collective stick full up and cyclic stick full forward. Minimum clearance is .125 inch.
- d) Place the cyclic control in the neutral position. This point is 8.3 inches to the right of full left travel and at the mid-point of the total fore and aft travel. (See Figure 10-1). Place the collective control full down.
- e) Apply full cyclic and collective friction.

#### NOTE

Care must be taken not to move the cyclic control from the neutral position.

### 10.112 Swashplate

- a) With the cyclic and collective controls locked in position per Section 10.111, adjust the A121-7 and A121-5 push-pull tubes to obtain a constant clearance from the A281-1 flange. The minimum clearance from the flange is 5/8 inches. (See Figure 10-2) Nominal setting is 3/4 inches.

### 10.113 Collective Control

Since the collective slider stop is non-adjustable, this check is to ensure full control travel is obtained and does not interfere with the swashplate travel.

- a) Lift the swashplate boot so the uniball and slider tube may be observed.
- b) Pull the collective control full up. The uniball must not extend past the top of the slider tube more than .060 inch. If this occurs, adjust the A121-5 and A121-7 push pull tubes as follows:
  1. Turn the upper rod ends of the A121-5 and A121-7 push-pull tubes in equally to lower the swashplate.
  2. Recheck the uniball-slider tube clearance per Step b above.

### 10.120 Main Rotor

The main rotor is rigged by determining the average blade angle. Blade angle measurements are taken at the .75 radius of the main rotor (or 37.75 inches in from the blade tip).

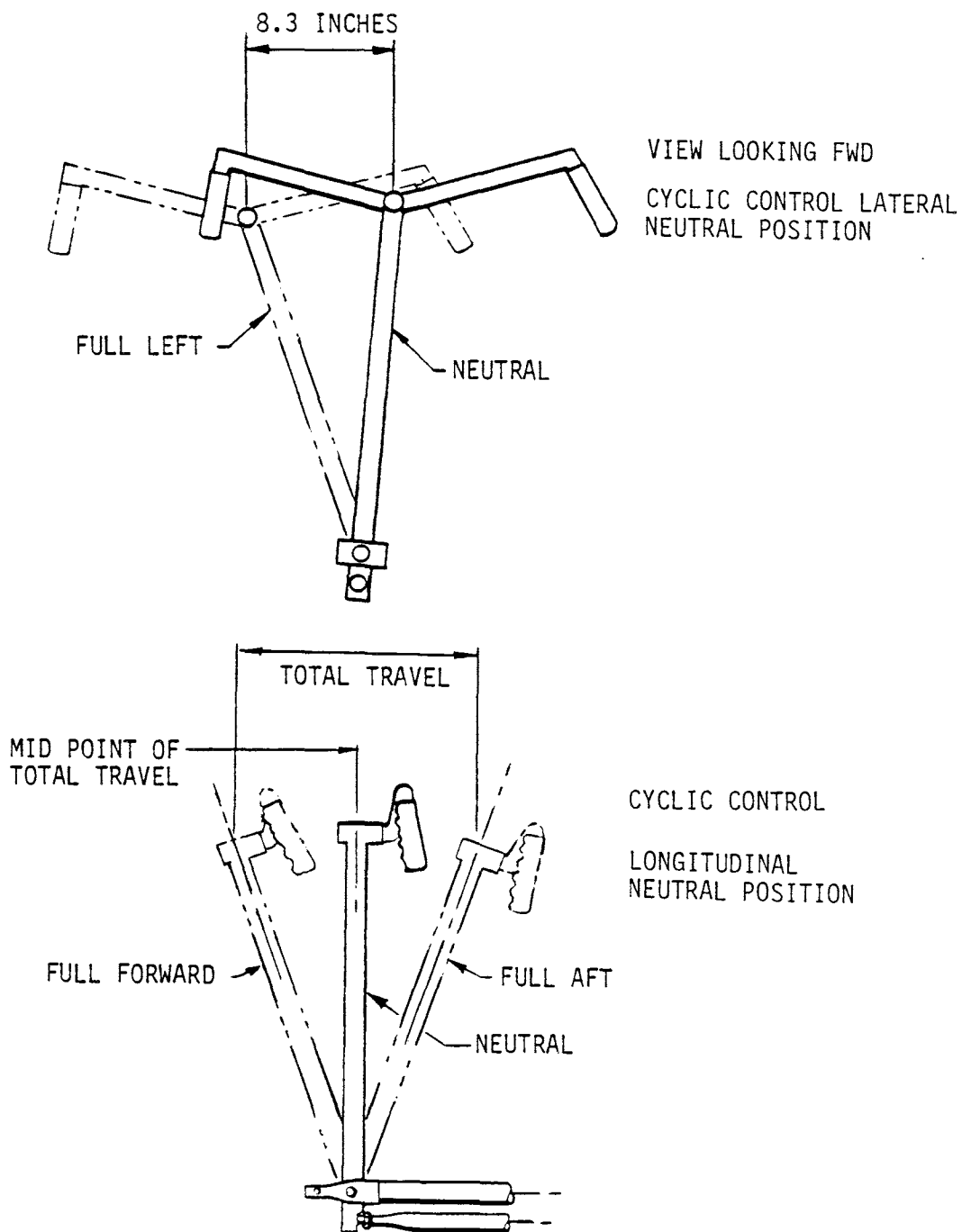


FIGURE 10-1 CYCLIC CONTROL STICK NEUTRAL POSITION

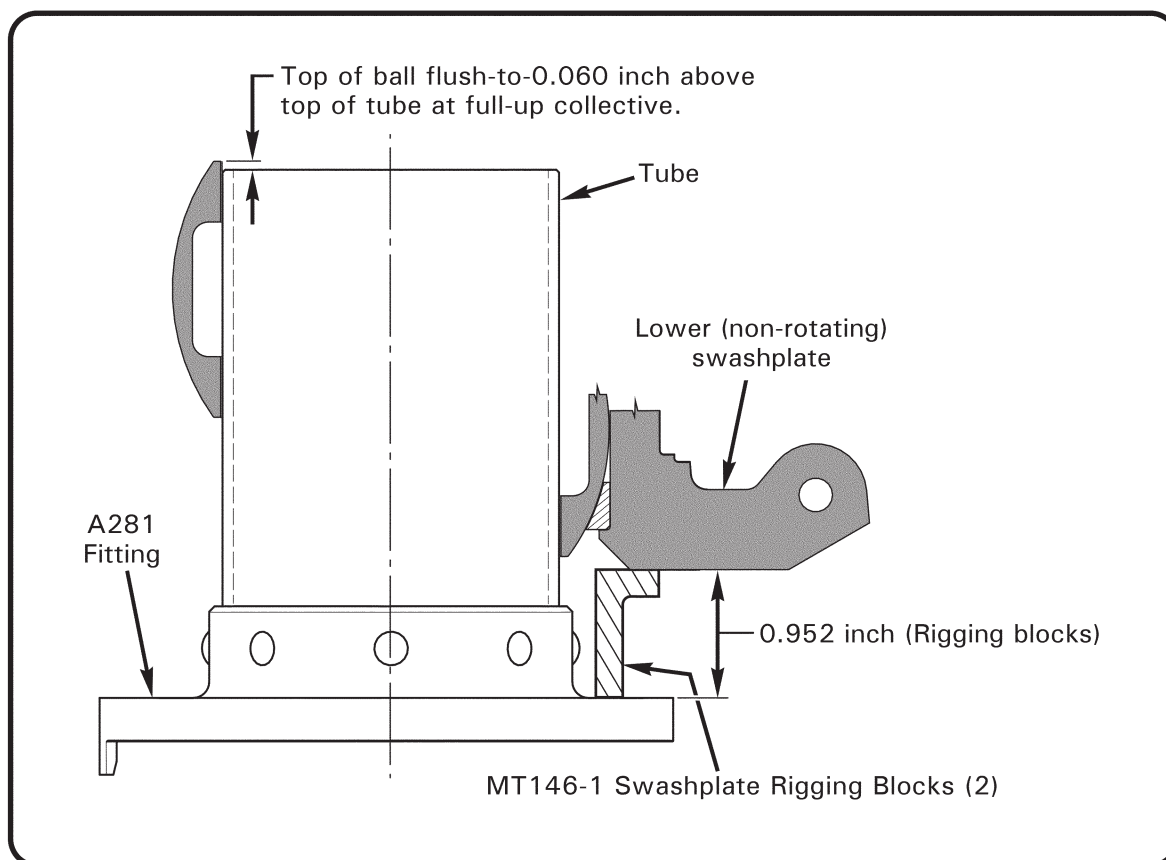


FIGURE 10-2 LOWER SWASHPLATE CLEARANCE

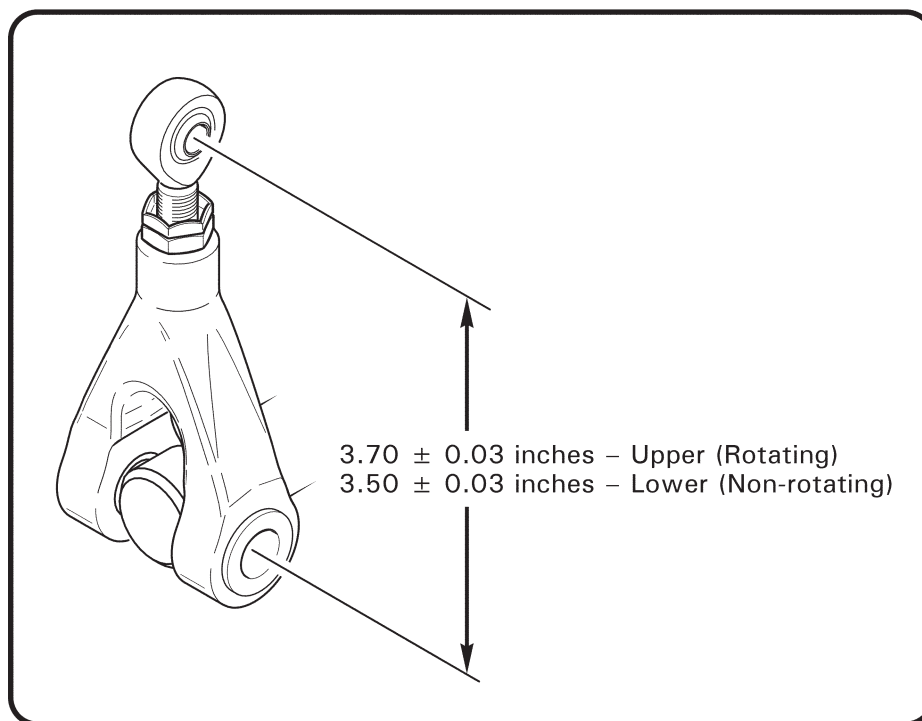


FIGURE 10-3 A205 (-9 SHOWN) DIMENSIONS FOR SWASHPLATE SCISSORS

### 10.120 Main Rotor

**NOTE**

Refer to § 23-34 for push-pull tube rod end adjustment procedure.

The main rotor is rigged by determining average blade angle. Blade angle is measured at 37.75 inches inboard from blade tip (main rotor 0.75 radius).

Main rotor blade angles are measured using MT050-1 rigging fixture and a Kell-Strom KS113 propeller protractor or a comparable protractor (refer to Figure 10-4). Use following procedure to set up for rigging:

1. All main rotor flight control rod ends must meet Figure 2-1 radial play & axial play tolerance.
2. Rig swashplate per § 10.112.
3. Initially, adjust both pitch links to 6.82 inches length between rod end centers (final length is determined during autorotation rpm adjustment).
2. Verify A205 forks at swashplate are set to proper length per Figure 10-3. Lower fork assembly must be  $3.50 \pm 0.03$  inches center-to-center and upper fork assembly must be  $3.70 \pm 0.03$  inches center-to-center.
3. Level helicopter laterally and longitudinally via main rotor hub per § 18-12.
4. Place a tracking stick at end of one rotor blade and mark height of blade tip. Rotate rotor  $180^\circ$  and mark height of opposite blade tip. Teeter main rotor as necessary to obtain a main rotor track of  $\pm 1$  inch.
5. Using tape, conspicuously mark one MR blade tip. Place protractor atop MR hub parallel to teeter hinge bolt and facing tape-marked blade tip. Zero propeller protractor to main rotor hub.

**NOTE**

When measuring blade angles, protractor face or dial must always face marked blade tip to avoid doubling of instrument error.

6. Measure in from tip of each main rotor blade 37.75 inches and temporarily mark one blade with red color and opposite blade with blue color

**WARNING**

Use masking tape, grease pencil, or soft marker to mark rotor blades. Ball point pens or other sharp instruments can scratch blade skins, causing cracks and fatigue failure of blade.



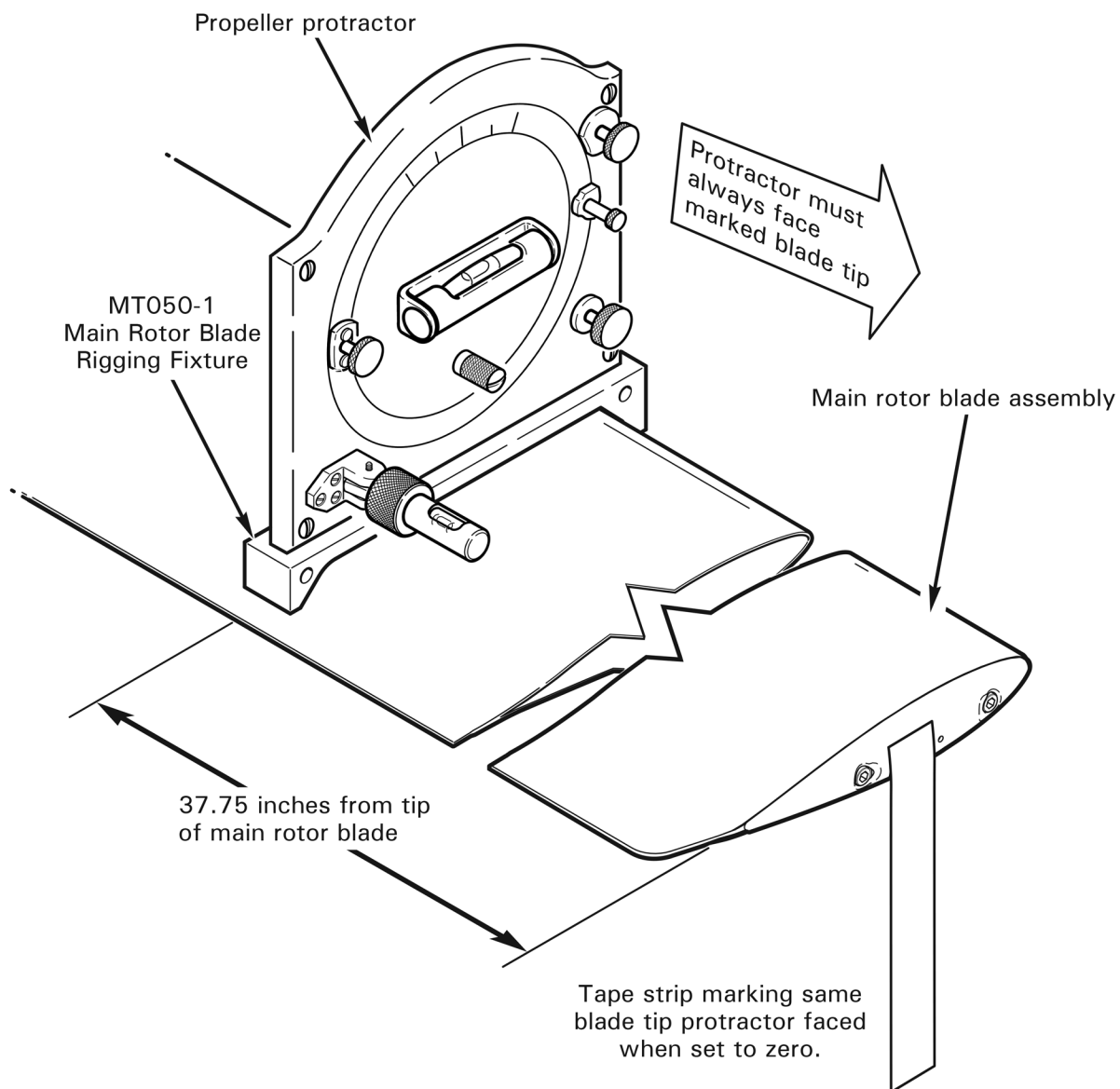


FIGURE 10-4 MAIN ROTOR BLADE RIGGING

10.121 Cyclic Travel Rigging

1. Determine if A958-1 bellcranks are installed in cyclic pivot assembly (ref. Figure 8-2A; original equipment on helicopter S/N 0256, 0301, 0350, 0351, and 0357 & subsequent).

2. Refer to Figure 10-1. Place collective control full down. Place cyclic control in neutral position laterally and hold against forward stop.

NOTE

Sand bags may be used to secure cyclic control against forward stop to ensure it will not move.

3. Rotate blades so pitch links are aligned with longitudinal axis of helicopter. Place tracking stick at tip of one blade for reference when rotating rotor.

4. Forward longitudinal cyclic:

a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below. Adjust blade angles per step 4.b.

BLUE BLADE

Pitch link aft

°

Pitch link forward

+

°

=

°

÷ 2 =

°

RED BLADE

Pitch link aft

°

Pitch link forward

+

°

=

°

÷ 2 =

°

10.5°/11.0° required, if A958-1 bellcranks are installed.

8.3°/8.8° required, if A175-1 bellcranks are installed.

- b. Adjust aft A121-5 push-pull tube at swashplate (one full turn = 0.42°) or both forward A121-7 push-pull tubes at swashplate (both must be adjusted exact same amount), as required to obtain required blade angle averages.

5. Refer to Figure 10-1. Place cyclic control in neutral position laterally and hold against aft stop.

## 10.121 Cyclic Travel Rigging (continued)

## 6. Aft longitudinal cyclic:

- a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below. Adjust blade angles per step 6.b.

**BLUE BLADE**

Pitch link aft \_\_\_\_\_ °  
 Pitch link forward + \_\_\_\_\_ °  
 = \_\_\_\_\_ °  
 ÷ 2 = \_\_\_\_\_ °

**RED BLADE**

Pitch link aft \_\_\_\_\_ °  
 Pitch link forward + \_\_\_\_\_ °  
 = \_\_\_\_\_ °  
 ÷ 2 = \_\_\_\_\_ °

8.5°/9.5° required.

- b. Adjust aft A121-5 push-pull tube at swashplate (one full turn = 0.42°) or both forward A121-7 push-pull tubes at swashplate (both must be adjusted exact same amount), as required.

**NOTE**

If adjustment is required to obtain aft cyclic control blade angles, forward cyclic must be rechecked.

7. Refer to Figure 10-1. Place cyclic control in neutral position longitudinally (mid-travel) and hold cyclic against left stop.
8. Rotate rotor until pitch links are aligned with lateral axis of helicopter. Place tracking stick at tip of one blade for reference when rotating rotor.
9. Left lateral cyclic:

- a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below. Adjust blade angles per step 9.b.

**BLUE BLADE**

Pitch link right \_\_\_\_\_ °  
 Pitch link left + \_\_\_\_\_ °  
 = \_\_\_\_\_ °  
 ÷ 2 = \_\_\_\_\_ °

**RED BLADE**

Pitch link right \_\_\_\_\_ °  
 Pitch link left + \_\_\_\_\_ °  
 = \_\_\_\_\_ °  
 ÷ 2 = \_\_\_\_\_ °

9.0°/9.5° required.

- b. Adjust right or left (forward) A121-7 push-pull tube at swashplate (one full turn = 0.6°), as required.

10.121 Cyclic Travel Rigging (continued)

10. Refer to Figure 10-1. Place cyclic control in neutral position longitudinally (mid travel) and hold against right stop.
11. Right lateral cyclic:

a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below. Adjust blade angles per step 11.b.

BLUE BLADE				RED BLADE			
Pitch link right			°	Pitch link right			°
Pitch link left	+		°	Pitch link left	+		°
	=		°		=		°
	÷ 2 =		°		÷ 2 =		°

5.5°/6.0° required.

- b. Adjust right or left (forward) A121-7 push-pull tube at swashplate (one full turn = .6°) as required.

NOTE

If adjustment is required to obtain right cyclic control blade angles, left cyclic must be rechecked.

12. Perform collective travel rigging per § 10.122.

## 10.122 Collective Travel Rigging

1. Rotate main rotor to align pitch links with longitudinal axis of helicopter. Place tracking stick at tip of one blade for reference when rotating rotor.
2. Refer to Figure 10-1. Place cyclic control in neutral position or install MT376-1 rigging blocks. Place collective control full down. Apply cyclic and collective friction.
3. Collective full down:
  - a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below. Adjust blade angles per steps 3.b.

**BLUE BLADE**

Pitch link forward \_\_\_\_\_ °

Pitch link aft + \_\_\_\_\_ °

= \_\_\_\_\_ °

÷ 2 = \_\_\_\_\_ °

$2^{\circ} \pm 0.5^{\circ}$  nose  
up required.

**RED BLADE**

Pitch link forward \_\_\_\_\_ °

Pitch link aft + \_\_\_\_\_ °

= \_\_\_\_\_ °

÷ 2 = \_\_\_\_\_ °

$2^{\circ} \pm 0.5^{\circ}$  nose  
up required.

- b. Adjust pitch links so blue blade and red blade measurements are within 0.2° of each other when each blade pitch link is in forward position, and when each pitch link is in aft position.

**NOTE**

Final collective down blade angles are determined by autorotation RPM requirements per § 10.250.

4. Raise collective control to full up position. Apply collective friction.
5. Collective full up:
  - a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below.

**BLUE BLADE**

Pitch link forward \_\_\_\_\_ °

Pitch link aft + \_\_\_\_\_ °

= \_\_\_\_\_ °

÷ 2 = \_\_\_\_\_ °

$14^{\circ} \pm 0.5^{\circ}$  nose  
up required.

**RED BLADE**

Pitch link forward \_\_\_\_\_ °

Pitch link aft + \_\_\_\_\_ °

= \_\_\_\_\_ °

÷ 2 = \_\_\_\_\_ °

$14^{\circ} \pm 0.5^{\circ}$  nose  
up required.

6. Verify top of swashplate ball is flush-to-0.060 inch above top of tube per Figure 10-2.
7. Perform track and balance per § 10.200.

### 10.130 Tail Rotor Flight Controls

<p style="text-align: center;"><b>NOTE</b></p>
--

<p>Refer to § 23-34 for push-pull tube rod end adjustment procedure.</p>
--

### 10.131 Pedals

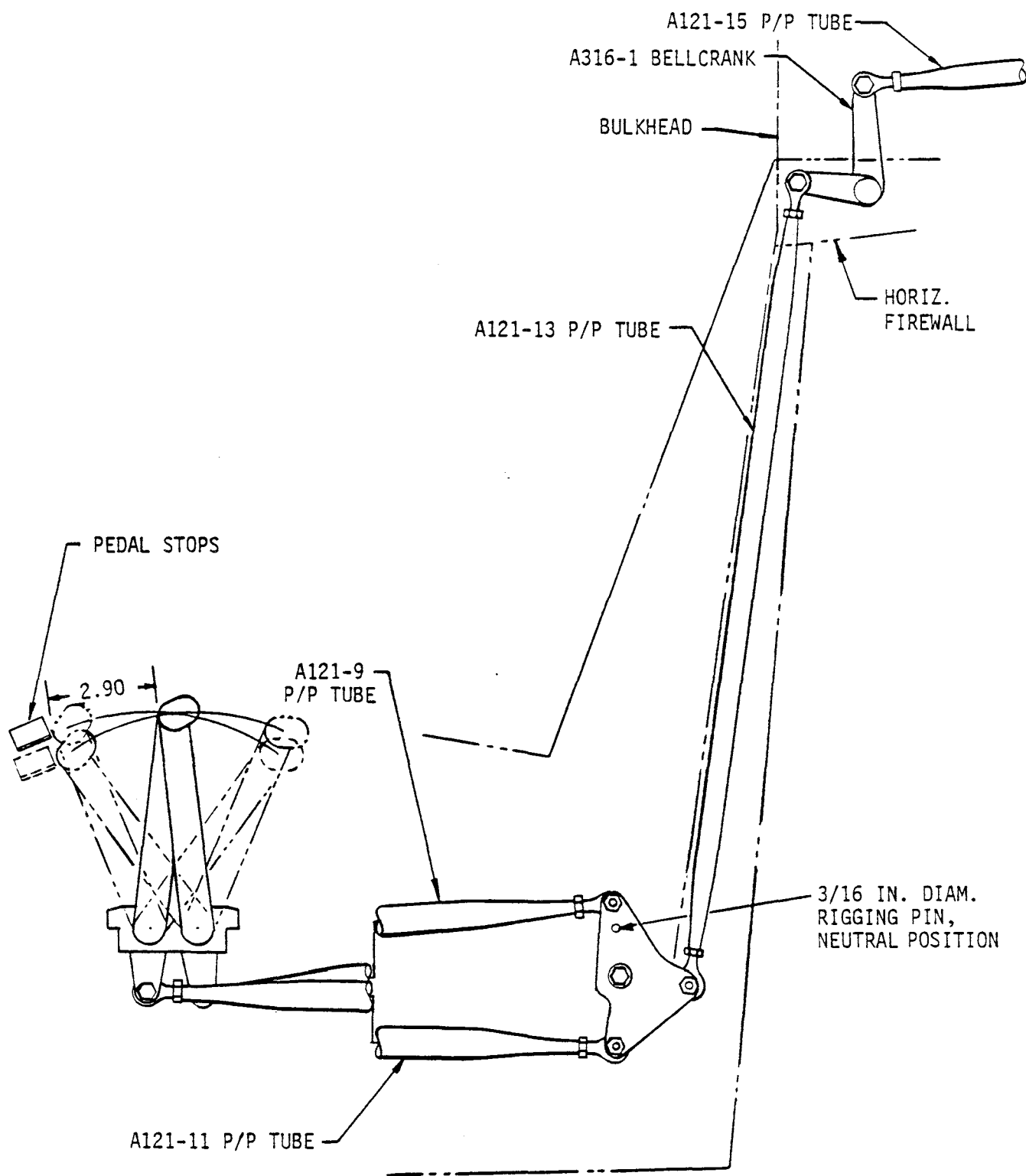
1. Refer to Figure 10-5. Insert a 3/16-inch diameter rigging pin (a long AN3 or NAS6603 bolt suffices) thru hole in right-side keel panel and rigging pin holes in A317-1 bellcrank.
2. Adjust A121-9 and -11 push-pull tubes as required to obtain a dimension of  $2.90 \pm 0.03$  inches from each pedal to stops located on each side of forward console. Remove rigging pin (or bolt, as applicable).

### 10.132 A316-1 Bellcrank

1. Refer to Figure 10-5. Place left pedal against forward stop.
2. Adjust vertical A121-13 push-pull tube to obtain a minimum of 0.060 inch between A316-1 bellcrank arm and vertical firewall control tunnel.

### 10.133 A331-1 Bellcrank

Place right pedal against forward stop. Adjust horizontal A121-15 push-pull tube to obtain a minimum clearance of 0.100 inch between A331-1 bellcrank and actuator gearbox housing (See Figure 10-6).



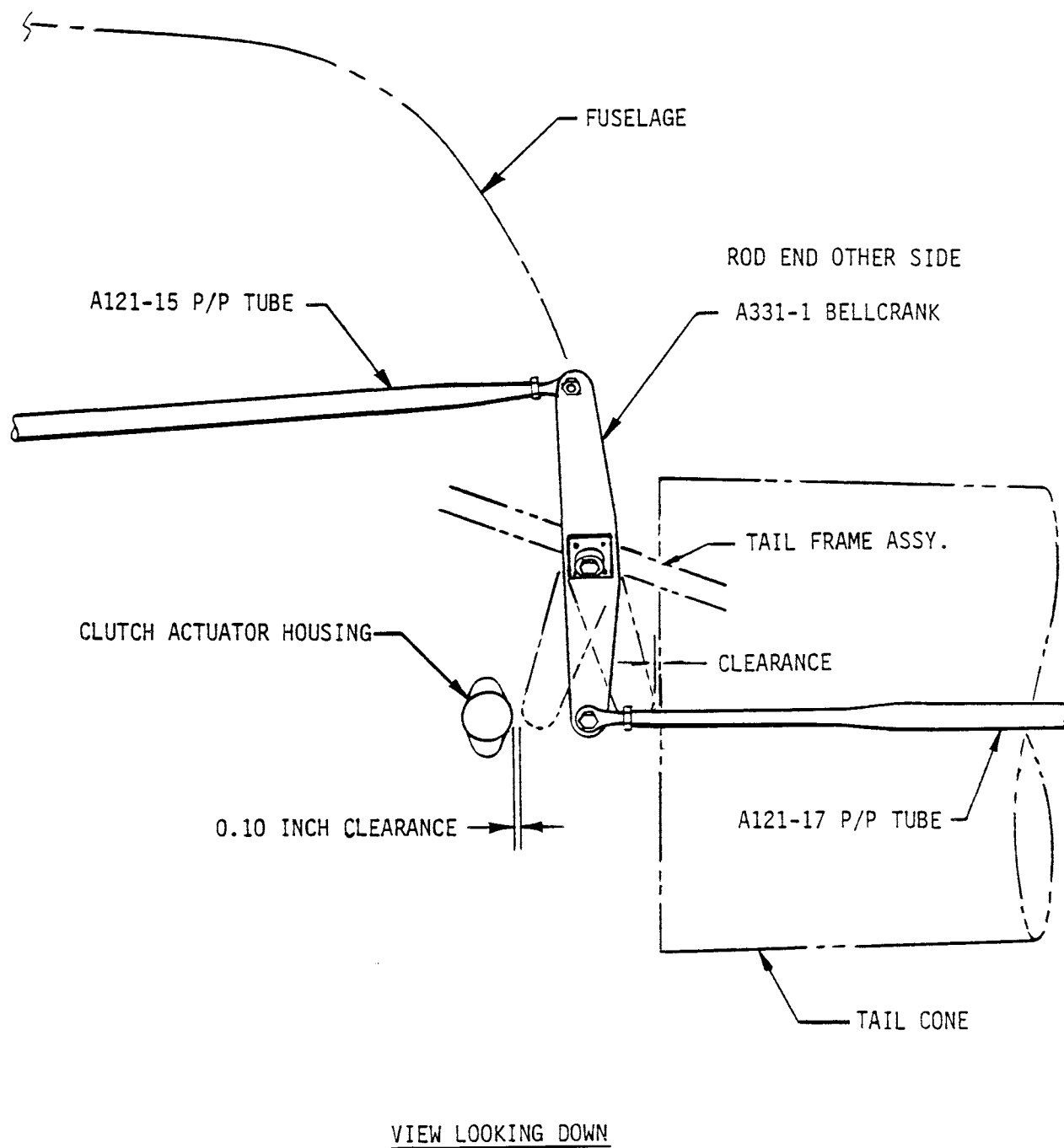


FIGURE 10-6 A331 BELLCRANK INSTALLATION



10.133 A120-3 Bellcrank (cont'd)**NOTE**

Actuator must be disengaged when adjusting A331 bellcrank to check closest point.

Place left pedal against its stop and check for clearance between A331-1 bellcrank and tailcone.

10.134 A120-1 Bellcrank

With tail rotor pedals in neutral position, adjust A121-17 push-pull tube as required to obtain a nominal dimension of 4.85 inches between bellcrank arm center line and machined face of tailcone casting (see Figure 10-7).

10.135 Tail Rotor Pitch Links

If applicable, adjust pitch links to a dimension of 2.360 inches between rod end centers (See Section 8.570).

10.140 Tail Rotor Rigging**WARNING**

Both pitch links must be same part number (same type and material). Mixing one-piece with adjustable-length pitch links is prohibited. Mixing steel one-piece with aluminum one-piece pitch links is prohibited.

1. Set up:
  - a. Ensure removable pedals are installed.
  - b. Level rotorcraft per Section 1.220 Method 2, Main Rotor Hub.
  - c. Rotate tail rotor until forward blade is parallel to tailcone.
  - d. Tape a tracking stick to tailcone at tip of forward blade.

**NOTE**

A tracking stick can be made using a 1 inch by 12 inch strip of aluminum with a 90° bend 2 inches from one end.

- e. Place left pedal against its stop. Using a tip drain hole as a reference, first mark tracking stick where blade tip passes stick.
- f. Using clutch shaft so teeter angle is not disturbed, rotate tail rotor 180° until opposite blade tip drain hole is aligned with tracking stick. Mark stick.

### 10.140 Tail Rotor Rigging (cont'd)

- g. Adjust teeter of tail rotor to position blade tip mid point between marks. This will be the left-pedal tacking mark. Rotate tail rotor and check that the blades track. Repeat above procedure as necessary to track tail rotor within 0.125 inch.

#### 2. Measure tail rotor blade angles as follows:

- a. Using a soft marker or grease pencil mark each blade as red or blue.
- b. Measure in from each blade tip 5.25 inches (0.75 radius) and place a mark chordwise on each blade at this point (soft marker or grease pencil).
- c. Have someone hold forward blade tip at left pedal track mark.
- d. Place MT050-2 rigging fixture on aft blade inboard side.

#### NOTE

The MT050-2 fixture must be centered on 0.75 radius mark.

- e. Using a propeller protractor measure blade angle and record below. Rotate tail rotor 180° and record opposite blade angle.

#### Pedals Full Left

Blue Blade	_____°nose right
Red Blade	+ _____°nose right
	= _____°
	÷ 2 = _____°
	(19.0°/19.5° required)

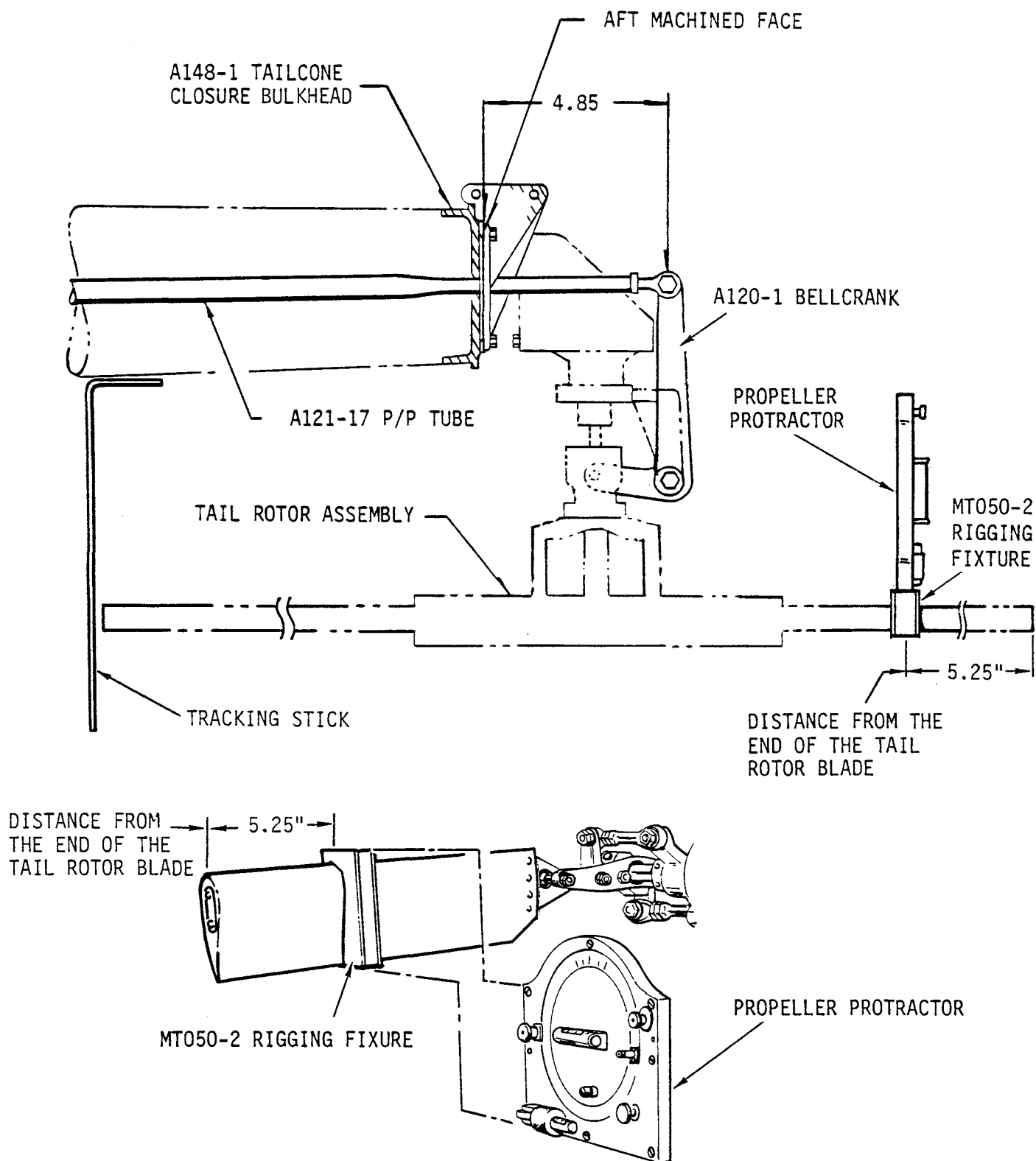


FIGURE 10-7 A120-1 BELLCRANK INSTALLATION

# 10.140 Tail Rotor Rigging (cont'd)

## CAUTION

For acceptable track, differences between Blue and Red blade angles must not exceed .4 degrees. If the blade angles cannot be adjusted to within .4 degrees of each other using the pitch links they should be replaced.

## NOTE

Pitch link jamnuts must be tight to ensure accurate blade angle measurements.

- f) Adjustment of the blade angles is made using the rod ends of the A121-17 push-pull tube. One full turn of the rod end will change the blade angles .42 degrees. Adjust the rod end as necessary to obtain 19.0 to 19.5 degrees.
- g) Place the right pedal against its stop. Measure the blade angles and record below.

## NOTE

When pedal is placed against the right stop, a new tracking mark must be placed on the track stick as the tip path will change due to blade angle change.

	<u>Pedals Full Right</u>
Blue Blade	_____ ° nose left
Red Blade	+ _____ ° nose left
	$\frac{\text{ }^\circ}{2} = \frac{\text{ }^\circ}{\text{ (9.6/10.6 deg. req'd) }}$

- h) Adjust the A121-17 push-pull tube as necessary to obtain blade angles of 9.6 to 10.6 degrees.

## NOTE

If adjustment is required to obtain right pedal blade angles, the left pedal angles must be rechecked.

10.140 Tail Rotor Rigging (cont'd)

- i) If the blade angle range, for left and right pedal settings, cannot be obtained using the above procedure, this indicates the pedal travel is either too great or too small. Use the following procedure to check and adjust pedal travel:
  - 1) Add the right and left pedal angles together. If the total is less than  $28.6^{\circ}$  the pedal total travel is too small. If the total is greater than  $30.1^{\circ}$  the total travel is too great.
  - 2) To increase the total travel, lengthen the A121-9 and -11 push-pull tubes attached to the tail rotor pedals.
  - 3) To decrease the total travel, shorten the A121-9 and -11 push-pull tubes.

## NOTE

These changes should be made in  $1/2$  turn increments of the push-pull tube rod ends.

- 4) Recheck the tail rotor blade angles per steps e through h above.
- j) Ensure all rod ends are installed properly by checking the push-pull tube witness holes. Tighten all rod end palnuts and jamnuts. Torque stripe all jamnuts.

10.150 Throttle Correlation Rigging (See Figure 10-8)

- a) For inservice check and adjustment, perform the following:
  - 1) Rotate the throttle in "off" direction through the overtravel spring to the positive stop.
  - 2) Holding the throttle tight against the stop, raise collective to full up stop while observing throttle bellcrank on carburetor. Throttle bellcrank should just barely start to move when the collective up stop is reached.

Adjust A327-1 Overtravel Spring Assembly to fit following geometry with no spring compression: Collective full up, throttle twist grip rotated full closed, A609-2 Arm at dimension shown. Then, adjust A336 or B364 Push-Pull Tube to fit with carburetor arm just off idle stop (0.02-0.05 inch movement at rod end bolt) (push-pull tube must be readjusted whenever idle stop is adjusted). Select A336-1 or -2 push-pull tube, or install A130-54 spacer(s), as required to obtain proper adjustment.

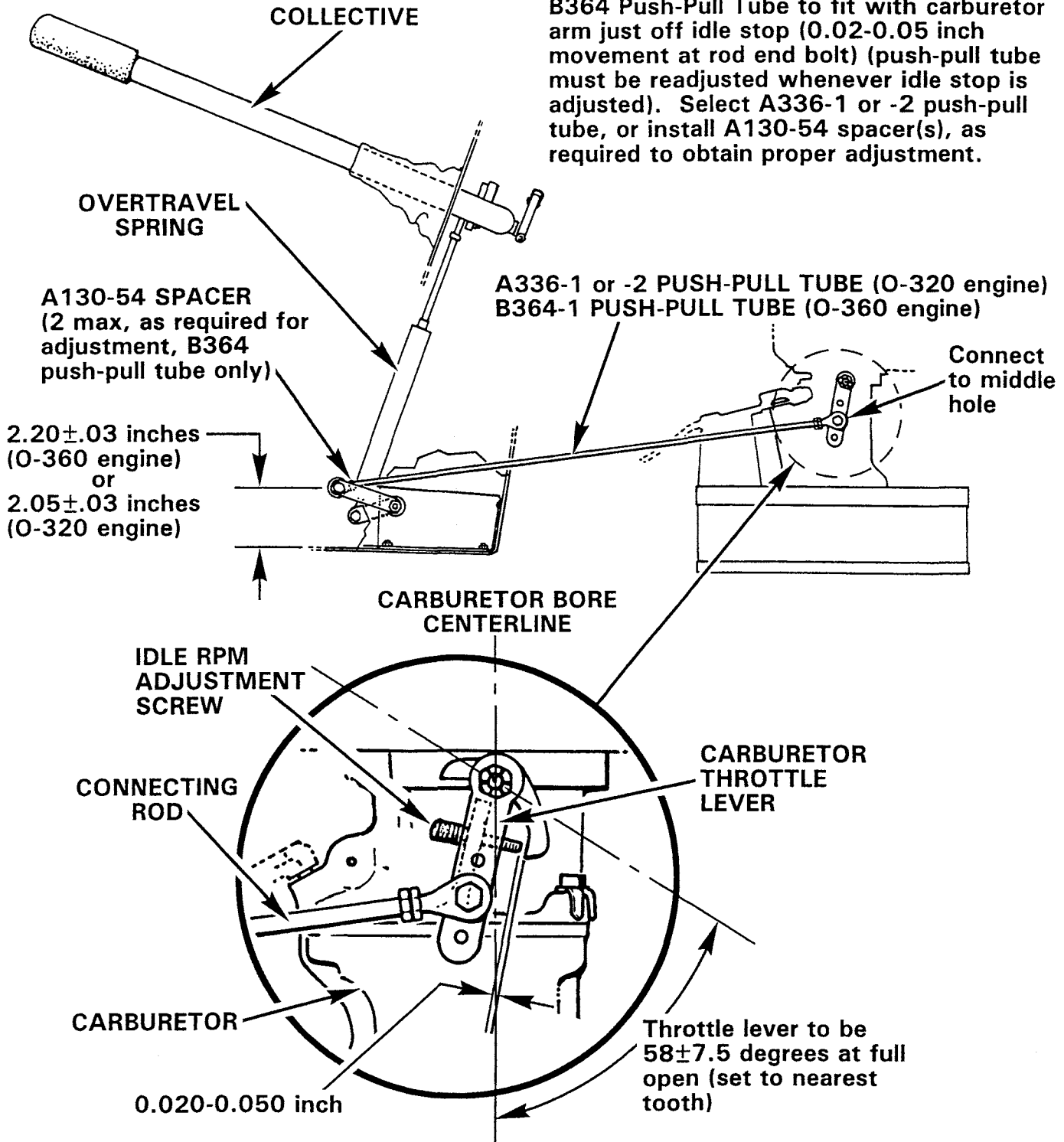


FIGURE 10-8 THROTTLE CORRELATION RIGGING

### 10.150 Throttle Correlation Rigging (continued)

#### NOTE

Before adjusting throttle connecting rod, ensure idle RPM and engine shimming are correctly adjusted per §§ 2.210 and 6.130.

3. See Figure 10-8. If required, adjust length of throttle connecting rod for 0.020–0.050 inch gap between carburetor butterfly bellcrank and idle RPM adjustment screw when performing step 2.
4. Tighten jamnut(s), check witness holes, and safety wire rod end, as required. (Note: If A933-3 rod end is installed, B330-7 palnut is required.)

### 10.200 Track and Balance

#### 10.210 Equipment Requirements

#### NOTE

Calibrate track and balance equipment per manufacturer's recommendation, at least once a year, or if equipment is dropped, misused, or calibration is suspect.

#### NOTE

The Chadwick-Helmuth Vibrex system, the TEC ACES system, the Dynamic Solutions Systems' MicroVib system, or equivalent equipment is required to perform dynamic rotor balancing and in-flight track checks.

### 10.220 Equipment Installation

#### 10.221 Main Rotor Equipment Installation

#### NOTE

Use the following track & balance procedures in conjunction with approved equipment manufacturer's balancing instructions.

#### CAUTION

Cable security is critical; helicopter will be flown at  $V_{NE}$ .

- a. Refer to Figure 10-9A. Using appropriate hardware, attach brackets to vibration transducer and attach assembly A359-1 panel as shown. Remove removable controls.
- b. Install magnetic pickup bracket onto swashplate if not previously installed.

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## 10.221 Main Rotor Equipment Installation (cont'd)

**WARNING**

Ensure attachment bolts are torqued to 100 in.-lbs plus nut drag. The PT121 bracket will remain installed for inflight track and balance.

- c) Install the 3030 magnetic pickup onto the PT121 bracket. Set the interrupter pickup gap to .030"  $\pm$  .010".
- d) Attach the 3319-1 cable to the magnetic pickup. Pull collective stick full up and cyclic stick full left. Secure the cable to the mast fairing with duct tape. Route the cable to the lower front of the left door frame. Secure the cable every 12" with duct tape.

**CAUTION**

Security of the cable is essential as the helicopter will be flown at Vne.

- e) Attach the 4296-1 cable to the accelerometer mounted on the console. Secure with duct tape.

**CAUTION**

Ensure the cable cannot become tangled with tail rotor pedals.

- f) Attach the cables to the balancer and secure excess cable to the bracket in front of the left seat.
- g) Apply the 4270 target tapes to the main rotor blades per Figure 10-9.

## 10.222 Tail Rotor Equipment Installation (See Figure 10-9C)

- a) Install the 4177 accelerometer under the top forward tail rotor gearbox output cartridge attachment bolt. Connector end of accelerometer must point up.
- b) Connect the 4296-2 cable to the accelerometer. Wrap cable around the tailcone several times towards the forward end. Secure with duct tape.

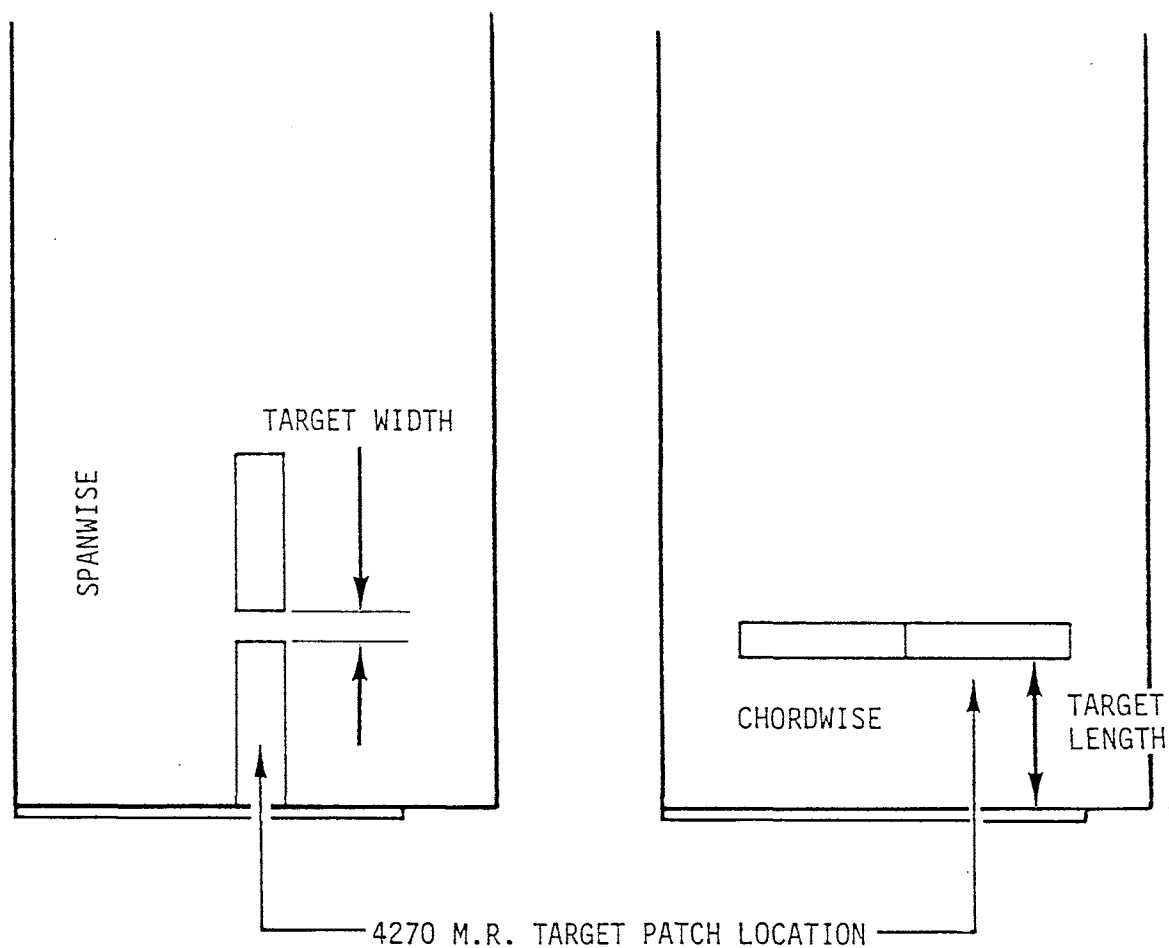


FIGURE 10-9 MAIN ROTOR TARGET PATCH LOCATION

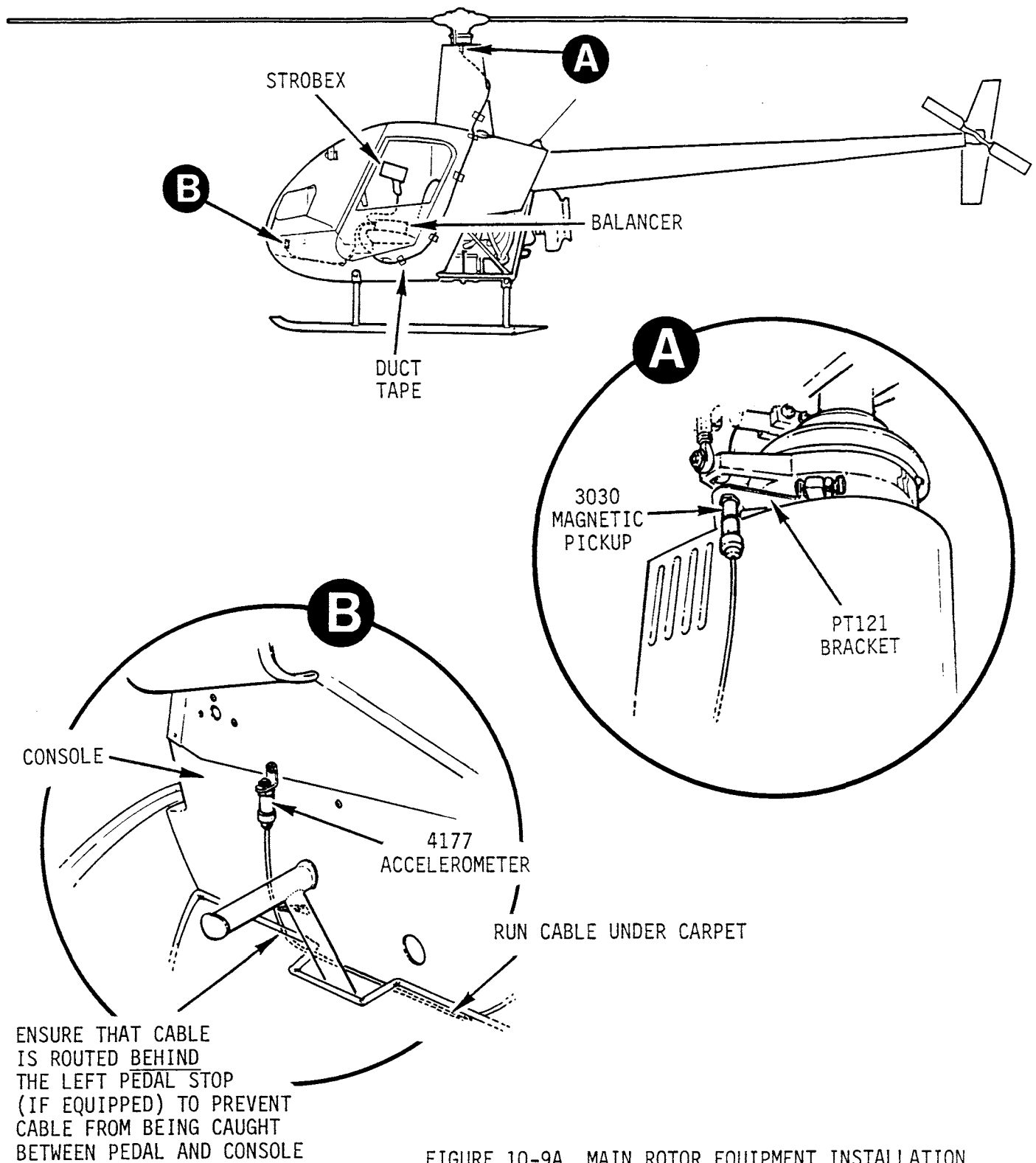


FIGURE 10-9A MAIN ROTOR EQUIPMENT INSTALLATION

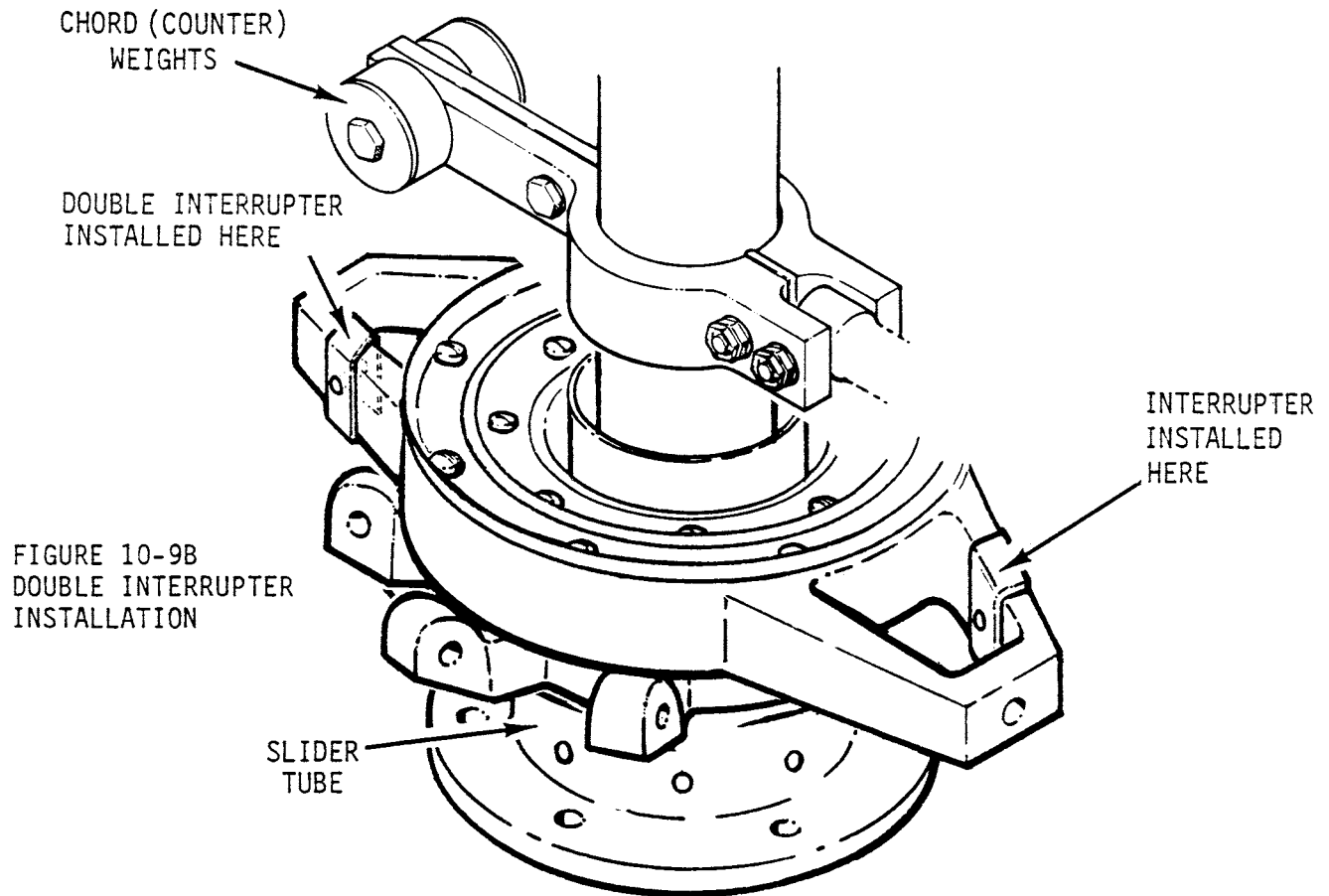


FIGURE 10-9B  
DOUBLE INTERRUPTER  
INSTALLATION

If the interrupters are installed as shown above the Main Rotor Balancing Chart will be out of phase.

Using a model 135M-10 Strobex with the interrupters installed per above drawing and using Doubler Interrupter Logic on the Balance Box, the Forward Blade must be relabeled as Aft. The Aft Blade must be relabeled Forward. Adding and subtracting chord weights and rotor head shifts would also be out of phase.

To use the Main Rotor Track and Balance Chart without correcting it, you must reverse the interrupters. The double interrupter must be on the opposite side of the driveshaft as the Chord (counter) weights.

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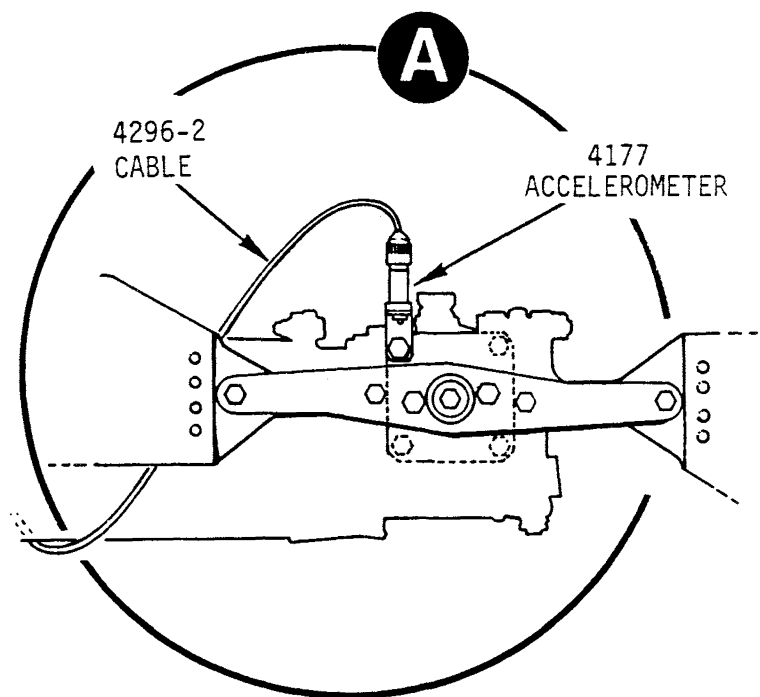
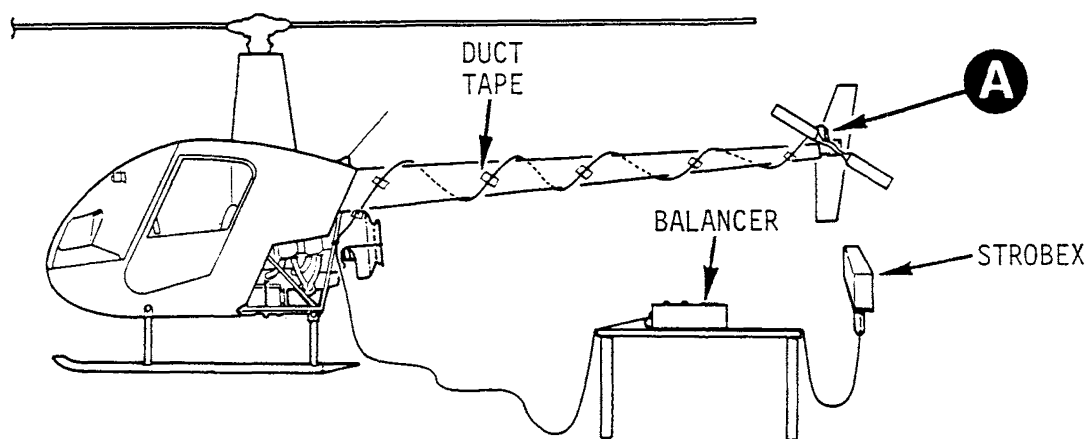
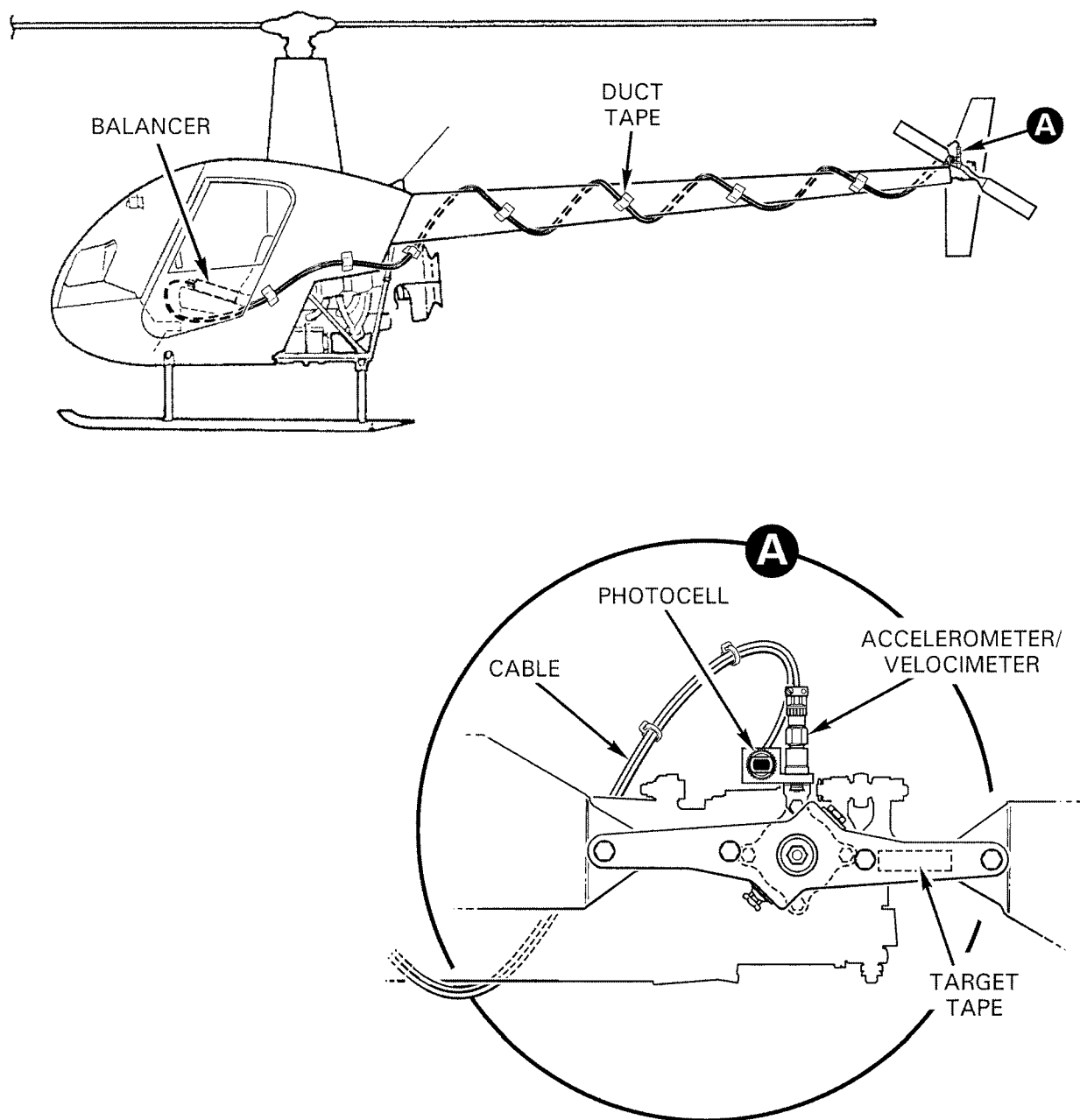


FIGURE 10-9C TAIL ROTOR EQUIPMENT INSTALLATION

10.222 Tail Rotor Equipment Installation (cont'd)

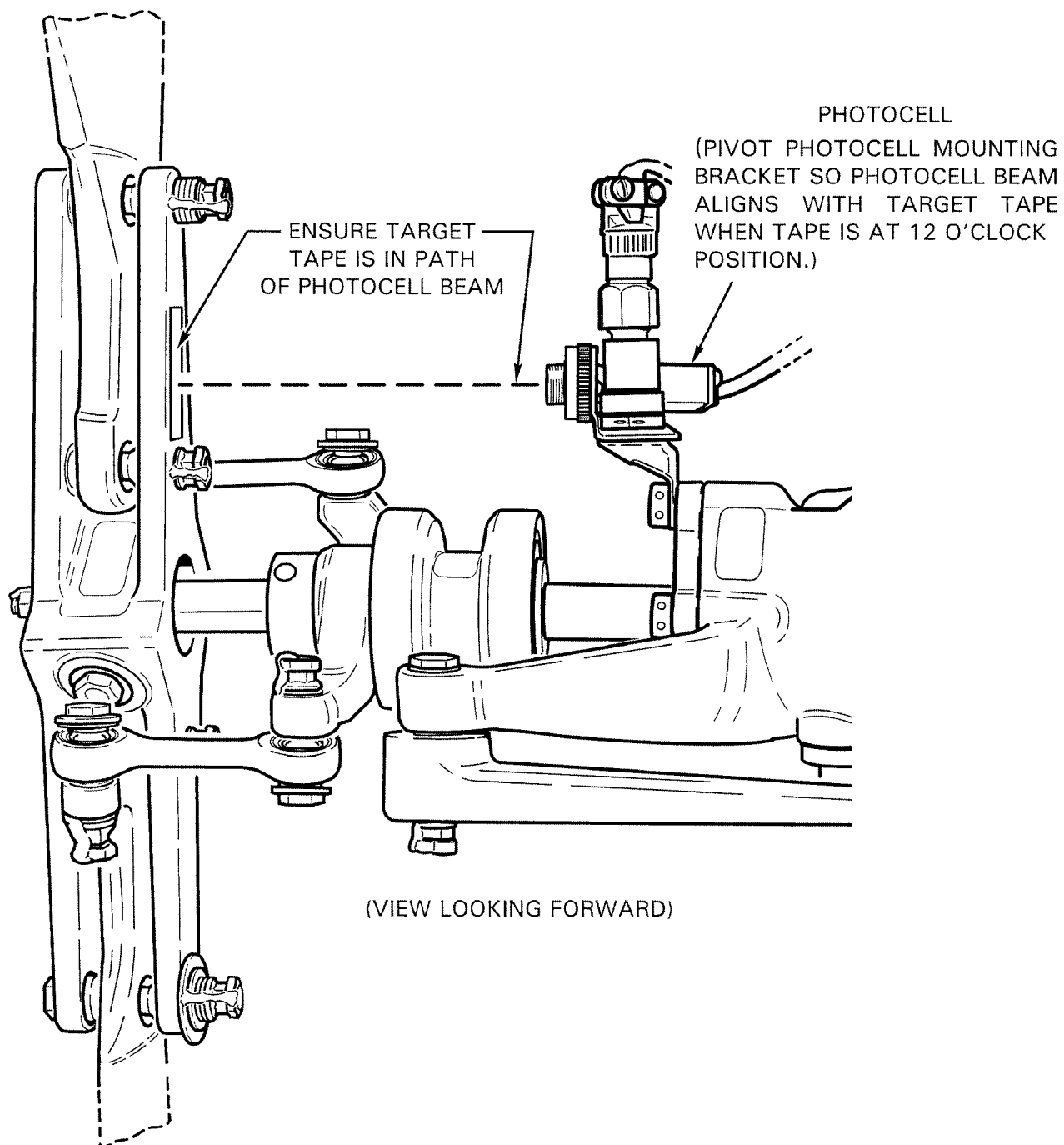


**WARNING**

Tail rotor balancing equipment must be removed for flight.

**FIGURE 10-9C TAIL ROTOR BALANCING EQUIPMENT INSTALLATION**

## 10.222 Tail Rotor Equipment Installation (cont'd)

**WARNING**

Tail rotor balancing equipment must be removed for flight.

**FIGURE 10-9D TAIL ROTOR PHOTOCELL INSTALLATION**



10.222 Tail Rotor Equipment Installation (continued)

- c. Place a target tape on tail rotor hub inboard surface approximately 1 inch in from on blade's outboard attach bolt.

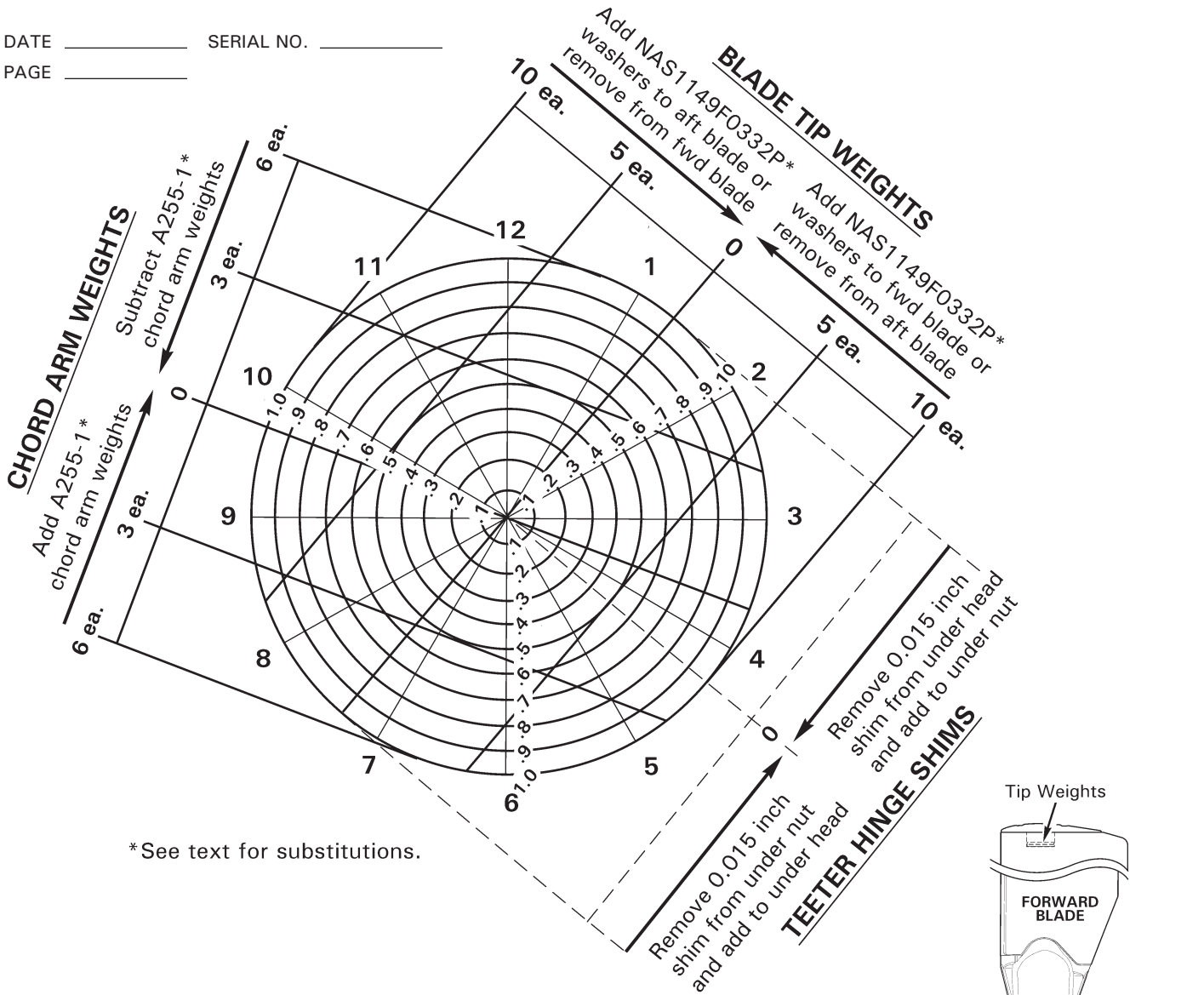
<b>CAUTION</b>
----------------

Ensure cables cannot become entangled in tail rotor.
--

- d. Refer to Figures 10-9C and 10-9D. Install and secure photocell and mounting bracket to velocimeter bracket as shown. Connect extension cable to photocell and wrap cable several times around tailcone and secure with duct tape.
- e. Connect cables to balancer.

DATE \_\_\_\_\_ SERIAL NO. \_\_\_\_\_

PAGE \_\_\_\_\_



BALANCE		TRACK (KNOTS)						
CLOCK	IPS	HOVER	50	60	70	80	90	100
Adjustment: _____								
CLOCK	IPS	HOVER	50	60	70	80	90	100
Adjustment: _____								
CLOCK	IPS	HOVER	50	60	70	80	90	100
Adjustment: _____								
CLOCK	IPS	HOVER	50	60	70	80	90	100

FIGURE 10-10 MAIN ROTOR TRACK AND BALANCE CHART

10.230 Main Rotor Track and Balance Procedure**NOTE**

Prior to installing balancing equipment, verify blades are clean and smooth, rod ends & spherical bearings & scissors play are within limits, correct upper (rotating) scissors friction, correct swashplate tilting friction, and coning hinge frictions. Verify interrupter is opposite chord arm.

In-flight track and balance is accomplished using the following testing and adjustment sequence:

1. Check main rotor track in a hover and record data. Adjust track by shortening high blade pitch link per § 10.232 to bring track within 0.25 inch.
2. Check main rotor balance in a hover and record data. Adjust balance as indicated by main rotor balance chart to within 0.2 IPS (inches per second).
3. Fly helicopter at 50, 60, 70, 80, 90, and 100 knots. Check track at each airspeed and record.

**WARNING**

**Do not exceed  $V_{NE}$  of helicopter when checking in-flight track.**

4. Make slight tab adjustment to correct for a climbing blade by bending trim tab down per § 10.233.
5. Repeat steps 3 & 4 as required until track is within 3/8 inch at all airspeeds.
6. Readjust main rotor balance in a hover to no greater than 0.2 IPS.
7. Check autorotational RPM per § 10.250. Adjust as required.
8. Evaluate collective trim, longitudinal cyclic trim, and lateral cyclic trim. Adjust as required.
9. Check main rotor balance in a hover. Verify no greater than 0.2 IPS. Adjust as required.

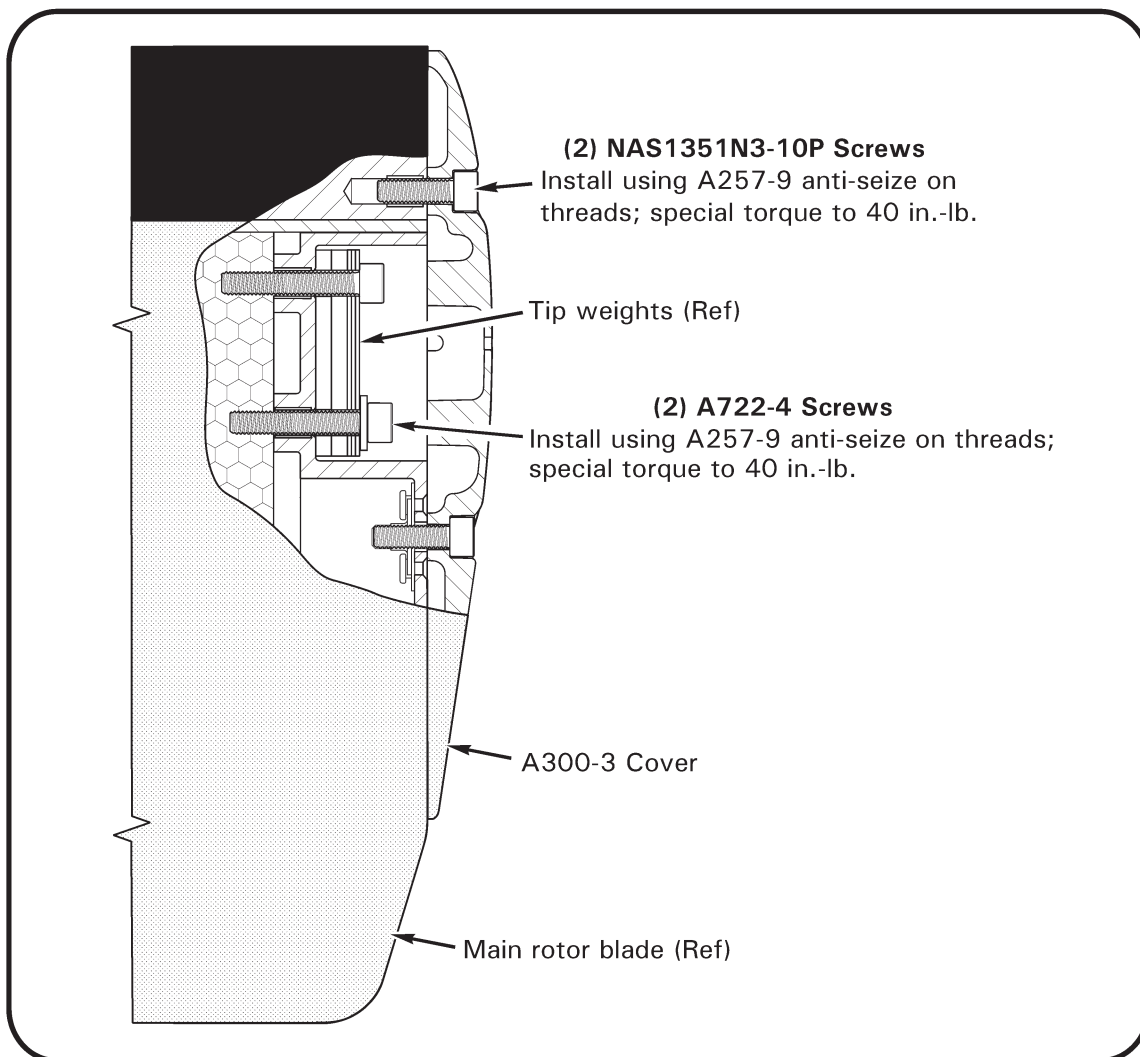


FIGURE 10-11 MAIN ROTOR BLADE TIP

10.231 Main Rotor Balance Adjustments**WARNING**

**A rotor which is smooth after balancing but goes out of balance within a few flights is suspect and must be examined by RHC before further flight.**

**A. Tip Weights (Spanwise Balance Adjustment)**

1. Remove screws securing tip cover to blade. Balance rotor assembly spanwise by adjusting tip weights as required per Figure 10-10. Washers may be trimmed. Refer to Figure 10-11. Apply light coat A257-9 anti-seize to threads and install screws securing tip weights to blade; special torque screws to 40 in.-lb. Apply light coat A257-9 anti-seize to threads and install screws securing tip cover to blade; special torque screws to 40 in.-lb.

(1) AN960-10 or NAS1149F0363P Washer = (2) AN960-10L or NAS1149F0332P Washers

(1) A298-2 Weight = 0.034 lb

(1) A298-3 Weight = 0.009 lb

**B. Teeter Hinge Bolt Shims (Chordwise Balance Adjustment – Coarse Adjustment)**

1. Remove and discard teeter hinge nut cotter pin. Remove nut, thrust washer, and any shims.
2. Have two people cone the main rotor blades. Push out teeter hinge bolt (and any shims) with another bolt.
3. Balance rotor assembly chordwise by moving (or exchanging) existing teeter hinge shims to other side of bolt (under head or under nut) as required per Figure 10-10. Install teeter hinge bolt per § 26-10.

**C. Chord Arm Weight (Chordwise Balance Adjustment – Fine Adjustment)**

1. Balance rotor assembly chordwise by adjusting chord arm weights or washers per Figure 10-10. Total weight not to exceed two A255-2 weights (or equivalent).

(1) A255-1 Weight = (8) AN970-4 Washers

(1) A255-2 Weight = (3) A255-1 Weights

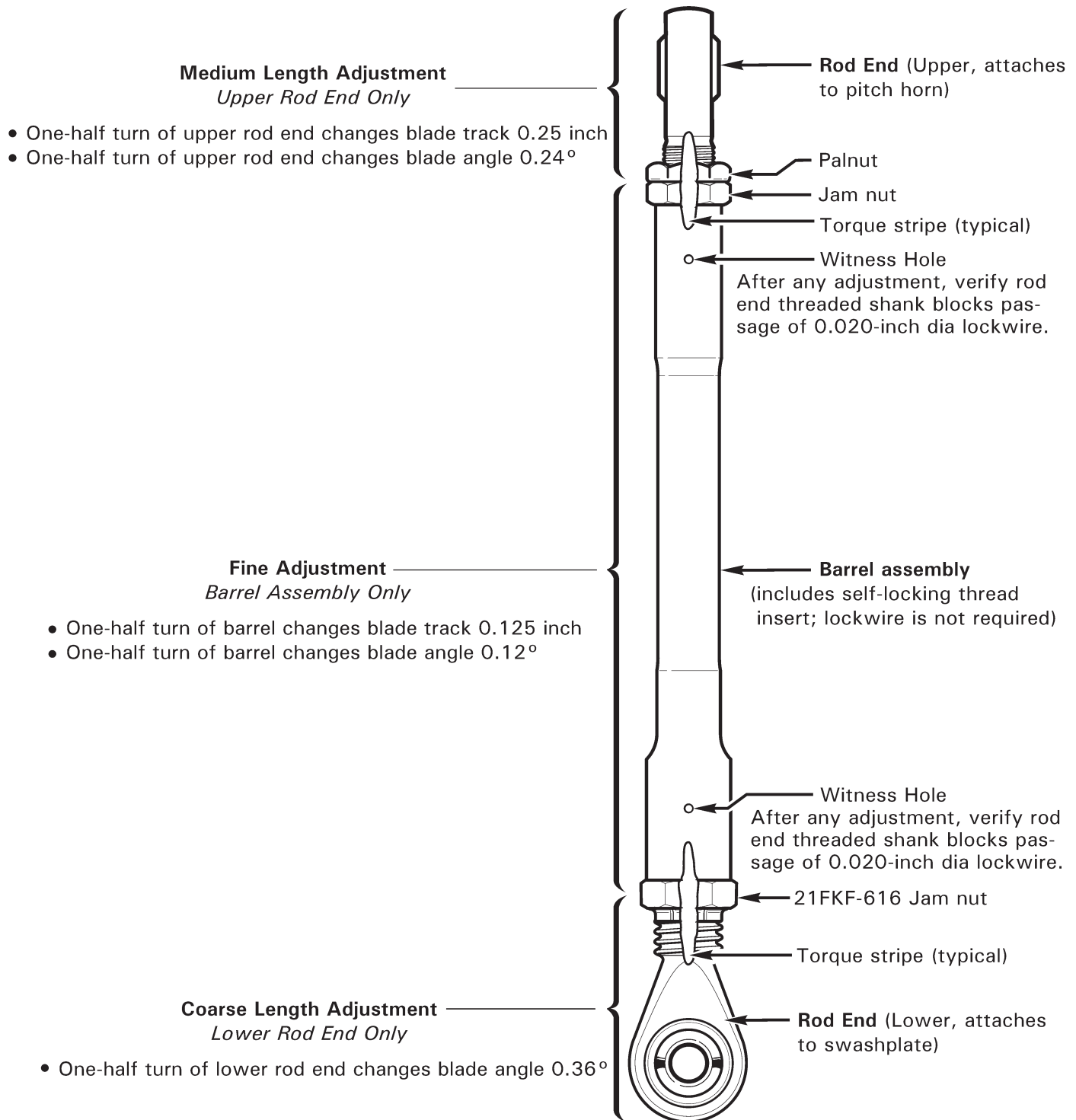


FIGURE 10-12A A258-5 MAIN ROTOR PITCH LINK

### 10.232 Main Rotor Pitch Link Adjustment

#### A. Main Rotor Blade Pitch Link

**NOTE**

Shorten high pitch blade when adjusting track in a hover.

**NOTE**

During rigging, adjust both pitch links exactly the same for collective adjustments.

1. For fine adjustment:

- a. A258-5 Pitch Link: Adjust barrel assembly only per the following steps:
  - i. Refer to Figure 10-12A. Using backup wrench on barrel assembly, loosen 21FKF-616 nut at lower rod end, and upper rod end palnut and jam nut.
  - ii. Rotate barrel assembly to shorten or lengthen pitch link as required. One-half turn of barrel changes blade track approximately 0.125 inch. One-half turn of barrel changes blade angle approximately  $0.12^{\circ}$ . For finer adjustment, rotate less than one-half turn as required.
  - iii. Refer to Figure 2-1. Verify rod end threaded shank blocks passage of 0.020-inch diameter lockwire through barrel assembly witness holes.
  - iv. Position rod ends to allow as much pitch link rotation as possible without binding. Using backup wrench on barrel assembly, special torque 21FKF-616 nut per § 23-33, and standard torque upper rod end jam nut and palnut per § 23-32.
  - v. Repeat steps on opposite pitch link as required; torque stripe per Figure 2-1.
- b. A258-1 Pitch Link: Adjust fitting only per the following:
  - i. Refer to Figure 10-12B. Cut and discard pitch link assembly safety wire. Using backup wrench on link assembly, loosen 21FKF-616 nut; using backup wrench on fitting, loosen upper rod end palnut and jam nut.
  - ii. Rotate fitting to shorten or lengthen pitch link as required. One-half turn of fitting changes blade track approximately 0.125 inch. One-half turn of fitting changes blade angle approximately  $0.12^{\circ}$ . For finer adjustment, rotate less than one-half turn as required.
  - iii. Refer to Figure 2-1. Verify rod end threaded shank blocks passage of 0.020-inch diameter lockwire through pitch link witness holes.
  - iv. Using backup wrench on link assembly, special torque 21FKF-616 nut per § 23-33. Using backup wrench on fitting, standard torque upper rod end jam nut and palnut per § 23-32. Safety fitting to link assembly using 0.032-inch diameter lockwire.
  - v. Repeat steps on opposite pitch link as required; torque stripe per Figure 2-1.

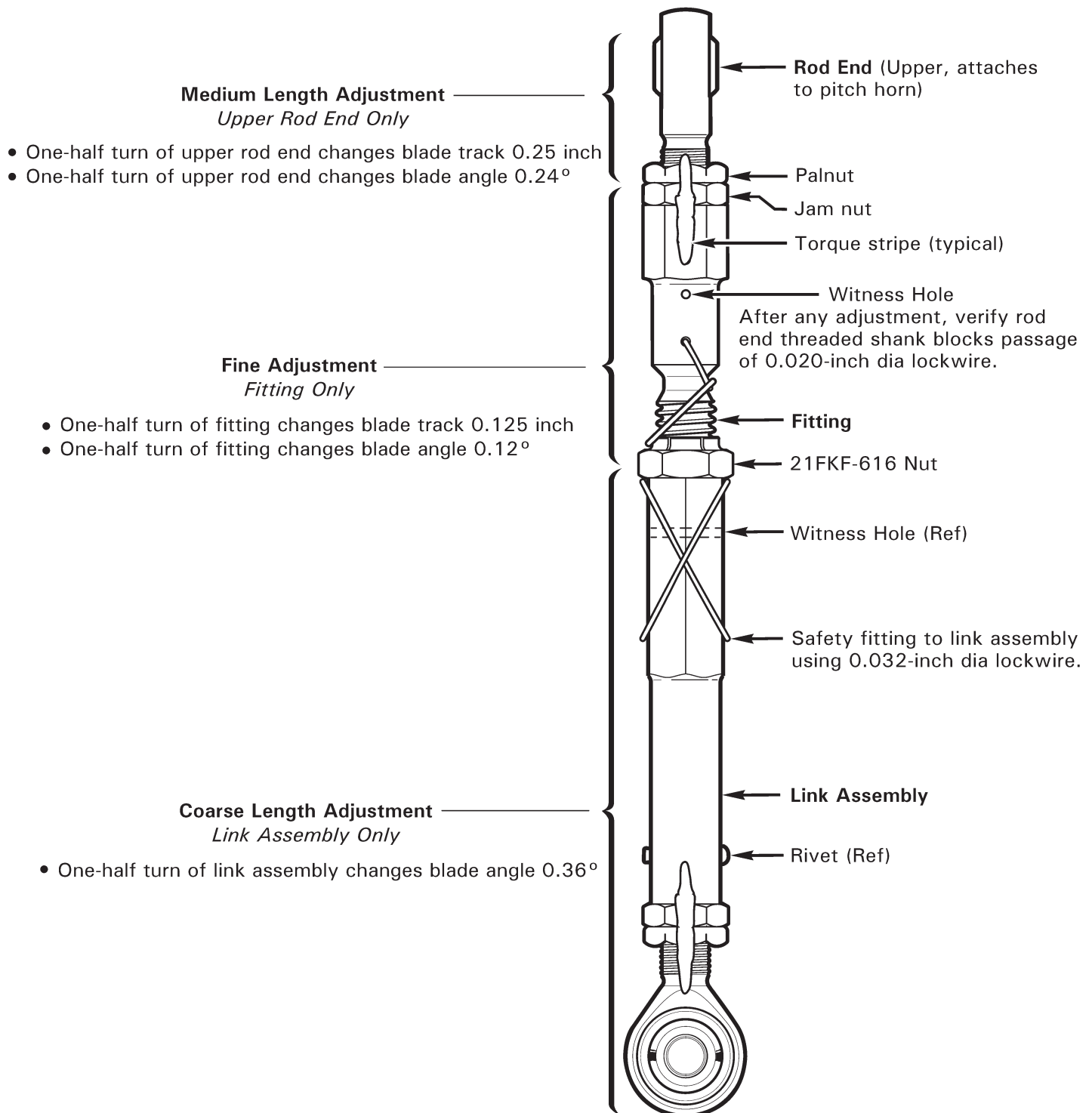


FIGURE 10-12B A258-1 MAIN ROTOR PITCH LINK



10.232 Main Rotor Pitch Link Adjustment (continued)**A. Main Rotor Blade Pitch Link (continued)**

2. For medium length adjustment, adjust upper rod end per the following:
  - a. Refer to Figure 10-12A or 10-12B. Using backup wrench on barrel assembly or fitting, loosen upper rod end palnut and jam nut. Remove hardware securing rod end to pitch horn.
  - b. Rotate upper rod end to shorten or lengthen pitch link as required. One-half turn of upper rod end changes blade track approximately 0.25 inch. One-half turn of upper rod end changes blade angle by approximately  $0.24^{\circ}$ .
  - c. Refer to Figure 2-1. Verify rod end threaded shank blocks passage of 0.020-inch diameter lockwire through barrel assembly (upper), or fitting, witness hole. Install hardware securing rod end to pitch horn and standard torque fasteners per § 23-32.
  - d. Position rod ends to allow as much pitch link rotation as possible without binding. Using backup wrench on barrel assembly or fitting, standard torque upper rod end jam nut and palnut per § 23-32.
  - e. Repeat steps on opposite pitch link as required; torque stripe per Figure 2-1.
3. For coarse length adjustment:
  - a. A258-5 Pitch Link: Adjust lower rod end per the following:
    - i. Refer to Figure 10-12A. Using backup wrench on barrel assembly, loosen 21FKF-616 nut at lower rod end. Remove hardware securing lower rod end to swashplate.
    - ii. Rotate lower rod end to shorten or lengthen pitch link as required. One-half turn of lower rod end changes blade angle by approximately  $0.36^{\circ}$ .
    - iii. Refer to Figure 2-1. Verify rod end threaded shank blocks passage of 0.020-inch diameter lockwire through barrel assembly (lower) witness hole. Install hardware securing rod end to swashplate and standard torque fasteners per § 23-32.
    - iv. Position rod ends to allow as much pitch link rotation as possible without binding. Using backup wrench on barrel assembly, special torque 21FKF-616 nut per § 23-33.
    - v. Repeat steps on opposite pitch link as required; torque stripe per Figure 2-1.

10.232 Main Rotor Pitch Link Adjustment (continued)**A. Main Rotor Blade Pitch Link (continued)**

## 3. For coarse length adjustment (continued):

b. A258-1 Pitch Link: Adjust link assembly per the following:

- i. Refer to Figure 10-12B. Cut and discard pitch link assembly safety wire. Using backup wrench on link assembly, loosen 21FKF-616 nut. Remove hardware securing lower rod end to swashplate.
- ii. Rotate link assembly to shorten or lengthen pitch link as required. One-half turn of link assembly changes blade angle by approximately  $0.36^{\circ}$ .
- iii. Refer to Figure 2-1. Verify rod end threaded shank blocks passage of 0.020-inch diameter lockwire through link assembly witness hole. Install hardware securing rod end to swashplate and standard torque fasteners per § 23-32.
- iv. Position rod ends to allow as much pitch link rotation as possible without binding. Using backup wrench on link assembly, special torque 21FKF-616 nut per § 23-33. Safety fitting to link assembly using 0.032-inch diameter lockwire.
- v. Repeat steps on opposite pitch link as required; torque stripe per Figure 2-1.

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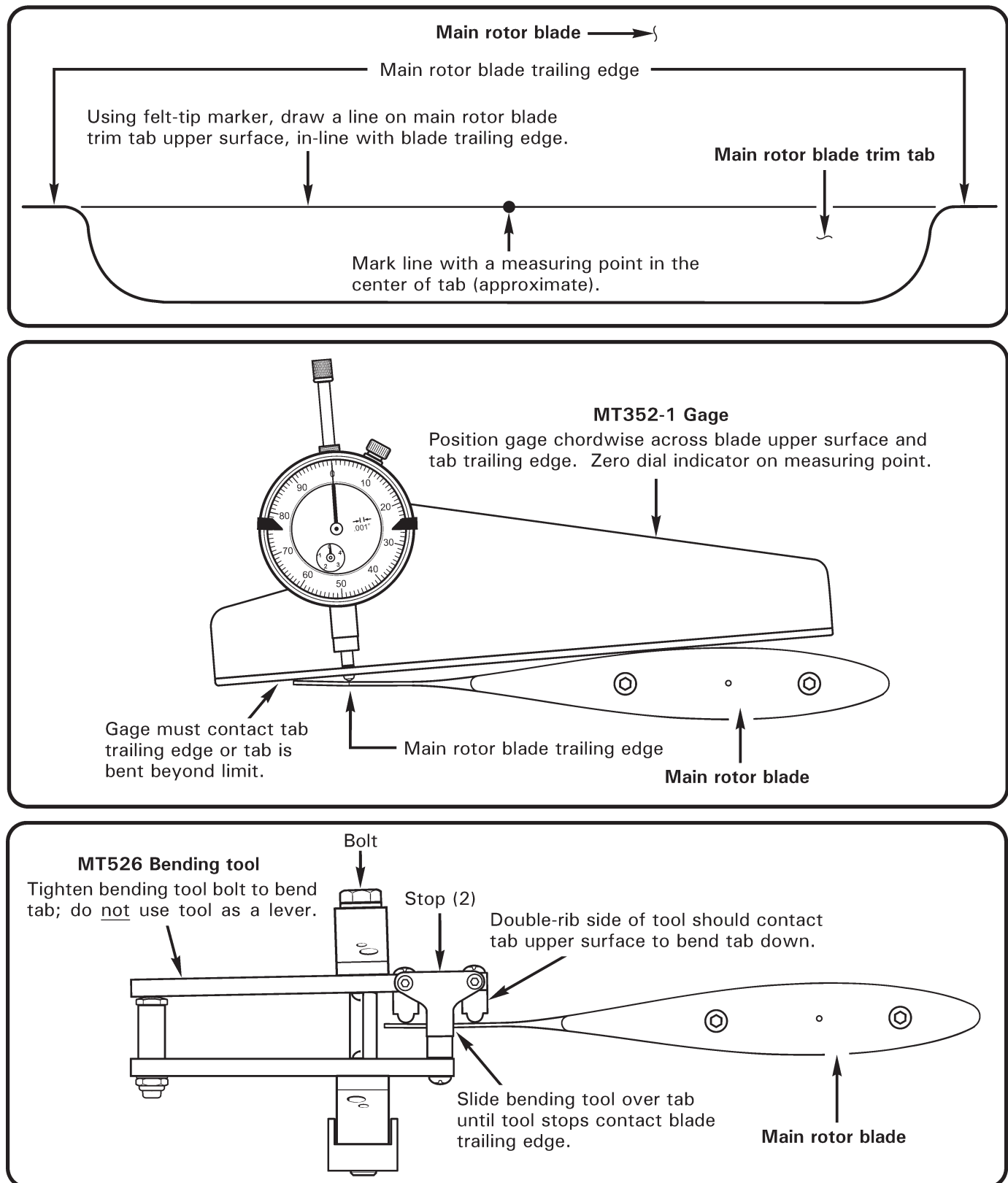


FIGURE 10-13 MAIN ROTOR BLADE TRIM TAB ADJUSTMENT

## 10.233 Main Rotor Blade Trim Tab Adjustment

## NOTE

To correct for a "climbing" blade condition (blade spread that exceeds 3/8 inch with forward airspeed), bend high blade trim tab down.

## CAUTION

Do not use other helicopter manufacturers' trim tab bending tools. Use of these tools will damage Robinson blades.

## CAUTION

MT352-1 gage must contact trim tab trailing edge. If gage does not contact tab trailing edge, tab is bent beyond limit.

## CAUTION

Tighten MT526-1 or MT526-8 trim tab bending tool bolt to bend tab; do not use tool as a lever.

## CAUTION

Bend tab upward only when absolutely necessary; bending tab upward can increase rotor vibration.

## CAUTION

MT526-1 trim tab bending tool (for A016-4 [stainless steel skin] blades) and MT526-8 trim tab bending tool (for A016-6 [aluminum skin] blades) are not interchangeable. Use of wrong bending tool can result in blade damage. MT090-1 trim tab bending tool (for earlier blades) is obsolete.

1. Using felt tip marker, ink mark main rotor blade trim tab per Figure 10-13. Mark | line with a measuring point in the center of the tab (approximate).
2. Position MT352-1 gage chordwise across blade upper surface and tab trailing edge. Zero dial indicator on measuring point.
3. Position MT526-1 (trim tab bending tool (for A016-4 [stainless steel skin] blades) or MT526-8 trim tab bending tool (for A016-6 [aluminum skin] blades) on tab per Figure 10-12. Slide tool completely over tab until tool stops contact blade trailing edge. Double-rib side of tool should contact tab upper surface to bend tab down. Double-rib side of tool should contact tab bottom surface to bend tab up.
4. Tighten MT526 bending tool bolt to bend tab. Make slight bends and re-measure tab with MT352-1 gage. Bend trim tab 0.015 inch (down) to effect dynamic movement of main rotor blade tip approximately 0.2 inch (downward).

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# 10.234 Main Rotor Track and Balance Troubleshooting

The following are some of the symptoms and corrections which occur in the Track and Balance operations of the helicopter. Decide on the various causes of a given trouble and then eliminate causes one by one, beginning with the most probable.

Symptom	Probable Cause	Correction
1. Excessive Cyclic Stick Shake	Main Rotor Out of Track or Balance	Track and Balance with Chadwick-Helmuth Balancing Equipment
	Rough or Binding A205-3 Fork Assy (Upper Swash-plate) Brinelled Spindle Bearings (rough movement) Blade surface rough (chipped) paint Rough or Binding Pitch Links M.R. Blade Boot Misaligned  M.R. Hub Teeter or Coning Hinge Binding M.R. Blade Trim Tabs Bent Upward Blade Match	Replace or refer to Section 8.6 of Maintenance Manual RHC replacement of Spindle Bearings Feather in rough edges or repaint Replace pitch link rod ends for smooth operation Replace boot or realign. Boot should show deformation as cyclic and collective are moved through their normal arc or travel. RHC replacement or rework for smooth operation Bend Trim Tabs down evenly RHC replacement of blade(s)
2. Excessive Ship Vibration	Main Rotor out of Track and Balance  M.R. Hub Teeter or Coning Hinge Friction Improperly Adjusted Sticky Coning Hinge Bearings in M.R. Hub	Track and Balance with Chadwick-Helmuth Balancing Equipment Refer to Section 9.123 of Maintenance Manual RHC replacement or refer to Section 9.123

## 10.234 Main Rotor Track and Balance Troubleshooting (cont'd)

Symptom	Probable Cause	Correction
2. Excessive Ship Vibration (cont'd)	Brinelled Spindle Bearings (rough movement) Worn Teeter Bearing in M.R. Hub	RHC replacement of Spindle Bearing RHC replacement of M.R. Hub Bearings
3. Excessive Cyclic Stick Forces	Brinelled Spindle Bearings (rough movement) M.R. Blade Trim Tabs Bent Upward	RHC replacement of Spindle Bearings Bend Trim Tabs down evenly
4. Intermittent Blade Track Picture	M.R. Hub Teeter or Coning Hinge Friction Improperly Adjusted Sticky Coning Hinge Bearings in M.R. Hub Teeter Hinge not Broken-In Brinelled Spindle Bearings (rough movement)	Refer to Section 9.123 RHC replacement or refer to Section 9.123 Adjust track to minimize error RHC replacement of Spindle Bearings
5. Radical Changes to Cyclic Trim	Worn Teeter Hinge Bearings in M.R. Hub Brinelled Spindle Bearings (rough movement)	RHC replacement of M.R. Hub Bearings RHC replacement of Spindle Bearings
6. Lateral Intermittent Aircraft Vibration	Engine misfiring due to malfunction in spark-plugs, ignition leads, magneto or engine not broken-in	Refer to Lycoming Maintenance Instructions



#### 10.240 Tail Rotor Balance Procedure

Refer to specific manufacturer's installation instructions when using balancing equipment other than Chadwick-Helmuth 177- or 8350- series Vibrex system.

Install Chadwick-Helmuth equipment per Section 10.222. Set Function Knob on Balancer to appropriate channel. Set balancer RPM Range knob to X10 and set RPM to 340. With helicopter running, with governor ON, view tail rotor assembly with Strobex. Tune Balancer while viewing target tape and adjusting RPM dial on Balancer. Record clock angle and IPS on tail rotor balance chart. Adjust as required until balance is less than 0.2 IPS.

#### **WARNING**

Both tail rotor blades must be same part number

Spanwise balance adjustments for A029-1 square-tip blades made by adding, subtracting, or exchanging weights under the removable tip cover. Use A134-1 or -2 tip weights or AN960-8 or -8L washers. -8L washers may be trimmed as a very fine adjustment.

Spanwise balance for A029-2 round-tip blades are made by exchanging different diameter washers under nut securing blade's outboard retaining bolt. The bolt has sufficient length to allow necessary spanwise weight changes; verify 2-4 threads protruding past nut after torquing per Section 1.320.

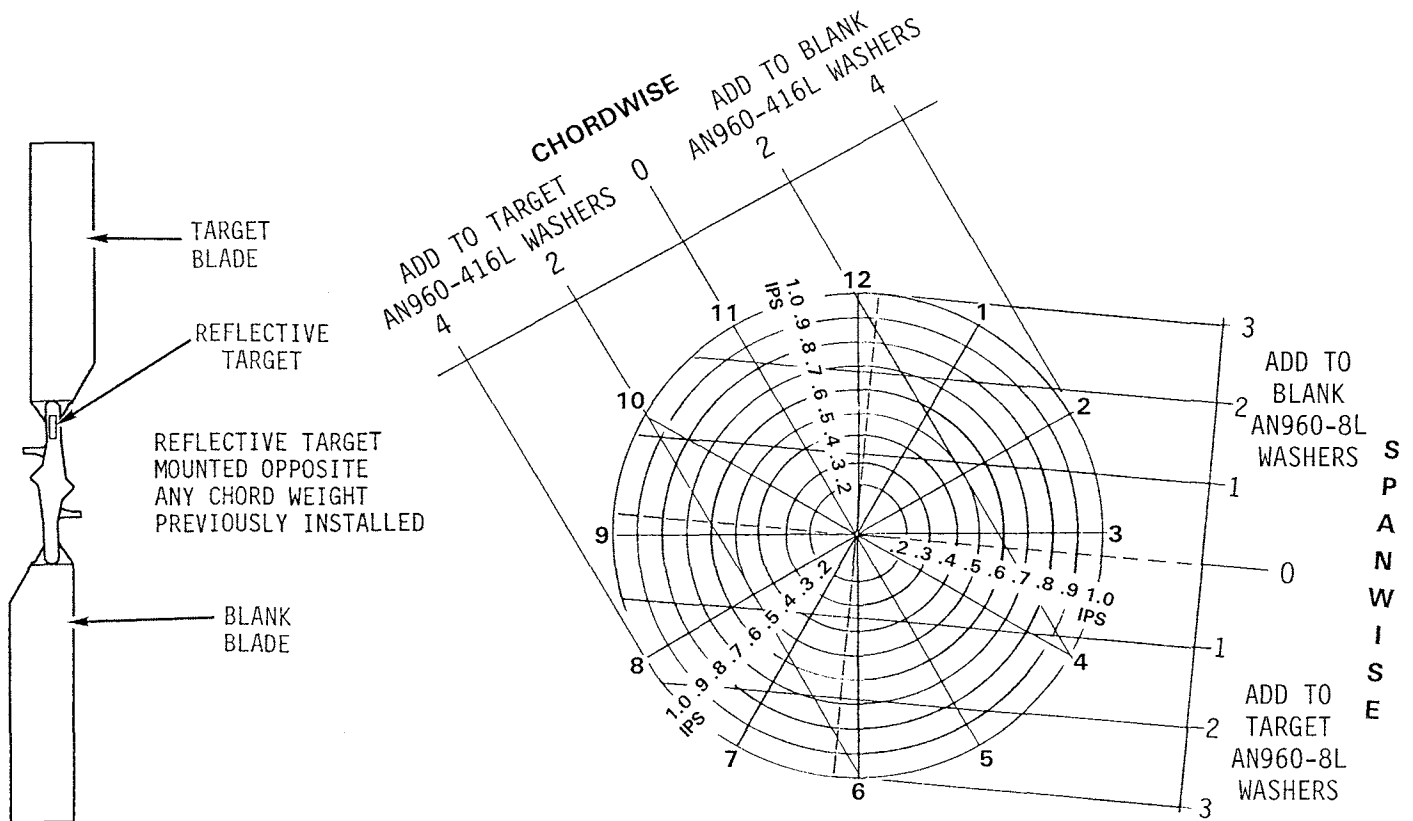
Chordwise balance is adjusted by adding, subtracting, or exchanging A141-14, A214-3, AN960-416 or -416L washers under nut securing blade's pitch link attaching bolt. Change pitch link, attaching bolt length as required for proper thread engagement (see Section 1.300, refer to IPC for allowable lengths).

A008-2 TAIL ROTOR  
(WITH A029-1 SQUARE-TIP BLADES)  
TRACK AND BALANCE CHART

SHIP S/N \_\_\_\_\_

DATE \_\_\_\_\_

HOURLY METER \_\_\_\_\_



CHORDWISE WEIGHTS

- (2)AN960-416L WASHERS = (1)AN960-416 WASHER
- (3.5)AN960-416L WASHERS = (1)A214-3 WASHER
- (5)AN960-416L WASHERS = (1)A141-14 WASHER

SPANWISE WEIGHTS

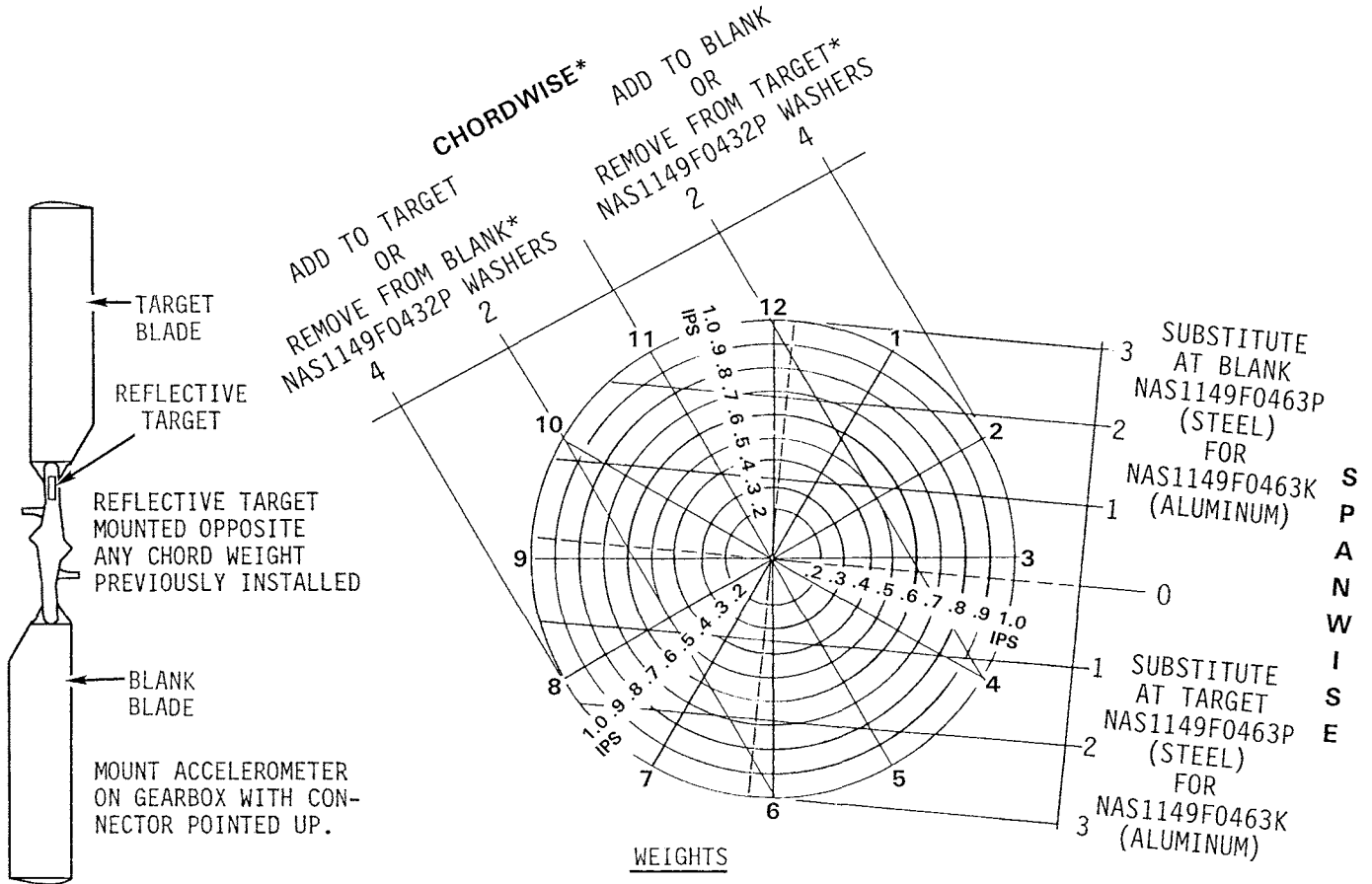
- (2)AN960-8L WASHERS = (1)AN960-8 WASHER
- (8)AN960-8L WASHERS = (1)A134-1 WEIGHT

RUN	CLOCK	IPS	CHANGE MADE BEFORE NEXT RUN

FIGURE 10-14

A008-4 TAIL ROTOR  
(WITH A029-2 ROUND-TIP BLADES)  
TRACK AND BALANCE CHART

SHIP S/N \_\_\_\_\_  
DATE \_\_\_\_\_  
HOURMETER \_\_\_\_\_



- (2)NAS1149F0432P WASHERS = (1)NAS1149F0463P WASHER  
(3.5)NAS1149F0432P WASHERS = (1)A214-3 WASHER  
(3)NAS1149F0463P WASHERS = (1)A141-14 WASHER  
(6.5)NAS1149F0463P WASHERS = (1)AN970-4 WASHER

\*A MINIMUM OF ONE NAS1149F0432P WASHER MUST BE INSTALLED  
IN CHORDWISE LOCATION ON EACH BLADE.

RUN	CLOCK	IPS	CHANGE MADE BEFORE NEXT RUN

FIGURE 10-14A

10.250 Autorotational RPM Adjustment

Use the following procedure for checking and adjusting autorotational RPM:

**WARNING**

Failure to properly adjust autorotational RPM (RPM too low) may prevent the rotorcraft from achieving proper RPM at low gross weights.

1. Perform autorotation RPM check at minimum practical weight. Calculate the takeoff gross weight of the helicopter. Record the time on the hour meter.

Take-Off gross weight \_\_\_\_\_

Take-Off hourmeter reading \_\_\_\_\_

2. Set the altimeter to 29.92" Hg (1013.2 millibars) prior to performing the autorotation. Autorotate with the collective control firmly held against the down stop with an airspeed of 50 KIAS.

**WARNING**

Do not allow the rotor to overspeed when performing autorotation checks. Progressively lengthen both main rotor pitch link rod ends until full down collective can be obtained without over-speeding the rotor.

Take at least 3 RPM readings at 500 to 1000 foot altitude intervals.

Record the following in-flight data:

Test #	Hourmeter Reading	OAT	Pressure Altitude	Test % RPM
1				
2				
3				
4				
5				

### 10.250 Autorotational RPM Adjustment (cont'd)

3. After each flight, refer to figure 10-15 and determine the following:

Test #	Elapsed Time (in-flight hourmeter reading minus take-off hourmeter reading)	Pounds of Fuel Consumed (elapsed time x 45 lbs/hr)	Test Gross Weight (take-off gross weight minus fuel consumed)	Chart % RPM	Test % RPM (from in-flight data)	RPM Correction (chart % RPM minus Test % RPM)
1						
2						
3						
4						
5						

4. Adjust the pitch links based on the average RPM correction required. Lengthen both pitch links to decrease RPM if the test RPM is greater than the chart RPM (lengthening the pitch links one full rod end turn will reduce RPM 3%). Shorten both pitch links to increase RPM. Be sure to adjust both pitch links exactly the same so track will not be affected.
5. Repeat steps (a) through (d) as required until the RPM correction is  $\pm 1\%$  of chart RPM. Determine chart RPM as follows:
  - a. Start at outside air temperature, and draw a vertical line up to the pressure altitude.
  - b. Draw a horizontal line from the pressure altitude to the rotorcraft gross weight at time of autorotation.
  - c. Draw a vertical line down from the gross weight to the required autorotation RPM.
  - d. Make adjustment to the main rotor pitch links as required to obtain test autorotation RPM within  $\pm 1\%$  of chart RPM (see Figure 10-15).

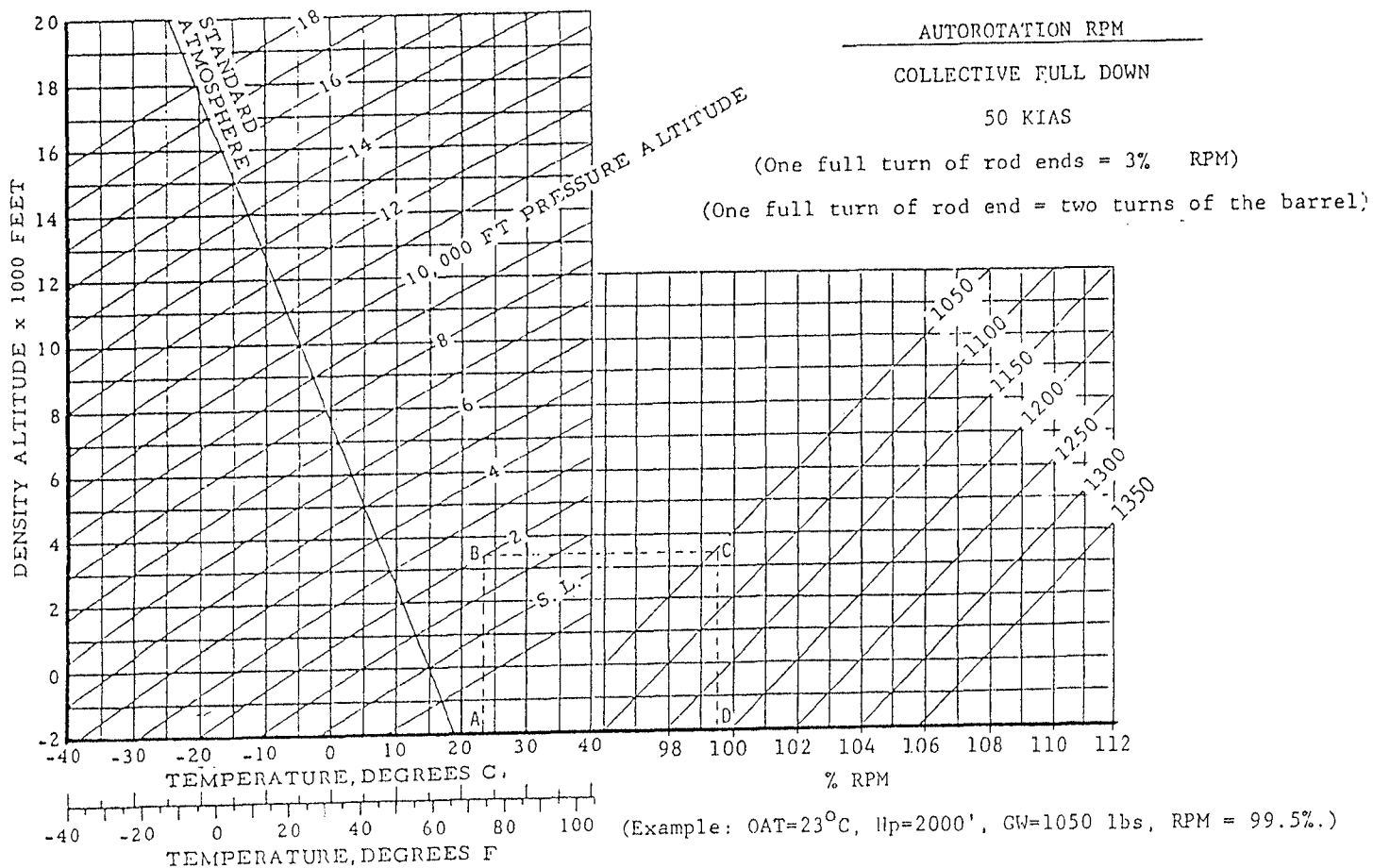


FIGURE 10-15

## CHAPTER 11

## ENVIRONMENT CONTROL |

<u>Section</u>	<u>Title</u>	<u>Page</u>
11-00	Description . . . . .	11.1
11-10	Ventilation . . . . .	11.3
11-11	Nose Vent . . . . .	11.3
11-20	Cabin Heater . . . . .	11.5
11-21	Heater Shroud . . . . .	11.5
11-22	Blower Assembly (Earlier Helicopters) . . . . .	11.6

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## CHAPTER 11

## ENVIRONMENT CONTROL

11-00 Description

Fresh air vents are located in each door and in the nose. Door vents are opened and closed using the knob near the vent door hinge. On earlier aircraft, pushing in on the knob will seal and lock the door vents closed. On later aircraft, a rotating knob is provided to lock the vents. For maximum ventilation, open door vents wide during hover but only one inch or less during cruise. The rotating knob can be used to hold vents partially open.

The fresh air inlet in the nose is opened by pulling the cabin air knob on the console face. Air from the nose inlet is directed along inside surface of the windshield for defogging as well as for ventilation.

A cabin heater is optional. It consists of an air outlet mounted on the left side of the engine cooling fan scroll, a muffler heat shroud, a control valve at the firewall, an outlet grille forward of the pilot's seat or forward of the tail rotor pedals, and interconnecting ducting. Earlier heaters used an electric blower, located on the left side of the engine compartment, and a blower switch, located on the ledge forward of the pilot's seat, for air. A push-pull control, located on the ledge forward of the pilot's seat, actuates a valve which directs heat either into the cabin or out an overboard discharge on the cabin underside.

## NOTE

For earlier heaters that use an electric blower for air, the heater shroud may be removed during warm seasons (when heater is not in use) to prolong muffler life. Current production heaters provide constant cooling air to muffler via the cooling fan scroll and are designed to remain installed.

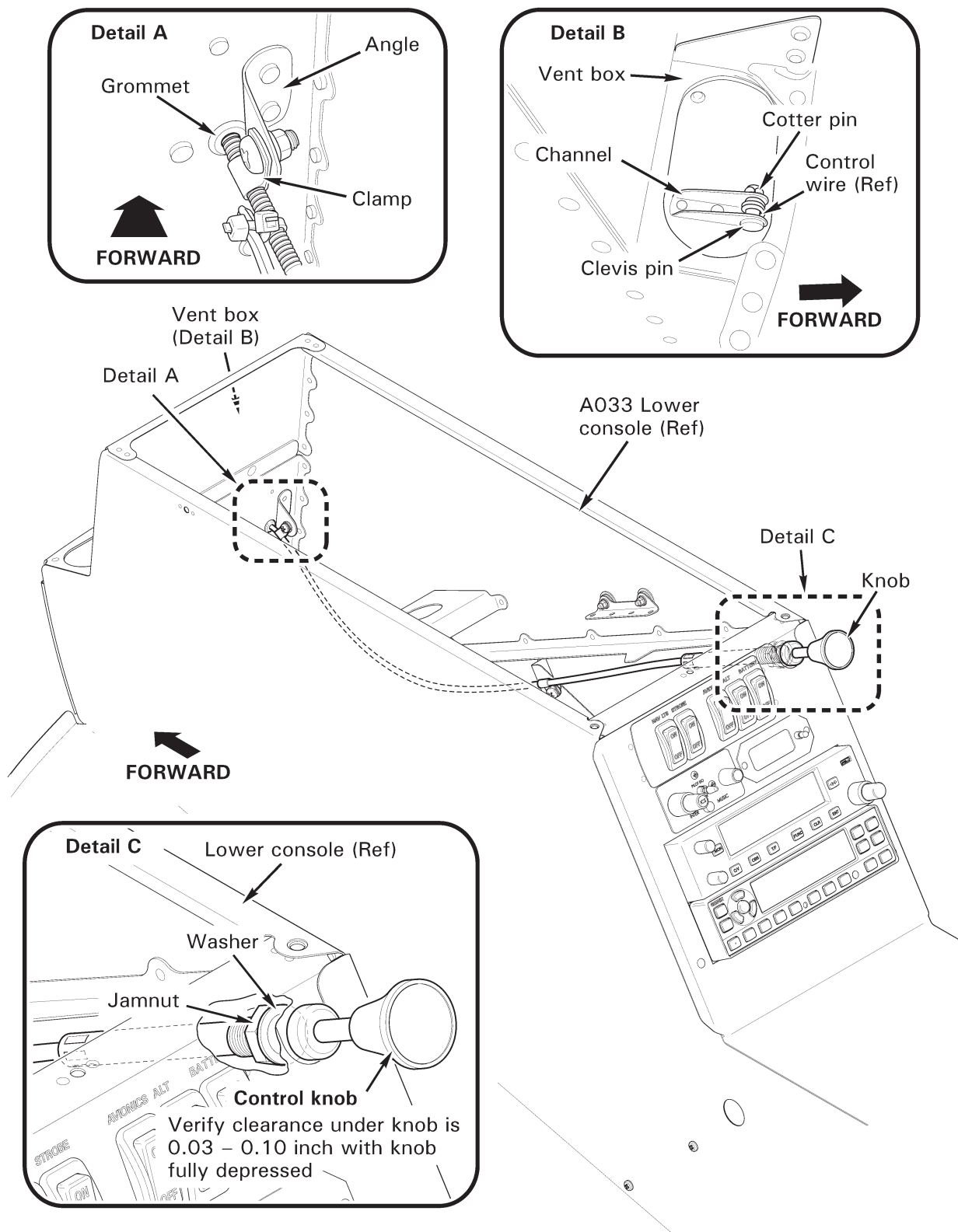


FIGURE 11-1 NOSE VENT

## 11-10 Ventilation

### 11-11 Nose Vent

#### **A. Removal**

1. Refer to Figure 11-1. Remove Aspen PFD per § 13-61, if installed. Remove screws securing upper console to lower console and tilt upper console aft. Protect instrument face with foam support or equivalent.
2. Remove battery per § 33-10 as required.
3. Remove and discard cotter pin securing clevis pin and A522-1 (air vent) control inner wire to vent box flap assembly. Remove and retain clevis pin.
4. Remove hardware securing AN742-3 clamps and control housing to lower console assembly.
5. Remove jam nut and lockwasher securing control (at knob) to lower console assembly; remove clamps and grommet as required and remove control.

#### **B. Installation**

1. Refer to Figure 11-1. Position A522-1 (air vent) control in lower console, install lockwasher and jam nut on control, and tighten nut against console support assembly. Verify security.
2. Install MS35489-4 grommet in vent box flap assembly.
3. Secure control inner wire to vent box flap assembly using clevis pin and (new) cotter pin. Verify security.
4. Install hardware securing AN742-3 clamps and control housing to lower console assembly. Verify security.
5. Actuate vent and adjust clamp position as required for proper vent operation. Verify control housing does not slip through clamp when opening and closing vent. Verify clearance under knob is 0.03–0.10 inch with knob fully depressed (closed).
6. Install battery per § 33-10 if removed.
7. Tilt console forward and install screws securing upper console to lower console. Verify security. Install Aspen PFD per § 13-61, if removed.

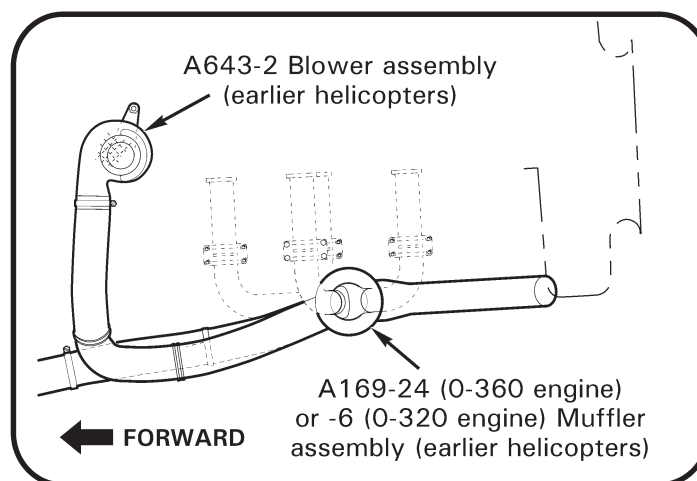
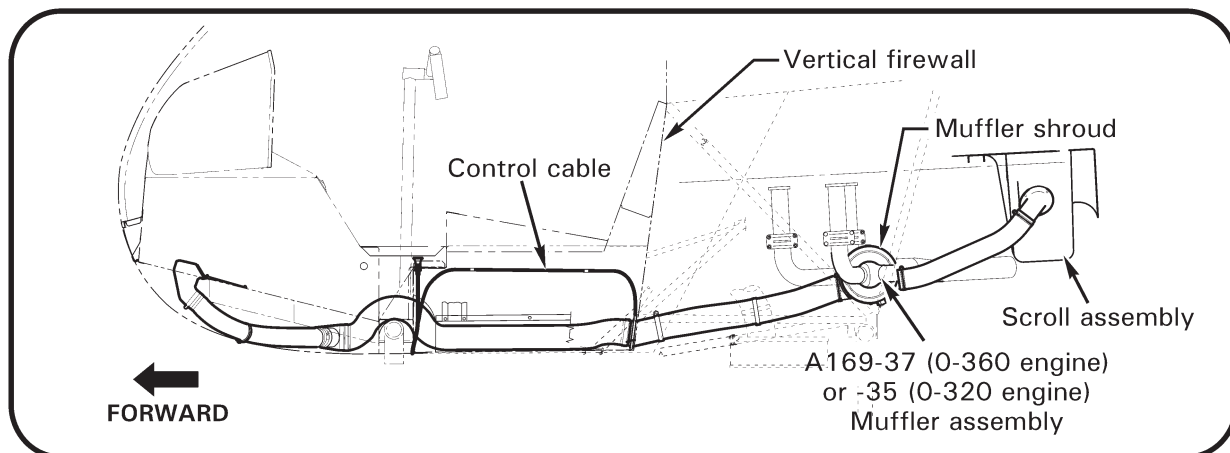
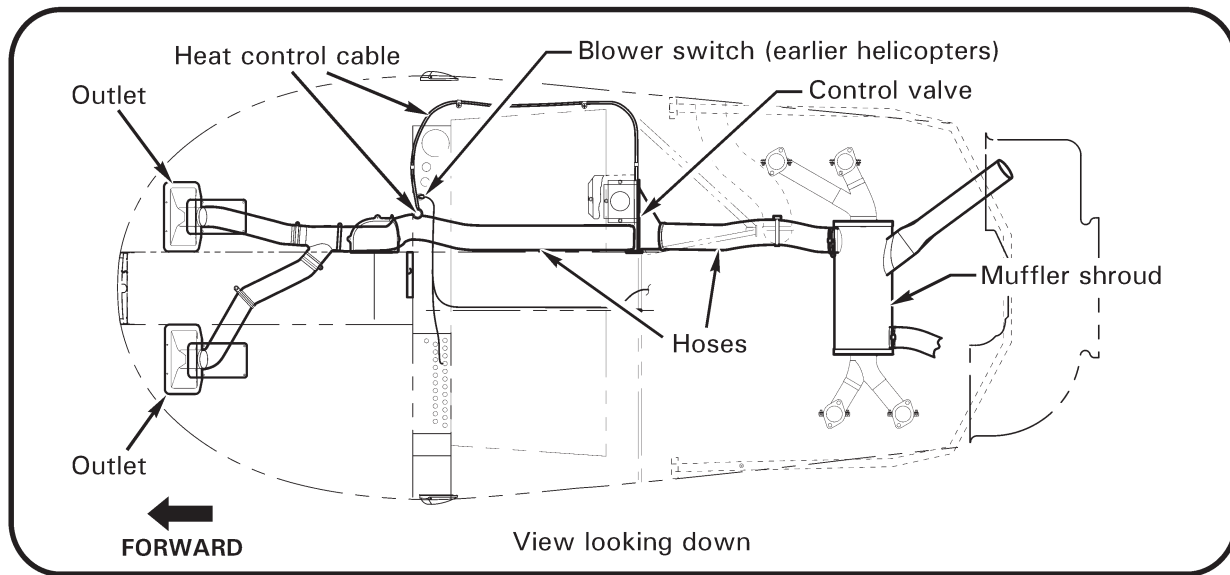


FIGURE 11-2 CABIN HEATER

## 11-20 Cabin Heater

### 11-21 Heater Shroud

#### **A. Removal**

1. Loosen clamps and disconnect hoses from heater shroud. Temporarily cover open hoses to protect system from contamination.
2. Remove exhaust system per § 6.510.
3. Remove screws securing shroud to muffler and remove shroud.

#### **B. Installation**

1. Install shroud on muffler and install screws. Verify security.
2. Install exhaust system per § 6.520.
3. Remove temporary covers and connect hoses to shroud. Tighten clamps and verify security.

#### **C. Configuration for Flight with Heater Shroud Removed (Earlier Helicopters):**

##### **NOTE**

For earlier heaters that use an electric blower for air, the heater shroud may be removed during warm seasons (when heater is not in use) to prolong muffler life. Current production heaters provide constant cooling air to muffler via the cooling fan scroll and are designed to remain installed.

1. Remove electric blower per § 11-22 Part A.
2. Remove heater shroud per Part A.
3. Remove hoses and attaching hardware from inside engine compartment.
4. Pull out HEATER circuit breaker (10 amp) at panel, and placard as required.

**11-22 Electric Blower (Earlier Helicopters)****A. Removal**

1. Remove hardware securing screen, spacer, and inlet to LH engine side skirt and blower assembly, and remove screen, spacer, and inlet. Remove LH engine side skirt.
2. Turn battery switch off and pull out HEATER circuit breaker (10 amp) at panel. Disconnect blower assembly wiring from airframe electrical harness at connectors.
3. Loosen clamp securing hose to blower assembly and disconnect hose. Temporarily cover open hose to protect system from contamination.
4. Remove hardware securing blower assembly and ground wire to frame and remove blower assembly.

**B. Installation**

1. Install hardware securing blower assembly and ground wire to frame, but do not torque.
2. Remove temporary cover and connect hose to blower assembly. Tighten clamp and verify security.
3. Turn battery switch off and pull out HEATER circuit breaker (10 amp) at panel. Connect blower assembly wiring to airframe electrical harness at connectors; verify security.
4. Install LH engine side skirt; install hardware securing screen, spacer, and inlet to LH engine side skirt and blower assembly (adjusting position of blower as required). Verify security. Standard torque hardware securing blower assembly and ground wire to frame, and torque stripe per Figure 2-1.

## CHAPTER 12

## FUEL SYSTEM

<u>Section</u>	<u>Title</u>	<u>Page</u>
12.000	Description . . . . .	12.1
12.100	Fuel Tanks . . . . .	12.3
12.110	Main Tank . . . . .	12.3
12.120	Auxiliary Tank . . . . .	12.7
12.130	Fuel Cap(s) . . . . .	12.9B
12.200	Fuel Vents . . . . .	12.11
12.210	(Vent Line) Rollover Valve Assemblies . . . . .	12.11
12.300	Drain Valves . . . . .	12.11
12.400	Fuel Quantity . . . . .	12.13
12.410	Fuel Quantity Senders . . . . .	12.13
12.420	Fuel Quantity Indication . . . . .	12.14
12.430	Low-Fuel Switch Assembly . . . . .	12.15
12.500	Gascolator Assembly . . . . .	12.16
12.600	Minimum Fuel Flow Check . . . . .	12.17

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## CHAPTER 12

## FUEL SYSTEM

12.000 Description

Fuel system maintenance is specific to either bladder or all-aluminum tank installations (current production aircraft have flexible bladders in aluminum enclosures while earlier aircraft use all-aluminum tanks). Mechanics are advised to identify fuel tank installation type, and to follow the appropriate maintenance procedures. Maintenance procedures for the carburetor or engine fuel system accessories may be found in the appropriate manufacturer's technical data.

The fuel system is gravity-flow (no fuel pumps) and includes a main tank, an auxiliary tank (optional for all-aluminum tanks), a shut-off valve control located behind the left seat, and a strainer (gascolator). Fuel tank air vents are located inside the mast fairing.

Plunger-style drain valves are provided for the gascolator and for each fuel tank sump. The gascolator is located on the lower left side of the firewall. The drain valves for the auxiliary tank and bladder-style main tank are located inside the cowl door below the auxiliary tank. Plastic tubes attached to the valves allow fuel to be drained overboard.

Fuel samples are taken by pushing on the plunger(s). For all-aluminum main tanks, the drain is located on the left side of the fuselage and is opened by pushing in on the plastic tube. On newer helicopters, a glass tube stowed inside the upper, aft cowl door is provided which may be used to catch the fuel samples. Fuel should be sampled from all three locations prior to the first flight of the day and after refueling to verify no contamination and correct grade.

The fuel gages are electrically operated by float-type transmitters in the tanks. When the gages read E the tanks are empty except for a small quantity of unusable fuel. The low fuel caution light is actuated by a separate electric sender located on the bottom of the main tank.

The auxiliary tank is interconnected with the main tank and is located somewhat higher so it will become empty first while fuel still remains in the main tank. The fuel shutoff valve controls flow from both tanks to the engine.

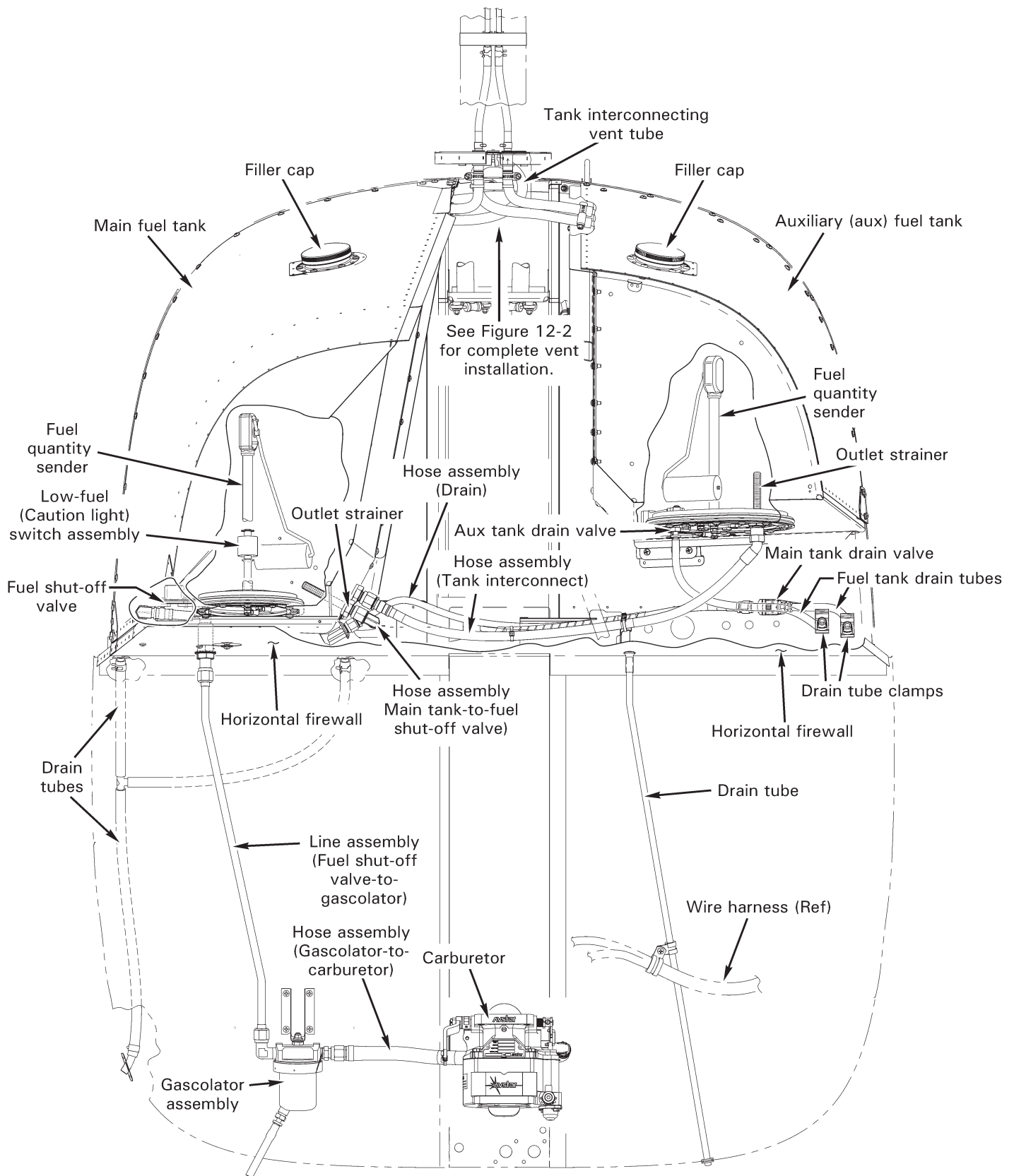


FIGURE 12-1 FUEL SYSTEM (BLADDER TANK INSTALLATION SHOWN)

### 12.100 Fuel Tanks

**CAUTION**

Flexible hoses kink easily; handle with care.

**CAUTION**

Temporarily cap fuel fittings when opened.

**WARNING**

**Fuel vapors are explosive. Do not use electric tools in vicinity of an opened fuel system.**

### 12.110 Main Tank

#### A. Removal

1. Defuel helicopter per § 1.150.
2. Remove mast fairing. Open access doors, disconnect ELT antenna and ground wire at connectors if ELT is installed, and remove tailcone fairing. Remove B423-1 channel assembly and B429 skins (cowling between tanks).
3. Remove left backrest assembly.
4. Loosen clamps, or cut and discard safety wire, securing vent tubes to main tank assembly and pull tubes off of tank. Remove hardware securing A713-1 strap to tank.
5. Cut and discard ty-raps as required and disconnect fuel quantity sender and low-fuel switch assembly wiring from airframe harness at connectors. Remove nuts securing wiring to fuel quantity sender if connectors are not installed.
6. a. Bladder Tank: Disconnect D205-32 (tank-to-fuel shut-off valve) hose assembly from valve and D205-33 (tank interconnect) hose assembly from aux tank. Cut and discard ty-raps attaching D205-34 (drain) hose assembly and D205-33 hose assembly to support, then disconnect hose from drain valve connector. (Hose assemblies remain attached to main tank during tank removal.)  
  
b. All-Aluminum Tank: Disconnect A726-2 (tank-to-fuel valve) and B141-1 (tank interconnect; aux tank option) line assemblies and remove line assemblies.
7. Remove hardware securing tank's A028-7 frame (panel) to B428-1 frame (panel) and A020-2 (steel tube) upper frame. Remove hardware securing tank outboard corners to horizontal firewall vertical flange. Remove hardware securing tank forward channel to underside of horizontal firewall (access from engine compartment).
8. Carefully remove tank assembly.

12.110 Main Tank (continued)**B. Installation****NOTE**

When positioning main tank in helicopter, verify vertical strip attached to horizontal firewall is between tank's D249-4 angle (attached to stiffener on bottom of tank) and tank's exterior skin.

**NOTE**

Electrically verify proper function of low-fuel warning switch and fuel quantity sender prior to main tank installation. Perform fuel quantity sender check per § 12.410 as required.

1. Bladder Tank: If not previously accomplished, connect D205-32 (tank-to-fuel shut-off valve) hose assembly to main tank strainer assembly, D205-33 (tank interconnect) hose assembly to main tank AN815-6D union, and D205-34 (drain) hose assembly to main tank AN815-4D union. Special torque hose nuts per § 1.330 and torque stripe per Figure 2-1.
2. Position main tank assembly in helicopter, carefully routing attached hose assemblies (bladder tanks) to appropriate locations.
3. Install hardware securing tank outboard corners to horizontal firewall vertical flange. Install hardware securing A713-1 strap to tank. Install hardware securing A028-7 frame (panel) to B428-1 frame (panel) and A020-2 (steel tube) upper frame. Install hardware securing tank forward channel to underside of horizontal firewall (access from engine compartment). Standard torque hardware per § 1.320 and torque stripe per Figure 2-1.
4. a. Bladder Tank: Connect D205-32 hose assembly to fuel valve elbow. Connect D205-33 hose assembly to aux tank strainer assembly. Connect D205-34 hose to drain valve connector. Special torque hose nuts per § 1.330 and torque stripe per Figure 2-1. Install two MS3367-5-9 ty-raps around D205-33 and D205-34 hose assemblies to stand-off ty-rop hoses to support, but do not tighten. Maintain 0.25 in. minimum clearance for D205-33 hose with frame assembly and firewall, and for D205-34 hose with firewall and support. Cinch ty-raps until snug without over-tightening, and trim tips flush with heads.  
  
b. All-Aluminum Tank: Connect A726-2 (tank-to-fuel shut-off valve) line assembly to tank elbow or tee (aux tank option) and fuel valve elbow. Connect B141-1 line assembly (aux tank option) to aux tank nipple and tank tee. Special torque line nuts per § 1.330 and torque stripe per Figure 2-1.
5. Connect fuel quantity sender and low-fuel switch assembly wiring to airframe harness at connectors. Install nuts securing wiring to fuel quantity sender if connectors are not installed; special torque nuts per § 1.330 and torque stripe per Figure 2-1. Install ty-raps as required.
6. Connect vent tubes to tank and tighten clamps until snug, or wrap two turns 0.032-in. dia. lockwire and safety tubes tight to tank. Verify security.

12.110 Main Tank (continued)**B. Installation (continued)**

7. Check fuel quantity indication per § 12.420. Verify no leaks.
8. Inspect fuel cap alignment stripes per R22 Service Bulletin SB-107. Verify proper installation and legibility of D682-44 decals.
9. Install left backrest assembly.
10. Install B423-1 channel assembly, B429 skins (cowlings between tanks), and A706-1 tailcone fairing. Install mast fairing. Connect ELT antenna & ground wire at connectors if ELT is installed. Secure access doors.
11. Perform pitot-static leak check if system was disturbed.

**C. Bladder Replacement****NOTE**

During disassembly, progressively tape bladder openings to protect interior from foreign object contamination. During assembly, progressively remove protective tape.

**CAUTION**

B028-1 bladder assembly temperature should be above 65°F before removing, installing, or flexing bladder.

1. Remove main fuel tank per Part A.
2. Remove fuel quantity sender per § 12.410.
3. Remove screws securing D250-6 cover assembly to B028-1 bladder assembly and tank. Carefully remove cover, with low-fuel switch assembly attached. Remove o-ring, and discard if condition warrants.
4. At vents, remove screw securing bladder to tank.
5. At fuel filler neck, remove fuel cap and screws securing bladder to tank.
6. At forward inboard corner, remove B254-3 strainer assembly, AN815-4D union, & AN815-6D union and discard o-rings. Remove screws securing bladder to tank.
7. Remove hardware securing B578-1 bulkhead assembly, B575-4 channel, and B575-5 stiffener to tank. Detach hook-and-loop tape and remove bulkhead.
8. Detach hook and loop tape and carefully remove bladder.
9. Carefully insert new B028-1 bladder assembly inside main tank assembly. Align bladder and tank fastener holes and press hook-and-loop tape together.
10. Install hardware securing B578-1 bulkhead assembly, B575-4 channel, and B575-5 stiffener to tank. Verify security.

12.110 Main Tank (continued)**C. Bladder Replacement (continued)**

11. At forward inboard corner, apply A257-9 anti-seize to screw threads and install screws securing bladder to tank. Lubricate new o-rings with A257-6 grease and install o-rings on B254-3 strainer assembly, AN815-4D union, and AN815-6D union. Install strainer and unions; special torque per § 1.330 and torque stripe per Figure 2-1.
12. At fuel filler neck, apply A257-9 anti-seize to screw threads and install screws securing bladder to tank. Install fuel cap.
13. At vents, apply A257-9 anti-seize to screw threads and install screw securing bladder to tank.
14. On bottom, lubricate (new) o-ring with A257-6 grease and install o-ring in bladder ring groove. Carefully insert D250-6 cover into bladder, with attached low-fuel switch assembly. Apply A257-9 anti-seize to threads and install screws securing cover to bladder and tank.
15. Install fuel quantity sender per § 12.410.
16. Pressure check assembled fuel tank by plugging vents and fittings and pressurizing bladder to no more than 1 psi. Check for leaks with a mild soap and water solution applied to all seams.
17. Install main fuel tank per Part B.

### 12.120 Auxiliary Tank

#### **A. Removal**

1. Defuel helicopter per § 1.150.
2. Open right side of mast fairing. Open access doors, disconnect ELT antenna & ground wire at connectors if ELT is installed, and remove tailcone fairing. Remove B423-1 channel assembly and B429 skins. Remove B430 door and skin.
3. Remove right backrest assembly.
4. Loosen clamps, or cut & discard safety wire, securing vent tubes to aux tank assembly and pull tubes off tank. Remove hardware securing pitot-static line clamp to tank channel.
5. Cut & discard ty-raps as required and disconnect fuel quantity sender wiring from airframe harness at connectors. Remove nuts securing wiring to sender if connectors are not installed.
6. Remove hardware securing rotor brake cable assembly to B112-1 lever. Cut & discard heat shrink and disconnect bead chain from cable at connector.
7. Cut & discard ty-rap securing drain tube to angle (bladder tank), or remove hardware securing drain tube clamp to firewall clip.
8. Disconnect hose or line assembly from tank fitting.
9. Bladder Tank: Above right seat, gently lift foam from bulkhead and remove fasteners securing tank to bulkhead.
10. Remove screws securing tank channel to frames.
11. Remove perimeter screws securing tank to bulkhead. Remove tank.

12.120 Auxiliary Tank (continued)**B. Installation**

1. Position aux tank assembly in helicopter. Install perimeter screws securing tank to bulkhead.
2. Install screws securing tank channel to frames.
3. Bladder Tank: Above right seat, gently lift foam from bulkhead and install fasteners securing tank to bulkhead.
4.
  - a. Bladder Tank: Connect D205-33 hose assembly to aux tank fitting, special torque hose nut per § 1.330, and torque stripe per Figure 2-1. Verify 0.25 in. minimum clearance with frame assembly and firewall (reposition hose assembly angle as required).
  - b. All-Aluminum Tank: Connect B141-1 line assembly to aux tank fitting, special torque line nut per § 1.330, and torque stripe per Figure 2-1.
5.
  - a. Bladder Tank: Install MS3367-5-9 ty-rap securing drain tube to angle. Cinch ty-rap until snug without over-tightening, and trim tip flush with head.
  - b. All-Aluminum Tank: Install hardware securing drain tube clamp to firewall clip.
6. Install hardware securing rotor brake cable assembly to B112-1 lever. Slip length of B158-6 heat shrink over rotor brake chain, connect chain and cable, and activate heat shrink over connector. Verify security.
7. Connect fuel quantity sender wiring at connectors. Install nuts securing wiring to fuel quantity sender if connectors are not installed. Install ty-raps as required.
8.
  - a. Bladder Tank: Connect vent tubes to tank and tighten clamps until snug. Verify security.
  - b. All-Aluminum Tank: Connect vent tubes to tank, wrap two turns 0.032-in. dia. lockwire and safety tubes tight to tank. Verify security.
9. Install hardware securing pitot-static line clamp to tank channel.
10. Check fuel quantity indication per § 12.420. Verify no leaks.
11. Inspect fuel cap alignment stripes per R22 Service Bulletin SB-107. Verify proper installation and legibility of D682-44 decals.
12. Install right backrest assembly.
13. Install B430 door and skin. Install B423-1 channel assembly and B429 skins. Install tailcone fairing, connect ELT antenna ground wire at connector if ELT is installed, and close access doors. Close right side of mast fairing.



12.120 Auxiliary Tank (continued)**C. Bladder Replacement****NOTE**

During disassembly, progressively tape bladder openings to protect interior from foreign object contamination. During assembly, progressively remove protective tape.

**CAUTION**

B028-2 bladder assembly temperature should be above 65°F before removing, installing, or flexing bladder.

1. Remove aux fuel tank per Part A.
2. Remove fuel quantity sender per § 12.410.
3. Remove screws securing D250-8 cover assembly to B028-2 bladder assembly and tank. Carefully remove cover, with strainer, siphon, and union attached. Remove and discard o-ring.
4. At vents, remove screw securing bladder to tank.
5. At fuel filler neck, remove fuel cap and screws securing bladder to tank.
6. Remove hardware securing B579-1 bulkhead assembly and B577-2 stiffener to tank. Detach hook-and-loop tape and remove bulkhead.
7. Detach hook-and-loop tape and carefully remove bladder.
8. Carefully insert new B028-2 bladder assembly inside aux tank assembly. Align bladder and tank fastener holes and press hook and loop tape together.
9. Install hardware securing B579-1 bulkhead assembly and B577-2 stiffener to tank. Verify security.
10. At fuel filler neck, apply A257-9 anti-seize to screw threads and install screws securing bladder to tank. Install fuel cap.
11. At vents, apply A257-9 anti-seize to screw threads and install screw securing bladder to tank.
12. Lubricate new o-ring with A257-6 grease and install o-ring in bladder ring groove. Carefully insert cover into bladder, with strainer, siphon, and union attached. Apply A257-9 anti-seize to threads and install screws securing cover to bladder and tank.
13. Install fuel quantity sender per § 12.410.
14. Pressure check assembled fuel tank by plugging vents and fittings and pressurizing bladder to no more than 1 psi. Check for leaks with a mild soap and water solution applied to all seams.
15. Install aux fuel tank per Part B.

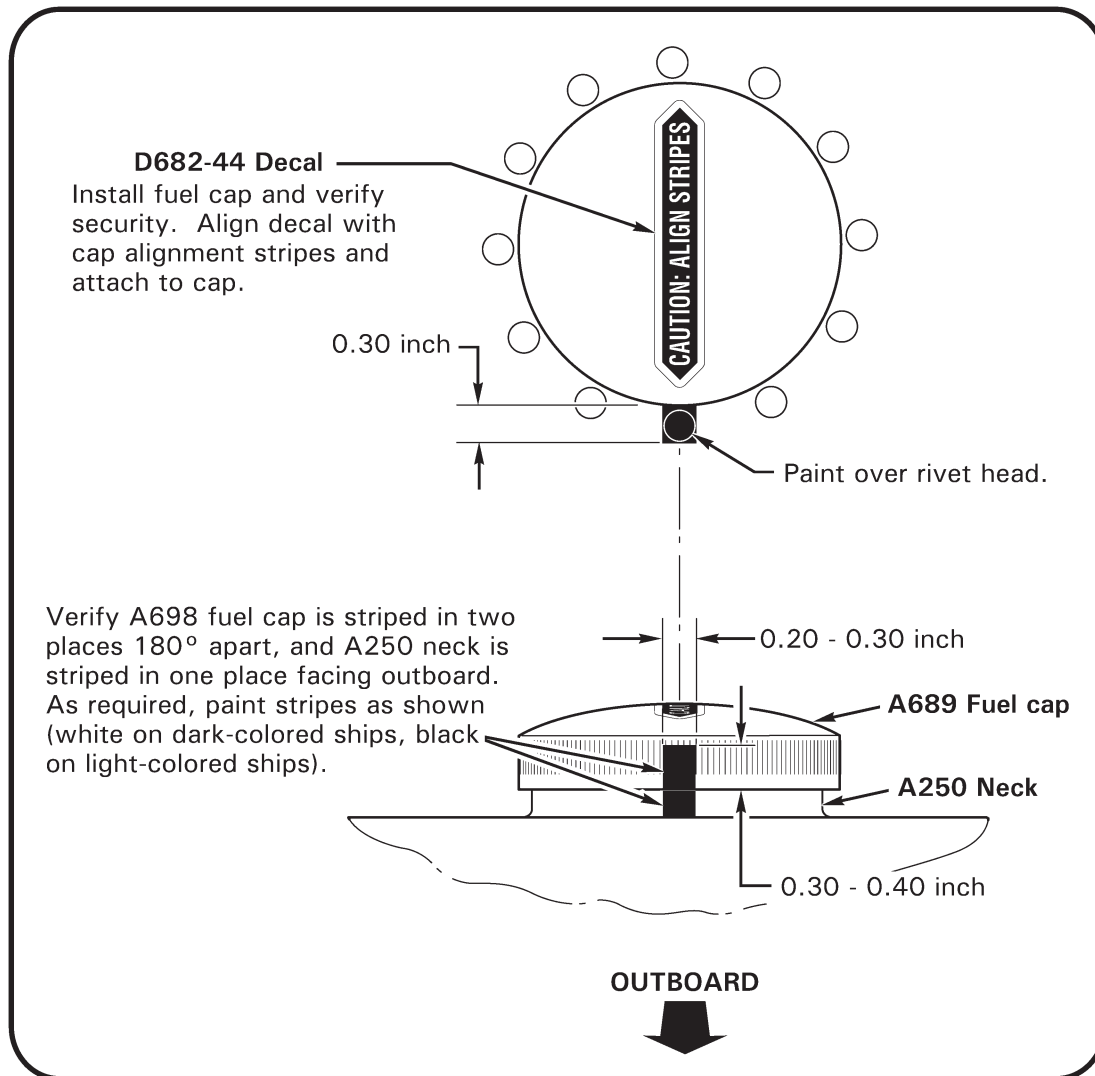


FIGURE 12-1A FUEL CAP ALIGNMENT STRIPES

12.130 Fuel Cap(s)**WARNING**

**Fuel cap alignment stripes are required by regulation and necessary for the pilot to verify fuel caps are properly secured. An improperly secured cap may come off in flight.**

1. Refer to Figure 12-1A. Paint fuel cap stripes (in two places 180° apart) and A250 neck if stripes have deteriorated (in one place facing outboard) per the following:
  - a. Clean surfaces to be painted using a lint-free, clean cloth dampened with acetone. Allow surfaces to dry.
  - b. Apply D257-7 black (Imron AF400/AF700) for light-colored ships or D257-5 white (Imron AF400/AF700) for dark-colored ships, mixed in accordance with paint manufacturer's recommendations, to surfaces.
2. Attach D682-44 decal to A689 fuel cap as shown.

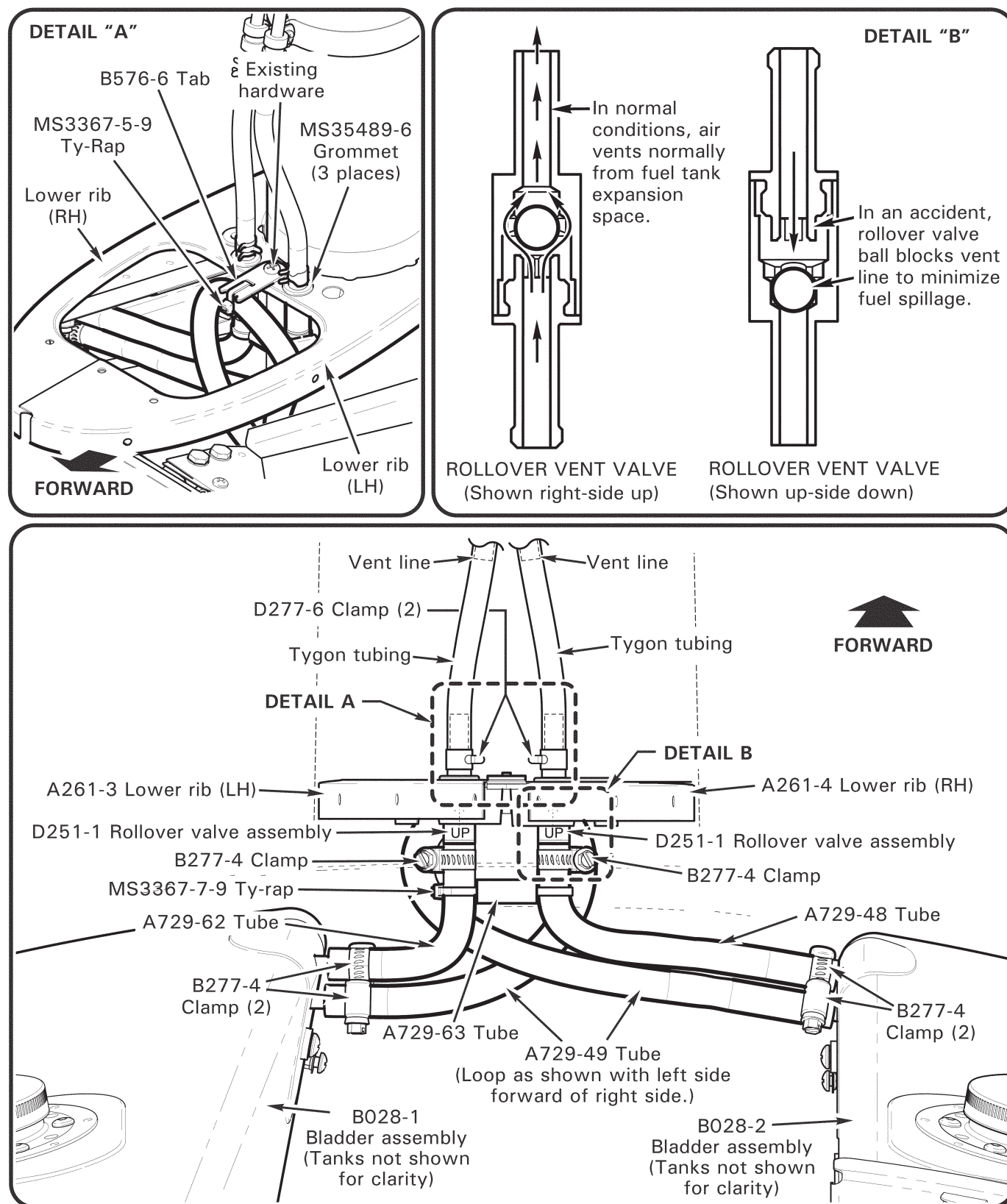


FIGURE 12-2 FUEL VENTS

## 12.200 Fuel Vents

### 12.210 (Vent Line) Rollover Valve Assemblies

R22 rollover valves contain one brass ball. In normal conditions, air flows around the vent ball from the bladder expansion spaces. In the event of inadvertent over-filling or in-flight fuel sloshing, the ball will float and seal the vent. If the aircraft is inverted, the ball seals the vent to minimize fuel spillage. There are no internal packings.

#### **A. Removal**

1. Open right side of mast fairing.
2. Above lower rib, remove D277-6 (spring) clamp securing A729-61 tube to D251-1 rollover valve assembly and pull tube off of valve. Pull valve downward, through rib grommet.
3. Loosen B277-4 (worm gear) clamp securing A729-48 or A729-62 tube to rollover valve and pull tube off of valve.

#### **B. Installation**

1. Observe orientation markings and push A729-48 or A729-62 tube onto D251-1 rollover valve assembly and tighten B277-4 (worm gear) clamp. Push valve upward, through lower rib grommet.
2. Above rib, push A729-61 tube onto rollover valve and install D277-6 (spring) clamp. Verify security.
3. Perform vent system check per Part C.

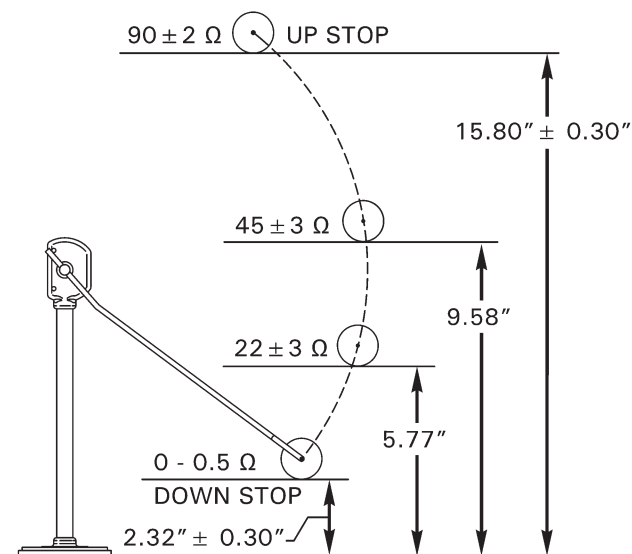
#### **C. Vent System Check**

1. Open right side of mast fairing. Verify main and aux fuel tank caps are installed.
2. Attach temporary hose to one A731-4 (vent) tube.
3. Blow into the temporary hose (do not use compressed air) and verify air blows out the other vent tube. If air does not blow out the other vent, remove obstruction(s) and repeat check.
4. Close mast fairing.

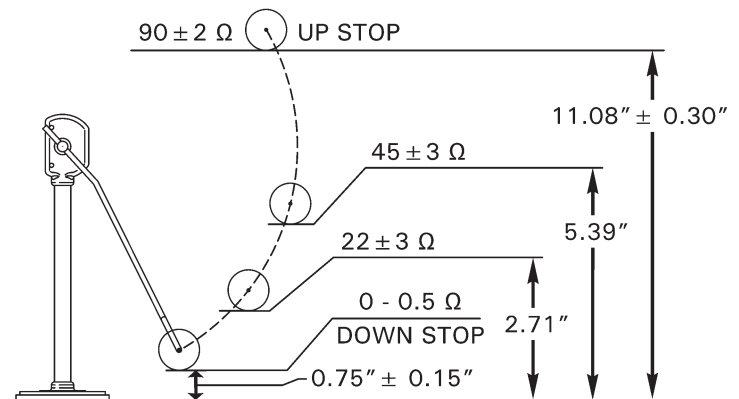
## 12.300 Drain Valves

#### **A. Removal**

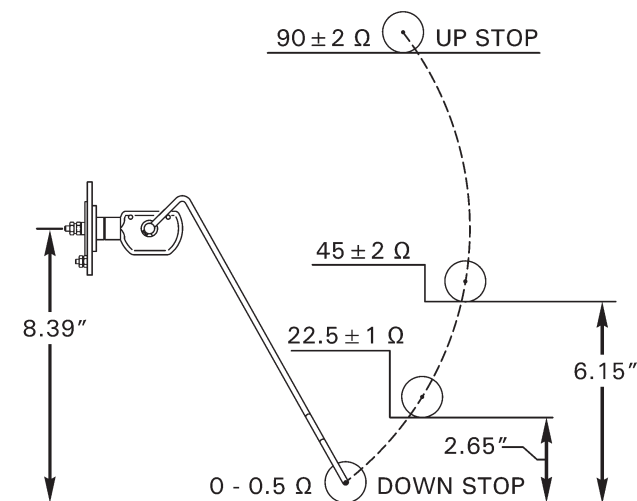
1. Defuel helicopter per § 1.150. Remove engine right cowling, as required.
2. Cut & discard safety wire securing A729 tube to A761-1 drain valve, if installed, and pull tube off of valve.
3. Remove valve from connector, tank, or gascolator assembly. Tape fuel system opening.
4. Actuate valve to expose stem, then remove & discard o-ring.



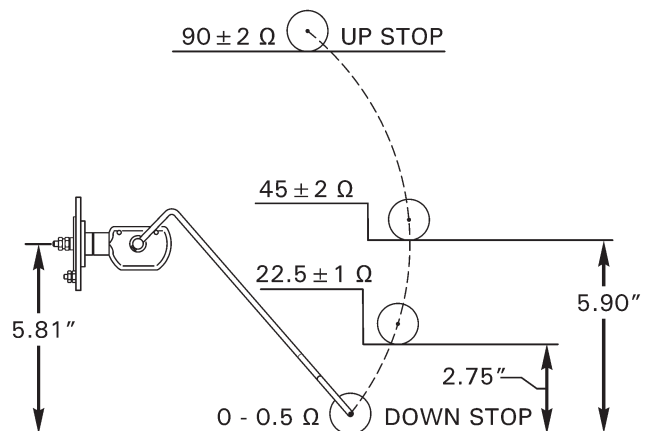
**D252-3 FUEL QUANTITY SENDER**  
Main Tank (Bladder Tank)



**D252-4 FUEL QUANTITY SENDER**  
Aux Tank (Bladder Tank)



**A550-1 FUEL QUANTITY SENDER**  
Main Tank (All-Aluminum Tank)



**B122-1 FUEL QUANTITY SENDER**  
Aux Tank (All-Aluminum Tank)

FIGURE 12-3 FUEL QUANTITY SENDER CHECK

### 12.300 Drain Valves (continued)

#### B. Installation

1. Actuate A761-1 drain valve to expose stem, and install new o-ring in stem seat.
2. Lightly coat valve threads using B270-6 sealant. Remove tape and install valve in connector, tank, or gascolator assembly. Standard torque valve per § 23-32 and torque stripe per Figure 2-1.
3. Push A729 tube onto valve. Wrap tube with two turns 0.032-inch diameter lockwire and safety tube to valve, as required.
4. Fuel helicopter per R22 Pilot's Operating Handbook Section 2 and inspect fuel system for leaks. Install engine right cowling, if removed.

### 12.400 Fuel Quantity

#### 12.410 Fuel Quantity Senders

##### CAUTION

Rotation of fuel sender center stud or base nut is not permitted.

##### WARNING

**Do NOT apply system voltage to installed fuel quantity senders.**

#### A. Removal

1. a. Bladder Tanks: If removing D252-3 fuel quantity sender, remove main fuel tank per § 12.110. If removing D252-4 fuel quantity sender, defuel helicopter per § 22-52.
- b. All-Aluminum Tanks: Defuel helicopter per § 22-52 until level is below fuel quantity sender mounting hole. Cut & discard ty-raps as required and disconnect sender wiring from airframe harness at connectors. Remove nuts securing wiring to sender if connectors are not installed.
2. Remove hardware securing fuel quantity sender to cover assembly or tank. Carefully pull sender lever through opening, then tape opening.

#### B. Installation

1. Perform fuel quantity sender check per Part C.
2. Inspect condition of sender gasket and replace as required. Remove tape from opening, position gasket on sender, and carefully insert sender lever through opening. Install hardware, special torque bolts in criss-cross pattern per § 23-33, and torque stripe per Figure 2-1.
3. Bladder Tanks: If removed, install main fuel tank per § 12.110.
4. Connect sender wiring to airframe harness at connectors. Install nuts securing wiring to sender if connectors are not installed. Install ty-raps as required.
5. Check fuel quantity indication per § 12.420. Verify no leaks.

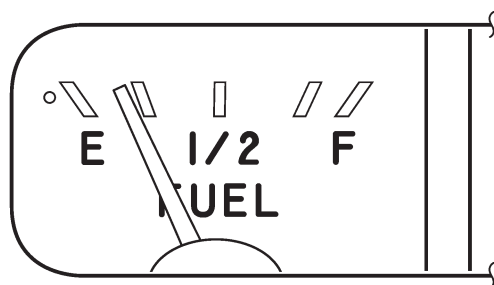
### 12.410 Fuel Quantity Senders (continued)

#### C. Check

1. Remove fuel quantity sender per Part A.
2. Simulate mounting position of appropriate sender per Figure 12-3. Position float arm as shown and measure the resistance with a multimeter. Verify resistance is within tolerance in the four positions given.
3. If resistance is out of tolerance at any of the four positions given, bend the float arm up for a sender with excessive resistance, or bend the float arm down for a sender with too little resistance. Repeat steps until sender resistance is within tolerance.
4. Install fuel quantity sender per Part B.

### 12.420 Fuel Quantity Indication

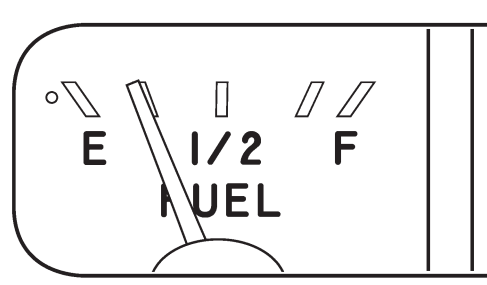
1. Defuel helicopter per § 22-52. Turn fuel shut-off valve off.
2. Fuel main tank with exactly 6.2 gallons (if equipped with main and aux bladder tanks), 5.6 gallons (if equipped with main bladder tank only), 6.3 gallons (if equipped with main and aux all-aluminum tanks), or 5.4 gallons (if equipped with main all-aluminum tank only) of fuel per R22 Pilot's Operating Handbook Section 2. Wait five minutes for fuel levels to equalize. Inspect for leaks.
3. Turn battery switch on and read fuel quantity gage. Verify fuel gage indicates one half to one and one half needle-widths below a quarter of a tank, as shown in Figure 12-4.
4. If indication is beyond allowable limit, perform fuel quantity sender check per § 12.410. If sender resistance is within tolerance, adjust fuel gage per § 33-110 Part D, or replace fuel gage as required and repeat check.



*Main Tank Gage*

#### MINIMUM ALLOWABLE INDICATION

1 ½ Needle-widths below ¼ of a tank



*Main Tank Gage*

#### MAXIMUM ALLOWABLE INDICATION

½ Needle-width below ¼ of a tank

FIGURE 12-4 FUEL QUANTITY INDICATION CHECK



### 12.430 Low-Fuel Switch Assembly

#### **CAUTION**

Avoid contaminating fuel bladder or tank interior. Cover arms with sleeves and use lint-free gloves when working inside interior.

#### **A. Removal**

1. Remove main fuel tank per § 12.110.
2. Remove A521 low-fuel switch assembly wiring pins from connector housing.
3. Remove fuel cap. Carefully capture switch assembly body with clean mechanical fingers (avoid capturing movable float). Remove AN924-5D nut securing switch assembly to cover or tank.
4. Carefully pull switch assembly through fuel cap opening, avoiding fuel quantity sender. Install fuel cap, and tape fuel bladder or tank opening.

#### **B. Installation**

1. Lubricate new o-ring with A257-6 grease, and install o-ring over A521 low-fuel switch assembly threads.
2. Tape switch assembly wiring to 30-inch length of lockwire.
3. Remove fuel cap and tape. Position tank upside down. Thread lockwire through fuel cap opening and switch assembly mounting hole. Pull switch assembly wires and threads through mounting plate and retaining nut.
4. Apply light coat B270-1 sealant to mating face of AN924-5D nut and install nut securing switch assembly to cover or tank. Special torque nut per § 1.330 and torque stripe per Figure 2-1.
5. Install main fuel tank per § 12.110.
6. Perform operation check per Part C.

#### **C. Operation Check**

1. Turn battery switch on. Fuel helicopter per R22 Pilot's Operating Handbook Section 2 as required and inspect fuel system for leaks.
2. With a clean wooden dowel, gently depress low-fuel switch assembly float and verify low fuel warning light illuminates after approximately 1 second delay.
3. If warning light does not illuminate when float is depressed, but does illuminate when activating push-to-test switch, replace switch assembly.

## 12.500 Gascolator Assembly

### **A. Cleaning Sediment Bowl**

1. Turn battery switch off. Turn fuel shut-off valve off. Remove left side skirts. Electrically ground helicopter. Drain fuel into an approved, electrically-grounded container using A666-1 gascolator assembly drain valve.
2. Cut & discard safety wire securing gascolator collar to outlet fitting. Unscrew collar, and remove collar, ring, and sediment bowl.
3. Remove gasket and screen from gascolator top. Inspect, then clean, sediment bowl and screen.
4. Install screen and gasket in gascolator top. Apply light coat A257-6 grease to collar threads and collar inner flange. Verify large diameter of ring contacts collar inner flange. Slide ring and collar over bottom of sediment bowl so small diameter of ring engages groove in bowl flange. Position sediment bowl drain valve thru hole in belly panel, and hand-tighten collar, ring, and bowl onto gascolator top until snug. Verify no threads exposed in gascolator top. Safety collar to outlet adapter using 0.032-inch diameter lockwire.
5. Turn fuel shut-off valve on. Perform ground check and run up per §§ 2.205 & 2.210. Verify no leaks; repair as required. Install left side skirts.

12.600 Minimum Fuel Flow Check

1. Turn battery switch off. Turn fuel shut-off valve off. Electrically ground helicopter. Remove right side skirts. Verify fuel tank cap(s) are installed.
2. Fuel main tank with exactly 3.0 gallons (bladder tanks) or 1.7 gallons (all-aluminum tanks) fuel per R22 Pilot's Operating Handbook Section 2.
3. Disconnect B283 hose assembly from carburetor, turn battery switch and fuel shut-off valve on, and defuel helicopter into an approved, electrically-grounded container until low fuel light illuminates. Turn battery switch and fuel shut-off valve off.
4. Place electrically-grounded, calibrated container beneath hose, turn fuel shut-off valve on, and record time required to fill container. Verify filling time does not exceed maximum time listed below:

ALLOWABLE FUEL FLOW RATE	
<i>QUANTITY</i>	<i>MAXIMUM TIME</i>
<b>1 U.S. Gallon</b>	2 minutes 25 seconds
<b>4 Liters</b>	2 minutes 33 seconds
<b>1 Imperial Gallon</b>	2 minutes 54 seconds

5. If filling time is exceeded, perform vent system check per § 12.210. Inspect fuel tank outlet strainer, line assembly, and hose assemblies for obstructions. Remove obstructions and repeat check.
6. Connect B283 hose assembly to carburetor, special torque nut per § 1.330, and torque stripe per Figure 2-1.
7. Perform ground check and run up per §§ 2.205 & 2.210. Verify no leaks. Install right side skirts.

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## CHAPTER 13

## INSTRUMENT SYSTEM

<u>Section</u>	<u>Title</u>	<u>Page</u>
13-00	Description . . . . .	13.1
13-10	Pitot-Static System . . . . .	13.3
13-20	Primary Instruments . . . . .	13.4
13-21	Vertical Speed Indicator . . . . .	13.4
13-22	Airspeed Indicator . . . . .	13.6
13-23	Dual Tachometer . . . . .	13.7
13-24	Altimeter . . . . .	13.9
13-25	Manifold Pressure Gage . . . . .	13.10
13-26	Magnetic Compass . . . . .	13.11
13-30	Engine Gages . . . . .	13.12
13-31	Ammeter . . . . .	13.12
13-32	Engine Oil Pressure Gage . . . . .	13.13
13-33	Engine Oil Temperature Gage . . . . .	13.14
13-34	Cylinder Head Temperature Gage . . . . .	13.14
13-35	Fuel Quantity Gages . . . . .	13.15
13-36	Carburetor Air Temperature Gage . . . . .	13.15
13-40	Additional Standard Indicating Equipment . . . . .	13.16
13-41	Clock . . . . .	13.16
13-42	Outside Air Temperature (OAT) Gage/Voltmeter . . . . .	13.17
13-43	Hourmeter . . . . .	13.18
13-50	Instrument Markings . . . . .	13.18
13-60	Electronic Flight Displays . . . . .	13.21
13-61	Aspen PFD Installation . . . . .	13.21
13-70	Console Assemblies . . . . .	13.23

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**CHAPTER 13****INSTRUMENT SYSTEM****13-00 Description**

Standard primary instruments include an airspeed indicator, engine and rotor dual tachometer, altimeter, manifold pressure gage, and magnetic compass. Engine gages include an ammeter, oil pressure, oil temperature, cylinder head temperature, and fuel quantity for main and aux (if installed) tanks. Also standard are a clock, a carburetor air temperature gage, and a digital outside air temperature gage. An hourmeter is located on the ledge just forward of the pilot's seat.

For instrument panels with electronic flight displays, a P/N D327 light filter may be used to reduce reflections in the windshield at night. The light filter is installed by clipping it to the front of the display. Filter use is at pilot discretion.

The pitot-static system supplies air pressure to operate the airspeed indicator, altimeter, and vertical speed indicator. The pitot tube is located on the front edge of the mast fairing. The static source is located inside the aft cowling inboard of the cowl door hinge.

Water can be drained from pitot-static lines by removing the plastic drain plugs which are accessible through the inspection panel on the underside of the cabin. Draining lines should only be required if the airspeed indicator or altimeter appears erratic.

Pitot and static sources should be inspected frequently for bugs or other obstructions.

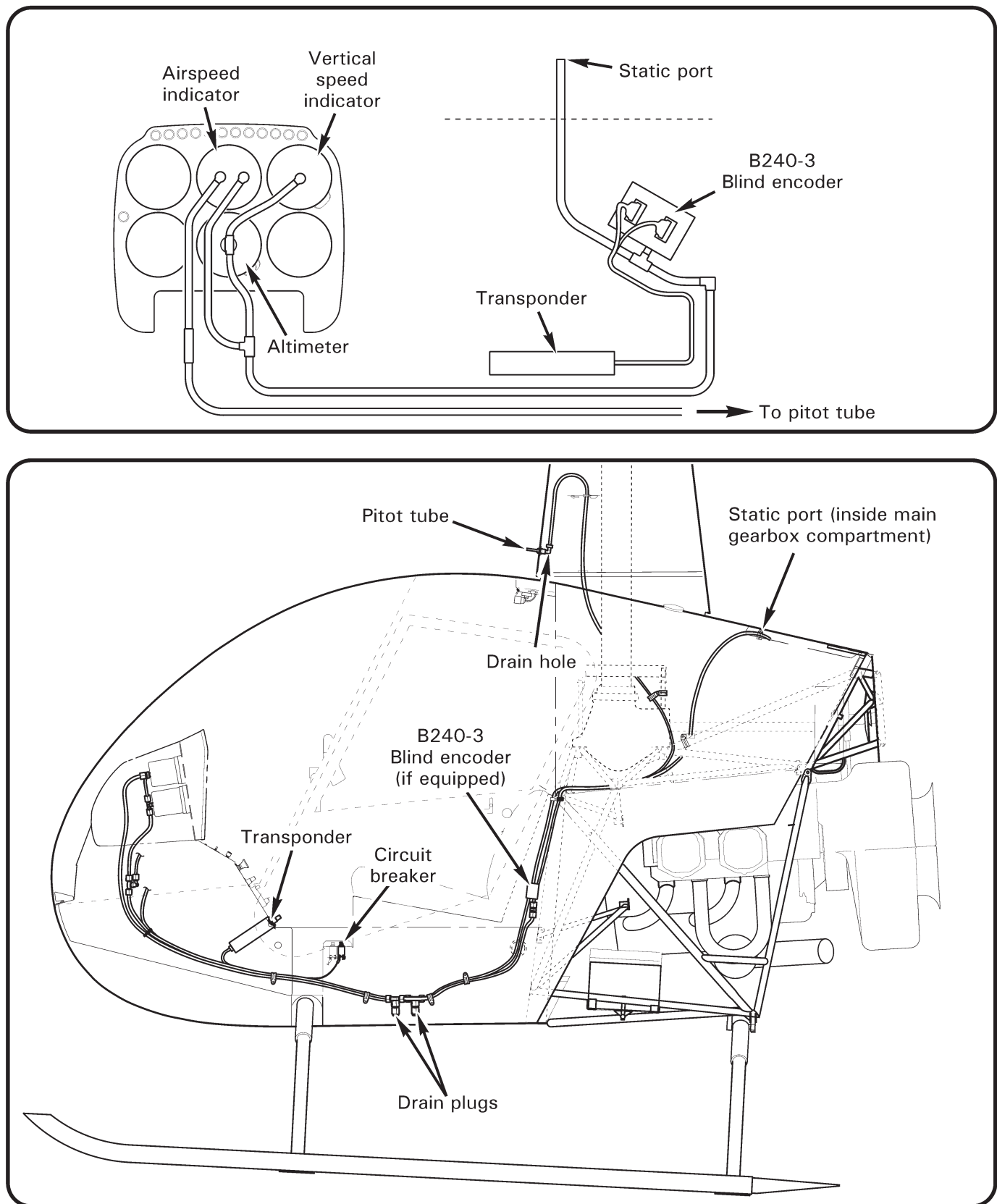


FIGURE 13-1 PITOT-STATIC SYSTEM



### 13-10 Pitot-Static System

**CAUTION**

Do not apply suction to pitot system or pressure to static system.

**A. Pitot System Leak Test**

1. Open mast fairing.
2. Refer to Figure 13-1. Seal drain hole in elbow aft of pitot tube with pressure-sensitive tape. Connect a medical syringe, with plunger withdrawn, to pitot tube via flexible tubing.
3. Slowly apply pressure to pitot line by depressing syringe plunger until airspeed indicator reads 70 knots (plunger will remain in place).
4. Gently tap airspeed indicator glass to remove friction effects.
5. If airspeed indication drops more than 10 knots in one minute, an unacceptable leak is indicated. Slowly release pressure. Locate and repair any leak(s). Retest after any repairs.
6. Remove tape from pitot tube drain hole and verify airspeed indicator has returned to zero.
7. Remove test equipment. Close mast fairing.

**B. Static System Leak Test****CAUTION**

Airspeed indicator, altimeter, and vertical speed indicator may be damaged if suction to static line is applied or removed rapidly.

1. Refer to Figure 13-1. Set altimeter to location elevation.
2. Connect a medical syringe, with plunger depressed, to static port tube via flexible tubing.
3. Slowly apply suction to static port by withdrawing syringe plunger until altimeter indicates 500 feet greater than location elevation (plunger will remain in place).
4. If altimeter indication drops more than 100 feet in one minute, an unacceptable leak is indicated. Slowly release suction. Locate and repair leak(s). Retest after any repairs.
5. Remove test equipment.

13-20 Primary Instruments13-21 Vertical Speed Indicator**A. Description**

The vertical speed indicator indicates rate of ascent or descent. Check vertical speed indicator for a zero-rate needle indication when rotorcraft is in a stationary hover.

**B. Diagram**

Refer to Figure 13-1 for pitot-static system diagram.

**C. Removal****CAUTION**

Protect instrumentation using foam padding or equivalent.  
Handle instruments like eggs.

1. Turn battery switch off and pull out applicable circuit breaker(s).
2. Remove perimeter screws securing face to console and pull face aft.
3. Remove screws securing instrument to face.
4. Disconnect wiring as applicable.
5. Disconnect pitot/static lines and cap & plug instrument and system fittings, as applicable.
6. Remove instrument and place on foam padding.

**D. Installation****CAUTION**

Protect instrumentation using foam padding or equivalent.  
Handle instruments like eggs.

1. Turn battery switch off and pull out applicable circuit breaker(s).
2. Remove caps and plugs and connect pitot/static lines. Verify security.
3. Connect wiring as applicable. Verify security.
4. Install screws securing instrument to face. Verify security.
5. Install perimeter screws securing face to console. Verify security.
6. Perform pitot-static system checks as required per § 13-10.
7. Perform appropriate function checks per § 2.200.

13-21 Vertical Speed Indicator (continued)**E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

**F. Special Maintenance and Inspections**

1. If vertical speed indicator displays climb indication but does not return to zero in level flight, or if indication is erratic:
  - a. Inspect static system for water or obstructions, and remove water or obstructions if found.
  - b. Perform pitot-static system checks as required per § 13-10.
2. Perform appropriate function checks per § 2.200. If vertical speed indicator still displays erratic indication, or displays no indication, remove indicator per Part C, and return to RHC for inspection.
3. Install airworthy indicator per Part D.

## 13-22    Airspeed Indicator

### **A. Description**

The airspeed indicator displays airspeed in knots and miles or kilometers per hour. The airspeed indicator operates properly in forward flight only; backward or lateral flight will not indicate correct airspeed. The airspeed indicator will indicate airspeeds up to a maximum of 102 knots (red line).

### **B. Diagram**

Refer to Figure 13-1 for pitot-static system diagram.

### **C. Removal**

Remove airspeed indicator per § 13-21 Part C.

### **D. Installation**

Install airspeed indicator per § 13-21 Part D.

### **E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

### **F. Special Maintenance and Inspections**

1. If airspeed indicator displays no indication:
  - a. Inspect pitot tube for obstructions and remove obstructions if found.
  - b. Inspect pitot tube connection, and tighten connection if loose.
  - c. Open upper console and inspect pitot line for kinks or bends.
  - d. Perform pitot-static system checks as required per § 13-10.
  - e. Perform appropriate function checks per § 2.200. If indicator still displays no indication, remove indicator per Part C, and return to RHC for inspection.
  - f. Install airworthy indicator per Part D.
2. If airspeed indicator displays erratic indication:
  - a. Inspect pitot-static system connection(s), and tighten connection(s) if loose.
  - b. Inspect pitot-static system lines and verify no lines are cracked or broken.
  - c. Inspect pitot-static system for water, and remove water if found.
  - d. Open upper console and inspect pitot lines for kinks or bends.
  - e. Perform pitot-static system checks as required per § 13-10.
  - f. Perform appropriate function checks per § 2.200. If indicator still displays erratic indication, remove indicator per Part C, and return to RHC for inspection.
  - g. Install airworthy indicator per Part D.

13-23 Dual Tachometer**A. Description****CAUTION**

Installation of electrical devices can affect accuracy and reliability of electronic tachometers.

An electronic engine and rotor dual tachometer is standard. Engine tachometer signal is provided by magneto breaker points. Rotor tachometer signal is provided by two magnetic senders at the main gearbox drive yoke. Each tachometer is on a separate circuit with its own circuit breaker. With battery and alternator switches off, the tachometers continue to receive power from the battery through a bypass circuit as long as the clutch actuator switch is in the engage position.

**NOTE**

Do not stow helicopter with clutch switch engaged. The tachometers are powered with the clutch engaged and will discharge the battery.

**NOTE**

Do not use magnetized tools.

**CAUTION**

Protect instrumentation using foam padding or equivalent. Handle instruments like eggs.

**B. Removal**

1. Turn battery switch off and pull TACHS E (2 amp) and R (2 amp) circuit breakers at panel.
2. Remove perimeter screws securing instrument face to console and pull face aft.
3. Remove screws securing console harness connector to A792 dual tachometer and unplug connector.
4. Supporting instrument, remove screws securing tachometer to face, and remove tachometer.

**C. Installation****NOTE**

When replacing an A792-4 tachometer with an A792-5 tachometer, install B792-1 dual tachometer harness assembly between tachometer & airframe harness, and tighten two screws on both connectors. Secure B792-1 harness as required with ty-raps.

13-23 Dual Tachometer (continued)**C. Installation (continued)**

1. Turn battery switch off and pull TACHS E (2 amp) and R (2 amp) circuit breakers at panel.
2. Install screws securing A792 dual tachometer to instrument face. Verify security.
3. Plug in console harness connector to tachometer and install connector screws. Verify security.
4. Install perimeter screws securing face to console. Verify security.
5. Perform accuracy check and needle synchronization per Part D.

**D. Adjustment****NOTE**

Adjust rotor tachometer if engine and rotor tachometer needles are not within 1% of each other at 104% RPM.

1. Remove screws securing instrument face panel to upper console and carefully pull panel aft.
2. Run-up helicopter per R22 Pilot's Operating Handbook (POH) Section 6 at 104% engine tachometer indication.
3. Turn adjustment screw on back of tachometer (apply 1/8 turns) clockwise to increase and counterclockwise to decrease rotor tachometer indication. Adjust rotor tachometer to indicate 104%.
4. Shutdown helicopter per POH Section 6. Tighten screws securing instrument panel to upper console.

**E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

Refer to § 1.102 for additional component maintenance.

**F. Special Maintenance and Inspections**

1. Perform adjustment as required per Part D.
2. If tachometer cannot be adjusted, remove tachometer per Part B, and return to RHC for inspection.
3. Install airworthy tachometer per Part C.

### 13-24 Altimeter

#### **A. Description**

The sensitive altimeter provides altitude information relative to mean sea level when the barometric pressure correction scale is properly set. Check altimeter calibration by setting correction scale to the current altimeter setting and checking the altimeter reading against field elevation; they must agree within 70 feet.

#### **B. Diagram**

Refer to Figure 13-1 for pitot-static system diagram.

#### **C. Removal**

Remove altimeter per § 13-21 Part C.

#### **D. Installation**

Install altimeter per § 13-21 Part D.

#### **E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

#### **F. Special Maintenance and Inspections**

1. If altimeter displays no indication:
  - a. Inspect static lines for obstructions and remove obstructions if found.
  - b. Perform pitot-static system checks as required per § 13-10.
  - c. Perform appropriate function checks per § 2.200. If altimeter still displays no indication, remove altimeter per Part C, and return to RHC for inspection.
  - d. Install airworthy altimeter per Part D.
2. If altimeter displays erratic indication:
  - a. Inspect static system for water, and remove water if found.
  - b. Perform pitot-static system checks as required per § 13-10.
  - c. Perform appropriate function checks per § 2.200. If altimeter still displays erratic indication, remove altimeter per Part C, and return to RHC for inspection.
  - d. Install airworthy altimeter per Part D.

### 13-25 Manifold Pressure Gage

#### **A. Description**

The manifold pressure gage provides an indicator of absolute air pressure in the engine intake manifold. The red line on the gage indicates the maximum manifold pressure that the rotorcraft is type certificated for at 104% rotor RPM. The manifold pressure gage should indicate within 0.3 inches Hg of ambient barometric pressure when engine is not running.

#### **B. Removal**

Remove manifold pressure gage per § 13-21 Part C.

#### **C. Installation**

Install manifold pressure gage per § 13-21 Part D.

#### **D. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

#### **E. Special Maintenance and Inspections**

##### Manifold Pressure System Leak Check

1. Disconnect A740-1 line assembly from engine fitting.
2. Connect a medical syringe, with plunger depressed, to line assembly fitting via flexible tubing.
3. Slowly apply suction to system by withdrawing syringe plunger until manifold pressure gage indicates 10 inches Hg (plunger will remain in place).
4. If manifold pressure gage indication rises more than one inch in one minute, an unacceptable leak is indicated. Slowly release suction. Locate and repair leak(s). Retest after any repairs.
5. Remove test equipment.



13-26 Magnetic Compass**NOTE**

United States operators may refer to FAA AC 43-215 for additional information.

**A. Description**

An internally illuminated, wet-type compass is attached to the center bow between the windshields above the instrument panel.

**B. Schematic**

Refer to Figure 14-39A for electrical schematic.

**C. Removal**

1. Remove hardware securing compass mount to windshield bow.
2. Remove hardware securing compass assembly to mount.
3. Remove heat shrink as required and disconnect light bar wires from airframe harness. Remove compass.

**D. Installation**

1. Install heat shrinks over wires and connect compass assembly's light bar wires to airframe harness. Verify security. Activate heat shrinks.
2. Install hardware securing compass to mount. Verify security.
3. Install hardware securing mount to windshield bow. Verify security.
4. At governed RPM, using the airport compass rose, align the helicopter skids on the rose lines, and record the indicated compass headings at 30° increments. Adjust compass compensator magnets as required until the maximum error at any heading is 5° or less with all avionics operating, all exterior lights on, and dimmer full bright. Record the final readings on the aircraft compass card. Re-check 4 cardinal headings with lights off and all avionics off except COM radio 1 and transponder. Verify maximum error remains 5° or less.

**E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

**F. Special Maintenance and Inspections**

1. Perform compass deviation check per Part D step 4.
2. If compass cannot be adjusted to limits specified, remove compass per Part C, and install airworthy compass per Part D.

## 13-30 Engine Gages

### 13-31 Ammeter

#### **A. Description**

The ammeter indicates electrical system loads. System load is measured at the shunt located on the lower-left side of the vertical firewall in the engine compartment.

#### **B. Schematic**

Refer to Figure 14-39A for electrical schematic.

#### **C. Instrument Cluster Removal**

1. Turn battery switch off and pull out applicable circuit breaker(s).
2. Remove Aspen PFD per § 13-61 if installed.
3. Remove screws securing upper console to lower console and tilt upper console aft.
4. Remove nuts securing console wiring to B144 instrument cluster and remove wiring.
5. Remove screws securing instrument cluster to shell assembly's face plate and remove instrument cluster.

#### **D. Instrument Cluster Installation**

1. Turn battery switch off and pull out applicable circuit breaker(s).
2. Position B144 instrument cluster on shell assembly's face plate and install screws. Verify security.
3. Install nuts securing console wiring to instrument cluster studs. Verify security.
4. Tilt console forward and install screws securing upper console to lower console. Verify security.
5. Install Aspen PFD per § 13-61 if removed.
6. Perform appropriate function checks per § 2.200.

#### **E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

#### **F. Special Maintenance and Inspections**

1. Check continuity across two 3-amp fuses in B304-18 fuse assembly (at the ammeter shunt) and replace fuse assembly as required.
2. Inspect wiring for loose, chafed, frayed, or broken wires. Verify no damaged connectors. Verify wiring neatness, proper routing and installation, and security.
3. If ammeter is still inoperative, remove ammeter per Part C, and install airworthy ammeter per Part D.

### 13-32 Engine Oil Pressure Gage

#### **A. Description**

The engine oil pressure gage indicates engine oil pressure and receives its signal from a variable-resistor-type sender located in left-hand forward corner of engine compartment next to hourmeter pressure switch.

#### **B. Schematic**

Refer to Figure 14-39A for electrical schematic.

#### **C. Removal**

Remove instrument cluster per § 13-31 Part C.

#### **D. Installation**

Install instrument cluster per § 13-31 Part D.

#### **E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

#### **F. Special Maintenance and Inspections**

1. Inspect wiring for loose, chafed, frayed, or broken wires. Verify no damaged connectors. Verify wiring neatness, proper routing and installation, and security.
2. Perform appropriate function checks per § 2.200. If accuracy of engine gage is suspected, remove instrument cluster per § 13-31 Part C, and return to RHC for inspection.
3. Install airworthy instrument cluster per § 13-31 Part D.

### 13-33 Engine Oil Temperature Gage

#### **A. Description**

The engine oil temperature gage indicates engine oil temperature and receives its signal from a probe mounted in the engine oil pressure screen housing or oil filter adapter.

#### **B. Schematic**

Refer to Figure 14-39A for electrical schematic.

#### **C. Removal**

Remove instrument cluster per § 13-31 Part C.

#### **D. Installation**

Install instrument cluster per § 13-31 Part D.

#### **E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

#### **F. Special Maintenance and Inspections**

Perform special maintenance and inspections per § 13-32 Part F.

### 13-34 Cylinder Head Temperature Gage

#### **A. Description**

The cylinder head temperature gage indicates the temperature of the #4 cylinder and receives its signal from a thermocouple installed in the #4 cylinder head.

#### **B. Schematic**

Refer to Figure 14-39A for electrical schematic.

#### **C. Removal**

Remove instrument cluster per § 13-31 Part C.

#### **D. Installation**

Install instrument cluster per § 13-31 Part D.

#### **E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

#### **F. Special Maintenance and Inspections**

Perform special maintenance and inspections per § 13-32 Part F.

### 13-35 Fuel Quantity Gages

#### **A. Description**

The fuel quantity gages indicate the fuel level of main and aux (if installed) fuel tanks and receive signals from variable resistance type senders mounted on the bottom of each tank.

#### **B. Schematic**

Refer to Figure 14-39A for electrical schematic.

#### **C. Removal**

Remove instrument cluster per § 13-31 Part C.

#### **D. Installation**

Install instrument cluster per § 13-31 Part D.

#### **E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

#### **F. Special Maintenance and Inspections**

Perform special maintenance and inspections per § 13-32 Part F.

### 13-36 Carburetor Air Temperature Gage

#### **A. Description**

The carburetor air temperature gage is used to determine when carburetor heat is required during possible carburetor icing conditions, such as high humidity. Apply heat as required to keep needle out of yellow band. The carburetor air temperature gage should read approximately the same as the OAT gage when engine is cold.

#### **B. Schematic**

Refer to Figure 14-39A for electrical schematic.

#### **C. Removal**

Remove instrument cluster per § 13-31 Part C.

#### **D. Installation**

Install instrument cluster per § 13-31 Part D.

#### **E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

#### **F. Special Maintenance and Inspections**

Perform special maintenance and inspections per § 13-32 Part F.

### 13-40 Additional Standard Indicating Equipment

#### 13-41 Clock

##### **A. Description**

A manually set electric analog clock is standard equipment; a digital clock is optional.

##### **B. Schematic**

Refer to Figure 14-39A for electrical schematic.

##### **C. Removal**

1. Turn battery switch off.
2. a. Remove perimeter screws securing face to console and pull face aft, or
  - b. Remove Aspen PFD per § 13-61 if installed, and remove screws securing upper console to lower console and tilt upper console aft.
3. Remove screws securing clock to face.
4. Disconnect console wiring from clock wiring at connectors, and remove clock.

##### **D. Installation**

1. Turn battery switch off.
2. Connect console wiring to clock wiring at connectors. Verify security.
3. Install screws securing clock to face. Verify security.
4. a. Install perimeter screws securing face to console and verify security, or
  - b. Tilt console forward and install screws securing upper console to lower console and verify security; install Aspen PFD per § 13-61 if removed.
6. Perform appropriate function checks per § 2.200.

##### **E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

##### **F. Special Maintenance and Inspections**

1. Check AGC-3 (3 amp) fuse at firewall for evidence of melting and replace fuse as required.
2. Inspect wiring for loose, chafed, frayed, or broken wires. Verify no damaged connectors. Verify wiring neatness, proper routing and installation, and security.
3. If clock is still inoperative, remove clock per Part C, and install airworthy clock per Part D.

### 13-42 Outside Air Temperature (OAT) Gage/Voltmeter

#### **A. Description**

**NOTE**

No cutting or splicing of OAT probe wires is permitted.

The outside air temperature indicator has a stainless steel probe protruding from chin of rotorcraft and is connected to gage by a calibrated length of cable.

#### **B. Schematic**

Refer to Figure 14-39A for electrical schematic.

#### **C. Removal**

1. Turn battery switch off.
2. Remove Aspen PFD per § 13-61 if installed.
3. Remove screws securing upper console to lower console and tilt upper console aft.
4. Remove screws securing OAT gage to face.
5. Disconnect console wiring from OAT gage wiring at connectors, and remove gage.

#### **D. Installation**

1. Turn battery switch off.
2. Connect console wiring to OAT gage wiring at connectors. Verify security.
3. Install screws securing OAT gage to face. Verify security.
4. Tilt console forward and install screws securing upper console to lower console. Verify security.
5. Install Aspen PFD per § 13-61 if removed.
6. Perform appropriate function checks per § 2.200.

#### **E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

#### **F. Special Maintenance and Inspections**

1. Inspect wiring for loose, chafed, frayed, or broken wires. Verify no damaged connectors. Verify wiring neatness, proper routing and installation, and security.
2. If OAT gage is still inoperative, remove OAT gage per Part C, and install airworthy OAT gage per Part D.

### 13-43 Hourmeter

#### **A. Description**

An hourmeter actuated by engine oil pressure is located on the ledge just forward of the pilot's seat.

#### **B. Schematic**

Refer to Figure 14-39A for electrical schematic.

#### **C. Removal**

1. Remove screws securing D830-1 hourmeter to ledge just forward of the pilot's seat.
2. Disconnect airframe wiring from hourmeter and remove hourmeter.

#### **D. Installation**

1. Connect airframe wiring to hourmeter (A859-42 to positive terminal). Verify security.
2. Install screws securing D830-1 hourmeter to ledge just forward of the pilot's seat. Verify security.

#### **E. Scheduled Maintenance and Inspections**

Refer to § 2.400 100-Hour/Annual Inspection.

#### **F. Special Maintenance and Inspections**

1. Inspect wiring for loose, chafed, frayed, or broken wires. Verify no damaged connectors. Verify wiring neatness, proper routing and installation, and security.
2. If hourmeter is still inoperative, remove hourmeter per Part C, and install airworthy hourmeter per Part D. Make appropriate maintenance record entries.

### 13-50 Instrument Markings

See R22 Pilot's Operating Handbook (POH) Section 2 for instrument markings.



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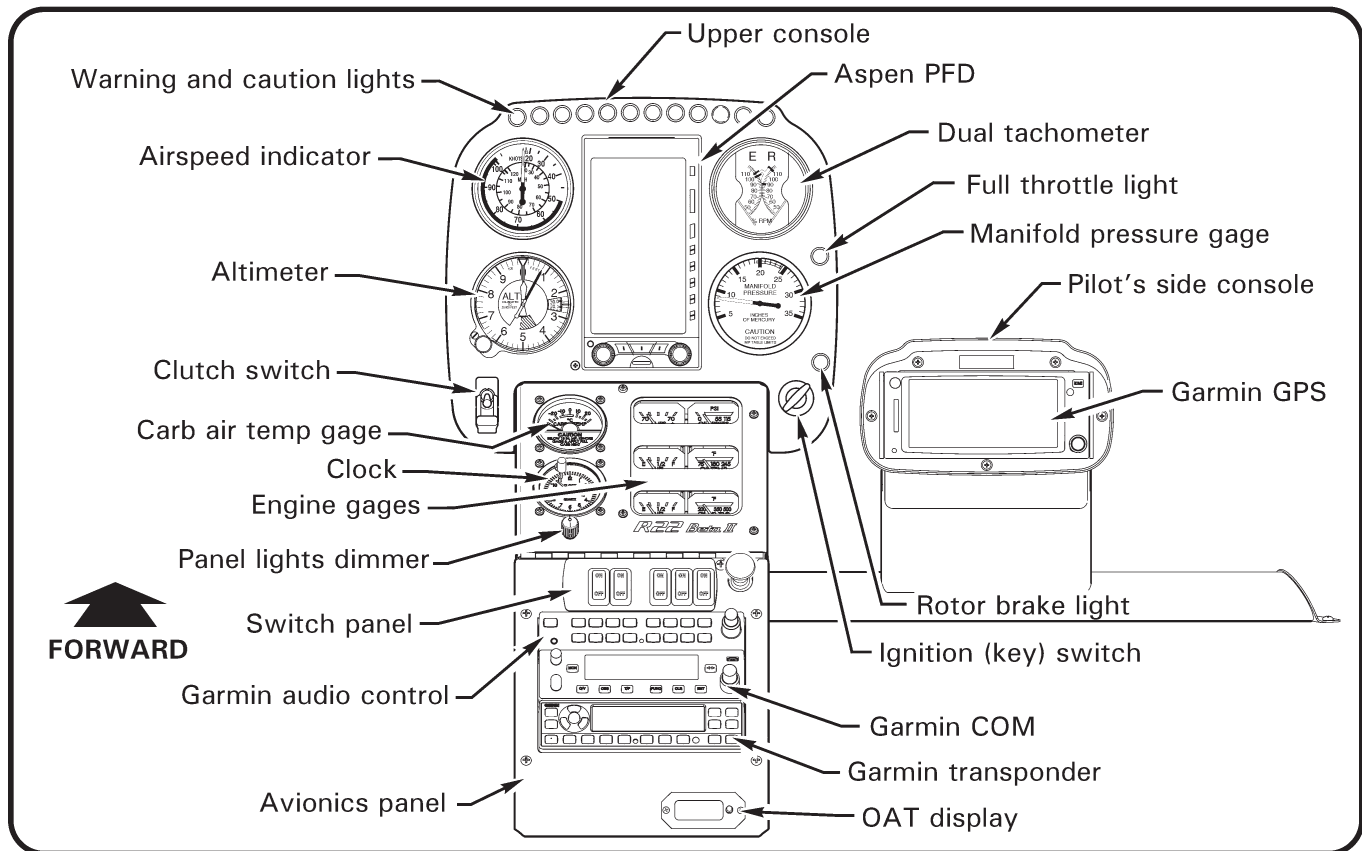


FIGURE 13-2 SIX-INSTRUMENT CONSOLE WITH ASPEN PFD – TYPICAL

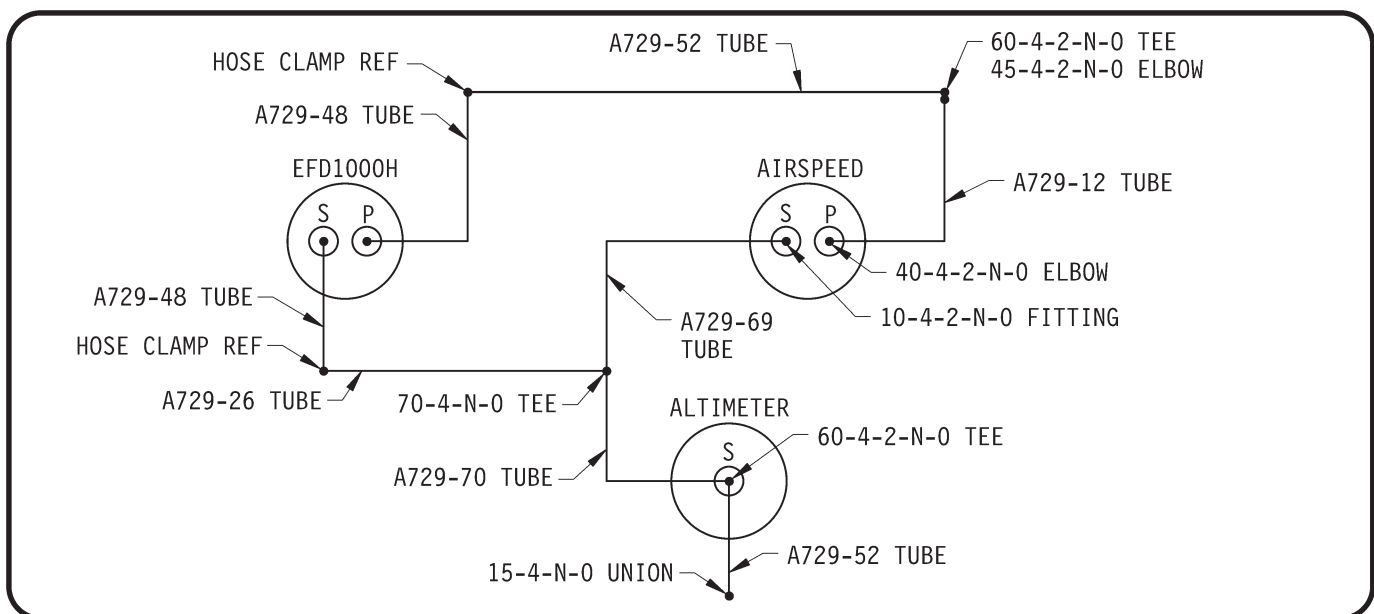


FIGURE 13-3 ASPEN PFD PITOT-STATIC SCHEMATIC

## 13-60 Electronic Flight Displays

### 13-61 Aspen PFD Installation

#### **A. Description**

The Aspen PFD (Primary Flight Display) is an LCD unit with displays for attitude, altitude, airspeed, heading, and optional NAV (HSI/CDI). The Aspen PFD is a situational awareness aid, to be used in conjunction with required VFR instruments (altimeter, airspeed indicator, and magnetic compass).

The standard Aspen PFD installation configures the lower half of the display as a directional gyro. An optional installation configures the lower half of the display to a Horizontal Situation Indicator (HSI).

#### **B. Schematic**

Refer to Figure 14-43 & 14-44 for C800-1 Aspen PFD electrical schematic. |

#### **C. Removal**

1. Turn battery switch off and pull EFIS circuit breaker (7.5 amp) at panel.
2. Gently depress blue tab at top of Aspen PFD to release display from mounting bracket.
3. Disconnect pitot and static lines from display using quick-disconnect couplers. Temporarily cap pitot and static line fittings at display and in aircraft to prevent contamination.
4. Loosen screws securing airframe wiring harness connector to display, unplug connector, and remove display.

#### **D. Installation**

1. Turn battery switch off and pull EFIS circuit breaker (7.5 amp) at panel.
2. Plug airframe wiring harness connector into Aspen PFD display and tighten screws. Verify security.
3. Remove temporary fitting caps and connect pitot and static lines to display using quick-disconnect couplers.
4. Insert display into mounting bracket until blue tab snaps into place. Verify security.
5. Push-in EFIS circuit breaker (7.5 amp) at panel. Turn battery & avionics switches on.
6. Perform appropriate functional checks per Aspen EFD1000H PFD Pilot's Guide. Turn battery and avionics switches off.
7. Perform pitot-static leak check.

13-61 Aspen PFD Installation (continued)**E. Antenna**

Refer to § 16-70 for antenna locations & R22 Illustrated Parts Catalog (IPC) Chapter 6.

**NOTE**

Do not use magnetized tools.

Removal

1. Turn battery switch off and pull EFIS circuit breaker (7.5 amp) at panel.
2. Using plastic scraper, remove B270-1 sealant from around EFIS antenna at corners where it attaches to tailcone.
3. Cut and discard ty-raps as required and disconnect antenna cable at connectors (secured to frame). Remove screws securing antenna and antenna ground wire to tailcone and remove antenna.

Installation

1. Turn battery switch off and pull EFIS circuit breaker (7.5 amp) at panel.
2. Remove paint and primer from antenna and antenna ground wire mating surfaces to ensure electrical ground.
3. Install screws securing antenna and antenna ground wire to tailcone. Verify security.
4. Apply small bead B270-1 sealant (0.1 inch max in height) around antenna at corners where it attaches to tailcone and allow to dry.
5. Connect antenna cable to antenna at connectors; secure to frame using ty-raps. Verify security.
6. Perform ground checks per Part D steps 5 and 6.

**F. Scheduled Maintenance and Inspections**

The internal battery must be tested for proper operation every 12 months. No calibration is necessary. Other maintenance is on condition. Contact Aspen Avionics at [www.aspenavionics.com](http://www.aspenavionics.com) for instructions for continued airworthiness.

**NOTE**

Refer to § 34-60 for avionics software information.

13-70 Console Assemblies**NOTE**

Refer to R22 Pilot's Operating Handbook Section 7 for views of typical instrument panels, and the Optional Avionics Supplement for views of panels with electronic flight displays.

**A. Opening Console**

Upper instrument panels that do not include Electronic Flight Displays (EFDs) or other avionics may be "opened" by removing screws securing console assembly to forward keel panels and hinging console aft. Secure console by hinging forward and installing screws. If an EFD or any other avionics are installed in the upper instrument panel, remove console per Part B.

**B. Removing Console**

1. Remove EFD if installed per § 13-60.
2. Remove avionics if installed and located in upper instrument console per Chapter 34.
3. Remove perimeter screws securing instrument face to console.
4. Disconnect instrument pitot-static lines. Plug lines.
5. Remove screws securing console assembly to forward keel panels. Remove console and disconnect console harness from airframe harness.

**C. Installing Console**

1. Connect console assembly harness to airframe harness and install screws securing console to forward keel panels.
2. Position instrument face in helicopter, remove plugs, and connect pitot-static lines.
3. Install perimeter screws securing face to console. Verify security.
4. Install avionics per Chapter 34, if removed.
5. Install EFD per § 13-60, if removed.
6. Perform pitot-static system leak check per § 13-10.

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## CHAPTER 14

## ELECTRICAL AND AVIONICS SYSTEMS

<u>Section</u>	<u>Title</u>	<u>Page</u>
14.000	Electrical and Avionics Systems . . . . .	14.1
14.600	Electrical Systems Schematics . . . . .	14.12
14.800	Avionics Schematics . . . . .	14.25
14.900	Upper Console Harness Plugs . . . . .	14.41
14.1000	IFR Trainer . . . . .	14.43
14.1010	IFR Trainer Component Loads . . . . .	14.43
14.1020	IFR Trainer Console Access . . . . .	14.45
14.1030	IFR Trainer Component Location . . . . .	14.46
14.1040	IFR Trainer Avionics Schematics . . . . .	14.47
14.1100	R22 Mariner Avionics Schematics . . . . .	14.60

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**CHAPTER 14****ELECTRICAL AND AVIONICS SYSTEMS**14.000 Electrical and Avionics Systems

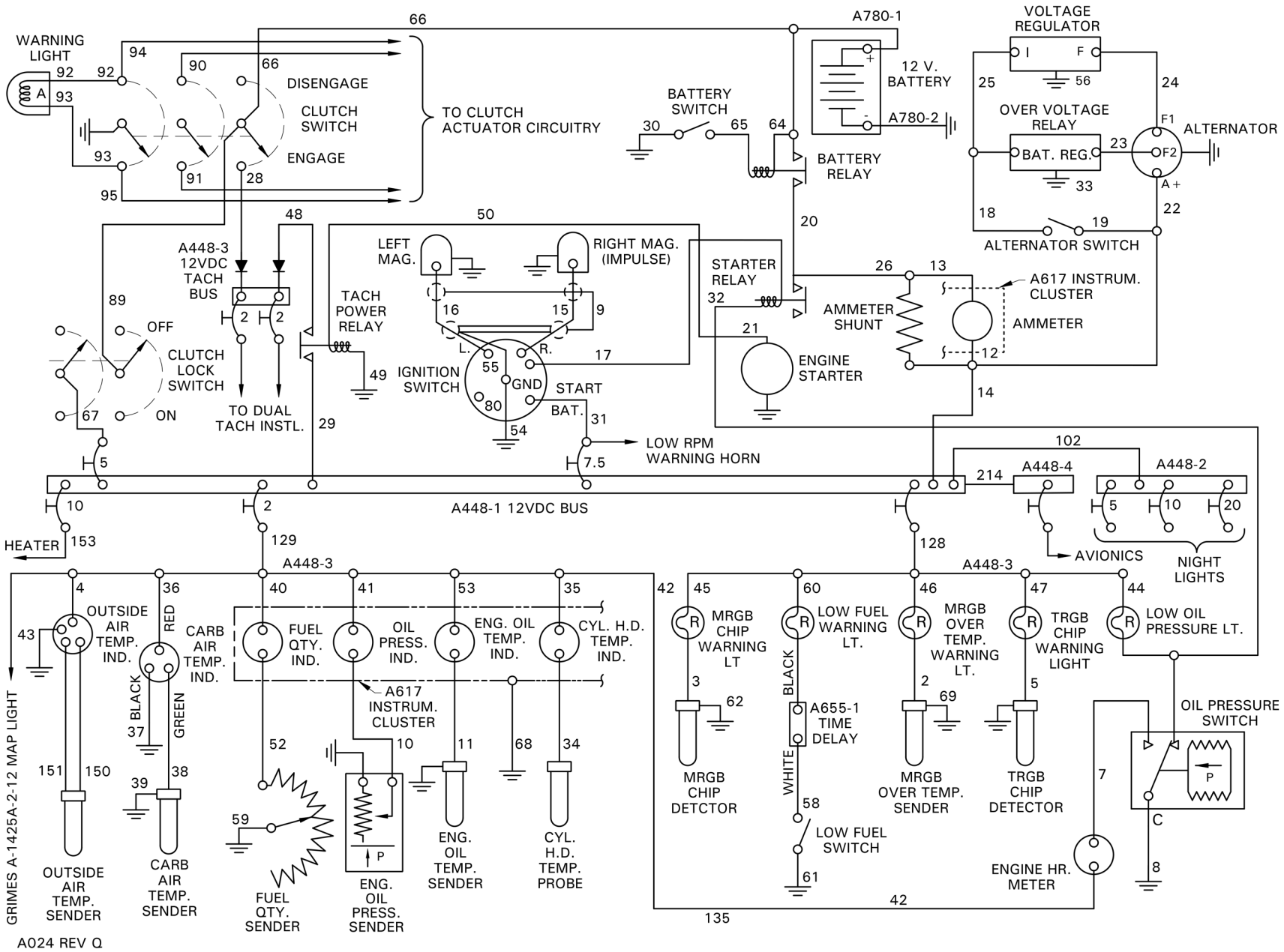
Electrical System information has been moved to Chapter 33.

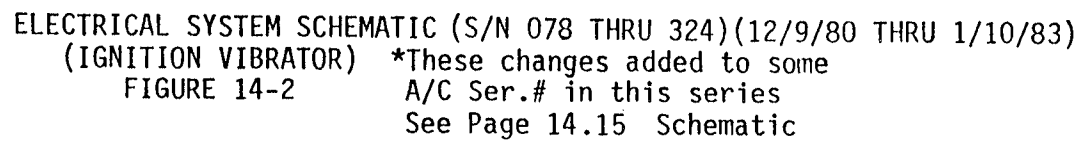
Avionics System information has been moved to Chapter 34.

[Pages 14.3 thru 14.11A have been deleted, are no longer effective, and should be discarded.]

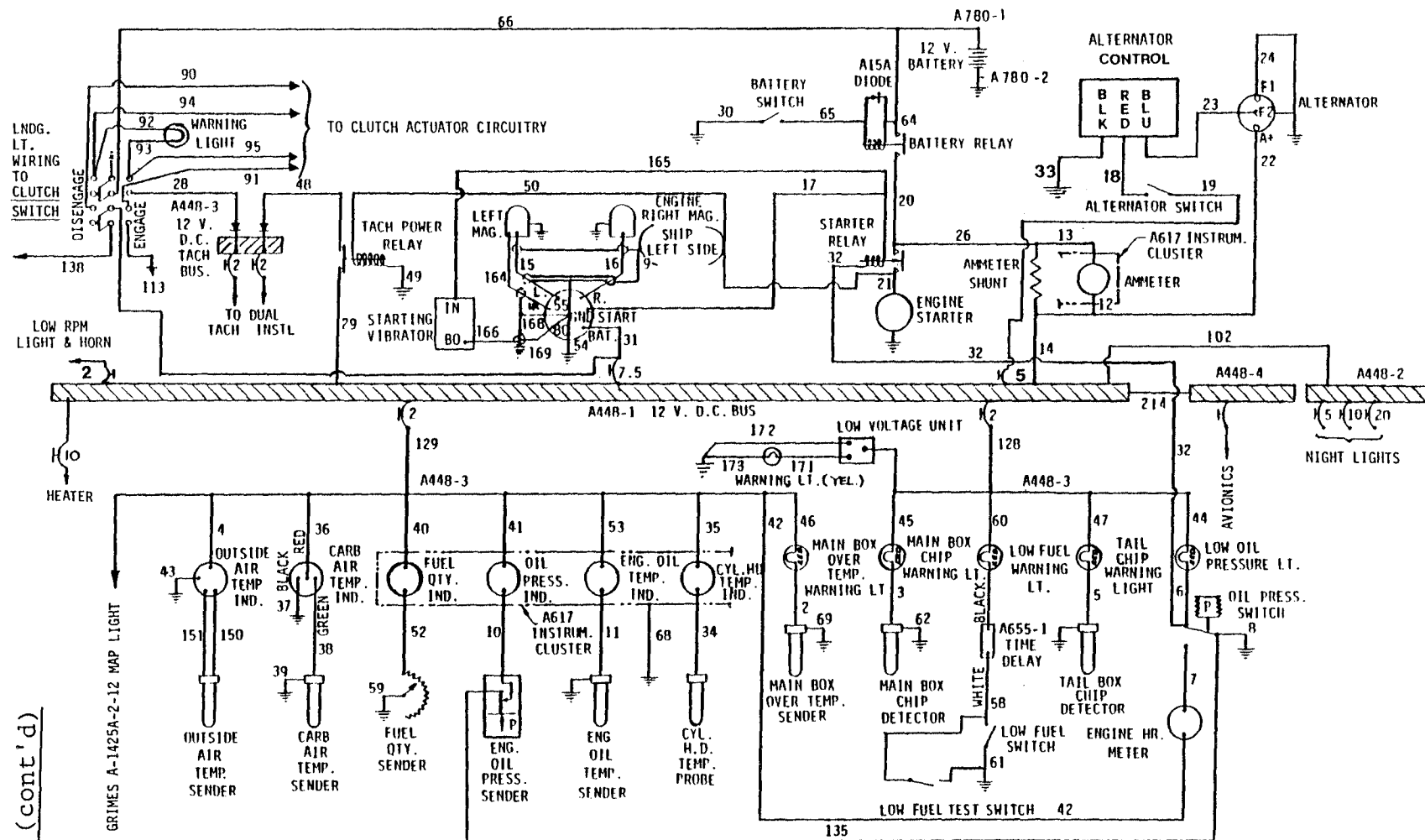
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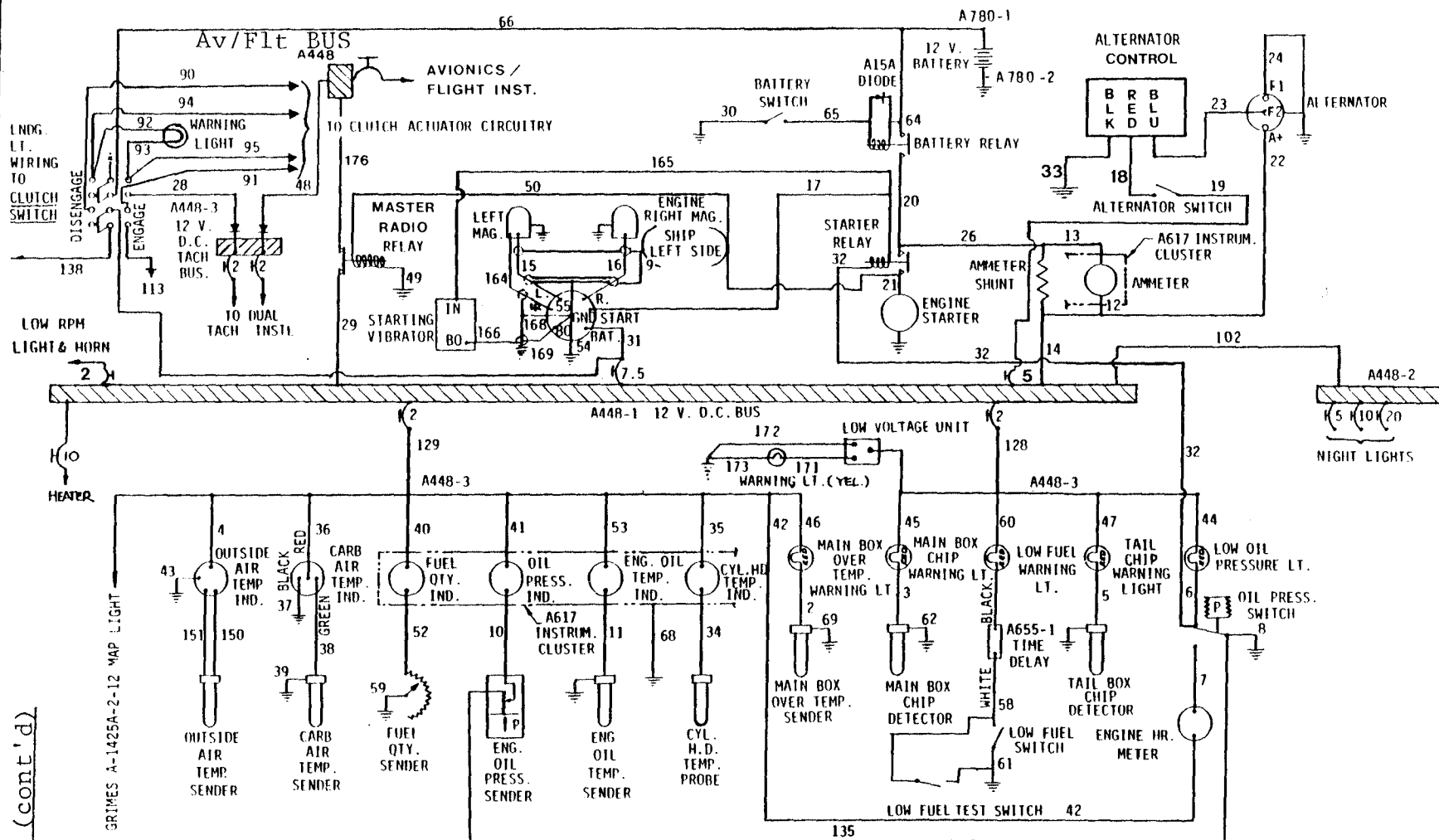


14.600 (cont'd)



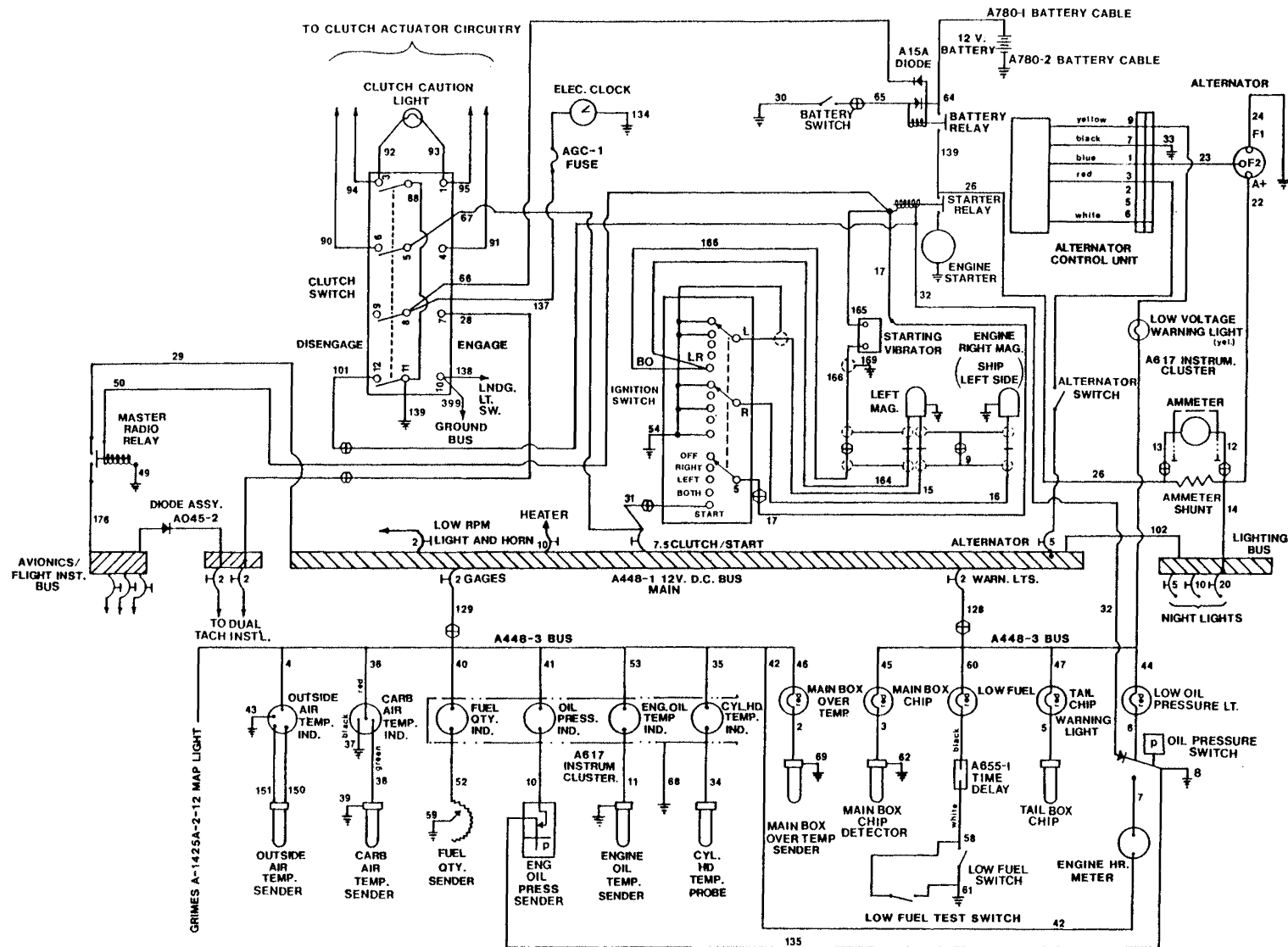
ELECTRICAL SYSTEM SCHEMATIC (S/N 324 THRU 363)(1/10/83 THRU 8/23/83)  
(IGNITION VIBRATOR)  
FIGURE 14-2A

14.600 (cont'd)



ELECTRICAL SYSTEM SCHEMATIC (S/N 350,351,357-361,& 364 THRU 411)  
 (IGNITION VIBRATOR)  
 R22 ALPHA  
 FIGURE 14-2B  
 (8/4/83 THRU 5/18/84)

14.600 (cont'd)



ELECTRICAL SYSTEM SCHEMATIC (S/N 412 thru 443)

(IGNITION VIBRATOR) (5/18/84 thru 10/1/84)

FIGURE 14-2C



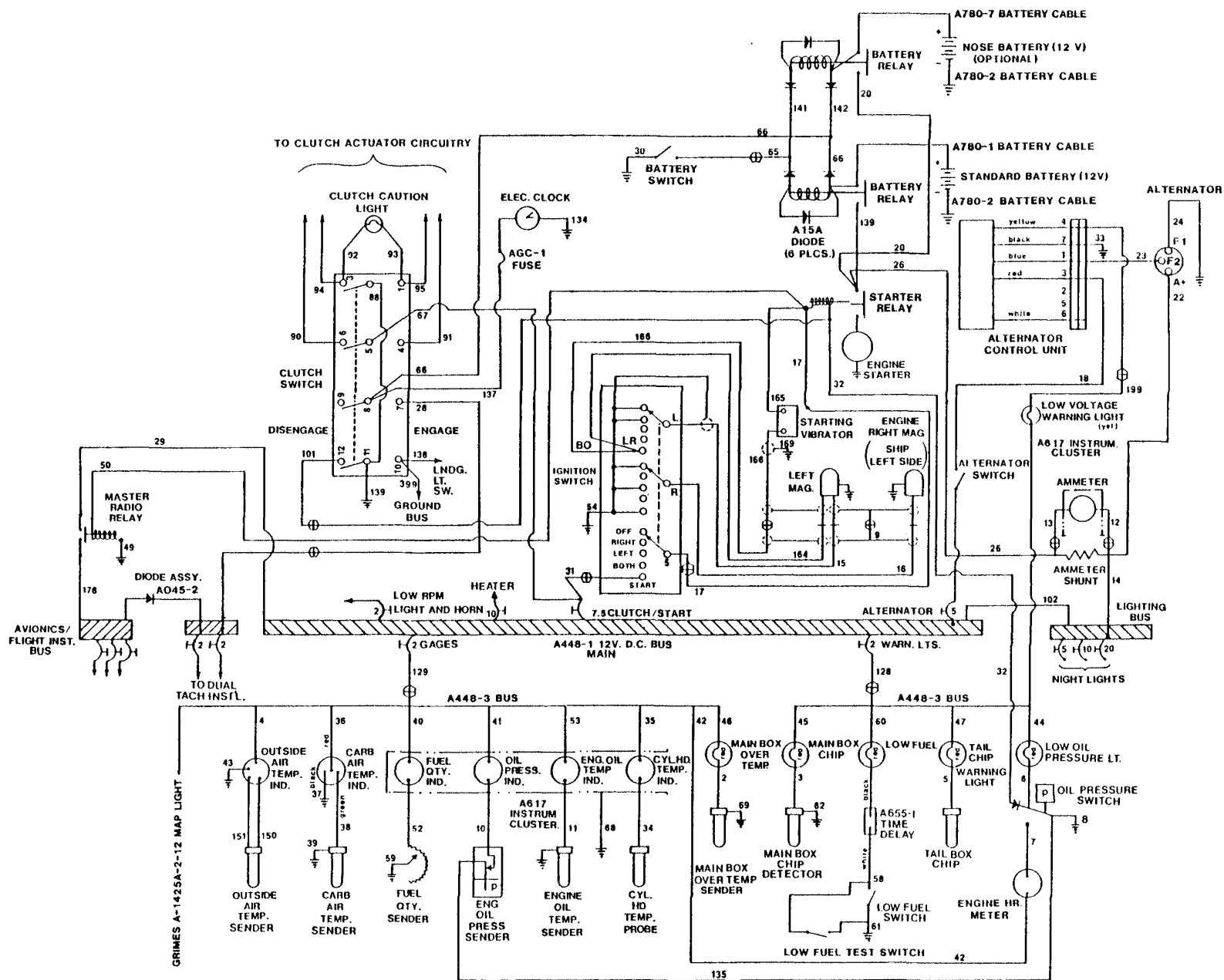


FIGURE 14-2D ELECTRICAL SYSTEM SCHEMATIC - DUAL BATTERY PROVISION  
(IGNITION VIBRATOR) (5/18/84 thru 10/1/84)

14.600 (cont'd)

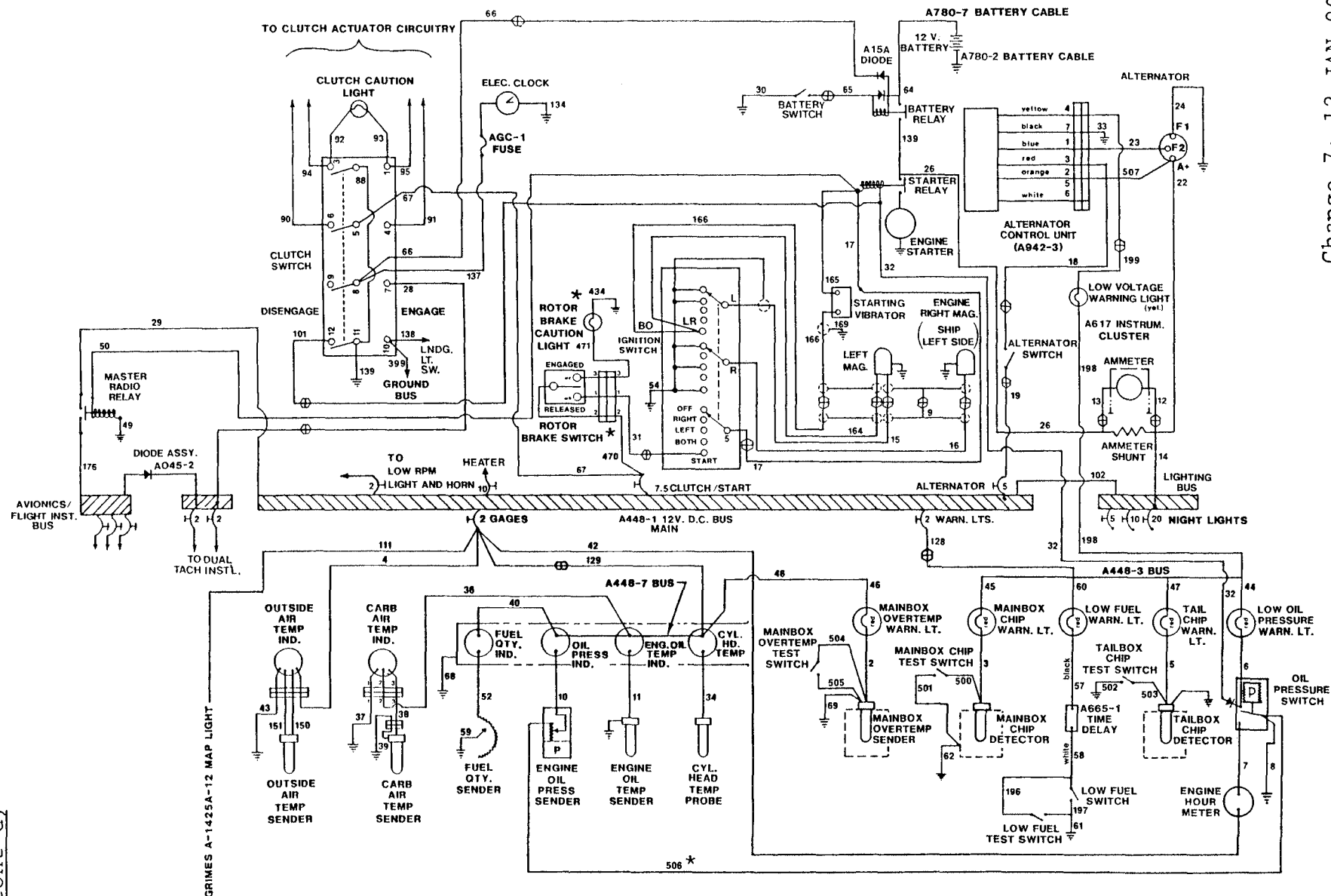


FIGURE 14-2F ELECTRICAL SYSTEM SCHEMATIC  
(IGNITION VIBRATOR) (S/N 444 thru 655, 10/2/84 thru 6/10/87)

\*If installed.

14.600 (cont'd)

# ROBINSON MAINTENANCE MANUAL

MODEL R22

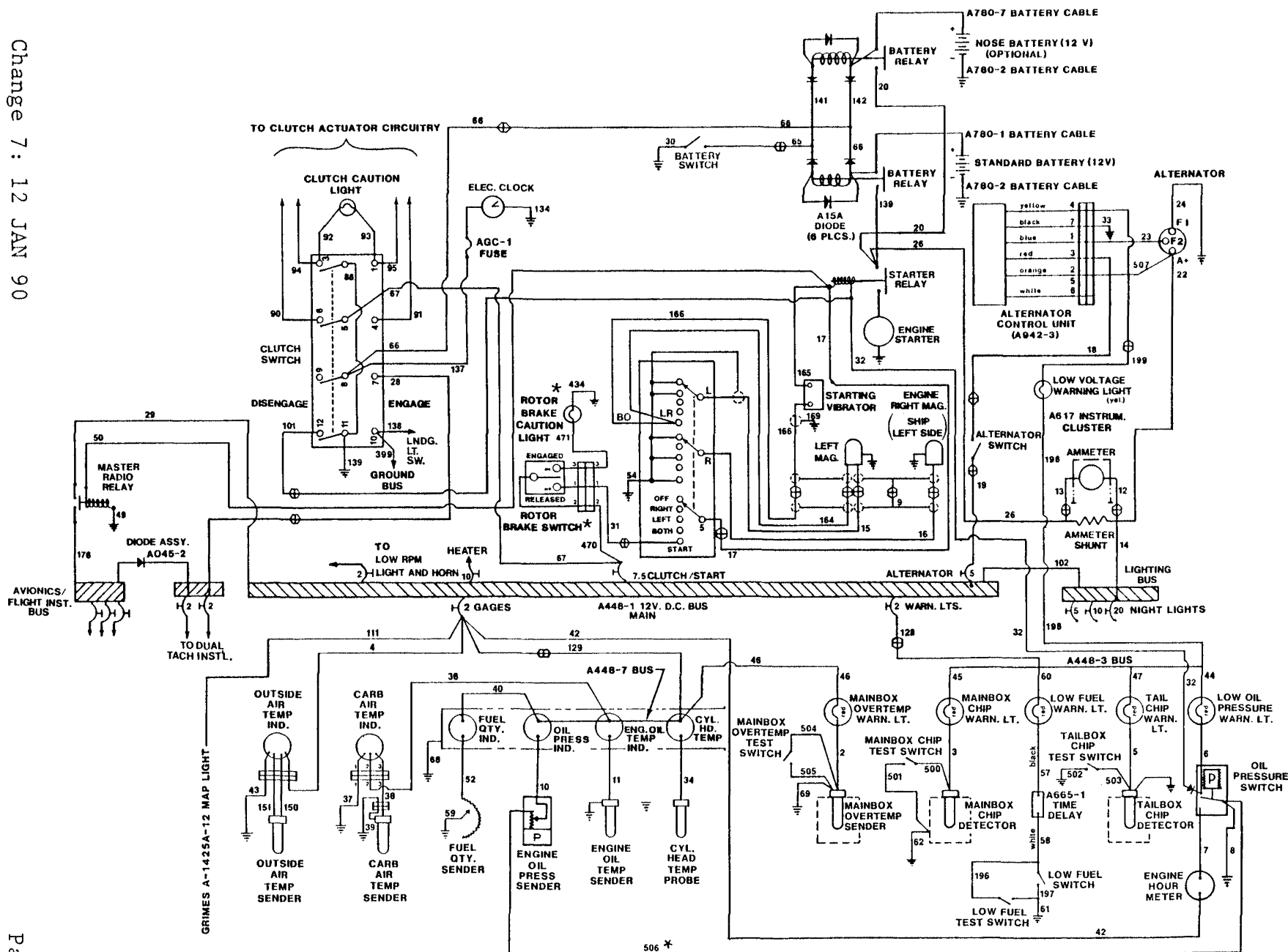


FIGURE 14-2F ELECTRICAL SYSTEM SCHEMATIC - DUAL BATTERY PROVISION (IGNITION VIBRATOR) (S/N 444 thru 655, 10/2/84 thru 6/10/87)

\*If installed.

14.600 (cont'd)

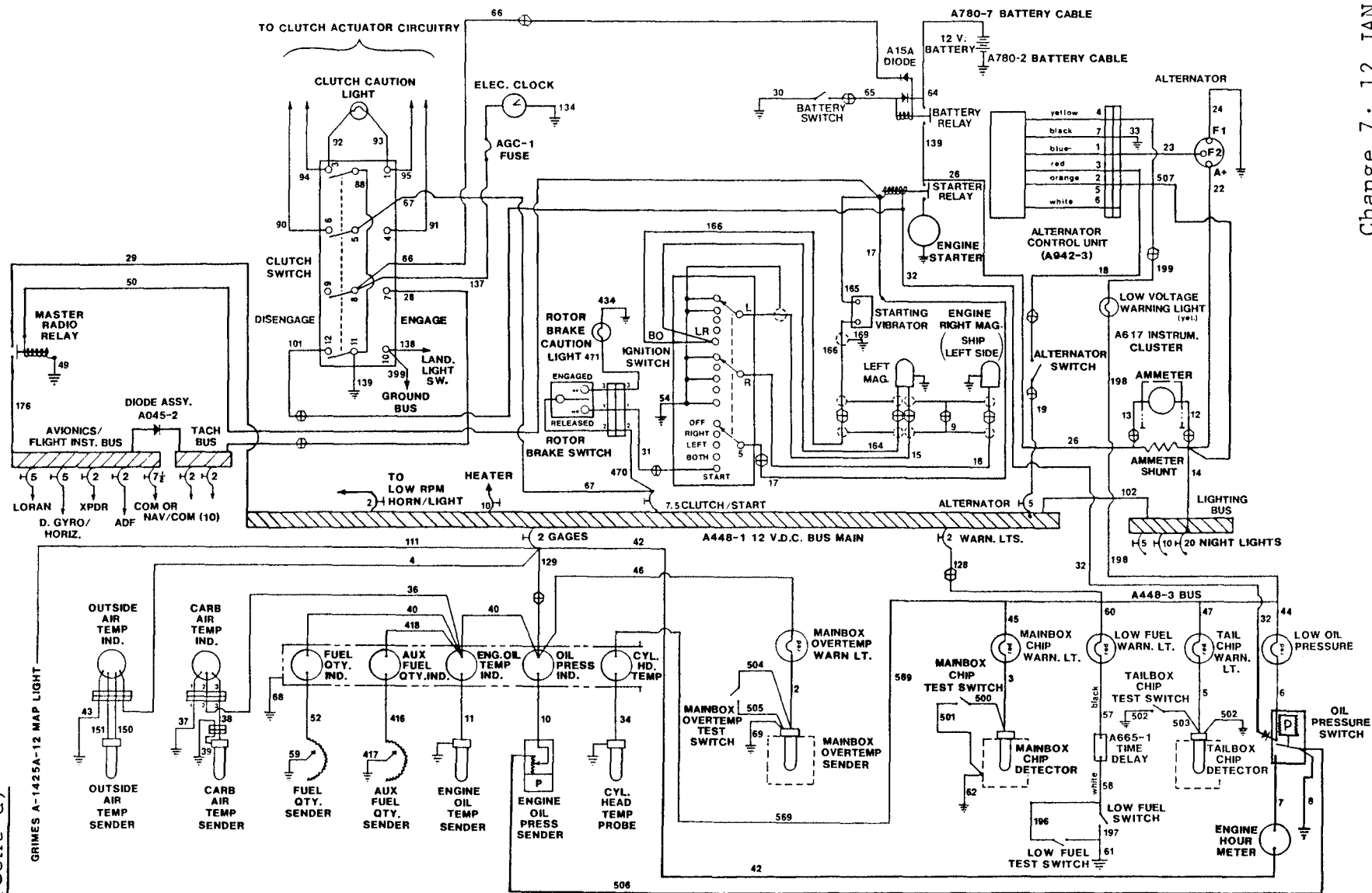


FIGURE 14-2G ELECTRICAL SYSTEM SCHEMATIC  
(IGNITION VIBRATOR) (S/N 656 THRU 1084 EXCEPT S/Ns  
1052, 1056, 1067, & 1071 AND OVERHAULED SHIPS  
6/10/87 AND ON)

14.600 (cont'd)

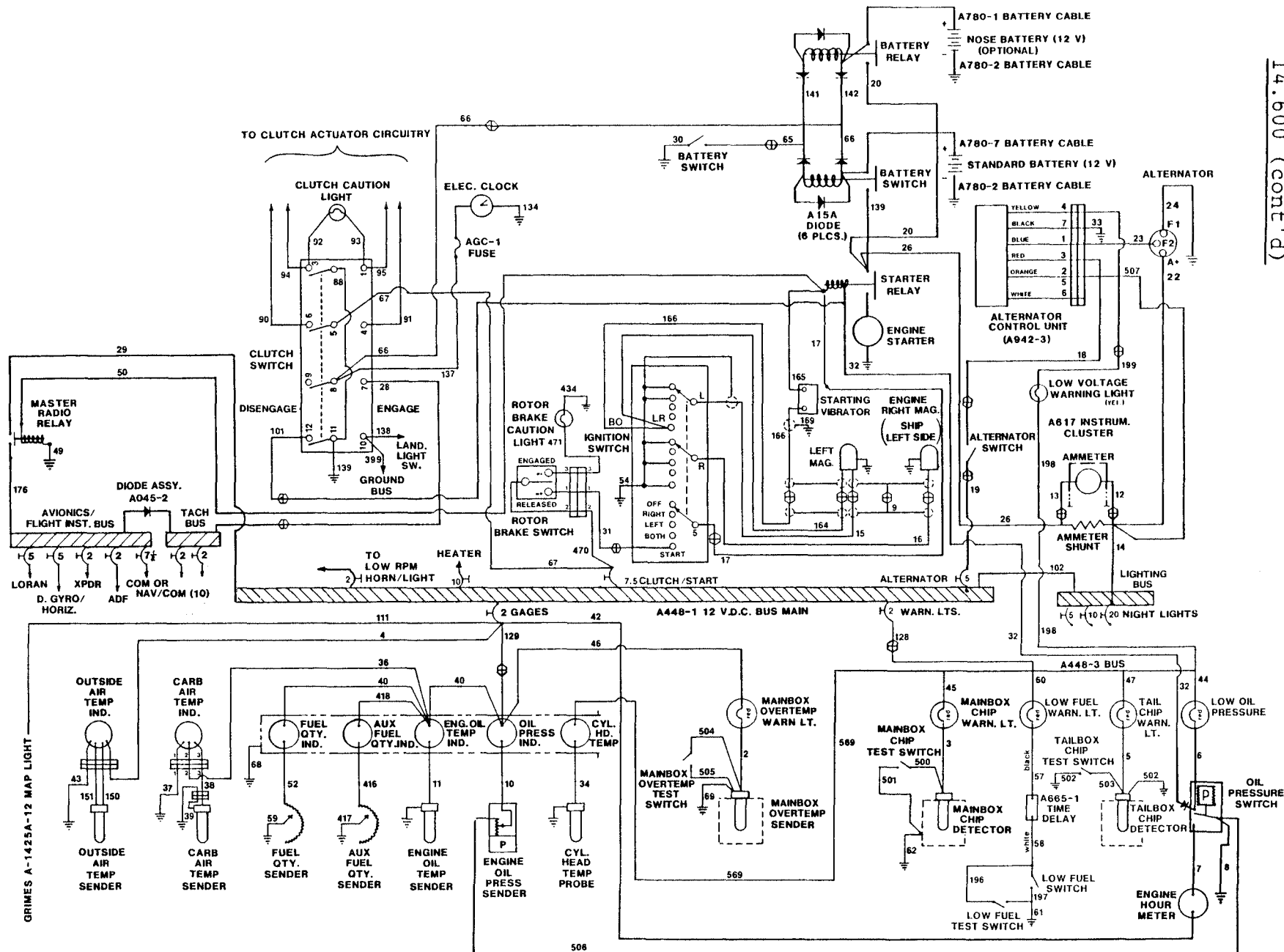


FIGURE 14-2H ELECTRICAL SYSTEM SCHEMATIC - DUAL BATTERY PROVISION (IGNITION VIBRATOR) (S/N 656 THRU 1084 EXCEPT S/Ns 1052, 1056, 1067, & 1071 AND OVERHAULED SHIPS 6/10/87 AND ON)

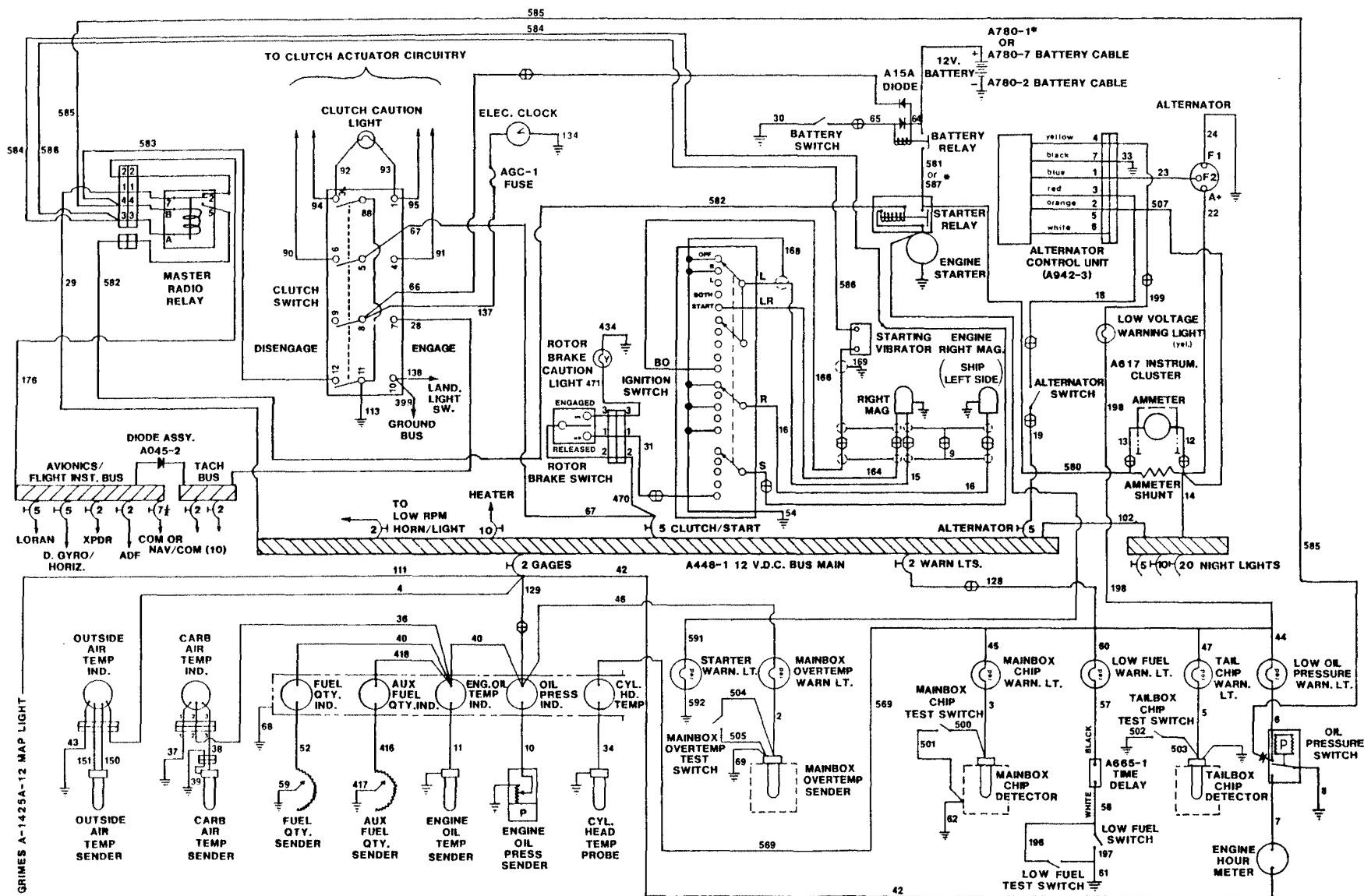
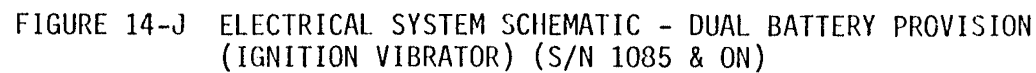


FIGURE 14-21 ELECTRICAL SYSTEM SCHEMATIC  
(IGNITION VIBRATOR) (S/N 1052, 1056, 1067, 1071, & 1085 AND ON.

\*A780-1 and #587 wire  
used with nose bat-  
tery installation.



## 14.600 (cont'd)

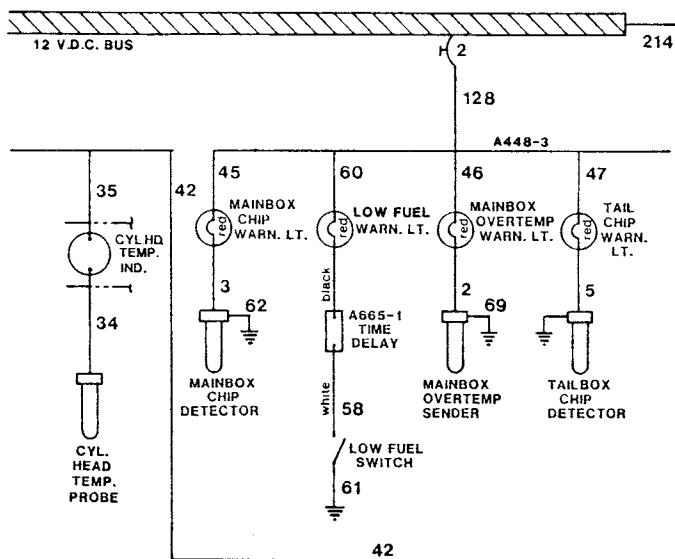


FIGURE 14-2K

M.R. GEARBOX OVERTEMP LIGHT  
ON 2 AMP WARNING LIGHT BREAKER

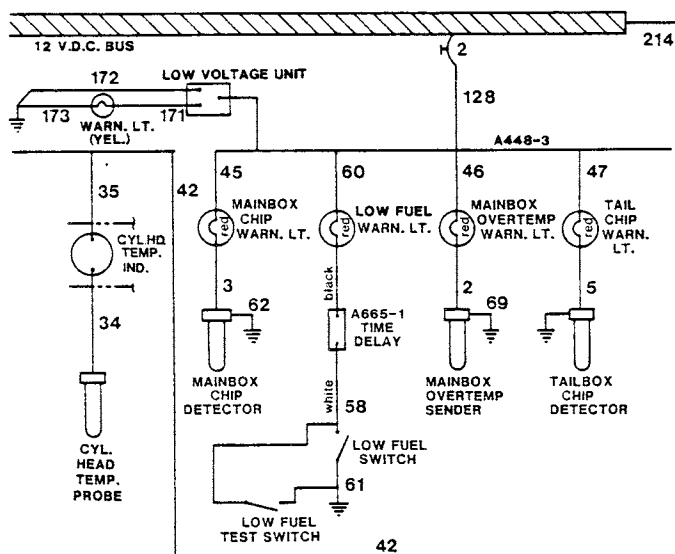


FIGURE 14-2L

M.R. GEARBOX OVERTEMP LIGHT  
ON 2 AMP WARNING LIGHT BREAKER

LOW VOLTAGE UNIT ON THE 2 AMP  
WARNING LIGHT BREAKER

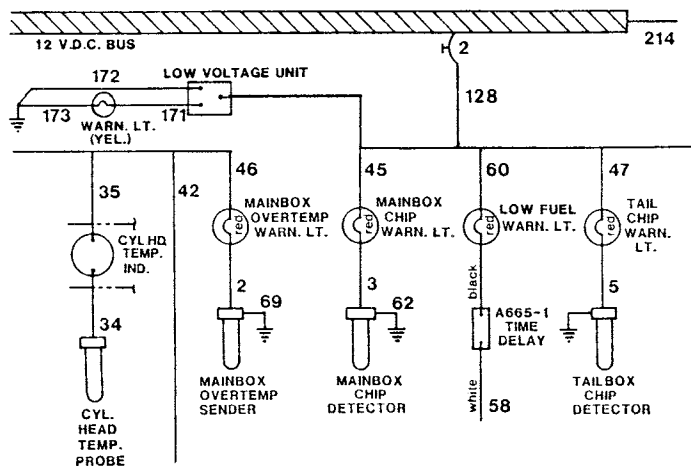


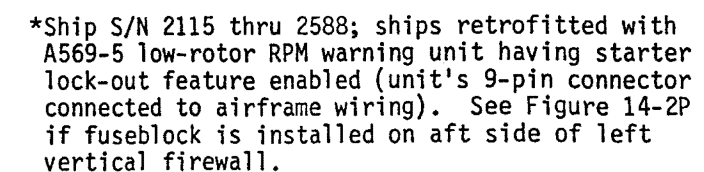
FIGURE 14-2M

M.R. GEARBOX OVERTEMP LIGHT  
ON 2 AMP GAGES BREAKER

LOW VOLTAGE UNIT ON THE 2 AMP  
WARNING LIGHT BREAKER

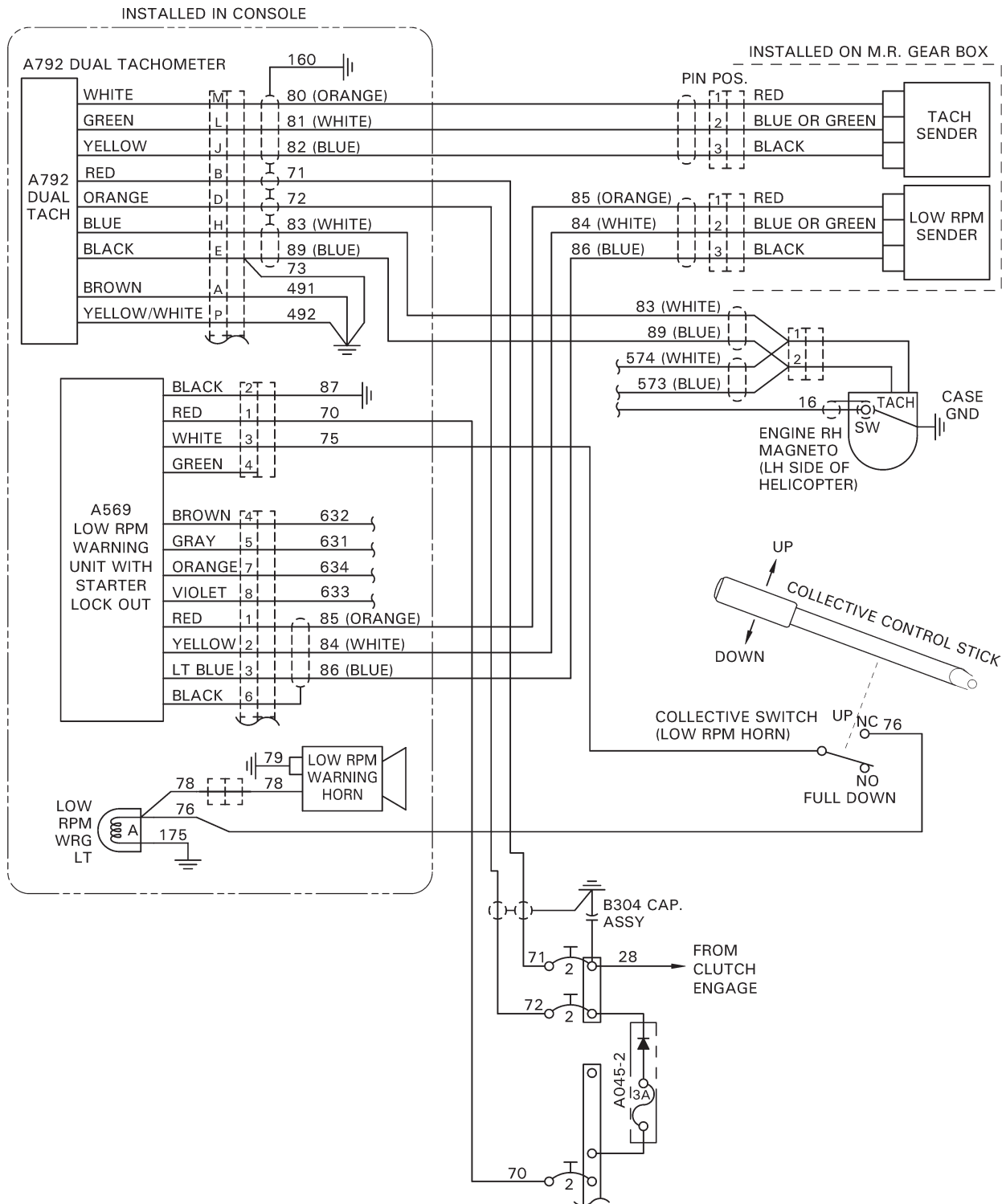


←	A059-3 HARNESS ASSEMBLY (Console)	A059-2 HARNESS ASSEMBLY (Cabin)	→
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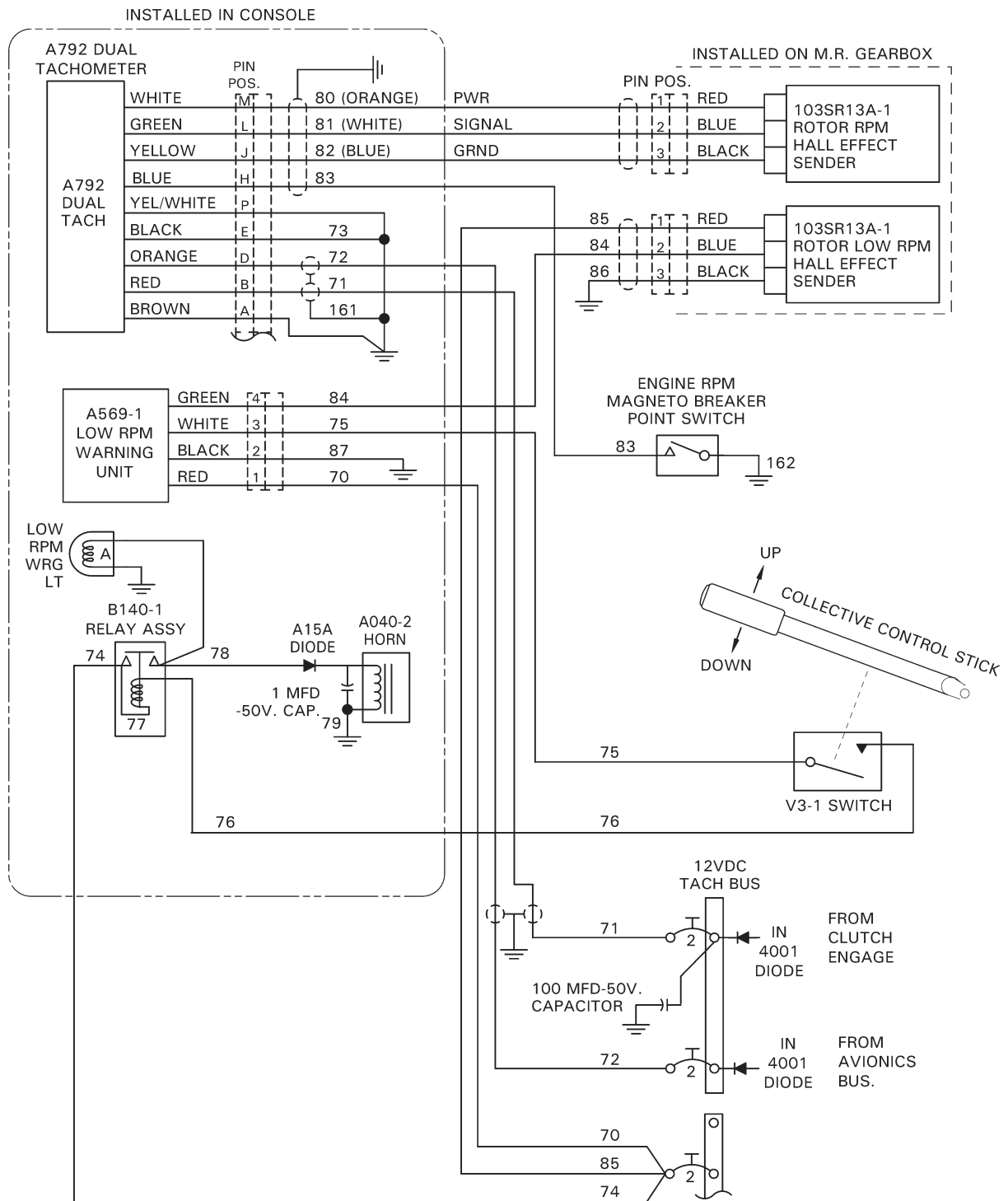
Page 14.18A

FIGURE 14-2P  
ELECTRICAL SYSTEM  
SCHEMATIC\*



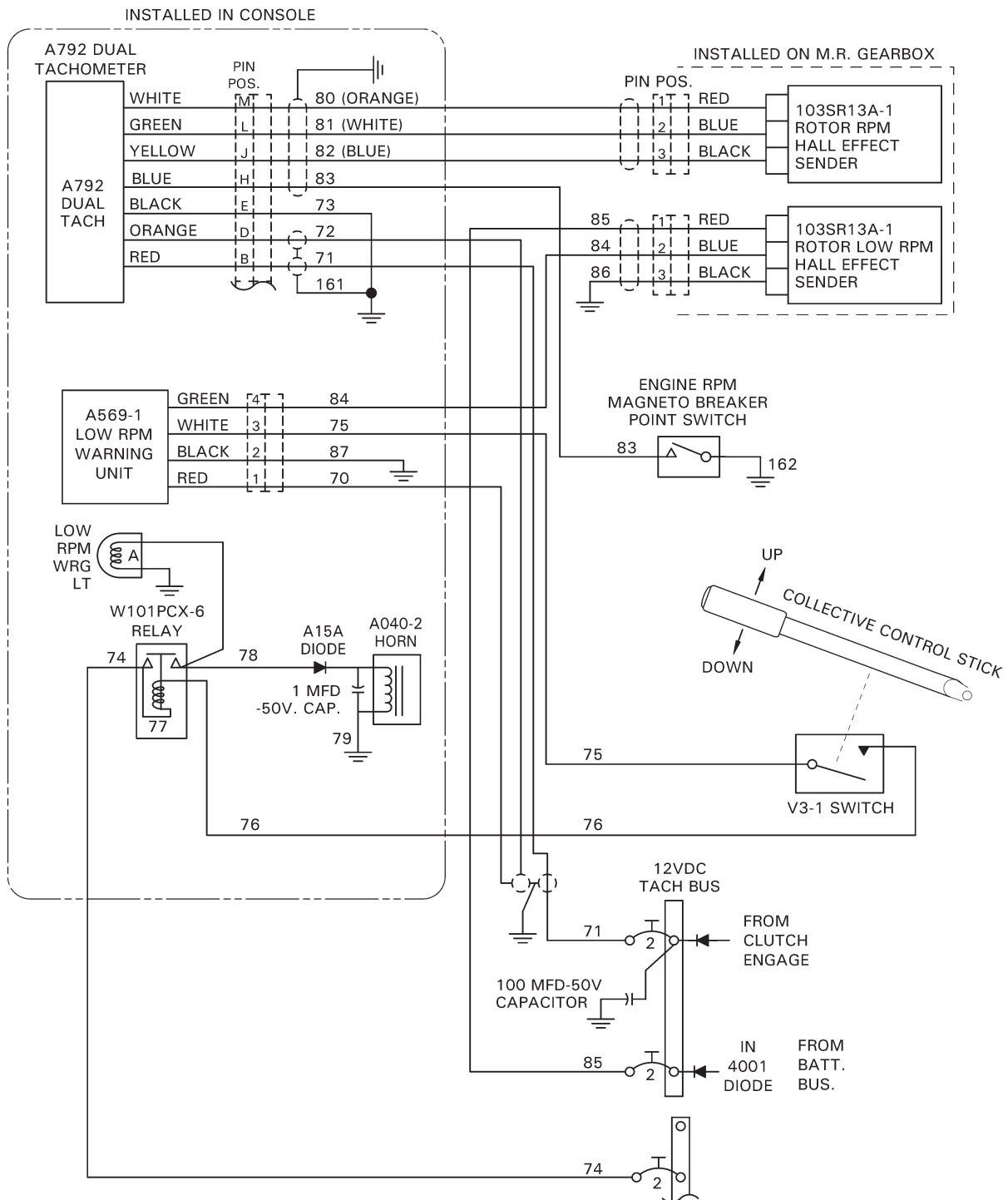
A024 REV B0

FIGURE 14-3 TACHOMETER &amp; LOW RPM WARNING HORN SCHEMATIC



A040 REV W

FIGURE 14-3A TACHOMETER &amp; LOW RPM WARNING HORN SCHEMATIC (EARLIER SHIPS)



A040 REV U

FIGURE 14-3B TACHOMETER &amp; LOW RPM WARNING HORN SCHEMATIC (S/N 0002 THRU 0223)

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## 14.600 ELECTRICAL SYSTEM SCHEMATICS (Cont'd)

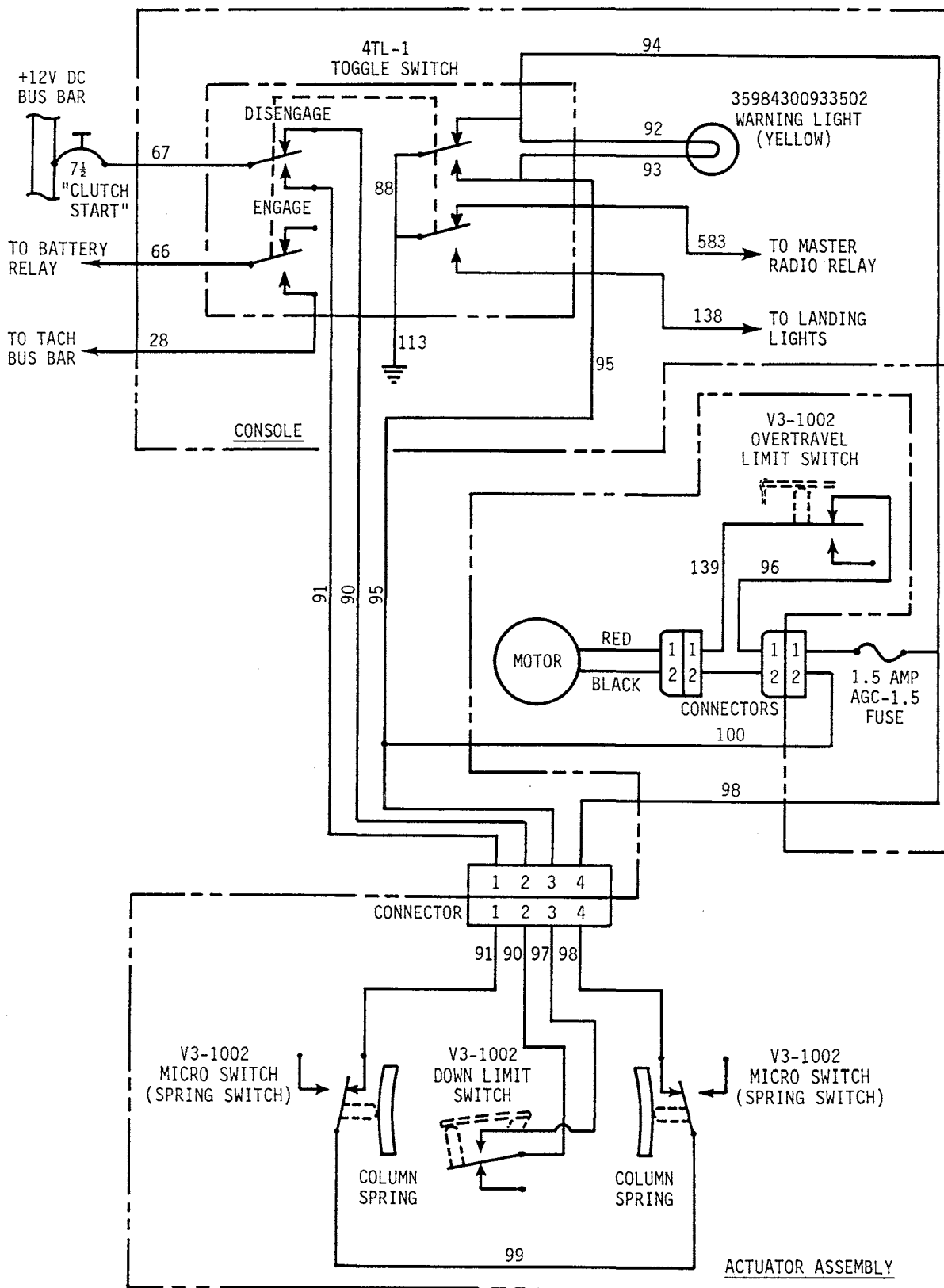
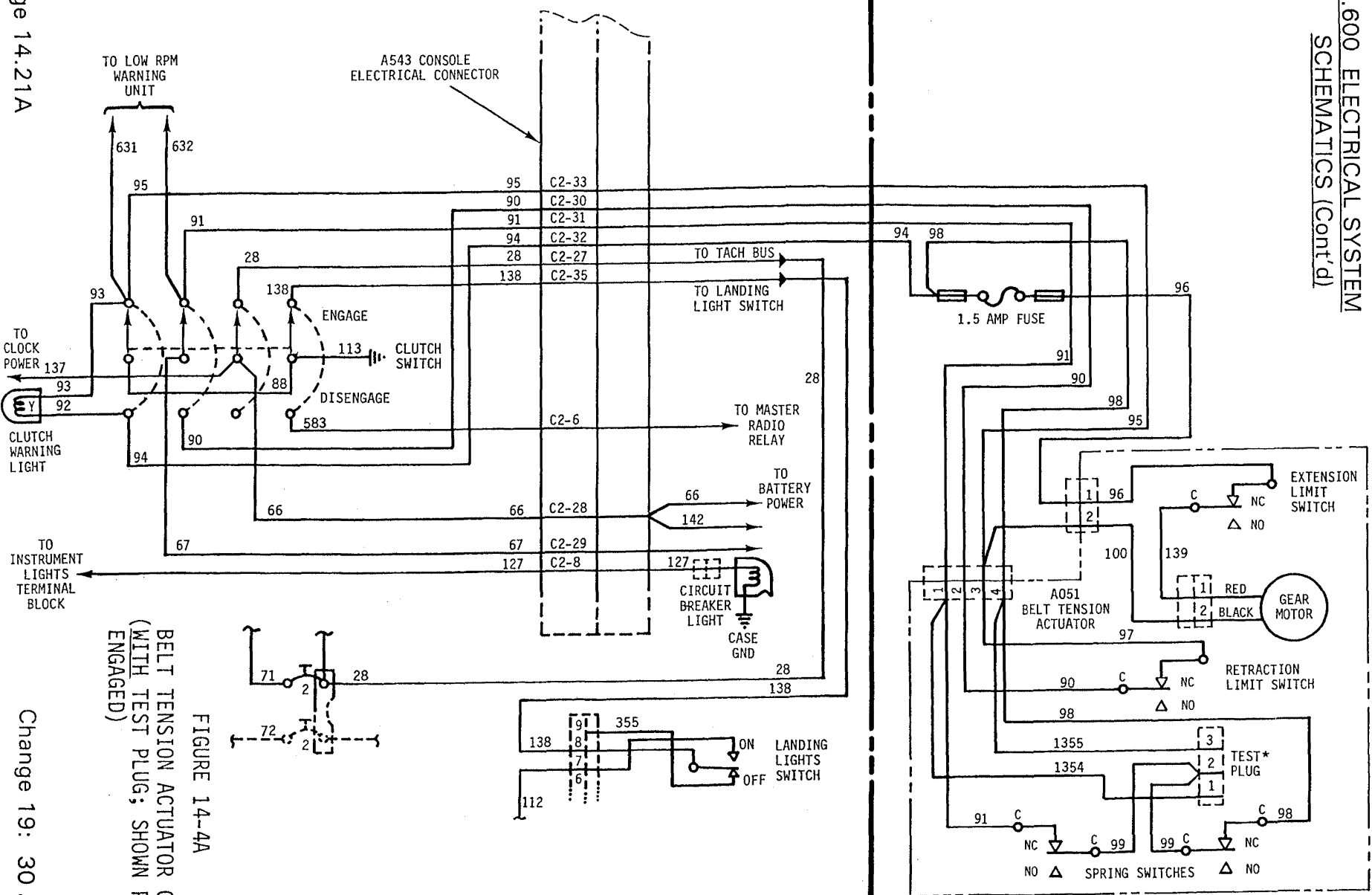


FIGURE 14-4 BELT TENSION ACTUATOR SCHEMATIC  
(WITHOUT TEST PLUG; SHOWN FULLY  
DISENGAGED)

### 14.600 ELECTRICAL SYSTEM SCHEMATICS (Cont'd)

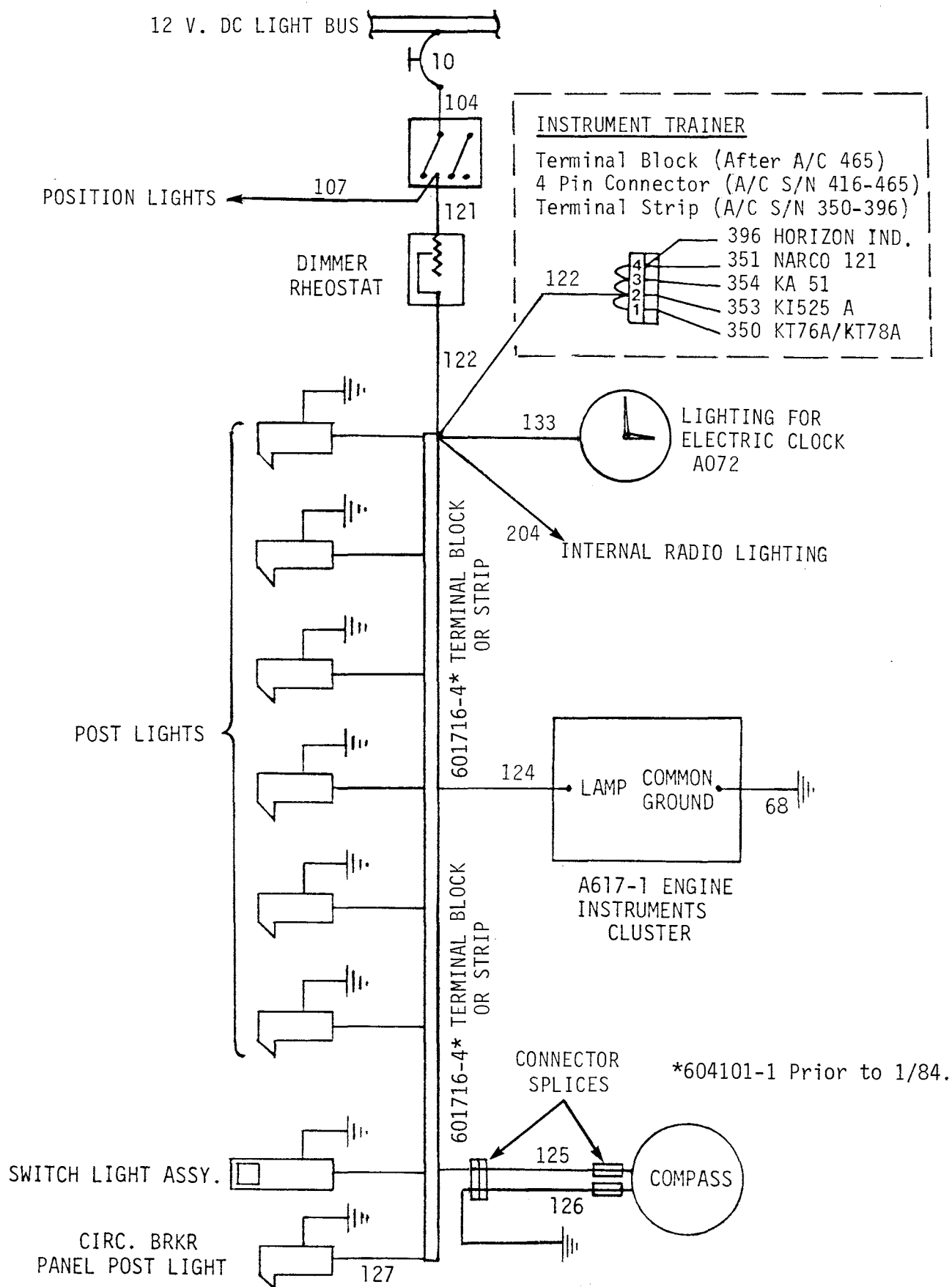


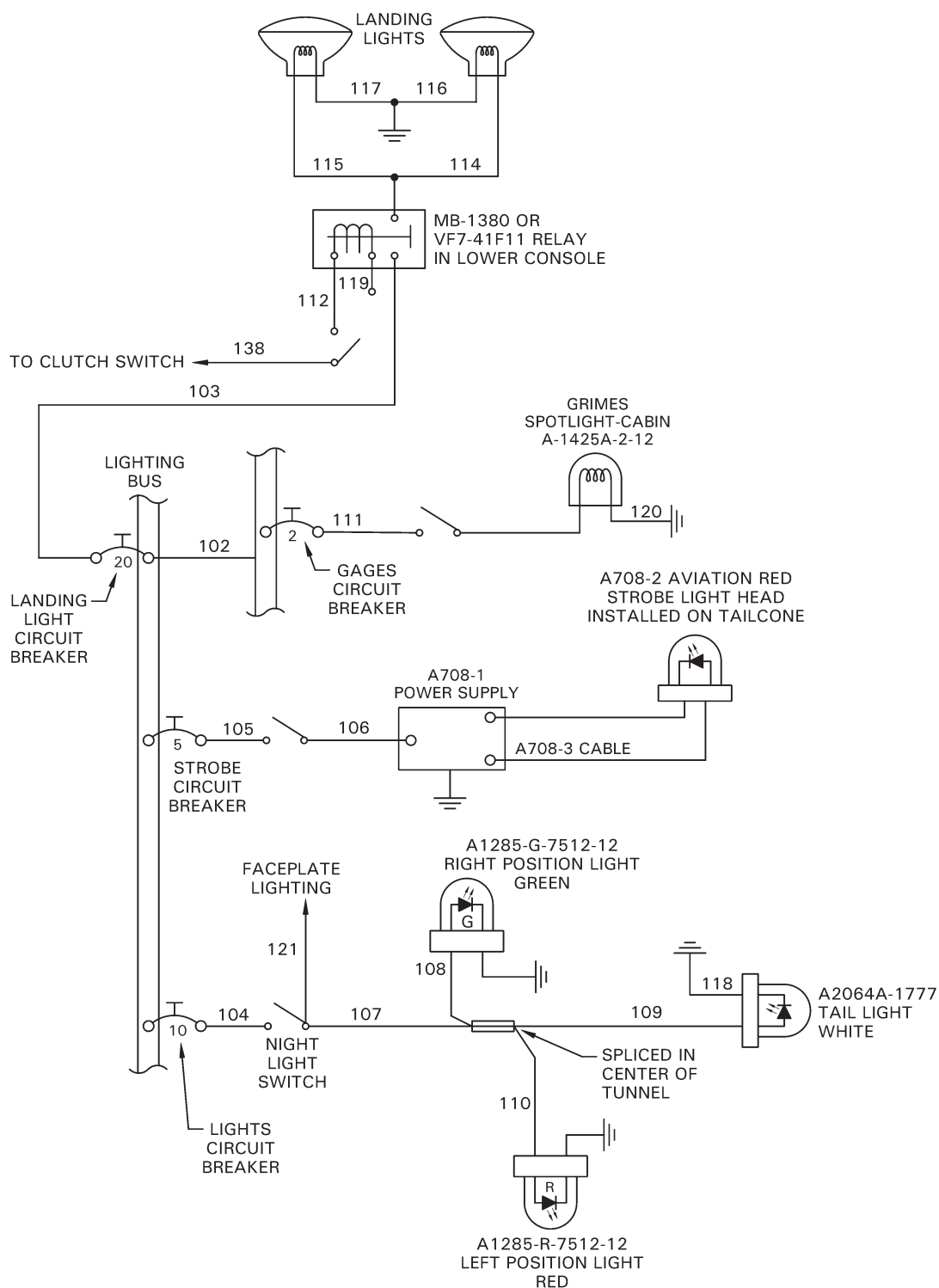
\*If installed.



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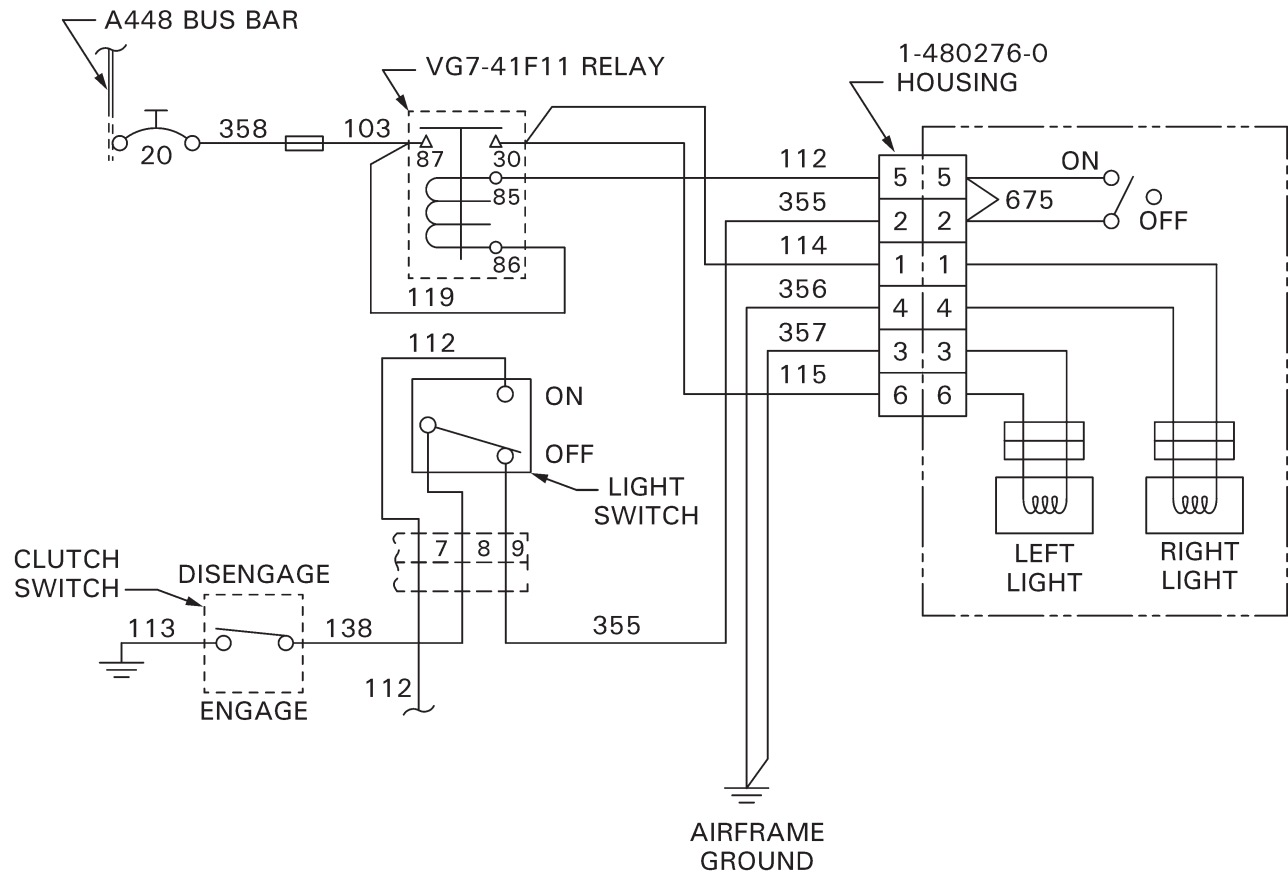
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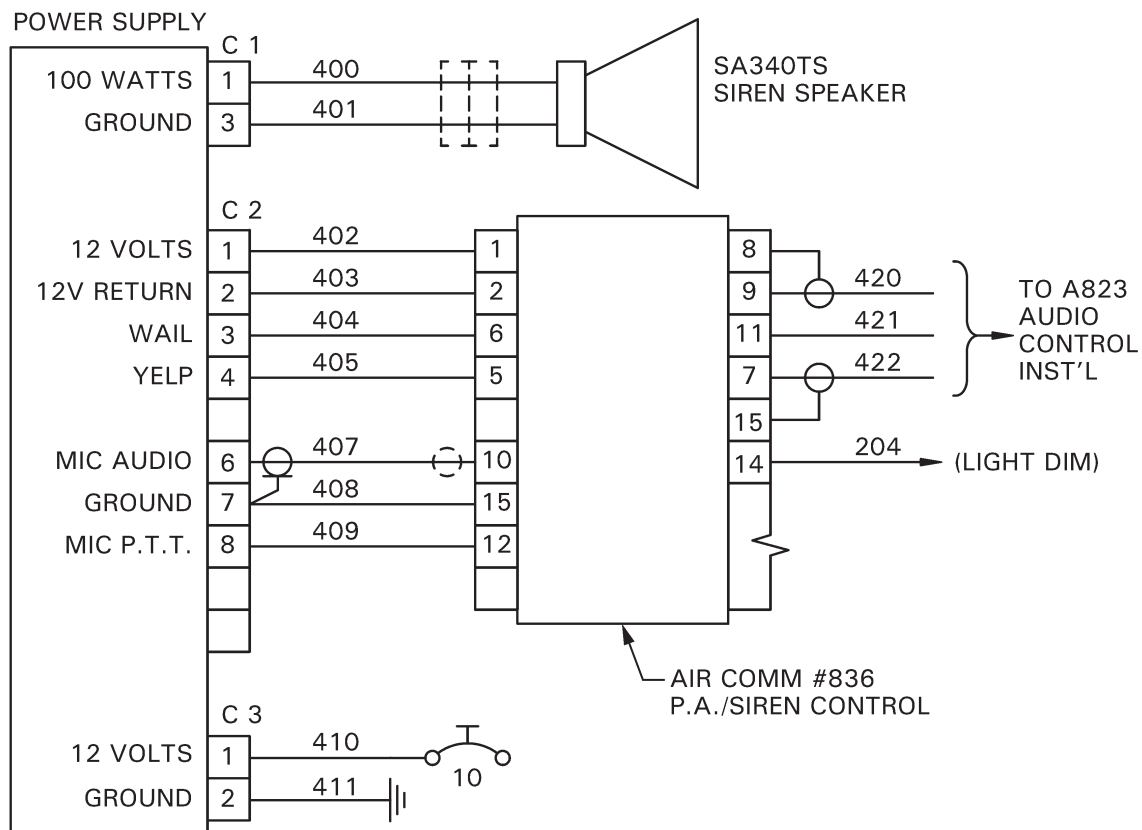
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FIGURE 14-5A NIGHT LIGHTING SCHEMATIC



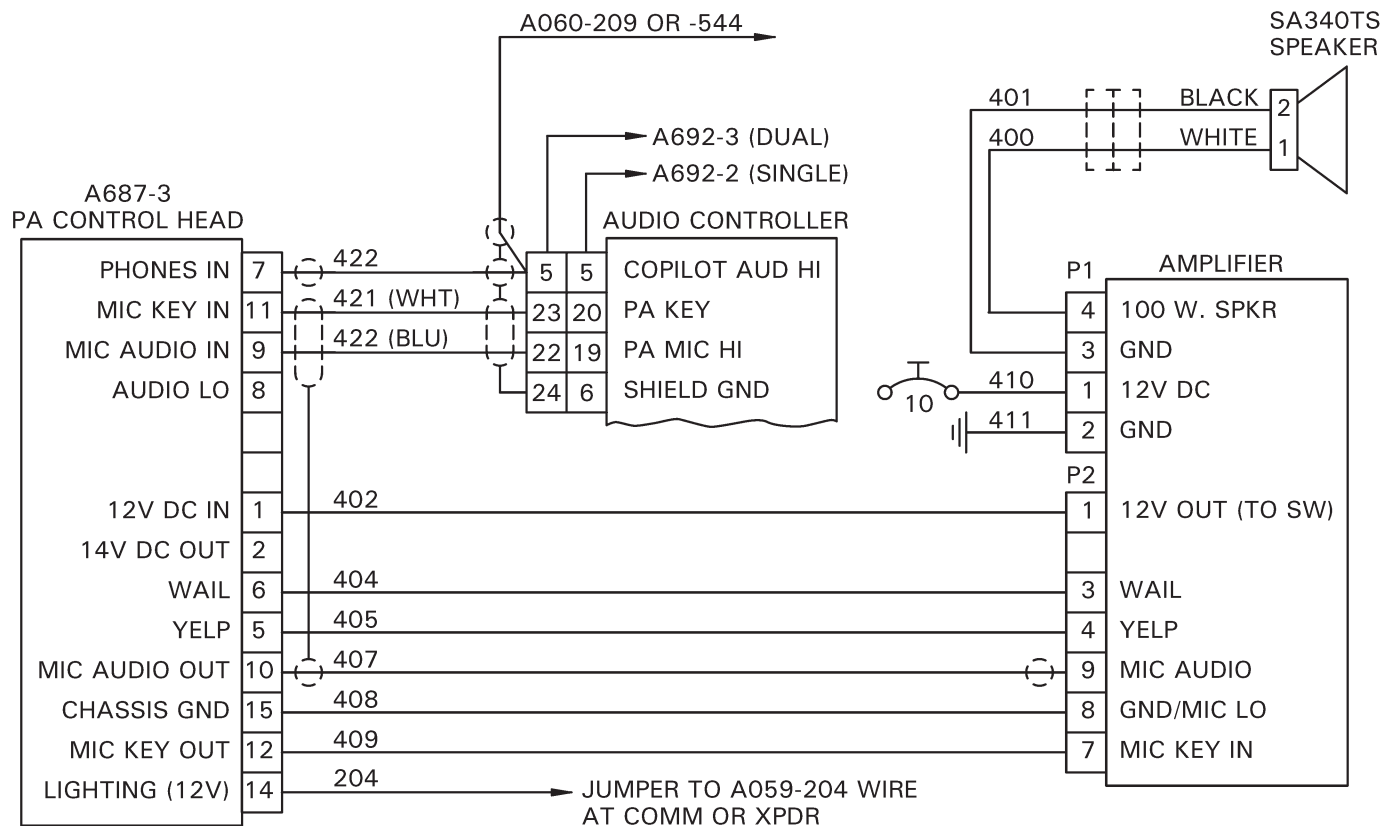
A081 REV M

FIGURE 14-6 WIRING SCHEMATIC FOR SEARCHLIGHT



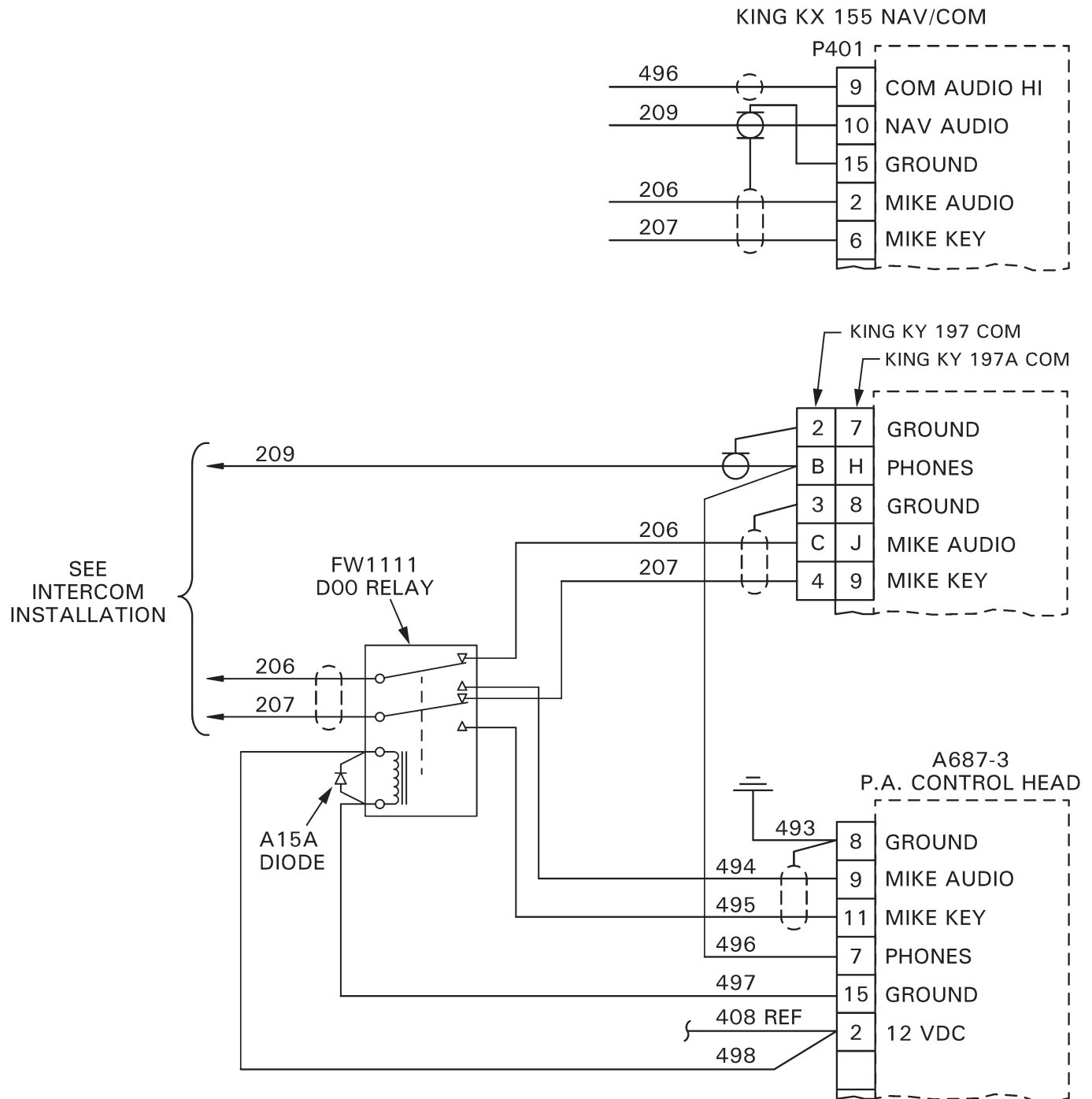
A079 REV J

FIGURE 14-6A PA SIREN WIRING SCHEMATIC



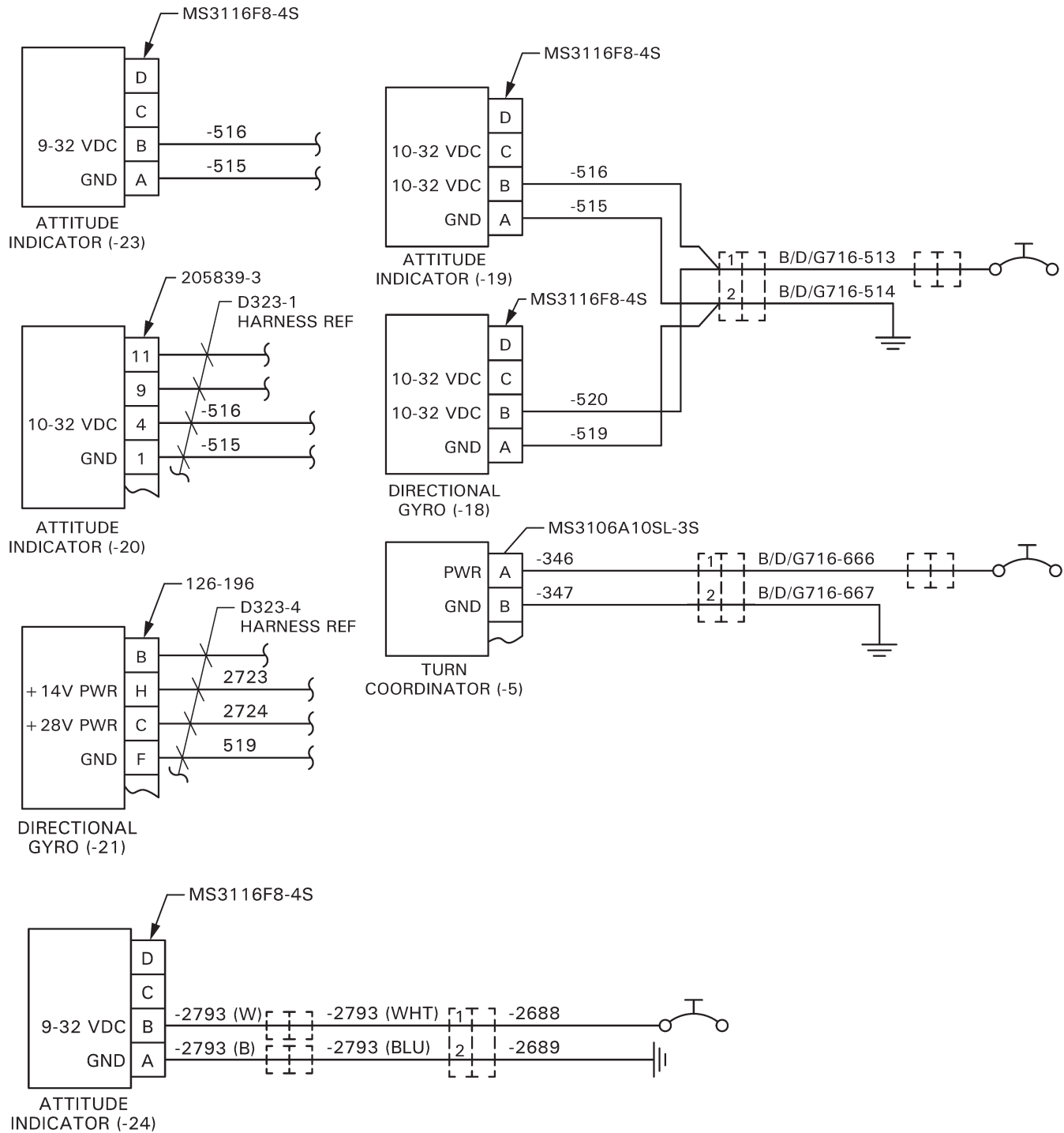
A079 REV L

FIGURE 14-6B PA SIREN SYSTEM SCHEMATIC (WITH AUDIO CONTROL)



A079 REV K

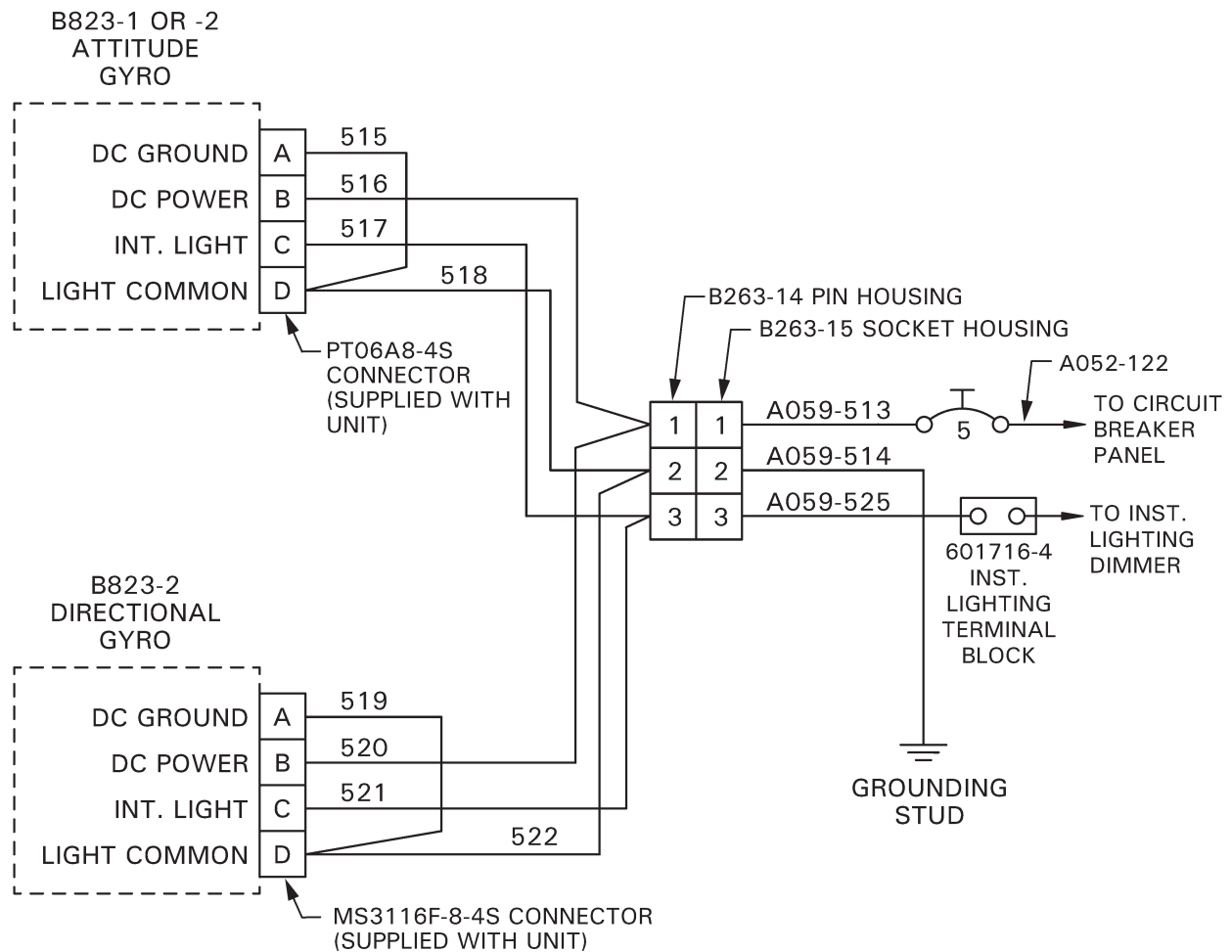
FIGURE 14-6C PA SIREN SYSTEM SCHEMATIC (WITH KING KX 155 OR KY 197)



B191 REV AE

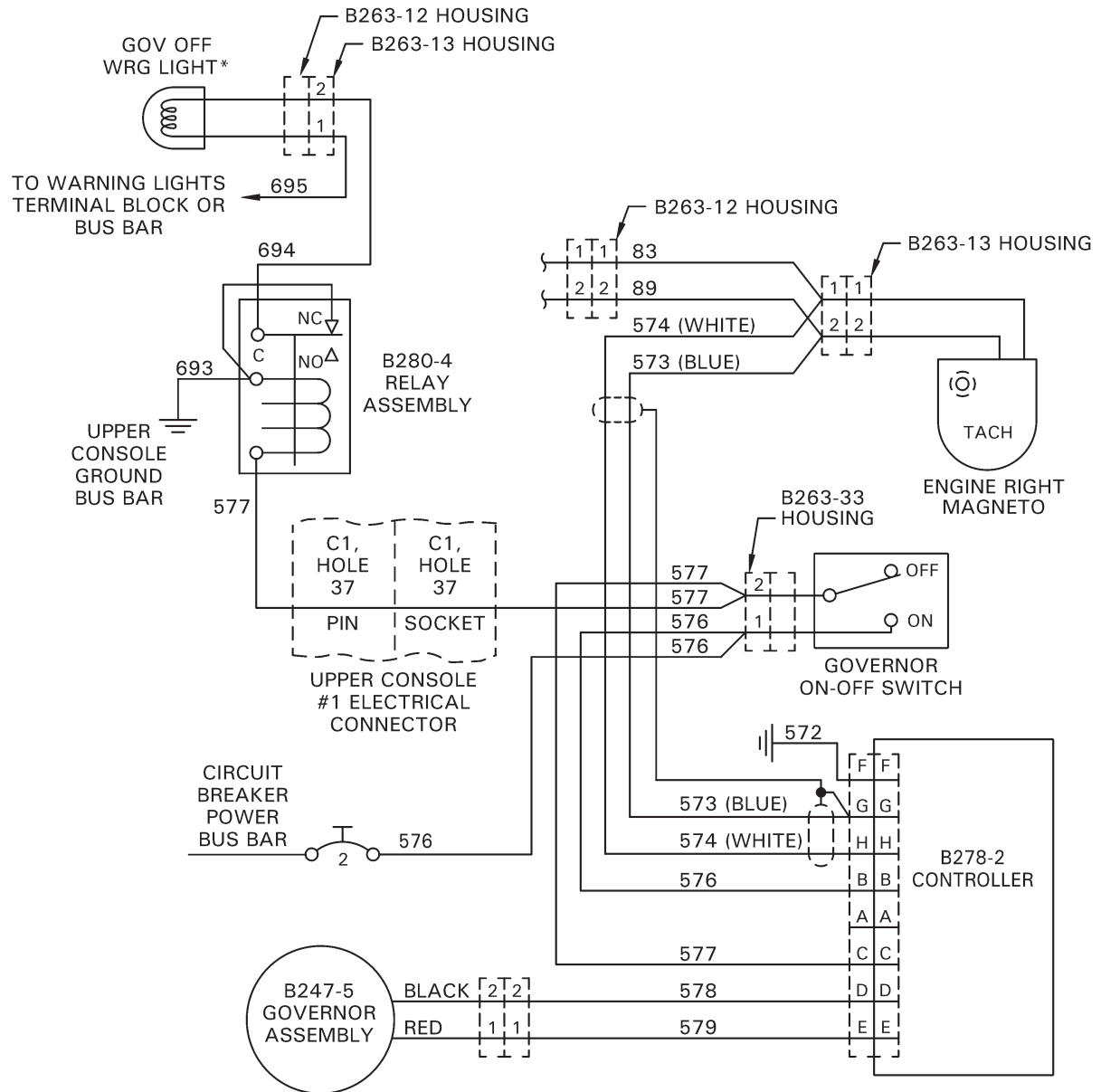
FIGURE 14-6D ATTITUDE GYRO AND DIRECTIONAL GYRO INSTALLATION





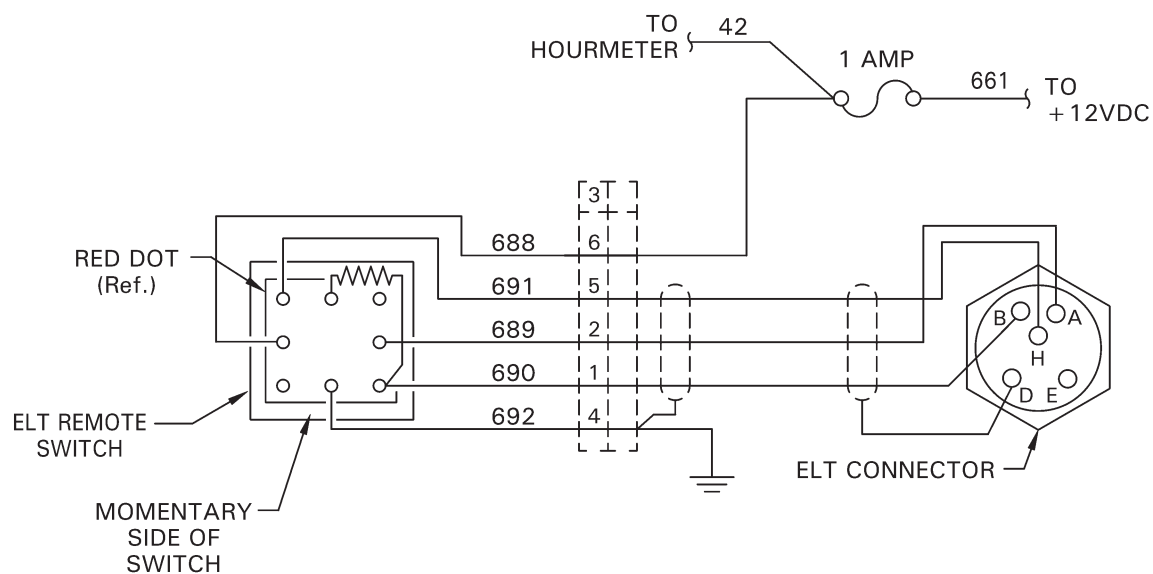
B191 REV E

FIGURE 14-6E ATTITUDE GYRO AND DIRECTIONAL GYRO INSTALLATION (EARLIER SHIPS)



\* If not installed, GOVERNOR OFF warning light may be added using KI-100 Kit.

FIGURE 14-6F GOVERNOR SYSTEM SCHEMATIC



A830 REV D

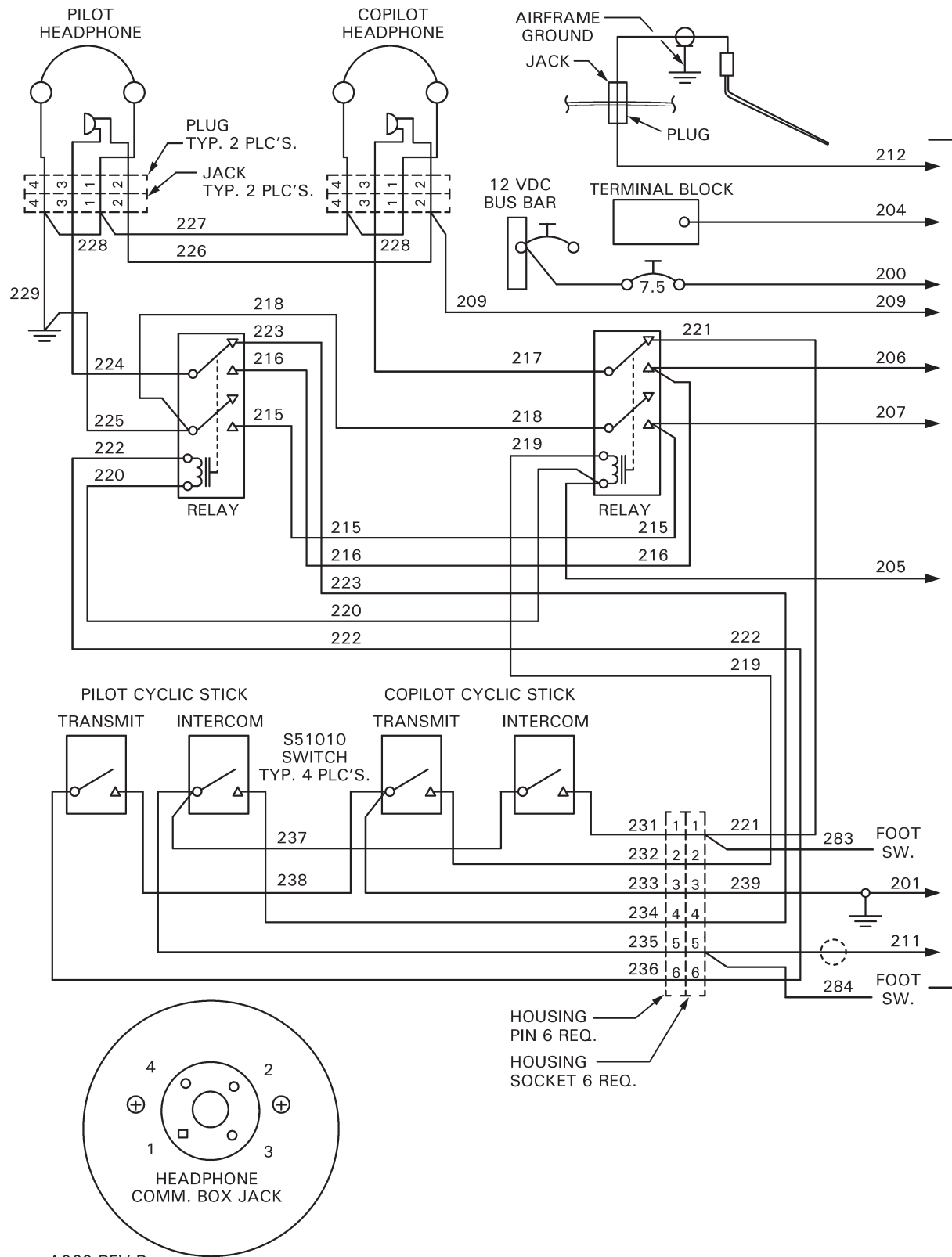
FIGURE 14-6G ELT REMOTE SWITCH WIRING SCHEMATIC

14.700 Antenna Locations

|    This section has been moved to § 16-70.

#### 14.800 Avionics Schematics

Basic communications wiring common to all the COM radio configurations include: Pilot and Co-Pilot cyclic stick switches (Transmit and Intercom), and an overhead COM box housing Pilot and Co-Pilot headphone jacks and relays. The intercom system operates through installed COM radio or audio selector panel.



A060 REV R

FIGURE 14-8 INTERCOM SYSTEM (EARLIER SHIPS)

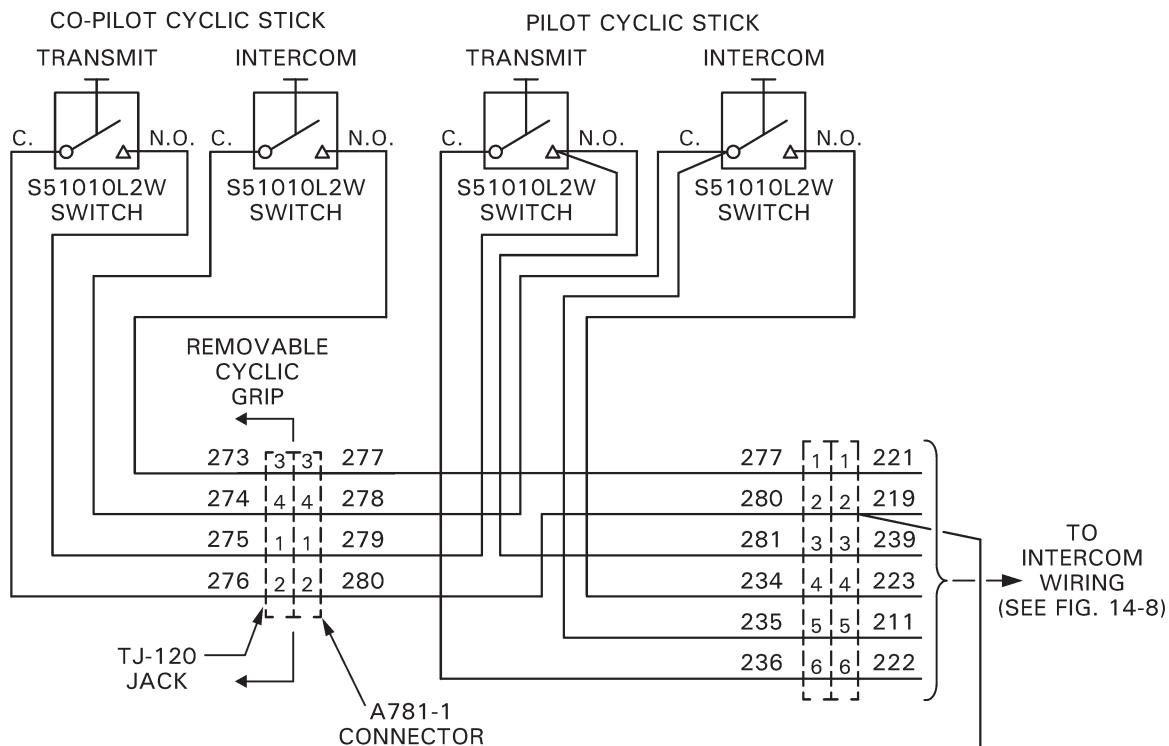


FIGURE 14-8A INTERCOM SCHEMATIC WITH  
REMOVABLE CYCLIC GRIP (EARLIER SHIPS)

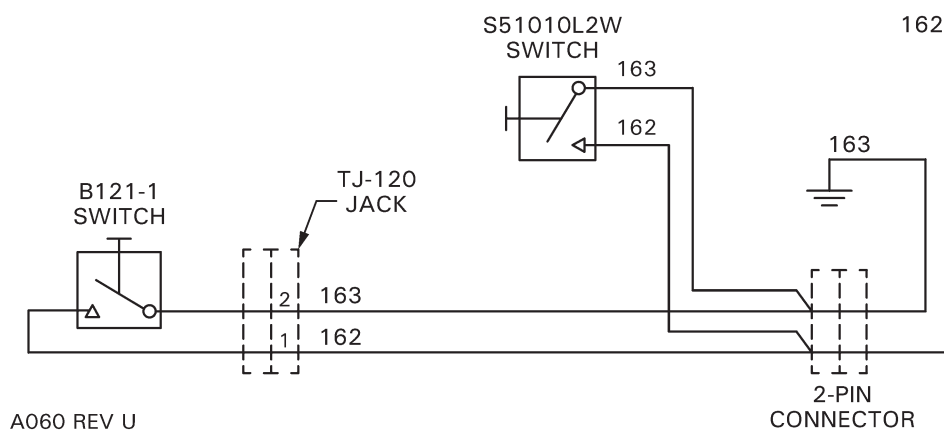
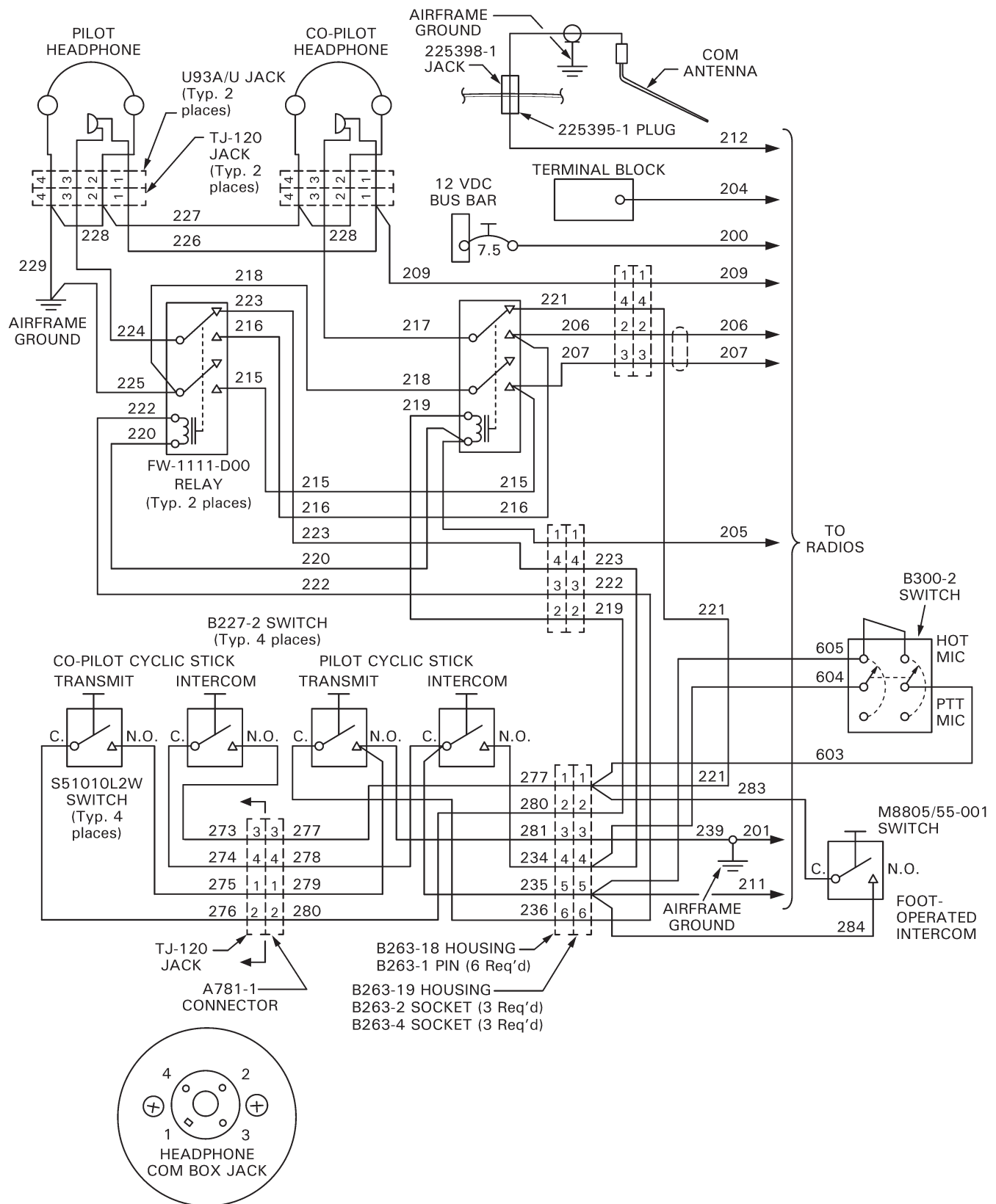


FIGURE 14-8B REMOTE CYCLIC SWITCH WIRING DIAGRAM (R22 MARINER; EARLIER SHIPS)



A060 REV AB

FIGURE 14-8C INTERCOM SCHEMATIC WITH HOT MIC SWITCH (EARLIER SHIPS)





(SHIP S/N 2967 & ON; EARLIER SHIPS)

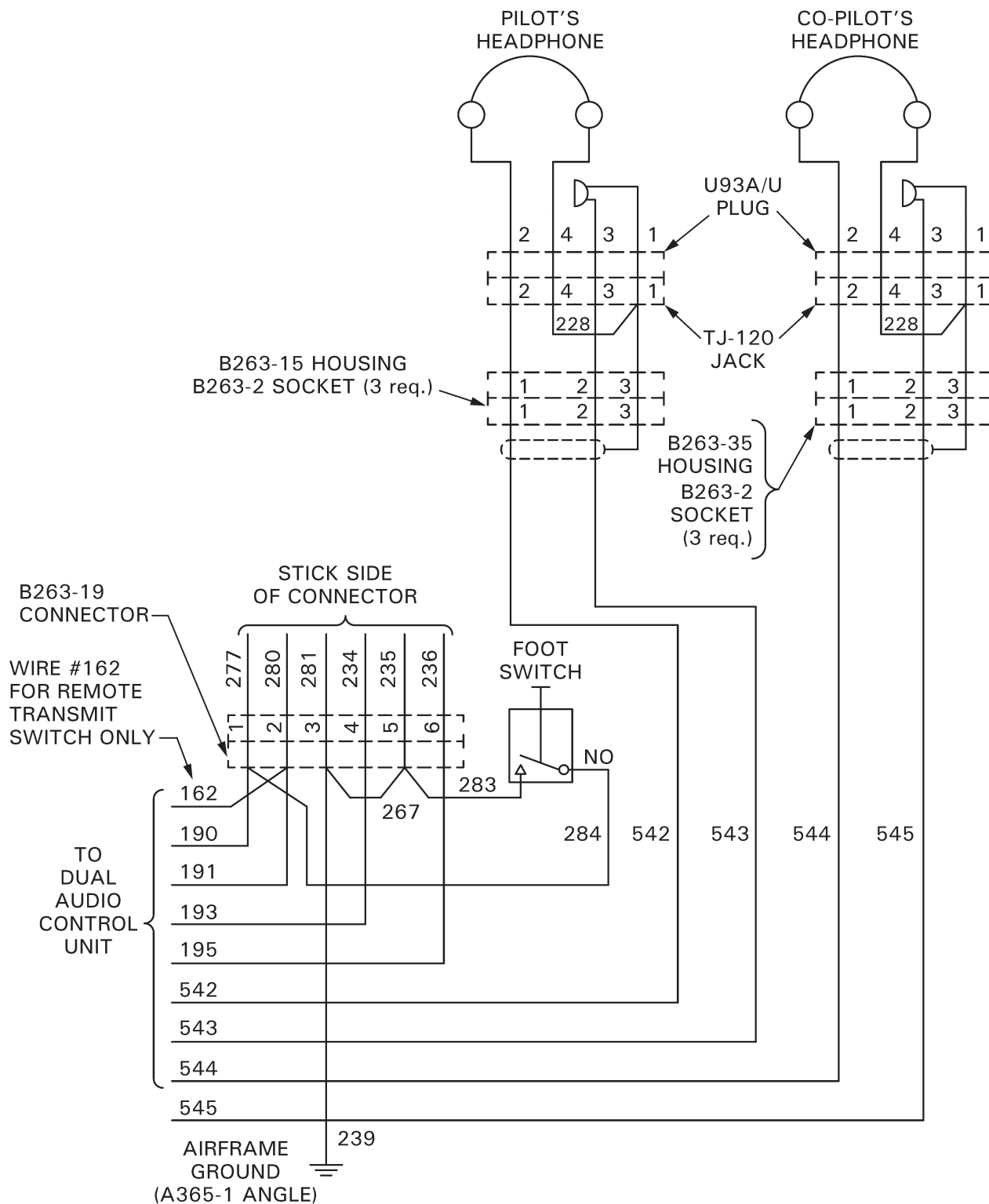
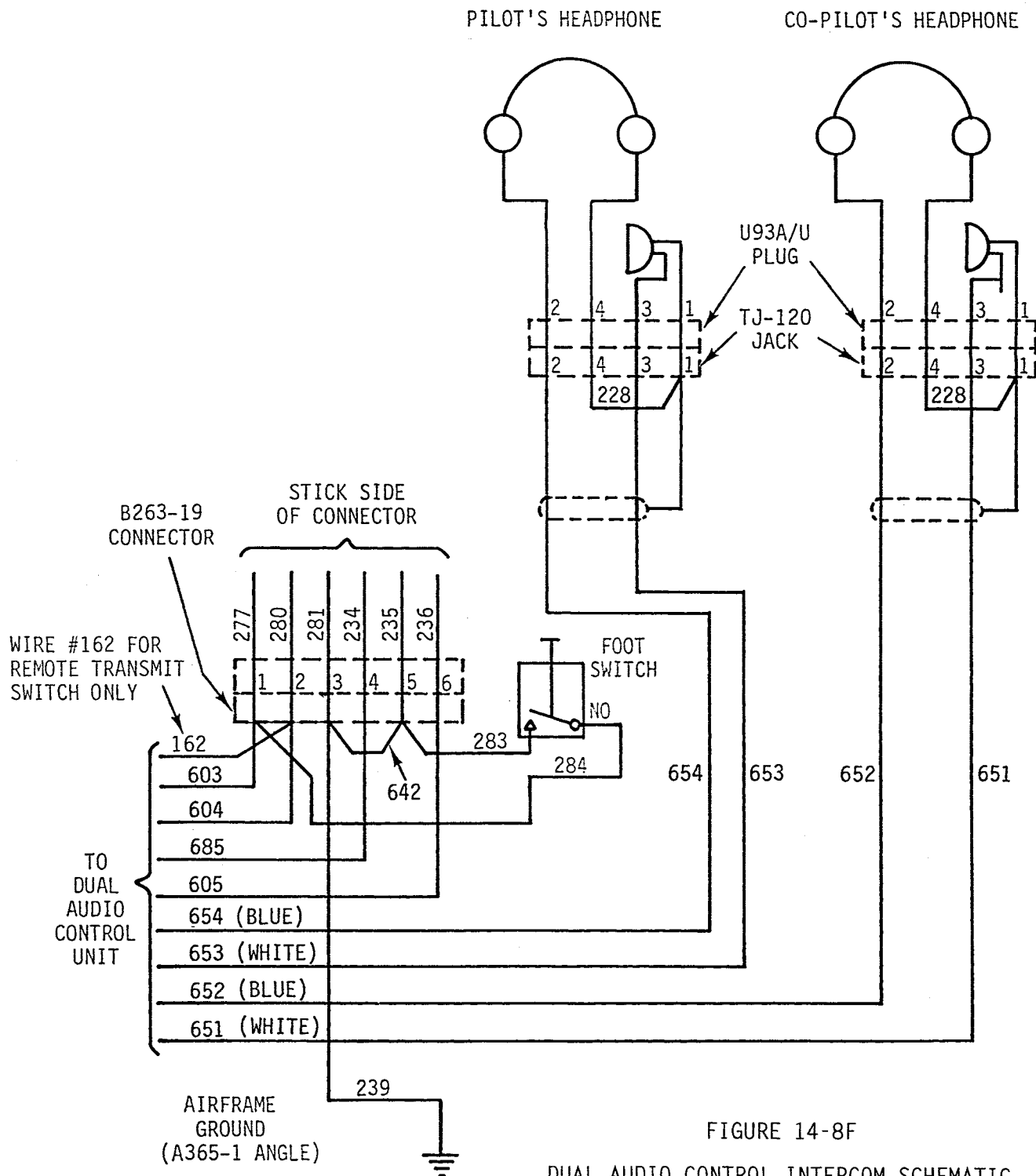


FIGURE 14-8E DUAL AUDIO CONTROL INTERCOM SCHEMATIC  
(FOR R22s WITH A692-3 [AIR COMM ACS 300] DUAL AUDIO CONTROL; EARLIER SHIPS)

**14.800 AVIONICS SCHEMATICS (cont'd)**

**FIGURE 14-8F**

DUAL AUDIO CONTROL INTERCOM SCHEMATIC  
(For R22s with AIR COMM ACS 300\* Dual  
Audio Control with NAT AA80-020\*\* ICS  
Control; Ship S/N 2967 and on.)

\*RHC part no. A692-3.

\*\*RHC part no. B338-1.

14.800 AVIONICS SCHEMATICS (cont'd)

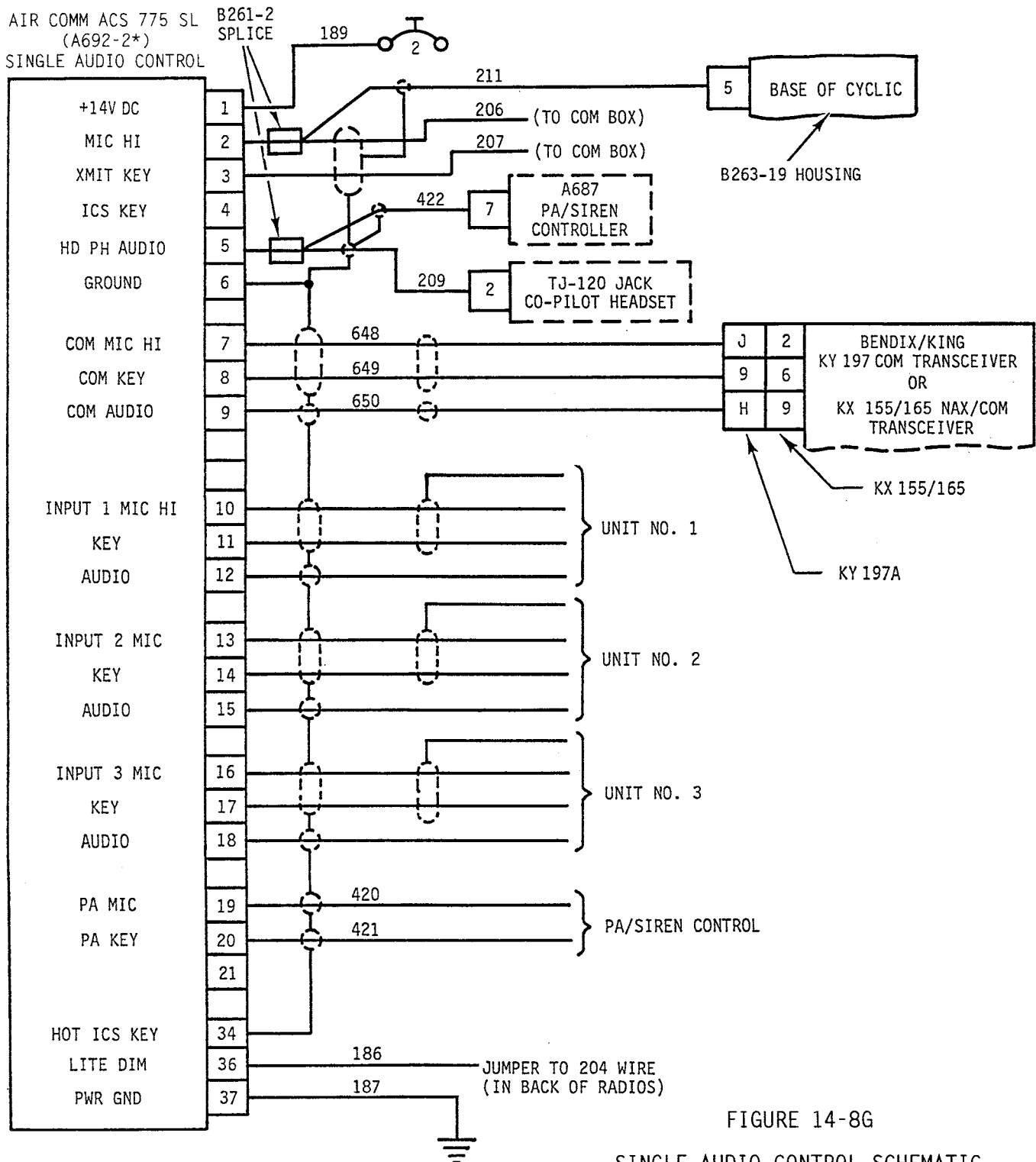


FIGURE 14-8G

SINGLE AUDIO CONTROL SCHEMATIC  
AIR COMM ACS 775 SL (A692-2\*)  
(Ship S/N 2967 and on)

\*RHC part no.

14.800 AVIONICS SCHEMATICS (cont'd)

AIR COMM ACS 775 SL  
(A692-2\*)  
SINGLE AUDIO CONTROL

NAT AA80-020 (B338-1\*)  
ICS CONTROL

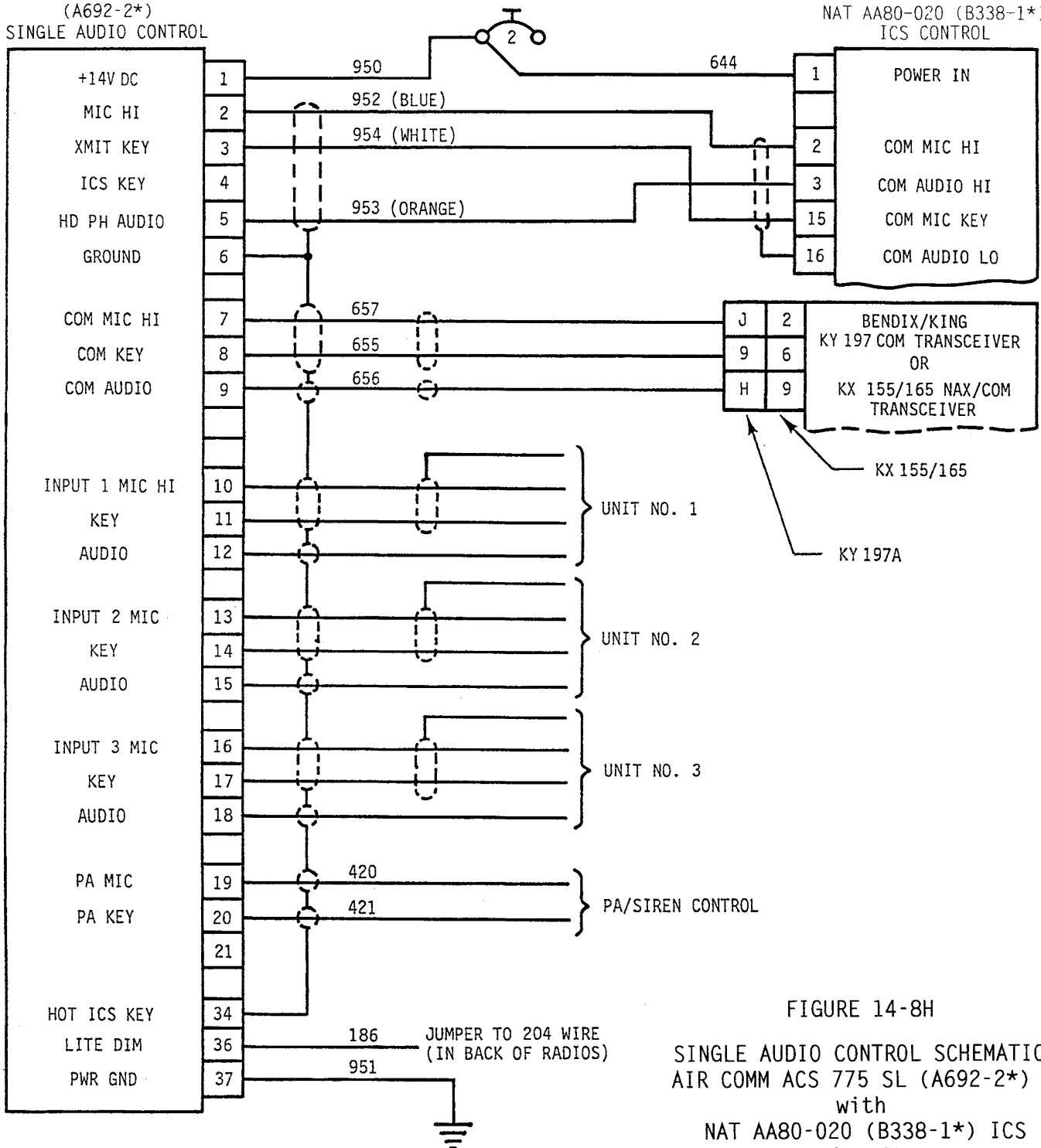


FIGURE 14-8H  
SINGLE AUDIO CONTROL SCHEMATIC  
AIR COMM ACS 775 SL (A692-2\*)  
with  
NAT AA80-020 (B338-1\*) ICS  
CONTROL  
(Ship S/N 2967 and on)

\*RHC part no.

## 14.800 AVIONICS SCHEMATICS (cont'd)

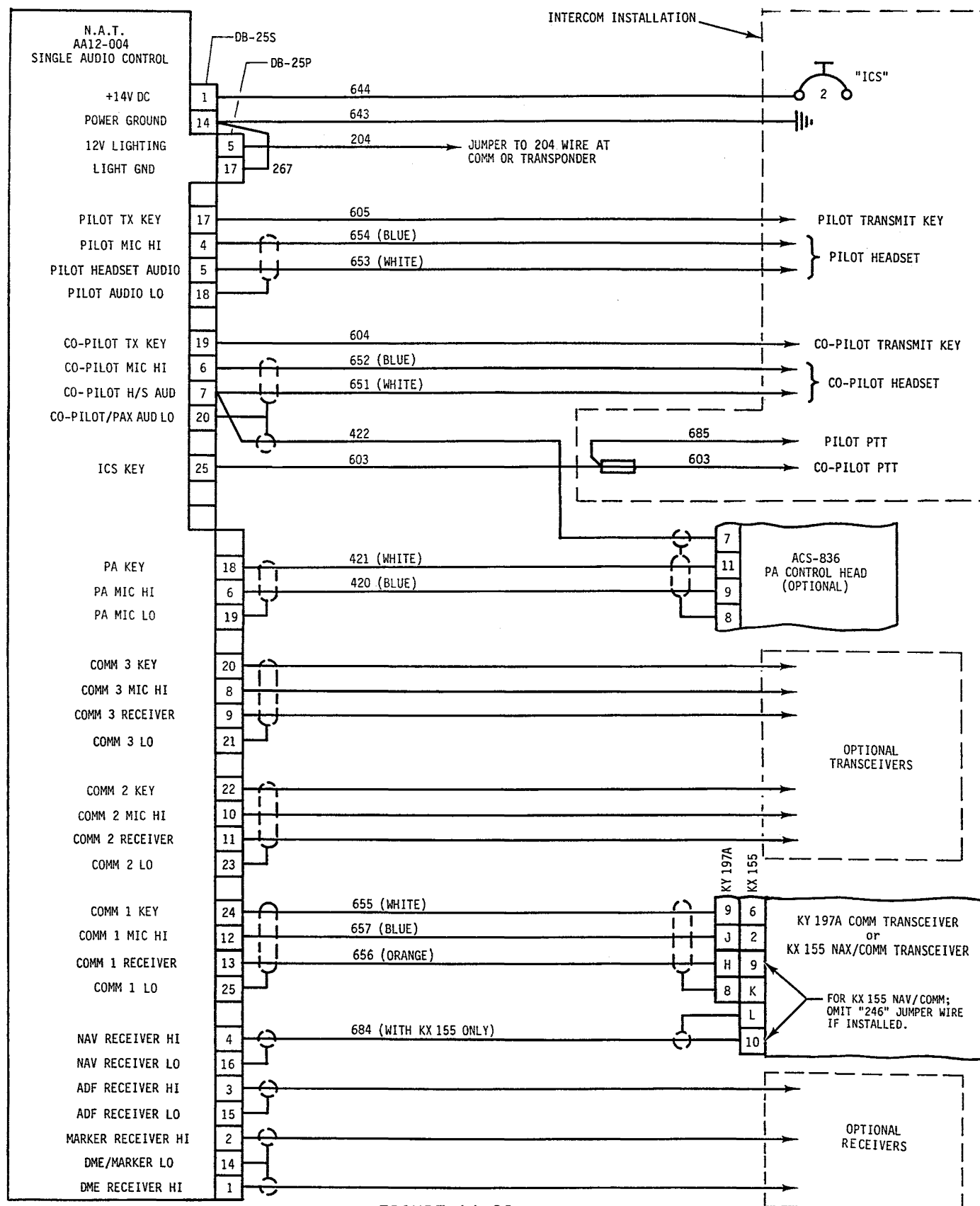


FIGURE 14-8I

NAT AA12-004 SINGLE AUDIO CONTROL SCHEMATIC  
(Ship S/N 2967 and on)

## 14.800 AVIONICS SCHEMATICS (cont'd)

AIR COMM ACS 300 (A692-3\*)  
DUAL AUDIO CONTROL

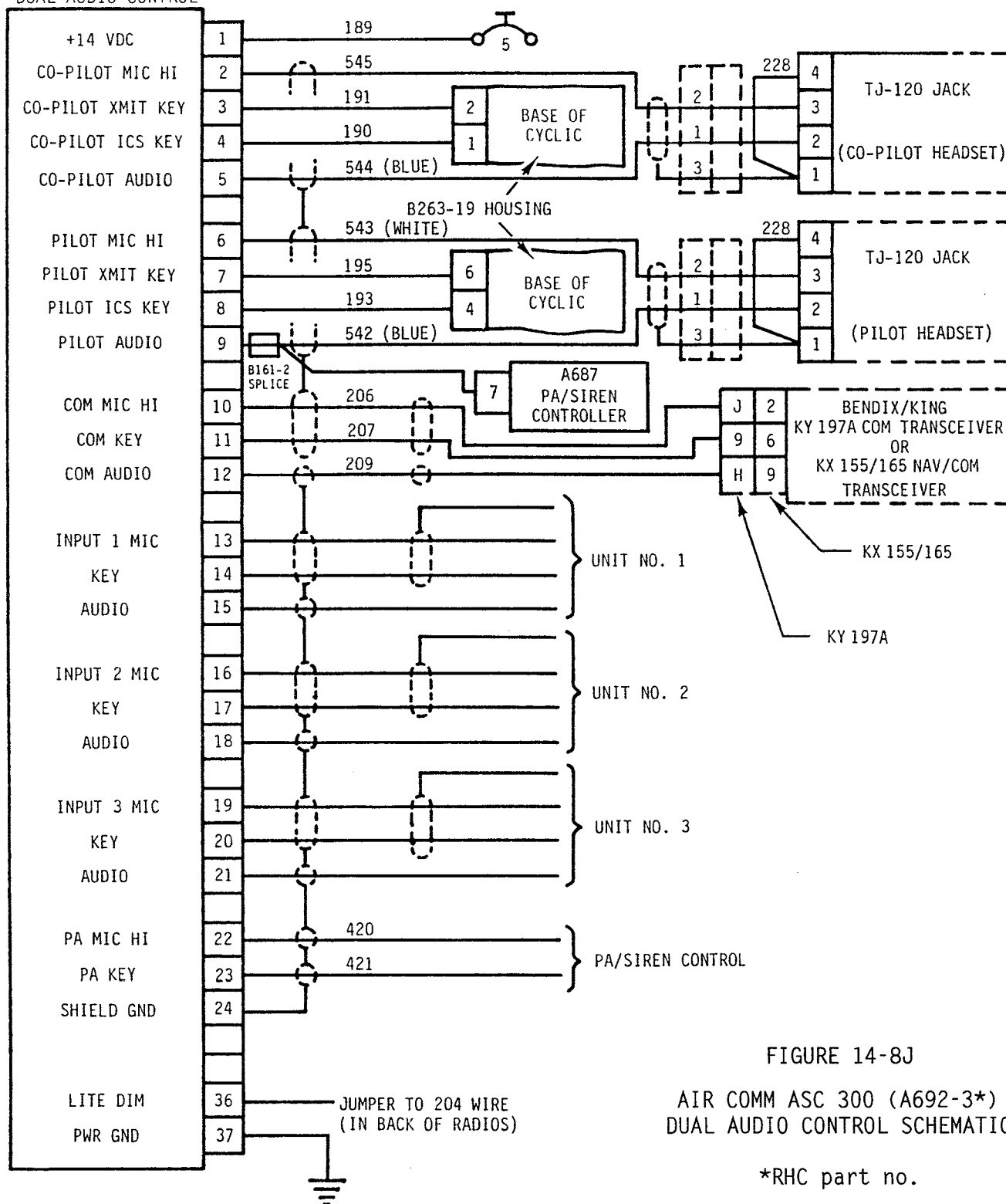


FIGURE 14-8J

AIR COMM ASC 300 (A692-3\*)  
DUAL AUDIO CONTROL SCHEMATIC

\*RHC part no.

## 14.800 AVIONICS SCHEMATICS (cont'd)

AIR COMM ACS 300 (A692-3\*)  
DUAL AUDIO CONTROL

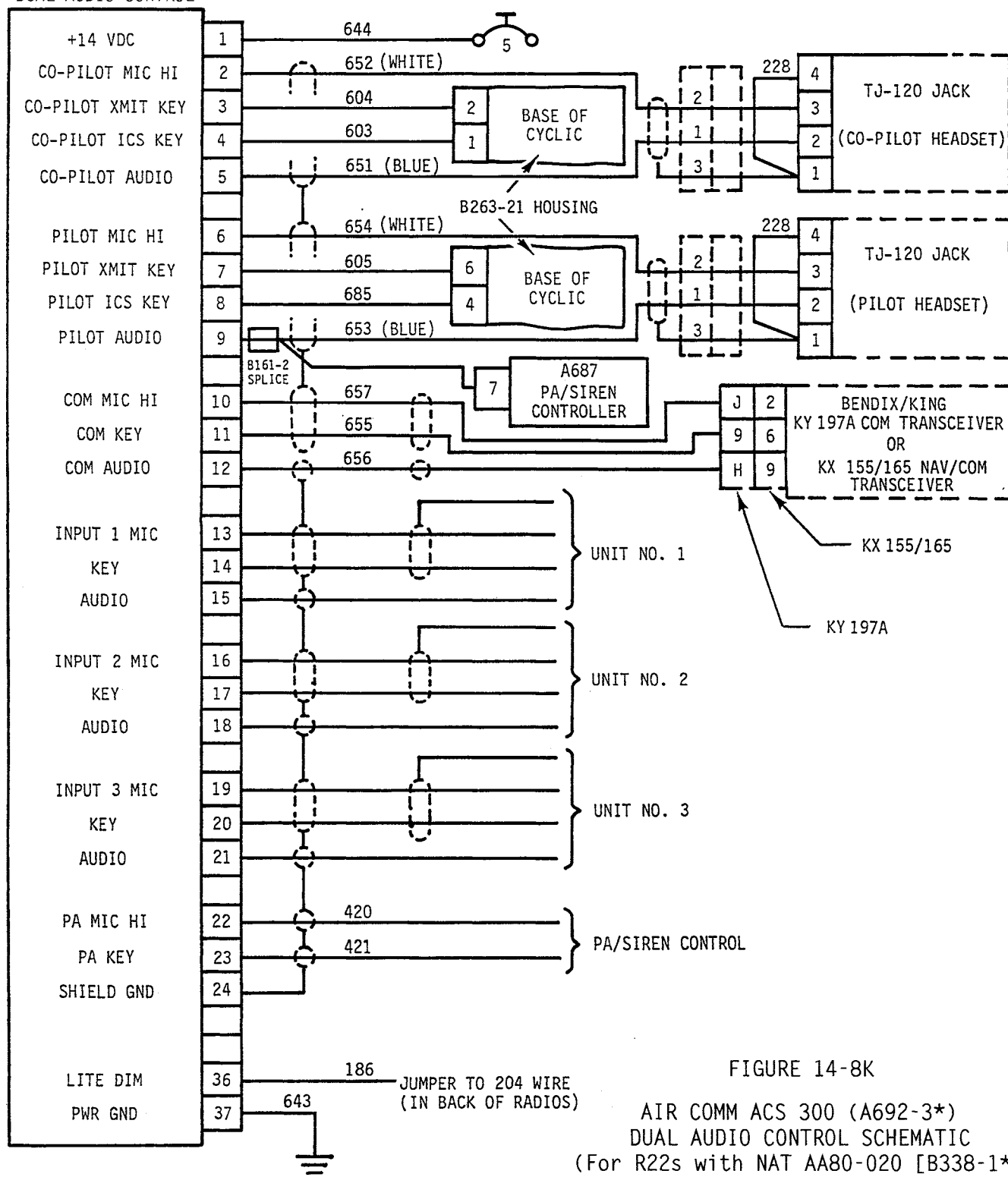
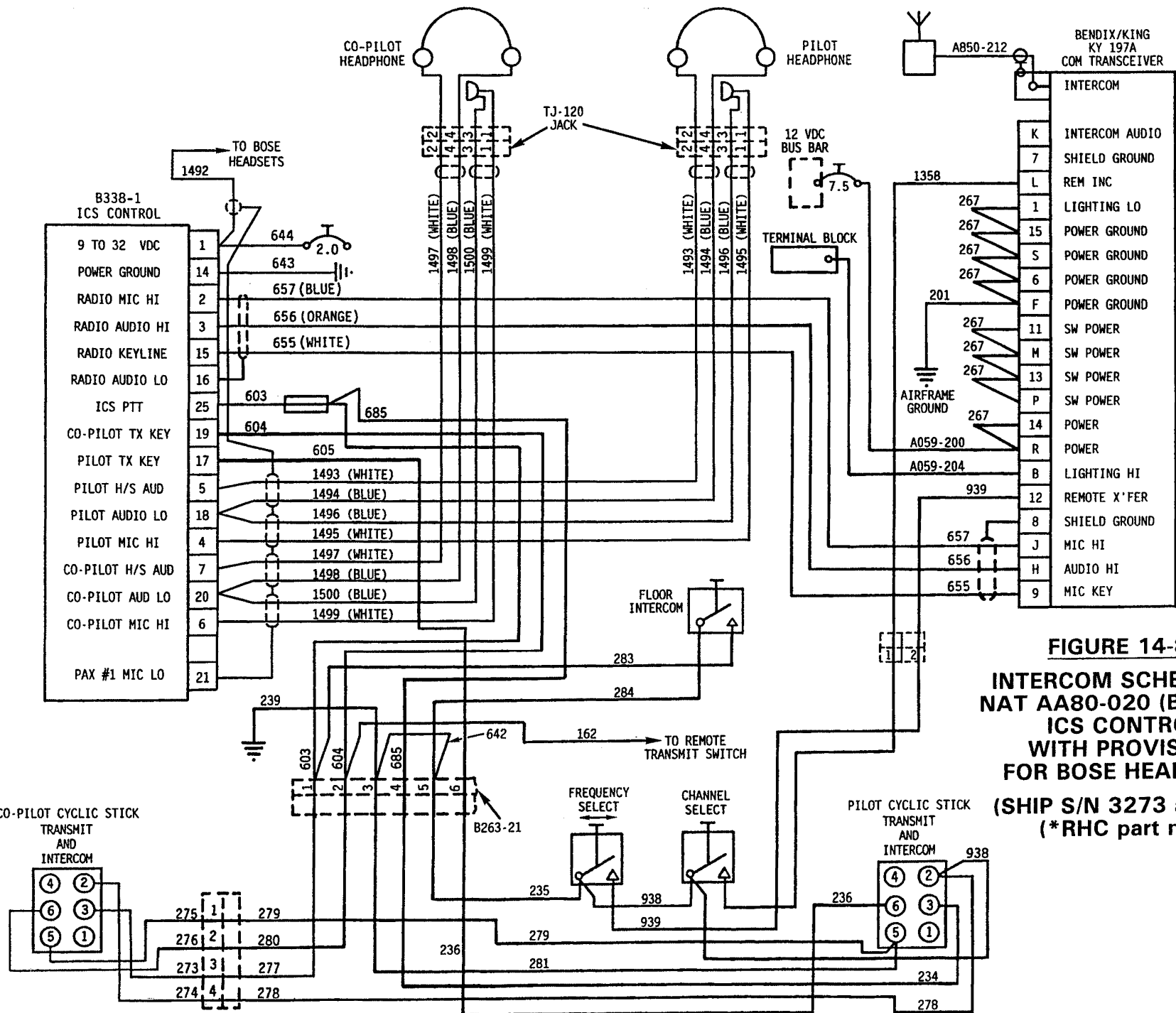


FIGURE 14-8K

AIR COMM ACS 300 (A692-3\*)  
DUAL AUDIO CONTROL SCHEMATIC  
(For R22s with NAT AA80-020 [B338-1\*]  
ICS Control; Ship S/N 2967 and on.)

\*RHC part no.





**FIGURE 14-8L**  
**INTERCOM SCHEMATIC**  
**NAT AA80-020 (B338-1\*)**  
**ICS CONTROL**  
**WITH PROVISION**  
**FOR BOSE HEADSETS**  
**(SHIP S/N 3273 and on)**  
**(\*RHC part no.)**

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## 14.800 (cont'd)

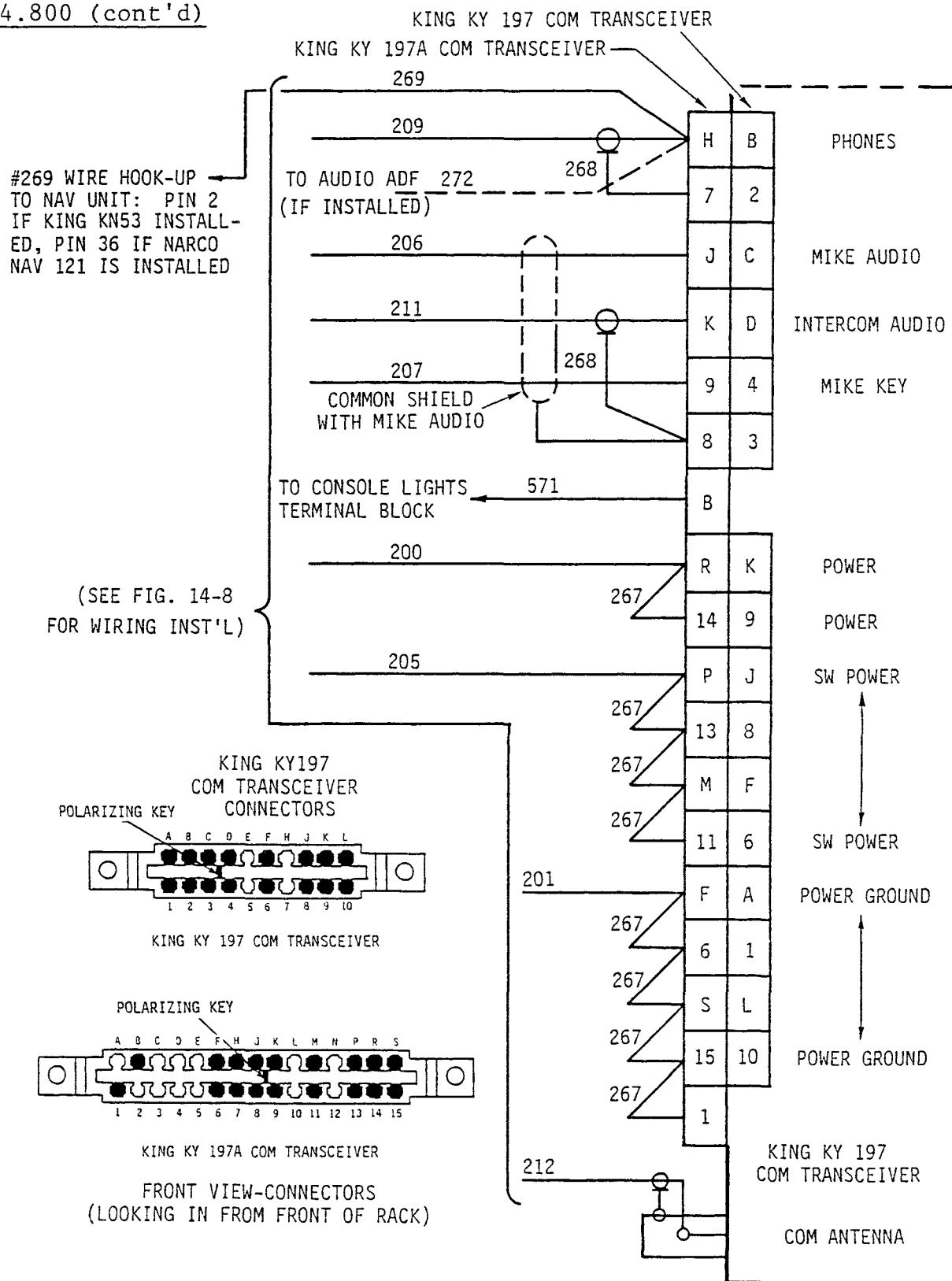


FIGURE 14-9 KING KY197/197A COM TRANSCEIVER

14.800 (cont'd)

212

KING KY 92  
COM TRANSCEIVER

COM ANTENNA

TYPE 247E-4Ω-5%  
10-WATT RESISTOR

5 SPEAKER  
6 GROUND

8 XMIT KEY

15 LIGHTS

D MIKE AUDIO

E XMIT AUDIO

11 POWER

M POWER

13 GROUND

P GROUND

J AUX. 500 Ω  
AUDIO

B PHONES

10 PREAMP OUT

H AUDIO IN

N SW POWER

12 SW POWER

14 SW POWER

R SW POWER

S GROUND

SEE FIG. 14-8  
FOR WIRING INS'L

HOOK UP TO PIN 2  
WHEN KING KN 53 IS  
INSTALLED, PIN 36  
WHEN NARCO NAV121  
IS INSTALLED.

POLARIZING  
KEY

FRONT VIEW - CONNECTOR  
(LOOKING IN FROM FRONT OF RACK)

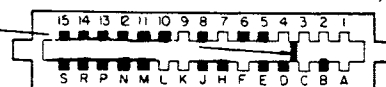


FIGURE 14-10 KING KY92 COM TRANSCEIVER

## 14.800 (cont'd)

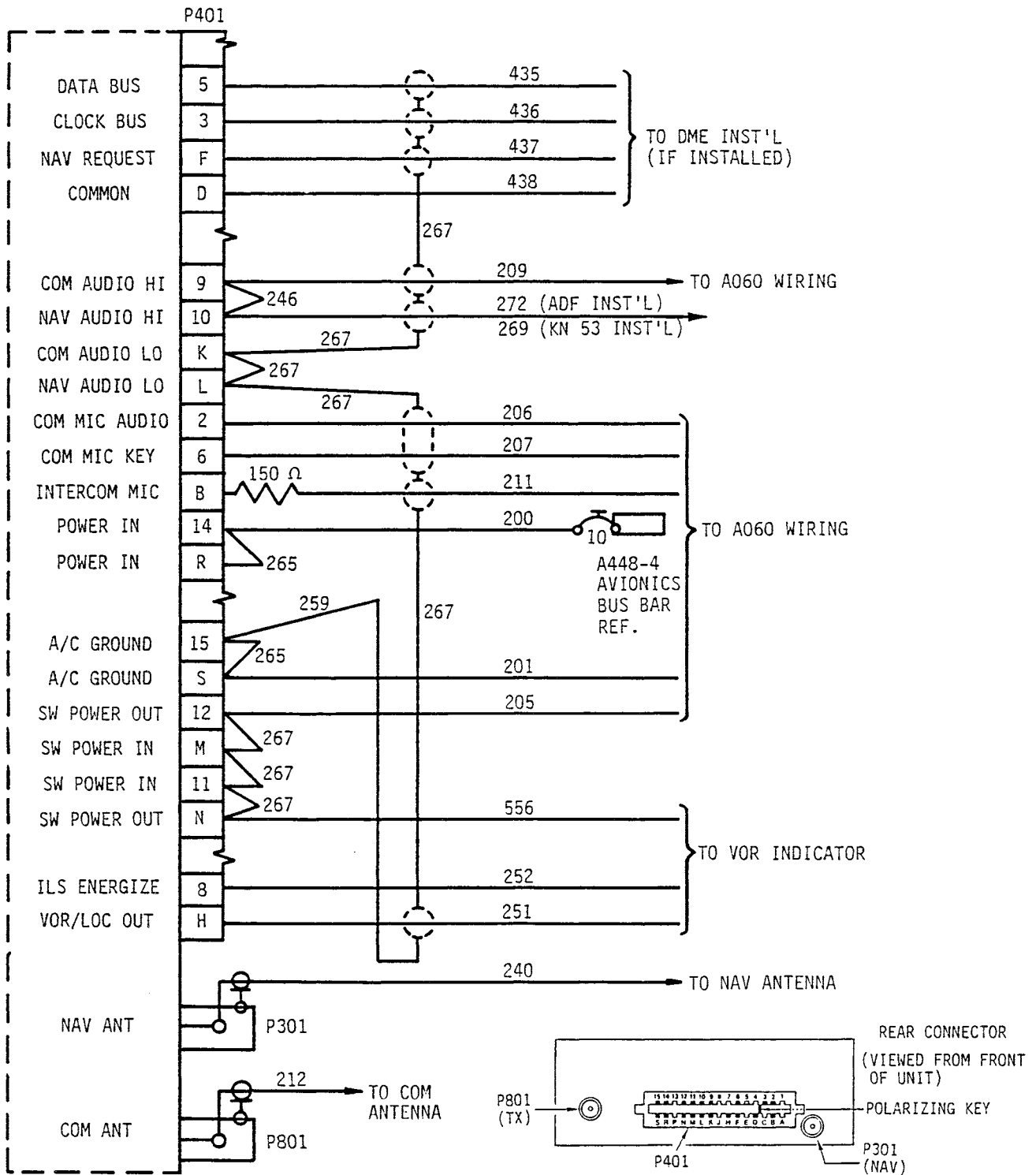


FIGURE 14-10A KING KX155 VHF NAV COM TRANSCEIVER

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14.800 (cont'd)

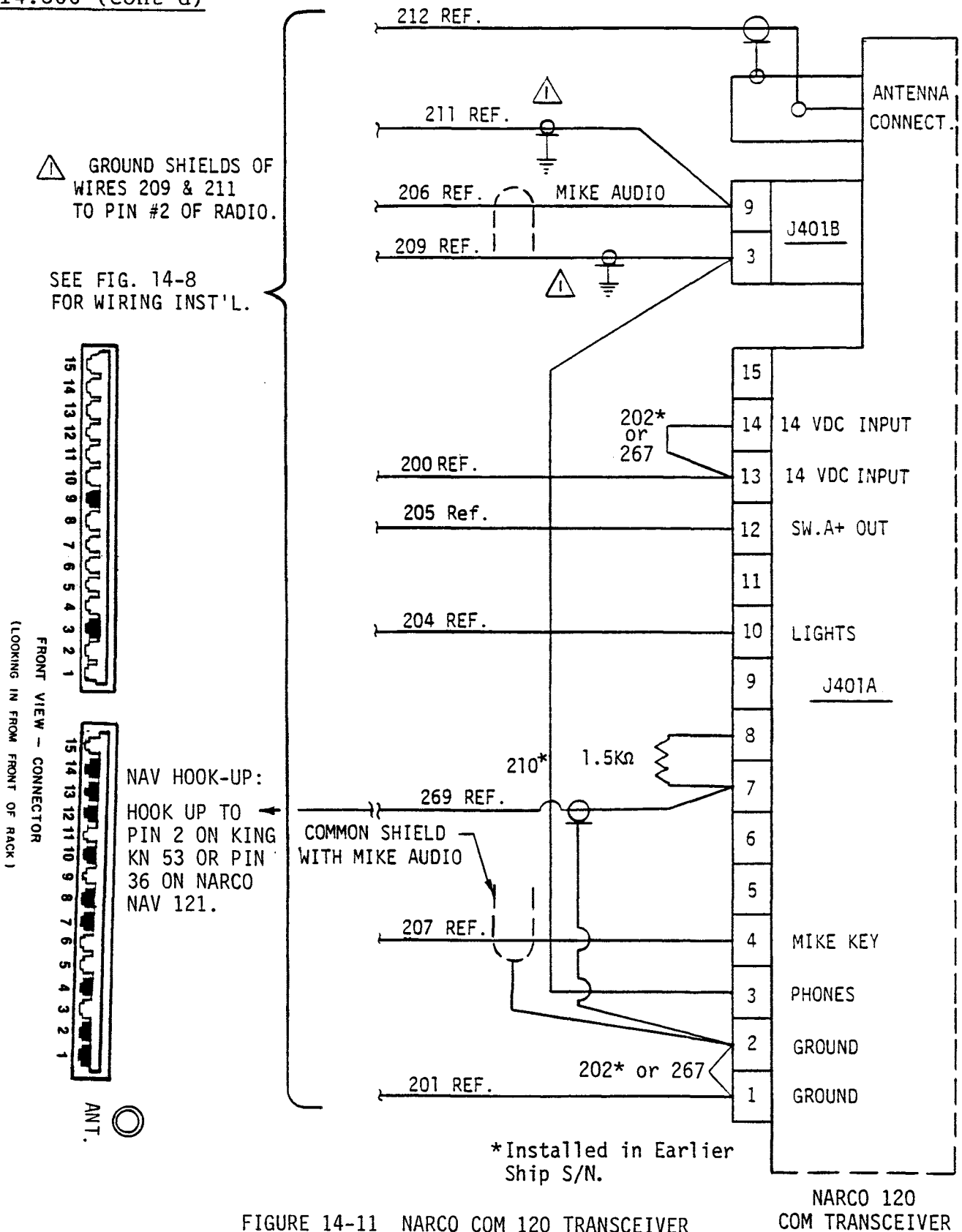
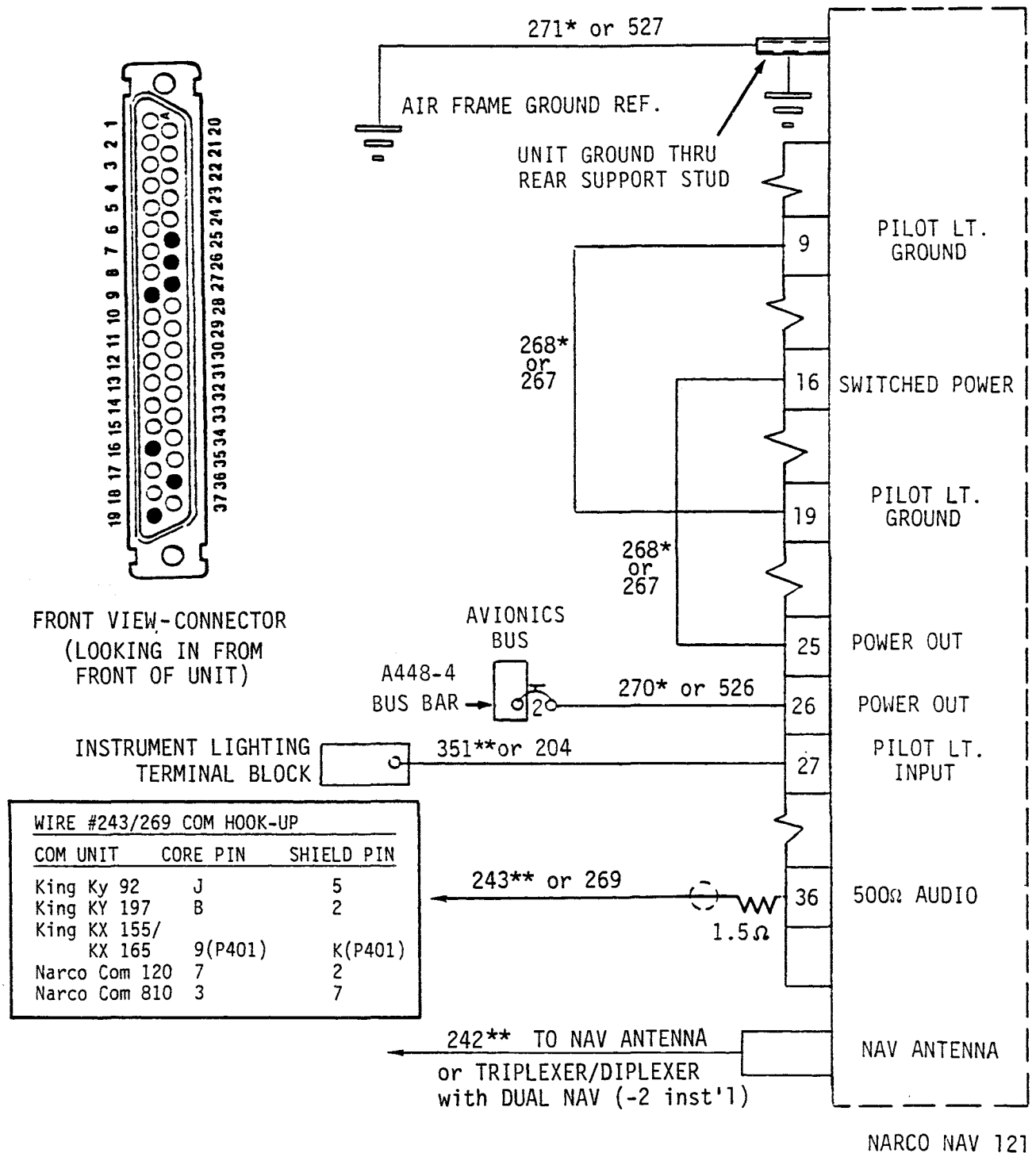


FIGURE 14-11 NARCO COM 120 TRANSCEIVER

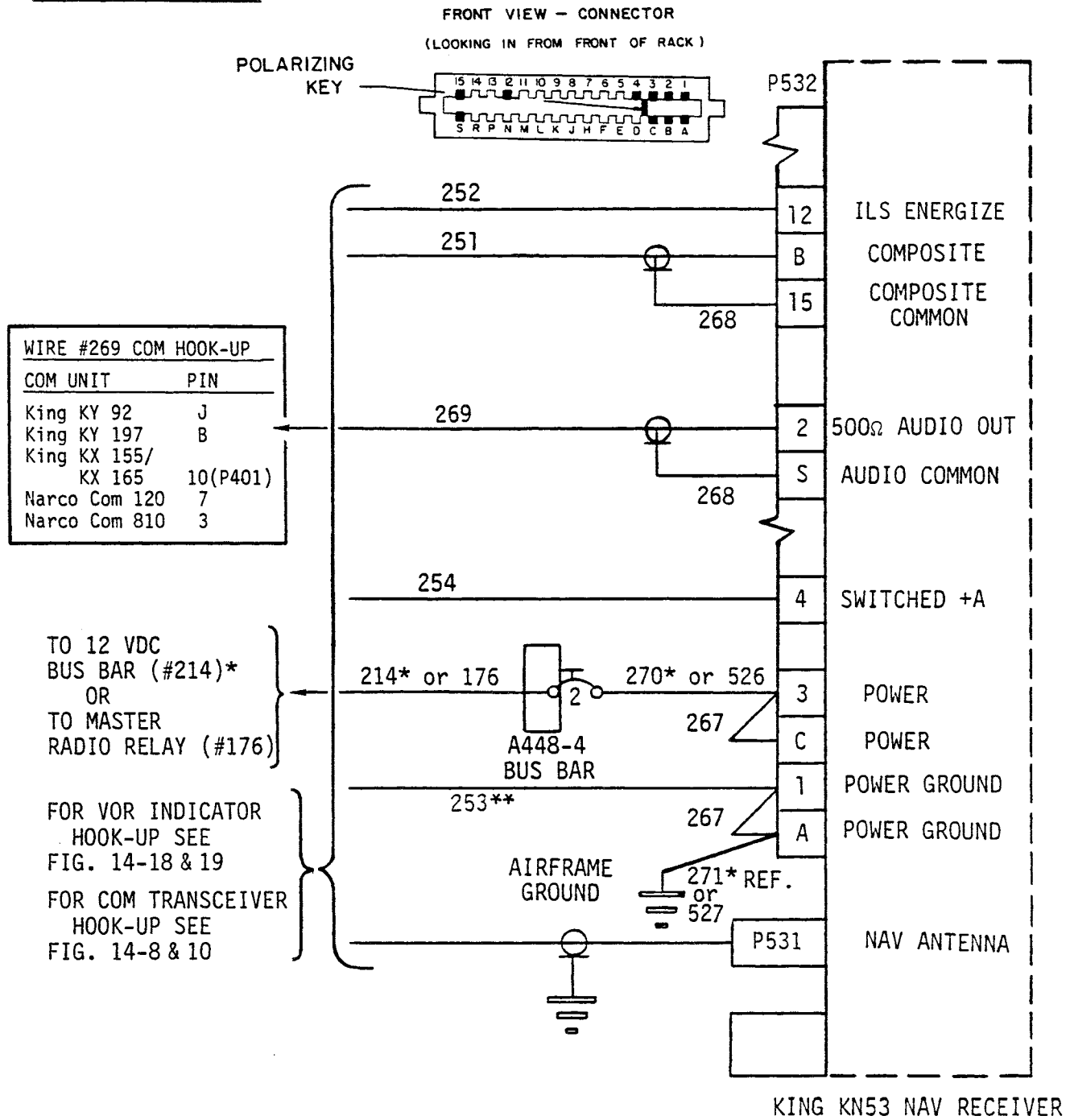
14.800 (cont'd)



\*Installed in earlier Ship S/N's.  
 \*\*10-Hole Upper Console



## 14.800 (cont'd)



\*Installed in Earlier Ship S/Ns.  
See Page 14.14-15

\*\*Wire #253 excluded after 3-86.

FIGURE 14-13 KING KN53 NAV RECEIVER

14.800 (cont'd)

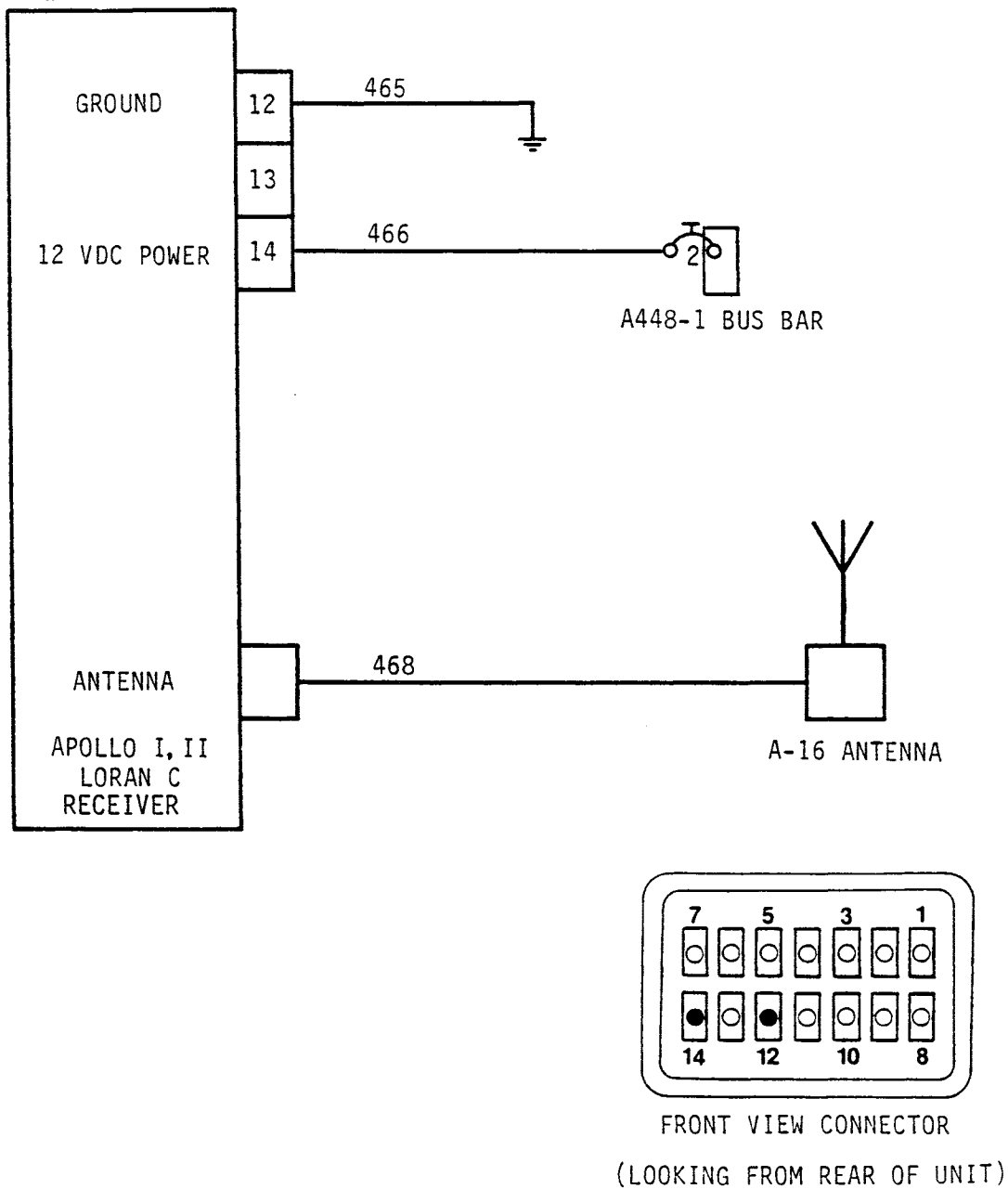
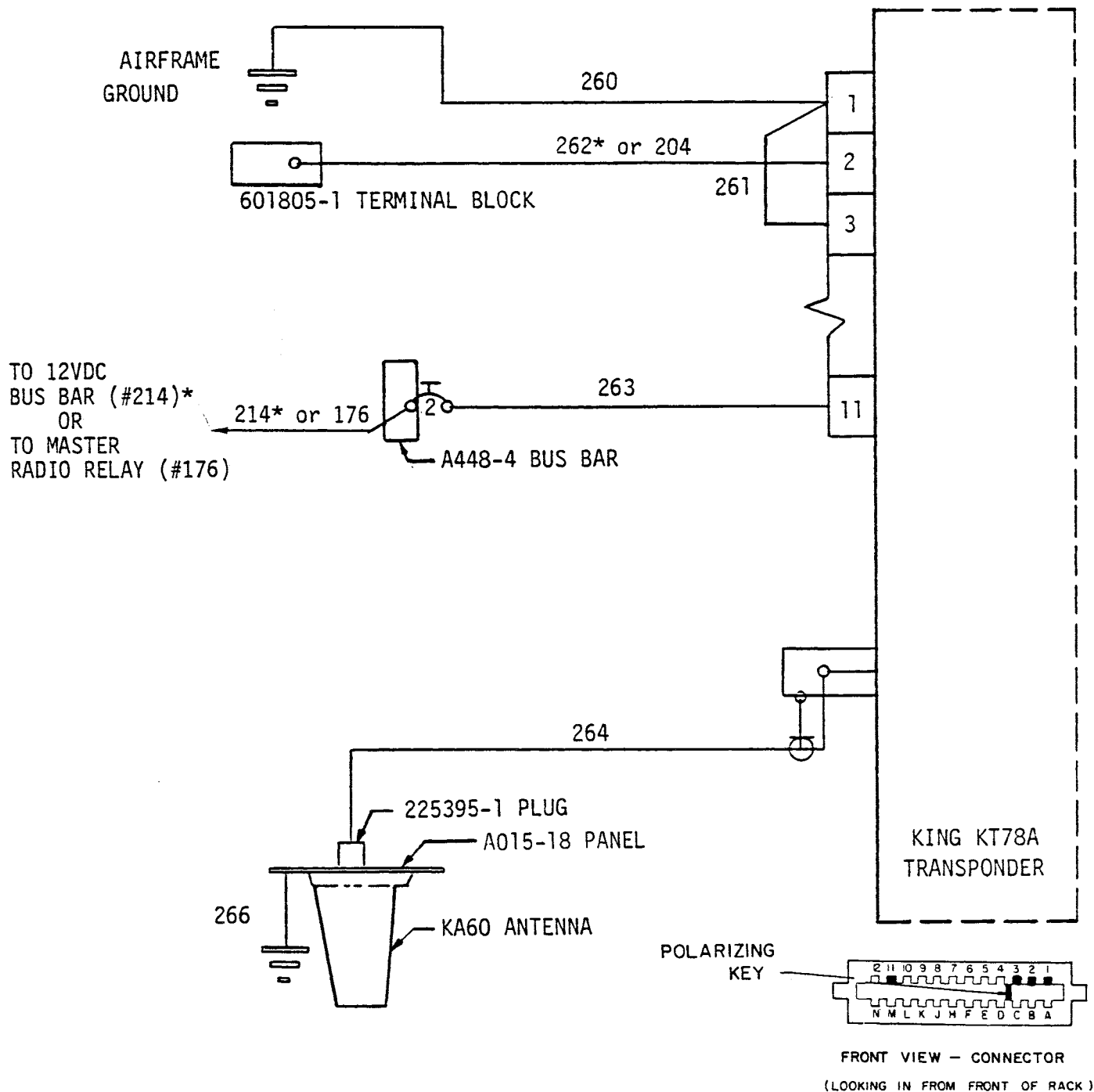


FIGURE 14-14 APOLLO I, II LORAN C RECEIVER

## 14.800 (cont'd)



\*Installed in Earlier Ship S/N's  
See Page 14.14-15

FIGURE 14-15 KING KT76A/78A TRANSPONDER

14.800 (cont'd)

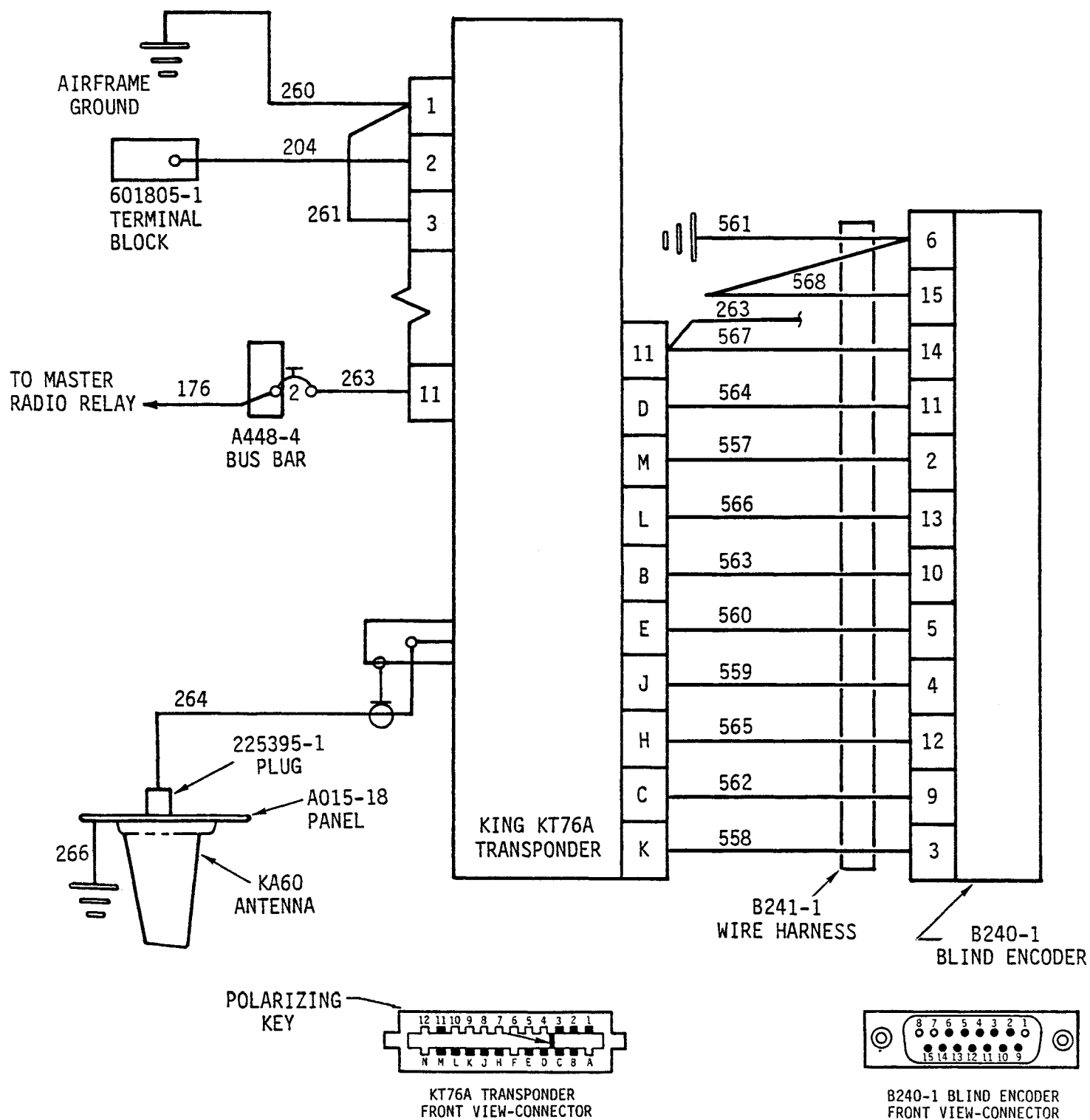
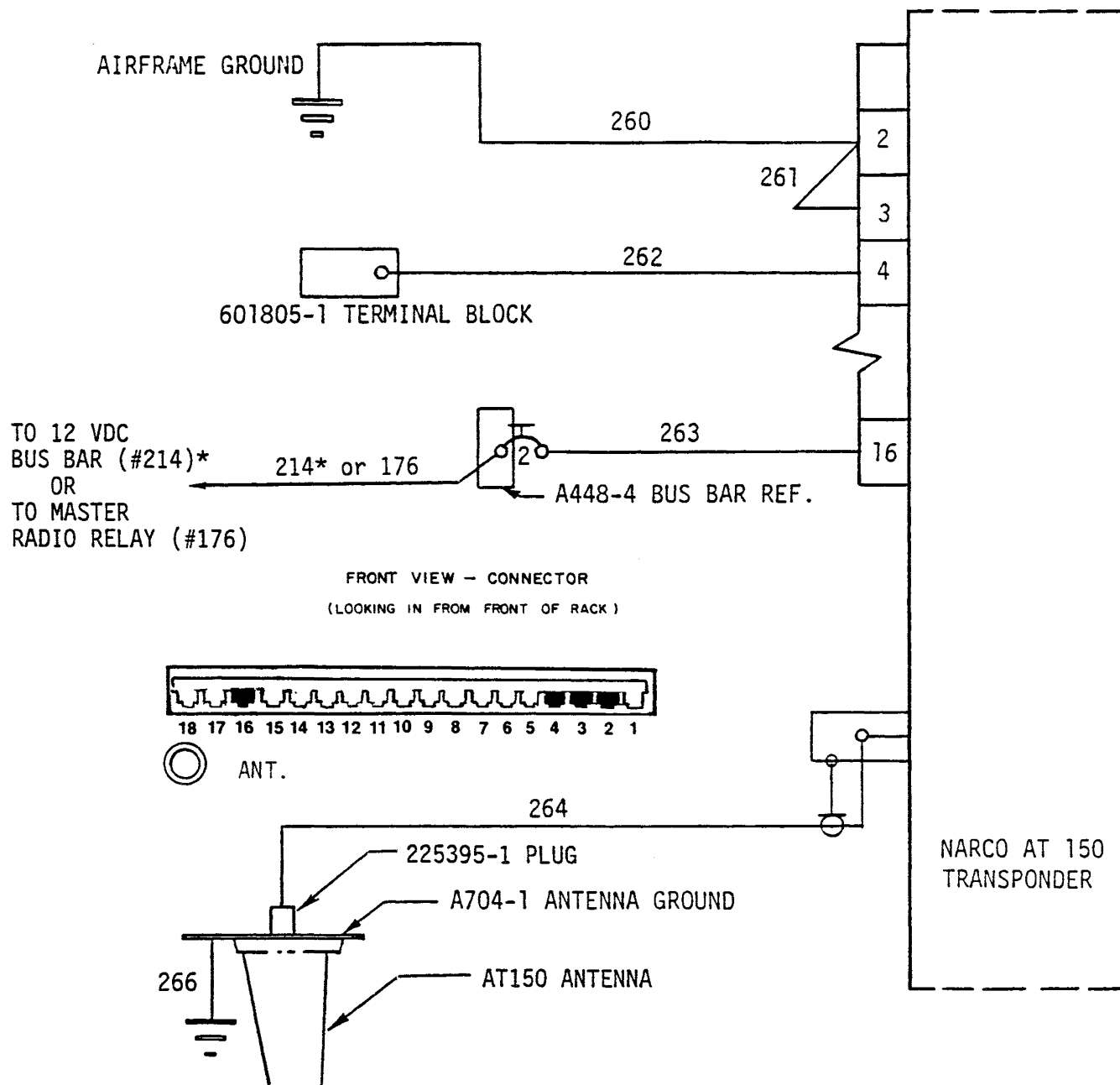


FIGURE 14-16 D120-P2-T BLIND ENCODER/DIGITIZER

14.800 (cont'd)

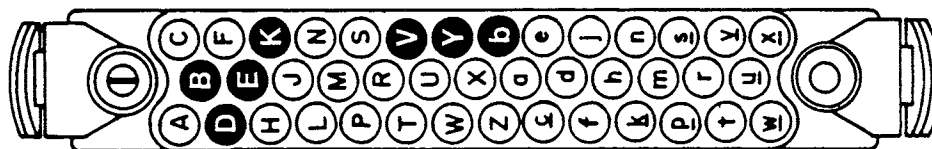


\*Installed in Earlier Ship S/Ns. See Page 14.14-15

FIGURE 14-17 NARCO AT 150 TRANSPONDER

14.800 (cont'd)

FRONT VIEW - CONNECTOR  
(LOOKING IN FROM FRONT OF RACK)



CONNECTOR PIN LOCATIONS

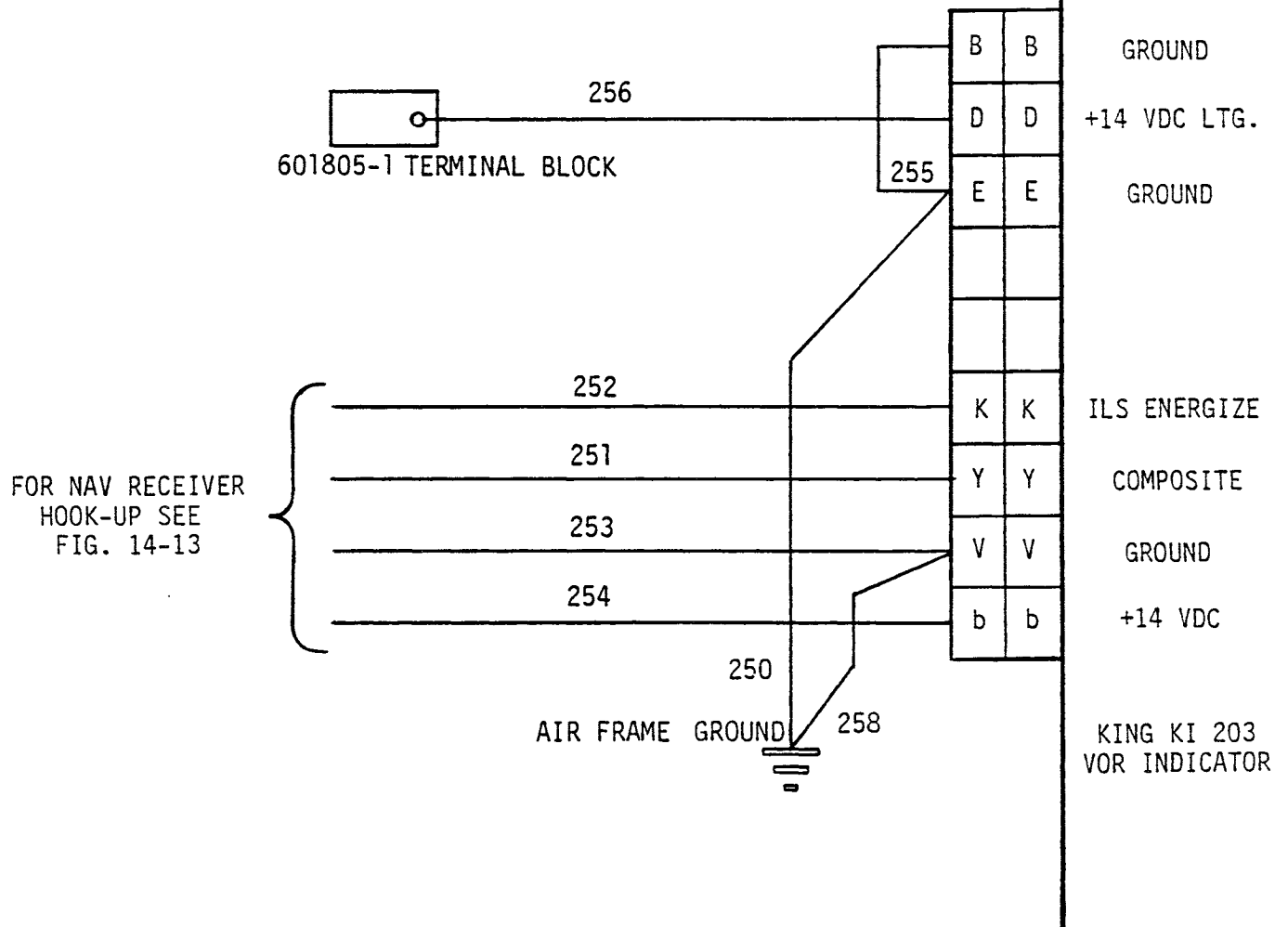


FIGURE 14-18 KING KI 203 VOR INDICATOR  
(Installed Prior to 1/87)

14.800 (cont'd)

FRONT VIEW - CONNECTOR  
(LOOKING IN FROM FRONT OF RACK)

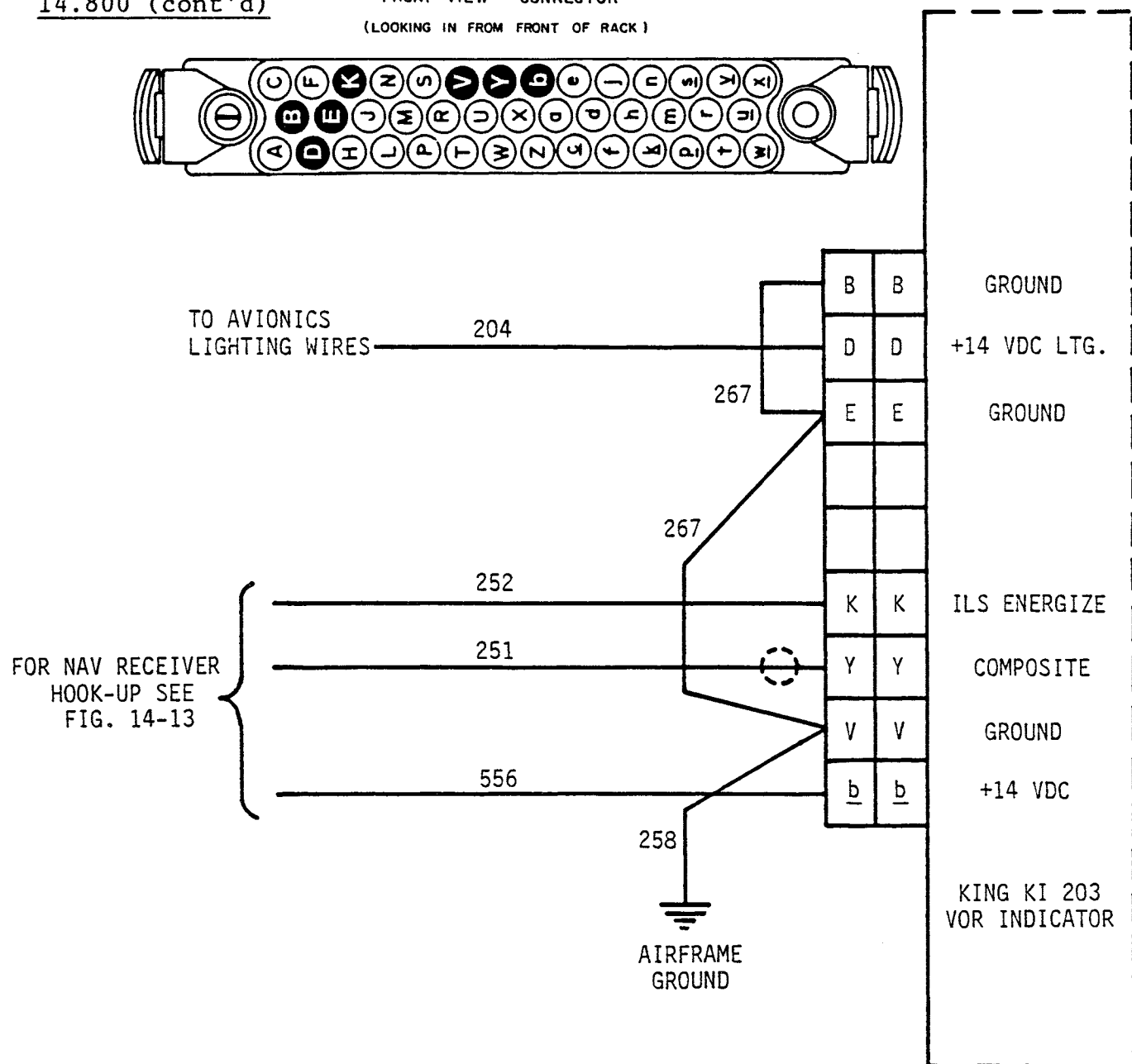


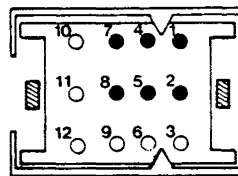
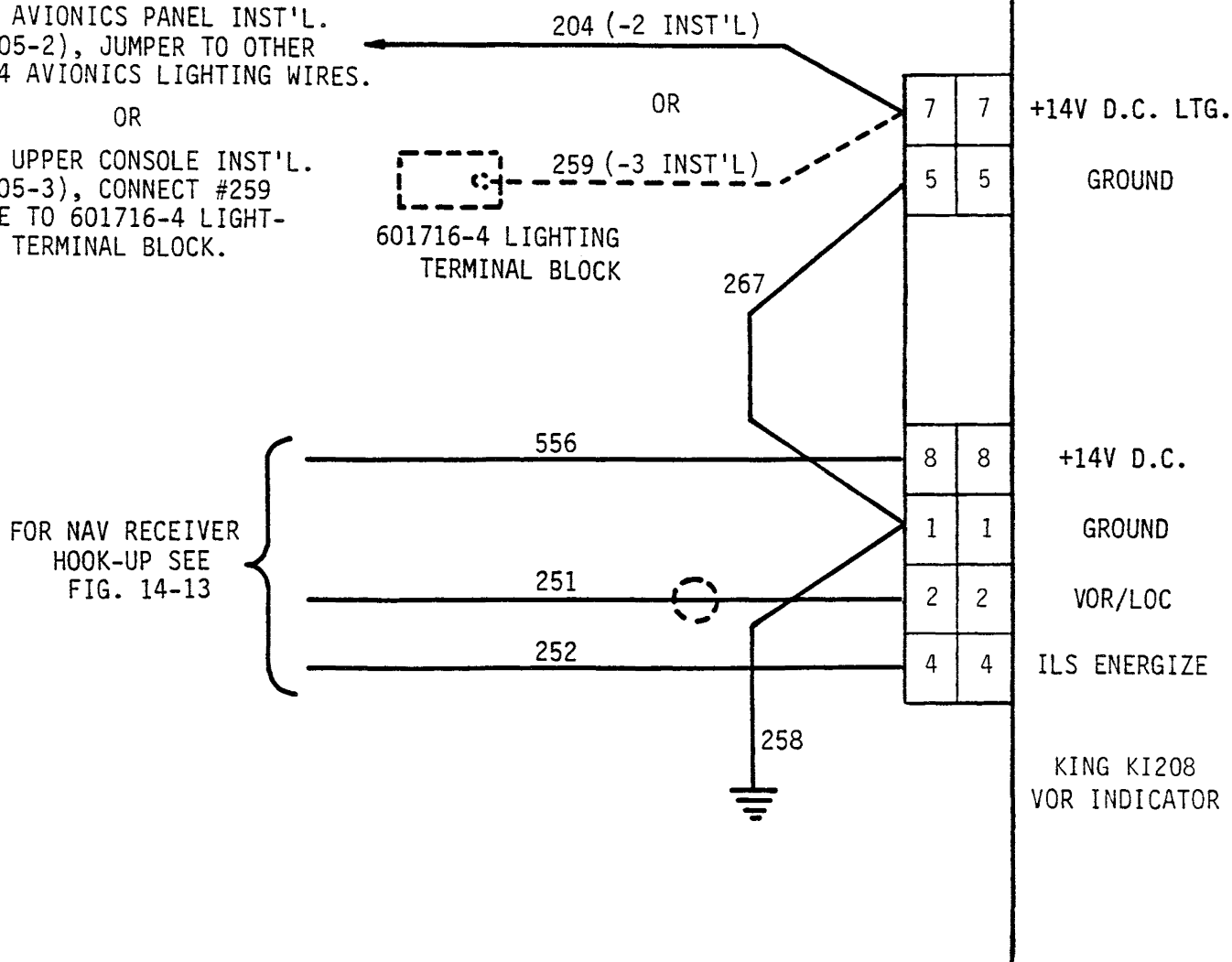
FIGURE 14-19 KING KI203 VOR INDICATOR  
(Installed after 1/87)

## 14.800 (cont'd)

FOR AVIONICS PANEL INST'L.  
(A805-2), JUMPER TO OTHER  
#204 AVIONICS LIGHTING WIRES.

OR

FOR UPPER CONSOLE INST'L.  
(A805-3), CONNECT #259  
WIRE TO 601716-4 LIGHT-  
ING TERMINAL BLOCK.



FRONT VIEW CONNECTOR  
(LOOKING FROM INDICATOR)

FIGURE 14-20 KING KI 208 VOR INDICATOR



14.800 (cont'd)

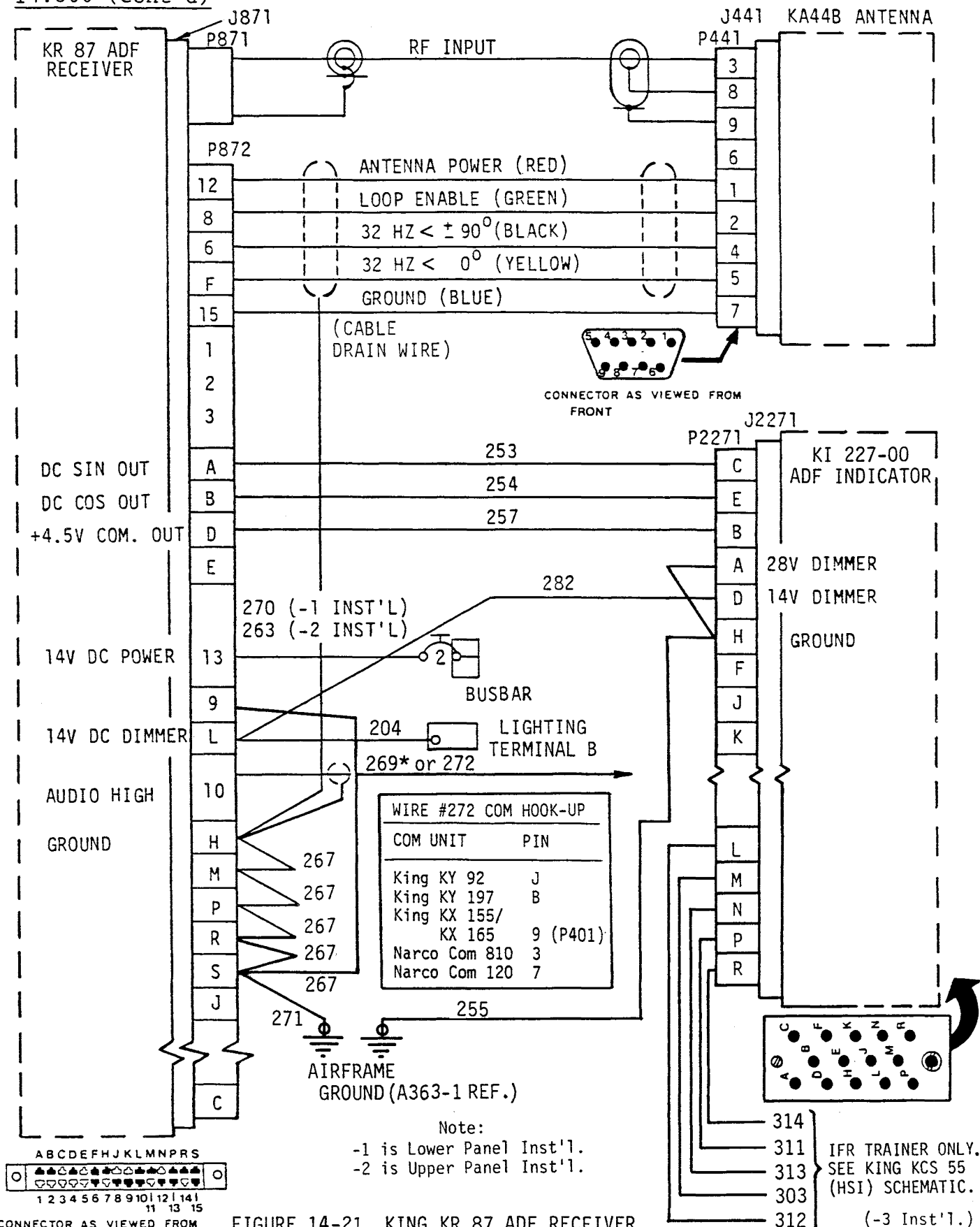
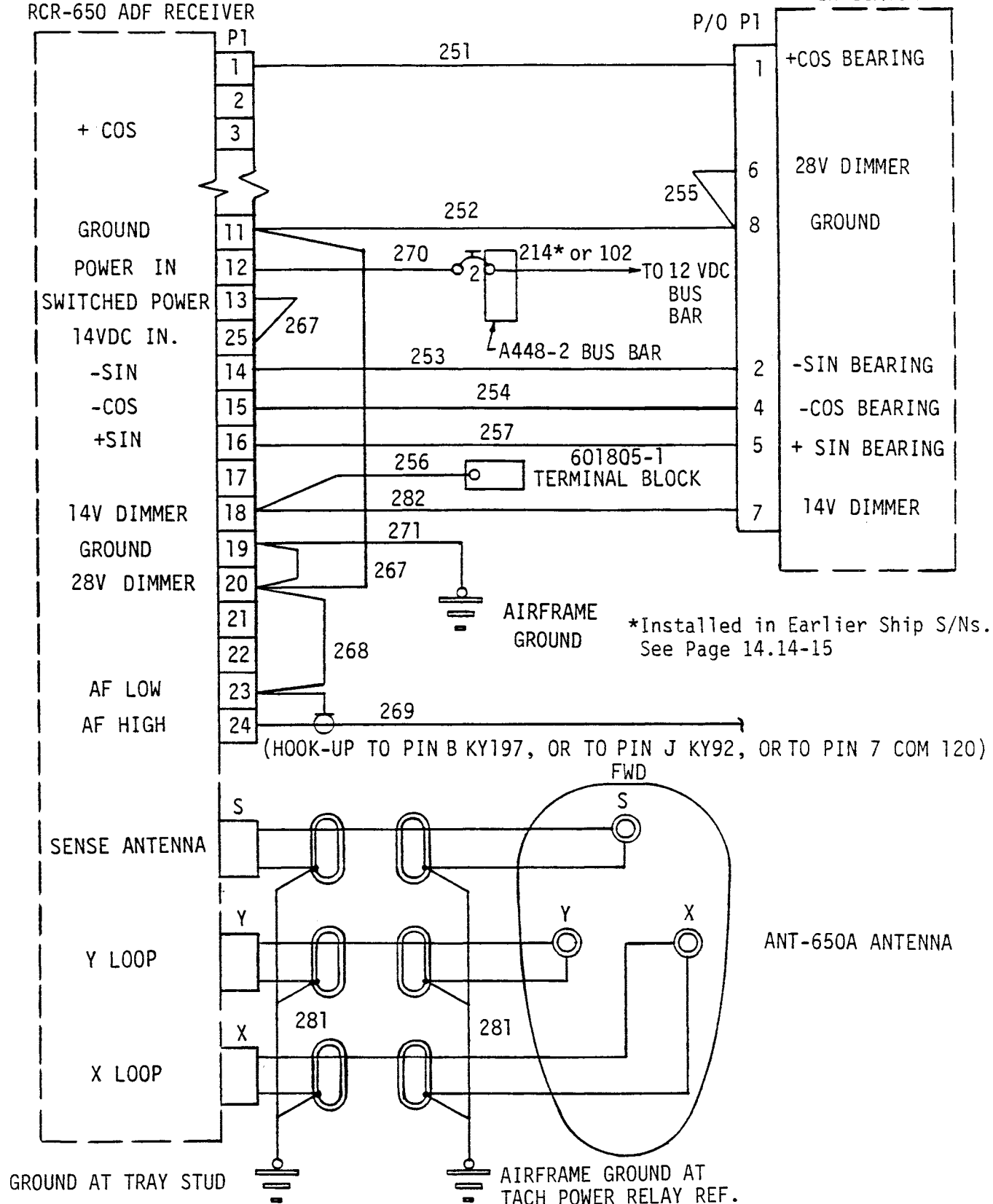


FIGURE 14-21 KING KR 87 ADF RECEIVER

14.800 (cont'd)

RCR-650 ADF RECEIVER

IND-650A ADF  
INDICATOR



14.800 AVIONICS SCHEMATICS (cont'd)

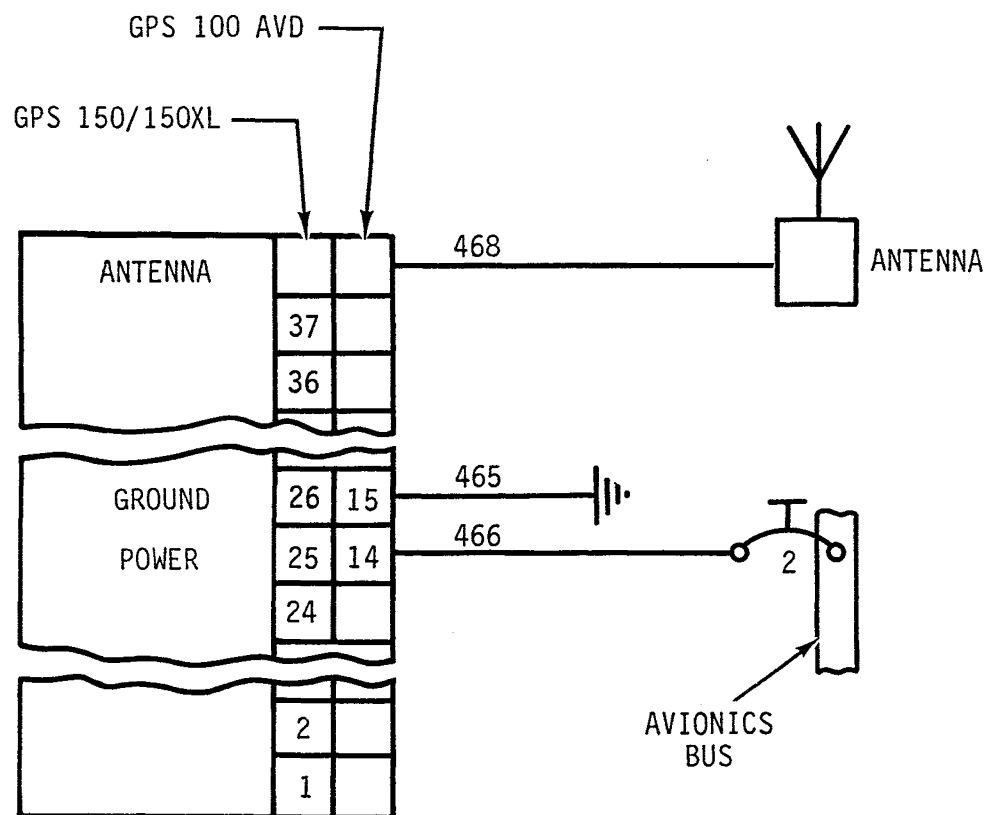


FIGURE 14-22A

GARMIN GPS 100, 150, and 150XL  
SCHEMATIC

14.800 AVIONICS SCHEMATICS (cont'd)

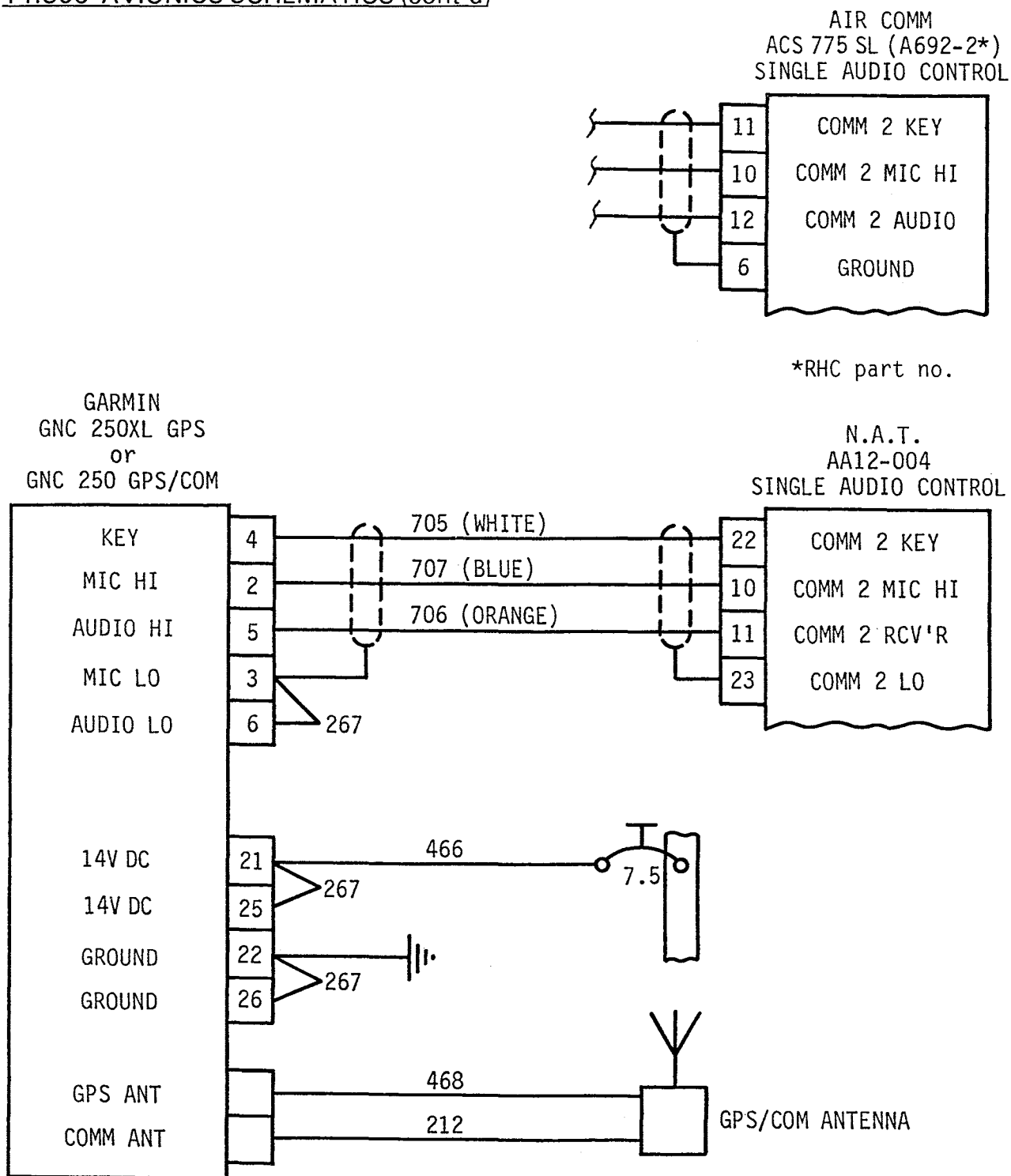


FIGURE 14-22B

GARMIN  
GNC 250XL GPS and GNC 250 GPS/COM  
SCHEMATIC

## 14.800 AVIONICS SCHEMATICS (cont'd)

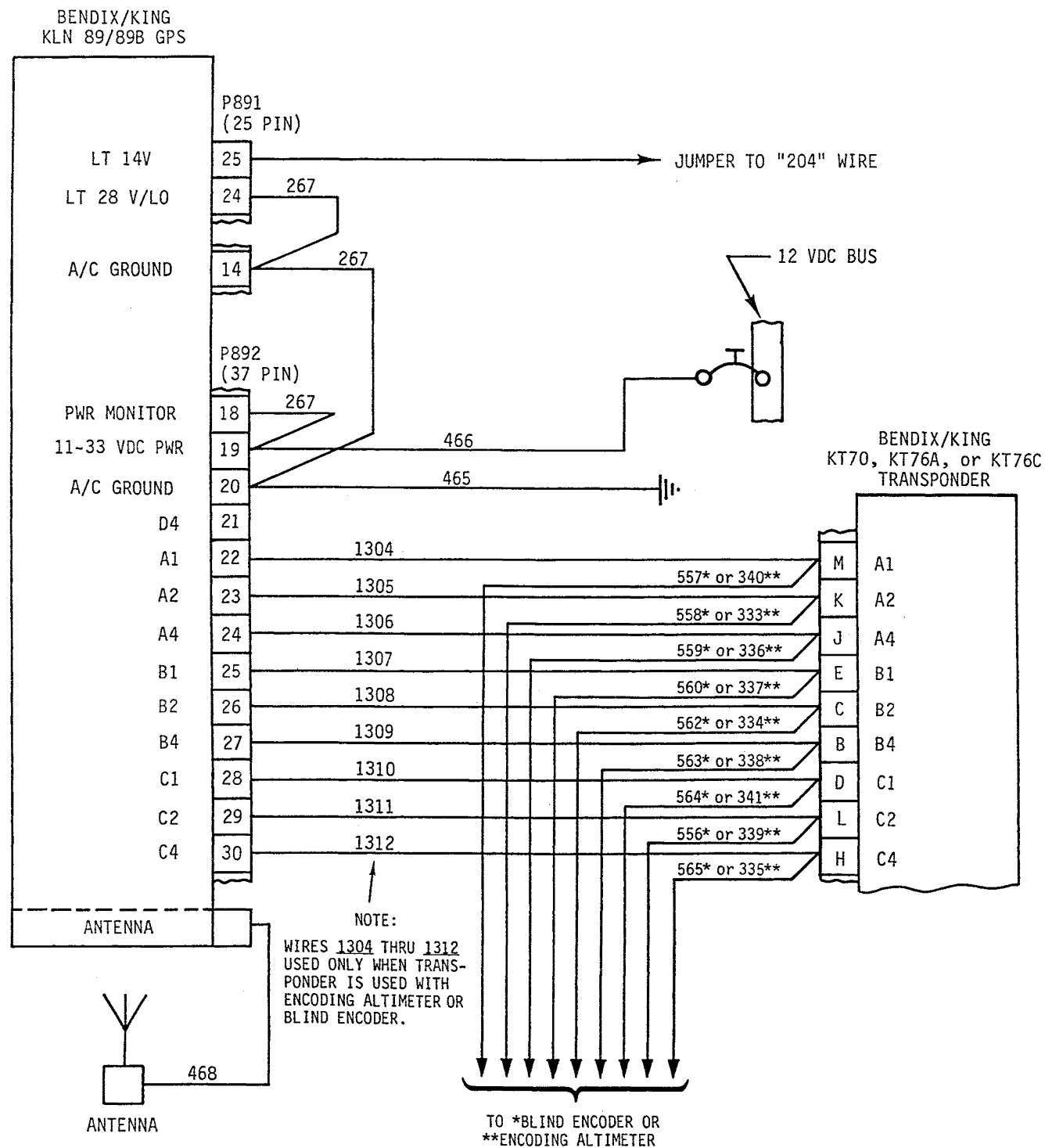
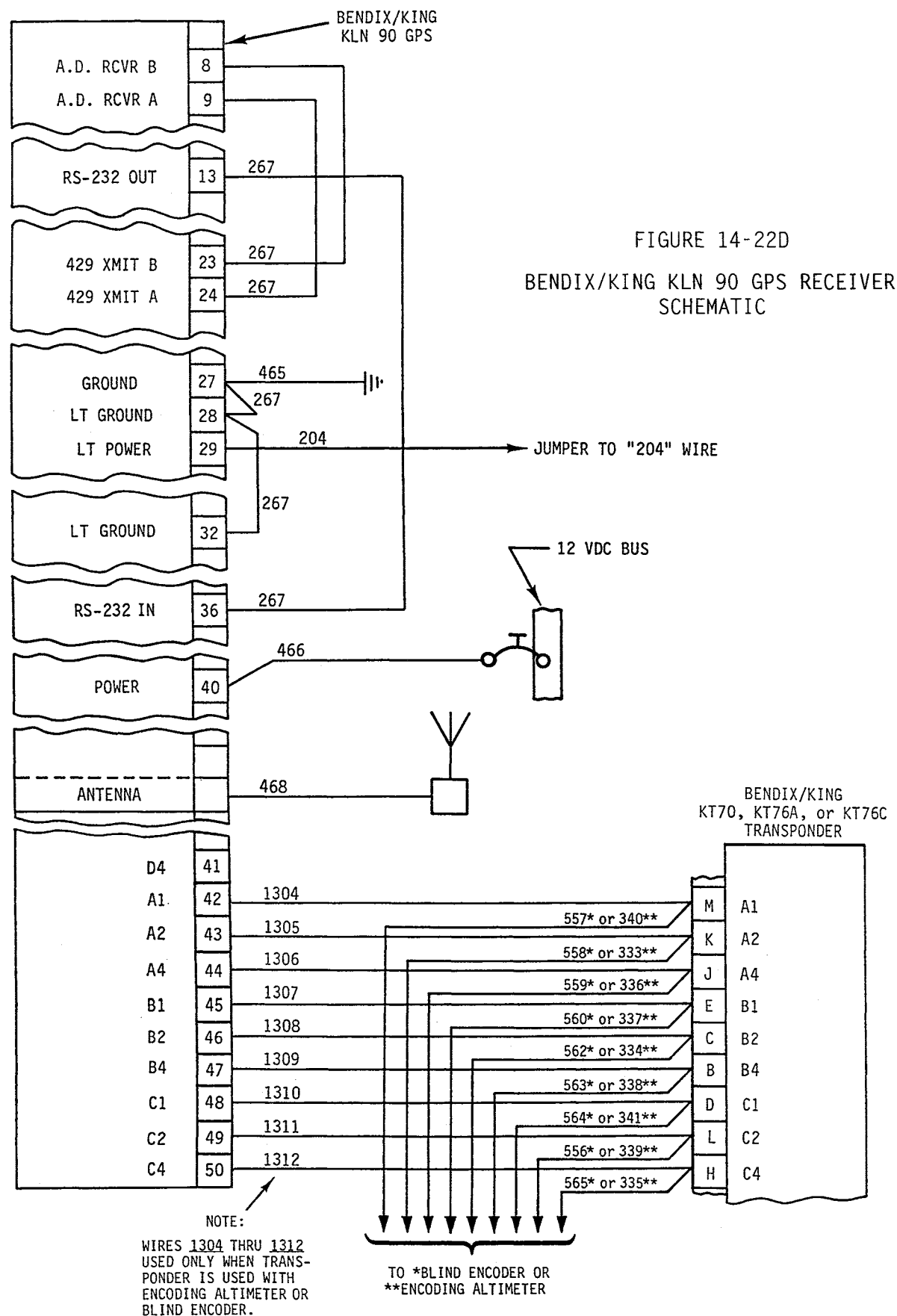


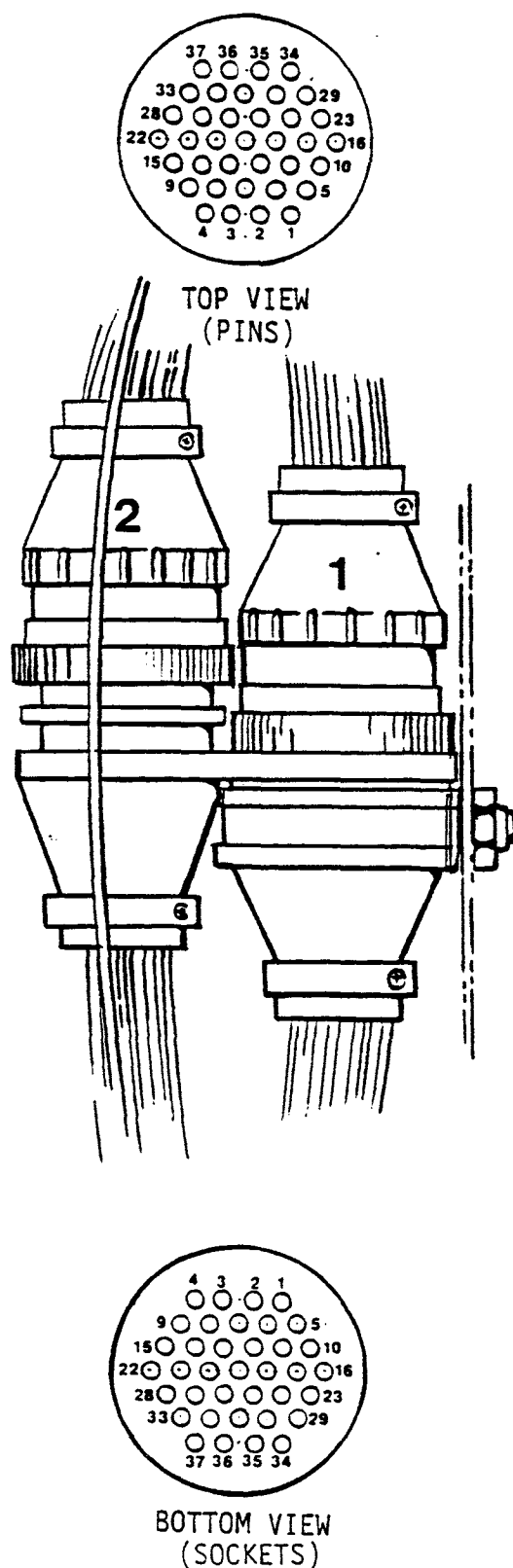
FIGURE 14-22C

BENDIX/KING KLN 89/89B GPS RECEIVER  
SCHEMATIC

## 14.800 AVIONICS SCHEMATICS (cont'd)



## 14.900 UPPER CONSOLE HARNESS PLUGS (STANDARD & HP)



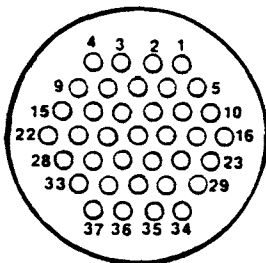
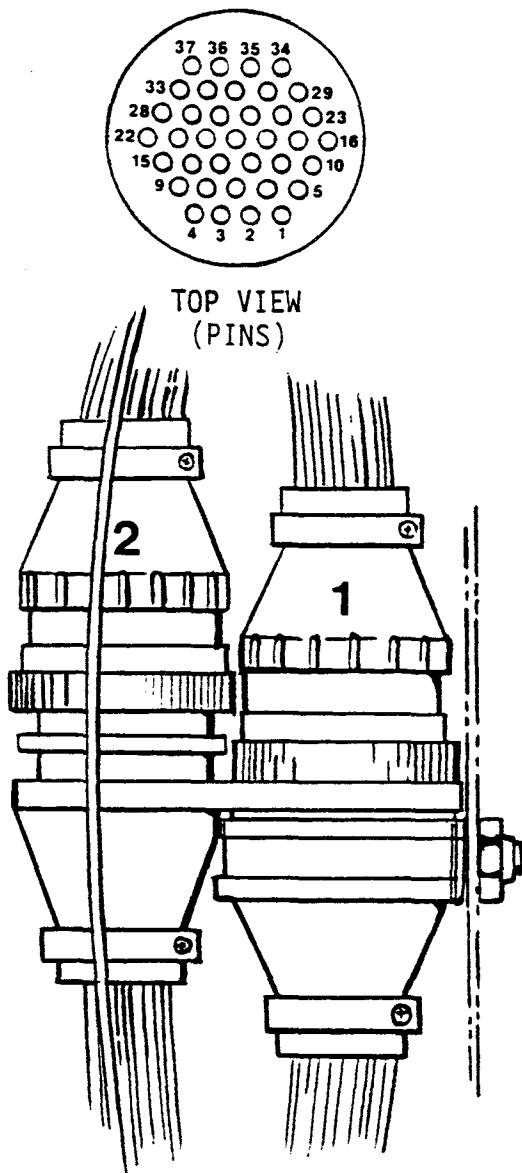
CONNECTOR 1	
PIN NO.	WIRE NO.
1	A059-2
2	A059-3
3	
4	A059-5
5	A059-6
6	A059-9
7	A059-10
8	A059-11
9	A059-12
10	A059-13
11	A059-15
12	A059-16
13	A059-17
14	A059-18
15	A059-19
16	A059-31
17	A059-34
18	A059-128
19	A059-129
20	A059-38
21	Spare
22	Spare
23	Spare
24	Spare
25	Spare
26	Spare
27	Spare
28	A059-52
29	A059
30	Spare
31	A059-58
32	A059-167
33	A059-65
34	A059-164
35	A059-67
36	A059-166
37	

CONNECTOR 2	
PIN NO.	WIRE NO.
1	Spare
2	A039-104
3	A039-105
4	A039-106
5	A039-107
6	Spare
7	A059-163
8	A052-127
9	A040-70
10	A040-71
11	A040-72
12	A040-74
13	A040-75
14	A040-76
15	A040-83
16	A040-81
17	A040-82
18	A040-80
19	A040-84
20	Spare
21	Spare
22	Spare
23	Spare
24	A053-89
25	*
26	A060-204
27	Spare
28	Spare
29	Spare
30	Spare
31	Spare
32	Spare
33	Spare
34	Spare
35	Spare
36	Spare
37	Or Avionics

\* INSTALL DRAIN WIRE OF THREE-CONDUCTOR CABLE (WIRES -80,-81,-82) AT NOTED PIN.

FIGURE 14-23 UPPER CONSOLE HARNESS PLUGS

## 14.900 UPPER CONSOLE HARNESS PLUGS (ALPHA & SUBSEQUENT)



BOTTOM VIEW  
(SOCKETS)

CONNECTOR 1	
PIN NO.	WIRE NO.
1	A059-2
2	A059-3
3	Spare
4	A059-5
5	A059-6
6	A059-9
7	A059-10
8	A059-11
9	A059-12
10	A059-13
11	A059-15
12	A059-16
13	A059-17
14	A059-18
15	A059-19
16	A059-31
17	A059-34
18	A059-128
19	A059-129
20	A059-38
21	Spare
22	B043-416
23	A059-513
24	Spare
25	Spare
26	Spare
27	Spare
28	A059-52
29	Spare
30	Spare
31	A059-58
32	Spare
33	A059-65
34	A059-164
35	Spare
36	A059-166
37	Spare

CONNECTOR 2	
PIN NO.	WIRE NO.
1	A059-199
2	A039-104
3	A039-105
4	A039-106
5	A039-107
6	A059-101
7	A059-163
8	A052-127
9	A040-70
10	A040-71
11	A040-72
12	A040-74
13	A040-75
14	A040-76
15	A040-83
16	A040-81
17	A040-82
18	A040-80
19	A040-84
20	Spare
21	Spare
22	Spare
23	Spare
24	Spare
25	*
26	A060-204
27	A059-28
28	A059-66
29	A059-67
30	A053-90
31	A053-91
32	A053-94
33	A053-95
34	Spare
35	A039-138
36	Spare
37	Spare

\* INSTALL DRAIN WIRE OF THREE-CONDUCTOR CABLE (WIRES -80,-81,-82) AT NOTED PIN.

FIGURE 14-23A UPPER CONSOLE HARNESS PLUGS



14.1000 IFR TRAINER
14.1010 IFR Trainer Component Loads
Continuously-Powered Equipment:

<u>Power &amp; Accessories</u>	<u>Part Number</u>	<u>Qty.</u>	<u>Max. Amps Each</u>	<u>Total Amps</u>
Battery relay	70-906	1	.75	.75
Alternator control	VR418-1	1	4.0	4.0
Master radio relay	W389CX-2	1	.13	.13
<u>Night Lights</u>				
Anti-Collision light	A470	1	3.2	3.2
Position lights	A7512/1777	3	2.2	6.6
Instrument lights	330	9	.08	.72
<u>Instruments</u>				
Engine gage cluster	A617/B144	1	.50/60	.50/60
Dual tachometer	A792-1	1	.10	.10
Hourmeter	773	1	.03	.03
Carb Air temp	A604	1	.13	.13
Ammeter shunt	MLS-60-100	1	.50	.50
Digital OAT gage	310-2	1	.13	.13
<u>Miscellaneous</u>				
Heater blower	A643-1	1	7.5	7.5
TOTAL =				24.29

Complete Avionics Panel for Instrument Trainer

COM/NAV Receiver	KX165	1	.70	.70
NAV Receiver	NAV121	1	.87	.87
Transponder	KT76A	1	1.80	1.80
ADF	KR87	1	1.24	1.24
Horizon ref ind	AIM500	1	1.80	1.80
Marker beacon	KR22	1	.50	.50
Turn coordinator	303700	1	.50	.50
Encoding altimeter	KE127	1	.12	.12
HSI	KI525A	1	.23	.23
Gyro	KG102A	1	3.0	3.0
TOTAL =				10.76

14.1010 IFR Trainer Component Loads (cont'd)
Intermittently-Powered Equipment:

<u>Starting Accessories</u>	<u>Part Number</u>	<u>Qty.</u>	<u>Max Amps Each</u>	<u>Total Amps</u>
Starter relay	SAZ4201E	1	4.5	4.5
Starting vibrator	10-176487-121	1	2.5	2.5
Starter motor	MZ4224	1	150	150

Drive System

Belt tension actuator	5A505-3	1	1.2	1.2
-----------------------	---------	---	-----	-----

Lights

Warning lights	330	8	.08	.64
Landing lights	4509	2	7.7	15.4

Miscellaneous

Map light	A-1425A-2-12	1	.58	*,58
Landing light relay	MB-1380	1	.20	.20
Low RPM horn & relay	16004042-W101PCX	1	.35	.35

TOTAL =\*16.18

Instrument Trainer Avionics

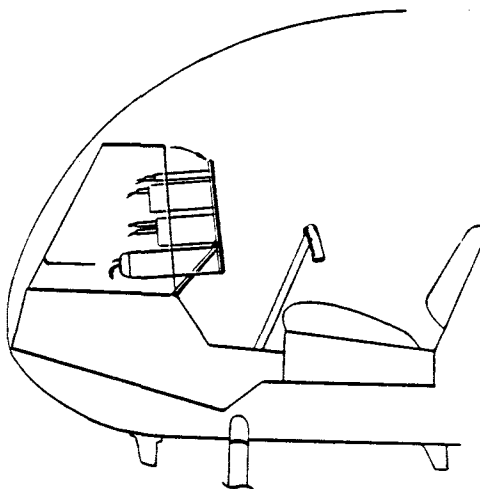
COM Transmitter	KX165	1	*6.8	*6.8
-----------------	-------	---	------	------

## 14.1020 IFR Trainer Console Access

Pull circuit breakers on all gyro instruments and allow 5 minutes for gyro run down to prevent gyro damage.

See R22 operator manual for caging instructions upon power application.

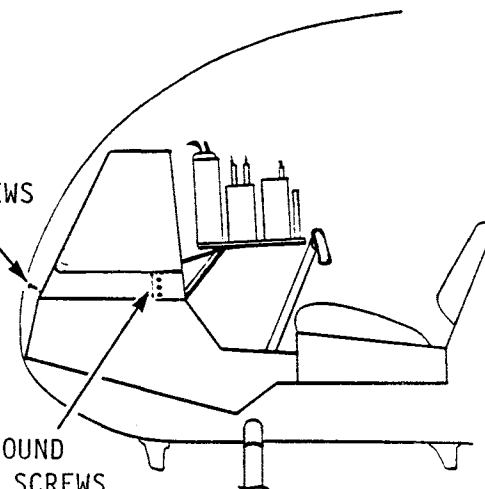
Remove (6) screws holding faceplate to console and carefully pull faceplate and instruments forward.



With cyclic full aft, instrument faceplate will now rotate to a horizontal position for access to back of instruments.

ALLEN SCREWS

GROUND  
PLATE SCREWS



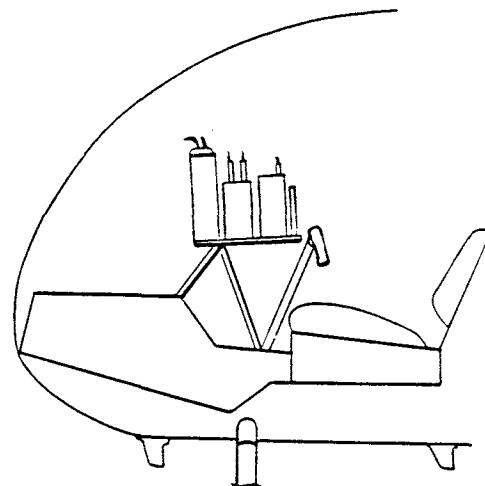
If console shell needs to be removed for access, place support under faceplate as shown.

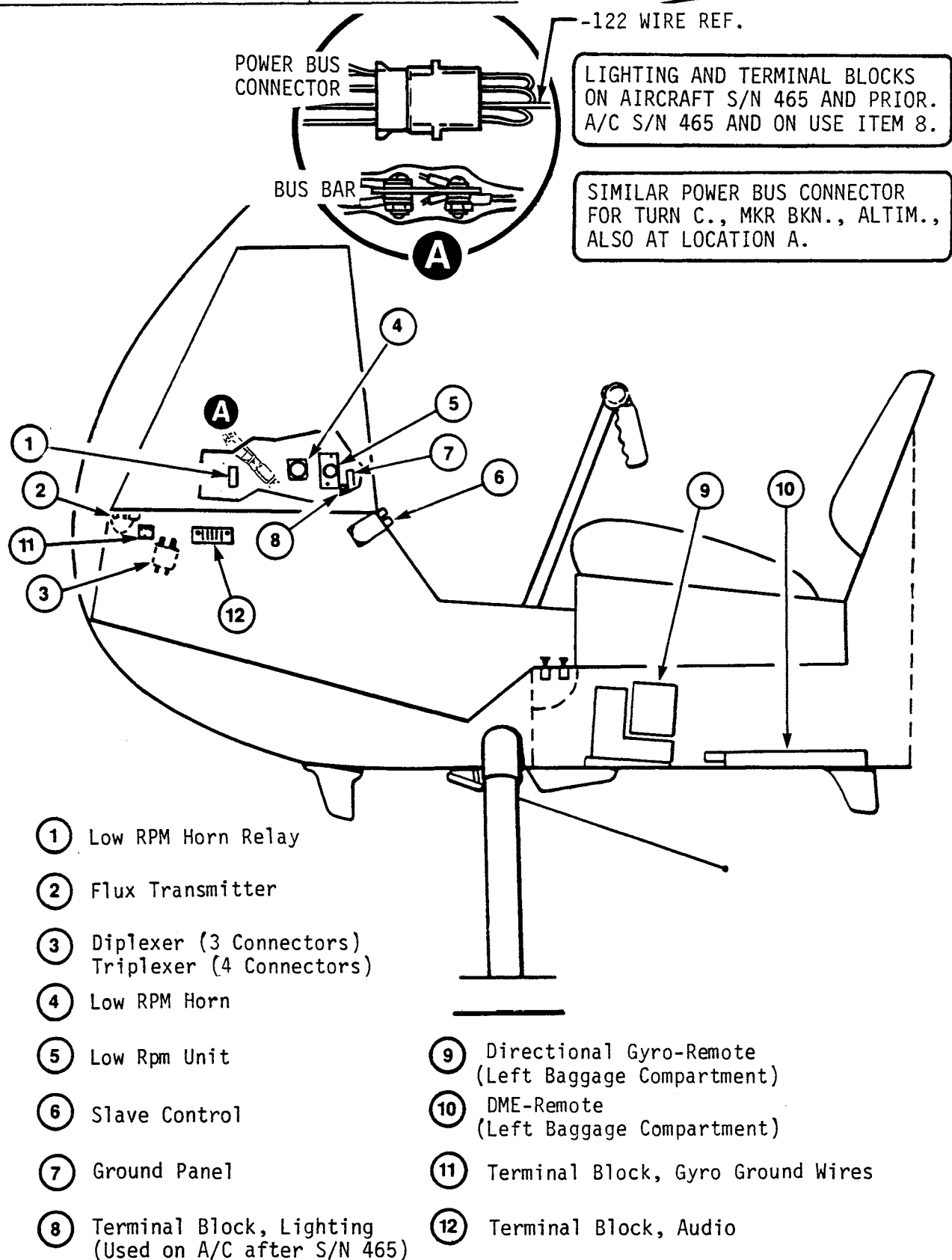
Remove three ground plate screws from each side of console.

Remove two allen head screws in nose of console. Remove two screws from each side of console.

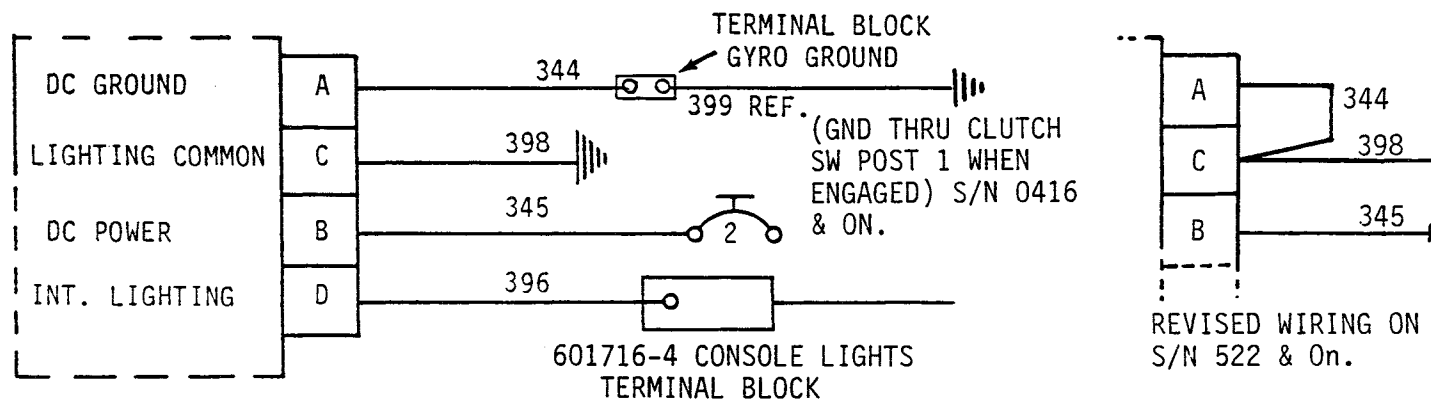
Disconnect wiring from horn, horn relay, and low RPM unit attached to console shell.

Carefully remove console shell.

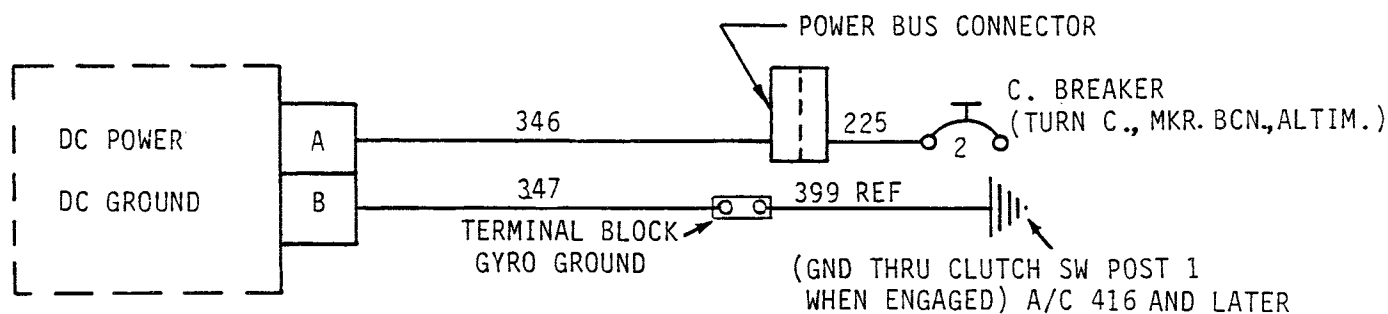


**14.1030 IFR Trainer Component Location**


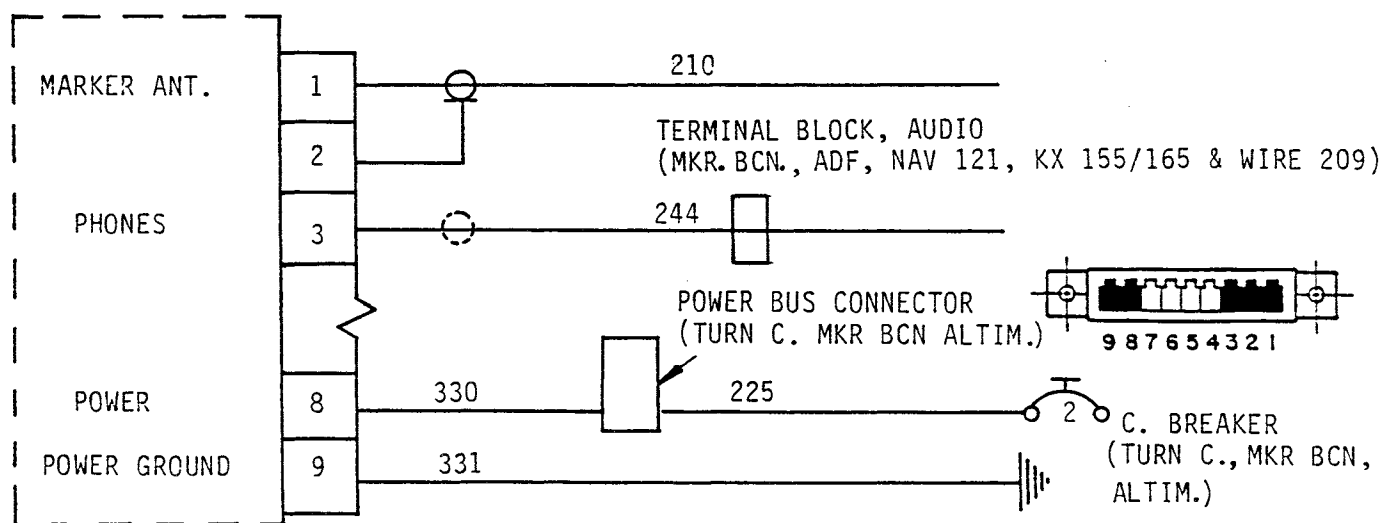
## 14.1040 IFR Trainer Avionics Schematics



AIM 500 HORIZONTAL REFERENCE INDICATOR

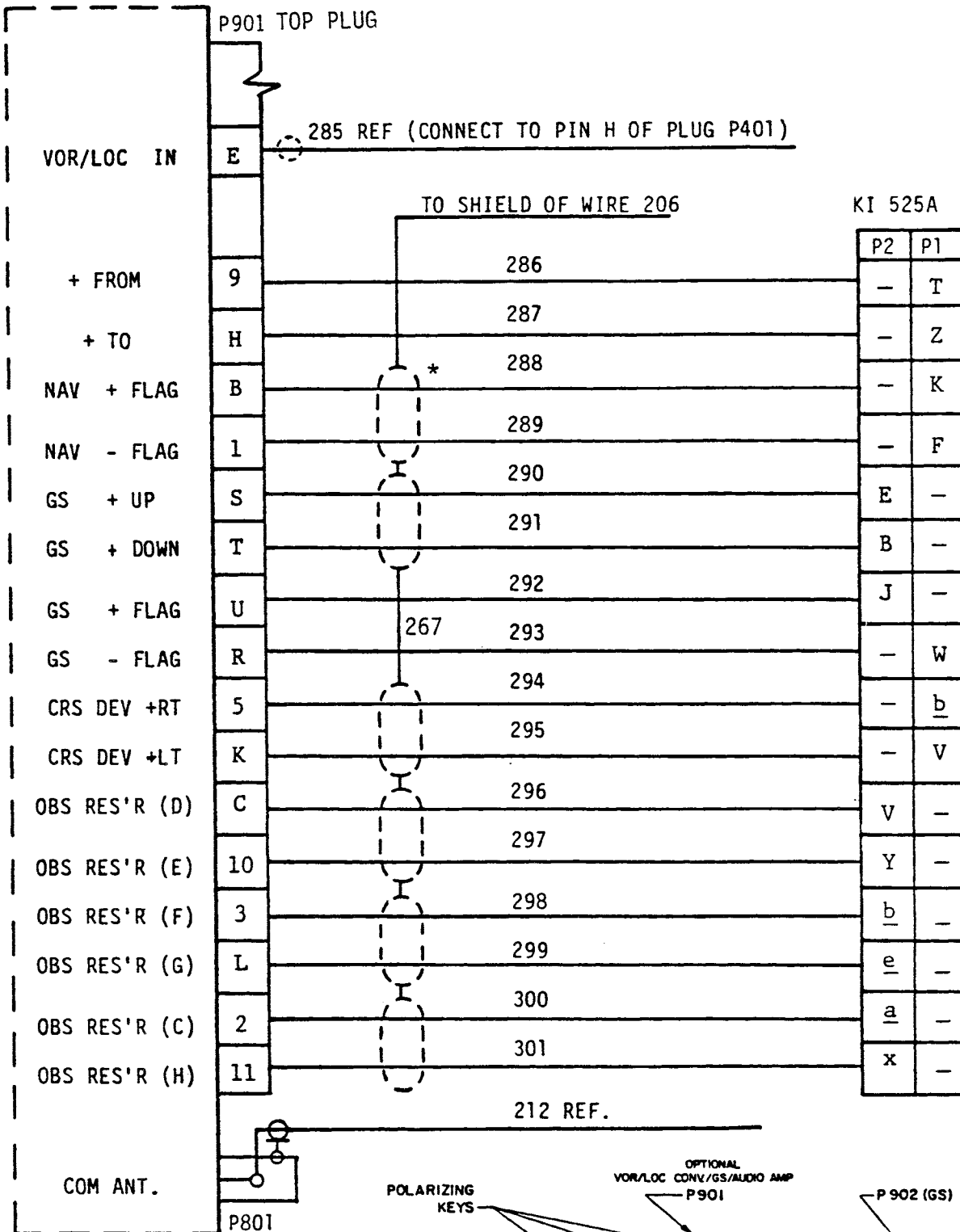


ASTRONAUTICS 303700 TURN COORDINATOR



KING KR 22 MARKER BEACON

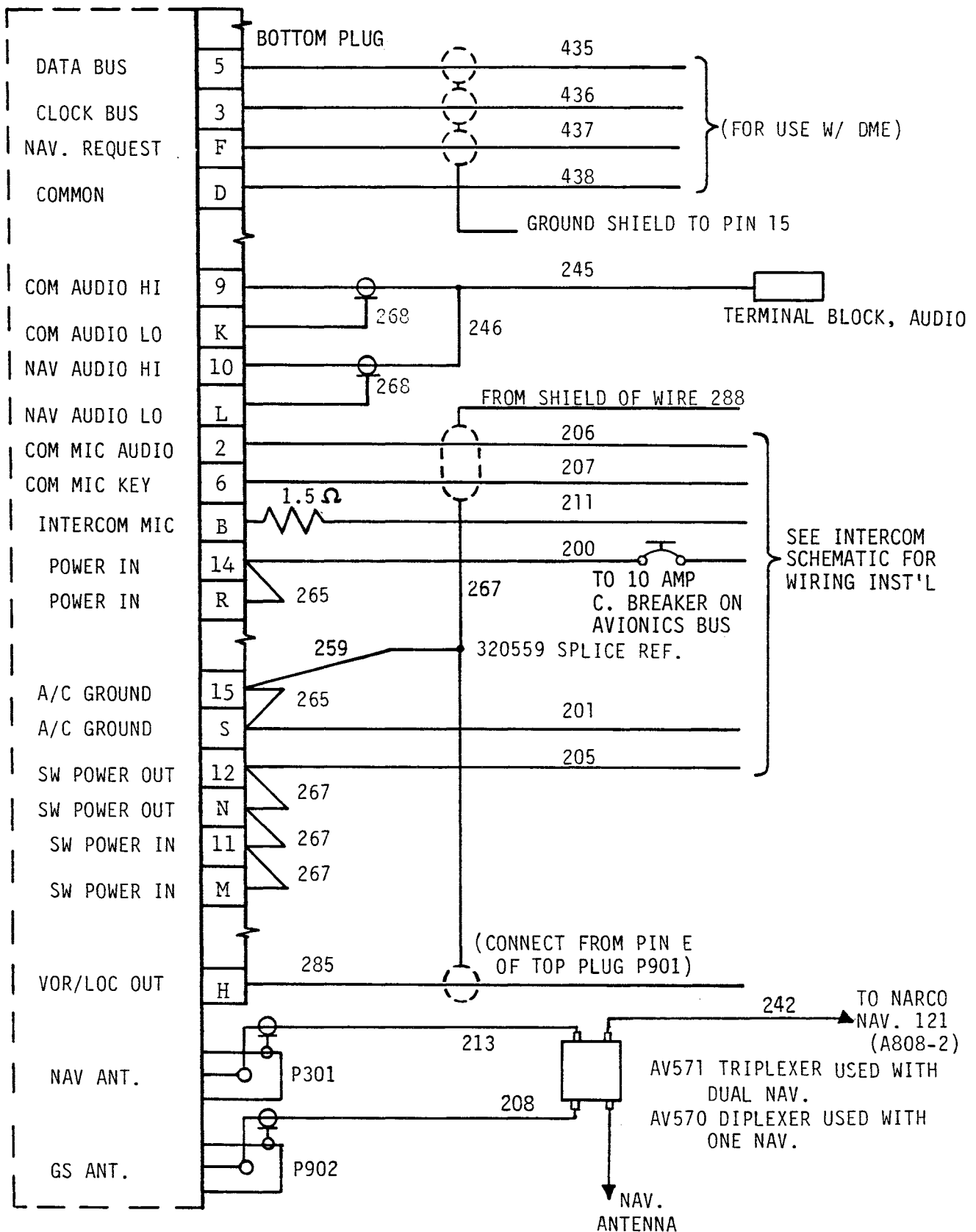
14.1040 (cont'd)



\*This Shield Installed on Earlier Ship S/Ns.

14.1040 (cont'd)

P401



## 14.1040 (cont'd)

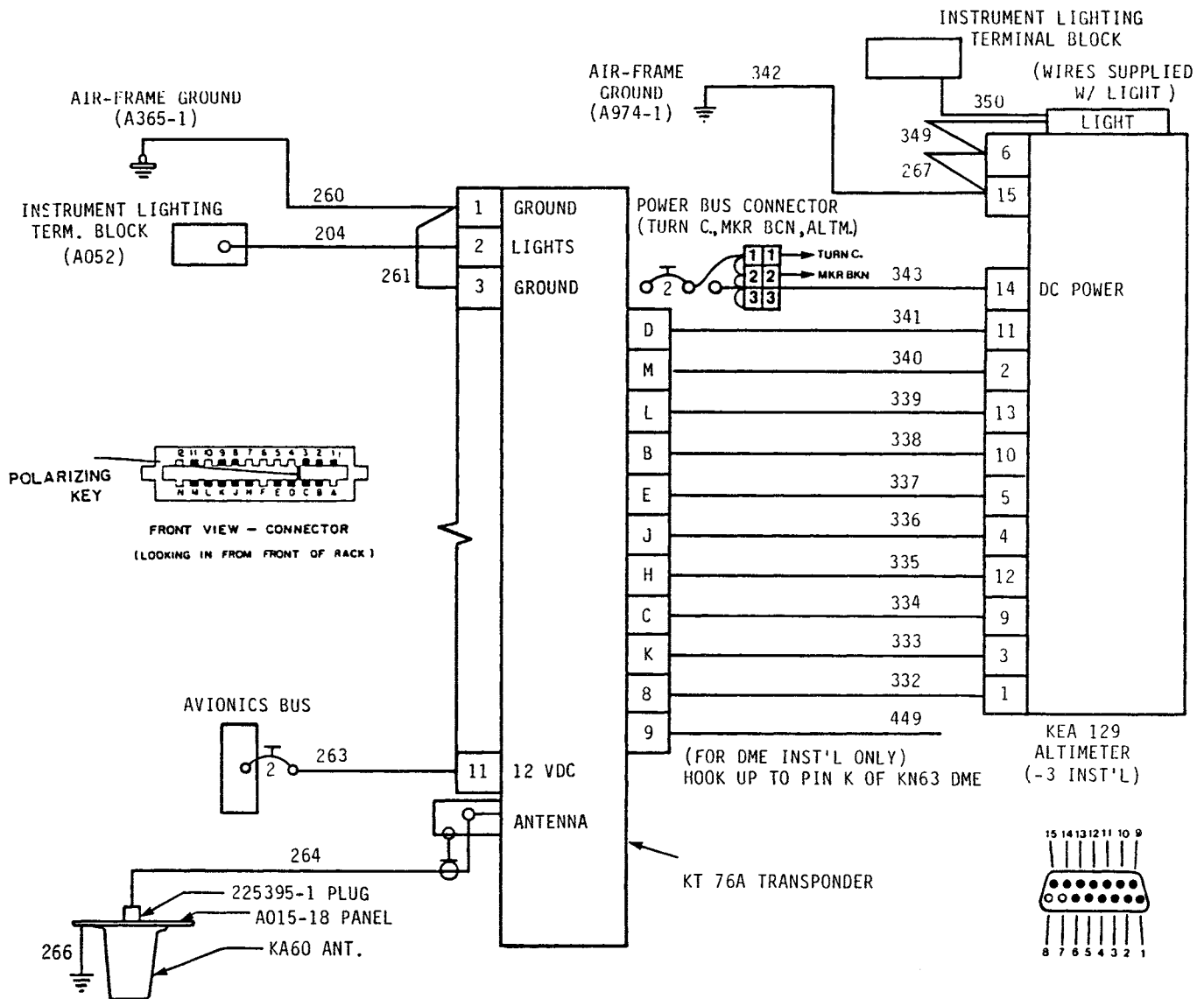


FIGURE 14-27 KING KT76A TRANSPONDER  
WITH  
KING KEA 129 ENCODING ALTIMETER



## 14.1040 (cont'd)

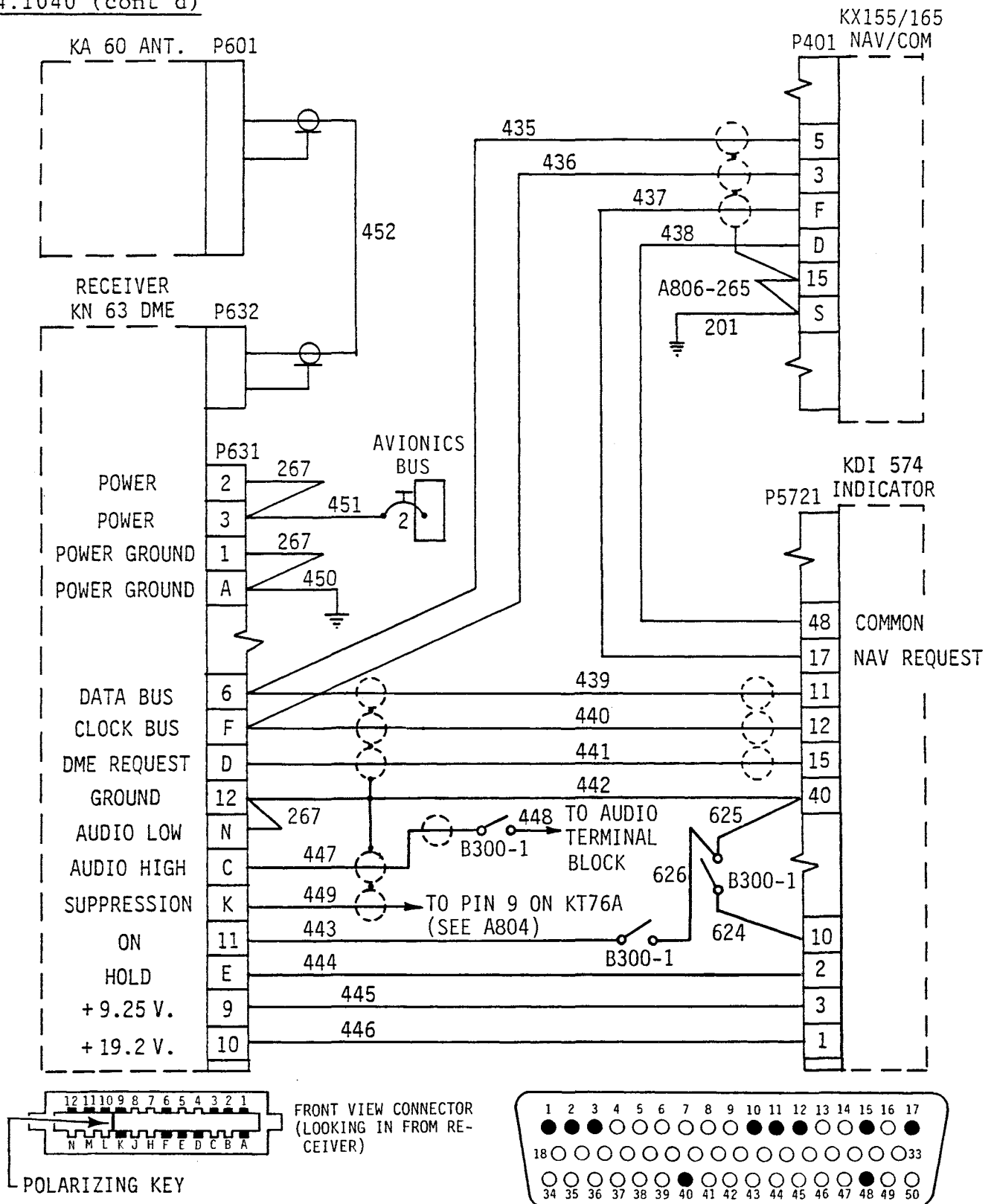


FIGURE 14-28 KING KN63 DME

KDI 574 CONNECTOR P5741/ J5741 PIN 5 KEYED  
PIN VIEW OF MALE OR SOLDER CUP VIEW OF FEMALE CONNECTOR.

14.1040 (cont'd)

VHF NAV/COM  
TRANSCIVER  
KX 165

P 901

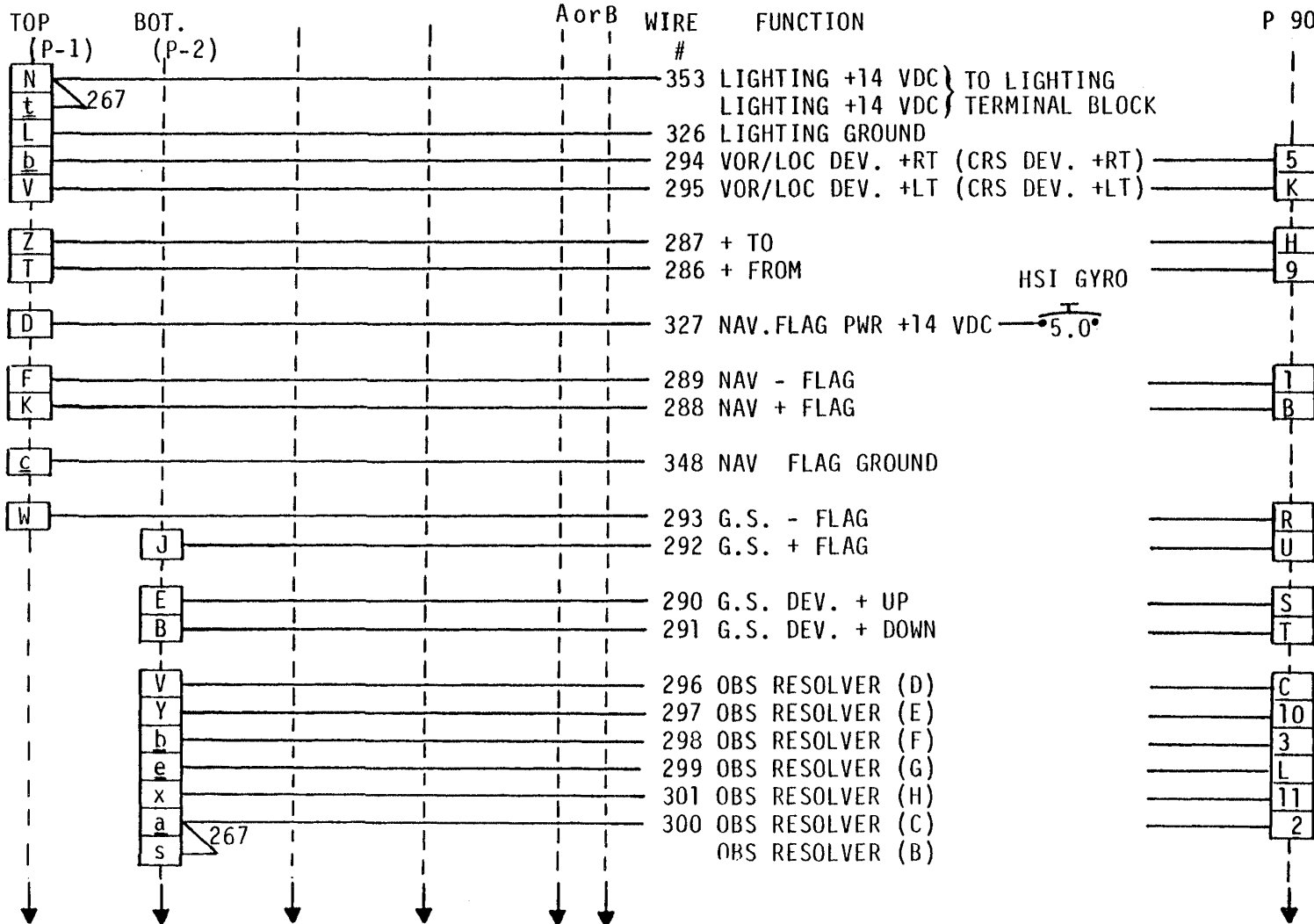
ADF INDICATOR  
KI 227-01

PICTORIAL NAV  
IND. (HSI)  
KI 525A

DIRECTIONAL  
GYRO  
KG 102A

FLUX  
XMTR  
KMT 112

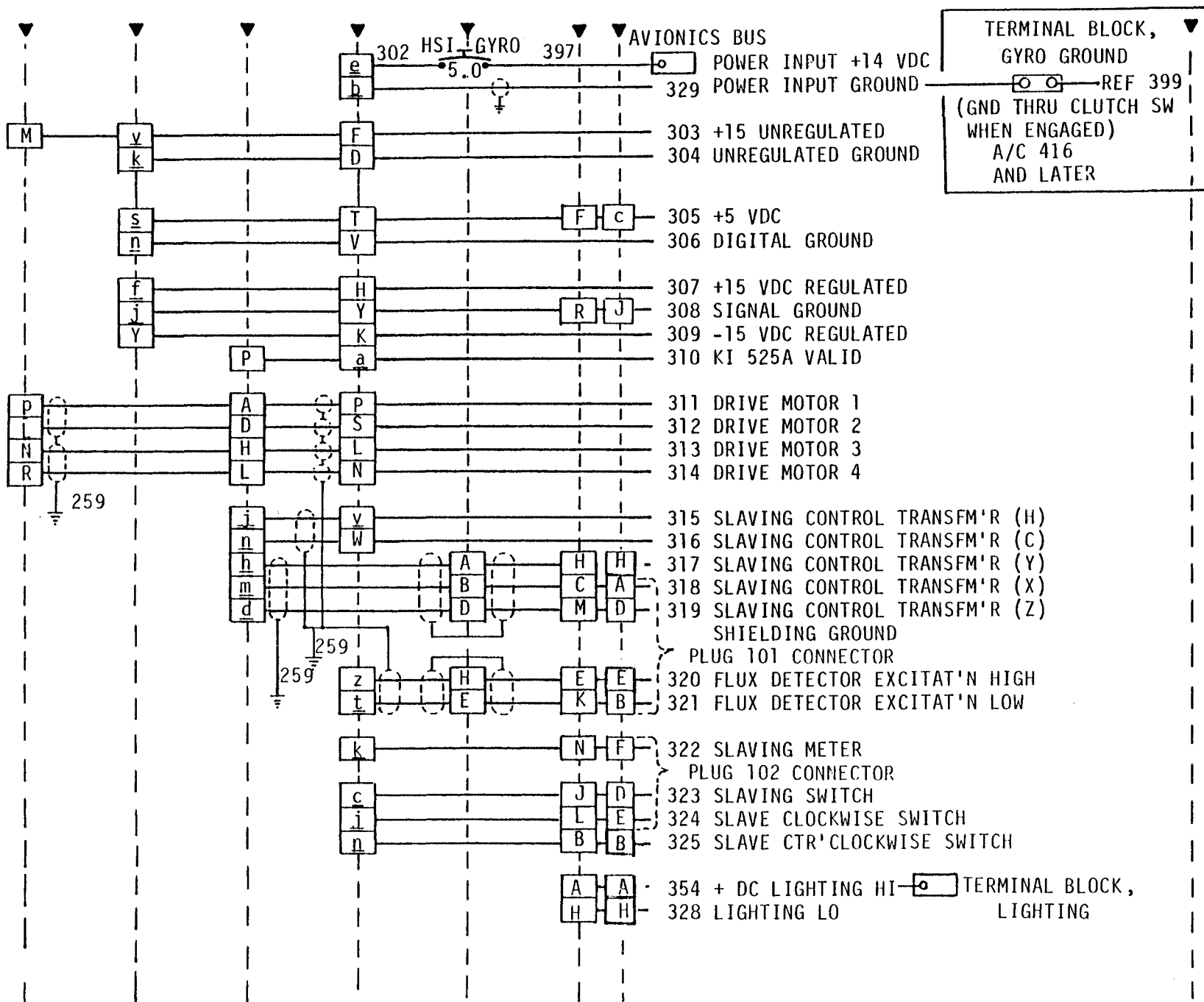
HSI SLAVE  
KA 51



CONT. ON NEXT PAGE

14.1040 (cont'd)

CONTINUED FROM PREVIOUS PAGE



[illegible]

Issued 4/22/87

14.1040 (cont'd)

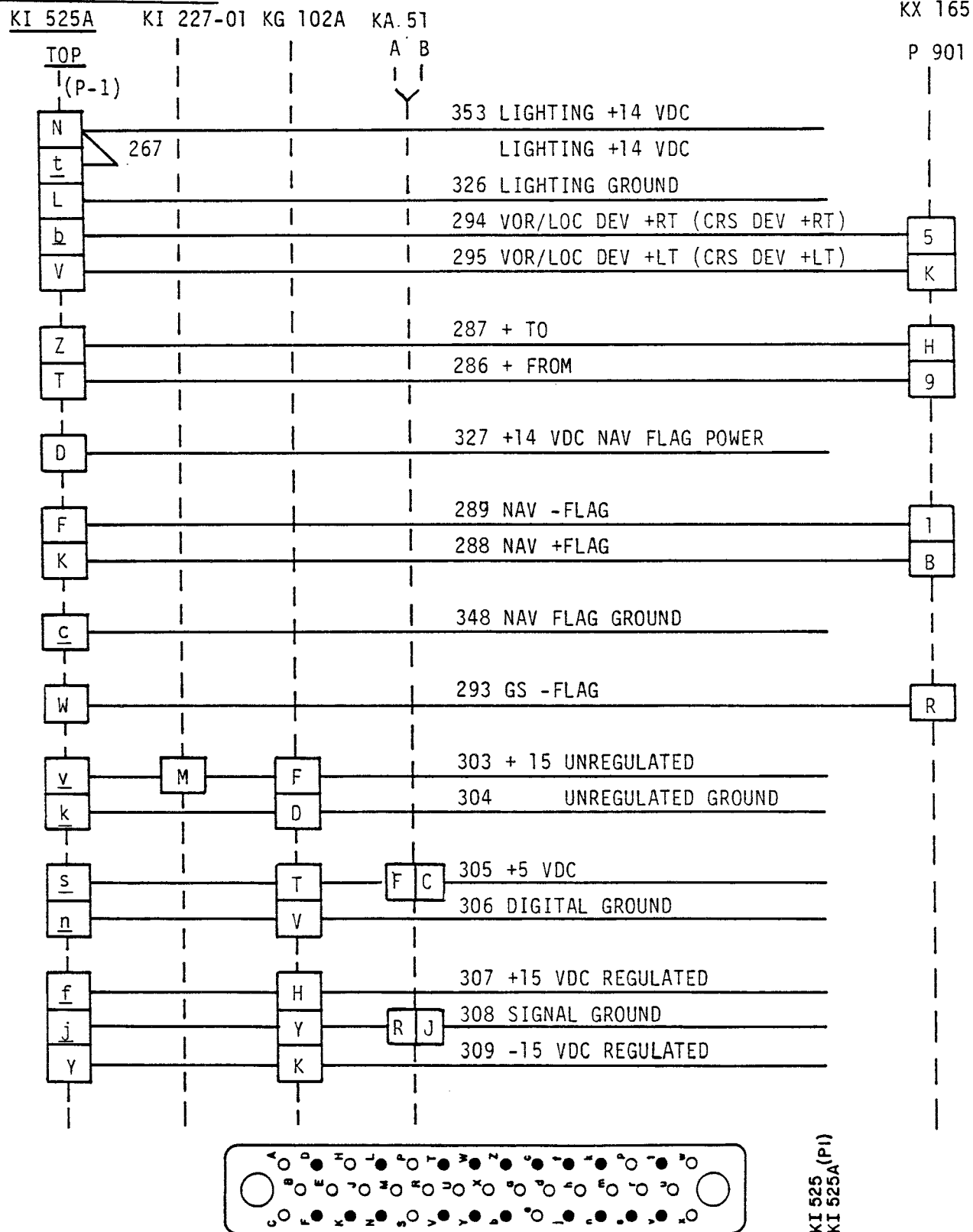


FIGURE 14-31A KI 525A PICTORAL NAV INDICATOR (TOP PLUG)

14.1040 (cont'd)

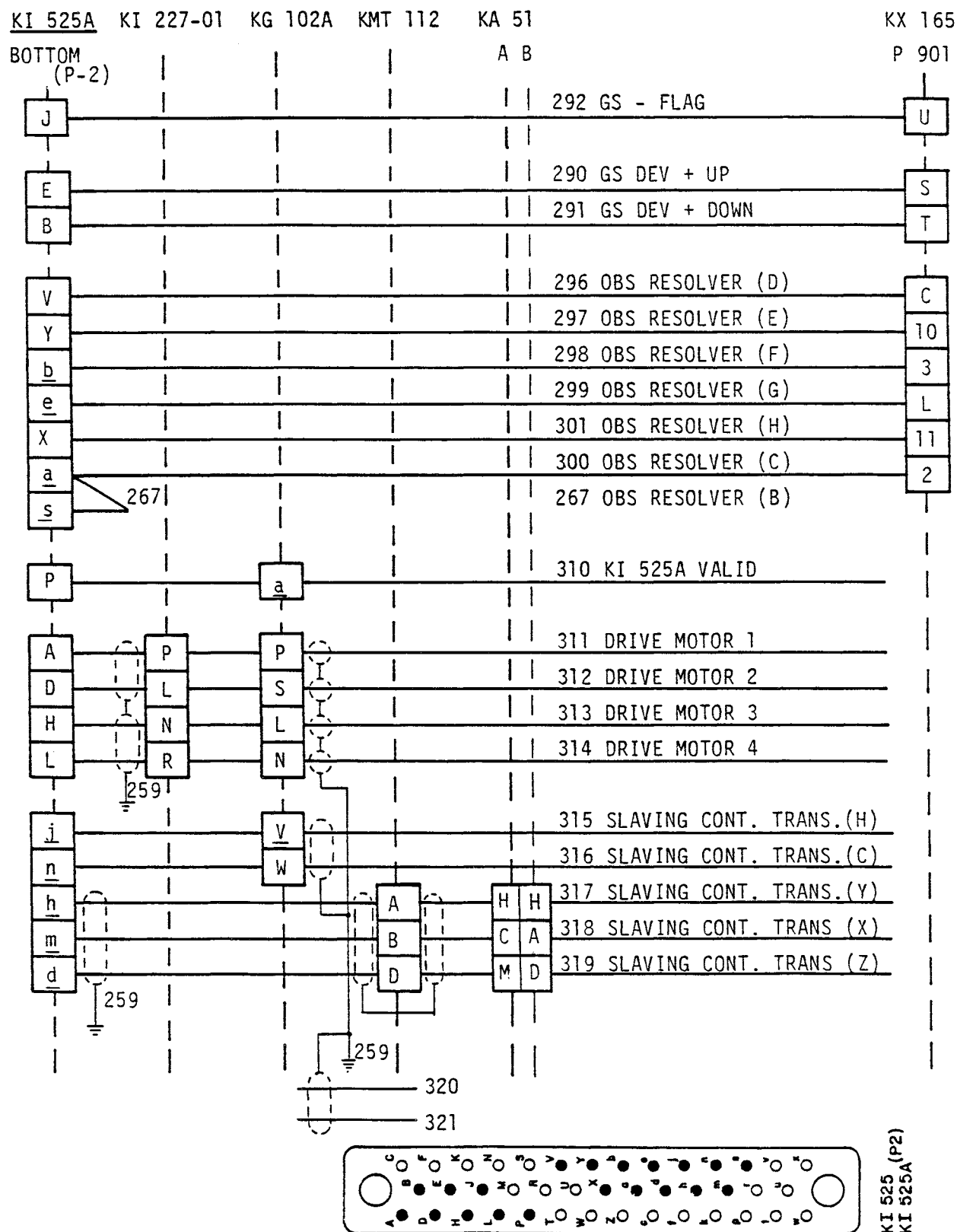
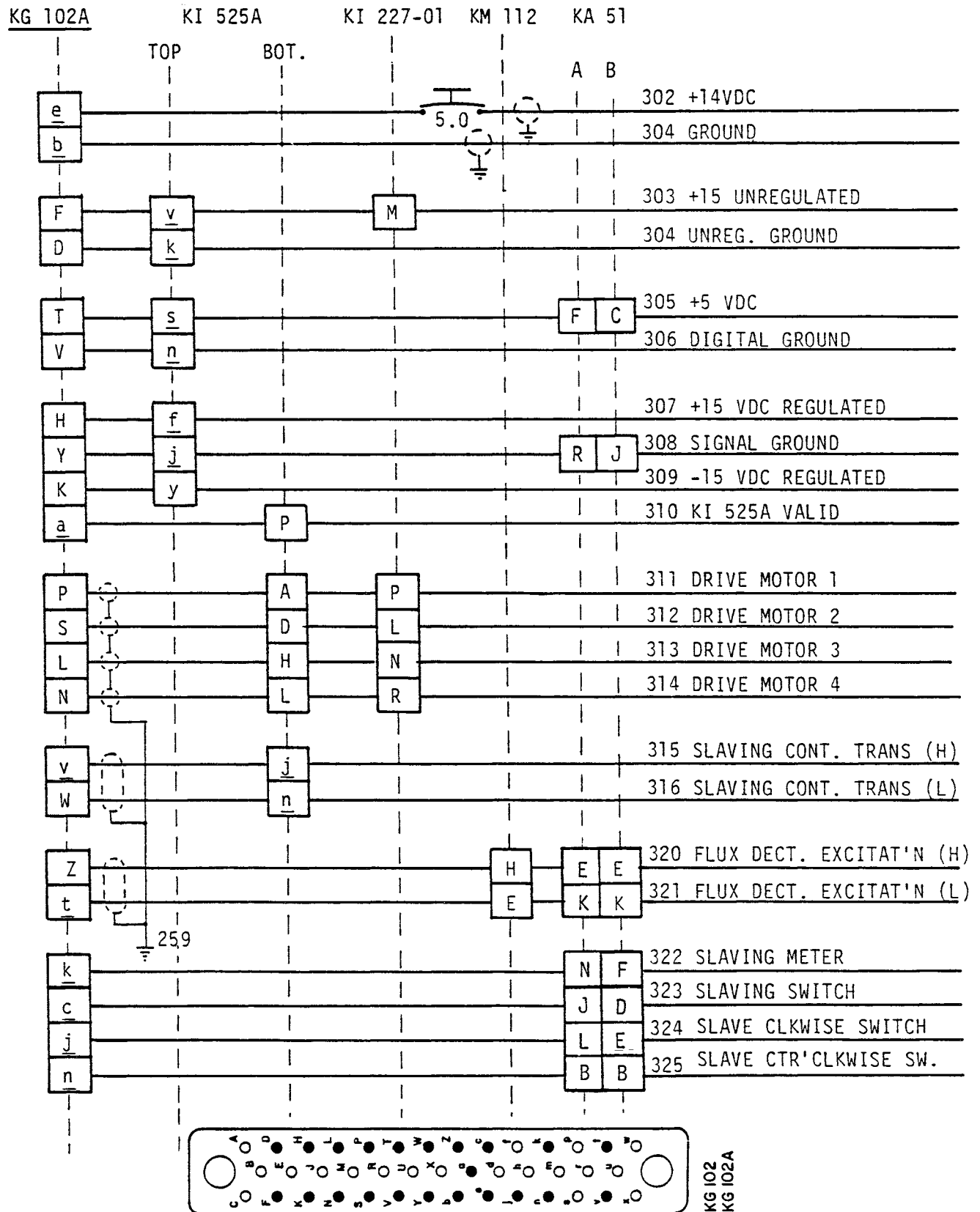
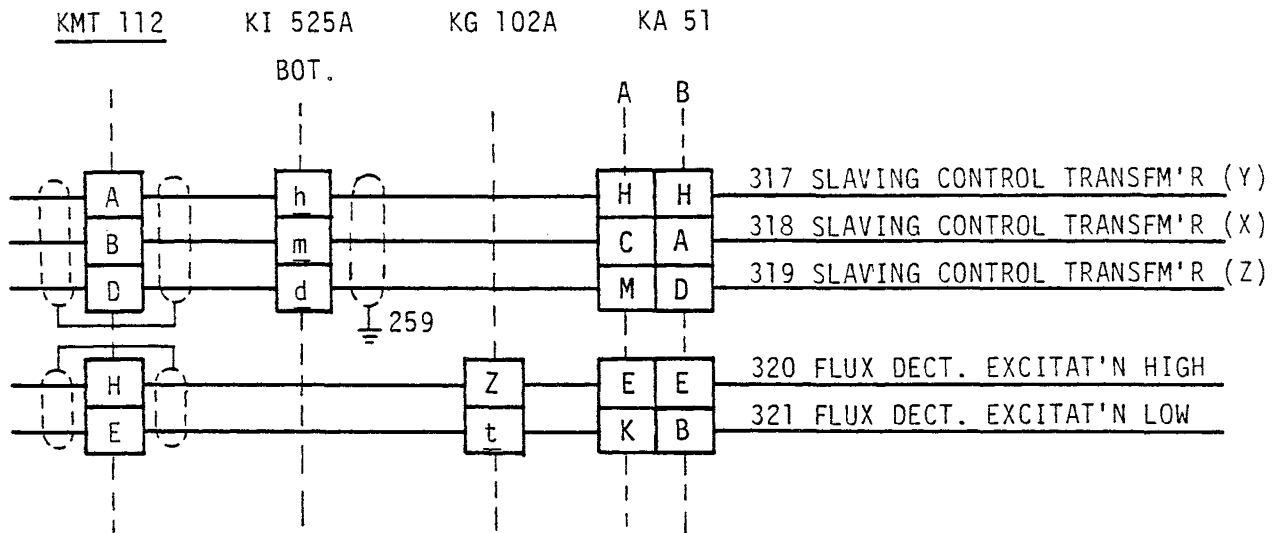


FIGURE 14-31B KI 525A PICTORAL NAV INDICATOR (BOTTOM PLUG)

## 14.1040 (cont'd)



## 14.1040 (cont'd)



KMT 112

FIGURE 14-33 KING KMT 112 FLUX TRANSMITTER



## 14.1040 (cont'd)

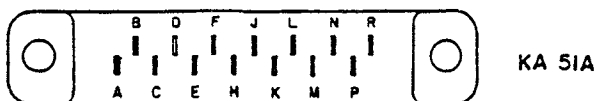
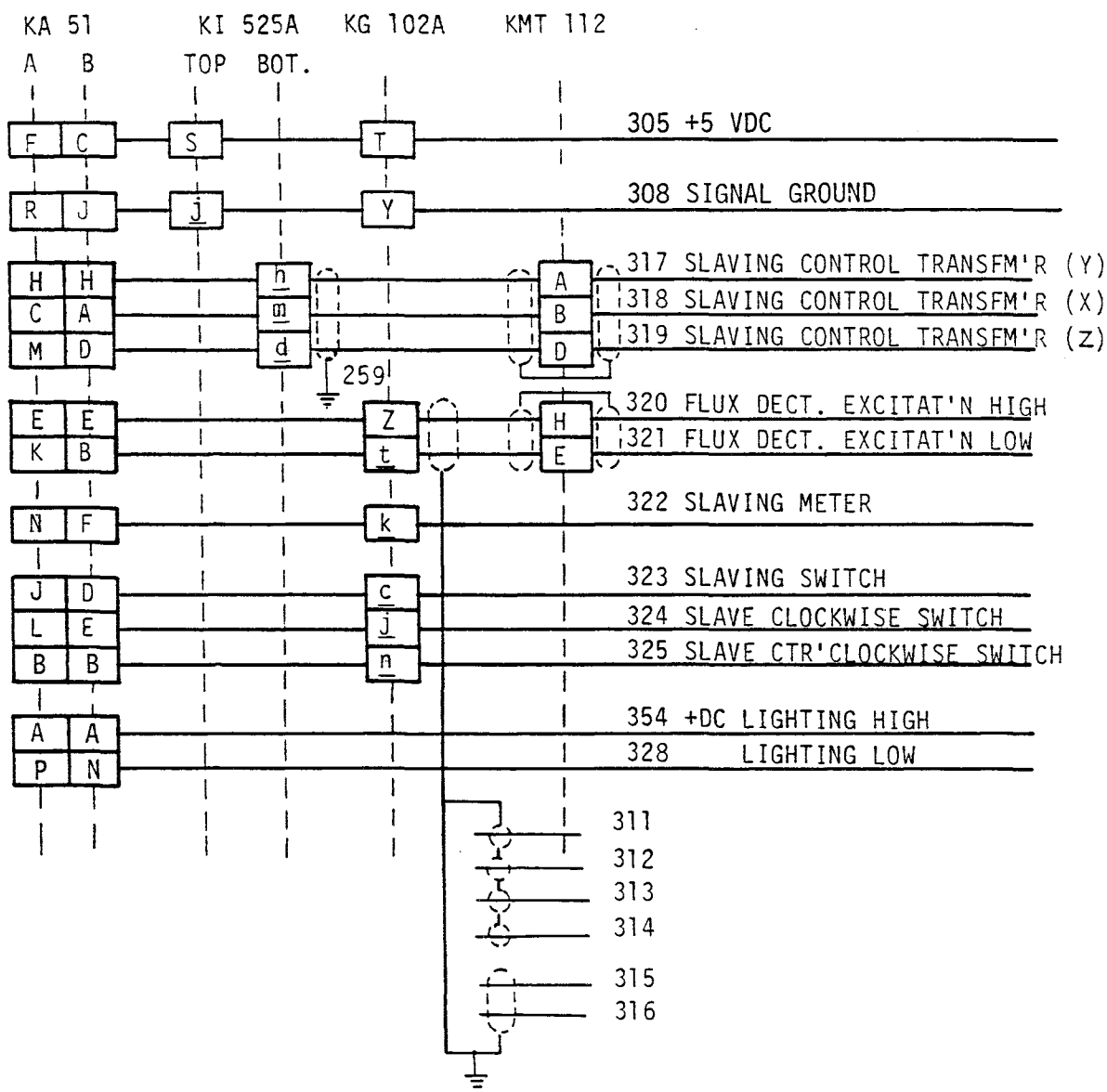
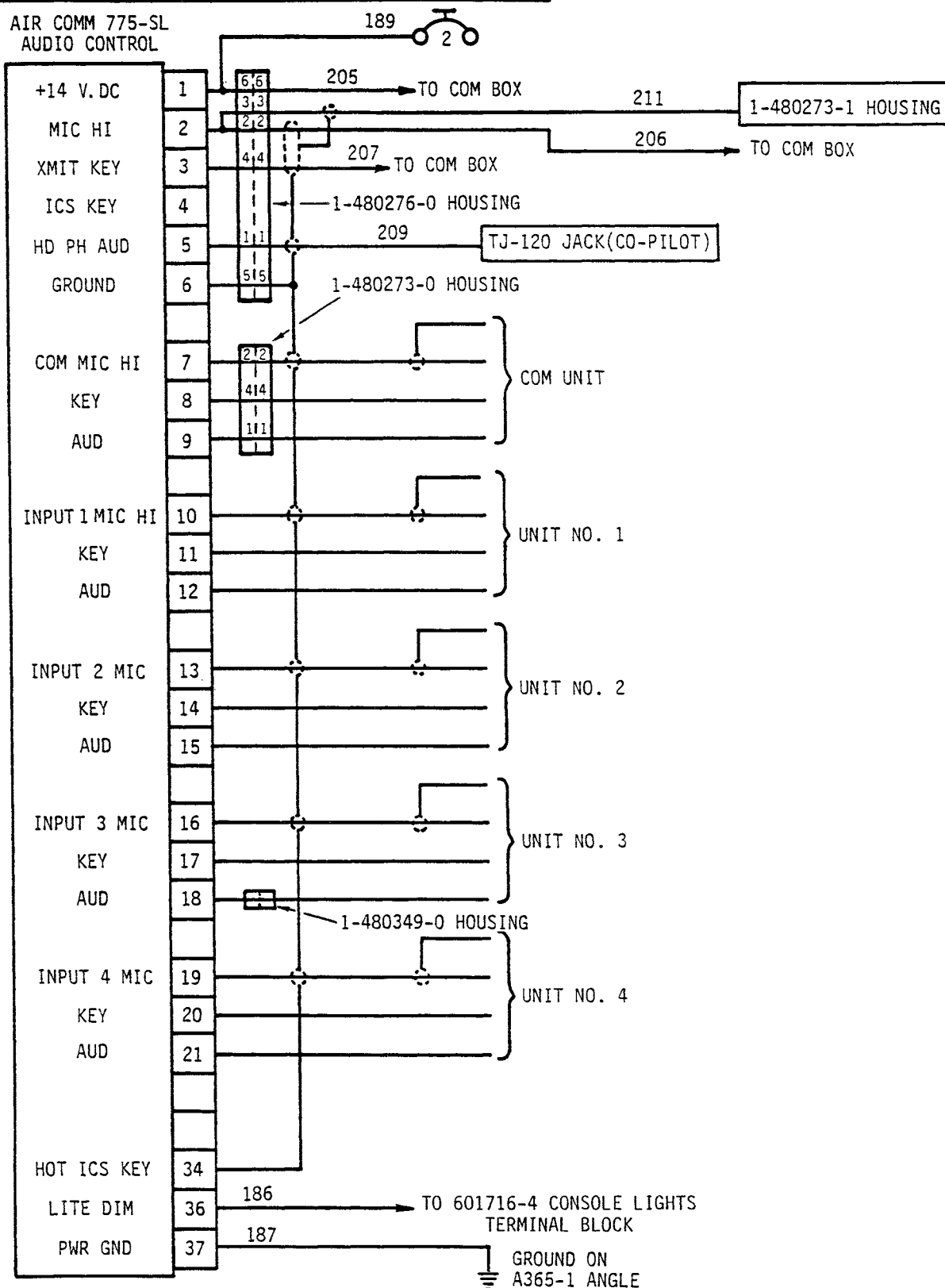


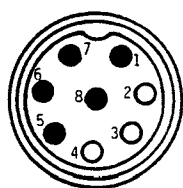
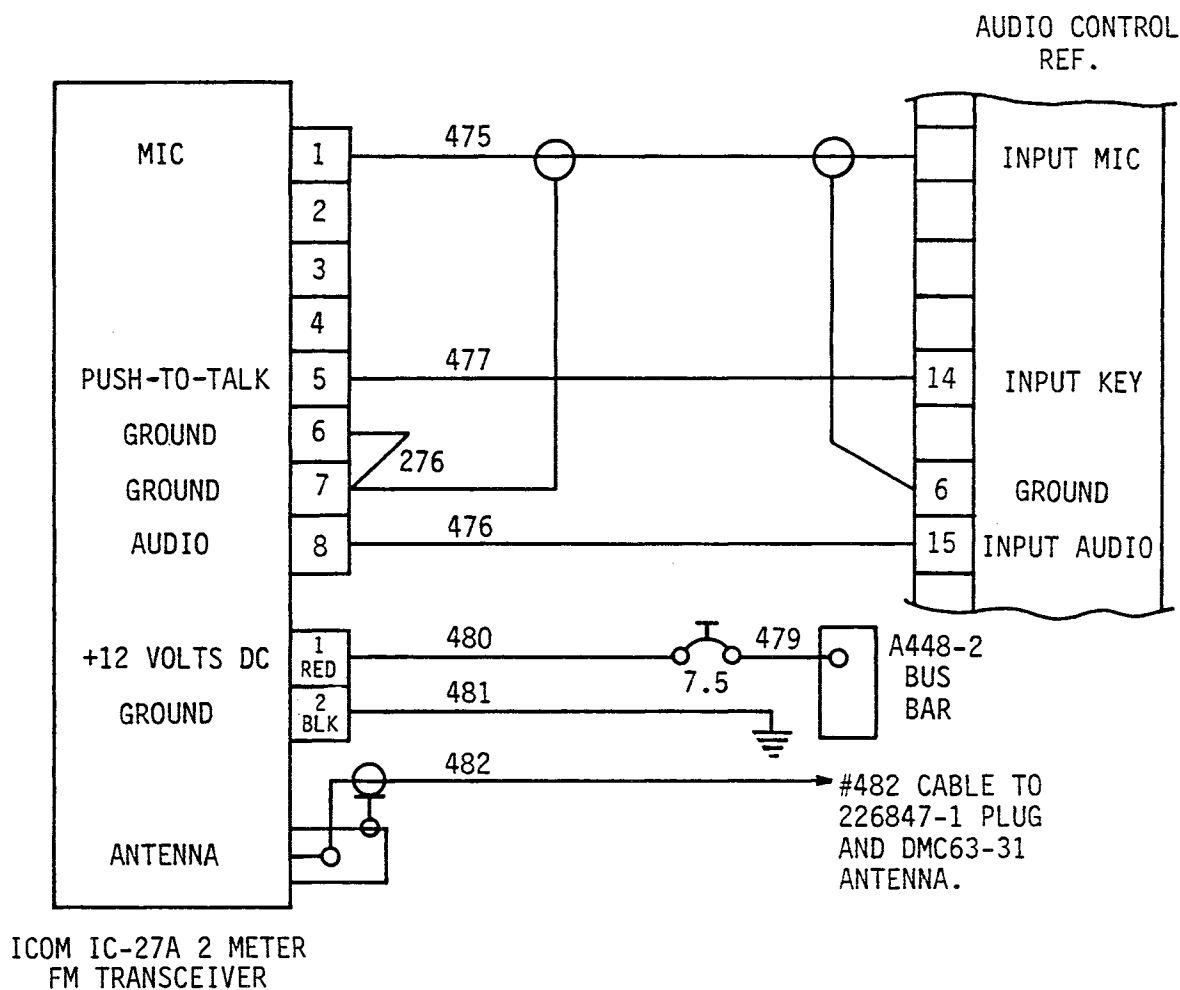
FIGURE 14-34 KING KA 51 (A & B) SLAVING ACCESSORY

## 14.1100 R22 MARINER

### 14.1110 R22 Mariner Avionics Schematics



14.1110 (cont'd)



AUDIO/MIC  
CONNECTOR

(LOOKING  
TOWARD  
AIRCRAFT)



POWER  
CONNECTOR

FIGURE 14-36 ICOM IC-27A 2-METER FM TRANSCEIVER

14.1110 (cont'd)

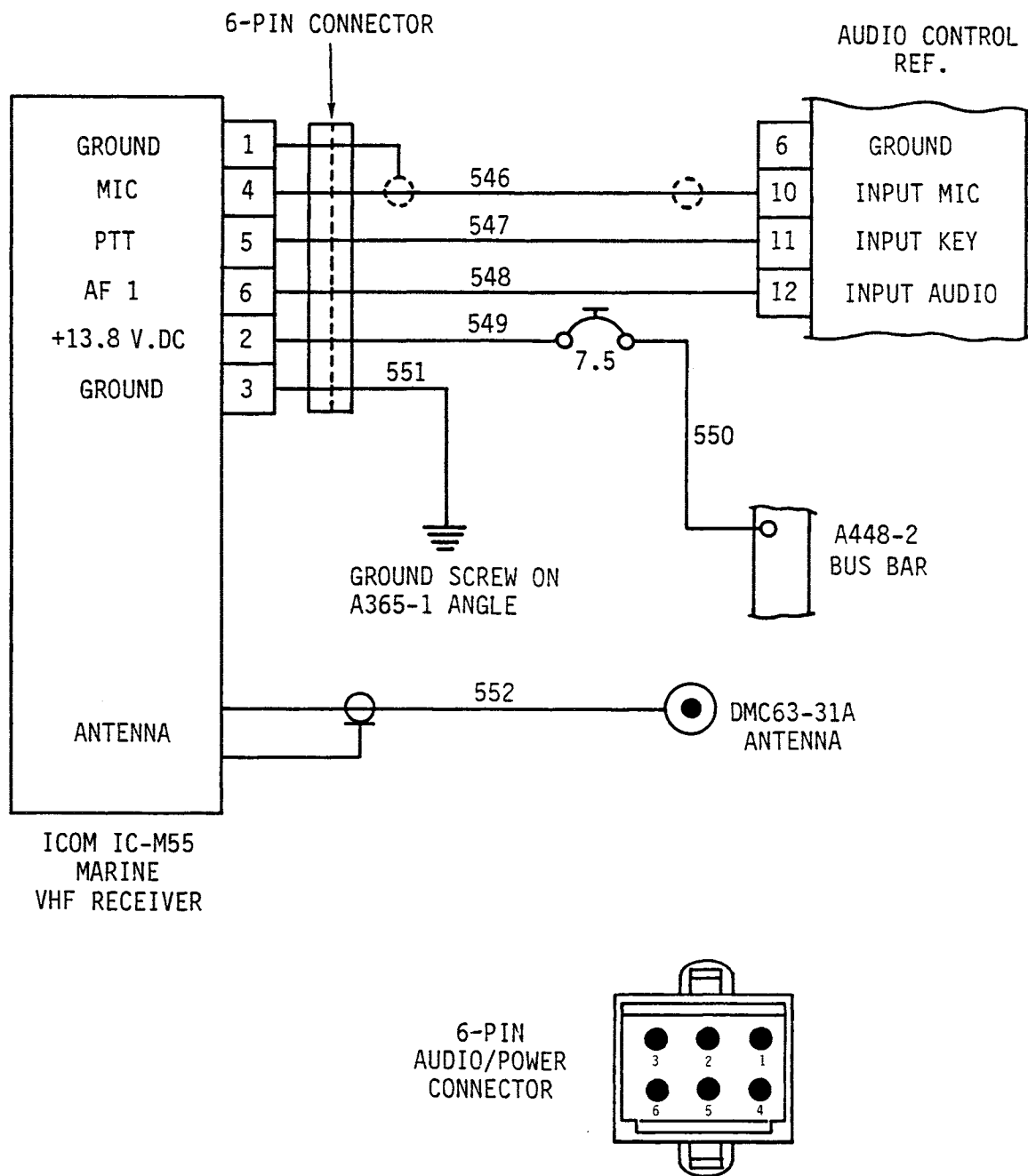


FIGURE 14-37 ICOM IC M55 MARINE VHF RECEIVER

14.1110 (cont'd)

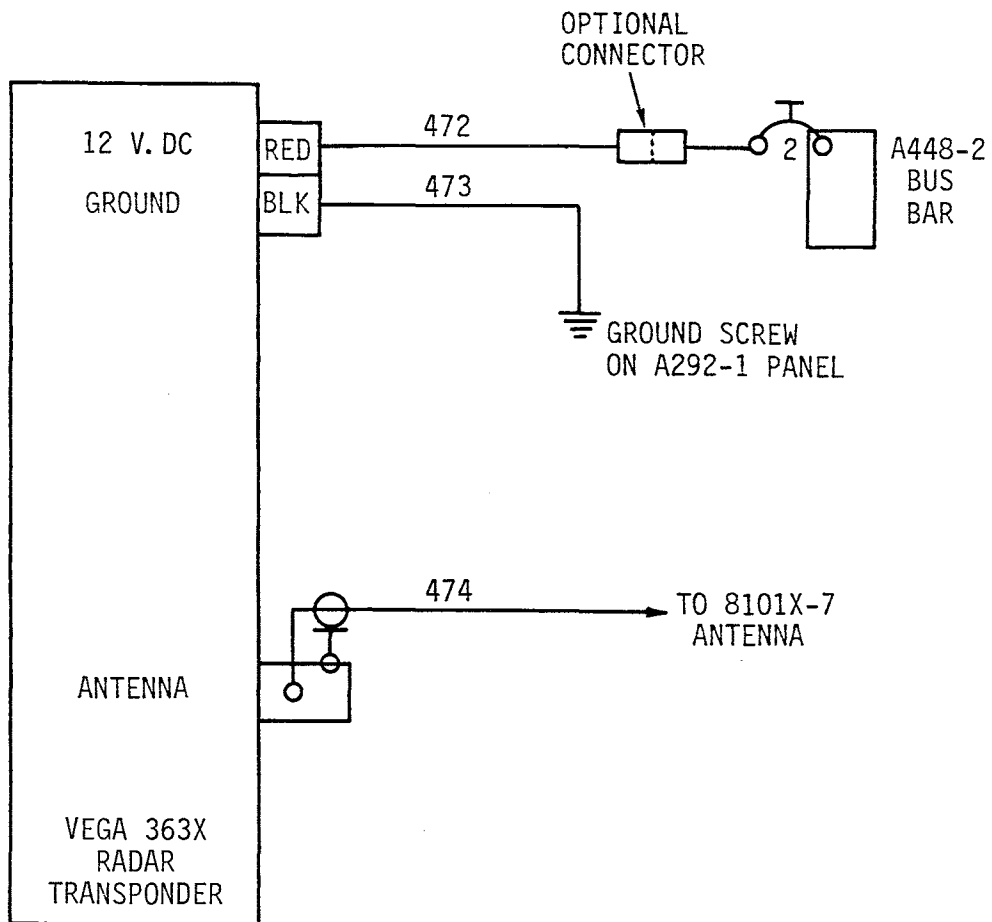


FIGURE 14-38 VEGA 363X RADAR TRANSPONDER

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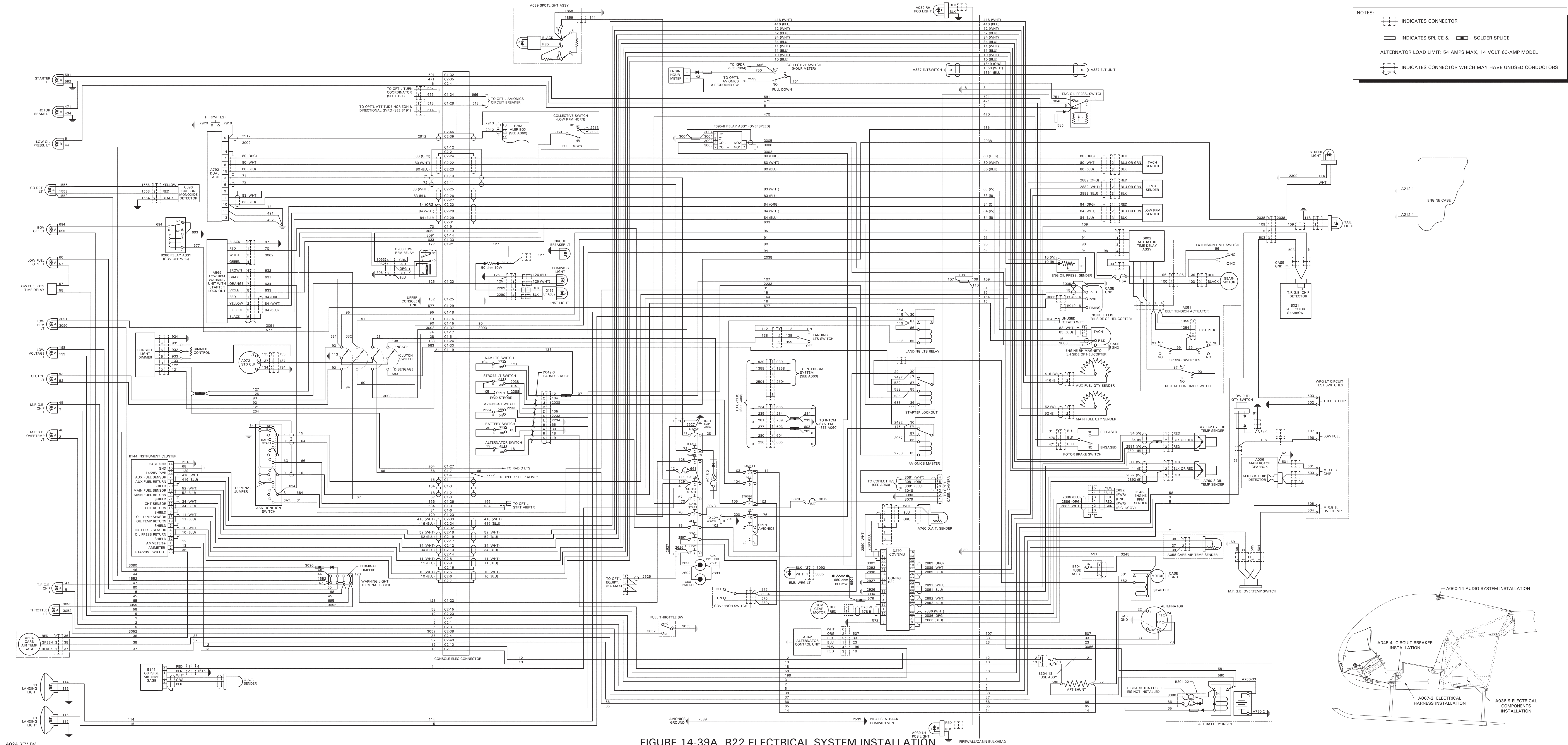
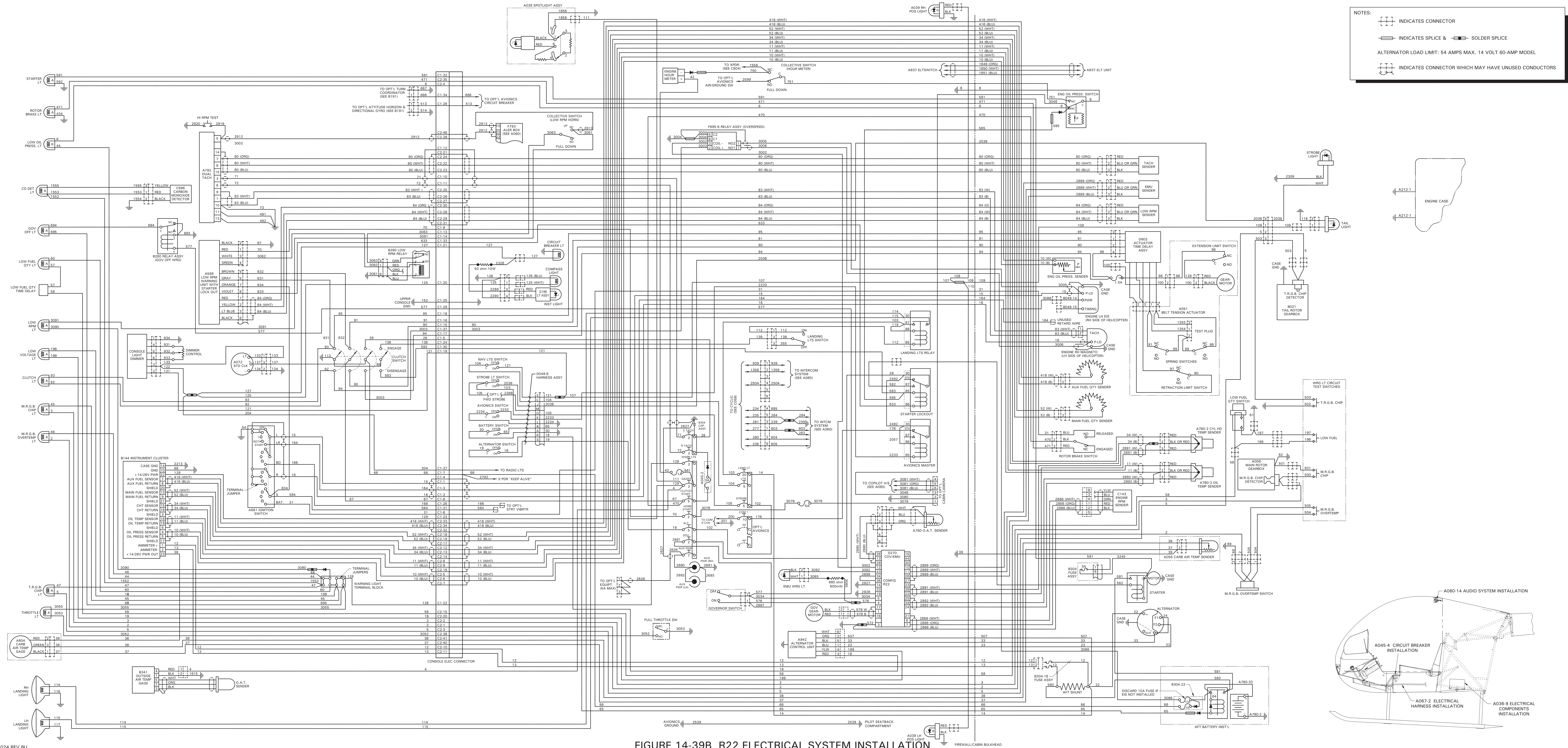


FIGURE 14-39A R22 ELECTRICAL SYSTEM INSTALLATION  
(A024 Revision BV shown)







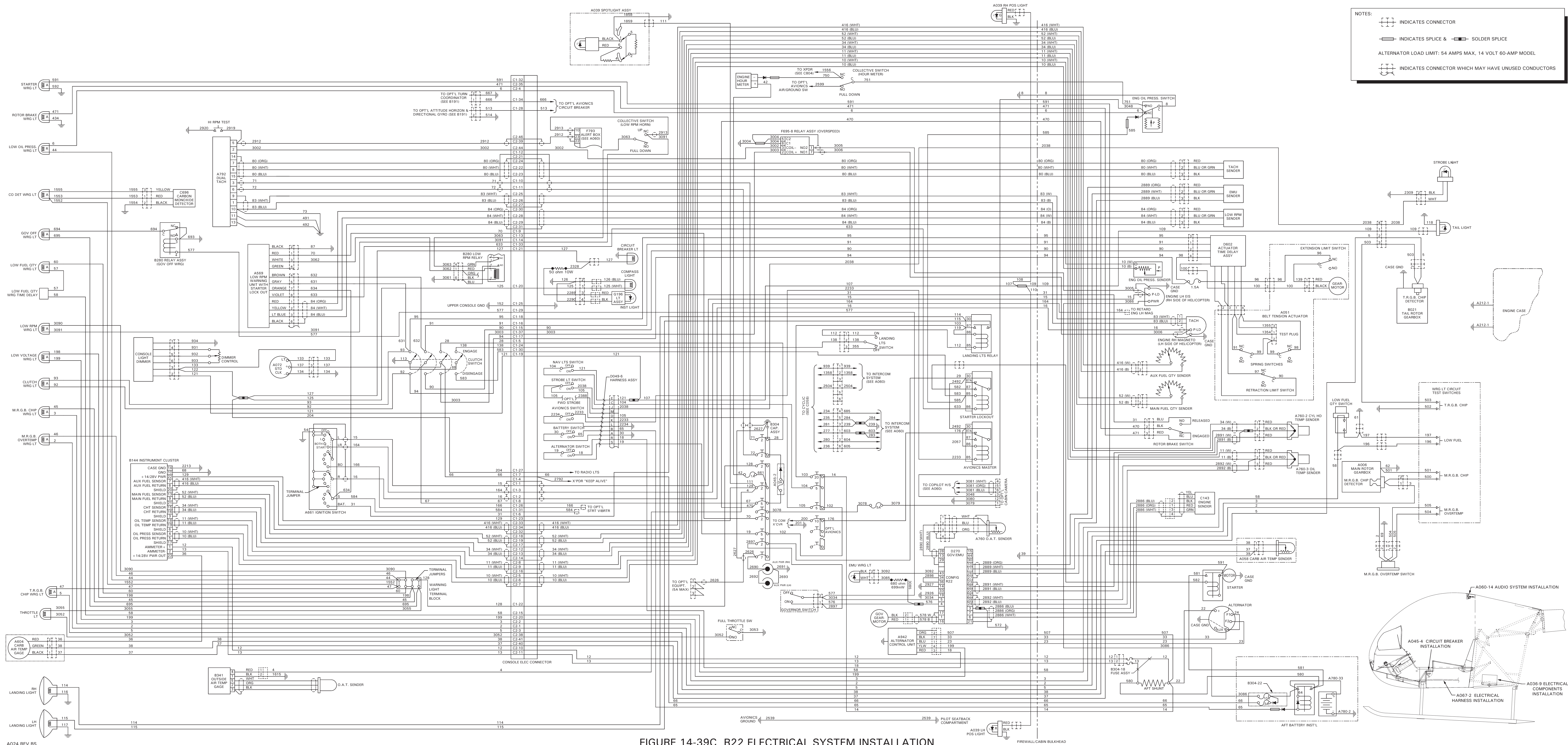


FIGURE 14-39C R22 ELECTRICAL SYSTEM INSTALLATION  
(A024 Revision BS shown)



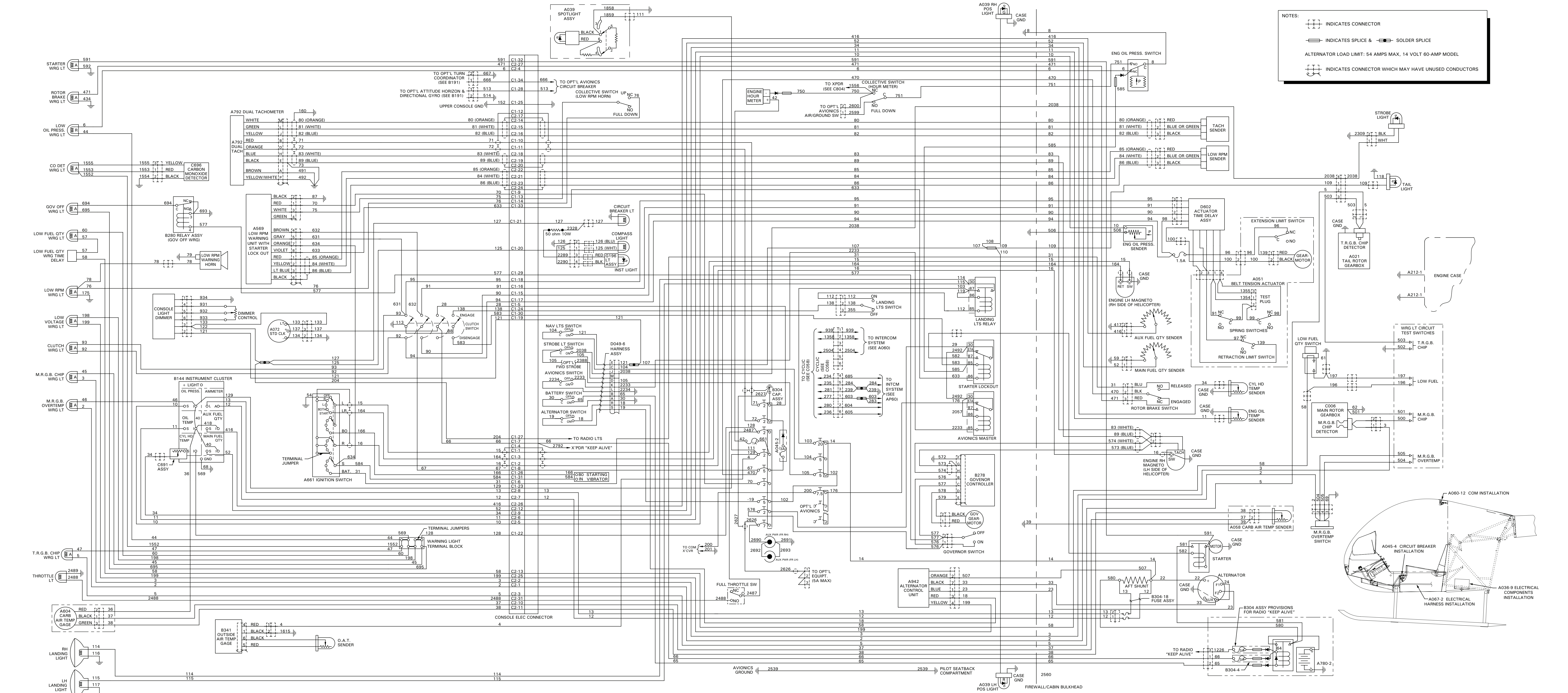
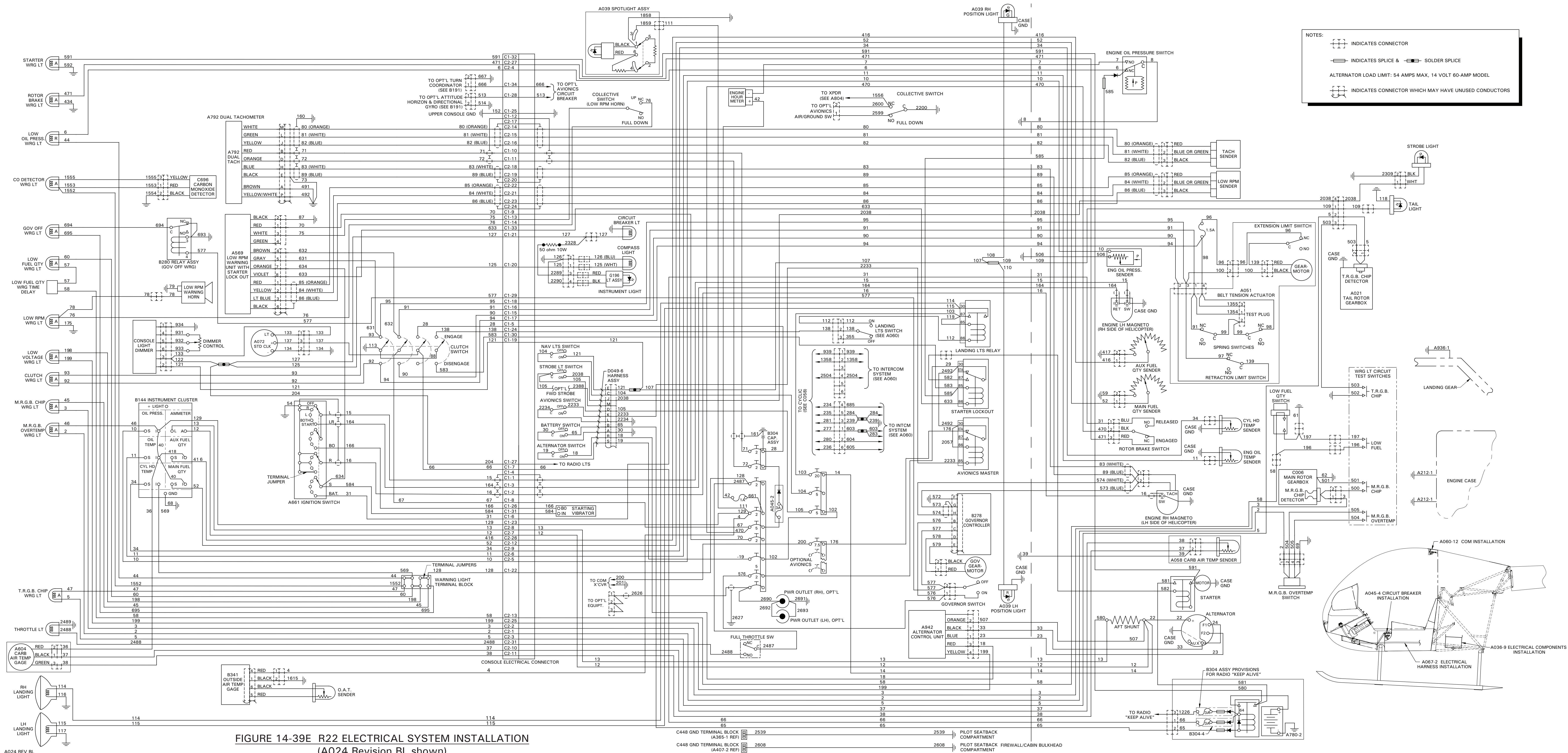
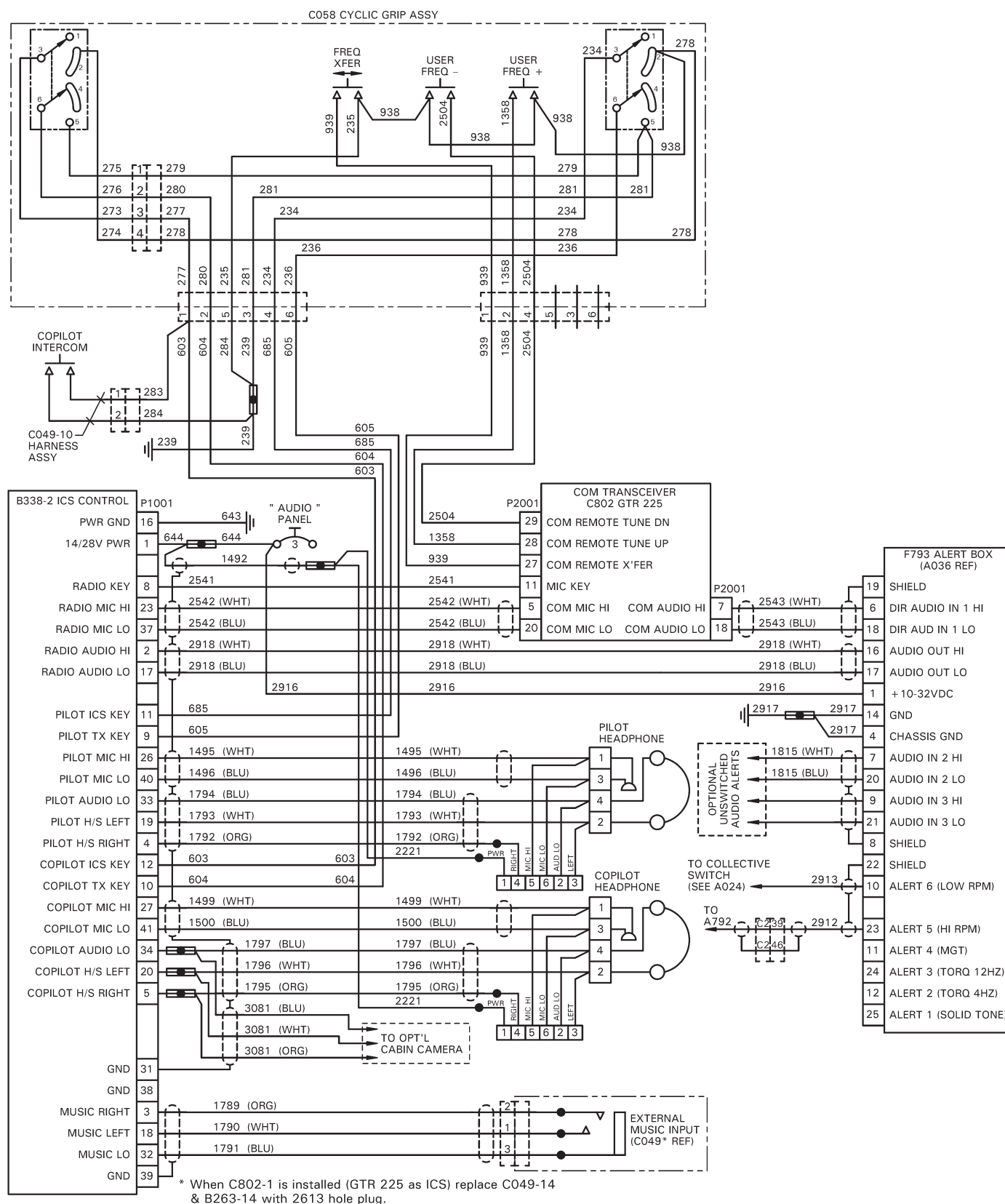


FIGURE 14-39D R22 ELECTRICAL SYSTEM INSTALLATION (A024 Revision BO shown)





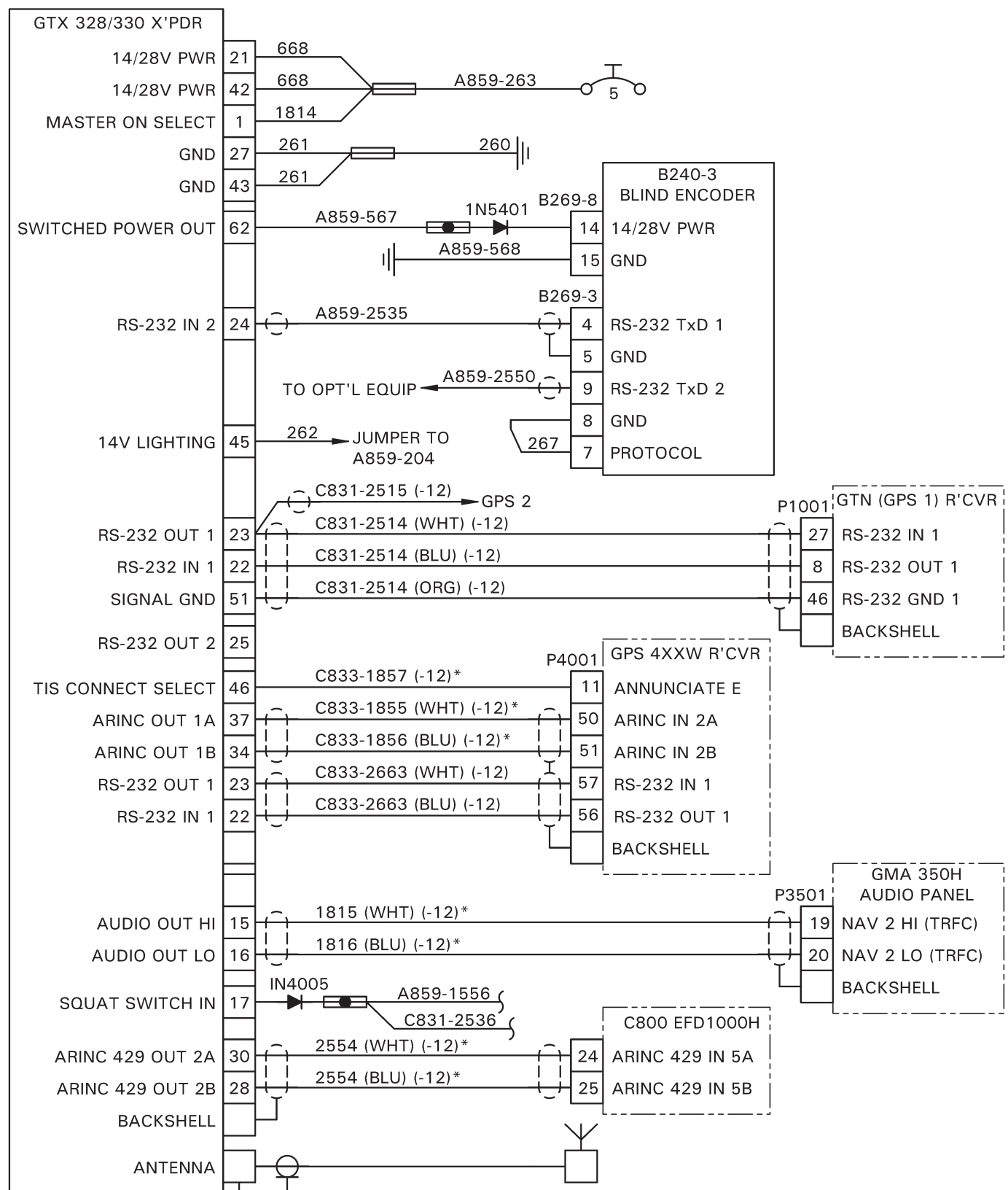
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A060 REV AQ

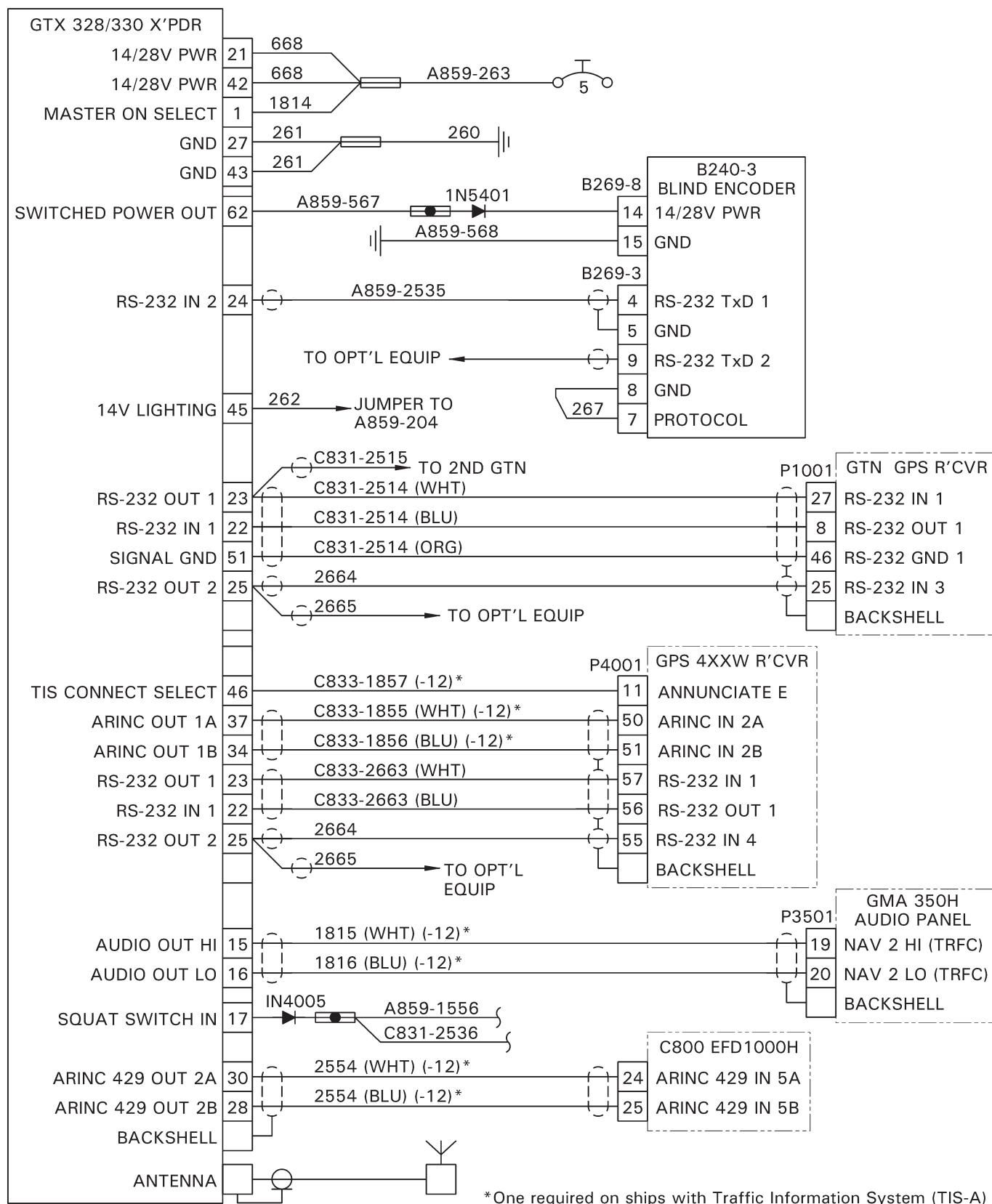
FIGURE 14-40 A060-14 AUDIO SYSTEM INSTALLATION

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A804 REV AH

FIGURE 14-41 A804-12 &amp; -13 TRANSPONDER SCHEMATIC (GARMIN GTX 330 ES)



A804 REV AG

FIGURE 14-42 A804-12 &amp; -13 TRANSPONDER SCHEMATIC (GARMIN GTX 330 ES; EARLIER SHIPS)



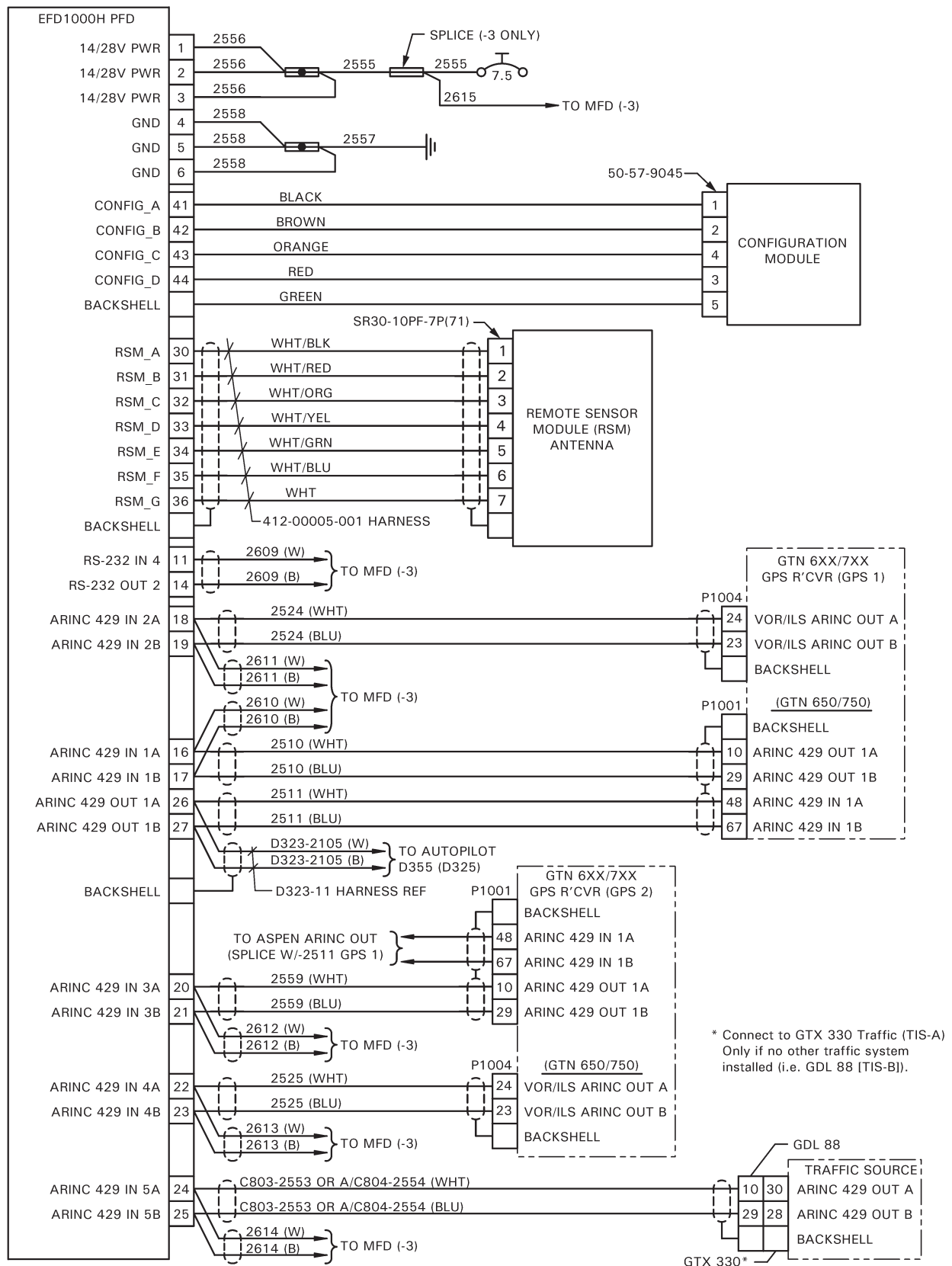


FIGURE 14-43 C800-1 ASPEN PFD ELECTRICAL SCHEMATIC

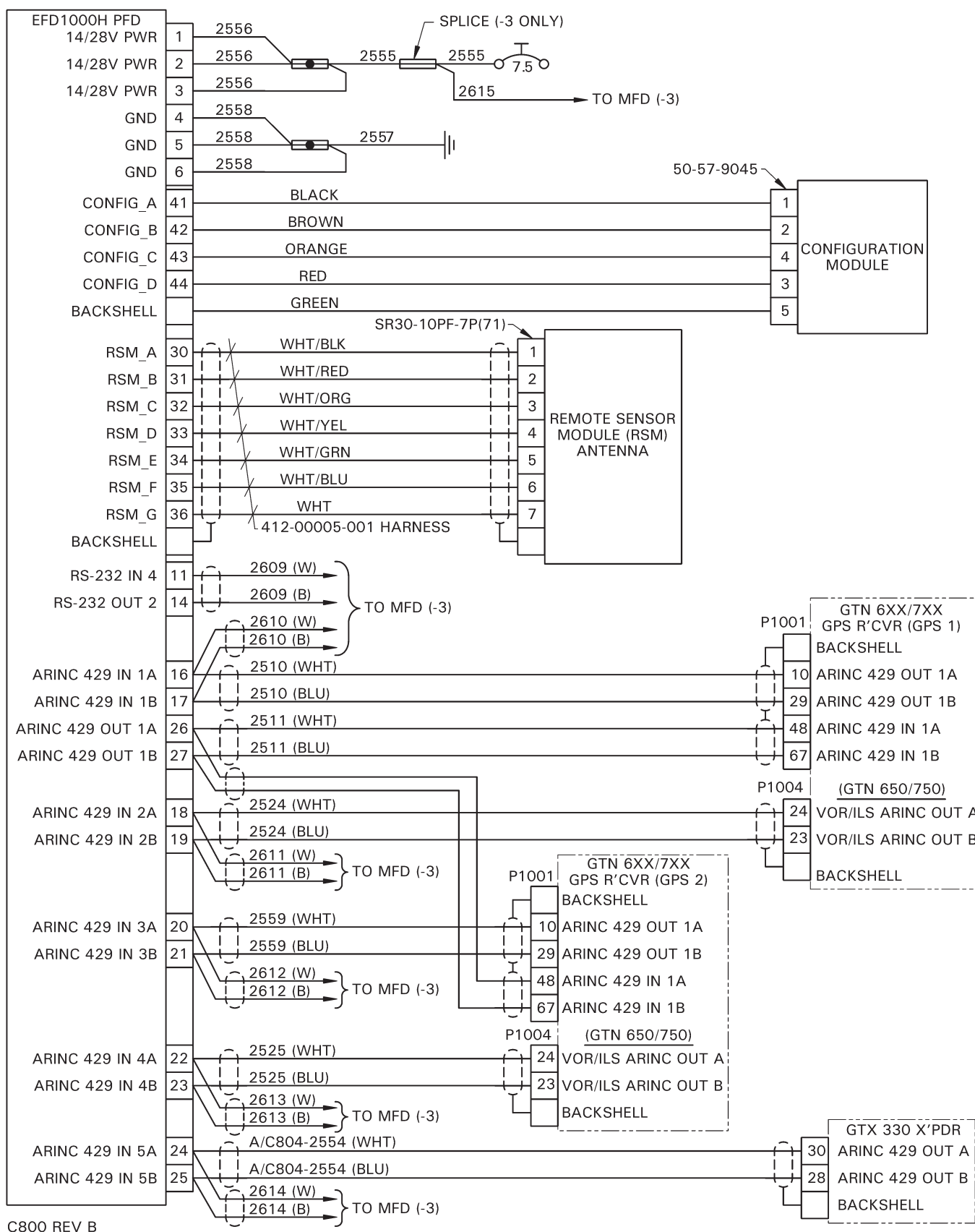
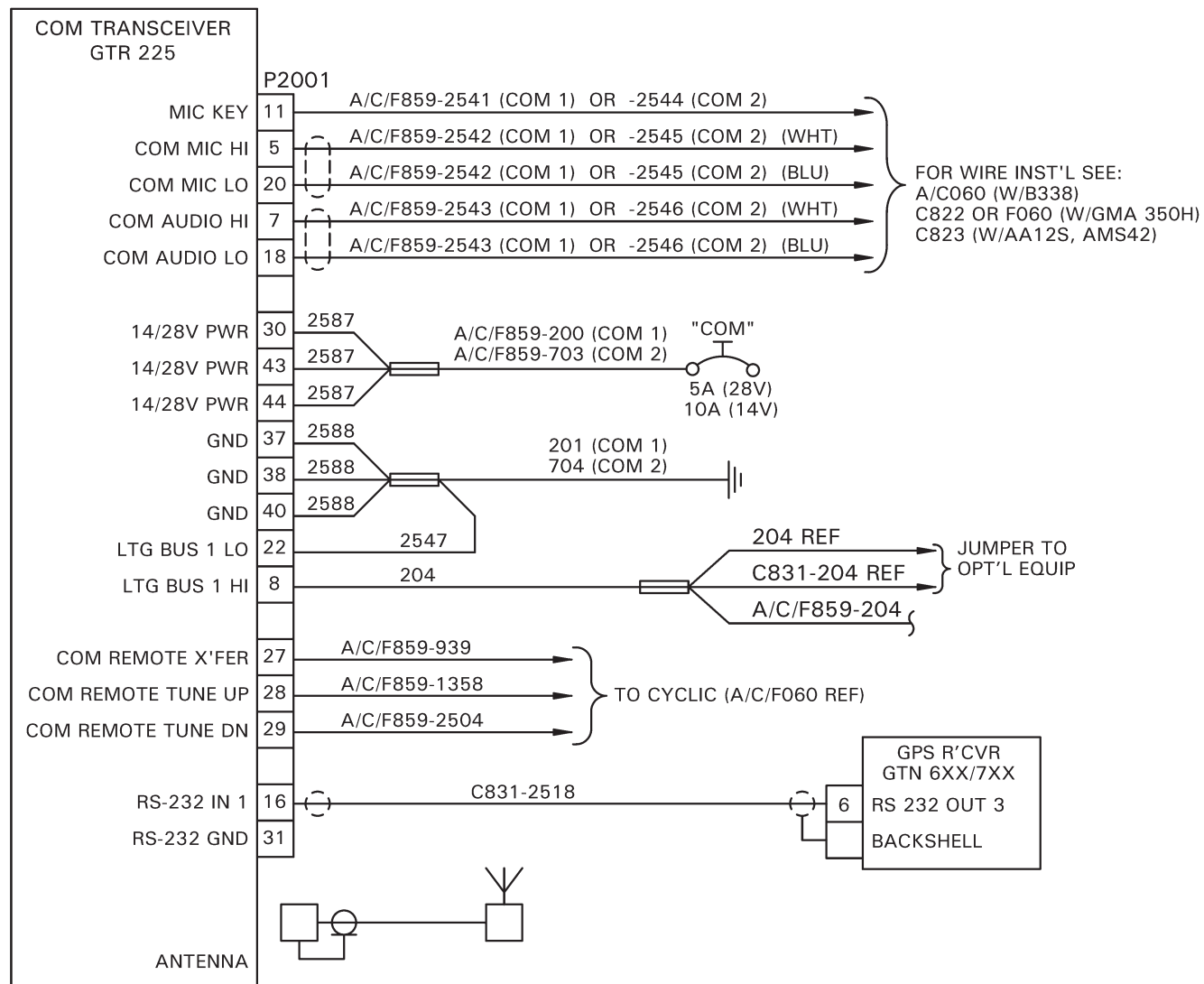


FIGURE 14-44 C800-1 ASPEN PFD ELECTRICAL SCHEMATIC (EARLIER SHIPS)

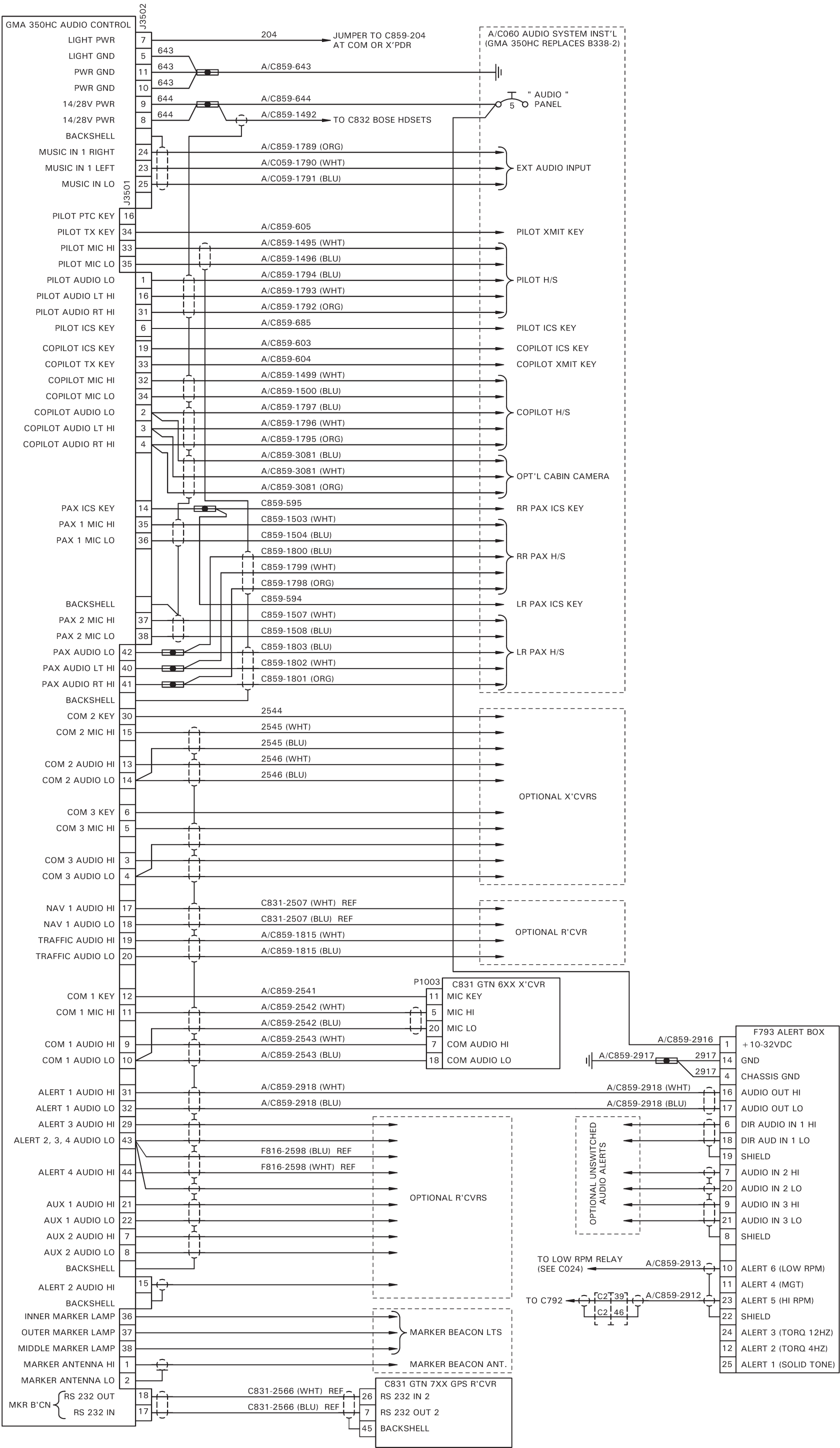
C802 REV E -2,-3, & -4

A805 GI 106B



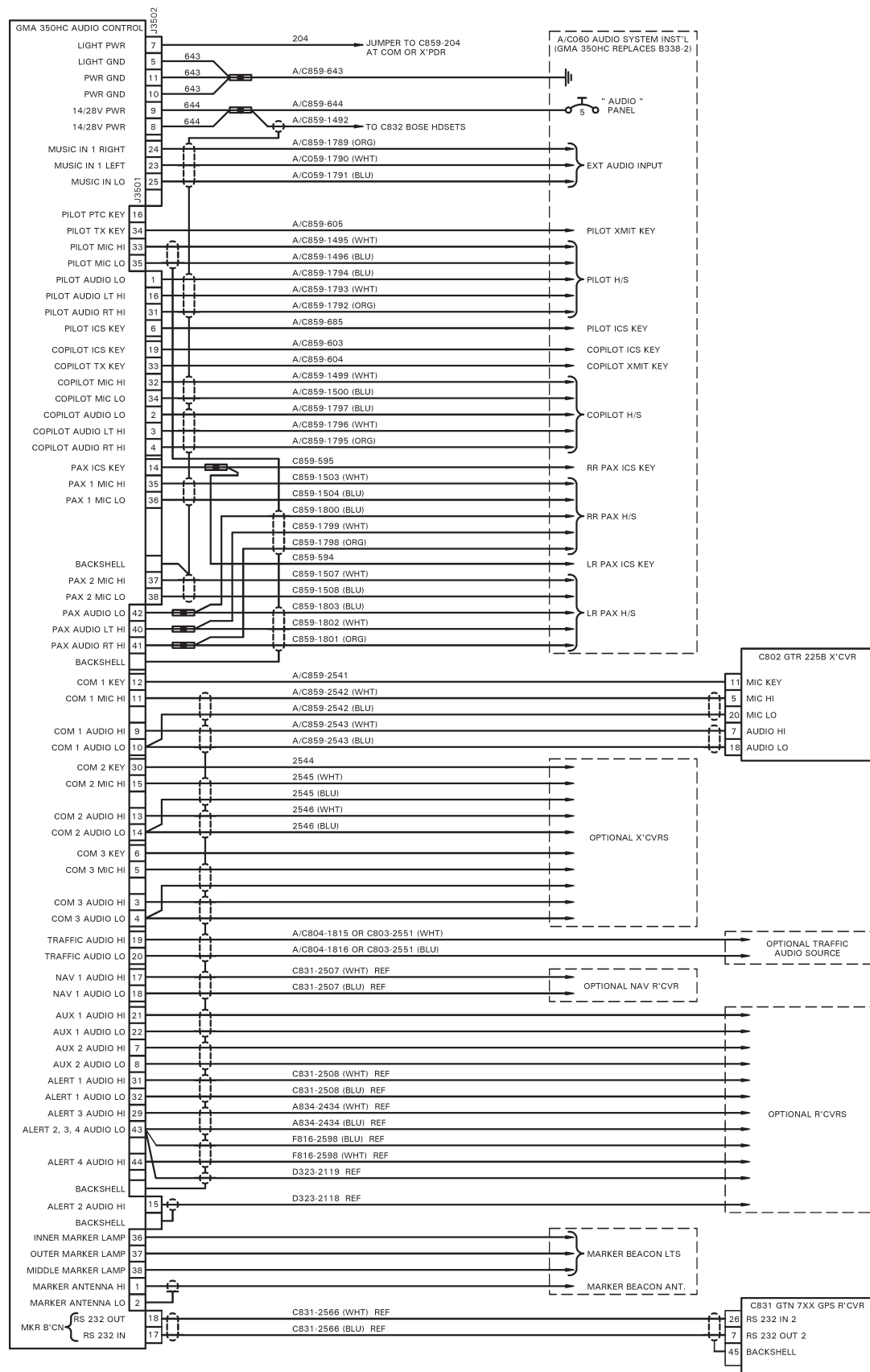
C802 REV D

FIGURE 14-46 C802-2 &amp; -3 COM RADIO SCHEMATIC (GARMIN GTR 225B; EARLIER SHIPS)



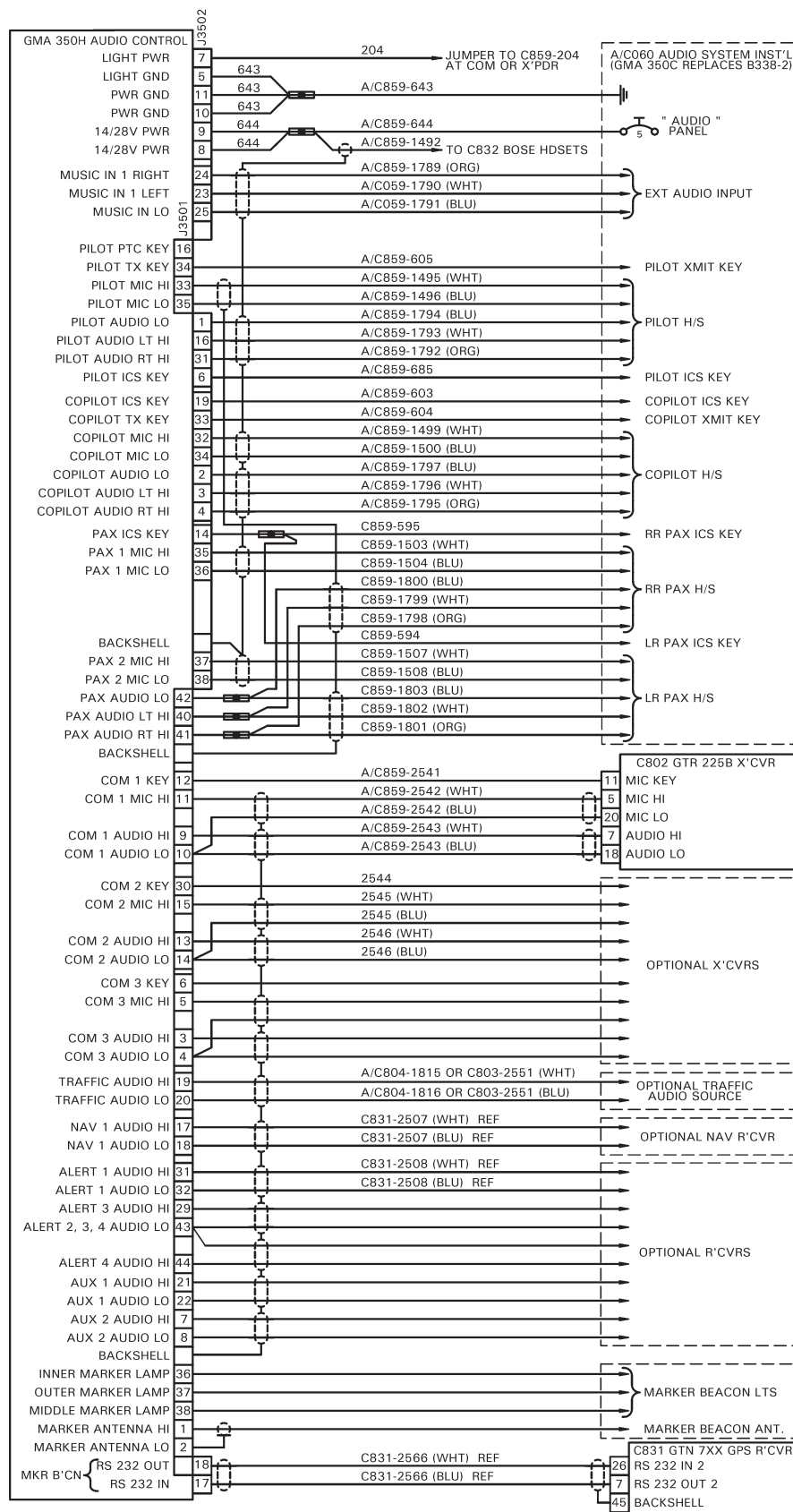
C822 REV G

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C822 REV D

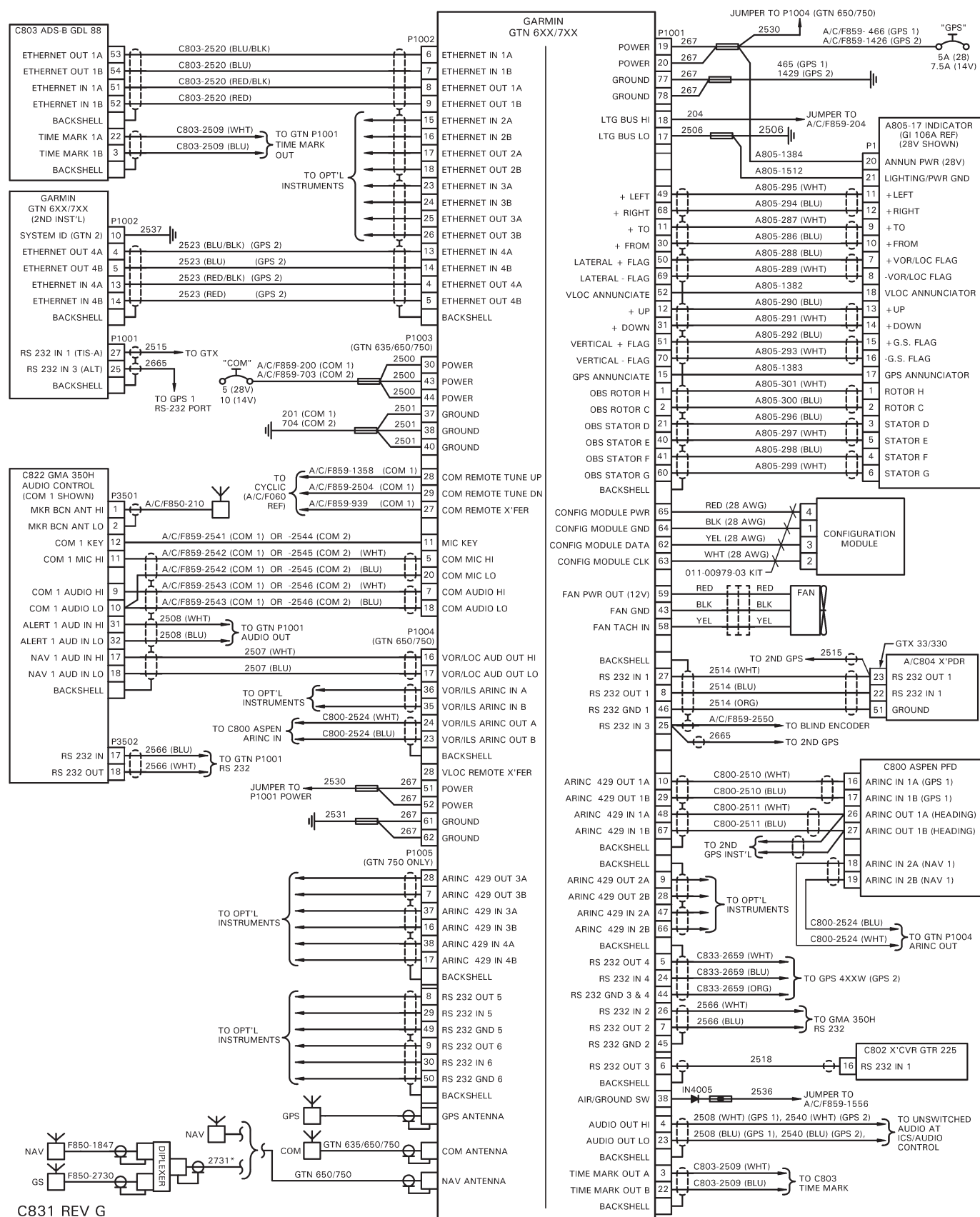
FIGURE 14-48A C822-1 AUDIO CONTROL SCHEMATIC (GARMIN GMA 350HC)



C822 REV C

FIGURE 14-48B C822-1 AUDIO CONTROL SCHEMATIC (GARMIN GMA 350H; EARLIER SHIPS)





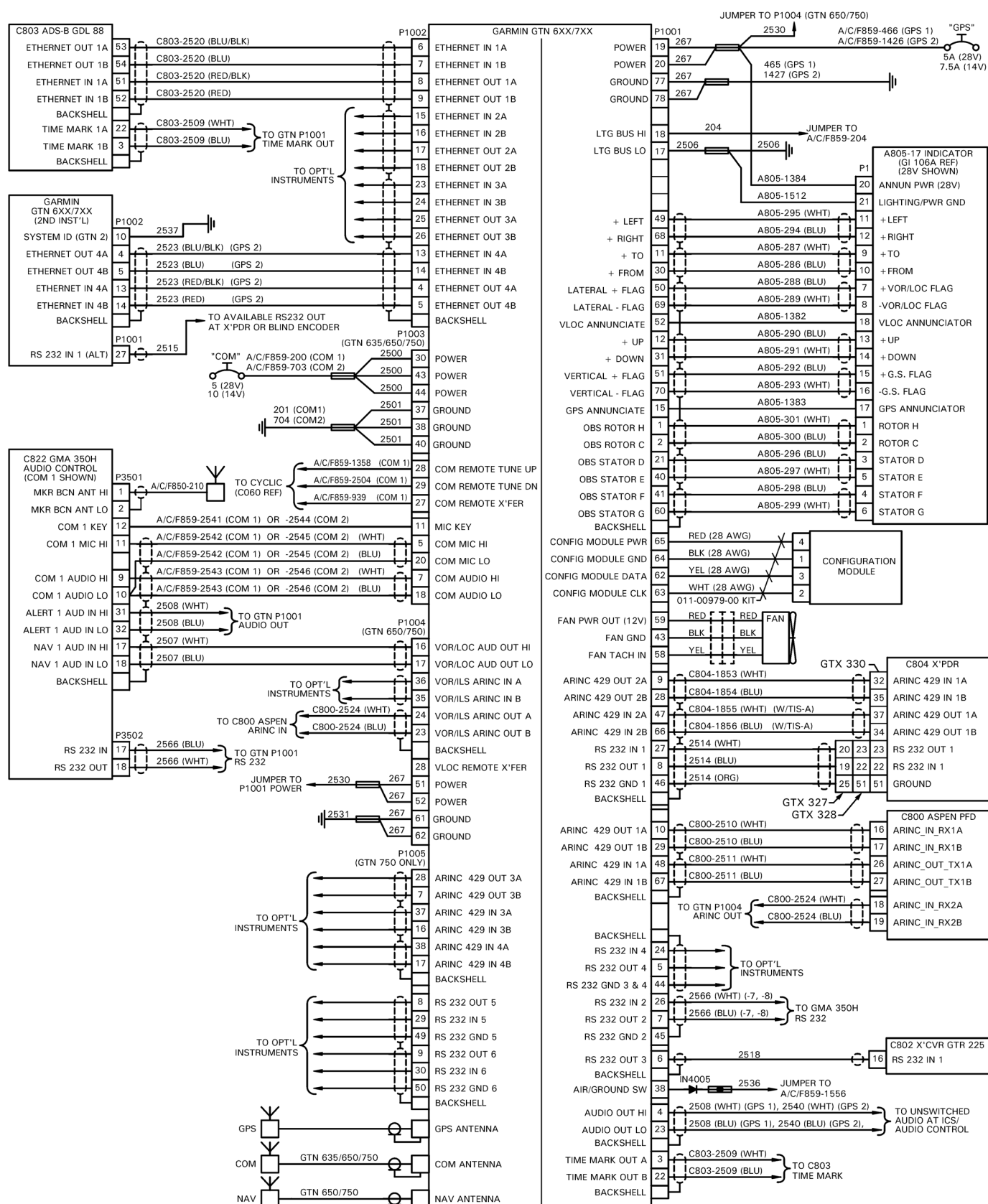


FIGURE 14-50 C831 GPS SCHEMATIC (GARMIN GTN 600 SERIES; EARLIER SHIPS)

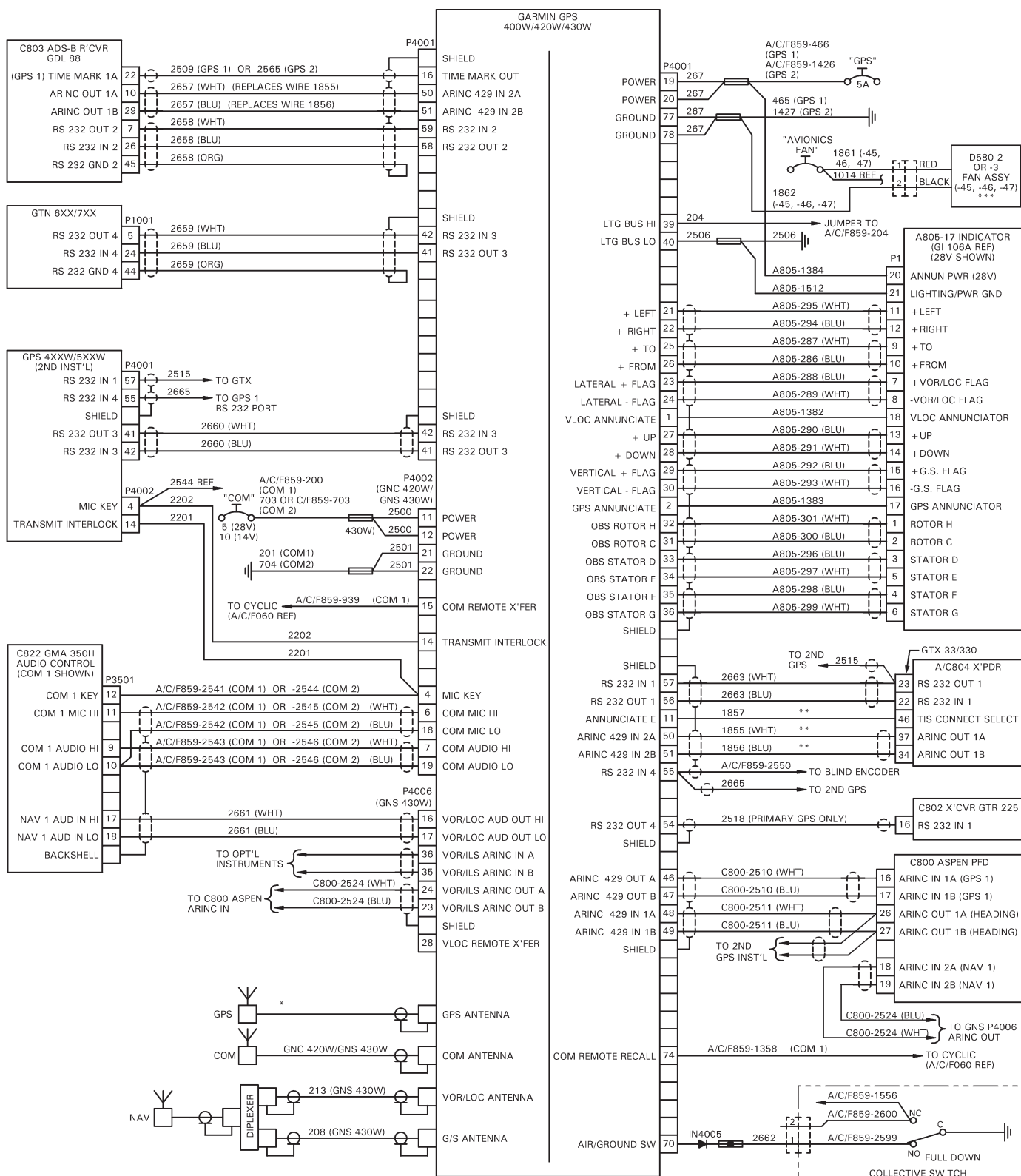


FIGURE 14-51 C833 GPS SCHEMATIC (GARMIN 400 SERIES)

C833 REV T

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## CHAPTER 15

## FURNISHINGS

<u>Section</u>	<u>Title</u>	<u>Page</u>
15-00	Description . . . . .	15.1
15-10	Seat Harnesses . . . . .	15.1
15-20	Seat and Seat Back Assemblies . . . . .	15.2
15-21	Seat Assemblies . . . . .	15.2
15-22	Seat Back Assemblies . . . . .	15.2
15-30	Carpet . . . . .	15.4
15-40	Insulation (Foam and Headliner) . . . . .	15.5
15-50	General Maintenance . . . . .	15.6
15-51	Pilot's Operating Handbook (POH) Strap Replacement . . . . .	15.6
15-52	License Holder Replacement . . . . .	15.6
15-53	Map Pocket Replacement . . . . .	15.6
15-60	Emergency Equipment . . . . .	15.7
15-61	Emergency Locator Transmitter (ELT) . . . . .	15.7
15-62	Fire Extinguisher . . . . .	15.8

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**CHAPTER 15****FURNISHINGS****15-00 Description**

The seats are not adjustable but each helicopter is delivered with a cushion which can be placed behind the pilot to position him farther forward. This allows shorter pilots to reach the pedals, the cyclic grip in its most forward position, and controls on the center console.

Each seat is equipped with a combined lap belt and inertia reel shoulder strap. The inertia reel is normally free but will lock if there is sudden movement as would occur in an accident.

A baggage compartment is located under each seat. Seat cushions hinge forward for access.

**15-10 Seat Harnesses****A. Removal**

1. Hinge seat assemblies forward.
2. Remove hardware securing F628-8 buckle assemblies to inboard anchors. Remove hardware securing lap belt fittings to outboard anchors.
3. Remove shoulder strap guide covers. Remove hardware securing guides to A259 bulkhead.
4. Remove inertia reel covers. Remove hardware securing reels to bulkhead. Remove A628-6 connector assemblies.

**B. Installation**

1. Install hardware securing A628-6 connector assembly inertia reels to A259 bulkhead. Install reel covers. Verify security.
2. Install hardware securing shoulder strap guides to bulkhead. Standard torque bolts per § 23-32. Install guide covers. Verify security.
3. Install hardware securing F628-8 buckle assemblies to inboard anchors; rotate buckles 20° forward from vertical. Standard torque bolts per § 23-32. Verify security.
4. Install hardware securing lap belt fittings to outboard anchors. Standard torque bolts per § 23-32. Verify security.

## 15-20 Seat and Seat Back Assemblies

### 15-21 Seat Assemblies

#### **A. Removal**

Remove hardware securing seat assembly to support and remove seat.

#### **B. Installation**

Position seat assembly on support and install hardware. Verify security.

### 15-22 Seat Back Assemblies

#### **A. Removal**

##### Left Seat Back

1. Remove screws securing pilot's collective boot and ring to A465-4 (vertical) panel assembly, remove ring, and unsnap boot. Remove screws securing panel to cabin and remove panel.
2. Remove screws securing A670-1 (fuel) valve's A798 plates to A003-13 seat back assembly and remove A798-1 plate.
3. Tilt seat assembly forward and remove screws securing co-pilot's collective boot and ring to seat back, remove ring, and unsnap boot. Remove screws securing seat back to cabin and remove seat back. (Remove A798-3 plate.)

##### Right Seat Back

1. Remove screws securing pilot's collective boot and ring to A465-4 (vertical) panel assembly, remove ring, and unsnap boot. Remove screws securing panel to cabin and remove panel.
2. Remove screws securing A003-14 seat back assembly to cabin and remove seat back.



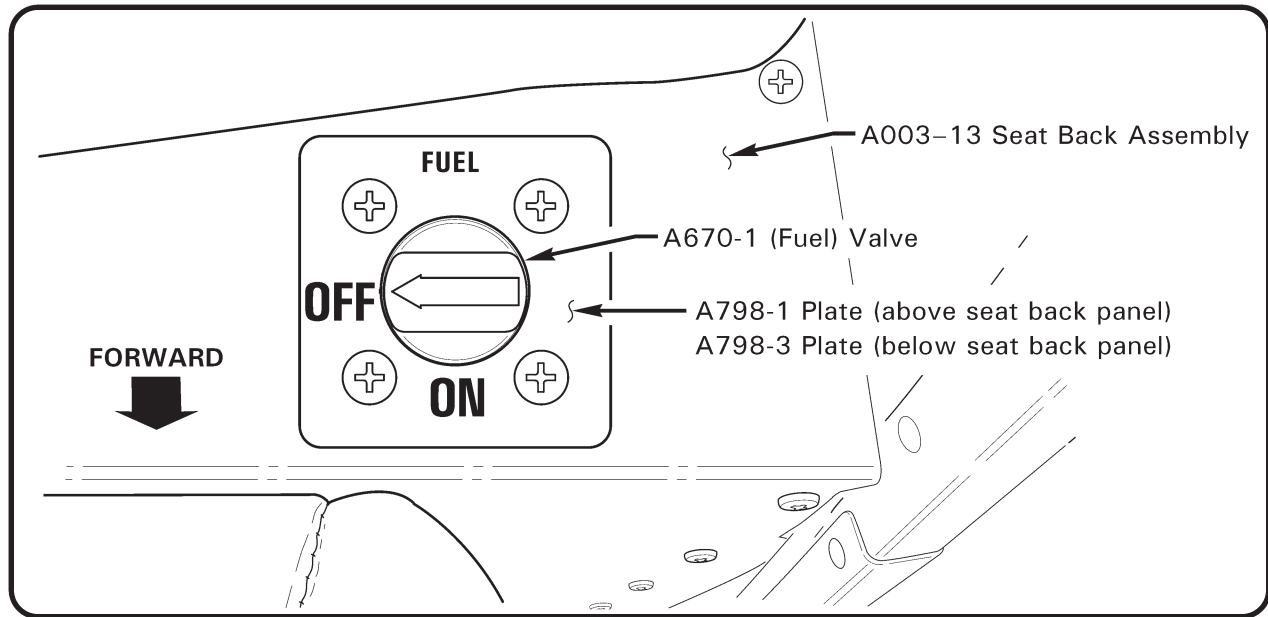


FIGURE 15-1 A798-1 PLATE ORIENTATION (VIEW LOOKING DOWN)

## 15-22 Seat Back Assemblies (continued)

### B. Installation

#### Left Seat Back

1. Position A798-3 plate on A670-1 (fuel) valve. Tilt seat assembly forward and position A003-13 seat back assembly on cabin and install screws. Verify security.
2. Install screws securing co-pilot's collective boot and ring to seat back and snap-up boot. Verify security.
3. Refer to Figure 15-1. Install A798-1 plate on seat back as shown. Special torque screws to 16 in.-lb.
4. Install screws securing A654-4 (vertical) panel assembly to cabin. Install screws securing pilot's collective boot and ring to panel and snap-up boot. Verify security.

#### Right Seat Back

1. Refer to Figure 15-1. Tilt seat assembly forward and position A003-14 seat back assembly on cabin and install screws. Verify security.
2. Install screws securing A654-4 (vertical) panel assembly to cabin. Install screws securing pilot's collective boot and ring to panel and snap-up boot. Verify security.

15-22 Seat Back Assemblies (continued)**C. Back Rest Assembly (Cushion) Replacement**

1. Remove seat back assembly per Part A.
2. Drill out rivets securing back rest assembly (cushion) to seat back panel and deburr holes. Remove cushion.
3. Center and straighten new back rest  $1.00 \pm 0.10$  inch above top edge of seat back panel. Match drill seat back panel #30 holes through back rest. Deburr holes and clean up debris.
4. Attach back rest cushion to seat back panel with rivets. Verify security.

15-30 Carpet**A. Removal**

1. Floor carpets: Remove hardware securing scuff plates (and carpet) to cabin floor and remove scuff plates, if installed.

**CAUTION**

Use caution when removing adhered carpet if carpet is intended for reuse.

2. Starting at corners, gently peel back carpet by hand, or with plastic wedge or putty knife.
3. Dampen old adhesive with Dupont Prep-Sol (or equivalent) to facilitate removal.

**B. Installation**

1. Verify proper carpet fit. Trim as required (do not trim carpet welt).
2. Apply B270-8 adhesive to bonding surface and carpet backing. Press carpet to surface, smooth wrinkles, and remove excess adhesive prior to curing.
3. Install hardware securing scuff plates (and carpet) to cabin floor if removed. Verify security.

15-40 Insulation (Foam and Headliner)**A. Removal****NOTE**

Use caution not to damage surface underneath insulation when removing insulation with tools.

**NOTE**

Insulation is installed using adhesive, except under seat assemblies. Order new insulation as required; reuse of removed insulation is not recommended.

1. Peel off insulation by hand.
2. Using plastic wedge or putty knife, carefully remove residual insulation and old adhesive.
3. Wipe bonding surface with clean cloth, wet with acetone.

**B. Installation**

1. Verify proper insulation fit. Trim as required.
2. Apply B270-8 adhesive to bonding surface and insulation backing. Press insulation to surface, smooth wrinkles, and remove excess adhesive prior to curing.

## 15-50 General Maintenance

### 15-51 Pilot's Operating Handbook (POH) Strap Replacement

#### **A. Removal**

Remove POH. Drill out rivets securing POH retaining strap to chin and remove strap. Deburr holes and clean up debris.

#### **B. Installation**

Cleco POH retaining strap to chin. Progressively remove clecos and install rivets. Verify security. Install POH.

### 15-52 License Holder Replacement

#### **A. Removal**

Remove contents. Drill out rivets securing license holder to chin and remove license holder. Deburr holes and clean up debris.

#### **B. Installation**

Cleco license holder to chin. Progressively remove clecos and install rivets. Verify security. Install contents and tuck holder under frame.

### 15-53 Map Pocket Replacement

#### **A. Removal**

Remove contents. Drill out rivets securing map pocket to seat support. Remove pocket, washers, and retaining strips. Deburr holes and clean up debris.

#### **B. Installation**

1. Fold (long) outboard pocket edge around (long) A913-1 strip, align holes, and align holes with front of forward seat box. Cleco in place.
2. Pull material taut, fold (short) inboard pocket edge around (short) A913-2 strip, align holes, and align holes with front of forward seat box. Cleco in place. Trim excess material.
3. Progressively remove clecos and install washers and rivets.

## 15-60 Emergency Equipment

### 15-61 Emergency Locator Transmitter (ELT)

#### **A. Description**

The ELT activates when subjected to a significant change in velocity (as in an accident), by remote control switch located on the cyclic control panel, or by a switch on the ELT transmitter. Refer to § 33-80 for system description.

Refer to Kannad Aviation AF Integra / AF-H Integra or 406 AF-Compact/406 AF-Compact (ER) ELT Installation and Operation Manual for maintenance requirements and procedures. Refer to § 1.101 for scheduled maintenance and inspections. |

Register an ELT when first purchased, when contact information changes, or when aircraft ownership, or tail number changes. Registration information is available online at: [www.cospas-sarsat.org](http://www.cospas-sarsat.org).

Dongles contain a memory chip that must be programmed with aircraft-specific information prior to installation for the ELT to function. The dongle may be removed and shipped to RHC or a Kannad Service Center for reprogramming. Kannad Aviation's Programming Data Sheet is available online at: [www.robinsonheli.com](http://www.robinsonheli.com).

#### **B. Transmitter**

##### Removal

1. Release D693-4 strap assembly or B359-2 (reusable) ty-rap.
2. Release Velcro strap; disconnect dongle and antenna wiring from transmitter at connectors and remove transmitter.

##### Installation

1. Connect dongle and antenna wiring to transmitter at connectors. Verify security.
2. Position transmitter on mounting bracket and secure with Velcro strap. Secure D693-4 strap assembly or install B359-2 (reusable) ty-rap around transmitter and bracket. Verify security.

#### **C. Dongle**

##### Removal

Cut and discard ty-raps as required, disconnect dongle from transmitter and airframe harness at connectors, and remove dongle.

##### Installation

1. Connect programmed dongle to transmitter and airframe harness at connectors.
2. Install ty-raps as required. Cinch ty-raps until snug without over-tightening, and trim tips flush with heads. Verify security.

15-62 Fire Extinguisher**CAUTION**

Extinguisher is rated for a storage and operating temperature of 120°F (49°C). If operating conditions would expose extinguisher to higher temperatures (e.g. long term parking in the sun in a hot climate), remove extinguisher and store it in a cooler area between flights.

**A. Inspection**

*Every month:* Visually inspect fire extinguisher and perform weight check (a scale with 1 gram precision or better is required). Remove extinguisher from service if total weight falls below 500 grams. If desired, order one G654-15 decal (blank maintenance log) and attach to extinguisher, to record weight checks.

*Every 12 years:* Remove fire extinguisher from service. Year of manufacture is labeled on bottom of extinguisher; remove extinguisher from service at end of 12th year from labeled date.

**B. Bracket Removal**

1. Unlatch fire extinguisher bracket and remove extinguisher.
2. Remove hardware securing bracket to chin and remove bracket.

**C. Bracket Installation**

1. Install hardware securing fire extinguisher bracket to chin. Select screw length as required to provide 0.00–0.06 inch thread exposure. Verify security.
2. Install fire extinguisher and latch bracket.

## CHAPTER 16

## DIMENSIONS AND DESCRIPTIONS

<u>Section</u>	<u>Title</u>	<u>Page</u>
16-10	Version Description . . . . .	16.1
16-20	Datum . . . . .	16.2
16-30	Method of Measurement . . . . .	16.2
16-40	External Dimensions . . . . .	16.3
16-50	Station Locations . . . . .	16.6
16-60	Access and Inspection Panels . . . . .	16.6
16-61	B526 Screws and B527-08 Washers . . . . .	16.6
16-70	Antenna Locations . . . . .	16.7

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## CHAPTER 16

## DIMENSIONS AND DESCRIPTIONS

16-10 Version Description

Refer to § 3.200 for Type Certificate Data Sheet.

**WARNING**

**Refer to R22 Illustrated Parts Catalog (IPC) for specific part number differences between versions.**

- R22 Standard: Approved March 16, 1979. Serial numbers 0002 thru 0199, except 0175. Lycoming O-320-A2B or Lycoming O-320-A2C engine normally rated at 150 horsepower and derated to 124 horsepower. 80/87 minimum grade aviation gasoline. Gross weight 1300 pounds. A044-1 stabilizer angle 1.8–2.3 degrees nose up.
- R22 HP: Serial numbers 0175, 0200 thru 0255, 0257 thru 0300, 0302 thru 0349, 0352 thru 0356. Lycoming O-320-B2C engine normally rated at 160 horsepower and derated to 124 horsepower. 100LL or 91/96 minimum grade aviation gasoline. Gross weight 1300 pounds. A044-1 stabilizer angle 1.8–2.3 degrees nose up.
- R22 Alpha: Approved October 12, 1983. Serial numbers 0256, 0301, 0350, 0351, 0357 thru 0500. Lycoming O-320-B2C engine derated to 124 horsepower. Extended lower steel frames. Tailcone higher than Standard/HP. Aft battery installation. Gross weight 1370 pounds. A044-1 stabilizer angle 2.8 –3.3 degrees nose down. Auxiliary fuel tank optional for serial numbers 0457 and subsequent.
- R22 Beta: Approved August 12, 1985. Serial numbers 0501 thru 2570. Lycoming O-320-B2C engine derated to 124 horsepower. 131 horsepower five-minute take off rating. Extended lower steel frames. Higher tailcone than Standard/HP. Aft battery installation. Seven-hole instrument panel. Larger oil cooler. 1370 pounds gross weight. A044-1 stabilizer angle 2.8–3.3 degrees nose down. Auxiliary fuel tank optional. A569-5 low-rpm warning unit with starter lockout feature installed in serial number 2115 and subsequent. Starter lockout prevents starter activation at less than 62% rotor rpm when actuator is not fully disengaged; starter may be activated above 69% rotor rpm to allow an in-flight engine start.

### 16-10 Version Description (continued)

R22 Mariner: Approved September 12, 1985. Serial numbers 0364, 0501 thru 2570 eligible (suffix "M" added to ship serial number). Similar to Beta configuration except includes utility floats and additional corrosion protection. Different tailcone with 1.8–2.3 degrees nose-up horizontal stabilizer angle. Battery in nose when floats installed. Float stabilizer on lower vertical stabilizer in place of tail skid. May be flown without floats VFR day or night. Day VFR flight only with floats installed. Auxiliary fuel tank optional. Marine radio package optional.

Instrument Trainer: Alpha, Beta, or Beta II configuration with 10-hole instrument panel. VMC operations only.

Police Helicopter: Alpha, Beta, or Beta II configuration with searchlight, police radio package, and 70 amp alternator.

R22 Beta II: Approved January 31, 1996. Serial numbers 2571 and subsequent. Lycoming O-360-J2A engine derated to 124 horsepower maximum continuous power. 131 horsepower 5-minute take-off rating. Carburetor heat assist. 1370 pounds gross weight. A044-1 stabilizer angle 2.8–3.3 degrees nose down. Throttle only engine governor standard. A569-5 low-rpm warning unit with starter lockout feature standard. Auxiliary fuel system optional.

R22 Mariner II: Approved January 31, 1996. Serial numbers 2571 thru 3414 eligible (suffix "M" added to ship serial number). Similar to Beta II configuration except includes utility floats and additional corrosion protection. Battery in nose when floats installed. Different tailcone with 1.8–2.3 degrees nose-up horizontal stabilizer angle. Float stabilizer on lower vertical stabilizer in place of tail skid. May be flown without floats VFR day or night. Day VFR flight only with floats installed. Marine radio package optional.

### 16-20 Datum

The datum is located 100 inches forward of main rotor centerline.

### 16-30 Method of Measurement

Fuselage station, tailcone station, water line station, and butt line station values are measured in inches, rounded to the nearest hundredth.

## 16-40 External Dimensions

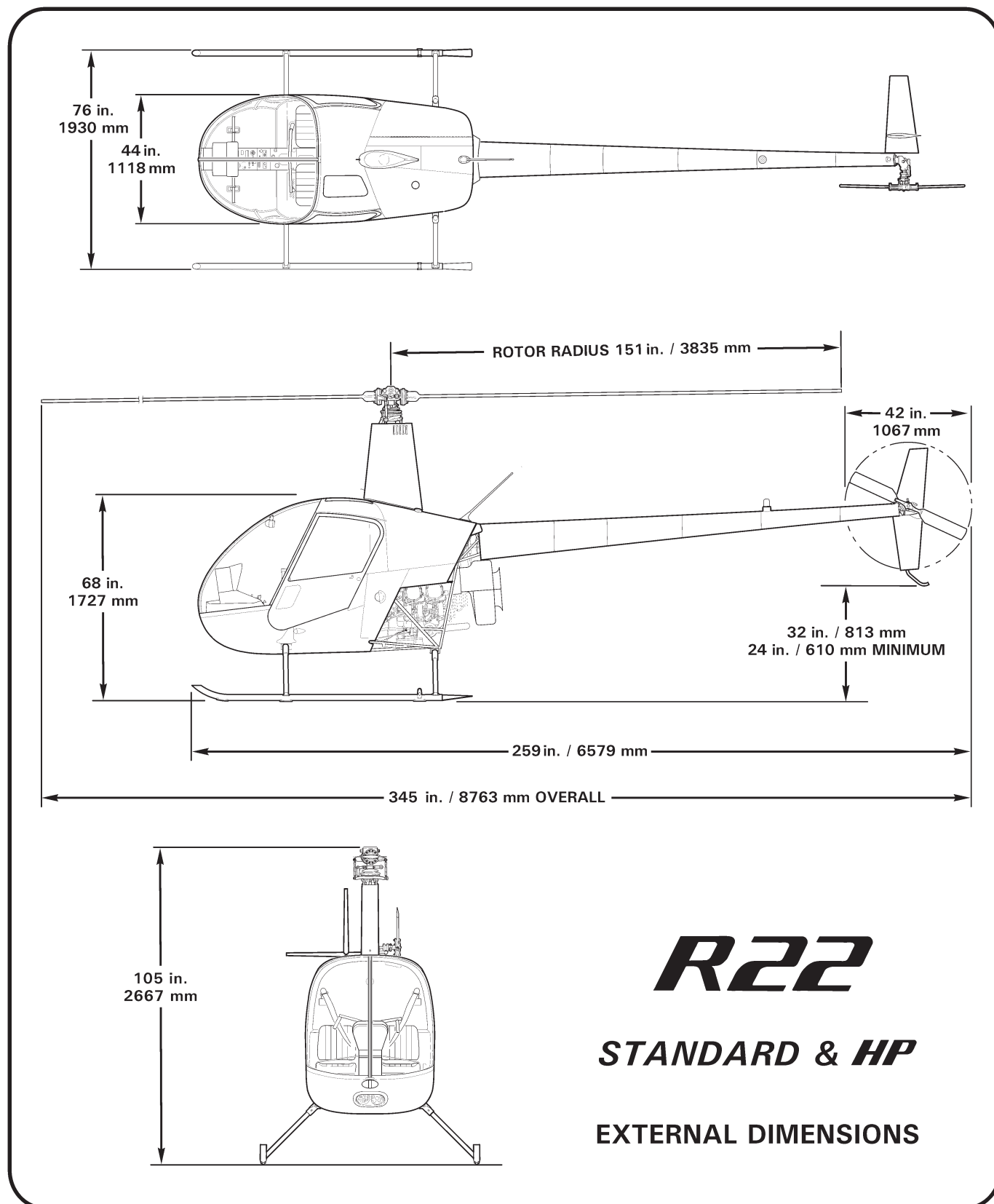


FIGURE 16-1 EXTERNAL DIMENSIONS

## 16-40 External Dimensions (continued)

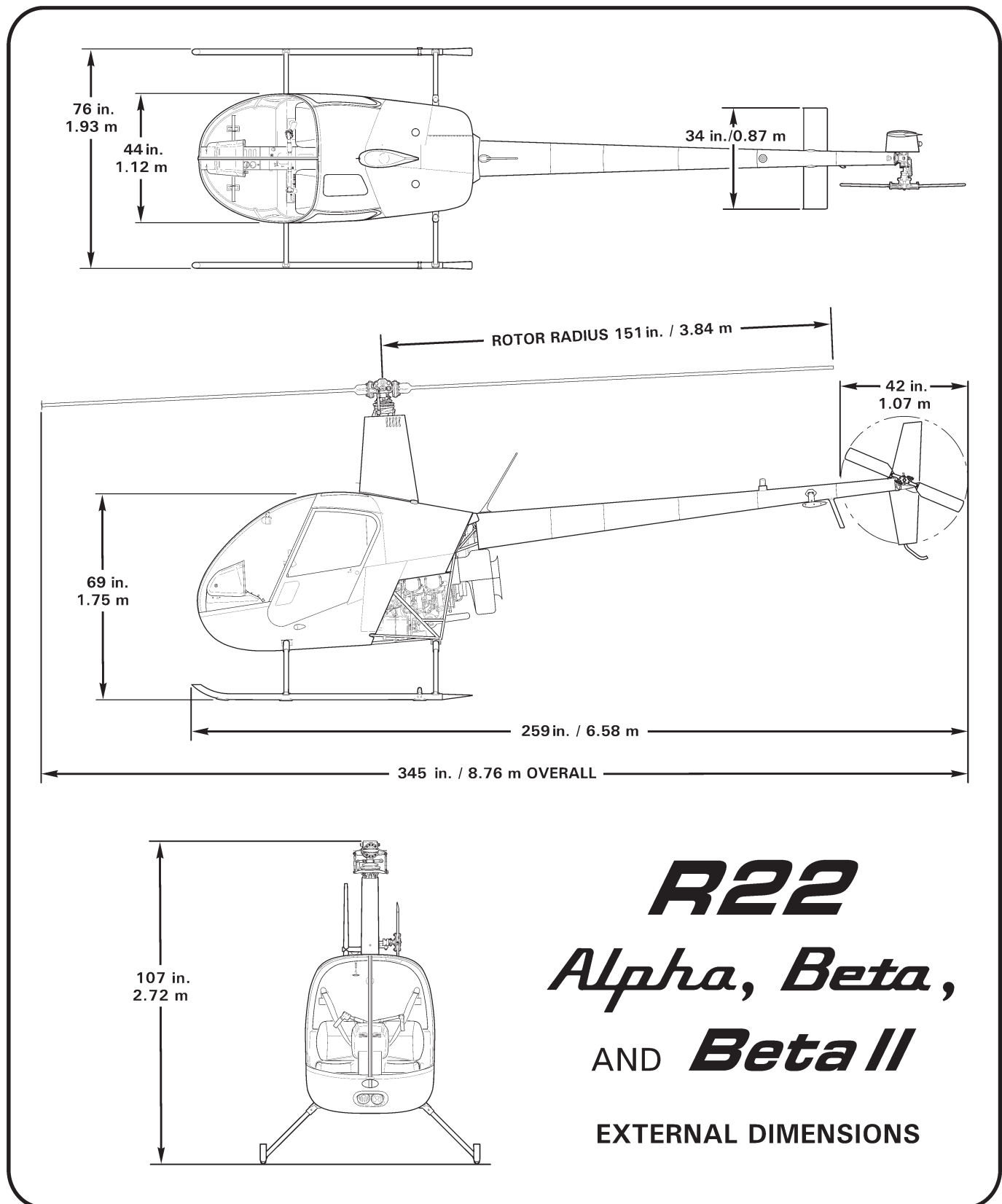


FIGURE 16-2 EXTERNAL DIMENSIONS

## 16-40 External Dimensions (continued)

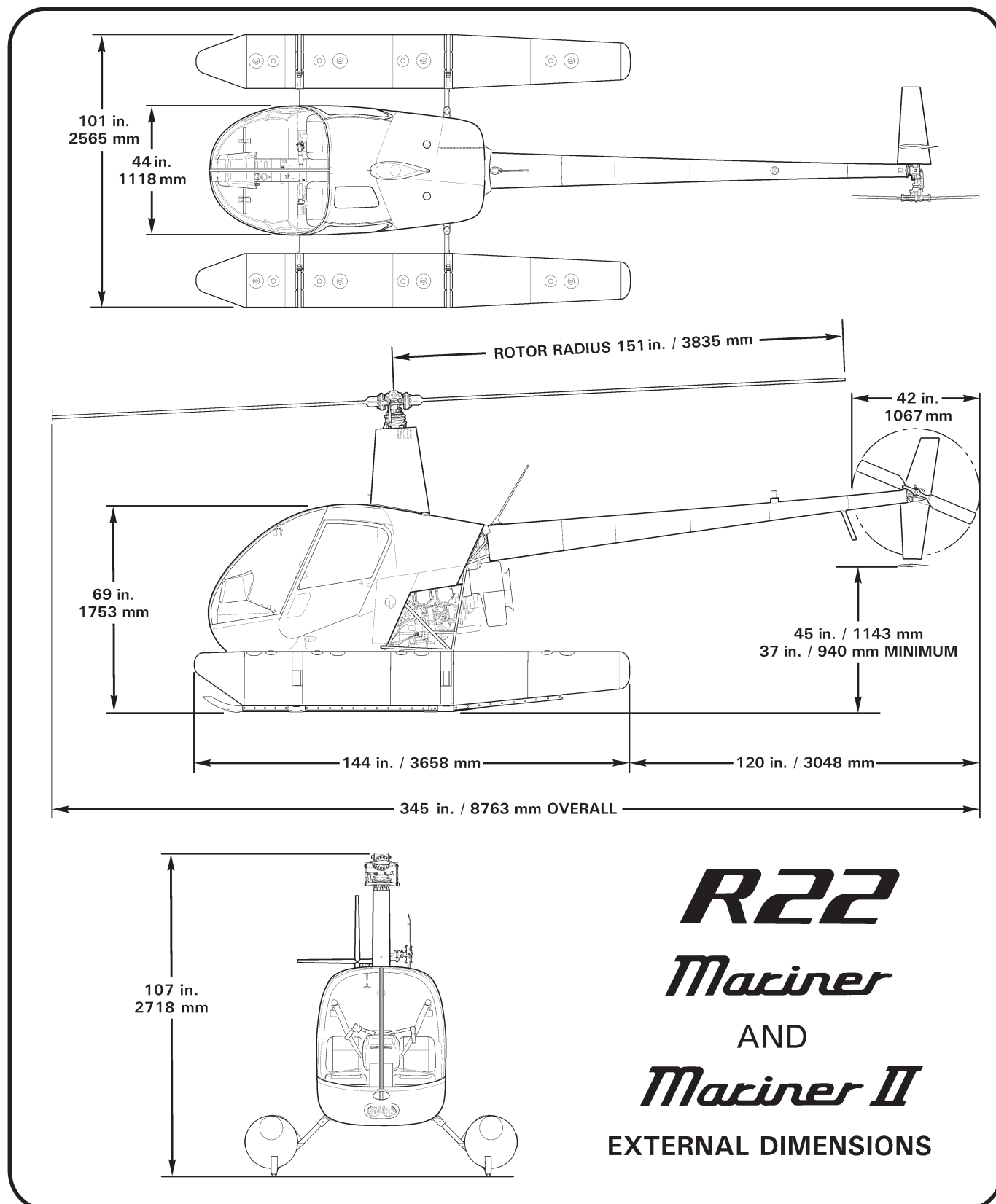


FIGURE 16-3 EXTERNAL DIMENSIONS

16-50 Station Locations

Reserved.

16-60 Access and Inspection Panels

Refer to R22 Illustrated Parts Catalog Chapter 6 for access and inspection panel locations.

16-61 B526 Screws and B527-08 Washers

B526 (TORX Plus®) truss head screws may be used to secure cowlings and access panels. A B527-08 nylon washer may be used under a B526 screw head to further protect thin or painted surfaces.

Following B526 screws are interchangeable with MS27039C080\_ screws used to secure cowlings and access panels:

<u>PART:</u>	<u>INTERCHANGEABLE WITH:</u>
MS27039C0806 screw . . . . .	B526-6 screw
MS27039C0807 screw . . . . .	B526-8 screw
MS27039C0808 screw . . . . .	B526-8 screw

Following B526 screws are interchangeable with AN525-832R\_ & AN526C832R\_ screws:

<u>PART:</u>	<u>INTERCHANGEABLE WITH:</u>
AN525-832R6 or AN526C832R6 screw . . . .	B526-6 screw
AN525-832R7 or AN526C832R7 screw . . . .	B526-8 screw
AN525-832R8 or AN526C832R8 screw . . . .	B526-8 screw

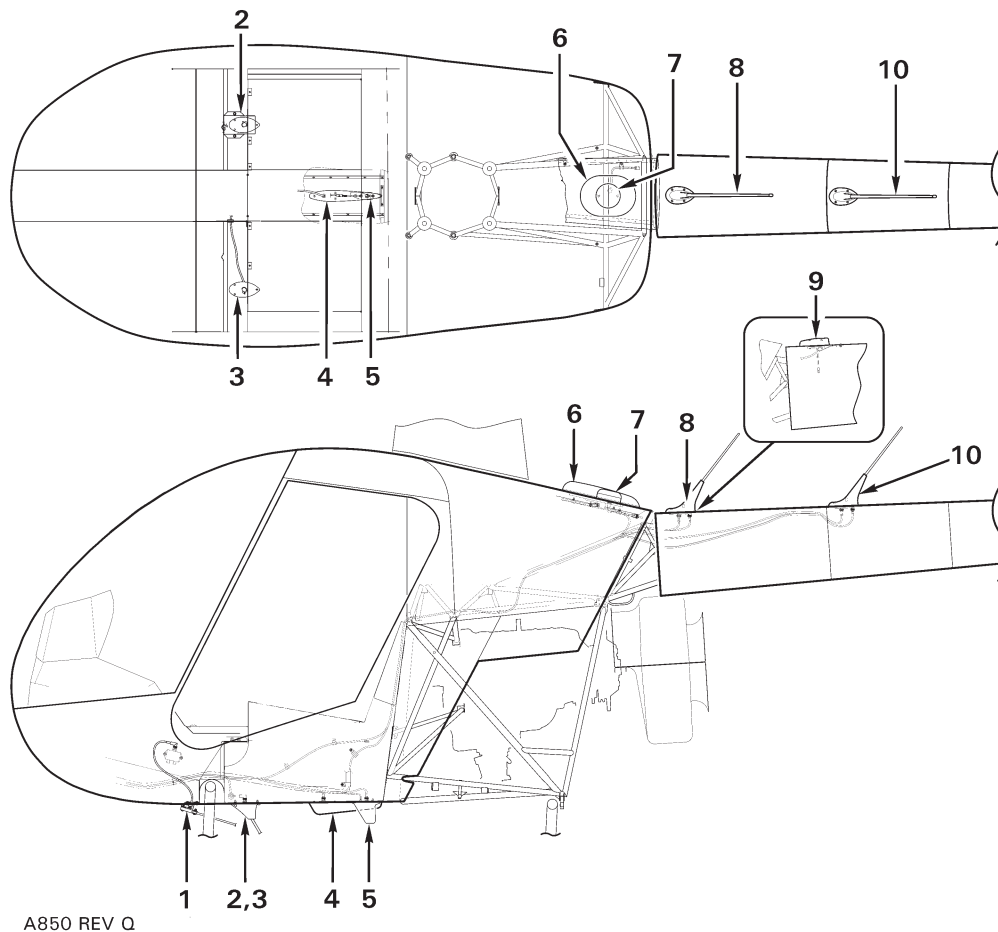
B526-66 screws (used to secure B376-3 plates to B375-2 stabilizer) are not interchangeable with other screws.

**NOTE**

B526 screws are compatible with T20 or 20IP drivers.

# 16-70 Antenna Locations

NO.	ANTENNA	PART NO.	NO.	ANTENNA	PART NO.
1	NAV .....	CI 259E	6	ADF .....	KA44B
	NAV .....	CI 259E (W/DIPLEXER)	7	Cowling GPS .....	GA 35
2	RH Belly FM .....	CI 292-3	8	Fwd Tailcone COM .....	CI 121 or CI 248-5
	RH Belly FM .....	CI 177-20		Fwd Tailcone COM/GPS .....	CI 2580-200
	RH Belly FM .....	CI 273 OR CI 271	9	RMS/GPS .....	910-00003-004 (Ant)
	RH Belly COM .....	CI 122		RMS/GPS .....	921-00003-001 (Kit)
	RH Belly FM .....	CI 272-1	10	Aft Tailcone COM .....	CI 121 or CI 248-5
3	LH Belly FM .....	CI 292-3		Aft Tailcone GPS/COM .....	CI 2580-200
	LH Belly FM .....	CI 177-20			
	LH Belly FM .....	CI 273 OR CI 271			
4	Marker Beacon .....	CI 102			
5	Transponder/UAT (ADS-B) ..	CI 105-16 OR KA60, FWD			
	Transponder .....	CI 105-16 OR KA60, AFT			
	DME .....	CI 105-16 OR KA60			



A850 REV Q

**FIGURE 16-4 ANTENNA LOCATIONS**

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CHAPTER 17

JACKING AND HOISTING

<i>Section</i>	<i>Title</i>	<i>Page</i>
17-10	Jacking . . . . .	17.1
17-20	Hoisting . . . . .	17.5

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## CHAPTER 17

## JACKING AND HOISTING

17-10 Jacking**CAUTION**

When jacking helicopter, use mechanical or locking hydraulic jacks, when available. Unlocked hydraulic jacks are subject to pressure-loss which can affect critical measurements during leveling or cause a raised helicopter to become unstable.

**CAUTION**

Never jack helicopter in windy conditions.

**CAUTION**

Perform jacking on a clean, flat, hard surface free of water, oil, solvent, grease, or residue that could cause equipment or personnel to slip during jacking procedure.

**CAUTION**

Do not actuate jacks from underneath helicopter. Remain clear of landing gear skid tubes when helicopter is raised.

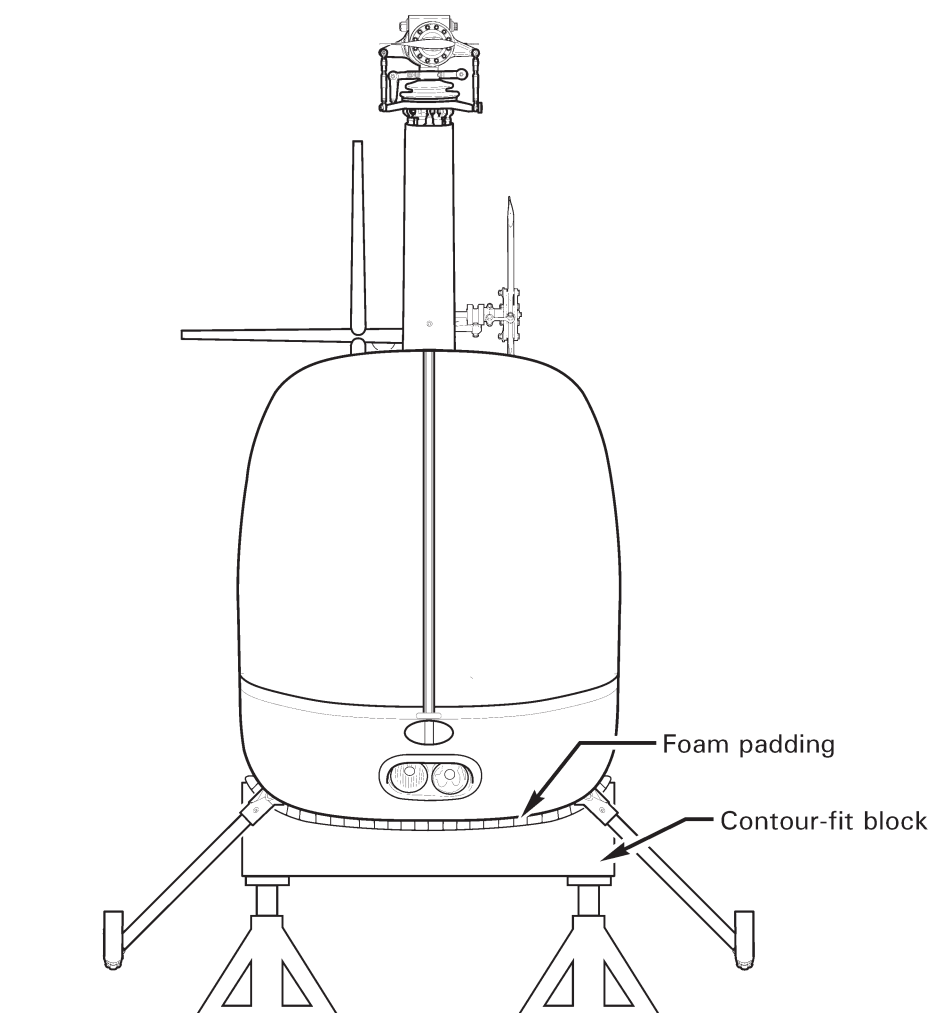
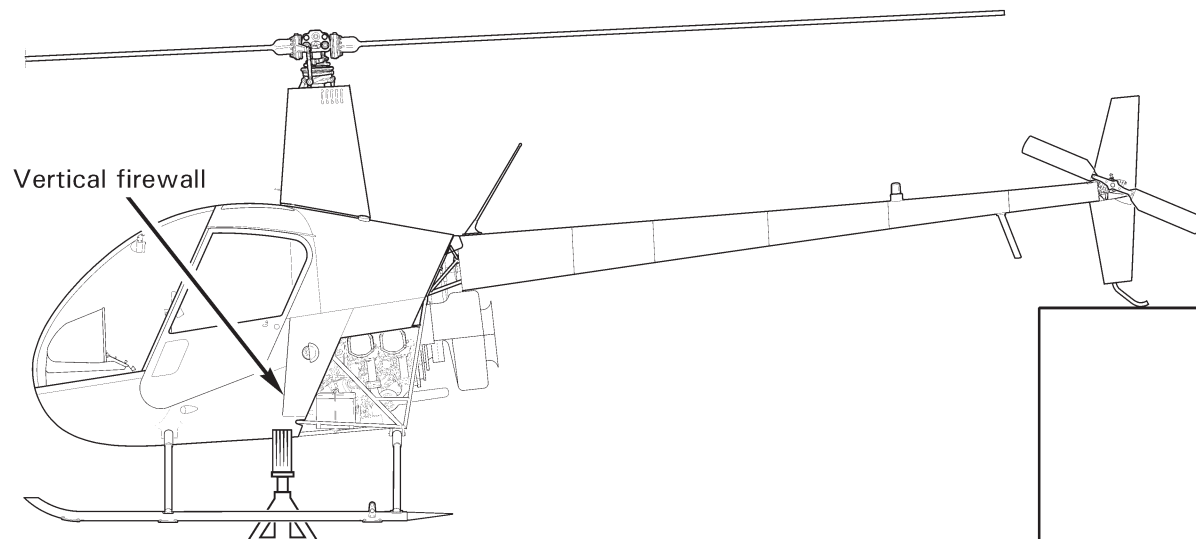


FIGURE 17-1 JACKING

17-10 Jacking (continued)**A. Jacking**

1. Two methods may be used to jack helicopter:

- a. Refer to Figure 17-1. Place a foam-covered contour block under vertical firewall. Install skid stand under tail. Place an appropriate capacity jack under each end of contour block.

**CAUTION**

Contour block must be directly under vertical firewall to support weight of helicopter.

- b. Place an appropriate capacity jack under each (landing gear) aft cross tube, one inch inboard of elbow fittings, and under the ground handling ball as required.

**CAUTION**

Ground handling ball must slide unrestricted across a flat surface during jacking. When weighing, verify ball is not under side load which could produce an erroneous weight indication.

2. Position jack levers for convenient access and engage jacks. Sandbag jacks for increased stability, as required.
3. Actuate jacks slowly and simultaneously (one person per jack recommended), maintaining helicopter stability. Raise helicopter to required height (at least 4 inches off ground if removing landing gear).

**CAUTION**

Minimize personnel movement around raised helicopter.

**B. Lowering****CAUTION**

Skids spread as aircraft weight settles on landing gear.

1. Slowly and simultaneously (one person per jack recommended) lower each jack ram, maintaining helicopter stability. Lower aircraft to ground.
2. Clear jacking equipment from area.

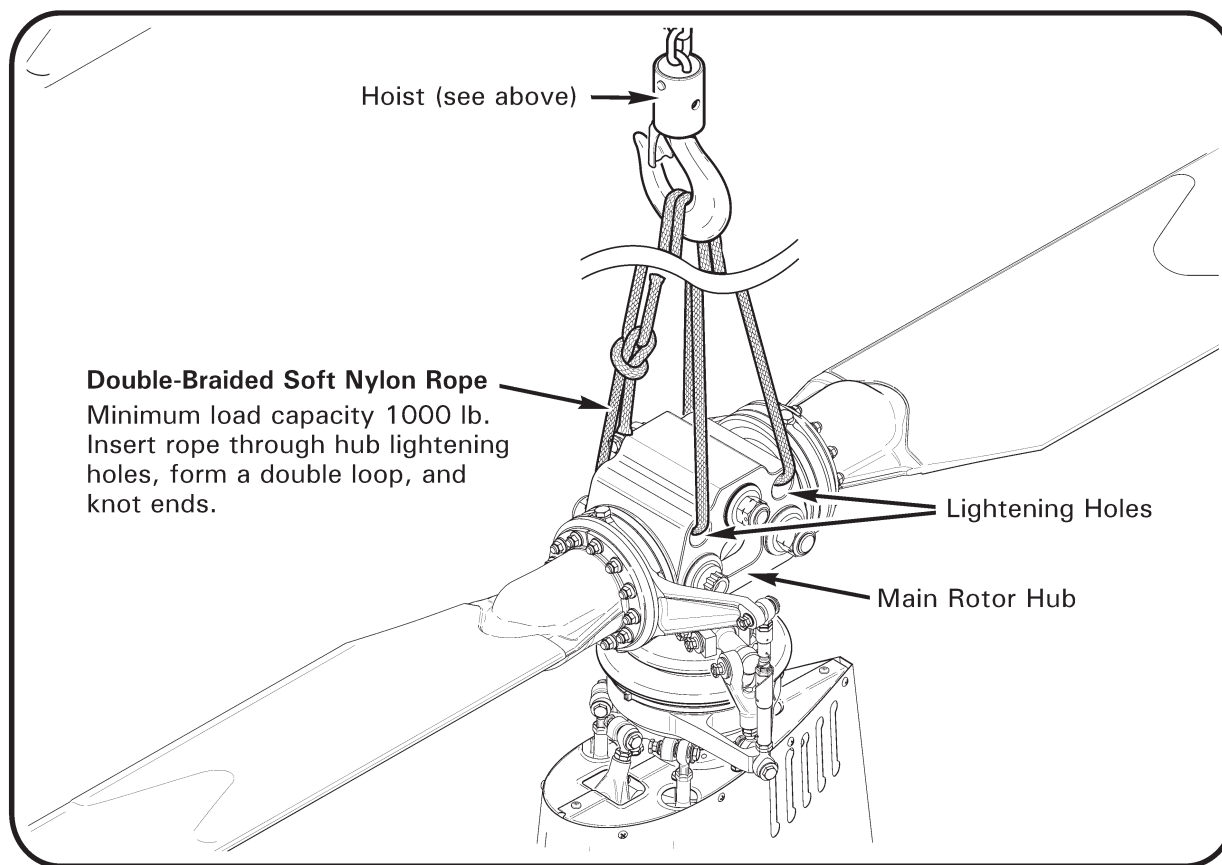
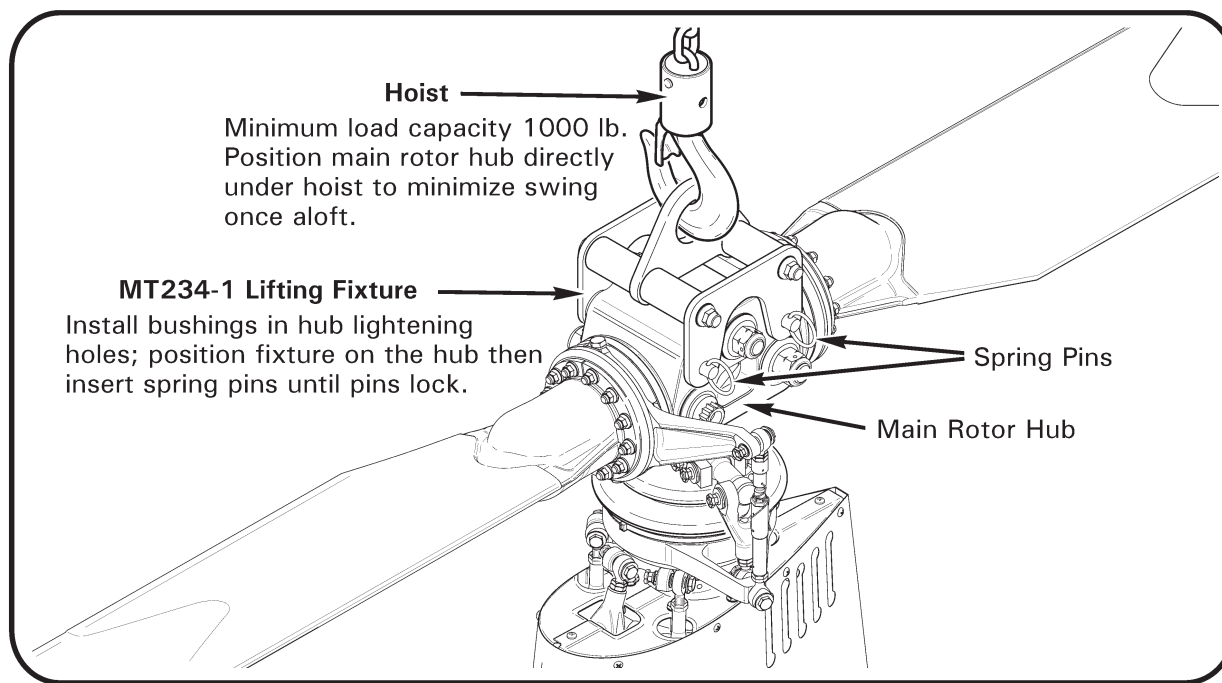


FIGURE 17-2 HOISTING

17-20 Hoisting**CAUTION**

Avoid hoisting helicopter in windy conditions.

**CAUTION**

Verify ground is free of water, oil, solvent, grease, or residue that could cause equipment or personnel to slip during hoisting procedure.

**CAUTION**

Remain clear of area beneath helicopter when helicopter is raised. Minimize personnel movement around raised helicopter.

**A. Hoisting with Lifting Fixture**

1. Refer to Figure 17-2. Verify hoisting equipment has minimum load capacity of 1000 lb.
2. Position main rotor hub directly under hoist to minimize helicopter swing once aloft.
3. Remove two spring pins and four nylon bushings from MT234-1 lifting fixture and install bushings in main rotor hub lightening holes. Position lifting fixture on hub then insert spring pins through fixture and bushings until pins lock. Verify security.
4. Connect hoist to lifting fixture. Verify security.
5. Stabilize helicopter as required by guiding tail skid, but do not exert force (tail skid is secondary structure). Raise helicopter to required height.

**B. Hoisting with Nylon Rope**

1. Refer to Figure 17-2. Verify hoisting equipment has minimum load capacity of 1000 lb. Verify minimum work load limit for 1-inch diameter twisted or double braided (preferred) soft nylon rope is 1000 lb.
2. Position main rotor hub directly under hoist to minimize helicopter swing once aloft.
3. Insert rope through main rotor hub lightening holes, form a double loop, and knot ends. Connect hoist to nylon rope. Verify security.
4. Stabilize helicopter as required by guiding tail skid, but do not exert force (tail skid is secondary structure). Raise helicopter to required height.

17-20 Hoisting (continued)**C. Lowering****CAUTION**

Skids spread as aircraft weight settles on landing gear.

1. Refer to Figure 17-2. Stabilize helicopter as required by guiding tail skid, but do not exert force (tail skid is secondary structure). Slowly lower aircraft to ground.
2. Disconnect hoisting equipment, remove lifting fixture or nylon rope from main rotor hub, and clear equipment from area.



CHAPTER 18

WEIGHT AND BALANCE

<i>Section</i>	<i>Title</i>	<i>Page</i>
18-10	Leveling . . . . .	18.1
18-11	Leveling at Lower Right Side Frame Tube & Aft Landing Gear Cross Tube . .	18.1
18-12	Leveling at Main Rotor Hub . . . . .	18.3
18-13	Leveling at Keel Panels . . . . .	18.3
18-20	Weighing and CG Calculation . . . . .	18.4
18-21	Preparing Helicopter for Weighing . . . . .	18.4
18-22	Weighing Procedure and Calculations . . . . .	18.5
18-30	Fixed Ballast . . . . .	18.9
18-31	Nose Ballast . . . . .	18.9
18-32	Empennage Ballast . . . . .	18.10

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## CHAPTER 18

## WEIGHT AND BALANCE

18-10 Leveling

## NOTE

Perform leveling and weighing in a zero-wind environment.

## NOTE

Verify spirit level is calibrated by placing level on a designated surface and noting bubble position. Rotate spirit level 180°; verify bubble is in the same position.

18-11 Leveling at Lower Right Side Frame Tube & Aft Landing Gear Cross Tube

## NOTE

Use this leveling method for R22 Standard & R22 HP models only.

1. Place a bubble level on lower right steel tube frame horizontal member at location marked LEVEL HERE.
2. Level helicopter longitudinally by placing shims under landing gear skid tubes or jacks under outboard edge of aft cross tube.
3. Place bubble level on center of landing gear aft cross tube.
4. Level helicopter laterally by placing shims under landing gear skid tubes or jacks under outboard edge of aft cross tube.
5. Recheck level per steps 1 & 3 and adjust as required.

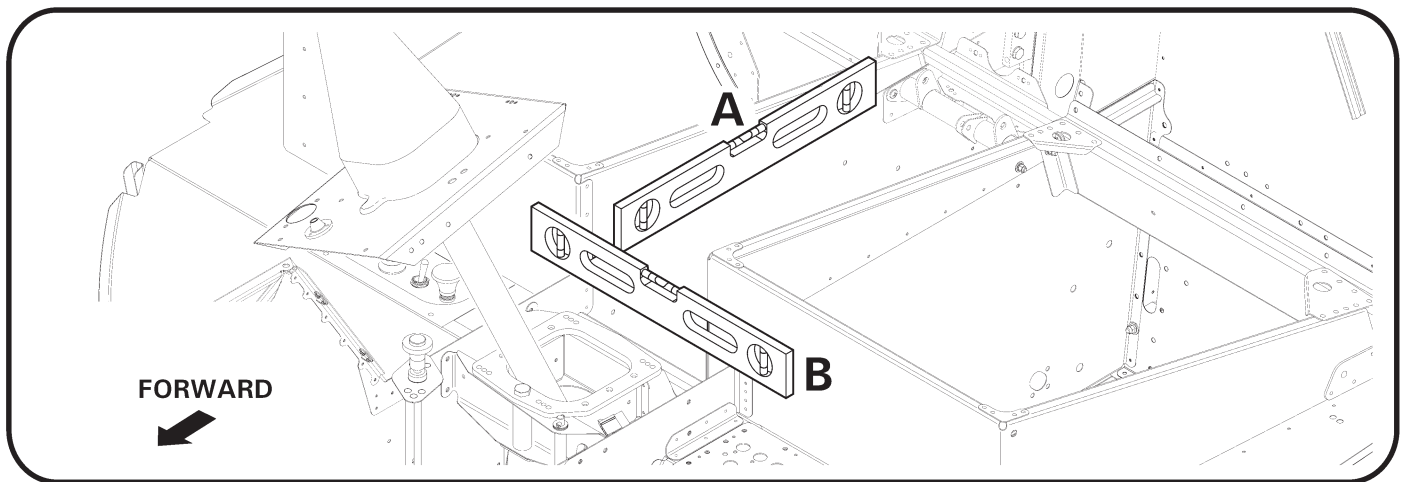


FIGURE 18-1 LEVELING AT KEEL PANELS

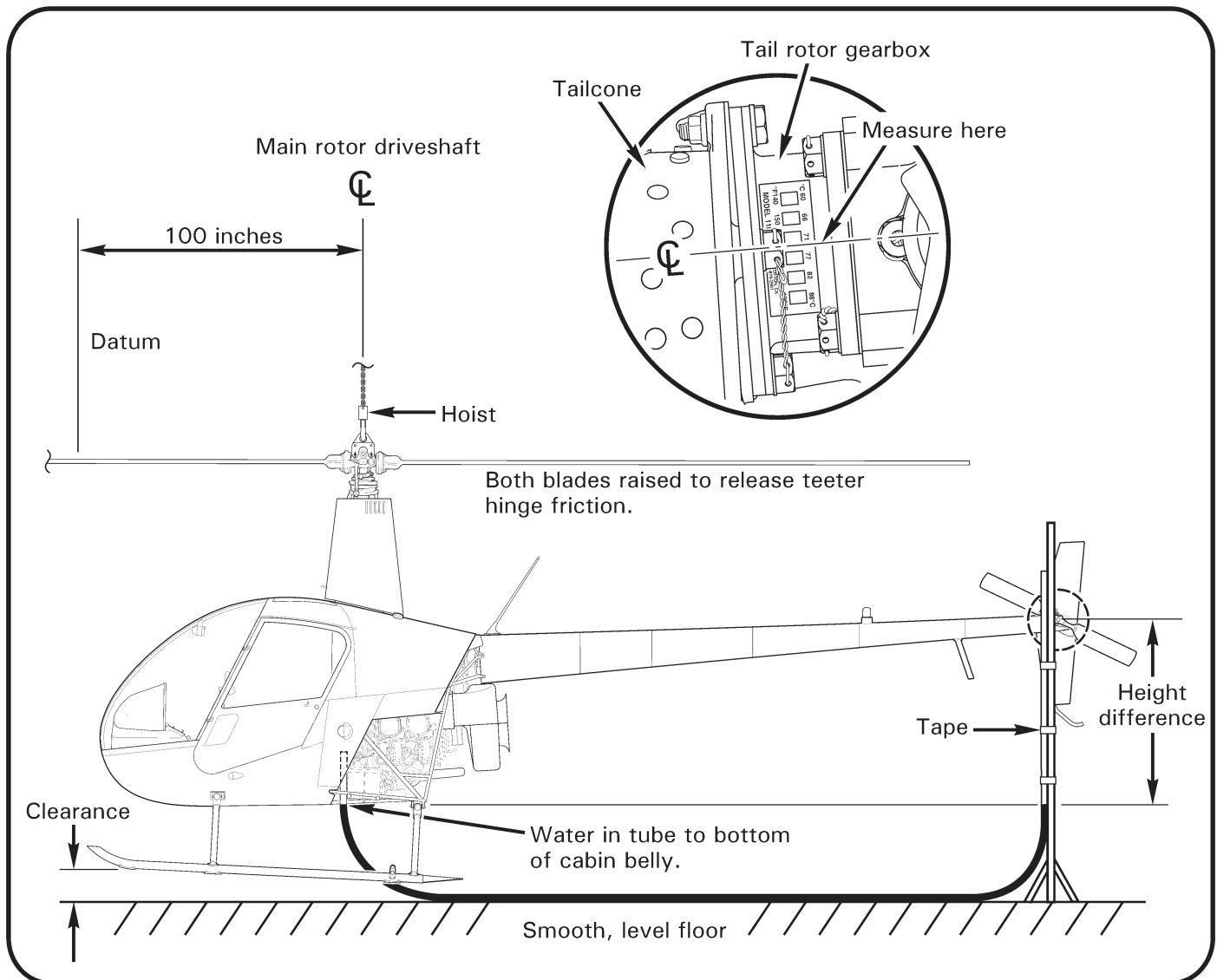


FIGURE 18-2 DETERMINING CG USING WATER LEVEL

### 18-12 Leveling at Main Rotor Hub

**NOTE**

Use this leveling method for all R22 models.

1. Place a bubble level atop MR hub.

**NOTE**

Level must be parallel to teeter hinge bolt.

2. Rotate main rotor until teeter hinge bolt is aligned with longitudinal axis of helicopter.
3. Level helicopter longitudinally by placing shims under landing gear skid tubes or jacks under outboard edge of aft cross tube.
4. Rotate main rotor until teeter hinge bolt is aligned with lateral axis of helicopter.
5. Level helicopter laterally by placing shims under landing gear skid tubes or jacks under outboard edge of aft cross tube.

**NOTE**

Jacks may be used under aft cross tube 1 inch inboard from each elbow.

6. Recheck level per steps 2 & 4 and adjust as required.

### 18-13 Leveling at Keel Panels

**NOTE**

Use this leveling method for all R22 models.

1. Remove horizontal panel between seat bottoms and remove cyclic box cover.
2. Place a bubble level on top edge of right keel panel per Figure 18-1 Detail A.
3. Level helicopter longitudinally by placing shims under landing gear skid tubes or jacks under outboard edge of aft cross tube.
4. Place a bubble level across two keel panels per Figure 18-1 Detail B.
5. Level helicopter laterally by placing shims under landing gear skid tubes or jacks under outboard edge of aft cross tube.
6. Recheck level per steps 2 & 4 and adjust as required.

### 18-20 Weighing and CG Calculation

Reweigh helicopter when helicopter empty weight and empty weight center of gravity have been modified and if the accuracy of additional calculations is suspect.

Maintain a continuous record of the helicopter's weight and balance using the Weight and Balance Record in R22 Pilot's Operating Handbook (POH) Section 6.

**NOTE**

Verify scales are calibrated. Operate scales according to scale manufacturer's instructions.

**NOTE**

Never weigh the helicopter in the wind. Weigh helicopter on a level, flat, hard surface in a zero-wind environment for accurate scale readings.

### 18-21 Preparing Helicopter for Weighing

1. Defuel helicopter per § 22-52.
2. Service engine oil per R22 Pilot's Operating Handbook (POH) Section 8. Fill main and tail gearboxes to center of sight gage using correct gearbox oil (refer to § 22-10 Part C).
3. Clean aircraft per POH Section 8. Verify helicopter is completely dry.
4. Remove items that are not installed equipment (tools, rags, charts, etc.) from baggage compartments and stowage areas.
5. Verify cowlings, removable panels, cabin doors, removable controls, and POH are installed.
6. Verify Equipment List/Weight and Balance Data sheet (RF 134) and modifications recorded in the Weight and Balance Record correspond with installed equipment and recorded equipment locations.

# 18-22 Weighing Procedure and Calculations

## NOTE

- Arm is the distance in inches from datum.
- Datum is located 100 inches forward of main rotor centerline.
- CG (arm) is determined by dividing total moment by total weight.

1. Refer to § 18-20. Prepare helicopter for weighing per § 18-21.
2. Hoist helicopter per § 17-20 approximately one foot above the ground. Have one person hold tail of helicopter while hoisting to stabilize helicopter.
3. With main rotor blades oriented approximately fore and aft, raise both blades off of droop stops to allow hub to teeter freely. Raise tail slightly and allow to settle.
4. Refer to Figure 18-2. With aircraft hanging freely and steady, use a water level and measure difference in vertical height between tail rotor gearbox centerline and cabin belly at vertical firewall. Ensure no air bubbles in water level tube.

Record height difference: \_\_\_\_\_ inches

5. Determine longitudinal center of gravity:

$114.47 - [0.315 \times (\text{height difference from step 4})] = \text{_____ inches}$

6. Place a 1000-lb capacity (minimum) scale under each skid. Locate center of scales approximately 10 inches forward of (ground handling wheel ) skid supports.
7. Lower helicopter until it rests entirely on scales. Helicopter must be well balanced on scales before releasing tail. Be sure helicopter is level laterally by placing level on center of aft landing gear cross tube.

8. Determine empty weight:

Right scale reading: \_\_\_\_\_ lb

Left scale reading: + \_\_\_\_\_ lb

Tare (leveling shims, hoist fixture, etc.): - \_\_\_\_\_ lb

Empty weight: = \_\_\_\_\_ lb

# 18-22 Weighing Procedure and Calculations (continued)

9. Determine CG with full fuel and minimum solo pilot:

a. Bladder tank(s):

i. **With aux tank:**

$$\frac{(CG \text{ from step 5}) \times (Empty \text{ weight from step 8}) + 28495}{(Empty \text{ weight from step 8}) + 303} = \text{_____ in.}$$

ii. **Without aux tank:**

$$\frac{(CG \text{ from step 5}) \times (Empty \text{ weight from step 8}) + 22064}{(Empty \text{ weight from step 8}) + 240} = \text{_____ in.}$$

b. All-aluminum tank(s):

i. **With aux tank:**

$$\frac{(CG \text{ from step 5}) \times (Empty \text{ weight from step 8}) + 30180}{(Empty \text{ weight from step 8}) + 319} = \text{_____ in.}$$

ii. **Without aux tank:**

$$\frac{(CG \text{ from step 5}) \times (Empty \text{ weight from step 8}) + 23011}{(Empty \text{ weight from step 8}) + 249} = \text{_____ in.}$$

10. If CG from step 9 is aft of aft limit (refer to R22 Pilot's Operating Handbook [POH] Section 2 for model-specific data), determine required nose ballast:

$$\frac{[CG \text{ from step 5} - (model's \text{ aft limit})] \times (Empty \text{ weight from step 8}) - 2358}{64.5} = \text{_____ lb}$$

11. Adjust weight and balance to correct for drained unusable fuel and ballast:

Item	Weight (lb)	Longitudinal CG (arm, inches)	Moment (in.-lb)
Multiply empty weight from step 8 by CG from step 5	_____ x _____		= _____
Nose ballast:	_____ x 37.5		= _____
Unusable fuel (add):	10.2*, 6.0**, or 3.6*** x 100.0		= _____
	_____	_____	_____

\* Bladder tanks

\*\* All-aluminum tank(s) with aux tank

\*\*\* All-aluminum tank(s) without aux tank



18-22 Weighing Procedure and Calculations (continued)**CAUTION**

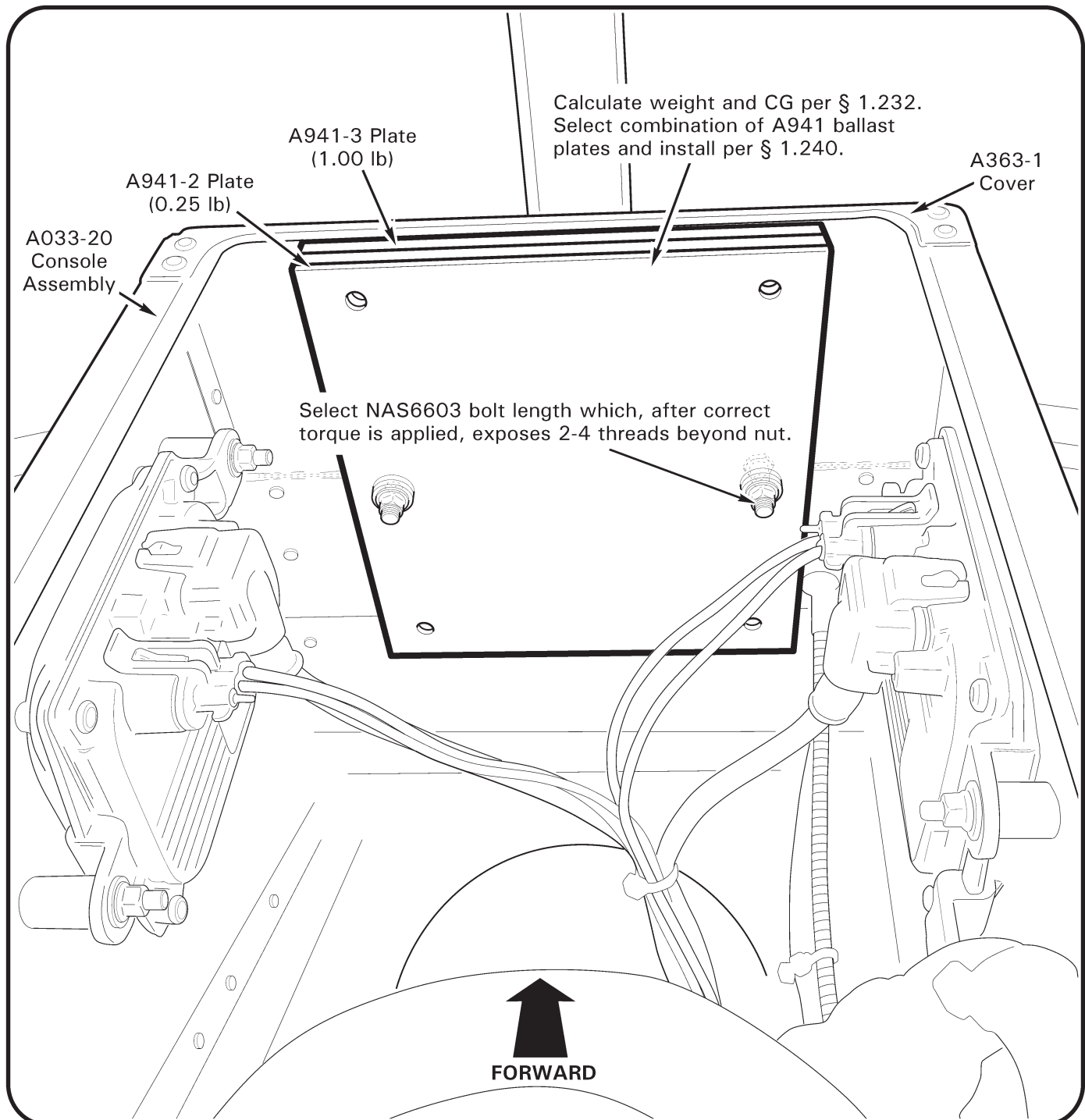
CG with full fuel and minimum solo pilot weight must be at or forward of aft CG limit.

12. Determine lateral center of gravity:

$$\frac{(\text{Right scale reading} - \text{Left scale reading})}{(\text{Right scale reading} + \text{Left scale reading})} \times 37 = \text{_____ in.}$$

13. Determine lateral moment:

$$(\text{Basic Empty Weight}) \times (\text{lateral CG}) = \text{_____ in.-lb}$$



**FIGURE 18-3 NOSE BALLAST**

(View inside lower console assembly with upper console hinged aft)

18-30 Fixed Ballast18-31 Nose Ballast**NOTE**

Maximum allowable nose ballast is 10.0 lb.

**CAUTION**

Changing fixed ballast amount affects helicopter empty weight & center of gravity (CG). If helicopter empty weight & CG historical data is suspect, weigh helicopter per § 18-20.

1. Open or remove console assembly per § 13-70.
2. Refer to Figure 8-3. Remove hardware securing A941-2 or -3 ballast plate(s), if installed, to A363-1 cover.
3. If A941 ballast attach holes are not previously drilled, use A941 ballast as template and mark hole locations. Drill 0.198 inch diameter (#8 drill size) hole at marked locations.
4. Remove or install ballast plates per calculations in § 18-22. Select NAS6603 bolt length to meet torque requirements per § 23-30 Part E. Install hardware, standard torque bolts per § 23-32, and torque stripe per Figure 2-1.
5. Install or close console assembly per § 13-70. Verify security.
6. Reweigh and/or calculate basic empty weight and CG per § 18-22.
7. Revise Weight and Balance Record in R22 Pilot's Operating Handbook (POH) Section 6 to reflect ballast removal or installation using the following data:

Item	Weight	Longitudinal Arm	Longitudinal Moment	Lateral Arm	Lateral Moment
Nose ballast	0–10.0 lb	37.5 in.	Variable	0.0 in.	0.0 in.-lb

18-32 Empennage Ballast**NOTE**

Approved materials are listed in § 23-70.

**CAUTION**

Changing fixed ballast amount affects helicopter empty weight & center of gravity (CG). If helicopter empty weight & CG historical data is suspect, weigh helicopter per § 18-20.

**A. Removal****CAUTION**

Maximum allowable empennage ballast is 2.00 lb, installed under B902-1 (or -2) mount assembly or A044-1 horizontal stabilizer, as applicable.

1. Leaving NAS6604-44 bolts installed in empennage assembly, remove palnuts, nuts, washers, and A301-5 ballast weight from empennage.
2. Remove one NAS6604-44 bolt and install NAS6604-28 bolt & associated hardware, finger tight.
3. Remove second NAS6604-44 bolt and install NAS6604-28 bolt & associated hardware. Standard torque bolts securing empennage to A148 bulkhead per § 23-32. Install palnuts and standard torque per § 23-32, do not torque stripe at this time.
4. As required, solvent-clean lower surface of empennage assembly around and between attach bolts. Apply light coat zinc-chromate or epoxy primer to noted surface and hardware. Apply topcoat as desired.
5. Apply torque stripe to hardware per Figure 2-1.
6. As required, weigh helicopter or calculate basic empty weight & CG per § 18-20.
7. Revise Weight and Balance Record in R22 Pilot's Operating Handbook (POH) Section 6 to reflect ballast removal using Table 8-1.

18-32 Empennage Ballast (continued)**B. Installation****CAUTION**

Maximum allowable empennage ballast is 2.00 lb, installed under B902-1 (or -2) mount assembly or A044-1 horizontal stabilizer, as applicable.

1. Remove empennage assembly per § 4.500.
2. Solvent-clean around and between 0.250 inch diameter holes on lower surface of B902-1 (or -2) mount assembly or A044-1 horizontal stabilizer, as applicable.
3. Temporarily position A301-5 weight on mount assembly or horizontal stabilizer lower surface using two NAS6604-44 bolts & associated hardware finger tight.
4. Trace outline of weight onto mount assembly or horizontal stabilizer lower surface using felt-tip marker or tape. Remove weight.
5. Remove paint within traced outlines on mount assembly or horizontal stabilizer using approved stripper (ref. § 23-71), or by block sanding (to maintain flatness) using 320-grit or finer aluminum-oxide abrasive sandpaper.
6. Remove tracing tape, if installed. Solvent-clean bare metal on mount assembly or horizontal stabilizer & weight clamping surfaces. Conversion coat lower bare metal surface of mount assembly or horizontal stabilizer per § 23-51.
7. Apply approved chromated-epoxy primer (ref. § 23-75) per § 23-60 to bare metal clamping surfaces of weight and mount assembly or horizontal stabilizer. While primer is still wet, install empennage assembly per § 4.500.
8. As required, apply primer and topcoat to exposed hardware.
9. Weigh helicopter or calculate basic empty weight and CG per § 18-20.
10. Revise Weight and Balance Record in R22 Pilot's Operating Handbook (POH) Section 6 to reflect ballast installation using Table 8-1.

Item	Weight	Longitudinal Arm	Longitudinal Moment	Lateral Arm	Lateral Moment
Empennage Ballast	2.0 lb	270.7 in.	541.4 in.-lb	2.6 in.	5.2 in.-lb

TABLE 8-1 EMPENNAGE BALLAST WEIGHT AND BALANCE

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## CHAPTER 19

## GROUND HANDLING

<u>Section</u>	<u>Title</u>	<u>Page</u>
19-10	Ground Handling . . . . .	19.1
19-11	Ground Handling Wheels . . . . .	19.1
19-12	Moving Helicopter on Ground Handling Wheels . . . . .	19.6
19-13	Ground Handling Carts . . . . .	19.6
19-20	Trailing . . . . .	19.7

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## CHAPTER 19

## GROUND HANDLING

19-10 Ground Handling19-11 Ground Handling Wheels**NOTE**

R22 ground handling wheels are installed outboard of landing gear skid tubes. A063-1 wheel assemblies are interchangeable (may be installed in right or left skid support). When wheels are installed and in locked position, handle on right skid tube points forward and handle on left skid tube points aft.

**CAUTION**

Handle has a tendency to snap over when raising and lowering the helicopter. Grip handle firmly with both hands during operation.

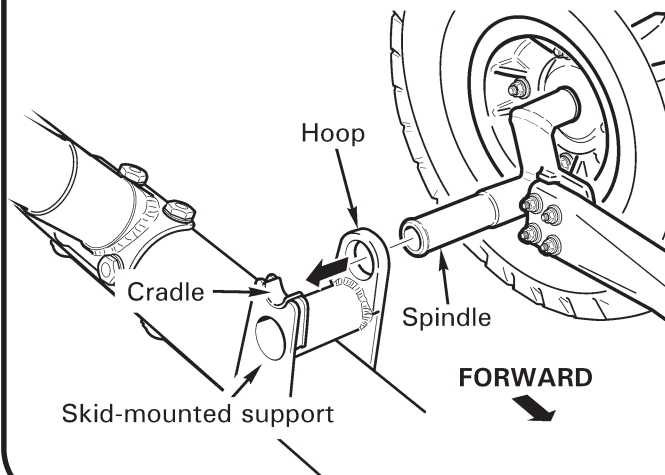
**CAUTION**

Remain clear of landing gear skid tubes when helicopter is raised.

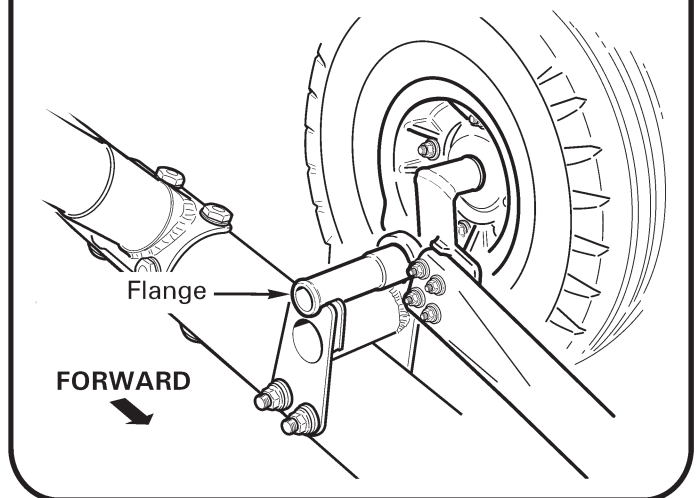
**WARNING**

**Remove ground handling wheels for flight.**

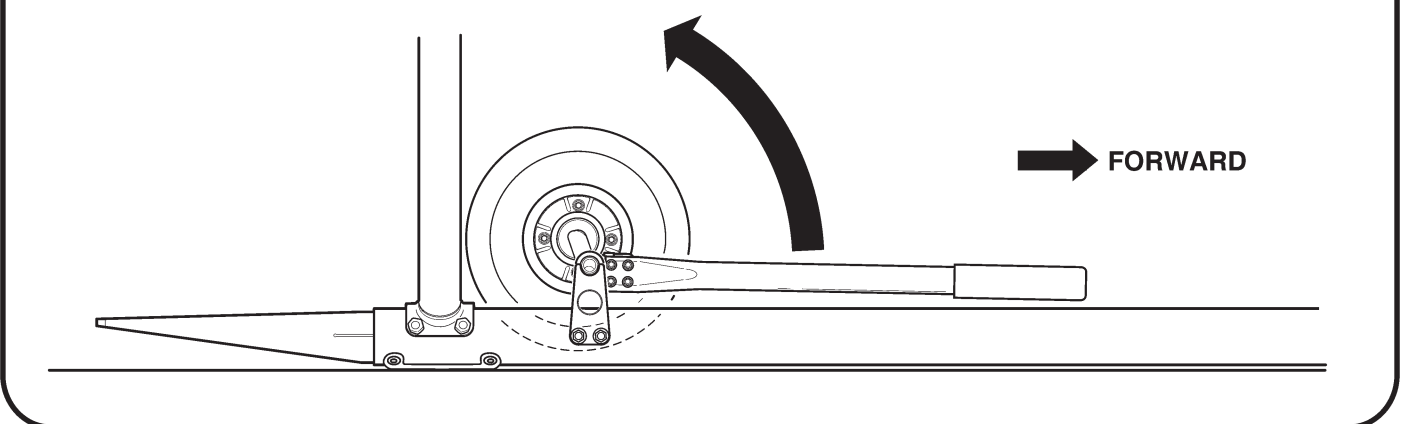
1. Insert spindle into skid-mounted support.



2. Verify flange is inboard of cradle.



3. Pull handle in rightward arc to raise helicopter.



4. Handle is in locked position when parallel with the skid.

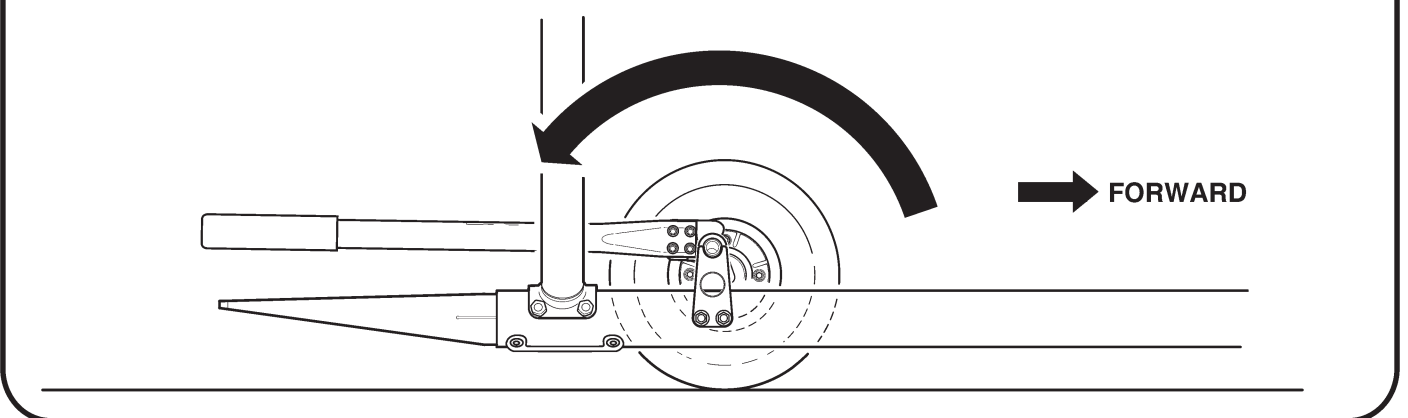


FIGURE 19-1 GROUND HANDLING WHEELS (LEFT SKID SHOWN)

19-11 Ground Handling Wheels (continued)**A. Installation****NOTE**

Verify proper inflation of ground handling wheel tires. Maximum tire inflation pressure is 60 psi (4 bar).

**NOTE**

Refer to Figure 19-2 for float ship landing gear ground handling wheels installation.

1. Refer to Figure 19-1. Hold ground handling wheel assembly outboard of skid with handle left, wheel right, and spindle pointed inboard. Insert spindle completely into skid-mounted support, then pull handle in rightward arc (raises helicopter) until handle is in locked position, parallel with the skid.
2. Repeat step to install second wheel assembly (helicopter will rest on skid toes).

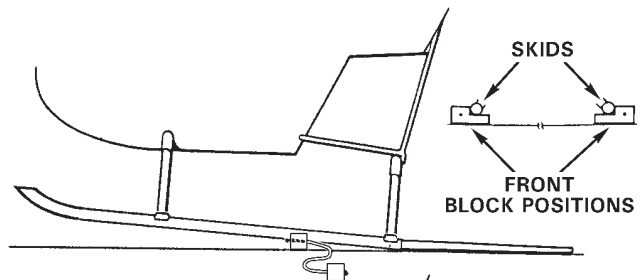
**B. Removal****NOTE**

Refer to Figure 19-3 for float ship landing gear ground handling wheels removal.

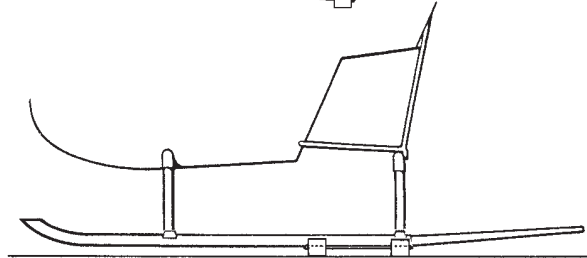
1. Refer to Figure 19-1. Pull ground handling wheel handle in leftward arc (lowers helicopter) until handle is in unlocked position, parallel with the skid. Remove spindle from skid-mounted support and remove wheel assembly.
2. Repeat step to remove second wheel assembly.

## INSTALLATION

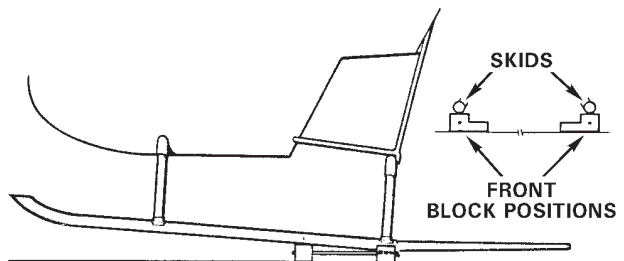
1. Pull tail down. Insert forward blocks at their lower height under both skids at forward marks.



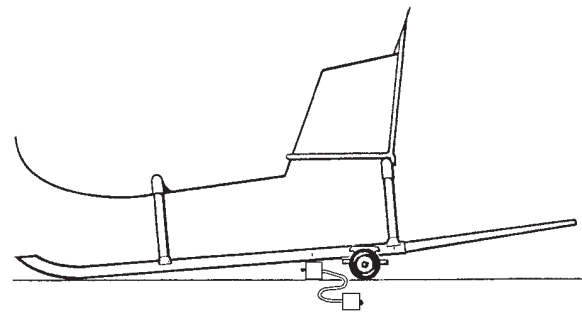
2. Push tail up. Insert rear blocks at their lower height under both skids at rear marks.



3. Pull tail down. Move forward blocks "inside" to their upper height under skid tubes.



4. Push tail up. Slide rear blocks out (upper height of rear blocks is not used) and insert wheels under skids at rear marks.



## NOTE

Adjust wheel placement as necessary to reduce force required to pull tail down.

5. Pull tail down and remove forward blocks. Installation is completed.

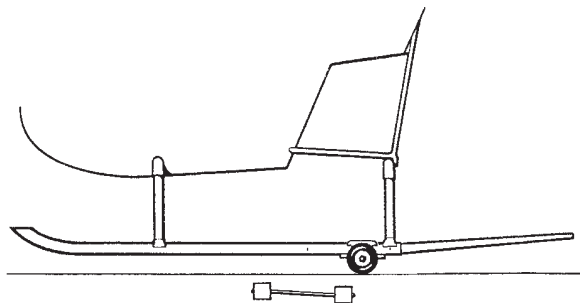
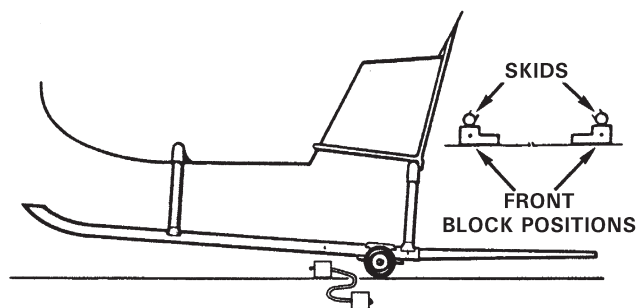


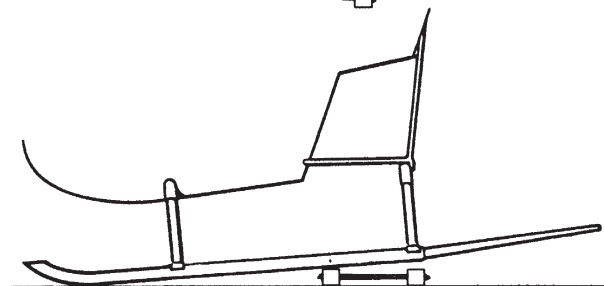
FIGURE 19-2 FLOAT LANDING GEAR GROUND HANDLING WHEELS INSTALLATION

## REMOVAL:

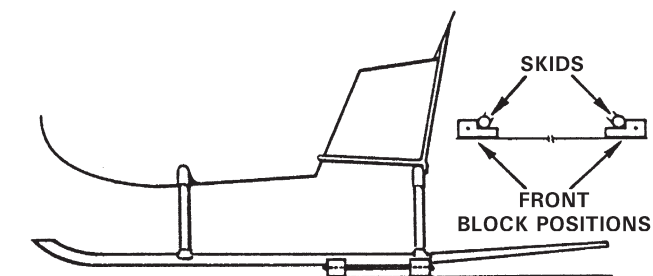
1. Pull tail down. Insert forward blocks at their upper height at forward marks under skids.



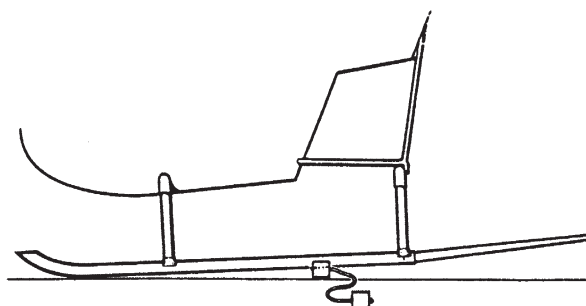
2. Push tail up. Remove wheels and insert rear blocks at their lower height (upper height of rear blocks is not used) at rear marks.



3. Pull tail down. Move forward blocks "outside" to their lower height.



4. Push tail up. Remove rear blocks.



5. Push tail down. Remove front blocks. Removal is completed.

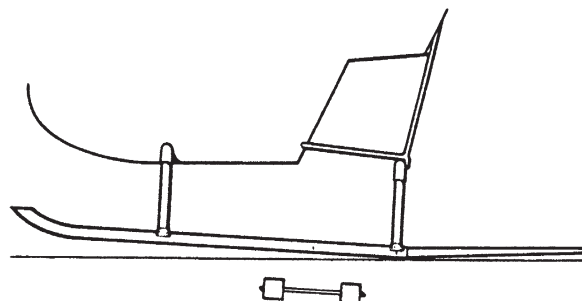


FIGURE 19-3 FLOAT LANDING GEAR GROUND HANDLING WHEELS REMOVAL

### 19-12 Moving Helicopter on Ground Handling Wheels

1. Position main rotor blades approximately fore and aft and apply rotor brake.
2. Install ground handling wheels per § 19-11.
3. Verify ground handling area is free of foreign object debris.
4. Have one person pull down on tail rotor gearbox until skid tubes are parallel with the ground. During ground handling, balance helicopter to minimize wear on forward skid shoes and rear extensions.

#### **NOTE**

Steer helicopter by gripping the tail rotor gearbox, aft tailcone section, or inboard part of horizontal stabilizer between tailcone and vertical stabilizers.

#### **CAUTION**

Do not steer helicopter by gripping the tail rotor guard, vertical stabilizers, outboard part of horizontal stabilizer, tail rotor, tail rotor controls, or tail skid.

5. If additional help is needed, a second person may push on one of the aft vertical frame tubes or on the nose.

### 19-13 Ground Handling Carts

The R22 can be handled by one person using the MT900-1 or MT950-1 ground handling cart.

MT900 and MT950 Operating Instructions, Maintenance Manuals, and Illustrated Parts Catalogs are available online at [www.robinsonheli.com](http://www.robinsonheli.com).

19-20 Trailing**CAUTION**

Trailing the R22 is not normally recommended. Most trailers large enough to accommodate the helicopter are designed for much heavier loads; the trailer's springs and shock absorbers will not function properly when lightly-loaded. Also, without support, the tailcone can resonate with trailer vibrations, subjecting the tailcone to greatly amplified loads.

If trailing is unavoidable, observe the following precautions:

1. Load trailer with ballast to an average weight the trailer is designed to carry.
2. Support the tailcone. Cushion support point(s) to prevent tailcone damage.
3. Perform one of the following options:
  - a. Remove main rotor blades per § 26-10. Pack blades in shipping crate.
  - b. Fabricate blade supports to unload droop stops. Position supports approximately five feet from blade tips. Cushion support points to prevent blade damage.
4. Restrain tail rotor to prevent teetering.
5. Fuel helicopter per § 22-51.
6. Protect windshield, windows, rotor systems, and all fragile equipment from exposure to highway debris and subsequent damage.
7. After trailing, perform 100-hour maintenance and inspection per § 2.400.

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CHAPTER 20

PARKING AND STORAGE

<i>Section</i>	<i>Title</i>	<i>Page</i>
20-10	Parking . . . . .	20.1
20-11	Parking in High Wind or Turbulent Air . . . . .	20.1
20-12	Main Rotor Blade Tie-Downs . . . . .	20.3
20-13	Main Rotor Blade Supports . . . . .	20.4
20-20	Storage (Greater than 30 Days) . . . . .	20.4

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## CHAPTER 20

## PARKING AND STORAGE

20-10 Parking

1. Place cyclic control in neutral and apply friction.
2. Put collective full down and apply friction.
3. Align rotor blades approximately fore and aft. Apply rotor brake. Install main rotor blade tie-down(s) in windy conditions per § 20-12.

**CAUTION**

Do not pull down on blades to teeter rotor. To lower a blade, push up on opposite blade.

4. During storm conditions, helicopter should be hangared or moved to a safe area (refer to § 20-11).

20-11 Parking in High Wind or Turbulent Air**A. High Wind or Turbulent Air**

Helicopter should be hangared or moved to a safe area during storm conditions or when storm conditions are forecasted. When parking helicopter in high winds or when aircraft is exposed to prop/rotor wash or jet blast:

1. Position helicopter with nose pointed in the direction of prevailing wind or turbulent air.
2. Park helicopter per § 20-10. Position rotor blades slightly offset from fore and aft to prevent aft blade from flapping into tailcone, and apply rotor brake.
3. If helicopter is hangared, turn fuel shutoff valve off.

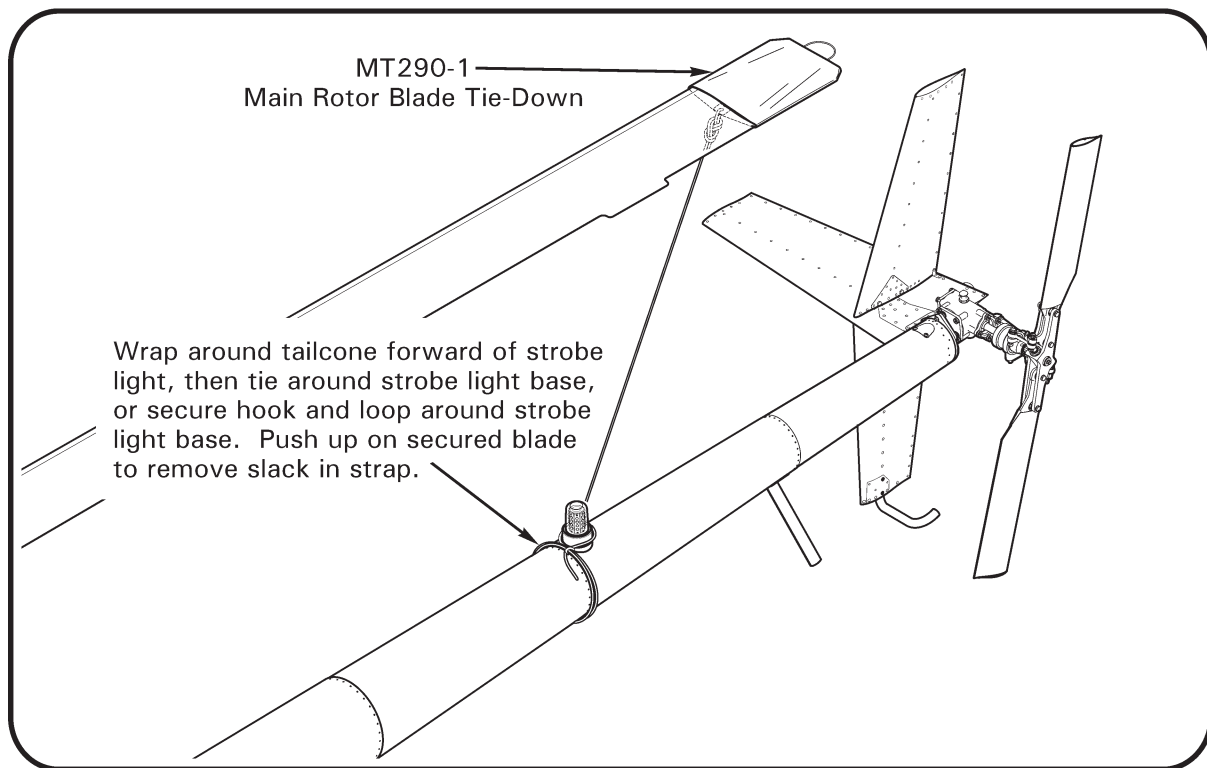
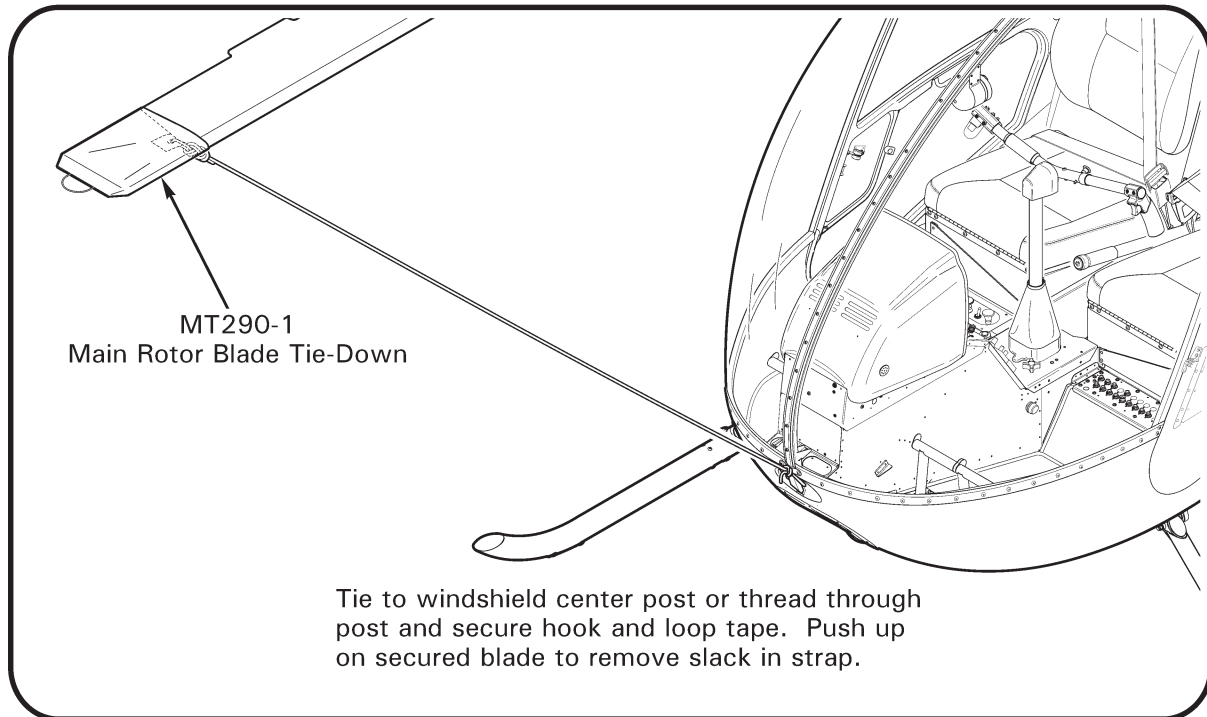


FIGURE 20-1 MAIN ROTOR BLADE TIE-DOWNS

20-11 Parking in High Wind or Turbulent Air (continued)**B. Extreme Conditions**

In extreme conditions, at the operator's discretion:

1. Remove main rotor blades per § 26-10. Remove tail rotor assembly per § 28-10. Store main rotor blades and tail rotor assembly in hangar or safe area.
2. Remove main rotor pitch links per steps below, or temporarily secure links together using ty-rap(s) or safety wire:
  - a. Mark an "X" on one pitch link lower rod end and corresponding swashplate ear using a colored grease pencil. Mark an "O" on opposite link and corresponding swashplate ear.
  - b. Remove hardware securing pitch links to swashplate assembly.
3. Remove tail rotor pitch links:
  - a. Refer to Figure 28-1. Tag each pitch link with corresponding blade serial number. Disconnect pitch links from tail rotor blades; keep associated balancing hardware with each link.
  - b. Remove hardware securing pitch links to tail rotor pitch control assembly.

20-12 Main Rotor Blade Tie-Downs**CAUTION**

Overtightening tie-down straps can damage main rotor blades. Maximum tie-down tension is 5 lb.

1. Park helicopter per § 20-10.
2. Refer to Figure 20-1. Slide MT290-1 tie-down jacket over forward (lowered) main rotor blade tip, white lettering facing down. Tie strap to windshield center post or thread strap through post and secure hook and loop tape. Push up on secured blade to remove slack in tie-down strap.
3. As required, install MT290-1 tie-down on aft main rotor blade. Slide jacket over blade tip, white lettering facing down. Wrap strap around tailcone forward of strobe light, then tie around strobe light base or secure hook and loop tape around strobe light base. Push up on secured blade to remove slack in tie-down strap.

20-13 Main Rotor Blade Supports

Reserved.

20-20 Storage (Greater than 30 days)

1. Record the date helicopter is prepared and placed in storage.

**CAUTION**

To minimize risk of electrical discharge: when disconnecting battery, disconnect negative (ground) cable from battery first, then the positive cable. When connecting battery, connect positive cable to battery first, then the negative (ground) cable.

2. Turn battery off. Remove cotter rings and wing nuts securing battery box cover to box and remove cover. Remove hardware securing cables to battery. Remove battery. Inspect and service battery according to battery manufacturer's instructions.
3. Preserve engine for storage per Lycoming Service Letter no. L180 (current revision).
4. Fill main and tail gearboxes to center of sight gage using correct gearbox oil (refer to § 22-10 Part C).
5. Fuel helicopter per R22 Pilot's Operating Handbook (POH) Section 8.

**NOTE**

Fuel lubricates bladder inner liner and keeps it from drying out or cracking. Refuel helicopter after run-ups during storage.

6. Clean aircraft per POH Section 8. Verify helicopter is completely dry.
7. Refinish main rotor blades per § 26-52. Refinish tail rotor blades per §§ 28-37 & 28-38. If blade painting is not feasible, wax blades.
8. If possible, store helicopter in a hangar or protected environment.
9. Apply suitable non-drying corrosion preventive compound to A166 clutch shaft adjacent to seals (where shaft enters and exits upper sheave).
10. Open door vents or remove doors to ventilate cabin as required.
11. Close and latch access doors.

**NOTE**

During storage, periodically inspect helicopter for corrosion; helicopters stored in humid environments will require more frequent inspection.

**CHAPTER 21**

**PLACARDS AND MARKINGS**

<u>Section</u>	<u>Title</u>	<u>Page</u>
21-10	Placards and Markings . . . . .	21.1

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**CHAPTER 21****PLACARDS AND MARKINGS****21-10 Placards and Markings**

Refer to R22 Illustrated Parts Catalog Chapter 11 for placard and marking locations.

**A. Removal**

To remove previously installed decals, start at corners and slowly peel off decal by hand or using a plastic wedge. Avoid damaging or removing paint or primer from surfaces. Remove decal entirely.

**B. Installation**

Verify surfaces are clean and dry before attaching decals. Use a clean cloth wet with acetone or mild soapy water to clean surfaces, but use caution when using acetone near silk-screened lettering on console and circuit breaker panel. Acetone can smudge or remove silk-screened letters. Attach decal and rub decal surface with finger, applying slight pressure.

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## CHAPTER 22

## SERVICING

<u>Section</u>	<u>Title</u>	<u>Page</u>
22-10	Main Rotor Gearbox . . . . .	22.1
22-11	Cleaning Chip Detector . . . . .	22.3
22-12	Cleaning Sight Gage . . . . .	22.3
22-13	Main Rotor Gearbox Drain and Flush . . . . .	22.4
22-20	Tail Rotor Gearbox . . . . .	22.5
22-21	Cleaning Chip Detector . . . . .	22.6
22-22	Cleaning Sight Gage . . . . .	22.6
22-23	Tail Rotor Gearbox Drain and Flush . . . . .	22.7
22-30	Clutch Assembly Lubricant Inspection and Servicing . . . . .	22.8
22-40	Clutch Actuator Upper and Lower Bearings . . . . .	22.9
22-41	Upper Bearing Lubrication . . . . .	22.9
22-42	Lower Bearing Lubrication . . . . .	22.10
22-50	Fuel System . . . . .	22.11
22-51	Fueling . . . . .	22.11
22-52	Defueling . . . . .	22.11
22-60	Main Rotor Blades . . . . .	22.13
22-61	Pitch Bearing Housing . . . . .	22.13

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## CHAPTER 22

## SERVICING

22-10 Main Rotor Gearbox

## NOTE

Inspect main rotor gearbox for leaks when “top off” is required.

## NOTE

Verify aircraft is on level ground when evaluating gearbox oil level.

## WARNING

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

**A. Draining Oil**

1. Run-up helicopter for approximately five minutes at 70–75% RPM per R22 Pilot's Operating Handbook (POH) Section 4 as required to warm oil and expedite draining.
2. Disconnect chip detector wiring from airframe harness at connectors. Remove chip detector from housing.
3. Refer to Figure 22-1B. Insert MT054-1 drain assembly (or MT053-1 drain assembly for threaded chip detector) into housing. Position drain hose overboard into a suitable drain container. Jam wedge between firewall and drain assembly to open valve and drain oil. Remove drain assembly after oil has drained.

**B. Adding Oil**

1. Install chip detector in housing, if removed. (Special torque threaded chip detector per § 23-33.) Connect chip detector wiring to airframe harness at connectors.
2. Remove gearbox filler-plug. Fill gearbox to center of sight gage using correct gearbox oil (refer to Part C). Rotate rotor system by hand for several revolutions and pull down on tail rotor gearbox several times. Check gearbox oil level and adjust as required. Install gearbox filler-plug and special torque plug per § 23-33.
3. Run-up helicopter approximately five minutes at 70–75% RPM per R22 Pilot's Operating Handbook (POH) Section 4.
4. Check gearbox oil level, and adjust as required.

22-10 Main Rotor Gearbox (continued)**C. Main and Tail Gearbox Oil**

R22 helicopters S/N 4825 and subsequent were delivered with P/N A257-22 (semi-clear amber, synthetic) gear oil in main and tail gearboxes; earlier helicopters were delivered with P/N A257-2 (blue or blue-green) gear oil in main and tail gearboxes.

Certain gearbox features are required to use A257-22 oil. Older gearboxes should continue to use A257-2 oil.

All R22 gearboxes (including new) may use A257-2 (traditional, blue) oil if more convenient or desired. Drain and flush per § 22-13 (main gearbox) and/or § 22-23 (tail gearbox) if converting from A257-22 oil.

Tail gearboxes are eligible for A257-22 oil provided a B563-4 sight gage is installed (refer to Figure 22-1A); not all tail gearboxes can be retrofitted with the B563-4 sight gage (due to thread differences).

A006 main gearboxes with A146-1 Revision Q & subsequent pinion are eligible for A257-22 oil. A146-1 pinion data plate is adjacent A006 gearbox data plate.

Ensure proper decal (F654-14 decal specifies A257-2 [blue] oil; F654-50 decal specifies A257-22 [amber] oil) is installed on aft wall of aux fuel tank (decal will need to be replaced if changing oil types). The same oil should be used in main and tail gearboxes to conform with the appropriate decal.

Do not mix A257-22 and A257-2 oil. If inadvertent mixture of oils occurs, drain and flush affected gearbox per § 22-13 (main) and/or § 22-23 (tail) followed by servicing with correct gearbox oil.

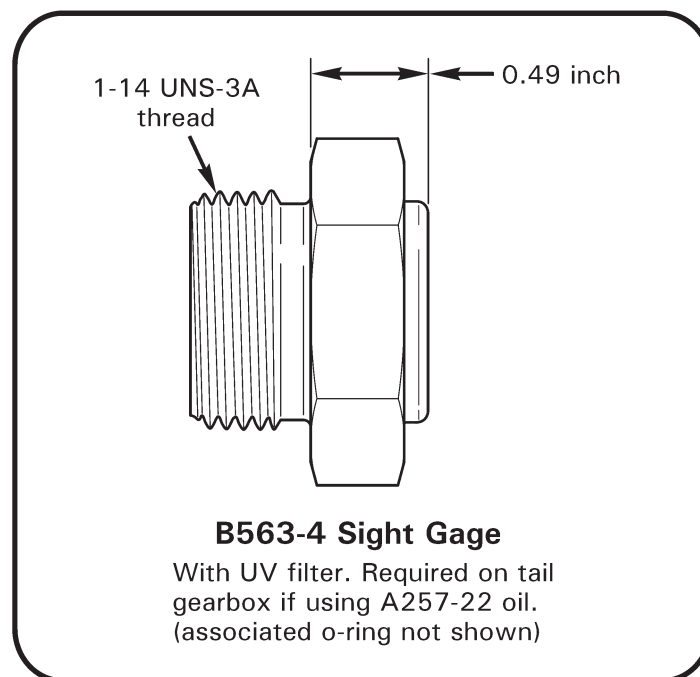


FIGURE 22-1A TAIL GEARBOX SIGHT GAGE AND GEAR OIL

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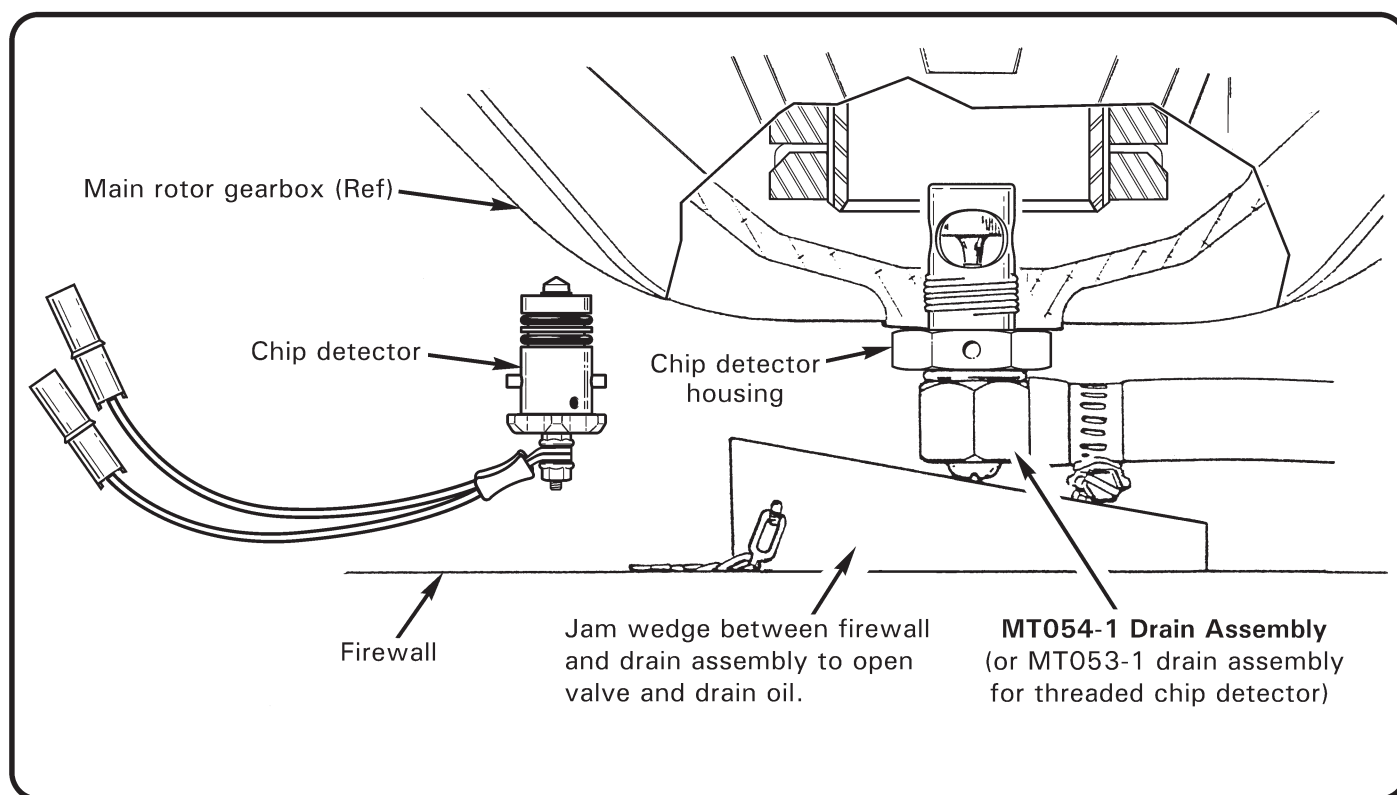


FIGURE 22-1B DRAINING MAIN ROTOR GEARBOX



22-11    Cleaning Chip Detector and Chip Detector Housing**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

1. Disconnect chip detector wiring from airframe harness at connectors. For tail gearbox chip detector, place suitable drain container below gearbox. Remove chip detector from housing or gearbox.
2. Clean chip detector using a toothbrush and approved solvent (refer to § 23-70). Remove debris using compressed air or masking tape; do not use a magnet. Dry chip detector using compressed air or a lint-free cloth. Inspect condition.
3. Connect chip detector wiring to airframe harness at connectors. Turn battery on. Touch detector's magnet to airframe and verify appropriate gearbox caution light illuminates. Turn battery off. Disconnect chip detector wiring from airframe harness at connectors.
4. Install chip detector in housing or gearbox. Special torque threaded chip detector per § 23-33. Connect chip detector wiring to airframe harness at connectors.
5. Turn battery on. Depress push-to-test button(s) and verify appropriate gearbox caution light illuminates. Turn battery off.
6. As required, remove filler-plug. Fill gearbox to center of sight gage using correct gearbox oil (refer to § 22-10 Part C). Rotate rotor system by hand for several revolutions and pull down on tail rotor gearbox several times. Check gearbox oil level and adjust as required. Install filler-plug in gearbox and special torque plug per § 23-33.

22-12    Cleaning Sight Gage

1. Drain main rotor gearbox oil per § 22-10.
2. Remove sight gage from gearbox.
3. Clean sight glass using a toothbrush and approved solvent (refer to § 23-70). Dry sight gage using compressed air or a lint-free cloth. Inspect condition.
4. Install sight gage in gearbox and special torque gage per § 23-33. Verify security.

22-13 Main Rotor Gearbox Drain And Flush**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

1. Run-up helicopter for approximately five minutes at 70-75% RPM per R22 Pilot's Operating Handbook (POH) Section 4 as required to warm oil and expedite draining.
2. Disconnect chip detector wiring from airframe harness at connectors. Remove chip detector from housing.
3. Refer to Figure 22-1B. Insert MT054-1 drain assembly (or MT053-1 drain assembly for threaded chip detector) into housing. Position drain hose overboard into a suitable drain container. Jam wedge between firewall and drain assembly to open valve and drain oil.
4. Remove drain assembly after oil has drained. Install chip detector (special torque threaded chip detector per § 23-33). Connect chip detector wiring to airframe harness at connectors.
5. Remove filler-plug. Fill gearbox to center of sight glass using SAE30, SAE40, SAE50, or SAE20W50 mineral oil. Install filler-plug and special torque plug per § 23-33.
6. Run-up helicopter for approximately five minutes at 70-75% RPM per POH Section 4.
7. After shutdown, drain mineral oil per steps 2 thru 4. Remove drain assembly after oil has drained.
8. Remove chip detector housing. Clean chip detector and housing using a toothbrush and approved solvent (refer to § 23-70). Remove debris using compressed air or masking tape; do not use a magnet. Dry chip detector and housing using compressed air or a lint-free cloth. Inspect condition.
9. Connect chip detector wiring to airframe harness at connectors. Turn battery on. Touch detector's magnet to firewall and verify MR CHIP caution light illuminates. Turn battery off. Disconnect chip detector wiring from airframe harness at connectors.
10. Install chip detector housing in gearbox and special torque housing per § 23-33. Install chip detector in housing. (Special torque threaded chip detector per § 23-33.) Connect chip detector wiring to airframe harness at connectors.
11. As required, remove sight gage and clean glass using approved solvent (refer to § 23-70). Install sight gage and special torque gage per § 23-33.
12. Remove filler-plug. Fill gearbox to center of sight gage using correct gearbox oil (refer to § 22-10 Part C). Rotate rotor system by hand for several revolutions and pull down on tail rotor gearbox several times. Check gearbox oil level and adjust as required. Install filler-plug in gearbox and special torque plug per § 23-33.
13. Turn battery on. Depress push-to-test MR CHIP button and verify caution light illuminates. Turn battery off.

22-20 Tail Rotor Gearbox**NOTE**

Inspect tail rotor gearbox for leaks when “top off” is required.

**NOTE**

Verify aircraft is on level ground when evaluating gearbox oil level.

**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

**A. Draining Oil**

1. Cut and discard ty-raps as required and disconnect chip detector wiring from airframe harness at connectors.
2. Place a suitable drain container under tail rotor gearbox to catch oil, then remove chip detector.

**B. Adding Oil**

1. Install chip detector in tail gearbox and special torque detector per § 23-33.
2. Connect chip detector wiring and install ty-raps, as required. Cinch ty-raps until snug without over-tightening, and trim tips flush with heads.
3. Turn battery switch on. Verify TR CHIP caution light illuminates when test button is depressed. Turn battery switch off.
4. Remove gearbox filler-plug and fill gearbox to center of sight gage using correct gearbox oil (refer to § 22-10 Part C). Rotate rotor system by hand for several revolutions and pull down on tail rotor gearbox several times. Check gearbox oil level and adjust as required.
5. Install filler-plug in gearbox and special torque plug per § 23-33.

**C. Main and Tail Gearbox Oil**

Refer to § 22-10 Part C.

### 22-21 Cleaning Chip Detector

1. Drain tail rotor gearbox oil per § 22-20.
2. Clean chip detector using a toothbrush and approved solvent (refer to § 23-70). Remove debris using compressed air or masking tape; do not use a magnet. Dry chip detector using compressed air or a lint-free cloth. Inspect condition.
3. Connect chip detector wiring to airframe harness at connectors. Turn battery switch on. Touch detector's magnet to airframe and verify TR CHIP caution light illuminates. Turn battery switch off. Disconnect chip detector wiring from airframe harness at connectors.
4. Install chip detector in gearbox and special torque detector per § 23-33. Connect chip detector wiring to airframe harness at connectors. Verify security.
5. Turn battery switch on. Depress push-to-test button and verify TR CHIP caution light illuminates. Turn battery switch off.

### 22-22 Cleaning Sight Gage

1. Drain tail rotor gearbox oil per § 22-20.
2. Remove sight gage from gearbox.
3. Clean sight gage using a toothbrush and approved solvent (refer to § 23-70). Dry sight gage using compressed air or a lint-free cloth. Inspect condition.
4. Install sight gage in gearbox and special torque gage per § 23-33. Verify security.

22-23 Tail Rotor Gearbox Drain And Flush**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

1. Run-up helicopter for approximately five minutes at 70–75% RPM per R22 Pilot's Operating Handbook (POH) Section 4 as required to warm oil and expedite draining.
2. Disconnect chip detector wiring from airframe harness at connectors. Place a suitable drain container below tail rotor gearbox and remove chip detector.
3. After oil has drained, install chip detector in gearbox and special torque detector per § 23-33. Connect chip detector wiring to airframe harness at connectors.
4. Remove filler-plug. Fill gearbox to center of sight gage using SAE30, SAE40, SAE50, or SAE20W50 mineral oil. Install filler-plug and special torque plug per § 23-33.
5. Run-up helicopter for approximately five minutes at 70–75% RPM per POH Section 4.
6. After shutdown, drain mineral oil per step 2.
7. Clean chip detector using a toothbrush and approved solvent (refer to § 23-70). Remove debris using compressed air or masking tape; do not use a magnet. Dry chip detector and housing using compressed air or a lint-free cloth. Inspect condition.
8. Connect chip detector wiring to airframe harness at connectors. Turn battery on. Touch detector's magnet to airframe and verify TR CHIP caution light illuminates. Turn battery off. Disconnect chip detector wiring from airframe harness at connectors.
9. Install chip detector in gearbox and special torque detector per § 23-33. Connect chip detector wiring to airframe harness at connectors.
10. As required, remove sight gage and clean glass using approved solvent (refer to § 23-70). Install sight gage and special torque gage per § 23-33.
11. Remove filler-plug. Fill gearbox to center of sight gage using correct gearbox oil (refer to § 22-10 Part C). Rotate rotor system by hand for several revolutions and pull down on tail rotor gearbox several times. Check gearbox oil level and adjust as required. Install filler-plug in gearbox and special torque plug per § 23-33.
12. Turn battery on. Depress push-to-test TR CHIP button and verify caution light illuminates. Turn battery off.

22-30 Clutch Assembly Lubricant Inspection and Servicing**A. Clutch Assemblies with A168-4 (Forward) Retainer****WARNING**

**Avoid contaminating drive belts and sheaves with lubricant. Clean contaminated surfaces with mild soap and water solution, followed by a warm water rinse. Place a clean, absorbent rag beneath MT147-2 fittings, when installed, to catch any drips.**

1. Open main rotor gearbox compartment access doors.
2. Rotate clutch shaft until bolts securing yokes to shaft are vertical. Engage rotor brake.
3. Remove A168-4 (forward) retainer's top B289-3 screw and install clean MT147-2 fitting. Attach drain hose.
4. Rotate sheave until fitting and attached drain hose are on bottom. Route drain hose into a suitable, clean container. Remove top B289-3 screw and allow lubricant to drain into container.
5. Install second clean MT147-2 fitting at top of retainer and connect a clean supply of A257-4 lubricant to fitting. Flush sprag clutch housing until exiting lubricant is obviously red. Disconnect lubricant supply and allow lubricant to drain completely into container.
6. Strain all lubricant from container through a 180-200 micron paint filter/strainer. Fluid may be dark, and may sparkle with very fine metallic debris; this is normal. If metallic debris is trapped in the filter/strainer, remove clutch assembly and return it to RHC, or an R22 Service Center authorized to overhaul clutch assemblies, for disassembly and inspection.
7. If metallic debris is not found in the filter, attach drain hose to top fitting. Route drain hose into a suitable container. Connect a clean supply of A257-4 lubricant to bottom fitting. Fill sprag clutch housing thru bottom fitting until no air bubbles are visible in drain hose. Shut-off fluid flow.
8. Remove top fitting and install screw. Rotate sheave until opposite fitting is on top. Remove fitting and verify lubricant level contacts threads; add lubricant as required. Install forward screw.
9. Close main rotor gearbox compartment access doors.

**B. Clutch Assemblies with Retainer without B289-3 Screws**

1. Perform clutch assembly (aft) seal replacement per § 7.213.

## 22-40 Clutch Actuator Upper and Lower Bearings

The actuator upper bearing is located on the clutch shaft, and the actuator lower bearing is located on the fanshaft. Failure of either actuator bearing in flight could cause loss of power to rotor system and result in a serious accident. Refer to § 2.110 for general indications of bearing failure. In addition, just before failure of an actuator bearing, clutch light may flicker (on and off in less than one second) constantly or illuminate for a longer time than usual. Do not be confused with normal retensioning in flight (light on for up to 8 seconds, then off). Flight should not be resumed until cause of abnormal clutch light illumination has been determined.

Perform the following bearing inspections whenever an actuator bearing discrepancy is suspected or fanwheel is removed:

## 22-41 Upper Bearing Lubrication

### **WARNING**

**Refer to Safety Data Sheets (SDS) and observe precautions when working in proximity to hazardous materials.**

### **NOTE**

KI-115 Special Tools Kit (syringe and probe) required to perform the following procedure.

1. Fill syringe with 2-3 grams A257-12 grease (refer to § 23-70). Note: 2.5 grams of grease fills a 0.5 inch (13 mm) long space inside a syringe body with a 0.63 inch (16 mm) inner diameter.
2. Thoroughly clean an accessible portion of A184 bearing assembly aft rubber seal and surrounding surface.
3. Gently press plastic tip of syringe against cleaned seal inner lip until lip deflects inward and tip slips into bearing. Do not damage seal. Inject grease with syringe perpendicular to seal. Withdraw syringe. Part of seal's inner lip remains deflected inward.
4. Slide tip of steel probe under seal inner lip and return deflected portion of lip to original position. Do not damage seal.
5. Run-up helicopter for approximately two minutes 104% RPM per R22 Pilot's Operating Handbook (POH) Section 4. Shut down, inspect bearing, and clean off any escaped grease.

### **WARNING**

**Bearing used in A184 bearing assembly has modified internal clearance for use on R22. Do not substitute any other bearing.**

22-42 Lower Bearing Lubrication**WARNING**

**A181-1 & A181-3 bearings are obsolete and must be removed from service.**

1. Remove fanwheel per § 6.210.
2. Disconnect lower end of belt tension actuator from bearing housing.
3. Rotate bearing housing. Verify no roughness, scraping, or excessive looseness (0.010 inch maximum axial play). Verify no seal damage, and no heat damage. Lubricate bearing:
  - a. Remove four perimeter screws, nuts, and washers.
  - b. Remove bearing block with attached outer race (bearing outer race is split type). Forward seal retainer, forward seal, bearing inner race and bearing rollers will remain on fan shaft.
  - c. Clean parts, including seals, and inspect for obvious damage.
  - d. Lubricate bearing by filling openings on both sides of roller cage with A257-12 grease, but do not fill spaces between rollers.
  - e. Reassemble. Ensure forward seal fits properly into recess provided in forward seal retainer (not applicable to Rev L bearings).
  - f. Standard torque MS24694-S61 screws per § 23-32.
  - g. Rotate bearing housing. Verify no roughness and no excessive looseness.
4. Inspect bearing inner race on fanshaft. No movement or fretting is allowed between inner race and fanshaft.
5. If any indication of bearing failure is found, replace A007-3 or -5 shaft and bearing assembly per § 7.290.
6. Install fanwheel per § 6.220.
7. If bearing was lubricated, inspect & clean off any escaped grease after balancing fanwheel.



## 22-50 Fuel System

### **WARNING**

**Refer to Safety Data Sheets (SDS) and observe precautions when working in proximity to hazardous materials.**

### **WARNING**

**Always fuel or defuel helicopter in a well-ventilated area. No smoking within 100 feet of aircraft during fueling.**

## 22-51 Fueling

1. Turn battery switch off.
2. Ground helicopter and ground fuel vehicle. Ground fuel vehicle to helicopter.
3. Verify proper grade of aviation fuel. See R22 Pilot's Operating Handbook (POH) Section 2 for approved fuel grades and instructions for use of anti-ice additive.

### **NOTE**

Refer to Figure 2-4A. Verify A689-6 fuel cap is revision J or subsequent if bladder tanks are installed (revision J or subsequent caps may also be used on all-aluminum tanks).

4. Remove fuel cap(s) and fuel helicopter as required.
5. Install fuel cap(s); verify security.
6. Remove grounding equipment.

## 22-52 Defueling

1. Turn battery switch and fuel valve off.
2. Place suitable drain container beneath carburetor and ground container to helicopter.
3. Disconnect fuel hose assembly from carburetor.
4. Turn fuel valve on to drain fuel. (Perform low-fuel switch operation check per § 12.430, if desired.)
5. Connect fuel hose assembly to carburetor, special torque hose assembly nut per § 23-33, and torque stripe per Figure 2-1.

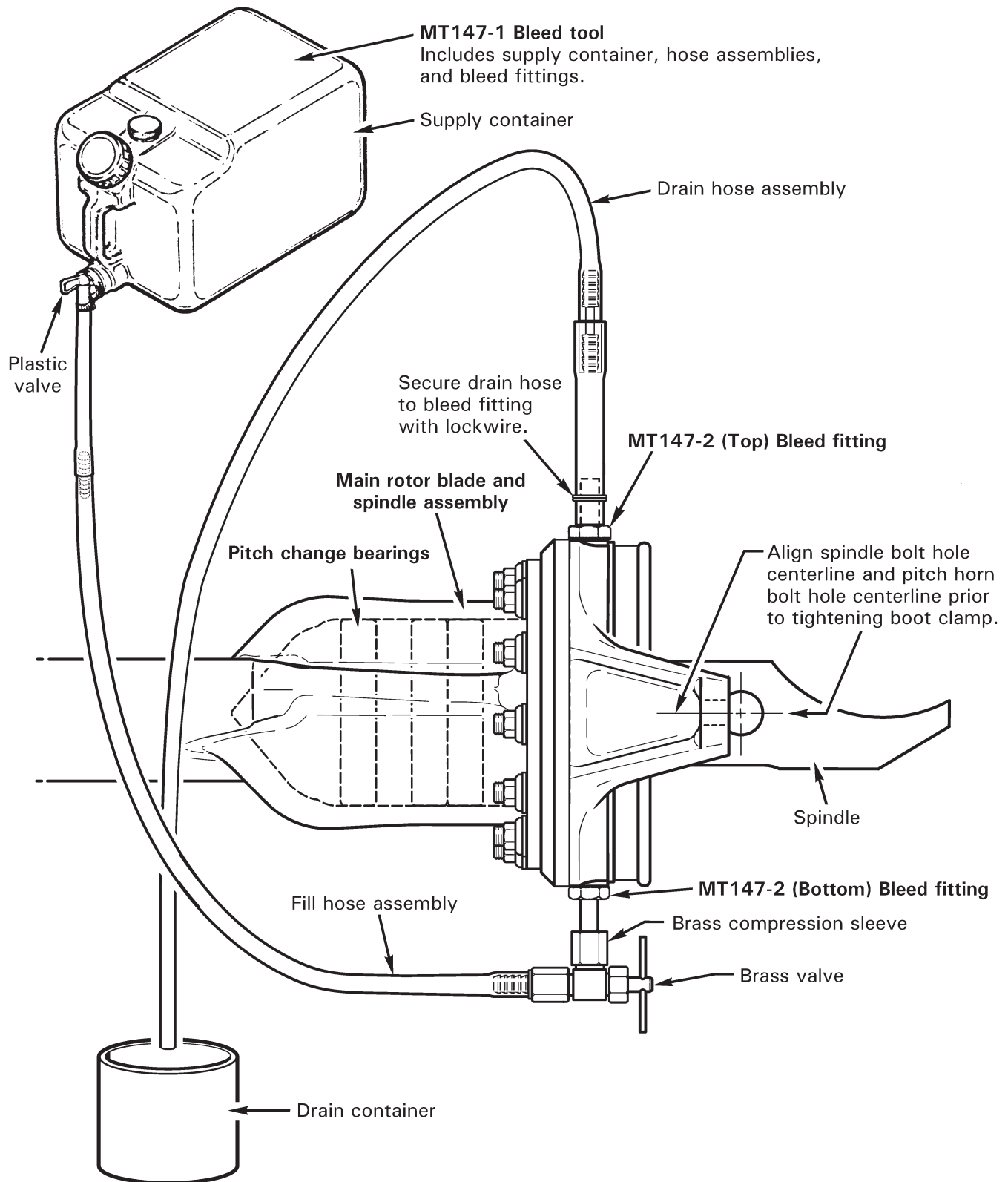


FIGURE 22-2 FILLING PITCH BEARING HOUSING

22-60 Main Rotor Blades22-61 Pitch Bearing Housing**NOTE**

MT147-1 Main rotor blade spindle air bleed tool includes supply container, hose assemblies, and bleed fittings.

**WARNING**

**Refer to Safety Data Sheets (SDS) and observe precautions when working in proximity to hazardous materials.**

1. Remove main rotor blades per § 26-10.
2. Refer to Figure 22-2. Place a suitable drain container below main rotor pitch horn. Remove two B289-2 bolts from pitch horn and drain fluid.
3. Install MT147-2 bleed fittings into pitch horn openings. Attach drain hose assembly to (top) bleed fitting, secure with two wraps of lockwire. Position drain hose into drain container.
4. Place supply container with sufficient A257-4 fluid approximately 3 feet above spindle. Route fill hose assembly into drain container and open brass valve. Open supply container plastic valve and purge air from fill hose. Close valves.
5. Connect brass valve to (bottom) bleed fitting by tightening brass compression sleeve.
6. Open valves and fill spindle housing until no air bubbles are visible in drain hose assembly. Massage spindle boot, oscillate spindle, and raise blade tip up & down to remove trapped air.
7. Remove drain hose assembly and (top) bleed fitting, and install B289-2 bolt. Roll the blade over. After five minutes, inspect the boot for leaks. If no leaks are found, close valves, remove fill hose assembly brass valve and (bottom) bleed fitting, and install other bolt.
8. Special torque B289-2 bolts per § 23-33 and torque stripe per Figure 2-1.
9. Repeat steps for opposite blade.

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## CHAPTER 23

## STANDARD PRACTICES

<i>Section</i>	<i>Title</i>	<i>Page</i>
23-10	Cleaning . . . . .	23.1
23-20	Lubrication . . . . .	23.3
23-30	Torque Requirements . . . . .	23.5
23-31	Torque Stripe . . . . .	23.7
23-32	Standard Torques . . . . .	23.8
23-33	Special Torques . . . . .	23.9
23-34	Push-Pull Tube Rod End Adjustment . . . . .	23.13
23-35	D210-series Nuts on Critical Fasteners . . . . .	23.13
23-36	A880 Flared Tube Components . . . . .	23.14
23-40	Non-Destructive Testing . . . . .	23.26
23-41	Magnetic Particle Inspection . . . . .	23.26
23-42	Fluorescent Penetrant Inspection . . . . .	23.27
23-50	Corrosion Control . . . . .	23.27
23-51	Conversion Coat – Aluminum . . . . .	23.27
23-60	Priming and Painting . . . . .	23.28
23-70	Approved Materials . . . . .	23.31
23-71	Paint Strippers . . . . .	23.31
23-72	Solvents and Cleaners . . . . .	23.31
23-73	Fillers and Putty . . . . .	23.32
23-74	Torque Seal . . . . .	23.32
23-75	Primers . . . . .	23.33
23-76	Powder Coat . . . . .	23.34
23-77	Paints . . . . .	23.36
23-78	Lubricants . . . . .	23.39
23-79	Adhesives and Sealants . . . . .	23.40
23-80	Miscellaneous Practices . . . . .	23.42
23-81	Part Interchangeability . . . . .	23.42
23-82	Thermal Fitting Parts . . . . .	23.42
23-83	Replacement Component Identification (Data) Plates . . . . .	23.43
23-84	Crimp Inspection . . . . .	23.43
23-85	Storage Limits . . . . .	23.44
23-86	B526 Screws and B527-08 Washers . . . . .	23.44

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## CHAPTER 23

## STANDARD PRACTICES

23-10 Cleaning**WARNING**

Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.

**A. Cleaning Exterior Surfaces****CAUTION**

Refer to § 23-10 Part B for cleaning windshield and windows.

**CAUTION**

Never use high-pressure spray to clean helicopter. Never blow compressed air into main or tail rotor blade tip drain holes, pitot tube, or static ports.

**CAUTION**

Wash helicopter exterior surfaces with mild soap (pH between 7 & 9) and water. Harsh abrasives, alkaline soaps, or detergents can scratch painted or plastic surfaces, or cause corrosion of metal. Protect areas where cleaning solution could cause damage.

1. Rinse away loose dirt and debris from exterior surface with clean water.
2. Apply mild soap (pH between 7 & 9) and clean warm water solution to exterior surface using a clean, soft cloth, sponge, or soft bristle brush. Use caution near antennas and sensitive equipment.
3. Remove oil and grease using a cloth wetted with aliphatic naphtha.
4. Rinse all surfaces thoroughly.
5. If desired, polish painted surfaces with a good quality automotive wax using soft cleaning cloths, or a chamois cloth, free of abrasive debris.

23-10 Cleaning (continued)**B. Cleaning Windshield and Windows**

1. Remove dirt, mud, and other loose particles from exterior surfaces with clean water.
2. Wash with mild soap (pH between 7 & 9) and warm water or with aircraft plastic cleaner. Use a soft cloth or sponge in a straight back and forth motion. Do not rub harshly.
3. Remove oil and grease with a cloth moistened with isopropyl alcohol (rubbing alcohol) or aliphatic naphtha.

**CAUTION**

Do not use gasoline, other alcohols, benzene, carbon tetrachloride, thinner, acetone, or window (glass) cleaning sprays.

4. After cleaning plastic surfaces, apply a thin coat of hard polishing wax. Rub lightly with a soft cloth. Do not use a circular motion.

**CAUTION**

Windshield surface must be water-repellent for good visibility in rain. When using a new cleaning or polishing product on windshield, verify water beads on surface before flying.

5. On acrylic windows (standard windshield), scratches can be removed by rubbing with jeweler's rouge followed by hand polishing with commercial plastic polish. Use a figure eight motion with polishing.

**NOTE**

Impact-resistant windshields are made from polycarbonate with a protective hardcoat and cannot be polished.

**C. Cleaning Seat Assemblies and Back Rests**

1. Vacuum and brush, then wipe with damp cloth. Dry immediately.
2. Soiled upholstery, except leather, may be cleaned with a good upholstery cleaner suitable for the material. Follow manufacturer's instructions. Avoid soaking or harsh rubbing.
3. Leather should be cleaned with saddle soap or a mild hard soap and water.

**D. Cleaning Carpet**

Remove loose dirt with a whisk broom or vacuum. For soiled spots and stains, use nonflammable dry cleaning liquid.



23-20 Lubrication**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

Most bearings are sealed or self-lubricated and do not require periodic lubrication. Bearings with scheduled lubrication intervals are listed in Table 1 (see Chapter 1).

Engine lubrication requirements are located in the R22 Pilot's Operating Handbook, the appropriate model Lycoming Operator's Manual, and Lycoming Service Instruction No. 1014 (current revision).

Main and tail gearboxes require servicing when indicated by sight gage level. Additionally, change gearbox oil and clean respective sight gage when oil becomes so dirty its level cannot be determined.

**WARNING**

**Use approved gearbox oils only (refer to § 22-10 Part C).**

When installing a new or overhauled gearbox, drain and flush gearbox after the first 4 hours of flight or first chip light, whichever occurs first. Thereafter, change gearbox oil at intervals listed in Table 1 (see Chapter 1).

**Given**

Y = Unknown  
T = 135 in.-lb  
L = 10 in.  
A = 1.5 in.

**Symbols**

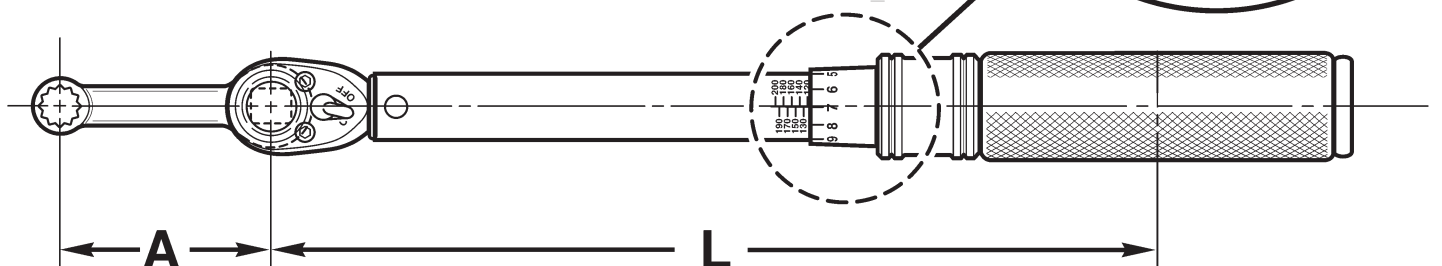
Y = Torque wrench setting  
T = Torque applied to fastener  
L = Length of torque wrench  
A = Length of adapter

When using an adapter that lengthens torque wrench effective length, calculate torque wrench setting using the formula below:

**EXAMPLE**

$$\text{Solve for } Y = \frac{T \times L}{L + A} = \frac{135 \times 10}{10 + 1.5} = \frac{1350}{11.5} = 117.39$$

Set torque wrench to 117 in.-lb to torque fastener to 135 in.-lb.



**FIGURE 23-1 LENGTHENING TORQUE WRENCH EFFECTIVE LENGTH**

**Given**

Y = Unknown  
T = 135 in.-lb  
L = 10 in.  
A = 1.5 in.

**Symbols**

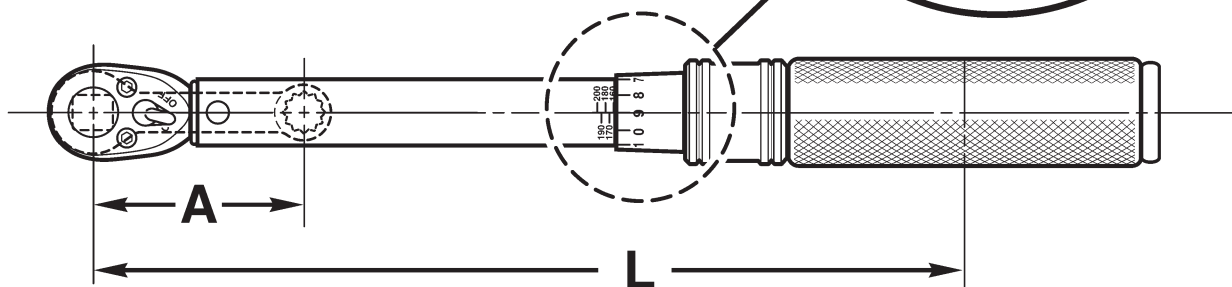
Y = Torque wrench setting  
T = Torque applied to fastener  
L = Length of torque wrench  
A = Length of adapter

When using an adapter that shortens the torque wrench effective length, calculate torque wrench setting using the formula below:

**EXAMPLE**

$$\text{Solve for } Y = \frac{T \times L}{L - A} = \frac{135 \times 10}{10 - 1.5} = \frac{1350}{8.5} = 158.82$$

Set torque wrench to 159 in.-lb to torque fastener to 135 in.-lb.



**FIGURE 23-2 SHORTENING TORQUE WRENCH EFFECTIVE LENGTH**

## 23-30 Torque Requirements

### A. Tool Calibration

Dimensions and tolerances given in this manual are critical. Calibrate measuring tools per manufacturer's recommendation at least once a year, when tool is dropped, misused, or calibration is suspect. Measuring tools include torque wrenches, micrometers, calipers, dial indicators, spring scales, protractors, and balancing equipment.

#### WARNING

Proper torque is critical. Always use calibrated wrenches and undamaged, properly lubricated (where applicable) hardware. Ensure clamping surfaces are clean, and clamp only bare metal or wet-primed surfaces. Improper torque or dirty or painted clamping surfaces may result in loss of clamp-up, hardware or part damage, and premature failure.

### B. Torque Value

Torque fasteners to standard dry values listed in § 23-32 unless otherwise specified. If torque is applied by rotating bolt, increase torque value by 10% to account for higher friction at bolt head and shank.

For example, the torque wrench setting for an NAS6605 bolt used with an MS21075 nutplate is determined as follows:

NAS6605 bolt (5 indicates 5/16 inch size) dry torque per § 23-32	240 in.-lb
Add 10% because torque must be applied at bolt head	+ 24 in.-lb
Torque wrench setting	264 in.-lb

### C. Secondary Locking Mechanism

A secondary locking mechanism is required on all critical fasteners. B330 stamped nuts (palnuts) serve as the secondary locking mechanism in most areas on the helicopter, and are torqued per § 23-32. Palnuts must be replaced when removed. The R22 Illustrated Parts Catalog (IPC) lists secondary locking mechanisms for specific fasteners.

23-30 Torque Requirements (continued)**D. Critical Fastener****CAUTION**

D210-series nuts, which supersede MS21042L-series and NAS1291-series nuts, are required on critical fasteners.

**WARNING**

**Assembly of flight controls is critical and requires inspection by a qualified person. If a second person is not available, RHC recommends the installer take a 5-minute break prior to inspecting flight control connections he has assembled.**

A critical fastener is one which, if removed or lost, would jeopardize safe operation of the helicopter. This includes joints in the primary control system, and non-fail-safe structural joints in the airframe, landing gear, and drive system.

23-30 Torque Requirements (continued)**E. Torque Requirements****CAUTION**

Never substitute AN bolts for NAS bolts. NAS bolts have higher tensile strength.

1. Any self-locking nut whose drag has deteriorated appreciably must be replaced. Damaged hardware must be replaced.
2. Bolt and nut are to be clean and dry except when assembly procedure specifies anti-seize or thread-locking compound.
3. If chattering or jerking occurs, disassemble and re-torque fastener.
4. If special adapters which change effective length of torque wrench are used, final torque value must be calculated using formulas in Figures 23-1 and 23-2.
5. Unless otherwise specified, proper thread engagement requires:
  - a. If palnut is not required, one to four threads exposed beyond primary nut.
  - b. If palnut is required, two to four threads exposed beyond primary nut.
  - c. For B526-8 screws, one to five threads exposed beyond primary nut.

**WARNING**

**Proper thread engagement ensures proper locking of fastener. Exceeding maximum thread exposure beyond primary nut may allow nut to seat against unthreaded shank, resulting in insufficient joint clamping.**

6. Refer to Part A. Torque wrenches must be calibrated annually, when dropped, or when a calibration error is suspected.

23-31 Torque Stripe**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

Refer to Figure 2-1. Lacquer-paint Torque Seal® is applied to all critical fasteners after palnut installation in a stripe ("torque stripe") extending from the fastener's exposed threads across both nuts and onto the component. Subsequent rotation of the nut or bolt can be detected visually. Position torque stripes for maximum visibility during preflight inspections. Approved Torque Seal® is listed in § 23-74.

## 23-32 Standard Torques

## NOTE

1. Torque values are in inch-pounds unless otherwise specified.
2. Torque values include nut self-locking torque.
3. Increase torque values 10% if torqued at bolt head.
4. Wet indicates threads lubricated with A257-9 anti-seize.
5. For elbow and tee fittings which require alignment, torque to indicated value, then tighten to desired position.
6. Tolerance is  $\pm 10\%$  unless range is specified.
7. Unless otherwise specified, thread sizes 8-32 and smaller are not used for primary structure and do not require control of torques.

FASTENER SERIES		SIZE	EXAMPLE FASTENER	TORQUE (IN.-LB)
NAS6603 thru NAS6608 Bolts NAS1303 thru NAS1308 Bolts NAS623 Screws NAS1351 & NAS1352 Screws NAS600 thru NAS606 Screws		10-32	NAS6603	50
		1/4-28	NAS6604	120
		5/16-24	NAS6605	240
		3/8-24	NAS6606	350
		7/16-20	NAS6607	665
		1/2-20	NAS6608	995
A142 screws AN3 Bolts AN4 Bolts AN6 Bolts AN8 Bolts	AN502 Screws AN503 Screws AN509 Screws AN525 Screws MS24694 Screws MS27039 Screws	10-32	A142-1, -3, -4, AN3	37
		1/4-28	AN4	90
		3/8-24	AN6	280
		1/2-20	AN8	795
STAMPED NUTS (PALNUTS)  Palnuts are to be used only once and replaced with new ones when removed.		10-32	B330-7 (MS27151-7)	6–15
		1/4-28	B330-13 (MS27151-13)	11–25
		5/16-24	B330-16 (MS27151-16)	20–40
		3/8-24	B330-19 (MS27151-19)	29–60
		7/16-20	B330-21 (MS27151-21)	42–85
		1/2-20	B330-24 (MS27151-24)	54–110
TAPERED PIPE THREADS		1/8-27	See note 5	60
			Straight fittings only	120
		1/4-18	See note 5	85
			Straight fittings only	170
		3/8-18	See note 5	110
			Straight fittings only	220
		1/2-14	See note 5	160
			Straight fittings only	320
3/4-14	See note 5	230		
	Straight fittings only	460		
ROD END JAM NUTS (AN315 and AN316)		10-32	AN315-3	15
		1/4-28	AN316-4	40
		5/16-24	AN316-5	80
		3/8-24	AN316-6	110

### 23-33 Special Torques

These torques are non-standard and supersede those in § 23-32.

#### NOTE

1. Torque values are in inch-pounds unless otherwise specified.
2. Torque values include nut self-locking torque.
3. Increase torque values 10% if torqued at bolt head.
4. Wet indicates threads lubricated with A257-9 anti-seize.
5. For elbow and tee fittings which require alignment, torque to indicated value, then tighten to desired position.
6. Tolerance is  $\pm 10\%$  unless range is specified.
7. Unless otherwise specified, thread sizes 8-32 and smaller are not used for primary structure and do not require control of torques.

AREA	(QUANTITY) FASTENER	TORQUE (IN.-LB)
COOLING SYSTEM	(8) nuts, supplied with engine, securing A484-3 plates	300
	(4) hose clamps – oil drain back tube (rotate to clear retainers)	10
	(2) NAS1352-4H14P screws, cooling panels	96
	(6) NAS1352-4H10P screws, cooling panels	96
DRIVE SYSTEM	(1) AN320-15 nut (1 ½ inch socket) on A007-3 shaft assembly	183–233 FT-LB, wet
	(1) AN320-18 nut (1 11/16 inch socket) on A007-5 or -6 shaft assembly	340–400 FT-LB, wet. Retorque after first engine run after installation.
	(6) NAS6606H23 or (6) NAS6606H24 bolts, lower sheave	300
ELECTRICAL SYSTEM	(2) nuts, securing wire terminals to 1465-70-104 shunt	18
	(2) MS21044B5 nuts, securing A780 cables to B415-1 relay	80
	(2) 01003621 screws, securing wire terminals to B415-1 relay	10
	(1) nut, supplied with OAT probe	18
	(2) engine supplied bolts, securing A212-1 ground straps	96
	(2) nuts, securing wire terminals to B308-1 oil pressure sender	10
	(4) A142-5 screws, securing TJ-120 jacks (B270-20)	2
	(2) dress nuts, at D746-4 harness	14
	(1) engine supplied nut, securing A780-2 cable	96 $\pm$ 10
	(2) MS35206 screw, V3 switches collective	4-5
	(2) D262-11 fuse holders	8-10
	(1) terminal nut, starter, -581 wire (use back up wrench)	100
	(1) terminal nut, starter, -3245 wire (use back up wrench)	60
	(1) terminal nut, alternator output terminal (use back up wrench)	50
	(2) terminal nuts, D748-3 alternator, F1 & F2 terminals (use back up wrench)	14
	(1) D748-3 alternator supplied screw (B270-20 on threads)	27
	(2) terminal nuts, D748-4 alternator, F1 & F2 terminals (use back up wrench)	20
	(3) terminal nuts, TCM magneto (use back up wrench)	15
	(3) terminal nuts, EIS magneto (use back up wrench)	10
	(1) EIS supplied screw, shield drain wire	15

## 23-33 Special Torques (continued)

AREA	(QUANTITY) FASTENER	TORQUE (IN.-LB)
EMPENNAGE	(4) NAS6603-2 & (4) NAS6603-5 bolts, vertical stabilizer attach	70
FANWHEEL & SCROLL ASSEMBLIES	(1) AN320-15 or AN320-18 nut – see DRIVE SYSTEM	
	(8) or (12) NAS6603-3 or -6 bolts and D210-3 nuts, cone-to-fanwheel	70
	(6) NAS6605-11, -12, -13, or -14 bolts, hub (3) B660-1 bolts optional equally spaced, hub	300, and retorque after first engine run after installation
	(12) D216-1 screw, A185 brackets	25
FUEL SYSTEM	(1) A457-15 bulkhead union and nut	285
	(1) A657-1 nut, fuel valve elbow-to-bulkhead union	120
	(1) A726-1 line assembly, bulkhead union-to-gascolator	285
	(1) A880-934, A880-964, or AN815-4D union, main tank, drain hose	145
	(1) A880-936, A880-966, or AN815-6D union, main tank, tank interconnect hose	200
	(1) A880-1004 or AN924-4D nut, main tank, drain valve	145
	(1) A880-1005 or AN924-5D nut, low-fuel warning switch	150
	(2) B254-3 strainer assembly, tank outlets	200, wet
	(1) B283 hose assembly nuts, gascolator-to-carburetor	120
	(10) B289-1 bolts, fuel sender (torque in criss-cross pattern)	37
	(2) D252 fuel sender center stud nut	11
	(2) B330-6 palnut at fuel sender center stud	9
	(2) D252 fuel sender ground stud nut	9
	(2) B330-5 palnut at fuel sender ground stud	9
	(1) C595-1 or D205-33 hose assembly nuts, tank interconnect	120
	(1) D205-32 hose assembly nuts, main tank-to-fuel valve	120
	(1) D205-34 hose assembly nuts, main tank drain	60
	(1) D210-4 nut, gascolator mounting plug	70
	(16) AN805 nuts, fuel primer line	20–30
	(1) AN894D4-2 bushing, primer system	50–65
	(1) AN894D6-4 bushing, primer system	110–130
	(4) engine supplied bolts, securing MS21333-96 clamp	96
	(4) MS27039C1-06 screws, fuel valve	16
	(4) MS27039DD1-26 screws, air bypass door	24
	(1) MS27769D2 plug, gascolator	60
	Primer system line assembly nuts, flared end fittings	20–30
FUSELAGE	(1) B277-052 clamp, lower rib	50
	(1) D210-5 nut, tow ball	240
	(8) MS51861-37C screws, door hinges	36
	(6) NAS6603-2 bolts, securing B375-2 stabilizer	70
LANDING GEAR	(4) AN4-25A bolts, ground handling support	70
	(56) NAS6604 bolts, floats to skids and skid extensions	50, torqued from nut



23-33 Special Torques (continued)

AREA	(QUANTITY) FASTENER	TORQUE (IN.-LB)
MAIN ROTOR BLADE	(2 per blade) A722-4 screw, tip weight retaining	40, wet
	(2 per blade) B289-2 self-sealing bolts in pitch horn	70
	(2 per blade) NAS1351N3-10P screw, cover retaining	40, wet
MAIN ROTOR GEARBOX	(1) AN320-8 nut, gearbox pinion	290–410
	(1) AN10-41A bolt, gearbox mounting with (3) A650-1 fittings, gearbox mounting	90 FT-LB torqued from nut
	(1) AN10-40A bolt, gearbox mounting with (3) A650-3 fittings, gearbox mounting	
	(1) F650-3 bolt, gearbox mounting with (3) A650-3 fittings, gearbox mounting	50 FT-LB, wet torqued from bolt head or nut
	(6) NAS1352-4-14 screws, end cover (no rotor brake)	140
	(3) NAS1352-4-28 screws, end cover with rotor brake	140
	(6) MS20074-04-06 screws, end cover (no rotor brake)	60
	(3) MS20074-04-15 screws, end cover with rotor brake	60
	(1) chip detector (threaded, non-quick-disconnect type)	Large nut 150 Small nut 75
	(1) chip detector housing	150
	(1) nut, chip detector wiring	4–6
	(1) filler-plug	150
	(1) sight gage	150
MAIN ROTOR HUB	(1) NAS630-80 (or MS21250-10080) teeter hinge bolt; (2) NAS630-80 (or MS21250-10080) coning hinge bolts in A154-1 hub  <div><b>WARNING</b> Scrap bolt &amp; nut if bolt is elongated more than 0.019 inch during tightening.</div>	New bolt: 0.016–0.017 inch elongation, wet  Used bolt: 0.015–0.017 inch elongation, wet, & cotter pin holes must align
	(2) NAS632-82 (or MS21250-12082) coning hinge bolts in B370-1 hub  <div><b>WARNING</b> Scrap bolt &amp; nut if bolt is elongated more than 0.014 inch during tightening.</div>	New bolt: 0.011–0.012 inch elongation, wet  Used bolt: 0.010–0.012 inch elongation, wet, & cotter pin holes must align
POWERPLANT (see also cooling & electrical systems)	(1) A058-5 carburetor air temp probe	36–48
	(2) A740-1 manifold pressure line nuts	25–35
	(1) A760-1 oil temperature sender, single	300
	(1) terminal nut supplied with A760-1	20
	(1) A760-2 cylinder head temperature sender	50
	(1) A760-3 oil temperature sender, dual	300
	(1) B200-4 lug, bolt supplied with engine	96

## 23-33 Special Torques (continued)

AREA	(QUANTITY) FASTENER	TORQUE (IN.-LB)
POWERPLANT (CONT'D) (see also cooling & electrical systems)	(1) C143-1, -3, or -5 sensor assembly	96
	(2) B277-024 clamps, carb heat scoop	30
	(4) AN818-8 or A880-108 nuts, oil cooler line (stainless-steel)	40 FT-LB
	(4) AN818-8 nuts, oil cooler line (aluminum lines)	230–260
	(1) AN894D4-3 bushing, manifold pressure line, at firewall	135–150
	(4) MS20074-04-04 bolts, air box-to-carburetor	30
	(1) 3080-38 cylinder head temperature probe	70–80
	(1) bolt, alternator belt tension	204
	(4) bolts, D723-1 oil adapter	90–100
	(4) carburetor-to-engine nuts	96 initial, 204 final, torque in a crisscross pattern
	(8) exhaust riser flange nuts, plain. Draw up all (8) nuts evenly prior to torquing	160–180
	(8) 21FKF-518 exhaust riser flange nuts, self-locking. Draw up all (8) nuts evenly prior to torquing	200–220
	(2) ground strap-to-engine nuts	96
	(1) nut, B315-1 clip for magneto harness clamp	60
	(8) spark plugs	35 FT-LB, wet with A257-16 oil
POWERPLANT CONTROLS	(1) thermostatic oil cooler bypass valve	290–310
	(6 per cover) valve cover retaining screws, when used with clean, dry, Lycoming P/N 06B26669 gasket on clean, dry valve cover and cylinder head mating surfaces screws	35
	(4) A142-4 screw, D334-5 bellcrank assembly	45
	(1) NAS6606-16 bolt, D334-5 bellcrank assembly	280
	(1) A486 screw, overtravel spring upper rod end	37
	(1) A933-3 rod end, B364-1 push-pull tube forward rod end	15-30
	(1) castellated nut, carburetor throttle arm	20-60
STEEL TUBE FRAME	(1) nut on A462-1 carburetor heat control wire-to-slider valve attach fitting	25–30
	(1) nut on A462-4 mixture control wire-to-carburetor mixture arm attach fitting	25–30
SWASHPLATE	(2) NAS1351-8H40P internal-wrenching screws	70–75 FT-LB, wet
	(3) NAS6604-3 bolts – (1) lower-left frame aft strut-to-upper frame, and (2) on removable aft, right strut	120 with B270-1 on shank to seal strut holes
	(2) NAS1352N08-6 screws, magnetic pick-up bracket	35
	(16) NAS1352N08-8 screws	35, wet
	(16) AN503-8-8 screws, 0.020 inch diameter safety wire, revision AL and prior swashplates	17
	(1) NAS6605-8 bolt clamping early revision A203 yokes	190
	(1 per link) 21FKF-616 jam nut, main rotor pitch link barrel	100

23-33 Special Torques (continued)

AREA	(QUANTITY) FASTENER	TORQUE (IN.-LB)
TAIL ROTOR GEARBOX	(1) B549-1 retainer, input seal	70 FT-LB, wet
	(1) D210-4 nut, A031 pitch control housing stud	90
	(1) D210-4 nut, A119-1 bumper retainer	120
	(1) D210-8 nut retaining B546 input yoke on B021 gearbox	70 FT-LB, wet with B270-11
	(3) MS20074-04-06 bolts, gearbox-to-tailcone mounting	100
	(3) MS90725-7 cap screws, gearbox-to-tailcone mounting	100
	(8) MS20074-04-06 bolts on A021 gearbox	60
	(12) MS20074-04-06 bolts on B021 gearbox	100
	(1) NAS1304-38 bolt, spherical tail rotor teeter (delta) hinge	150
	(1) NAS6604-38 bolt, elastomeric tail rotor teeter (delta) hinge	150
	(1) chip detector on A021 gearbox	100
	(1) chip detector on B021 gearbox	60
	(1) nut, chip detector wiring on B021 gearbox	4-6
	(1) filler-plug vent assembly	100
	(1) sight gage on A021 gearbox	150
	(1) B563-4 (flat, UV filter) sight gage on B021 gearbox	150
	(1) B563-1 (bubble) sight gage on B021 gearbox	100
WINDSHIELD	(24) AN526C832R12 screw, thru center brace	16
	(64) B526-6 screw, polycarbonate windshield fasteners	24
	(1) B295-1 or-2 clip, yaw string	16

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### 23-34 Push-Pull Tube Rod End Adjustment

**NOTE**

Refer to § 10.232 to adjust A258 main rotor pitch links.

The following procedure is standard for adjusting push-pull tube rod ends:

1. Loosen palnut and jam nut on rod end shank.
2. Remove hardware securing push-pull tube rod end to attachment point per respective instructions.
3. Screw rod end in or out of push-pull tube as required to obtain proper rigging adjustment. Apply B270-21 (corrosion) protectant to exposed threads.
4. After any rod end adjustment, verify rod end threaded shank blocks passage of 0.020-inch diameter wire thru the witness hole in the push-pull tube per Figure 2-1. When no witness hole is provided, refer to Figure 2-1 for maximum rod end extension.
5. Install fastener securing push-pull tube to attachment point per respective instructions.
6. Refer to Figure 2-1A. Position rod ends to allow as much push-pull tube rotation as possible without binding. Standard torque jam nuts & palnuts per § 23-32 & torque stripe per Figure 2-1.

### 23-35 D210-series Nuts on Critical Fasteners

When performing maintenance that involves disassembly of a critical fastener (joints with a secondary lock), reassemble the fastener using a D210-series nut.

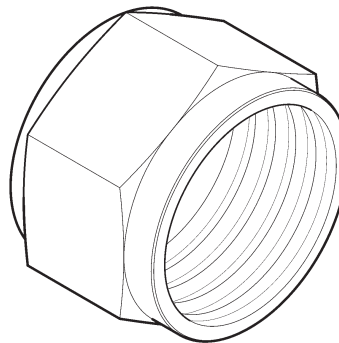
If a fastener is disassembled that has an MS21042L-series or NAS1291-series nut with a B330-series palnut or B332-series lockwasher (secondary lock),

replace MS21042L08 nut or NAS1291-08 nut with D210-08 nut,  
replace MS21042L3 nut or NAS1291-3 nut with D210-3 nut,  
replace MS21042L4 nut or NAS1291-4 nut with D210-4 nut,  
replace MS21042L5 nut or NAS1291-5 nut with D210-5 nut,  
replace MS21042L6 nut or NAS1291-6 nut with D210-6 nut,  
replace NAS1291-7 nut with D210-7 nut,  
replace NAS1291-8 nut with D210-8 nut, or  
replace NAS1291-10 nut with D210-10 nut.

## 23-36 A880 Flared Tube Components

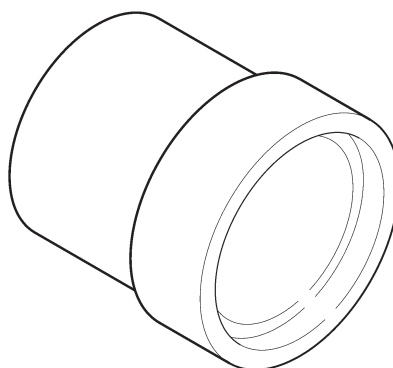
### A. Nuts – Flare

Dash Numbers	Allowable Part Numbers	Material REF	Tube OD REF
-102	AN818-2D, AN818-2W, AS5175W02	AL	1/8-inch
-103	AN818-3D, AN818-3W, AS5175W03	AL	3/16-inch
-104	AN818-4D, AN818-4W, AS5175W04	AL	1/4-inch
-105	AN818-5D, AN818-5W, AS5175W05	AL	5/16-inch
-106	AN818-6D, AN818-6W, AS5175W06	AL	3/8-inch
-108	AN818-8D, AN818-8W, AS5175W08	AL	1/2-inch
-110	AN818-10D, AN818-10W, AS5175W10	AL	5/8-inch
-202	AN818-2J, AS5175J02	CRES	1/8-inch
-203	AN818-3J, AS5175J03	CRES	3/16-inch
-204	AN818-4J, AS5175J04	CRES	1/4-inch
-205	AN818-5J, AS5175J05	CRES	5/16-inch
-206	AN818-6J, AS5175J06	CRES	3/8-inch
-208	AN818-8J, AS5175J08	CRES	1/2-inch
-210	AN818-10J, AS5175J10	CRES	5/8-inch



23-36 A880 Flared Tube Components (continued)
**B. Sleeves**

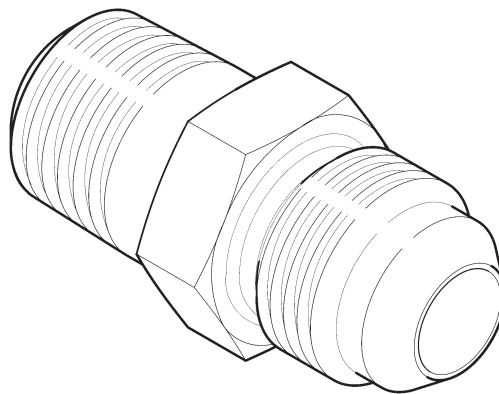
Dash Numbers	Allowable Part Numbers	Material REF	Tube OD REF
-302	MS20819-2D, AS3220D02, AS3220W02	AL	1/8-inch
-303	MS20819-3D, AS3220D03, AS3220W03	AL	3/16-inch
-304	MS20819-4D, AS3220D04, AS3220W04	AL	1/4-inch
-305	MS20819-5D, AS3220D05, AS3220W05	AL	5/16-inch
-306	MS20819-6D, AS3220D06, AS3220W06	AL	3/8-inch
-308	MS20819-8D, AS3220D08, AS3220W08	AL	1/2-inch
-310	MS20819-10D, AS3220D10, AS3220W10	AL	5/8-inch
-402	MS20819-2J, AS5176J02	CRES	1/8-inch
-403	MS20819-3J, AS5176J03	CRES	3/16-inch
-404	MS20819-4J, AS5176J04	CRES	1/4-inch
-405	MS20819-5J, AS5176J05	CRES	5/16-inch
-406	MS20819-6J, AS5176J06	CRES	3/8-inch
-408	MS20819-8J, AS5176J08	CRES	1/2-inch
-410	MS20819-10J, AS5176J10	CRES	5/8-inch



### 23-36 A880 Flared Tube Components (continued)

#### C. Adapters – NPT to Flare

Dash Numbers	Allowable Part Numbers	Material REF	Tube OD REF
-502	AN816-2D, AS5194D0202	AL	1/8-inch
-503	AN816-3D, AS5194D0302	AL	3/16-inch
-504	AN816-4D, AS5194D0402	AL	1/4-inch
-505	AN816-5D, AS5194D0502	AL	5/16-inch
-506	AN816-6D, AS5194D0604	AL	3/8-inch
-508	AN816-8D, AS5194D0806	AL	1/2-inch
-510	AN816-10D, AS5194D1008	AL	5/8-inch
-532	AN816-2J, AS5194J0202	CRES	1/8-inch
-533	AN816-3J, AS5194J0302	CRES	3/16-inch
-534	AN816-4J, AS5194J0402	CRES	1/4-inch
-535	AN816-5J, AS5194J0502	CRES	5/16-inch
-536	AN816-6J, AS5194J0604	CRES	3/8-inch
-538	AN816-8J, AS5194J0806	CRES	1/2-inch
-540	AN816-10J, AS5194J1008	CRES	5/8-inch
-562	AN816-2, AS5194-0202	STL	1/8-inch
-563	AN816-3, AS5194-0302	STL	3/16-inch
-564	AN816-4, AS5194-0402	STL	1/4-inch
-565	AN816-5, AS5194-0502	STL	5/16-inch
-566	AN816-6, AS5194-0604	STL	3/8-inch
-568	AN816-8, AS5194-0806	STL	1/2-inch
-570	AN816-10, AS5194-1008	STL	5/8-inch

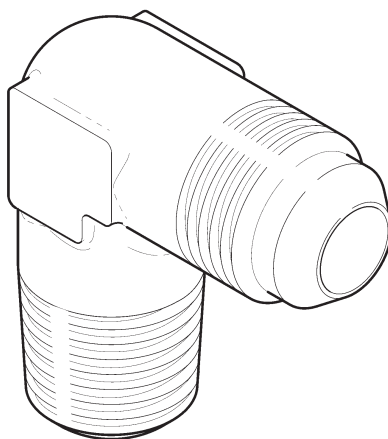




## 23-36 A880 Flared Tube Components (continued)

## D. Elbows – 90°, NPT to Flare

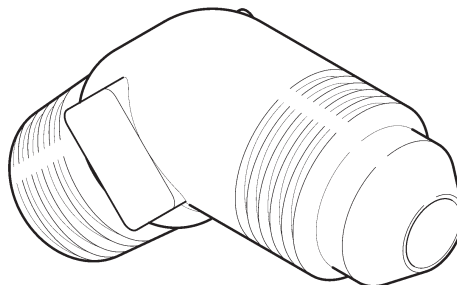
Dash Numbers	Allowable Part Numbers	Material REF	Tube OD REF
-602	AN822-2D, MS20822-2D, AS5195W0202	AL	1/8-inch
-603	AN822-3D, MS20822-3D, AS5195W0302	AL	3/16-inch
-604	AN822-4D, MS20822-4D, AS5195W0402	AL	1/4-inch
-605	AN822-5D, MS20822-5D, AS5195W0502	AL	5/16-inch
-606	AN822-6D, MS20822-6D, AS5195W0604	AL	3/8-inch
-608	AN822-8D, MS20822-8D, AS5195W0806	AL	1/2-inch
-610	AN822-10D, MS20822-10D, AS5195W1008	AL	5/8-inch
-632	AN822-2J, MS20822-2J, AS5195J0202	CRES	1/8-inch
-633	AN822-3J, MS20822-3J, AS5195J0302	CRES	3/16-inch
-634	AN822-4J, MS20822-4J, AS5195J0402	CRES	1/4-inch
-635	AN822-5J, MS20822-5J, AS5195J0502	CRES	5/16-inch
-636	AN822-6J, MS20822-6J, AS5195J0604	CRES	3/8-inch
-638	AN822-8J, MS20822-8J, AS5195J0806	CRES	1/2-inch
-640	AN822-10J, MS20822-10J, AS5195J1008	CRES	5/8-inch
-662	AN822-2, MS20822-2, AS5195-0202	STL	1/8-inch
-663	AN822-3, MS20822-3, AS5195-0302	STL	3/16-inch
-664	AN822-4, MS20822-4, AS5195-0402	STL	1/4-inch
-665	AN822-5, MS20822-5, AS5195-0502	STL	5/16-inch
-666	AN822-6, MS20822-6, AS5195-0604	STL	3/8-inch
-668	AN822-8, MS20822-8, AS5195-0806	STL	1/2-inch
-670	AN822-10, MS20822-10, AS5195-1008	STL	5/8-inch



### 23-36 A880 Flared Tube Components (continued)

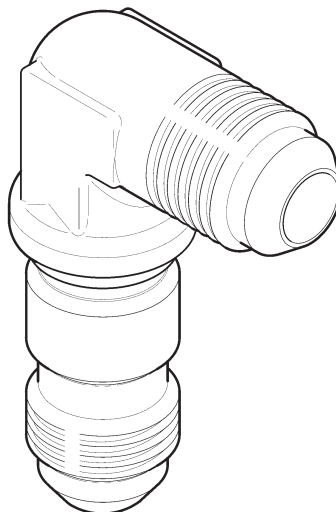
#### E. Elbows – 45°, NPT to Flare

Dash Numbers	Allowable Part Numbers	Material REF	Tube OD REF
-702	AN823-2D, MS20823-2D, AS5196W0202	AL	1/8-inch
-703	AN823-3D, MS20823-3D, AS5196W0302	AL	3/16-inch
-704	AN823-4D, MS20823-4D, AS5196W0402	AL	1/4-inch
-705	AN823-5D, MS20823-5D, AS5196W0502	AL	5/16-inch
-706	AN823-6D, MS20823-6D, AS5196W0604	AL	3/8-inch
-708	AN823-8D, MS20823-8D, AS5196W0806	AL	1/2-inch
-710	AN823-10D, MS20823-10D, AS5196W1008	AL	5/8-inch
-732	AN823-2J, MS20823-2J, AS5196J0202	CRES	1/8-inch
-733	AN823-3J, MS20823-3J, AS5196J0302	CRES	3/16-inch
-734	AN823-4J, MS20823-4J, AS5196J0402	CRES	1/4-inch
-735	AN823-5J, MS20823-5J, AS5196J0502	CRES	5/16-inch
-736	AN823-6J, MS20823-6J, AS5196J0604	CRES	3/8-inch
-738	AN823-8J, MS20823-8J, AS5196J0806	CRES	1/2-inch
-740	AN823-10J, MS20823-10J, AS5196J1008	CRES	5/8-inch
-762	AN823-2, MS20823-2, AS5196-0202	STL	1/8-inch
-763	AN823-3, MS20823-3, AS5196-0302	STL	3/16-inch
-764	AN823-4, MS20823-4, AS5196-0402	STL	1/4-inch
-765	AN823-5, MS20823-5, AS5196-0502	STL	5/16-inch
-766	AN823-6, MS20823-6, AS5196-0604	STL	3/8-inch
-768	AN823-8, MS20823-8, AS5196-0806	STL	1/2-inch
-770	AN823-10, MS20823-10, AS5196-1008	STL	5/8-inch



23-36 A880 Flared Tube Components (continued)
**F. Elbows – 90°, Bulkhead Flare to Flare**

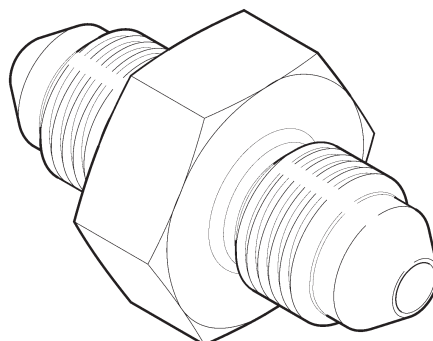
Dash Numbers	Allowable Part Numbers	Material REF	Tube OD REF
-802	AN833-2D, AS1038D0202, AS1038W0202	AL	1/8-inch
-803	AN833-3D, AS1038D0303, AS1038W0303	AL	3/16-inch
-804	AN833-4D, AS1038D0404, AS1038W0404	AL	1/4-inch
-805	AN833-5D, AS1038D0505, AS1038W0505	AL	5/16-inch
-806	AN833-6D, AS1038D0606, AS1038W0606	AL	3/8-inch
-808	AN833-8D, AS1038D0808, AS1038W0808	AL	1/2-inch
-810	AN833-10D, AS1038D1010, AS1038W1010	AL	5/8-inch
-832	AN833-2J, AS1038J0202	CRES	1/8-inch
-833	AN833-3J, AS1038J0303	CRES	3/16-inch
-834	AN833-4J, AS1038J0404	CRES	1/4-inch
-835	AN833-5J, AS1038J0505	CRES	5/16-inch
-836	AN833-6J, AS1038J0606	CRES	3/8-inch
-838	AN833-8J, AS1038J0808	CRES	1/2-inch
-840	AN833-10J, AS1038J1010	CRES	5/8-inch
-862	AN833-2, AS1038-0202	STL	1/8-inch
-863	AN833-3, AS1038-0303	STL	3/16-inch
-864	AN833-4, AS1038-0404	STL	1/4-inch
-865	AN833-5, AS1038-0505	STL	5/16-inch
-866	AN833-6, AS1038-0606	STL	3/8-inch
-868	AN833-8, AS1038-0808	STL	1/2-inch
-870	AN833-10, AS1038-1010	STL	5/8-inch



### 23-36 A880 Flared Tube Components (continued)

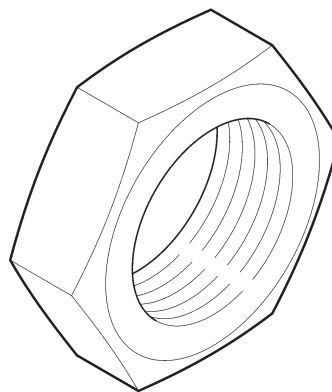
#### G. Unions – Flare to Flare

Dash Numbers	Allowable Part Numbers	Material REF	Tube OD REF
-902	AN815-2D, AS5174D0202, AS5174W0202	AL	1/8-inch
-903	AN815-3D, AS5174D0303, AS5174W0303	AL	3/16-inch
-904	AN815-4D, AS5174D0404, AS5174W0404	AL	1/4-inch
-905	AN815-5D, AS5174D0505, AS5174W0505	AL	5/16-inch
-906	AN815-6D, AS5174D0606, AS5174W0606	AL	3/8-inch
-908	AN815-8D, AS5174D0808, AS5174W0808	AL	1/2-inch
-910	AN815-10D, AS5174D1010, AS5174W1010	AL	5/8-inch
-932	AN815-2J, AS5174J0202	CRES	1/8-inch
-933	AN815-3J, AS5174J0303	CRES	3/16-inch
-934	AN815-4J, AS5174J0404	CRES	1/4-inch
-935	AN815-5J, AS5174J0505	CRES	5/16-inch
-936	AN815-6J, AS5174J0606	CRES	3/8-inch
-938	AN815-8J, AS5174J0808	CRES	1/2-inch
-940	AN815-10J, AS5174J1010	CRES	5/8-inch
-962	AN815-2, AS5174-0202	STL	1/8-inch
-963	AN815-3, AS5174-0303	STL	3/16-inch
-964	AN815-4, AS5174-0404	STL	1/4-inch
-965	AN815-5, AS5174-0505	STL	5/16-inch
-966	AN815-6, AS5174-0606	STL	3/8-inch
-968	AN815-8, AS5174-0808	STL	1/2-inch
-970	AN815-10, AS5174-1010	STL	5/8-inch



23-36 A880 Flared Tube Components (continued)
**H. Nuts – Hex**

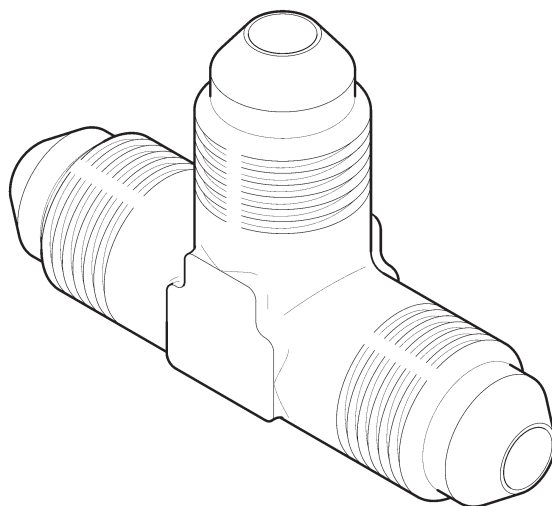
Dash Numbers	Allowable Part Numbers	Material REF	Tube OD REF
-1002	AN924-2D, AN924-2W, AS5178W02	AL	1/8-inch
-1003	AN924-3D, AN924-3W, AS5178W03	AL	3/16-inch
-1004	AN924-4D, AN924-4W, AS5178W04	AL	1/4-inch
-1005	AN924-5D, AN924-5W, AS5178W05	AL	5/16-inch
-1006	AN924-6D, AN924-6W, AS5178W06	AL	3/8-inch
-1008	AN924-8D, AN924-8W, AS5178W08	AL	1/2-inch
-1010	AN924-10D, AN924-10W, AS5178W10	AL	5/8-inch
-1032	AN924-2J, AS5178J02	CRES	1/8-inch
-1033	AN924-3J, AS5178J03	CRES	3/16-inch
-1034	AN924-4J, AS5178J04	CRES	1/4-inch
-1035	AN924-5J, AS5178J05	CRES	5/16-inch
-1036	AN924-6J, AS5178J06	CRES	3/8-inch
-1038	AN924-8J, AS5178J08	CRES	1/2-inch
-1040	AN924-10J, AS5178J10	CRES	5/8-inch
-1062	AN924-2, AS5178-02	STL	1/8-inch
-1063	AN924-3, AS5178-03	STL	3/16-inch
-1064	AN924-4, AS5178-04	STL	1/4-inch
-1065	AN924-5, AS5178-05	STL	5/16-inch
-1066	AN924-6, AS5178-06	STL	3/8-inch
-1068	AN924-8, AS5178-08	STL	1/2-inch
-1070	AN924-10, AS5178-10	STL	5/8-inch



# 23-36 A880 Flared Tube Components (continued)

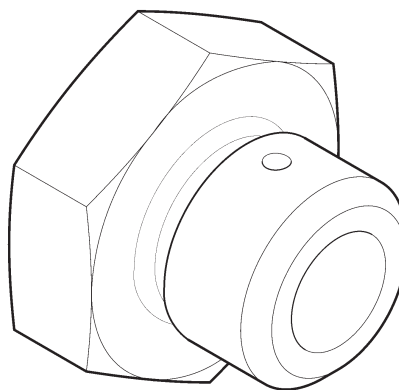
## I. Tees – NPT to Flare

Dash Numbers	Allowable Part Numbers	Material REF	Tube OD REF
-1102	AN826-2D, MS20826-2D, AS5198W020202	AL	1/8-inch
-1103	AN826-3D, MS20826-3D, AS5198W030203	AL	3/16-inch
-1104	AN826-4D, MS20826-4D, AS5198W040204	AL	1/4-inch
-1105	AN826-5D, MS20826-5D, AS5198W050205	AL	5/16-inch
-1106	AN826-6D, MS20826-6D, AS5198W060406	AL	3/8-inch
-1108	AN826-8D, MS20826-8D, AS5198W080608	AL	1/2-inch
-1110	AN826-10D, MS20826-10D, AS5198W100810	AL	5/8-inch
-1132	AN826-2J, MS20826-2J, AS5198J020202	CRES	1/8-inch
-1133	AN826-3J, MS20826-3J, AS5198J030203	CRES	3/16-inch
-1134	AN826-4J, MS20826-4J, AS5198J040204	CRES	1/4-inch
-1135	AN826-5J, MS20826-5J, AS5198J050205	CRES	5/16-inch
-1136	AN826-6J, MS20826-6J, AS5198J060406	CRES	3/8-inch
-1138	AN826-8J, MS20826-8J, AS5198J080608	CRES	1/2-inch
-1140	AN826-10J, MS20826-10J, AS5198J100810	CRES	5/8-inch
-1162	AN826-2, MS20826-2, AS5198-020202	STL	1/8-inch
-1163	AN826-3, MS20826-3, AS5198-030203	STL	3/16-inch
-1164	AN826-4, MS20826-4, AS5198-040204	STL	1/4-inch
-1165	AN826-5, MS20826-5, AS5198-050205	STL	5/16-inch
-1166	AN826-6, MS20826-6, AS5198-060406	STL	3/8-inch
-1168	AN826-8, MS20826-8, AS5198-080608	STL	1/2-inch
-1170	AN826-10, MS20826-10, AS5198-100810	STL	5/8-inch



23-36 A880 Flared Tube Components (continued)
**J. Plugs without Holes**

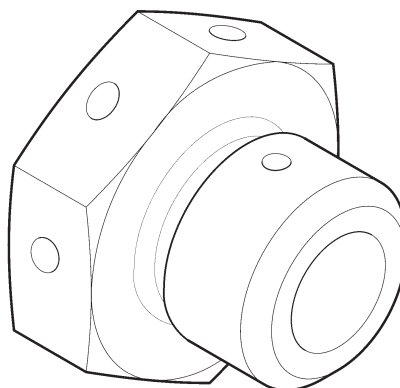
Dash Numbers	Allowable Part Numbers	Material REF	Tube OD REF
-1202	AN814-2D, AN814-2W, AS5169D02, AS5169W02	AL	1/8-inch
-1203	AN814-3D, AN814-3W, AS5169D03, AS5169W03	AL	3/16-inch
-1204	AN814-4D, AN814-4W, AS5169D04, AS5169W04	AL	1/4-inch
-1205	AN814-5D, AN814-5W, AS5169D05, AS5169W05	AL	5/16-inch
-1206	AN814-6D, AN814-6W, AS5169D06, AS5169W06	AL	3/8-inch
-1208	AN814-8D, AN814-8W, AS5169D08, AS5169W08	AL	1/2-inch
-1210	AN814-10D, AN814-10W, AS5169D10, AS5169W10	AL	5/8-inch
-1232	AN814-2J, AS5169J02	CRES	1/8-inch
-1233	AN814-3J, AS5169J03	CRES	3/16-inch
-1234	AN814-4J, AS5169J04	CRES	1/4-inch
-1235	AN814-5J, AS5169J05	CRES	5/16-inch
-1236	AN814-6J, AS5169J06	CRES	3/8-inch
-1238	AN814-8J, AS5169J08	CRES	1/2-inch
-1240	AN814-10J, AS5169J10	CRES	5/8-inch
-1262	AN814-2, AS5169-02	STL	1/8-inch
-1263	AN814-3, AS5169-03	STL	3/16-inch
-1264	AN814-4, AS5169-04	STL	1/4-inch
-1265	AN814-5, AS5169-05	STL	5/16-inch
-1266	AN814-6, AS5169-06	STL	3/8-inch
-1268	AN814-8, AS5169-08	STL	1/2-inch
-1270	AN814-10, AS5169-10	STL	5/8-inch



# 23-36 A880 Flared Tube Components (continued)

## K. Plugs with Holes

Dash Numbers	Allowable Part Numbers	Material REF	Tube OD REF
-1302	AN814-2DL, AN814-2WL, AS5169D02L, AS5169W02L	AL	1/8-inch
-1303	AN814-3DL, AN814-3WL, AS5169D03L, AS5169W03L	AL	3/16-inch
-1304	AN814-4DL, AN814-4 WL, AS5169D04L, AS5169W04L	AL	1/4-inch
-1305	AN814-5DL, AN814-5WL, AS5169D05L, AS5169W05L	AL	5/16-inch
-1306	AN814-6DL, AN814-6WL, AS5169D06L, AS5169W06L	AL	3/8-inch
-1308	AN814-8DL, AN814-8WL, AS5169D08L, AS5169W08L	AL	1/2-inch
-1310	AN814-10DL, AN814-10WL, AS5169D10L, AS5169W10L	AL	5/8-inch
-1332	AN814-2JL, AS5169J02L	CRES	1/8-inch
-1333	AN814-3JL, AS5169J03L	CRES	3/16-inch
-1334	AN814-4JL, AS5169J04L	CRES	1/4-inch
-1335	AN814-5JL, AS5169J05L	CRES	5/16-inch
-1336	AN814-6JL, AS5169J06L	CRES	3/8-inch
-1338	AN814-8JL, AS5169J08L	CRES	1/2-inch
-1340	AN814-10JL, AS5169J10L	CRES	5/8-inch
-1362	AN814-2L, AS5169-02L	STL	1/8-inch
-1363	AN814-3L, AS5169-03L	STL	3/16-inch
-1364	AN814-4L, AS5169-04L	STL	1/4-inch
-1365	AN814-5L, AS5169-05L	STL	5/16-inch
-1366	AN814-6L, AS5169-06L	STL	3/8-inch
-1368	AN814-8L, AS5169-08L	STL	1/2-inch
-1370	AN814-10L, AS5169-10L	STL	5/8-inch





Intentionally Blank

23-40 Non-Destructive Testing**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

23-41 Magnetic Particle Inspection

Ferromagnetic steel parts are inspected for structural defects using magnetic particle inspection. Steel parts covered by this specification are inspected per ASTM E1444 wet continuous process with ultra-violet light. Applicable requirements and limitations of the above standard apply.

Procedures and equipment used to perform the inspection shall conform to requirements of ASTM E1444. A magneto test penetrameter or a 30–60 gauss meter is used to verify the direction and effectiveness of all magnetic fields produced. Whenever possible, parts shall be inspected with both circular and longitudinal magnetization, but at least in two directions at right angles to each other. Minimum duration of application is ½ second.

Pre- and post-solvent clean parts using PCBTF or similar solvent. Demagnetizing is accomplished using  $AC \pm 3$  oersteds maximum. Verify part is demagnetized using a magnetic field strength indicator which does not exceed an absolute value above three gauss.

Area of part to be examined, position of part, directions of magnetization to be used and method of establishing the magnetization are presented within the inspection section of individual parts. Record the size and location of all rejectable indications.

**A. Inspection Criteria**

Parts (except gears) which are inspected by magnetic particle inspection shall be accepted or rejected according to the following criteria:

Acceptable indications:

- Indications smaller than 0.015 inch are not considered rateable.
- Indications caused by sharp changes in cross-section or part geometry.

Rejectable indications:

- Indications interpreted as cracks, seams, laps, shuts, or any flaws which are open to the surface.
- Indications oriented at an angle of more than 15 degrees from the longitudinal axis with length exceeding 0.125 inch.
- Circumferential indications on any shoulder or fillet (changes in diameter).
- Any indications which break over an edge, shoulder, fillet radius, keyway, spline, or an adjacent area of part more than 0.015 inch.
- Indications caused by undercuts at the toe of a weld.
- Indications caused by cracks in the weld or parent metal.
- Indications caused by inclusions in weld material exceeding 0.1 inch in length.

### 23-42 Fluorescent Penetrant Inspection

This specification provides for surface inspection of parts fabricated from nonmagnetic materials to detect discontinuities open to the surface, such as cracks, cold shuts, laps, porosity and other surface defects.

Applicable requirements and limitations of ASTM E1417 shall apply. After inspection is complete, solvent clean parts.

The step-by-step procedure and equipment used to perform the inspection shall be accomplished per ASTM E1417. The following types, methods, and sensitivity levels are recommended:

Type: 1–Fluorescent dye  
Method: A–Water washable  
Sensitivity: Level 2–Medium  
Form: A–Dry powder

#### **A. Inspection Criteria**

Parts inspected by fluorescent penetrant method shall be accepted or rejected on basis of acceptance limits specified. If acceptance limits are not specified, rejectable surface defects and any of the following:

- Cracks
- Seams
- Cold shuts or laps
- Surface inclusions
- In castings, aligned discontinuous surface indications other than cracks, cold shuts and inclusions are rejectable if more than 3/8 inch in length.

### 23-50 Corrosion Control

#### 23-51 Conversion Coat – Aluminum

Use the following procedures to prepare and apply conversion coat to aluminum alloys. Conversion coat improves corrosion resistance and adherence of paint and adhesives.

#### **CAUTION**

Do not allow Bonderite C-IC 33 Aero or M-CR 1201/1132 Aero to contact bonded joints.

#### **A. Procedure**

1. Unless otherwise specified, lightly scuff clean surface with 320-grit aluminum-oxide abrasive paper to remove corrosion or other contaminants.
2. Apply Bonderite C-IC 33 Aero to surface for 2–5 minutes. DO NOT allow Bonderite C-IC 33 Aero to dry; re-apply as required.
3. Rinse thoroughly with clean, potable water.

23-51 Conversion Coat – Aluminum (continued)**A. Procedure (continued)**

4. Apply Bonderite M-CR 1201 Aero to surface for 2–5 minutes (should be light golden brown). DO NOT allow Bonderite M-CR 1201 Aero to dry; re-apply as required.
5. Rinse thoroughly with clean, potable water. Gently wipe with clean & dry cloth, blow dry, or allow to air dry.

**B. Felt Tip Applicator**

Apply Bonderite M-CR 1132 Aero per manufacturer's recommendations.

23-60 Priming and Painting

This specification outlines preparation and application requirements for primers and topcoat. Primers provide corrosion protection and a final finish or a base for topcoat. Approved materials are listed in § 23-70.

Unless directed, do not prime or paint the following:

- Sliding friction joints.
- Stainless steel parts.
- Swivel joints and adjustable rod ends.
- Plastic, rubber, electrical components and wires or similar materials.
- Bolted joints where torque is a specific requirement for clamping action.
- Bearing press-fit, or close tolerance slip-fit, joints (except where wet primer is part of the assembly procedure).

**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

**A. Priming**

1. Preparing Aluminum (for Steel parts see step 2)

Unless otherwise specified, conversion coating per § 23-51 is standard treatment before priming aluminum. If bare aluminum is primed without conversion coating, the following procedure must be used:

- a. Alkaline clean if immersion is practical, otherwise wipe clean with an approved degreasing agent. Do not allow alkaline cleaner to contact bonded joints.
- b. Lightly scuff the surface with Scotch-Brite pads.
- c. Wipe with a tack rag to remove any foreign material or damp wipe with an approved solvent.
- d. Air dry. Do not touch parts with bare hands until primed.

23-60 Priming and Painting (continued)**A. Priming (continued)****2. Preparing Steel (for Aluminum see step 1)**

Alkaline clean is the preferred method for cleaning stainless steel. Alternately, stainless steel may be cleaned using an approved solvent. Do not allow alkaline cleaner to contact bonded joints.

Steel parts should only be cleaned using an approved solvent; using an alkaline cleaning process on steel may cause a corrosive reaction.

Where immersion is not practical or for extremely greasy or dirty parts, a preclean in a solvent vapor degreaser may be used.

Air or blow dry using filtered, dry, compressed air.

**3. Application**

Apply primer after mixing per manufacturer's recommendations. Primer coating is not to exceed 0.0005–0.0020 inch thickness per coat. For parts with internal openings, such as tubes, prime the inside as follows:

- a. Thin primer to watery consistency using required reducer.
- b. Pour in primer, slosh around, then drain immediately.
- c. Dry parts at least (6) hours before using.

**4. Inspection**

Inspect for complete coverage and excessive thickness. If primer is excessively thick, strip part and re-prime. Refer to § 23-70 for approved materials.

**NOTE**

Primed areas that have been sanded to bare metal must have conversion coating (if required) and primer re-applied prior to topcoat to restore anti-corrosion properties.

**B. Painting Topcoat**

Prior to liquid topcoat application, ensure surfaces have been cleaned and primed. In general, most parts will be cleaned and primed as detail parts. However, in some cases, such as the gearbox assembly, this is not practical and primer and topcoat are applied on the assembled component.

Previously primed surfaces, or primed surfaces that have completely cured require the following preparation before paint:

1. Lightly sand using 220-grit or finer aluminum-oxide abrasive paper.
2. Lightly scuff with Scotch Brite pads (optional).
3. Wipe with clean cloth and approved solvent.
4. Wipe with tack cloth.
5. Apply topcoat.

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23-70 Approved Materials

The following items are available from the noted manufacturer(s) or their distributor(s). Check with appropriate regulatory authority(s) for allowable usage of materials.

**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

**CAUTION**

Follow product manufacturer's instructions for handling and storage.

23-71 Paint Strippers**CAUTION**

Use of non-approved liquid-strippers may lead to part failure.

PRODUCT	MANUFACTURER/SUPPLIER	APPLICATION
Cee-Bee Stripper A-292NC-M	McGean-Rohco: Cee-Bee Division. Downey, CA. <a href="https://Cee-Bee.com">https://Cee-Bee.com</a>	Metal parts, except blades and flex plates. Do not use near mechanically fastened or bonded joints.
Plastic Media Blasting System, AMMO 301 size 20/30, type II (or equivalent polymer media)	Pauli Systems Inc. Fairfield, CA	Metal parts except blades and unsupported sheet metal less than 0.040 inch thick. Blast pressure for steel frames: 40–55 PSI Blast pressure for aluminum parts: 30–40 PSI

23-72 Solvents and Cleaners

PRODUCT	MANUFACTURER/SUPPLIER	APPLICATION
QSOL 220	Safety-Kleen Systems, Inc. Plano, TX	General use and for cleaning prior to applying primer, topcoat, adhesive, or sealant.
Benzene, 1-Chloro-4 (Trifluoromethyl) PCBTF***	Any	
Acetone***	Any	
220 Low VOC Cleaner	Axalta, Wilmington, DE	
Final Klean 3909S	Du Pont Chemical Los Angeles, CA	
XP Aerospace Prep Surface Cleaner	AkzoNobel, Waukegan, IL	Removing adhesive residue on cabin and polycarbonate & acrylic windshield.
EM-Citro*	LPS Laboratories, Inc. Tucker, GA	
Lacolene (Aliphatic Hydrocarbon)	Any	
Plexus®	B.T.I. Chemical Co. Oak Park, CA	Windshield and plastic cleaning and general residue removal.

23-72 Solvents and Cleaners (continued)

PRODUCT	MANUFACTURER/SUPPLIER	APPLICATION
Presolve	LPS Laboratories, Inc. Tucker, GA	Hydraulic components only.
Tetrachloroethylene (Perchloroethylene)	Any	Vapor degreaser.
815 GD	Brulin Corporation Indianapolis, IN	Ultrasonic cleaning, general use.**
SF50	L&R Mfg. Co. Kearny, NJ	
#112 Ammoniated or #222 Nonammoniated cleaning solution	L&R Mfg. Co. Kearny, NJ	Ultrasonic cleaning, avionics components only.
#194 rinse solution		
Cleanup Wipe E-4365	Sontara Candler, NC	Cleaning and drying.
Snoop Liquid Leak Detector	Swagelok Salon, OH	Leak detector.

\* May be used on acrylic plastic.

\*\* Mix 5%–20% by volume; titration not required.

\*\*\* Acetone and PCBTf may be mixed 50-50.

23-73 Fillers and Putty

PRODUCT	MANUFACTURER/SUPPLIER	APPLICATION
05960 Glazing Putty 05860 Dry Guide Coat 31180 Finishing Glaze	3M St. Paul, MN	Minor surface imperfections.
SBF1191 Filler	Gearhead Products Indianapolis, IN	
FE-351 Cream Hardener	Catalyst Systems Gnadenhutten, OH	

23-74 Torque Seal

PRODUCT	MANUFACTURER/SUPPLIER	APPLICATION
83314 thru 83321 Except 83316 (red)	Dykem Cross-Check ITW Pro Brands	Torque seal.



## 23-75 Primers

## A. Non-chromate Primers

	Corlar 13580S*	Desoprime CA7502*	Desoprime CA7422*
Manufacturer	Axalta	PPG	PPG
Base	Corlar 13580S Epoxy Primer	CA7502A	CA7422A
Activator	Corlar 13180S Epoxy Activator	CA7502B	CA7422B
Reducer	13756S VOC-Exempt Reducer	CA7502C	CA7422C
Base: Activator: Reducer	4:1:1	4:4:1	4:4:1
Viscosity	17-21 sec in Zahn #2	15-19 sec in Zahn #2	15-19 sec in Zahn #2
Induction time	30 minutes	2 hours at 55–70°F 1 hour at 71–80°F 30 minutes > 70°F	2 hours at 55–68°F 1 hour at 69–95°F
Pot life	8 hours at 70°F	4 hours at 70°F	4 hours at 70°F
Flash off time	None	30 minutes	30 minutes
Dry time	2 hours at 70°F 1 hour at 130°F	3 hours at 70°F 30 minutes at 120°F	3 hours at 70°F 30 minutes at 120°F
Recoat window	48 hours	48 hours	48 hours

\* Shelf life per manufacturer's recommendation.

## B. Chromate Primers

	44GN007*	10P20-44*
Manufacturer	PPG	AkzoNobel
Base	44GN007	10P20-44
Activator	44GN007CAT	EC-265 or EC-273
Reducer	Distilled or deionized water	TR-114 or TR-102
Base: Activator: Reducer	3:1:8	3:1:1
Viscosity	18–22 seconds in Zahn #2	13–19 seconds in Zahn #2
Induction time	None	None
Pot life	4 hours at 70°F	4 hours at 77°F
Flash off time	15 minutes	30 minutes
Dry time	2 hours at 70°F 45 minutes at 120°F	30 minutes at 140°F
Recoat window	24 hours	24 hours

\* Shelf life per manufacturer's recommendation.

23-76 Powder Coat

PRODUCT	MANUFACTURER
Interpon 100-AL101QF Gray Zinc Rich Epoxy Powder*	AkzoNobel Santa Fe Springs, CA
81-2158 Vitralon Gray Zinc Rich Epoxy Powder*	Pratt & Lambert Chemical Coatings Buffalo, NY
39/80020 Smooth Matte Black Polyester Topcoat Powder*	Tiger Drylac USA Cucamonga, CA
49/72460 Smooth Glossy Gray RAL 7043 Polyester Topcoat Powder*	" "
49/22460 Smooth Glossy Yellow RAL 1028 Polyester Topcoat Powder*	" "
PFWF104S9 White Polyester Topcoat Powder*	Dupont Co. Wilmington, DE

\* Shelf life is 12 months from date of manufacture at ambient temperature.

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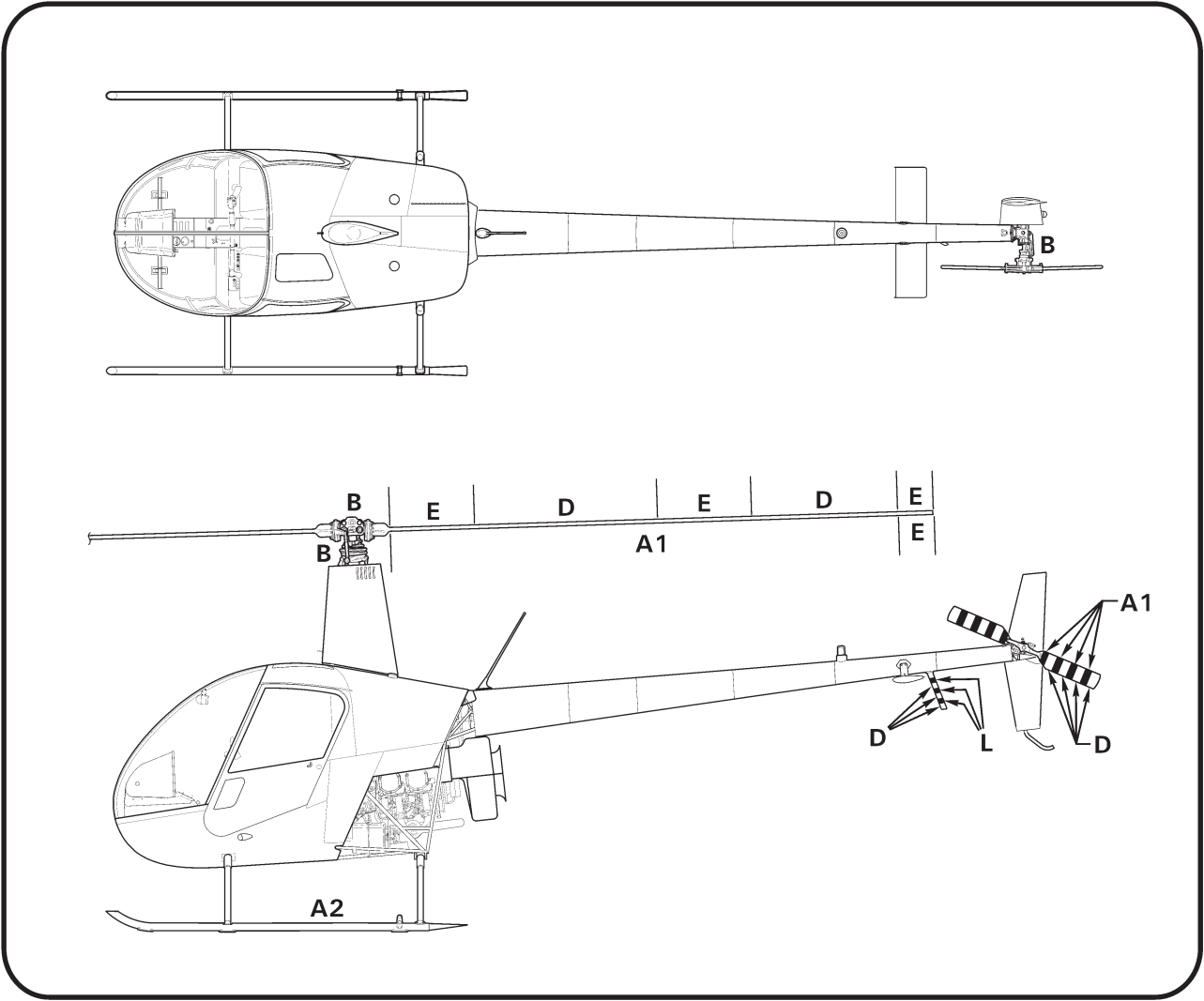


FIGURE 23-3 PAINT CODES  
(Refer to Chapter 26 for rotor blade paint dimensions. Exterior surface codes are D & F unless otherwise specified.)

23-77 Paints

Refer to Figures 23-3 & 23-4 for paint code application. Paint codes for specific helicopter serial numbers are listed on the inside cover of Airframe Maintenance Record (logbook).

FINISH CODE	MATERIAL*	ADDITIVES	MANUFACTURER	RHC PART NO.	APPLICATION
A1	Flat Black 18BK006	18BK006CAT Catalyst	PPG Aerospace; Irvine, CA	18BK006	Blade black
	Abrasion Resistant 23T3-90 Black	PC-216 Curing Solution	AkzoNobel; Waukegan, IL	23T3-90	
A2	FR2-55 Mat Top Coat	Thinner: water	Mapaero Pamiers, France	557Z7038B005K	Interior, skid tube, windshield, & window trim black
	Aerofine 8250 Topcoat	Thinner: water	AkzoNobel; Waukegan, IL	A8250/F9007	

23-77 Paints (continued)

FINISH CODE	MATERIAL *	ADDITIVES	MANUFACTURER	RHC PART NO.	APPLICATION
<b>A3</b>	Cardinal A-2000 Flat Black		Cardinal; Cleveland, OH	A-2000-BKE30903	Interior, skid tube, windshield, & window trim Touch Up (Aerosol)
	Krylon 1613 Semi-Flat Black		Krylon; Columbus, OH	1613	
<b>B</b>	Dark gray Imron AF400/AF700	13100S Activator 13110S Activator	Axalta; Wilmington, DE	DS020EP	Dark gray
<b>C</b>	Engine Gray IE-8948		Randolph, Chicopee, MA	IE-8948	Engine Enamel
	Lycoming Gray G-5436		Randolph, Riverside, CA	G-5436	
	Lycoming A219		Randolph, Cleveland, OH	A219	
<b>D</b>	White Imron AF400/AF700	13100S Activator 13110S Activator	Axalta; Wilmington, DE	N0774EP	White
<b>E</b>	Yellow Imron AF400/AF700	13100S Activator 13110S Activator	Axalta; Wilmington, DE	N0680EP	Yellow
<b>F</b>	Imron AF400/AF700 Colors	13100S Activator 13110S Activator	Axalta; Wilmington, DE	(Refer to logbook)	Exterior
<b>G</b>	Clear Imron AF740	13100S Activator 13110S Activator 13930S Reducer	Axalta; Wilmington, DE	AF740	Clear coat
	1311 Matte Clear Coat		Krylon; Columbus, OH	1311	Clear coat aerosol
<b>J</b>	White Imron 2.1 FT	9T00-A Activator D-121 Tint D-101 Tint 2100-P 2.1 Binder 9T20 Flatteners	Axalta; Wilmington, DE	9T00-A D121 D101 2100P 9T20	Floats
<b>K</b>	Printcolor White Ink 750-9005 Printcolor Black Ink 750-8005 Printcolor Maize Yellow Ink 750-1205 Printcolor Carnation Red 750-3005	Printcolor Glass Hardener 700 Gensolve Thinner GS-017 Slow Retarder 10-03432	Deco; Orange, CA	7509005 7508005 7501205, 7503005	Silkscreen
<b>L</b>	Red Imron AF400/AF700	13100S Activator 13110S Activator	Axalta; Wilmington, DE	N0759EP	Red
<b>Q</b>	ProtectaClear		Everbrite; Rancho Cordova, CA	Protecta	Optional on bare area of MR spar

\* Shelf life per manufacturer's recommendation.

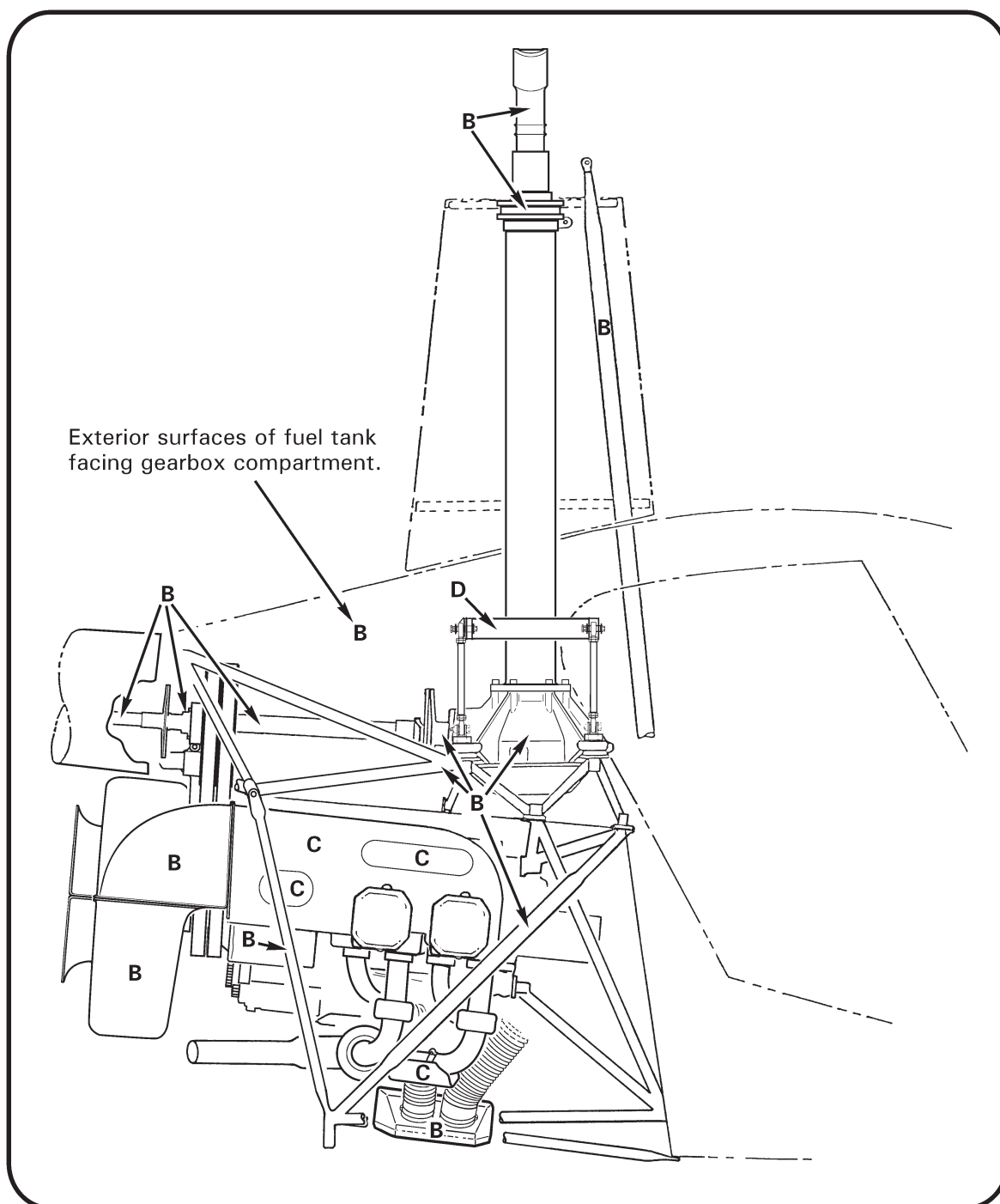


FIGURE 23-4 PAINT CODES

### 23-78 Lubricants

RHC PART NO.	LUBRICANT TYPE	MANUFACTURER'S PART NO.	MANUFACTURER
A257-1	Grease (general purpose)	101	Southwestern Petroleum Corp. Fort Worth, TX
A257-2	Gear oil	201 SAE 90	Southwestern Petroleum Corp. Fort Worth, TX
A257-3	Grease	Aero Shell 14 MIL-G-25537	Shell Oil Co.
A257-4	Oil (automatic transmission fluid)	Dexron II or Dexron II/Mercon or Dexron III/Mercon or Dex/Merc	Any
A257-6	Grease (fuel resistant)	Fuelube	Fleet Supplies Inc. Cleveland, OH
		EZ Turn	United-Erie Div. of Interstate Chemical Co. Erie, PA
A257-7	Dry film lubricant	Lubri-Kote Type A 1040 CR	Mealey Ind. Lubricants Cleveland, OH
A257-8	Rubber lubricant	P-80	International Products Corp. Trenton, NJ
A257-9	Anti-seize	Silver Grade	Loctite Corp. Newington, CT
A257-10	Substitute A257-16		
A257-12	Grease	MobilGrease 28 MIL-PRF-81322	Exxon Mobil Corp., Fairfax, VA
A257-16	Engine Oil Approved for 0–90° F ambient). Substitute A257-24 as required.	SAE 20W-50, SAE J1966	Any
A257-17	Substitute A257-19		
A257-19	Valve lubricant and sealant compound	111	Dow Corning Corp. Midland, MI
A257-22	Gear oil, synthetic	Mobil SHC 629	Exxon Mobil Corp., Fairfax, VA
A257-24	Engine oil (Approved for > 60°F ambient)	SAE 50, SAE J1966	Any

### 23-79 Adhesives and Sealants

RHC PART NO.	DESCRIPTION	COLOR	MFR. PART NO.	MANUFACTURER
B270-1	Sealant – manganese-cured, fuel resistant (2-part)	Gray	AC-730 B-*	3M Co. St. Paul, MN
B270-2	Substitute B270-1			
B270-4	Substitute B270-13			
B270-5	Sealant – synthetic rubber putty (1-part)	White Light Gray	Q4-2805 94-031	Dow Corning Corp. Midland, MI
B270-6	Sealant & lubricant – thread (1-part)	Gray	80631, 80632, 80633	Permatex, Inc. Solon, OH
			Titeseal 55	Radiator Spec. Co. Charlotte, NC
B270-7	Substitute B270-14			
B270-8	Adhesive – rubber, nitrile/acetone (1-part)	Tan	C 160	Stabond Corp. Gardena, CA
		Dark Brown	847	3M Co. St. Paul, MN
B270-9	Adhesive – epoxy, structural, flexible (2-part)	Gray	2216 B/A	3M Co. St. Paul, MN
B270-10	Adhesive/sealant – threadlocker, anaerobic, tight-fits (1-part)	Red	271	Henkel Loctite Corp. Rocky Hill, CT
B270-11	Adhesive/sealant – threadlocker, anaerobic, loose-fits (1-part)	Red	277	Henkel Loctite Corp. Rocky Hill, CT
B270-12	Sealant – electrical potting (1-part epoxy)	Gray	50-3122RGR15 (1-qt can) 50-3122RGR33 (syringe)	Epoxies Etc., Cranston, RI
B270-13	Sealant – silicone rubber, noncorrosive (1-part)	Translucent	3145	Dow Corning Corp. Midland, MI
B270-14	Substitute B270-8			
B270-15	Adhesive – plastic, for vinyl (1-part)	Clear	2262	3M Co. St. Paul, MN
B270-16	Substitute B270-14			
B270-17	Adhesive – cyanoacrylate, instant (1-part)	Clear	Super Bonder 495	Henkel Loctite Corp. Rocky Hill, CT
B270-18	Adhesive – weatherstrip (1-part)	Black	051135-08008	3M Co. St. Paul, MN
B270-19	Adhesive – epoxy structural, rigid (2-part)	Green	1838 B/A	3M Co. St. Paul, MN
B270-20	Adhesive/sealant – threadlocker, anaerobic, non-permanent (1-part)	Purple	222 or 222MS	Henkel Loctite Corp. Rocky Hill, CT



23-79 Adhesives and Sealants (continued)

RHC PART NO.	DESCRIPTION	COLOR	MFR. PART NO.	MANUFACTURER
B270-21	Protectant – corrosion, non-drying (1-part)	Amber	Max Wax	Corrosion Technologies Corp. Garland, TX
		Lt. Amber	LPS 3	LPS Laboratories, Inc. Tucker, GA
B270-22	Substitute B270-21			
	Protectant – corrosion, drying (1-part)	Amber	LPS Hardcoat	LPS Laboratories, Inc. Tucker, GA
B270-23	Sealant – gasket (1-part)	Purple	515	Henkel Loctite Corp. Rocky Hill, CT
B270-24	Activator/primer – anaerobic adhesive (1-part)	Translucent Green	7649	Henkel Loctite Corp. Rocky Hill, CT
B270-25	Clear coat – automotive touch up, brush in bottle (1-part)	Clear	Clear Coat Touch up Bottle	Automotive Touchup Harahan, LA
B270-26	Sealant – polysulfide, window glazing (2-part)	Black	AC-251 B-1	3M Co. St. Paul, MN
B270-27	Adhesive – epoxy, high strength structural, flexible (2-part)	Translucent Red Blue	EA 9309NA EA 9309.2NA	Henkel Loctite Corp. Rocky Hill, CT
B270-28	Substitute B270-27			

\* Dash number for minimum hours application life may be -½, -2, -6, or -12.

## 23-80 Miscellaneous Practices

### 23-81 Part Interchangeability

Refer to R22 Illustrated Parts Catalog for part interchangeability information.

### 23-82 Thermal Fitting Parts

General Procedures for using heat to fit parts during assembly or evaluating parts that may have been overheated in service:

*Aluminum parts* must not be heated above 200° F for more than 5 minutes. Higher temperatures or longer times adversely affect strength and corrosion properties. Scrap any aluminum parts suspected of going above 325° F regardless of time at temperature.

*Steel parts (bare)* – Maximum temperature 300° F. Higher temperature can reduce the strength or cause temper brittleness in some alloys.

*Steel parts (cadmium plated)* – Maximum temperature 300° F. Higher temperatures will melt the plating and adversely affect steel strength by a process called liquid metal embrittlement.

*Bearings and carburized parts* such as gears, clutch shafts, and clutch housings should not be heated above 300° F. Higher temperatures will reduce the surface hardness and increase wear rates.

Always heat parts in an oven with temperature control set no greater than the maximum temperature allowed for the part.

Always attach a pyrometer and thermocouple to the smallest aluminum part in the oven. Never depend on the oven control to determine part temperature.

Cooling a part for thermal fitting at assembly is not recommended. Water vapor from the air will condense on the part and frequently introduce water into the assembly causing severe internal corrosion over time.

### 23-83 Replacement Component Identification (Data) Plates

In order to issue a replacement component identification plate for field installation, RHC must first receive the old identification plate in legible condition. If old identification plate is lost or destroyed, then RHC must have an original letter (photocopies or faxes are NOT acceptable) from customer's Civil Aviation Authority (sent via postal mail, or via electronic mail directly from authority domain, such as "faa.gov") authorizing identification plate replacement AND stating component name, part number, and serial number for each requested identification plate. There is a charge for each plate issued.

Identification plates may be carefully removed using a sharp plastic scraper. If necessary, use a heat gun to soften plate adhesive. Retain in a dry, contaminate-free area until ready for reinstallation.

Damp wipe local area with acetone or equivalent solvent prior to reinstallation. Residual adhesive on identification plate is usually sufficient for good adhesion. If necessary, use B270-9 adhesive or equivalent to secure.

### 23-84 Crimp Inspection

Refer to Figure 23-5.

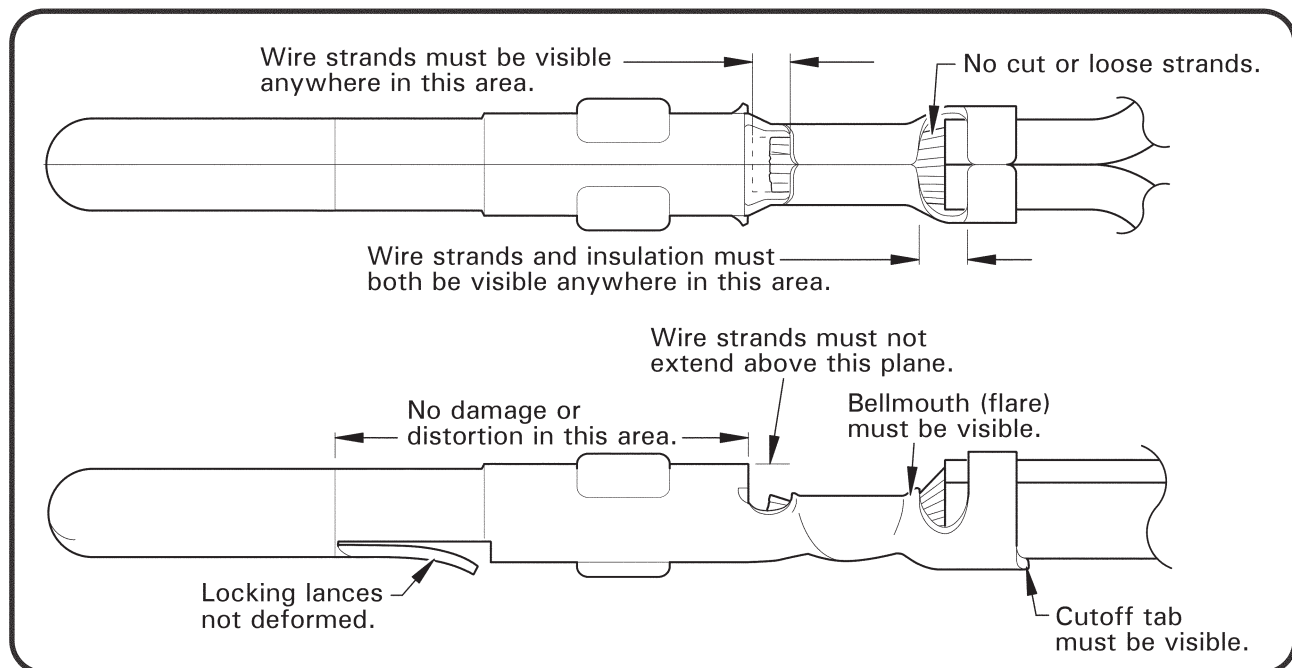


FIGURE 23-5 CRIMP INSPECTION

### 23-85 Storage Limits

1. B283 hoses have a shelf storage life of 5 years. Hose service life is "on condition", with a maximum of 12 years.
2. Elastic cords have a shelf storage life of 5 years. Elastic cord service life is "on condition", with a maximum of 12 years. Use invoice or FAA Form 8130 date as start date.
3. Store V-belts at less than 85°F (30°C), with relative humidity below 70%. Avoid solvent and oil vapors, atmospheric contaminants, sunlight, and ozone sources (electric motors, arc welding, ionizing air purifiers, etc.). Belt shelf life is 4 years if preceding recommendations are followed. Use invoice date or FAA Form 8130 date as start date.
4. Oils and greases have a 5 year shelf life when stored and kept sealed in their original container. Use invoice date or FAA Form 8130 date as start date unless the manufacturer has marked container with manufacture date (in which case use manufacture date as start date).
5. Rubber O-rings, seals, and gaskets have a twenty (20) quarter, five (5) year shelf life from the indicated cure date. Fluorocarbon (Viton) and silicon rubber products shall adhere to manufacturer's expiration date(s). Service life is "on condition" with a maximum of 12 years.
6. Store uninstalled fuel bladder in original container (if available) at 70°F to 80°F and below 70% humidity. Coat bladder with clean, non-detergent engine mineral oil to prevent rubber from drying out and cracking. Store bladder in relaxed condition free from tension, compression, or other deformation such as creases or folds.

### 23-86 B526 Screws and B527-08 Washers

|      This section has been moved to § 16-61 B526 Screws and B527-08 Washers.

## CHAPTER 24

## LIGHTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
24-00	Description . . . . .	24.1
24-10	Exterior Lights . . . . .	24.1
24-11	Strobe Light . . . . .	24.1
24-12	Navigation Lights . . . . .	24.2
24-13	Landing Lights . . . . .	24.3
24-20	Interior Lights . . . . .	24.4
24-21	Instrument Lighting . . . . .	24.4

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## CHAPTER 24

## LIGHTS

24-00 Description

A red anti-collision light is installed on the tailcone and is controlled by the strobe switch. Position lights are installed on each side of the cabin and in the tail and are controlled by the nav lights switch. Post and internal lights (earlier aircraft) or a light at the top of the windshield (later aircraft) illuminate the instruments. Instrument lighting is active when the nav lights switch is on and lighting is dimmed via the knob above the nav lights switch. An overhead map light mounted on a swivel is controlled by an adjacent switch. The map light may be used for emergency lighting of the instrument panel.

Two landing lights are installed in the nose at different vertical angles to increase lighted area. One landing light switch controls both lights and is located on the cyclic center post or near OAT gage.

## NOTE

Landing lights operate only when clutch actuator switch is in the engage position.

24-10 Exterior Lights24-11 Strobe Light**A. Removal**

1. Turn battery switch off. Pull out STROBE circuit breaker (5 amp) at panel.
2. Remove hardware securing A708 strobe light assembly's retainer (or clamp), lens, and gasket to strobe (or flash tube assembly).
3. Remove screws securing A708-14 strobe to tailcone mount.
4. Disconnect strobe (or flash tube assembly) wire harness from airframe harness at connectors and remove strobe (or flash tube assembly).

24-11 Strobe Light (continued)**B. Installation**

1. Turn battery switch off. Pull out STROBE circuit breaker (5 amp) at panel.
2. Connect A708 strobe light assembly's wire harness to airframe harness at connectors. Verify security.
3. Loop wires and connectors inside mount and install screws securing A708-14 strobe to tailcone mount.
4. Assemble gasket, lens (red forward if red/white), and retainer (or clamp) on tailcone mount and install hardware. Verify security.
5. Push in STROBE circuit breaker (5 amp) at panel. Turn battery switch and strobe switch(es) on and verify function. Turn battery switch off.

24-12 Navigation Lights**A. Removal**

1. Turn battery switch off. Pull out LTS circuit breaker (5 amp) at panel.
2. a. Position Lights: Remove screw, retainer, lens, (lamp), and gasket to light assembly. Remove hardware securing light assembly, gasket, and ground wire to chin. Cut and discard ty-rap securing excess wire to light assembly, pull out light assembly, and disconnect light assembly harness from airframe harness at connectors.  
  
b. Tail Light: Remove screws securing retainer, lens, gasket, (lamp), and light assembly to stabilizer mount. Pull out light assembly and disconnect light assembly harness from airframe harness at connectors.

**B. Installation**

1. Turn battery switch off. Pull out LTS circuit breaker (5 amp) at panel.
2. a. Position Lights: Connect light assembly harness to airframe harness at connectors. Install hardware securing light assembly, gasket, and ground wire to chin. Verify security. Install ty-rap securing excess wire to light assembly. Cinch ty-rap until snug without over-tightening, and trim tip flush with head. Install lamp (earlier R22s). Install screw securing retainer, lens, and gasket to light assembly. Verify security.  
  
b. Tail Light: Connect light assembly harness to airframe harness at connectors. Position light assembly in stabilizer mount and install screws securing retainer, lens, gasket, and light to mount. Verify security.
3. Push in LTS circuit breaker (5 amp) at panel. Turn battery switch and NAV LTS switch on and verify function. Turn battery switch and NAV LTS switch off.



## 24-13 Landing Lights

### NOTE

Landing lights operate only when clutch actuator switch is in the engage position.

#### **A. Removal**

1. Turn battery switch off. Pull out LAND LT circuit breaker (15 amp for HIDs, 20 amp for B196-26 lamps) at panel.
2. Remove screws securing A526-1 retainer to chin and remove retainer.
3. Unplug landing light cable from (or remove hardware securing landing light wires to) lamp and remove lamp.

#### **B. Installation**

1. Turn battery switch off. Pull out LAND LT circuit breaker (15 amp for HIDs, 20 amp for B196-26 lamps) at panel.
2.
  - a. HIDs: Connect landing light cable to B557-1 (spot; LH) landing light or B557-2 (flood) taxi light, as required. Verify security.
  - b. B196 lamps: Install hardware securing landing light wires to lamp. Verify security.
3. Install screws securing A526-1 retainer to chin.
4. Push in LAND LT circuit breaker (15 amp for HIDs, 20 amp for B196-26 lamps) at panel. Turn battery switch and landing light switch on (cyclic center post) and verify function. Turn battery switch and landing light switch off.

24-20 Interior Lights24-21 Instrument Lighting**A. LED Assembly Replacement**

1. Turn battery switch off. Pull out LTS circuit breaker (5 amp) at panel.
2. Remove hardware securing G196-6 light assembly to windshield stiffener. Remove two cap screws securing cover and LED-lamp assembly to housing. Disconnect lamp wires from airframe harness and remove lamp.
3. Connect A238-2289 (white) airframe harness wire to LED-lamp assembly red wire, and A238-2290 airframe harness wire to lamp black wire. Install cover (chamfer facing away from housing) and install two cap screws. Install hardware securing G196-6 light assembly to windshield stiffener. Verify security.
4. Push in LTS circuit breaker (5 amp) at panel. Turn battery switch and NAV LTS switch on and verify function. Verify dimming knob adjusts brightness. Turn battery switch and NAV LTS switch off.

CHAPTER 25

DOORS AND WINDOWS

<i>Section</i>	<i>Title</i>	<i>Page</i>
25-00	Description . . . . .	25.1
25-10	Door Assembly . . . . .	25.1
25-20	Windshield Installation . . . . .	25.3
25-21	Standard (Acrylic) Windshield Installation . . . . .	25.3
25-22	Impact-Resistant (Polycarbonate) Windshield Installation . . . . .	25.6

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## CHAPTER 25

## DOORS AND WINDOWS

25-00 Description

Both cabin doors may be removed and installed by maintenance personnel or pilots.

Two windshield halves are retained in aluminum frames and an aluminum tubular bow oriented vertically along the helicopter's centerline. A standard (acrylic) windshield installation and an impact-resistant (polycarbonate) windshield installation are available. Refer to § 25-20 for detailed description.

25-10 Door Assembly**A. Cleaning**

Refer to § 23-10 Part B for cleaning windows.

**B. Removal**

Remove cotter pins from door hinge pins. Open door and lift door pins from door frame hinge assemblies and remove door. Adjust weight and balance per R22 Pilot's Operating Handbook Section 6.

**C. Installation****WARNING**

**Failure to install a cotter pin in each door's two hinge pins may allow door to depart aircraft in flight.**

1. Align and insert door hinge pins in door frame hinge assemblies; latch door.
2. Install a cotter pin in both upper and lower door hinge pins.
3. Adjust weight and balance per R22 Pilot's Operating Handbook Section 6.

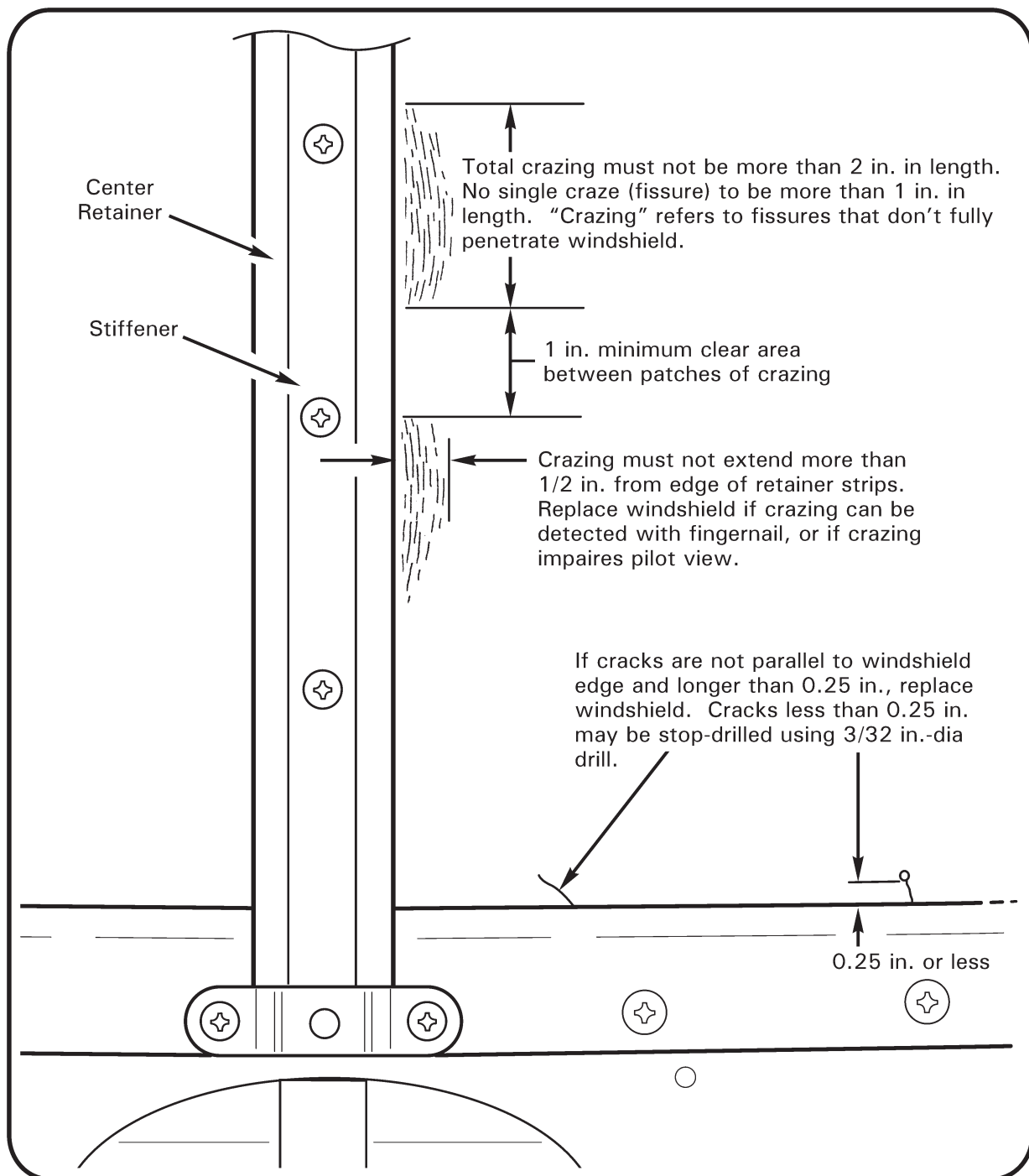


FIGURE 25-1 WINDSHIELD INSPECTION (ACRYLIC WINDSHIELD SHOWN)

## 25-20 Windshield Installation

### 25-21 Standard (Acrylic) Windshield Installation

#### **A. Description**

Acrylic windshields are sandwiched between thin aluminum retainers that are screwed to the door and windshield frames. An adhesive/sealant is applied between the retainers and the windshields for security and weatherproofing.

#### **B. Cleaning**

Refer to § 23-10 Part B for cleaning windshield.

#### **C. Inspection**

Inspect both windshields for cracks and crazing adjacent to retainers per Figure 25-1. If cracks exceed these limits, replace damaged windshield per § 25-21 Part F.

Minor defects or imperfections that do not impair pilot visibility or indicate impending structural failure are acceptable.

#### **D. Removal**

1. Remove door assembly per § 25-10 Part B. Remove hardware securing A228-1 (upper) hinge assembly to door frame and remove hinge.

#### **NOTE**

If windshield is to be reinstalled, prior to removal, tape protective paper or film to the inside and outside of the windshield to prevent damage.

2. Remove hardware securing A238-17 or A238-18 (side) retainer to door frame and remove retainer.
3. Install upper hinge assembly, and install door assemblies for cabin structure support with windshield removed.
4. Support windshield. With a second person inside cabin to remove nuts, latch doors. Remove hardware securing A238-16 (upper) retainer, B409-5 gusset, D805-3 restraint (if installed), B409-7 (lower) retainers, B295-1 clip with trim string, B410-3 stiffener, and B410-1 (center) retainer to cabin and remove parts. Remove windshield.
5. Remove sealant from cabin and parts.
6. If windshield is to be reinstalled, remove sealant from windshield.
7. Repeat steps to remove opposite-side windshield, as required.

25-21 Standard (Acrylic) Windshield Installation (continued)**E. Installation****NOTE**

Prior to installation, if not previously accomplished, tape protective paper or film to the inside and outside of the windshield to prevent damage.

1. Verify sealant has been removed from cabin, parts, and windshield.
2. Position windshield on helicopter and cleco retainers to frames.
3. Attach 1/2"-wide masking tape to windshield along edge of retainers to catch sealant squeeze-out during retainer installation.
4. Remove A238-17 or A238-18 (side) retainer and install A228-1 (upper) door hinge assembly. Install door assemblies for cabin structure support during windshield installation.
5. Remove B410-1 (center) retainer. Run a bead of B270-26 sealant along entire edge of tape line. Install hardware securing center retainer, B410-3 stiffener, and B295-1 clip with trim string to cabin. Special torque screws per § 23-33. Remove tape and wipe off excess sealant with cheesecloth wet with lacolene.
6. Remove B409-7 (lower) retainers. Run a bead of B270-26 sealant along entire edge of tape line. With a second person inside cabin to tighten nuts, latch doors. Install hardware securing lower retainers to cabin. Remove tape and wipe off excess sealant with cheesecloth wet with lacolene.
7. Remove A238-16 (upper) retainer. Run a bead of B270-26 sealant along entire edge of tape line. With a second person inside cabin to tighten nuts, latch forward doors. Install hardware securing upper retainer and B409-5 gusset to cabin. Remove tape and wipe off excess sealant with cheesecloth wet with lacolene.
8. Remove door and hinge assembly. Run a bead of B270-26 sealant along entire edge of tape line. Install hardware securing side retainer and D805-3 restraint (if installed) to cabin. Remove tape and wipe off excess sealant with cheesecloth wet with lacolene.
9. Reinstall hinge assembly, and install door assembly per § 25-10 Part C.
10. Ensure all fasteners are tight. Wipe off excess sealant with cheesecloth wet with lacolene.
11. Allow sealant to dry according to manufacturer's instruction.
12. Remove protective paper or film from inside and outside of the windshield.
13. Repeat steps to install opposite-side windshield, as required.



25-21 Standard (Acrylic) Windshield Installation (continued)**F. Replacement****NOTE**

Prior to installation, if not previously accomplished, tape protective paper or film to the inside and outside of the windshield to prevent damage.

1. Verify sealant has been removed from cabin and parts.
2. Cleco retainers to frames, checking for proper alignment. Remove retainers, except A238-17 or A238-18 (side) retainer.
3. Install A228-1 (upper) door hinge assembly, and install door assemblies for cabin structure support during windshield installation.
4. Lay out masking tape on frames to identify location for windshield edge (estimate edge where side retainer is clecoed to frame). Hold oversized windshield in place by hand and verify it overlaps masking tape on all frames and retainer. When satisfied with alignment, lay out masking tape on windshield for trimming.

**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

5. A band saw with a blade containing at least 24 teeth per inch is recommended for initial trimming. Tape cardboard to band saw table to prevent scratching of windshield. Trim windshield carefully to prevent binding of saw blade and cracking windshield. Finish initial cut using an orbital sander, as required.
6. Hold windshield in place and check for fit. Re-trim as necessary.
7. After windshield is fitted, use sanding block with 100-grit paper to smooth edges. Finish edge and bevel corners using a triangular machinist's scraping tool. Verify all edges are clean and free of notches.
8. Remove trimming debris from windshield and cabin.
9. Install windshield per § 25-21 Part E.

## 25-22 Impact-Resistant (Polycarbonate) Windshield Installation

### **A. Description**

The polycarbonate windshield installation is similar to the acrylic windshield installation, but the windshields fasten to the door and windshield frames via small stainless steel straps.

While polycarbonate has superior strength and flexibility properties when compared with acrylic, it is also more susceptible to ultraviolet (UV) degradation, and has a low scratch resistance. A hardcoat is applied during manufacturing to protect against UV damage and scratching, however, further effort must be made by the operator to maximize windshield service life. Follow instructions closely to avoid scratching windshield during cleaning (refer to § 23-10 Part B). Exposure to incompatible cleaning agents or solvents can result in embrittlement or crazing. Use a cabin cover when parking helicopter outdoors, or store helicopter in hanger when possible.

### **B. Cleaning**

Refer to § 23-10 Part B for cleaning windshield.

### **C. Inspection**

Inspect both windshields for cracks and crazing adjacent to retainers per Figure 25-1. Also inspect areas adjacent to fasteners and stainless steel straps for cracks and crazing. If cracks exceed these limits, replace damaged windshield per § 25-21 Part F.

Inspect windshields for any significant discoloration or cloudiness. Minor defects or imperfections that do not impair pilot visibility or indicate impending structural failure are acceptable.

Touch up perimeter paint using flat black (refer to § 23-77).

### **D. Removal**

1. Perform § 25-21 Part D steps 1 thru 3.
2. Support windshield. With a second person inside cabin to remove nuts and washers, latch doors. Remove hardware securing G367 ties and straps to windshield near center bow (all other hardware installed in windshield may remain in place during windshield removal).
3. Remove hardware securing A238-16 (upper) retainer, B409-5 gusset, D805-3 restraint (if installed), B409-7 (lower) retainers, B295-1 clip with trim string, B410-3 stiffener, and B410-1 retainer to cabin and remove parts. Remove windshield.
4. Remove sealant from cabin and parts.
5. If windshield is to be reinstalled, remove sealant from windshield but leave hardware and G367 ties, straps, pads, and tabs installed. If replacing windshield, remove hardware and G367 ties, straps, pads, and tabs, as required.
6. Repeat steps to remove opposite-side windshield, as required.

25-22 Impact-Resistant (Polycarbonate) Windshield Installation (continued)**E. Installation****NOTE**

Prior to installation, if not previously accomplished, tape protective paper or film to the inside and outside of the windshield to prevent damage.

**NOTE**

Inspect condition of G367 ties, straps, pads, and tabs to be installed. Verify no obvious damage, deformation, or stretching. If windshield is being replaced due to bird strike or other impact which could deform ties, straps, pads, or tabs, replacement of these items is recommended.

**NOTE**

Refer to R22 Illustrated Parts Catalog Chapter 52. Note location of G367 ties, straps, pads, and tabs on work table or by marking on tape at fasteners to facilitate installation.

1. Verify sealant has been removed from cabin, parts, and windshield.
2. Position windshield on helicopter and cleco G367 ties, straps, tabs, and retainers to frames. Also, cleco G367 ties, straps, and tabs to windshield at center bow, if drilled.
3. Install A228-1 (upper) door hinge assembly. Install forward door assemblies for cabin structure support during windshield installation.
4. If windshield is drilled and has hardware, G367 ties, straps, pads, and tabs installed:
  - a. With a second person inside cabin to tighten nuts, latch forward doors. Remove clecoes and install hardware securing G367 ties and straps to windshield at center bow; special torque screws per § 23-33.
  - b. Attach 1/2"-wide masking tape to windshield along edge of retainers to catch sealant squeeze-out during retainer installation.
  - c. Remove B410-1 (center) retainer. Run a bead of B270-26 sealant along entire edge of tape line. Install hardware securing center retainer, B410-3 stiffener, and B295-1 clip with trim string to cabin; special torque screws per § 23-33. Remove tape and wipe off excess sealant with cheesecloth wet with lacolene.
  - d. Perform § 25-21 Part E steps 6 thru 13.

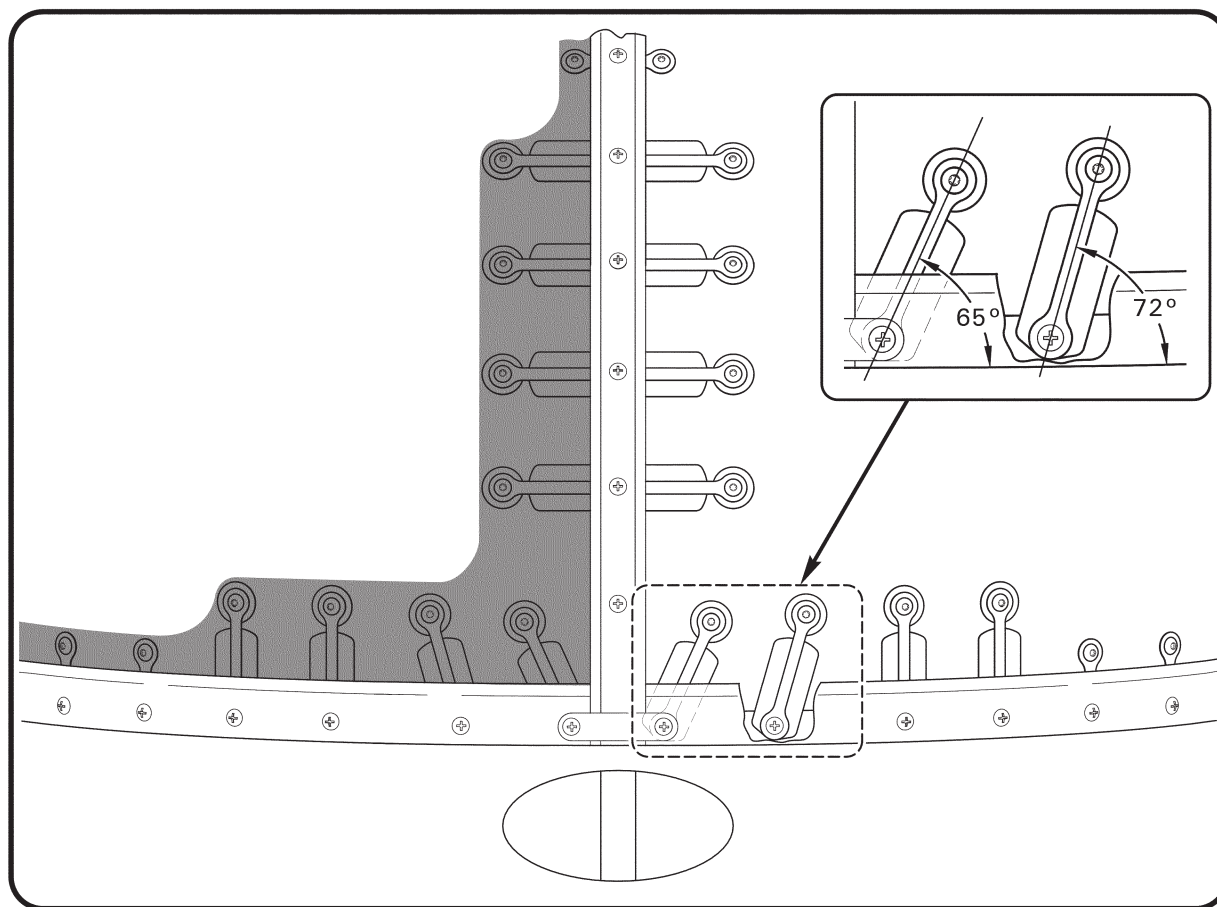


FIGURE 25-2 G367 TIES AND STRAPS INSTALLATION

## 25-22 Impact-Resistant (Polycarbonate) Windshield Installation (continued)

### E. Installation (continued)

5. Refer to Figure 25-2. Align G367 ties and straps perpendicular to retainers within  $2^{\circ}$ , except at locations shown. Install B410-3 stiffener and special torque screws per § 23-33. Match drill #40 pilot holes through windshield and install clecos.
6. At center bow:
  - a. Remove B410-3 stiffener and B410-1 (center) retainer. Remove G367 ties and straps and expand pilot holes to 0.169–0.175 inch diameter holes thru windshield. Finish holes with reamer; deburr back side of holes using plastic razor. Clean up debris.
  - b. Apply B270-26 sealant to G367 tabs and pads and position on windshield. Run a bead of B270-26 sealant along entire edge of windshield. Install hardware securing center retainer, B410-3 stiffener, and B295-1 clip with trim string to cabin. Special torque screws per § 23-33.
  - c. With a second person inside cabin to tighten nuts, latch doors and install hardware securing G367 ties and straps to windshield; special torque screws per § 23-33. Wipe off excess sealant with cheesecloth wet with lacolene.

25-22 Impact-Resistant (Polycarbonate) Windshield Installation (continued)**E. Installation (continued)**

7. At lower retainers:
  - a. Remove B409-7 (lower) retainers. Remove G367 straps and expand pilot holes to 0.169–0.175 inch diameter holes thru windshield. Finish holes with reamer; deburr back side of holes using plastic razor. Clean up debris.
  - b. Apply B270-26 sealant to G367-12 tabs and position on windshield. Run a bead of B270-26 sealant along entire edge of windshield. With a second person inside cabin to tighten nuts, latch doors, and install hardware securing lower retainers to cabin. Install hardware securing G367 straps to windshield; special torque screws per § 23-33. Wipe off excess sealant with cheesecloth wet with lacolene.
8. At upper retainer:
  - a. Remove A238-16 (upper) retainer. Remove G367 straps and expand pilot holes to 0.169–0.175 inch diameter holes thru windshield. Finish holes with reamer; deburr back side of holes using plastic razor. Clean up debris.
  - b. Run a bead of B270-26 sealant along entire edge of windshield. With a second person inside cabin to tighten nuts, latch forward doors, and install hardware securing upper retainer and B409-5 gusset to cabin. Install hardware securing G367 straps and ties to windshield; special torque screws per § 23-33. Wipe off excess sealant with cheesecloth wet with lacolene.
9. At door frame:
  - a. Remove door and hinge assembly. Remove G367 straps and expand pilot holes to 0.169–0.175 inch diameter holes thru windshield. Finish holes with reamer; deburr back side of holes using plastic razor. Clean up debris.
  - b. Run a bead of B270-26 sealant along entire edge of windshield. Install hardware securing side retainer and D805-3 restraint to cabin. Install hardware securing G367 straps and ties to windshield; special torque screws per § 23-33. Wipe off excess sealant with cheesecloth wet with lacolene.
10. Reinstall hinge assembly, and install door assembly per § 25-10 Part C.
11. Ensure all fasteners are tight. Wipe off excess sealant with cheesecloth wet with lacolene.
12. Allow sealant to dry according to manufacturer's instruction.
13. Remove protective paper or film from inside and outside of the windshield.
14. Repeat steps to install opposite-side windshield, as required.

25-22 Impact-Resistant (Polycarbonate) Windshield Installation (continued)**F. Replacement**

1. Perform § 25-21 Part F steps 1 thru 4.

**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

2. A band saw with 20°–30° clearance angle, 0–5° rake angle, 600–1000 m/min rotation speed, and 1.5–4 mm tooth spacing is recommended for initial trimming. Tape cardboard to band saw table to prevent scratching of windshield. Trim windshield carefully to prevent binding of saw blade and cracking windshield. Finish initial cut using an orbital sander, as required.
3. Hold windshield in place and check for fit. Re-trim as necessary.
4. After windshield is fitted, use sanding block with 100-grit paper to smooth edges. Verify all edges are clean and free of notches.
5. Remove trimming debris from windshield and cabin.
6. Install windshield per § 25-22 Part E.

## CHAPTER 26

## MAIN ROTOR

<i>Section</i>	<i>Title</i>	<i>Page</i>
26-00	Description . . . . .	26.1
26-10	Main Rotor Blades . . . . .	26.1
26-11	Blade Boots . . . . .	26.6
26-12	Filling Pitch Bearing Housing . . . . .	26.9
26-20	Main Rotor Hub . . . . .	26.10
26-21	Bearing Replacement . . . . .	26.12
26-30	Main Rotor Assembly . . . . .	26.15
26-31	Journal and Shim Calculations . . . . .	26.15
26-32	Adjusting Hinge Friction . . . . .	26.20
26-33	Shifting the Main Rotor Hub . . . . .	26.21
26-34	Drilling Installed Main Rotor Hub Bolts . . . . .	26.21
26-40	Inspection of Main Rotor Blades . . . . .	26.23
26-41	Scratches and Corrosion on Blade Skins and Doublers . . . . .	26.23A
26-42	Dents . . . . .	26.25
26-43	Root Fitting Damage . . . . .	26.27
26-44	Voids . . . . .	26.29
26-50	Repair of Main Rotor Blades . . . . .	26.31
26-51	Trimming . . . . .	26.33
26-52	Painting . . . . .	26.33
26-53	Leading Edge Care . . . . .	26.35
26-60	Main Rotor Blade Tip Maintenance . . . . .	26.36

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## CHAPTER 26

## MAIN ROTOR

26-00 Description

The main rotor has two all-metal blades mounted to the hub by coning hinges. The hub is mounted to the shaft by a teeter hinge. The coning and teeter hinges use self-lubricated bearings. Droop stops for the main rotor blades provide a teeter hinge friction restraint which normally prevents the rotor from teetering while starting or stopping. Pitch change bearings for each blade are enclosed in a housing at the blade root. The housing is filled with oil and sealed with an elastomeric boot. Each blade has a thick stainless steel spar at the leading edge which is resistant to corrosion and erosion. The skins are bonded to the spar approximately one inch aft of the leading edge. Blades must be refinished if the paint erodes to bare metal at the skin-to-spar bond line. Bond may be damaged if bond line is exposed.

26-10 Main Rotor Blades**WARNING**

Due to potentially destructive results, use of blade tape (anti-erosion tape) is prohibited.

**A. Removal**

Refer to Figure 26-1. Four people will be required to remove the blades. One person must support the blade near the blade tip while another supports the root and removes or installs the attachment bolt.

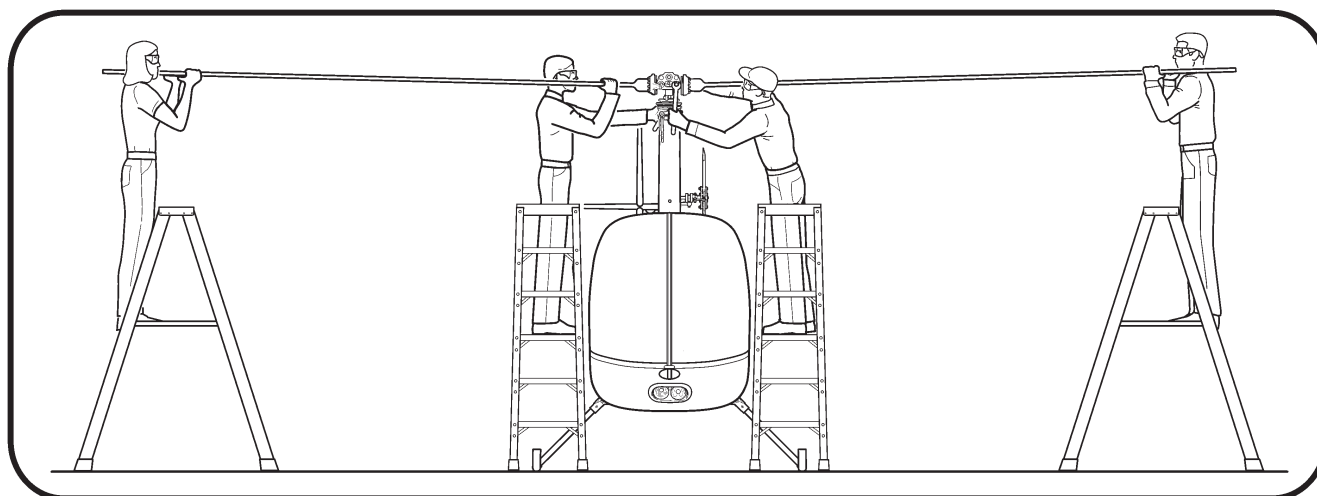


FIGURE 26-1 SUPPORTING MAIN ROTOR BLADES DURING BLADE REMOVAL OR INSTALLATION

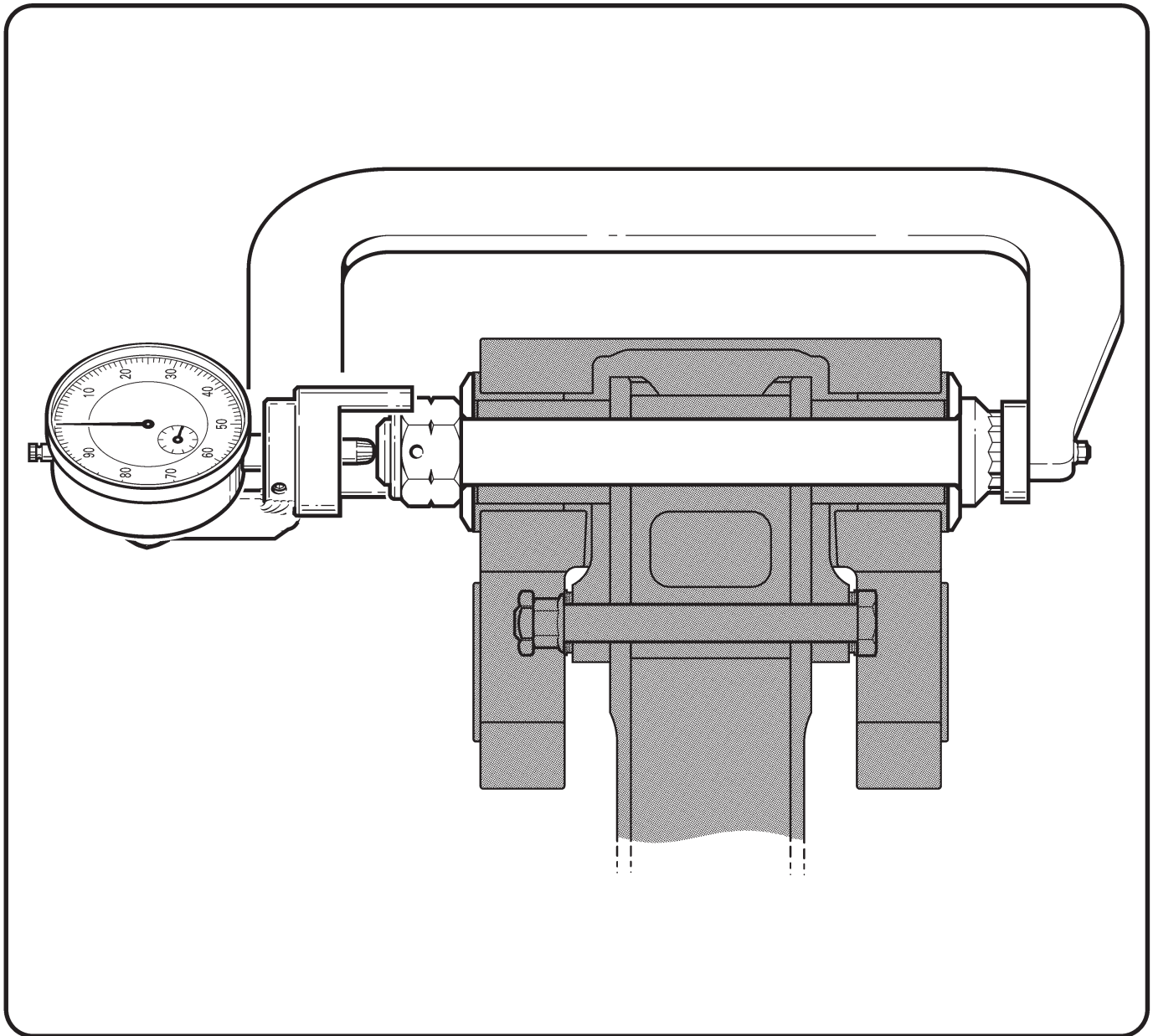


FIGURE 26-2 MEASURING BOLT STRETCH (SHOWN ON TEETER BOLT, BLADES REMOVED)

26-10 Main Rotor Blades (continued)**A. Removal (continued)**

1. Mark one main rotor blade and its corresponding hub location, pitch link, and retaining nut & bolt with "X" using a marker or grease pencil. Mark opposite blade and its hub location, pitch link, and retaining nut & bolt with "O".
2. Measure and record coning hinge axial gaps per Figure 26-8.
3. Remove hardware securing main rotor pitch links to blade pitch horns.
4. Remove cotter pins and loosen blade coning hinge retaining nuts until finger tight.

**CAUTION**

After removing one blade, support installed blade in a level position until it is removed.

5. Remove nut, thrust washer, and trailing-edge shims (if used) from one blade. Cone blade as required to position spindle tusk off of droop stop. Supporting blade at root, rotate pitch horn down, and remove hinge bolt and thrust washer.

**CAUTION**

Do not drop journals (inside hub bearings) which can slide out when removing blade bolt.

**NOTE**

Blade installation hardware is specific to each blade, each blade's leading and trailing edge, and each blade's location in hub. It is good practice after blade removal to install hardware in hub finger tight exactly as removed.

6. Place blade on a cushioned surface to prevent damage to skins.
7. Remove opposite blade per steps 5 and 6.

26-10 Main Rotor Blades (continued)**B. Installation**

1. Identify hub and spindle part numbers and ensure correct corresponding installation hardware.
2. Check teeter hinge friction and adjust as required per § 26-32.
3. If coning hinge axial gap recorded during blade removal was beyond tolerance, or if corresponding hub bearing(s) or spindle was replaced, perform coning hinge journal and shim calculation per § 26-31.
4. Level hub and insert journals in hub bearings. Install thrust washer on blade bolt.
5. Insert main rotor blade spindle in hub and align spindle and journal bores. Cone blade as required to position tusk off of droop stop. Rotate pitch horn down and install hinge bolt at leading-edge side.

**NOTE**

A bolt may be inserted from trailing-edge side to align spindle and journal bores (it is pushed out as coning hinge bolt is installed).

6. Install trailing-edge shims (if used) and thrust washer. Apply light coat A257-9 anti-seize to bolt threads and nut face. Install nut finger tight.

**NOTE**

Do not allow anti-seize to contact journals, shims, or hub bearing areas. These areas must be clean and dry.

**CAUTION**

After installing one blade, support blade in a level position until opposite blade is installed.

7. Install opposite blade per steps 4 thru 6.
8. Tighten nut on coning hinge bolt until journals and thrust washer are firmly seated. Loosen nut until both thrust washers can be freely rotated.
9. Refer to Figure 26-2. Install MT122 main rotor bolt elongation (stretch) tool on hinge bolt. Zero dial indicator by rotating dial face and lock dial. Remove tool.
10. Using wrenches with at least 150 ft-lb torque capacity, tighten nut until drilled holes in nut and bolt align. Install MT122 tool and measure bolt elongation:

**WARNING**

**Do not under-stretch or over-stretch teeter or coning hinge bolts to obtain proper clamping force. Under-stretching or over-stretching can cause failure.**

26-10 Main Rotor Blades (continued)**B. Installation (continued)**

10. a. A154-1 hub with NAS630-80 (or MS21250-10080) coning hinge bolts:
  - i. If bolt elongation is 0.015–0.017 inch, remove tool and install a new cotter pin wet with approved primer (chromate primer preferred; refer to § 23-75).
  - ii. If bolt elongation is not 0.015–0.017 inch, remove old nut and old bolt and install a new bolt and a new nut. Stretch new bolt per § 23-33, and drill new nut and bolt per § 26-34. Install a new cotter pin wet with approved primer.
- b. B370-1 hub with NAS632-82 (or MS21250-12082) coning hinge bolts:
  - i. If bolt elongation is 0.010–0.012 inch, remove tool and install a new cotter pin wet with approved primer (chromate primer preferred; refer to § 23-75).
  - ii. If bolt elongation is not 0.010–0.012 inch, remove old nut and old bolt and install a new bolt and a new nut. Stretch new bolt per § 23-33, and drill new nut and bolt per § 26-34. Install a new cotter pin wet with approved primer.
11. Install hardware securing main rotor pitch link to pitch horn. Standard torque hardware per § 23-32 and torque stripe per Figure 2-1.
12. Perform steps 8 thru 11 on opposite blade.
13. Track and balance main rotor blades per § 10.230.

**CAUTION**

When fitting a replacement main rotor blade(s), remove both main rotor blade tip covers after initial run-up and clean out debris.

26-11 Blade Boots**A. Removal**

1. Remove main rotor blades per § 26-10.
2. Place a suitable drain container below pitch horn. Remove two B289-2 bolts and drain fluid.
3. Remove outer boot clamp and hold boot back to expose inner boot clamp. Remove inner clamp and peel boot from spindle.

**B. Installation**

1. Visually inspect and verify boot is undamaged. Carefully stretch new boot over spindle.
2. Solvent-clean surfaces clamped by boot inner lip. Properly position boot inner lip; install A165-1 (inner) clamp assembly and tighten clamp to  $2.330 \pm 0.005$  inch outside diameter. Rotate spindle and verify adequate clearance between clamp assembly and pitch horn.

**NOTE**

When installing inner clamp, ensure that shoulder of boot inner lip is not wedged beneath clamp or clamp may loosen in service. Inspect boot interior and verify no cuts or punctures.

3. Stretch boot outer lip over pitch horn flange. Rotate spindle and align pitch horn bolt hole with spindle bolt hole per Figure 26-3. Install A165-7 (outer) clamp assembly and tighten clamp. Verify security.
4. Fill root fitting per § 26-12.

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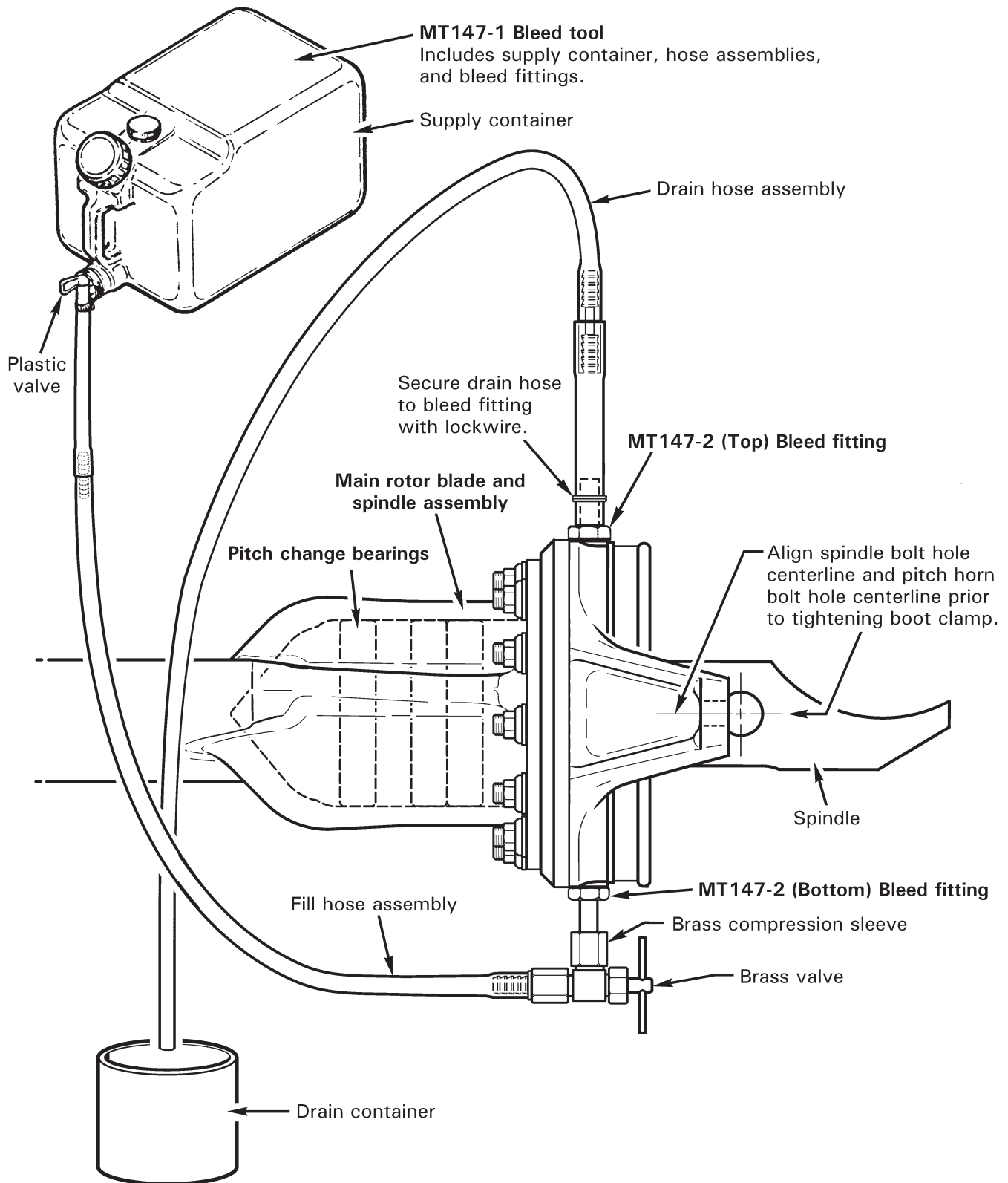


FIGURE 26-3 FILLING PITCH BEARING HOUSING



26-12 Filling Pitch Bearing Housing**NOTE**

MT147-1 Main rotor blade spindle air bleed tool includes supply container, hose assemblies, and bleed fittings.

**WARNING**

**Refer to Safety Data Sheets (SDS) and observe precautions when working in proximity to hazardous materials.**

1. Remove main rotor blades per § 26-10.
2. Refer to Figure 26-3. Place a suitable drain container below main rotor pitch horn. Remove two B289-2 bolts from pitch horn and drain fluid.
3. Install MT147-2 bleed fittings into pitch horn openings. Attach drain hose assembly to (top) bleed fitting, secure with two wraps of lockwire. Position drain hose into drain container.
4. Place supply container with sufficient A257-4 fluid approximately 3 feet above spindle. Route fill hose assembly into drain container and open brass valve. Open supply container plastic valve and purge air from fill hose. Close valves.
5. Connect brass valve to (bottom) bleed fitting by tightening brass compression sleeve.
6. Open valves and fill spindle housing until no air bubbles are visible in drain hose assembly. Massage spindle boot, oscillate spindle, and raise blade tip up & down to remove trapped air.
7. Remove drain hose assembly and (top) bleed fitting, and install B289-2 bolt. Roll the blade over. After five minutes, inspect the boot for leaks. If no leaks are found, close valves, remove fill hose assembly brass valve and (bottom) bleed fitting, and install other bolt.
8. Special torque B289-2 bolts per § 23-33 and torque stripe per Figure 2-1.
9. Repeat steps for opposite blade.

26-20 Main Rotor Hub**A. Removal**

1. Remove main rotor blades per § 26-10.
2. Refer to Figure 26-5. Mark rotor hub using a grease pencil, tape, or soft marker as follows:
  - a. Indicate nut side of teeter bolt.
  - b. Indicate chord arm side of drive shaft.
3. If same hub will be installed, measure teeter hinge friction per Figure 26-9 and record value.
4. Remove cotter pin, nut, A152 thrust washers, A117 shims, A106 journals, and bolt. Rotate hub as required and remove hub. Do not drop thrust washers or journals.
5. Reinstall bolt, thrust washers, shims, journals, and nut in rotor hub exactly as removed.

**CAUTION**

Main rotor chordwise balance is adjusted using A106 journals and A117 shims. If assembly stack-up is altered, an out-of-balance condition can occur.

**B. Installation**

1. Clean and dry teeter hinge hardware using approved solvent per § 23-70. Inspect journals and thrust washers for chipping of chrome plating, corrosion, and/or wear grooves extending through chrome plating. Replace journal or thrust washer if any of these conditions exist.
2. If teeter hinge friction recorded during hub removal was less than 5 ft-lb or more than 15 ft-lb, if teeter hinge hub bearing(s) was replaced, or if previous installation information is unavailable, perform teeter hinge journal and shim calculation per § 26-31.
3. Refer to Figure 26-5. Line up mark on hub with chord arm on drive shaft. Install teeter hinge bolt, thrust washers, shims, and journals (if previous installation information is available, install parts exactly as removed).

26-20 Main Rotor Hub (continued)**B. Installation (continued)**

4. Coat nut face and bolt threads with A257-9 anti-seize compound, install and tighten nut, then loosen nut until both thrust washers can be freely rotated. Ensure journals do not “pinch” droop stops and fully contact drive shaft.

**WARNING**

**Do not allow anti-seize compound to contaminate drive shaft, journals, shims, or thrust washer inner faces. Contamination prevents proper joint clamp-up and may cause failure.**

5. Refer to Figure 26-2. Install MT122 main rotor bolt elongation (stretch) tool on teeter bolt. Zero dial indicator by rotating dial face and lock dial. Remove tool.
6. Using wrenches with at least 150 ft-lb torque capacity, tighten nut until drilled holes in nut and bolt align. Install MT122 tool and measure bolt elongation:
  - a. If bolt elongation is 0.015–0.017 inch, remove tool and verify correct teeter hinge friction per § 26-32. Adjust teeter hinge friction as required.
  - b. If bolt elongation is not 0.015–0.017 inch, remove old nut and old bolt and install a new bolt and a new nut. Stretch new bolt per § 23-33 and verify correct teeter hinge friction per § 26-32. Adjust teeter hinge friction as required. Drill new nut and bolt per § 26-34.

**WARNING**

**Do not under-stretch or over-stretch teeter or coning hinge bolts to obtain proper clamping force. Under-stretching or over-stretching can cause failure.**

7. Install a new cotter pin wet with approved primer (chromate primer preferred; refer to § 23-75).

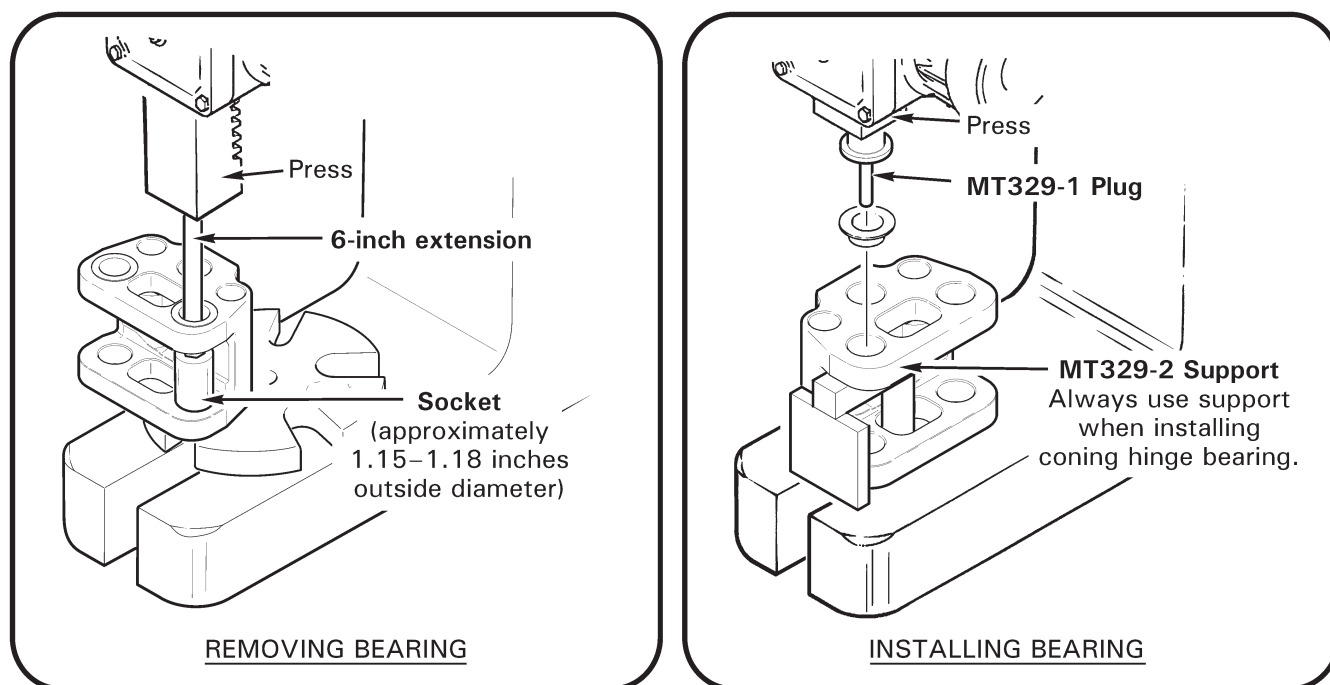


FIGURE 26-4 MAIN ROTOR HUB BEARING REPLACEMENT

### 26-21 Bearing Replacement

1. Remove main rotor hub per § 26-20.
2. Refer to Figure 26-4. Verify tooling surfaces are smooth to avoid damaging hub and bearings. Press A648-1 and/or A648-3 bearing(s) from hub using MT329-1 plug assembly (Rev H or subsequent) with MT329-10 tube. Press A648-2 bearing(s) from hub using MT329-11 plug assembly with MT329-10 tube.
3. Visually inspect hub bearing bore(s) per § 2.610 step 3a.

#### NOTE

Do not allow primer to contact bearing's Teflon liner.

4. Verify bearing mating surfaces are smooth and clean and apply light coat of approved primer (chromate primer preferred; refer to § 23-75). If visible, orient coning hinge bearing's Teflon liner seam toward top of hub. While approved primer is wet, press in new A648-1 and/or A648-3 bearing(s) using MT329-1 plug assembly or A648-2 bearing(s) using MT329-11 plug assembly (always use MT329-13 or MT329-2 [A154-4 Hub] support when replacing coning hinge bearing) until bearing flange is completely seated against hub.
5. Using a syringe, seal between bearing's outboard flange and hub and bearing's inboard edge and hub with small fillet of approved primer.

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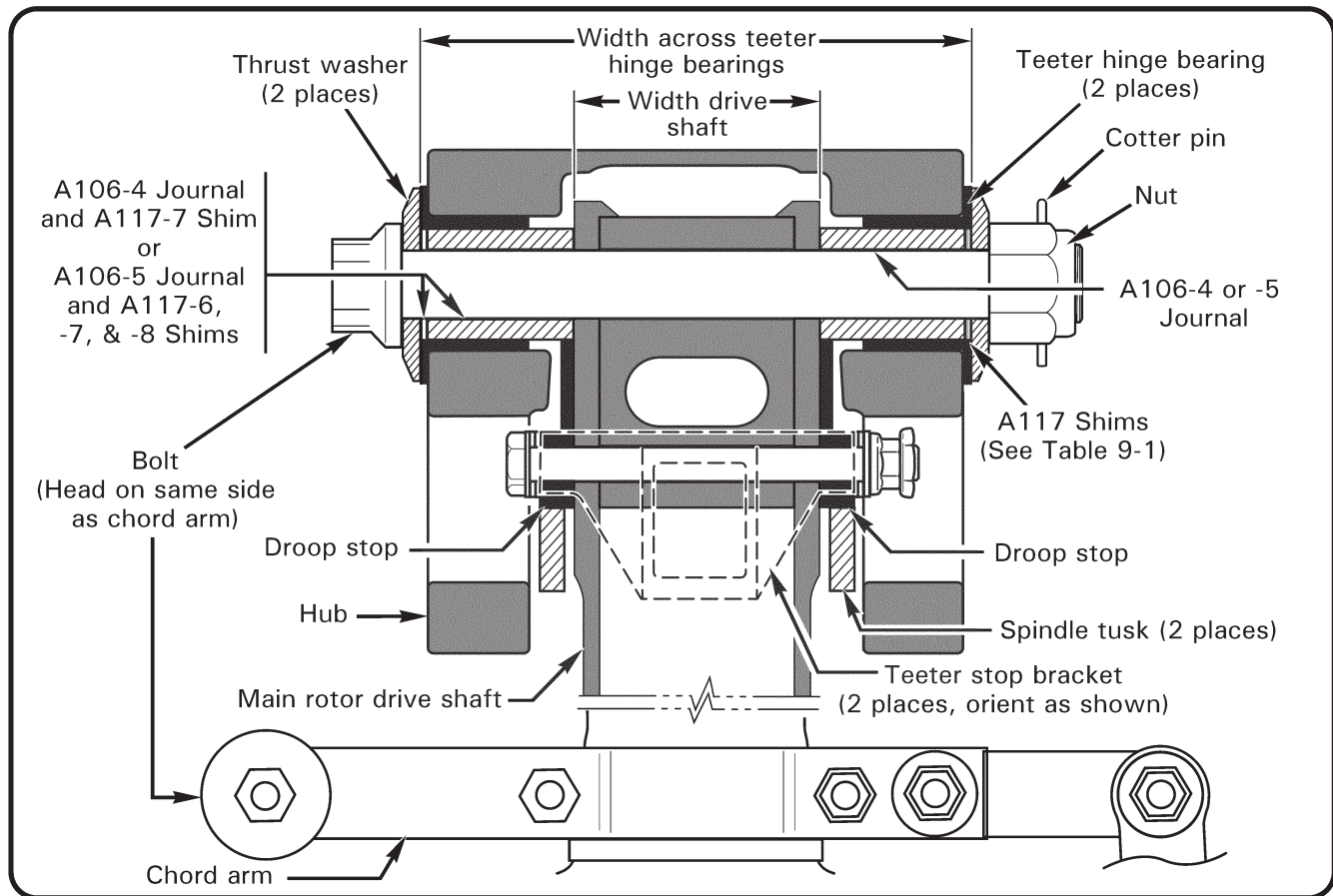


FIGURE 26-5 TEETER HINGE (HUB INSTALLATION)

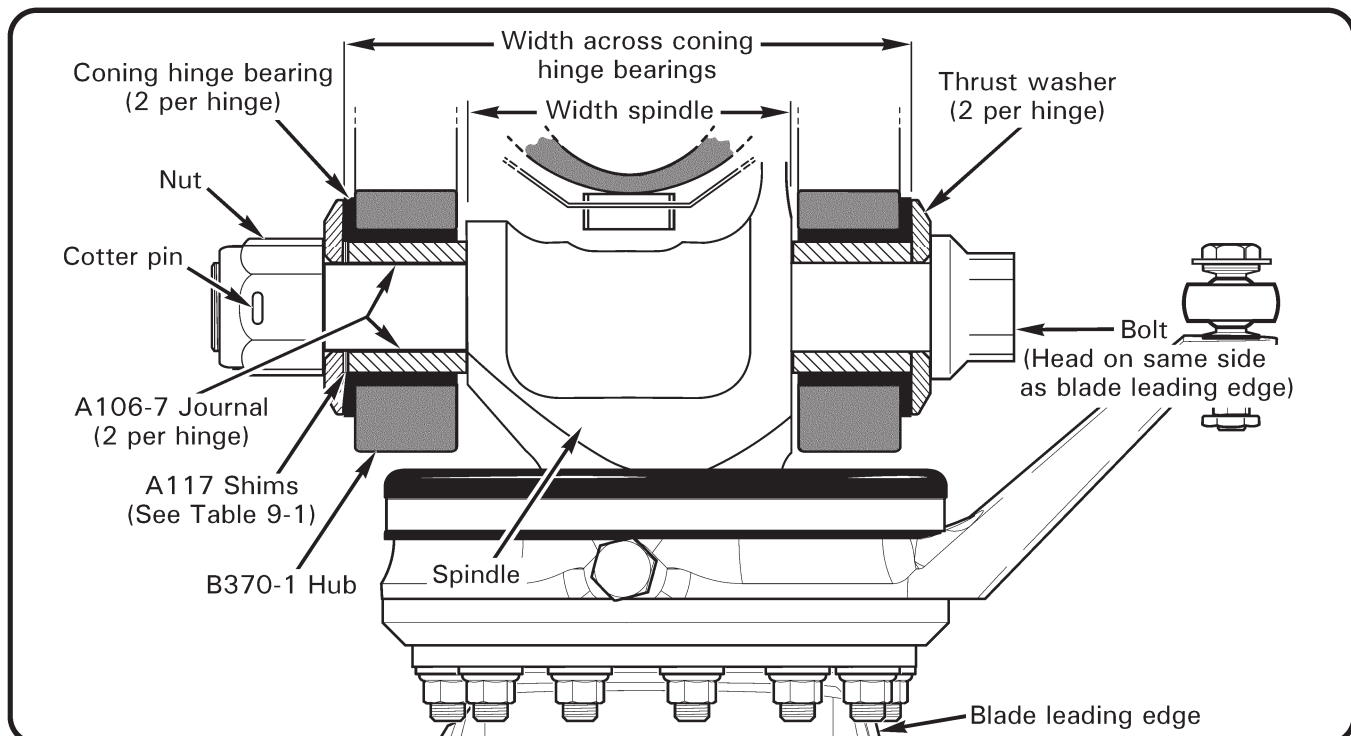


FIGURE 26-6 B370-1 HUB CONING HINGE (BLADE INSTALLATION; VIEW LOOKING DOWN)

## 26-30 Main Rotor Assembly

### 26-31 Journal and Shim Calculations

Refer to Table 26-1 and Figures 26-5, 26-6, and 26-7.

#### A. Teeter Hinge Calculation

1. Measure main rotor hub width across the teeter hinge bearing faces: \_\_\_\_\_ in.
2. Subtract measured width of A251 driveshaft at teeter hinge bolt hole: – \_\_\_\_\_ in.  
Calculated empty space: = \_\_\_\_\_ in.

3. Assemble thrust washer under teeter bolt head, and:

- a. One A117-7 shim (0.020 inch), and one A106-4 journal (1.300 inches), or
- b. One each A117-6, -7, & -8 shims (0.015, 0.020, and 0.025 inch), and one A106-5 journal (1.260 inches).

Insert bolt thru hub and drive shaft.

Subtract combined measured thickness of A117 shim(s) &  
A106-4 or -5 journal: – \_\_\_\_\_ in.

Difference: = \_\_\_\_\_ in.

4. Subtract measured length of nut-side A106-4 or A106-5 journal: – \_\_\_\_\_ in.

Difference: = \_\_\_\_\_ in.

#### CAUTION

Initial teeter hinge hardware stack-up must be adjusted to 0.005/0.008 inch greater than calculated empty space. A smaller initial stack-up could damage thrust washers and hub bearings during installation.

5. To accommodate dimensional change due to clamping force, add: + 0.005/  
0.008 in.

/

Initial A117 shim stack between nut-side journal & thrust washer: = \_\_\_\_\_ in.

#### NOTE

Use as many different size A117 shims as possible to facilitate head shifting during balancing.

6. Refer to § 26-32. Adjust shim stack as required to meet teeter hinge friction requirement (less than 15 ft-lb).

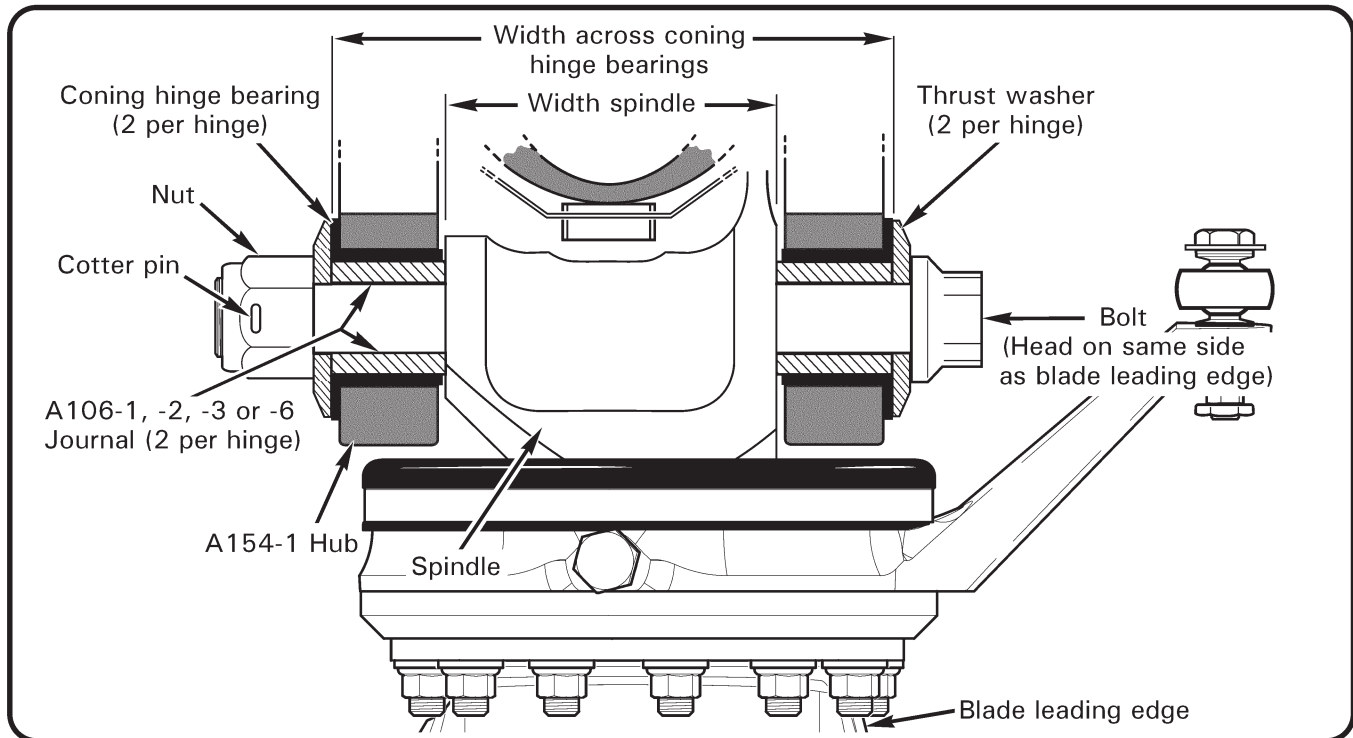


FIGURE 26-7 A154-1 HUB CONING HINGE (BLADE INSTALLATION; VIEW LOOKING DOWN)

**A106 Journal Lengths**

Part No.	Length	Location
A106-1	1.000 in.	Coning hinge, no shims (A154-1 Hub)
A106-2	0.995 in.	Coning hinge, no shims (A154-1 Hub)
A106-3	0.990 in.	Coning hinge, no shims (A154-1 Hub)
A106-4	1.300 in.	Teeter hinge (two, or one + A106-5 per hinge), shims
A106-5	1.260 in.	Teeter hinge (two, or one + A106-4 per hinge), shims
A106-6	1.005 in.	Coning hinge, no shims (A154-1 Hub)
A106-7	1.005 in.	Coning hinge (B370-1 Hub)

**A117 Shim Sizes**

Part No.	Thickness	Location (Between thrust washer and journal)
A117-5	0.012 in.	Teeter hinge
A117-6	0.015 in.	Teeter hinge
A117-7	0.020 in.	Teeter hinge
A117-8	0.025 in.	Teeter hinge
A117-48	0.012 in.	Coning hinge (B370-1 Hub)
A117-49	0.015 in.	Coning hinge (B370-1 Hub)
A117-50	0.020 in.	Coning hinge (B370-1 Hub)
A117-51	0.025 in.	Coning hinge (B370-1 Hub)

TABLE 26-1 A106 JOURNAL LENGTHS AND A117 SHIM SIZES



26-31 Journal and Shim Calculations (continued)
**B. Coning Hinge Calculation**
B370-1 Hub:

1. Measure main rotor hub width across the coning hinge bearing faces:      \_\_\_\_\_ in.
2. Subtract measured width of blade spindle at teeter hinge bolt hole:      – \_\_\_\_\_ in.  

Calculated empty space: = \_\_\_\_\_ in.
3. Subtract combined measured length of two A106-7 journals:      – \_\_\_\_\_ in.  

Difference: = \_\_\_\_\_ in.

**CAUTION**

Initial teeter hinge hardware stack-up must be adjusted to 0.003/0.006 inch greater than calculated empty space. A smaller initial stack-up could damage thrust washers and hub bearings during installation.

4. To accommodate dimensional change due to clamping force, add:      + 0.003/  

0.006      in.

/

Initial A117 shim stack between nut-side journal & thrust washer: = \_\_\_\_\_ in.
5. Adjust shim stack combination as required to meet coning hinge axial gap requirement per Figure 26-8 and to maintain teeter friction requirement as follows: It must be possible to manually cone each blade without teetering the hub when blades are held up off the droop stops and lifted at tip.

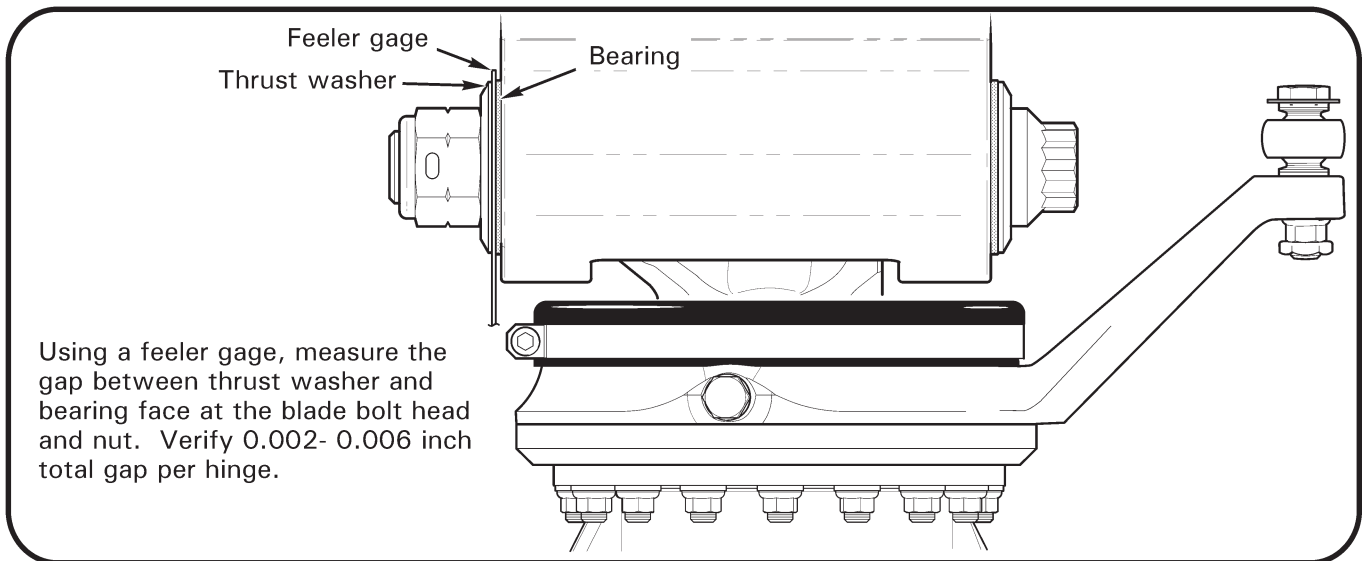


FIGURE 26-8 MEASURING CONING HINGE AXIAL GAP

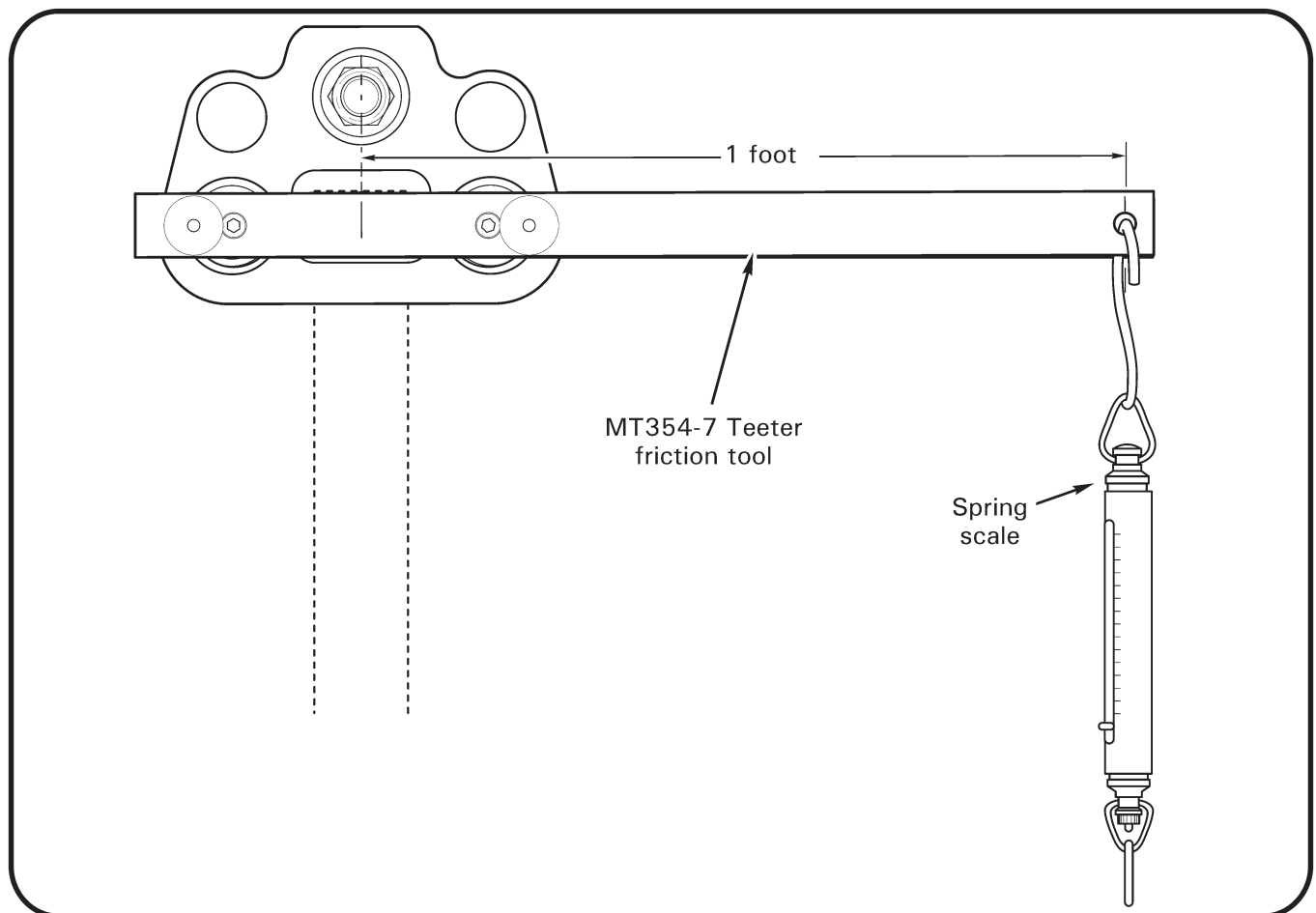


FIGURE 26-9 MEASURING TEETER HINGE FRICTION

26-31 Journal and Shim Calculations (continued)**B. Coning Hinge Calculation (continued)**A154-1 Hub:

1. Measure main rotor hub width across the coning hinge bearing faces: \_\_\_\_\_ in.
2. Subtract measured width of blade spindle at coning hinge bolt hole: – \_\_\_\_\_ in.  
Calculated empty space: = \_\_\_\_\_ in.

**CAUTION**

Initial coning hinge hardware stack-up must be adjusted to 0.003/0.006 inch greater than calculated empty space. A smaller initial stack-up could damage thrust washers and hub bearings during installation.

3. To accommodate dimensional change due to clamping force, add: + 0.003/  
0.006 in.  
/   
Sum: = \_\_\_\_\_ in.
4. Select a combination of A106-1, -2, -3, or -6 journals whose combined measured lengths equal Sum. The same journal dash number must be used under the head of both coning hinge bolts to maintain symmetry.
5. Adjust journal combination as required to meet coning hinge axial gap requirement per Figure 26-8 and to maintain teeter friction requirement as follows: It must be possible to manually cone each blade without teetering the hub when blades are held up off the droop stops and lifted at tip.

## 26-32 Adjusting Hinge Friction

### **A. Teeter Hinge Friction Adjustment**

1. Remove main rotor blades per § 26-10.
2. Refer to Figure 26-5 and Table 26-1. Remove cotter pin, nut, thrust washer, and nut-side A117 shims. Adjust teeter hinge friction by changing nut-side shim stack thickness in small increments; reducing shim stack thickness increases friction, increasing shim stack thickness reduces friction. Install shims, thrust washer, and nut.
3. Refer to Figure 26-9. While torquing teeter hinge bolt per § 23-33, check teeter hinge friction frequently. To check friction, install MT354 teeter friction tool into coning hinge bearings on one side of main rotor hub and measure moving force (not breakaway force) required to teeter main rotor hub with a spring scale. Teeter friction must be less than 15 ft-lb.
4. Install a new bolt and nut per § 26-20.

### **B. Coning Hinge Friction Adjustment**

1. Refer to Figure 26-6 and Table 26-1. Remove cotter pin, nut, thrust washer, and cone blade to remove nut-side journal.
  - a. B370-1 Hub: Adjust coning hinge friction by changing trailing-edge shim stack thickness in small increments; reducing shim stack thickness increases friction, increasing shim stack thickness reduces friction. Coning hinge friction is zero when there is a measurable axial gap per Figure 26-8. Install shims, thrust washer, and nut.
  - b. A154-1 Hub: Adjust coning hinge friction by changing trailing-edge journal length in small increments; using a shorter journal increases friction, using a longer journal reduces friction. Coning hinge friction is zero when there is a measurable axial gap per Figure 26-8. Install journal, thrust washer, and nut.
2. Install a new bolt and nut per § 26-20, steps 5 thru 7. Repeat steps for opposite blade.
3. Check coning hinge friction by lifting blades until spindle tusks clear droop stops. Hold one blade level and cone opposite blade. Rotor hub must not teeter as blade is coned. Repeat check on opposite blade.
4. Using a feeler gage, measure gap between thrust washers and bearing faces at coning hinge bolt head and nut. Verify 0.002-0.006 inch total gap per hinge.
5. Drill nut and bolt per § 26-34. Install a new cotter pin wet with approved primer (chromate primer preferred; refer to § 23-75).

### 26-33 Shifting the Main Rotor Hub

1. Remove cotter pin, nut, thrust washer, and nut-side A117 shims.
2. Have two people cone the main rotor blades. Push out teeter hinge bolt with another bolt.
3. Move or exchange existing shims from one side of hub to the other as indicated by main rotor balance chart (refer to § 10.230).
4. Install teeter hinge bolt per § 26-20.

### 26-34 Drilling Installed Main Rotor Hub Bolts

#### NOTE

Protect hub from damage due to chuck contact by wrapping chuck and/or covering hub edge with several layers of tape.

New bolts and nuts must be installed and bolts stretched per § 23-33 prior to drilling.

Using a 0.125-inch diameter Cobalt twist-drill and cutting oil, drill a hole through nut and bolt using an accessible pre-drilled hole in nut. The MT569-1 and MT569-6 (B370-1 hub coning hinge bolts) drill guide assembly will facilitate drilling a perpendicular hole. If a pre-drilled hole is inaccessible, completely loosen nut, slightly rotate bolt to favorable position, then special torque per § 23-33. Protect adjacent area from drilling debris.

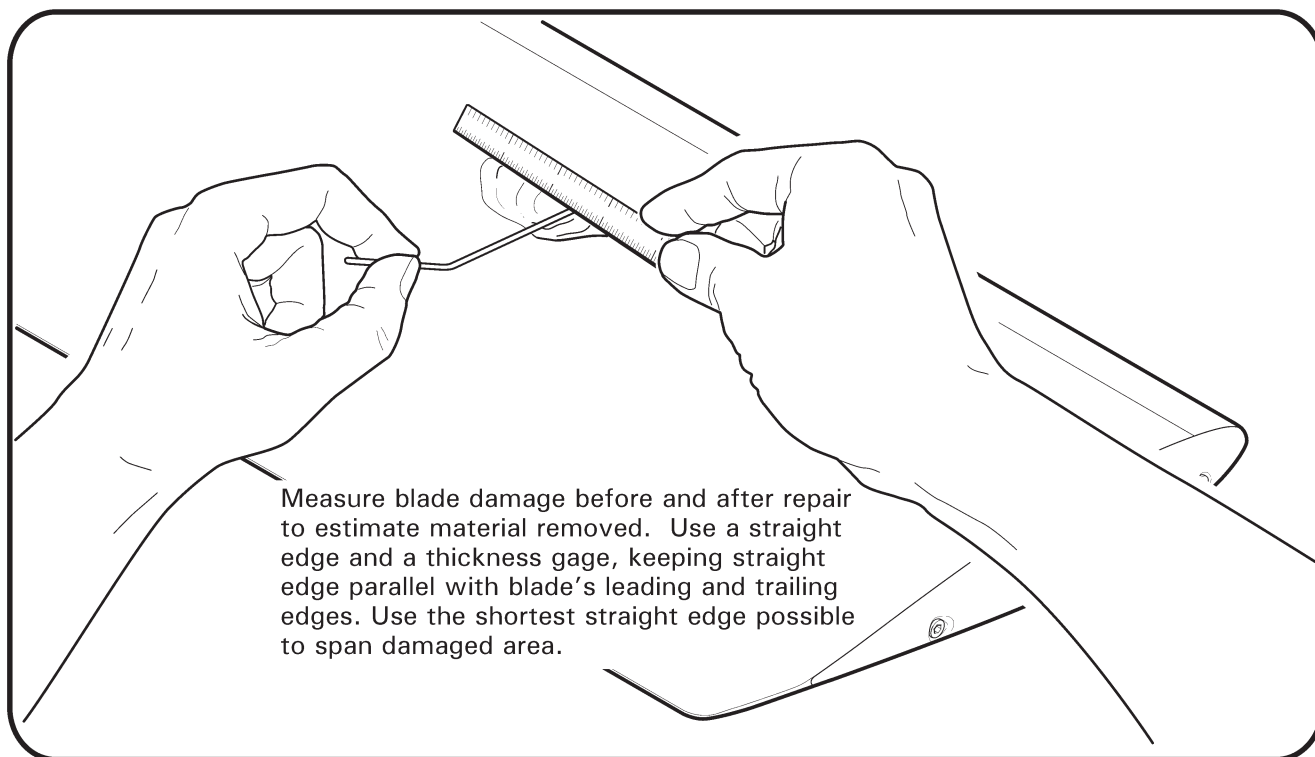


FIGURE 26-10 MEASURING MAIN ROTOR BLADE DAMAGE

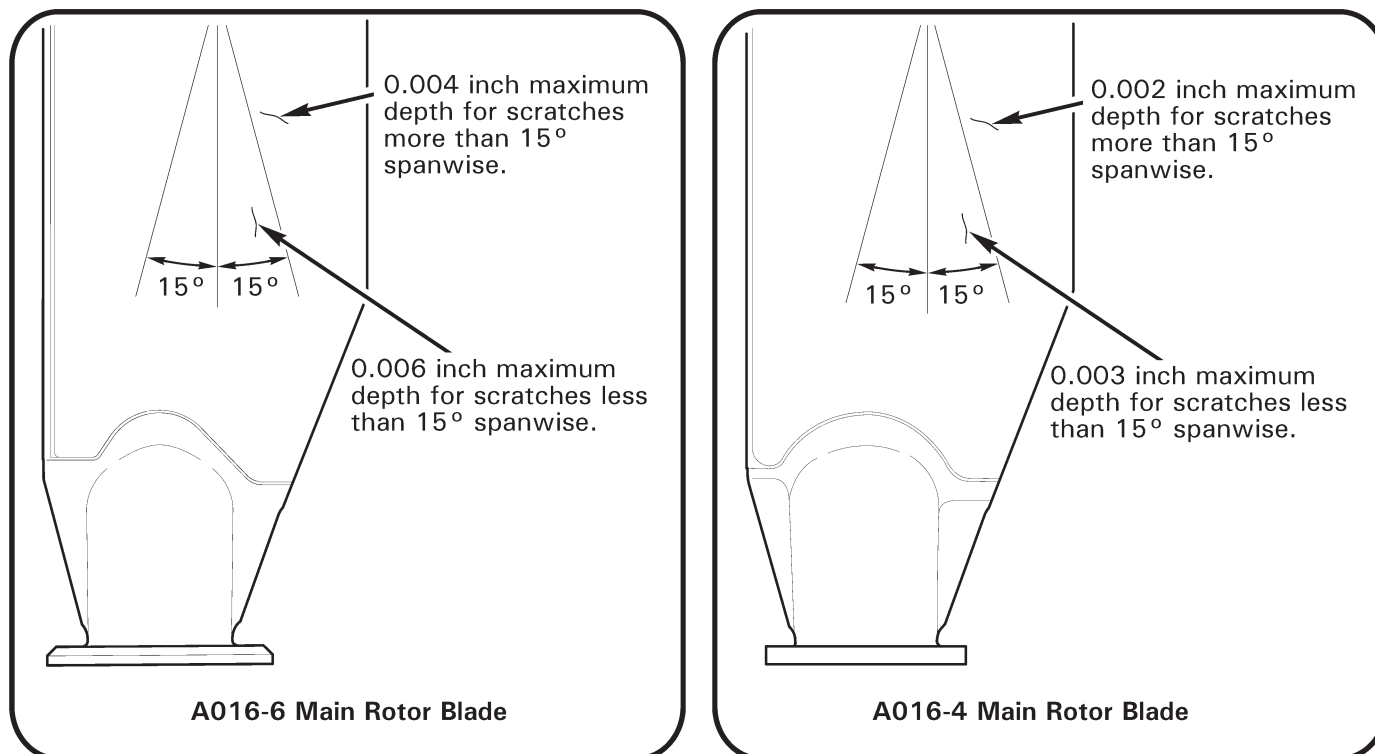


FIGURE 26-11 SCRATCH LIMITS

**26-40 Inspection of Main Rotor Blades****NOTE**

Main rotor blades are 14 CFR § 27.602 critical parts. Notify RHC Technical Support when voids exceeding the limits specified in the instructions below are found, providing blade serial number, helicopter serial number, time in service for the rotor blade, and location and size of the voids that exceed the limits.

**NOTE**

The inspection criteria in this section applies to blade damage that occurs after blade manufacturing (including shipping and handling and time in service). Damage after blade manufacturing usually exhibits paint scuffing, scratches, or freshly-exposed metal in the form of scratches in the finish. If a blade manufacturing irregularity is suspected, contact RHC Technical Support.

**CAUTION**

A blade may be repaired more than one time. However, in no case can more than the maximum material be removed or the maximum dent depth be exceeded in any one location.

**CAUTION**

Any blade that encounters inspection-penetrant (dye or fluorescent) of a blade bond joint is scrap.

**A. Measuring Damage**

1. Refer to Figure 26-10. Measure blade damage using a straight edge and a thickness gage. Keep straight edge parallel with the leading and trailing edges.
2. If blades are installed on the helicopter, measure damage using the shortest straight edge possible to span damaged area. Using a straight edge of excessive length will cause a false reading due to natural droop of the blade.

**B. Measuring Material Removed After Repair**

1. Use calipers or micrometers and compare measurements before and after repair to estimate amount of material removed.
2. Use a straight edge and thickness gage to measure repaired areas less than 2 inches across in the blade skins and spar.

26-41 Scratches and Corrosion on Blade Skins and Doublers

1. Refer to Figure 26-11. Damage may not exceed the following limits after rework:

**A016-6 Blades:**

- a. 0.004 inch maximum depth for scratches more than 15° from spanwise axis.
- b. 0.006 inch maximum depth for scratches less than 15° from spanwise axis.
- c. 0.012 inch maximum corrosion between RS 127.0 and RS 151.1.
- d. 0.008 inch maximum corrosion between RS 75.5 and RS 127.0.
- e. 0.006 inch maximum corrosion between RS 21.0 and RS 75.5.
- f. 0.010 inch maximum corrosion between RS 10.4 and RS 21.0.

**A016-4 Blades:**

- a. 0.002 inch maximum depth for scratches more than 15° spanwise.
  - b. 0.003 inch maximum depth for scratches less than 15° spanwise.
2. Refer to § 26-50 for repair procedures for damage within limits. Polish out scratches and corrosion greater than 0.0005 inch deep using a 0.10 inch blend radius.



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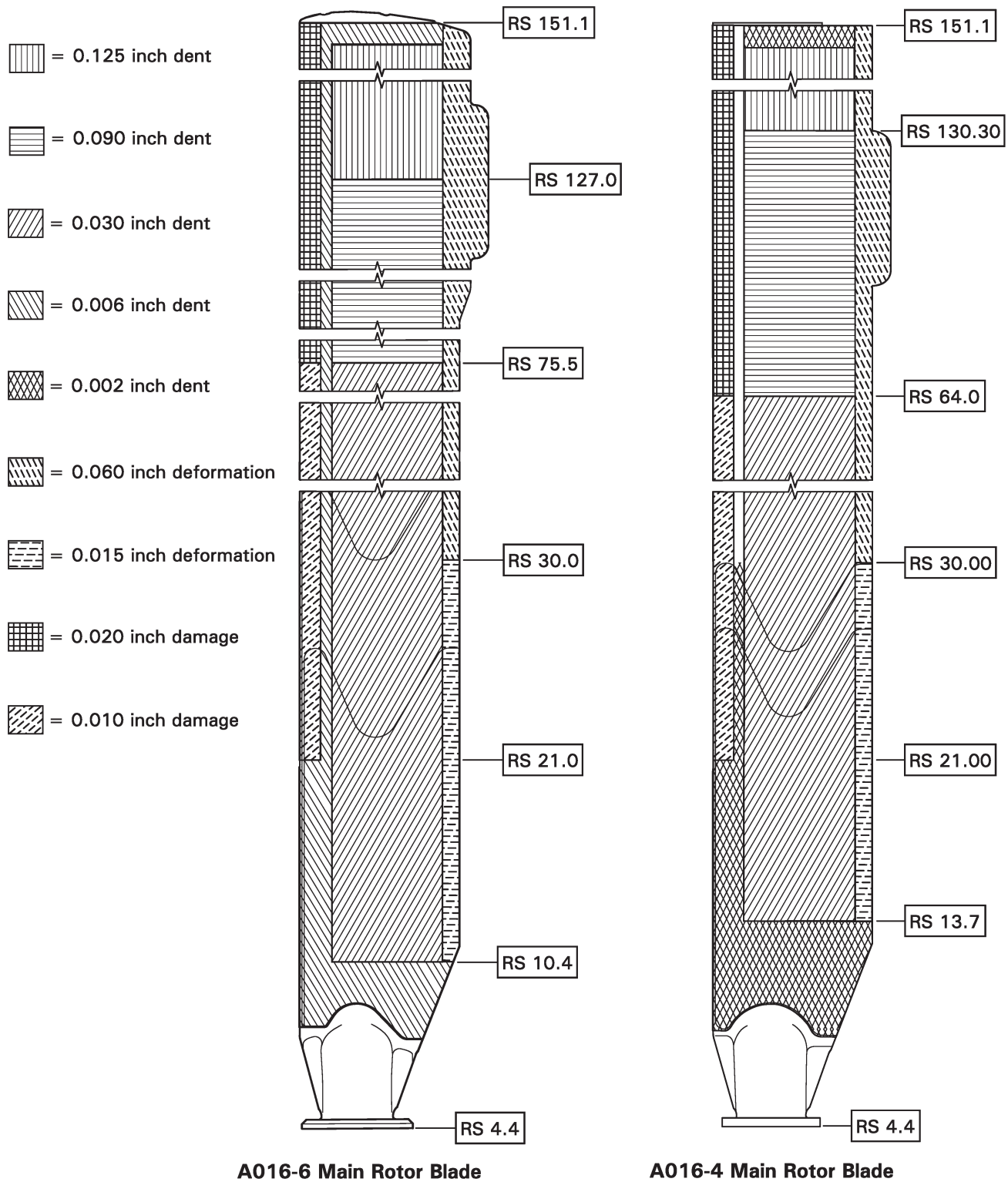


FIGURE 26-12 DENTS AND LOCAL DEFORMATIONS

26-42 Dents**CAUTION**

Tap-test dented areas in honeycomb using an AN970-4 washer or 1965-or-later U.S. quarter dollar coin in good condition. If any voids are found associated with dents, contact RHC Technical Support.

**CAUTION**

Do not repair any dent that has a sharp cut or break in the skin; dent must have 0.060 inch minimum bottom radius. If necessary, locally penetrant inspect, keeping penetrant materials away from bond joints.

1. Refer to Figure 26-12. Damage may not exceed the following limits:

a. Honeycomb:

**A016-6 Blades:**

- i. 0.020 inch maximum bulge on opposite side of blade, opposite dent.
- ii. 0.125 inch maximum depth dent between RS 127.0 and RS 151.1.
- iii. 0.090 inch maximum depth dent between RS 75.5 and RS 127.0.
- iv. 0.030 inch maximum depth dent between RS 10.4 and RS 75.5.

**A016-4 Blades:**

- i. 0.020 inch maximum bulge on opposite side of blade, opposite dent.
- ii. 0.125 inch maximum depth dent between RS 130.30 and RS 151.1.
- iii. 0.090 inch maximum depth dent between RS 64.00 and RS 130.30.
- iv. 0.030 inch maximum depth dent between RS 13.7 and RS 64.00.

b. Leading edge of doublers:

**A016-6 Blades:** 0.010 inch maximum depth dent.

c. Supported bond joints:

**A016-6 Blades:** 0.006 inch maximum depth dent.

**A016-4 Blades:** 0.002 inch maximum depth dent, tip cap only; refer to SB-103A. |

d. Local deformations:

**A016-6 Blades:** Within 0.75 inch forward of trailing edge:

- i. 0.060 inch deformation between RS 30.0 and RS 151.0.
- ii. 0.015 inch deformation between RS 10.4 and RS 30.0.

**A016-4 Blades:** Within 0.75 inch forward of trailing edge:

- i. 0.060 inch deformation between RS 30.00 and RS 151.00.
- ii. 0.015 inch deformation between RS 13.70 and RS 30.00.

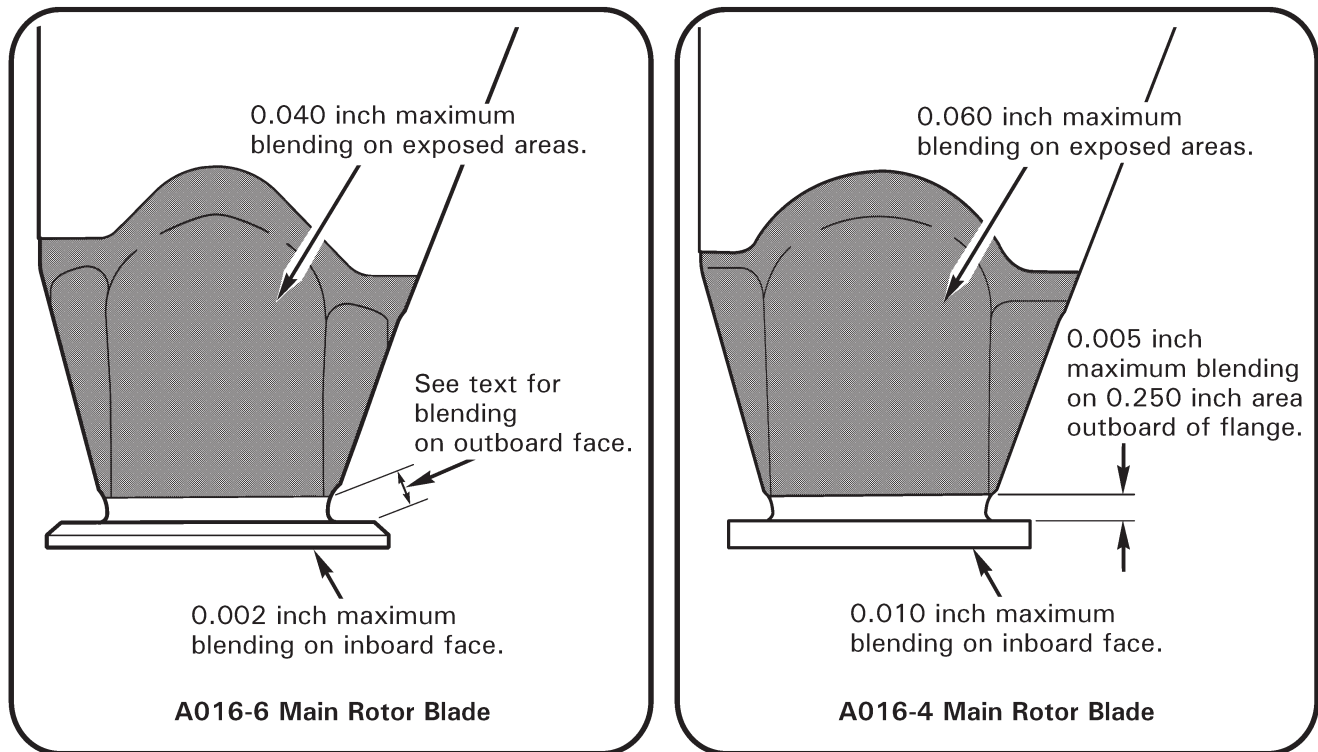


FIGURE 26-13 ROOT FITTING BLEND LIMITS

#### 26-42 Dents (continued)

1. e. Spar: Refer to step 2. Blend damaged areas by hand with a minimum 1.0 inch blend radius. Blending is not allowed within 0.010 inch of spar groove leading edge.

##### **A016-6 Blades:**

- i. 0.020 inch maximum depth damage between RS 75.5 and RS 151.0.
- ii. 0.010 inch maximum depth damage between RS 21.0 and RS 75.5.

##### **A016-4 Blades:**

- i. 0.020 inch maximum depth damage between RS 64.0 and RS 151.0.
- ii. 0.010 inch maximum depth damage between RS 21.00 and RS 64.00.

2. Refer to § 26-50 for repair procedures for damage within limits. Smooth, round bottom dents with 0.060 inch minimum radius may be filled and faired to an aerodynamic shape.

26-43 Root Fitting Damage

1. Refer to Figure 26-13. Damage may not exceed the following limits:

**A016-6 Blades:**

Refer to step 2. Blend damaged areas by hand with a minimum 0.030 inch blend radius.

- a. 0.002 inch maximum depth blending on flange inboard face.
- b. 0.005 inch maximum depth, 0.250 inch maximum diameter blending on flange outboard machined face (3 blends maximum). 0.10 inch minimum distance from hole edges.
- c. 0.040 inch maximum depth blending on exposed areas of root fitting.

**A016-4 Blades:**

Refer to step 2. Blend damaged areas by hand with a minimum 0.10 inch blend radius.

- a. 0.010 inch maximum depth blending on flange inboard face.
- b. 0.005 inch maximum depth blending on 0.250 inch area outboard of flange.
- c. 0.060 inch maximum depth blending on exposed areas of root fitting.

2. Refer to § 26-50 for repair procedures for damage within limits.

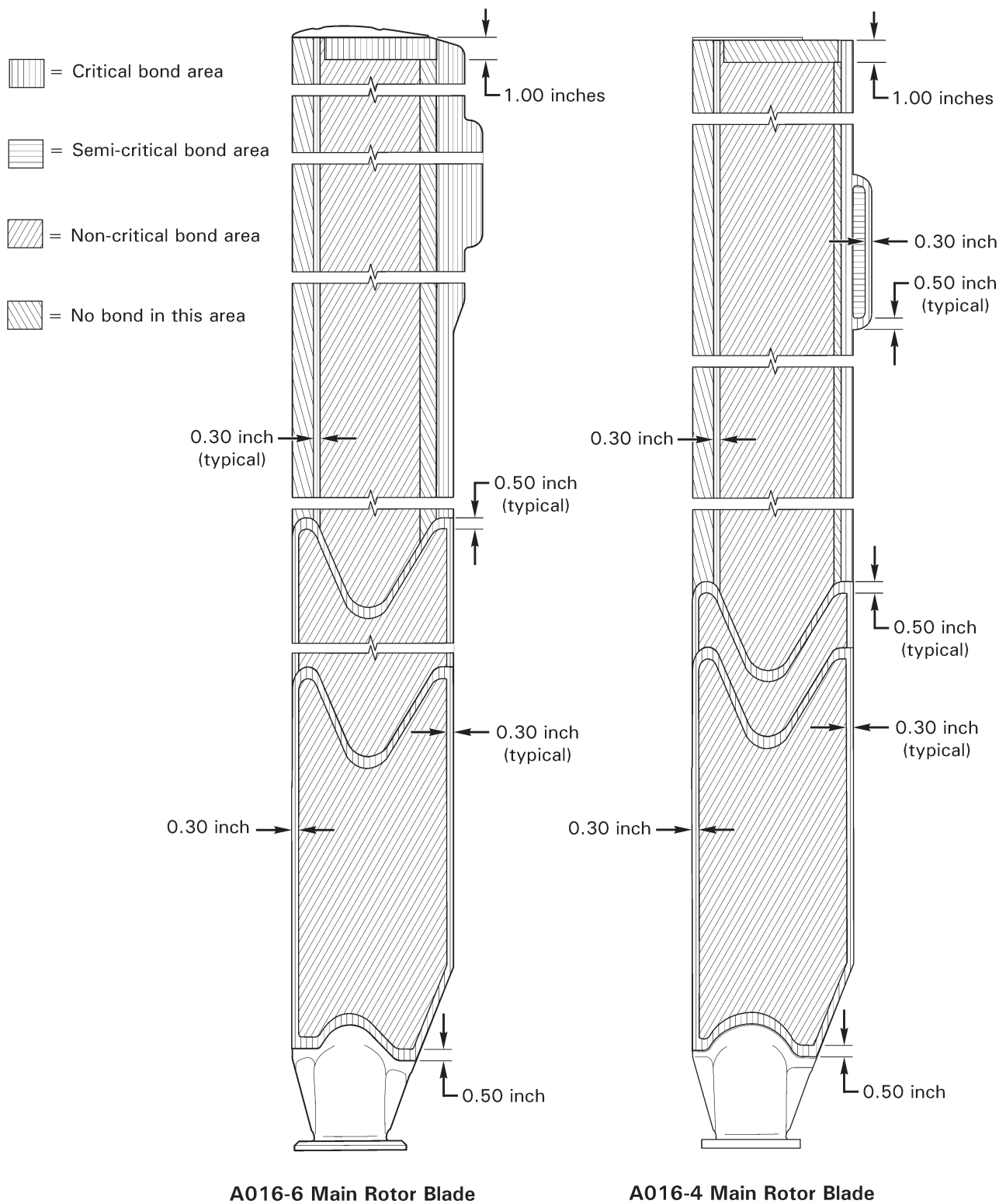


FIGURE 26-14 BOND AREAS

26-44 Voids**WARNING**

Voids or debonds in rotor blades are not field repairable. Notify RHC Technical Support when voids exceeding the limits specified in the instructions below are found, providing blade serial number, helicopter serial number, time in service for the rotor blade, and location and size of the voids that exceed the limits.

**CAUTION**

Tap-test voids and debonds in blades using an AN970-4 washer or 1965-or-later U.S. quarter dollar coin in good condition.

**A. Critical Bond Areas**

Refer to Figure 26-14. Critical bond areas are areas less than 0.50 inch spanwise and less than 0.30 inch chordwise from the edge of any structural bond joint.

Bond areas not defined as semi-critical or non-critical are considered critical.

Voids separated by less than 0.25 inch are considered continuous.

1. Damage may not exceed the following limits:

- a. 0.10 square inch maximum void.
- b. Area must be at least 90% bonded.

**B. Semi-Critical Bond Areas****A016-6 Blades:**

A016-6 Blades do not have semi-critical bond areas.

**A016-4 Blades:**

Refer to Figure 26-14. Semi-critical bond areas are areas more than 0.50 inch spanwise or more than 0.30 inch chordwise from the edge of the trim tab.

Voids separated by less than 0.25 inch are considered continuous.

1. Damage may not exceed the following limits:

- a. 0.80 inch diameter circle maximum void.
- b. 0.90 square inch maximum void.
- c. 0.10 square inch maximum of a void extending into a critical bond area.
- d. Area must be at least 80% bonded.

26-44 Voids (continued)**C. Non-Critical Bond Areas**

Refer to Figure 26-14. Non-critical bond areas are areas more than 0.50 inch spanwise or more than 0.30 inch chordwise from B440 cap (A016-4 blades), from doubler edges, and from bonded areas between skin and honeycomb.

**A016-6 Blades:**

1. Voids in doubler bond joints separated by less than 0.25 inch are considered continuous. Damage in doubler bond joints may not exceed the following limits:
  - a. Area must be at least 80% bonded.
  - b. 5.0 square inches, 1.0 inch chordwise, & 6.0 inches spanwise max. void.
  - c. 0.10 square inch maximum of a void extending into a critical bond area.
  - d. Voids are permissible within 0.30 inch of doubler leading edge where it wraps around spar and root fitting.
2. Voids in honeycomb bond joints separated by less than 0.50 inch spanwise or 1.0 inch chordwise are considered continuous. Damage in honeycomb bond joints may not exceed the following limits:
  - a. Area must be at least 80% bonded.
  - b. 8.0 square inches, 1.0 inches chordwise, & 20.0 inches spanwise maximum void inboard of RS 92.0.
  - c. 14.0 square inches, 2.0 inches chordwise, & 20.0 inches spanwise maximum void outboard of RS 92.0.

**A016-4 Blades:**

1. Voids in A934 doubler bond joints may not exceed the following limits:
  - a. 5.0 square inches, 1.10 inches chordwise & 6.0 spanwise max. void.
  - b. 0.10 square inch maximum void extending into a critical bond area.
  - c. 2.0 inches maximum void from outboard tips (refer to R22 SL-55).
2. Voids in honeycomb bond joints inboard of RS 106.0 may not exceed 8.00 square inches, 1.00 inches chordwise, & 20.00 inches spanwise maximum.
3. Voids in honeycomb bond joints outboard of RS 106.0 may not exceed 14.00 square inches, 2.00 inches chordwise, & 20.00 inches spanwise maximum.
4. Voids in honeycomb bond joints between RS 120.0 and RS 133.5, and between RS 150.0 and 166.0, must be at least 1.0 inch forward of honeycomb trailing edge and the skin over void may not move when trim tabs are flexed.
5. Voids in A934 doubler bond joints separated by less than 0.25 inch, less than 0.50 inch spanwise, or less than 1.0 inch chordwise are considered continuous. Area must be at least 80% bonded.



26-50 Repair of Main Rotor Blades**WARNING**

**Unauthorized repairs to rotor blades have caused fatal crashes.**

**CAUTION**

Do NOT use power tools, chemical paint strippers, or chemical corrosion removers to repair main rotor blades.

**NOTE**

Refer to § 23-70 for approved materials.

1. Measure damage per § 26-40.
2. Remove damage at trailing edges, trim tab edges, tip cap, and/or tip corner by trimming per § 26-51 as required.
3. Polish out damage using 220 grit or finer wet-or-dry aluminum-oxide abrasive paper, and finish with 320 grit or finer wet-or-dry abrasive paper. A fine-toothed file may be used along the spar and trailing edge, provided the area is finished with 320 grit or finer wet-or-dry abrasive paper. Sand or file in spanwise direction. Remove only the material necessary to remove the damage and blend to the radius or dimension specified. Maintain squareness of trailing edge per Figure 26-16. Visually inspect and verify damage is removed.
4. Measure material removed per § 26-40. Verify repair does not exceed limit specified.
5. Seal or fill as required per the following:
  - a. Clean area to be sealed or filled using approved solvent (refer to § 23-70).
  - b. Apply approved primer (chromate primer preferred; refer to § 23-75) to bond joints with pin holes or other openings. Mix primer per manufacturer's instructions. Allow a minimum of 24 hours cure time.
  - c. Using 220-grit or finer wet-or-dry aluminum-oxide or silicon-carbide abrasive paper, hand-sand cured adhesive in spanwise direction to a smooth, aerodynamic finish, congruent with the blade airfoil. Do not remove metal.
  - d. Hand-sand surrounding painted surface until 25% primer remains. Keep bare metal to a minimum.
6. Paint per § 26-52 as required.
7. Track and balance main rotor per § 10.230 as required.

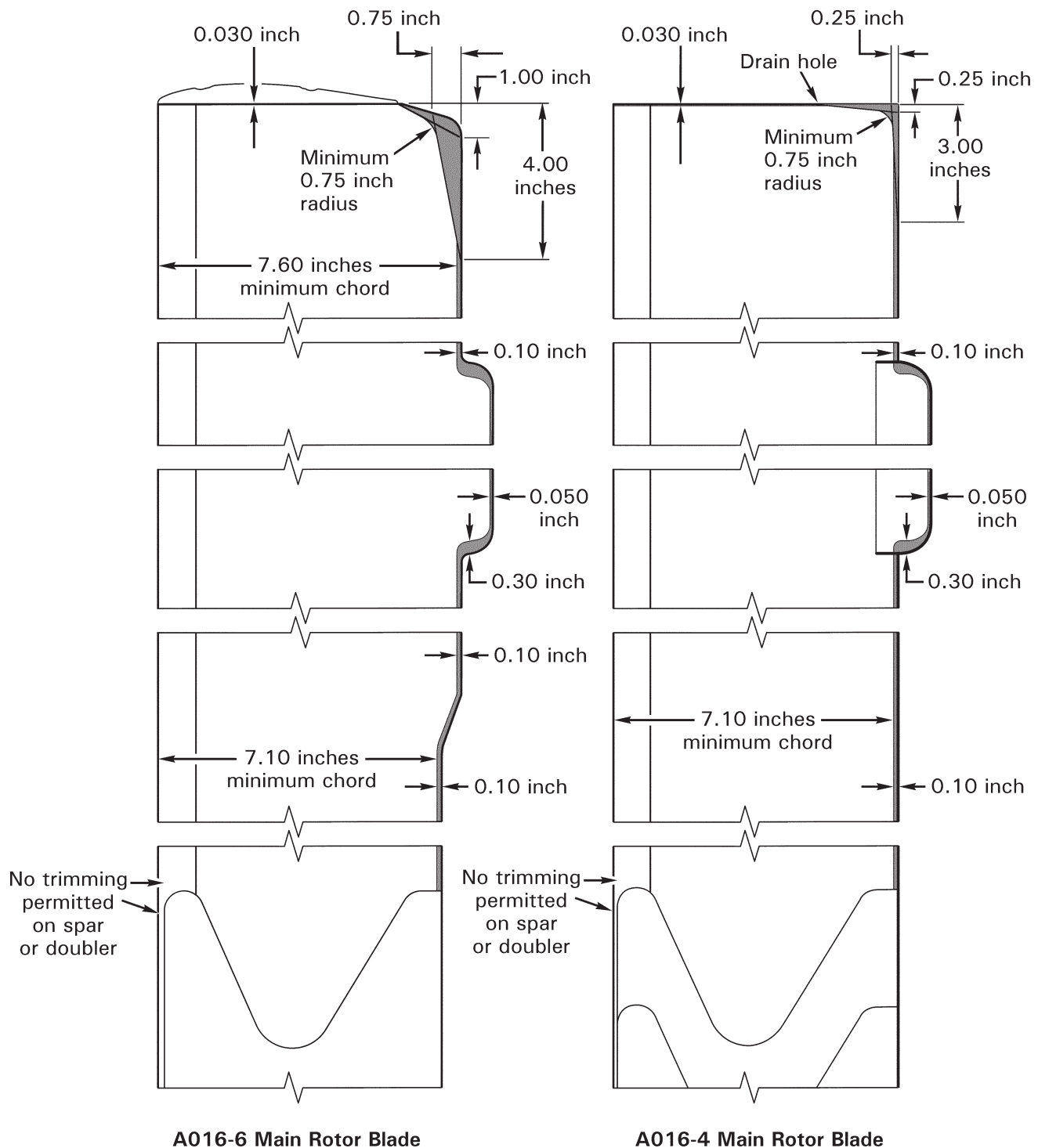


FIGURE 26-15 TRIM LIMITS

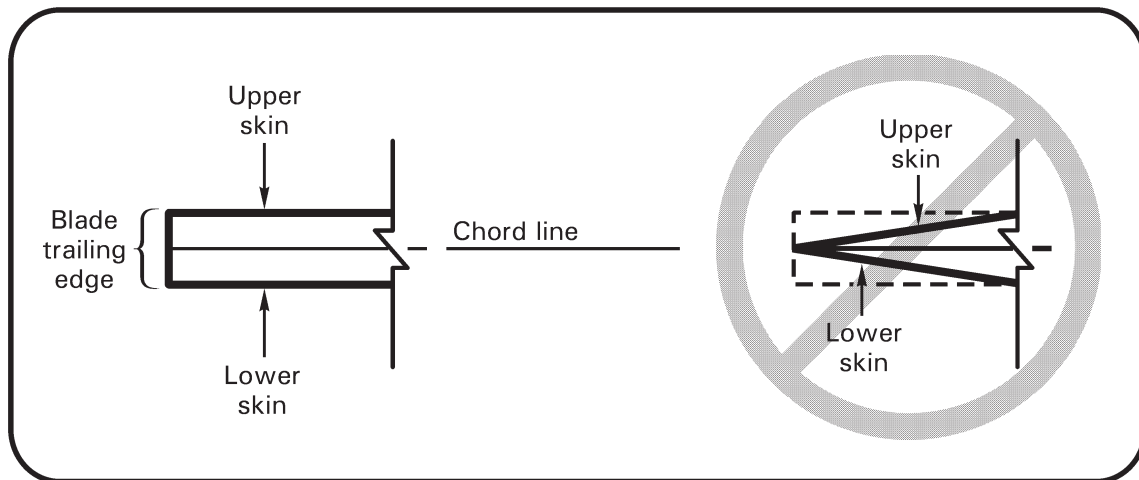


FIGURE 26-16 SANDING/FILING SKIN EDGES SQUARE

### 26-51 Trimming

Refer to Figures 26-15 & 26-16. Trimming may be performed on the trailing edge of main rotor blade skins and trim tab edges within limits shown. (Alternately, a trailing edge nick or notch may be blended out 1.0 inch minimum spanwise, each side of nick or notch within limits shown.) Trimming is not permitted on spar or doublers.

Tip cap and tip corner may be trimmed within limits shown.

Finish repair per § 26-50 steps 2 thru 7. File trailing edge or trim tab edges square with skins (do not file into a point). Verify minimum chord dimension.

### 26-52 Painting

Refer to § 23-70 for approved materials. Refer to paint manufacturer's recommendations.

#### CAUTION

If force-drying paint, do not exceed 175° F surface temperature on blade; monitor blade temperature.

1. Remove main rotor blade tip cover(s) as required. Clean the blade(s).
2. Feather edge of paint bordering bare metal by hand-sanding spanwise with 220-grit or finer wet-or-dry aluminum-oxide abrasive paper. Do not remove metal.
3. Mask area to prevent overspray contamination.
4. Clean bare metal to be painted with a lint-free cloth dampened with an approved solvent (ref. § 23-70).
5. Prime bare metal, including bare metal under tip cover(s) as required, with at least two coats approved primer (chromate primer preferred; refer to § 23-75). Scuff first coat of primer with 320-grit abrasive paper (or very fine Scotch-Brite), and wipe down with a lint-free cloth dampened with an approved solvent (ref. § 23-70) prior to applying second coat.

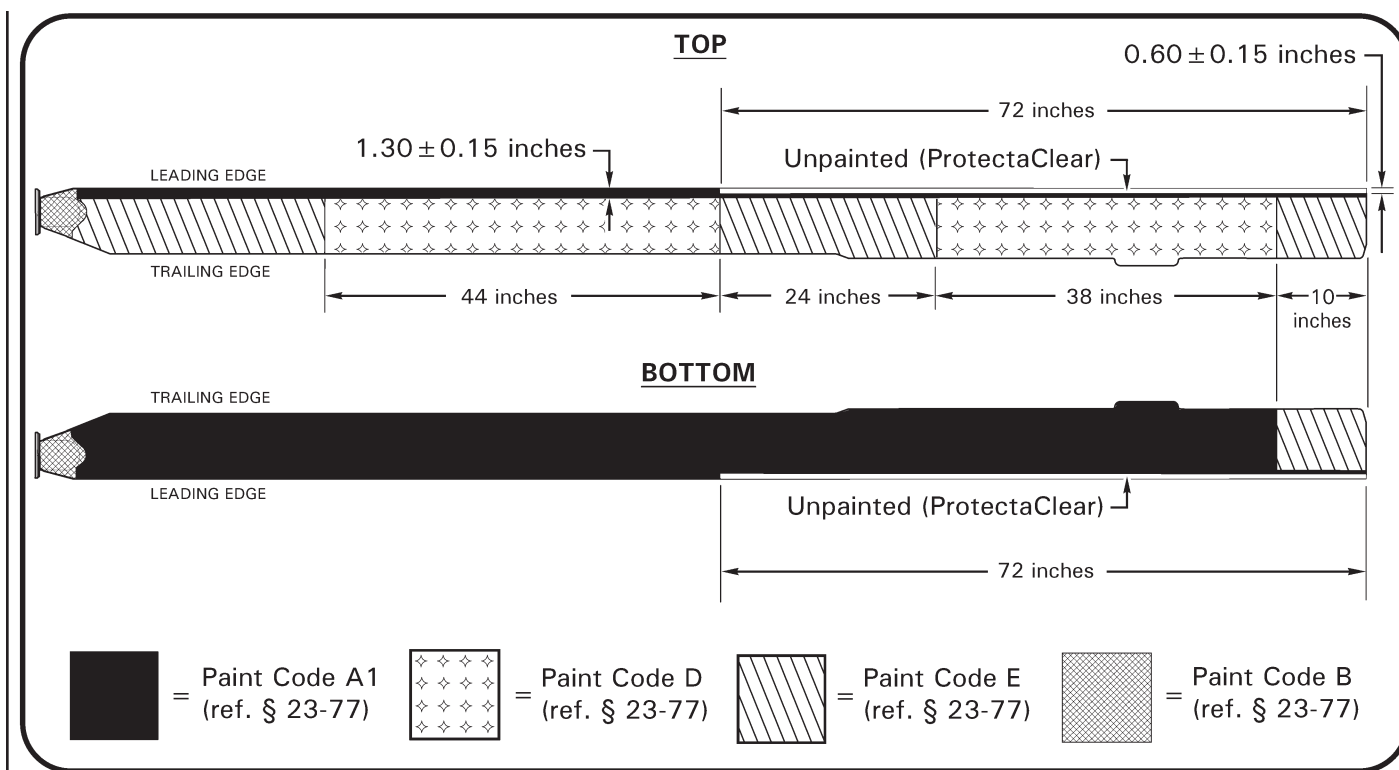


FIGURE 26-17 MAIN ROTOR BLADE PAINT SCHEME (A016-6 BLADE SHOWN)

#### 26-52 Painting (continued)

6. Refer to Figure 26-17. Apply dark gray (root), flat black, white, and/or yellow polyurethane enamel, as required, to primed area in accordance with paint manufacturer's recommendations.

#### NOTE

Allow Imron paint to cure at least 72 hours before flying in erosive conditions (such as drizzle, rain, or dust).

7. Remove masking materials.
8. Using 320-grit or finer aluminum-oxide abrasive paper, feather spanwise leading edges (upper & lower) of paint by hand as required.
9. Install blade tip cover(s), if removed.

26-53 Leading Edge Care**NOTE**

Blades with painted outboard leading edge may be paint-stripped per Part C to match new-blade paint scheme, if desired.

**A. Unpainted Leading Edge**

1. Remove any oxidation from unpainted leading edges using maroon-colored Scotch-Brite™ pad (3M General Purpose Hand Pad 7447).
2. Clean surface to be coated using mild soap and water (acetone may be used as necessary; do not use MEK or alcohol). Water-rinse immediately and allow to dry.
3. Wearing a nitrile glove, apply a coat of ProtectaClear using lint-free cloth and allow to dry (approximately one hour).
4. A second coat may be applied for additional protection.

**B. Painted Leading Edge**

Refer to Figure 26-17. Outboard leading edge may be paint-stripped per Part C or repainted per § 26-52. Repaint inboard leading edge per § 26-52 if required.

**C. Leading Edge Refinishing****CAUTION**

Do NOT use power tools or chemical paint strippers to remove blade paint.

1. Remove main rotor blade tip cover(s). Clean the blade(s).
2. Using a felt-tip marker, draw a straight line on blade upper and lower surfaces 0.65-inch aft of leading edge from blade-tip to 72 inches inboard of blade-tip.
3. Support blade while sanding to avoid pushing blade down. Hand-sand marked area with 220-grit or finer wet-or-dry aluminum-oxide abrasive paper. Remove paint without removing metal and feather paint edge.
4. Clean stripped-surface to be painted with a lint-free cloth dampened with an approved solvent (ref. § 23-70).
5. Refer to Figure 26-17. Using 3M vinyl tape (or equivalent), apply masking to blade(s). Protect blade(s) and helicopter from overspray contamination.
6. Wipe bare metal using PreKote wipes (or equivalent adhesion promoter) and allow to air dry.
7. Apply light coat of approved primer (chromate primer preferred; refer to § 23-75).

26-53 Leading Edge Care (continued)**C. Leading Edge Refinishing (continued)**

8. Apply black paint (ref. § 23-77), as required.
9. Remove masking materials.
10. Using 320-grit or finer aluminum-oxide abrasive paper, feather spanwise leading edges (upper & lower) of paint by hand as required.
11. Wipe bare metal leading edge using PreKote wipes (or equivalent adhesion promoter) and allow to air dry.
12. Wearing nitrile glove, apply a coat of ProtectaClear using lint-free cloth and allow to dry (approximately one hour).
13. A second coat may be applied for additional protection.
14. Install main rotor blade tip cover(s).

26-60 Main Rotor Blade Tip Maintenance

After removing rounded tip covers, use 10X magnification when visually inspecting blade tip to verify no loose or blistered paint, white-powder corrosion products, or pitting of skins aft of skin-to-spar bond lines (upper & lower). If bare metal (other than spar leading edge) or corrosion is detected, proceed as follows:

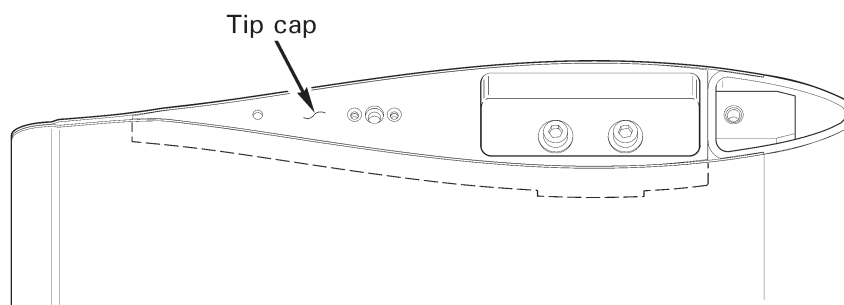
**WARNING**

**Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.**

**CAUTION**

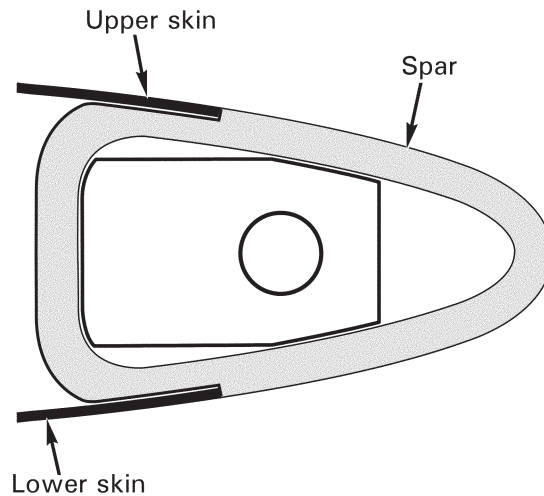
**Do NOT use power tools or chemical paint strippers to remove blade paint.**

1. Remove any corrosion and loose paint on tip cap and outboard edges of blade skins by hand-sanding vertical surface in a chordwise direction; use a hard, flat block with 220-grit aluminum-oxide abrasive paper, then finish sand with 320-grit aluminum-oxide abrasive paper. Remove only material necessary to eliminate corrosion.



26-60 Main Rotor Blade Tip Maintenance (continued)

2. Remove any corrosion and loose paint from skins on upper or lower surface of blade, aft of skin-to-spar bond joint, by hand-sanding in a spanwise direction using 220-grit aluminum-oxide abrasive paper and minimum 0.1 inch blend radius; finish sand with 320-grit aluminum-oxide abrasive paper. Remove only material necessary to eliminate corrosion.



3. Clean bare metal area with lint-free cloth dampened with an approved solvent (ref. § 23-70) and allow to dry.
4. Seal exposed bond joints, including bond joints on vertical surfaces, with smooth layer of B270-1 sealant (poly-sulfide, refer to § 23-79) and allow to cure.
5. Prime remaining exposed metal with two coats of epoxy primer (chromated epoxy preferred).
6. Apply yellow paint topcoat within 2–48 hours of primer application. For best performance, allow paint to cure 48 hours before flight.
7. Install screws, wet with A257-9 anti-seize, securing tip covers. Special torque screws per § 23-33; ensure cover edges are flush with blade profile.

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**CHAPTER 27**

**MAIN ROTOR DRIVE SYSTEM**

<u>Section</u>	<u>Title</u>	<u>Page</u>
27-00	Description . . . . .	27.1

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**CHAPTER 27****MAIN ROTOR DRIVE SYSTEM**27-00 Description

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## CHAPTER 28

## TAIL ROTOR

<u>Section</u>	<u>Title</u>	<u>Page</u>
28-00	Description . . . . .	28.1
28-10	Tail Rotor Assembly . . . . .	28.1
28-11	Static Balance . . . . .	28.5
28-20	Tail Rotor Blades . . . . .	28.7
28-30	Tail Rotor Blade Inspection and Repair . . . . .	28.9
28-31	Scratches and Corrosion . . . . .	28.9
28-32	Dents . . . . .	28.10
28-33	Erosion . . . . .	28.11
28-34	Root Fitting Damage . . . . .	28.11
28-35	Nicks and Notches . . . . .	28.12
28-36	Blade Refinishing . . . . .	28.12
28-37	Painting . . . . .	28.13
28-38	Tail Rotor Blade Condition and Care . . . . .	28.15
28-40	Tail Rotor Hub . . . . .	28.19
28-41	Bearing Replacement . . . . .	28.19
28-42	Inspection . . . . .	28.19

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## CHAPTER 28

## TAIL ROTOR

28-00 Description

The tail rotor has two all-metal blades and a teetering hub with a fixed coning angle. The pitch change bearings in the tail rotor blade root have self-lubricated liners. The hub teeter hinge bearings are elastomeric. The tail rotor blades are constructed with aluminum skins and forged root fittings. Maintaining the paint finish will reduce corrosion and erosion.

28-10 Tail Rotor Assembly**A. Removal**

1. Refer to Figure 28-1. Tag each pitch link with corresponding blade serial number. Disconnect pitch links from tail rotor blades; keep associated hardware with each link.

**NOTE**

Tail rotor pitch link-to-blade attachment bolts may be different lengths and/or have different washers installed under nut for dynamic balancing.

2. Remove nut and A141-14 washer securing A119-1 bumper to tail rotor gearbox output shaft.
3. Mark hub with teeter hinge bolt orientation for reinstallation. Remove teeter hinge bolt, then slide tail rotor assembly and bumper off of shaft.

**NOTE**

Protect tail rotor assembly from damage when maintenance is performed on workbench.

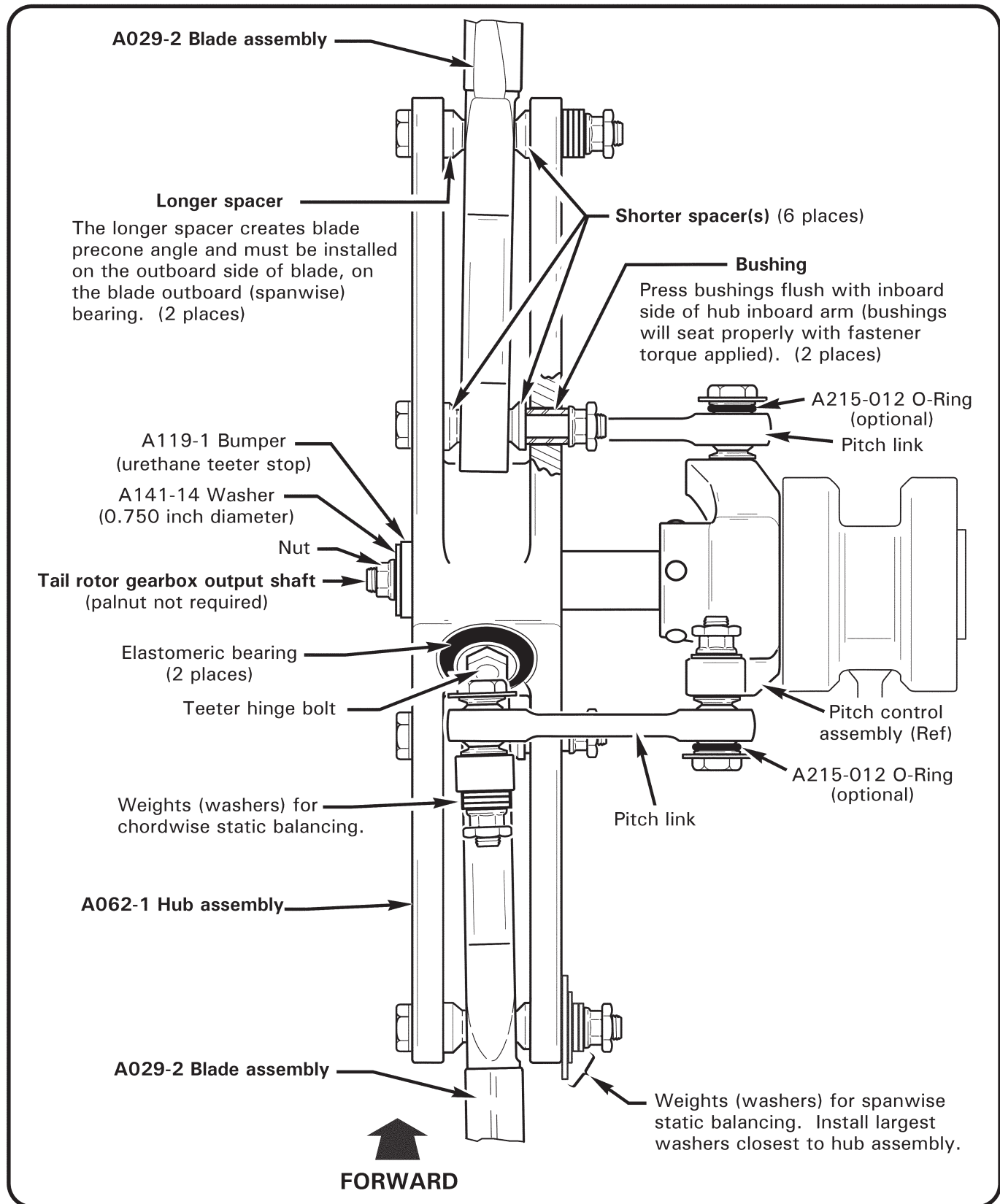


FIGURE 28-1 TAIL ROTOR ASSEMBLY INSTALLATION



28-10 Tail Rotor Assembly (continued)**B. Installation**

1. Perform static balance per § 28-11 if balancing hardware information is unknown, if blades were replaced, or if any rework has changed mass of rotor assembly.
2. Clean tail rotor gearbox output shaft and elastomeric bearing spacer clamping surfaces with mild soap (pH between 7 & 9) and warm water. Water-rinse to remove all soap residue, dry with lint-free cloth.
3. Refer to Figure 28-1. Position tail rotor assembly on tail rotor gearbox output shaft, matching tail rotor blades to corresponding pitch links. Verify tail rotor is installed for counter-clockwise rotation when viewed from left side of aircraft.
4. Install teeter hinge bolt and tighten nut until elastomeric bearing metal spacers contact output shaft, but do not torque. Verify blades cone toward tail rotor gearbox.
5. Remove tags. Install hardware securing tail rotor blades to pitch links as removed, or as determined by static balancing. Standard torque nuts & palnuts per § 23-32, and torque stripe per Figure 2-1.
6. Fabricate a tracking aid using 1x12-inch aluminum sheet; make a 90° bend 2 inches from one end. With tail rotor horizontal, tape tracking aid to tailcone near blade tip.
7. Rotate tail rotor drive shaft and mark tracking aid where each blade tip drain hole passes. Adjust (teeter) tail rotor until both blade tips pass the same point within 0.125 inch. Special torque teeter hinge bolt per § 23-33. Recheck track. Repeat step until blades are tracked.
8. Install palnut on teeter hinge bolt, standard torque per § 23-32, and torque stripe per Figure 2-1. Remove tracking aid.
9. Teeter tail rotor hub back and forth. Verify teeter hinge bolt, bearing metal spacers, washers, and nuts remain stationary when tail rotor is teetered.
10. Install A119-1 bumper, A141-14 washer, and nut. Special torque nut per § 23-33 | and torque stripe per Figure 2-1.
11. Dynamically balance tail rotor per § 10.240.

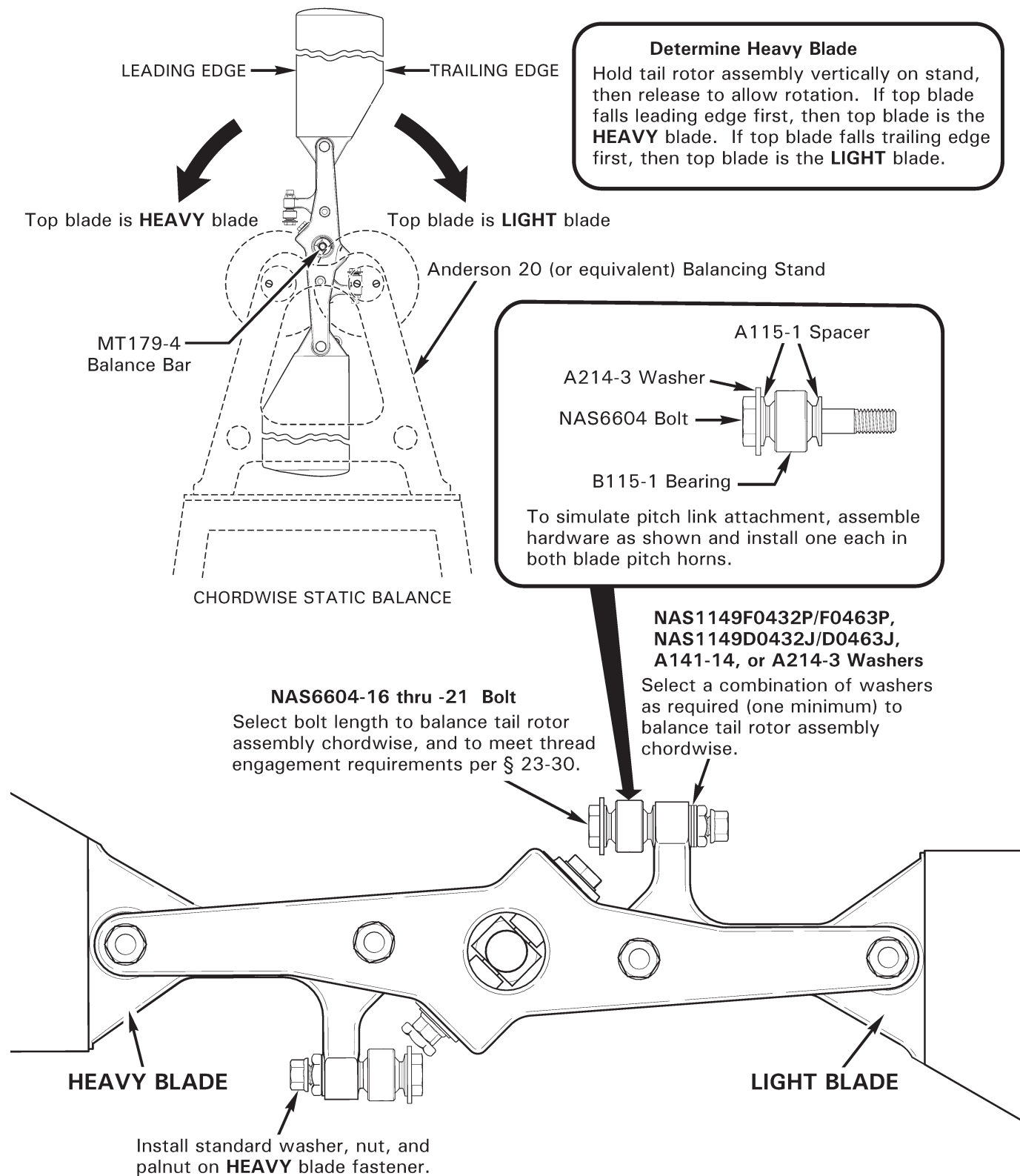


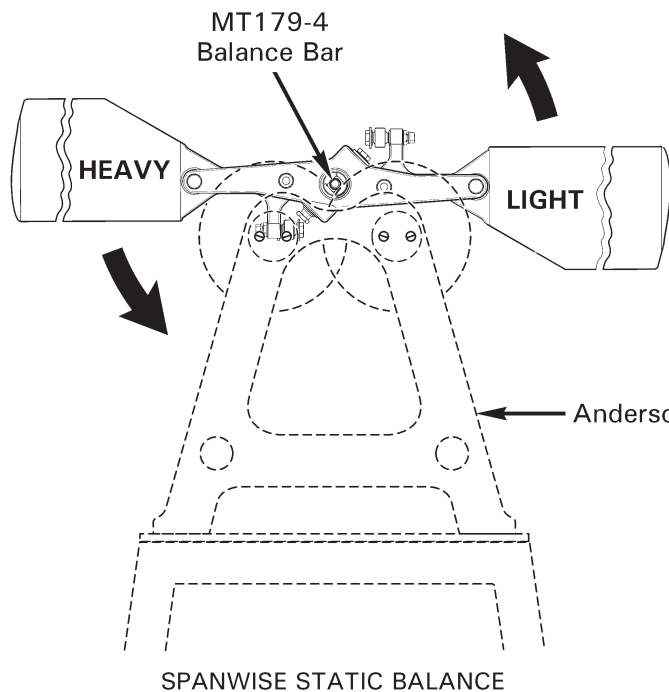
FIGURE 28-2 CHORDWISE STATIC BALANCE

28-11 Static Balance

## NOTE

Tail rotor assemblies received from RHC are static balanced at factory. Perform static balance in calm-air environment.

1. Refer to Figure 28-2. Install MT179-4 balance bar into tail rotor assembly. Install teeter hinge bolt thru smaller hole, install nut and tighten until elastomeric bearing metal spacers contact bar. Using a protractor or square, adjust balance bar until approximately perpendicular to hub. While maintaining perpendicularity, special torque nut per § 23-33; install palnut finger-tight. Mark hub with teeter hinge bolt orientation for reinstallation.
2. Using NAS6604-16 bolts, assemble hardware as shown in blade pitch horns using bearing to simulate pitch link. Install standard washer, palnut, and nut on each bolt hand-tight.
3. Place tail rotor assembly with balance bar on Anderson 20 or equivalent balancing stand. Adjust pitch of both blades so they are similar. Hold tail rotor assembly vertically, then release to allow rotation. If top blade falls leading edge first, then top blade is the heavy blade. If top blade falls trailing edge first, then top blade is the light blade.
4. Chordwise balancing is achieved by varying NAS6604 bolt length and nut-side washers at light blade pitch horn. Select bolt length & washers for balancing, and to meet thread engagement requirements per § 23-30 Part E step 5 and install hand-tight.
5. Repeat steps 3 & 4 until top blade does not fall (or falls very slowly) when tail rotor is positioned vertically on balancing stand. Balance within one thin steel washer.
6. Place tail rotor assembly with balance bar on balancing stand. Hold tail rotor horizontally, then release to allow rotation. The falling blade is the heavy blade; the rising blade is the light blade.
7. Spanwise balancing is achieved by varying nut-side washer mass on light blade's outboard blade-to-hub attach bolt. Four washers are required under nut on outboard blade-to-hub attach bolt; place largest washers closest to hub. Select washers for balancing, standard torque hardware per § 23-32, and repeat step 6.
8. Repeat steps 6 & 7 until tail rotor does not rotate (or rotates very slowly) when positioned horizontally on balancing stand. Balance within one thin aluminum washer.
9. From each blade pitch horn, remove A214-3 washer, two A115-1 spacers, & B115-1 bearing from bolt; install palnut & nut finger-tight to retain bolt and washer(s) in the correct pitch horn.
10. Remove MT179-4 balance bar. Install teeter hinge bolt & washers in hub, and install palnut & nut finger-tight on bolt.
11. As required, touch-up bolt heads using § 23-77 approved paint.



#### Determine Heavy Blade

Hold tail rotor assembly horizontally on stand, then release to allow rotation. The falling blade is the **HEAVY** blade; The rising blade is the **LIGHT** blade.

Install (4) NAS1149D0463J washers under nut of **HEAVY** blade outboard fastener for initial spanwise static balance check.

(4) NAS1149F0432P/F0463P, NAS1149D0432J/D0463J, A141-14, or AN970-4 Washers

Select a combination of four washers to balance tail rotor assembly spanwise. Place largest washers closest to hub assembly.

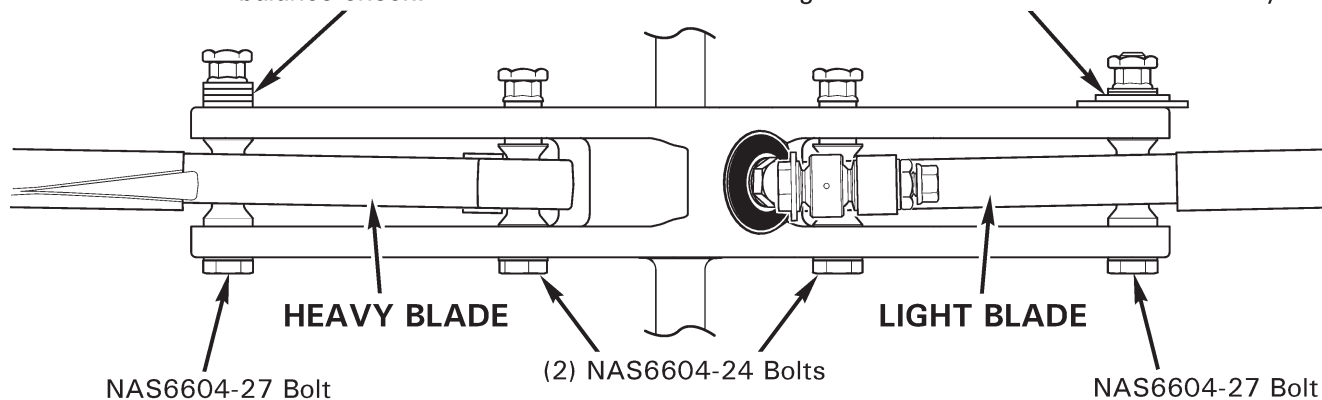


FIGURE 28-3 SPANWISE STATIC BALANCE

## 28-20 Tail Rotor Blades

### **NOTE**

Protect tail rotor assembly from damage when maintenance is performed on workbench.

### **A. Removal**

1. Remove tail rotor assembly per § 28-10.
2. Refer to Figure 28-1. Remove hardware securing A029-2 blade assemblies to A062-1 hub assembly. Remove blades, spacers, and hardware; do not remove A138-1 bushings unless required.

### **B. Installation**

### **CAUTION**

A029 tail rotor blades are a matched set from RHC. If only one blade is being replaced, contact RHC Customer Service with airworthy blade serial number for a matching replacement blade.

1. Refer to Figure 28-1. If removed, apply light coat of approved primer per § 23-75 to outer surface of A138-1 bushings; while primer is wet, press bushings flush with inboard side of hub inboard arm (bushings will seat properly with fastener torque applied).

### **CAUTION**

A137-2 spacer creates blade precone angle and must be installed on the outboard side of blade, on the blade outboard (spanwise) bolt.

2. Install tail rotor blades and spacers in hub. Assemble blades for counter-clockwise rotation when viewed from left side of aircraft, and so blades will cone toward tail rotor gearbox. Install hardware securing blades to hub; standard torque per § 23-32, and torque stripe inboard nuts only.
3. Perform tail rotor assembly static balance per § 28-11.

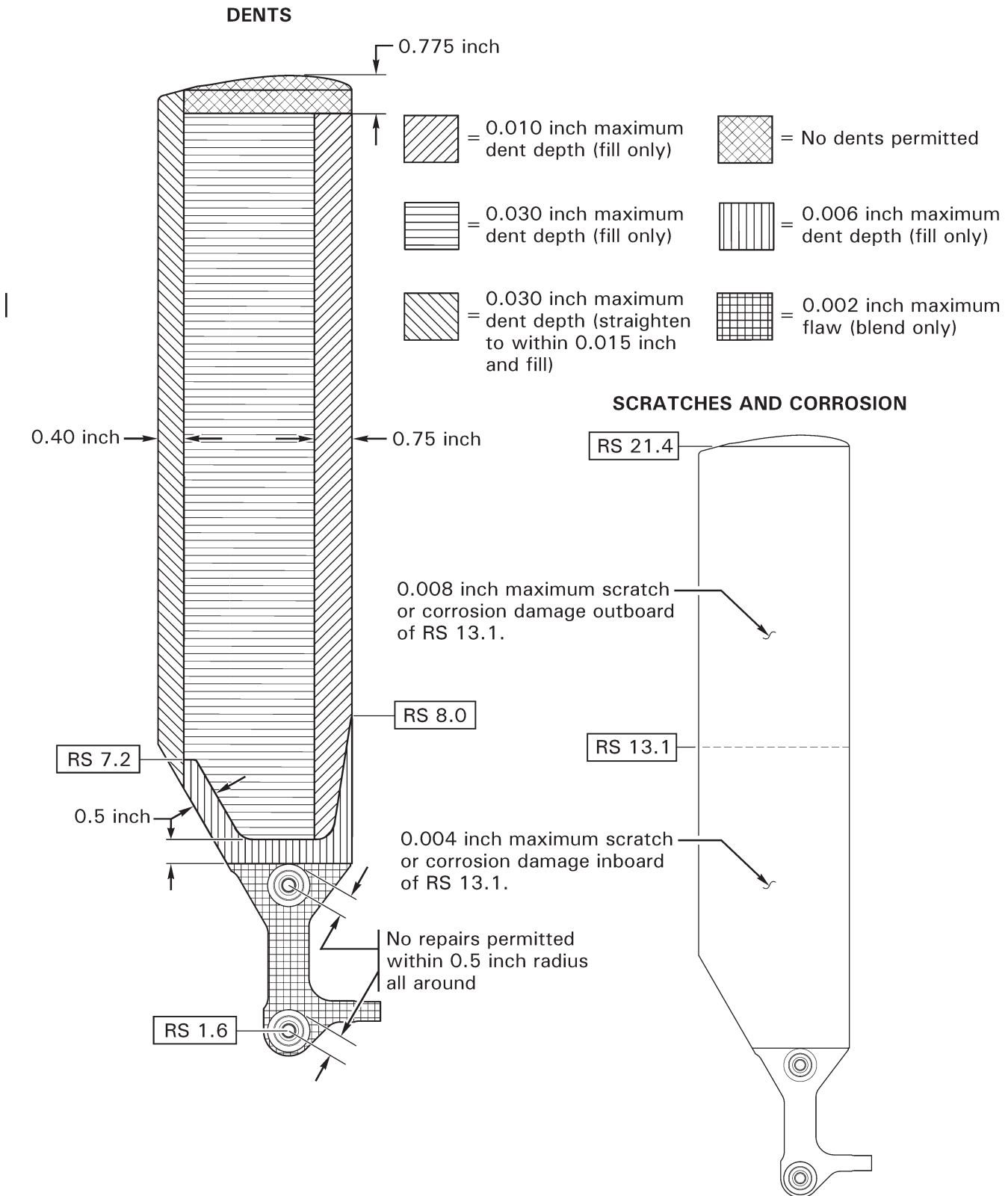


FIGURE 28-4 TAIL ROTOR BLADE INSPECTION CRITERIA

28-30 Tail Rotor Blade Inspection and Repair**WARNING**

**Unauthorized repairs to rotor blades have caused fatal crashes.**

**CAUTION**

Do NOT use power tools, chemical paint strippers, or chemical corrosion removers to repair rotor blades.

This blade repair procedure outlines the repair limits, methods and materials used for repairing tail rotor blades. Repairs are limited to blending out scratches, dents, nicks, removing corrosion, and refinishing the blades. The inspections, repairs and limitations contained herein refer to damage sustained in service, including damage during shipping and handling (manufacturing irregularities are treated separately by the factory). In-service damage will generally exhibit paint scuffing or scratches and often times freshly exposed metal in the form of scratches in the finish. If there are any questions as to the possibility of a manufacturing irregularity, contact RHC Technical Support.

**CAUTION**

A blade may be repaired more than one time. However, in no case can more than the maximum material be removed or the maximum dent depth be exceeded in any one location.

28-31 Scratches and Corrosion**A. Limits**

1. Refer to Figure 28-4. Measure damage in blade skins per § 26-40; verify damage does not exceed the following limits:
  - a. 0.004 inch maximum damage inboard (spanwise) of RS 13.1.
  - b. 0.008 inch maximum damage outboard (spanwise) of RS 13.1.
2. If damage is within limits, repair blade skins per Part B but do not exceed limits.

**B. Repair**

1. Blend out scratches or corrosion on blade skins in spanwise direction with a 0.10 inch blend radius minimum. Use 220-grit or finer wet-or-dry aluminum-oxide abrasive paper, and finish with 320-grit or finer wet-or-dry abrasive paper.
2. Measure material removed per § 26-40; verify repair does not exceed limits per Part A.
3. Refinish blade repairs per § 28-36.

28-32 Dents**CAUTION**

Tap-test dented areas in honeycomb. If any voids are found associated with dents, contact RHC Technical Support.

Tap-test voids, debonds, and dents in blades using an AN970-4 washer or 1965-or-later U.S. quarter-dollar coin in good condition.

**CAUTION**

When dented areas are found, inspect opposite side of the blade for a bulge. Replace blade with a bulge greater than 0.010 inch opposite a dent.

**CAUTION**

Do not repair any dent that has a sharp cut or break in the skin. If necessary, locally fluorescent penetrant inspect, keeping penetrant materials away from bond joints.

**WARNING**

**Any damaged tail rotor blade that cannot be repaired within the limits of this section must be removed from service immediately and marked "scrap."**

**A. Limits**

1. Measure dents in blade skin per § 26-40.
2. Refer to Figure 28-4. Smooth, round bottom dents with 0.060 inch minimum radius may be repaired when damage does not exceed the following limits:
  - a. Forward of 0.75 inch (chordwise) from leading edge:
    - i. 0.010 inch maximum dent depth.
  - b. Aft of 0.75 inch (chordwise) from leading edge, and forward of 0.40 inch (chordwise) from trailing edge:
    - i. 0.030 inch maximum dent depth.
  - c. Aft of 0.40 inch (chordwise) from trailing edge:
    - i. 0.030 inch maximum dent depth (repair: straighten to within 0.015 inch depth before fill).
  - d. Dents over the skin-to-root fitting bond joint:
    - i. 0.006 inch maximum dent depth.
3. No dents are permitted on visible portion of tip cap or on blade skin within 0.775 inch of blade tip.
4. If damage is within limits, repair blade skins per Part B.



28-32 Dents (continued)**B. Repair**

1. Using 10X magnification, visually inspect blade skin dented area for cracked metal; remove blade from service if metal is cracked.
2. Remove cracked paint by hand-sanding spanwise with 220-grit or finer wet-or-dry aluminum-oxide abrasive paper, and finishing with 320-grit or finer wet-or-dry abrasive paper. Avoid removing metal.
3. Refinish dented area per § 28-36.

28-33 Erosion

Replace any blade where erosion has caused deformation or ripples in the leading edge.

28-34 Root Fitting Damage**A. Limits**

1. Measure damage in root fitting per § 26-40.
2. Refer to Figure 28-4. All damage must be repaired within the following limits:
  - a. No repairs permitted within 0.5-inch radius from center of spherical feathering bearings.
  - b. Pitch horn clamping surfaces:
    - i. 0.002 inch deep each side (may only be repaired one time).
    - ii. Parallel to each other within 0.002 inch.
    - iii. Perpendicular to 0.250 inch diameter hole within 0.002 inch.
  - c. 0.250 inch diameter hole may be enlarged to 0.252 inch diameter maximum.
  - d. 0.002 inch maximum depth on other root fitting exposed areas.
3. If damage is within limits, repair root fitting per Part B.

**B. Repair**

1. All damage on root fitting must be hand-blended spanwise using a 0.10 inch blend radius minimum within Part A limits.
2. Use 220-grit or finer wet-or-dry aluminum-oxide abrasive paper, and finish with 320-grit or finer wet-or-dry abrasive paper. Remove minimum material necessary for damage removal and meet specified blend radius.
3. Conversion coat and prime (chromated epoxy primer preferred) bare aluminum per § 23-60. Do not allow conversion coat chemical to contact blade bond joint.
4. Paint root fitting per § 28-37.

28-35 Nicks and Notches (Trailing Edge)**A. Limits**

1. Refer to Figure 28-4A. Verify damage (or repair) does not exceed following limits:
  - a. 0.050 inch maximum depth (chordwise) in trailing edge.
  - b. Overall chord length 3.950 inches minimum.
  - c. Blended area to extend 1.0 inch minimum to each side of damage with a 2.0 inch radius minimum.
2. If damage is within limits, repair blade skins per Part B but do not exceed limits.

**B. Repair**

1. Refer to Figure 28-4A. Trailing edge must remain square with skins; skin must not taper.
2. Polish out blade damage using 220-grit or finer wet-or-dry aluminum-oxide abrasive paper, and finish with 320-grit or finer wet-or-dry abrasive paper. Hand-sand in spanwise direction.
3. A fine-toothed file may be used along trailing edge, provided the area is finished with 320-grit or finer wet-or-dry abrasive paper. Hand-sand or file in spanwise direction only.
4. Remove only the material necessary to reach the bottom of the damage, and to blend the reworked area to the radius or dimension required. Visually inspect and verify all damage is removed.
5. Measure reworked area and verify material removed and/or new chord dimension is permissible per Part A.
6. Apply B270-27 sealant to exposed bond joints.
7. Refinish blade per § 28-36, as required.

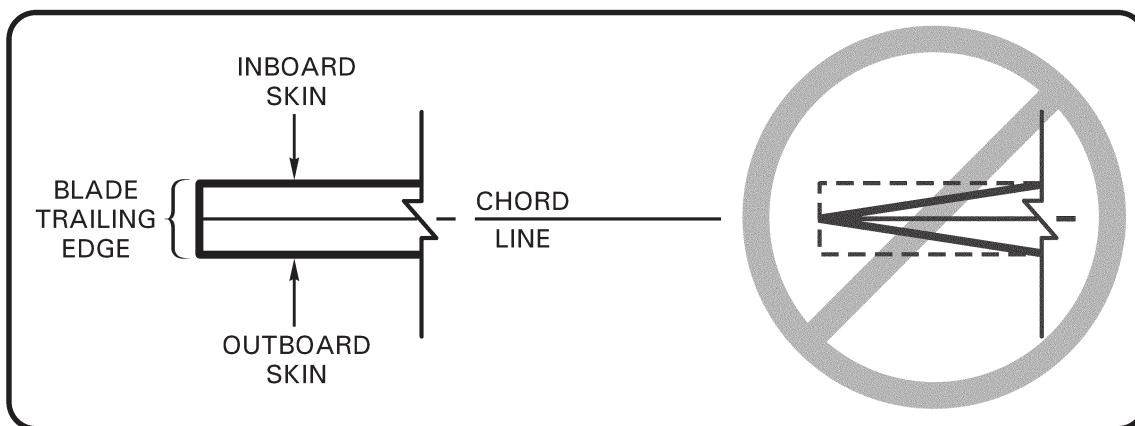


FIGURE 28-4A REPAIRS TO BLADE TRAILING EDGE

28-36 Blade Refinishing

1. Using 320-grit or finer wet-or-dry aluminum-oxide abrasive paper, feather existing paint around blade repairs. Do not remove metal.
2. Conversion coat and prime (chromated epoxy primer preferred) bare aluminum per § 23-60.
3. In areas where damage or repair has affected blade airfoil, apply layers of Corlar 13580S Epoxy Primer (or equivalent high-build primer) to build up airfoil.
4. Hand-sand cured epoxy primer (or block sand) in spanwise direction to a smooth, aerodynamic finish, congruent with blade airfoil.
5. Paint blade per § 28-37.

28-37 Painting

1. Perform § 28-36 as required.
2. Apply two coats of Desoprime CA7502 epoxy primer (or equivalent) to required areas. Scuff primer prior to applying second coat. Time limits are 10 minutes minimum, 8 hours maximum between coats. If 8 hours is exceeded, scuff with 600-grit wet-or-dry aluminum oxide abrasive paper in a spanwise direction, QSOL 220 wipe and mist primer before applying next coat.
3. Reference § 23-77. Apply white Imron polyurethane enamel or equivalent paint to required areas. Allow to dry before masking for trim stripes.
4. Refer to Figure 28-5. Apply masking to bearings and white trim stripes. Apply black paint to black trim stripes and root fitting.
5. Remove all masking materials.

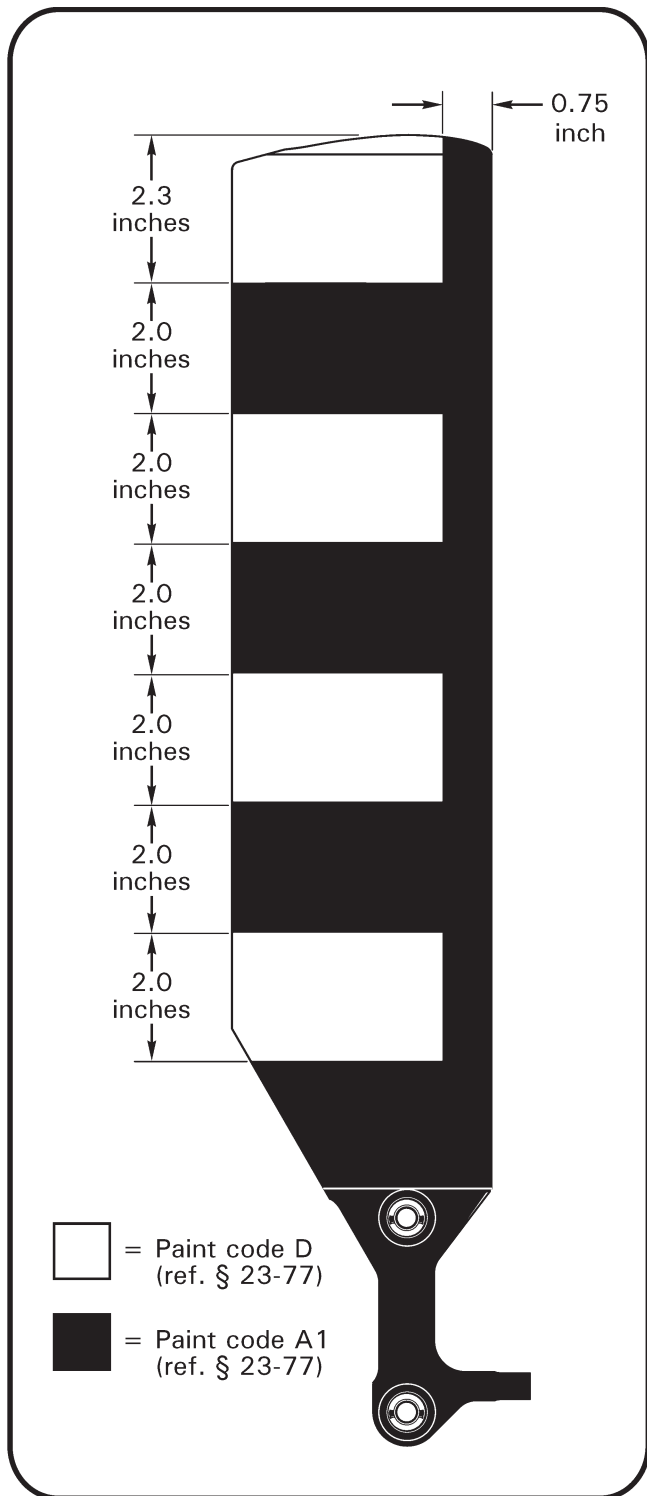


FIGURE 28-5 TAIL ROTOR BLADE PAINT SCHEME

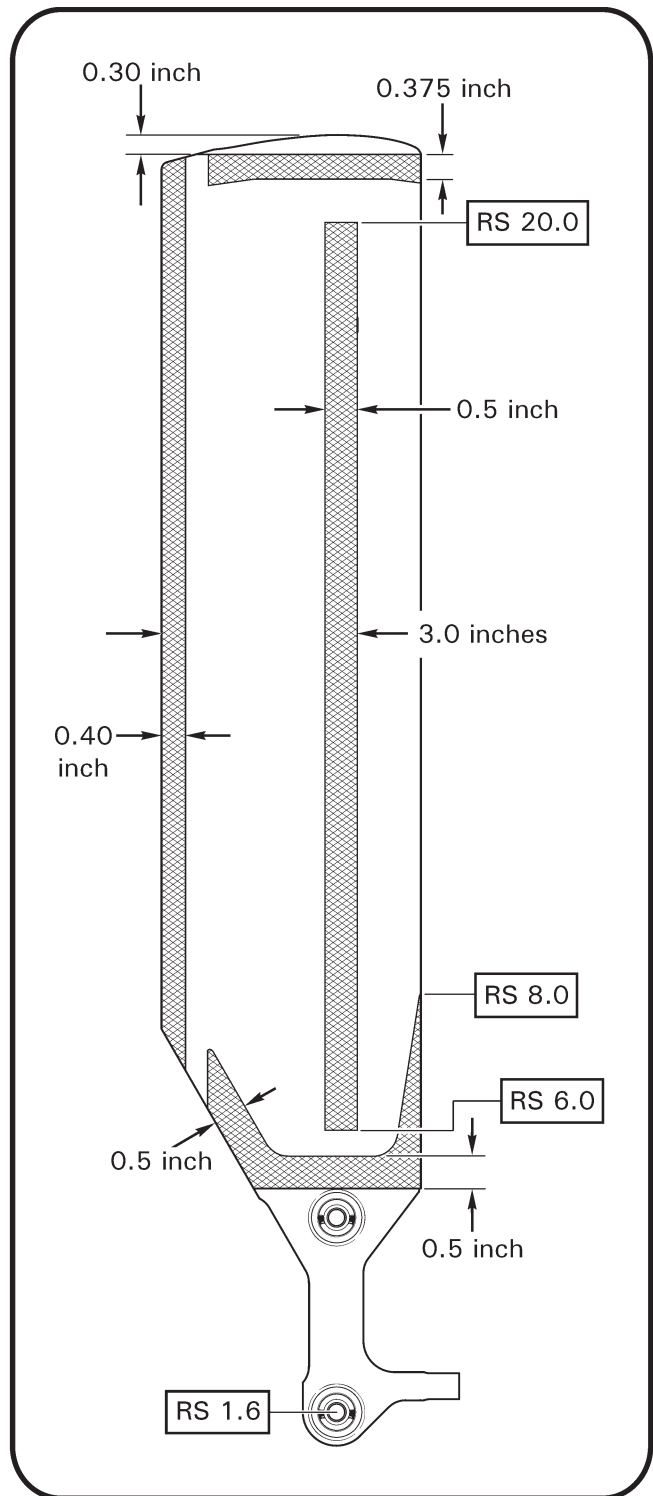


FIGURE 28-6 TAIL ROTOR BLADE BONDED AREAS

### 28-38 Tail Rotor Blade Condition and Care

Regular preventive maintenance of tail rotor blades is imperative for continued safe operation. Leading edge pitting or degradation of the bond at the tip cap can result if regular preventive maintenance is not performed; additional care may be required in corrosive environments such as coastal or shipboard operations. The following maintenance is recommended to prevent and mitigate the effects of corrosion:

1. Bubbled paint can be an indication of underlying corrosion. If bubbled paint is observed at or adjacent to tip cap bond line, or if bond line is exposed, perform following maintenance prior to further flight.

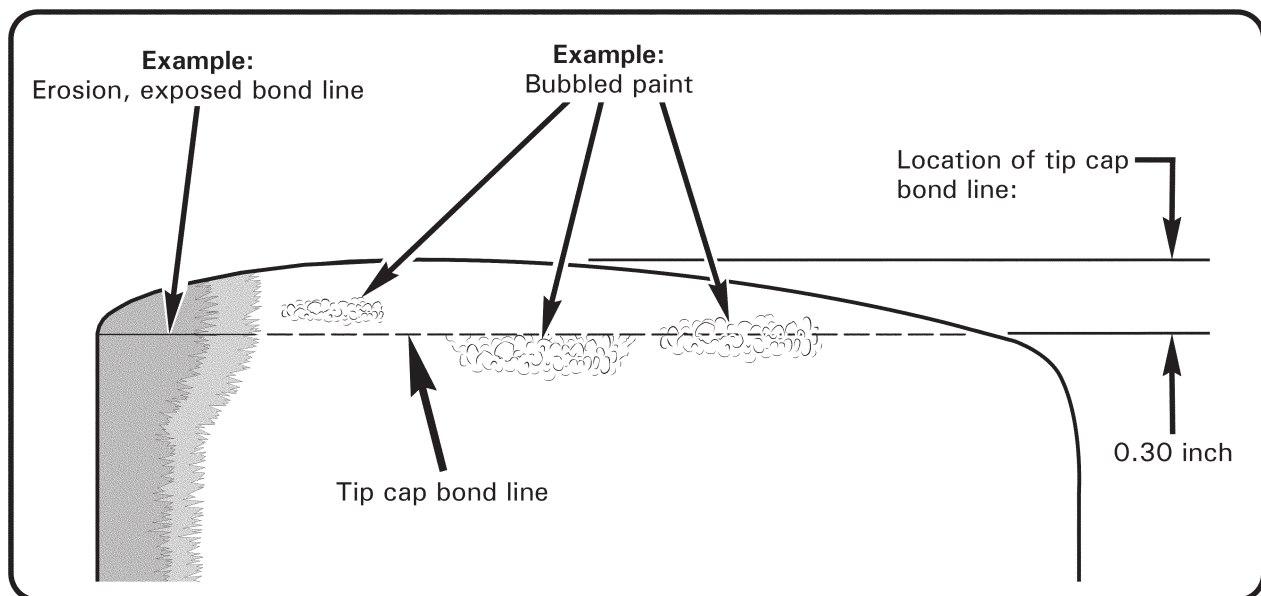


FIGURE 28-7 TAIL ROTOR BLADE TIP CAP BOND LINE

#### 2. Maintain blade condition as follows:

- a. At, or adjacent to, tip cap bond line: Remove loose or bubbled paint with fingernail or plastic scraper. Using minimum 10X magnification, examine bond line for both presence of adhesive & no corrosion (white powder and/or pitting). Metal-to-metal contact of tip cap to skin is permissible, but any gaps in remaining bond line due to missing blue (or brown) adhesive requires blade replacement. Any evidence of corrosion at bond line requires blade replacement. If blade(s) require replacement, contact RHC Technical Support with part number & serial number of affected and opposite blades.
- b. At areas away from tip cap bond line: Remove any corrosion, and bubbled or loose paint, by hand-sanding in a spanwise direction using 220-grit aluminum-oxide abrasive paper and minimum 0.1 inch blend radius; finish sand with 320-grit aluminum-oxide abrasive paper. Remove only material necessary to eliminate corrosion; any hole that completely penetrates blade skin requires blade replacement.

28-38 Tail Rotor Blade Condition and Care (continued)

2. c. Feather edge of paint bordering any bare metal by hand-sanding spanwise with 320-grit or finer wet-or-dry aluminum-oxide abrasive paper. Do not remove bare metal when feather sanding.

Preferred blade condition is with fully painted leading edge. Use two coats of Desoprime CA7502 epoxy primer (or equivalent). Scuff primer prior to applying second coat. Use Imron polyurethane enamel or equivalent paint. Refer to § 23-77 for specific paint codes. Blades with striped leading edges may be painted with solid black leading edge (ref. Figure 28-5) if desired for ease of application.

Paint offers the best protection against leading edge corrosion. If painting blades is impractical, at least a single coat of primer on leading edges provides some protection.

3. Balance tail rotor per § 10.240 after any corrosion removal or painting.
4. When operating in a corrosive environment, clean tail rotor daily per POH section 8, Cleaning Helicopter (mild soap means a pH between 7 & 9). If waxing blades is impractical, wipe blade leading edges with standard WD-40® brand light oil or equivalent; do not use ACF-50® lubricant or "Specialist" versions of WD-40® on blades, and do not use Salt-Away®.

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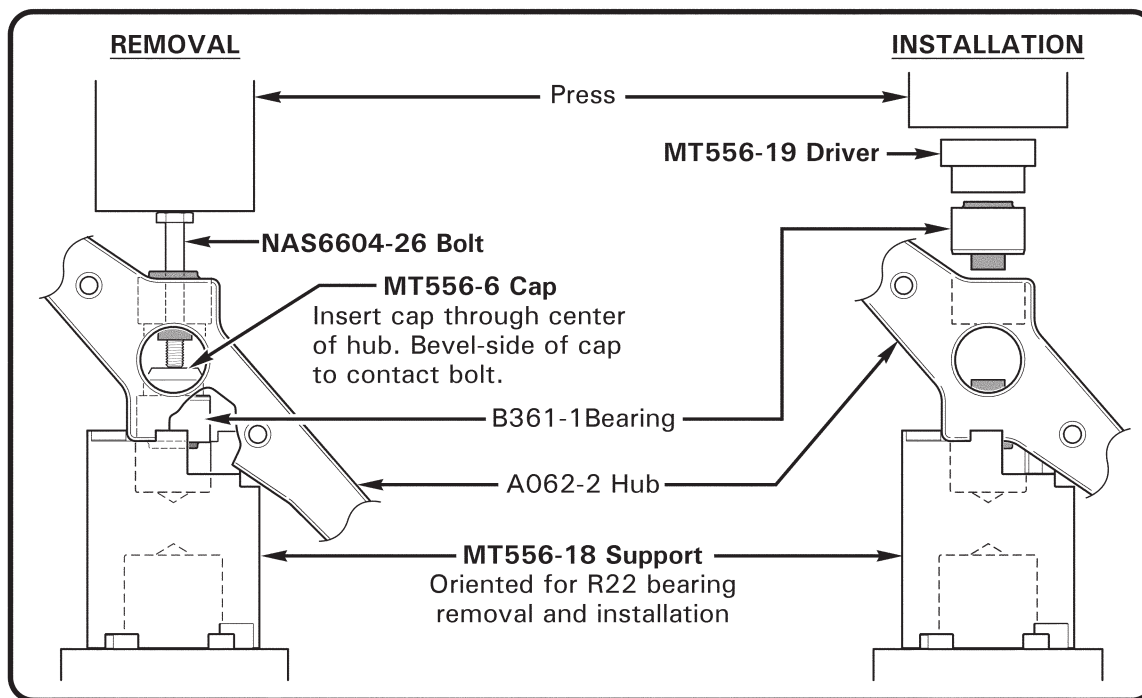


FIGURE 28-8 MT556-17 (ALL-MODEL) TAIL ROTOR HUB BEARING REPLACEMENT TOOL KIT

(Kit includes [1] MT556-6 Cap [R22], [1] MT556-16 Cap [R44 & R66], [1] MT556-18 Support, [1] MT556-19 Driver, [1] NAS6604-26 Bolt [R22], and [1] NAS6606-36 Bolt [R44 & R66])

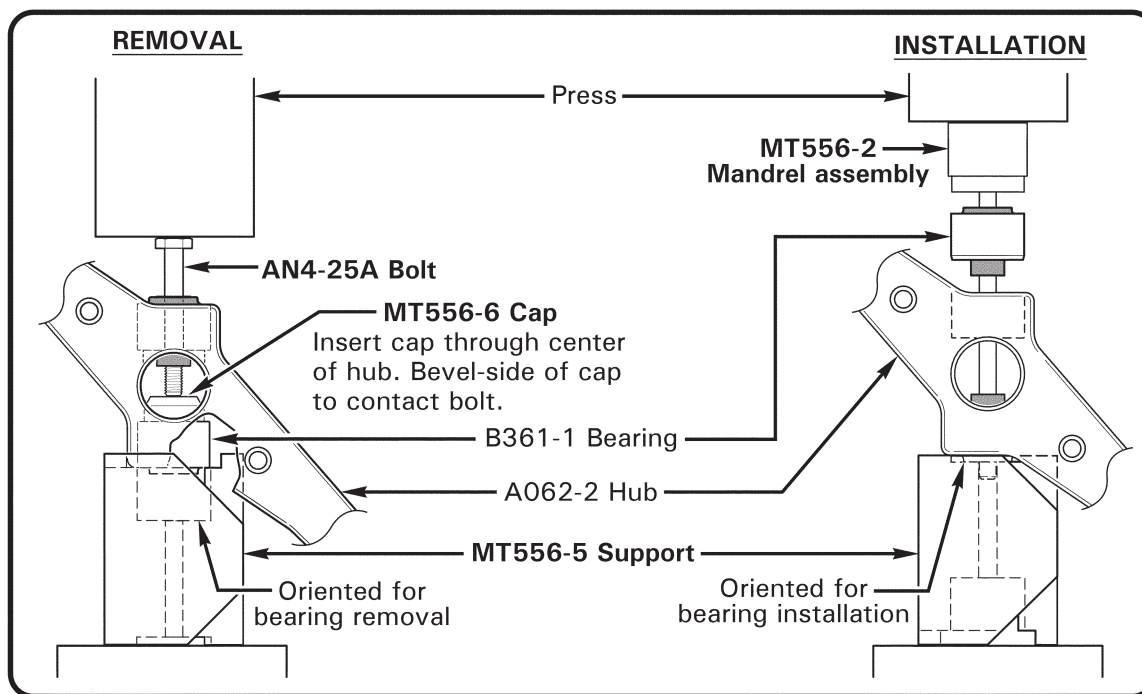


FIGURE 28-9 (EARLIER) MT556-1 (R22) TAIL ROTOR HUB BEARING REPLACEMENT TOOL KIT

(Kit includes [1] MT556-2 Mandrel assembly, [1] MT556-5 Support, [1] MT556-6 Cap, and [1] AN4-25A Bolt)



## 28-40 Tail Rotor Hub

### 28-41 Bearing Replacement

#### **A. Removal**

1. Remove tail rotor assembly per § 28-10.
2. Remove tail rotor blades per § 28-20.
3. Refer to Figures 28-8 or 28-9, as applicable. Press bearing(s) from hub using MT556-17 or MT556-1 bearing replacement tools as shown.

#### **B. Installation**

1. Inspect tail rotor hub per § 28-42.

#### **CAUTION**

Elastomeric bearings are a slight press fit in tail rotor hub bores. Inspect bores for fretting; if fretting is detected, hub is unairworthy.

2. Refer to Figures 28-8 or 28-9, as applicable. Using a cotton or foam tipped applicator, apply light coat of approved primer per § 23-70 to bottom of hub bearing bore. Apply a thin line of primer to center of bearing outside diameter. While primer is wet, press bearing(s) into hub using MT556-17 or MT556-1 bearing replacement tools as shown. Wipe away excess primer.

### 28-42 Inspection

1. Remove tail rotor blades per § 28-20, and inspect blades per § 28-30.
2. Remove elastomeric bearings per § 28-41.
3. Clean A062-1 tail rotor hub using approved solvent per § 23-70.
4. Visually inspect for indications of damage, wear, nicks, dings, and corrosion. Check arms for straightness, bolt holes for elongation, and bearing bores for fretting or galling. Corrosion is not permitted on clamp-up surfaces.
5. For suspect areas, locally remove paint from hub using approved paint stripper per § 23-70; dye penetrant or fluorescent penetrant inspect per § 23-40.
6. Touch-up bare metal using approved materials per § 23-70.
7. Install elastomeric bearings per § 28-41.
8. Install tail rotor blades per § 28-20.

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CHAPTER 29

TAIL ROTOR DRIVE SYSTEM

<u>Section</u>	<u>Title</u>	<u>Page</u>
29-00	Description . . . . .	29.1

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**CHAPTER 29****TAIL ROTOR DRIVE SYSTEM**29-00 Description

Reserved.

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CHAPTER 30

ENGINE CONTROLS

<i>Section</i>	<i>Title</i>	<i>Page</i>
30-00	Description . . . . .	30.1

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**CHAPTER 30****ENGINE CONTROLS**30-00 Description

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**CHAPTER 31**

**ENGINE OIL SYSTEM**

<u>Section</u>	<u>Title</u>	<u>Page</u>
31-00	Description . . . . .	31.1

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**CHAPTER 31****ENGINE OIL SYSTEM**31-00 Description

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**CHAPTER 32**

**POLICE VERSION**

<u>Section</u>	<u>Title</u>	<u>Page</u>
32-00	Description . . . . .	32.1

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**CHAPTER 32****POLICE VERSION**32-00 Description

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## CHAPTER 33

## ELECTRICAL SYSTEM

<i>Section</i>	<i>Title</i>	<i>Page</i>
33-00	Description . . . . .	33.1
33-10	Battery . . . . .	33.2
33-20	Clutch Actuator . . . . .	33.3
33-30	Lighting System . . . . .	33.3
33-40	Audio System . . . . .	33.4
33-50	Dual Tachometer . . . . .	33.5
33-60	Warning and Caution Lights . . . . .	33.7
33-70	Carbon Monoxide Detector . . . . .	33.8
33-80	Emergency Locator Transmitter (ELT) . . . . .	33.9
33-90	Low Rotor RPM Warning System . . . . .	33.9
33-100	Alternator Output Voltage Adjustment without A942-1 . . . . .	33.10
33-110	Troubleshooting . . . . .	33.10
33-120	Electrical Load Analysis . . . . .	33.20
33-130	Governor System for R22 Helicopter S/N 4825 & subsequent . . . . .	33.23
33-131	A760 Temperature Senders . . . . .	33.23
33-131-1	A760-1 (Single) and A760-3 (Dual) Oil Temperature Senders . . . . .	33.23
33-131-2	A760-2 Cylinder Head Temperature (CHT) Sender . . . . .	33.25
33-132	A760-4 Outside Air Temperature (OAT) Sender . . . . .	33.28
33-133	A024 Electrical System Installation . . . . .	33.28
33-134	A060-14 Audio System Installation . . . . .	33.28
33-135	C143-1 Hall Effect Sensor Assembly . . . . .	33.29
33-136	C822-1 Audio Control (Garmin GMA 350HC) Installation . . . . .	33.29
33-137	D270-1 Governor Controller and Engine Monitoring Unit (EMU) . . . . .	33.30
33-138	F793-1 Audio Alert Box . . . . .	33.30
33-140	Lycoming Electronic Ignition System (EIS) . . . . .	33.31
33-150	Audio Alerts . . . . .	33.31
33-160	Cockpit Camera . . . . .	33.31
33-170	Overspeed Protection . . . . .	33.33

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## CHAPTER 33

## ELECTRICAL SYSTEM

33-00 Description**CAUTION**

The installation of electrical devices can affect the accuracy and reliability of the electronic tachometer.

The electrical system includes a 14-volt, 60 ampere alternator (standard, 70 ampere optional), battery relay, alternator control unit and 14-volt battery.

The battery is in a fiberglass container normally located on the lower left steel tube frame. An optional location is in the nose under the upper console. Some R22 HP models may have the battery in the left-seat baggage compartment.

Circuit breakers are located on the ledge just forward of the forward left seat. The breakers are marked to indicate their function and amperage and are of the push-to-reset type.

The master battery switch, located on the console, controls the battery relay which disconnects the battery from all circuits except the tachometer and the clock. The tachometer and clock receive power directly from the battery via a Clutch switch terminal.

The alternator control unit (ACU) senses system voltage at the ammeter shunt via a remote sense wire. The ACU has three functions: it regulates alternator output voltage to maintain a battery voltage of 13.4–13.9 volts, warns of low-voltage by illuminating the ALT warning light if voltage decreases to 12.55–12.95 volts, and protects against over-voltage by shutting off alternator field if voltage increases to 15.75–16.25 volts.

The clutch actuator circuit incorporates a low-amperage fuse, in addition to its circuit breaker, to prevent a motor overload from tripping the circuit breaker and turning off the clutch light prematurely.

The lighting system includes the anti-collision light, navigation lights, landing lights, post and internal lights for the instruments and an overhead map light. Landing lights are wired through the clutch switch, turning the lights off when the clutch switch is disengaged. Warning lights on the instrument panel include clutch, low oil pressure, low fuel, main rotor and tail rotor gearbox chip lights, main rotor gearbox over-temp, low rotor RPM light, low voltage, rotor brake (if installed), governor off and starter on.

The gage cluster includes an ammeter and oil pressure, oil temperature, cylinder head temperature, and main and auxiliary fuel quantity gages. Included on the gages circuit are the carburetor air temperature and outside air temperature gages. The map light is also on the gages circuit as a “back-up” in the event of a short and failure of the lighting circuit.

### 33-00 Description (continued)

The tachometer is an electronic engine and rotor dual tachometer. The sensor for the engine tach is breaker points in the magneto on the left side of the helicopter. A Hall Effect sensor for the rotor tachometer senses the passage of two magnets on the main rotor gearbox input yoke. The signals from these sensors are conditioned by solid state circuits inside the dual tachometer. Each tachometer circuit has a separate circuit breaker and is completely independent of the other. They can be powered by either the alternator or the battery and receive current from two redundant sources. Power to the tachometer is interrupted only when the master battery and alternator switches are off and the clutch switch is disengaged.

### 33-10 Battery

#### **NOTE**

Refer to Concorde Battery Corporation's Owner/Operator's Manual, and Instruction for Continued Airworthiness for battery maintenance procedures.

#### **CAUTION**

To minimize risk of electrical discharge: When disconnecting battery, disconnect negative (ground) cable from battery first, then the positive cable. When connecting battery, connect positive cable to battery first, then the negative (ground) cable.

#### **A. Disconnecting Battery**

1. Verify battery switch is off.
  - a. Aft Battery: Remove engine left side skirt, as required. Remove cotter rings and wing nuts to release rods attaching battery box assembly to lower frames. Remove cover.
  - b. Nose battery: Open upper console and remove battery box cover.
2. Remove hardware securing negative (ground) cable to battery negative terminal.
3. Remove hardware securing positive cable to battery positive terminal.

#### **B. Removing and Installing Battery**

If removing battery, disconnect battery per Part A, and carefully remove battery. If installing battery, position battery in battery box, and connect battery per Part C.

#### **C. Connecting Battery**

1. Verify battery switch is off.
2. Connect battery cables. Special torque terminal bolts as noted on battery label and torque stripe per Figure 2-1.
3. Install cover.
  - a. Aft Battery: Install wing nuts and cotter rings to secure rods attaching battery box assembly to lower frames. Verify security. Install engine left side skirt, if removed.
  - b. Nose battery: Secure upper console.

### 33-20 Clutch Actuator

After the engine is started, it is coupled to the rotor drive system through vee-belts which are tensioned by raising the upper drive sheave. An electric actuator, located between the drive sheaves, raises the upper sheave when the pilot engages the clutch switch. The actuator senses compressive load (belt tension) and switches off when the vee-belts are properly tensioned. The clutch caution light illuminates whenever the actuator circuit is energized, either engaging, disengaging, or re-tensioning the belts. The light stays on until the belts are properly tensioned or completely disengaged.

Belt slack during engine start should be adjusted such that blades begin turning within five seconds of clutch engagement. Excessive slack may cause belts to jump out of sheave grooves during start. Periodic readjustment by a mechanic may be required as belts wear in service.

A fuse located on or near the test switch panel prevents an actuator motor overload from tripping the circuit breaker. If the fuse blows, the actuator motor will stop but the clutch caution light will remain illuminated. An open circuit breaker removes power from both the motor and the light. With an open circuit breaker, no belt tensioning will occur, and the light will not function to indicate an abnormal condition.

#### **CAUTION**

Never take off while clutch caution light is on.

### 33-30 Lighting System

A red anti-collision light is installed on the tailcone and is controlled by the strobe switch. Position lights are installed on each side of the cabin and in the tail and are controlled by the nav lights switch. Post and internal lights (earlier aircraft) or a light at the top of the windshield (later aircraft) illuminate the instruments. Instrument lighting is active when the nav lights switch is on and lighting is dimmed via the knob above the nav lights switch. An overhead map light mounted on a swivel is controlled by an adjacent switch. The map light may be used for emergency lighting of the instrument panel.

Two landing lights are installed in the nose at different vertical angles to increase the lighted area. One landing light switch controls both lights and is located on the cyclic center post.

#### **NOTE**

Landing lights operate only when clutch actuator switch is in the engage position.

#### **NOTE**

Continuous operation of landing and position lights in flight is recommended to promote collision avoidance.

### 33-40 Audio System

A voice-activated intercom/audio system is standard and is controlled by a small control panel above the avionics stack. The ICS volume knob controls intercom volume but does not affect radio volume. The VOX squelch knob is used to set the threshold volume at which the intercom is activated. When the VOX knob is turned fully clockwise, keying is required to activate the intercom. Later intercom systems include a music input jack located on the circuit breaker panel. This input is muted when the intercom is active, when transmitting, and during reception of radio signals.

Headset jacks are located in the ceiling near each seat. The cyclic grips are equipped with either transmit and intercom buttons or trigger-style intercom/transmit switches. For the trigger-style switch, the first detent activates the intercom and the second detent transmits. An additional intercom button is located on the left-hand floor or seat support.

Earlier R22s are equipped with an intercom system that operates in either push-to-talk (PTT) or hot mic modes. A toggle switch to the left of the cyclic center post is used to change modes. In PTT mode, the intercom is activated using the intercom buttons.

Audio control panels from several manufacturers are offered as options in place of the standard intercom system. Pilots should consult the manufacturer's operating instructions if an audio panel is installed.



### 33-50 Dual Tachometer

An electronic engine and rotor dual tachometer is standard. Engine tachometer signal is provided by magneto breaker points. Rotor tachometer signal is provided by two magnetic senders at the main gearbox drive yoke. Each tachometer is on a separate circuit with its own circuit breaker. With battery and alternator switches off, the tachometers continue to receive power from the battery through a bypass circuit as long as the clutch actuator switch is in the engage position.

#### **NOTE**

Do not stow helicopter with clutch switch engaged. The tachometers are powered with the clutch engaged and will discharge the battery.

#### **A. Adjustment**

1. The early model A792-1 Dual Tachometer is pre-set at the factory and is not adjustable in the field. For repair or adjustment, the unit must be returned to Robinson Helicopter. (No adjustment screw on early models.)
2. The A792-2 Dual Tachometer is pre-set at the factory. Slight variations between rotorcraft may require readjustment of rotor side of tachometer. To adjust tachometer:
  - a. Remove screws that fasten instrument face panel to upper console and carefully pull panel aft.
  - b. Ground run helicopter at 104% indication on the engine tachometer. Adjust the rotor tachometer to read 104%. On back of tachometer, turn the adjustment screw clockwise to increase and counter-clockwise to decrease rotor tachometer indication (1/8 turn changes indication approximate 1%).
  - c. Reinstall instrument panel.
  - d. If tachometer cannot be adjusted, replace or return to Robinson Helicopter Company for repair.

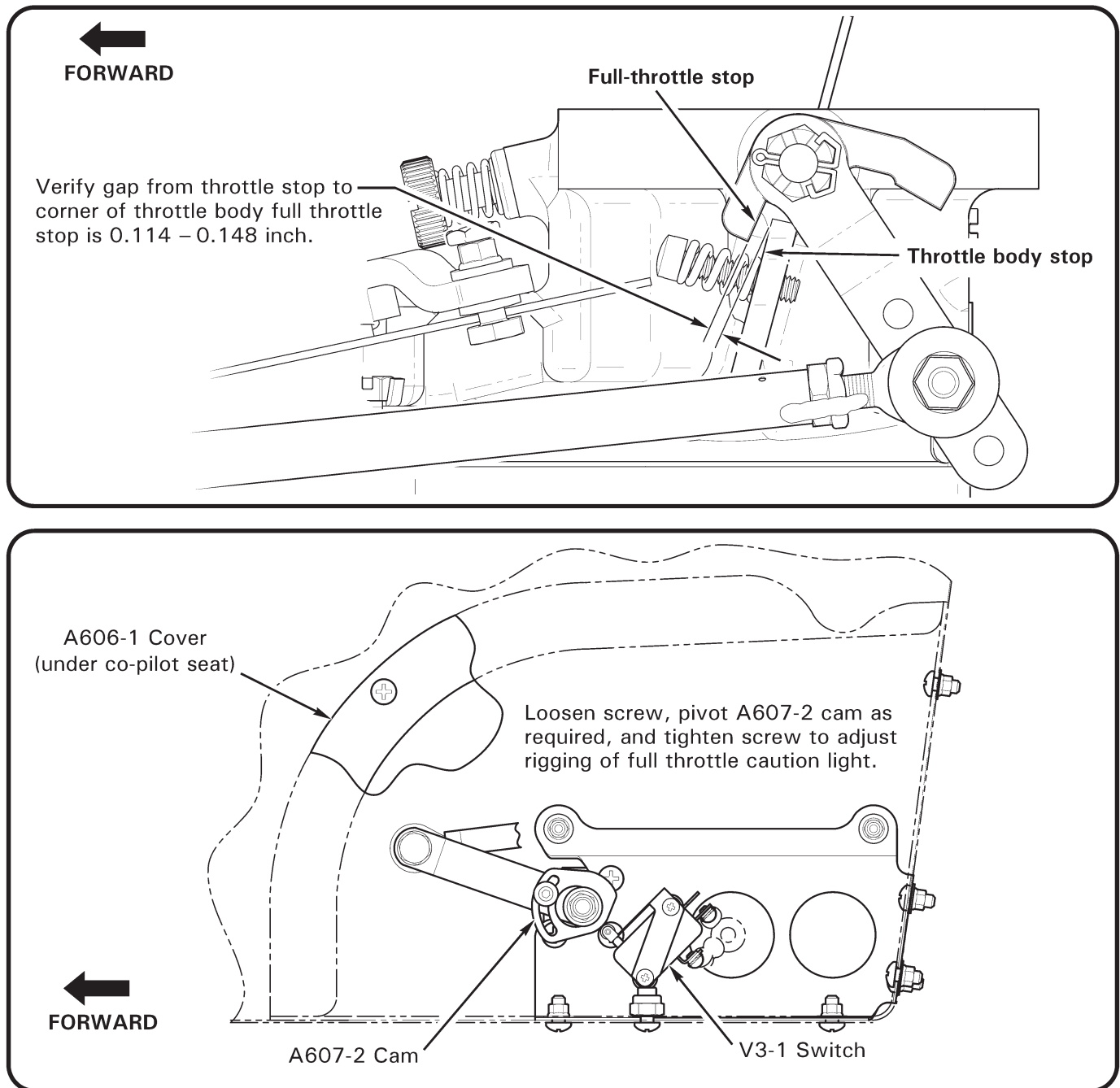


FIGURE 33-1 FULL THROTTLE CAUTION LIGHT RIGGING CHECK

### 33-60 Warning and Caution Lights

Warning and caution lights include clutch, main gearbox over-temperature, main and tail gearbox chip, starter on (later aircraft), low fuel, low RPM, alternator, low oil pressure, rotor brake, governor off, carbon monoxide (aircraft with cabin heater), and full throttle (later aircraft). The clutch light indicates that the clutch actuator is operating. The low RPM light and horn indicate rotor RPM at 97% or below. The low oil pressure and low fuel lights are actuated by sensors in those systems and are independent of the gage indicators. The alternator light warns of a possible alternator failure. The governor-off light indicates the RPM governor is switched off.

The main and tail gearbox chip detectors are magnetic devices located in the drain plug of each gearbox. When metallic particles are drawn to the magnets they close an electrical circuit, illuminating the caution light. Metal particles may be caused by a failing bearing or gear, thus giving warning of impending gearbox failure. The main gearbox over-temp light is actuated by a temperature switch located near the input pinion.

The carbon monoxide light is actuated by a sensor above the pilot's heater outlet and indicates elevated cab in carbon monoxide levels.

The full throttle light is activated by a switch in the throttle linkage and indicates that the engine is near full throttle.

#### **A. Full Throttle Caution Light**

##### 1. Rigging Check

- a. Turn fuel shut-off valve off.
- b. Turn battery switch on. Raise collective full up and slowly rotate twist grip open until full throttle caution light just illuminates.
- c. Refer to Figure 33-1. Verify gap from throttle stop to corner of throttle body full-throttle stop is 0.114–0.148 inch. Adjust as required per step 2.
- d. Lower collective & turn battery switch off. Turn fuel shut-off valve on.

##### 2. Switch Adjustment

- a. Refer to Figure 33-1. Raise collective full up, rotate (throttle) twist grip as required, loosen screw, and pivot A607-2 slotted cam (in throttle linkage, under co-pilot seat) so V3-1 switch activates when throttle stop is approximately 0.130 inch from corner of throttle body full-throttle stop. Tighten screw.
- b. Perform rigging check per step 1.

### 33-70 Carbon Monoxide Detector

The carbon monoxide (CO) detector, if installed, indicates elevated cabin CO levels. CO is an odorless, toxic gas present in engine exhaust which causes headaches, drowsiness, and possible loss of consciousness. CO levels may become elevated due to an exhaust leak or exhaust recirculation during prolonged hovering.

The CO detector system consists of a sensor above the pilot's heater outlet and a caution light. A system check (light flashes twice) is performed each time power is switched on. A sensor malfunction is indicated by a continuing flash every four seconds.

If the caution light illuminates, shut off heater and open nose and door vents as required to ventilate the cabin. If hovering, land or transition to forward flight. If symptoms of CO poisoning (headache, drowsiness, dizziness) accompany caution light, land immediately. Have exhaust system inspected before next flight.

Many chemicals can damage the CO sensor. Avoid use of solvents, detergents, or aerosol sprays near the sensor. Temporarily tape off openings in top and bottom of sensor housing when cleaning cabin interior.

### 33-80 Emergency Locator Transmitter (ELT)

The Emergency Locator Transmitter (ELT) installation consists of a transmitter with internal battery pack, an external antenna, and a remote switch/annunciator. The transmitter is mounted to the upper steel tube frame and is accessible through the aft, upper cowl door. The remote switch/annunciator is located left of the cyclic stick.

The ELT is operated by a switch on the transmitter and a remote switch in the cockpit. The transmitter switch has been secured in the AUTO or ARM position at installation and should always be in this position for flight. The remote switch/annunciator is a three position switch with indicator light. This switch should also be in the AUTO or ARMED (middle) position for flight. With both switches set to AUTO/ARM, the ELT will begin transmitting when subjected to a high "G" load. When the unit is transmitting, the red indicator light illuminates.

Moving the remote switch to ON activates the transmitter. Use the ON position if an emergency landing is imminent and time permits.

If the ELT is inadvertently activated, use the RESET position of the remote switch to stop transmission and reset the unit. The red indicator will extinguish when unit is reset.

#### **NOTE**

Earlier aircraft may have ELT installations without remote switch.

For more detailed instructions on ELT operation, maintenance, and required tests, refer to manufacturer's instructions supplied with the unit.

### 33-90 Low Rotor RPM Warning System

#### **A. Horn Adjustment**

When the collective is raised 0.2 to 0.4 inches (measured at grip) above fully down, the low-rotor RPM warning unit must activate the low-rpm warning horn and low-rpm light at 97% to 96% rotor RPM; horn and light must turn off above 96% to 97% rotor RPM.

The low rotor RPM warning unit is inside the upper console mounted on the left vertical panel. Some older helicopters may mount the unit on the right side, or ty-rapped to upper console's main wire bundle. Adjustments are made by turning an exposed screw on warning unit, accessible by removing a black-plastic plug from a 3/8-inch diameter hole on the left vertical panel. The A569-1 warning unit's (potted circuit board type) adjustment screw sensitivity is approximately 1/16 turn per 1% change. The A569-5 warning unit's (metal box type) adjustment screw sensitivity is approximately 2 turns per 1% change. If warning unit cannot be adjusted to above values it must be replaced.

**33-100 Alternator Output Voltage Adjustment without A942-1**

To check or adjust the output voltage:

1. Connect a voltmeter to "I" terminal of voltage regulator and ground with helicopter running and read voltage (13.2 to 13.8 volts).
2. Output voltage may be adjusted using range screw on voltage regulator.

**33-110 Troubleshooting****A. A569-5 Low Rotor RPM Warning Unit**

Perform following tests prior to replacing A569-5 low rotor-rpm warning unit:

1. Verify:
  - a. Low RPM light bulb is functional.
  - b. Master switch off.
  - c. Full-down collective.
  - d. Horn circuit breaker in.
2. Access and disconnect both horn and A569-5 low rotor-rpm warning unit from airframe electrical wiring.
3. Turn Master switch on and verify Horn circuit breaker remains in. If Horn circuit breaker pops then -70 wire is shorted to ground; repair as required. Turn Master switch off.
4. On the warning unit's airframe electrical connector, install a jumper between wires -70 & -75.
5. Turn Master switch on and verify Horn Start circuit breaker remains in. If Horn Start circuit breaker pops then a short-to-ground exists in -75 wire and/or collective activated V3-1 switch; repair as required.
6. Fully raise collective and verify Horn Start circuit breaker remains in and Low RPM light illuminates. If Horn Start circuit breaker pops then a short-to-ground exists in -76 wire and/or -78 wire and/or collective-activated V3-1 switch; repair as required. If Low RPM light does not illuminate then collective-activated V3-1 switch is faulty or mis-adjusted and/or an open exists in -70, -75, or -76 wires.
7. Slowly raise and lower collective fully several times while simultaneously manipulating throttle. Verify Horn Start circuit breaker remains in and Low RPM light remains illuminated whenever collective is raised. If Horn Start circuit breaker pops then a short-to-ground condition is occurring in -70, -75, or -76 wires and/or collective-activated V3-1 switch due to collective movement. Check for pinched/rubbing wiring and repair as required.
8. Turn Master switch off. Connect horn to airframe wiring.

**33-110 Troubleshooting (continued)****A. A569-5 Low Rotor RPM Warning Unit (continued)**

9. Turn Master switch on. Raise collective and verify horn activates and has consistent tone. If Horn Start circuit breaker pops then horn is faulty and/or -78 wire is shorted to ground; repair as required. If horn fails to activate then -79 wire is open or horn is faulty; repair as required. If tone is inconsistent then horn is faulty and/or poor connections exist; repair as required.
10. If A569-5 warning unit has starter lockout circuit enabled (warning unit's 9-pin connector plugged into airframe harness), also perform following steps:
11. Check A999-1 master radio relay current draw:
  - a. Master switch off and belt tension actuator fully disengaged.
  - b. Disconnect A569-5 low-rpm warning unit's 9-pin connector and place an ammeter in series (positive lead on pin 7) between pins 7 and 8 on airframe side of connector.
  - c. Master switch on, Horn Start and Clutch Start circuit breakers in, avionics off, rotor brake released, mixture at idle cut-off.
  - d. Select key switch to Start position and crank engine. Note and record current draw at ammeter while cranking engine. Select key switch to Off position.
  - e. Disconnect 582 wire at tab on starter solenoid and isolate connector (do not let it ground). Select key switch to Start position. Note and record current draw at ammeter; current should be 94-156 milliamps and a buzzing sound should be heard from the starter vibrator. Select key switch to Off position.
12. Check starter circuit:
  - a. Master switch off and belt tension actuator fully disengaged.
  - b. Disconnect A569-5 low-rpm warning unit's 9-pin connector and jump pins 7 and 8 on airframe side of connector.
  - c. Master switch on, Horn Start and Clutch Start circuit breakers in, rotor brake released, mixture at idle cut-off.
  - d. Select key switch to Start position and crank engine. If engine does not crank there is a problem in the starter circuit. If engine cranks then there is a problem in either the A569-5 unit or the sense circuit.

33-110 Troubleshooting (continued)**A. A569-5 Low Rotor RPM Warning Unit (continued)**

## 13. Check A596-5 sense circuit:

- a. Master Switch on.
- b. Momentarily engage clutch and verify Clutch light illuminates then disengage clutch completely.
- c. Master switch off.
- d. Disconnect A051-1 actuator's black four-pin connector. Ground airframe-side plug's pin 1 thru a #330 (post light type) lamp.

**CAUTION**

Failure to ground pin 1 thru a #330 lamp (such as direct grounding) may result in wiring damage.

- e. Verify less than 200 ohms (20 ohm nominal) to ground at pin 4 and at pin 5 on ship side of A569-5's 9-pin connector.
  - f. Master switch on.
  - g. With A569-5 unit connected to airframe harness, verify voltage does not exceed 0.5V from pin 4 to ground and from pin 5 to ground.
  - h. Master switch on, Horn Start and Clutch Start circuit breakers in, rotor brake released, mixture at idle cut-off.
  - i. Select key switch to Start position and crank engine. Failure of engine to crank indicates problem in A569-5 unit.
14. Upon successful completion of preceding tests the A569-5 low rotor-rpm warning unit may be replaced and adjusted per § 33-90.



### 33-110 Troubleshooting (continued)

#### B. General

TROUBLE	PROBABLE CAUSE	CORRECTION
No electrical power	Battery terminals corroded	Clean terminals.
	Bad or no ground	Clean ground path.
	Tripped circuit breaker	Check circuit, if circuit checks ok, reset circuit breaker.
	Low battery voltage	Check battery. Recharge if necessary.
	Low or no alternator output	Check alternator belt tension, wiring, and alternator control unit.
	Bad wire or terminal	Replace.
Engine cranks slowly, but will not start	Low battery voltage	Service or replace battery.
	Insufficient drive belt deflection	Adjust actuator down-limit screw.
	Corroded or dirty battery or starter terminals	Clean terminals.
	Bad starter relay, wires or terminals	Replace defective parts.
Engine cranks but will not start	Bad ignition switch	Replace switch.
	Bad starting vibrator	Repair or replace vibrator.
	Incorrect retard timing	Adjust retard magneto internal timing.
Starter fails to operate	Rotor brake engaged	Release rotor brake.
	Low battery charge	Check and recharge if necessary.
	Circuit breakers tripped	Reset both HORN START and CLUTCH START circuit breakers.
	Actuator not fully disengaged	Engage actuator momentarily, then fully disengage.
	Loose connections	Check all wiring (refer to wiring diagram).
	Defective wiring	Check all wiring (refer to wiring diagram).
	Starter motor - burned winding or bad brushes	Repair or replace starter.

33-110 Troubleshooting (continued)
**B. General (continued)**

TROUBLE	PROBABLE CAUSE	CORRECTION
Discharged battery	Battery worn out	Replace
	Charging rate not set correctly	Reset
	Standing too long	Remove and recharge battery
	Equipment left on accidentally	Remove and recharge battery
Starter - Low cranking speed	Same electrical causes as listed under "starter fails to operate"	Same remedies as listed under "starter fails to operate"
Battery life is short	Impurities in electrolyte	Replace battery
	Low charging rate	Adjust voltage regulator
Battery runs out of electrolyte	Too much water added to battery and charging rate too high	Drain and keep battery at proper level and adjust voltage regulator
Excessive corrosion inside container	Spillage from overfilling	Use care in adding water
	Vent lines leaking or clogged	Repair or clean
	Charging rate too high	Adjust voltage regulator
Battery consumes excessive water	Charging rate too high (if in all cells)	Correct charging rate
Alternator fails to supply charging current with engine operating	Alternator defective	Replace
	Voltage regulator defective	Replace
	Overvoltage relay defective	Replace
	Alternator switch defective	Replace

## 33-110 Troubleshooting (continued)

## B. General (continued)

TROUBLE	PROBABLE CAUSE	CORRECTION
Starter kicks back while cranking; may cause broken starter or starter ring gear	Retard breaker contact in engine left magneto pushed out or no connection between lead and magneto contact	Measure retard breaker lead connection. Must be 0.609 in. $\pm$ 0.10 in. There must be a small amount of springback which into magneto.
	Incorrect ignition vibrator wiring	Trace ignition vibrator wiring from ignition switch to magneto. Correct as required.
	Bad ignition switch (See RHC Service Letter R22 SL-29)	Replace ignition switch
	Bad ignition vibrator	Replace vibrator
	Incorrect internal magneto retard breaker timing. Engine left magneto	Correct as required. Consult TCM Aircraft Products literature.
	Impulse coupling starting assist	Replace impulse coupling with ignition vibrator starting assist. RHC KI-4.

### 33-110 Troubleshooting (continued)

#### C. Clutch Actuator Electrical Troubleshooting

TROUBLE	CLUTCH LIGHT		PROBABLE CAUSE
	ON	OFF	
Disengaged actuator will not engage	X		Motor assembly seized
	X		Motor fuse blown (1 ½-amp)
	X		Open circuit in motor wiring
	X		Overtravel switch assembly tripped
		X	No voltage at circuit breaker
		X	Circuit breaker tripped
		X	Spring switch open (normally closed)
		X	-88 wire not grounded
Engaged actuator will not disengage	X		Motor assembly seized
	X		Motor fuse blown (1 ½-amp)
	X		Open circuit in motor wiring
	X		Overtravel switch assembly tripped
		X	No voltage at circuit breaker
		X	Circuit breaker tripped
		X	Up limit switch stuck (normally closed)
		X	-88 wire not grounded
Clutch light flickers in flight			Actuator column spring uncalibrated
			A190 drive belts mismatched
			Lower drive sheave improperly torqued
			A184 or A181 bearing running rough
Clutch light comes on for 1–6 seconds in flight			Normal operation of actuator as it retensions drive belts
Clutch light comes on for more than 6 seconds in flight			Drive belts stretched beyond limit of actuator overtravel switch. Belts must be replaced.
			Actuator overtravel switch activated by outside force

### 33-110 Troubleshooting (continued)

#### D. Electrically Powered Instrument Calibration Values

Using Vibrex 2000 balancing equipment (or similar) capable of displaying  $\pm 1$  rpm resolution and calibrated within one year, verify tachometer accuracy per following tables. Connect equipment in accordance with §§ 10.221 and 6.240 (use photocell instead of Strobex per Figure 6-4A). Operate aircraft at noted tachometer indications and verify engine and rotor rpms as specified. Tachometer needles are 1% wide.

##### A792-x Dual Tachometer

Tachometer indication	Engine RPM	Rotor RPM
97%	2471-2476	494-495
100%	2548-2552	509-510
104%	2649-2655	529-530

The rotor tachometer may be adjusted per § 33-50. No other adjustments are permitted. If tachometer does not meet accuracy tolerance then it must be replaced or returned to RHC for repair.

##### A058-5 Carb. Air Temp. Probe

0° = 89.68/91.08 ohms
15° = 95.67/98.07 ohms
16° = 96.10/98.50 ohms
17° = 96.54/98.94 ohms
18° = 96.97/99.37 ohms
19° = 97.40/99.80 ohms
20° = 97.83/100.23 ohms
21° = 98.27/100.67 ohms
22° = 98.70/101.10 ohms
23° = 99.13/101.53 ohms
24° = 99.56/101.96 ohms
25° = 100.00/102.40 ohms

##### A604-2 Carb. Air Temp. Gage at 13.7 Vdc;

77.40 ohms = -30° $\pm$ 2°C
81.73 ohms = -20° $\pm$ 1.75°C
86.05 ohms = -10° $\pm$ 1.5°C
90.38 ohms = 0° $\pm$ 1°C
94.71 ohms = 10° $\pm$ 1.5°C
99.03 ohms = 20° $\pm$ 1.75°C
103.36 ohms = 30° $\pm$ 2°C

Example: Replacing the carburetor air temperature probe with a ¼ to 1-watt 100-ohm resistor should result in an indication of approximately 21°C (measure exact resistor value & refer to above). A probe dipped in a Styrofoam cup full of crushed ice and water should indicate 90.38 ohms resistance per above table. Probe installation torque is 3 to 4 inch-pounds; over-torquing probe will result in damage.

33-110 Troubleshooting (continued)**D. Electrically Powered Instrument Calibration Values (continued)**

Following instrument cluster gages are calibrated at 20 to 25 degree angle from horizontal.

Fuel level senders should have  $90 \pm 2$  ohms resistance when fully up (full fuel) and 0 to 0.5 ohm when fully down (no fuel). Perform fuel sender calibration per § 12.410 whenever sender is replaced, or if factory-set fuel gage potentiometers have been disturbed. On backside of each fuel gage are "Null" and "Gain" potentiometer screws, covered with aluminum tape pressed against the screw heads to prevent rotation. "Null" potentiometer is adjusted so gage indicates empty at 0.7 ohm sender circuit resistance; "Gain" potentiometer is adjusted so gage indicates half at 42 ohms sender circuit resistance. Calibration values are:

**Fuel Quantity Gages 6246-00473 (14V)**

0.70 ohm	=	E (empty) -1, +0	pointer width
21.20 ohms	=	1/4 full $\pm 1$	pointer width
42.00 ohms	=	1/2 full $\pm 1$	pointer width
67.50 ohms	=	3/4 full $\pm 1$	pointer width
90.00 ohms	=	F (full) $\pm 1$	pointer width

**Ammeter 6246-00468 (14V)**

-104 mV	=	-70 amps $\pm 1$	pointer width
-52 mV	=	-35 amps $\pm 1$	pointer width
0 mV	=	0 amps $\pm \frac{1}{4}$	pointer width
+52 mV	=	+35 amps $\pm 1$	pointer width
+104 mV	=	+70 amps $\pm 1$	pointer width

**CHT Probe 3080-38 (14V)**

200°F	=	745 ohms
475°F	=	38 ohms
500°F	=	32 ohms

**CHT Gage 6246-00088 (14V)**

745 ohms	=	200 degrees F $\pm 1$	pointer width
110 ohms	=	350 degrees F $\pm 1$	pointer width
34 ohms	=	500 degrees F $\pm \%$	pointer width

**Oil Pressure Sender  
B308-1 (14V)**

0 psi	=	5-13 ohms
29 psi	=	48-57 ohms
58 psi	=	84-94 ohms
87 psi	=	119-131 ohms
115 psi	=	145-161 ohms

**115-psi redline Oil Pressure Gage  
6246-00647 (14V)**

9 ohms	=	0 psi $\pm 1$	pointer width
46 ohms	=	25 psi $\pm 1$	pointer width
84 ohms	=	55 psi $\pm 1$	pointer width
131 ohms	=	95 psi $\pm 1$	pointer width
152 ohms	=	115 psi $\pm 1$	pointer width

33-110 Troubleshooting (continued)**D. Electrically Powered Instrument Calibration Values (continued)**

**Older, 100-psi red line Oil Pressure Gage**  
**6246-00089 (14V)**

0 psi	=	10.0 ohms
25 psi	=	46.5 ohms
60 psi	=	90.0 ohms
90 psi	=	125.5 ohms
100 psi	=	137.0 ohms

**Oil Temperature Sender**  
**A760-1 (14V)**

100°F	=	497 ohms
150°F	=	179 ohms
200°F	=	72 ohms
250°F	=	34 ohms

**Oil Temperature Gage**  
**6246-00090 (14V)**

903.5 ohms	=	75°F ± 1 pointer width
100.0 ohms	=	180°F ± 1 pointer width
36.0 ohms	=	245°F ± 1 pointer width

### 33-120 Electrical Load Analysis

To calculate the total electrical load for a specific helicopter, identify all items of equipment installed on the helicopter from the table below and sum the corresponding continuous and intermittent loads.

Maximum continuous alternator load is given in the table below:

System Voltage	Alternator Rating	Maximum Continuous Load
14V	60 amp	54 amps

Intermittent loads are provided for reference.

Alternately, the electrical load may be measured directly at the battery output terminal with the alternator switched off and all other equipment turned on. The measured load may be scaled by the ratio of battery voltage to nominal system voltage to obtain a value that is compared with the alternator load limit.

#### WARNING

Field (non-factory) installation of electronic equipment can be hazardous. Due to the compactness of the console and tunnel containing the controls and wire bundles, installation of any additional wires can interfere with flight controls. Electronic tachometers, warning systems, and navigation equipment essential to flight are sensitive to interference from other electrical devices. The reliability and accuracy of the tachometers is essential for safe operation of the helicopter, and installation of an electrical device not tested and approved by RHC may result in a hazardous condition.

EQUIPMENT	QTY	CONTINUOUS AMPS EACH	INTERMITTENT AMPS EACH	CONTINUOUS TOTAL	INTERMITTENT TOTAL
<b>MAIN BUS</b>					
ESSEX BATTERY RELAY	1	0.75	0.75	0.75	0.75
KISSLING BATTERY RELAY	1	0.35	0.35	0.35	0.35
ALTERNATOR FIELD	1	2.40	2.40	2.40	2.40
AVIONICS RELAY	1	0.13	0.13	0.13	0.13
ENGINE GAGE CLUSTER	1	0.60	0.60	0.60	0.60
HOURLY METER	1	0.03	0.03	0.03	0.03
CARB AIR TEMP	1	0.13	0.13	0.13	0.13
AMMETER	1	0.50	0.50	0.50	0.50
DIGITAL OAT GAGE	1	0.15	0.15	0.15	0.15
MAP LIGHT	1	0.00	0.58	0.00	0.58
WARNING LIGHTS	8	0.00	0.08	0.00	0.64
FULL THROTTLE CAUTION LIGHT	1	0.00	0.08	0.00	0.08



**33-120 Electrical Load Analysis (continued)**

EQUIPMENT	QTY	CONTINUOUS AMPS EACH	INTERMITTENT AMPS EACH	CONTINUOUS TOTAL	INTERMITTENT TOTAL
<b>MAIN BUS (continued)</b>					
RPM GOVERNOR MOTOR	1	0.00	1.50	0.00	1.50
BELT TENSION ACTUATOR	1	0.00	1.20	0.00	1.20
AUX POWER PLUG (MAX)	1	10.00	10.00	10.00	10.00
HEATER BLOWER	1	7.50	7.50	7.50	7.50

EQUIPMENT	QTY	CONTINUOUS AMPS EACH	INTERMITTENT AMPS EACH	CONTINUOUS TOTAL	INTERMITTENT TOTAL
<b>TACH BUS</b>					
DUAL TACHOMETER (E)	1	0.10	0.10	0.10	0.10
DUAL TACHOMETER (R)	1	0.10	0.10	0.10	0.10

EQUIPMENT	QTY	CONTINUOUS AMPS EACH	INTERMITTENT AMPS EACH	CONTINUOUS TOTAL	INTERMITTENT TOTAL
<b>LIGHTS BUS</b>					
POSITION LIGHTS (L, R, & AFT, INCANDESCENT)	3	2.20	2.20	6.60	6.60
POSITION LIGHTS (L & R, LED)	2	0.25	0.25	0.50	0.50
POSITION LIGHT (AFT, LED)	1	0.30	0.30	0.30	0.30
OVERHEAD PANEL LIGHT	1	1.00	1.00	1.00	1.00
POST LIGHTS	7	0.08	0.08	0.56	0.56
INSTRUMENT LIGHTS	4	0.20	0.20	0.80	0.80
LANDING LIGHT RELAY	1	0.20	0.20	0.20	0.20
LANDING LIGHTS (INCANDESCENT)	2	7.70	7.70	15.40	15.40
LANDING LIGHTS (HID)	2	2.90	9.52	5.80	19.04
ANTI-COLLISION LIGHT & POWER SUPPLY	1	3.20	3.20	3.20	3.20
ANTI-COLLISION LIGHT (LED)	1	0.90	4.00	0.90	4.00

EQUIPMENT	QTY	CONTINUOUS AMPS EACH	INTERMITTENT AMPS EACH	CONTINUOUS TOTAL	INTERMITTENT TOTAL
<b>AVIONICS</b>					
KY197A COM	1	0.80	5.20	0.80	5.20
GTR225B COM	1	0.59	5.31	0.59	5.31
GNS430 COM/NAV/GPS	1	2.44	8.40	2.44	8.40
GTN650 COM/NAV/GPS	1	2.65	6.97	2.65	6.97
KX155 OR KX165 NAV/COM	1	0.70	8.50	0.70	8.50

**33-120 Electrical Load Analysis (continued)**

EQUIPMENT	QTY	CONTINUOUS AMPS EACH	INTERMITTENT AMPS EACH	CONTINUOUS TOTAL	INTERMITTENT TOTAL
<b>AVIONICS (continued)</b>					
KR87 ADF	1	1.24	1.24	1.24	1.24
KN63 DME	1	1.21	1.21	1.21	1.21
GARMIN TRANSPONDER	1	1.10	3.10	1.10	3.10
GARMIN RADIO NAVIGATION INDICATOR	1	0.41	0.41	0.41	0.41
KING RADIO NAVIGATION INDICATOR	1	0.08	0.08	0.08	0.08
MARKER BEACON	1	0.50	0.50	0.50	0.50
KCS55A HSI	1	3.23	3.23	3.23	3.23
RADAR ALTIMETER	1	1.45	1.45	1.45	1.45
AA12S AUDIO CONTROL	1	1.00	1.00	1.00	1.00
GMA 350H AUDIO CONTROL	1	0.80	1.50	0.80	1.50
ASPEN 1000H EFD	1	4.80	4.80	4.80	4.80
ATTITUDE HORIZON (MECHANICAL)	1	0.54	1.40	0.54	1.40
ATTITUDE HORIZON (LCD)	1	0.20	0.20	0.20	0.20
TURN COORDINATOR	1	0.70	0.70	0.70	0.70
DIRECTIONAL GYRO	1	0.44	1.40	0.44	1.40
PA/SIREN CONTROL	1	0.05	0.05	0.05	0.05
PA/SIREN SPEAKER	1	7.70	7.70	7.70	7.70
ICOM IC-M412 MARINE TRANSCIEVER	1	1.50	5.50	1.50	5.50
KENWOOD TK-7160 OR TK8160 FM TRANSCIEVER	1	1.00	8.00	1.00	8.00
KENWOOD TK-7180 OR TK8180 FM TRANSCIEVER	1	1.00	9.00	1.00	9.00
YAESU FT-8800R FM TRANSCIEVER	1	0.50	8.00	0.50	8.00
VERTEX VX-2200 FM TRANSCIEVER	1	2.50	11.00	2.50	11.00

EQUIPMENT	QTY	CONTINUOUS AMPS EACH	INTERMITTENT AMPS EACH	CONTINUOUS TOTAL	INTERMITTENT TOTAL
<b>OTHER EQUIPMENT</b>					
STARTER RELAY	1	0.00	15.00	0.00	15.00
STARTING VIBRATOR	1	0.00	2.50	0.00	2.50
STARTER MOTOR	1	0.00	200.00	0.00	200.00
CLOCK, STANDARD	1	0.02	0.02	0.02	0.02
CLOCK, DIGITAL	1	0.00	0.00	0.00	0.00

33-130 Governor System for R22 Helicopter S/N 4825 & subsequent33-131 A760 Temperature Senders33-131-1 A760-1 (Single) and A760-3 (Dual) Oil Temperature Senders**A. Description**

A760-1 Oil temperature sender (single) is for use with the B144-3 (14V) instrument cluster. A760-3 oil temperature sender (dual) is for use with the B144-5 (10–32V) instrument cluster.

**B. Schematic**

Refer to Figure 14-39 for A024 electrical system schematic.

**C. Removal**

1. Remove left side engine cowling.
2. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
3. Using backup wrench, remove nut securing C049 harness assembly's wire terminal to A760 oil temperature sender stud.
4. Cut and discard lockwire securing sender to thermostatic oil cooler bypass valve. Remove sender from D723-1 adapter assembly.

**D. Installation**

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Install gasket supplied with A760 oil temperature sender, and sender, in D723-1 adapter assembly. Special torque sender to 300 in.-lb and torque stripe per Figure 2-1. Safety sender to thermostatic oil cooler bypass valve using 0.032-inch diameter lockwire.
3. Attach C049 harness assembly's wire terminal to sender; using backup wrench, install nut securing wire terminal to sender. Special torque nut to 20 in.-lb and torque stripe per Figure 2-1.
4. Install left side engine cowling. Push in GOV (2 amp) circuit breaker on circuit breaker panel.

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**33-131-2 A760-2 Cylinder Head Temperature (CHT) Sender****A. Description**

A760-2 Cylinder head temperature sender is for use with the B144-5 (10–32V) instrument cluster. 3080-00038 cylinder head temperature probe is for use with the B144-3 (14V) instrument cluster.

**B. Schematic**

Refer to Figure 14-39 for A024 electrical system schematic.

**C. Removal**

1. Remove right side engine cowling.
2. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
3. Using backup wrench, remove palnut and brass nut securing C049 harness assembly's -34 wire terminal to A760-2 or 3080-00038 cylinder head temperature sender/probe stud (one brass nut remains on stud). Discard palnut.
4. Remove sender/probe from cylinder head (forward, RH [#4]).

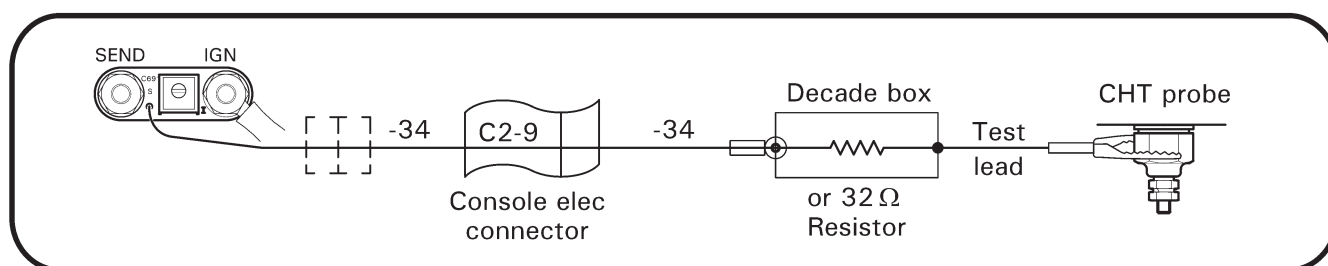
**D. Installation**

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Install gasket supplied with A760-2 or 3080-00038 cylinder head temperature sender/probe, and sender/probe, in cylinder head (forward, RH [#4]). Special torque sender/probe to 70–80 in.-lb and torque stripe per Figure 2-1.
3. Calibrate cylinder head temperature gage per Part E, as required.
4. Attach C049 harness assembly's -34 wire terminal to sender/probe. Using backup wrench, install brass nut securing wire terminal to sender/probe; tighten nut. Install new B330-2 palnut; tighten palnut. Torque stripe per Figure 2-1.
5. Install right side engine cowling. Push in GOV (2 amp) circuit breaker on circuit breaker panel.

33-131-2 A760-2 Cylinder Head Temperature (CHT) Sender (continued)**E. Calibration****NOTE**

C691-1 Circuit board assembly must be installed on B144 instrument cluster to perform calibration. For earlier helicopters, order and install KI-249 CHT Gage Calibration Kit, as required (refer to R22 Service Letter SL-73).

1. Turn battery switch off and pull all circuit breakers.
2. Remove right side engine cowling, as applicable.
3. Using backup wrench, remove palnut and brass nut securing C049 harness assembly's -34 wire terminal to A760-2 or 3080-00038 cylinder head temperature sender/probe stud (one brass nut remains on stud). Discard palnut.
4. Open instrument console for access to back side of CHT gage in B144 instrument cluster.
5. Refer to Figure 33-2. Adjust resistance decade box to  $32 \pm 0.4$  ohms and verify resistance with multimeter. Alternately, a  $32.0 \pm 0.4$  ohm resistor may be used instead of decade box. Connect a low-impedance ( $< 1$  ohm) test lead to one terminal on decade box and clamp opposite end of lead to hexagonal body of CHT probe; do not connect lead to center conductor of sender/probe. Connect -34 wire to remaining terminal on decade box.



**FIGURE 33-2 CYLINDER HEAT TEMPERATURE GAGE CALIBRATION**

6. Refer to Figure 33-3. Push in GAGES 2-amp circuit breaker. Turn battery switch on and observe CHT gage. Adjust potentiometer screw on C691-1 circuit board assembly until gage indicates within limits shown with console in closed position (CHT probe resistance is  $32 \pm 0.4$  ohms at  $500^{\circ}$  F).
7. Cut small square of A701-1 aluminum tape sized to fit potentiometer face. Apply tape to potentiometer and press tape tight against adjustment screw to prevent rotation (pressing with a pencil eraser works well). Verify CHT needle has not moved. If movement is noted, remove tape and repeat step 6 as required. Turn battery switch off.

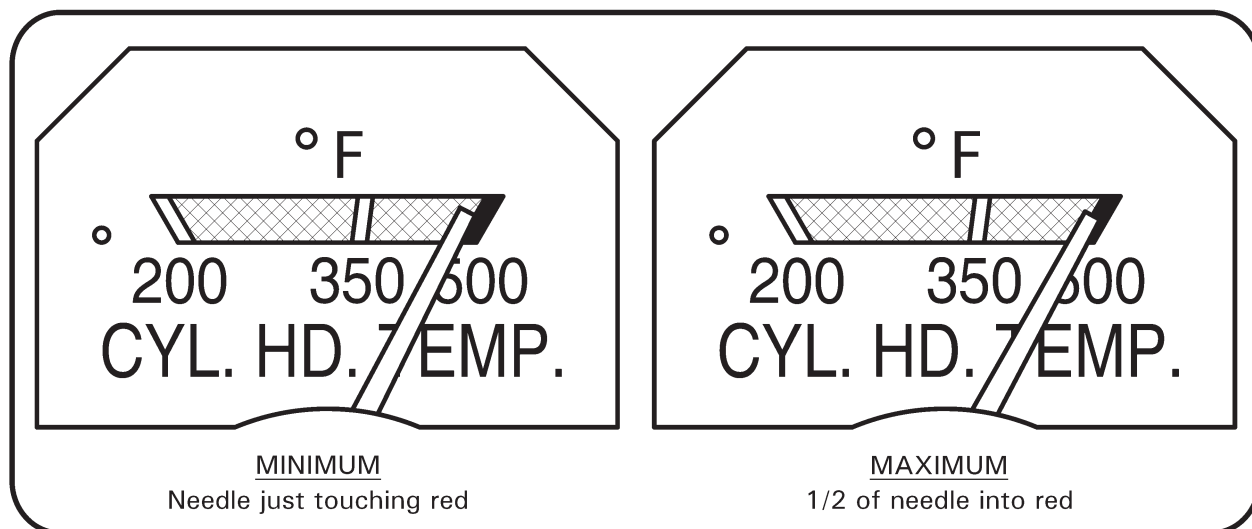


FIGURE 33-3 CYLINDER HEAD TEMPERATURE GAGE CALIBRATION

33-131-2 A760-2 Cylinder Head Temperature (CHT) Sender (continued)

**E. Calibration (continued)**

8. Close and secure instrument console. Push in all remaining circuit breakers.
9. Attach C049 harness assembly's -34 wire terminal to sender/probe. Using backup wrench, install brass nut securing wire terminal to sender/probe; tighten nut. Install new B330-2 palnut; tighten palnut. Torque stripe per Figure 2-1.
10. Install engine side cowling.

**33-132 A760-4 Outside Air Temperature (OAT) Sender****A. Description**

The A760-4 OAT sender is the data input for the D270-1 governor/engine monitoring unit; the B341-2 OAT sender is the data input for the B341-1 OAT gage.

**B. Schematic**

Refer to Figure 14-39 for A024 electrical system schematic.

**C. Removal**

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Cut and discard ty-raps as required and disconnect A760-4 OAT wiring from airframe harness at connectors; remove hardware securing ground wire. Using backup wrench, remove nut and lockwasher securing sender probe to cabin.

**D. Installation**

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Install lockwasher and nut securing A760-4 OAT sender probe to cabin. Using backup wrench, special torque nut to 18 in.-lb. Verify security.
3. Connect OAT sender wiring to airframe harness at connectors; install hardware securing ground wire. Verify security. Install ty-raps as required to securing wiring; cinch ty-raps until snug without overtightening and trim tips flush with heads.
4. Install forward belly panel. Push in GOV (2 amp) circuit breaker on circuit breaker panel.

**33-133 A024 Electrical System Installation**

Refer to Figure 14-39 for A024 electrical system schematic.

**33-134 A060-14 Audio System Installation**

Refer to Figure 14-40 for A060-14 audio system schematic.



**33-135 C143-1 Hall Effect Sensor Assembly****A. Schematic**

Refer to Figure 14-39 for A024 electrical system schematic.

**B. Removal**

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Remove engine left side cowling.
3. Cut and discard ty-raps as required and disconnect C143-1 hall effect sensor assembly wiring from airframe harness at connectors.
4. Remove engine-supplied hardware securing sensor assembly and engine-supplied gasket to engine; remove sensor assembly and gasket.

**C. Installation**

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Install engine-supplied gasket and C143-1 hall effect sensor assembly on engine and install engine-supplied hardware. Special torque nuts to 96 in.-lb. Verify security.
3. Connect sensor assembly wiring to airframe harness at connectors and install ty-raps, as required. Cinch ty-raps until snug without overtightening and trim tips flush with heads.
4. Install engine left side cowling. Push in GOV (2 amp) circuit breaker on circuit breaker panel.

**33-136 C822-1 Audio Control (Garmin GMA 350HC) Installation**

Refer to Figures 14-47 & 14-48 for C822-1 audio control installation schematic.

**33-137 D270-1 Governor Controller and Engine Monitoring Unit (EMU)**

Refer to § 8.230 for D270-1 governor controller maintenance procedures. Refer to the EMU Technician's Guide and EMU User Guide online at [www.robinsonheli.com](http://www.robinsonheli.com) for data access.

Later aircraft are equipped with an Engine Monitoring Unit (EMU), which is a digital recording device within the engine RPM governor control box. The EMU continuously monitors engine and rotor speed, engine oil temperature, and cylinder head temperature.

EMU status is indicated by an amber light located in the right-side baggage compartment on the aft seat support panel. The EMU requires approximately ten seconds to complete a self-test after the aircraft battery is switched on. Once the self-test is complete, steady illumination of the light means normal EMU operation. A slowly flashing light (once every two seconds) or no light means there is a fault in the EMU's senders or circuitry. A fast flashing light (four times per second) indicates the EMU has detected an exceedance. EMU data can be downloaded to a computer with the appropriate software. A fault or exceedance should be investigated and the indication reset by a qualified mechanic prior to the next flight. Current exceedances may be reviewed (but not reset) using the Robinson EMU App on an Apple iPad (download the EMU App from [www.robinsonheli.com](http://www.robinsonheli.com) or from the Apple App Store).

The EMU is intended to be used only as a maintenance aid. It remains the pilot's responsibility to report any observed exceedances.

**33-138 F793-1 Audio Alert Box****A. Schematic**

Refer to Figure 14-39 for A024 electrical system schematic.

**B. Removal**

1. Turn battery switch off and pull all circuit breakers.
2. Open instrument console for access to F793-1 audio alert box.
3. Loosen screws securing audio system harness receptacle to alert box connector and disconnect receptacle from connector.
4. Remove hardware securing alert box to keel panel and remove alert box.

**C. Installation**

1. Turn battery switch off and pull all circuit breakers.
2. Open instrument console.
3. Install hardware securing F793-1 audio alert box to right side keel panel; verify security.
4. Connect audio system harness receptacle to alert box connector and tighten screws. Verify security.
5. Close and secure instrument console. Push in all circuit breakers.

### 33-140 Lycoming Electronic Ignition System (EIS)

Later aircraft are equipped with a Lycoming Electronic Ignition System (EIS) single module magneto replacement. The EIS installation replaces the left starting magneto (and starter vibrator). The remaining right magneto provides redundant ignition, which eliminates the need for a back-up battery system (required on dual module EIS installations).

Refer to Lycoming SI 1569, current revision for instructions for continued airworthiness for EIS modules. SI 1569 also provides instruction for module internal timing and module-to-engine timing for single (and dual) EIS installed.

### 33-150 Audio Alerts

All R22 helicopters have a low-RPM horn which sounds when rotor RPM is below 97%. The horn is muted when the collective is fully down. On earlier aircraft, the horn is provided by a speaker in the side of the instrument console. On later aircraft, a tone generator in the audio system provides the horn through crew headsets.

Later aircraft include a high rotor RPM alert through the headsets. A warble tone (high/low tone) indicates rotor RPM is approaching 110%. A test button on the instrument panel permits pre-flight or in-flight testing of the high-RPM alert.

Additional audio alerts may be provided in the headsets depending on optional equipment installed, such as terrain and traffic warnings.

### 33-160 Cockpit Camera

An optional video camera may be installed in the cabin ceiling. The camera records 4K video, intercom audio and radio communications, and GPS position both internally and to a removable flash drive. Recording starts automatically when the battery switch is turned on and stops when it is turned off.

Recording to the flash drive can be stopped or audio muted using the record and audio switches on the front of the camera housing. A switch in the down position turns off the associated function. Do not remove the flash drive while a recording is in progress as this will corrupt the video file. To remove a flash drive when the helicopter battery switch is on, first stop the recording using the record switch.

A blue flashing light on the camera housing indicates video is being recorded to the flash drive. A green steady light indicates the camera is powered and operating normally. The green light will change to an amber flashing light if an internal camera fault is detected, in which case video may not be recorded.

Video can be viewed on a Windows PC or Mac by removing the flash drive from the camera, inserting it into a USB port on a computer, and double clicking on the desired video file. Video is recorded in sequential 4 GB files with each file approximately 25 minutes in length. Video files are labeled HELICAM\_XXXX.MP4, where XXXX is a sequential number. GPS position and altitude are recorded to files labeled HELICAM\_XXXX.GPX on the flash drive, and are optionally displayed in the upper left hand corner of the video. A 128 GB flash drive (one supplied with each helicopter) will record approximately 13 hours of video. When full, the earliest video file is overwritten with the latest recording.

33-160 Cockpit Camera (continued)

## NOTE

Flash drives used with the camera must meet the criteria described in the Cockpit Camera User Guide in order to function reliably.

Complete instructions are provided in the Cockpit Camera User Guide on the Robinson website <https://robinsonheli.com>. The guide also provides camera lens cleaning instructions, additional playback suggestions, instructions for visualizing GPS data, setting user preferences, updating camera software, and video post-processing and troubleshooting tips. User options include on screen display of time & date and/or GPS position, time zone and daylight saving time status, and units for on screen display of GPS altitude.

**A. Removal**

1. Turn battery & camera switches off.
2. Using a backup screwdriver, remove (2) B340-4 nuts and associated washers & spacers securing F039-1 camera assembly to cabin.
3. Cut & discard ty-raps securing wiring. Disconnect F714-2 antenna assembly from camera assembly and disconnect wiring at connectors. Remove nut securing -1858 ground wire terminal to ground stud.
4. Mark headset jacks for re-installation. Remove dress nuts and/or screws securing each headset jack to camera assembly and remove camera assembly from helicopter.

**B. Installation**

1. Connect F039-1 camera assembly electrical wiring at connectors. Lock connectors using MS3367-4-9 ty-rap. Cinch ty-rap until snug without over-tightening and trim tip flush with head.
2. If applicable, install dress nuts securing each D746-3, or -4 harness to camera assembly. Align keyway facing aft within 5° and special torque dress nuts using MT640-1 key per § 23-33.
3. Install A142-5 screws wet with B270-20 adhesive securing TJ-120 jacks to camera assembly. Special torque screws per § 23-33.
4. Install nut securing -1858 ground wire to ground stud. Connect F714-2 antenna assembly to camera assembly.
5. Install hardware and spacers securing camera assembly to cabin. Verify security.
6. Refer to cockpit camera user guide online at <https://robinsonheli.com>. Verify camera function and video image is approximately level.
7. To adjust video image loosen (2) NAS1352-04-4 screws securing lens. Rotate lens clockwise to rotate video image counterclockwise or rotate lens counterclockwise to rotate video image clockwise. Tighten screws. Repeat steps 3 and 4 as required.

33-160 Cockpit Camera (continued)**C. Battery Replacement**

1. Remove camera assembly per Part A steps 1 & 2.
2. Gently separate RV-BATT-LIPO500 battery connector from circuit board.
3. Pull tab on 1024A38 tape to release battery. If battery is secured using A701-7 tape, use a plastic razor blade to separate battery from F039-1 camera assembly housing. Remove old tape and clean mating surfaces using an alcohol wipe.
4. Install new 1024A38 tape on battery and secure battery to camera assembly. Carefully connect battery to circuit board.
5. Install camera assembly per Part B steps 5 thru 7.

33-170 Overspeed Protection

An engine start-up overspeed protection circuit is standard electrical equipment on R22 ship S/N 4825 & subsequent.

R22 S/N 4825 thru 4880 factory installed circuit activates when A792-5 dual tachometer [internally] grounds pin 2 for 3s-5s.

R22 S/N 4881 & subsequent factory installed circuit activates when D270-1 governor controller [internally] grounds pin 12 (of 44-pin connector) for 3s-5s.

Engine start-up overspeeds typically occur if a start is initiated with the throttle open.

The start-up overspeed protection circuit is only active during the following conditions:

R22 S/N 4825 thru 4880 Refer to A024 Revision BR schematic	R22 S/N 4881 & subsequent Refer to A024 Revision BU schematic
A792 Engine rpm is above $90 \pm 3\%$	D270 Engine RPM is above $85\% \pm 3\%$
A792 Rotor rpm is below $50 \pm 10\%$	D270 Rotor RPM is below $50\% \pm 10\%$
Clutch switch is Disengaged i.e. wire -66 is routing power to wire -3003	

Start-up overspeed protection occurs when dual tachometer or governor [internally] grounds wire -3002, activating F695-9 overspeed relay's coil and in turn grounding both magnetos' p-leads.

During flight, the start-up overspeed relay is disabled because the clutch switch is in the Engage position.

No periodic maintenance of the start-up overspeed protection circuit is required.

**The start-up overspeed protection circuit cannot prevent all engine overspeeds.**

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## CHAPTER 34

## AVIONICS

<u>Section</u>	<u>Title</u>	<u>Page</u>
34-10	Avionics Switch Description . . . . .	34.1
34-20	Transponder Installations . . . . .	34.1
34-21	A804-12 Transponder (Garmin GTX 330 ES) Installation . . . . .	34.1
34-30	COM Radio Installations . . . . .	34.4
34-31	C802-2 COM Radio (Garmin GTR 225B) Installation . . . . .	34.4
34-40	Audio Control Installations . . . . .	34.6
34-41	C822-1 Audio Control (Garmin GMA 350H) Installation . . . . .	34.6
34-50	GPS Installations . . . . .	34.8
34-51	C831 GPS (Garmin GTN 600 series) Installation . . . . .	34.8
34-60	Avionics Software . . . . .	34.10

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## CHAPTER 34

## AVIONICS

34-10 Avionics Switch Description

R22 Helicopters S/N 4591, 4650, 4651, 4656 & subsequent have a dedicated avionics switch located on the main switch panel on top of the avionics stack. Earlier R22s have an avionics bus, but the master radio relay interrupts power to the avionics bus during start-up, eliminating the need for a switch. The avionics switch controls a relay which interrupts power to the avionics bus (system is fail-safe ON).

34-20 Transponder Installations34-21 A804-12 Transponder (Garmin GTX 330 ES) Installation

## NOTE

Refer to Garmin GTX 330 ES Maintenance Manual and Instructions for Continued Airworthiness.

**A. Description**

Automatic Dependent Surveillance-Broadcast (ADS-B) "Out" equipment transmits aircraft specific-data and position information to air traffic control via GPS-based surveillance (rather than radar-based surveillance). ADS-B Out equipment will be required for R22 operation in certain airspace in the United States after January 1, 2020.

ADS-B Out system operates mostly automatically. ADS-B Out equipment is programmed with aircraft-specific data at installation. ADS-B Out system uses the primary installed GPS for position information. Additional flight-specific data is entered by the pilot using transponder controls. ADS-B data is transmitted via the transponder's Extended Squitter (ES) on frequency 1090 MHz.

ADS-B Out equipment (transponder and primary GPS) must have power and must be in normal operating modes for systems to function properly. ADS-B Out system faults are annunciated on the transponder and primary GPS screens.

Change of aircraft registration may require ADS-B equipment programming by qualified maintenance personnel.

Refer to R22 Pilot's Operating Handbook Section 9 for additional information.

**B. Schematic**

Refer to Figure 14-41 for A804-12 transponder & blind encoder electrical schematic.

34-21 A804-12 Transponder (Garmin GTX 330 ES) Installation (continued)**C. Removal**

1. Turn battery switch off and pull out XPDR circuit breaker (5 amp) at panel.
2. Loosen radio key securing A804-12 transponder to avionics tray.
3. Carefully unplug/remove transponder from tray.

**D. Installation**

1. Turn battery switch off and pull out XPDR circuit breaker (5 amp) at panel.
2. Carefully plug-in/install A804-12 transponder in appropriate location in avionics tray.
3. Tighten radio key securing transponder to tray. Verify equipment security.
4. Push in XPDR circuit breaker (5 amp) at panel. Turn battery & avionics switches on.
5. Perform appropriate functional checks per Garmin GTX 330 ES Pilot's Guide. Turn battery and avionics switches off.

**E. Antenna**

Refer to § 16-70 for antenna locations and R22 Illustrated Parts Catalog (IPC) Chapter 6.

**NOTE**

Antenna installation depends on optional equipment installed.

Removal

1. Turn battery switch off and pull out XPDR circuit breaker (5 amp) at panel.
2. Using plastic scraper, remove B270-1 sealant from around transponder antenna at corners where it attaches to A794-2 panel.
3. Remove screws securing panel to cabin skin and disconnect antenna cable from antenna. Remove hardware securing antenna and ground wire to panel and remove antenna.

34-21 A804-12 Transponder (Garmin GTX 330 ES) Installation (continued)**E. Antenna (continued)**Installation

1. Turn battery switch off and pull out XPDR circuit breaker (5 amp) at panel.
2. Remove paint and primer from A794-2 panel where ground wire attaches to ensure electrical ground.
3. Install hardware securing transponder antenna and ground wire to panel. Verify security. Connect antenna cable to antenna and install screws securing panel to cabin skin. Verify security.
4. Apply small bead B270-1 sealant (0.1 inch max in height) around antenna at corners where it attaches to panel and allow to dry.
5. Perform ground checks per Part D steps 4 and 5.

**F. Scheduled Maintenance and Inspections****NOTE**

All factory-installed Garmin units are "on condition" and do not require scheduled periodic maintenance. Units feature a BIT (Built-In Test) function during each initial power-up that will detect internal failure(s) and alert pilot.

**NOTE**

Refer to § 34-60 for avionics software information.

**G. Special Maintenance and Inspections**

1. Turn battery and avionics switches off. Open circuit breaker panel and upper console.
2. Inspect condition of and verify no obvious damage to transponder, radio tray, copper bus bars, circuit breaker, and wiring. Verify no loose, chafed, or broken wires or terminals. Verify no evidence of arcing. Verify equipment security.
3. Secure circuit breaker panel and upper console. Perform ground checks per Part D steps 4 and 5.

### 34-30 COM Radio Installations

#### 34-31 C802-2 COM Radio (Garmin GTR 225B) Installation

##### **A. Description**

The C802-2 COM radio (Garmin GTR 225B) includes similar communication features available in the earlier King KY197A COM radio, but includes an airport frequency database, ability to monitor the standby frequency, and improved user memory channel functionality. The Garmin GTR 225B is a dual voltage unit, suitable for use in 14V and 28V systems.

##### **B. Schematic**

Refer to Figure 14-43 for C802-2 COM Radio Installation electrical schematic.

##### **C. Removal**

1. Turn battery switch off and pull-out COM radio circuit breaker (10 amp) at panel.
2. Loosen radio key securing C802-2 COM radio to avionics tray.
3. Carefully unplug/remove radio from tray.

##### **D. Installation**

1. Turn battery switch off and pull-out COM radio circuit breaker (10 amp) at panel.
2. Carefully plug-in/install C802-2 COM radio in appropriate location in avionics tray.
3. Tighten radio key securing radio to tray. Verify equipment security.
4. Push-in COM radio circuit breaker (10 amp) at panel. Turn battery and avionics switches on.
5. Perform appropriate functional checks per Garmin GTR 225B Pilot's Guide. Turn battery and avionics switches off.

##### **E. Antenna**

Refer to § 16-70 for antenna locations and R22 Illustrated Parts Catalog (IPC) Chapter 6.

##### **NOTE**

Antenna installation depends on number of COM installations and additional equipment installed.

34-31 C802-2 COM Radio (Garmin GTR 225B) Installation (continued)**E. Antenna (continued)**Removal

1. Turn battery switch off and pull out COM radio circuit breaker (10 amp) at panel.
2. Using plastic scraper, remove B270-1 sealant from around COM antenna at corners where it attaches to tailcone.
3. Disconnect antenna cable from antenna. As required, remove B270-13 sealant from fastener holes. Remove screws securing antenna to tailcone and remove antenna.

Installation

1. Turn battery switch off and pull out COM radio circuit breaker (10 amp) at panel.
2. Remove paint & primer from antenna mating surfaces to ensure electrical ground.
3. As required, apply light coat B270-13 sealant to screw threads and install screws securing antenna to tailcone. As required, seal around screw heads and fill fastener holes using B270-13 sealant and allow to dry. Verify security.
4. Apply small bead B270-1 sealant (0.1 inch max in height) around antenna at corners where it attaches to tailcone and allow to dry.
5. Connect antenna cable to antenna. Verify security.
6. Perform ground checks per Part D steps 4 and 5.

**F. Scheduled Maintenance and Inspections****NOTE**

All factory-installed Garmin units are "on condition" and do not require scheduled periodic maintenance. Units feature a BIT (Built-In Test) function during each initial power-up that will detect internal failure(s) and alert pilot.

**NOTE**

Refer to § 34-60 for avionics software information.

**G. Special Maintenance and Inspections**

1. Turn battery and avionics switches off. Open circuit breaker panel and upper console.
2. Inspect condition of and verify no obvious damage to COM radio, radio tray, copper bus bars, circuit breaker, and wiring. Verify no loose, chafed, or broken wires or terminals. Verify no evidence of arcing. Verify equipment security.
3. Secure circuit breaker panel and upper console. Perform ground checks per Part D steps 4 and 5.

## 34-40 Audio Control Installations

### 34-41 C822-1 Audio Control (Garmin GMA 350H) Installation

#### NOTE

Refer to Garmin GMA 350H series Maintenance Manual and Instructions for Continued Airworthiness.

#### **A. Description**

The Garmin GMA 350H audio control includes improved squelch and background noise suppression, 3D audio (if stereo headsets are used) which allows inputs from separate radios to sound as if they are coming from separate locations around the listener, and some control functions via voice command when a momentary push-button switch is depressed on the pilot's cyclic grip.

#### **B. Schematic**

Refer to Figure 14-44 for C822-1 Audio Control Installation electrical schematic.

#### **C. Removal**

1. Turn battery switch off and pull out AUDIO PANEL circuit breaker (5 amp) at panel.
2. Loosen radio key securing Garmin GMA 350H audio control to avionics tray.
3. Carefully unplug/remove audio control from tray.

#### **D. Installation**

1. Turn battery switch off and pull out AUDIO PANEL circuit breaker (5 amp) at panel.
2. Carefully plug-in/install Garmin GMA 350H audio control in appropriate location in avionics tray.
3. Tighten radio key securing audio control to tray. Verify equipment security.
4. Push in AUDIO PANEL circuit breaker (5 amp) at panel. Turn battery & avionics switches on.
5. Perform appropriate functional checks per Garmin GMA 350H series Pilot's Guide. Turn battery & avionics switches off.

#### **E. Antenna**

Refer to § 16-70 for antenna locations and R22 Illustrated Parts Catalog (IPC) Chapter 6.

34-41 C822-1 Audio Control (Garmin GMA 350H) Installation (continued)**E. Antenna (continued)**Removal

1. Turn battery switch off & pull out AUDIO PANEL circuit breaker (5 amp) at panel.
2. Using plastic scraper, remove B270-1 sealant from around CI 102 marker beacon antenna at corners where it attaches to A794-2 panel.
3. Remove hardware securing panel to belly and disconnect A850-210 antenna cable from antenna. Carefully remove screws (they are installed with threadlocker) securing antenna to panel and remove antenna.

Installation

1. Turn battery switch off & pull out AUDIO PANEL circuit breaker (5 amp) at panel.
2. Remove paint & primer from antenna mating surfaces to ensure electrical ground.
3. Apply light coat B270-11 adhesive to new screw threads and install screws securing CI 102 marker beacon antenna to A794-2 panel. Verify security.
4. Connect A850-210 antenna cable to antenna. Install screws securing forward belly panel to belly. Verify security.
5. Apply small bead B270-1 sealant (0.1 inch max in height) around antenna at corners where it attaches to belly panel and allow to dry.
6. Perform ground checks per Part D steps 4 and 5.

**F. Scheduled Maintenance and Inspections****NOTE**

All factory-installed Garmin units are "on condition" and do not require scheduled periodic maintenance. Units feature a BIT (Built-In Test) function during each initial power-up that will detect internal failure(s) and alert pilot.

**NOTE**

Refer to § 34-60 for avionics software information.

**G. Special Maintenance and Inspections**

1. Turn battery & avionics switches off. Open circuit breaker panel and upper console.
2. Inspect condition of and verify no obvious damage to audio control, radio tray, copper bus bars, circuit breaker, and wiring. Verify no loose, chafed, or broken wires or terminals. Verify no evidence of arcing. Verify equipment security.
3. Secure circuit breaker panel and upper console. Perform ground checks per Part D steps 4 and 5.

## 34-50 GPS Installations

### 34-51 C831 GPS (Garmin GTN 600 series) Installation

#### NOTE

Refer to Garmin GTN 600 series Maintenance Manual and Instructions for Continued Airworthiness.

#### **A. Description**

The C831 GPS (Garmin GTN 600 series) includes similar navigation features available in the earlier Garmin GNS 400 series GPS, but the interface offers a combination of touch screen technology with traditional buttons and knobs.

One GTN 600 series GPS may be installed in the pilot-side console location only.

Note: R22 ADS-B Out system requires Garmin GTN 600-series GPS. Refer to § 14.1230.

#### **B. Schematic**

Refer to Figure 14-45 for C831 GPS (Garmin GTN 600 series) installation electrical schematic.

#### **C. Removal**

1. Turn battery switch off and pull out COM circuit breakers(s) (10 amp) and GPS circuit breaker(s) (7.5 amp) as required at panel.
2. Loosen radio key securing C831 GPS to tray in pilot's side console.
3. Carefully unplug/remove GPS from tray.

#### **D. Installation**

1. Turn battery switch off and pull out COM circuit breakers(s) (10 amp) and GPS circuit breaker(s) (7.5 amp) as required at panel.
2. Carefully plug-in/install C831 GPS in tray in pilot's side console.
3. Tighten radio key securing GPS to tray. Verify equipment security.
4. Push in COM circuit breaker(s) (10 amp) and GPS circuit breaker(s) (7.5 amp) as required at panel. Turn battery and avionics switches on.
5. Perform appropriate functional checks per Garmin GTN 600 series Pilot's Guide. Turn battery and avionics switches off.



34-51 C831 GPS (Garmin GTN 600 series) Installation (continued)**E. Antenna**

Refer to § 16-70 for antenna locations and R22 Illustrated Parts Catalog (IPC) Chapter 6.

**NOTE**

Antenna installation depends on number COM installations and additional equipment installed.

Removal

1. Turn battery switch off and pull out COM circuit breaker(s) (10 amp) and GPS circuit breaker(s) (7.5 amp) as required at panel.
2. Using plastic scraper, remove B270-1 sealant from around GPS antenna at corners where it attaches to tailcone.
3. Disconnect antenna cable from antenna. As required, remove B270-13 sealant from fastener holes. Remove screws securing antenna to tailcone and remove antenna.

Installation

1. Turn battery switch off and pull out COM circuit breaker(s) (10 amp) and GPS circuit breaker(s) (7.5 amp) as required at panel.
2. Remove paint & primer from antenna mating surfaces to ensure electrical ground.
3. As required, apply light coat B270-13 sealant to screw threads and install screws securing antenna to tailcone. As required, seal around screw heads and fill fastener holes using B270-13 sealant and allow to dry. Verify security.
4. Apply small bead B270-1 sealant (0.1 inch max in height) around antenna at corners where it attaches to tailcone and allow to dry.
5. Connect antenna cable to antenna. Verify security.
6. Perform ground checks per Part D steps 4 and 5.

**F. Scheduled Maintenance and Inspections****NOTE**

All factory-installed Garmin units are "on condition" and do not require scheduled periodic maintenance. Units feature a BIT (Built-In Test) function during each initial power-up that will detect internal failure(s) and alert pilot.

**NOTE**

Refer to § 34-60 for avionics software information.

34-51 C831 GPS (Garmin GTN 600 series) Installation (continued)**G. Special Maintenance and Inspections**

1. Turn battery and avionics switches off. Open circuit breaker panel. Remove hardware securing pilot's side console shell assembly to tray and carefully pivot shell assembly upward (GPS and faceplate may be also be removed).
2. Inspect condition of and verify no obvious damage to GPS, tray, copper bus bars, circuit breaker, and wiring. Verify no loose, chafed, or broken wires or terminals. Verify no evidence of arcing. Verify equipment security.
3. Secure circuit breaker panel and pilot's side console. Perform ground checks per Part D steps 4 and 5.

34-60 Avionics Software

Modern avionics software is complex and subject to rigorous testing by RHC to assure proper function and integration in the aircraft. Only specified software versions and software configurations have been FAA-approved for installation in Robinson helicopters. Software updates should not be attempted without a thorough understanding of approval status and compatibility. Technical support from either RHC or the avionics manufacturer will likely be required. In some cases, updating software for one item of avionics may require additional avionics to be updated to assure compatibility.

As long as RHC-installed equipment is functioning properly, there is no continuing airworthiness requirement to check or update software levels in Robinson helicopters; RHC will issue an SB (or FAA will issue an AD) for any mandatory updates.

Consult [www.robinsonheli.com](http://www.robinsonheli.com) > Customer Support > Avionics Support > Avionics Software page for approved software configurations.

**NOTE**

The above statements apply to avionics operating software. Databases (e.g. charts, terrain, etc.) may be updated regularly using avionics manufacturer's recommended procedures.

CHAPTER 35

WIRING DIAGRAMS

<i>Section</i>	<i>Title</i>	<i>Page</i>
35-00	Description . . . . .	35.1

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**CHAPTER 35****WIRING DIAGRAMS**35-00 Description

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## CHAPTER 36

## SPECIAL TOOLS

<u>Section</u>	<u>Title</u>	<u>Page</u>
36-10	Special Tools . . . . .	36.1
36-20	Illustrations and Tasks . . . . .	36.2

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**CHAPTER 36****SPECIAL TOOLS****36-10 Special Tools**

The following is a list of Robinson R22-series special tools.

R22-series special tools are to be used in conjunction with the applicable instructions for continued airworthiness, for their designated maintenance task.

### 36-20 Illustrations and Tasks

Refer to Figure 36-1.

Item	Part Number	Description
1	MT016-1	Engine Hoist
2	MT050-1	Main Rotor Rigging Fixture
3	MT050-2	Tail Rotor Rigging Fixture
4	MT053-1	Main Gearbox Drain Assembly – Thread Type Chip Detector
5	MT054-1	Main Gearbox Drain Assembly – Quick Disconnect Chip Detector
6	MT068-1	Horizontal Stabilizer Rigging Tool
7	MT091-1	Holder – Engine Ring Gear (includes MT091-3 decal)
8	MT091-3	Decal (torquing instructions)

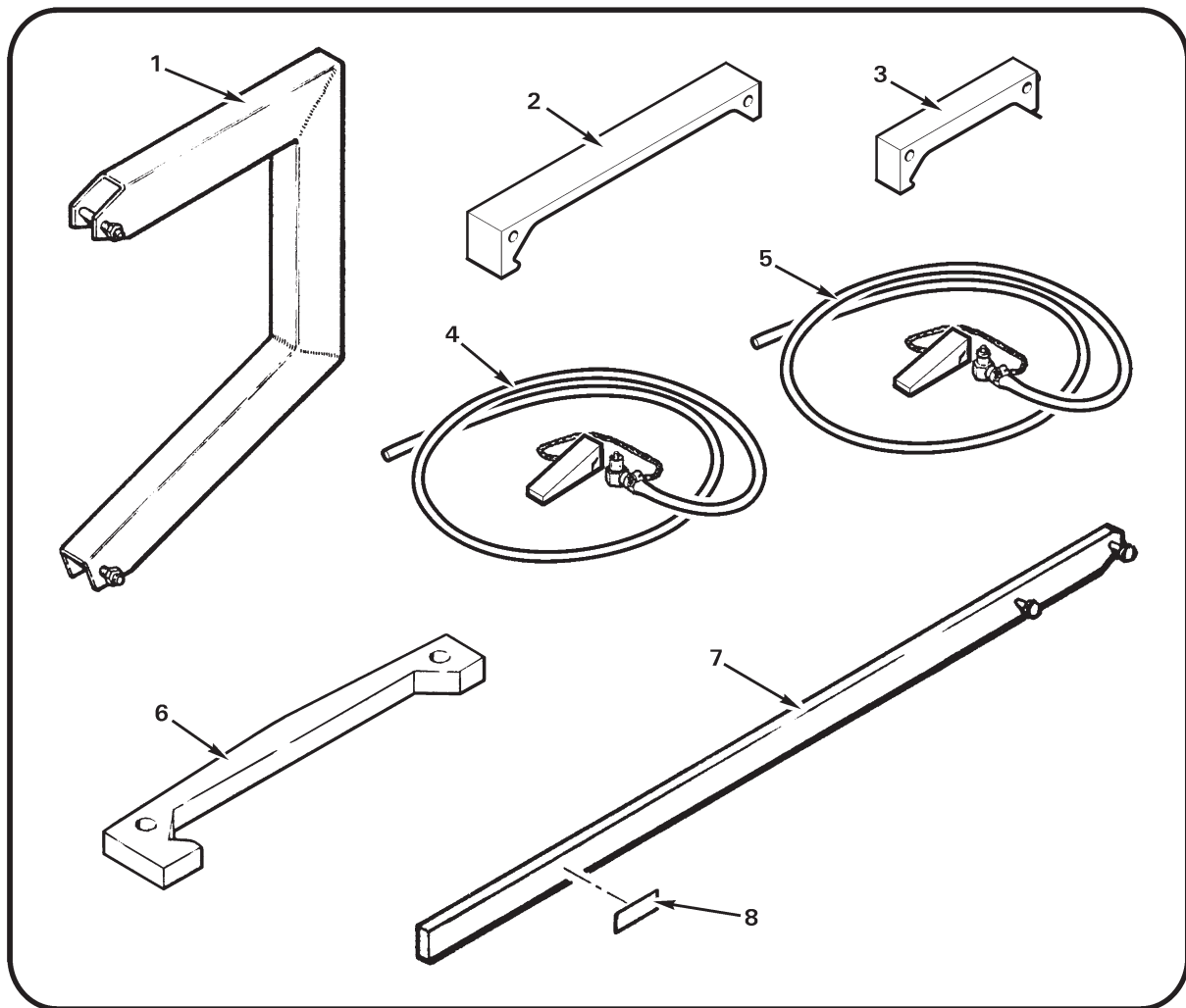
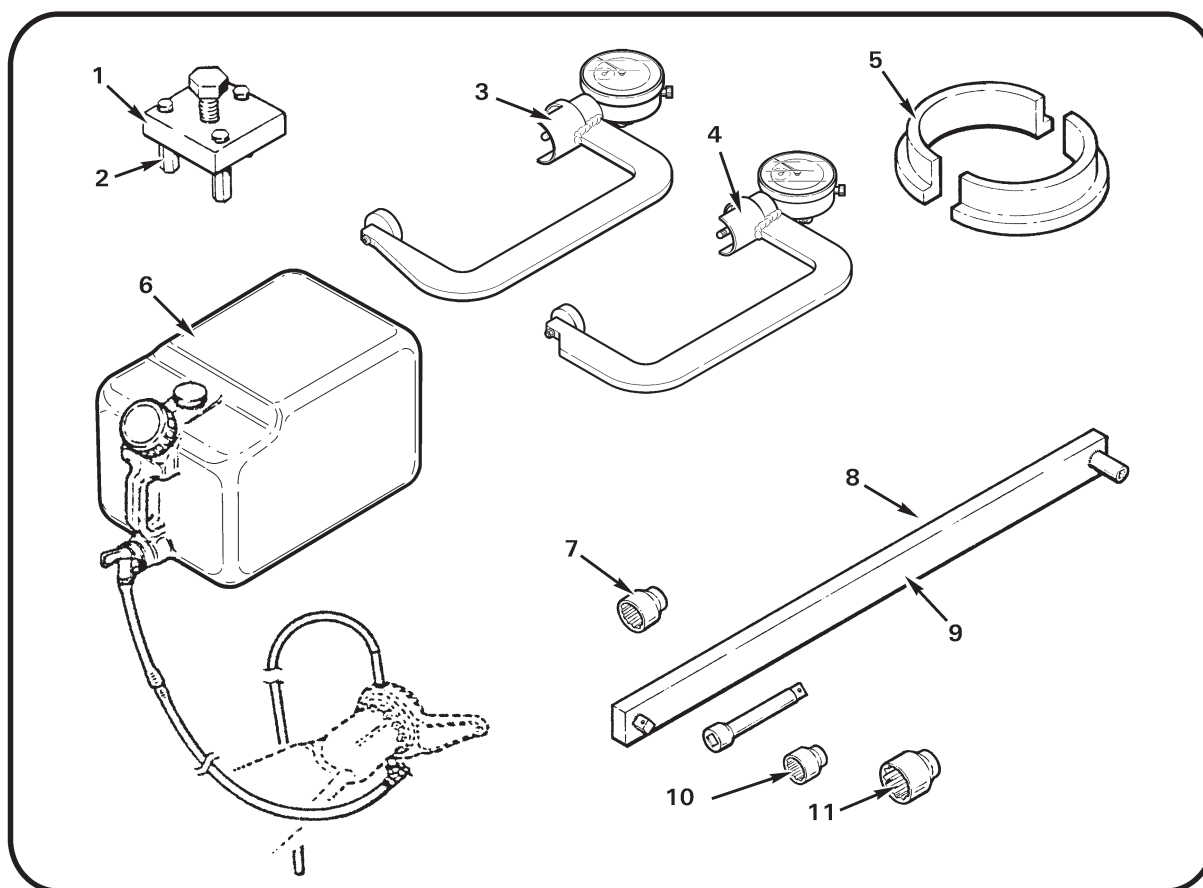


FIGURE 36-1 SPECIAL TOOLS

**36-20 Illustrations and Tasks (continued)**

Refer to Figure 36-2.

Item	Part Number	Description
1	MT092-1	Fan Puller (includes MT092-3 spacer)
2	MT092-3	Spacer – Fan Puller
3	MT122-1	Main Rotor Hub, Bolt Elongation (teeter hinges & A154-1 hub coning hinges)
4	MT122-15	Main Rotor Hub, Bolt Elongation (B370-1 hub coning hinges)
5	MT146-1	Blocks – Swashplate Rigging (set of 2)
6	MT147-1	Bleed Tool – Main Rotor Blade Spindle
7	MT173-4	Socket – 1-11/16 (3/4-inch drive, 12-point)
8	MT173-5	Torque Wrench Extension – Tool Set (no longer available)
9	MT173-6	Tube Weldment (no longer available)
10	MT173-7	Socket – 1-1/2-inch (3/4-inch drive, 12-point)
11	MT173-8	Socket – 2-inch (3/4-inch drive, 12-point)

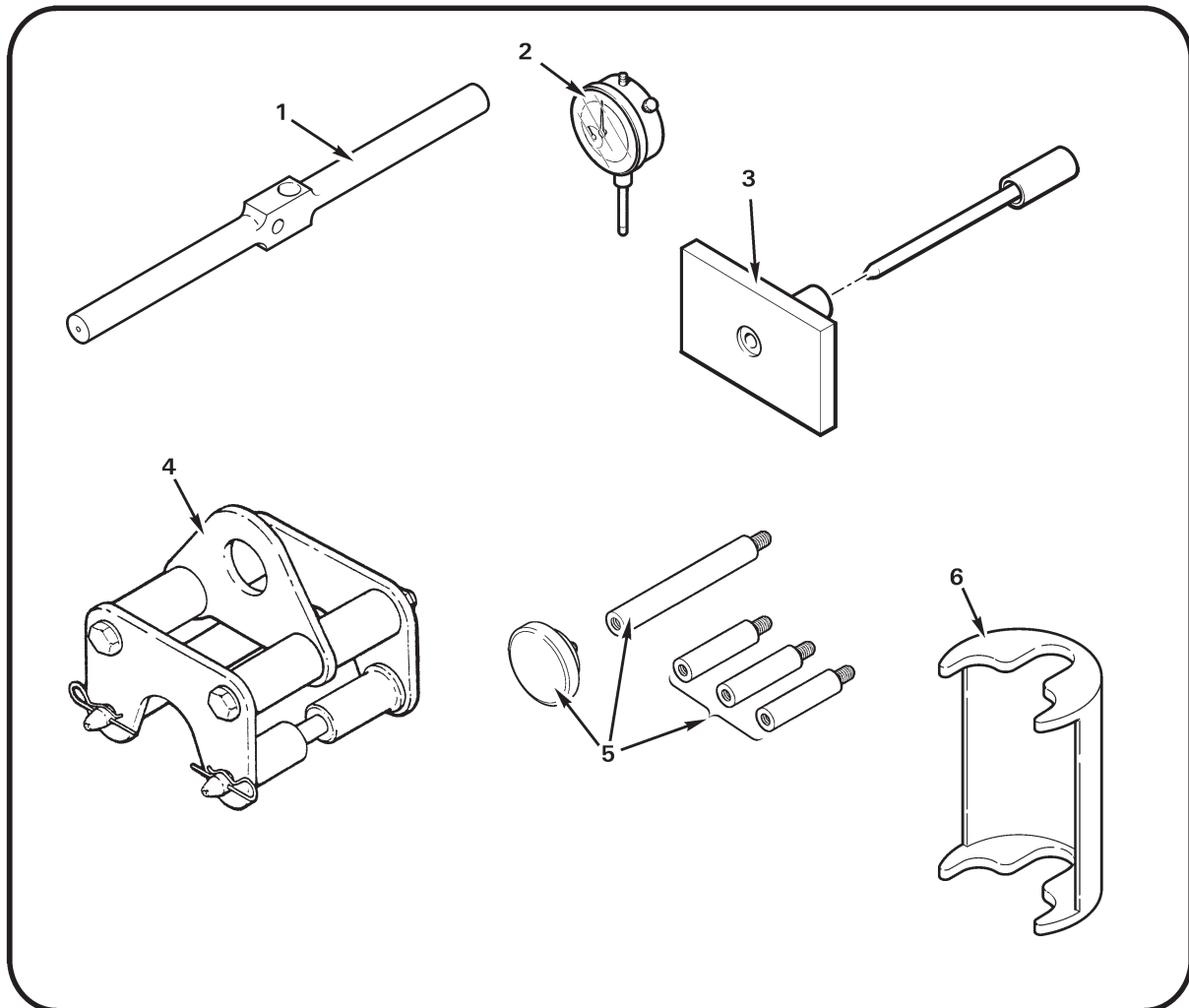


**FIGURE 36-2 SPECIAL TOOLS**

### 36-20 Illustrations and Tasks (continued)

Refer to Figure 36-3.

Item	Part Number	Description
1	MT179-4	Balancing Bar – Tail Rotor Assembly Static Balance
2	MT200-1	Dial Indicator
3	MT201-1	Pressing Fixture – Tail Rotor Hub Bearing
4	MT234-1	Helicopter Lifting Fixture
5	MT260-6	Tail Rotor Drive Shaft Runout Attachments Kit
6	MT294-1	Collective Spring Retainer



**FIGURE 36-3 SPECIAL TOOLS**

### 36-20 Illustrations and Tasks (continued)

Refer to Figure 36-4.

Item	Part Number	Description
1	MT295-1	Tail Rotor Gearbox Output Shaft Seal Replacement Tools (includes items 2, 3, 4, and Figure 36-9 item 5)
2	MT295-3	Punch
3	MT295-6	Screw
4	MT295-10	Mandrel
5	MT303-1	Clutch Bearing (A184) Removal and Installation Tools
6	MT303-3	Clutch Bearing (A184) Removal and Installation Tools (use with MT303-1 tools when hydraulic press is unavailable)

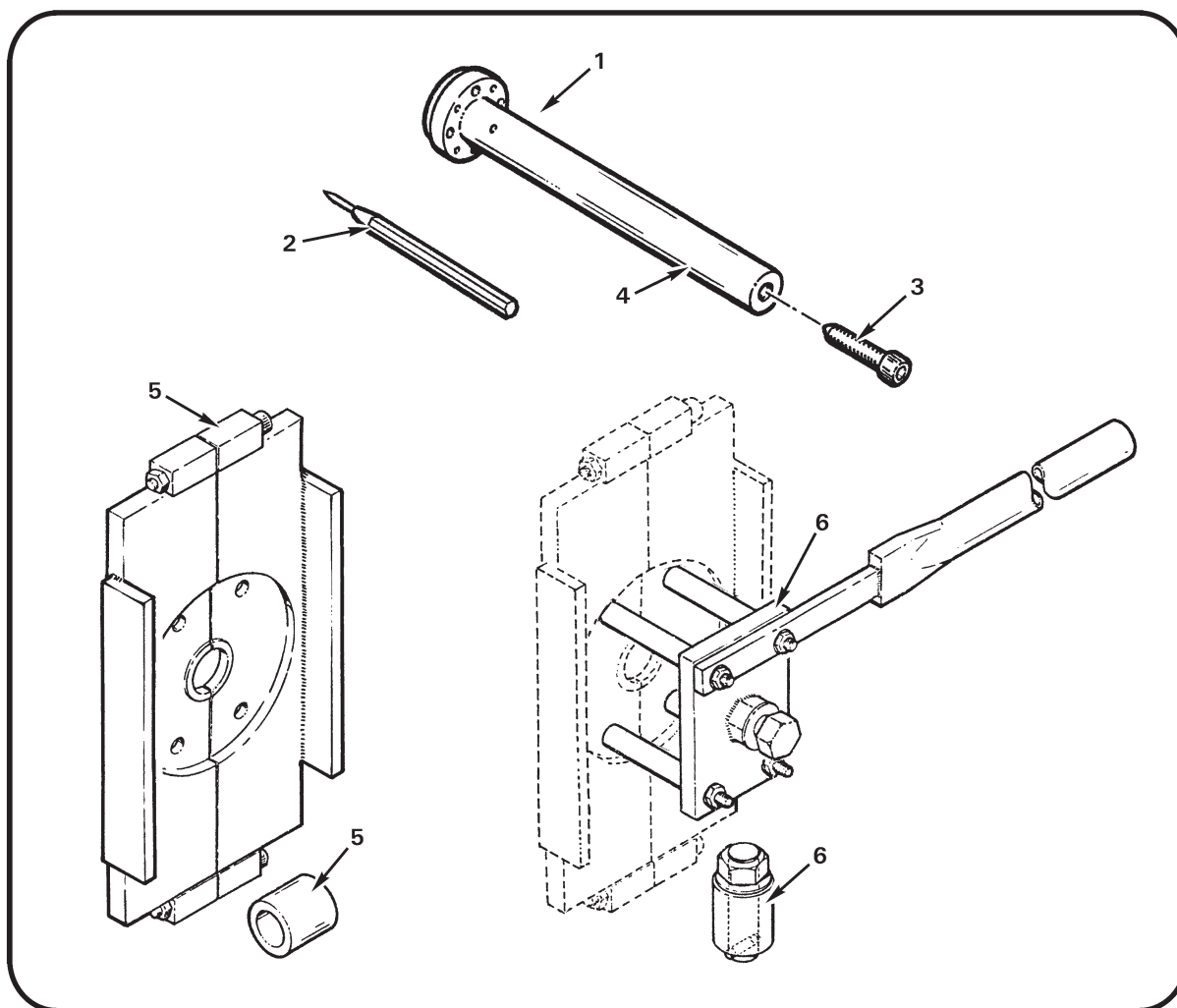


FIGURE 36-4 SPECIAL TOOLS

### 36-20 Illustrations and Tasks (continued)

Refer to Figure 36-5.

Item	Part Number	Description
1	MT329-1	Plug Assembly (A648-1 or A648-3 Bearings)
2	MT329-2	Support Weldment (A154-1 Hub)
3	MT329-8	Plug – Main Rotor Hub Bearing Installation
4	MT329-10	Tube
5	MT329-11	Plug Assembly (A648-2 Bearings)
6	MT329-13	Support Weldment
7	MT331-4	Sheave Alignment Bar
8	MT352-1	Main Rotor Blade Trim Tab Gage (includes MT200-1 dial indicator)
9	MT354-1	Teeter Moment Tool (no longer available; replaced by MT354-7)
10	MT354-7	Teeter Moment Tool (R22, R44, R66)

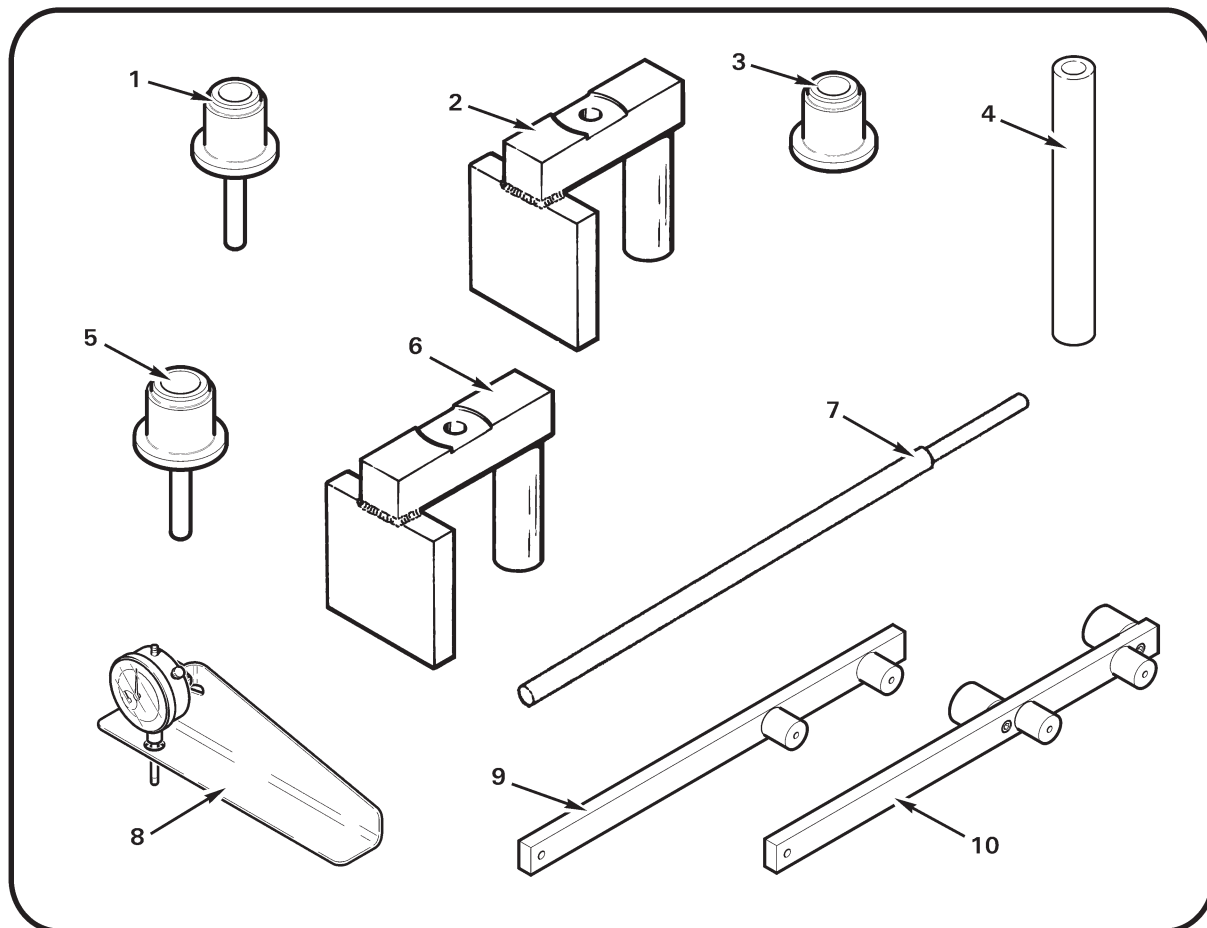
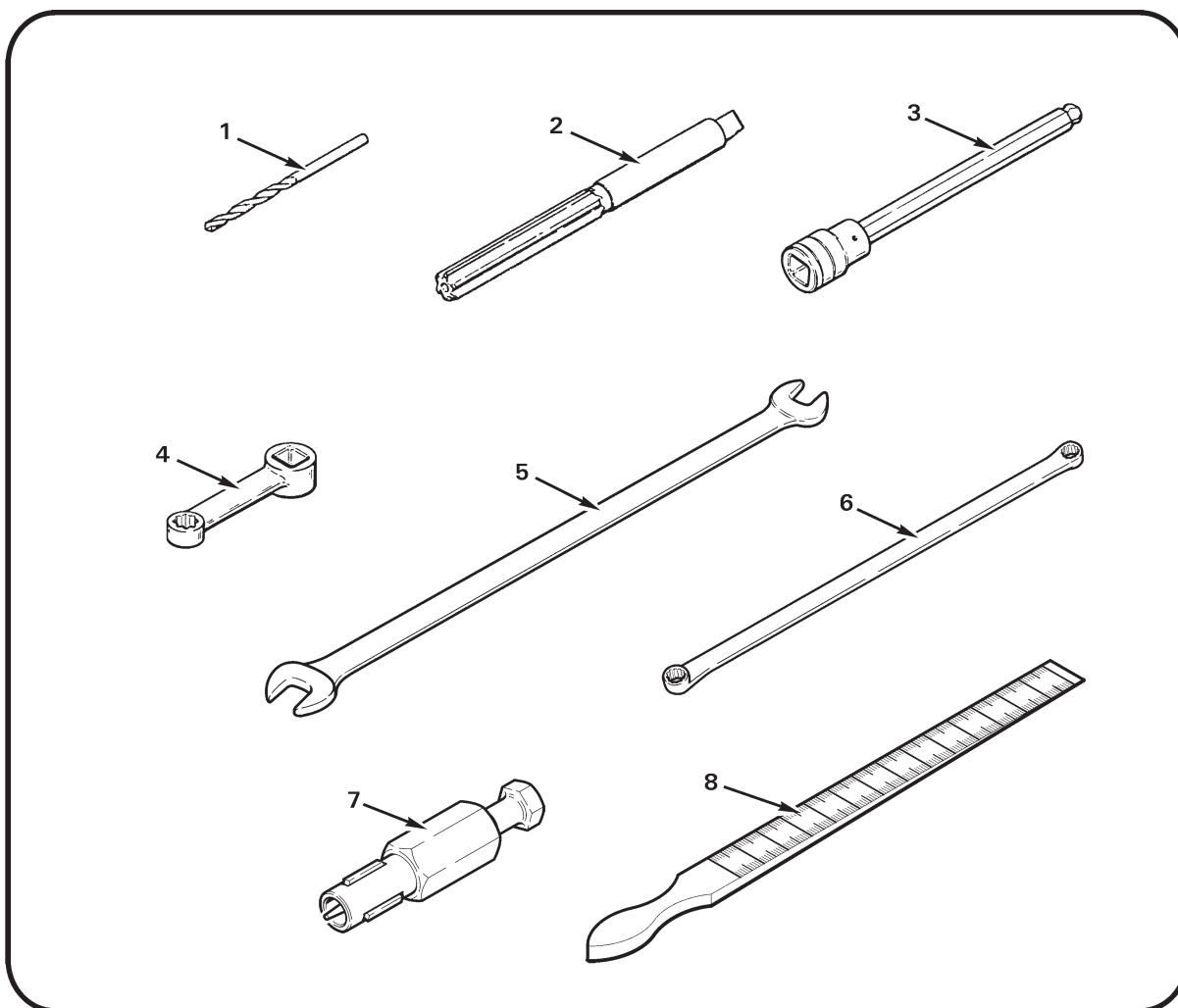


FIGURE 36-5 SPECIAL TOOLS

### 36-20 Illustrations and Tasks (continued)

Refer to Figure 36-6.

Item	Part Number	Description
1	MT357-1	0.125-inch dia. Cobalt Drill Bit
2	MT357-2	0.375-inch diameter Reamer
3	MT357-4	Hex Driver (Snap-On Part No. FABL8)
4	MT357-5	Torque Adapter (Snap-On Part No. FRDH101)
5	MT357-6	Wrench (Open end; Snap-On Part No. LTA1214)
6	MT357-7	Wrench (Box end; Snap-On Part No. XDH78A)
7	MT357-8	Nipple Chuck
8	MT357-9	Taper Gage

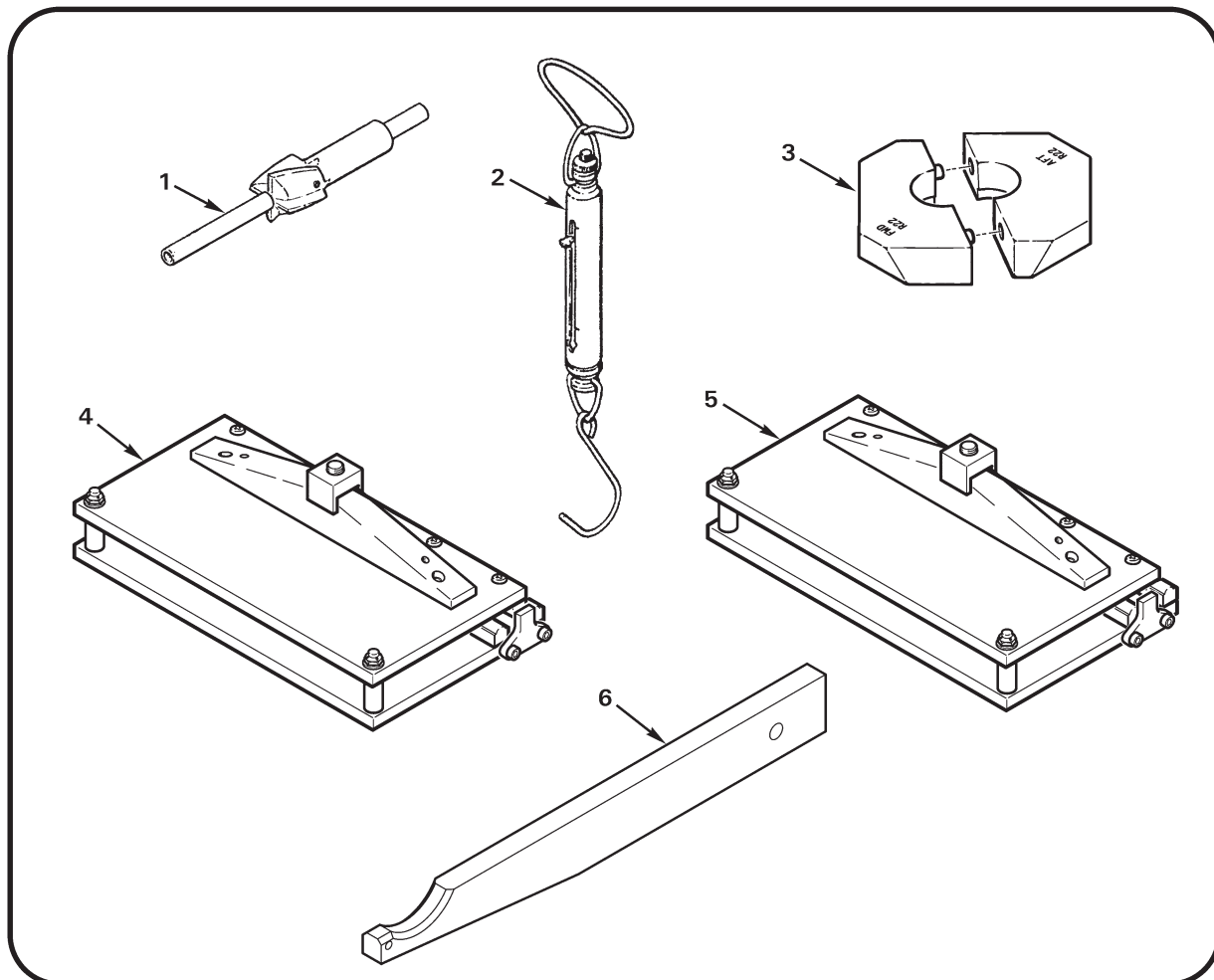


**FIGURE 36-6 SPECIAL TOOLS**

### 36-20 Illustrations and Tasks (continued)

Refer to Figure 36-7.

Item	Part Number	Description
1	MT358-1	0.750-inch dia. Spot-Facing Tool
2	MT359-1	Spring Scale (0-30 lb)
3	MT376-1	Blocks – Main Rotor Rigging (set; holds cyclic in neutral position)
4	MT526-1	<b>OBSOLETE</b> , ref only, for A016-4 Main Rotor Blade only, Trim Tab Bender
5	MT526-8	A016-6 Main Rotor Blade Trim Tab Bender (aluminum skin)
6	MT548-8	Engine Hoist – Fitting



**FIGURE 36-7 SPECIAL TOOLS**



### 36-20 Illustrations and Tasks (continued)

Refer to Figure 36-8.

Item	Part Number	Description
1	MT556-1	Tail Rotor Elastomeric Bearing Replacement Tools (includes items 2 thru 4, and 7)
2	MT556-2	Mandrel Assembly
3	MT556-5	Support
4	MT556-6	Cap
5	MT569-1	Main Rotor Bolt Drilling Fixture (teeter hinge & A154-1 hub coning hinge bolts)
6	MT569-6	Main Rotor Bolt Drilling Fixture (B370-1 hub coning hinge bolts)
7	AN4-25A	Bolt
8	AN970-4*	Washer – Tap Test Tool

\* Or 1965 or later U.S. quarter dollar coin in good condition.

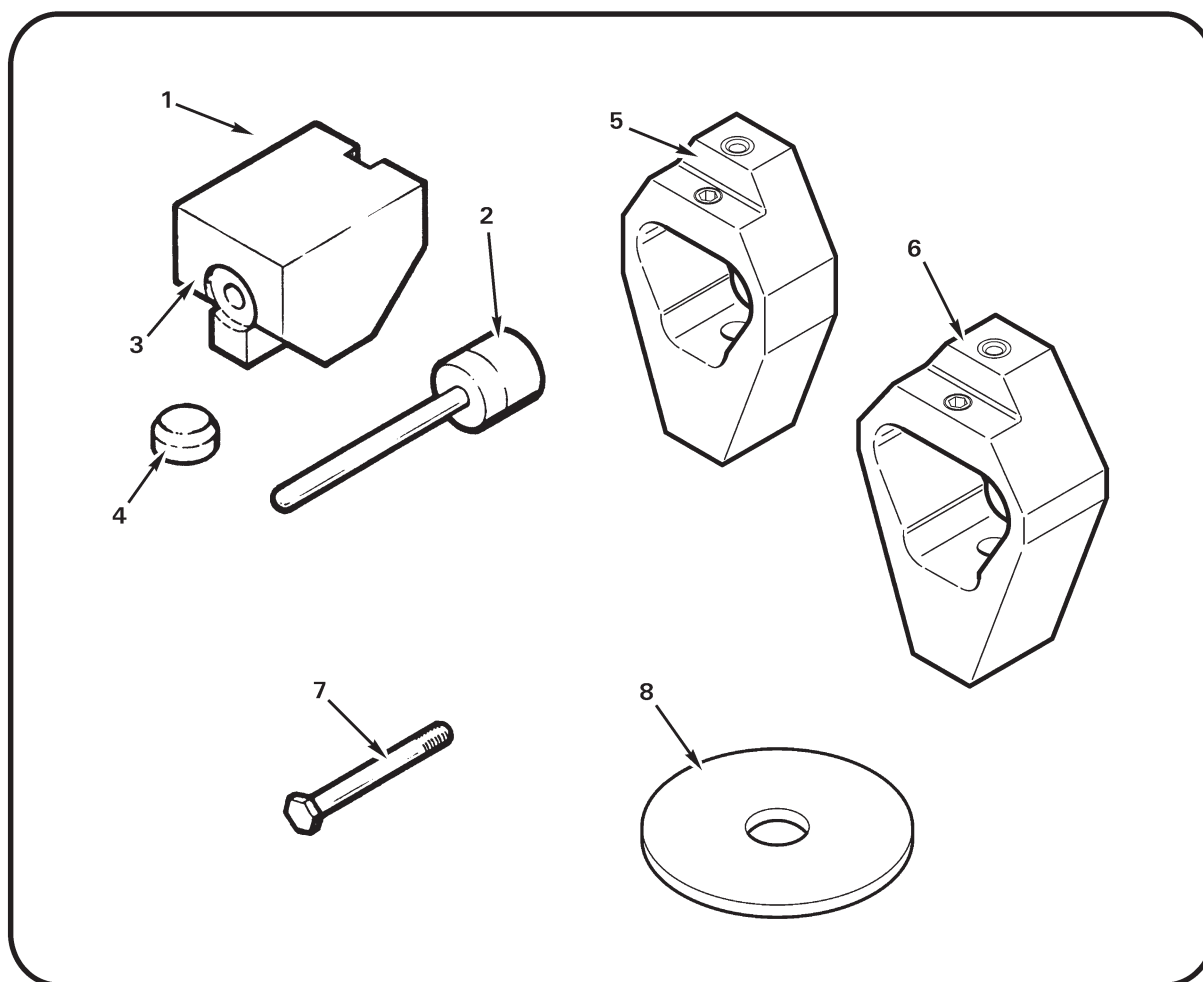


FIGURE 36-8 SPECIAL TOOLS

### 36-20 Illustrations and Tasks (continued)

Refer to Figure 36-9.

Item	Part Number	Description
1	2020HR	ACES Probalancer Analyzer (or equivalent dynamic balancer)
2	60297-12	Engine Operator's Manual (O-360 engine; refer to Lycoming Service Letter No. L114)
3	60297-30	Engine Operator's Manual (O-320 engine; refer to Lycoming Service Letter No. L114)
4	9HT4441	Extension Bar (3/4 square drive x 8 inch)
5	92470A113	Screws (#4 x 0.75 inch)

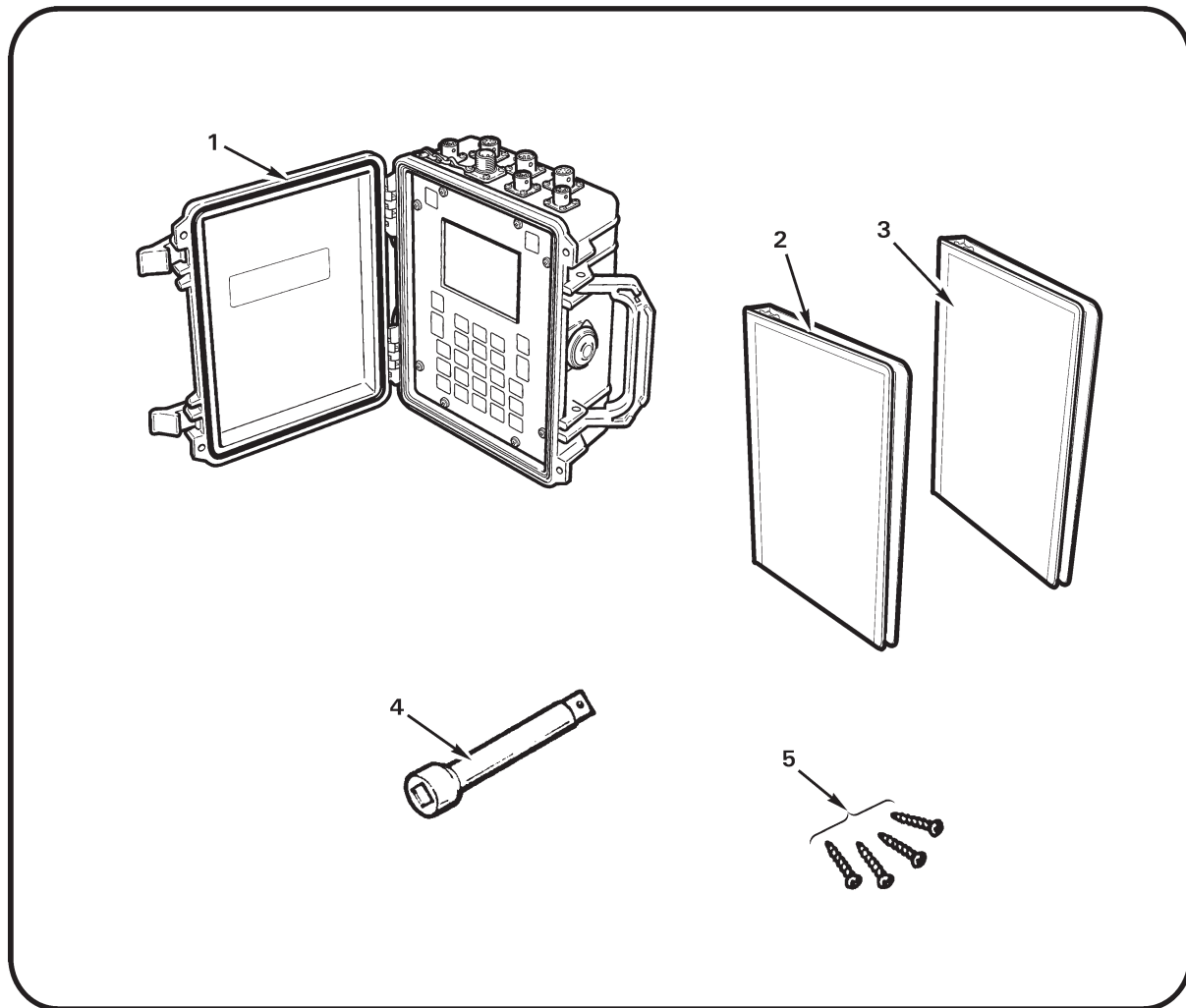


FIGURE 36-9 SPECIAL TOOLS

**CHAPTER 37**

**REVISION LOG**

<u>Section</u>	<u>Title</u>	<u>Page</u>
37-00	Revision Log . . . . .	37.1

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## REVISION LOG

DEC 2024

The R22 Maintenance Manual (MM) list of effective pages and effective dates are given below. If a previously issued page is not listed below, it is no longer an effective page and must be discarded. The issue or revision date is in bold at the top of each revision log page.

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<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>
i .....	DEC 2024	2.5 .....	OCT 2018	2.37 .....	NOV 2020
ii .....	DEC 2024	2.6 .....	OCT 2018	2.38 .....	NOV 2020
iii .....	OCT 2018	2.7 .....	OCT 2018	2.39 .....	NOV 2024
iv .....	OCT 2018	2.8 .....	OCT 2018	2.40 .....	NOV 2024
v .....	OCT 2018	2.9 .....	APR 2007	2.41 .....	OCT 2018
vi .....	OCT 2018	2.10 .....	JUN 2006	2.42 .....	OCT 2018
		2.11 .....	JUN 2006	2.43 .....	NOV 2020
1.i .....	NOV 2020	2.12 .....	JUN 2006	2.44 .....	NOV 2020
1.ii .....	NOV 2020	2.13 .....	NOV 2020	2.45 .....	NOV 2020
1.1 .....	NOV 2020	2.14 .....	NOV 2020	2.46 .....	NOV 2020
1.2 .....	NOV 2020	2.15 .....	JUN 2006	2.47 .....	DEC 2022
1.3 .....	JUN 2024	2.16 .....	JUN 2006	2.48 .....	DEC 2022
1.4 .....	JUN 2024	2.17 .....	NOV 2020	2.49 .....	NOV 2020
1.5 .....	JUN 2024	2.18 .....	NOV 2020	2.50 .....	NOV 2020
1.6 .....	JUN 2024	2.19 .....	OCT 2018	2.51 .....	NOV 2020
1.7 .....	DEC 2022	2.20 .....	OCT 2018	2.52 .....	NOV 2020
1.8 .....	DEC 2022	2.21 .....	OCT 2018	2.53 .....	NOV 2020
1.9 .....	DEC 2023	2.22 .....	OCT 2018	2.54 .....	NOV 2020
1.10 .....	DEC 2023	2.23 .....	OCT 2018	2.55 .....	NOV 2020
1.11 .....	JUN 2024	2.24 .....	OCT 2018	2.56 .....	NOV 2020
1.12 .....	JUN 2024	2.25 .....	NOV 2020	2.57 .....	NOV 2020
1.13 .....	NOV 2024	2.26 .....	NOV 2020	2.58 .....	NOV 2020
1.14 .....	NOV 2024	2.26A .....	NOV 2020	2.59 .....	DEC 2022
1.15 .....	NOV 2024	2.26B .....	NOV 2020	2.60 .....	DEC 2022
1.16 .....	NOV 2024	2.27 .....	NOV 2020	2.61 .....	NOV 2020
1.17 .....	JUN 2024	2.28 .....	NOV 2020	2.62 .....	NOV 2020
1.18 .....	JUN 2024	2.29 .....	JUN 2024	2.63 .....	NOV 2020
		2.30 .....	JUN 2024	2.64 .....	NOV 2020
2.i .....	NOV 2020	2.31 .....	JUN 2024	2.65 .....	NOV 2020
2.ii .....	NOV 2020	2.32 .....	JUN 2024	2.66 .....	NOV 2020
2.1 .....	JUN 2024	2.33 .....	DEC 2022	2.67 .....	JUN 2024
2.2 .....	JUN 2024	2.34 .....	DEC 2022	2.68 .....	JUN 2024
2.3 .....	OCT 2018	2.35 .....	NOV 2020		
2.4 .....	OCT 2018	2.36 .....	NOV 2020	3.i .....	DEC 2024

## REVISION LOG

DEC 2024

<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>
3.ii .....	DEC 2024	4.29 .....	JUN 2024	6.12 .....	NOV 2024
3.1 .....	DEC 2023	4.30 .....	JUN 2024	6.13 .....	NOV 2024
3.2 .....	DEC 2023	4.31 .....	JUN 2024	6.14 .....	NOV 2024
3.3 .....	DEC 2024	4.32 .....	JUN 2024	6.15 .....	NOV 2024
3.4 .....	DEC 2024	4.33 .....	JUN 2024	6.16 .....	NOV 2024
3.5 .....	DEC 2024	4.34 .....	JUN 2024	6.16A .....	7 AUG 92
3.6 .....	DEC 2024	4.35 .....	JUN 2024	6.16B .....	JAN 2005
		4.36 .....	JUN 2024	6.16C .....	7 AUG 92
				6.16D .....	7 AUG 92
4.i .....	JUN 2024	5.i .....	OCT 2018	6.17 .....	APR 2007
4.ii .....	JUN 2024	5.ii .....	OCT 2018	6.18 .....	APR 2007
4.1 .....	OCT 2018	5.1 .....	OCT 2018	6.19 .....	APR 2007
4.2 .....	OCT 2018	5.2 .....	OCT 2018	6.20 .....	APR 2007
4.3 .....	OCT 2018	5.3 .....	OCT 2018	6.21 .....	NOV 2020
4.4 .....	OCT 2018	5.4 .....	OCT 2018	6.22 .....	NOV 2020
4.5 .....	NOV 2020	5.5 .....	OCT 2018	6.22A .....	NOV 2020
4.6 .....	NOV 2020	5.6 .....	OCT 2018	6.22B .....	NOV 2020
4.7 .....	5/22/87	5.7 .....	5/22/87	6.23 .....	MAR 2004
4.8 .....	5/22/87	5.8 .....	28 JUL 89	6.24 .....	MAR 2004
4.9 .....	5/22/87	5.9 .....	28 JUL 89	6.24A .....	NOV 2020
4.10 .....	JAN 2005	5.10 .....	28 JUL 89	6.24B .....	NOV 2020
4.11 .....	5/22/87	5.11 .....	28 JUL 89	6.25 .....	APR 2007
4.12 .....	APR 2007	5.12 .....	JUN 2000	6.26 .....	APR 2007
4.13 .....	5/22/87	5.13 .....	28 JUL 89	6.27 .....	APR 2007
4.14 .....	29 MAR 93			6.28 .....	APR 2007
4.15 .....	JUN 2024	6.i .....	NOV 2024	6.29 .....	APR 2007
4.16 .....	JUN 2024	6.ii .....	NOV 2024	6.30 .....	APR 2007
4.17 .....	JUN 2024	6.1 .....	OCT 2014		
4.18 .....	JUN 2024	6.2 .....	OCT 2014	7.i .....	OCT 2018
4.19 .....	JUN 2024	6.3 .....	APR 2007	7.ii .....	OCT 2018
4.20 .....	JUN 2024	6.4 .....	APR 2007	7.1 .....	OCT 2014
4.21 .....	JUN 2024	6.5 .....	NOV 2020	7.2 .....	OCT 2014
4.22 .....	JUN 2024	6.6 .....	NOV 2020	7.3 .....	JUN 2006
4.23 .....	JUN 2024	6.7 .....	NOV 2020	7.4 .....	5/22/87
4.24 .....	JUN 2024	6.8 .....	NOV 2020	7.5 .....	NOV 2020
4.25 .....	JUN 2024	6.9 .....	NOV 2024	7.6 .....	NOV 2020
4.26 .....	JUN 2024	6.10 .....	NOV 2024	7.7 .....	OCT 2018
4.27 .....	JUN 2024	6.11 .....	NOV 2024	7.8 .....	OCT 2018
4.28 .....	JUN 2024				

## REVISION LOG

DEC 2024

<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>
7.9 .....	NOV 2020	7.39 .....	19 SEP 97	8.11 .....	JUN 2024
7.9A .....	NOV 2020	7.40 .....	19 SEP 97	8.12 .....	JUN 2024
7.9B .....	19 SEP 97	7.41 .....	19 SEP 97	8.13 .....	JUN 2024
7.10 .....	JUN 2000	7.42 .....	19 SEP 97	8.14 .....	JUN 2024
7.11 .....	5/22/87	7.43 .....	19 SEP 97	8.15 .....	JUN 2024
7.12 .....	3 MAR 99	7.44 .....	19 SEP 97	8.16 .....	JUN 2024
7.13 .....	3 MAR 99	7.44A .....	4/15/88	8.17 .....	JUN 2024
7.14 .....	JUN 2000	7.44B .....	5 JUL 90	8.18 .....	JUN 2024
7.15 .....	OCT 2018	7.44C .....	26 JUL 96	8.19 .....	JUN 2024
7.16 .....	OCT 2018	7.44D .....	7 AUG 92	8.20 .....	JUN 2024
7.17 .....	APR 2005	7.45 .....	OCT 2018	8.21 .....	5/22/87
7.18 .....	MAR 2004	7.46 .....	OCT 2018	8.22 .....	5/22/87
7.19 .....	OCT 2018	7.47 .....	DEC 2022	8.23 .....	5/22/87
7.20 .....	OCT 2018	7.48 .....	DEC 2022	8.24 .....	5/22/87
7.21 .....	OCT 2018	7.48A .....	NOV 2020	8.25 .....	JUN 2024
7.22 .....	OCT 2018	7.48B .....	NOV 2020	8.26 .....	JUN 2024
7.23 .....	OCT 2018	7.49 .....	OCT 2018	8.27 .....	JUN 2024
7.24 .....	OCT 2018	7.50 .....	OCT 2018	8.28 .....	JUN 2024
7.25 .....	NOV 2020	7.51 .....	OCT 2018	8.29 .....	JUN 2024
7.26 .....	NOV 2020	7.52 .....	OCT 2018	8.30 .....	JUN 2024
7.27 .....	OCT 2018	7.53 .....	OCT 2018	8.31 .....	JUN 2024
7.28 .....	OCT 2018	7.54 .....	OCT 2018	8.32 .....	JUN 2024
7.29 .....	NOV 2020	7.55 .....	OCT 2018	8.33 .....	JUN 2024
7.29A .....	NOV 2020	7.56 .....	OCT 2018	8.34 .....	JUN 2024
7.29B .....	NOV 2020	7.57 .....	31 JAN 89	8.34A .....	JUN 2024
7.30 .....	NOV 2020			8.34B .....	JUN 2024
7.31 .....	OCT 2018	8.i .....	JUN 2024	8.35 .....	5/22/87
7.32 .....	OCT 2018	8.ii .....	JUN 2024	8.36 .....	5/22/87
7.33 .....	NOV 2020	8.1 .....	JUN 2024	8.37 .....	JUN 2006
7.33A .....	NOV 2020	8.2 .....	JUN 2024	8.38 .....	JUN 2006
7.33B .....	MAR 2004	8.3 .....	JUN 2024	8.39 .....	OCT 2018
7.34 .....	5/22/87	8.4 .....	JUN 2024	8.40 .....	OCT 2018
7.35 .....	26 JUL 96	8.5 .....	JUN 2024	8.41 .....	OCT 2018
7.36 .....	MAR 2004	8.6 .....	JUN 2024	8.42 .....	OCT 2018
7.37 .....	26 JUL 96	8.7 .....	JUN 2024	8.43 .....	OCT 2018
7.38 .....	26 JUL 96	8.8 .....	JUN 2024	8.44 .....	OCT 2018
7.38A .....	26 JUL 96	8.9 .....	JUN 2024	8.45 .....	OCT 2018
7.38B .....	26 JUL 96	8.10 .....	JUN 2024	8.46 .....	OCT 2018

## REVISION LOG

DEC 2024

<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>
8.47 .....	19 SEP 97	10.13 .....	5/22/87	10.39 .....	JAN 2005
8.48 .....	26 JUL 96	10.14 .....	5/22/87	10.40 .....	JAN 2005
8.49 .....	MAR 2004	10.15 .....	APR 2007		
8.50 .....	5/22/87	10.16 .....	APR 2007	11.i .....	OCT 2018
8.51 .....	5/22/87	10.17 .....	5/22/87	11.ii .....	OCT 2018
8.52 .....	5/22/87	10.18 .....	5/22/87	11.1 .....	OCT 2018
8.53 .....	5/22/87	10.19 .....	5/22/87	11.2 .....	OCT 2018
8.54 .....	5/22/87	10.20 .....	MAR 2004	11.3 .....	OCT 2018
8.55 .....	JAN 2005	10.21 .....	OCT 2018	11.4 .....	OCT 2018
8.56 .....	JAN 2005	10.22 .....	OCT 2018	11.5 .....	OCT 2018
8.57 .....	5/22/87	10.23 .....	28 JUL 89	11.6 .....	OCT 2018
8.58 .....	5/22/87	10.24 .....	30 JUN 99		
8.59 .....	JUN 2006	10.25 .....	5/22/87	12.i .....	OCT 2018
8.60 .....	JUN 2006	10.25A .....	28 JUL 89	12.ii .....	OCT 2018
8.61 .....	22 JAN 93	10.25B .....	28 JUL 89	12.1 .....	OCT 2018
8.62 .....	22 JAN 93	10.26 .....	28 JUL 89	12.2 .....	OCT 2018
8.63 .....	APR 2005	10.26A .....	JUN 2006	12.3 .....	OCT 2014
8.64 .....	APR 2005	10.26B .....	JUN 2006	12.4 .....	OCT 2014
		10.27 .....	NOV 2020	12.5 .....	OCT 2014
9.i .....	DEC 2022	10.28 .....	NOV 2020	12.6 .....	OCT 2014
9.ii .....	DEC 2022	10.29 .....	NOV 2020	12.7 .....	OCT 2014
9.1 .....	DEC 2022	10.30 .....	NOV 2020	12.8 .....	OCT 2014
9.2 .....	DEC 2022	10.31 .....	NOV 2020	12.9 .....	OCT 2018
		10.32 .....	NOV 2020	12.9A .....	OCT 2018
10.i .....	NOV 2020	10.32A .....	NOV 2020	12.9B .....	OCT 2018
10.ii .....	NOV 2020	10.32B .....	NOV 2020	12.10 .....	OCT 2018
10.1 .....	NOV 2020	10.32C .....	NOV 2020	12.11 .....	OCT 2014
10.2 .....	NOV 2020	10.32D .....	NOV 2020	12.12 .....	OCT 2014
10.3 .....	5/22/87	10.32E .....	NOV 2020	12.13 .....	NOV 2020
10.4 .....	5/22/87	10.32F .....	NOV 2020	12.14 .....	NOV 2020
10.5 .....	DEC 2023	10.32G .....	NOV 2020	12.15 .....	OCT 2014
10.6 .....	DEC 2023	10.32H .....	NOV 2020	12.16 .....	OCT 2014
10.7 .....	JUN 2024	10.33 .....	5/22/87	12.17 .....	OCT 2014
10.8 .....	JUN 2024	10.34 .....	5/22/87	12.18 .....	OCT 2014
10.9 .....	JUN 2024	10.35 .....	JAN 2005		
10.10 .....	JUN 2024	10.36 .....	JAN 2005	13.i .....	NOV 2020
10.11 .....	DEC 2023	10.37 .....	JAN 2005	13.ii .....	NOV 2020
10.12 .....	DEC 2023	10.38 .....	JAN 2005	13.1 .....	OCT 2018



## REVISION LOG

DEC 2024

<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>
13.2	OCT 2018	14.17B	12 JAN 90	14.27	5 JUL 90
13.3	OCT 2018	14.17C	12 JAN 90	14.28	5/22/87
13.4	OCT 2018	14.17D	12 JAN 90	14.28A	5 JUL 90
13.5	OCT 2018	14.18	5/22/87	14.28B	5 JUL 90
13.6	OCT 2018	14.18A	30 JUN 99	14.29	5/22/87
13.7	NOV 2020	14.18B	30 JUN 99	14.30	5/22/87
13.8	NOV 2020	14.19	OCT 2018	14.31	5/22/87
13.9	OCT 2018	14.20	OCT 2018	14.32	5/22/87
13.10	OCT 2018	14.20A	OCT 2018	14.33	5/22/87
13.11	OCT 2018	14.20B	OCT 2018	14.34	5/22/87
13.12	OCT 2018	14.21	30 JUN 99	14.35	5/22/87
13.13	OCT 2018	14.21A	30 JUN 99	14.36	5/22/87
13.14	OCT 2018	14.21B	30 JUN 99	14.37	5/22/87
13.15	OCT 2018	14.22	5/22/87	14.38	5/22/87
13.16	OCT 2018	14.23	OCT 2018	14.39	28 JUL 89
13.17	OCT 2018	14.23A	OCT 2018	14.40	5/22/87
13.18	OCT 2018	14.23B	OCT 2018	14.40A	JUN 2000
13.19	OCT 2018	14.23C	OCT 2018	14.40B	JUN 2000
13.20	OCT 2018	14.23D	OCT 2018	14.40C	JUN 2000
13.21	NOV 2020	14.23E	OCT 2018	14.40D	JUN 2000
13.22	NOV 2020	14.23F	OCT 2018	14.41	9/25/87
13.23	NOV 2020	14.23G	OCT 2018	14.42	9/25/87
13.24	NOV 2020	14.23H	OCT 2018	14.43	5/22/87
		14.24	OCT 2018	14.44	5/22/87
14.i	OCT 2018	14.25	NOV 2020	14.45	5/22/87
14.ii	OCT 2018	14.26	NOV 2020	14.46	5/22/87
14.1	OCT 2018	14.26A	NOV 2020	14.47	5/22/87
14.2	OCT 2018	14.26B	NOV 2020	14.48	5/22/87
14.11B	OCT 2018	14.26C	NOV 2020	14.49	9/25/87
14.12	OCT 2018	14.26D	NOV 2020	14.50	5/22/87
14.13	5/22/87	14.26E	JUN 2000	14.51	7 AUG 92
14.14	5/22/87	14.26F	JUN 2000	14.52	5/22/87
14.15	5/22/87	14.26G	JUN 2000	14.53	5/22/87
14.16	12 JAN 90	14.26H	JUN 2000	14.54	4/22/87
14.16A	12 JAN 90	14.26I	JUN 2000	14.55	5/22/87
14.16B	12 JAN 90	14.26J	JUN 2000	14.56	5/22/87
14.17	12 JAN 90	14.26K	MAR 2004	14.57	5/22/87
14.17A	12 JAN 90	14.26L	MAR 2004	14.58	5/22/87

## REVISION LOG

DEC 2024

<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>
14.59 .....	5/22/87	15.8 .....	NOV 2020	19.ii .....	OCT 2018
14.60 .....	5/22/87			19.1 .....	OCT 2018
14.61 .....	5/22/87	16.i .....	OCT 2018	19.2 .....	OCT 2018
14.62 .....	5/22/87	16.ii .....	OCT 2018	19.3 .....	OCT 2018
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14.64 .....	19 SEP 97	16.2 .....	JUN 2024	19.5 .....	OCT 2018
14.65 .....	JUN 2024	16.3 .....	JUN 2024	19.6 .....	OCT 2018
14.65A .....	JUN 2024	16.4 .....	JUN 2024	19.7 .....	OCT 2018
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14.65C .....	JUN 2024	16.6 .....	JUN 2024		
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14.65E .....	JUN 2024	16.8 .....	JUN 2024	20.ii .....	OCT 2018
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14.66A .....	NOV 2020	17.i .....	OCT 2018	20.2 .....	OCT 2018
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14.71 .....	OCT 2018	17.4 .....	OCT 2018	21.ii .....	OCT 2018
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14.73 .....	NOV 2020	17.6 .....	OCT 2018	21.2 .....	OCT 2018
14.73A .....	NOV 2020				
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14.74A .....	NOV 2020	18.ii .....	JUN 2024	22.ii .....	OCT 2018
14.75 .....	OCT 2018	18.1 .....	OCT 2018	22.1 .....	NOV 2020
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		18.5 .....	OCT 2018	22.3 .....	NOV 2020
15.i .....	OCT 2018	18.6 .....	OCT 2018	22.4 .....	NOV 2020
15.ii .....	OCT 2018	18.7 .....	OCT 2018	22.5 .....	NOV 2020
15.1 .....	NOV 2020	18.8 .....	OCT 2018	22.6 .....	NOV 2020
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15.3 .....	OCT 2018	18.10 .....	JUN 2024	22.8 .....	NOV 2020
15.4 .....	OCT 2018	18.11 .....	JUN 2024	22.9 .....	OCT 2018
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15.6 .....	OCT 2018			22.11 .....	OCT 2018
15.7 .....	NOV 2020	19.i .....	OCT 2018	22.12 .....	OCT 2018

## REVISION LOG

DEC 2024

<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>	<u>Page</u>	<u>Date</u>
22.13 .....	OCT 2018	23.32 .....	JUN 2024	26.3 .....	OCT 2018
22.14 .....	OCT 2018	23.33 .....	NOV 2020	26.4 .....	OCT 2018
		23.34 .....	NOV 2020	26.5 .....	NOV 2020
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23.1 .....	JUN 2024	23.37 .....	JUN 2024	26.8 .....	OCT 2018
23.2 .....	JUN 2024	23.38 .....	JUN 2024	26.9 .....	OCT 2018
23.3 .....	NOV 2020	23.39 .....	NOV 2020	26.10 .....	OCT 2018
23.4 .....	NOV 2020	23.40 .....	NOV 2020	26.11 .....	NOV 2020
23.5 .....	NOV 2020	23.41 .....	NOV 2020	26.12 .....	NOV 2020
23.6 .....	NOV 2020	23.42 .....	NOV 2020	26.13 .....	JUN 2024
23.7 .....	JUN 2024	23.43 .....	JUN 2024	26.14 .....	JUN 2024
23.8 .....	JUN 2024	23.44 .....	JUN 2024	26.15 .....	JUN 2024
23.9 .....	JUN 2024			26.16 .....	JUN 2024
23.10 .....	JUN 2024	24.i .....	OCT 2018	26.17 .....	OCT 2018
23.11 .....	JUN 2024	24.ii .....	OCT 2018	26.18 .....	OCT 2018
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23.12A .....	JUN 2024	24.2 .....	OCT 2018	26.20 .....	NOV 2020
23.12B .....	JUN 2024	24.3 .....	OCT 2018	26.21 .....	OCT 2018
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23.15 .....	NOV 2020	25.i .....	NOV 2020	26.23A .....	NOV 2020
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23.24 .....	NOV 2020	25.8 .....	NOV 2020	26.31 .....	NOV 2020
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23.26 .....	NOV 2020	25.10 .....	NOV 2020	26.33 .....	NOV 2024
23.27 .....	DEC 2023			26.34 .....	NOV 2024
23.28 .....	DEC 2023	26.i .....	NOV 2024	26.35 .....	NOV 2024
23.29 .....	DEC 2023	26.ii .....	NOV 2024	26.36 .....	NOV 2024
23.30 .....	DEC 2023	26.1 .....	OCT 2018	26.37 .....	NOV 2024
23.31 .....	JUN 2024	26.2 .....	OCT 2018	26.38 .....	NOV 2024

REVISION LOG

DEC 2024

<i>Page</i>	<i>Date</i>	<i>Page</i>	<i>Date</i>	<i>Page</i>	<i>Date</i>
27.i . . . . .	OCT 2018	31.i . . . . .	OCT 2018	33.26 . . . . .	NOV 2020
27.ii . . . . .	OCT 2018	31.ii . . . . .	OCT 2018	33.27 . . . . .	NOV 2020
27.1 . . . . .	OCT 2018	31.1 . . . . .	OCT 2018	33.28 . . . . .	NOV 2020
27.2 . . . . .	OCT 2018	31.2 . . . . .	OCT 2018	33.29 . . . . .	NOV 2020
28.i . . . . .	DEC 2022	32.i . . . . .	OCT 2018	33.30 . . . . .	NOV 2020
28.ii . . . . .	DEC 2022	32.ii . . . . .	OCT 2018	33.31 . . . . .	NOV 2024
28.1 . . . . .	DEC 2022	32.1 . . . . .	OCT 2018	33.32 . . . . .	NOV 2024
28.2 . . . . .	DEC 2022	32.2 . . . . .	OCT 2018	33.33 . . . . .	NOV 2024
28.3 . . . . .	JUN 2024			33.34 . . . . .	NOV 2024
28.4 . . . . .	JUN 2024	33.i . . . . .	NOV 2024	34.i . . . . .	OCT 2018
28.5 . . . . .	DEC 2022	33.ii . . . . .	NOV 2024	34.ii . . . . .	OCT 2018
28.6 . . . . .	DEC 2022	33.1 . . . . .	NOV 2020	34.1 . . . . .	OCT 2018
28.7 . . . . .	JUN 2024	33.2 . . . . .	NOV 2020	34.2 . . . . .	OCT 2018
28.8 . . . . .	JUN 2024	33.3 . . . . .	OCT 2018	34.3 . . . . .	OCT 2018
28.9 . . . . .	DEC 2022	33.4 . . . . .	OCT 2018	34.4 . . . . .	OCT 2018
28.10 . . . . .	DEC 2022	33.5 . . . . .	OCT 2018	34.5 . . . . .	OCT 2018
28.11 . . . . .	JUN 2024	33.6 . . . . .	OCT 2018	34.6 . . . . .	OCT 2018
28.12 . . . . .	JUN 2024	33.7 . . . . .	OCT 2018	34.7 . . . . .	OCT 2018
28.13 . . . . .	DEC 2022	33.8 . . . . .	OCT 2018	34.8 . . . . .	OCT 2018
28.14 . . . . .	DEC 2022	33.9 . . . . .	OCT 2018	34.9 . . . . .	OCT 2018
28.15 . . . . .	JUN 2024	33.10 . . . . .	OCT 2018	34.10 . . . . .	OCT 2018
28.16 . . . . .	JUN 2024	33.11 . . . . .	OCT 2018	35.i . . . . .	OCT 2018
28.17 . . . . .	DEC 2022	33.12 . . . . .	OCT 2018	35.ii . . . . .	OCT 2018
28.18 . . . . .	DEC 2022	33.13 . . . . .	OCT 2018	35.1 . . . . .	OCT 2018
28.19 . . . . .	DEC 2022	33.14 . . . . .	OCT 2018	35.2 . . . . .	OCT 2018
28.20 . . . . .	DEC 2022	33.15 . . . . .	OCT 2018	36.i . . . . .	OCT 2018
29.i . . . . .	OCT 2018	33.16 . . . . .	OCT 2018	36.ii . . . . .	OCT 2018
29.ii . . . . .	OCT 2018	33.17 . . . . .	OCT 2018	36.1 . . . . .	OCT 2018
29.1 . . . . .	OCT 2018	33.18 . . . . .	OCT 2018	36.2 . . . . .	OCT 2018
29.2 . . . . .	OCT 2018	33.19 . . . . .	OCT 2018	36.3 . . . . .	OCT 2018
30.i . . . . .	OCT 2018	33.20 . . . . .	OCT 2018	36.4 . . . . .	OCT 2018
30.ii . . . . .	OCT 2018	33.21 . . . . .	OCT 2018	36.5 . . . . .	OCT 2018
30.1 . . . . .	OCT 2018	33.22 . . . . .	OCT 2018	36.6 . . . . .	OCT 2018
30.2 . . . . .	OCT 2018	33.23 . . . . .	NOV 2020	36.7 . . . . .	NOV 2024
		33.24 . . . . .	NOV 2020	36.8 . . . . .	NOV 2024
		33.25 . . . . .	NOV 2020		

## REVISION LOG

DEC 2024

<u>Page</u>	<u>Date</u>
36.9 .....	OCT 2018
36.10 .....	OCT 2018
37.i .....	NOV 2020
37.ii .....	NOV 2020
37.1 .....	DEC 2024
37.2 .....	DEC 2024
37.3 .....	DEC 2024
37.4 .....	DEC 2024
37.5 .....	DEC 2024
37.6 .....	DEC 2024
37.7 .....	DEC 2024
37.8 .....	DEC 2024
37.9 .....	DEC 2024
37.10 .....	DEC 2024

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