MD HELICOPTERS INC.

CSP–H–2

BASIC HANDBOOK OF MAINTENANCE INSTRUCTIONS

FOR

MDHI 369H HELICOPTERS
ISSUED: 15 SEPTEMBER 1981

NOTE
This manual has been reprinted and now contains
Revisions 1 through 21

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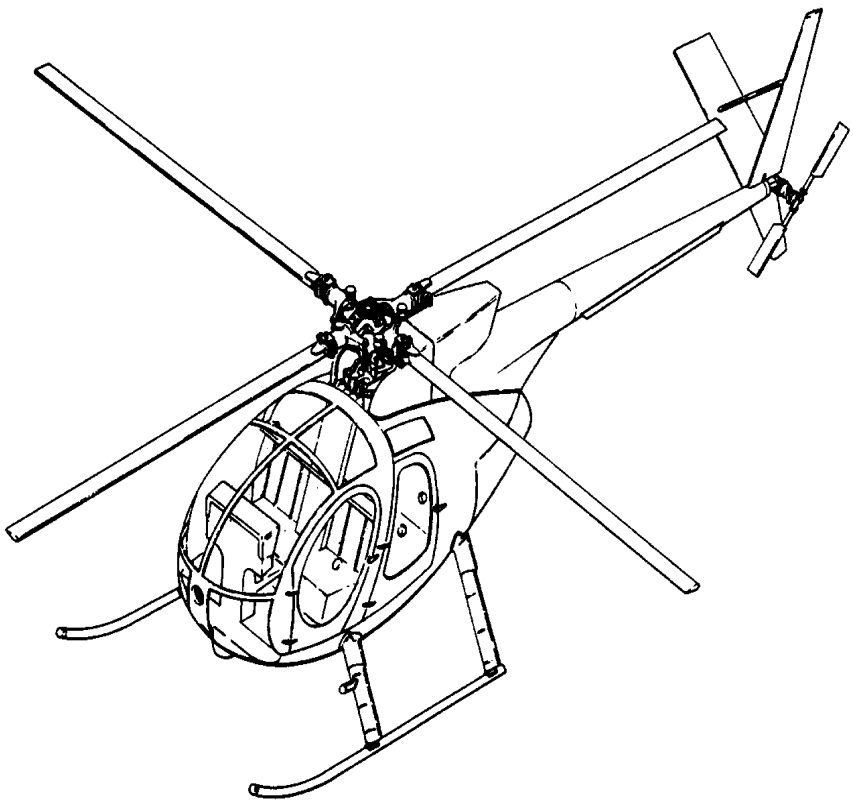
MDHI MODEL HELICOPTERS

MODEL 369H

BASIC HANDBOOK

OF

MAINTENANCE INSTRUCTIONS



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This manual has been prepared and distributed by the Technical Publications Department and is intended for use by personnel responsible for the maintenance of MDHI Helicopters. Periodic revision of this manual will be made to incorporate the latest information. If, in the opinion of the reader, any information has been omitted or requires clarification, please direct your comments to this office via this form (or a duplicate). An endeavor will be made to include such information in future revisions.

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Manual Title: _____ Page Number(s): _____

Chapter Title: _____ Paragraph Number(s): _____

ATA Section Number: _____ Step Number(s): _____

Issue Date: _____ Figure Number(s): _____

Revision No. and Date: _____ Table Number(s): _____

Remarks / Instructions: _____

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_____

_____

_____

_____

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RECORD OF TEMPORARY REVISIONS

MANUAL TITLE: **CSP-H-2, Basic Handbook of Maintenance Instructions**

REV. NO.	DATE INSERTED	BY	REMOVED BY INCORPORATING
95–001	10–18–95		
95–002	11–01–95		Revision 13
96–001	01–19–96		

REV. NO.	DATE INSERTED	BY	REMOVED BY INCORPORATING

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LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGE PAGES, DESTROY SUPERSEDED PAGES

The highest revision number indicates pages changed, added or removed by the current change.

Date of original and revision pages are:

Original	15 September 1981	Revision 11	27 April 1994
Revision 1	15 June 1985	Revision 12	10 February 1995
Revision 2	14 March 1988	Revision 13	23 August 1996
Revision 3	15 January 1989	Revision 14	19 May 2000
Revision 4	1 November 1989	Revision 15	18 August 2000
Revision 5	15 June 1990	Revision 16	16 February 2001
Revision 6	1 July 1991	Revision 17	15 May 2001
Revision 7	15 October 1992	Revision 18	29 January 2003
Revision 8	13 September 1993	Revision 19	22 June 2005
Revision 9	2 March 1994	Revision 20	22 November 2005
Revision 10	5 April 1994	Revision 21	25 April 2007

Cover/Title

Cover/Title . . . . . Revision 20

Change Request

CRi and CRii . . . . . N/A

Temporary Revision

1 and 2 . . . . . Revision 21

List of Effective Pages

A and B . . . . . Revision 21

Table of Contents

i and ii . . . . . Revision 19

Bulletins

1 . . . . . Revision 14
2 . . . . . Revision 19
3 thru 5 . . . . . Revision 14
6 . . . . . Revision 21
7/(8 blank) . . . . . Revision 14

Section 1

1–i/(1–ii blank) . . . . . Revision 16
1–1 . . . . . Revision 15
1–2 . . . . . Revision 14
1–3 and 1–4 . . . . . Revision 15
1–5/(1–6 blank) . . . . . Revision 16

Section 2

2–i thru 2–iv . . . . . Revision 19
2–1 thru 2–7 . . . . . Revision 14
2–8 and 2–11 . . . . . Revision 19
2–12 thru 2–15 . . . . . Revision 14
2–16 . . . . . Revision 16
2–17 . . . . . Revision 18
2–18 thru 2–20 . . . . . Revision 14
2–21 thru 30B . . . . . Revision 19
2–31 thru 2–52 . . . . . Revision 14
2–53 thru 2–54B . . . . . Revision 19
2–55 . . . . . Revision 14
2–56 . . . . . Revision 20
2–57 . . . . . Revision 14
2–58 . . . . . Revision 20
2–59 . . . . . Revision 14
2–60 . . . . . Revision 20
2–61 thru 2–79/(2–80 blank) . . . . . Revision 14

Section 3

3–i thru 3–iv . . . . . Revision 19
3–1 thru 3–5 . . . . . Revision 14
3–6 thru 3–8 . . . . . Revision 19
3–8A and 3–8B . . . . . Revision 18
3–9 thru 3–39/(3–40 blank) . . . . . Revision 14

Section 4

4–i thru 4–iii/(iv blank) . . . . . Revision 14
4–1 thru 4–24 . . . . . Revision 14

Section 5

5–i and 5–ii . . . . . Revision 14
5–1 thru 5–12 . . . . . Revision 14

Section 6

6–i and 6–ii . . . . . Revision 18
6–1 thru 6–21/(6–22 blank) . . . . . Revision 15

Section 7

7–i thru 7–vii/(7–viii blank) . . . . . Revision 17
7–1 thru 7–14 . . . . . Revision 16
7–15 . . . . . Revision 19
7–16 thru 7–32 . . . . . Revision 16
7–33 thru 7–36A/(7–36B blank) . . . . Revision 17
7–37 and 7–38 . . . . . Revision 16
7–39 . . . . . Revision 19
7–40 thru 7–42 . . . . . Revision 16
7–43 and 7–44 . . . . . Revision 19
7–45 thru 7–74 . . . . . Revision 16
7–75 . . . . . Revision 18
7–76 thru 7–125 . . . . . Revision 16
7–126 . . . . . Revision 20
7–127 thru 7–129/(7–130 blank) . . . . Revision 16

Section 8

8–i thru 8–iii/(8–iv blank) . . . . . Revision 17
8–1 thru 8–7 . . . . . Revision 17
8–8 . . . . . Revision 19
8–9 thru 8–10 . . . . . Revision 17
8–11 and 8–12 . . . . . Revision 19
8–13 thru 8–15 . . . . . Revision 17
8–16 and 8–17 . . . . . Revision 19
8–18 thru 8–26 . . . . . Revision 17
8–27 . . . . . Revision 19
8–28 thru 8–49/(8–50 blank) . . . . . Revision 17

Section 9

9–i and 9–ii . . . . . Revision 17
9–iii and 9–iv . . . . . Revision 18
9–1 thru 9–34 . . . . . Revision 17
9–35 . . . . . Revision 20
9–36 thru 9–38 . . . . . Revision 17
9–39 . . . . . Revision 20
9–40 . . . . . Revision 17
9–41 . . . . . Revision 18
9–42 thru 9–48 . . . . . Revision 17
9–49 thru 9–54 . . . . . Revision 18
9–55 . . . . . Revision 17
9–56 thru 9–58 . . . . . Revision 18

Section 10

10–i and 10–ii . . . . . Revision 18
10–1 thru 10–22 . . . . . Revision 18

Section 11

11–i and 11–ii . . . . . Revision 18
11–1 thru 11–32 . . . . . Revision 18

Section 12

12–i and 12–ii . . . . . Revision 18
12–1 thru 12–24 . . . . . Revision 18

Section 13

13–i and 13–ii . . . . . Revision 18
13–1 thru 13–12 . . . . . Revision 18

Section 14

14–i and 14–ii . . . . . Revision 18
14–1 and 14–2 . . . . . Revision 18

Section 15

15–i and 15–ii . . . . . Revision 18
15–1 thru 15–4 . . . . . Revision 18

Section 16

16–i and 16–ii . . . . . Revision 19
16–1 thru 16–6 . . . . . Revision 19

Section 17

17–i thru 17–vi . . . . . Revision 19
17–1 thru 17–78 . . . . . Revision 19

Section 18

18–i and 18–ii . . . . . Revision 19
18–1 thru 18–4 . . . . . Revision 19

Section 19

19–i thru 19–iii/(19–iv blank) . . . . . Revision 15
19–1 thru 19–44 . . . . . Revision 15

Section 20

20–i and 20–ii . . . . . Revision 20
20–1 thru 20–102 . . . . . Revision 20

TABLE OF CONTENTS

CSP-H-2

Cover/Title Page

Technical Manual Recommended Change Report

Record of Temporary Revisions

List of Effective Pages

Service Bulletins

1 Introduction

2 Servicing and General Maintenance

3 Fuselage

4 Furnishings

5 Tailboom and Tail Surfaces

6 Landing Gear

7 Main Rotor and Control System

8 Tail Rotor and Control System

9 Transmissions and Drives System

10 Engine Installation and Cooling System

11 Engine Control Systems

12 Engine Fuel System

13 Engine Oil System

14 Engine Ignition System

15 Engine Exhaust System

16 Engine Air Induction System

17 Instrument Panel and Indicating Systems

18 Heating and Ventilating Systems

19 Electrical System

20 Wiring and Schematic Diagrams

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Contents

SERVICE BULLETINS

INDEX

NOTE: As Service Information Notices are re-issued, they will be identified as Service Bulletins using the helicopter model designation as the prefix.

1. Service Bulletins (Notices)

This Index provides a current list of Service Bulletins (Notices), active and cancelled or superceded.

2. Active Service Bulletins (Notices)

Table 1 is a list of Service Bulletins (SB), previously published as Service Information Notices (SIN) that have been issued and are currently active against the 369H Model Helicopter.

3. Scope

The following is an explanation of how to read Table 1.

(1). **Model Effectivity** - The following is a list of the aircraft models effected by the following Service Bulletins.

DESIGNATION

MODEL		SERVICE DOCUMENT	
FAA	Marketing	New SB	Old SIN
369H	500C	SB369H-	HN-

(2). **Subject** - A brief description of the Bulletin.

(3). **Date** - Date of the last issuance of the Bulletin.

Table 1. ACTIVE SERVICE BULLETINS

369H	SUBJECT	DATE
1.1	Inspection of 369A5400 Tail Rotor Transmission Assembly	10-06-69
1.1*	Addendum x1	10-27-69
8	Inspection and Possible Retirement of 369A1100-501 Main Rotor Blades	11-19-68
11	M30223 Kit Installation - Main Rotor Locknut and Retaining Ring	12-8-69
17	Installation of Dual Bolt - Lower Vertical Stabilizer	4-21-70
18	M30209 Kit Installation - Engine Fuel Filter Pressure Switch	4-21-70
23	Modification for Door-Off Flight - 369A2405-3 & -4 Canopy Upper Windshield Assemblies	9-11-70
28.1	M50027 Modification Kit - Transmission and Coupling Fan Assembly	3-1-71
30	M50023 Modification Kit - Heat Control Valve Assembly	12-21-70
34.1	M50438 Modification Kit - Trim Potentiometer, Engine Oil Pressure Gage	6-16-71
35	M50436 Modification Kit - Engine-Out Warning Horn Support	5-18-71
37	Rework of 369H8062 Engine Oil Cooler Fan Assembly	8-12-71
38	New Pressure-Actuated Switch - 369H90118-501 or 369H90140 Automatic Engine Re-ignition Kit Installations	8-23-71
39	Provision for Drainage of Water Entrapment Areas	8-23-71
40.1	Inspection of Tail Rotor Transmission Output Bevel Gearshaft	12-13-71
42	Shock-Mounted Vertical-to-Horizontal Stabilizer Strut Assembly	12-17-71
45	Installation of New V_{NE} Placards	2-9-72
47	Modification of Mechanical Release System - 369H90065 Cargo Hook Kit Installation	4-10-72
48	Modification and Alignment Check - Rotor Brake Installation	5-1-72
49	Relocation of Engine Fuel Supply Hose	5-1-72
50	Inspection and Shimming of Cabin Heater Control Valve Assembly	5-31-72
51	Rework of 369H2048 Door Latching System (Autolatching)	7-24-72
53.1	369A5400 Tail Rotor Gearbox Revised Overhaul Schedule (TBO) and Component Infinite Life (Input Gearshaft Assembly)	8-7-72

Table 1. ACTIVE SERVICE BULLETINS (Cont.)

369H	SUBJECT	DATE
54	Inspection of 369H6340 and 369H92131 Landing Gear Damper Assembly (Poppet Type)	10-23-72
55	Valve Housing Modification - Heat Control Valve Assembly, Cabin Heating System Kit Installation	3-1-73
56	369A5100 Series Main Transmission Assembly (Including Basic and All Dash-Numbered Configuration) - Installation of New Ring Gear Bolts and Serial Number Identification	3-6-73
57	Engine Anti-Icing and Cabin Heating System Installations - Conversion from Electrical to Manual Operation	5-1-73
58	Installation of SCR Assembly - M50036 Auto-Reignition Modification Kit	5-29-73
61	Periodic Inspection of 369A5174 or 369A5145 Main Transmission Ring Gear Bolts	7-31-73
62	Installation of M50037 or M50038 Nickel-Cadmium Battery Temperature Sensing Modification Kit	8-6-73
64	Sealing 369H4534-21 and -22 Skid Mounted Position Lights	3-3-74
65	Replacement of 369A1613-3 Metal Tail Rotor Blade - Compatibility Criteria	3-4-74
66	Inspection of 369A2515-3 Frame and Battery	3-25-74
67	Corrosion Prevention/Inspection - 369A1100-501 Main Rotor Blade	4-15-74
68	Terminal Inspection/Modification - 369A4530 and 369H4540 Nickel-Cadmium Battery	4-15-74
69	Installation of Heater System Muffler Assembly	6-10-74
70	Installation of 369A8136-503 or -701 Fuel Shutoff Valve Control	8-5-74
71	Installation of M50039 Modification Kit Noise Filter	8-5-74
72	M50041 Emergency Release Mechanism Modification - 369H90065 Cargo Hook Kit Installation	8-5-74
73	Inspection of Main Rotor Blade Trailing Edge	8-19-74
74.2	Installation of 369N2697 Aluminum Type Main Rotor Blade Pendulum Weight Vibration Absorber Assembly	9-29-75
75	Rework or Replacement of 369H8101-3, -5 and 369A8102-3, -5 Fuel Cell Assemblies	8-19-74
77	Relocation of 369H4508 Magnetic Compass	9-30-74
79.1	Re-greasing Double Row Bearing - 369A7003-3 Main Rotor Swashplate Bearing Assembly	9-24-82
80	Bendix Service Bulletin No. 109, Dated 10-22-74, Inspection of Flexible Coupling Locknut	11-18-74
81	Modification of M50042 Fuel Cell Vent System Installation Modification Kit	1-2-75
82.1	Inspection/Repair of Aft Fuselage Skin Cracks	9-26-75
83	Inspection of 369A1613-Basic and -3 Root Fitting of Metal Tail Rotor Blades	4-15-75
84	Inspection of 369A8437 Hinges; Engine Air Filter Bypass Door	5-5-75
85.1	Relocation of 369H8144 Fuel Filter Pressure Switch	6-20-75
86	Tail Rotor Drive System Inspection - Installation of 369A5518-601 Tail Rotor Drive Shaft and Bungee Assembly Associated with Metal Tail Rotor Blades and Indexing of all Helicopter Tail Rotor Drive Shafts	4-28-75
87	Inspection and Relocation of 369H8144 Fuel Filter Pressure Switch	6-23-75
88	Inspection of 369A1710-Basic, -9, -11, 369A6120, 369A1607 and 369CSK22 Fiberglass Tail Rotor Blades	8-28-75
89	M50047 Modification Kit - Tank Unit Fuel Quantity Rheostat 369A4225-501	11-7-75
90	Field Modification of M50440 Door Latch Kit	12-11-75
91	Modification for Seating and Belts - (4) Kit Installation, Additional of 369H90035-501 Head and Back Restraint Panels	1-23-76
92	Field Maintenance of 369A1400-603 to -605 Configuration Main Rotor Damper Assembly	3-1-76
93	Operational Check and Adjustment of Autolatching Mechanism - Pilot and Cargo Doors	3-11-76
94	Removal of Inboard Tab - 369A1100-501 Main Rotor Blade	4-1-76
95	Inspection and Repair of 369H8016-1 and -2 Adjustable Upper Engine Mount Assemblies	4-26-76
96	369H90148 Basic and -501 Configurations Engine Air Particle Separator Filter Assembly Kit Installation - Installation of New 369H90157 Aft Screen Assembly	5-10-76
97	Relocation of 369H4515 Outside Air Temperature (OAT) Indicator M30301 Modification Kit	6-18-76
98	Potting of 369A4580 N_2 Governor Control - Pilot's and Co-pilot's Collective Pitch Stick Assemblies	6-18-76

Table 1. ACTIVE SERVICE BULLETINS (Cont.)

369H	SUBJECT	DATE
99	Inspection of 369A1807-Basic and -5 Tail Rotor Pitch Control Link Assemblies	6-18-76
101	Field Replacement of Lock Fitting - 369A9905 Ground Handling Wheel Assemblies AER-BEA AB 2387	8-10-76
102.3	Inspection of 369A2001-601 Shock-Mounted Stabilizer Strut Assembly and Possible Replacement of 369A2130 Damper Plunger	12-24-76
103.2	Rework of 369A7120 Longitudinal Friction Guide Link - Cyclic Pitch Control Installation	9-12-77
104	M50455 Modification Kit for Fan Assembly - Engine Oil and Compartment Cooling	11-5-76
108	Inspection of Attachment Hardware - Main Rotor Pitch Control Rods to Pitch Housing Assembly	12-24-76
109	100 Hour Inspection of 369A1234-Bsc, -7 Main Rotor Hub, 80-369H1234 Lead-Lag Links and 369H1203 Lead-Lag Link Assembly	12-24-76
110	Inspection of 369A5506 Tail Rotor Drive Shaft Damper	12-24-76
111.1	Inspection of 369A3511-15 and 369A3511-17 Tailboom Bracket Assemblies - Tail Rotor Transmission Attachment	9-12-77
112	Field Fix for Main Rotor Swashplate Uniball	12-24-76
113	M50049 Modification Kit - Tachometer Generator Assembly	12-24-76
114	Replacement of 23111357 Tavco Solenoid Valve - 369H92036-1/-2 Emergency Float Kits	4-15-77
116	M50450 Wiring Modification Kit - 369H90118-505, -507, -509, -511 Automatic Engine Re-ignition Kit	8-8-77
117	Inspection and Modification of 369H8301 or 710108 Oil Cooler Duct - M50451 Kit Installation	7-22-77
118.2	369A5350-601 Overrunning Clutch Assembly - Inspection of 3695350-11 Clutch Assembly; 369A5361 Ball Bearing and 369A5368 Seal	10-27-78
119	Door Latch Synchroization Check - Pilot's and Cargo Doors Autolatching Mechanisms	9-12-77
120	Installation of Auxiliary Drain Valve - Fuel System Installation 369H92255 Drain Kit	10-3-77
121	Inspection of 369H90085 Litter Door Installation	11-30-77
122	Removal of AAE or LSI Model VR204 Capacitor - Voltage Regulator; Installation of 369A4558 or MS24166D1 Varistor - Landing Light Relay	2-6-78
123	Installation of 369A1907-5 Tail Rotor Pitch Control Links	4-3-78
124	369A92537 Engine Compressor Water Wash Kit Installation - Inspection and Replacement of Rivets	4-14-78
125	Replacement of Plenum Wall Fittings - Torque Pressure Gage Tubing and Engine Oil Pressure Gage Tubing	6-6-78
127	Field Inspection and Corrosion Repair - 369A5500 Main Rotor Drive Shaft	7-5-78
128.1	Inspection and Rework of 369A1725-Basic and 369A1725-5 Tail Rotor Hub	12-8-78
129.1	Installation of 369H90022-501 Anti-Ice Fuel Filter	11-24-80
130	Periodic Inspection of Battery Over-Temperature Warning System	1-10-79
131.1	Replacement of 369A1602 Tail Rotor Drive Fork Hinge Bolt and 369A1603 Nut, New Assembly Procedure for Tail Rotor Hub and Drive Fork Unit, Periodic Check of Flapping Bolt Preload	9-2-80
132	Field Repair of 369A7170 and 369A7171 Series Cyclic Trim Actuator Assemblies	1-29-79
135	Field Repair of 369A1100 Series Trim Tab - Main Rotor Blade	2-15-79
136	Field Rigging Check of 369A8013 and 369A8051 Series Heater Control Valve Assembly	2-16-79
137	Replacement of Radio Transmit/Intercom Trigger Switch; - Rework of Cycle Stick Grip Assembly	5-10-79
139	Inspection and Repair of 369A3035-11 and 369A3035-15 Tail Control Sta. 142.00 Bellcrank Support	6-11-79
140	Inspection of Main Rotor Blade Root Fitting Assemblies; Inspection of Main Rotor Hub Lead-Lag Assemblies	9-5-79
141.1	Installation of Voltage Transient Suppressors	11-26-79
143	Rework of Ground Handling Wheel Assemblies (Float Type)	8-20-79
144	369D290140 Kit Installation - Auxiliary Fairing and Seals Air Filter (Particle Separator)	7-23-79
145.2	100-Hour Periodic Inspection of Fuel Tank Sending Unit and Fuel Low Warning Light Indication System	5-4-81
146	Inspection of 369A7304 Magnesium, 369H2608 Aluminum Collective Torque Tube Support Bracket and 369A7339 Magnesium, 369N2650 Aluminum Collective Bungee Support Bracket	8-1-79

Table 1. ACTIVE SERVICE BULLETINS (Cont.)

369H	SUBJECT	DATE
150	369A1800 and 369H1800 Series Tail Rotor Pitch Control Assembly - Seating of Bearing Inner Race; Torque Increase for 369A1817 Locknut	11-26-79
151	Installation of 369D22099-101 Fiberglass Cabin Heat Duct Assemblies	1-15-80
152	Removal of Filter Gasket - 369H90148 and 369H90148-501 Engine Air Inlet (Particle Separator) Filter Kit Installation	3-3-80
154	Rework of 369A7010 Series One-Way Lock Assembly	6-2-80
155	Polarity Check of Diode Assemblies	6-30-80
156	Identification and Possible Rework of Seat Belt and Shoulder Harness Assemblies	7-11-80
157	Conversion from Pressure Switch Activated to EPO Activated Auto-Reignition System	8-1-80
158	Wiring Modification - Untility Light Circuit and Transmission Oil Pressure and Temperature Warning Light Circuit	9-30-80
159	Installation of 369D28300-501 Drain Kit - Engine Oil Tank and Oil Cooler	8-18-80
160	Relocation of Auto-Reignition Controls and Modification of System for Full Time Operation	2-22-83
161	Rework of Static Pressure Tube Installation to Minimize Altimeter Needle Oscillation	12-8-80
162.1	Inspection of 369A7003-3 Swashplate Bearing	9-14-81
163	Sealing of Interface - Abrasion Strip and Main Rotor Blade Skin	1-30-81
164.1	Inspection of Overrunning Clutch Sprag Assembly	5-10-83
165	Field Inspection and Repair of 369A5401 Tail Rotor Transmission Main Housing Assembly	4-15-81
166	Installation of M30287-501 Engine Air Inlet Deflector Kit	4-21-81
167	Shimming Procedure - Gas Producer Interconnecting Torque Tube Assembly	5-4-81
168	Special Inspection of 369A7003-1 Swashplate Bearing Assembly	5-6-81
169	Replacement of 369A7706-3 RPM Governor Lever Control Rod	5-15-81
170	Corrosion Inspection/Treatment of 369A7314 and 369N2648 One-Way Lock Support Assembly	6-4-81
171	Inspection/Modification of BI-16600-12 Breeze Corporation Inc. Hoist	6-18-81
172	Inspection and Torque Requirements - Scroll Mounted Bleed Air Fittings	7-21-81
173	Deactivation of Main Rotor Brake System (if installed); Periodic Inspection of 369A5501 or 369H92564 Tail Rotor Drive Shaft Forward Flexible Coupling. Installation of Fail Safe Device at 369A5501 or 369H92564 Tail Rotor Drive Shaft Forward Flexible Coupling Check of Flexible Couplings.	11-2-81
174	369H90123 Series Main Rotor Brake System - Installation of 369D292585 Master Cylinder Stop	8-28-81
175	Inspection of 369A1200 Series Main Rotor Hub Assembly; Inspection of 369A1220 Main Rotor Blade Lead-Lag Pivot Bolt (Vertical Hinge Pin)	1-4-82
176	Installation of 3569H4237-21 Resistor Board Assembly for Easier Accurate Adjustment of TOT Indicator	2-1-82
177	Instrument Cluster 3-Pack Conversion - AC-to-Rochester	2-15-82
178	Rework of 369A9905-Basic and -3 Ground Handling Wheel Assemblies to Accommodate Installation of New 369D26107 Landing Gear Skid Fittings	6-29-82
179	Replacement of Intercom (ICS) Switch and Jack Assembly	7-1-82
181	New Shimming Procedure - 369A5501 or 369H92564 Tail Rotor Drive Shaft Forward Flexible Coupling With Fail Safe Device Installed	10-12-82
182	Replacement of Float Inflation System Solenoid Valves with Squib Valves, 369H90121 Series Emergency Float Assemblies	1-10-83
183	Relocation of 369A8448 Engine Air Inlet Filter Bypass Door Aft Pulley and 369A8447 Bracket, and 369H90152-3 Particle Separator Filter Gasket Inspection	1-10-83
184	Center Passenger Seat, Lap Belt Check; Preflight Check of Passenger Lap Belt and Shoulder Strap Fit and Adjustment	2-15-83
185	Fuel System Service, Maintenance and Testing	3-15-83
186	Fuel Vent System Hose Inspection	5-2-83
187.1	Installation of Collective Stick Support Bracket Reinforcement Strap	11-23-83

Table 1. ACTIVE SERVICE BULLETINS (Cont.)

369H	SUBJECT	DATE
187.1	Installation of Collective Stick Support Bracket Reinforcement Strap	11–23–83
188	Installation and Replacement of 084956 Protective sleeve (Speedi–Sleeve) on Tail Rotor Transmission Output Gearshaft	5–21–83
189.1	Inspection and Overhaul of 369A8104–5 Fuel Shutoff Valve	8–20–84
190	Battery Case Inspection	10–28–83
191	Main Rotor Swashplate Bearing Inspection and Possible Replacement	12–23–83
192	Instrument Cluster 4–Pack Conversion – AC–to–Rochester	2–15–84
193	369A8137–503 and –603 Fuel Shut–Off Valve Control Cable Pull Test	4–9–84
195	Riveting Tip Cap to Tail Rotor Blade	8–27–84
196	Inspection of Landing Gear Feet and Strut	10–1–84
197.2	One–Time Inspection of Tail Rotor Blade Leading Edge Abrasion Strip Bonding; Pilot's Preflight Check of Tail Rotor Blade Leading Edge Abrasion Strip	3–23–87
198.1	Corrosion Removal – Main Rotor Drive Shaft ID	10–30–87
199.1	Riveting Tail Rotor Tip Cap–to–Blade	5–1–85
200	Non–Airworthy Parts	3–18–85
201	Exit Warning Decal (Including AC 91–32 Safety In and Around Helicopters)	8–7–85
202	EON Seat Belt Removal	5–15–86
203	Installation of 369D28318 Oil Tank Filler Nozzle Strainer Assembly	4–15–86
205	Inspection/Rework of United Instrument Inc. Altimeter	5–20–86
206.1	Installation/Inspection of Tail Rotor Driveshaft Aft Fail Safe Device	11–28–86
208.1	Daily/Pre–Flight Examination of Main Rotor Blade Leading Edge Abrasion Strip Bonding	9–10–92
209	3659A8010 Engine Oil Pressure and Torque Tube Pull Test	9–15–87
210	Start Pump Wire Routing and Fuel Quantity Sender Inspection	9–15–87
211.6	Inspection of Main Rotor Blade Root Fitting Assemblies; Inspection of Main Rotor Hub Lead–Lag Link Assemblies	1–3–00
212.2	Inspection and Replacement of 369A1602 Tail Rotor Fork Bolt	4–21–89
213	Replacement of 369A8442–Basic Latch Assembly on the Particle Separator Door	12–18–87
214	Main Rotor Hub Strap Pack Lamination Inspection and Tri–Flow Wash Procedure	1–15–88
215.2	Inspection of 369A5352 Outer Race – 369A5350 Overrunning Clutch Assembly	4–11–97
216	One–Time Inspection of 369H5660 Transmission Driveshaft Couplings	4–5–89
217.1	One–Time Inspection and Rework of 369A7007, 369A7009, 369A7011 and 369A7012 Main and Tail Rotor Control Tubes	7–21–89
218	One–Time Inspection of 369A8352, 369H8306, 369H8025, 369H8024–5 and 369D28651 Aeroquip Hoses	6–12–89
219	Finite Service Life Reduction of 369A1706–Bsc Tail Rotor Tension Torsion Strap Pack Assembly	6–20–89
220	One–Time Inspection of 369A5358 Lockwasher in the Overrunning Clutch Assembly and Inspection of Engine Output Drive Splines	10–27–89
221	Installation of Oil Flow Restricting Devices into the Engine Oil and Torque Pressure Sensing System	10–27–89
222	Conversion to 369A5350–41 Overrunning Clutch Sub–Assemblies	5–4–90
223	One–Time Replacement of 369A9817 Polycarbonate Cover Assemblies	6–15–90
224	One–Time Replacement of Tail Rotor Blade Pitch Arm Bolt Attaching Nuts	6–15–90
225.1	One–Time Torque Check and Inspection of Main Rotor Blades	5–15–91
226.1	One–Time Installation of 369D24054–3 Warning Decals in the Engine Compartment	9–4–90
227	Inspection of Lead–Lag Link Attach Nuts	9–4–90
228	One–Time Inspection of 369H8407 Engine Bleed Air Tube Flexible Area	11–21–91

Table 1. ACTIVE SERVICE BULLETINS (Cont.)

369H	SUBJECT	DATE
229	One–Time Re–Installation of 369A1602 Tail Rotor Fork Bolt	11–21–91
230.1	Pre–flight Check and One–Time Inspection of Tail Rotor Blades	3–3–91
231	One–Time Rework of Main Transmission Oil Cooling Fan Mounting Bracket	2–1–91
232	One–Time Addition of Rivets to Tail Rotor Abrasion Strip	9–27–91
233	Inspection of Overrunning Clutch Outer Race – 369A5352 Overrunning Clutch Assy.	1–17–92
234.1	Inspection/Rework of Fuel Vent System (Helicopters Equipped With 369H8108, 369H8108–501 or 369H8108–503 Fuel Vent Line Emergency Shutoff Valve)	1–17–92
235	One–Time Inspection/Rework of Engine Air Inlet Area	3–20–92
236	Four–Way Trim Switch Replacement Program	3–10–94
237	Firewall Fuel Fitting Modification	9–26–94
238	Tail Rotor Blade Abrasion Strip Modification	10–26–94
239	Main Rotor Blade Root End Inspection	10–27–95
240	Input Shaft Coupling Assembly Inspection	9–26–97
241.1	T/R Blade, Leading Edge Inspection for Cracks	5–3–99
243R3	M/R Blade Root End Inspection and Termination Action for Suspect M/R Blades	7–13–98
244	Landing Gear Strut Inspection and Fairing Modification	4–7–00
245.2	Main Rotor Blade Assembly Torque Event Inspection	2–2–04
246R1	Tail Rotor Blade Abrasion Strip Tap Test and Modification	1–23–06

4. Cancelled or Superceded Service Information Notices

(1). Table 2 is a list of Service Information Notices that have been cancelled or superceded.

(2). Updated information, pertinent to the Notice, has been incorporated into the appropriate manuals.

(3). If the Notice is superceded by another Notice, it will be noted in the Subject column after the description.

5. Scope

The following is an explanation of how to read Table 2.

(1). **HN-** 369H Model Helicopters.

(2). **Subject** - A brief description of the Notice.

(3). **Date** - Date the Notice was cancelled or superceded.

Table 2. CANCELLED OR SUPERCEDED SERVICE INFORMATION NOTICES

369H	SUBJECT	DATE
194	Oil Pressure and Torque Pressure Fire-Wall Fitting Check (Superceded by HN-209)	9-15-87
204	Main Rotor Hub Strap Pack Inspection (Superceded by HN-214)	1-15-88
207	Tail Rotor Elastomeric Bearing Shimming Procedure	7-11-86
242	M/R Blade Root End Inspection (Superceded by HN-243R3)	7-13-98

Section

1

Introduction

TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 1 Introduction		**1-1**
1.	Proprietary Rights	1–1
2.	This Handbook and Your Helicopter	1–1
3.	Model Configuration	1–1
4.	369H Helicopter Description	1–1
	Figure 1–1. Helicopter – Major Components	1–2
5.	Scope	1–3
6.	Organization of Handbook Contents	1–3
7.	Associated MDHI Manuals	1–3
A.	Optional Equipment Manual	1–3
B.	Inspection Requirements	1–3
C.	Component Overhaul Manual	1–3
D.	Structural Repair Manual	1–3
E.	Illustrated Parts Catalog	1–3
8.	Engine Data	1–3
9.	MDHI Publications Changes and Revisions	1–4
A.	Revision	1–4
B.	Reissue	1–4
C.	Reprint	1–4
D.	Service Information Notices and Letters	1–4
10.	Application of Warnings, Cautions and Notes	1–5
11.	Service and Operations Report Form 1601	1–5

SECTION 1
INTRODUCTION

1. Proprietary Rights

MD Helicopters, Inc. proprietary rights are included in the information disclosed herein. Recipient, by accepting this document, agrees that neither this document nor any part thereof shall be reproduced or transferred to other documents or used or disclosed to others for manufacturing or any other purpose, except as specifically authorized in writing by MD Helicopters, Inc. All rights are reserved under the copyright laws by MD Helicopters, Inc.

2. This Handbook and Your Helicopter

Hughes 500 (Model 369H) Series Helicopter, Manufactured by Hughes Helicopter Inc.. Culver City, California, now MD Helicopter, Inc., Mesa, Arizona, are produced in three model configurations.

3. Model Configuration

Model 369HM (500M International Military)
Model 369HS (500S Standard) and
Model 369HE (500E Executive).

Except for interior trim upholstery and floor coverings, equipment furnishings, paint finish and other details described in Section 4, the 500S and 500E are essentially identical helicopters.

The main differences are the type and arrangement of interior furnishings and equipment, the pilot's flight control position, and the variety of special or optional (kit) equipment installed in the individual helicopter. Normally, the 500S has the standard trim package and the 500E has the executive trim package.

The basic design features and performance characteristics of each model configuration are essentially the same.

4. 369H Helicopter Description

(Ref. Figure 1-1) The MDHI 369H helicopter is a turbine-powered, rotor wing aircraft, constructed primarily of aluminum alloy. The main rotor is the four-bladed, fully articulated type. The tail rotor is two bladed, anti-torque, and semi-ridged type. Power from the turboshaft engine is coupled to the main and tail rotors by driveshafts and two transmissions. The driveshaft from the engine to the main transmission incorporates an overrunning (one-way) clutch that permits free wheeling of the main rotor for autorotational descent.

The fuselage (incorporating a central frame work consisting of a mast support structure, two bulkheads and a center beam) is a semimonocoque structure that is divided into three main sections.

The forward section includes a pilot's compartment and a cargo/passenger compartment. The pilot's compartment is normally equipped with seating for the pilot and one or two passengers. The seat on the left side of the pilot's compartment (when looking forward) is the pilot's seat (command position) except in Model 369HM helicopters where the pilot's seat is on the right side. The cargo compartment in back of the pilot compartment contains provisions for installation of two additional passenger seats. The cargo compartment seats may be easily folded out of the way or completely removed for the accommodation of cargo.

The aft section includes the structure for the tailboom attachment and houses the engine.

The lower section is divided by the center beam and provides a housing for the two fuel cells.

The tailboom is a monocoque structure of aluminum alloy frames and an aluminum alloy skin. The tailboom serves as the supporting structure to which the horizontal stabilizer, the upper and lower vertical stabilizers, and the tail rotor transmission and tail rotor are attached. In addition, the tailboom houses the tail rotor transmission, driveshaft and the tail rotor blade angle control rod.

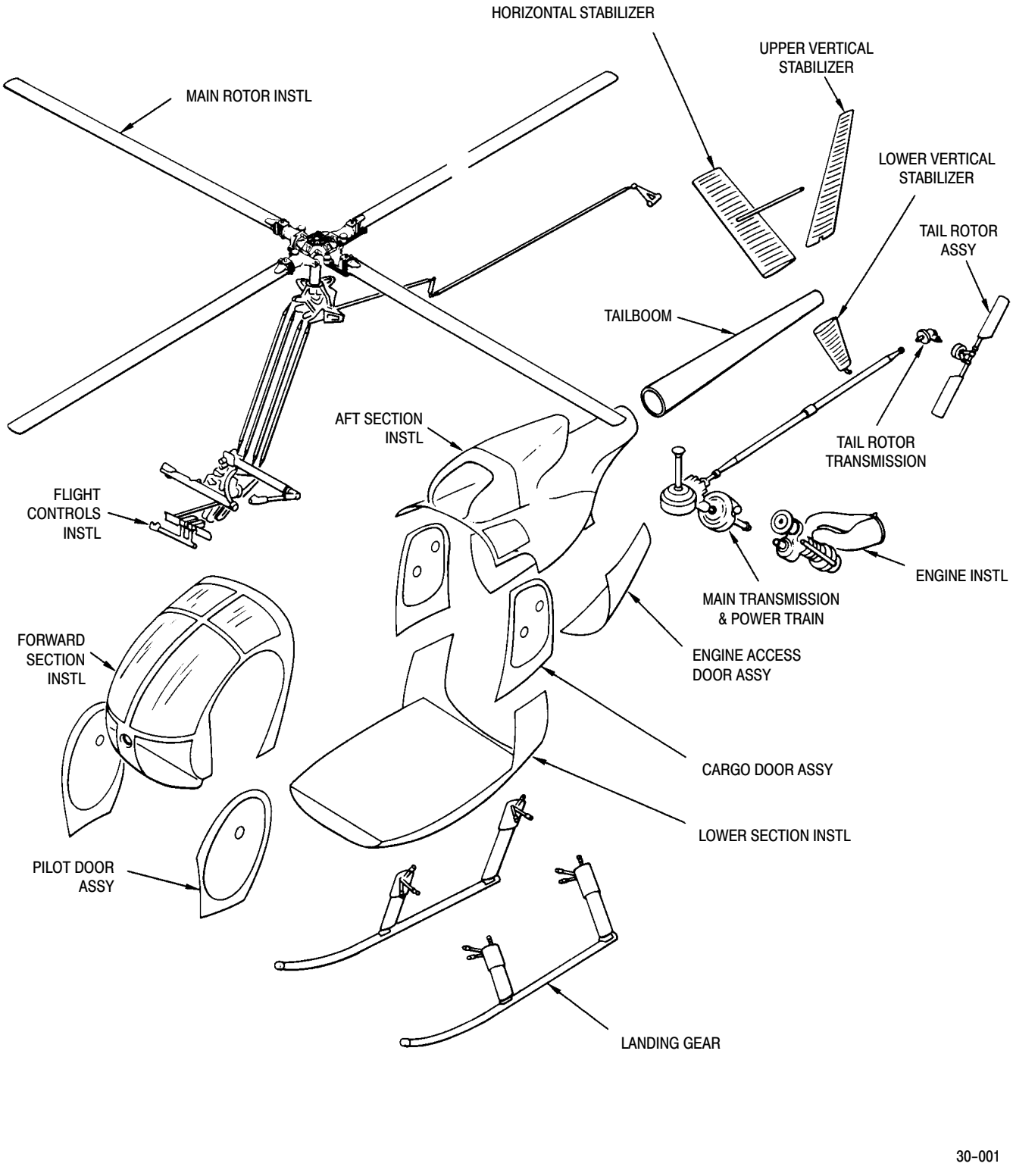


Figure 1-1. Helicopter - Major Components

The main rotor group consists of four rotor blades, a fully articulated main rotor hub assembly that incorporates offset flapping hinges, a scissors assembly and a swashplate, and associated mixer control mechanisms. The main rotor blades are secured to the rotor hub assembly with standard hardware and/or by quick-release lever type pins that permit easy and fast removal of the blades.

The landing gear is the horizontal, skid type, attached to the fuselage at 12 points; it is non-retractable. The struts, from the fuselage to the skids, are covered with aerodynamic fairings. Nitrogen-charged landing gear dampers, between the struts and structure, act as shock absorbers to cushion landings.

5. Scope

MDHI maintenance manuals provide system descriptions, servicing and maintenance procedures, periodic and special inspections, overhaul schedules, limited life component replacement schedules, and weight and balance calculations.

This manual is one of a group of publications that form the information file for the helicopter. The maintenance and inspection procedures are to be used for the 369H helicopters only. Study the contents to gain an understanding of the arrangement and use of this and associated manuals before working on the aircraft.

6. Organization of Handbook Contents

The contents of this handbook are grouped into Sections as outlined by the Table of Contents. Each Section of this manual has its own Table of Contents and List of Figures. The content of each Section is organized to provide comprehensive coverage on an entire system, on a major assembly or on a group of equipment items that are similar or associated. Maintenance procedures for each component, assembly or system are presented in sequence. Instructions for all or part of the following maintenance functions are included as applicable.
Troubleshooting
Operational Check
Rigging Check
Tracking
Balancing
Removal
Inspection (Other than Daily or Periodic)
Disassembly
Reassembly
Installation
Adjustment (Other than System Rigging or Tracking)
Repair

7. Associated MDHI Manuals

Information beyond the scope of the Maintenance Manual may be found in these basic associated manuals which are prepared as separate publications but should always be kept and used with this manual:

A. Optional Equipment Manual

CSP-H-3, Appendix A, contains descriptive and maintenance information on the various accessory and system equipment options available for each of the three helicopter model configurations.

B. Inspection Requirements

CSP-H-4, Appendix B, contains the daily and recurrent inspections that must be performed on a repetitive cycle basis to verify that the helicopter is airworthy. CSP-H-4 B also includes special inspections, overhaul and retirement schedule for components that have a limited hourly life between overhaul periods or for retirement, and weight and balance procedures.

C. Component Overhaul Manual

CSP-H-5, Appendix C, contains overhaul instructions for major components such as main transmission, tail rotor transmission, overrunning clutch, etc.

D. Structural Repair Manual

CSP-H-6, Appendix D, contains helicopter structural maintenance and repair information.

E. Illustrated Parts Catalog

The 369 Series Illustrated Parts Catalog (CSP-H-7) provides, by means of text and companion illustrations, complete definition of all repair parts and spare items available for all configurations of the helicopter. Use CSP-H-7 for parts procurement only.

8. Engine Data

The Model 250 Series gas turbine engines are manufactured by the Allison Engine Company

Inc.. Refer to the applicable Allison Engine Repair and Maintenance Manual and the Illustrated Parts Catalog supplied with the engine for specific engine maintenance information. Fault isolation and maintenance procedures for the helicopter/engine interface systems are in divisions specified by the index.

9. MDHI Publications Changes and Revisions

Changes in the helicopter, equipment, maintenance practices, procedures and additional information developed by experience affect manual content. To ensure that MDHI manuals continue to reflect current changes, revised information is provided by one or more of the following communications:

A. Revision

Alteration of portions of the handbook by the replacement, addition and/or deletion of pages is accomplished by revision. The List of Effective Pages (LOEP) that accompanies each revision identifies all affected pages; such pages should be removed from the handbook and destroyed. Added or replacing pages should then be inserted and checked against the LOEP.

B. Reissue

When large numbers of changes are involved, the handbook is reissued. The preceding issue of the handbook then becomes obsolete and should be discarded.

C. Reprint

When large numbers of changes are involved, the manual is reprinted to include all prior revisions.

D. Service Information Notices and Letters

Service information is to be considered as part of the handbook.

(1). Service Information Notices and Bulletins are broken into two categories as follows:

(a). Red Border Notices: The red border notices deal with critical items that must be corrected. These notices are mandatory and require a record of accomplishment. They may be re-occurring (flight-time or calendar) or one-time only notices.

(b). Blue Border Notices: The blue border notices are not mandatory and can be accomplished at the owner/operator's discretion. When instructed, these notices may require a record of accomplishment. These notices deal with non-critical or optional items only.

(c). Service Bulletins: The Service Bulletin deal with critical items that must be corrected. These bulletins are mandatory and require a record of accomplishment. They may be re-occurring (flight-time or calendar) or one-time only notices. The service bulletin replaces the red border notice.

(d). Technical Bulletin: The Technical Bulletins are not mandatory and can be accomplished at the owner/operator's discretion. When instructed, these bulletins may require a record of accomplishment. These bulletins deal with non-critical or optional items only. the technical bulletin replaces the blue border notice.

(e). For a complete listing and explanation of current and cancelled notices, refer to Service Information Notices Index.

(2). Service Information Letters are strictly information only. They may inform the owner/operator of options available, up-coming notices, warranty/repair changes, etc.

10. Application of Warnings, Cautions and Notes

Throughout this manual, and associated manuals, Warnings, Cautions and Notes are used to emphasize instructions or information considered to be unusual or critical.

WARNING and **CAUTION** statements are always placed before the information or instructions to which they apply.

A **NOTE** may appear in the text either before or after instructions to which it applies, depending on the relative significance of the information.

The conditions that warrant use of Warnings, Cautions and Notes are defined as follows:

WARNING **Operating procedures and practices which, if not strictly observed, may result in personal injury, or loss of life.**

CAUTION Operating procedures and practices which, if not strictly observed, may result in damage to or destruction of equipment.

NOTE: An operating procedure or condition that is essential to highlight.

11. Service and Operations Report Form 1601

MDHI Service and Operations Report Form 1601 may be used to report to MD Helicopters, Inc. in detail any service difficulties encountered with any MDHI helicopter. Use of the form is encouraged and recommended to enable MDHI to provide owners and operators improved service, support and product improvements. The form also serves as a convenient detailed record for owners and operators. Copies of the form may be procured by contacting the Product Support Dept.

Section

2

Servicing and General Maintenance

TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 2 Servicing and General Maintenance		**2-1**
1.	Maintenance and Operational Check Requirements and Precautions	2–1
	Figure 2–1. Principal Dimensions	2–2
2.	Helicopter Fundamentals	2–3
	A. Principal Dimensions	2–3
	B. Airframe Stations Locations	2–3
	C. Component Weights for Hoisting	2–3
	Table 2–1. Approximate Maximum Hoisting Weights of Components	2–3
3.	Helicopter Ground Handling	2–3
	A. Use of External Power	2–3
	B. Hoisting	2–3
	Figure 2–2. Hoisting, Jacking and Leveling	2–4
	C. Jacking	2–5
	D. Leveling	2–5
	E. Parking	2–5
	F. Mooring	2–5
	G. Ground Handling Wheels	2–6
	H. Helicopter Moving and Towing	2–6
	Figure 2–3. Ground Handling Wheels	2–7
	Table 2–2. Ground Support Equipment and Special Tools	2–8
	Figure 2–4. Parking and Mooring	2–12
4.	Servicing	2–13
	A. Fuel System Filling	2–13
	B. Fuel System Draining	2–13
	C. Engine Oil System Filling	2–13
	Figure 2–5. Servicing Points	2–14
	D. Engine Oil System Draining (with Sta. 137.50 Bulkhead Drain Ports Installed)	2–14
	E. Engine Oil System Draining (with Drain Valve Installed)	2–14
	F. Engine Oil System Flushing	2–15
	G. Main Rotor and Tail Rotor Transmission Filling	2–15
	H. Main Rotor Transmission Draining	2–15
	I. Main Rotor Transmission Oil System Flushing	2–16
	J. Tail Rotor Transmission Draining	2–16
	K. Tail Rotor Transmission Oil System Flushing	2–16
	L. One–Way Lock Control system Servicing	2–16
	Table 2–3. Component Servicing and Materials	2–17

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
5.	Battery Handling and Servicing Precautions	2-18
6.	Battery Servicing	2-18
7.	Battery Charging	2-19
A.	Normal Battery Charging	2-19
B.	Battery Deep Cycling	2-20
Table 2-4.	Maintenance Materials	2-21
8.	Access and Inspection Provisions	2-31
A.	Main Gearbox Access Cover	2-31
B.	Main Transmission Drain Assembly (used with Shaft-Driven Blower)	2-31
Figure 2-6.	Access and Inspection Provisions (Sheet 1 of 6)	2-32
C.	Main Transmission Cover	2-38
D.	Main Transmission Cover Assembly Seals Replacement	2-39
E.	Cargo Compartment Aft Bulkhead Access Covers	2-39
Figure 2-7.	Main Rotor Transmission Cover Seals Installation	2-39
F.	Pilot Compartment Floor Access Doors	2-40
G.	Fuel Cell Access Doors	2-40
H.	Controls Tunnel Cover	2-41
I.	Engine Air Inlet Forward Fairings	2-41
J.	Engine Air Inlet Fairing Access Doors	2-42
K.	Aft Section Air Inlet (Tail Rotor Drive) Access Door	2-42
L.	Controls Access Door and Foot Support Fairings	2-42
M.	Pilot's Seat Cover	2-43
N.	Outboard (LH) Collective Stick Cover and Wiring Cover	2-43
O.	Fuel Vent Cover	2-43
P.	Fuel Filler Shield	2-43
Q.	Boom Bolts Access Doors and Tail Rotor Control Bellcrank Access Door	2-43
R.	Exterior Lights Covers	2-44
S.	Cargo Swing/Hook Fairing Cover	2-44
T.	Instrument Panel Fairings	2-44
U.	Instrument Panel Lower Section Side Cover Panels	2-44
V.	Instrument Panel Lower Section Front Cover Panel	2-44
W.	Pilot and Cargo Doors	2-45
X.	Engine Access Doors	2-45
9.	Helicopter Cleaning	2-45
A.	Fuselage Interior Trim and Upholstery Cleaning	2-45
B.	Airframe Exterior and Rotor Blade Cleaning	2-46
C.	Transparent Plastic Cleaning	2-46

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
D.	Battery Cleaning	2–46
E.	Battery Electrolyte Spillage Cleaning	2–47
F.	Transmission Lubrication Pump Oil Filter Cleaning	2–47
Figure 2–8.	Transmission Lubrication Pump Oil Filter	2–47
G.	Engine Fuel and Oil Filter Cleaning	2–48
H.	Engine Compression Cleaning	2–48
I.	Engine Air Inlet Screen Cleaning	2–48
10.	Corrosion Control	2–48
A.	Standard Practices for Corrosion Prevention	2–48
B.	Magnesium Alloy Corrosion	2–49
C.	Aluminum Alloy Corrosion	2–49
D.	Alloy Steel Corrosion	2–50
E.	Temporary Anti–Corrosion Measures	2–50
F.	Corrosion Arresting on Main Rotor Blades	2–50
G.	Main Rotor Hub Corrosion Prevention (Tri–Flow Wash Procedure)	2–50
H.	Magnesium Alloy Exterior Surface Touch–Up Treatment	2–51
I.	Aluminum Alloy Exterior Surface Touch–Up Treatment	2–51
J.	Steel Alloy Exterior Surface Touch–Up Treatment	2–51
11.	Paint Finish	2–52
A.	Paint Removal	2–52
B.	Paint Touch–Up	2–52
12.	Main Rotor Blade Paint	2–53
A.	Main Rotor Blade Paint Removal	2–53
B.	Main Rotor Blade Paint Application	2–54
13.	Metal Tail Rotor Blade Paint	2–54
A.	Metal Tail Rotor Blade Paint Removal	2–54
B.	Metal Tail Rotor Blade Paint Application	2–54A
14.	Fluid Leak Analysis	2–54A
A.	Main Rotor or Tail Rotor Transmission Oil Leaks	2–54A
B.	Engine Oil Leaks	2–54B
C.	Landing Gear Damper Hydraulic Fluid Leaks	2–54B
Figure 2–9.	Checking Overrunning Clutch Oil Level	2–54B
D.	Overrunning Clutch Oil Leak Analysis and Servicing	2–55
E.	One–Way Lock (Uniloc) Fluid Leak	2–55
15.	Preservation and Storage	2–56
A.	Flyable Storage (No Time Limit)	2–56

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
B.	Storage up to 45 Days	2–56
C.	Storage up to 6 Months	2–57
16.	Torque Data	2–58
A.	Torque Wrenches	2–58
17.	Torque Wrench Load Application	2–58
18.	Installation, Staking or Swaging Force Needed for Bearings	2–60
19.	Useful Conversion Data	2–60
20.	Related Publications	2–60
21.	Maintenance Information Requests	2–60
22.	Inspection Practices and Technical Definitions	2–60
23.	Service and Operations Report Form 853	2–60
	Table 2–5. Recommended Standard Torques for Tension–Type Nut: Min. and Max. Torque Values; AN310, AN365, MS20365, MS21042, NAS1021, NAS1291, NAS679	2–61
	Table 2–6. Recommended Standard Torques for Shear–Type Nut: Min. and Max. Torque Values; AN320, AN364, MS20364, NAS1022, MS21083	2–62
	Table 2–7. Self–Locking Nut Minimum Run–On Torque Values	2–63
	Table 2–8. Minimum Breakaway Torque For Used Self–locking Bolts or Screws	2–63
	Table 2–9. Special Torques	2–64
	Table 2–10. Temperature Convervision	2–67
	Table 2–11. Conversion of Inches to Millimeter	2–68
	Table 2–12. Conversion of Millimeter to Inches	2–68
	Table 2–13. Conversion of Fractional Inches to Decimals and Millimeter	2–69
	Table 2–14. Conversion of U.S. Measure used in Servicing and Maintenance	2–69
	Table 2–15. Related Publications and Directives	2–70
	Figure 2–10. Technical Definitions	2–73
	Table 2–16. Technical Definitions	2–74

SECTION 2

SERVICING AND GENERAL MAINTENANCE

1. Maintenance and Operational Check Requirements and Precautions

All maintenance on the helicopter is to be accomplished in compliance with the following requirements and precautions.

(1). All maintenance and operational checks that require operation of the helicopter must be preformed in accordance with requirements and limitations specified in the MDHI 369 Owners Manual and the applicable optional equipment supplement to the Owners Manual for the specified model helicopter.

(2). After performance of maintenance or modification (disassembly, cleaning parts, parts replacement, repair, reassembly, installation, etc.) the affected parts, assemblies installation(s) or system(s) are to be inspected for discrepancies and an operational check is to be preformed. Should maintenance questions arise, refer to Table 2-15.

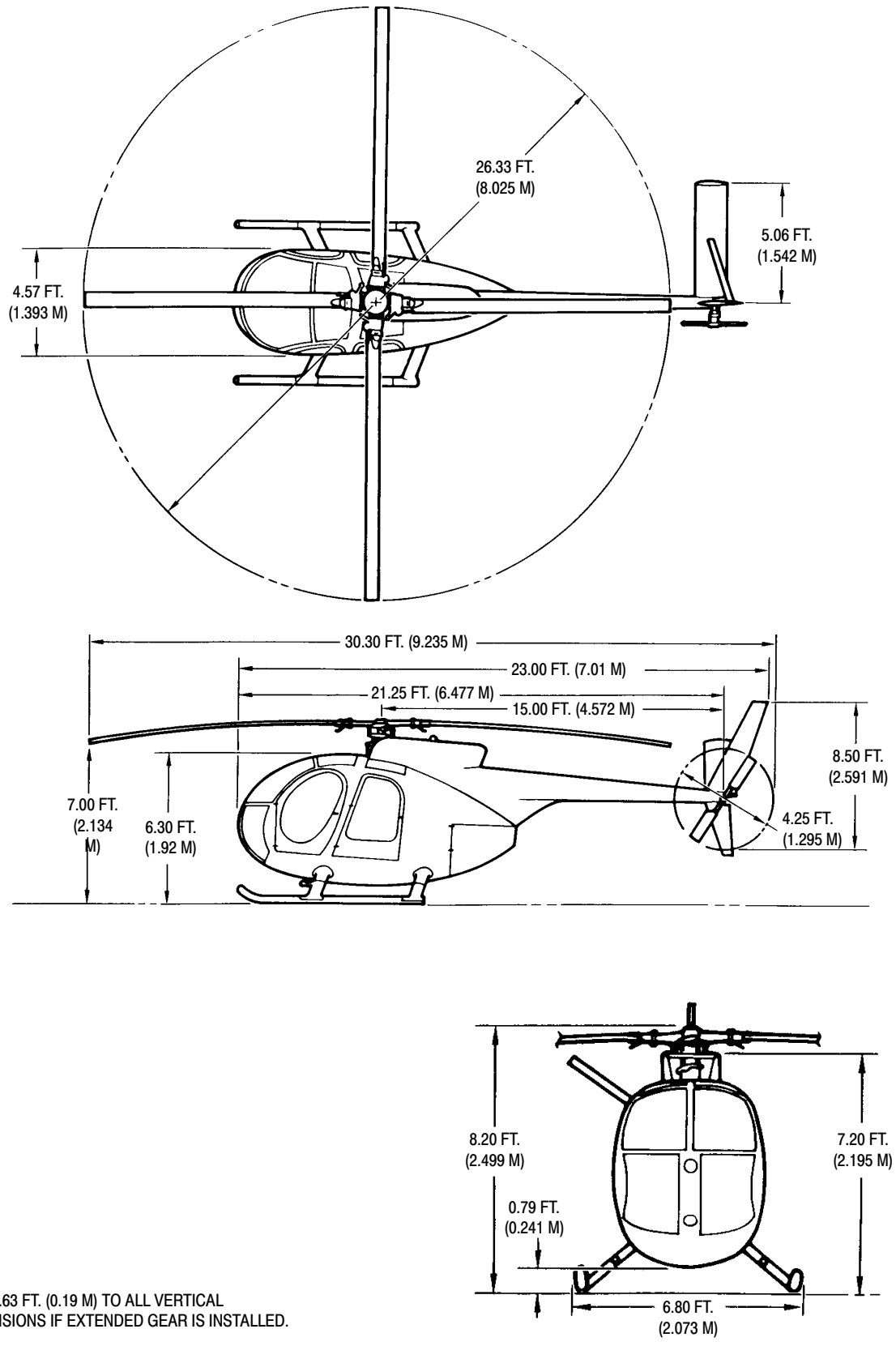
(3). Cautions and Warning statements throughout this HMI are provided to promote safe maintenance of the helicopter as defined in Section 1. To avoid repetitious appearance in text, certain precautions that should always be observed will not always be stated at each possible point of application. Cautions and warnings of this nature are listed below to emphasize that appropriate compliance is required at all times even though the precautionary statement are not repeated. Always comply with the following precautions.

WARNING

- **Before disconnecting, removing, installing or connecting components of the electrical system or associated equipment with electrical wiring, check that all electrical power is OFF. If units are not immediately replaced, ensure all electrical connectors are suitably capped and stowed and loose cable ends are properly insulated and stowed to prevent the possibility of shorting. Serious injury or death could result from voltages present in electrical wiring of the electrical system or associated equipment.**
- **Install bungee installation tool (26, Table 2-2) before disconnecting any pilot's collective stick hardware (Ref. Sec. 7). There is strong bungee spring pressure present in the stick linkage; if suddenly released, spring reaction in the linkage can cause personnel injury, or parts damage.**

CAUTION

- Whenever work is performed near the engine air inlet, use care to prevent entry of foreign objects. Tape covers of cardboard or other suitable material in place over the engine inlet or screen in the plenum chamber and also the oil cooler air inlets. Do not remove covers until work is completed and any debris is thoroughly cleaned out of the area. After removing covers, verify that area around base of mast, inlet plenum, and entire plenum chamber is free from foreign material.
- Use care when drilling and removing riveted rod ends from control rods. Tighten jam nut before drilling or riveting; the rod end is steel and the rod is aluminum.
- When working on the belt-drive blower, the impeller must be hand- held for removal and installation of the pulley attachment nut. Do not hold impeller blades with tool or other devices. Tool damage can affect precision balance of impeller as well as cause physical damage. Do not use any type of holding device that will place strain on the blower scroll. Impeller is balanced to within 0.03 inch ounce (0.0002 Nm). Slight impeller deformation or damage can cause impeller imbalance.
- Do not use vibration dampers for turning main rotor or handholds. Such use can damage vibration damper bracket.



NOTE:
ADD 0.63 FT. (0.19 M) TO ALL VERTICAL DIMENSIONS IF EXTENDED GEAR IS INSTALLED.

30-002D

Figure 2-1. Principal Dimensions

2. Helicopter Fundamentals

A. Principal Dimensions

Principal dimension are shown in Figure 2-1.

B. Airframe Stations Locations

Reference is occasionally made to “station” and “waterline” throughout the handbook. To assist in locating the components being discussed, refer to the station diagram provided in CSP-H-6. Station and waterline references are also necessary for weight and balance procedures.

C. Component Weights for Hoisting

The maximum weight for large components that may require hoisting are listed in Table 2-1.

Table 2-1. Approximate Maximum Hoisting Weights of Components

Item	Wgt Lb/kg
Tailboom	14/6
Main Rotor Hub	58/26
Main Transmission	79/36
Engine (built up)	170/77
Helicopter (less engine)	1000/455
Helicopter (less main rotor hub, swashplate, scissors, and rotor blades)	998/453
Helicopter (complete)	1170/531

3. Helicopter Ground Handling

Ground handling of the helicopter includes hoisting, jacking, leveling, parking and mooring. The following paragraphs present the instructions and precautions for all ground handling functions.

A. Use of External Power

An external receptacle is located at the right side of the pilot’s compartment seat structure. The right door must be opened to use the receptacle. Any source of external 28 volt, direct-current power may be connected provided the negative terminal of the plug mates with the negative terminal of the receptacle and the amperage available is sufficient. Engine starting requirements are approximately 375 amperes minimum.

CAUTION Before connecting external power, make certain that the helicopter main electrical power selector switch is in the **OFF** position. After power is connected to the receptacle, the power switch must be at the **EXT** position to connect external power to the helicopter electrical system.

NOTE: The positive (+) and negative (-) voltage terminals are clearly marked on the base of the receptacle to prevent reversing of polarity if a standard auxiliary power plug is not available.

B. Hoisting

(Ref. Figure 2-2) Observe the following precautions during any hoisting operation.

CAUTION Use a hoist of no less than 3500 pound (1598 kg) capacity when hoisting the complete helicopter. Use hoisting equipment of sufficient capacity (minimum twenty-percent over-rate) to hoist the heavier components if handled separately. (Ref. Table 2-1 for approximate weights.)

(1). Install hoisting adapter (1, Table 2-2) on main rotor hub so that the four hoisting eyebolts fit into the slots on the hoisting adapter.

(2). Install the four clevis pins.

(3). Attach cable from overhead hoist to the adapter eye.

(4). Secure a line to the tailboom. Have an assistant hold the line to keep the helicopter from swinging.

(5). Hoist slowly and smoothly to maintain a steady lifting force.

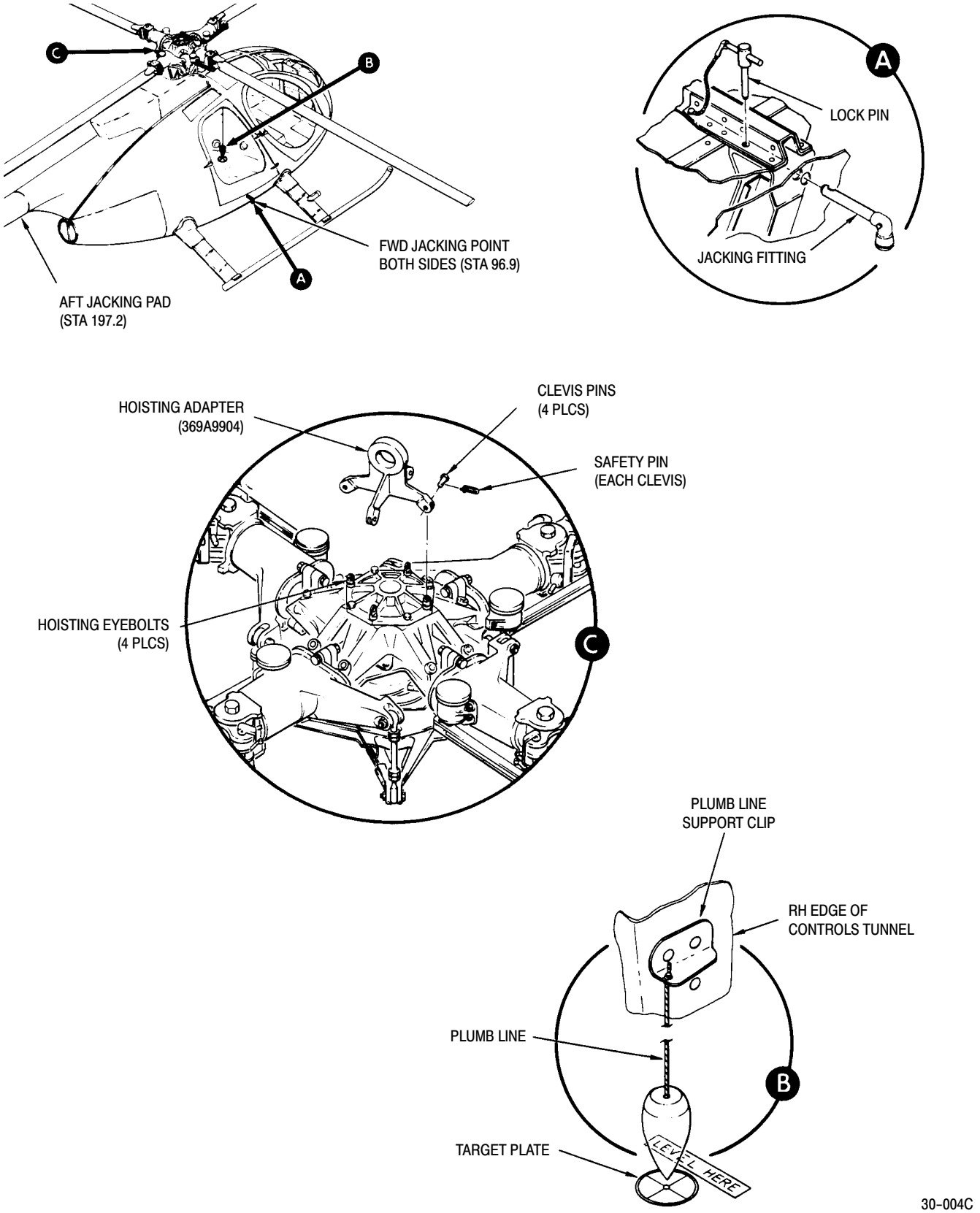


Figure 2-2. Hoisting, Jacking and Leveling

C. Jacking

(Ref. Figure 2-2) Provisions for jacking the helicopter are provided by two forward (side) jacking point fittings and an aft jacking pad.

NOTE: When the helicopter is jacked from one side only, a cushioned saddle-type support should be placed under the tailboom at the boom jacking fitting location for extra stability.

(1). Install jacking fittings (2, Table 2-2) in the fuselage jacking points. Secure the jacking fittings with the locking pins that are secured to the fuel cell access doors.

(2). Place suitable jacks under jacking fittings, and under aft jacking pad.

(3). Raise the helicopter to the desired height.

D. Leveling

(Ref. Figure 2-2) Leveling is accomplished by causing a plumb bob to intersect register marks inscribed on the target plate located on the cargo compartment floor

NOTE: Access to plumb line support bracket and target plate on floor of passenger/cargo compartment requires removal of trim on right side of controls tunnel and floor carpet in aft compartment.

(1). Suspend plumb line from bracket on right side of controls tunnel at Sta. 92.64, BL +6.20.

(2). Adjust plumb line swing to leveling target plate on floor of passenger/cargo compartment.

(3). With weight of helicopter supported by load cells or jacks, adjust appropriate jack until plumb line is centered.

(4). Adjust side jacks to level helicopter laterally.

(5). Adjust tailboom jack to level helicopter longitudinally.

(6). Recheck lateral and longitudinal levels until the plumb bob exactly aligns with marks on target plate.

(7). After leveling helicopter, remove plumb bob, reinstall trim and carpet and close compartment door.

E. Parking

(Ref. Figure 2-4) To park the helicopter for short intervals, perform steps (1). thru (4). For longer duration parking, also perform steps (5). and (6).

CAUTION To prevent rotor damage from blade flapping (droop stop pounding) as a result of air turbulence from other aircraft landing or taking off, or sudden wind gusts, rotor blades should be secured whenever the aircraft is parked.

(1). Locate the helicopter slightly more than blade clearance from near-by objects.

(2). Apply friction to lock the cyclic stick so that the friction control knobs are positioned on the lateral and longitudinal travel stop guides as follows: neutral laterally (center of slot), and one-third from full aft longitudinally (one-third up from bottom of slot).

NOTE: If not all ready accomplished, apply a paint mark on the edge of the guide to locate the neutral position for future reference.

(3). Locate the helicopter on the most level ground available.

(4). Secure the main rotor blades as follows.

(a). Turn blades until they are at 45 degrees angle to the fuselage centerline.

(b). Install blade socks (3, Table 2-2) on all blades.

CAUTION When securing tiedown cords, take up slack but do not exert bending loads on blades.

(c). Secure blade sock tiedown cords to fuselage jacking fittings.

(5). Install engine air inlet cover assembly (46 on engine air inlet front fairing.

(6). Install engine exhaust outlet cover (47) on exhaust tailpipes.

F. Mooring

(Ref. Figure 2-4) Whenever severe storm conditions or wind velocities higher than 40

knots are forecast, the helicopter should be hangared or evacuated to a safer area. If these precautions are not possible moor the helicopter in the following manner.

(1). Park helicopter and remove main rotor blades and install engine inlet and exhaust covers.

(2). Install pitot tube cover (4, Table 2-2).

(3). Fill fuel tank (if possible).

(4). Apply friction to lock the cyclic and collective sticks.

(5). Secure the helicopter to the ground by attaching restraining lines (cable or rope) between the jacking fittings and stakes or ground anchors.

G. Ground Handling Wheels

(Ref. Figure 2-3) Standard ground handling wheels, available as a special tool (6, Table 2-2), are used for moving the helicopter. The handling wheels consist of two, two-wheeled jacking assemblies that can be straddle-mounted to the left and right landing gear skids by use of the existing ground handling wheel fittings. The wheels are manually lowered with detachable jack handle. Either the straight handle (7) or the offset handle (8) may be used depending on clearance requirements. The wheels are held in down position (helicopter raised on wheels) by a mechanical lock. The wheels are equipped with tow bar attach fittings. Attach the ground handling wheels as follows:

NOTE: Special optional ground handling wheels (5) are used for moving the helicopter when equipped with option emergency floats (Ref. CSP-H-3). If helicopter with extended gear is tilted back on the tail skid to install ground handling wheels, approximately one pint of oil is trapped in the tail rotor gearbox. This condition will give a false sight gage oil level indication after return to a level attitude. The oil will return to normal after ground runup.

(1). Position ground handling wheel assembly over the skid tube at the location of the skid fitting.

(2). With ground handling wheels in the retracted position, align and engage the skid fittings.

(3). Install jack handle in the wheel assembly socket, install lock pin, and rotate handle downward to lower the wheels and raise the helicopter.

WARNING **Hold downward pressure on jack handle until the extend lock snaps into lock position. If the lock is not properly engaged and the handle is released, the upward swing of the handle could cause serious personal injury.**

(4). Check that the extend lock is engaged; then release downward pressure and remove jack handle.

(5). Install second ground handling wheel assembly in the same manner.

(6). At regular intervals, the ground handling wheels tire pressure should be checked for 80-90 psi (552-621 kPa) and the wheel bearings lubricated with grease (18, Table 2-4).

H. Helicopter Moving and Towing

(1). Manually move the helicopter on ground handling wheels by balancing the tail boom and pushing on the rear fuselage portion of the airframe.

CAUTION The helicopter should always be towed at slowed speeds, not over 5 mph, except in extreme emergency conditions. Do not allow the front end of the skid tubes to drag on the ground. Avoid sudden stop and starts, and short turns which could cause the helicopter to turn over. Allow the inside wheels to turn (not pivot) while the helicopter is being turned. The proper minimum turning radius is approximately 20 ft. (6 M).

(2). Towing the helicopter on ground handling wheels by attaching a suitable tow bar to the two bar fittings. If the tow bar is not equipped to keep the front ends of the skid tubes from dragging, have an assistant balance the helicopter at the tail boom.

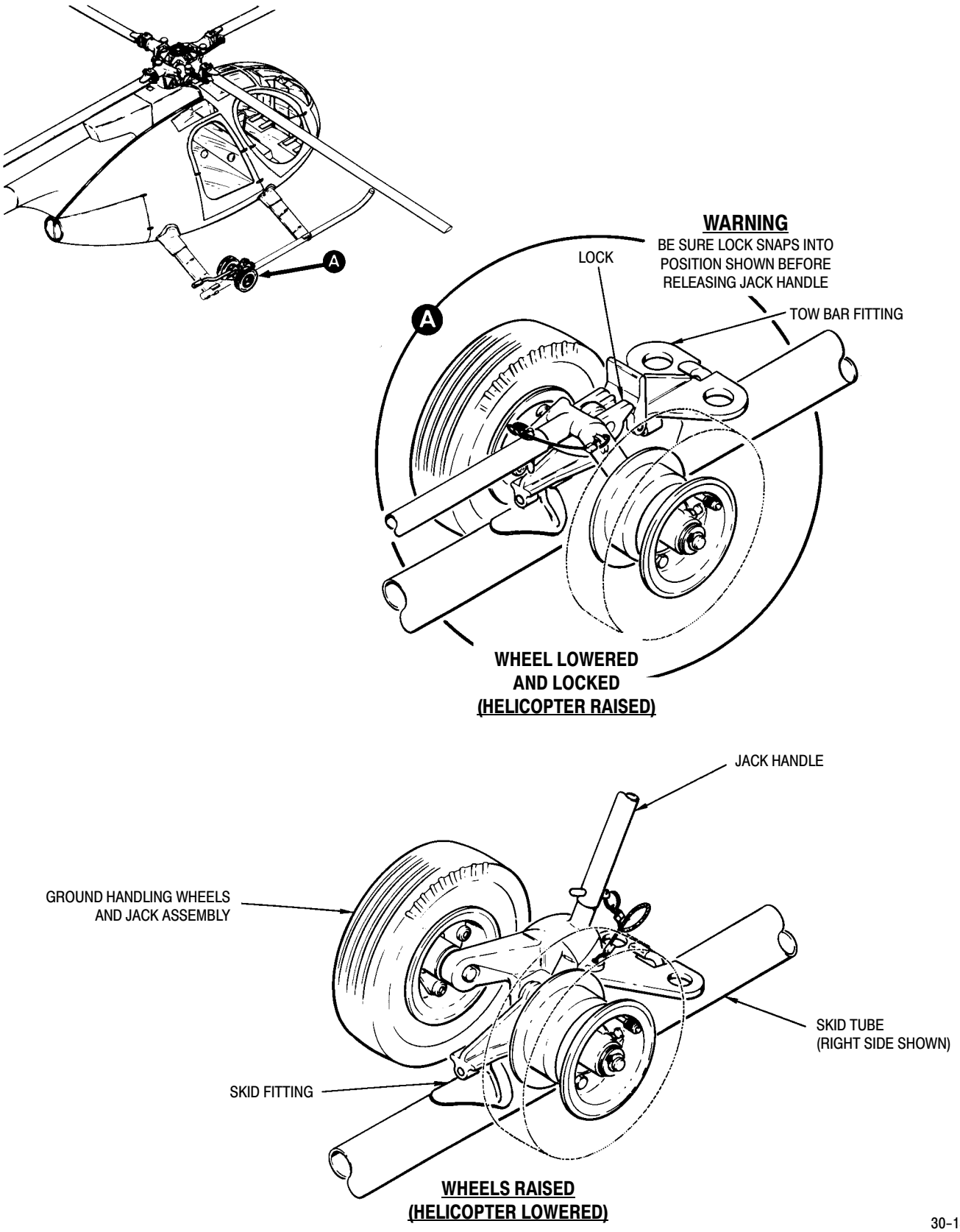


Figure 2-3. Ground Handling Wheels

Table 2-2. Ground Support Equipment and Special Tools

NOTE: Most of the equipment and tool items in this table are used to support and maintain all configurations of the 369H helicopter, except when an asterisk symbol (*) is part of the item number to indicate limited use. Limited applications noted in the Application or Use column. Special tools used only for major disassembly-repair and/or overhaul of components are listed in applicable section of CSP-H-3. See end of table for explanation of deltas and daggers.

Item No.	Part No.	Nomenclature	Application or Use
1	369A9904-501	Hoisting adapter	Hoisting entire helicopter or removing main rotor.
2	369A2010	Jacking fittings	Jacking, leveling or tie down of helicopter.
3	369D2661	Blade socks	Main rotor blade tie downs.
4	369H4009	Pitot tube cover	Pitot tube protection.
5	369H90126	Ground handling wheels (one side)	Ground handling of helicopter equipped with utility or emergency floats. (Ref. CSP-H-3)
6	369A9905	Ground handling wheel (one side less handle)	Ground handling of helicopter.
7	369H9801	Handle-Jack assembly ground handling (straight)	Raising and lowering helicopter with ground handling wheels.
8	369A9906	Handle-Jack assembly, ground handling (offset)	Raising and lowering helicopter with ground handing wheels when addition clearance is required.
9	369H9925	Collective rigging fixture	Rigging of main rotor collective controls (369HE and 369HS only).
10	369A9927	Collective rigging fixture	Rigging of main rotor collective controls (369HM only).
11	369A9930	Mixer rigging plate	Rigging of main rotor collective and cyclic controls.
12	369A9929-9	Longitudinal rigging fixture	Rigging of main rotor cyclic controls (369HE and 369HS only).
13	369A9929-5	Longitudinal rigging fixture	Rigging of main rotor cyclic controls (369HM only).
14	369A9928-9	Lateral rigging fixture	Rigging of main rotor cyclic controls (369HE and 369HS only).
15	369A9928-5	Lateral rigging fixture	Rigging of main rotor cyclic controls (369HM only).
16	369A9926-7 or 369A9926-5 (1)	Main rotor blade tracking high intensity strobe light installation and assembly	Tracking of main rotor blades.
17	369A9958	Main rotor blade tab bending tool	Adjusting main rotor blade tab angle for blade track.
18	369H9928	Main rotor blade tab bending tool	Adjusting main rotor blade tab angle for blade track.
19	369A9934-601 (replaced by 21)	Main rotor mast nut wrench	Loosening/Torquing of main rotor mast nut.
20	369A9934	Main rotor mast nut wrench	Loosening/Torquing of main rotor mast nut (non-slotted mast only).

Table 2-2. Ground Support Equipment and Special Tools (Cont.)

Item No.	Part No.	Nomenclature	Application or Use
21	369A9829	Main rotor wrench assembly	Loosening/Torquing of main rotor mast nut.
22	369A9932 369A9932 (2)	Hub puller	Breaking loose main rotor hub from mast.
23	369A9949	Torque wrench adapter	Checking main rotor damper first stage friction.
24	369A9933 369A9933-5 (3)	Main rotor hub driver	Seating main rotor hub.
25	369A9983	Torque wrench adapter	Torque tailboom attachment bolts.
26	369A9936	Bungee installation tool	Holding collective bungee spring in compression for bungee removal and installation.
27	369A9985	Bungee spring compression tool rod and channel	Removing bungee installation tool and disassembling bungee spring assembly.
28	369A9931 or 369A9931-3	Tail rotor swashplate rigging tool	Rigging of tail rotor controls (fiberglass blades).
29	369A9931-5	Tail rotor swashplate rigging tool	Rigging of tail rotor controls (metal blades).
30	369A9937	Torque wrench adapter	Installing tail rotor nut.
31	369A9999 (4)	Tail rotor balancing kit	Strobe light analysis for balancing installed tail rotors.
32	FRDH 101	Torque wrench adapter	Installing main rotor drive shaft bolts and eyebolts.
33	RXT20-5 (extraction) RTM20-9 (insertion)	HYTIP insertion/extraction tool (mfg by Burndy, Norwalk, Connecticut)	Installing and removing HYTIP electrical contacts into and from terminal block modules.
34	M8ND & N14HTC	HYTOOL M8ND (catalog No. Y14 MRC); Die-Sets N22PCT-1 & -2, and N14HCT (mfg: same as item No. 33)	Manual crimping of MINILOK and MODILOK terminal block contact tips on electrical wire harness leads.
35	107-0970	Hand-operated crimping tool (Catalog No. 107-0970) with positioners (Catalog No. 107-0976 and 107-0977)(mfg by Winchester Electronics, Division of Litton Industries, Main St. and Hillside Ave, Oakville, Connecticut 06779)	Hand crimping of removable contacts in rectangular connectors. **NOTE:** Tool conforms to MS-3191-2 (MIL-T-22520, Class 1).
36	107R1001 and 107-1015	Removable contact removal tool (Catalog No. 107R1001) and insertion tool (Catalog No. 107-1015) (mfr: same as item No. 25)	Removing and inserting removable contacts from and into inserts of rectangular connectors.
37	Deleted		
38	369A9948	Engine stand	Support for removal or replacement engine.
39	369A8009	Engine hoist	Removing and replacing engine in airframe.

Table 2-2. Ground Support Equipment and Special Tools (Cont.)

Item No.	Part No.	Nomenclature	Application or Use
40	369A6001-50506-1	Left landing gear foot drill jig	Enlarging holes in left lockbolt-type landing gear struts for installation of machine-bolt-attached skids.
41	369A6001-50506-2	Right landing gear foot drill jig	Enlarging holes in right lockbolt- type landing gear struts for installation of machine-bolt-attached skids.
42	CIET 20	Insertion/extraction tool, No. 20 Wire Mate connector (mfd. by I. T. T. Cannon Electric, 3208 Humbolt St., Los Angeles, Calif. 90031)	Connecting and disconnecting No. 20 Wire Mate electric connectors.
43	CIET 16	Insertion/extraction tool, No. 16 Wire Mate connector (mfr: same as No. 42)	Connecting and disconnecting No. 16 Wire Mate electrical connectors.
44	369A9822-5	Locknut torque wrench adapter	Installing and removing tail rotor swashplate-to-control housing bearing nut.
45	369A9922-3	Pitch control assembly holding block	Holding tail rotor swashplate while removing and installing nut.
46	369H9803	Engine air inlet cover	Covering for engine air inlet front fairing.
47	369H9804	Engine exhaust outlet cover	Covering for engine exhaust tailpipes.
48	369A1710-80901	Fiberglass tail rotor blade, static balance moment fixture	Determination of fiberglass blade static balance moment.
49	369A9825	Pitch bearing stud wrench	Removing main rotor hub pitch bearing pivot pin.
50	369A9826	Stud nut wrench	Holding main rotor hub pitch bearing pivot pin nut.
51	369H9807	Main transmission drain hose	Draining main transmission oil.
52	2312-G	Turbine temperature indicating system test set (Barfield Instrument Corp.)	Test and calibration of the TOT indicating system.
	BH112JA-36	Jetcal tester (Howell Instrument Inc.)	Test and calibration of the TOT indicating system.
53	369A1600-80902	Bushing wrench	Installation and torquing tail rotor hub threaded bushing.
54	83006-809-00090-1	Arbor press fixture, 369A7951-5 bearing	Installing bearing in tail rotor pitch control link.
55	83006-809-00090-15	Staking tool, 369A7951-5 bearing	Staking bearing in tail rotor pitch control link.
56	83006-809-00068	Staking tool, (pilot and punch), pitch control assembly double row bearing 369A7951-45	Installing bearing and swage ring in pitch control housing.
57	WSI-HT-12AS	Installation tool, WSI-B-12AS grommet (mfd. by Western Sky Industries, 21300 Cloud Way, Hayward, CA 94545)	Installing grommets for tail rotor control rod.
58	269A9232	Plug, 269A5050-18 bearing removal.	Removing double-row bearing from tail rotor pitch control housing.

Table 2-2. Ground Support Equipment and Special Tools (Cont.)

Item No.	Part No.	Nomenclature	Application or Use
59		Chadwick-Helmuth Balancer / Analyzer Instrument Kit	Equipment for tracking and balancing of dynamic components. Main/Tail rotor vibration analyzer.
60	369D29999	Main rotor and tail rotor balance spare kit	Used with Item 59 to balance tail rotor and main rotor.
61	830006-809-00090-8	Arbor press fixture for 369A7951-15 bearing	Installation of bearing in main rotor blade.
62	830006-809-00090-20	Staking tool for 369A7951-15 bearing	Staking of bearing in main rotor blade.
63	36-D-284	Prop protractor	Measure angle of incidence.

NOTE:

(1) Main rotor blade tracking equipment 369A9926-7 and -5 each contain a strobe light 369A9925, magnetic pickup 369A9944, one set of interrupters, a set of tracking cap reflectors and associated mounting hardware. The 369A9942-27, -29, -31 and -33 Tip Cap Assemblies are to be ordered as replacement for the 369A9942-7, -9, -11, and -13 and the 369A9942-501 Tip Cap Assemblies.

(2) Handle, frames and puller nut same as 369A9932; -31 thrust pad replaces -3 thrust pad.

(3) Hammer and handle same as 369A9933; -7 driver -3 driver.

(4) Tail rotor balancing equipment 369A9999 contains a vibration analyzer 369A9801, protractor assembly 369A9979, acceleration mounting bracket 369A9920 and associated attachment and balancing hardware.

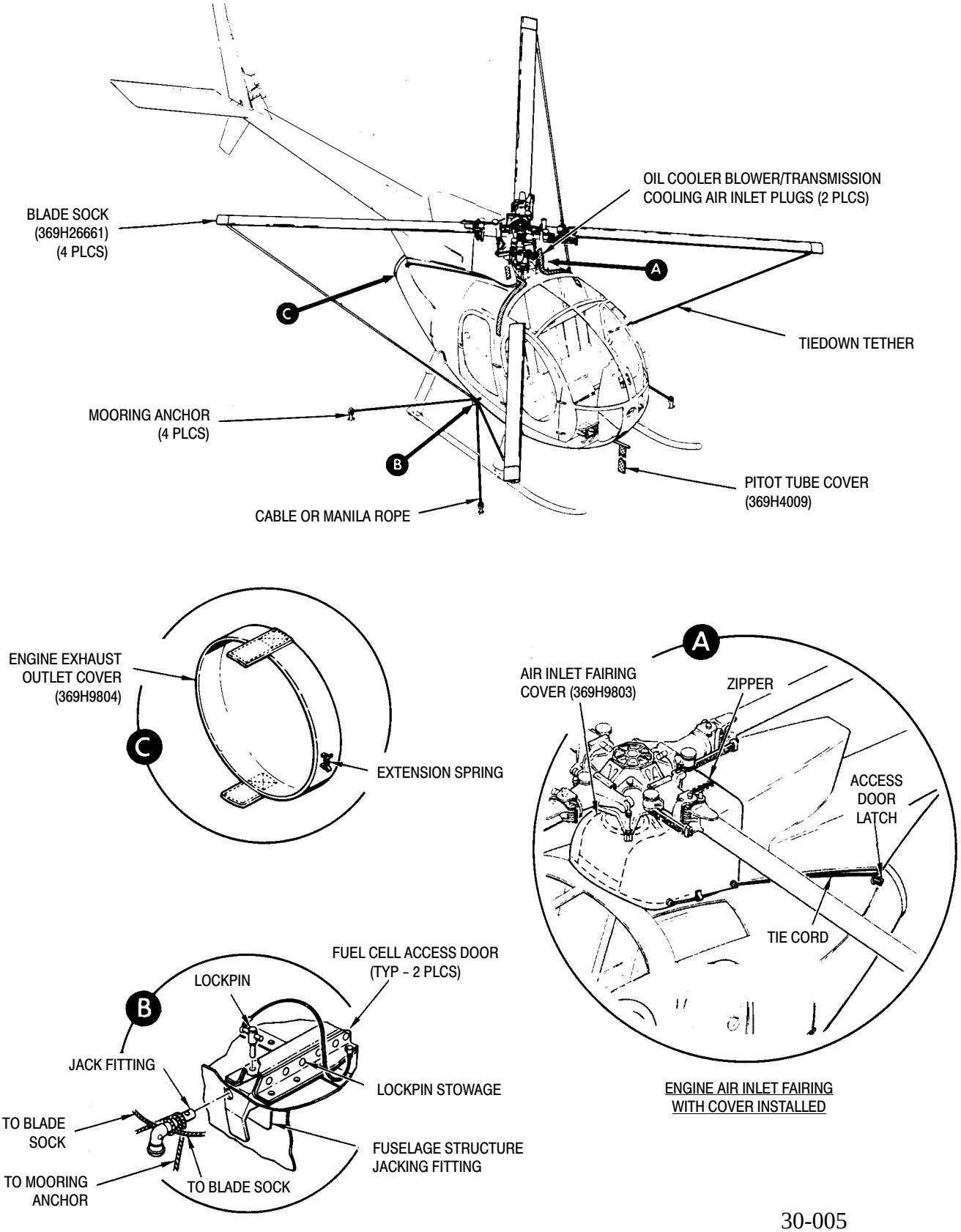


Figure 2-4. Parking and Mooring

4. Servicing

(Ref. Figure 2-5) Servicing of the helicopter includes replenishment of fuel, changing or replenishment of oil and other such maintenance functions. Fuels, oils, others servicing materials and capacities are listed in Table 2-3. Observe the following precautions when servicing the fuel system.

WARNING **Turn off electrical switches and disconnect external power from the helicopter.**

(1). The helicopter must be electrically grounded prior to refueling or defueling. The possibility of static discharge (difference in electrical potential) and presence of fuel vapors always presents fire and explosion hazards.

(2). The refueling vehicle should be parked a minimum of 20 ft. (6 M) from the helicopter during the fueling operation. Before starting the fueling operation, always ground the fueling nozzle or fuel truck to the **GROUND HERE** receptacle or to another bare metal location.

CAUTION Use extreme care when applying any type of lubricant (grease, oil, dry-film, etc) in the vicinity of teflon bearings. Most lubricant will form a dirt retaining film or have other detrimental effects that can cause rapid detertioration of bearing surfaces.

A. Fuel System Filling

The fuel system has two fuel cells that are interconnected for simultaneous flow venting. The fuel filler cap is on the right side of the helicopter.

(1). Refuel helicopter with correct fuel as soon after landing as possible to prevent moisture condensation and to keep the helicopter as heavy as possible in case of winds.

(2). Keep fuel nozzle free of all foreign matter.

(3). Check filler cap for security after fueling.

B. Fuel System Draining

Fuel draining should be accomplished with helicopter as level as possible.

(1). Fuel system may be defueled in either of two ways:

CAUTION To avoid possible damage to fuel pump, do not operate fuel pump with fuel tanks drained.

(a). Defuel through filler port using a pump.

(b). Open system drain valves on fuselage underside and in engine compartment.

(2). Fuel supply line drain valves are spring loaded type and open by pushing valve and attached drain line.

(3). Fuel cells drain valve is spring-loaded closed and is opened by pressing internal plunger.

C. Engine Oil System Filling

The engine oil filler cap is on the right side of the helicopter. A liquid level plug for checking the oil level in the tank is visible through a transparent window near the filler.

NOTE:

- Before adding oil, the oil container must be shaken to ensure proper mixture of the anti-foaming additive.
- If sight gauge does not permit positive determination, remove filler cap and visually check the oil level.

(1). Check oil level within 15 minutes of engine shutdown; replenish if low.

(2). If engine oil level is low after helicopter has set for more than 15 minutes;

(a). Run engine for at least one minute at ground idle.

CAUTION Ensure engine oil pressure is attained when starting engine (Ref. applicable Pilot's Flight Manual).

(b). Shut down engine, check oil level, replenish if low.

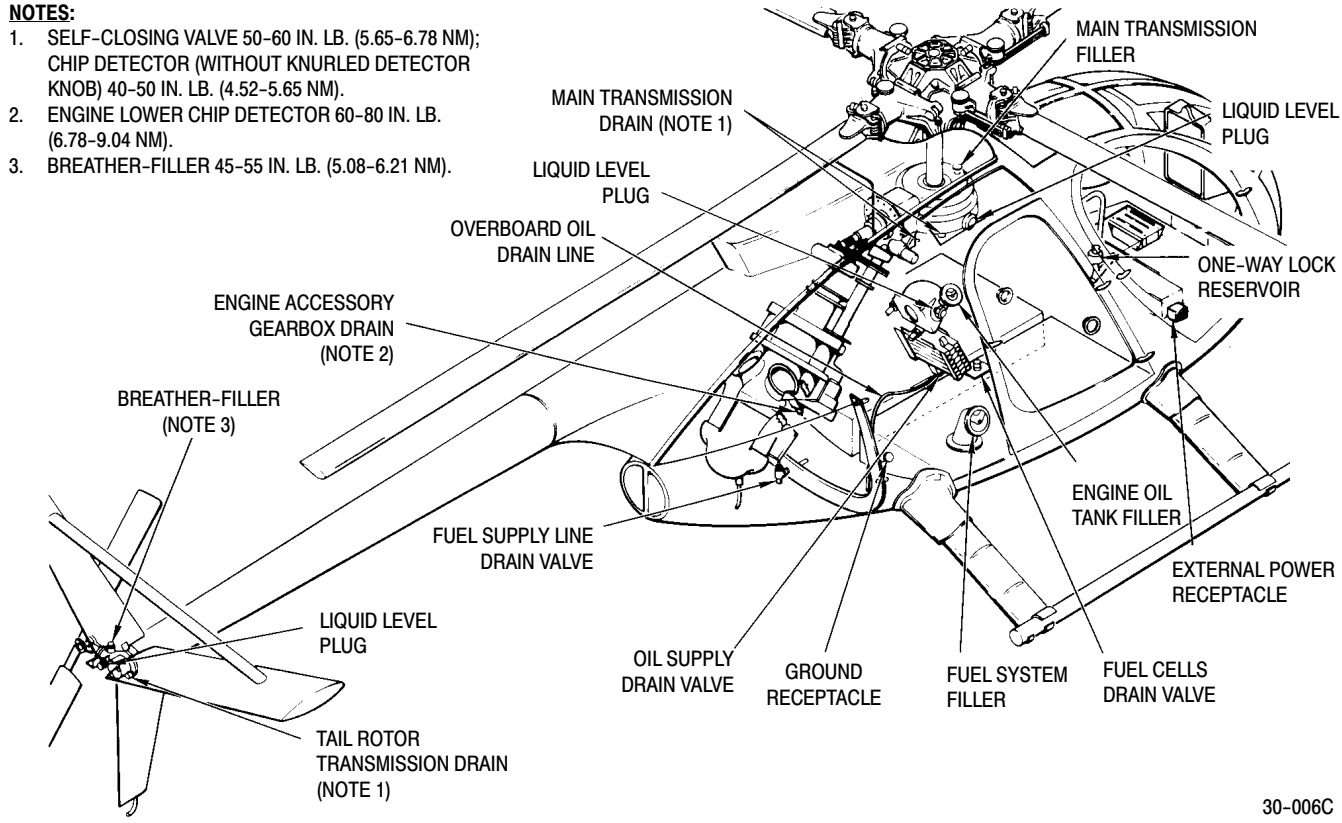


Figure 2-5. Servicing Points

NOTE:

- Motoring engine can draw oil from the oil tank to the gearbox, giving low oil level indications.
- If engine oil level indicates a low condition after setting overnight, engine check valve may be leaking oil from tank to engine gearcase.

(3). Ensure oil tank filler cap is securely tightened immediately after servicing.

D. Engine Oil System Draining (with Sta. 137.50 Bulkhead Drain Ports Installed)

(1). Open engine access doors.

(2). Place suitable container under engine oil tank drain and remove engine oil tank filler cap.

(3). Remove engine oil tank drain cap.

(4). After draining oil from tank, reinstall engine oil tank drain cap and oil tank filler cap.

(5). To drain residual oil from engine accessory gearbox drain, remove wire lead and lower chip detector. Use suitable container to catch oil. Check that detector O-ring is serviceable (replace if necessary); reinstall detector, torque to **50 - 60 inch-pounds (5.65 - 6.78 Nm)** and reconnect wire lead.

E. Engine Oil System Draining (with Drain Valve Installed)

(1). Remove sound insulation from cargo compartment aft bulkhead right-hand access door (Ref. Figure 2-6). Remove the right-hand access door.

(2). Place a suitable container under the overboard oil drain line where it exits the fuselage underside at the firewall.

(3). Remove cap from oil tank filler. Pull out knurled spring-loaded button to open valve in engine oil drain line just below cooler. Rotate button and valve poppet so that locking pin rest on shoulder of pin slot.

(4). After draining the oil from the tank, reinstall the filler cap and close oil drain valve; ensure that poppet pin is in stop slot.

(5). Install access door and sound insulation.

(6). To drain approximately 1/2 pint (0.23 L) of residual oil from engine accessory gearbox drain (Ref. Figure 2-5) remove the wire lead and the lower chip detector. Use a suitable container to catch the oil. Check that detector packing is serviceable (replace if necessary), reinstall detector, torque to **50 - 60 inch-pounds (5.65 - 6.78 Nm)**, and reconnect wire lead.

F. Engine Oil System Flushing

The following procedure is for flushing oil that as been contaminated or when changing the type of oil.

(1). Drain oil from engine, oil tank and oil cooler (Refer to Engine Oil System Draining).

(2). Replace engine oil filter(s) (Ref. Allison Operation and Maintenance Manual)

(3). Refill engine oil system (Refer to Filling - Engine Oil System).

(4). Operate engine for five minutes, shut down and repeat steps (1). thru (3).

G. Main Rotor and Tail Rotor Transmission Filling

Transmission (gearbox) oil should be replaced with new oil whenever it is drained from the gearbox.

NOTE: Inspection of internal ring gear bolts is required after oil is drained from the main rotor transmission, at intervals specified in CSP-H-4, before refilling with oil.

(1). Check transmission oil level in liquid level plug.

(2). Replenish with correct oil until the level reaches **FULL** on the plug.

(a). Fill main transmission by lifting breather-filler cap and inserting spout of oil can into opening. Check that spring-loaded cap closes when oil can spout is removed.

(b). Fill tail rotor transmission by removing lockwire, unscrewing breather-filler and pouring oil into transmission. Check that filler O-ring is serviceable (replace if necessary), reinstall breather-filler and torque to **45 - 55 inch-pounds (5.08 - 6.21 Nm)**; secure with lockwire.

NOTE: Breather- filler plugs that have the threaded insert are installed with the breather hole rearward.

H. Main Rotor Transmission Draining

(1). If installed, remove circular drain cover plug and padding for main transmission from forward underside of transmission cover panel. Otherwise remove, in order, sound insulation, gearbox access cover, transmission drain assembly and main transmission cover).

(2). Position a suitable (min. 4 qt/4 L) container under main transmission drains or drain current configuration transmission using transmission drain hose (41, Table 2-2).

NOTE: Two types of chip detector are installed on the main transmission. The current type chip detector have a knurled knob to remove electrical chip detector probe. Hand-tighten knob when reinstalling.

(3). Remove wire leads, lockwire, chip detector and self-closing valves.

NOTE: The self-closing valve need not be removed if special drain hose is used. Insert hose fitting and turn to drain oil.

(4). If damaged, replace O-rings used with chip detector and self-closing valves.

(5). After oil has drained, install self-closing valve and chip detectors. Torque chip detector,without the knurled chip detector probe knob, **40 - 50 inch-pounds (4.52 - 5.65 Nm)**. Lockwire valve to gearbox and detector to valve. Reconnect wire leads.

(6). If used, reinstall padding and circular drain cover plug on forward underside

transmission cover panel. Otherwise, reinstall, in order, the main transmission cover, the drain assembly, the main gearbox access cover and the sound installation.

NOTE:

- If equipped with a metal filter, the main transmission filter should be cleaned whenever the oil is drained.
- If equipped with a paper filter, the main transmission filter should be replaced whenever the oil is drained.

I. Main Rotor Transmission Oil System Flushing

The following procedure is for flushing oil that as been contaminated or when changing the type of oil.

(1). Drain oil from transmission and oil cooler (Ref. Main Rotor Transmission Draining).

(2). If equipped with a metal filter, clean the transmission oil filter (Ref. Transmission Lubrication Pump Oil Filter Cleaning). If equipped with a paper filter, replace the filter.

(3). Refill transmission oil system (Ref. Main Rotor Transmission and Tail Rotor Transmission Filling).

(4). Operate aircraft for five minutes, shut down and repeat steps (1). thru (3).

J. Tail Rotor Transmission Draining

(1). Position suitable container under the tail rotor transmission drain.

(2). Remove wire lead, lockwire, chip detector and self-closing valve

(3). If damaged, replace packings used with chip detector and self-closing valve.

(4). After oil has drained install self-closing valve and chip detector. Lockwire valve to gearbox and detector to valve. Reconnect wire lead.

(5). Wipe dry any oil spillage with a clean cloth moistened with solvent (1, Table 2-4).

K. Tail Rotor Transmission Oil System Flushing

The following procedure is for flushing oil that as been contaminated or when changing the type of oil.

(1). Drain oil from tail rotor transmission (Ref. Tail Rotor Transmission Draining).

(2). Refill tail rotor transmission (Ref. Main Rotor Transmission and Tail Rotor Transmission Filling).

(3). Operate aircraft for five minutes, shut down and repeat steps (1). and (2).

L. One-Way Lock Control system Servicing

(1). To check oil level, remove control access cover.

NOTE: Reservoir should be 1/2 to 3/4 full.

(2). If oil level in reservoir is low, lift filler cap and add oil as needed.

(3). Reinstall pilot's seat cover.

NOTE:

- If oil level is consistently low, one- way lock should be repaired to stop oil leakage (Ref. Component Overhaul Manual).
- Hydraulic fluid leakage from any part of one- way lock is not permissible. When leakage is observed, assembly should be overhauled (Ref. Component Overhaul Manual) as required and a serviceable unit installed. If leaking one-way lock is not replaced when leakage occurs, continuation in service may result in mechanical malfunction that could be hazardous to flight safety.

Table 2-3. Component Servicing and Materials

Item No.	Component		Capacity	Material
1	Tail Rotor Transmission (1)(2)(5)		0.5 U.S. Pt. (0.23 Liter)	MIL-L(PRF)-23699 (3) Mobil Oil SHC 626 (3)(6)
2	Main Transmission		4 U.S. Qt (3.78 L)	Refer to Item 1
3	Engine Oil Tank (4)		3 U.S. Qt (1.32 L)	Refer to Allison Engine Operation and Maintenance Manual
4	Fuel Cells			
5	Standard nonself-sealing cells	Capacity	64.0 U.S. Gal. (242 Liters) (416.0 pounds)	Refer to Appropriate Pilot's Flight Manual
6		Usable	62.1 U.S. Gal. (235 Liters) (403.5 pounds)	Refer to Appropriate Pilot's Flight Manual
7	Optional self-sealing cells	Capacity	62.0 U. S. Gal. (234 Liters) (402.0 pounds)	Refer to Appropriate Pilot's Flight Manual
8		Usable	59.9 U.S. Gal. (226.8 Liters) (389.5 pounds)	Refer to Appropriate Pilot's Flight Manual
9	Overrunning Clutch	-11, -21, -31	1.52 U.S. Oz. (45cc)	MIL-L (PRF)-23699 (3)
10		-41, -51	1.01 U.S. Oz. (30cc)	
11	One-Way Lock		0.67 U.S. Oz. (20 cc)	MIL-H-5606
12	Battery (Nicad)		As required	MS36300 or 0-B-41 Distilled Water

NOTES:

(1) Oils approved for use in MDHI 369 Series Helicopter main and tail rotor transmissions are synthetic compounds having Ryder Gear Value in excess of 2500 pounds.

(2) Not a preferred lubricant for MDHI transmissions. Use MIL-L-7808 lubricating oil in transmissions only when other oils listed are not available.

(3) Approved for use above -40°F (-40°C).

(4) For Model 250 Series engine oil change requirements and restrictions on mixing oils, refer to Allison Commercial Service Letters.
CAUTION: Mixing of oils within an oil series not in the same group is permitted only in an emergency. Use of mixed oils (oils not in the same group) in an engine is limited to five hours total running time. Adequate maintenance records must be maintained to ensure that the five hour limit is not exceeded. Mixing of oils from different series is not permitted.

(5) Listed is the basic Military Specification only. Check the specification sheet for the latest alpha change letter to determine whether the materials being used conform.

(6) Mobil oil SHC 626 can be formulated such that it may have two different colors. The oil can still be mixed with no adverse effects.

5. Battery Handling and Servicing Precautions

WARNING **The electrolyte used in nickel- cadmium batteries contains potassium hydroxide, a casuistic chemical agent. Serious burns will result if the electrolyte contacts skin. Explosive gases may be released from the battery during charging. Before removing the battery from the helicopter, make sure that the power selector switch is in the OFF position. Removal or installation of the battery connector while the battery is under load may result in explosions, electrical arcing or possible severe personal burns.**

(1). Satisfactory battery operation is largely dependent upon proper operation of the helicopter voltage regulator. Battery problems may often be prevented or eliminated by maintaining the voltage regulator setting at the precise voltage specified.

(2). Nickel-cadmium batteries contain an electrolyte mixture of potassium hydroxide and distilled water. Chemically, this is just the opposite of an acid. Take every possible step to keep the nickle-cadmium battery as far away as possible from the lead-acid type of battery. Do not use the same tools and materials (screwdrivers, wrenches, syringes, gloves, apron, etc.) for both types of batteries. Anything associated with the lead-acid battery, even the air, must never come in contact with the nickel-cadmium battery or its electrolyte. Even a trace of sulfuric acid fumes from a lead-acid battery may result in damage to the nickel-cadmium battery.

(3). A low electrolyte does not necessarily indicate that the water must be added to the cells. The electrolyte level in the cell will vary, depending upon battery's state of charge.

(4). During operation of the battery, some water is lost from the electrolyte as a result of normal gassing, venting, or overcharging. This loss should be replaced with pure distilled water only; do not use potassium hydroxide solution.

(5). The state of charge of a nickel-cadmium can not be determined by either the specific gravity of the electrolyte nor the battery voltage. The specific gravity will remain the same whether is charged are discharged or the electrolyte mix contains potassium hydroxide or is contaminated with potassium carbonate. The voltage will not change appreciably until the battery is almost completely discharged.

(6). If sulfuric acid has been inadvertently mixed with the electrolyte in the battery, the upper areas of the cells will appear greenish in color. In such cases, the battery must be replaced.

6. Battery Servicing

Battery servicing consist of replenishing any electrolyte water that may have been lost through normal gassing, venting or overcharging. Lost water should be replaced with pure distilled water only. Never use potassium hydroxide solution.

CAUTION The electrolyte level should be checked only after the battery has been fully charged and then allowed to rest (stand idle) for a period of two hours. If the helicopter has operated continuously for a minimum of one hour or more, the battery may be considered fully charged.

(1). Turn power selector switch **OFF**.

(2). Raise pilot compartment floor left access door and remove battery cover.

CAUTION Use care to avoid damaging battery temperature sensing wires and switch connections during cleaning and servicing.

(3). Wipe tops of cells with clean cloth and remove filler vent caps.

(4). Check electrolyte level in each cell. A gage will be seen at the the bottom of each filler cavity. The gage may be a rod, a ball, or an orange-colored strip with two notches in the sides. The electrolyte level should be just above the rod or ball, or between the notches in the orange stripe.

CAUTION Do not add distilled water if the battery has remained idle for more than two hours after flight (charging). The electrolyte level will drop in a longer time interval and any water would result in overfilling.

NOTE: If electrolyte level has lowered to the extent that it is not visible, remove battery from helicopter for bench charging and servicing.

(5). Using a thoroughly clean bulb-type syringe that has never been used for servicing a lead-acid battery, add pure distilled water as necessary to raise the electrolyte 1/4 - 3/8 inch (6.35-9.525 mm) above baffle (between level holes or above nylon rod gage, as applicable). If there is surplus electrolyte, replace the battery or remove the battery and service it in accordance with manufacturer's instructions.

NOTE: If a battery with surplus electrolyte is serviced, it must be checked for serviceability according to manufacturer's instructions before reinstallation and reuse in the helicopter

(6). Reinstall filler vent caps.

(7). Reinstall battery cover, mounting screws and washers; close and latch access door.

7. Battery Charging

Nickel-cadmium battery charging is accomplished by either the normal charging method or the deep-cycling method, depending upon the circumstance. Normal battery charging consist of charging the battery by the constant potential method or the constant current method and adjusting the electrolyte level if required. Normal battery charging is accomplished when the need arises. Deep cycling consists of intentionally discharging and then recharging the battery, adjusting the electrolyte level, checking the battery output capability (capacity discharge test), and again recharging. Deep cycling should be accomplished on a new battery before it is installed in the helicopter, if required, and at the inspection intervals specified in CSP-H-4. Deep cycling should also be accomplished after battery repairs such as replacement of individual cells or the battery case, and after any idle period of ninety (90) days or more.

NOTE: Follow the manufacturer's operating instruction for the battery charger; however, all voltage values, discharge rates, and charging schedules given (Ref. Battery Deep Cycling) shall apply in event of conflict with the constant potential battery charger instructions.

A. Normal Battery Charging

WARNING **Review the battery handling and servicing precautions (Ref. Battery Handling and Service Precautions) before preforming the following charging operations.**

(1). If battery is installed in the helicopter, turn power selector switch **OFF** and remove battery.

(2). Clean battery (Ref. Battery Cleaning).

(3). Inspect battery for any damage that would require battery replacement or repair.

CAUTION Do not add distilled water to the electrolyte prior to charging, even if the electrolyte is not visible. The electrolyte level will raise as charging progresses.

(4). Charge the battery as follows:

NOTE: The following procedure provide instructions for charging with the constant potential method. When charging by the constant charging method, disregard the procedure in steps (a). and (b). below and charge the battery according to battery and battery charger manufacturer's instructions. Charging is accomplished with cell filler vent caps installed. Temperature of battery may rise during charging.

(a). Using a constant potential charger, charge battery for 30 minutes taking care to maintain a constant and accurate charging voltage of 28.0 to 28.5 Vdc for the full charging period.

(b). If necessary, monitor and manually adjust charging voltage to prevent any drop or rise in charging voltage.

(5). Switch charger **OFF** and then disconnect battery from charger.

(6). Remove filler vent caps and check electrolyte level. Replenish with pure distilled water (Ref. Table 2-3) if necessary, taking care not to over-fill.

(7). Replace and tighten filler vent caps.

B. Battery Deep Cycling

WARNING **Review the battery handling and servicing precautions (Ref. Battery Handling and Service Precautions) before preforming the following charging operations.**

(1). Perform normal charging (Ref. Normal Battery Charging).

(2). Connect a 9 ohm resistance (9 ohm, 200 watt-resistor or three 3 ohm, 75 watt resistors in series) across the battery terminals and allow the battery to discharge for approximately 12 hours, or until the battery voltage decrease below one volt.

(3). Remove 9 ohm load resistance from battery and loosen cell filler vent caps.

(4). Charge battery until charging drops below 0.30 ampere.

(5). While continuing to charge the battery at a rate less than 0.30 ampere, use an accurate voltmeter to measure the voltage across the terminals of each individual battery cell. Each individual cell should be within 0.05 volt of the cell voltage specified below for applicable charging voltage.

Charging Voltage (volts dc)	Cell Voltage (volts dc)
28.0	1.47
28.1	1.48
28.2	1.48
28.3	1.49
28.4	1.49
28.5	1.50

NOTE: Nominal individual cell voltage is 1.25 volts for a normal, disconnected, fully charged cell.

(6). Switch charger **OFF** and then disconnect battery charger.

(7). Allow battery to rest for a minimum of one hour maximum and a maximum of 2 hours; adjust electrolyte level.

(8). If electrolyte level is adjusted, reconnect battery to charger and allow the battery continue charging for thirty minutes.

CAUTION If battery temperature exceeds room temperature during initial charging, battery temperature must be allow to decrease to room temperature before recharging the second time.

(9). After allowing battery temperature to decrease to room temperature, repeat the procedures described in steps (2). thru (8). above to cycle the battery a second time.

NOTE: When making the individual cell voltage measurement the second time, the voltage of each individual cell must measure within the voltage limits specified in step e above. If the voltage of any individual cell does not measure within the specified voltage limits, the cell must be discarded. Replace a defective cell according to instructions.

(10). Switch charger off and then disconnect battery from charger.

(11). Tighten cell filler vent caps.

Table 2-4. Maintenance Materials

Item No.	Material	Specification No. (1)	Commercial Products (2) Name/No.	Mfr
1	Solvent, dry-cleaning	P-D-680	(3)	
2	Lockwire (diameter as required)	MS200995C	CRES Safety wire (3)	
3	Sealing compound (color as noted)	MIL-S-8802	890	Coast Pro Seal
		MIL-S-8516 Class II	3C-3007	Churchill Chemical Corp. Los Angeles, CA
			PR1422 A1/2 Type I	Product Research
			RTV 730 Type I	Dow Corning Midland, MI
4	Primer	MIL-P-85582	(3)	
5	Chromic Acid solution (pH 2.6 to 3.4): magnesium touch up	(4)	Dow #19 or equivalent	Dow Chemical Co.
6	Lacquer, acrylic (Fed-Std-595)	MDM 15-1083	Black #17038 Black #37038 Parchment #20371 Green #34151 Blue #15102 Blue #35044 Brown #30140	(3)
7	Primer, catalyzed acrylic (yellow)		(Refer to item No. 6	
8	Chemical film and chemical film materials for aluminum and aluminum alloys.	MIL-C-5541B (Class 2, unless noted. Grade and type optional.)	Iridite 14-2 Al-coat Alodine 1201	Richardson Co. Allied-Kelite Products Division 2400 E. Devon Ave. Des Plaines, IL
9	Abrasive paper, silicon carbide (grade as noted)	P-P-101	(3)	
10	Surface cleaner (pre-painted solution with phosphoric acid base)	TT-C-490 or MIL-C-10578, Type II	WO #1	Turco Products, Inc. Wilmington, CA

Table 2-4. Maintenance Materials (Cont.)

Item No.	Material	Specification No. (1)	Commercial Products (2) Name/No.	Mfr
11	Paint remover (acid type for epoxy)	TT-R-248	Turco 5851 #A202	Turco Products, Inc. Cee-Bee Chemical Company
	Paint remover (solvent type)	MIL-R-25134	(3)	
	Plastic bead, spherical 20 - 30 mesh		Poly Plus 20/30 (6)	Polyrock Co. 4763 Murrita Ave. Chino, CA 91710
				Abrasive Cleaning Equip. 20122 State Rd. Cerritos, CA 92701
				Abrasives Unlimited 4653 S. 33rd St. Phoenix, AZ 85040
12	Thinner, acrylic-nitrocellulose lacquer	MIL-T-19544	Prepsol (Dupont 3919)	E. I. DuPont Co. Los Angeles, CA
13	Corrosion preventive, aircraft gas turbine engine, synthetic base	MIL-C-8188		
14	Masking tape, pressure sensitive	UU-T-106	#216 (High temp)	3M Co. St. Paul, MN
15	Protective coating	MIL-C-6799 Type 1		
16	Tape, pressure sensitive, water-proof for packaging and sealing (width and thickness as noted)	PPP-T-60 Class I		3M Co.
17	Silicone adhesive/ sealant	MIL-S-8660B	DC 4	Dow Corning
			G-624 Silastic	General Electric Silicone Products Dept Waterford, NY
18	Grease, oscillating bearing	MIL-G-25537	Aero Shell 14	Shell Oil Co.
			TG-4851	Texaco Inc.
19	Adhesive, epoxy, non-structural	MIL-A-52194	Scotch-Weld EC 1838 (Part A&B)	3M Co.
		Commercial	A-1177-B	B. F. Goodrich
20	Abrasive cloth, aluminum oxide (grade as noted)	P-C-451	(3)	

Table 2-4. Maintenance Materials (Cont.)

Item No.	Material	Specification No. (1)	Commercial Products (2) Name/No.	Mfr
21	Grease	MIL-G-81322	Mobil Grease 28	Mobil Oil Company
			Aero Shell 22	Shell Oil Company
			Braycote 622	Castrol Industries 1001 W. 31 st St. Downers Grove, IL 60515 (630) 241-4000 (800) 621-2661
22	Methyl-ethyl-ketone (MEK)	TT-M-261	(3)	
23	Crocus cloth	P-C-458	(3)	
24	Adhesive, silicone rubber		Silastic 140	Dow Corning
25	Lubricant, solid film	MIL-L-8937 MIL-L-23398 HMS 4-1078 Type I/XI	Lubri-Bond 220 (3)	Electro-film Inc. 7116 Laurel Canyon Blvd. P.O. Box 106, No. Hollywood, CA
			Molykote 3402 (3)	Product Techniques, Inc. 511 E. 87th Pl. Los Angeles, CA
			Kal-Gard AD (3)	Kal-Gard Coating & Mfg. Co. 16616 Shoenborn Street Sepulveda, Ca. 91343
			Pera-Silk G (3)	Highway 52 N.W. West Lafayette, IN 47906
26	Grease, aircraft and instrument	MIL-G-23827	Braycoat 627	Bray Oil Company 9950 Flair Drive El Monte, CA
			Aero Shell 7	Shell Oil Company
			Exxon 5114EP	Exxon Co. Houston, TX
27	Acetone	O-A-51	(3)	
28	Surface primer, locking compound (grade and form optional)	MIL-S-22473	Locquic	Loctite Inc., 702 No. Mountain Road, Newington, CT 06111
29	Sealing, locking and retaining compounds; single component (grade as noted)	MIL-S-22473 MIL-R-46082	Loctite #35 or RC/609	Loctite, Inc.
30	Twine, nylon	MIL-T-713	(3)	

Table 2-4. Maintenance Materials (Cont.)

Item No.	Material	Specification No. (1)	Commercial Products (2) Name/No.	Mfr
31	Insulation sleeving, electrical (vinyl tubing; size as noted)	MIL-I-631 Type F, Form U, Grade A, Class I, Category 1	(3)	
32	Tape, pressure sensitive (width and thickness as noted)	PPP-T-66 Type I, Class A	Scotch Cal #471 VEF	3M Co.
33	Loctite remover (for disassembled parts)		Oakite 156	Oakite Product Inc., Los Angeles, CA
34	Petrolatum (petroleum jelly)	VV-L-236	(3)	
35	Lubricating oil, general purpose, preservative	VV-L-800	(3)	
36	Antiseize compound, high temperature	MIL-A-907		
37	Lacing cord, high temperature		Type T-333	Warren Wire Co.
38	Dichloromethane (methylene chloride)	MIL-D-6998	(3)	
39	Ethylene chloride (ethylene dichloride EDC)	MIL-E-10662	(3)	
40	Gasket material (adhesive on one side only)		Scotchfoam # 4304	3M Co.
41	Tape, pressure sensitive adhesive, filament reinforced	PPP-T-97	(3)	
42	Tape, pressure sensitive polyurethane (width as noted)		#Y8560	3M Co.
43	Adhesive (epoxy), nonstructural		Lefkoweld Type 109 Resin/LM-52 Activator	Leffingwell Chemical Co., Whittier, CA.
44	Barrier material, grease proof	MIL-B-121 Type I, Gr A, Class 2 MIL-B-131 Class 1	(3)	
45	Cement	MIL-A-8576B	PS-18 S147	Rohm and Haas Co. Swedlow, Inc.
46	Tetrahydrofuran (THF)			Foremost-McKesson Corp. Chemical Dept. Los Angeles CA

Table 2-4. Maintenance Materials (Cont.)

Item No.	Material	Specification No. (1)	Commercial Products (2) Name/No.	Mfr
47	Lacquer, clear, aluminum clad alloy surfaces	MIL-L-6066		
48	Solder, tin alloy, rosin core	QQ-S-571 (Composition SN60WRP2	(3)	
49	Emery cloth, fine		(3)	
50	Patching material (inside/outside)		5187	Uniroyal, Inc. Fuel Container Dept. Mishawaka, IN
51	Patching material (outside only)		5200	Uniroyal Inc.
52	Soap paste	P-S-560	(3)	
53	Cheesecloth		(3)	
54	Cement	MIL-A91 17	EC-678	3M Co.
55	Solvent		3339	Uniroyal
56	Vinyl tape and activator		Tape: Scotch Cal #455 Activator: Scotch Title A-2	3M Co.
57	Grease		130A	Lubriplate Manufacturing
58	Grease		930A	Lubriplate Manufacturing
59	Naphtha, aliphatic	TT-N-95	(3)	
60	Sealant		HT-4	
61	1,1,1, Trichloroethane technical inhibited	O-T-620	(3)	
62	Tape, aluminum foil		# 425	3M Co.
63	Detergent, general purpose	MIL-O-16791	(3)	
64	Hydrofluoric Acid	O-H-795	(3)	
65	Nitric Acid	O-N-350	(3)	
66	Brazing flux, paste	O-F-499	(3)	
67	Brazing alloy, silver base	MIL-B-15395	(3)	
68	Tape, nitrile rubber		NE-71A	Armstrong Cork Co. Lancaster, PA
69	Adhesive, bonding, vulcanized (synthetic rubber-to-steel)		EC1300L	3M Co.
70	Corrosion preventive compound, solvent cutback, cold application	MIL-C-16173 Grade 3	Braycote	Bray Oil Company
71	Isopropyl alcohol	TT-I-735	(3)	

Table 2-4. Maintenance Materials (Cont.)

Item No.	Material	Specification No. (1)	Commercial Products (2) Name/No.	Mfr
72	Zinc chromate putty, general purpose	MIL-P-81 16	Compound 3998	Fuller-O'Brien Paints Santa Fe Springs, CA
73	Non-slip tape, pressure sensitive, medium grade (black)	P-D-00455	(3)	
74	Electric tape, plastic	MIL-I-7798	# 33	3M Co.
75	Cleaning compound, alkaline waterbase	MIL-C-25769		
76	Acetylene, technical grade	BB-A-106	(3)	
77	Oxygen, industrial grade	BB-O-925 Type I, Grade B	(3)	
78	Welding rod, corrosion and heat resisting alloys (Class or type as noted)	MIL-T-9821B or C Nitronic 40	21-6-9	Johnston Stainless Welding Rods 13729 E. Rosecrans Santa Fe Springs, CA
79	Teflon tape		# 520	Permacel
			# 48	3M Co.
80	Use item 19			
81	Fiberglass repair kit		Cordokit RK-10	Ferro Corp. Composites Division 34 Smith St. Norwalk, CT 06852
82	Epoxy resin with catalyst, low pressure laminating	MIL-R-9300 Type I	(3)	
83	Adhesive		Epon 919	Shell Chemical Co. Pittsburgh, PA
84	Fuel cell repair kit		RK3CL	Uniroyal
85	Rod, welding	QQ-R-566 CLFS RA12 or RA143 (4043) 5% silicon	(3)	
86	Solder, tin alloy, acid core	QQ-S-571	(3)	
87	Insulation sleeving, electrical, fiberglass (size as applicable)	MIL-L-3190	(3)	
88	Lubricant, solid film	MIL-L-46010	(3)	
89	Tape, pressure sensitive (width as noted)		4104	3M Co.
90	Tape, double-faced		E-706	Arno Adhesive Tapes Inc., Los Angeles, CA
91	Cement		C-1 11	Sta-Bond Corp. Gardena, CA

Table 2-4. Maintenance Materials (Cont.)

Item No.	Material	Specification No. (1)	Commercial Products (2) Name/No.	Mfr
92	Adhesive, polyurethane		U-136, (AC AAAA)	Sta-Bond Corp.
93	Tape		#850	3M Co.
94	Filler, resin		Epon 960F	Shell Chemical Co.
95	Filler, resin		#RP1257-3	Ren Plastics Inc.
96	Rubber cement	MIL-A-5092	(3)	
97	Preservative oil, hydraulic	MIL-H-6083		Ref. Table 2-3
98	Grease		GD 568-S	GC Electronics, Los Angeles, CA
99	Insulation varnish		Glyptal 1201	General Electric Insulation Dept., Schenectidy, NY
100	Vinyl plastic tape		#330	Technical Tape Co. New Rochelle, NY
101	Rust inhibitor spray (aerosol)		WD-40	Rocket Chemical Co., Inc., San Diego, CA
102	Adhesive	MIL-A-46106, Type I	RTV732	Dow Corning Corp.
103	High temperature tape (thickness as noted)		Temp-R	Insulectro Co. 1410 W. Olympic Los Angeles, CA
104	Corrosion preventive oil		Steelgard 1301	Harry Miller Corp. Philadelphia, PA
105	Use item 17			
106	Sealant		#5220	Fiber-Resin Corp. 170 W. Providencia Ave. Burbank, CA
107	Epoxy coating		Poly-EP	Detroit Graphite Co. Detroit, MI
108	Thinner (for item 107)		Poly-EP	Detroit Graphite Co.
109	Primer Resin (paint base for polycarbonate plastic)		Q-881	Bee Chemical Company Gardena CA
110	Thinner (for item 109)		T-80679	Bee Chemical Co.
111	Graphite, powdered		(3)	
112	Tape		Temp R Tape (Type TV)	Connecticut Hard Rubber Co. New Haven, CT
113	Parting agent		Fre-Kote 33	Fre-Kote Inc.
114			Slip-Spray	E. I. DuPont Co. Los Angeles, CA
115	Fastener tapes, nylon hook and pile		Velcro	American Velcro, Inc. Dow and Manchester St. Manchester, NH

Table 2-4. Maintenance Materials (Cont.)

Item No.	Material	Specification No. (1)	Commercial Products (2) Name/No.	Mfr
116	Kerosene	VV-K-21 1	(3)	
117	Anti-seize compound, low temperature	MIL-T-5544	Thread Lube	Parker-Hannifin 17325 Euclid Ave. Cleveland, OH 44112
118	Fluorocarbon dry lubricant		S-122	Miller-Stephenson Chemical Co., Inc. 1001 E. First St. Los Angeles, CA
119	Foam tape, adhesive backing		4104Y 92772	3M Co.
120	Cement		2210	3M Co.
121	Adhesive (epoxy)		EA9330.3 EA9314	Hysol Division Dexter Corporation Pittsburg, CA
122	Adhesive		444R	Coast ProSeal
123	Tape, pressure sensitive		#471	3M Co.
124	Potting compound	MIL-S-8516B	727	Coast ProSeal
			3C-737	Churchill Chemical Corp. Vernon, CA
			PR1201	Product Research Co.
125	Seal rubber extrusion (main transmission)	MIL-R-6855 Class I Grade 60	1317	Rubbercraft Corp. Torrance, CA
126	Paper, fine abrasive		(3)	
127	Adhesive (2-part mix)		EC3549	3M Co.
128	Coating, logo white		Q881 (Color No. 484)	Bee Chemical Co.
129	Thinner (for item 128)		T-80695	Bee Chemical Co.
130	Paint		(5)	Advance Coating and Chemicals 2213 N. Tyler S. El Monte, CA 91733
131	Epoxy primer / Catalyst reducer		1-1G-69 / 1-1H-75	Advance Coating and Chemicals
132	Polyethylene tape		#483	3M Co.
133	Adhesive - cyanoacrylic (used for bonding acrylic windows to geon strips)		Hysol Super Drop Cyanoacrylic 3CI-1000	Hysol Division
134	Accelerator (for item 133)		Hysol Super Drop Accelerator	Hysol Division
135	Plastic steel		Devcon A	Devcon Corp. Danvers, MA 01923
136	Tape, pressure sensitive		#471	3M Co.
137	Molybdenum disulfide powder, lubricant	MIL-L-7866		

Table 2-4. Maintenance Materials (Cont.)

Item No.	Material	Specification No. (1)	Commercial Products (2) Name/No.	Mfr
138	Tape, pressure sensitive (dimensions as noted)	- -	#4508	3M Co.
139	Spray lubricant	- -	Moly-Dee	Arthur Withrow 5511 District Blvd. Los Angeles, CA
140	Adhesive primer	HMS 16-1069 Class I	Liquid primer	MDHI
141	Fluorocarbon release agent, dry film lubricant		6611N	E.I. DuPont Co.
142	Sealer	HMS 16-1068	EA9313	Hysol Division Dexter Corporation
143	Lubricant		LPS3	LPS Research laboratories Inc. 2050 Cotner Ave. Los Angeles, CA
144	Cement		Grip	Talor Industries City of Industry, CA
145	Catalyst reducer		1-1H-75	Advance Coating and Chemicals
146	Metal protector, aerosol		Molykote	Dow Corning Corp.
147	Wash primer	MIL-C-8514	(3)	
148	Enamel, epoxy (Fed-Std-595)	MDM 15-1100 Type II	Black #37038 White #37769 Tan #20318 Parchment #20371 Red #11958 Green #34151 Gray #36231 Yellow #13655	(3)
149	Lubricant, spray		Tri-Flow	Costa Mesa Lubricant P.O. Box 125 Olive Branch, MS 38645
150	Washing compound with wax		Zip Wax (2)	Turtle Wax Inc. 5565 W. 73rd St. Chicago, IL 60638
151	Sealant		RTV106 (2)	General Electric
152	Tape		CT93C	Jones Industrial Supply Culver City, CA
153	Tube, silicone		No. 4 (H.A.I.)	Varflex Corp. Rome, NY
154	Sleeve, vinyl		No. 2 Resinate	Borden Chemical Compton, CA
155	Thread sealant		P412	Permacel
156	Epoxy cement	Hughes HP16-1	Type II EC 1300L	Dow Corning Corp.

Table 2-4. Maintenance Materials (Cont.)

Item No.	Material	Specification No. (1)	Commercial Products (2) Name/No.	Mfr
157	Dry lubricant	MIL-L-46010A	Ecoalube No. 642	Everlube Corp. North Hollywood, CA
158	Leak detector, liquid	MIL-L-25567C Type I	Leak-Tec	American Gas and Chemical Co. Cresskill, NJ
159	Fiberglass cloth, 0.022, 2 ply	MIL-C-9084 No. 181		(3)
160	Polyester laminating resin	MIL-R-7575		(3)
161	Sealing compound, silicone		RTV11	General Electric
162	Dykem, red of blue		SP1100	Dykem Company 8501 Delport Dr. St. Louis, MO 63114
163	Tape, duct		(3)	
164	Xylene		(3)	
165	Adhesive		A-4000	Dow Corning Corp.
166	Primer		A-4004	Dow Corning Corp.
167	Catalyst		xy22	Dow Corning Corp.
168	Adhesive, epoxy, non-structural		EC2216 2 Part Resin: B (White) Activator: A (Gray)	3M Co.
169	Adhesive		Stabond G-304	Sta-Bond Corp.
170	Varnish, moisture resistant	MIL-V-173 Type II	(3)	
171	Sealing compound	MIL-S-81733	PR-1431 Type IV PR- 1436G Type II- 2 PR-1436GB-2	Product Research
172	Cement		Uniroyal #3230	Uniroyal Inc. Engineering Systems Dept. Mishawaka, Indiana 46544
173	Repair kit, non-self-sealing cell		Uniroyal #RK-10-34	
174	Patch material, self-sealing cell, exterior		Uniroyal #5241/5241 sandwich	
175	Alcohol, denatured Type I	O-E-760		
176	Catalyzed epoxy primer		Type I and Type II	Advance Coating and Chemicals
177	Pre-treatment	MIL-P-15328	(3)	
178	Kit, dye penetrant	MIL-I-25135	(3)	
179	Tape, pressure sensitive sponge rubber		Y-9132-B	3M Co.

Table 2-4. Maintenance Materials (Cont.)

Item No.	Material	Specification No. (1)	Commercial Products (2) Name/No.	Mfr
180	Adhesive, epoxy Part A & B		EA9314	
181	Tubing, vinyl, clear		PVC tubing Size 2 GA Clear 105C	Sea Wire and Cable Inc. P.O. Box 647 Madison, AL 35758 1-800-633-7210
182	Release agent		TC7-527	EDP Industries 2055 E. 223 Street Long Beach, CA 90810
			225	Ram Chemical Co. Gardena, CA
183	Cleaner		Desoclean 45	DeSoto Aerospace Coating, Inc. 1608 4th. St. Berkley, CA 90621 (818) 549-7823
184	Adhesive		HMS16-1149, T-5	Sta-Bond Corp.
185	Dielectric compound		DC4	Dow Corning Corp.

NOTES:

(1) Numbers are U.S.A. Specifications and Standards. Prefix symbols are defined as follows: AMS - American Material Standard; MS - Military Standard; MIL - Military Specification; Single, double or triple alpha prefix of same letter - Federal Specification; AN - Air Force-Navy Aeronautical Standard; NAS - National Aerospace Standard.

(2) Primary selection. Any equivalent material may be used as an alternate selection.

(3) Use best comparable grade material when conformity of available materials of same type with listed Specification No. cannot be determined.

(4) Several types of original protective treatment are used on magnesium alloy parts. With paint removed, treatment process should be identifiable from coating appearance as outlined in following table. Parts should not be reprocessed either completely or partially without first contacting MDHI Customer Service Department. However, regardless of original process used, chromic acid brush-on treatment (Dow #19, or equivalent) is acceptable for touchup of coatings removed by abrasion, scratches or rework.

(5) When ordering paint from Advance Coating and Chemicals, specify each paint by type (i.e., acrylic, epoxy, polyurethane), by color, and by AC part number. Also include compatible HS or Fed. Std. No. to ensure that correct type and color paint is provided. The color code numbers for finish paints used on new Model 369 helicopters are now being entered in helicopter log books prior to delivery of aircraft. Owners/operators of earlier models should check sales order for paint numbers listed and enter them in some log books, or sales orders. If so, ensure when ordering Advance Coating paints that AC No. and SA No. are compatible.

(6) Do not use over 50 psig air pressure for abrasive cleaning method. Mask or shield threaded areas or critical surfaces where damage may result from abrasive blasting.

Table 2-4. Maintenance Materials (Cont)

NOTE: (4) (Continued)

Process	Applicable Specification	Normal Coating Thickness and Color
Dow #1 (Chrome Pickle)	MIL-M-3171, Type I	Removes metal. Iridescent yellow or red; gray coatings are unacceptable.
Dow #7	MIL-M-3171, Type III	No dimensional change. Wrought or extruded parts - chestnut brown; castings - light brown to black; AZ91C-T6 and AZ92A-T6 alloys - gray.
Dow #17 (Anodize)	MIL-M-45202, Type I - light coat Type II - heavy coat	 Class C - 0.0002-0.0003; light green. Class D - 0.0002-0.0035; dark green.
Dow # 19 (Chromic Acid Brush on Treatment)	MIL-M-3171, Type VI	No dimensional change. Gray to Black.

8. Access and Inspection Provisions

(Ref. Figure 2-6)

CAUTION Any time maintenance work is to be preformed near the engine air inlet, use care to prevent entry of foreign objects that might later be sucked into the compressor. Tape covers of cardboard or other suitable material in place over the engine inlet screen in the plenum chamber. Plug the oil cooler inlets. Covers should not be removed until work is completed and debris is thoroughly cleaned out of the area. Removable access doors and covers are provided in the helicopter for servicing, inspection, removal, installation and adjustment of components. Except for stress areas, the access provisions provided in the outer fuselage, the pilot's compartment, the cargo compartment and at bulkhead stations have turnlock fasteners. Screws are used to secure access door in stress areas. Liquid level plugs allow "sight" inspection of the lubricant levels of the main transmission, engine oil tank and tail rotor transmission.

A. Main Gearbox Access Cover

Different main gearbox access covers are used with the shaft-driven and belt-driven oil cooler blower installations. The cover provides access to the main transmission, oil cooler blower and engine-to-transmission drive shaft. A silicone-rubber-sponge gasket along the upper edge of the fiberglass cover provides a water-and dust-tight seal. Turnlock fasteners secure the cover to the structure. With the shaft-driven blower the cover must be removed before the main transmission drain assembly or the transmission cover can be removed.

(1). Removal: Disengage turnlock fasteners and remove cover.

(2). Inspection:

(a). Inspect cover for cracks or other visible damage.

(b). Inspect turnlock fasteners and receptacles for improper fastening action.

(c). Inspect cover gasket for deterioration or missing sections.

(3). Installation: (With main transmission cover and drain assembly already installed - shaft-driven blower.) Position access cover and secure by engaging turnlock fasteners.

B. Main Transmission Drain Assembly (used with Shaft-Driven Blower)

The main transmission drain assembly is a clear polycarbonate plastic yoke-type collector that provides an overboard drain for water or oil seepage from the transmission input pinion oil seal. Foam gaskets cushion and seal the amounting edges. The drain assembly must be removed before the main transmission cover can be removed.

(1). Removal: (With main transmission cover removed.)

(a). Remove the two screws, two bolts and washers securing the drain assembly to the structure, transmission shroud mount and blower scroll.

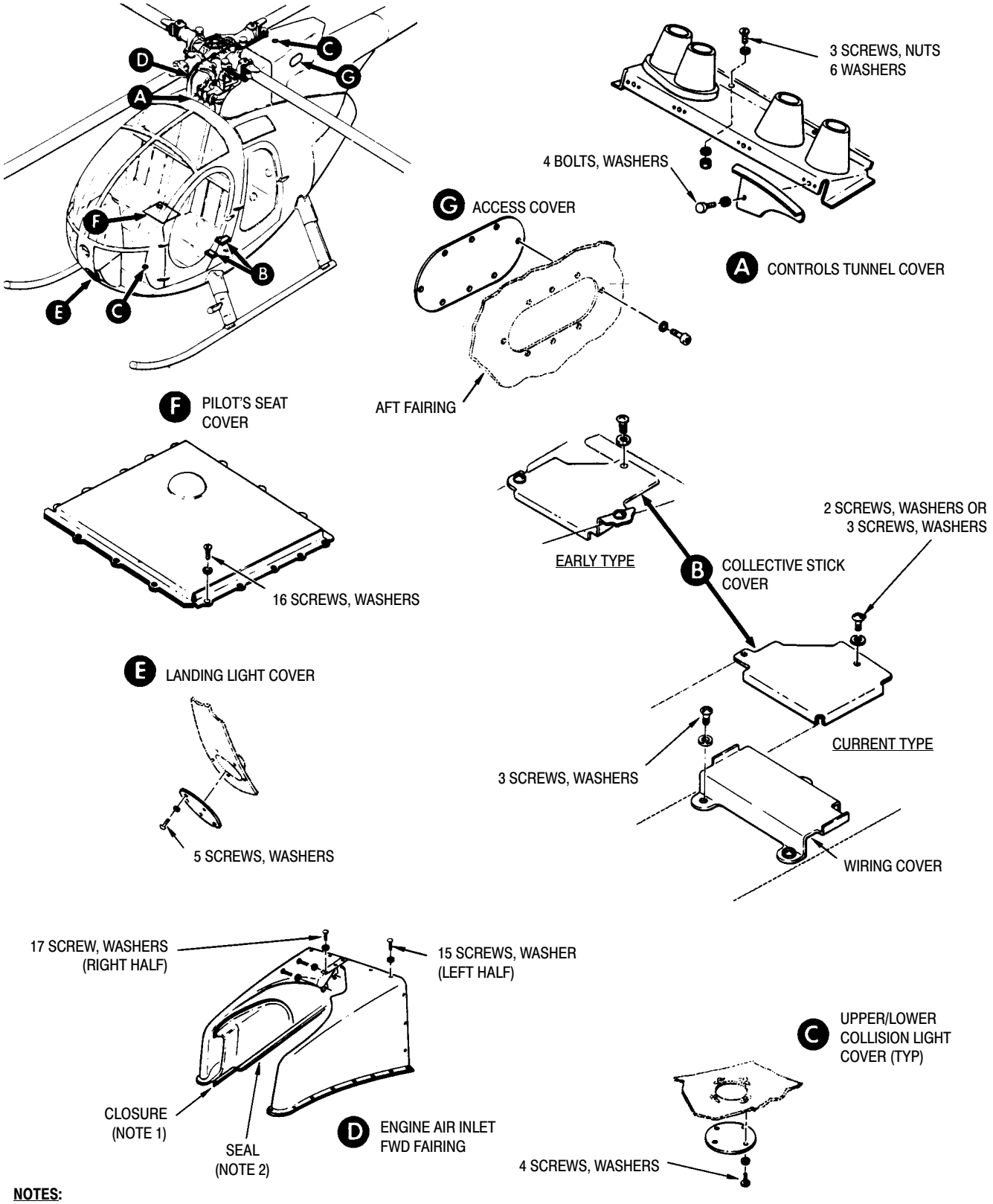
(b). Remove the one nut and washer from the scroll stud under the drain outlet tube. Lift drain assembly from shroud mount.

(c). Unless replacing drain assembly, leave drain hose lockwired and attached.

(2). Inspection: Inspect drain assembly for cracks, gaskets for deterioration and outlet tube for internal obstruction.

(3). Installation: (With main transmission cover installed.)

(a). Position drain assembly on the transmission shroud. Check that the short plastic drain tube from the transmission input pinion seal drain port enters the drain assembly outlet tube port.



NOTES:

1. NOTE INSTALLED ON ALL HELICOPTERS.
2. TAPE SEAL (42, TABLE 2-4).

30-007-1E

Figure 2-6. Access and Inspection Provisions (Sheet 1 of 6)

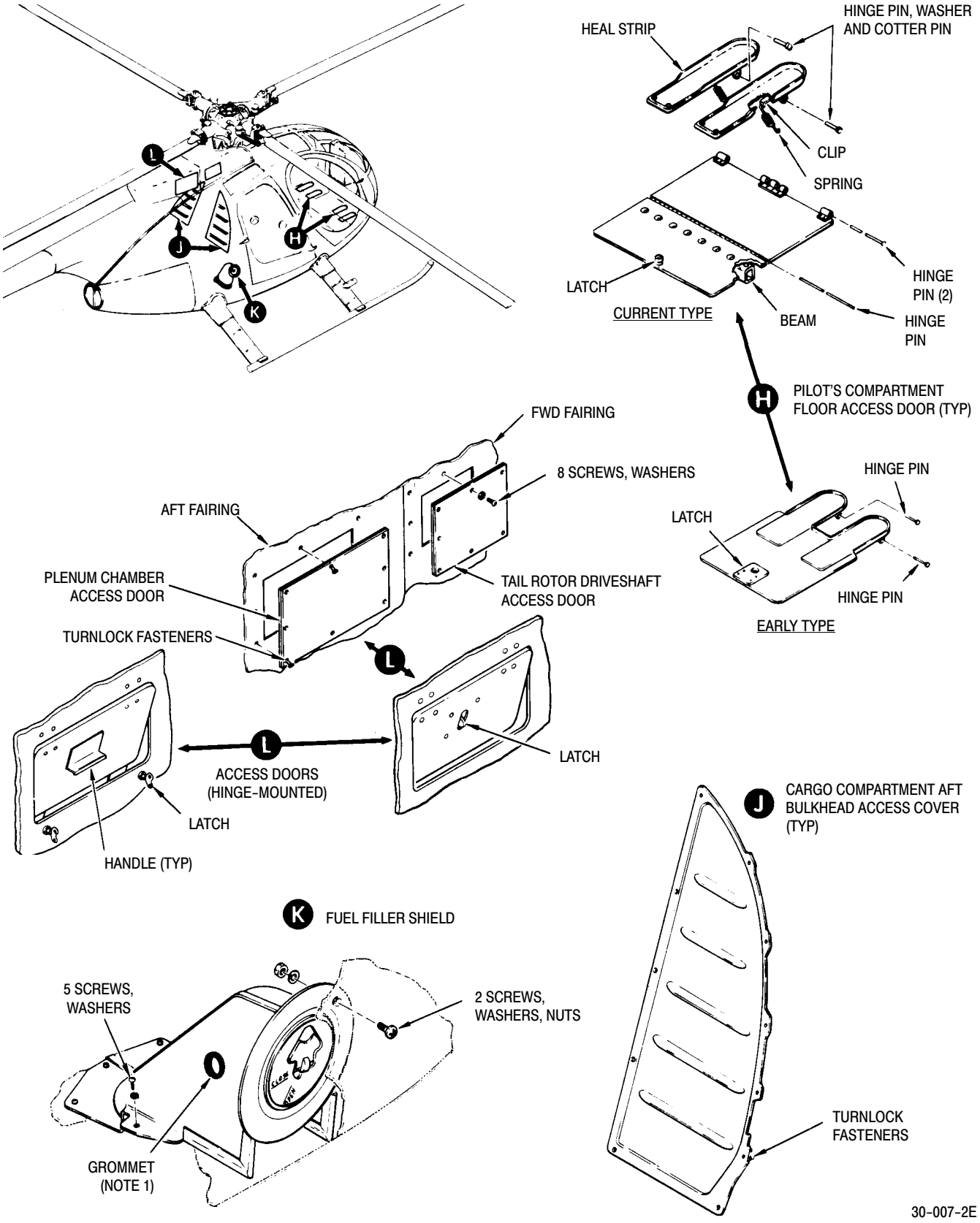


Figure 2-6. Access and Inspection Provisions (Sheet 2 of 6)

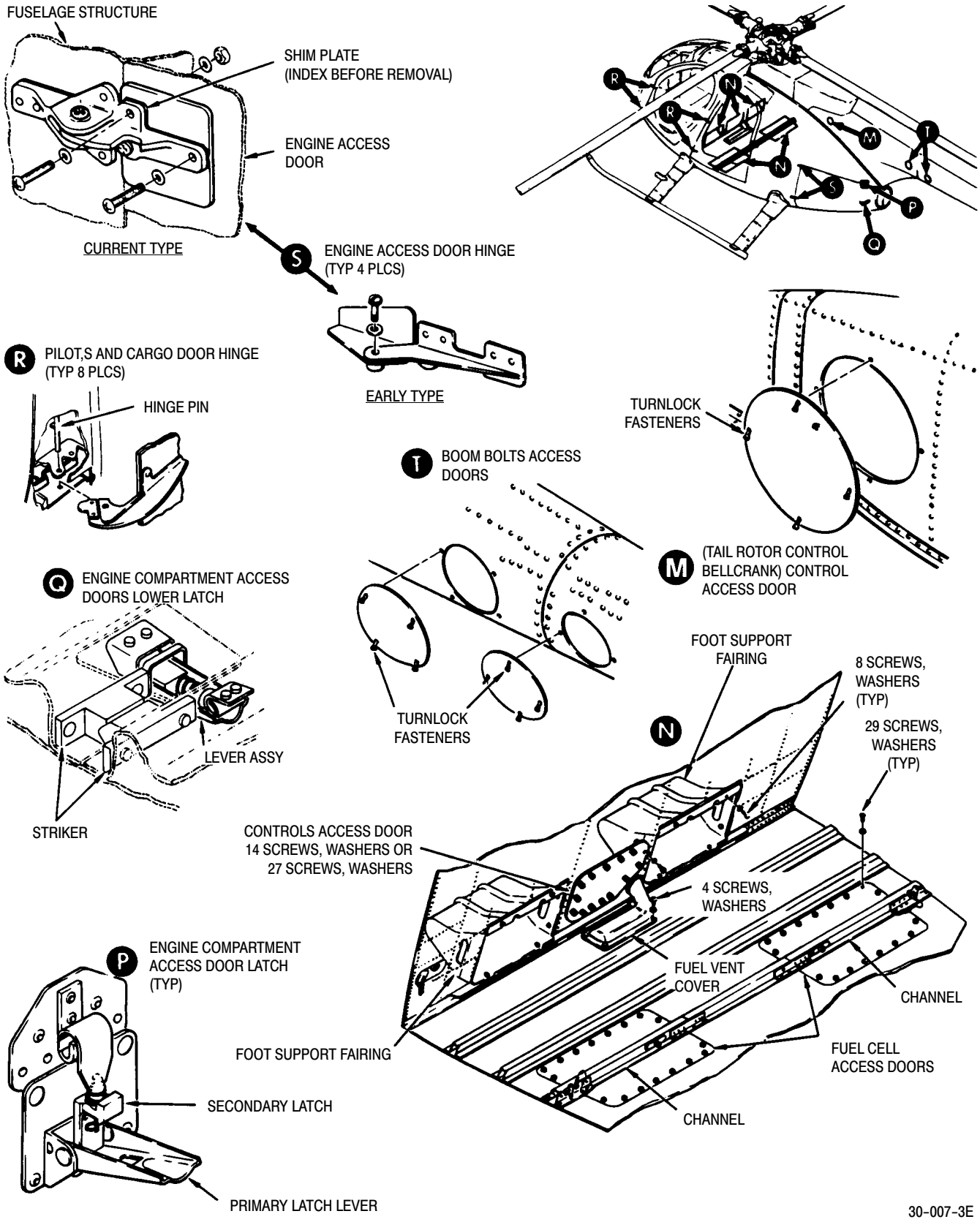


Figure 2-6. Access and Inspection Provisions (Sheet 3 of 6)

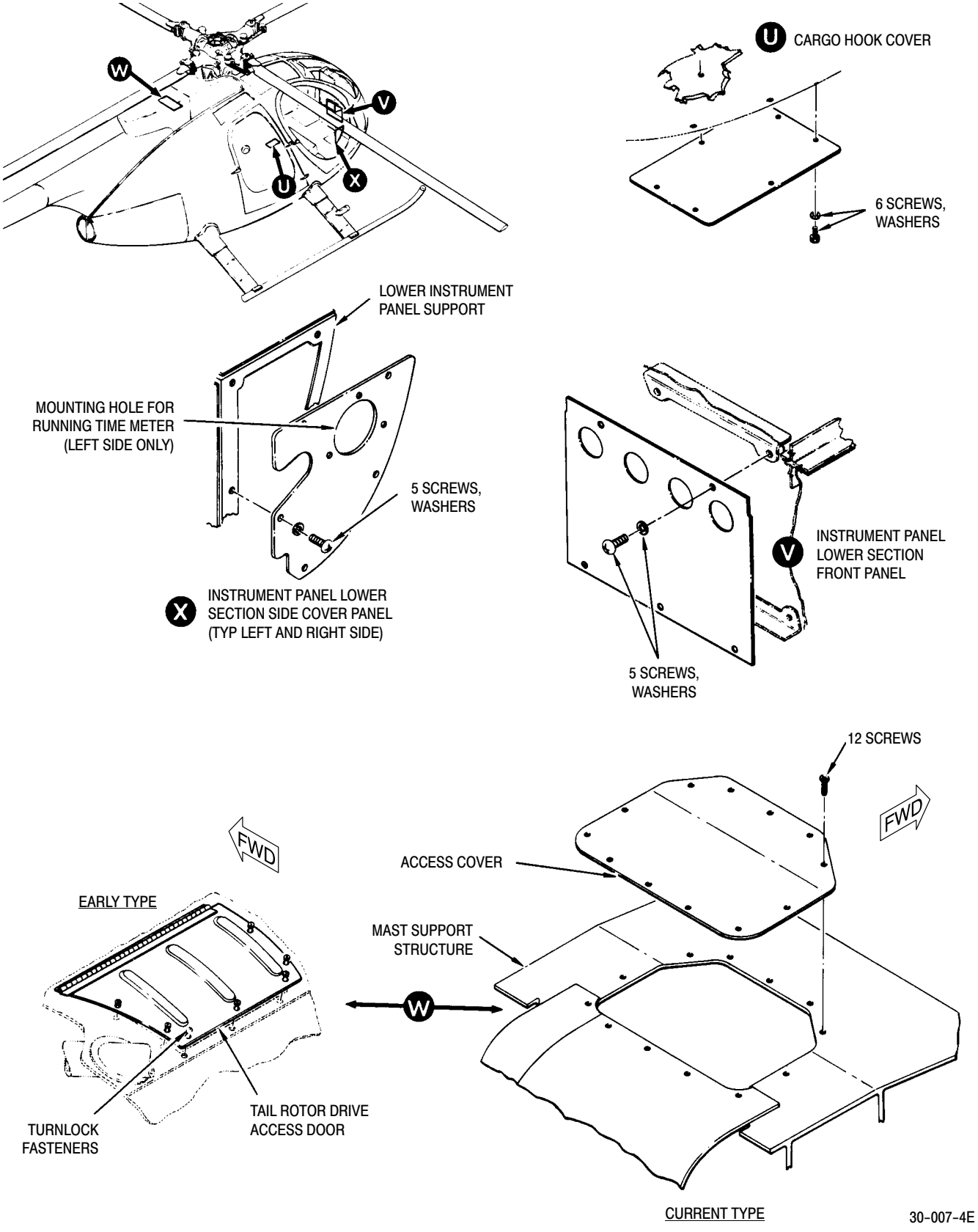
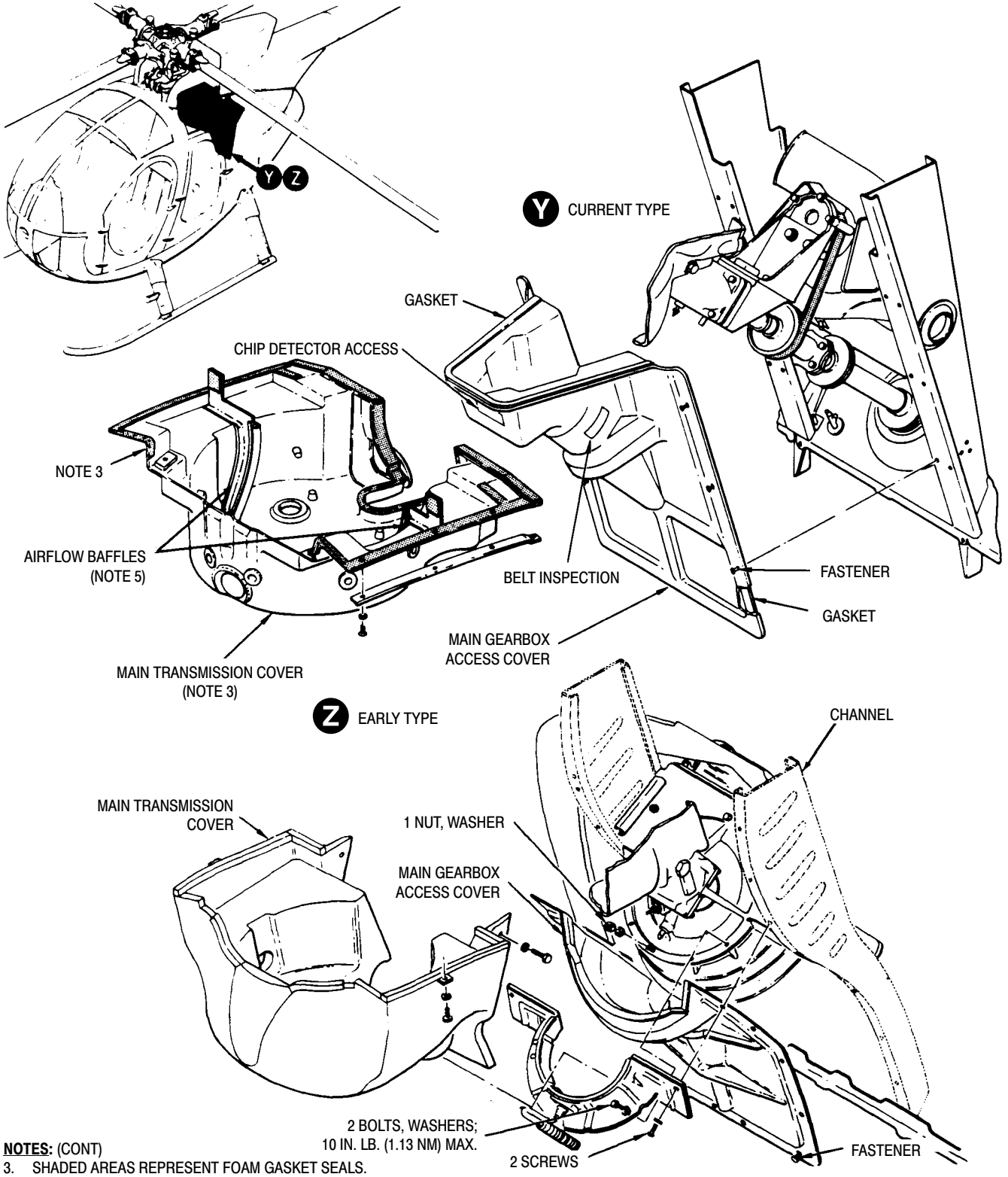


Figure 2-6. Access and Inspection Provisions (Sheet 4 of 6)



NOTES: (CONT)

3. SHADED AREAS REPRESENT FOAM GASKET SEALS.
4. COAT MATING SURFACES OF TRANSMISSION AND STRUCTURE WITH PARTING AGENT (112, TABLE 2-4). JUST PRIOR TO INSTALLATION, COAT SURFACES AND EDGES OF COVER (EXCEPT SEALS) THAT MATE WITH TRANSMISSION AND STRUCTURE WITH SEALING COMPOUND (105).
5. PART OF 369A8063-505 COVER ASSY ONLY. (REQUIRED WITH 250-C20 ENGINE,)

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Figure 2-6. Access and Inspection Provisions (Sheet 5 of 6)

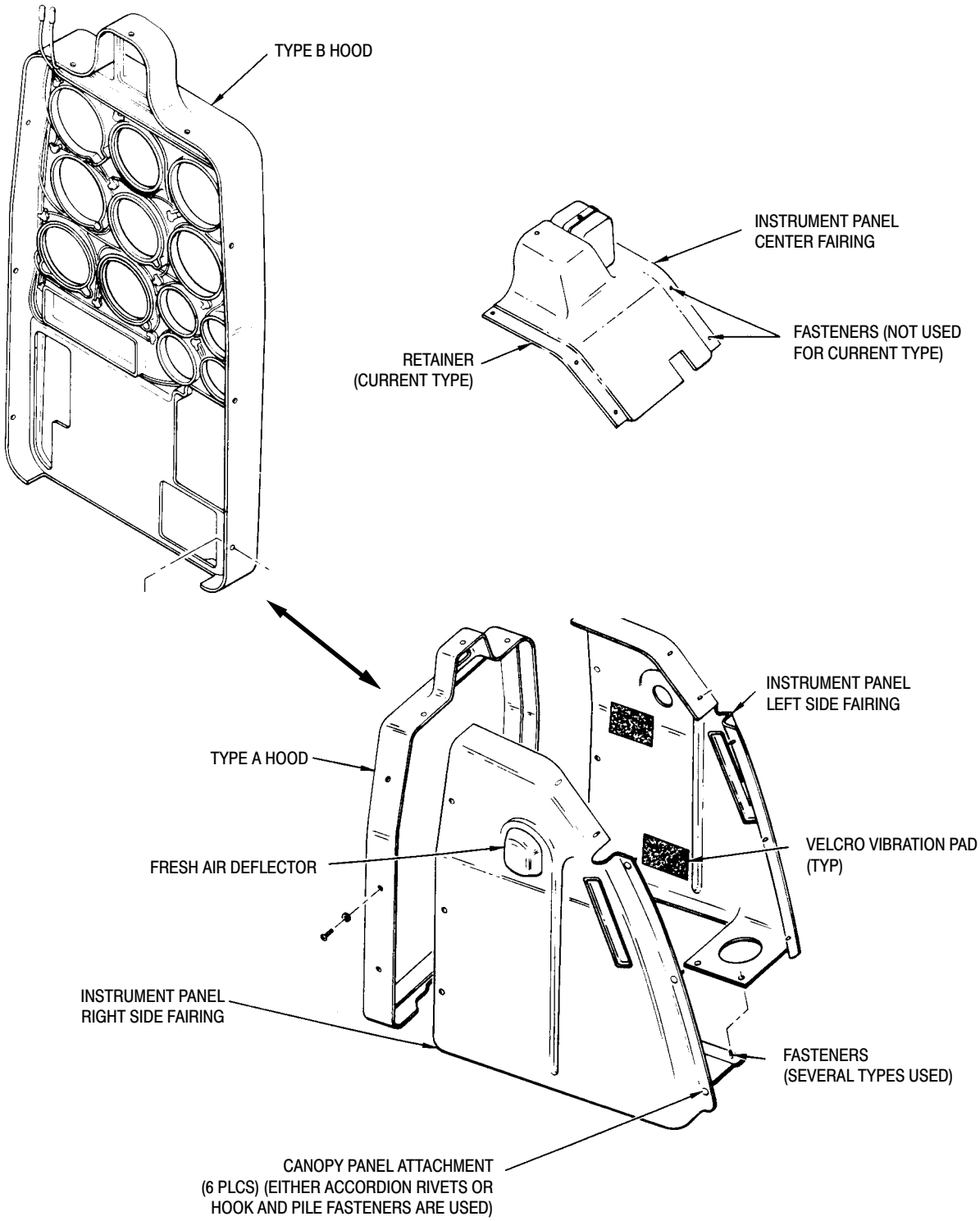


Figure 2-6. Access and Inspection Provisions (Sheet 6 of 6)

(b). Install the two screws, two bolts and nut and washers that secure the drain assembly to the structure, shroud and scroll.

NOTE: Do not overtighten the two bolts and nut. Torque to **10 inch-pounds (1.13 Nm) maximum**.

(c). If drain assembly is a replacement, connect the flexible drain hose and secure with two wraps to lockwire (2, Table 2-4).

C. Main Transmission Cover

Different main transmission covers are used with the shaft-driven and belt-driven oil cooler blower installations. The main transmission cover is a polycarbonate plastic form that essentially matches the transmission housing contour. The plastic form has a permanently bonded insulation blanket cover with a fiberglass core and flexible vinyl exterior. Plastic form gaskets cushion the cover surfaces that mate with the adjacent structure. When installed, there is space between the cover and transmission to allow inlet air flow for transmission cooling. With the shaft-driven blower, a yoke-type drain assembly fits around the lower end of the cover. A flexible hose connects to the drain assembly outlet tube and pipes overboard any water or oil that collects in the cover.

(1). Removal (Shaft-Driven Blower):

(a). Detach the main transmission drain assembly.

(b). Release nylon tape edging (Velcro hook tapes) from mating nylon pile fasteners (Velcro piles) at aft edges of cover.

(c). Remove four screws and washers from cover.

(d). Remove bolt from heater duct flange at lower left aft inside corner of cover if heating system ducting is installed; then lower cover to remove it..

(2). Inspection (Shaft-Driven Blower): Inspect foam gaskets and cover blanket for deterioration and plastic cover for cracks.

(3). Installation (Shaft-Driven Blower):

(a). Position cover over transmission.

(b). Install heater duct bolt at lower left aft inside corner of cover if heating system ducting is installed.

(c). Install the four screws and washers fingertight. Check cover for proper fit and that liquid level plug is visible.

(d). Tighten screws.

(e). Set the nylon tape edging to the mating file fasteners by using hand pressure.

(f). Attach the main transmission drain assembly.

(4). Removal (Belt-Driven Blower):

(a). Disconnect electrical wiring from transmission temperature sensor and chip detector.

NOTE: The cover assembly may be installed with sealant. To remove the cover, split the sealant with a sharp knife to protect seals and surface finish from damage.

(b). Remove 14 washers and screws to remove cover from fuselage structure, trim support strips and upper transmission baffle.

(c). Remove cover from left and right cooling ducts.

(5). Installation (Belt-Driven Blower):

(a). Apply parting agent (113, Table 2-4) and sealant (106) to areas indicated in Figure 2-6.

(b). Position cover over transmission and install cooling ducts.

(c). install 14 screws and washers to secure cover and trim support strips.

(d). Connect electrical wiring to transmission temperature sensor and chip detector.

D. Main Transmission Cover Assembly Seals Replacement

(Ref. Figure 2-7) Cover seals PN 369H8063-85, 89, and -91 in the 369H8063-505 polycarbonate type main transmission cover assembly may be removed on a one time basis for inspection, and reinstalled using a rubber adhesive to ensure adequate bond between the seals and the polycarbonate cover. This procedure, which follows, does not apply to 369H8097 fiberglass type main transmission cover.

(1). Remove main transmission cover assembly.

(2). Remove 369H8063-85, -89 and -91 rubber seals from cover assembly. Discard seal if any deterioration is noted.

(3). Use X-acto knife or equivalent to remove loose adhesive material adhering to polycarbonate cover and rubber seals. Use abrasive paper to remove remaining adhesive residue from cover and seals.

(4). Abrade inside flange of rubber seals.

(5). Wipe clean the abraded areas of cover and seals, using naphtha and clean cloth.

(6). Apply adhesive (3, Table 2-4) to both rubber seal and cover assembly. Align seals and press into place.

(7). Allow bond to cure for 24 hours; reinstall cover assembly.

E. Cargo Compartment Aft Bulkhead Access Covers

The cargo compartment aft bulkhead access covers enclose essentially symmetrical openings to the fuselage spaces at either side of the engine air inlet plenum chamber. The right side cover provides access to the oil tank, oil cooler and oil system drain valve. The left side cover provides access to elements of the cabin heating installation on the helicopters so equipped. Turnlock fasteners secure the outer edge of each cover to the fuselage.

(1). Removal: Release turnlock fasteners and lift cover from structure.

(2). Inspection:

(a). Inspect turnlock fasteners and receptacles for condition.

(b). Inspect cover for corrosion and cracks.

(3). Installation: Position the cover over the opening in the structure and engage the turnlock fasteners.

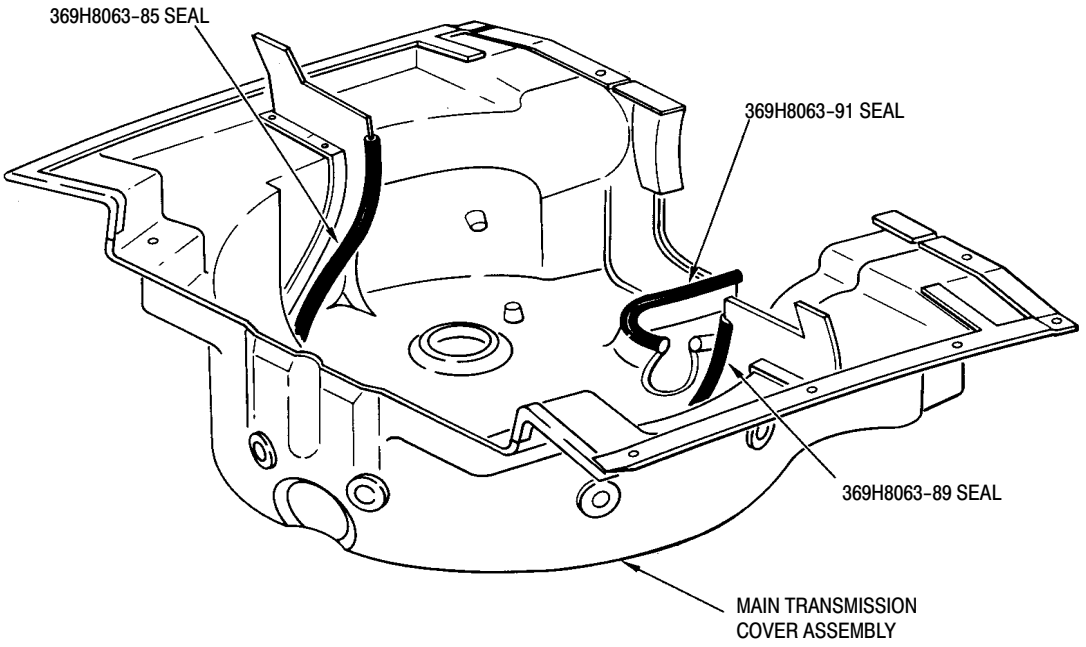


Figure 2-7. Main Rotor Transmission Cover Seals Installation

F. Pilot Compartment Floor Access Doors

Each of the two pilot's compartment access doors are formed by two hinged aluminum or fiberglass panels, hinged at the forward edge to the pilot's compartment floor. A latch at the rear secures each door in place. Two aluminum heel strips, on which two stainless steel skids are bonded, are hinged and held in place over each door by a spring. early type doors are a single piece of fiberglass with heel strips bonded in place and the forward ends of the strips hinged to permit opening the doors.

(1). Removal: Remove either floor access door as follows.

NOTE: The one-piece door is removed according to step (d).

(a). Release the latch at the rear of the door.

(b). Raise and hold up the rear of the heel strips for access to the long hinge pin at forward end of door.

NOTE: Heel strips may be removed for ease of access by detaching springs from clips (or brackets) on underside of strips and removing hinge pins attaching forward ends of strips to the anti- torque pedal mounting bracket.

(c). Remove the long hinge pin securing forward edge of door to pilot's compartment floor; remove door.

(d). Remove one-piece access door by releasing the flush-mounted latch and removing the two hinge pins that secure the door at the forward end.

(2). Inspection:

(a). Inspect doors for cracks and other visible damage.

(b). Check security of heel strip bonding.

(c). As applicable, inspect hinges and hinge pins for damage.

(3). Installation:

(a). Position door and secure forward edge to floor using a long hinge pin.

(b). If removed, heel strips are reinstalled by inserting hinge pins through brackets on forward end of strip and antitorque pedal mounting bracket and connecting springs to clips or brackets on underside of heel strips. Crimp or stake end of pins slightly after installation or use hinge pins secured by a cotter pin as follows:

1). Detach spring from clip or bracket on underside of each heel strip (not applicable to early type one-piece pilot compartment floor access door).

2). Remove existing hinge pins securing forward end of heel strips.

3). Install new hinge pins and secure end of each pin with washer and cotter pin. Direction of pinhead is optional.

4). Attach spring to clip or bracket on underside of each heel strip, as applicable.

5). Check installation of new hinge pins for discrepancies.

(c). Position one-piece door and install hinge pins through hinges and antitorque pedal mounting bracket.

G. Fuel Cell Access Doors

The fuel cell access doors are stiffener-reinforced aluminum plates that form a portion of the cargo floor. the left access door provides access to the fuel quantity transmitter (tank unit) and fuel shutoff valve and the fuel cell cover (for access to the engine start pump), as well as the left fuel cell. A quick-release lock pin is secured with a 4 inch (10 cm) lanyard to the outboard edge of each door. The pins retain the removable jacking fittings that are used for jacking, parking and mooring the helicopter. A stud on the stiffener of current type doors provides an attachment point for floor cushion material.

CAUTION These are stressed doors. The helicopter must never be flown with either door removed.

(1). Removal: Remove the 29 retaining screws and washers and lift out door.

(2). Installation:

(a). Position door over opening and secure in place with retaining screws and washers.

(b). Stow quick-release lock pin in its hole.

H. Controls Tunnel Cover

Four tunnel-routed control rods exit the tunnel area through a cover mounted at the top of the Sta. 78.50 canted frame. The cover or cover boots must be removed before any of the control rods are removed. The cover has four naugahyde boots, two of which are sewed together while the other two are individual. All boots are secured to the cover with self-clinching nylon straps.

(1). Removal: The right- and left-side engine air inlet forward fairings should be removed for best access to the controls tunnel cover.

(a). Remove the three screws, nuts, and six washers, and the four bolts and washers from controls cover.

(b). Remove the cotter pin, nut, bolt and washers that secure the upper end of each tunnel-routed control rod. Disengage the rods ends from the bellcranks.

(c). Lift controls cover over rod ends.

(2). Installation:

(a). Place controls tunnel cover over the four control rods, with double boot section fitting over the two right-side control rods.

(b). Attach each control rod end to its bellcrank with bolt (head to left, two washers, nut and cotter pin.

(c). Install controls tunnel cover with the three screws, nuts and six washers aft, and the four bolts and washers forward. Tighten bolts and screws evenly.

(d). If removed, reinstall right- and left-side engine inlet fairings.

(e). Check that control rods move freely in the cover boots.

I. Engine Air Inlet Forward Fairings

Ambient air is directed to the engine and the engine oil cooler through the two removable forward engine air inlet fairings and the aft fairing that is riveted to the structure. The engine inlet fairings are fabricated of glass cloth layers over polyurethane foam fillers. The forward fairing halves establish the main air inlet duct. Each half contains a smaller duct on its inside leading edge that diverts cooling air to the main transmission and oil cooler blower. The forward fairings provide access to the main rotor mixer controls and the main rotor mast, its base and supporting structure.

(1). Removal: A total of 32 screws with washers secure the fairing halves together and to the structure. Either half may be independently removed or the joined halves may be removed as an assembly. Two screws and washers join the halves at the center splice.

(a). Remove screws and washers attaching forward fairing to fuselage. Remove forward fairing.

(b). Remove two screws and washers at the splice if it is necessary to separate the two halves.

(2). Inspection: Inspect the engine air inlet fairings for structural damage. inspect for cracked or frayed glass cloth surfaces and crushed fillers. Inspect tape seals on closures inside fairings for deformation and damage.

(3). Repair: Make general repairs to the engine air inlet fairings according to CSP-H-6. Replace the tape seals on closures inside fairings with 0.25 x 0.50 inch (6.35 x 12.7 mm) pressure-sensitive tape (42, Table 2-4), cut to length as required.

(4). Installation:

(a). Position engine air inlet fairings on fuselage and align attachment holes.

(b). Install attaching washers and screws in mounting flanges and through splice at top of left-side fairing, if fairing halves separated.

J. Engine Air Inlet Fairing Access Doors

Access doors are provided on both the forward and aft engine air inlet fairings. The right side of the forward fairing contains the tail rotor drive shaft access door. The right side of the aft fairing contains a removable or hinge-mounted plenum chamber access door.

(1). Removal: Remove screws and washers or release turnlock fasteners to take off desired access door.

(2). Inspection:

(a). Inspect turnlock fasteners and receptacles for proper fastening action.

(b). Inspect fiberglass doors for structural damage such as cracked or frayed glass cloth surfaces.

(c). Inspect the hinge-mounted door for structural damage and loose or missing latching mechanism hardware.

(d). Check latching mechanism and door hinges for proper operation and locking capability.

(e). Inspect seal installed around aft fairing door for security and condition.

(3). Installation:

CAUTION Check that all areas of the air inlet and plenum chambers are clean and free of debris. check that all protective covers are removed. Engine damage will result if these precautions are not observed.

(a). Position door on fairing and install applicable screws and washers or engage turnlock fasteners.

(b). Close the hinge-mounted plenum chamber access door and ensure that locking mechanism locks in place.

K. Aft Section Air Inlet (Tail Rotor Drive) Access Door

The early type aft section air inlet (tail rotor drive) access door is hinge-mounted to the aft fuselage structure above the plenum chamber and is secured in place with turnlock fasteners. The current type access door is a flat cover on the mast support structure. Twelve screws secure the access cover in place. When an engine air inlet vertical screen is installed, five of the cover screws with washers also retain the front of the screen base. Primarily intended for access to the front end of the tail rotor shaft, the door/cover provides limited access to the accessories mounted on the aft end of the main transmission.

(1). Removal:

(a). Remove engine air inlet forward fairing.

(b). Remove screws from cover or release turnlock fasteners to release door.

(2). Inspection: Inspect turnlock fasteners and receptacles for proper fastening action. Inspect door for structural defects and door hinge for damage and operation.

(3). Installation:

CAUTION Check that all areas of the air inlet and plenum chamber are clean and free of debris. Check that all protective covers are removed. Engine damage will result if these precautions are not observed.

(a). Close access door and engage turnlock fasteners or position access cover on mast support structure and secure with screws (and five washers as applicable to inlet screen).

(b). Install engine air inlet forward fairing.

L. Controls Access Door and Foot Support Fairings

The controls access door and the two foot support fairings provide access to the forward landing gear struts and dampers, lower elements of the underseal installation for the engine and flight control systems and portions of the electrical wiring routed beneath the pilot's seat structure. The foot fairings are fiberglass assemblies, each having two small polycarbonate plastic windows. the outboard windows allow inspection of the forward landing gear damper assemblies without prior removal of the fairings. The inboard windows

are not for inspection by establish left-or right-hand interchangeability. The controls access door is aluminum plate that provides primary access to the lower end of the tunnel-routed flight control push rods in addition to other elements of the control system.

CAUTION The controls access door is a stressed door. The helicopter must never be flown with this door removed.

(1). Removal: Remove eight screws and washers to release each foot fairing. Remove 14 screws and washers, or 27 screws and washers as applicable, to release controls access door.

(2). Installation: Position controls access door (bevel at lower right corner) or foot support fairings and secure with screws and washers.

M. Pilot's Seat Cover

The pilots seat cover is an aluminum alloy panel assembly with a honeycomb core. The seat cover provides primary access to the upper elements of the underseat installation of engine and flight control systems.

(1). Removal: Remove 16 screws and washers to release the pilot's seat cover.

CAUTION Use all necessary precautions to prevent the possible entry of foreign objects into the controls linkage exposed by removal of the cover. Unnoticed debris in this area could jam or damage the controls when they are moved.

(2). Installation: Check that there are no foreign objects present in the controls linkage. Position pilot's seat cover and secure with screws and washers.

N. Outboard (LH) Collective Stick Cover and Wiring Cover

The two small covers installed at the left side of the seat structure keep the left seat belt from fouling the aft end of the collective stick. They also shield the electrical wiring where it exits the seat structure and where it connects to the auxiliary circuit receptacles mounted in the left corner of the bulkhead.

(1). Removal: Remove screws and washers to release either cover.

(2). Installation: Check that there are no foreign objects in the area shielded by the covers, position cover and secure with screws and washers.

O. Fuel Vent Cover

The formed aluminum fuel vent cover provides access to the fuel cell vent system crossover fitting that interconnects the forward top inboard corners of the two cells.

(1). Removal: Remove four screws and washers to release the fuel vent cover.

(2). Installation: Check that area to be covered is clean. Position cover and secure with screws and washers.

P. Fuel Filler Shield

The polycarbonate plastic fuel filler shield protects the right fuel cell filler extension from possible damage from cargo impact, and also covers the cargo floor opening for the filler.

(1). Removal:

(a). Remove five screws and washers that secure the fuel filler shield base to the cargo floor.

(b). Remove the two nuts, screws and washers that secure the shield tabs to the fuselage skin and fuel filler cap to release the shield.

NOTE: Use care not to dislodge or damage the sealing grommet (if installed) that fits around the extended range fitting opening in the shield.

(2). Installation: Position the fuel filler shield and install the two screws, washers and nuts that secure the shield tabs to the fuselage skin and fuel filler cap; do not tighten.

NOTE: Check that extended range fitting grommet (if installed) provides a tight seal between the shield and fitting. Replace grommet if deteriorated.

Q. Boom Bolts Access Doors and Tail Rotor Control Bellcrank Access Door

The forward and aft boom bolts access doors provide access to the bolts that secure the tailboom to the fuselage aft section. These doors are also removed for access to perform

removal and installation of the tail rotor drive shaft and/or tailboom (tail rotor blade angle) control rod and to check drive shaft damper friction or replace the damper. The tail rotor control bellcrank access door provides primary access to the Sta. 142 bellcrank link between the Sta. 100 tail rotor control rod and the tailboom control rod.

(1). Removal: Release turnblock fasteners and lift boom bolts or controls access door from fuselage.

(2). Inspection: Inspect turnlock fasteners and receptacles for proper fastening action.

(3). Installation: Position boom bolts or controls access door and engage turnlock fasteners.

R. Exterior Lights Covers

Three fuselage openings for exterior lights are closed off by round aluminum covers. Information on night lights is provided in CSP-H-3.

S. Cargo Swing/Hook Fairing Cover

The well of the cargo swing/hook fairing is closed off by a rectangular aluminum alloy cargo hook cover. Information on the cargo swing and hook is provided in CSP-H-3.

T. Instrument Panel Fairings

The three instrument panel fairings and hood around the instrument panel are molded thermoplastic enclosures that shield the area froward of the panel from direct sunlight and foreign material. Removal of the side fairings provides access to the shutoff valve controls, electrical and indicating system components and any optional avionics equipment mounted to the instrument panel and on the panel support structure.

(1). Removal:

NOTE: On helicopters equipped with a type B instrument panel with full face hood, eight face attachment screws and two panel lights knife splices must be disconnected before hood removal. Ref. Sec. 17 for attachment and disconnect points.

(a). Remove hood attachment screws and washers; remove hood.

(b). Remove or release fasteners joining the two side fairings.

(c). Detach side fairings from the canopy structure by releasing accordion rivets or velcro fasteners.

(d). Disconnect and tag-identify electrical loads from light/switch and horn housing; then remove center fairing.

(e). If required, remove attaching hardware and horn and light assembly from center fairing.

(2). Installation: Install the instrument panel fairings in reverse order starting with the last fairing section removed. Refer to Section 19 for battery sensing and engine out warning horn equipment.

U. Instrument Panel Lower Section Side Cover Panels

The two side cover panels that enclose the lower instrument panel support assembly structure are aluminum alloy sheet. Removal of the covers provides access to wiring, tubing and the fuel shutoff control cable routed upward to the instrument panel, as well as parts of the tail rotor control torque tube installation. Refer to applicable configuration supplement for removal of instrument panel lower section.

(1). Removal: Remove five screws and washers to release either side cover.

NOTE: The running time meter is mounted in the left side cover and the landing light relay is mounted on the right side cover of helicopters equipped with either or both of these options. For instructions or replacement of either item, refer to CSP-H-3.

(2). Installation: Check that there are no foreign Objects present in the controls linkage, position the cover(s) and secure with screws and washers.

V. Instrument Panel Lower Section Front Cover Panel

The front panel inside the lower section of the instrument panel support is aluminum alloy. Removal of the cover provides access to electrical and avionics wiring at the lower forward area of the instrument panel.

(1). Removal: Remove five screws and washers to release the cover.

(2). Installation: Position panel and secure with screws and washers.

W. Pilot and Cargo Doors

The two pilot doors and two cargo doors are bonded aluminum alloy frames containing large plastic windows. Current type doors are auto-latching (automatically latch) when closed. Early type doors are latched manually. The door latching mechanism consists of four latches, two lengths of wire-reinforced cable within housings and a latch rod. The door hinges on each door are provided with quick removal type ball-lock hinge pins. The doors do not incorporate jettison provisions.

(1). Removal:

(a). Open the door and individually pull the hinge pins up and out by the tabs.

(b). Hold door in alignment so that hinges do not bind and slide door hinges from hinge sockets to remove door.

(2). Installation:

(a). Lift door into position so that hinges are aligned and engage door hinges with fuselage hinge sockets.

(b). Hold door open and insert hinge pins far enough for the spring-loaded ball detent to emerge past the lower side of the hinge socket. Close and latch the door.

X. Engine Access Doors

The two engine access doors are stamped and bonded aluminum alloy structures that form the fuselage contour below the aft section engine compartment. The hinge-mounted doors are secured in the closed position by three lever type, draw hook latches.

NOTE: For removal of current type doors, do not attempt to remove hinge pivot bolts and spacers. Refer to Section 3 for disassembly at hinge points and for all door maintenance.

(1). Removal (Current Type): Release the three latches to open access doors. Index mark the hinge, shim and serrated plate to the door structure. Remove the three engine access door hinge attachment screws with washers. The forward screws are attached with nuts and the aft screws attach to rivnuts.

(2). Installation (Current Type): Position door and temporarily install shim, serrated plate and attachment hardware. Align indexing marks on shim, serrated plate and hinge with those on the door and then tighten the screws. Close and latch the doors and check for firm fit with no deflection. If further adjustment is required.

(3). Removal (Early Type): Release the three latches to open access doors. Remove the pivot point attaching hardware from the door hinge and lift door from fuselage hinge halves.

(4). Installation (Early Type): Lift access door into position, align hinges and install attaching hardware. Close and latch the doors and check for firm fit with no deflection. If further adjustment is required, refer to Section 3.

9. Helicopter Cleaning

General cleaning of oil and dirt deposits from the helicopter and its components must be accomplished by using dry-cleaning solvent (1, Table 2-4), standard commercial grade kerosene or a solution of detergent soap and water. The exceptions that must be observed are specified in the following cleaning paragraphs.

CAUTION Some commercial cleaning agents, such as readily available household cleaners, contain chemicals that can cause corrosive action and/or leave residue that can result in corrosion. Examples of cleaning agents that are not to be used are “Fantastik” and “409” type cleaners, or locally made strong soap cleaners.

A. Fuselage Interior Trim and Upholstery Cleaning

(1). Clean dirt or dust accumulations from floors and other metal surfaces with a vacuum cleaner or small hand brush.

(2). Sponge soiled upholstery and trim panels with a mild soap and lukewarm water solution. Avoid complete soaking of the upholstery and flocked trim panels. Wipe solution residue from upholstery with a cloth dampened by clean water.

(3). Remove imbedded grease or dirt from upholstery and carpeting by sponging or wiping with an upholstery cleaning solvent recommended for nylon fabric.

(4). Clean leather surfaces with saddle soap and warm water. Wipe residue with a clean cloth and warm water.

NOTE: If necessary, seat upholstery may be thoroughly dry-cleaned with solvent. When complete dry-cleaning is performed, upholstery must be re- flame- proofed in compliance with FAR Part 27.

B. Airframe Exterior and Rotor Blade Cleaning

CAUTION Use care to prevent scratching of the aluminum skin when cleaning main rotor blades. Never use volatile solvents or abrasive materials. Never apply bending loads to blades or blade tabs during the cleaning process.

(1). Wash the helicopter exterior, including fiberglass components and rotor blades, when necessary, by using a solution of clean water and mild soap.

NOTE: Avoid directing soapy or clean water concentrations toward the engine air intake area and the instrument static source ports in the aft fairing.

(2). Clean those surfaces that are stained with fuel or oil by initial wiping with a soft cloth dampened by solvent (1, Table 2-4), followed by washing with clean water and mild soap.

(3). Rinse washed areas with clean water and dry with a soft cloth.

C. Transparent Plastic Cleaning

(1). Clean the outside surfaces of plastic panels by rinsing with clean water and rubbing lightly with palm of hand.

(2). Use a mild soap and water solution or aircraft type plastic cleaner to remove oil spots and similar residue.

CAUTION Never attempt to dry plastic panels with a dry cloth; To do so will cause any abrasive particles lying on the plastic to scratch or dull the surface. Wiping with a dry cloth will also build up an electrostatic charge that will attract dust particles from the air.

(3). After dirt is removed from surface of plastic, rinse with clean water and let air dry or dry with a soft, damp chamois.

(4). Clean the inside surfaces of plastic panels by using aircraft type plastic cleaner and tissue quality paper wipers.

D. Battery Cleaning

(1). Check that electrical power selector switch on instrument panel is **OFF**.

(2). Unlatch and raise pilot compartment floor left side access door. Remove four screws and washers securing battery cover and remove cover.

CAUTION Use care to avoid damaging battery temperature sensing wires and switch connections during cleaning.

(3). Use a clean cloth dampened by clean water to remove any accumulation of dust, dirt or white powder (potassium carbonate).

(4). If battery is unusually dirty or shows evidence of caked crystals around the cells it should be removed from the helicopter for further cleaning with a nylon (or other non-metallic) brush and clean running water.

(5). Dry the top of the battery thoroughly with a clean cloth.

(6). Reinstall battery cover, mounting screws and washers.

(7). Lower and latch the floor access door.

E. Battery Electrolyte Spillage Cleaning

WARNING **Electrolyte is a strong alkaline solution and is harmful to the skin and clothing. Wear protective clothing that is used exclusively for servicing nickel-cadmium batteries. Neutralize and flush electrolyte from the skin or hands as described below. Where there is evidence of spewed or spilled battery electrolyte, flush off the surface immediately with water (cold if possible) and neutralize with a 3 percent boric acid solution. Follow with a thorough flushing of clean water (cold if possible).**

F. Transmission Lubrication Pump Oil Filter Cleaning

(1). Remove, in order, sound insulation, gearbox access cover, transmission drain assembly and main transmission cover.

(2). Remove lockwire from filter housing.

(3). Position a container of cloth to catch residual oil. Loosen and remove filter housing by turning it counterclockwise.

(4). Remove filter element and O-ring from pump housing.

(5). Inspect the filter element for metal particles. If metal particles are present, remove the main transmission chip detectors and inspect for other evidence of internal failure in the gearbox.

(6). Clean the filter element and housing with solvent (1, Table 2-4) and ultrasonic equipment, if available, or by reverse flushing using a solvent blowgun. Repeat cleaning until solvent is clear and then let element dry.

(7). Inspect element for cracks or dents that would make it unserviceable. Replace element if condition is questionable. Check condition of O-rings and replace if damaged.

(8). Lubricate O-rings with transmission oil and install on end of filter and in pump housing.

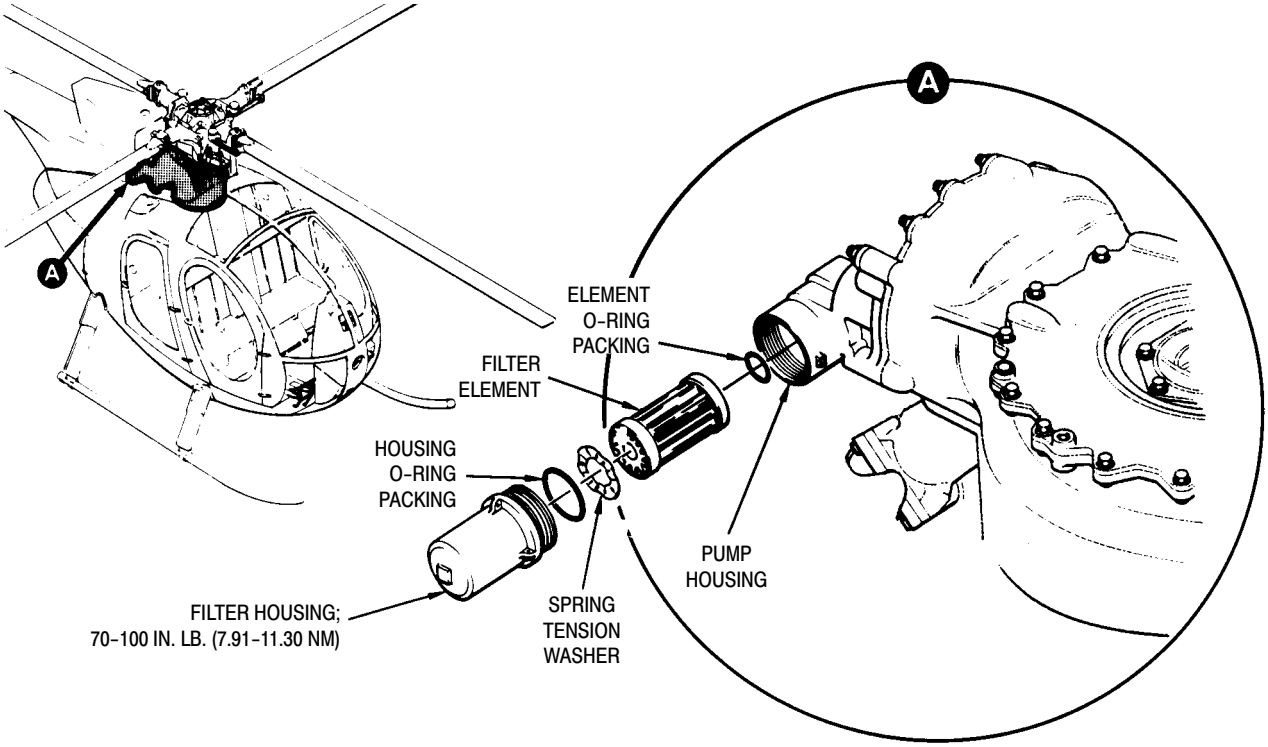


Figure 2-8. Transmission Lubrication Pump Oil Filter

(9). Check that tension washer is in filter housing and install element in filter housing. Check that the O-ring on the element will seat properly in the pump housing when element is installed.

(10). Turn filter housing clockwise and tighten to **70 - 100 inch-pounds (7.91 - 11.30 Nm)**. Safety the filter housing to the pump housing with lockwire (2).

(11). Replenish transmission oil supply if necessary; then perform ground runup of helicopter and check splitline for oil leakage.

(12). Reinstall, in order, the main transmission cover, the drain assembly, the main gearbox access cover and sound insulation.

G. Engine Fuel and Oil Filter Cleaning

Refer to the appropriate Allison Operation and Maintenance Manual.

H. Engine Compression Cleaning

Clean engine compressor according to the Allison Operation and Maintenance Manual and the following limits. The Lear-Siegler Model Number 23032-020 starter-generator can be used to motor the Allison 250 Series engine for compressor cleaning cycles each 50 or more hours. Input voltage should be 24 Vdc, but it is permissible to use 12 Vdc. To prevent starter-generator damage, the duty cycle (cranking) time limits that must not be exceeded are:

24 Vdc External Auxiliary Power			24 Vdc Helicopter Battery Power		
25	Seconds	**ON**	40	Seconds	**ON**
30	Seconds	**OFF**	60	Seconds	**OFF**
25	Seconds	**ON**	40	Seconds	**ON**
30	Seconds	**OFF**	60	Seconds	**OFF**
25	Seconds	**ON**	40	Seconds	**ON**
30	Minutes	**OFF**	30	Minutes	**OFF**

12 Vdc External Auxiliary Power

2 Minutes **ON**

30 Minutes **OFF**

2 Minutes **ON**

NOTE: The current drawn by the starter-generator to maintain 10% N_1 rpm should be approximately 150 amperes with 12 Vdc input.

I. Engine Air Inlet Screen Cleaning

(1). Remove vertical air inlet screen.

(2). Clean filter screen with a soft brush to remove dirt accumulations.

(3). Immerse screen assembly in a solution of detergent soap (63, Table 2-4) and allow to soak approximately 15 minutes. Flush out with clear water. Allow screen assembly to drain and air-dry thoroughly.

10. Corrosion Control

The airframe is fabricated mainly of aluminum and some magnesium alloys, with selective use of stainless steel and titanium, and should be checked regularly for any signs of corrosion, especially at points of dissimilar and overlapping metal contact.

(1). Corrosion of dissimilar metals is the result of several conditions; lack of sufficient insulation in the areas of metal contact, tears or punctures in the metal itself, and areas where the protective finishes have been scuffed, scratched, chipped or worn away.

(2). Inspections and maintenance precautions should be performed to inhibit the start of corrosive action (Ref. Standard Practices for Corrosion Prevention).

(3). Common types of corrosion that may be encountered are described in the following paragraphs.

(4). Restoration procedures for marred but uncorroded surfaces, as well as surfaces in which corrosion is found, are given in the touch-up procedures.

(5). Refer to MDHI Publication No. CSP-A-3 Corrosion Control Manual for a more complete treatment of this maintenance area.

A. Standard Practices for Corrosion Prevention

(1). Inspection of Interior Metal Surfaces:

(a). Inspect primer-painted surfaces for scratches and other damage.

(b). Inspect finish-painted (color coated) surfaces for condition of finish.

(c). Inspect areas of metal overlap (faying surfaces) for evidence of corrosion.

(d). Inspect the attachment area of bolts, screws and other fasteners for corrosion.

(2). Inspection of Exterior Metal Surfaces:

(a). Inspect finish for scratches, cracks, peeling, fading, or other damage, particularly around bolts, screws, and other fasteners.

(b). Inspect normally sealed seams and joints for loose or missing sealing compound.

(c). Inspect exposed skin edges for condition of corrosion-protective finish or sealing compound and for evidence of corrosion.

(d). Inspect areas of metal overlap for evidence of corrosion.

(3). Insulation of Magnesium Alloys Against Corrosion: To prevent galvanic corrosion between magnesium and any dissimilar metals:

(a). Coat contacting surfaces with a layer of sealing compound (3, Table 2-4) in addition to the primer (4 or 7).

(b). Use 5056S aluminum alloy washers under boltheads and nuts that would otherwise contact magnesium. If 5056S aluminum is not available, use 5052S alloy washers.

CAUTION Do not use steel washers.

(c). Apply primer (4) on the attaching hardware before installation.

(4). Application of Sealing Compound: Use sealing compound (3) to replace loose or missing sealant on exterior surfaces. Sealant is used to fill seams and joints that might trap water. Apply sealant as follows:

(a). Check that seam or joint is clean and free of foreign matter and moisture.

(b). Apply sealant with a putty knife or similar tool.

(c). Force the sealant well down into the seam to eliminate any air pockets.

(d). Fillet the sealant to give the joint or seam a smooth appearance.

(5). Removal of Salt Deposits: To inhibit corrosion, helicopters operating over salt water and those that come in contact with salt water or spray should be washed with fresh water as frequently as possible.

B. Magnesium Alloy Corrosion

Corrosion will not normally be present on painted, treated or protected surfaces.

Corrosion will attack magnesium when nicks or scratches through the surface protection expose the metal to moisture or air. Corrosion is present if the following conditions are in evidence.

CAUTION Bare magnesium alloys, when exposed to salt- laden air, will corrode very rapidly. Adequate protective finishes must at all times be maintained on magnesium.

(1). Whitish powdered deposits.

(2). Zinc chromate primer discoloration over an area.

(3). Blistering or cracking of the finish coating.

C. Aluminum Alloy Corrosion

Corrosion will not normally be present on aluminum surfaces that have a chemical protective finish; however, because moisture can permeate paint that is nicked or scratched, corrosion might attack the metal even though it is painted. In such cases, the affected areas will generally be characterized by:

(1). A scaly or blistered appearance of the finish surface.

(2). A dulling and pitting of the area.

(3). Whitish powdered deposits.

NOTE: To differentiate between aluminum and magnesium alloy, apply one drop of ordinary sulfuric acid (dropped from a glass rod) to the surface of the metal being tested. If the alloy is magnesium, a foaming or boiling action of the liquid, accompanied by a black discoloration of the metal, will immediately occur. If the alloy is aluminum, no reaction to the acid will be evidenced.

CAUTION Do not apply sulfuric acid to or near bolts, fasteners, seams, or faying surfaces. Immediately after completing the magnesium and aluminum test, wash the tested area with water to prevent burns and continued acid action on the material.

D. Alloy Steel Corrosion

Corrosion (rust) will not normally be present on steel surfaces that have been painted; however, surfaces may corrode where moisture has permeated the paint. Such corrosion will be characterized by:

(1). A reddish or brownish blistered appearance in the corroded area.

(2). Blistering of the painted surfaces.

E. Temporary Anti-Corrosion Measures

The temporary anti-corrosion measures outlined here are to be used only in cases where the proper materials or equipment are not available.

WARNING **These temporary anti-corrosion measures apply to the helicopter airframe only. If a part of the structure is corroded too badly to withstand normal loads before the helicopter can reach a repair station, metal patches will have to be installed before the helicopter is flown**

(1). Examine part or area in question for extent of corrosion.

(2). Remove loose paint and powdery products of corrosion by scraping with a sharp phenolic scraper, or brushing the area with a heavy fiber brush.

(3). Wash off the affected areas with mild soap and clean fresh water; rinse thoroughly.

(4). If protective paint coatings are not available, liberally apply a corrosion-preventive compound or any available grease to affected areas.

F. Corrosion Arresting on Main Rotor Blades

The following outlines a method of arresting a corrosive condition on main rotor blades.

CAUTION Wear rubber gloves when using phosphoric solution in next step.

(1). Wipe down main rotor blades with a 10 percent phosphoric acid solution (10, Table 2-4).

(2). Rinse main rotor blades immediately with water and wipe dry.

(3). Wax main rotor blades.

NOTE: As a preventive measure to assist in arresting further corrosion the main rotor blades should be washed with water and waxed on a weekly basis.

G. Main Rotor Hub Corrosion Prevention (Tri-Flow Wash Procedure)

The following procedure will help prevent corrosion of main rotor hub components, especially on helicopters operated in marine environments. The procedure should be accomplished following the last flight each day for helicopters operated in marine or other corrosive environments, and at each 25 hour inspection, or more often if desired, for helicopters not operated in corrosive environments.

WARNING **Use care when working around turning rotor blades. Stay low. Remain on right side of helicopter to avoid tail rotor blades.**

NOTE: Perform the first step below prior to engine shutdown, following the last flight of the day if possible. When the rotor stops turning, the laminates of the strap- pack spread apart slightly. Contaminates collected on the edges of the strap-pack assembly can enter the area between the laminates as they spread apart. If the rotor continues turning until the contaminants are washed away, centrifugal force will keep the laminates compressed and not allow the corrosive substances to enter the area between the laminates.

(1). Bring engine to ground idle; set **SCAV AIR** to **ON** (Ref. applicable PFM). Perform the following:

(a). Spray fine fresh water mist on main rotor blades.

(b). Direct a strong stream of fresh water into main rotor hub and control system at main rotor hub.

(c). Spray entire rotor hub with lubricant (149, Table 2-4).

NOTE: Lift main rotor blades to separate strap pack laminates in next step, and spray directly between individual laminates.

(2). Shut down engine. When rotor blades stop turning, spray strap-packs with lubricant.

(3). Perform engine water wash.

(4). Wash remainder of helicopter exterior using fresh water spray.

(5). Wash main rotor blades with Zip Wax (150), or equivalent, mixed per manufacturer's instructions.

H. Magnesium Alloy Exterior Surface Touch-Up Treatment

(1). Prepare solution of chromic acid, 20 ounces per gallon (150 g/L), ammonium sulfate, 14 ounces per gallon (105 g/L), and ammonium hydroxide, 12 fluid ounces per gallon (94 g/L). Solution pH should be 2.6 - 3.4 and operating temperature should be ambient.

(2). Clean painted parts for three to five minutes in alkaline solution (Oakite 61 or equivalent); swab unpainted parts with MEK or aliphatic naphtha.

(3). Dampen clean cloth or soft brush in prepared solution and apply to touch-up areas for ten to thirty minutes until desired color is produced. Color range is from gold through yellow to brown.

(4). Rinse or swab parts thoroughly in clean, room temperature water. Dry; paint as required.

I. Aluminum Alloy Exterior Surface Touch-Up Treatment

NOTE: If there is any question of whether or not the protective coating is removed, it should always be assumed that bare metal is exposed.

(1). Wash affected area with a solution of mild soap and fresh water. Rinse area with clean water and wipe dry with a clean soft lint-free cloth.

(2). Using a swab, liberally apply chemical film solution (8, Table 2-4).

(3). Allow solution to remain on surface for 1 to 3 minutes, or until surface becomes amber to brown in color.

NOTE: Avoid letting the chemical mixture dry on the surface. If it has dried, re-wet the surface with the solution.

(4). Rinse treated surface thoroughly with clean water. After rinsing, wipe off excess moisture with a clean lint-free cloth. If dry compressed air is available, blow any moisture from joints or crevices and allow to dry completely at room temperature for approximately one hour.

(5). Apply paint finish touch-up.

J. Steel Alloy Exterior Surface Touch-Up Treatment

(1). Remove loose paint and corrosion products by scraping area with a sharp phenolic scraper, brushing with a heavy fiber brush and light sanding with 320 grit or finer sandpaper (9, Table 2-4).

(2). Wash off the area with mild soap and clean fresh water; rinse thoroughly.

(3). Treat surface with surface cleaner (10) or equivalent.

(4). Allow solution to remain on surface for approximately five minutes. Keep surfaces wet.

(5). Rinse thoroughly roughly with clean water. Dry with a clean lint-free cloth and then allow to air-dry completely.

(6). Apply paint finish touchup.

11. Paint Finish

Refer to the applicable configuration supplement for details of standard production paint finish, color and color scheme. (Customized paint schemes are not shown.)

A. Paint Removal

(1). Use paint remover (11, Table 2-4)when it becomes necessary to remove the finish paint coatings. Ordinarily, the use of paint remover should be limited to stripping of paint from parts that require magnetic particle or fluorescent-penetrant inspection and to parts that require the removal of excessive paint buildup.

(2). Solvent type paint remover is usually not capable of removing the primer coating. However, complete removal of the epoxy primer coating may not be required to perform dye-penetrant inspection.

(3). If necessary, it may be possible to remove small amounts of primer by light scrubbing of the primer surface with solvent type paint remover and a stiff bristle brush. No other means, short of sanding or mechanical scraping, will prove more suitable or effective for removal of epoxy primer except use of the acid type remover.

(4). Whenever the acid type remover is used all special safety precautions noted on the container must be observed. Use all necessary precautions to prevent the entry of any type paint remover into structural seams or joints, and the joint lines of bearings and bushings that are still assembled with the part to be stripped.

(5). When possible, use a high pressure water spray to rinse off paint remover and paint particles and to neutralize the paint remover.

CAUTION If paint remover is used in the vicinity of drive shaft couplings, ensure the couplings are completely masked and covered. if paint remover contacts the coupling diaphragms, rust spots will develop and coupling replacement will be required.

B. Paint Touch-Up

Whenever possible, paint touch up should be performed in a dust-free shelter that is free of excessive air currents and that has ventilation provisions for adequate (safe) personal respiration.

CAUTION The following items should never be touched up, primed or finish-painted: rod ends containing bearings; bolts and nuts securing rod ends; decals and serialization plates; transparent surfaces (canopy, etc); parts made from natural, synthetic or silicone rubber; electrical bonds; close tolerance holes; and parts continuously coated with grease, oil or fluid.

NOTE: Following procedures apply to application of both polyurethane and acrylic paints. The primary interior finish of the helicopter is acrylic paint. Polyurethane paint is used for the exterior finish on a current 369HS/HE helicopter. The exterior of a 369HM or early 369HS/HE helicopter is finished with acrylic paint. Polyurethane paint may be applied directly over acrylic paint since the two are compatible.

(1). Touch up - Small Sanded Areas (Reworked Scratches, Nicks, Gouges, etc):

(a). If metal protection is not adequate, apply applicable chemical surface treatment.

(b). If chemical surface treatment is undamaged or has already been applied, wipe the surface clean with thinner (12, Table 2-4). Wipe dry immediately.

(c). Apply coat of epoxy primer (7). Feather primer coating onto surrounding color coat.

(d). Allow primer to air-dry for 30 minutes.

(e). Apply lacquer color coats (6), to match original finish color, as applicable.

(2). Touchup - Flaking or Dried Paint or Primer:

(a). Using 320-grit or finer sandpaper (9), and wet or dry sanding method, sand the nonadherent surface to a smooth feather edge with the surrounding area. Do not sand beyond point where chemical film protection begins to show through primer.

(b). Touchup sanded area according to step (1). above.

(3). Touchup - Primer Not Adhering to Metal Finish:

(a). Use 320-grit or finer sandpaper and wet or dry sanding method to sand through chemical film to bare metal. Feather edge the surrounding surface with the bare surface.

(b). Touchup re-treated surface according to step (1). above.

(4). Touchup - Glass Fiber Laminate Parts:

(a). Use 100-grit or coarser sandpaper to abrade area requiring finish. Remove all gloss until there is a uniform dull condition.

(b). Wipe surface clean with 1:1 mixture of MEK (22) and isopropyl alcohol (71).

(c). Squeeze one coat of Poly-EP (107), thinned as required with thinner (108), into fiberglass pores until surface of fibers is smooth.

(d). Lightly sand surface with 320-grit sandpaper. Normal grain appearance does not require further filling or sanding.

(e). Apply epoxy primer according to step (1). above.

(5). Touchup - Polycarbonate Plastic Parts:

(a). Wipe surface clean with a 1:1 mixture of naphtha (59) and isopropyl alcohol (71).

(b). Mix equal parts (1:1) of primer resin (109) and thinner (110). Apply one coat to surface and allow to air-dry minimum of three hours.

(c). Apply epoxy primer and color finish according to step (1). above.

(6). Touchup - ABS Thermoplastic Parts:

(a). Clean surface with mild soap and water. Dry thoroughly.

(b). Apply one coat of lacquer according to step (1).(e).

12. Main Rotor Blade Paint

The following procedures is to be used whenever the main rotor blades require either repainting or paint touch-up.

NOTE:

- Repaint main rotor blades only in sets to maintain rotor balance. Never completely repaint only one main rotor blade installed on helicopter.
- New main rotor blades have the inboard 24 inches (610 mm) painted gloss white. This aids in inspection of the blade.
- At owner-operators convenience, in-service main rotor blades may have the inboard 24 inches (610 mm) painted gloss white.

A. Main Rotor Blade Paint Removal

(1). Position main rotor blade on a bench of sufficient length to provide support.

(2). Inspect main rotor blade (Ref. Sec. 7, Main Rotor Blade Inspection).

CAUTION When removing paint from main rotor blade, do not use any paint remover. Bonding agents used in manufacture of the blade may be damaged by the chemicals causing the blade to be unserviceable.

(3). Apply tape (14, Table 2-4) to all bushings, bearing, data plates and the abrasion strip.

CAUTION

- When sanding paint from the main rotor blade, take care to not damage rivet heads and sealant.
- Do not sand through the paint and primer into the base metal.

(4). Using 320 grit, or finer, abrasive paper (9) and wet or dry sanding method, sand areas that require painting.

(5). Using a soft cloth, dampened in isopropyl alcohol (71), thoroughly clean main rotor blade.

(6). Inspect sanded areas for damage.

B. Main Rotor Blade Paint Application

NOTE: If inboard 24 inches (610 mm) of main rotor blade is to be painted white, paint is to be applied to the entire circumference of the blade. There is to be no ridges in the paint when completed.

(1). Inspect main rotor blade (Ref. Sec. 7, Main Rotor Blade Inspection).

(2). Ensure all bushings, bearing, data plates and the abrasion strip are protected from paint with tape (14).

(3). Using a soft cloth, dampened in isopropyl alcohol (71), thoroughly clean main rotor blade.

(4). Treat any bare metal areas of main rotor blade with chemical coating (8).

NOTE: Mix primer (4) according to manufacturer's recommendations.

(5). Allow mixed primer (4) to stand for 15 to 30 minutes prior to use.

NOTE:

- Working life of mixed primer is four hours maximum.
- Primer allowed to stand for more than two hours must be stirred or shaken before use.
- Addition of freshly mixed primer to replenish an older mixture is not permitted.

(6). Apply primer to sanded areas, feather into surrounding color coat.

(7). Allow to air-dry for one hour minimum.

NOTE: Mix paint (148) according to manufacturer's recommendations.

(8). Allow mixed paint (148) to stand for 20 minutes minimum prior to use.

NOTE:

- Working life of mixed paint is four hours maximum.
- Addition of freshly mixed primer to replenish an older mixture is not permitted.

(9). Apply paint to primed areas. Feather-edge paint while applying.

(10). Allow to air-dry for eight hours minimum.

(11). Remove protective tape from main rotor blade.

NOTE: Main rotor assembly may need to be rebalanced after painting.

13. Metal Tail Rotor Blade Paint

The following procedures is to be used whenever the metal tail rotor blades require either repainting or paint touch-up.

NOTE: Repaint tail rotor blades only in sets to maintain rotor balance. Never completely repaint only one tail rotor blade installed on helicopter.

A. Metal Tail Rotor Blade Paint Removal

(1). Inspect tail rotor blade (Ref. Sec. 8, Metal Blade Inspection).

CAUTION When removing paint from tail rotor blade, do not use any paint remover. Bonding agents used in manufacture of the blade may be damaged by the chemicals causing the blade to be unserviceable.

(2). Apply tape (14, Table 2-4) to all bushings, data plates and the abrasion strip.

(3). Plug root end of tail rotor blade to ensure no paint enters.

CAUTION

- When sanding paint from the tail rotor blade, take care to not damage rivet heads and sealant.
- Do not sand through the paint and primer into the base metal.

(4). Using 320 grit, or finer, abrasive paper (9) and wet or dry sanding method, sand areas that require painting.

(5). Using a soft cloth, dampened in isopropyl alcohol (71), thoroughly clean tail rotor blade.

(6). Inspect sanded areas for damage.

B. Metal Tail Rotor Blade Paint Application

(1). Inspect tail rotor blade (Ref. Sec. 8, Metal Blade Inspection).

(2). Ensure all bushings, data plates and the abrasion strip are protected from paint with tape (14).

(3). Ensure root end of tail rotor blade is plugged to prevent entry of paint.

(4). Using a soft cloth, dampened in isopropyl alcohol (71), thoroughly clean tail rotor blade.

(5). Treat any bare metal areas of tail rotor blade with chemical coating (8).

NOTE: Mix primer (4) according to manufacturer's recommendations.

(6). Allow mixed primer (4) to stand for 15 to 30 minutes prior to use.

NOTE:

- Working life of mixed primer is four hours maximum.
- Primer allowed to stand for more than two hours must be stirred or shaken before use.
- Addition of freshly mixed primer to replenish an older mixture is not permitted.

(7). Apply primer to sanded areas, feather into surrounding color coat.

(8). Allow to air-dry for one hour minimum.

NOTE: Mix paint (148) according to manufacturer's recommendations.

(9). Allow mixed paint (148) to stand for 20 minutes minimum prior to use.

NOTE:

- Working life of mixed paint is four hours maximum.
- Addition of freshly mixed primer to replenish an older mixture is not permitted.

(10). Apply paint to primed areas. Feather-edge paint while applying.

(11). Allow to air-dry for eight hours minimum.

(12). Remove protective tape from tail rotor blade.

NOTE: Tail rotor assembly may need to be rebalanced after painting.

14. Fluid Leak Analysis

A. Main Rotor or Tail Rotor Transmission Oil Leaks

Oil leakage, seepage or capillary wetting at oil seals assembly joint lines of main or tail rotor transmission are permissible if leakage rate does not exceed 2 cc per hour (one drop per minute). An acceptable alternate rate of leakage from either transmission is, if oil loss is not more than from full to the add mark on sight gage within 25 flight hours. Repair leaks according to instructions in CSP-H-5.

NOTE: On transmission input and output pinion gear oil seals with less than 2 hours of operation, some seepage or wetting of adjacent surfaces is normal until seal is wetted and worn-in (seated). If seepage continues at rate of one drop per minute or less, seal may be continued in service. Check transmission oil level and observe seepage rate after every 2 hours of operation. Shorter inspection periods may be required if seal leakage appears to be increasing.

NOTE: If excessive tail rotor gearbox oil seepage occurs, check breather filler for sticky piston (Ref. CSP- H- 5 for cleaning procedures).

B. Engine Oil Leaks

Refer to the appropriate Allison Operation and Maintenance Manual for definition of permissible engine oil leakage.

C. Landing Gear Damper Hydraulic Fluid Leaks

Hydraulic fluid leakage from any of landing gear dampers is not permissible. When leakage is observed, the damper assembly should be overhauled as required and serviceable unit installed. If leaking landing gear damper is not replaced when leakage is noticed, continuation of damper in service can cause internal damage that might otherwise not occur.

NOTE: It is normal for a thin hydraulic oil film to remain on the damper piston as a result of wiping contact with the piston seal. Newly installed dampers may also exhibit slight oil seepage caused by oil trapped in the end cap threads during damper assembly. Neither of these should be construed as damper leakage or cause for damper replacement.

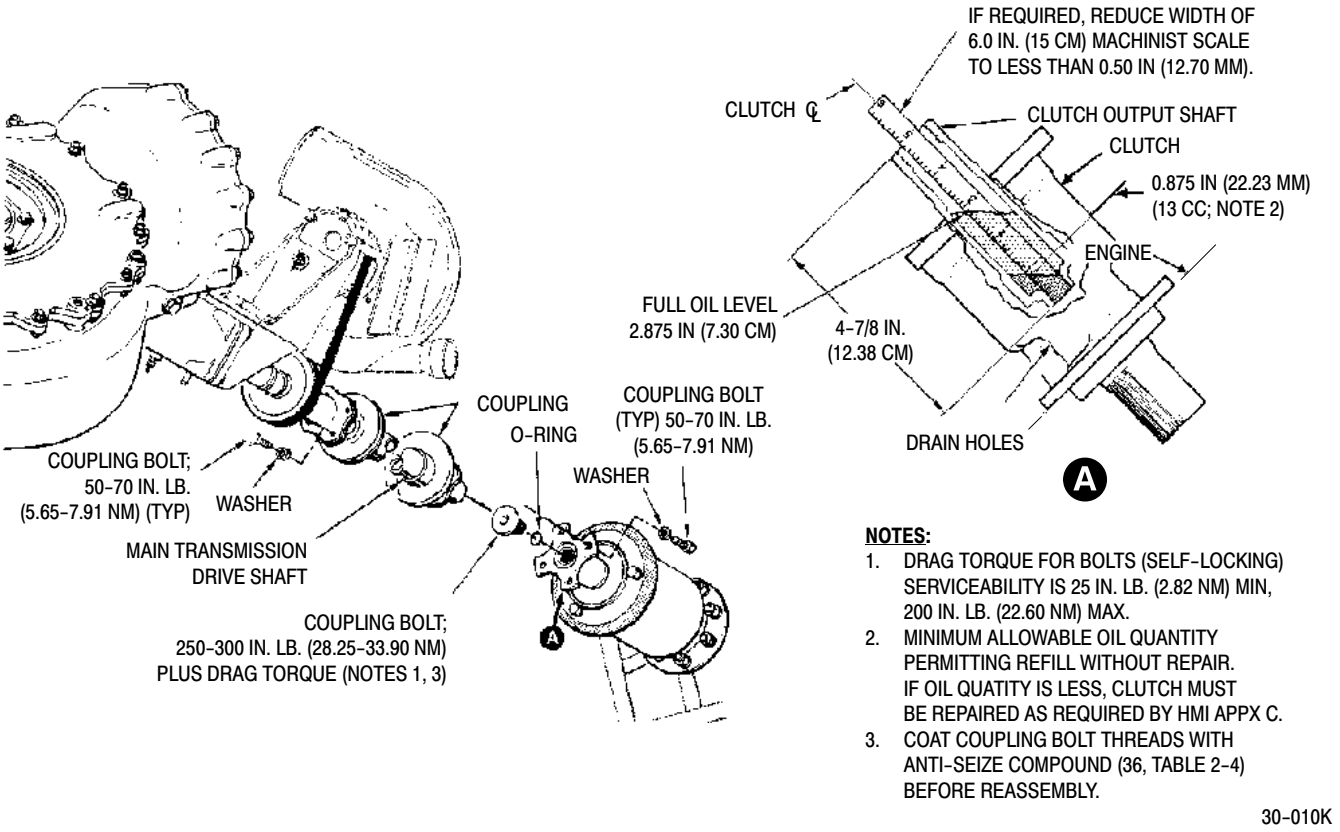


Figure 2-9. Checking Overrunning Clutch Oil Level

D. Overrunning Clutch Oil Leak Analysis and Servicing

(Ref. Figure 2-9) When oil leakage or seepage is noticed at the oil seals or assembly joint lines of the overrunning clutch, the clutch requires further inspection and investigation as follows.

CAUTION

- Mixing of oils within an oil series, not in the same group, is not recommended. If oils of different groups are mixed, flush and re-service overrunning clutch.
- Checking clutch oil level requires removal of the main transmission drive shaft. Do not stress the drive shaft diaphragms during shaft removal and installation. Diaphragm deflection is limited because of material hardness.

(1). Remove, in order, the sound insulation, gearbox access cover, and transmission drain assembly.

(2). Remove four bolts and washers from each end of main transmission drive shaft. Carefully slide shaft from drive couplings; do not strike shaft against any object.

(3). Remove bolt and O-ring packing from end of clutch.

(4). On helicopters with clutch housing drain holes, check that the three drain holes are clean and free of obstruction. Oil leakage may indicate engine power output seal leakage if clutch oil level is checked and found within limits.

(5). Using a CLEAN, 6 inch (15.24 cm) machinists scale, 1/2 inch (12.7 mm) width, slowly insert the scale into center of clutch output shaft until scale bottoms. Scale must be inserted 4-7/8 inches (12.38 cm).

NOTE: Reduce 1/2 inch (12.7 mm) scale width as required to allow scale to bottom in clutch.

(6). Read scale to determine oil level and servicing required.

(a). Full oil level will read 2-7/8 inches (7.30 cm) on LOWER edge of 6 inch (15.24 cm) scale. Recheck reading a minimum of three times.

(b). Minimum allowable oil quantity (13 cc of trapped oil) will read 7/8 inch (2.22 cm) on bottom edge of scale. Recheck reading a minimum of three times.

NOTE: If oil quantity is less than 13 cc, the clutch must be removed for repair according to instructions in CSP-H-5.

(7). Service clutch with lubricating oil (Table 2-3) if oil level readings indicate less than the full level. Do not overfill. Recheck oil level.

(8). If coupling was removed, shim coupling so that there is 0.035-0.055 inch (0.889-1.397 mm) O-ring gap from end of clutch shaft to face of coupling recess (surface that bolt head contacts). Measure gap with feeler gage.

CAUTION When installing the clutch coupling bolt in the installation torque on the **bolt must not be less than 250 - 300 inch pounds (28.25 - 33.90 Nm)**. Torquing to a lower value will reduce clutch bearing clamp-up and possibly lead to bearing race spinning.

(9). Coat bolt threads with anti-seize compound (36). Install coupling bolt and O-ring packing. **Check drag torque for bolt self locking serviceability is 25 inch-pounds (2.82 Nm) minimum, 200 inch-pounds (22.60 Nm) maximum**. Torque bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**.

(10). Position main transmission drive shaft between drive couplings and install.

(11). Reinstall, in order, the transmission drain assembly, gearbox access cover, and the sound insulation.

E. One-Way Lock (Uniloc) Fluid Leak

Hydraulic fluid leakage from any part of the one-way lock is not permissible. When leakage is observed the assembly should be overhauled as required and a serviceable unit installed. If a leaking one-way lock is not replaced when

leakage is noticed, continuation in service may result in mechanical malfunction that could be hazardous to safety of flight.

15. Preservation and Storage

Helicopters to be put in storage or non-operational status must get adequate inspection, maintenance and preservation to avoid unnecessary deterioration of the airframe, components or equipment during the storage or non-operational interval. The extent of preventive maintenance that should be performed will depend on the anticipated time in storage. The following paragraphs establish what should be performed on a helicopter: for flyable storage; for up to 45 days in storage; and for up to 6 months in storage.

A. Flyable Storage (No Time Limit)

(1). Inspection Before Storage:

(a). Perform a preflight inspection.

(b). Ensure that fuel cells are full (topped off), and that the engine oil tank and rotor transmissions are at the **FULL** level.

(2). Storage: To maintain a flyable storage condition, perform daily inspection. A ground runup must also be performed at least once every 5 days.

(a). Perform a preflight inspection.

(b). Start the engine (Ref. PFM). After idle has stabilized, accelerate the engine to 100 percent N_2 collective full down. Operate until the oil temperature is in normal operating range and ammeter indicates battery is fully charged.

(c). Drain fuel cell sump (Ref. Figure 2-5). (Replenish fuel as necessary.)

(d). Ensure that fuel shutoff valve is closed.

(e). Open movable air vents in each door of the cargo compartment. Position opening in each air vent downward. Close all other vents.

(f). Install covers and equipment used to park and moor helicopter.

(g). Install a static ground.

(3). Return to Service:

(a). Remove covers and equipment used to park and moor the helicopter.

(b). Perform a preflight inspection.

B. Storage up to 45 Days

(1). Inspection During Storage:

(a). Where local average humidity exceeds 40 percent carefully inspect the helicopter every 15 days for corrosion. Apply corrosion control as necessary. In conducting an inspection for corrosion, pay particular attention to those area where moisture deposits will not evaporate rapidly.

(b). Where local average humidity is 40 percent or less, inspect for corrosion every 30 days.

(c). If interior temperature of fuselage exceeds 160°F (71°C), ventilate helicopter by opening all doors and vents. If necessary, promote air circulation by use of fans or other forced air equipment.

(d). Ensure that fuel cells are full (topped off) and that the rotor transmissions are at the **FULL** level.

(e). Drain fuel cell sump daily. (Replenish fuel as necessary.)

(f). Check fuel and oil systems periodically for leakage. Repair as necessary.

(2). Storage:

(a). Perform engine preservation according to the engine operation and maintenance manual and current engine service letters.

(b). Remove battery and store it in a cool, dry area.

(c). Clean the battery compartment, if necessary.

(d). Ensure that the fuel shutoff valve is closed.

(e). Clean entire helicopter.

(f). Inspect all drain holes (blades, fuselage, etc) for obstructions and clear them where necessary.

(g). Open movable air vents in each door of cargo compartment. Position opening in each air vent downward. Close all other air vents.

(h). Install main rotor blade covers, if on hand. Park and moor the helicopter.

(i). Install a static ground.

(j). Remove from the area any objects that are likely to strike the helicopter during high wind conditions.

(3). Return to Service:

(a). Check that the battery area is clean; then install and connect battery.

(b). Check that fuel cells are full.

(c). Remove covers and equipment used to park and moor the helicopter.

(d). Inspect areas around mooring attachments for damage. Repair damage as necessary.

(e). Clean the helicopter, as necessary.

(f). Check that all drain holes in helicopter are free of obstructions.

(g). Perform a preflight inspection.

C. Storage up to 6 Months

(1). Inspection During Storage:

(a). Perform same inspection as for 45 days of storage.

(b). Check rotor blades for damage every 15 days.

(c). Check areas around mooring attachments for damage every 15 days.

(2). Storage:

(a). Perform engine preservation according to the engine operation and maintenance manual and current engine service letters.

(b). Drain the engine oil system and fill the engine oil tank with corrosion preventive (13, Table 2-4).

(c). Remove battery and store it in a cool, dry area.

(d). Clean the battery compartment, if necessary.

(e). Ensure that the fuel shutoff valve is closed.

(f). Seal static source openings in the engine inlet fairing with tape (14) and cover pitot tube with pitot cover (4, Table 2-2).

(g). Clean entire helicopter.

(h). Inspect all drain holes (blades, fuselage, etc) for obstructions and clear them where necessary.

(i). Spray or brush on the canopy and all windows a 0.008 inch (0.2032 mm) thickness of protective coating (15, Table 2-2). Cover and overlap all edges.

(j). Inspect all external access doors for close fit. If doors are likely to admit moisture, seal edges with tape.

(k). Install main rotor blade covers, if on hand. Park and moor helicopter.

(l). Install a static ground.

(m). Remove from the area any objects that are likely to strike the helicopter during high wind conditions.

(3). Return to Service:

(a). Carefully lift protective coating along the edges and peel it from the canopy and windows.

(b). Remove masking tape from all external access doors.

CAUTION Do not use steam or unauthorized cleaning compounds to clean the helicopter as damage to equipment may result.

(c). Drain corrosion preventive from the oil tank and replenish with correct oil (Table 2-3).

(d). Perform same procedures as for return to service after 45 days of storage.

NOTE: Depreservation of the engine fuel system can usually be accomplished by making a normal start. (Refer to the engine operation and maintenance manual, and current engine service letters for engine depreservation procedures.)

16. Torque Data

A. Torque Wrenches

Torque wrenches should be of good quality and must be calibrated at least every 90 days to verify accuracy. Torque wrench accuracy at room temperature, 70°F (21°C) must be within the following limits.

(1). From zero thru 19 percent of the torque wrench range, the error may not exceed ±7 percent of the load applied.

(2). From 20 thru 79 percent of the torque wrench range, the error may not exceed ±4 percent of the load applied.

(3). From 80 thru 100 percent of the torque wrench range, the error may not exceed ±5 percent of the load applied.

17. Torque Wrench Load Application

Recommended tightening torque values and minimum drag torque values for fine and coarse thread nuts, and minimum breakaway torque for used self-locking bolts or screws are shown in Table 2-5 thru Table 2-8.

(1). Requirements Governing Application of Torque Loads:

(a). The values apply to cadmium- plated bolts, cadmium-plated nuts and nuts coated with molybdenum disulfide (MoS2).

(b). Manufacturer-applied lubricant must not be removed nor additional lubricant added.

(c). The bolts, nuts and surfaces they bear on must be clean, dry and free of lubricant (except as stated in step (b). above).

(d). The turning (drag) torque required to install self-locking nut or bolt up to point of final tightening must always be added to the final torque value or the maintenance instruction, as applicable.

(e). Torques specified in handbook maintenance instructions are special torque that take precedence over those listed in Table 2-5 thru Table 2-8.

(f). If adapters are used such that the adapter and the torque wrench are not at right angles (90°) to each other, wrench or indicator reading must be corrected.

(g). Any reuse of self-locking nuts over 3/8 inch will be governed by the values in Table 2-8.

(h). The bolt must not be rotated during installation or torquing of the mating nut.

NOTE: All special (non-standard) torque values appearing in Table 2-9

(2). Installation of Castellated Nuts on Non-rotating (Static) Parts: Finger-tighten the nut on installation. Turn the nut a minimum of 60 degrees and a maximum of 110 degrees (or the next slot after 60 degrees of rotation) past finger-tight and insert and secure cotter pin for final installation. Maximum applied torque must not exceed the applicable values in Table 2-5 and Table 2-6.

(3). Installation of Castellated Nuts on Rotating (Dynamic) Parts: When tightening castellated nuts and bolts, it is possible that the cotter pin holes will not line up with the slots in the nuts for the range of recommended installation torques. In such a case, the nut may be overtighten just enough to line up the nearest slot with the cotter pin hole, but the maximum applied torque must not exceed the applicable values in Table 2-5 and Table 2-6.

(4). Installation of Self-Locking Tension- and Shear-Type Nuts:

NOTE: Non-metallic self-locking nuts should not be subjected to temperatures in excess of 250°F (121°C).

(a). Use torques in Table 2-5 for tension-type cadmium-plated steel nuts.

(b). Use torques in Table 2-6 for shear-type cadmium-plated steel nuts.

(5). Installation of Bolts - General:

(a). If bolt can be inserted through the material and started into the nut by fingers, use the applicable torque in Table 2-5 and Table 2-6.

(b). If installing the bolt in a close tolerance hole, or under other conditions that increase the tightening resistance, torque to the high limit of the applicable recommended torque in Table 2-5 and Table 2-6.

(6). Installation of Bolts Into Threaded Parts:

(a). When installing the bolt into a threaded part, use the applicable torque in Table 2-5 if the mating thread length is equal to or greater than one diameter of the bolt.

(b). Use Table 2-6 if the mating thread length is less than one diameter of the bolt.

NOTE: The requirements in steps (5). and (6). above also apply to thread inserts.

(7). Installation of Used Self-Locking Bolts or Screws: New self-locking nuts or bolts provide tight connections which will not loosen under vibration. Self-locking nuts or bolts approved for use on helicopters meet critical specifications as to strength, corrosion-resistance and temperatures. Reuse of self-locking nuts or bolts are limited to those nuts and bolts that meet the minimum requirements established in Table 2-7 and Table 2-8 for drag or breakaway torque values.

(a). Self-locking nuts come in two general types: metallic lock type which are all metal and non-metallic which have non-metallic locking inserts. Non-metallic self-locking nuts should not be subject to temperatures in excess of 250°F (121°C).

(b). Self-locking bolts come in three general types: a round pellet, a hex pellet or a strip type insert is placed in the threaded area to provide the self-locking feature. In addition to checking for breakaway torque values listed in Table 2-8, the bolts should be checked for loose or missing inserts.

NOTE: Burrs on cotter pin holes tend to tear the non-metallic inserts.

(c). Bolts, nuts or screws of 5/16 inch (7.94 mm) diameter and over with cotter pin holes may be used with self-locking nuts provided the cotter pin holes are free from burrs.

(d). Bolts and screws of 1/4 inch (6.35 mm) diameter and under with cotter pin holes may be used with self-locking nuts only in an emergency for one time flight. They will be replaced before the next flight with the specified type.

(e). Self-locking nuts will not be used at joints in control systems of the helicopter when movement of the joint may result in motion of the nut relative to the surface against which it is bearing.

(f). Self-locking nuts may be used with anti-friction bearings and control pulleys provided the inner race of the bearing is clamped to the supporting surfaces by the nut and bolt.

(g). The nuts which are attached to the structure must be attached in a positive manner to eliminate the possibility of their rotating or misaligning when the tightening is to be accomplished by rotating the bolts or screws.

(h). The manner of attachment must permit removal without injury to the structure and the replacement of the nuts.

(i). Round or chamfered-end bolts must extend at least the full round or chamfer through the nut.

(j). Flat end bolts must extend at least 1/32 inch (0.794 mm) through the nut.

18. Installation, Staking or Swaging Force Needed for Bearings

The following procedure explains how to convert from a given "Force" which is required to perform a given task to a proper hydraulic pressure reading.

(1). Determine the diameter of the ram on the hydraulic press to be used.

NOTE: The hydraulic press to be used must have a pressure gauge.

(2). Divide the ram diameter by two to get the radius.

(3). Multiply 3.14159 (pi, π) times the Radius squared (R^2). This will give the area of the ram.

(4). Divide the force required for the task by the area of the ram. This gives the actual PSI reading for the hydraulic press pressure gauge needed to perform the task.

EXAMPLE:

(a). Ram Diameter = 2.65 inch

(b). Ram Radius (R) = 1.325 inch

(c). Radius squared (R^2) = 1.756

(d). R^2 x 3.14159 = 5.517 (Area of ram)

(e). Force required = 7500-8500 pounds (variable)

(f). $\frac{7500\text{-}8500}{}$ = 1359-1540 PSI

(g). PSI Required = 1359 PSI Minimum 1540 PSI Maximum

$$\frac{\text{FORCE NEEDED}}{(R^2) \times 3.14159} = \text{Pressure Gauge Reading}$$

19. Useful Conversion Data

Table 2-10 thru Table 2-14 provide useful information for converting common engineering units of one system into different but related units of other systems.

20. Related Publications

Table 2-15 provides a listing of publications and directives that form part of the available information file for maintenance of helicopter components.

21. Maintenance Information Requests

Questions that may arise during maintenance of the helicopter or it's components should, when possible, be referred to the company's Field Service Representative assigned to the geographic area in which the helicopter is being operated. Should there be no factory representative in the area, contact Customer Service, MDHI, Mesa, Arizona or the manufacturer of the component as appropriate. Table 2-15 lists manufacturers of major components, and addresses.

22. Inspection Practices and Technical Definitions

Inspection procedures and serviceability (wear) tolerances for maintenance of the helicopter are provided either as part of the instructions for reassembly and installation of components or in inspection and repair paragraphs. Any damage or wear of a part that exceeds the given tolerance or that affects the function and/or integrity of the part is cause for replacement with a new or serviceable unit. Definitions of technical terms normally associated with the inspection and repair of the helicopter and its components are shown in Figure 2-10 and listed in Table 2-16.

23. Service and Operations Report Form 853

MDHI Service and Operations Report Form 853 may be used to report to MDHI in detail any service difficulties encountered with any MDHI helicopter. Use of the form is encouraged and recommended to enable MDHI to provide Owner's and Operator's improved service,support and product improvements. The form also serves a convenient detailed record for Owner's and Operator's. Copies of the form may be procured by contacting the Customer Service Department - Commercial Service Publications.

Table 2-5. Recommended Standard Torques for Tension-Type Nut: Min. and Max. Torque Values; AN310, AN365, MS20365, MS21042, NAS1021, NAS1291, NAS679

Thread Size	Recommended Torque in. lb (Nm)	Maximum Allowable in. lb (Nm)	Thread Size	Recommended Torque in. lb (Nm)	Maximum Allowable in. lb (Nm)
8 - 36	12 - 15 (1.13 - 1.36)	20 (2.26)	8 - 32	12 - 15 (1.36 - 1.69)	20 (2.26)
10 - 32	20 - 25 (2.26 - 2.82)	40 (4.52)	10 - 24	20 - 25 (2.26 - 2.82)	35 (3.95)
1/4 - 28	50 - 70 (5.65 - 7.91)	100 (11.30)	1/4 - 20	40 - 50 (4.52 - 5.65)	75 (8.47)
5/16 - 24	100 - 140 (11.30 - 15.82)	225 (25.42)	5/16 - 18	80 - 90 (9.04 - 10.17)	160 (18.08)
3/8 - 24	160 - 190 (18.08 - 21.47)	390 (44.06)	3/8 - 16	160 - 185 (18.08 - 20.90)	275 (31.07)
7/16 - 20	450 - 500 (50.84 - 56.49)	840 (94.91)	7/16 - 14	235 - 255 (26.55 - 28.81)	475 (53.67)
1/2 - 20	480 - 690 (54.23 - 77.96)	1100 (124.3)	1/2 - 13	400 - 480 (45.19 - 54.23)	880 (90.39)
9/16 - 18	800 - 1000 (90.39 - 112.98)	1600 (180.8)	9/16 - 12	500 - 700 (56.49 - 79.09)	1100 (124.3)
5/8 - 18	1100 - 1300 (124.3 - 146.9)	2400 (271.2)	5/8 - 11	700 - 900 (79.09 - 101.69)	1500 (169.5)
3/4 - 16	2300 - 2500 (259.9 - 282.5)	5000 (565.0)	3/4 - 10	1150 - 1600 (129.95 - 180.8)	2500 (282.5)
7/8 - 14	2500 - 3000 (282.5 - 339.0)	7000 (791.0)	7/8 - 9	2200 - 3000 (248.6 - 339.0)	4600 (542.4)
1 - 14	3700 - 5500 (418.1 - 621.5)	10000 (1130.0)	1 - 8	3700 - 5000 (418.1 - 565.0)	7600 (858.8)
1-1/8 - 12	5000 - 7000 (565.0 - 791.0)	15000 (1695.0)	1-1/8 - 8	5500 - 6500 (621.5 - 734.5)	12000 (1356.0)
1-1/4 - 12	9000 - 11000 (1017.0 - 1243.0)	25000 (2825.0)	1-1/4 - 8	6500 - 8000 (734.5 - 904.0)	16000 (1469.0)

Table 2-6. Recommended Standard Torques for Shear-Type Nut: Min. and Max. Torque Values; AN320, AN364, MS20364, NAS1022, MS21083

Thread Size	Recommended Torque in. lb (Nm)	Maximum Allowable in. lb (Nm)	Thread Size	Recommended Torque in. lb (Nm)	Maximum Allowable in. lb (Nm)
8 - 36	7 - 9 (0.79 - 1.02)	12 (1.36)	8 - 32	7 - 9 (0.79 - 1.02)	12 (1.36)
10 - 32	12 - 15 (1.36 - 1.69)	25 (2.82)	10 - 24	12 - 15 (1.36 - 1.69)	21 (2.37)
1/4 - 28	30 - 40 (3.39 - 4.52)	60 (6.78)	1/4 - 20	25 - 30 (2.82 - 3.39)	45 (5.08)
5/16 - 24	60 - 85 (6.78 - 9.60)	140 (15.82)	5/16 - 18	48 - 55 (5.42 - 6.21)	100 (11.30)
3/8 - 24	95 - 110 (10.73 - 12.43)	240 (27.12)	3/8 - 16	95 - 110 (10.73 - 12.43)	170 (19.21)
7/16 - 20	270 - 300 (30.51 - 33.90)	500 (56.49)	7/16 - 14	140 - 155 (15.82 - 17.51)	280 (31.64)
1/2 - 20	290 - 410 (32.77 - 46.32)	660 74.57)	1/2 - 13	240 - 290 (27.12 - 32.77)	520 (58.75)
9/16 - 18	480 - 600 (54.23 - 67.79)	960 (108.47)	9/16 - 12	300 - 420 (33.90 - 47.45)	650 (73.44)
5/8 - 18	660 - 780 (74.57 - 88.13)	1400 (158.2)	5/8 - 11	420 - 540 (47.45 - 61.01)	900 (101.69)
3/4 - 16	1300 - 1500 (146.9 - 169.5)	3000 (339.0)	3/4 - 10	700 - 950 (79.09 - 107.34)	1500 (169.5)
7/8 - 14	1500 - 1800 (169.5 - 203.4)	4200 (474.6)	7/8 - 9	1300 - 1800 (146.9 - 203.4)	2700 (305.1)
1 - 14	2200 - 3300 (248.6 - 372.9)	6000 (678.0)	1 - 8	2200 - 3000 (248.6 - 339.0)	4500 (508.5)
1-1/8 - 12	3000 - 4200 (339.0 - 474.6)	9000 (1017.0)	1-1/8 - 8	3300 - 4000 (372.9 - 452.0)	7200 (813.6)
1-1/4 - 12	5400 - 6600 (610.2 - 745.8)	15000 (1695.0)	1-1/4 - 8	4000 - 5000 (452.0 - 565.0)	10000 (1130.0)

Table 2-7. Self-Locking Nut Minimum Run-On Torque Values

Fine Thread Series		Fine Thread Series	
Thread Size	**Minimum Drag in. lb (Nm)**	**Thread Size**	**Minimum Drag in. lb (Nm)**
7/16 - 20	8 (0.90)	7/16 - 14	8 (0.90)
1/2 - 20	10 (1.13)	1/2 - 13	10 (1.13)
9/16 - 18	13 (1.47)	9/16 - 12	14 (1.58)
5/8 - 18	18 (2.03)	5/8 - 11	20 (2.26)
3/4 - 16	27 (3.05)	3/4 - 10	27 (3.05)
7/8 - 14	40 (4.52)	7/8 - 9	40 (4.52)
1 - 12	55 (6.21)	1 - 8	51 (5.76)
1-1/8 - 12	73 (8.25)	1-1/8 - 7	68 (7.68)
1-1/4 - 12	94 (10.62)	1-1/4 - 7	88 (9.94)

Table 2-8. Minimum Breakaway Torque For Used Self-locking Bolts or Screws

Fine Thread Series (UNF)		Coarse Thread Series (UNC)	
Thread Size	**Minimum Drag in. lb (Nm)**	**Thread Size**	**Minimum Drag in. lb (Nm)**
		4 - 40	0.5 (0.06)
		6 - 32	1.0 (0.11)
		8 - 32	1.5 (0.17)
10 - 32	2.0 (0.23)	10 - 24	2.0 (0.23)
1/4 - 28	3.5 (0.40)	1/4 - 20	4.5 (0.51)
5/16 - 24	6.5 (0.73)	5/16 - 18	7.5 (0.85)
3/8 - 24	9.5 (1.07)	3/8 - 16	12.0 (1.36)
7/16 - 20	14.0 (1.58)	7/16 - 14	16.5 (1.86)
1/2 - 20	18.0 (2.03)	1/2 - 13	24.0 (2.71)
9/16 - 18	24.0 (2.71)	9/16 - 12	30.0 (3.39)
5/8 - 18	32.0 (3.62)	5/8 - 11	40.0 (4.52)
3/4 - 16	50.0 5.65)	3/4 - 10	60.0 (6.78)
7/8 - 14	70.0 (7.91)	7/8 - 9	82.0 (9.27)
1 - 12	90.0 (10.17)	1 - 8	110.0 (12.43)
1-1/8 - 12	117.0 (13.22)		
1-1/4 - 12	143.0 (16.16)		

CAUTION If any size self-locking nut under 3/8 inch (9.525 mm) can be run down with the fingers after the locking feature engages the bolt or stud, indicating the locking friction does not exist, the nut or friction device must be replaced. These values for self-locking nuts over 3/8 inch (9.525 mm) are to be used only for determining continued serviceability. The values apply only when the nut is being run down on the mating threads prior to reaching the clamp-up point. Standard torque values for final tightening are shown in Table 2-5 thru Table 2-8.

NOTE:

- The final torque value for self- locking nuts must be determined by adding the free running torque (torque wrench reading) to the specified torque value. The free running torque (drag torque) is the torque required to overcome the friction of the nut running down the bolt threads prior to tightening.
- Minimum breakaway torque will be the minimum torque required to start removal (turning) of the bolt or screw from the installed position. The installed position is after the self-locking device of the bolt or screw has been completely engaged plus two or three turns of engagement.

Table 2-9. Special Torques

Location		Torque	
		in. lb. (Nm)	ft. lb. (Nm)
Transmission and Drive System			
Main transmission mounting nuts		60-80 (6.78-9.04)	
Main transmission lubrication pump attach nuts		50-70 (5.65-7.91)	
Oil pressure sender		30-40 (3.39-4.52)	
Oil temperature sender		12-25 (1.36-2.82)	
Main transmission oil level sight plug		80-90 (9.04-10.17)	
Main rotor drive shaft head hoisting eyebolts nuts		120-140 (13.56-15.82)	
Main rotor drive shaft head attach nuts		120-140 (13.56-15.82)	
Main transmission output pinion/tail rotor drive shaft coupling bolts		250-300 (28.25-33.90)	
Main transmission input pinion coupling bolt		250-300 (28.25-33.90)	
Overrunning clutch coupling bolt		250-300 (28.25-33.90)	
Main transmission drive shaft coupling flange attach bolts		50-70 (5.65-7.91)	
Oil cooler blower scroll to transmission attach bolts		5-10 (0.56-1.13)	
Oil cooler blower driven pulley		160-190 (18.08-21.47)	
Oil cooler blower impeller shaft fiber locknut		250-300 (28.25-33.90)	
Tail rotor transmission output cover attach bolts		65-70 (7.34-7.91)	
Tail rotor transmission chip detector valve:	body	50-60 (5.65-6.78)	
	detector	40-50 (4.52-5.65)	
Tail rotor transmission breather-filler		45-55 (5.08-6.21)	
Tail rotor transmission liquid level plug		50-60 (5.65-6.78)	
Tail rotor gearbox coupling bolt		250-300 (28.25-33.90)	
Tail rotor drive shaft coupling flange attach bolts		80-100 (9.04-11.30)	
Deleted			
Main Rotor and Controls System			
Rotor tracking magnetic pickup nut			15 - 20 (20-26)
Forward tip cap and tracking tip cap attaching screws		15-20 (1.69-2.26)	
Blade vibration absorber attach bolts:	long	50-60 (5.65-6.78)	
	short	15-20 (1.69-2.26)	
Main rotor pitch control bearing attach nuts		50-70 (5.65-7.91)	

Table 2-9. Special Torques (Cont.)

Location	Torque	
	in. lb. (Nm)	ft. lb. (Nm)
Main rotor mast nut		200 - 250 (271-339)
Main rotor damper attach nuts	50-70 (5.65-7.91)	
Main rotor damper arm to damper attach nut	30-60 (3.39-6.78)	
Pitch control rod upper attach nut	60-140 (6.78-15.82)	
Pitch control rod lower attach nut	30-60 (3.39-6.78)	
Scissors link to crank attach nut	30-40 (3.39-4.52)	
Scissors link to swashplate attach nut	30-60 (3.39-6.78)	
Scissors crank to hub nut	30-60 (3.39-6.78)	
Swashplate bearing retainer nuts	50-70 (5.65-7.91)	
Swashplate bearing flange to stationary swashplate nuts	30-40 (3.39-4.52)	
Tracking interrupter (369A9946 -23 & -25) attach nuts	15-20 (1.69-2.26)	
Tracking interrupter (369A9946 -27 & -29) attach nuts	30-60 (3.39-6.78)	
Mixer support bracket to mast base attach nuts	80-100 (9.04-11.30)	
Torque tube bungee adjusting bolt	30-40 (3.39-4.52)	
Fuselage		
Main rotor mast holddown bolts	700-820 (79.09-92.65)	58 - 68 (79-92)
Main rotor mast studs	160-190 (18.08-21.47)	
Tail Rotor and Control System		
Spar to strap assembly bolts and nuts, tail rotor blade	600-650 (67.79-73.44)	50 - 54 (68-73)
Pitch control link to swashplate bolt	50-80 (5.65-9.04)	
Pitch control link to pitch control arm	50-80 (5.65-9.04)	
Tail rotor retaining nut (Ref. Sec. 8 for torquing method)	400-450 (45.19-50.84)	
Left pedal bushing bolt	50-80 (5.65-9.04)	
Bellcrank support to mast structure attach nuts	80-100 (9.04-11.30)	
Hub threaded bushing	60-65 (6.78-7.34)	
Hub to fork hinge bolt and nut	170-210 (19.21-23.73)	
Servicing and General Maintenance		
Engine accessory gearbox chip detector	50-60 (5.65-6.78)	
Tail rotor transmission breather/filler	50-60 (5.65-6.78)	
Main transmission self-closing valves	50-60 (5.65-6.78)	
Main transmission lubrication pump oil filter housing	70-100 (5.65-11.30)	
Main transmission chip detectors (without knurled detector knob)	40-50 (4.52-5.65)	
Tail rotor transmission chip detector	40-50 (4.52-5.65)	
Main transmission drain assembly nut	10 (1.13) max.	
Overrunning clutch coupling bolt	250-300 (28.25-33.90)	
Main transmission drive shaft coupling flange attach bolts	50-70 (5.65-7.91)	
Tailboom and Tail Surfaces		
Tailboom attach nuts	200-240 (22.60-27.12)	
Upper vertical stabilizer forward attach bolts	50-70 (5.65-7.91)	
Upper vertical stabilizer attach nuts	170-200 (19.21-22.60)	
Horizontal to vertical stabilizer strut bolts	50-70 (5.65-7.91)	
Horizontal stabilizer forward mounting bolt	50-70 (5.65-7.91)	
Horizontal stabilizer attach nuts	380-410 (42.93-46.32)	

Table 2-9. Special Torques (Cont.)

Location		Torque in. lb. (Nm)	Torque ft. lb. (Nm)
Lower vertical stabilizer adjustable bolt		25-40 (2.82-4.52)	
Engine Installation and Cooling System			
Engine mount fitting-to-engine bolt		140-160 (15.82-18.08)	
Compressor bleed air tube nuts		150-250 (16.95-28.25)	
Engine hoist fitting:	3/8 inch dia. bolts	160-190 (18.08-21.47)	
	5/16 inch dia. bolts	140-160 (15.82-18.08)	
Fuel pressure switch		40-50 (4.52-5.65)	
Engine mount-to-engine fitting bolts		100-140 (9.04-11.30)	
Engine oil vent line nut		120-140 (13.56-15.82)	
Accessories drive overboard vent tube nut		150-250 (16.95-28.25)	
Cabin air outlet tube to firewall fitting tube nuts		150-250 (16.95-28.25)	
Engine fuel pump seal drain line nut		20-30 (2.26-3.39)	
Fuel inlet line to fuel pump line nut		120-140 (13.56-15.82)	
Anti-icing lever cable wire adapter nut		10 (1.13) max.	
Engine Fuel System			
Power plant fuel supply tube nuts		150-250 (16.95-28.25)	
Left fuel cell cover (and cell support brackets) attach bolts		50-70 (5.65-7.91)	
Right fuel cell cover attach bolts		50-70 (5.65-7.91)	
Forward fuel vent crossover fitting bolts		20-25 (2.26-2.82)	
Aft vent tube nuts		80-100 (9.04-11.30)	
Fuel inlet mounting pad bolts		20-25 (2.26-2.82)	
Fuel shutoff valve inlet hose nut		150-250 (16.95-28.25)	
Fuel supply tube nuts		250-300 (28.25-33.90)	
Engine fuel pump supply hose nut (drain valve end)		270-420 (30.51-47.45)	
Engine fuel hose coupling halves		120-140 (15.82-18.08)	
Fuel inlet hose to start pump		270-325 (30.51-36.72)	
Pump-to-mounting pad attach bolt		20-25 (2.26-2.82)	
Sta. 124 bulkhead fitting nut		270-420 (30.51-47.45)	
Engine Oil System			
Oil tank liquid level plug		80-90 (9.04-10.17)	
Oil supply 1/4 inch tube nuts		80-100 (9.04-11.30)	
Oil supply 5/16 inch tube nuts		150-200 (16.95-22.60)	
Engine Exhaust System			
Engine-to-tailpipe clamp nuts		15-18 (1.69-2.03)	
Support fitting bolt		12-15 (1.36-2.82)	
Instrument Panel and Indicating System			
Engine oil temperature sender		100-150 (11.30-16.95)	
Fuel quantity tank unit attach bolts		50-70 (5.65-7.91)	
Fuel pressure switch		40-50 (4.52-5.65)	
Electrical System			
Battery cell bus bar attach screw	(Gulton)	20-25 (2.26-2.82)	
	(Marathon/Sonotone)	26-30 (2.94-3.39)	

Table 2-10. Temperature Conversion

Numbers in the center column (between those marked C and F) refer to temperature, either Centigrade or Fahrenheit, which it is desired to convert into the other scale. To convert from Fahrenheit to Centigrade, find equivalent temperature in left-hand column marked C; in like manner, find equivalent temperature in right-hand column when converting from Centigrade to Fahrenheit. Example: 50F is 10C; 50C is 122F.

C.		F.	C.		F.	C.		F.	C.		F.	C.		F.	C.		F.
-40.0	**-40**	-40.0	-6.7	**20**	68.0	15.6	**60**	140.0	37.8	**100**	212.0	82.2	**180**	356.0	137.8	**280**	536.0
-38.9	**-38**	-36.4	-6.1	**21**	69.8	16.1	**61**	141.8	38.9	**102**	215.6	83.3	**182**	359.6	140.6	**285**	545.0
-37.8	**-36**	-32.8	-5.6	**22**	71.6	16.7	**62**	143.6	40.0	**104**	219.2	84.4	**154**	363.2	143.3	**290**	554.0
-36.7	**-34**	-29.2	-5.0	**23**	73.4	17.2	**63**	145.4	41.1	**106**	222.8	85.6	**186**	366.8	146.1	**295**	563.0
-35.6	**-32**	-25.6	-4.4	**24**	75.2	17.8	**64**	147.2	42.2	**108**	226.4	86.7	**188**	370.4	148.9	**300**	572.0
-34.4	**-30**	-22.0	-3.9	**25**	77.0	18.3	**65**	149.0	43.3	**110**	230.0	87.8	**190**	374.0	151.7	**305**	581.0
-33.3	**-28**	-18.4	-3.3	**26**	78.8	18.9	**66**	150.8	44.4	**112**	233.6	88.9	**192**	377.6	154.4	**310**	590.0
-32.2	**-26**	-14.8	-2.8	**27**	80.6	19.4	**67**	152.6	45.6	**114**	237.2	90.0	**104**	381.2	157.2	**315**	599.0
-31.1	**-24**	-11.2	-2.2	**28**	82.4	20.0	**68**	154.4	46.7	**116**	240.8	91.1	**196**	384.8	160.0	**320**	608.0
-30.0	**-22**	-7.6	-1.7	**29**	84.2	20.6	**69**	156.2	47.8	**118**	144.4	92.1	**198**	388.4	162.8	**325**	617.0
-28.9	**-20**	-4.0	-1.1	**30**	86.0	21.1	**70**	158.0	48.9	**120**	248.0	93.3	**200**	392.0	165.5	**330**	626.0
-27.9	**-18**	-0.4	-0.6	**31**	87.8	21.7	**71**	159.8	50.0	**122**	251.6	94.4	**202**	395.6	168.3	**335**	635.0
-26.7	**-16**	+3.2	0.0	**32**	89.6	22.2	**72**	161.6	51.1	**124**	255.2	95.6	**204**	399.2	171.1	**340**	644.0
-25.6	**-14**	6.8	+0.6	**33**	91.4	22.8	**73**	163.4	52.2	**126**	258.8	96.7	**206**	402.8	173.9	**345**	653.0
-24.4	**-12**	10.4	1.1	**34**	93.2	23.3	**74**	165.2	53.3	**128**	262.4	97.8	**208**	406.4	176.7	**350**	662.0
-23.3	**-10**	14.0	1.7	**35**	95.0	23.9	**75**	167.0	54.4	**130**	266.0	98.9	**210**	410.0	179.4	**355**	671.0
-22.2	**-8**	17.6	2.2	**36**	96.8	24.4	**76**	168.8	55.6	**132**	269.6	100.0	**212**	413.6	182.2	**360**	680.0
-21.1	**-6**	21.2	2.8	**37**	98.6	25.0	**77**	170.6	56.7	**134**	273.2	101.1	**214**	417.2	185.0	**365**	689.9
-20.0	**-4**	24.8	3.3	**38**	100.4	25.6	**78**	172.4	57.8	**136**	276.8	102.2	**216**	420.8	188.2	**370**	698.0
-18.9	**-2**	28.4	3.9	**39**	102.2	26.1	**79**	174.2	58.9	**138**	280.4	103.3	**218**	424.4	190.6	**375**	707.0
-17.8	**0**	32.0	4.4	**40**	104.0	26.7	**80**	176.0	60.0	**140**	284.0	104.4	**220**	428.0	193.3	**380**	716.0
-17.2	**+1**	33.8	5.0	**41**	105.8	27.2	**81**	177.8	61.1	**142**	287.6	105.6	**222**	431.6	196.1	**385**	725.0
-16.7	**2**	35.6	5.6	**42**	107.6	27.8	**82**	179.6	62.2	**144**	291.2	106.7	**224**	435.2	198.9	**390**	734.0
-16.1	**3**	37.4	6.1	**43**	109.4	28.3	**83**	181.4	63.3	**146**	294.8	107.8	**226**	438.8	201.7	**395**	743.0
-15.6	**4**	39.2	6.7	**44**	111.2	28.9	**84**	183.2	64.4	**148**	298.4	108.9	**228**	442.4	204.4	**400**	752.0
-15.0	**5**	41.0	7.2	**45**	113.0	29.4	**85**	185.0	65.6	**150**	302.0	110.0	**230**	446.0	210.0	**410**	770.0
-14.4	**6**	42.8	7.8	**46**	114.8	30.0	**86**	186.8	66.7	**152**	305.6	111.1	**232**	449.6	215.6	**420**	788.0
-13.9	**7**	44.6	8.3	**47**	116.6	30.6	**87**	188.6	67.8	**154**	309.2	112.2	**234**	453.2	221.1	**430**	806.0
-13.3	**8**	45.4	9.9	**48**	118.4	31.1	**88**	190.4	68.9	**156**	312.8	113.3	**236**	456.8	226.7	**440**	824.0
-12.8	**9**	48.2	9.4	**49**	120.2	31.7	**89**	192.2	70.0	**158**	316.4	114.4	**238**	460.4	232.2	**450**	842.0
-12.2	**10**	50.0	10.0	**50**	122.0	32.2	**90**	194.0	71.1	**160**	320.0	115.6	**240**	464.0	237.8	**460**	860.0
-11.7	**11**	51.8	10.6	**51**	123.8	32.8	**91**	195.8	72.2	**162**	323.6	116.7	**242**	467.6	243.3	**470**	878.8
-11.1	**12**	53.6	11.1	**52**	125.6	33.3	**92**	197.6	73.3	**164**	327.2	117.8	**244**	471.2	248.9	**480**	896.0
-10.6	**13**	55.4	11.7	**53**	127.4	33.9	**93**	199.4	74.4	**166**	330.8	118.3	**245**	473.0	254.4	**490**	914.0
-10.0	**14**	57.2	12.2	**54**	129.2	34.4	**94**	201.2	75.6	**168**	334.4	121.1	**250**	482.0	260.0	**500**	932.0
-9.4	**15**	59.0	12.8	**55**	131.0	35.0	**95**	203.0	76.7	**170**	338.0	123.9	**255**	491.0	265.6	**510**	950.0
-8.9	**16**	60.8	13.3	**56**	132.8	35.6	**96**	204.8	77.8	**172**	341.6	126.7	**260**	500.0	271.1	**520**	968.0
-8.3	**17**	62.6	13.9	**57**	134.6	36.1	**97**	206.6	78.9	**174**	345.2	129.4	**265**	509.0	276.7	**530**	986.0
-7.8	**18**	64.4	14.4	**58**	136.4	36.7	**98**	208.4	80.0	**176**	348.8	132.2	**270**	518.0	282.3	**540**	1004.0
-7.2	**19**	66.2	15.0	**59**	138.2	37.2	**99**	210.2	81.1	**178**	352.4	135.0	**275**	527.0	287.8	**550**	1022.0

Table 2-11. Conversion of Inches to Millimeter

Inches	Milli-meters	Inches	Milli-meters	Inches	Milli-meters
0.001	0.025	0.290	7.37	0.660	16.76
0.002	0.051	0.300	7.62	0.670	17.02
0.003	0.076	0.310	7.87	0.680	17.27
0.004	0.102	0.320	8.13	0.690	17.53
0.005	0.127	0.330	8.38	0.700	17.78
0.006	0.152	0.340	8.64	0.710	18.03
0.007	0.178	0.350	8.89	0.720	18.29
0.008	0.203	0.360	9.14	0.730	18.54
0.009	0.229	0.370	9.40	0.740	18.80
0.010	0.254	0.380	9.65	0.750	19.05
0.020	0.508	0.390	9.91	0.760	19.30
0.030	0.762	0.400	10.16	0.770	19.56
0.040	1.016	0.410	10.41	0.780	19.81
0.050	1.270	0.420	10.67	0.790	20.07
0.060	1.524	0.430	10.29	0.800	20.32
0.070	1.778	0.440	11.18	0.810	20.57
0.080	2.032	0.450	11.43	0.820	20.83
0.090	2.286	0.460	11.68	0.830	21.08
0.100	2.540	0.470	11.94	0.840	21.34
0.110	2.794	0.480	12.19	0.850	21.59
0.120	3.048	0.490	12.45	0.860	21.84
0.130	3.302	0.500	12.70	0.870	22.10
0.140	3.56	0.510	12.95	0.880	22.35
0.150	3.81	0.520	13.21	0.890	22.61
0.160	4.06	0.530	13.46	0.900	22.86
0.170	4.32	0.540	13.72	0.910	23.11
0.180	4.57	0.550	13.97	0.920	23.37
0.190	4.83	0.560	14.22	0.930	23.62
0.200	5.08	0.570	14.48	0.940	23.88
0.210	5.33	0.580	14.73	0.950	24.13
0.220	5.59	0.590	14.99	0.960	24.38
0.230	5.84	0.600	15.24	0.970	24.64
0.240	6.10	0.610	15.49	0.980	24.89
0.250	6.35	0.620	15.75	0.990	25.15
0.260	6.60	0.630	16.00	1.000	25.40
0.270	6.86	0.640	16.26	. . . . .	. . . . .
0.280	7.11	0.650	16.51	. . . . .	. . . . .

Table 2-12. Conversion of Millimeter to Inches

Milli-meters	Inches	Milli-meters	Inches	Milli-meters	Inches
0.01	0.0004	0.35	0.0138	0.68	0.0268
0.02	0.0008	0.36	0.0142	0.69	0.0272
0.03	0.0012	0.37	0.0146	0.70	0.0276
0.04	0.0016	0.38	0.0150	0.71	0.0280
0.05	0.0020	0.39	0.0154	0.72	0.0283
0.06	0.0024	0.40	0.0157	0.73	0.0287
0.07	0.0028	0.41	0.0161	0.74	0.0291
0.08	0.0031	0.42	0.0165	0.75	0.0295
0.09	0.0035	0.43	0.0169	0.76	0.0299
0.10	0.0039	0.44	0.0173	0.77	0.0303
0.11	0.0043	0.45	0.0177	0.78	0.0307
0.12	0.0047	0.46	0.0181	0.79	0.0311
0.13	0.0051	0.47	0.0185	0.80	0.0315
0.14	0.0055	0.48	0.0189	0.81	0.0319
0.15	0.0059	0.49	0.0193	0.82	0.0323
0.16	0.0063	0.50	0.0197	0.83	0.0327
0.17	0.0067	0.51	0.0201	0.84	0.0331
0.18	0.0071	0.52	0.0205	0.85	0.0335
0.19	0.0075	0.53	0.0209	0.86	0.0339
0.20	0.0079	0.54	0.0213	0.87	0.0343
0.21	0.0083	0.55	0.0217	0.88	0.0346
0.22	0.0087	0.56	0.0220	0.89	0.0350
0.23	0.0091	0.57	0.0224	0.90	0.0354
0.24	0.0094	0.58	0.0228	0.91	0.0358
0.25	0.0098	0.59	0.0232	0.92	0.0362
0.26	0.0102	0.60	0.0236	0.93	0.0366
0.27	0.0106	0.61	0.0240	0.94	0.0370
0.28	0.0110	0.62	0.0244	0.95	0.0374
0.29	0.0114	0.63	0.0248	0.96	0.0378
0.30	0.0118	0.64	0.0252	0.97	0.0382
0.31	0.0122	0.65	0.0256	0.98	0.0386
0.32	0.0126	0.66	0.0260	0.99	0.0390
0.33	0.0130	0.67	0.0264	1.00	0.0394
0.34	0.0134	. . . . .	. . . . .	. . . . .	. . . . .

Table 2-13. Conversion of Fractional Inches to Decimals and Millimeter

Inches	Decimal Inch	Millimeter	Inches	Decimal Inch	Millimeter
1/64	0.015625	0.396785	33/64	0.515625	13.096875
1/32	0.03125	0.79375	17/32	0.53125	13.49375
3/64	0.046875	1.190625	35/64	0.546875	13.890625
1/16	0.0625	1.5875	9/16	0.5625	14.2875
5/64	0.078125	1.984375	37/64	0.578125	14.684375
3/32	0.093125	2.38125	19/32	0.59375	15.08125
7/64	0.109375	2.778125	39/64	0.609375	15.478125
1/8	0.125	3.175	5/8	0.625	15.875
9/64	0.140625	3.571875	41/64	0.640625	16.271875
5/32	0.15625	3.96875	21/32	0.65625	16.66875
11/64	0.171875	4.365625	43/64	0.671875	17.065625
3/16	0.1875	4.7625	11/16	0.6875	17.4625
13/64	0.203125	5.159375	45/64	0.703125	17.859375
7/32	0.21875	5.55625	23/32	0.71875	18.25625
15/64	0.234375	5.953125	47/64	0.734375	18.653125
1/4	0.25	6.35001	3/4	0.75	19.05
17/64	0.265625	6.746875	49/64	0.765625	19.446875
9/32	0.28125	7.14375	25/32	0.78125	19.84375
19/64	0.296875	7.540625	51/64	0.796875	20.240625
5/16	0.3125	7.9375	13/16	0.8125	20.6375
21/64	0.328125	8.334375	53/64	0.828125	21.034375
11/32	0.34375	8.73125	27/32	0.84375	21.43125
23/64	0.359375	9.128125	55/64	0.859375	21.828125
3/8	0.375	9.525	7/8	0.875	22.225
25/64	0.390625	9.921875	57/64	0.890625	22.621875
13/32	0.40625	10.31875	29/32	0.90625	23.01875
27/64	0.421875	10.715625	59/64	0.921875	23.415625
7/16	0.4375	11.1125	15/16	0.9375	23.8125
29/64	0.453125	11.509375	61/64	0.953125	24.209375
15/32	0.46875	11.90625	31/32	0.96875	24.60625
31/64	0.484375	12.303125	63/64	0.984375	25.003125
1/2	0.50	12.7	1	1.00000	25.4

Table 2-14. Conversion of U.S. Measure used in Servicing and Maintenance

Multiply	By	To Obtain
Pints	0.437	Liters
Quarts	0.946	Liters
Liters	1000	Cubic Centimeters (CC)
Ounces	29.57	CC
Gallons	3.785	Liters
Gallons	0.833	Imperial Gallon
Pounds / sq in.	703.1	Kgs. / sq Meter
Inch-pounds	1152	Gram - Centimeters
Foot-pounds	0.1383	Kilogram - Meters

Table 2-15. Related Publications and Directives

NOTE: Publication numbers marked with an asterisk should be maintained and treated as part of the primary information file for the helicopter.

Component and Manufacture, or Source	Publication Title	Publication or Directive
General Information		
Superintendent of Documents U.S. Government Printing Office Division of Public Documents Washington D.C. 20402	Acceptable Methods, Techniques, and Practices-Aircraft Inspection and Repair (GPO Catalog No. TD 4-28/2:972)	FAA AC No. 43.13-1A* AC No. 43-13-2B*
	Advisory Circular - Corrosion Control for Aircraft	FAA AC No. 43-4*
Aerospace Industries Association of America, Inc. 1725 De Sales Street, N.W. Washington 6, D.C.	National Aerospace Standard (Title as applicable)	NAS No. as applicable
MDHI Publications		
MD Helicopters, Inc. Commercial Technical Publications 4555 E. McDowell Rd Mesa, Arizona 85215-9734	Illustrated Parts Catalog, MDHI Helicopter, Model 369HS, 369HM, 369HE	369H Series IPC*
	Corrosion Control Manual	CSP-A-3*
Battery		
Marathon Battery Company Cold Spring, New York 10516 Phone: (817) 776-0650 (formerly Sonotone)	Marathon Battery Instruction Manual	BA-89 (Rev. 2-71)
Gulton Industries Inc. Metuchen, N.J. 08840	Gulton Instructions for Use and Care of Sintered Plate Nickel Cadmium Storage Batteries	ABD1100
Engine		
Allison Engine Company, Inc. Parts Distribution Center 7100 Riverport Drive Louisville, KY 40258 USA	Operation and Maintenance Manual, Turboshaft Engine Models 250-C18, -C18A, -C18B, C18C	5W2*
	Overhaul Manual, Turboshaft Engine Models 250-C18,-C18A, -C18B, C18C	5W3*
	Illustrated Parts Catalog, Turboshaft Engine Models 250-C18,-C18A, -C18B, C18C	5W4*
	Operation and Maintenance Manual, Turboshaft Engine Model 250-C20	10W2*
	Overhaul Manual, Turboshaft Engine Model 250-C20	10W3*
	Illustrated Parts Catalog, Turboshaft Engine Model 250-C20	10W4*

Table 2-15. Related Publications and Directives (Cont.)

Component and Manufacture, or Source	Publication Title	Publication or Directive
Starter-Generator		
Aircraft Parts Corporation 160 Finn Court Farmingdale, NY 11735 Phone: (516) 249-3053 Datafax: (516) 249-2577	Brush Seating - APC Brushes in High Speed Starter/Generators: MDHI Part No. 369A4550	SB150SG105
Lucas Aerospace (formerly Lear Siegler, Inc.) 17600 Broadway Ave. Maple Heights, Ohio 44137 Phone: (216) 662-1000 Datafax: (216) 663-5336	Overhaul Instructions with Parts Breakdown, Models 23032-010, 23032-011, 23032-020, 23032-022	File No. 23206
Avionics Equipment		
Vhf COMM Receiver-Transmitter Bendix Avionics Division Fort Lauderdale, Florida	Maintenance Manual, CNS-220 VHF Comm-Nav System, RT-221 Receiver-T ransmitter	RT-221
VHF Navigation Receiver Bendix Avionics Division	Maintenance Manual, CNS-220 VHF Comm-Nav System, RN-222 Receiver	RN-222
VOR/LOC Converter Bendix Avionics Division	Maintenance Manual, CNS-220 VHF Comm-Nav System, IN-225 VOR/LOC Converter	IN-225
Distance Measuring Equipment National Aeronautical Corp., Fort Washington, Pennsylvania	Maintenance Manual for CN-142A Narco DME Model UDI-4 Interrogator Distance Measuring Equipment	UDI-4
Automatic Directional Finder Bendix Radio Division, Avionics Products, Baltimore, MD 21204	Type ADF-73 Automatic Direction Finder System Maintenance Manual	TM34-53-0 IB1073-1
	Automatic Direction Finder System Type DFA-73A-1 ADF Receiver Overhaul Manual	TM34-53-1 IB1073A-1
	Automatic Direction Finder System ADF 73 System Access Overhaul Manual	TM34-53-3 IB1073C-1
ATC Transponder System Bendix Avionics Division	Maintenance Manual, TPR-640 ATC Transponder System	Manual Number I,.B. 2640A
	Installation Manual, TPR-610 ATC Transponder System	I.B. 2610A
Vhf COMM Transceiver RCA Aviation Eqpt. Dept. 11819 W. Olympic Blvd. Los Angeles, CA 90064	AVC-1 10 VHF Communication Transceiver Instruction Manual	IB8029004
Vhf NAV Receiver RCA Aviation Equipment Dept.	AVN-210 Series Integrated Navigation Systems	IB96460

Table 2-15. Related Publications and Directives (Cont.)

Component and Manufacture, or Source	Publication Title	Publication or Directive
University Sound of LTV Ling Altec, Inc. Oklahoma City, Okla.	Operators Manual, SA-250 & SA-500 High Power Sound and Siren	
	Operators Manual, Model 500 Super High Power Solid-State Amplifier and Model RMC-1 Remote Control	
Automatic Direction Finder King Radio Corp. 400 North Rogers Road Olathe, Kansas	KR 85 Automatic Direction Finder Installation Manual	KPN 006-0043-00
	KR 85 Automatic Direction Finder Maintenance Manual	
Automatic Direction Finder King Radio Corp	Maintenance Manual for King KR80 Automatic Direction Finder	KR80
Nav/Comm Transceiver and Communications Transceiver King Radio Corp.	Maintenance/Overhaul Manual KX 170A/KX 175 Nav/Comm Transceiver, KY 195 Communications Transceiver	006-5053-00
Transponder King Radio Corp.	Installation Manual, KT 76/78 Transponder	006-0067-1
	Maintenance/Overhaul Manual, KT 76/78 Transponder	006-5085-02
Sunair Electronics, Inc. 3101 S. W. Third Avenue Fort Lauderdale, Fla. 33315	Maintenance Manual SSB Communications Equipment ASB-125, ASB-60	99655
Spilsbury & Tindall, Ltd. 120 E. Cordova Street Vancouver 4, B. C. Canada	Instruction Manual ”Stringer” Model AC-31 Mobile Antenna System	65-018
Hoist Equipment		
Hoist Winch Assembly Breeze Corporations, Inc., 700 Liberty Avenue Union, New Jersey 07083	BL-16600 Series 300 Lb Capacity Hoist Operating Instructions - Use and Maintenance of Aircraft Hoist Cable	HB-136
Maintenance and Test Equipment		
Tail Rotor Balancer Chadwick-Helmuth Co., Inc. 111 E. Railroad Avenue Monrovia, Ca. 91016	Operation and Maintenance Manual for Model 170 Tail Rotor Balancer	
Rotor Blade Tracker Chadwick-Helmuth Co., Inc.	Operation and Maintenance Manual for Point Source Strobex Rotor Blade Tracker Model 135M- ( )	
Model 177MÄ6 Balancer and Model 135MÄlOB Strobex Blade Tracker Chadwick-Helmuth Co., Inc.	Chadwick-Helmuth Operation and Service Instruction Handbook for Helicopter Main and Tail Rotor Track and Balance	
Landing Gear Equipment		
Helicopter Float Assemblies Garrett-Air Cruiser Company P. O. Box 180 Belmar, New Jersey	Overhaul Manual With Illustrated Parts List Helicopter Float Assemblies Utility Floats, 21D24368-1/-2 Emergency Floats, D24484-5/-6	

Determination of Excessive Wear or Damage

NOTE: Wear tolerances are provided in this manual whenever practical. In addition, excessive wear or damage can usually be determined by visual inspection as shown in the following table.

	QUESTIONABLE WEAR / DAMAGE CONDITIONS	* YES √	NO √
1	Is the condition dangerous for flight		
2	Is the condition on a highly stressed part of the helicopter		
3	Could the condition contribute to failure of another part		
4	Will the condition continue to worsen at the same rate (or faster)		
5	Does the condition affect the quality of performance, function or apperance		

*Any check mark (√) in the YES column indicates that the part is worn or damaged excessively and should be replaced with a new or serviceable unit.

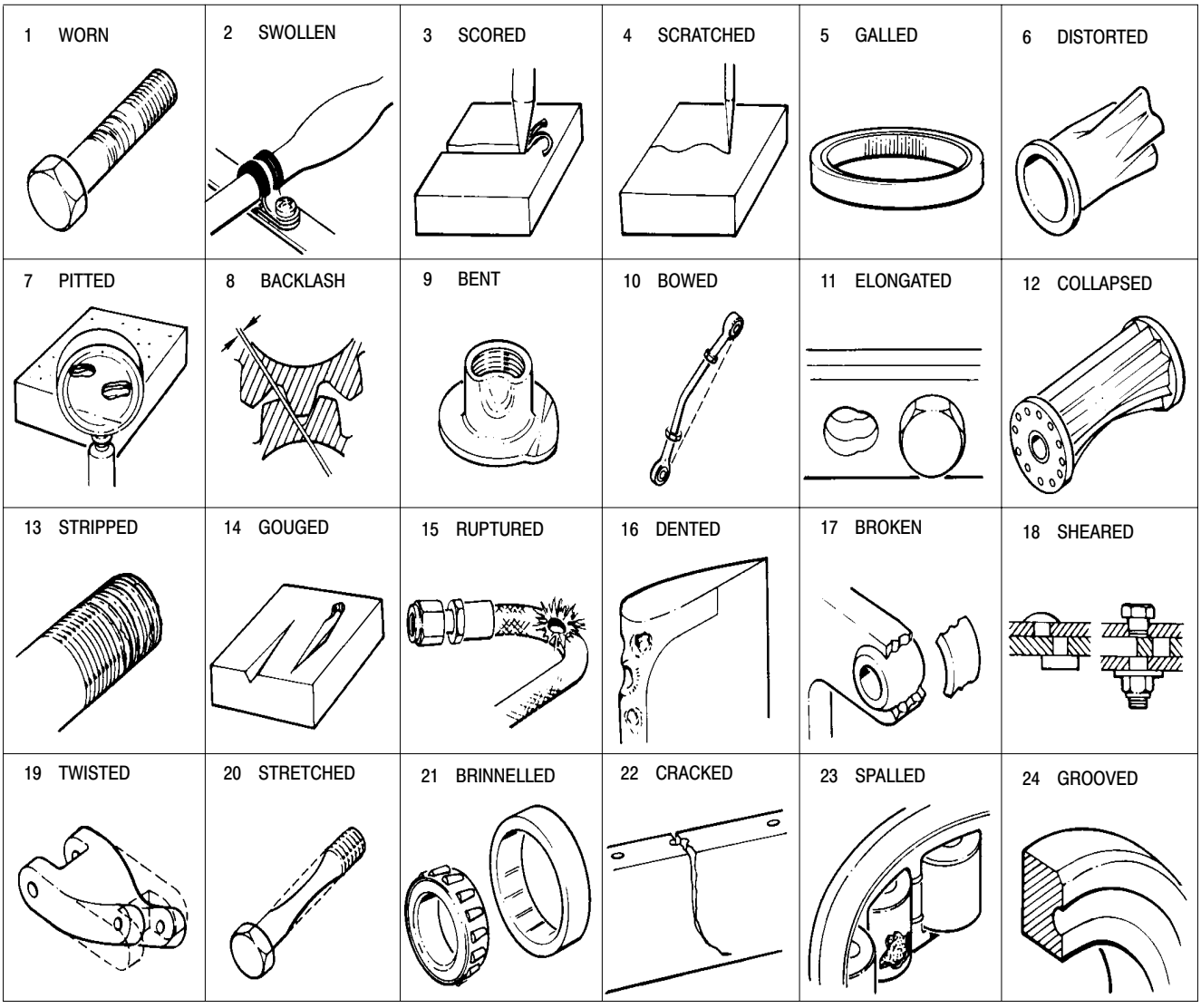


Figure 2-10. Technical Definitions

Table 2-16. Technical Definitions

Technical Terms	Example No. (Figure 2-10)	Definition
Abrasion	-	An area of roughened scratches or marks; usually caused by foreign matter between moving parts or surfaces.
Arced	-	Visible effects (burn spots, fused metal) of an undesired electrical discharge between two electrical connections.
Axial play	-	The back and forth movement of a part along the line (shaft, tube or bolt) about which it rotates; usually a bearing.
Backlash	8	The lost motion between two mating gear teeth; the amount the first has to move owing to distance between tooth contact surfaces.
Bent	9	Sharp deviation from original line or plane; usually caused by lateral force.
Binding	-	Restricted movement such as tightened or sticking condition resulting from misalignment or jamming.
Blend	-	To form or smooth metal or fiberglass so there is no sharp change or line from one area to another.
Blister	-	An enclosed raised spot or bulge, usually with a void underneath.
Bowed	10	Curved or gradual deviation from original line of plane; usually caused by lateral force.
Brinnelled	21	Circular surface indentions on bearing races; usually caused by repeated shock loading of the bearing: i. e., ball or roller indention.
Broken	17	Separated by force into two or more pieces.
Burning	-	Surface damage due to excessive heat; usually caused by improper fit, defective lubrication, overtemperature operation.
Burrs	-	A sharp projection or rough edge remaining after machining or rework.
Chafed	-	Frictional wear damage; usually caused by two rubbing together with limited motion.
Checked	-	Surface cracks.
Chipped	-	A breaking away of the edge, corner or surface of material; usually caused by heavy impact (not flaking).
Chord	-	An imaginary straight line joining the leading and trailing edges of an airfoil: i. e., main and tail rotor blades, stabilize.
Circuit - grounded	-	Undesired current path to ground (common).
Circuit - open	-	Incomplete electrical circuit due to separation at or between electrical connection points.
Circuit - shorted	-	Undesired current path between leads or circuits that normally are at a different potential.
Clogging	-	Blockage of fluid or air passage or line; usually by foreign material.
Collapsed	12	Inward deformation of the original contour of a part; usually due to high pressure differential.
Concentricity	-	Perfect roundness about a common center. The appearance of a part and its readiness to function.
Condition	-	The appearance of a part and its readiness to function.

Table 2-16. Technical Definitions (Cont.)

Technical Terms	Example No. (Figure 2-10)	Definition
Contamination	-	The introduction of undesirable elements, usually into a fluid.
Corrosion	-	Pitting, or a surface breakdown of a material due to chemical or electro-chemical attack by atmosphere, moisture or other agents. (Sometimes called rust on steel surfaces.)
Cracked	22	Visible (not requiring special fluorescent or magnetic penetrants) partial separation of material which may progress to a complete break.
Crossed	-	Damage to parts (crossed threads) or parts made inoperative (crossed wires) from improper assembly.
Crushed	-	Destruction of a part or structure by a squeezing force. Changes original shape.
Defect	-	Imperfection; anything that will not allow a part to function as intended or that might cause failure.
Deflection	-	The turning away from original shape or direction by an undesired force.
Delamination	-	Separation into layers; usually fiberglass.
Dented	16	A surface indention with rounded bottom usually caused by impact of a foreign object. Material is displaced, seldom separated.
Depression	-	See dent.
Deterioration	-	To grow worse; quality less than new or original.
Dimension	-	Under blueprint dimension or other dimensions published in an authoritative publication (not caused by wear).
Discoloration	-	A color that is not normal to a part; usually caused by heat.
Distorted	6	Extensive deformation of the original shape of apart; usually due to structural stresses, excessive localized heating or any combination of these.
Dye-penetrant inspection	-	A portable method of detecting small cracks in metal too small to be seen with the naked eye. The questionable area is thoroughly cleaned and dye is then applied to the area. After penetration time the excess dye is removed and developer is applied. After a drying period, a mark will appear in the developer if a crack is present.
Eccentric	-	Part(s) wherein the intended common center is displaced significantly.
Elongated	11	A hole (bolt or rivet) that is not round; usually due to loose fastener or improper drilling.
Erosion	-	Carry away of material by flow of fluids or gases, accelerated by heat or grit.
Excessive	-	Greater than the usual or specified amount; more than normal.
Faulty	-	See defect.
Ferrous	-	Metal having a high iron content such as steel.
Finite life	-	A definite time limit for part serviceability; established by the manufacturer and usually in accumulated hours of operation.

Table 2-16. Technical Definitions (Cont.)

Technical Terms	Example No. (Figure 2-10)	Definition
Fluctuation	-	Moving or swinging back-and-forth: often seen as an unstable instrument indication.
Fluorescent-penetrant inspection	-	Method of inspecting components used for detecting cracks, flaws, or defects in nonferrous metal which are too small or in such a position that they cannot be detected with the naked eye. This method uses the principle of submerging the component in a penetrating dye and placing it under ultra-violet light.
Foreign particle	-	A piece of material not normally found in or around a part or location.
Fouling	-	Clogging or choking with a foreign substance; usually found in oil.
Frayed	-	Worn into shreds by rubbing action.
Freedom of motion	-	Operating as intended without binding or excessive friction.
Friction	-	Rubbing together of two parts, resisting motion; usually causes excessive wear.
Fused	-	Joining together of two materials; usually caused by heat, friction or current flow.
Galled	5	A transfer of metal from one surface to another in an advanced case of fretting corrosion or pitting.
Gap	-	An opening, break, space or separation.
Gouged	14	Scooping out of material; usually caused by a foreign object.
Grooved	24	Smooth, rounded furrow or furrows of wear; usually wider than scoring, with rounded corners and smooth on the groove bottom.
Hot-Spot	-	Subjected to excessive temperature; usually evidenced by change in color and appearance of part.
Impact	-	The forceful striking or contact of one thing against another.
Imperfection	-	See defect.
Inclusion	-	A particle of foreign matter in the metal; usually associated with magnetic particle inspection.
Indications	-	Cracks, inclusions, fractures, etc., not visible without fluorescent or magnetic penetrant.
Inoperative	-	Not functioning.
Intermittent	-	A coming and going at various times, not all the time.
Internal	-	Inside, within the surface or structure.
Kink	-	A short tight twist or curl caused by doubling or winding of something upon itself.
Leakage	-	Escaping fluid or air; usually caused by a crack, hole or worn seal.
Longitudinal	-	The length or lengthwise dimension; usually the longest area.

Table 2-16. Technical Definitions (Cont.)

Technical Terms	Example No. (Figure 2-10)	Definition
Magnetic-particle inspection	-	The method used to detect cracks, flaws or defects in ferrous metal which are too small or in such a position that they cannot be seen with the naked eye. Two distinct magnetic fields are established around a flaw in ferrous metal. By submerging the specimen into a solution containing iron filings and exposing it to a magnetic field, the iron filings, attached to the ferrous specimen, form a pattern about the flaw.
Malfunction	-	Not operating as intended.
Misalignment	-	Not in correct relative position.
Mismatched	-	Improper association of two or more parts.
Mis-positioned	-	Improper installation of a part resulting in damage to the installed part or to associated parts.
Moisture	-	Condensed liquid; usually a small quantity of water.
Nicked	-	A sharp surface indentation caused by impact of a foreign object. Material is displaced, seldom separated.
Obstruction	-	A condition of being clogged or blocked; in the way of something.
Out-of-round penetration	-	Diameters of part not constant.
Penetration	-	The amount that an object has entered a material by overcoming resistance.
Peripheral	-	The outer surface or edge of a body.
Pitted	7	Small irregular shaped hollows in the surface; usually caused by corrosion, chipping or heavy electrical discharge.
Play	-	Movement of one part in relation to another: free motion. (Limited play between parts is often required.)
Plugged	-	Pipe, hoses, tubing, channeling, internal passage, etc., which are totally or partially blocked.
Preload	-	The exact clamping force applied to bearing races or mating parts to eliminate the possibility of play during operation; usually established in bearings by shimming and measuring rotational drag torque.
Propagation	-	To grow, spread out; usually referring to cracks.
Puncture	-	A hole through material; usually caused by complete penetration of a foreign object.
Radial play	-	The perpendicular movement of a part outward (at right angles) from the line (shaft, tube or bolt) about which it rotates; usually a bearing.
Radius	-	The distance from the center of a circle to the outside edge. Often used to discuss a curve in material.
Resistance - high	-	High electrical resistance in an electrical circuit, causing improper component or circuit operation.
Resistance - low	-	Low electrical resistance in an electrical circuit, causing improper component or circuit operation.

Table 2-16. Technical Definitions (Cont.)

Technical Terms	Example No. (Figure 2-10)	Definition
Restricted	-	Blocked or limited; usually refers to limited flow in hoses or tubing.
Rough	-	Usually applies to operation as opposed to surface finish; i. e., a condition of bearings where during the spin test the rotation is rough.
Rubbed	--	To move with pressure or friction against another part.
Ruptured	-	Extensive breaking apart of material; usually caused by high stresses, differential pressure, locally applied force or any combination of these.
Rust	-	See Corrosion.
Scored	3	Deep scratch or scratches made during part operation by sharp edges of foreign particles.
Scratched	4	Light narrow, shallow mark or marks caused by movement of a sharp object or particle across a surface.
Security	-	Correctly installed or fastened so as not to loosen.
Seized	-	Parts bound together because of expansion or contraction due to high or low temperature; foreign object jammed in mechanism.
Separation	-	A space or gap caused by two parts moving away from each other.
Sheared	18	Dividing a body by cutting action; i.e., division of a body so as to cause its parts to slide relative to each other in a direction parallel to their plane of contact.
Spalled	23	Sharply roughened area characterized by progressive chipping-away of surface material (Not to be confused with flaking). Usual causes are surface cracks, inclusions or any similar surface injury causing a progressive breaking away of the surface under load.
Snug	-	A close fit between two parts.
Spanline	-	The maximum distance from tip to root, as of main rotor blade.
Springback	-	The partial return motion of a control handle or lever back from its end stop after release; usually ensures complete actuation of unit being controlled. Sometimes called cushion.
Stress	-	Force running through an object or material, caused externally; usually tension or shearing.
Stretched	20	Elongation of a part as a result of exposure to operating conditions (tension type stress) or overtorquing.
Stripped	13	A condition usually associated with threads or insulation. Involves removal of material (threads) by force.
Swollen	2	A bulge; usually found in hoses and plastic tubing. A puffed-up or expanded area caused by internal pressure.
TIR	-	Total indicator reading. The result of checking (usually with a dial indicator) for an out-of-round condition; usually of a shaft surface and/or shaft rotational axis.
Torn	-	Separation by pulling apart.

Table 2-16. Technical Definitions (Cont.)

Technical Terms	Example No. (Figure 2-10)	Definition
Torsional (windup)	-	A twisting action; usually caused by holding one end of a part while turning the other.
Torque	-	Rotational force; usually the amount of measurable force required to rotate a shaft or bearing.
Transverse	-	Extended or lying crosswise; usually cracks or scratches across material.
Twisted	19	A change in original shape of a part by a turning motion. Sometimes called distorted.
Void	-	An empty space, opening, cavity or gap in metal or plastics.
Worn	1	Material or part consumed as a result of exposure to operation or usage.

Section

3

Fuselage

TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 3 Fuselage		**3-1**
1.	Fuselage Assembly	3–1
2.	Fuselage Sheet Metal Repair	3–1
A.	Stressed Sheet Metal Panels	3–1
B.	Non–Stressed Sheet Metal Panels	3–1
Figure 3–1.	Major Sections of Fuselage	3–2
3.	Mast Support Structure	3–3
A.	Mast Support Structure Inspection	3–3
4.	Main Rotor Mast	3–3
A.	Main Rotor Mast Removal	3–3
Figure 3–2.	Main Rotor Mast and Support Structure	3–4
Figure 3–3.	Main Rotor Mast Inspection and Repair Criteria	3–5
B.	Main Rotor Mast Installation	3–6
C.	Main Rotor Mast Inspection and Repair	3–6
5.	Fuselage Structure	3–7
A.	Center Beam	3–7
B.	Sta. 78.50 Canted Frame	3–7
C.	Sta. 124.00 Canted Frame and Lower Section Frame	3–7
D.	Pilot's Compartment Floor	3–7
E.	Instrument Panel Support Structure	3–7
F.	Pilot's Seat Support Structure	3–7
G.	Cargo Compartment Floor	3–7
H.	Cargo Floor Fittings	3–8
I.	Fuel Tank Support Skins	3–8
J.	Fuel Tank Support Skin Inspection	3–8
K.	Fuel Tank Support Skin Repair	3–8
6.	Firewalls	3–8
A.	Firewall Inspection	3–8
B.	Upper Firewall Replacement	3–8
Figure 3–4.	Major Bulkheads and Structural Members	3–8A
C.	Upper Firewall Patch Silver Brazing	3–9
Figure 3–5.	Firewall Installation	3–10
7.	Fuselage Fittings	3–11
A.	Fuselage Fitting Repair	3–11
8.	Aft Section Strut	3–11
A.	Aft Section Strut Repair	3–11
9.	Landing Gear Fitting Swivel Bearing Replacement	3–11

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
10.	Optional Equipment Structural Hard Points	3–11
11.	Engine Air Inlet Fairing	3–11
12.	Engine Air Inlet (Plenum Chamber)	3–12
A.	Plenum Chamber Inspection	3–12
B.	Plenum Chamber Hole Sealing	3–12
13.	Aft Fuselage Skin Cracks Inspection/Repair (Sta. 146.62)	3–12
14.	Underfloor Compartments	3–13
A.	Underfloor Compartment Inspection	3–13
15.	Firewall and Sta. 124.00 Insulation	3–13
A.	Insulator Padding and Insulation Tape Inspection	3–13
B.	Insulator Padding Replacement	3–13
C.	Oil Cooler/Tank Insulation Tape Replacement	3–13
Figure 3–6.	Insulation Padding	3–14
Figure 3–7.	Oil Cooler/Tank Compartment Sealing	3–15
16.	Engine Access Doors	3–16
A.	Engine Access Door Removal	3–16
B.	Engine Access Door Inspection	3–16
C.	Engine Access Door Repair	3–16
Figure 3–8.	Engine Access Doors (Sheet 1 of 2)	3–17
D.	Engine Access Door Fit Adjustment	3–19
17.	Aft Section Windows	3–19
A.	Aft Section Window Repair	3–19
18.	Canopy and Windshield	3–19
A.	Canopy Panel Inspection	3–19
Figure 3–9.	Canopy and Window Installation	3–20
B.	Canopy Panel Repair	3–20
C.	Canopy Frame Replacement	3–20
19.	Pilot and Cargo Doors	3–20
A.	Pilot and Cargo Door Removal	3–21
B.	Pilot and Cargo Door Auto–Latching Operational Check	3–21
C.	Pilot and Cargo Door Manual–Latching Operational Check	3–21
D.	Pilot and Cargo Door Hinge Repair	3–21
E.	Pilot and Cargo Door Window Repair	3–22
Figure 3–10.	Pilot's Door, Auto–Latching (Sheet 1 of 2)	3–23
Figure 3–11.	Pilot's Door, Manual Latching	3–25
Figure 3–12.	Cargo Door, Auto–Latching (Sheet 1 of 2)	3–26
Figure 3–13.	Cargo Door, Manual Latching (Sheet 1 of 2)	3–28

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
F.	Geon Strip Repair	3–30
G.	Window Snapvent Replacement	3–30
20.	Door Latching Mechanism	3–30
A.	Door Latching Mechanism Inspection and Repair	3–31
B.	Pilot and Cargo Door Automatic Latch Replacement	3–31
C.	Pilot and Cargo Door Automatic Latch Adjustment	3–32
Figure 3–14.	Latch Engagement for Auto–Latching Door Handle Positions	3–33
D.	Pilot and Cargo Door Manual Latch Adjustment	3–34
E.	Pilot and Cargo Door Auto–Latching Handle Replacement	3–35
21.	369H90085 Litter Door Installation Inspection	3–36
22.	Pilot and Cargo Door Seal Compression Check	3–36
A.	Pilot and Cargo Door Seal Replacement	3–36
Figure 3–15.	Door Seal Installation, Current Type	3–37
B.	Partially Separated Pilot and Cargo Door Seal Repair	3–38
C.	Pilot and Cargo Door Frame Anti–Chafing Tape Repair	3–38
23.	Improved Door Seal Installation	3–38
Figure 3–16.	Improved Door Seal Installation	3–39

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page

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SECTION 3
FUSELAGE

1. Fuselage Assembly

(1). Forward Section

The fuselage forward section includes upper-, center-, and lower-canopy windshield assemblies, door frames, and a canopy panel containing an air intake duct and provisions for a landing/hovering light.

(2). Lower Section

The fuselage lower section includes the pilot's compartment floor, cargo compartment floor, underfloor stowage compartment and battery area, floor and seat support bulkheads and seat support bulkheads and associated structure, the center beam assembly, landing gear fittings, and the fuel tank support structure.

(3). Aft Section

The fuselage aft section includes the main rotor mast support structure, cargo door frames, engine compartment, engine air inlet (plenum chamber) installation, engine inlet aft fairing, firewall installation, and the boom fairing.

2. Fuselage Sheet Metal Repair

Perform repair of the structure according to applicable instructions in CSP-H-6. Refer to the following paragraphs for classification and definition of the types of negligible damage, and for guidelines defining the extent of damage requiring repair or replacement.

A. Stressed Sheet Metal Panels

Stressed sheet metal panels consist primarily of the helicopter fuselage skins and bulkhead webs. The most highly stressed skin sections are those that form the cylindrically tapered boom assembly.

(1). Negligible Damage

No damage can be considered negligible. All repairable damage shall be repaired upon detection. Cracks, tears or punctures in stressed sheet metal panels that do not exceed 0.20 inch (5.08 mm) diameter and can be removed by drilling out with a 1/4 inch (6.35 mm) or smaller diameter drill do not require structural doublers.

(2). Repair or Replacement

Cracks, tears or punctures in stressed sheet metal panels exceeding 0.20 inch (5.08 mm) diameter are to be repaired.

B. Non-Stressed Sheet Metal Panels

Non-stressed sheet metal members consist primarily of hinged covers and doors except the fuel cell access and controls access doors which are stressed (Ref. Stressed Sheet Metal Panels).

(1). Negligible Damage

Small dents, scratches, nicks, and light corrosion deposits are considered negligible damage. Cracks that do not exceed 0.250 inch (6.35 mm) in length, are less than one-fourth the width of the damaged component, and are removed at least one-inch from the end of the damaged component or an attachment point, may also be con—sidered negligible damage.

(2). Repair or Replacement

Repair or replacement of non-stressed panels shall be at the discretion of the owner. Refer to CSP-H-6.

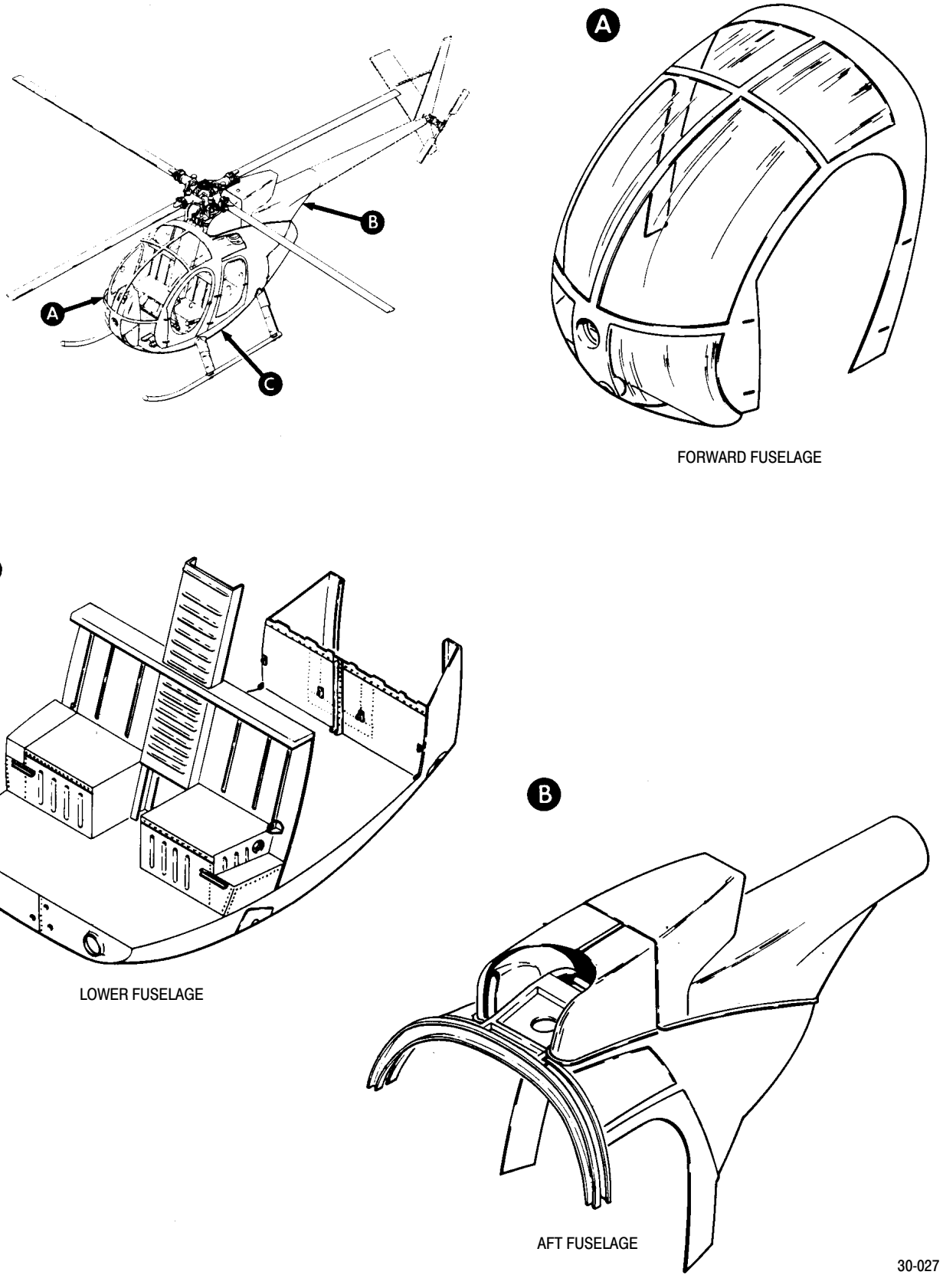


Figure 3-1. Major Sections of Fuselage

3. Mast Support Structure

(Ref. Figure 3-2) The mast support structure consists of two mast support fittings, stiffener angles, a panel riveted to the upper-rear surface of the mast support fittings, a pan, a doubler riveted to the lower forward surfaces of the mast support fittings, and two channels. Two bolt holes in each mast support fitting provide the four attach points for mounting the main rotor mast support base. Three additional holes through the forward end of the left-hand mast support fitting provide attach points for mounting the tail rotor control rod bellcrank support bracket. The forward end of the mast support fittings are riveted to the upper ends of two channels on the rear surface of Sta. 78.50 canted bulkhead. The aft ends of the mast support fittings are riveted to the upper ends of two channels on the forward surface of Sta. 124.00 canted bulkhead.

A. Mast Support Structure Inspection

CAUTION Any time work is being performed near the engine air inlet, use care to prevent entry of foreign objects. Tape covers of cardboard or other suitable material in place over the engine inlet screen and oil cooler air inlets. Do not remove covers until work is completed and debris is thoroughly cleaned out of the area. After removing covers, verify that the area around base of mast, air inlet, and entire plenum chamber are free of foreign material.

(1). Remove left and right forward sections of air inlet forward fairing.

(2). Remove main transmission cover and main gearbox access cover.

(3). Detach controls tunnel cover from structure. Slide cover up on control rods and secure it out of the way. and slide out of way.

(4). Using a bright light and a 5-power magnifying glass, carefully inspect the following areas for evidence of cracks.

(a). Inspect the side channels and forward and aft webs of the controls tunnel, from the mast support fitting down to the top of the pilot's seat-back (canted bulkhead waterline 45.36).

(b). Inspect visible areas of mast support fitting, mast base and mast tube, with particular attention to base attachment areas and shaded areas.

(c). Inspect both side of channels on aft canted bulkhead from mast support fitting down to waterline 34.00 with particular attention to points of attachment.

(d). Clean and inspect any suspected area; use dye-penetrant to determine if a crack does exist. If a crack is found, part must be replaced.

(5). Inspect mast support structure for corrosion, loose bolts and rivets and general condition of finish.

(6). Check that the two 1/4 inch (6.35 mm) drain holes located in the pan are not plugged.

(7). Reinstall controls tunnel cover.

(8). Reinstall left and right forward sections of air inlet fairing.

(9). Reinstall main transmission access cover and main gearbox access cover.

4. Main Rotor Mast

(Ref. Figure 3-3) The main rotor mast consists of a steel tube and a forged base assembly. The mast encloses the main rotor drive shaft and supports the main rotor hub assembly.

A. Main Rotor Mast Removal

CAUTION Main rotor mast is highly stressed. Do not allow tools to strike mast or mast to strike any object. Any impact damage may require replacement of mast.

(1). Remove main rotor hub.

(2). Remove main rotor controls.

(3). Remove main transmission. Transmission removal is required for access to the mounting studs.

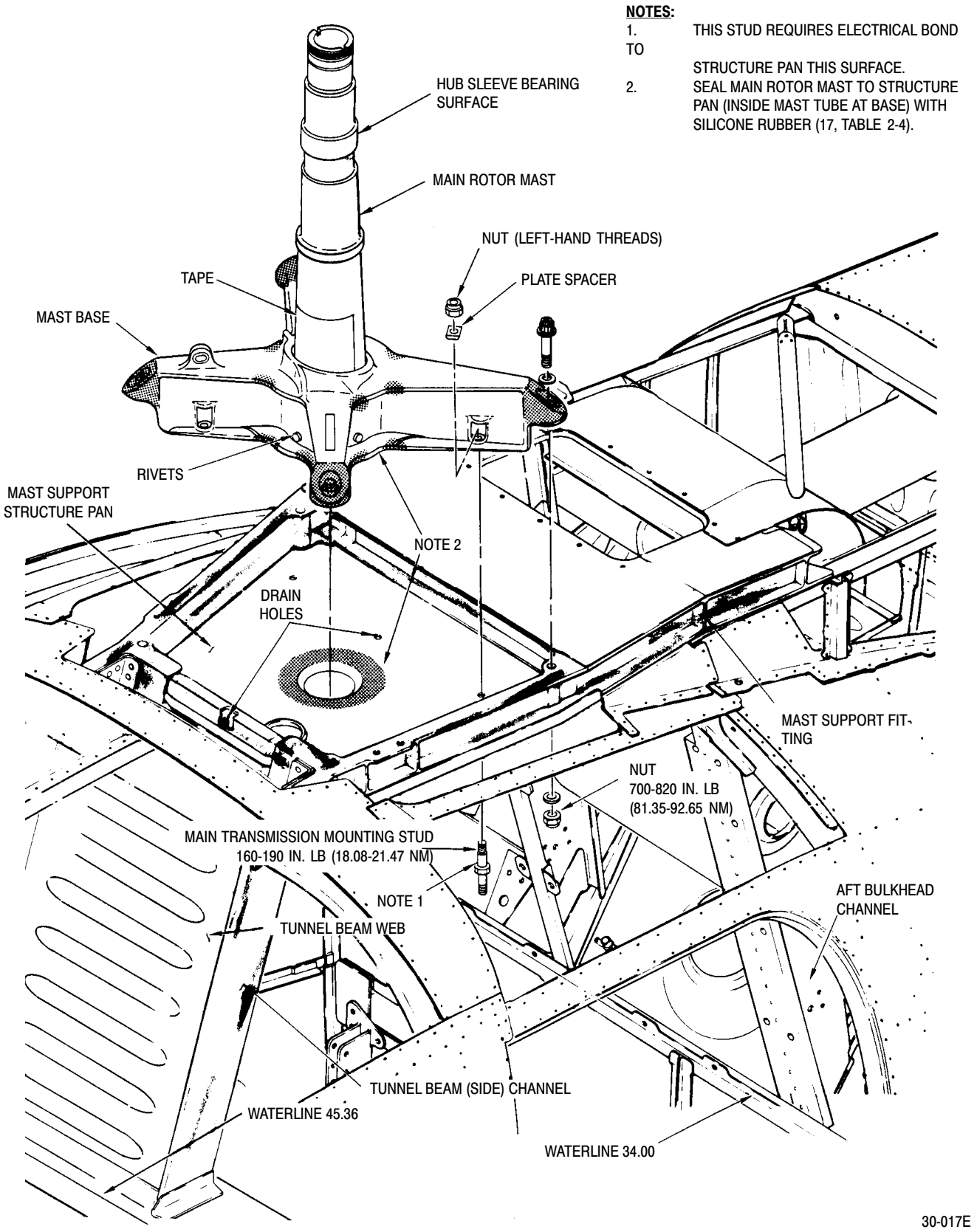
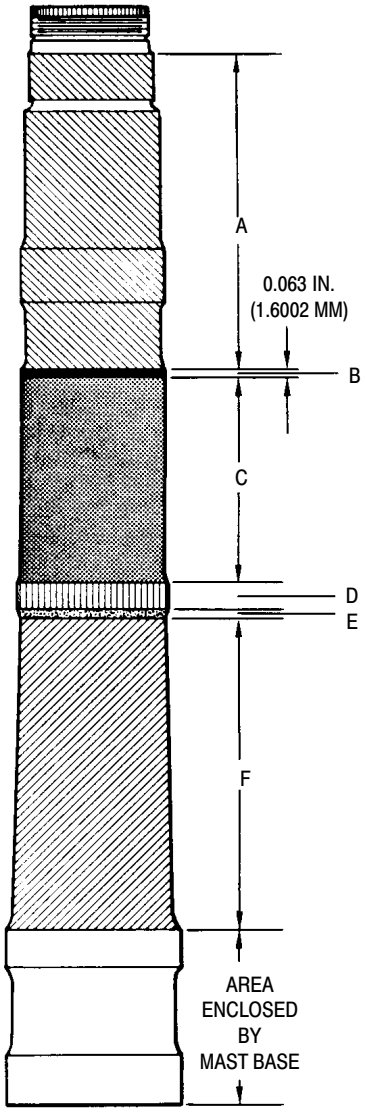


Figure 3-2. Main Rotor Mast and Support Structure



MAST TUBE TO BE PERPENDICULAR TO MAST BASE WITHIN 0.010 IN. (0.254 MM) IN 10 INCHES (25.4 CM)

AREA	REPAIRABLE DAMAGE	MAXIMUM REMOVAL OF MATERIAL (DEPTH)	REPAIR PROCEDURE
A	CORROSION AND SCRATCHES	0.010 IN. (0.254 MM)	POLISH AREA SMOOTH WITH ABRASIVE CLOTH (20 AND 23, TABLE 2-4) IF CADMIUM PLATING HAS BEEN PENETRATED. TREAT REWORKED AREA WITH PRIMER (4).
B	CHIPPING OF NICKEL PLATING	THICKNESS OF NICKEL PLATING 0.0035 IN. (0.0889 MM) MAXIMUM	POLISH AREA SMOOTH WITH ABRASIVE CLOTH (20 AND 23, TABLE 2-4). THREAT REWORKED AREA WITH PRIMER (4).
C	LONGITUDINAL SCRATCHES THAT DO NOT PENETRATE THROUGH THE NICKEL PLATE. SCRATCHES MUST BE A MINIMUM OF 0.25 IN. (6.35 MM) APART. RADIAL SCRATCHES ARE NOT PERMITTED.	MUST NOT PERNETRATE NICKEL PLATING 0.0035 IN. (0.0889 MM) MAXIMUM	POLISH AREA WITH ABRASIVE CLOTH (20 AND 23, TABLE 2-4) TO REMOVE BURRS AND SHARP EDGES ONLY.
D	CORROSION AND SCRATCHES	0.020IN. (0.508 MM)	POLISH AREA SMOOTH WITH ABRASIVE CLOTH (20 AND 23, TABLE 2-4)
E	CORROSION AND SCRATCHES	0.010 IN. (0.254 MM)	POLISH AREA SMOOTH WITH ABRASIVE CLOTH (20 AND 23, TABLE 2-4). TREAT REWORKED AREA WITH PRIMER (7) AND A TOP COAT OF LACQUER (6).
F	CORROSION AND REPLACEMENT OF TAPE	0.010 IN. (0.254 MM)	REMOVE DAMAGED OR DETERIORATED TAPE. POLISH CORROSION SPOTS WITH ABRASIVE CLOTH (20 AND 23, TABLE 2-4). TREAT REWORKED AREA WITH PRIMER (7) AND A TOP COAT OF LACQUER (6). REPLACE TAPE (32).

NOTE: FOR MAGNETIC PARTICLE INSPECTION, REMOVE PAINT FROM APPLICABLE SURFACES.

30-160B

Figure 3-3. Main Rotor Mast Inspection and Repair Criteria

(4). Remove four studs, washers and nuts (Ref. Figure 3-3). Nuts securing studs have left-hand threads.

(5). Remove shaft support hold-down nuts, washers and bolts.

(6). Lift main rotor mast from helicopter.

B. Main Rotor Mast Installation

(1). Apply silicone sealant (17, Table 2-4) on bottom surface of mast tube and base at drive shaft opening to seal base to mast support structure at installation. Sealing will contain any oil leakage coming from top of transmission.

(2). Position main rotor mast so that holes in base align with holes in mast support structure.

(3). Install four holddown bolts, eight washers and four nuts; torque nuts to **700 - 820 inch-pounds (79.09 - 92.65 Nm)**.

(4). Check underside of mast support structure at left aft stud hole location. Stud-to-pan doubler surface must be clean to bare metal for electrical bonding (Ref. Figure 3-2). Install main transmission mounting four studs, plate spacers and nuts. Torque studs to **160 - 190 inch-pounds (18.08 - 21.47 Nm)**.

(5). Using 0.001-0.0015 inch (0.0254-0.0381 mm) feeler gage, check for gap between self-locking nuts and plate spacers. No gap is allowed.

(6). If gap is observed, remove nut and replace with new self-locking nut. Torque studs into replacement nuts to **160 - 190 inch-pounds (18.08 - 21.47 Nm)** and repeat step (5). above. Continue until each nut is flush against its spacer. Seal bare bond area with clear lacquer (47).

(7). Install main transmission.

(8). Install main rotor controls.

(9). Install main rotor hub.

C. Main Rotor Mast Inspection and Repair

Inspect all areas of main rotor mast for cracks, nicks, scratches and evidence of impact damage. Refer to Figure 3-3 for inspection and repair criteria. Inspect bearing surfaces for scoring and galling. Inspect threads and serrations for damage. Inspect four rivets that secure base to mast tube for security. Check that tape on forward edge of mast tube is secure and undamaged.

NOTE: To inhibit corrosion of mast when operating in salt water environment, check tape at frequent intervals. Also, apply thin grease film (18, Table 2-4) to bearing journals.

(1). Inspect all areas of main rotor mast for cracks, nicks, scratches and evidence of impact damage.

(2). Inspect bearing surfaces for scoring and galling.

(3). Inspect threads for damage.

(4). Inspect rivets that secure base to mast tube for security.

(5). Check that tape (Ref. Figure 3-2) on forward edge of mast tube is secure and undamaged; replace if defective.

(a). Peel defective tape from mast.

(b). As required, polish area to remove burrs and sharp areas with abrasive cloth (20, Table 2-4) or crocus cloth (23).

(c). Clean mast thoroughly with cleaner (183) and allow to dry.

(d). Apply primer (4) and paint (6) to affected area.

(e). Apply pressure sensitive tape (123) to mast.

NOTE: To inhibit corrosion of mast when operating in salt water environment, check tape at frequent intervals. Also, apply thin grease film (18, Table 2-4) to bearing journals.

(6). Inspect internal bore for paint chipping, orange peeling or flaking, none allowed.

NOTE: Chipping, orange peeling or flaking paint will normally be at the base of the static mast tube.

(7). Re-apply finish to mast internal bore as follows:

(a). Remove main rotor hub (Ref. Sec. 62-20-00 or 62-20-60, Main Rotor Hub Replacement).

(b). Remove main transmission (Ref. Sec. 63-20-00 or 63-20-25, Main Transmission Replacement).

(c). Remove static mast (Ref. Main Rotor Static Mast Replacement).

(d). Thoroughly clean interior tube with Solvent (1).

(e). Inspect for any corrosion, none allowed.

(f). Remove paint from bad areas and lightly feather paint edge with crocus cloth (23), remove any residue from feathering.

(g). Apply primer (131) to repair areas.

(h). Allow to cure per manufacturer's instructions.

(i). Reinstall static mast.

(j). Reinstall main transmission.

(k). Reinstall main rotor hub.

5. Fuselage Structure

A. Center Beam

(Ref. Figure 3-4) The lower section center beam is a primary structural member of the helicopter. The beam is a riveted and bolted assembly of aluminum alloy webbing, stiffeners and doublers. Landing gear fittings of machined aluminum forgings are mounted at the forward and aft ends of the center beam. Each fitting contains four swivel bearings for attachment of the landing gear braces and struts. The forward fittings have two additional bearing attachment points for the longitudinal and lateral cyclic trim actuators.

B. Sta. 78.50 Canted Frame

The Sta. 78.50 canted frame establishes the forward portion of the cross-sectional form of the helicopter. The canted frame, constructed of formed sheet metal webs, stiffeners and doublers, is a primary structural member of the helicopter. Three cutouts, at cargo floor level, provide access to the landing gear dampers, other underseat components and the four flight control push rods that are routed upward through the canted tunnel.

C. Sta. 124.00 Canted Frame and Lower Section Frame

The Sta. 124.00 upper and lower section frames are primary structural members of the helicopter. The upper canted frame is formed of channel and sheet aluminum. Passenger seat, shoulder harness and engine mount support fittings are bolted to the chanted frame. The lower section frame is formed of titanium sheet and aluminum channel members.

D. Pilot's Compartment Floor

The pilot's compartment floor is a structure of aluminum alloy formed channels, intercostals, clips, gussets and skin. The pilot's seat support structure attaches to the aft end of the floor. Tail rotor control support fittings are at the forward end of the floor and there are openings on each side for access to the underfloor compartments.

E. Instrument Panel Support Structure

The instrument panel support assembly is aluminum alloy sheeting, stiffeners, webs and channels riveted together to form a pedestal assembly.

F. Pilot's Seat Support Structure

The pilot's seat support structure is formed of aluminum alloy ribs and sheet. The seat structure incorporates forged or cast and machined aluminum alloy and/or magnesium fittings for seat belt attachment, landing gear damper attachment, and flight and engine control components. Refer to Section 2 for corrosion control and identification of magnesium and aluminum alloy.

G. Cargo Compartment Floor

The cargo compartment provides a multi-use area for accommodation of cargo and/or passengers. If floor is bent or punctured, remove appropriate fuel cell access cover and inspect fuel cell. If water accumulation is noted, refer to CSP-H-6 for drain hole addition instructions.

H. Cargo Floor Fittings

The cargo floor incorporates 8 cargo tiedowns, 4 seat belt attachment fittings and on the underside of the floor, 12 tiedown eyelets that support the fuel cell and lacing.

I. Fuel Tank Support Skins

The fuel tank support skins located under the cargo compartment floor are made of fiberglass sheets riveted to the tank support ribs.

J. Fuel Tank Support Skin Inspection

When the cells are removed, check security of fiberglass skin attachment to support angles and brackets, and inspect the anti-abrasion tape for security of adhesion over rivet heads, all sharp edges and lap joints.

K. Fuel Tank Support Skin Repair

(1). Cover exposed rivet heads with 10-mil by one inch (2.54 cm) tape (16, Table 2-4) to prevent chafing fuel cell fabric.

(2). Perform repair of the fuel tank support skins according to applicable instruction in CSP-H-6.

6. Firewalls

(Ref. Figure 3-5) The shell like aft section upper firewall surrounds the upper portion of the engine combustion chamber and exhaust pipe assembly and is designed to contain engine heat as well as any fire that might develop within the engine compartment. The upper firewall is thin, 0.0015 inch (0.0381 mm) thick sheet, rigidized CRES sheet, covered with a double thickness of nonflammable ceramic fiber blanket. Flanges at the forward and lower edges of the upper firewall are covered with heat-resistant tape. Pronged fasteners attach the upper firewall to three vertical fuselage rings and to a horizontal rib. The semicircular forward firewall is an assembly of CRES sheets that contain circular cutouts for passage of the engine drive shaft and engine oil cooler lines, and a reinforced rectangular opening for the engine oil cooler. The forward firewall is riveted to the fuselage structure.

A. Firewall Inspection

Inspect the aft upper firewall for security, punctures, and corrosion. Inspect the forward firewall for punctures, corrosion, and for a complete seal around the openings for the overrunning clutch, engine compressor air inlet, and the oil cooler. No un-repaired damage is permissible. Refer to CSP-H-6 for forward firewall repair.

B. Upper Firewall Replacement

CAUTION Be careful when working on or around the firewall shell. It is extremely light gage, 0.0015 inch (0.0381 mm) thick sheet.

(1). Remove tailpipes.

(2). Remove tape covering fasteners and firewall edges.

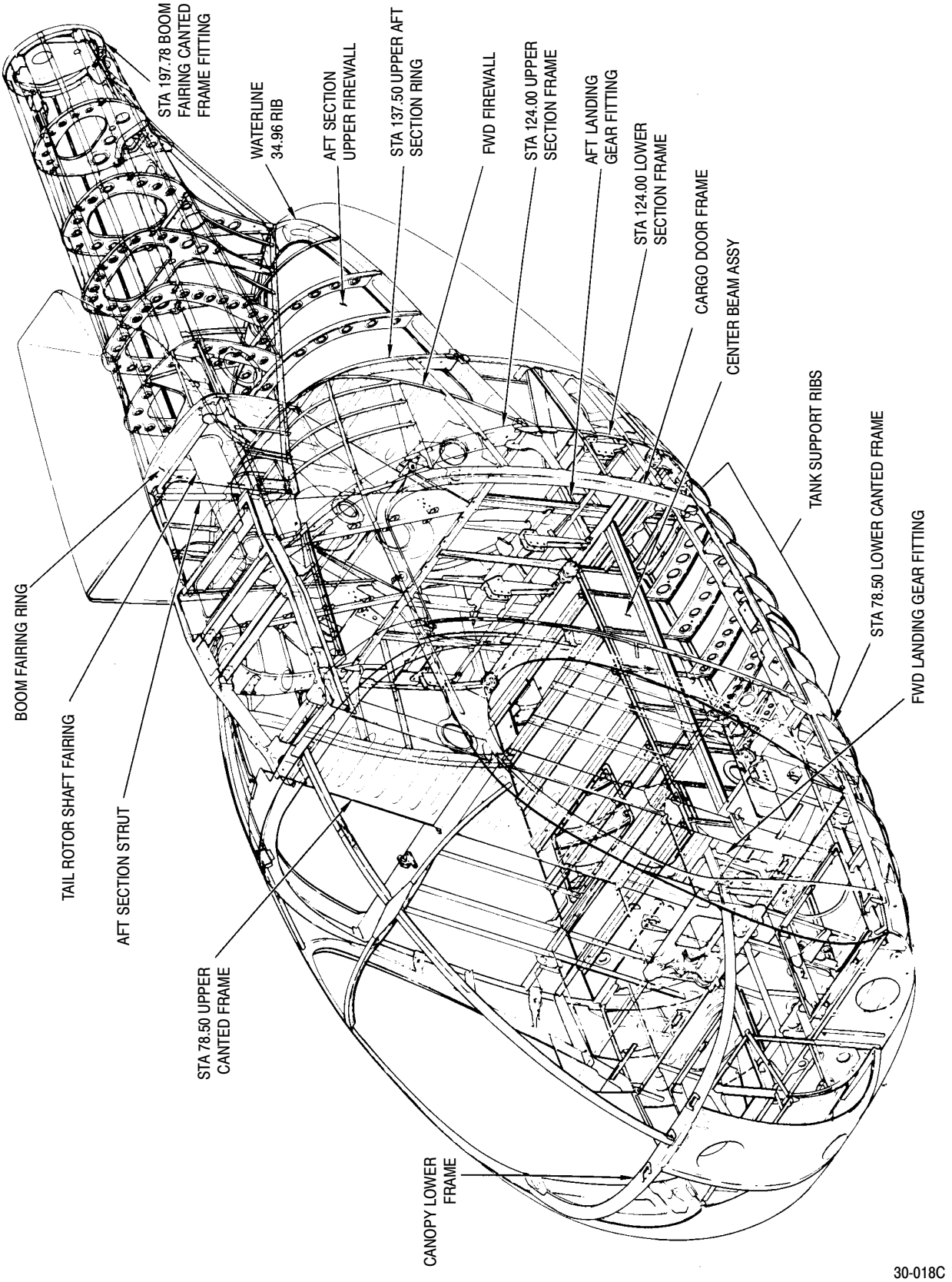


Figure 3-4. Major Bulkheads and Structural Members

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(3). Detach the compressor cooling air duct support bracket. Remove firewall shell by pulling out the button head fasteners attaching it to surrounding fuselage.

(4). Replace damaged or corroded fasteners.

(5). Replace aft firewall shell if damaged beyond practical repair. Trim replacement shell to fit installation. Allow sufficient trim excess for folding back the edge to provide double thickness at the attach points.

(6). Pierce fastener holes in new firewall shell to align holes in surrounding fuselage rings and waterline 34.96 rib.

(7). Place firewall shell in position and secure in place by pressing fasteners into holes. Attach the compressor cooling air duct support bracket to hoist fitting.

(8). Using solvent (1, Table 2-4) clean the forward flanges, lower flanges, and surface where tape routing will cover the fasteners; then apply tape (62).

(9). Install tailpipes.

C. Upper Firewall Patch Silver Brazing

(1). Remove the aft section upper firewall.

(2). Remove tape and ceramic fiber blankets from the firewall shell.

(3). Clean the firewall with a stiff bristle brush moistened with solvent (1, Table 2-4) and wipe dry with a clean, dry cloth.

(4). Smooth out the rigidized pattern in the area on which the patch will be brazed.

(5). Prepare a cleaning solution as follows: 1 - 30 percent hydrofluoric acid (64) and 18 - 30 percent nitric acid (65) by volume at 75 - 140°F (24 - 60°C) maximum temperature.

(6). Cut a suitable repair patch from Type 321 stainless steel sheet in the thickness range of 0.0015-0.0018 inch (0.0381-0.04572 mm).

(7). Contour the patch to match the contour of the firewall shell repair area.

(8). Use a stiff bristle brush with the cleaning solution prepared in step (5). to clean the inner and outer surfaces of the stainless steel patch and firewall.

(9). Rinse the patch and firewall shell thoroughly with clean water and allow to air dry.

(10). Coat the surfaces to be joined with a thin even coating of silver alloy brazing flux (66).

(11). Use a clamp or other suitable device to hold the patch in place during the brazing operation.

(12). Braze the patch in place with Class 8 silver brazing alloy (67) using a suitable torch to heat the patch area to a temperature moderately above the flow point, 1295°F, (707°C) of the brazing alloy.

CAUTION Use extreme care not to overheat and burn through the firewall shell.

(13). Allow joint to cool for at least 60 seconds before removing clamping device.

(14). Remove flux by immersing repaired area in water at 160-212°F (71-100°C) for 40 minutes.

(15). Follow by a thorough rinse in clear, running water and air-dry, or wipe dry with a clean, dry cloth.

(16). Install ceramic blanket on outer surface of firewall shell.

(17). Install aft section upper firewall shell.

(18). Install tape (62) on flanges of firewall shell.

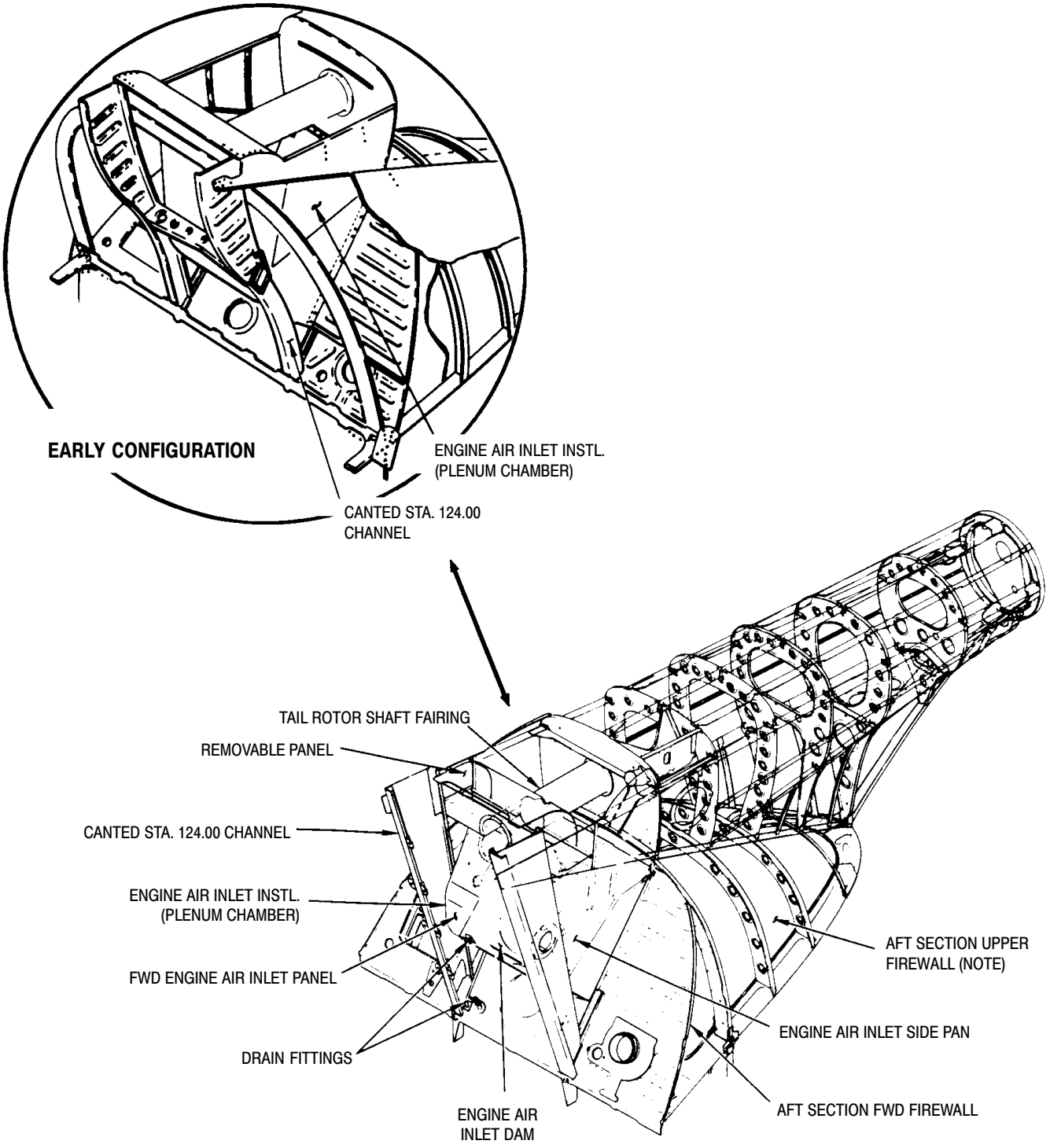


Figure 3-5. Firewall Installation

7. Fuselage Fittings

The mast support structure fittings and the fuselage boom fairing frame fitting are critical fatigue-loaded parts. Any damage in excess of negligible limits requires replacement of the damaged part. Any crack, regardless of length, requires replacement of the part. Refer to CSP-H-6 for location and identification of fuselage fitting

A. Fuselage Fitting Repair

Repair of cast and forged fittings should be performed only when replacement components are not immediately available. Replacement of bushings, bearings or inserts that become part of the fitting assembly are considered insertion repairs. Insertion repairs are described in CSP-H-6.

(1). Negligible Damage

Longitudinal scratches, nicks or dents shall not exceed 0.010 inch (0.254 mm) depth or 15 percent of the length of the fitting. Transverse scratches, nicks or dents shall not exceed 0.010 inch (0.254 mm) depth or 10 percent of the thickness of the fitting. The preceding damage limits apply after polishing,or repair is accomplished.

(2). Replacement

Replace fittings according to applicable instructions CSP-H-6.

8. Aft Section Strut

(Ref. Figure 3-4) The aft section strut is approximately 28 inches (71 cm) long, is diagonally attached by lock-bolts to the aft end of the left mast support structure fitting at the canted firewall, and to a longeron and angle in the upper right corner of the boom fairing ring.

A. Aft Section Strut Repair

Repair of the strut is limited to smoothing out minor dents, scratches or nicks. Replace the strut if it is badly damaged, according to applicable instructions in CSP-H-6.

9. Landing Gear Fitting Swivel Bearing Replacement

Replace landing gear swivel bearings according to applicable instructions in CSP-H-6.

10. Optional Equipment Structural Hard Points

Structural hard points for attachment of optional equipment are installed on certain helicopters. The associated structure is strengthened for installation of options such as a hoist, cargo hook or litter. On early configuration helicopters, hard points may not be provided. However, equivalent mounting brackets and other provisions are available by modification of the helicopter or by installation of alternate equipment. If external provisions for the optional hoist installation are not in use, the mounting holes are filled with nylon screws. The holes are located near and above the cargo door opening in the fuselage and must be filled with the screws to prevent entry of moisture when the hoist is not installed. Current configuration hard points are located as follows.

(1). Three hoist attachment points are located on the exterior fuselage above both cargo doors.

(2). Eight litter bracket attachment points are located on the passenger/cargo compartment side of the Sta. 78.50 bulkhead.

(3). A cargo hook attachment fitting is riveted to the helicopter lower center beam structure for attachment of an external cargo hook.

11. Engine Air Inlet Fairing

The engine air inlet fairing on top of the fuselage structure directs ambient outside air to the engine air inlet, oil cooler blower, and main transmission. The fairing installation consists of a forward fairing section and an aft fairing section. The removable right and left halves of the forward fairing encircle the mast support structure above the cargo compartment. The aft fairing is riveted to the fuselage structure and directs airflow down into the plenum chamber of the engine air inlet. A uhf/vhf antenna, consisting of a triangular-shaped aluminum sheet and and antenna cable connection bracket, is bonded to the aft

vertical face and is part of the aft fairing. Refer to Section 2 for maintenance information on the forward fairing section.

12. Engine Air Inlet (Plenum Chamber)

The engine air inlet plenum chamber is just below the engine air inlet aft fairing. The basic air chamber is formed by a forward panel, two side panels, and a pan that extends between the lower edges of the side panels. The pan contains an opening for entry of the engine compressor bell mouth into the air chamber. The boom fairing ring at Sta. 137.50 forms the rear wall of the plenum chamber. A diagonal strut passes through a cutout in the upper left side of the forward panel (Ref. Figure 3-4). The strut braces the structure opening from in back of the left mast support fitting to the boom fairing ring. The tail rotor drive shaft fairing passes through the chamber. Five angle clips, each with a nutplate, provide attach points for the engine air shield screen.

A. Plenum Chamber Inspection

(1). Open two access doors on right side of engine air inlet fairing and open the engine compartment access doors.

(2). Inspect all panels for evidence of corrosion, for rivet security and for punctures.

(3). Inspect the engine air shield mounting clips for secure attachment.

(4). Inspect the aft section strut for rivet corrosion and for edge clearance where it passes through the cutout in the forward panel.

(5). On belt-driven blower installation, check that removable forward panels are secure. Inspect rubber seals for security and partial compression.

(6). Inspect the tail rotor drive shaft tube fairing for dents, buckled or wrinkled areas and signs of corrosion.

(7). Close the engine compartment access doors and two air inlet access doors.

B. Plenum Chamber Hole Sealing

CAUTION All tape must be applied to outside of inlet surfaces, so that any subsequently loosened tape cannot enter plenum chamber. The engine can be badly damaged by entry of foreign materials.

(1). Using 10-mil by l inch (2.54 cm) pressure-sensitive tape (32, Table 2-4), tape all small holes 0.130 inch (3.302 mm) diameter or larger.

(2). Using sealant (60), seal all holes less than 0.130 inch (3.302 mm) diameter.

(3). Rebond loose rubber seals with adhesive (69) according to container instructions.

13. Aft Fuselage Skin Cracks Inspection/Repair (Sta. 146.62)

(1). Remove tail rotor control bellcrank access door from left side of fuselage boom fairing.

(2). Use light source and mirror and visually inspect fuselage skin adjacent to doublers for evidence of cracks. If no cracking is found, replace boom fairing access door.

(3). Commence repair procedure when cracking is found by removing engine from helicopter.

(4). Remove tail rotor control bellcrank access door from left side of fuselage boom fairing when not previously removed.

(5). Gain access through boom fairing access door and use angled drill motor and appropriate bit to drill out manufactured head of four rivets each which secure 369A3000-67 and -68 doublers.

(6). Drill out four rivets each to left and right of helicopter centerline securing aircraft skin to Sta. 146.62 ringer former flange.

(7). Stop-drill all cracks.

(8). Slide 88-369H3000-3 doubler between Sta. 146.62 ring former flange and fuselage skin (equally distant) on either side of center line.

(9). Align doublers with existing rivet pattern.

(10). Drill doubler to match existing rivet pattern; deburr holes and remove chips as required.

(11). Secure doublers, former, and skin using wet primer (4, Table 2-4), rivet gun, and rivets. Install rivets from inside engine compartment.

(12). Remove all debris from work area, inspect installation for discrepancies, and touch up as required with primer.

(13). Reinstall removed components in reverse order of removal; inspect installations for discrepancies.

14. Underfloor Compartments

Underfloor compartments are those areas below fuselage floor level, on both sides of the center beam and forward of seat structure. The left forward area contains electrical equipment and the battery. The right forward area is for utility storage and is lined by an area contour-matching thermoplastic container. The utility compartment is rated for 50 pounds (23 kg) maximum weight.

A. Underfloor Compartment Inspection

Inspect electrical harnesses and wiring for frayed insulation and grounding terminals for corrosion.

15. Firewall and Sta. 124.00 Insulation

(Ref. Figure 3-5) The engine compartment forward firewall is insulated on current configuration helicopters and helicopters so modified to provide heat reduction in the passenger/cargo compartment. Insulator pads covered with heat reflective material are bonded to the helicopter structure inside the engine compartment on the forward firewall and plenum chamber, on the rear passenger/cargo compartment firewall and inside the oil cooler/tank access cover. In addition, the oil cooler/tank area at the Sta. 124.00 bulkhead is sealed with aluminum foil tape between the right mast base support frame and the right side of the plenum chamber. An external air vent and scoop, located on the right side of the fuselage, provides airflow through the sealed-oil cooler/tank area. A small drain hole is located directly below the forward air scoop at WL 32.00.

A. Insulator Padding and Insulation Tape Inspection

(Ref. Figure 3-6 and Figure 3-7)

(1). Check that the drain hole is free and clear of obstruction.

(2). Inspect insulator padding and insulation tape for security.

(3). Inspect oil cooler/tank area for possible air gaps and insufficient sealing.

B. Insulator Padding Replacement

(1). Remove individual insulator pads by pulling away from the structure.

(2). Clean insulator attachment surface with naphtha (59, Table 2-4). Surface must be completely free of oil, grease and grit to assure bond.

NOTE: Insulator pads are installed with the silver reflective material outside and the cushion (red) side against the structure.

(3). Apply a thin film of adhesive (102) over the entire contact surface of either the structure or the insulator pad.

(4). Press the surfaces to be bonded together and work gently from the center outward in all directions.

(5). Allow the bond to cure approximately 24 hours.

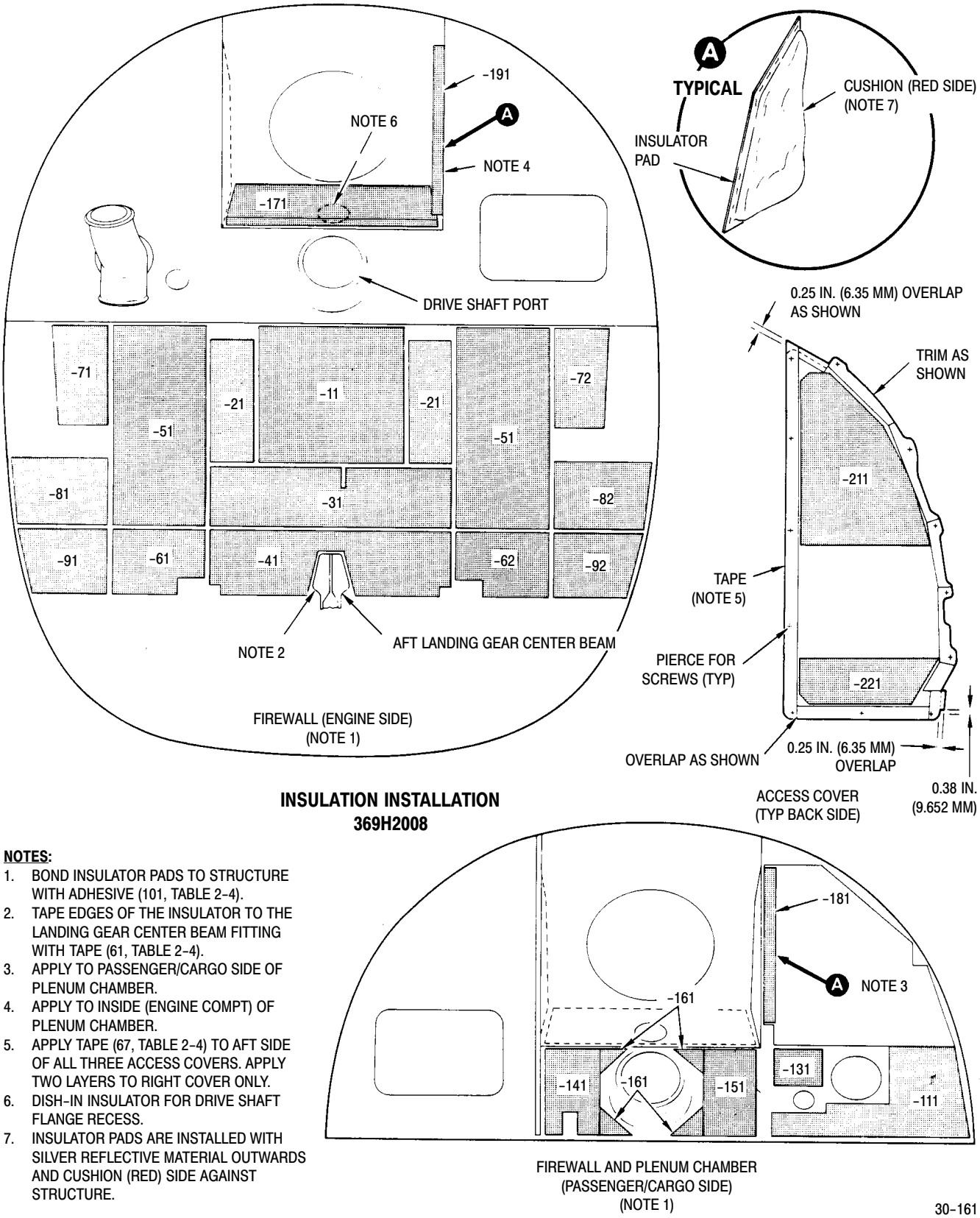
C. Oil Cooler/Tank Insulation Tape Replacement

(Ref. Figure 3-7)On helicopters with a vented oil cooler/tank compartment, remove any loose tape and seal all gaps between the mast base support frame and right side of the plenum chamber, and between access covers and supporting structure.

(1). Tape must overlay metal surfaces by a minimum of 1 inch (2.54 cm).

(2). Overlay tape on tape a minimum of 1/4 inch (6.35 mm).

(3). Tape around junction of frame and firewall must extend a minimum of 1 inch (2.54 cm) on both surfaces.



INSULATION INSTALLATION
369H2008

NOTES:

1. BOND INSULATOR PADS TO STRUCTURE WITH ADHESIVE (101, TABLE 2-4).
2. TAPE EDGES OF THE INSULATOR TO THE LANDING GEAR CENTER BEAM FITTING WITH TAPE (61, TABLE 2-4).
3. APPLY TO PASSENGER/CARGO SIDE OF PLENUM CHAMBER.
4. APPLY TO INSIDE (ENGINE COMPT) OF PLENUM CHAMBER.
5. APPLY TAPE (67, TABLE 2-4) TO AFT SIDE OF ALL THREE ACCESS COVERS. APPLY TWO LAYERS TO RIGHT COVER ONLY.
6. DISH-IN INSULATOR FOR DRIVE SHAFT FLANGE RECESS.
7. INSULATOR PADS ARE INSTALLED WITH SILVER REFLECTIVE MATERIAL OUTWARDS AND CUSHION (RED) SIDE AGAINST STRUCTURE.

Figure 3-6. Insulation Padding

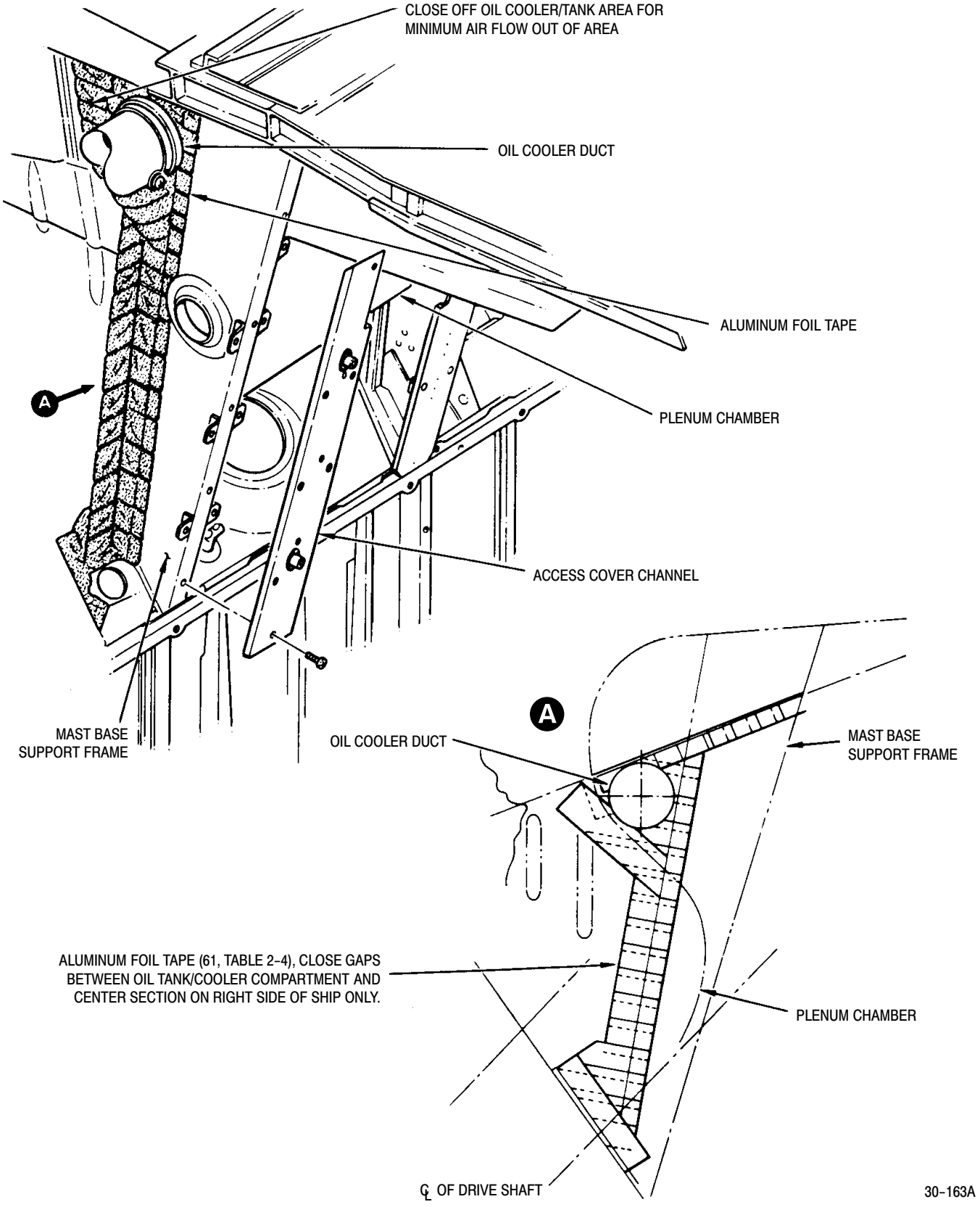


Figure 3-7. Oil Cooler/Tank Compartment Sealing

(4). Tape upper corner at oil cooler duct hose to obtain a minimum flow of air through corners.

(5). Seal all holes with aluminum foil tape (62, Table 2-4).

(6). Apply strips of nitrite tape (68) to the attaching surfaces of the three access covers and trim the tape as shown in Figure 3-6. Apply a double layer of tape to the right access cover. Pierce the tape at all attachment screw holes.

16. Engine Access Doors

Current type doors have upper and lower door hinges that allow door fit adjustment. Fore and aft adjustment of the doors is made possible by slotted holes in the hinges and serrated mating surfaces between the hinges and doors. Lateral adjustment is obtainable by installing laminated shims under the door hinges. Door alignment during closing is provided by V-type striker blocks (with or without shims) or spring-type retainers riveted to the door frames next to the lower latch, and two locating pins that engage holes in the lower fuselage structure.

A. Engine Access Door Removal

(Ref. Section 2)

B. Engine Access Door Inspection

(1). Check the door hinges, door attaching hardware, and latches for looseness, cracks and damage.

(2). Check the outside edge of door for security of bonding between outer and inner skin. Any separation requires repair.

(3). Inspect doors for corrosion, distortion, breaks or cracks and condition of abrasion strip tape along upper inside door edge.

C. Engine Access Door Repair

(Ref. Figure 3-8) Refer to CSP-H-6 for sheet metal repair procedures.

(1). Replace worn abrasion strip tape by cleaning the contact area with naphtha (59, Table 2-4). Allow to air-dry a minimum of 30 minutes. Install a 0.50 x 40 inch (1.27 x 101.6 cm) strip of polyurethane tape (42) to the clean dry surface. Apply hand pressure to ensure firm contact and trim as required.

(2). Replace adjustable door hinges as follows:

(a). Remove door from fuselage structure.

(b). Remove nut, washer and hinge pivot screw.

(c). Carefully press out the hinge pivot point spacer and separate the hinge halves. Retain the two nylon spacers.

CAUTION Rivets must be carefully drilled out. Removal by the standard method of drilling and drift punching could result in damage to the internal structure and surrounding material.

(d). Drill out rivets that secure the defective hinge half to the fuselage structure.

(e). Transfer existing hole pattern in fuselage structure to replacement fuselage hinge half and drill out holes. Install hinge and shim on fuselage structure and secure with replacement rivets.

(f). Assemble the hinge halves with nylon bushings. Press the steel pivot spacer coated with wet primer (4) through the mating holes. Install pivot screw with washer and nut.

(g). Install door and check for alignment.

NOTE: Install shims under door hinge to obtain a firm fit without binding at door-to fuselage contact surfaces when the door is closed. Use slotted holes in hinge and serrated surfaces to obtain forward and aft adjustment. When adjustments are complete, tighten screws that secure hinge to access door.

(h). Refinish repaired area.

(3). Replace defective catches or latch hooks as follows.

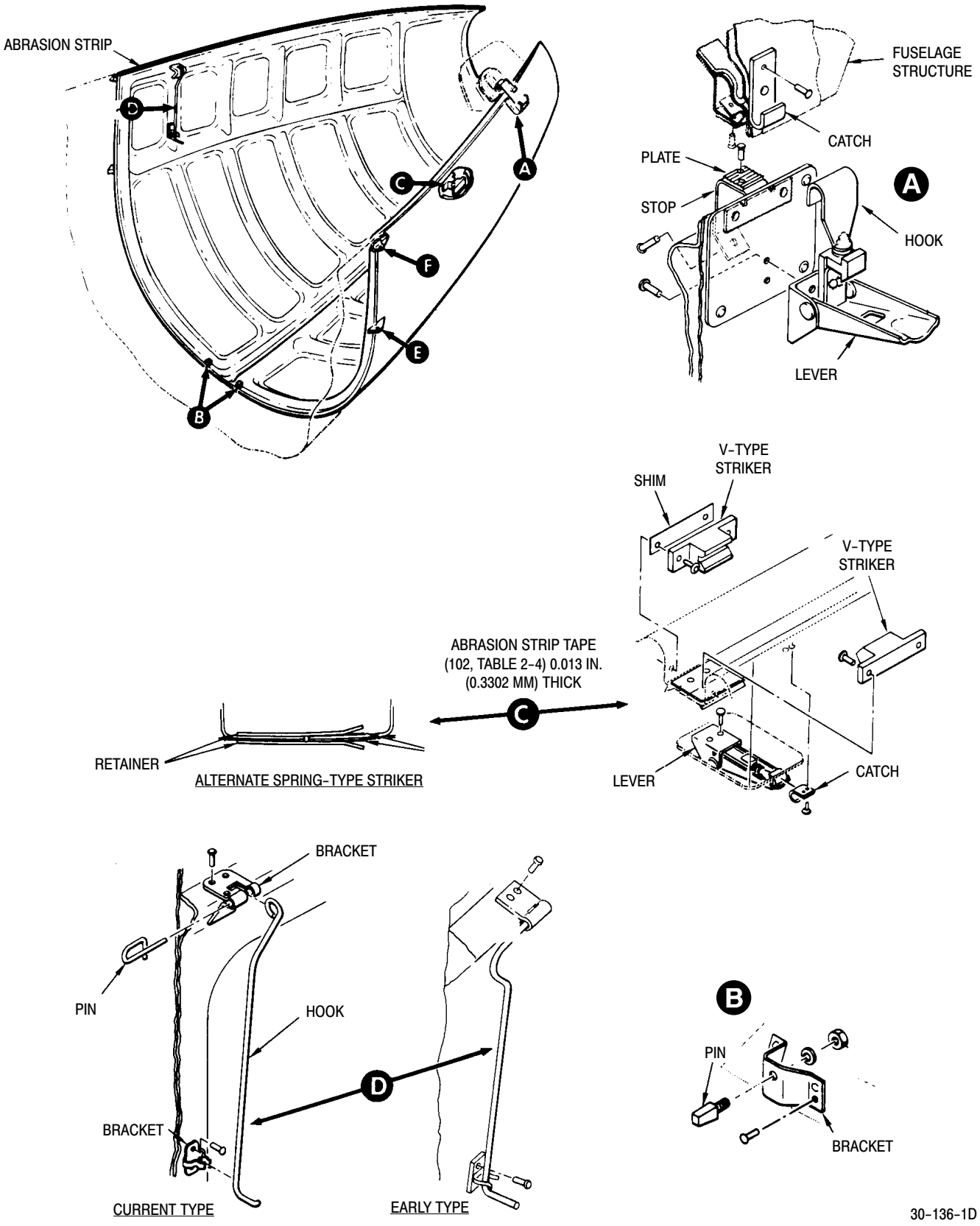
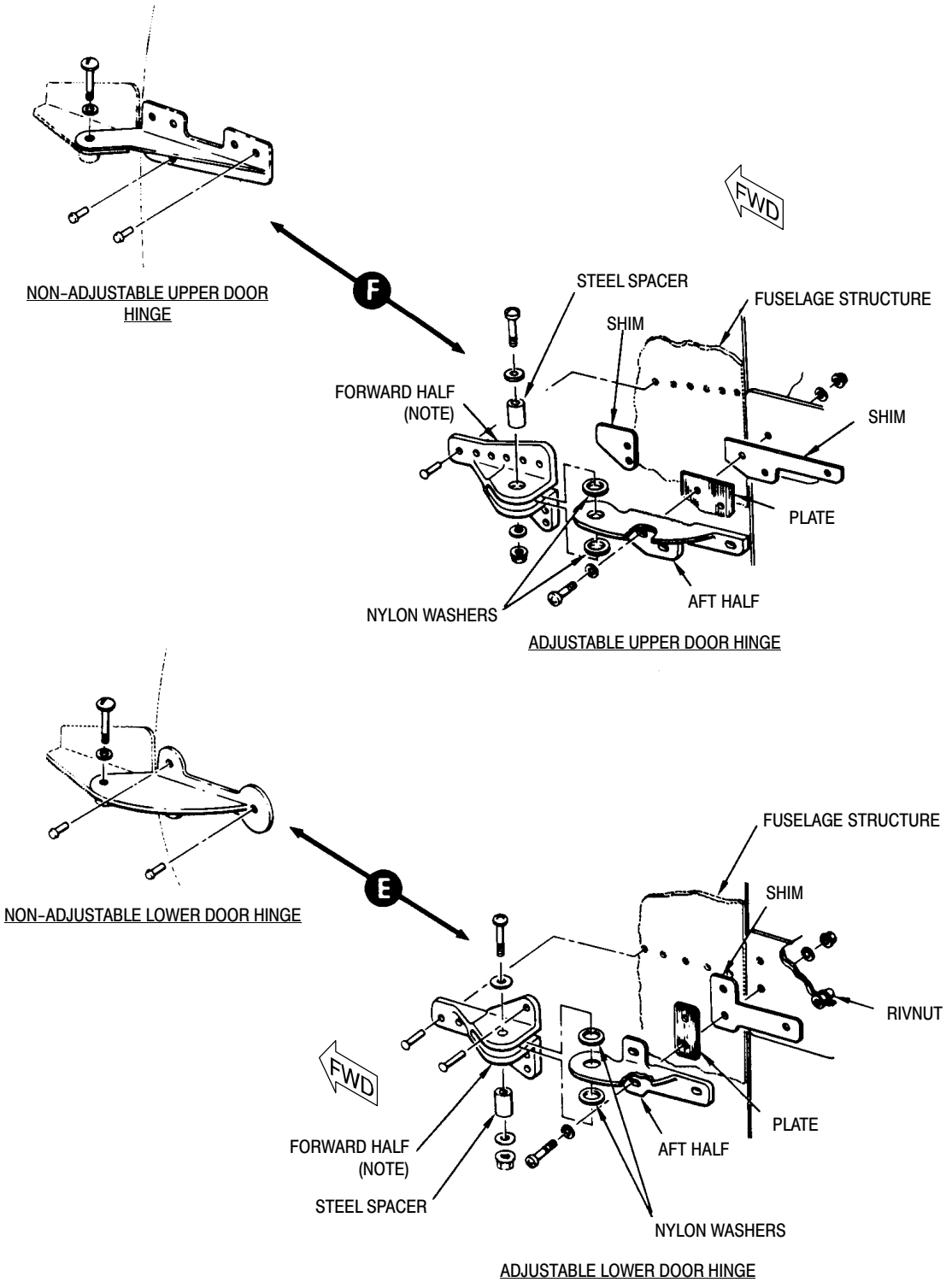


Figure 3-8. Engine Access Doors (Sheet 1 of 2)



NOTE:
UPPER AND LOWER FORWARD HINGE HALVES SHOWN AT LEFT SIDE ARE REVERSED AT RIGHT SIDE LOCATIONS (UPPER LEFT USED AT LOWER RIGHT AND LOWER LEFT USED AT UPPER RIGHT).

30-136-2B

Figure 3-8. Engine Access Doors (Sheet 2 of 2)

CAUTION Rivets must be carefully drilled out. Removal by the standard method of drilling and drift punching could result in damage to the internal structure and surrounding material.

(a). Drill out rivets and remove defective latch or catch from engine access door or fuselage structure. Replace defective stops or serrated adjustment plates, if required, by drilling out attaching rivets.

(b). Locate existing rivet holes and install replacement latch, catch, door stop or adjustment plate. Secure with replacement rivets.

(c). Adjust latches as required for proper tension of latch lever to catch without deflecting the door.

(d). Refinish area, except latch lever assembly, as required.

D. Engine Access Door Fit Adjustment

(Ref. Figure 3-8) Door alignment is provided by means of V-type striker blocks or spring-type retainers riveted in the door frames adjacent to the lower latch.

(1). Remove lockwire from threaded (adjustment) end of hooks.

(2). Loosen all hooks until strikers engage in light contact with no door deflection when the hooks are latched.

(3). Unlatch the doors and tighten all hooks four to five turns. Check door latching and make additional minor adjustments as required.

(4). Install lockwire (2, Table 2-4) in hook threaded end in a manner to allow latching and unlatching without interference.

17. Aft Section Windows

The aft section window installation consists of a left and right transparent window of tinted gray cast acrylic or plexiglass in a formed plastic retainer. The early type acrylic window panels are installed without retainers. Each window extends from the top of the cargo door to the outboard edge of the engine air inlet fairing, and between the canted bulkheads. The window retainers are riveted to the fuselage structure. Doubler strips are used along all riveted edges of the early type window.

A. Aft Section Window Repair

Refer to FAA AC 43.13-1 for repair of plastics. Replace the aft section window if it is damaged beyond practical repair, according to applicable instructions in CSP-H-6.

18. Canopy and Windshield

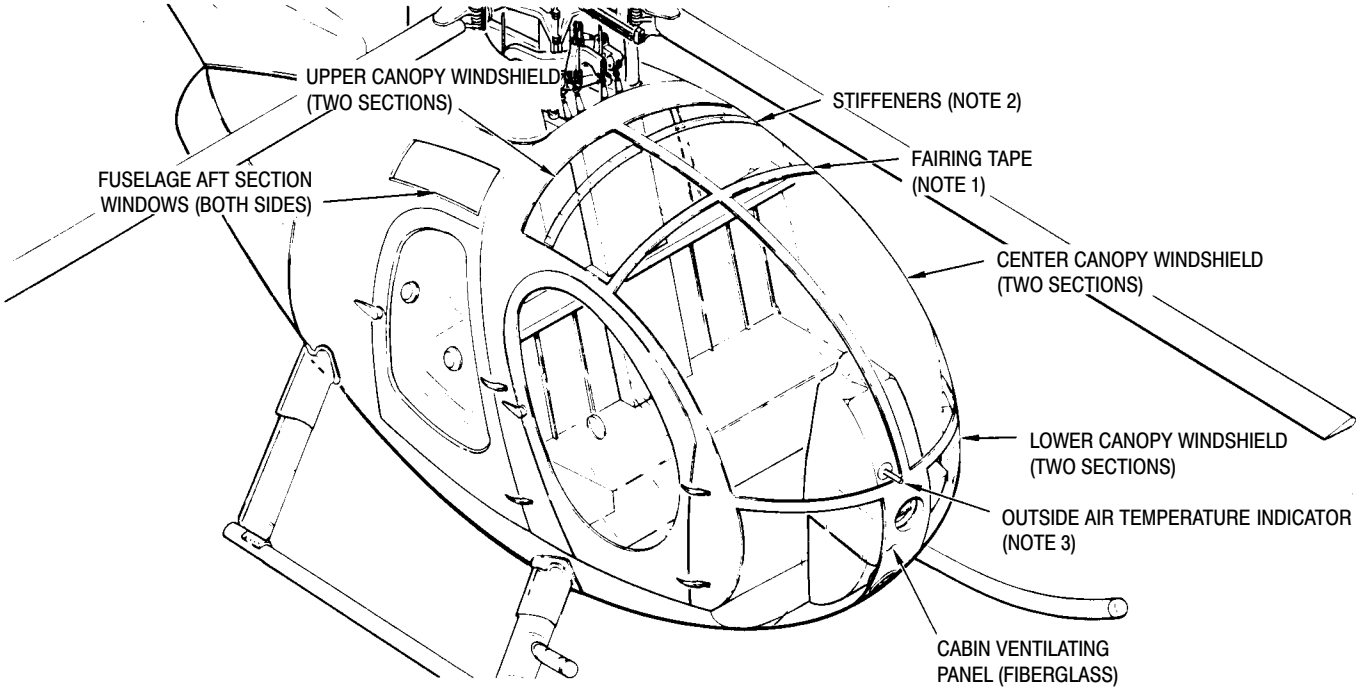
The canopy and windshield installation forms the forward part of the fuselage airframe enclosing the pilot's compartment. The canopy has three sections: a lower windshield, a center windshield and an upper windshield. Each section consists of symmetrical left and right side panels extending from the windshield centerline to the edges of the pilot's compartment door frames and the lower edge of the floor structure. The center and lower sections are clear cast acrylic. The upper section is smoke-grey-tinted cast acrylic. Each panel has Y-section plastic retainers bonded to the edges. These retainers are riveted to the canopy frame, the fiberglass canopy ventilating panel and fuselage structure. Early upper canopy windshields are of slightly thinner material than the current type and require the addition of stiffeners if the helicopter is to be flown with doors off in excess of 85 knots (98 mph) unless canopy upper windshield assemblies 369A2405-3 and -4 are replaced with 360H2410-3 and -4, 0.080 inch (2.032 mm) minimum thickness. Refer to CSP-H-3 for modification information.

A. Canopy Panel Inspection

Minor defects or imperfections that do not impair pilot's critical visibility, or that obviously are not signs of impending structural failure may be considered as negligible. Negligible damage includes:

(1). Nicks not more than 0.010 inch (0.254 mm) deep and occupying an area not larger than 0.250 x 0.50 inch (6.35 12.7 mm); one only per square foot (929 cm2) allowed.

(2). Scratches not more than 0.010 inch (0.254 mm) deep and 5 inches (12.7 cm) long.



NOTES:

1.. FAIRING TAPE NO LONGER USED IN PRODUCTION. IF REMOVED, REINSTALLATION IS NOT REQUIRED PROVIDED RETAINERS ARE SEALED TO FRAMEWORK WITH SEALING COMPOUND (3, TABLE 2-4).
2. STIFFENER MODIFICATION HUGHES NOTICE HN-23 IS REQUIRED FOR DOORS-OFF HIGH SPEED FLIGHT IF UPPER WINDSHIELDS ARE THE EARLY TYPE, 0.060 IN. (1.524 MM) THICKNESS INSTEAD OF THE THICKER CURRENT TYPE.
3. EARLY LOCATION SHOWN, SEE SECTION 17 FOR CURRENT CONFIGURATION.

30-019E

Figure 3-9. Canopy and Window Installation

(3). Any surface defect such as minute spots or stains that can be removed by light polishing.

(4). Delamination of doubler or stiffener in not more than one area within each square foot of panel.

(5). Crazing around delaminated areas less than 0.010 inch (0.254 mm) deep.

(6). Minor punctures in panels (other than windshields and windows) not exceeding 0.020 inch (0.508 mm) diameter.

(7). Minor polarization faults (distortion) in small areas of windshield near edges.

B. Canopy Panel Repair

Refer to FAA AC 43.13-lA for repair of plastics. Replace canopy panel if it is damaged beyond practical repair, according to applicable instructions in CSP-H-6.

C. Canopy Frame Replacement

(Ref. CSP-H-6)

19. Pilot and Cargo Doors

The two pilot doors and two cargo doors are bonded aluminum alloy frames containing large smoke-grey-tinted cast acrylic windows in extruded plastic retainers. Early type windows are clear cast acrylic. Plastic snapvents are installed in each of the four door windows, inside strengthening doublers. An acrylic stop, bonded to the doubler, prevents normal airflow from pulling the snapvent from the window during flight. These units may be rotated in the reinforced window holes for intake or exhaust of ventilating air and may be pulled inward for complete closure. Damaged snapvents should be replaced; repair is not practical. Current type doors are equipped with an automatic latching mechanism; early type doors have a manual latching mechanism. Two door hinges on each door are provided with quick-removal type ball-lock hinge pins. Current type cargo doors are

approximately 4 inches (10 cm) higher than the early type.

A. Pilot and Cargo Door Removal

(Ref. Section 2)

B. Pilot and Cargo Door Auto-Latching Operational Check

(1). When opening door, apply light inward force on the door. This will reduce wear of the latching mechanism by overcoming the door seal pressure.

(2). Open door and check for smooth operation of handles and latch mechanism. Check operation of door stop.

(3). Close door from inside. Check all inside latches for correct engagement at latch and safelock positions of interior and exterior handle.

(4). Check that setting interior and exterior handles to safelock position pulls door inward for proper closure and sealing.

(5). Check that key will lock and unlock door handle.

C. Pilot and Cargo Door Manual-Latching Operational Check

(1). When opening door, apply light inward force on the door. This will reduce wear of the latching mechanism by overcoming the door seal pressure

(2). Open door and check for smooth operation of handles and latch mechanism. Check operation of door stop and springs (if installed).

(3). Close door from inside and check latching mechanism on inside of door. Inspect the forward latch lever to ensure that it is within the detent position of the main striker plate. Visually check he remaining latch levers for correct positioning and snug fit.

D. Pilot and Cargo Door Hinge Repair

(1). Removal of Door Hinges

(a). Remove door and drill out hinge attaching rivets.

(b). Install replacement hinges at body attach points with door hinge pins.

(c). With damaged hinges removed, install doors in closed position. Have an assistant retain door in place by actuating door handle locking levers.

(d). If required for door fit, use one-piece solid aluminum alloy shim, up to 0.040 inch (1.016 mm) maximum thickness trimmed flush with hinge outer edges, under upper or lower hinge (between hinge and door exterior).

(e). Mark hinge rivet attach locations through existing holes in door. Locate and mark blind rivet attach points (cargo door only).

(f). Remove door hinges and check for proper edge distance.

(g). Drill holes with a No. 41 drill at pilot's door upper and lower hinge aft attach points. Use a No. 21 drill at all other pilot and cargo door attach points.

(h). On pilot's door upper hinge, install rivets with washer's under bucked heads.

(i). Install rivets at remaining pilot's door attach points.

(j). Install two mechanically expanding rivets at aft cargo door hinge attach points.

(k). Install four rivets at remaining attach points.

(l). Paint as required.

(m). Install doors and perform an operational check.

(2). Replacement of Pilot's and Cargo Door Hinge and Preload Spring

(Ref. Figure 3-13)

NOTE: Preload spring is used only on current type door hinge installation.

(a). Remove two cotter pins and clevis pins.

(b). Remove door spring first; then preload spring.

(c). Replace preload spring; with longest flat area outboard and aft in hinge body recess.

(d). Replace door spring; with longest flat area also outboard and aft in body hinge recess. Forward curved area of door hinge presses against preload spring inboard curved area, at installed position.

(e). Install hinge pins and cotter pins. Pins may be installed upward if interference does not permit installation with cotter pin hole down.

(f). Cover exposed sharp edges of cotter pins and pins with sealer (60, Table 2-4).

(3). Replacement of Pilot's and Cargo Door Rubber Stop

Replace rubber door stop if damaged or partially separated. Remove door stops by carefully prying bonded rubber out of hinge recess. Bond new stop to forward end of hinge recess with adhesive (19).

E. Pilot and Cargo Door Window Repair

(Ref. Figure 3-10) Refer to FAA AC 43.13.1 For repair of plastics. Replace window as follows. refer to FAA AC 43.13-1A. Replace window as follows:

(1). Remove snap vent from window.

(2). Drill out rivets attaching window retainers to door structure and remove window. Remove two screws, washers and nuts from door hinge doubler.

(3). If door frame or window is to be reused, carefully scrape off sealant around edge of door or window frame using a wooden, plastic or other suitable nonmetallic scraper.

(4). Repair retainer-to-window bond, if applicable, with dichloromethane (38, Table 2-4) or ethylene chloride (39); or use PS-18 or S147 cement (45).

(5). Trim retainer as required to provide clearance for door handle and end butt joint.

(6). For windows with the flat retainer, clamp replacement in position and drill retainer using holes in door flange as a guide. 0.380 inch (9.652 mm) minimum engagement and flush fit with window frame. Trim excess if required.

(7). For windows with the angled retainer, clamp window in position and use a hole finder to locator holes in door reinforcing frame. Mark the retainer; then remove window assembly and drill retainer.

(8). For sealed Windows with the single leg type retainer:

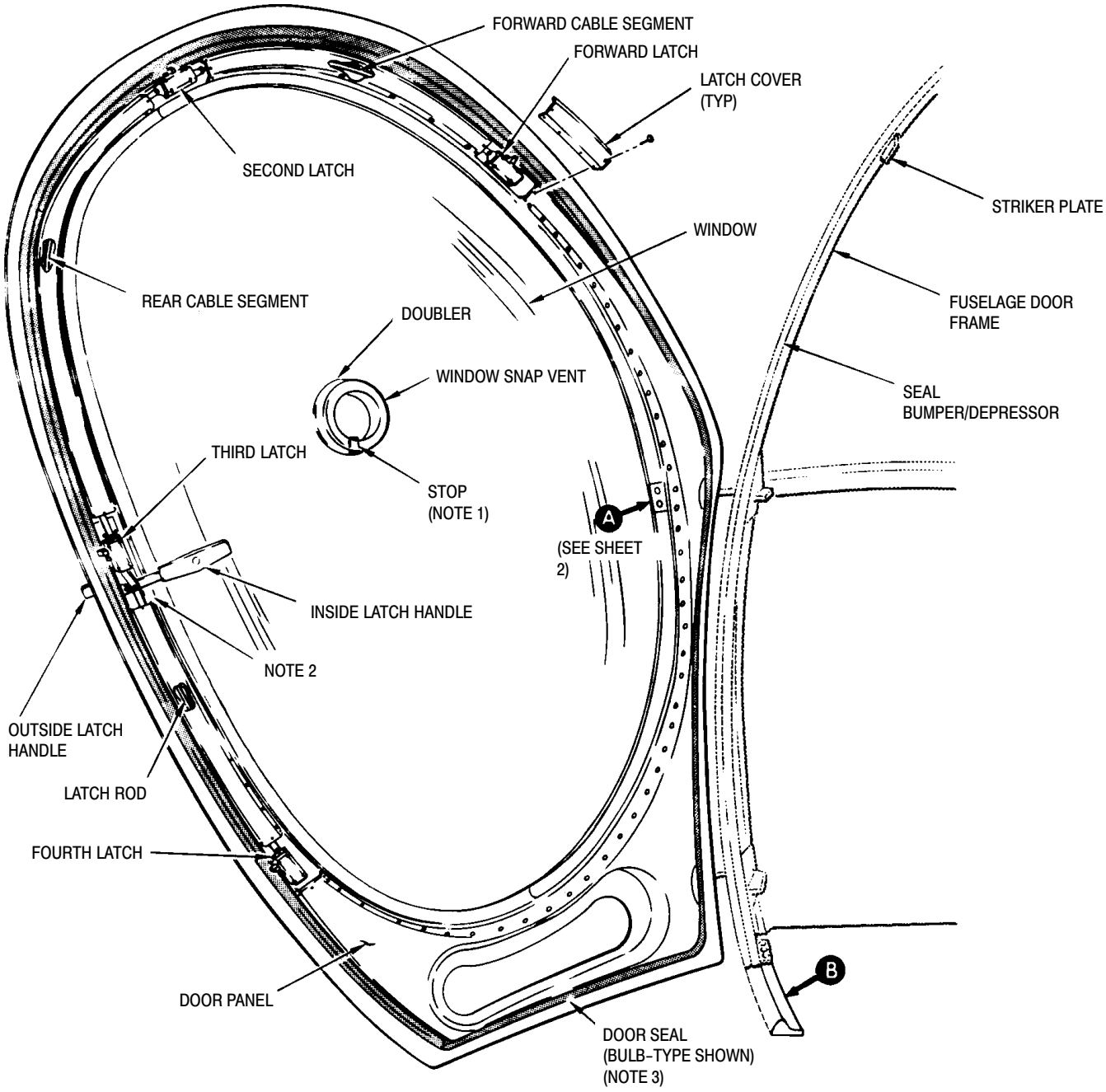
(a). Place window in position and check for 0.380 inch (9.652 mm) minimum engagement and flush fit with window frame. Trim excess if required.

(b). Use 3M Company #4508 tape (138), 0.50 inch (12.7 mm) width, to replace original sponge rubber seal. Bond seals to retainer and to door frame using adhesive (69); bond inside of seals to window using sealant (3). Do not stretch seals when bonding.

(c). With retainer and window in position on door frame, press down firmly and evenly on retainer so that seals are compressed tightly against window around full circumference of door frame.

(d). Using a hole finder, locate existing holes in door reinforcing frame. Mark and drill and drill holes in retainer. It is permissible to install new rivets between existing holes in rivet pattern.

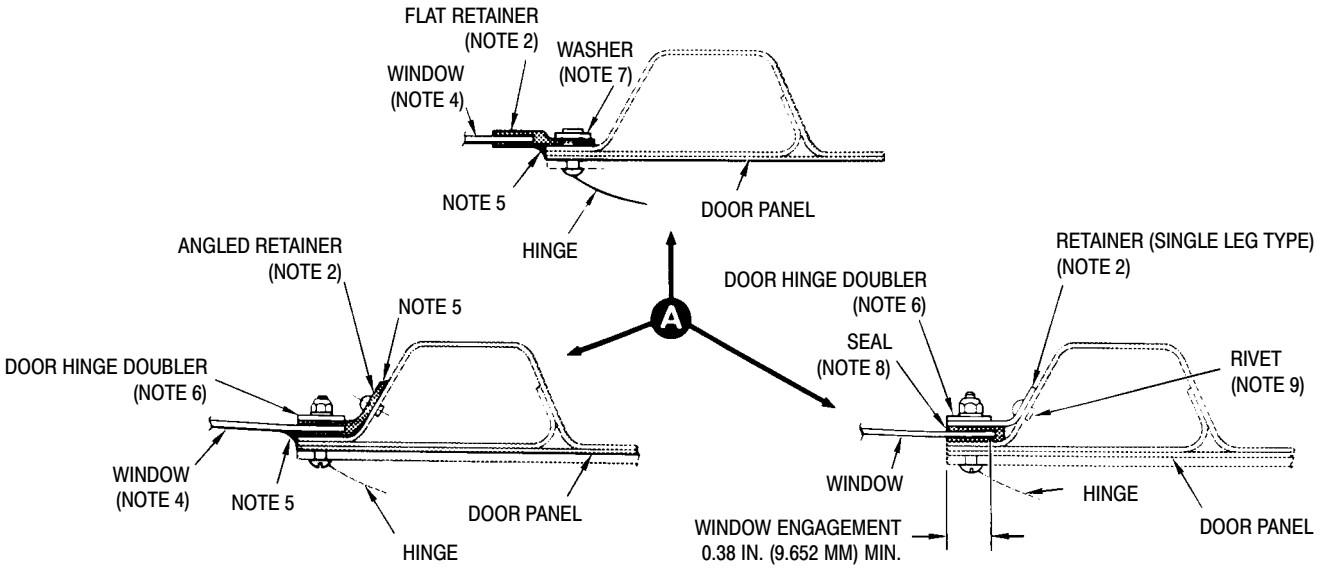
(9). Rivets window to door using rivets of appropriate length Note that blind rivets are used for retainers riveted to door reinforcing frame.



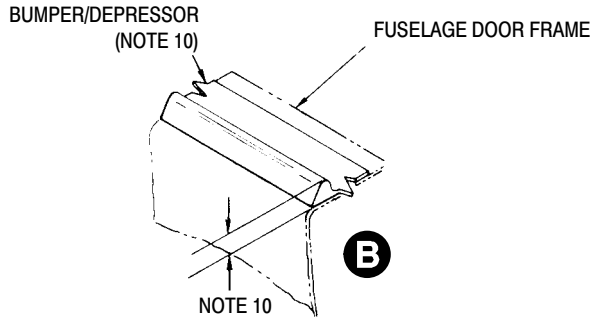
NOTES:
1. NOT ON ALL WINDOWS.
2. TRIM RETAINER IF REQUIRED TO PROVIDE CLEARANCE FOR DOOR HANDLE.
3. BOND SEAL TO DOOR WITH ADHESIVE (68, TABLE 2-4).

30-142-1A

Figure 3-10. Pilot's Door, Auto-Latching (Sheet 1 of 2)



TYPES OF WINDOW ATTACHMENT

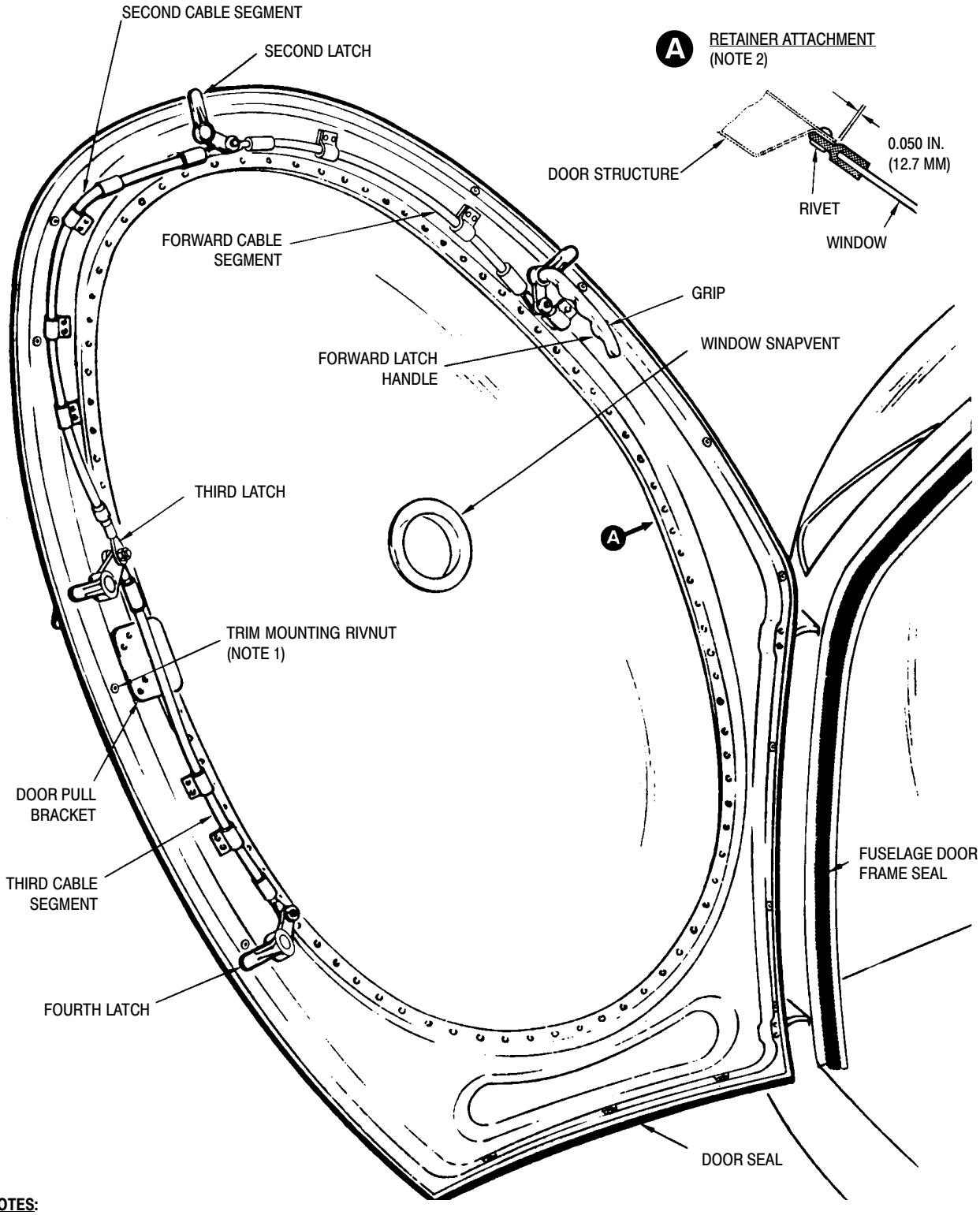


NOTES: (CONT)

4. CLEAN PLASTIC SURFACES TO BE BONDED WITH ALIPHATIC NAPTHA (58, TABLE 2-4). REPAIR WINDOW-TO-RETAINER BOND WITH DICHLOROMETHANE (38) OR ETHYLENE CHLORIDE (39) OR USE PS-18 OR S147 CEMENT (45).
5. APPLY A 0.060 IN. (1.524 MM) BEAD OF SEALING COMPOUND (3, TABLE 2-4).
6. ON THIS TYPE, INSTALL DOUBLER AT HINGE LOCATION WITH TWO SCREWS, WASHERS AND NUTS.
7. ON THIS TYPE, INSTALL WASHER UNDER SHOP-FORMED RIVET HEAD AT HINGE LOCATION.
8. USE 3M COMPANY #4508 TAPE, 0.50 IN. (12.7 MM) WIDTH, TO REPLACE ORIGINAL SPONGE RUBBER SEAL. BOND SEALS TO DOOR FRAME WITH ADHESIVE (68, TABLE 2-4). BOND INSIDE OF SEAL TO WINDOW WITH SEALANT (3). DO NOT STRETCH SEAL WHEN BONDING.
9. COMPRESS SEAL EVENLY AROUND DOOR FRAME WITH RETAINER IN PLACE; LOCATE HOLES, DRILL AND RIVET. NEW RIVETS MAY BE INSTALLED BETWEEN HOLES OF EXISTING RIVET PATTERN.
10. TWO TYPES ARE IN USE;
    BUMPER EXTRUSION IS 0.22 IN. (5.588 MM) HIGH WITH 0.060 IN. (1.524 MM) RADIUS.
    DEPRESSOR EXTRUSION IS 0.31 IN. (7.874 MM) HIGH WITH 0.030 IN. (0.762 MM) RADIUS.

30-142-2C

Figure 3-10. Pilot's Door, Auto-Latching (Sheet 2 of 2)

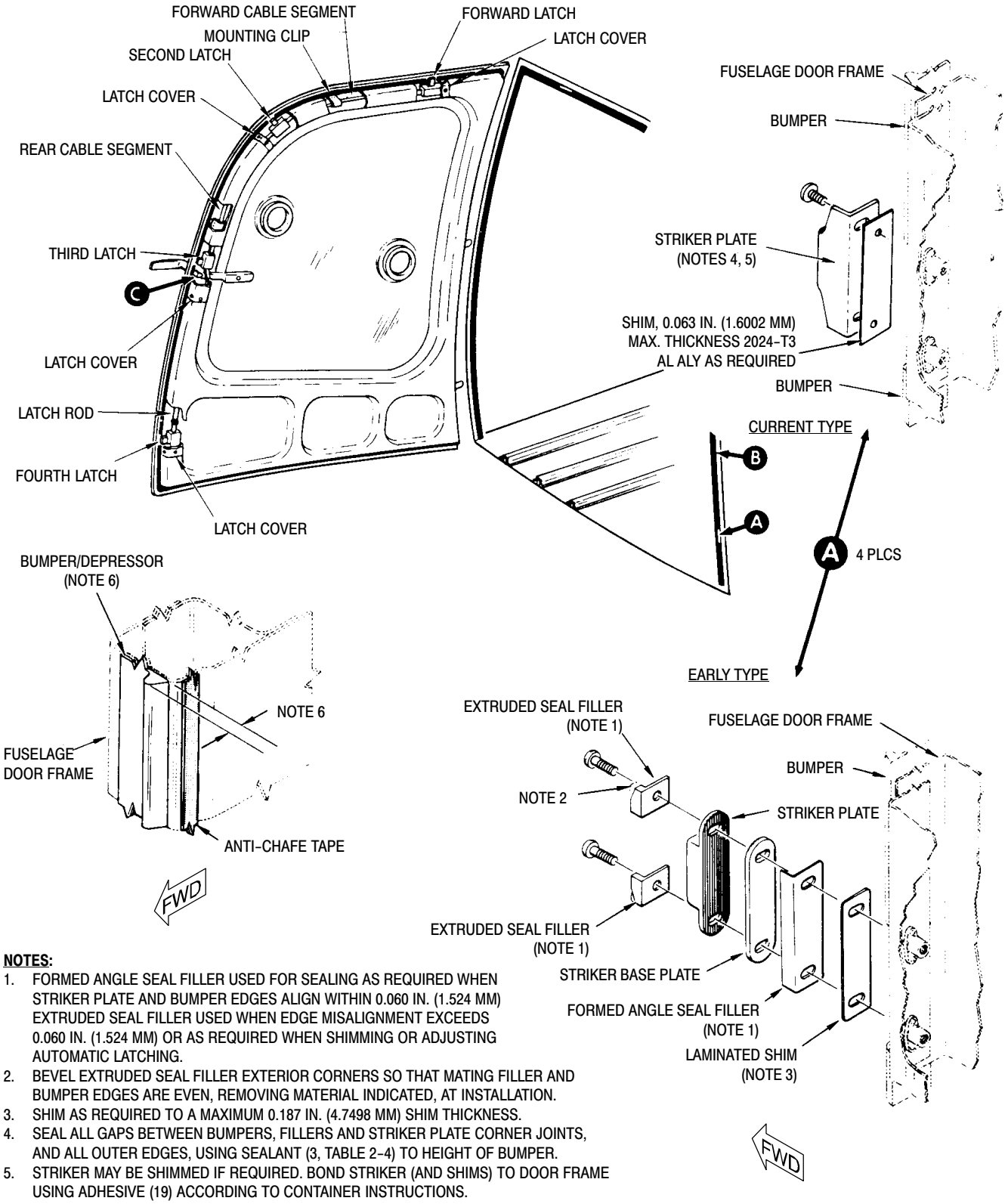


NOTES:

1. DOOR INTERIOR TRIM NOT SHOWN.
2. THE SINGLE LEG RETAINER AND SEAL TYPE OF WINDOW ATTACHMENT SHOWN FOR AUTOLATCHING PILOT'S DOOR ALSO APPLIES TO THIS.

30-021E

Figure 3-11. Pilot's Door, Manual Latching



NOTES:

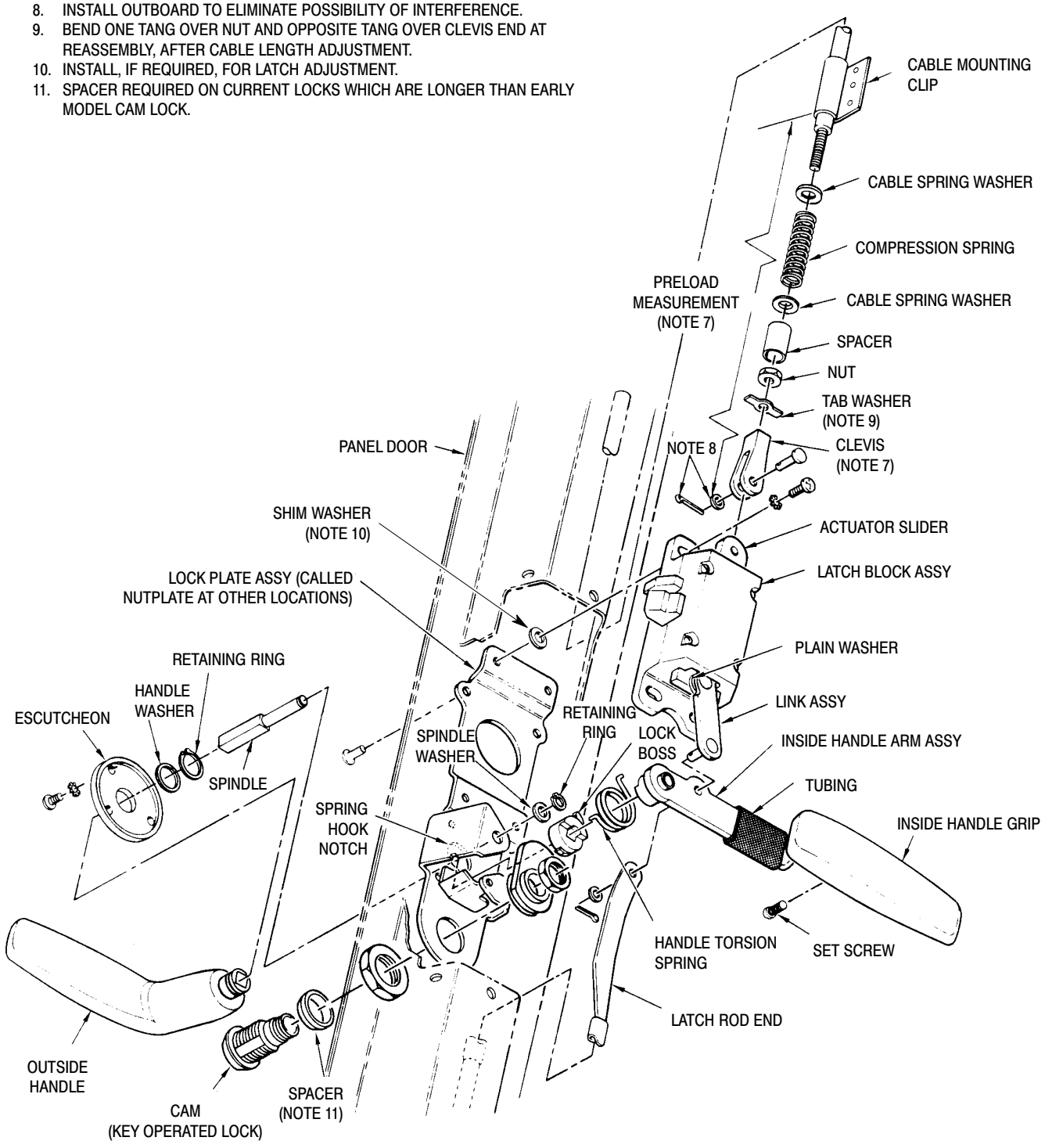
1. FORMED ANGLE SEAL FILLER USED FOR SEALING AS REQUIRED WHEN STRIKER PLATE AND BUMPER EDGES ALIGN WITHIN 0.060 IN. (1.524 MM) EXTRUDED SEAL FILLER USED WHEN EDGE MISALIGNMENT EXCEEDS 0.060 IN. (1.524 MM) OR AS REQUIRED WHEN SHIMMING OR ADJUSTING AUTOMATIC LATCHING.
2. BEVEL EXTRUDED SEAL FILLER EXTERIOR CORNERS SO THAT MATING FILLER AND BUMPER EDGES ARE EVEN, REMOVING MATERIAL INDICATED, AT INSTALLATION.
3. SHIM AS REQUIRED TO A MAXIMUM 0.187 IN. (4.7498 MM) SHIM THICKNESS.
4. SEAL ALL GAPS BETWEEN BUMPERS, FILLERS AND STRIKER PLATE CORNER JOINTS, AND ALL OUTER EDGES, USING SEALANT (3, TABLE 2-4) TO HEIGHT OF BUMPER.
5. STRIKER MAY BE SHIMMED IF REQUIRED. BOND STRIKER (AND SHIMS) TO DOOR FRAME USING ADHESIVE (19) ACCORDING TO CONTAINER INSTRUCTIONS.
6. TWO TYPES ARE IN USE:
   BUMPER EXTRUSION IS 0.22 IN. (5.588 MM) HIGH WITH 0.060 IN. (1.524 MM) RADIUS.
   DEPRESSOR EXTRUSION IS 0.31 IN. (7.874 MM) HIGH WITH 0.030 IN. (0.762 MM) RADIUS.

30-143-1A

Figure 3-12. Cargo Door, Auto-Latching (Sheet 1 of 2)

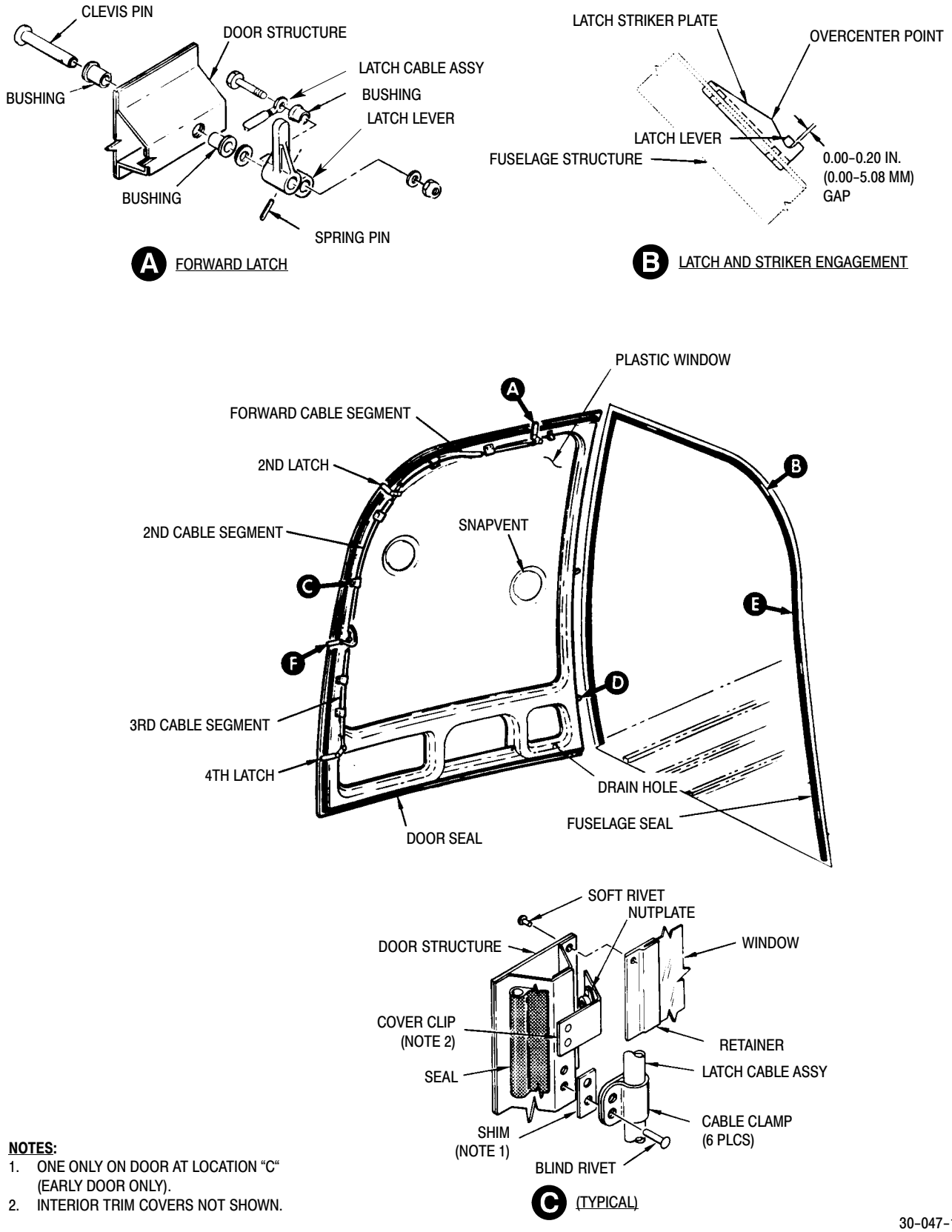
NOTES: (CONT)

7. REFER TO TEXT FOR CABLE LENGTH AND FOR SPRING PRELOAD ADJUSTMENTS.
8. INSTALL OUTBOARD TO ELIMINATE POSSIBILITY OF INTERFERENCE.
9. BEND ONE TANG OVER NUT AND OPPOSITE TANG OVER CLEVIS END AT REASSEMBLY, AFTER CABLE LENGTH ADJUSTMENT.
10. INSTALL, IF REQUIRED, FOR LATCH ADJUSTMENT.
11. SPACER REQUIRED ON CURRENT LOCKS WHICH ARE LONGER THAN EARLY MODEL CAM LOCK.



30-143-2F

Figure 3-12. Cargo Door, Auto-Latching (Sheet 2 of 2)

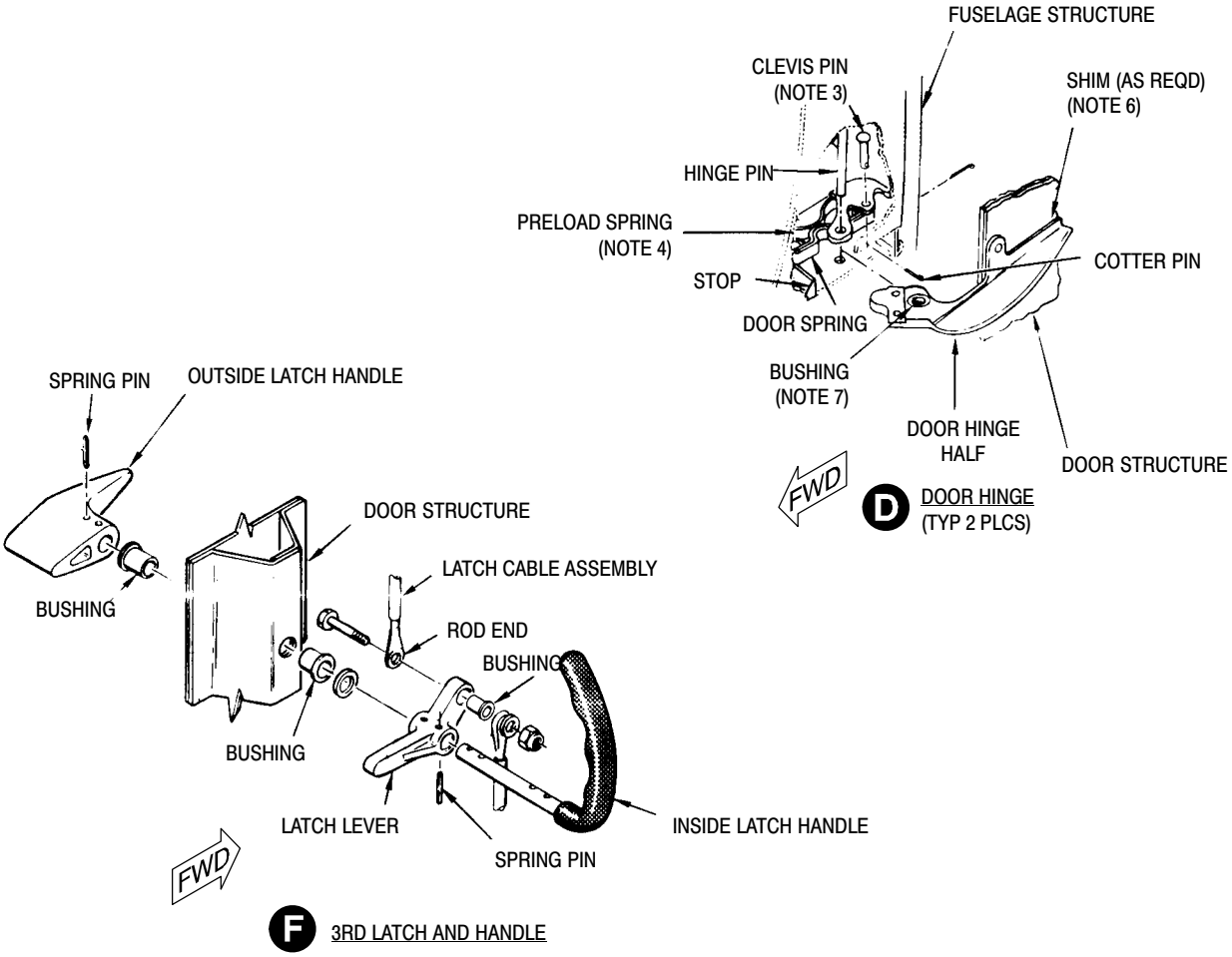


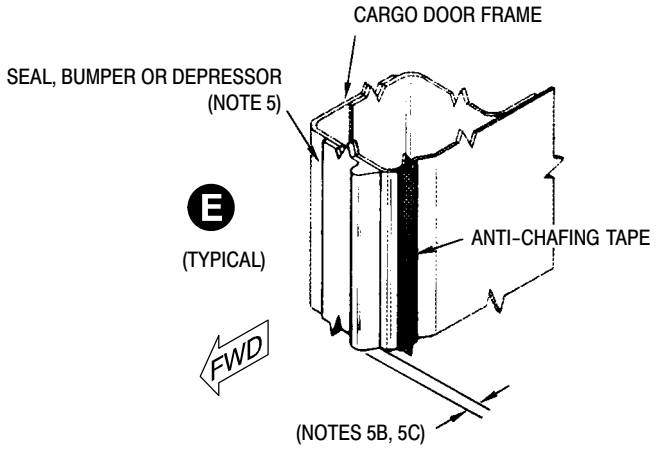
NOTES:

1. ONE ONLY ON DOOR AT LOCATION "C" (EARLY DOOR ONLY).
2. INTERIOR TRIM COVERS NOT SHOWN.

30-047-1C

Figure 3-13. Cargo Door, Manual Latching (Sheet 1 of 2)





NOTES: (CONT)

3. SEAL BOTH ENDS WITH SEALANT (59, TABLE 2-4) AT INSTALLATION.
4. CURRENT DOOR HINGES ONLY.
5. THREE TYPES ARE IN USE:
   A. RUBBER SEAL.
   B. BUMPER EXTRUSION 0.22 IN. (5.588 MM) HIGH WITH 0.060 IN. (1.524 MM) RADIUS.
   C. DEPRESSOR EXTRUSION 0.31 IN. (7.874 MM) HIGH WITH 0.030 IN. (0.762 MM) RADIUS.
6. MAXIMUM 0.040 IN. (1.016 MM) SHIM IF REQUIRED FOR DOOR FIT. ONE-PIECE ALUMINUM ALLOY SHIM TRIMMED FLUSH WITH HINGE HALF OUTER EDGES.
7. BUSHING NOT USED ON STEEL DOOR HINGES.

30-047-2D

Figure 3-13. Cargo Door, Manual Latching (Sheet 2 of 2)

(10). Spread a 0.060 inch (1.524 mm) bead of sealant compound (3) around exterior edge of window and door flange (except sealed windows with single leg retainer) frame.

(11). On doors originally equipped with doubler, install doubler over retainer at hinge area with two screws, washers, and nuts. Drill (No. 21 drill) and ream (0.166 inch (4.2164 mm) diameter) window panel for screws, using slow speed drill (700 to 800 rpm).

(12). Install snapvent.

(13). Remove protective covering and clean window.

F. Geon Strip Repair

Fill voids between geon strips and transparencies as follows.

(1). Measure the insertion depth of acrylic windshield into geon slot, reject parts having less than 0.125 inch (3.175 mm) insertion. Replace parts with debonding areas over 8 inches (20 cm) in length.

(2). Mask the geon weather strip and windshield on both sides with 3M polyethylene masking tape (132, Table 2-4).

(3). Wipe all faying surfaces with aliphatic naphtha (59) and air dray for a minimum of 15 minutes.

(4). For small voids.

(a). Apply cyanoacrylic adhesive (133) to all fraying surfaces using syringe if necessary.

(b). Use light pressure to hold the joint closed for a minimum of 2 minutes.

(5). For large voids, Hysol Super Drop Accelerator (134) may be used.

(a). Apply accelerator to the acrylic transparency and air dry for a minimum of 2 minutes.

(b). Apply 3CI-1000 adhesive to the geon weatherstrip only.

(c). Apply local pressure to insure complete contact between adherents and maintain pressure for a minimum of 30 seconds.

(6). Remove masking tape and remove residue with aliphatic naphtha.

G. Window Snapvent Replacement

(1). Removal of Window Snapvent

Push snapvent outward in window (open position). Grasp open side of snapvent and gently squeeze it into an elliptical shape. Slip snapvent out of window hole at about a 30 degree angle to surface of window.

(2). Installation of Window Snapvent

Grasp open end of snapvent and gently squeeze it into an elliptical shape. Slip snapvent flange into window hole at an angle of about 30 degrees to window surface. Be sure that ends of wire stiffener are inside window hole.

20. Door Latching Mechanism

Current type door latching mechanisms automatically latches the door when the door are closed. Early type door latching mechanisms are manually actuated. The automatic door latching mechanism (Ref. Figure 3-10), installed within the door panel, consist of four latching blocks that house spring-loaded latch bolts and safelock bolts together with actuator sliders. The latch sliders are interconnected by cables and connectors and are moved by turning the inside or an outside door handle. The system allows the door to be closed and safelocked from inside or outside. The handle contains a key-operated cam lock, actuated from outside. Moving the inside handle to the open position will overrides the cam lock and allow the door to be opened. Movement of either handle into safelock position is prevented until the door is closed and the safelock bolts are actuated by strikes. This actuation causes the safelock bolts to clear notches on actuator sliders, allowing the sliders and linkage to move into safelock position. The pilot's and cargo door auto-latching mechanisms are essentially the same except for length of interconnecting cables. The manual door latching mechanism (Ref. Figure 3-11) consists of four lever type latches and three

lengths of wire-reinforced cable within aluminum housing.

A. Door Latching Mechanism Inspection and Repair

(1). Inspection

As applicable to type of installation, check the following under magnification and strong light:

(a). All parts for excessive wear, nicks, cracks and corrosion.

(b). Threaded parts for worn, crossed or otherwise damaged threads.

(c). Latch block assemblies for broken springs and wear on strike contact surfaces of latching bolts; and for undue wear of latch sliders, bolts and bolt rollers.

(d). Retaining rings for distortion.

(e). Cam lock for jamming when key is operated.

(f). Link assembly for wear or distortion.

(g). Handles for distortion, worn pivot holes and worn finish.

(h). Escutcheon and handle for dents, distortion, or worn finish.

(i). Lock plate assembly for wear, distortion, thread damage and breakage.

(j). Latch block nutplates for thread damage and loose rivets.

(k). Cables and connector for wear in clevis pin holes, thread damage, distortion or loose clamps. holes, thread damage, and distortion.

(2). Repair

Replace worn or damaged parts as necessary. Disassemble only to extent required for replacement of parts. Refer to Figure 3-12 for an exploded view showing disassembly relationship for the auto-latching door mechanism, or Figure 3-13 for the manually actuated door latching mechanism. Also perform following steps as required:

(a). Lubricate all moving parts except lock, with grease (57, Table 2-4) to prevent binding.

(b). Lubricate lock with powdered graphite (111).

(c). At time of disassembly clean reusable parts except locks, using soft bristle brush dipped in solvent (1). Dry parts, using clean, lint-free cloth or dry compressed air at 20 psi (138 kPa) maximum.

(d). Clean key-operated cam locks, using dry compressed air at 20 psi (138 kPa) maximum.

(e). Touch up handles with semigloss black acrylic lacquer (6).

(f). Eliminate binding by lubricating moving parts, Eliminate persistent binding in the cables by bending the conduits, taking care not to dent or crease them.

NOTE: Cables are bonded to clamps that are riveted to the structure. If removal is necessary, rivets must be drilled out.

B. Pilot and Cargo Door Automatic Latch Replacement

(1). Perform this procedure with the door in the open position. Handles will be at the latched rest position (Ref. Figure 3-1 1).

(2). Remove screws securing cover (Ref. Figure 3-12) on door and remove cover.

(3). Mark the lock plate so that replacement latch block can be installed at approximately the same position as the latch that is to be removed.

(4). Remove four screws and washers securing latch block to lock plate. Make note of any washers found between the latch block and lock plate. These are adjustment shims and should be reinstalled in the same position during latch installation.

(5). Remove cotter pin, washer and pin securing rod or cable end clevis to top of latch block. Remove latch block from door.

NOTE: The latch rod end below the inside handle arm is detached by removing the cotter pin and washer from the latch block link that attaches rod end to inside handle. Latch movement may be required to disengage link pin from handle and clevis from latch block.

(6). Install replacement latch block by performing applicable latch removal procedures inverse order. Replacement latch should be installed at approximate same position from which old latch was removed.

NOTE: When reconnecting latch rod end or cable clevis, the washer and cotter pin should be installed outboard to eliminate possibility of interference.

(7). Adjust latch engagement and be sure door closes and seals correctly.

C. Pilot and Cargo Door Automatic Latch Adjustment

(Ref. Figure 3-10, Figure 3-12 and Figure 3-14)

(1). Make a preliminary check of door latching as follows.

(a). Pull the door closed from inside. Each of the latch bolts should make contact with their respective striker plates at the same time and latch evenly. Unequal striking and latching indicates that latch assembly or striker plate positions should be adjusted.

(b). Safelock the door and observe that the door is forced inward for seal compression at each latch position. Check that a minimum of 0.125 inch (3.175 mm) of the flat surface (beyond the angled leading edge) of each latch bolt is engaged with the face of the striker plate. Unequal safe-locking may indicate that the latch cables are not properly adjusted for complete extension of the latch bolts.

(2). Remove the four latch covers.

(3). Adjust the positions of the latch assemblies and/or striker plates as required, using the following methods.

(a). Adjust the door inboard or outboard by moving the striker plates in their slotted mounting holes or by the removal or addition of shim washers under the latch assemblies.

(b). Adjust the depth of engagement of the latch bolts with the striker plates by moving the latch assemblies in their slotted mounting holes or by the removal or addition of shims under the striker plates.

NOTE: Current type striker plates are also bonded to door frame structure. If loosening or removal of these plates is required, clean the mating surfaces with naphtha (59, Table 2-4) andrebond with adhesive (19) after correct striker plate position is determined.

(4). Adjust latch cables and rod for simultaneous latch bolt extension and complete safe-locking as follows.

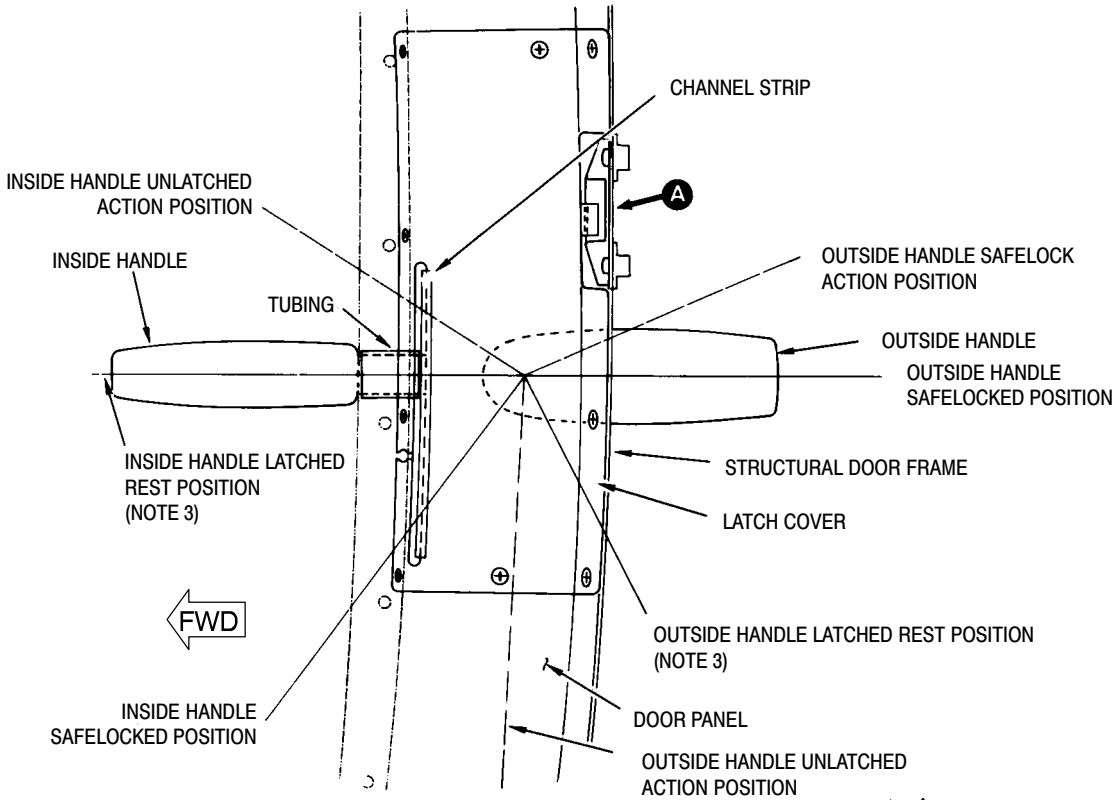
NOTE: Complete safe-locking is that point at which latch bolt extension is at maximum and the roller on the safelock trigger is engaged in the safelock slot in the latch slide (Ref. Figure 3-14). In this position the safelock trigger can be observed to retract when the latch slide is moved slightly in unlatch direction.

(a). With the door in the open position or removed from the helicopter, actuate the latches to safelocked position.

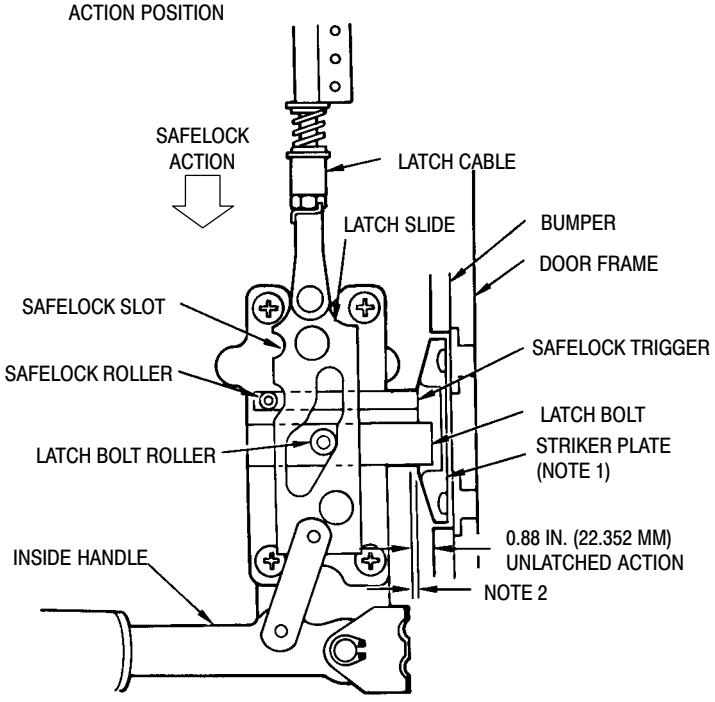
NOTE: With the door open or removed it is necessary to depress all safelock triggers at the same time in order to rotate the latch handle to safelock position.

(b). Remove the clevis pin from the cable or latch rod of the latch being adjusted. Move the latch slide manually to the complete safelock position and then adjust the cable or latch rod length so that clevis pin can be reinstalled easily.

NOTE: The fourth and the forward latches can be individually adjusted without disturbing the adjustment of the other latches. However, if the second or third latches are adjusted then all should be checked.



HANDLE POSITIONS
(RIGHT DOOR INSIDE VIEW)



A LATCH ENGAGEMENT
(THIRD LATCH INTERIOR SHOWN FOR CLARITY)

NOTES:
1. CURRENT TYPE STRIKER PLATE SHOWN.
2. WHEN LATCH IS COMPLETELY SAFELOCKED, A MINIMUM OF 0.125 IN. (3.175 MM) OF FLAT SURFACE (BEYOND ANGLED LEADING EDGE) OF LATCH BOLT MUST BE ENGAGED WITH STRIKER PLATE.
3. LATCHED REST POSITION APPLIES WITH DOOR OPEN OR CLOSED.

30-144E

Figure 3-14. Latch Engagement for Auto-Latching Door Handle Positions

(c). For complete rigging of all latches, remove clevis pins from all cable and latch rod connections and move all latch slides to the complete safelock position. Adjust cable and latch rod length for easy installation of clevis pins. Start with the third latch and proceed to the second, to the forward and then to the fourth.

(5). Latch compression spring preload adjustment should be checked if a change has occurred to affect spring preload. Replacement of parts in the stack-up between the upper clevis pin on the third latch and the first cable mounting clip (Ref. Figure 3-12) or a change in position of the cable mounting clip is cause for preload adjustment.

(a). With the main (third) latch in safe-locked position measure the distance from the center of the upper clevis pin to the shoulder of the cable mounting clip. Add 0.060-0.080 inch (1.524-2.032 mm) to this measurement and record. This is the required parts stack-up length.

(b). Remove clevis and the complete stack up of parts from the third latch to the cable mounting clip. Note and record the number of turns required to remove clevis so that it can be returned to original position without further adjustment.

(c). Assemble the stack-up with all parts in contact and the spring in relaxed condition. Measure from the center of the clevis pin hole to the outer edge of the last washer and record.

(d). Compare this last measurement, Step (c)., with the required stack-up length recorded in Step (a). above. Record the amount to be added or subtracted.

(e). Adjust stack-up length by the amount recorded in Step (c). by using a longer or shorter spacer and by grinding and filing the spacer as required.

(f). Reinstall all parts and be sure that clevis is engage to the same of number of turns as recorded in Step (b). above.

(6). Tighten all clevis retaining nuts and bend tangs of tab washer, one over the clevis and one over the nut, for safety.

(7). Install washers and cotter pins in all clevis pins. Washers and cotter pins are to be installed on the outboard side to preclude interference with door structure.

(8). Make a final check of door latching, safe-locking and key-locking. Install the latch covers.

(9). Fill in gaps and fair-in the area between latch striker plates and bumper strips at each position, using sealant (3).

D. Pilot and Cargo Door Manual Latch Adjustment

(Ref. Figure 3-11 and Figure 3-13)

(1). With the door in the open position, rotate the latch handle to the locked position.

(2). Check all latch levers. The levers should be positioned at approximately 90 degrees to the straight door edge and in line with the radius of the curved door edges.

(3). Remove nuts, washers and bolts at the adjustable rod end on each cable segment.

(4). Turn adjustable rod ends and change cable length as required to properly position latch levers with bolt installed in Step (2).

NOTE: A change in the length of one cable segment can affect the position of all the latch levers. Therefore, start adjustment at the forward cable segment and work progressively to second: then third segments while maintaining adjusted latch position.

(5). Close and latch the door. Check that the latch levers rotate past the over-center point on striker plates and are in the position shown in detail B of Figure 3-13.

(6). Open the door and make adjustment of cable rod ends as necessary to meet requirements of Step (5).

(7). Check that bushings are installed in latch levers. Install bolts, washers and nuts.

E. Pilot and Cargo Door Auto-Latching Handle Replacement

(1). Replacement of Outside Handle.

(a). Open the door.

(b). Remove three screws and washers securing handle escutcheon to door exterior. Drive spring pin (if installed) from handle and slide handle from spindle (Ref. Figure 3-12).

(c). Remove escutcheon from handle by removing retaining ring and handle washers.

(d). Attach replacement handle to escutcheon with handle washers and retaining ring. Use the maximum number of handle washers possible without impeding free movement between the handle and the escutcheon.

(e). Slide handle on spindle and secure escutcheon to door with washers and screws.

NOTE: Spring pin NAS561P4-16 may be installed for additional security of handle attachment: line drill through exterior door handle and door latch shaft (spindle), then install pin through handle and shaft. Be sure that handles are horizontal when mechanism is in the safe-lock position.

(2). Replacement of Inside Handle or Cam Lock.

(a). Open the door.

(b). Remove outside handle (Step (1).) but do not disassemble escutcheon from handle.

(c). Remove cotter pin and washer from link assembly pin connecting latch rod end to link and handle arm.

(d). Loosen latch block mounting screws far enough to allow raising of latch block to disengage link pin from latch rod end and handle arm. If required, remove the four latch block mounting screws.

NOTE: Marking the location of the latch block on the lock plate inside the door panel aids reattachment at approximate same position.

(e). Note position of the lock boss and handle torsion spring to aid reinstallation.

(f). Remove retaining ring and spindle washer securing spindle to the lock plate.

(g). Hold handle, lock boss and torsion spring in position and withdraw spindle. Then slide handle, lock boss and torsion spring out of the lock plate. Use care to avoid dropping parts into the door channel cavity.

(h). Disassemble handle grip from handle arm by loosening setscrew and sliding grip from arm.

NOTE: Current cam lock is longer than early model cam lock and requires a spacer between lock flange and outside surface of door skin.

(i). As required, replace key-operated cam lock by unscrewing hexagonal nut.

NOTE: When the lock is in the locked position, be sure that the cam has actuated the hinged lock bar. When lock is in correct position, lock it in place by center punching surface of lock plate assembly close to flat on hexagonal locking nut.

(j). Holding lock boss, torsion spring and replacement handle together, slide the assembly into position and insert spindle.

(k). Install spindle washer and retaining ring to secure the spindle in the lock plate.

(l). Attach one spring hook to ear of lock boss (or in hole of current type boss) and attach the other spring hook at notch in the lock plate. Use safety-wire to pull the spring hook into plate.

(m). Reconnect link and latch rod end to handle arm with cotter pin and washer.

NOTE: Cotter pin and washer should be installed on outboard side of latch rod end to eliminate possibility of interference. Use extra washers for shimming to eliminate excess play.

(n). Secure latch block to lock plate at original marked position with four screws and washers.

(o). Install outside handle (Step (1).).

(p). Check door latching and safe-locking operation and make any adjustments necessary.

21. 369H90085 Litter Door Installation Inspection

(1). Visually inspect installation to ensure proper condition and security of the quick-release fastener assemblies and the rubber seal (gasket) installed between the window glass and door frame.

(2). Remove quick-release fasteners securing windows to litter doors and inspect each fastener for condition and each anchor receptacle in door structure for condition and security of attachment.

(3). Replace fastener if stud is loose or worn; replace anchor receptacle and/or rivets as required.

(4). Rebond rubber seal to door structure if it is not fully intact. Replace seal if it is worn, cracked or hard.

(5). Reinstall window assemblies to litter doors with quick-release fasteners, then check for gaps between window glass, rubber seal and door structure.

(6). Replace seal and/or use shorter length studs to close any gaps. Use longer length studs if seal is extruded.

22. Pilot and Cargo Door Seal Compression Check

Inspect the rubber weather-strip compression seal for tight compression between the door and frame as follows.

(1). Open door.

(2). Hold a strip of heavy paper against the door seal so that the strip extends approximately 1/4 inch (6.35 mm) beyond the seal toward the outside of the doorway.

(3). While holding the paper strip in place, close and lock the door.

(4). Attempt to pull the paper strip from between the door frame and the seal. The strip should not pull out unless a moderately heavy pull is exerted.

NOTE: Correct fit is indicated by an approximate 0.060 inch (1.524 mm) interference fit between door seal and bumper. Where the strip can be withdrawn with a light pull, the fit of the door against the frame is not sufficiently tight to provide an adequate seal. This condition be due to deterioration of the weatherstrip compassion seal, deformation of the door frame, worn hinges or improper latching.

(5). Repeat steps (1). thru (4). at approximately 1 foot (30 cm) increments along the length of the door seal.

A. Pilot and Cargo Door Seal Replacement

(1). Carefully pull or scrape away damaged seal.

(2). Restore chemical film protection to any base metal exposed during cleaning process.

(3). Clean the seal contact area on metal and rubber seal.

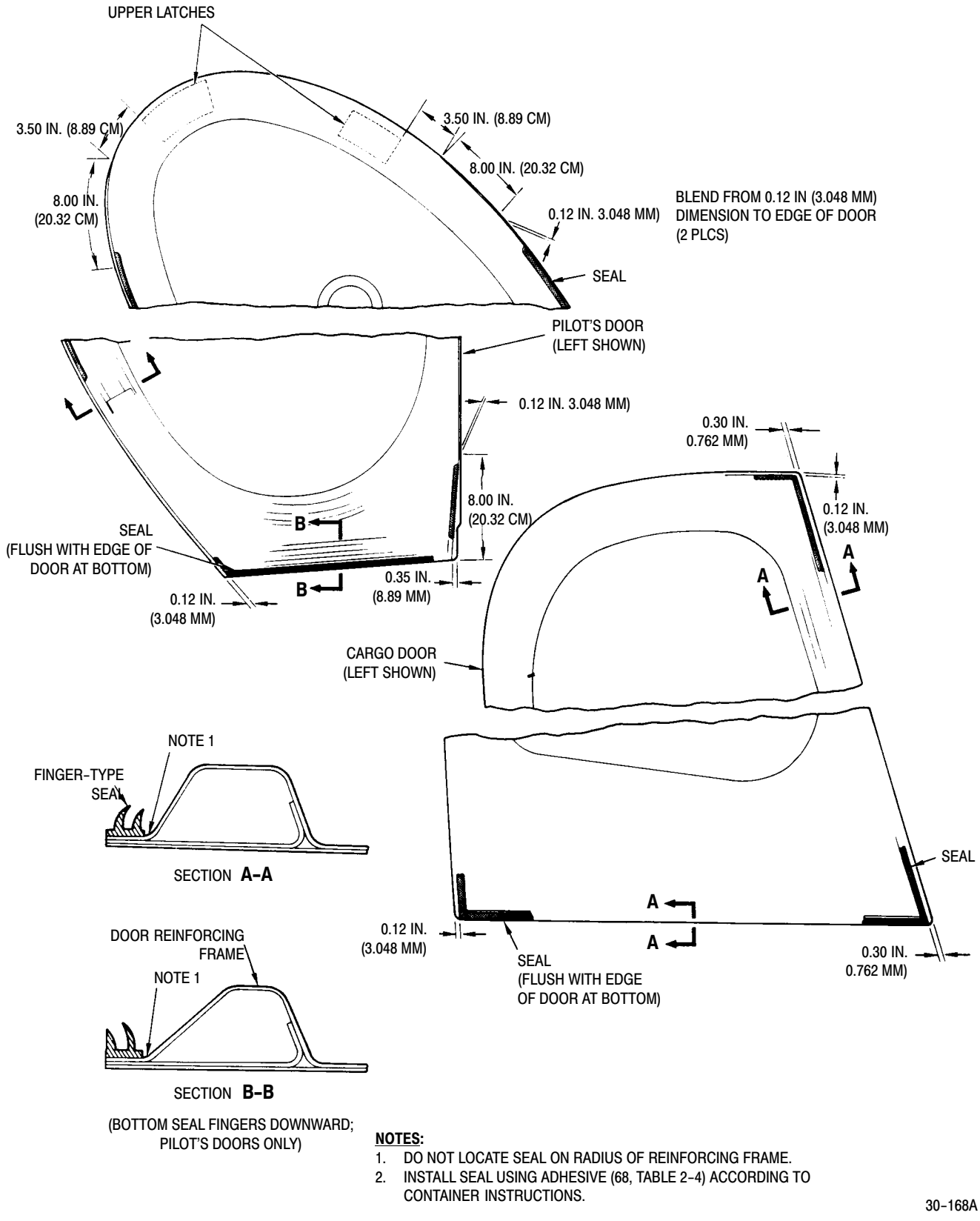


Figure 3-15. Door Seal Installation, Current Type

NOTE: The bulb-type seal is installed on the door reinforcing frame with the bulb radius and frame radius coincident (Ref. Figure 3-13) . The finger-type seal is installed on the flat door flange at the outer edge of the reinforcing frame radius. Refer to Figure 3-15 for proper location and installation.

(4). Carefully align and bond to mounting surface with adhesive (69, Table 2-4) according to container instructions.

NOTE: Correct seal mounting position results in an approximately 0.060 inch (1.524 mm) interference fit between door seal and bumper.

B. Partially Separated Pilot and Cargo Door Seal Repair

(1). Clean the separated area with naphtha (59, Table 2-4) and allow to dry for a minimum of 20 minutes.

(2). Thoroughly stir adhesive (69).

(3). Apply one uniform brush coat of adhesive to both the rubber seal and mating surface contact area. Allow to dry for 5 minutes and press mating surfaces together.

C. Pilot and Cargo Door Frame Anti-Chafing Tape Repair

Inspect the condition of the anti-chafing tape installed on the pilot's and cargo compartment door frames. For minor repair,remove defective tape where necessary. Clean frame surface with methyl -ethyl-ketone (22, Table 2-4). Replace with polyurethane pressure sensitive tape (42).

23. Improved Door Seal Installation

The following procedure is for installation of QGR2178 door seals on the cargo/passenger doors.

(1). Remove existing door seals using Desoclean 45 (183, Table 2-4) or naphtha aliphatic (59). Ensure that all surfaces are clean to allow proper adhesion of new seal material. Allow surface to air-dry a minimum of 15 minutes.

NOTE: Seals are to be installed around the entire circumference of the aft doors.

(2). Prime seal faying surface with red silicone primer and allow to air-dry a minimum of 15 minutes.

(3). Apply a thin uniform coat of cyanoacrylic adhesive (133) to faying surface of door and seal. Allow to air-dry a minimum of five minutes.

(4). Apply a second thin uniform coat of cyanoacrylic adhesive to faying surface of door and seal. Allow to air-dry a minimum of five minutes.

(5). Test glue with clean knuckle. If adhesive does not transfer to knuckle, press the seal into place.

(6). Butt joints at forward and aft lower locations.

(7). Maximum gap of 0.030 inch (0.762 mm) at butt joints.

(8). Miter joints at upper locations.

(9). Bond mitered joints with adhesive (184).

NOTE: Use glue very sparingly to achieve best bond.

(10). Trim seal flush with edge of door.

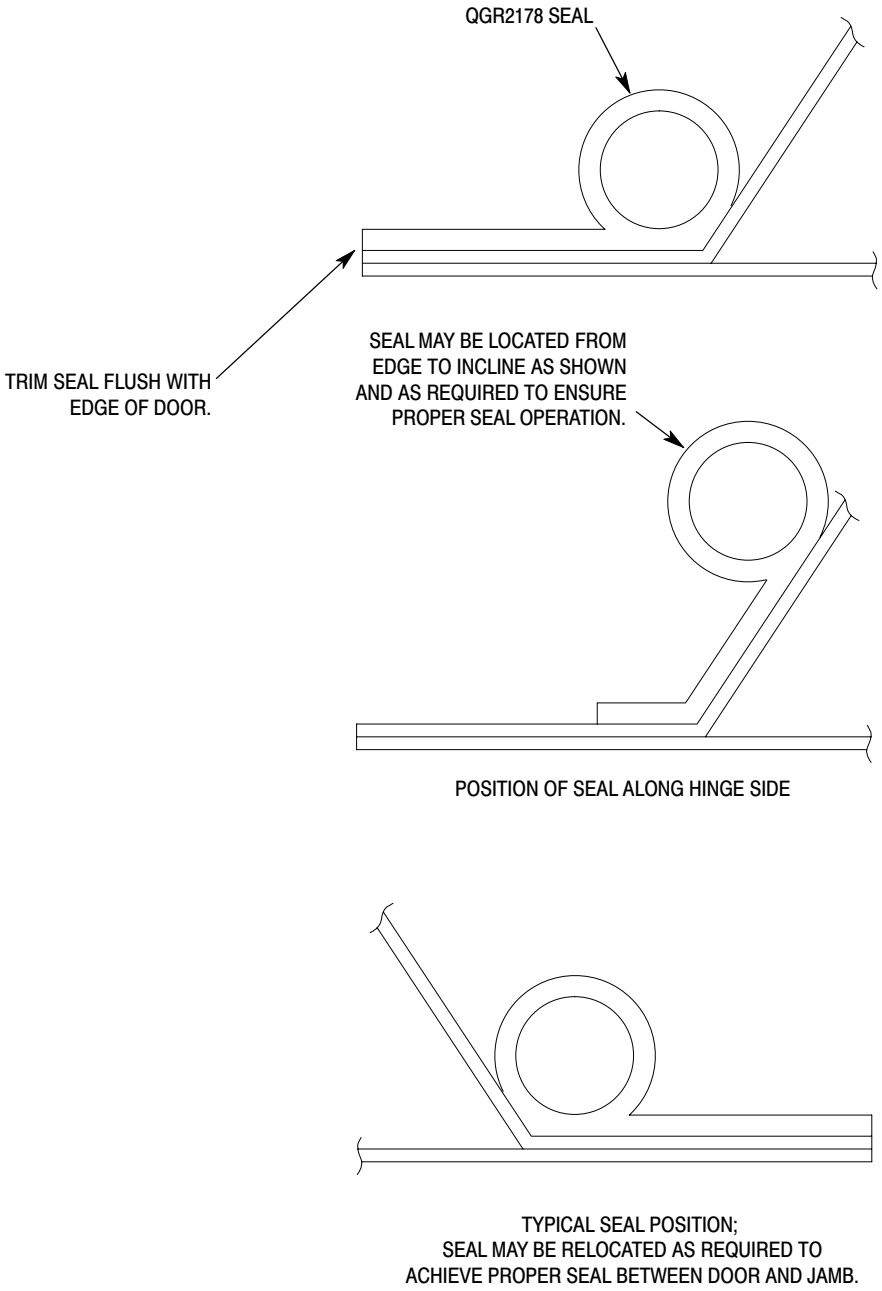


Figure 3-16. Improved Door Seal Installation

Section

4

Furnishings

TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 4 Furnishings		**4-1**
1.	Furnishings	4–1
A.	General Description of S / E Differences	4–1
2.	Crew Compartment Seats	4–1
A.	Crew Compartment Seat Replacement	4–1
B.	Passenger Compartment Seats	4–1
C.	Passenger Compartment Seat Replacement	4–1
D.	Seat Inspection	4–1
Figure 4–1.	Seat Installation – Typical (Sheet 1 of 2)	4–2
Figure 4–2.	Early Configuration Seat Belt and Shoulder Harnesses	4–4
E.	Seat Repair	4–5
3.	Seat Belts and Shoulder Harnesses	4–5
A.	Seat Belt and Shoulder Harness Replacement	4–5
B.	Seat Belt and Shoulder Harness Inspection	4–5
C.	Seat Belt Load Testing	4–5
D.	Seat Belt and Shoulder Harness Repair	4–5
4.	Interior Trim	4–5
A.	Crew Compartment Interior Trim Removal	4–6
B.	Crew Compartment Interior Trim Installation	4–6
C.	Passenger Compartment Interior Trim Removal	4–6
D.	Passenger Compartment Interior Trim Installation	4–6
Figure 4–3.	Crew Compartment Interior Trim and Covers (Sheet 1 of 3)	4–7
E.	Interior Trim Inspection	4–10
F.	Interior Trim Repair	4–10
5.	Control Covers	4–10
A.	Control Covers Removal	4–10
B.	Control Covers Installation	4–10
C.	Control Covers Inspection	4–10
D.	Control Covers Repair	4–10
Figure 4–4.	Passenger Compartment Interior Trim and Covers (Sheet 1 of 3)	4–11
6.	Boltaron Trim Panel Repair	4–14
A.	Fiberglass Patch Method	4–14
B.	Solvent Bonding Patch Method	4–14
Figure 4–5.	Boltaron Panel Repair	4–15
C.	Epoxy Adhesive Patch Method	4–16
D.	Bond and Rivet Patch Method	4–16

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
E.	Main Transmission/Engine Drive Shaft Access Door Assembly	4–17
F.	Main Transmission/Engine Drive Shaft Access Door Assembly Seal Replacement	4–17
7.	Crew Compartment Floor Trim	4–17
8.	Passenger Compartment Floor Trim	4–17
A.	Passenger Compartment Floor Trim Removal	4–17
B.	Passenger Compartment Floor Trim Installation	4–17
C.	Floor Trim Inspection	4–17
D.	Floor Trim Repair	4–17
Figure 4–6.	Main Transmission/Engine Drive Shaft Access Door Assembly	4–18
9.	Miscellaneous Furnishings	4–18
A.	Stowage Compartment Box	4–18
B.	Stowage Compartment Box Replacement	4–18
C.	Stowage Compartment Box Repair	4–18
Figure 4–7.	Crew and Passenger Compartment Floor Trim	4–19
D.	Cargo Tiedown Fittings	4–20
E.	Cargo Tiedown Fitting Inspection	4–20
F.	Pilot's Compartment Canopy Frame Trim and VNE Card Cover	4–20
G.	Helicopter Checklist	4–20
H.	VNE Card and Holder (Bracket Mounted)	4–20
I.	Magnetic Compass Card	4–20
J.	Operation Record Holder	4–20
K.	Heat Duct and VNE Card Cover	4–20
L.	Heat Duct and VNE Card Cover Replacement	4–20
M.	Heat Duct and VNE Card Cover Removal	4–20
N.	Heat Duct and VNE Card Cover Installation	4–21
O.	Heat Duct and VNE Card Cover Inspection	4–21
P.	Heat Duct and VNE Card Cover Repair	4–21
Q.	Ashtrays	4–21
R.	Passenger Compartment Upper Convenience Panel (Without Trim)	4–21
S.	Passenger Compartment Upper Convenience Panel (Standard Trim)	4–21
T.	Folding Table Assembly (Executive Trim)	4–21
Figure 4–8.	Basic Helicopter Furnishings	4–22
U.	Passenger Compartment Lower Convenience Panel (Executive Trim)	4–23
V.	Passenger Compartment Upper Convenience Panel (Executive Trim)	4–23
W.	Pilot's Compartment Footrest	4–23
X.	Pilot's Compartment Footrest Replacement	4–23

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
Y.	Pilot's Compartment Footrest Inspection	4–23
Z.	Pilot's Compartment Footrest Repair	4–23
AA.	Passenger Step	4–23
Figure 4–9.	Miscellaneous Furnishings	4–24

SECTION 4
FURNISHINGS

1. Furnishings

The MDHI Model 369HS (500S) Helicopter is the standard configuration of the Model 369H Helicopter Series, manufactured by Hughes Helicopter, now MD Helicopters, Inc. The Model 369HE (500E) is an executive configuration, Model 369HS (500S) is a standard configuration. The 500S and 500E differ from other Series 500 Helicopters primarily as described below.

A. General Description of S / E Differences

Except for interior trim upholstery and floor coverings, equipment furnishings, paint finish and the other details described in this section, the 369S and 369E are essentially identical to the basic helicopter configuration. Normally, the 369S has the standard trim package and the 369E has the executive trim package. Furnishing variations between models include a passenger/cargo compartment folding table, passenger steps, and different ashtray locations and passenger/cargo convenience panels.

2. Crew Compartment Seats

(Ref. Figure 4-1) The crew compartment equipped with single controls has a three-place arrangement to accommodate the pilot and two passengers. The seat consist of a left-side, right-side and center seat bottom, each with a seat backrest. Seat cushions with standard trim are upholstered and trimmed with vinyl. Seats with executive trim are upholstered and trimmed with leather. Velcro fastener strips on the underside of the seat and on the fuselage structure secure the seats in place.

A. Crew Compartment Seat Replacement

(1). Clear the seat of seat belts and shoulder harness.

(2). Lift seats away from fuselage structure to release Velcro fastener hook from Velcro pile strips.

(3). To install the seats, position seating in place and press down so Velcro fasteners mate.

B. Passenger Compartment Seats

The passenger/cargo compartment contains two single or a bench type seat for accommodating two passengers.

The seat consists of a tubular structure that supports a cushioned and upholstered seat bottom and seat backrest or optional nylon mesh seat without cushions.

Seat cushions with standard trim are upholstered and trimmed with vinyl.

Seats with executive trim are upholstered and trimmed with leather.

The seat cushion and backrest can be detached. The seats can be folded to provide additional room in the cargo compartment and are easily removable from the floor and bulkhead attach points by quick-disconnect fittings on the seat tubular structure. The later configuration seat structure incorporates an adjustable feature at the seat structure leg.

C. Passenger Compartment Seat Replacement

(1). Release quick-disconnect fitting at bulkhead and then at floor points.

(2). To install the seats, position seat(s) in place and allow quick disconnects to lock in place first at floor points and then at bulkhead fittings.

D. Seat Inspection

(1). Inspect seating material for cuts, loose stitching and for other evidence of unserviceable condition.

(2). Inspect quick disconnect on seat structure for correct operation and damage that might prevent positive locking.

(3). Inspect the various Velcro fastener hook and pile strips installed on seat structure and fuselage structure for security of attachment and condition.

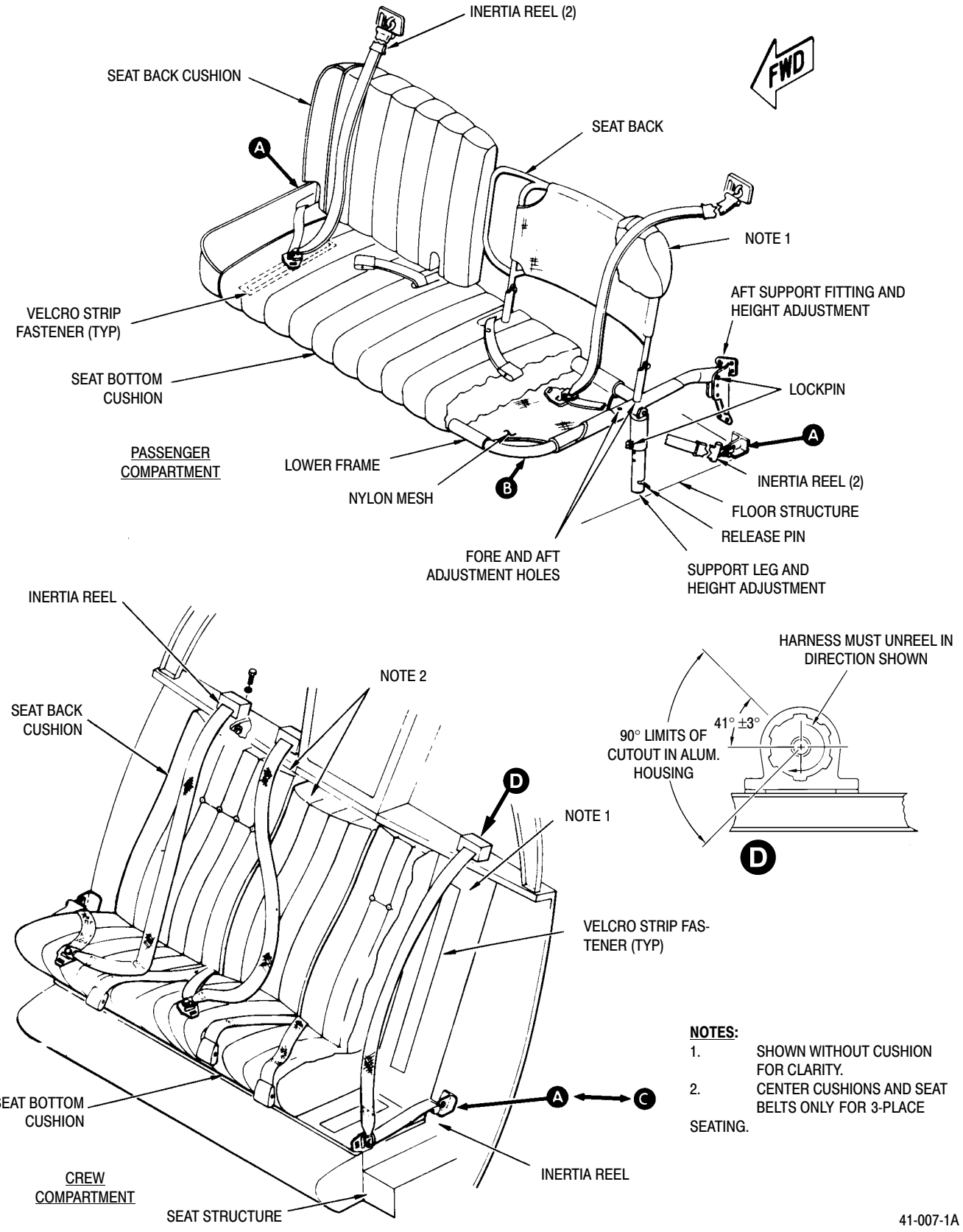


Figure 4-1. Seat Installation - Typical (Sheet 1 of 2)

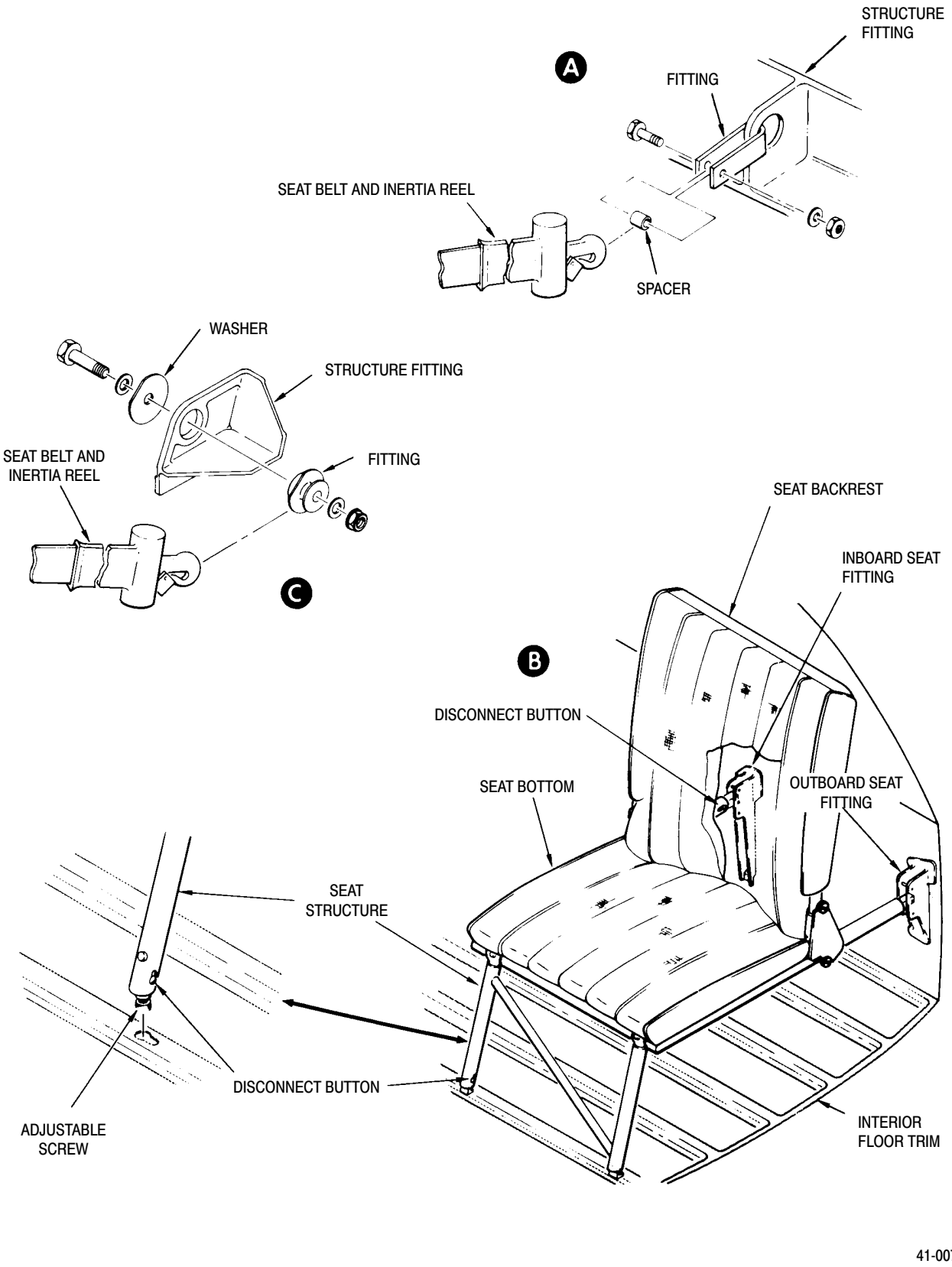


Figure 4-1. Seat Installation - Typical (Sheet 2 of 2)

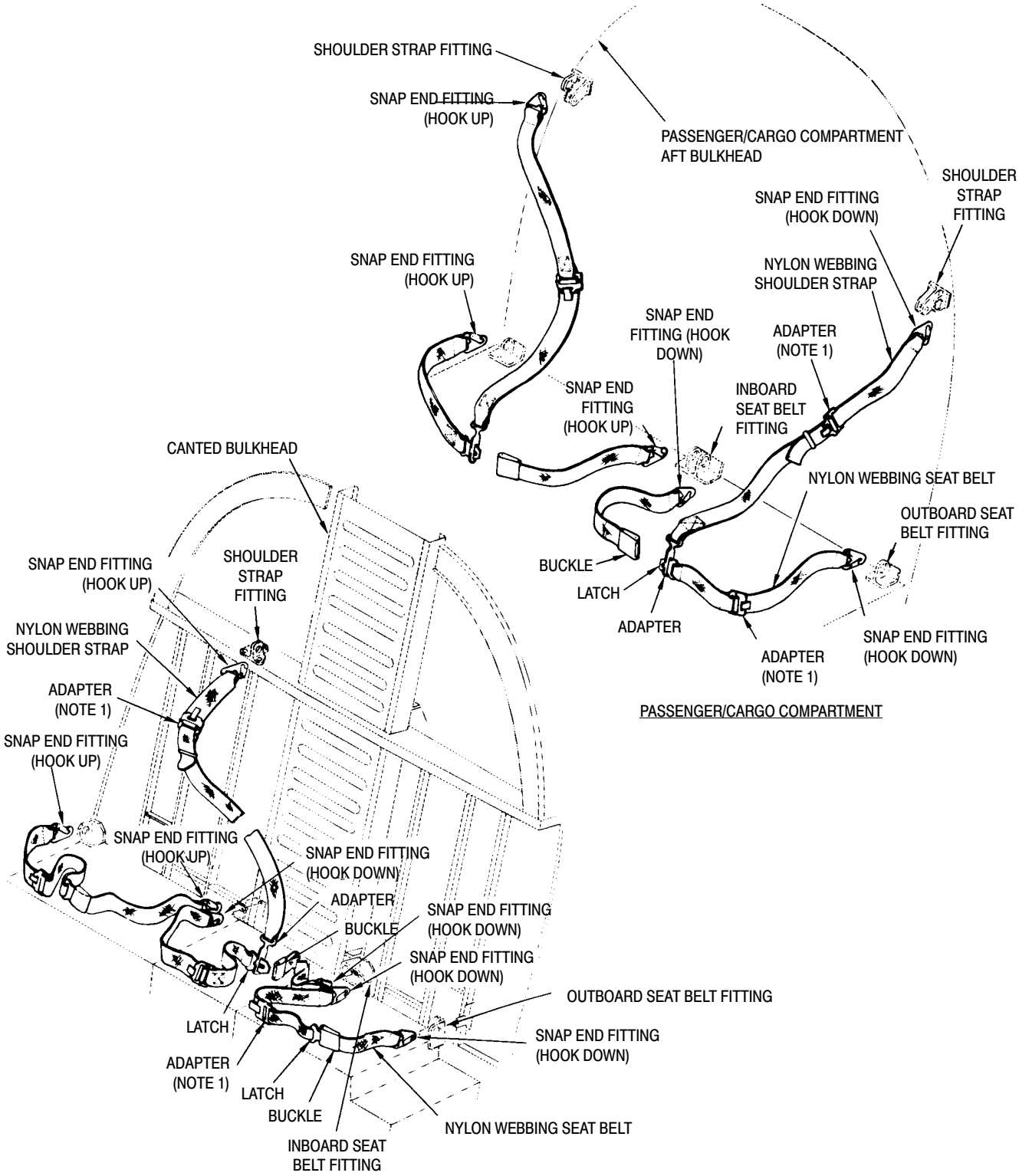


Figure 4-2. Early Configuration Seat Belt and Shoulder Harnesses

E. Seat Repair

(1). Lap-stitch frayed or worn upholstery.

(2). Replace unserviceable Velcro fastener hook and pile strips. Install new Velcro pile and hook strips to mate, and bond with cement (91, Table 2-4).

NOTE: Loosened Velcro fasteners can be reactivated for adhesion by wiping the original adhesive with methyl ethyl ketone (MEK) (22).

3. Seat Belts and Shoulder Harnesses

(Ref. Figure 4-1 and Figure 4-2) Seat belts and shoulder harnesses are provided at the five seat positions.

The early configuration seat belts and shoulder harnesses are fabricated of nylon webbing with sewn-in buckles, attachment fittings and adjusters.

Later configuration seat belts and shoulder harnesses have sewn-in snap end fittings and buckles, and are equipped with inertia reels at each seat position.

Crew compartment shoulder harness inertia reels and fittings are attached to the canted bulkhead with a bolt, nut and washer.

Executive trim seat belts pass through a semi-rigid cover and seat cushion and frame in the passenger compartment.

A. Seat Belt and Shoulder Harness Replacement

(1). Early configuration seat belts and shoulder harnesses are removed by unfastening the snap-type end fittings from structure attachments.

(2). Remove later configuration seat belts by unfastening the snap-type fitting from special fittings.

(3). Remove nut, bolt and washer securing inertia reel and fitting to bulkhead. If required, remove access door on right side outboard trim panel to unsnap seat belt fitting.

(4). Install seat belts and shoulder harnesses in reverse order of removal.

B. Seat Belt and Shoulder Harness Inspection

(1). Inspect seat belts and shoulder harnesses for worn or frayed condition and loose stitching.

(2). Inspect snap-end fitting for cracks, excessive wear, corrosion and deformation.

(3). Check for freedom from binding, ease of adjustment, and operation as applicable.

C. Seat Belt Load Testing

Perform seat belt load testing in accordance with FAA AC 43.13-1A and TSO-C22.

D. Seat Belt and Shoulder Harness Repair

(1). Replace shoulder harness or seat belt if webbing is excessively worn or there is loose stitching.

(2). Polish out minor nicks and scratches, restore protective finish to aluminum parts and renew paint finish as necessary.

4. Interior Trim

(Ref. Figure 4-3 and Figure 4-4) The trim panels are fabricated from thermoplastic material and are contoured to cover the interior fuselage structure, doors and door frames. The interior trim panels provide the interior finish, insulation for the compartment interior and also provide mounting surfaces for convenience items.

Trim panels furnished with early configuration executive trim are flocked. Trim installed on early configuration helicopters are attached with Hedlok semi-rigid interlocking nylon fasteners and attaching screws.

Trim installed in later configuration helicopters are attached with upholstery screws that fasten to mating rivnuts and isolator nut mounts on the fuselage structure.

Later configuration trim have access doors at hinge pin locations and in lower right and left panels for access to fuselage structure seat belt fittings.

The map case trim cover panel located on the central control tunnel contains a map case

pocket and provisions for an optional untility light.

On later configuration helicopters, crew compartment doors use trim only on the lower area.

On helicopters equipped with standard trim, the upper convenience panel trim cover contains panel provisions for optional heating and lighting items. The forward bulkhead standard trim panel contains two literature pockets and an ashtray and cigarette lighter.

On helicopters furnished with executive trim, the upper convenience panel cover contains a blank panel with provisions for an optional utility light. The forward bulkhead executive trim panel assembly contains two folding tables, literature pockets and convenience panel.

On later configuration helicopters, passenger compartment doors use trim only on the lower area. A later transmission cover panel contains two cover plugs for access to the main transmission drain and chip detector plugs.

A. Crew Compartment Interior Trim Removal

(1). Identify trim panels, applicable attaching devices, and attaching devices, and attaching screws.

(2). Remove all attaching screws securing trim panel. On early configuration helicopters where Hedlok fasteners are used, remove all visible attaching screws; then gently pry and lift off the selected trim panel.

(3). Disconnect electrical wires from untility light when removing map case trim cover from canted Sta. 78.50.

B. Crew Compartment Interior Trim Installation

(1). Identify trim panels, applicable attaching devices, and the number and approximate location of attaching screws.

(2). Position trim panels using Hedlok fasteners in place and engage all Hedlok fasteners. Install applicable screws.

(3). Connect electrical wires for utility light when installing map case trim cover on canted Sta. 78.50.

C. Passenger Compartment Interior Trim Removal

(1). Identify trim panels, applicable attaching devices and locations.

(2). Remove all screws used to secure trim panel.

(3). On helicopters where trim panels use Hedlok fasteners, remove all visible attachment screws and gently lift off trim panel to disengage fasteners.

NOTE: The upper convenience panel cover must be removed before the transmission cover panel can be lowered. Release fasteners and push panel slightly upwards; then pivot lower end to clear the bulkhead. Remove the transmission cover trim panel by rotating forward end downward.

(4). Disconnect electrical wires from ashtray and cigarette lighter when removing forward bulkhead trim panel.

(5). Disconnect electrical wires from optional utility light when removing upper convenience panel trim cover panel.

(6). Remove passenger compartment seats when removing lower bulkhead trim panel.

D. Passenger Compartment Interior Trim Installation

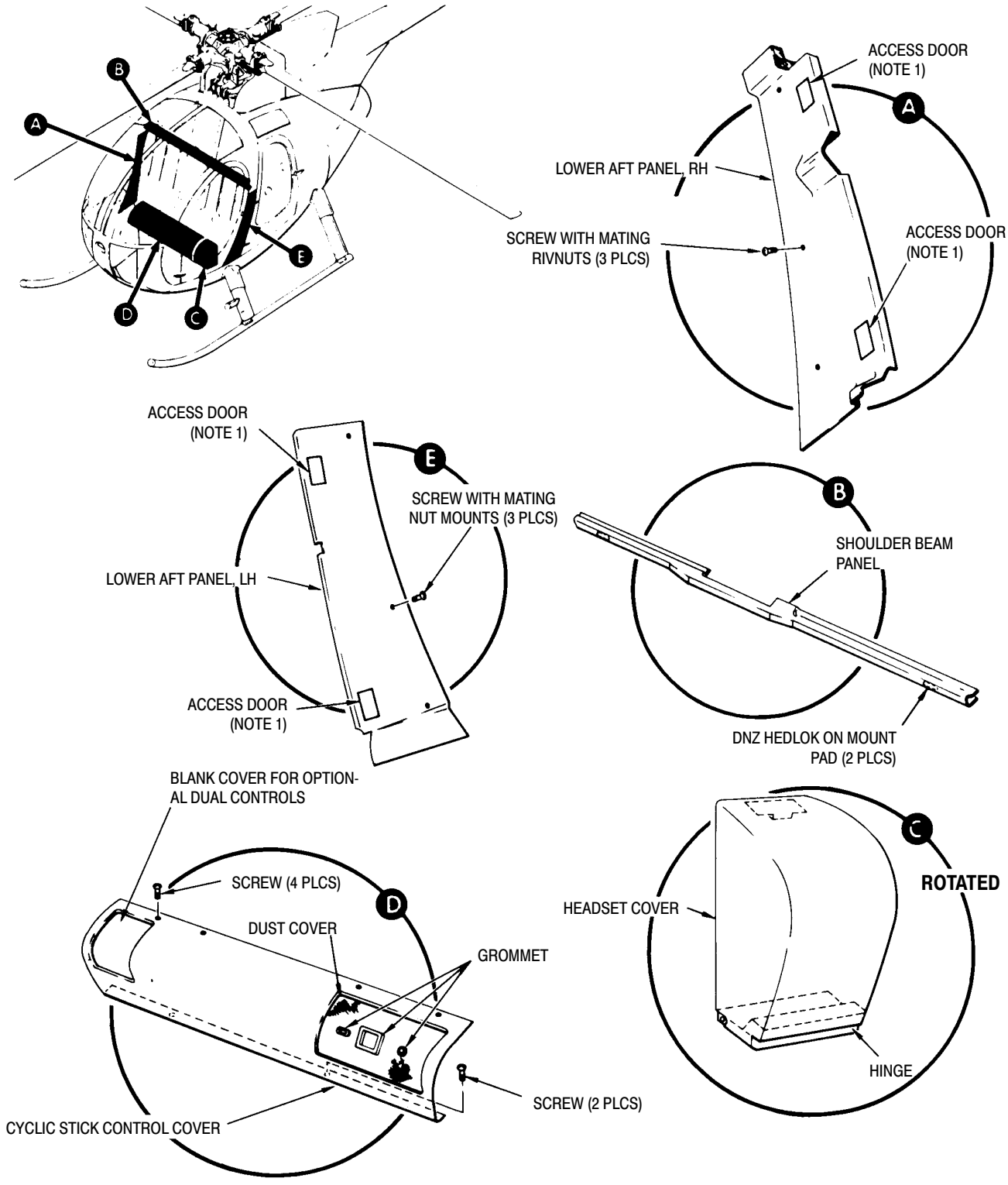
(1). Identify all trim panels, applicable attaching devices and locations. Refer to Passenger Compartment Interior Trim Removal and install in reverse order.

(2). Position trim panels with Hedlok fasteners in place.

(3). Press on panel to engage all Hedlok fasteners. Install applicable screws.

(4). Connect electrical wires to ashtray and cigarette lighter assembly when installing forward bulkhead trim panel.

(5). Connect electrical wires to optional utility light when installing upper convenience panel trim cover panel.



NOTES:

1. CURRENT CONFIGURATION ONLY.
2. CONTAINS MAGNETIC COMPASS CARD

41-013-1B

Figure 4-3. Crew Compartment Interior Trim and Covers (Sheet 1 of 3)

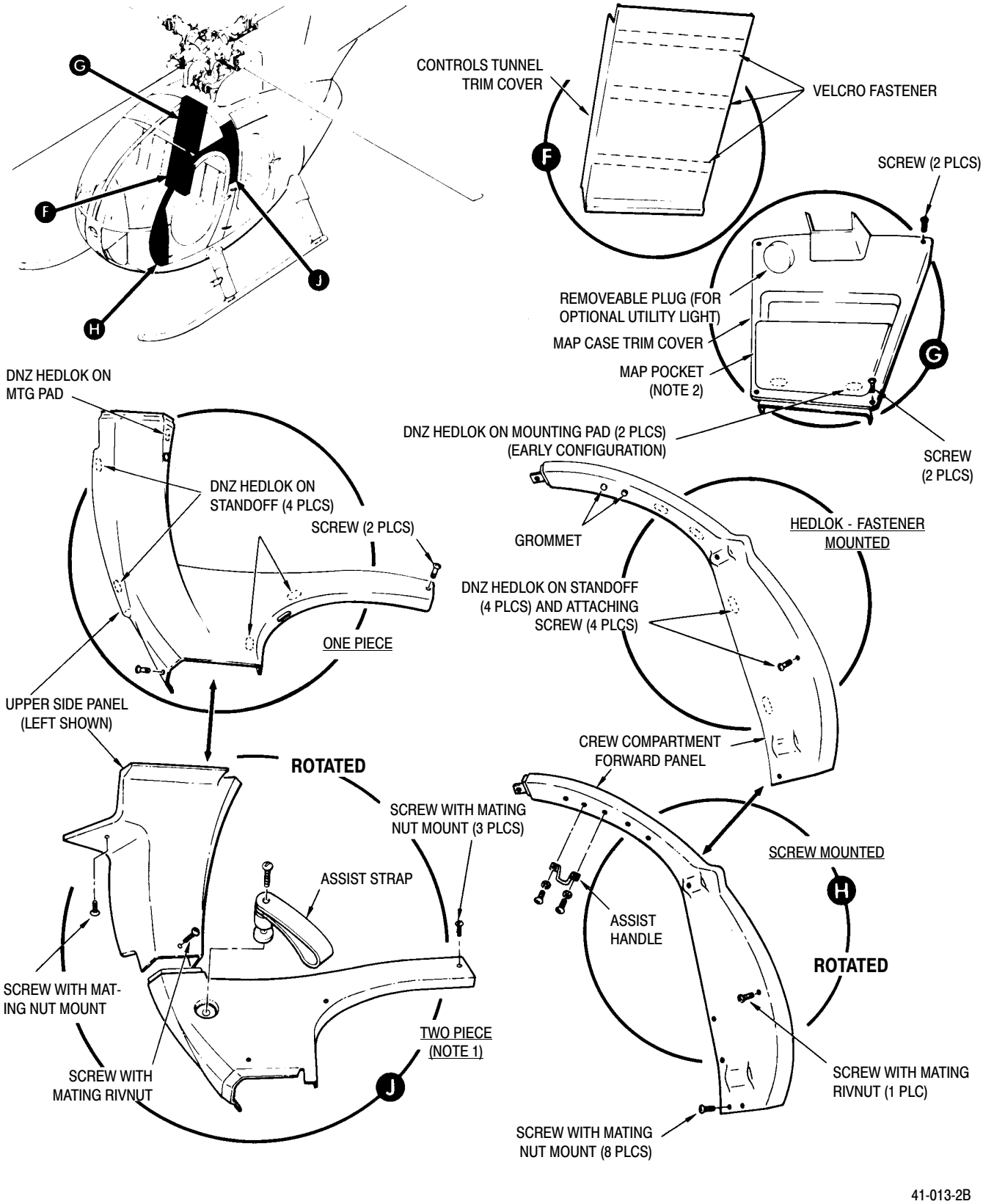


Figure 4-3. Crew Compartment Interior Trim and Covers (Sheet 2 of 3)

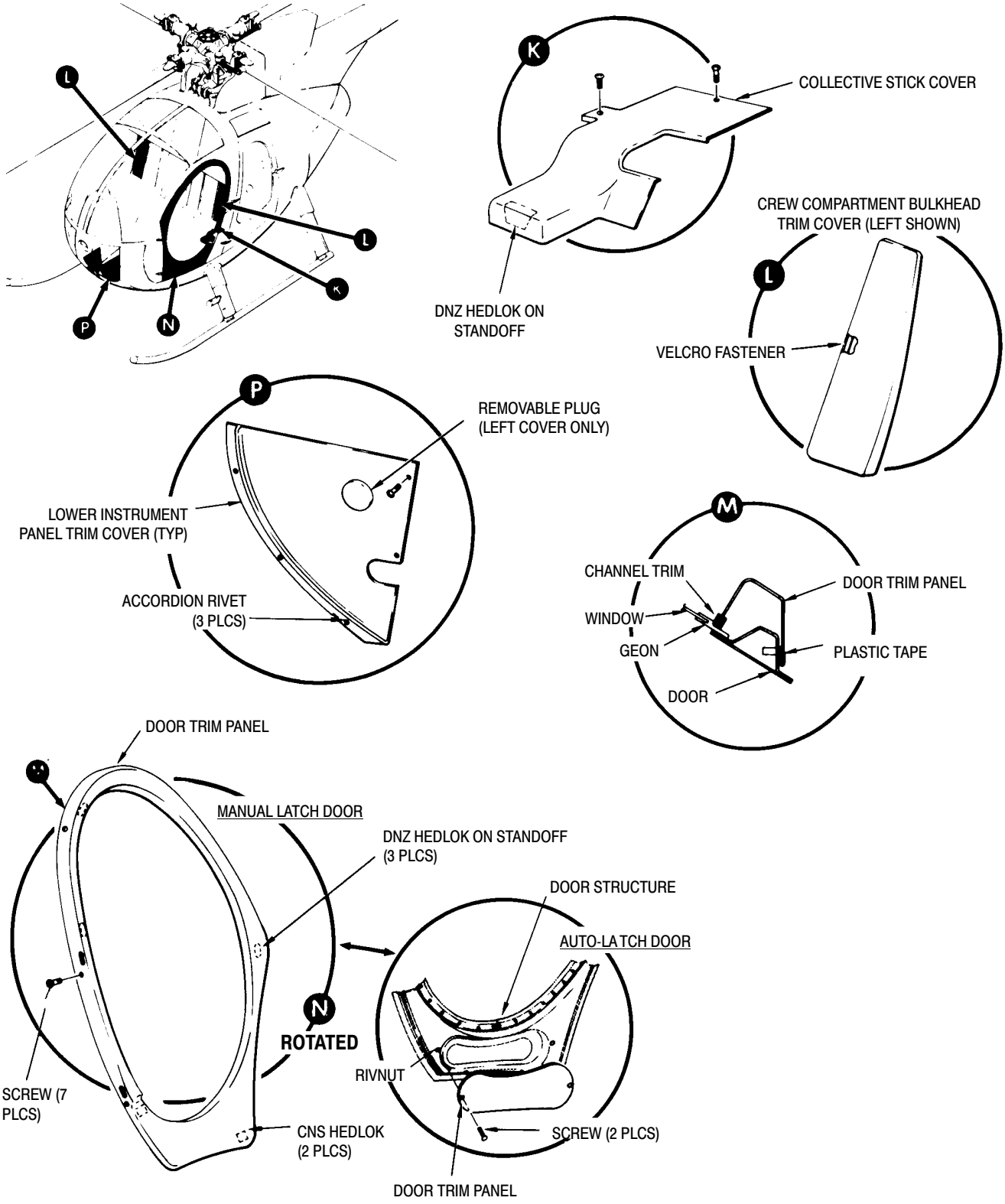


Figure 4-3. Crew Compartment Interior Trim and Covers (Sheet 3 of 3)

E. Interior Trim Inspection

(1). Inspect trim panels for teats, cuts, breaks or other evidence of an unserviceable condition. Inspect underside of trim panels for the condition and security of insulation.

(2). Inspect underside of trim panels for broken, damaged, or missing Hedlok fasteners, as applicable.

(3). Inspect fuselage structure for loose, damaged, or missing mating Hedlok fasteners or isolator nut mounts, as applicable.

(4). Inspect Velcro fasteners used to secure trim panels for serviceable condition.

F. Interior Trim Repair

(1). Remove and replace broken or missing Hedlok fastener of trim panels or on fuselage structure.

(2). Remove and replace broken or missing isolator nut mounts, as applicable.

(3). Remove and replace unserviceable seat fitting cover installed on aft section lower bulkhead trim panel.

(4). Rebond loose insulation material on underside of trim panel or on fuselage structure with cement (91, Table 2-4).

(5). Remove and replace unserviceable Velcro fastener hook and pile strips. Install new Velcro pile and hook strip to mate; bond with cement.

NOTE: Loosened Velcro fasteners can be reactivated for adhesion by wiping the original film with MEK (22).

5. Control Covers

(Ref. Figure 4-3) The crew compartment control cover consist of a cyclic stick control cover, headset cover and a collective stick cover. The cyclic control cover is mounted to the forward portion of the seat structure and covers the control linkage and friction controls. A cutout with a flexible cloth dust cover is provided in the cover at the cyclic base. The control cover has cutout provisions for optional dual controls. The headset case, a component of the controls cover group, is located on the left of the cyclic controls cover. The base of the case is hinge-mounted to the fuselage structure and allows the case to swing open.

A. Control Covers Removal

(1). Separate the Velcro fastened-attached fabric dust cover from cyclic cover and locate the four interior attaching screws at the base.

(2). Remove interior attaching screws.

(3). To remove cyclic control cover, remove crew compartment seats and four screws atop the seat structure.

B. Control Covers Installation

(1). Identify all control covers, applicable attaching devices, and the number and approximate location of attaching screws.

(2). Install cyclic control cover over cyclic controls linkage and install the four inside interior attaching screws.

(3). Install attaching screws atop the fuselage seat structure.

(4). Attach Velcro-fastened cloth dust cover to cyclic control cover.

(5). Install crew compartment seating.

C. Control Covers Inspection

(1). Inspect control covers for tears, cuts, breaks or other evidence of an unserviceable condition.

(2). Inspect condition of dust cover, grommet and Velcro fasteners on cyclic stick control cover.

D. Control Covers Repair

(1). Remove and replace unserviceable Velcro fastener hook and pile strips installed on cyclic stick control cover and dust cover. Install new Velcro hook and pile to mate; bond with (91, Table 2-4).

(2). Remove and replace worn or torn Velcro-fastened cloth dust cover on cyclic controls cover.

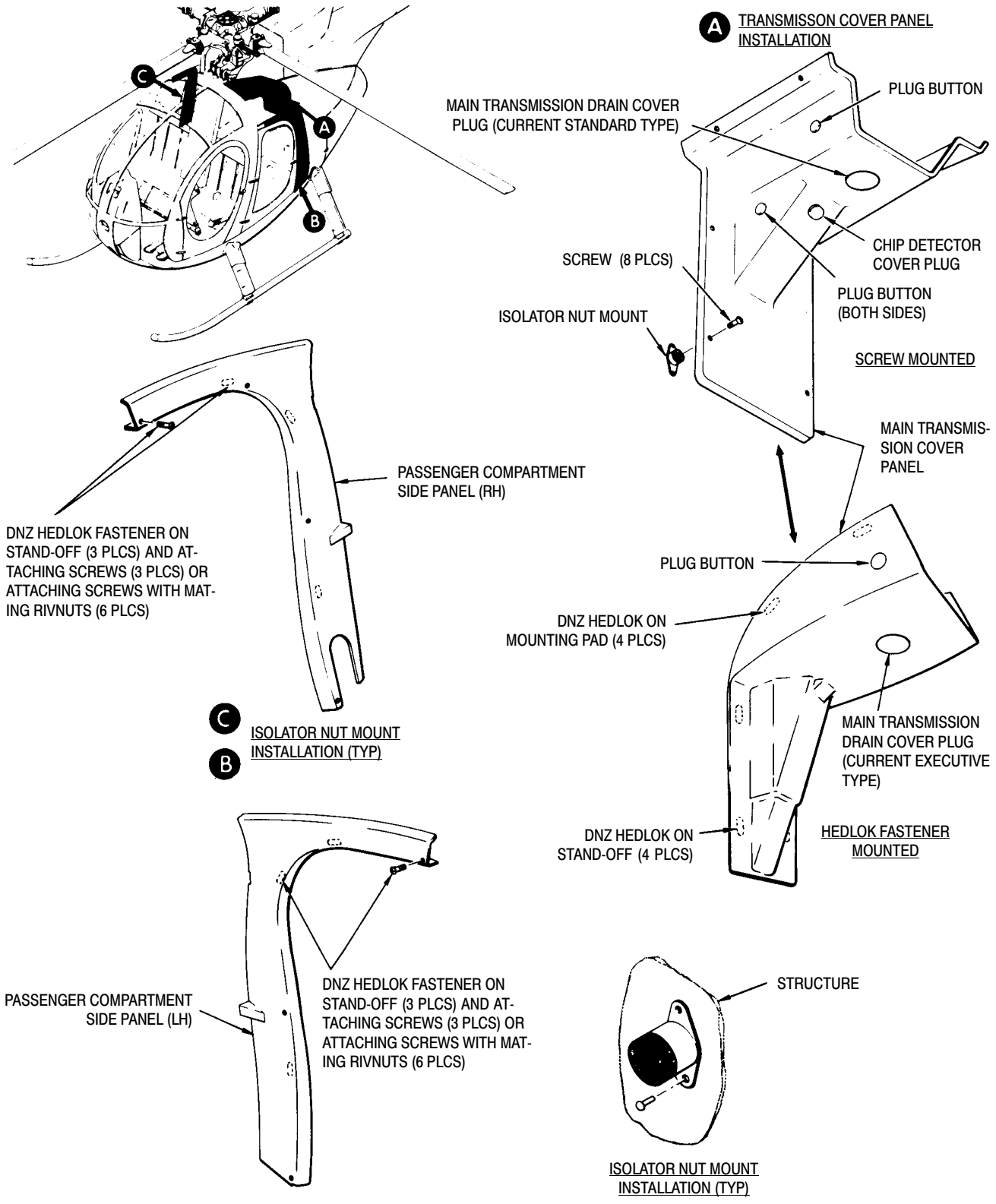


Figure 4-4. Passenger Compartment Interior Trim and Covers (Sheet 1 of 3)

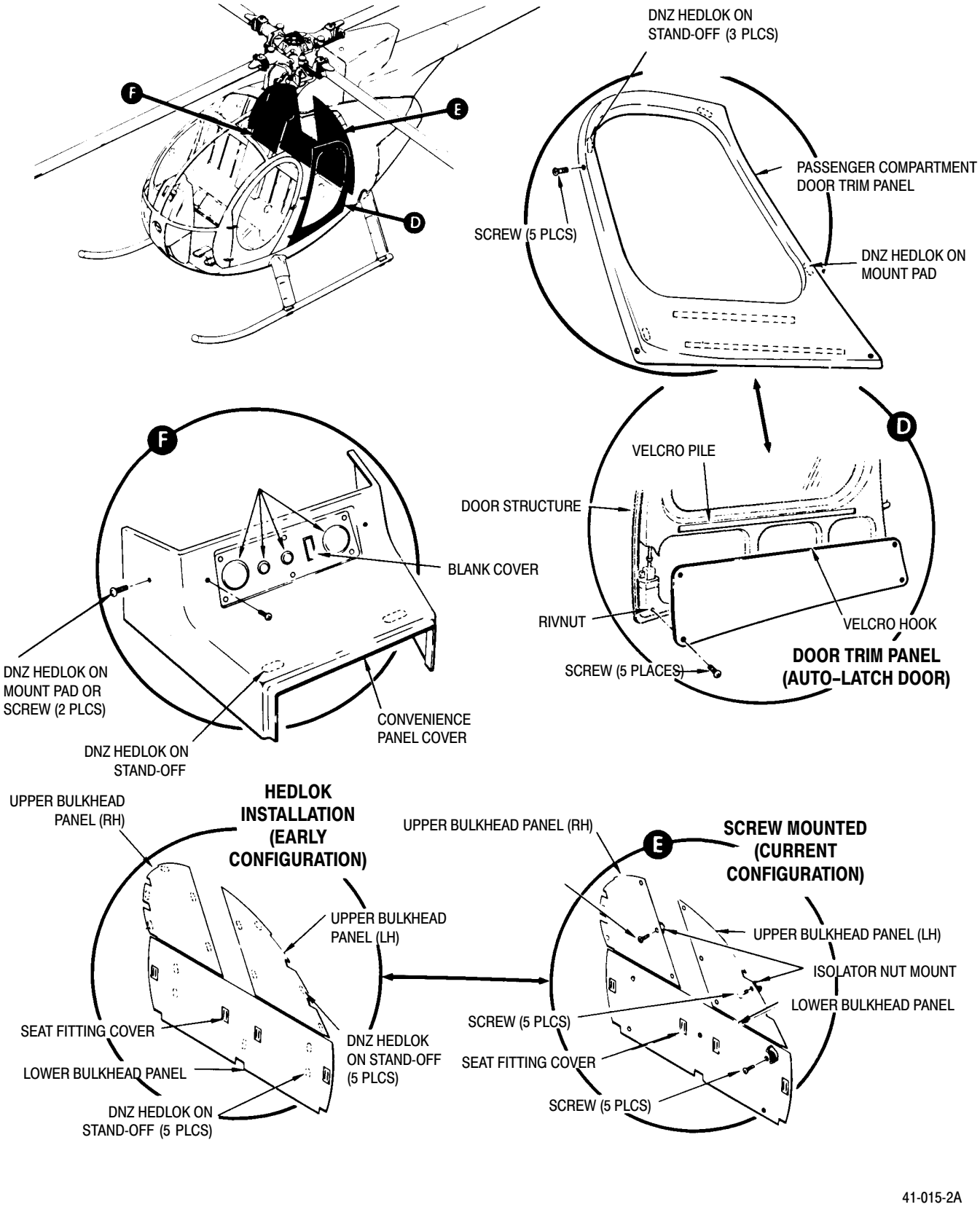


Figure 4-4. Passenger Compartment Interior Trim and Covers (Sheet 2 of 3)

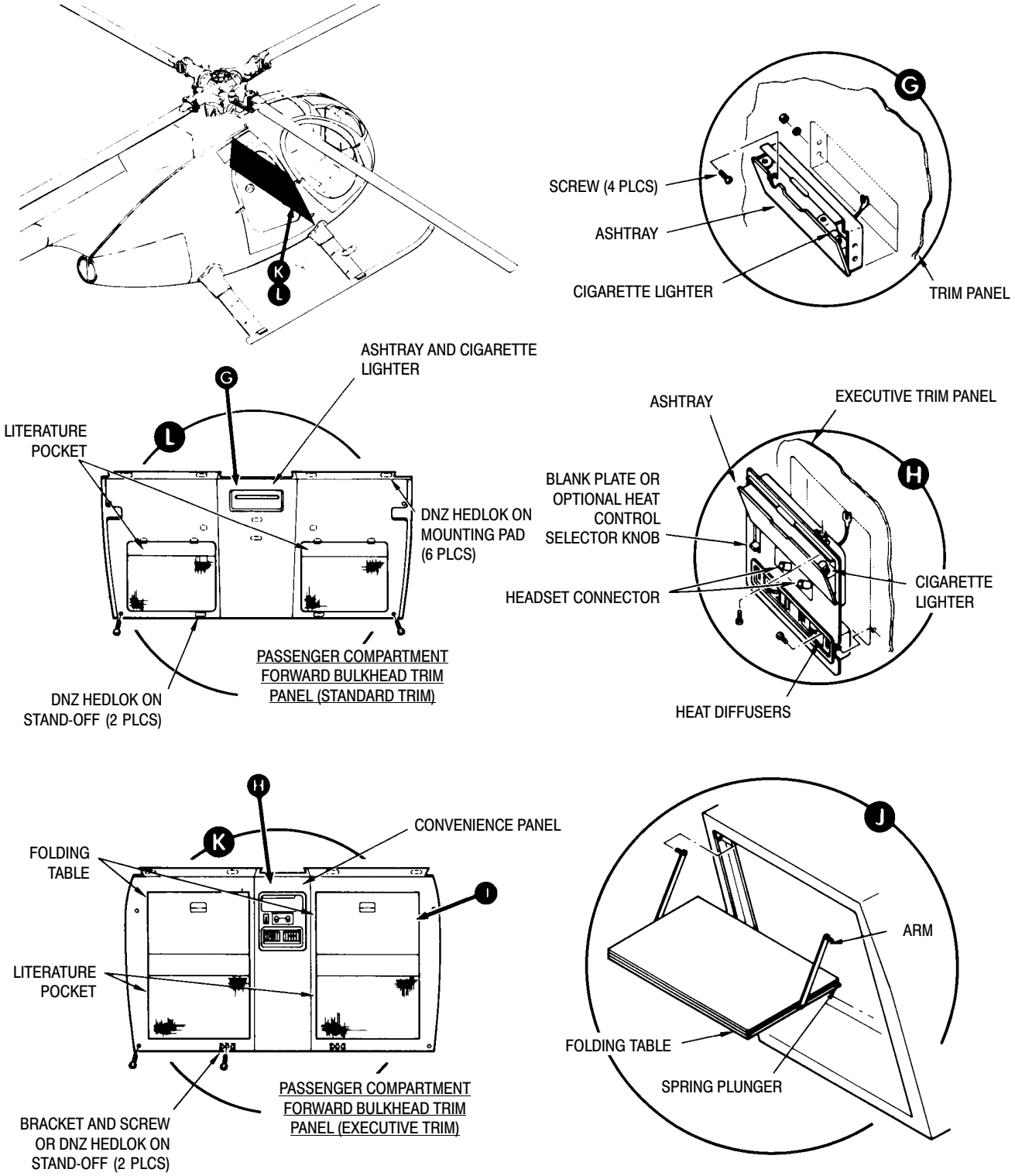


Figure 4-4. Passenger Compartment Interior Trim and Covers (Sheet 3 of 3)

6. Boltaron Trim Panel Repair

(Ref. Figure 4-5)

A. Fiberglass Patch Method

(1). Remove damaged panel.

(2). Stop drill end(s) of crack.

(3). Deburr stop drill(s) and clean any jagged area of crack.

(4). Cut patch from fiberglass cloth to overlap damaged area or crack, minimum 1 inch in all directions.

(5). Cut second patch to overlap first, minimum 0.50 inch (12.7 mm) in all directions. If required, cut third patch to overlap second, minimum 0.50 inch (12.7 mm) in all directions.

(6). Abrade surface of panel, in area to be patched, with emery cloth (49, Table 2-4).

(7). Clean surface by wiping with cloth, dampened not saturated, with solvent (10).

(8). Place panel in horizontal position. Tape around area to be repaired with masking tape, to catch residual resin.

(9). Apply glass cloth (159) to panel, one ply at a time.

(10). Apply resin (160) to material with a brush or squeegee.

(11). Continue adding material and resin until desired thickness has been achieved.

(12). Allow repair to cure, minimum 45 minutes at 265° ±10°F (129° ±5°C). As alternate, heat lamp may be used, minimum 2 hours.

NOTE: Heat lamp should be placed a minimum of 12 inches from fiberglass repair area.

B. Solvent Bonding Patch Method

(1). Remove damaged panel.

(2). Stop drill end(s) of crack.

(3). Deburr stop drill(s) and clean any jagged area of crack.

(4). Select a piece of boltaron material, same contour of area to be patched. Plating surfaces must provide a snug fit. Patch material to overlap damaged area a minimum of 1 inch (25.4 mm) in all directions.

(5). Clean mating surfaces with aliphatic naphtha (59, Table 2-4). Ensure surfaces are free from oil, grease or other contaminates.

(6). Assemble patch, when possible, with mating surface of patch in contact with panel but without application of pressure.

WARNING **Bonding solvent, tetrahydrofuran, is a flammable liquid; care must be exercised in handling.**

CAUTION Solvent shall be applied carefully so no excess material will run over other surfaces and mar the finish.

(7). Inject tetrahydrofuran (46) between mating surfaces by means of syringe or eye dropper.

(8). On larger parts, solvent shall be applied evenly to mating surfaces with brush.

(9). Assemble mating surfaces as quickly as possible by firmly pressing together.

(10). Apply clamps to assembly, immediately after solvent application, with sufficient pressure to force out air bubbles.

(11). After forcing out bubbles, adjust clamps to minimum pressure required to hold parts together.

(12). If solvent has evaporated at or near edge of patch, apply more solvent in accordance with step (7).

(13). Leave clamps in place for a minimum of 20 minutes.

(14). Allow the panel to cure for 24 hours prior to reinstallation.

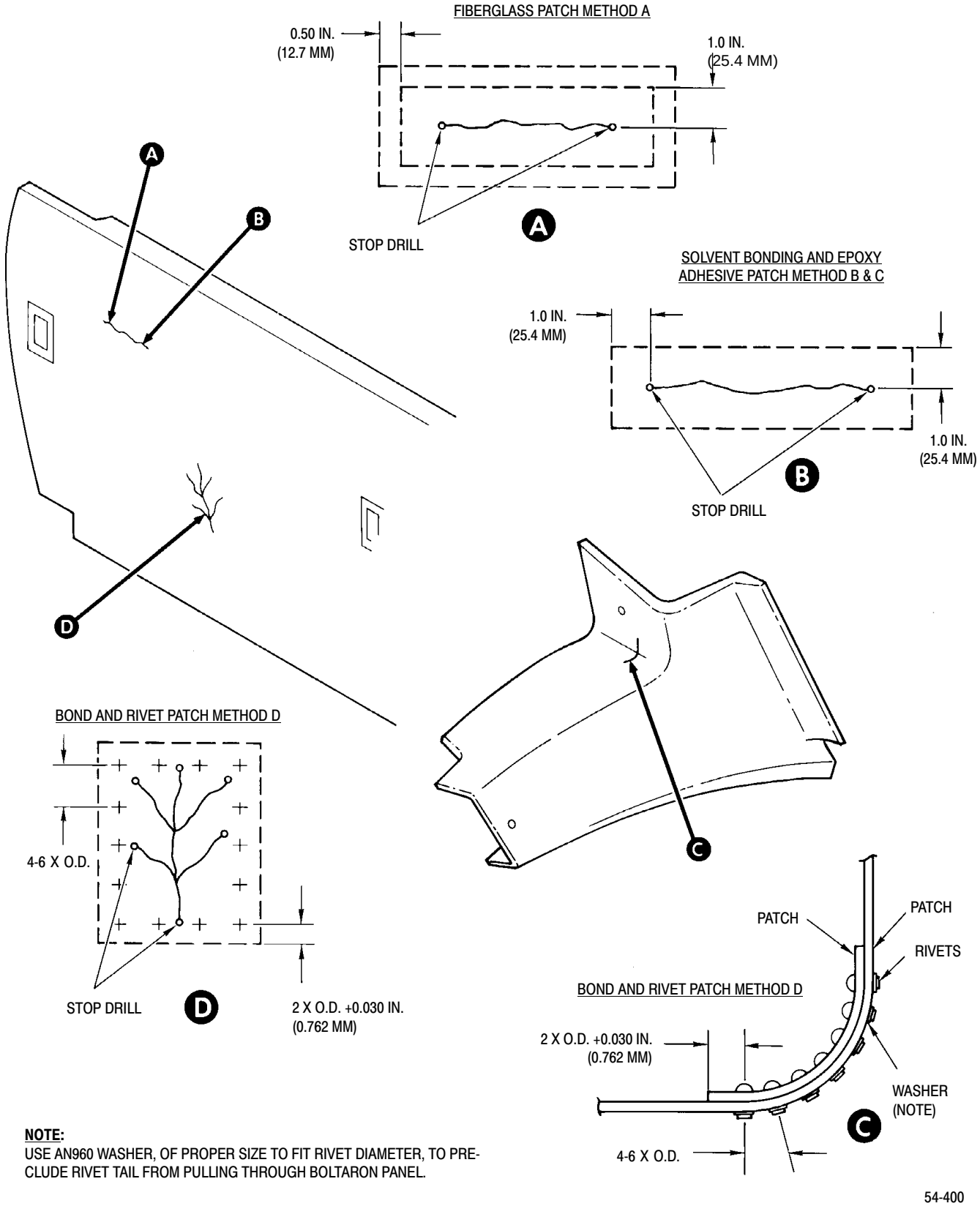


Figure 4-5. Boltaron Panel Repair

C. Epoxy Adhesive Patch Method

(1). Remove damaged panel.

(2). Stop drill end(s) of crack.

(3). Deburr stop drill(s) and clean any jagged area of cracks.

(4). Select a piece of boltaron material, same contour of area to be patched. Mating surfaces must provide a snug fit. Patch to overlap damaged area a minimum of one inch (25.4 mm) in all directions.

(5). Lightly abrade mating surfaces with emery cloth (49, Table 2-4) and clean with solvent (10).

(6). Air dry for 30 minutes at ambient temperature. Apply adhesive (19) within 2 hours of drying.

(7). Thoroughly mix equal parts, by weight, of adhesive. Color should be uniform green. Use unwaxed disposable container and wooden tongue depressor or metal spatula for mixing. Pot life of mixed adhesive is 45 minutes at ambient temperature.

(8). Spread thin uniform layer, 0.002-0.010 inch (0.051-0.254 mm), of adhesive lightly on mating surfaces and clamp lightly together.

(9). Wipe excess adhesive from bond line.

(10). The clamps are to remain in place for 8 hours minimum at ambient temperature or 2 hours at 160° ±10°F (71° ±5°C).

(11). Allow panel to cure for 24 hours prior to installation.

D. Bond and Rivet Patch Method

The following procedure may be used in conjunction with one of the above bonding procedures. If cracks are excessive and/or a piece of boltaron isn't available that fits contour in area to be repaired, rivets may be used to help secure patch to panel.

MS20426A4 Countersunk Rivets

MS20470A4 Universal Rivets

(1). Cut patch to proper size.

(2). Determine rivet spacing.

(a). Rivet spacing to be 4-6 times rivet diameter.

(b). Minimum edge distance to be 2X rivet dia. +0.030 inch (0.762 mm). Example: For #4 rivet, min. edge distance is 0.028 inch (0.711 mm). Rivet diameter 0.125 in. (3.175 mm) X 2 +0.030 in. (0.762 mm) = 0.280 in. (7.112 mm)

(3). Lay out rivet pattern on patch and drill holes. Position patch on panel and drill holes.

(4). Deburr all holes on both sides of patch and panel.

(5). Countersink holes on patch if MS20426A4 rivets are to be used.

(6). Comply with the following procedures if using solvent bonding method (tetrahydrofuran).

(a). Perform step (5). of Fiberglass Patch Method.

(b). Set patch in place, using a minimum amount of clecos required to hold patch in contact with panel without applying too much pressure (Ref: step (6).).

(c). Perform steps (7). thru (9).

(d). Install clamps per steps (10). and (11). Keep all clamps in place for a minimum of 20 minutes. Perform step (12). if necessary.

NOTE: If gap exists between patch and panel, perform step (7). in immediate area of each rivet hole with a gap prior to installing rivets

(e). Rivet patch to panel.

(f). Allow panel to cure for a minimum of 24 hours prior to installation.

(7). Comply with the following procedures if using the epoxy adhesive method (scotchweld EA 1838A4-8).

(a). Perform steps (5). thru (7). of Fiberglass Patch Method.

(b). Spread a thin uniform layer, 0.002-0.010 inch (0.051-0.254 mm), of adhesive on mating surfaces. Try to keep adhesive out of the rivet holes.

(c). Install the patch on the panel with clecos.

(d). Rivet the patch to the panel.

(e). Wipe excess adhesive from bond line and from around the rivets.

(f). Allow the panel to cure for 24 hours prior to installation.

E. Main Transmission/Engine Drive Shaft Access Door Assembly

(Ref. Figure 4-6) The Access Door Assembly is made of 0.093 inch (2.362 mm) thick boltaron plastic, on some models pre-impregnated layers of fiberglass cloth form the access door. The door provides access to the air cooler blower fan assembly and engine to transmission drive shaft.

F. Main Transmission/Engine Drive Shaft Access Door Assembly Seal Replacement

WARNING **MEK is highly flammable and toxic. Use only in well ventilated area and away from heat and flame.**

(1). Remove seal from access door; remove seal residue from access door using a cloth dampened with MEK (22, Table 2-4).

(2). Install new seal.

7. Crew Compartment Floor Trim

(Ref. Figure 4-7) The crew compartment floor is furnished with either standard or executive trim. The standard trim uses a fire resistant vinyl floor covering material. The executive trim consist of fire resistant carpeting. The plastic vinyl material and carpeting are secured to the floor area with double-backed-faced tape and bonded to the two floor access doors.

8. Passenger Compartment Floor Trim

(Ref. Figure 4-7) The passenger compartment floor is furnished with standard or executive trim. The floor trim consists basically of a form-fitted plastic two-section floor trim panel with floor covering. Floor covering for executive trim is carpeting. Floor covering for standard trim is a plastic vinyl material. The area below the forward bulkhead trim panel and the control access door is also trimmed. Foot support fairings are only trimmed on executive models. A trim flap (lower left) encloses the electrical receptacle recess and is secured in placed with Velcro fasteners.

A. Passenger Compartment Floor Trim Removal

(1). Remove passenger compartment seats.

(2). Remove cargo tiedown fittings (when installed).

(3). Pry and lift trim panel from floor structure.

(4). Remove foot support fairings and controls access door (Ref. Sec. 2).

B. Passenger Compartment Floor Trim Installation

(1). Clear floor of seat belts and check that floor structure is clean and free of debris.

(2). Place trim panel over floor structure and press in place.

(3). Install passenger compartment seats.

(4). Install foot support fairings, if required, and controls access door (Ref. Sec. 2).

C. Floor Trim Inspection

(1). Inspect floor trim panel for cuts, breaks, or other evidence of an unserviceable condition.

D. Floor Trim Repair

(1). Repair loose or torn plastic vinyl floor covering material or carpeting by using new application of double-backed-faced tape (90, Table 2-4).

(2). Repair loose or torn floor covering or carpeting on access doors by rebonding with cement (91).

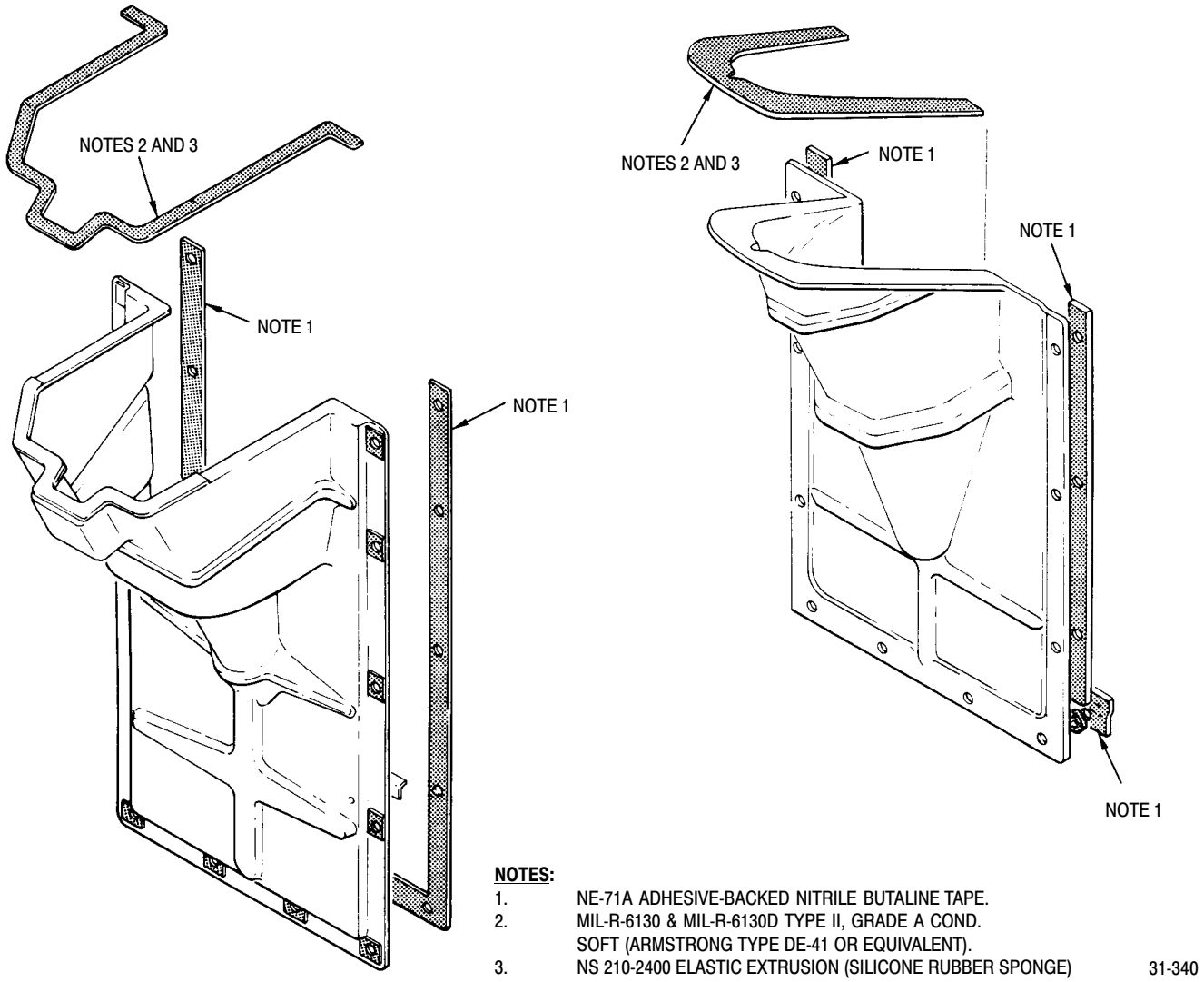


Figure 4-6. Main Transmission/Engine Drive Shaft Access Door Assembly

(3). Replace unserviceable Velcro fasteners on the electrical receptacle recess trim flap.

9. Miscellaneous Furnishings

A. Stowage Compartment Box

(Ref. Figure 4-8) The stowage compartment box is a bonded, stitched and riveted thermoplastic box with a uniformly distributed load capacity of 50 pounds (23 kg) maximum. It is located under the pilot's compartment floor on the right side.

NOTE: Helicopters equipped with certain optional communications and avionics installations will not have a stowage compartment box installed.

B. Stowage Compartment Box Replacement

(1). Raise pilot's compartment floor right access door. Remove tape covering screwheads and 10 screws and washers to release stowage box.

(2). Install replacement stowage box and secure with screws and washers. Cover screwheads with tape (42, Table 2-4). Close and latch access door.

C. Stowage Compartment Box Repair

Perform fiberglass repair of stowage compartment box according to applicable instructions in CSP-H-6, HMI Appendix D.

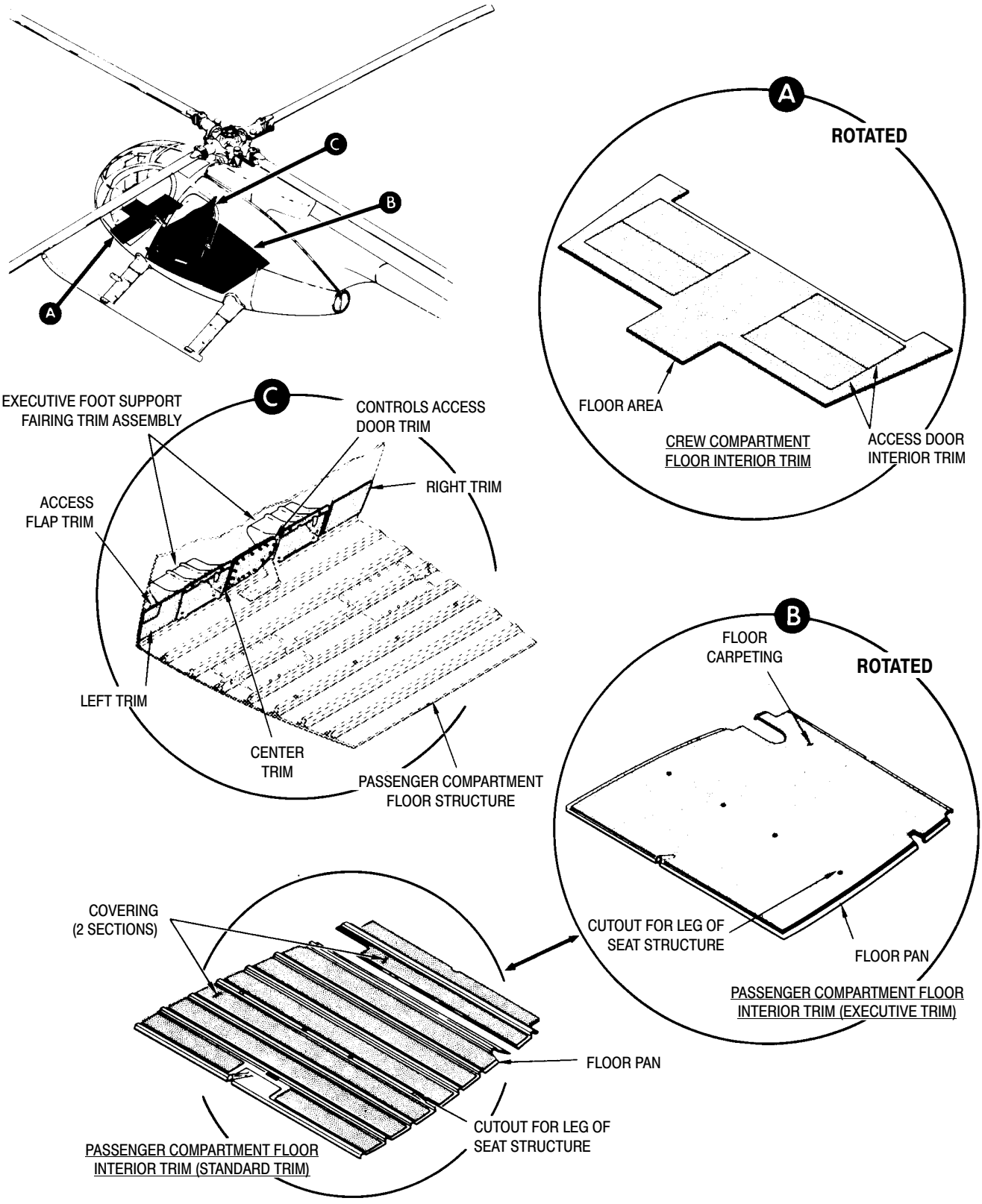


Figure 4-7. Crew and Passenger Compartment Floor Trim

D. Cargo Tiedown Fittings

(Ref. Figure 4-8) The cargo tiedown fittings are formed of 0.250 inch (6.35 mm) diameter, U-shaped steel rods, with ends flattened. The flats are drilled to accept a quick-release pin for attaching the fitting to the cargo floor. The pin is secured to the fitting with a 4 inch (10.16 cm) lanyard. Cargo tiedown fittings can be fastened to the cargo floor at any of 12 locations for various cargo loads.

E. Cargo Tiedown Fitting Inspection

(1). Check for cracks or deformation.

(2). Check that quick-release pin functions properly and that lanyard is secure.

F. Pilot's Compartment Canopy Frame Trim and V_{NE} Card Cover

(Ref. Figure 4-9) On all later configuration helicopters, trim is provided for the canopy center frame in the pilot's compartment. The trim is screw-mounted to the canopy frame and consists of an upper and lower section, and a V_{NE} card cover that provides the trim joint. On certain configuration helicopters, the magnetic compass is mounted to the trim just above the instrument panel. When electronically activated engine anti-icing and cabin heat control systems are installed, the V_{NE} card cover also provides the mounting surface for the **ENGINE DE-ICE** and **CABIN HEAT** switches. The trim sections also function as heat ducts when the optional heating system is installed. When the heating system is not installed, removable end-caps enclose the upper and lower ends of the trim.

G. Helicopter Checklist

The helicopter checklist contains instructions for an interior check, engine starting, engine runup and stopping the engine. The checklist is stored with the magnetic compass card in the map case trim cover on the upper forward side of the central controls tunnel in the crew compartment.

H. V_{NE} Card and Holder (Bracket Mounted)

(Ref. Figure 4-8 and Figure 4-9) The V_{NE} (Velocity to Never Exceed) card is held by a holder directly above the hood of the instrument console. The holder may be bonded in place or riveted to the center canopy frame on the early configuration.

I. Magnetic Compass Card

The magnetic compass card contains calibration information for the specific compass installed in the helicopter.

J. Operation Record Holder

(Ref. Figure 4-9) The operation record holder with a transparent window is attached to the outboard side of the right instrument panel fairing on later configuration helicopters. On early configuration helicopters, the holder is attached to the lower right front of the pilot's seat structure.

K. Heat Duct and V_{NE} Card Cover

(Ref. Figure 4-9) The heat duct and V_{NE} card cover assembly provides interior trim for the canopy frame and a mounting surface for the V_{NE} card. A wire pin on the V_{NE} card is used to mount the card to the cover. The pin installation enables the V_{NE} card to be flipped for a view of either side. Velcro fasteners secure the V_{NE} card in the desired viewing position. Several configuration of the heat duct and V_{NE} card cover are installed. On a helicopter equipped with an electrically controlled engine anti-icing system (Ref. Sec. 11) and cabin heating system (Ref. CSP-H-3), an engine de-ice switch and a cabin heat switch are mounted to the heat duct and V_{NE} card cover assembly. The cover may be secured to the canopy frame with Hedlok fasteners or attaching screws.

L. Heat Duct and V_{NE} Card Cover Replacement

(Ref. Figure 4-9)

M. Heat Duct and V_{NE} Card Cover Removal

(1). Remove screws securing heat duct and V_{NE} card cover assembly to canopy frame.

(2). On early configuration helicopters where Hedlok fasteners are used on the cover, gently pry and lift cover off canopy frame.

(3). On covers that have side-mounted switches, disconnect wiring for engine de-ice switch (Ref. Sec. 11). Refer to

CSP-H-3 for wiring of the optional cabin heat switch.

N. Heat Duct and V_{NE} Card Cover Installation

(1). On cover assemblies that have side-mounted switches, connect electric wires for engine de-ice switch (Ref. Sec. 11). Refer to CSP-H-3 for wiring of the optional cabin heat switch.

(2). Where Hedlok fasteners are used on the cover, position in place and engage fasteners.

(3). On screw-mounted cover assemblies, reinstall mounting screws.

O. Heat Duct and V_{NE} Card Cover Inspection

(Ref. Figure 4-9)

(1). Inspect cover for tears, cracks, breaks or other evidence of unserviceable condition and legibility.

(2). Check that the V_{NE} card mounting is secure. Check that Velcro fasteners are not defective.

(3). On covers using the Hedlok fasteners installation, check that fasteners on cover and mating fasteners on canopy frame are not defective.

P. Heat Duct and V_{NE} Card Cover Repair

(Ref. Figure 4-9)

(1). Replace defective or illegible V_{NE} cards. Replace unserviceable Velcro fastener strips on card or at card cover location. Install new Velcro fastener strips to mate. Bond in place with cement (91, Table 2-4).

(2). Remove and replace broken or missing Hedlok fasteners.

(3). Repair or replace loose or illegible switch bezels. Bond bezel to cover with adhesive (19).

Q. Ashtrays

(Ref. Figure 4-4 and Figure 4-8) The crew compartment is equipped with an ashtray and cigarette lighter located in the lower portion of the instrument panel.

On helicopters with standard trim, an ashtray and cigarette lighter is installed on the forward bulkhead trim panel. On helicopters furnished with executive trim, the ashtray and cigarette lighter assembly is mounted on the forward bulkhead trim panel as part of the lower convenience panel.

On early configuration helicopters without interior trim, an ashtray and cigarette lighter assembly is installed on the forward bulkhead.

R. Passenger Compartment Upper Convenience Panel (Without Trim)

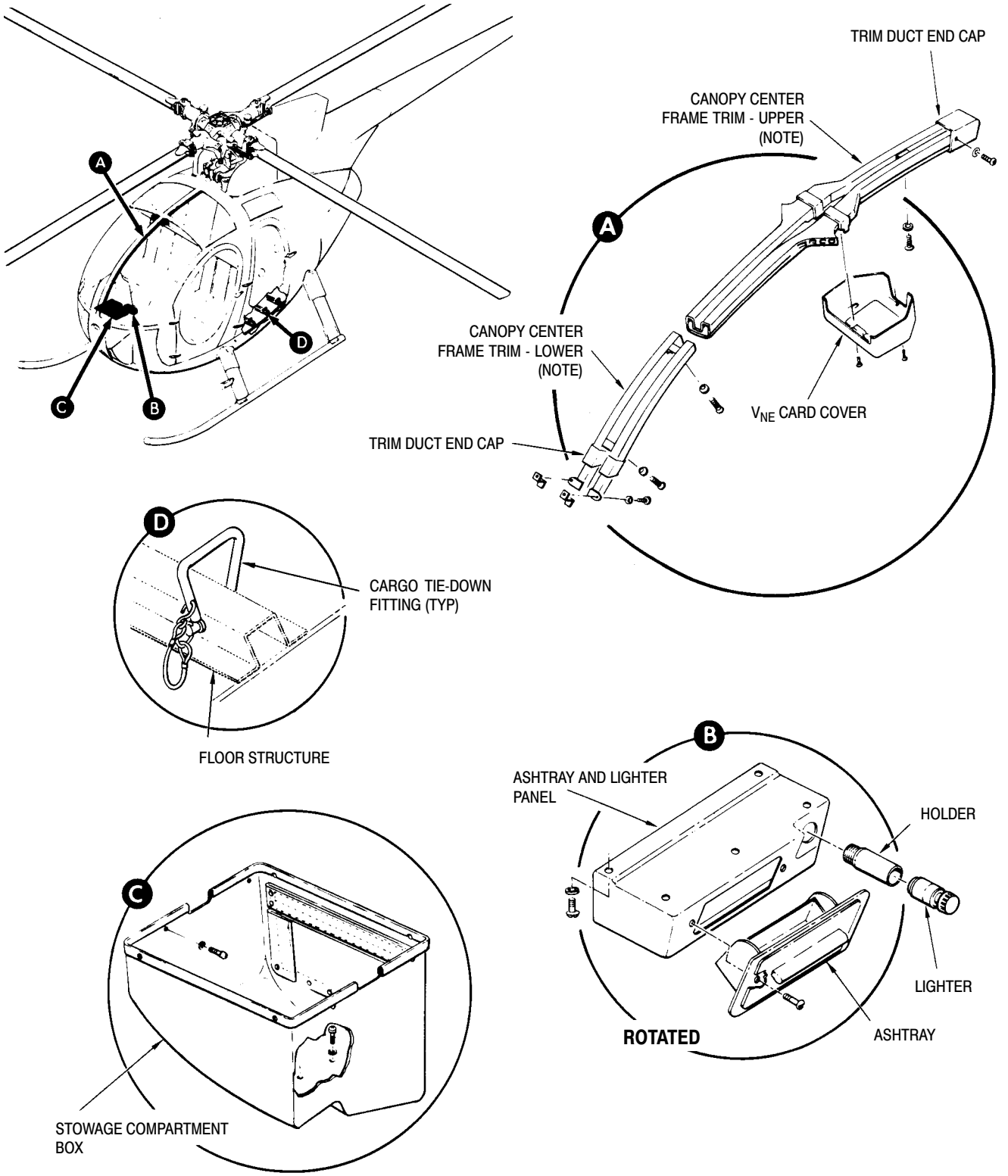
(Ref. Figure 4-4) On early configuration helicopters without interior trim, a plastic convenience panel is located above the compartment forward bulkhead. The convenience panel provides mounting facilities for utility light switch, heated air outlet diffuser valve and two head set connectors (all optional equipment). Six screws attach the panel to the fuselage structure. Plugs and covers are supplied with the panel when optional equipment is not installed.

S. Passenger Compartment Upper Convenience Panel (Standard Trim)

(Ref. Figure 4-4) On helicopters with standard trim, the upper convenience panel is contained in the convenience panel panel trim cover. The convenience panel provides mounting facilities for a utility light switch, heated air outlet diffuser valve and two headset connectors. Six screws attach the panel to the convenience panel trim cover. Plugs and covers are supplied with the panel when the optional equipment is not installed.

T. Folding Table Assembly (Executive Trim)

(Ref. Figure 4-4) On helicopters with executive trim, two folding tables are provided in the passenger/cargo compartment for passenger use. The folding tables are installed on the compartment forward bulkhead trim panel.



NOTE:
TRIM SECTIONS USED FOR HEAT DISTRIBUTION WHEN HEATING SYSTEM INSTALLED.

30-122D

Figure 4-8. Basic Helicopter Furnishings

U. Passenger Compartment Lower Convenience Panel (Executive Trim)

(Ref. Figure 4-4) On helicopters with executive trim, the passenger/cargo compartment is equipped with a lower convenience panel. The panel is mounted in the compartment forward bulkhead trim panel. The convenience panel contains an ashtray and cigarette lighter assembly, heat diffusers and provisions for an optional heat control selector knob and two headset connectors.

V. Passenger Compartment Upper Convenience Panel (Executive Trim)

(Ref. Figure 4-3) On helicopters with executive trim, the convenience panel trim cover contains provisions for an optional utility light (Ref. CSP-H-3). When the optional utility light is not installed in the trim cover, a removeable plug is used.

W. Pilot's Compartment Footrest

(Ref. Figure 4-9) The pilot's compartment foot rest consist of welded aluminum alloy tubes attached to the floor support bulkhead (Sta. 44.65) at the right side of the compartment.

X. Pilot's Compartment Footrest Replacement

(1). Remove stowage compartment box.

(2). Remove four bolt and nuts, and sixteen washers to release foot rest.

(3). Position replacement foot rest on floor support bulkhead and install four bolts, sixteen washers and four nuts. When necessary, use thin aluminum washers to shim between footrest and bulkhead attach points to obtain fourpoint contact before tighten bolts.

(4). Reinstall stowage compartment box.

Y. Pilot's Compartment Footrest Inspection

Inspect the foot rest for security and serviceable condition.

Z. Pilot's Compartment Footrest Repair

Perform weld repair of the foot rest tubing according to FAA AC 43.13-1A, Aircraft Inspection and Repair.

AA. Passenger Step

(Ref. Figure 4-9) The executive trim helicopter is furnished with a removable passenger step, that readily attaches to the helicopter side jacking points, to make entering or leaving the cargo/passenger compartment more convenient. The step assembly consists of a step plate attached to a tubing arm with a step support pin and is rated for 340 pounds (154 kg). A locking pin on the step support pin ensures security of the step in the jacking point when the step is installed. The step may be stowed in the cargo/passenger compartment when not in use.

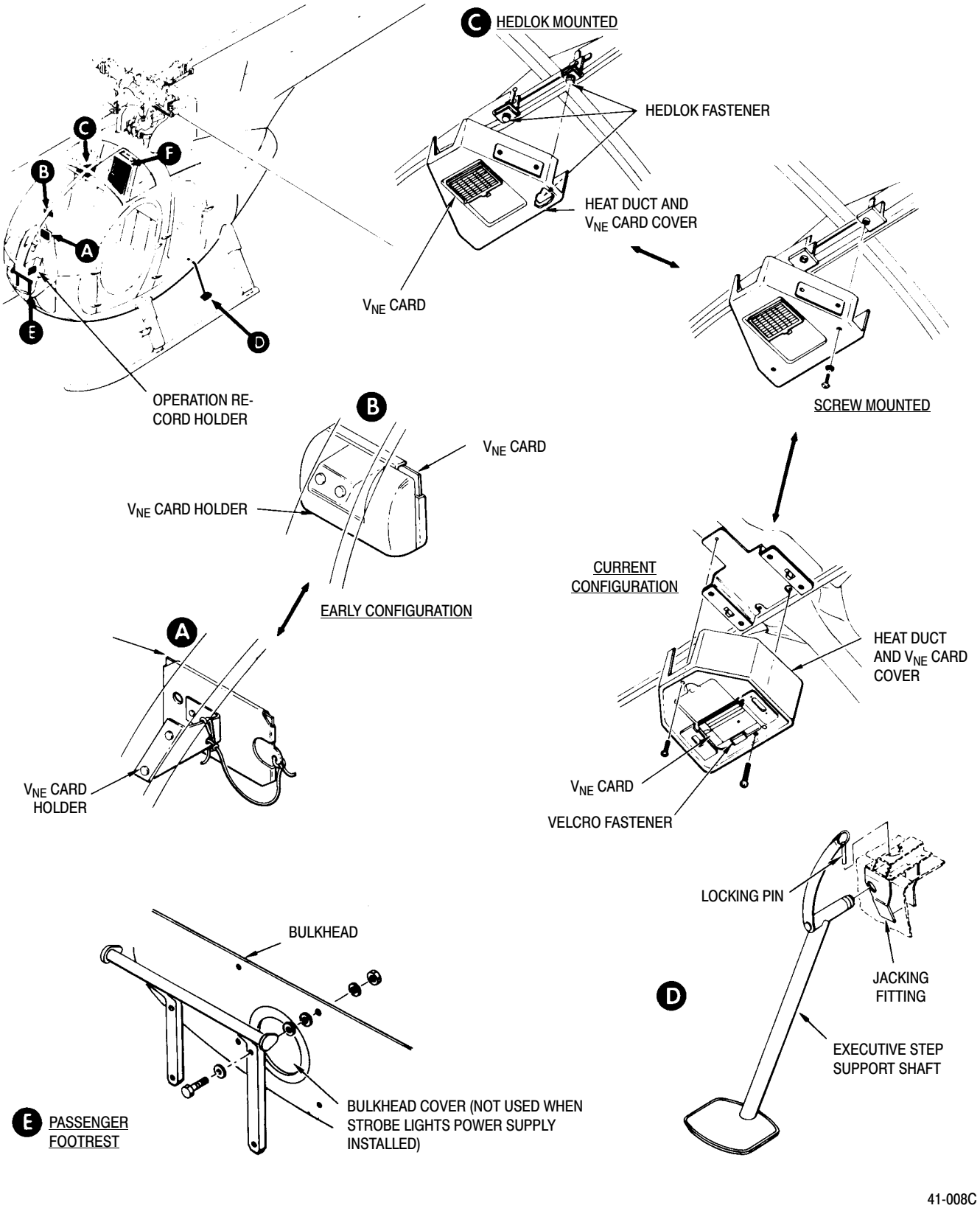


Figure 4-9. Miscellaneous Furnishings

Section

5

Tailboom and Tail Surfaces

TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 5 Tailboom And Tail Surfaces		**5-1**
1.	Tailboom Assembly	5–1
2.	Troubleshooting Tailboom and Tail Surfaces	5–1
3.	Tailboom Assembly Replacement	5–1
A.	Tailboom Assembly Removal	5–1
B.	Tailboom Assembly Installation	5–1
Table 5–1.	Troubleshooting Tailboom and Tail Surfaces	5–1
4.	Tailboom Assembly Inspection	5–2
5.	Tailboom Assembly Repair	5–2
6.	Tail Surfaces	5–2
Figure 5–1.	Empennage and Boom Assembly	5–3
Figure 5–2.	Tailboom Removal and Installation	5–4
7.	Stabilizer Sheet Metal Repair	5–5
8.	Upper Vertical Stabilizer Replacement	5–5
A.	Upper Vertical Stabilizer Removal	5–5
B.	Upper Vertical Stabilizer Installation	5–5
9.	Upper Vertical Stabilizer Inspection	5–5
10.	Upper Vertical Stabilizer Repair	5–5
11.	Horizontal Stabilizer Replacement	5–5
A.	Horizontal Stabilizer Removal	5–5
B.	Horizontal Stabilizer Installation	5–5
Figure 5–3.	Empennage Removal and Installation (Sheet 1 of 2)	5–6
12.	Horizontal Stabilizer Inspection	5–8
13.	Horizontal Stabilizer Repair	5–8
14.	Lower Vertical Stabilizer Replacement	5–8
A.	Lower Vertical Stabilizer Removal	5–8
B.	Lower Vertical Stabilizer Installation	5–9
15.	Lower Vertical Stabilizer Inspection	5–9
16.	Lower Vertical Stabilizer Repair	5–9
17.	Stabilizer Strut Replacement	5–10
A.	Stabilizer Strut Removal	5–10
B.	Stabilizer Fixed Strut Installation	5–10
C.	Stabilizer Damped Strut Installation	5–10
D.	Damped Stabilizer Strut Disassembly	5–11
E.	Damped Stabilizer Strut Re–Assembly	5–11
18.	Stabilizer Strut Inspection	5–11

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
19.	Stabilizer Strut Repair	5-11
	Figure 5-4. Strut Damper Disassembly and Inspection	5-12

SECTION 5
TAILBOOM AND TAIL SURFACES

1. Tailboom Assembly

(Ref. Figure 5-1) The boom assembly, a monocoque structure of aluminum skin over forged aluminum frames, houses the tail rotor drive shaft and tail rotor control rod, and supports the horizontal and vertical stabilizer tail surfaces. The horizontal stabilizer is mounted at an upward angle of 25 degrees. The tail surfaces stabilize the helicopter and maintain it in a relatively level attitude during high speed forward flight. (CSP-H-3 contains information on optional exterior lights.)

2. Troubleshooting Tailboom and Tail Surfaces

(Ref. Table 5-1)

3. Tailboom Assembly Replacement

(Ref. Figure 5-2)

A. Tailboom Assembly Removal

(1). Remove the tail rotor transmission and drive shaft (Ref. Section 9).

(2). Remove the tail rotor control rod (Ref. Section 8).

(3). Position suitable cradles under the tailboom at the canted Sta. 209.78 frame fitting and the forward stabilizer boom mounting frame.

CAUTION To avoid damage, ensure that the boom is properly supported before removing the boom attach bolts

(4). Open the boom bolts access doors and remove the bond jumper from the boom.

(5). Disconnect connector of chip detector wiring, and optional night lighting system wiring if installed. Disconnect knife splice by hand or use appropriate connector insertion/extraction tool (42 or 43, Table 2-2) for wire mate type connector (Ref. Section 19).

(6). Remove the nuts, washers and bolts that attach boom to fuselage and remove boom.

B. Tailboom Assembly Installation

(1). Support tailboom so that mating bulkheads are flush.

NOTE: Prior to tailboom installation, coat threads of external wrenching bolts and attaching nuts with lubricant (25, Table 2-4).

(2). Slide countersunk washers on external wrenching bolts with countersunk side facing bolt heads.

CAUTION If washers are installed backwards, structural failure may result due to insufficient surface in bearing that can cause spreading or cracking of washers and result in loss of clamp-up torque.

(3). Install bolts through aft section fuselage frame into boom frame and place flat washer(s) on each bolt as required for correct bolt grip. Use no more than three flat washers under each nut. Install nuts and torque only the nuts to **200 - 240 inch-pounds (22.60 - 27.12 Nm).**

Table 5-1. Troubleshooting Tailboom and Tail Surfaces

Symptom	Probable Trouble	Corrective Action
High-frequency vibration	Loose lower vertical stabilizer	On stabilizer attached with adjustable bolt, retorque to 25-40 inch-pounds (2.82-4.52 Nm). On stabilizers attached with two bolts, retorque to 90-110 inch-pounds (10.17-12.43 Nm)

NOTE: High frequency vibrations on the helicopter can also be caused by components in other systems. (Ref. Sections 8, 9, and 10.)

NOTE: Bolts may be reversed for access to torque nuts. Torque wrench adapter (25, Table 2-2) is used for torquing.

(4). Install bond jumper to boom and connect chip detector wiring. Connect night lighting wiring if used.

(5). Install the tail rotor transmission and drive shaft.

(6). Install the tail rotor and control rod.

(7). Check rigging of tail rotor control.

(8). Install boom bolts access doors.

4. Tailboom Assembly Inspection

(Ref. Figure 5-2)

(1). Inspect the boom interior skin and frames for corrosion and cracks.

(2). Check the attaching nuts and bolts in the boom canted Sta. 197.78 frame fitting for security.

(3). Inspect the tail rotor control rod grommets in the boom frames for evidence of deterioration.

(4). Inspect the bond jumper for security and corrosion.

(5). Inspect the boom exterior for loose or missing rivets.

(6). Inspect the boom stabilizer and gearbox mounting frames for cracks, security of attachment and elongated holes.

5. Tailboom Assembly Repair

Refer to CSP-H-5 for sheet metal repair.

NOTE: The most highly stressed skins on the helicopter are the two panels that form the monocoque boom assembly (Ref. Figure 5-1).

(1). Negligible Damage:

There is no damage that can be considered negligible. All drainage must be repaired upon detection.

(2). Replacement - Defective Tail Rotor Control Rod Grommets:

Replacement of control rod grommets may require removal of tailboom frames. Refer to CSP-H-5 for available information on replacement grommets with increased service life and for grommet replacement.

6. Tail Surfaces

(Ref. Figure 5-3) Helicopter tail surfaces consist of a vertical and horizontal stabilizer attached to the aft end of the tailboom. A fixed or a damped strut interconnects the horizontal stabilizer and the upper vertical at their approximate midpoints.

The stabilizers are constructed of beaded aluminum alloy sheet metal skin over formed sheet metal ribs. Each stabilizer is supported by a forged aluminum attached fitting.

The upper stabilizer incorporates a 5-degree twist which improves the tail rotor (anti-torque) pedal neutral position during cruise flight.

The upper end of the skid attaches to the lower stabilizer and gearbox mounting frame. The tail skid is formed from an aluminum tube which tapers from its attach point in the root to a curved end just below the bottom rib of the lower stabilizer.

CAUTION Ensure the countersunk washers used with the internal wrenching bolts that attach the tail surfaces are installed with the beveled edge facing the bolt head. If washers are installed backwards, structure failure may result due to insufficient surface in bearing that can cause spreading or cracking of the washers and result in loss of clamp-up torque.

NOTE: MDHI Service Information Notice HN-42 provides instructions for optional rework of an existing fixed strut to the damped strut configuration which is designed to decrease vibration effects on the stabilizer resulting from a tail rotor out-of-balance condition.

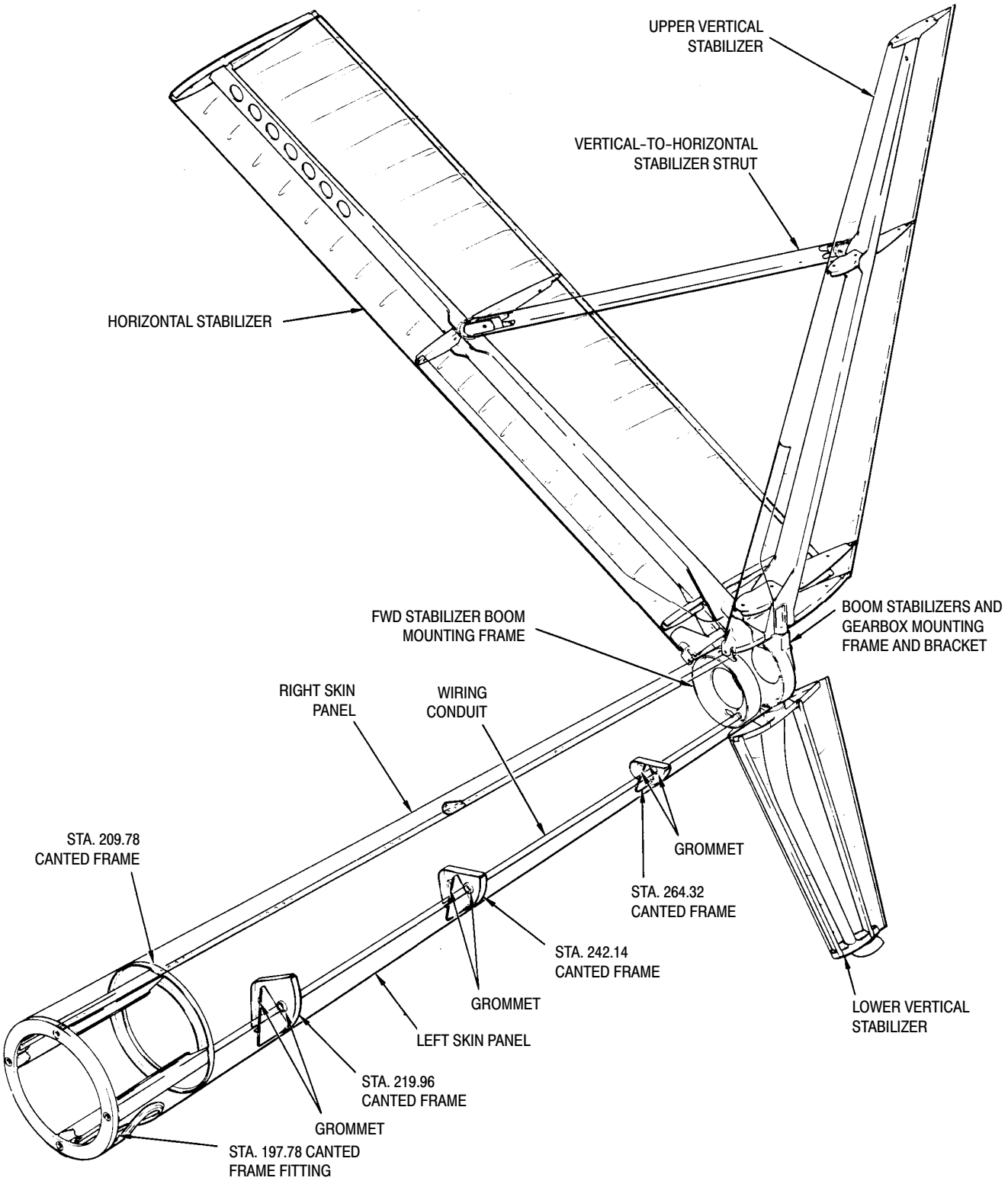
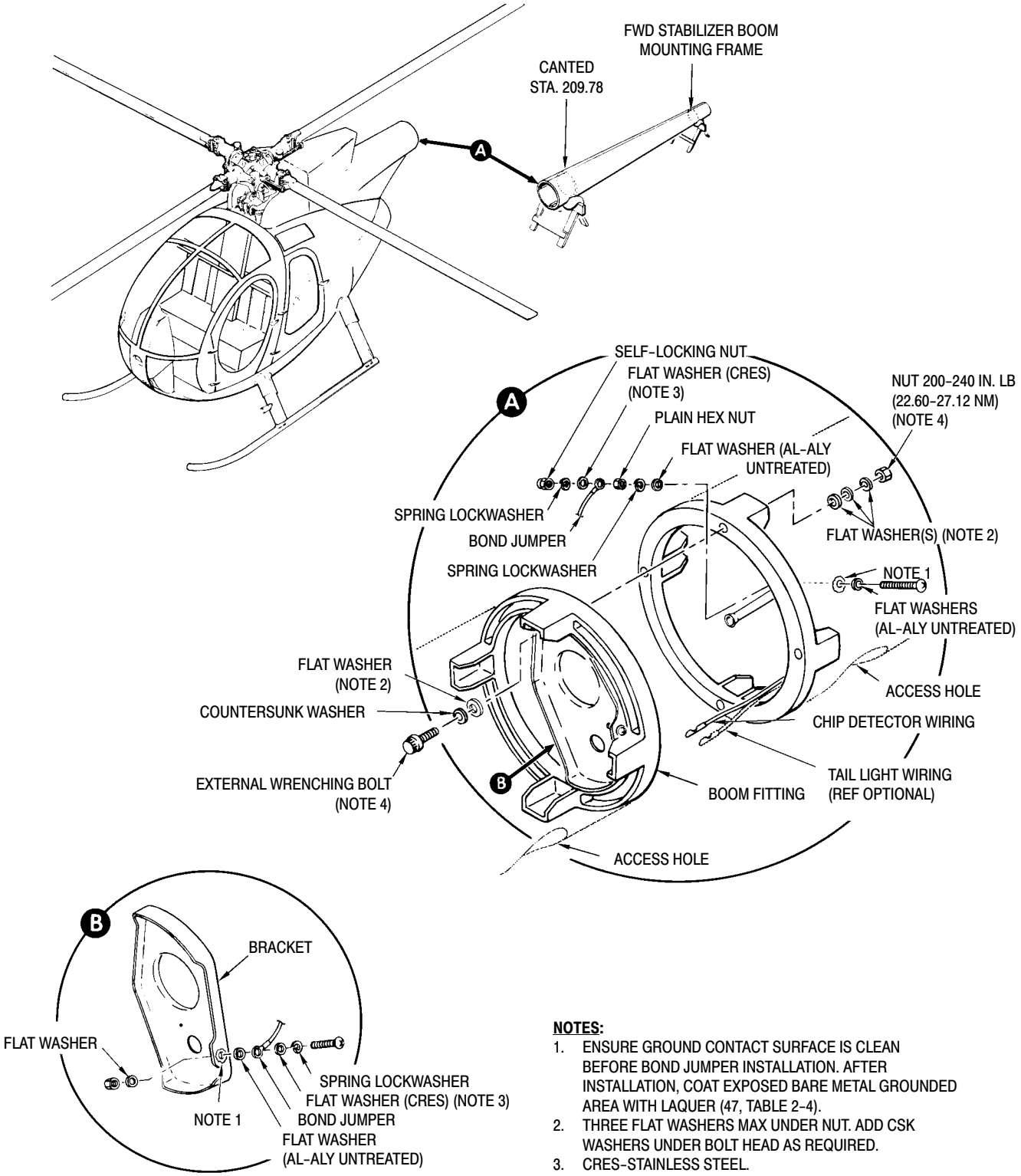


Figure 5-1. Empennage and Boom Assembly



NOTES:

1. ENSURE GROUND CONTACT SURFACE IS CLEAN BEFORE BOND JUMPER INSTALLATION. AFTER INSTALLATION, COAT EXPOSED BARE METAL GROUNDED AREA WITH LAQUER (47, TABLE 2-4).
2. THREE FLAT WASHERS MAX UNDER NUT. ADD CSK WASHERS UNDER BOLT HEAD AS REQUIRED.
3. CRES-STAINLESS STEEL.
4. COAT THREADS WITH LUBRCANT (25, TABLE 2-4) PRIOR TO INSTALLATION.

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Figure 5-2. Tailboom Removal and Installation

7. Stabilizer Sheet Metal Repair

(1). Negligible Damage:

Shallow scratches, nicks, light corrosion deposits, and smooth contour dents that blend into surrounding surfaces are considered negligible damage and require only normal corrosion control and paint finish maintenance.

(2). Repairable Damage:

Repair stabilizer sheet metal according to applicable instructions in CSP-H-5.

8. Upper Vertical Stabilizer Replacement

(Ref. Figure 5-3)

A. Upper Vertical Stabilizer Removal

(1). Remove stabilizer strut.

(2). Remove forward attach bolts and countersunk washers and nuts that secure stabilizer to tailboom structure; remove bonding jumper and upper vertical stabilizer.

B. Upper Vertical Stabilizer Installation

(1). Place upper vertical stabilizer in position on tailboom. Install bonding jumper, forward attach bolt, countersunk washer and bushing. Countersunk side of washer must face bolthead; do not tighten.

(2). Insert external wrenching bolts with counter-sunk washers through mounting holes; countersunk side of washer must face bolthead. Install two new nuts and washers; do not tighten.

(3). Install strut; do not tighten strut bolts.

(4). Torque forward attach bolt to **50 - 70 inch-pounds (5.65 - 7.91 Nm)**.

NOTE: Torque values for the nuts may be applied to the corresponding bolthead at the high limit of the tolerance in cases where the nut is not accessible.

(5). Torque the two nuts to **170 - 200 inch-pounds (19.21 - 22.60 Nm)**.

(6). Torque the strut bolts to **50 - 70 inch-pounds (5.65 - 7.91 Nm)**.

(7). Position access plates at each end of fixed strut and attach with screws and washers.

9. Upper Vertical Stabilizer Inspection

(Ref. Figure 5-3)

(1). Inspect metal skin for holes, cracks, loose rivets or corrosion.

(2). Inspect attach fitting for cracks, loose rivets or corrosion.

(3). Inspect attach bolts and mating holes for evidence of wear caused by looseness in service. Inspect questionable bolts or attach fittings by the dye-penetrant or magnetic particle method, as applicable.

(4). Inspect bonding jumper for security, corrosion and fraying.

10. Upper Vertical Stabilizer Repair

Perform repair of the upper vertical stabilizer according to applicable instructions in CSP-H-5.

11. Horizontal Stabilizer Replacement

(Ref. Figure 5-3)

A. Horizontal Stabilizer Removal

(1). Remove tail rotor transmission and drive shaft (Section 9).

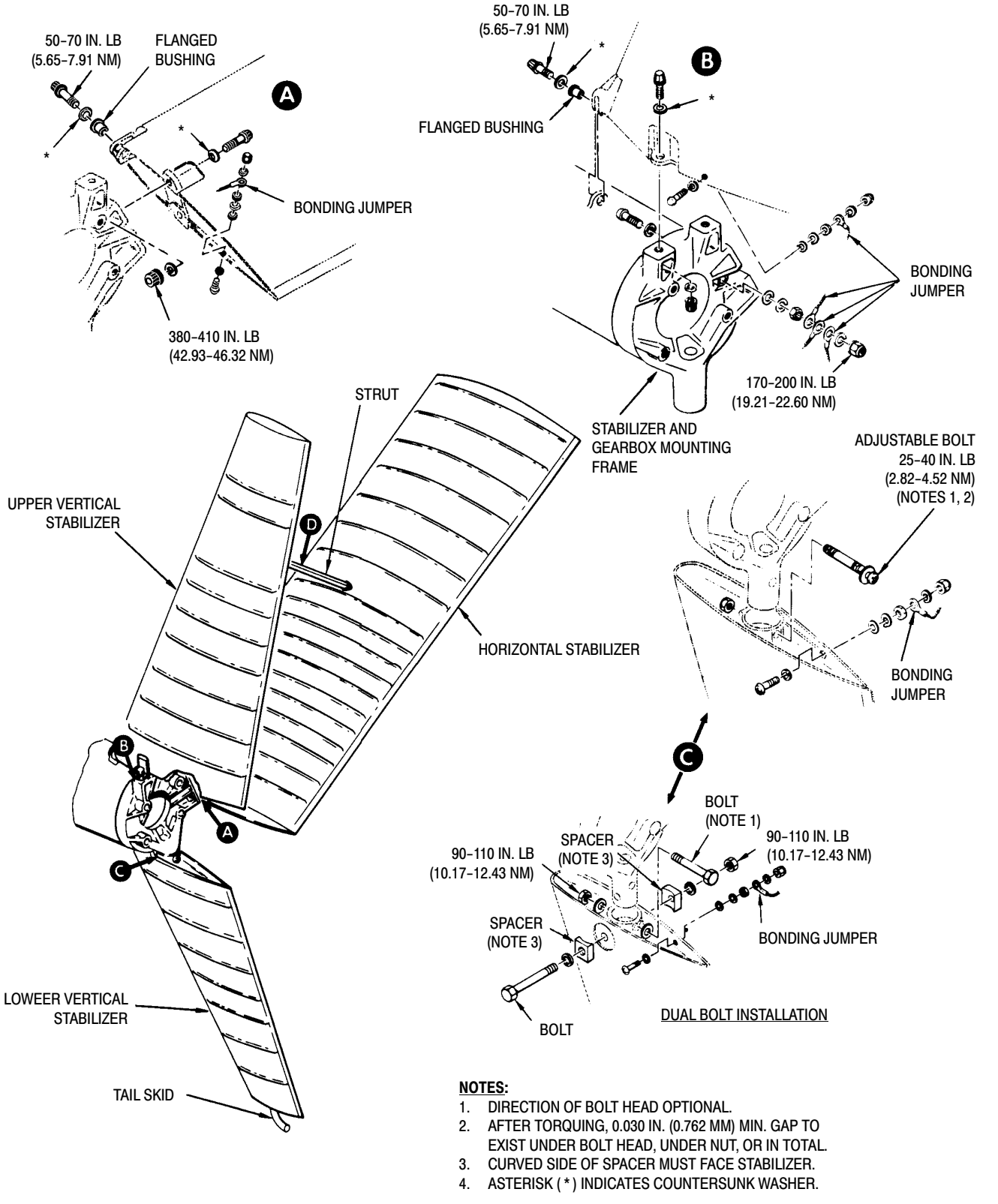
(2). Remove stabilizer strut.

(3). Remove three bolts, washers, nuts and bushing; remove bonding jumper and horizontal stabilizer.

B. Horizontal Stabilizer Installation

(1). Place horizontal stabilizer in position on tailboom. Install a countersunk washer and bushing on external wrenching bolt; countersunk side of washer must face bolthead. Insert bolt in forward mounting hole; do not tighten. Install bonding jumper.

(2). Install a countersunk washer on each of the other external wrenching bolts; countersunk side of washer must face the bolthead. Insert bolts through aft mounting holes and install a nut and washer on each bolt; do not tighten.



NOTES:

1. DIRECTION OF BOLT HEAD OPTIONAL.
2. AFTER TORQUING, 0.030 IN. (0.762 MM) MIN. GAP TO EXIST UNDER BOLT HEAD, UNDER NUT, OR IN TOTAL.
3. CURVED SIDE OF SPACER MUST FACE STABILIZER.
4. ASTERISK (*) INDICATES COUNTERSUNK WASHER.

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Figure 5-3. Empennage Removal and Installation (Sheet 1 of 2)

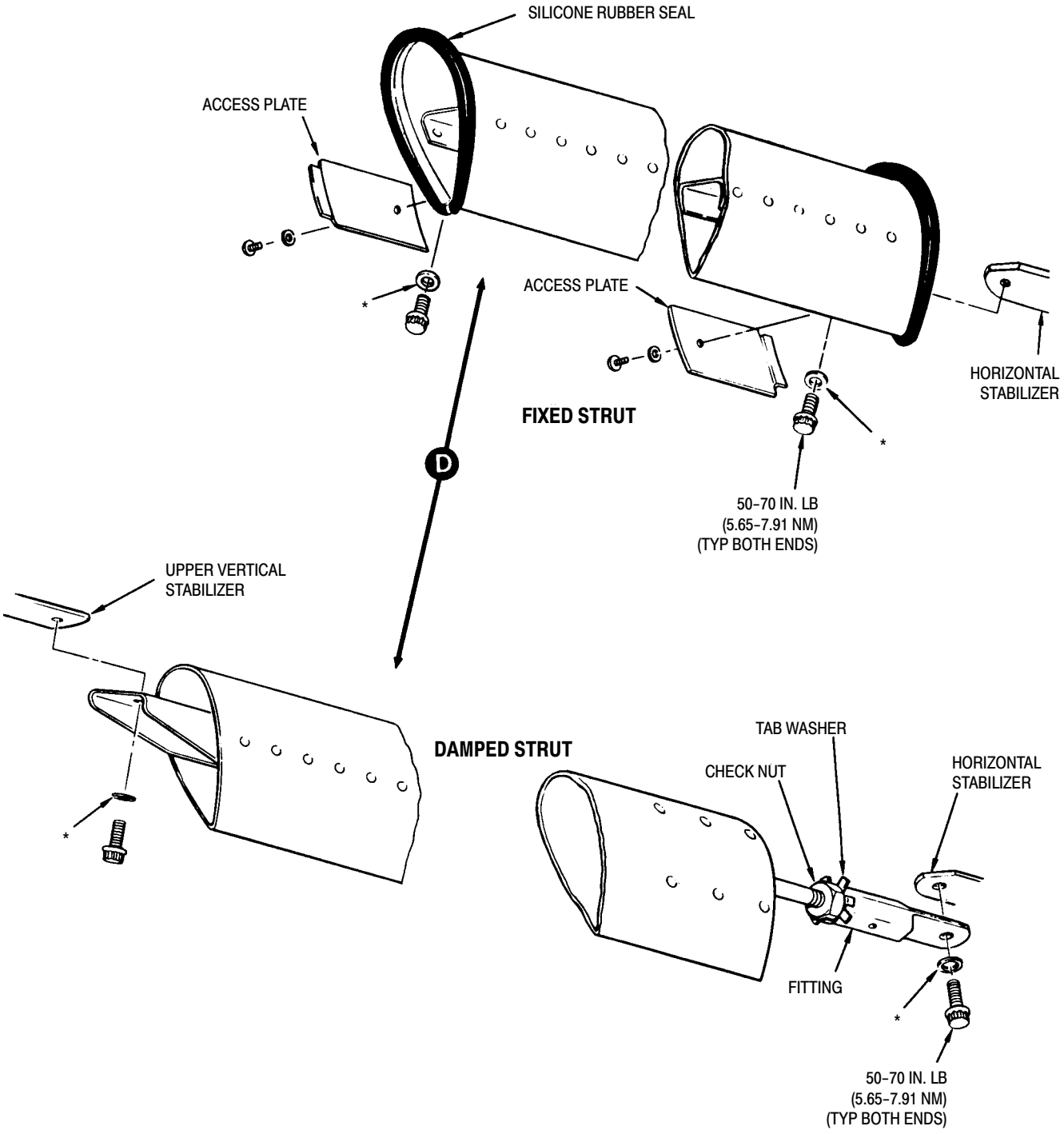


Figure 5-3. Empennage Removal and Installation (Sheet 2 of 2)

(3). Install strut between horizontal and upper vertical stabilizer. Use MS21250-04004 bolts and MS20002C4 washers; do not tighten bolts at this time.

(4). Torque forward mounting bolt to **50 - 70 inch-pounds (5.65 - 7.91 Nm)**.

NOTE: Torque values for the nuts may be applied to the corresponding bolthead at the high limit of the tolerance in cases where the nut is not accessible.

(5). Torque the two remaining nuts to **380 - 410 inch-pounds (42.93 - 46.32 Nm)**.

(6). Tighten strut rut attachment bolts.

(7). Install access plates at each end of fixed strut with screws and washers.

(8). Reinstall tail rotor transmission and drive shaft.

12. Horizontal Stabilizer Inspection

(Ref. Figure 5-3)

(1). Apply an approximate 75 pound (34 kg) downward load to horizontal stabilizer tip and visually check for the following:

(a). Abnormal deflections.

(b). Any motion between skin and rivets on upper surface across first three skin beads out-board of strut attach fitting.

CAUTION If either one of the above conditions is noted, perform steps (2). thru (6). below; otherwise, no further action is required.

(2). Cut three 1 inch (25.4 mm) diameter holes through bottom of skin surface with the center line of the holes 2.0 inches (50.8 mm) aft of the spar rivet line at following locations.

(a). First hole midway between chordwise row of rivets and first bead outboard of strut attach fitting.

(b). Second hole midway between first and second bead.

(c). Third hole between second and third bead.

(3). Reapply the 75 pound (34 kg) downward load to stabilizer tip. Inspect spar web and upper flange through access holes for cracks, using flashlight. Pay particular attention to area around first rivet at each side of bead.

NOTE: If spar cracking is noted, horizontal stabilizer must be replaced.

(4). Smooth the inspection hole edges to eliminate surface irregularities. Cover holes with masking tape, or equivalent, in place of patching.

NOTE: Smooth the access hole edges to remove possible stress risers. At each subsequent 300-Hour Inspection, remove tape and inspect skin area around holes for possible cracks; repair as required (HMI Appx D). Re-tape holes

(5). Replace all loose (working) rivets with correct length CR2249NS-4 or OCKLP-B4 rivets.

(6). Check tail rotor balance.

NOTE: A tail rotor badly out of balance imposes excessive stabilizer fatigue loads.

(7). Inspect metal skin for cracks, holes or corrosion.

(8). Inspect attach fitting for cracks, loose rivets or corrosion.

(9). Inspect attach bolts and mating holes for evidence of wear caused by looseness in service. Replace questionable bolts and dye-penetrant inspect questionable attach fittings as applicable.

(10). Inspect bonding jumper for security, corrosion and fraying.

13. Horizontal Stabilizer Repair

Perform repair of the horizontal stabilizer according to applicable instructions in CSP-H-5.

14. Lower Vertical Stabilizer Replacement

(Ref. Figure 5-3)

A. Lower Vertical Stabilizer Removal

(1). Remove bonding jumper.

(2). On helicopters with adjustable bolt installation, loosen the adjustable bolt until it is free but do not remove.

(3). Firmly push bolt inward to free the bushing stack; then turn the bolt approximately 1/4 turn clockwise to engage the threaded end bushing.

(4). Remove the bolt and bushing stack as an assembly.

(5). On helicopter with dual mounting bolt installation, remove nuts, washers, spacers and bolts.

(6). Slide stabilizer from gearbox mounting frame.

B. Lower Vertical Stabilizer Installation

(1). Apply a coat of zinc chromate paste (72, Table 2-4), or lubricant (21), on the gearbox mounting frame post.

(2). Position stabilizer on mounting frame post and align holes in stabilizer and mounting post.

(3). On helicopters using the adjustable bolt, install the bolt and engage threads in nut. (Direction of bolthead is optional; nut facing aft makes torquing easier.)

CAUTION Tighten bolt by turning bolthead; do not turn the nut. After torquing, check for proper installation by measuring the gap between the bolthead and fitting and the nut and fitting. A minimum gap of 0.030 inch (0.762 mm) must exist at either end or in combined total for the bolt to be correctly installed. If at least one full thread is not visible through the nut, the wrong bolt is installed, or bolt is installed incorrectly. Do not try to eliminate gap by over-torquing.

(4). Torque the adjustable bolt to **25 - 40 inch-pounds (2.82 - 4.52 Nm)**. If no torque wrench is available, tighten bolt until bolt just binds in hole; then tighten nut one more complete turn.

(5). On helicopters using dual mounting bolts, install bolts, spacers (curved side against stabilizer), washers and nuts. Direction of bolthead is optional; upper nut facing aft makes torquing easier. Torque nuts to **90 - 110 inch-pounds (10.17 - 12.43 Nm)**.

(6). Install bonding jumper.

15. Lower Vertical Stabilizer Inspection

(Ref. Figure 5-3)

(1). Inspect the metal skin for holes, cracks, loose rivets or corrosion. Any crack must be stop-drilled or patched (CSP-H-5).

(2). Inspect attach fittings for cracks, loose rivets or corrosion. Check that the drain holes in stabilizer bottom rib are open. If there appears to be excessive clearance between the stabilizer tube and attach fitting, a temporary repair should be made using aluminum laminated shim stock to reduce this clearance installation fit.

(3). Check adjustable bolt or the two mounting bolts for condition. Oversized or elongated bolt holes in both the stabilizer and the stabilizer and gearbox mounting frame must be repaired.

(4). Inspect visible portion of tail skid tube for cracks, deformation and condition of plastic sleeve between tube and bottom rib.

(5). Inspect bonding jumper for security, corrosion and fraying.

16. Lower Vertical Stabilizer Repair

(1). Repair lower vertical stabilizer sheet metal or mounting tube according to applicable instructions in CSP-H-5.

(2). Repair oversized holes in stabilizer and gearbox mounting frame having single bolt attachment as follows.

NOTE: An ABC 4677 bolt is originally used in unbushed holes. Maximum serviceable diameter for worn unbushed holes is 0.257 inch (6.5278 mm). Bolt hole wear in excess of the maximum should be repaired by the bushing method given in CSP-H-5.

(a). If the mounting hole is oversized or elongated, but within maximum permissible diameter in either or both the gearbox mounting frame and stabilizer fitting, rework and bush the damaged hole(s) according to CSP-H-5 and continue to use an ABC 4677 bolt.

(b). If mounting hole(s) are already bushed but bushing ID is not within the permissible wear limit, re-bush the hole(s) according to CSP-H-5 and continue to use an ABC 4677 bolt.

NOTE: The oversize bolt repair given in step (c). below should be used only as an expedient repair. Use of the oversize bolt will affect interchangeability of other stabilizers on the gearbox mounting frame. Also, if the oversize bolt repair is made and any subsequent wear causes hole diameter to exceed 0.3125 inch (7.9375 mm), the bushing repair is not permissible.

(c). For expedient repair, oversized or elongated mounting bolt holes in both stabilizer and mounting frame may be drilled and reamed to 0.312 inch (7.9248 mm) diameter and an oversize adjustable ABC 4678 bolt installed. The ABC 4678 bolt is similar to the ABC 4677 bolt except the bolt bushing OD is 0.312 inch (7.9248 mm) instead of 0.250 inch (6.35 mm) and it has a hex head instead of a recessed head.

17. Stabilizer Strut Replacement

(Ref. Figure 5-3)

A. Stabilizer Strut Removal

(1). Remove access plates at each end of fixed strut.

(2). Remove attachment bolts and washers that attach strut to stabilizers.

(3). At root of upper vertical stabilizer, loosen bolts and nuts far enough to allow the fixed strut to clear the stabilizer attach fittings.

(4). Remove the strut.

B. Stabilizer Fixed Strut Installation

NOTE: The use of AN bolts for strut attachment is not recommended because this bolt type lacks uniformity in tensile strength.

(1). Position strut between horizontal and upper vertical stabilizers. Attach strut to stabilizers with washers and bolts (countersunk side of washers to face bolthead). Do not tighten.

(2). Torque upper vertical stabilizer root mounting bolts.

(3). Torque the attachment bolts to **50 - 70 inch-pounds (5.65 - 7.91 Nm)**.

(4). Position access plates at each end of strut and attach with screws and washers.

C. Stabilizer Damped Strut Installation

NOTE: The use of AN bolts is not recommended for strut attachment due to the lack of uniformity in tensile strength of AN type bolts.

(1). Torque upper vertical stabilizer root mounting bolts if these were loosened for fixed type strut removal.

(2). Position the damped strut assembly and temporarily install the upper strut attachment bolt.

(3). Re-adjust the lower end fitting of the damper assembly so that a bolt will slide into the lower vertical stabilizer attachment hole.

(4). Disengage fitting and turn the fitting inward one full turn to shorten the strut length and establish damper preload.

(5). Install both fitting attachment bolts and countersunk washers (countersunk side toward bolthead) and torque to **50 - 70 inch-pounds (5.65 - 7.91 Nm)**.

(6). Tighten check nut on damper fitting.

(a). If installed, bend one tab of tab washer over a hex flat on the check nut and another tab over a hex flat on the damper fitting.

(b). If check nut and fitting with lockwire provisions are used, lockwire check nut to fitting.

D. Damped Stabilizer Strut Disassembly

(Ref. Figure 5-4) Disassemble the damped stabilizer strut by removing retaining ring and pulling plunger out of damper housing. Further disassembly, as illustrated, may be performed if required. Do not remove inboard snubbers unless outboard snubbers are found unserviceable upon inspection. Discard used tab washer.

E. Damped Stabilizer Strut Re-Assembly

(Ref. Figure 5-4)

Refer to Hughes Notice HN-102.3 for inspection and/or modification of strut assemblies.

(1). Assemble damper as shown. Be sure to place the thin snubbers next to the collar on damper plunger. If a slotted plunger is used, install a new tab washer.

(2). Push assembled plunger firmly into damper housing and install retaining ring. Additional compression of snubbers, by pushing on cap assembly, may be required in order to completely seat the retainer in the housing.

(3). Check that plunger will move smoothly with no binding in bearings. A 25 - 80 pound (11 - 36 kg) pushing or pulling load applied to the plunger should produce 0.010 inch (0.254 mm) movement.

(4). Adjust the nominal length of the damper assembly to the dimension shown. If installed, do not bend tab washer at this time.

18. Stabilizer Strut Inspection

(Ref. Figure 5-4)

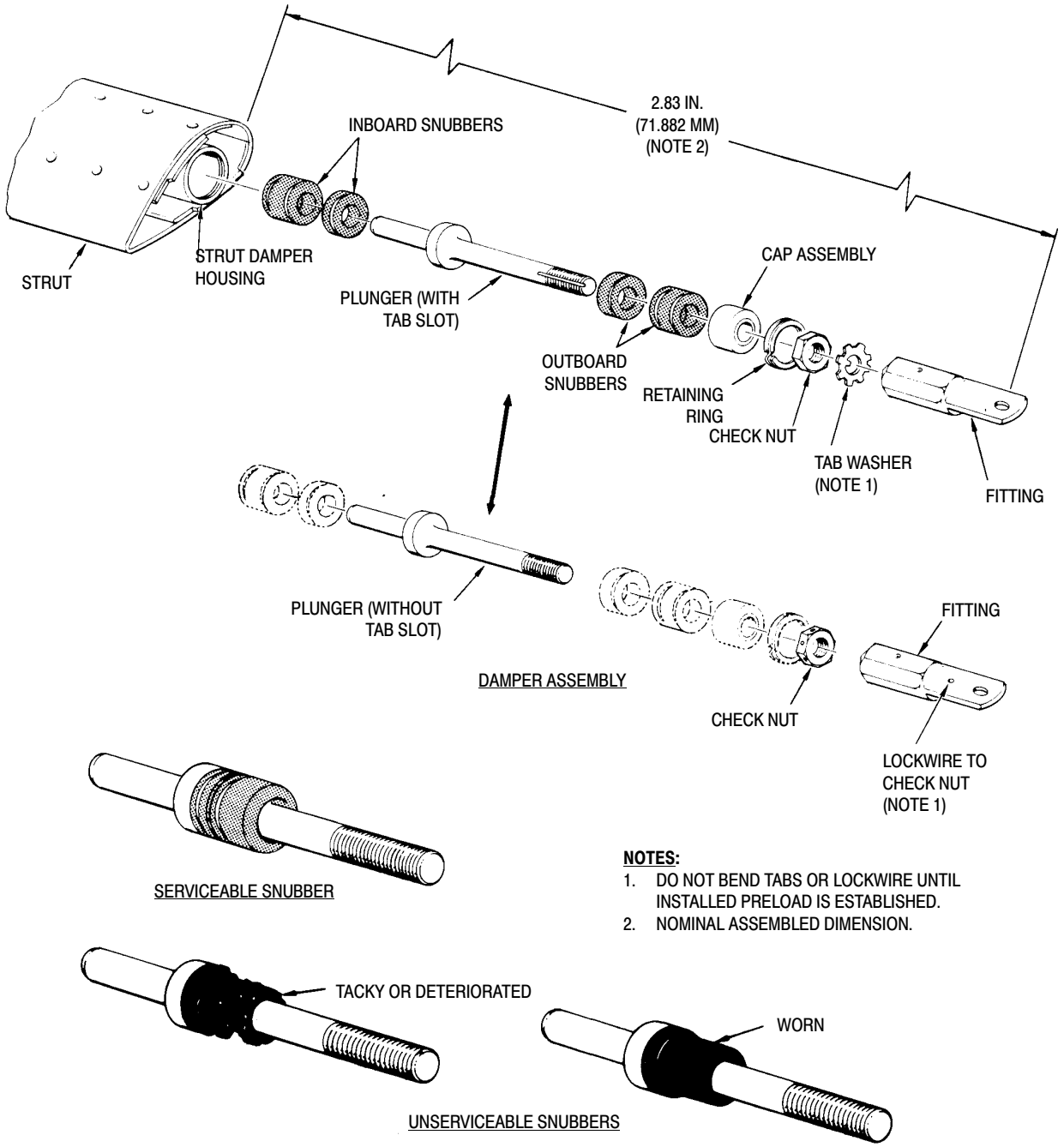
(1). Inspect the strut for holes, cracks and corrosion.

(2). Inspect cushion seals at each end of fixed strut for deterioration and security of bonding.

(3). Inspect outboard snubbers of damped strut for serviceability as shown. If outboard snubbers are not serviceable, replace all four snubbers.

19. Stabilizer Strut Repair

No structural repair is currently authorized for the stabilizer strut. Replace deteriorated cushion seals on fixed strut, using adhesive (69, Table 2-4) according to container instructions. Replace unserviceable snubbers and other parts of the damper on damped struts.



DAMPER INSPECTION

REMOVE RETAINING RING. PULL PLUNGER AND FITTING (WITH TWO OUTBOARD DAMPER SNUBBERS ATTACHED) OUT OF DAMPER HOUSING. INSPECT FOR CONDITION AND SERVICEABILITY. IF OUTBOARD SNUBBERS ARE SERVICIBLE, REINSTALL PLUNGER ASSEMBLY.

DO NOT REMOVE INBOARD SNUBBER DISCS UNLESS OUTBOARD SNUBBERS ARE INSPECTED AND FOUND UNSERVICIBLE.

30-172C

Figure 5-4. Strut Damper Disassembly and Inspection

Section

6

Landing Gear

TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 6 Landing Gear		**6-1**
1.	Landing Gear Description and Operation	6–1
2.	Landing Gear Replacement	6–1
A.	Landing Gear Removal	6–1
Figure 6–1.	Landing Gear	6–2
B.	Landing Gear Installation	6–3
3.	Landing Gear Inspection	6–3
Figure 6–2.	Repair and Replacement of Landing Gear (Sheet 1 of 2)	6–4
4.	Landing Gear Strut Inspection	6–6
Figure 6–3.	Landing Gear Strut Inspection	6–7
5.	Landing Gear Repair	6–8
6.	Landing Gear Strut Drag Brace Hole Repair	6–8
A.	Landing Gear Strut with Bushing Installed	6–8
B.	Landing Gear Strut with No Bushing Installed	6–8
7.	Landing Gear Skid Description	6–9
8.	Landing Gear Skid Replacement	6–9
A.	Landing Gear Skid Removal	6–9
B.	Landing Gear Skid Installation	6–9
Table 6–1.	Maximum Damage Limits for Landing Gear Components	6–10
9.	Heavy–Duty Abrasion Strip Replacement	6–11
10.	Landing Gear Skid Inspection	6–11
11.	Landing Gear Skid Repair	6–11
A.	Repair of Scratches, Nicks, Dents and Punctures	6–11
B.	Skid Plug Replacement	6–11
C.	Abrasion Strip Replacement	6–11
D.	Skid Cap Replacement	6–12
E.	Ground Handling Fitting Replacement	6–12
F.	Safety Walk Tape Replacement	6–12
G.	Skid Tube Nutplate Fitting Replacement	6–12
12.	Landing Gear Damper Description and Operation	6–12
13.	Landing Gear Damper Replacement	6–13
A.	Landing Gear Damper Removal	6–13
B.	Landing Gear Damper Installation	6–13
Table 6–2.	Damper Assembly Identification	6–14
14.	Landing Gear Damper Inspection	6–14
Figure 6–4.	Landing Gear Damper Assembly Extension Check	6–15
Table 6–3.	Minimum Damper Extension (Dimension A)	6–15

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
15.	Landing Gear Damper Repair	6–15
16.	Landing Gear Fairing Assembly Description	6–16
17.	Landing Gear Fairing Replacement	6–16
A.	Landing Gear Fairing Assembly Removal	6–16
B.	Landing Gear Fairing Assembly Installation	6–17
Figure 6–5.	Repair and Replacement of Fairing (Sheet 1 of 2)	6–18
18.	Landing Gear Fairing Assembly Inspection	6–20
19.	Landing Gear Fairing Assembly Repair	6–20
20.	Cabin Entry Step Description	6–21
21.	Cabin Entry Step Replacement	6–21
22.	Cabin Entry Step Inspection and Repair	6–21

SECTION 6
LANDING GEAR

1. Landing Gear Description and Operation

(Ref. Figure 6-1) The landing gear consists of two strut-mounted, shock-dampened skids aligned longitudinally along the helicopter fuselage. Both right and left skids pivot as the damper assemblies extend and retract. Five replacement abrasion pads are installed on each skid to retard skid wear on hard surfaces. Fairings on each strut reduce aerodynamic drag during flight. Forged aluminum alloy landing gear braces are attached between the landing gear strut and fuselage center beam. The braces prevent shearing of the struts, and keep the strut in alignment with the landing gear. The landing gear struts, made of aluminum alloy forgings, attach to the fuselage center beam. At the lower ends of the struts, feet attach the landing gear skids to the struts. A cabin entry step is mounted on the forward struts of all current configuration helicopters. The step has provisions for optional side position lights (part of optional night lighting system). On early configuration helicopters, the cabin entry step was provided as an optional item and may not be installed on all helicopters. Helicopters not having cabin entry steps are equipped with a forward fairing cover.

NOTE: A skid vibration damper kit may be installed on standard or extended landing gear skids equipped with heavy duty or cobalt insert type abrasion strips. The optional kit, described in CSP- H- 3, will reduce any excessive skid vibration by addition of weight to the aft end of each skid tube.

2. Landing Gear Replacement

(Ref. Figure 6-2)

A. Landing Gear Removal

NOTE: The following procedure removes the entire landing gear, except the landing gear damper, as an assembled unit. For removal of an individual component, refer to the applicable paragraph following this procedure. Two personal are required to accomplish removal.

(1). Jack up the helicopter until the landing gear dampers are fully extended (Ref. Section 2). Place support beneath the skid tubes at the strut locations.

(2). Gain access to the forward brace, strut, and damper at fuselage attachment points by opening the compartment access doors and foot support fairings, respectively.

(3). Gain access to aft landing gear attachment points by opening the engine access doors.

(4). Disconnect lower end of landing gear dampers. Remove clamp that attaches the bonding jumper to strut.

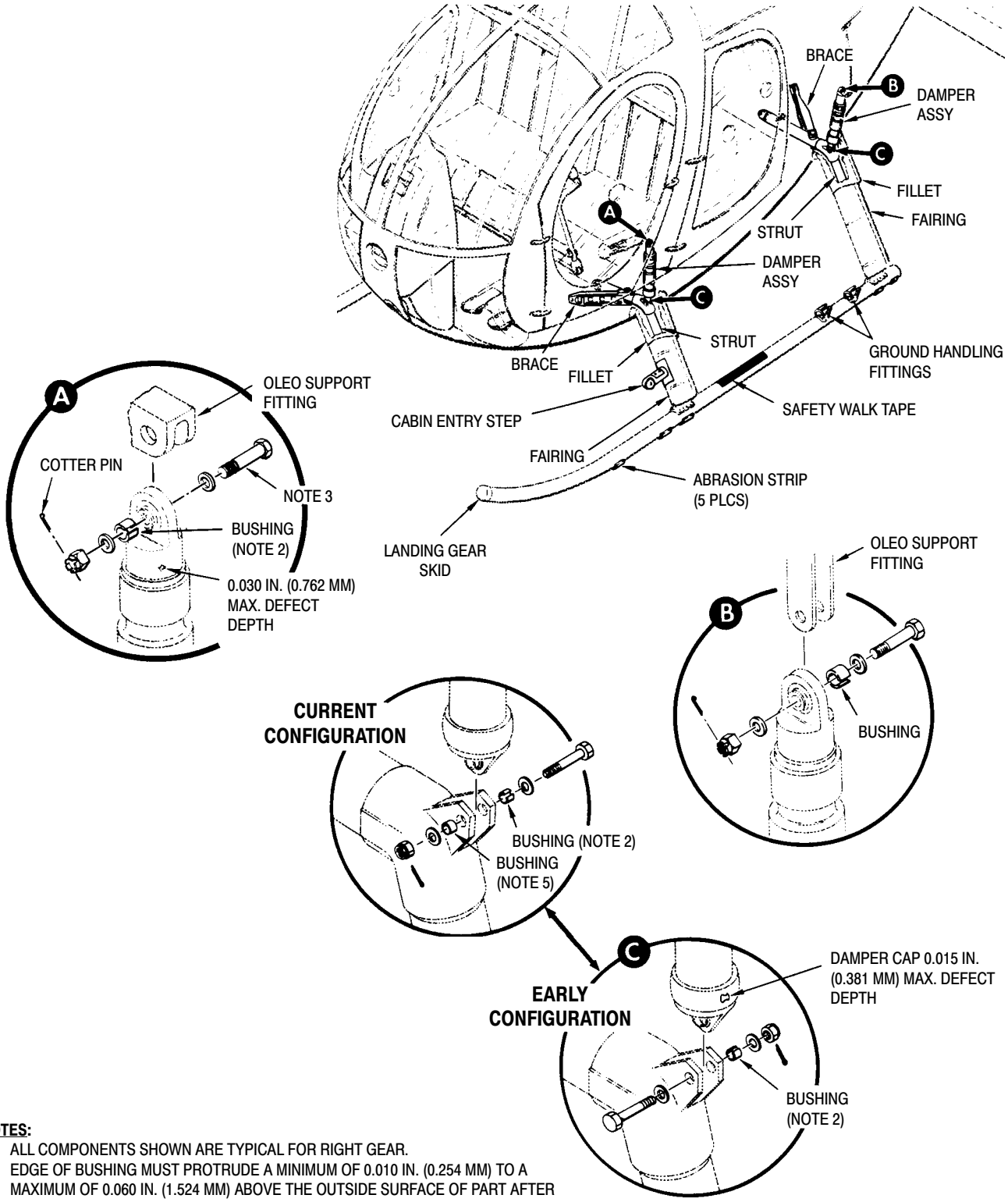
(5). Pull fairing fillet downward against spring tension and secure with tape (14, Table 2-4).

(6). If optional night lighting system is installed, disconnect wiring by using appropriate connector insertion/extraction tool (42 or 43, Table 2-2).

(7). Remove cotter pins, nuts, washers and bolts that attach braces to struts and support fittings, and struts to support fittings, on left side of fuselage. Remove braces.

(8). Remove supports from beneath left skid and carefully remove left struts, skid and fairings as an assembled unit.

(9). Repeat the sequence to remove the right landing gear.



NOTES:

1. ALL COMPONENTS SHOWN ARE TYPICAL FOR RIGHT GEAR.
2. EDGE OF BUSHING MUST PROTRUDE A MINIMUM OF 0.010 IN. (0.254 MM) TO A MAXIMUM OF 0.060 IN. (1.524 MM) ABOVE THE OUTSIDE SURFACE OF PART AFTER NUT IS TIGHTENED.
3. LEFT FWD DAMPER ATTACHING BOLT HEAD AFT FOR REMOVAL CLEARANCE.
4. NOT INSTALLED ON EARLY CONFIGURATION HELICOPTERS.
5. INSTALL FLUSH WITH INSIDE SURFACE.

30-068C

Figure 6-1. Landing Gear

B. Landing Gear Installation

(1). Gain access to landing gear attachment points by opening or removing fuselage access doors, engine access doors and foot support fairings.

(2). With helicopter supported by jacks, position left landing gear to align the struts with their openings in the fuselage structure.

NOTE: Check that the fairing fillet guide pins are engaged with the fairing guide holes before positioning the struts for attachment to the structure (Ref. Figure 6-5).

(3). Lift and carefully position the left landing gear; then place supports beneath the landing gear to hold it in place.

NOTE: The left forward damper upper bolt must be installed with bolt head aft (Ref. Figure 6-2). Bolt direction on right side is optional.

(4). Check that slotted bushing is in place. Align lower bearing of dampers with mating holes in strut and install bolt, two washers, nut and new cotter pin to secure each damper.

(5). Align struts with mating bearings in fuselage support fittings and install bolt, two washers, nut and new cotter pin.

(6). Align inboard end of each brace with mating bearing in fuselage support fitting and install bolt, two washers, nut and new cotter pin.

(7). Install bonding jumper with clamp and attaching hardware.

CAUTION Do not overtighten brace to strut hardware. Maximum permissible torque of nut is **5 inch- pounds (0.56 Nm)**.

(8). Align outboard end of each brace with mating hole in strut and install bolt, install two washers and nut.

(9). Torque nut to **2 - 5 inch-pounds (0.226 - 0.56 Nm)** and install cotter pin.

(10). If optional night lighting system is installed, connect wiring by using appropriate connector/insertion/extraction tool (42 or 43, Table 2-2).

(11). Repeat steps (1). thru (8). to install the right landing gear.

(12). Remove skid supports, lower helicopter, and remove jacks.

(13). Close engine and underfloor compartment access doors; install foot fairings.

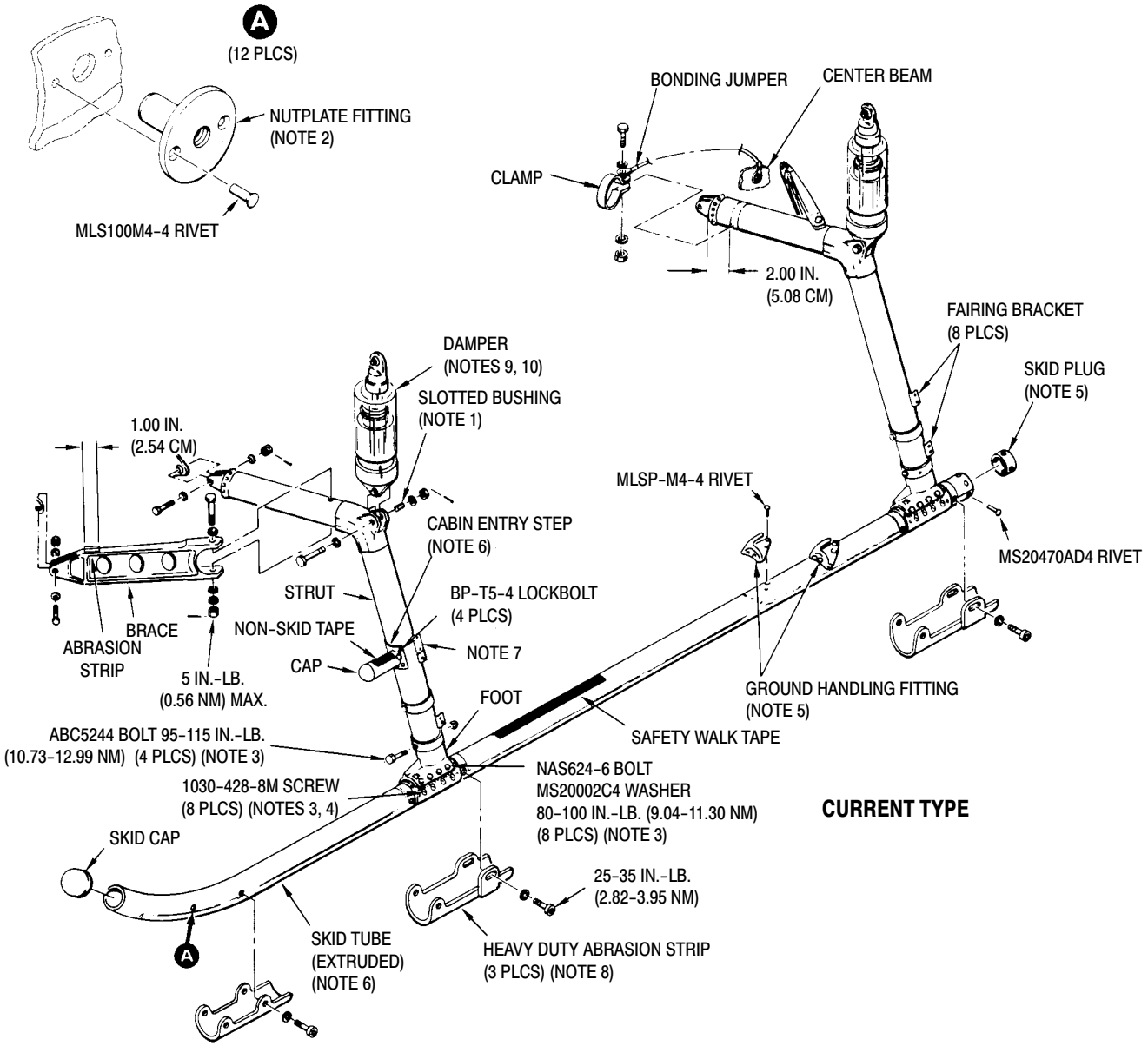
3. Landing Gear Inspection

NOTE: Inspection should be performed with helicopter skids clear of the ground.

(1). Inspect skids, skid abrasion strips, struts, feet, braces and fairings for dents, cracks, loose components or rivets, missing cotter pins and loose nuts.

(2). Inspect the skid-to-foot and foot-to-strut attachments for loose bolts and relative motion between connecting parts. If the bolts are loose, replace with original size (if holes are not elongated) or next larger size bolts.

NOTE: On other than lock bolt type installations, use of next larger size lock bolt requires replacement of nutplate.

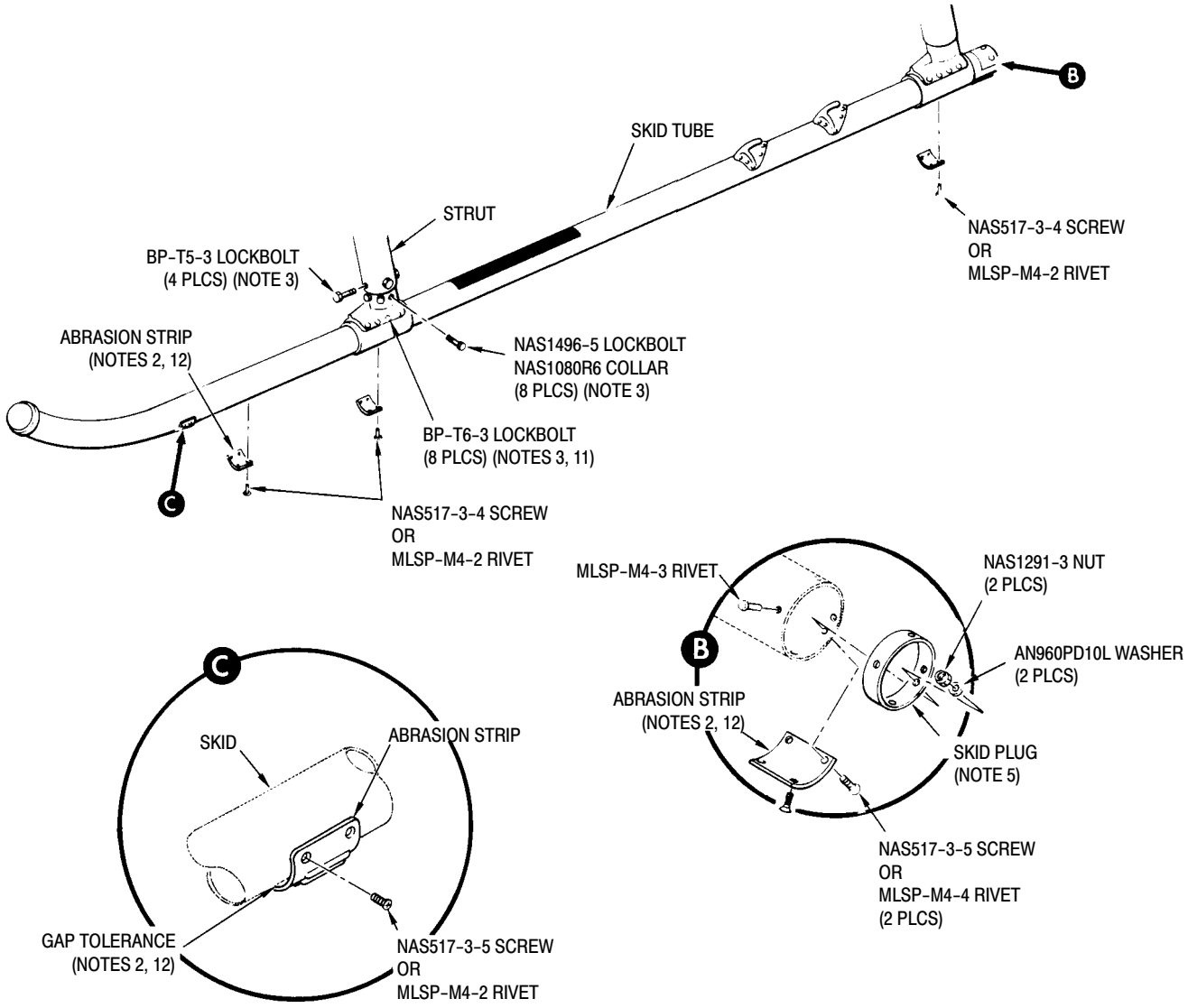


NOTES:

1. EDGE OF BUSHING MUST PROTRUDE A MINIMUM OF 0.010 IN. (0.254 MM) TO A MAXIMUM OF 0.060 IN. (1.524 MM) ABOVE OUTSIDE SURFACE OF PARTS AFTER NUT IS TIGHTENED.
2. SEAL PARTING EDGE WITH A FILLET OF SEALING COMPOUND (3, TABLE 2-4).
3. INSTALL ALL RIVETS, AND OTHER HARDWARE WHERE NOTED, WITH WET PRIMER (4, TABLE 2-4).
4. INSTALL SCREWS ON OUTBOARD SIDE OF INTERCHANGEABLE SKID TUBES.
5. SEAL MATING SURFACES WITH ZINC CHROMATE PUTTY (71, TABLE 2-4).
6. NOT INSTALLED ON EARLY TYPE.
7. LONGER BRACKET WITH THREE MOUNTING HOLES USED ON EARLY TYPE.
8. MAXIMUM 0.050 IN. (1.27 MM) GAP PERMISSIBLE FORE-AND-AFT CENTERLINE OF ABRASION STRIP AND SKID TUBE.
9. USE OF PLASTIC COVER IS OPTIONAL ON POPPET TYPE DAMPERS.
10. AT INSTALLATION, POSITION SO THAT TORQUE STRIPES ON CAPS ARE VISIBLE.

30-069-1C

Figure 6-2. Repair and Replacement of Landing Gear (Sheet 1 of 2)



EARLY CONFIGURATION CHANGES

NOTES: (CONT.)

11. BT-T6-4 LOCKBOLTS MAY BE USED AS ALTERNATE, IF REQUIRED, AS BY TOLERANCE BUILDUP.
12. SMALL GAPS ARE ALLOWED BETWEEN SKID TUBE AND ABRASION STRIPS:
    AT FWD STRIP (DETAIL C) - 0.030 IN. (0.762 MM) GAP AT FWD EDGE AND 0.010 IN. (0.254 MM) GAP AT AFT EDGE; AT ALL OTHER STRIPS - 0.030 IN. (0.762 MM) GAP AT BOTH EDGES.

30-069-2B

Figure 6-2. Repair and Replacement of Landing Gear (Sheet 2 of 2)

4. Landing Gear Strut Inspection

(Ref. Table 6-1 and Figure 6-3)

(1). Check landing gear dampers for correct servicing by observing stance of helicopter. Check rear dampers for correct extension and signs of leakage.

(2). Remove foot support fairings in passenger/cargo compartment and open engine access doors.

(3). Visually inspect strut attachment points and pivot bearing for signs of fretting, wear and damage. Fretting will be evident by gray or black material around bearing, rivets or seams.

(4). Jack helicopter until landing gear dampers are fully extended.

(5). Shake landing gear assemblies and note any play or looseness at pivot bearings, inboard strut assembly fittings and drag brace holes.

(6). If any play or looseness is noted, remove landing gear (Ref. Landing Gear Removal) and inspect drag brace and strut.

(7). If bushing is installed in drag brace attach hole in strut, proceed as follows:

(a). Check bushing for looseness. If bushing is loose, remove it.

(b). Using 10X glass and bright light, inspect strut around drag brace attach holes (top and bottom surfaces) for cracks.

(c). Check drag brace attach holes in strut for elongation.

1). Diameter of top hole (DIM. A) should be 0.5313 inch (13.495 mm) maximum in any direction.

2). Diameter of bottom hole (DIM. B) should be 0.50 inch (12.70 mm) maximum in any direction.

(d). If no cracks are found around drag brace attach hole in strut and hole is not elongated, install new bushing in hole with wet primer (4, Table 2-4).

(e). If either hole is oversized or cracking is noted, rework strut (Landing Gear Strut Drag Brace Hole Repair).

(8). If no bushing is installed in drag brace attach hole in strut, proceed as follows:

(a). Using 10X glass and bright light, inspect strut around drag brace attach holes (top and bottom surfaces) for cracks. If any cracks longer than 0.030 inch (0.762 mm) in length are noted, strut must be scrapped and serviceable strut installed.

(b). Check drag brace attach holes in strut for elongation.

(c). If any cracks, 0.030 inch (0.762 mm) in length or less, are noted or hole is elongated, rework strut (Landing Gear Strut Drag Brace Hole Repair).

(9). Reinstall landing gear (Ref. Landing Gear Installation).

(10). Inspect strut for cracks or dents.

(a). If strut is cracked, scrap strut and replace with serviceable strut.

(b). If dents in strut exceed 0.060 inch (1.524 mm) depth; or, if scratches and repair area depth would exceed 0.010 inch (0.254 mm) when measured to surrounding unrepaired surface strut must be scrapped and serviceable strut installed.

(11). Remove plug button from underside of fairing assembly. Using a bright light and 10X magnifying glass, inspect rivet hole in underside of strut for cracks. If crack is found, strut must be scrapped and serviceable strut installed.

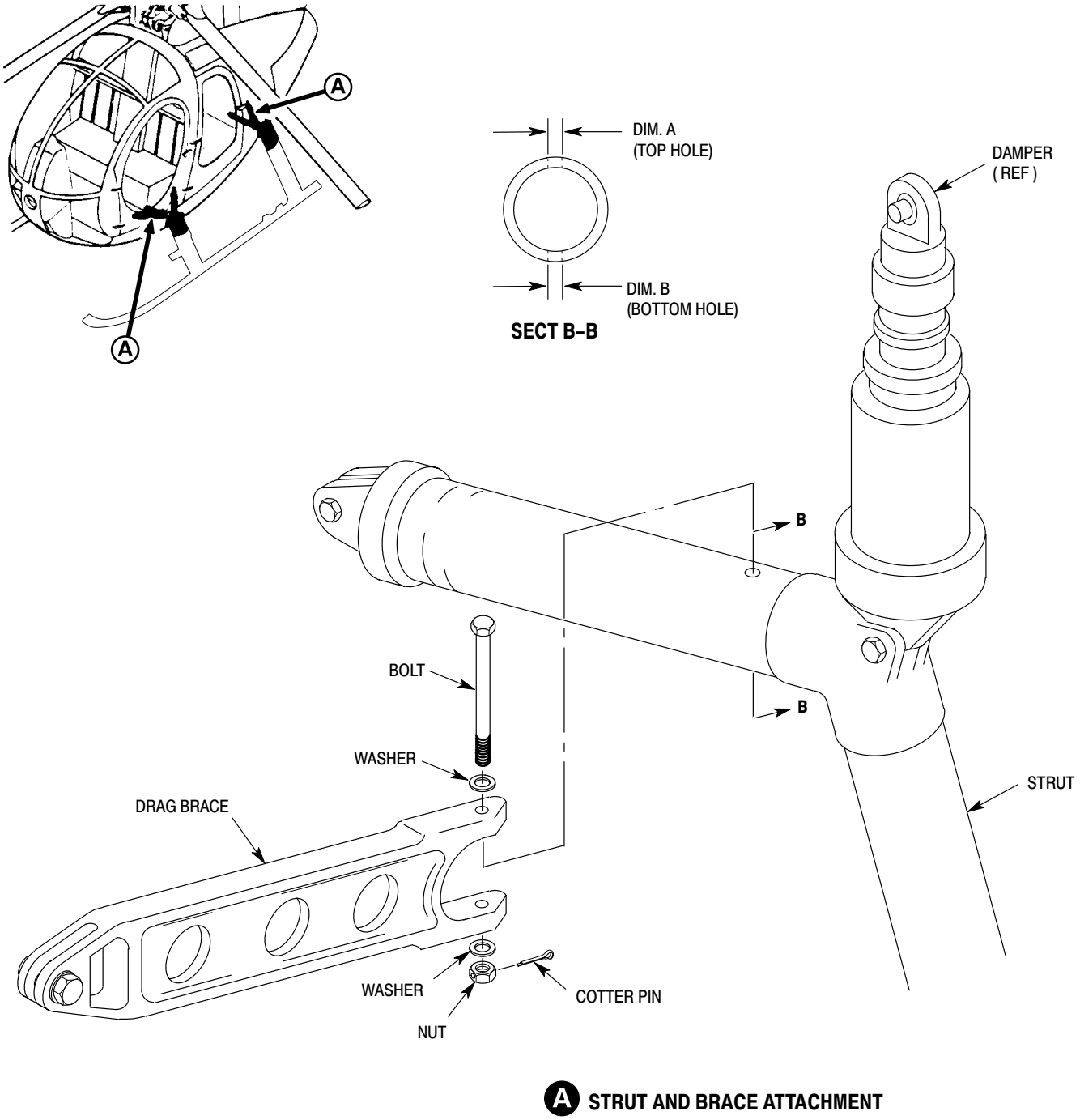


Figure 6-3. Landing Gear Strut Inspection

5. Landing Gear Repair

(Ref. Figure 6-2)

(1). Repair scratches and nicks by smoothing sharp edges.

(2). Repair elongated, enlarged or worn bolt holes in strut fittings, either inboard or outboard (Ref. CSP-H-6).

(3). Repair bolt holes at large end of brace that attaches to strut (Ref. CSP-H-6).

(4). Replace a strut that is cracked or for the following damage.

(a). Dents with depth in excess of 0.060 inch (1.524 mm).

(b). Scratches if repaired area depth exceeds 0.010 inch (0.254 mm) when measured to surrounding unrepaired surface.

(5). Replace defective or badly damaged fairing.

(6). Repair fairing fiberglass damage, such as small tears or punctures that do not impair the telescoping action of the fairing (Ref. CSP-H-6).

(7). Replace cracked, dented or distorted braces.

(8). Repair or replace damaged skid tube.

(9). Replace center beam-to-landing gear attachment bearings that exceed 0.040 inch (1.016 mm) axial play. Refer to CSP-H-6 for replacement procedure.

6. Landing Gear Strut Drag Brace Hole Repair

(Ref. Figure 6-3) The following procedure is for repair of the bolt hole in the landing gear strut where the drag brace attaches. This rework is for either elongated or cracks in the bolt hole area (Ref. Landing Gear Strut Inspection).

A. Landing Gear Strut with Bushing Installed

(1). Ream out top hole (DIM. A) to 0.5608-0.5613 inch (12.244-14.257 mm) and ream out bottom hole (DIM. B) to 0.5295-0.530 inch (13.449-13.462 mm).

(2). Perform fluorescent penetrant inspection of reworked areas for cracks. If any cracks are noted, replace strut assembly with serviceable strut assembly.

(3). Perform fluorescent penetrant inspection of reworked areas for cracks.

(a). If any cracks are noted, rework strut per step (4).

(b). If no cracks are noted, install new 369H6023-1 bushing in hole with wet primer (4, Table 2-4).

(4). Ream out top hole (DIM. A) to 0.5908-0.5913 inch (15.006-15.019 mm) and ream out bottom hole (DIM. B) to 0.5595-0.560 inch (14.211-14.224 mm).

(5). Perform fluorescent penetrant inspection of reworked areas for cracks.

(a). If crack is found, strut must be scrapped and serviceable strut installed.

(b). If no cracks are noted, install new 369H6023-3 bushing in hole with wet primer.

B. Landing Gear Strut with No Bushing Installed

(1). Ream out top hole (DIM. A) to 0.5308-0.5313 inch (13.482-13.495 mm) and ream out bottom hole (DIM. B) to 0.4995-0.50 inch (12.687-12.70 mm).

(2). Perform fluorescent penetrant inspection of reworked areas for cracks.

(a). If any cracks are noted, rework strut per step (3).

(b). If no cracks are noted, install new 369H6002-1 1 bushing in hole with wet primer (4, Table 2-4).

(3). Ream out top hole (DIM. A) to 0.5608-0.5613 inch (12.244-14.257 mm) and ream out bottom hole (DIM. B) to 0.5295-0.530 inch (13.449-13.462 mm).

(4). Perform fluorescent penetrant inspection of reworked areas for cracks.

(a). If any cracks are noted, proceed with step (5).

(b). If no cracks are found around drag brace attach hole in strut and hole is not elongated, install new 369H6023-1 bushing in hole with wet primer.

(5). Ream out top hole (DIM. A) to 0.5908-0.5913 inch (15.006-15.019 mm) and ream out bottom hole (DIM. B) to 0.5595-0.560 inch (14.211-14.224 mm).

(6). Perform fluorescent penetrant inspection of reworked areas for cracks.

(7). If crack is found, strut must be scrapped and serviceable strut installed.

(8). If no cracks are noted, install new 369H6023-3 bushing in hole with wet primer.

7. Landing Gear Skid Description

(Ref. Figure 6-2) The landing gear skids consist of contoured aluminum alloy tubes, bonded skid caps and riveted end plugs, ground handling wheel fittings and abrasion strips having cobalt-barium inserts. Skid tubes (excepting the early configuration) are extruded and have a 0.095 inch (2.413 mm) wall thickness along underside and around entire perimeter of tube at both strut foot attachment locations. Table 6-1 lists maximum damage limits.

8. Landing Gear Skid Replacement

(Ref. Figure 6-2)

A. Landing Gear Skid Removal

(1). Jack up the helicopter until the landing gear dampers are fully extended. Place supports beneath the skid tubes at the strut locations.

(2). Remove the lower fairing from the two-piece fairing assembly.

(3). As applicable, remove the machine bolts or lockbolts that attach the skid tube assembly to feet on forward and aft struts.

(4). Remove skid from landing gear.

B. Landing Gear Skid Installation

NOTE: Left and right side machine bolt attached skids are interchangeable. As required, eight 1032-428-8M screws are removed from inboard side of skid tube an installed on outboard side with primer (4, Table 2-4) . If machine bolt-attached skids are to be used with the lockbolt struts, perform steps (4). thru (11). below to enlarge strut holes. When machine bolt style strut is to be used with lockbolt style skid, use Huck or Olympic 0.250 inch (6.35 mm) lock-bolts with a washer to protect counterbore surface on strut foot.

(1). Apply a thin coating of primer (4, Table 2-4) to strut and skid tube mating surfaces.

(2). Align mating parts and install lockbolts with primer, or secure with machine bolts and washers.

(3). Seal edges of landing strut foot with 0.060 inch (1.524 mm) fillet of sealing compound (3). Seal the two unused holes on the top of each strut foot (if present) with silicone rubber (17).

(4). To enlarge strut foot mounting holes for machine bolt-attached skids, place the left (-1 detail) landing gear foot drill jig (40, Table 2-2) on the left strut forward foot. Use the small diameter alignment pin to locate the existing lockbolt hole.

(5). Clamp the tool to strut with C-clamps in three places.

(6). Insert the drill bushing in the jig and drill a 0.250 inch (6.35 mm) hole in the strut by a flat end (bottom) drill (size F). Install the large diameter alignment pin in the drilled hole. Use the bushing and drill the remaining holes.

(7). Remove special tool from strut. Deburr drilled holes.

(8). Enlarge counterbore of mounting holes on face of strut to 0.687 inch (17.4498 mm) diameter, flush with, or 0.020 inch (0.508 mm) above original depth (0.090 inch (2.286 mm) minimum thickness remaining). Maintain the 0.030-0.060 inch (0.762-1.524 mm) lower corner radius.

(9). Apply chemical film protection (8, Table 2-4) on exposed aluminum surfaces.

(10). Repeat steps (4). thru (9). above for left aft strut foot.

(11). Perform steps (4). thru (10). above, using the right (-2 detail) drill jig (41, Table 2-2) for the right struts as necessary.

(12). Install lower fairing of two-piece fairing assembly.

Table 6-1. Maximum Damage Limits for Landing Gear Components

Component	Dents in. / mm	Nicks in. / mm	Scratches in. / mm	Cracks in. / mm	Holes in. / mm
Skid tube (1)	0.200 / 5.08 (2)	0.010 / 0.254 from aft side of aft strut to 10 / 254 forward of the strut, with cleanup not exceeding 0.015 / 0.381 if forward of that point to start of curved section, with cleanup not exceeding 0.020 / 0.508 (1)	Same as (2) for nicks	No cracks allowed	0.250 / 6.35 (2)(3)
Foot	0.060 / 1.524	0.060 / 1.524	0.010 / 0.254	No cracks allowed	No holes allowed
Strut	0.060 / 1.524	(2)	(2)	No cracks allowed	No Holes allowed
Brace	0.040 / 1.016	0.010 / 0.254	0.005 / 0.127	No cracks allowed	No holes allowed
Damper Assembly	0.060 / 1.524	0.010 / 0.254	0.010 / 0.254	No cracks allowed	No holes allowed
Fitting	0.010 / 0.254	0.010 / 0.254	0.010 / 0.254	No cracks allowed	No holes allowed
Plug	0.200 / 5.08	0.250 / 6.35	0.010 / 0.254	0.250 / 6.35	0.250 / 6.35

NOTES:

(1) Repair of minor skid tube damage aft of the rear strut and on the forward (curved) section is not required but surface finish must be restored.

(2) Refer to CSP-H-6 for other repair data.

(3) Hole must be plugged with correct size blind rivet.

9. Heavy-Duty Abrasion Strip Replacement

(Ref. Figure 6-2)

(1). Remove bolts and washers attaching heavy-duty abrasion strips to landing gear skid tube.

(2). Completely remove any residual zinc chromate putty or sealing compound from attachment and mating areas of the skid tube.

(3). Attach and secure replacement heavy-duty abrasion strip to nutplate fittings on skid tube with four bolts and washers. Comply with the following.

(a). Use washer under each bolt head.

(b). Apply a 0.060 inch (1.524 mm) bead of sealing compound (3, Table 2-4) to all mating part edges.

(c). Install with minimum gap between abrasion strip and skid tube. Gap limit is 0.030 inch (0.762 mm) maximum along fore-and-aft centerline of abrasion strip.

(d). Torque bolts to **25 - 35 inch-pounds (2.82 - 3.95 Nm)**.

10. Landing Gear Skid Inspection

(1). Jack the helicopter until the landing gear dampers are fully extended.

(2). Remove the lower fairing from a two-piece fairing assembly.

(3). Inspect for dents and depressions in excess of 0.20 inch (0.508 mm) in depth.

(4). Inspect for punctures.

(5). Perform fluorescent penetrant inspection of areas adjacent to punctures.

(6). Inspect from the aft end of the tube to a point 10 inches (25.4 cm) forward of the aft strut for scratches and nicks which will exceed a length of 0.250 inch (6.35 mm) and a depth of 0.015 inch (0.381 mm) when repaired.

(7). Inspect from the forward end of the tube to 10 inches (25.4 cm) forward of the aft strut for scratches and nicks which will exceed a length of 0.250 inch (6.35 mm) and a depth of 0.020 inch (0.508 mm) when repaired.

(8). Inspect ground handling fittings for cracks, loose rivets and corrosion.

(9). Install the lower fairing.

11. Landing Gear Skid Repair

(Ref. Figure 6-2)

A. Repair of Scratches, Nicks, Dents and Punctures

(1). Repair scratches and nicks by smoothing sharp edges (Ref. Table 6-1).

(2). Drill (0.250 inch (6.35 mm) maximum) out dents, nicks and scratches to the nearest blind rivet size when such damage exceeds the depth limits specified in Landing Gear Skid Inspection. Clean out puncture holes in the same manner.

(3). Apply zinc chromate putty (72, Table 2-4) to edges of drilled repair holes and install the appropriate size rivet to close the hole.

(4). Repair the skid tube assembly when puncture hole, or drilled out dents, nicks or scratches will exceed 0.250 inch (6.35 mm) diameter, or when fluorescent penetrant inspection reveals damage adjacent to punctures. Perform repair of the skid tube according to CSP-H-6.

B. Skid Plug Replacement

(1). Drill out rivets or remove screws attaching skid plug. Remove unserviceable plug by drilling a hole in the center of the plug and using a suitable puller.

(2). Apply a thin layer of zinc chromate putty (72, Table 2-4) to the mating surfaces of the new plug and skid tube to ensure a watertight fit.

(3). Rivet new skid plug through aft abrasion strip to tube.

C. Abrasion Strip Replacement

(1). Remove screws or drill out rivets, as applicable. Drill out rivets attaching abrasion strip and remove unserviceable strip.

(2). Completely remove any residue zinc chromate putty. Apply primer (4) to any bare metal.

(3). Secure new skid plug to tube with screws, or rivets, as applicable, through the aft abrasion strip.

(4). Coat new screws or rivets with primer. As applicable screw or rivet the replacement abrasion strip to tube while primer is still wet.

NOTE: To allow use of common abrasion strips on the curved portion of the skid, a maximum gap of 0.10 inch (2.54 mm) between center underside of skid and aft end of the abrasion strip is permissible. Permissible gap at forward end is 0.030 inch (0.762 mm).

(5). After installation, seal all of the parting edge of the abrasion strip next to the skid tube. Apply an approximate 0.060 inch (1.524 mm) bead (fillet) of sealing compound (3) to ensure a watertight assembly.

D. Skid Cap Replacement

(1). Remove skid cap.

(2). Using isopropyl alcohol (71, Table 2-4) clean bonding area.

(3). Bond new cap to skid tube with sealing compound (3).

E. Ground Handling Fitting Replacement

(1). Replace an unserviceable ground handing fitting using the same procedures as Abrasion Strip Replacement except gaps are not allowable and seal mating surfaces with zinc chromate putty (72, Table 2-4) instead of primer.

F. Safety Walk Tape Replacement

(1). Carefully pull or scrape away damaged tape. Remove all residual adhesive from skid tube by wiping with a clean cloth wetted by naphtha (59, Table 2-4).

(2). Carefully align new tape (73) with mounting surface and press firmly into place. Expel air bubbles while pressing down the tape.

G. Skid Tube Nutplate Fitting Replacement

(1). Drill out rivets attaching nutplate fitting to skid tube and remove fitting.

(2). Completely remove any residual zinc chromate putty or sealing compound from nutplate mounting area on skid tube.

(3). When installing replacement nutplate fitting on skid tube, use sealing compound (3). Rivet nutplate fitting in place. Apply a 0.060 inch (1.524 mm) bead of sealing compound around mating part edges.

12. Landing Gear Damper Description and Operation

Each landing gear assembly is equipped with a front and rear damper assembly.

The landing gear dampers absorb vertical shock to the landing gear struts during helicopter landings. The front damper assemblies are attached to the oleo attachment fittings located on the outboard side of the pilot's compartment seat structure. The aft damper assemblies are attached to oleo support fittings in the engine compartment. The damper assemblies are 12.21 inches (31.0134 cm) long when extended and 8.96 inches (22.7584 cm) long when compressed. There are two basic types of landing gear dampers which can be installed on the helicopter:

(1) A bladder-type damper assembly consisting of a barrel, upper and lower mounting cap, and internal rubber bladder, and a piston.

(2) A poppet-type damper assembly consisting of a barrel, upper and lower mounting cap, main poppet, rebound poppet and a piston.

The poppet-type damper is one-way interchangeable (in sets of four only) with the bladder-type damper. Use of poppet-type dampers requires larger bushings and 5/16 inch diameter hardware for both upper and lower attachment. A damper must be replaced if damaged, or if loss of pneumatic pressure (nitrogen gas) or hydraulic oil occurs. Replacement of a single damper must be with the same type and configuration as the one removed. Refer to Table 6-2 for damper application.

13. Landing Gear Damper Replacement

(Ref. Figure 6-1 and Figure 6-2)

A. Landing Gear Damper Removal

CAUTION Be sure the helicopter is jacked up evenly and in a level area; otherwise, jacks might slip and damage the helicopter structure.

(1). Jack up the helicopter until the landing gear skids just clear the ground.

(2). For forward damper removal, remove foot support fairings located in the passenger compartment.

WARNING

- **Check that all electrical power is OFF. This precaution will prevent personal injury or helicopter damage which could result from body or tool contact with electrical terminals.**
- **Use extreme care during damper removal if a green or white bladder-type damper is extended beyond 11.38 inches (28.9052 cm) as measured between flat surface of both end caps. This condition indicates an internal failure of the damper that will result in a sudden release of internal pressure and explosion of the bladder if the damper is released from the fuselage fittings before accomplishing step (3). below.**

(3). Bladder-type dampers that show evidence of, or are suspected of, internal failure must have the pressure relieved, steps (a). thru (c). below, before performing removal.

(a). Removal any avionics equipment in the immediate area of the damaged damper. Cover all electrical connectors with plastic material.

(b). Wrap the damaged damper with 1 inch (2.54 cm) thick polyfoam (or material equivalent absorption property) to minimize spraying of hydraulic oil.

WARNING **Protective glasses and heavy gloves must be worn when drilling the pressure relief hole in the damaged damper. The spray of hydraulic oil under pressure can result in injury to personnel.**

(c). Drill a 0.0625 inch(1.5875 mm) hole in lower end of the damper body. Keep the drill bit in the hole until the hydraulic fluid stops flowing.

NOTE: Note damper part number and color code to be sure that correct dampers are reinstalled.

(4). Remove hardware, except bushings, attaching the damper assemblies to the fuselage fitting and to landing gear struts; remove damper assemblies.

B. Landing Gear Damper Installation

NOTE: Ensure the replacement damper is correct for the helicopter (Ref. CSP-H-7 and Table 6-2). Also check that the cap torque stripes will be visible for inspection after installation.

(1). Install replacement damper in upper and lower mounting position with attaching hardware. Ensure bushings are in place.

NOTE: Left forward damper upper bolt must be installed with bolt head aft. Bolt direction on right side is optional.

(2). For aircraft 0001 thru 0100, torque nuts to **25 - 30 inch-pounds (2.82 - 3.39 Nm)** and install cotter pin.

(3). For aircraft 0101 & subs, torque nuts to **48 - 55 inch-pounds (5.42 - 6.21 Nm)** and cotter pin.

(4). Check installation for proper alignment of torque stripes.

(5). Install foot support fairings and close engine access doors.

Table 6-2. Damper Assembly Identification

Part No.	Configuration	Color	Type	Factory Charge psi / kPa	Landing Gear Application
369A6300	Basic	Light Green	Bladder	560 ±10 / 3861 ±69	Early standard (4)
369A6300	-501	Light Green	Bladder	560 ±10 / 3861 ±69	Early standard (4)
369A6300	-503	Light Green	Bladder	560 ±10 / 3861 ±69	Current standard (4)
369A6300	-601	White	Bladder	560 ±10 / 3861 ±69	Early standard (4)
369H6340	Basic	Blue	Poppet	520 ±2 / 3585 ±14 * * *	Current standard (4) Extended option (2 fwd)
369H92131	Basic	Orange	Poppet	850 ±3 / 5861 ±21 * * *	Extended option (2 aft)
369H92800 *	Basic	Medium Green	Poppet	705 ±2 / 4861 ±14	Winterized standard option (4) Winterized extended option (2 fwd)
369H92801 * *	Basic	Yellow	Poppet	1075 ±3 / 7412 ±21	Winterized extended option (2 aft)

NOTES:

* Not available for replacement purposes; replaced by winterized version of 369H6340. May be modified to 369H6340 at overhaul; refer to CSP-H-5.

* * Not available for replacement purposes; replaced by winterized version of 369H92131. May be modified to 369H92131 at overhaul; refer to CSP-H-5.

* * * Requires a higher charge and adjustment of oil level for winterized service; refer to CSP-H-5 for charging data.

14. Landing Gear Damper Inspection

NOTE: It is normal for a thin hydraulic oil film to remain on damper as a result of wiping contact with piston seal. Newly installed dampers may also have slight oil seepage from oil trapped in end cap threads during damper assembly. Neither of these should be considered damper leakage or cause for damper replacement.

(1). With helicopter on jacks, inspect damper assemblies for evidence of bearing looseness in upper and lower caps, worn bearings (excessive radial play) loose or cracked caps and oil leakage. Any misalignment of torque stripes on caps, piston and barrel indicates loosening of caps. Replace immediately and repair damper according to CSP-H-5.

(2). Inspect damper for security of attaching hardware and condition of plastic cover. Plastic cover is no longer required or installed in production; it may be discarded, or replaced if spare is available.

(3). Inspect landing gear dampers for condition by observing stance of helicopter (normal stance is slightly nose up). If stance indicates excessive nose up/nose down attitude, perform damper extension check.

(a). Inspect landing gear damper assemblies for proper extension, with helicopter in empty weight configuration (no passengers or cargo) but with full fuel tanks. This configuration should weight between 1675-1825 pounds (760-583 kg) exclusive of skid mounted float gear. Place helicopter on smooth concrete or equivalent surface (not asphalt).

(b). Check dampers which have been modified (winterized) for cold weather operation are to be checked at not more than 30°F (-1°C) above the coldest temperature at which the helicopter is operated.

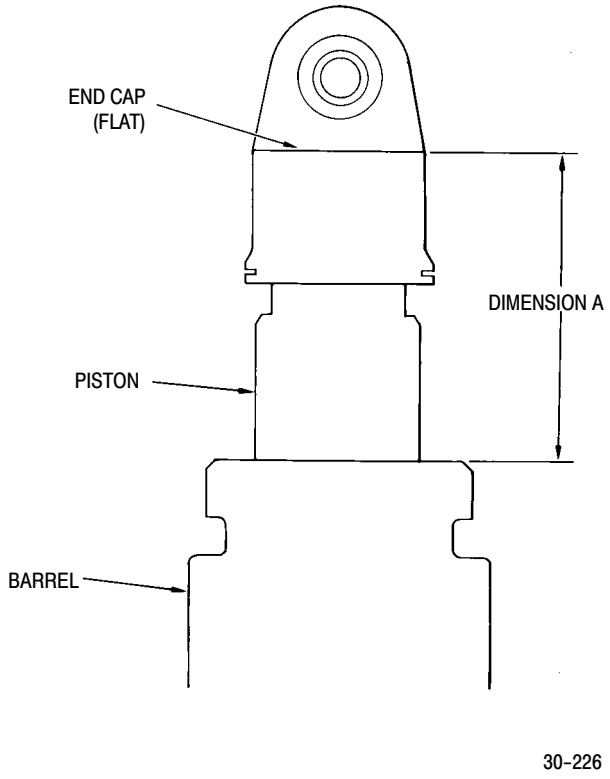


Figure 6-4. Landing Gear Damper Assembly Extension Check

(c). Raise and lower tailboom above and below the normal at-rest position three times. On the last cycle, allow the tailboom to slowly settle to the at-rest position.

(d). Measure and record dimension from upper end cap to upper end of barrel on all four damper assemblies (Ref. Dimension A, Figure 6-4).

(e). Repeat steps (c). and (d). two more times.

(f). Lower and raise tailboom below and above the normal at-rest position three times. On the last cycle, allow the tailboom to slowly rise to the at-rest position.

(g). Measure and record dimension from upper end cap to upper end of barrel on all four damper assemblies (See dimension A, Figure 6-4).

(h). Repeat steps (f). and (g). two more times.

(i). Determine average extension from all six readings for each damper assembly. Remove and overhaul any damper assembly not meeting dimensions shown in Table 6-3.

NOTE: If two damper assemblies fail to meet the minimum extension shown in Table 6-3, replace the damper having the greater amount of deflection with a known serviceable damper and repeat steps (c). thru (i). If the original damper again fails to meet minimum extension requirements, replace it with serviceable damper, reinstall the first damper, and repeat steps (c). thru (i). This will determine whether one or both dampers require overhaul. Dampers which have been modified (winterized) for cold weather operation are to be soaked at -3° to +3°F (-19 to -16°C) for 24 hours minimum prior to conducting the bench check.

(4). Inspect for damper internal failure by checking for clearance between the bottom of the landing gear strut and measuring the length of the damper. If the gear strut is touching the fuselage or the length of the damper measured between the end cap flat surfaces is 11.38 inches (28.9052 cm) or more, it must be replaced.

Table 6-3. Minimum Damper Extension (Dimension A)

Standard Landing Gear		Extended Landing Gear	
	in. / cm		in. / cm
Aft	2.55 / 6.477	Aft	2.60 / 6.604
Fwd	3.00 / 7.62	Fwd	2.90 / 7.366

15. Landing Gear Damper Repair

Exterior damage limits for the landing gear damper are provided in Table 6-1. Refer to CSP-H-5 for available repair and overhaul information. Remove scratches and nicks in damper fittings as follows:

(1). Use grade 400 (or finer) wet or dry abrasive paper (9, Table 2-4) to remove any raised or sharp edges and to blend the defect smoothly with the surrounding surfaces.

(2). Use crocus cloth (23) to remove any surface scratches left by the coarser

abrasive and to polish the repaired area to match the surrounding surfaces.

(3). Apply corrosion protection treatment (Ref. Section 2).

NOTE: If dust cover is not installed, there is no requirement for the felt spacer, rubber retaining sleeve and the tie strap (or plastic tape) for securing cover. When replacing or discarding a plastic cover, only the upper end of the damper must be detached.

(4). To replace a damper assembly plastic cover (installed only at aft locations on early damper configurations), remove plastic tape or rubber sleeve and tie strap used to compress cover tangs and carefully but firmly pull cover toward top end to disengage tangs from bearing cap groove. Install replacement by reversing the procedure. Secure the cover tangs in place with rubber sleeve and tie strap or by wrapping several turns of tape (74) around tanged end of cover

16. Landing Gear Fairing Assembly Description

The landing gear fairing consists of a streamlined fiberglass fairing surrounding each landing gear strut, extending from the fuselage to the landing gear skid. Each fairing assembly is constructed of either two or three main parts; a fillet and an upper and lower (two-piece) fairing are used on all but early configurations which have a one-piece fairing. The fillet is spring-loaded to remain in firm contact with a fiberglass rubbing plate that is bonded and riveted to the fuselage. The upper part of the two-piece fairing is bonded and riveted to a strut bracket that is riveted to the strut. The lower part of the two-piece fairing is attached to the upper fairing and strut brackets with screws for ease of removal and/or replacement of the strut feet and skid tubes. The fairing telescopes inside the fillet to allow movement of the strut as the landing gear dampers compress or extend. A seal on the bottom edge of the fairing forms a fillet between the fairing and the skid tube. The forward fairing may have a fairing cover installed. When a cabin entry step is installed, the fairing assembly has an opening with a rubber seal.

17. Landing Gear Fairing Replacement

(Ref. Figure 6-5)

A. Landing Gear Fairing Assembly Removal

The following removal instructions are typical for all four fairing assemblies.

(1). Remove 6 screws, 12 washers and 6 nuts that secure trailing edge of lower fairing and 6 screws and washers that secure lower fairing to the two strut brackets.

(a). Carefully spread trailing edge of lower fairing and remove in a forward direction.

NOTE: Be sure that doublers between laminations at trailing edge are retained for reuse.

(2). Remove the fillet from the upper part of the fairing assembly as follows.

(a). Remove the four rivets from the trailing edge of the fillet.

(b). Drill out one of the six rivets securing the fillet to the upper guide. Replace the rivet with a sheet metal hole fastener (Cleco, or equivalent). Repeat this step on the other five rivets.

(c). Open underfloor compartment or engine compartment doors to gain access to the strut cutout in the fuselage skin. Have an assistant push down on the upper guide with a suitable tool (wood dowel or equivalent) to relieve the spring tension.

(d). With spring tension off the guide, take out the six fasteners. Slowly relax the dowel pressure on the guide until the springs reach maximum travel.

(e). Carefully spread fillet at trailing edge and remove in a forward direction.

(3). Remove the upper part of the fairing, or the one-piece fairing as follows.

(a). As applicable, remove one or two (or eight or nine) rivets that secure trailing edge of fairing.

(b). Remove two (or eight) rivets that secure fairing to strut bracket(s).

(c). Use a putty knife or similar thin-bladed tool to carefully pry apart the bonding and separate the upper 5 inches (12.7 cm) of the trailing edge; then separate the fairing from the flange of the lower guide.

(d). Carefully spread trailing edge of fairing and remove in a forward direction.

B. Landing Gear Fairing Assembly Installation

The following installation instructions are typical for all four fairing assemblies. Where riveting is required, use rivets of the type shown.

(1). Install the upper part of the fairing, or the one-piece fairing as follows.

(a). Assemble upper guide, pin assembly, inner guide half, outer guide half, springs and lower guide on the landing gear strut. Install two rivets with wet primer (4, Table 2-4) to secure lower guide to strut.

(b). Push guide pins into the matching holes of the lower guide. Wedge a temporary holding device between the upper guide and the strut to keep the pins engaged.

NOTE: Use two small wood blocks or any similar suitable means to keep the springs in compression. The device used must be small enough to be removed through the strut cut-out in the skin after the fillet is assembled.

(c). Install blind hole transfer punches (two or four places, as applicable) or fabricate suitable tools as shown in Figure 6-5. Install tool(s) between opposing holes in strut bracket(s).

(d). Carefully spread trailing edge of fairing and position the fairing on the strut bracket(s) and the lower guide. Have an assistant hold the fairing in this position.

NOTE: On the one-piece fairing, there should be 0.020-0.080 inch (0.508-2.032 mm) compression of the fairing seal against the skid tube when the fairing is correctly positioned.

(e). Back up the fairing with a fiber block at the transfer punch location. Using a plastic hammer, hit the opposite side of the fairing hard enough to transfer the hole centers.

(f). Remove fairing and check that all the transfer marks appear within the outline of the small laminated doublers. Drill out the located holes.

(g). Carefully bond the fairing to the lower guide. Use adhesive (19) according to container instructions.

(h). As applicable, install two (or eight) rivets to secure the fairing to the strut bracket(s).

(i). As applicable, install one or two (or eight or nine) rivets to secure the trailing edge of the fairing.

(j). Using a soft lead pencil, draw a continuous line along the horizontal center of the upper guide flange.

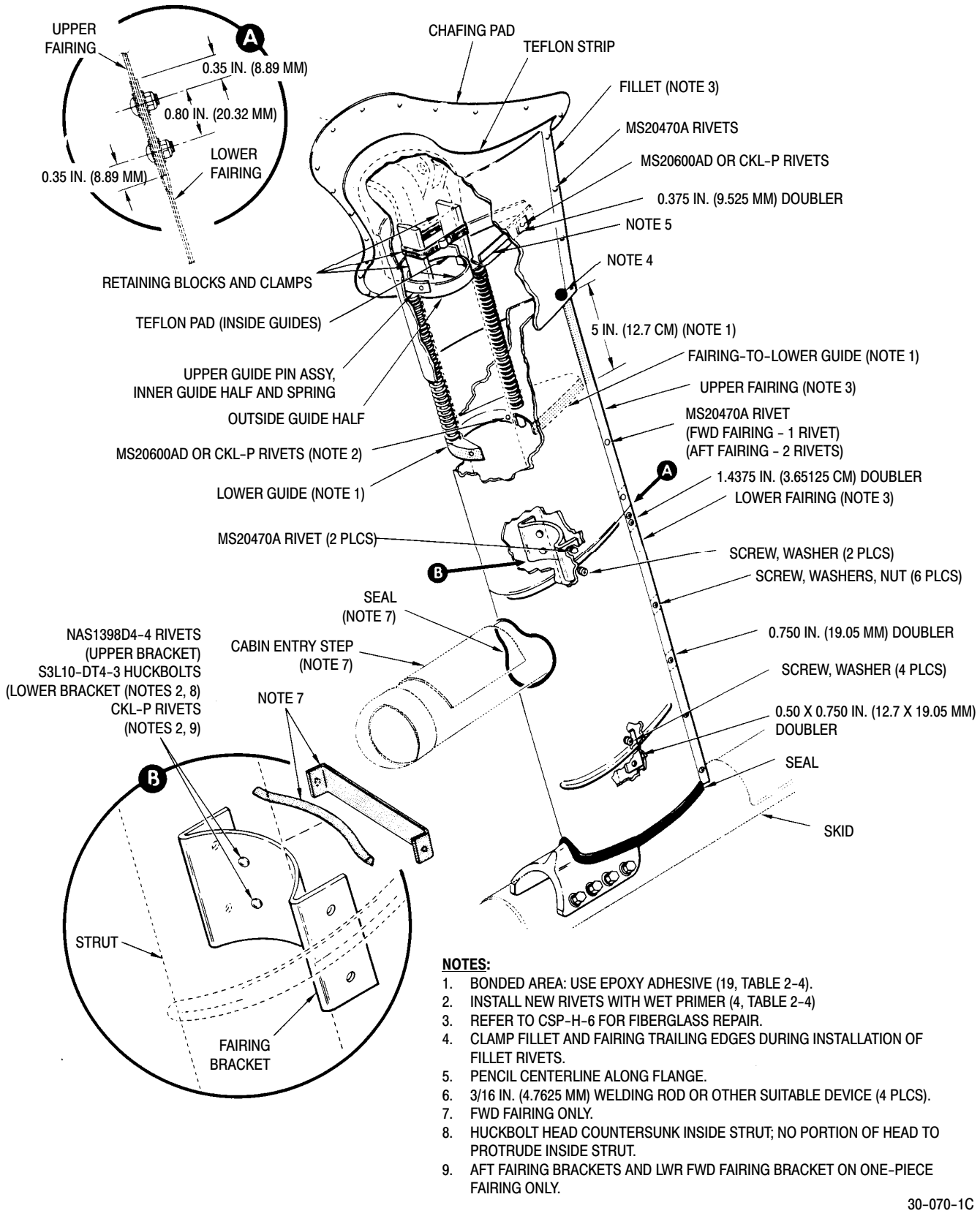
(2). Install the fillet as follows.

(a). Drill a 0.0980 inch(2.4892 mm) hole in the center of each 0.375 inch (9.525 mm) square doubler in the fillet. (There are six doublers.)

(b). Carefully spread trailing edge of fillet and position about upper guide. Clamp the lower end of the fillet trailing edge to the upper end of the fairing trailing edge. Clamping will prevent fillet movement when the fillet rivets are installed.

(c). Have an assistant remove the temporary holding device and push down on the upper guide with a suitable tool (wood dowel, etc). Have the guide pushed down to a point where the pencil line drawn on the guide flange is visible through one of the 0.0980 inch(2.4892 mm) holes in the fillet. Match-drill the guide and secure the fillet and guide with a hole fastener (Cleco, or equivalent). Repeat the procedure for all six rivet locations. Remove the pushing tool from the strut opening.

(d). Remove one fastener at a time, enlarge the hole to rivet diameter and install a blind rivet.

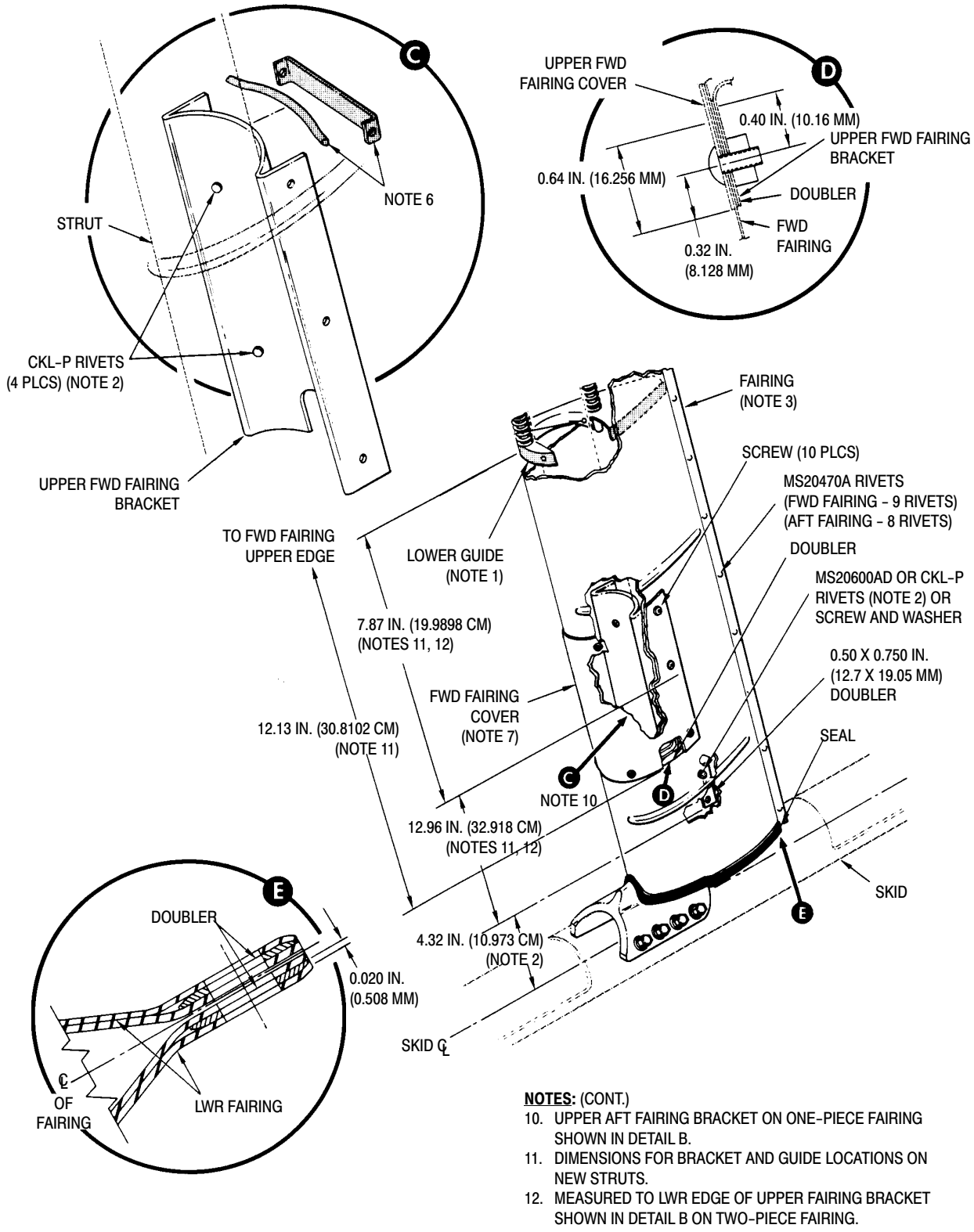


NOTES:

1. BONDED AREA: USE EPOXY ADHESIVE (19, TABLE 2-4).
2. INSTALL NEW RIVETS WITH WET PRIMER (4, TABLE 2-4)
3. REFER TO CSP-H-6 FOR FIBERGLASS REPAIR.
4. CLAMP FILLET AND FAIRING TRAILING EDGES DURING INSTALLATION OF FILLET RIVETS.
5. PENCIL CENTERLINE ALONG FLANGE.
6. 3/16 IN. (4.7625 MM) WELDING ROD OR OTHER SUITABLE DEVICE (4 PLCS).
7. FWD FAIRING ONLY.
8. HUCKBOLT HEAD COUNTERSUNK INSIDE STRUT; NO PORTION OF HEAD TO PROTRUDE INSIDE STRUT.
9. AFT FAIRING BRACKETS AND LWR FWD FAIRING BRACKET ON ONE-PIECE FAIRING ONLY.

30-070-1C

Figure 6-5. Repair and Replacement of Fairing (Sheet 1 of 2)



NOTES: (CONT.)

10. UPPER AFT FAIRING BRACKET ON ONE-PIECE FAIRING SHOWN IN DETAIL B.
11. DIMENSIONS FOR BRACKET AND GUIDE LOCATIONS ON NEW STRUTS.
12. MEASURED TO LWR EDGE OF UPPER FAIRING BRACKET SHOWN IN DETAIL B ON TWO-PIECE FAIRING.

30-070-2B

Figure 6-5. Repair and Replacement of Fairing (Sheet 2 of 2)

(e). Install four rivets to secure the fillet trailing edge together.

(f). Check for smooth telescoping action of fairing into fillet by manually sliding the fillet up and down several times.

(g). Close access doors.

(3). Install the lower part of the two-piece fairing as follows.

(a). Carefully spread the trailing edge of fairing and position the fairing on the upper fairing and lower strut bracket; at the correct position there should be 0.020-0.080 inch (0.508-2.032 mm) compression of the fairing seal against the skid tube. Have an assistant hold the fairing in this position.

(b). Back up the fairing with a fiber block at the transfer punch location. Using a plastic hammer, hit the opposite side of the fairing hard enough to transfer the hole centers.

(c). Remove fairing and check that all transfer marks appear within the outline of the small laminated doublers. Drill out the located holes.

(d). Reinstall the fairing in mounting position and secure to upper strut bracket with two screws and washers and lower strut bracket with four screws and washers.

(e). Secure fairing trailing edge with 6 screws, 12 washers and 6 nuts.

NOTE: Ensure doublers are installed between laminations at trailing edge.

18. Landing Gear Fairing Assembly Inspection

(Ref. Figure 6-5)

(1). Refer to Landing Gear Inspection for inspection of installed fairing assemblies.

(2). Inspect fairing support brackets for security of attachment to strut, cracks and deformation.

(3). Inspect fairing-to-skid seal for deterioration.

(4). Inspect the fuselage rubbing plate for security of bond and excessive wear.

(5). Inspect fairing cover for damage.

(6). Inspect fairing step seal for deterioration.

19. Landing Gear Fairing Assembly Repair

(Ref. Figure 6-5) If the two-piece upper fairing or one-piece fairing fiberglass is damaged beyond repair limits (Ref. CSP-H-6), the fillet as well as the fairing must be removed.

(1). Replace an excessively damaged lower fairing or step fairing cover.

(2). Replace a damaged fairing bracket or lower guide. Remove the rivets, locate the new part, and install blind rivets. Use next larger size rivets if mating holes in strut are enlarged.

(3). Replace a damaged guide/pin assembly or guide half if guide is cracked, pins are bent or badly worn, or Teflon pad is loose or badly worn.

(4). Replace springs that are badly worn, rusty, or if free length is less than 8.72 inches (22.1488 cm).

(5). Replace fillet if the Teflon strip is loose or badly worn.

(6). Replace a damaged strut bracket. Remove the rivets, locate the new part, and install blind rivets. Use next larger size rivets if mating holes in strut are enlarged.

(7). Replace unserviceable rubber seals. Use adhesive (69, Table 2-4) according to container instructions.

20. Cabin Entry Step Description

(Ref. Figure 6-2) The landing gear step is formed of aluminum alloy tubing, covered with non-skid tape and attached to the forward landing gear strut with lockbolts. The step also has mounting provisions for a position light when this type of optional night lighting system is installed.

21. Cabin Entry Step Replacement

(Ref. Figure 6-2)

(1). Remove the landing gear fairing.

(2). If installed, disconnect and remove the optional side position light.

(3). Remove four lockbolts and step from front of forward landing gear strut.

(4). Install replacement step on forward landing gear strut, using four lockbolts (BP-T5-4) with wet primer (4, Table 2-4). The four holes in the step collar must be drilled out to 0.164-0.167 inch (4.1656-4.2418 mm) for installation of the lockbolts. If holes are elongated use next size larger lockbolts.

(5). If applicable, install and connect the optional side position light in the step.

(6). Install the lower fairing on the strut.

22. Cabin Entry Step Inspection and Repair

(Ref. Figure 6-2)

(1). Remove landing gear fairing assembly.

(2). Inspect step to strut attachment for loose lockbolts by checking for relative motion between mating parts. Replace loose lockbolts with lockbolts same size as original if holes are not elongated; otherwise, use next size larger lockbolts.

(3). Inspect safety walk tape for condition and security. Replace unserviceable tape.

(4). Inspect fairing step cover and seal for condition.

(5). Install landing gear fairing assembly.

Section

7

Main Rotor and Control System

TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 7 Main Rotor and Control System		**7-1**
1.	Main Rotor and Control System	7-1
2.	Main Rotor and Control System Troubleshooting	7-1
	Figure 7-1. Main Rotor Control System	7-2
	Table 7-1. Troubleshooting Main Rotor Vibrations	7-3
	Table 7-2. Troubleshooting Controls	7-4
	Table 7-3. Isolating Control System Troubles	7-5
3.	Cyclic, Collective and Main Rotor Control Rigging	7-6
A.	Collective Control Rigging	7-6
B.	Cyclic Control Rigging	7-6
	Figure 7-2. Rigging Main Rotor Control System (Sheet 1 of 2)	7-8
4.	Main Rotor Blades	7-10
5.	Main Rotor Blade Tracking	7-10
6.	Main Rotor Tracking Equipment Installation	7-1 1
	Figure 7-3. Main Rotor Blade Assembly	7-12
	Figure 7-4. Installation of Main Rotor Blade Tracking Strobe	7-13
	Table 7-4. Summary Procedure for Blade Tracking	7-14
7.	Main Rotor Blade Track Adjustment	7-14
A.	Pitch Control Rod Adjustment	7-15
B.	Blade Tab Adjustment	7-15
	Figure 7-5. Main Rotor Blade Tab Adjustment	7-16
	Figure 7-6. Typical Tracking Conditions and Adjustments	7-17
C.	Main Rotor Blade Ground Tracking	7-17
D.	Hover Track Verification	7-18
E.	Forward Flight Tracking	7-18
F.	Autorotation RPM Check	7-18
G.	Autorotation Rpm Adjustment	7-19
	Table 7-5. Autorotation RPM Chart	7-20
8.	Main Rotor Balancing	7-20
A.	Balancing Equipment and Balance Spare Kit	7-20
B.	Procedural Instruction	7-20
C.	Balance Equipment Installation	7-20
	Figure 7-7. Main Rotor Hub - Cross Section	7-21
D.	Balancing Procedure	7-22
	Table 7-6. Main Rotor Balancing Hardware	7-22
9.	Main Rotor Blade Replacement	7-22
A.	Main Rotor Blade Removal	7-22

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
B.	Main Rotor Blade Installation	7-22
10.	Main Rotor Blade Inspection	7-22
Figure 7-8.	Main Rotor Blade Damage and Repair Limits for Nicks, Scratches, Gouges and Cracks	7-25
Figure 7-9.	Main Rotor Blade Damage and Repair Limits for Dents and Depressions	7-26
11.	Main Rotor Blade Repair	7-27
A.	Nicks, Scratches and Wear Spots	7-27
B.	Dents, Depressions and Erosion	7-28
C.	Forward Tip Cap Insert	7-28
D.	Loose Balance Weights	7-28
E.	Loose or Missing Rivets or Aft Tip Cap	7-28
F.	Vibration Absorber	7-29
12.	Leading Edge Erosion Protection	7-29
13.	Bearing Replacement - Damper Attach, Blade Fitting	7-29
Figure 7-10.	Bearing Replacement - Main Rotor Blade Attach Fitting Repair	7-30
14.	Repair of Trim Tab and Trailing Edge (369A1100 Series)	7-30
Figure 7-1 1.	Repair and Removal of Trim Tab, Main Rotor Blade	7-31
15.	Main Rotor Blade and Damper Attach Pin Inspection and Corrosion Protection	7-31
16.	Main Rotor Blade and Damper Attach Pin Disassembly and Special Inspection	7-32
Figure 7-12.	Main Rotor Blade and Damper Attach Pin	7-32
17.	Main Rotor Blade and Damper Attach Pin Adjustment	7-32
18.	Main Rotor Blade Forward Tip Cap Inspection and Corrosion Prevention	7-33
19.	Main Rotor Blade Upper and Lower Root Fitting Attach Lug and Lead-Lag Link Inspection (25 Hour)	7-33
20.	Main Rotor Blade Upper and Lower Root Fitting, Attach Lug and Lead-Lag Link Inspection (100 Hour)	7-33
21.	Main Rotor Blade Leading Edge Abrasion Strip Check	7-35
22.	Main Rotor Blade Torque Event Inspection	7-35
23.	Vibration Absorber	7-35
A.	Vibration Absorber Removal	7-35
B.	Vibration Absorber Installation	7-36
Figure 7-13.	Main Rotor Blade Root Fitting Attach Lugs and Lead-Lag Link Assembly Inspection	7-36A
Figure 7-14.	Application of Slippage Mark to Main Rotor Blade Bushings and Root Fittings	7-37
C.	Vibration Absorber Inspection	7-38
D.	Vibration Absorber Disassembly	7-38

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
E.	Vibration Absorber Repair	7-38
Figure 7-15.	Vibration Absorber	7-38
F.	Vibration Absorber Reassembly	7-38
G.	Vibration Absorber Weighing	7-39
24.	Main Rotor Hub Assembly	7-39
25.	Main Rotor Hub Assembly Replacement	7-39
A.	Main Rotor Hub Assembly Removal	7-39
B.	Main Rotor Hub Assembly Installation	7-39
Figure 7-16.	Main Rotor Hub Installation	7-41
Figure 7-17.	Main Rotor Mast Locknut Installation	7-42
Figure 7-18.	Pulling Hub Assembly	7-43
26.	Main Rotor Hub Assembly Inspection	7-44
Figure 7-19.	Repair of Main Rotor Hub Components (Sheet 1 of 3)	7-45
27.	Main Rotor Strap Pack Lamination Inspection	7-48
Table 7-7.	Strap Pack Inspection	7-50
Figure 7-20.	Strap Pack Lamination Inspection (Sheet 1 of 2)	7-51
28.	Main Rotor Strap Pack Repair	7-53
29.	Pitch Housing Assembly Repair	7-53
30.	Pitch Housing Parts Repair or Replacement	7-54
A.	Pitch Control Bearing Housing Assembly, Spacer or Striker Strip Replacement	7-54
B.	Replacing Pitch Control Bearing	7-55
C.	Lead-Lag Link Blade Stop Replacement	7-55
D.	Corrosion Control - Lead-Lag Bolt	7-56
E.	Taping Broken Strap Ends of Strap Pack	7-56
31.	Pitch Control Bearing Pivot Pin Repair or Replacement	7-56
32.	Droop Stop Restrainer and Roller Repair or Replacement	7-57
33.	Droop Stop Ring Repair	7-57
34.	Droop Stop Ring Replacement	7-57
Figure 7-21.	Main Rotor Hub Assembly Repair	7-58
35.	Droop Stop Plunger Inspection and Replacement	7-59
36.	Main Rotor Hub Tapered Bearing Replacement	7-60
Figure 7-22.	Main Rotor Hub Tapered Bearing Tools	7-62
37.	Main Rotor Hub Assembly Droop Angle Check	7-63
38.	Main Rotor Hub Assembly Droop Angle Adjustment	7-63
39.	Main Rotor Damper (Friction Type, P/N 369A1400)	7-63
A.	Main Rotor Damper Removal (Friction Type, P/N 369A1400)	7-64

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
B.	Main Rotor Damper Installation (Friction Type, P/N 369A1400)	7-64
C.	Main Rotor Damper Inspection (Friction Type, P/N 369A1400)	7-64
D.	Main Rotor Damper Torque Check (Friction Type, P/N 369A1400)	7-65
Table 7-8.	Temperature vs Damper Torque	7-66
E.	Installed Main Rotor Damper Phasing Check (Friction Dampers Only, P/N 369A1400)	7-66
40.	Main Rotor Damper (Elastomeric Type, P/N 369D21400-503)	7-66
A.	Main Rotor Damper Removal (Elastomeric Type, P/N 369D21400-503)	7-67
B.	Main Rotor Damper Installation (Elastomeric Type, P/N 369D21400-503)	7-67
C.	Main Rotor Damper and Attachments Inspection (Elastomeric Type, P/N 369D21400-503)	7-67
D.	Main Rotor Damper Weight Loading and Extension Check (Elastomeric Dampers Only, P/N 369D21400-503)	7-68
E.	Blade Phasing Procedure (Elastomeric Type, P/N 369D21400-503)	7-68
Figure 7-23.	Periodic Check of Main Rotor Elastomeric Damper Assembly	7-69
41.	Main Rotor Controls	7-70
42.	Pitch Control Rods	7-70
A.	Pitch Control Rod Removal	7-70
B.	Pitch Control Rod Installation	7-70
43.	Scissors Assembly	7-71
A.	Scissors Assembly Removal	7-71
B.	Scissors Assembly Installation	7-71
C.	Scissors Disassembly	7-71
Figure 7-24.	Pitch Control Rods and Swashplate Scissors Assembly Installation	7-72
D.	Scissors Inspection	7-73
E.	Scissors Reassembly	7-73
44.	Main Rotor Swashplate	7-73
A.	Swashplate Assembly Removal	7-73
Figure 7-25.	Main Rotor Swashplate Assembly	7-74
B.	Swashplate Assembly Installation	7-74
C.	Swashplate Disassembly	7-75
D.	Swashplate Assembly Inspection	7-75
E.	Swashplate Reassembly	7-75
45.	Mixer Controls	7-76
A.	Mixer Controls Removal	7-76
B.	Mixer Controls Installation	7-76
Figure 7-26.	Mixer Controls Assembly	7-77

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
C.	Mixer Controls Inspection	7-78
D.	Mixer Control Repair	7-78
46.	Tunnel-Routed Control Tubes	7-79
A.	Tunnel-Routed Control Tube Removal	7-79
B.	Tunnel-Routed Control Tube Installation	7-79
C.	Tunnel-Routed Control Tube Inspection	7-79
D.	Tunnel-Routed Control Tube Repair	7-80
Figure 7-27.	Tunnel-Routed Control Tubes	7-81
47.	Tunnel-Routed Control Tube Inspection and Sleeve Installation	7-82
A.	Control Tube Tapered Area Sleeve Installation	7-82
Figure 7-28.	Sleeve Fabrication and Installation	7-83
Table 7-9.	Control Tube Re-Identification	7-84
B.	Control Tube Straight Area Sleeve Installation	7-84
Table 7-10.	Control Tube Straight Area Repair Limits	7-84
Figure 7-29.	Control Tube Boot Rework	7-85
48.	Controls Support Bracket and Bellcranks	7-85
A.	Controls Support Bracket and Bellcrank Removal	7-85
Figure 7-30.	Installation of Controls Support Bracket, Idler Bellcranks and Cyclic Trim Actuators	7-86
B.	Controls Support Bracket and Bellcrank Disassembly	7-87
C.	Controls Support Bracket and Bellcrank Inspection	7-87
D.	Control Support Bracket and Bellcrank Repair	7-87
E.	Controls Support Bracket and Bellcrank Reassembly	7-87
F.	Controls Support Bracket and Bellcrank Installation	7-87
49.	Collective Controls	7-88
50.	Pilot's Collective Pitch Control Stick (Left Position)	7-88
A.	Pilot's Collective Pitch Stick Removal (Left Position)	7-88
Figure 7-31.	Pilot's Compartment Collective Controls	7-89
B.	Pilot's Collective Pitch Stick Installation (Left Position)	7-90
Figure 7-32.	Assembly of Pilot's Collective Pitch Stick (L/H Command)	7-91
Figure 7-33.	Copilot's Collective Pitch Stick (R/H Command)	7-92
C.	Pilot's Collective Pitch Stick Disassembly (Left Position)	7-93
D.	Pilot's Collective Pitch Stick Inspection (Left Position)	7-93
E.	Pilot's Collective Pitch Stick Repair (Left Position)	7-93
F.	Pilot's Collective Pitch Stick Reassembly (Left Position)	7-94
51.	Gas Producer Linkage Adjustment	7-95
Figure 7-34.	Gas Producer Drive Mounting Distance and Backlash Adjustment (Pilot's Collective Pitch Stick)	7-96

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
52.	Gas Producer Interconnect Torque Tube Shimming	7-97
53.	Pipe Plug Adjustment for Zero Backlash	7-97
Figure 7-35.	Collective Pitch Stick Friction Adjustment	7-98
Figure 7-36.	Shimming of Gas Producer Interconnecting Torque Tube Assembly	7-99
54.	Collective Pitch Stick Friction	7-100
A.	Collective Stick Friction Mechanism Operational Check	7-100
B.	Collective Stick Friction Mechanism Adjustment	7-101
Figure 7-37.	Collective Torque Tube, Gas Producer Torque Tube, Collective Bungee (Sheet 1 of 2)	7-102
55.	Collective Control Interconnect Torque Tube	7-104
A.	Collective Control Interconnect Torque Tube Inspection	7-104
B.	Collective Control Interconnect Torque Tube Removal	7-104
C.	Collective Control Interconnect Torque Tube Repair	7-104
D.	Collective Control Interconnect Torque Tube Installation	7-104
56.	Collective Bungee	7-105
A.	Collective Bungee Removal	7-105
B.	Collective Bungee Installation	7-106
C.	Collective Bungee Disassembly	7-106
D.	Collective Bungee Inspection	7-106
E.	Collective Bungee Reassembly	7-106
F.	Collective Bungee Adjustment	7-107
57.	Inboard Collective Stick Socket Assembly	7-108
A.	Inboard Collective Stick Socket Assembly Removal	7-108
B.	Inboard Collective Stick Socket Assembly - Disassembly	7-108
C.	Inboard Collective Stick Socket Assembly Inspection	7-108
Figure 7-38.	Inboard Collective Stick Socket Assembly	7-109
D.	Inboard Collective Stick Socket Assembly Repair	7-1 10
E.	Inboard Collective Stick Socket Assembly - Reassembly	7-1 10
F.	Inboard Collective Stick Socket Assembly Installation	7-1 10
58.	Cyclic Controls	7-1 11
Figure 7-39.	Adjustment of Gas Producer Drive Backlash (Inboard Collective Stick Socket Assembly)	7-1 12
59.	Pilot's Cyclic Control Stick (Left Position)	7-1 13
A.	Pilot's Cyclic Control Stick Removal (Left Position)	7-1 13
B.	Pilot's Cyclic Control Stick Installation (Left Position)	7-1 13
C.	Pilot's Cyclic Control Stick Grip Removal	7-1 13
D.	Pilot's Cyclic Control Stick Grip Installation	7-1 13

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
Figure 7-40.	Pilot's Cyclic Stick, Control Linkage and Friction Controls	7-1 14
E.	Pilot's Cyclic control Stick Inspection (Left Position)	7-1 15
F.	Pilot's Cyclic Control Stick Repair (Left Position)	7-1 15
G.	Pilot's Friction Mechanism Replacement	7-1 15
60.	Cyclic Stick Guard	7-1 15
A.	Cyclic Stick Guard Replacement	7-1 15
61.	Pilot's Compartment Lateral and Longitudinal Cyclic Control Linkage	7-1 15
A.	Lateral Control Rods and Station 67 Bellcrank Removal	7-1 15
Figure 7-41.	Pilot's Compartment Cyclic Control and Guard Installation	7-1 16
B.	Lateral Control Rods and Station 67 Bellcrank Installation	7-1 16
C.	Lateral Control Rods and Station 67 Bellcrank Repair	7-1 17
D.	Cyclic Pitch Interconnect Torque Tube Removal	7-1 17
E.	Cyclic Pitch Interconnect Torque Tube Repair	7-1 17
F.	Cyclic Pitch Interconnect Torque Tube Installation	7-1 18
62.	One-W ay Lock Control System	7-1 18
A.	One-W ay Lock Removal	7-1 19
B.	One-W ay Lock Inspection	7-1 19
C.	One-W ay Lock Repair	7-1 19
Figure 7-42.	Cyclic Torque Tube and One-Way Lock Control System	7-120
D.	One-W ay Lock Installation	7-121
63.	Installation of Fuselage Access Panels for Cyclic Trim Actuator Assemblies	7-121
Figure 7-43.	Removal of Stiffeners and Doublers	7-122
Figure 7-44.	Installation of Trim Actuator Assembly Access Panels	7-123
64.	Cyclic Trim Actuators	7-125
A.	Cyclic Trim Actuator Removal	7-125
B.	Cyclic Trim Actuator Installation	7-125
C.	Cyclic Trim Actuator Inspection	7-126
D.	Cyclic Trim Actuator Bench Testing	7-126
Figure 7-45.	Cyclic Trim Actuator	7-127
65.	Cyclic Trim Actuator Repairs	7-128
A.	Cyclic Trim Actuator Drive Gear Retention Nut Field Repair	7-128
B.	Cyclic Trim Actuator Spring Assembly Replacement	7-129
C.	Cyclic Trim Actuator Housing or Trim Tube Replacement	7-129
D.	Cyclic Trim Actuator (Motor/ Gear Drive Mechanism) Replacement	7-129

SECTION 7
MAIN ROTOR AND CONTROL SYSTEM

1. Main Rotor and Control System

(Ref. Figure 7-1) The main rotor is located at the approximate center of the CG range and provides lateral control, longitudinal control, and the lifting force of the helicopter.

The main rotor is fully articulated with offset flapping hinges and consists primarily of four removable rotor blades attached to rotor hub pitch housings and a central hub with cross-connected retention straps, and associated pitch change mechanism.

The main rotor is controlled by the collective pitch control system that governs the rate of ascent or decent and the cyclic pitch control system that controls horizontal movement.

The four major installations are the main rotor installation, the upper (exterior) main rotor controls, the pilot's compartment cyclic controls, and the pilot's compartment collective controls.

2. Main Rotor and Control System Troubleshooting

WARNING **Sudden onset, excessive and/or unusual main rotor vibrations should be investigated as to cause, prior to continued flight. Under no circumstance should main rotor tracking be attempted to correct the problem until a thorough inspection of the main rotor blades, hub assembly and strap assembly has been performed.**

(1). Troubleshooting information is divided into:

(a). Investigation of operational vibration problems originating with the main rotor assembly (Ref. Table 7-1).

(b). Investigation of symptoms that can be recognized (Ref. Table 7-2).

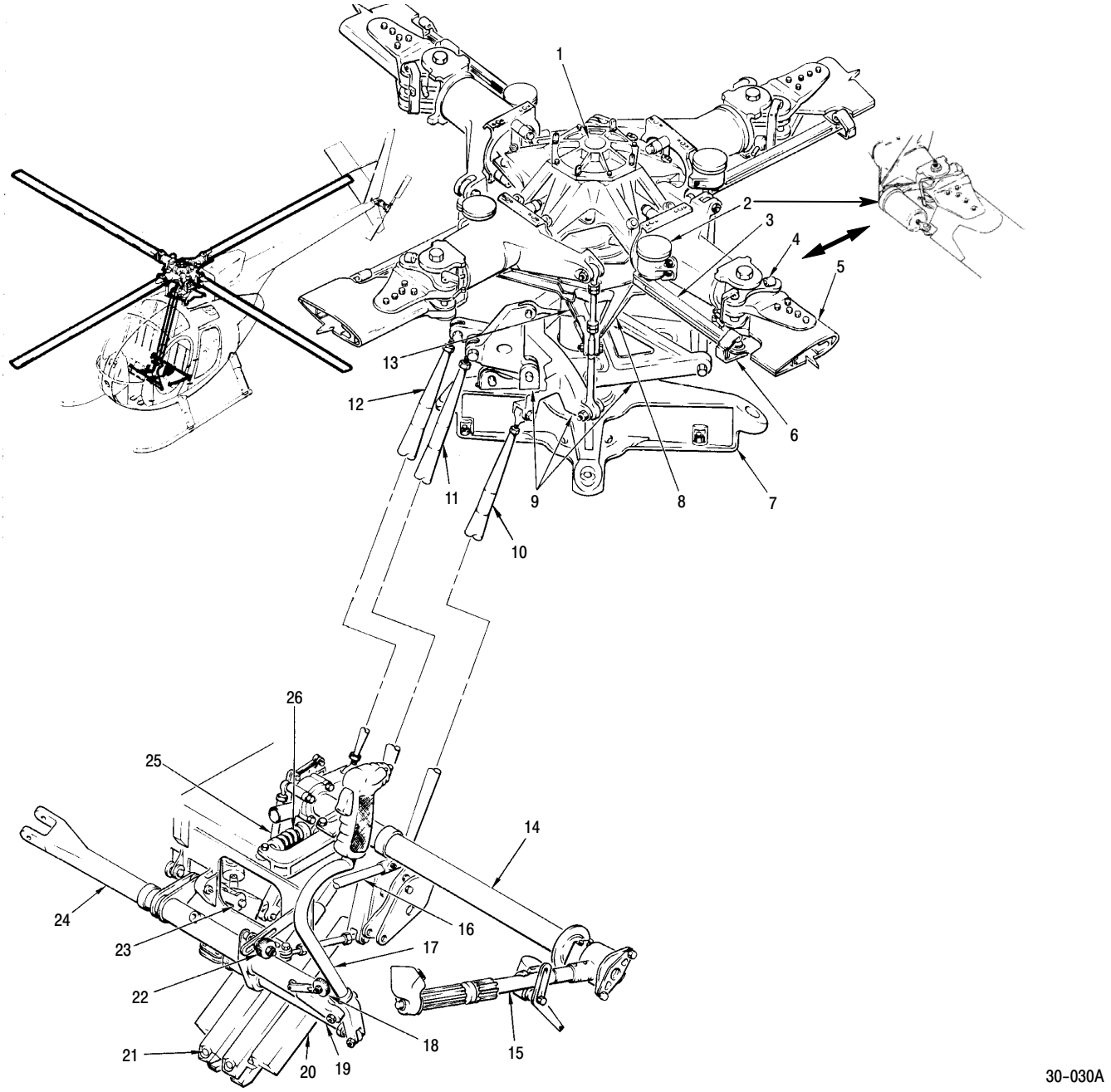
(c). Isolation of an unusual controls malfunction (Ref. Table 7-3).

(2). First determine which of the four major installations is defective.

(3). Isolate each linkage installation from the others until the area in which the malfunction is occurring has been located.

(4). Then investigate and locate the malfunction and repair or replace the defective component.

NOTE: Since the first indication of trouble will appear at the cyclic control stick or the collective pitch stick, the isolation procedures in Table 7-2 and Table 7-3 begin with symptoms detected during operation of these controls.



1. MAIN ROTOR DRIVE SHAFT (REF. SEC. 9)
2. DAMPER
3. DAMPER ARM (LINK)
4. BLADE ATTACH PIN (TYP)
5. MAIN ROTOR BLADE
6. DAMPER LINK ATTACH PIN
7. MAIN ROTOR MAST BASE
8. ROTATING SWASHPLATE
9. MAIN ROTOR CONTROLS (MIXER, IDLER BELLCRANKS AND LINKS)
10. LATERAL MIXER CONTROL ROD (CYCLIC)
11. LONGITUDINAL MIXER CONTROL ROD (CYCLIC)
12. COLLECTIVE MIXER CONTROL ROD
13. STATIONARY SWASHPLATE
14. COLLECTIVE CONTROL TORQUE TUBE
15. PILOT'S COLLECTIVE PITCH STICK
16. DROOP CONTROL OVERRIDE LINK (REF. SEC. 1)
17. PILOT'S CYCLIC STICK
18. LATERAL CYCLIC FRICTION KNOB
19. CYCLIC LATERAL CONTROL ROD
20. LATERAL CYCLIC TRIM ACTUATOR
21. LONGITUDINAL CYCLIC TRIM ACTUATOR
22. LONGITUDINAL CYCLIC FRICTION KNOB
23. ONE-W AY LOCK (LONGITUDINAL CYCLIC CONTROL)
24. CYCLIC CONTROL TORQUE TUBE
25. GAS PRODUCER CONTROL ROD (REF SEC 1)
26. COLLECTIVE BUNGEE

Figure 7-1. Main Rotor Control System

Table 7-1. Troubleshooting Main Rotor Vibrations

Symptom	Probable Trouble	Corrective Action
Unusual and/or excessive vibration: Vertical or lateral.	Damage to main rotor blades.	Inspect blades.
	Damage to main rotor hub components.	Inspect main rotor hub and strap pack assemblies(Ref. Figure 7-20).
One per revolution lateral beat first encountered at high power settings, in autorotation, and in turns. This beat may also occur on the ground during warmup or shutdown.	Damper torque is not at required value.	Check damper torque. Replace damper if torque not within limits.
Lateral beat occurs at low (idle) rotor rpm. When operating at normal (flight) rotor rpm, lateral beat becomes a vertical beat.	Damper torque is not at require value.	Check damper torque. Replace damper if torque not within limits.
Four per revolution or medium frequency beat.	Main rotor dampers sticking, or low range torque is not at required value.	Check damper torque. Replace damper if torque not within limits.
	Vibration absorber defective.	Replace vibration absorber.
	Worn feathering bearings.	Replace feathering bearings.
One per revolution vertical beat. Beat may appear throughout entire flight regime, becoming more pronounced at higher airspeeds.	Main rotor blades not tracked correctly.	Track main rotor blades.
Lateral feedback (beat) in cyclic control stick (no longitudinal feedback detected).	Rotor blades out of track.	Track main rotor blades.
One per revolution lateral beat, continuous.	Main rotor blade tip weights not secure.	Check tip weights for security, repair as necessary.
	Torque setting on main rotor blade damper(s) too high for proper operation at low ambient temperature.	Set torque of all four dampers to the allowable minimum torque value.
High frequency vibrations.	Loose or defective component in another system.	Ref. Sec. 5, 8, 9 and 10.

Table 7-2. Troubleshooting Controls

Symptom	Probable Trouble	Corrective Action
Cyclic control stick pressures cannot be reduced by operating trim switch.	Improperly set cyclic trim.	Re-trim cyclic control stick.
Trim change is too slow.	Trim actuator inoperative.	Troubleshoot cyclic trim electrical circuit; replace defective component.
Cyclic control sticks have tendency to move to aft position.	Low fluid in one-way lock fluid reservoir.	Add fluid to one-way lock reservoir as required (Ref. Sec. 2).
Inadequate cyclic control during flight.	Helicopter loaded out of center of gravity range.	Check and correct weight and balance.
Excessive pressure required for lateral or longitudinal movement of cyclic control sticks on the ground and during flight. Some droop stop friction will always be felt when there is no rotor rpm.	Lateral friction device improperly adjusted.	Loosen lateral friction device.
	Swashplate spherical bearing surface damaged.	Replace swashplate bearing assembly if torque required to rotate bearing exceeds 120 inch-pounds (13.56 Nm).
	Scissors crank bearings or hub lower shoe bearings binding or frozen.	Replace defective bearings.
	Lateral interconnecting rod end bearing binding due to incorrect alignment.	Realign rod end bearing.
	Droop stop plunger sticking.	Clean plungers and mating brushes with isopropyl alcohol (71, Table 2-4).
	Droop stop striker plate(s) or cam roller(s) damaged.	Replace striker plate and/or cam roller.
	Longitudinal friction devise improperly adjusted.	Loosen longitudinal friction devise.
	Binding rod end bearings in longitudinal push rods.	Realign rod end bearings.
	One-way lock check valve or push rod shaft that unseats the valve galled or seized.	Replace one-way lock assembly.
	Swashplate spherical bearing surface damaged.	Replace swashplate bearing assembly if torque required to rotate bearing exceeds 120 inch-pounds (13.56 Nm).

Table 7-3. Isolating Control System Troubles

Symptom	Isolating Step	Corrective Action
Binding, locking-up and erratic action of cyclic control stick.	Disconnect one-way lock.	If symptom gone, replace one-way lock.
Symptom remains	Disconnect upper ends of longitudinal and lateral control rods (10 and 11, Figure 7-1).	If symptom gone and rod ends are good, disassemble and inspect main rotor mixer controls until defective part is located.
Symptom remains.	Reconnect upper ends of longitudinal and lateral control rods, and disconnect lower ends.	If symptom gone and rod ends are good, disassemble and inspect pilot compartment controls until defective part is located.
Trouble corrected (Reconnect all control linkage)		
WARNING: Do not disconnect any hardware from the pilot's collective stick unless collective bungee installation tool 369A9936 is installed. Strong bungee spring pressure can cause linkage reaction and severe personal injury, or parts damage.		
Binding, locking-up, and erratic action of collective control stick.	Disconnect upper ends of collective pitch control rod (12, Figure 7-1) and operate stick.	If symptom gone and rod ends are good, disassemble and inspect main rotor mixer controls until defective part is located.
Symptom remains	Leave upper end of collective pitch control rod disconnected.	Trouble is in pilot's compartment collective control linkage.
Symptom remains	Disconnect gas producer control rod (25, Figure 7-1) from collective stick. Disconnect droop control override link (16) from collective control torque tube.	If symptom gone, trouble is in engine controls (Ref. Sec. 11).
Symptom remains	Leave gas producer control rod and droop control override link disconnected.	Disassemble and inspect pilot's compartment collective control linkage until defective part is located.
Trouble corrected (Reconnect all control linkage)		

3. Cyclic, Collective and Main Rotor Control Rigging

(Ref. Figure 7-2) Rigging of the main rotor control system must be accomplished immediately after replacement of linkage that can not be accurately measured (by trammeling) before it is installed in the main rotor control system, or if helicopter operation reveals a rigging deficiency.

NOTE: The cyclic and collective controls must be rigged, in sequence, starting with the collective. Control rod end bearing adjustments are to be made to the nearest half turn that will produce correct rigging. When tightening the jam nut at the adjustable end of control rods, always hold the rod end with a wrench to prevent jamming of the bearing.

A. Collective Control Rigging

(1). Remove main rotor blades, or manually raise the blades off their droop stops by simultaneously lifting the blade tips.

NOTE: All four blades must be off the stops during rigging. Padded supports should be used, if available.

(2). Release the friction and raise pilot's collective stick.

(3). Position collective rigging fixture (9, Table 2-2) in outboard lower end of slot in collective friction guide link (Ref. Detail A).

(4). Lower collective stick on rigging fixture and tighten friction grip (drive gear).

(5). Position mixer rigging plate (11) on mast support fitting and secure firmly by use of the two toggle clamps.

(6). Measure the distance from horizontal centerline of the mast support bracket hingeline bolt (attaching the longitudinal idler bellcrank and collective pitch mixer bellcrank to the mast support bracket) to the surface of mixer rigging plate and record actual distance (Detail B).

(7). Measure the distance from the horizontal centerline the bolt that attaches the collective pitch mixer bellcrank to the longitudinal pitch mixer bellcrank (Detail C), to the surface of mixer rigging plate; it should be the same as the dimension recorded in step (6). above.

(a). If not, loosen checknut, disconnect upper end of collective control rod, and adjust rod end of collective control rod, and adjust rod end until dimensions are the same.

(8). Reconnect the control rod, remove the collective stick rigging fixture and check mixer travel.

(9). With stick at the down stop, the centerline of the collective pitch mixer bellcrank bolt (Detail C) should move down so that the dimensions recorded in step (6). above is decreased by not less than 0.074 inches (1.8796 mm).

(10). With stick at the up stop, the centerline of the collective pitch mixer bellcrank bolt should move up so that the dimension recorded in step (6). above is increased by not less than 0.74 inch (1.8796 mm).

(11). Adjust rod end of collective pitch control rod if necessary to meet the limits specified in steps (8). and (10). above. When adjustment is complete, tighten checknut and make certain that length of control rod is not changed.

CAUTION When tightening rod end checknuts, ensure that rod end bearings at both ends of rod are aligned between the bellcrank ears.

(12). Reconnect collective pitch control rod and secure with a new cotter pin.

(13). Reinstall collective rigging fixture. All mixer rigging is done with collective in mid-position.

B. Cyclic Control Rigging

CAUTION When timing the longitudinal trim motor for full travel in the following step, do not continue to hold the trim switch after the actuator has reached the travel limit.

(1). Loosen longitudinal friction knob.

(2). Actuate longitudinal cyclic trim for no load by accurately timing trim motor

from full aft to full forward trim. Return trim to full aft; then trim forward for one-third the travel time.

(3). Position cyclic stick so that longitudinal rigging fixture (12, Table 2-2) will fit in outboard side of slot in longitudinal friction guide link.

(a). Bushing end of fixture butts against forward end of the slot, and friction knob stud fits in fixture detent (Detail D).

(4). Secure fixture hook in aft end of slot, tighten knurled thumbnut to seat bushing at forward end, and tighten friction knob.

(5). Measure the distance from the horizontal centerline of bolt at aft end of longitudinal pitch mixer bellcrank (Detail E) to the surface of mixer rigging plate;

(a). It should be the same as the dimension recorded in step A.(6).

(b). If not, loosen checknut, disconnect longitudinal pitch control rod, and adjust rod end until dimensions are the same.

(6). Reconnect the control rod, remove the longitudinal stick rigging fixture and check mixer travel.

(7). With stick at the forward stop, the centerline of the longitudinal pitch mixer bellcrank bolt (Detail E) should move up so that the dimension recorded in step A.(6). is increased by not less than 1.12 inches (28.448 mm).

(8). Reposition the mixer rigging plate to clear the longitudinal pitch mixer bellcrank.

(9). With the stick at the aft stop, the centerline of the longitudinal pitch mixer bellcrank bolt (Detail E) should move down so that the dimension recorded in step A.(6). is decreased by not less than 0.60 inch (15.24 mm).

(10). Adjust rod end of longitudinal pitch control rod if necessary to meet the limits specified in steps A.(6). and A.(7).

NOTE: Make adjustment carefully as there is only 1/2 turn tolerance. When adjustment is complete, tighten checknut and make certain that length of control rod does not change.

(11). Reconnect control rod to longitudinal pitch idler and secure with a new cotter pin.

(12). Reinstall longitudinal rigging fixture, reposition and secure mixer rigging plate, and continue with lateral rigging.

(13). Loosen friction knob and actuate lateral cyclic trim for no load.

(14). Position cyclic stick so that lateral rigging fixture (14) will fit in forward side of slot in lateral friction guide link.

(a). Bushing end of fixture butts against outboard end of slot, and friction knob stud fits in fixture detent (Detail F).

(15). Secure fixture hook in inboard end of slot, tighten knurled thumbnut to seat bushing at outboard end, and tighten friction knob.

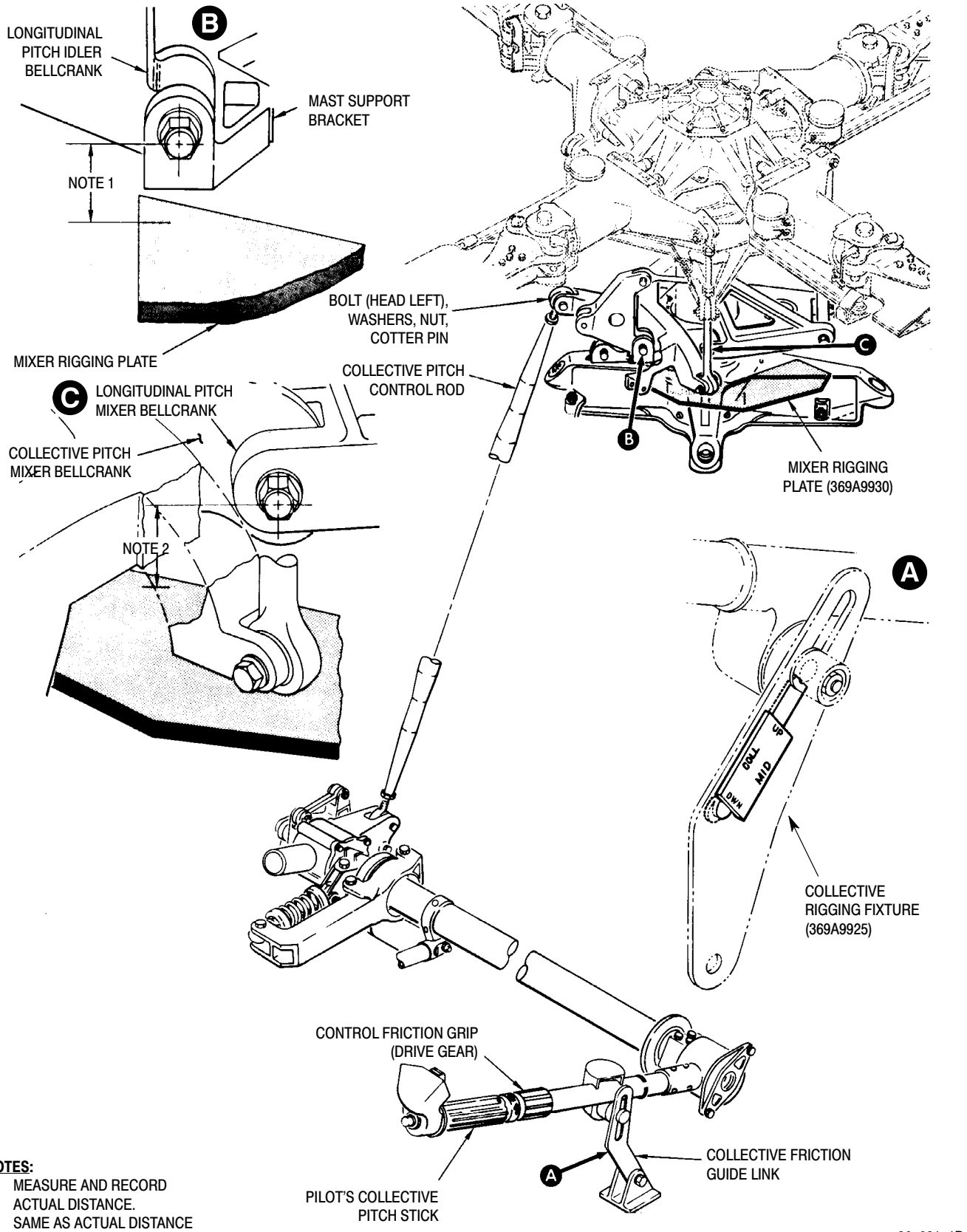
(16). Measure the distance from the horizontal centerline of bolt connecting lateral bellcrank to stationary swashplate mixer link (Detail G) to the surface of mixer rigging plate;

(a). It should be the same as the dimension recorded in step A.(6).

(b). If not, loosen checknut, disconnect lateral pitch control rod, and adjust rod end until dimensions are the same.

(17). Reconnect the control rod, remove the lateral stick rigging fixture and check mixer travel.

(a). With stick at the left stop, the centerline of the lateral bellcrank bolt (Detail G) should move down so that the dimension recorded in step A.(6). is decreased by not less than 0.50 inch 12.7 mm).



NOTES:
1. MEASURE AND RECORD ACTUAL DISTANCE.
2. SAME AS ACTUAL DISTANCE MEASURED (DETAIL B).

Figure 7-2. Rigging Main Rotor Control System (Sheet 1 of 2)

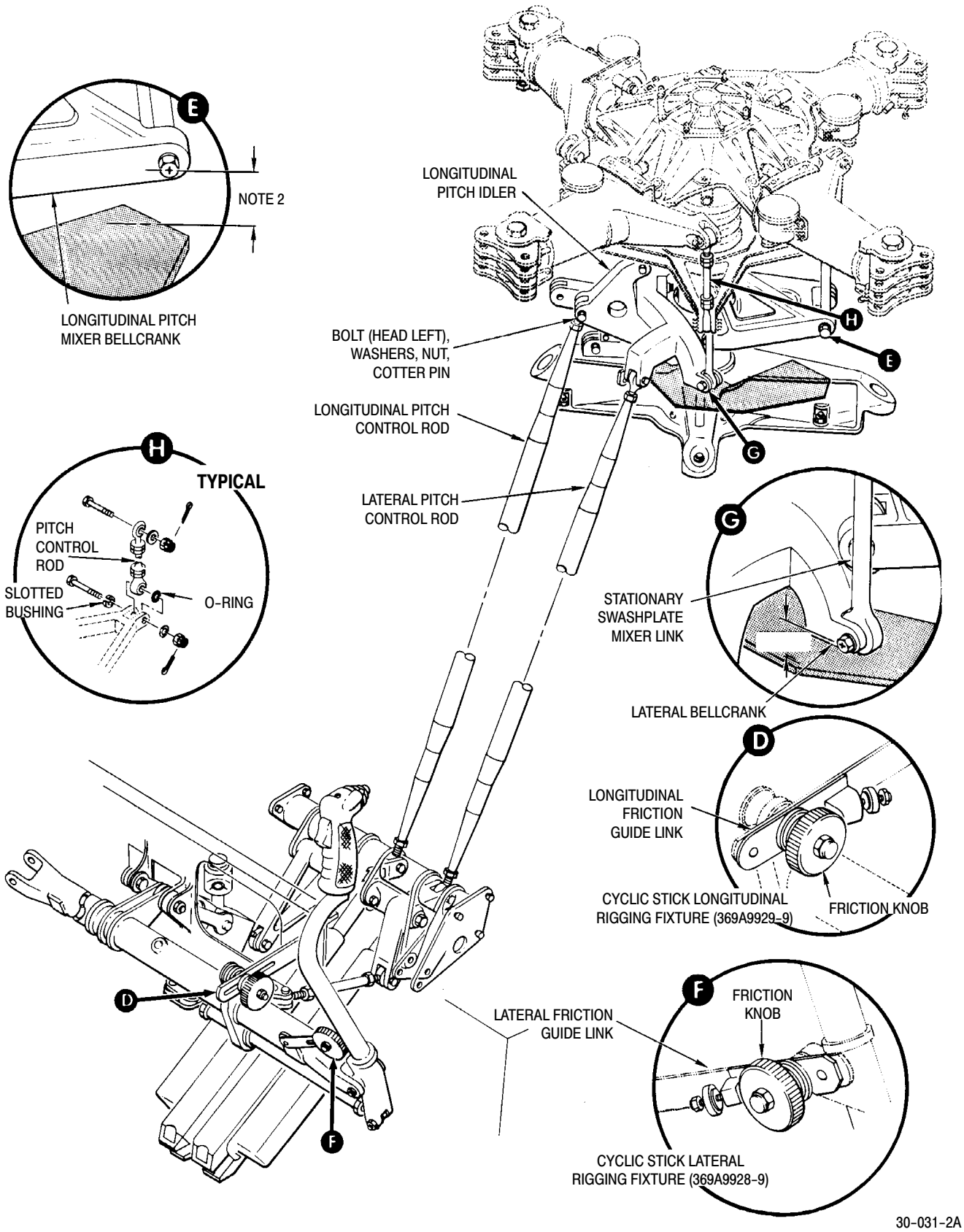


Figure 7-2. Rigging Main Rotor Control System (Sheet 2 of 2)

(18). With stick at the right stop, the centerline of the lateral bellcrank bolt should move up so that the dimension recorded in step A.(6). is increased by not less than 0.43 inch (10.922 mm).

(19). Adjust rod end of lateral pitch control rod, if necessary, to meet the limits specified in steps (17). and (18). above.

(20). When adjustment is complete, tighten checknut, and make certain that length of control rod is not changed.

(21). Reconnect control rod to lateral bellcrank and secure with a new cotter pin.

(22). Loosen friction control, friction knobs, knurled thumbnuts and hooks of rigging fixture and remove all three fixtures.

NOTE: The following step establishes initial adjustment of the main rotor pitch control rods.

(23). Set each pitch control rod (Detail H) (centerline to centerline of rod bearings) to the applicable strap pack pitch link length specified on the tower tracking data decal of the mating blade.

(a). Set pitch control rods to 6.60 inches (16.764 cm) (between rod end bearing centerlines) for the two blades attached to the hub upper strap pack

(b). Set pitch control rods to 6.35 inches (16.129 cm) (between rod end bearing centerlines) for the two blades attached to the lower strap pack.

(c). Install the pitch control rod.

(24). Install main rotor blades or remove supports and simultaneously lower all four blades to normal position.

(25). Track main rotor blades and adjust autorotation rpm.

4. Main Rotor Blades

(Ref. Figure 7-3) Each of the four main rotor blades is a balanced airfoil that consists of a wrap-around, aluminum alloy skin bonded to an extruded aluminum alloy spar, and upper and lower root fitting.

A vibration absorber is installed on the lower inboard end, and two balance weights are installed in the tip end of each blade.

A removable forward tip cap, attached to the outboard end of the blade, is replaced with a tracking cap when tracking procedures are performed.

The blade trailing edge tab may be bent up or down to compensate for the differences in diving or climbing characteristics between individual blades during forward flight.

5. Main Rotor Blade Tracking

(Ref. Figure 7-4 thru Figure 7-5)Track of the main rotor blades is observed by means of tracking tip caps temporarily attached to the tip of each blade, and a high-intensity strobe light that flashes in synchronization with the rotating blades.

The strobe light operates from electrical power obtained from the helicopter electrical system.

By observing the image pattern formed by the four reflectors attached to the blade tips, it is possible to view the track of the rotating blades.

WARNING **Sudden onset, excessive and/or unusual main rotor vibrations should be investigated as to cause, prior to continued flight. Under no circumstances should main rotor tracking be attempted to correct the problem until a thorough inspection of the main rotor blades, hub assembly and the strap pack assembly has been performed.**

NOTE: Before attempting to track the rotor blades, it is important to read and thoroughly understand the tracking sequence and interrelationship of the various adjustments. A review of the following should prove helpful.

(1). Install the tracking strobe light, blade tip cap reflectors and related equipment (Ref. Main Rotor Tracking Equipment Installation).

(2). Refer to Table 7-4 for a condensed summary of the proper sequence for blade tracking.

(3). Ground tracking basically involves track-observation and adjustment at idle rpm and at flight rpm.

(a). Track at idle rpm is adjusted by the pitch control rods connecting the rotating swashplate and the blades.

(b). Ground track at flat pitch and flight rpm is corrected by blade tab adjustment.

NOTE: No track adjustments are made on the basis of track observations during hovering.

(4). Hover track verification is essentially an observation to check for track variation that might occur between high rpm (flat pitch) ground track check and hovering. However, track variations should be noted and recorded for reference use during the check of track in forward flight.

(5). Forward flight tracking requires track observation during the following airspeeds and maneuvers.

(6). Flight track is corrected by making blade tab adjustments ONLY.
* Flight at 0-100 knots.
* Forty-five degree banked turns at 80-100 knots.
* Flight at 100-130 knots.

(7). Obtaining correct autorotation rpm consists of checking the main rotor rpm during stabilized autorotation flight and adjusting rpm to specified limits as necessary.

(8). The autorotation rpm check must be accomplished to ensure that track adjustments have not altered the rotor performance necessary for safe power-off landings.

6. Main Rotor Tracking Equipment Installation

(Ref. Figure 7-4) Prepare for main rotor blade tracking by installing strobe light components furnished either with the strobe light installation kit (16, Table 2-2) or tracking analyzer instrument kit (59).

If the tracking analyzer instrument kit is used, instructions for equipment installation are part of the Balancer and Strobex Blade Tracker Manual supplied with the kit. Any of the following instructions that differ with the manual apply (instead of any conflicting instructions in the manual).

Install equipment as follows:

NOTE: The helicopter is originally equipped with four tracking interrupters (369A9946-23, -25, -27 and -29) installed on the rotating swashplate, and a support bracket (369A9943) for the magnetic pickup installed on the stationary swashplate. (Spare swashplate assemblies are also provided with these tracking devices.) The duplicate set of interrupters and pickup bracket included in the strobe light installation kit will not have to be used unless existing parts are unserviceable. See Figure 7-4 when replacement is necessary.

(1). Install strobe light (369A9925) container on cargo floor, using four adjustable straps for tiedown.

(a). Straps should extend diagonally outward from container to tiedown fittings attached to cargo floor.

(2). Remove strobe light from container and pass light through opening in forward bulkhead to observer's seat location.

(3). Route all three electrical cables from container through cutout opening in container and close cover.

(4). Attach 24 Vdc power cord connector to utility power receptacle at lower left corner of forward canted bulkhead.

CAUTION When maintenance work is being performed near the engine air inlet, use care to prevent entry of foreign objects. Tape covers of cardboard or other suitable material in place over the engine inlet screen and oil cooler air inlets. Do not remove covers until work is completed and debris is thoroughly cleaned out of the area. After removing covers, verify that area around base of mast, inlet-to-plenum, and entire plenum chamber is clean.

(5). Route triggering cable through either vent in right-side cargo door, continuing up around engine air inlet.

(a). Use strips of pressure-sensitive tape (32, Table 2-4) to attach cable to fuselage and air intake.

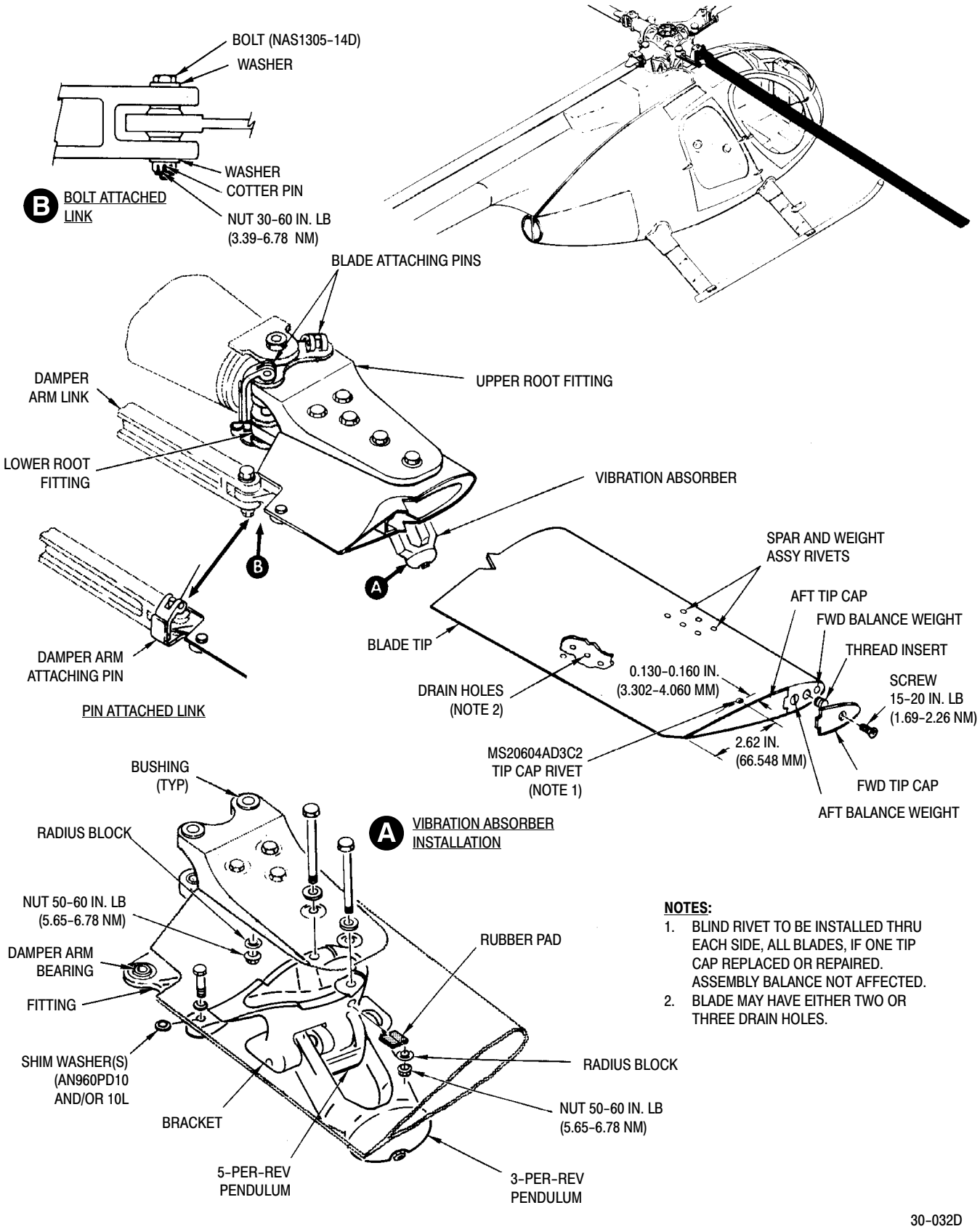


Figure 7-3. Main Rotor Blade Assembly

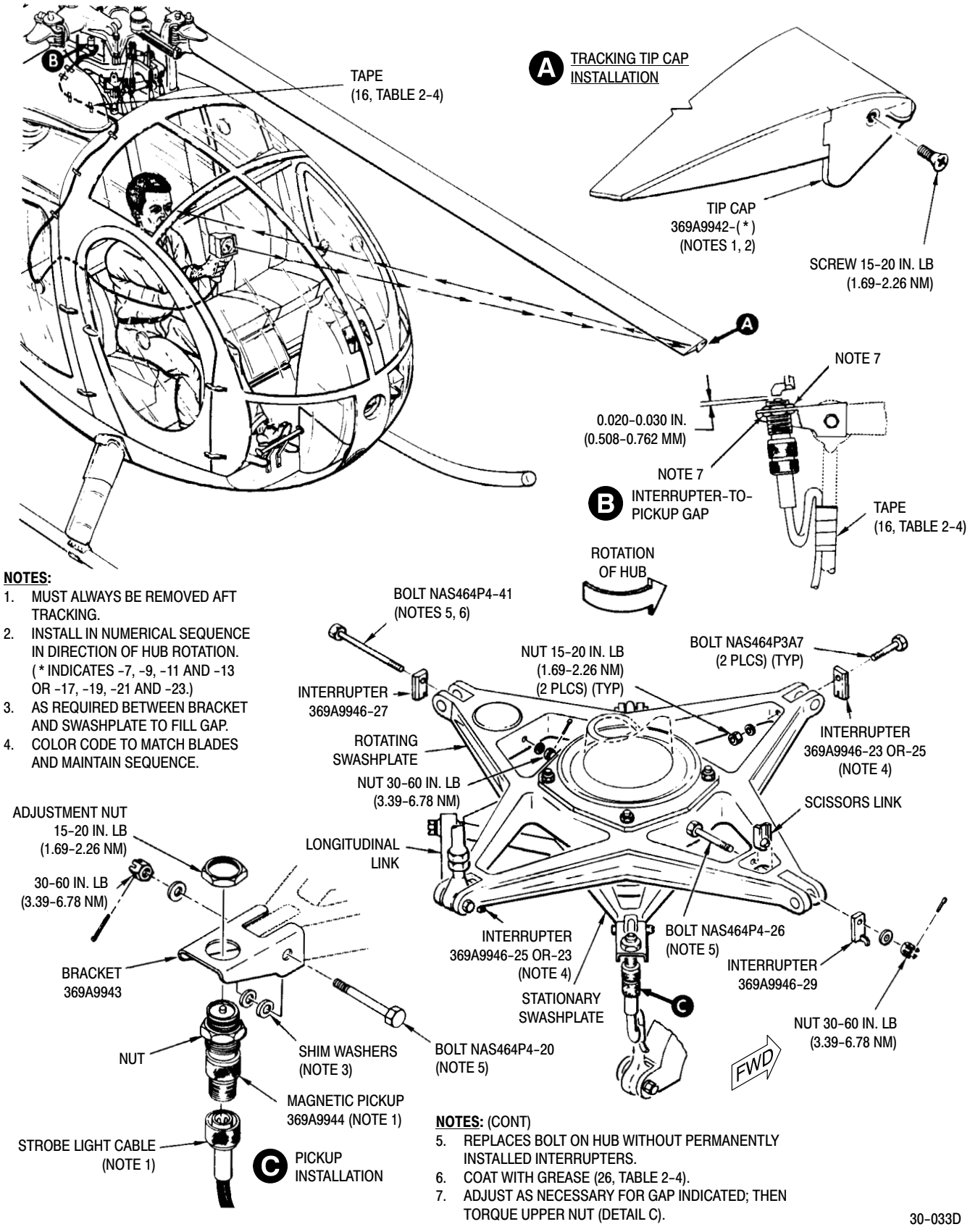


Figure 7-4. Installation of Main Rotor Blade Tracking Strobe

Table 7-4. Summary Procedure for Blade Tracking

NOTE: The 0.50 inch (12.7 mm) diameter tracking tip cap reflector size should be used as a guide for estimating track accuracy. For example: a reflector image displaced a half diameter upward or downward indicates that the corresponding blade tip is approximately 0.250 inch (6.35 mm) out of track; one full reflector diameter indicates 0.50 inch (12.7 mm) out of track.

Observed ground track		
Satisfactory	Unsatisfactory	Adjust pitch control rods and/or blade tabs as required and repeat track observation.
Perform hover verification		
Satisfactory	Unsatisfactory	Record track verification and proceed with forward flight tracking.
Perform forward flight tracking		
Satisfactory	Unsatisfactory	Adjust blade tabs and repeat forward flight tracking.
Perform autorotational rpm check		
Satisfactory	Unsatisfactory	Adjust autorotation rpm and repeat rpm check.
Remove tracking equipment and return helicopter to service.		

(6). Install magnetic pickup (369A9944) in bracket on stationary swashplate.

NOTE: Do not tighten top nut securing pickup at this time.

(7). Plug triggering cable into pickup and secure cable so that it will not interfere with extreme control movements.

(8). Adjust gap between interrupters and pickup to 0.020-0.030 inch (0.508-0.762 mm) and torque top nut securing pickup to **15 - 20 inch-pounds (1.69 - 2.26 Nm)**.

CAUTION Gap must not be less than 0.020 inch (0.508 mm). Swashplate must be rotated to check the clearance between each interrupter and the pickup. Do not use over **20 inch-pounds (2.26 Nm)** torque in tightening nut on pickup.

(9). Remove existing forward tip caps from tips of rotor blades and install reflector-equipped tip caps starting with cap 369A9942-17, followed by caps -19, -21 and -23 in dash number order and in direction of hub rotation. (Early type caps 369A9942-7, -9, -11 and -13, without retainers over reflectors, are furnished with tracking equipment 369A9926-5). Torque attaching screws to **15 - 20 inch-pounds (1.69 - 2.26 Nm)**. Do not to over-tighten screws.

(10). To operate strobe, turn ON the UTILITY switch/circuit breaker. Refer to strobe manufacturer's instructions for strobe operation and other additional information on the strobe equipment. Rotor must be turning to trigger the lamp.

NOTE: Strobe light operation can be checked with no signal input (rotor not turning) by actuating the lamp trigger several times. This action will flash the light. Do not depress lamp trigger for prolonged periods when rotor is not turning; to do so may damage lamp circuitry. The tracking strobe light unit is a Model 135M (or 135M-( )) Point Source Strobex Rotor Blade Tracker manufactured by Chadwick-Helmuth Co., Inc.

7. Main Rotor Blade Track Adjustment

(Ref. Figure 7-6 and Figure 7-5) Although adjustment of pitch control rods will affect blade track at all rotor speeds, they should be adjusted only when necessary to establish acceptable track at ground idle speed; the blade tabs are used for all other track corrections.

NOTE:

- If pitch control rods are badly out of adjustment, or if the rod end bearings have been replaced, set the length of the affected pitch control rod(s) (as measured between the rod end bearing centerline) to the applicable strap pack pitch link length specified on the tower tracking data decal of the mating blade. Observe the ground track before adjusting control rods.
- Blade tab and/or track can make the collective heavy or light.

A. Pitch Control Rod Adjustment

Repeat this adjustment procedure as necessary to establish ground idle track.

(1). Remove lockwire from both ends of pitch control rod and loosen the rod end jam nuts.

NOTE: The upper jam nut and rod end have left-hand threads.

(a). To lower a blade tip, shorten the pitch control rod assembly by turning the rod in a counterclockwise direction as viewed from below.

(b). To raise a blade tip, lengthen the pitch control rod assembly by turning in a clockwise direction.

(c). One-sixth of a turn of the rod (one flat) will raise or lower the blade tip approximately 0.250 inch (6.35 mm).

CAUTION After adjusting pitch control rods, check that the rod end threads are engaged far enough to block the rod body inspection (witness) hole. Center each rod end or fitting wear will result. Make sure there is no binding in the full up travel position.

(2). After adjusting the pitch control rod length, center each rod end in its fitting and hold while tightening the jam nuts. Safety with lockwire.

B. Blade Tab Adjustment

(Ref. Figure 7-5)

(1). Once ground idle track is obtained, all remaining tracking correction is accomplished by VERY SLIGHT bending of the various blade tab zones with tab bending tool (17 or 18, Table 2-2).

(2). Different zones of the tabs are used to adjust blade track at different airspeeds.

(a). Tab Zone A is used for high-rpm, flat pitch ground tracking (103% N_2).

(b). Zones C, D, and E are used for tracking at the higher airspeeds.

(c). Zone B is used to supplement Zone A track correction when maximum tab (5 degrees) has been applied to Zone A; Zone B may also be used, if necessary, for correction in the 0 to 100 knot airspeed range.

CAUTION Restrict bending to very small increments so that the bonded trailing edge joint between the upper and lower skins will not be damaged. All tabs must never be displaced more than 5 degrees above or below the normal position (parallel to the chordline).

NOTE: Tab zones on same blade can require bending in opposite directions. For example, after bending tab zone C downward to get good tracking at 60 to 90 knots, it might become necessary to bend tab zone E upward to correct track at redline airspeed. In any case, do not use larger tab corrections than are actually necessary.

(3). To lower the blade tip that tends to climb during ground tracking at high rpm or during forward flight, bend the appropriate tab section slightly downward.

(4). To raise the tip of a blade that tends to descend, bend the tab slightly upward.

(5). If only slight track correction is necessary, limit tab bending to the width of the bending tool.

(6). If more correction is necessary, bend a slightly wider section of the tab.

NOTE: Avoid excessive re-bending of tabs by using small adjustments until the necessary result is obtained.

(7). Each time blade tabs are adjusted, recheck ground idle track and readjust if necessary.

(8). After completion of forward flight tracking, and check autorotation rpm.

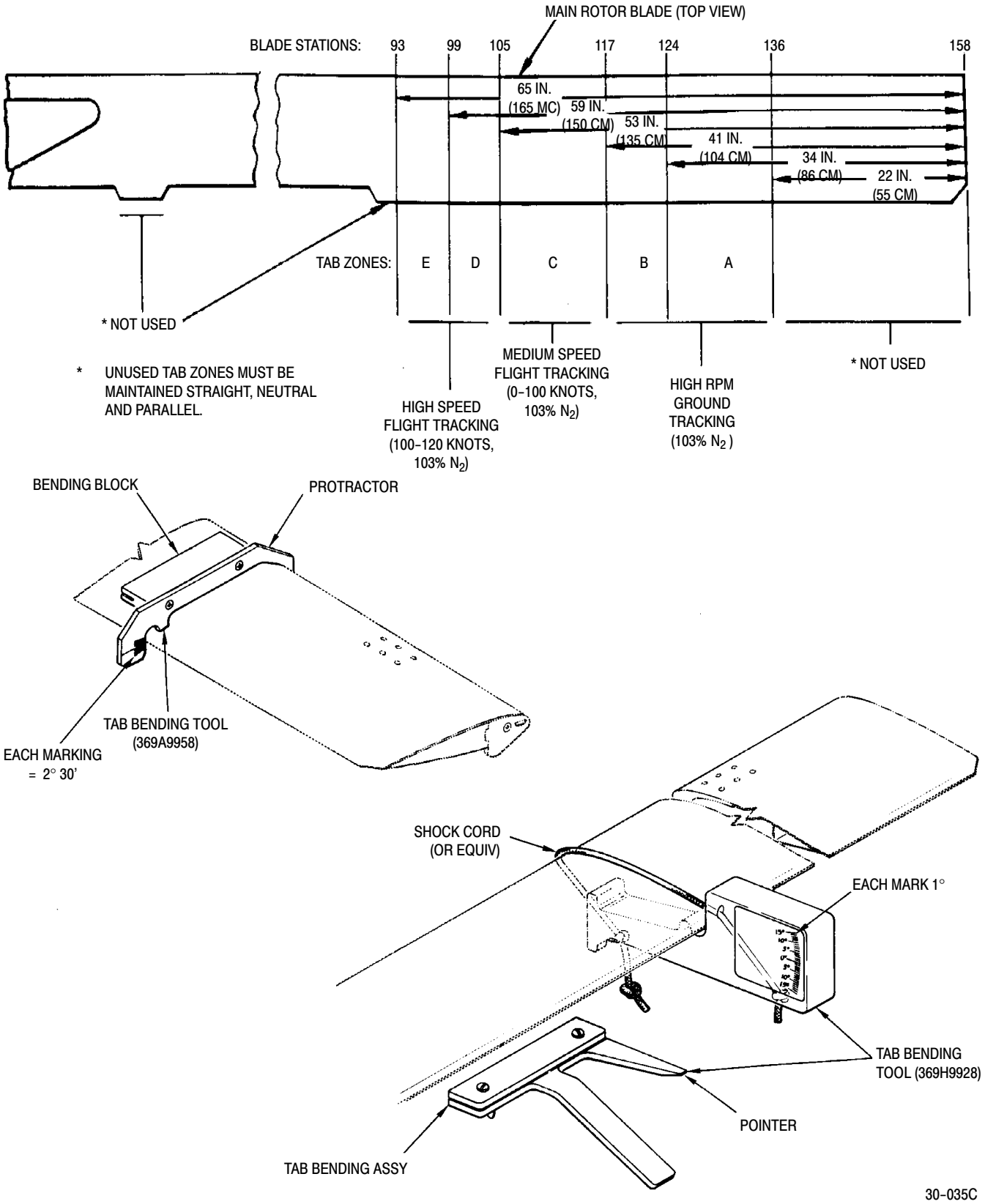
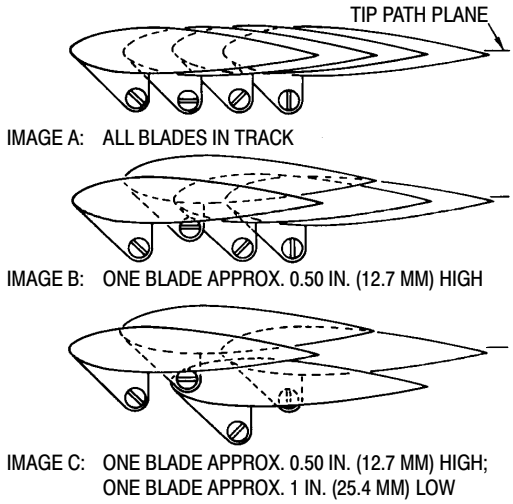


Figure 7-5. Main Rotor Blade Tab Adjustment



	CORRECTIVE ACTION	
CONDITION	GROUND IDLE RPM	HIGH RPM AND FWD FLIGHT
IMAGE A	NONE REQUIRED	NONE REQUIRED
IMAGE B	SHORTEN PITCH CONTROL ROD (2^{ND} BLADE)	MOVE TAB DOWNWARD (2^{ND} BLADE)
IMAGE C	SHORTEN PITCH CONTROL ROD (2^{ND} BLADE); LENGTH CONTROL ROD (3^{RD} BLADE)	MOVE TAB DOWNWARD (2^{ND} BLADE); MOVE TAB UPWARD (3^{RD} BLADE)

30-034A

Figure 7-6. Typical Tracking Conditions and Adjustments

C. Main Rotor Blade Ground Tracking

(Ref. Figure 7-6 and Figure 7-5) For best results, tracking should be performed under calm air conditions. Wind velocity should not exceed 6 knots during preliminary adjustments or 3 knots for final adjustment.

Accurate adjustment of initial ground track is very important. In most instances, forward flight tracking problems can be avoided or greatly reduced by setting initial track as nearly perfect as possible.

Tolerances specified in following instructions should be considered maximum permissible deviation rather than desired goal.

NOTE: If a replacement main rotor hub has been installed, or if a replacement pitch control rod assembly or rod end bearing has been installed, set the length of each pitch control rod assembly to the applicable strap pack pitch link length specified on the tower tracking data decal of the mating blade before proceeding with ground tracking

(1). Before tracking blades that are NOT new, check that normally straight (not to be used) tab areas (Ref. Figure 7-5) are in neutral position (centered on chordline) and straight.

NOTE: On NEW (untracked) blades, check that all tab areas are straight and in neutral position (centered on chordline 0° ±5°).

(2). Load helicopter to a gross weight of approximately 1900-2250 pounds (862-1021 kg).

(3). With collective pitch stick full down, operate engine for a brief period at 103% N_2 and then reduce rpm to the ground-idle (approximately 62% N_1); this will ensure that the blade dampers are correctly positioned.

(4). Observe tracking tip cap reflector image by directing strobe light beam toward blade tip path and sweeping beam slowly back and forth until reflector images are clearly seen.

(a). The tracking image should appear directly in front of helicopter or slightly off helicopter centerline.

(5). If blades are in track, tip cap reflector image pattern should resemble image A, (Ref. Figure 7-6) (none of the blade tip more than 1/4 of one tracking reflector diameter, 0.125 inch(3.175 mm) above or below adjacent reflectors).

(a). If blades are in track, proceed with step (6). below.

(b). If blades are out of track, adjust pitch control rods and repeat step (3). above.

(6). With collective pitch stick full down, increase engine speed to 103% N_2 and observe tip cap reflector image to see if blade track is changed from ground idle track.

(a). When all four blades are in track within 1/4 of one reflector diameter, 0.125 inch(3.175 mm), ground track is good; proceed with hover verification.

(b). When a blade is out of track, adjust blade tab zone A until high rpm ground track is within tolerance.

D. Hover Track Verification

(Ref. Figure 7-6 and Figure 7-5) Hover track verification must be performed after ground tracking and before forward flight tracking. Verification is only a CHECK of hover track.

DO NOT adjust pitch control rods or blade tabs because of track images observed during hovering.

Tab adjustments often cause variation between ground track and hovering track.

A large track variation may indicate that one or more blades is beyond its chordwise balance tolerance, but this can only be determined during forward flight tracking.

NOTE: Collective pitch stick may be "heavy" after tracking reflectors are mounted on blade tips. This condition is not unusual and may be disregarded.

(1). Verify helicopter gross weight, 1900-2200 pounds (862-998 kg).

(2). With collective pitch stick full down, increase N_2 to 103 percent.

(3). Observe tracking reflector images to verify that ground track is within limits.

(4). With helicopter in a stable hover, observe reflector images.

(a). If one or more blades are out of track, record condition(s) for reference during forward flight tracking.

(5). Proceed with forward flight tracking.

E. Forward Flight Tracking

(Ref. Figure 7-6 and Figure 7-5) Forward flight tracking should be performed whenever vertical flight vibrations indicate that blades may be out of track.

(1). Verify helicopter gross weight, 1900-2200 pounds (862-998 kg).

(2). Perform flight tracking from hover up to 100 knots at 103% N_2. If flight track varies from hover track more than 0.50 inch (12.7 mm), bend tab zone C (five degrees maximum) to limit variation to tab zone B (five degrees maximum).

(3). Check autorotation rpm; rpm must not be less than 450.

CAUTION Do not attempt to adjust chordwise balance of a blade found to be faulty when performing banked turns ((4). below). Chordwise balance corrections must be accomplished by manufacturer (MDHI).

(4). Perform a series of 45 degree banked turns 80-100 knots and observe track change from level flight. If any blade climbs or dives more than one inch out of track with others, chordwise balance (center of gravity) of that blade is beyond its tolerance and blade must be replaced. (Hover track variations of this type that do not repeat during banked-turn maneuver may be disregarded.)

(5). Perform flight tracking at 100-130 knots at 103% N_2. If necessary, adjust tab zone D (five degrees maximum) to limit track variation to 0.50 inch (12.7 mm) or less and to minimize excessive vertical (one-per revolution) vibration. If variation is excessive, bend tab zone E (five degrees maximum).

NOTE: When determining whether blade track is acceptable, overall vibration level of helicopter should be determining factor. Some combinations of rotor blades might produce higher four- per- revolution vibration as blade tips are brought into close track; in such cases, lowest vibration level is preferred, even though observed blade track may be beyond specified tolerances.

(6). After flight tracking is completed, perform a autorotation rpm check.

F. Autorotation RPM Check

(Ref. Table 7-5) An autorotation rpm check is required after each blade tracking operation and whenever rpm is outside limits. Check rotor rpm and make adjustments as follows:

CAUTION Main rotor blade (targets- cap/plates) reduce blade to tailboom clearance. Performing autorotations to-the-ground could result in tailboom strikes.

(1). Load helicopter to a gross weight of 1900-2200 pounds (862-998 kg).

(2). Perform a practice autorotative descent according to the Owner's Manual,

taking care not to allow rpm to exceed the rotor speed limitations.

(3). During autorotative descent, take careful note of the stabilized autorotative rpm at one of the gross weight/ density altitude combinations given.

(4). After landing, compare observed rpm with the values given in Table 7-5.

(a). If observed rpm is within the limits given in the table, rpm setting is correct.

(b). If limits were exceeded, make corrections adjustments until rpm falls within limits.

NOTE: When the rotor track autorotation rpm adjustment have been satisfactorily accomplished, remove tracking equipment before returning helicopter to service. Take care to properly tighten and safety all bolts after they have reinstalled.

G. Autorotation Rpm Adjustment

(Ref. Table 7-5)

NOTE: RPM adjustments in excess of 25 RPM should be accomplished by adjusting the four pitch control links.

(1). Hold the lower end of the collective mixer control rod with a wrench to restrain it against rotation and loosen the upper rod end jam nut.

(2). Remove bolt that attaches upper control rod end to bellcrank and shorten rod by turning rod end clockwise (as viewed from above) to decrease rotor rpm or counter clockwise to increase rotor rpm. Each 1/2 turn of rod end will change rotor speed by approximately 6 rpm.

CAUTION After adjusting collective pitch control rod, check to make sure that all threads of the rod are engaged far enough to block the rod body inspection (witness) hole.

(3). After adjusting collective mixer control rod length, install bolt and check for control interference as described in steps (4). and (5). below.

(4). Check for interference between the lateral bellcrank and longitudinal pitch idler (Ref. Figure 7-2, Details B and G) of the mixer control by positioning the collective stick full up and the cyclic stick at the aft stop.

(a). If interference exists, lengthen the collective pitch mixer control rod enough to eliminate the interference; then lengthen the four blade pitch link control rods (Detail H) equally the same amount.

(5). Check for interference between the rotating swashplate and longitudinal pitch idler of the mixer controls by positioning the collective stick on the downstop and the cyclic stick full forward and full left.

(a). If less than 0.150 inch (3.81 mm) clearance exists, shorten the collective pitch mixer control rod enough to establish clearance, 0.250 inch (6.35 mm) preferred; then shorten the four blade pitch link control rods equally by the same amount.

(6). After accomplishing checks and adjustments in steps (4). and (5). above, install nut, washer and new cotter pin. Tighten the rod assembly jam nut while holding rod end centered in the bellcrank fitting.

(7). If more adjustment is needed, change the length of all four pitch link control rods as necessary to obtain additional autorotation rpm.

NOTE: Lengthen or shorten all four rods exactly the same or blade track will be changed. One flat (1/6 turn) of the control rod body will cause approximately 8 rpm change in autorotation rpm.

Table 7-5. Autorotation RPM Chart

Stabilized Autorotation RPM at Density Chart						
Gross Wt lb / kg	**Sea Level**	**1000 Ft (305 M)**	**2000 Ft (610 M)**	**3000 Ft (915 M)**	**4000 Ft (1220 M)**	**5000 Ft (1525 M)**
1900 / 862	447-457	454-464	461-471	468-478	475-486	482-492
2000 / 907	459-469	466-476	473-483	480-490	487-497	494-504
2100 / 953	471-481	478-488	485-495	492-502	499-509	---
2200 / 998	483-493	490-500	497-507	504-514	---	---

NOTE:

(1) Chart values based upon 15°C (59°F) OAT. At sea level, 8°C (14°F) temperature change is equal to 1000 ft.. (305 M) of change in density altitude.

(2) Perform autorotation rpm checks at gross weight/density altitude combinations for which rpm values are given. Blank spaces indicate that application of collective pitch may be necessary to avoid rotor overspeed.

8. Main Rotor Balancing

(Ref. Figure 7-7) Analysis of main rotor balance is accomplished using instrumentation that measures and localizes vibrations due to main rotor imbalance.

Data provided by the instrumentation is plotted on a chart designed to indicate how much weight shall be added to or subtracted from thin bolts installed through the hollow lead-lag bolts.

No other means of balancing is to be used.

Do not attempt the balancing procedure without first tracking the blades.

WARNING **Never add weight to, subtract weight from, nor redistribute weight on the main rotor blades.**

A. Balancing Equipment and Balance Spare Kit

The balancing equipment (59, Table 2-2) contains all equipment needed to analyze main rotor balance. The balance spare kit (60) contains quantities of the balancing hardware listed in Table 7-6.

CAUTION The maximum allowable balance weight per pitch case housing on the main rotor hub assembly is 150 grams.

B. Procedural Instruction

The Tracking and Balancing Manual for Helicopter Main Rotor and Tail Rotor Track and Balance is a part of the balancing equipment (59, Table 2-2) and shall be used for equipment installation and balancing procedure, except that any following instructions that differ apply (instead of any conflicting instruction in the Tracking and Balancing Manual).

C. Balance Equipment Installation

Complying with instructions in the Chadwick-Helmuth Balancer and Strobex Blade Tracker Manual to install that portion of the balancing kit (59, Table 2-2) needed to balance the main rotor.

CAUTION When working near engine air inlet, comply with precautions to prevent entry of foreign material. During main rotor balancing the helicopter is airborne. Carefully observe precautions in the Tracking and Balancing Manual relating to the placement and security of equipment (especially cables) fastened to the exterior of the helicopter.

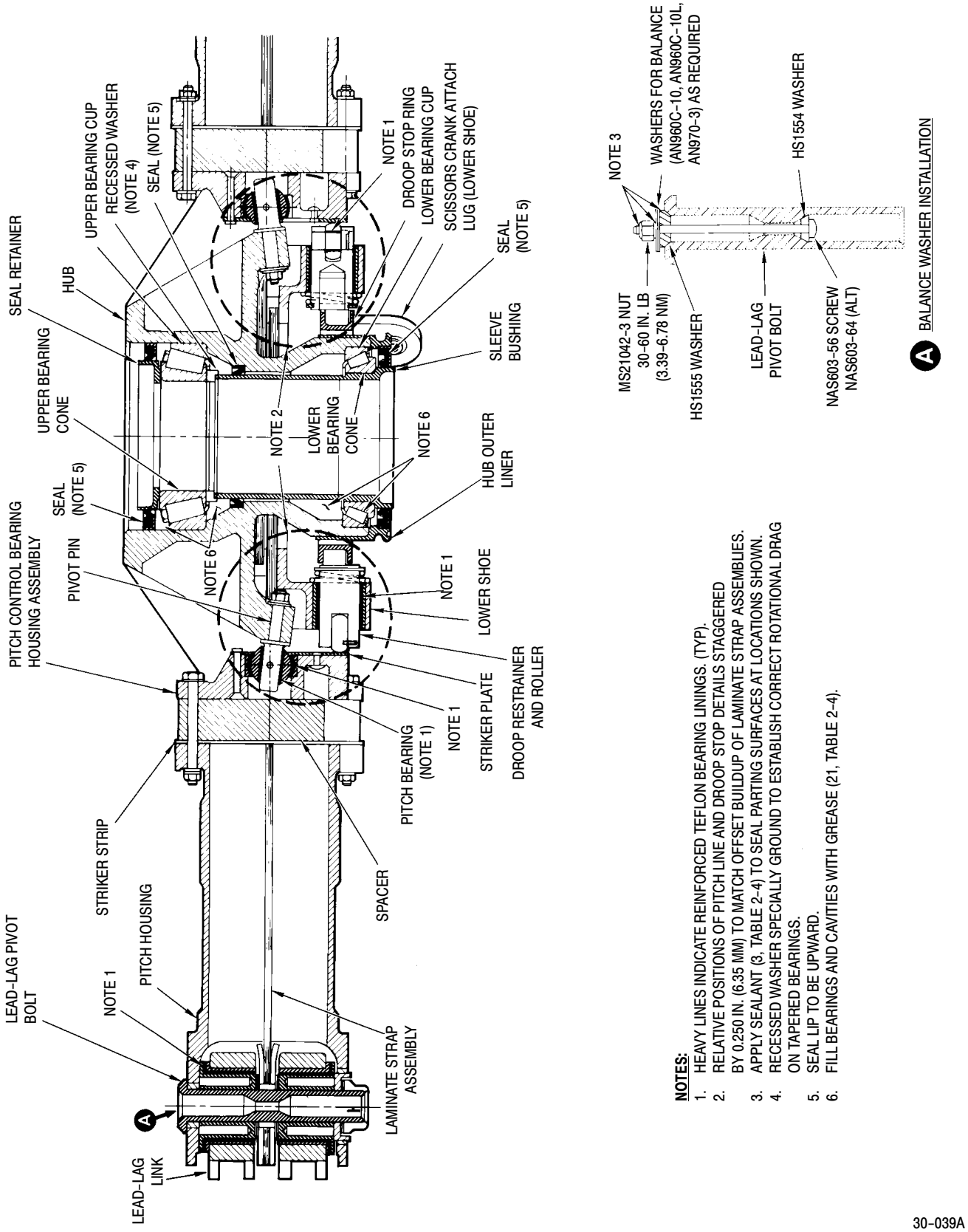


Figure 7-7. Main Rotor Hub - Cross Section

D. Balancing Procedure

Balance the main rotor according to instructions in the Tracking and Balancing Manual.

Since vibration reduction by weight adjustment depends on mechanical condition and functioning of the main rotor and the main rotor drive system, the troubleshooting information (Ref. Main Rotor and Control System Troubleshooting and Troubleshooting the Power Train System) should be used in conjunction with balancing kit instructions.

Acceptance criteria for balance and vibration are contained in the balancing kit (59, Table 2-2) and on each balancing chart. The charts are components of the balancing equipment.

Figure 7-7 shows how balancing hardware is installed and sealed at the lead-lag bolts.

Table 7-6 lists approved balancing hardware and gives the weight of each item.

The balancing charts indicate an option of adding or subtracting weight. Keep overall weight at a minimum always removing when possible.

Table 7-6. Main Rotor Balancing Hardware

Hardware	Unit Weight (Grams)
NAS603-56 Screw	11.10
NAS603-64 Screw	12.25
MS21042-3 Nut	1.90
AN960C10 Washer	0.63
AN960C10L Washer	0.32
AN970-3 Washer	4.33
HS1554 Washer	1.00
HS1555 Washer	2.80

9. Main Rotor Blade Replacement

(Ref. Figure 7-3)

A. Main Rotor Blade Removal

(1). Relieve load on blade attachment points by supporting main rotor blade from below.

(2). Identify blade attaching hardware and pins for location (grease pencil, tape, etc). Detach damper arm link from blade by removing cotter pin, nut, two washers and bolt. Or, if damper link attaching pin is used, unlock and remove pin. Remove the two blade fitting attaching pins.

(3). Using masking tape and/or grease pencil, mark each blade and its respective pitch housing links so that blades can be reinstalled in same relative positions.

B. Main Rotor Blade Installation

(1). Position main rotor blade in its (marked) pitch housing links. Install blade attaching pins.

NOTE:

- If new blade is to be installed, or if blades are not reinstalled in same positions from which removed or are installed on new rotor hub, blade attach pins must be adjusted. It is also necessary to track blades.
- Check that cutout (scalloped) area on inboard end of damper arm link is installed towards the damper (Ref. Figure 7-16). If incorrectly installed interference between the arm and damper can occur.

(2). Align damper arm link with fitting on main rotor blade; install damper attach pin or bolt to attach link to blade.

NOTE: Standard hardware may be used to replace damper attach pins. If used, install at all four locations, torque nuts to **30 - 60 inch-pounds (3.39 - 6.78 Nm)** and safety with cotter pin.

(3). Lock all attaching pins.

(4). Remove blade-to-pitch housing link match-markings.

10. Main Rotor Blade Inspection

(Ref. Figure 7-8 and Figure 7-9)

NOTE: MDHI Notice HN-8 requires additional inspections of a limited number of main rotor blades with specific serial numbers. These blades must be inspected for the possibility of unsatisfactory bonding of root fitting doublers which can impose a reduction in service life.

(1). Inspect skin for evidence of cracks and holes.

(a). Cracks or holes in blade skin surface, regardless of location, are cause for rejection of the blade. Scratches, dents, nicks and other surface defects in the blade skin are limited according to steps (2). and (3). below.

(b). Use a suitable dial indicator to check depth of blade dents and scratches.

CAUTION The repairable limit dimensions presented in the following procedure apply to surfaces that have not been repaired before. Be sure that material has not been removed from damaged areas before determining that the damage depth has not been exceeded. Refer all questionable surface damage, not covered by the following information, to MDHI as outlined in Section 2.

(2). Limitations for surface scratches, nicks, gouges and erosion in seven areas of the blade skin are described below. Scratches that do not penetrate the clad surface are acceptable without rework in all areas except areas 5 and 8.

AREA l: Minor scratches, nicks and gouges without skin penetrations are acceptable without repair. Skin deformation with holes is cause for replacement. Blade leading edge erosion may be repaired (Ref. Main Rotor Blade Repair) if the skin is not eroded through. If the leading edge skin is eroded through, no matter how slightly, the blade must be immediately replaced.

AREA 2: Scratches to 0.005 inch (0.127 mm) deep if oriented 0 to 30 degrees from spanline and to 0.003 inch (0.076 mm) deep if oriented between 30 and 90 degrees from spanline are acceptable without repair. Nicks and gouges not exceeding 0.003 inch (0.076 mm) in depth are acceptable without repair and to 0.005 inch (0.127 mm) with repair.

AREA 3: Scratches to 0.005 inch (0.127 mm) deep if oriented 0 to 30 degrees from spanline and to 0.003 inch (0.076 mm) deep if oriented between 30 and 40 degrees from spanline must be removed. No sharp nicks or gouges requiring more than 0.005 inch (0.127 mm) removal of skin surface are permissible.

AREA 4: Scratches to 0.003 inch (0.076 mm) deep if oriented 0 to 30 degrees and to 0.003 inch (0.076 mm) deep if oriented between 30 and 90 degrees from span-line must be removed. No sharp nicks or gouges requiring more than 0.003 inch (0.076 mm) removal of skin surface are permissible.

AREA 5: Scratches exceeding a depth of 0.001 inch (0.025 mm) are cause for rejection. Remove scratches to a depth of 0.001 inch (0.025 mm). The area inside of the outboard two root fitting bolt holes (includes both upper and lower surfaces) and including the skin surface adjacent to these bolt holes within a radius of l.00 inch (25.4 mm) from each hole must be free of scratches, nicks, or gouges as would be detected under 5X magnification (minimum).

AREA 6: Scratches to 0.005 inch deep and oriented 0 to 15 degrees from spanline are acceptable without repair. Scratches to 0.005 inch (0.127 mm) deep and oriented from 15 to 30 degrees from spanline must be removed. Scratches 0.003 inch (0.076 mm) deep and oriented from 15 to 30 degrees from spanwise are acceptable without repair. Scratches to 0.003 inch (0.076 mm) deep and oriented from 30 to 90 degrees from spanline must be repaired. Nicks and gouges not exceeding 0.005 inch (0.127 mm) depth must be repaired. All gouges, nicks, scratches and cracks on trailing edge not exceeding 0.030 inch (7.62 mm) depth must be smoothed and radiused out over 0.120 inch (3.048 mm) area on each side of damage. Defects beyond 0.030 inch (7.62 mm) depth are cause for rejection.

AREA 7: Scratches, nicks, or gouges up to 0.005 inch (0.127 mm) deep and detectable with 5X magnification are not acceptable without repair. Defects beyond 0.005 inch (0.127 mm) depth are cause for rejection. Gouges, nicks, scratches and cracks not exceeding 0.250 inch (6.35 mm) depth on trailing edge, except for AREA 8, must be

smoothed and radiused out to 0.250 inch (6.35 mm) area on each side of damage center. Defects beyond 0.250 inch (6.35 mm) depth are cause for rejection.

AREA 8: Check for gouges, nicks, scratches and cracks detected by using a bright light and 5X magnification at trailing edge corners where blade and tabs join. View area from different angles during inspection. Damage at this point not exceeding 0.030 inch (7.62 mm) depth must be smoothed and radiused out over a 0.120 inch (3.048 mm) area on each side of damage. Defects beyond 0.030 inch (7.62 mm) depth are cause for rejection.

(3). Depth limitations for surface dents or depressions in eight areas of blade skin are described below. A dent or depression is defined as a smooth depression or discontinuity with no sharp changes in section.

AREA A: Dents and depressions exceeding 0.015 inch (0.381 mm) without sharp changes in section to a maximum of 0.062 inch (1.5748 mm) must be repaired.

AREA B: Dents and depressions to a maximum of 0.010 inch (0.254 mm) are acceptable without repair. No repairs are permitted in this area.

AREA C: No repairs permitted.

AREA D: Dents and depressions exceeding 0.005 inch (0.127 mm) without sharp change in section to a maximum of 0.030 inch (0.762 mm) must be repaired.

AREA E: Dents and depressions exceeding 0.010 inch (0.254 mm) without sharp change in section to a maximum of 0.040 inch (1.016 mm) must be repaired.

AREA F: Dents and depressions exceeding 0.010 inch (0.254 mm) without sharp change in section to maximum of 0.040 inch (1.016 mm) must be repaired.

AREA G: No repairs permitted.

AREA H: Dents and depressions exceeding 0.010 inch (0.254 mm) without sharp change in section to maximum of 0.040 inch (1.016 mm) must be repaired.

AREA J: Dents and depressions exceeding 0.010 inch (0.254 mm) without sharp changes in section to a maximum of 0.040 inch (1.016 mm) must be repaired. Dents and depressions exceeding these limitations require blade replacement.

NOTE: MDHI Notice HN- 211 contains information relative to inspection of main rotor fittings and lead-lag link assemblies.

(4). Inspect surface areas of upper- and lower-root fittings (other than Area 5) for evidence of nicks, scratches, and wear spots.

(a). Nicks, scratches, and wear spots deeper than 0.010 inch (0.254 mm) in attachment lug area, and bolt hole area are not repairable.

(b). Damage 0.010 inch (0.254 mm) deep or less must be repaired.

(5). Inspect four attachment lug bushings in root fittings for security, and evidence of cracks or severe scoring.

(6). Inspect trailing edge bearing for binding, evidence of galling or scoring in bore and wear.

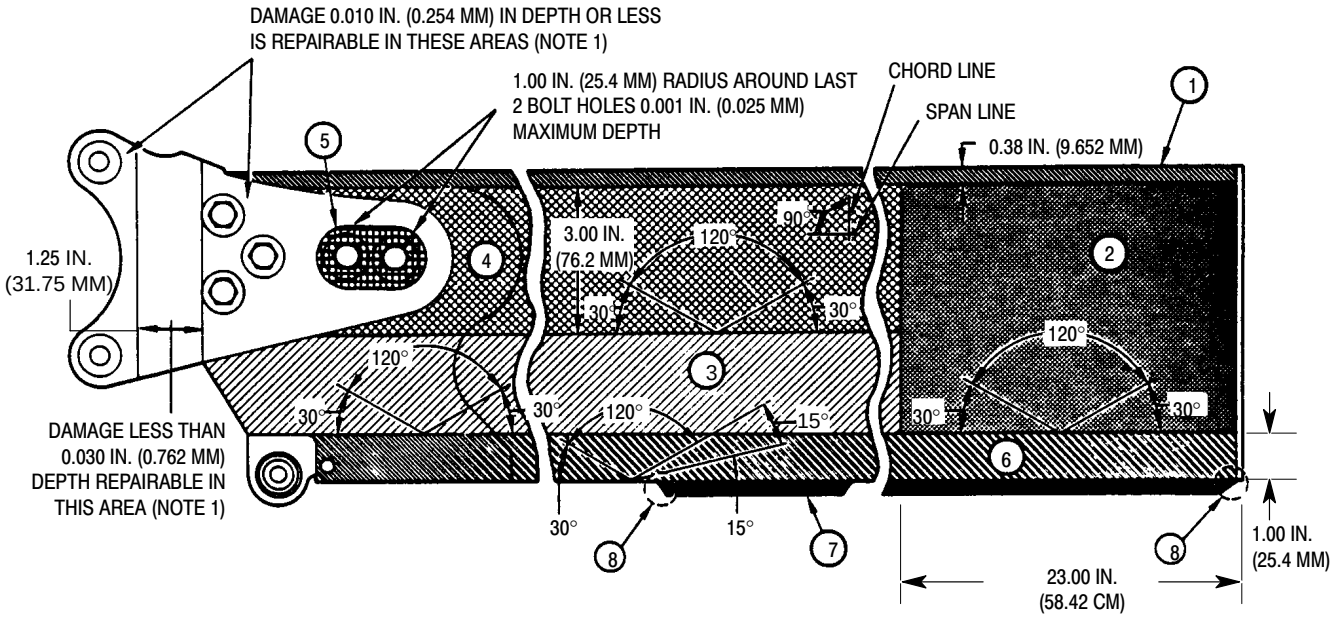
(a). No radial play is permissible.

(b). Maximum axial play is 0.015 inch (0.381 mm).

(7). Inspect all bonded areas for evidence of separation.

(a). If there appears to be separation of trailing edge bond, lightly probe joint with a 0.001-0.002 inch (0.025-0.051 mm) plastic inspection tool.

(b). If plastic inspection tool can be inserted to a depth of 0.50 inch (12.7 mm) or more, either above or below V insert, separation is evident.



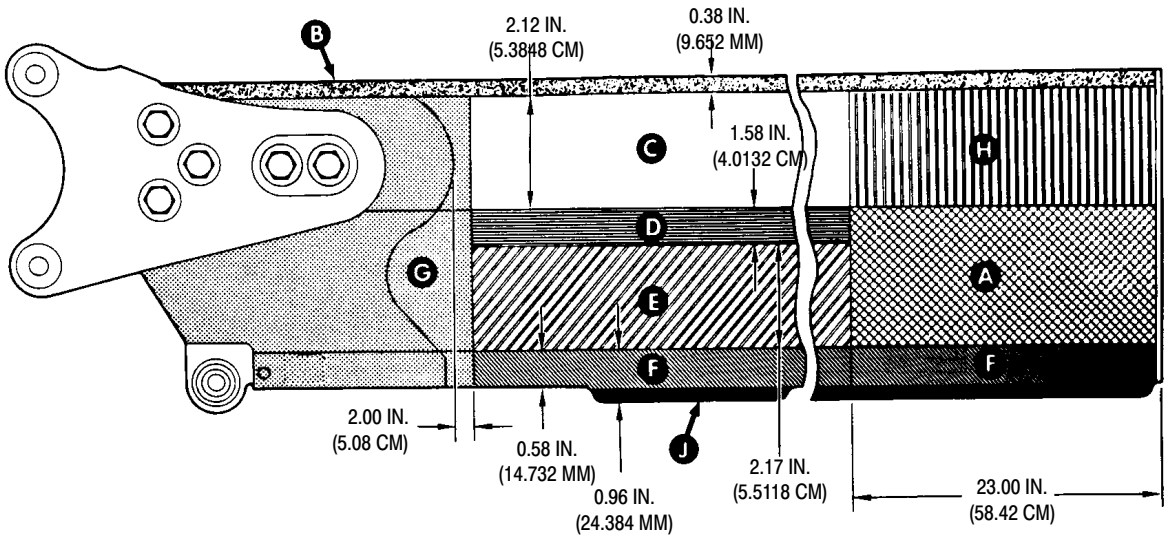
SCRATCHES				GOUGES AND NICKS		GOUGES, NICKS AND CRACKS TRAILING EDGE ONLY	
AREA	ORIENTATION FROM SPANLINE	MAX. DEPTH WITHOUT REPAIR	MAX. DEPTH WITH REPAIR	MAX. DEPTH WITHOUT REPAIR	MAX. DEPTH WITH REPAIR	MAX. DEPTH WITHOUT REPAIR	MAX. DEPTH WITH REPAIR
1	0°–90°	MINOR WITHOUT SKIN PENETRATION	MINOR WITHOUT SKIN PENETRATION	MINOR WITHOUT SKIN PENETRATION	MINOR WITHOUT SKIN PENETRATION	N/A	N/A
2	0°–30° 30°–90°	0.005 IN. (0.127 MM) 0.003 IN. (0.076 MM)	0.005 IN. (0.127 MM) 0.003 IN. (0.076 MM)	0.003 IN. (0.076 MM) 0.003 IN. (0.076 MM)	0.005 IN. (0.127 MM) 0.005 IN. (0.127 MM)		
3	0°–30° 30°–90°	NONE NONE	0.005 IN. (0.127 MM) 0.003 IN. (0.076 MM)	NONE NONE	0.005 IN. (0.127 MM) 0.005 IN. (0.127 MM)		
4	0°–30° 30°–90°	NONE NONE	0.003 IN. (0.076 MM) 0.002 IN. (0.051 MM)	NONE NONE	0.003 IN. (0.076 MM) 0.003 IN. (0.076 MM)		
5 NOTE 2	0°–90°	NONE	0.001 IN. (0.025 MM) (NOTE 3)	NONE	0.001 IN. (0.025 MM) (NOTE 3)		
6	0°–15° 15°–30° 30°–90°	0.005 IN. (0.127 MM) 0.003 IN. (0.076 MM) NONE	0.005 IN. (0.127 MM) 0.003 IN. (0.076 MM) NONE	NONE NONE NONE	0.005 IN. (0.127 MM) 0.005 IN. (0.127 MM) 0.005 IN. (0.127 MM)	NONE	0.030 IN. (0.762 MM) (NOTES 3, 5)
7	0°–90°	NONE	0.005 (NOTE 3)	NONE	0.005 IN. (0.127 MM) (NOTES 3, 6)	NONE	0.250 IN. (6.35 MM) (NOTES 3, 4, 6)
8 TAB END	NOT APPLICABLE					NONE	0.030 IN. (0.762 MM) (NOTES 3, 5, 6)

NOTES:

1. DAMAGE LIMITS APPLY TO BOTH UPPER AND LOWER ROOT FITTING SURFACES.
2. INSPECTION UNDER 5X MAGNIFICATION (MIN.) REQUIRED.
3. AREAS NOTED: 0.25 SMOTHERED AND RADIUSED CLEANOUT ALLOWED.
4. SMOOTHED AND RADIUSED CLEANOUT OVER 0.12 IN. (3.048 MM) AREA ON EACH SIDE OF DAMAGE.
5. REFER TO TRIM TAB DAMAGE REPAIR.

G62-1001A

Figure 7-8. Main Rotor Blade Damage and Repair Limits for Nicks, Scratches, Gouges and Cracks



DENTS AND DEPRESSIONS (NOTE)					
AREA	MAXIMUM DEPTH WITHOUT REPAIR	MAXIMUM DEPTH WITH REPAIR	MAXIMUM ALLOWED AREA	MAXIMUM NUMBER OF DEFECTS	MINIMUM DISTANCE BETWEEN DEFECT CENTERS
A	0.015 IN. (0.381 MM)	0.062 IN. (1.5748 MM)	1.5 X 1.5 IN. (3.81 X 3.81 CM)	1	N/A
B	0.010 IN. (0.254 MM)	0.000	0.25 X 0.25 IN. (6.35 X 6.35 MM)	2	18 IN. (45.72 CM)
C	0.000	0.000	0.000	NONE ALLOWED	N/A
D	0.005 IN. (0.127 MM)	0.030 IN. (0.762 MM)	1.5 X 1.5 IN. (3.81 X 3.81 CM)	2	18 IN. (45.72 CM)
E	0.010 IN. (0.254 MM)	0.040 IN. (1.016 MM)	1.5 X 1.5 IN. (3.81 X 3.81 CM)	2	18 IN. (45.72 CM)
F	0.010 IN. (0.254 MM)	0.040 IN. (1.016 MM)	1.5 X 1.5 IN. (3.81 X 3.81 CM)	3	18 IN. (45.72 CM)
G	0.000	0.000	0.000	NONE ALLOWED	N/A
H	0.010 IN. (0.254 MM)	0.040 IN. (1.016 MM)	1.5 X 1.5 IN. (3.81 X 3.81 CM)	1	N/A
J	0.010 IN. (0.254 MM)	0.35 IN. (8.89 MM) (NOTE 3)	1.5 X 1.5 IN. (3.81 X 3.81 CM)	N/A	N/A

NOTES:
1. N/A – NOT APPLICABLE.
2. REFER TO TRIM TAB DAMAGE REPAIR.

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Figure 7-9. Main Rotor Blade Damage and Repair Limits for Dents and Depressions

NOTE: Trailing edge structural bond line to V insert starts 0.250 inch (6.35 mm) in (chordwise) from trailing edge joint: therefore the above tolerance allows 0.250 inch (6.35 mm) separation. Be sure measurement is taken from the trailing edge joint, not the tab trailing edge. Maximum trailing edge joint gap allowed during fabrication is 0.080 inch (2.032 mm).

(8). Inspect doubler shown in area G for bonding voids between doubler and blade skin top and bottom.

(a). Use a heavy coin and lightly tap doubler surface.

(b). A void will appear as a distinct change in sound.

NOTE: Tapping sound will differ slightly due to blade structure in leading and trailing edge, internal channel and doubler areas.

(9). Ensure that vent holes are open.

NOTE: Two or three vent holes are located in the lower blade skin 5.50 inches (13.97 cm) aft of the leading edge with the first hole 7.50 inches (19.05 cm) inboard from the tip.

(10). Inspect the fasteners that secure upper and lower root fittings, and the six rivets that secure skin to spar near tip, for security.

(11). Inspect forward tip cap screw insert for security and thread damage.

(12). When continuous one-per-revolution lateral vibration occurs, inspect forward and aft balance weights for security (Ref. Figure 7-3).

(a). Weights are normally recessed 0.050 inch (1.270 mm) below the end surface of the weight assembly tip.

(b). Security of the weights may be checked by using a torque wrench with a screwdriver socket in the slot of the weight to detect if the weight can be rotated by less than **20 inch-pounds (2.26 Nm)**.

(c). If a torque wrench is not available, check weight security by fitting a small coin in the slots and applying the maximum force that can be exerted by ONLY the index finger and thumb.

(13). Inspect vibration absorber pad on underside of blade for security.

(14). Inspect vibration absorber for security of installation on blade.

(15). Ensure both pendulums swing freely and no more than 0.015 inch (0.381 mm) radial play exists between the pendulums and the hinge pins.

(a). Maximum allowable axial play between pendulums and bracket is 0.085 inch (2.159 mm).

(16). Inspect all parts of the vibration absorber for cracks and breaks.

(17). Inspect pad on bracket below pivot end of largest pendulum for security.

(18). Inspect thrust washers bonded to the bracket, to the 5-per-revolution pendulum, and to the 3-per-revolution pendulum for evidence of damaged Teflon surfaces, wear and failure of bond.

11. Main Rotor Blade Repair

A. Nicks, Scratches and Wear Spots

(Ref. Figure 7-8)

(1). Using abrasive paper (9, Table 2-4), no coarser than grade 320, remove nicks, scratches and wear spots from upper and lower root fittings, and from blade skin.

(2). Use finer grade of paper, as necessary to restore surface roughness to original finish.

(3). Remove material in such a manner that no abrupt changes occur in surface contours.

(4). Apply chemical film surface treatment to repaired surface (Ref. Sec. 2).

B. Dents, Depressions and Erosion

(Ref. Figure 7-9)

CAUTION Repair only those damaged areas that are within repairable limits.

(1). Use paint remover (11, Table 2-4) to remove paint from surface area to be repaired.

(2). Wipe away all residue with clean cloth dampened by solvent (1). Allow to dry for minimum of 15 minutes.

(3). Mask edges of repair areas with one layer of tape (93).

CAUTION Do not cut tape after it is applied to blade.

(4). Mix filler (94), three parts “A” and two parts “B” by weight. Mix thoroughly until mixture is dark red in color. An alternate filler (95) may be used if equal parts “A” and “B” by weight are mixed.

(5). Allow filler to cure for minimum of 24 hours at room temperature.

(6). Smooth filler area with grade 400 abrasive paper (9). Limit smoothing to masked area.

(7). Remove the tape and inspect alclad coating of area around repair. Penetration of coating is cause for blade replacement.

(8). Clean repaired area with a cloth dampened by solvent (58).

(9). Apply chemical film treatment to repaired surface.

C. Forward Tip Cap Insert

Replace a loose or stripped insert. Use self-locking insert NAS1394 of correct size for replacement and install with wet primer (4, Table 2-4) (Comply with replacement requirements of applicable NAS standard).

D. Loose Balance Weights

Reinstall loose forward and aft balance weights as follows:

(1). Unscrew loose weight until it projects approximately one-half inch and remove old accumulation of powdered compound.

(2). Apply grade A locking compound (29) and screw the weight back into the blade until slotted end of the weight is recessed 0.050 inch (1.27 mm) below the surface of the weight assembly tip. Wipe off excess compound.

CAUTION Allow to cure for a minimum of 12 hours. If faster cure is desired, complete cure can be obtained by allowing part to set for 30 minutes at room temperature and then heating for 30 minutes at approximately 212°F (100°C).

(3). If locking compound is not available, screw weight into normal position and centerpunch the end of the weight into the mating threads at three evenly spaced points to prevent rotation.

E. Loose or Missing Rivets or Aft Tip Cap

Replace all loose or missing rivets. Reinstall or replace loose or missing aft tip cap as follows:

NOTE: Spare tip caps are supplied with the bonding surface pretreated (coated) with a nylon primer to facilitate installation.

(1). Lightly abrade primed surfaces of the tip cap with grade 180 abrasive paper (9, Table 2-4).

(2). Wipe away residue with cloth dampened in solvent (1) and allow tip cap to dry at room temperature for 30 minutes.

(3). Mix two-part bonding adhesive (19) in equal proportions by weight.

(4). Apply bonding adhesive previously prepared tip cap and mating surfaces at rotor blade tip. To extent possible, be sure that there are no adhesive voids.

(5). Install tip cap in blade tip, apply uniform clamping pressure to the joint, and wipe away excess adhesive. Allow adhesive to cure for 8 hours at room temperature or 2 hours at 150°F (66°C).

(6). Install two MS20604AD3C2 blind rivets, one through each side of the blade tip and tip cap (Ref. Figure 7-3).

(7). Check other blades of rotor for tip cap security. Rebond if necessary and add rivets to the other tip caps in the same manner.

NOTE: Main rotor balance will not be affected.

F. Vibration Absorber

(Ref. Vibration Absorber Repair)

12. Leading Edge Erosion Protection

Blades subjected to operation in a highly abrasive environment should have the outer 12-36 inches (30-91 cm) of each blade leading edge covered equally by protective tape so that blade life will not be reduced by excessive erosion.

NOTE: Cement and tape must be applied to a thoroughly clean surface with no rough paint edges. Work out trapped air bubbles during application and allow 2 hours for tape to set.

(1). Thoroughly wash the blade leading edge with clean cloths dampened with MEK (22, Table 2-4). Allow to air dry at least 15 minutes.

(2). Mask around the outside of the area to be taped leaving a 0.250 inch (6.35 mm) gap.

(3). Apply a uniform brush coat of cement (120). Allow to air dry for 5 to 10 minutes.

(4). Remove backing from 3 inch (7.62 cm) width by 0.014 inch (0.3556 mm) thick tape (42), and apply along the leading edge so that tape overlap over bottom and top of leading edge is equal.

(5). Roll out any air trapped under the tape with a cylindrical object.

(6). Remove masking tape; then carefully remove cement residue using MEK.

(7). Replace the tape when it becomes abraded. Operation in rain reduces tape life and more frequent replacement will be necessary.

NOTE: The use of abrasion tape will not affect flight characteristics or vibration levels; however, with 36 inches (91 cm) of tape applied there is a 3 to 4 hp loss in rotor power.

13. Bearing Replacement - Damper Attach, Blade Fitting

(Ref. Figure 7-10)

(1). Use fly or circle cutter with 5/16 inch (0.3125 mm) pilot to remove staked lip from one side of bearing without removing any material from fitting.

CAUTION If fitting is damaged by cutter, blade must be replaced.

(2). Use an arbor press to press bearing from fitting.

(3). Clean primer residue from fitting bore with MEK (22, Table 2-4). Remove locking compound residue (if any) with locking compound remover (33).

(4). Using 10 power magnifying glass, inspect fitting bore for cracks. No cracks are permitted.

(5). Measure fitting bore diameter. Acceptable limits are 0.7488-0.7493 inch (19.0195-19.0322 mm).

(6). Apply thin coat of primer (4) to fitting bore.

(7). Press bearing into fitting with arbor press and fixture (61, Table 2-2). Wipe away excess primer.

(8). Stake bearing at both sides of fitting with staking tool (62) in hydraulic press with **6000 - 8000 pounds (26689 - 35586 N)** of force.

(a). When staked, outer race of bearing shall be flush to not more than 0.010 inch (0.254 mm) above fitting surface (both sides).

(b). Gap between staked lip of bearing race and chamfered surface of fitting bore shall not exceed 0.005 inch (0.127 mm) as checked with feeler gage.

(c). Staking operation shall produce no cracks in fitting or bearing.

(9). Fill staking gap (if any) with primer (4, Table 2-4).

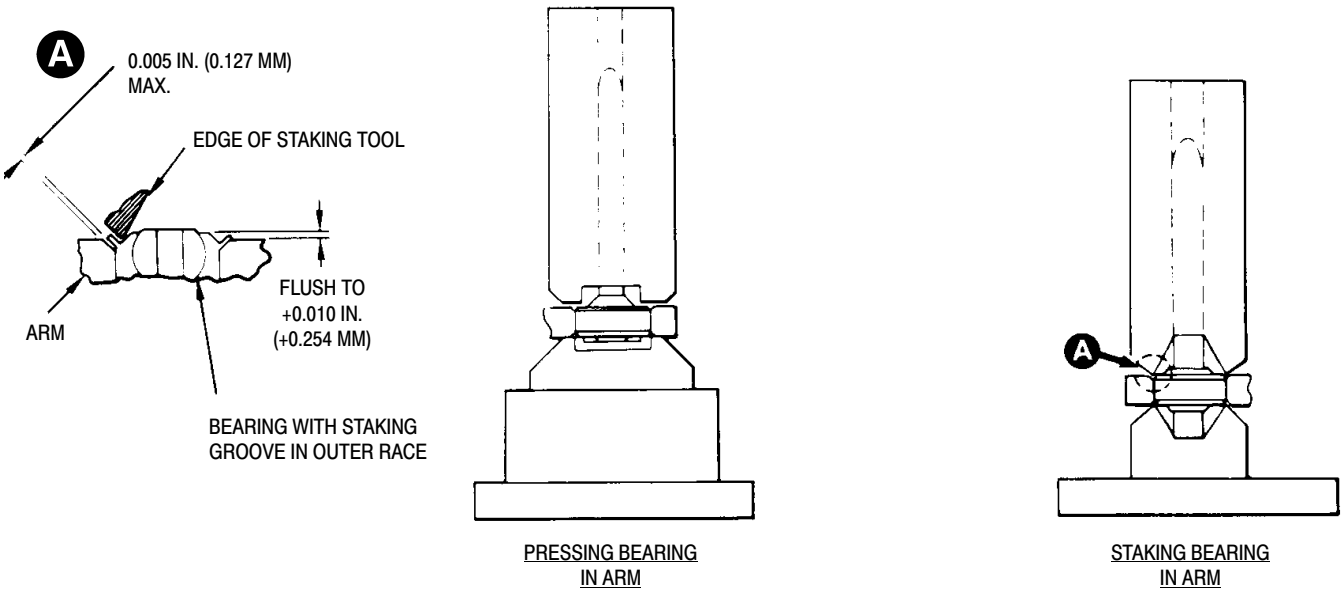


Figure 7-10. Bearing Replacement - Main Rotor Blade Attach Fitting Repair

14. Repair of Trim Tab and Trailing Edge (369A1100 Series)

(Ref. Figure 7-11) The following procedures provide broad cleanup of a damaged trim area, which distributes stresses over a larger area to preclude cracking and permit continued use of the rotor blade.

No minimum length of trim tab is required. The entire trim tab or portion of the trim tab may be removed.

Main rotor blades with and without trim tabs are 100% interchangeable, individually and in ship sets.

(1). Inspect trim tab area of main rotor blade and repair tab area, as required.

NOTE: If damage to trim tab area exceeds limitations (Ref. Figure 7-9), perform the following:

(2). As applicable, remove main rotor blade.

CAUTION Provide protective surface and/or covering to prevent scratching, nicking or other damage to blade during rework. Position blade on work bench or equivalent.

(3). Wipe away dirt on and around trim tab area with clean cloth dampened with dry cleaning solvent.

(4). Mask edges of blade area around trim tab area with tape; DO NOT cut tape after it has been applied to blade.

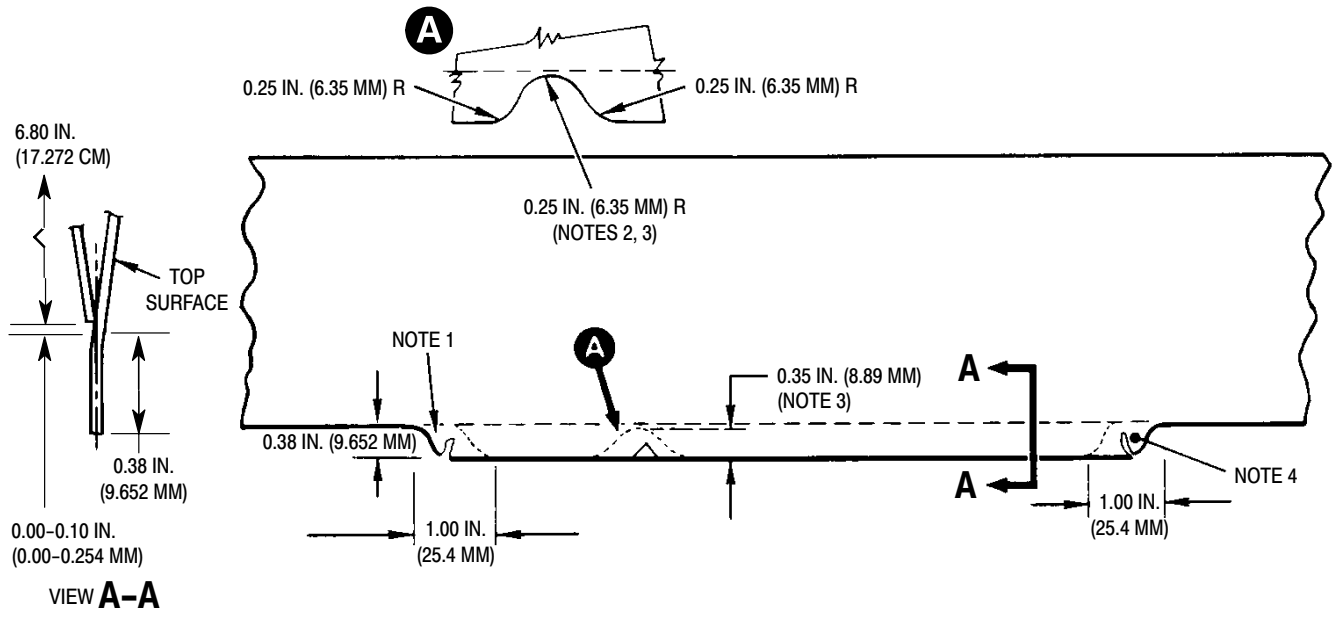
(5). Remove damaged area of trimtab by making V-type cut with 45° sides joined by a 0.250 inch (6.35 mm) radius at the bottom of the V. Blend into trailing edge of the blade with a 0.250 inch (6.35 mm) radius as shown.

NOTE: Maximum V cut depth is 0.350 inch (8.89 mm); do NOT cut past trim tab area into portion of blade.

(6). If damage occurs within 1 inch (25.4 mm) of either or both ends of trim tab, remove tab end(s) and restore contour as shown.

(7). If excessive damage requires full or partial removal of trim tab from blade, perform the following (no minimum length of trim tab is required):

(a). Position blade on workbench so that a firm straight edge is provided for cutting or filing off trim tab.



NOTES:
1. REMOVE DAMAGED END(S) IF THEY OCCUR WITHIN 1.00 IN. (25.4 MM) OF TAB ENDS.
2. 0.25 IN. (6.35 MM) RADIUS CLEANUP. FINISH PER BASIC HMI.
3. MAXIMUM DEPTH OF REPAIR 0.35 IN. (8.89 MM).
4. NO MINIMUM LENGTH OF TAB REQUIRED. IF DAMAGE OCCURS AT BOTH ENDS. IT IS PERMISSIBLE TO REMOVE BOTH ENDS.
5. ENTIRE TAB MAY BE REMOVED IF REQUIRED.

30–217A

Figure 7-11. Repair and Removal of Trim Tab, Main Rotor Blade

CAUTION Cutting, grinding or filing to remove trim tab, and deburring of reworked blade trailing edge, are to be performed in a spanwise direction only. DO NOT use shears or clippers to remove trim tab.

(b). Use metal cutting saw or equivalent to remove the 0.380 inch (9.652 mm) wide trim tab, view A - A Deburr edges in a spanwise direction only.

(8). Peel and remove tape from blade and inspect area around repair; clean repaired area with cloth dampened in solvent (aliphatic naphtha).

(9). Apply chemical film treatment (Iridite) to reworked area of blade trailing edge or trim tab; apply a thin film of primer and paint lightly.

(10). As applicable, reinstall main rotor blade.

15. Main Rotor Blade and Damper Attach Pin Inspection and Corrosion Protection

(Ref. Figure 7-12)

(1). Inspect pin cam handle lobe for cracks and excessive wear. Remove pin from service if cracking or excessive wear is noted.

NOTE: If hard anodizing surface of cam lobes is worn, cam lobes can be re- anodized or treated with corrosion preventive oil (104, Table 2-4).

(2). Inspect attach pin for evidence of corrosion or wear and straightness.

(a). Pay particular attention to area along edges of barrel nut and bore in cam handle.

(b). Remove pin from service if corrosion or wear is noted or pin is bent. Standard hardware (Ref. Figure 7-3) may be used to replace faulty damper attach pins.

(c). If used, install at all four locations.

NOTE: Corrosion protection treatment is to be applied at each periodic inspection to ensure continued serviceability of attach pin; and at each pin removal, if subject to salt laden atmosphere.

(3). With attach pin removed, lubricate mating surfaces of barrel nut and cam handle, using corrosion preventive oil. Rotate cam handle back and forth on barrel nut several times to ensure that oil penetrates all sections of pin operating mechanism. Wipe excess oil from pin surfaces.

(4). Adjust pin at installation.

16. Main Rotor Blade and Damper Attach Pin Disassembly and Special Inspection

(Ref. Figure 7-12) This inspection is to be performed in event of a main rotor blade strike.

CAUTION Do not intermix bushings, spacers and thrust washers between bolts. Components parts make up a single bolt assembly.

(1). Remove adjusting nut and remove adjustable bushings, spacer and thrust washers from pin.

(2). Using brush and clean cloth, clean parts with isopropyl alcohol (71, Table 2-4). Dry with clean cloth.

(3). Inspect pins as follows:

(a). Fluorescent inspect pin per MIL-STD-6866.

(b). Magnetic particle inspection; thrust washers, bushings and spacers per MIL-STD-1949.

(4). Reassemble pin in sequence as follows; install thrust washer, three (3) adjustable bushings, spacer, three (3) adjustable bushings, spacer, three (3) adjustable bushings, thrust washer and secure with adjusting nut.

(5). Lubricate mating surfaces of barrel nut and cam handle with corrosion preventive oil (104).

(6). Reinstall and adjust pin.

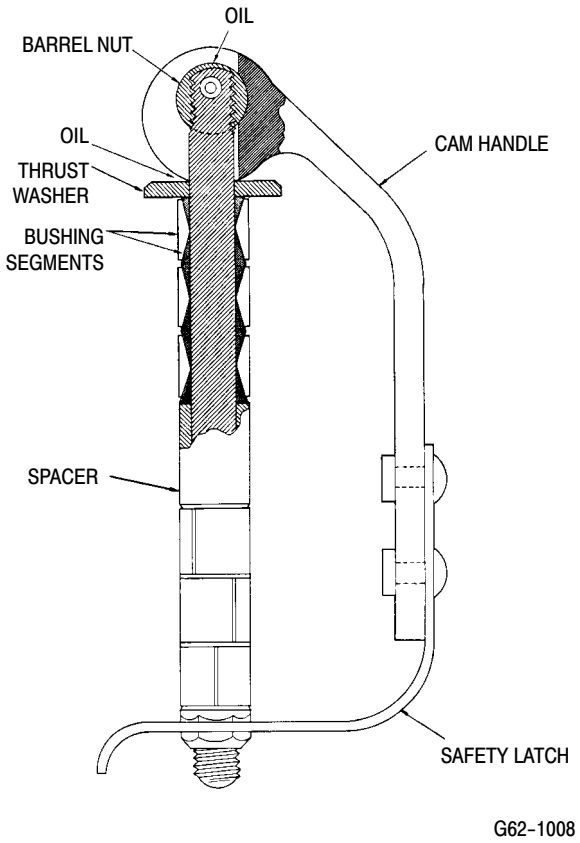


Figure 7-12. Main Rotor Blade and Damper Attach Pin

17. Main Rotor Blade and Damper Attach Pin Adjustment

(Ref. Figure 7-3)

NOTE: Whenever a new attach pin is installed, a main rotor blade is replaced, or the rotor hub assembly is replaced, adjustment is required to ensure that the pin(s) properly seize in the mating holes.

(1). Check the main rotor blade and damper arm attach pins for cracks, wear and corrosion.

(2). Support the blade tip to establish alignment of the holes in the blade root fittings and lead-lag links; Install pin.

NOTE: After final adjustment of main rotor blade and damper attach pins, thread protrusion from adjuster nut of 1/2 to 1 thread is acceptable if attach pin safety latch is securely latched over the adjuster nut.

(3). Adjust the pin for correct seizure by turning the small hex nut at end of pin until **25 - 35 pounds (111 - 156 N)**

hand pressure is required to snap the safety latch into place over the nut.

NOTE: After adjustment, the installed length of the pins, measured from the face of the thrust washer to the outer edge of last bushing, should be 0.99- 1.04 inch (25.146- 26.416 mm) for damper pins and 2.84- 2.89 inches (72.136- 73.406 mm) for main rotor blade pins.

(4). For final installation, the locking levers of the two blade root fitting pins should be located inboard of (behind) the stop springs of the pitch housing lead-lag links.

18. Main Rotor Blade Forward Tip Cap Inspection and Corrosion Prevention

(1). Inspect tip caps for evidence of corrosion, pay particular attention to mating area of blade skin to tip weight interface, verify integrity of sealant coating.

(2). If damage is evident, remove tip caps and apply penetrating oil to blade tip weight area. The oil will arrests any corrosion between blade skin and weight assembly.

(3). Using brush and clean cloth, clean area with isopropyl alcohol (71, Table 2-4). Dry with clean cloth.

(4). Spray area with light film of rust inhibitor (101); then apply thin film of primer and paint lightly as required.

19. Main Rotor Blade Upper and Lower Root Fitting Attach Lug and Lead-Lag Link Inspection (25 Hour)

(Ref. Figure 7-13 and Figure 7-14) The following procedure pertains to helicopters equipped with 369A1100-501 thru -505 main rotor blades and/or 369A1234, 369H1203-BSC thru -31 lead-lag link assemblies.

NOTE: Main rotor blades and hub assemblies installed on helicopters operating in a salt water or corrosive environment should be cleaned and washed on a daily basis as a preventative measure to arrest corrosion (Ref. Sec. 2, Main Rotor Hub Corrosion Prevention (Tri-Flow Wash Procedures)).

(1). Visually inspect exposed portion of all installed main rotor blade upper and lower root fitting attach lugs, and main rotor hub lead-lag link attach lugs for broken or cracked lugs, corrosion or other damage to the lug areas.

NOTE: If movement is suspected but cannot be verified with the blades installed, remove those blades and inspect bushings for movement.

(2). Using a bright light, inspect slippage marks on the root fitting bushings to ensure there has been no movement of the bushings.

(a). If bushings have moved, replace main rotor blade before next flight.

(b). Return those main rotor blades where bushing movement has occurred to MDHI for possible rework.

CAUTION

- If broken or cracked lugs are noted in main rotor blade upper or lower root fittings, replace main rotor blade before further flight.
- If broken or cracked lugs are noted in main rotor lead-lag links, replace main rotor hub.
- If cracking is suspected in either the rotor blade or hub lead- lag link attach lugs, perform dye penetrant (178, Table 2-4) inspection of lugs per MIL- I- 25135. If cracking is noted, replace main rotor blade, or, replace or repair main rotor hub assembly, before further flight.

NOTE: Lead-Lag link assemblies may only be replaced by MDHI authorized personnel or under MDHI supervision. Contact your local MDHI Field Service Representative for further information.

20. Main Rotor Blade Upper and Lower Root Fitting, Attach Lug and Lead-Lag Link Inspection (100 Hour)

(Ref. Figure 7-13 and Figure 7-14) The following procedure pertains to helicopters equipped with 369A1100-501 thru -511 and 369D21123-501 main rotor blades and/or 369A1234, 369H1203-BSC thru -31 lead-lag link assemblies.

(1). Remove affected main rotor blades.

CAUTION

- If broken or cracked lugs are noted in main rotor blade upper or lower root fittings, replace main rotor blade before further flight.
- If broken or cracked lugs are noted in main rotor lead-lag links, replace main rotor hub.
- If cracking is suspected in either the rotor blade or hub lead- lag link attach lugs, perform dye penetrant (178, Table 2-4) inspection of lugs per MIL- I- 25135. If cracking is noted, replace main rotor blade, or, replace or repair main rotor hub assembly, before further flight.

NOTE: Do not remove bushings or corrosion inhibiting sealer.

(2). Using a bright light and 5X magnifying glass, visually inspect the attach lugs of all main rotor blade upper and lower root fitting and main rotor lead-lag links for broken or cracked lugs, corrosion or other damage to the lug areas.

(a). Pay particular attention to area around attach pin hole bushings in the lugs.

(b). Pay particular attention to the cross-hatched areas.

(c). If slippage marks have already been applied, inspect the root fitting for any indication of movement of the bushings; no movement is allowed.

(d). Return main rotor blades that have root fitting bushing movement to MDHI for possible rework.

(e). If slippage mark is degraded, reapply per steps (6). and (8).

(3). Inspect main rotor blade root fitting for missing (no squeeze-out) or cracked adhesive/paint around the periphery of the root fitting. If this condition exists, proceed as follows:

(a). Loosen, but do not remove the extreme outboard bolt.

(b). Insert a 0.004 inch (0.102 mm) thick piece of mylar/viewfoil between the fitting and the doubler.

(c). If the mylar can be inserted, contact Field Service Representative for disposition of blade.

(d). If the insertion is 0.10 inch (2.540 mm) or greater, remove blade from service.

NOTE: Measurement of the insertion is from the edge of the root fitting.

(e). Retorque root fitting outboard bolt to **60 - 65 inch-pounds (6.78 - 7.34 Nm) plus drag torque**.

NOTE: Lead-Lag link assemblies may only be replaced by MDHI authorized personnel or under MDHI supervision. Contact your local Field Service Representative for further information.

(4). Inspect lead-lag link blade attach pin hole bushings for any indication of movement of the bushings in the links. If any of the bushings have movement, replace the link.

CAUTION If required, apply a light but thorough coat of sealer or zinc-chromate primer around bushings. Note that excessive amounts of sealant or zinc-chromate primer around the bushings are not desirable and can unbalance the main rotor system.

(5). If sealing compound (171) is not already installed or becomes loose, clean and seal all junctions between all the steel bushings and the main rotor blade root fitting attach lugs with a film of sealing compound or primer (4) without removing the bushings.

(6). For the main rotor blade root fitting attach lugs, carefully remove sufficient amount of sealant and paint from only the bushing in the area where the slippage mark is to be applied (if not already done).

(7). Using isopropyl alcohol (71), clean the area where the slippage mark is going to be applied to allow adequate adherence of epoxy paint.

NOTE:

- Locate slippage mark in a position that can be viewed at subsequent inspections with main rotor blade installed in the hub. Slippage marks should not be applied to cross-hatched areas to preclude masking possible cracks.
- Insure that slippage mark is applied to bushing at upper and lower root fitting inside surfaces.
- Do not use torque seal.

(8). Apply epoxy paint slippage marks to four locations as shown.

(9). Install main rotor blades.

21. Main Rotor Blade Leading Edge Abrasion Strip Check

The leading edge abrasion strip should be checked prior to each flight or on every daily check. The following is a comprehensive checklist:

(1). Check for any blistering, bubbling or lifting of the abrasion strip; this indicates a void.

(a). Voids cannot be closer than 0.50 inch (12.7 mm) to any outside edge of abrasion strip.

(b). Voids exceeding 1.5 square inch (9.6774 square cm) are unacceptable.

(c). Voids cannot be closer than one inch (25.4 mm) to any other void.

(2). Number of acceptable voids depends upon length of abrasion strip.

(a). There cannot be more than three voids on either the top or bottom of the 36 inch long (91 cm) abrasion strip surface.

(b). There cannot be more than two voids on either the top or bottom of the 18 inch (46 cm) long abrasion strip surface.

(3). Record all voids in regards to size and location in the helicopter log book and check each void prior to each flight for growth and acceptable criteria.

22. Main Rotor Blade Torque Event Inspection

(Ref. Figure 7-13)

NOTE: This inspection requires the use of a bright light.

(1). Lifting from the outboard end of the blade, lift blade off the droop stop.

(2). Inspect the bottom-side of the blade as follows:

(a). Inspect the area around the root fitting, doubler and skin for cracks.

(b). Inspect the attach lugs at the bushings for cracks.

(c). Inspect the entire length of the blade for cracks.

(d). Lower blade back onto droop stop.

(3). With blade resting on the droop stop, inspect the top-side of the blade as follows:

(a). Inspect the area around the root fitting, doubler and skin for cracks.

(b). Inspect the attach lugs at the bushings for cracks.

(c). Inspect the entire length of the blade for cracks.

(4). If any of the above defects are found, the main rotor blade is to be rejected and scrapped.

23. Vibration Absorber

(Ref. Figure 7-15) One vibration absorber is installed on the lower inboard end of each main rotor blade. Each vibration absorber consists of two pendulums that pivot about a common axis. These pendulums are tuned to cancel out the first and second harmonic beats of the natural vibration frequency of each individual blade. The largest pendulum counteracts any 3-per-revolution vibrations; the smallest pendulum counteracts any 5-per-revolution vibrations.

A. Vibration Absorber Removal

(1). Remove bolt and washer at trailing edge of blade; remove shim washer(s) if installed.

NOTE: Shim washers are installed between vibration absorber and main rotor blade as required to compensate for minor variations in blade contour.

(2). Remove two nuts, radius blocks, washers and bolts that attach absorber to blade.

(3). Remove vibration absorber.

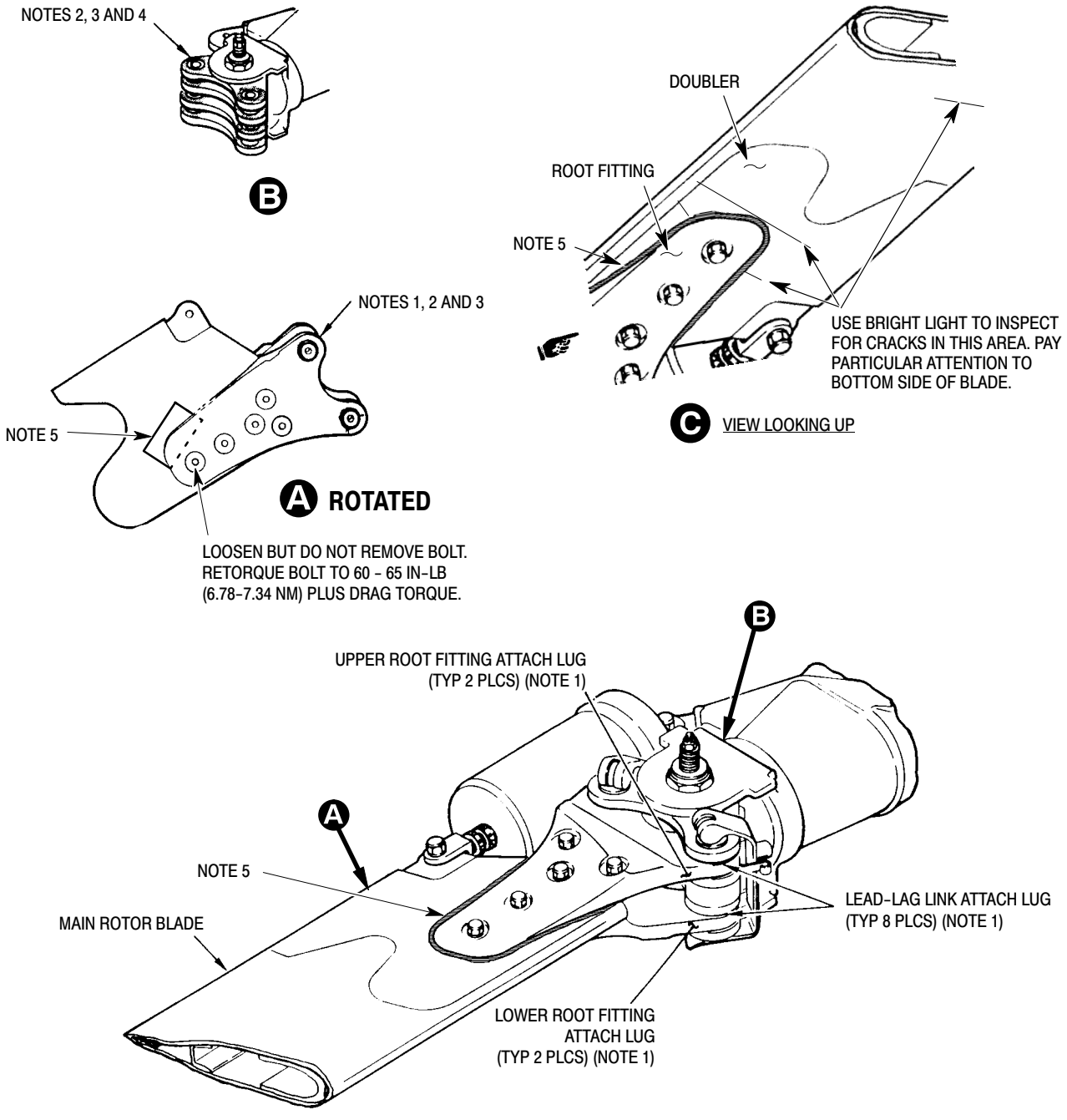
B. Vibration Absorber Installation

(1). Apply primer (4, Table 2-4) on the two long bolts.

(2). Align vibration absorber with holes in main rotor blade. Install two long bolts and washers while primer is still wet; then install radius block nuts. Check that the shorter of the bolts is in the outboard hole. Torque bolts to **50 - 60 inch-pounds (5.65 - 6.78 Nm)**.

(3). If a gap exists between the trailing edge of vibration absorber and main rotor blade, shim with washers. If no gap exists, install trailing edge bolt and washer without shim washers. Apply chromate primer to bolt and install bolt and washer while primer is still wet.

(4). Torque bolt to **15 - 20 inch-pounds (1.69 - 2.26 Nm)**.



NOTES:

1. VISUALLY INSPECT AREAS OF ALL ROOT FITTINGS AND LEAD-LAG ATTACH LUGS FOR CRACKS OR BREAKS. INSPECT BLADE ATTACH BUSHINGS FOR LOOSENESS. IF LOOSE, REPLACE LEAD-LAG LINKS.
2. PAY PARTICULAR ATTENTION TO AREA AROUND ATTACH PIN HOLES IN LUGS.
3. SEAL ALL JUNCTIONS BETWEEN BUSHINGS AND ATTACH LUGS WITH SEALER OR PRIMER (4, TABLE 2-4).
4. LEAD-LAG LINK ASSEMBLIES ARE SUB-ASSEMBLIES OF THE MAIN ROTOR HUB ASSEMBLY.
5. INSPECT MAIN ROTOR BLADE UPPER AND LOWER ROOT FITTING FOR MISSING OR CRACKED ADHESIVE.
6. USING BRIGHT LIGHT, INSPECT MAIN ROTOR BLADE DOUBLER FOR CRACKS. PAY PARTICULAR ATTENTION TO BOTTOM SIDE OF BLADE, JUST BEYOND ROOT FITTING AND IN LINE WITH ROOT FITTING ATTACH BOLTS.

88-347F

Figure 7-13. Main Rotor Blade Root Fitting Attach Lugs and Lead-Lag Link Assembly Inspection

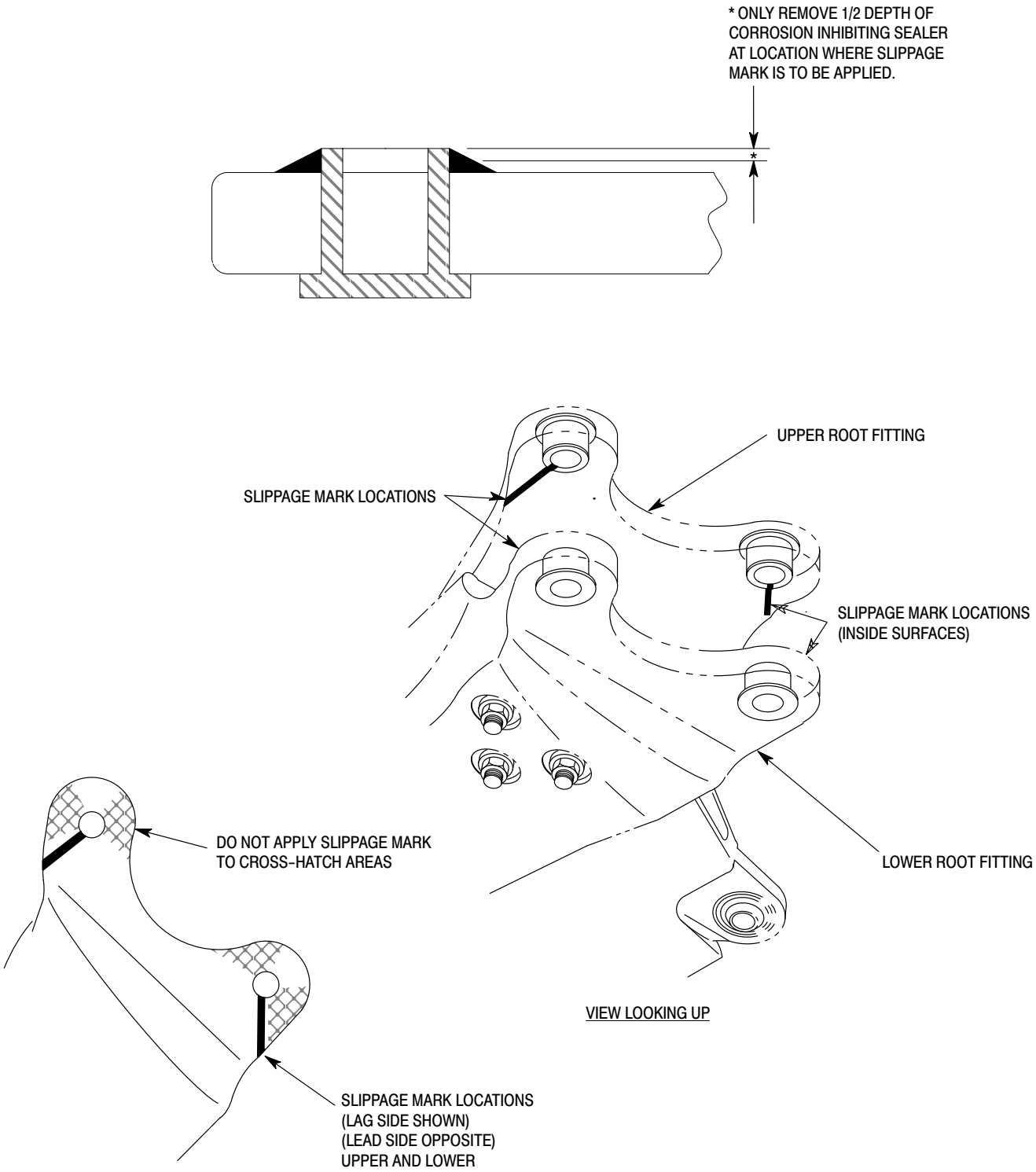


Figure 7-14. Application of Slippage Mark to Main Rotor Blade Bushings and Root Fittings

C. Vibration Absorber Inspection

(1). Inspect bracket for presence of ballast weights. Evidence of lost ballast will require weighing of complete vibration absorber (Ref. Vibration Absorber Weighing).

(2). Refer to Main Rotor Blade Inspection for installed absorber inspection requirements.

D. Vibration Absorber Disassembly

(1). Remove rivet that secures pivot shaft to bracket.

(2). Remove pivot shaft by inserting a pin through the hole in the forward end of the bracket and pushing shaft out of bracket.

(3). Remove 5-per-revolution pendulum and 3-per-revolution pendulum.

(4). Do not remove shaft bearings or thrust washers unless replacement is necessary.

(5). Use dry, low pressure compressed air to blow out bearing bores and drain hole in bracket.

(6). Inspect bores of bearings for evidence of galling, scoring and wear. Maximum allowable bore dimension is 0.268 inch (6.8072 mm).

(7). Inspect shaft for distortion and wear.

E. Vibration Absorber Repair

Repair of the vibration absorber is limited to disassembly and replacement of pivot shaft bearings, thrust washers and rubber pads on the bracket. The pendulum weights may be inter-changed subject to total weight restrictions (Ref. Vibration Absorber Weighing). The weight shims must not be altered because the weights and the assembly have been tuned. The absorber bracket may be either an aluminum or magnesium casting. Refer to Section 2 for corrosion control and identification of magnesium and aluminum alloys.

(1). Use press to remove and install new pivot bearing into pendulums.

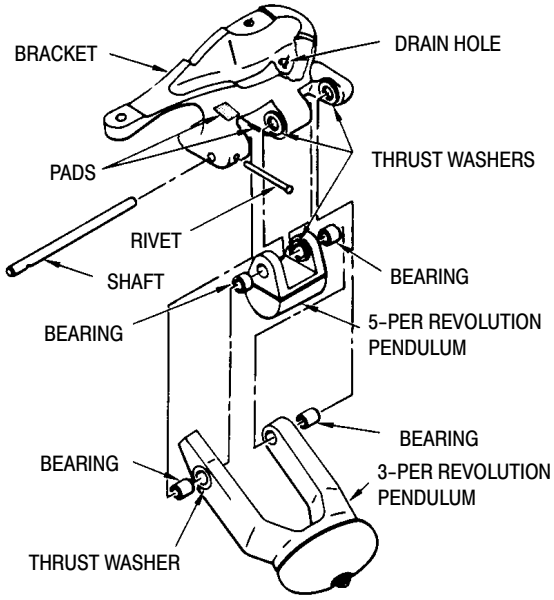


Figure 7-15. Vibration Absorber

(2). Using adhesive (19, Table 2-4), install new or rebond loosened thrust washers to bracket or pendulums. Follow container instructions for adhesive application.

(3). Using sealing compound (3), install new or rebond loosened 3-per-revolution and 5-per-resolution pads to bracket. Follow container instructions for compound application. After bonding, seal the edges of the pad with sealing compound. Ensure that center hole in pad at 5-per-resolution location does not block the drain hole through the bracket.

F. Vibration Absorber Reassembly

NOTE: During reassembly, do not allow chromate primer to get on to the shaft bearings.

(1). Using primer (4, Table 2-4), coat cavity in bracket where undrilled end of shaft will seat.

(2). Align bores of pendulums with bracket.

(3). Install shaft so that rivet hole in shaft aligns with matching hole in bracket while primer is still wet.

(4). Install new rivet and flush the shop formed end.

(5). Coat open hole in bracket with primer. Check that the pendulums rotate freely

on shaft, without binding, and that the shaft is free of primer.

G. Vibration Absorber Weighing

Vibration absorbers may have either an aluminum or magnesium bracket as part of the assembly. The total weight of an assembled magnesium absorber is 1360 grams ±0.1 gram when installed in sets of four. The total weight of an assembled aluminum vibration absorber is 1405-1425 grams maximum. Absorbers may be mixed in a ship set if additional weight is added to magnesium absorber(s) to obtain the equivalent aluminum damper total weight (1405-1425 gram). Paint an identifying yellow band on a magnesium bracket lug if so modified.

(1). Add lead weights (lead shot or equivalent) as required to establish total weight of 1360 grams ±0.1 gram (magnesium absorber) or 1405-1425 grams (aluminum absorber).

(2). Bond lead weight into recess cut area of bracket with adhesive (24, Table 2-4).

24. Main Rotor Hub Assembly

(Ref. Figure 7-16) The main rotor hub assembly consist of a hub and four identical pitch housing assemblies that are 90° apart and slightly offset. Lead-lag links, a blade damper and damper arm, a droop stop striker strip and spacer, and a pitch control bearing assembly are combined with each pitch housing to produce the pivoting axis, blade flapping stop contact surfaces and lead-lag hinge for the rotor blades. Two laminated retention strap assemblies that are both vertically and torsionally flexible extend through the pitch housings and connect to the lead-lag links. A lower shoe assembly attached to the central hub contains, a droop stop ring and droop restrainers that support the blades at rest and distribute droop loads at low blade rpm.

NOTE: MDHI HN- 11 defines mast modification and replacement requirements for non-lockwired main rotor hub nut and retainer with safetywired dual screw retainer and nut. Note also that prebalanced hub assemblies may have balancing hardware installed in the hollow cores of the lead-lad bolts.

25. Main Rotor Hub Assembly Replacement

(Ref. Figure 7-16)

A. Main Rotor Hub Assembly Removal

(1). Remove four main rotor blades.

(2). Remove main rotor drive shaft; then reinstall hoisting eyebolts, washers and nuts in rotor hub.

(3). Remove lockwire and disconnect flexible boot from lower end of hub liner.

(4). Disconnect scissors crank from main rotor hub or scissors link (Ref. Figure 7-24).

(5). Disconnect each pitch change rod from pitch housing.

NOTE: Color code each pitch change rod to match the pitch housing and blade to which it is attached, so that the main rotor can be reinstalled in the same position from which removed.

(6). Cut lockwire and removed two screws securing retainer to main rotor hub nut (Ref. Figure 7-17).

(7). Remove nut retainer.

(8). Using main rotor mast nut wrench (19, Table 2-2), remove nut from mast.

NOTE: On mast having nut without safety-wired dual screw installation, main rotor mast nut wrench (20), may be used.

(9). Using hub puller (22), break loose main rotor hub. (Ref. Figure 7-18). Remove hub puller. Then remove main rotor hub, using suitable hoisting adapter attached to eyebolts in hub.

B. Main Rotor Hub Assembly Installation

NOTE:

- Removal of the recessed spacer, upper bearing cone, upper seal and seal retainer is not mandatory for installation of the main rotor hub. If these items are installed, perform steps (1). thru (4). and steps (11). thru (18). Caution should be used when installing the hub to prevent damage to these parts.
- If recessed spacer, upper bearing cone, upper seal and seal retainer have been re-

moved, these parts should not be assembled in hub before installation of hub on helicopter. These items are reassembled in hub after seating hub on mast. Prior to installing the main rotor hub, insure that all bearings are adequately serviced with grease (21, Table 2-4).

(1). Inspect for interference between damper housings and pitch housings. If less than 0.002 inch (0.051 mm) gap exists between the housings, rework area as required in step (2). below prior to hub installation.

(2). Remove main rotor damper. Rework pitch housing by smooth blending into the surrounding area with grade 320 abrasive cloth (20). Finish polish to restore original finish with crocus cloth (23). Maximum rework depth is limited to 0.010 inch (0.254 mm). Clean reworked area with MEK (22), prime with primer (4) and repaint (Ref. Sec. 2).

NOTE: The main rotor hub is a highly stressed component. Use extreme care to prevent if from striking any object. Any impact damage may require replacement of the hub.

(3). Attach hoisting adapter to eyebolts in main rotor hub and connect a suitable hoist.

NOTE: If the hub assembly (with sleeve bushing, spacer, upper bearing and seal retainer installed) does not seat properly onto the mast, do not attempt to force it into position. Remove hub assembly from mast and determine cause of hub not seating, correct the problem and follow the procedures for installation.

(4). Check; that rotor mast is clean. Hoist main rotor hub and position over the mast then lower hub onto mast.

NOTE: To inhibit mast corrosion when operating in salt water environment, lightly coat bearing journals of mast with grease (21).

(5). Remove adapter, hoist and eyebolts.

(6). Use main rotor hub driver tool (24, Table 2-2) to ensure that main rotor hub is fully seated on mast.

(7). Install recessed washer, upper bearing cone, upper seal, and seal retainer in hub and lubricate components as follows:

(a). Hand-pack hub cavity, between sleeve bushing and hub, with grease (21, Table 2-4).

(b). Place recessed washer, recess down, on top of sleeve bushing.

(c). Hand-pack upper bearing cup and cone with grease; then install cone in cup and use hub driver tool to fully seat cone.

(d). Fill remaining cavity up to level of upper seal with grease.

(e). Position upper seal, with lip up, and press in hub counterbore.

(f). Using light mallet, carefully tap seal to seat in counterbore. Wipe away any excess grease.

(g). Install seal retainer, recess up, and seat it against the top surface of the upper bearing cone.

(h). Apply grease (21) to exposed threads on mast.

WARNING **Refer to CSP-H-5 for a required modification of the mast and replacement of the mast nut and lockwasher with a lockwired dual screw retainer and nut.**

NOTE:

- Ensure seal is properly positioned against seal retainer and that seal retainer does not pinch seal. Check by inserting a loop of approximately 0.040 inch (1.016 mm) lockwire, round feeler gage or other suitable tool without sharp edges between seal lip and retainer.
- To insure that hub is seated onto the mast properly before torquing, 2-4 threads should be showing above the mast nut with nut installed finger tight.

(8). Install mast nut using wrench (19, Table 2-2); torque nut to **200 foot-pounds (271 Nm)**. Apply a coat of corrosion preventive compound (70, Table 2-4) to the screw holes in the mast nut.

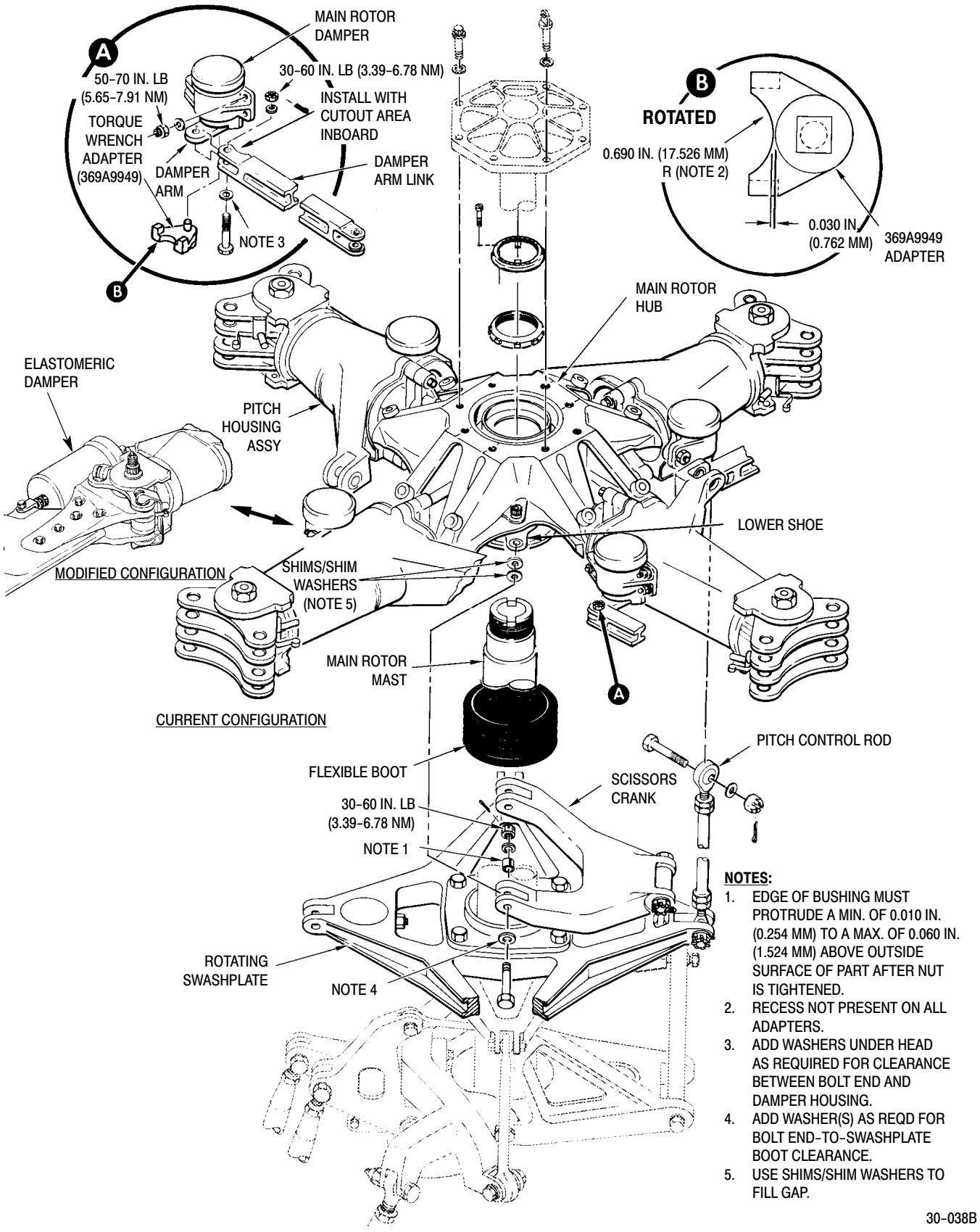
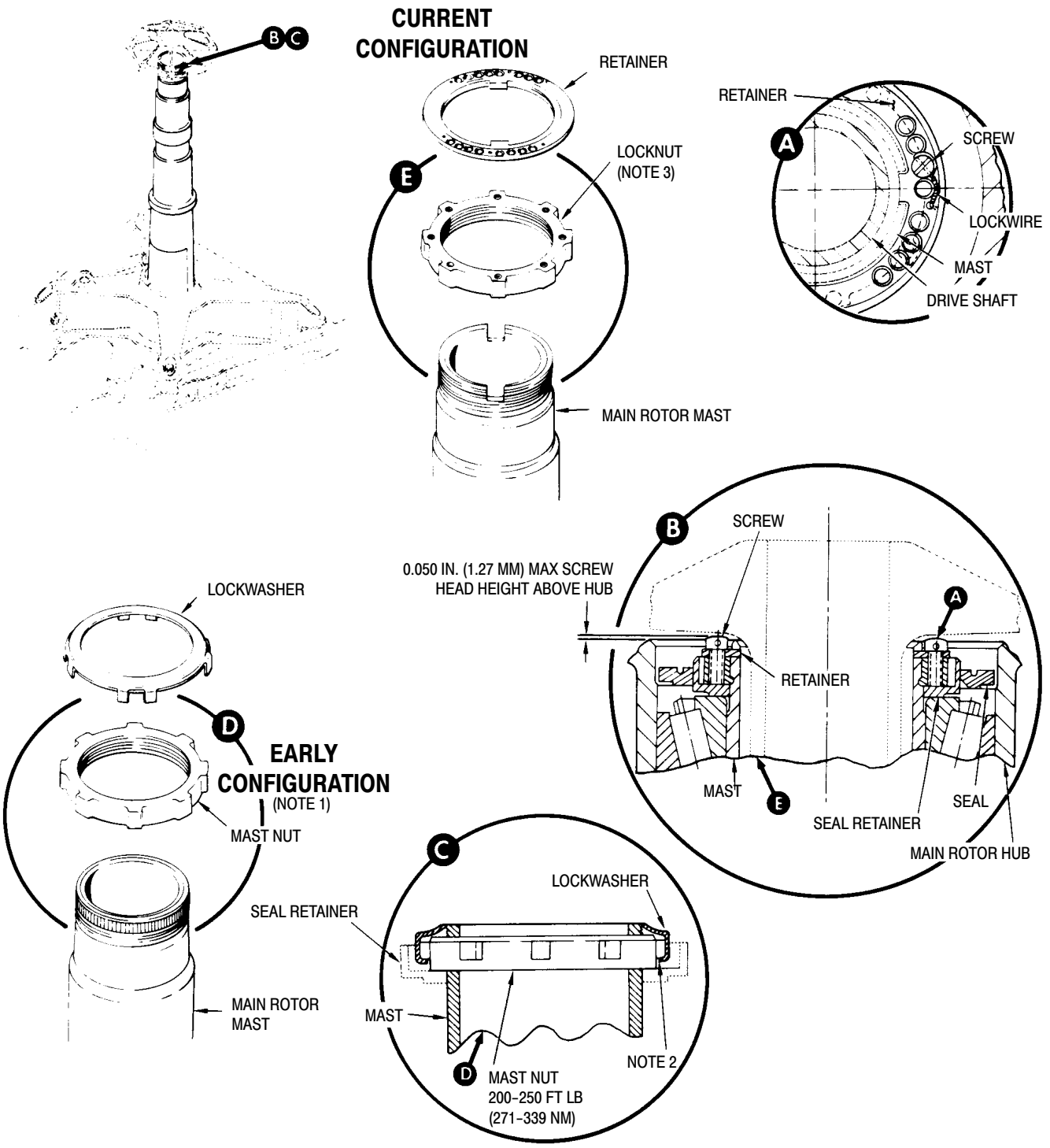


Figure 7-16. Main Rotor Hub Installation



NOTES:

1. MANDATORY MOD TO THIS CONFIGURATION: REFER TO TEXT.
2. RELIEVED EDGE OF NUT MUST BE DOWN.
3. IF LOCKNUT AND RETAINER SCREW HOLES WILL NOT MATCH WITHIN THE 200–250 FT LB (271–339 NM) RANGE, INVERT LOCKNUT.

30–156B

Figure 7-17. Main Rotor Mast Locknut Installation

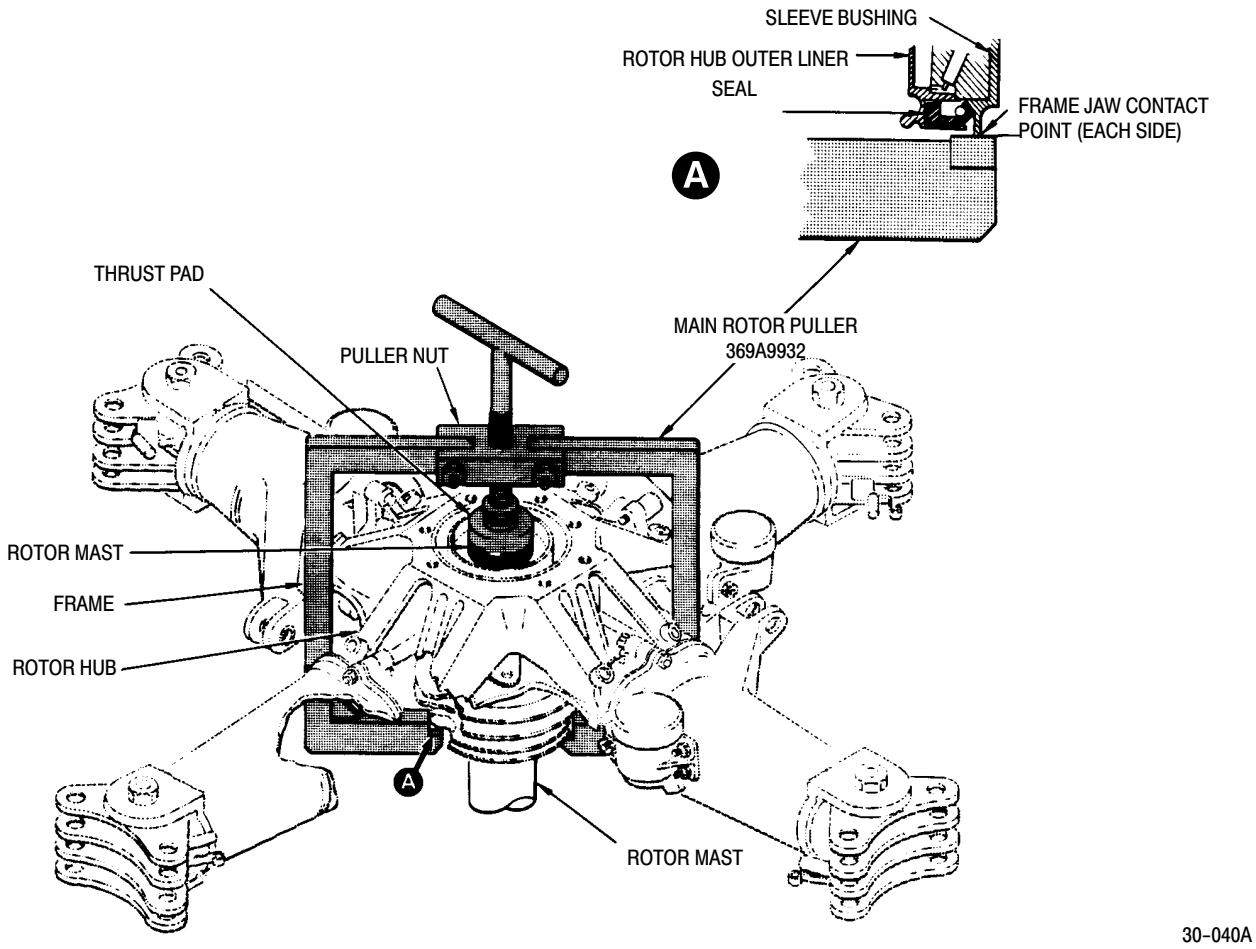


Figure 7-18. Pulling Hub Assembly

NOTE: If wrench (19, Table 2-2) is not available, wrench (20) may be modified for use on nut by hand-filing and increasing slot widths symmetrically to 0.343 ±0.007 inch (8.7122 ±0.178) mm).

(9). Place retainer on nut and check retainer to nut screw hole alignment.

(10). Increase nut torque to not more than **250 foot-pounds (339 Nm)** to align holes in retainer and nut.

NOTE: If holes cannot be aligned in the **200 - 250 foot- pound (271 - 339 Nm)** torque range, remove and invert the nut and repeat procedures in Steps (8). thru (10). to align holes.

(11). Secure retainer to nut with two screws and lockwire the screws.

NOTE: Be sure that no washers are used under screwheads and that screwheads are free of burrs.

(12). Verify that screwheads do not project more than 0.050 inch (1.270 mm) above hub upper surface for adequate clearance between screwheads and driveshaft flange underside.

(a). Place straight edge across hub upper surface and extend straightedge to screw to make the check.

(13). Install four pitch change rods to pitch housing.

NOTE: Be sure pitch change rods are reinstalled in the same position from which removed.

(14). Connect scissors crank to main rotor hub lower shoe and/or to scissors link.

(15). Connect flexible boot to lower end of rotor hub liner and secure with lockwire (2, Table 2-4).

(16). Install main rotor driveshaft (Ref. Sec. 19).

(17). Install four main rotor blades.

(18). Perform main rotor blade droop angle check if rotor hub is new or a replacement.

26. Main Rotor Hub Assembly Inspection

(Ref. Figure 7-19)

(1). Inspect pitch housing for scratches, nicks and cracks.

(a). No cracks are permissible.

(b). Scratches and nicks must be cleaned up before measuring the depth of the damage to determine housing serviceability.

(c). Accomplish repairs or replacement according to Pitch Housing Assembly Repair.

(2). Inspect sleeve bushing for snug fit in pitch housing arm clevis lug; the lug must not show evidence of wear caused by bushing movement.

(a). Maximum allowable diameter for the bushed lug is 0.5004 inch (12.71016 mm); for unbushed lug, not more than 0.1320 inch (3.3528 mm).

(b). Inspect inner surfaces of all pitch housing arm clevis lugs for chafing caused by misaligned pitch control rod end bearings.

(c). Chafing will be in the form of crescent-shaped grooves.

(d). If chafing wear is found, accomplish repair or replacement (Ref. Pitch Housing Assembly Repair).

(e). The chafed area must be cleaned up before measuring the depth of the damage to determine housing serviceability.

(3). Inspect the droop stop ring for corrosion, dents and scratches. If defects are found, repair or replacement droop stop ring.

NOTE: To inhibit corrosion, spray droop stop ring, rollers and pitch bearings with rust inhibitor (101, Table 2-4).

(4). Inspect droop stop roller for flat spots, pit marks and looseness on roller shaft.

(5). Inspect striker plate for dents (brinelling) and pit marks that exceed 0.030 inch (0.762 mm) depth. Damage exceeding this limit requires replacement of striker plate.

(6). Press each pitch housing downward several times and check for evidence of a binding pitch bearing or droop restrainer follower.

(7). Inspect visible portion of droop restrainer for cracks and the follower spring for breaks.

NOTE: Do not remove tetrafluoroethylene (TFE) debris which works out of pitch bearing edge. The debris is normal and helps lubricate bearing. Removal of debris will increase bearing wear rate.

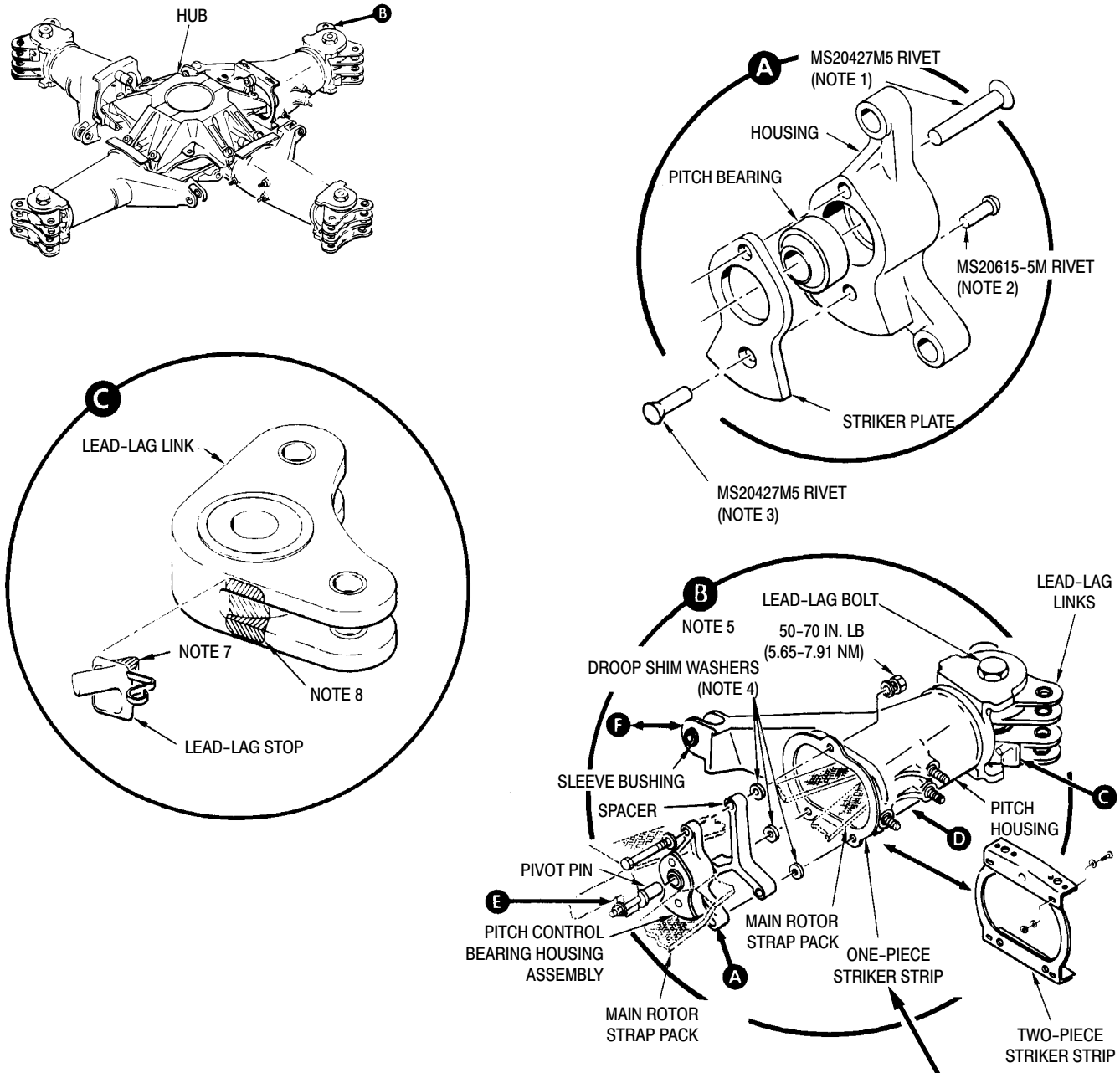
(8). Inspect each of the four main rotor hub lead-lag link assemblies after removing the bolt or pin attaching damper arm to main rotor blade and blade attach pins. Rotate blade about lead blade attach pin and visually inspect for signs of cracking around the blade pin hole in the lug of the lag portion.

(9). Use a bright light and 5X magnifying glass to inspect all main rotor hub assembly lead-lag links for discoloration, pitting, intergranular cracks or stress corrosion cracks.

(a). Any discoloration or pitting is evidence of more than superficial corrosion and the main rotor hub must be removed for replacement of lead-lag links.

(b). Otherwise reinstall lag blade attach pin and damper attach pin or bolt. As applicable, torque nut to **30 - 60 inch-pounds (3.39 - 6.78 Nm)**; install cotter pin.

NOTE: Normal or premature overhaul requires visual inspection plus dye-penetrant inspection of the links for the same conditions.

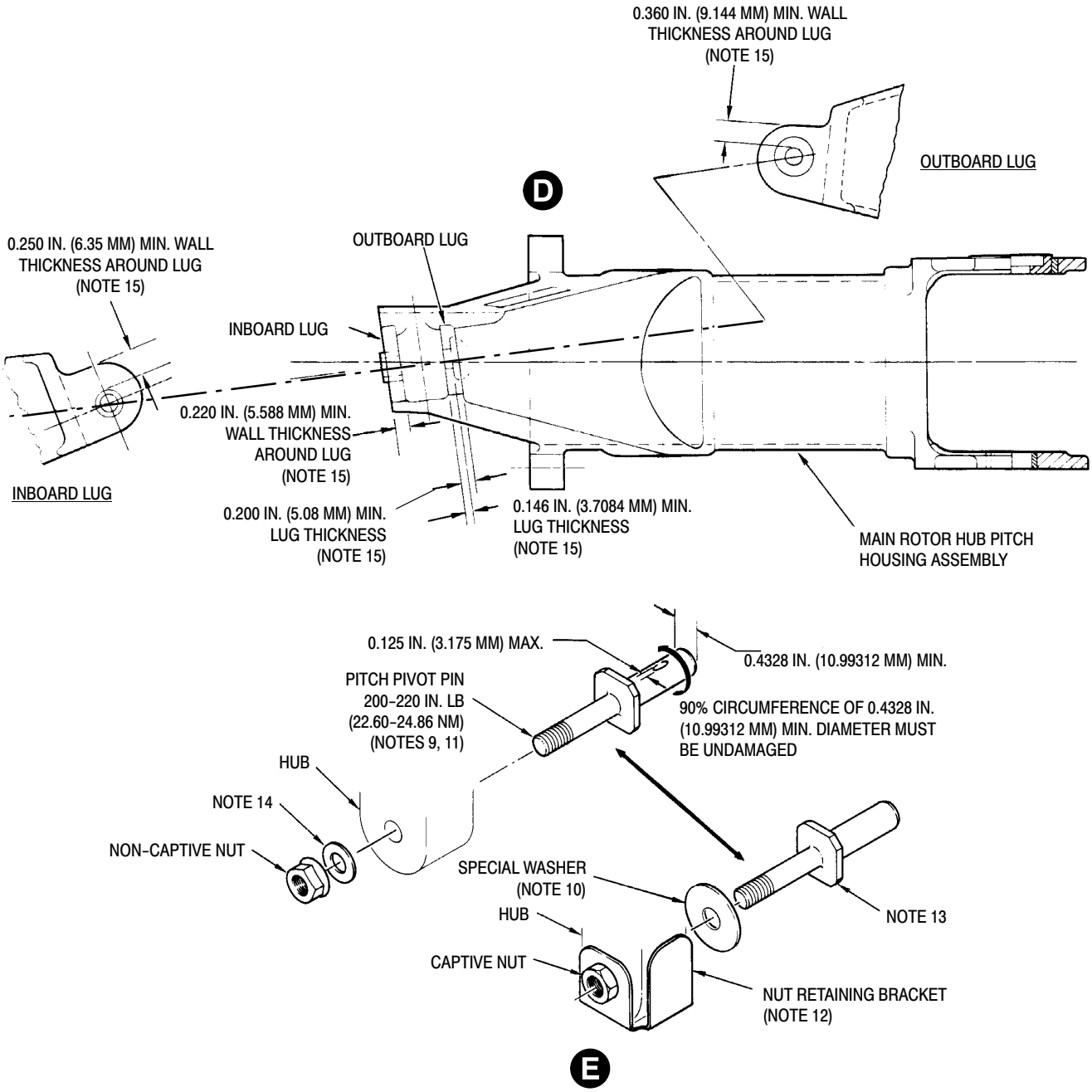


NOTES:

1. COUNTERSUNK RIVET HEAD MUST BE FLUSH WITH HOUSING. IF STRIKER PLATE IS COUNTERSUNK, COUNTERSUNK HEAD MUST BE FLUSH WITH PLATE.
2. SHOP-FORMED HEAD MUST BE FLUSH WITH PLATE.
3. COUNTERSUNK RIVET HEAD MUST BE FLUSH WITH PLATE IN ALTERNATE RIVET INSTALLATION.
4. CAUTION: WASHERS ARE INSTALLED BETWEEN SPACER AND STRIKER STRIP TO ESTABLISH CORRECT STATIC DROOP ANGLE BETWEEN HOUSING AND HUB. ENSURE THAT THE EXACT NUMBER REMOVED ARE REINSTALLED. THE THREE PITCH BEARING HOUSING BOLTS MUST EACH HAVE THE SAME NUMBER (THICKNESS) OF WASHERS WHEN SHIMMING IS NECESSARY.
5. SHOWN EXPLODED ONLY FOR CLARITY.
6. CUT OUT 0.25-0.50 IN. (6.35-12.7 MM) PIECE OF THE STRIKER STRIP BETWEEN LOWER BOLT HOLES. DEBURR AND RADIUS CUT EDGES.
   CAUTION: DO NOT SCRATCH STRAP PACK WHEN INSTALLING THROUGH STRAP ASSEMBLY.
7. FOR STOP REMOVAL, PLACE WOOD DOWEL HERE, STRIKE SHARPLY WITH HAMMER TO BREAK STOP BOND.
8. BOND ALL STOP-TO-LINK SHADED CONTACT SURFACES WITH ADHESIVE (90, TABLE 2-4).

30-041-1D

Figure 7-19. Repair of Main Rotor Hub Components (Sheet 1 of 3)



NOTES: (CONT)

9. LIGHTLY LUBRICATE THE THREADED SHANK WITH GREASE (18, TABLE 2-4) BEFORE INSTALLATION.
10. APPLY WET PRIMER (4 TABLE 2-4) ON WASHER AND MATING SURFACES BEFORE INSTALLATION.
11. TORQUE WITH PITCH BEARING STUD WRENCH 369A9825. HOLD NON-CAPTIVE NUT WITH PITCH BEARING STUD WRENCH 369A9826. BEFORE APPLYING THE LAST 20-30 IN. LB (2.26-3.39 NM) OF REQUIRED TORQUE, USE A 0.002 IN. (0.051 MM) FEELER GAGE AND CHECK FOR GAP BETWEEN THE PIN FLANGE AND MOUNTING LUG SURFACE. NO GAP IS ALLOWED.
12. THE NUT RETAINING BRACKET IS BONDED TO CURRENT TYPE HUB AND IS REPLACEABLE AT OVERHAUL FACILITY.
13. CURRENT TYPE PIVOT PIN HAS LETTER "M" ETCHED ON OUTER FACE OF FLANGE.
14. DISCARD AT REPLACEMENT OF EARLY TYPE PIVOT PIN. SPECIAL WASHER REQUIRED UNDER CURRENT TYPE PIN FLANGE FOR INSTALLATION AND TORQUING.
15. MAINTAIN MINIMUM WALL THICKNESS AROUND LUG AND MINIMUM LUG THICKNESS FOR FIELD REPAIR OF CLEVIS LUG.

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Figure 7-19. Repair of Main Rotor Hub Components (Sheet 2 of 3)

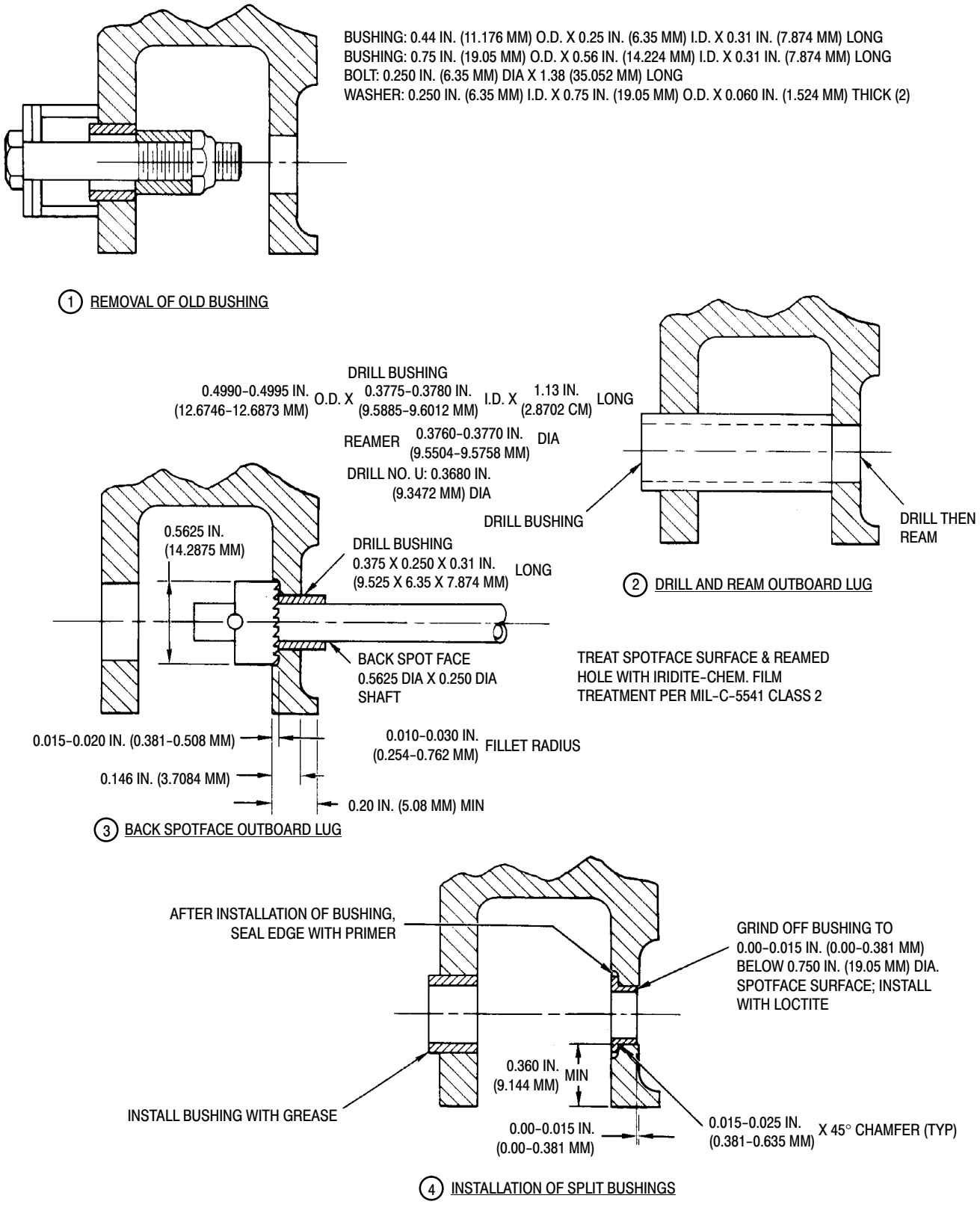


Figure 7-19. Repair of Main Rotor Hub Components (Sheet 3 of 3)

(10). Inspect lead-lag link stop for broken spring, cracks, breaks, or visible bond line cracks.

(11). Inspect ID of lead-lag bolts for presence of corrosion. Bolts having evidence of corrosion should be treated for corrosion.

NOTE: There are prebalanced rotor hub assemblies in service. The lead-lag bolts in prebalanced hub assemblies may contain balancing hardware. If such is the case, remove the balancing hardware to perform inspection. Each set of removed hardware should be tagged or color-coded to ensure correct reinstallation.

(12). Inspect each striker strip for cracks, deformation and badly worn contact surfaces.

(13). Inspect all parts of main rotor hub for cracks, breaks, scratches, and nicks. (Refer all questionable damage to MDHI for deposition.)

(14). Visually inspect the main rotor retention straps for gaps between the pack laminations (Ref. Figure 7-20).

(a). A single straight lamination gap not in excess of 0.030 inch (0.762 mm) is permissible within the pack or next to either the upper or lower outer shoe.

NOTE: On some strap packs the teflon may appear wrinkled or extend past the end of the laminates obstructing the view. When this condition exists, visual inspection should be made from the leading and trailing edges of the strap packs.

(b). Retention strap packs showing a fanning or bowing of the laminations indicate an improper condition and the hub must be repaired. (Available repair/overhaul information is provided in CSP-H-5.)

(c). Check for cracks or breaks in the strap pack laminations at the inboard and outboard ends of the pitch housing where the straps are accessible to view. Check both the lead and lag legs of the straps at these locations.

NOTE: Do not pry at the strap pack with a sharp or hard-edged tool. If edges become nicked, the strap pack assembly must be replaced.

(d). If no obvious strap failure is noted, use a blunt-nosed wooden or phenolic pin, pencil size with 0.0625 inch (1.5875 mm) radius point, to probe at the upper and lower strap laminations at the outboard end of the blade pitch housings. A failed strap, either in the lead or lag of the pack, will move away from the other straps. If the upper and lower strap laminations remain in tension under this probing operation, no failure has occurred.

(e). If a single strap failure is noted during inspection, rotor operation can still be continued. The pack must be inspected again in 300 hours. When three straps to any one blade are broken (at one side of the rotor hub) the strap pack assembly must be replaced.

NOTE: Ends of permissible broken straps must be taped to prevent scratching adjacent straps.

(15). Whenever a new or replacement main rotor hub has been installed, determine that the droop angle of the main rotor blades does not exceed the maximum allowable angle of 6 degrees.

27. Main Rotor Strap Pack Lamination Inspection

(Ref. Table 7-7 and Figure 7-20)

NOTE:

- If a hub assembly or strap assembly (other than new parts in storage) are subjected to extended periods of non-use, whether installed on the helicopter or not, the strap assembly should be inspected critically for corrosion and pitting due to corrosion before being returned to service.

If corrosion is found on the strap pack assemblies, contact MDHI for disposition.

- Figure 7-20 depicts the main rotor hub and strap pack assembly disassembled for clarity of location and area to be inspected for cracks. Under no circumstances should the strap pack or main rotor hub assembly ever be disassembled in the field. MDHI and MDHI Approved Licensees are the only approved repair stations for main rotor hub assembly overhaul.
- It is acceptable to operate a helicopter with a hub assembly having a strap pack with up to two failed laminates in any one leg of the strap assembly. When a laminate in the strap assembly fails, the remaining laminates pick up and carry the load. This increased load causes slightly more elongation in the remaining laminates of that leg thus shifting the mass of the rotor system. Any time a vibration develops or there is an increase in vibration level over a short period of time, the main rotor strap pack assembly should be inspected for cracked or failed laminates.
- Conduct inspection indoors, if possible, or in a shaded area to eliminate glare of sun or bright outdoor light. To facilitate inspection, field fabricate and use plastic inspection tool.

(1). Remove main rotor blades.

(2). Trim teflon from edges of laminates.

(3). Field fabricate plastic tool per Figure 7-20. Run plastic inspection tool in both directions along each laminate, feeling for a “catch” from a crack on a single laminate.

(4). Using a light and mirror, visually inspect each of the main rotor strap pack assemblies for evidence of cracks or breaks in strap pack laminates in the areas of the outboard shoes and pitch housing assemblies.

(5). Using a 10X magnifying glass, visually inspect the edge of strap pack laminates on both sides at outboard end of blade pitch housing (area between outboard shoes).

CAUTION A **laminate** has failed:

- If a crack is found in tongue area of the laminate.
- If a crack is found in both legs (lead and lag) of the same laminate.

CAUTION A **strap pack** is to be rejected (return hub for overhaul):

- If three or more laminates in a single strap pack have failed, as defined above.
- If three or more laminates in a single strap pack are cracked in the same leg (lead or lag).
- If one laminate is cracked at the outboard end (area between outboard shoes).
- Two or more gaps in the same strap pack requires main rotor hub replacement. A single gap in any one strap pack assembly is allowed.

NOTE:

- Do not pry at strap pack assemblies with sharp or hard edged tools. If edges become nicked or laminates get scratched, additional cracking can occur thus causing hub replacement.
- Where accessible, ends of acceptable cracked or broken laminates should be taped to prevent scratching and damaging of adjacent laminates.

(6). Visually inspect strap pack assemblies for evidence of corrosion. If corrosion is found on strap pack laminates contact MDHI service department for disposition.

(7). Using a blunt-nosed wooden or phenolic pin, pencil size, with 0.0625 inch (1.5875 mm) radius point, probe at the upper and lower strap laminations at the outboard ends of the blade pitch housings for evidence of laminate failure.

(a). A failed laminate, either at the lead or lag end of the strap pack, will move away from the other laminates.

(b). If the adjacent upper and lower laminates remain in tension under the probing operation, no laminate failures have occurred.

NOTE: Laminate failures are defined in step (5). (Ref. **CAUTION:**).

Table 7-7. Strap Pack Inspection

Inspect	Procedure (1)	For	Acceptable	Replace or Return Hub for Overhaul if:
Outboard end	Visually. Use blunt nosed wooden or phenolic pin (Ref. Figure 7-20). Probe at upper and lower end of pack. Failed laminate in lead or lag leg will move away from other laminates	Failed laminates (3)	Two or less per pack	Three or more laminate failures in one pack.
	Visually.	Gaps between laminates	Single straight gap not exceeding 0.030 inch (0.762 mm) within pack or next to either upper or lower outer shoe	More than one gap found; gap exceeds acceptable limit.
	Visually using light and mirror (2)	Cracks or breaks	None	Cracks or breaks are noted.
In area of and within pitch housing assemblies	Visually with light and mirror (2)	Cracks or breaks	Two or less laminate failures per strap pack (2)	Three or more laminate failures (2) in a pack; three or more laminates in pack with crack in same leg (lead or lag).
Shims at attach points	Visually with light and mirror	Cracks or breaks	Inspect top laminate around shim (4)	Top laminate is cracked in area of cracked or broken shim.

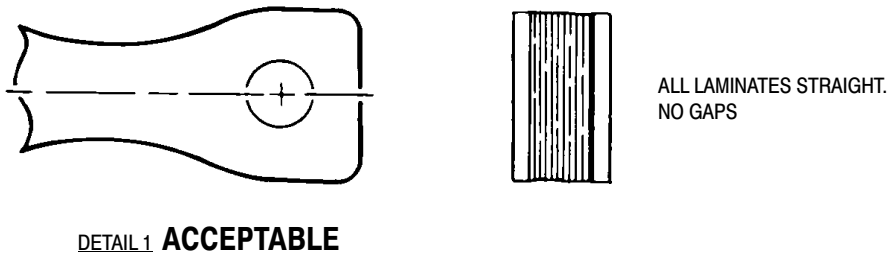
NOTE:

(1) Conduct visual inspections indoors or in shaded area to eliminate glare of sun or bright outdoor light.

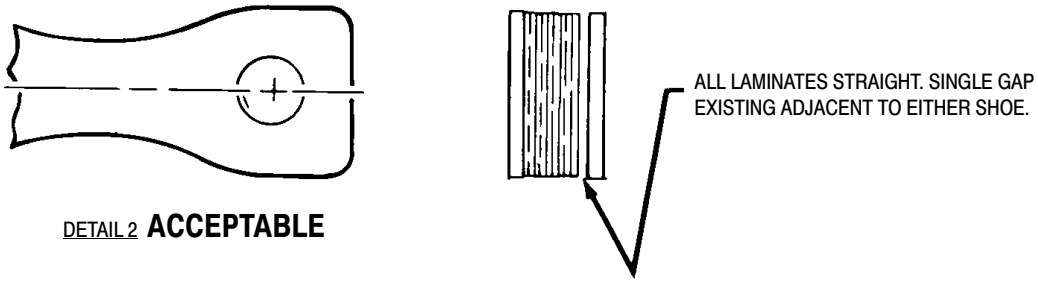
(2) Removal of teflon covering is required for visual inspection of laminate edges. Use aluminum chisel fabricated from stock 0.025 x 6.00 x 0.10 inch (0.635 x 152.4 x 2.54 mm) to carefully scrape excess interlaminate teflon sheets from both sides of strap pack between top and bottom shoes at outboard attachment bolt of all five strap packs. Remove excess teflon from a point 0.50 inch (12.7 mm) outboard of bolt centerline to 1.50 inches (38.1 mm) inboard of bolt centerline. Field fabricate and use plastic tool (Ref. Figure 7-20). Run plastic tool in both directions along each laminate feeling for cracked laminate. Use of plastic tool will ensure that shreds of teflon still hanging free does not obscure small cracks.

(3) Laminate has failed if crack is found in tongue area or if crack is found in both legs (lead and lag).

(4) Pay particular attention to shim installed at upper side of lead leg of each strap pack assembly. Maximum of two shims may have been installed on top side of lead leg of strap pack to accommodate tolerance buildup during strap pack assembly. If more than one top shim is installed, pay particular attention to lower shim when checking for cracks or breaks.

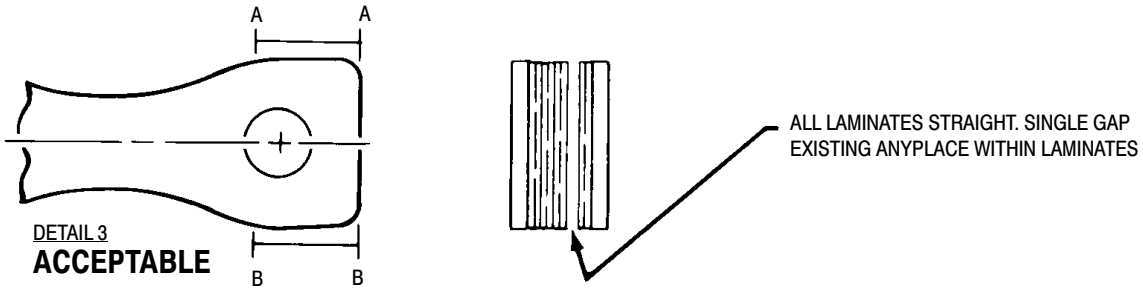


DETAIL 1 **ACCEPTABLE**

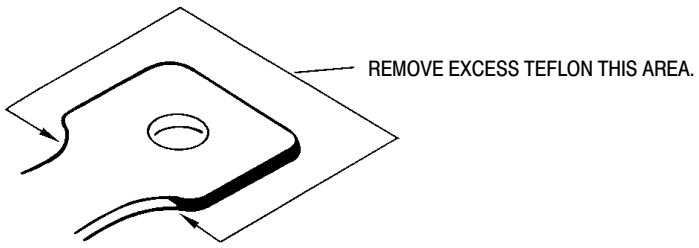


DETAIL 2 **ACCEPTABLE**

NOTE:
WHITE TEFLON MAY APPEAR WRINKLED AND EXTEND PAST END OF LAMINATES PREVENTING CLEAR VIEW OF LAMINATE. WHEN THIS OCCURS, LOOK ALONG EITHER SIDE IN AREA A-A OR B-B (DETAIL 3).

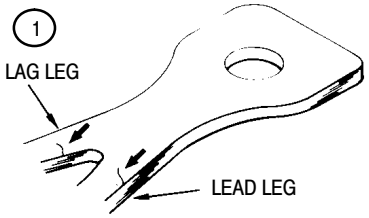


DETAIL 3
ACCEPTABLE

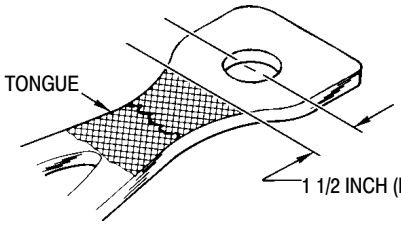


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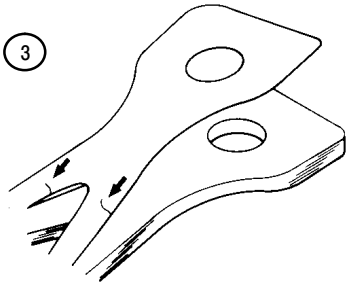
Figure 7-20. Strap Pack Lamination Inspection (Sheet 1 of 2)



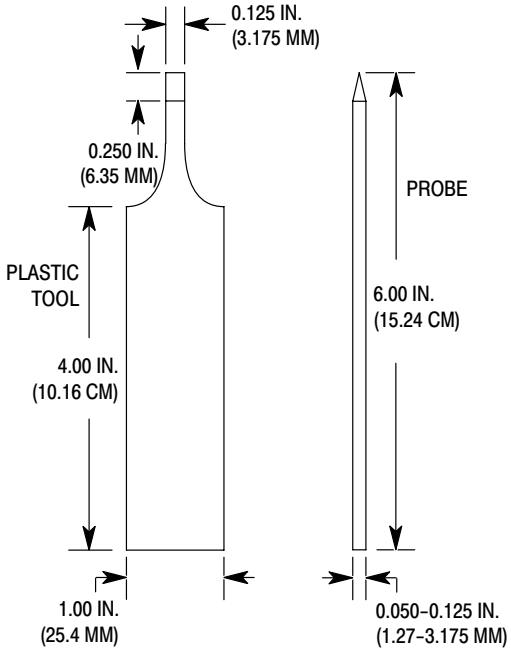
LAMINATE HAS FAILED IF CRACKS OCCUR ON BOTH LEAD AND LAG LEGS OF SAME LAMINATE.



LAMINATE HAS FAILED IF CRACK OCCURS IN TONGUE OF LAMINATE (SHADED AREA SHOWN BEYOND JOINT OF STRAP PACK LEGS).

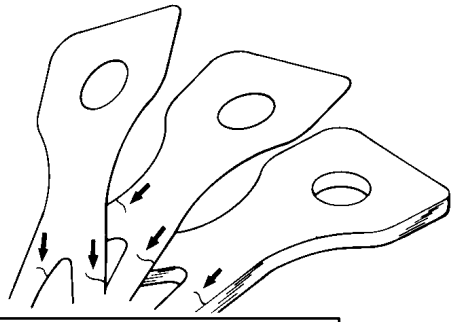


TWO LAMINATE FAILURES AS DEFINED IN (1) AND/OR (2) ARE ALLOWED IN EACH STRAP PACK ASSEMBLY. (TOTAL OF EIGHT LAMINATE FAILURES PER HUB ASSEMBLY.)



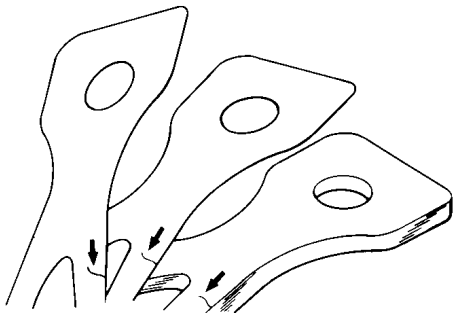
FIELD FABRICATED INSPECTION TOOL

4 STRAP PACK IS REJECTED IF THREE OR MORE LAMINATES IN SAME PACK HAVE FAILED AS DEFINED IN (1) AND/OR (2) ABOVE.



CAUTION:
DO NOT DISASSEMBLE STRAP PACK ASSEMBLY – LAMINATIONS ARE SHOWN SEPARATED ONLY TO DEPICT POSSIBLE CRACK LOCATIONS.

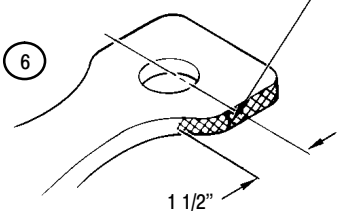
5



STRAP PACK IS REJECTED IF THREE OR MORE LAMINATES IN THE SAME PACK ARE CRACKED IN THE LEG (LEAD OR LAG).

FAILED LAMINATE IF CRACK IS FOUND ON EITHER EDGE OF LAMINATE.
IF ONE LAMINATE IS FAILED, REMOVE HUB.

6



NOTE:
ANY CRACK IN LAMINATE IS CONSIDERED A BREAK. THE LAMINATE HAS NOT FAILED HOWEVER, UNLESS BOTH LEAD AND LAG LEGS ARE CRACKED, CRACK IS LOCATED IN TONGUE AREA OF LAMINATE, OR IS UNDER SHOES (SEE DETAIL 6).

44–060–2E

Figure 7-20. Strap Pack Lamination Inspection (Sheet 2 of 2)

(8). Inspect upper, lower and center laminates for cracks and breaks.

NOTE: Cracks, breaks or other noticeable damage to the laminate/shims require main rotor hub overhaul/replacement.

(9). Install main rotor blades.

(10). Perform tracking of main rotor blades.

(11). Record location of all cracked/broken laminates in helicopter Log Book including strap serial number, blade color, leg (lead or lag) and laminate position, if possible numbering from the top down.

28. Main Rotor Strap Pack Repair

(Ref. Figure 7-20) Where accessible, ends of permissible cracks or broken laminates should be taped to prevent scratching and damaging adjacent laminates.

NOTE: Do not bend broken ends excessively and scratch adjacent straps.

(1). Carefully wipe ends of broken strap with a clean soft cloth moistened with solvent (1, Table 2-4).

(2). Use mild blast of filtered air to dislodge any foreign particles between broken strap ends and adjacent strap.

(3). Carefully tape broken ends of strap with plastic electrical tape (74).

29. Pitch Housing Assembly Repair

(Ref. Figure 7-19)

NOTE: During repair, use adequate covering over engine air inlet fairing opening to prevent entry of foreign objects into air intake. When reconnecting a pitch control rod, be sure that the rod ends are centered in the swashplate and housing arm clevis lugs. Realign, if necessary, and hold rod to prevent turning while tightening locknuts.

(1). Use grade 320 abrasive cloth (20, Table 2-4) to smooth scratches, nicks and chafing wear in pitch housing.

(2). After smoothing (removal of all sharp or raised edges) repair depth must not exceed 0.010 inch (0.254 mm) in any area of the housing except the inner surfaces of arm clevis lugs.

(3). A maximum (repaired) depth of 0.050 inch (1.270 mm) is acceptable in the clevis lug with the sleeve bushing.

(a). On the opposite clevis lug, a maximum (repaired) depth of 0.010 inch (0.254 mm) is permissible in the area of the spot faces and maximum of 0.050 inch (1.270 mm) in the area outside the spot faces.

(4). Repair elongated hole in unbushed side of clevis lug (View E). Maximum hole diameter is 0.3135 inch (7.9629 mm).

(a). Disconnect pitch control rod from clevis lugs on pitch control housing.

(b). Remove existing bushing from inboard lug.

(c). Use drill bushing as guide and drill elongated hole in outboard lug to 0.368 inch (9.3472 mm) diameter; line ream hole to 0.375-0.376 inch (9.525-9.5504 mm) diameter.

NOTE: Prior to back spot- facing, check outboard lug two places for minimum wall thickness of 0.146 and 0.20 inch (3.7084 and 5.08 mm).

(d). Use drill bushing as guide for spotface pilot, and back spotface inside surface of outboard lug to 0.5625 inch (14.2875 mm) diameter and 0.015-0.020 inch (0.381-0.508 mm) depth. Add chamfer to clear bushing in two places, as shown.

(e). Use attach bolt or assembly pin as guide to ensure proper alignment, and install 369D21309 flanged bushing and seal edges with Loctite sealing compound.

(f). Install slotted bushing with grease (58) in inboard lug.

NOTE: Check outboard and inboard lugs of pitch control horn for evidence of interference with upper jam nut on pitch control rod. If evidence of interference is noted, perform step (5).

(g). Reconnect pitch control rod assembly if check of pitch control rod lugs discloses no evidence of interference with rod upper jam nut.

(5). Remove pitch control horn lug interference with pitch control rod upper jam nut clearance (View E).

(a). Using file or portable grinder, carefully trim off interfering corner of pitch housing lugs so there is sufficient pitch control rod clearance. It is not necessary to trim to minimum wall thickness, and do not exceed rework limitations shown.

(b). Reconnect pitch control rod assembly. Check for proper clearance between outboard lug and upper jam nut on pitch control rod.

(6). Touch up repaired areas with chemical film (8) followed by primer (4); paint with matching color.

(7). Remove main rotor hub assembly for pitch housing or hub replacement.

30. Pitch Housing Parts Repair or Replacement

(Ref. Figure 7-19)

NOTE: Use care during removal of parts from around the strap pack. Any nicks or scratches on the straps requires scrapping of the strap pack.

A. Pitch Control Bearing Housing Assembly, Spacer or Striker Strip Replacement

(1). Support blade and pitch housing from beneath. Remove three nuts, six washers and three bolts that secure bearing housing.

NOTE: Check if washers are installed between the spacer and the striker strip. These washers must be reinstalled to establish correct static droop angle between the pitch housing and hub.

(2). Carefully remove spacer by sliding it downward past striker strip. Retain exact number of droop shim washers, if installed.

(3). Slide bearing assembly off pivot pin. Inspect pivot pin for grooving or excessive wear.

NOTE: Do not remove TFE debris which works out of pitch bearing edge. The debris is normal and helps lubricate bearing. Removal of debris will increase bearing wear.

(4). Remove and discard pitch bearing if defective. Total radial looseness of assembled ball and pivot pin must not exceed 0.010 inch (0.254 mm).

(5). Replace striker strip if it is cracked or the flapping stop contact areas are worn through hard anodized surface.

NOTE: Hub assemblies may have either one- or two-piece striker strips.

(6). Prepare one-piece striker strip for installation as follows:

(a). Remove sealant between pitch housing and striker strip, use care not to scratch pitch housing

(b). Remove striker strip from pitch housing.

(c). Cut old striker strip to facilitate removal from retention strap assembly. Do not scratch strap assembly.

(d). Clean old sealant from pitch housing using 1,1,1 trichloroethane (61, Table 2-4).

(e). Cut out area of new striker strip (View B), deburr, smooth and radius cut edges.

(f). Apply sealant (3) to faying surfaces of the striker strip and pitch housing.

(7). Position pitch control bearing housing on pivot pin.

NOTE: If droop shim washers were removed from between spacer and striker strip, the exact thickness removed must be reinstalled. There must be an equal number of washers on each of all three bolts. These washers establish correct static droop between pitch housing and the hub.

(8). Slide spacer into position between bearing housing assembly and striker strip on pitch housing. Install exact

thickness of droop shim washers removed at time of disassembly. Align holes for the three bolts.

(9). Install three bolts, six washers and three nuts. Torque nuts to **50 - 70 inch-pounds (5.65 - 7.91 Nm)**.

(10). Seal all the parting lines (joints) of the assembly with a bead of sealing compound.

B. Replacing Pitch Control Bearing

(1). Drill out rivets to remove striker plate. Discard striker plate if brinelling or pitting exceeds 0.030 inch (0.762 mm) depth.

(2). Press bearing from housing bore. Clean any residual primer from housing bore with MEK solvent (22, Table 2-4).

(3). Rework minor surface abrasion in housing bore by polishing with crocus cloth (23). Restore chemical film (8), where removed.

(4). Apply one thin coat of primer (4) to the bearing OD and the housing bore.

(5). Press bearing into bore while primer is still wet.

(6). Wipe away any excess primer using care to keep it out of bearing races.

(7). Check Teflon linings of bearing after installation to determine that no damage has occurred from the pressing operation.

NOTE: Outside edge of bearing outer race must be at least flush with the face of the bearing housing. However, the bearing can be recessed up to 0.015 inch (0.381 mm).

(8). Install striker plate with one MS20427M5 rivet (upper hole) and one MS20615-5M rivet (lower hole).

(a). If upper hole of striker plate is countersunk, rivet must installed with shop-formed head flush with the plate.

(b). The shop-formed head of the MS20615-5M rivet must be flush with the plate.

(c). An MS20427M5 rivet may be used as an alternate for the MS20615-5M rivet.

(d). When the alternate is used, install the rivet from the plate side of the assembly.

(e). The heads of all countersunk rivets must be completely flush.

C. Lead-Lag Link Blade Stop Replacement

Replace a blade stop if it is broken or cracked, has a broken spring, or if there are visible bond line cracks.

NOTE: The lead-lag link assembly must not be removed from pitch control housing for this repair, the retention bolt cannot be retorqued without a special adapter.

(1). Remove lead-lag link stop as follows;

(a). Provide a backup support for the link assembly.

(b). Use a 0.50 inch (12.7 mm) wood dowel and a hammer to drive stop from link.

(c). Strike the dowel sharply to break the adhesive bond.

(2). Using a sharp-edged metal scraper, carefully scrape any adhesive residue from the link.

(a). If scraper penetrates through the paint and chemical surface film, the surface must be refinished.

(b). The depth of gouges or nicks is limited to 0.010 inch (0.254 mm) maximum after rework.

(c). Rework by smooth blending into the surrounding area with grade 320 abrasive cloth (20).

(d). Final polish with crocus cloth. Restore chemical film protection.

(3). Clean the bond area of all contact surfaces by wiping with surface cleaner (10).

(a). Flush-wipe the cleaned surface four times with a mixture of equal parts of distilled water and isopropyl alcohol (71) to remove all traces of the phosphoric acid.

(b). Rinse the cleaned surface with tap water, followed by a rinse of distilled water until the surface is "water break" free.

(c). Dry for 30 minutes minimum at 150°F (66°C).

(4). Check the fit of the stop in the link.

(a). The flange and radius contact surfaces of the stop must mate with the link within 0.010 inch (0.254 mm).

(b). Maximum clearance between the stop and inside surfaces of the link ears is limited to 0.020 inch (0.508 mm).

NOTE: This tolerance applies to either side of the stop.

(5). Prepare a mixture of epoxy adhesive (91).

(a). Apply a uniform coating of the mixed adhesive to all contact surfaces.

(b). Hand press the stop into place between link ears until all mating surfaces are in firm contact.

(c). Apply a suitable clamping device so that contact is maintained.

(d). Cure for a minimum of 8 hours at room temperature, or 2 hours at 150°F (66°C).

D. Corrosion Control - Lead-Lag Bolt

NOTE: Do not disturb the torque on the lead-lag bolts. A special adapter is needed to re-torque the lead-lag bolts.

(1). Remove and tag or color-code each set of balance hardware that is installed.

(2). Remove corrosion with grade 180 abrasive cloth (20, Table 2-4) and finish with grade 400 abrasive cloth.

(3). Swab cleaned surface with methyl ethyl ketone (22) and apply unthinned primer (4).

(4). Reinstall balance hardware that was removed.

E. Taping Broken Strap Ends of Strap Pack

NOTE: Be careful not to bend broken ends excessively and scratch adjacent straps.

(1). Carefully wipe ends of broken strap with a clean, soft cloth moistened with solvent (1, Table 2-4).

(2). Use a mild blast of filtered air to dislodge any foreign particles between broken strap ends and adjacent strap

(3). Carefully tape broken ends of strap with plastic electrical tape (74).

31. Pitch Control Bearing Pivot Pin Repair or Replacement

(Ref. Figure 7-19) Minimum allowable pin diameter is 0.4328 inch (10.99312 mm). Pivot pin grooving or excessive side wear may be polished to original finish as long as minimum allowable pin diameter remains after rework. Replace any pin requiring more rework, as follows:

NOTE: Due to tolerance build-ups in forging and casting of individual main rotor hubs, insertion of the stud nut holding wrench (50, Table 2-2) may not be possible with some hubs. If the holding wrench cannot be inserted properly to engage the stud attach nuts, the hub assembly must be sent to an overhaul facility for stud replacement.

(1). Hold nut with stud nut wrench (50) and remove pivot pin with pitch bearing stud wrench (49). The stud nut wrench is not required when nut retaining brackets are installed on the hub.

(2). Lightly lubricate the threaded shank of the replacement pivot pin with grease (18, Table 2-4).

NOTE: Before applying the last **20 - 30 inch-pounds (2.26 - 3.39 Nm)** of the torque specified in steps (3). and (5). below, use a 0.002 inch (0.0508 mm) feeler gage and check for gap between the pin flange and mounting lug surface. No gap is allowed.

(3). If nut retaining brackets are not installed;

(4). Install pivot pin in mounting lug and secure with a washer coated with wet primer (4) and a nut.

(a). Hold nut with stud nut wrench.

(b). Using pitch bearing stud wrench, torque pivot pin to **200 - 220 inch-pounds (22.60 - 24.86 Nm)**.

(5). If nut retaining brackets are installed;

(a). Install pivot pin in mounting lug with washer.

(b). Using pitch bearing stud wrench, torque pivot pin to **200 - 220 inch-pounds (22.60 - 24.86 Nm)**.

32. Droop Stop Restrainer and Roller Repair or Replacement

(Ref. Figure 7-21) Replace a defective droop stop roller if clearance between roller bearing liner and shaft is more than 0.015 inch (0.381 mm), replace the worn part.

Roller shaft OD must not be less than 0.437 inch (11.0998 mm).

A defective follower or spring is replaceable after removal of the droop stop ring (Ref. Droop Stop Ring Replacement).

(1). Remove pitch control bearing housing assembly that contacts the lower shoe roller to be removed.

NOTE: Only one roller of each opposing pair of droop stop rollers can be removed at one time. One droop stop restrainer must be pressed against the droop stop ring to force the opposite restrainer out and expose the roller shaft for removal. The same condition pertains during installation.

(2). Press down on pitch housing that is opposite to the roller to be removed. Remove cotter pin and shaft.

(3). Remove droop stop roller.

(4). To install replacement roller, press down on pitch housing at the opposite side of the hub from the roller to be installed. Install roller, shaft, and new cotter pin.

(5). Install pitch control bearing housing assembly.

33. Droop Stop Ring Repair

(Ref. Figure 7-21)

(1). The repair depth limit for corrosion, nicks or scratches in the droop stop ring is 0.007 inch (0.1778 mm) for all surfaces except the edges of the ring OD.

The depth limit for the ring OD edges is 0.030 inch (0.762 mm) (Detail C).

All reworked areas must be blended smoothly with a 15:1 ratio into the surrounding area.

(2). Touch up repaired areas of cadmium-plated rings, except the channel, with chemical film (8, Table 2-4) followed by primer (4).

(3). Repairs in the channel of cadmium-plated rings and in all areas of stainless steel rings should be sprayed with dry film lubricant (25) only.

(4). Replace the droop stop ring if repair limits have been exceeded.

34. Droop Stop Ring Replacement

(Ref. Figure 7-21)

(1). Turn the hub upside down. Support the hub so that the pitch housings will unload the cam followers and provide maximum clearance between the striker plates and droop stop rollers.

(2). Release the retaining (snap) ring of each droop stop restrainer from its groove.

(3). Move the retaining ring flush against the T-head to provide additional clearance and reduce the spring tension.

(4). Remove the four droop stop rollers.

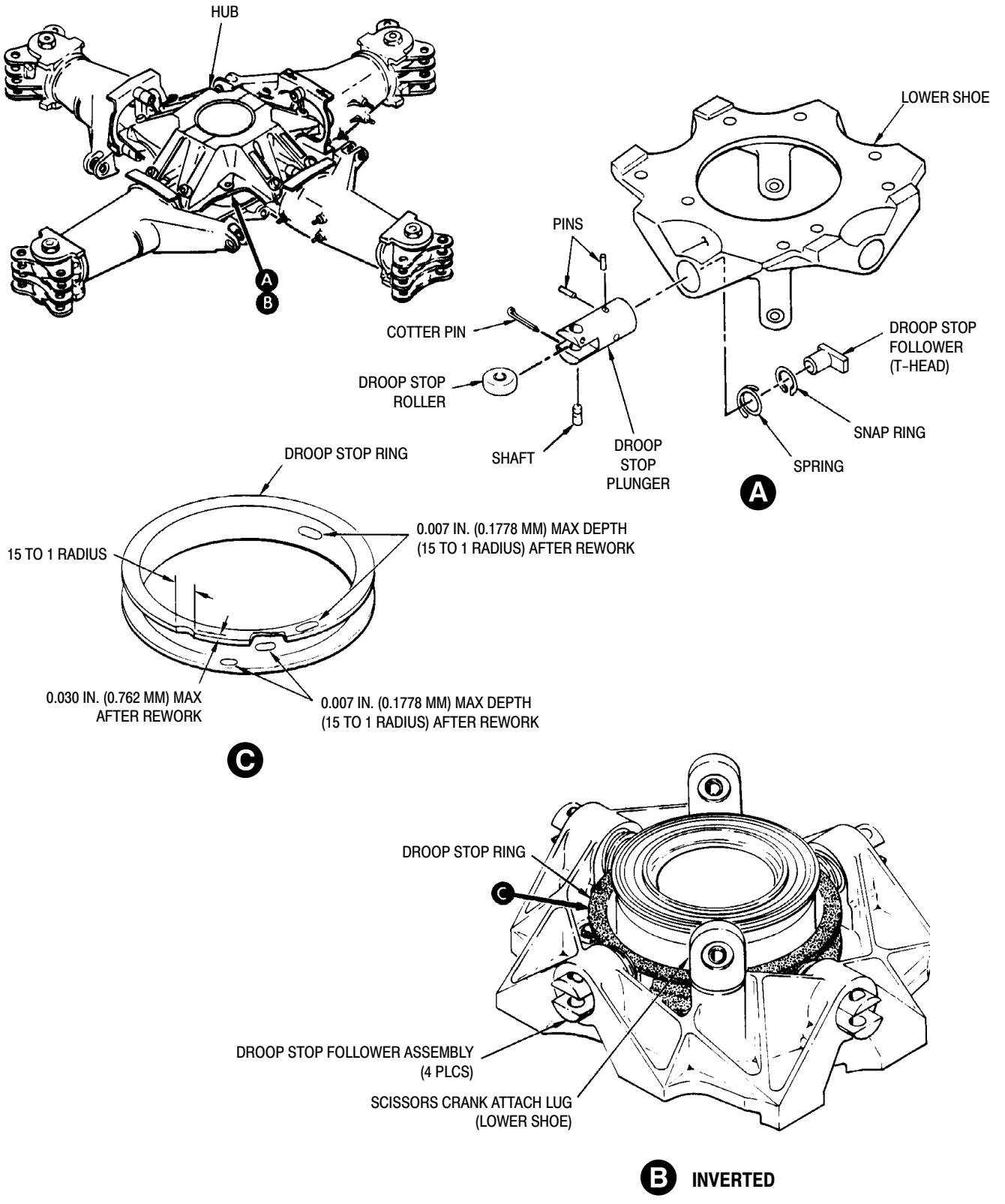


Figure 7-21. Main Rotor Hub Assembly Repair

(5). Starting from either scissors crank attach lug, number the four droop restrainers in a clockwise direction for identification during the replacement procedure.

(a). This number code should be replaced on the outboard (roller) upper end of the follower.

(b). Guard against the accidental removal of the codes during the remaining steps.

NOTE: Designation of upper and lower droop restrainer followers is in relation to the hub as it sits, not as it is installed on the helicopter. Notice that the odd numbered (1 and 3) followers are in the upper position and the even numbered (2 and 4) followers are in the lower position.

(6). Push the droop stop ring toward the number 1 and 2 followers.

(7). Pull the number 3 and 4 follower T-heads from the droop stop ring channel.

(8). When the T-heads are free of the ring channel they should be turned perpendicular (vertical) to the channel.

NOTE: The followers can be easily rotated by the use of a non-metallic drift in the hole for the droop stop roller shaft.

(9). Tilt the ring up on the number 3 and 4 followers as far as possible.

(10). While pulling upward on the ring, turn the number 4 follower to rotate the T-head under the ring.

(11). Continue pulling upward on the ring and turn the number 3 follower to rotate the T-head under the ring.

(12). Withdraw the number 1 and 2 T-heads from the ring channel.

(13). Remove the ring from the hub assembly.

(14). Prepare for installation of replacement droop stop ring by orienting the number 4 follower for incorrect (upper) position.

(15). Orient the number 1 and 3 followers for correct (upper) position.

(16). Orient the number 2 follower for correct (lower) position.

(17). Pull the number 1 and 2 followers outboard and engage the number 1 and 2 T-heads in the new droop stop ring channel.

(18). Rotate the number 3 follower in the direction that has the greatest amount of clearance between the T-head and ring. Continue the rotation of the number 3 follower until the T-head is in the incorrect (lower) position and engages the ring channel.

(19). Rotate the number 4 follower 180° which will position the T-head in the correct (lower) position and engage the ring channel.

(20). Pull the number 3 follower outboard to disengage the T-head from the ring channel.

(21). Rotate the number 3 follower 90° until the T-head is perpendicular (vertical) to the ring channel.

(22). Push down on the ring. Rotate the number 3 follower 90° until the T-head is in the correct (upper) position and engages the ring channel.

(23). Check the number 1 and 3 followers for correct (upper) orientation.

(24). Check the number 2 and 4 followers for correct (lower) orientation.

(25). Check the droop stop ring for correct (level) installation.

(26). Compress the droop restrainer spring and install the retaining (snap) ring in its groove on each follower.

(27). Reinstall the droop stop rollers.

35. Droop Stop Plunger Inspection and Replacement

(Ref. Figure 7-21)

(1). Remove droop stop ring.

(2). Remove pitch control bearing housing assembly that contacts the lower shoe roller.

(3). Remove cotter pin and shaft from droop stop follower assembly.

(4). Remove droop stop roller.

(5). Push droop stop plunger out of lower shoe.

(6). Check droop stop plunger for wear as follows:

(a). The minimum acceptable diameter after wearing in service, should be 0.996 inch (25.2984 mm).

(b). The acceptable amount of wear through the anodized coating shall not exceed 40% or 2.1 square inches (13.55 square cm) of the total sliding surface area of the cylinder.

(c). The maximum wear condition may exist in one spot or in several spots totaling 2.1 square inches (13.55 square cm).

(7). Wet down and clean plunger and mating shoe bushing with isopropyl alcohol (71, Table 2-4).

(8). Install droop stop plunger into lower shoe.

(9). Install roller, shaft and new cotter pin.

(10). Complete droop stop ring installation.

36. Main Rotor Hub Tapered Bearing Replacement

(Ref. Figure 7-7) Replace tapered roller bearing cup or cone if it has any flat spots, scoring, pitting, grooving, discoloration (blue) or if it feels rough when rotated. If a cone is unserviceable, the mating cup must be replaced, and vice versa.

NOTE: The roller bearing cones and cups should always be replaced as a set.

(1). Use pressing tools equivalent to items A and B (Ref. Figure 7-22) to press upper and lower bearing cups from hub assembly, press ram of 1 to 2 tons is sufficient for removal.

(2). Press lower bearing cone from sleeve bushing.

NOTE: In next step, do not spin reusable bearings while cleaning. Coat bearings lightly with oil (35, Table 2-4) after cleaning.

(3). Clean the hub bore, sleeve bushing, seal retainer and reusable bearings, using filtered solvent (1) spray.

(4). Check bearing cup hub bore for scoring.

(a). Smooth out any roughness with grade 400 to 600 abrasive cloth (20).

(b). Restore chemical film protection (Ref. Sec. 2), where removed.

(c). Maximum diameter of the hub bore for upper bearing cup is 4.4335 inches (11.26109 cm), measured in any direction.

(d). Maximum diameter of the hub bore for lower bearing cup is 4.3095 inches (10.94613 cm), measured in any direction.

(5). Check upper seal retainer. No cracks, sharp nicks or burrs are allowed. Minor corrosion or other surface defects may be polished out using crocus cloth (23). Grooving on seal contact surfaces must not exceed 0.004 inch (0.1016 mm) depth after polishing.

WARNING **The bearing cups are installed in the hub by the differential temperature (shrink-fit) method. Take appropriate precautions to prevent burns when handling parts that have been cooled down to sub-zero temperatures.**

(6). Place bearing cups in a closed container of dry ice and cool down for not less than 20 minutes to -40°F (-40°C).

(7). Coat bore of hub with grease (21). Use care to maintain cup to hub bore alignment and press cup into bore, using tools D and E until cup is seated.

(8). Apply a film of grease to sleeve bushing. Use d pressing tool equivalent to tool C and press bearing cone onto sleeve bushing.

(9). Install center seal in hub by hand pressing it into place. Check that seal lip is upward.

(10). Apply a film of grease on mast. Install preassembled sleeve bearing and bearing cone on mast. Do not apply any additional lubricant to roller bearing

set. Wipe any excess preservative oil from bearing cone and cup.

(11). Place assembled hub over mast and seat on lower roller bearing cone.

(12). Install a lead spacer 369A1224-5 (thickness gage substitute for upper seal retainer) over dummy mast. Rest spacer on top of sleeve bushing.

NOTE: If a lead spacer 369A1224-5 is not available, fabricate its equivalent from lead sheet. Spacer dimensions are: 2.96 inches (7.5184 cm) OD; 2.68 inches (6.8072 cm) ID; 0.075-0.085 inch (1.905-2.159 mm) thick.

(13). Install upper bearing cone into hub and on top of lead spacer.

NOTE: This step is not required. However, the use of a substitute washer for the retainer will prevent unnecessary scoring of the retainer. Several tightening and loosening actions might be required to get the correct rotational drag on the hub bearings.

(14). Install a steel ring washer, equivalent to tool F, as a substitute for packing retainer.

(15). Install mast nut on mast.

(a). Tighten using mast nut wrench (19 or 20, Table 2-2) until bearings are preloaded to **10 - 12 inch-pounds (1.13 - 1.36 Nm)** of rotational drag.

(b). Measure rotational drag using a **0 - 10 pound (0 - 44 N)** spring scale, hooked over one of the hub fairing bosses, 6.5 inches (16.5 cm) from hub centerline.

(c). Read a **1.50 - 1.75 pound (6.67 - 7.78 N)** pull with hub in motion.

(16). Remove mast nut, ring washer F or seal retainer, and upper bearing cone.

(17). Remove lead spacer and measure compressed thickness.

(18). Obtain a serviceable recessed washer of the same thickness if one is available.

(a). If not, grind a new recessed washer to the required dimension.

(19). Discard lead spacer after recessed washer is ground.

NOTE:

- If the hub assembly (with sleeve bushing, spacer, upper bearing and seal retainer installed) does not seat properly onto the mast, do not attempt to force it into position. Remove hub assembly from mast and determine cause of hub not seating, correct the problem and follow the procedures for installation.
- To insure that hub is seated onto the mast properly before torquing, 2 to 4 threads should be showing above the mast nut with nut installed finger tight.

(20). Install recessed washer, recess down, on the top of sleeve bushing.

(21). Reinstall upper bearing cone, the ring washer (or seal retainer) and mast nut.

(22). Tighten nut to **200 - 250 foot-pounds (271 - 339 Nm)** and check for rotational drag of **10 - 20 inch-pounds (1.13 - 2.26 Nm)**. This will be **1.50 - 3.0 pounds (6.67 - 13.34 N)** on the spring scale used as in step (15). above.

(23). Remove hub and sleeve bushing with lower bearing cone from mast.

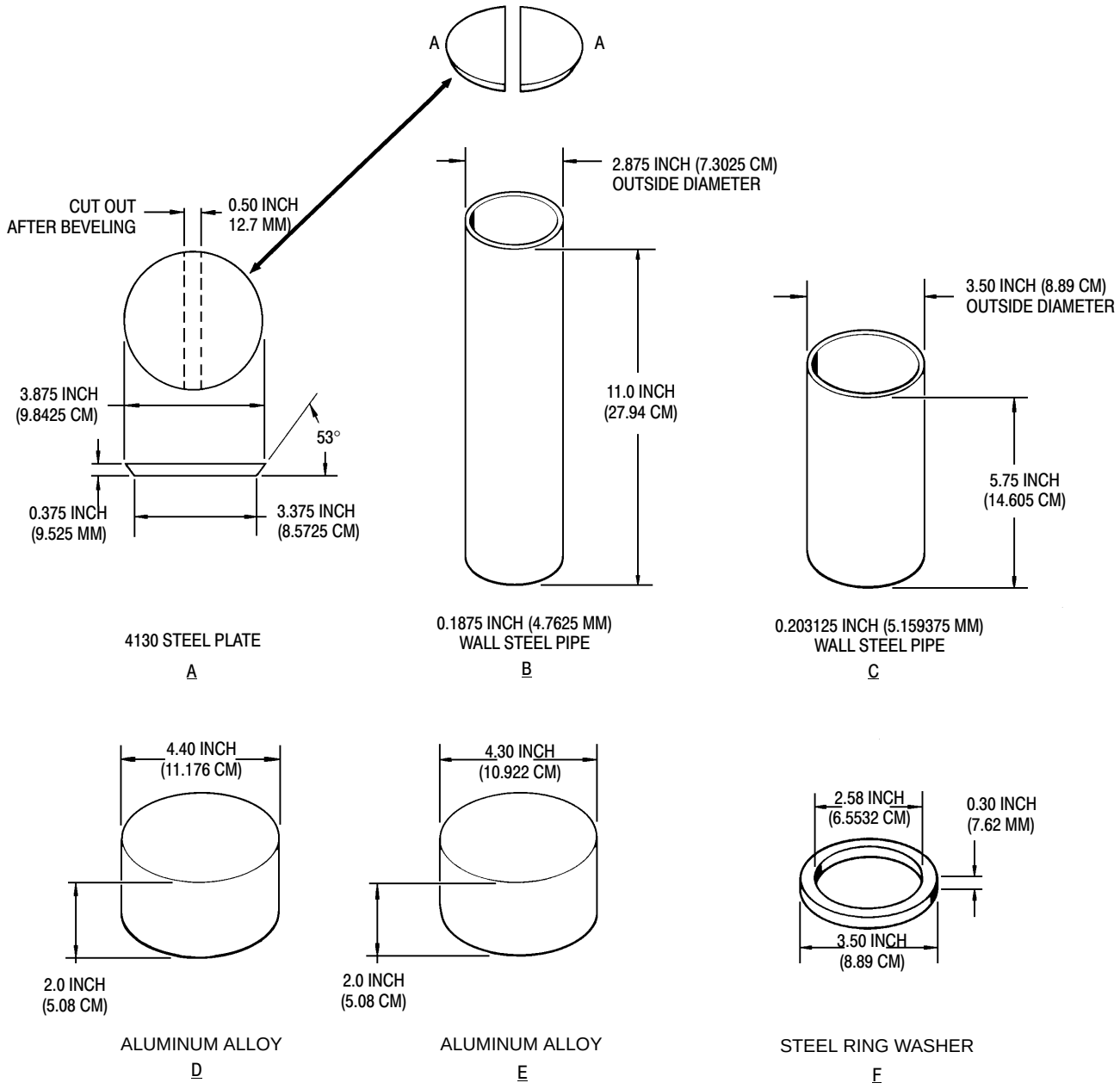
(24). Position hub upside-down on a suitable work bench. Hand-pack the lower hub cavity and the bearing cone on sleeve bushing with grease (21, Table 2-4).

(25). Install sleeve bushing with bearing cone in the hub.

(26). Hand-pack the cavity between bearing and the hub liner with grease; then press in the lower seal with seal lip toward top of hub. Wipe off excess grease.

(27). With the aid of an assistant, turn hub assembly right side up on the bench.

(28). Complete reassembly of hub by installing recessed washer, upper bearing cone, upper seal, and seal retainer in hub at installation of hub on the mast.



TOOL USE:

A & B – PRESS BEARING CUPS OUT OF HUB
C – PRESS LOWER BEARING CONE ON SLEEVE BUSHING
D – PRESS UPPER BEARING CUP INTO HUB
E – PRESS LOWER BEARING CUP ONTO HUB
F – IN PLACE OF UPPER SEAL RETAINER WHILE ADJUSTING ROTATIONAL DRAG
G – HUB BEARING REMOVAL – FABRICATION

G62-2010-1

Figure 7-22. Main Rotor Hub Tapered Bearing Tools

37. Main Rotor Hub Assembly Droop Angle Check

When a new or replacement main rotor hub is installed or whenever excessive droop angle is suspected, measure the static droop angle of all four rotor blades. Droop angle must be between 5 and 6 degrees.

(1). Install cyclic lateral rigging fixture (14, Table 2-2), cyclic longitudinal rigging fixture (12) and collective rigging fixture (9).

(2). Position main rotor with one blade over the tailboom.

(3). Raise and support the forward blade until the droop stop roller of the forward blade is no longer in contact with the striker plate.

(4). Place an accurate prop protractor (63) beside head of main rotor driveshaft and seat protractor on flat machined surface of main rotor hub. Adjust protractor to zero setting.

NOTE: If sufficient flat surface area is not available on hub to properly support protractor, four bolts, nuts and associated washers securing driveshaft maybe removed and a metal plate with four equal length spacers can be temporarily attached at the four holes to provide a flat level surface for the protractor.

(5). Place the protractor on the machined surface of the outboard end of the aft blade pitch housing, alongside the lead-lag bolthead (Ref. Figure 7-18). Measure and record the static droop angle.

(6). Repeat steps (2). thru (5). for the remaining blades.

(7). The maximum allowable static droop angle is 6 degrees. If the measured droop angle exceeds 6 degrees, inspect the striker plate and roller for excessive wear and adjust the droop angle.

(8). If metal plate and spacers were used to provide surface for protractor, remove plate, spacers and reinstall removed bolts, washers and nuts as specified in installation procedures for main rotor drive shaft in Section 9.

38. Main Rotor Hub Assembly Droop Angle Adjustment

(Ref. Figure 7-19) If static droop angle exceeds 6 degrees, adjust as follows.

(1). Remove main rotor blades.

(2). Use "AN960 _____" (C416, C416L, KD416 or KD416L) flat washers to adjust the spacing between spacer and striker strip.

NOTE: Any one type, or combination, of the washers specified may be used; however, an identical washer selection (thickness) must be installed on each of the three bolts that secure the pitch control bearing assembly to the pitch housing.

(3). Remove nuts and washers and separate spacer from striker strip.

NOTE: The use of one thick 0.016 inch (0.4064 mm) washer will raise the static droop angle approximately one-half a degree.

(4). Add sufficient washers to adjust droop angle to within the range of 5 to 6 degrees. Reinstall nuts and washers.

(5). If more than 0.063 inch (1.6002 mm) spacing (above factory spacing) is required, inspect striker plate, droop stop roller, follower and ring for excessive wear; Replace as required.

NOTE: The average factory spacing on new and rebuilt hubs is 0.032 inch (0.8128 mm).

(6). Reinstall blades. Repeat the measurement of static droop angle to recheck the droop angle.

(7). Check track of main rotor blades following reinstallation or replacement of parts.

39. Main Rotor Damper (Friction Type, P/N 369A1400)

(Ref. Figure 7-16) A main rotor damper is attached to each pitch housing of the rotor hub assembly. The damper is connected to the inboard trailing edge of the associated main rotor blade by a damper arm link to prevent lateral vibrations from occurring in the main rotor blades.

The damper contains spring-loaded friction plates and associated parts in an oil filled housing. The damper functions as a rotary friction damper with either three or four consecutive separate torque stages through an overall torque range of **300 - 1950 inch-pounds (2.12 - 13.77 Nm)**. A damper torque adjustment bolt retains the components inside the housing and provides the means for torque adjustment.

The main rotor damper is designed to operate as a sealed unit and does not require the addition of hydraulic oil at regular intervals. Refer to CSP-H-5 for maintenance information such as torque adjustment, internal phasing, weight adjustment (if applicable), detail parts inspection, repair and overhaul.

NOTE: The main rotor damper may be a basic four-stage, uniform four-stage or uniform three-stage damper. The basic four- stage damper is not weight controlled. Both the uniform four-stage and uniform three-stage dampers are weight controlled to maintain a completely balanced main rotor hub configuration.

A. Main Rotor Damper Removal (Friction Type, P/N 369A1400)

NOTE: If more than one damper is being removed, the main rotor blades should be removed.

(1). If in use, unlock damper arm link attach pin, but do not remove.

(2). Remove cotter pin, nut, washer and bolt that attach damper arm link to damper.

(3). Swing damper arm link aside.

(4). Remove three nuts and washers that mount damper and remove damper.

B. Main Rotor Damper Installation (Friction Type, P/N 369A1400)

(1). Position main rotor damper on studs of pitch housing.

NOTE: Slight looseness of damper attaching studs is allowable. The maximum displacement of the threaded end (tip) of the stud is limited to 0.015 inch (0.381 mm). The large portion of the stud must be below the mounting surface on the pitch housing. Damper attaching studs not meeting these requirements require replacement. Refer to CSP-H-5 for available repair and overhaul information.

(2). Install three washers and nuts. Torque the nuts to **50 - 70 inch-pound (5.65 - 7.91 Nm)**.

(3). Inspect for a minimum of 0.002 inch (0.0508 mm) gap between damper and pitch housing. If gap is insufficient, rework pitch housing.

(4). Align damper arm link with damper; install bolt with head down, washer and nut.

(a). Install washers under bolthead as required to provide additional clearance between bolt end and damper housing.

(b). Torque nut to **30 - 60 inch-pounds (3.39 - 6.78 Nm)**. Install new cotter pin.

NOTE: Cutout (scalloped) area on damper arm link must be installed towards damper. If incorrectly installed, interference between arm and damper can occur.

(5). Attach damper arm link to fitting on blade with bolt, two washer and nut.

(a). Torque nut to **30 - 60 inch-pound (3.39 - 6.78 Nm)** and install new cotter pin.

(b). If damper arm attach pin is in use, install pin and lock into place.

NOTE: Ensure damper arm (blade) attach pins are adjusted correctly.

(6). If removed, reinstall main rotor blade(s).

C. Main Rotor Damper Inspection (Friction Type, P/N 369A1400)

(1). Inspect bearing in arm of damper for looseness, binding and galling or scoring in bore.

(a). Bearing radial play is limited to 0.010 inch (0.254 mm) maximum; axial play is limited to 0.020 inch (0.508 mm) maximum.

(b). Bearing roughness is not permissible.

(c). If these limits are exceeded, or the bearing outer race is loose in the arm bore, the damper must be replaced.

(2). Inspect housing and cap for cracks and breaks, for evidence of oil leakage and lockwire for security. Replace a leaking damper.

NOTE: Damper repair must only be performed according to CSP-H-5.

D. Main Rotor Damper Torque Check (Friction Type, P/N 369A1400)

When trouble has been experienced with rotor vibration, refer to Table 7-8. Check damper phasing and first stage torque as follows.

(1). If in use, unlock damper arm link attach pin but do not remove.

(2). If recessed torque wrench adapter (23, Table 2-2) is used, disconnect damper arm link at blade and rotate link to align with arm of damper.

(3). If non-recessed adapter is to be used, disconnect link from arm of damper.

NOTE: Do not use vibration dampers for turning main rotor or handholds. Such use can damage damper bracket.

(4). Move rotor blade out of the way, as necessary and attach torque wrench adapter to damper arm; then attach a suitable tool and cycle the damper through the first stage approximately 50 times.

NOTE: Repeated cycling of the damper prior to torque check will provide an in-service condition for a true check of damper torque setting.

(5). Remove tool and attach dial indicating torque wrench so torque wrench can be used to move arm.

(6). Move arm slowly toward lag stop from phased position through first stage travel (approximately 5 to 10 degrees).

(a). Minimum allowable torque required to move arm can vary according to temperature as indicated in Table 7-8.

(b). Maximum torque required to move arm must not exceed **240 inch-pounds (27.12 Nm)** on current dampers, or **385 inch-pounds (43.50 Nm)** on early dampers, regardless of temperature.

(c). If torque is outside these range limits, torque must be adjusted or the damper replaced, or repaired.

NOTE:

- Reducing damper torque to the minimum allowable setting for low temperature operation may smooth out damper performance and eliminate one-to-one lateral vibrations (Ref. Table 7-1).
- It is important that the correct minimum torque value be used. This especially so when adjusting damper torque at extreme low temperatures.
- For optimum results, damper should be (set) to the ambient (indoor or outdoor) temperature. For temperature of +40°F (+4°C), minimum damper torque setting would be **289 inch-pounds (32.65 Nm)**; or at -20°F (- 29°C), it is **265 inch-pounds (29.94 Nm)**, etc. (Intermediate settings within each temperature range listed would be proportional; for instance, between 0° and +40°F (- 17° and +4°C), the correction would be **1 inch-pound (0.113 Nm)** per each 3.5°F (1.5°C) change.)

(7). Remove torque wrench and adapter and reposition damper arm link.

(8). If non-recessed adapter was used, reinstall bolt, head down, washer and nut. Torque nut to **30 - 60 inch-pound (3.39 - 6.78 Nm)**, and install new cotter pin. If recessed adapter was used, reinstall attach pin or standard hardware in blade.

(9). If in use, lock the attach pin and check tightness.

Table 7-8. Temperature vs Damper Torque

Ambient Temperature F (C)	Minimum Damper Torque in. -lb (Nm)
+70 (+21)	300 (33.90)
+40 (+4)	289 (32.65)
0 (-18)	278 (31.41)
-20 (-29)	265 (29.94)
-40 (-40)	243 (27.46)

E. Installed Main Rotor Damper Phasing Check (Friction Dampers Only, P/N 369A1400)

Phasing of the main rotor dampers may be necessary if there is ground rocking or if a one-to-one lateral (main rotor) vibration occurs during certain flight maneuvers. A check of damper internal phasing can be made as outlined below. The phasing should be accomplished by two persons.

NOTE:

- Do not use vibration dampers for turning main rotor or handholds. Such use can damage vibration damper bracket.
- To move the damper arm back and forth through the first (low torque) stage, only **10 - 15 pounds (44.48 - 66.72 N)** of fingertip pressure is required at the tip of the main rotor blade.
- If pressure in excess of approximately **19 pounds (84.52 N)** is applied to blade tip in a lag direction, the internal friction plates can be shifted out of phase with each other and only rephasing by the bench method outlined in CSP-H-5 will restore the damper for proper operation. If light pressure at the blade tip will not move the blade, check damper for proper torque.

(1). Rotate and position one main rotor blade over the tailboom.

(2). Engage rotor brake (if installed) or hold tail rotor blades to prevent rotation of main rotor blades.

(3). Carefully push the main rotor blade at right side of helicopter in a lead direction and when a positive increase in friction is detected, release pressure.

(4). Carefully push same main rotor blade in a lag direction and again release pressure when a positive increase in friction is felt.

(5). Repeat step (3).

(a). Obtain or fabricate a main rotor damper check tool for installed dampers (a template is provided in CSP-H-5) and chock for correct damper arm tang position by measurement.

(b). One inch (2.54 cm) between lag edge of tang and lag stop of housing is approximate dimension required.

NOTE: If phasing is correct, an aid to any future check of phasing would be to apply vertical paint marks on the damper housing to indicate the lead and lag positions of the damper arm (link attach bolt) centerline for correct first stage travel.

(6). Release drive system, rotate main rotor blades and repeat the above procedure for the remaining three dampers.

40. Main Rotor Damper (Elastomeric Type, P/N 369D21400-503)

(Ref. Figure 7-16) A main rotor damper is attached to each pitch housing of the rotor hub. The damper is connected to the inboard trailing edge of the associated main rotor blade by an adjustable clevis to prevent lateral vibrations from occurring in main rotor blades. Neither damper travel nor stiffness is adjustable on the helicopter. Phasing of rotor blades is affected by turnbuckle adjustment. Any phasing problem caused by a defective damper should be corrected by replacing damper.

NOTE:

- Excessive lead- lag load applied to the main rotor blades during ground handling can result in damage to the elastomeric damper buns and failure of the damper assembly. Operators and maintenance personnel should use extra caution to avoid lead- lag loads in excess of **35 pounds (156 N)** at the tip of the main rotor blades.
- If one or more main rotor blades strike an object while rotating or the drive system has been subjected to sudden stop, inspect damper.

A. Main Rotor Damper Removal (Elastomeric Type, P/N 369D21400-503)

(1). Note and record location from which damper is to be removed from main rotor hub.

NOTE: At reinstallation, if damper is not reinstalled at same location, main rotor balancing is required.

(2). Remove main rotor blade.

(3). Remove damper.

NOTE:

- If damper is to be reinstalled at same location, do not disturb damper clevis, jam nuts or turnbuckle setting.
- If damper is not to be reinstalled, remove bushing from damper ear and retain with hub.

B. Main Rotor Damper Installation (Elastomeric Type, P/N 369D21400-503)

(1). Check, and if necessary, preset main rotor damper length (center-to-center dimension between mounting holes in damper ears and clevis) to approximately 8.229 inches (209.0166 mm). Leave jamnuts fingertight.

NOTE: Ensure that bushing is installed in large hole of damper ears.

(2). With damper rotational direction decal facing outboard so it can be read, attach damper ears to pitch housing lug with bolt (head up), washers, and nut. Torque nut to **30 - 60 inch-pounds (3.39 - 6.78 Nm)** and install cotter pin.

(3). Adjust main rotor blade phasing for associated main rotor blade.

(4). After final phasing adjustments, torque jamnuts to **95 - 110 inch-pounds (10.73 - 12.43 Nm)**. Safety jamnuts to turnbuckle with new lockwire. Lockwire must be located out-board, away from pitch housing.

NOTE: Threaded end of damper turnbuckle shaft must protrude through clevis base a minimum of two full threads and must clear blade damper attach fitting.

(5). Install main rotor blade.

(6). Connect damper to blade.

(7). Remove blade support.

C. Main Rotor Damper and Attachments Inspection (Elastomeric Type, P/N 369D21400-503)

NOTE: Excessive lead-lag load applied to the main rotor blades during ground handling can result in damage to the elastomeric damper buns and failure of the damper assembly. Operators and maintenance personnel should use extra caution to avoid lead-lag loads in excess of **35 pounds (156 N)** at the tip of the main rotor blades.

(1). Inspect bearing in rotor blade and bearing in the pitch housing for looseness around outer race. No degree of radial or axial play is permitted.

(2). Inspect pitch housing and blade bearings for binding, galling, or scoring in bore and for wear.

(a). No radial play is permitted.

(b). Maximum allowable axial play is 0.015 inch (0.381 mm).

(3). Inspect clevis bushings for wear and looseness.

(4). Inspect damper flange bushing for wear and play.

(5). Inspect lower bolt hole in damper flange for wear.

(6). Inspect damper housing (including flanges) for damage.

(7). Inspect damper turnbuckle, jamnuts and safetywire for security. No end play is permitted when manually tested.

NOTE: When performing lead-lag of main rotor blades, apply rotor brake (if installed) or have assistant hold main rotor hub from moving. A second assistant is recommended to measure approximate damper extension and compression.

(8). Lead-lag each main rotor blade in turn to provide approximately 0.10 inch (2.54 mm) extension and compression of the damper elastomer.

(9). Visually check each damper in turn for cracks in elastomer or in elastomer-to-metal bond at end face of damper:

(a). If bonding or elastomer cracks are noted, measure depths of cracks, using depth gage fabricated of shim stock or equivalent having a 0.20 inch (0.508 mm) indication.

(b). If depth of crack exceeds 0.20 inch (0.508 mm), remove and check damper.

D. Main Rotor Damper Weight Loading and Extension Check (Elastomeric Dampers Only, P/N 369D21400-503)

(Ref. Figure 7-23)

(1). Remove damper assembly.

(2). Attach dial indicator or equivalent to outer case of damper; position indicator arm on center aluminum disc as shown.

NOTE: Fabricate holding bar or fixture capable of sustaining 100 pound (45.36 kg) static load.

(3). Attach damper end cap to holding bar or fixture.

NOTE: Perform weight loading and extension check at ambient temperature of 70° ±l0°F (21° ±5°C). Apply total 100 pound (45.36 kg) weight load to damper at one time, not in weight increments.

(4). Using hydraulic jack or equivalent, raise and attach 100 pound (45.36 kg) weight load at damper clevis end. Slowly lower jack to avoid shock loading. After period of two minutes under load, measure damper extension on dial indicator.

(5). If extension exceeds 0.063 inch (1.6002 mm), replace the damper assembly.

(6). Reinstall existing damper; or as required; install replacement damper.

NOTE: If replacement damper is installed, record part number, serial number, and other pertinent information in Components Record of helicopters Log Book.

E. Blade Phasing Procedure (Elastomeric Type, P/N 369D21400-503)

(1). Remove all four main rotor blade dampers from helicopter.

(2). Store all four dampers together in horizontal position for minimum of six hours. Preferred ambient temperature during storage is 55° - 85°F (13° - 29°C).

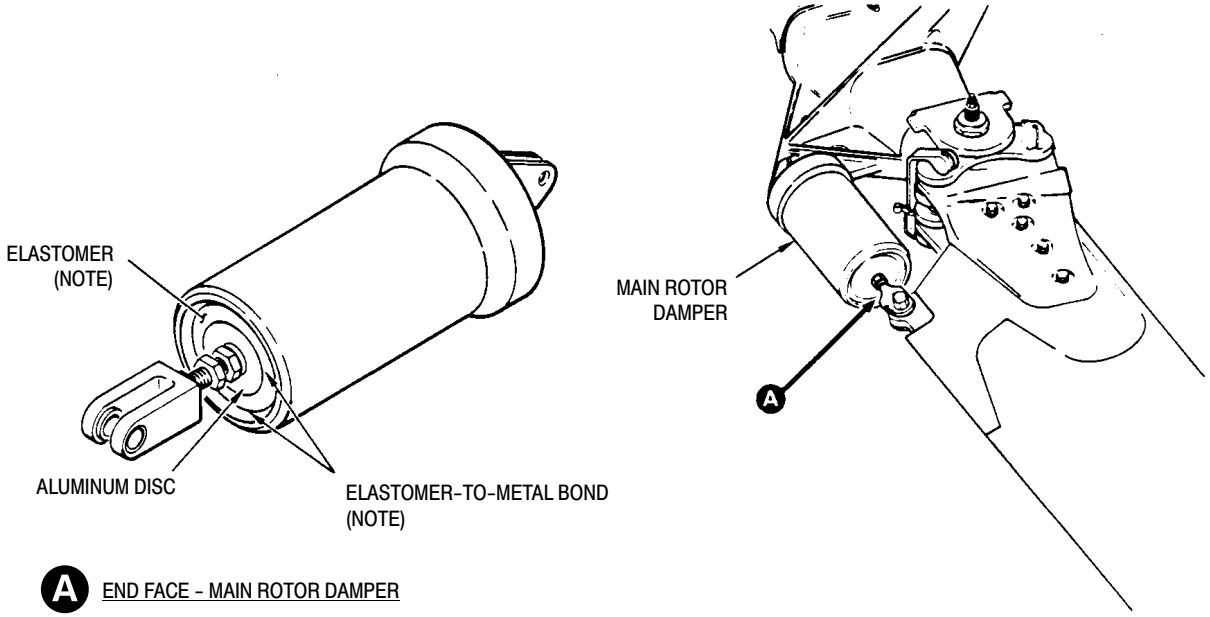
(3). Set damper length, centerline-to-centerline of bolt attach holes, to 8.229 ±0.015 inch (209.0166 ±0.381 mm) for initial installation.

(4). Install dampers on helicopter.

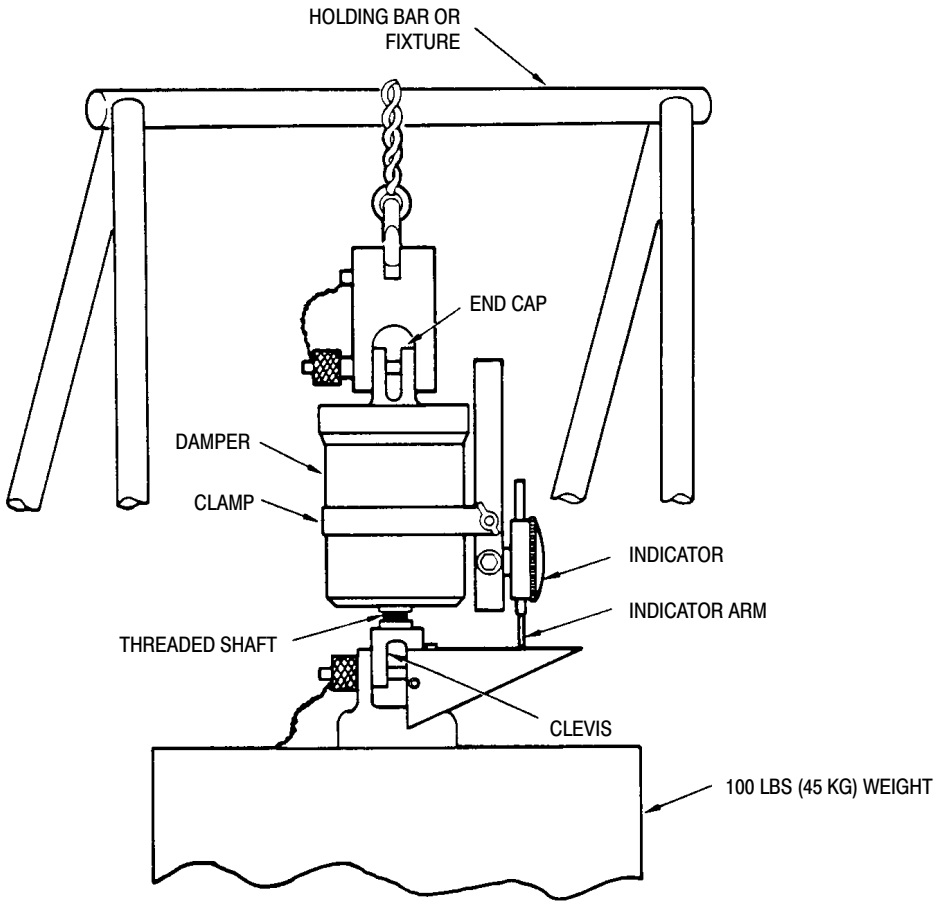
NOTE: If ground rock or stick shake is noted, complete step (5).

(5). Length of damper may be adjusted after initial setting by checking main rotor system balance (Ref. Main Rotor Balancing). Check of main rotor system balance should be accomplished only after main rotor blades have been tracked.

NOTE: If more than four flats turn of turnbuckle adjustment is necessary to correct balance, return to step (1). and repeat procedure.



A END FACE - MAIN ROTOR DAMPER



NOTE:
CHECK ELASTOMER AND ELASTOMER-TO-METAL BOND FOR CRACKS.

DIAL INDICATOR SETUP

G62-2008A

Figure 7-23. Periodic Check of Main Rotor Elastomeric Damper Assembly

41. Main Rotor Controls

(Ref. Figure 7-24) The main rotor controls consist of a scissors assembly, rotating swashplate, stationary swashplate, mixer controls (lateral bellcrank, longitudinal idler, collective pitch mixer bellcrank, longitudinal bellcrank, longitudinal control-mixer link, longitudinal link, and two mixer links) and four pitch control rods.

Movement of collective pitch stick and cyclic control sticks is transferred to mixer controls through control rods routed up through the controls tunnel at the center of Sta. 78.50 bulkhead. The mixer controls transfer the required combination of collective, longitudinal and lateral travel to the main rotor blades through the main rotor swashplate assembly.

CAUTION

- Ensure main rotor controls do not strike or get struck by any object. Many of the components are highly stressed and must not be returned to service if surface damage occurs.
- When maintenance work is being performed near the engine air inlet use care to prevent entry of foreign objects. Tape covers of cardboard or other suitable material in place over the engine inlet screen and oil cooler air inlets. Do not remove covers until work is completed and debris is thoroughly cleaned out of the area. After removing covers, verify that area around base of mast, inlet to plenum, and entire plenum chamber is free of foreign material.

42. Pitch Control Rods

(Ref. Figure 7-24) Four pitch control rods transfer pitch control from the rotating swashplate to main rotor blades.

A. Pitch Control Rod Removal

(1). Remove cotter pin, nut washer and bolt from each end of pitch control rod.

(2). Remove pitch control rod and O-ring.

NOTE: Rods are color coded to prevent reinstallation in the wrong locations. Observe coding and location at time of removal. If coding is no longer visible, reapply appropriate color identity.

(3). Measure rod length before replacing.

B. Pitch Control Rod Installation

(1). If pitch control rods are badly out of adjustment, or if the rod end bearing have been replaced, set length of the affected pitch control rod(s).

(a). For blades with a lower-tracking data decal, set pitch control rods, between rod end bearing centerlines, to the applicable strap pack pitch link length specified on the decal of the mating blade.

(b). For blades without a decal, set pitch control rods to 6.60 inches (16.764 cm) between rod end bearing centerlines for the two blade attached to the hub upper strap pack, and 6.35 inches (16.1544 cm) for the two blades attached to the lower strap pack.

(2). Observe the ground track before making addition adjustments.

(3). Install O-ring and pitch control rod.

NOTE:

- Check pitch control rods for location color code.
- Blades must be tracked if rod length is changed. Be sure that rod end threads are engaged beyond witness hole in rod body (hole blocked).
- After proper bearing alignment (centering) in swashplate lugs and pitch housing lugs, tighten locknuts and install lockwire.
- Rod ends must be centered; if not centered, fitting wear will result.
- Be sure that pitch rod bolts are installed with the bolthead in the direction of rotation (counter-clockwise as viewed from above).

(4). Install bolt, washer and nut in upper end of rod. Torque nut to **100 - 140**

inch-pound (11.30 - 15.82 Nm) and install new cotter pin.

NOTE: If castellation alignment is not possible with the torque specified in step (5). below, add another washer. Do not exceed the maximum torque value.

(5). Install bolt, washer, and nut in lower end of rod. Torque nut **30 - 60 inch-pound (3.39 - 6.78 Nm)** and install new cotter pin.

43. Scissors Assembly

(Ref. Figure 7-24) The scissors assembly is a pivoting link that provides a movable connection between the rotating swashplate and the main rotor hub.

A. Scissors Assembly Removal

CAUTION Removal of all pitch control rods is recommended prior to scissors removal. Failure to observe this precaution could result in damage to pitch control rods, swashplate and/or hub.

(1). Disconnect lower end of pitch control rod that is in line with scissors link in rotating swashplate.

(2). Remove cotter pin, nut, washer, and bolt from each leg of scissors crank. Disconnect crank from hub lower shoe, use care to prevent loss of shim washers.

(3). Remove cotter pin, nut, washer, and bolt connecting scissors link to swashplate; remove scissors assembly.

B. Scissors Assembly Installation

(1). Place scissors assembly link in mounting position, chamfered edge of link must face outboard.

(2). Check that slotted bushing is in swashplate web and install attaching hardware. Torque nut to **15 - 20 inch-pounds (1.69 - 2.26 Nm)**. Install new cotter pin.

CAUTION Scissors crank must be positioned with hole in crank web down and decal, if present, up.

NOTE: Ensure crank- to- hub lower shoe lugs are not preloaded.

(3). Position scissors crank and required shim washers on hub lower shoe lugs.

(a). Install bolts with bolt heads facing outward and a washer under the head of the bolt.

(b). Torque nut to **30 - 60 inch-pounds (3.39 - 6.78 Nm)**. Install new cotter pin.

NOTE: Shim washers may be required on shouldered bushing side of clevis.

(4). Position O-ring and lower end of pitch control rod in swashplate lug and install attaching hardware.

(a). Nut is to be adjacent to bushing in swashplate.

(b). Torque nut to **30 - 60 inch-pounds (3.39 - 6.78 Nm)**. Install new cotter pin.

C. Scissors Disassembly

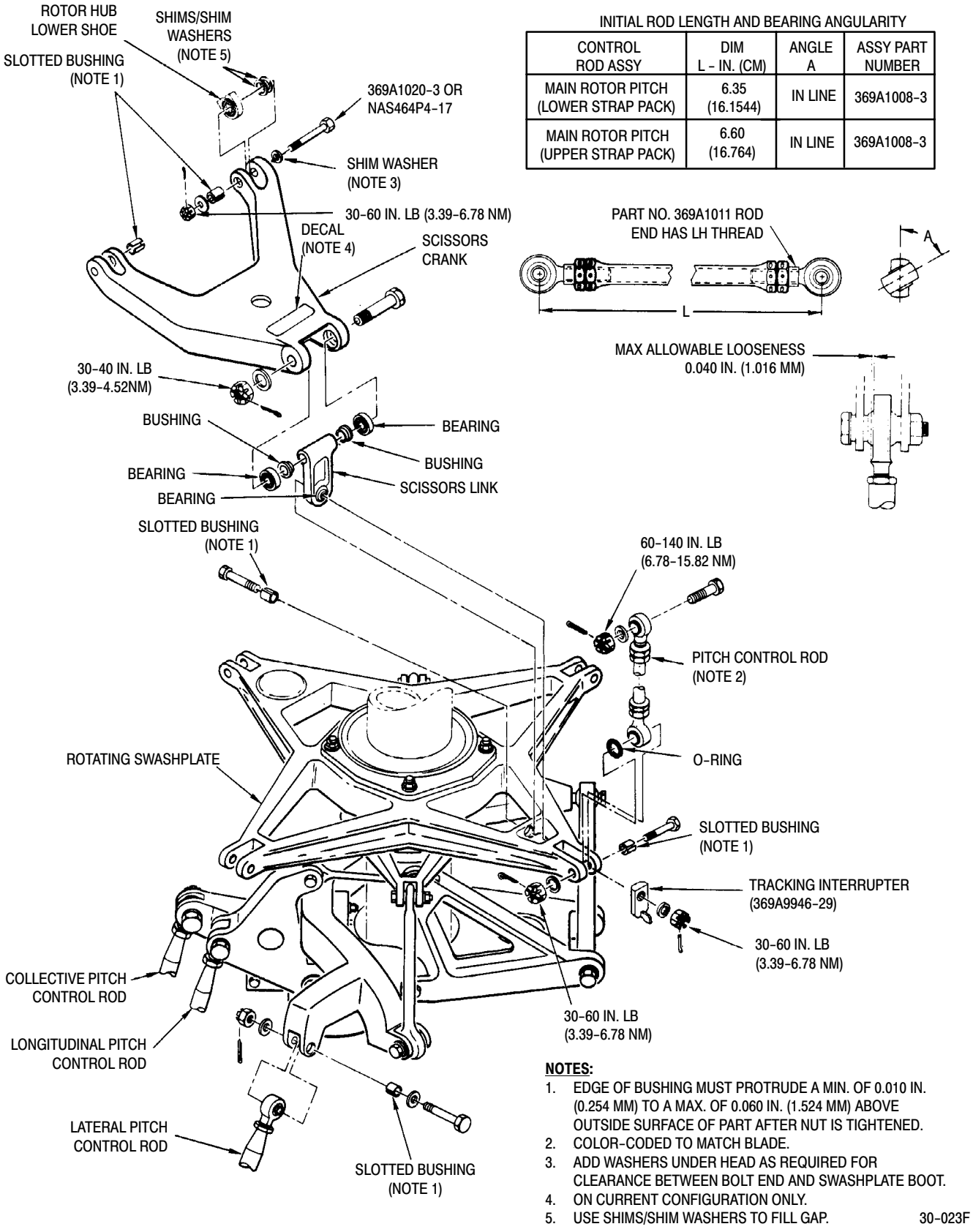
(1). Remove cotter pin, nut, washer, and bolt that join link and crank.

(2). Remove two bushings from link only if replacement is necessary.

(3). Do not remove bearing from link. Replace complete link if bearing is defective.

(4). Remove two lotted bushings and two bearings from crank, only if replacement is necessary,

NOTE: During cleaning, do not allow solvent to enter the races of scissors assembly bearings.



INITIAL ROD LENGTH AND BEARING ANGULARITY

CONTROL ROD ASSY	DIM L - IN. (CM)	ANGLE A	ASSY PART NUMBER
MAIN ROTOR PITCH (LOWER STRAP PACK)	6.35 (16.1544)	IN LINE	369A1008-3
MAIN ROTOR PITCH (UPPER STRAP PACK)	6.60 (16.764)	IN LINE	369A1008-3

NOTES:

1. EDGE OF BUSHING MUST PROTRUDE A MIN. OF 0.010 IN. (0.254 MM) TO A MAX. OF 0.060 IN. (1.524 MM) ABOVE OUTSIDE SURFACE OF PART AFTER NUT IS TIGHTENED.
2. COLOR-CODED TO MATCH BLADE.
3. ADD WASHERS UNDER HEAD AS REQUIRED FOR CLEARANCE BETWEEN BOLT END AND SWASHPLATE BOOT.
4. ON CURRENT CONFIGURATION ONLY.
5. USE SHIMS/SHIM WASHERS TO FILL GAP.

30-023F

Figure 7-24. Pitch Control Rods and Swashplate Scissors Assembly Installation

D. Scissors Inspection

WARNING **Any evidence of failure, damage, or deformation of crank or link is justification for replacement of either crank, link, or the complete scissors assembly. Failure of any of these component in flight can result in failure of movable flight controls, loss of helicopter, and possible injury or loss of life.**

(1). Inspect crank and link for evidence of impact damage and deformation. If condition is questionable, perform a fluorescent dye penetrant inspection.

(2). Inspect bearings for binding, looseness in mating bore and wear. Maximum wear limits are 0.010 inch (0.254 mm) radial and 0.020 inch (0.508 mm) axial.

(3). Inspect bushings for condition.

E. Scissors Reassembly

(1). If bushings were removed from the crank during disassembly, install new bushings. Use lubricant (25, Table 2-4); do not use primer. Seat bushings until ends are flush with inside surface of crank inboard ears.

(2). If bearings were removed from crank during disassembly, reinstall using the following procedure:

(a). Clean bearing outerace, counterbore, and faying surfaces with trichloroethane (61).

(b). Coat the faying surfaces with Locquic Activator (28) as per manufacturer's instructions.

(c). Apply Loctite Sealant A (29) to faying surfaces and press bearing until outer face is seated firmly against shoulder of counterbore.

(d). Remove excess sealant.

CAUTION Do not allow sealant to enter bearing race.

(e). Apply a small fillet of sealant to the faying edges of the bearing housing.

(f). Use cellophane or masking tape to exclude air and allow sealant to cure for 24 hours at ambient temperature or force cure by heating to 140°-160 °F (60°-71 °C) for 1 hour prior to use of assembly.

(3). If bushings were removed from link during disassembly, install new bushings. Dimension between outside faces of bushings is 1.616-1.628 inches (4.1046-4.1351 mm).

(4). Align bore of link with bore of crank; install bolt, washer and nut. Torque nut to **30 - 40 inch-pounds (3.39 - 4.52 Nm)**. Install new cotter pin.

44. Main Rotor Swashplate

(Ref. Figure 7-25) The main rotor swashplate consists primarily of a rotating swashplate, stationary swashplate, a bearing assembly and retainer, and a counterweight.

A. Swashplate Assembly Removal

(1). Tag or color-identify the four pitch control rods to facilitate their replacement in the same location.

CAUTION Failure to reinstall the four pitch control rods in the correct location will most likely result in the main rotor blades being badly out of track.

(2). Disconnect pitch control rods from the rotating swashplate.

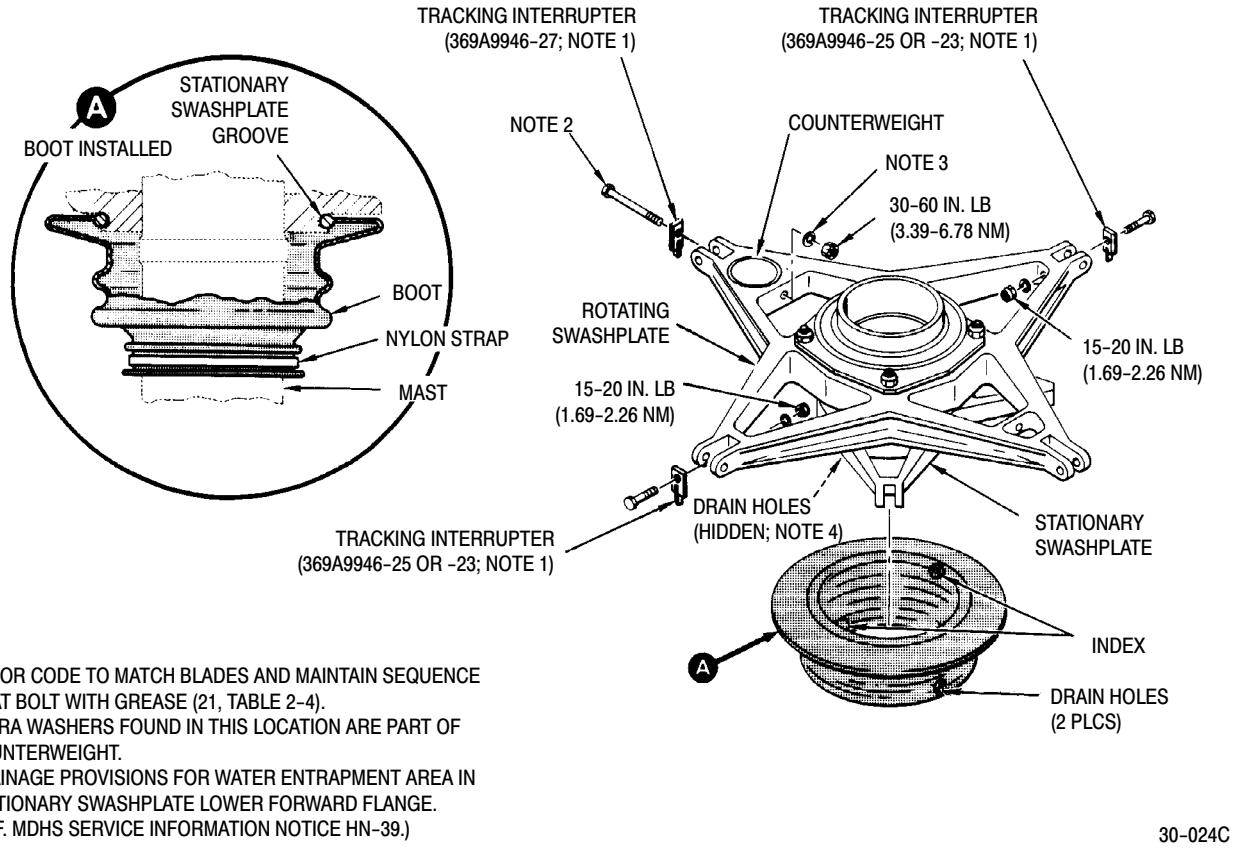
(3). Remove scissors assembly.

(4). Remove main rotor hub.

(5). Disconnect longitudinal link from stationary swashplate.

(6). Disconnect right and left side mixer links from stationary swashplate.

(7). Remove protective boot from groove in lower side of stationary swashplate.



NOTES:
1. COLOR CODE TO MATCH BLADES AND MAINTAIN SEQUENCE
2. COAT BOLT WITH GREASE (21, TABLE 2-4).
3. EXTRA WASHERS FOUND IN THIS LOCATION ARE PART OF COUNTERWEIGHT.
4. DRAINAGE PROVISIONS FOR WATER ENTRAPMENT AREA IN STATIONARY SWASHPLATE LOWER FORWARD FLANGE. (REF. MDHS SERVICE INFORMATION NOTICE HN-39.)

30-024C

Figure 7-25. Main Rotor Swashplate Assembly

CAUTION Do not strike rotating swashplate or bearing assembly with tools or in any way deface these components. The rotating swashplate is a stressed part that has had all surfaces shot peened. Use particular care to protect Teflon liner in bearing bore. A damaged swashplate bearing must not be retained in service. (Refer to HN-1 12 if stiff main rotor controls traceable to excessive preload torque on main rotor swashplate bearing occurs.)

(8). Lift swashplate assembly carefully up and off of mast.

(9). To remove boot from mast, remove self-clinching nylon strap.

B. Swashplate Assembly Installation

(1). If swashplate lower boot was removed, install boot on mast.

(2). Position swashplate over main rotor mast and carefully lower into place.

NOTE: To inhibit mast corrosion when operating in salt water environment, fresh water rinse and thoroughly dry the sliding swashplate area of mast and lightly coat area with grease film (18, Table 2-4).

(3). Engage upper end of boot in groove at lower side of stationary swashplate. Secure boot with self-clinching nylon strap.

(4). Align longitudinal link with stationary swashplate (Ref. Figure 7-26).

(5). Install flanged bushing (if removed), bolt, two washers, nuts and new cotter pin to secure upper end of longitudinal link.

(6). Align upper ends of mixer links with stationary swashplate. Install slotted bushing (if removed), bolt, two washers nut and new cotter pin to secure each link to swashplate.

(7). Install scissors assembly.

(8). Using color code, reinstall pitch control rods at same locations from which removed.

(9). Check track of main rotor blades following installation of any removed or replaced parts.

C. Swashplate Disassembly

Disassembly other than as illustrated is considered a part of swashplate overhaul. Refer to CSP-H-5 for this type of information. If tracking interrupters are removed, mark them to match the blade color code so that they may be returned to the original positions. Also note the number and type of washers used under the nut at the counterweight location. These are a part of the counterweight required for rotating swashplate balance.

D. Swashplate Assembly Inspection

CAUTION When cleaning swashplate assembly for inspection, use care to prevent solvent from entering the race area of either the spherical ball bearing or the double row ball bearing. Use a cloth, moistened in alcohol (71, Table 2-4) to wipe clean the spherical ball, ball bore liner and exterior of double row ball bearing.

NOTE:

- The swashplate may be constructed of either magnesium or aluminum alloy. Ref. Sec. 2 for corrosion control and identification of magnesium and aluminum alloys.
- In the following inspection, the rotating and stationary swashplates must be disconnected (Ref. Swashplate Assembly Removal/Installation).

(1). Inspect swashplate bearing assembly for evidence of binding in either radial or axial movement.

(2). Inspect Teflon liners for good condition. Ensure that all flexible rubber seals enclosing ball bearing races are in place; inspect for deterioration and indication of grease leakage. Refer to CSP-H-5 for re-greasing and seal replacement.

NOTE: The swashplate bearing assembly will normally show some signs of grease leakage for the first 10-15 hours of operation after a new installation.

(3). Inspect swashplate spherical ball and double row ball bearing for condition.

(a). Maximum radial play between sliding surface liner and the stationary mast is 0.020 inch (0.508 mm).

(b). Maximum axial play between spherical ball and Teflon liner is 0.010 inch (0.254 mm).

(c). If play is suspected in double row ball bearing, turn rotating swashplate until arms line up with those of stationary swashplate and check motion between the arms at the control bolt in the stationary swashplate. A maximum total vertical movement of 0.015 inch (0.381 mm) is allowable.

(d). Nicks and dents that do not deform ID chamfered edge of the hard anodized ball and that do not extend more than 0.040 inch (1.016 mm) along spherical ball surface from edge are allowed.

(4). Check the existing preload on the spherical bearing.

(a). Hold the ball to prevent rotation; then hook a spring scale over one of the bolts securing the stationary swashplate to the bearing flange.

(b). With the stationary swashplate in motion, drag should be no more than **30 pounds (13.61 kg)**. (Use the average of two readings taken 90 degrees apart.)

(5). Perform a careful visual inspection of the stationary and rotating swashplate for cracks, wear in bolt and bushing bores and fork inner surfaces, and for corrosion, nicks and dents. Perform dye penetrant check on questionable areas.

(6). Check that counterweight is securely bonded in rotating swashplate.

E. Swashplate Reassembly

Reinstall tracking interrupters in original color coded positions and torque nuts to the values shown.

NOTE: When installing tracking interrupter at the counterweight position, apply grease (21, Table 2-4) to the bolt and to the 0.250 inch (6.35 mm) diameter bore areas. Also be sure to reinstall all washers that were originally installed under the nut. These area part of the counterweight required for rotating swashplate balance.

45. Mixer Controls

(Ref. Figure 7-26) The mixer controls consist of various links, bellcranks, idlers, a support bracket and associated fasteners that secure these components in place and to the control tubes and main rotor swashplate.

A. Mixer Controls Removal

(1). Remove air intake forward fairing for access (Ref. Sec. 2).

(2). Disconnect upper end of the collective mixer, lateral mixer and longitudinal mixer control tubes.

NOTE: The control tubes are attached by slightly different length bolts. Reinstall each bolt in its bellcrank following control tube removal to facilitate reinstallation of the correct size.

(3). Remove mixer links. (Mixer link bearings are not replaceable.)

(4). Disconnect longitudinal link.

(5). Disconnect each end of longitudinal control-mixer link and remove link.

(6). Disconnect lateral bellcrank and lift from collective pitch mixer bellcrank.

(7). Disconnect longitudinal pitch mixer bellcrank and carefully remove bellcrank.

(8). Remove hardware from hingeline of support bracket, longitudinal pitch idler and collective pitch mixer bellcrank. Separate the three parts.

(9). Disconnect support bracket from mast base and remove.

(10). Remove the mixer support attaching bushing.

CAUTION Do not allow solvent to enter bearing races when cleaning mixer control components to prevent washing of dirt into bearing surfaces or grease out of the bearings.

B. Mixer Controls Installation

(1). Position support bracket over forward lug on mast base.

(2). Install the two aft bolts and washers in the support bracket and mast base. Install two thin washers and nuts; torque nuts to **80 - 100 inch-pounds (9.04 - 11.30 Nm) plus drag torque**.

(3). Using a ball hole gage and standard micrometer, check that misalignment between the forward bolt hole bore in the support bracket and the bore in the mast base lug is 0.015 inch (0.381 mm) or less.

NOTE: If necessary, loosen the aft two bracket-to-fitting nuts, position support bracket to minimize misalignment and retighten nuts.

(4). Install mixer support attaching bushing in bracket and mast base lug.

(5). Check that the sleeve bushing is in place; then install bolt, two washers and nut. Torque nut to **80 - 100 inch-pounds (9.04 - 11.30 Nm)**.

(6). Position longitudinal pitch idler and collective pitch mixer bellcrank on support bracket.

(a). Position washer between right side of longitudinal pitch idler bearing and center bearing of mixer support bracket.

(b). Install left-hand bearing, bolt, two washers, nut and new cotter pin.

(7). Position lateral bellcrank between collective pitch mixer bellcrank bearings and install bolt, two washers, nut and new cotter pin.

(8). Position longitudinal bellcrank with collective pitch mixer bellcrank.

(a). Insert the two flanged bushings into place.

(b). Install two bolts, six washers (two under each nut), two nuts and new cotter pins.

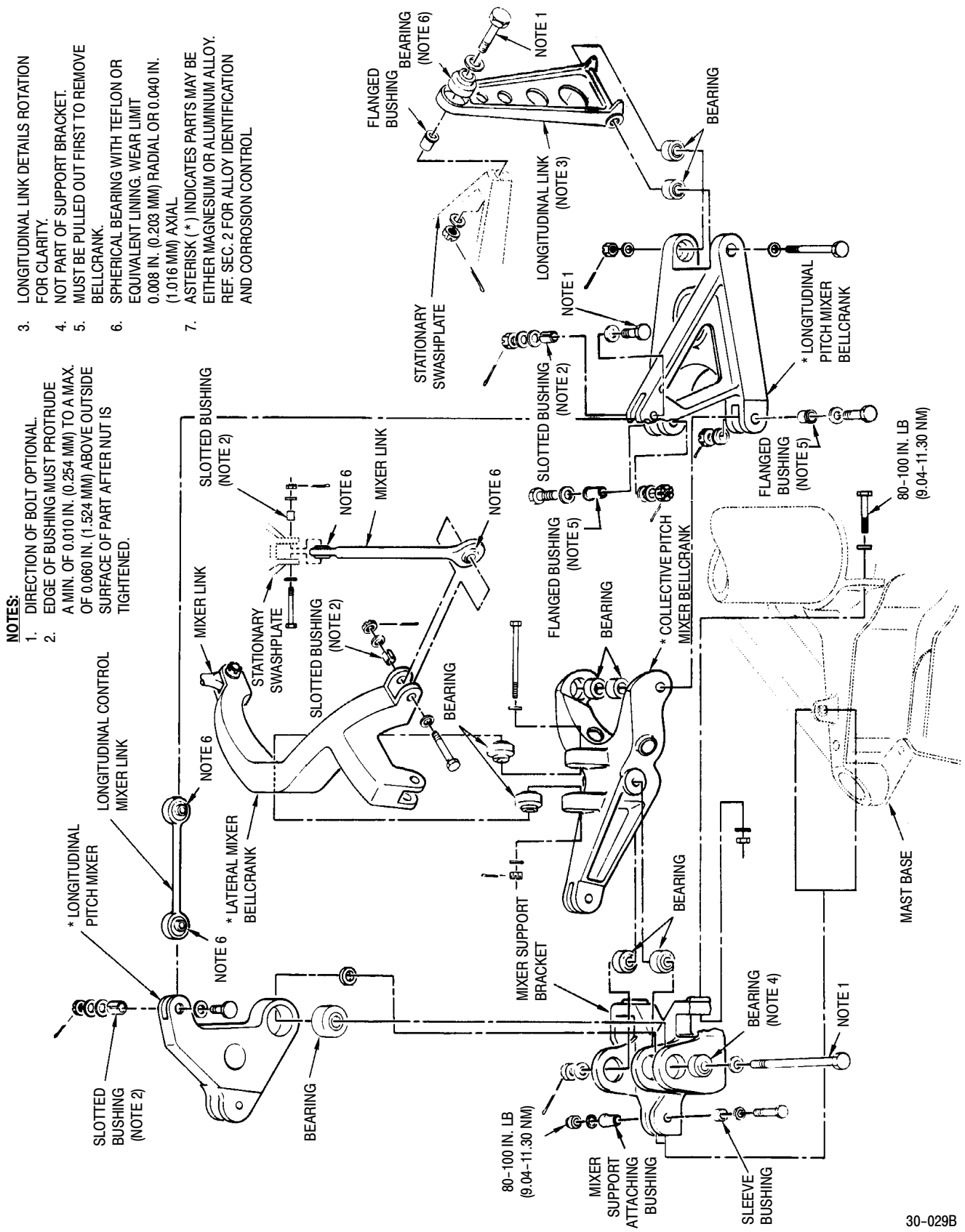


Figure 7-26. Mixer Controls Assembly

(9). Position longitudinal control-mixer link between longitudinal pitch idler and longitudinal pitch mixer bellcrank.

(a). Check that two slotted bushings are in place.

(b). Install bolt, three washers (two under each nut), nut and new cotter pin at each end of link.

(10). Position longitudinal link between longitudinal, pitch mixer bellcrank bearings. Install bolt, two washers, nut, and new cotter pin.

(11). Position mixer links in stationary swashplate and lateral bellcrank; check that slotted bushings are in place. Install bolt, two washers, nut, and new cotter pin at each end of link.

(12). Place the collective mixer, lateral mixer, and longitudinal mixer control tubes in position.

(a). Check that slotted bushings are in place.

(b). Install bolt, two washers, nut, and new cotter pin to secure each rod end.

(13). Install air intake forward fairing.

(14). Check rigging of collective and cyclic controls following installation of any removed or replaced parts.

C. Mixer Controls Inspection

(1). Inspect all bushings for security of fit.

(2). Inspect longitudinal link, support bracket, longitudinal control-mixer link, mixer links, longitudinal pitch idler, longitudinal pitch mixer bell-crank, lateral bellcrank and collective pitch mixer bellcrank for scratches, cracks, corrosion and similar surface defects. Perform a fluorescent dye penetrant inspection on components that are questionable.

(3). Inspect spherical, Teflon (or equivalent) lined bearings for binding/looseness in link bore and wear.

(a). Wear limit is 0.008 inch radially and 0.040 inch (1.016 mm) axially.

(b). Replace complete mixer link if bearings are faulty.

(c). Inspect bearings in other linkage for binding and looseness in mating bores.

D. Mixer Control Repair

Repair minor surface defects such as scratches, nicks and corrosion using abrasive cloth (20, Table 2-4), grade 400-600 to smooth out and blend in such defects. The following depth limits represent total limits, including the effects of all previous repair to any given area.

(1). Cast and forged surfaces may be reworked to a depth of 0.020 inch (0.508 mm).

(2). Flat machined surfaces, except clevis inner ears, may be reworked to a depth of 0.015 inch (0.381 mm). Clevis inner ear surfaces may be reworked to a depth of 0.020 inch (0.508 mm).

(3). Machined holes, may have 0.003 inch (0.0762 mm) removed from the bore wall in an area no greater than 15 percent of the circumference and 50 percent of the depth.

(4). All edges may have 0.030 inch (0.076 mm) removed except round machined holes which are limited to 0.010 inch (0.254 mm) chamfer.

(5). All rework must be smoothly blended into the adjacent surfaces and the finish must be restored on magnesium parts and aluminum parts (Ref. Sec. 2).

(6). Replace defective bearings and bush-ings, except swaged spherical bearings in mixer links which require link replacement.

(a). Remove bearings or bushings by pressing out the old part.

(b). Install a new bearing of the correct type with surface primer and grade A locking compound (28 and 29) according to container instructions.

NOTE: The left-hand bearing in the support bracket is not supplied as a part of the bracket. This bearing is installed at the time the support bracket and longitudinal pitch idler are assembled. Install a new bearing by seating flush with inner face of support bracket flange.

(7). Mixer links at the lateral mixer bellcrank are either smooth contoured or octagonal shaped with check nuts. Do not disassemble or intermix types.

46. Tunnel-Routed Control Tubes

(Ref. Figure 7-27) Each tunnel-routed control tube consists of two rod end bearings and an anodized aluminum alloy tube. The control tubes mechanically transfer displacement of the flight controls to the associated bellcranks and idler at the front of the main rotor mast base. All the tunnel-routed control tubes are removed, inspected, repaired and installed in the same manner.

A. Tunnel-Routed Control Tube Removal

CAUTION Before disconnecting collective pitch control tube, install collective bungee installation tool to prevent spring reaction due to droop stop load on control tube.

(1). Install collective bungee installation tool (26, Table 2-2).

(2). Gain access to lower tube ends by removing controls access door at base of canted bulkhead in cargo compartment.

(3). Disconnect lower tube end from bellcrank or fitting.

(4). Hand turn main rotor blades to obtain clear space for tube removal.

(5). Remove cotter pin, two washers, and bolt securing upper end of control. Disconnect upper end of control tube.

(6). Remove boot from control tunnel cover.

CAUTION Use care during removal of control tubes. Any surface damage caused by hasty removal may result in unserviceable control tubes.

(7). Grasp upper end of control tube and carefully withdraw tube until lower end clears the cover.

B. Tunnel-Routed Control Tube Installation

(1). Hand turn main rotor blades to obtain clear space for tube installation.

CAUTION Use care during installation of a control tube to avoid striking other installed control tubes.

(2). With the riveted rod end at the lower position, carefully lower tube through cover opening into tunnel.

(3). Install control tunnel cover boot and secure with self-clinching nylon strap.

CAUTION Do not tighten loosened jam nuts on rod end bearings without holding the rod end with a wrench.

(4). Align lower rod end with mating bellcrank. Install bolt, two washers, nut, and new cotter pin.

(5). Align upper rod end of control tube with mating idler or bellcrank. Install bolt, two washers, nut, and new cotter pin.

(6). Remove bungee installation tool used for removal of collective control tube.

(7). Perform controls rigging check following installation of removed or replaced parts.

C. Tunnel-Routed Control Tube Inspection

(1). Inspect rod end bearings for binding and excessive wear, 0.040 inch (1.016 mm) maximum axial play.

(2). Inspect control tube for surface damage and evidence of bending.

(3). Inspect for loose rivets at fixed rod end (lower end).

(4). Inspect longitudinal mixer control tube. Control tube is an “On Condition” item.

CAUTION When tightening loosened jam nut on rod ends as in step (5). below, always hold rod end with wrench.

(5). Determine if excessive rod end looseness exists in tunnel-routed control

tube assemblies by checking the upper end as follows.

CAUTION Do not disconnect rod ends from mixer assembly to perform this inspection except as instructed.

(a). Loosen jam nut a minimum of two threads.

(b). Apply light finger pressure to the top of the rod end to preload it against one side of attaching clevis. This will eliminate play other than where inspection is desired.

(c). Use a dial indicator or position a 6 inch (15 cm) rule horizontally at the upper end of the tube (where the tube end enters). Lightly deflect tube laterally from one extreme to other.

NOTE: Maintain the preload of the rod end bearing to eliminate the effect of bearing looseness.

(d). Measure the total movement of the top of the tube where the tube end centers.

(e). If total lateral movement from one extreme to the other is in excess of 0.0625 inch (1.5875 mm), the entire tube assembly must be replaced with serviceable parts.

NOTE: Because of normal tolerance build some play or looseness is expected. Play or looseness less than 0.0469 inch (1.1906 mm) is no cause for concern.

(f). If the total lateral movement is less than 0.0469 inch (1.1906 mm), the tube assembly is serviceable; tighten the jam nut. Movement of less than 0.0469 inch (1.1906 mm) is considered negligible.

(g). If the lateral movement is 0.0469-0.0625 inch (1.1906-1.5875 mm), the rod end should be further inspected for serviceable steps (h). thru (n). below.

(h). Disconnect rod end from control system.

(i). Screw rod end completely out of control tube.

(j). Use 0.339 inch (8.6106 mm) diameter drill to check tube threads.

(k). If drill can be inserted, tube assembly is unserviceable and must be replaced.

(l). If drill cannot be inserted, tube is serviceable.

(m). Reinstall rod end, reconnect tube to control system and tighten jam nut.

(n). Check rigging of reconnected control system.

D. Tunnel-Routed Control Tube Repair

(1). Perform straightness check on control tube that appears bent or bowed.

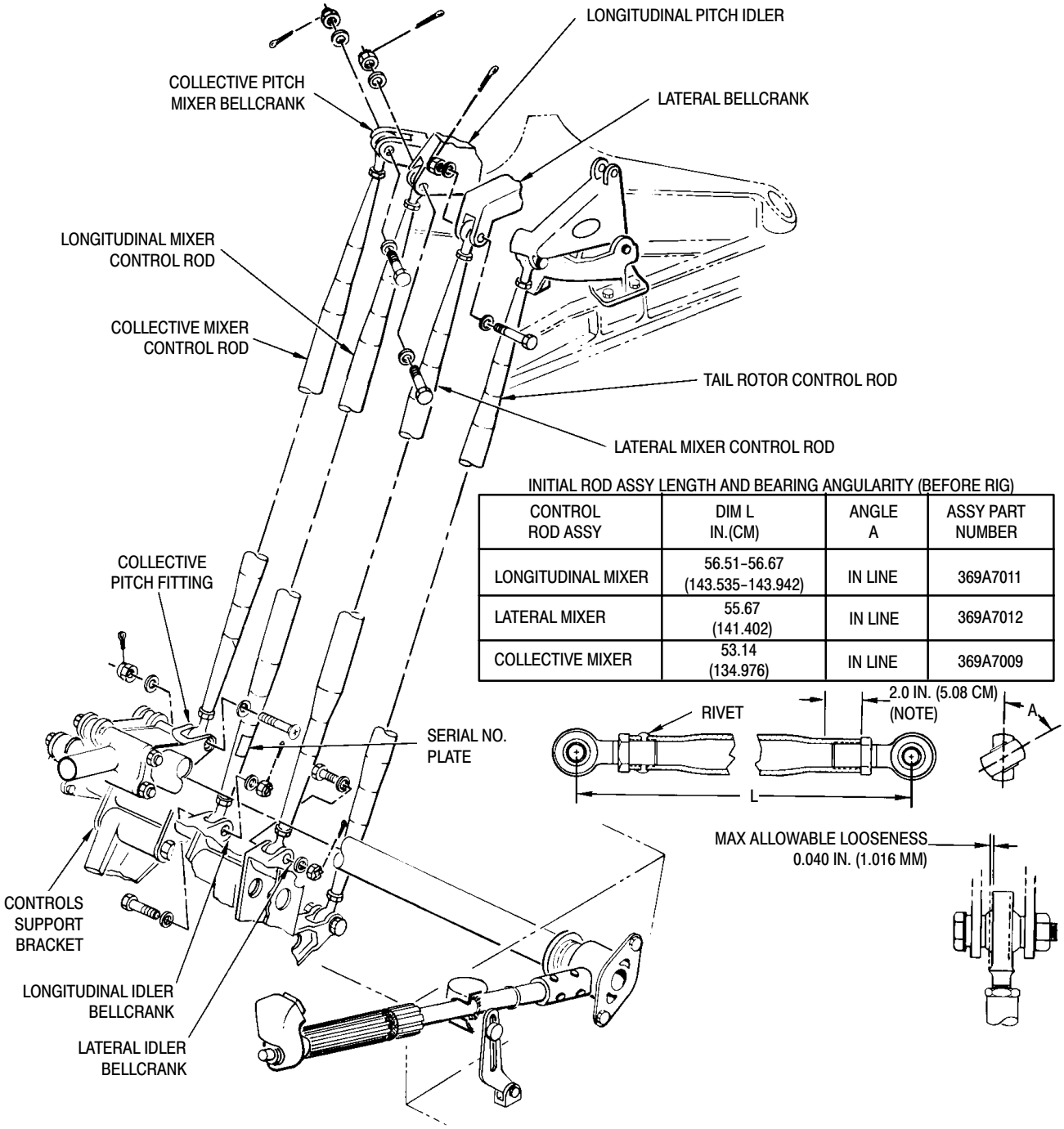
(a). Total length of any tunnel-routed tube (excluding rod ends) must be straight within 0.050 inch (1.270 mm), with straightness variation limited to maximum of 0.010 inch (0.254 mm) in each foot of length.

WARNING **Dye-check for cracking must always be performed after cold- straightening. Replace cracked tube, or cracked or bent rod end.**

(2). Cold-straighten bent tube that is not within tolerance (step (1). above) provided there are no nicks or sharp dents in bent length. Do not use rod ends to support tube during straightening.

CAUTION Use care when drilling to remove or install riveted rod end; the rod end is steel and the tube is aluminum.

(3). Replace a control rod end if bearing axial play is more than 0.040 inch (1.016 mm). Set initial control tube length and bearing angularity.



INITIAL ROD ASSY LENGTH AND BEARING ANGULARITY (BEFORE RIG)

CONTROL ROD ASSY	DIM L IN.(CM)	ANGLE A	ASSY PART NUMBER
LONGITUDINAL MIXER	56.51–56.67 (143.535–143.942)	IN LINE	369A7011
LATERAL MIXER	55.67 (141.402)	IN LINE	369A7012
COLLECTIVE MIXER	53.14 (134.976)	IN LINE	369A7009

NOTE:
INSPECT FOR WEAR. REPLACE RODS WITH WEAR DEPTH EXCEEDING 0.020 IN. (5.06 CM) OR HAVING O.D. LESS THAN ALLOWABLE MINIMUM.

30-045C

Figure 7-27. Tunnel-Routed Control Tubes

47. Tunnel-Routed Control Tube Inspection and Sleeve Installation

(Ref. Figure 7-28) The following procedures are for inspection and installation of reinforcing sleeves to the tunnel-routed control tubes.

A. Control Tube Tapered Area Sleeve Installation

(1). Remove all four control tubes (Ref. Tunnel-Routed Control Tube Replacement).

(2). Using paint remover (11, Table 2-4) remove paint approximately six inches (15 cm) back from end of each tube, tape and cover-rap remaining area of tube.

NOTE: Control tubes that are cracked must be removed from service.

(3). Dye penetrant inspect external surface of stripped area for cracks.

(a). Cracks are indicated by heavy bleed out.

NOTE: It may be necessary to wipe off and reapply the developer to distinguish between surface defects caused during swaging operation.

(b). Light penetrant indications are not cause for rejection.

(4). If no cracks are found; inspected control tube can be reworked for sleeve installation. All four control tubes are to be reworked as follows:

(a). Measure and record length of control tubes for reinstalling rod ends and to prevent rerigging after tube reinstallation.

CAUTION Drilled out rivets may damage threads upon removal. Visually inspect control tube threads for damage from rivet and rod end removal. Replace damaged control tubes. Drilled rod ends are matched drilled to each control tube and must be reinstalled into control tube end from which removed.

(b). Remove rod ends, MS20470AD3 rivets must be removed from fixed end.

(c). Measure outside diameter of control tube end and select proper sleeve.

(d). Temporarily install sleeve onto control tubes.

(e). Align sleeve and control tube witness hole.

(f). If sleeve protrudes past end of control tube, trim end of sleeve flush, 0.0 inch (0.0 mm), or back 0.080 inch (2.032 mm) from end of tube.

NOTE: Bond integrity is dependent on clean surfaces.

(g). Thoroughly clean end of control tube and interior surface of sleeve with lint free cloth and MEK (22) or equivalent.

(h). Mix epoxy adhesive (121) per manufacturer's instructions.

(i). Remove excessive adhesive with lint free cloth moistened with MEK or equivalent. Do not saturate the cleaning cloth. Remove adhesive from witness holes.

(j). Plug end of control tube to prevent adhesive from entering threads. Bond sleeve to control tube. Apply adhesive to both surfaces and install sleeve. Align witness/rivet hole in sleeve and tube.

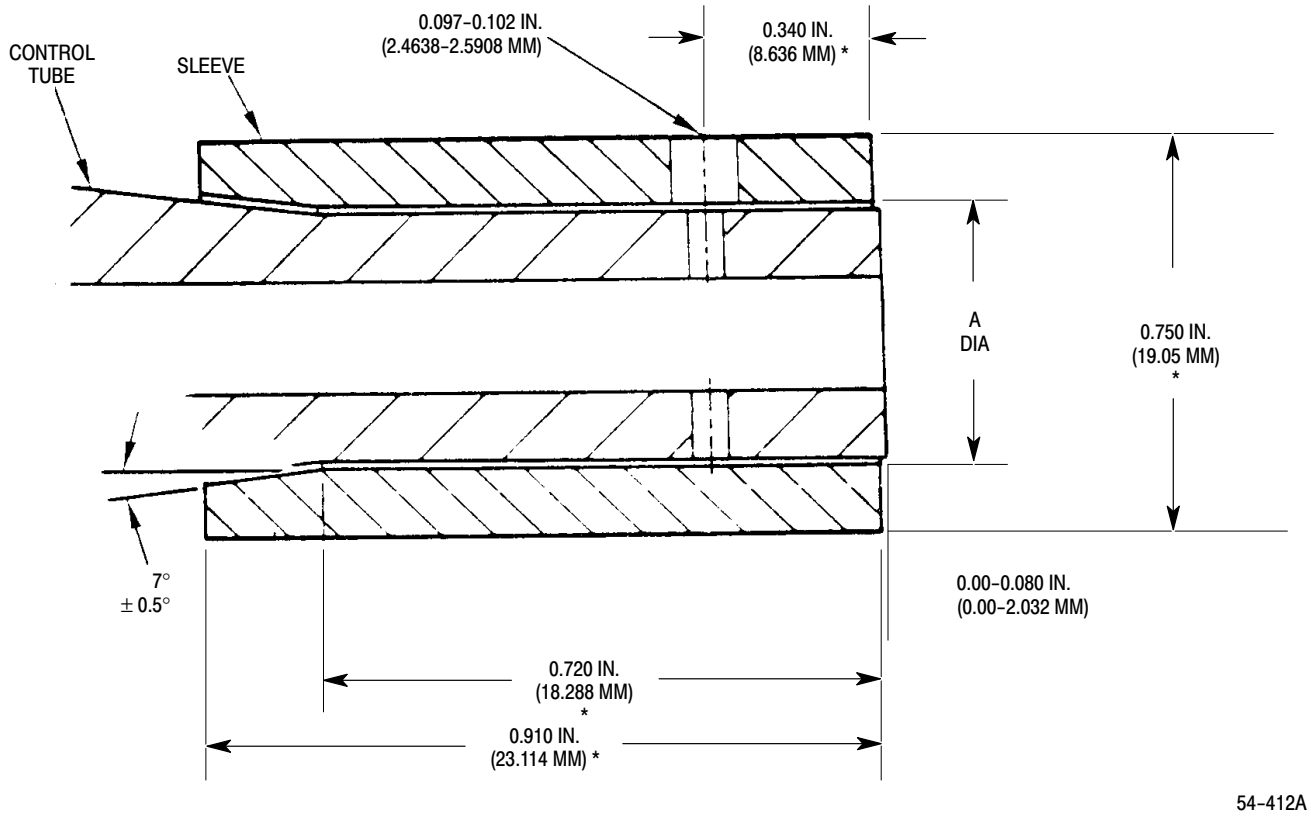
CAUTION Do not use heat gun. Use of heat lamp is acceptable.

(k). Allow to cure for 24 hours at minimum ambient temperature of 68°F (20°C); alternate cure 4 hours at 115°-140 °F (46°-60 °C).

(l). Repeat procedure for ends of each control tube.

(m). Using primer (4), touch-up repaired area(s) of control tube.

(n). Install rod ends into ends in which it was removed. On fixed rod end, align witness/rivet hole in sleeve and tube with rivet hole in rod end. Drill (#40) thru opposite end of sleeve. Rivet fixed end with MS20470AD3-15 rivet.



Dimensional Table

Tube No.	Sleeve No. 369D27013	Dim A inch (mm)	Tube O.D. inch (mm)
369A7007 369A7009	-1	0.540-0.545 (13.716-13.843)	0.501-0.530 (12.7254-13.462)
	-2	0.510-0.515 (12.954-13.081)	0.470-0.500 (11.938-12.7)
369A7011	-3	0.590-0.595 (14.986-15.113)	0.551-0.580 (13.9954-14.732)
	-4	0.560-0.565 (14.224-14.351)	0.520-0.550 (13.208-13.97)
369A7012	-5	0.570-0.575 (14.478-14.605)	0.530-0.560 (13.462-14.224)

NOTE:

(1) Material; 2024-T351 or T4 (QQA 225/6) bar or round stock.

(2) Break sharp edges 0.005-0.015 inch (0.127-0.381 mm).

(3) Surface finish 125 RMS.

(4) Chemical film per MIL-C-5541.

(5) * - Tolerance ±0.010 inch (0.254 mm).

Figure 7-28. Sleeve Fabrication and Installation

(o). Adjust each control tube to its previously measured length and paint the control tube ends with primer. Paint adjustable ends of control tube flat black.

(p). Re-identify, with permanent ink, the control tubes that have been re-worked (Ref. Table 7-9).

(q). Rework control tube boot (Ref. Figure 7-29).

CAUTION If control tube is not accurately measured, flight controls will require re-rigging.

(r). Reinstall control tubes. Reinstall trimmed boot with vertical seam facing aft. Check flight controls for interference or binding.

Table 7-9. Control Tube Re-Identification

Old Part Number	New Reworked Part Number
369A7007	369A7007-5
369A7009	369A7009-5
369A7011	369A7011-5
369A7012	369A7012-5

B. Control Tube Straight Area Sleeve Installation

This repair is permissible on the straight area of the tube only and increases the outside diameter.

NOTE: Ensure adequate clearance exists prior to performing the repair. Determine and repair condition that caused damage. Maximum length of repair sleeve is 6 inches. Two sleeve repairs permitted per control tube.

(1). Remove damaged control tube(s) (Ref. Tunnel-Routed Control Tube Replacement).

(2). Tape around area to be repaired.

(3). Using paint remover (11, Table 2-4), strip paint 1.0 inch (2.54 cm) beyond area of repair.

(4). Polish out burrs and sharp edges. Ensure defects do not exceed allowable limits (Ref. Table 7-10). Dye penetrant inspect area per MIL-I-25135; no cracks allowed.

Table 7-10. Control Tube Straight Area Repair Limits

Control Tube	Nicks and Gouges (2)		Dents and Depressions (2)		Repair Sleeve (3)	
	Max. Depth W/O Repair (4)	Max. Depth With Repair (1)	Max. Depth W/O Repair (4)	Max. Depth With Repair (1)	O.D.	Wall Thickness
369A7007	0.006 inch (0.152 mm)	0.015 inch (0.381 mm)	0.010 inch (0.254 mm)	0.025 inch (0.635 mm)	1.375 inch (3.4925 cm)	0.049 inch (1.2446 mm)
369A7009	0.008 inch (0.203 mm)	0.020 inch (0.508 mm)	0.010 inch (0.254 mm)	0.025 inch (0.635 mm)	1.50 inch (3.810 cm)	0.049 inch (1.2446 mm)
369A7011 369A7012	0.010 inch (0.254 mm)	0.025 inch (0.635 mm)	0.010 inch (0.254 mm)	0.025 inch (0.635 mm)	1.625 inch (4.1275 cm)	0.049 inch (1.2446 mm)

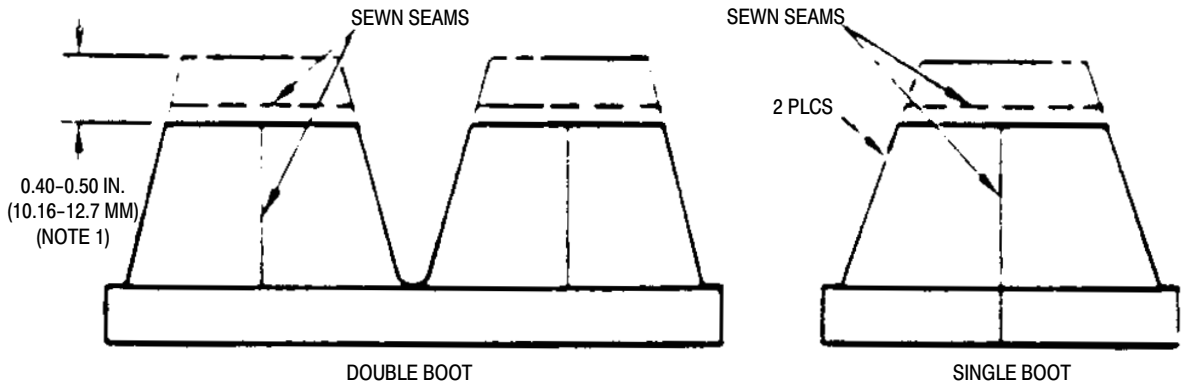
NOTE:

(1) Sleeve repair not permitted in tapered area. Two sleeve repairs per control tube. Maximum defect area 0.375 in^2 (2.41935 cm^2) per sleeve.

(2) Must be free of burrs and sharp areas.

(3) Aluminum tube 6061-T6 WW-T-700/6 or 2024-T3 WW-T-700/3. Alternate: field fabricate from 2024-T351 or 2024-T4 (QQ-A-225/6 or QQ-A-200/3). Inside diameter to be 0.010-0.025 inch (0.254-0.635 mm) larger than outside diameter of tube to be repaired. Outside diameter as listed in table, ±0.010 inch (0.254 mm) and concentric to inside diameter 0.005 inch (0.127 mm). Maximum length of repair sleeve 6 inches (15.24 cm). Break sharp edges 0.005-0.015 inch (0.127-0.381 mm).

(4) Maximum defect area without repair 0.10 in^2 (0.64516 cm^2) total. For threaded area, last 2 inches (5.08 cm) of both ends, maximum depth of defect 0.020 inch (0.508 mm).



NOTES:
1. TRIM BOOTS BELOW HORIZONTAL SEAM.
CAUTION: DO NOT USE SOLVENTS OR PETROLEUM BASED CLEANING FLUIDS ON VINYL BOOTS.
2. CLEAN INSIDE AND OUTSIDE OF VERTICAL SEAM AND TOP OF BOOT WITH CLEAN CLOTH DAMPENED WITH ISOPROPYL ALCOHOL.
3. COAT BOTH SIDES OF VERTICAL SEAM WITH CONTACT CEMENT.
4. APPLY THIN COAT OF CONTACT CEMENT ALONG TRIMMED EDGE AND 0.125–0.250 IN. (3.175–6.35 MM) DOWN INSIDE AND OUTSIDE SURFACES OF BOOTS TO PREVENT FRAYING.

G67–1036A

Figure 7-29. Control Tube Boot Rework

NOTE: Bond integrity is dependent on clean surfaces.

(a). Thoroughly clean repair area of control tube and interior surface of sleeve with lint free cloth and MEK (22) or equivalent.

(b). Mix epoxy adhesive per manufacturer's instructions.

(c). Apply adhesive (121) to both surfaces and install sleeve.

(d). Remove excessive adhesive with lint free cloth moistened with MEK or equivalent. Do not saturate the cleaning cloth.

CAUTION Do not use heat gun. Use of heat lamp is acceptable.

(e). Allow to cure for 24 hours at minimum ambient temperature of 68°F (20°C); alternate cure 4 hours at 115°-140 °F (46°-60 °C).

(f). Using primer (4), touch-up repaired area(s) of control tube.

48. Controls Support Bracket and Bellcranks

(Ref. Figure 7-30) The controls support bracket is a cast magnesium bracket that mounts below the pilot's seat cover, between the right and left inboard sides of the seat structure. The bracket provides the hingeline for the longitudinal and lateral idler bellcranks, the tail rotor bellcrank, and the engine droop control bellcrank, which are also made of magnesium. It also provides the inboard support for the collective torque tube.

A. Controls Support Bracket and Bellcrank Removal

(1). Remove foot fairings and controls access door (Sta. 78.50), and remove pilot's seat cover.

(2). Remove collective bungee.

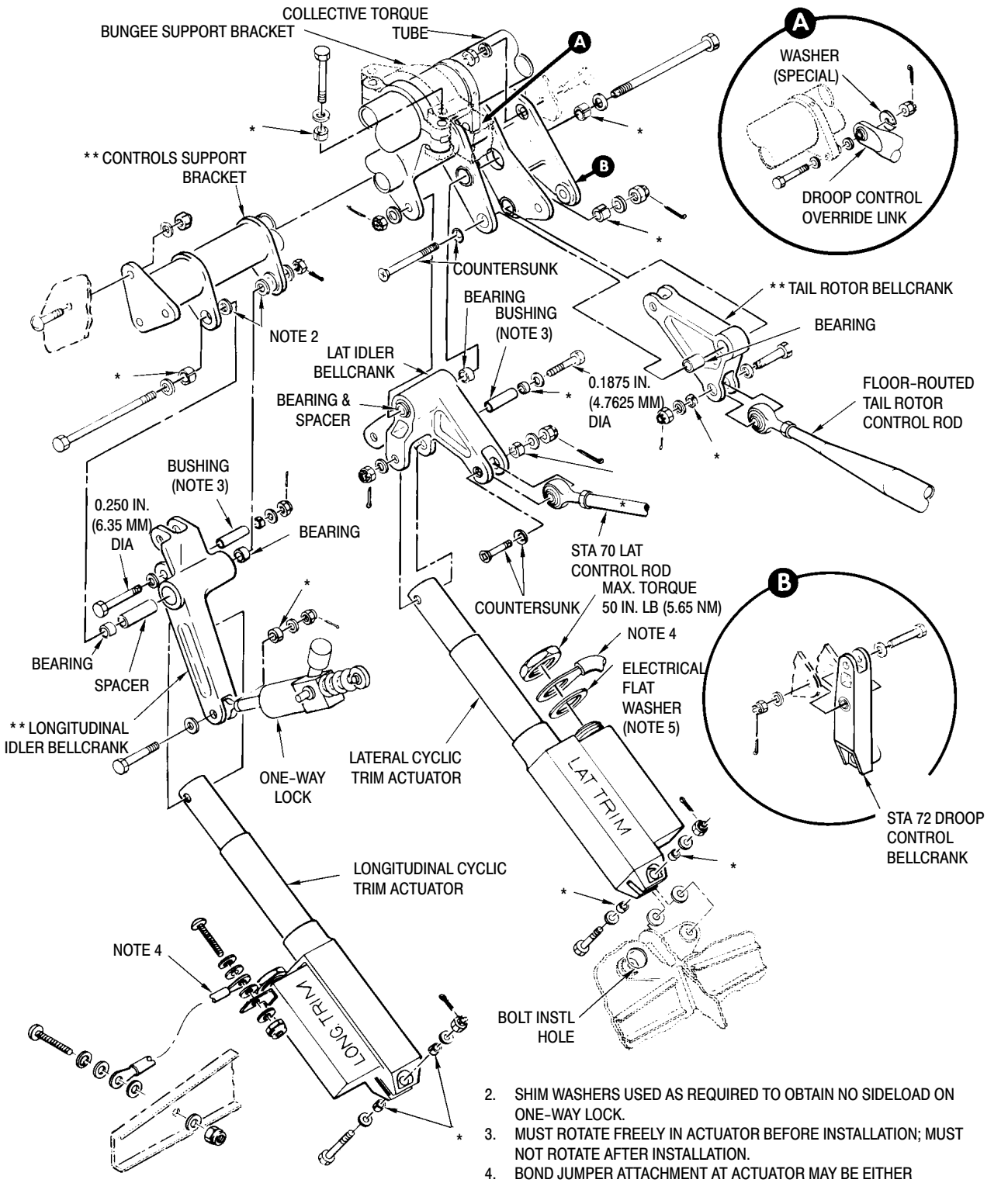
(3). Disconnect tunnel-routed control tubes.

(4). Remove cotter pin, nut, two washers and bolt; disconnect upper end of each cyclic trim actuator.

(5). Disconnect floor-routed tail rotor control tube from tail rotor bellcrank.

(6). Disconnect Sta. 70 lateral control tube from lateral idler bellcrank.

(7). Disconnect one-way lock from longitudinal idler bellcrank.



NOTES:

1. ASTERISK (*) IDENTIFIES SLOTTED BUSHINGS. EDGE OF BUSHING MUST PROTRUDE A MIN. OF 0.010 IN. (0.254 MM) TO A MAX. OF 0.080 IN. (2.032 MM) ABOVE OUTSIDE SURFACE OF PART AFTER NUT IS TIGHTENED.
2. SHIM WASHERS USED AS REQUIRED TO OBTAIN NO SIDELOAD ON ONE-WAY LOCK.
3. MUST ROTATE FREELY IN ACTUATOR BEFORE INSTALLATION; MUST NOT ROTATE AFTER INSTALLATION.
4. BOND JUMPER ATTACHMENT AT ACTUATOR MAY BE EITHER CONFIGURATION SHOWN.
5. ON CURRENT CONFIGURATION ONLY. INSTALL AT FIRST OPPORTUNITY.
6. DOUBLE ASTERISK (**) INDICATES PARTS THAT MAY BE EITHER MAGNESIUM OR ALUMINUM ALLOY. REF. SEC. 2 FOR ALLOY IDENTIFICATION AND CORROSION CONTROL.

30-046D

Figure 7-30. Installation of Controls Support Bracket, Idler Bellcranks and Cyclic Trim Actuators

(8). Remove pilot's collective pitch stick.

(9). Provide support for collective torque tube. Remove two bolts, four washers, and two nuts securing bungee support bracket and collective torque tube to controls support bracket.

(10). Remove cotter pin, nut, three washers, and bolt (Detail A); disconnect aft end of droop control override link from collective torque tube bracket.

(11). Remove cotter pin, nut, two washers, bolt, and Sta. 72 droop control bellcrank from support bracket (Detail B).

(12). Remove six screws, six washers, and six nuts securing support bracket to seat structure.

(13). Remove support bracket; use care to avoid striking any of the bellcranks and push tubes.

B. Controls Support Bracket and Bellcrank Disassembly

(1). Remove cotter pin, nut, two washers, bolt, and lateral idler bellcrank. Do not remove slotted bushing unless replacement is necessary.

(2). Remove cotter pin, nut, two washers, bolt, and tail rotor bellcrank. Do not remove slotted bushing unless replacement is necessary.

(3). Remove cotter pin, nut, two washers, bolt, and longitudinal idler bellcrank. Do not remove slotted bushing unless replacement is necessary.

NOTE: The shim washers between the longitudinal idler bellcrank and support bracket are used to align the one-way lock for no sideload. Keep the washer selection with the bracket for use during reassembly.

C. Controls Support Bracket and Bellcrank Inspection

(1). Inspect bearings in bellcranks for binding.

(2). Perform a fluorescent dye penetrant inspection on any suspected part.

NOTE: Parts identified with a double asterisk (**) may be either magnesium or aluminum alloy. Ref. Sec. 2 for corrosion control and identification of magnesium and aluminum alloys.

D. Control Support Bracket and Bellcrank Repair

(1). Replace unserviceable bearings. Install a new bearing of the correct type with surface primer and grade A locking compound (28 and 29, Table 2-4), according to container instructions.

NOTE: Ensure that the idler bellcrank spacers are reinstalled between bearings whenever idler bellcrank bearings are replaced.

(2). Replace bellcranks or the controls support bracket for distortion, cracks, or enlongated holes.

E. Controls Support Bracket and Bellcrank Reassembly

(1). Install longitudinal idler bellcrank with bolt, two washers, nut, and new cotter pin. Check that the slotted bushing is in place in the support bracket lug, and reinstall the shim washers used between the bellcrank and bracket for no sideload of the one-way lock.

(2). Install lateral idler bellcrank, bolt, two washers, nut, and new cotter pin. Check that the slotted bushing is in place in the support bracket lug.

(3). Install tail rotor bellcrank, countersunk head bolt two washers (one countersunk), nut, and new cotter pin. Check that the slotted bushing is in place n the support bracket lug.

F. Controls Support Bracket and Bellcrank Installation

(1). Carefully position assembled support bracket and bellcranks between the seat structure bulkheads and secure with six screws, six washers, and six nuts.

(2). Position Sta. 72 droop control bellcrank in support bracket and install with bolt, two washers, nut, and new cotter pin (Detail B).

NOTE: The cap is matched to the cradle of each control support bracket. Check that the numbers on each part are the same before accomplishing step (a). below.

(3). Position collective torque tube and bungee bracket on support bracket cradle and install cradle bolts, four washers, and two nuts.

(a). Check that two slotted bushings are in place in the bungee support bracket.

(b). Check that index groove in edge of cap that clamps torque tube to support bracket cradle mates with matching index at bracket cradle parting surface.

(4). Install pilot's collective pitch stick.

(5). Connect aft end of droop control override link to collective torque tube droop control bracket.

(6). Connect one-way lock to longitudinal idler bellcrank.

(7). Connect Sta. 70 lateral control tube to lateral idler bellcrank. Check that slotted bushing is in place in the bellcrank ear.

(8). Connect floor-routed tail rotor control tube to tail rotor bellcrank. Check that slotted bushing is in place in bellcrank ear.

(9). Connect upper end of each cyclic trim actuator with bolt, two washers, bushing, nut, and new cotter pin.

(a). Check that slotted bushing is in place in bellcrank ear.

NOTE: Lateral actuator upper hingeline has 0.1875 inch (4.7625 mm) ID; longitudinal has 0.25 inch (6.35 mm) ID.

(10). Connect lower ends of tunnel-routed control tubes.

(11). Install collective bungee.

49. Collective Controls

(Ref. Figure 7-31) The pilot's compartment collective controls consist of the left position collective pitch stick, the collective bungee installation, and the interconnecting shafts and linkage. All components, except the stick and tunnel-routed collective mixer control tube, are located within the pilot's seat structure.

Dual control provisions are incorporated into the pilot's compartment collective controls installation. Refer to CSP-HMI-3, HMI Supplement M, as applicable for information on dual collective controls.

50. Pilot's Collective Pitch Control Stick (Left Position)

(Ref. Figure 7-32) The pilot's collective pitch stick consists primary of a switch housing, throttle grip and friction mechanism, collective stick tube and friction mechanism, and gas producer control shafts having right angle (pinion and bevel gear) drive. Collective pitch stick controls include: the N_1 throttle and idle stop release ring, an N_2 governor trim switch, a landing light switch, a stick friction adjustment grip, a throttle friction nut, and a starter-ignition switch.

A. Pilot's Collective Pitch Stick Removal (Left Position)

WARNING **Install bungee installation tool (26, Table 2-2) before disconnecting any pilot's collective stick hardware. There is strong bungee spring pressure present in the stick linkage; if suddenly released, spring reaction in the linkage can cause personal injury or parts damage.**

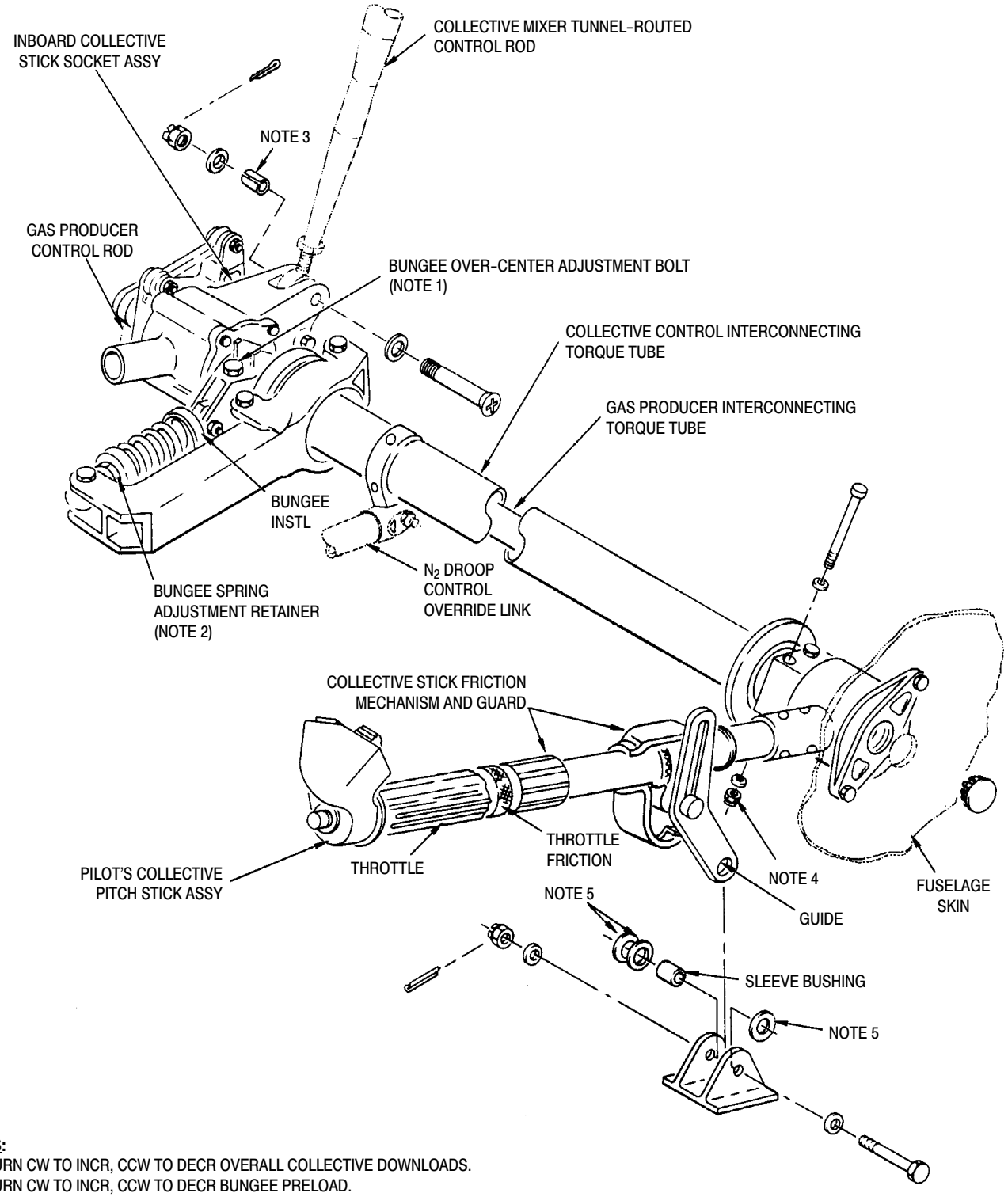
(1). Remove outboard collective stick cover (Ref. Sec. 2).

(2). Disconnect pilot's collective pitch stick electrical plug.

(3). Install bungee installation tool (26, Table 2-2) on collective bungee (Ref. Collective Bungee Installation).

(4). Remove attaching hardware that secures the guide to the seat structure bracket.

(5). Remove collective bungee.



NOTES:

1. TURN CW TO INCR, CCW TO DECR OVERALL COLLECTIVE DOWNLOADS.
2. TURN CW TO INCR, CCW TO DECR BUNGEE PRELOAD.
   CAUTION: DO NOT ADJUST BUNGEE SPRING TENSION WHILE BUNGEE INSTL TOOL (369A9936) IS INSTALLED. USE OVERCENTER ACTION OF STICK TO COMPRESS SPRING TO REMOVE TOOL.
3. BUSHINGS MUST PROTRUDE A MIN. OF 0.010 IN. (0.254 MM) AFTER BOLT IS TIGHTENED.
4. TORQUE PER TABLE 2-5; APPLY EQUALLY AND BY SMALL INCREMENTS.
5. ARRANGE WASHERS TO LINE UP GUIDE WITH STICK; SPACE LOOSELY WITH THREE WASHERS.

30-048B

Figure 7-31. Pilot's Compartment Collective Controls

(6). Remove inboard collective socket assembly;

(a). Disconnect droop control override link.

(b). Slide bungee bracket to side.

(c). Remove cradle cap and slide collective torque tube inboard (Ref. Collective Control Interconnecting torque Tube Removal).

(7). Remove nuts, washers, and bolts that connect stick housing to torque tube.

(8). Remove stick by sliding it outboard and off torque tube.

B. Pilot's Collective Pitch Stick Installation (Left Position)

(1). Lubricate stick housing socket with grease (26, Table 2-4).

(2). Install stick by sliding housing on collective control interconnecting torque tube.

(a). Align matching holes and install bolts, washers and nuts.

(b). Tighten nuts equally and by small increments until correct torque is applied (Ref. Table 2-5).

NOTE:

- On completing attachment of pilot's collective pitch stick and inboard collective socket assembly on collective control interconnect torque tube, ensure both pilot's throttle grip and inboard socket N_1 pinion gear are at mid-travel position.
- At mid-travel, wide tooth-space of inboard socket pinion gear will be at approximately one o'clock as viewed looking aft into open end of socket.
- Gas producer control rod-to-inboard stick assembly idler bolt holes should be in line with centerline of stick assembly housing cap.
- At mid-travel, two pilot's throttle grip attaching bolts should be approximately straight down.
- The inboard pinion and outboard grip should be set to and held at these positions while socket and stick gearing is interconnected by gas producer interconnect torque tube.
- If mid-travel positions are not synchronized, further adjustment of installation is required.

(3). Complete insertion of collective torque tube, install cradle cap, position bungee bracket in mounting position, connect droop control override link, install collective socket assembly and install collective bungee.

(4). Position friction guide in the seat structure bracket.

(a). Arrange three washers and bushings, loosely spaced between bracket ears, so that guide is in line (parallel) with the stick.

(b). Install bolt, two washers, nut and new cotter pin.

(5). Connect the electrical plug.

(6). Install outboard collective stick cover. Check that wiring will not foul when stick is raised and lowered.

(7). Remove snap plug from exterior skin.

(a). Rotate throttle and visually check for zero backlash between gas producer interconnect torque tube and the hexagonal ID of the drive gearshaft in the stick housing.

(b). Eliminate any backlash by tightening pipe plug in end of torque tube; zero backlash is required at both ends of tube.

(8). Check that inboard stick socket gears are at mid-travel when pilot's stick throttle grip is set to mid-travel. If not, adjust collective pitch stick(s) gas producer control linkage.

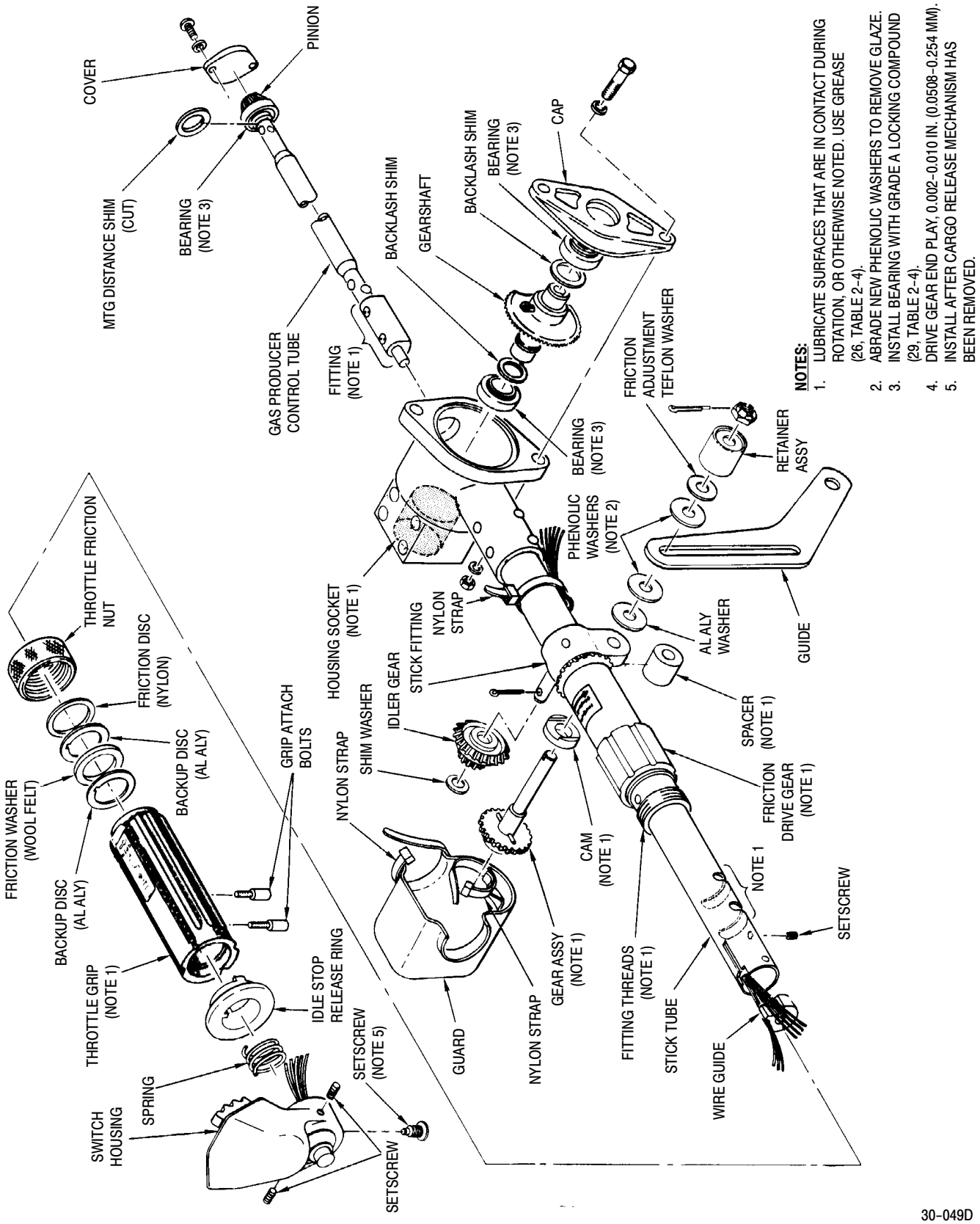


Figure 7-32. Assembly of Pilot's Collective Pitch Stick (L/H Command)

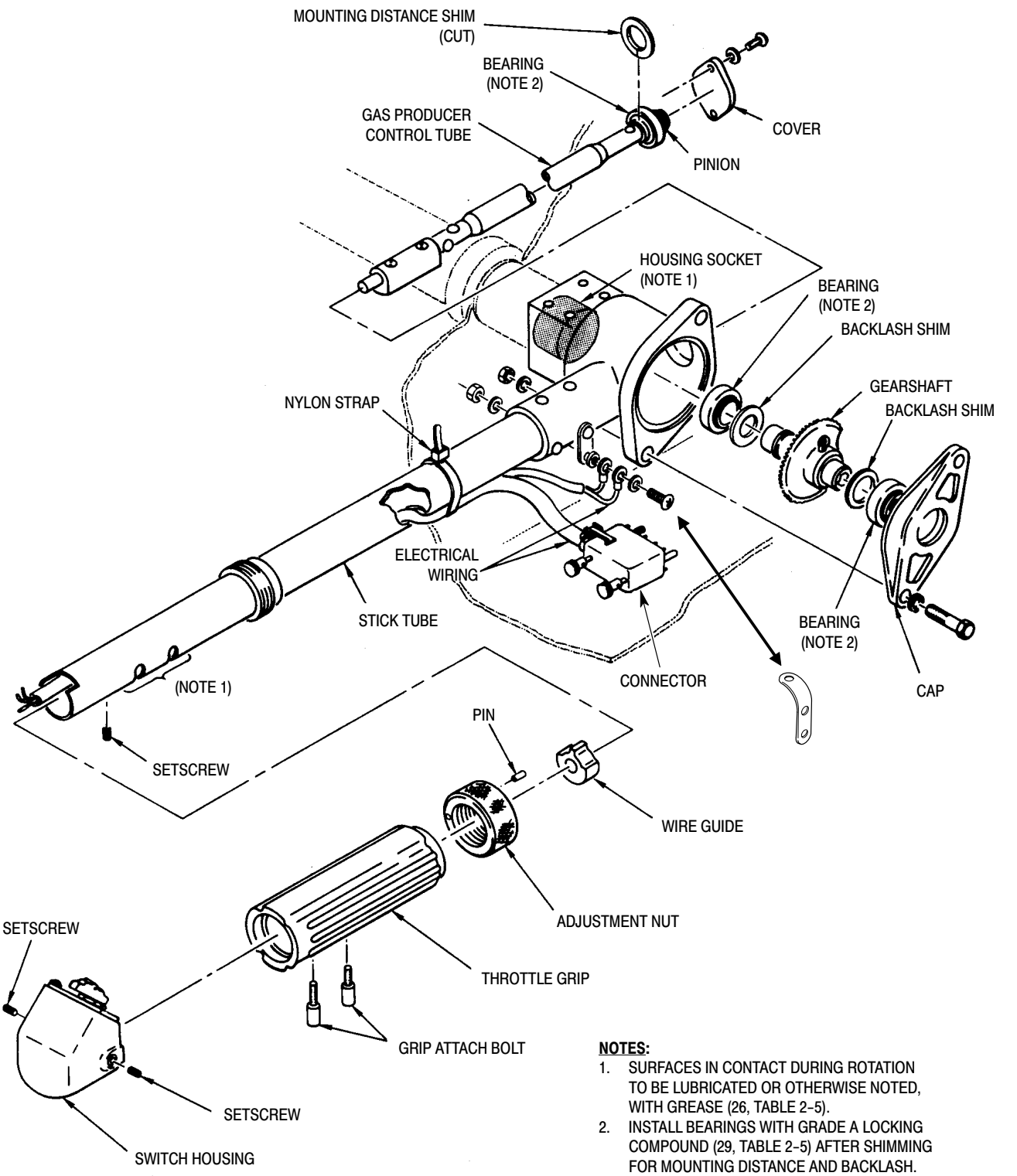


Figure 7-33. Copilot's Collective Pitch Stick (R/H Command)

C. Pilot's Collective Pitch Stick Disassembly (Left Position)

(1). Cut the two nylon straps, and remove stick friction mechanism guard.

(2). Remove setscrews that secure switch housing.

NOTE: Removal of an additional setscrew is also required on helicopters equipped with a cargo release mechanism.

(3). Cut nylon strap or twine that secures electrical wiring to stick tube.

(4). Push wire slack into stick, carefully pull housing and wiring from end of stick tube and disconnect wiring from switches (Ref. Sec. 19).

(5). Remove setscrew and wire guide from forward end of stick. Tie a "fish", string on each wire bundle to aid reassembly and remove wiring.

(6). Remove spring and idle stop release ring.

(7). Remove grip attach bolts and slide throttle grip, friction washer and discs, and friction nut from stick tube.

(8). Remove friction mechanism and guide from stick fitting.

(9). Remove idler gear from stick fitting.

NOTE: Do not remove bearing from cap unless replacement is necessary.

(10). Remove cap from stick housing.

NOTE: Keep backlash shims with gear shaft and do not remove bearing from stick housing unless replacement is necessary.

(11). Remove gear shaft assembly.

(12). Remove cover from back of stick housing.

(13). Remove gas producer control tube through access hole at back of stick housing.

(a). Remove mounting distance shim only if necessary to adjust pinion gear mounting distance.

(b). Remove pinion and bearing from control tube only if replacement is necessary.

D. Pilot's Collective Pitch Stick Inspection (Left Position)

(1). Inspect bearings for binding or looseness.

(2). Inspect all gears for cracks and chipped or broken teeth.

(3). Inspect stick tube and gas producer control tube for corrosion, deformation, and loose rivets.

NOTE: The pitch stick housing and cap may be either a magnesium or aluminum alloy casting. (Ref. Sec. 2 for corrosion control and identification of magnesium or aluminum alloys.)

E. Pilot's Collective Pitch Stick Repair (Left Position)

(1). Replace bearings if corroded, excessively worn, or if the outer or inner races of bearings rotate on mating surfaces and locking compound is inadequate to prevent rotation.

(2). Replace loose rivets in the gas producer control tube.

(3). Replace a friction drive gear or idler gear having cracked, chipped or broken teeth.

(4). Replace friction drive gear if it does not rotate freely on stick tube, or if the rotating stop is damaged (Ref. Figure 7-35, Detail B). Drill out rivets that attach throttle friction nut fitting to the stick to remove gear.

NOTE: Before replacing a drive gear for binding, clean and then relubricate the ID with grease (26, Table 2-4) . Reinstall gear on stick tube and recheck for free rotation. If gear still binds it must be replaced.

(5). Replace the phenolic friction washers that slide against the guide if worn to less than 0.03125 inch (0.79375 mm) thickness.

(6). Replace the friction gear assembly if the driven gear has cracked, chipped or broken teeth, or if the cam pin is bent.

(7). Replace a damaged idle stop release ring. The ring must slide freely on the tube and in the throttle grip.

F. Pilot's Collective Pitch Stick Reassembly (Left Position)

(1). Check gear shaft bearings in housing cap and housing for security of outer races.

(a). Use grade A locking compound (29, Table 2-4) to install replacement bearings.

(b). Use care to prevent compound from entering bearings, and make sure that each bearing is seated against its bore shoulder.

(2). Using grease (26), lubricate the stick tube interior where the gas producer control tube fitting makes contact.

(3). Attach "fish" strings routed through the stick tube during disassembly, and thread the electrical wire bundles from the plug through the exit hole, throttle friction nut, friction washers and discs, throttle grip, idle stop release ring, and the spring.

(4). Pull wiring out through front end of stick tube.

(5). Install wire guide so that it divides the switch wiring, three wires in one cutout and four in the other.

(a). Align guide with matching hole in stick tube and install set-screw.

(b). When tightened, setscrew must be at least flush and not recessed more than 0.010 inch (0.254 mm) below outer surface of tube.

NOTE: Ensure gas producer control tube is installed into stick tube housing with elongated area of fitting facing down.

(6). Install gas producer control tube through access hole in back of stick housing, and through stick tube until control tube fitting engages wire guide bore.

(7). Reinstall mounting distance shims forward side of pinion bearing if removed during disassembly.

NOTE: One edge of shim must be cut for installation.

(8). Establish gas producer control tube pinion mounting distance (Ref. Figure 7-34).

(9). After mounting distance shimming is correct.

(a). Remove gas producer control tube and apply grade A locking compound to outside diameter pinion bearing outer race and stick housing bore.

(b). Reinstall control tube, and check that compound does not enter bearing and that bearing outer race and shims are firmly seated against housing bore.

(10). Install throttle friction nut, friction discs and washers.

(11). Using grease, lubricate interior of throttle grip and install grip on stick tube.

(a). Align grip and gas producer control tube fitting and install grip attach bolts.

(b). When tightened, bolts must be flush or not more than 0.010 inch (0.254 mm) below outer surface of grip.

(12). Establish gas producer control tube pinion and shaft assembly bevel gear backlash (Ref. Figure 7-34).

(13). After backlash shimming is correct, remove housing cap and gear shaft.

(14). Lubricate teeth of pinion gear and shaft assembly bevel gear with grease.

(15). Apply grade A locking compound to gear shaft and to ID of bearings.

NOTE: With throttle grip at mid-travel the two grip attach bolts will be positioned approximately straight down.

(16). Install housing cap on shaft assembly and seat with hand pressure while slowly rotating the grip back and forth.

Secure cap to side of housing and cover to back of housing.

(17). Using solder (48), connect wiring to stick switches.

(18). Pull electrical wiring slack out through exit holes in stick tube, position release ring and. spring and install switch housing with setscrews.

(19). Using nylon strap, or twine (30), secure electrical wiring to stick tube approximately one inch (25.4 mm) aft of exit holes.

(20). Install friction cam and driven gear assembly on stick fitting. Temporarily mesh idler gear and driven gear, and rotate friction drive gear counter-clockwise to maximum stop (Ref. Figure 7-35, Detail B).

(21). Hold drive gear at stop and re-mesh idler gear and driven gear so that gear assembly pin is at high point of cam (Detail C).

(22). Use shim washers sufficient to limit gear end play to maximum of 0.010 inch (0.254 mm) (Detail A), and secure idler gear with cotter pin.

(23). Assemble remainder of friction mechanism.

(24). Adjust collective friction mechanism.

51. Gas Producer Linkage Adjustment

(Ref. Figure 7-34) The following procedure is for adjustment of gas producer linkage in installed collective pitch stick(s) and/or inboard socket assembly.

(1). Remove cap and outboard bearing from pilot's collective pitch stick housing.

(2). Remove backlash shims and gear shaft assembly from socket housing.

NOTE: Note locations and mark removed shim thicknesses to ensure proper reassembly.

(3). Ensure inboard collective pitch stick socket internal gears are aligned and mated.

NOTE: If gears are correctly aligned and mated, do not perform steps (4). thru (6). and continue with step (7). If gears are misaligned, continue with step (4).

(4). Disconnect link from idler and remove link and bellcrank as an assembly from gearshaft of inboard collective pitch stick socket by removing bolt, two washers and nut (Ref. Figure 7-38).

NOTE: During gear shaft rotation to establish correct mid-position for gearshaft and pinion in the next step, the gearshaft cutout can be seen through the hole in back of the socket assembly housing.

(5). Rotate end of the gas producer interconnect torque tube in the pilot's stick socket housing until the gearshaft-to-N_1 pinion gearmesh is at mid-travel and N_1 pinion gear wide toothspace is positioned at approximately one o'clock. View pinion by looking aft into open end of collective stick socket.

NOTE: The inboard collective N_1 pinion gear must be held in correct position while steps (7). thru (9). below are performed. If available, the optional co-pilot's collective pitch stick can be used to hold the gear in position by setting the copilot's throttle grip attach bolts at approximately seven o'clock (looking aft) before engaging the stick and socket.

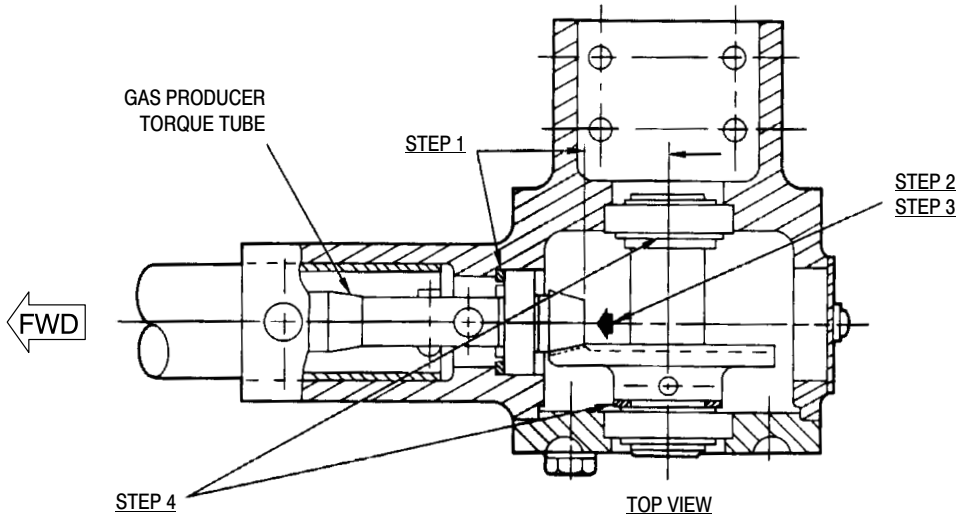
(6). Reattach inboard collective pitch stick socket bellcrank to the gearshaft and link to the idler. Bellcrank attachment bolt must be installed with head slightly down and forward.

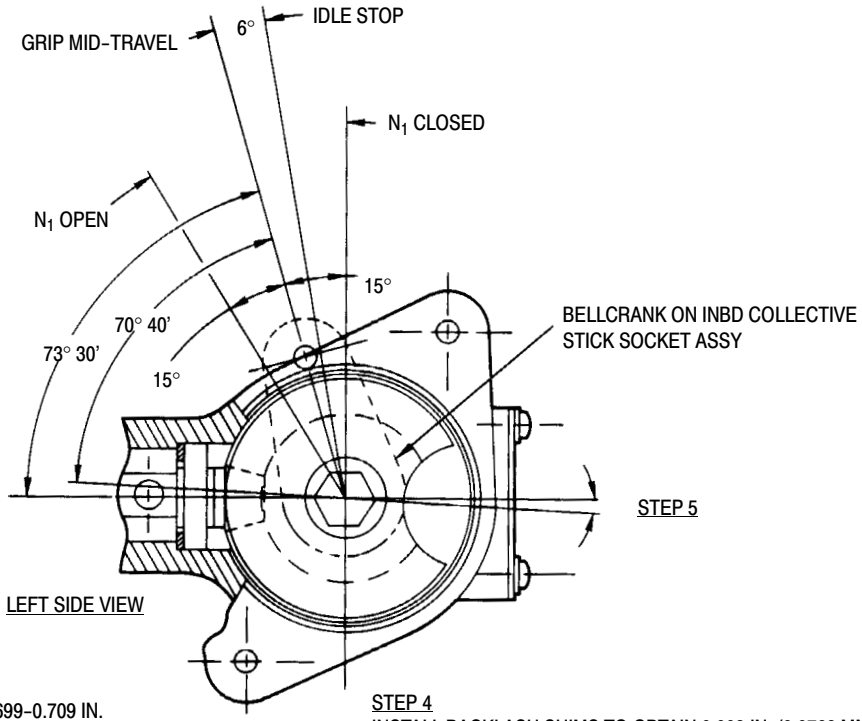
(7). With inboard collective pitch stick socket N_1 pinion gear held at position described in step (5)., rotate pilot's collective pitch stick throttle grip to mid-travel position (grip attaching bolts approximately straight down).

(8). Install backlash shims and gear shaft in pilot's collective stick socket housing (Ref. Figure 7-32). Be sure that gearshaft and pinion are aligned and mated when pilot's throttle grip is at mid-travel.

NOTE: Be sure that shims are installed in original locations.

(9). Reinstall outboard bearing and cap on pilot's stick housing.





GENERAL NOTE:
SELECT SHIMS AS REQUIRED. CRES SHIMS PROVIDED IN 0.001, 0.002, 0.005, 0.012 AND 0.032 IN. (0.0254, 0.0508, 0.127, 0.3048 AND 0.8128 MM) THICKNESS.

STEP 1
INSTALL MTG DISTANCE SHIMS TO GET 0.699–0.709 IN. (17.7546–18.0086 MM) AFTER SHIMMING IS CORRECT, INSTALL BEARING IN HOUSING WITH GRADE A LOCKING COMPOUND (29, TABLE 2-4).
NOTE: SHIMS ARE CUT THRU ONE EDGE FOR INSTALLATION.

STEP 2
APPLY10 LB (45 N) MIN. LOAD TO END OF PINION DURING CHECK OF MTG DISTANCE DIMENSION.
NOTE: TIGHTENING THE THROTTLE FRICTION NUT WILL APPLY ENOUGH LOAD.

STEP 3
POSITION THROTTLE GRIP AT MID-TRAVEL.
NOTE: ONE PINION GEAR TOOTH EQUALS 5° 38'.

STEP 4
INSTALL BACKLASH SHIMS TO OBTAIN 0.003 IN. (0.0762 MM) MAX. BACKLASH.
CAUTION: HSG AND CAP BEARINGS MUST BE SEATED AGAINST BORE SHOULDER, GEARS MUST NOT BIND AND PINION MTG DISTANCE MUST BE CORRECT.

STEP 5
AFTER SHIMMING IS CORRECT, INSTALL SHAFT ASSY SO THAT ℄ OF GEAR TOOTH CUTOUT MATCHES ℄ OF STICK. USE GRADE A LOCKING COMPOUND (29, TABLE 2-4) TO BOND SHAFT TO I.D. OF BEARINGS.
NOTE:
℄ OF SHAFT ASSY GEAR CENTER TOOTH IS 2° -50' OFF THE CUTOUT ℄.

30-051B

Figure 7-34. Gas Producer Drive Mounting Distance and Backlash Adjustment (Pilot's Collective Pitch Stick)

(10). Check that both the pilot's throttle grip and the inboard collective pitch stick socket N_1 pinion gear wide toothspace are correct at mid-travel.

(11). Remove snap plug from skin, rotate pilot's throttle grip and visually check for evidence of backlash between gas producer interconnect torque tube and hexagonal ID of the gear shaft.

(a). Zero backlash is preferred and 10 degree is maximum allowed.

(b). If necessary, remove cover and gear shaft from torque tube and eliminate any excessive backlash by tightening pipe plug in end of torque tube.

(c). Zero backlash is preferred at both ends of the tube.

(12). Reinstall snap plug.

52. Gas Producer Interconnect Torque Tube Shimming

(Ref. Figure 7-36)

(1). Remove pilot's seat cover and controls access door.

(2). Make an index mark on end of collective torque tube fitting flush with inboard end of pilot's collective stick assembly housing.

(3). Remove bolts securing pilot's collective stick assembly to end of collective torque tube fitting

(4). Loosen pipe plug in end of gas producer interconnecting torque tube which secures it to the gas producer gearshaft in pilot's collective stick assembly.

(5). Remove pilot's collective stick assembly.

(6). Using rubber mallet or equivalent soft tool, tap gas producer interconnecting torque tube assembly toward copilot's collective socket assembly. Avoid damage to gas producer interconnect torque tube hex end or pipe plug threads.

(7). Measure distance between index mark on end collective torque tube fitting and hex end of gas producer interconnect torque tube.

(8). Measure distance between inboard end of pilot's collective stick assembly housing and inboard face of gas producer gearshaft in pilot's collective stick assembly.

(9). Subtract measurement taken in step (8). from measurement taken in step (7). Remainder is engagement of gas producer interconnect torque tube with gearshaft in pilot's collective stick assembly.

(10). Subtract engagement (remainder) from 0.750 inch (19.05 mm).

(a). In addition to thickness of external snap ring, add AN960-C816 washers to end of gas producer interconnect torque tube to a total thickness equal to the remainder from 0.750 inch (19.05 mm) less engagement.

(b). Equivalent washers varying in thickness may be made from corrosion resistant steel sheet and used in combination with AN960C816 washers.

(11). Reinstall pilot's collective stick assembly.

NOTE: If the normally installed plug does not expand tube, a 1/8- 27 internal-wrenching pipe plug 0.380 inch (9.652 mm) long may be substituted. Whichever plug is used, it must not protrude more than 0.030 inch (7.62 mm) when tightened.

(12). Tighten pipe plug of gas producer interconnect torque tube to obtain zero backlash between torque tube and gearshaft in pilot's collective stick assembly.

(13). Reinstall pilot's seat cover and controls access door.

53. Pipe Plug Adjustment for Zero Backlash

(Ref. Figure 7-37)

(1). Remove pilot seat cover for access to under seat controls (Ref. Sec. 2).

(2). Remove snap plug from exterior skin.

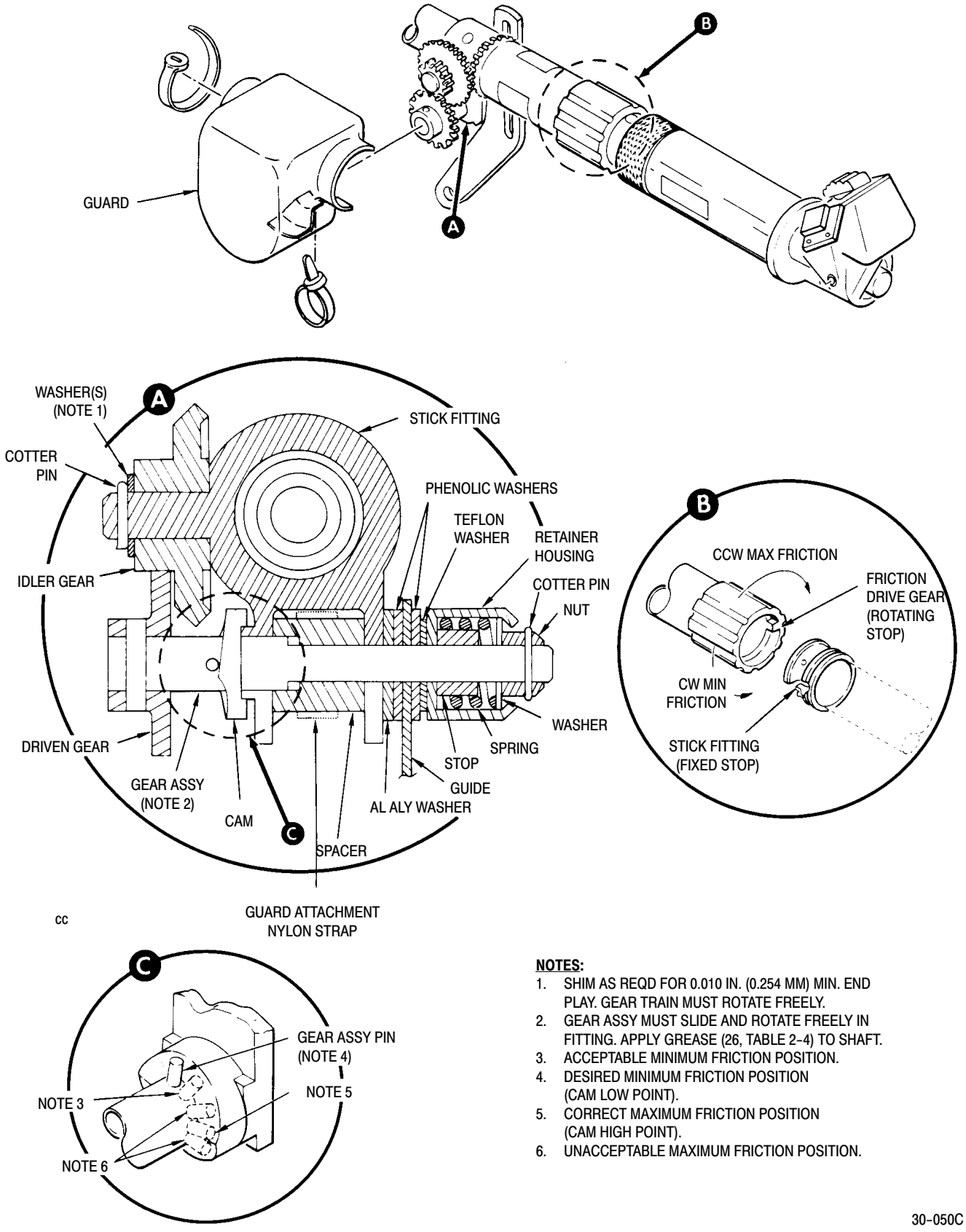
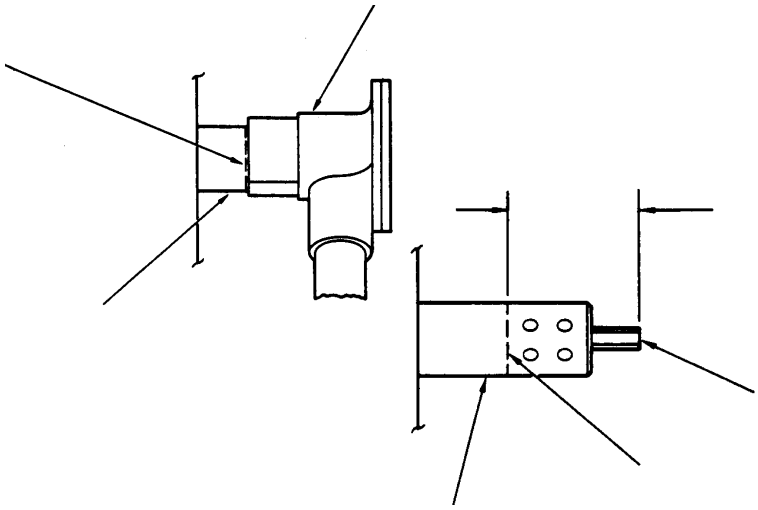


Figure 7-35. Collective Pitch Stick Friction Adjustment



GAS PRODUCER INTERCONNECT TORQUE TUBE MEASUREMENT

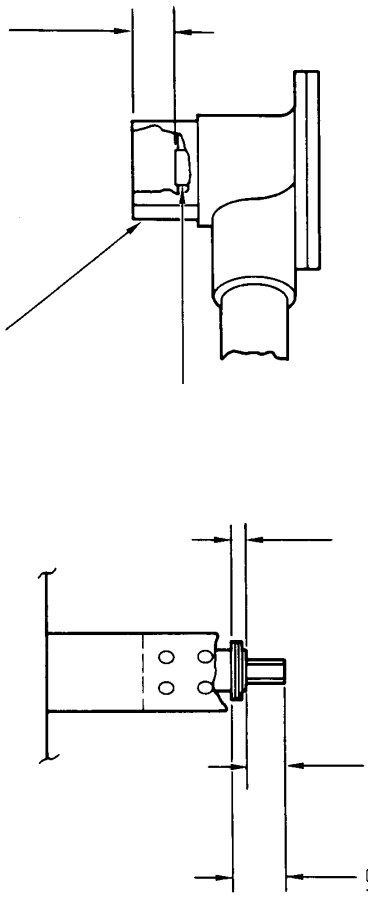


Figure 7-36. Shimming of Gas Producer Interconnecting Torque Tube Assembly

(3). Remove bolt securing bellcrank to inboard gearshaft.

(4). Position throttle midway between idle stop and full open.

(5). With assistant, tighten pipe plugs at each and of torque tube simultaneously; maintain throttle as set in step (4). Initial torque required to turn pipe plugs may be high because of dried primer used at installation.

NOTE: If the normally installed plug does not expand tube, a 1/8- 27 internal-wrenching pipe plug 0.380 inch (9.652 mm) long may be substituted. Whichever plug is used, it must not protrude more than 0.030 inch (7.62 mm) when tightened.

(6). Reinstall bolt to secure bellcrank to inboard gearshaft.

(7). Reinstall snap plug in exterior skin.

(8). Reinstall pilot seat cover.

NOTE: If optional dual controls are installed, perform following rigging and deceleration check using co-pilot's throttle.

(9). Check engine gas producer control rigging.

(10). Perform deceleration check per Pilot's Flight Manual.

54. Collective Pitch Stick Friction

(Ref. Figure 7-35) The pilot's collective pitch stick friction allows the pilot to vary the amount of effort required to raise and lower the collective pitch stick as well as increasing stick resistance to position change resulting from sudden changes in main rotor collective forces. The grip is marked with arrows indicating the direction of rotation for increasing or decreasing the friction. Friction can be applied or released with one hand by rotating the friction adjustment grip.

The collective stick friction mechanism is designed so that positive locking of the pitch stick cannot be obtained at the maximum friction point.

Safety of flight considerations require that pilot be able to instantly overcome the established collective pitch stick position, without changing the friction adjustment in the event of a power failure.

There is no suitable check that the pilot can make, with helicopter on the ground, to determine if maintenance adjustment of collective friction is correct. This is due to the large force application necessary to overcome the collective bungee and the blades resting on the droop stops.

If stick friction is inadequate during flight, a maintenance check should be performed.

Once friction adjustment is determined to be correct at the low friction point, any further mechanical adjustment to alter (increase) friction at the low point can cause the mechanism gear to be stripped when the grip is fully rotated for maximum friction.

A. Collective Stick Friction Mechanism Operational Check

(1). Remove the two nylon straps that secure guard to pitch stick and remove guard.

(2). Check that teeth of friction drive gear, idler gear, and driven gear are not stripped or otherwise damaged.

(3). Rotate the friction drive gear grip counter-clockwise to the maximum friction stop; the gear train must rotate freely.

(4). Check the position of the shaft assembly pin. The pin should be at the highest point of cam (Detail C).

(5). If the pin is not at the approximate peak of the cam or has overridden the peak (Detail C), the friction mechanism must be readjusted.

(6). If the pin is in correct position, continue with step (7). below.

(7). Rotate the drive gear grip clockwise to the minimum friction position and release the grip; the gear train must rotate freely. The pin should be at the approximate low point of the cam. (Detail C) for the range of desired and acceptable minimum friction position positions for the pin.

(8). With the pin in the low point of the cam, hand-rotate the spring retainer housing.

(a). If there is drag on the retainer, there is friction on the guide and collective friction must be readjusted.

(b). If the retainer rotates freely, without obvious looseness, the low point friction setting is correct.

B. Collective Stick Friction Mechanism Adjustment

For the collective friction mechanism to be correctly adjusted for maximum friction, three actions must occur at the same time:

- The drive gear must contact stick fitting fixed stop (Detail B);
- The spring retainer housing washer must contact the retainer internal stop (Detail A);
- The gear assembly pin must be at the approximate peak of the cam (Detail C).

CAUTION Do not overtighten the retainer nut so that the retainer washer contacts the retainer stop before the friction drive gear reaches the stick fitting stop. Adjustment that does not produce approximately simultaneous contact will allow excessive additional rotation of the drive gear grip and cause the composition nylon gear to be stripped.

(1). Remove the friction mechanism guard.

(2). Rotate the friction drive gear counterclockwise to the maximum friction position.

(3). Remove cotter pin, nut, retainer assembly, teflon washer, and one phenolic washer.

(4). Slide the gear assembly out far enough to disengage it from the idler gear. Use care to keep other washer and spacer from dropping.

(5). Remesh the gear assembly with the idler gear to position the pin on highest part of the cam gear (Detail C). Check that the drive gear is still at the maximum friction stop position.

(6). If the gear assembly does not correctly position the pin, reposition the idler gear on the drive gear.

NOTE: The gear ratio of idler gear-to-gear assembly is 3:1 which permits fine adjustments. When repositioning the idler gear, be sure to reinstall the same number of washers that were removed from between the cotter pin and idler. These washers limit gear end play to a maximum of 0.010 inch (0.254 mm). When reassembled, the gear train must rotate freely.

(7). Reinstall phenolic washer, teflon washer, retainer assembly and nut.

(8). With the drive gear still at the maximum friction position, tighten the retainer nut until it just bottoms on retainer stop.

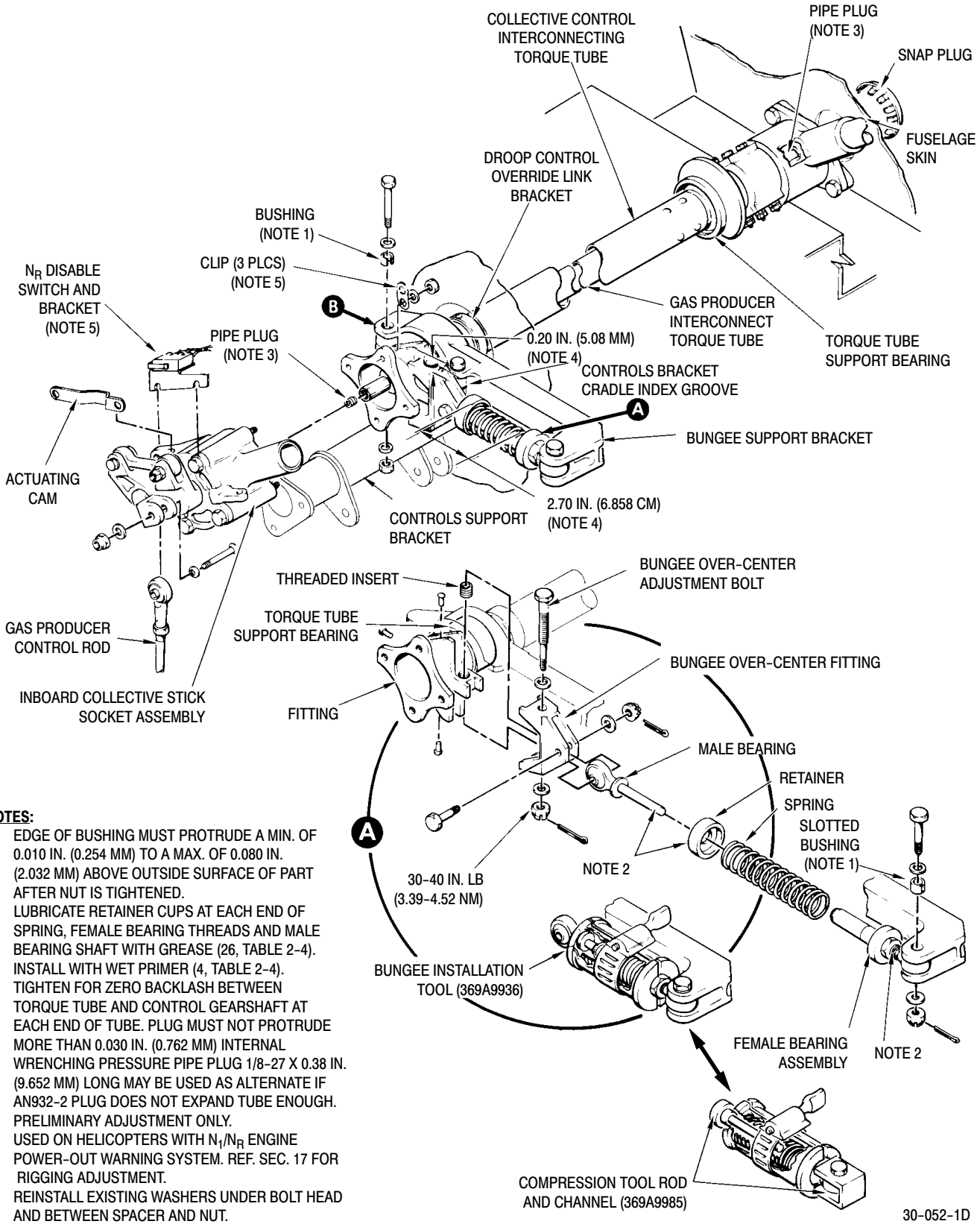
(9). Rotate the friction drive gear clockwise to the minimum friction stop position and release the grip. Check the following:

(a). If the pin has overridden the low point of the cam (Detail C) (desired minimum friction position), and grip-to-stick friction prevents spring back of the pin to the cam low point, manually turn the grip and move pin to low point.

NOTE: A drive gear that does not rotate freely (binds) on the collective stick tube should be replaced.

(b). With pin in cam low point, manually rotate the retainer assembly; it should turn freely on the shaft of the gear assembly with only light finger pressure. Adjust retainer nut to the nearest castellation that produces zero friction (no drag on the retainer assembly during rotation). Install new cotter pin.

NOTE: If undesirable collective forces (i.e. light, heavy or creeping collective) are reported to exist in the collective stick during flight, do not attempt to compensate by an increase in collective friction. The reported condition should be corrected elsewhere in the control system.



NOTES:

1. EDGE OF BUSHING MUST PROTRUDE A MIN. OF 0.010 IN. (0.254 MM) TO A MAX. OF 0.080 IN. (2.032 MM) ABOVE OUTSIDE SURFACE OF PART AFTER NUT IS TIGHTENED.
2. LUBRICATE RETAINER CUPS AT EACH END OF SPRING, FEMALE BEARING THREADS AND MALE BEARING SHAFT WITH GREASE (26, TABLE 2-4).
3. INSTALL WITH WET PRIMER (4, TABLE 2-4). TIGHTEN FOR ZERO BACKLASH BETWEEN TORQUE TUBE AND CONTROL GEARSHAFT AT EACH END OF TUBE. PLUG MUST NOT PROTRUDE MORE THAN 0.030 IN. (0.762 MM) INTERNAL WRENCHING PRESSURE PIPE PLUG 1/8-27 X 0.38 IN. (9.652 MM) LONG MAY BE USED AS ALTERNATE IF AN932-2 PLUG DOES NOT EXPAND TUBE ENOUGH.
4. PRELIMINARY ADJUSTMENT ONLY.
5. USED ON HELICOPTERS WITH N_1/N_R ENGINE POWER-OUT WARNING SYSTEM. REF. SEC. 17 FOR RIGGING ADJUSTMENT.
6. REINSTALL EXISTING WASHERS UNDER BOLT HEAD AND BETWEEN SPACER AND NUT.

Figure 7-37. Collective Torque Tube, Gas Producer Torque Tube, Collective Bungee (Sheet 1 of 2)

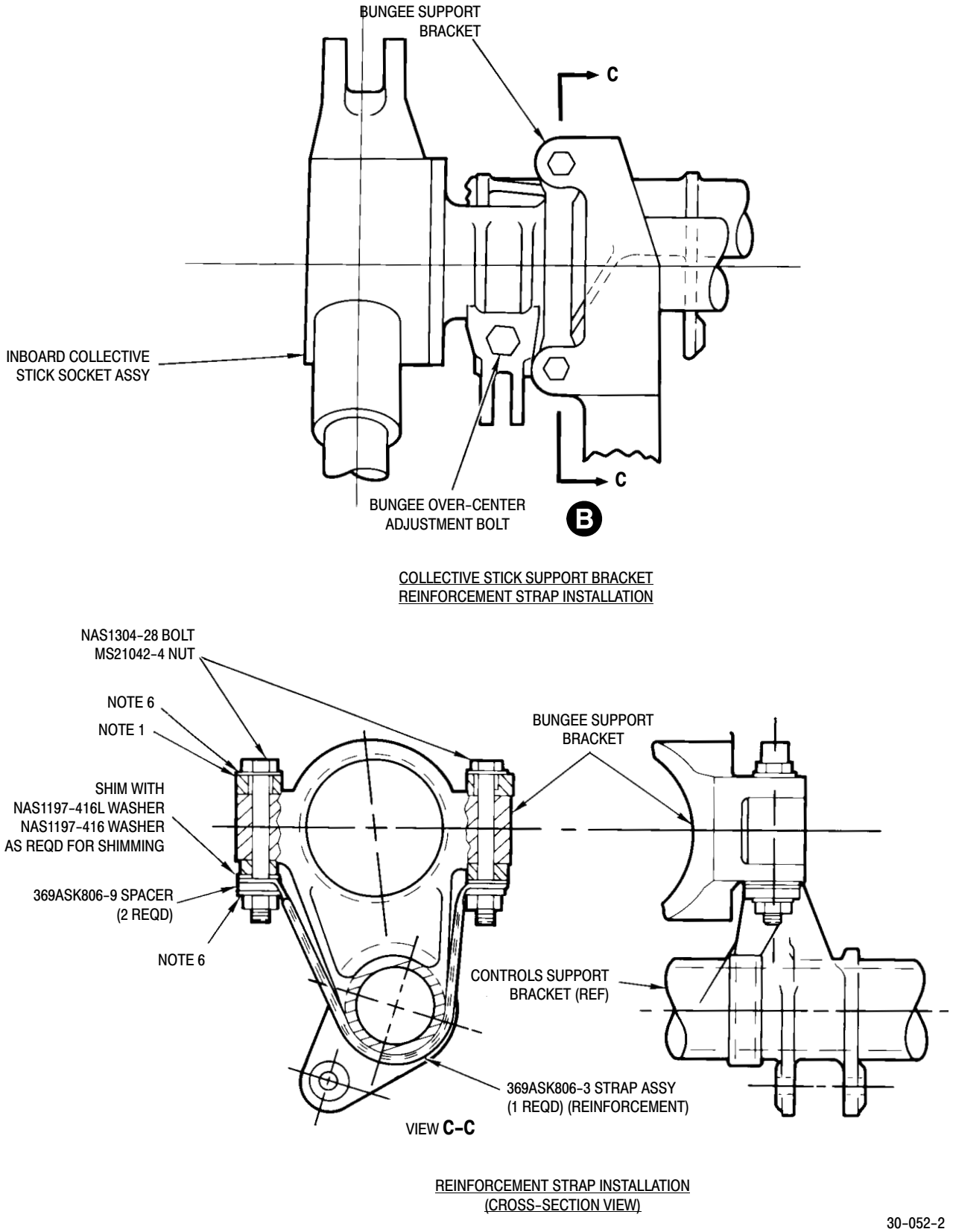


Figure 7-37. Collective Torque Tube, Gas Producer Torque Tube, Collective Bungee (Sheet 2 of 2)

55. Collective Control Interconnect Torque Tube

(Ref. Figure 7-37) The collective interconnect torque tube consist of the tube, a bungee bracket, bungee fitting, and a tube support bearing. The torque tube interconnects the pilot's collective pitch stick and the inboard collective stick socket assembly. The torque is supported at the left end by a bearing installed in the seat structure, and at the right end by the controls support bracket.

A. Collective Control Interconnect Torque Tube Inspection

(1). Remove pilot's seat cover, control access door, and left side foot support fairing (Ref. Sec. 2).

(2). Inspect collective interconnect torque tube for cracks, and bends or similar distortions.

(3). Inspect bungee bracket, and bungee fitting for security and condition.

(4). Inspect all accessible rivets for looseness and support bearings for security, and evidence of binding.

(5). Reinstall pilot's seat cover, control access door and foot fairing.

B. Collective Control Interconnect Torque Tube Removal

(1). Remove collective bungee.

(2). Remove inboard collective socket assembly.

(3). Disconnect aft end of droop control override link from torque droop control bracket (Ref. Figure 7-30, Detail A).

(4). Remove hardware securing reinforcement strap, bungee support bracket and torque tube to controls support bracket.

(5). Slide bungee bracket to side and remove controls bracket cradle cap and reinforcement strap.

(6). Slide the collective control torque tube sufficiently towards the right side of the seat structure to remove the pilot's collective pitch stick housing from end of tube.

(7). Remove nuts, washers and bolts that connect stick housing to torque tube.

(8). Remove stick by sliding it outboard and off torque tube.

(9). Remove torque tube by sliding it a total of approximately 3 inches (7.62 cm) toward the right side of the seat structure to disengage left end from support bearing inside left torque tube support. Provide support at seat structure lightening hole and carefully withdraw torque tube from structure.

(10). Remove gas producer interconnect torque tube by carefully sliding it out of collective torque tube.

C. Collective Control Interconnect Torque Tube Repair

(1). Replace loose or binding torque tube support bearing.

(a). Drill out rivets securing retainer and doubler to seat structure to replace left support bearing.

(b). Drill out three rivets securing right end fitting to torque tube to replace right support bearing.

(c). Pick up existing hole patterns and install new bearings.

(2). Replace torque tube if it is cracked or has elongated holes.

NOTE: The torque tube droop control bracket may be either an aluminum or magnesium casting. Ref. Sec. 2 for corrosion control and identification of magnesium alloy parts.

(3). Replace a bent or stripped bungee adjustment bolt. Torque nut to **30 - 40 inch-pounds (3.39 - 4.52 Nm)** and install new cotter pin.

(4). Replace scratched, nicked or damaged reinforcement strap.

D. Collective Control Interconnect Torque Tube Installation

(1). Install gas producer interconnect torque tube by sliding it carefully into place in collective control interconnect torque tube.

(2). Insert torque tube into lightening hole in seat structure. Use care when

inserting tube into place to prevent scraping on edge of hole; insert tube only to a position that provides sufficient space between tube end and fuselage skid for installation of pilot's stick housing on end of tube.

(3). Lubricate pilot's stick housing with grease (26, Table 2-4).

NOTE: Stick housing must be placed on torque tube before installing torque tube attaching hardware.

(4). Slide Pilot's Stick housing on collective control interconnect torque tube.

(5). Complete insertion of tube and position left end of tube in fixed bearing bore. Rotate torque tube slowly back and forth until right end bearing rests cradle of controls support bracket.

(a). Check that two slotted bushings are in place in upper lugs of bungee bracket. position torque tube, control bracket cradle cap, reinforcement strap, and bungee bracket on control support bracket.

(b). Check that cap-to-cradle index grooves are matched. Install attaching hardware and ensure that reinforcement strap is tight with bolts torqued, shim with washers as required.

(c). Apply a thin layer of grease to sliding surface of bungee overcenter fitting.

(6). Install droop control override link to torque tube droop control bracket (Ref. Figure 7-30, Detail B).

(7). Install inboard collective socket assembly.

(8). Complete installation of pilot's collective pitch stick.

(9). Install collective bungee.

56. Collective Bungee

(Ref. Figure 7-37) The collective bungee installation consists of a male bearing assembly, female bearing assembly, spring, and retainer.

This unit attaches between the bungee over-center fitting and bungee bracket of the collective interconnecting torque tube.

The collective bungee is provided to help maintain selected collective pitch stick position in flight by counter-acting forces that are fed back to the collective pitch sticks: blade pitching moments; rotor head strap pack torsion when collective pitch stick is raised or lowered from mid-position (strap pack neutral position); combined imbalance of forces in the control system.

The flight characteristics of the helicopter are such that collective forces are relatively low during most of stick travel from low pitch toward high pitch. At a point near full pitch the stick forces reverse and become heavy. The purpose of the adjustable bungee and the overcenter bracket attachment is to counteract these forces so that collective stick loads are relatively constant throughout the full range of travel.

There are two adjustments available to establish or correct collective flight loads. Adjustment of the collective bungee spring will correct a variation in collective load from low pitch (level flight) to high pitch (climb). Setting of overcenter bolt to raise or lower bungee fitting will cause an overall reduction or increase of collective forces in both low pitch (level flight) and high pitch (climb).

A. Collective Bungee Removal

(1). Remove pilot's seat cover from seat structure (Ref. Sec. 2).

(2). Raise the collective stick and use the torque tube over-center action to compress the bungee spring until bungee installation tool (26, Table 2-2) will fit over the spring retainers. Secure tool halves in place with clamp.

(3). With stick in over-center position, remove cotter pin, nut, washer, and bolt that secure male bearing to bungee over-center fitting.

(4). Remove cotter pin, nut, two washers, and bolt that attach female bearing end of bungee to the bungee bracket.

(5). Remove collective bungee and installation tool as a unit.

CAUTION Remove installation tool only as directed (Ref. Collective Bungee Disassembly).

B. Collective Bungee Installation

(1). Position the collective bungee in installation tool (26, Table 2-2) so that the female bearing assembly is forward and aligns with mating hole in the bungee bracket (Detail A).

(2). Check that slotted bushing for bracket lug is in place, install bolt, two washers, nut and new cotter pin.

(3). Position male bearing to align with mating hole in bungee over-center fitting.

(4). Install bolt, washer, nut and new cotter pin.

CAUTION Do not turn the female bearing assembly spring retainer while the bungee installation tool is under spring load.

(5). Raise the collective stick and use the torque tube over-center action to compress spring until bungee installation tool can be removed.

(6). With collective stick at full down position, make preliminary adjustment of the bungee installation.

(7). Adjust bungee after flight evaluation, as required.

C. Collective Bungee Disassembly

(1). Remove male bearing from bungee clamped in compression by the installation tool.

(2). Install bungee compression tool rod and channel (27) on compressed bungee. Insert a 0.250 inch (6.35 mm) bolt through channel and female bearing rod end (Detail A).

(3). Line the jaws of a bench vise with masking tape or similar nonskid material.

(4). Place compression tool and bungee in the vise so that the vise jaws make contact with tool rod and channel.

(5). Compress spring by closing vise until the bungee clamp may be removed from bungee.

(6). Slowly open vise until bungee spring is fully extended.

(7). Remove retainer, spring and female bearing assembly.

NOTE: Do not disassemble female bearing assembly. Replace as a unit if defective.

D. Collective Bungee Inspection

NOTE:

- The bungee support bracket may be either an aluminum or magnesium casting. Ref. Sec. 2 for corrosion control and identification of magnesium and aluminum alloys.
- Replace any bungee parts having questionable condition.

(1). Inspect spherical bearings in male bearing and female bearing assembly for evidence of binding, corrosion and galling.

(2). Inspect female bearing assembly threads for damage.

(3). Inspect spring for evidence of deformation. Free length of spring must be 4.50 ±0.060 inches (11.43 ±0.1524 cm).

(4). Inspect male bearing rod for cracks, evidence of binding, corrosion and deformation.

E. Collective Bungee Reassembly

(1). Use a bench vise having jaws that are lined with a nonskid material.

(2). Lubricate cups of spring retainers and threads and bore of female bearing assembly with grease (26, Table 2-4).

(3). Assemble retainer, spring, and female bearing assembly. Install compression tool rod and channel (27, Table 2-2) in position. Insert a 0.250 inch (6.35 mm) bolt through channel and female bearing rod end (Detail A).

(4). Position assembly in jaws of bench vise.

(5). Close the jaws to compress bungee spring until bungee installation tool

(26) will fit over the retainers. Secure tool halves in place with clamp.

(6). Open bench vise jaws slowly, and remove the bungee compression tool rod and channel.

(7). Install male bearing into place in compressed bungee.

F. Collective Bungee Adjustment

(Ref. Figure 7-31) Adjustment of the bungee system is only permissible when the helicopter is on the ground.

(1). Collective load forces are affected by any adjustment made in the main rotor system. Observe the following:

(a). Bungee adjustment should only be made when the main rotor blades are in track and autorotation rpm is established.

(b). Ensure that collective stick friction is correctly adjusted.

(c). Perform flight evaluation of collective forces with helicopter takeoff weight at 2200 pounds (998 kg), N_2 at 103% and ZERO COLLECTIVE STICK FRICTION.

(2). Prior to test flight, establish the half-way point of the collective friction adjustment grip (drive gear) as follows.

(a). Using a soft, colored pencil, index the collective friction adjustment grip at zero friction.

(b). Roll on maximum friction (approximately 275 degrees rotation). Note travel and reset friction grip half-way. Hold in this position.

(c). Using a dot of white paint or similar method, temporarily mark the top of the friction grip and the adjacent exposed area of the collective stick. The friction half-way index mark should be visible to the pilot.

(3). While helicopter is on ground, adjust bungee to extent necessary to avoid any upload in flat pitch at normal rpm.

(a). This adjustment must also provide absence of an excessive download or upload while in hover and at 120 knots level cruise.

(b). Helicopter must be landed after each flight check, before making corrective adjustment.

WARNING **Use all necessary precautions to prevent possible entry of any foreign objects into controls linkage exposed by removal of pilot's seat cover to make adjustment of bungee system.**

CAUTION After each bungee adjustment is made, collective stick must be slowly moved through its full travel range to assure that there is no binding or restriction of stick motion, and that spring does not bottom at overcenter position.

NOTE: Do not turn female bearing assembly retainer while bungee installation tool is spring loaded.

(c). If an upload exists on ground at flat pitch and normal rpm but a download prevails during hover and at 120 knots level cruise, turn bungee adjustment retainer nut clockwise to increase preload in bungee system.

(d). To correct a download on ground during flat pitch at normal rpm and an upload condition during hover and 120 knots level cruise, turn bungee adjustment retainer nut counterclockwise to decrease preload in bungee system.

(e). When a relatively constant upload condition prevails during flat pitch at normal rpm on the ground, at hover, and at 120 knot level cruise, decrease upload by turning bungee over-center adjustment bolt clockwise.

(f). When a relatively constant download condition prevails during flat pitch normal rpm on the ground, at hover, and at 120 knot level cruise, decrease download by turning bungee over-center adjustment bolt counterclockwise.

NOTE: Rotation of the adjustment bolt head is the only mechanical operation required to adjust the over-center position of the bungee fitting.

(g). After minimum and balanced collective forces have been obtained, not more than one-half the available collective stick friction (friction grip at half-way index) must cancel collective forces during flight test at 120 knots level flight.

(h). If friction applied in step (g). above is insufficient to cancel collective forces, repeat adjustment procedure just concluded.

57. Inboard Collective Stick Socket Assembly

(Ref. Figure 7-38) The inboard collective stick socket assembly is a cast magnesium housing that contains gas producer linkage and provisions for attachment of dual collective controls.

The internal gas producer drive gear linkage is essentially the same as that in the pilot's collective stick housing with the addition of a splined N_1 pinion gear for simplified installation or removal of a pilot's collective stick.

The lower end of the collective mixer tunnel-routed control rod is attached to the socket housing, and the exterior bellcrank, idler and link transfer movement of the pilot's collective stick throttle to the gas producer controls routed through the fuselage to the engine.

A. Inboard Collective Stick Socket Assembly Removal

(1). Remove the pilot's seat cover and the controls access door (Ref. Sec. 2).

(2). Disconnect collective mixer tunnel-routed control rod.

(3). Disconnect gas producer control rod from idler (Ref. Figure 7-37).

(4). Remove N_R disable switch if installed.

(5). Remove the four nuts and washers that attach the socket assembly to the collective torque tube and remove the assembly.

NOTE: If disassembly is not intended, install four spacers and reinstall the washers and nuts on the protruding bolts to keep the assembly intact.

B. Inboard Collective Stick Socket Assembly - Disassembly

(1). Disconnect the link from the idler.

(2). Remove the idler from the socket housing. Do not remove idler bearing unless replacement is necessary.

(3). Remove the four bolts and washers that attach housing cap to socket housing.

(4). Rotate the shaft assembly until gear tooth cutout clears pinion (bellcrank ears at approximately 195 degrees); then separate the bellcrank, housing cap and shaft assembly from the housing.

(5). Remove the bellcrank from shaft assembly to separate housing cap from shaft.

NOTE: Do not press bearings from cap or housing unless replacement is necessary. Keep backlash shims with shaft assembly.

(6). Remove link from bellcrank.

(7). Remove snap ring that retains the N_1 pinion gear aft bearing in the housing.

(8). Press the pinion gear and aft bearing, as an assembly, out through the access hole at the back of the housing.

NOTE: Disassemble pinion bearings from pinion and housing only if replacement is necessary.

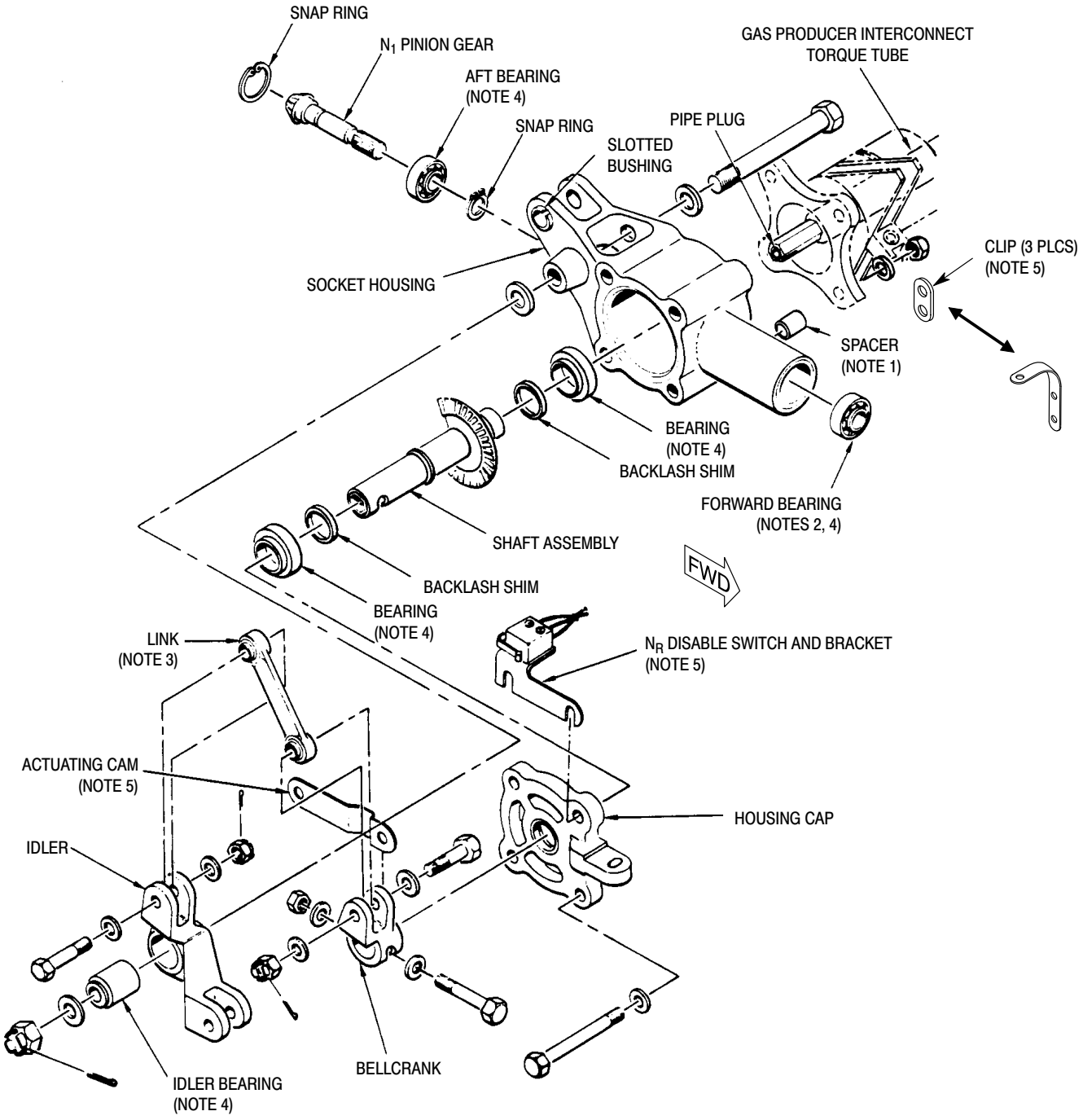
C. Inboard Collective Stick Socket Assembly Inspection

(1). Inspect all bearings for binding or looseness.

(2). Inspect gears for cracks, and chipped or broken teeth.

(3). Inspect all components for cracks, corrosion and deformation.

NOTE: The bellcrank and idler may be either an aluminum or magnesium casting. Ref. Sec. 2 for corrosion control an identification of magnesium and aluminum alloy parts.



NOTES:

1. FOUR SPACERS USED ONLY ON REMOVED SOCKET ASSEMBLY TO KEEP ASSEMBLY INTACT.
2. N_1 PINION FORWARD BEARING IS LIGHT PRESS FIT IN HOUSING BORE.
3. LINK MUST BE BOLTED TO BELLCRANK BEFORE BELLCRANK AND SHAFT ASSEMBLY ARE INSTALLED.
4. INSTALL BEARINGS WITH GRADE A LOCKING COMPOUND (29, TABLE 2-4). BOND THE TWO SHAFT ASSEMBLY BEARINGS ONLY AFTER SHIMMING FOR BACKLASH.
5. USED ON HELICOPTERS WITH N_1/N_R ENGINE POWER-OUT WARNING SYSTEM. REF. SEC. 17 FOR RIGGING AND ADJUSTMENT.

30-053

Figure 7-38. Inboard Collective Stick Socket Assembly

D. Inboard Collective Stick Socket Assembly Repair

(1). Replace bearings if corroded, excessively worn, or if the outer or inner races of bearings rotate on mating surfaces and locking compound is inadequate to prevent rotation.

(a). Install new bearings with grade A locking compound (29, Table 2-4).

(b). Check that replacement bearing is properly seated in its bore.

(2). Replace any part that is cracked.

(3). Replace entire link if bearings are defective; link bearings are not replaceable.

(4). Replace a pinion gear or shaft assembly bevel gear when correct backlash cannot be maintained because of tooth irregularities caused by wear or deformation.

E. Inboard Collective Stick Socket Assembly - Reassembly

(1). Check gear shaft bearings in housing cap and housing for security of outer races.

(a). Use grade A locking compound (29, Table 2-4) to install replacement bearings.

(b). Use care to prevent compound from entering bearings, and make sure that each bearing is seated against its bore shoulder.

(2). Apply grade A locking compound (29) to pinion gear aft bearing OD, and matching bore in socket housing.

(3). Install the assembled N_1 pinion gear and aft bearing; seat bearing firmly against bore shoulder.

(4). Install snap ring that retains aft bearing in housing bore.

(5). Apply locking compound to bond pinion shaft and forward bearing ID.

(6). Establish N_1 pinion and shaft assembly bevel gear backlash (Ref. Figure 7-39).

(7). After backlash shimming is correct, remove housing cap and gear shaft.

(8). Install bellcrank on shaft assembly, and link to bellcrank.

NOTE: Bellcrank attachment bolt must be installed with head slightly down and forward.

(9). Lubricate teeth of pinion gear and shaft assembly bevel gear with grease (26).

(10). Apply grade A locking compound to gear shaft and ID of bearings.

(11). With the centerline (wide) toothspace of the N_1 pinion gear up (on top), install shaft assembly gear at midtravel position.

NOTE: N_1 pinion gear side toothspace should be position up at approximately one o'clock position, as viewed looking aft into open end of socket.

(12). Install four bolts, eight washer, four spacers and nuts to secure cap to housing.

(13). Install idler to housing, and link to idler.

NOTE: As installed, idler to gas producer control rod bolt holes should be in line with centerline of stick assembly housing cap when gear shaft and pinion gears are positioned as outlined in step (11). above.

F. Inboard Collective Stick Socket Assembly Installation

(1). Remove four nuts washers and spacers from socket assembly mounting bolts.

(2). With throttle grip on pilot's collective stick at midtravel (Ref. Figure 7-34), rotate bellcrank back and forth slightly to engage socket assembly to gearshaft on hexagonal end of gas producer interconnect torque tube.

(a). Bellcrank centerline, N_1 pinion gear centerline toothspace and pilot's throttle must be as shown.

NOTE: With pilot's throttle grip at midtravel, two grip attach bolts should be approximately straight down. Simultaneously, idler-to-gas producer control rod bolt holes should be in line with centerline of inboard stick assembly housing cap. At midtravel, inboard N_1 pinion gear spline wide toothspace should be at approximately 1 o'clock as viewed looking aft into open end of socket.

(3). Install N_R disable switch if required, and secure socket assembly housing to collective torque tube.

(4). Rotate pilot's throttle and check for zero backlash between gas producer interconnect torque tube and the hexagonal (ID) interior of drive gearshaft in socket assembly housing.

(5). Eliminate backlash by removing housing cap and gearshaft, and then removing pipe plug in end of torque tube (Ref. Figure 7-37).

(a). Coat pipe plug with wet primer (4, Table 2-4), reinstall and tighten it so that there is no backlash between torque tube and control gearshaft at each end of the tube.

NOTE: If the normally installed plug does not sufficiently expand tube, a 8- 27 internal-wrenching pipe plug 0.380 inch (9.652 mm) long may be substituted.

(b). Whichever plug is used, it must not protrude more than 0.030 inch (0.762 mm) when tightened.

(c). Zero degree backlash is required at both ends of tube.

(d). After plug is tightened, reinstall gearshaft and housing cap.

(6). Connect gas producer control rod to idler.

(7). Connect collective mixer tunnel-routed control rod.

(8). Remove bungee installation tool.

(9). Reinstall pilot's seat cover and the controls access door.

(10). Check that inboard collective pitch stick socket gears are at midtravel when pilot's collective pitch stick throttle grip is set to midtravel. If not, adjust collective pitch stick(s) gas producer control linkage.

(11). Adjust N_R disable switch if installed.

58. Cyclic Controls

The cyclic pitch control system is a fully mechanical control system. Any combination of lateral and longitudinal cyclic pitch stick movement is mixed by cyclic lateral and longitudinal control mixers and transferred to the main rotor swashplate, which applies the combined motion through pitch control rods to the main rotor blades.

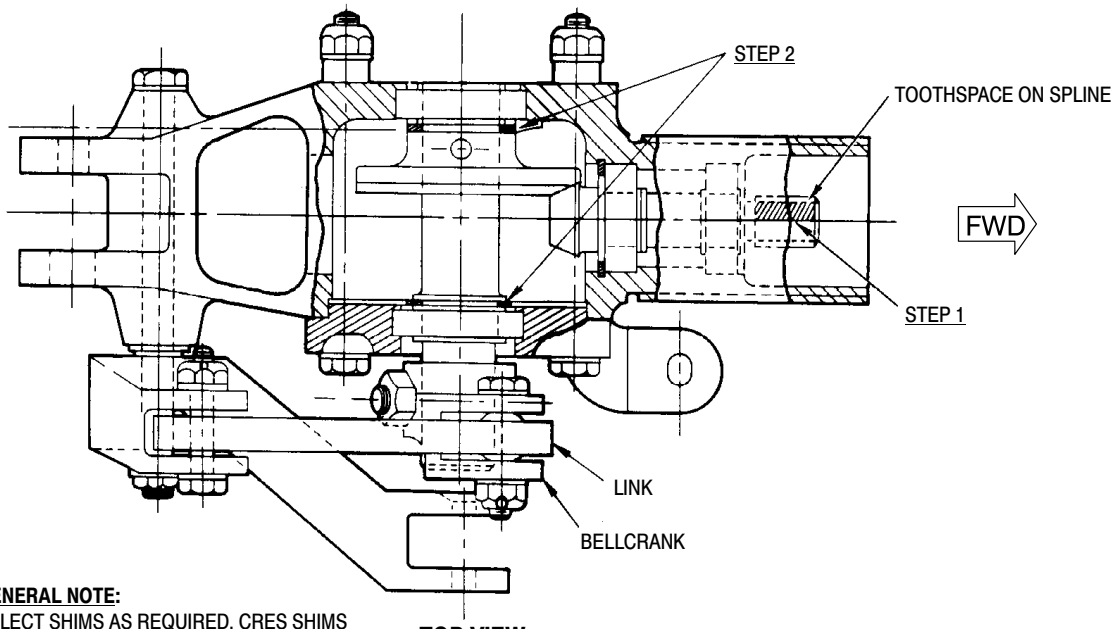
Forward and rearward movement of the cyclic pitch stick causes helicopter motion in a longitudinal direction, while side-to-side movement provides motion in a lateral direction. This action varies the lift developed by main rotor blades and thus serves as primary control of horizontal flight.

The pilot's compartment cyclic controls include the control stick, a lateral interconnecting rod, lateral cyclic bellcrank, longitudinal cyclic control interconnecting torque tube and lateral and longitudinal friction mechanisms.

The one-way lock assembly, longitudinal cyclic trim actuator, lateral cyclic trim actuator, longitudinal idler bellcrank and lateral idler bellcrank are located beneath the pilot's seat structure.

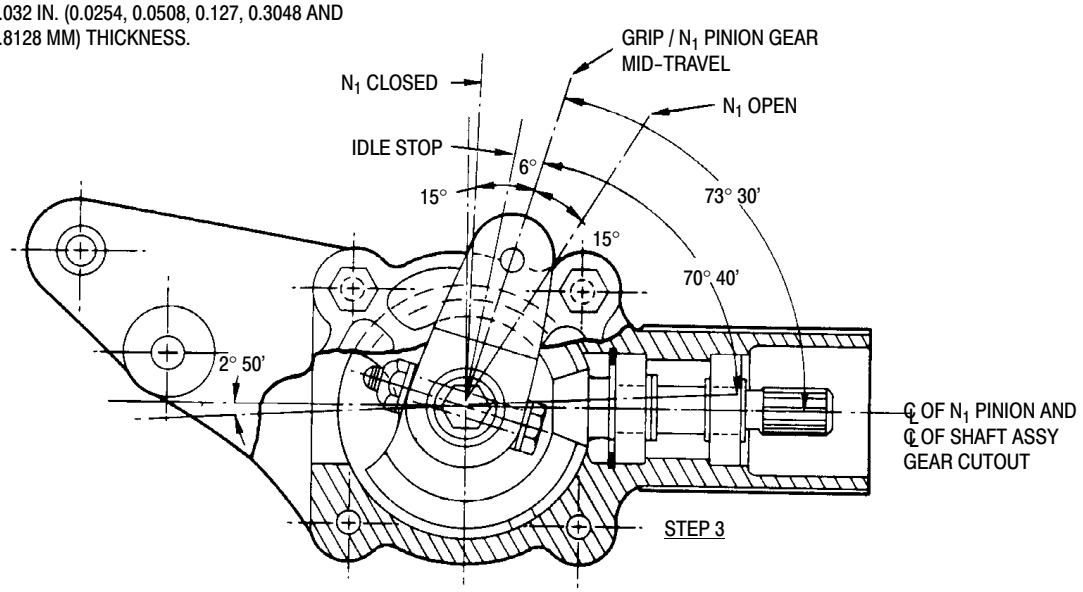
Tunnel-routed longitudinal and lateral control rods connect the underseat idler bellcranks to the main rotor lateral pitch mixer bellcrank and longitudinal pitch idler.

Dual control provisions are incorporated into the pilot's compartment cyclic controls installation. Dual control information for the helicopter is provided in CSP-018, CSP-H-3, or HMI Supplement M, as applicable.



TOP VIEW

GENERAL NOTE:
SELECT SHIMS AS REQUIRED. CRES SHIMS PROVIDED IN 0.001, 0.002, 0.005, 0.012 AND 0.032 IN. (0.0254, 0.0508, 0.127, 0.3048 AND 0.8128 MM) THICKNESS.



RIGHT SIDE VIEW

STEP 1
POSITION ℄ (WIDE) TOOTHSPACE OF N_1 PINION GEAR SPLINE UP AT APPROX 1 O'CLOCK VIEWED FROM SOCKET END.
NOTE: ONE STANDARD PINION GEAR TOOTH EQUALS 5° 38'.

STEP 2
INSTALL BACKLASH SHIMS TO OBTAIN 0.003 IN. MAXIMUM BACKLASH.
CAUTION: BEARINGS MUST BE SEATED AGAINST BORE SHOULDER AND GEARS MUST NOT BIND.

STEP 3
AFTER SHIMMING IS CORRECT, INSTALL SHAFT ASSY BEARINGS WITH GRADE A LOCKING COMPOUND (29, TABLE 2-4).
INSTALL SHAFT ASSY (WITH LINK ATTACHED TO BELLCRANK) SO THAT POSITION OF BELLCRANK, ℄ OF SHAFT ASSY GEAR CUTOUT AND ℄ (WIDE) TOOTHSPACE OF PINION SPLINE ARE AS SHOWN.
NOTE: ℄ OF SHAFT ASSY GEAR CENTER TOOTH IS 2° 50' OFF THE CUTOUT ℄.

30-054B

Figure 7-39. Adjustment of Gas Producer Drive Backlash (Inboard Collective Stick Socket Assembly)

59. Pilot's Cyclic Control Stick (Left Position)

(Ref. Figure 7-40) The left position pilot's cyclic control stick consists of a grip, and a anodized aluminum alloy tube riveted in a magnesium or aluminum socket. The cyclic grip contains a toggle-type switch for the cyclic trim controls and a trigger-type switch for radio/interphone communication. A blank switch socket is provided to the left of the trim switch for optional equipment switch installation. Coiled and deadened wiring is provided in the grip for connection to the optional switch.

A. Pilot's Cyclic Control Stick Removal (Left Position)

(1). Disconnect control stick electrical plug.

(2). Remove the cotter pin, nut, washers and bolt that secure the pilot's lateral control rod to the stick socket.

(3). Remove the cotter pin, nut, washers and bolt that attach the lateral friction mechanism link to the cyclic torque tube.

(4). Remove the cotter pin, nut, washers and bolt that attach the stick socket to the end of the cyclic torque tube. Remove stick with lateral friction mechanism attached.

B. Pilot's Cyclic Control Stick Installation (Left Position)

(1). Position pilot's cyclic control stick to align with mating holes in torque tube (Ref. Figure 7-33).

(2). Install bolt, two washers, nut, and new cotter pin.

(3). Check that slotted bushing is in place; then align plot's lateral control rod with stick socket.

(4). Install bolt, two washers, nut and new cotter pin.

(5). Position guide link to align with mating hole in torque tube.

(6). Install bolt, sleeve bushing, three washers, nut and new cotter pin.

(7). Connect electrical plug.

C. Pilot's Cyclic Control Stick Grip Removal

(1). Disconnect removable contacts from electrical plug (Ref. Sec. 19).

(2). Remove the nylon strap that secures wiring to stick socket.

NOTE: Remove strap mounting plate only if unserviceable.

(3). Remove screw from grip and separate grip from tube.

(4). Tie a "fish" string to each wire bundle to aid reassembly.

(5). Push wire slack into wiring exit holes in stick socket while pulling grip wiring from stick tube.

(6). Remove grip and wiring; leave strings in tube.

D. Pilot's Cyclic Control Stick Grip Installation

(1). Separate grip wiring into approximately equal color-coded bundles, according to the wiring diagram in Section 20.

(2). Install an 8 inch (20.32 cm) length of AWG Size No. 3 electrical insulation sleeving (31, Table 2-4) on each bundle and push sleeving into grip.

(3). Route wiring through stick tube and out wiring exit holes with the aid of "fish" strings.

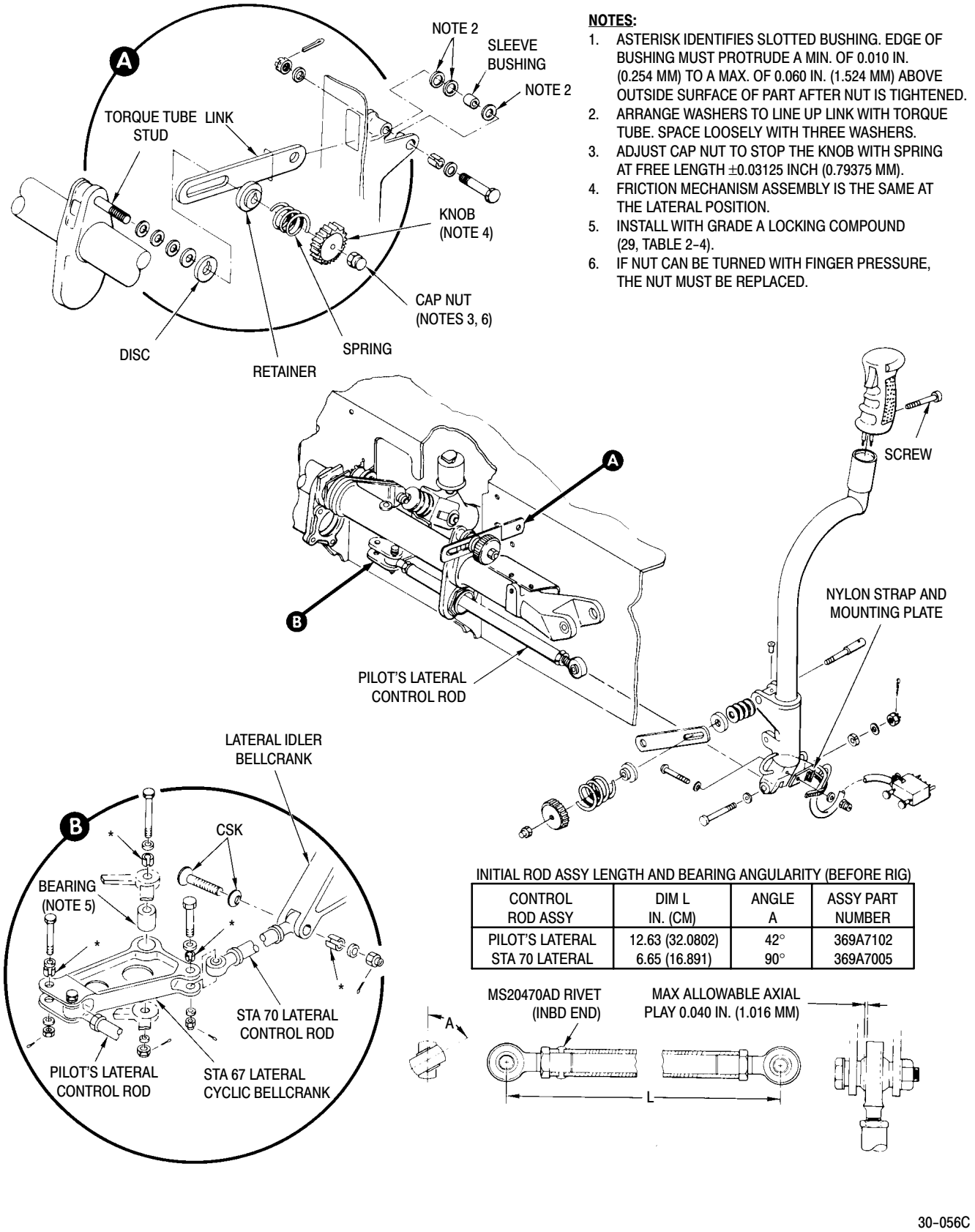
(4). Push wires at grip end while pulling slack out of socket.

(5). Install an additional 8 inch (20.32 cm) length of insulation sleeving to protect each wire bundle where routed through exit holes in socket.

(6). Position grip on stick tube and install screw.

(7). Push as much wire slack as possible back into the stick.

(8). Secure wiring to socket with a new nylon strap, or equivalent.



NOTES:

1. ASTERISK IDENTIFIES SLOTTED BUSHING. EDGE OF BUSHING MUST PROTRUDE A MIN. OF 0.010 IN. (0.254 MM) TO A MAX. OF 0.060 IN. (1.524 MM) ABOVE OUTSIDE SURFACE OF PART AFTER NUT IS TIGHTENED.
2. ARRANGE WASHERS TO LINE UP LINK WITH TORQUE TUBE. SPACE LOOSELY WITH THREE WASHERS.
3. ADJUST CAP NUT TO STOP THE KNOB WITH SPRING AT FREE LENGTH ±0.03125 INCH (0.79375 MM).
4. FRICTION MECHANISM ASSEMBLY IS THE SAME AT THE LATERAL POSITION.
5. INSTALL WITH GRADE A LOCKING COMPOUND (29, TABLE 2-4).
6. IF NUT CAN BE TURNED WITH FINGER PRESSURE, THE NUT MUST BE REPLACED.

INITIAL ROD ASSY LENGTH AND BEARING ANGULARITY (BEFORE RIG)

CONTROL ROD ASSY	DIM L IN. (CM)	ANGLE A	ASSY PART NUMBER
PILOT'S LATERAL	12.63 (32.0802)	42°	369A7102
STA 70 LATERAL	6.65 (16.891)	90°	369A7005

30-056C

Figure 7-40. Pilot's Cyclic Stick, Control Linkage and Friction Controls

E. Pilot's Cyclic control Stick Inspection (Left Position)

(1). Inspect stick tube attachment to socket for evidence of loose rivets, distortion and corrosion.

NOTE: The socket may be either an aluminum or magnesium casting. Ref. Sec. 2 for corrosion control and identification of magnesium and aluminum alloys.

(2). Inspect parts of friction mechanism for physical damage. Free length of friction spring should be approximately 0.580 inch (14.732 mm).

(3). To check installation:

(a). Loosen lateral and longitudinal friction knobs, move cyclic control stick and check for binding or unusual noises.

(b). Check that the rod end bearings of the pilot's lateral control do not jam when the stick is full forward and full aft.

F. Pilot's Cyclic Control Stick Repair (Left Position)

Disassemble cyclic control stick only as necessary to replace damaged or faulty parts.

NOTE: The stick tube should not be removed from the stick socket; the assembly should only be replaced as a unit.

(1). Cut wiring to correct length and reinstall replaceable contacts and electrical plug according to Sec. 19 and wiring diagram in Sec. 20.

G. Pilot's Friction Mechanism Replacement

(1). Remove cap nut from friction stud and disassemble friction mechanism from stick socket or torque tube (Detail A).

(2). Replace a bent or stripped friction stud.

(a). Drill out rivet and press stud from socket; install new stud and rivet in place.

(b). Press a replacement spring pin into friction stud until one end of pin is flush with surface of stud.

(3). Assemble friction mechanism to stick socket or torque tube (Detail A).

(4). Adjust friction knob cap nut to stop the knob when the spring reaches free length, no compression ±0.03125 inch (±0.79375 mm).

60. Cyclic Stick Guard

(Ref. Figure 7-41) The cyclic stick guard installation protects passengers in the pilot's compartment from movement of the cyclic linkage forward of the seat structure and also blocks the entry of any large foreign objects that might jam or foul the control linkage.

The guard installation consists of three polycarbonate plastic guards and one aluminum alloy guard, attached to the floor and face of the seat structure. The small aluminum guard (second from left) forms the stationary half of its rotating counterpart that is riveted to the cyclic torque tube.

A. Cyclic Stick Guard Replacement

Remove and reinstall cyclic stick guards by removing the attaching screws and washers. The right guard has two slip-fit locating pins (rivets) that engage the large central guard to keep the two guards aligned.

NOTE: Riveted nutplates are provided at all screw locations except for the top left and two top center screws of the large (central) guard; regular washers and nuts are installed at these three places.

61. Pilot's Compartment Lateral and Longitudinal Cyclic Control Linkage

(Ref. Figure 7-40) The pilot's compartment lateral and longitudinal cyclic control linkage consists of the two control rods and bellcrank that interconnect lateral control movement, and the cyclic torque tube and one-way lock control system that interconnect longitudinal control movement of the pilot's cyclic stick to the tunnel-routed mixer control rods.

A. Lateral Control Rods and Station 67 Bellcrank Removal

(Ref. Figure 7-41)

(1). Remove the large (central) cyclic stick guard.

(2). Remove the pilot's seat cover, and controls access door from Sta. 78.50 canted bulkhead (Ref. Sec. 2).

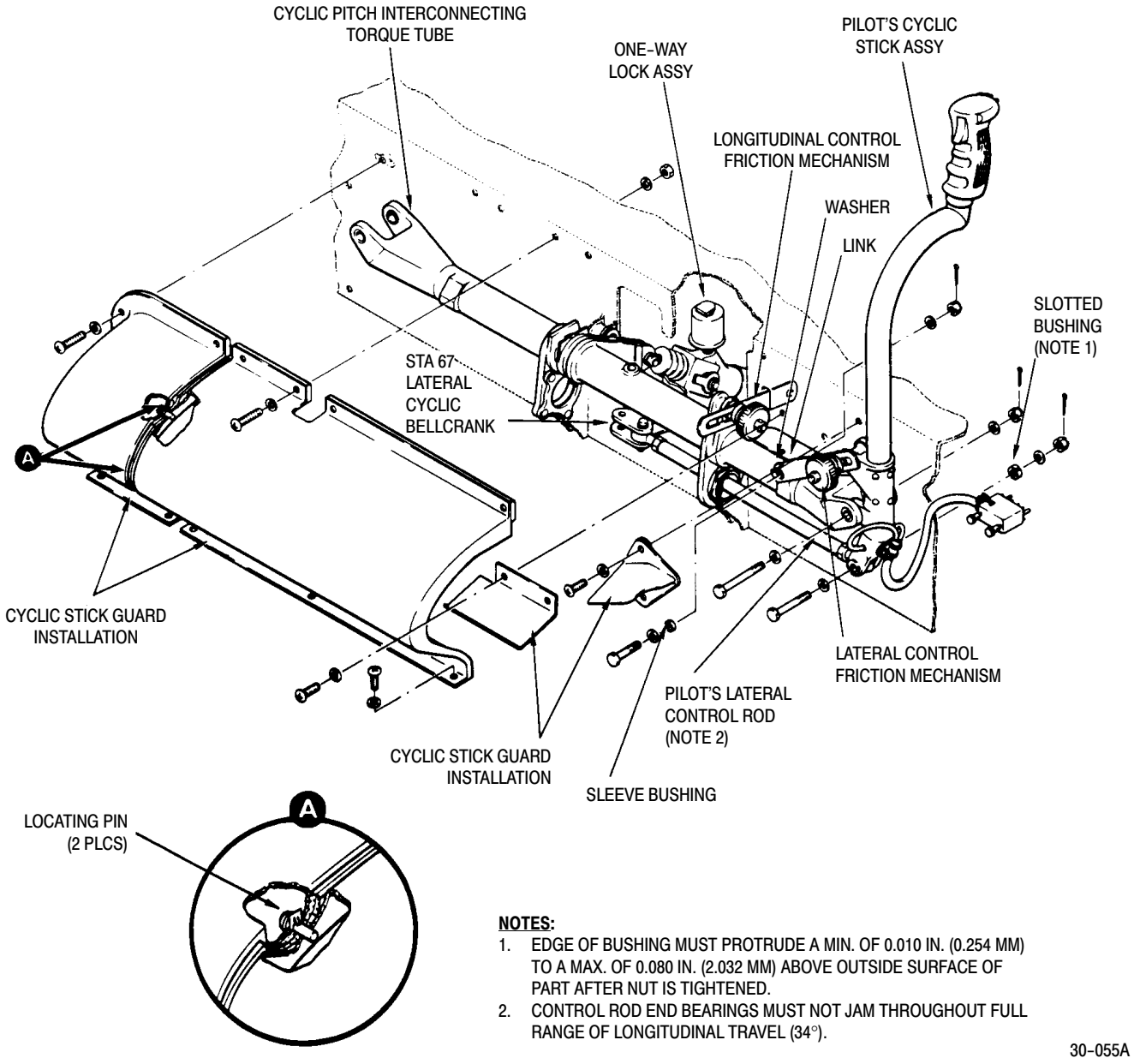


Figure 7-41. Pilot's Compartment Cyclic Control and Guard Installation

(3). Remove the cotter pin, nut, two washers and bolt from each end of the pilot's lateral control rod, or Sta. 70 lateral control rod, as applicable; remove rod assembly.

(4). Remove the cotter pin, two washers and bolt that secure Sta. 67 lateral cyclic bellcrank to seat structure fitting; remove bellcrank.

(5). If rod or rod ends require replacement, accurately measure and record distance between rod end bearing centers for future reference; use the trammel method, or equivalent.

B. Lateral Control Rods and Station 67 Bellcrank Installation

(1). Check that slotted bushing is in upper web of seat structure fitting. Align Sta. 67 lateral bellcrank and install bolt, two washers, nut and new cotter pin.

(2). Check that slotted bushings are in place and install Sta. 70 lateral control

rod and pilot's lateral control rod at each end with bolt, two washers, nut and new cotter pin.

(3). Move cyclic stick full forward, then full aft and set pilot's lateral control rod end bearing angularity so that the bearings do not jam at the full throw positions; hold rod end and tighten jam nut.

(4). If a new control rod or rod ends were replaced, perform a cyclic control rigging check.

(5). Install the large (central) cyclic stick guard, pilot's seat cover and controls access door.

C. Lateral Control Rods and Station 67 Bellcrank Repair

(1). Replace the Sta. 67 lateral bellcrank if it has elongated holes or is cracked.

(2). Replace the pivot bearing if it binds or is excessively worn; install with grade A locking compound (29, Table 2-4).

(3). Check free play of a bellcrank having a newly installed pivot bearing by applying light up and down pressure at forward end of bellcrank with bearing secured.

(4). Bellcrank total play measured at centerline of bolt that attaches pilot's lateral control rod end must not be more than ±0.024 inch (±0.6096 mm) for the bearing to be acceptable.

NOTE: The Sta. 67 lateral bellcrank may be either an aluminum or magnesium machined forging. Ref. Sec. 2 for corrosion and identification of magnesium and aluminum alloys.

(5). Perform a straightness check on a control rod that appears bent or bowed.

(a). The total length of the rod (excluding rod ends) must be straight within 0.010 inch (0.254 mm).

(b). Cold-straightening of the rod is permissible provided there are no nicks or sharp dents in the bend length, and the rod ends are NOT used to support the rod during the straightening process.

(c). A dye-check for cracking shall always be performed after cold-straightening; replace a cracked rod, or cracked or bent rod end.

CAUTION Use care when drilling to remove or install riveted rod end; the rod end is steel and the rod is aluminum. Do not tighten adjustable rod end jam nut on pilot's lateral control rod until rod is installed and cyclic stick longitudinal travel is checked.

(6). Replace a control rod end if bearing axial play is more than 0.040 inch (1.016 mm). Set initial control rod length and bearing angularity.

D. Cyclic Pitch Interconnect Torque Tube Removal

(Ref. Figure 7-40)

(1). Remove pilot's seat cover (Ref. Sec. 2).

(2). Position pilot's cyclic stick to align holes in one-way lock support links with the bolt that attaches forward end of one-way lock to torque tube; tighten longitudinal friction.

(3). Disconnect rod end from torque tube arm.

(4). Remove the pilot's cyclic stick.

(5). Remove all of the cyclic stick guard installation except the small guard next to the pilot's cyclic stick.

(6). Remove the longitudinal control friction mechanism (Detail A).

(7). Remove pilot's lateral control rod from Sta. 67 lateral bellcrank.

(8). Cut lockwire and remove the support nuts, support bolts and the two wide (left-hand) support spacers from the seat structure fitting lugs and torque tube.

NOTE: Use care to prevent the torque tube from dropping as the bolts are removed.

(9). Remove the torque tube and two narrow (right-hand) support spacers.

E. Cyclic Pitch Interconnect Torque Tube Repair

(Ref. Figure 7-42)

(1). The cyclic torque tube may be either a machined magnesium or aluminum

casting. Ref. Sec. 2 for corrosion control and identification of magnesium and aluminum alloys.

(2). Replace the torque tube if it is cracked, has elongated holes or deformed bearing supports.

(3). Replace the main support bearings or cyclic stick pivot bearings if they bind or are excessively worn.

(a). Drill out the four rivets and remove bearing retainer to replace right support bearing.

(b). Install cyclic stick pivot bearing and the right support bearing with grade A locking compound (29, Table 2-4).

NOTE: The left support bearing is a slip-fit in the torque tube lug; coat OD of replacement bearing with grade (26).

(4). Replace a bent or stripped friction stud. Drill out rivet; install new stud, pick up predrilled hole in stud and rivet in place.

F. Cyclic Pitch Interconnect Torque Tube Installation

(Ref. Figure 7-40)

(1). Align cyclic torque tube support bearings with holes in structure fitting lugs.

(2). Place a narrow support spacer on the right side of each support bearing, and install the two wide support spacers and support bolts.

NOTE: The support bolts may be installed from either direction, and the two narrowest (right-hand) support spacers may be interchanged to get best alignment of the torque tube with the one-way lock.

(3). Check that slotted bushing is in torque tube arm, and fit one-way lock rod end against unbushed lug of arm.

(4). If tightening of the attachment bolt will apply sideload on the rod end, interchange the two narrowest (right-hand) support spacers, and/or adjust the lateral position shimming of the longitudinal idler bellcrank or one-way lock rod ends until there is no sideload on the one-way lock control system.

(5). Check that no structural interference results from the spacer interchange.

(6). When there is no sideload on one-way lock, install and tighten the support nuts.

(7). Using 0.032 inch (0.8128 mm) lockwire (2, Table 2-4), safetywire each nut to the hole in the threaded end of the mating bolt.

NOTE: Use care when installing lockwire as both the nut and bolt are aluminum.

(8). Install pilot's lateral control rod (riveted rod end) to Sta. 67 lateral bellcrank.

(9). Install the longitudinal control friction mechanism (Ref. Detail A).

(10). Install cyclic stick guards.

(11). Install the pilot's cyclic stick.

(12). Position pilot's cyclic stick to align bolt holes in torque tube arm with holes in one-way lock support links.

(13). Install bolt, two washers, nut and new cotter pin.

(14). Install pilot seat cover.

62. One-W ay Lock Control System

(Ref. Figure 7-42) The cyclic control system one-way lock (Uni-loc) is located in the longitudinal control linkage within the pilot's seat structure.

The one-way lock control system is essentially a self-contained closed-loop hydraulic unit consisting of a check valve, relief valve and pushrod mechanism.

The check valve is seated when longitudinal control force (feed-back) originated by the main rotor tends to move the one-way lock (and cyclic stick) in an aft direction. Seating the check valve prevents unwanted aft movement of the cyclic stick and shunts the feed-back force into the helicopter structure.

Normally, only very slight aft movement of the cyclic stick is required to unseat the check valve. Should the check valve or pushrod shaft that unseats the valve gall and freeze in the

valve-closed position, a force of approximately 30 pounds is necessary to open the relief valve and bypass the check valve. This force will then be required for each subsequent movement of the cyclic stick, either forward or aft.

Conversely, should the check valve spring fail, the one-way lock will not function to shunt longitudinal feed-back forces into the structure.

The unit is mounted in two pivoting supports attached to the seat structure, and has an unbreakable, transparent, vented reservoir with a capacity of approximately 0.670 fluid ounce (20 cc). The one-way lock control system is serviced through the filler as necessary with hydraulic oil (11, Table 2-3).

A. One-Way Lock Removal

(1). Remove pilot's seat cover, and controls access door from Sta. 78.50 canted bulkhead (Ref. Sec. 2).

(2). Remove the large (central) cyclic stick guard.

(3). Position pilot's cyclic stick to align holes in one-way lock support links with the bolt that attaches forward end of one-way lock to cyclic torque tube; tighten longitudinal friction. Disconnect rod end from torque tube arm.

(4). Disconnect one-way lock lower rod end from longitudinal idler bellcrank.

(5). Disconnect upper end of each support link from the seat structure and remove one-way lock with links attached.

(6). Remove the two cotter pins, washers and links. Do not remove the pivot bushings from the links unless replacement is necessary.

B. One-Way Lock Inspection

(1). Replace reservoir if it is cracked, leaking or has a loose or damaged filler cap.

(2). Replace input end rod end bearing if bearing is binding.

CAUTION Do not remove cotter pin from output shaft end bearing or make any adjustment on serrated end. Malfunction of one-way lock will result. Overhaul replacement instructions are provided in CSP-H-5.

(3). Replace one-way lock if output shaft end bearing is binding.

(4). Replace protective boot if it is cracked, torn or deteriorated.

(5). Replace the one-way lock if the exposed portion of the piston has nicks, scratches or wear penetrating the chrome plating.

(6). Replace the one-way lock if the OD of the external mounting bushing is less than 0.4979 inch (12.64666 mm).

(7). One-way lock must be replaced if nicks, dents and scratches to the body exceed 0.040 inch (1.016 mm) after repair.

(8). One-way lock must be replaced if end play between rod ends exceeds 0.010 inch (0.254 mm) measured at the input end.

(9). One-way lock must be replaced if it is leaking, except as noted for the reservoir in step (1). above.

C. One-Way Lock Repair

Refer to CSP-H-5 for overhaul information.

(1). Remove dents, nicks and scratches by using grade 400 abrasive paper (9, Table 2-4) to remove rough edges. Finish by polishing with crocus cloth (23). Maintain a smooth transition into the surrounding area. After repair treat the area with chemical film (8).

(2). When replacing input shaft rod end bearing be sure that with the piston in mid stroke the bearing center-to-center distance is 8.58 ±0.030 inches (21.7932 ±0.0762 cm). Adjust as required. After correct length has been obtained, tighten and lockwire the lock nut.

(3). Support links may be either forged aluminum or magnesium castings. Ref. Sec. 2 for corrosion control and identification of magnesium and aluminum parts.

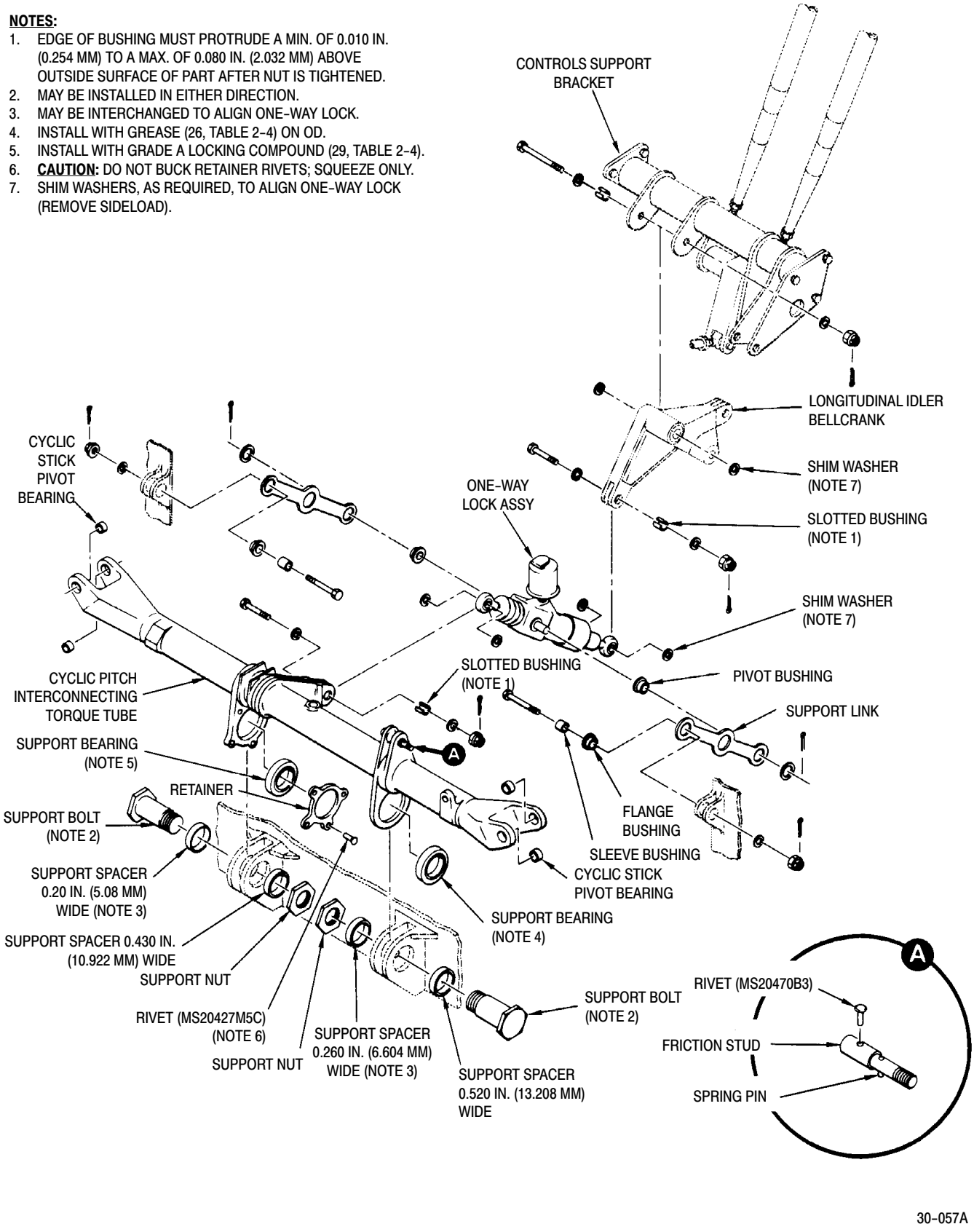


Figure 7-42. Cyclic Torque Tube and One-Way Lock Control System

D. One-Way Lock Installation

(1). Check that rod end bearing center-to-center distance.

(2). Install new pivot bushings in support links if replacement is necessary

(3). Attach lower ends of links to one-way lock; use new cotter pins.

(4). Align upper ends of links with mating holes in seat structure fitting and attach each link with bolt, sleeve bushing, washer, nut and new cotter pin.

(5). Check that slotted bushing is in place in longitudinal idler bellcrank; then fit lower rod end bearing against unbushed lug of bellcrank to check if sideloading will occur when attachment bolt is tightened.

NOTE: There must be no sideloading applied to the one-way lock mechanism.

(6). Arrange shim washers, as necessary, to position longitudinal idler bellcrank and/or lower rod end for no sideload alignment.

(7). Position pilot's cyclic stick to align holes in support links with hingeline for upper end of one-way lock and cyclic torque tube arm; tighten longitudinal friction.

(8). Repeat the check for no sideload on the one-way lock, step (4). above, and arrange shim washers, as necessary, to position upper rod end for no-sideload alignment.

NOTE: The two narrowest (right-hand) cyclic torque tube support spacers may also be interchanged to align the one-way lock.

(9). When there is no sideload on one-way lock, secure each rod end bearing with bolt, two washers, nut and new cotter pin.

(10). Check the oil cup fluid level (Ref. Sec. 2)

(11). Install large (central) cyclic stick guard.

(12). Install pilot's seat cover, and controls access door.

63. Installation of Fuselage Access Panels for Cyclic Trim Actuator Assemblies

(Ref. Figure 7-43 and Figure 7-44)

(1). Gain access to pilot's underfloor compartment.

(2). Jack up helicopter to provide access to work area at underside of fuselage structure (Ref. Sec. 2).

NOTE: If ADF or transponder antenna is installed, remove antenna (Ref. CSP-H-3).

(3). Drill out rivets securing 369A2500-163 stiffener and 369A2500-169 doubler.

(4). Drill out rivets securing 369A2500-164 stiffener and 369A2500-169 doubler.

(5). Drill out rivets securing 369A2500-165 doubler.

(6). Remove doublers and stiffeners; remove any sealing compound residue.

(7). Drill out rivets securing 369A2500-9 stiffener, 369A2500-10 stiffener, and 369A2524 center beam assembly to fuselage skin between Sta. 60.73 and Sta. 74.287.

(8). Remove any sealing compound residue.

NOTE: Read step (26). below before drilling or riveting per steps (9). thru (25). Number and placement of rivets may have to be altered accordingly.

(9). Insert 369D22501-43 doubler (RH) in position between -10 stiffener and 369H2524 center beam assembly, and fuselage skin.

(10). Mark rivet hole centers on doubler; remove doubler and drill rivet holes.

(11). Insert 369D22501-41 doubler (LH) in position between -9 stiffener and 369H2524 center beam assembly, and fuselage skin.

(12). Mark rivet hole centers on doubler; also mark hole centers on doubler for two existing 0.311-0.318 inch (7.8994-8.0772 mm) diameter holes in fuselage skin.

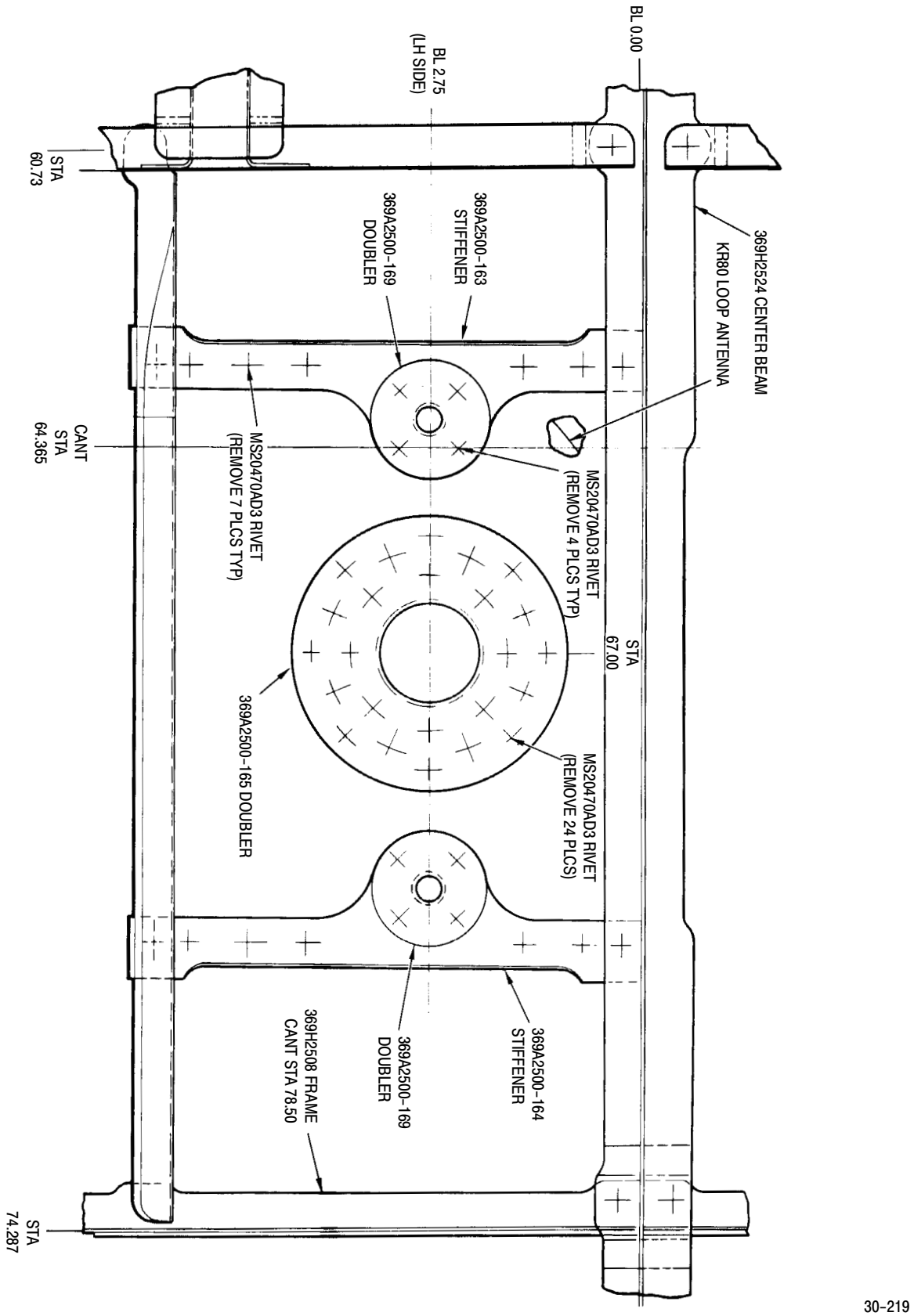


Figure 7-43. Removal of Stiffeners and Doublers

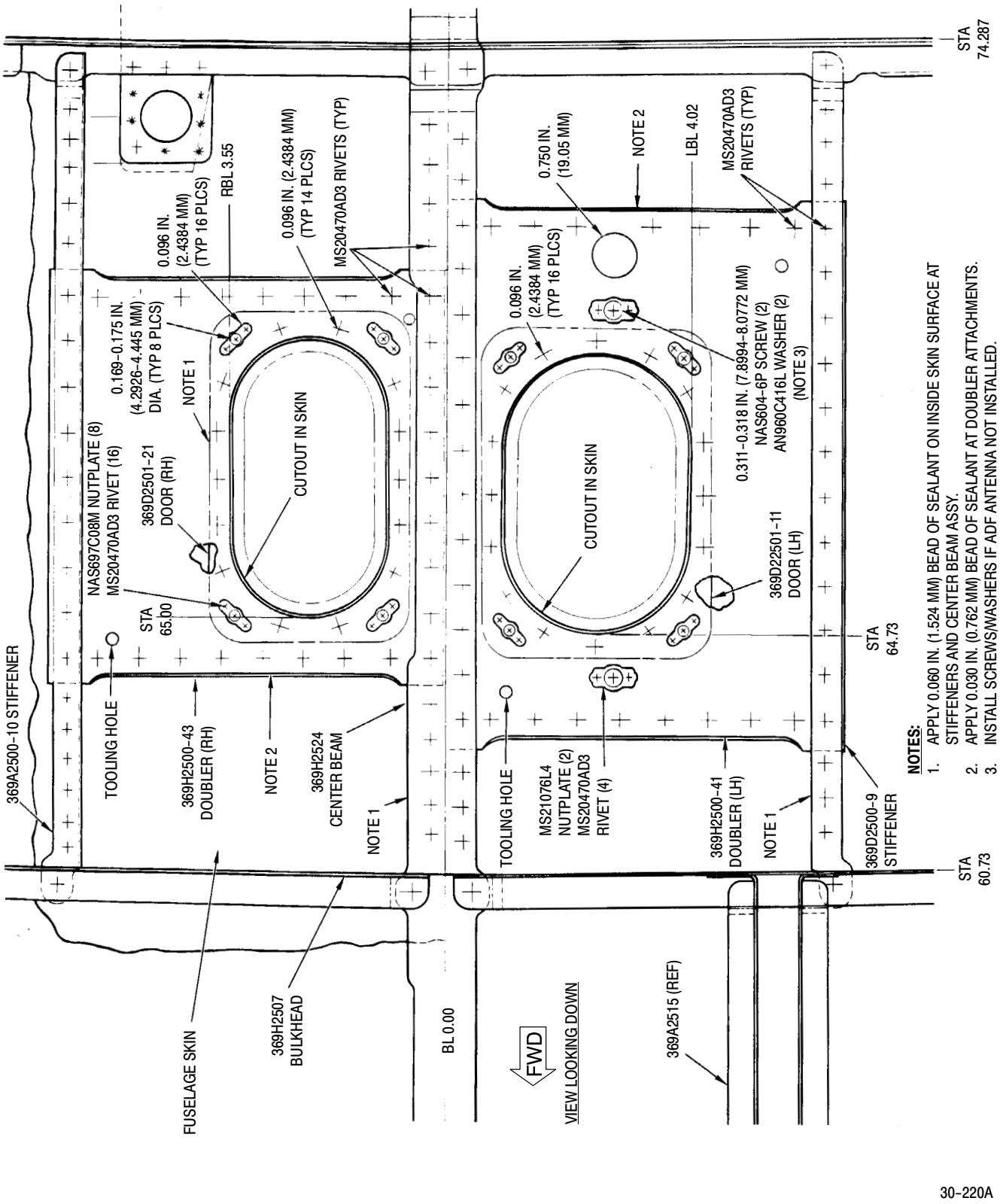


Figure 7-44. Installation of Trim Actuator Assembly Access Panels

(13). Remove -41 doubler; drill rivet holes and two 0.311- 0.318 inch (7.8994-8.0772 mm) diameter holes in doubler.

(14). Position 369D22501-21 door on -43 doubler; mark and drill four 0.169-0.175 inch (4.2926-4.445 mm) diameter holes and eight 0.096 inch (2.4384 mm) diameter rivet holes in doubler for nutplates.

(15). Install four NAS697C08M nutplates on upper side of doubler as shown.

(16). Drill fourteen 0.096 inch (2.4384 mm) diameter rivet holes in doubler around circumference of cutout as shown.

(17). Position 369D22501-11 door on -41 doubler; mark and drill four 0.169-0.175 inch (4.2926-4.445 mm) diameter, and 0.096 inch (2.4384 mm) diameter rivet holes for six nutplates.

(18). Install four NAS697C08M nutplates and two MS21076L4 nutplates on upper side of doubler as shown.

(19). Drill sixteen 0.096 inch (2.4384 mm) diameter rivet holes in doubler around circumference of cutout as shown.

(20). Using doublers as templates, mark and make cutouts in fuselage skin to match doublers as shown.

(21). Drill four 0.169-0.175 inch (4.2926-4.445 mm) diameter holes in skin to match nutplate holes in doublers, as applicable.

(22). Cut or drill 0.750 inch (19.05 mm) diameter hole through skin to match -41 doubler if transponder antenna is to be installed.

(23). Drill 0.096 inch (2.4384 mm) diameter rivet holes in skin to match rivet holes around circumference of each cutout as shown.

(24). Insert -43 doubler in place between -10 stiffener and center beam assembly, and fuselage skin; secure with rivets 34 places as shown; install additional rivets 14 places around circumference of cutout.

(25). Insert -41 doubler in place between -9 stiffener and center beam assembly, and fuselage skin; secure with rivets 39 places as shown; install additional rivets 16 places around circumference of cutout.

(26). Replace rivets removed in step (7). as required to secure stiffeners and center beam assembly to fuselage skin between Sta. 60.73 and Sta. 74.287.

(27). Install rivets (through both skin and doubler) to plug any open rivet holes that exist in skin due to step (3). thru (5). above, meeting the following criteria:

(a). Rivets reinstalled in existing holes must NOT be closer than 1.5 x diameter (edge distance) minimum from edge of applicable parts involved. If this criterion cannot be met, leave rivet hole in skin blank and fill in with ProSeal 890 sealant.

(b). Rivets reinstalled in existing holes must NOT be closer than 3.0 x diameter (rivet spacing) minimum from location of any new rivet added per this installation. If this criterion cannot be met, install ONLY the rivet through the existing hole in the structure and eliminate the new rivet intended for this location.

(28). Apply a 0.060 inch (1.524 mm) bead of PR1221 sealant on inside skin surface at stiffeners and center beam assembly; apply a 0.030 inch (0.762 mm) bead of sealant at doubler attachments.

NOTE: Perform step (29). below if ADF antenna is not to be installed.

(29). Install two NAS604-6P screws and AN960C416L washers as plugs in MS21076L4 nutplates on LH side installation as shown.

(30). Install access door(s) using NAS602-7P screws and AN960C8 washers. Eliminate 369D22501-11 door (LH) and its attaching hardware if antenna is to be installed.

(31). Check installation of doublers and access door for discrepancies.

(32). As applicable, install ADF or transponder antenna per CSP-H-3.

64. Cyclic Trim Actuators

Each of the two cyclic trim actuators consists of an actuator, housing support, trim tube, and spring assembly.

The actuator is a motor-driven shaft that compresses a spring assembly, counteracting feedback forces from the main rotor and compensating for imbalance conditions such as those imposed by crosswinds or unevenly distributed cargo.

Cyclic trim is controlled by the cyclic trim switch located on top of cyclic stick grip. The cyclic trim switch has five positions: normally **OFF** in the center, and momentary **FORWARD**, **AFT**, **LEFT**, and **RIGHT**. When the trim switch is moved off center to any of the four trim directions, the electrical system energizes one of the trim motors to apply trim spring force in the desired direction. By momentarily moving the switch, very small trim increments may be obtained.

Trim forces cannot be applied in two directions simultaneously; when both lateral and longitudinal trim corrections are required, it is necessary to apply first one, then the other.

The cyclic trim mechanism does not limit travel of the cyclic pitch control stick trim spring tension can be overridden at any time.

A. Cyclic Trim Actuator Removal

(Ref. Figure 7-30)

(1). Jack up the helicopter until the landing gear is fully extended and clears the ground (Ref. Sec. 2).

(2). Remove foot fairing, controls access door from Sta. 78.50 canted bulkhead, and open or remove pilot's compartment floor access door, as applicable.

(3). Disconnect bonding jumper and electrical connector from actuator housing.

(4). Disconnect upper end of trim actuator. Keep pivot bushing with actuator unless actuator is being replaced.

NOTE: Lateral actuator upper hingeline has a 0.1875 inch (4.7625 mm) bolt hole; longitudinal has a 0.250 inch (6.35 mm) bolt hole.

(5). Disconnect lower end of trim actuator. Access to the attaching nut is through a hole in the underfloor compartment aft bulkhead, near the centerline beam.

(6). Remove trim actuator. Reinstall the lower end attaching hardware to go with actuator if the actuator is being replaced; a new actuator includes this hardware.

B. Cyclic Trim Actuator Installation

(Ref. Figure 7-30)

(1). Check the trim actuator spring assembly for free play between the spring and spring adapters. Tighten spring adapter screw until no play can be felt while pushing and pulling on spring assembly.

(2). Remove the hardware supplied in housing end of a new trim actuator.

(3). Check that slotted bushings are in place in actuator housing.

(4). Place one AN960-716L washer around each side of the pivot bearing in the center beam support lug and align the actuator housing with the bearing.

(5). Install the bolt, two washers, nut and new cotter pin (all new if actuator is a replacement).

(6). Align actuator with idler bellcrank.

(7). Check that slotted bushing is in bellcrank lug; install actuator pivot bushing if actuator is a replacement.

NOTE: The pivot bushing must rotate freely in the actuator.

(8). Install bolt, two washers, nut and new cotter pin. After the bolt is tightened the pivot bushing must not rotate in the idler bellcrank.

NOTE: Lateral actuator upper hingeline has a 0.1875 inch (4.7625 mm) bolt hole; longitudinal has a 0.250 inch (6.35 mm) bolt hole.

(9). Connect bonding jumper. Jumper connected over actuator electrical

receptacle should have an electrical flat washer installed under jumper terminal to keep nut from bottoming on threads. Retaining nut torque must not exceed **50 inch-pounds (5.65 Nm)**.

(10). Connect electrical plug to actuator.

(11). With main rotor blades lifted off the droop stops, perform a power-on operational check of the cyclic trim actuator. The actuator must not bind throughout the travel range in either direction, and must maintain at least 0.015 inch (0.381 mm) minimum clearance with the center beam structure.

(12). Lower the helicopter and remove the jacks.

C. Cyclic Trim Actuator Inspection

(Ref. Figure 7-45)

(1). Inspect electrical connector for evidence of damage, and broken or missing contacts.

(2). Inspect exterior of trim actuator for evidence of damage and deformation.

(3). When actuator speed (response time) is questionable, perform the bench test (Ref. Cyclic Trim Actuator Bench Testing).

D. Cyclic Trim Actuator Bench Testing

(1). Connect cyclic trim actuator to test harness and equipment.

(2). Mount the actuator in a suitable fixture that will allow vertical extension and retraction.

(3). Turn on direct-current power and adjust output to 25.75-26.25 Vdc.

CAUTION During the following tests, do not retract the spring assembly (ram) so that actuator length is less than 13.50 inches between attach bolt centers.

(4). With actuator spring assembly (ram) approximately halfway between travel limits, actuator length at 14.46 inches (36.7284 cm) between attach bolt centers, set up test dial indicator and measure the ram end play.

(a). The end play must not exceed 0.0075 inch (0.1905 mm).

(b). Remove any spring free play in the spring assembly by tightening the spring adapter screw until no play can be felt.

(c). While tightening the screw, check that there is thread-locking friction from the self-locking threaded insert.

(d). Replace actuator assembly if end play is excessive.

(5). Position test switch to RETRACT and allow the actuator ram to fully retract.

(a). Using the end of the trim tube as a reference point, measure the portion of the ram that remains out of the tube to the nearest 0.015625 inch (0.396785 mm).

(b). Record this measurement for use in step (7). below.

(6). Set the stopwatch to zero second.

(a). Start the actuator and stopwatch at the same time.

(b). Observe the time it takes the actuator ram to travel from fully retracted to fully extended.

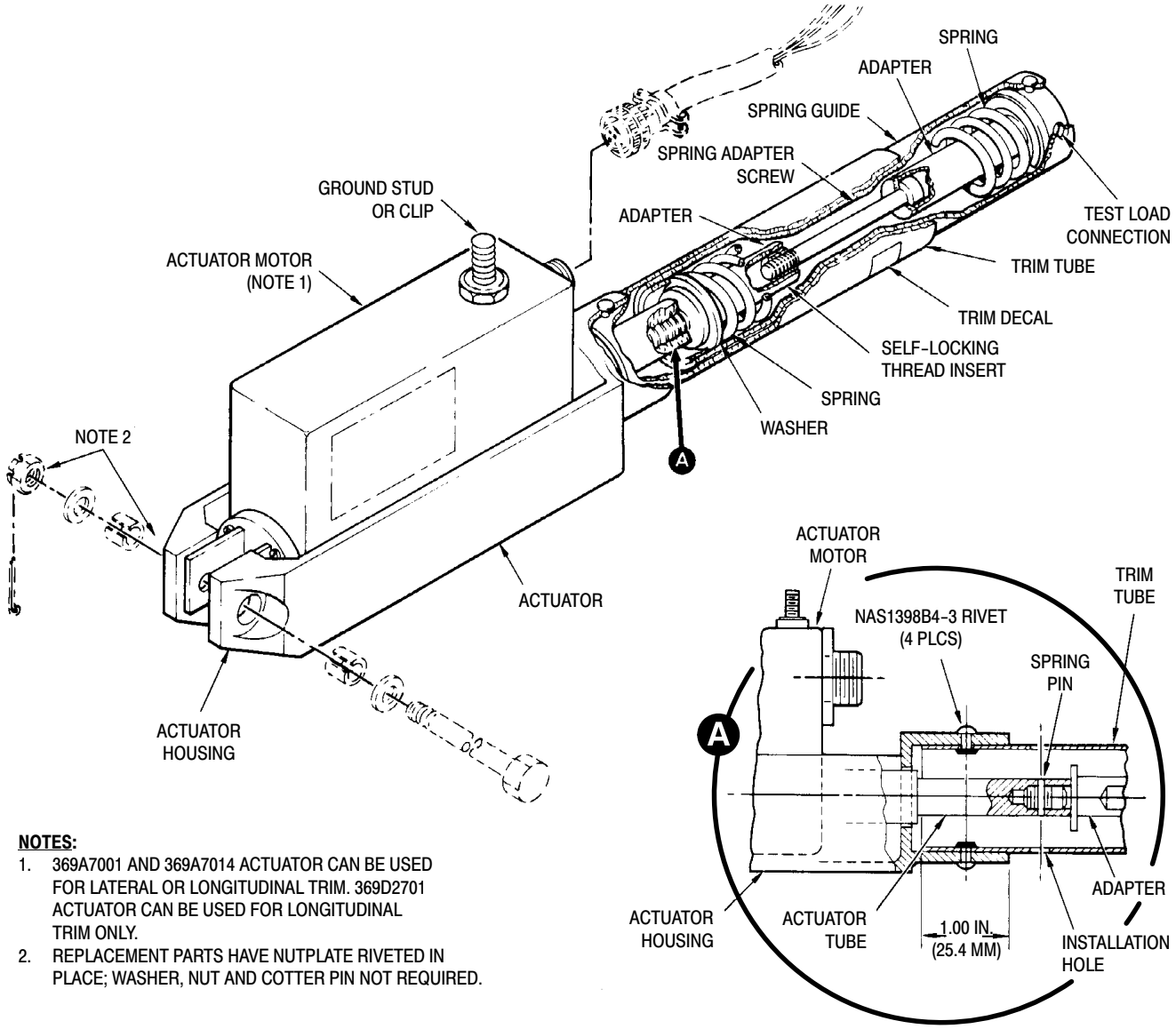
(c). Check time interval for actuator motor tested.

Actuator Motor Part Number	Time Interval (Seconds)
369A7001	58.4
369A7014 (High Speed)	38.0
369A27001 (Super Fast)	15.5

(7). Measure the length of the extended ram.

(a). Subtract the measured result of step (5). above from this value.

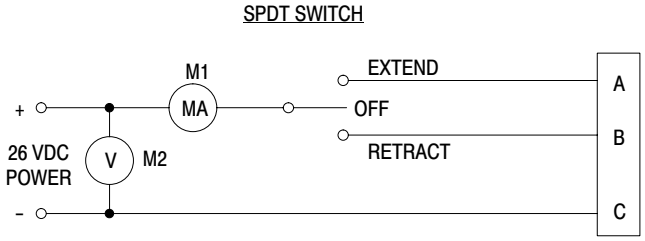
(b). The result must be 1.92 inches (4.8768 cm) minimum.



NOTES:

1. 369A7001 AND 369A7014 ACTUATOR CAN BE USED FOR LATERAL OR LONGITUDINAL TRIM. 369D2701 ACTUATOR CAN BE USED FOR LONGITUDINAL TRIM ONLY.
2. REPLACEMENT PARTS HAVE NUTPLATE RIVETED IN PLACE; WASHER, NUT AND COTTER PIN NOT REQUIRED.

ITEM NO.	EQUIPMENT DESCRIPTION
1	STOPWATCH, CALIBRATED IN 1/10 SECOND INCREMENTS (MINERVA OR EQUIVALENT).
2	6 IN. (15 CM) SCALE.
3	DC VOLTMETER, CALIBRATED 0-50 VOLTS (WESTON MODEL 931 OR EQUIVALENT).
4	DC MILLIAMETER, CALIBRATED 0-5 AMPERES (WESTON MODEL 931 OR EQUIVALENT).
5	VARIABLE DC POWER SUPPLY, 10-36 VOLTS (N. J. E. MODEL SY 36-10 OR EQUIVALENT).
6	DIAL INDICATOR GAGE (BROWN AND SHARP MODEL 740 OR EQUIVALENT).
7	SWITCH, SPDT, CENTER OFF.



TEST HOOKUP

30-059C

Figure 7-45. Cyclic Trim Actuator

CAUTION In the following test, do not run actuator against extend limit stop with the 163 pound (73.94 kg) weight aiding actuation. The actuation thrust bearing may be damaged.

(8). Connect a 163 pound (73.94 kg) load to the actuator.

(a). Set test switch to **RETRACT**. Check the time it takes the ram to travel 1.72-1.78 inches (4.3688-4.5212 cm) to the retract stop.

(b). Check retraction time for actuator motor tested.

Actuator Motor Part Number	Time Interval (Seconds)
369A7001	30-50
369A7014 (High Speed)	15-25
369A27001 (Super Fast)	7-12

(9). The operating current under load conditions must not exceed 1.2 amperes running and 2.0 amperes stalled.

NOTE: It is not necessary to extend or retract the actuator ram more than 0.250 inch (6.35 mm) for the test in the next two steps.

(10). Reduce the voltage input to 21 volts. The actuator ram must retract and extend. Overtravel is limited to 0.020 inch (0.508 mm) with an overriding (aiding) load; otherwise there must be no overtravel.

(11). Increase the input voltage to 28 Vdc. The actuator arm must retract and extend. Overtravel is limited to 0.020 inch (0.508 mm) maximum with an overriding (aiding) load; otherwise there must be no overtravel.

(12). Remove 163 pound (73.94 kg) load and repeat step (4). above.

(13). Run actuator until the arm is extended 1.750 inches (4.445 cm). Turn power off and disconnect the cyclic trim actuator.

65. Cyclic Trim Actuator Repairs

(Ref. Figure 7-45)

A. Cyclic Trim Actuator Drive Gear Retention Nut Field Repair

Loosening of drive gear retention nut of the cyclic trim actuator may occur. Whether the actuator is inoperative because of a stalled rather than an electrical failure can be determined from this procedure to remove and reinstall the retention nut with a Loctite sealant.

NOTE:

- Rework of operative trim actuators is recommended at major inspection period.
- Rework is NOT applicable to actuators having letter “R” following vendor part number on actuator housing.

(1). Remove cyclic trim actuator from helicopter.

NOTE: If actuator is inoperative, bench test unit. A reading of 0.00- 0.10 ampere indicates electrical failure; replace actuator. Motor runs but output shaft does not move to indicate mechanical failure; replace actuator. An 0.070 ampere (approximately) reading of actuator extends partway and stalls indicates mechanical failure; rework actuator per steps (2). thru (7). below.

(2). Remove lockwire and six screws securing actuator cover to housing.

CAUTION When removing housing, note location and number of shims on each gear for reassembly in proper location.

NOTE: Step (3). does not apply if actuator is operative. Perform steps (4). thru (7). below.

(3). Using fingers only, check gear drive retention (hex) nut for looseness. If nut is loose, rework per instructions below. If nut is NOT loose, replace actuator assembly.

(4). Remove nut and clean threads. Reinstall nut using Loctite No. 290 on threads. **Torque nut to 30 - 40 inch-pounds (3.39 - 4.52 Nm)**.

(5). Reinstall actuator cover with existing screws; lockwire screws.

(6). Add letter “R” at end of vendor part number on actuator housing.

(7). As applicable, reinstall trim actuator.

B. Cyclic Trim Actuator Spring Assembly Replacement

(1). Insert a screwdriver into the open end of the spring guide and remove the screw that connects the two spring adapters.

NOTE: Identify the screw for lateral or longitudinal trim because the screws are no interchangeable. The lateral actuator screw is 2.875 inches (7.3025 cm) long; the longitudinal screw 2.625 inches (6.6675 cm) long.

(2). Slide spring assembly out of the trim tube.

(3). Clean the inside of the trim tube with solvent (1, Table 2-4).

(4). Coat the outside of the replacement spring assembly tube lightly with grease (26).

(5). Slide replacement spring assembly into the trim tube.

(6). Install spring adapter screw in the open end of spring assembly and tighten screw until no free play can be felt while pushing and pulling on spring assembly. While tightening the screw, check that there is thread-locking friction from the self-locking threaded insert.

(7). Wipe off all excess grease.

(8). Perform a bench test to check actuator operation.

C. Cyclic Trim Actuator Housing or Trim Tube Replacement

(1). Remove the actuator spring assembly.

(2). Carefully drill out the four trim tube attaching rivets. Remove trim tube.

(3). Remove actuator from actuator housing. Check housing for condition and evidence of corrosion.

NOTE: The housing may be either an aluminum or magnesium casting. Ref. Sec. 2 for corrosion control and identification of magnesium and aluminum alloys.

(4). Use the dimensions to assemble the replacement actuator housing and trim tube. Pick up and drill, 0.098 inch (2.4892 mm), the four attaching rivet holes, if required.

(5). Coat the mating surfaces of the trim tube and actuator housing with primer (4, Table 2-4). Assemble while primer is still wet.

(6). Install the four mechanically expanding rivets (NAS1398B4-3).

(7). Reinstall the actuator.

(8). Reinstall the actuator spring assembly.

(9). Perform a bench test.

D. Cyclic Trim Actuator (Motor/ Gear Drive Mechanism) Replacement

(1). Remove actuator spring assembly.

(2). Remove the trim tube.

(3). Support the actuator tube and press out the spring pin.

(4). Unscrew the adapter from the actuator and remove the actuator from the housing.

(5). Screw the adapter into the replacement actuator shaft until it bottoms. If the spring pin hole drilled in the adapter intersects the guide hole in the actuator, the adapter must be replaced; otherwise, the adapter may be reused.

(6). Use a 0.0625 inch (1.5875 mm) drill to drill the spring pin hole through the adapter and actuator. Deburr the hole.

(7). Reassemble the actuator housing and trim tube.

(8). Install the actuator in the housing. Screw the adapter onto the actuator.

(9). Support the actuator shaft. Press in the spring pin. Be sure that the pin is flush with the shaft.

(10). Install the actuator spring assembly.

(11). Bench test the actuator assembly.

Section

8

Tail Rotor and Control System

TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 8 Tail Rotor and Control System		**8-1**
1.	Tail Rotor and Control System	8–1
2.	Tail Rotor and Control System TroubleShooting	8–1
	Figure 8–1. Tail Rotor and Control System	8–2
	Table 8–1. Troubleshooting Tail Rotor/Vibrations	8–3
	Figure 8–2. Isolating Control System Troubles	8–4
3.	Tail Rotor Controls Rigging	8–5
	Figure 8–3. Tail Rotor Control System Rigging	8–6
4.	Tail Rotor and Pitch Control Assembly	8–7
5.	Tail Rotor and Pitch Control Assembly Replacement	8–7
A.	Tail Rotor and Pitch Control Assembly Removal	8–7
B.	Tail Rotor and Pitch Control Assembly Installation	8–8
	Figure 8–4. Replacement of Tail Rotor and Pitch Control Assemblies (Sheet 1 of 2)	8–9
6.	Tail Rotor and Pitch Control Assembly Inspection	8–12
A.	Pitch Control Assembly Inspection	8–12
B.	Metal Blade Inspection	8–12
C.	Fiberglass Blade Inspection	8–12
D.	Tail Rotor Bearing Inspection	8–13
E.	Remaining Components Inspection	8–14
7.	Elastomeric Bearing Inspection	8–14
	Figure 8–5. Tail Rotor and Pitch Control Assemblies – Inspection of, and Handling Limits (Sheet 1 of 4)	8–15
	Figure 8–6. Blade Flapping Resistance Measurement (Elastomeric Bearings)	8–18
8.	Elastomeric Bearing Care and Cleaning	8–19
9.	Tail Rotor and Pitch Control Assembly Repair	8–19
10.	Pitch Control Link Replacement	8–19
11.	Leading Edge Tape Replacement (Fiberglass Blade)	8–20
12.	Tail Rotor Assembly Bungee Initial Installation (Fiberglass–to–Metal Tail Rotor Blade Conversion)	8–20
	Figure 8–7. Tail Rotor Assembly Bungee Installation (Metal Blade)	8–21
13.	Tail Rotor Balance Adjustment (Without Balance Kit)	8–21
14.	Tail Rotor Balance Adjustment (With Balancing Kit)	8–22
A.	Tail Rotor Balance Preliminary Adjustment	8–22
	Figure 8–8. Tail Rotor Vibration Analysis Equipment	8–23
B.	Tail Rotor Vibration Analysis Kit Installation	8–24
C.	Preparation for Balancing	8–24

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
	Figure 8–9. Tail Rotor Balancing	8–25
D.	Vibration analysis	8–26
E.	Balance at Fiberglass Blade Tip	8–26
F.	Balance at Metal Blade Tip	8–27
	Table 8–2. Rotor Balance Weight Location Chart	8–28
	Table 8–3. Tail Rotor Balance Weight Value Chart	8–29
15.	Tail Rotor Blade Track Verification	8–30
16.	Tail Rotor Blades	8–30
A.	Fiberglass Blades	8–30
B.	Metal Blades	8–30
C.	Fiberglass Tail Rotor Blade Replacement	8–30
D.	Metal Tail Rotor Blade Replacement	8–31
17.	Tail Rotor Blade Replacement	8–31
18.	Pitch Control Assembly	8–33
19.	Pitch Control Assembly Replacement	8–33
20.	Pitch Control Assembly Inspection	8–34
	Figure 8–10. Assembled Tail Rotor Hub and Blades – Cross Section View	8–35
	Figure 8–11. Assembled Tail Rotor and Blades – Cross Section View (Elastomeric Bearings)	8–36
21.	Tail Rotor Swashplate Regreasing	8–37
22.	Tail Rotor Hub and Fork Assembly	8–37
23.	Hub and Fork Assembly Maintenance	8–38
A.	Inspection of Hub and Fork Assembly – Blades Removed	8–38
B.	Strap Pack Assembly Precautions	8–38
C.	Parts Replacement Information	8–38
24.	Tail Rotor Pedal Installation (Left Position)	8–38
25.	Tail rotor Pedal Installation Replacement	8–38
A.	Tail rotor Pedal Installation Removal (Left Position)	8–38
	Figure 8–12. Tail Rotor Swashplate Bearing Regreasing	8–39
	Figure 8–13. Tail Rotor Swashplate Bearing Regreasing Tool	8–39
B.	Installation of Tail Rotor Pedal Installation (Left Position)	8–40
26.	Disassembly of Tail Rotor Pedal Installation (Left Position)	8–40
A.	Reassembly of Tail Rotor Pedal Installation (Left Position)	8–41
27.	Tail Rotor Pedal Installation Inspection (Left Position)	8–41
A.	Tail Rotor Pedal Installation Repair (Left Position)	8–41
	Figure 8–14. Pilot's Compartment and Intermediate Tail Rotor Controls	8–42
28.	Floor–and–tunnel–Routed Control Rods	8–43

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
29.	Floor–Routed Tail Rotor Control Rod Repair	8–43
30.	Sta. 78.50 Tail Rotor (Tunnel–Routed) Control Rod	8–43
31.	Tail Rotor Idler Bellcrank	8–43
32.	Upper Fuselage and Boom Tail Rotor Control Linkage	8–43
33.	Sta. 100 Control Rod Sta. 142 Bellcrank Replacement	8–44
A.	Sta. 100 Control Rod Sta. 142 Bellcrank Removal	8–44
B.	Sta. 100 Control Rod or Sta. 142 Bellcrank Installation	8–44
Figure 8–15.	Upper Fuselage and Boom Tail Rotor Control Linkage	8–45
34.	Sta. 282.00 Bellcrank Replacement	8–46
A.	Sta. 282.00 Bellcrank Removal	8–46
B.	Sta. 282.00 Bellcrank Installation	8–46
35.	Tailboom Control Rod Replacement	8–46
A.	Tailboom Control Rod Removal	8–46
B.	Tailboom Control Rod Installation	8–46
36.	Sta. 95 Bellcrank and Support Replacement	8–47
A.	Sta. 95 Bellcrank and Support Removal	8–47
B.	Sta. 95 Bellcrank and Support Installation	8–47
37.	Upper Fuselage and Boom Tail Rotor Control Linkage Inspection	8–47
38.	Upper Fuselage and Boom Tail Rotor Control Linkage Repair	8–47
Figure 8–16.	Rework of Sta. 142 Bellcrank Assembly	8–49

SECTION 8
TAIL ROTOR AND CONTROL SYSTEM

1. Tail Rotor and Control System

(Ref. Figure 8-1) The tail rotor, mounted on the tail rotor transmission at the end of the tail boom, counteracts main rotor torque and controls the heading of the helicopter. The rotor consists of two variable-pitch blades mounted on a teetering delta-type hub.

The tail rotor control system produces directional control by varying the pitch of the tail rotor blades. Depressing the antitorque pedals moves a system of bellcranks and push-rods routed through the fuselage and tailboom to the tail rotor.

Blade angle is controlled by a pitch control, assembly consisting of links connecting pitch controls arms to a swashplate that slides axially on the tail rotor transmission output shaft. During flight, the pedal position and pressure required to maintain a desire heading will vary depending on main rotor torque variations, altitude and airspeed conditions.

The control linkage on the helicopter with the cambered metal-bladed tail rotor includes a bungee spring designed to relieve left forces in flight.

When the helicopter is on the ground, the pedal to seat distance is adjustable by removing quick-release pins on the pedal arms and repositioning the pedals.

Dual control provisions are included with the pilot's compartment tail rotor control installation.

2. Tail Rotor and Control System TroubleShooting

Troubleshooting information is divided into:

(1). Investigation of operational vibration problems originating with the tail rotor assembly, or symptoms that can be recognized (Ref. Table 8-1).

(2). Isolation of an unusual controls malfunction (Ref. Figure 8-2).

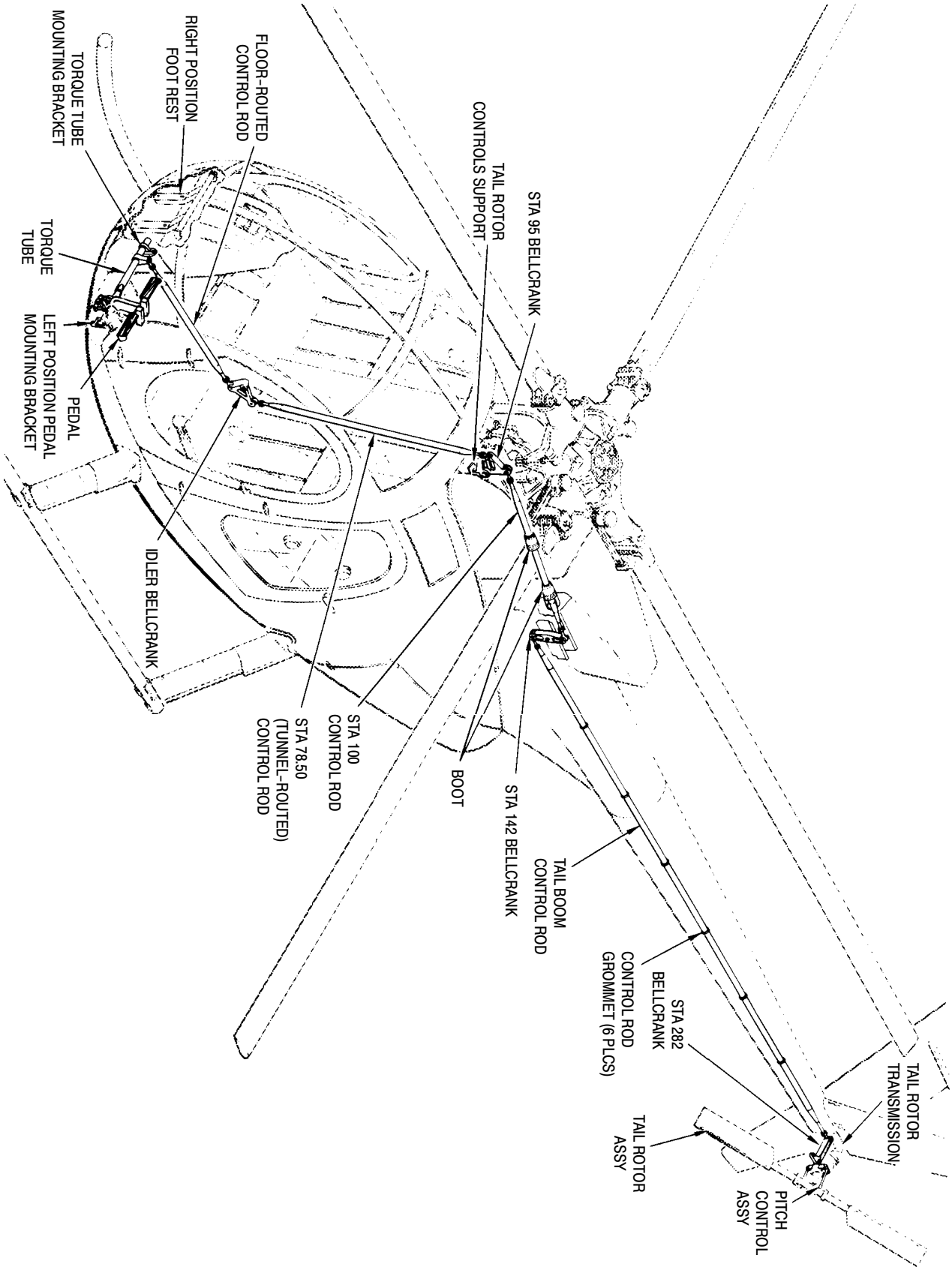


Figure 8-1. Tail Rotor and Control System

Table 8-1. Troubleshooting Tail Rotor/Vibrations

Symptom	Probable Trouble	Corrective Action
Heavy medium-frequency vibration in tail rotor assembly vibration sometimes felt in pedal as a buzzing sensation.	Tail rotor out of balance.	Rebalance tail rotor assembly.
	Runout of tail rotor transmission output shaft excessive.	Replace gearbox if runout (TIR) of shaft exceeds 0.003 in. (0.0762 mm) maximum.
High frequency vibration, primarily in pedals as a buzzing sensation.	Tail rotor blades slightly out of balance.	Replace pitch control link bearings if they have a staking groove (CSP-H-5). Replace link if bearing is pressed-lip assembly.
NOTE: High frequency vibration in the helicopter can also be caused by components of other systems (Ref. Sec. 5, 9 and 10).	Excessive wear of swashplate or double-row bearing in housing of pitch control assembly.	Replace double-row bearing or swashplate (CSP-H-5) or pitch control assembly.
	Excessive looseness in tail rotor folk bearings.	Adjust bearing preload by reshimming hub or replace bearings (CSP-H-5); or replace tail rotor assembly.
	Tail rotor hub-to-fork play.	Adjust bearing preload by resembling hub or replace bearings CSP-H-5, (HMI Appx C); or replace tail rotor assembly.
	Separation of leading edge abrasion strip (fiberglass blades only) or excessive dents in leading edge of metal blades.	Replace blade(s) or tail rotor assembly (Ref. CSP-H-5 for dent limits).
	Insufficient torque on stabilizer strut bolts or tail rotor assembly retaining nut.	Retorque bolts (Ref. Sec. 5) or retaining nuts.
	Leading edge abrasion tape worn away or lost from blade. (fiberglass blades only)	Replace leading edge abrasion tape.
	Worn or deteriorated damped type stabilizer strut snubber discs.	Replace damper snubber discs.
Excessive play in pitch control link assemblies.	Worn pitch control link bearings.	Replace excessively worn bearings if they have a staking groove (CSP-H-5). Replace link if bearing is pressed-lip staked.
High left pedal forces required in flight (metal blade tail rotor only).	Bungee spring (Sta. 63.00) disconnected, broken or stretched.	Reconnect or replace bungee spring as required.

Table 8-1. Troubleshooting Tail Rotor/Vibrations (Cont.)

Symptom	Probable Trouble	Corrective Action
Pedals binding.	Excessive drag of pitch control swashplate on gearbox outputshaft.	Clean swashplate bore and output shaft splines; reduplicate splines if swashplate liner is oilite bronze.
	Nylon liner loose in swashplate.	Replace swashplate (CSP-H-5).
Snapping noise heard in nonoperating tail rotor when pitch angle changed from one extreme to the other.	No trouble - noise is normal action of strap pack and caused by tension-torsion pack straps twisting and bending when blade is feathered without centrifugal load present.	None required - noise indicates pack straps are intact.

Figure 8-2. Isolating Control System Troubles

Symptom	Isolating Step	Corrective Action
Binding, locking-up and erratic action of foot pedals (1).	Disconnect pitch control links from pitch control assembly.	If symptom gone, replace tail rotor assembly.
Symptom remains	Disconnect Sta. 282 aft boom bellcrank from pitch control assembly (Ref. Figure 8-4).	If symptom gone, clean swashplate bore and output shaft splines. Lubricate splines if swashplate liner is oilite bronze. Replace swashplate if necessary. Check for elongation of bolt hole in support arm portion of main housing assembly of tail rotor gearbox, caused by looseness of bellcrank fulcrum bolt and nut. (2).
Symptom remains	Disconnect floor-routed tail rotor control rod from foot pedal torque tube fitting (Ref. Figure 8-14).	If symptom gone, inspect tail rotor control rods and bellcranks until defective part is located.
Symptom remains	Loosen foot pedal torque tube bracket mounted on front of floor structure.	If symptom gone, pedal torque tube misaligned; shim for correct alignment. If symptom remains, disassemble and inspect tail rotor foot pedal installation until defective part is located (Ref. Figure 8-14).
Trouble corrected		

NOTES:

(1) Never force controls.

(2) Binding of swashplate with nylon liners may be caused by extreme low temperatures. Check by running helicopter until control system is warmed.

3. Tail Rotor Controls Rigging

Rigging of the tail rotor control system must be accomplished immediately after replacement of linkage that can not be accurately measured (by trammeling, etc.) before it is installed in the tail rotor control system or if helicopter operation reveal a rigging deficiency.

CAUTION Remove pilot's pedals to prevent possible contact with the lower windshield during rigging sequence.

NOTE: Control rod end bearing adjustment is to be made to the nearest half turn that will produce correct rigging. When tightening the jam nut at the adjustable end of a control rod, always hold the rod end with a wrench to prevent jamming of the bearing.

(1). Using two pieces of wood and a C-clamp or a rope, secure pilot's foot pedal arms so they are aligned (Detail A, Figure 8-3). With the pilot's foot pedals clamped in the neutral position and the control rod lengths adjusted as shown in Figure 8-14 and Figure 8-15, the control system bellcrank positions may be checked as follows:

NOTE: On helicopters with cambered metal tail rotor blades, disconnect bungee spring at connection to the aft end of the floor−routed control rod.

(a). Tail rotor idler bellcrank: Centerline of aft arm should be at 90 ±2 degrees to Sta. 78.50 bulkhead.

(b). Sta. 95 bellcrank: Centerline of tunnel-routed control rod attach bolt should be 4.30 ±0.090 inches (10.922 ±0.2286 cm) above the mast base structure.

(c). Sta. 142 bellcrank: Centerline of tailboom control rod attach bolt should be 4.75-5.09 inches (12.065-12.9286 cm) from the aft face of the Sta. 137.50 bulkhead. Gain access to bellcrank by removing the tail rotor control bellcrank access door.

(2). Loosen rod end checknut at forward end of tailboom control rod.

(3). Remove hardware attaching tailboom control rod to inboard end of Sta. 282.00 bellcrank on tail rotor transmission (Ref. Figure 8-4).

(4). Tie back the tail rotor rotating boot. Place the midtravel portion of tail rotor swashplate rigging tool (28 or 29, Table 2-2) between the swashplate and the tail rotor fork split retaining ring (Detail B, Figure 8-3).

NOTE: Check that the rigging tool is in contact with the split ring and not on the fork.

(5). Turn tailboom control rod at aft end. Adjust rod length to the nearest half turn of the rod end that will allow the tool to just slide between the split ring and swashplate.

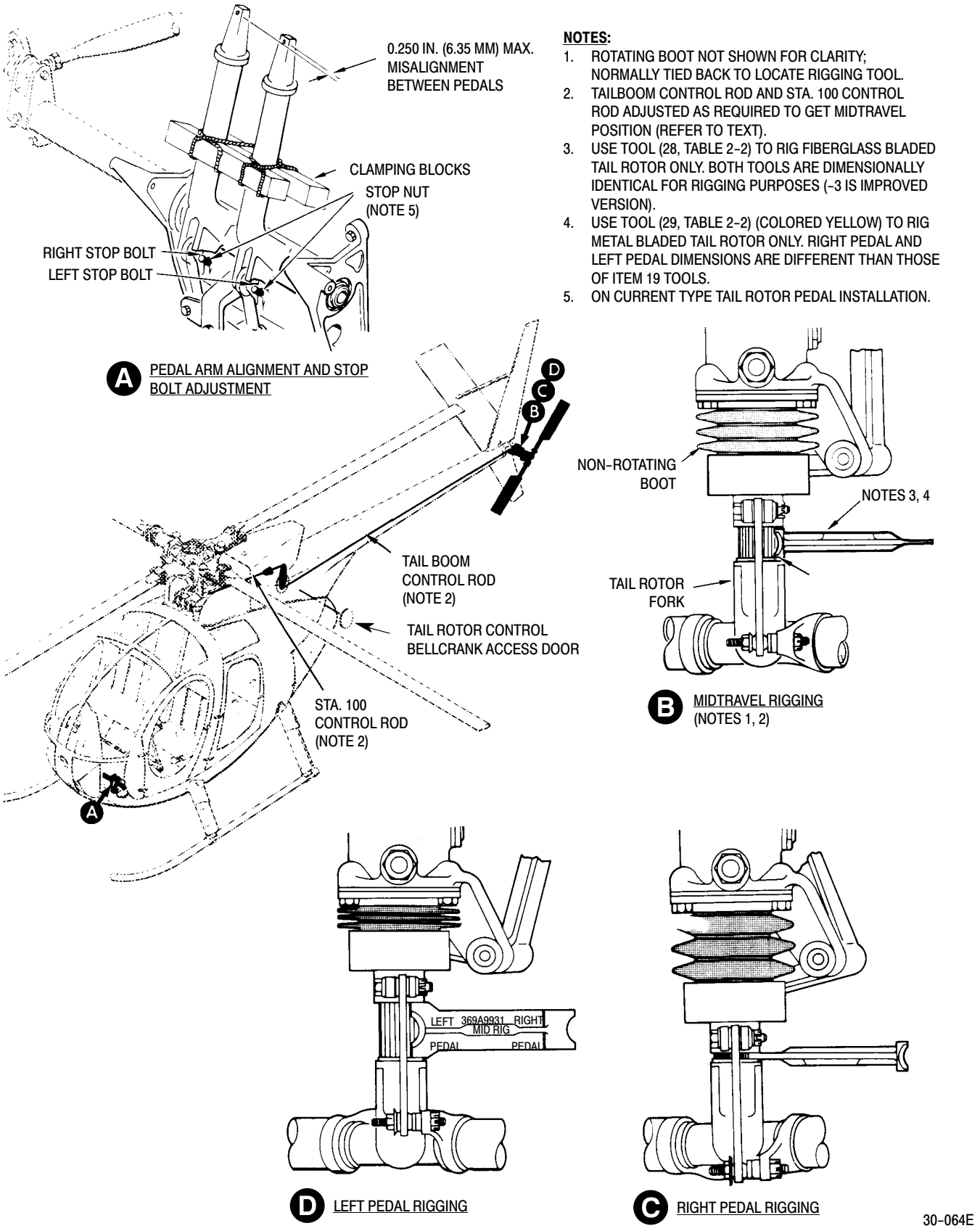
(6). Recheck that centerline of tailboom control rod forward attach bolt is still 4.75-5.09 inches (12.065-12.9286 cm) from aft face of Sta. 137.50 bulkhead. Also check check forward rod end for not less than one and one-half exposed threads with checknut snug against rod. If either condition does not exist, disconnect forward end of Sta. 100 control rod and readjust both control rods until Sta. 142 bellcrank position and exposed threads of both control rods are within tolerance.

(7). Ensure that slotted bushing is in place in bottom ear of Sta. 282 bellcrank and inboard ear of Sta. 95 bellcrank. Connect control rods using hardware removed and cotter pin.

(8). Check witness holes for proper thread engagement. Align rod ends to get approximately equal angular throw in bellcrank, and tighten checknuts.

(9). Remove clamping device from foot pedal arms.

(10). If installed, loosen stop nuts on pedal stop bolts (Detail A). Screw in the pedal stop bolts approximately 0.50 inch (12.7 mm).



NOTES:

1. ROTATING BOOT NOT SHOWN FOR CLARITY; NORMALLY TIED BACK TO LOCATE RIGGING TOOL.
2. TAILBOOM CONTROL ROD AND STA. 100 CONTROL ROD ADJUSTED AS REQUIRED TO GET MIDTRAVEL POSITION (REFER TO TEXT).
3. USE TOOL (28, TABLE 2-2) TO RIG FIBERGLASS BLADED TAIL ROTOR ONLY. BOTH TOOLS ARE DIMENSIONALLY IDENTICAL FOR RIGGING PURPOSES (-3 IS IMPROVED VERSION).
4. USE TOOL (29, TABLE 2-2) (COLORED YELLOW) TO RIG METAL BLADED TAIL ROTOR ONLY. RIGHT PEDAL AND LEFT PEDAL DIMENSIONS ARE DIFFERENT THAN THOSE OF ITEM 19 TOOLS.
5. ON CURRENT TYPE TAIL ROTOR PEDAL INSTALLATION.

Figure 8-3. Tail Rotor Control System Rigging

CAUTION Use care when actuating pedals to avoid the possibility of damaging the tool or the windshield.

(11). Adjust right pedal stop bolt (Detail A) so that when pedal arm is held against the stop the right pedal portion of rigging tool will just slide between the split ring and swashplate (Detail C). The fit should be tight enough to support the tool weight. Without changing adjustment of bolt or tool fit, tighten stop nut (if installed) on bolt.

(12). Adjust left pedal stop bolt (Detail A) so that when pedal arm is held against the stop with **20 - 25 pounds (89 - 111 N) pressure** (or pull on right pedal) the left pedal portion of rigging tool will just slide between the split ring and swashplate (detail D). The fit should be tight enough to support the tool weight. Without changing adjustment of bolt or tool fit, tighten stop nut (if installed) on bolt. Remove rigging tool and restore rotating boot to normal position.

(13). Reinstall pedals. Slowly press the outboard pedal to its full travel position against the stop bolt. With not more than **20 pounds (89 N)** of pressure applied, the upper and lower edges of the pedal must clear the canopy glass by not less than 0.20 inch (5.08 mm).

(14). Operate through full range of travel. While the controls are being moved:

(a). Check that there is never less than 0.060 inch (1.524 mm) clearance around the Sta. 100 control rod where it passes through the structure at Sta. 137.50.

(b). Check that there is never less than 0.010 inch (0.254 mm) clearance around the tailboom control rod where it exits between the boom and tail rotor transmission.

(15). On helicopters with a cambered metal-blade tail rotor, connect bungee spring between aft end of floor-routed control rod and Sta. 63.00 bracket. Note that pilot's left pedal moves to its normal forward position.

(16). Reinstall Sta. 142 bellcrank access door.

4. Tail Rotor and Pitch Control Assembly

The tail rotor and pitch control assembly consists of a hub, drive fork and two blades assembled to a pitch control assembly.

The two blades are telescoped over the hub and interconnected by a tension-torsion strap assembly inside the hub.

The hub is bolted in the drive fork and two pitch control links are attached between the blade arms and the pitch control assembly.

The metal-blade tail rotor assembly is standard on current production helicopters and optional for earlier helicopters originally equipped with the fiberglass blade tail rotor assembly. The metal-blade tail rotor assembly is required on a helicopter with an Allison 250-C20 Engine.

All following information applies to both metal- and fiberglass-blade tail rotor assemblies, unless specifically indicated otherwise. Maintain both the metal- and fiberglass-blade tail rotor assemblies as specified as follows.

5. Tail Rotor and Pitch Control Assembly Replacement

(Ref. Figure 8-4)

A. Tail Rotor and Pitch Control Assembly Removal

CAUTION

- Whenever the blades and hub are removed as an assembly, or whenever the pitch control links are disconnected, do not allow blade pitch to exceed 30 degrees from the neutral pitch position (Ref. Figure 8-5). This is equal to blade pitch control arm movement of approximately 1 inch (25.4 mm) in either direction. Unrestricted rotation of blades on the hub can excessively bend or stretch the internal tension-torsion strap assembly and cause undetected damage to the strap assembly and an out-of-balance condition for the tail rotor when reassembled.
- To prevent balance problems at reassembly of parts and hardware, note and mark the exact locations and positions of all items before removal to ensure reinstalla-

tion at the same locations and positions during reassembly. It is advisable to separate, tags and index all items as disassembled, for subsequent ease of reassembly in proper position.

- Do not remove the hub- to- drive fork hinge bolt to remove the tail rotor assembly. This bolt should be removed according to overhaul instructions (CSP-H-5). It is possible to damage the strap pack if any other procedure is used.

(1). Perform one of the following, as applicable.

(a). If only the tail rotor is to be removed:

1). Color code the pitch control arms, links and attaching hardware (Ref. Figure 8-9).

2). Disconnect pitch control links from blade pitch control arms (Ref. Figure 8-4) and retain attaching hardware.

(b). If the complete tail rotor assembly including the pitch control assembly is to be removed:

1). Remove Sta. 282 bellcrank from transmission at pivot points so that bellcrank pivot pin is disengaged from self-aligning bearing in pitch control housing (fig. 8-3).

(2). Cut lockwire and pull beaded end of non-rotating boot out of inboard groove of pitch control housing.

(3). Straighten tang of tang washer. Using torque wrench adapter (30, Table 2-2), loosen retaining nut and slide tail rotor outward on shaft to remove blade stop and spacer (or stop support), then remove nut.

CAUTION Tail rotor tang washer must not be reused.

(4). Remove and discard tang washer.

NOTE:

- Placing a grease pencil mark on the drive fork, to key it to the transmission output shaft will enable subsequent installation of tail rotor assembly at same position. Also, application of a small painted matchmark next to the centerline splined groove on both the pitch control assembly and tail rotor drive fork aids reassembly at same position on the transmission shaft.
- One spline groove of the fork is located directly on the centerline passing through the centers of the two fork bearings while, at the opposite side of the spline bore, the same centerline passes through a spline tooth. A similar condition exists with respect to the swashplate splines, except that the reference centerline originates between the swashplate arms. (Ref. CSP- H- 5 for illustrations showing matchmarks and additional information.)

(5). Slide tail rotor assembly (including pitch control assembly if being removed) off shaft: catch or remove split rings from shaft.

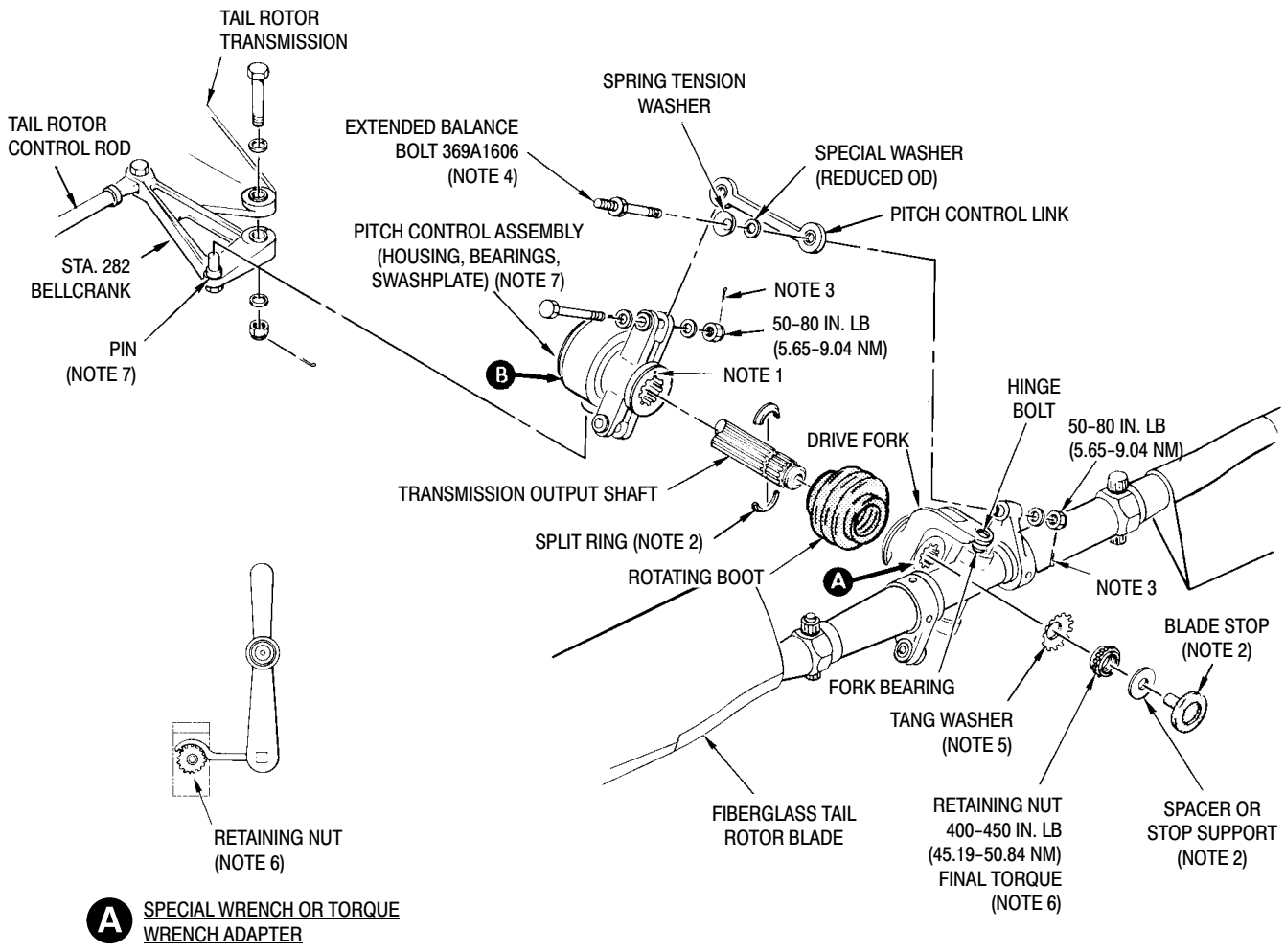
NOTE: Two types of split ring consisting of two half sections, are in service. Half sections of different types must not be inter-mixed and should be retained as a matched set when removed from the helicopter. (Ref. Figure 8-4 for correct applicability.)

B. Tail Rotor and Pitch Control Assembly Installation

(1). Pull beaded end of rotating boot from groove of drive fork and position tail rotor assembly in line with transmission output shaft.

NOTE: Installing tail rotor blades at 90 degrees to the high and low extremes of shaft runout, using reference marks placed on the shaft at time of inspection, reduces chances of high frequency vibrations and lessens possibility of requirement for tail rotor balancing.

(2). If pitch control assembly is installed, position complete tail rotor and pitch control assembly in line with transmission output shaft and rotate tail rotor back and forth slightly until splined swashplate engages splines of shaft.

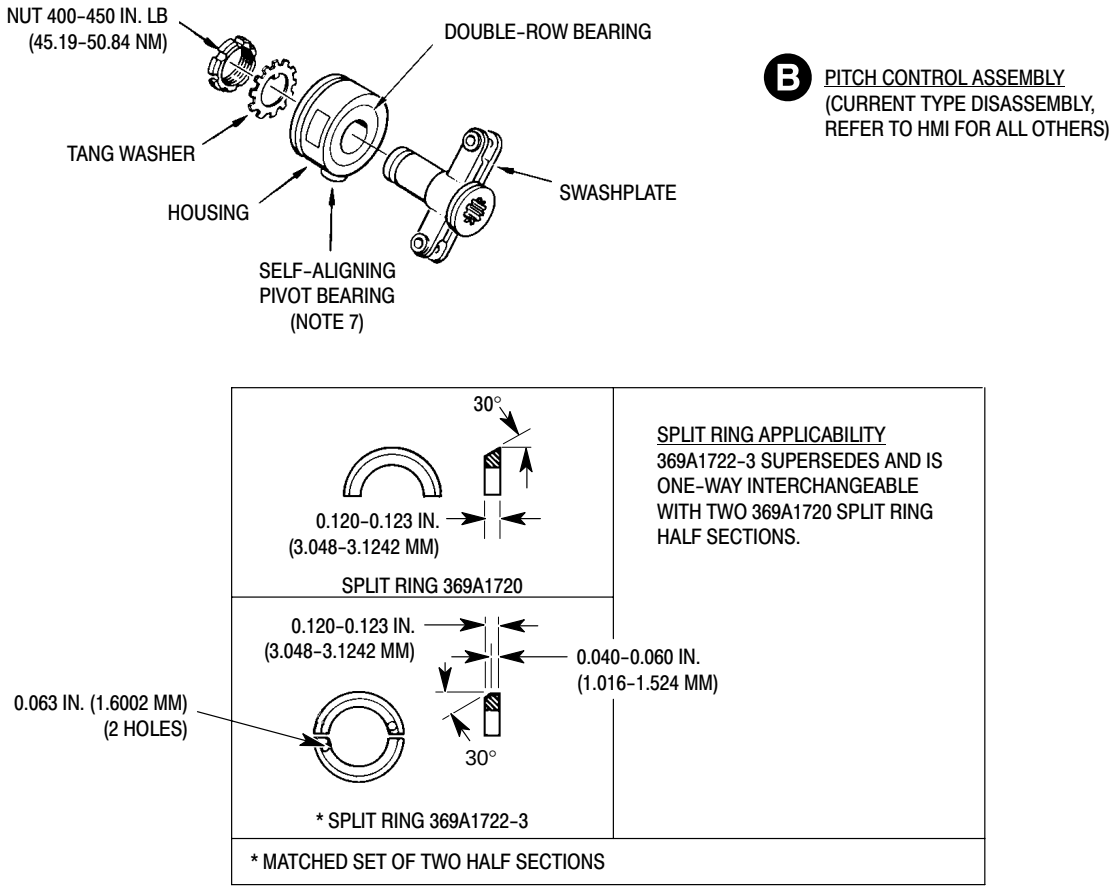


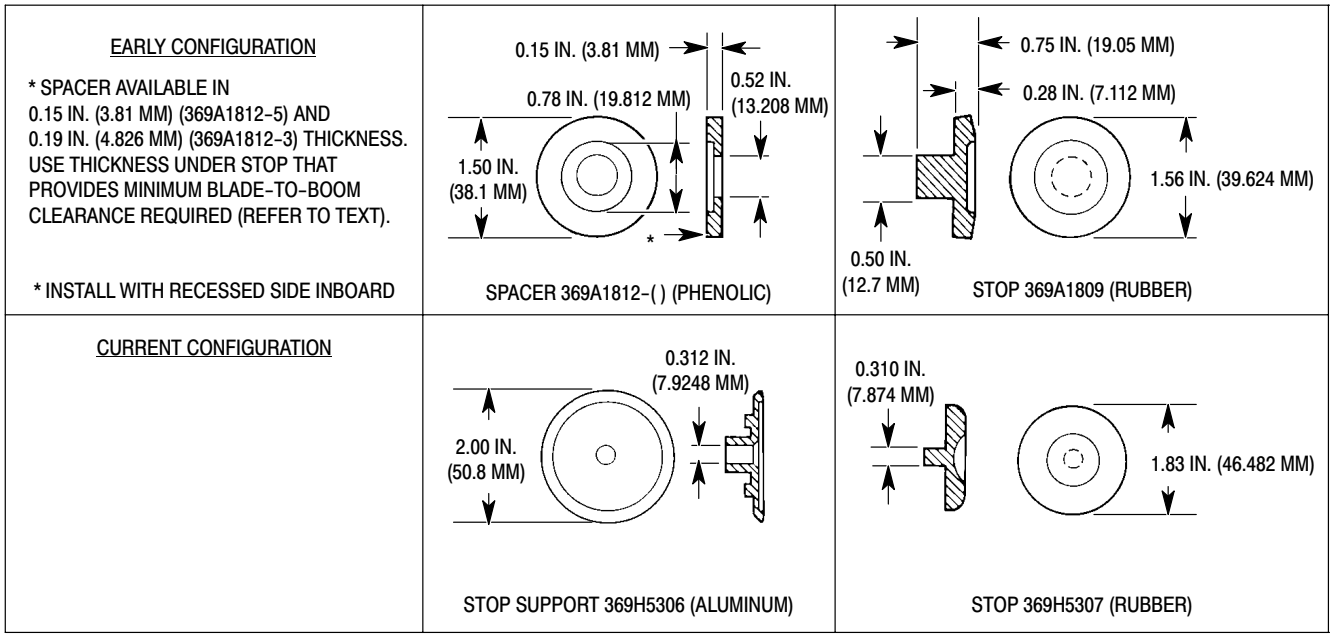
NOTES:

1. CENTERLINE TOOTHSPACE MATCHMARK MUST MATE TO CENTERLINE TOOTHSPACE MARK ON DRIVE FORK WHEN ASSEMBLED ON OUTPUT SHAFT.
2. SEE BOXED DETAILS FOR INSTALLATION INFORMATION.
3. COAT WITH PRIMER (4, TABLE 2-4) AT INSTALLATION.
4. BALANCING WASHERS NOT SHOWN. IF ALTERNATE STANDARD BOLT NAS464P-( ) IS USED. REFER TO TEXT FOR INFORMATION ON INSTALLATION AND ASSOCIATED HARDWARE USED.
5. AT REPLACEMENT, USE HS1551S290 STRAIGHT TANG WASHER OR HS1551-290 CONED TANG WASHER. DIMENSION ACROSS INSIDE (BORE) DIAMETER FROM EDGE OF KEY TO OPPOSITE EDGE (ON CENTERLINE) SHOULD BE 0.695-0.715 IN.(17.653-18.161 MM).
6. TORQUE NUT TO 550-600 IN. LB (62.14-67.79 NM) USING WRENCH ADAPTER (30, TABLE 2-4), BACK OFF TO 50-250 IN. LB (5.65-28.25 NM), THEN RETORQUE TO 400-450 IN. LB (45.19-50.84 NM).
7. LUBRICATE WITH GREASE (18, TABLE 2-4).

30-065-1B

Figure 8-4. Replacement of Tail Rotor and Pitch Control Assemblies (Sheet 1 of 2)





30-065-2B

Figure 8-4. Replacement of Tail Rotor and Pitch Control Assemblies (Sheet 2 of 2)

CAUTION

- In next step, be sure that two spline bore matchmarks (one on swashplate and one on drive fork) are in direct alignment with each other. This assures that swashplate and drive fork will both be located on the same spline bore centerline and prevents the possibility of an approximate 180 degree misalignment of the splines. Spline misalignment will damage the pitch control links when the tail rotor assembly is installed.
- Arrangement of the hardware and bolt heads in direction of rotation must be as shown in Figure 8-4. An out-of-balance tail rotor assembly will result if bolt, nut and washer combinations is not maintained.

(3). Slide tail rotor assembly onto shaft, keeping the drive fork-to-hub pivot bolt aligned with lugs of swashplate. Position tail rotor assembly on shaft so that approximately two threads at end of shaft are exposed outboard of drive fork.

CAUTION It is possible for pitch control swashplate to be misaligned by one- half spline in relation to drive fork. Make sure drive fork, pitch links and swashplate are in exact alignment with transmission shaft centerline. If incorrectly assembled, swashplate will be misaligned approximately 10 degrees from drive fork. To correct this condition, remove and rotate the tail rotor 180 degrees, and reinstall.

NOTE: Preassembly of tang washer, nut, phenolic spacer and rubber stop as a unit aids in their installation when performing steps (4). and (5). below. Marking the outer tang that is next to the inner key on tang washer, before assembly of the parts, simplifies alignment with keyway on shaft. Teeter blades to start tang washer on the shaft.

(4). Slip new tang washer (Note 5, Figure 8-4) over exposed threads of shaft; key tang must face inboard towards gearbox. Install nut approximately two full turns on shaft threads to verify threads engaged.

CAUTION In next step do not force blade stop into position with a screwdriver; this can crack the stop.

(5). Refer to Figure 8-4, Sheet 2 and determine whether rubber stop and phenolic spacer or aluminum stop support is used for tail rotor installation. Either combination is acceptable. Slide tail rotor assembly outboard against nut. Install phenolic spacer (recessed side facing inboard) or aluminum stop and rubber stop.

NOTE: The phenolic spacer comes in two thicknesses. Use only one spacer with the thickness, 0.10 or 0.15 inch (2.54 or 3.81 mm) that provides minimum blade- to- boom clearance of 2 inches (5.08 cm) when control pedals are in neutral and 2 pounds (8.90 N) plus the break- loose value of pressure is applied at blade tip.

(6). Fold back rotating boot to expose groove in shaft. Groove must be clean and free of paint and foreign material. Insert split ring in groove of shaft with beveled edges of split rings facing beveled seat in drive fork.

NOTE: Two types of split rings are in service. Half sections of the different types should not be intermixed because they are fabricated as matched sets. Installing split ring with gaps centered on blade span line reduces chances of high frequency vibrations, and lessens possibility of requirement for tail rotor balancing.

(7). While holding split ring in place, slide tail rotor assembly inboard. Be sure that beveled ring faces remain completely nested in beveled seat of drive fork, and that the fork contacts both split rings. Replace the split ring if a gap of more than 0.002 inch (0.0508 mm) exists between the fork and one split ring half with the other ring half in contact.

(8). Visually align a tang on tang washer with any convenient reference point.

(9). Using torque wrench adapter (30, Table 2-2), torque nut to **550 - 600 inch-pounds (62.14 - 67.79 Nm)**, back off to **50 - 200 inch-pounds (5.65 - 22.60 Nm)**, and then retorque to **400**

- 450 inch-pounds (45.19 - 50.84 Nm). Check blade-to-boom clearance at the maximum teetering position; refer to **NOTE** in (5). above.

(10). Check that tang has not moved more than one tang width in relation to reference point noted in step (8).

NOTE: Tang washer movement of more than one tang width is an indication that the tang washer inner key has sheared. This condition requires replacement of the washer and reassembly of parts according to the initial installation procedure.

(11). Bend tang on tang washer to lock the nut. When bending the tang, do not force-form tang to match nut contour; maintain the natural bend radius that develops at the tang root.

(12). Insert beaded end of non-rotating boot (drain/vent holes down) into groove of pitch control housing and beaded end of rotating boot into groove of drive fork. Secure with lockwire (2, Table 2-4).

(13). Make sure that pivot pin on Sta. 282.00 bellcrank and self-aligning bearing in underside of pitch control housing are lubricated with grease (18, Table 2-4).

(14). If removed, position Sta. 282.00 bellcrank so that pivot pin slips into bearing of pitch control assembly. Rotate bellcrank back and forth as required to align bellcrank bearing with gearbox arm and install bolt, two washers, nut and cotter pin.

(15). If disconnected, position pitch control links and install hardware.

(16). Position tail rotor pedals in neutral and recheck that drive fork, the pitch links and the swashplate are in exact alignment with gearbox output shaft centerline.

(17). If fiberglass-blade tail rotor assembly was replaced with metal-blade tail rotor assembly, rig tail rotor controls. Check rigging of tail rotor controls following installation of any removed or replaced parts.

(18). If conical bearing tail rotor hub has been disassembled, recheck fork bolt torque (CSP-H-5) after 50 hours of operation.

6. Tail Rotor and Pitch Control Assembly Inspection

(Ref. Figure 8-5) Inspect an assembled tail rotor and pitch control assembly as follows:

A. Pitch Control Assembly Inspection

(1). Excessive drag on gearbox output shaft if there is binding in the control system.

(2). Surface defects.

(3). Wear on inner surfaces of swashplate clevis ears.

(4). Evidence of contact between swashplate and housing.

(5). Evidence of slippage between double-row bearing inner race and swashplate (early type swaged assembly).

(6). Wobble on the gearbox output shaft.

B. Metal Blade Inspection

(1). Surface for cracks, scratches, nicks, gouges, dents, pits or corrosion

(2). Leading edges for erosion or dents.

(3). Root fitting for cracks, scratches, nicks, and gouges. No cracks are allowable. Scratches that do not exceed 0.020 inch (0.508 mm) depth are permissible with rework.

(4). Presence and security of tip weights and attachment hardware.

(5). Clogged drain openings.

(6). All exposed edges for possible adhesive separation.

NOTE: If any of these conditions are found, perform appropriate detailed inspections and allowable repairs according to limits and procedures in CSP-H-5. Additionally, preform a balance check at the interval specified in CSP-H-4.

C. Fiberglass Blade Inspection

(1). Presence of either a green or white dot located just outboard of the blade data plate.

(2). Evidence of collapsed airfoil.

If either or both of the blades show signs of a collapsed airfoil, the blades or the assembly should be replaced. Minor contour variation is allowed.

NOTE: Minor contour variations on tail rotor blades are not considered a safety of flight condition. Affected tail rotor assemblies may be continued in service until a replacement is available or pedal position for cruise flight changes 1 inch (25.4 mm) or more.

(3). Leading edge damage or separation.

(4). Fiberglass skin damage.

(5). Trailing edge separation and clogged vent/drain holes.

If trailing edge is separated the blade must be replaced. No trailing edge separation is allowable.

(6). Loose or damaged tip caps.

(7). Spar for cracks, scratches, nicks and gouges. No cracks allowed.

Scratches and nicks between attachment bolt hole and pitch control arm that do not exceed 0.050 inch (1.27 mm) depth are permissible with rework.

NOTE: If any of the above conditions are found, perform appropriate detailed inspection and allowable repair according to limits and procedures in CSP-H-5.

(8). Stainless steel leading edge abrasion strip damage or starting to separate from blade.

(9). Loose, unserviceable or missing leading edge abrasion tape. If any such condition exists, replace tape.

(10). Perform a balance check at the internal specified in CSP-H-4.

D. Tail Rotor Bearing Inspection

Inspect pitch control link bearings, drive fork bearings and pitch (feathering) bearings in blade spars (fiberglass blade) or root fittings (metal blades) for excessive looseness or play from wear, as follows:

(1). Maximum axial looseness for bearing in pitch control link is 0.020 inch (0.508 mm).

NOTE: If bearings secured in link by staking of the bearing (pressed-lip staked) the bearing is not replaceable. However, since bearing wear will usually occur only at the blade pitch control arm because of greater displacement during operation, the link can be continued in service until either or both bearings exceed the wear tolerance.

(2). Inspect area of link around staked bearings for cracks. Scrap link assembly if any cracks are found.

(3). Inspect for excessive wear at both ends of pitch links. Check that wear is smooth and does not extend into inner race of bearing. Touch up wear area with primer (4, Table 2-4) and matching paint (6).

(4). Inspect staked groove in outer race of bearings for cracks. No cracks are allowed.

(5). Maximum allowable play for spherical drive fork bearings is 0.024 inch (0.6096 mm) axial, or 0.008 inch (0.2032 mm) radial, if vibration is not excessive. No axial or radial play is allowed for the conical drive fork bearings. Refer to Figure 8-10 for configuration identification.

NOTE: A physical check for pitch bearing wear (step (6). below), that causes spar looseness on the hub, can be made by holding one blade firmly and measuring the flapping play at the tip of the opposite blade. The measured play will indicate the combined wear of the pitch bearings. For fiberglass blades, excessive tail rotor vibration will usually result when play is approximately 0.250 inch (6.35 mm) or more.

(6). Maximum allowable wear for the pitch (feathering) bearing in the spars is limited only by the effect of the wear on tail rotor vibration.

NOTE: If any of these conditions are found, replace the defective bearing or preload shim fork bearings as applicable (CSP-H-5).

(7). Check for indications of rust and corrosion on hub fork bolt. If surface is

not protected, clean and coat with primer (4).

E. Remaining Components Inspection

(1). Inspect for evidence of rotational binding by hand-turning the tail rotor assembly a few turns while listening for unusual sounds. If condition is questionable, perform Inspection of Pitch Control Assembly.

NOTE: Change of blade pitch angle when the tail rotor is static can produce an audible snapping noise. The blade strap pack causes the noise as the laminations are twisted and bent without a centrifugal load imposed. Such a noise is not harmful and of no concern.

(2). Teeter the blades back-and-forth and check for evidence of abnormal binding. (Some stiffness is normal, especially when the blade stop is newer.)

(3). Check that hub-to-blade pitch arm clearance is within typical dimensions of 0.001-0.130 inch (0.0254-3.302 mm).

(4). Inspect fork and hub for scratches, nicks, dents, cracks, corrosion and similar surface defects. No cracks are allowable. Scratches and nicks that do not exceed 0.005 inch (0.127 mm) depth are permissible with rework.

(5). Inspect all bolts and nuts for security.

(6). Inspect blade stop and boots for deterioration. Be sure to check for cracking or splitting in the stem area of the stop.

(7). Check both halves of the split ring for damage and width conformity. (Ref. Figure 8-4). Smooth out any roughness, burrs or irregularities on the bevel surfaces, using grade 400 abrasive paper or crocus cloth (9 or 23, Table 2-4).

NOTE: For any questionable and all other items, refer to the complete and detailed inspection, damage wear and repair limits and requirements for the tail rotor assembly provided in CSP-H-5.

7. Elastomeric Bearing Inspection

Visually inspect elastomeric bearings installed in fork assembly, at intervals specified in CSP-H-4, for damage and debonding from fork as follows:

CAUTION Elastomeric material can be damaged by solvents, grease or oil. If cleaning is necessary, refer to Care and Cleaning of Elastomeric Bearings.

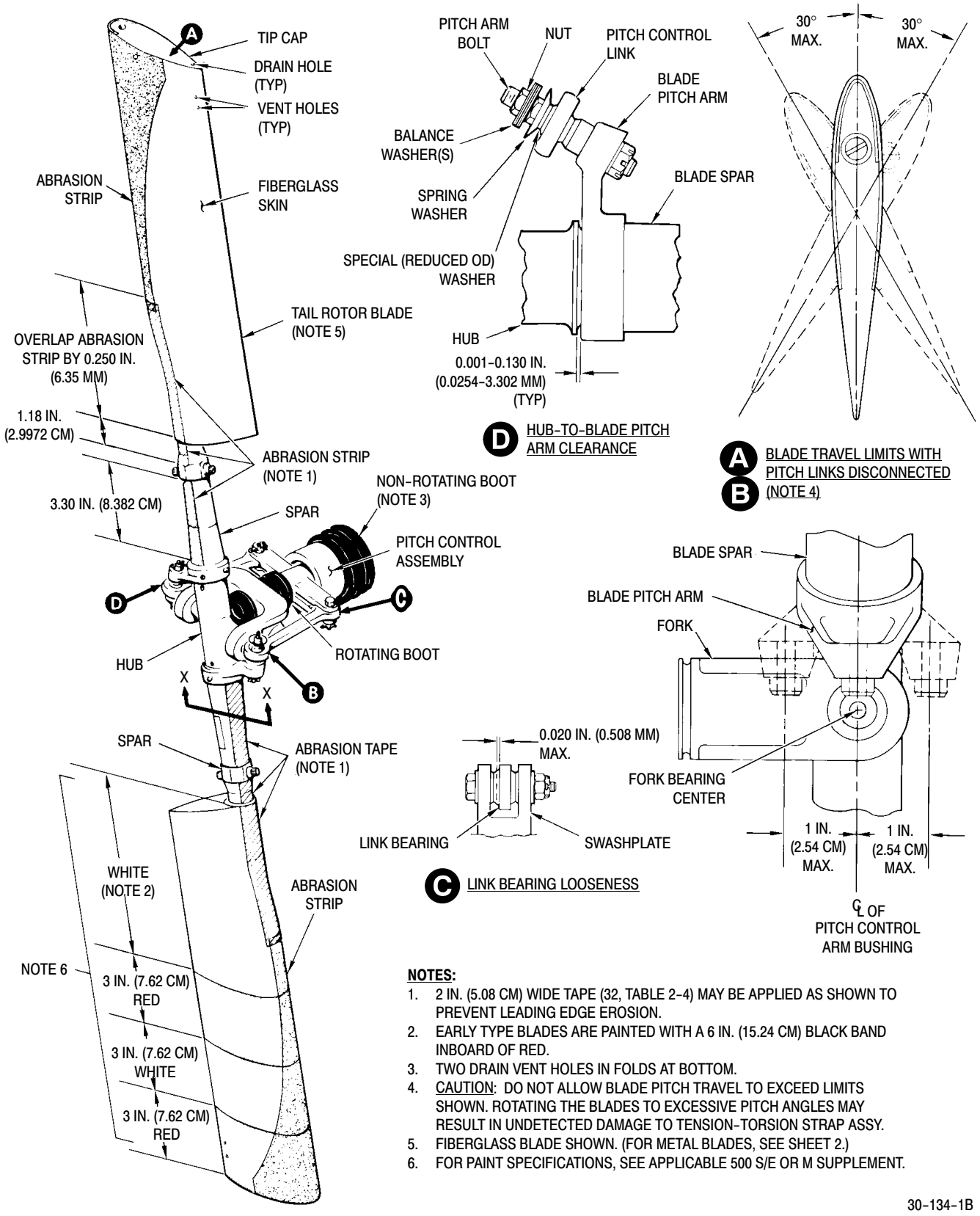
(1). Apply teetering force by hand to rotor blades (stop-to-stop). Check for fork-to-bearing failure. Failure is indicated by any motion between outer bearing cage and fork (bearing turns in fork). If failure is noted, remove bearing and rebind in fork according to instructions in CSP-H-5.

(2). Teeter blades stop-to-stop as in step (1). Observe four radial molded ridges on each bearing as teetering takes place. If ridges assume continue curved shape, bearing are intact. Discontinuity in molded ridges indicates bearing failure and bearing must be replaced according to instructions in CSP-H-5.

(3). Check bearing for general condition. Replace bearing if damaged. Evidence of light swelling, pock marks and crumbs are surface conditions and are not indications of bearing failure.

(4). Elastomeric bearings are suspected of being unserviceable, if visual inspection reveals rubber deterioration, separation or a vibration is reported. Perform following steps to check blade flapping resistance measurement to determine if suspect elastomeric bearing has failed.

(5). To perform the measurement, remove rubber blade stop between tail rotor hub and fork on two bladed tail rotor.



NOTES:

1. 2 IN. (5.08 CM) WIDE TAPE (32, TABLE 2-4) MAY BE APPLIED AS SHOWN TO PREVENT LEADING EDGE EROSION.
2. EARLY TYPE BLADES ARE PAINTED WITH A 6 IN. (15.24 CM) BLACK BAND INBOARD OF RED.
3. TWO DRAIN VENT HOLES IN FOLDS AT BOTTOM.
4. CAUTION: DO NOT ALLOW BLADE PITCH TRAVEL TO EXCEED LIMITS SHOWN. ROTATING THE BLADES TO EXCESSIVE PITCH ANGLES MAY RESULT IN UNDETECTED DAMAGE TO TENSION-TORSION STRAP ASSY.
5. FIBERGLASS BLADE SHOWN. (FOR METAL BLADES, SEE SHEET 2.)
6. FOR PAINT SPECIFICATIONS, SEE APPLICABLE 500 S/E OR M SUPPLEMENT.

30-134-1B

Figure 8-5. Tail Rotor and Pitch Control Assemblies - Inspection of, and Handling Limits (Sheet 1 of 4)

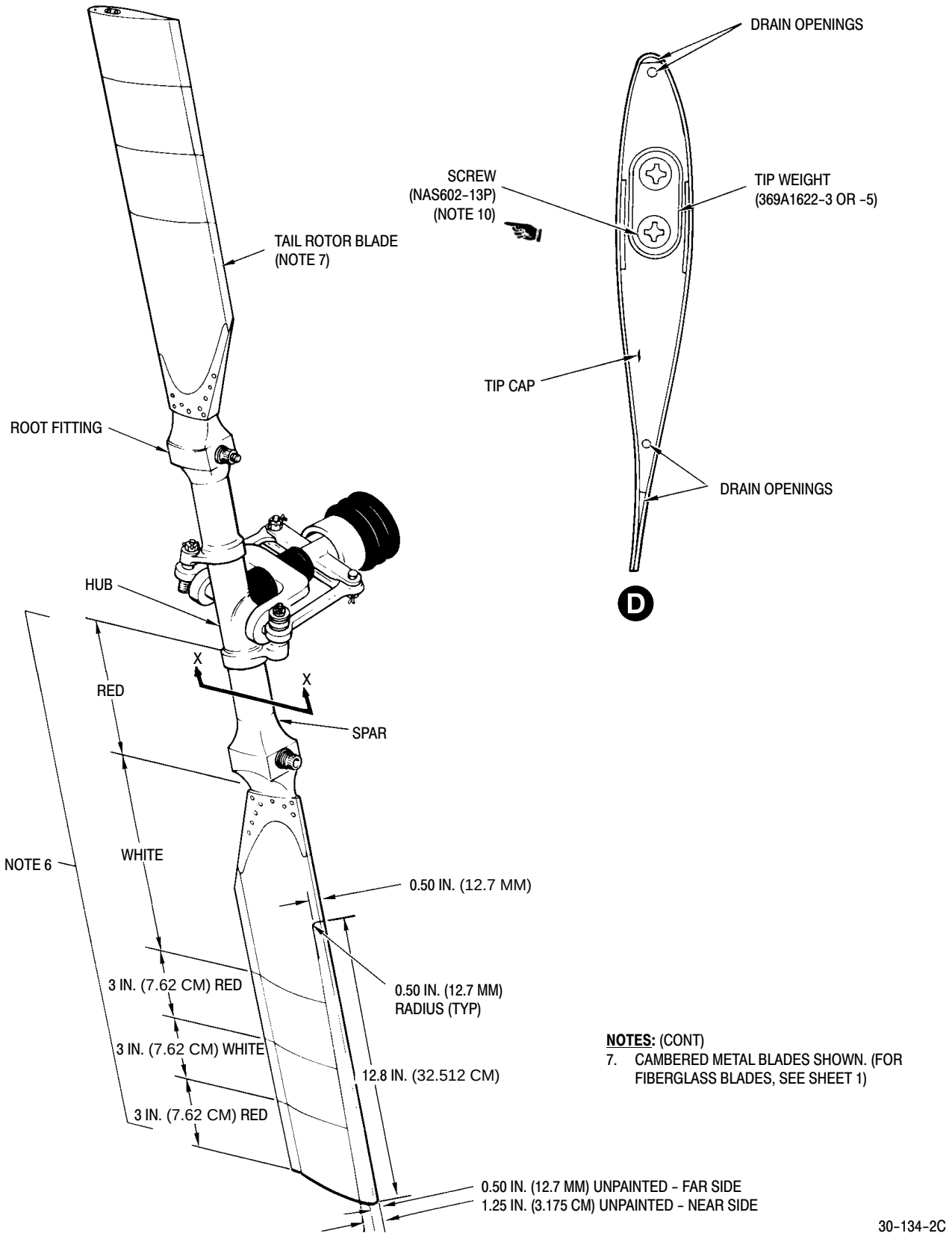
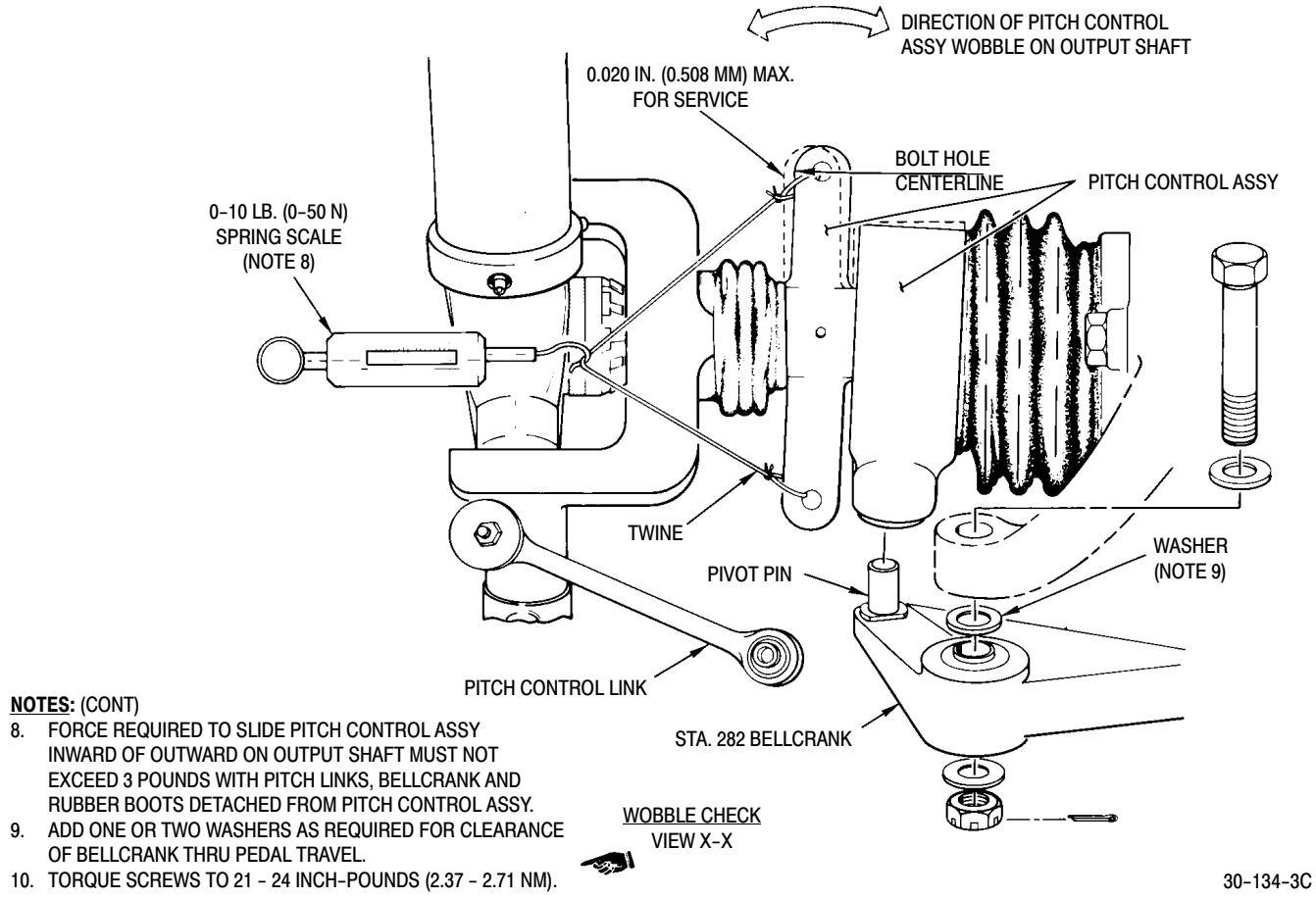


Figure 8-5. Tail Rotor and Pitch Control Assemblies - Inspection of, and Handling Limits (Sheet 2 of 4)



NOTES: (CONT)

8. FORCE REQUIRED TO SLIDE PITCH CONTROL ASSY INWARD OF OUTWARD ON OUTPUT SHAFT MUST NOT EXCEED 3 POUNDS WITH PITCH LINKS, BELLCRANK AND RUBBER BOOTS DETACHED FROM PITCH CONTROL ASSY.
9. ADD ONE OR TWO WASHERS AS REQUIRED FOR CLEARANCE OF BELLCRANK THRU PEDAL TRAVEL.
10. TORQUE SCREWS TO 21 – 24 INCH–POUNDS (2.37 – 2.71 NM).

Figure 8-5. Tail Rotor and Pitch Control Assemblies - Inspection of, and Handling Limits (Sheet 3 of 4)

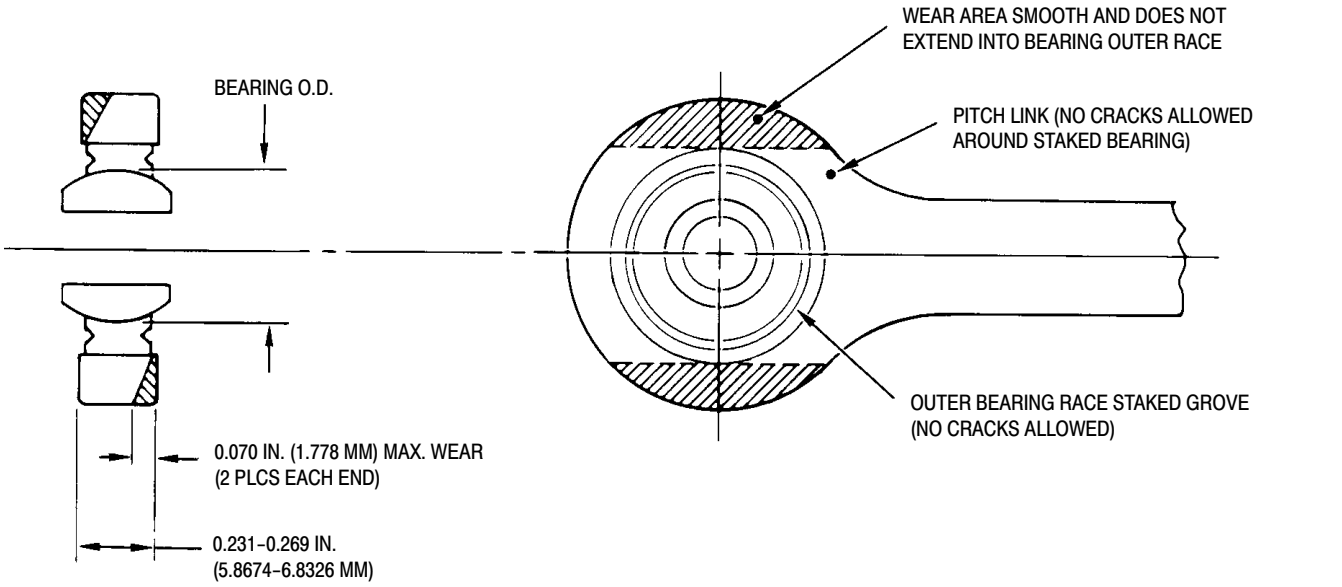


Figure 8-5. Tail Rotor and Pitch Control Assemblies - Inspection of, and Handling Limits (Sheet 4 of 4)

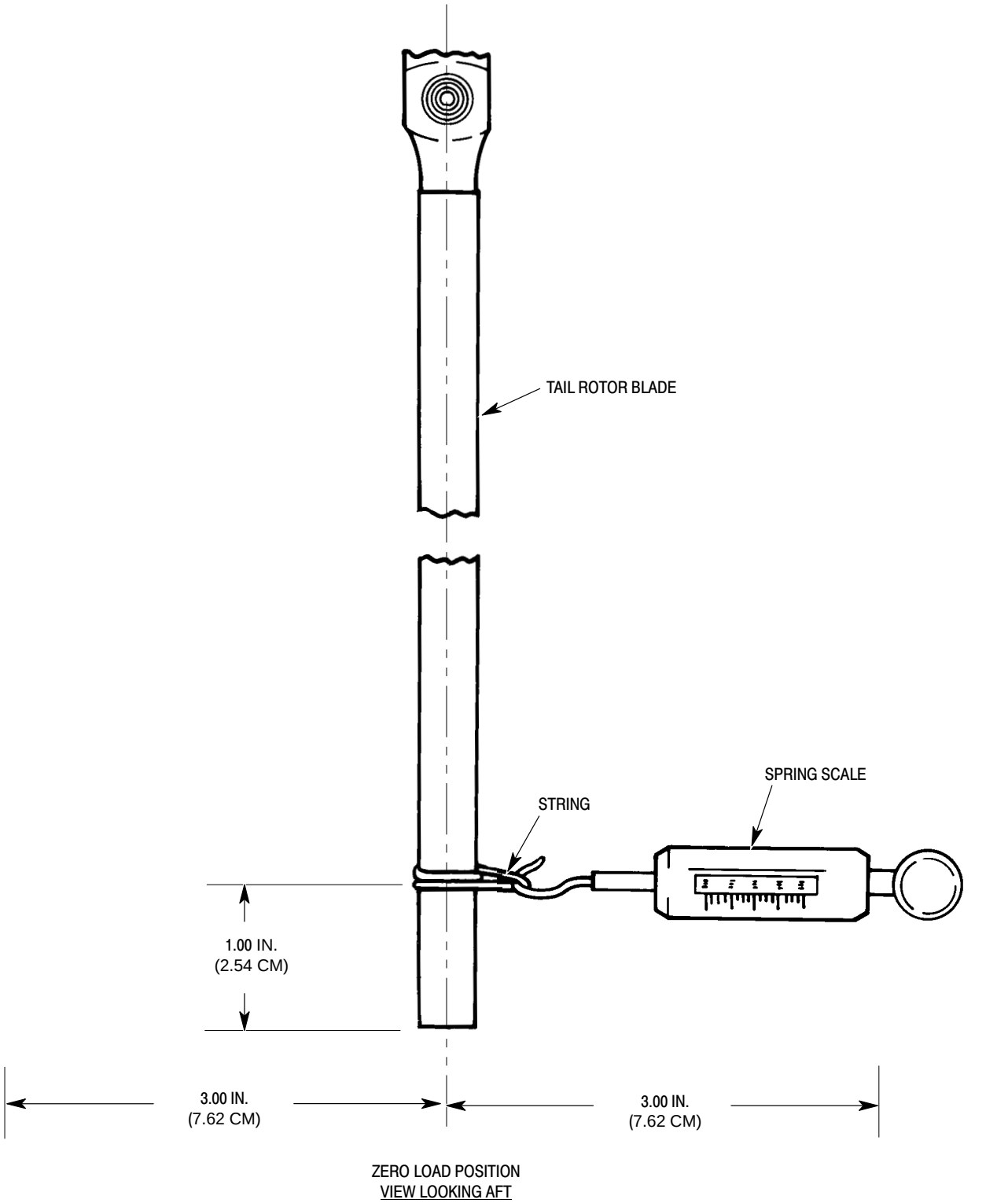


Figure 8-6. Blade Flapping Resistance Measurement (Elastomeric Bearings)

CAUTION Do not remove hub- to- drive forkhinge bolt to remove tail rotor assembly. This bolt should only be removed according to instructions in CSP-H-5. Damage to strap pack may occur if any other procedure is used.

(6). Measure flapping resistance of blade using spring scale attached within 1.00 inch (25.4 mm) inboard of blade tip (Ref. Figure 8-6).

(a). Block or hold tail rotor pedal in neutral position, record spring scale value when blade tip is 3.00 inches (7.62 cm) inboard and outboard from no load position.

(b). Scale must indicate 1.5-5.0 pounds (6.67-22.24 N). If load is not within specified limit, replace bearing Ref. CSP-H-5).

(7). Reinstall rubber blade stop.

NOTE: When reinstalling tail rotor fork assembly a new tang washer must be used.

8. Elastomeric Bearing Care and Cleaning

Elastomeric bearings are not inherently resistant to greases, oils, or solvents if immersed. They are however, somewhat resistant to occasional splash or spillage of these materials if exposed on an occasional basis. If elastomeric material do come in contact with these fluids, the elastomeric surface should be immediately cleaned. If cleaning is accomplished properly, the effect of greases, oils, or solvents on the performance of the elastomeric material will be minimal.

(1). If greases, oils or solvents come in contact with the elastomeric damper material, wipe immediately with a clean dry rag.

(2). If wiping is not sufficient (oil or grease is too thick) clean the affected area of the elastomer with a soft bristle brush and a solution of pure soap and water.

(3). Rinse with tap water.

9. Tail Rotor and Pitch Control Assembly Repair

(1). Repair of allowable surface defects on fork and hub that may be reworked by using grade 320 abrasive paper (20, Table 2-4) to round out and blend defect.

(2). Apply exterior surface touchup treatment and paint touchup (Ref. Sec. 2) (Repairable damage limits are defined in CSP-H-5).

(3). Repair both halves of split ring by rounding out or blending any roughness, burrs or irregularities on the beveled surfaces, using grade 400 emery paper or crocus cloth (23).

10. Pitch Control Link Replacement

CAUTION

- Prior to removal of pitch control links, color code pitch control arm, bolt and all washers used at each arm (Ref. Figure 8-10) . The bolt, or an identical one, and same combination of washers must be reassembled at locations from which removed or tail rotor balance can be seriously affected.
- Do not allow blade pitch angles to exceed 30 degrees, approximately one inch (25.4 mm) in each direction (Ref. Figure 8-5). Undetected damage to the internal tension torsion strap pack may occur.

(1). Disconnect ends of pitch control link from clevis ear of swashplate and from blade pitch control arm (Ref. Figure 8-4).

(2). Insert either end of repaired or replacement pitch control link between clevis ears of swashplate.

(3). Install bolt, two washers and nut, torque nut to **50 - 60 inch-pounds (5.65 - 6.78 Nm)**; install cotter pin.

(4). Pull pitch control assembly inboard or outboard as required to align pitch control link bearing with pitch control arm bushing.

(5). Check or apply color code for correct match. Place special (reduced outside

diameter) washer and large diameter spring tension washer on extended balance bolt so that concave (dished) surface of spring washer is against bolt head. With washers in place on bolt, insert bolt through bearing of pitch control link and bushing in pitch control arm.

NOTE: If alternate (standard NAS 464P -) bolts are used instead of extended balance bolts, first install balance washers(s) of same color code as pitch control arm and bolt, then install an AN 960-416 washer under bolt head before installing bolt. Insert bolt shank through spring washer, reduced OD washer, bearing of link and bushing of blade pitch arm. The AN 960-416 washer prevents balance washer contact with spring washer.

(6). Install washer(s) of same color code as pitch control arm and bolt, install nut, Section 8, torque nut to **50 - 60 inch-pounds (5.65 - 6.78 Nm)** and install cotter pin with wet primer (4, Table 2-4) (Ref. Figure 8-4).

(7). If removed from extended balance bolt, install balance washer(s) of same color code as pitch control arm on extended balance bolt and secure with nut.

11. Leading Edge Tape Replacement (Fiberglass Blade)

(Ref. Figure 8-5)

CAUTION Do not allow solvent to soak into blade crevices as it may cause damage to bonding adhesive.

(1). Remove old adhesive tape from three locations on leading edge of blade and spar; clean areas from which removed with solvent (1, Table 2-4).

CAUTION Do not cut tape after it has been installed on blade.

(2). Measure and cut 2 inch (5.08 cm) wide tape (32) to lengths indicated for locations as follow:

(a). Spar inboard length is 3.30 inches (8.382 cm).

(b). Spar outboard length is 1.18 inches (2.9972 cm).

(c). Tape length at blade root is to overlap metal abrasion strip by 0.250 inch (6.35 mm).

(3). Apply tape on leading edge centerline of blade and spar; press down firmly to eliminate all air pockets.

12. Tail Rotor Assembly Bungee Initial Installation (Fiberglass-to-Metal Tail Rotor Blade Conversion)

(Ref. Figure 8-7) Installation of new metal tail rotor assembly is preceded by removal of the existing fiberglass-bladed tail rotor assembly and inspection of split rings. Existing tail rotor pitch control sub-assembly is to be used. Tail rotor controls must be rerigged using a different rigging tool (29, Table 2-2).

(1). Remove access cover between pilot's seat and left passenger's footwell on aft side of canted bulkhead.

NOTE: If the riveted bearing is installed at aft end of floor-routed control rod, the control rod must be removed from helicopter.

(2). Removal the nonriveted bearing installed at one end of control rod; discard bearing. Do not remove riveted bearing.

(3). Place locknut and fitting on new bearing and install on end of rod assembly. Adjust rod assembly to 30.06 inches (76.3524 cm) as shown.

(4). Drill 0.190-0.194 inch (4.826-4.9276 mm) hole through bracket and touchup with primer (4, Table 2-4).

(5). Install eyebolt on bracket.

(6). Install eyebolt on fitting at new bearing.

(7). Install floor-routed control rod, with new bearing and fitting at aft end.

(8). Install bungee spring as shown.

(9). Reinstall footwell.

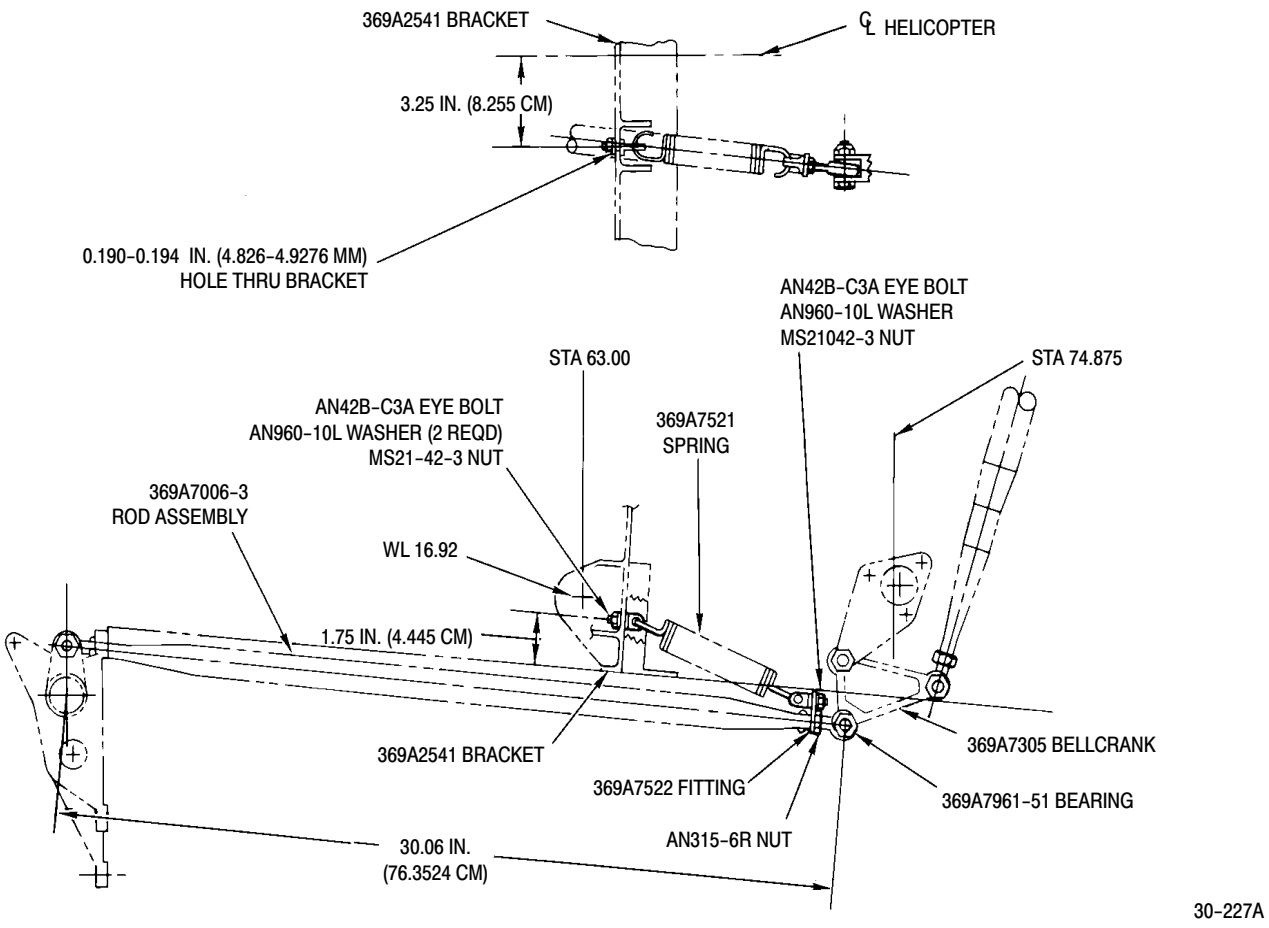


Figure 8-7. Tail Rotor Assembly Bungee Installation (Metal Blade)

13. Tail Rotor Balance Adjustment (Without Balance Kit)

WARNING **The following procedure should only be used if a slight out-of-balance condition is noted on a operating tail rotor and a tail rotor balance kit is not available. Tail balance should normally be accomplished using the balancing kit equipment described in paragraph 8-15. Damage can occur with an excessively out-of-balance tail rotor.**

NOTE: High frequency vibrations in the helicopter can also be produced by other components besides the tail rotor (Ref. Sec. 5, 9 and 10). Be sure that any excessive high frequency vibrations are tail rotor induced. before readjusting tail rotor balance.

(1). Evaluate tail rotor high frequency vibration

NOTE: Blurry appearance of lower vertical or horizontal stabilizer, at 100-103% N2 with tail rotor pedals in neutral position, is a typical vibrations.

(a). With tail rotor operating at normal rpm, feel the control pedals for the presence of high frequency vibration (buzz).

(b). If vibration is noticeable, observe the outboard tip of the horizontal stabilizer. Determine if stabilizer buzz is in excess of 0.0625 inch (1.5875 mm).

(c). If stabilizer buzz appears excessive (cannot be damped easily by holding tip with one hand) or pedal buzz feels excessive, tail rotor balance should be improved by performing the actions outlined in steps (2). thru (5). below.

(2). Attempt imbalance correction by repositioning tail rotor on driveshaft:

(a). Remove tail rotor and pitch control assembly, rotate 45 degrees from original index position and reinstall.

(b). With rotor operating at normal rpm, determine if the vibration is improved to an acceptable level.

(c). If vibration level is increased, reposition tail rotor 45 degrees in the opposite direction from the original index position.

(d). If vibration level is still unacceptable, return tail rotor to the original index position and proceed with step (3). below.

(3). Attempt rebalancing of the tail rotor by addition of tape as follows:

(a). Select either blade. Assuming that it is the light blade, wrap two layers of 2 inch (5.08 cm) width pressure-sensitive abrasion tape (32, Table 2-4) around the shank of the blade.

(b). Operate the tail rotor at normal flight rpm and evaluate the vibration level.

(c). If vibration level has decreased, continue to add tape until the vibration level is acceptable.

(d). If vibration level has increased, remove the tape and evaluate the opposite blade in the same manner.

(4). If an acceptable vibration level can be produced according to above, continue tail rotor in service with tape installed.

(5). If vibration level is unacceptable after attempt correction (steps (2). or (3). above):

(a). Obtain the special tail rotor balance analyzer kit (31, Table 2-2) that is used to balance installed tail rotors.

(b). Alternately, remove the complete tail rotor assembly and send to overhaul for balancing.

14. Tail Rotor Balance Adjustment (With Balancing Kit)

(Ref. Figure 8-8) Tail rotor balancing may be accomplished by strobe light observation of the tail rotor during ground run.

A vibration pick-up (accelerometer), mounted on the tail rotor gearbox, causes the strobe light to flash in each vibration cycle. The flashing light stops the rotating blade image, as viewed by the operator.

The vibrations, measured in mils on an analyzer dial, and the tail rotor angle, measured with a protractor mounted on the strobe light, are recorded by the operator. This data is applied to tables showing location and weight required to restore tail rotor balance.

Complete instructions for tail rotor balancing are contained in the Chadwick-Helmuth Strobex Blade Tracker Manual. This handbook is a component of balancing kit (59, Table 2-2).

A. Tail Rotor Balance Preliminary Adjustment

To prevent damage from an excessively out-of-balance tail rotor, the following check should be accomplished prior to use of the above kit, at each 100 hour tail rotor balance inspection, and whenever new or rebuilt tail rotor assembly is installed. Use the equipment cited for the above-noted manuals.

(1). Install tail rotor vibration analyzer kit.

(2). Ground run engine with main rotor blades at flat pitch, tail rotor pedals in neutral, and engine at ground idle speed.

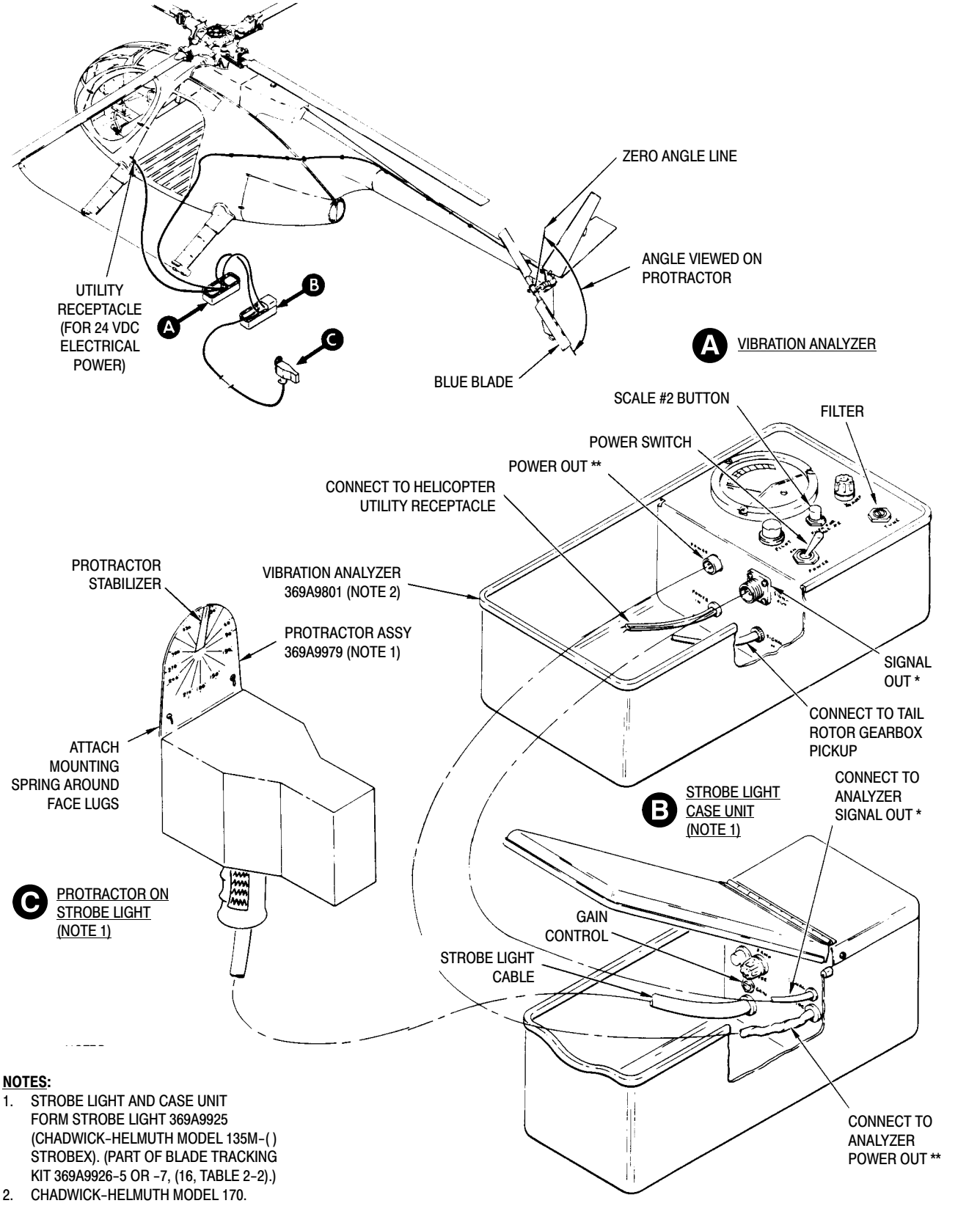
(3). With utility switch on, adjust analyzer and strobe per Chadwick-Helmuth handbook of instructions.

(4). Set RPM tune dial to 229 (2289 tail rotor rpm with engine at ground idle).

(5). Set rpm range dial to X10.

(6). Direct strobe light at tail rotor and observe Clock Angle of grip target.

(7). Press Verify Tune Button and adjust RPM Tune Dial while button is pushed, to return target to angle observed before button was pushed.



NOTES:

1. STROBE LIGHT AND CASE UNIT FORM STROBE LIGHT 369A9925 (CHADWICK-HELMUTH MODEL 135M-( ) STROBEX). (PART OF BLADE TRACKING KIT 369A9926-5 OR -7, (16, TABLE 2-2).)
2. CHADWICK-HELMUTH MODEL 170. (PART OF TAIL ROTOR BALANCE ANALYZER KIT 369A9999, (31, TABLE 2-2).)

Figure 8-8. Tail Rotor Vibration Analysis Equipment

(8). Release button, observe angle, press and adjust again to match new "unpushed" angle.

(9). Repeat until there is no change whether button is pushed or released.

NOTE: Adjust RPM Tune Dial only when button is pushed.

(10). Read Clock Angle with button released, and IPS without strobe flashing.

CAUTION If IPS meter reading is 0.5 or greater, do not increase rpm.

(11). If IPS meter reading is 0.5 or greater, proceed with preliminary adjustment as follows:

(a). Plot the low rpm IPS and Clock Angle on chart.

(b). Use four times the indicated weight and re-run the helicopter at ground idle.

(c). Correct Clock Angle, if necessary, using Chart Corrector.

(d). Repeat until IPS meter reading less than 0.5 (preferably 0.2).

(12). Accomplish final balancing with engine speed 103% N2 and RPM Tune Dial set at 310 (X10 3100 tail rotor rpm at 103% N2). Reduce IPS to 0.2 or less.

B. Tail Rotor Vibration Analysis Kit Installation

NOTE: Equipment required: Main rotor blade tracking kit 369A9926-5 or -7 (16, Table 2-2); tail rotor balancing kit 369A9999 (31). (Ref. Figure 8-8) The detailed balancing instructions outlined in adjustment steps (1). thru (6). below supercede those instructions contained in both the analyzer and the tracking kit.

(1). On tail rotor gearbox without breather-filler threaded for vibration pickup, install pickup mounting bracket assembly 369A9920 as shown in Detail C, Figure 8-9; then install vibration pickup on mounting bracket.

(2). On tail rotor gearbox having a breather-filler with a threaded hole, install pickup on breather (finger-tight).

(3). Connect vibration pickup cable to pickup. Route cable forward along right side of tailboom. Secure with tape (32, Table 2-4).

CAUTION Place weights on cable on ground to prevent possible fouling of tail rotor.

(4). Connect components of the vibration analyzer kit (369A9999) (31, Table 2-2) and blade tracking kit (369A9926-5 or -7) (16) as shown in Figure 8-8.

(5). Attach protractor assembly 369A9979 to strobe light.

(6). If not already marked, identify blue blade with paint provided in analyzer kit.

(7). Set strobe light ON-OFF switch to ON.

(8). Adjust analyzer indicator needle to zero, if necessary.

CAUTION Always perform first run in a cautious manner so that vibrations from an out-of-balance tail rotor will not cause damage.

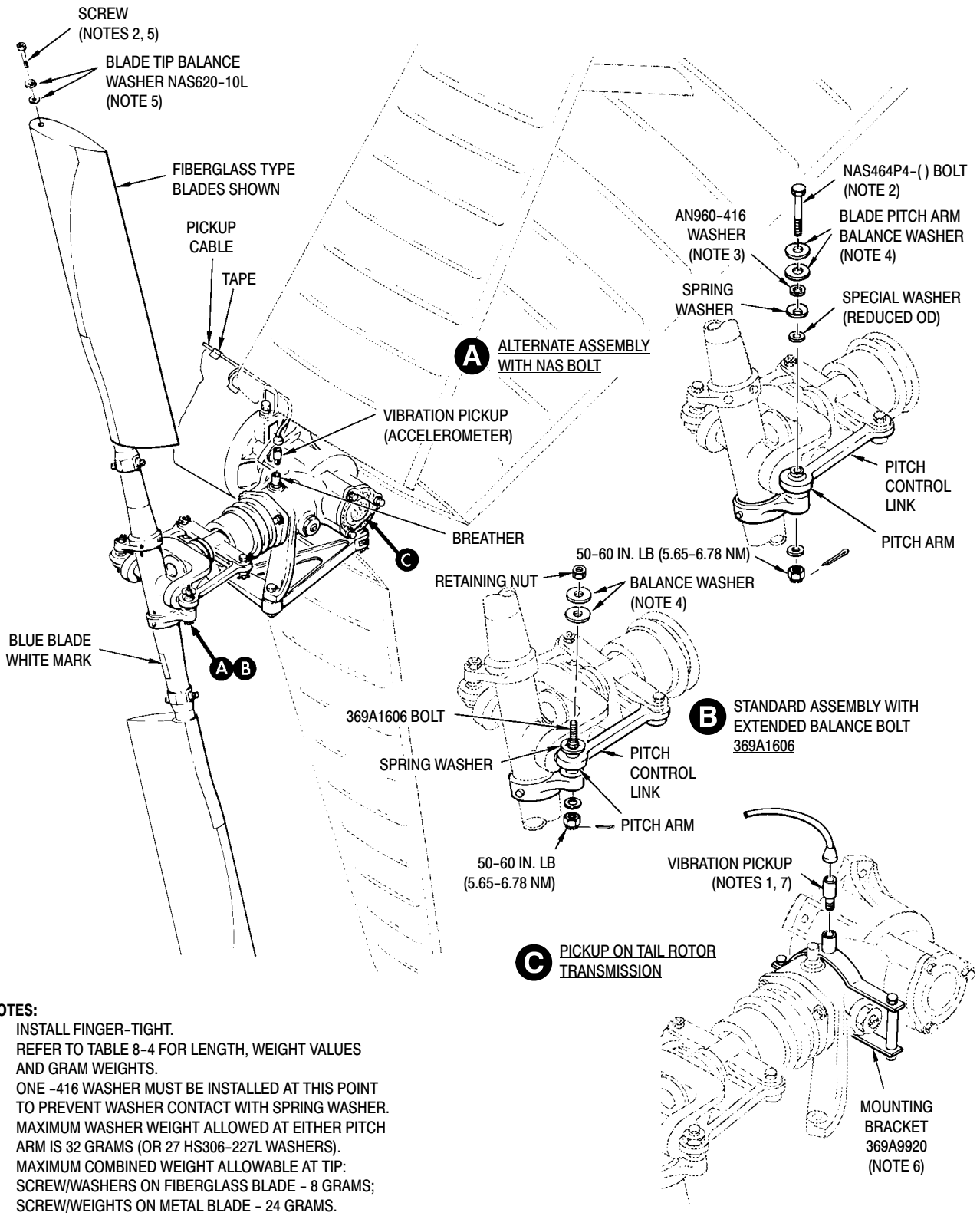
C. Preparation for Balancing

(Ref. Figure 8-8) Ground run engine with main rotor blades in flat pitch and tail rotor pedal in neutral. Slowly increase engine speed to 103% N2. With Utility switch ON, adjust analyzer and strobe as follows:

(1). Adjust analyzer kit filter TUNE until the needle reads maximum.

(2). In blade blade tracking kit, adjust GAIN control counterclockwise until strobe light flashes; then rotate 1/8 turn more.

NOTE: Do not operate the strobe light with the Gain too high as this may cause the light to flash erratically and indicate false angles.



NOTES:

1. INSTALL FINGER-TIGHT.
2. REFER TO TABLE 8-4 FOR LENGTH, WEIGHT VALUES AND GRAM WEIGHTS.
3. ONE -416 WASHER MUST BE INSTALLED AT THIS POINT TO PREVENT WASHER CONTACT WITH SPRING WASHER.
4. MAXIMUM WASHER WEIGHT ALLOWED AT EITHER PITCH ARM IS 32 GRAMS (OR 27 HS306-227L WASHERS).
5. MAXIMUM COMBINED WEIGHT ALLOWABLE AT TIP: SCREW/WASHERS ON FIBERGLASS BLADE - 8 GRAMS; SCREW/WEIGHTS ON METAL BLADE - 24 GRAMS.
6. PART OF TAIL ROTOR BALANCE ANALYZER KIT 369A9999 (3, TABLE 2-2).
7. PART OF VIBRATION ANALYZER 369A9801 (PART OF BALANCE ANALYZER KIT 369A9999).

30-146A

Figure 8-9. Tail Rotor Balancing

D. Vibration analysis

(Ref. Figure 8-8)

(1). Stand approximately 10 feet (3 m) away from the tail rotor and 90 degrees to the axis of rotation.

(2). Direct the strobe light toward the rotating tail rotor and align the leading edge of the protractor stabilizer with the leading edge of the upper vertical stabilizer: read the angle on the protractor between the blue blade leading edge and zero degree centerline. Record reading.

NOTE: Erratic strobe light flashing is expected at a meter reading of 1.50 mils or lower and is an indication of a good balance.

(3). Read the value on analyzer upper dial. If analyzer meter needle reads above 10, depress SCALE #2 button and read the lower dial.

(4). If meter reading is 2 or less (strobe light flashing erratic), balance is acceptable.

(5). If meter reading is more than 2, record reading, shut down engine and proceed with steps (6). or (7). below, as appropriate.

(6). When meter reading is more than 2, but less than 20:

(a). Use Table 8-2 and Table 8-3 to determine number and location of balance washers required.

(b). Install or remove washers or weight on the specified blade tip and/or pitch arm bolt.

(c). Repeat vibration analysis until balance is acceptable.

(7). When meter reading is more than 20, inspect tail rotor installation on the gearbox as follows:

NOTE: Tail rotor fork bearings that are improperly seated or that have excessive looseness between races can cause tail rotor vibration. Such bearings must be replaced (Ref. Tail Rotor and Pitch Control Assembly Replacement). If bearings are serviceable, continue with the following inspections.

(a). Remove tail rotor assembly and inspect split ring (Ref. Figure 8-4). Replace damaged or mismatched.

(b). With tail rotor removed, check tir in split ring groove of gearbox output shaft. Run-out is limited to 0.003 inch (0.0762 mm) tir.

(c). Check that there is no axial play in output shaft; none is allowed.

(d). Replace tail rotor gearbox if output shaft condition is beyond limits. (Ref. Sec. 9 for gearbox replacement.)

(e). After any required replacement, reinstall tail rotor and pitch control assembly.

(f). Repeat vibration analysis. If meter reading is still more than 20, replace tail rotor blade(s) or assembly.

E. Balance at Fiberglass Blade Tip

(Ref. Figure 8-9) A weight increase at a light blade tip may be obtained by removal of equipment washer weight from the opposite blade tip. Always remove washers from opposite tip, if installed, and subtract from the weight added before adding more weight.

(1). Remove blade tip screw and any existing balance washers.

(2). Select the new washer and screw combination by using Table 8-2 and Table 8-3 and by observing the following.

(a). Screw used at tip must be NAS1351-3-( )P. A selection of these NAS screws is provided in the vibration analyzer kit.

(b). Thread length for engagement must not exceed 0.750 inch (19.05 mm) nor be less than 0.3125 inch (7.9375 mm), with or without washers installed.

NOTE:

- Each blade tip must have a screw installed; however, no minimum number of washers is required.
- Screw head protrusion beyond blade tip after installation is not desirable but is allowable provided the weight limit for the tip is not exceeded.

(c). Screw length may be changed to increase or decrease tip weight and/or maintain minimum screw engagement. A longer or shorter screw also can replace washers.

CAUTION Combined weight of screw/ washer selection must not exceed 8 grams at either tip.

(3). Install selected screw and washer combination.

F. Balance at Metal Blade Tip

When balancing indicates that a weight increase at a light tip is required, it is always best to remove equivalent weight from the opposite tip if possible. The blade weight can thus be kept as near the manufactured (prebalanced) weight as possible. Adjust tip weight as follows:

NOTE: The two tip screws may be used without tip weights if required.

(1). Remove the blade tip screws and weights. Select proper weights to add or remove as determined using Table 8-2 and Table 8-3.

NOTE: The screws (NAS602-13P installed the tips during manufacture and original balance are long enough to accommodate the maximum thickness of tip weights that may be used while maintaining thread engagement of 0.3125 inch (7.9375 mm) minimum.

(2). Install the combination of weights required, using the two screws. The maximum weight is 24 grams (approximately 11 thick weights (washers) 369A1622-5 and two NAS602-13P screws). Torque screws to **21 - 24 inch-pounds (2.37 - 2.71 Nm).**

(3). If shorter than normal tip screws have been used, check for 0.3125 inch (7.9375 mm) minimum thread engagement. Do not use longer than the original 0.8125 inch (20.6375 mm) screws.

(4). Balance at Blade Pitch Arm

(Ref. Figure 8-9). A weight increase at a light pitch arm may be obtained by removal of equivalent washer weight from the opposite pitch arm. Always remove washers from opposite pitch arm, if installed and subtract from the weight to be added before adding more weight. Adjust pitch are weight as follows:

(5). On a standard tail rotor assembly with extended balance bolts, remove balance washer retaining nut (Detail B) and install or remove washers as determined by use of Table 8-2 and Table 8-3. Maximum washer weight allowed at either pitch arm bolt is 32 grams (27 “standard size” washers).

(6). On a tail rotor assembly with alternate NAS bolts, remove cotter pin, nut, washers and bolt (Detail A) and install or remove washers next to bolt head as determined by use of Table 8-2 and Table 8-3.

NOTE: The alternate bolt used at pitch arm must be NAS465P-( ). A selection of these NAS bolts is provided in the vibration analyzer kit. NAS bolt length may be changed to increase or decrease blade pitch arm weight and/or provide for washers. A longer or shorter bolt also can replace washers.

(7). Assemble washers and bolt as shown in Details A & B, as appropriate. Be sure that washer weight distribution is within limits.

(8). Torque nut to **50 - 80 inch-pounds (5.65 - 9.04 Nm)** for either type of bolt.

NOTE: There is a possibility of slight weight variation between pitch control links after forging and machining.

(9). If a tail rotor has the maximum balance washer weight allowed on one pitch arm, compare the two links.

(10). If the pitch link opposite the weight requirement appears larger, exchange one link for the other and repeat vibration analysis.

Table 8-2. Rotor Balance Weight Location Chart

	Angle (degrees)		Meter reading (mils)								
	Fiber-glass	Metal	2	4	6	8	10	12	14	16	18
Blue Tip / Green Pitch Arm	0	340	1/2	1/4	1/7	1/10	1/13	1/15	1/16	1/22	1/23
	15	355	1/2	1/4	2/7	2/9	3/12	3/14	3/17	4/20	5/21
	30	10	1/2	3/4	3/7	3/8	4/9	5/11	6/12	7/14	7/17
Blue Tip Only	45	25	1	2	3	4	5	6	7	7	8
	60	40	1	2	3	4	5	6	7	8	9
	75	55	1	2	3	4	5	6	7	8	9
	90	70	1	2	3	4	5	6	6	7	8
	105	85	1	2	3	3	4	4	5	7	7
	120	100	1	1	2	3	3	3	4	5	6
	135	115	1	1	2	2	2	2	3	3	3
Blue Tip / Blue Pitch Arm	150	130	0/2	1/4	1/6	1/10	1/12	1/14	1/17	1/20	1/23
	165	145	0/2	0/4	0/7	0/10	0/13	0/15	0/18	0/20	0/23
Green Tip / Blue Pitch Arm	180	160	1/2	1/4	1/7	1/10	1/13	1/15	1/18	1/22	2/23
	195	175	1/2	1/4	2/7	2/9	3/12	3/14	3/17	4/20	5/21
Green Tip Only	210	190	1	2	3	3	4	5	6	7	7
	225	205	1	2	3	4	5	6	7	7	8
	240	220	1	2	3	4	5	6	7	8	9
	255	235	1	2	3	4	5	6	7	8	9
	270	250	1	2	3	4	5	6	6	7	8
	285	265	1	2	3	3	4	4	5	7	7
	300	280	1	1	2	3	3	3	4	5	6
	315	295	1	1	2	2	2	2	3	3	3
Green Tip / Green Pitch Arm	330	310	0/2	1/4	1/6	1/10	1/12	1/14	1/17	1/20	1/23
	345	325	0/2	0/4	0/7	0/10	0/13	0/15	0/18	0/20	0/23

USE OF DIAGONAL LINE NUMBERS:
The numbers in the Meter reading (mils) columns indicate the number of “standard size” washers and weights with a weight value of “1” (table 8–4) to be added at the blade tip or pitch arm. The number above the diagonal line is for the tip and the number below is for the pitch arm.

EXAMPLE OF CHART APPLICATION:
Angle viewed on protractor – 195° (fiberglass blades) – 175° (metal blades)
Analyzer meter reading – 4
Read down the angle (degrees) column to 195 or 175, as applicable; then read to the right to Meter reading (mils) column 4. At this point, the numbers 1/4 are to be found indicating the need for one tip washer or weight, as appropriate, having a weight value of “1” and four pitch arm washers each of which has a weight value of “1”. If an equivalent number of “standard size” washers or weights already exist on the opposite blade, remove them rather than installing the additional weight. Also check whether appropriate bolt or screw substitution on one blade might not eliminate the need for adding weight to the other. If washer sizes used at pitch arm are not the “standard sizes” listed in table 8–4, the numbers on location chart 8–3 will be invalid unless there is gram weight equivalence.

30–147

Table 8-3. Tail Rotor Balance Weight Value Chart

At Fiberglass Blade Tip (7)			
Screws (2)(8)	Length inch (mm)	Weight (Grams)	Weight Value (4)
NAS1351-3-6P (1)	0.375 (9.525)	2.17 minus	4-1/2
NAS1351-3-12P	0.750 (19.05)	2.17	0
NAS1351-3-14P	0.875 (22.225)	3.86	1-1/2
NAS1351-3-16P	1.00 (25.4)	4.26	3
Standard Size Washer - Steel	Thickness inch (mm)	Weight (Grams)	Weight Value
NAS620-10L	0.032 (0.8128)	0.272	1
At Metal Blade Tip			
Screws	Length inch (mm)	Weight (Grams)	Weight Valve
NAS602-13P	0.8125 (2.06375)	2.44	0
Weights	Thickness inch (mm)	Weight (Grams)	Weight Valve
369A1622-3	0.016 (0.4064)	0.29	1
369A1622-5	0.036 (0.9144)	1.76	6
At Any Blade Pitch Arm (10)			
Bolts (5)	Length inch (cm)	Weight (Grams)	Weight Value (4)
NAS464P4-18	1.46875 (3.730625)	12.17	0
NAS464P4-19	1.0 (2.54)	12.56	1/2
NAS464P4-20	1.59375 (4.048125)	12.94	1
NAS464P4-21	1.65625 (4.206875)	13.34	1
NAS464P4-22	1.71875 (4.365625)	13.73	1-1/2
NAS464P4-23	1.78125 (4.524375)	14.12	2
Standard Size Washers (Steel) (6)(9) Thickness in. (mm)	OD inch (mm)	Weight (Grams)	Weight Value
AN960-416 (3) 0.063 (1.6002)	0.50 (12.7)	1.45	1
HS306-227L 0.016 (0.4064)	0.80 (20.32)	1.17	1

NOTES:

(1) If necessary, a -6P screw may be used without washer.

(2) Screw threads for engagement in blade insert (with or without washers): 0.3125 in. (7.9375 mm) minimum, 0.750 in. (19.05 mm) maximum.

(3) One -416 washer required next to spring washer on alternate NAS bolt. Not required on extended bolt.

(4) Weight Value - Example: A change from NAS 464P4-18 to a -23 bolt has a weight value of ‘‘2”; that is the change in length is equal to two ‘‘standard size” washers in Table 8-3. Measure installed screw or bolt length and compare with this chart to determine weight value.

(5) Extended balance bolt 369A1606 used on standard assembly. NAS bolts used on alternate assembly. NAS bolt values not applicable to extended bolt.

(6) Used on either extended bolt or alternate NAS bolt.

(7) Maximum combined screw and washer weight limited to 8 grams a tip.

(8) Protrusion of screw head beyond tip cap is undesirable but allowed.

(9) Maximum of 27 washers with 0.432 in. (10.9728 mm) total thickness on extended balance bolt.

(10) Minimum of two threads must extend past locknut securing balance washers on extended balance bolt.

(11). If maximum allowable weight at one pitch arm will not correct the assembly balance, the tail rotor hub may be shifted in the fork and hub-to-fork shimming adjusted, if maximum allowable play in the fork bearings is not exceeded.

(a). This is done by transferring fork-to-hub spacing shims from the balance weighted side to the opposite side of the hub, according to hub and fork reassembly procedures in CSP-H-5.

NOTE: Span wise balance will probably be affected by any chordwise shift of the fork.

(12). The cordwise weight shift resulting from each 0.001 inch (0.0254 mm) of spacing shim thickness transferred will reduce the requirement at the weighted pitch arm by one “standard size” (HS307-227L) balance washer.

Example: Transferring one 369A1717-53 spacing shim, 0.010 inch (0.254 mm), would allow initial removal of 10 thin washers from the pitch arm.

NOTE: A tail rotor out- of- balance condition that cannot be corrected by standard balancing procedures may be an indication of excessive play in tail rotor hub components.

(13). If maximum allowable play in the fork bearings is exceeded, the bearings must be replaced.

(14). Replacement or adjustment of parts requires balancing of the tail rotor following reassembly.

15. Tail Rotor Blade Track Verification

Blade track cannot be adjusted, but it can be verified by use of the tracking equipment contained in balance kit (59, Table 2-2). If this kit is available, it is recommended that track verification be accomplished before attempting to balance tail rotor, to avoid performing balancing procedures that are ineffective due to an out-of-track condition that can only be remedied by blade replacement.

Completed instructions for the blade track verification are contained in the Chadwick-Helmuth Blade Tracker Manual. This handbook is a component of balancing kit.

16. Tail Rotor Blades

Either metal or fiberglass tail rotor may be installed. The basic differences between metal and fiberglass blades are as follows:

A. Fiberglass Blades

(1). Fiberglass blades are used for normal performance requirements.

(2). Each consists of a tapered-wall, steel alloy spar with a fiberglass skin bonded to form the airfoil.

(3). The outer fiberglass ply is painted as shown in Figure 8-5.

(4). Corrosion-resistant steel abrasion strips form the leading edges of the blades.

(5). Fiberglass blades are either painted, or on early type paper-covered blades, have a layer of colored paper directly bonded to the outer ply of the fiberglass skin.

(6). The position and width of the stripes for either blade is shown in Figure 8-5.

NOTE: The stripes on paper- covered blades are overlaid and bonded on a red base layer of paper that covers the outboard 15 inches (38 cm) of skin.

B. Metal Blades

(1). Metal blades are cambered for high thrust to provide increased directional control at high altitude.

(2). Each consists of an aluminum honeycomb spar, aluminum skin, riveted aluminum blade fittings and a aluminum tip cap, all structurally bonded together.

(3). The blades are painted as shown in Figure 8-5.

C. Fiberglass Tail Rotor Blade Replacement

Ensure that replacement fiberglass blades are serviceable and blade static balancing moments are within required limitations.

CAUTION A balancing check and/or adjustment is required after blade removal, at subsequent replacement or reinstallation of blade.

(1). One or both blades may be replaced; however, fiberglass blades must be matched.

(2). Static balancing moments of fiberglass blades must be within 80 grams-inches of each other.

(3). When both are being replaced with fiberglass blades, a matched set of blades should be ordered.

(4). When replacing a single fiberglass blade, it is necessary to find the static balancing moment of the used blade being retained in serviced, as well as that of the replacement blade.

NOTE: For additional information on and determination of the static balancing moment for fiberglass blades, refer to CSP-H-5.

(5). The retirement schedule and remaining service life of a used blade should be considered when making the decision to replace a single blade.

NOTE: If fiberglass blades are replaced with metal blades, installation of a bungee spring and rerigging of tail rotor controls is required.

D. Metal Tail Rotor Blade Replacement

(1). For replacement, metal blades are divided into two categories. These are category "A" and category "B".

(a). Category "A" blades, identified by the letter "A" following the serial number, must be installed in a set with another "A" blade.

(b). Category "B" blades, so identified, must be installed in a set with a "B" blade.

NOTE: The blade categories are not interchangeable within a set.

(2). As manufactured, the static balancing moments of all metal blades are brought within plus or minus 40 gram-inches of each other in either of the two categories by use of a special balancing fixture and prebalancing with tip weights.

(3). Erosion or allowable repairs may cause minor balance moment changes for metal blades. Such changes are considered negligible enough to allow direct replacement of any used blade with a new one and interchangeable use of blades with remaining service life.

(4). In any case of blade selection or use, the inspection, repair and serviceability requirements specified in CSP-H-5 must be complied with for metal blades.

(5). The retirement schedule and remaining service life of a used blade should always be considered when making the decision to replace a single blade.

17. Tail Rotor Blade Replacement

Before blade replacement, refer to Fiberglass Tail Rotor Blade Replacement and Metal Tail Rotor Blade Replacement for fiberglass or metal tail rotor blade replacement matching criteria.

NOTE: Always record the number and location of balance washers when installing a new blade. This record will assist dynamic balance troubleshooting.

(1). Remove cotter pin, nut, washer and pitch arm bolt from outboard end of pitch control link (Ref. Figure 8-4).

CAUTION Bushings and crush washers installed on current model blades can be reused, but must be installed on the same blade and strap assembly in the exact location from which they were removed.

NOTE: If same blade is to be reinstalled, retain intact for reuse (or note and record number and type of) balance washers and attachment hardware used on bolt at blade pitch arm.

(2). For fiberglass blades or early configuration metal blades:

(a). Remove nut, bolt, and countersunk washer, special (flat aluminum) washer for a metal blade and sleeve bushing attaching blade to the tension-torsion strap (Ref. Figure 8-10).

(3). For current configuration metal blades:

(a). Remove nut, bolt, shoulder bushing and crush washer attaching blade to the tension-torsion strap.

(4). Withdraw blade from hub trunnion.

CAUTION

- Do not disassemble outboard shoes from end of tension- torsion strap assembly protruding from trunnion. Strap assembly parts are not individually replaceable and must remain assembled.
- Avoid damaging strap assembly. Scratches or nicks on strap laminates may make strap assembly unserviceable.

(5). If strap assembly is to remain exposed for any length of time, wrap exposed end of strap assembly with wax paper or other similar non-abrasive material to protect from damage.

(6). If blade being removed is to be reinstalled, do not remove blade tip screw, any balance washers or weight from blade.

(7). Remove any protective covering from tension-torsion strap assembly extending from hub trunnion.

NOTE: Remove old primer from mating surfaces and attaching hardware prior to reassembly.

CAUTION

- Bolt, nut, washers and bushings may be reinstalled if serviceable.
- If bushing and crush washers are to be reused, they must be installed in the exact location from which they were removed.
- If either the blade or strap pack assembly from which they were removed is replaced, replace crush washers and bushing.
- Bushings must be free of nicks and burrs.
- Comply with special inspection and installation requirements described in CSP-H-5.

(8). Install O-ring on hub trunnion.

(9). Slide blade on hub with blade leading edge facing in a counterclockwise direction. Use care to keep blade properly aligned so that hub trunnion slides into blade pitch (feathering) bearings. Do not use force.

(10). Align bolt holes in blade with hole through bushing in outboard shoes of tension-torsion strap assembly.

(11). Coat bolt with primer (4, Table 2-4).

(12). For fiberglass blades or early configuration metal blades:

(a). Install special countersunk washer on bolt with chamfered edge of washer next to bolt head.

(b). Install special (flat aluminum) washer on the bolt against the countersunk washer for a metal blade.

(13). For current configuration metal blades:

(a). Install shoulder bushing on bolt with crush washer.

(14). Insert attaching bolt through leading edge of blade, shoe of strap assembly and trailing edge of blade (both threads at trailing edge).

(15). For fiberglass blades or early configuration metal blades:

(a). Slide sleeve bushing over end of bolt and into blade until bushing end contacts outboard shoe on strap assembly.

(16). For current configuration metal blades:

(a). Slide shoulder bushing, with crush washer, over end of bolt and into blade until bushing end contacts outboard shoe on strap assembly.

NOTE: It is recommended that the MS 21250 bolt be replaced with any of the alternate bolts called out with the higher torque at the operators earliest convenience.

(17). If an MS 21250 bolt is installed, install nut and torque to **600 - 650 inch-pounds (67.79 - 73.44 Nm)** while primer is wet. If an HS 5482-6, HS 805-6, HS 3532-6 or a HS 84208-6 bolt is installed, torque nut to **750 - 775 inch-pounds (84.74 - 87.56 Nm)** while primer is wet.

CAUTION After blade is secured to strap assembly, do not allow blade pitch travel from neutral to exceed 30 degrees in either direction (Ref. Figure 8-5). Rotating the blade to excessive pitch angles may result in undetected damage to the strap assembly.

(18). Attach outboard end of pitch control link to pitch control arm of blade with spring washer, special (reduced OD) washer, pitch arm (extended balance or NAS) bolt, washer at outer side of pitch control arm and nut.

(19). Torque nut to **50 - 80 inch-pounds (5.65 - 9.04 Nm)** and safety with cotter pin coated with primer.

NOTE: Standard NAS bolts may be used as alternates at the pitch arms if extended balance bolts are not available.

(20). If the same blade that was removed is being reinstalled with the original remaining blade, reinstall the same hardware and number of balance washers on the pitch arm bolt that were present at initial removal of the blade.

(21). For a replacement blade, install balance washers required for static cordwise balance of the assembled tail rotor which have been determined by using an appropriate balance fixture.

(22). If fiberglass blades were replaced with metal blades, rig tail rotor controls.

CAUTION Perform first run-up in a cautious manner so that vibrations from an unbalanced tail rotor will not cause damage.

(23). Balance the tail rotor using vibration analyzer and strobe light.

18. Pitch Control Assembly

(Ref. Figure 8-4) The pitch control assembly consists of a swashplate assembly that rotates in a double-row bearing inside a housing.

A self-aligning bearing at the underside of the housing provides the pivot for transferring motion of Sta. 282.00 bellcrank to the housing. Two clevis ears on each end of the swashplate provide for connection of pitch control links.

Movement of the Sta. 282.00 bellcrank shifts the housing axially on the output shaft of the tail rotor transmission and moves pitch control links inward and outward to change pitch of the tail rotor blades.

Two types of pitch control assemblies are in service. The swashplate on the current pitch control assembly has oilite bronze liners. The early type swashplate has a nylon composition liner.

The replaceable swashplate on the current pitch control assembly is retained in the housing by a washer and locknut. Parts of an early type pitch control assembly without a locknut are not individually replaceable.

The self-aligning bearing is swaged in place in the pitch control housing.

19. Pitch Control Assembly Replacement

(1). Remove complete tail rotor assembly including the pitch control assembly.

(2). Disconnect ends of pitch control links from clevis ears of swashplate and remove pitch control assembly.

NOTE: Ensure matchmarks are aligned when performing step (3). below.

(3). Connect ends of pitch control links to clevis ears on swashplate pitch control assembly.

(4). Install tail rotor and pitch control assembly.

20. Pitch Control Assembly Inspection

(1). If tail rotor control system drag or friction is suspected, use a spring scale (Ref. Figure 8-5) to measure drag (sliding friction) of the pitch control assembly on the output shaft of the tail rotor transmission.

NOTE: Pitch control links, Sta. 282.00 bellcrank and rubber boots must be detached from the assembly during the drag check.

(2). If drag exceeds 3 pounds (13.34 N), remove the pitch control assembly and clean the swashplate and output shaft splines. Use solvent (1, Table 2-4) and grade 400 emery paper or crocus cloth (23).

NOTE: If tail rotor swashplate with a bronze liner is installed, coat the output shaft splines with a light film of grease (18).

(3). If surface defects such as nicks, scratches, dents or corrosion are found, make detailed inspections and perform allowable repairs according to limits and procedures in CSP-H-5.

(4). If brinnelling wear of the inner surfaces of the swashplate clevis ears is detected, 0.003 inch (0.0762 mm) depth is allowable without rework or repair. For wear of greater depth refer to CSP-H-5 for limits and allowable repairs.

(5). If there is evidence of swashplate contact with housing, check that minimum clearance of 0.010 inch (0.254 mm) exists through 360 degrees of rotation with axial loading applied. If contact is apparent, replace swashplate; or double-row bearings if axial play can be measured.

(6). (Early type only) If there is evidence of slippage between double-row bearing inner race and swashplate, replace the pitch control assembly.

(7). Check pitch control wobble on output shaft (Ref. Figure 8-5).

(a). Up to 0.020 inch (0.508 mm) pitch control wobbles on the transmission output shaft is allowable.

(b). If greater amount of wobble is present replace the swashplate or pitch control housing double-row bearing or the complete assembly, as applicable.

NOTE: Wobble may be accurately measured by attaching a dial indicator support to the tail rotor drive fork, with the indicator probe in contact with the swashplate clevis ear location shown in Figure 8-5. Use care not to allow the pitch control assembly to slide on the output shaft while measuring wobble.

(8). Perform following inspections for pitch control bearings at the time specified in CSP-H-4 and when bearing condition is questionable.

NOTE: An early type pitch control assembly without swashplate nut should not be disassembled. If it has defective bearings, the complete pitch control assembly should be replaced.

(a). Remove cotter pin, nut, washers and bolt securing Sta. 282.00 bellcrank to transmission.

(b). Separate pivot pin on bellcrank from pitch control assembly (Ref. Figure 8-4).

(c). Rotate pitch control housing by hand:

1). Check for rough binding or hard turning.

2). Inspect for grease leakage.

3). If any of these conditions are noted, remove pitch control assembly and inspect bearing for further evidence of damage.

(d). To inspect double-row bearing, remove grease seal at gearbox end of bearing housing by first removing seal lockring with thin sharp blade.

NOTE: Pitch control double-row bearing may be repacked or replaced, as appropriate.

(e). Check that self-aligning bearing on underside of pitch control housing is adequately lubricated (packed approximately 40% full) with grease (18, Table 2-4), is movable and is serviceable.

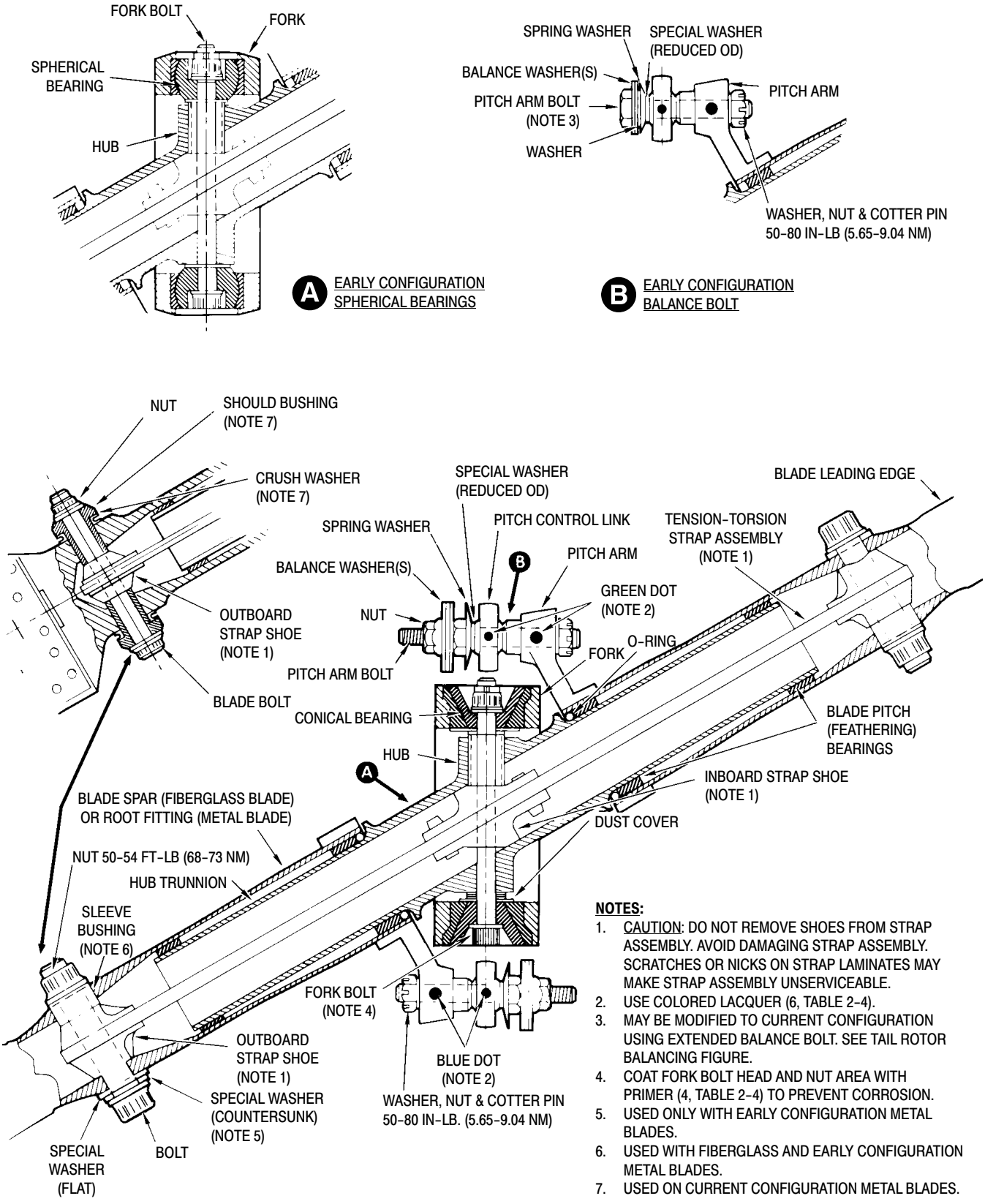


Figure 8-10. Assembled Tail Rotor Hub and Blades - Cross Section View

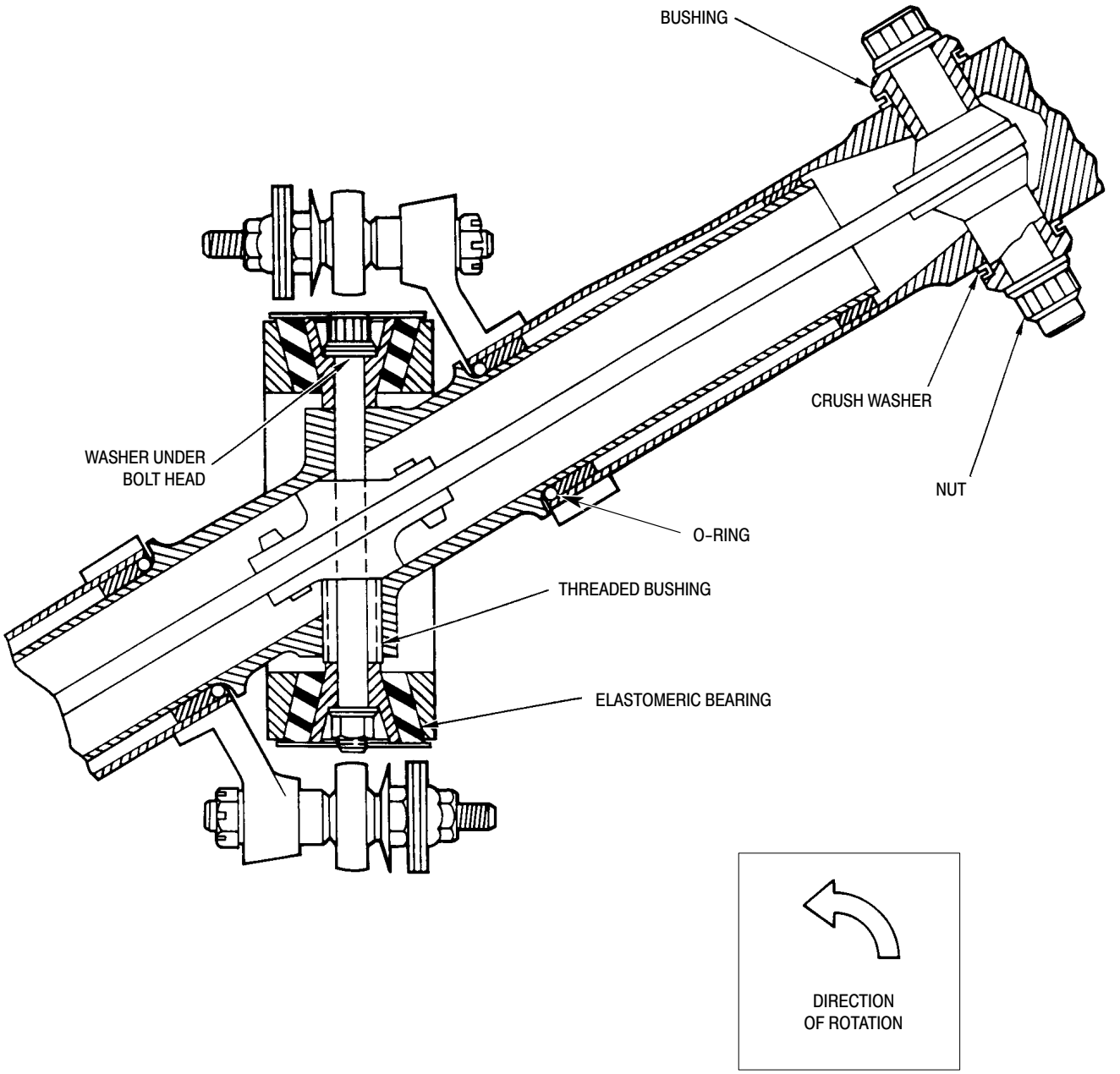


Figure 8-11. Assembled Tail Rotor and Blades - Cross Section View (Elastomeric Bearings)

(f). Make sure that pivot pin on Sta. 282.00 bellcrank is lubricated with grease. Position bellcrank to engage pivot pin with pitch control assembly. Secure bellcrank to gearbox with bolt, washers, nut and cotter pin.

NOTE: For any questionable and all other items, refer to the complete and detailed inspection, damage, wear and repair limits and requirements for the pitch control assembly provided in CSP-H-5.

21. Tail Rotor Swashplate Regreasing

(Ref. Figure 8-12)

(1). Remove tail rotor and swashplate from helicopter (Ref. Tail Rotor and Pitch Control Assembly Removal).

(2). Remove pitch control links from swashplate assembly.

CAUTION Tail rotor swashplate bearings cannot be removed from housing without damage to the bearings. If bearings are removed from housing, install new bearings.

(3). Using wrench (44, Table 2-2) and holding block (45), Remove nut and tang washer from threaded end of swashplate. Discard tang washer.

(4). Carefully remove bearing grease seal at gearbox end of housing (seal will be reused at reassembly).

(5). Inspect seal for damage; no damage is allowed.

(6). Install regreasing tool (Ref. Figure 8-13) and plug tang washer groove with locally fabricated plastic wedge (or equivalent plug).

NOTE: The following procedure provides 100% grease fill. Normal grease fill is 20 to 40%. Excess grease will extrude past seals for several hours of operation until the proper level is met.

(7). Purge bearings with grease (21, Table 2-4).

(a). Purge bearings slowly to prevent damage to outer seal.

(b). Rotate bearings while greasing.

(8). Remove plastic wedge (or equivalent plug) and regreasing tool.

(9). Hand rotate bearing to remove excess grease.

NOTE: Ensure seal is serviceable. If new seal is required, seals and bearings must come from the same vendor.

(10). Install serviceable seal, new tang washer and nut.

(11). Install nut with a new tang washer. Using wrench and holding block, torque nut to **400 - 450 inch-pounds (45.19 - 50.84 Nm)**.

(12). Bend one tang of washer into any aligned slot on nut.

NOTE: Avoid getting alcohol in bearings.

(13). Clean surface of locknut and swashplate with a lint-free cloth dampened with alcohol (71).

NOTE: Avoid getting torque seal in swashplate splines.

(14). Apply a 0.125 inch (3.175 mm) wide torque strip, using torque seal or equivalent, to surface of swashplate assembly and locknut in two places.

22. Tail Rotor Hub and Fork Assembly

(Ref. Figure 8-10) The hub, with internal tension-torsion strap assembly, is held inside a drive fork assembly by a fork bolt, shims, washer, nut and cotter pin to form a hub and fork assembly.

Types of bearings in service include the early type spherical and conical bearings and current type elastomeric bearings. Conical spherical and elastomeric teeter bearing differ in size and configuration. The existing tail rotor drive fork may be replaced with a new drive fork assembly equipped with elastomeric bearings. Refer to CSP-H-5 for modification instructions.

The tension-torsion strap assembly consists of a strap pack to which inboard shoes are riveted with shims, collars and rivets and outboard shoes containing bushings. The strap pack consists of 20 (or 19, as required for

correct thickness) corrosion-resistant (cold rolled and tempered) steel straps, each approximately 0.009 inch (0.2286 mm) thick, that form a pack. A bushing threaded into the hub against the inboard shoe holds the center of the strap pack assembly in place inside the hub.

23. Hub and Fork Assembly Maintenance

A. Inspection of Hub and Fork Assembly - Blades Removed

After removal of blades and before installation of replacement blades, inspect components of fork and hub assembly as follows:

(1). Two types of hubs are in service: one is a 4340 steel hub with chrome plated trunnions and the current type is marriaging steel.

(2). For hub with chrome plated trunnions, check surface area on trunnion that mate with blade pitch (feathering) bearing for wear. Wear through chrome platting is not allowed and requires hub replacement (CSP-H-5).

(3). Check visible areas of tension-torsion strap assembly for nicks or scratches on strap laminates, cracked laminates and kinks, sharp bends or permanent twist in laminates.

(a). Any one of these defects, except minor outer surface defects that can be removed by abrasive polishing requires replacement of the strap pack assembly.

NOTE: For information on allowable repairs, serviceability requirements and replacement, refer to CSP-H-5.

B. Strap Pack Assembly Precautions

(1). When blades are removed from the hub and fork assembly, the exposed ends of the strap pack assembly should be protected with a covering and the hub and fork assembly should be handled carefully to avoid damage to the strap pack assembly.

C. Parts Replacement Information

(1). Replace bearing in and reinstall an original serviceable fork assembly on an original hub as specified in CSP-H-5.

(2). Removal of the strap pack assembly from the hub is accomplished according to CSP-H-5.

(3). Disassembly of the strap pack assembly is not recommended; parts should not be removed from the strap pack assembly.

24. Tail Rotor Pedal Installation (Left Position)

(Ref. Figure 8-14) The tail rotor pedal installation consist of a pair of adjustable pedals, pedal arms with interconnecting linkage, a pedal mounting bracket for the left control position, a torque tube with control rod fitting and torque tube mounting bracket.

Forward pressure on the right pedal rotates the torque tube rearward, moving control system linkage to increase tail rotor blade pitch. Pressure on the left pedal decreases tail rotor blade pitch.

A bungee spring is installed on the aft end of the floor-routed control rod in the underseat tail rotor control linkage of helicopters with the cambered metal-blade tail rotor. This spring relieves left pedal forces during flight and causes the left pedal to remain in the forward position when the helicopter is on the ground and not operating.

NOTE: Parts identified in Figure 8-14 with an (*) may be either magnesium or aluminum alloy. Refer to Section 2 for corrosion control and identification of magnesium and aluminum alloys.

25. Tail rotor Pedal Installation Replacement

(Ref. Figure 8-14)

A. Tail rotor Pedal Installation Removal (Left Position)

(1). Pull the two hinge pins from pilot's compartment floor access door hinges and remove door. Remove the access panel from each side of the instrument panel lower support structure.

(2). Remove battery.

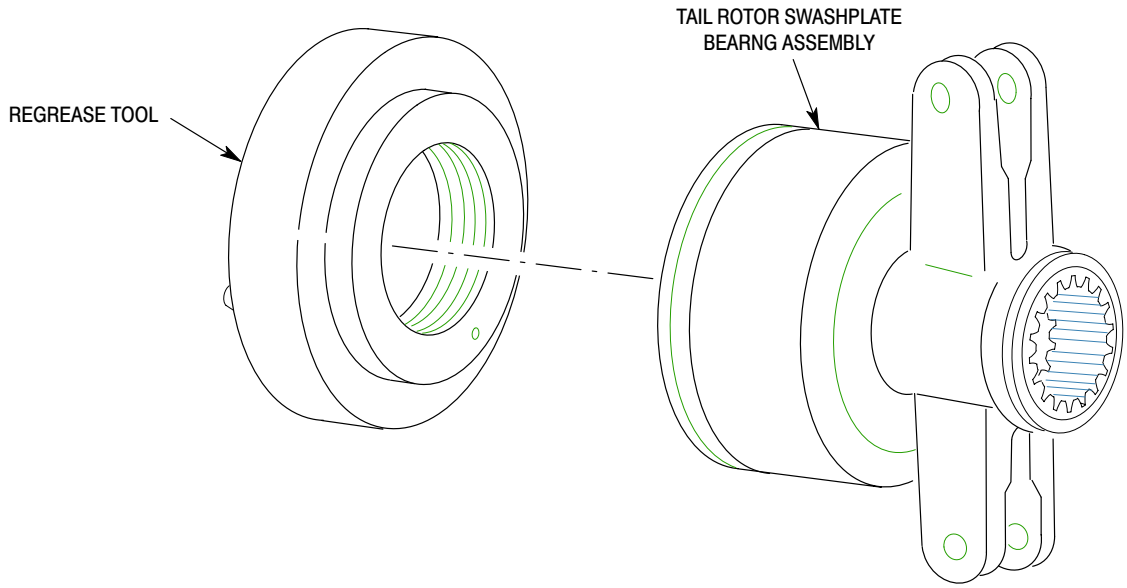
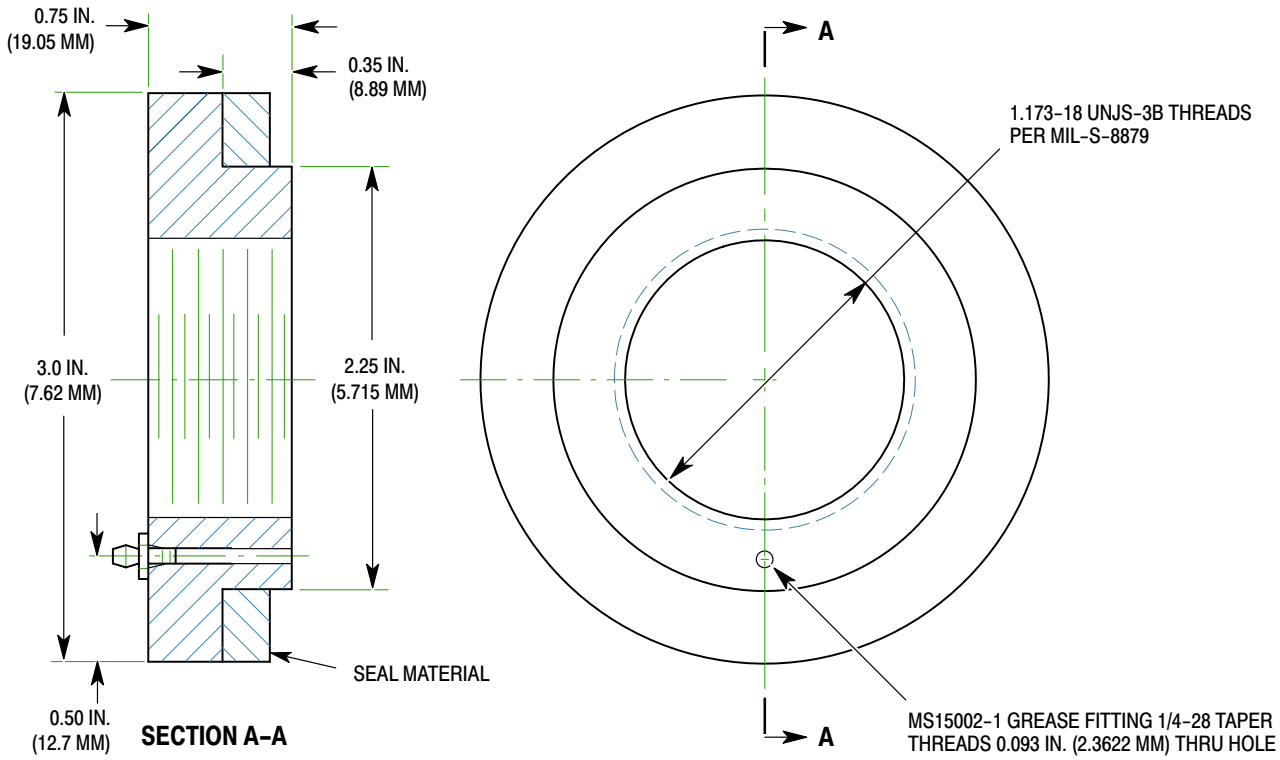


Figure 8-12. Tail Rotor Swashplate Bearing Regreasing



MATERIAL:
1. MATERIAL 6061-T651 ALUM PER QQ-A-250/11, OR EQUIVALENT.
2. SURFACE FINISH 125 RMS.
3. BREAK SHARP EDGES 0.002-0.015 IN. (0.0508-0.381 mm).
4. CHEMICAL FILM TREAT PER MIL-C-5541.
5. DIMENSIONAL TOLERANCE ±0.030 IN. (±0.762 MM); DIAMETERS TO BE CONCENTRIC TO CENTERLINE WITHIN 0.002 IN. (0.0503 MM).

GH08-001A

Figure 8-13. Tail Rotor Swashplate Bearing Regreasing Tool

(3). Remove pins securing pedals to pedal arms and remove pedals.

(4). On a helicopter with a metal-blade tail rotor, perform steps (a). thru (d). below.

(a). Gain access to the bungee by removing the access cover between the pilot's seat and/or by removing the left passenger's footwell on the aft side of the canted bulkhead.

(b). Block the left tail rotor control pedal in the full forward position to relieve tension on bungee.

(c). Remove eyebolt at Sta. 63.00 with bungee attached.

(d). Disconnect bungee from eyebolt on fitting at the aft end of the floor-routed control rod and remove bungee.

(5). Remove cotter pin, two washers and bolt that connect floor-routed control rod to torque tube fitting.

(6). Remove two nuts, four washers, any shim washers and two bolts that secure torque tube bracket to bulkhead. (Keep shim washer selection with bracket to facilitate torque tube alignment during reinstallation.)

(7). Remove four nuts, eight washers, any shim washers and four bolts that secure pedal bracket to bulkhead. Remove the control pedal installation. (Keep shim washer selection with bracket.)

B. Installation of Tail Rotor Pedal Installation (Left Position)

(1). Install pedal bracket with four bolts, eight washers and four nuts.

(2). Add shim washers as required at pedal bracket attachment points to keep centerline alignment of pedal bracket bearings within 0.010 inch (0.254 mm).

NOTE: Correct alignment is indicated by free rotational movement of torque tube after the nuts are tightened.

(3). Position torque tube bracket over mating holes in bulkhead and check alignment with bulkhead.

(4). Add skim washers as required at bracket attachment points to maintain the bearing alignment established in step (1). above.

(5). Install two bolts, four washers and two nuts.

(6). On a helicopter with a metal-blade tail rotor, perform steps (a). and (b). below.

(a). Install forward eyebolt on replacement bungee and then hook aft end of bungee into eyebolt on floor-routed control rod fitting.

(b). Stretch bungee into position at Sta. 63.00 bracket, install washer and nut on eyebolt and tighten.

(7). Check that slotted bushing is in place; then install floor-routed control rod in torque tube fitting and install bolt, two washers, nut and cotter pin.

(8). Check rigging of tail rotor control and pedal-to-canopy clearance following installation of any removed or replaced parts.

26. Disassembly of Tail Rotor Pedal Installation (Left Position)

(Ref. Figure 8-14)

(1). Disconnect links from pedal arms and bellcrank; remove links.

(2). Remove bellcrank from pedal bracket.

(3). Remove nut washer of the two bushing assemblies that secure the left pedal arm and control rod fitting to torque tube. Carefully remove ABC bushing bolt and reinstall washer and nut on bolt.

(4). Side pedal bracket and pedal arms off end of torque tube.

(5). Do not remove the two teflon-lined bushings from the right pedal arm unless replacement is required.

(6). Do not remove the two stop bolts, stop nuts (if installed) on stop bolts or bearings from the pedal bracket unless replacement is required.

(7). Slide torque tube bracket and control rod fitting off torque tube.

A. Reassembly of Tail Rotor Pedal Installation (Left Position)

(Ref. Figure 8-14)

(1). If previously removed, thread a stop nut on each of the two stopbolts and install the two stopbolts into thread inserts of pedal bracket.

(2). Slide torque bracket and control rod fitting onto torque tube.

(3). Locate pedal bracket and pedal arms for correct position on torque tube; slide bracket and arms onto torque tube.

(4). Fasten left pedal arm and control rod fitting to torque tube with adjustable bushing assemblies; install the bushing bolt so that the shank at the bolt head end protrudes at least 0.002 inch (0.0508 mm). Torque nut to **50 - 80 inch-pounds (5.65 - 9.04 Nm) plus drag torque**. Do Not allow the bolt to turn.

(5). Check that each end of the bushing assembly shank protrudes at least 0.002 inch (0.0508 mm). If not, loosen and repeat step (4). above.

(6). Check that slotted bushing is in place; then attach bellcrank to pedal bracket with bolt, two washers, nut and cotter pin.

(7). Check that slotted bushings are in place; then fasten each link to bellcrank with bolt, two washers nut and cotter pin.

(8). Check that slotted bushings are in place; then fasten each link in pedal arm lugs with bolt, two washers, nut and cotter pin.

27. Tail Rotor Pedal Installation Inspection (Left Position)

(Ref. Figure 8-14)

(1). Inspect pedals and pedal arms for cracks, elongated pedal attach holes, and open drain holes. Inspect teflon-reinforced bushing liners for deterioration.

(2). Inspect pedal-to-arm quick-release locking pin for condition and positive spring action.

(3). Inspect links and bellcrank for cracks and bends, and bearings for excessive looseness.

(4). Inspect control rod fitting, torque tube mounting bracket, and pedal mounting bracket for cracks and corrosion.

(a). Using an 8X-power magnifying glass, a mirror and a flashlight, inspect the pedal link bellcrank fitting of the pedal bracket in the center forward area where the fitting (fork piece) joins the tubular section.

(b). If any cracks are detected, replace the bracket assembly.

(c). Inspect bracket bearing for excessive looseness.

(5). Inspect torque tube for cracks, scratches, nicks, dents and similar surface defects.

A. Tail Rotor Pedal Installation Repair (Left Position)

(1). Replace parts that are cracked, or have elongated attachment holes.

CAUTION Do not attempt to straighten a bent torque tube or pedal link.

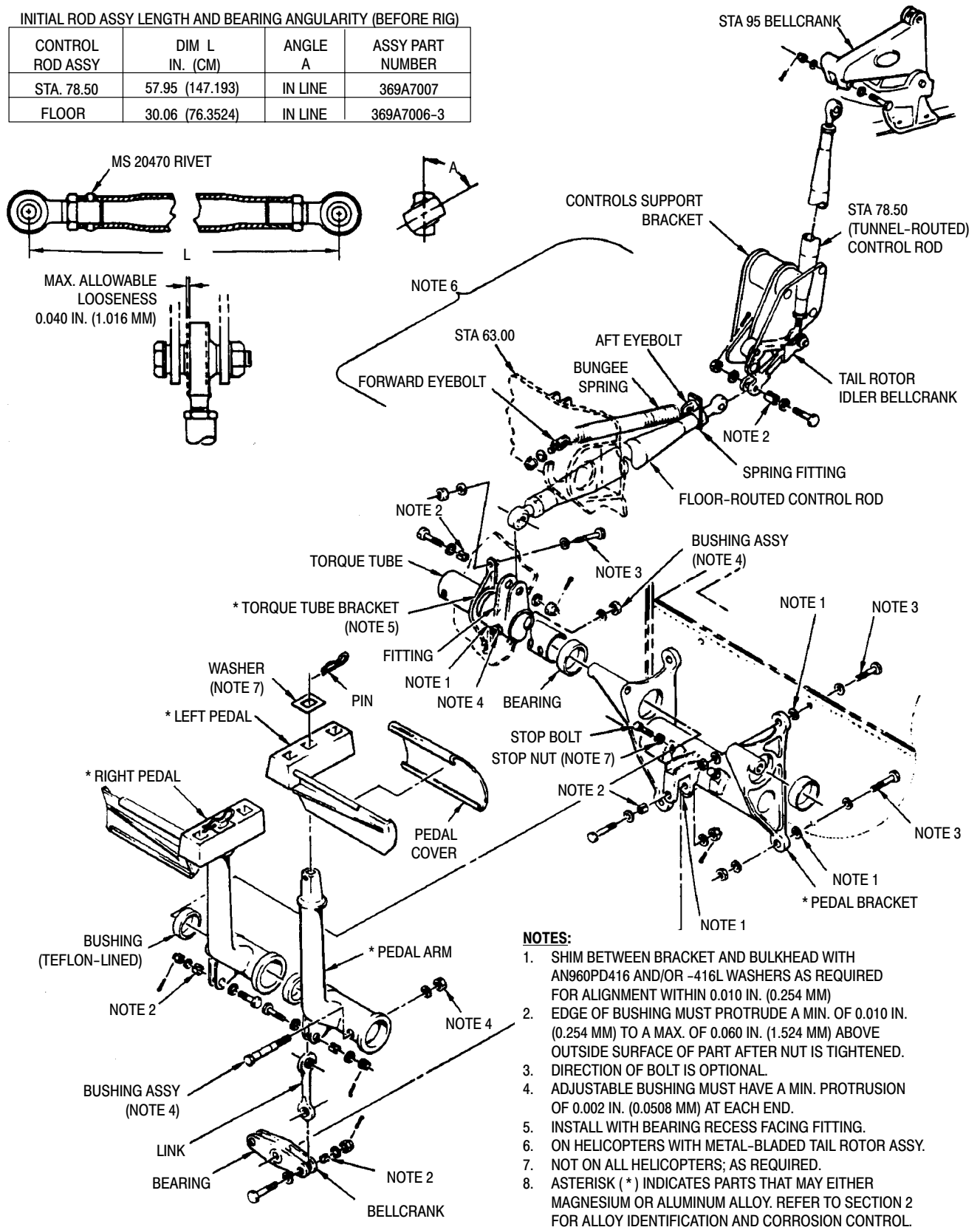
(2). Replace unserviceable pedal covers. Apply cement (3, Table 2-4) to approximately 30 percent of the upper and lower edge surfaces that contact the metal; cure according to container instructions.

(3). Replace complete pedal link if it is cracked or contains unserviceable bearings; bearings are not replaceable.

(4). Replace unserviceable bearings in the mounting brackets or pedal link bellcrank. Install replacement with grade A locking compound (29).

INITIAL ROD ASSY LENGTH AND BEARING ANGULARITY (BEFORE RIG)

CONTROL ROD ASSY	DIM L IN. (CM)	ANGLE A	ASSY PART NUMBER
STA. 78.50	57.95 (147.193)	IN LINE	369A7007
FLOOR	30.06 (76.3524)	IN LINE	369A7006-3



NOTES:

1. SHIM BETWEEN BRACKET AND BULKHEAD WITH AN960PD416 AND/OR -416L WASHERS AS REQUIRED FOR ALIGNMENT WITHIN 0.010 IN. (0.254 MM)
2. EDGE OF BUSHING MUST PROTRUDE A MIN. OF 0.010 IN. (0.254 MM) TO A MAX. OF 0.060 IN. (1.524 MM) ABOVE OUTSIDE SURFACE OF PART AFTER NUT IS TIGHTENED.
3. DIRECTION OF BOLT IS OPTIONAL.
4. ADJUSTABLE BUSHING MUST HAVE A MIN. PROTRUSION OF 0.002 IN. (0.0508 MM) AT EACH END.
5. INSTALL WITH BEARING RECESS FACING FITTING.
6. ON HELICOPTERS WITH METAL-BLADED TAIL ROTOR ASSY.
7. NOT ON ALL HELICOPTERS; AS REQUIRED.
8. ASTERISK (*) INDICATES PARTS THAT MAY EITHER MAGNESIUM OR ALUMINUM ALLOY. REFER TO SECTION 2 FOR ALLOY IDENTIFICATION AND CORROSION CONTROL.

30-066F

Figure 8-14. Pilot's Compartment and Intermediate Tail Rotor Controls

CAUTION The right pedal arm bushings are glass- filled phenolic. Ensure bushing does not cock during replacement, and that it is fully seated in arm bore. Keep tools from contact with bushing liners to avoid fraying.

(5). Replace bearings in right pedal arm when teflon-reinforced liner is galled or frayed. Pull bushing to remove; press to install.

28. Floor-and-tunnel-Routed Control Rods

(Ref. Figure 8-14) The floor-and-tunnel-routed control rods interconnect the tail rotor pedal installation with the upper fuselage and tailboom control linkage (Ref. Figure 8-15).

The control rods, each an anodized, aluminum alloy tube with two rod end bearings, are linked by a cast magnesium tail rotor bellcrank mounted on the under-seat control support bracket. An aluminum alloy tail rotor bellcrank may be installed to replace the magnesium bellcrank. (Refer to Control Support Bracket and Bellcranks, Section 7.)

29. Floor-Routed Tail Rotor Control Rod Repair

(1). Replace rod end if bearing axial play is more than 0.040 inch (1.016 mm).

NOTE:

- The riveted rod end bearing is replaceable without removal if located at forward end of rod. If riveted rod end is aft, rod removal is required to replace the rod end bearing.
- The floor-routed control rod will normally not require replacement unless the helicopter has received extensive impact or crash damage.

(2). On current configuration helicopters, remove the control rod forward through the landing light wiring grommet hole after the landing light is removed.

(3). Early configuration helicopters may be modified for this purpose by relocating the landing light wire hole and opening up the hole to 1.25 inch (3.175 cm); then install a 369H4011 grommet after the control rod is reinstalled.

(4). Disconnect control rod from pedal torque tube fitting or from tail rotor idler bellcrank (Ref. Figure 8-14). Remove metal tail rotor control bungee spring if installed.

NOTE: Check rigging of tail rotor controls following installation of any removed or replaced parts.

(5). Accurately measure and record distance between un-chamfered edge of rod end jamnut and center of rod end bearing hole. Record measurement.

CAUTION Use care when drilling to remove or install riveted rod end; the rod end is steel and the rod is aluminum.

(6). Drill out rivet(s) (as applicable), loosen jam nut and unscrew rod end.

(7). Screw replacement rod end into rod, and adjust jam nut to obtain same measurement made in step (5). above.

(8). Align control rod ends so that the bearings have equal space for angular throw; hold rod end and tighten jam nut.

(9). As applicable, install rivet(s) to secure rod end.

(10). Check that slotted bushing is in place; then secure control rod in torque tube fitting or idler bellcrank with bolt, two washers, nut and cotter pin.

(11). Reinstall metal tail rotor control bungee spring as required.

(12). Reinstall access doors.

30. Sta. 78.50 Tail Rotor (Tunnel-Routed) Control Rod

(Ref. Section 7, Tunnel-Routed Control Rods) All the tunnel-routed control rods are removed, inspected, repaired and installed in same manner. Ref. Figure 8-14 for initial length and rod end angularity.

31. Tail Rotor Idler Bellcrank

(Ref. Section 7, Control Support Bracket and Bellcranks)

32. Upper Fuselage and Boom Tail Rotor Control Linkage

(Ref. Figure 8-15) Upper fuselage tail rotor controls consist of the Sta. 95 bellcrank and

support at the front of the main rotor mast base, the Sta. 100 control rod and the Sta. 142 bellcrank inside the boom fairing.

The boom linkage consist of the tailboom control rod, supported by six nylon bushings or teflon grommets, and the Sta. 282 bellcrank that is mounted on the tail rotor transmission.

The Sta. 95 bellcrank support and the Sta. 100 and 142 bellcranks are either cast magnesium, or forged or cast aluminum; the control rods are aluminum alloy. Aluminum alloy parts may be installed to replace magnesium parts.

33. Sta. 100 Control Rod Sta. 142 Bellcrank Replacement

(Ref. Figure 8-15)

A. Sta. 100 Control Rod Sta. 142 Bellcrank Removal

The Sta. 142 bellcrank and Sta. 100 control rod must be removed as an assembled unit.

(1). Remove tail rotor control bellcrank access door from left side of boom fairing.

(2). Disconnect tailboom control rod from lower end of Sta. 142 bellcrank.

(3). Remove hardware that secures Sta. 142 bellcrank to boom fairing brackets.

(4). Remove plenum chamber access door (early type) or open hinge-mounted access door (current type) on engine inlet aft fairing.

(5). Remove clamp on boot support tube at front of engine air inlet screen (Sta. 119.50) if screen is installed.

(6). Disconnect forward end of Sta. 100 control rod from Sta. 95 bellcrank.

NOTE: The Sta. 95 bellcrank must also be detached from its support to get clearance from the air inlet fairing for rod end bolt removal.

(7). Carefully pull at forward end of control rod and withdraw assembled and bellcrank out through boot support tube at plenum chamber Sta. 137.50 and also through boot support tube at front of engine air inlet screen (Sta. 119.50) if installed.

(8). Disconnect control rod from upper end of bellcrank.

B. Sta. 100 Control Rod or Sta. 142 Bellcrank Installation

The Sta. 142 bellcrank and Sta. 100 control rod must be installed as an assembled unit by routing assembled end of bellcrank and control rod through boot support tube at air inlet screen (when installed) and through boot support tube at plenum chamber Sta. 137.50.

(1). Gain access to bellcrank support bracket through access door in boom fairing.

(2). Check that slotted bushings are in place at each end of bellcrank.

(3). Position riveted rod end in bellcrank and install bolt, two washers, nut and cotter pin.

NOTE: Check to be sure that the hump of the bellcrank will face forward.

(4). Carefully feed assembled control rod and bellcrank through forward air intake at left side of control mixer installation while an assistant guides the assembly through boot support tubes to the bellcrank support bracket.

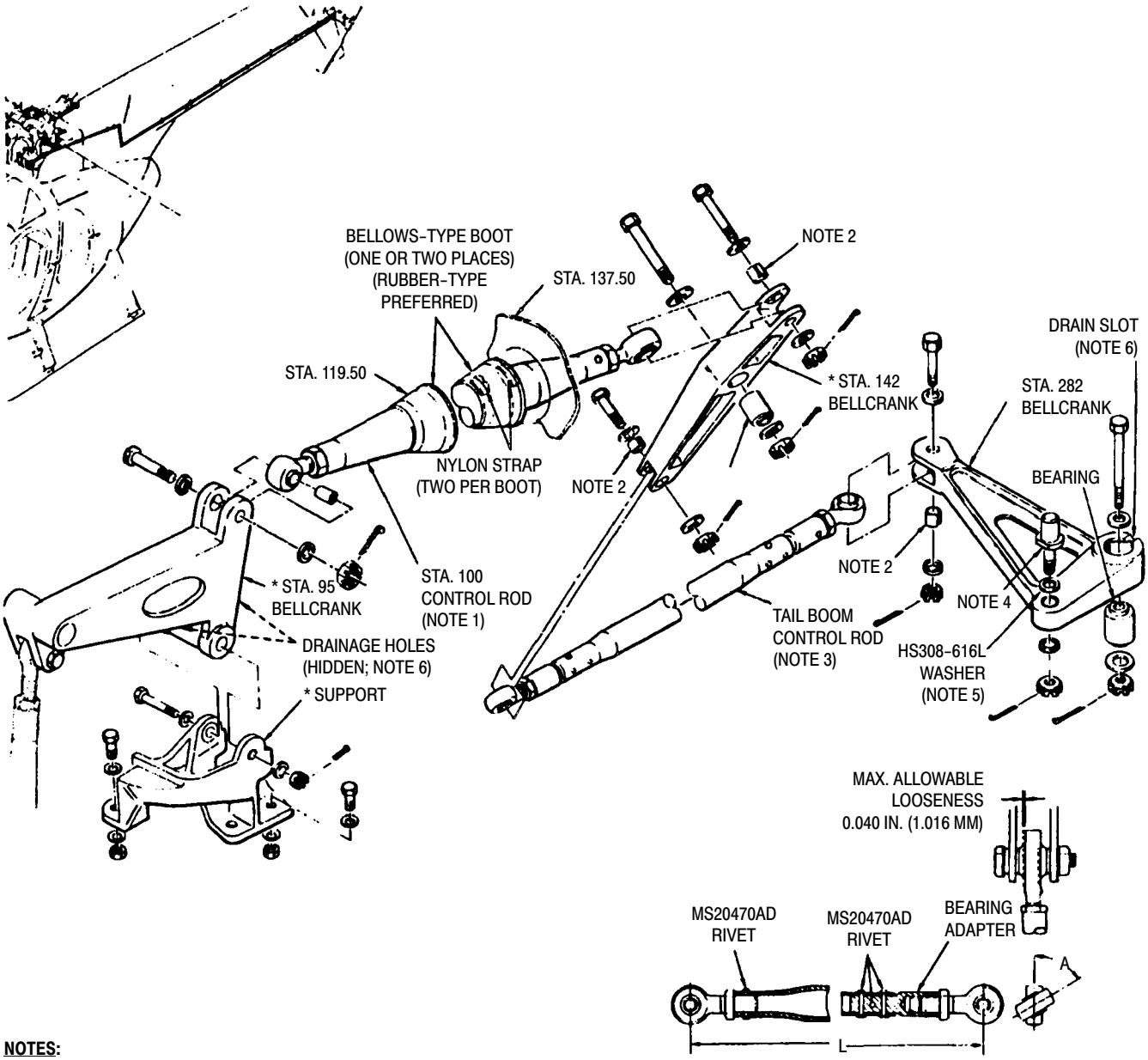
(5). Position rubber boot or fabric boot and grommet in place at Sta. 137.50, and also at front air inlet screen if installed.

(6). Position Sta. 142 bellcrank in support bracket and install bolt, two washers, nut and cotter pin.

CAUTION Check Sta. 142.00 bellcrank for clearance with support structure. Pay particular attention to area above 369A7951-23 bearing when top of bellcrank is in forward position. If contact is noted, machine surface of bellcrank (machine surface with interference only) (Ref. Figure 8-16).

(7). Check that slotted bushing is in place in Sta. 95 bellcrank.

(8). Install forward rod end in bellcrank with bolt (head to left), two washers, nut and cotter pin.



NOTES:

1. MIN. OF 0.060 IN. (1.524 MM) CLEARANCE FOR FULL RANGE OF TRAVEL THRU STA. 137.50 BULKHEAD.
2. EDGE OF BUSHING MUST PROTRUDE A MIN. OF 0.010 IN. (0.254 MM) TO A MAX. OF 0.060 IN. (1.524 MM) ABOVE OUTSIDE SURFACE OF PART AFTER NUT IS TIGHTENED.
3. MIN. OF 0.010 IN. (0.254 MM) CLEARANCE FOR FULL RANGE OF TRAVEL BETWEEN BOOM AND TAIL ROTOR TRANSMISSION.
4. MUST BE CHROME PLATED OR NITRIDED.
5. USE TO PREVENT DISSIMILAR METAL CONTACT; INSTALL AT EARLIEST OPPORTUNITY.
6. DRAINAGE PROVISIONS FOR WATER ENTRAPMENT AREAS (REFER TO MDHI HN-39).
7. ASTERISK (*) INDICATES PARTS THAT MAY BE EITHER ALUMINUM OR MAGNESIUM ALLOY. REFER TO SECTION 2 FOR ALLOY IDENTIFICATION CONTROL.

INITIAL ROD ASSY LENGTH AND
BEARING ANGULARITY (BEFORE RIG)

CONTROL ROD ASSY	DIM L	ANGLE A	ASSY PART NUMBER
STA. 100	45.88 IN. (116.5352 CM)	IN LINE	369A7006-5
TAILBOOM	141.70 IN. (359.918 CM)	63°	369A7518

30-067G

Figure 8-15. Upper Fuselage and Boom Tail Rotor Control Linkage

(9). Reinstall Sta. 95 bellcrank in its support with bolt, two washers, nut and cotter pin.

(10). Secure grommet to fabric boot with nylon strap and boot to support tube with nylon strap.

(11). If rubber boot is used:

(a). Secure end at support tube with nylon strap.

(b). Clamp tail rotor pedals in neutral.

(c). Set free length of bellows portion of boot at approximately 5.50 inches (13.97 cm) and secure end to control rod with nylon strap.

(12). Check rigging of tail rotor controls after installation of any removed or replaced parts.

34. Sta. 282.00 Bellcrank Replacement

(Ref. Figure 8-15)

A. Sta. 282.00 Bellcrank Removal

(1). Disconnect bellcrank from tailboom control rod.

(2). Disconnect bellcrank from tail rotor transmission arm. Disengage bellcrank pitch control pin from tail rotor assembly and remove bellcrank.

B. Sta. 282.00 Bellcrank Installation

(1). Position tail rotor pitch control assembly to align with pitch control pin in bellcrank and engage pin.

(2). Position bellcrank to align with mating hole in tail rotor transmission arm and install bolt, two washers, nut and cotter pin.

(3). Check that slotted bushing is in place in lower lug of bellcrank; then attach tailboom control rod to bellcrank with bolt, two washers, nut and cotter pin.

(4). Check rigging of tail rotor controls after installation of any removed or replaced parts.

35. Tailboom Control Rod Replacement

(Ref. Figure 8-15)

A. Tailboom Control Rod Removal

(1). Disconnect control rod from Sta. 282.00 bellcrank.

(2). Accurately measure and record distance between un-chamfered edge of forward rod end bearing jam nut and center of bearing attach bolt hole.

(3). Hold forward rod end, loosen jam nut and un-thread control rod from rod end by turning aft end of rod.

(4). Slowly pull at aft end of control rod and withdraw rod out through opening in tail rotor transmission mounting frame.

B. Tailboom Control Rod Installation

NOTE: Tailboom control rod is routed through the boom with the forward rod end removed. Use of special grommet installation tool (57, Table 2-2) simplifies installation of tail rotor control rod grommets. For replacement of grommets, refer to CSP-H-6.

(1). Guide control rod through boom aft frame opening and carefully route through the six control rod grommets. Rotate the rod slightly to start it through each grommet.

(2). Check that slotted bushing is in place in lower lug of Sta. 282 bellcrank; then attach aft rod end to bellcrank with bolt, two washers, nut and cotter pin.

(3). Using measurement recorded at time of rod removal, install forward rod end bearing. Align rod ends so that the bearings have equal space for angular throw; hold rod end and tighten jam nut.

(4). Check that slotted bushing is in place in lower end of Sta. 142 bellcrank; then attach forward rod end to bellcrank with bolt, two washers, nut and cotter pin.

(5). Check rigging of tail rotor controls following installation of any removed or replaced parts.

(6). Reinstall or close plenum chamber access door as applicable (Ref. Sec. 2).

36. Sta. 95 Bellcrank and Support Replacement

(Ref. Figure 8-15)

A. Sta. 95 Bellcrank and Support Removal

(1). Disconnect tunnel-routed control rod from bellcrank.

(2). Disconnect bellcrank from support.

(3). Disconnect bellcrank from Sta. 100 control rod and remove bellcrank.

(4). Remove hardware that secures support to mast structure; remove support.

B. Sta. 95 Bellcrank and Support Installation

(1). Install bellcrank support to mast structure with three bolts, seven washers and three nuts. (The forward bolt requires an extra washer (AN960PD416) under the bolthead).

NOTE: Two thin washers are used at all three locations.

(2). Torque nuts to **80 - 100 inch-pounds (9.04 - 11.30 Nm)**.

(3). Check that slotted bushings are in place in bellcrank; then attach Sta. 100 control rod to bellcrank with bolt (head to left), two washers, nut and cotter pin.

(4). Install bellcrank in support with bolt, two washers, nut and cotter pin.

(5). Attach tunnel-routed control rod to bellcrank with bolt, two washers, nut and cotter pin.

37. Upper Fuselage and Boom Tail Rotor Control Linkage Inspection

(1). Inspect rod end bearing for binding and excessive wear, 0.040 inch (1.016 mm) maximum axial looseness.

(2). Inspect for loose rivet at fixed rod end.

(3). Inspect control rod for surface damage and evidence of bending.

(4). Inspect the rubber boot, or fabric boot with grommet, at Sta. 137.50 bulkhead and, when applicable, at front of engine air inlet screen for good condition.

(5). Clean any accumulation of dirt from the grommet in the fabric boot to minimize abrasive wear on the control rod.

(6). Inspect Sta. 100 control rod for chafing of the surface that feeds through the fabric boot grommet; serviceable wear is limited to 0.004 inch (0.1016 mm) measured from adjacent undamaged area.

NOTE: A fabric boot with grommet may be replaced with a rubber bellows type boot 369A8415 to eliminate grommet chafing of rod.

(7). Inspect for wear of the tailboom control rod surfaces that pass through the control rod grommets.

(a). Serviceable wear is limited to the thickness of the hard anodic coating.

(b). Check that all grommets are secure.

(8). Inspect bellcranks for scratches, corrosion and similar surface defects.

(9). Inspect bellcrank bearing for looseness and binding.

(10). Check that Sta. 282 (tail rotor gearbox) bellcrank drain slot, if provided, is free of obstruction.

(11). Replace Sta. 282.00 bellcrank pivot pin if worn or corroded. Install washer HS308-616L between pin and bellcrank.

38. Upper Fuselage and Boom Tail Rotor Control Linkage Repair

(1). Perform a straightness check on a control rod that appears bent or bowed.

(a). The total length of Sta. 100 control rod, excluding rod ends, must be straight within 0.040 inch (1.016 mm), with straightness variation limited to a maximum of 0.010 inch (0.254 mm) in each foot of length.

(b). The total length of the tailboom control rod, excluding rod ends, must be straight within 0.120 inch (3.048 mm), with straightness variation limited to a maximum of 0.010 inch (0.254 mm) in each foot (30.48 cm) of length.

WARNING **A dye-check for cracking must always be performed after cold-straightening. Replace a cracked rod, or a cracked or bent rod end.**

(2). Cold-straighten a bent rod that is not within tolerance provided there are no nicks or sharp dents in the bend length. **DO NOT** use the rod ends to support the rod during straightening process.

CAUTION Use care when drilling to remove or install riveted rod end; the rod is steel and the rod and bearing adapter are aluminum.

(3). Replace a control rod end if bearing axial play is more than 0.040 inch (1.016 mm). Set initial control rod length and bearing angularity as shown in Figure 8-15.

(4). Replace unserviceable control rod bearing adapter.

NOTE: Use the trammel method, or equivalent, to establish rod length when replacing an adapter.

(a). Measure length and record position of rod end in adapter; then remove affected rod end.

(b). Observe the CAUTION above and drill out rivets securing adapter to rod and aft rod end.

(c). Install rod end in replacement adapter and position at recorded measurement.

(d). Fit adapter into rod and position to fit recorded trammel position.

(e). Drill through existing rivet holes in rod and install rivets to secure adapter to rod.

(5). Replace unserviceable bellcrank and support pivot bearings.

(a). Install replacement bearing with grade A locking compound (29, Table 2-4). Check that bearing seats against bore shoulder.

NOTE: The installation direction of Sta. 142 bellcrank bearing may be from either side, depending on location of bearing shoulder. There must not be less than 0.010 inch (0.254 mm) protrusion of bearing inner race beyond the sides of the bellcrank after the bearing is installed.

(6). Repair minor surface defects such as scratches, nicks and corrosion on bellcranks and support bracket.

(a). Use abrasive cloth grade 400-600 (20) to smooth out and blend in such defects.

(7). The following rework limits represent total limits, including the effects of all previous repairs to any given area.

NOTE: Parts identified in Figure 8-15 with an asterisk (*) may be either magnesium or aluminum alloy. Refer to Section 2 for corrosion control and identification of magnesium and aluminum alloys.

(a). Cast surfaces may be reworked to depth of 0.020 inch (0.508 mm).

(b). Flat machined surfaces, except clevis inner ears, may be reworked to depth of 0.015 inch (0.381 mm).

(c). Clevis inner ear surfaces may be reworked to depth of 0.020 inch (0.508 mm).

(d). Machined holes may have 0.003 inch (0.0762 mm) removed from the bore wall in an area no greater than 15 percent of the circumference and 50 percent of the depth.

(e). All edges may have 0.030 inch (0.762 mm) removed except around machined holes, which are limited to 0.010 inch (0.254 mm) chamfer.

(f). All rework must be smoothly blended into the adjacent surfaces and the finish must be restored. Refer to preceding NOTE.

(8). Repair surface abrasion on Sta. 100 control rod by smoothing the area with

grade 400 abrasive cloth (20) and restoring protective finish with primer (4). Replace rod if wear or depth of repair exceeds 0.004 inch (0.1016 mm).

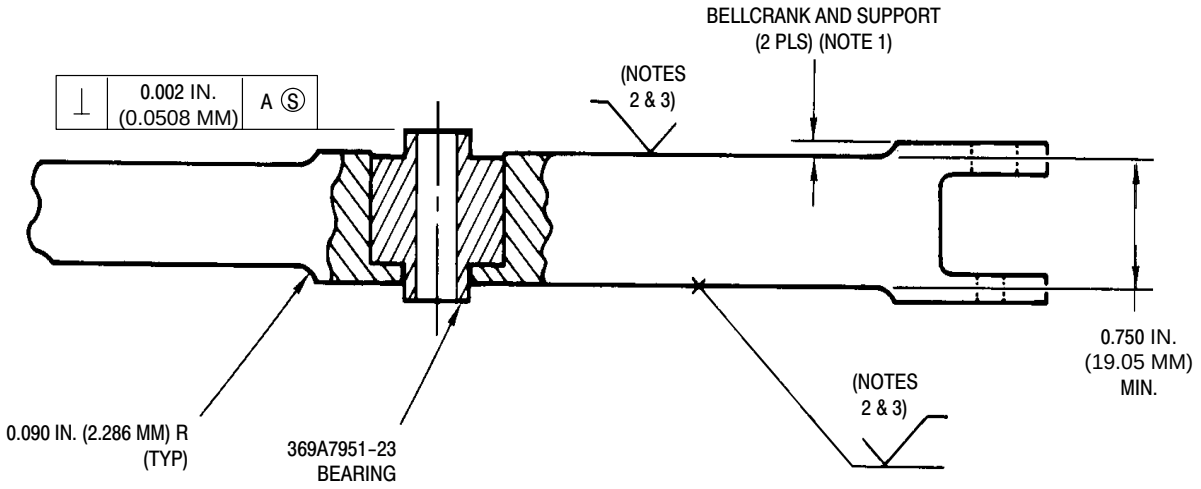
(9). Replace tailboom control rod if hard anodic coating is worn through and aluminum base metal is visible.

(10). Replace split or torn boot or a cracked grommet:

(a). Remove Sta. 100 control rod.

NOTE: A fabric boot with grommet may be replaced with a rubber bellows type boot 369A8415.

(b). Replace boot, as required, and reinstall Sta. 100 control rod.



NOTES:
1. 0.010 IN. (0.254 MM) MIN. CLEARANCE REQUIRED IN THIS AREA.
2. TREAT MACHINED AREA (5, TABLE 2-4).
3. TOUCH-UP (COLOR 34151 GREEN).

44-475A

Figure 8-16. Rework of Sta. 142 Bellcrank Assembly

Section

9

Transmissions and Drives System

TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 9 Transmissions and Drives System		**9-1**
1.	Power Train System	9–1
2.	Power Train System Troubleshooting	9–1
	Table 9–1. Troubleshooting the Power Train System	9–1
	Figure 9–1. Power Train System	9–4
3.	Main Transmission	9–5
A.	Main Transmission Removal	9–5
	Figure 9–2. Main Transmission Installation	9–6
B.	Main Transmission Installation	9–7
C.	Main Transmission Inspection	9–7
D.	Main Transmission Stripping	9–8
E.	Main Transmission Buildup	9–8
F.	Main Transmission Repair	9–8
	Figure 9–3. Main Transmission Cross–Section	9–9
4.	Lubrication Pump and Oil System Accessories	9–10
A.	Lubrication Pump Removal	9–10
B.	Lubrication Pump Installation	9–10
C.	Lubrication Pump and Oil System Accessories Inspection	9–10
D.	Transmission Filter Replacement	9–10
E.	Chip Detector Replacement	9–10
F.	Tachometer Generator Replacement	9–11
G.	Oil Pressure Sender and Temperature Switch Replacement	9–11
H.	Liquid Level (Sight) Plug Replacement	9–11
I.	Application of Markings on Liquid Level Plug	9–11
J.	Repair and Replacement of Transmission Drains and Tubing	9–11
	Figure 9–4. Main Transmission Drain Tubing	9–12
5.	Main Rotor Drive Shaft	9–13
A.	Main Rotor Drive Shaft Removal	9–13
B.	Main Rotor Drive Shaft Installation	9–14
C.	Main Rotor Drive Shaft Inspection	9–14
	Figure 9–5. Main Rotor Drive Shaft	9–15
D.	Main Rotor Drive Shaft Exterior Repair	9–16
6.	Main Transmission Drive Shaft	9–16
A.	Main Transmission Drive Shaft Removal	9–16
B.	Main Transmission Drive Shaft Installation	9–16
C.	Main Transmission Drive Shaft Inspection (Bendix)	9–17
D.	Main Transmission Drive Shaft Inspection (Kamatic)	9–18

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
E.	Main Transmission Drive Shaft Couplings Corrosion Removal	9–18
F.	Main Transmission Drive Shaft Repair (Bendix)	9–19
G.	Main Transmission Drive Shaft Repair (Kamatic)	9–19
7.	Oil Cooler Blower	9–19
A.	Oil Cooler Blower Removal (Early–Type, Belt–Driven)	9–19
	Figure 9–6. Main Transmission Driveshaft and Early Type Belt–Driven Oil Cooler Blower (Sheet 1 of 2)	9–20
B.	Oil cooler Blower Installation (Early–Type, Belt–Driven)	9–22
C.	Oil Cooler Blower Removal (Current–Type, Belt–Driven)	9–24
D.	Oil Cooler Blower Installation (Current–Type, Belt–Driven)	9–24
	Figure 9–7. Main Transmission Driveshaft and Current Type Belt–Driven Oil Cooler	9–25
E.	Oil Cooler Blower Inspection (Belt–Driven)	9–27
	Figure 9–8. Belt–Driven Oil Cooler Blower (Screw–Assembled), Exploded View	9–28
	Figure 9–9. Early Type Belt–Driven Oil Cooler Belt Tension and Pulley Alignment	9–29
F.	Oil Cooler Blower Removal (Shaft–Driven)	9–30
G.	Oil Cooler Blower Installation (Shaft–Driven)	9–30
H.	Oil Cooler Blower Inspection (Shaft–Driven)	9–31
I.	Oil Cooler Blower Disassembly (Belt–Driven)	9–31
J.	Oil Cooler Blower Reassembly (Belt–Driven)	9–32
	Figure 9–10. Main Transmission Driveshaft and Shaft–Driven Oil Cooler Blower	9–33
K.	Oil Cooler Blower Repair	9–34
	Figure 9–11. Cutaway View of Belt–Driven Oil Cooler Blower	9–35
8.	Overrunning Clutch	9–36
A.	Overrunning Clutch Removal	9–36
B.	Overrunning Clutch Installation	9–36
	Figure 9–12. Overrunning Clutch Repair or Replacement	9–37
C.	Overrunning Clutch Inspection	9–38
D.	Overrunning Clutch Sub–Assembly and Ball Bearing Inspection	9–38
E.	Overrunning Clutch Sub–assembly Replacement	9–38
F.	Overrunning Clutch Repair/Overhaul	9–38
9.	Tail Rotor Transmission	9–38
A.	Tail Rotor Transmission Removal	9–38
	Figure 9–13. Tail Rotor Transmission and Drive Shaft Installation with Kamatic Couplings Installed (Sheet 1 of 2)	9–39
	Figure 9–14. Tail Rotor Transmission and Drive Shaft Installation with Bendix Couplings Installed (Sheet 1 of 2)	9–41

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
B.	Tail Rotor Transmission Installation	9–43
C.	Tail Rotor Transmission Inspection	9–43
D.	Tail Rotor Transmission Stripping	9–43
E.	Tail Rotor Transmission Buildup	9–43
Figure 9–15.	Replacement of Tail Rotor Transmission Liquid Level Plug and Breather–Filler	9–44
F.	Protective Sleeve (Speedi–Sleeve) Installation, Output Gearshaft	9–45
Figure 9–16.	Protective Sleeve Installation/Replacement, Output Gearshaft	9–46
G.	Protective Sleeve (Speedi–Sleeve) Replacement, Output Gearshaft	9–47
10.	Tail Rotor Drive Shaft	9–47
A.	Tail Rotor Drive Shaft Removal	9–47
B.	Tail Rotor Drive Shaft Installation with Kamatics Couplings	9–47
C.	Tail Rotor Drive Shaft Installation with Bendix Couplings	9–49
D.	Tail Rotor Drive Shaft Twist Inspection	9–51
E.	Tail Rotor Drive Shaft Index Stripe Application	9–52
F.	Tail Rotor Drive Shaft Inspection	9–52
Figure 9–17.	Drive Shaft Twist Check	9–53
G.	Tail Rotor Drive Shaft Repair	9–54
11.	Tail Rotor Drive Shaft Damper	9–54
A.	Tail Rotor Drive Shaft Damper Inspection	9–54
B.	Tail Rotor Drive Shaft Damper Replacement	9–54
Figure 9–18.	Tail Rotor Drive Shaft Damper Friction – Checking	9–55
C.	Tail Rotor Drive Shaft Damper Friction Adjustment	9–56
12.	Tail Rotor Drive Shaft Couplings	9–56
A.	Tail Rotor Drive Shaft Coupling Removal	9–56
B.	Tail Rotor Drive Shaft Coupling Inspection (Bendix)	9–56
C.	Tail Rotor Drive Shaft Coupling Inspection (Kamatic)	9–56
D.	Tail Rotor Drive Shaft Coupling Repair (Bendix)	9–56
E.	Tail Rotor Drive Shaft Coupling Repair (Kamatic)	9–57
F.	Tail Rotor Drive Shaft Coupling Installation	9–57

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page

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SECTION 9
TRANSMISSIONS AND DRIVES SYSTEM

1. Power Train System

(Ref. Figure 9-1) The power train system starting at the engine power take-off pad, consists of the overrunning clutch, drive shafts and transmissions.

Engine input through the clutch to the main transmission is 6000 rpm in a clockwise direction: main transmission output to the main rotor is 470 rpm, also clockwise.

Main transmission output through the tail rotor drive shaft to the tail rotor transmission is 2045 rpm in a clockwise direction: tail rotor transmission output to the tail rotor is 3018 rpm, also clockwise.

2. Power Train System Troubleshooting

(Ref. Table 9-1)

Table 9-1. Troubleshooting the Power Train System

Symptom	Probable Cause	Corrective Action
Main drive shaft vibrates	Loose attaching bolts on main drive shaft	Retorque bolts to 50 - 70 inch-pounds (5.65 - 7.91 Nm).
	Shaft dented or bent	Check drive shaft limits for serviceability.
Excessive noise or vibration in oil cooler blower assembly	Defective impeller or damaged scroll	Replace impeller or scroll.
Overrunning clutch will not operate	Defective overrunning clutch	Replace overrunning clutch.
Main transmission requires frequent addition of oil	Leakage at main transmission input or output seals	If leakage is found at input pinion, replace the face seal according to applicable instructions in CSP-H-5, HMI Appx C. If leakage is past either output seal, replace the defective seal.
	Oil leak around accessory drive cover	Tighten cover or replace transmission.
Oil temperature warning light comes on when oil temperature is normal	Defective oil temperature switch	Replace oil temperature switch.
Oil temperature warning light comes on when oil temperature is excessive	Blockage of cooling air	Check airflow paths for blockage.
	Low oil level or oil above full level in main transmission	Establish correct oil level (Ref. Sec. 2).
	Defective lube pump	Replace lube pump.
	Defective bearings or gears	Replace transmission.
NOTE: Noise that signals a defective transmission should not be confused with normal gear backlash noise at rundown or low rpm and power conditions.		
Excessive noise in main transmission	Inadequate oil supply	Service main transmission (Ref. Sec. 2).
	Defective bearings or gears in main transmission	Replace transmission.

Table 9-1. Troubleshooting the Power Train System (Cont.)

Symptom	Probable Cause	Corrective Action
Oil pressure warning light on (oil pressure low). Light should go out at approximately 55% N_2	Low oil level in main transmission	Service main transmission (Ref. Sec. 2).
	Defective oil pressure sender	Replace oil pressure sender.
	Defective main lube pump	Replace lube pump.
	Filter clogged	Clean filter (Ref. Sec. 2).
NOTE: Rapid or abrupt maneuvers that involve extreme changes in aircraft attitude and/or produce negative G-forces, can result in transmission oil pressure caution warning light illuminating briefly.		
Tail rotor drive shaft damper vibrates	Damper out of adjustment	Adjust damper friction.
	Damper defective	Replace damper.
	Tail rotor drive shaft bent or dented	Check tail rotor drive shaft condition. Replace shaft if straightness or tir is beyond limits.
	Tail rotor out of balance	Adjust tail rotor balance (Ref. Sec. 8).
Tail rotor transmission output shaft vibrates	Worn or damaged bearings or gears in tail rotor transmission	Replace tail rotor transmission.
	Bent shaft or excessive shaft run-out	Replace tail rotor transmission.
Excessive noise in tail rotor transmission	Inadequate oil supply	Service tail rotor transmission (Ref. Sec. 2).
	Defective bearings or gears in tail rotor transmission	Replace tail rotor transmission.
Chip detector caution light on	Metallic chips in either main or tail rotor transmissions	Inspect and clean chip detector magnetic plugs. If there are heavy chip deposits (chips larger than 0.125 inch (3.175 mm) in any direction), replace the transmission. If chips are smaller, drain and refill transmission with new oil. Reinstall chip detector and check after 4 hours of flight. If more chips are found, replace the transmission.
	Defective chip detector	Replace chip detector.

Table 9-1. Troubleshooting the Power Train System (Cont.)

Symptom	Probable Cause	Corrective Action
NOTE: High frequency vibrations in the helicopter can also be caused by components in other systems (Ref. Sec. 5, 8, and 10).		
High frequency vibration	Loose tail rotor drive shaft couplings	Retorque couplings bolt to 250 - 300 inch-pounds (28.25 - 33.90 Nm), plus allowable drag torque.
	Tail rotor drive shaft couplings shimmed improperly	Check shimming: correct as required.
	Loose, mismatched or bottomed hardware retaining tail rotor drive shaft couplings to main transmission	Tighten or install proper hardware and be sure hard ware is installed correctly.
	Oil cooler blower impeller has cracks, loose rivets, defective blades or other damage	Replace impeller.
	Tail rotor drive shaft damper out of adjustment	Adjust damper friction.
	Defective overrunning clutch	Replace overrunning clutch.
	Tail rotor drive shaft bent, dented or otherwise damaged.	Check tail rotor drive shaft condition. Replace shaft if straightness or tir is beyond limits
NOTE: Drag is excessive when force required to rotate the transmission input shaft exceeds 25 inch-pounds (2.82 Nm) with all shafting disconnected and transmission temperature between 50°F (10°C) and 100°F (38°C).		
Abnormal drag in the drive system	Excessive rotational drag in main transmission	Replace transmission if drag torque exceeds 25 inch-pounds (2.82 Nm).

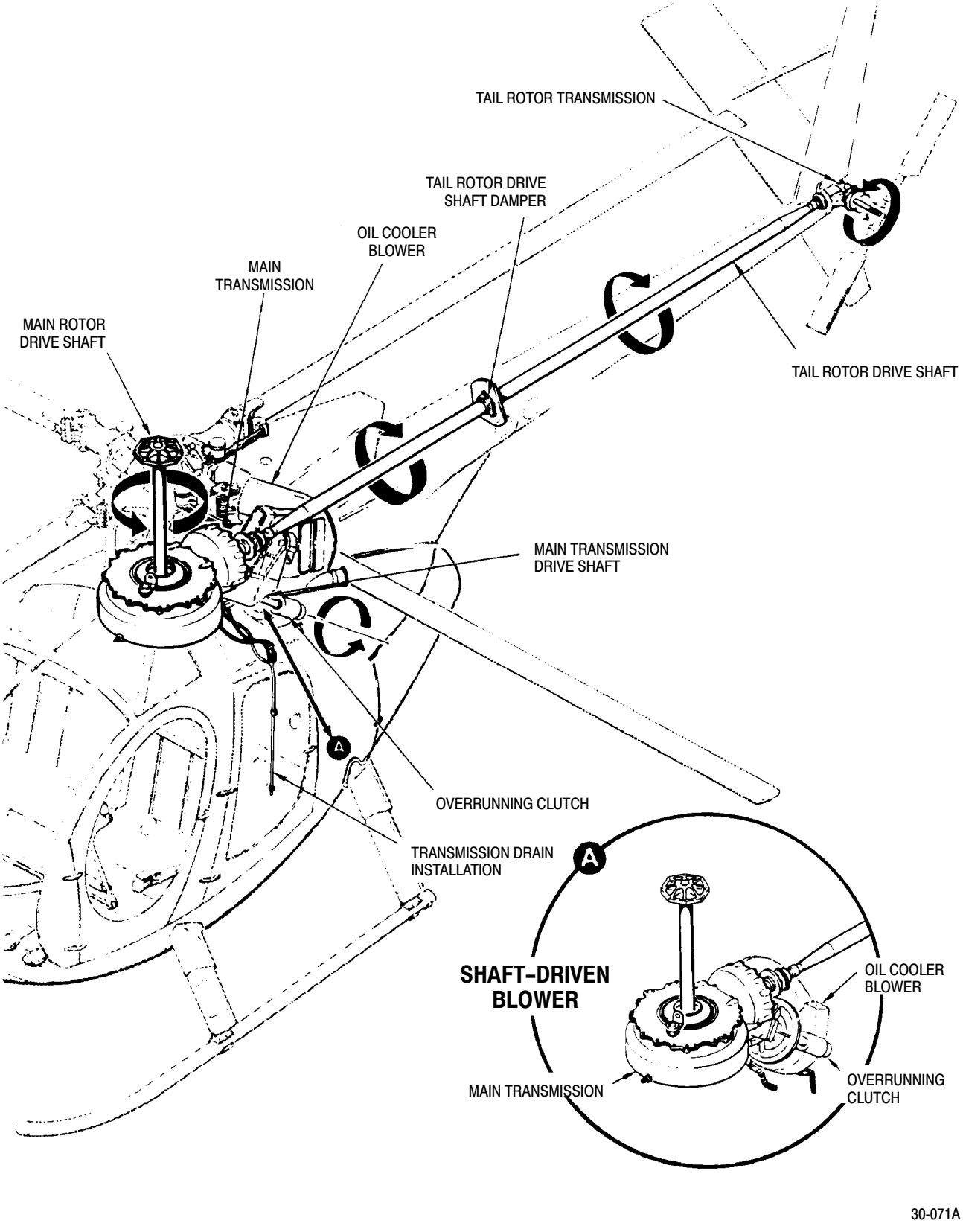


Figure 9-1. Power Train System

3. Main Transmission

(Ref. Figure 9-2) The main transmission is mounted on the main rotor mast support structure. The transmission is a two-stage, speed reduction unit, utilizing the first reduction stage for the tail rotor drive system and accessory drive trains, and the second stage to further reduce rpm for the main rotor.

All of the gears are spiral-bevel type, except for the accessory drive gears which are spur type.

The transmission housing is magnesium alloy.

The input pinion drives the input bevel gear which is concentrically mounted on the tail rotor output pinion.

The output pinion simultaneously drives the output bevel gear, main rotor drive shaft, tail rotor drive shaft and accessory drive train.

The accessory gear train drives, at 4200 rpm, both the rotor tachometer generator and the transmission oil pump which are mounted on drive pads at the back of the transmission.

Transmission cooling is accomplished by the lubrication oil and by air drawn over the housing by the oil cooler blower and ram air routed to the gearbox by the two side ducts in the forward end of the air inlet fairing.

A. Main Transmission Removal

(1). Remove the sound insulation and transmission access covers.

(2). Remove main transmission driveshaft (Ref. Main Transmission Drive Shaft Removal).

(3). Remove belt-driven oil cooler blower (Ref. Oil Cooler Blower Removal, Current Type, Belt-Driven) or scroll from shaft-driven oil cooler blower (Ref. Oil Cooler Blower Removal, Shaft-Driven).

(4). Remove tail rotor driveshaft (Ref. Tail Rotor Drive Shaft Removal).

NOTE: Removal of the main rotor driveshaft, step (5)., is optional. If help is not available to rotate the rotor hub for spline alignment, shaft removal could facilitate reinstallation of the transmission.

(5). Remove main rotor driveshaft (Ref. Main Rotor Drive Shaft Removal).

(6). Disconnect wiring from tachometer generator, two chip detector, and oil pressure and temperature senders.

(7). Drain oil from transmission.

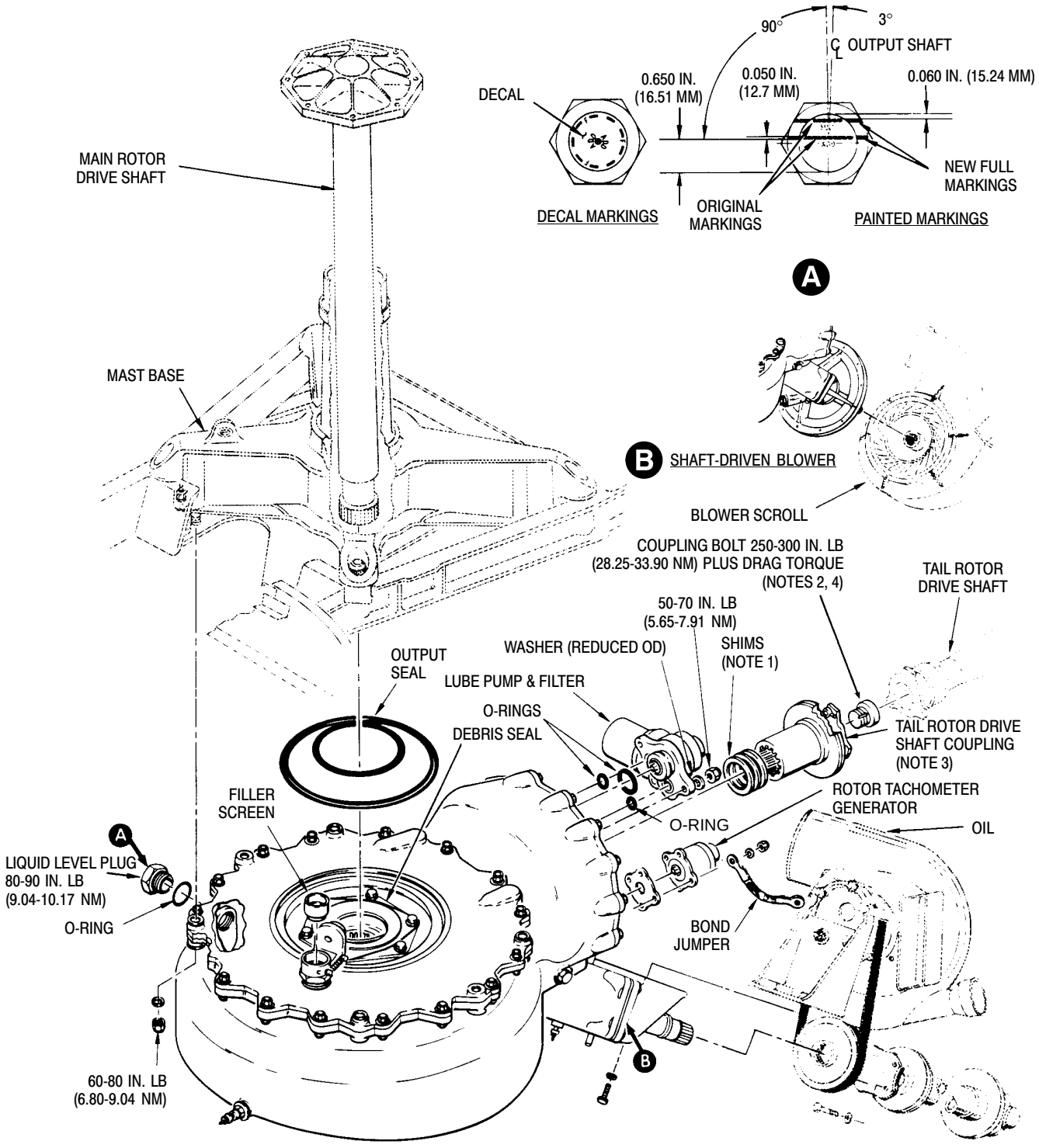
(8). Obtain assistance to support the transmission, then remove four nuts and washers.

CAUTION Lower the transmission with extreme care to prevent contact between the tail rotor drive coupling and the surrounding structure. Any dents, nicks or scratches on the coupling diaphragm requires that the coupling be scrapped. Use care to protect temperature sender and chip detector terminal studs from damage during handling or when placing transmission on any surface.

(9). With help from assistant, carefully lower transmission from mounting studs; Blower impeller is left attached on helicopter with shaft -driven oil cooler blower.

(10). Keep output seal with transmission by tapping or tying in place to prevent loss during handling, shipping or storage.

NOTE: Apply covering over the top opening of the transmission to prevent entry of dirt or water. The residual operating lubricant is an approved preservative for transmission shipment or storage.



NOTES:

1. ALUMINUM ALLOY; 0.002-IN. LAMINATIONS.
2. DRAG TORQUE FOR BOLT (SELF LOCKING) IS 25 IN LBS. (2.82 NM) MIN., 200 IN LBS. (22.60 NM) MAX.
3. COAT COUPLING SPLINES WITH CORROSION PREVENTIVE COMPOUND (70, TABLE 2-4) BEFORE ASSEMBLY.
4. COAT COUPLING BOLT THREADS WITH ANTISEIZE COMPOUND (36) BEFORE ASSEMBLY.

30-072G

Figure 9-2. Main Transmission Installation

B. Main Transmission Installation

CAUTION Install only a 369A5100- 705, - 705M, -707, -707M, or -709 main transmission on helicopters equipped with a 250- C20 engine. In addition, a 369A5186-1 1 temperature switch is also required with either of these transmissions if the transmission is not already identified with a 0.50 inch (12.7 mm) white dot located next to the identification plate. Refer to CSP- H- 5 for addition main transmission qualifying information.

(1). If transmission is a replacement, perform buildup.

CAUTION

- If transmission is new, remove output seal from shipping container and install on transmission.
- Damage to main rotor drive shaft or main transmission splines can occur during installation. Care should be taken while meshing driveshaft splines into transmission output splines to prevent damage.

(2). Apply petrolatum (34, Table 2-4) to outer edge of output seal. Press firmly into recess in top of transmission housing.

(3). With help from an assistance, carefully lift and position transmission in place on mounting studs.

(4). Install four washers and nuts; torque to **60 - 80 inch-pounds (6.78 - 9.04 Nm)**.

(5). If transmission is new, drain any residual preservative oil. Service transmission with lubricating oil (2, Table 2-3).

(6). Connect wiring to tachometer generator, two chip detectors and oil pressure and temperature sender switch.

(7). Install tail rotor drive shaft.

CAUTION When reinstalling main rotor drive shaft, check that there is no gap between shaft mounting flange and rotor hub before tightening installation bolts. Gap indicates that shaft splines are not correctly meshed in transmission.

(8). If main rotor drive shaft has been removed, apply coating of oil (35, Table 2-4) on shaft before reinstallation. Install drive shaft.

(9). Install blower on helicopter equipped with belt-driven oil cooler blower, or blower scroll for shaft-driven oil cooler blower. Install drain assembly, drain lines, and aft cover on transmission.

(10). Install main transmission drive shaft.

(11). Ground run helicopter according to the Pilot's Flight Manual and check drive system for excessive vibration and unusual noise. Check transmission for correct warning light operation and oil leakage (Ref. Sec. 2, Fluid Leak Analysis). Replace unserviceable output seals.

(12). Install access covers and sound insulation.

NOTE: If a 250- C20 engine is installed, a transmission cover with airflow baffles must be used to assure adequate cooling.

C. Main Transmission Inspection

(1). Remove the sound insulation and transmission access covers.

(2). Inspect transmission for oil leaks, cracks, corrosion, secure electrical connections, and proper oil level. Evaluate oil leakage according to Fluid Leak Analysis.

(3). Inspect the four mounting flanges on main transmission housing for corrosion and cracks. Check that transmission mounting studs and nuts are secure. This should be accomplished from the fuselage interior as well as the exterior at the main rotor mast base.

(4). Check that all safety wiring is intact and secure.

(5). Reinstall transmission access covers and sound insulation.

(6). Inspect internal ring gear bolts in the main transmission as follows.

(a). Drain the main transmission.

(b). Remove liquid level (sight) plug.

(c). Using an adequate light source, rotate main rotor 360 degrees while visually checking that all sixteen (16) ring gear bolts and lockwire are intact. Also check visible areas of the ring gear and carrier for cracks and other discrepancies.

NOTE: If damage (bolt heads sheared, lockwire broken, crack or other discrepancies) is visible, replace transmission or overhaul (Ref. CSP-HMI-5).

(d). Reinstall liquid level plug.

(e). Fill main transmission.

D. Main Transmission Stripping

(Ref. Figure 9-2 and Figure 9-3)

(1). Remove tachometer generator.

(2). Remove shaft-driven oil cooler impeller from transmission.

(3). Remove internal wrenching bolt, tail rotor drive coupling and shims. Keep shims with coupling for reuse.

(4). Install suitable covers and plugs to protect seal ports, stud threads and the tachometer generator pad.

NOTE: Further disassembly is not required.

E. Main Transmission Buildup

(Ref. Figure 9-2 and Figure 9-3)

(1). Install one preliminary 0.010 inch (0.254 mm) shim on transmission output (tail rotor drive) gearshaft to prevent internal wrenching bolt from bottoming against end of gearshaft.

(2). Coat coupling splines with corrosion preventive compound (70, Table 2-4) before assembly. Install tail rotor drive shaft coupling and tighten against shim with internal wrenching bolt.

(3). On helicopter equipped with shaft-driven oil cooler blower, install oil cooler blower impeller; install input gearshaft coupling.

(4). Install tachometer generator.

(5). Install transmission input gearshaft seal drain tube if not already in place.

F. Main Transmission Repair

(Ref. Figure 9-2 and Figure 9-3) Replace electrical components, the breather-filler and/or screen, the output seal, externally accessible O-rings, the lubrication pump and/or filler, and the output pinion gearshaft oil seal when they become defective. Repair housing outer surface damage within the limits outlined below. Replace or repair other components of the main transmission according to applicable instructions in CSP-H-5.

(1). If the depth of a depression does not exceed 0.030 inch (0.762 mm) and the area is no greater than 0.60 square inch (3.87096 square cm), repair according to steps (3)., (4). and (6)..

(2). If the depth of a depression exceeds 0.030 inch (0.762 mm) but does not exceed 0.10 inch (2.54 mm) and the area is no greater than 0.60 square inch (3.87096 square cm), repair according to steps (3). thru (6).

NOTE: Any evidence of lubricating oil leakage in a repaired area requires replacement of the transmission.

(3). Clean area with solvent (1, Table 2-4) and remove sharp edges with grade 320 abrasive paper (9).

(4). Apply a coat of primer (4) on the repaired surface.

(5). Fill depression with epoxy adhesive (19) and blend to surrounding surfaces.

(6). Touch up the reworked area with paint

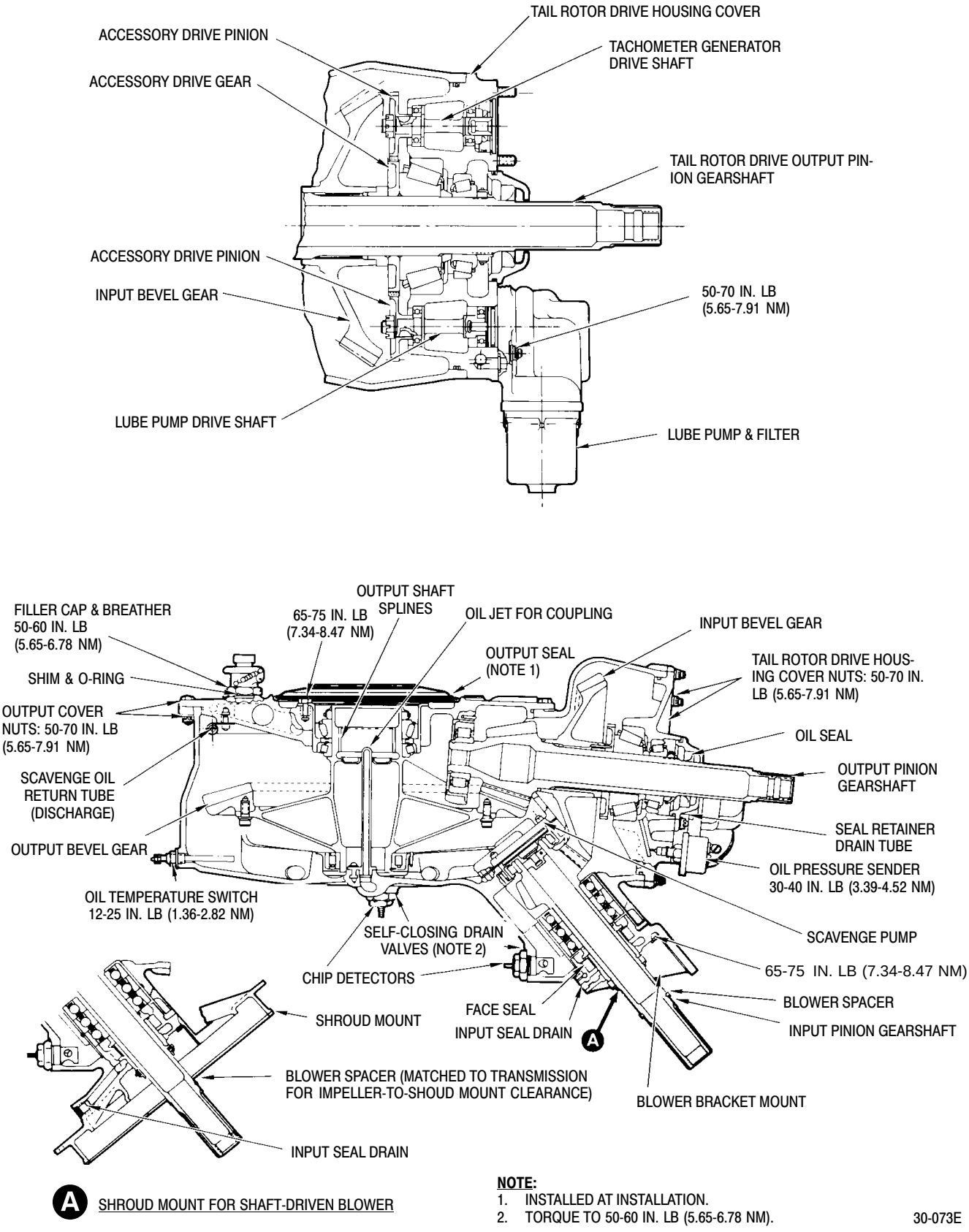


Figure 9-3. Main Transmission Cross-Section

4. Lubrication Pump and Oil System Accessories

(Ref. Figure 9-3) The main transmission has a self-contained oil system.

A lubrication pump draws oil from the main sump of the transmission housing and provides oil flow to the oil pressure sender, bearings, gears and the output spline for the main rotor drive shaft.

The pump is a positive-displacement, vane-type with a non-adjustable discharge pressure of 25-50 psi (172-345 kPa). It is driven at 4200 rpm by the accessory drive gear splined to the tail rotor output gearshaft.

A relief valve that cracks open above 60 psi (414 kPa), with full flow bypass at 100 psi (690 kPa) maximum, and a filter are integral parts of the lubrication pump housing.

A vane-type scavenge pump, with a discharge pressure of 10-20 psi (69-138 kPa) is mounted on the upper end of the input pinion.

The scavenge pump draws oil from the input gearshaft sump and pumps the oil to a discharge tube mounted inside the top of the transmission housing.

The tube is perforated to direct oil against the interior sides of the transmission housing to produce cooling as the oil drains down to the main sump.

Externally mounted oil system accessories include a combined filler/breather, a liquid level plug, two chip detectors, an oil pressure sender and temperature warning switch.

A. Lubrication Pump Removal

(Ref. Figure 9-2)

(1). Remove sound insulation and transmission access covers.

(2). Remove three nuts and washers that secure pump housing to mounting pad.

(3). Remove pump and discard the three O-rings. To exclude foreign matter, plug inlet and discharge ports in pump housing, and the drive bore.

B. Lubrication Pump Installation

(Ref. Figure 9-2)

(1). Remove plugs from pressure ports in pump and transmission.

(2). Install new O-rings in ports and O-ring groove of pump sleeve. Apply a light coating of petrolatum (34, Table 2-4) to both the O-ring and mating bore in transmission to prevent damage to O-ring.

(3). Align square drive of pump with drive shaft in transmission and carefully press pump into place on mating surface.

(4). Install three washers and nuts; torque **50 - 70 inch-pounds (5.65 - 7.91 Nm)**.

(5). Ground run the helicopter according to the Owner's Manual and check pump parting surfaces for leaks, and pressure warning light for proper operation. Refer to Fluid Leaks Analysis (Ref. Sec. 2). Replace defective O-rings. Continued excessive leakage requires pump replacement.

(6). Reinstall access covers and sound insulation.

C. Lubrication Pump and Oil System Accessories Inspection

(1). Inspect for external leaks around mounting pad and ports, and for cracks or corrosion.

(2). Check that all safetywire is intact.

(3). Check sender, switch, tachometer, and electrical connections for security.

D. Transmission Filter Replacement

Refer to Transmission Lubrication Pump Oil Filter Cleaning (Ref. Sec. 2) for removal, cleaning, inspection and installation of the filter.

E. Chip Detector Replacement

Refer to Main Transmission Draining (Ref. Sec 2) for removal and installation instructions. Refer to Section 17 for functional test of detector circuit.

F. Tachometer Generator Replacement

(Ref. Section 17)

G. Oil Pressure Sender and Temperature Switch Replacement

(Ref. Figure 9-3)

NOTE: When oil temperature switch is to be replaced, drain oil from transmission.

(1). Cut safetywire from temperature switch.

(2). Remove electrical wire from terminal post.

(3). Unscrew switch or sender in a counterclockwise direction. Catch any residual oil from the transmission port in an absorbent cloth.

(4). Apply a light coat of antiseize compound or tightly wrap two to three turns of teflon tape (36 or 79, Table 2-4) on the replacement sender or switch.

(5). Install oil pressure sender; torque to **30 - 40 inch-pounds (3.39 - 4.52 Nm)**.

(6). Install oil temperature switch; torque to **12 - 25 inch-pounds (1.36 - 1.69 Nm)**.

(7). Safetywire the temperature switch hex to adjacent lug on transmission housing.

(8). Connect electrical wire to terminal post.

NOTE: If the oil pressure sender is the dual contact type used in conjunction with a running time meter, refer to wiring diagram in CSP- H- 3 to be sure wire connections are properly made.

(9). Service transmission (Ref. Sec. 2).

H. Liquid Level (Sight) Plug Replacement

(Ref. Figure 9-2)

(1). Drain oil from transmission until oil level is well below edge of sight plug and port.

(2). Remove safetywire from sight plug.

(3). Remove sight plug by unscrewing counterclockwise.

(4). Remove and inspect O-ring. Install new O-ring, if required on sight plug.

NOTE: When a new sight plug is to be installed, use the S-51HL bullseye type that may be torqued to any position.

(5). Install sight plug by screwing clockwise. Torque sight plug to **80 - 90 inch-pounds (9.04 - 10.17 Nm)**; install safetywire.

I. Application of Markings on Liquid Level Plug

(Ref. Figure 9-2) If decal type oil level markings are not available, paint markings can be applied to the sight gage after it is torqued into the transmission. Use the dimensions shown in detail A, and proceed as follows.

(1). Using a machinists level and scale, scribe an ADD line horizontally on both outer faces of the sight plug, Do NOT mark the window.

(2). Scribe the FULL line horizontally on both outer edges of the sight plug. DO NOT mark the window.

CAUTION Application of any paint not expressly made for polycarbonate plastic or any cleaning material other than soap and water to the sight plug window may cause it to craze.

(3). Using white paint (6, Table 2-4), paint four 0.050 inch (1.27 mm) wide lines with the edges touching the scribe marks as shown in detail A. DO NOT paint the surface of the window.

J. Repair and Replacement of Transmission Drains and Tubing

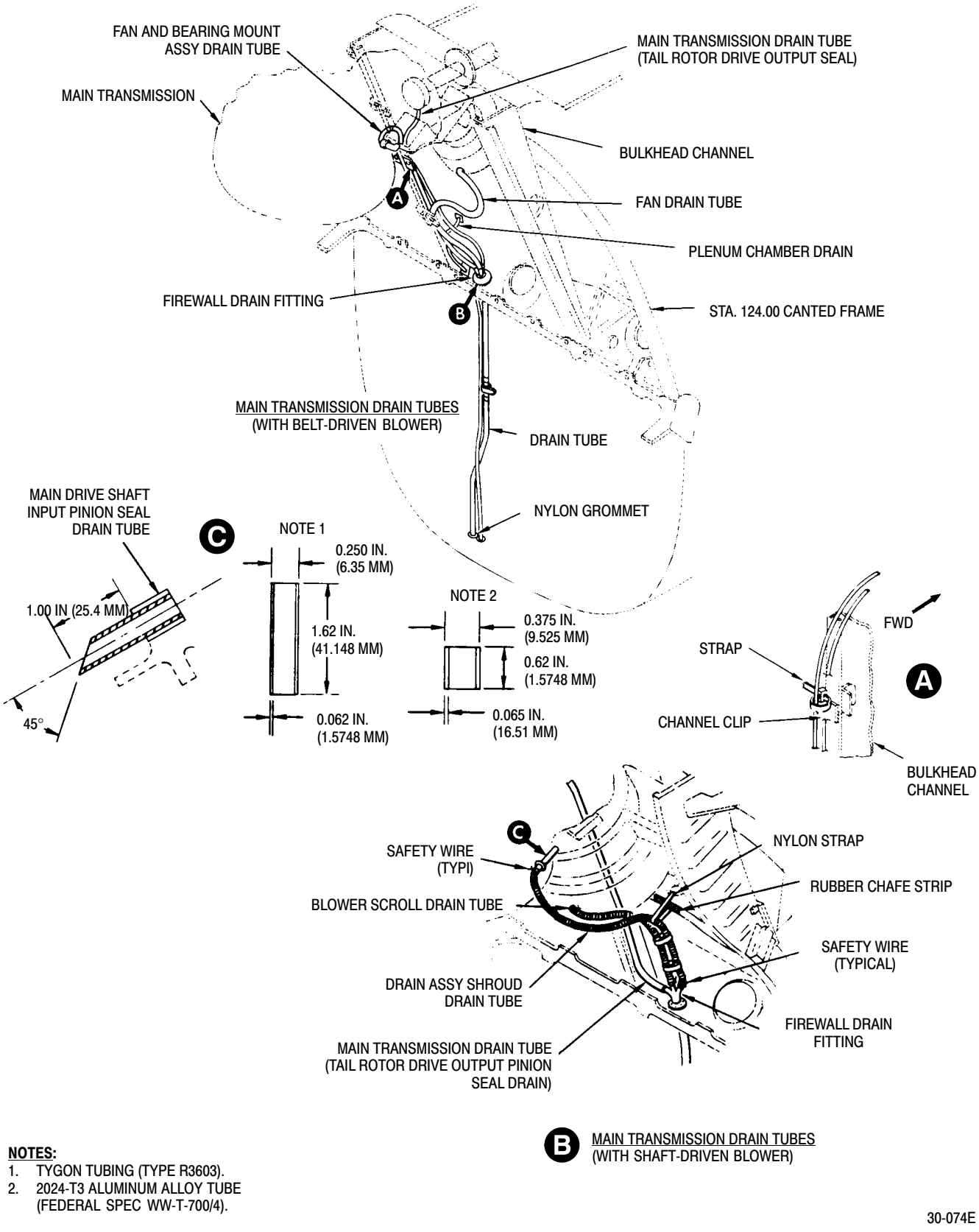
(Ref. Figure 9-4)

(1). Removal

(a). Disconnect transmission drains tubes from transmission components and at the firewall drain fitting.

(b). Release supporting nylon straps and remove drain tubes.

(c). Remove attaching clamp on engine compartment lower firewall drain tube and remove drain tube.



NOTES:
1. TYGON TUBING (TYPE R3603).
2. 2024-T3 ALUMINUM ALLOY TUBE (FEDERAL SPEC WW-T-700/4).

Figure 9-4. Main Transmission Drain Tubing

NOTE: Remove main transmission input pinion drain and bushing (detail C) whenever the transmission is replaced. The flex-tube and bushing are not normally part of a spare transmission assembly.

(d). Grasp the flex-tube and pull out to release the bond. Insert a 5/16 or 3/8 inch tap or easy-out into tube ID and rotate to pull out bushing.

(2). Inspection

Inspect drains and tubing for serviceability and repair as necessary.

(3). Repair

(a). Repair a damaged polycarbonate plastic drain assembly according to the criteria and methods specified for for acrylic plastic in FAA AC 43.13-1A, Aircraft Inspection and Repair. Use dichloromethane (38, Table 2-4) or ethylene dichloride (39) as the bonding agent.

(b). Repair deteriorated or otherwise damaged mounting gasket segments on the plastic drain assembly by replacing with new gasket material (40).

(c). Repair damaged flexible drain tubing with tape (41).

(4). Installation

(a). On newly installed main transmission clean mating surfaces of flex-tube, bushing and transmission drain outlet with solvent (1).

NOTE: A replacement flex- tube and bushing may be fabricated using materials and dimensions shown in detail C.

(b). Bond flex-tube to bushing and bushing to transmission with sealing compound (3), according to container instructions.

(c). Remove excess sealing compound and scarf the flex-tube 45 degrees (detail C).

(d). Position transmission drain assembly and install bolts. Check that transmission flex-tube will drain directly into mating assembly port.

(e). Attach upper ends of drain tubing to transmission drain assembly; secure with double wraps of 0.032 inch lockwire.

(f). Route drain tubing and secure with nylon straps as shown in detail B. Position tubing so that drainage traps are formed.

(g). Secure lower ends of drain tubing to firewall drain fitting with double wraps of 0.032 inch lockwire.

(h). Position engine compartment firewall drain tube; wrap tube with one layer of 1 inch (2.54 cm) width pressure-sensitive polyurethane tape (42) at clamp-attach point, and install clamp.

5. Main Rotor Drive Shaft

(Ref. Figure 9-5) The main rotor drive shaft is a shot-peened, nitrated steel alloy forging having a spline coupling at one end that mates with the main transmission output shaft, and an octagon shaped head that attaches to the main rotor hub with four bolts and four hoisting eyebolts.

CAUTION The main rotor drive shaft is a highly stressed part. Do not allow tools to strike the shaft, or the shaft to strike any object. Any impact damage may require replacement of the drive shaft.

A. Main Rotor Drive Shaft Removal

(1). Remove the nuts, washers, bolts, and hoisting eyebolts.

CAUTION Whenever the drive shaft is removed, cover the opening in the top of the main rotor hub to prevent possible entry of foreign matter into the hub, mast, and the transmission.

(2). Lift drive shaft clear of main rotor hub.

B. Main Rotor Drive Shaft Installation

CAUTION Damage to main rotor drive shaft or main transmission splines can occur during installation. Care should be taken while meshing driveshaft splines into transmission output splines to prevent damage.

(1). Position drive shaft over main rotor hub with gear coupling down.

(2). Slowly and carefully lower drive shaft through main rotor hub and mast until rotor shaft splines and transmission shaft splines engage.

(3). Rotate drive shaft head to align holes in flange with holes in hub.

(4). Install in every other hole, four hoisting eyebolts, each with a countersunk washer (beveled next to head).Then install the nuts, each with two standard thin flat washers; do not tighten nuts.

(5). Install the four remaining bolts, with washers and nuts in the same manner.

(6). Align hoisting eyebolt so that a center-line through the eyebolt flats intersects the drive shaft axis. Using torque wrench adapter (32, Table 2-2), torque all nuts to **120 - 140 inch-pounds (13.56 - 15.82 Nm)**.

C. Main Rotor Drive Shaft Inspection

(1). Inspect all surfaces of drive shaft for dents, nicks scratches, and evidence of deformation. Inspect splines on end of drive shaft for excessive wear. No damage of any kind is permissible in the area within 2 inches (5.08 cm) of the spur gear. Dents less than 0.050 inch (1.27 mm) deep and 0.050 inch (1.27 mm) diameter are permissible in other areas. A dent is defined as a smooth depression on the surface with no sharp edges or abrupt changes in contour. No nicks or scratches are permitted.

(2). If shaft condition is questionable, perform a magnetic particle inspection according to Specification ASTM E1444. No surface or sub-surface defects are permissible.

(3). Inspect all external surfaces of drive shaft for corrosion. Remove corrosion as follows.

(a). Degrease corroded area of drive shaft with clean cloth saturated in trichloroethane.

CAUTION Surface cleaner irritates hands on repeated exposure. Rubber gloves should be worn.

(b). Swab shaft exterior with diluted solution of surface cleaner (10, Table 2-4) (Mix one part surface cleaner with four parts water). Keep wet with solution for 10 minutes or until corrosion appears to be removed. Wipe clean and inspect. Repeat as necessary until there is no further evidence of corrosion.

(c). Rinse with water and dry thoroughly with compressed air.

CAUTION Exercise care when removing pits to ensure that shot peening is not completely penetrated. Also, remove only minimum material necessary to remove pits.

(d). Light abrade corroded surface with crocus cloth to remove pits. If pit removal exceeds depth of 0.0012 inch (0.03048 mm) in area 2, shaft is unserviceable and must be replaced.

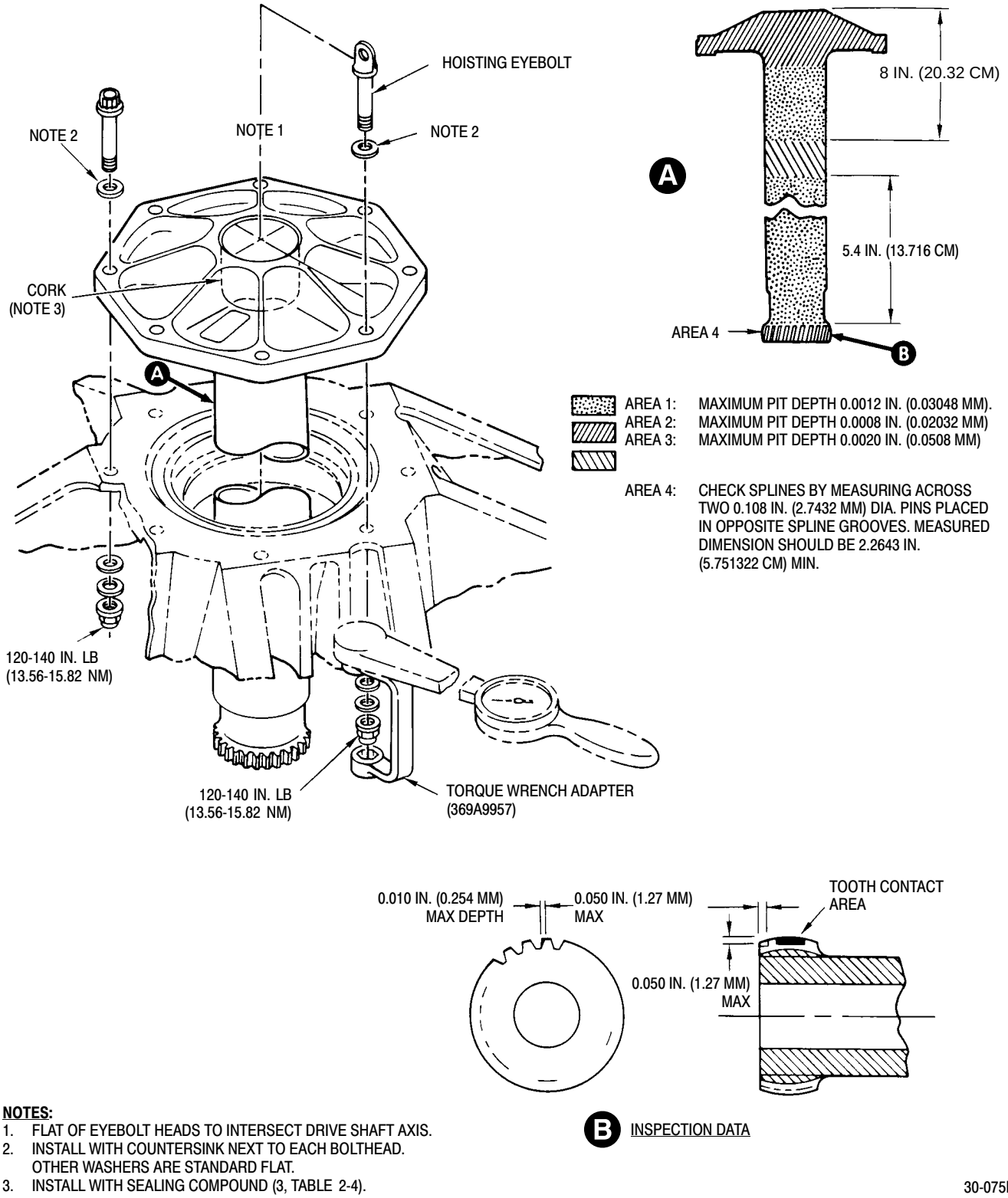
(e). Repeat steps (a). thru (c). above.

(f). Spray two coats of primer (4, Table 2-4) on shaft exterior. DO NOT primer spline teeth of mounting surface.

(4). Apply preservative oil to spline teeth and mounting surface.

(5). Immediately reinstall main drive shaft.

(6). Apply 0.060 inch (1.524 mm) bead of sealing compound around interface of hub and drive shaft.



NOTES:
1. FLAT OF EYEBOLT HEADS TO INTERSECT DRIVE SHAFT AXIS.
2. INSTALL WITH COUNTERSINK NEXT TO EACH BOLTHEAD. OTHER WASHERS ARE STANDARD FLAT.
3. INSTALL WITH SEALING COMPOUND (3, TABLE 2-4).

30-075E

Figure 9-5. Main Rotor Drive Shaft

D. Main Rotor Drive Shaft Exterior Repair

No repair of drive shaft is permitted except for removal of light surface corrosion and polishing of minor nicks and chips in noncritical spline areas indicated below.

(1). Remove corrosion as follows:

(a). Degrease corroded area of drive shaft with clean cloth saturated with trichloreothane (61, Table 2-4).

WARNING **Surface cleaner used in 2 below irritates hands on repeated exposure. Rubber gloves should be worn.**

(b). Swab shaft exterior with diluted solution of surface cleaner (10) (Mix one part surface cleaner with four parts water). Keep wet with solution for 10 minutes or until corrosion appears to be removed. Wipe clean and inspect. Repeat as necessary until there is no further evidence of corrosion.

(c). Rinse with water and dry with compressed air.

CAUTION Exercise care when removing pits to ensure that shot peening is not completely penetrated.

(d). Lightly abrade corroded surface with crocus cloth (23) to remove pits. If pit removal exceeds depth of 0.0012 inch (0.03048 mm) in Area 1 or 0.0008 inch (0.02032 mm) in Area 2, shaft is unserviceable and must be replaced.

(e). Repeat steps (a). thru (c).

(f). Spray two coats of epoxy primer and catalyst reducer (128 and 129), mixed per manufacturer's instructions, on shaft exterior. Do not prime spline teeth or mounting surface.

(2). Polish out minor nicks and chips on shaft spline teeth as follows:

(a). Using 320 to 400 grit abrasive stone, carefully grind, blend and polish out nicks and chips which are outside the critical (active) spline tooth contact areas (see Area 4 profile and end views for permissible repair areas).

(b). If the repair (grind and polish) operation extends beyond limits shown, or if any tooth damage exists within the critical tooth contact area, shaft is unserviceable and must be replaced.

(c). Perform magnetic particle inspection according to Specification MIL-I-6868. No surface or sub-surface defects are permissible.

6. Main Transmission Drive Shaft

(Ref. Figure 9-6, Figure 9-10 and Figure 9-7) The main transmission drive shaft is a dynamically pre-balance steel shaft equipped with a flexible diaphragm-type joint and mounting flange (coupling) at each end. The shaft interconnects the overrunning clutch and the transmission input shaft.

A. Main Transmission Drive Shaft Removal

(1). Remove sound insulation and main transmission access cover over main transmission drive shaft in cargo compartment.

(2). Remove eight bolts and washers that secure shaft to couplings.

(3). Remove drive shaft; use care to keep it from striking any object.

NOTE: The clutch oil level should be checked any time engine or main drive shaft is removed (Ref. Sec. 2).

B. Main Transmission Drive Shaft Installation

(1). Check overrunning clutch for proper oil level, indications of oil seepage, drive shaft couplings for corrosion and that the bolt securing the clutch coupling seated properly. With anti-seize compound (36, Table 2-4) on threads, torque bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**. Check coupling bolt for drag torque

serviceability of **25 inch-pounds (2.82 Nm)** minimum, **200 inch-pounds (22.60 Nm)** maximum.

CAUTION Compression of the drive shaft diaphragms (static state) is limited to 0.020 inch (0.508 mm). Do not stress the diaphragms by forcing the drive shaft into position for installation in step (2). below.

NOTE: If original shaft and couplings are being reinstalled, a check of shimming as described below is not necessary. Install drive shaft to clutch and transmission couplings as described in steps (1). and (4).

(2). Position drive shaft alongside the transmission input and clutch couplings. If compression will be required to fit driveshaft between the couplings, continue with step (3). If there is a gap between the drive shaft flanges and the coupling flanges continue with step (4).

NOTE: Removal or addition of shims should be accomplished at transmission input coupling only. Shims at overrunning clutch coupling are predetermined thickness to provide 0.035-0.055 inch (0.889-1.397 mm) gap to prevent O-ring packing damage and oil leakage.

(3). Remove coupling bolt that secures transmission input coupling and remove coupling. Remove sufficient shims so there is no compression of shaft flexible coupling. A minimum of 0.010 inch (0.254 mm) shim is required between end of drive input shaft and coupling; to prevent coupling bolt from bottoming out on bolt seating surface and end of shaft input. Lubricate input shaft splines with grease (21) Coat bolt threads with anti-seize compound (36). Reinstall coupling and bolt. Check coupling bolt for drag torque serviceability of **25 inch-pounds (2.82 Nm)** minimum, **200 inch-pounds (22.60 Nm)** maximum. Torque bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**.

NOTE: Transmission input coupling shims are laminated stock. Each lamination is 0.002 inch (0.0508 mm) thick. Peel away as required.

CAUTION DO NOT USE clutch coupling shims under transmission input coupling. The ID of clutch coupling shims are 1.260- 1.270 inches (32.004- 32.258 mm), that's approximately 0.070 inch (1.778 mm) larger than the ID of shims used at the transmission coupling, while the OD is the same. The difference in ID can cause an improperly seated shim, misalignment and cocking of the coupling.

(4). Attach driveshaft to clutch coupling with four bolts and washers. Torque bolts to **50 - 70 inch-pounds (5.65 - 7.91 Nm)**.

(5). Manually align the driveshaft and transmission input coupling flange. Using a feeler gage, measure the gap between the flanges (detail A). If gap is 0.010 inch (0.254 mm) or less, attach upper end of driveshaft to transmission input coupling according to step (4). If gap exceeds 0.010 inch (0.254 mm), repeat step (3)., except install a thickness of shims equal to the measured gap, plus 0.010 inch (0.254 mm) additional thickness. A nominal 0.010 inch (0.254 mm) compression of the shaft diaphragm is the preferred static state condition.

(6). Install access door and sound insulation over main transmission driveshaft.

C. Main Transmission Drive Shaft Inspection (Bendix)

(1). Inspect drive shaft diaphragms for dents, cracks, scratches, nicks, rust spots and evidence of joint separation from shaft or outside edges. Evidence of any such defects on either diaphragm requires removal of shaft from service.

(2). Inspect drive shaft tube between diaphragms for dents, scratches, cracks or corrosion pits.

(a). Measure depth and diameter of dents. Dents that blend smoothly into surrounding surface area with no sharp change in contour and do not exceed 0.015 inch (0.381 mm) depth are acceptable. Dents not within these limits require removal of shaft from service.

(b). Measure depth of cracks, nicks, corrosion pits, or scratches; length and direction are not limited. Maximum depth allowed before rework is 0.003 inch.

(c). Check suspected cracks using dye penetrant. If crack indication appears, remove black (phenolic compound) coating from area (Ref. Main Transmission Drive Shaft Repair (Bendix).

NOTE: Drive shaft is coated with special phenolic thermosetting compound. It is a brittle coating that may indicate a crack that does not penetrate tube.

(d). Reinspect suspected area using magnetic-particle or dye-penetrant methods. If crack does not reappear, touch up cleaned area with primer coating (4, Table 2-4) and return part to service.

NOTE: Perform inspections in steps (3). and (4). only if shaft damage is suspected.

(3). Inspect shaft tube for out-of-round condition. Ovality shall not exceed 0.060 inch (1.524 mm) tir.

(4). Inspect shaft for straightness. Shaft shall be within 0.030 inch (0.762 mm) tir at all locations relative to the centerline of the two flange mounting bolt pattern.

(5). Inspect all attaching hardware for serviceable condition. Check nut plates for drag torque. Discard defective hardware.

D. Main Transmission Drive Shaft Inspection (Kamatic)

(1). Inspect drive shaft for dents, cracks, scratches, nicks, rust spots and evidence of joint separation from shaft or outside edges.

(2). Inspect drive shaft tube between couplings for dents, scratches, cracks or corrosion pits.

(a). Measure depth and diameter of dents. Dents that blend smoothly into surrounding surface area with no sharp change in contour and do not exceed 0.010 inch (0.254 mm) in depth are acceptable. Dents not within these limits require removal of shaft from service.

(b). Measure depth of cracks, nicks, corrosion pits or scratches; length and direction are not limited. Maximum depth allowed before rework is 0.005 inch (0.127 mm).

(c). Check suspected cracks using dye penetrant. If crack indication appears, remove coating from surface.

(d). Re-inspect suspected area using magnetic particle or dye penetrant methods. If crack does not reappear, touch up cleaned area with primer coating (4, Table 2-4) and return part to service. If shaft is found to be cracked, remove shaft from service.

CAUTION Kamatic parts cannot be interchanged between drive shafts.

(3). Inspect all attaching hardware for serviceable condition. Discard and replace defective hardware.

NOTE: Perform the following inspections if shaft damage is suspected.

(4). Inspect shaft tube for out-of-round condition not to exceed 0.060 inch (1.524 mm).

(5). Inspect shaft for straightness. Shaft shall be straight within 0.030 inch (0.762 mm) at all locations relative to centerlines of two flange mounting bolt patterns.

E. Main Transmission Drive Shaft Couplings Corrosion Removal

(1). Prior to installing original drive shaft coupling (369A5512 or 369H5560 only), inspect flange face of coupling for fretting corrosion. Evidence of fretting may be removed by hand lapping the effected parts using a sheet of # 440 (or finer) emery cloth (49, Table 2-4) or wet or dry abrasive paper (9) placed on a

surface table with a figure eight motion, using care not to let the part rock.

NOTE: Coupling may be reused if flange thickness is not less than 0.10 inch (0.254 mm) after cleanup; Recheck shimming.

F. Main Transmission Drive Shaft Repair (Bendix)

(1). Repair of drive shaft diaphragms is not permissible.

(2). Repair all damage that is no deeper than 0.003 inch (0.0762 mm).

(a). Completely remove defect. Maintain smooth transition into surrounding surface.

(b). Use grade 400 wet or dry abrasive paper (9, Table 2-4) for preliminary finishing, and then polish with crocus cloth (23). Restore surface until it equals original finish of shaft.

(c). After rework, check shaft tube wall thickness in repair area. Wall thickness shall not be less than 0.025 inch (0.635 mm).

(d). Apply primer coating (4) for corrosion protection.

G. Main Transmission Drive Shaft Repair (Kamatic)

(1). Repairs of Kamatic drive shaft flexible couplings are limited. Repairs to spring area are not allowed. No cracks are allowed.

(2). Repair drive shaft tube area damage that is no deeper than 0.005 inch (0.127 mm). Maximum depth after repair is 0.010 inch (0.254 mm). The maximum thickness of material removed shall not be more than 10 percent of the original material thickness.

(a). Completely remove defect. Maintain smooth transition into surrounding surface.

(b). Use grade 400 wet or dry abrasive paper (9, Table 2-4) for preliminary finishing, then polish with crocus cloth (23). Restore surface until it equals original finish of shaft.

(c). After rework, check shaft tube wall thickness in repair area.

(d). Apply primer coating (4) for corrosion protection.

7. Oil Cooler Blower

The belt-driven blower is mounted to a bracket on the back underside of the main transmission and coupled to the transmission input shaft through a pulley drive.

The blower consists of a riveted and brazed impeller assembly of a casting and aluminum blades within a polycarbonate plastic scroll enclosure.

The fiberglass scroll enclosure is used on the current configuration helicopter and those with the optional 250-C20 Series engine.

The belt driven impeller is dynamically balanced for operation at approximately 12,000 rpm.

On the shaft-driven blower, the impeller is mounted directly on the transmission input pinion gearshaft and is enclosed in a scroll that is attached to the transmission housing.

The shaft-driven impeller is dynamically balanced and rotates at approximately 6000 rpm.

The blower draws cooling air over the main transmission in addition to supplying forced ambient air to the engine oil cooler, compartment heating system and the engine area.

Sections 10 and 13 provide information on the engine cooling and oil cooler ducting

A. Oil Cooler Blower Removal (Early-Type, Belt-Driven)

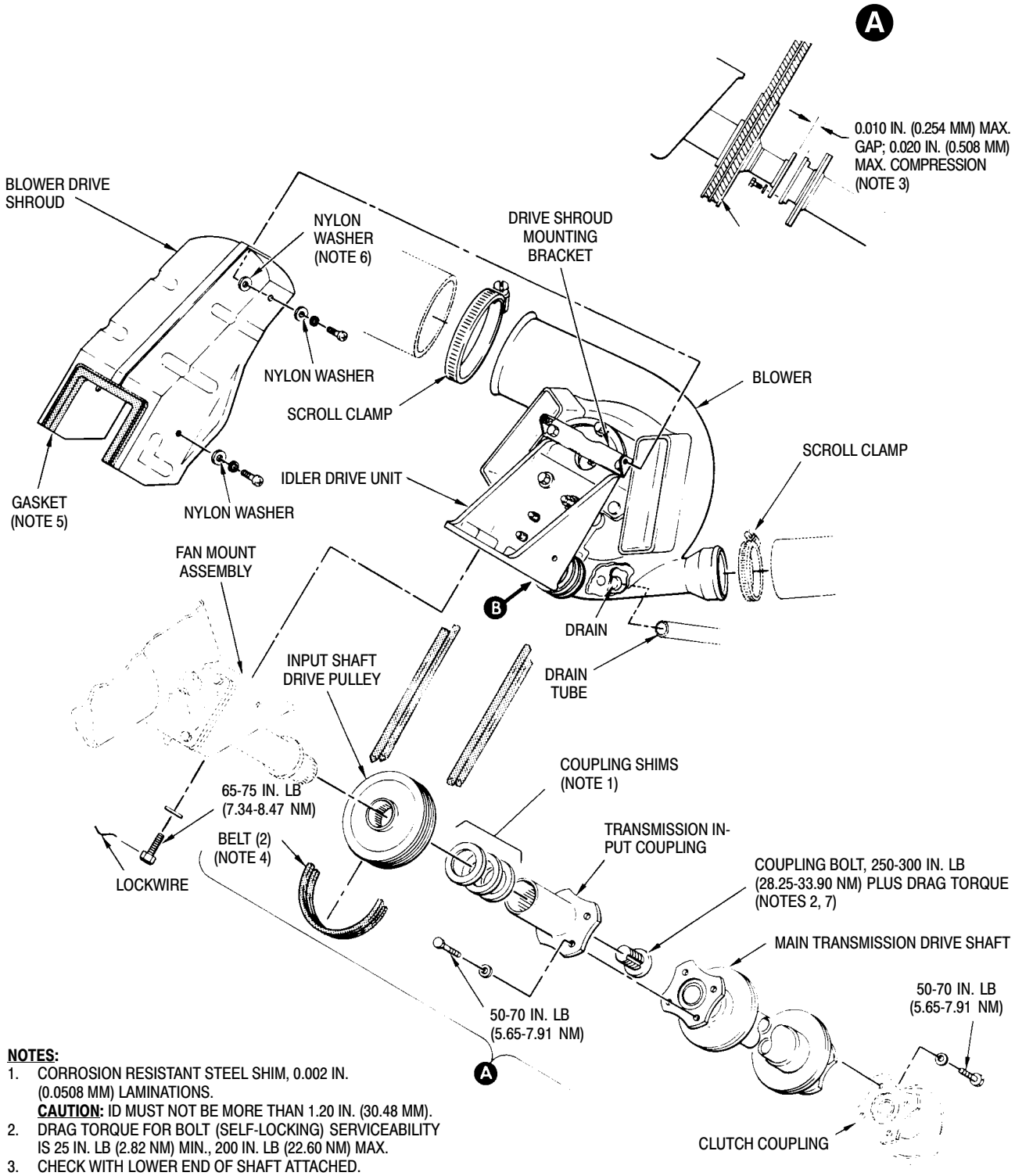
(Ref. Figure 9-6)

(1). Remove main transmission driveshaft.

(2). Remove belt-driven blower and attached idler drive unit as follows.

(a). Remove four screws and nylon washers that attach blower belt drive shroud to sides of transmission fan mount assembly and mounting bracket on idler drive unit. Remove blower belt drive shroud.

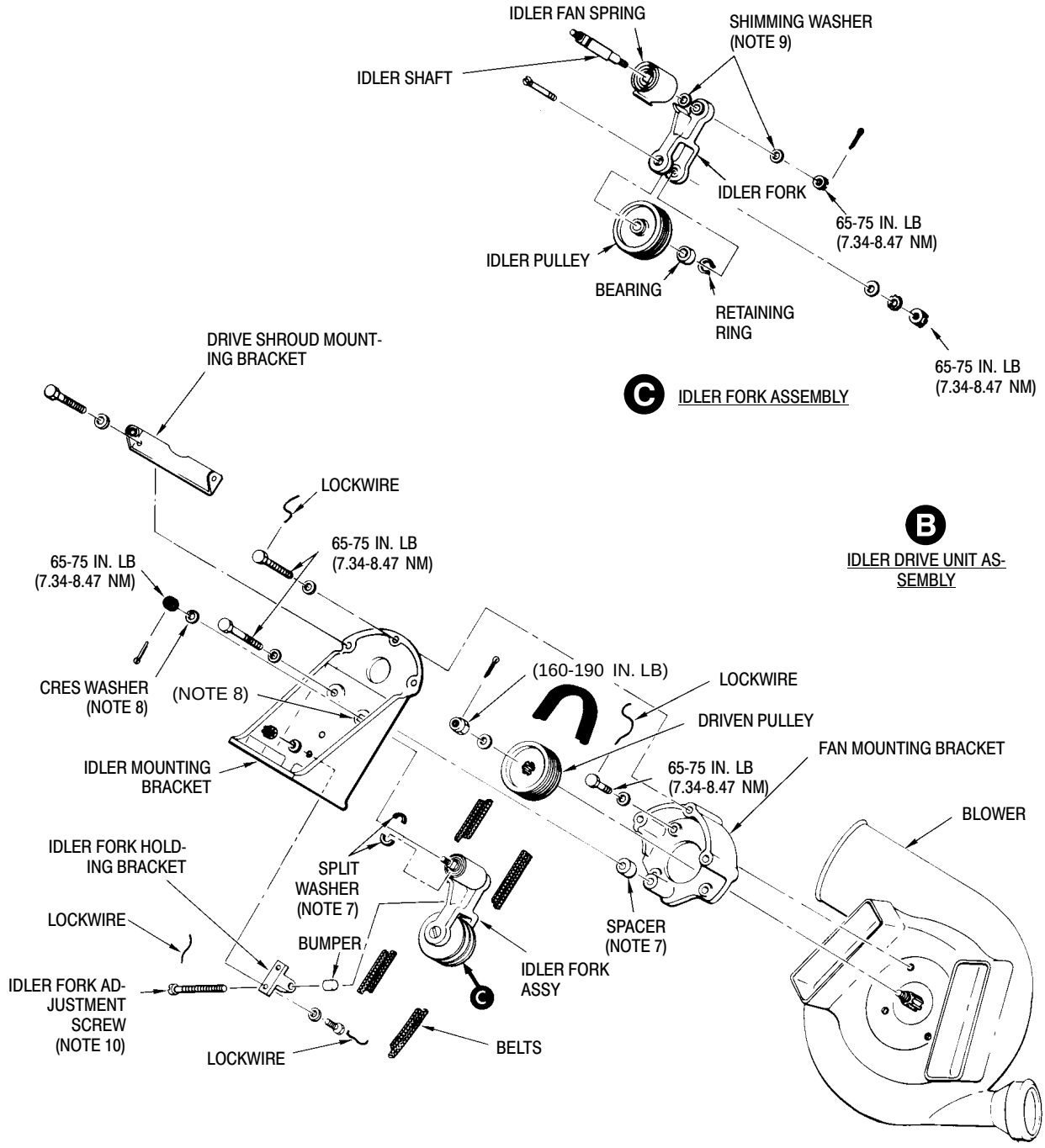
(b). Disconnect drain tube and loosen scroll clamps.



NOTES:

1. CORROSION RESISTANT STEEL SHIM, 0.002 IN. (0.0508 MM) LAMINATIONS.
   CAUTION: ID MUST NOT BE MORE THAN 1.20 IN. (30.48 MM).
2. DRAG TORQUE FOR BOLT (SELF-LOCKING) SERVICEABILITY IS 25 IN. LB (2.82 NM) MIN., 200 IN. LB (22.60 NM) MAX.
3. CHECK WITH LOWER END OF SHAFT ATTACHED.
4. REPLACE ONLY AS A MATCHED SET.
5. BOND TO SHROUD WITH ADHESIVE (91, TABLE 2-4).
6. USE AS REQUIRED TO CLOSE SHROUD TO BRACKET GAP.
7. COAT COUPLING BOLT THREADS WITH ANTI-SEIZE COMPOUND (36) BEFORE REASSEMBLY.

Figure 9-6. Main Transmission Driveshaft and Early Type Belt-Driven Oil Cooler Blower (Sheet 1 of 2)



NOTES: (CONT)

8. APPLY PRIMER (4, TABLE 2-4).
9. USE AS REQUIRED TO ALIGN IDLER PULLEY GROOVES WITH DRIVE PULLEY GROOVES. (SEE BELT TENSION AND PULLEY ALIGNMENT FIGURE.)
10. USE TO ADJUST IDLER FORK HOLD POSITION. (SEE BELT TENSION AND PULLEY ALIGNMENT FIGURE.)

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Figure 9-6. Main Transmission Driveshaft and Early Type Belt-Driven Oil Cooler Blower (Sheet 2 of 2)

(c). Cut lockwire from idler fork adjustment adjustment screw sufficiently so that idler fork can be positioned to release belt tension.

(d). Move idler fork to release belt tension and disengage both belts from main transmission input shaft drive pulley.

(e). Remove the lockwire, bolts and washers that attach idler drive unit to the transmission fan mount assembly.

(f). Remove the assembled fan and idler drive unit.

(g). As required, remove coupling bolt, transmission input coupling shim(s) and drive pulley from transmission input shaft. Keep shim(s) with couping for reuse.

(3). Remove components from the idler drive unit only to the extent required for maintenance, as follows.

(a). Remove nylon bumper from idler fork adjustment screw and adjustment screw from fork holding bracket on idler mounting bracket.

(b). Remove lockwire, bolts, and washers that attach fan mounting bracket to idler mounting bracket

(c). Remove spacer, belts fan and attached fan mounting bracket from idler mounting bracket. Keep spacer with fan mounting bracket for reuse.

CAUTION The impeller must be hand-held for pulley attachment nut removal. Do not hold impeller blades with tools or other devices to remove nut. Such action can physical damage.

(d). Remove cotter pin, pulley attachment nut and driven pulley for access to fan mounting bolts. Nut is removed by reaching through blower scroll primary air outlet and carefully hand-holding the impeller.

(e). Remove lockwire, bolts and washers attaching fan to fan mounting bracket; remove fan.

(f). Remove cotter pin, nut, washer and any shimming washers that attach idler fork to idler shaft.

(g). Remove idler yoke with attached idler pulley, washer and any shimming washers from idler shaft.

NOTE: The shaft bushing is factory installed by temperature-difference or press fit method and is to remain in idler yoke.

(h). Remove idler fan spring from shaft remaining on idler mounting bracket.

(i). Remove nut, washer and bolt attaching idler pulley to idler yoke.

NOTE: Retain shim washers with idler yoke.

(j). Remove retaining ring to remove bearing from idler pulley.

(k). Remove cotter pin, nut and CRES washer securing idler shaft in mounting bracket; remove idler shaft and split washer from idler mounting bracket.

(l). Remove idler fork holding bracket.

B. Oil cooler Blower Installation (Early- Type, Belt- Driven)

(1). Install belt-driven blower and idler drive unit as follows:

(a). Reassemble components on the idler mounting bracket, to the extent disassembled for maintenance, by reversing the order of disassembly and complying with the following instructions. See Figure 9-9 for stack of parts.

(b). Assemble idler pulley parts but do not torque nut at this time.

(c). Reinstall shim washers on sides of idler fork attachment end as required so that dimensions “B” and “C” (Ref. Figure 9-9) are equal and provide 0.001-0.020 inch (0.0254-0.508 mm) coaxial clearance.

(d). Install idler spring on idler shaft so that spring hook will be approximately 3 O’clock on the shaft centerline looking aft (at idler fork free position).

(e). Apply primer (4, Table 2-4) to inside of square hole in idler mounting bracket and split washer when installing idler spring shaft and idler fork. Torque nuts attaching idler fork to idler spring shaft to **65 - 75 inch-pounds (7.34 - 8.47 Nm)**. Ensure free movement of idler spring is not hampered.

(f). Torque bolts that attach fan to fan mounting bracket to **65 - 75 inch-pounds (7.34 - 8.47 Nm)**.

CAUTION Impeller must be hand- held when torquing pulley nut. DO NOT use tools or other devices to hold impeller while torquing pulley attachment nut.

(g). Reach through scroll primary air outlet and hand-hold impeller. Torque nut attaching driven pulley to impeller shaft to **160 - 190 inch-pounds (18.08 - 21.47 Nm)**.

(h). Position drive belt on driven pulley and attach fan mounting bracket (with blower assembly) to idler mounting bracket. Install spacer with primer and torque fan mounting bracket bolts to **65 - 75 inch-pounds (7.34 - 8.47 Nm)**.

(i). Rotate the idler arm to extreme position away from holding bracket. Position strap so that side of slot closest to spring touches the slot bolt. Torque the idler pulley bolt to **65 - 75 inch-pounds (7.34 - 8.47 Nm)**. Check movement of idler strap by pivoting idler arm. If necessary, adjust strap position to assure full travel within limits of slot.

NOTE: Prior to installation, inspect all ducting inlets and outlets and entire blower fan and scroll area for blockage or foreign objects.

(j). Position and install assembled drive belt unit (with blower) on transmission mounting pad, using existing washers and bolts. Do Not torque bolts at this time. Reconnect scroll ducting and rubber connectors.

(k). Install shroud mounting bracket on idler mounting bracket, using washers and bolts. Torque bolts to **65 - 70 inch-pounds (7.34 - 7.91 Nm)**.

(l). Install hard-anodized driver pulley on splined transmission input shaft. Reinstall existing shims and output coupling. Coat coupling threads with anti-seize compound (36) and install bolt. Check that bolt self-locking torque is not less than **25 inch-pounds (2.82 Nm)** or more than **200 inch-pounds (22.60 Nm)**. Torque bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**.

(m). Position drive belt on driver, driven and idler pulleys.

(2). Check for proper alignment of all three pulleys as follows

(a). Clamp alignment tool 369H9008 to left side upper surface of the driver pulley.

NOTE: Alignment tool is designed so that if idler pulley and driven pulley are in perfect alignment with the driver pulley, 0.030 inch (0.762 mm) feeler gage will just fit under offsets in tool at both idler and driven pulley surfaces. This tool is required to ensure alignment each time belt drive components are removed and replaced.

(b). If misalignment of driver pulley to driven pulley exceeds 0.020 inch (0.508 mm), perform one or both of the following.

1). Loosen four bolts attaching idler mounting bracket to transmission mounting pad and slide bracket in direction desired. Re-secure and torque bolts to **65 - 75 inch-pounds (7.34 - 8.47 Nm)**.

2). If adjustment in step 1). is not sufficient and driven pulley still needs to be raised, remove the driver pulley from the transmission input shaft and transfer 369A5625 coupling shims, as required, to upper side of driver pulley. Reinstall driver pulley and coupling bolt.

(c). Align idler pulley to driven pulley, as required, by transferring shims between dimensions “B” and “C” (Ref. Figure 9-9); hold to 0.020 inch (0.508 mm) maximum misalignment. Ensure that idler arm is not hampered.

(d). Remove and clamp alignment tool on right (opposite) side of driver pulley and recheck alignment to driven pulley on that side. Alignment should agree within 0.015 inch (0.381 mm) to measurement obtained in step (b).

(3). Adjust idler fork for proper belt tension.

(4). Reconnect blower scroll drain tube. Reinstall channel assemblies, as applicable, using eight screws, washers and nuts. Do not use rivets.

(5). Install guard, using existing shroud hardware. Install transmission input shaft seal drain tube on right side of guard, using clamp shown in Figure 9-6, view C. Pull drain tube downward and secure to helicopter structure with tie-strap.

(6). Connect blower scroll drain tube and check for excess slack and close proximity to driveshaft. Reposition and secure drain tube with tie-strap to helicopter structure, as required, to eliminate slack or possible interference with driveshaft. Check drain tube for kinks.

(7). Install main transmission driveshaft.

(8). Rotate driveshaft by hand and check pulley operation.

(9). Lockwire in pairs: the four bolts securing the idler mounting bracket to the transmission mounting pad; and the four bolts securing idler mounting bracket to fan mounting bracket.

(10). Perform operational check of belt-driven oil cooler blower system.

(11). Install main transmission access covers and trim cover panel.

C. Oil Cooler Blower Removal (Current-Type, Belt-Driven)

(Ref. Figure 9-7)

(1). Remove main transmission driveshaft.

(2). Remove transmission input coupling bolt, input coupling, coupling shims and input shaft drive pulley. Retain shim for reinstallation.

(3). Cut lockwire and remove four bolts attaching mounting bracket to transmission fan mount assembly. Retain laminated shims for reinstallation.

(4). Cut lockwire and remove four bolts attaching mounting bracket to fan mounting bracket.

(5). Disconnect blower scroll drain tube. Loosen scroll duct clamp and roll back rubber connectors; disconnect scroll ducts.

NOTE: The capstrip on the right channel, adjacent to blower, may be removed if required for access.

(6). Remove fan mounting bracket (with blower scroll, pulley and belt) from helicopter.

CAUTION The impeller must be handheld for removal of driven pulley attachment nut. Do not hold impeller blades with tools or other devices to remove nut. Such action can affect impeller balance as well as cause physical damage.

(7). Remove nut and washer securing driven pulley on impeller shaft.

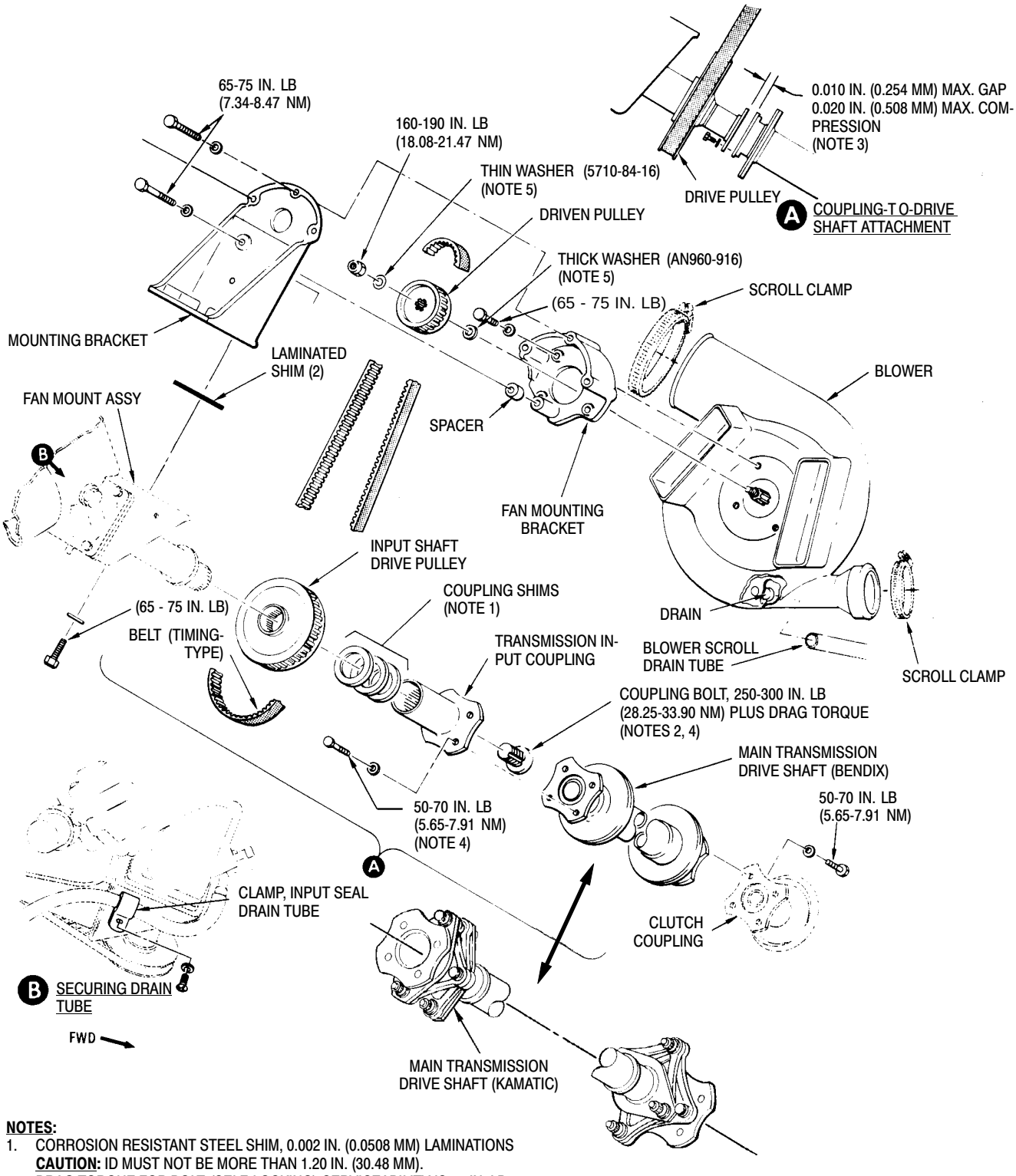
(8). If required, cut lockwire and remove bolts attaching fan mounting bracket tom blower assembly.

D. Oil Cooler Blower Installation (Current- Type, Belt- Driven)

(1). Install fan mounting bracket on blower assembly.

NOTE: Before tightening bolts, remove bolt hole slack in the belt tension direction by moving blower toward, and bracket away from, the transmission driveshaft side.

(2). Torque bolts to **65 - 75 inch-pounds (7.34 - 8.47 Nm)**.



NOTES:

1. CORROSION RESISTANT STEEL SHIM, 0.002 IN. (0.0508 MM) LAMINATIONS
   CAUTION: ID MUST NOT BE MORE THAN 1.20 IN. (30.48 MM).
2. DRAG TORQUE FOR BOLT (SELF-LOCKING) SERVICEABILITY IS 25 IN. LB (2.82 NM) MIN., 200 IN. LB (22.60 NM) MAX.
3. CHECK WITH LOWER END OF SHAFT ATTACHED.
4. COAT COUPLING BOLT THREADS WITH ANTISEIZE COMPOUND (36, TABLE 2-4) BEFORE ASSEMBLY.
5. REPLACE ANY EXISTING ALUMINUM WASHER WITH STEEL WASHER INDICATED.

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Figure 9-7. Main Transmission Driveshaft and Current Type Belt-Driven Oil Cooler

CAUTION Impeller must be hand- held when torquing pulley nut. Do not use tools or other devices to hold impeller while torquing pulley attachment nut.

NOTE: When performing step (3). below, replace any original aluminum washers with thick and thin steel washers.

(3). Install pulley on impeller shaft with a thick washer under pulley and a thin washer under shaft nut. Reach through scroll primary air outlet and hand-hold impeller. Torque nut attaching driven pulley to impeller shaft to **160 - 190 inch-pounds (18.08 - 21.47 Nm)**.

(4). Position timing-type belt on driven pulley and attach fan mounting bracket (with blower assembly to mounting bracket. Install spacer with primer (4, Table 2-4).

NOTE: Before tightening bolts, remove all bolt hold slack in the belt tension direction by moving mount bracket away from the transmission driveshaft side.

(5). Torque bolts to **65 - 75 inch-pounds (7.34 - 8.47 Nm)** and then safetywire.

NOTE: Prior to installation of blower assembly, inspect all ducting inlets and entire blower fan and scroll area or foreign objects.

(6). Install timing-belt type driver pulley on splined transmission input shaft; do not hammer or strike on pulley if force fit. Reinstall existing shims and output coupling. Coat coupling threads with anti-seize compound (36) and install bolt. Check that bolt self-locking torque is not less than **25 inch-pounds (2.82 Nm)** or more than **200 inch-pounds (22.60 Nm)**. Torque bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**.

(7). Position assembled drive belt unit and blower assembly on transmission mounting pad, without shims, washers and bolts. Position belt on driver pulley and check position on driver pulley.

CAUTION Do not use levers or tools on belt or in any way force belt onto driver pulley.

(8). Install four mounting bolts, washers and two laminated shims. Reconnect scroll ducting and rubber connectors.

(9). Adjust belt tension as follows:

(a). Check that laminated shims are in position between mounting bracket and transmission fan mount assembly. Tighten the four mounting bolts. Rotate pulley by hand a few turns to even out belt tension.

(b). Measure belt deflection at approximate center of one of the spans. The force required to deflect the belt 0.170-0.200 inch (4.318-5.08 mm) must be 1.00-1.75 pounds (4.448-7.784 N). This load is to be applied at a right angle to the outside face of the belt.

(c). If the tension is too high, greater than 1.75 pounds (7.784 N): Tension can be reduced by peeling off a layer of the laminated shim, one at a time alternately from shim to shim, until tension falls into proper range.

(d). If the tension is to low: Add layers from a spare shim in the same manner as removed in step (c). above, until tension falls into proper range.

(e). Make a final check of bolt torque, **60 - 75 inch-pounds (6.78 - 8.47 Nm)** and then safetywire.

(10). Install transmission input shaft seal drain tube on right side of transmission fan mount, using clamp shown in Figure 9-7. Pull drain tube downward and secure to helicopter structure with tie-strap.

(11). Connect blower scroll drain tube and check for excess slack and proximity to driveshaft. Reposition and secure drain tube with tie-strap to helicopter structure, as required, to eliminate slack or possible interference with the driveshaft.Check the drain tube for kinks.

(12). Install main transmission driveshaft.

(13). Rotate driveshaft by hand and check pulley operation.

(14). Perform operational check of belt-driven oil cooler system.

E. Oil Cooler Blower Inspection (Belt-Driven)

(Ref. Figure 9-8 and Figure 9-9) For recommended replacement intervals of bearings and belt, refer to CSP-H-4.

(1). Early Type Installed Blower-Belt Condition:

(a). Remove plug buttons (or tape) from inspection ports on main transmission trim cover panel

(b). Visually inspect drive belt for proper seating in pulley grooves and for condition of belt.

NOTE: Belt should be fully seated in pulley grooves. Cracking or separation of the belt between pulley grooves is acceptable. Visually monitor propagation. Belt should be replaced if any one separation exceeds 3.00 inches (7.62 cm) in length or if total separation exceeds 50% of the peripheral length of the belt.

(c). Install plug buttons (or tape) at inspection ports of trim cover panel.

(2). Early Type Installed Blower-Belt Tension:

(a). Remove main transmission access cover and trim panel.

NOTE: Whenever belt drive components are removed and/or replaced at specified intervals, belt should be adjusted per steps (b). thru (g). below.

(b). Loosen bumper stop jam nut and back off stop screw for free movement of idler fork.

(c). On installation with a slotted idler strap, check that idler fork is free to move under spring tension. If the slotted strap binds to prevent movement of fork, loosen the idler pulley bolt and strap bolt and reposition strap for free movement. Tighten idler pulley bolt. The strap bolt should be loose enough to allow strap movement.

(d). Check idler spring tension using a spring scale attached to the idler pulley bolt. Spring tension should be **4 - 5.5 pounds (17.8 - 24.5 N)** just as idler pulley contacts belt. Spring tension is adjusted by rotating the square idler shaft bolt in the idler mounting bracket (Ref. Figure 9-6, detail C).

(e). Rotate drive pulley by hand a few turns so that belt tension is evened out under the spring tension.

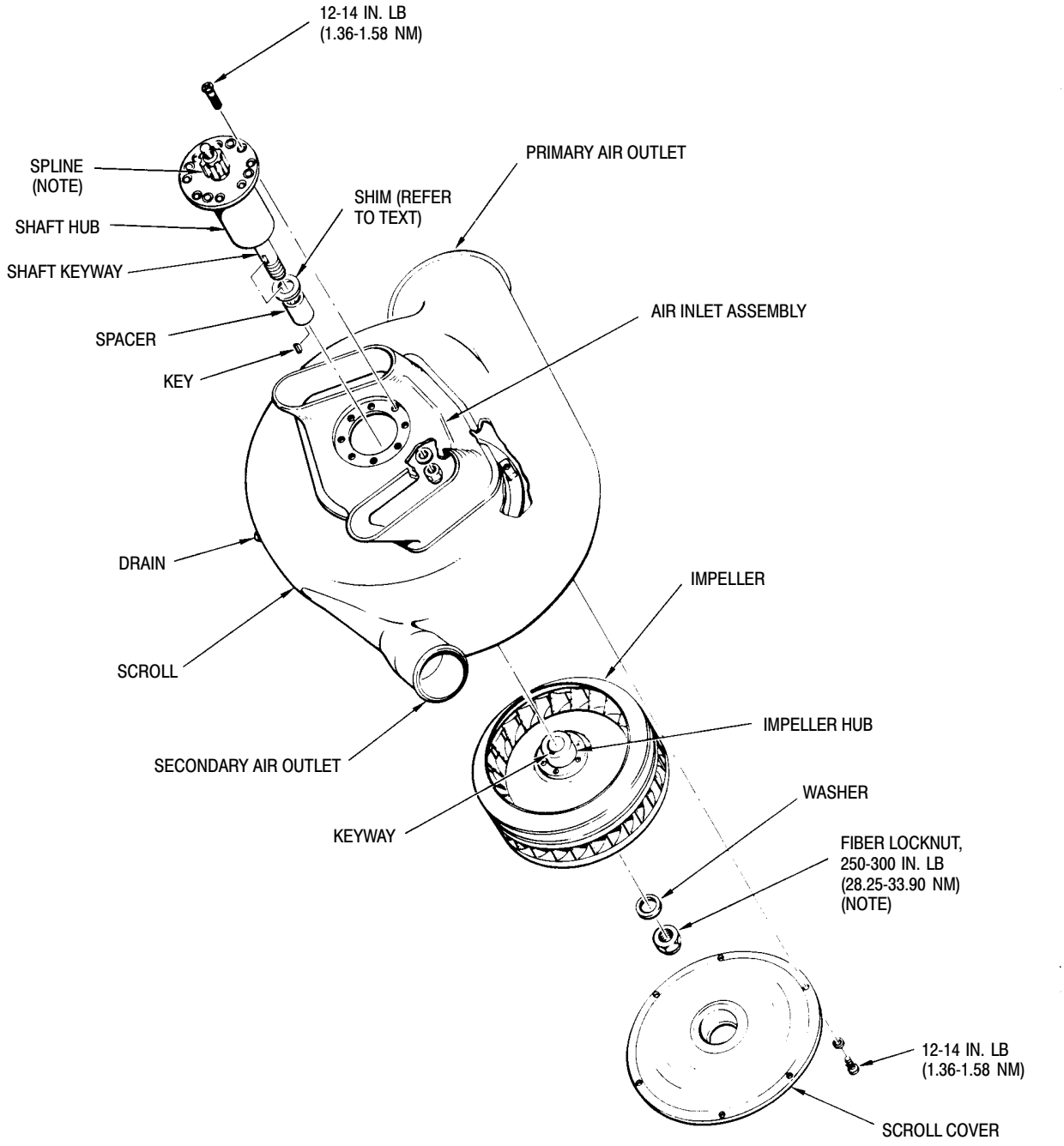
(f). Adjust stop by turning in the stop screw until the stop bumper just contacts the idler fork arm. If screw head bottoms on bracket, additional extension is available by turning the stop.

(g). After contact is made, lock the nut against the stop. Check for over-extension of stop by inserting wire through safety hole to determine that stop screw is not retracted beyond the safety hole.

(h). Install the main transmission access cover and trim panel.

(3). Installed Blower General Inspection:

(a). Check oil cooler blower and drive components for smoothness and correct operation while hand-turning main rotor through several complete revolutions, first clockwise and then counter-clockwise. Listen and feel for evidence of rubbing or chafing between impeller and blower scroll. No rubbing or noise is permissible. Belts should remain seated and be a snug fit in pulley grooves while rotating. Also check for parallel alignment of belts between pulleys.



NOTE:
HOLD ONLY THE SHAFT HUB SPLINE WHEN LOOSENING OR TIGHTENING THE FIBER NUT.

CAUTION:
DO NOT HOLD IMPELLER WITH TOOLS OR OTHER DEVICES. TOOLS WILL DAMAGE THE PRECISION BALANCE OF THE IMPELLER. ALL ROTATING COMPONENTS ARE MATCHED AND BALANCED AND MUST BE REASSEMBLED TOGETHER TO MAINTAIN DYNAMIC BALANCE.

30-157B

Figure 9-8. Belt-Driven Oil Cooler Blower (Screw-Assembled), Exploded View

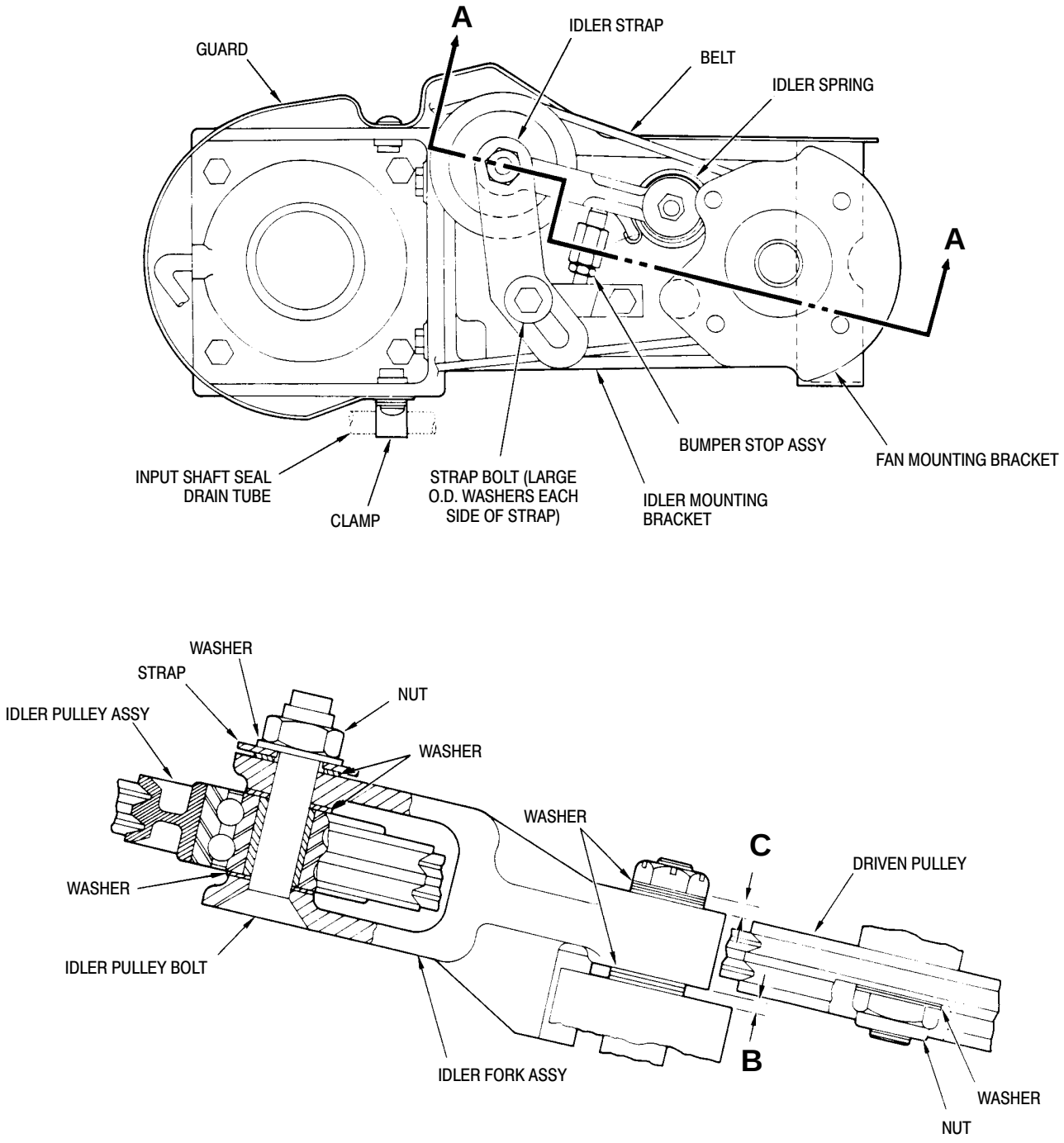


Figure 9-9. Early Type Belt-Driven Oil Cooler Belt Tension and Pulley Alignment

(b). Check ducting and shrouds for cracks. Also check boots, if installed, for condition. Ducting is to be repaired as required. Replace boots if wear, damage or deterioration is noted.

(c). Check blower scroll for condition (Ref. Oil Cooler Blower Inspection (Shaft-Driven)) and security of attaching hardware. Check drain tube for freedom from obstruction. Check drain tube for kinks, collapsed walls and proper position.

(d). Visually inspect impeller for cracks and separated or deform vanes. Direct a light through duct openings in scroll. An impeller having any damage, including scratches, cracks, notches and deformation, requires replacement of the blower.

(4). Removed Blower Inspection When Assembled:

NOTE: The following inspection procedures are to be performed whenever the blower is removed.

(a). Inspect normally inaccessible areas for damage (Ref. Oil Cooler Blower Inspection (Shaft-Drive)).

(b). Visually inspect (minimum 10X magnification) or dye-penetrant inspect impeller root areas for cracks, scratches and notches. Impeller scratches and notches in excess of 0.006 inch (0.1524 mm) depth, deformation, and any other impeller damage is not allowable.

CAUTION Any impeller damage requires blower replacement.

(5). Removed Blower Inspection When Disassembled:

NOTE: The following applies only to the screw-assembled blower, not a riveted blower assembly.

(a). Inspect scroll areas inaccessible on an assembled blower for damage (Ref. Oil Cooler Blower Inspection (Shaft-Driven)).

(b). Visually inspect (minimum 10X magnification) all blower rotating components for wear, cracks, scratches and any other damage.

CAUTION Handle rotating components carefully, especially impeller, to prevent damage and imbalance. Any impeller damage requires blower replacement.

(c). Visually inspect vanes for deformation,separation and cracks.

(d). Dye-penetrant inspect impeller root area for cracks, scratches and notches.

(e). Inspect for foreign material attached to impeller; foreign material attachment is not is not allowable.

(f). Check for free end play between blower shaft and internal bearings in hub; no play is permitted.

(g). Inspect for surface damage; use an electroprobe or a gage of equivalent accuracy to measure depth of scratches and nicks. Any metal surface damage is not allowable.

F. Oil Cooler Blower Removal (Shaft-Driven)

(Ref. Figure 9-10)

(1). Remove main transmission driveshaft.

(2). Loosen scroll clamp.

(3). Remove the bolts and washers that attach scroll to main transmission.

(4). Remove scroll, lower end of drain tube, aft cover, and main transmission drain assembly.

(5). Remove coupling bolt, transmission input coupling, shim(s) and impeller. Keep shim(s) with coupling for reuse.

G. Oil Cooler Blower Installation (Shaft-Driven)

(1). Position impeller on transmission input shaft.

(2). Install coupling shim(s) and transmission input coupling. Coat coupling bolt threads with anti-seize compound (36, Table 2-4) and install bolt. Check that

bolt self-locking drag torque is not less than **25 inch-pounds (2.82 Nm)** or more than **200 inch-pounds (22.60 Nm)**. Torque bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**.

(3). Position scroll to engage oil cooler and heater system ducting. Position aft cover and yoke-type drain assembly. Install bolts and washers to secure scroll to transmission. Torque the bolts; torque should not exceed **5 - 10 inch-pounds (0.56 - 1.13 Nm)**.

(4). Tighten scroll clamp and connect output seal drain tube. Secure drain tube. Secure drain tube with a double wrap of lockwire.

(5). Turn impeller and check for clearance with scroll.

(6). Install main transmission driveshaft.

(7). Install capstrip on right channel, if removed, main transmission access cover and trim cover panel.

H. Oil Cooler Blower Inspection (Shaft-Driven)

(Ref. Figure 9-10)

(1). Scroll:

(a). Inspect for surface damage; use an electroprobe or a gage of equivalent accuracy to measure depth of scratches and nicks. Scratches and nicks that do not exceed 0.012 inch (0.3048 mm) depth are repairable.

(b). Inspect for and measure length of cracks. Cracks that do not exceed 3 inches (7.62 cm) in length, do not extend to the hardware mounting holes and will not impair the function of the scroll are repairable.

(c). Inspect ribs and seams for separation, and thread nutplates or inserts for stripped threads or looseness in flange.

NOTE: There may be small irregular- shaped voids in the cement between the cemented pieces. Such voids should not be considered as delamination (separation).

(d). Check for scroll wear caused by impeller rubbing.

(e). Check rectangular gasket for deterioration.

(f). Inspect teflon seal ring that is bonded to the transmission shroud and bearing-retainer mount. Seal ring must be completely bonded around the mount perimeter.

(2). Impeller:

(a). Inspect for cracks and separated or deformed vanes. A cracked impeller or one having damaged vanes shall be considered unserviceable and be replaced.

(b). Inspect for surface damage; use an electroprobe or gage of equivalent accuracy to measure depth of scratches and nicks. Scratches and nicks not exceeding 0.006 inch (0.1524 mm) depth are repairable if impeller imbalance does not result.

I. Oil Cooler Blower Disassembly (Belt-Driven)

(Ref. Figure 9-8) The following information provides disassembly procedures that apply only to the screw-assembled belt-driven blower and is intended for use to the extent required for inspection of specific components. The riveted belt-driven blower should not be disassembled.

CAUTION The blower assembly is a balanced unit and must be handled carefully to prevent damage that could result in assembly imbalance. The blower contains match-balanced rotating components and assemblies that must be reused together. Retain all rotating parts for subsequent reassembly. Disassembly only to the extent specified in the procedures.

(1). Remove scroll cover from scroll by removing screws and washers.

CAUTION In the following steps, do not use tools or other devices to hold impeller. Tool damage can affect the precision balance of the impeller. Do not use any type of holding device that will place a strain on the blower scroll. The holding device must be capable of holding the shaft with **250 - 300 inch-pounds (28.25 - 33.90 Nm)** torque applied to the fiber nut.

(2). Secure pulley (splined) end of impeller shaft with a holding device that will prevent shaft and impeller rotation while removing fiber nut that secures impeller hub to shaft.

(3). While holding the pulley (splined) end of the impeller, loosen and remove fiber nut and washer securing impeller hub on shaft.

CAUTION Be careful to prevent impeller damage. Slight impeller deformation or damage can cause imbalance. Protect shaft threads and use non-metallic mallet when performing step (4). below.

(4). Manually support impeller with the fingers and separate impeller from blower shaft by carefully tapping impeller hub end of shaft.

(5). Remove impeller from inside scroll. As impeller slides off shaft end, remove and retain shaft key, spacer and shims (if any) for reuse.

(6). Detach shaft hub from blower air inlet assembly by removing screws, washers and nuts (spacer and nut ring on fiberglass assemblies).

NOTE: If spacer is removed from splined end of shaft retain spacer and shims (if any) for reuse.

J. Oil Cooler Blower Reassembly (Belt-Driven)

(Ref. Figure 9-11)

CAUTION Review the Cautions in Oil Cooler Blower Disassembly (Belt- Driven) regarding holding, handling and reuse of belt- driven blower blower matched- balanced rotating component. These components must be handled carefully to avoid damage.

(1). Insert impeller shaft into blower scroll and install shaft blower air inlet assembly with screws, washers and nuts (spacer and nut ring on fiberglass assemblies). Torque screws to **12 - 14 inch-pounds (1.36 - 1.58 Nm)**.

(2). Install spacer and impeller on shaft.

(3). Install washer and locknut on end of shaft. Using a holding device on splined end of shaft, tighten locknut sufficiently to remove all end clearance from the stack-up of parts.

(4). Check for minimum clearance between impeller and shroud lip, using a feeler gage through the larger air outlet port.

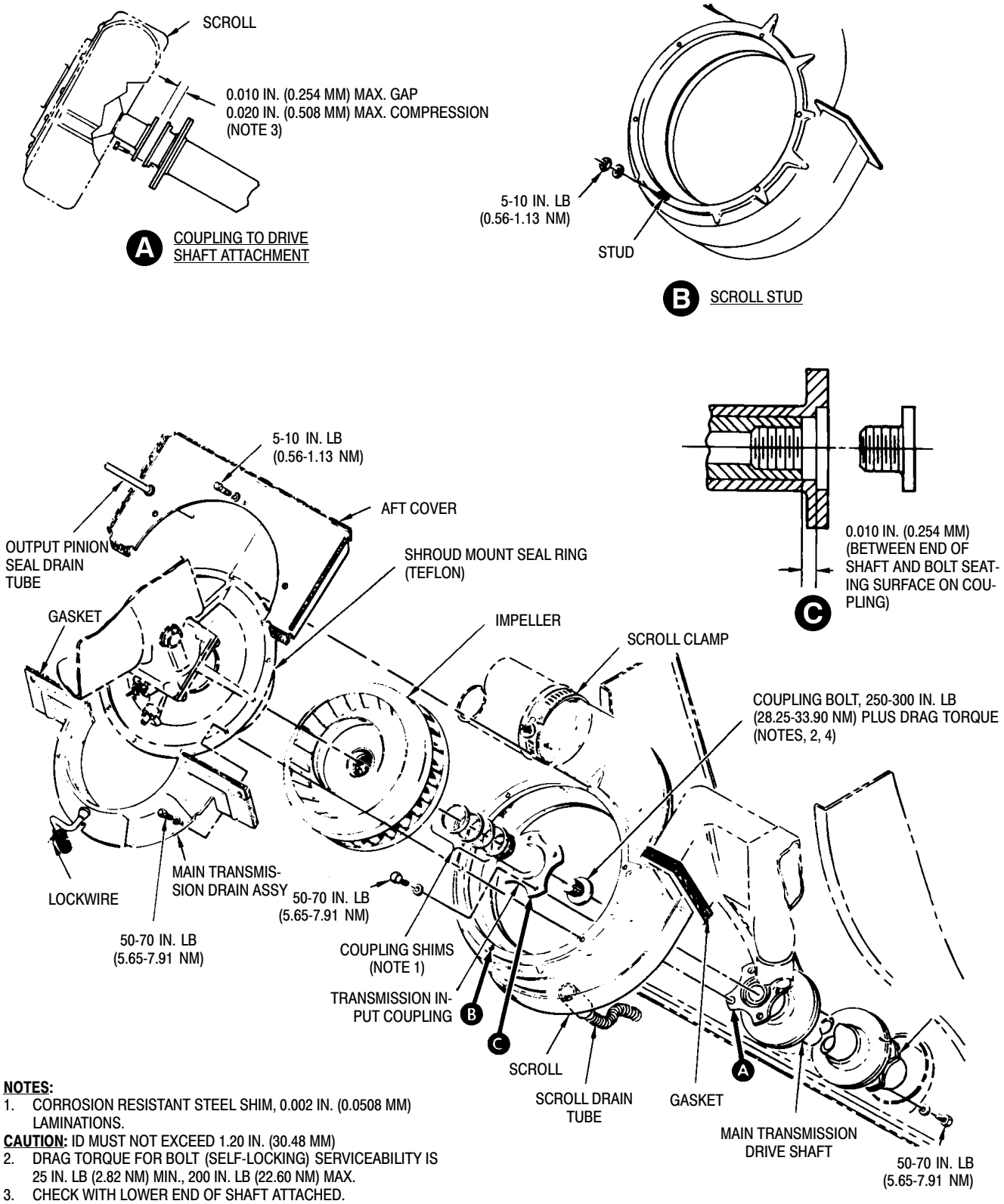
(5). Remove impeller and spacer and grind or file spacer to remove the minimum clearance measured in step (4). Coat reworked end of spacer with primer (4, Table 2-4).

(6). Reinstall spacer, impeller, washer and locknut. Tighten to remove all end clearance and then rotate impeller and check for rubbing. If impeller rubs shroud, disassemble and install shim(s) 369H5654, 0.002 inch (0.0508 mm) thick, between bearing inner race and spacer to eliminate rubbing.

NOTE: This procedure (steps (4). thru (6). above) ensures that impeller is at minimum clearance without rubbing shroud lip.

(7). When clearance is properly adjusted, remove impeller, and install shaft key, impeller, washer and locknut. Torque locknut **250 - 300 inch-pounds (28.25 - 33.90 Nm)**. Use care to avoid placing stress on the impeller or scroll. Hold the splined end of the shaft in a suitable device.

(8). For fiberglass scrolls, install scroll cover with a bead of sealant (3) between mating surfaces. Secure cover to scroll with screws and washers. Torque screws to **12 - 14 inch-pounds (1.36 - 1.58 Nm)**.



NOTES:
1. CORROSION RESISTANT STEEL SHIM, 0.002 IN. (0.0508 MM) LAMINATIONS.

CAUTION: ID MUST NOT EXCEED 1.20 IN. (30.48 MM)

2. DRAG TORQUE FOR BOLT (SELF-LOCKING) SERVICEABILITY IS 25 IN. LB (2.82 NM) MIN., 200 IN. LB (22.60 NM) MAX.
3. CHECK WITH LOWER END OF SHAFT ATTACHED.
4. COAT COUPLING BOLT THREADS WITH ANTI-SEIZE COMPOUND (36, TABLE 2-4) BEFORE ASSEMBLY.

30-152E

Figure 9-10. Main Transmission Driveshaft and Shaft-Driven Oil Cooler Blower

K. Oil Cooler Blower Repair

(Ref. Figure 9-8 and Figure 9-10)

(1). Scroll:

The early type scroll is made of acrylic plastic while the later type is of laminated fiberglass. For fiberglass repair refer to CSP-H-6 and use only the applicable portions of the following procedure.

NOTE: All permissible patching repairs must be made on exterior surfaces so that internal airflow is not restricted. Any repair made must not restrict airflow. Patching or repair that prevents proper duct mating and sealing, or that results in interference at installation, is not allowable. On the belt-driven blower, patching is not permissible on the upper flat and depressed attachment areas of the inlet assembly. Patching is permissible on shroud flat and circular surface areas.

(a). Repairs cracks that do not exceed 3 inches (7.62 cm) in length, do not extend to the hardware mounting holes and will not impair the function of the scroll. Such scroll damage is repairable by bonding a patch according to the criteria and methods specified for acrylic in FAA AC 43.13-1A, Aircraft Inspection and Repair. Use dichloromethane (38, Table 2-4) or ethylene dichloride (39) as the bonding agent.

(b). Repair scratches and nicks not exceeding 0.012 inch (0.3048 mm) depth by sanding the affected area to blend smoothly with surrounding surface area. Use grade 320 abrasive paper (9).

(c). On a shaft-driven blower, replace inserts that are stripped or loose. Use self-locking inserts NAS1394-3L for replacement. (Drill and tap the scroll according to the NAS insert specification.)

(d). Repair small areas of rib or seam separation by injecting ethylene dichloride into the void area and clamping together under light pressure. On shaft-driven blower, repair deteriorated or otherwise damaged gasket by replacing with 0.50 inch (12.7 mm) thickness of gasket material (40).

(e). On a shaft-driven blower, repair a teflon seal ring that is not completely secure around outside edge of transmission shroud and bearing-retainer mount. Bond the loose area with a mixture of 100 parts of resin to 74 parts of activator (43). Cure at 150°F (66°C) for 1 hour or for 8 hours at room temperature.

(2). Impeller:

(a). Replace impeller that is cracked or that has damaged vanes or loose rivets securing adapter to impeller or balance weights to impeller.

(b). Repair scratches and nicks not exceeding 0.006 inch (0.1524 mm) depth by sanding. Use grade 320 abrasive paper to blend defect into surrounding surface area.

(3). Bearing Replacement (Belt-Driven Blower):

(a). Disassemble belt-driven oil cooler blower assembly.

(b). Remove snap ring, washer and wave washer from impeller end of shaft.

(c). Install existing nut on splined end of shaft.

(d). Using fiber/rubber mallet or equivalent, tap gently on nut to remove shaft and bearings from hub; remove nut.

(e). Using a arbor press or equivalent tool, press bearing from shaft. When removing bearing from splined end of shaft, retain the shim (if installed) and spacer for reinstallation. Check spacer for 0.5630-0.5645 inch (14.3002-14.3383 mm) ID. Ream if necessary and coat reworked surface lightly with primer (4).

(f). Discard old bearings.

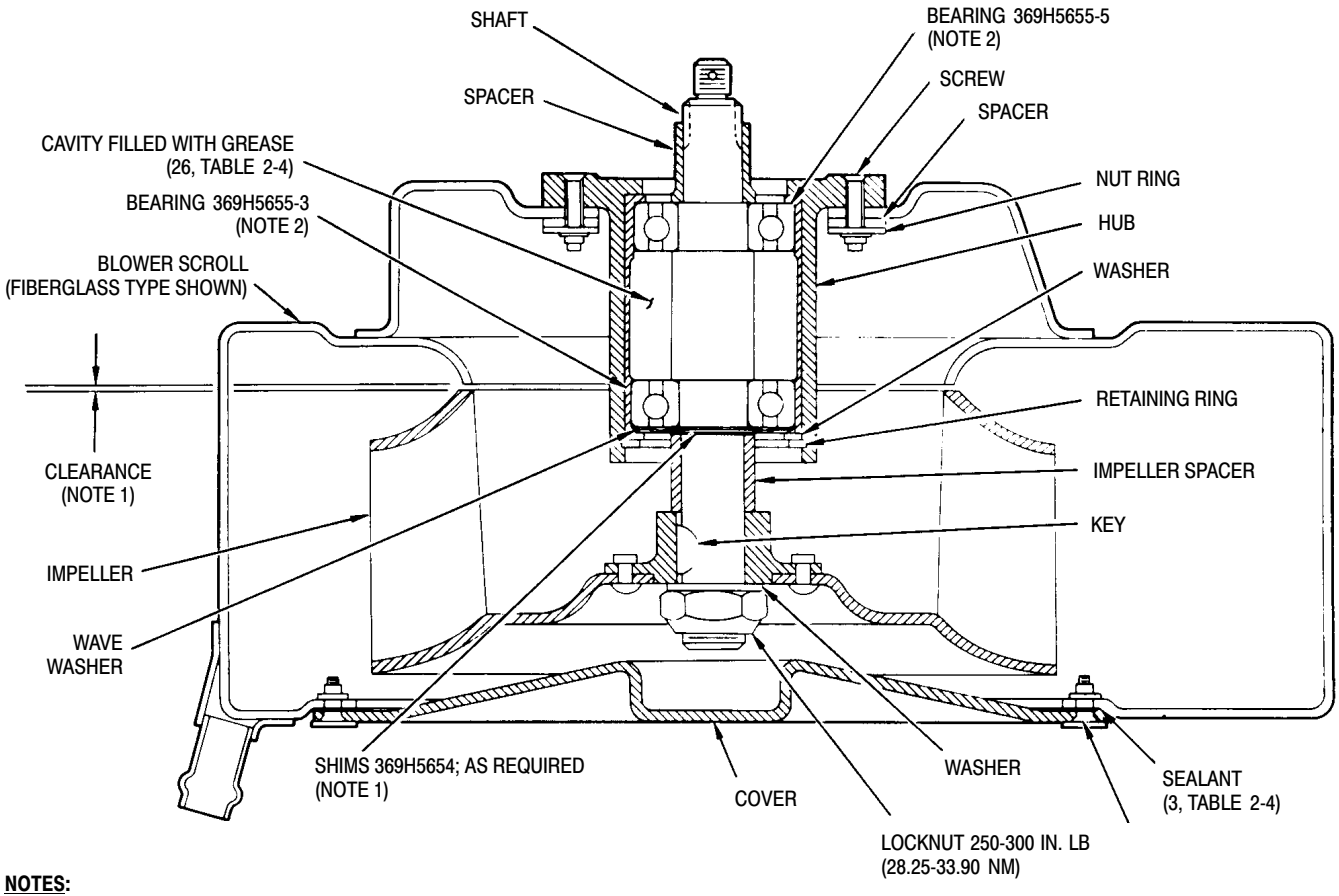


Figure 9-11. Cutaway View of Belt-Driven Oil Cooler Blower

(g). Clean the shaft and interior of hub with solvent (1).

(h). Lightly coat bearing journal or splined end of shaft and ID of bearing 369H5655-5 with grease (26) Position bearing on shaft with rubber grease seal outward. Press against bearing inner race until bearing is seated on shaft shoulder.

(i). Install shims (if applicable) on splined end of shaft; then press on the upper spacer with larger OD end toward bearing inner race.

(j). Lightly coat interior of hub with grease; then install the shaft and upper bearing assembly. Press against bearing outer race if necessary.

(k). Fill hub cavity with grease up to about half the width of the lower bearing land in hub.

(l). Position bearing 369H5655-3 on shaft with rubber grease seal outward (toward impeller). Press against bearing inner and outer races simultaneously to seat bearing in hub and on shaft journal.

(m). Wipe away excess grease that is forced from bearing seals at both ends of shaft.

(n). Install a nut temporarily on splined end of shaft. Using a fiber/rubber mallet, tap on nut to extend lower bearing out of hub enough for excess to hub interior.

(o). Remove approximately 1/4 teaspoon of grease from hub interior an then reinstall shaft and bearings in hub; secure with wave washer, washer and snap ring.

NOTE: Ensure that wave washer is installed next to bearing on impeller end. Also check that OD of the washer is completely seated against the outer race of bearing.

(p). Rotate shaft by hand to check smoothness of operational. Reassemble blower.

8. Overrunning Clutch

(Ref. Figure 9-12) The overrunning clutch transmits power from the engine to the main transmission driveshaft in a clockwise direction. The purpose of the clutch is to disengage the engine from the remainder of the drive system (allow free-wheeling) in case of engine failure and during auto-rotations. The clutch contains a sprag unit that disengages automatically when N_2 rpm is less than the corresponding main rotor rpm.

A. Overrunning Clutch Removal

NOTE: Refer to Overrunning Clutch Assembly Replacement for removal of only the internal clutch subassembly as an alternative to complete clutch removal.

(1). Remove engine (Ref. Sec. 10).

(2). Remove the bolts, washers, nuts and engine shaft firewall seal from the clutch.

NOTE: Removal of the clutch coupling from the clutch in step (3). is unnecessary unless the clutch is being replaced.

(3). Remove coupling bolt, packing, clutch coupling and coupling shim(s). Keep shim(s) with coupling for reuse. Reinstall bolt and packing to prevent spillage of lubricating oil from clutch housing during final steps of removal.

(4). Remove nuts and washers that secure the overrunning clutch; remove clutch.

(5). If the clutch is being replaced, install a spare coupling bolt 369A5513 or 369A5528 and packing MS29561-017 or suitable plug in the output shaft (clutch inner race bore) to prevent contamination during clutch handling, shipping or storage.

NOTE: The operating lubricant is an approved preservative for shipping or storage.

(6). Wrap clutch in barrier material (44, Table 2-4) to protect splined areas of race shaft.

B. Overrunning Clutch Installation

NOTE: Trapped oil can be removed by inverting the clutch a minimum of three times.

(1). If clutch is new, remove tag, drain residual (trapped) preservative oil and add lubricating oil (9, Table 2-3).

NOTE: The -11, -21 and -31 clutch assembly capacity is 1.52 U.S. Oz (45cc).
The -41 and -51 clutch assembly capacity is 1.01 U.S. Oz (30cc).

(2). Check fluid level of clutch assembly before installing clutch coupling.

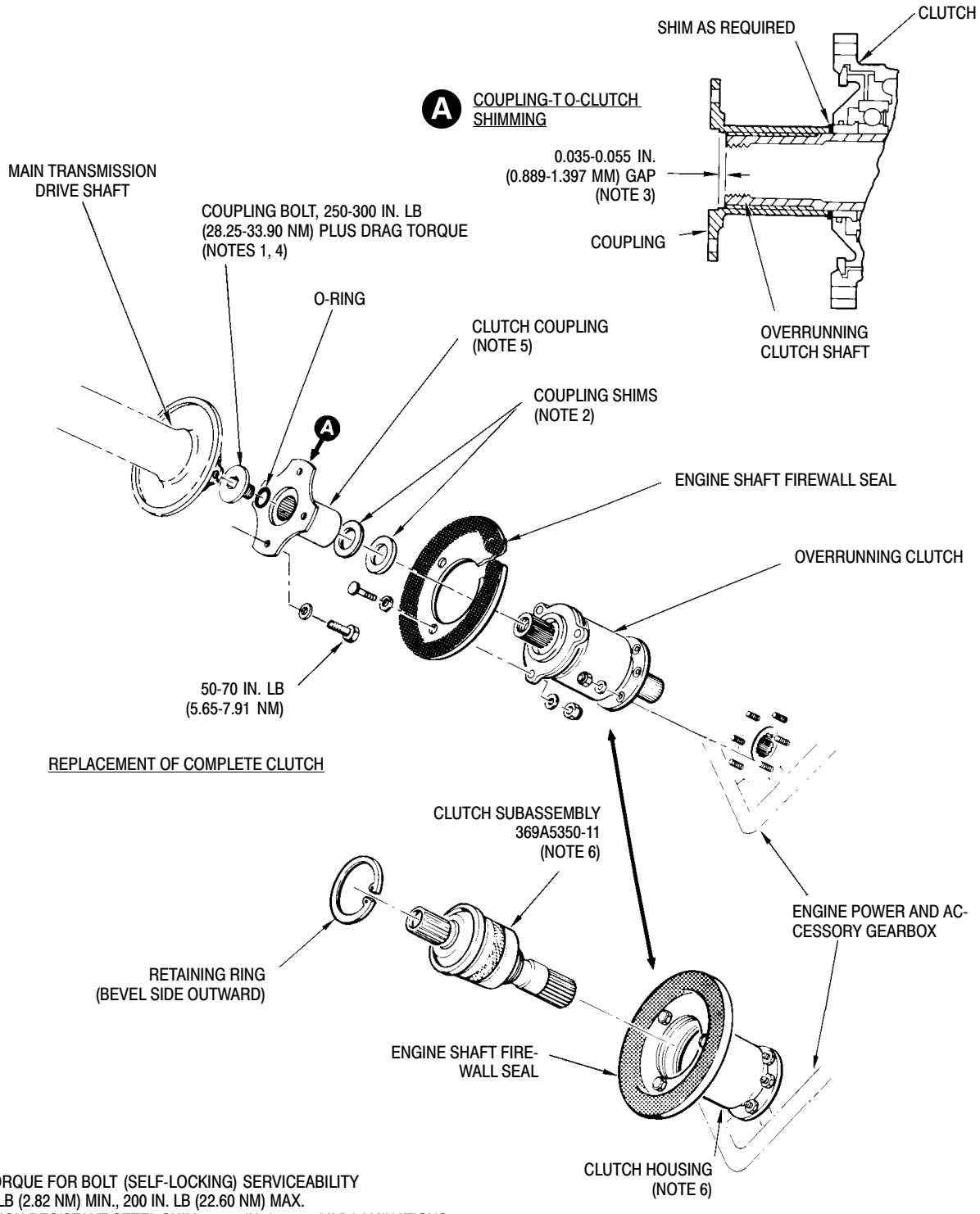
(3). Temporarily install coupling bolt and packing.

(4). Coat clutch splines with grease (21, Table 2-4). Insert overrunning clutch outer-race spline into engine and install six washers and nuts.

(5). Remove coupling bolt and shim coupling so that there is 0.035-0.055 inch (0.889-1.397 mm) gap from end of clutch shaft to edge of coupling recess (surface that bolt head contacts). Measure gap with feeler gage. Install new O-ring. Check that bolt self-locking torque is not less than **25 inch-pounds (2.82 Nm)** or not more than **200 inch-pounds (22.60 Nm)** drag torque. Torque bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**.

(6). Install engine shaft firewall seal, bolts, washers and nuts.

(7). Reinstall engine.



NOTES:

1. DRAG TORQUE FOR BOLT (SELF-LOCKING) SERVICEABILITY IS 25 IN. LB (2.82 NM) MIN., 200 IN. LB (22.60 NM) MAX.
2. CORROSION RESISTANT STEEL SHIM; 0.002 IN. (0.0508 MM) LAMINATIONS.
3. USE FEELER GAGE TO CHECK GAP DIMENSION.
4. COAT COUPLING BOLT THREADS WITH ANTI-SEIZE COMPOUND (36, TABLE 2-4) BEFORE ASSEMBLY.
5. COAT COUPLING-TO-CLUTCH SPLINES WITH GREASE (57).
6. THE CLUTCH SUBASSEMBLY SERIAL NUMBER IDENTIFIES THE COMPLETE REPAIRED CLUTCH.

30-077J

Figure 9-12. Overrunning Clutch Repair or Replacement

C. Overrunning Clutch Inspection

Perform the following inspections anytime the helicopter engine or overrunning clutch assembly is removed from the helicopter.

NOTE: Overrunning clutch subassembly can be replaced with engine installed.

(1). Check clutch oil level (Ref. Sec. 2).

(2). Remove grease and visually check clutch input shaft splines for wear. If wear is noted, refer to Part II, COM.

NOTE: Relubricate splines on clutch input shaft and splines inside engine power and accessory gearbox with grease (21, Table 2-4) prior to reinstalling overrunning clutch.

(3). Inspect overrunning clutch sub-assembly and ball bearing.

D. Overrunning Clutch Sub-Assembly and Ball Bearing Inspection

Accomplish inspection of overrunning clutch, clutch sub-assembly and ball bearing according to applicable instructions in CSP-H-5.

E. Overrunning Clutch Sub-assembly Replacement

The overrunning clutch sub-assembly can be replaced while the engine installed as followed:

(1). Remove main transmission drive shaft.

(2). Remove coupling bolt, clutch coupling and shims.

(3). Remove retaining ring from clutch housing. Then pull complete clutch sub-assembly out of housing.

(4). Remove shipping plug and O-ring from end of shaft in replacement clutch sub-assembly.

(5). Drain preservative oil from clutch sub-assembly by inverting it several times. Then add lubricating oil (5, Table 2-3).

NOTE: The -11, -21 and -31 clutch assembly capacity is 1.52 U.S. Oz (45cc).

The -41 and -51 clutch assembly capacity is 1.01 U.S. Oz (30cc).

(6). Using care to avoid oil spillage, insert clutch sub-assembly into clutch housing and install retaining ring with beveled side outward.

NOTE: On the identification plate on the clutch housing, obliterate the serial number and lubrication specification. Change part number to read 369A5350-603. The serial number on the clutch sub-assembly identification plate will now identify the complete clutch.

(7). Install clutch.

(8). Install main transmission drive shaft.

F. Overrunning Clutch Repair/Overhaul

Accomplish repair/overhaul of the overrunning clutch according to applicable instructions in CSP-H-5.

9. Tail Rotor Transmission

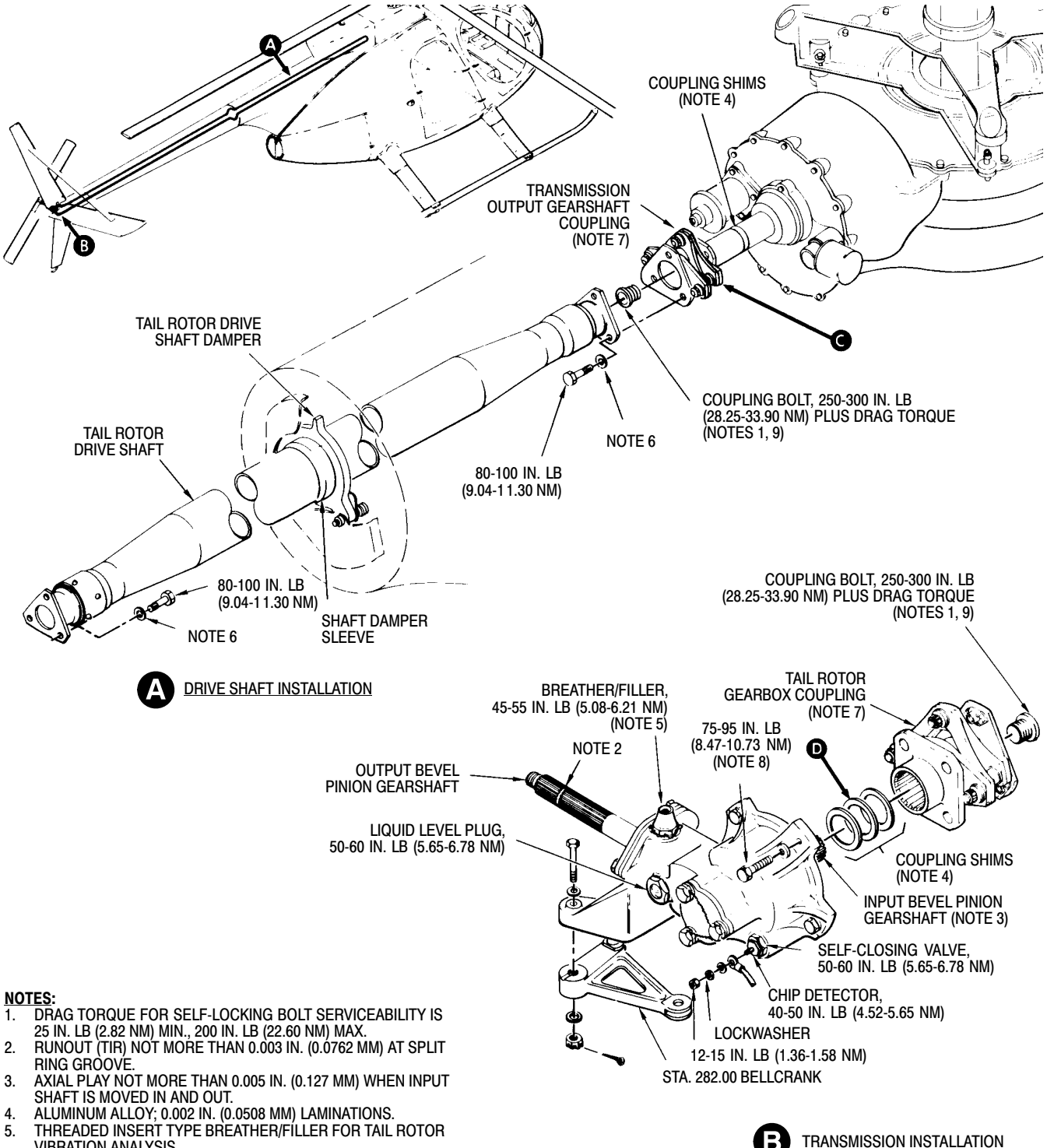
The tail rotor transmission is a right-angle, speed-increasing transmission (2045-3018 rpm at 100% N_2) having a magnesium alloy housing. The transmission drive consists of a pair of spiral-bevel gears that are splash lubricated. An oil level sight plug and magnetic chip detector are located on the aft end of the transmission and a breather-filler is located on top. The breather-filler, on all except early gearboxes, is threaded for attachment of a strobe light pickup of a tail rotor balancing kit (31, Table 2-2) when tail rotor balancing is required. Section 2 provides servicing information.

A. Tail Rotor Transmission Removal

(Ref. Figure 9-13 and Figure 9-14)

(1). Remove tail rotor drive shaft and transmission as a unit.

(2). Remove tail rotor from tail rotor transmission (Ref. Sec. 8).

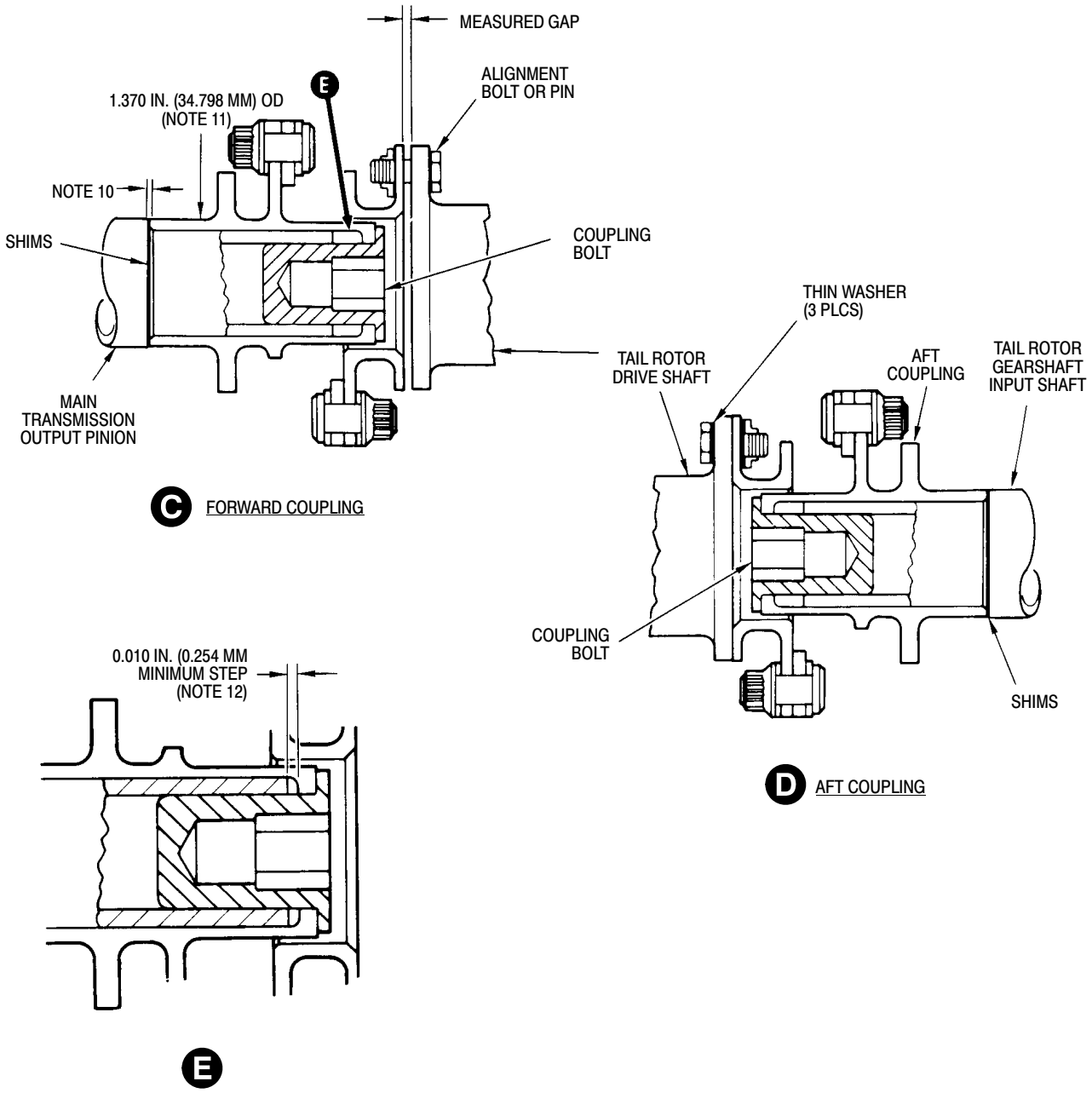


NOTES:

1. DRAG TORQUE FOR SELF-LOCKING BOLT SERVICEABILITY IS 25 IN. LB (2.82 NM) MIN., 200 IN. LB (22.60 NM) MAX.
2. RUNOUT (TIR) NOT MORE THAN 0.003 IN. (0.0762 MM) AT SPLIT RING GROOVE.
3. AXIAL PLAY NOT MORE THAN 0.005 IN. (0.127 MM) WHEN INPUT SHAFT IS MOVED IN AND OUT.
4. ALUMINUM ALLOY; 0.002 IN. (0.0508 MM) LAMINATIONS.
5. THREADED INSERT TYPE BREATHER/FILLER FOR TAIL ROTOR VIBRATION ANALYSIS.
6. REASSEMBLY USING CORROSION RESISTANT STEEL WASHER IN PLACE OF AL ALY.
7. COAT COUPLING SPLINES WITH CORROSION PREVENTIVE COMPOUND (70, TABLE 2-4).
8. USE ONLY NAS1304-24H OR -26H BOLTS. CHECK BOLT HOLE DEPTH FOR PROPER BOLT INSTALLATION.
9. COAT COUPLING BOLT THREADS WITH ANTI-SEIZE COMPOUND (36) BEFORE ASSEMBLY.

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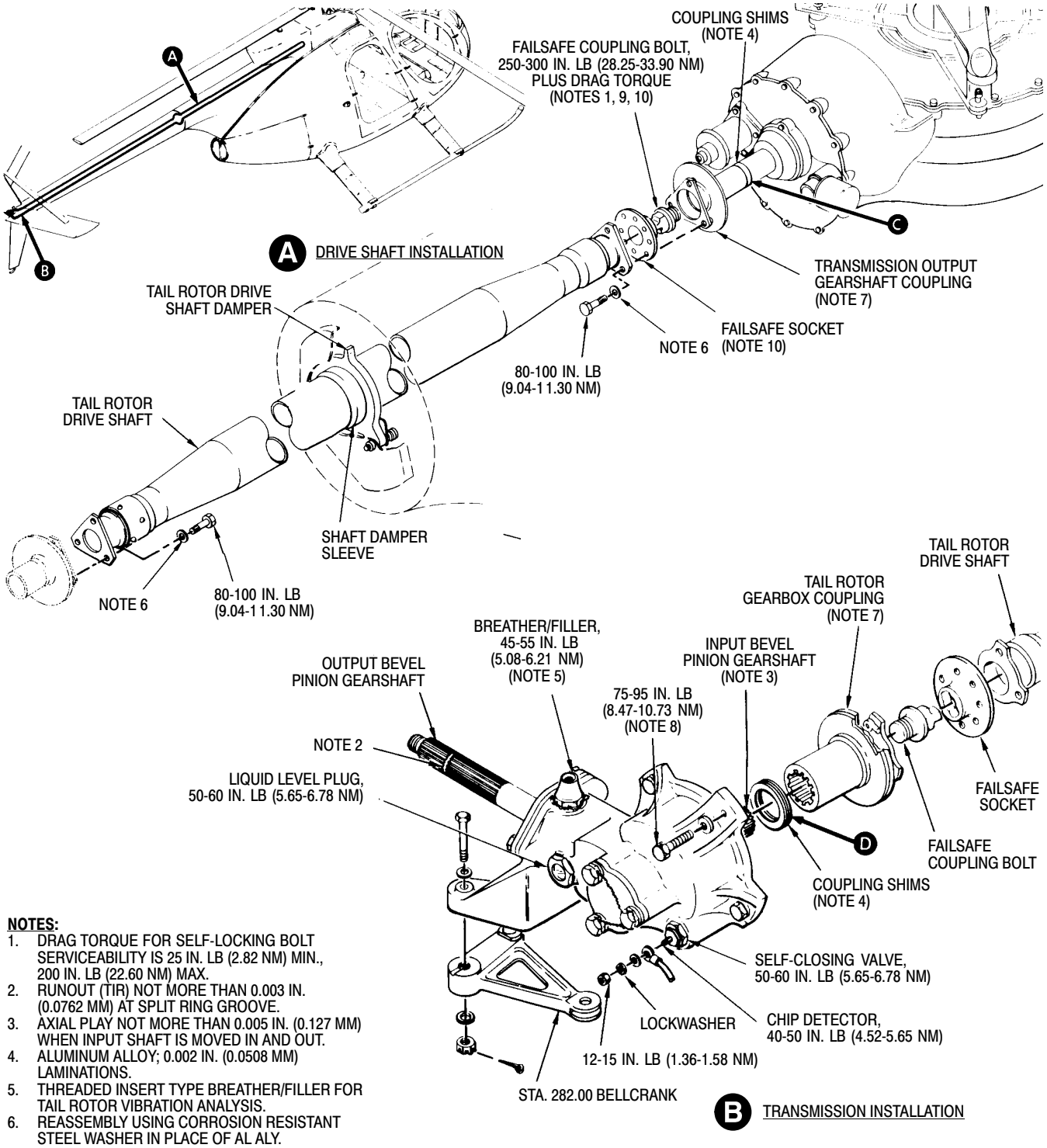
Figure 9-13. Tail Rotor Transmission and Drive Shaft Installation with Kamatic Couplings Installed (Sheet 1 of 2)



NOTES: (CONT)
10. ADD 0.005 IN. (0.127 MM) TO MEASURED GAP FOR MINIMUM SHIM THICKNESS.
11. HOLD COUPLING AT 1.370 IN. (34.798 MM) OD ONLY, TO BOTTOM COUPLING.
12. MINIMUM 0.010 IN. (0.254 MM) STEP BETWEEN AFT END OF OUTPUT SHAFT AND SHOULDER OF FORWARD COUPLING.

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Figure 9-13. Tail Rotor Transmission and Drive Shaft Installation with Kamatic Couplings Installed (Sheet 2 of 2)

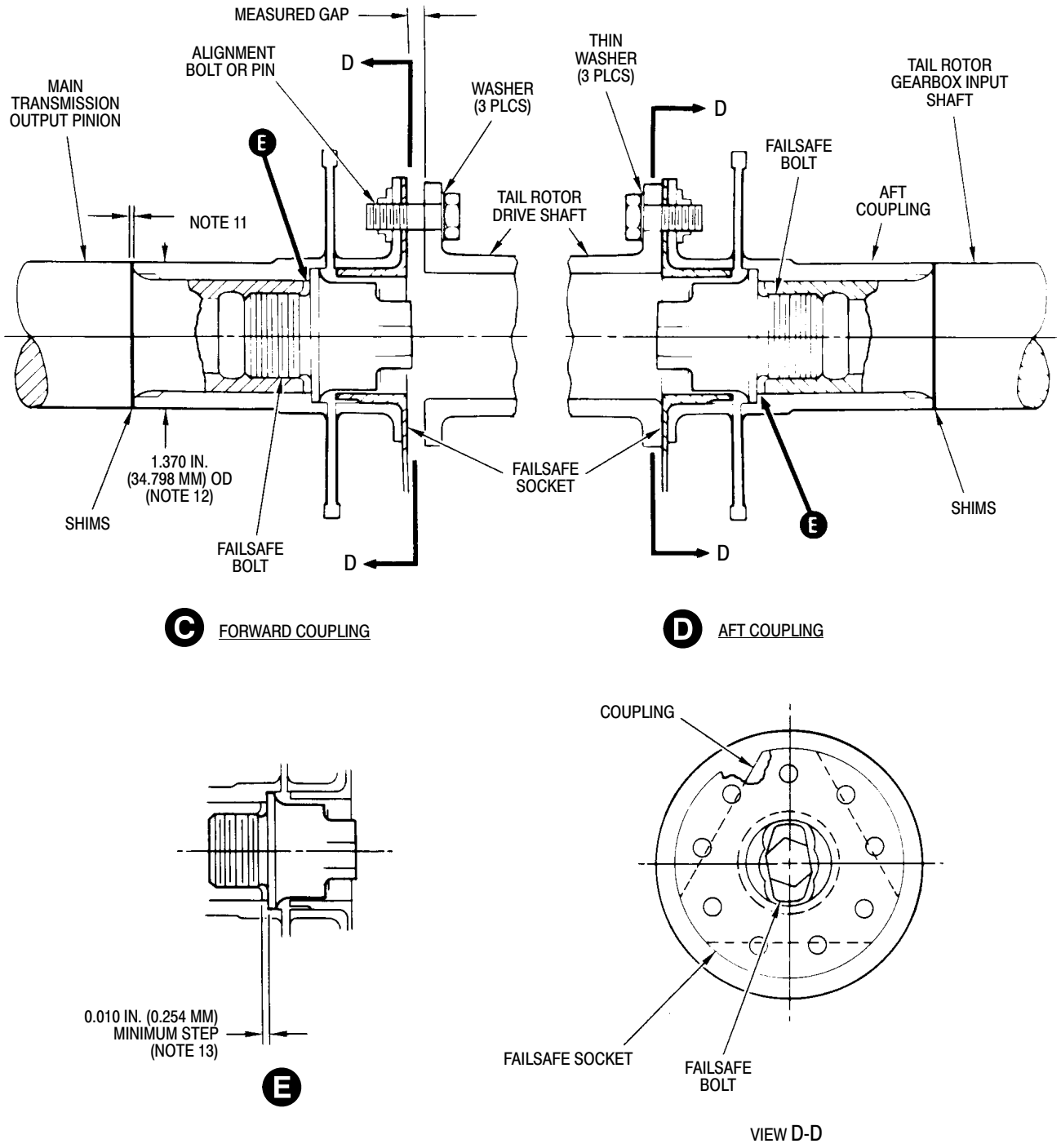


NOTES:

1. DRAG TORQUE FOR SELF-LOCKING BOLT SERVICEABILITY IS 25 IN. LB (2.82 NM) MIN., 200 IN. LB (22.60 NM) MAX.
2. RUNOUT (TIR) NOT MORE THAN 0.003 IN. (0.0762 MM) AT SPLIT RING GROOVE.
3. AXIAL PLAY NOT MORE THAN 0.005 IN. (0.127 MM) WHEN INPUT SHAFT IS MOVED IN AND OUT.
4. ALUMINUM ALLOY; 0.002 IN. (0.0508 MM) LAMINATIONS.
5. THREADED INSERT TYPE BREATHER/FILLER FOR TAIL ROTOR VIBRATION ANALYSIS.
6. REASSEMBLY USING CORROSION RESISTANT STEEL WASHER IN PLACE OF AL ALY.
7. COAT COUPLING SPLINES WITH CORROSION PREVENTIVE COMPOUND (70, TABLE 2-4).
8. USE ONLY NAS1304-24H OR -26H BOLTS. CHECK BOLT HOLE DEPTH FOR PROPER BOLT INSTALLATION.
9. COAT COUPLING BOLT THREADS WITH ANTI-SEIZE COMPOUND (36) BEFORE ASSEMBLY.
10. FAILSAFE COUPLING AND FAILSAFE BOLT REQUIRED ON BENDIX COUPLING INSTALLATION.

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369A5000 / 369H5600

Figure 9-14. Tail Rotor Transmission and Drive Shaft Installation with Bendix Couplings Installed (Sheet 1 of 2)



NOTES: (CONT)
11. ADD 0.005 IN. (0.127 MM) TO MEASURED GAP FOR MINIMUM SHIM THICKNESS.
12. HOLD COUPLING AT 1.370 IN. (34.798 MM) OD ONLY, TO BOTTOM COUPLING.
13. MINIMUM 0.010 IN. (0.254 MM) STEP BETWEEN AFT END OF OUTPUT SHAFT AND SHOULDER OF FORWARD COUPLING.

44-462-1A

Figure 9-14. Tail Rotor Transmission and Drive Shaft Installation with Bendix Couplings Installed (Sheet 2 of 2)

B. Tail Rotor Transmission Installation

CAUTION Do not carry or otherwise support the gearbox by the coupling, as the coupling diagram will buckle if excessively deflected. During performance of all maintenance on the gearbox, use extra care to keep contaminants such as paint, dirt, etc. from the areas around the input and output shaft seals.

(1). If gearbox is a replacement, perform buildup.

(2). Install tail rotor on tail rotor transmission (Ref. Sec. 8).

(3). Install tail rotor drive shaft and transmission as a unit (Ref. Tail Rotor Drive Shaft Installation with Kamatic Couplings or Tail Rotor Drive Shaft Installation with Bendix Coupling).

(4). Drain any residual preservative oil and service transmission with lubricating oil (1, Table 2-3).

C. Tail Rotor Transmission Inspection

(Ref. Figure 9-13 and Figure 9-14) If the following inspections reveal damage, perform repair according to applicable instructions in CSP-H-5.

(1). Check the transmission for leaks, cracks or corrosion. (Refer to Fluid Leak Analysis, Section 2, to evaluate oil leakage.)

(2). Check the input bevel gearshaft for axial play by moving the input shaft in and out. The gearbox must be cold. Axial play is limited to 0.005 inch (0.127 mm) maximum.

(3). Check tir in the split ring groove of the output bevel pinion gearshaft. Runout is limited to 0.003 inch (0.0762 mm) tir. Check the gearshaft for axial play; no play is permissible.

(4). Check for high and low runout at the split ring groove on the output shaft; mark the high and low extremes on the outer end of the shaft with grease pencil.

NOTE: Although not required, placing marks on the end of the output shaft provides guides for subsequent installation of the tail rotor assembly in a manner that reduces chances of high frequency tail rotor vibrations and lessens possibility of requirement for tail rotor balancing.

(5). Inspect all scoring or scratching of the output shaft to determine if the marks penetrate through the cadmium plating and into the steel shaft. Penetration of the steel shaft is allowable to a maximum depth of 0.010 inch (0.254 mm).

D. Tail Rotor Transmission Stripping

(Ref. Figure 9-13 and Figure 9-14)

(1). Remove coupling bolt, coupling, and coupling shims from input gearshaft. Keep shims with coupling for reuse.

NOTE: Further stripping is not required, as a replacement transmission is equipped with all other accessories.

(2). Drain oil from gearbox. The residual operating lubricant is approved internal preservative for shipping or storage.

(3). Wrap gearbox in barrier material (44, Table 2-4) to protect shaft splines and chip detector stud during handling, shipping or storage.

E. Tail Rotor Transmission Buildup

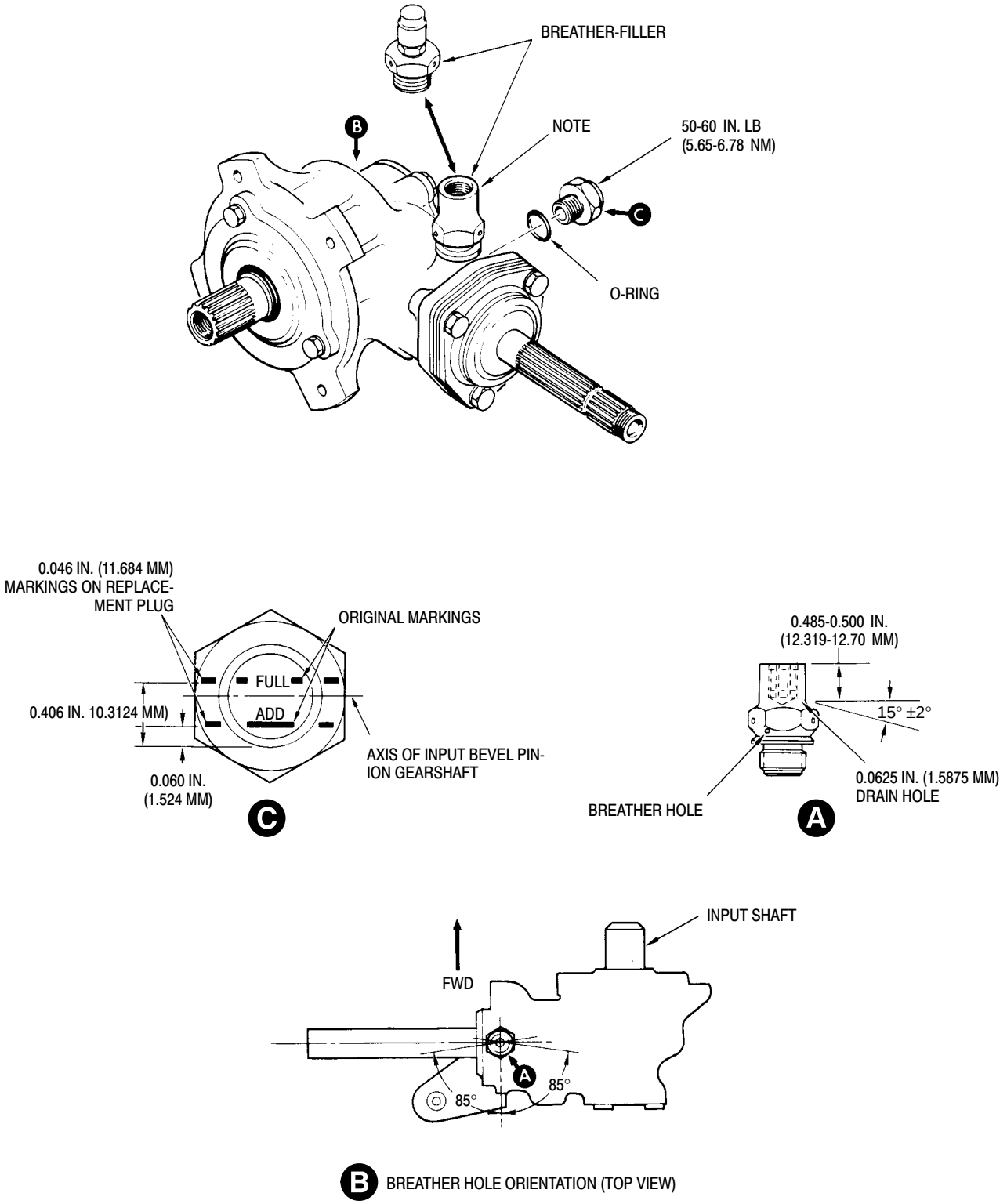
(Ref. Figure 9-13, Figure 9-14 and Figure 9-15) Replace the liquid level plug, chip detector and breather-filler according to the following information. Repair other components or replace tail rotor transmission oil seals according to applicable instructions in CSP-H-5.

(1). Replacement of Chip Detector, Liquid Level Plug and Breather-Filler:

Use the following torque values for accessories; lubricate with petrolatum (34, Table 2-4) to prevent damage to O-rings.

(a). Chip detector:

Valve body - **50 - 60 inch-pounds (5.65 - 6.78 Nm)**;
Detector - **40 - 50 inch-pounds (4.52 - 5.65 Nm)**.



NOTE:
THREADED INSERT-TYPE BREATHER-FILLER
FOR TAIL ROTOR VIBRATION ANALYSIS;
NOT PART OF EARLY GEARBOX.

30-079E

Figure 9-15. Replacement of Tail Rotor Transmission Liquid Level Plug and Breather-Filler

(b). Liquid Level Plug:

50 - 60 inch-pounds (5.65 - 6.78 Nm).

(c). Breather-Filler:

45 - 55 inch-pounds (5.08 - 6.21 Nm). Locate the breather hole on threaded insert breather-filler. The breather hole must be directed rearward at final torque relative to gearbox installation on helicopter (Ref. Figure 9-15). Locating the vent at any angle aft of the output shaft centerline (viewed from above) adequately directs vent rearward. One or two AN960PD1016L washers may be added between the O-ring and breather flange, one washer changes orientation by approximately 100°.

(2). Install shim selection retained for reuse at disassembly, 0.010 inch (0.254 mm) minimum, on input gearshaft.Coat coupling splines with corrosion preventive compound (70) and coupling bolt threads with anti-seize compound (36) before assembly. Install coupling and bolt. Check that bolt self-locking drag torque is not less than **25 inch-pounds (2.82 Nm)** or more than **200 inch-pounds (22.60 Nm)**. Torque coupling bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**.

(3). Install tail rotor drive shaft.

F. Protective Sleeve (Speedi-Sleeve) Installation, Output Gearshaft

(Ref. Figure 9-16) Repair oil leaks at output gearshaft cover by installing a protective sleeve (Speedi-Sleeve PN 084957) on the gearshaft area contacted by the oil seal lip. Install the protective sleeve as follows;

(1). Remove tail rotor and pitch control assembly (Ref. Sec. 8).

(2). Drain lubricant from tail rotor transmission (Ref. Sec. 2).

(3). Remove safety wire, three bolts and washers attaching output gearshaft cover to housing; remove cover and shim. Retain all hardware except safety wire for use at reassembly.

(4). Using heat gun or blow dryer, heat output housing bore to 275° ±25°F (135° ±l2°C); remove gearshaft and contact pattern shim(s). Retain shim(s) for use at reassembly.

(5). Install Speedi-Sleeve as follows:

CAUTION Do not allow any contaminants to enter shaft bearings. Dust and other contaminants can damage or shorten the service life of the bearings.

(a). Set gearshaft on end, bearings down, on hard, clean, level surface. Wipe away dust and foreign particles from gearshaft using a clean, lint free cloth, dampened by solvent (1, Table 2-4).

NOTE: If shaft has been grooved from rubbing against lip of output gearshaft cover seal, and depth of groove exceeds 0.005 inch (0.127 mm), shaft must be replaced (Ref. CSP-H-5). If groove does not exceed 0.005 inch (0.127 mm) depth, it may be repaired with plastic steel (135).

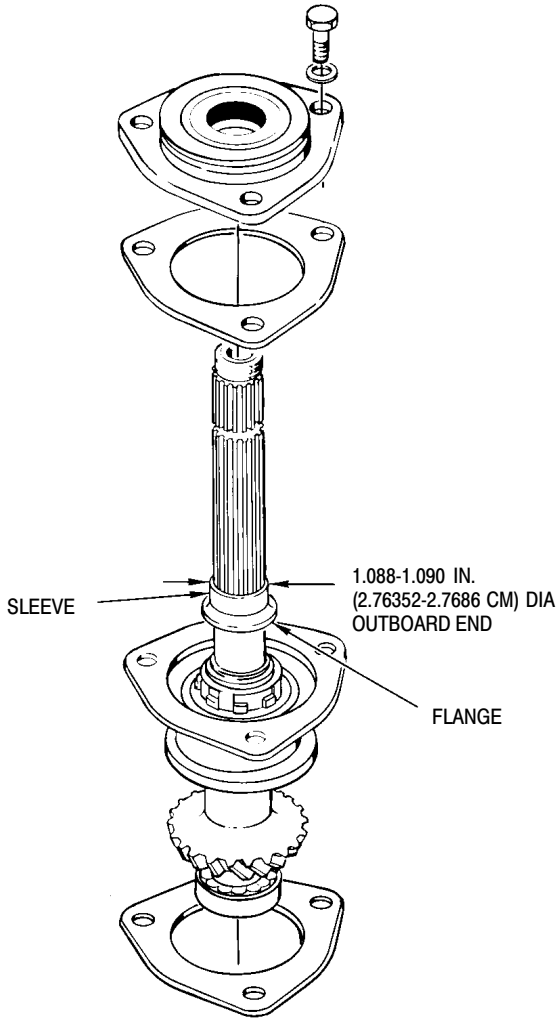
(b). Apply light coat of plastic steel (135) to shaft area to be covered by sleeve.

(c). While plastic steel is wet, put sleeve on shaft, flange down, and press or tap in place using 1.250 inch (3.175 cm) tube or pipe bottomed on flange of sleeve. Unflanged end of sleeve must be even with outboard end of 1.088-1.090 inch (2.76352-2.7686 cm) diameter portion of shaft. Tap end of pipe with hammer or mallet as necessary to correctly position sleeve on shaft. Wipe any excess plastic steel from shaft using a clean, lint free cloth.

(d). Clip flange of sleeve to notch line and peel from shaft.

(6). Reassemble tail rotor transmission.

(a). Apply heavy coating of petroleum jelly (34) to bearings on gearshaft end.



NOTES:

REPAIRABLE
DAMAGED SHAFT
1. FILL GROOVED AREA AND BOND SLEEVE TO SHAFT WITH DEVCON A.
2. CLIP FLANGE AND PEEL FLANGE OFF SHAFT AT NOTCH LINE.

UNDAMAGED SHAFT
1. BOND SLEEVE TO SHAFT WITH DEVCON A.
2. CLIP FLANGE AND PEEL FLANGE OFF SHAFT AT NOTCH LINE.

SLEEVE REPLACEMENT
1. CUT EDGE OF DAMAGED SLEEVE WITH FILE AND PEEL BACK.
2. PEEL SLEEVE FROM SHAFT.
3. CLEAN WITH KEROSENE; DRY WITH CLEAN, LINT-FREE CLOTH.
4. BOND SLEEVE TO SHAFT WITH DEVCON A.
5. CLIP FLANGE AND PEEL FLANGE OFF SHAFT AT NOTCH LINE.

44-230A

Figure 9-16. Protective Sleeve Installation/Replacement, Output Gearshaft

(b). Install contact pattern shim(s) removed at disassembly, and gearshaft in housing. Heat output housing bore using heat gun or blow dryer until gearshaft bearing retainer assembly fits easily into housing.

(c). Install clamp-up shim removed at disassembly and output gearshaft cover assembly (Ref. CSP-H-5).

(7). Install tail rotor and pitch control assembly (Ref. Sec. 8).

(8). Fill tail rotor transmission with approved lubricant (Ref. Sec. 2).

G. Protective Sleeve (Speedi-Sleeve) Replacement, Output Gearshaft

(Ref. Figure 9-16) Replace a worn protective sleeve (Speedi-Sleeve PN 084957) on the output gearshaft as follows:

CAUTION Use care not to cut into or damage gearshaft when removing damaged sleeve. Do not allow filings or other contaminants to enter shaft bearings.

(1). Remove output gearshaft from tail rotor transmission.

(2). Use file or other suitable instrument to cut through edge of sleeve; carefully pry cut edge away from shaft.

(3). Grasp raised edge with pliers and peel damaged sleeve off shaft.

(4). Remove any plastic steel residue from shaft using dry cleaning solvent (1, Table 2-4); dry shaft with clean, lint free cloth.

(5). Install replacement sleeve on shaft (Ref. Protective Sleeve (Speedi-Sleeve) Installation, Output Gearshaft.

10. Tail Rotor Drive Shaft

(Ref. Figure 9-13 and Figure 9-14) The tail rotor drive shaft interconnects the main transmission and the tail rotor transmission. The shaft is a dynamically balanced and positively dampened aluminum alloy tube, approximately 13 feet (4 M) long, that rotates at 2,045 rpm. Identical mounting flanges, riveted to each tapered end of the tube, connect the shaft to the flexible joint couplings on the transmission. A damper located near the center of the shaft maintains a minimum vibrations level in the tail rotor drive system.

A. Tail Rotor Drive Shaft Removal

(Ref. Figure 9-13 and Figure 9-14)

(1). Remove (or open) tail rotor drive shaft access doors.

(2). Remove three bolts and washers that secure shaft to output gearshaft coupling on main transmission.

(3). Disconnect chip detector wiring from tail rotor transmission.

(4). Detach Sta. 282 bellcrank from tail rotor transmission.

(5). Remove lockwire, bolts and washers that attach tail rotor transmission to tailboom.

CAUTION To prevent damage to the gearbox coupling during and after removal, provide good level support for both the transmission and tail rotor, as the weight of these items might buckle the coupling.

(6). With help from an assistant in guiding the shaft through the damper, remove tail rotor driveshaft as an assembly. Slowly and carefully slide the assembly aft until drive shaft clears the tailboom.

(7). Support assembly along its entire length, remove the three gearbox coupling bolts and washers, and remove drive shaft from gearbox.

CAUTION Do not carry or otherwise support the gearbox by use of the coupling. Use care with removal tools to prevent scratching coupling.

B. Tail Rotor Drive Shaft Installation with Kamatics Couplings

(Ref. Figure 9-13) Whenever main transmission, tail rotor transmission, transmission couplings, coupling shims, tail rotor drive shaft or tailboom assembly have been replaced, start installation with step (1). If none of these components has been replaced, and only installation is involved, start with step (5).

NOTE:

- Kamatic coupling to not require failsafe bolts and sockets.
- When installing 369D25501- 9 Kamatic coupling, install SKCP2554- 15 or 369D25503-1 coupling bolt supplied with the Kamatic coupling.
- If tail rotor drive shaft is replaced for torsional buckling, replace and discard main transmission output gearshaft coupling, tail rotor gearbox coupling and both coupling bolts.

(1). Coat coupling splines with grease (21, Table 2-4) and coupling bolt threads with anti-seize compound (36) before assembly. Install coupling onto tail rotor gearbox and torque coupling bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**. Check coupling bolt for drag torque serviceability of **25 inch-pounds (2.82 Nm)** minimum, **200 inch-pounds (22.60 Nm)** maximum.

(2). Coat forward coupling splines with grease (21) and coupling bolt threads with anti-seize compound (36) before assembly. Install coupling onto tail rotor gearbox and torque coupling bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**. Check coupling bolt for drag torque serviceability of **25 inch-pounds (2.82 Nm)** minimum, **200 inch-pounds (22.60 Nm)** maximum.

(3). Support entire length of tail rotor drive shaft and position end stamped **AFT** to align with tail rotor transmission coupling.

(4). Install three bolts and washers to connect tail rotor gearbox coupling to shaft; torque bolts to **80 - 100 inch-pounds (9.04 - 11.30 Nm) plus drag torque**.

(5). With assistance, support transmission and shaft in line, for minimum deflection of coupling, and guide drive shaft carefully through tailboom and damper into position.

(6). Install four tail rotor mounting bolts with washers and torque to **75 - 95 inch-pounds (8.47 - 10.73 Nm) plus drag torque**.

(7). Align forward end of drive shaft with coupling on main transmission output gearshaft. Partially install two bolts as an alignment aid but do not tighten. Align drive shaft inspection markings. If any of four white stripes is indistinct or does not exist, paint replacement stripes.

(8). Obtain 0.010-0.020 inch (0.254-0.508 mm) gap between forward flange of tail rotor drive shaft and flange of forward coupling using using the following procedure:

(a). Ensure alignment bolts in previous step are backed off between 0.050-0.100 inch (1.27-2.54 mm).

(b). Remove end play in tail rotor transmission by applying force to tail rotor blades in opposite direction of operation rotation while holding forward coupling of tail rotor drive shaft on main transmission to prevent rotation. Do not push tail rotor drive shaft fore or aft.

(c). Using feeler gage, measure gap between forward coupling flange and flange of tail rotor drive shaft. Record the gap.

(d). With assistance, remove tail rotor transmission and driveshaft in line for minimum deflection of coupling.

(e). Using measured gap from step (c). above, add or remove required number of shims at main transmission between output pinion shaft and forward coupling to obtain specified gap of 0.010-0.020 inch (0.254-0.508 mm).

(9). Coat forward coupling splines with grease (21) and coupling bolt threads with antiseize compound (36) before assembly. Install coupling and torque coupling bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**. Check coupling bolt for drag torque serviceability of **25 inch-pounds (2.82 Nm)** minimum, **200 inch-pounds (22.60 Nm)** maximum.

(10). With assistance, support transmission and shaft in line for minimum deflection of coupling and guide drive shaft carefully through tailboom and damper into position.

NOTE: If in use, four AN174H-17A bolts are to be replaced with either NAS1304- 24H or - 26H bolts to provide increased tail rotor transmission to tailboom mounting frame attachment strength (check bolt hole depth for proper bolt installation). The gearbox mounting bolt washers are 5052 aluminum alloy (NAS1197-416) and are used specifically for corrosion protection. When new, the outside edge is painted orange for identification.

(11). Measure bolt holes for proper bolt installation as follows:

(a). Fabricate a tool for measuring bolt hole depth.

(b). Install three gearbox mounting bolts and lightly tighten bolts.

(c). Measure depth of remaining bolt hole to determine proper bolt length.

(d). Remove bolts and proceed with following steps.

(12). Apply primer (4) to the four gearbox mounting bolts. Install bolts and aluminum washers while primer is still wet: torque evenly to **75 - 95 inch-pounds (8.47 - 10.73 Nm) plus drag torque.**

(13). Install three bolts and washers at forward coupling; torque bolts to **80 - 100 inch-pounds (9.04 - 11.30 Nm) plus drag torque.**

(14). Connect electrical wire to tail rotor transmission chip detector. Torque nut to **12 - 15 inch-pounds (1.36 - 1.69 Nm)**.

(15). Coat pin of Sta. 284.00 bellcrank with grease (18) and insert it into bearing in tail rotor pitch control. Pivot bellcrank to align with mating hole in tail rotor transmission and install bolt, washers and nut and cotter pin (Ref. Sec. 8).

(16). Check transmission oil level and service as required (Ref. Sec. 2).

(17). Slowly rotate drive shaft and check for not less than 0.250 inch (6.35 mm) clearance between shaft and fairing tube at Sta. 137.50. In addition, check for minimum clearance of 0.190 inch (4.826 mm) between shaft and cooling blower scroll.

(18). Install all access doors and covers.

C. Tail Rotor Drive Shaft Installation with Bendix Couplings

(Ref. Figure 9-14) Whenever main transmission, tail rotor transmission, transmission couplings, coupling shims, tail rotor drive shaft or tailboom assembly have been replaced, start installation with step (1). If none of these components has been replaced, and only installation is involved, start with step (7).

NOTE: If tail rotor drive shaft is replaced for torsional buckling, replace and discard main transmission output gear shaft coupling and tail rotor gearbox coupling.

(1). Remove existing shims and install one 0.010 inch (0.254 mm) shim on tail rotor transmission input shaft. Coat coupling splines with grease (21, Table 2-4) and coupling failsafe bolt threads with anti-seize compound (36) before assembly. Install coupling and torque failsafe coupling bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**. Check coupling bolt for drag torque serviceability of **25 inch-pounds (2.82 Nm)** minimum, **200 inch-pounds (22.60 Nm)** maximum.

(2). Determine shim thickness required at forward flexible coupling:

CAUTION Bottom the flexible coupling by holding at the 1.370 inch (3.4798 cm) OD of coupling. Do not bottom coupling by pushing on drive shaft attach flange; doing so may damage coupling.

(a). Bottom forward coupling on main transmission output shaft.

(b). Measure gap between end of flexible coupling and shoulder of output shaft. Add 0.005 inch (0.127 mm) to gap measured. This is the minimum shim thickness required at the forward coupling, to prevent coupling from bottoming on output shaft.

(c). Install minimum shim thickness on main transmission output shaft.

(d). Measure step between aft end of output shaft and shoulder of coupling, by bottoming coupling against shims. (Ref. **CAUTION** above)

NOTE: Maintain minimum 0.010 inch (0.254 mm) step between aft end of output shaft and coupling shoulder to prevent coupling bolt from bottoming on output shaft.

(e). Install additional shims to maintain 0.010 inch (0.254 mm) minimum step as required.

(3). Position failsafe socket on aft face of forward coupling so that three of the nine holes are indexed to the three nutplates of the coupling in such a way that maximum clearance is obtained between the bolt key and socket. Visually verify proper clearance before in stalling tail rotor drive shaft.

(4). Repeat previous step to install failsafe socket on input coupling of tail rotor transmission.

(5). Support entire length of tail rotor drive shaft and position end stamped **AFT** to align with tail rotor transmission coupling.

(6). Install three bolts and washers to connect tail rotor transmission coupling to shaft; torque bolts to **80 - 100 inch-pounds (9.04 - 11.30 Nm) plus drag torque**.

CAUTION When reinstalling tail rotor transmission and drive shaft, do not compress the forward or aft couplings as damage to the couplings could result.

(7). With assistance, support transmission and shaft in line, for minimum deflection of coupling, and guide drive shaft carefully through tailboom and damper into position.

(8). Install four tail rotor gearbox mounting bolts with washers and; torque to **75 - 95 inch-pounds (8.47 - 10.73 Nm) plus drag torque**.

(9). Align forward end of drive shaft with coupling on main transmission output gearshaft. Partially install two bolts as an alignment aid but do not tighten. Align drive shaft inspection markings. If any of four white stripes is indistinct or does not exist, paint replacement stripes.

(10). Obtain 0.010-0.020 inch (0.254-0.508 mm) gap between forward flange of tail rotor drive shaft and aft end of failsafe socket using the following procedure:

(a). Ensure alignment bolts in previous step are backed off between 0.050-0.100 inch (1.27-2.54 mm).

(b). Remove end play in tail rotor transmission by applying force to tail rotor blades in opposite direction of operational rotation (while holding forward coupling of tail rotor driveshaft on main transmission output shaft to prevent rotation). Do not push tail rotor drive shaft fore or aft.

(c). Using feeler gage, measure gap between socket flange and flange of tail rotor drive shaft. Socket flange must be in full contact with flange of forward flexible coupling. Record the gap.

(d). With assistance, remove tail rotor transmission and driveshaft, supporting transmission and driveshaft in line for minimum deflection of coupling.

(e). Using measured gap from step (c). above, add or remove required number of shims at main transmission between output shaft and forward coupling to obtain specified gap of 0.010-0.020 inch (0.254-0.508 mm).

NOTE:

- Maintain minimum 0.010 inch (0.254 mm) step between coupling shoulder and output shaft (step (2).).
- Shim, 0.010 inch (0.254 mm), installed in step (1). may be removed from aft coupling if necessary. If less than specified gap, 0.010-0.020 inch (0.254-0.508 mm), exists under minimum shim requirements, install a maximum of one NAS1197- 416 washer between gearbox housing and boom fitting. Apply zinc chromate primer (4) to both sides of washer at installation. After washer installation, repeat steps (10). (a). thru (e).
- If adding a washer between gearbox and boom fitting, it may be necessary to install a longer bolt. Ensure proper bolt thread engagement while ensuring that bolt does not shank out.

(11). Coat forward coupling splines with grease (21) and coupling bolt threads with anti-seize compound (36) before assembly. Install coupling and torque failsafe coupling bolt to **250 - 300 inch-pounds (28.25 - 33.90 Nm) plus drag torque**. Check coupling bolt for drag torque serviceability of **25 inch-pounds (2.82 Nm)** minimum, **200 inch-pounds (22.60 Nm)** maximum.

(12). With assistance, support tail rotor transmission and shaft in line for minimum deflection of coupling and guide drive shaft carefully through tailboom and damper into position.

NOTE: If in use, four AN174H-17A bolts are to be replaced with either NAS1304- 24H or - 26H bolts to provide increased tail rotor transmission to tailboom mounting frame attachment strength (check bolt hole depth for proper bolt installation). The gearbox mounting bolt washers are 5052 aluminum alloy (NAS1197-416) and are used specifically for corrosion protection. When new, the outside edge is painted orange for identification.

(13). Measure bolt holes for proper bolt installation as follows:

(a). Fabricate a tool for measuring bolt hole depth.

(b). Install three gearbox mounting bolts and lightly tighten bolts.

(c). Measure depth of remaining bolt hole to determine proper bolt length.

(d). Remove bolts and proceed with following steps.

(14). Apply primer (4) to the four gearbox mounting bolts. Install bolts and aluminum washers while primer is still wet; torque evenly to **75 - 95 inch-pounds (8.47 - 10.73 Nm) plus drag torque**.

(15). Install three bolts and washers at forward end of tail rotor drive shaft to connect to forward coupling; torque bolts to **80 - 100 inch-pounds (9.04 - 11.30 Nm) plus drag torque**.

(16). Connect electrical wire to tail rotor transmission chip detector. Torque nut to **12 - 15 inch-pounds (1.36 - 1.69 Nm)**.

(17). Coat pin of Sta. 284.00 bellcrank with grease (18) and insert it into bearing in tail rotor pitch control. Pivot bellcrank to align with mating hole in tail rotor transmission and install bolt, washers, nut and cotter pin (Ref. Sec. 8).

(18). Check transmission oil level and service as required (Ref. Sec. 2).

(19). Slowly rotate drive shaft and visually check to ensure shaft is not bent and for not less than 0.250 inch (6.35 mm) clearance between shaft and fairing tube at Sta. 137.50. In addition, check for minimum clearance of 0.190 inch (4.826 MM) between shaft and cooling blower scroll.

(20). Install all access doors and covers.

D. Tail Rotor Drive Shaft Twist Inspection

(Ref. Figure 9-17) The following inspection determines if the drive shaft has been torsionally strained to the extent that permanent twist exists.

(1). Remove left side aft fairing access door; then hand turn main rotor until two white stripes (View A) are aligned.

(2). At tail rotor transmission, look inboard from tail rotor side of helicopter and

locate two white stripes (View B). Stripe on input shaft bearing retainer flange of tail rotor transmission is located at approximately 2 O'clock, looking aft. Stripe on coupling should be approximately 10 O'clock, looking forward. Both stripes should be aligned.

NOTE: Any time the associated tail rotor drive shaft units are removed or replaced, an indexing check and reapplication of index marks is required.

E. Tail Rotor Drive Shaft Index Stripe Application

(Ref. Figure 9-17) If any of four white stripes used for inspection of tail rotor drive shaft twist are indistinct or do not exist, paint replacement aligning index stripes (128, Table 2-4) as follows:

(1). Remove tail rotor drive shaft, tail rotor transmission as an assembly.

CAUTION To prevent damage to the gearbox coupling during and after shaft removal, provide good level support for both the tail rotor transmission and shaft, as the weight of these items might buckle the coupling.

(2). Inspect tail rotor drive shaft for evidence of torsional twist or buckling.

(3). Remove any old index stripes.

(4). Apply white index stripe 0.120 inch (3.048 mm) wide and approximately 0.250 inch (6.35 mm) long on the tail rotor transmission input shaft bearing retainer flange at approximately 10 O'clock position looking forward, so it will be seen when standing on the left of tail rotor.

(5). Apply white index stripe 0.120 inch (3.048 mm) wide and any length on the coupling inline with the index stripe on tail rotor gearbox retainer.

(6). Install tail rotor drive shaft.

(7). Align index stripes on tail rotor gearbox bearing retainer and aft coupling.

(8). Remove tail rotor bellcrank access door fairing and observe the area where tail rotor drive shaft passes through the fairing forward bulkhead.

(9). Apply white index stripe 0.120 inch (3.048 mm) wide and 0.50 inch (12.7 mm) long on boom fairing bulkhead doubler (Sta. 137.50) at approximately 6-8 O'clock position looking forward.

(10). Apply a corresponding joining index stripe on the tail rotor drive shaft at Sta. 137.50. approximately 0.120 inch (3.048 mm) wide and 0.50 inch (12.7 mm) long.

NOTE: Any time the associated tail rotor drive shaft units are removed or replaced, an indexing check and re- application of index marks is required.

(11). Install all access doors and covers.

F. Tail Rotor Drive Shaft Inspection

(1). Inspect a removed shaft by the following indications:

(a). Scratches in the shaft section that passes through the plenum chamber fairing tube. Such scratches indicate possible contact with the tube edges at the bulkhead openings.

(b). Evidence of torsional buckling or shaft bending as a result of blade strike or hard ground contact by the lower stabilizer (tail low, hard landing).

(c). Corrosion.

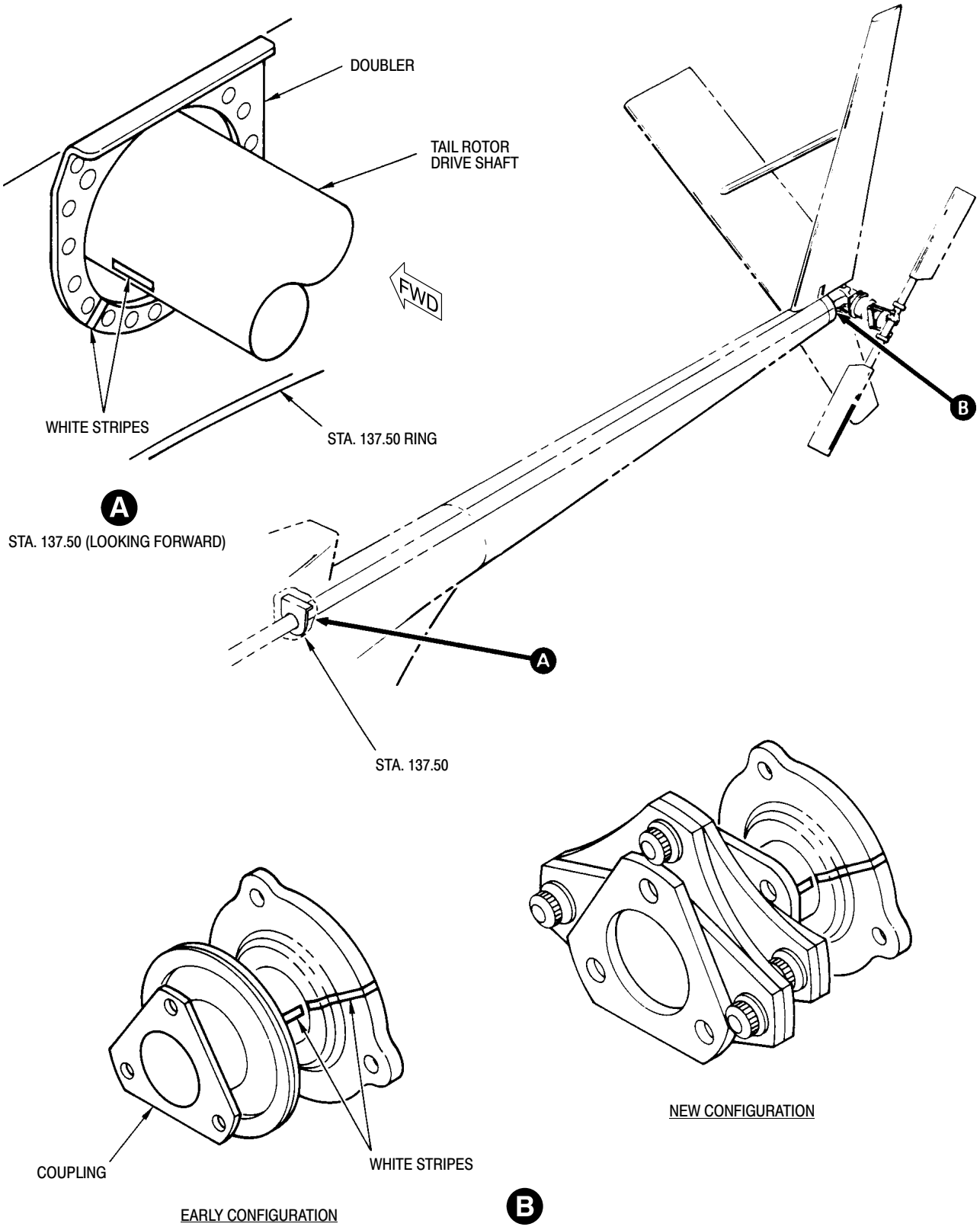
(d). Evidence of shaft damper sleeve bond failure (sleeve shifting) from excessive heat or loads.

(2). Take the following action with shafts having the above indications:

(a). Replace shafts for bending, or for scratches that exceed limits.

(b). Repair corrosion.

(3). If there is abnormal shaft vibration, check damper friction and shaft straightness or runout. When rotated between centers, or with ends plugged and rolled over rollers, the runout of the large diameter must not exceed 0.060 inch (1.524 mm) tir (permissible dents exclude).



30-080B

Figure 9-17. Drive Shaft Twist Check

G. Tail Rotor Drive Shaft Repair

(1). Nicks and scratches no deeper than 0.0015 inch (0.0381 mm) are allowable without rework but require finish protection with chemical film (8, Table 2-4).

(2). Other surface damage shall be evaluated and repaired according to the limits specified below. Use grade 400 abrasive paper (9) to smooth out and blend the repair area into the surrounding material until the damage is completely removed; then polish with crocus cloth (23) to equal the original finish. Apply finish protection with chemical film (8) and two coats of primer (4).

CAUTION Any section of the shaft that appears to be scratched, nicked or corroded in a previously reworked area must not be repaired a second time. Remove such a shaft from further service. Replace any shaft that has damage in excess of the specified limits.

(a). Scratches 0.007 inch (0.1778 mm) deep to a maximum length of 1.00 inch (2.54 cm), at any random angle.

(b). Scratches 0.007 inch (0.1778 mm) deep to a maximum length of 0.250 inch (6.35 mm), at any random angle.

(c). Circumferential scratches 0.004 inch (0.1016 mm) deep.

(3). Smoothly contoured dents are allowable when the ratio of dent diameter to dent depth is at least 15:1; for example, when the depth is 0.040 inch (1.016 mm), the minimum acceptable diameter would be 0.60 inch (1.524 mm). The maximum acceptable depth of a dent is 0.040 inch (1.016 mm). Dents that raise material require that the shaft be replaced.

11. Tail Rotor Drive Shaft Damper

(Ref. Figure 9-18) Tail rotor drive shaft damper is a graphite-filled teflon plate that controls and limits deflection of the tail rotor drive shaft about its approximate mid-point at all drive system speeds. The damper is spring-loaded against a structural support bracket mounted on the aft section tailboom fairing. Maximum possible shaft deflection in one direction is limited to less than 1.50 inch (3.81 cm) at the extreme throw positions of the damper.

A. Tail Rotor Drive Shaft Damper Inspection

(Ref. Figure 9-18) If there is excessive drive shaft vibration as shaft passes through the first critical rpm range, the probable cause is a defective or loose damper.

(1). Inspect the damper for correct drag friction adjustment (Ref. Tail Rotor Drive Shaft Damper Friction Adjustment).

(2). Inspect the damper for shaft clearance as follows:

(a). Remove boom-bolts access doors.

(b). Inspect the tail rotor drive shaft damper and support structure for broken, cracked or bent parts.

(c). Displace the damper so that it touches the tail rotor drive shaft.

(d). Use a wire gage to measure the damper to shaft clearance 180° from the contact point. Minimum acceptable clearance is 0.020 inch (0.508 mm).

(e). Repeat steps (c). and (d). above at 90° intervals from the initial check point until clearance on each side (360°) of damper has been checked.

(f). Dampers not meeting the minimum clearance of 0.020 inch (0.508 mm) on each side are to be replaced.

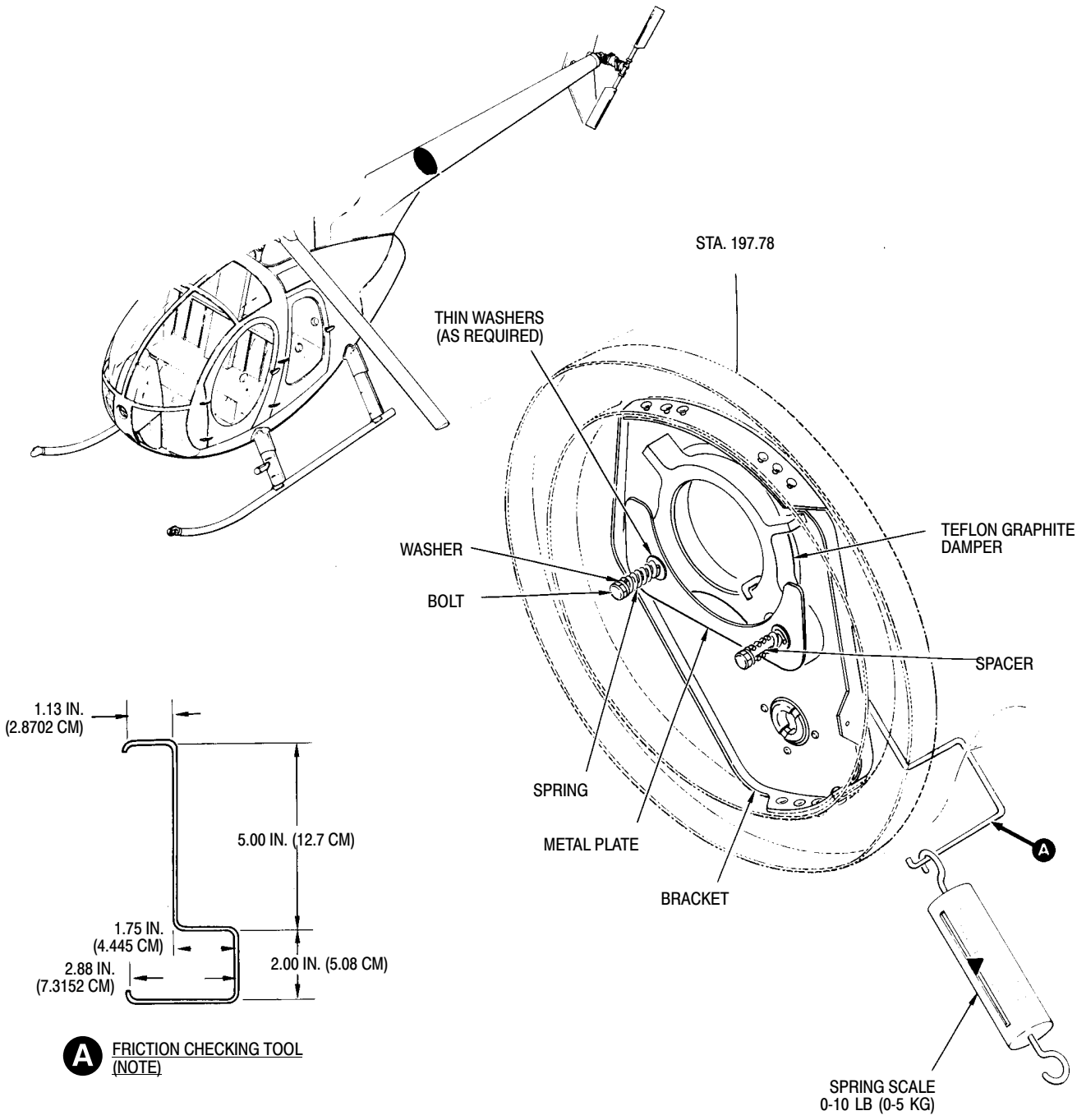
(3). Inspect the inside diameter of the damper for excessive wear. If the diameter is more than 3.035 inches (7.7089 cm), damper must be replaced.

B. Tail Rotor Drive Shaft Damper Replacement

(Ref. Figure 9-18)

(1). Remove boom-bolts access doors.

(2). Remove tail rotor drive shaft.



NOTES: MANUFACTURED LOCALLY FROM 0.125 IN. (3.175 MM) CORROSION-RESISTANT SPRING WIRE.

44-120A

Figure 9-18. Tail Rotor Drive Shaft Damper Friction - Checking

(3). Remove the two bolts, washers, springs, shim washers, plate and spacers, and damper.

(4). Position new damper over mounting holes in support bracket. Install plate and spacers with bolts, washers, springs and spacer washers.

CAUTION Make certain that the two bolts and washers under the bolt-heads are seated against the spacers when tightened. The bolts will wear rapidly if the clamp-up is not solid.

C. Tail Rotor Drive Shaft Damper Friction Adjustment

(Ref. Figure 9-18)

(1). Remove tail rotor drive shaft.

(2). Using a 0-10 lb. (0-5 kg) spring scale, measure the force required to move the damper radially on bulkhead. Pressure friction must be adjusted so that a pull of 2 ±0.25 lb. (0.91 ±0.11 kg) is required to slide the damper between the plate and support bracket.

(3). To increase friction, add spacer washers between the springs and the plate. To decrease friction, remove washers. (Add or remove the same number of washers at each pressure point.)

NOTE: A minimum of one washer must always remain between each spring and the plate.

(4). Install tail rotor drive shaft.

12. Tail Rotor Drive Shaft Couplings

A. Tail Rotor Drive Shaft Coupling Removal

(Ref. Figure 9-13 and Figure 9-14)

(1). Remove tail rotor drive shaft.

(2). Remove rear coupling from tail rotor transmission by removing attaching coupling. Retain shims with coupling for reinstallation.

(3). Remove front coupling from main rotor transmission by removing attaching bolt. Retain shims with coupling for reinstallation.

B. Tail Rotor Drive Shaft Coupling Inspection (Bendix)

(Ref. Figure 9-14)

(1). Inspect coupling diaphragms for dents, cracks, nicks, rust spots and joint separation at the weld junction. If any such defect is evident, the coupling must be replaced.

(2). Inspect coupling ends for scratches, nicks, dents, cracks and corrosion pits. No cracks are allowed. Maximum depth of other defects allowed before rework is 0.005 inch (0.127 mm).

(3). Measure the overall length of the couplings at three different points. If average of the readings exceeds 2.541 inches (6.45414 cm), the coupling must be replaced.

C. Tail Rotor Drive Shaft Coupling Inspection (Kamatic)

(Ref. Figure 9-13)

(1). Inspect coupling springs for dents, cracks, nicks and rust spots.

(2). Inspect coupling splined section and flange for scratches, nicks, dents, cracks and corrosion pits. No cracks are allowed. Maximum depth of other defects allowed before rework is 0.005 inch (0.127 mm).

(3). Measure overall length of coupling at three different points. If average of readings exceed 2.630 inches (6.6802 cm), coupling must be replaced.

(4). Inspect drive shaft flange for signs of contact. If signs of contact are noted, remove and reinstall coupling bolt.

D. Tail Rotor Drive Shaft Coupling Repair (Bendix)

(Ref. Figure 9-14)

(1). Repairs to flexible web areas of diaphragms are not allowed.

(2). Repair damage to splined section and flange of coupling that is no deeper than 0.005 inch (0.127 mm). Use abrasive paper grade 400 - 600 (9, Table 2-4) and crocus cloth (23) to

completely remove and polish out defect. Maximum depth after rework is 0.010 inch (0.254 mm). Apply primer (4) to repaired area.

(3). Repair damage to outer welded portion of diaphragm halves as in step (2). above, except that maximum thickness of material removed shall be not more than 10 percent of original material thickness.

E. Tail Rotor Drive Shaft Coupling Repair (Kamatic)

(Ref. Figure 9-13)

(1). Repairs to coupling spring areas are not allowed.

(2). Repair damage to splined section and flange of coupling that is no deeper than 0.005 inch (0.127 mm). Use abrasive paper grade 320 grit or finer (9, Table 2-4) and crocus cloth (23) to completely remove and polish out defect. Maximum depth after rework is 0.007 inch (0.1778 mm). Apply primer (4) to repaired area.

NOTE: Flange may be hand lapped using a sheet of #440 emery cloth (49), placed on a surface table. A figure “8” motion should be used while lapping the coupling, using care not to let part “rock”.

(3). Minimum flange thickness after cleanup is 0.10 inch (0.254 mm).

F. Tail Rotor Drive Shaft Coupling Installation

(Ref. Figure 9-13 and Figure 9-14, Tail Rotor Drive Shaft Installation with Kamatics Couplings or Tail Rotor Drive Shaft Installation with Bendix Couplings).

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Section

10

Engine Installation and Cooling System

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TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 10 Engine Installation and Cooling System		**10-1**
1.	Engine	10–1
2.	Engine Installation Troubleshooting	10–1
	Table 10–1. Engine Installation Troubleshooting	10–1
3.	Engine Removal	10–2
A.	Engine Disconnecting for Removal	10–2
B.	Removal of Disconnected Engine	10–2
4.	Engine Installation	10–3
A.	Engine Installation in Mounts	10–3
B.	Connecting an Installed Engine	10–3
	Figure 10–1. 250–C18 Engine Removal and Installation (Sheet 1 of 2)	10–4
	Figure 10–2. 250–C20 Engine Removal and Installation (Sheet 1 of 2)	10–6
5.	Engine Stripping	10–8
6.	Engine Build–Up	10–9
	Figure 10–3. 250–C18 Engine Stripping and Buildup (Sheet 1 of 2)	10–10
	Figure 10–4. 250–C20 Engine Stripping and Buildup (Sheet 1 of 2)	10–12
7.	Installation of 369H8144–3 Engine Fuel Pump Pressure Switch Assembly	10–15
8.	Engine Mounts and Fittings	10–15
9.	Lower Engine Mount Replacement	10–16
A.	Lower Engine Mount Removal	10–16
B.	Lower Engine Mount Installation	10–16
10.	Upper Engine Mount Replacement	10–16
A.	Upper Engine Mount Removal	10–16
	Figure 10–5. Engine Mounts and Fittings	10–17
B.	Upper Engine Mount Installation	10–18
C.	Engine Mounts and Fittings Inspection	10–18
D.	Engine Mounts and Fittings Repair	10–18
E.	Engine–to–Transmission Alignment Check	10–18
	Figure 10–6. Adjustable Engine Mounts	10–19
11.	Engine Cooling System	10–19
A.	Engine Cooling System Inspection	10–20
B.	Cooling System Repair or Replacement	10–20
12.	Engine Shaft Firewall Seal	10–20
A.	Engine Shaft Firewall Seal Replacement	10–20
B.	Engine Shaft Firewall Seal Inspection	10–20
C.	Engine Shaft Firewall Seal Repair	10–20
	Figure 10–7. Engine Cooling (Sheet 1 of 2)	10–21

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page

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SECTION 10
ENGINE INSTALLATION AND COOLING SYSTEM

1. Engine

The helicopter may be equipped with either the Allison 250-C18A, 250-C18C or 250-C20 engine.

The free turbine, turboshaft engine is mounted in the helicopter on centerline at a 43-degree angle from horizontal. It consists of a multi-stage axial-centrifugal compressor, a single combustion chamber, a two-stage gas producer turbine and a two-stage power turbine which provides the output power of the engine.

The engines are basically identical in external appearance except for variations in fuel control system components on the 250-C20 engine. In addition, a start (cycle) counter is included as part of the 250-C20 engine electrical system.

When engine automatic reignition is installed, the counter is modified to prevent counter operation when automatic reignition occurs. Section 14 of this manual provides basic ignition troubleshooting information.

Internal differences in the 250-C20 engine allow for operation at higher turbine outlet temperatures (TOT) and consequently higher output power, particularly at higher altitudes.

Refer to the applicable engine operation and maintenance manual for detailed maintenance information and theory of engine operation.

Starter limitations for engine compressor cleaning are given in Section 2. A daily water rinse that is accomplished without disconnecting the compressor discharge pressure (P_c) sensing tube is recommended for helicopters operating in a corrosive environment to remove any contaminants and corrosive air particles. A periodic (200 to 300 hours) compressor waterwash using cleaning solvents to remove dirt buildup is recommended for helicopters that operate in smoggy areas. The Pc tube must be disconnected and the opening capped to prevent introduction of chemical agents into the controls system Pc connection during the wash operation.

NOTE: Engine conversion information that modifies the helicopter for 250- C20 engine installation is provided in CSP-H-3.

2. Engine Installation Troubleshooting

(Ref. Table 10-1)

Table 10-1. Engine Installation Troubleshooting

Symptom	Probable trouble	Corrective action
NOTE: Refer to the engine operation and maintenance manual for troubleshooting information on the engine assembly. Verify that the associated helicopter system is functioning correctly (i.e. chip detectors, instruments, fuel supply system, etc.) before troubleshooting the engine.		
High frequency vibration	Loose engine mount bolts	Retorque engine mount bolts to 100 -140 in.-lb. (11.30 - 15.82 Nm)
NOTE: High frequency vibrations may also be caused by components in other systems. (Ref. Sec. 5, 8 and 9.)		

3. Engine Removal

(Ref. Figure 10-1 and Figure 10-2)

NOTE: Removal of the engine does not require removal of the engine mounts.

A. Engine Disconnecting for Removal

(1). Turn all switches OFF and disconnect external power.

(2). Remove main transmission drive shaft (Ref. Sec. 9).

(3). Remove engine tailpipes (Ref. Sec. 15).

CAUTION Cap all disconnected lines and fittings. Do not use tape to cover fuel and oil openings. Tape adhesive is soluble in fuel or oil and can cause contamination.

NOTE: As an aid to reassembly, attach identifying tags to all electrical wires and fuel and oil hoses prior to disconnection.

(4). Remove lockwire and engine electrical harness plug from the receptacle mounted on the right side oleo structural fitting.

(5). Disconnect thermocouple leads from terminal studs and leads from terminals E, C and B of starter-generator. Disconnect bond jumper at center firewall stud.

(6). Remove clamp on right engine mount to release engine harness.

(7). Remove combustion chamber drain line from burner drain valve.

(8). Disconnect fuel inlet line at pump and seal drain line.

(9). Disconnect cabin air outlet tube at firewall fitting.

(10). Loosen compressor cooling air duct clamp at firewall coupling, disconnect support bracket at hoisting eye and remove duct from engine compartment.

(11). Disconnect oil line from torquemeter fitting.

(12). Disconnect N_2 control rod from idler bellcrank. Tie or tape control rod out of the way against the firewall.

(13). If cable-actuated anti-icing control valve lever is installed, disconnect by removing cotter pin, loosening nut on adapter and detaching control cable. If anti-icing valve electrical actuator is installed, remove two clamps at forward firewall.

(14). Disconnect N_1 control rod from gas producer lever. Tape or tie control rod out of the way against the firewall.

(15). Disconnect accessory drive overboard vent.

(16). Disconnect oil line from engine oil pressure reducer fitting.

(17). On 250-C20 engine, disconnect drain line from fuel control.

CAUTION Remove the oil inlet and outlet lines only at the engine. Removal at the oil cooler end will damage the cooler frame if the frame oil port boss is not supported with a wrench. For the same reason, do not apply extreme bending loads on the oil cooler lines after they are disconnected from the engine.

(18). Disconnect engine oil inlet line.

(19). Disconnect engine oil outlet line.

(20). Disconnect engine oil vent line.

B. Removal of Disconnected Engine

(1). Install engine hoist (39, Table 2-2) between hoisting eye fitting (located on intercostal above engine) and the hoist fitting provided on engine.

(2). Station an assistant on engine hoist and apply tension on hoist line.

(3). Remove bolt and washer from bottom engine mount. Maintain slight downward pressure at rear of engine during removal of engine mount bolts.

(4). Remove two bolts and washers from the left and right engine mounts.

CAUTION Do not use fuel or oil lines to handle engine during removal. Take care not to contact adjoining structure or compartments while lowering engine. Use particular care to prevent damage to the N_1 bearing oil return line on the underside of the compressor, and to avoid cracking or breaking the engine air inlet bell on the compressor.

(5). Remove detent pin and unscrew the adjustable support shaft in engine stand (38) for clearance.

(6). Align the engine stand under the engine so that the adjustable support shaft will engage the left engine mount fitting.

(7). Slowly lower engine from the helicopter. Align engine side mount fittings between the fixed and the adjustable support shaft.

(8). Screw the adjustable support shaft inward until engine mount bosses are securely engaged with the support shaft sockets.

(9). Insert detent pin through the adjustable support shaft.

(10). If engine is to be stored or transported, engage the engine stand transport and storage bar in the engine lifting eye fitting.

4. Engine Installation

(Ref. Figure 10-1 and Figure 10-2)

A. Engine Installation in Mounts

(1). Position engine stand as close as possible to helicopter with engine access doors open. Remove detent pin from the adjustable support shaft on engine stand. Detach transport and storage bar from engine lifting eye fitting.

(2). Install engine hoist (39, Table 2-2) between engine hoist fitting on structure above engine and on engine hoist fitting on engine. Have assistant apply and hold tension on the hoist. With engine supported manually, unscrew the adjustable support shaft with handle. Shift engine toward side of stand with disconnected shaft to disengage the fixed shaft. Roll stand away from engine.

CAUTION Do not grasp fuel or oil lines during engine installation. Use particular care not to contact adjoining structure or components and to avoid cracking or breaking engine air inlet bell on compressor.

(3). Have assistant slowly raise the engine while necessary pressure is applied downward at rear of engine.

(4). Align left and right engine mounts with mount fittings and install bolts and washers. Torque bolts to **100 - 140 inch-pounds (11.30 - 15.82 Nm)**. Align hole in lower engine mount with mount fitting and install bolt and washer. Torque bolt to **100 - 140 inch-pounds (11.30 - 15.82 Nm)**. Safety bolts with lockwire (2, Table 2-4).

(5). Check to ensure that the engine air inlet firewall seal ring contacts the firewall seal all the way around.

(6). Remove engine hoist from helicopter.

B. Connecting an Installed Engine

(1). Connect engine oil vent line; torque the line nut to **120 - 140 inch-pounds (13.56 - 15.82 Nm)**.

CAUTION Do not overtorque engine oil inlet or outlet couplings; damage to the coupling orself- closing valve, if installed, may result. Do not apply extreme bending loads on the oil outlet line. Such loads will be transferred to the oil cooler inlet port boss and can cause the cooler frame to fracture.

(2). Connect engine oil outlet and inlet lines. Hand-tighten until snug; then wrench-tighten approximately 1/4 turn or until definite resistance is felt.

(3). Connect engine oil pressure line.

(4). Position accessories drive overboard vent elbow and torque to **150 - 250 inch-pounds (16.95 - 28.25 Nm)**.

(5). Connect accessories drive overboard vent. Torque tube nut to **20 - 30 inch-pounds (2.26 - 3.39 Nm)**.

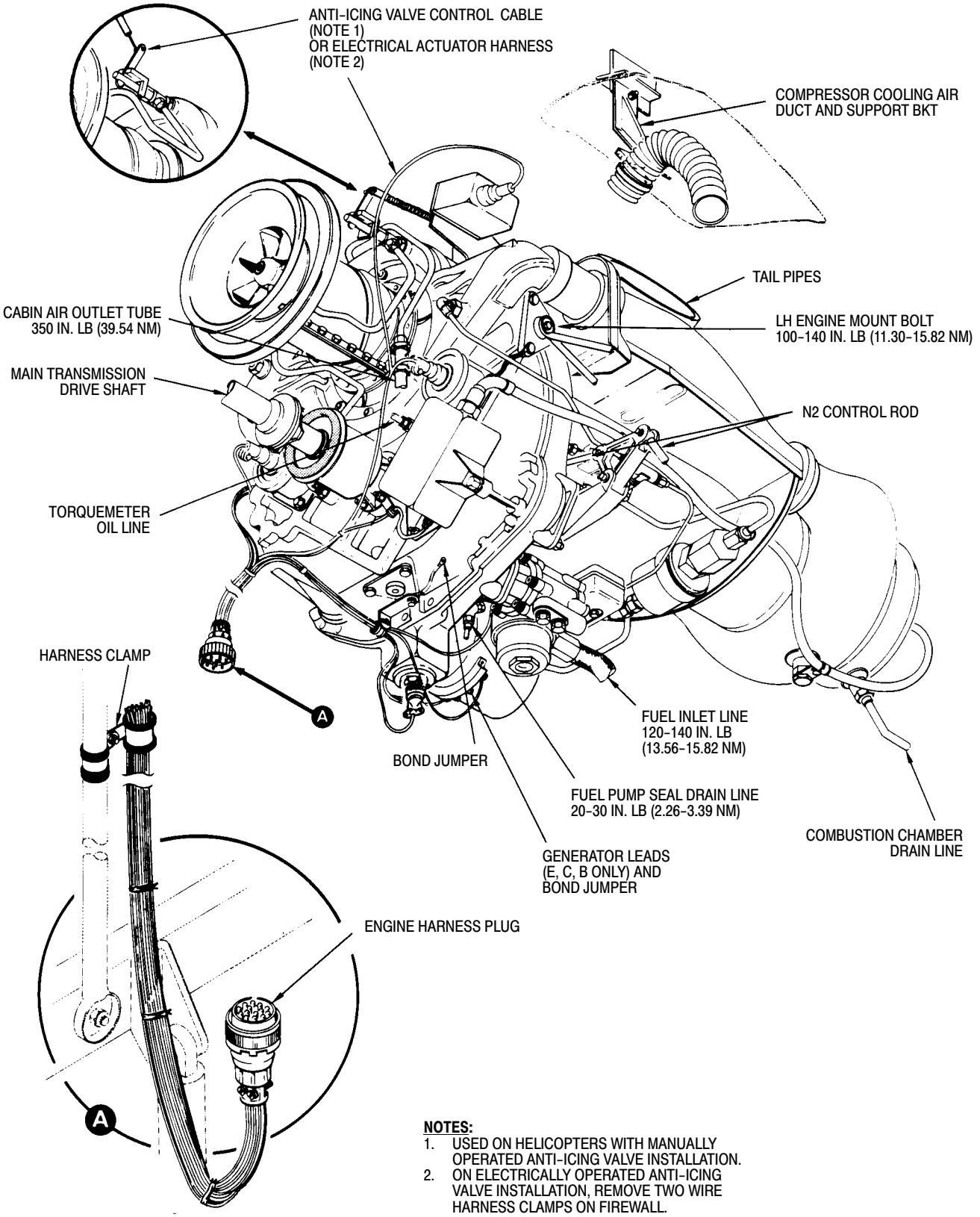
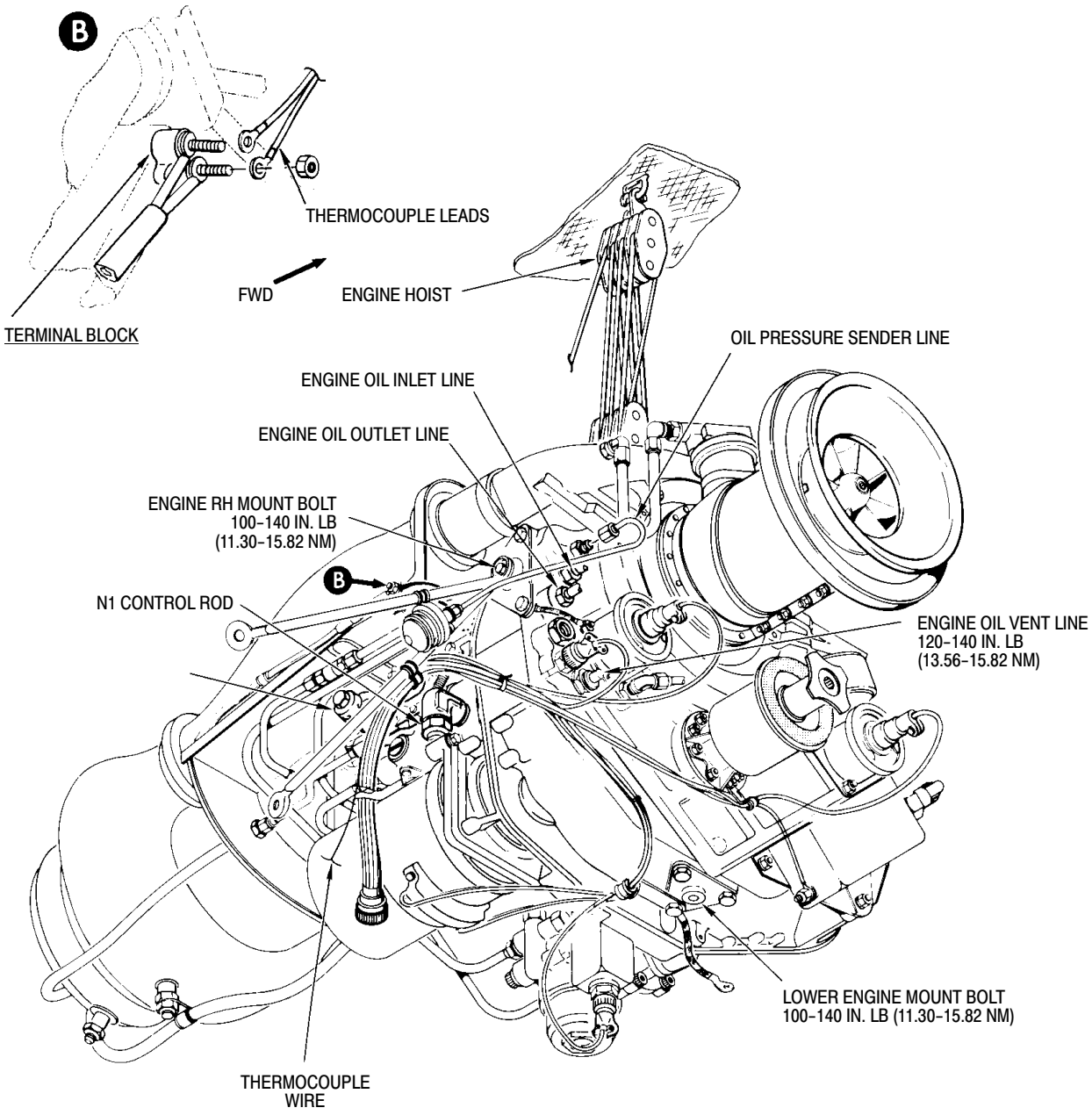


Figure 10-1. 250-C18 Engine Removal and Installation (Sheet 1 of 2)



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Figure 10-1. 250-C18 Engine Removal and Installation (Sheet 2 of 2)

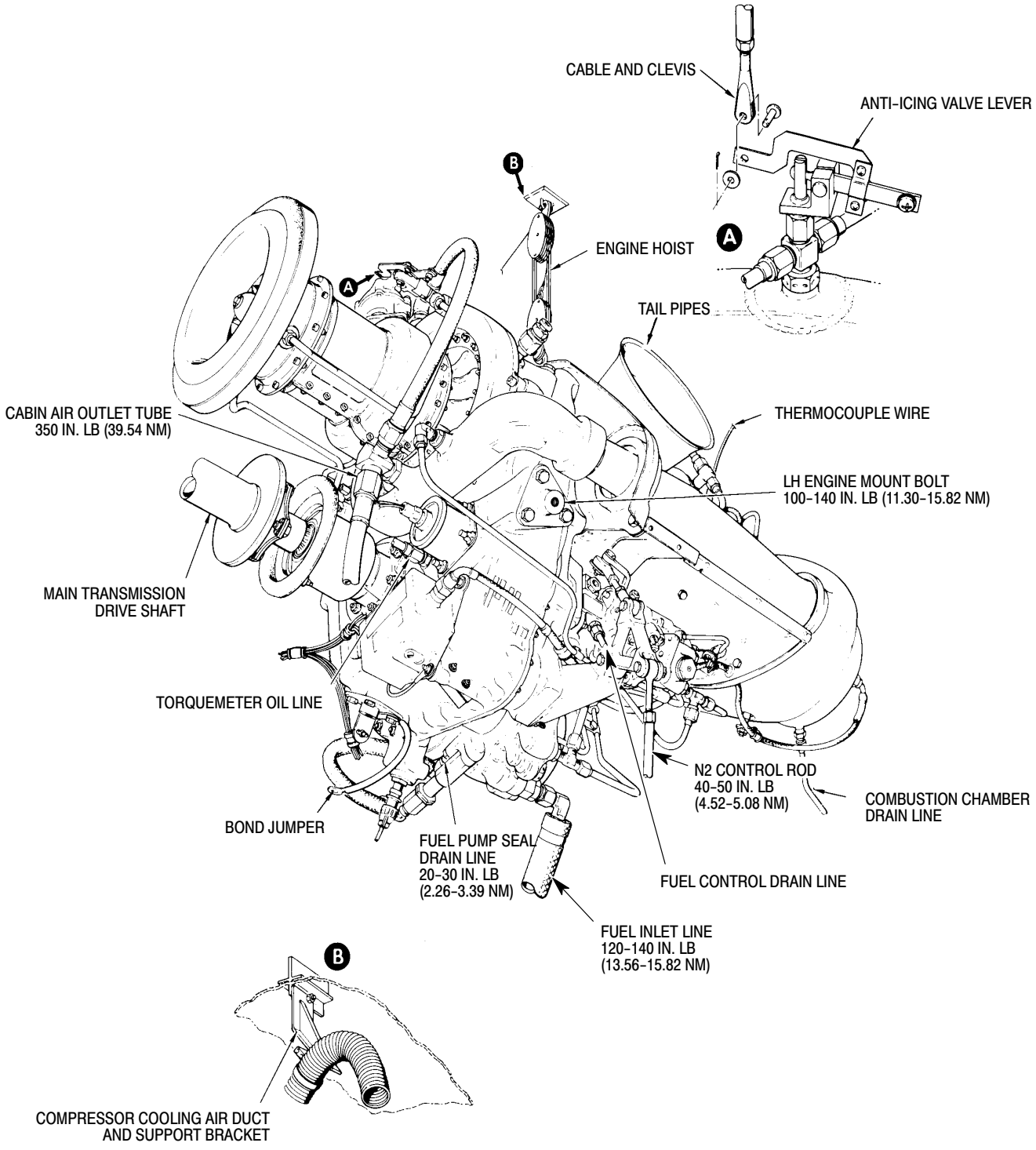
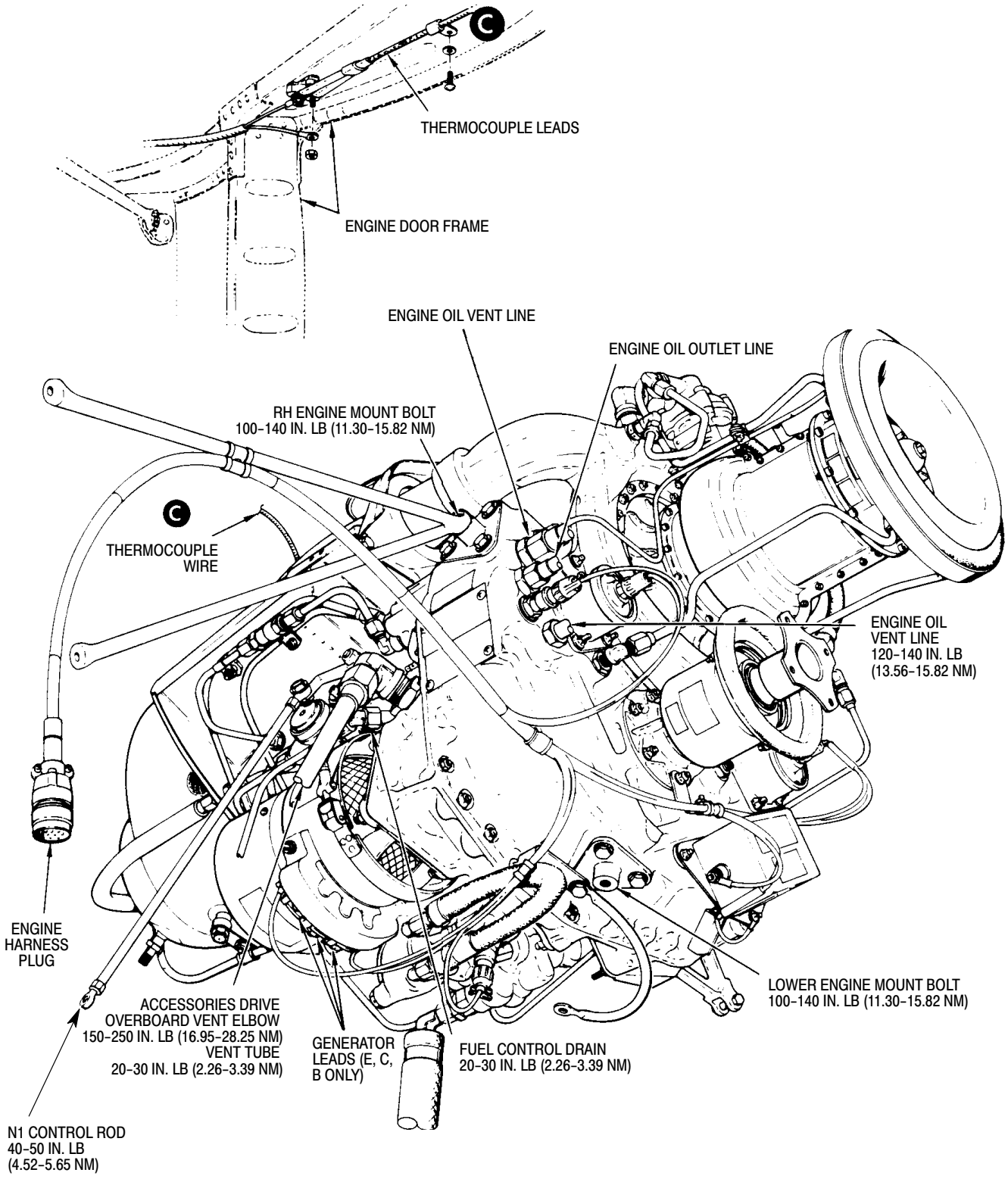


Figure 10-2. 250-C20 Engine Removal and Installation (Sheet 1 of 2)



30-206-2B

Figure 10-2. 250-C20 Engine Removal and Installation (Sheet 2 of 2)

(6). On 250-C20 engine, connect drain line to fuel control. Torque nut to **20 - 30 inch-pounds (2.26 - 3.39 Nm)**.

(7). Connect N_1 control rod to lever with bolt, two washers, nut and new cotter pin. Install the bolt with head outboard, one washer (standard OD) under the nut and one large OD, 0.80 inch (20.32 mm) washer under the head. Torque nut to **40 - 45 inch-pounds (4.52 - 5.08 Nm)** and install new cotter pin.

(8). If anti-icing valve is manually controlled, install control cable in lever adapter. If valve is electrically controlled, install wire harness clamps at firewall. Make an operational check of either installation (Ref. Sec. 11).

(9). Connect short N_2 control rod to governor lever with bolt (head up), one washer (standard OD) under head, one large OD, 0.80 inch (20.32 mm) washer under the nut and a new cotter pin. Connect long N_2 control rod with bolt-head forward), two washers, nuts and new cotter pin.

(10). Connect oil line to torquemeter fitting below N_2 tach generator.

(11). Install compressor cooling air duct support bracket on hoisting eye above engine. Connect and tighten flexible duct on firewall coupling.

(12). Connect cabin air outlet tube (or hose) to firewall fitting. Make sure no interference exists between compressor bleed air tube and 3/8 inch diameter engine bleed air tube. Tighten both tube nuts to **350 inch-pounds (39.54 Nm)**.

(13). Connect engine fuel pump seal drain line. Torque tube nut to **20 - 30 inch-pounds (2.26 - 3.39 Nm)**.

(14). Connect fuel inlet line to fuel pump. Torque line nut to **120 - 140 inch-pounds (13.56 - 15.82 Nm)**.

(15). Install combustion chamber drain line on drain valve.

NOTE: Check that the burner drain valve and plug are correctly installed in the combustion chamber. Each part must be installed with a packing. The drain valve is installed in the aft (lowest) position.

(16). Secure engine harness to engine mount with cushioned loop clamp. Connect oil pressure sender lead if the electrical indicating system is used.

(17). Install E, C, B generator leads on starter/generator and secure with washers and nuts.

(18). Connect thermocouple leads to terminal block studs and secure with chromel and alumel nuts provided. Install clamp on door frame.

(19). Connect engine harness plug to receptacle and safety with 0.032 inch (0.8128 mm) lockwire (2, Table 2-4). Install bond jumper terminal to lower engine attach fitting. Torque bolt to **140 - 160 inch-pounds (15.82 - 18.08 Nm)**. Safety bolt with 0.032 inch (0.8128 mm) lockwire.

(20). Install engine exhaust tailpipes (Ref. Sec. 15).

(21). Install main transmission drive shaft (Ref. Sec. 9).

(22). Remove all identifying tags from electrical wires and fuel and oil lines.

(23). Check rigging of gas producer (N_1) and power turbine (N_2) engine power controls (Ref. Sec. 17).

(24). Check overall condition of engine installation and connections.

5. Engine Stripping

(Ref. Figure 10-3 and Figure 10-4)

(1). Disconnect A and D leads from starter-generator. Loosen mounting clamp that secures starter-generator to mounting flange and remove starter-generator. Remove four nuts and washers; then remove mounting flange and gasket. Install pad cover on engine.

(2). Disconnect electrical connectors from both chip detectors.

(3). Disconnect both tachometer generator connectors, anti-icing valve actuator connector (if installed), ignition exciter lead, fuel filter pressure switch and start counter leads (if installed).

(4). Remove bracket or clamp at overrunning clutch and lower engine mount fitting; then remove entire wire harness.

(5). Remove fuel inlet reducer and O-ring.

(6). Remove oil inlet and outlet couplings with O-rings.

(7). Remove accessory drive overboard vent elbow, nut and O-ring.

(8). Loosen both ends of the compressor bleed air tube and detach from engine.

(9). Remove elbow, nut and gasket from the compressor scroll.

(10). Remove tee, nut and gasket from compressor scroll.

(11). Remove oil pressure reducer, snubber and two O-rings.

(12). Remove both tachometer generators by removing four nuts and washers and lifting directly off mounting pad; then remove gasket.

(13). Remove tube or hose assembly, reducer, fuel filter pressure switch and two O-rings from fuel pump assembly.

(14). Remove engine air inlet bell and engine-to-firewall seal (Ref. Sec. 16).

(15). On helicopter equipped with electrically actuated anti-icing valve, remove actuator and controls (Ref. Sec. 11).

(16). On helicopter equipped with manually actuated anti-icing valve, remove anti-icing valve lever assembly from poppet guide.

(17). Remove three bolts, washers and engine hoist fitting, and actuator bracket, if installed.

(18). Remove elbow, nut and O-ring from the fuel pump seal drain port.

(19). Remove governor control idler support, bellcrank and short N_2 control rod as an assembly. Install vacuum/hydraulic pump pad cover.

(20). Remove torque pressure snubber, reducer and two O-rings.

(21). Remove three bolts, washers and nuts attaching firewall seal to overrunning clutch and remove seal.

(22). Remove the overrunning clutch (Ref. Sec. 9), install pad cover.

(23). On 250-C20 engine, remove fuel control vent elbow fitting, nut and O-ring.

(24). On engines with a Bendix fuel system installed, remove the three cubic inch accumulator from fuel line in accordance with the engine manufacturer's applicable installation bulletin.

(25). With engine supported manually, unscrew the adjustable support shaft with handle.

(26). Switch engine toward side of stand with disconnected shaft to disengage the fixed shaft.

(27). Keep engine in vertical position and remove carefully from stand.

(28). Position engine on a stable surface. Remove bolts, washers, bond jumper and three mount fittings from engine.

6. Engine Build-Up

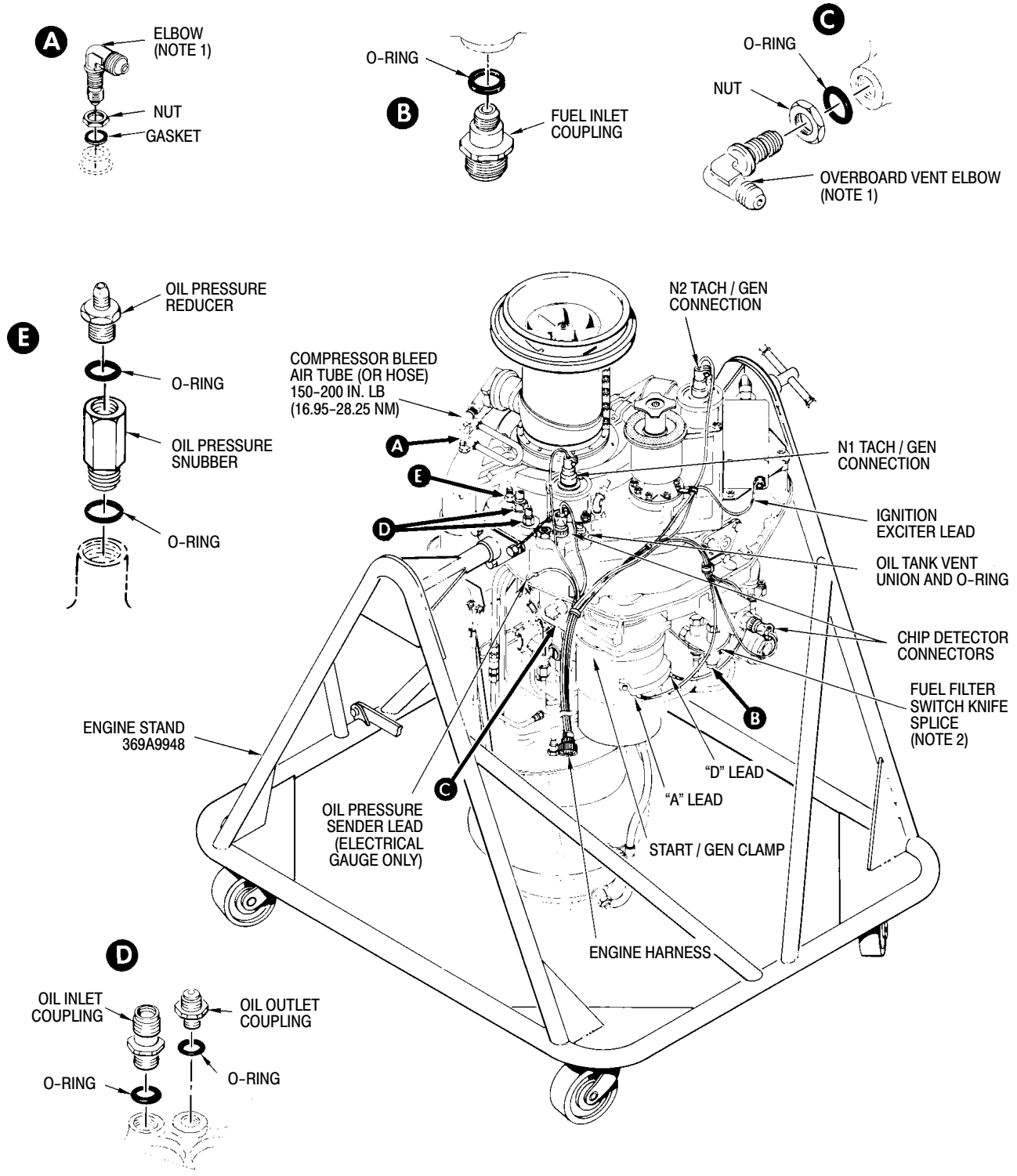
(Ref. Figure 10-3 and Figure 10-4)

(1). Support replacement engine in position for access to engine mount fitting locations.

(2). Install the three engine mount fittings, using washers and bolts. Torque to **140 - 160 inch-pounds (15.82 - 18.08 Nm)** and safety with lockwire. Do not safety lower engine mount fitting at this time.

(3). Install engine in engine stand (38, Table 2-2).

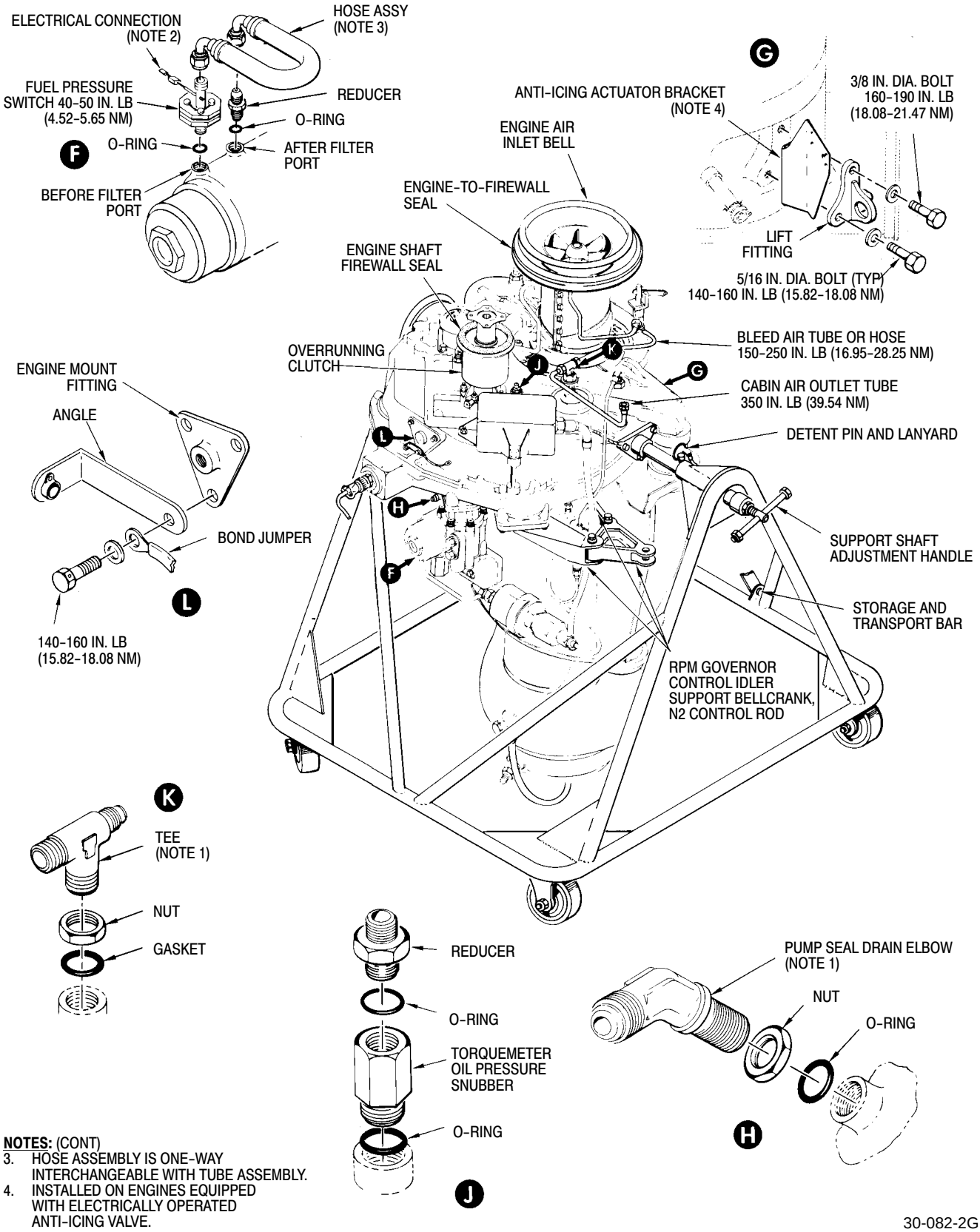
(4). Install O-ring, nut and special tee in compressor scroll. Do not tighten.



NOTES:
1. OBSERVE POSITION OF FITTING BEFORE REMOVING TO AID REASSEMBLY AT CORRECT ANGLE.
2. INSULATE WITH FIBERGLASS SLEEVING (87, TABLE 2-4.).

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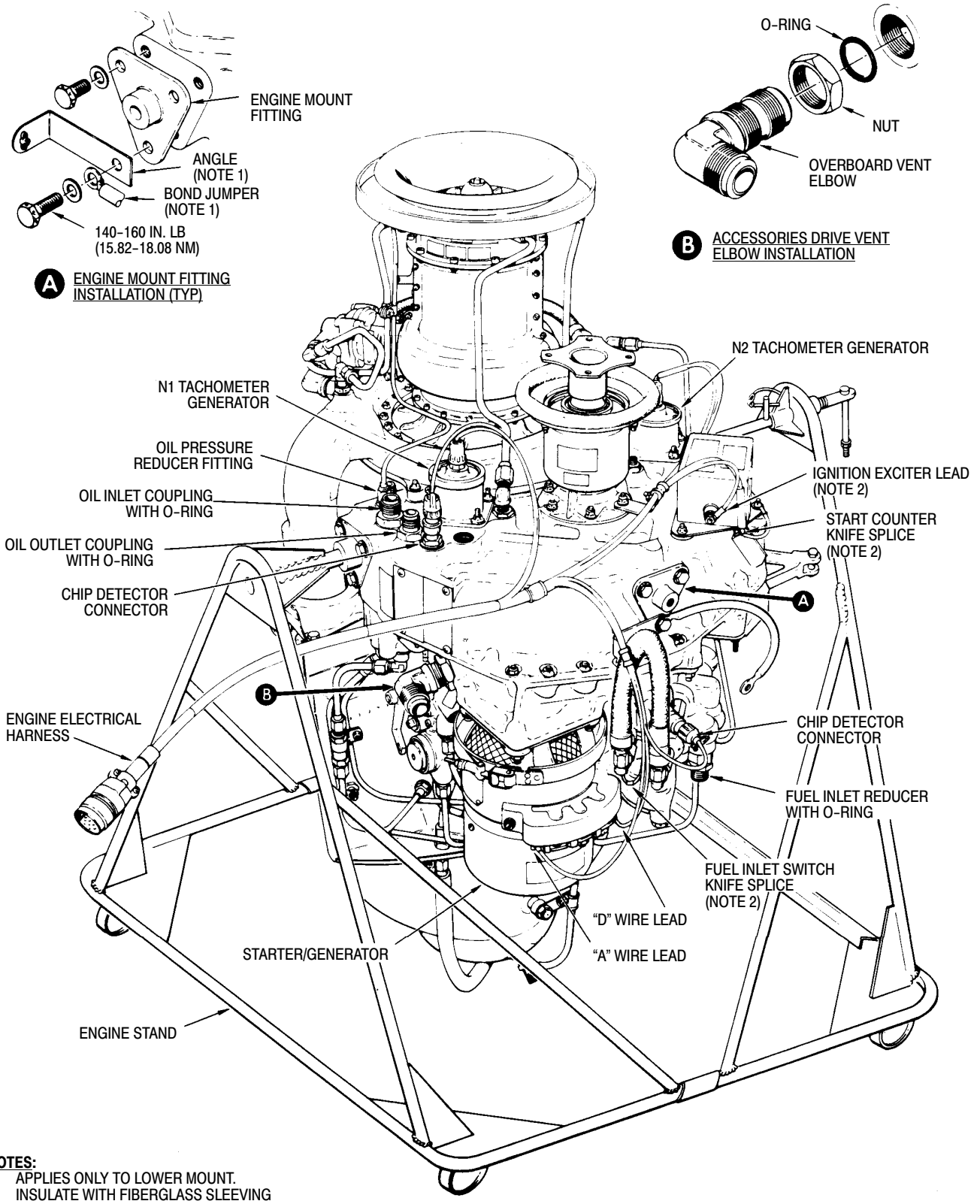
Figure 10-3. 250-C18 Engine Stripping and Buildup (Sheet 1 of 2)



NOTES: (CONT)

3. HOSE ASSEMBLY IS ONE-WAY INTERCHANGEABLE WITH TUBE ASSEMBLY.
4. INSTALLED ON ENGINES EQUIPPED WITH ELECTRICALLY OPERATED ANTI-ICING VALVE.

Figure 10-3. 250-C18 Engine Stripping and Buildup (Sheet 2 of 2)



NOTES:
1. APPLIES ONLY TO LOWER MOUNT.
2. INSULATE WITH FIBERGLASS SLEEVING (87, TABLE 2-4).
3. CHECK THAT LEVER ARM IS INSTALLED PARALLEL WITH TOP OF ENGINE.

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Figure 10-4. 250-C20 Engine Stripping and Buildup (Sheet 1 of 2)

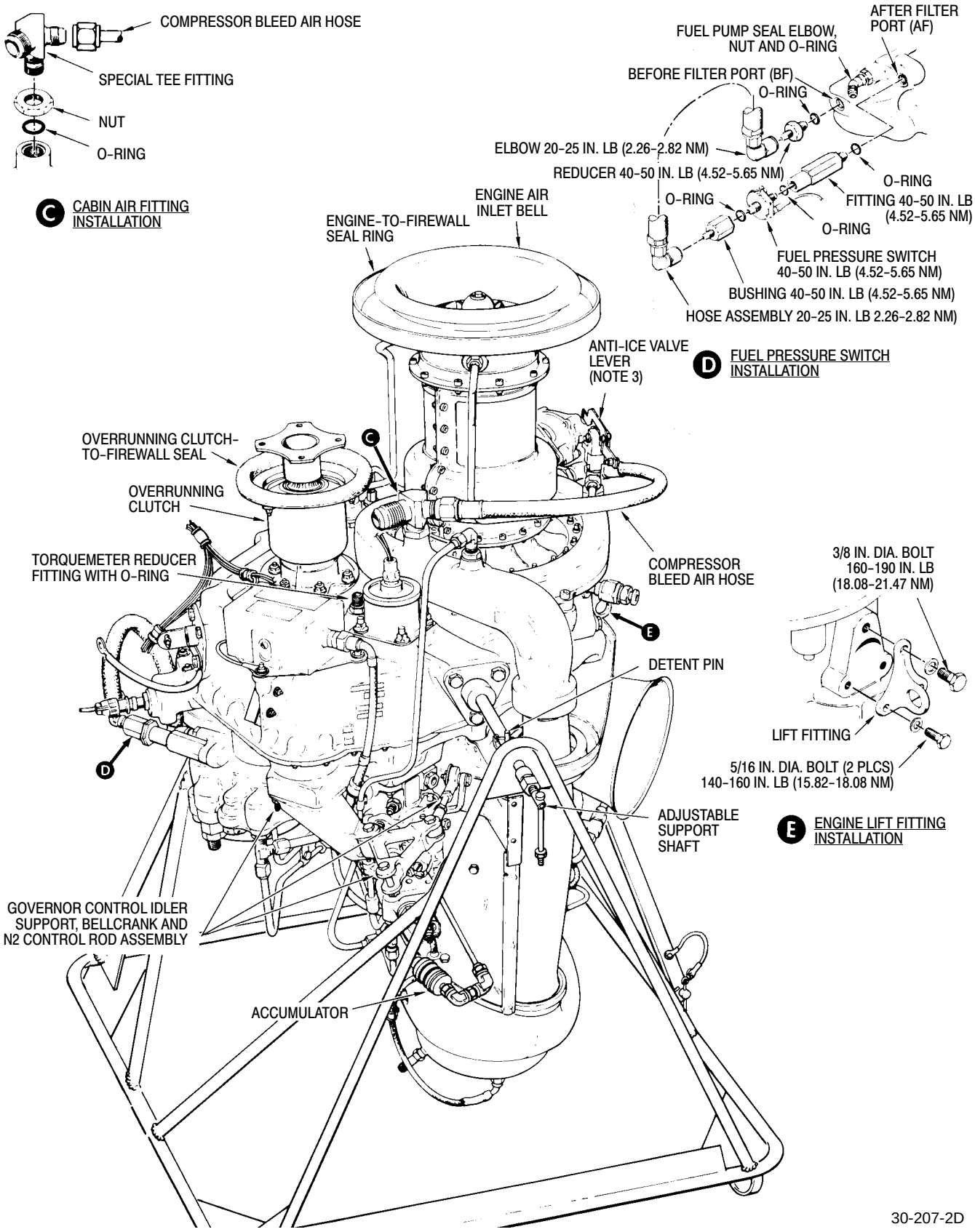


Figure 10-4. 250-C20 Engine Stripping and Buildup (Sheet 2 of 2)

(5). Connect compressor bleed air hose between special tee and compressor elbow. Tighten special tee nut; then torque hose nut to **150 - 250 inch-pounds (16.95 - 28.25 Nm)**.

(6). Install overrunning clutch (Ref. Sec. 9).

(7). Install engine firewall seal on overrunning clutch and secure with three bolts, six washers and three nuts.

(8). Install torquemeter oil pressure reducer and snubber with O-rings.

CAUTION The engine spark igniter lead on a new or overhauled engine is routed above the N_2 governor causing interference with and possible obstruction of the governor arm. During installation of the governor idler support, check that the engine spark igniter lead is routed as shown in Figure 10-3 and Figure 10-4. Also, check that only cushioned clamps are used to attach the igniter lead and replace if required. If not as shown, re-route the lead below the governor as shown using existing hardware and additional cushioned clamps as necessary.

(9). Install governor control idler support, bellcrank and short N_2 control rod as an assembly.

NOTE: Only high temperature all metal nuts (not the fiber insert type) are to be used for anchoring governor control idler support bracket to engine accessory pad.

(10). Install oil pressure reducer fitting, snubber and O-rings.

(11). Install fuel inlet reducer coupling and O-ring.

(12). Install O-ring, nut and elbow fitting in fuel pump seal drain port.

(13). Position anti-icing valve actuator bracket, if so equipped, and install engine hoist fitting using three washers and bolts. Torque the 3/8 inch-diameter bolt to **160 - 190 inch-pounds (18.08 - 21.47 Nm)**. Torque the two 5/16 inch-diameter bolts to **140 - 160 inch-pounds (15.82 - 18.08 Nm)**.

(14). Install anti-icing valve lever with attaching hardware on poppet guide (Ref. Sec. 11). If required, reposition poppet guide so that lever is parallel with top of engine.

(15). On helicopters equipped with electrically actuated anti-icing valve, install actuator and controls (Ref. Sec. 11).

(16). Install engine-to-firewall seal and engine inlet bell (Ref. Sec. 16).

(17). On 250-C18, install O-ring and fuel filter pressure switch in the before-filter port of the pump. Torque switch to **40 - 50 inch-pounds (4.52 - 5.65 Nm)**. Install O-ring and reducer in the after-filter port. Install tube assembly.

(18). On 250-C20, install fuel pressure switch fitting with O-ring in after (AF) port of the fuel pump; then install fuel filter pressure switch an O-ring and torque to **40 - 50 inch-pounds (4.52 - 5.65 Nm)**. Install bushing in switch. Install reducer fitting with O-ring in before filter (BF) port; then install hose between (AF) and (BF) fittings.

(19). Install tachometer generators (Ref. Sec. 17).

(20). Install O-ring, nut and elbow for accessories drive overboard vent. DO NOT tighten until final installation in helicopter.

(21). Install oil inlet and outlet couplings with O-rings.

(22). Install starter-generator (Ref. Sec. 19).

(23). Install engine harness. Connect ignition exciter lead, starter-generator A and D leads, fuel pressure switch splice and start counter splice. Install fiber glass sleeving (87, Table 2-4) over knife splice and secure with high temperature lacing cord (37). Install electrical connectors to tach generators and chip detectors. Safety the connectors with lockwire.

(24). On engines with Bendix fuel system installed, install the three cubic inch accumulator in fuel line according to the engine manufacturer's applicable installation instructions.

7. Installation of 369H8144-3 Engine Fuel Pump Pressure Switch Assembly

This procedure is for replacement of the existing 369H8144 engine fuel pump fuel pressure switch assembly with new 369H8144-3 switch assembly to be accomplished in conjunction with installation of 5 micron filter replacement kit (Allison PN 6895028). The -3 switch assembly accommodates the 5 micron filter element to preclude premature actuation of the fuel filter warning light on the instrument console.

(1). Check that all electrical power is OFF; disconnect battery.

(2). Gain access to engine accessory section; locate fuel filter pressure (by-pass) switch on front of engine driven fuel pump (Ref. Figure 10-4).

(3). Remove protective sleeving and disconnect knife splice on by-pass switch wiring.

(4). Disconnect and cap by-pass hose assembly at AN894-3-2 bushing.

(5). Remove 369H8020 adapter fitting (with switch and bushing intact) from after filter port. Plug after filter port.

(6). Remove bushing and adapter from switch, discard switch and packing.

(7). Install bushing with new MS29512-03 packing on new 369H8144-3 switch; install switch with new MS29512-02 packing on adapter; torque switch and bushing **40 - 50 inch pounds (4.52 - 5.65 Nm)**.

(8). Perform function test of new 369H8144-3 switch as follows:

(a). Remove cap from by-pass hose and reconnect bushing (with switch and adapter fitting intact) in hose fitting.

(b). Connect knife splice on switch wiring; connect jumper wire to ground by-pass switch to airframe ground (E-12).

(c). Have assistant hold switch clear; connect battery and electrical power and actuate start pump. Filter by-pass warning light should actuate, indicating proper operation of filter by-pass switch.

(d). Shut off electrical power, start pump, battery switch; disconnect battery and jumper wire.

(e). Disconnect bushing at by-pass hose; cap hose assembly.

(9). Remove plug from after filter port; install 369H8020 adapter fitting with new MS29512-03 packing at the after filter port.

(10). Remove cap from by-pass hose; reconnect bushing at by-pass hose.

(11). Check fuel filter pressure switch installation for discrepancies.

(12). Run up engine and perform operational check of engine and fuel system; check for leaks and non-actuation of fuel filter by-pass light when start pump is actuated.

8. Engine Mounts and Fittings

(Ref. Figure 10-5) The engine mount installation consists of one lower and two upper engine mounts, six structural attach fittings, three engine mount fittings and associated attaching hardware.

Each of the three engine mounts is a tubular steel, V-shaped, welded assembly.

The lower engine mount is bolted to the two bulkhead splice fittings and an engine mount fitting located on the underside mounting pad of the power and accessories gearbox.

The two upper engine mounts are symmetrically opposite assemblies; the longer end is bolted to an upper engine attach fitting on the firewall; the shorter end to the oleo support fitting and the aft end to an engine attach fitting on the side mounting pad of the power and accessory gearbox.

On current configuration helicopters, the left and right upper engine mounts may be adjustable for engine-to-transmission alignment. Adjustment is accomplished by turning a left and right threaded fitting that is part of each upper engine mount leg.

The three engine mount fittings, bolted to the power and accessory gearbox are machined aluminum alloy forgings, each having a self-locking, steel-thread insert.

The engine lift fitting (hoisting eye) is an anodized machined aluminum alloy forging, mounted on top of the power and accessory gearbox just aft of the air inlet scroll.

CAUTION

- If engine mount adjustment fittings are disturbed or if new or replacement upper engine mounts (either fixed or adjustable) are installed, realignment of the engine is required.
- To avoid disturbing security of the engine installation or alignment of the engine, do not loosen and/or remove more than one engine mount at any one time.
- Do not readjust adjustable engine mount fittings unless an engine- to- transmission alignment check is performed.
- Do not use open end wrenches when removing engine attach fittings and attaching hardware. Use box end and socket wrenches to avoid tool damage to hardware and engine mount fittings.

9. Lower Engine Mount Replacement

A. Lower Engine Mount Removal

(1). Remove the bolt and nut attaching the compressor air duct support bracket to the overhead engine hoist fitting.

(2). Install engine hoist (39, Table 2-2). Apply enough tension with hoist to remove weight from lower mount. Engine load will be neutral when the attaching bolts turn freely with nuts backed off one-half turn.

(3). Release cargo compartment upholstery enough to gain access to the bulkhead fitting boltheads.

(4). Disconnect the left and right forward ends of the lower engine mount; discard the two nuts.

(5). Disconnect lower engine attach fitting.

B. Lower Engine Mount Installation

CAUTION

- Do not tighten bolts until the engine attach bolt is tightened.
- Retorque the engine attach bolt after 3 to 5 hours of flight if the engine mount will be attached to a previously unused mount fitting.

NOTE: All engine mount fitting bolts, washers and nuts are corrosion resistant steel.

(1). Place ends of lower engine mount against bulkhead fittings. Install two bolts, four washers and two new nuts at bulkhead attach points. Torque nuts to **30 - 40 inch-pounds (3.39 - 4.52 Nm) plus drag torque**.

(2). Install engine attach bolt and washer securing mount to fitting on engine. Torque bolt to **100 - 140 inch-pounds (11.30 - 15.82 Nm)**; safety with 0.032 inch (0.8128 mm) lockwire.

(3). Tighten bulkhead fitting bolts and nuts.

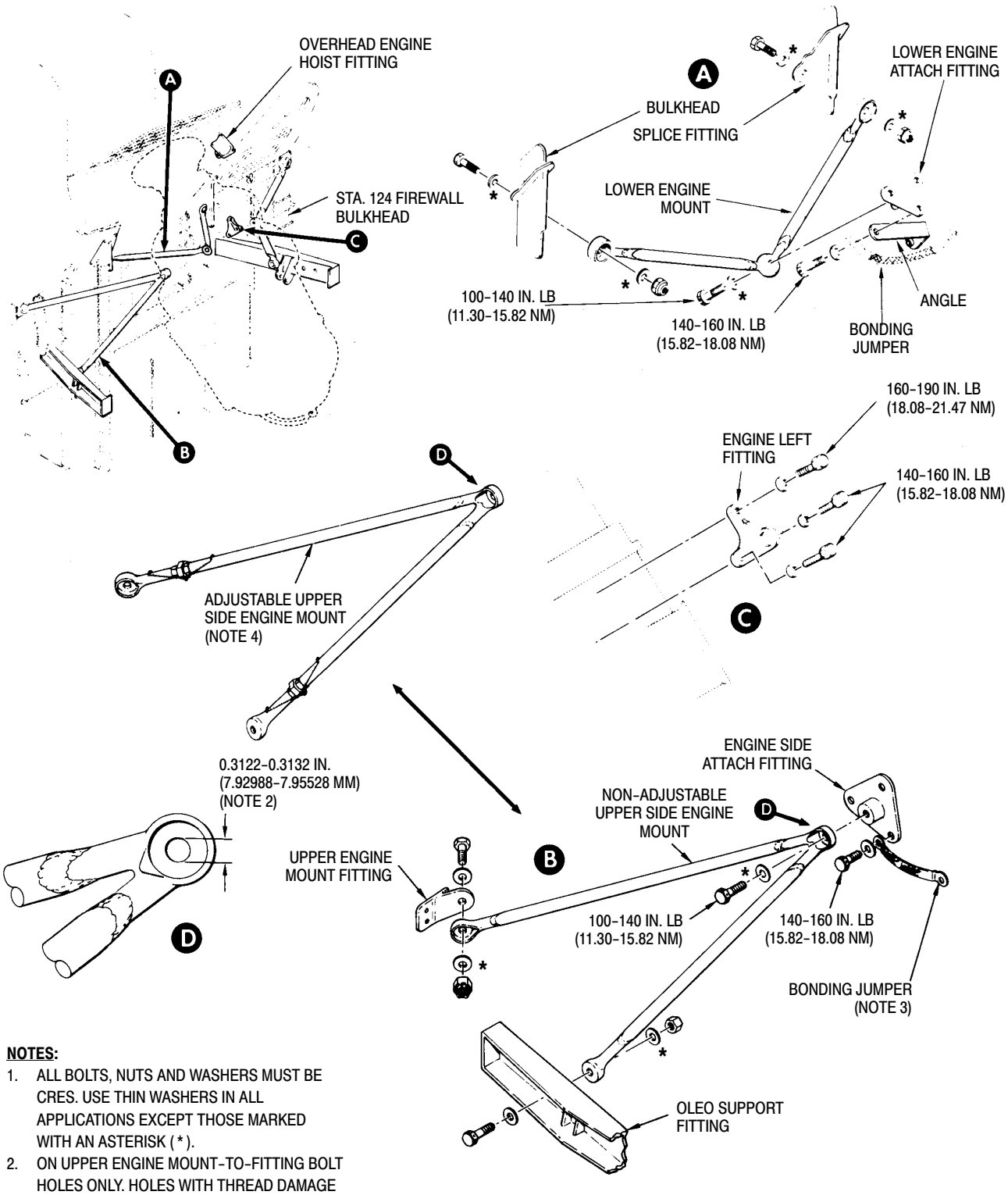
10. Upper Engine Mount Replacement

A. Upper Engine Mount Removal

(1). Remove engine oil pressure sender clamps, if installed, and engine harness clamp from right side engine mount.

(2). Disconnect forward attach points of upper engine mount at upper mount fitting and oleo support; discard the nuts.

(3). Remove aft end of mount from mount fitting on pad of power and accessory gearbox.



NOTES:

1. ALL BOLTS, NUTS AND WASHERS MUST BE CRES. USE THIN WASHERS IN ALL APPLICATIONS EXCEPT THOSE MARKED WITH AN ASTERISK (*).
2. ON UPPER ENGINE MOUNT-TO-FITTING BOLT HOLES ONLY. HOLES WITH THREAD DAMAGE MAY BE ENLARGED TO 0.3170 IN. DIAMETER PROVIDED ENGINE ALIGNMENT IS NOT AFFECTED.
3. NOT USED ON ALL HELICOPTER MOUNTS.
4. REFER TO TEXT FOR ADJUSTMENT AND ENGINE ALIGNMENT CHECK.

30-084E

Figure 10-5. Engine Mounts and Fittings

B. Upper Engine Mount Installation

CAUTION

- Do not tighten bolts until the engine attach bolt is tightened.
- Retorque the engine attach bolt after 3 to 5 hours of flight if the engine mount will be attached to a previously unused mount fitting.

NOTE: All engine mount fitting bolts, washers and nuts are corrosion resistant steel.

(1). Place short end of upper engine mount against oleo support fitting and long end against firewall attach fitting. Install bolt, two washers and new nut to fasten mount to structure.

(2). Install bolt and washer that attach mount to fitting on engine. Torque bolt to **100 - 140 inch-pounds (11.30 - 15.82 Nm)**.

(3). Torque upper mount fitting and oleo support nuts to **30 - 40 inch-pounds (3.39 - 4.52 Nm) plus drag torque**.

(4). Remove engine hoist and reinstall the compressor air duct support bracket in the overhead hoist fitting.

(5). Reinstall engine oil pressure sender clamps (if used) and engine harness clamp on right engine mount.

C. Engine Mounts and Fittings Inspection

(1). Inspect all engine mount assemblies for good condition of painted surface.

(2). Inspect all engine mount tubes for straightness. Hold a steel straight-edge against the surface of tubes to reveal any warps or bends in the tubes.

(3). Check that jam nuts and lockwire on mounts with adjustable fittings are secure and have not been disturbed. If not secure or adjustment has been disturbed, a check of engine-to-transmission alignment is required.

(4). Visually inspect all the tubes and welded joints for cracks and evidence of corrosion. Magnetic-particle inspect suspected engine mount assemblies. If cracks are evident, the mount is unserviceable.

(5). Inspect flanges and bosses of engine mount fittings and lifting eye for flatness, cracks and corrosion. Replace defective fittings.

(6). Inspect threaded steel insert for damaged threads, corrosion and for full bottoming to seat of insert hole.

D. Engine Mounts and Fittings Repair

No straightening or weld repair of the engine mounts is authorized. Thread damage to either upper engine mount, at the engine attach point, can be repaired by re-drilling the hole up to a maximum diameter of 0.3170 inch (8.0518 mm), provided that re-drilling does not permit engine-to-main transmission drive shaft misalignment and resulting clutch or main transmission to drive shaft coupling gaps in excess of that specified in Section 9. Otherwise, replace defective mounts and fittings.

NOTE: Re- drilling (opening) the hole on one mount usually will not cause misalignment beyond permitted tolerance. However, if both mounts are reworked, engine to drive shaft alignment must be checked.

E. Engine-to-T ransmission Alignment Check

(Ref. Figure 10-6) Adjustable upper left and right engine mounts should normally not be disassembled except for spares replacement or magniflux inspection. In this event, a realignment check of the engine is required. Realignment of the engine is also required if adjustable mounts are interchanged between helicopters.

(1). If only one adjustable upper mount is replaced or readjusted, check and readjust engine-to-transmission alignment using engine-to-transmission aligning tool 369A50000-40101 according to instructions in CSP-H-6. Following adjustment, proceed with steps (3). and (4).

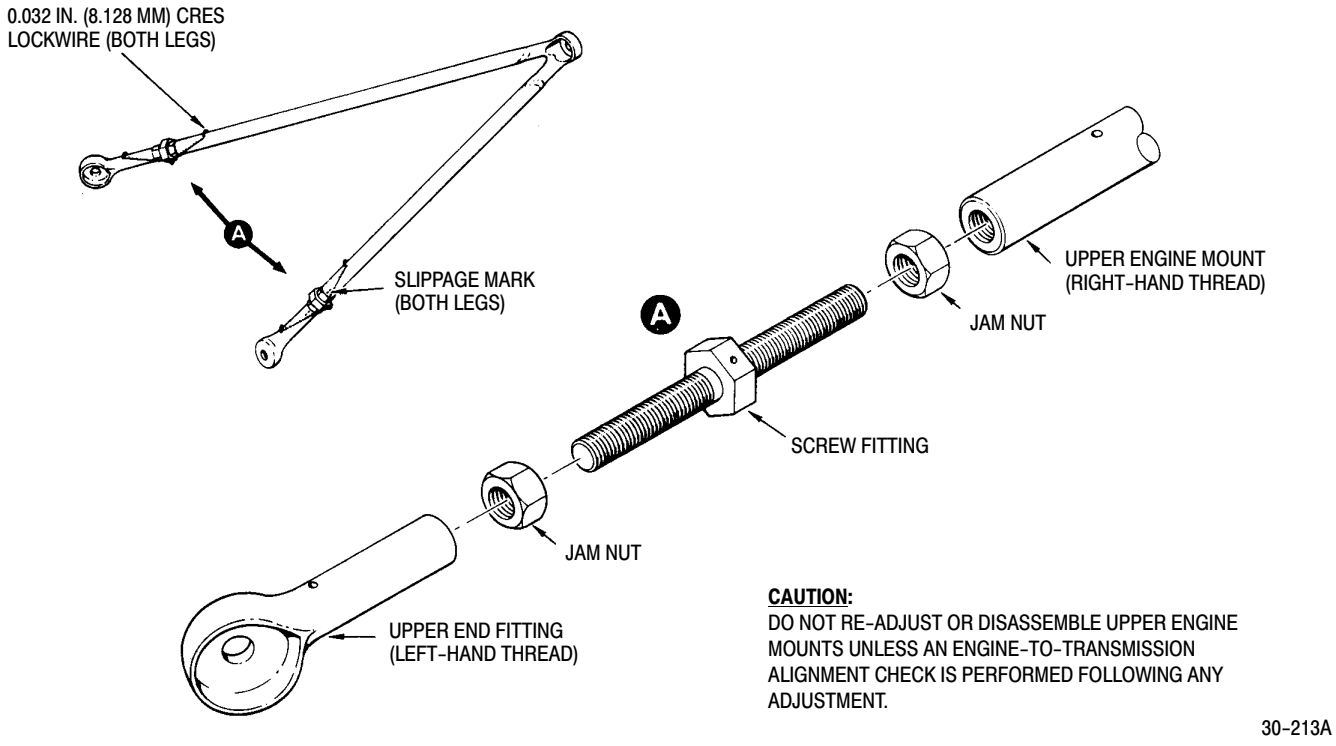


Figure 10-6. Adjustable Engine Mounts

(2). If both adjustable upper engine mounts are replaced or readjusted, install engine and tailboom check fixture 369A9900-80906 (Ref. CSP-H-6) and adjust mounts as required. Following adjustment proceed with steps (3). and (4).

(3). Adjust mount(s) to bring engine into alignment with transmission; then tighten jam nuts and recheck alignment.

(4). Secure jam nuts with 0.032 inch (0.8128 mm) lockwire; then paint a slippage mark across both jam nuts at each mount leg.

11. Engine Cooling System

(Ref. Figure 10-7) The engine cooling system consists of two ram air scoops integral with the air inlet fairing, an oil cooler blower driven by the main transmission input gear shaft, an oil cooler duct and engine gearcase and compressor cooling ducts.

The oil cooler blower is belt-driven on the current configuration helicopter and shaft-driven on the early configuration.

Air enters the ram air scoops, flows into the transmission cover around the transmission and through ducts to the oil cooler blower. The transmission cover is equipped with special baffles on helicopters with a 250-C20 engine.

Air from the oil cooler blower is directed to and through the engine oil cooler by the oil cooler duct and into the engine compartment. The oil cooler blower also supplies a constant air flow through the engine gearcase and compressor cooling ducts into the lower and upper areas of the engine compartment.

Two duct outlets direct the air upon the engine gearcase and the compressor section. Engine differences require variations in air flow direction. All cooling air then exhausts from the engine compartment through a gap provided around and between the exhaust pipes and the engine access doors.

A. Engine Cooling System Inspection

Visually inspect for general condition, security of clamps and for fraying or tears in the flexible tubing.

B. Cooling System Repair or Replacement

Repair damaged hose with tape (32, Table 2-4). Remove attaching clamps to remove hose. Install clamps on each end of replacement hose; position hose and tighten clamps.

12. Engine Shaft Firewall Seal

(Ref. Figure 10-1 or Figure 10-2) The engine shaft firewall seal assembly consists of a stamped steel backing and a seal that is bonded to the cupped diameter of the backing. A slightly larger seal is used on helicopters equipped with the 250-C20 engine.

A. Engine Shaft Firewall Seal Replacement

(1). Remove engine.

(2). Remove three bolts, six washers and three nuts that attach engine shaft firewall seal to overrunning clutch.

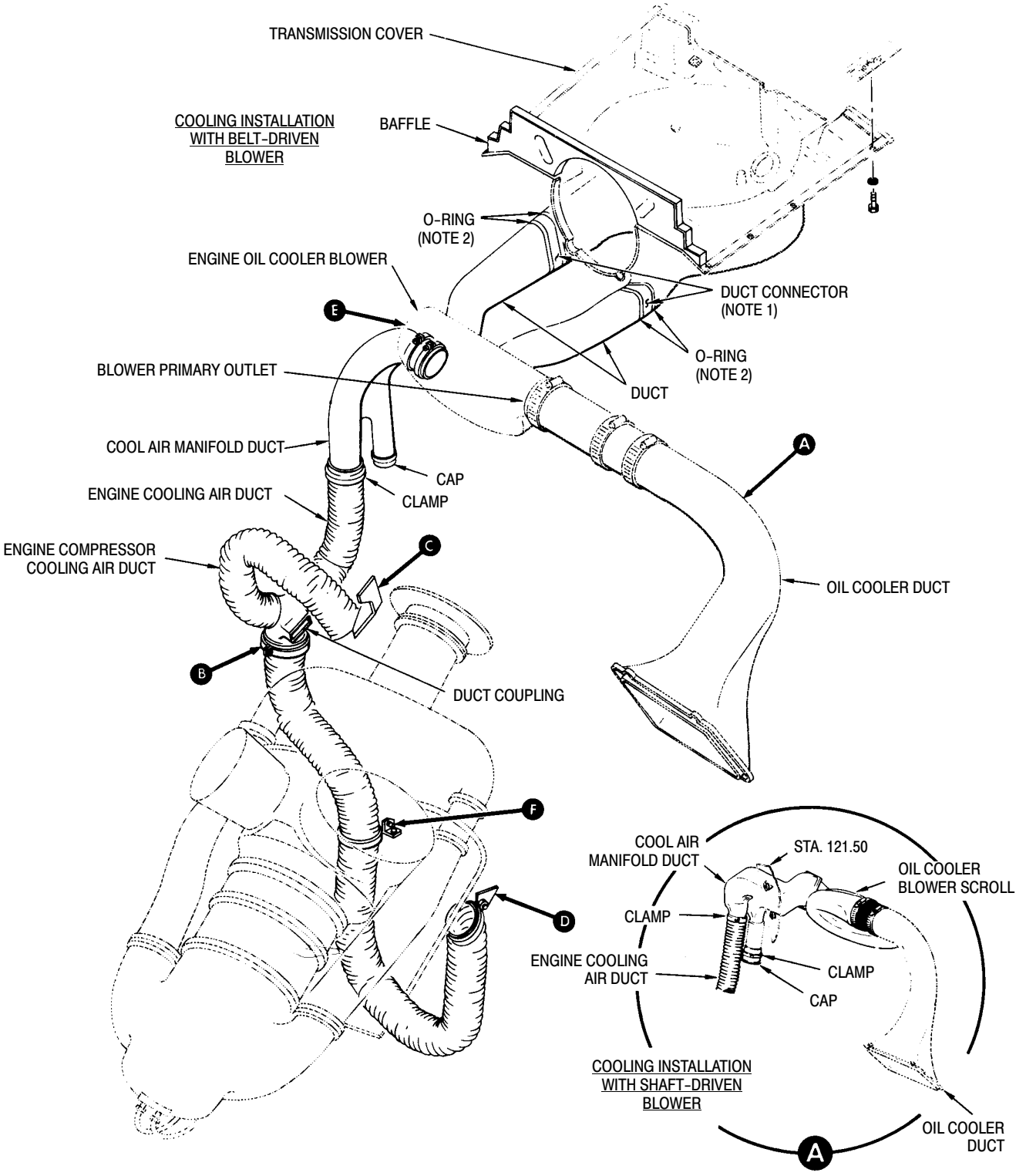
(3). Position replacement engine shaft firewall seal assembly on flange of clutch and secure with attaching hardware.

B. Engine Shaft Firewall Seal Inspection

Inspect the firewall seal and backing for cracks, breaks, corrosion or other damage that would prevent complete sealing of the firewall opening.

C. Engine Shaft Firewall Seal Repair

Replace engine shaft firewall seal by bonding new seal to backing with adhesive (19, Table 2-4).

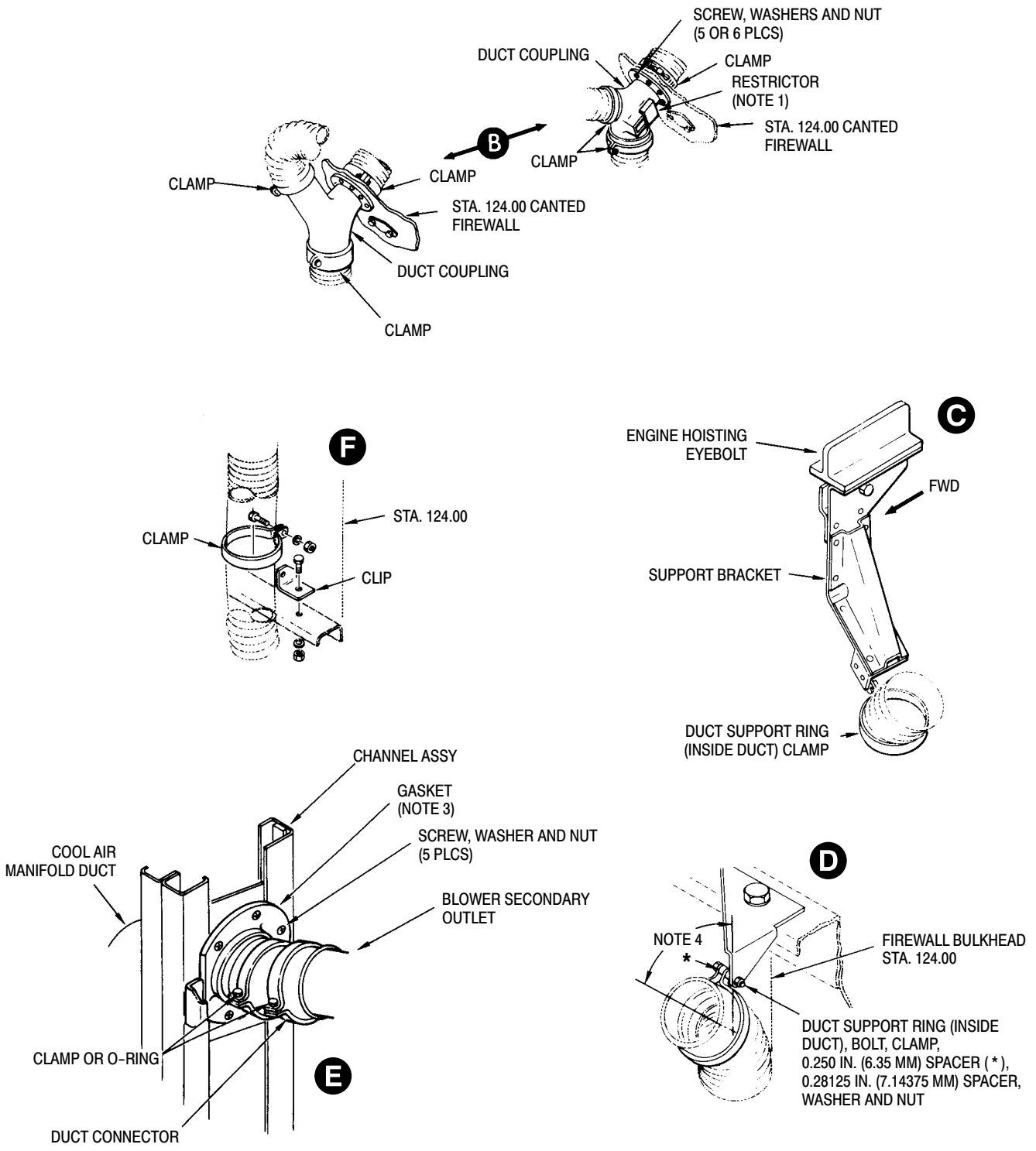


NOTES:

1. NOT INSTALLED ON ALL DUCTS.
2. MAY BE REPLACED WITH NYLON TWINE (30, TABLE 2-4).

30-083-1B

Figure 10-7. Engine Cooling (Sheet 1 of 2)



NOTES: (CONT)

3. BOND TO STRUCTURE WITH ADHESIVE (19, TABLE 2-4) ACCORDING TO CONTAINER INSTRUCTIONS.
4. ADJUST AT 45 DEGREES FOR 250-C18 ENGINE AND 30 DEGREES FOR 250-C20 ENGINE.

30-083-2E

Figure 10-7. Engine Cooling (Sheet 1 of 2)

Section

11

Engine Control Systems

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TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 11 Engine Control System		**11-1**
1.	Power Control System	11–1
2.	Power Controls Troubleshooting	11–1
	Table 11–1. Power Controls Troubleshooting	11–1
	Figure 11–1. Engine Power Controls System	11–2
3.	Power Control System Rigging	11–3
A.	Bendix Gas Producer Controls Rigging	11–3
	Figure 11–2. Bendix Gas Producer Controls Rigging	11–4
	Figure 11–3. Bendix Gas Procedure Fuel Control Adjustments	11–5
B.	CECO Gas Producer Fuel Control Rigging	11–6
	Figure 11–4. CECO Gas Producer Control Rigging	11–7
	Figure 11–5. Gas Producer Fuel Control Adjustment CECO	11–8
C.	Power Turbine Governor Controls Rigging (Bendix or CECO)	11–9
	Figure 11–6. Bendix Power Turbine Governor Controls Rigging (Sheet 1 of 2)	11–10
	Figure 11–7. CECO Power Turbine Governor Controls Rigging	11–12
4.	Gas Producer Controls	11–15
A.	Gas Producer Linkage Replacement	11–15
B.	Gas Producer Control Linkage Inspection	11–16
	Figure 11–8. Gas Producer Control Linkage Disassembly	11–17
C.	Gas Producer Control Linkage Repair	11–18
D.	Gas Producer Throttle Linkage	11–18
5.	Power Turbine Governor Controls	11–18
A.	Power Turbine Governor Linkage Replacement	11–18
	Figure 11–9. Governor Control Linkage Disassembly (Forward of Engine Compartment)	11–19
	Figure 11–10. Governor Control Linkage Disassembly (Engine Compartment)	11–20
B.	Governor Control Linkage Inspection	11–21
C.	Governor Control Rods and Bellcranks Repair	11–21
D.	Relocation of Locknut and Installation of Spacer	11–22
E.	Droop Control Override Link Assembly Repair	11–22
	Figure 11–11. Relocation of Locknut – Sta. 68.00 Bellcrank Assembly	11–23
6.	RPM Governor (N2) Trim Actuator	11–24
A.	N2 Trim Actuator Replacement	11–24
B.	N2 Trim Actuator Repair	11–24
C.	N2 Trim Actuator Testing	11–24
	Figure 11–12. N2 Trim Actuator Test hookup	11–24
7.	Anti–Icing System	11–25

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
8.	Anti-Icing System Troubleshooting	11-25
	Table 11-2. Anti-Icing System Troubleshooting	11-25
9.	Anti-Icing Controls (Electrically Operated System)	11-26
A.	Anti-Icing Controls Operational Check (Electrically Operated0	11-26
B.	Electrically Operated Anti-Icing Valve Rigging	11-26
C.	Anti-Icing Valve Actuator and Linkage Replacement	11-26
	Figure 11-13. Engine Anti-Icing Valve Electrically Actuated Equipment	11-27
10.	Anti-Icing Valve Control Cable (Manually Operated)	11-28
A.	Anti-Icing Valve Control Operational Check (Manually Operated)	11-29
B.	Anti-Icing Valve Control Cable Inspection (Manually Operated)	11-29
C.	Anti-Icing Valve Control Cable Replacement (Manually Operated)	11-29
	Figure 11-14. Engine Anti-Icing Valve Manual Control Installation	11-30
D.	Anti-Icing Control Cable Repair (Manually Operated)	11-31

SECTION 11
ENGINE CONTROL SYSTEM

1. Power Control System

(Ref. Figure 11-1) The power controls system consists of the gas producer (N_1) controls and the power turbine (N_2) governor controls. The mechanically operated gas producer controls actuate the gas producer control lever that schedules the quantity of fuel metered to the engine. The electrically operated trim actuator and the mechanically operated droop compensator change the position of the power turbine governor control lever that regulates the operating rpm of the engine. Bendix fuel control system components are standard on Allison 250-C18 engines and may also be installed on the 250-C20 engine. Current configuration helicopters equipped with the 250-C20 engine use Chandler Evans (CECO) fuel control system components. Refer to the engine operation and maintenance manual for fuel system theory of operation and other detailed information.

NOTE: The Bendix system may be used on 250- C18 Series engines converted to 250- C20 configuration provided that Allison Commercial Engine Bulletin 250 CEB-126 and 250-C20 Installation Bulletin 1005 are complied with, and provided that only the special ignition exciter Allison PN 6870885 (GLA PN 43754) is used if automatic reignition equipment is installed. Refer to CSP-H-3 for information on auto-reignition equipment and the Model 250-C18 to 250-C20 engine conversion.

2. Power Controls Troubleshooting

(Ref. Table 11-1)

Table 11-1. Power Controls Troubleshooting

Symptom	Probable Trouble	Corrective Action
Movement of control results in springy feeling; response lags behind control movement	Lost motion in linkage; gas producer interconnect torque tube loose in collective stick gearshafts	Tighten pipe plugs in torque tube for zero backlash (Ref. Sec. 7).
	Worn rod ends; worn bellcrank bearings	Replace worn parts.
Control action stiff	Rod ends binding in fitting	Realign rod end bearings to eliminate jamming.
Low power; improper idling speed; improper acceleration; variable power output at constant setting	Incorrectly adjusted gas producer or power turbine governor controls	Adjust gas producer or power turbine governor controls for correct operation.
	Defective gas producer control assembly or power turbine governor	Replace faulty unit (Ref. Engine Operation and Maintenance Manual).
Stagnated or hot engine starts	Fuel control derichment misadjusted (BENDIX)	Adjust derichment valve (BENDIX).
	Fuel control light off and start derichment controls misadjusted (CECO)	Adjust variable start and derichment control (CECO).
Excessive TOT readings during engine shutdown	Incorrectly adjusted engine power controls	Adjust engine power controls for correct operation.

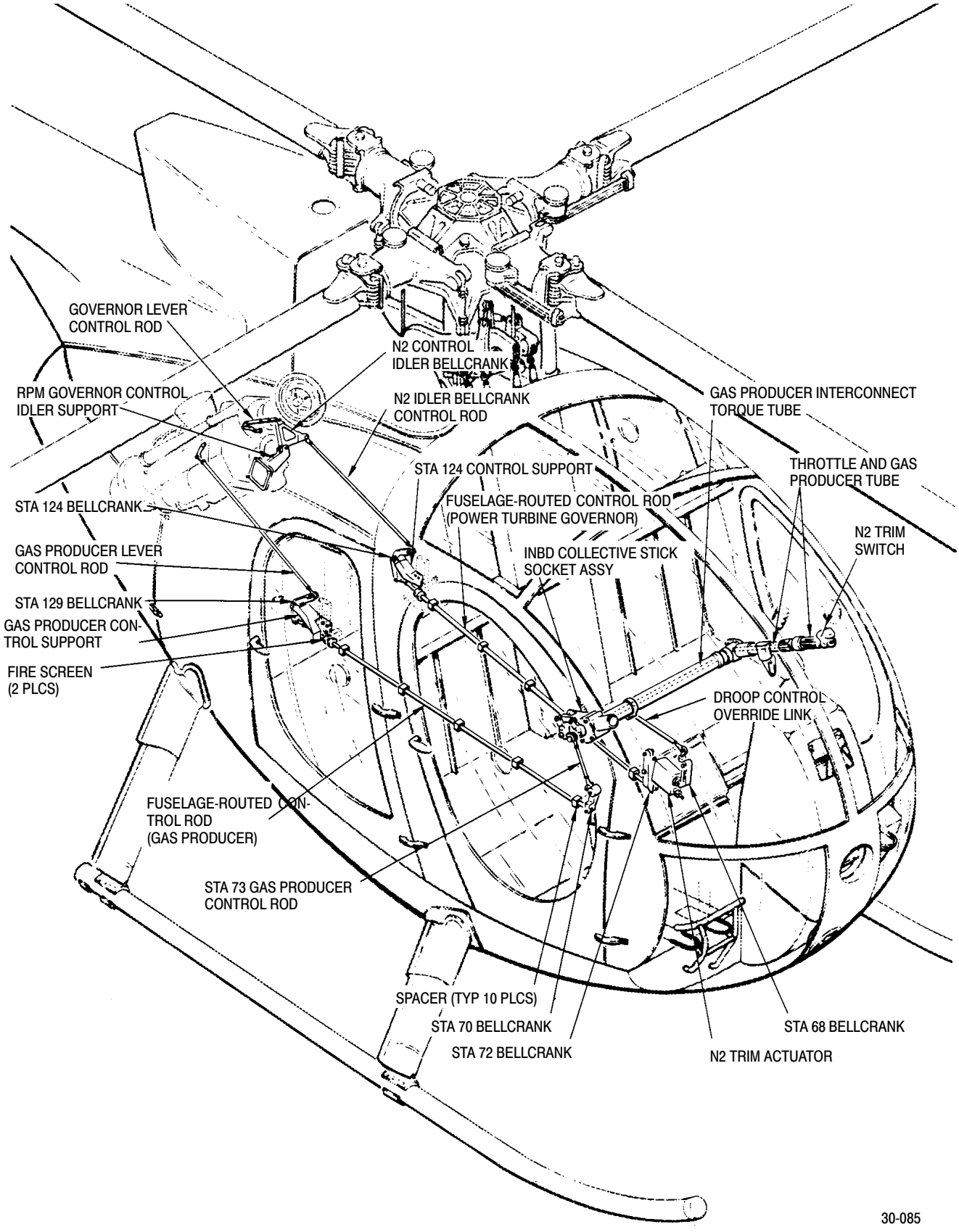


Figure 11-1. Engine Power Controls System

3. Power Control System Rigging

Rigging of the engine power controls system must be accomplished:

(1). Immediately after replacement of linkage that cannot be accurately measured (by trammeling, etc.) before it is installed in either the gas producer control system or the power governor control system; or

(2). If engine operation reveals a rigging deficiency.

CAUTION When tightening a jam nut to secure a control end, always hold the rod end with a wrench to prevent jamming of the bearing against the fitting. Check that all misalignment is divided equally between bearings of each control rod assembly.

A. Bendix Gas Producer Controls Rigging

(Ref. Figure 11-2) The following rigging instructions apply to all 250-C18 engines and 250-C20 engines with a Bendix fuel control system.

NOTE: Adjustment steps (1). thru (4). of this procedure are necessary only when the pilot's compartment linkage or the fuselage-routed control rod have been removed and reinstalled or replaced, or if there is insufficient clearance between the lower firewall bellcrank and its support. Otherwise, perform adjustment of gas producer controls starting with step (5).

(1). Position the collective stick and throttle at mid-travel.

(2). Adjust the length of the Sta. 73 control rod so that the long arm of Sta. 70 bellcrank is vertical.

(3). Adjust the length of the fuselage-routed gas producer control rod so that the bolt center in the lower arm of Sta. 129 bellcrank is 5.00 ±0.03 inch (127 ±0.762 mm) from the firewall.

CAUTION When repositioning the gas producer lever in d below, do not exceed the lever nut torque limit of **40 - 50 inch-pounds (4.52 - 5.65 Nm)**. Overtorquing will cause binding of the lever.

(4). With the engine compartment gas producer control rod length set to 16.56 inches (420.624 mm), re-establish the gas producer lever mid-position so that lever centerline is half way between the "closed" and "maximum" travel stops; lever serrations have 15 degree spacing. (The "closed" stop position is parallel to the engine compartment door frame within ±5 degrees.)

CAUTION If any interference exists at the gas producer lever, check that the correct lever is installed.

(5). Lower collective stick to full down.

(6). Rotate pilot's throttle counterclockwise to maximum rpm, then clockwise to idle.

(7). With pilot's throttle held at idle, adjust upper rod end of gas producer lever rod until gas producer pointer is positioned at 30-31 degrees on quadrant (detail A). Mark pointer position on quadrant with grease pencil.

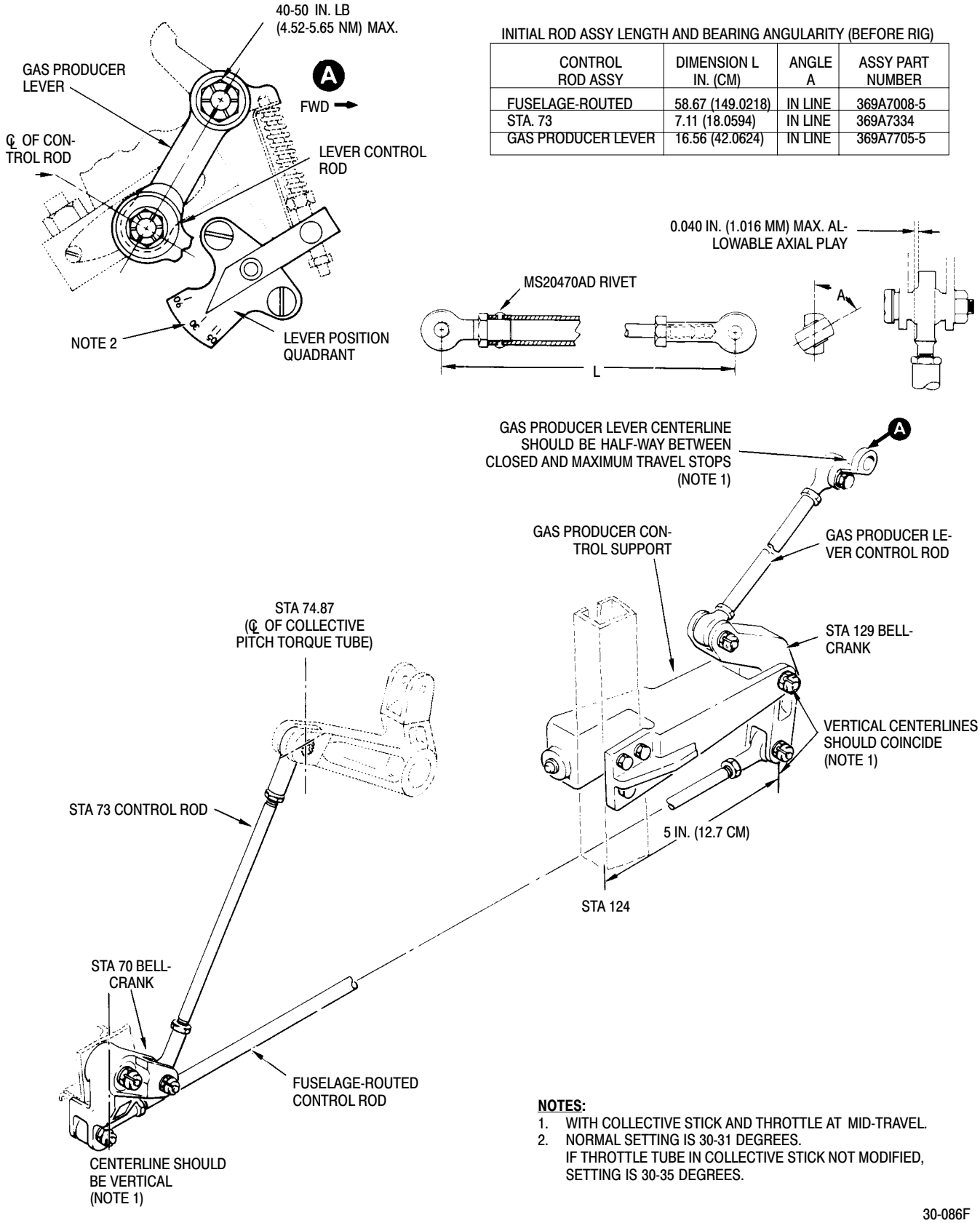
CAUTION Do not alter gas producer lever position or control linkage to adjust idle speed. Idle speed will be checked during flight test and, if necessary, adjusted by the fuel control idle screw, not by the linkage. Check extreme travel position of the linkage to ensure that gas producer lever hits the fuel control stops before the throttle grip stops make contact. There must be no interference or binding in the linkage. Ensure linkage clears engine tubing.

(8). Rotate pilot's throttle counterclockwise to maximum rpm.

(9). Observe gas producer lever to ensure it strikes the maximum travel stop.

(10). Raise collective stick to full up.

(11). If gas producer lever does not strike maximum travel stop, check gas producer controls for binding.



INITIAL ROD ASSY LENGTH AND BEARING ANGULARITY (BEFORE RIG)

CONTROL ROD ASSY	DIMENSION L IN. (CM)	ANGLE A	ASSY PART NUMBER
FUSELAGE-ROUTED	58.67 (149.0218)	IN LINE	369A7008-5
STA. 73	7.11 (18.0594)	IN LINE	369A7334
GAS PRODUCER LEVER	16.56 (42.0624)	IN LINE	369A7705-5

Figure 11-2. Bendix Gas Producer Controls Rigging

(12). Rotate pilot's throttle fully clockwise to fuel off. Observe gas producer lever to ensure it strikes minimum travel stop (closed position).

(13). Lower collective stick to full down. Observe gas producer lever to ensure it does not move from the minimum travel stop.

(14). At the full closed and full open positions of the throttle, check all the movable linkage for clearance with supporting or adjacent parts. Check that control rod bearings are not jammed when the linkage is in the extreme control positions.

NOTE: Before operating an engine in 250-C20 configuration with a Bendix gas producer fuel control, check that the maximum fuel flow adjusting screw is fixed in position shown in Figure 11-3.

(15). Start and operate engine at idle with main rotor blades in flat pitch according to the Owner's Manual.

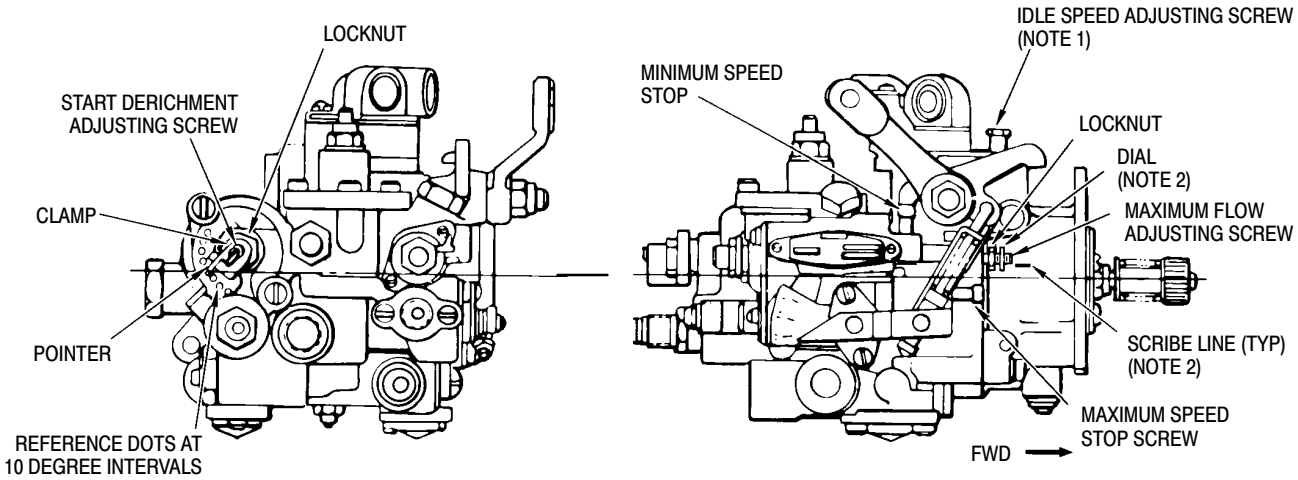
(16). With pilot's throttle at idle, observe N_1 tachometer indicator to ensure N_1 speed stabilizes at 62-67 percent. Adjust N_1 speed with the fuel control idle speed adjustment screw (Ref. Figure 11-3).

(17). If idle rpm does not stabilize within limits in step (16)., proceed with engine troubleshooting in engine operation and maintenance manual.

NOTE: Bendix gas producer fuel controls equipped with a variable derichment valve may be adjusted to eliminate stagnated or hot starts (Ref. Allison Operation and Maintenance Manual).

WARNING **The following check must be made to ensure that engine shutdown will not occur due to throttle chop. Refer to NOTE: after step (17).**

(18). Rotate pilot's throttle control counterclockwise to normal engine operating rpm; then clockwise to idle in a manner simulating a pilot training throttle chop. Repeat this check using the copilot's throttle if optional dual controls are installed. If shutdown occurs, perform steps (19). and (20).



NOTES:
1. TURN CLOCKWISE TO INCREASE, COUNTERCLOCKWISE TO DECREASE N1 SPEED. ENGINE SPEED CHANGES APPROXIMATELY 5% PER 1/8 TURN (USE ALLISON TOOL P/N 6798292.)
2. USED ONLY WITH 250-C20 ENGINE WITH BENDIX FUEL CONTROL. INDEX LINE ON FACE OF DIAL TO ALIGN WITH SCRIBE MARK ON SIDE OF DRIVE BODY.

30-155B

Figure 11-3. Bendix Gas Procedure Fuel Control Adjustments

(19). Adjust upper rod end of gas producer lever rod to increase rod length by one or two rod turns to obtain slightly higher setting (31 degrees maximum) on lever position quadrant. Be sure maximum control rod length is not exceeded by checking at the control rod witness hole.

(20). Repeat procedures in (5). thru (19). until engine shutdown does not occur from a throttle chop.

NOTE: After rigging and testing of Bendix or CECO gas producer controls, perform a deceleration check in accordance with procedures found in the pilot's flight manual, If confirmed deceleration time is less than the allowable minimum, refer to the applicable Allison Operation and Maintenance Manual.

B. CECO Gas Producer Fuel Control Rigging

(Ref. Figure 11-4) The following rigging instructions apply to 250-C20 engines with a CECO fuel control system.

NOTE: For all new fuel control unit installations, check that the maximum fuel flow stop adjustment screw (Figure 11-5) is set at the minus (-) mark, 235 PPH (107 kgPH). Use a 3/32 inch Allen wrench to reset the screw if required.

NOTE: Adjustment steps (1). thru (4). of this procedure are necessary only when the pilot's compartment linkage or the fuselage-routed control rod have been removed and reinstalled or replaced, or if there is insufficient clearance between the lower firewall bellcrank and its support. Otherwise, perform adjustment of gas producer controls starting with step (5).

(1). Position the collective stick and throttle at midtravel.

(2). Adjust the length of the Sta. 73 control rod (Figure 11-4) so that the long arm of Sta. 70 bellcrank is vertical.

(3). Adjust the length of the fuselage-routed gas producer control rod so that the bolt center in the lower arm of Sta. 129 bellcrank is 5.00 ±0.03 inch (127 ±0.762 mm) from the firewall.

(4). Set gas producer lever control rod length to 16.56 inches (420.624 mm).

CAUTION When reinstalling control lever on fuel control shaft in next step, do not exceed nut torque of **40 - 50 inch-pounds (4.52 - 5.65 Nm)**. Overtorquing will cause binding of the lever.

(5). Remove control lever from gas producer fuel control, rotate quadrant pointer to 0° and then reinstall control lever so that it is approximately parallel to engine compartment door frame.

NOTE: Control lever serrations have a 15° spacing.

(6). Rotate pilot's throttle to cutoff position and connect gas producer rod to control lever.

CAUTION If any interference exists at the gas producer lever, check that the correctlever is installed.

(7). Rotate pilot's throttle to fully open position and check that fuel control quadrant pointer is on 90° and that maximum stop on fuel control is contacted before throttle grip stop is contacted.

(8). Rotate pilot's throttle to idle position and check that fuel control pointer is at the 30° mark and that rigging pin holes are aligned. Make small adjustments in length of gas producer control rod, at the control lever end, if required.

NOTE: The maximum allowable rigging error at idle position (pointer position not at 30°) is 0.078 inch (1.984 mm) below the 30° mark. However, the higher setting (30°) is required to prevent inadvertent over- control and shutdown when dual controls are installed.

(9). Rotate pilot's throttle to cutoff position and check that quadrant pointer is at 0° to minus 2° and that stop is in contact. The minimum stop on the fuel control should be in contact before the throttle grip stop is contacted.

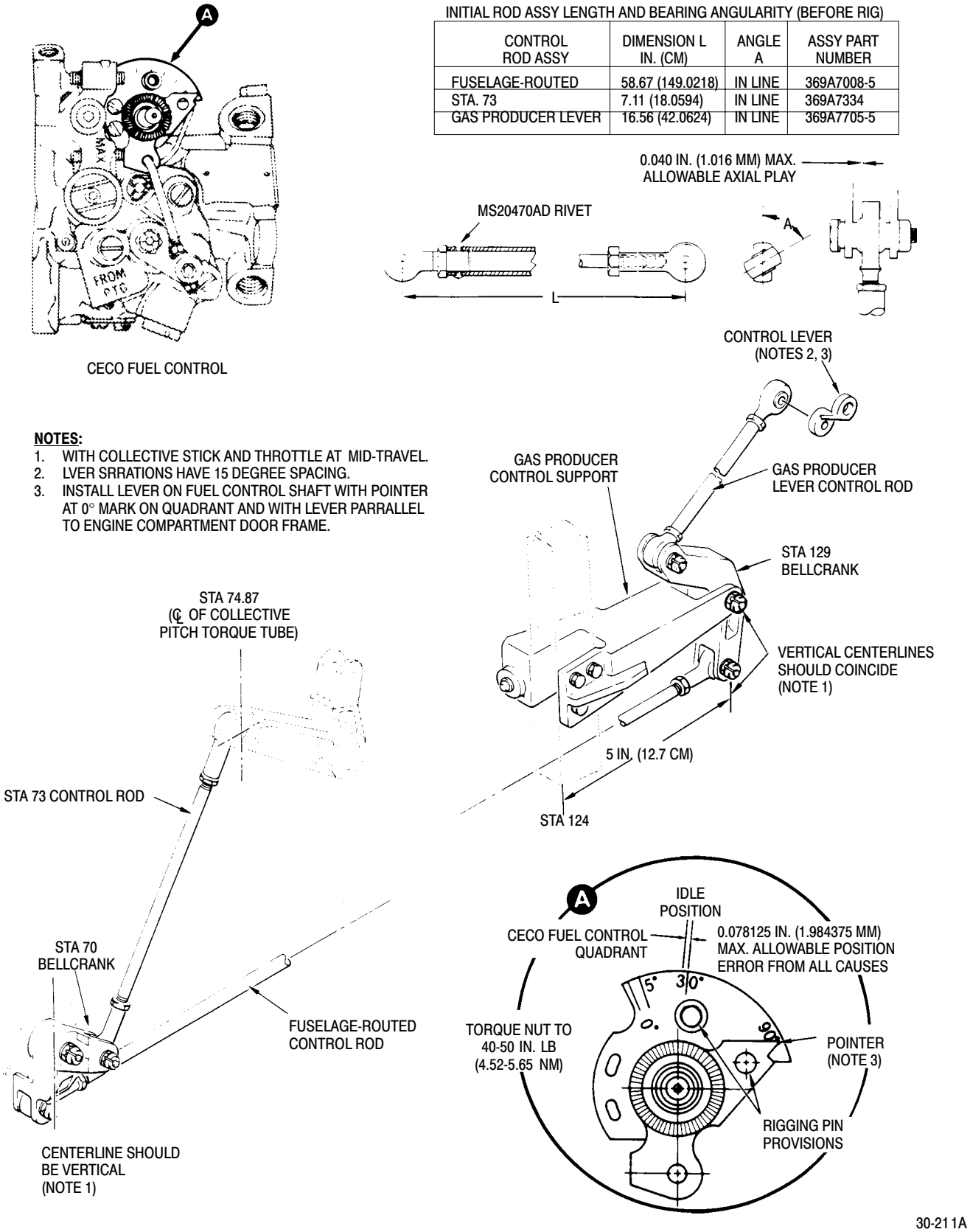
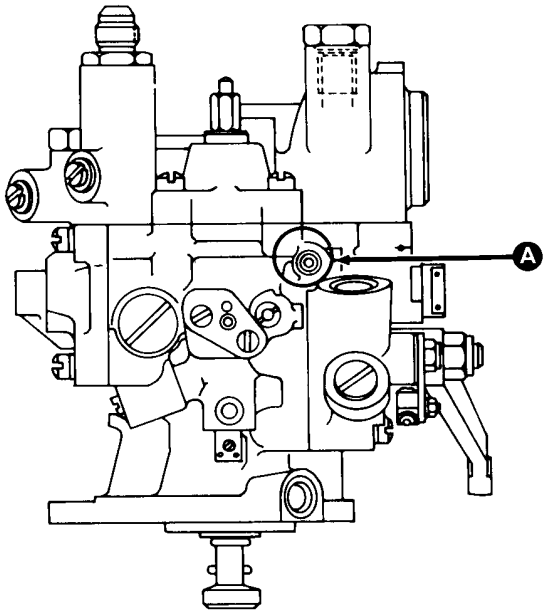
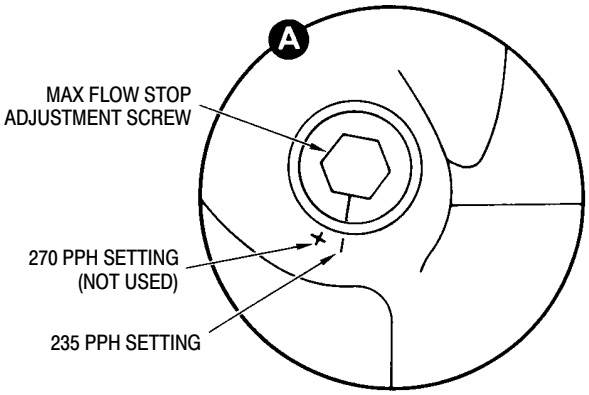
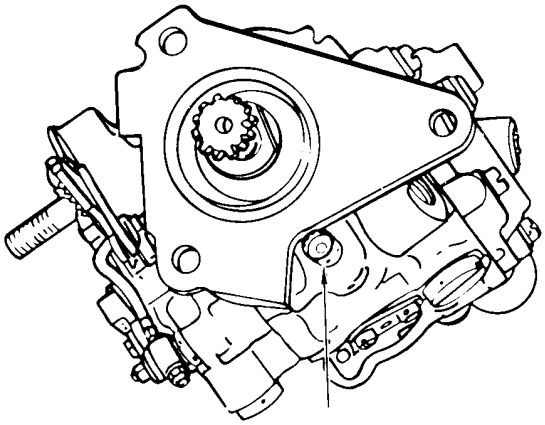


Figure 11-4. CECO Gas Producer Control Rigging

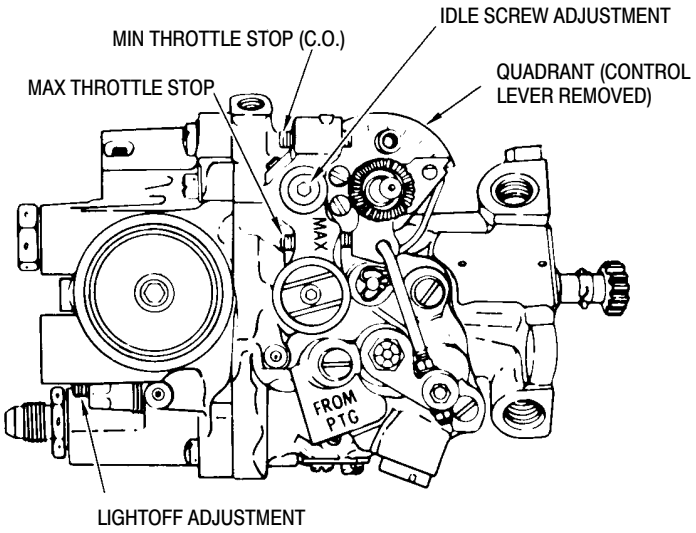


BOTTOM VIEW





PAD END
(CONTROL LEVER REMOVED)



RIGHT SIDE VIEW
(AS INSTALLED)

30-210

Figure 11-5. Gas Producer Fuel Control Adjustment CECO

CAUTION The minus 2° pointer position is desired for positive fuel cut-off. One-half turn on the minimum stop screw equals 2° of pointer travel.

(10). Rotate pilot's throttle to fully open position and check that fuel control pointer is at 90° and in contact with the maximum stop.

(11). Raise collective stick to full up position and check that fuel control pointer remains in contact with the maximum stop.

(12). Rotate pilot's throttle to cutoff position and check that fuel control pointer contacts the minimum stop.

(13). Lower the collective stick to full down position and check that fuel control pointer remains on the minimum stop.

(14). Recheck idle position rigging by rotating pilot's throttle from cutoff position to idle and from full open position to idle. The fuel control pointer should indicate 30° with rigging pin holes aligned in both cases.

(15). While operating the throttle through its complete range, check all movable linkage for clearance from supporting and adjacent parts and check that control rod bearings are not jammed at extremes of travel.

(16). Start and operate engine at idle with main rotor blades in flat pitch according to the Owner's Manual.

(17). With pilot's throttle at idle, observe N_1 tachometer indicator to ensure N_1 speed stabilizes at 61-65 percent. Adjust N_1 speed with the fuel control idle speed adjustment screw (Figure 11-5) using 5/16 inch Allen wrench. A 1/8 turn equals approximately 1% N_1. Turn the screw clockwise to increase N_1 idle speed.

(18). If idle rpm does not stabilize within limits in step (17)., proceed with engine troubleshooting in engine operation and maintenance manual.

NOTE: The CECO fuel control is equipped with lightoff and start derichment controls which may be adjusted to eliminate stagnated or hot starts. (Ref. Allison Operation and Maintenance Manual)

WARNING **The following check must be made to ensure that engine shutdown will not occur due to throttle chop.**

(19). Rotate pilot's throttle control counter-clockwise to normal engine operating rpm; then clockwise to idle in a manner simulating a pilot's training throttle chop. If optional dual controls are installed, repeat this check using the copilot's throttle. If shutdown occurs perform steps (20). and (21).

(20). Recheck rigging and adjust rod length at upper rod end of gas producer lever rod, as required, until neither the pilot's or copilot's throttle will move quadrant pointer below 30° at idle. Be sure maximum control rod length is not exceeded by checking at the control rod witness hole.

(21). Recheck engine operation to determine that shutdown does not occur at throttle chop, using both the pilot's and copilot's throttles.

C. Power Turbine Governor Controls Rigging (Bendix or CECO)

Before rigging the power turbine governor controls, determine the type governor installed (either BENDIX or CECO).

(Ref. Figure 11-6 for the BENDIX installation.

(Ref. Figure 11-7 for the CECO installation.

(1). Bendix Rigging Adjustments:

NOTE: Adjustment steps (a). thru (d). of this procedure are necessary only when: the underseat linkage or the fuselage-routed control rod has been removed and reinstalled or replaced; or with Bendix governors prior to Allison PN 6873450 installed, if there is less than 0.030 inch (0.762 mm) clearance between the lower firewall bellcrank and its support when the governor lever is at the maximum stop. (If governor nameplate does not have an Allison part number, the governor is prior to PN 6873450.) Otherwise, perform adjustment of power turbine governor controls starting with step (e).

INITIAL ROD ASSY LENGTH AND BEARING ANGULARITY (BEFORE RIG)

CONTROL ROD ASSY	DIMENSION L IN. (CM)	ANGLE A	ASSY PART NUMBER
FUSELAGE-ROUTED	56.13 (142.5702)	IN LINE	369A7008-3
N2 IDLER BELLCRANK	14.38 (36.5252)	90°	369A7705
GOVERNOR LEVER	3.94 (10.0076)	90°	369A7706

NOTES:
1. INITIAL DIMENSION: SHORTEN TO INCR COMPENSATION. LENGTHEN TO DECREASE.
2. DROOP CONTROL OVERRIDE LINK SPRING STARTS TO COMPRESS, GOV LEVER AT APPROX. 78° AND STA 124.00 BELLCRANK BOTTOMED.

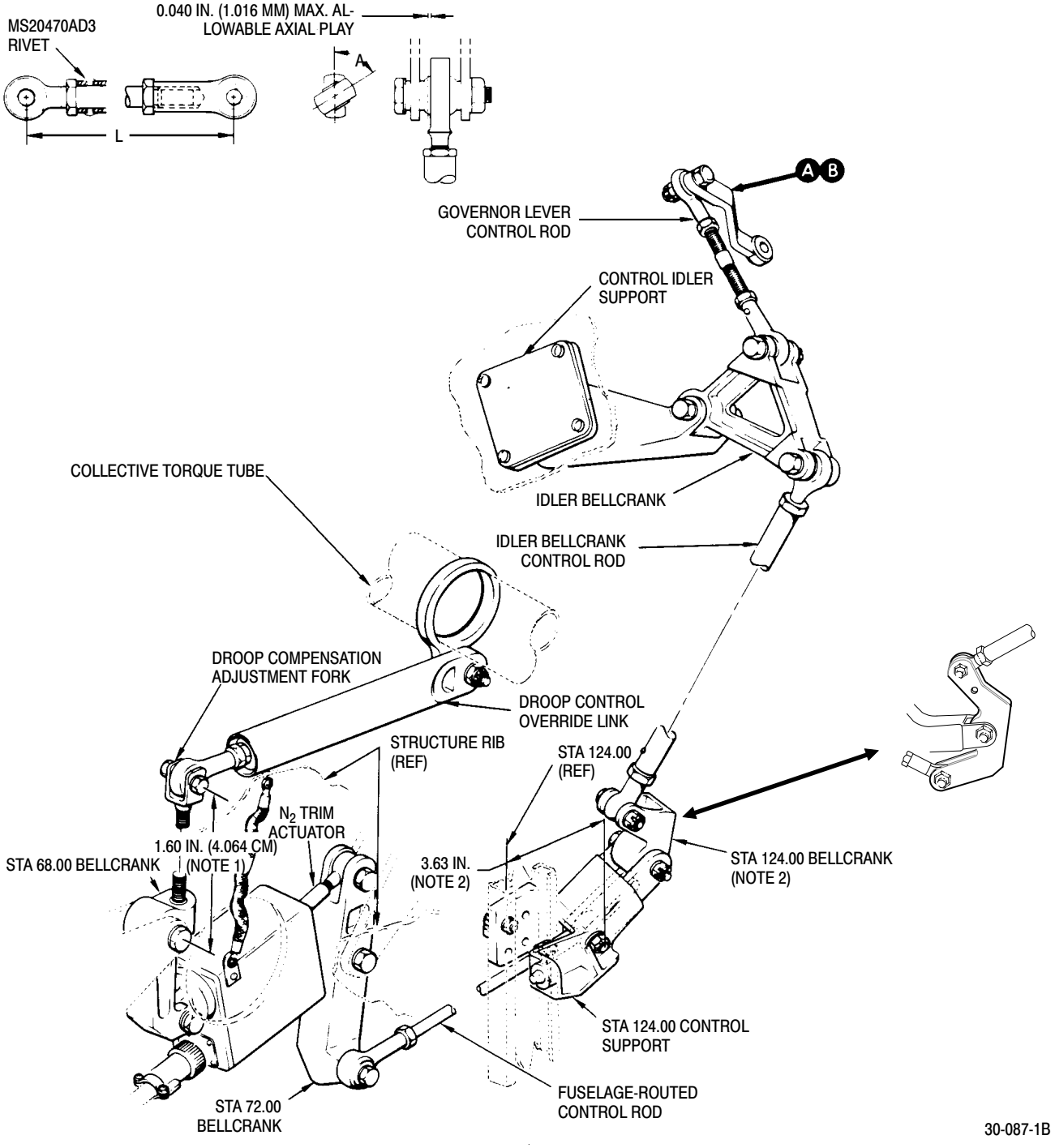
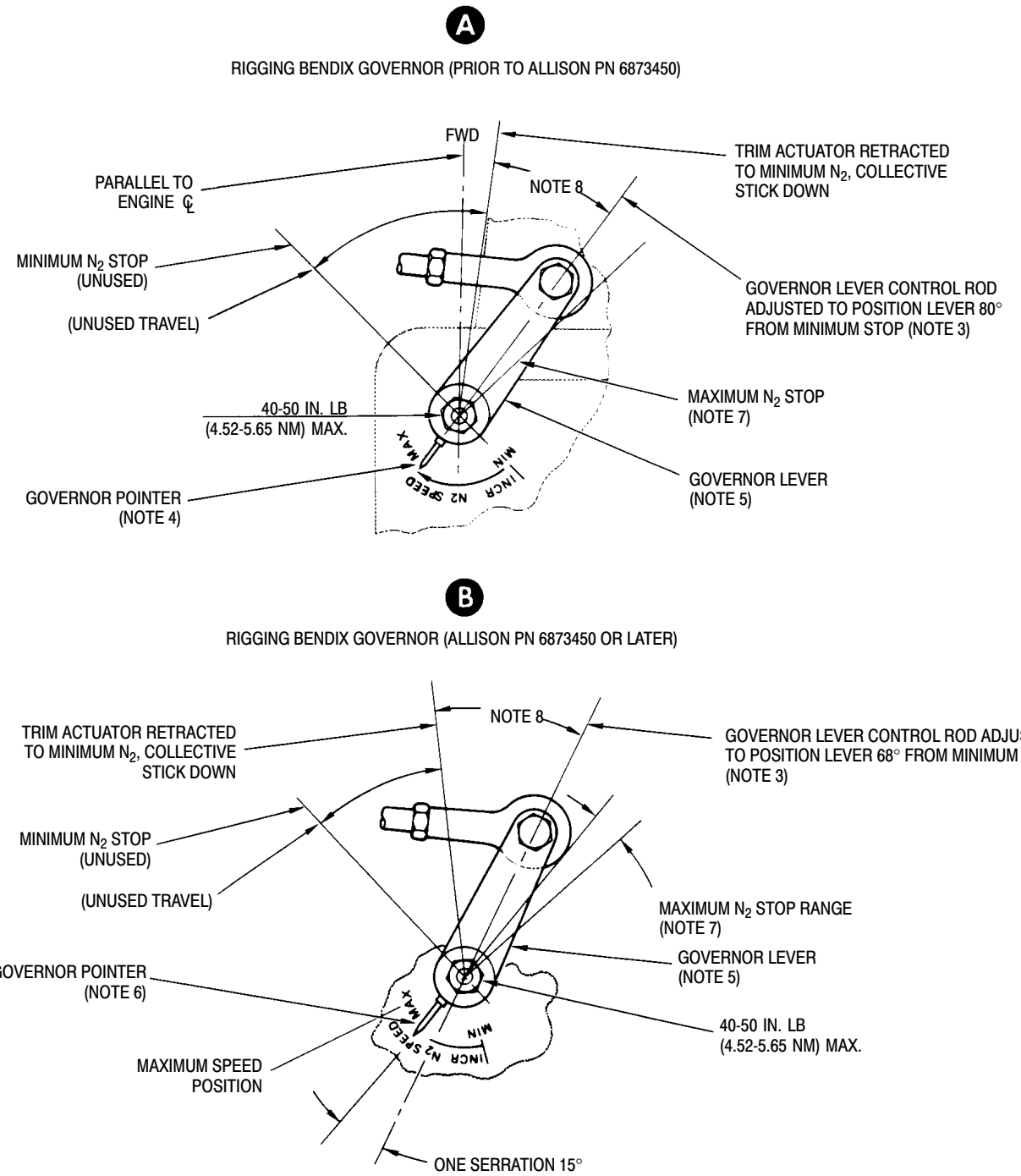


Figure 11-6. Bendix Power Turbine Governor Controls Rigging (Sheet 1 of 2)



NOTES: (CONT)

3. WITH TRIM ACTUATOR EXTENDED TO MAXIMUM N_2, COLLECTIVE STICK DOWN.
4. POINTER SHOULD ALIGN WITH GOVERNOR LEVER CENTERLINE.
5. LEVER SERRATIONS HAVE 15° SPACING.
6. WITH POINTER ONE SERRATION CLOCKWISE (AWAY FROM ENGINE) FROM LEVER CENTERLINE, TIP SHOULD ALIGN BETWEEN LETTERS P & E OF WORD SPEED.
7. DROOP CONTROL OVERRIDE LINK SPRING STARTS TO COMPRESS, ARM IS NOT REQUIRED TO HIT MAXIMUM STOP WITH FULL COLLECTIVE AND ACTUATOR EXTENDED.
8. TRAVEL LIMIT OF TRIM ACTUATOR IS 32°.

30-087-2D

Figure 11-6. Bendix Power Turbine Governor Controls Rigging (Sheet 2 of 2)

INITIAL ROD ASSY LENGTH AND BEARING ANGULARITY (BEFORE RIG)

CONTROL ROD ASSY	DIMENSION L IN. (CM)	ANGLE A	ASSY PART NUMBER
FUSELAGE-ROUTED	56.13 (142.5702)	IN LINE	369A7008-3
N2 IDLER BELLCRANK	14.28 (36.2712)	90°	369A7705
GOVERNOR LEVER	4.15 (10.541)	90°	369A7706

NOTES:
1. INITIAL DIMENSION: SHORTEN TO INCREASE COMPENSATION, LENGTHEN TO DECREASE.
2. WITH PILOT'S COLLECTIVE STICK AT FULL DOWN AND N_2 TRIM ACTUATOR AT FULL INCREASE.

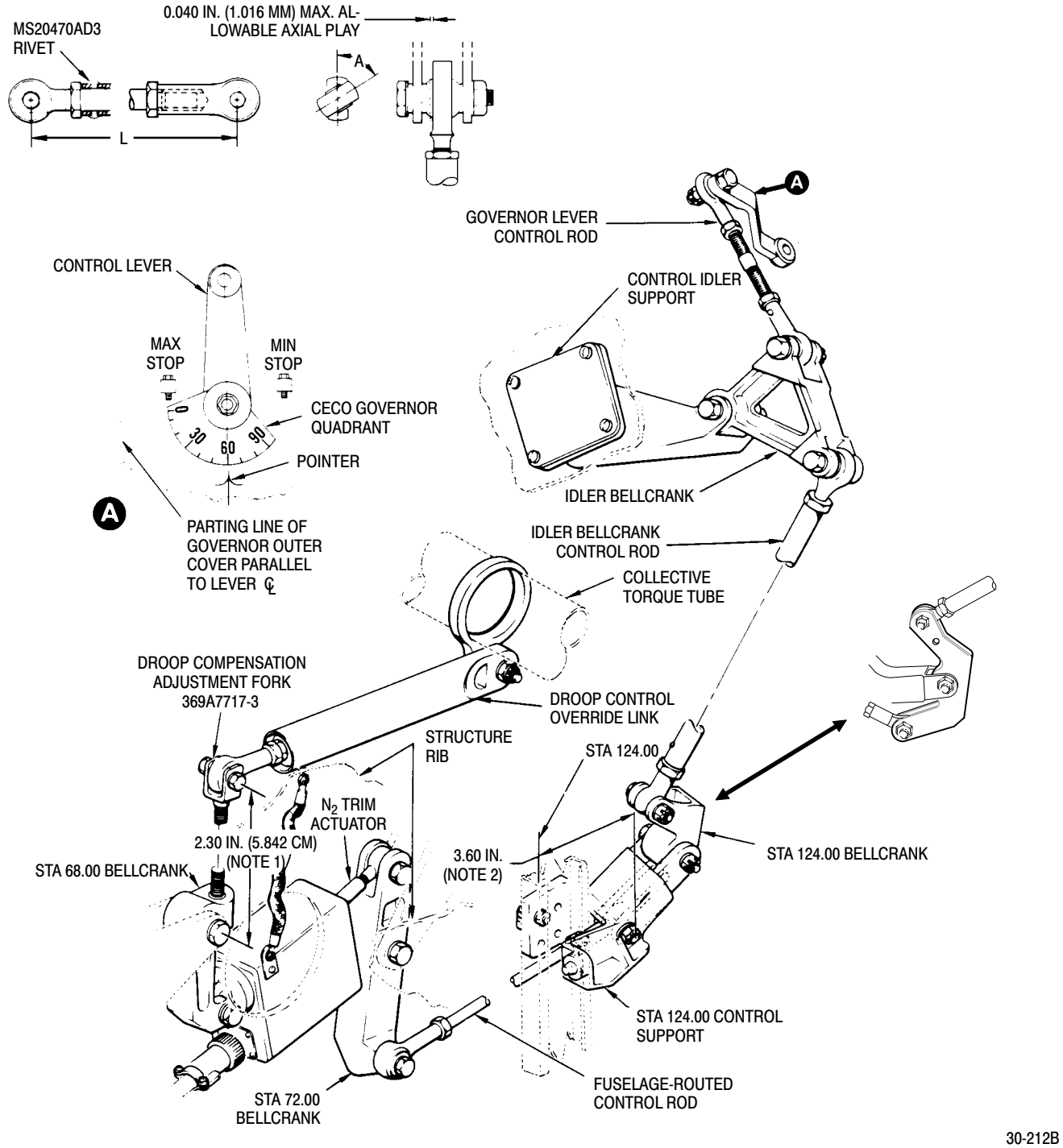


Figure 11-7. CECO Power Turbine Governor Controls Rigging

(a). Check that droop control override link total end play does not exceed 0.015 inch (0.381 mm).

(b). Check that the correct droop compensation adjustment fork is installed. Fork must measure 2.50-2.75 inches (63.50-69.85 mm) from center of link hole to end of threaded shaft. Adjusted so that the installed dimension between the centerlines of the Sta. 68 bellcrank pivot bolt and the fork bolt is 1.60 ±0.03 inches (40.64 ±0.762 mm).

(c). Connect and turn on external power. Check that the N_2 trim actuator is adjusted so that the dimension between attach bolt centers is 5.47 ±0.03 inches (138.938 ±0.762 mm) with actuator at maximum extension.

(d). With the pilot's collective stick full down and the N_2 trim actuator at maximum extension, adjust the length of the fuselage-routed governor control rod so that the bolt center in the lower arm of Sta. 124 bellcrank is 3.63 ±0.03 inches (92.202 ±0.762 mm) from the firewall.

(e). Check that the engine compartment N_2 idler bellcrank control rod length is set to 14.38 ±0.03 inches (365.252 ±0.762 mm).

(f). Check position of governor lever and pointer.

1). On Bendix governors prior to Allison PN 6873450, the lever pointer should align with the lever centerline (detail A).

2). On Bendix governors with Allison PN 6873450 or later, the lever pointer should be positioned one serration clockwise (away from engine) from lever centerline (detail B).

3). Reposition lever and pointer, if necessary, starting with both the lever and governor shaft at the minimum stop; lever serrations have 15 degree spacing.

NOTE: Do not exceed the lever nut torque limit of **40 - 50 inch-pounds (4.52 - 5.65 Nm)** or the lever will bind.

NOTE: The pointer-to-lever positions specified above are standard production settings. Occasionally, slight variation in pointer-to-lever position may be required to obtain proper travel and satisfactory engine operation. Such variation is acceptable provided all other rigging and engine performance requirements are met. Governor lever travel produced by trim actuator operation, from forward travel point (trim actuator retracted, collective stick down) to the aft travel point (trim actuator extended - collective stick down), is 32°. Approximately 48° degrees of governor lever travel from the minimum N_2 stop is unused on governors prior to Allison PN 6873450; 36 degrees is unused on governors with Allison PN 6873450 or later.

(g). Adjust governor lever control rod length until the governor pointer is at the center of the letter D in the word SPEED embossed on the power turbine governor (detail A) or between the letters P and E in the word SPEED (detail B), as applicable.

(h). Raise the pilot's collective stick approximately one-third to one-half of full up travel and note the following with the N_2 trim actuator fully extended:

1). With governor shown in detail A installed, the governor lever may shift to the maximum travel stop.

NOTE: As the stick is raised above this position and until it reaches full up travel the droop control override spring compression continues to increase.

2). With governor shown in detail B installed, check that the governor lever shifts to between the E and D in the word SPEED before the linkage (lower arm of Sta. 124 bellcrank) bottoms out.

(i). Lower collective stick to full down and decrease N_2 trim to minimum. Check that the governor lever shifts back to approximately over the N of N_2 embossed on the governor.

CAUTION If any interference exists at the governor lever, check that the correct lever is installed.

(2). CECO Rigging Adjustments:

(a). Check that droop control override Link total end play does not exceed 0.015 inch (0.381 mm).

(b). Check that correct droop compensation adjustment fork is installed. Fork must measure 3.00 inches (76.2 mm) from center of the link hole to end of threaded shaft. Adjusted so that the installed dimension between the centerlines of the Sta. 68 bellcrank pivot bolt and the fork bolts is 2.30 ±0.02 inches (58.42 ±0.508 mm).

(c). Connect and turn on external power. Check that the N_2 trim actuator is adjusted so that the dimension between attach bolt centers is 5.47 ±0.02 inches (138.938 ±0.508 mm) with actuator at maximum extension.

(d). With the pilot's collective stick full down and the N_2 trim actuator at maximum extension, adjust the length of the fuselage-routed governor control rod so that the bolt center in the lower arm of Sta. 124 bellcrank is 3.60 ±0.02 inches (91.44 ±0.508 mm) from the firewall.

(e). Check that the engine compartment N_2 idler bellcrank control rod length is set to 14.28 ±0.03 inches (362.712 ±0.762 mm).

(f). Adjust governor lever control rod length to 4.15 inches (105.41 mm) between attaching bolt centers.

(g). Remove control lever from turbine governor. Rotate control quadrant until 60° mark aligns with pointer on housing and then reinstall control lever so that it is approximately parallel to the governor outer cover parting line.

NOTE: Lever and quadrant serrations have 15° spacing. Do not exceed **40 - 50 inch-pounds (4.52 - 5.65 Nm)** torque when tightening the lever nut.

(h). Install governor lever control rod and check rigging as indicated by governor quadrant and pointer.

1). With pilot's collective stick full down and with full increase trim, read 75° ±2°. Operate N_2 trim to full decrease and read 45° ±2°.

2). With pilot's collective stick full up and with full decrease trim read 64° ±2°. Operate N_2 trim to full increase and read 90° (quadrant contacting maximum stop screw).

NOTE: Use a mirror to view quadrant and pointer squarely when taking readings.

(i). Adjust length of governor lever control rod as required to achieve travel within the limits of steps (h). 1). and 2).

CAUTION If any interference exists at the governor lever, check that the correct lever is installed.

(3). Final Check and Adjustment (Bendix or CECO):

(a). At the full up and full down positions of the collective stick, check all movable linkage for clearance with supporting or adjacent parts. Check that the control rod, N_2 actuator and override link bearings are not jammed when the linkage is in the extreme control positions.

(b). Start and operate engine at idle with main rotor blades in flat pitch according to Pilot's Flight Manual.

(c). Rotate pilot's throttle counterclockwise to maximum rpm.

(d). Decrease N_2 trim to minimum.

(e). Observe N_2 tachometer pointer for 98 percent or less (250-C18); 100 percent or less (250-C20) when rotor rpm pointer is superimposed on N_2 pointer and N_1 tachometer pointer is stabilized.

(f). With collective stick down, increase N_2 trim to maximum.

(g). Observe N_2 tachometer pointer for 103 percent minimum (250-C18), 104 percent minimum (250-C20); 104 percent maximum (250-C18), 105 percent maximum (250-C20) when rotor rpm pointer is superimposed on N_2 pointer and N_1 tachometer pointer is stabilized.

CAUTION Make all engine compartment control rod adjustments with engine shut down.

(h). Stop the engine. Adjust the length of the governor lever control rod until N_2 trim is within limits given in steps (e). and (g). Adjust one rod end not more than one turn at a time.

(i). Restart the engine, actuate N_2 trim for 102 percent with main rotor blades in flat pitch, lift off and hover.

(j). Observe N_2 tachometer pointer when pointer of N_1 tachometer is stabilized. N_2 pointer indication (droop compensation) should be 1 to 2 percent (250-C18) 0.50 to 1 percent (250-C20) above N_2 setting in step (i).

(k). Land and shut down engine.

(l). If droop compensation does not occur as required in step (k)., perform the following:

1). Recheck entire power turbine governor (N_2 rpm) control linkage rigging.

2). Check gas producer (N_1 fuel control) linkage adjustment.

CAUTION Any change to initial droop compensation fork length may result in interference between N_2 trim actuator case and fork threaded end. Move collective through full travel after adjustment and check for clearance between movable linkage and adjacent parts.

3). If N_1 and N_2 linkage are correctly adjusted, an additional adjustment may be made at droop compensation adjustment fork.

a). Shorten droop compensation adjustment fork to increase compensation.

b). Lengthen fork extension to decrease compensation.

c). Align fork with override link rod end before tightening fork jam nut.

d). Three to five turns of droop compensation fork may be necessary to change droop compensation approximately 0.5 percent.

(m). If high operating range for N_1 and TOT cannot be reached when full power is demanded in flight, the gas producer fuel control maximum throttle stop may require adjustment. (Refer to Allison Operation and Maintenance Manual.)

NOTE: After rigging and test of Bendix or CECO power turbine governor controls, perform deceleration check in accordance with procedure found in the pilot's flight manual. If confirmed deceleration time is less than the allowable minimum, refer to the applicable Allison Operation and Maintenance Manual.

4. Gas Producer Controls

(Ref. Figure 11-1) The gas producer controls include the throttle and its associated linkage in the collective controls system (Ref. Sec. 7), a fuselage-routed control rod and engine compartment linkage. The control rod assemblies consist of aluminum alloy tubes or solid rods with spherical bearing rod ends. Bellcranks and supports are either cast aluminum or magnesium, each bellcrank containing a roller bearing. Refer to Section 2 for corrosion control and identification of magnesium and aluminum alloy parts.

A. Gas Producer Linkage Replacement

(Ref. Figure 11-8) Disassemble linkage only to extent necessary to replace worn or damaged parts, or to perform repairs.

(1). Remove cotter pins, nuts, washers and bolts as necessary to disconnect the appropriate control rod, bellcrank or support.

(2). Remove the control support from the firewall by removing the three standard bolts, washers and nuts from the vertical stiffener; then remove the pull-type lockbolt from the firewall as follows:

(a). Locate the lockbolt installation at the floorline of the cargo compartment. Split the collar axially with a sharp cold chisel. Use a backup bar on the collar opposite to the side being split, to prevent deformation or breakout of the hole.

(b). Drive the lockbolt pin out with a drift.

NOTE: If lockbolt is carefully removed, another lockbolt of same diameter may be used as replacement. If hole is enlarged to more than 0.1870 inch (4.7498 mm), an oversized lockbolt must be installed.

(3). Fit replacement control support on the firewall. Align the three standard bolt holes and the lockbolt hole with the matching holes. Install, but do not tighten the three standard bolts, washers, and nuts.

NOTE: If locknut hole diameter in the firewall does not exceed 0.1870 inch (4.7498 mm), a standard diameter pin can be used. If the hole is oversize and can be cleaned up with a #7 drill, 0.2015 inch (5.1181 mm) maximum, use an oversize 3/16 inch nominal diameter pin (Cherry or Huck part #R3007- T, or equivalent).

(4). Install the replacement lockbolt pin and collar; best fit results when the compressed air line pressure to the pulling gun is 90-125 psi (621-862 kPa). Use up to three AN960PD10 washers under the pin head, if necessary, to obtain correct lockbolt grip.

(5). Visually inspect the lockbolt installation. No measurable gap is permissible under either the pin head or collar. If the pin grip length or completeness of the collar swaging is questionable, use a Cherry or Huck inspection (strip) gage (#HG85-10) or an equivalent inspection gage per NAS1563 to check for proper installation. Replace an incorrectly installed lockbolt.

(6). Tighten the three nuts that attach the control support to the firewall.

NOTE: Before installing any control rod, measure the rod assembly for correct length (Ref. Figure 11-2 or Figure 11-4).

CAUTION When tightening a jam nut to secure a control rod end, always hold the rod end with a wrench to prevent jamming of the bearing against the fitting. Check that all misalignment is divided equally between the bearings of each control rod assembly.

(7). Install replacement control rod or bellcrank with bolt, washers, nut, and new cotter pin (Ref. Figure 11-8).

(8). Rig the gas producer control system.

B. Gas Producer Control Linkage Inspection

(1). Inspect rod end bearings for binding and excessive wear, 0.040 inch (1.016 mm) maximum axial play.

(2). Inspect control rod for surface damage and evidence of bending.

(3). Inspect for loose rivet at fixed rod end (lower end).

(4). Inspect bearings in bellcranks for binding.

(5). Perform a fluorescent dye penetrant inspection on any suspected part.

NOTE: After replacement and inspection of gas producer controls linkage, perform deceleration check in accordance with the procedures found in the pilot's flight manual. If confirmed deceleration time is less than the allowable minimum, refer to the applicable Allison Operation and Maintenance Manual.

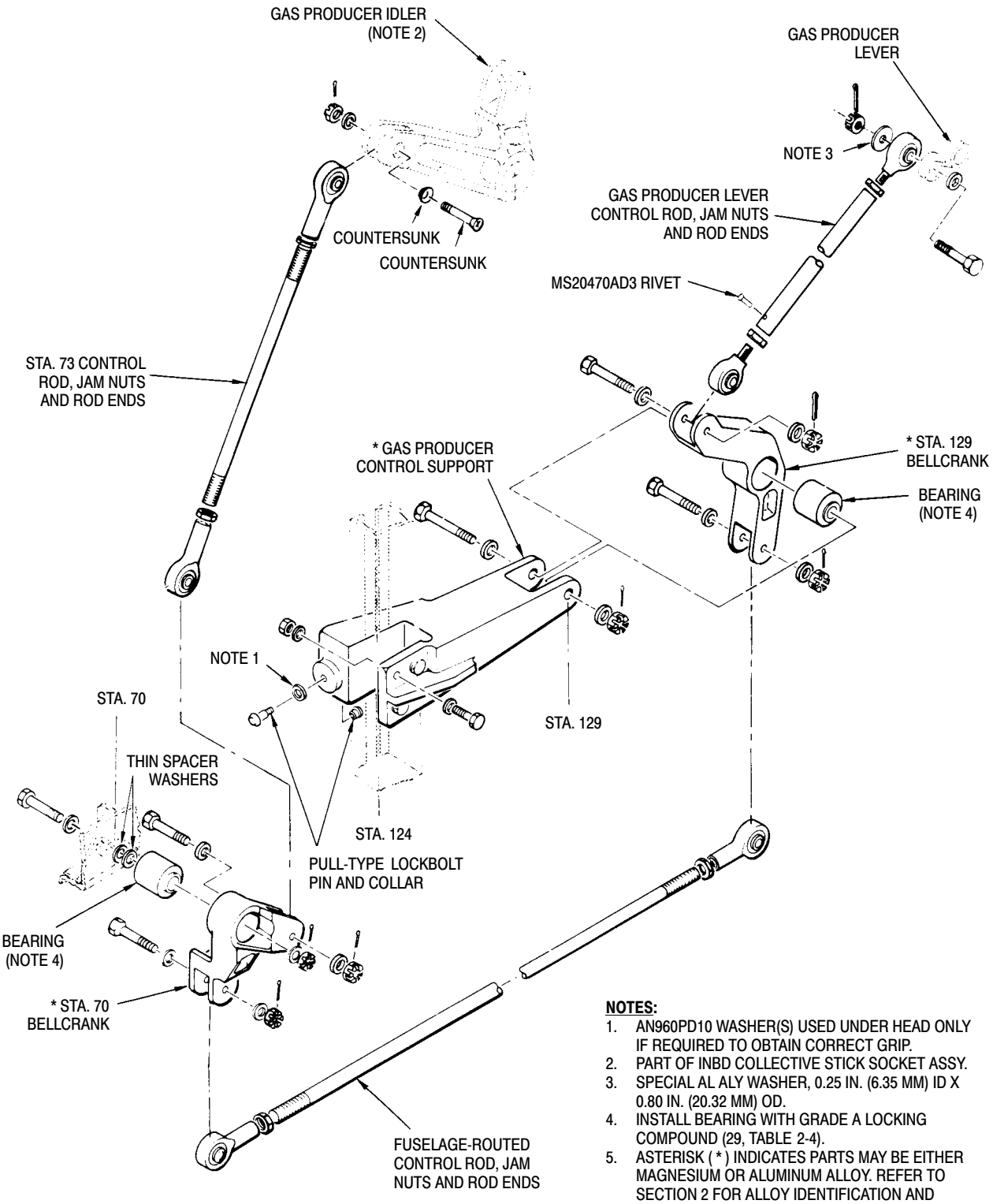


Figure 11-8. Gas Producer Control Linkage Disassembly

C. Gas Producer Control Linkage Repair

(1). Perform a straightness check on a control rod that appears bent or bowed. The total length of gas producer controls rods (excluding rod ends) must be straight within the following tolerances, with straightness variation limited to a maximum of 0.010 inch (0.254 mm) in each 12 inches (304.8 mm) of length.

(a). Fuselage-routed control rod: 0.050 inch (1.27 mm).

(b). Sta. 73 control rod: 0.010 inch (0.254 mm).

(c). Gas producer lever control rod: 0.020 inch (0.508 mm).

WARNING **A dye-check for cracking shall always be performed after cold-straightening. Replace a cracked rod, or a cracked or bent rod end.**

(2). Cold-straighten a bent rod that is not within tolerance (Ref. step (1).) provided there are no nicks or sharp dents in the bend length. DO NOT use the rod ends to support the rod during the straightening process.

CAUTION Use care when drilling to remove or install a riveted rod end; the rod end is steel and the rod is aluminum. Tighten the jam nut before drilling and riveting.

(3). Replace a control rod end if bearing axial play is more than 0.040 inch (1.016 mm). Set initial control rod length and bearing agularity as shown in Figure 11-2 or Figure 11-4.

(4). Replace unserviceable bellcrank bearings. Install a new bearing of the correct type with surface primer and grade A locking compound (28 and 29, Table 2-4), according to container instructions.

(5). Replace bellcranks or control supports for distortion, cracks or elongated holes.

D. Gas Producer Throttle Linkage

Refer to Collective Controls in Section 7 for information on the throttle gas producer control tube, interconnect torque tube and associated linkage.

5. Power Turbine Governor Controls

(Ref. Figure 11-1) The power turbine governor controls include the N_2 trim actuator and/control (beeper) switch on the collective stick, the governor trim, droop control and override linkage within the pilot's seat structure, a fuselage routed control rod, and the engine compartment linkage. The control rod assemblies consist of aluminum alloy tubes or solid rods with spherical bearing rod ends. The bellcranks and supports may be either aluminum or magnesium castings, each bellcrank containing a roller bearing. The N_2 trim actuator consists of a reversible continuous duty 26 Vdc motor that drives a gear train having non-jamming mechanical stops. Refer to Section 2 for corrosion control and identification of magnesium and aluminum alloy parts.

A. Power Turbine Governor Linkage Replacement

Replace control rods, bellcranks or supports according to Gas Producer Linkage Replacement, and Figure 11-9 and Figure 11-10, with the following exceptions: the trim actuator and Sta. 72 bellcrank which must be removed as a unit, and the droop control override link assembly.

NOTE: Only high temperature all metal nuts (not fiber insert type) are to be used for anchoring control idler support (Figure 11-10) to engine gear case accessory pad.

(1). Remove the droop control override link by disconnecting the link housing end fitting from the collective torque tube, and the rod end from the droop compensation fork.

(2). Remove the N_2 trim actuator and Sta. 72 bellcrank as a unit:

(a). Disconnect the bonding jumper and electrical connector from the actuator.

(b). Disconnect the actuator from Sta. 68 bellcrank.

NOTES:
1. BUSHINGS MUST ROTATE FREELY AFTER ASSEMBLY.
2. INSTALL BEARINGS WITH GRADE A LOCKING COMPOUND (29, TABLE 2-4).
3. LUBRICATE SPRING, RETAINERS, PLUNGER AND INSIDE OF HOUSING WITH GREASE (26) BEFORE INSTALLATION OF RIVETS.
4. PLUNGER HEX FLATS ALIGN AT 90 DEGREES WITH ROD END VERTICAL. PLUNGER HEAD MUST HAVE FREE TRAVEL TO END OF OBLONG SLOT IN HOUSING END FITTING.
5. JAM NUT TIGHTENED FOR MINIMUM FREE PLAY IN SPRING.

NOTES: (CONT)
6. TAB ON CURRENT TYPE; STRAP ON EARLY TYPE.
7. ASTERISK (*) INDICATES CORROSION RESISTANT STEEL.
8. DOUBLE ASTERISK (* *) INDICATES THAT PARTS MAY BE EITHER MAGNESIUM OR ALUMINUM ALLOY. REFER TO SECTION 2 FOR ALLOY IDENTIFICATION AND CORROSION CONTROL.

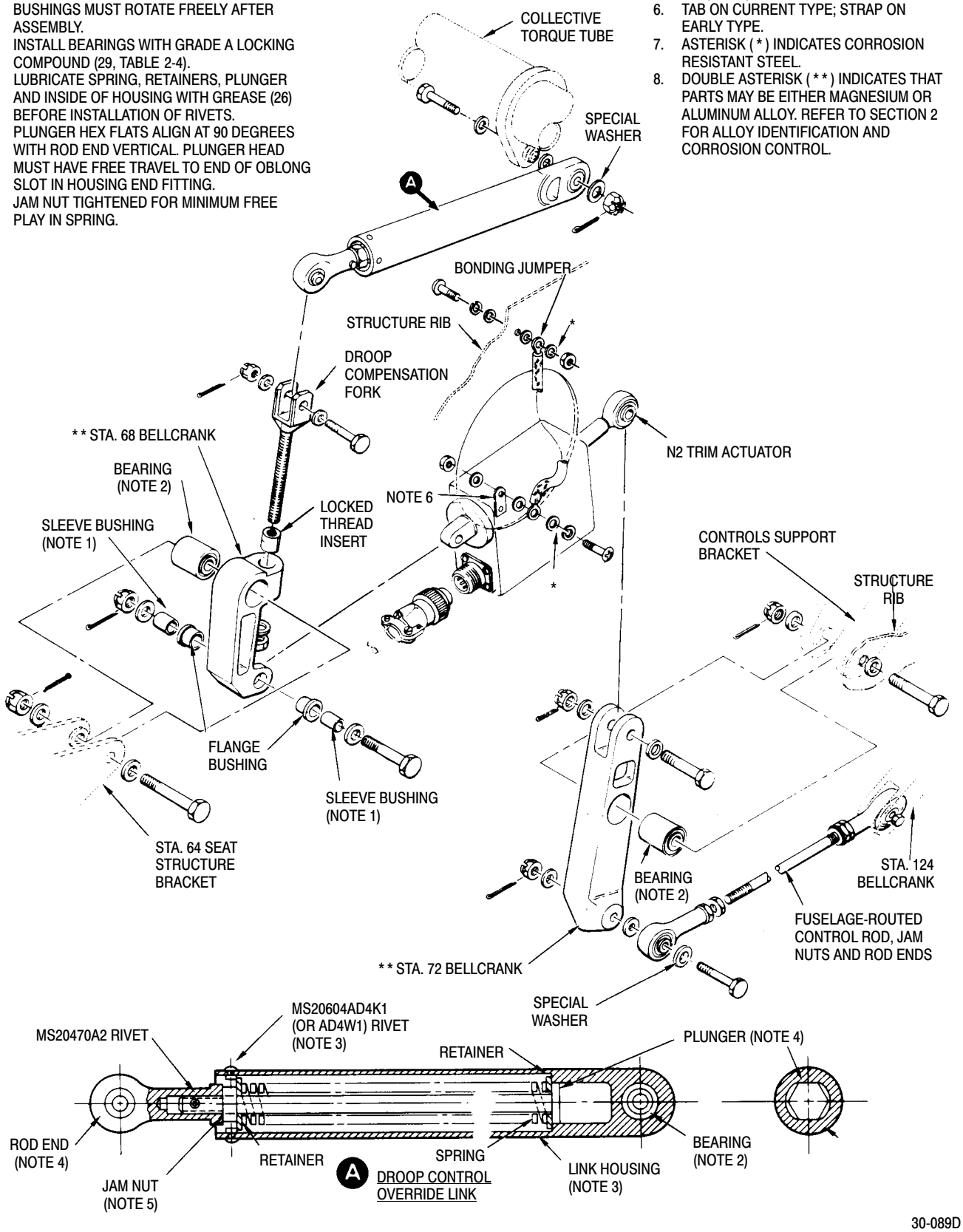
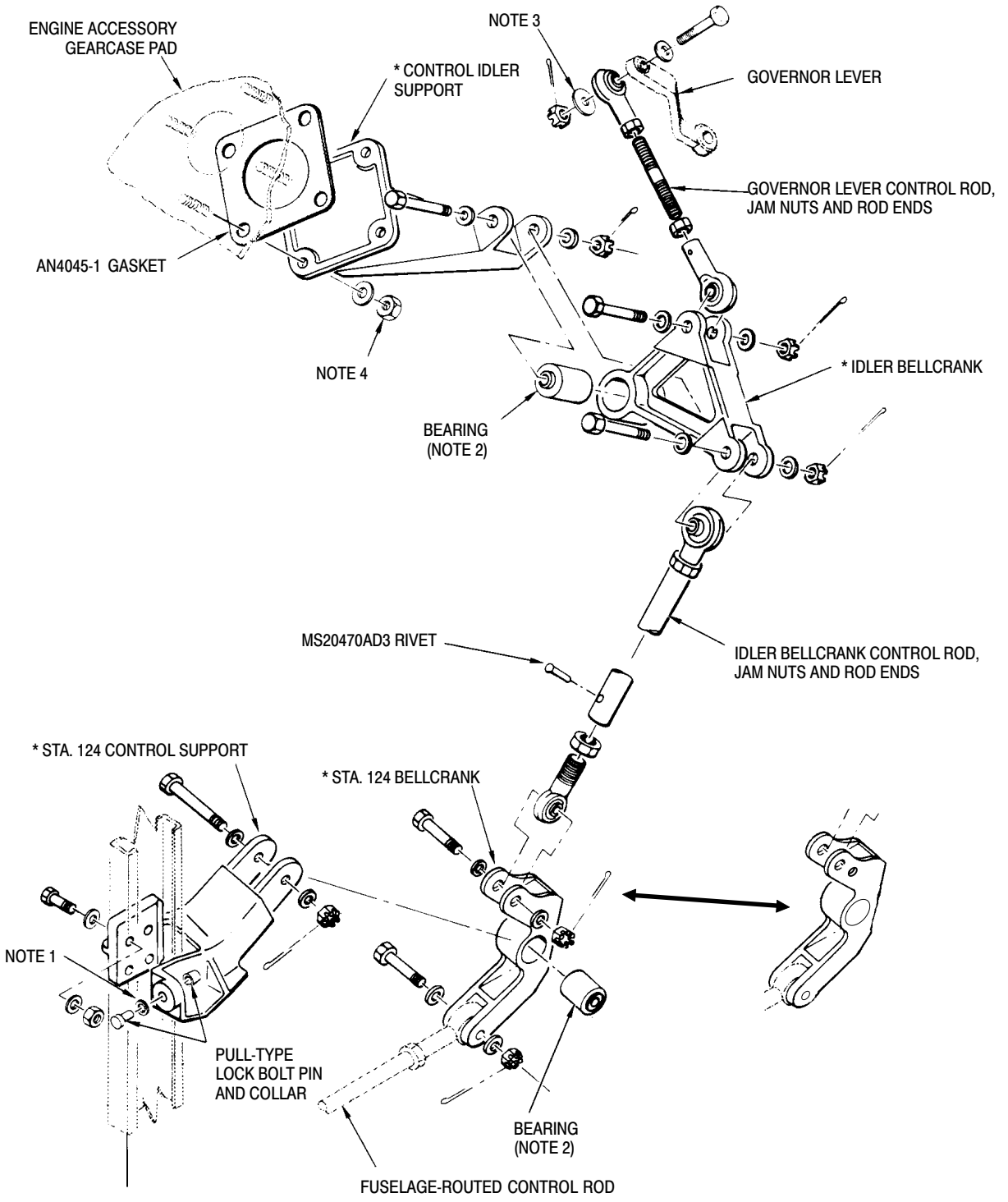


Figure 11-9. Governor Control Linkage Disassembly (Forward of Engine Compartment)



NOTES:

1. AN960PD10 WASHERS USED UNDER HEAD ONLY IF REQD TO OBTAIN CORRECT GRIP.
2. INSTALL BEARING WITH GRADE A LOCKING COMPOUND (29, TABLE 2-4).
3. SPECIAL ALUMINUM ALLOY WASHER; 0.25 IN. (6.35 MM) ID X 0.80 IN. (20.32 MM) OD.
4. USE HIGH TEMPERATURE ALL-METAL NUTS ONLY.
5. ASTERISK (*) INDICATES THAT PARTS MAY BE EITHER MAGNESIUM OR ALUMINUM ALLOY. REFER TO SECTION 2 FOR ALLOY IDENTIFICATION AND CORROSION CONTROL.

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Figure 11-10. Governor Control Linkage Disassembly (Engine Compartment)

(c). Disconnect Sta. 72 bellcrank from the fuselage-routed control rod end.

(d). Remove the pivot bolt that attaches Sta. 72 bellcrank to structure rib and controls support bracket; remove actuator and bellcrank.

(3). Disconnect the trim actuator from Sta. 72 bellcrank. Use care to keep sleeve bushings with bellcrank.

(4). Check a replacement trim actuator for correct maximum extended length of 5.47 ±0.03 inches (138.938 ±0.762 mm) between attach bolt centers. If dimension is not correct, test actuator for proper operation.

(5). Assemble original or replacement trim actuator to original or replacement Sta. 72 bellcrank with a bolt, two washers, nut and new cotter pin. Check that both sleeve bushings are in place in Sta. 68 bellcrank arm before connecting the actuator; then install assembled unit in controls support bracket and connect linkage as shown in Figure 11-9. The sleeve bushings in Sta. 68 bellcrank arm must rotate freely, without any binding, after the actuator is attached and the connecting hardware is tightened.

(6). Connect replacement droop control override link to collective torque tube. Push on rod end and check that the link assembly plunger head is free to slide back and forth in the link housing end fitting. Connect rod end to droop compensation fork; the rod end should align with the fork.

(7). Connect the bonding jumper and electrical connector to the actuator.

NOTE: Replacement trim actuator may have a tab or use a bonding strap/clamp for connection of the bonding jumper.

(8). Rig the control system.

B. Governor Control Linkage Inspection

(1). Inspect rod end bearings for binding and excessive wear, 0.040 inch (1.016 mm) maximum axial play.

(2). Inspect control rod for surface damage and evidence of bending.

(3). Inspect for loose rivet at fixed rod end (lower end).

(4). Inspect bearings in bellcranks for binding.

(5). Perform a fluorescent dye penetrant inspection on any suspected part.

NOTE: After replacement and inspection of the power turbine governor controls linkage, perform deceleration check in accordance with procedures found in the pilot's flight manual. If confirmed deceleration time is less than the allowable minimum, refer to the applicable Allison Operation and Maintenance Manual.

C. Governor Control Rods and Bellcranks Repair

(1). Perform a straightness check on a control rod that appears bent or bowed. The total length of governor control rods (excluding rod ends) must be straight within the following tolerances, with straightness variation limited to a maximum of 0.010 inch (0.254 mm) in each 12 inches (304.8 mm) of length.

(a). Fuselage-routed control rod: 0.050 inch (1.27 mm).

(b). Governor lever control rod: 0.010 inch (0.254 mm).

(c). N_2 idler bellcrank control rod: 0.020 inch (0.508 mm).

WARNING **A dye-check for cracking shall always be performed after cold-straightening. Replace a cracked rod, or a cracked or bent rod end.**

(2). Cold-straighten a bent rod that is not within tolerance (step (1).) provided there are no nicks or sharp dents in the bend length. DO NOT use the rod ends

to support the rod during the straightening process.

CAUTION Use care when drilling to remove or install a riveted rod end; the rod end is steel and the rod is aluminum. Tighten the jam nut before drilling and riveting.

(3). Replace a control rod end if bearing axial play is more than 0.040 inch (1.016 mm). Set initial control rod length and bearing angularity as shown in Figure 11-6 or Figure 11-7.

(4). Replace unserviceable bellcrank bearings. Install a new bearing of the correct type with surface primer and grade A locking compound (28 and 29, Table 2-4), according to container instructions.

(5). Replace bellcranks or control supports for distortion, cracks or elongated holes.

D. Relocation of Locknut and Installation of Spacer

The following procedure to relocate the existing droop compensation adjustment locknut on the PN 369A7717-3 extension to a new location above the arm assembly is to preclude loosening and/or loss of the locknut during helicopter operation. This procedure affects PN 369H7825 droop control bellcrank assembly (Sta. 68.00); it does NOT affect PN 369H7825-1 1 droop control bellcrank assemblies.

(1). Remove pilot's floor access panels and control covers to gain access to underseat linkage for power turbine governor controls.

(2). Remove PN 369A7717-3 extension from droop control override link and Sta. 68.00 bellcrank.

NOTE: Spotface through radius of arm only. DO NOT spotface below flat surface of arm around circumference of insert in arm.

(3). Spotface PN 369A7716 or 369N2606 arm assembly, as shown in Figure 11-1 1.

(4). Touch up reworked surface of arm with Dow 7 or Dow 17 chemical treatment. Apply primer (4, Table 2-4) to reworked area.

(5). Install existing locknut and new NAS42DD1010 spacer on -3 extension; reinstall extension (Ref. Figure 11-1 1).

(6). Perform rigging of power turbine governor controls.

(7). Reinstall control covers and floor access panels.

E. Droop Control Override Link Assembly Repair

(Ref. Figure 11-9)

(1). Replace an unserviceable link housing end fitting bearing (detail A). Install a new bearing of the correct type with surface primer and grade A locking compound (28 and 29, Table 2-4), according to container instructions.

(2). Replace an unserviceable rod end or broken spring:

(a). Remove the four rivets from rod end of housing.

(b). Drill out rod end rivet and disassemble spring assembly. Discard rod end and plunger.

(c). Assemble new plunger, retainers, spring and jam nut. Screw down the jam nut on plunger threads until there is minimum free play of the spring.

(d). Install replacement rod end to point of contact with jam nut. Check alignment of the flats on the plunger head and the rod end; with rod end vertical, two of the flats must be perpendicular at 90 degrees (detail A). Tighten jam nut against rod end.

NOTE: When the override link assembly is installed between the droop compensation fork and the collective torque tube, the plunger must be free to travel to the end of the oblong slot in the link housing end fitting without binding.

(e). Using a #50 drill, drill through rod end and plunger at the witness hole of the rod end. Install an MS20470A2 rivet of correct length.

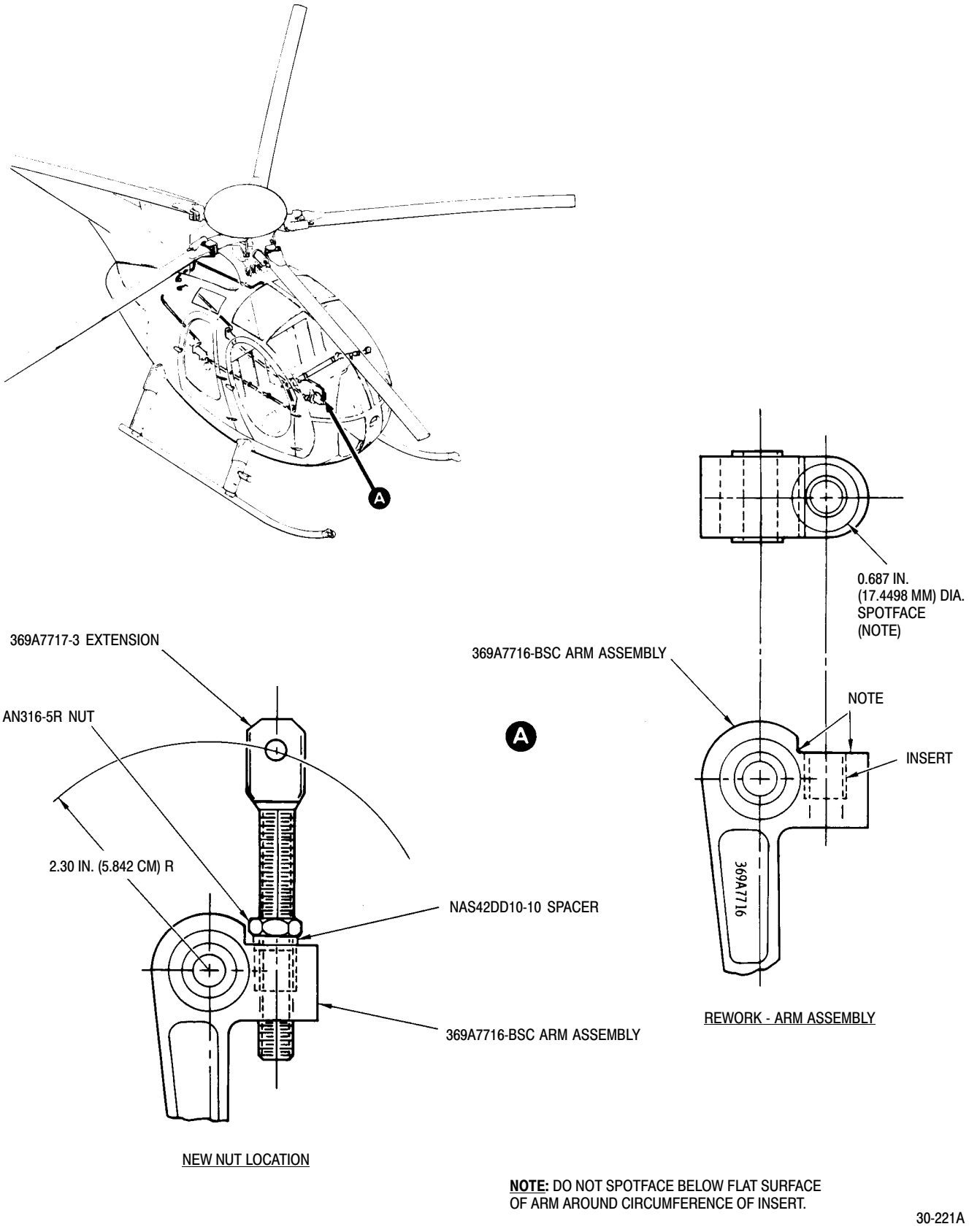


Figure 11-1 1. Relocation of Locknut - Sta. 68.00 Bellcrank Assembly

(f). Lubricate the interior of the housing, the spring retainers and plunger with grease (26). Install the spring assembly in the housing so that plunger hex enters end fitting slot and rod end aligns vertically with housing bearing (detail A).

(g). Complete the link assembly by installing the four retention rivets (MS20604AD4K1 or W1) in the housing (detail A).

6. RPM Governor (N_2) Trim Actuator

The N_2 trim actuator (a linear electro-mechanical actuator that is operated by a "beeper" switch on the collective pitch stick) allows N_2 speed to be varied over a range of approximately 94-105 percent. Any change in actuator length or in collective pitch actuates the governor linkage and establishes a new power output demand on the engine. For all practical purposes, the main rotor speed is held constant. Operating stroke of the actuator ram is approximately 1.00 inch (25.4 mm), and linear speed is 0.15 inch (3.81 mm) per second; full travel from full retraction to full extension is approximately 7 seconds. The actuator is lubricated by the manufacturer and no further lubrication is required for the life of the actuator.

A. N_2 Trim Actuator Replacement

Refer to Power Turbine Governor Linkage Replacement.

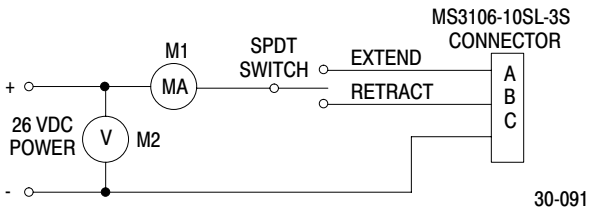
B. N_2 Trim Actuator Repair

Repair of the N_2 trim actuator, other than that performed by an authorized overhaul agency or the manufacturer, is limited to replacement of an unserviceable rod end in the actuator ram. With the ram at full extension, set the distance between attach bolt centers to 5.47 inches (138.938 mm) before reinstalling the actuator.

C. N_2 Trim Actuator Testing

(1). Connect the N_2 trim actuator to test harness and equipment shown in Figure 11-12.

(2). Turn on dc power and adjust output to 25.75-26.25 volts.



ITEM NO.	EQUIPMENT DESCRIPTION
1	6 in. (152.4 mm) scale.
2	Dc voltmeter, calibrated 0-50 volts (Weston Model 931 or equivalent).
3	Dc miliiammeter, calibrated 0-5 amperes (Weston Model 931 or equivalent).
4	Variable dc power supply, 10-36 volts (N.J.E. Model SY36-10 or equivalent).
5	Dial indicator gauge (Brown and Sharp Model 740 or equivalent).
6	Switch, SPDT, center off.

Figure 11-12. N_2 Trim Actuator Test hookup

(3). With actuator ram approximately halfway between stops, set up dial test indicator and measure the ram end play. The end play must not exceed 0.005 inch (0.127 mm) tir when measured under a 10 lb. (4.5 kg) reversing load.

(4). Position test switch to RETRACT and allow the actuator ram to fully retract. Using the end of the ram sleeve as a reference point, measure the portion of ram that remains out of the sleeve to the nearest 0.015625 inch (0.396785 mm). Record this measurement for use in step (5).

(5). Position test switch to EXTEND and run ram to the extend stop. Measure the length of the extended ram, Subtract the measured result of step (4). from this value. The result should be 0.97-1.03 inches (24.638-26.162 mm).

(6). The operating current under no-load conditions, at 26.0 Vdc input should be between 0.60-1.25 amperes when running and 2.0 amperes maximum when stalled.

(7). Operate the actuator motor in both extend and retract direction. Overtravel

must not exceed 0.020 inch (0.508 mm) maximum when power is turned off.

(8). Reduce the voltage input to 21 volts. The actuator ram must retract and extend to the stops without binding on the stops or between the stops.

(9). Increase the input voltage to 28 volts. The actuator ram must retract and extend to the stops without binding on the stops or between stops.

(10). Run the actuator to the fully extended position. The overall length of the extended actuator should be 5.47 inches (138.938 mm) between attach bolt centers. Turn power off and disconnect the actuator.

7. Anti-Icing System

8. Anti-Icing System Troubleshooting

(Ref. Table 11-2)

Table 11-2. Anti-Icing System Troubleshooting

Symptom	Probable Trouble	Corrective Action
NOTE: Refer to Section 19 for interconnection wiring and circuit information for the electrically operated anti-icing system.		
Actuation of anti-ice system does not restore normal engine operation when compressor icing occurs.	Inoperative or defective actuator.	Replace actuator.
	Defective N_2 GOV circuit breaker or electrical circuits.	Ref. Sec. 19.
	Actuator not rigged properly.	Check rigging.
	Lack of anti-icing air.	Check engine air lines for leaks.
	Defective or stuck anti air valve.	Replace anti-icing valve.
	*Cable wire loose in anti-icing air valve lever adapter or adapter stud sheared or stripped.	*Tighten or replace adapter with cable and valve in correct position.
De-actuation of anti-ice system does not return anti-icing valve lever to forward position. (Inflight symptom is continuation of approximately 10% reduction in available power or torque.)	Same as troubles above.	Same as actions above.
	*Cable to control lever piston retaining pin sheared (inside lever housing).	Replace damaged parts.
	*Adapter nut over-tightened.	*Loosen adapter nut and retorque to not more than **10 inch-pounds (1.13 Nm)**.
Movement of anti-icing valve control lever very difficult.	**Control cable sleeve kinked or one or more routing bend radii less than a 3 inch (76.2 mm) minimum.	**Check cable operation with cable wire detached from shutoff valve lever adapter (early system) or cable clevis detached from shutoff valve lever (current system). Replace kinked cable or remove sharp bends in cable routing.

NOTE:

* Indicates early manually operated anti-icing system only.

* * Indicates early and current manually operated anti-icing systems.

9. Anti-Icing Controls (Electrically Operated System)

(Ref. Figure 11-13) Anti-icing valve electrical control equipment consists of an anti-icing valve control switch, an electrical actuator and associated electrical wiring and miscellaneous hardware.

The actuator is attached to a bracket mounted under the engine hoist fitting behind the anti-icing valve.

An adjustable rod connects the anti-icing lever to the actuator crank arm.

A three-position anti-icing control valve switch located overhead in the pilot's compartment controls actuator operation in either a clockwise or counterclockwise direction.

Actuator circuits are protected by the N_2 GOV circuit breaker on the instrument panel (Ref. Section 19). When the switch is moved to the full aft (OFF) position the actuator shaft rotates counterclockwise (viewed from the shaft end) closing the anti-icing valve. Stop-to-stop actuator shaft rotation normally requires a minimum of 20 seconds.

A. Anti-Icing Controls Operational Check (Electrically Operated0

NOTE: The N_2 GOV circuit breaker on the instrument panel must be set (pushed in) for the anti-icing actuator to operate.

(1). Set the DE-ICE switch to the OFF (aft) position.

(2). Observe that the anti-icing valve lever moves to the forward (OFF) position.

NOTE: If the installation is equipped with a spring-loaded anti-icing rod, carefully observe the pin position in the forward terminal slot. The pin must be in the center of the slot (Figure 11-13). If the pin is not centered in the slot, re-rig the anti-icing rod.

(3). Alternately set the DE-ICE switch to the ON and OFF positions. Make sure the actuator operates the anti-icing valve from the OFF (forward) to ON (aft) position. Allow a minimum of 20 seconds for the crank arm to travel between full throw positions.

(4). If anti-icing valve lever has insufficient travel or linkage binds, re-rig (Ref. Electrically Operated Anti-Icing Valve Rigging).

B. Electrically Operated Anti-Icing Valve Rigging

(1). Disconnect the aft end of the engine ant-ice rod (if connected).

(2). Manually position the engine anti-ice lever to the full OFF (forward) position.

CAUTION Rigging adjustment is made by changing anti- ice rod length. Do not reposition the actuator arm on the shaft. Also, do not force the actuator arm in either direction. Use the DE-ICE switch to position the actuator arm.

(3). Turn power ON. Set DE-ICE switch to OFF (aft) position.

(4). For the spring-loaded anti-ice rod, loosen jam nut on engine anti-ice rod. Adjust the rod end until the forward terminal slide pin is centered in the slot with aft terminal attached to the actuator arm.

(5). For the non-spring-loaded double end adjustable engine anti-ice rod, loosen jamnut and adjust disconnected aft rod end until rod length is proper for connection of rod to actuator crank arm; then tighten jamnut.

(6). Secure the aft rod end to the actuator arm with a clevis pin, washer and cotter pin.

(7). Perform an operational check of the installed electrical actuator.

C. Anti-Icing Valve Actuator and Linkage Replacement

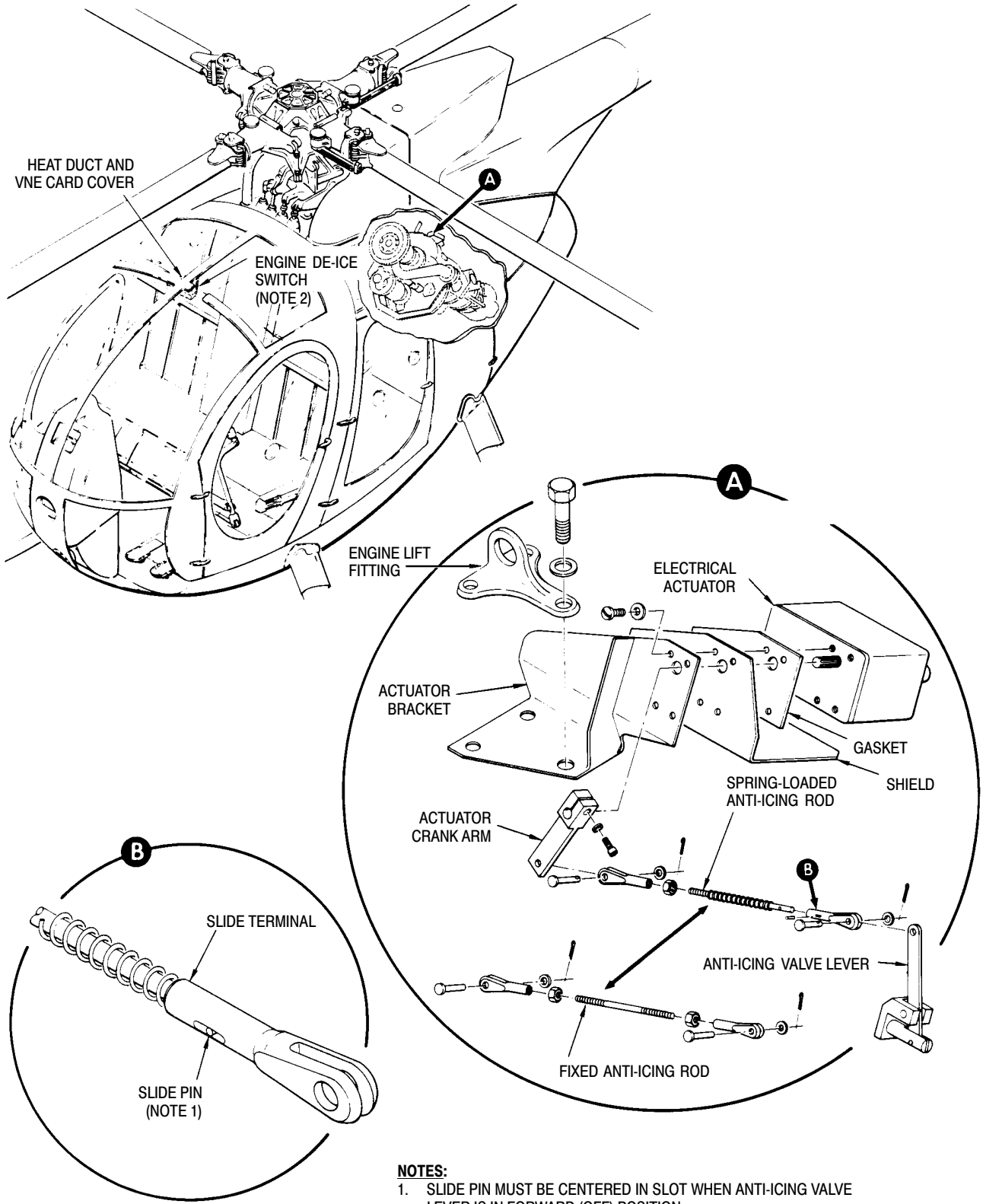
(Ref. Figure 11-13)

(1). Check that all electrical power is OFF.

NOTE: Although not mandatory, removal of the tailpipe assembly provides best access to components.

(2). Disconnect the electrical connector from the actuator.

(3). Remove cotter pins, washer and pins to disconnect anti-icing rod from actuating levers.



NOTES:

1. SLIDE PIN MUST BE CENTERED IN SLOT WHEN ANTI-ICING VALVE LEVER IS IN FORWARD (OFF) POSITION.
2. SIDE-MOUNTED SWITCH (EARLY CONFIGURATION) OR FACE-MOUNTED SWITCH (CURRENT CONFIGURATION) MAY BE LOCATED EITHER LEFT OR RIGHT SIDE FOR PILOT SEAT CONVENIENCE.

30-158A

Figure 11-13. Engine Anti-Icing Valve Electrically Actuated Equipment

(4). Disassemble rod only to the extent necessary to replace worn or damaged parts.

(5). Release setscrew tension on actuator crank arm and remove crank from actuator.

(6). Remove the actuator, gasket and shield by removing the lockwire, four attaching screws and washers from the support bracket.

NOTE: Refer to Section 10 for actuator bracket assembly replacement.

(7). Install replacement actuator with gasket and shield on bracket assembly with four screws and washers. Safety screwheads with lockwire.

(8). Connect the electrical connector to actuator.

(9). Turn power ON and set DE-ICE switch to OFF (aft) position.

(10). Install actuator crank arm on serrated actuator shaft at 23 degree angle aft of shaft vertical centerline. (Vertical centerline is parallel to forward edge of anti-ice actuator.) Alignment of missing tooth in arm and shaft (with arm positioned down and aft) indicates correct arm-to-shaft alignment. Be sure that shaft clears actuator screwheads. Tighten the setscrew.

NOTE: If the engine anti-ice rod has a spring-loaded slide terminal and an adjustable terminal jamnut, the slide terminal end must be installed on the engine anti-ice lever.

(11). Connect the slide (forward) terminal end of engine anti-ice rod to the engine anti-ice lever with clevis pin, washer and cotter pin.

(12). Refer to Electrically Operated Anti-Icing Valve Rigging for instructions on connection of the adjustable end of the anti-ice rod and proper rigging.

10. Anti-Icing Valve Control Cable (Manually Operated)

(Ref. Figure 11-14) There are two types of manually operated anti-icing valve control cable installations.

The early type anti-icing valve control consists of a flexible, enclosed wire-type cable assembly bonded to a control housing.

The control housing with cable actuating knob, is attached to the left side of the overhead canopy frame in the pilot's compartment.

Movement of the control lever rearward to the latch notch opens the anti-icing valve completely. Releasing the control lever from the latch notch results in spring-loaded return of the lever to the forward (OFF) position.

Control lever piston travel in the housing is approximately 1.50 inches (38.1 mm), from the open to closed positions.

The current type anti-icing valve control has a control handle and the push-pull wire and conduit assembly incorporated at the right side of a heat duct attached to the overhead canopy structure.

Movement of the cable actuating control handle forward opens the anti-icing valve completely. A spring-type detent holds the handle in the forward (on) position. The control handle must be manually returned to the rearward (off) position.

Minimum travel for the control handle is 1.44 inches (36.576 mm), from the open to the closed positions.

Cable routing for the early type installation is on the left side of the main rotor mast support structure alongside the torquemeter oil pressure line as far as the plenum chamber; at this point the anti-ice cable is routed downward through the firewall into the engine compartment.

Cable routing for the current type installation is similar but along the right side of the mast support structure and back to the plenum chamber.

No electrical switching is used in the manually controlled anti-icing valve control systems.

NOTE: Hughes Notice HN- 151 provides instructions for replacing existing cabinet heat duct assemblies with new fiberglass-type duct assemblies. The new configuration for the optional cabin heating system is designed to provide greater resistance against heat, deformation, and wear. A procedure for rework of the control cable assemblies to make them compatible with the new fiberglass duct installation also is provided by HN-151.

A. Anti-Icing Valve Control Operational Check (Manually Operated)

(1). Move control lever knob to full aft position (early system) or control handle to full forward position (current system) to open anti-icing air valve. Control knob or handle should not creep away from anti-icing valve full open position.

(2). In engine compartment, check that anti-icing air valve lever is positioned at aft travel limit and that cable wire does not appear to be distorted by overtravel.

(3). Early system: Release control lever knob from housing notch; lever piston return spring should return lever knob to housing forward stop without manual assistance. If valve does not return, the valve lever adapter nut may be over-tightened; refer to step (6). Current system: Manually return control handle to full aft (of position.

(4). Recheck position of anti-icing valve lever; lever should be positioned at forward travel limit.

(5). If anti-icing valve lever does not have sufficient travel or the cable appears to distort when actuated, adjust cable wire (early system) or cable clevis (current system) for correct lever stroke,

NOTE: On current system, check that poppetguide and arm are positioned as shown in engine build-up illustration.

(6). When control cable operation is stiff, isolate the trouble by removing the cable wire or clevis from the valve lever and checking for binding during full movement of control lever knob or lever from ON to OFF positions. Manually actuate the anti-icing valve lever to check freedom of movement. Early system: Reinstall cable wire and torque adapter nut to **10 inch-pounds (1.13 Nm)** maximum. Secure nut with new cotter pin. Current system: Reinstall clevis to valve lever with clevis pin, washer and cotter pin.

B. Anti-Icing Valve Control Cable Inspection (Manually Operated)

(1). Inspect cable for kinks, crushed sleeve and corrosion.

(2). Early system: Inspect piston for wear or elongation of knob shaft or lock pin holes; inspect control spring for kinks or breaks.

(3). Inspect valve lever or valve lever adapter for excessive wear.

C. Anti-Icing Valve Control Cable Replacement (Manually Operated)

(Ref. Figure 11-14)

(1). Unlatch or remove plenum chamber access door, and left or right half of engine air inlet forward fairing, as appropriate, for access to cable.

(2). Remove two screws, washers, and nuts and spacers that attach cable housing to structure (early system); or remove seven screws attaching heat duct outer box to heat duct and canopy frame (current system)

(3). Remove clamps and straps that attach cable to structure along its full length.

(4). Loosen the nut of adapter at the anti-icing valve on the engine (early system); or remove clevis pin, washer and cotter pin attaching clevis to valve lever (current system).

(5). Remove control cable.

(6). Route the replacement cable assembly into position. Check that grommets (two on early type, one on current type cable) are in place on the cable.

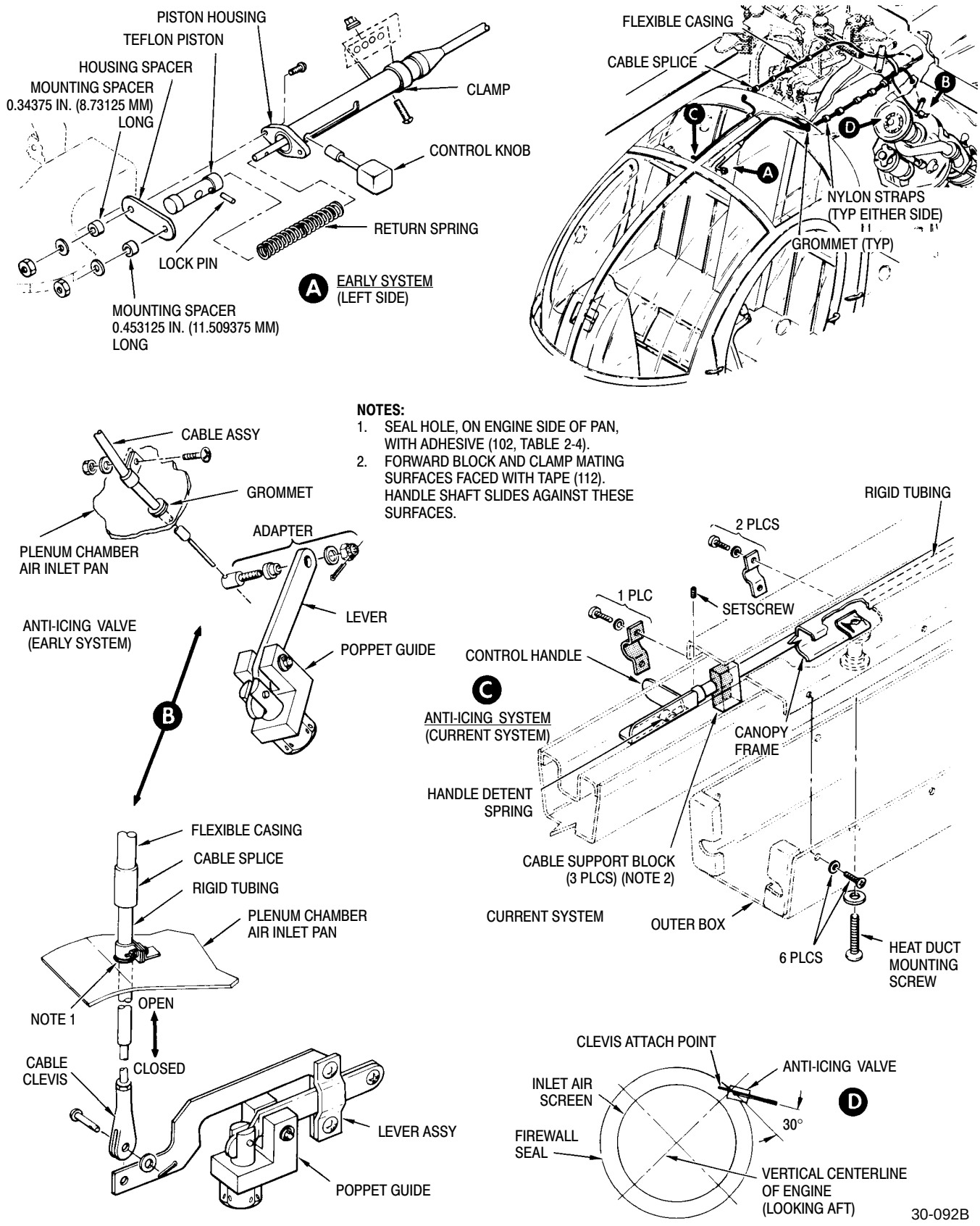


Figure 11-14. Engine Anti-Icing Valve Manual Control Installation

(7). Early system only: Attach control housing to canopy structure bracket with two screws, the housing spacer, mounting spacers (0.34375 inch (8.73125 mm) length inboard), washers and nuts.

(8). Install clamps and straps that attach cable to structure. Seal hole at engine side of plenum pan where current type cable passes through, using adhesive (102, Table 2-4).

NOTE: The clamp nearest to the valveshould not be aligned until after travel is checked.

(9). Current system only: Attach heat duct outer box to heat duct and canopy frame with seven screws.

(10). Adjust cable wire in valve lever adapter (early system) or cable clevis at valve lever (current system).

(11). When assured that control will operate the valve through full range of travel, tighten the clamp nearest the valve.

(12). Latch or reinstall plenum chamber access door and removed half of engine air inlet forward fairing.

(13). Current system only: After installation, adjust handle to be parallel with windshield glass.

D. Anti-Icing Control Cable Repair (Manually Operated)

(Ref. Figure 11-14) Early system only: The control assembly is normally replaced as a unit. However, disassembly to the extent shown in Figure 11-14 can be accomplished for inspection purposes No repairs are recommended except for replacement of lever mechanism parts.

(1). Move control knob to full extent of forward travel.

(2). Pull control knob shaft out of piston.

(3). Pull piston out of housing.

(4). Remove lock pin from piston to free cable and piston.

(5). Inspect and replace worn lever mechanism parts as required.

(6). Extend cable rod through housing so parts can be assembled.

(7). Apply a thin film of grease (26, Table 2-4) on a serviceable spring.

(8). Fit serviceable piston on cable rod and secure with lockpin.

(9). Push piston into housing until large hole in piston is aligned with large hole in end of housing slot.

(10). Insert control knob through housing slot and into piston.

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Section

12

Engine Fuel System

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TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 12 Engine Fuel System		**12-1**
1.	Engine Fuel System	12–1
2.	Troubleshooting the Fuel System	12–1
3.	Fuel System Inspection	12–1
	Table 12–1. Troubleshooting the Fuel Supply System	12–1
4.	Fuel Cells	12–2
5.	Fuel Cell Replacement	12–2
A.	Left Fuel Cell Removal	12–2
B.	Right Fuel Cell Removal	12–2
C.	Fuel Cell Installation	12–2
6.	Fuel Cell Cover Replacement	12–3
A.	Left Fuel Cell Cover Removal	12–3
B.	Right Fuel Cell Cover Removal	12–3
C.	Left Fuel Cell Cover Installation	12–3
	Figure 12–1. Fuel Cell Installation (Sheet 1 of 2)	12–4
D.	Right Fuel Cell Cover Installation	12–5
7.	Fuel Cell Repair	12–6
A.	Preparing Fuel Cell for Repairs	12–6
B.	Fuel Cell Cleaning	12–6
C.	Repair of Fuel Cell	12–6
8.	Fuel Cell Pressure Test	12–8
9.	Fuel Filler Shield	12–8
A.	Fuel Filler Shield Replacement	12–8
B.	Fuel Filler Shield Inspection	12–8
C.	Fuel Filler Shield Repair	12–8
10.	Fuel Filler Cap	12–9
11.	Fuel Filler Cap Replacement	12–9
12.	Fuel Filler Cap Inspection	12–9
13.	Fuel Filler Cap Repair	12–9
14.	Fuel Cell Vents	12–9
15.	Fuel Cell Vent System Replacement	12–9
A.	Forward Fuel Cell Vent System Removal	12–9
B.	Aft Fuel Cell Vent System Removal	12–10
C.	Forward Fuel Cell Vent System Installation	12–10
D.	Aft Fuel Cell Vent System Installation	12–10
16.	Fuel Cell Vent System Inspection	12–10

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
Figure 12–2.	Forward Vent – Fuel Cell	12–11
17.	Fuel Shutoff Valve Control Assembly	12–12
18.	Fuel Shutoff Valve Control Assembly Replacement	12–12
A.	Fuel Shutoff Valve Control Assembly Removal	12–12
B.	Fuel Shutoff Valve Control Assembly Installation	12–12
19.	Fuel Shutoff Valve Control Assembly Inspection	12–13
20.	Fuel Shutoff Valve Control Assembly Adjustment	12–13
21.	Fuel Shutoff Valve Control Assembly Repair	12–13
Figure 12–3.	Fuel Shutoff Valve (Sheet 1 of 2)	12–14
22.	Fuel Shutoff Valve	12–16
23.	Fuel Shutoff Valve Replacement	12–16
A.	Fuel Shutoff Valve Removal	12–16
B.	Fuel Shutoff Valve Installation	12–16
24.	Fuel Shutoff Valve Inspection	12–16
25.	Fuel Supply Drain Valves	12–16
26.	Fuel Supply Drain Valve Replacement	12–16
A.	Fuel Supply Drain Valve Removal	12–16
B.	Fuel Supply Drain Valve Installation	12–17
27.	Fuel Supply Drain Valve Inspection	12–17
28.	Engine Fuel Supply System	12–17
29.	Engine Fuel Supply System Replacement	12–17
A.	Engine Fuel Supply System Removal	12–17
B.	Engine Fuel Supply System Installation	12–18
30.	Engine Fuel Supply System Inspection	12–18
31.	Start Pump	12–18
32.	Start Pump Replacement	12–18
A.	Start Pump Removal	12–18
B.	Start Pump Installation	12–19
33.	Fuel System Bleeding	12–19
Figure 12–4.	Fuel Start Pump Installation (Sheet 1 0f 4)	12–20

SECTION 12
ENGINE FUEL SYSTEM

1. Engine Fuel System

The fuel system is a suction type (non-gravity feed) system that consists of two flexible interconnected fuel cells,located in separate compartments beneath the cargo/passenger compartment.

Both fuel cells are vented to the atmosphere through a venting system to the lower side of the fuselage.

Additional components of the fuel system include forward and aft vents, two drainvalves, starting fuel pump, shutoff valve, tank unit, filler neck (with an extended range tank fuelline connection) various interconnecting fuel lines and associated electrical wiring.

The fuel cells are serviced through a filler neck on the rightside of the fuselage.

Once the engine is started, fuel is drawn from the cells through the shut-off valve by the engine-driven fuel pump.

The engine operation and maintenance manual provides detailed information and theory of operation for the engine fuel system.

Refer to Section 17 for fuel filter switch and fuel quantity tank unit information.

2. Troubleshooting the Fuel System

(Ref. Table 12-1 and Sec. 17)

3. Fuel System Inspection

(1). Inspect the fuselage skin beneath the fuel cells for indications of fuel leakage.

(2). Inspect the fuel cell drain valve for leaks and lockwire for security.

(3). Inspect fuel lines, fittings, fuel cell covers and tank unit for leakage, damage and security.

(4). Inspect electrical wiring for damage and security.

(5). Inspect fuel shutoff valve for operation, leaks, damage and security.

(6). Inspect fuel inlet line, engine pump drain valve and fuel line connections at pump and bulkhead fittings for leaks, damage and security. Inspect fire sleeve for cuts, tears and punctures.

(7). Check that vent fairing opening (and alternate opening, if installed) is free of obstructions such as ice, mud or other foreign matter that may have come in contact with underside of helicopter. Inspect for damage and security.

Table 12-1. Troubleshooting the Fuel Supply System

Symptom	Probable Trouble	Corrective Action
Engine fails to start (starting pump in operation).	Starting fuel pump defective.	Replace starting fuel pump.
No fuel flow or insufficient fuel flow to engine-driven fuel pump (starting pump operating properly).	Disconnected, ruptured or broken fuel line.	Check all fuel lines for security; replace damaged fuel line.
	Defective fuel shutoff valve or fuel shutoff control disconnected or loose at valve.	Replace fuel shutoff valve; repair control installation as necessary.
	Clogged fuel line.	Clean or replace defective fuel line.
	Twisted fuel inlet hose.	Remove and correctly install inletline.
FUEL FILTER warning light ON.	Clogged fuel filters.	Remove and clean engine-driven fuel pump and gas producer fuel control filters. (Refer to engine operation and maintenance manual.

4. Fuel Cells

The two fuel cells are interconnected, bladder type cells enclosed within the lower fuselage section, directly under the cargo compartment floor.

Fuel is delivered to the engine from the left fuel cell, which contains the fuel quantity tank unit, engine starting fuel pump, an access cover and a forward and aft vent crossover connection.

The mechanically actuated fuel shutoff valve is located adjacent to the fuel quantity tank unit on the access cover of the left fuel cell.

The right fuel cell contains an access cover, a filler neck, and a forward and aft vent crossover connection.

The fuel cells are supported by a fiberglass liner on the fuselage frames and secured by nylon lacing strung through non-metallic hangers on the cells and supporting eyelets on the structure.

5. Fuel Cell Replacement

(Ref. Figure 12-1)

A. Left Fuel Cell Removal

(1). Remove fuel cell covers.

(2). Using a spanner wrench to hold the crossover fitting in the right cell, remove nut and O-ring from fitting in left cell.

(3). Remove lacing from left cell.

(4). Remove starting pump.

(5). Remove four bolts and washers that secure mounting pad to structure.

(6). Remove the fuel vent cover (Ref. Sec. 2). Remove two bolts and washers from forward vent crossover fitting.

(7). Remove nut and seal washer from rear vent tube fitting. Disconnect clamp and remove powerplant supply tube from the union in Sta. 124.00 bulkhead.

(8). Release two baffle support hooks from structure by lifting tank upward at each end of the baffle support rod (detail A). Remove baffle support rod from nipple and tabs in baffle.

(9). Remove the two aluminum washers that are installed between crossover fitting flange and the cell.

(10). Fold the fuel cell lengthwise and remove through floor access opening.

B. Right Fuel Cell Removal

(1). Remove fuel filler shield (Ref. Sec. 2). Remove clamp and disconnect filler from fuel cell neck.

(2). Remove nylon lacing.

(3). Remove two bolts and washers from forward fuel vent crossover fitting: remove the two aluminum washers between the fitting and cell.

(4). Remove nut and seal washer from aft vent fitting.

(5). Release two baffle support hooks by lifting tank upward at each end of baffle support rod (detail A).

(6). Remove baffle support rod from nipple and tabs of baffle.

(7). Fold the fuel cell lengthwise and remove through floor access opening.

C. Fuel Cell Installation

(1). Check that all electrical power is OFF and disconnect battery and external power. Check that helicopter is electrically grounded and left and right fuel cell compartments are clean and free of obstructions.

(2). Fold fuel cells lengthwise and insert the fuel cells into their respective compartment. Align openings in the fuel cells with associated openings in the structure.

(3). Install starting pump.

(4). Install the baffle support rods through the tank baffle tabs and insert ends of rod into the mating nipples inside the fuel cells. Connect the four baffle support hooks to the structure (detail A).

(5). Coat O-ring with petrolatum (34, Table 2-4) and install O-ring and cell

interconnect fitting nut. Hold the fitting in the right cell with a spanner wrench and tighten nut. After nut has been tightened, end face of cell fitting must not be located more than 0.005 inch (0.127 mm) inside exposed face of nut; protrusion through nut is acceptable (detail B).

(6). Install right fuel cell cover with twelve washers and bolts; torque bolts to **50 - 70 inch-pounds (5.65 - 7.91 Nm)**.

(7). Connect forward fuel vent crossover fitting with four steel washers, four aluminum washers between crossover fitting and fuel cell, and bolts. Torque bolts to **20 - 25 inch-pounds (2.26 - 2.82 Nm)**.

(8). Install nylon lacing (details C, D, and E). Draw lacing taut and tie each end with a bowline (detail D).

(9). Place clamp on filler and connect filler to fuel cell neck; tighten clamp. Install fuel filler shield.

(10). Install new seal washers and aft vent tube nuts. Torque nuts to **40 - 60 inch-pounds**.

(11). Install four washers and bolts to secure fuel inlet mounting pad; torque bolts to **20 - 25 inch-pounds**. Install fuel cell drain valve in fuel inlet mounting pad and safety with 0.032 inch (0.8128 mm) lockwire (2).

(12). Install lacing (details C and E). Draw lacing taut and tie each end with a bowline (detail D).

(13). Install left fuel cell cover.

(14). Install tank unit (Ref. Sec. 17)

(15). Connect powerplant supply tube at fuel shutoff valve and torque tube nut to **150 - 250 inch-pounds (16.95 - 28.25 Nm)**. Connect control cable wire to shutoff valve lever and rig the control. Connect electrical plug to tank unit and starting fuel pump plug to receptacle.

(16). Fill the fuel cells. Connect the battery and external power. Operate fuel pump and make fuel leak check. Inspect fuel cells and associated plumbing for fuel leaks. Repair cause of any leakage as necessary. Check fuel quantity indicator for correct indication.

(17). Install left and right access plates in cargo compartment floor.

6. Fuel Cell Cover Replacement

(Ref. Figure 12-1)

A. Left Fuel Cell Cover Removal

(1). Check that all electrical power is OFF and disconnect battery and external power.

(2). Check that helicopter is electrically grounded.

(3). Drain all fuel from the fuel cells.

(4). Purge the fuel cells with dry filtered compressed air.

(5). Remove lockwire and disconnect electrical connections from tank unit and from fuel pump receptacle.

(6). Loosen nut and disconnect control cable wire from swivel in lever of fuel shutoff valve. Disconnect powerplant supply tube at fuel shutoff valve.

(7). Remove tank unit (fuel quantity transmitter) (Ref. Sec. 17).

(8). Remove bolts and washers from left fuel cell cover. (A headless setscrew is installed in place of the most inboard bolt and washer.)

(9). Remove the six attaching screws that secure the three left fuel cell cover support brackets. Remove the brackets and the three washers that are installed between the brackets and the cover.

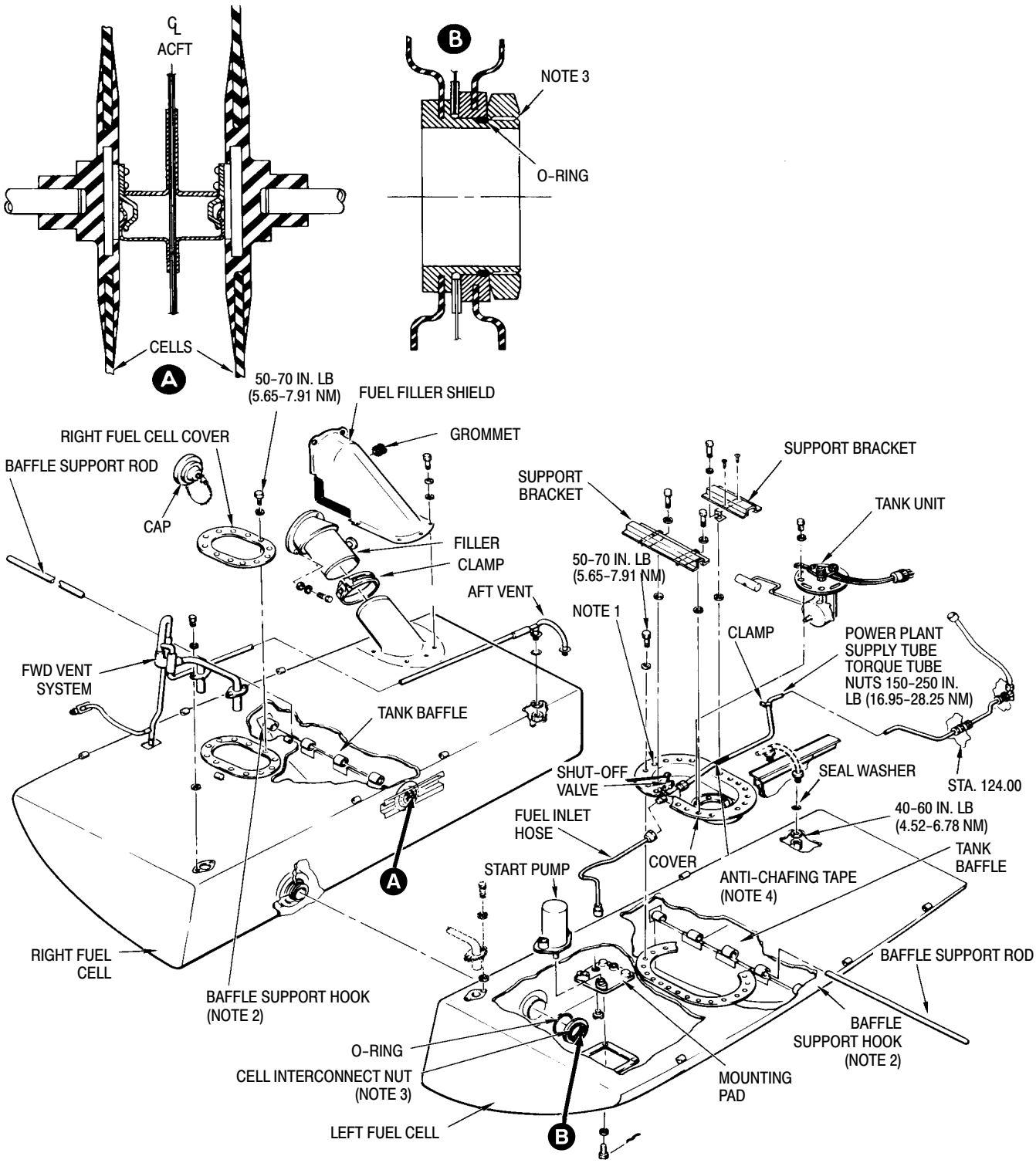
(10). Move left fuel cell cover sufficiently to gain access to the starting pump supply hose and electrical connector. Disconnect hose and connector from cover: then remove cover.

B. Right Fuel Cell Cover Removal

Perform steps (1). thru (4). for removal of Left Fuel Cell Cover Removal. Remove right fuel cell cover attaching hardware; remove cover.

C. Left Fuel Cell Cover Installation

(1). Check that all electrical power is OFF and disconnect battery and external power.



NOTES:

1. LOCATION FOR HEADLESS SET SCREW.
2. OUTBOARD CLIP TYPICAL OF INBOARD CLIP.
3. AFTER NUT HAS BEEN TIGHTENED, END FACE OF CELL FITTING MUST NOT BE LOCATED MORE THAN 0.005 IN. (0.127 MM) INSIDE OF EXPOSED FACE OF NUT; FITTING PROTRUSION THROUGH NUT IS ACCEPTABLE.
4. USE TAPE (42 OR 56, TABLE 2-4).

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Figure 12-1. Fuel Cell Installation (Sheet 1 of 2)

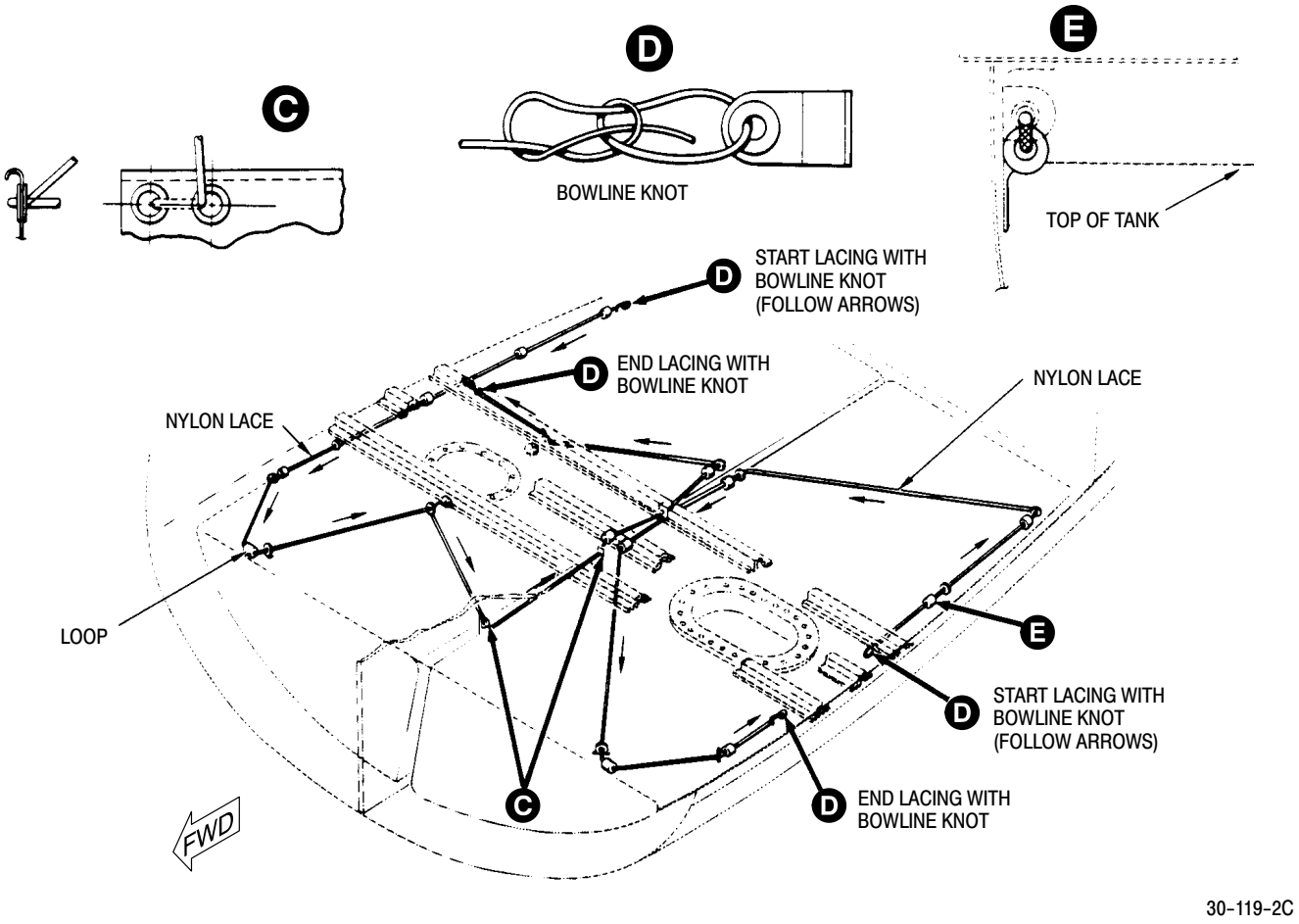


Figure 12-1. Fuel Cell Installation (Sheet 2 of 2)

(2). Check that helicopter is electrically grounded.

(3). Install fuel pump electrical receptacle in fuel cell cover with nut; secure with lockwire.

(4). Check condition of anti-chafing tape on powerplant supply tube. If worn, replace with new tape (42 or 56, Table 2-4).

(5). Position cover over cell opening.

(6). Place clamp on powerplant supply tube and connect tube to union at Sta. 124.00 bulkhead; torque to **150 - 250 inch-pounds (16.95 - 28.25 Nm)**. Secure clamp to cargo floor with screw, washer and nut.

(7). Install the three left fuel cell cover support brackets and secure with six screws. Install one washer between each of the bracket legs and the cover.

(8). Install washers and bolts to attach support brackets to left cell cover, and cover to cell. (Substitute a headless setscrew for the most inboard bolt and washer if the hex-head bolt contacts the cargo floor structure.) Torque bolts to **50 - 70 inch-pounds (5.65 - 7.91 Nm)**.

(9). Install tank unit (fuel quantity transmitter) (Ref. Sec. 17).

(10). Connect powerplant supply tube at fuel shutoff valve and torque tube nut to **150 - 250 inch-pounds (16.95 - 28.25 Nm)**. Connect control cable wire to shutoff valve control. Connect electrical plug to tank unit and starting fuel pump plug to receptacle.

D. Right Fuel Cell Cover Installation

Perform steps (1). and (2). for installation of Left Fuel Cell Cover Installation. Install right fuel cell cover with twelve washers and bolts;

torque bolts to **50 - 70 inch-pounds (5.65 - 7.91 Nm)**.

7. Fuel Cell Repair

The time and effort required for making temporary repairs to fuel cells is as great as that necessary for permanent repairs and the results are not satisfactory: therefore, the repair procedures provided are for permanent cold type repairs.

The repairs are made with a cold type repair kit (84, Table 2-4) which contains consumable materials listed in Table 2-4.

Either side of the fuel cell can be patched: however, repair of a hole or tear larger than 2 inches should not be attempted using the cold repair procedure. In such a case. contact the fuel cell manufacturer for information on factory type repairs.

A. Preparing Fuel Cell for Repairs

(1). Accomplish repair work on fuel cells in a warm, dry place, 60° to 80°F (16° to 27°C) with a 50 percent humidity. High humidity, especially in combination with low temperature, will cause condensation to form on cemented surfaces and make adhesion of repair patches difficult.

(2). Drain cell and dry thoroughly as soon as possible after damage. Drying may be speeded up by keeping cell in a warm place, 80° F (27°C) and by using an air hose on the inside. Do not keep cells warm for long periods at a time.

(3). Thoroughly clean the cell.

B. Fuel Cell Cleaning

Any one of three methods outlined in steps (1). thru (3). is recommended for cleaning the fuel cells.

CAUTION Do not use soaps or strong detergents when cleaning fuel cells. Certain powerful detergents can react with fuel to form a compound that may block fuel filters.

NOTE: The fuel cells are susceptible to fungus growth after contact with contaminated fuel. Fungus in a fuel cell is usually caused by improper servicing and storage of jet fuels. Suitable filters and water traps should always be used in fuel storage tanks and servicing equipment. If evidence of fungus is present in the fuel cells, contamination is usually present in the helicopter fuel filters which should be cleaned or replaced.

(1). Use hot water not exceeding 160°F (71°C) and clean fuel cells by hand or with a soft brush.

(2). Use a solution of acetic acid (10% max.) for fuel cell cleaning. Vinegar may also be used as vinegar contains a 4-5 percent acetic acid concentration that will clean and inhibit airborne fungus growth.

(3). Use jet fuels for fuel cell cleaning. The oil content in the jet fuel will assist in protecting the fuel cell during storage.

(4). Do NOT use MEK or similar solvents, alcohol, or soap for fuel cell cleaning.

NOTE: To prevent formation of bacteria, an FAA approved fuel additive is recommended for routine addition to the helicopter fuel cells while refueling. This is the same as the anti-icing additive recommended in the fuel servicing section of the Owner's Manual. Usually one treatment will kill the bacteria and prevent re-growth in the fuel cells for some time. Use Owner's Manual instructions for blending additive with fuel during servicing.

C. Repair of Fuel Cell

(1). Remove the fuel cell.

(2). Collapse the cell and expose the damaged area on a flat working surface.

(3). Wipe the damaged area and surrounding surface with a piece of cheesecloth (53, Table 2-4) dampened with solvent

(55) to remove any foreign material. The surface must be absolutely clean and dry to apply the patch.

(4). Select and prepare a patch of synthetic rubber-coated repair fabric: inside material (50) or outside material (51) as follows:

(a). Select a patch 2 inches (5.08 cm) larger in all directions than the damaged area.

(b). Hand buff the material lightly and thoroughly with fine emery cloth (49).

(c). Remove buffing dust by wiping patch with slightly dampened cheesecloth dipped in cement solvent.

(d). Apply two thin, even coats of fuel cell cement (54) to buffed side of patch, allowing first coat to dry 15 minutes before application of second coat; allow second coat to dry 15 minutes.

NOTE: Cement is to be used sparingly. Two thin, even coats provide better adhesion than thick uneven coats.

(5). Prepare damaged area of cell as follows:

(a). Hand-buff damaged area of cell lightly and thoroughly with fine emery cloth: buffed area is to be slightly larger in size than the patch.

(b). Remove buffing dust and apply two thin coats of fuel cell cement to the buffed area as described in steps (4).(c). and (d).

(6). Wipe the cemented area of the patch and the fuel cell with cheesecloth moistened with solvent to make the surface of the cement tacky.

NOTE: Application of the solvent to the cement freshens the surface of the cement after it has become dry to the touch.

(7). While still tacky, center and apply patch to cemented area on the fuel cell over the damaged area. Using a steel roller, or the smooth, round handle of a screwdriver, roll the patch down on the cemented area. Roll the patch down from one edge, a half-inch to an inch across at a time, so that air is not trapped between the patch and the fuel cell material.

NOTE: Buffing and cementing of patch and cell is normally down at the same time. A clamping device consisting of two pieces of board or metal, one on each side of the seal, should be placed over the patch and held in place by two C-clamps under pressure for 8 hours. If such equipment is not available, a 25 pound (12 kg) shot bag may be used. Oiled paper or polyethylene should be placed between the equipment and the patch to prevent sticking.

(8). Allow repair to remain undisturbed for at least 8 hours; fuel cell is not to be returned to service for a minimum of 24 hours.

NOTE: Twenty-four hours at temperatures of 60° to 80° F (16° to 27°C) is the minimum time required forthe cement to fully cure for the cold patch.

(9). Make additional minor repairs as follows:

(a). Loose reinforcement edges, hangers or lap splices are to be lifted, buffed, cemented thoroughly and looseness remedied, using procedures in steps (6). thru (8).

(b). Scuffed areas where fabric is exposed are to be buffed and cemented, and allowed to air-dry for 8 hours as instructed in preceding steps. No patch is required unless the fabric is torn

(10). Repairing Blisters:

An inner blister is caused by trapped air between the liner and sealant. Blisters under 1 inch (2.54 cm) in diameter are not injurious and need not be repaired.

To repair a blister:

(a). Buff surface of blister and an area extending 2 inches (5.08 cm) in all directions from its edge. Slit blister with a knife and buff underside of loose edges.

(b). Thoroughly clean buffed area and apply two coats of cement to inside surfaces, allowing proper time between coats.

(c). Roll down blister to remove all trapped air.

(d). After blister has dried completely, apply a patch of repair material (50) extending 1.50 inches (3.81 cm) in all directions from edge of blister, and complete the repair in same manner as for inside repair.

(11). Repairing Loose Seams and Patches:

Loose lap seams must be repaired as soon as possible.

To repair loose seams and patches:

(a). Buff both surfaces inside separation. Buff an area on top of loose seam extending 2 inches (5.08 cm) in all directions from edges of separation, continuing measurement on next cell wall if necessary

(b). Clean area inside separation with a rag moistened with solvent (1). Allow area to dry. Apply two coats of cement (54). Allow proper drying time between coats.

(c). Roll separation down firmly to remove trapped air and allow to dry before proceeding.

(d). Cut a patch of repair material (50) extending 1.50 inches (3.81 cm) in all directions from edge of separation. Round corners slightly and slice one edge of patch at an angle by tilting shears instead of cutting square. Buff patch on flat side.

(e). Clean buffed surface of patch and apply patch and complete the repair in the same manner as for inside repair.

(f). Loose lap seams on outside of cell are repaired in the same manner as inside repair except that material comparable to outside material of cell is used.

(g). Loose patches may also be repaired by buffing, washing and cementing separation unless it is obviously better to replace patch with a new one.

8. Fuel Cell Pressure Test

(1). Plug the forward vent system.

(2). Install a manometer and air pressure equipment.

(3). Apply and hold 2 psi (14 kPa) of air pressure for 10 minutes as a preconditioning measure. This will force trapped air out from between the fuel cells and helicopter structure. Repeat if necessary until the cells are adjusted to the contour of the cell bay.

(4). Apply 2 psi (14 kPa) air pressure and hold for 15 minutes with no visible, less than 0.250 inch (6.35 mm), drop on manometer. If a pressure drop occurs, check all fittings and retest the cells. After careful testing, repair or replace parts as necessary to eliminate the pressure drop.

(5). Remove plug(s) from forward vent system, the manometer, and air pressure equipment after completion of pressure test and or repairs.

9. Fuel Filler Shield

A. Fuel Filler Shield Replacement

(Ref. Sec. 2, Fuel Filler Shield)

B. Fuel Filler Shield Inspection

Inspect shield for cracks, crazing, and radius of flanges for chipping and cracking. Inspect the fuel inlet shield seals and grommet on side (if installed) for security and deterioration.

C. Fuel Filler Shield Repair

(1). Repair polycarbonate fuel inlet shield body cracks by bonding a patch according to the criteria and methods specified for acrylic plastic in FAA AC 43. 13-1, Aircraft Inspection and Repair. Use dichloromethane (38, Table 2-4) or ethylene dichloride (39) as the bonding agent.

(2). Repair small areas of seam separation by injecting ethylene dichloride into the

void area and clamping together under light pressure.

(3). Replace damaged or deteriorate grommet (if installed).

10. Fuel Filler Cap

(Ref. Figure 12-1) The fuel filler cap is located flush with the fuselage skin aft of the right cargo door. The filler cap is attached to the filler neck by a safety chain.

11. Fuel Filler Cap Replacement

(1). Removal. Remove the filler cap from filler neck by raising the spring-loaded lever and rotating it counterclockwise to OPEN. Remove the filler cap and disconnect the wire clip.

(2). Installation. Verify that the safety chain is securely attached to filler neck in fuselage and connect the safety chain to the replacement filler cap with a wire clip. Insert cap in filler neck and rotate clockwise to CLOSE. Check that filler cap is tight and firmly seated in filler neck.

12. Fuel Filler Cap Inspection

Inspect the filler cap gasket for deterioration. Inspect the cap body for damage and the condition of the spring that keeps the lever flush.

13. Fuel Filler Cap Repair

Replace an unserviceable filler cap gasket or cap. Smooth scratches and nicks by filing.

14. Fuel Cell Vents

(Ref. Figure 12-1) Fuel cell vents are located in the forward and aft end of each fuel cell.

The aft vent is a short, U-shaped tube that interconnects the top aft end of each fuel cell; the vent line is routed forward and connected to the forward vent tube.

The forward end of each fuel cell is interconnected by a vent crossover fitting (Ref. Figure 12-2) that is routed into the control rod tunnel in the canted bulkhead.

The vent tube is routed downward through the control rod tunnel to a vent fairing mounted on the bottom of the fuselage.

An alternate venting source is provided on current helicopters. Hughes Notice HN-8l provides instructions for modifying early helicopters for the second vent provision.

A fuel cell vent line emergency shutoff valve, if installed, connects the forward and aft vent line hoses. The valve remains open as long as the helicopter is within 45 degrees of normal attitude in any direction. If this limit is exceeded, the vent valve closes to prevent fuel spillage.

15. Fuel Cell Vent System Replacement

(Ref. Figure 12-1 and Figure 12-2)

A. Forward Fuel Cell Vent System Removal

(1). Check that all electrical power is OFF. Disconnect external power and battery.

(2). Drain all fuel from the fuel cells into suitable containers.

(3). Remove right foot support fairing, controls access door, and fuel vent cover (Ref. Sec. 2), Remove lockwire from connector hoses; remove hoses as required.

(4). Remove forward fuel vent line attaching hardware; remove fuel vent line. On helicopters equipped with a vent line emergency shutoff valve, remove the right pilot's seat for access to the third attachment bolt.

(5). On helicopters with an alternate venting air source, remove lockwire and disconnect necessary tubing and connector at lower tee to release lower vent tube.

NOTE: After disconnecting the vent system tubing and attaching hardware, removal is best accomplished with the collective pitch stick in the full down position. Then rotate the vent valve assembly inboard and slide down over landing gear structure. This positions the assembly for removal through the controls access door opening.

(6). Carefully pull vent tube inboard, to release from clip, and upward to

withdraw from flared tubing riser of plastic vent fairing; remove vent tube.

(7). Remove crossover fitting attaching hardware; remove crossover fitting with two clamps and two seals attached.

(8). Provide suitable covers or plugs for fuel vent holes in fuel cells and aft vent line tube to prevent contamination.

B. Aft Fuel Cell Vent System Removal

(1). Remove fuel cell covers.

(2). Remove two nuts to disconnect aft vent from left and right fuel cells.

(3). Remove the hose that connects the aft vent to the forward vent; remove aft vent and discard two seal washers.

C. Forward Fuel Cell Vent System Installation

(1). Remove protective covers or plugs from fuel vent holes in fuel cells and aft vent line tube.

(2). Install two clamps and seals on cross-over fitting and position fitting in fuel cell vent openings. Install attaching hardware (steel washers on top of fitting flange).

(3). Assemble lower vent tube as shown in Figure 12-2 and place lower end into vent fairing tube and press outboard to snap upper end of vent tube into clip.

(4). Install upper vent tube with two washers, bolt, nut and clamp.

(5). Install fuel vent hoses (if removed) and alternate vent tube (if installed); protect vent tube against chaffing by wrapping with tape (42, Table 2-4) as it passes through landing gear brace. Secure all hoses with a double wrap of 0. 032 inch (0.8128 mm) lockwire (2) that ends in at least five full twists.

(6). Check that complete installation does not interfere with free movement of flight controls.

(7). Secure controls access cover, right foot support fairing, fuel vent cover and right pilot's seat, if removed.

D. Aft Fuel Cell Vent System Installation

(1). Position aft vent over center beam at aft end of the fuel cell compartments and install new seal washers.

(2). Secure aft vent to each fuel cell with nuts: torque nuts to **40 - 60 inch-pounds (4.52 - 6.78 Nm)**.

(3). Connect hose from forward vent line and install clamp.

(4). Install fuel cell covers.

16. Fuel Cell Vent System Inspection

(Ref. Figure 12-1 and Figure 12-2)

(1). Check fuel cell vent fairing(s) for freedom of obstruction and undamaged condition.

(2). Inspect vent tube for dents, cracks, deformation or corrosion. Minor (or smooth) dents are permissible except at the lower end which must fit flush with inner diameter of lower plastic vent fairing flared riser.

(3). Inspect hoses, tubes, and connectors for cracks, deterioration or obstructions.

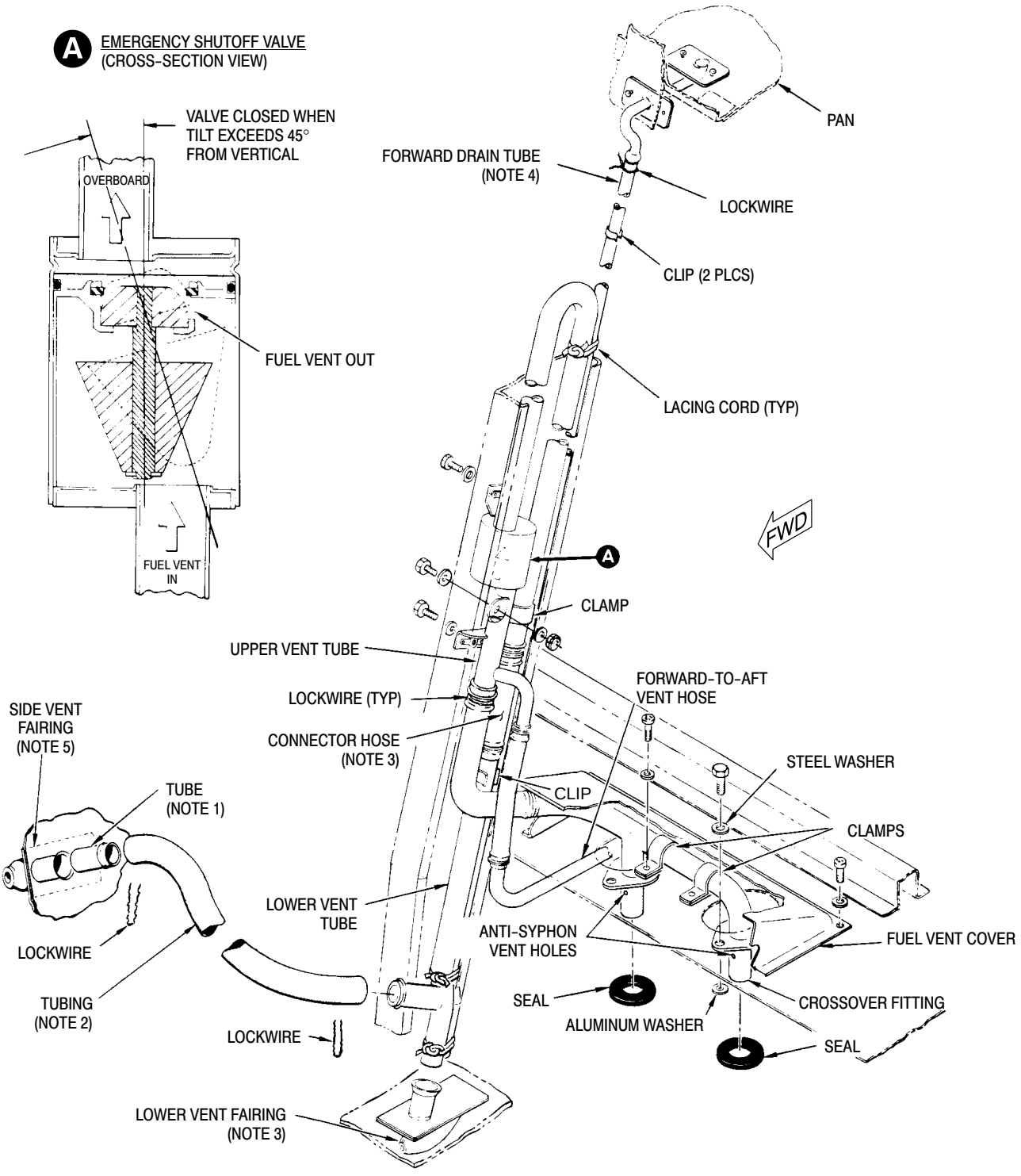
(4). Inspect crossover fitting for cracks, dents, or corrosion. Minor (or smooth) dents are permissible. Check that the two anti-syphon vent holes are open and that the hole diameter, 0.025-0.030 inch (0.635-0.762 mm) is not decreased by residue.

(5). Inspect the vent line emergency shutoff valve (detail A, Figure 12-2) as follows.

(a). Inspect for condition outlined in steps (1). and (2).

(b). Valve should remain open when tilted in any direction up to 45 degrees off vertical.

(c). Gently blow in valve and check that valve is closed at any angle in excess of 45 degrees from vertical in any direction.



NOTES:
1. BONDED TO FAIRING WITH ADHESIVE (121, TABLE 2-4).
2. ROUTED THRU LANDING GEAR BRACE.
3. NOT TO BE PAINTED.
4. FOR ADDITIONAL INFORMATION, REFER TO SECTION 9.
5. DO NOT PAINT FAIRINGS MADE FROM LEXON (TRANSPARENT).
   O.K. TO PAINT FAIRINGS MADE FROM FIBERGALSS (NON-TRANSPARENT).

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Figure 12-2. Forward Vent - Fuel Cell

17. Fuel Shutoff Valve Control Assembly

(Ref. Figure 12-3) The fuel shutoff valve control assembly consists of a flexible sheathed control wire actuated by a red PULL TO CLOSE knob mounted on the instrument panel.

Pulling the control knob will close the fuel shutoff valve attached through a swivel to the control wire.

On early configuration helicopters, the control wire is routed aft near the helicopter centerline to the shutoff valve located under the cargo compartment floor. On current configuration helicopters, the control wire is routed aft through the outboard left side of the helicopter floor structure.

Due to control wire routing, the respective valves close in opposite directions when actuated.

Optional modification of early helicopters to the current fuel shutoff control configuration, i.e., PN 369A8104-3 to 369A8104-5, may be accomplished as follows:

(1). Check that existing 369A8104-3 fuel shutoff control valve is in CLOSED position, with valve lever arm pointing towards C/L of helicopter.

NOTE:

- Use care in removing valve lever arm and cam, to prevent loss of two detentballs seated in detent cavities in valve boss.
- Note existing position of cam valve stem to facilitate repositioning (Ref. view F).

(2). Remove cotter pin securing valve lever arm and cam to valve stem; remove valve lever arm.

(3). Remove cam and detent balls; reposition cam on valve stem 90 degrees clockwise from original position, with holes in cam and valve stem aligned.

(4). Insert detent balls in holes in top of cam**;** check that ball bearings are seated properly in detent cavities in valve boss.

(5). Install valve lever on cam and valve stem; check that lever arm bends downward and points away from C/L of helicopter, and that hole in lever arm aligns with holes in cam and stem.

(6). Secure valve lever arm and cam to valve stem with cotter pin.

(7). Check operation of fuel shutoff valve assembly; full throw of valve lever arm is 90 degrees, stop-to-stop.

18. Fuel Shutoff Valve Control Assembly Replacement

(Ref. Figure 12-3)

A. Fuel Shutoff Valve Control Assembly Removal

(1). Remove left fuel cell access door.

(2). Remove cotter pin, nut, washer and swivel at valve.

(3). Remove control wire end clamp or strap.

(4). Remove clamps or straps from flexible sheath.

(5). Remove instrument panel left fairing and lower cover panels.

(6). Loosen control assembly nut at instrument panel and run nut off threaded portion of plunger housing.

(7). Pull fuel shutoff control through instrument panel mounting hole. Catch the lockwasher and nut when control wire end passes through mounting hole.

(8). Remove any unserviceable hardware.

B. Fuel Shutoff Valve Control Assembly Installation

(1). Determine fuel shutoff control configuration.

(2). Install bracket (if used) and new grommets if required.

(3). Place control wire end of fuel shutoff control assembly through mounting hole in instrument panel and place lockwasher and nut over end of control wire.

(4). Thread fuel shutoff control assembly through mounting hole in panel, through grommets back to fuel shutoff valve.

(5). Tighten nut to secure forward end of control.

(6). Install clamps and/or straps as shown in Figure 12-3.

(7). Install valve arm swivel and washer. Insert control wire through hole in swivel and draw taut. Install and tighten nut. Install cotter pin.

(8). Adjust control assembly.

19. Fuel Shutoff Valve Control Assembly Inspection

(Ref. Figure 12-3)

(1). Remove left fuel cell access door.

(2). Inspect the fuel shutoff control assembly, nylon grommets and attachments for security.

(3). Inspect control bracket, if installed, for deformation and security.

(4). Inspect valve lever for corrosion, damage, and freedom of movement. Operate control and check for binding. Minimum bend radius of cable at any point must not be less than 2.75 inches (6.985 cm). Push knob in and check for 0.090-0.150 inch (2.286-3.81 mm) gap between the bottom of the operating hand knob and the surface of the fixed housing.

20. Fuel Shutoff Valve Control Assembly Adjustment

(Ref. Figure 12-3)

NOTE: If the wire end of the control cable is disconnected or loose in the swivel, avoid pulling the control plunger more than 2 inches (5.08 cm) from the open position to prevent the ball bearing from moving out of place.

(1). Pull control to close fuel shutoff valve.

NOTE: Shutoff valves on early configuration helicopters move clockwise to OPEN as viewed from above. Current configuration shutoff valves and shutoff systems so modified move counterclockwise to OPEN. If in doubt, blow gently through valve to determine open and closed positions or verify correct part number.

(2). Watch fuel shutoff valve lever to check that lever has moved to closed position.

(3). Remove cotter pin and loosen nut on valve lever. Press lever arm against open stop. Position control knob to provide a 0.090-0.150 inch (2.286-3.81 mm) gap between the bottom of the operating knob and the surface of the fixed housing. Tighten nut on swivel to secure.

(4). Operate control to close fuel shutoff valve.

(5). Check that fuel shutoff valve lever arm is in the closed position against stop.

NOTE: Full throw of valve lever is 90 degrees, stop to stop. If both stops are not contacted, check valve for angular installation of 90 degrees to fuel tank cover.

(6). Operate control to open the fuel shutoff valve. Recheck for proper gap under control knob when control lever is against the open stop.

21. Fuel Shutoff Valve Control Assembly Repair

(Ref. Figure 12-3) If the fuel shutoff valve control assembly is pulled out more than 2 inches (5.08 cm) and the ball bearing moves out of place, accomplish the following.

(1). Loosen the swivel that secures control wire to the valve arm and establish free movement of the wire.

(2). Pull plunger of control assembly outward until small hole in side of plunger is slightly beyond the plunger housing. Insert release rod into mating opening of the plunger. Use care to align the notch in the release rod with the hole in the plunger.

(3). Apply grease (18, Table 2-4) between the plunger and plunger housing.

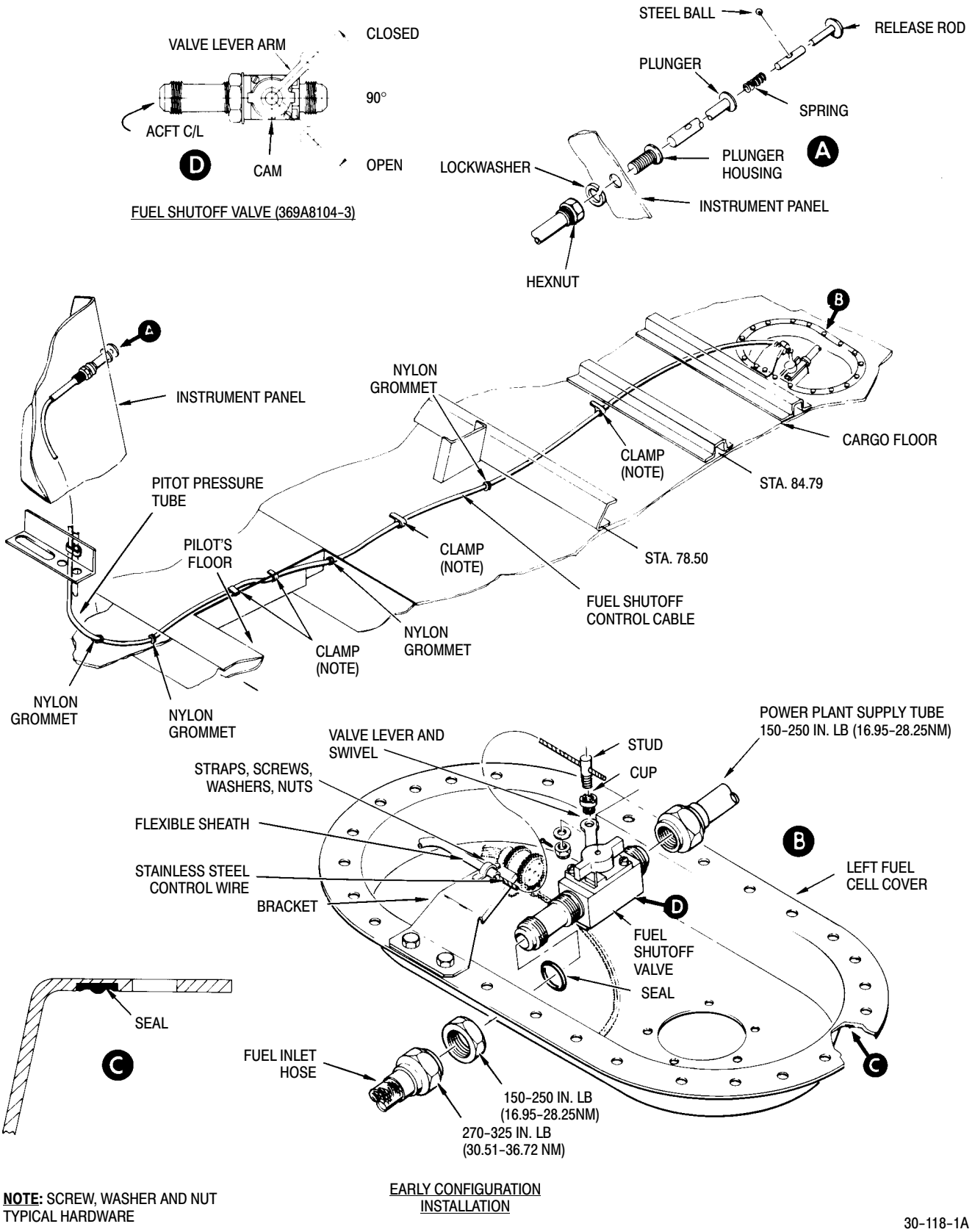
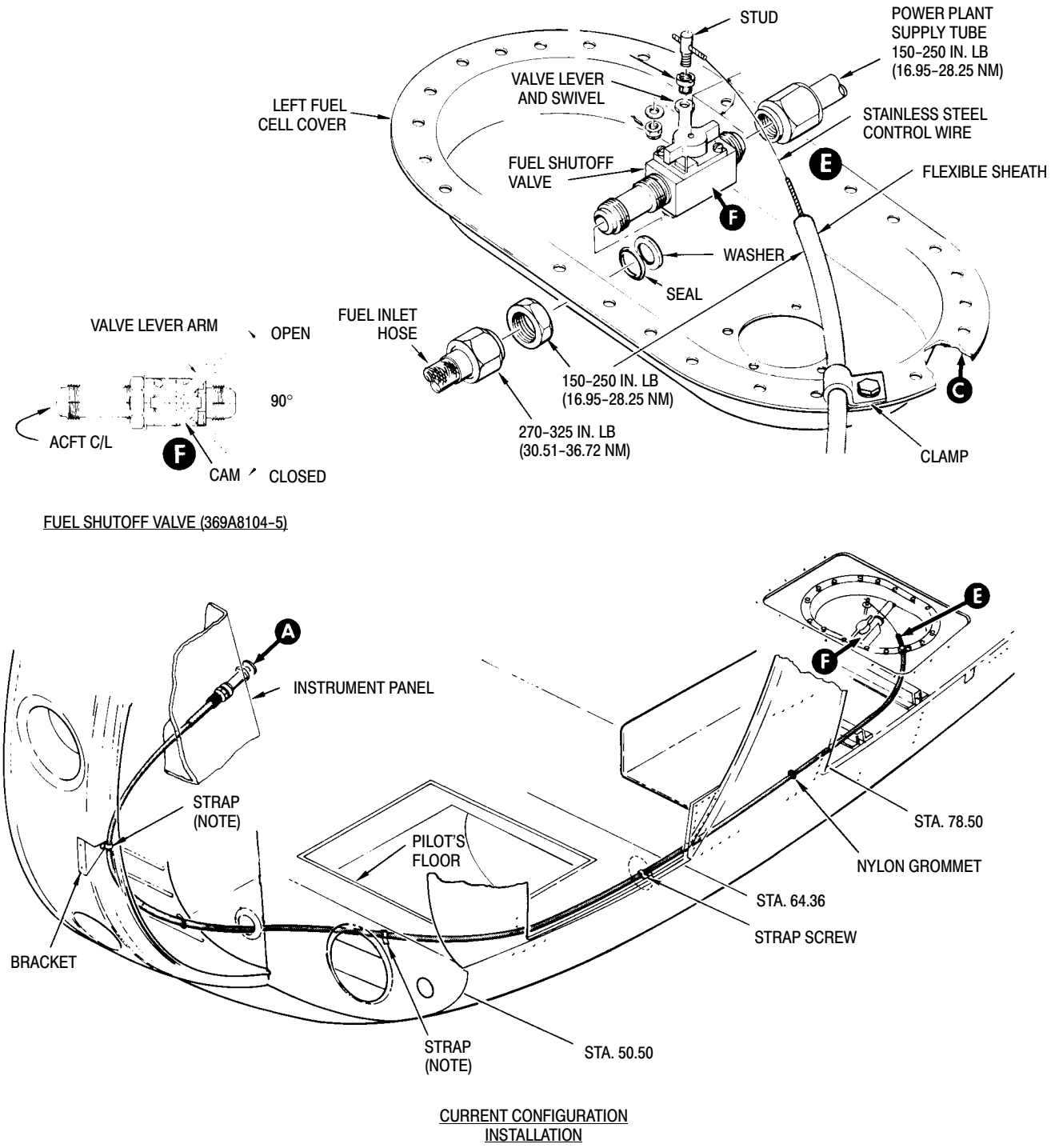


Figure 12-3. Fuel Shutoff Valve (Sheet 1 of 2)



30–118–2A

Figure 12-3. Fuel Shutoff Valve (Sheet 2 of 2)

(4). Install ball bearing into hole of plunger and push both release rod and plunger inward to full open position.

CAUTION Use care to hold ball bearing in thehole until it goes into the plunger housing.

(5). Adjust control assembly.

22. Fuel Shutoff Valve

The fuel shutoff valve is located on the left fuel cell cover. A lever arm, mounted on top of the fuel shutoff valve, is actuated through an arc of 90 degrees by push-pull control action from the FUEL VALVE control on the instrument panel. The lever arm is detented in the open and closed positions. One of two part number valves are used. The respective valves close in opposite directions when actuated. Refer to Figure 12-3 for valve identification.

23. Fuel Shutoff Valve Replacement

(Ref. Figure 12-3)

A. Fuel Shutoff Valve Removal

(1). Disconnect the powerplant supply tube assembly and swivel assembly; remove the left fuel cell cover.

(2). Remove nut and seal to disconnect fuel shutoff valve from fuel cell cover.

B. Fuel Shutoff Valve Installation

(1). Install fuel shutoff valve with washer (if installed) and seal on left fuel cell cover.

(2). Install nut; torque nut to **150 - 250 inch-pounds (16.95 - 28.25 Nm)**.

(3). Install fuel cell cover).

(4). Install tank unit (Ref. Sec. 17).

(5). Connect powerplant supply tube at fuel shutoff valve and torque tube nut to **150 - 250 inch-pounds (16.95 - 28.25 Nm)**. Connect control cable wire to shutoff valve lever. Refer to Fuel Shutoff Valve Control Assembly Adjustment for rigging instructions. Connect electrical plug to tank unit and starting fuel pump lug to receptacle.

(6). Fill the fuel tanks. Connect the battery and external power. Operate fuel pump and make fuel leak check. Inspect fuel cells and associated plumbing for fuel leaks. Repair cause of any leakage as necessary. Check fuel quantity indicator for correct indication.

(7). Install left access door in cargo compartment floor.

24. Fuel Shutoff Valve Inspection

(Ref. Figure 12-3)

(1). Inspect the fuel shutoff valve for obvious damage

(2). Check that the control lever arm operates through a 90 degree arc of rotation with a pull of 2.5 ±1.0 lb. (1.13 ±0.454 kg) and seats firmly in detent at the full open and closed positions. Replace a defective shutoff valve.

25. Fuel Supply Drain Valves

(Ref. Figure 12-4) Two drain valves are provided in the fuel supply system.

The main drain valve is installed in the start pump mounting pad and is accessible from the underside of the helicopter. The engine fuel drain valve is installed in the engine compartment as part of the engine fuel supply system.

The main drain valve and early configuration engine compartment valves are identical. These valves consist of a spring loaded plunger which is depressed and rotated clockwise or counterclockwise to the open-stop position with a screwdriver.

Depress the plunger to release it from the open-stop position, turn and allow valve spring tension to return it to the closed position. Current configuration engine compartment drain valves are attached to the engine compartment firewall fuel fitting and drain overboard through a flexible tube. The valve is actuated by depressing the plunger at the tube attachment.

26. Fuel Supply Drain Valve Replacement

(Ref. Figure 12-4)

A. Fuel Supply Drain Valve Removal

(1). Check that all electrical power is OFF and disconnect battery and external power.

(2). Drain all fuel from the fuel cells if removing the fuel cell sump drain valve. Drain only the supply line and engine-driven pump if removing the supply tube drain valve.

NOTE: Current supply tube drain valve is theneedle and seat type and is recommended re-placement for early type valve.

(3). Remove lockwire, disconnect drain tube on firewall mounted valve; then unscrew drain valve and remove O-ring. Discard O-ring if it is unserviceable.

B. Fuel Supply Drain Valve Installation

(1). Install O-ring (new, if necessary) on drain valve. Install and tighten drain valve in mounting pad or firewall fitting as applicable.

(2). Safety fuel cell drain valve to adjacent bolthead and/or fuel line drain valve to body of firewall fitting (supply tube) with lockwire (2, Table 2-4).

(3). On firewall mounted drain valve, connect drain line and secure with lockwire. Check that drain tube is routed through grommet in underside of fuselage.

(4). Check that drain valves are closed. Refill fuel tanks and check drain valves for leakage. Open fuel shutoff valve and operate pump to pressurize the system during the leak check.

27. Fuel Supply Drain Valve Inspection

(Ref. Figure 12-4)

(1). Inspect drain valve for obvious damage. Check for positive shutoff in the closed position.

(2). On firewall mounted drain valves, check that drain tube is secure and is routed through the grommet in underside of the fuselage. Check that slack is provided in the drain tube to allow for depression of the drain valve.

28. Engine Fuel Supply System

(Ref. Figure 12-4) The engine pump fuel hose is located at the lower left side of the engine compartment. The fuel hose-to-engine pump connection is a self closing coupling. The Sta. 124.00-to-Sta. 137.50 supply tube is only used on early fuel systems. Hughes Notice HN-49 provides instructions for optional modification and relocation of engine fuel hose and supply tube to the current routing, to preclude chafing and damage to the fuel line in event of a hard landing or a collapsed landing gear damper.

29. Engine Fuel Supply System Replacement

(Ref. Figure 12-4)

A. Engine Fuel Supply System Removal

(1). Check that all electrical power is OFF and disconnect battery and external power.

(2). Close the fuel shutoff valve by pulling outward on the fuel control knob.

(3). Drain fuel from engine supply system.

(4). Remove current configuration engine fuel supply system as follows:

(a). Loosen hose nuts and remove engine fuel hose.

(b). Remove lockwire and overboard drain line from firewall drain valve.

(c). Release nuts and remove firewall fitting drain valve and elbow with O-ring as required.

(5). Remove early configuration engine pump fuel hose and supply tube as follows:

(a). Loosen or remove clamps; then slide fire sleeve down away from the engine pump and unscrew the coupling halves.

(b). Slide fire sleeve upward and disconnect the hose coupling assembly at the structural ring tee fitting; cap open fittings.

(c). Loosen tube nut on supply tube at Sta. 137.50 structural ring and at Sta. 124.00 bulkhead.

(d). Spring structural ring slight aft until flare on supply tube clears lip on tee fitting. Remove supply tube; cap ends of tube.

B. Engine Fuel Supply System Installation

(1). Install current configuration engine fuel supply system as follows:

(a). Assemble Sta. 124.00 firewall fitting, elbow and drain valve with O-ring as shown in Figure 12-4. Position the fitting so that the drain valve tilts down from the horizontal plane 12-16 degrees.

(b). Install the engine fuel hose between the fitting elbow and the engine fuel pump.

(c). On the 250-C18 series engine, torque both hose ends to **120 - 140 inch-pounds (13.56 - 15.82 Nm)**.

(d). On the 250-C20 engine, torque the fuel hose-to-pump connection to **120 - 140 inch-pounds (13.56 - 15.82 Nm)** and the firewall connection to **150 - 250 inch-pounds (16.95 - 28.25 Nm)**.

(2). Install early configuration engine pump fuel hose and supply tube as follows:

NOTE: A washer should be installed under Sta. 124.00 bulkhead union jamnut. When not present, install AN960PD1216 washers if union loosens or when left fuel cell is removed. Jamnut torque is **400 - 420 inch-pounds (45.19 - 47.45 Nm)**.

(a). Spring structural ring slightly aft so that supply tubes flares will fit over lip of fittings at Sta. 124.00 and Sta. 137.50.

(b). torque supply tube nuts to **250 - 300 inch-pounds (28.25 - 33.90 Nm)**.

(c). Position engine fuel hose and coupling assembly between fuel supply line fitting in structural ring and the engine fuel pump. Torque fuel pump coupling nut to **120 - 140 inch-pounds (13.56 - 15.82 Nm)**. Torque the nuts at the fuel drain valve ends to **150 - 250 inch-pounds (16.95 - 28.25 Nm)**.

CAUTION A twisted line will result in a partial blockage in the line, causing flame-out at high power settings.

(d). Slide fire sleeve over coupling assembly at pump and tee fitting and secure with clamps.

(e). Secure split end of fire sleeve with a double wrap of lockwire (2, Table 2-4) at a point just above the fitting drain valve.

30. Engine Fuel Supply System Inspection

(Ref. Figure 12-4)

(1). Inspect self-closing coupling halves and bulkhead fitting for obvious damage.

(2). Inspect fire sleeve for serviceable condition (no cuts, tears, ect.).

(3). Inspect hose for damage and signs of leakage.

(4). If installed, inspect Sta. 124.00-to-Sta. 137.50 supply tube for obvious damage.

31. Start Pump

(Ref. Figure 12-4) The start pump is a submerged type installed in the left fuel cell. The pump operates on 24 Vdc power and is controlled by a 7.5 ampere circuit breaker type switch on the instrument panel.

CAUTION Do not operate start pump if fuel is not present. Without fuel, pump rpm is to high resulting in failure of the pump motor.

32. Start Pump Replacement

WARNING **After each opening, removal or replacement of any part of the engine and/or aircraft fuel system between the aircraft fuel tank and the engine fuel nozzle, the fuel system must be bled to remove trapped air. Failure to comply with this procedure can result in engine flameout or power loss.**

A. Start Pump Removal

(1). Remove left fuel cell cover.

(2). Remove the three bolts and washers that attach the electrical pump to the mounting pad; remove pump.

(3). Remove fuel inlet hose and fitting from pump and retain for re-use on replacement pump.

B. Start Pump Installation

(1). Check that all electrical power is OFF and disconnect battery and external power. Check that helicopter is electrically grounded.

(2). Check that fuel cell is clean and free of foreign material.

(3). Install O-ring and fitting in pump outlet port.

WARNING **Proper tightening of engine tubing connections is critical to flight safety. Correct torque values must be used at all times. Excessive torque on fuel or pneumatic sensing system connections can result in cracking of the flare causing an air leak which can cause flameout, power loss, or overspeed.**

CAUTION Ensure start pump wire lead is wrapped around or tie-wrapped (using only MS3367 Ty-Raps) to fuel supply hose so that there is no possibility of its interfering with fuel quantity transmitter float mechanism. Ensure electrical connections will not be strained by G-induced hose movements.

(4). Install fuel inlet hose of fuel pump fitting and torque to **270 - 325 inch-pounds (30.51 - 36.72 Nm)**.

(5). Install pump assembly on mounting pad with three bolts and washers. Torque bolts to **20 - 25 inch-pounds (2.26 - 2.82 Nm)**.

(6). Connect inlet hose to shut off valve fitting. With fuel cell cover correctly oriented, torque hose nut to **270 - 325 inch-pounds (30.51 - 36.72 Nm)**.

(7). Install fuel cell cover.

33. Fuel System Bleeding

WARNING **Fuel/air vapor discharged during bleeding procedure is highly flammable. Ensure helicopter is electrically grounded and is not enclosed in a space (i.e.. hanger) where fuel fumes can accumulate. Do not allow fuel/air mixture to get into eyes as irritation or injury may result.**

(1). Ground helicopter per general maintenance instructions.

(2). Set helicopter master switch to battery and start pump switch to on (up) position.

(3). Place an empty container under overboard drain line on underside of fuselage at Sta. 124.00.

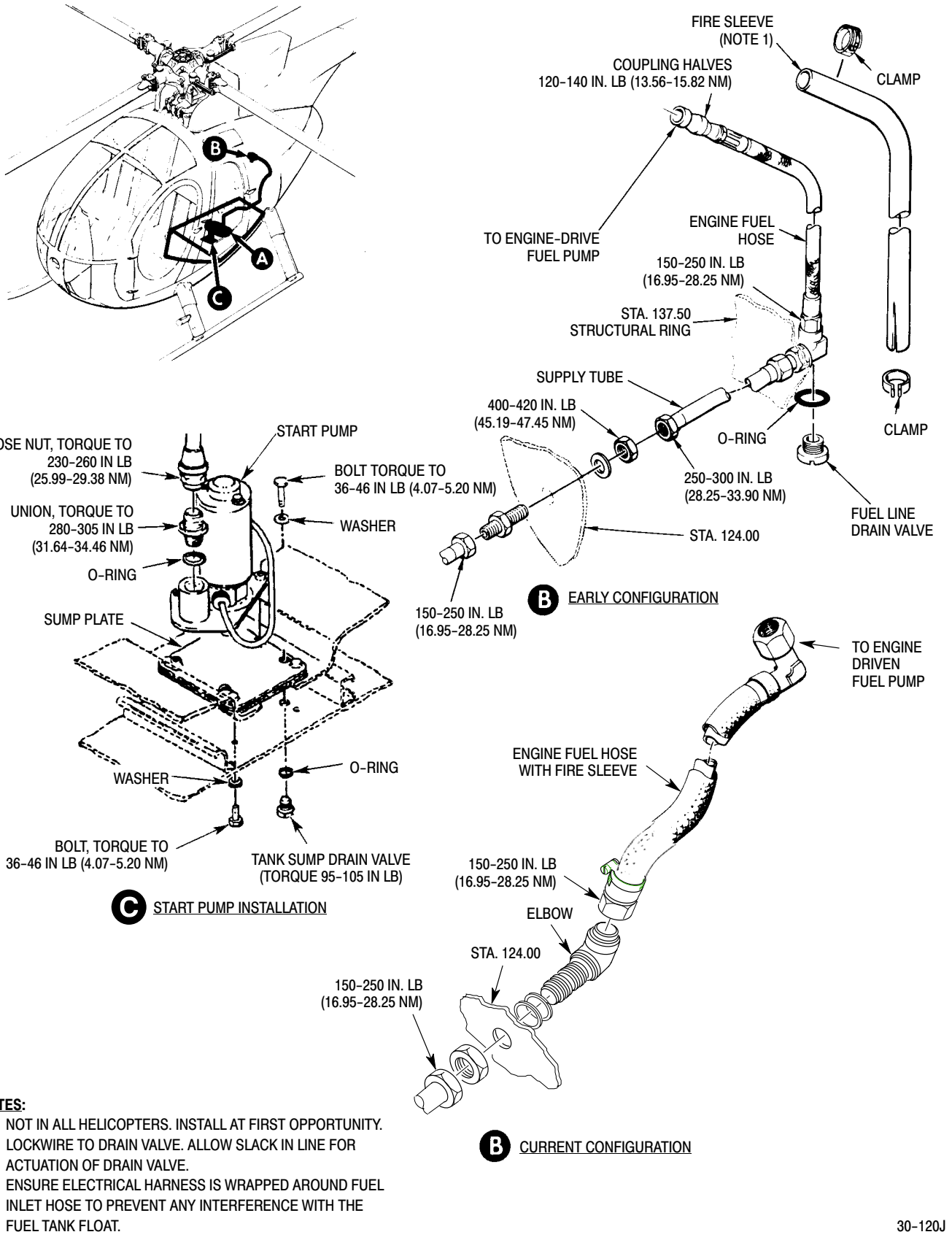
NOTE: On helicopter with optional drain kit installed, drain valve will be located on firewall fitting.

(4). Open drain valve and allow fuel to flow until a steady stream flow uninterrupted without air bubbles. Close drain valve.

(5). Purge air from engine fuel system (Refer to applicable Allison engine operation and maintenance manuals.

(6). Set start pump and master switches to OFF position.

(7). Replace any safety wire removed during this procedure.

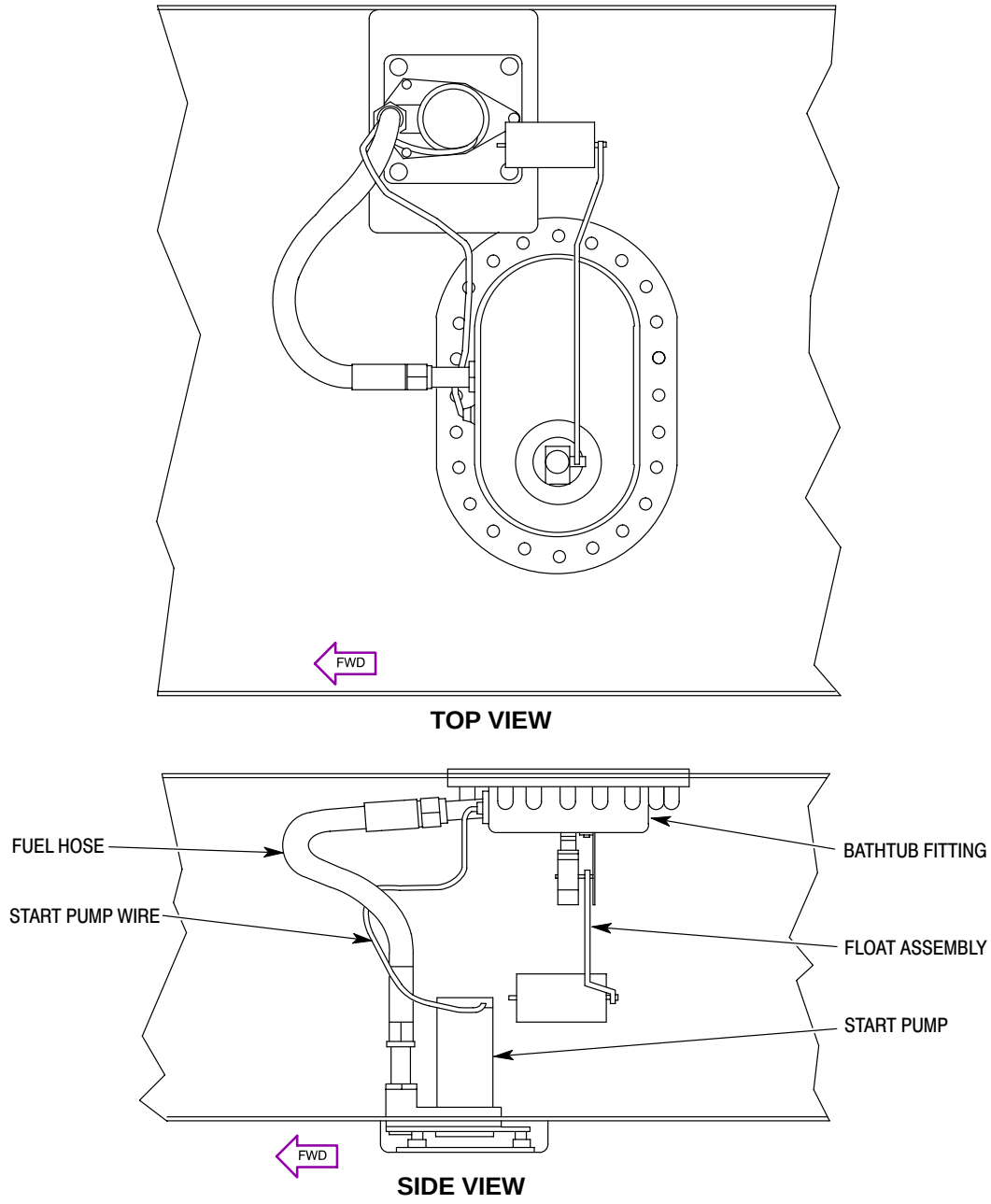


NOTES:

1. NOT IN ALL HELICOPTERS. INSTALL AT FIRST OPPORTUNITY.
2. LOCKWIRE TO DRAIN VALVE. ALLOW SLACK IN LINE FOR ACTUATION OF DRAIN VALVE.
3. ENSURE ELECTRICAL HARNESS IS WRAPPED AROUND FUEL INLET HOSE TO PREVENT ANY INTERFERENCE WITH THE FUEL TANK FLOAT.

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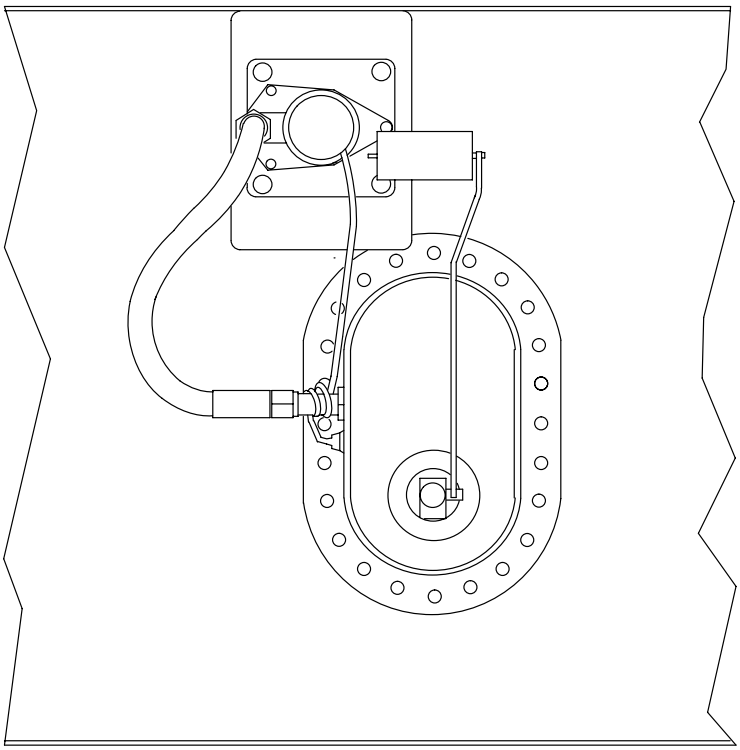
Figure 12-4. Fuel Start Pump Installation (Sheet 1 0f 4)

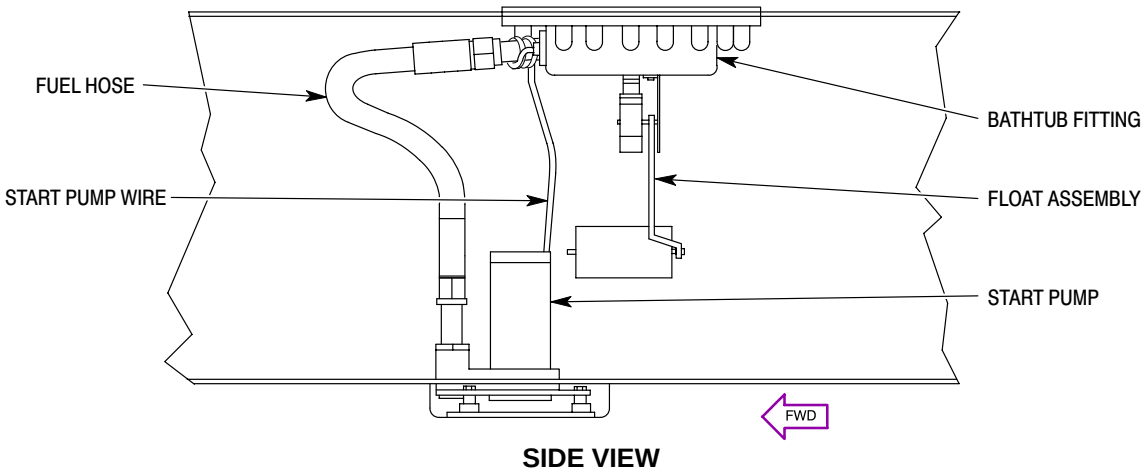


NOTE: WRAP WIRE AROUND FUEL INLET HOSE TO PREVENT INTERFERENCE WITH FLOAT.

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Figure 12-4. Fuel Start Pump Installation (Sheet 2 0f 4)

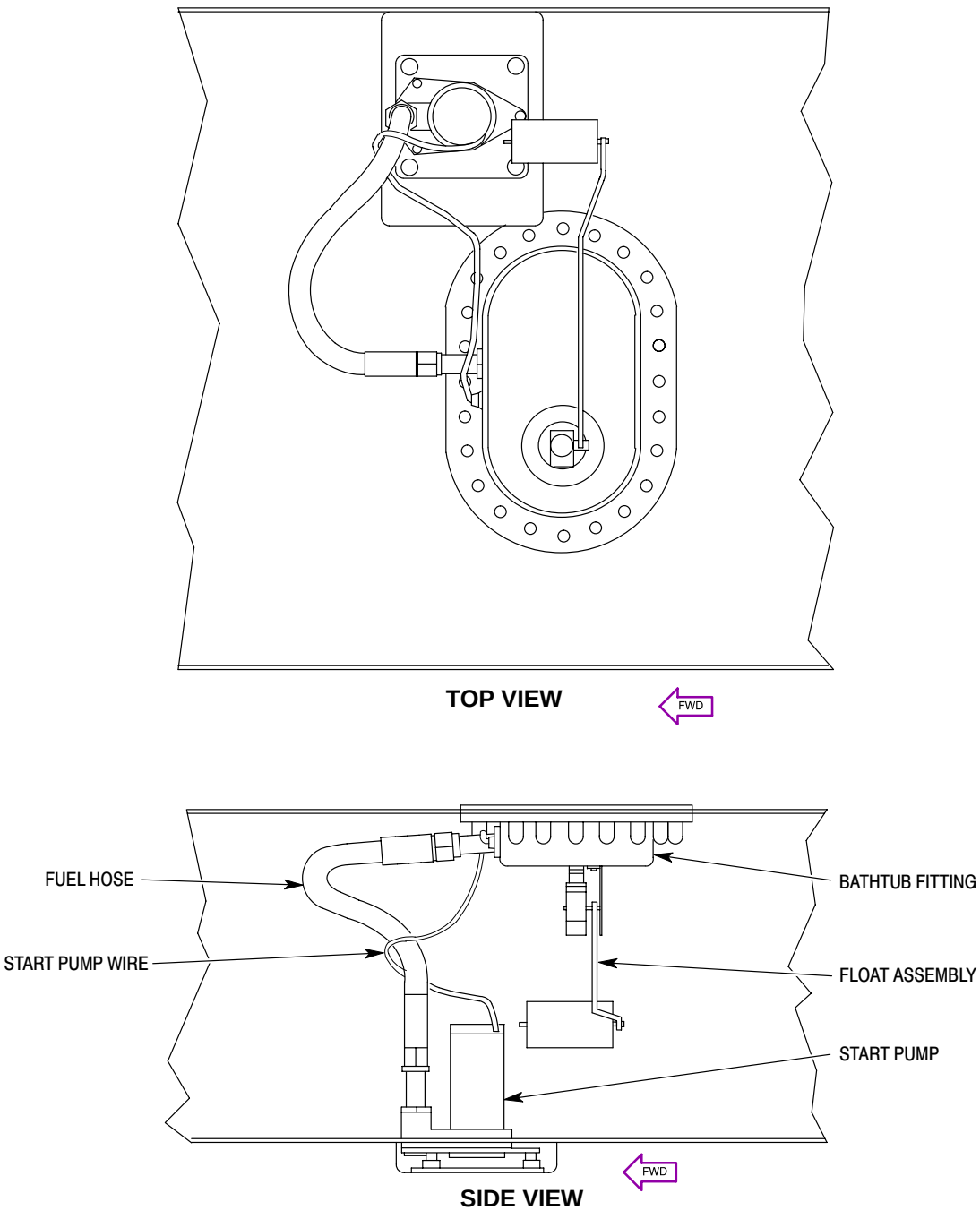




NOTE: WRAP WIRE AROUND FUEL INLET HOSE TO PREVENT INTERFERENCE WITH FLOAT.

G28-0004-3

Figure 12-4. Fuel Start Pump Installation (Sheet 3 0f 4)



NOTE: WRAP WIRE AROUND FUEL INLET HOSE TO PREVENT INTERFERENCE WITH FLOAT.

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Figure 12-4. Fuel Start Pump Installation (Sheet 4 0f 4)

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Section

13

Engine Oil System

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TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 13 Engine Oil System		**13-1**
1.	Engine Oil Supply System	13–1
2.	Troubleshooting the Oil Supply System	13–1
	Table 13–1. Troubleshooting the Oil Supply System	13–1
	Figure 13–1. Engine Oil System Schematic	13–3
3.	Engine Oil Tank	13–4
4.	Engine Oil Tank Replacement	13–4
A.	Engine Oil Tank Removal	13–4
B.	Engine Oil Tank Installation	13–4
5.	Engine Oil Tank Inspection	13–4
6.	Engine Oil Tank Repair	13–4
	Figure 13–2. Engine Oil Tank	13–5
7.	Liquid Level (Sight) Plug Replacement	13–6
8.	Engine Oil Cooler	13–6
9.	Engine Oil Cooler Replacement	13–6
A.	Engine Oil Cooler Removal	13–6
B.	Engine Oil Cooler Installation	13–6
	Figure 13–3. Engine Oil Cooler and Duct	13–7
10.	Oil Cooler Inspection	13–8
11.	Oil Cooler Flushing	13–8
	Figure 13–4. Oil Cooler Cleaning Setup	13–8
12.	Engine Oil Cooler Repair	13–9
13.	Upper Flanges, Oil Cooler Duct and Engine Oil Cooler Assembly Attachment	13–9
	Figure 13–5. Nutplate Installation – Oil Cooler Duct Attachment	13–9
14.	Oil Cooler Duct Assembly	13–9
15.	Oil Cooler Duct Assembly Replacement	13–9
A.	Oil Cooler Duct Assembly Removal	13–9
B.	Oil Cooler Duct Assembly Installation	13–9
16.	Oil Cooler Duct Assembly Inspection	13–9
17.	Oil Cooler Duct Assembly Repair	13–10
18.	Engine Oil Supply System Drain Valve and Check Valve	13–10
19.	Oil Supply System Drain Valve and Check Valve Replacement	13–10
A.	Oil Supply System Drain Valve and Check Valve Removal	13–10
B.	Oil Supply System Drain Valve and Check Valve Installation	13–10
20.	Oil Supply System Drain Valve and Check Valve Inspection	13–10
21.	Oil Supply System Hoses, Fittings and Tubing	13–11
22.	Oil Supply System Hoses, Fittings and Tubing Replacement	13–11

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
A.	Oil Supply System Hoses, Fittings and Tubing Removal	13–11
B.	Oil Supply System Hoses, Fittings and Tubing Installation	13–11
23.	Oil Supply System Hoses, Fittings and Tubing Inspection	13–11

SECTION 13
ENGINE OIL SYSTEM

1. Engine Oil Supply System

(Ref. Figure 13-1) The engine oil system is a circulating dry sump-type system that includes the engine internal lubrication system, oil tank and cooler, oil cooler duct, oil temperature and pressure senders, drain and check valves and associated interconnecting pressure and drain hoses and tubes.

Oil flows from the engine through a check valve at the inlet port of the oil cooler. The circulating oil is cooled to approximately 185°F (85°C) by air blown through the cooler by the cooler blower that is driven by the main transmission drive shaft.

The oil cooler contains a thermostat for bypassing oil around the cooler until the engine oil reaches operating temperature and a pressure relief by-pass valve. Oil then flows from the cooler into the spherical oil tank from which the oil is pumped backed to the engine internal lubrication system.

Section 17 provides information on the engine oil temperature and oil pressure indicating systems.

The Engine Operation and Maintenance Manual provides detailed information and theory of operation for the engine.

Refer to CSP-H-3 for information on optional armor installation engine oil system and an optional engine oil tank and oil cooler drain kit.

2. Troubleshooting the Oil Supply System

(Ref. Table 13-1)

Table 13-1. Troubleshooting the Oil Supply System

Symptom	Probable Trouble	Corrective Action
No oil pressure or low oil pressure	Restriction in oil lines	Inspect, clean, or replace as necessary.
	Oil filter element restricted	Inspect and clean as necessary. (Refer to engine operation and maintenance manual.)
	Defective sender or indicator	Inspect and replace as necessary (Ref. Sec. 17).
	Oil pressure regulator valve improperly adjusted	Adjust as necessary (Ref. Engine Operational and Maintenance Manual).
	Oil supply low	Check oil supply and refill as necessary.
	Contaminated oil	Drain oil system and refill.
Oil pressure drops off severely	Oil supply low	Check oil supply and refill as necessary.
	Defective sender or indicator	Inspect and replace as necessary (Ref. Sec. 17).
	Oil pressure regulator valve sticking or broken spring	Adjust as necessary. Replace valve if spring is broken (Ref. Engine Operation and Maintenance Manual).
	Defective oil pump	Test oil pump (Ref. Engine Operation and Maintenance Manual).

Table 13-1. Troubleshooting the Oil Supply System (Cont.)

Symptom	Probable Trouble	Corrective Action
Excessive oil pressure fluctuation	Defective indicator	Inspect and replace as necessary (Ref. Sec. 17).
	Oil leaks	Inspect oil system hoses and tubes. Replace as necessary.
	Restriction in oil filter or pressure regulator valve	Clean oil filter; adjust pressure regulator valve. Replace valve if pressure cannot be regulated (Ref. Engine Operation and Maintenance Manual).
	Defective oil pump	Replace oil pump (Ref. Engine Overhaul Manual).
High oil pressure	Defective indicator	Inspect and replace as necessary (Ref. Sec. 17).
	Pressure regulator valve improperly adjusted	Adjust as necessary (Ref. Engine Operation and Maintenance Manual).
Abnormal oil temperature indication.	Defective temperature sender or indicator	Inspect and replace as necessary (Ref. Sec. 17).
Oil consumption exceeds 6.50 oz (28.35 g) per hour	Leakage at loose fittings or connections	Inspect and tighten fittings and connections as necessary.
	Restricted vent lines	Inspect and clean as necessary.
	Defective internal engine oil seals	Replace seals or engine.
Chip detector waring light comes on	System lubricant contaminated	Inspect engine chip detector (Ref. Engine Operation and Maintenance Manual).

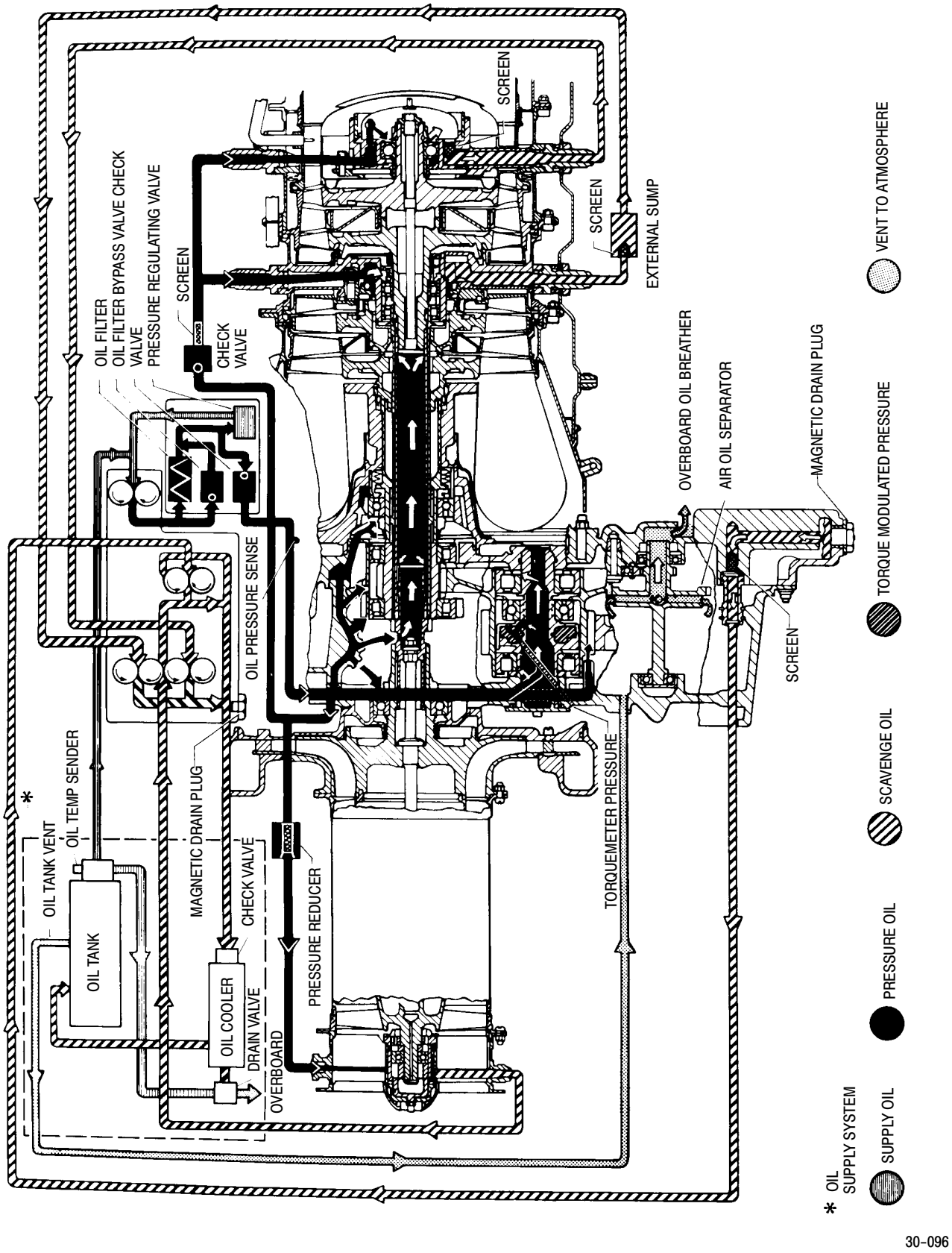


Figure 13-1. Engine Oil System Schematic

3. Engine Oil Tank

(Ref. Figure 13-2) The engine oil tank is constructed of two hemispherical aluminum alloy halves welded together to form a sphere. Welded fittings for the vent tube, inlet line, outlet line, sight plug and mounting support complete the assembly. The replaceable sight plug allows visual reading of the oil level within the tank without use of a dip stick.

4. Engine Oil Tank Replacement

A. Engine Oil Tank Removal

(1). Drain oil system.

(2). Remove oil cooler duct for access to oil tank.

(3). Disconnect oil tank vent hose at oil tank support by loosening clamp securing the fire sleeve and sliding the clamp and fire sleeve back to clear the fitting; cap open end of hose.

(4). Disconnect oil-in hose coupling at oil tank outlet fitting by loosening clamp securing the fire sleeve and sliding the clamp and fire sleeve back to clear fitting; allow hose to drain; then cap open end of hose.

(5). Disconnect oil cooler tank return hose at oil tank fitting; allow tube to drain; then cap open end of fitting.

(6). Disconnect tank drain tube at oil tank fitting; allow tube to drain; then cap open end of fitting.

(7). Remove oil tank filler seal clamp. Remove four nuts, washers and screws; then cap retaining plate and the filler seal.

(8). Remove four bolts and washers that mount tank and remove the tank.

(9). Remove sight plug and O-ring when tank repair is necessary or the plug becomes defective.

(10). Remove engine oil temperature sender when tank repair is necessary or if the sender becomes defective (Ref. Sec. 17).

B. Engine Oil Tank Installation

(1). Install new packings and drain tube union.

(2). Install replacement sight plug.

(3). Position oil tank and align nutplate holes with holes in mounting bracket secure with four bolts and washers.

(4). Install oil tank filler seal and retaining plate. Check that oil tank filler seal neck is properly mated over oil tank filler neck and secure with four screws, washers, and nuts. Install oil tank filler seal clamp.

(5). Connect drain tube (tank) to oil tank fitting and tighten.

(6). Connect oil cooler tank return hose to oil tank fitting and tighten.

NOTE: After installing engine oil-in hose coupling and engine oil tank vent hose, steps (7). and (8)., pull fire sleeves into position and tighten clamps.

(7). Install new O-ring, connect oil-in hose coupling to oil tank fitting and tighten.

(8). Install new O-ring, connect engine oil tank vent hose to fitting on oil tank support and tighten.

(9). Install oil cooler duct.

5. Engine Oil Tank Inspection

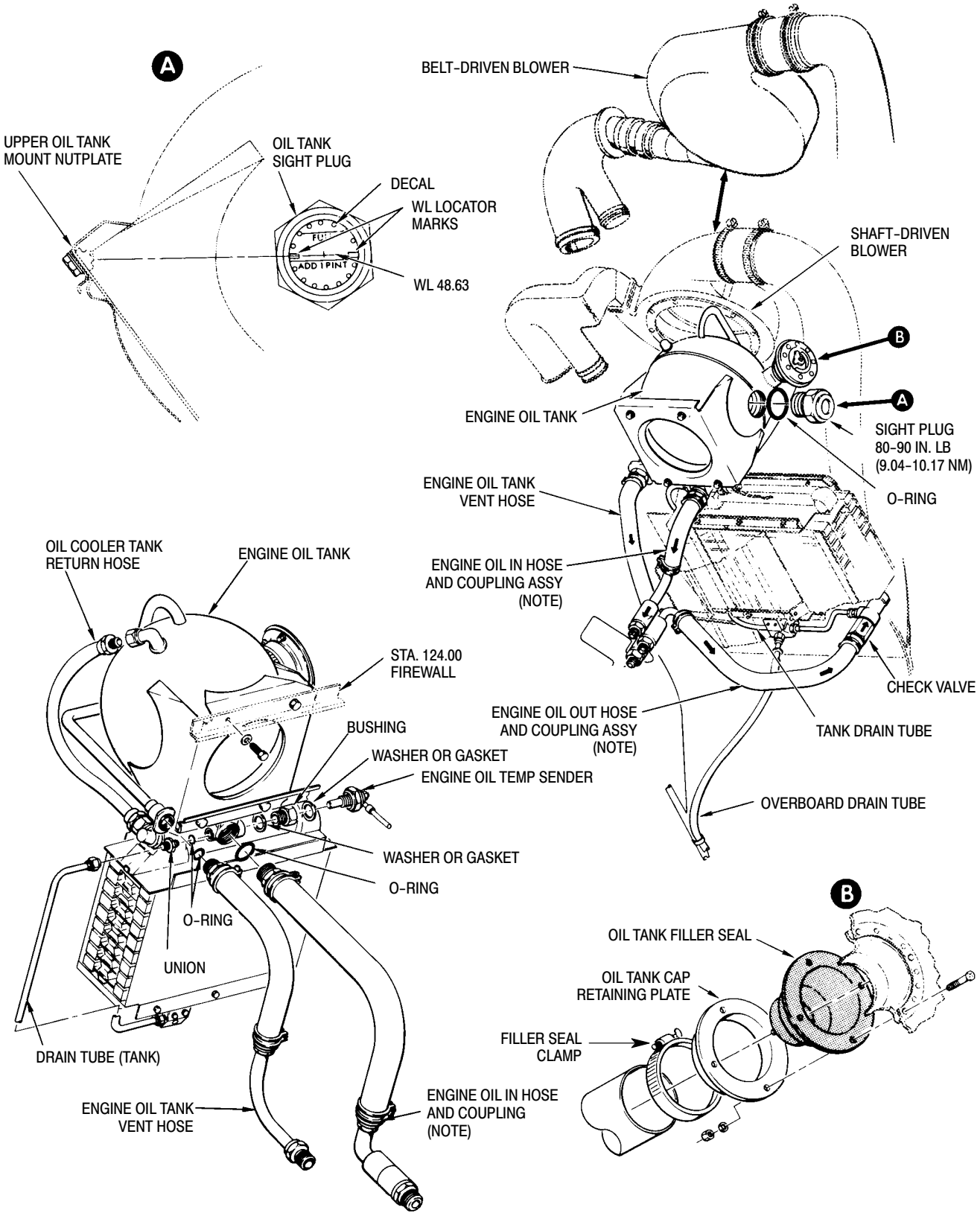
Inspect engine oil tank assembly for cracks, corrosion distortion, obvious damage, leaks and security. Inspect all associated hoses, lines and fittings for oil leaks and security.

6. Engine Oil Tank Repair

(1). Weld all cracks, loose fittings, open seams, and tubes with acetylene (76, Table 2-4), oxygen (77), and welding rod (85). Replace a damaged tank when repair is impractical or excessive.

(2). Remove or smooth scratches and nicks by sanding and touch up the surface with chemical film (8).

(3). Replace a damaged sight plug.



NOTE: SELF-CLOSING COUPLING NOT INSTALLED ON ALL HELICOPTERS.

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Figure 13-2. Engine Oil Tank

7. Liquid Level (Sight) Plug Replacement

(1). Remove lockwire from sight plug.

(2). Remove sight plug by unscrewing counterclockwise.

(3). Remove and inspect O-ring. Install new O-ring if required, on sight plug.

NOTE: When a new sight plug is being installed the liquid level decal is applied after the plug is installed and torqued.

(4). Coat threads of replacement sight plug with lubricating oil (3, Table 2-3) and place new O-ring on sight plug. Torque sight plug to **80 - 90 inch-pounds (9.04 - 10.17 Nm)**. Secure with 0.032 inch (0.8128 mm) lockwire (2).

(5). Project a line from the oil tank upper mounting nutplate center across the center of the sight plug and pencil mark as shown in Figure 13-2, detail A. Position decal WL locator marks to match pencil marks and install decal.

8. Engine Oil Cooler

(Ref. Figure 13-3) The engine oil cooler is a radiator-type heat exchanger that is constructed of aluminum alloy tubes welded to an aluminum frame.

Engine outlet oil enters the cooler through an inlet fitting at the lower right corner, circulates through the tubes, and exits through an outlet fitting at the upper left corner of the cooler.

The pressure relief bypass valve opens at 25-30 psi (172-207 kPa); the thermostat valve closes at +140°-180 °F (60°-82 °C).

9. Engine Oil Cooler Replacement

A. Engine Oil Cooler Removal

NOTE: Oil cooler removal requires two people.

(1). Drain oil system.

(2). Disconnect oil cooler tank return hose from cooler fitting and allow to drain into a suitable container. Cap open end of the oil cooler tank return hose and the cooler port.

(3). Remove oil cooler duct assembly.

(4). Remove cooler drain tube. union, and O-ring. Cap the cooler port.

CAUTION Have an assistant hold pressure with a wrench across flats of the oil cooler inlet fitting during removal of the engine oil- out hose and/or check valve, steps (5). and (6)., to prevent deformation of the fitting or cooler frame.

(5). Disconnect engine oil-out hose from check valve.

(6). Remove check valve and O-ring. Install protective caps on oil line and in oil cooler boss.

(7). Remove screws and washers attaching deflector to mounting flange: remove deflector.

(8). Remove six bolts, washers, and nuts attaching oil cooler to structure; remove cooler.

(9). Cut lockwire and remove shields from oil cooler, if installed.

B. Engine Oil Cooler Installation

(1). Position shields on sides of oil cooler so that missing tab on outboard shield is adjacent to oil in fitting. Tie shields in place with lockwire completely around front and rear sides of cooler.

(2). Position oil cooler on the firewall. Install union with a new O-ring and install cooler drain tube.

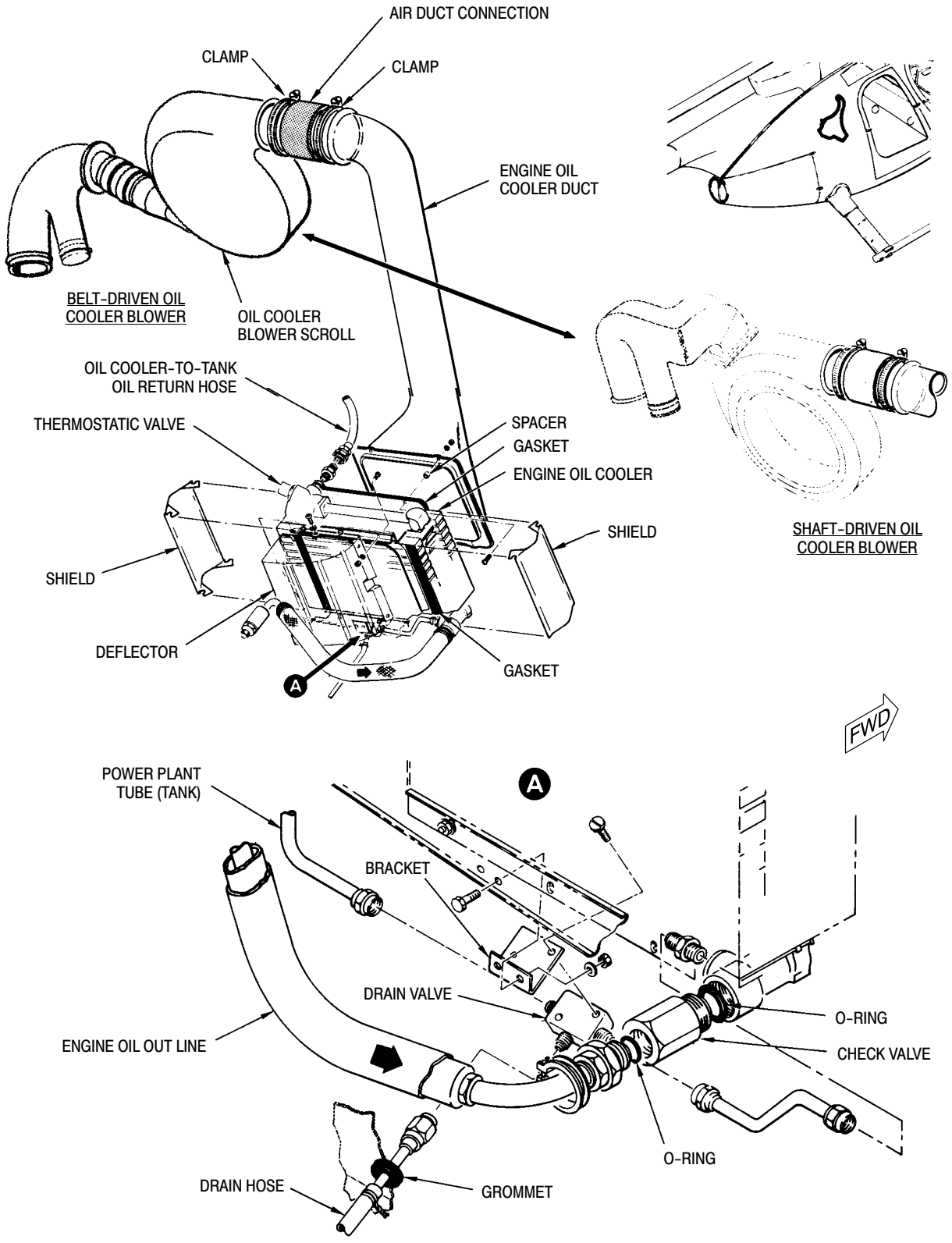
(3). Install six bolts, washers and nuts to attach cooler to firewall.

(4). Coat threads of check valve with lubricating oil (3, Table 2-3).

CAUTION Have an assistant hold pressure on a wrench across flats of the oil cooler inlet fitting during tightening of the check valve and/or engine oil-out hose, steps (5). and (6)., to prevent deformation of the fitting or cooler frame.

(5). Install check valve with a new O-ring.

(6). Install engine oil-out line with a new O-ring.



30-095C

Figure 13-3. Engine Oil Cooler and Duct

(7). Install plastic deflector using screws and washers.

(8). Install tank return hose.

(9). Install oil cooler duct (para 13-23).

(10). Fill oil tank with lubricating oil.

(11). Start and operate engine according to the Owner's Manual. Inspect oil cooler and related parts for oil leaks.

10. Oil Cooler Inspection

Inspect engine oil cooler for cracks, corrosion, damaged or bulged plates, broken welds, foreign matter clogging, oil leaks, and security. Inspect all associated hoses and fittings for oil leaks and security.

11. Oil Cooler Flushing

(Ref. Figure 13-4)

(1). Remove thermostatic valve and plug all openings in engine oil cooler.

(2). Clean exterior of engine oil cooler with steam.

CAUTION Use only recommended cleaning solutions or one that is satisfactory for use on aluminum. Many solutions satisfactory for cleaning copper or copper nickel are highly corrosive to aluminum and. if used, will result in the destruction of the oil cooler assembly. If equipment has been previously used with any other cleaning solutions, it should be thoroughly washed out and flushed with the recommended solution.

(3). Establish flushing setup as shown in Figure 13-4. Use solvent (1, Table 2-4) to clean oil cooler interior.

(4). Connect hose from discharge side of pump to oil cooler outlet to provide a cleaning solution flow opposite to direction of normal flow.

(5). Connect hose from storage tank to inlet port of oil cooler.

(6). Start centrifugal pump and allow to flush for 30 minutes or until the cleaning solution appears clean after flowing through oil cooler.

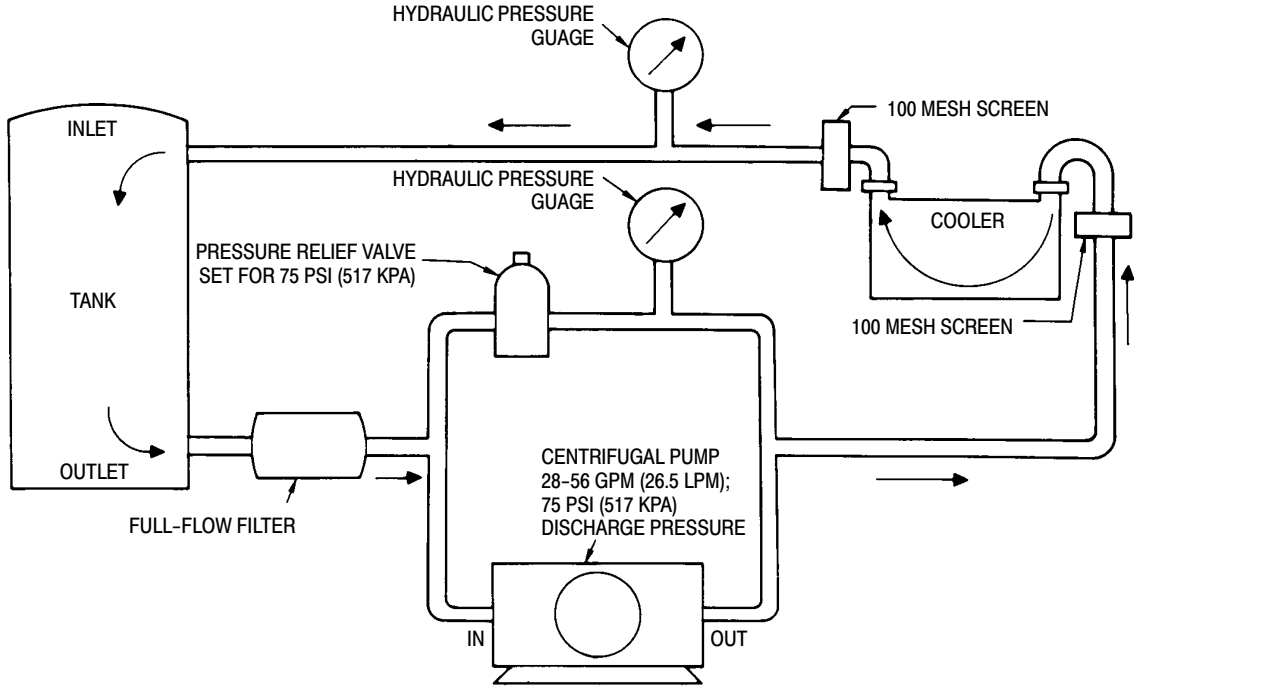


Figure 13-4. Oil Cooler Cleaning Setup

NOTE: After each flushing operation, (7). thru (11)., examine the 100 mesh screens for metal or other foreign particles. If metal particles are found, clean screens with solvent and dry with clean, filtered compressed air.

(7). Drain oil cooler.

(8). Flush oil cooler with compound (75) in reverse direction for 30 minutes.

(9). Reverse hoses and flush engine oil cooler for 10 to 15 minutes in normal oil flow direction.

(10). To rinse, flush engine oil cooler with solvent for 10 minutes.

(11). Check filter screens for metal particles. Discard oil cooler if metal particles still appear in filter screens.

12. Engine Oil Cooler Repair

(1). Replace a defective thermostatic valve.

(2). Straighten bent cooling fins with a pair of duckbill pliers ground to fit between cooling tubes.

(3). Weld all small holes, cracked seams, or loose fittings with welding rod (85, Table 2-4).

(4). Smooth scratches and nicks by sanding, and touch up the surface with chemical film (8).

13. Upper Flanges, Oil Cooler Duct and Engine Oil Cooler Assembly Attachment

A nutplate installation to facilitate field maintenance is accomplished as follows:

(1). Disconnect oil cooler duct from engine oil cooler assembly. Discard existing two nuts and 369A8304-13 spacers used at upper flanges of duct and oil cooler.

CAUTION Overtorquing bolts can crack duct flange; tighten bolts only to point of firm contact and security.

(2). Reconnect duct to engine oil cooler with existing hardware, except install front ferrules and clip-type nutplates to secure top two bolts as shown in Figure 13-5.

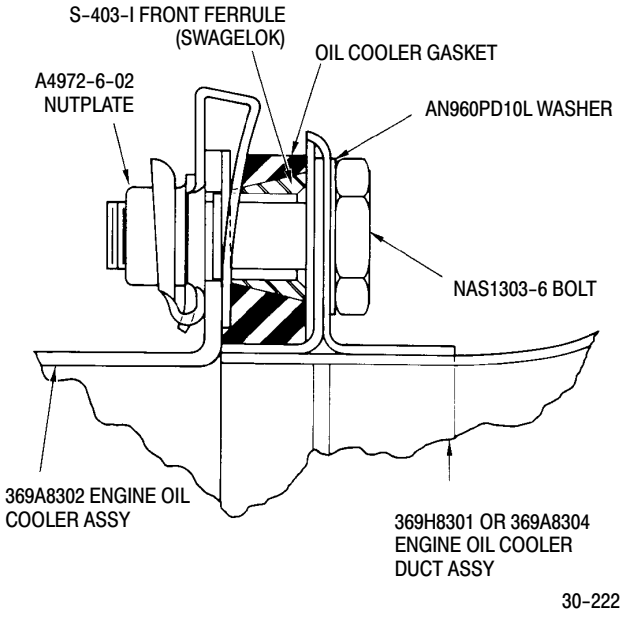


Figure 13-5. Nutplate Installation - Oil Cooler Duct Attachment

14. Oil Cooler Duct Assembly

(Ref. Figure 13-3) The engine oil cooler duct is a plastic assembly that directs cooling air from the oil cooler blower to the engine oil cooler.

15. Oil Cooler Duct Assembly Replacement

A. Oil Cooler Duct Assembly Removal

(1). Remove two clamps and air duct connector.

(2). Remove four bolts, spacers, washers, and nuts; remove engine oil cooler duct assembly. Use care to retain spacers for reinstallation of duct.

B. Oil Cooler Duct Assembly Installation

(1). Position oil cooler duct. Install spacer at each attaching bolt location.

CAUTION Overtightening bolts can crack the duct flange. Tighten nuts only to the point of firm contact.

(2). Install four bolts, washers, and nuts.

(3). Install air duct connector and clamps.

16. Oil Cooler Duct Assembly Inspection

Inspect oil cooler duct assembly for cracks, foreign matter clogging, security and other signs of damage.

17. Oil Cooler Duct Assembly Repair

(1). Repair polycarbonate duct assembly body cracks by bonding a patch according to the criteria and methods specified for acrylic plastic in FAA AC 43.13-1, Aircraft Inspection and Repair. Use dichloromethane (38, Table 2-4) or ethylene dichloride (39) as the bonding agent.

(2). Repair small areas of seam separation by injecting ethylene dichloride into the void area and clamping together under light pressure.

18. Engine Oil Supply System Drain Valve and Check Valve

(Ref. Figure 13-3) The oil supply system drain valve is a three port plug-type valve mounted on a bracket beneath the oil cooler.

Three oil tubes are connected to the drain valve; one from the oil tank, one from the oil cooler, and the third providers an overboard drain. The drain valve is spring-loaded in the close position. When the valve is opened, all ports are closed.

The oil system check valve is a one-way, ball type valve mounted at the inlet fitting of the oil cooler. The check valve functions to prevent hot oil from flowing back into the engine when the engine is not operating.

19. Oil Supply System Drain Valve and Check Valve Replacement

A. Oil Supply System Drain Valve and Check Valve Removal

(1). Drain oil system.

CAUTION Have an assistant hold pressure on a wrench across the flats of the oil cooler inlet fitting during removal of the engine oil-out hose and/or check valve to prevent deformation of the fitting or cooler frame.

(2). Disconnect engine oil-out hose coupling and allow to drain.

(3). Remove check valve and O-ring.

(4). Plug opening at inlet fitting of oil cooler and cap open end of engine oil-out hose coupling.

(5). Disconnect tube assemblies at drain valve, and cap open ends of tubes.

(6). Remove two bolts, and the valve mounting bracket.

(7). Cut lockwire and remove the two screws that attach drain valve to bracket.

B. Oil Supply System Drain Valve and Check Valve Installation

(1). Install new O-ring in oil cooler inlet fitting.

CAUTION Have an assistant hold pressure on a wrench across the flats of the oil cooler inlet fitting during installation of the engine oil-out hose and/or check valve to prevent deformation of the fitting or cooler frame.

(2). Coat threads of check valve with lubricating oil (3, Table 2-3), install check valve and tighten to secure.

(3). Install new O-ring in inlet port of check valve.

(4). Connect engine oil-out hose coupling to inlet port of check valve and tighten to secure.

(5). Install the drain valve on mounting bracket and safety with lockwire (2, Table 2-4).

(6). Install bracket on oil cooler flange.

(7). Install bracket on oil cooler flange. Connect tube assemblies to drain valve, and tighten to secure.

(8). Start and operate engine according to the Owner's Manual. Check oil supply system check valve, drain valve, and associated plumbing for oil leaks.

20. Oil Supply System Drain Valve and Check Valve Inspection

Inspect the oil system drain valve and check valve for cracks, corrosion, security, and leaks. Check connected hoses and tubing for leakage at connections.

21. Oil Supply System Hoses, Fittings and Tubing

(Ref. Figure 13-2 and Figure 13-3) The hoses and tubing used in the oil supply system are lightweight assemblies incorporating permanent fittings. The hoses located near the engine are provided with fire shields.

22. Oil Supply System Hoses, Fittings and Tubing Replacement

A. Oil Supply System Hoses, Fittings and Tubing Removal

When removing an oil supply system hose or tube that is connected to lower end of oil cooler or oil tank, drain the oil from the cooler or tank before disconnecting the hose or tube. Tagging or otherwise identifying fittings, tubing and hardware will facilitate reassembly.

(1). Disconnect lower end of oil line. Drain residual oil from line into suitable container.

(2). Disconnect upper end of oil line and remove line.

(3). Cap oil lines and all open lines to prevent entry of foreign matter.

B. Oil Supply System Hoses, Fittings and Tubing Installation

(1). Remove caps or plugs from fittings, oil hoses and tubes. Apply lubricating oil (3, Table 2-3) to all fittings.

(2). Install lower end of oil line but do not tighten.

(3). Install upper end of oil line.

NOTE: During tightening, rotate coupling nut of hose or tubing with one wrench while holding the fitting to which it is being attached securely with another wrench. This procedure will prevent twisting and possible deformation of the hose or tubing.

(4). Torque nuts of 1/4 inch tubes to **80 - 100 inch-pounds (9.04 - 11.30 Nm)** and nuts on 5/16 inch tubes to **150 - 200 inch-pounds (16.95 - 22.60 Nm)**.

23. Oil Supply System Hoses, Fittings and Tubing Inspection

(1). Inspect oil lines for kinks, uniformity of diameter, breaks, and freedom from interference with adjoining structure or other components.

(2). Replace defective oil lines. Inspect and reject oil tubes for the following:

(a). Kinks or dents which could obstruct oil flow. Dents are allowable up to 0.015 inch (0.381 mm) deep.

(b). Cracked or broken tubes or coupling nuts.

(c). Cross-threaded, crushed, or otherwise damaged coupling nuts.

(d). Chafing within clamp areas in excess of 0.010 inch (0.254 mm). No chafing is allowed at or near the flared tubing end.

(e). Nicks are allowable up to 0.010 inch (0.254 mm) deep.

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Section

14

Engine Ignition System

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TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 14 Engine ignition System		**14–1**
1.	Engine Ignition Control System	14–1
2.	Troubleshooting the Ignition System	14–1
	Table 14–1. Troubleshooting Ignition System	14–1

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page

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SECTION 14
ENGINE IGNITION SYSTEM

1. Engine Ignition Control System

The engine starter–ignition switch is a push–button switch located on the pilot's collective stick. The switch is marked START and is spring–load to the OFF position.

Once the keyswitch is turned on, depressing the start switch energizes both the start relay and ignition exciter, and causes the generator field circuit in the voltage regulator to open so that the starter will operate as a series motor.

Electrical power to the keyswitch, starter and ignition system is controlled by the main power selector switch on the instrument panel.

Refer to Section 19 when keyswitch or start switch replacement is necessary.

Current configuration helicopters are equipped with start circuitry protection. A dedicated START circuit breaker (optional equipment) can be installed on earlier model helicopters. Refer to Section 20 for information on engine ignition control system wiring.

Electrical power to the key switch is controlled by the main power switch (master switch).

The engine operation and maintenance manual provides detailed information for maintenance of the ignition system.

Refer to CSP–H–3 for information on optional engine automatic reignition equipment.

2. Troubleshooting the Ignition System

(Ref. Table 14–1)

Table 14-1. Troubleshooting Ignition System

Symptom	Probable Trouble	Corrective Action
WARNING: Before removing or installing components of the electrical system, check that all electrical power is OFF. If units are not immediately replaced, ensure that all electrical connector are suitably capped and stowed and all loose cable ends are properly insulated and stowed to prevent the possibility of shorting. Serious injury or death could result from voltages present in the electrical system.		
Engine fails to ignite (Starter operation normal)	Preservative oil fouling spark igniter	Try a second start.
	Faulty circuit to ignition unit	Listen for ignition operation. Check for fuel from vapor exhaust.
		Check input power to ignition unit. Isolate and replace defective part.
	Faulty igniter exciter	Listen for ignition operation. Check for fuel vapor from exhaust. Replace with serviceable unit (Ref. Engine Operation and Maintenance Manual).

Table 14-1. Troubleshooting Ignition System (Cont.)

Symptom	Probable Trouble	Corrective Action
	Faulty spark igniter	Listen for igniter operation. Check for fuel vapor from exhaust. Replace with serviceable unit (Ref. Engine Operation and Maintenance Manual).
	Spark igniter firing intermittently	Check input voltage to exciter. Check ignition exciter by temporarily replacing with serviceable unit (Ref. Engine Operation and Maintenance Manual).
Starter-generator fails to function with START switch pressed	Key switch, start switch or interconnecting wiring defective	Replace defective switch or repair defective wiring (Ref. Sec. 19).
	Battery voltage low	Start with APU or charge battery (Ref. Sec. 2).
	Start relay defective	Replace relay.
	Voltage regulator defective	Replace regulator.
	Circuit breaker out	Replace circuit breaker (If installed).

Section

15

Engine Exhaust System

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TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 15 Engine Exhaust System		**15-1**
1.	Exhaust System	15–1
2.	Tailpipe Assembly Replacement	15–1
A.	Tailpipe Assembly Removal	15–1
B.	Tailpipe Assembly Installation	15–1
3.	Tailpipe Assembly Inspection	15–2
4.	Tailpipe Assembly Repair	15–2
Figure 15–1.	Exhaust System	15–3

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page

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SECTION 15
ENGINE EXHAUST SYSTEM

1. Exhaust System

(Ref. Figure 15-1) The exhaust system consists of two engine tailpipes attached to the engine exhaust collector outlets by two engine-to tailpipe clamps and supported at the airframe exhaust outlet by a cushioned hanger assembly. The hanger assembly is suspended from an attach fitting located above the tailpipes. The upper and lower hangers are spring-loaded together. The inconel wire mesh cushions and the adjoining spring provide a flexible coupling between the aft ends of the tailpipes and the supporting structure.

2. Tailpipe Assembly Replacement

(Ref. Figure 15-1)

A. Tailpipe Assembly Removal

(1). Remove right side thermocouple hardware if installed; then remove tailpipe clamp nuts and clamps.

(2). Remove cotter pin, nut, washers and bolt attaching tailpipe hanger to structure fitting,

CAUTION Whenever tailpipes are removed, cover the engine exhaust ports with barrier material (44, Table 2-4) or other suitable material into the engine power turbine section.

(3). Remove the two tailpipes as an assembly.

(4). Remove spring and hangers; then separate the tailpipes.

B. Tailpipe Assembly Installation

(1). Remove the protective covers from the engine exhaust ports.

CAUTION During steps (2). thru (5)., an assistant must support the aft ends of the exhaust tailpipes while the tailpipes are being secured in place. Do not allow the aft ends of the tailpipes to become displaced from their proper mounting locations; to do so may damage the forward mounting flanges or result in a poorly mated clamp joint. When assembling the tailpipe and hanger assemblies, take care not to tear or otherwise damage the inconel pads that serve as cushions between the hangers and tailpipes.

(2). Position the forward end of each tailpipe over its respective engine exhaust outlet opening and install the two clamps. Position the clamp joints at the upper surfaces of the tailpipes and partially tighten the clamp; final tightening will be accomplished later.

(3). Taking care not to displace the ends of the tail pipes, install the two hanger assemblies as shown in Figure 15-1. Make certain that the hanger assembly saddles are properly positioned between the locating flanges at the aft ends of the tailpipes.

(4). Secure the tailpipes and hanger assemblies together by installing the spring over the rivets connecting each pair of hanger clips. Attach the upper spring hook so that the four captive washers on the rivet are divided equally on either side of the spring hook (two washers separating the hook from each hanger clip), Attach the lower spring hook between the left side of the lower hanger support link and the adjacent clip,

(5). Attach the vertical link of the lower hanger assembly to the support fitting on the structure with a bolt, two washers and nut (all CRES hardware). Tighten the nut only finger-tight at this time.

(6). Torque the two engine-to-tailpipe clamp nuts to **15 - 18 inch-pounds (1.69 - 2.03 Nm)**. On helicopters with a

250-C20 engine installed, install thermocouple wire support on right tailpipe clamp and secure with nut and washer as shown in Figure 15-1.

(7). Using a plastic or rawhide mallet, tap lightly around the outer circumference of both clamps to ensure that they are properly seated; then re-torque the clamp nuts.

(8). Torque the support fitting bolt and nut to **12 - 15 inch-pounds (1.36 - 1.69 Nm)** and safety with a cotter pin.

3. Tailpipe Assembly Inspection

(1). Inspect for cracks and broken weld seams.

(2). Inspect for dents and bends.

(3). Inspect inconel wire pads or cushion assemblies on hanger assemblies for wear, tears and for spotweld security.

4. Tailpipe Assembly Repair

(1). Repair dents and bends using a form block and suitable mallet.

NOTE: Either inconel wire pads welded to the hanger assembly or replaceable wire cushion assemblies may be installed on the exhaust system. If so desired, the welded wire pads may be replaced with PN 369H8202 cushion assemblies after the welded pad is removed and the hanger is cleaned up.

(2). Replace hanger assembly inconel wire pads or cushions as follows:

(a). Remove damaged pad by tearing off inconel wire pad or by bending five tabs to release each cushion assembly.

(b). If a welded pad has been installed, use a hand file and carefully grind spot welds and residue of pad from hanger.

(c). Install replacement cushion assembly by positioning on the hanger and then bending the five tabs as shown in Figure 15-1.

(d). Install the replacement wire pad by resistance welding (poke weld) the edges of the pad (inconel wire, Tadpole-type, Johns-Manville PN 2069 Rev. 2) to the hanger. The weld spots should be approximately 0.250 inch (6.35 mm) apart.

(3). Repair cracks and breaks in the tailpipes (CRES material No. 21-6-9) as follows:

(a). Using a stainless steel brush, thoroughly clean at least 1 inch (2.54 cm) on all sides of the cracked area. The cleaning should remove all carbon from both inner and outer surfaces and from the crack itself.

(b). Weld, using the inert arc method, with rod (78, Table 2-4). Shield the back side of the weld with inert gas or a suitable stainless steel flux.

(c). Repair single cracks less than 2 inches (5.08 cm) in length by stop-drilling a 0.040 inch (1.016 mm) diameter hole at the termination of the crack. This method of repair does not apply to intersecting racks that form an acute angle leaving an unsupported section.

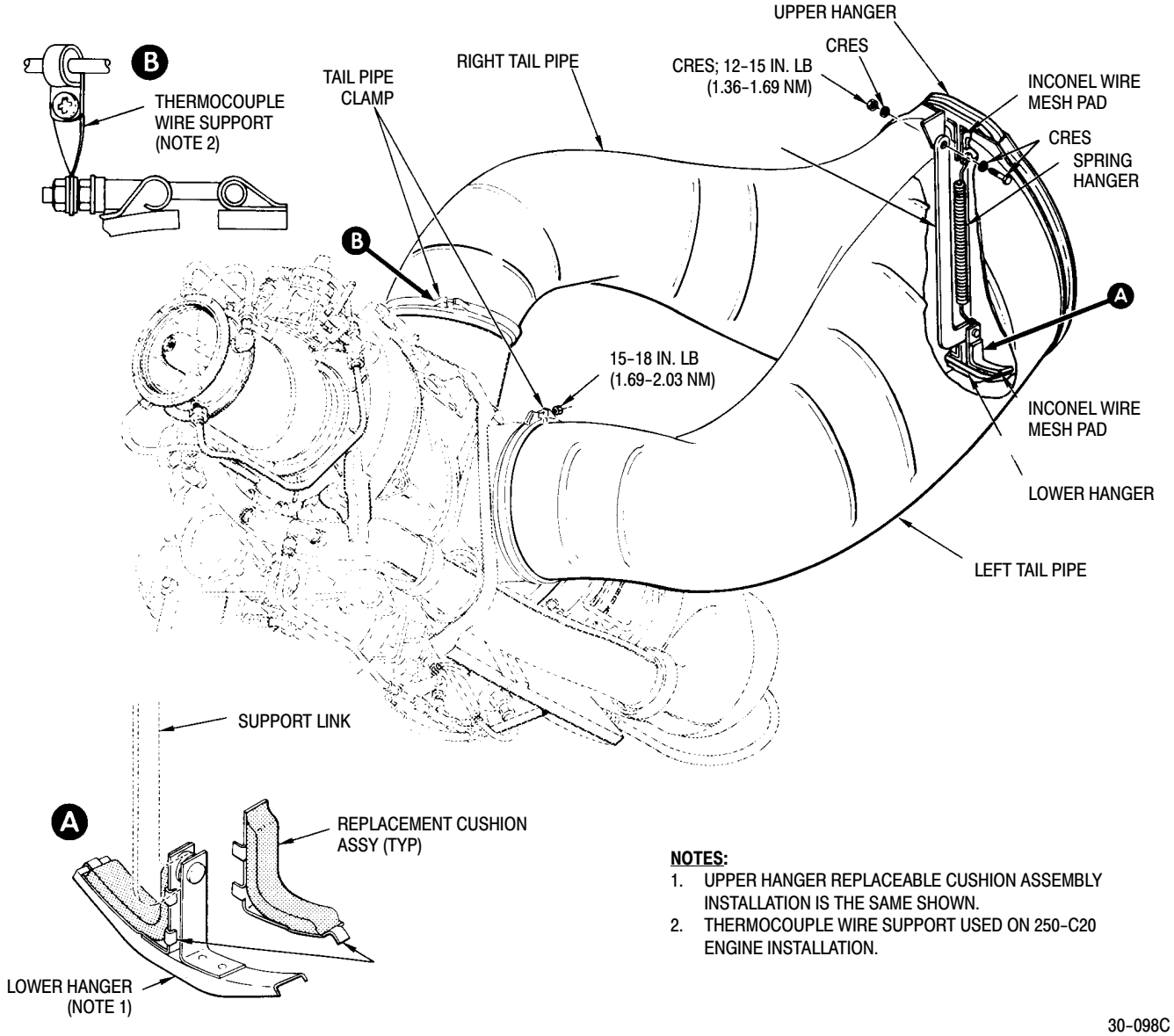


Figure 15-1. Exhaust System

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Section

16

Engine Air Induction System

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TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 16 Engine Air Induction System		**16-1**
1.	Engine Air Induction System	16–1
2.	Engine Air Induction System Inspection	16–1
3.	Engine Air Inlet Screen	16–1
4.	Engine Air Inlet Screen Replacement	16–1
A.	Engine Air Inlet Screen Removal	16–1
Figure 16–1.	Air Induction System (Without Air Inlet Screen)	16–2
Figure 16–2.	Air Inlet Screen Installation	16–3
B.	Engine Air Inlet Screen Installation	16–4
5.	Engine Air Inlet Screen Inspection	16–4
6.	Engine Air Shield Screen Assembly	16–4
7.	Engine Air Shield Screen Assembly Replacement	16–4
8.	Engine Air Shield Screen Assembly Inspection	16–4
9.	Engine Air Inlet Bell, Engine–to–Firewall Seal Ring and Engine Air Inlet–to–Firewall Seal	16–4
10.	Engine Air Inlet Bell and Engine–to– Firewall Seal Ring Replacement	16–5
A.	Engine Air Inlet Bell and Engine–to– Firewall Seal Ring Repair	16–5
B.	Engine Air Inlet–to–Firewall Seal Replacement	16–5
11.	Air Induction System Drains	16–5
12.	Air Induction System Drain Tubing Replacement	16–5
Figure 16–3.	Air Induction System Drain Installations	16–6

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page

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SECTION 16
ENGINE AIR INDUCTION SYSTEM

1. Engine Air Induction System

(Ref. Figure 16-1) The basic air induction system consists of an engine air inlet installation (plenum chamber), engine air shield screen, engine air inlet bell, engine-to-firewall seal ring, and engine air inlet-to-firewall seal.

(Ref. Figure 16-2) The current type engine air induction system includes an air inlet screen vertically mounted in the forward position of the aft fairing.

The screen provides filtration of air flowing into the engine air intake and protects against foreign object entry. The upper portion of the air inlet screen ends approximately 1-1/2 inches from the top of the aft fairing to provide a bypass air area.

Air enters the engine air inlet fairings which are part of the airframe. Air flows from the inlet fairings to the plenum chamber above the engine air inlet bell, through the engine air shield screen (when used) above the inlet bell and to the compressor inlet.

Air loss from the inlet chamber is prevented by the engine-to-firewall seal ring that is spring-loaded against the engine side of the firewall.

Refer to Section 10 for engine drive shaft firewall seal information.

Refer to CSP-H-3 for maintenance instructions.

2. Engine Air Induction System Inspection

(Ref. Figure 16-1 or Figure 16-2)

(1). On helicopters equipped with the air inlet vertical screen, inspect for security of attachment, deformation, and screen damage. Check that screen area is not clogged. Inspect boot(s) on station 100 tail rotor control rod for condition and security of attachment.

(2). On helicopter equipped with plenum chamber engine air shield screen, inspect unit for security of attachment, cracks, breaks and screen damage.

(3). Inspect engine inlet bell for cracks breaks or other damage.

(4). Inspect engine-to-firewall seal ring for weak springs, cracks, corrosion or damage that prevents complete sealing of the firewall. Repair or replace a damaged ring.

(5). Inspect engine air inlet-to=firewall seal for conditions that prevent complete contact of the seal ring, Replace a damaged seal.

(6). On current type system with plenum chamber drain tubing, check that tubing is not deformed, corroded or clogged.

3. Engine Air Inlet Screen

The engine air inlet screen assembly is shaped to fit the inlet area of the aft fairing. The screen assembly is constructed of a polycarbonate material bonded to an aluminum alloy frame. The filter screen is arranged in a saw-tooth pattern to provide maximum filtering capacity.

4. Engine Air Inlet Screen Replacement

(Ref. Figure 16-2)

A. Engine Air Inlet Screen Removal

(1). Remove engine air inlet forward fairings.

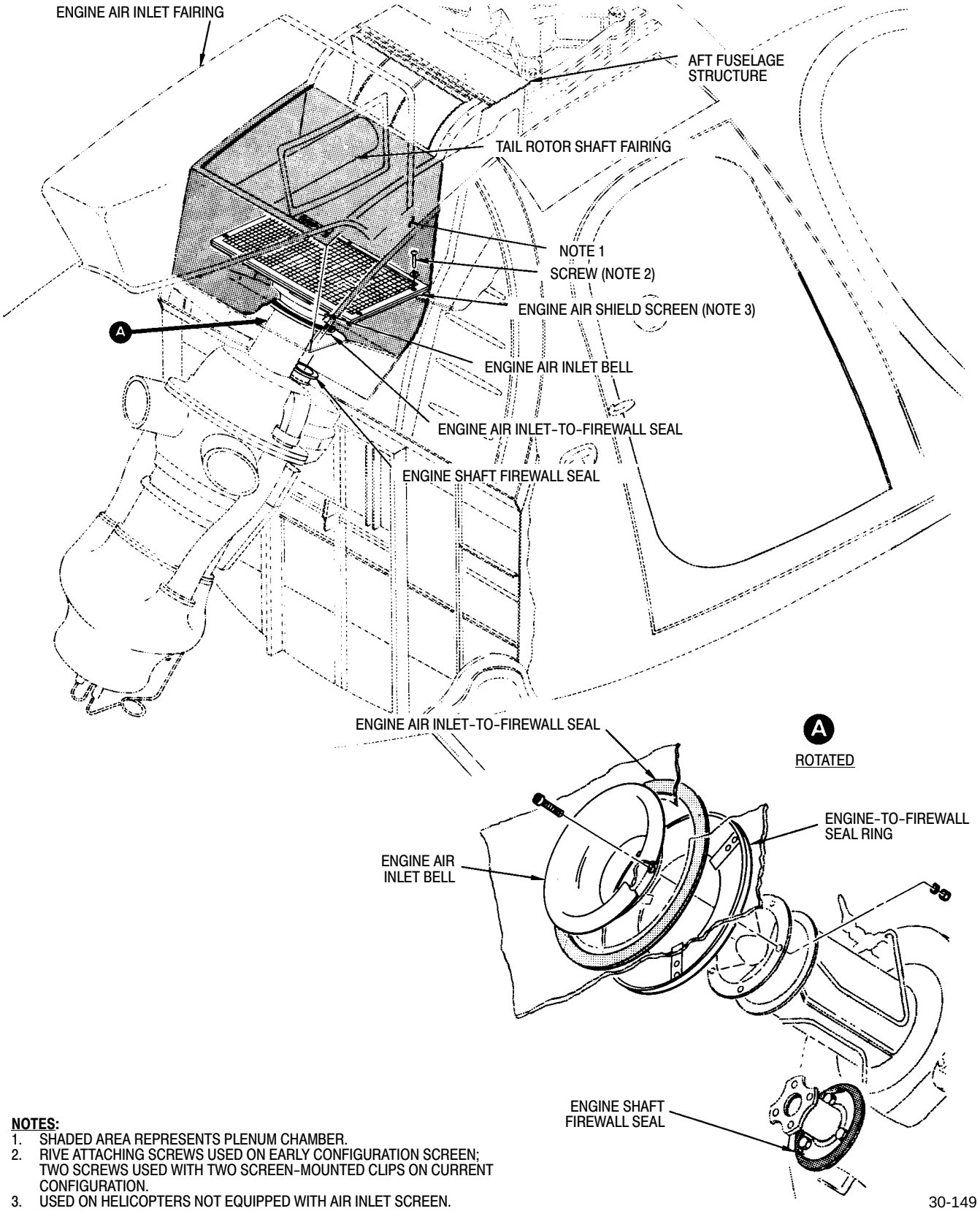
(2). Open hinge-mounted plenum chamber access door on aft fairing (Section 2).

(3). Install a temporary cover of cardboard or suitable material over the engine air intake.

CAUTION Use care to avoid dropping screws, washers or any foreign material into the engine air intake. The engine can be badly damaged by the entry of such objects.

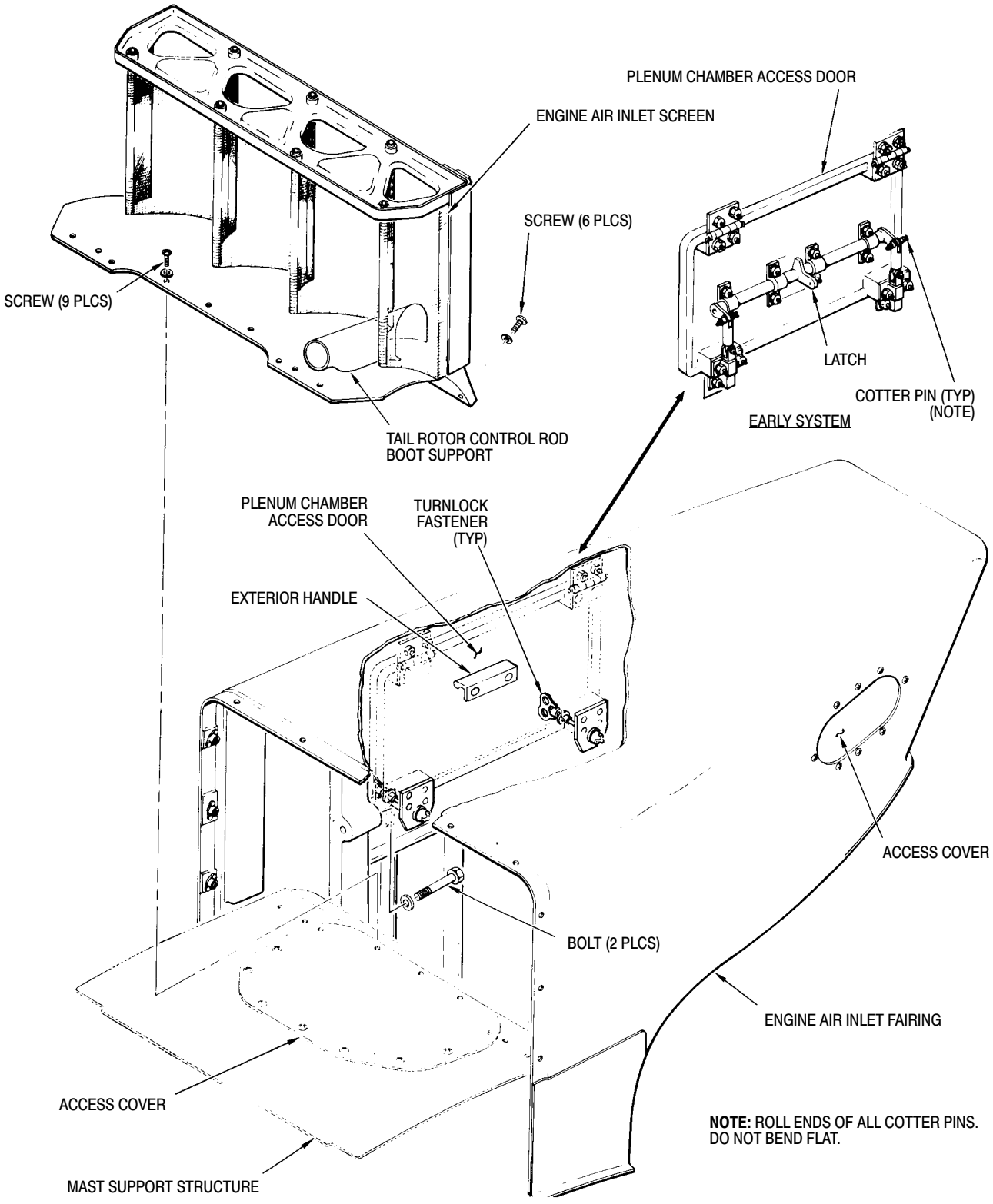
(4). Remove clamps securing tail rotor control rod boot to inlet screen.

(5). Remove Sta. 100 tail rotor control rod.



NOTES:
1. SHADED AREA REPRESENTS PLENUM CHAMBER.
2. RIVE ATTACHING SCREWS USED ON EARLY CONFIGURATION SCREEN; TWO SCREWS USED WITH TWO SCREEN-MOUNTED CLIPS ON CURRENT CONFIGURATION.
3. USED ON HELICOPTERS NOT EQUIPPED WITH AIR INLET SCREEN.

Figure 16-1. Air Induction System (Without Air Inlet Screen)



30-150

Figure 16-2. Air Inlet Screen Installation

(6). Remove two bolts securing screen to aft fairing. Remove six screws securing aft base of screen to air inlet panel. Remove nine screws securing forward base of screen to mast support structure.

B. Engine Air Inlet Screen Installation

(1). Position inlet screen in place and install attaching hardware.

(2). Install Sta. 100 tail rotor control rod.

(3). Install tail rotor control rod boot on inlet screen and secure with clamps.

CAUTION Before removing the temporary cover for reinstallation of the screen , check the entire plenum area for any foreign material that could fall into the engine as the is removed. The engine can be badly damaged by the entry of such objects.

(4). Remove temporary cover from engine air intake.

(5). Close hinge-mounted plenum chamber access door on aft fairing and be sure door is locked closed.

(6). Install engine air inlet forward fairings.

5. Engine Air Inlet Screen Inspection

(1). Inspect filter for cleanliness, clogged areas, and foreign particle accumulation. Refer to Section 2 for cleaning of air inlet screen.

(2). Inspect unit for cracks, breaks and distortion. Check fiberglass filtering screen for cuts, breaks and other damage.

6. Engine Air Shield Screen Assembly

(Ref. Figure 16-1) The engine air shield screen assembly is used on early helicopter configuration not equipped with an air inlet screen. The engine air shield screen consists of four aluminum alloy frames and a six-mesh, aluminum screen which are assembled and dip brazed.

CAUTION Use care to avoid dropping screws, washers, or any foreign material into the engine air intake. The engine can be badly damaged by the entry of such objects.

7. Engine Air Shield Screen Assembly Replacement

(Ref. Figure 16-1)

(1). Open plenum chamber access door.

(2). Remove two screws and washers and un-clip engine air screen from engine air inlet pan, or remove five screws and washers and lift screen from support clips (early configuration).

(3). Tape a temporary cover of card board or suitable material over the engine air intake.

CAUTION Before removing the temporary cover for reinstallation of the screen, check the entire plenum area for any foreign material that could fall into the engine as the cover is removed. The engine can be badly damaged by the entry of such objects.

(4). Remove temporary cover from engine air intake.

(5). Install replacement engine air shield with two screws and washers, or five screws and washers (early configuration).

(6). Inspect air inlet, base of mast, and entire plenum chamber; remove any foreign material (dirt, cotter pins, chips, etc.).

8. Engine Air Shield Screen Assembly Inspection

Inspect the engine air shield screen for holes, breaks, tears, corrosion, or other damage. Replace a damaged screen.

9. Engine Air Inlet Bell, Engine-to-Firewall Seal Ring and Engine Air Inlet-to-Firewall Seal

(Ref. Figure 16-1) The engine air inlet bell is a molded nylon assembly with the bell and mounting flange formed as a unit. The engine air inlet bell provides a method of collecting and directing air from the plenum chamber to the engine compressor.

The engine-to-firewall seal ring is a stamped steel assembly incorporating three flat springs for mounting on the inlet bell mounting flange. The engine inlet-to-firewall seal is a high temperature, all synthetic seal. The seal provides a pliable surface for the rim of steel to press against when the engine is installed.

10. Engine Air Inlet Bell and Engine-to-Firewall Seal Ring Replacement

(Ref. Figure 16-1)

(1). Remove engine.

(2). Remove five screws, washers and nuts; remove engine air inlet bell.

(3). Pull engine to firewall seal ring from bell.

(4). Attach replacement engine-to-firewall seal ring to engine air inlet bell by lifting the leaf springs on the ring and repositioning them over bell flange.

(5). Position engine air inlet bell and firewall seal ring on compressor inlet mounting flange; secure with five screws, washers and nuts.

(6). Reinstall engine.

A. Engine Air Inlet Bell and Engine-to-Firewall Seal Ring Repair

(1). To repair engine-to-firewall seal ring, replace any damaged or broken springs.

(2). There is no authorized repair for the inlet bell.

B. Engine Air Inlet-to-Firewall Seal Replacement

(Ref. Figure 16-1)

(1). Remove engine.

(2). Pull engine air inlet to firewall seal from firewall.

(3). Carefully scrape firewall as necessary to remove seal particles. Remove residue from firewall with methyl-ethyl-ketone (MEK) (22, Table 2-4).

(4). Using adhesive (19), bond replacement engine air inlet-to-firewall seal so that it is centered on firewall opening.

(5). Reinstall engine.

11. Air Induction System Drains

Air induction system drains are provided for the plenum chamber, the transmission cooling shroud, and the oil cooler blower shroud. The drains are located at the low points

of these components to prevent accumulations of moisture that may have been entrained with the inducted air. The drain tubes are generally of clear plastic material which is attached to metal drain fittings with lockwire.

12. Air Induction System Drain Tubing Replacement

Replace the drain tubing using standard shop procedures. See Figure 16-3 for routing and installation details for tubing located on the aft side of the firewall. See a similar figure in Section 9 for tubing located on the forward side of the firewall.

NOTE: When replacing drain tubing, the routing should be as direct as possible. Avoid creating loops that can become liquid traps.

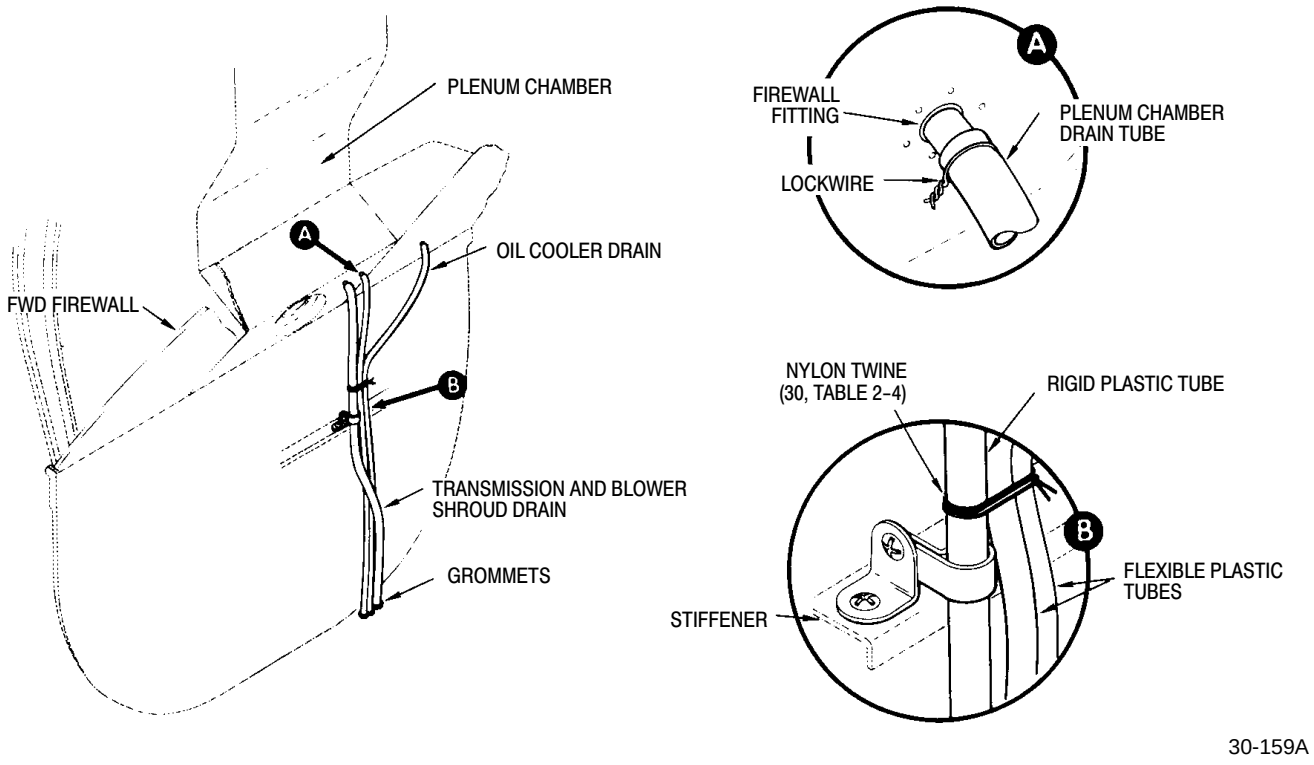


Figure 16-3. Air Induction System Drain Installations

Section

17

Instrument Panel and Indicating System

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TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 17 Instrument Panel and Indicating System		**17-1**
1.	Instrument Panel	17–1
A.	Instrument Panel Maintenance	17–1
B.	Instrument Panel Removal	17–1
Figure 17–1.	Arrangement of Instruments and Indicators (Instrument Panel Type A)	17–2
Figure 17–2.	Arrangement of Instruments and Indicators (Instrument Panel Type B)	17–3
C.	Instrument Panel Installation	17–4
Figure 17–3.	Component Locations (Instrument Panel Type A)	17–5
Figure 17–4.	Component Location (Instrument Panel Type B) (Sheet 1 of 2)	17–6
2.	Instrument Panel Type B Hood	17–7
3.	Instrument Indicating System	17–7
A.	Instrument Indicating System Troubleshooting	17–8
Table 17–1.	Troubleshooting the Instrument Indicating System	17–8
B.	Indicating System Instrument Replacement	17–11
C.	Indicating System Instrument Inspection	17–11
D.	Indicating System Instrument Repair	17–11
4.	Pitot–Static System	17–11
A.	Pitot–Static System Inspection	17–12
B.	Pitot Tube Assembly Replacement	17–12
C.	Static Pressure Tubing Replacement	17–12
Figure 17–5.	Pitot Static System	17–13
D.	Static Pressure Tube Aft End Protective Screen Installation	17–14
Figure 17–6.	Installation of Static Pressure Tube Bug Screen	17–14
5.	Altimeter	17–14
A.	Altimeter Maintenance	17–14
6.	Airspeed Indicator	17–14
A.	Airspeed Indicator Maintenance	17–15
7.	N1, N2 and Rotor Tachometer Indicating System	17–15
A.	N1, N2 and NR Tachometer Indicator Maintenance	17–15
B.	Tachometer Generator Replacement	17–15
C.	Tachometer Generator Testing	17–15
8.	Turbine Outlet Temperature (TOT) Indicating System	17–16
A.	TOT Indicator Maintenance	17–16
B.	Thermocouple Harness Maintenance	17–16
C.	TOT Indicating System Calibration	17–16

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
	Figure 17-7. Indicating System Electrical Senders (Sheet 1 of 3)	17-17
	Figure 17-8. Test Hookup For Tachometer Generator	17-20
9.	Engine Torque Indicating System	17-20
A.	Torque Gage Maintenance	17-20
B.	Torque Gage Pressure Line Removal	17-21
C.	Torque Gage Pressure Lines Installation	17-21
	Figure 17-9. Torque Gage and Direct Reading Engine Oil Pressure Gage (Sheet 1 of 2)	17-22
10.	Direct Reading Oil Pressure Indicating System	17-24
A.	Engine Oil Pressure Gage Tubing Replacement	17-24
B.	Torque or Direct Reading Engine Oil Pressure Line Bleeding and Servicing	17-24
11.	Instrument Cluster Three-Pack or Four-Pack Indicating System	17-24
A.	Instrument Cluster Three-Pack or Four-Pack Maintenance	17-25
B.	Instrument Cluster Three-Pack or Four-Pack Calibration Check	17-25
	Figure 17-10. Instrument Cluster Three-Pack with Wiring Harness (Instrument Panel Type B) (Sheet 1 of 2)	17-26
	Figure 17-11. Instrument Cluster Four-Pack with Wiring Harness	17-28
12.	Engine Oil Temperature Sender	17-29
A.	Engine Oil Temperature Sender Replacement	17-29
13.	Engine Electrical Oil Pressure System	17-30
A.	Engine Electrical Oil Pressure Sender Replacement	17-30
B.	Electrical Oil Pressure Gage Calibration	17-30
14.	Fuel Quantity System	17-31
A.	Fuel Quantity Transmitter (Tank Unit) Replacement	17-31
B.	Fuel Quantity Transmitter and Indicator Operational Check	17-32
C.	Fuel Tank Sending Unit and Fuel Low Warning Light Indicating System Inspection	17-33
	Figure 17-12. Bench Test and Potting of Fuel Tank Sending Unit	17-34
D.	Tank Unit Testing	17-35
15.	Outside Air Temperature Indicator	17-35
A.	Outside Air Temperature Indicator Replacement	17-35
16.	Magnetic Compass	17-36
A.	Magnetic Compass Maintenance	17-36
17.	Caution and Warning Lights Indicating System	17-36
A.	Caution and Warning Lights Indicating System Troubleshooting	17-37
	Figure 17-13. Testing of Tank Unit	17-38
	Figure 17-14. Outside Air Temperature Indicator and Magnetic Compass	17-39
	Table 17-2. Caution and Warning Lights Troubleshooting Data	17-40

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
Table 17–3.	Troubleshooting the Caution and Warning Lights Indicating System	17–41
18.	Instrument Panel Type A Caution and Warning Indicator Lights	17–45
A.	Instrument Panel Type A Indicator Lights Replacement	17–46
19.	Instrument Panel Type B Caution and Warning Indicator Lights	17–46
A.	Panel Type B Indicator Lights Replacement	17–47
20.	Engine Out Warning System	17–47
A.	N1 Sensing Equipment	17–47
B.	N1/NR Sensing Equipment	17–48
C.	Engine Out Warning System Functioning	17–48
21.	Vapair 26530332M Engine Power Out (EPO) Warning Control Unit	17–49
A.	Engine Power Out Warning Unit Circuit	17–49
B.	Engine Out Frequency Sensor and Light Flasher Circuits	17–49
C.	Dc Voltage Regulator Circuit	17–49
D.	Audio Tone Signal Generators	17–49
Figure 17–15.	N1/NR Engine Power Out Warning System Combined Simplified Block and Schematic Diagram (Panel Type B) (Sheet 1 of 2)	17–50
E.	Transmission Oil and Temperature Light Flasher	17–52
F.	Vapair 26530332M EPO Warning Unit Frequency Sensing Adjustment	17–52
Figure 17–16.	Vapair 26530332M Engine Power Out Warning Control Unit Schematic Diagram	17–53
Figure 17–17.	Vapair 26530332M Warning Audio and Light Flashing Control Circuit (Sheet 1 of 2)	17–54
G.	Vapair 26530332M EPO Warning Unit Repair	17–56
H.	Vapair 26530332M EPO Warning Control Unit Replacement	17–56
22.	Autronics 2146–5 Engine Power Out (EPO) Warning Control Unit	17–56
A.	Engine Power Out Warning Circuits	17–56
B.	Engine Out Frequency Sensing Circuits	17–56
C.	Engine Out and Transmission Lights Flasher Circuits	17–57
D.	Audio Tone Circuits	17–57
E.	Audio Tone Output Level Adjustment – Autronics 2146–5 EPO Warning Control Unit	17–57
Figure 17–18.	Autronics 2146–5 Engine Power Out Warning Control Unit Schematic Diagram	17–58
F.	Autronics 2146–5 EPO Warning Control Unit Repair	17–59
G.	Autronics 2146–5 EPO Warning Control Unit Replacement	17–59
Figure 17–19.	Autronics 2146–5 Warning Audio and Lights Flashing Control Circuit (Sheet 1 of 2)	17–60
23.	Autronics 2200–3 EPO Warning Control Unit	17–61

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
A.	Autronics 2200–3 EPO Warning Control Unit Maintenance	17–61
24.	Grimes 70–0054–1 Indicator Lights Dimmer Assembly (Panel Type A)	17–62
A.	Indicator Lights Dimming Assembly Circuits	17–62
B.	Negative (Ground) Input Fault Dimming Circuits	17–62
C.	Positive (+28 Vdc) Input Fault and Function Dimming Circuits	17–62
D.	Panel Lights Dimming Circuit	17–63
E.	Grimes 70–0054–1 Indicator Lights Dimmer Assembly Repair	17–63
F.	Grimes 70–0054–1 Indicator Lights Dimmer Assembly Replacement	17–63
25.	Autronics 2245–1 Indicator Lights Dimmer Assembly (Panel Type B)	17–63
A.	Dimmer Assembly Associated Circuits	17–63
Table 17–4.	Input/Output Signals – Autronics 2200–3 EPO Unit	17–64
Figure 17–20.	Grimes 70–0054–1 Indicator Dimming Assembly Schematic Diagram	17–65
Figure 17–21.	Caution and Warning Indicating Light System Dimming Circuits (Instrument Panel Type A)	17–66
B.	Negative (Ground) Input Fault Caution Light Indicator Circuits	17–67
C.	Negative (Ground) Input Fault Warning Light Indicator Circuits	17–67
D.	Positive (+28 Vdc) Input Start Pump Warning Light Circuit	17–67
E.	Engine Out warning Light and Horn Circuit	17–67
F.	Panel and Instrument Lights Dimming Circuit	17–67
G.	Caution and Warning Lights Press–To–Test Circuits	17–67
H.	Autronics 2245–1 Dimmer Assembly Test and Repair	17–68
I.	Autronics 2245–1 Dimmer Assembly Replacement	17–68
26.	Engine Power Out (EPO) Audio Amplifier (Used with Vapair EPO Warning Control Unit)	17–68
A.	EPO Audio Amplifier Replacement	17–68
Figure 17–22.	Autronics 2245–1 Dimmer Schematic Diagram (Instrument Panel Type B)	17–69
Figure 17–23.	Caution and Warning Indicating Lights System Circuits (Instrument Panel Type B) (Sheet 1 of 2)	17–70
Figure 17–24.	Audio Amplifier (Dual and Single Channel) Schematic Diagram	17–72
27.	Engine Power Out (EPO) Audible Warning Horn	17–73
A.	Edwards Audible Warning Horn Replacement	17–73
28.	NR Disable Switch	17–73
A.	NR Disable Switch Replacement	17–73
Figure 17–25.	NR Disable Switch Installation (Sheet 1 of 2)	17–74
B.	NR Disable Switch Adjustment	17–76
29.	Chip Detector Circuits Operational Check	17–76

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
30.	Fuel Pressure Switch	17–76
A.	Fuel Pressure Switch Operational Check	17–76
Figure 17–26.	Fuel Pressure Switch Test Set–Up	17–77
B.	Fuel Pressure Switch Replacement	17–78
31.	Running Time Meter	17–78

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page

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SECTION 17
INSTRUMENT PANEL AND INDICATING SYSTEM

1. Instrument Panel

The instrument panel is an assembly of aluminum alloy angles and a 0.040 inch (1.016 mm) thick aluminum alloy panel. The panel assembly is riveted to an aluminum alloy structural framework called the upper instrument panel support assembly.

This instrument panel and upper support assembly is fabricated so that it is removable from the lower structural framework, called the lower instrument panel support assembly, that is attached to the pilot's compartment floor.

Contour-molded thermoplastic fairings and a hood enclose the instrument panel structure, shield the instruments and equipment from direct sunlight and prevent instrument glare.

All standard flight, navigation and engine instrument, except the canopy-located outside air temperature gage, are mounted in the instrument panel.

Two different types of instrument face panels are provided; panel type A (Figure 17-1) and type B (Figure 17-2). The major differences are that panel type B provides integral provisions for the addition of optional equipment and panel type B instruments are recessed in a thermoplastic hood covering the face of the panel. See Figure 17-3 and Figure 17-4 for structure details and location of indicating system components.

The switches, circuit breakers and other manually operated controls on the panel face that are parts of the fuel supply system (Section 12), heating and ventilating system (Section 18) and electrical system (Section 19) are discussed as part of the system in which they function.

Caution and warning lights indicators are mounted in a row horizontally across the top of the panel face.

Engine out warning equipment functions with an audible warning horn and the caution and warning lights indicating system to provide visual and audible signals for the pilot during certain conditions. The caution and warning lights indicating system and engine out warning equipment are described in this section.

Provisions are incorporated in the panel face for installation of night-lighting, vhf/uhf communication equipment, navigational aid equipment and miscellaneous instrumentation.

Information on instruments, controls and equipment other than those shown in Figure 17-1 and Figure 17-2 is provided in CSP-H-3.

A. Instrument Panel Maintenance

Perform maintenance on the instrument panel and supporting structure according to the Cleaning, Corrosion Control and Paint Finish in Section 2, the Fuselage Sheet Metal Repair in CSP-H-6 and Maintenance of Electric Bonding Connections in Section 19.

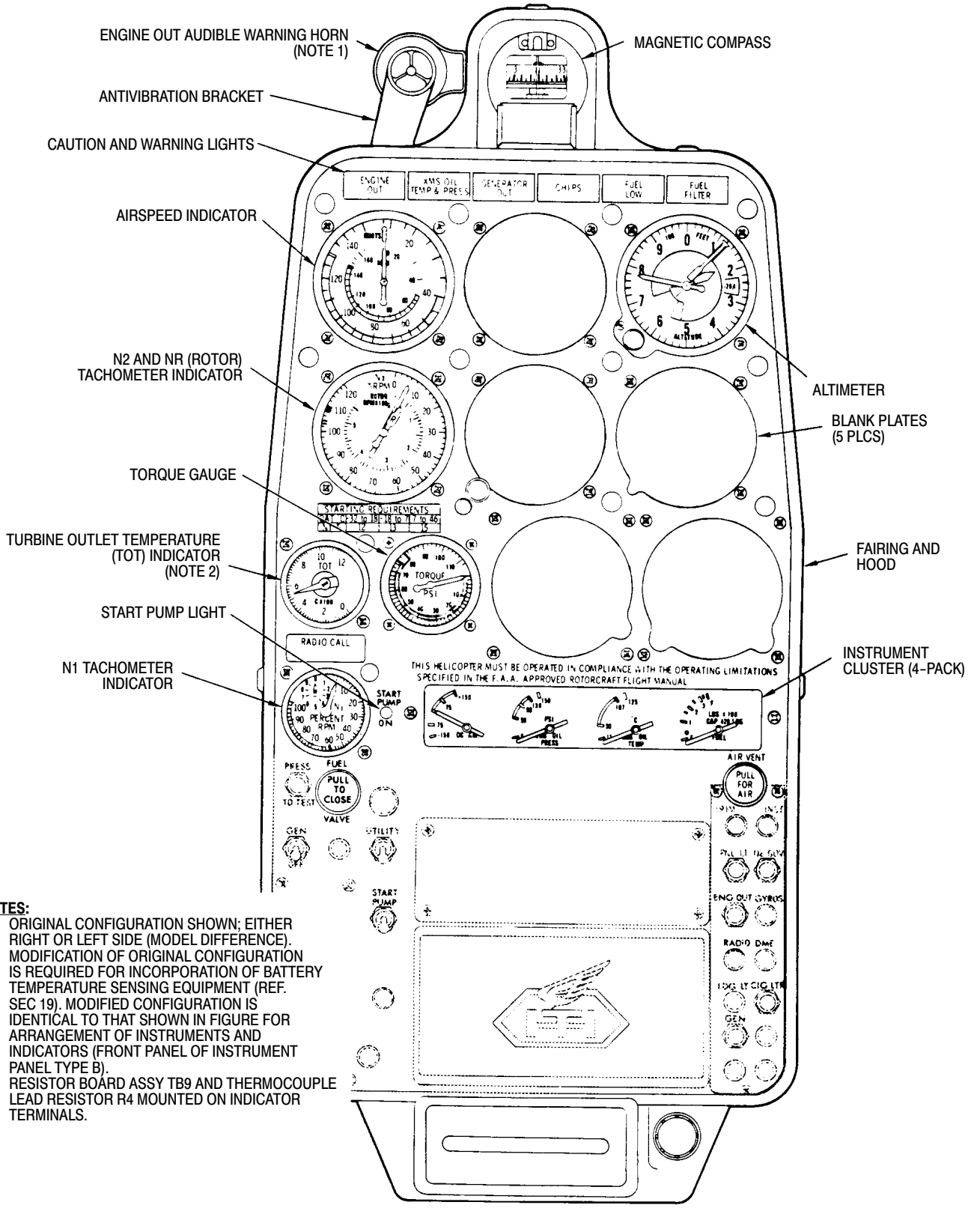
B. Instrument Panel Removal

The instrument panel and upper support assembly, along with installed instruments and most of the electrical wiring, is removeable as an assembled unit. Follow the basic requirements outlined below to accomplish removal.

WARNING **The main electrical power supply wiring is disconnected for removal of the panel assembly. External power and the battery must remain disconnected at all times during this procedure.**

(1). Remove the instrument panel side fairings.

(2). Disconnect the torque gage, engine oil pressure gage (panel type B), and the pitot and static pressure lines to the altimeter and airspeed indicator. Cap the lines and fittings.

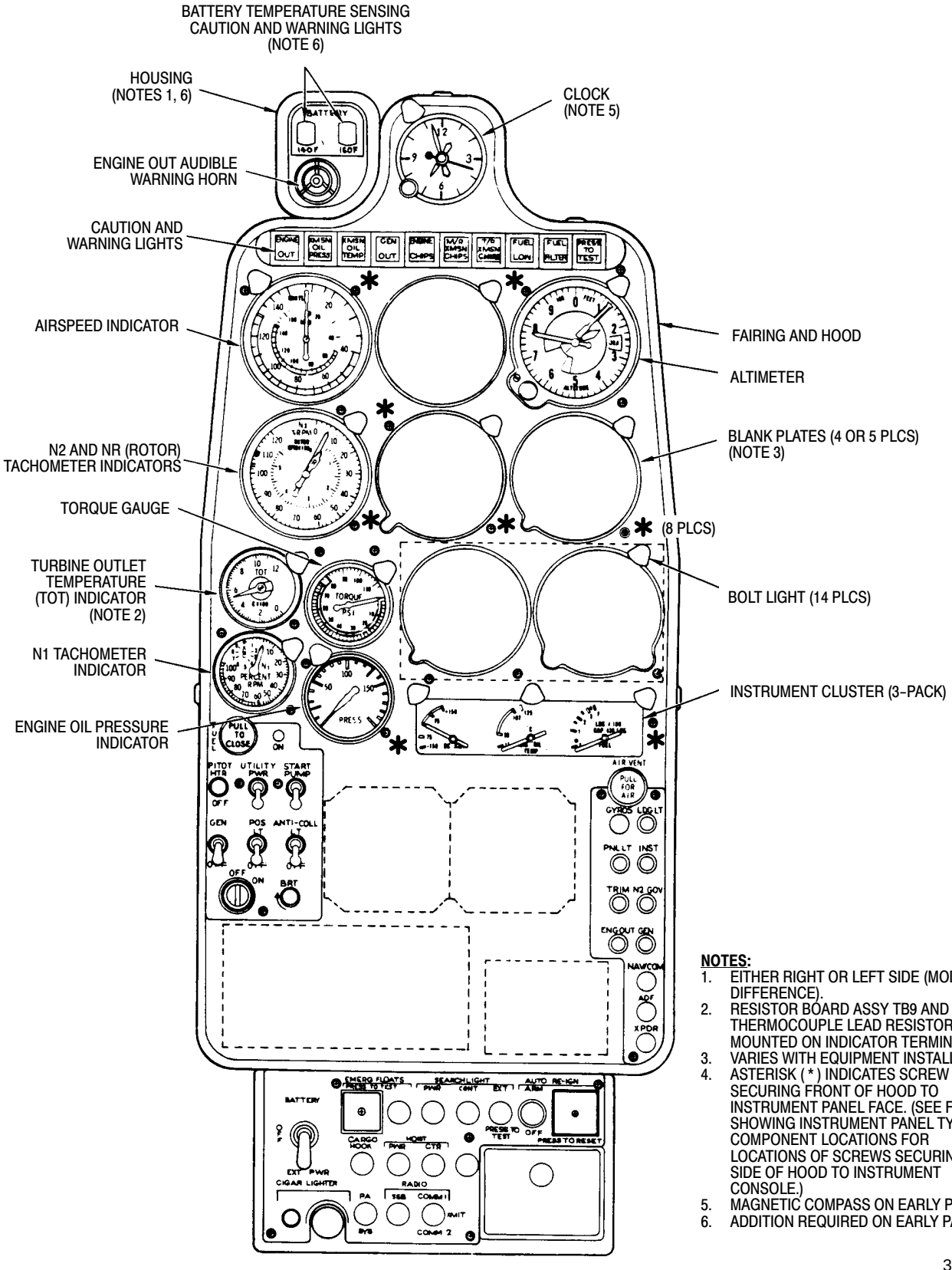


NOTES:

1. ORIGINAL CONFIGURATION SHOWN; EITHER RIGHT OR LEFT SIDE (MODEL DIFFERENCE). MODIFICATION OF ORIGINAL CONFIGURATION IS REQUIRED FOR INCORPORATION OF BATTERY TEMPERATURE SENSING EQUIPMENT (REF. SEC 19). MODIFIED CONFIGURATION IS IDENTICAL TO THAT SHOWN IN FIGURE FOR ARRANGEMENT OF INSTRUMENTS AND INDICATORS (FRONT PANEL OF INSTRUMENT PANEL TYPE B).
2. RESISTOR BOARD ASSY TB9 AND THERMOCOUPLE LEAD RESISTOR R4 MOUNTED ON INDICATOR TERMINALS.

30-115A

Figure 17-1. Arrangement of Instruments and Indicators (Instrument Panel Type A)



NOTES:

1. EITHER RIGHT OR LEFT SIDE (MODEL DIFFERENCE).
2. RESISTOR BOARD ASSY TB9 AND THERMOCOUPLE LEAD RESISTOR R4 MOUNTED ON INDICATOR TERMINALS.
3. VARIES WITH EQUIPMENT INSTALLED.
4. ASTERISK (*) INDICATES SCREW SECURING FRONT OF HOOD TO INSTRUMENT PANEL FACE. (SEE FIGURE SHOWING INSTRUMENT PANEL TYPE B COMPONENT LOCATIONS FOR LOCATIONS OF SCREWS SECURING SIDE OF HOOD TO INSTRUMENT CONSOLE.)
5. MAGNETIC COMPASS ON EARLY PANEL.
6. ADDITION REQUIRED ON EARLY PANEL.

30-1183C

Figure 17-2. Arrangement of Instruments and Indicators (Instrument Panel Type B)

(3). Disconnect thermocouple leads from terminal board TB9 on the TOT indicator.

(4). Remove the fuel shutoff valve control cable. Disconnect the wire end of the ventilating valve control cable. (Removing the fuel shutoff cable will also release a clamp holding the pitot pressure line; leave the line detached.)

(5). Disconnect the electrical plugs from the connector support bracket under the upper support assembly.

(6). Disconnect coaxial antenna cables if radio equipment is installed.

(7). Disconnect the wiring (three wire bundles) from the power selector switch and insulate the wiring terminals. Remove clamps that secure the three wire bundles to the panel structure.

(8). Check the entire instrument panel and upper support assembly for clamps or nylon straps that would restrict separation from the lower support assembly. Disconnect any such items.

(9). Remove the two screws, washers and nuts that attach the upper support (Z brace) to the panel structure.

(10). Remove the screws and washers that attach the base of the panel assembly to the lower support (Figure 17-3 or Figure 17-4).

NOTE: Make notes of the routing of all lines, cables and wiring before removing the panel assembly to aid reinstallation.

(11). Obtain assistance and carefully lift out the panel and support assembly.

C. Instrument Panel Installation

Before and during placement of the instrument panel and upper support assembly into position on the supporting structure, check all cables, wiring and lines are routed properly. Incorrect routing can result in lines or wiring not being long enough to reach the connection point, or in lines or wiring being subjected to unnecessary strain and possible damage from chafing.

(1). Mount the instrument panel and support assembly on the supporting structure and secure the base in place with screws and washers (Figure 17-3).

NOTE: If upper support does not align with canopy structure, use special shim washers, 0.120 inch (3.048 mm) thickness, under both forward or both aft console-to-support attachment points. Use one- half the shim thickness at both middle attachment screws and vary screw length accordingly.

(2). Attach the Z-brace to the upper structure.

(3). Route all lines and wiring into position for connection. Check that there is sufficient slack for proper connection without straining the lines or wiring.

(4). Connect power supply wiring (three-wire bundles) to the power selector switch and reinstall wiring support clamps and straps where previously removed.

(5). Connect coaxial antenna cables if radio equipment is installed.

(6). Connect the electrical plugs under the upper support assembly.

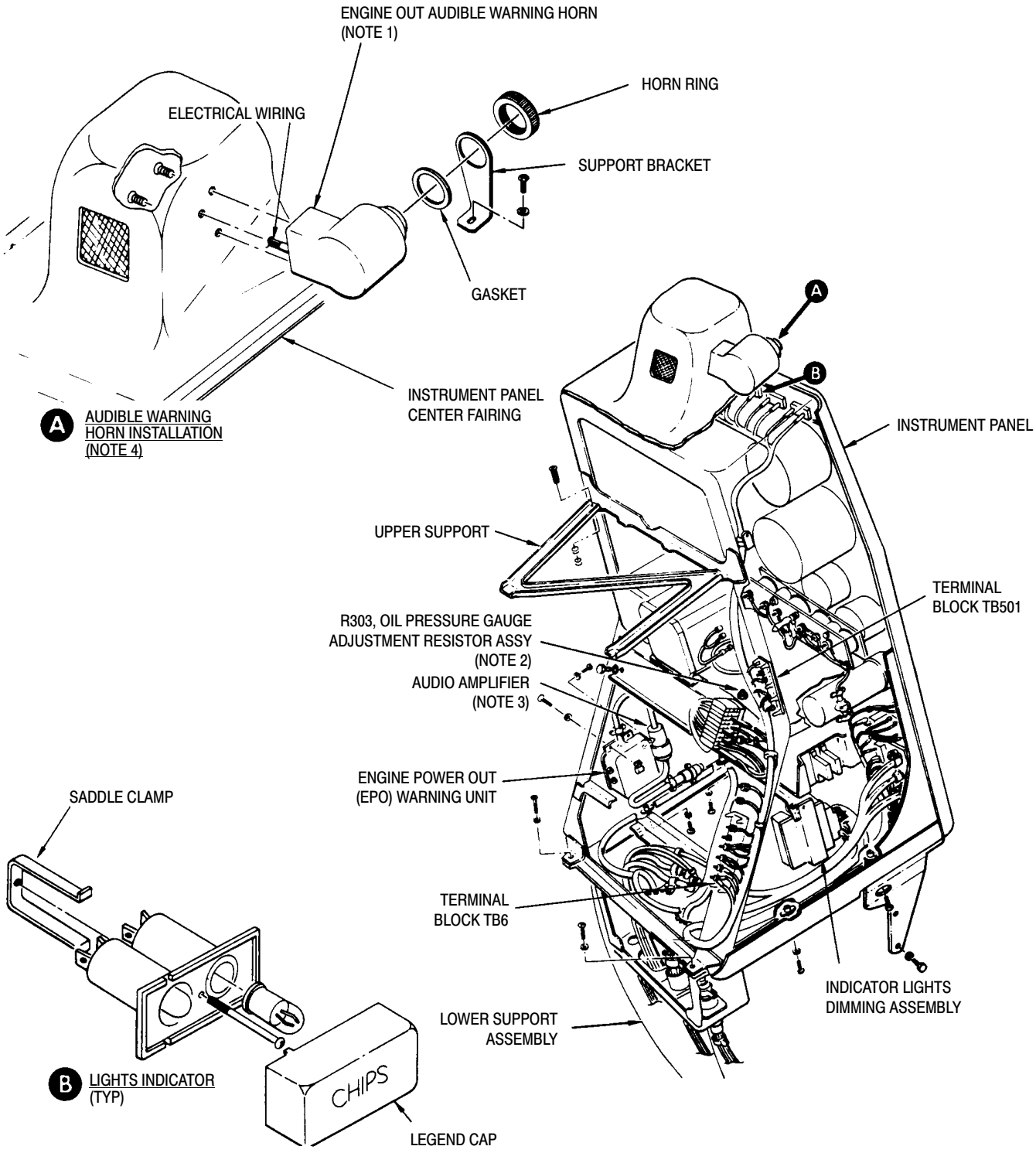
(7). Connect the ventilating valve control cable and perform an operational check.

(8). Install the fuel shutoff valve control cable and perform an operational check. Reattach the pitot pressure line clamp with the hardware used to attach the cable under the upper support assembly.

(9). Connect the thermocouple leads to terminal board TB9 on the TOT indicator. Check for correct thermocouple circuit resistance.

(10). Connect the torque gage, engine oil pressure gage (panel type B), and the pitot and static pressure lines to the altimeter and airspeed indicator (Figure 17-5).

(11). Check that all lines and wiring are connected and secure; then reconnect the battery.



NOTES:

1. EITHER RIGHT OR LEFT SIDE INSTALLATION (MODEL DIFFERENCE). SUPPORT BRACKET IS PART OF KIT M50436.
2. PART OF OIL PRESSURE GAGE CIRCUIT (KIT M50438).
3. USED WITH VAPAIR EPO UNIT ONLY.
4. MODIFICATIONS OF ORIGINAL CONFIGURATION SHOWN IS REQUIRED.

30-117E

Figure 17-3. Component Locations (Instrument Panel Type A)

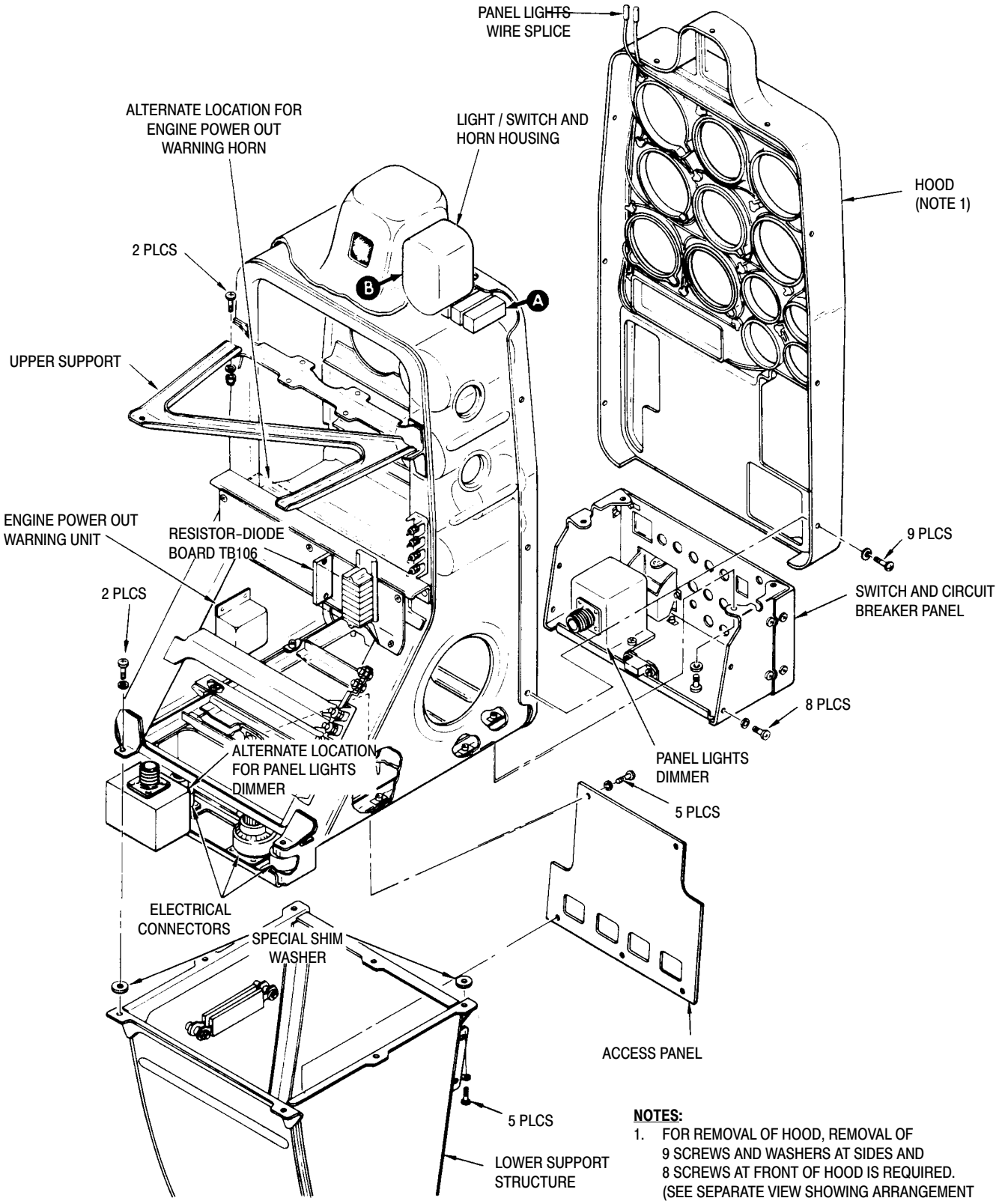


Figure 17-4. Component Location (Instrument Panel Type B) (Sheet 1 of 2)

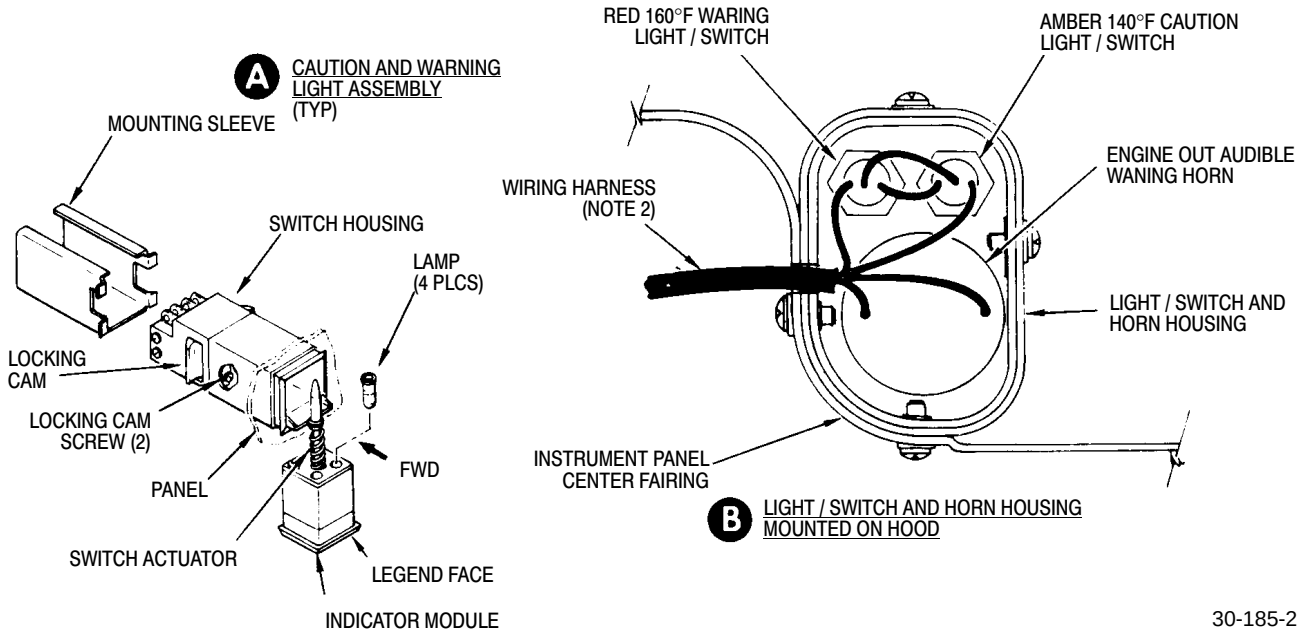


Figure 17-4. Component Location (Instrument Panel Type B) (Sheet 2 of 2)

(12). Connect an external power supply, if available, and perform a power-on check of all systems. If there is a malfunction, correct the trouble as necessary.

(13). Perform a ground run-up of the helicopter according to the Owner's Manual to check operation of all systems. Bleed the torque gage and engine oil pressure gage (panel type B) pressure lines as necessary.

(14). Shut down helicopter and reinstall the instrument panel side fairings.

2. Instrument Panel Type B Hood

The panel type B hood, formed of 0.063 inch (1.6002 mm) thick thermoplastic, covers the upper portion of the instrument panel face and is secured to the instrument console with nine screw and washers at side and top edges of the hood.

Built-in panel bolt lights on the hood provide illumination for all standard instruments and indicators, except the magnetic compass and optional clock. The panel lights are part of the night lighting system that is standard equipment on the helicopter with panel type B.

To remove the hood, remove nine attaching screws and washers at sides of hood (Figure 17-4), eight screws at front of hood (Figure 17-2) and pull hood away from panel far enough to disconnect two panel light wiring splices.

Use tetrahydrofuran (46, Table 2-4), or equivalent, to bond and repair cracks and tears in the hood.

3. Instrument Indicating System

Three basic types of instrument indicating system are installed in the helicopter.

The first group includes indicators that are actuated by other than electrical power input these are the airspeed indicator, altimeter, outside air temperature indicator, torque gage, engine oil pressure gage (panel type B) and the magnetic compass.

The second group of indicators are interconnected with electrical sending units that self-generate the power source necessary for indicator operation once they are mechanically or thermally actuated; indicators in this are N_1 and N_2 rotor tachometer indicators and the TOT indicator.

The third group includes those indicators and sending units that rely on power from the helicopter electrical system for functional

capability; such indicators include the caution and warning lights and the instrument cluster 3-pack or 4-pack.

NOTE: Instrument limit markings shown in this section may differ depending on helicopter configuration and engine installation. Refer to the Owner's Manual for specific helicopter instrument limit markings. Instrument markings used with the Model 250- C20 Engine Conversion Kit M50031 are also described in CSP-H-3.

A. Instrument Indicating System Troubleshooting

(Ref. Table 17-1)

Table 17-1. Troubleshooting the Instrument Indicating System

Symptom	Probable Trouble	Corrective Action
NOTE: Ref. Table 17-3 for Troubleshooting the Caution and Warning Lights Indicating System.		
Pitot-Static System		
No reading on airspeed indicator	Ice or water in pitot lines or static pressure tube	Thaw out; clean and dry lines and tube.
Erratic readings on airspeed indicator or altimeter	Leak in pressure lines	Tighten line connections.
	Ice or water in pitot lines and static pressure tube	Thaw out; clean and dry lines.
	Defective interconnecting lines	Check pitot static system using test set. Repair leaks by tightening connections and replacing lines as required.
Pointer of altimeter or airspeed indicator does not move	Obstruction in pressure source	Clear static and pitot lines.
	Defective altimeter or airspeed indicator	Replace defective indicator.
	Disconnected line	Check for disconnected line and make necessary connections.
Altimeter or airspeed indicator pointer oscillates	Loose static connections	Tighten static source line connections.
	Moisture in lines	Clear line.
	Defective indicator	Replace defective indicator.
Altimeter pointer will not adjust to airport altitude within 70 feet (21 M) on ground with proper barometric scale setting	Moisture in static pressure lines	Clear static source and interconnecting lines.
	Altimeter instrument case leaking	Replace altimeter.
	Barometric scale out of adjustment	Replace altimeter or remove for adjustment by an authorized instrument repair agency.
High reading	Improper venting	Clear lines.
Altimeter adjustment knob binds	Defective altimeter	Replace altimeter.
Airspeed indicator pointer does not align with 0 ±1/16 inch (0 ±1.6 mm) on ground	Defective indicator	Replace indicator.
	Moisture in lines	Clear lines.
N_1, N_2 and Rotor Tachometer Indicators		
Excessive scale error (low reading)	Weak magnet in tachometer indicator	Replace indicator.

Table 17-1. Troubleshooting the Instrument Indicating System (Cont.)

Symptom	Probable Trouble	Corrective Action
Excessive scale error (high reading	Weak restraining spring in tachometer indicator	Replace indicator.
Pointer off zero position with engine inoperative	Pointer shifted	Replace indicator.
No reading or intermittent reading	Loose wiring, disconnected connector or bad ground terminal connection	Check continuity through wiring and connectors. Repair as necessary.
	Defective tachometer indicator or generator	Replace defective indicator or generator.
	Poor ground connection on tachometer generator	Check for good bond between tachometer generator mounting flange and engine pad stud.
Turbine Outlet Temperature Indicator		
No reading on indicator	Loose connection	Check and tighten all connections.
	Defective airframe thermocouple harness	Replace or repair thermocouple harness.
	Defective engine thermocouple harness	Replace engine thermocouple harness. (Refer to engine operational and maintenance manual.)
	Defective indicator	Replace indicator.
	Open adjustable resistor R4	Replace resistor.
Erratic reading on indicator	Defective indicator	Replace indicator.
	Defective connections or resistor R4 on TB9 at back of instrument	Repair connections or replace resistor.
Torque Gage and Direct Reading Engine Oil Pressure Gage		
Pointer fails to respond	Pressure line kinked or bent	Check entire length of line; replace if necessary.
Pointer indications sluggish	Torquemeter oil pressure snubber inoperative due to cold weather	Remove torquemeter oil pressure snubber. (Reinstall snubber when weather conditions improve.)
	Obstruction in line	Clear the line.
	Defective gage	Replace gage.
Pointer indicates incorrectly	Line or line connectors leaking	Check for damaged ring gasket under fitting hex and tighten connections; if leak persists, replace line.
	Air trapped in line	Check for air bubbles and bleed if necessary.

Table 17-1. Troubleshooting the Instrument Indicating System (Cont.)

Symptom	Probable Trouble	Corrective Action
Instrument Cluster 3-Pack and 4-Pack		
Engine oil temperature pointer or oil pressure pointer (4-pack) off either end of scale or does not respond	Open or short circuit in indicator	Replace instrument cluster.
	Open or short circuit in wiring harness	Replace sender.
	Defective sender	Replace sender.
No reading or erratic ammeter rereading	Malfunctioning voltage regulator	Replace voltage regulator.
	Shunt leads open or intermittent or defective resistor R3	Check security of shunt leads; tighten if loose. Replace defective resistor R3.
	Open or short circuit in ammeter	Replace instrument cluster.
	Dirty or worn mechanism in ammeter	Replace instrument cluster.
Fuel quantity indicator inaccurate, erratic or inoperative	Wire loose, shorted or open	Check tank unit electrical connections; repair as necessary.
	NOTE: The top of a later type tank unit is potted with sealant (3, Table 2-4) to prevent shorting due to moisture accumulation	Check electrical wires between tank unit and instrument cluster. Repair as necessary.
	Fuel indicator or tank unit defective	Perform operational check. Replace instrument cluster or tank unit. Calibrate fuel system.
Magnetic Compass		
Excessive error	External magnetic interference	Locate and eliminate magnetic interference.
	Defective bearings	Replace magnetic compass.
	Improper compensation	Compensate compass as required. (Refer to FAA AC 43.13-1A.)
Excessive oscillation	Insufficient liquid in bowl	Replace compass.
Rotating element not level	Leaking float chamber	Replace compass.
	Magnets detached from rotating element	Replace compass.
Sluggish operation	Dirty jewels or pivots	Replace compass.
	Weak cards magnets	Replace compass.
Liquid leakage or bubbles visible under normal flight conditions	Defective gasket or float chamber	Replace compass.

B. Indicating System Instrument Replacement

The following instructions are typical and apply to all instruments installed in the instrument panel.

(1). Check that all electrical power is OFF to avoid the possibility of electrical shorts while working in the area of the instrument panel.

(2). Remove instrument panel fairings. For instrument panel type B, remove hood attaching screws and move hood aft far enough for access to instrument mounting screws.

(3). Disconnect electrical plug, wiring or tubing, as applicable, from back of the instrument. Install suitable covers over tube fittings, instrument fittings and loose wire terminals.

(4). At the face of the panel, remove the screws (usually two or four) that attach instrument to panel and remove instrument from back side of panel.

NOTE: The N_1 tachometer and TOT indicators are mounted to the panel with clamps that only have to be loosened to remove the instrument. Always loosen the cinching screws in the upper left corner of the clamp first to release the clamp adjusting mechanism; then loosen the lower right, or holding screw and slide the instrument outward, away from the panel face and out of the clamp.

(5). Position replacement instrument into panel cutout from back side of panel and secure with mounting screws.

NOTE: When installing either the N_1 tachometer or TOT indicator, slide the instrument into the face side of the panel and through the supporting clamp. Align the instrument, tighten the lower right (holding) screw and then tighten the upper left (cinching) screw to tighten the clamp and secure the case.

(6). Connect tubing, electrical plug or wiring to the back of the instrument. Use care to avoid reversing connections for the pitot and static lines.

(7). Reinstall panel fairings. Install hood on instrument panel type B.

(8). Perform engine run-up and flight test to check instrument operation.

C. Indicating System Instrument Inspection

(1). Inspect instrument case for dents and cover glass for slippage and cracks.

(2). Inspect fitting or electrical receptacle at back of instrument for damaged threads that might prevent proper connection of the tube nut or electrical plug.

(3). Inspect index markings and numerals on dial face for discoloration and legibility. Inspect pointers for cracked or peeling fluorescent paint.

(4). Inspect for presence of all required range markings and white slippage mark at bottom of glass.

D. Indicating System Instrument Repair

Refer to FAA AC 43.13-lA, Aircraft Inspection and Repair, when repair or overhaul of instruments becomes necessary.

4. Pitot-Static System

CAUTION

- Do not blow air through the pitot-static system lines without disconnecting the altimeter and airspeed indicator. Instantaneous air pressure may result in distortion or rupture of the instrument diaphragm.
- Before performing maintenance near the engine air inlet, covers of cardboard or other suitable material should be taped in place over the engine inlet screen and oil cooler air inlets to prevent entry of foreign objects into the engine compressor. Covers should not be removed until work is completed and debris is thoroughly cleaned out of the area. After removing covers, verify that area around base of mast, inlet to plenum and entire plenum chamber is free of foreign material.

(Ref. Figure 17-5) The pitot-static system consists of a pitot tube assembly, a static pressure port installation and interconnecting tubing and fittings.

The pitot tube, in the lower center of the canopy panel, is connected to the airspeed indicator by a nylon pitot line.

The static pressure port may be either a single or dual type.

The dual type has interconnected ports in each side of the engine air intake fairing while the single type has one port in the aft end of the fairing. The port(s) are connected to a pressure line routed between the port(s) and the altimeter.

On current configuration helicopters, spring loaded drain valves are provided at the static line low points aft of Sta. 127.00 and forward of the instrument panel.

A static source crossover line interconnects the altimeter and airspeed indicator.

A. Pitot-Static System Inspection

(1). Inspect system lines for damage that could prevent an airtight connection.

(2). Inspect pitot tube opening, drain hole and line for foreign matter. Clear and clean the pressure line, as necessary.

(3). Inspect static pressure tube port(s) for foreign matter. Clear and clean the port(s) and pressure lines, as necessary.

(4). Inspect pitot tube for lateral misalignment. The pitot tube should be parallel to the longitudinal centerline of the helicopter.

B. Pitot Tube Assembly Replacement

(Ref. Figure 17-5)

(1). Remove the instrument panel fairings and the cover panel from the left side of the lower instrument panel support assembly.

(2). Remove the clamps, screws, washers and nuts that attach pitot tube assembly to structure.

(3). Disconnect pitot tube from back of airspeed indicator, slide aluminum head end of tube from canopy panel grommet and remove the assembly.

(4). Insert the replacement pitot tube assembly head into place in canopy panel grommet and connect pitot line to elbow at back of airspeed indicator.

(5). Secure tube to structure with the removed hardware.

(6). Check that pitot tube head is aligned parallel to the longitudinal centerline of the helicopter.

(7). Check pitot pressure system for leaks; repair leaks as necessary.

(8). Reinstall instrument panel fairings and cover panel.

C. Static Pressure Tubing Replacement

(Ref. Figure 17-4)

(1). Remove the instrument panel fairings, forward right side fairing of engine air intake and plenum chamber access door.

(2). Remove tube(s) from single or dual pressure ports in engine air intake fairing by breaking the bondline or disconnecting coupling nuts at the tee fitting.

(3). Remove nylon straps attaching the main tube (detail B) and drain valve, if installed, to the canopy structure.

(4). Remove nylon straps attaching the main tube to air intake fairing longeron, aft section strut and structure (detail A and C).

(5). Disconnect aft end of tube from tee fitting.

(6). Disconnect the main tube from altimeter and cover instrument opening.

(7). Withdraw the main tube through canted bulkhead grommet.

(8). Remove crossover tube from altimeter and airspeed indicator.

(9). Route replacement static pressure tube through the grommet in canted bulkhead and locate aft end of the tube at pressure port tee fitting.

(10). Secure the main tube to the canopy structure with nylon straps (detail B).

(11). Attach the main tube to the air intake fairing longeron, aft section strut and structure (details A and C).

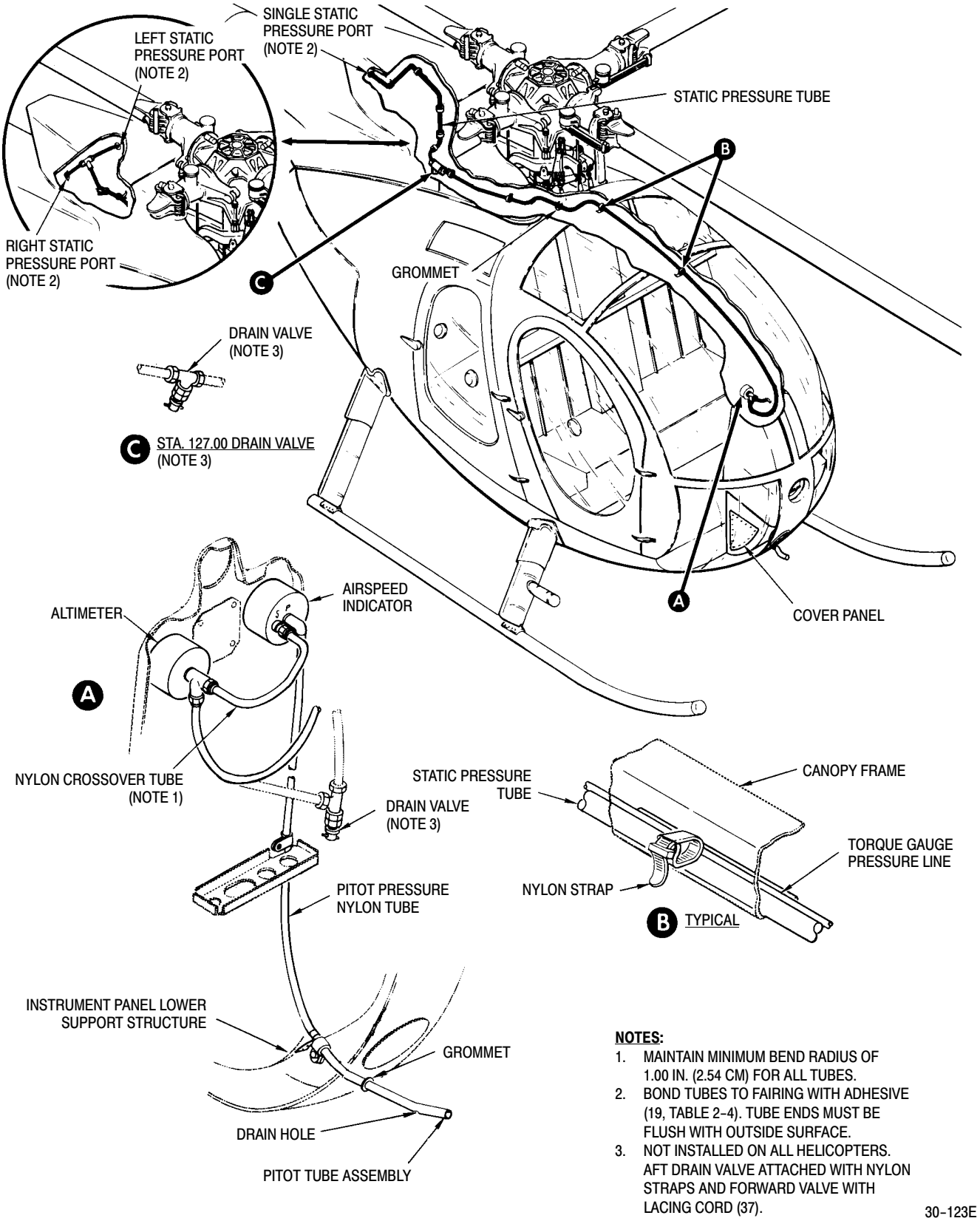


Figure 17-5. Pitot Static System

(12). Secure static pressure tube and drain valve, if installed, to canopy structure; then connect tube to tee on altimeter.

(13). Using adhesive (19, Table 2-4), bond tube to static pressure port(s) in engine air intake fairing. The outer end of the tube must be flush with the fairing surface. Connect lines of dual type to tee fitting.

(14). Connect crossover tube to altimeter and airspeed indicator.

(15). Check that system tubing and fittings are secure and air tight.

(16). Reinstall instrument panel fairings, air intake fairing and plenum chamber access door.

D. Static Pressure Tube Aft End Protective Screen Installation

(Ref. Figure 17-6) Protective screen D3738 or D4272 may be installed at the aft end of the static pressure tube to preclude entry of foreign material or objects and improve the maintainability of the pitot-static system.

(1). Check static pressure tube aft port for foreign matter; clear and clean port, as necessary.

(2). Clean faying surface of protective screen and coat with adhesive.

(3). Insert and seat protective screen in static pressure tube.

(4). Check installation of protective screen for discrepancies.

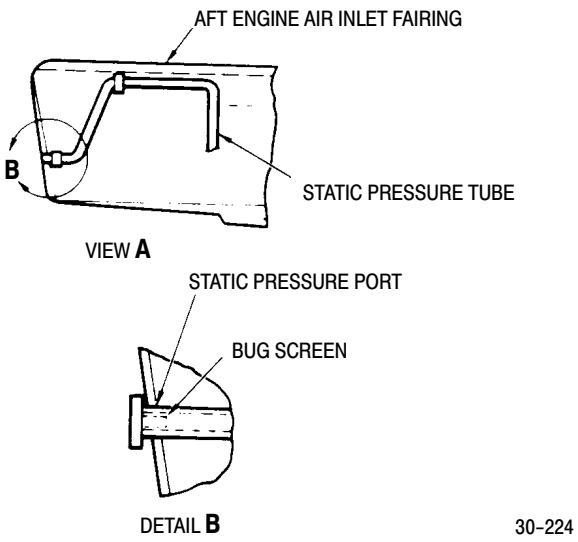


Figure 17-6. Installation of Static Pressure Tube Bug Screen

5. Altimeter

(Ref. Figure 17-1 and Figure 17-2) The altimeter presents helicopter altitude in feet above sea level under standard conditions of atmospheric pressure and temperature.

The range of the internal mechanism is 0-50,000 feet. Three pointers, concentrically arranged, indicate altitude in increments of 100, 1000 and 10,000 feet.

A small scale, located between the 2 and 3 index marking on the instrument face is calibrated in inches of mercury. The scale is rotated by a knob at the lower left of the instrument for adjustment to the ambient barometric pressure. After this adjustment is accomplished, the reading of the altimeter will indicate the actual height of the helicopter in feet above sea level.

A. Altimeter Maintenance

Use the information in Instrument Indicating System Troubleshooting thru Indicating System Instrument Repair for troubleshooting, inspection, replacement and repair of the altimeter.

6. Airspeed Indicator

(Ref. Figure 17-1 and Figure 17-2) The airspeed indicator is a pressure-sensitive unit actuated by the differential between impact and static air pressures.

The impact (pitot) pressure is connected from the pitot tube to the inside of a pressure-sensi-

tive diaphragm in the indicator case. Static air pressure, derived from the static port(s) in the engine air intake fairing, is connected to the interior of the indicator case.

The pitot tube and airspeed indicator function in forward flight only; the speed of rearward or sideward movement is not indicated.

A. Airspeed Indicator Maintenance

Use the information in Instrument Indicating System Troubleshooting thru Indicating System Instrument Repair for troubleshooting, inspection, replacement and repair of the airspeed indicator.

7. N_1, N_2 and Rotor Tachometer Indicating System

(Ref. Figure 17-1 and Figure 17-2) The N_1 tachometer indicator indicates the speed of the gas producer turbine in percent of rpm.

(Ref. Figure 17-1 and Figure 17-2) The N_2 and rotor tachometer indicator provides two indications: the actual rpm of the main rotor is indicated on the inner scale with the small ($_R$) pointer; the engine power turbine speed is indicated in percent of rpm on the outer scale with the long pointer.

Three 3-phase, 2-pole, synchronous tachometer generators produce the voltages that energize the power turbine rpm (N_2), gas producer turbine rpm (N_1) and main rotor rpm (N_R) indicators.

The N_2 and N_1 tachometer generators are located on the front of the engine accessories gear case and the N_R tachometer generator is located by the tail rotor drive output shaft on the main transmission accessory section. The tachometer generators are connected through individual wiring circuits to the indicators.

A. N_1, N_2 and N_R Tachometer Indicator Maintenance

Use the information in Instrument Indicating System Troubleshooting thru Indicating System Instrument Repair for troubleshooting, inspection, replacement and repair of the N_1, N_2 and N_R tachometer indicators.

B. Tachometer Generator Replacement

(Ref. Figure 17-7) The following instructions are typical and apply to all three tachometer generators.

(1). Gain access to the generators by opening the engine access doors or the air inlet and tail rotor drive shaft access door, as applicable.

(2). Remove electrical connector from tachometer generator and install protective cover on the generator receptacle.

(3). Remove four nuts and washers, remove bonding jumper and lift tachometer generator straight off mounting pad. Discard gasket if unserviceable.

(4). Check the grounding surface on nut side of replacement generator case flange to be sure it will provide a good electrical bond.

(5). Position gasket and generator on mounting studs with shaft aligned so that it will mate with driving gear. If generator with side mounted electrical connector is used at the transmission, install with connector outboard. Rotate driven shaft as necessary to obtain flush mounting.

(6). Secure generator with four washers and nuts, with bonding jumper attached at appropriate stud.

(7). Remove protective cover and connect electrical plug to generator receptacle.

C. Tachometer Generator Testing

(1). Connect the tachometer generator to test harness and equipment shown in Figure 17-8.

(2). Mount tachometer generator on test stand. Check that the case grounding surface has good contact.

(3). Start tachometer test stand. Set speed control to zero rpm. Turn strobe light switch to ON.

(4). Connect the tachometer generator to test setup for 20 ohm load test (test No. 1).

(5). Increase tachometer generator speed to 1000 rpm. Check phase to phase voltage; TP1 to TP2, TP1 to TP3 and TP2 to TP3. Voltage should be 3.0-4.0 Vac for each measurement.

(6). Reduce tachometer generator speed to zero, disconnect 20 ohm test setup and connect 40 ohm load test setup.

(7). Increase tachometer generator speed to 3600 rpm. Check phase to phase voltage; TP1 to TP2, TP1 to TP3 and TP2 to TP3. Voltage should be 17.5-18.5 Vac for each measurement.

(8). Increase tachometer generator speed to 4200 rpm. Check phase to phase voltage; TP1 to TP2, TP1 to TP3 and TP2 to TP3. Voltage should be 20.0-22.0 Vac for each measurement.

(9). Reduce tachometer generator speed to zero, disconnect 40 ohm test setup and prepare for open circuit test.

(10). Increase tachometer generator speed to 3600 rpm. Check phase voltage; pin A to ground, pin B to ground and pin A to pin B. Voltage should be 25.0-31.0 Vac for each measurement.

(11). Replace generator if its output does not meet test requirements.

8. Turbine Outlet Temperature (TOT) Indicating System

(Ref. Figure 17-1 and Figure 17-2) The TOT indicator indicates the temperature of the gases moving from the gas producer turbine to the power turbine.

The indicator is calibrated in major units from 0-12; reading is in degrees centigrade times one hundred (0-1200 degrees centigrade).

The indicator is energized by electrical signals received from the 8 ohm thermocouple harness mounted on the engine.

The thermocouple harness is chromel and alumel and is self-generating; there is no connection to the helicopter electrical system.

A variable resistor, mounted on a resistor board that is attached to the indicator terminals, is adjusted to establish and maintain an accurate circuit resistance of 8 ohms.

A. TOT Indicator Maintenance

Use the information in Instrument Indicating System Troubleshooting thru Indicating System Instrument Repair for troubleshooting, inspection, replacement and repair of the TOT indicator.

B. Thermocouple Harness Maintenance

The thermocouple harness that interconnects the engine thermocouple harness from the engine terminal block to the TOT indicator is a one-piece harness.

(1). Replace the helicopter thermocouple leads according to harness replacement instructions in Section 19.

(2). Replace damaged harness lead terminal; install new terminal with silver solder.

(3). Adjust TOT circuit resistance after completion of any repair.

(4). Maintain the engine thermocouple harness according to instructions in the engine operation and maintenance manual.

C. TOT Indicating System Calibration

The following procedure is to be performed periodically as specified in CSP-H-4 and when required due to system malfunction or suspected error in indications.

(1). Remove the left instrument panel fairing.

(2). Check that the engine thermocouple lead connections are tight and that there are no signs of corrosion on the terminals.

CAUTION Do not connect test equipment to the TOT indicating system until the indicator is disconnected.

(3). Disconnect resistor board TB 9 from the indicator terminal lugs and remove indicator from instrument panel

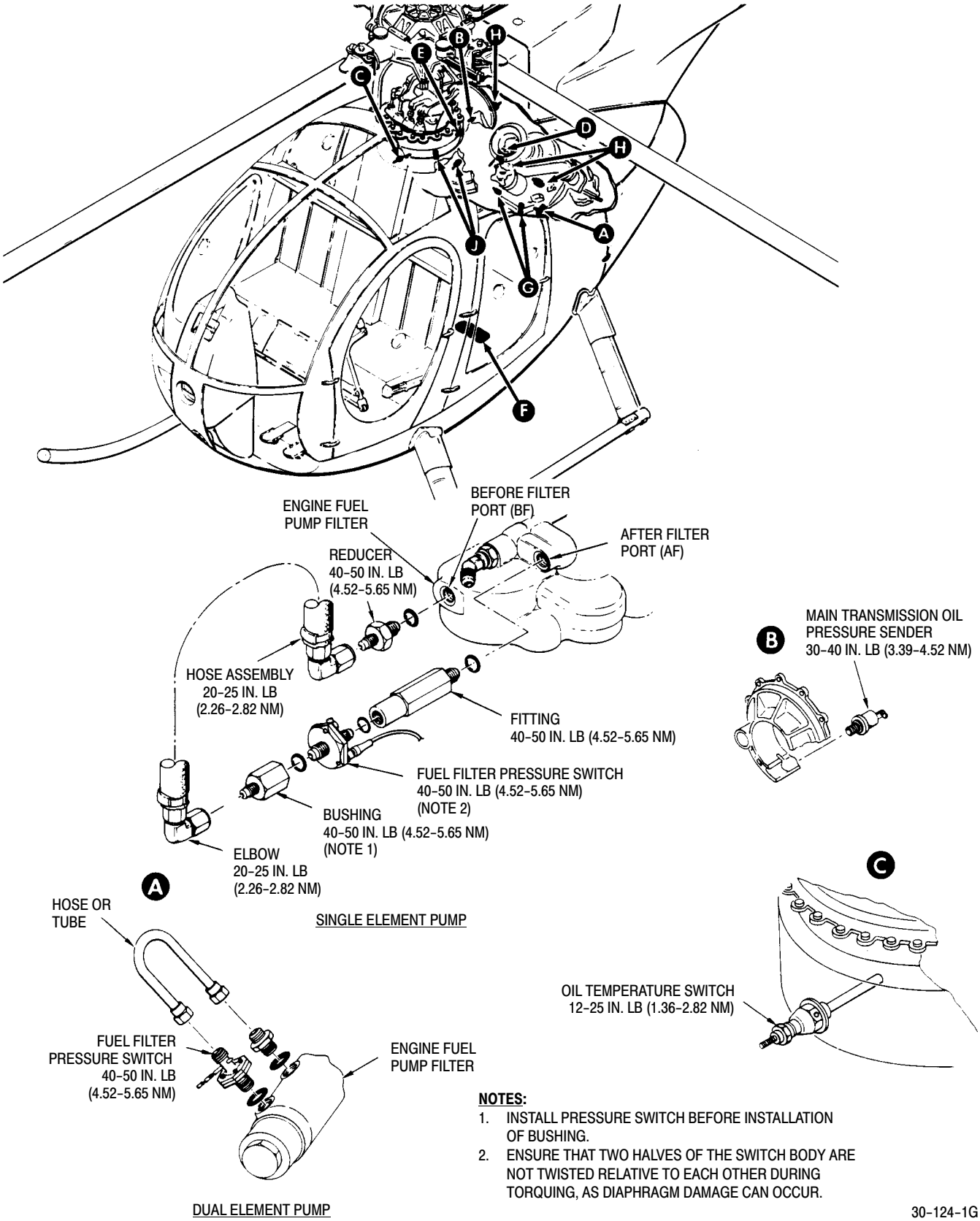


Figure 17-7. Indicating System Electrical Senders (Sheet 1 of 3)

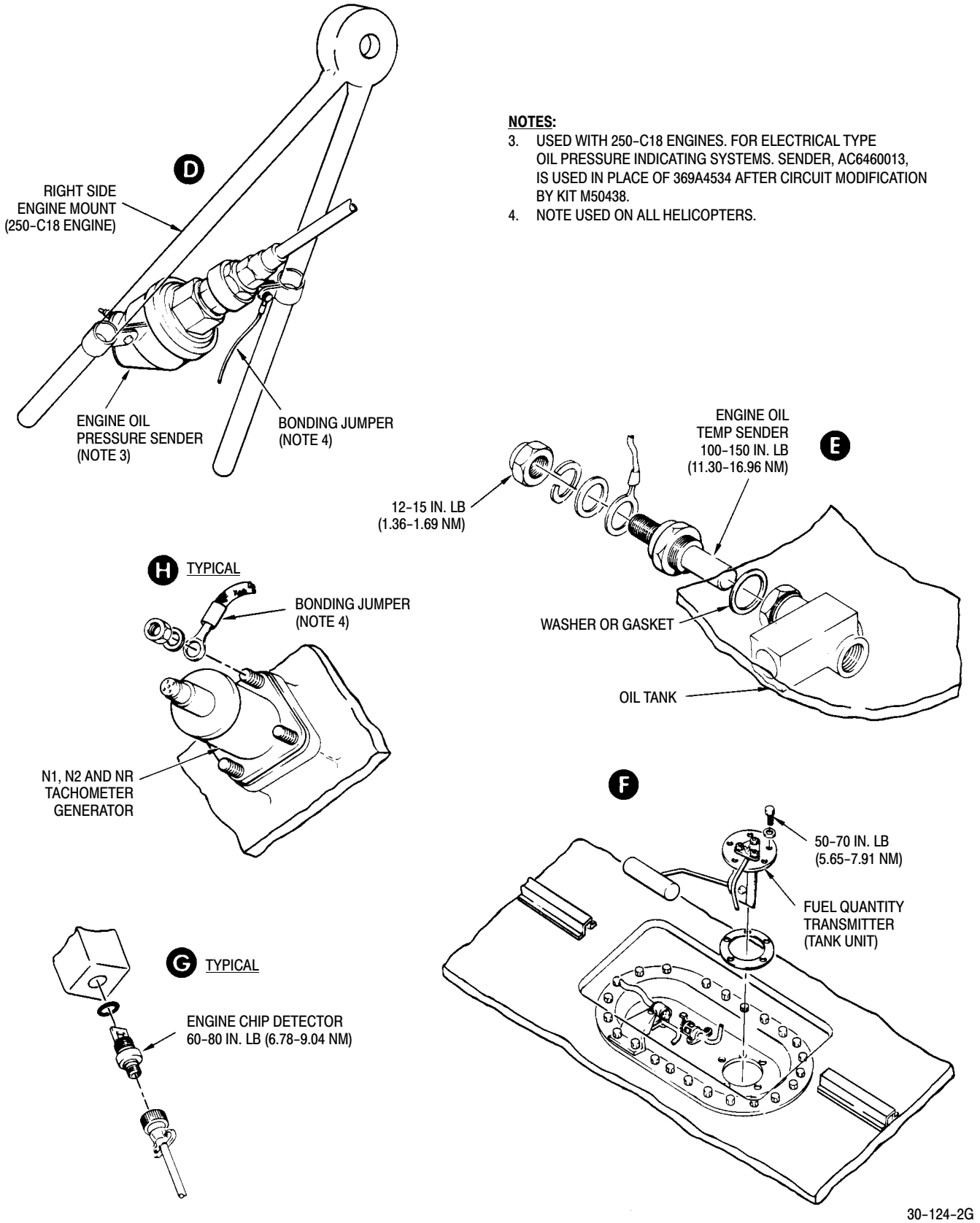


Figure 17-7. Indicating System Electrical Senders (Sheet 2 of 3)

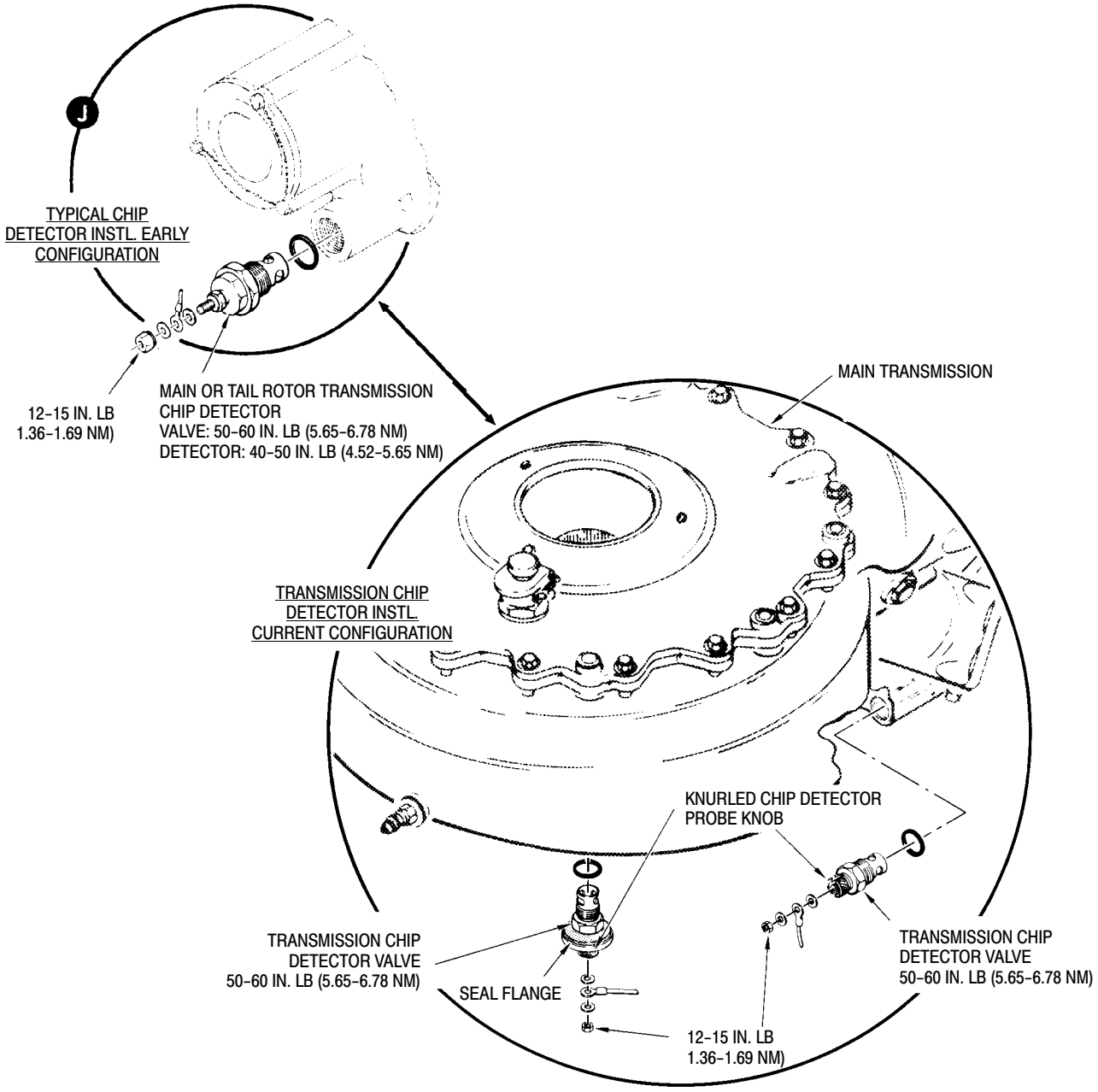
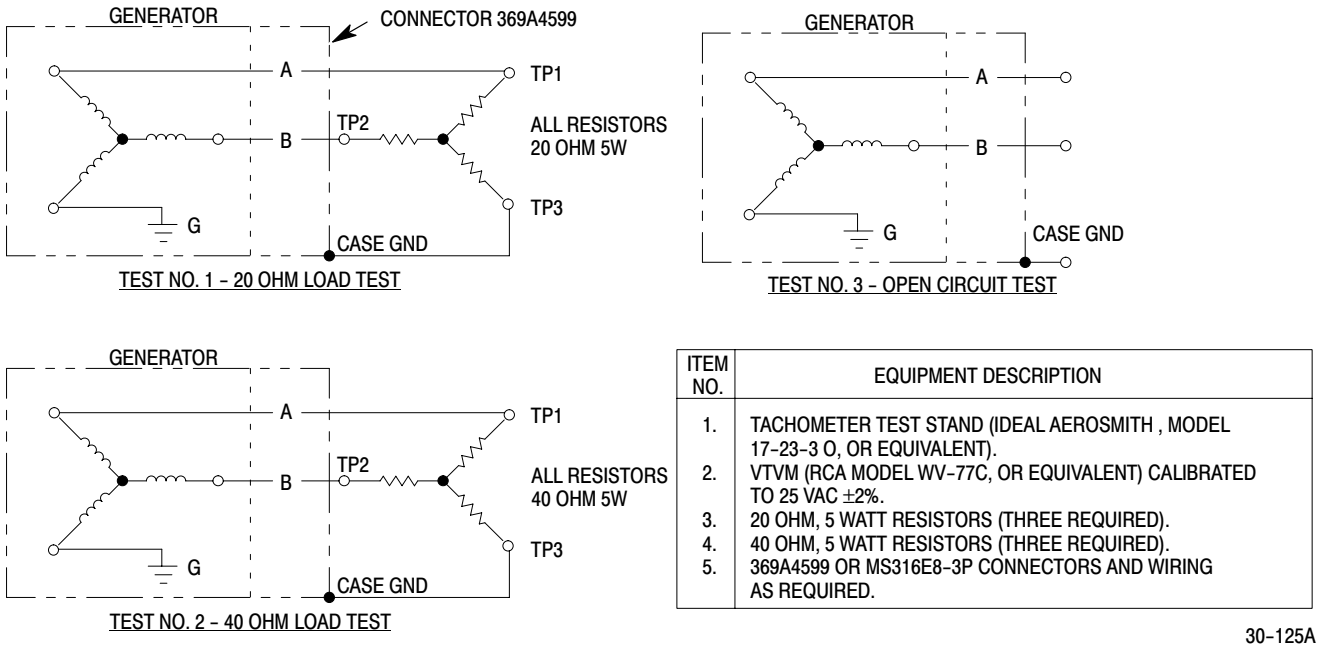


Figure 17-7. Indicating System Electrical Senders (Sheet 3 of 3)



ITEM NO.	EQUIPMENT DESCRIPTION
1.	TACHOMETER TEST STAND (IDEAL AEROSMITH , MODEL 17-23-3 O, OR EQUIVALENT).
2.	VTVM (RCA MODEL WV-77C, OR EQUIVALENT) CALIBRATED TO 25 VAC ±2%.
3.	20 OHM, 5 WATT RESISTORS (THREE REQUIRED).
4.	40 OHM, 5 WATT RESISTORS (THREE REQUIRED).
5.	369A4599 OR MS316E8-3P CONNECTORS AND WIRING AS REQUIRED.

30-125A

Figure 17-8. Test Hookup For Tachometer Generator

(4). Using tester (52, Table 2-2) or an equivalent precision ohmmeter, check total circuit resistance through resistor R 4 and complete thermocouple system. Resistance must be 8 +0.05, -0.0 ohms. If adjustment is required, loosen screw and retighten finger-tight in sliding contact on older type resistor R4 or by turning rotating contact on resistor currently being used, adjust contact position to obtain specified resistance. Fully tighten screw on older type resistor. Recheck resistance and repeat adjustment, if necessary.

(5). Connect tester or an equivalent tester to the indicator terminal lugs. Select 750°C (250-C18) or 790° (250-C20) on the tester dial. The indicator must indicate the selected temperature ±5°C,. Adjust slotted adjustment screw on back of indicator if required.

(6). Select 1000°C on tester dial; the indicator must indicate 1000° ±20°C. If this requirement is not met, recheck adjustment of repeating step (5).

(7). Seal the adjustment screw on the back of the indicator with a small amount of sealant (24, Table 2-4) and reinstall indicator in the instrument panel.

(8). Reconnect TB 9 to indicator terminal lugs and reinstall instrument panel fairings.

9. Engine Torque Indicating System

(Ref. Figure 17-1 and Figure 17-2) The torque gage indicates engine torque supplied to the engine output shaft.

The torque gage is a reading instrument that indicates a pound-per-square inch reading equivalent to the amount of pressure (torque) exerted on the accessory gear train by the turbine output shaft.

Oil pressure is routed from the torquemeter pressure port of the engine through metal tubing and nylon tubing to the gage.

A. Torque Gage Maintenance

WARNING **Federal Aviation Administration rules CAR 6.606(b) & 6.613 require the installation of a restriction device at the pressure source of engine oil and torque sensing system to restrict oil flow in the event of system failure. (Refer to HN-221).**

Use the information in Instrument Indicating System Troubleshooting thru Indicating System Instrument Repair for troubleshooting, inspection, replacement and repair of the torque gauge.

B. Torque Gage Pressure Line Removal

(Ref. Figure 17-9)

(1). Forward Tube Section (Nylon):

(a). Check that all electrical power is OFF and remove left instrument panel fairing.

(b). Disconnect pressure line from fitting on torque gage (detail B).

(c). Cap the openings in torque gage and pressure line.

(d). Remove nylon pressure line by releasing or cutting the three nylon straps along center canopy frame (detail C). If center tube section (aluminum alloy or corrosion-resistant steel) is installed, disconnect the pressure line nut at upper frame of canted Sta. 78.50 (detail F). Cap end of line

(e). Remove left forward air inlet fairing and left aft bulkhead access cover in cargo compartment.

(f). Remove screws, clamps, nuts and washers that secure line along left side of mast support structure and at left side of air inlet (plenum) chamber (detail D).

(g). If center tube section (aluminum alloy or corrosion-resistant steel) is installed, disconnect pressure line nuts at bulkhead fittings. Cap ends of line.

(2). Aft Tube Section (Corrosion-Resistant Steel):

(a). Open left engine compartment access door.

(b). Remove screw, clamp, nut and washer (detail D).

(c). Disconnect pressure line nuts at plenum chamber pan fitting and at engine torquemeter fitting (details E and A).

C. Torque Gage Pressure Lines Installation

NOTE: At replacement, use only a 3/16 inch diameter nylon forward tube section line. The 3/16 inch diameter replacement line is longer and replaces both the 1/8 inch diameter forward tube section and 1/8 inch aluminum (or corrosion- resistant steel) center tube section on an early installation. After replacement of any section of the pressure line installation, pressure and leak test the assembled lines between the engine and the gage at 200 psi (1379 kPa).

(1). Forward Tube Section (Nylon):

(a). Remove covers from pressure line and torque gage fitting.

(b). Connect pressure line to torque gage. Connect bleed valve at torquemeter on helicopters so equipped.

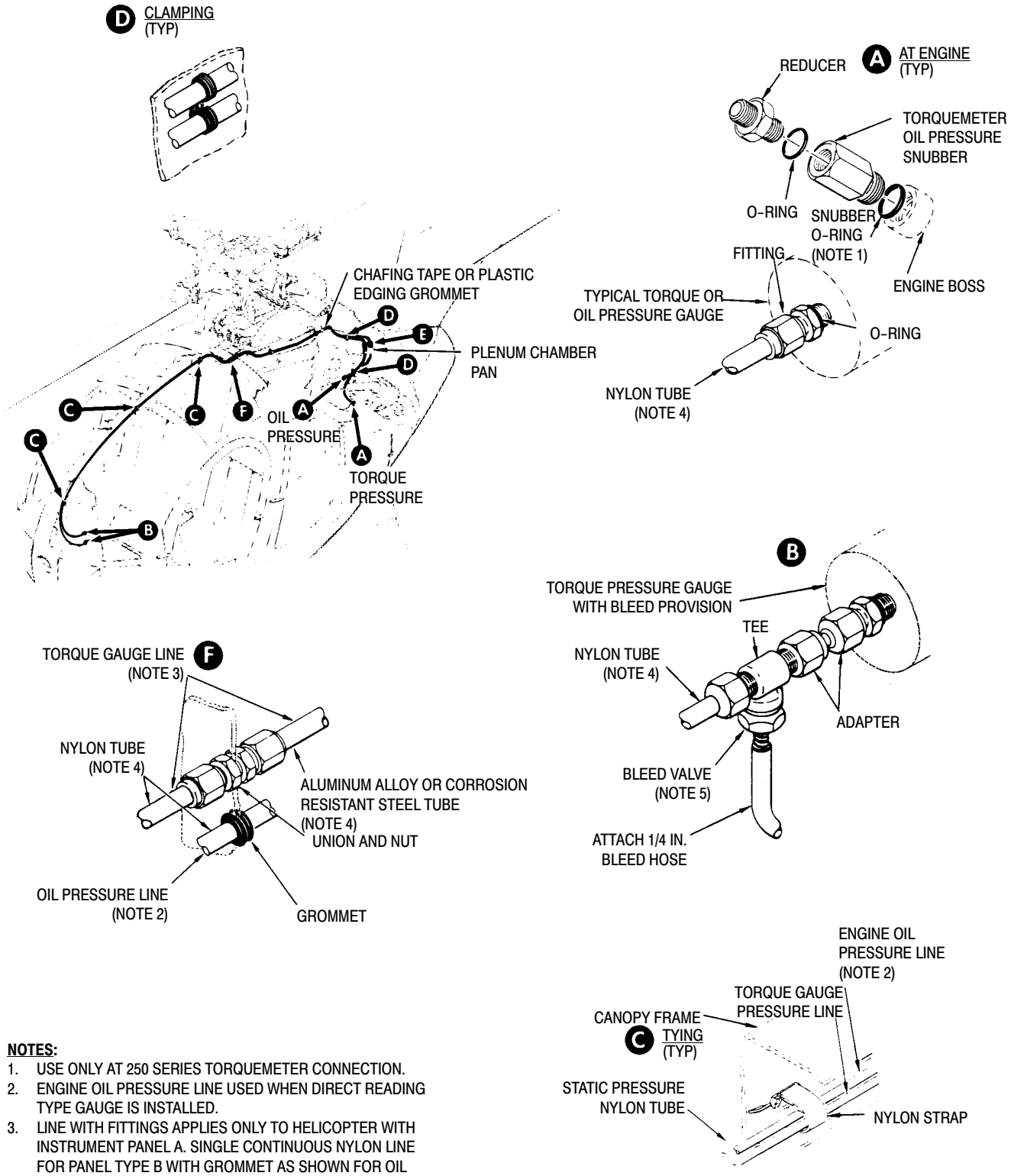
(c). Route line along center canopy frame, and connect line to bulkhead at upper frame of canted Sta. 78.50.

(d). If a fitting is installed at bulkhead and a 1/8 inch diameter nylon line is being reinstalled, connect the line to the fitting. Or if a 3/16 inch diameter line is being installed, remove any fitting at the bulkhead and route line aft through hole in bulkhead to plenum chamber pan fitting. Use grommet to secure line in bulkhead hole.

1). Wrap duct tape around tube, approximately one inch in front of bulkhead fittings.

2). Tie a small loop in one end of a 2-3 foot (0.6-0.9 m) length of cord. Tie opposite end of cord to tube using a rolling hitch; slide rolling hitch down tube until it rests on duct tape; tighten hitch.

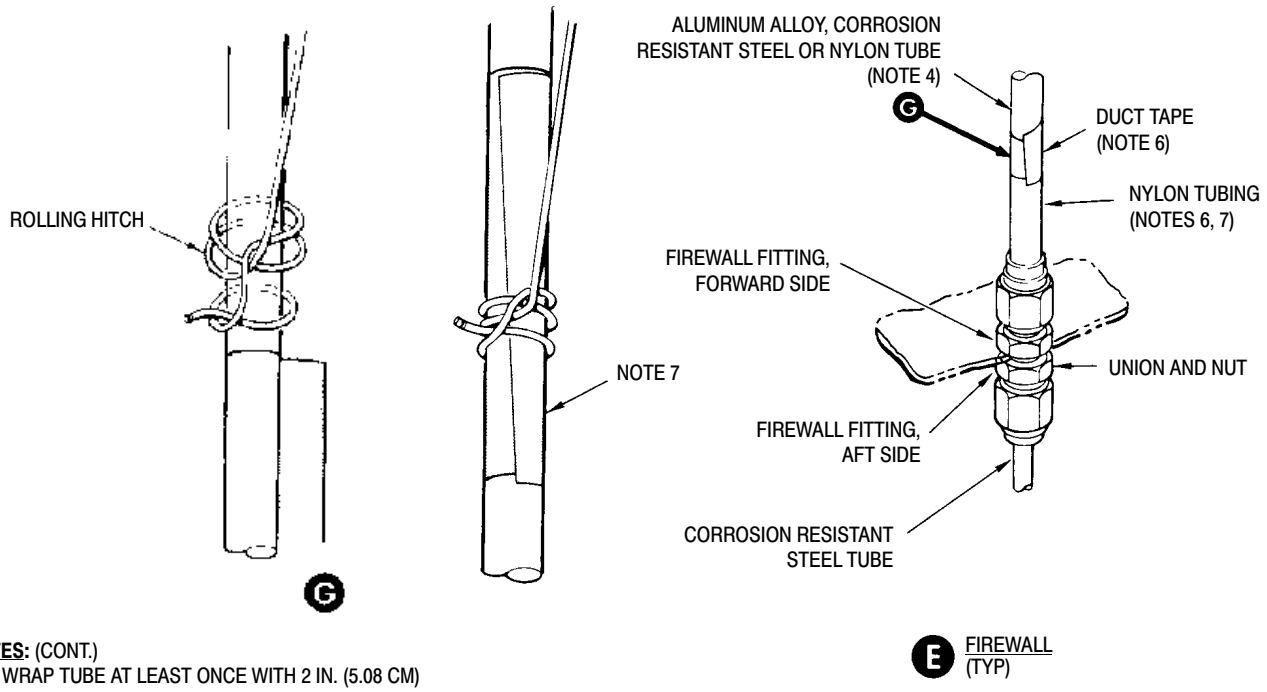
3). Using a short body length spring scale, capacity, **0 - 25 pounds(0 - 12 kg)**, attach hook on scale to loop in free end of cord. Apply **15 - 20 Lbs. (6.80 - 11.34 kg)** straight pull, using cord. on oil pressure tube for approximately 15 seconds. If tube pulls partially or completely out of fitting, replace fitting.



NOTES:

1. USE ONLY AT 250 SERIES TORQUEMETER CONNECTION.
2. ENGINE OIL PRESSURE LINE USED WHEN DIRECT READING TYPE GAUGE IS INSTALLED.
3. LINE WITH FITTINGS APPLIES ONLY TO HELICOPTER WITH INSTRUMENT PANEL A. SINGLE CONTINUOUS NYLON LINE FOR PANEL TYPE B WITH GROMMET AS SHOWN FOR OIL PRESSURE LINE (REF. NOTE 4).
4. AT REPLACEMENT, USE SINGLE CONTINUOUS 3/16 IN. O.D. LINE. ORIGINAL LINES ARE 3/16 IN. O.D. FOR PANEL TYPE B AND 1/8 IN. O.D. FOR PANEL TYPE B.
5. AT INSTALLATION, WRAP VALVE THREADS WITH TEFLON TAPE (79, TABLE 2-4).

Figure 17-9. Torque Gage and Direct Reading Engine Oil Pressure Gage (Sheet 1 of 2)



NOTES: (CONT.)
6. WRAP TUBE AT LEAST ONCE WITH 2 IN. (5.08 CM) WIDE DUCT TAPE APPROX. 1 IN. (2.54 CM) FROM FITTING.
7. SLIDE HITCH DOWN TUBE UNTIL IT RESTS ON DUCT TAPE.

30-126-2

Figure 17-9. Torque Gage and Direct Reading Engine Oil Pressure Gage (Sheet 2 of 2)

4). Remove cord, scale and duct tape from tube assembly.

(e). Secure line in place along side static pressure line, using the canopy frame slots and nylon straps, or tying twine (30, Table 2-4) if straps arc is not available.

(f). After pressure and leak test, reinstall instrument panel fairing.

(2). Aft Tube Section (Corrosion-Resistant Steel):

(a). Locate pressure line in position, connect to plenum chamber pan fitting and engine torquemeter fitting, and tighten.

(b). Secure pressure line to left side of mast support structure and plenum chamber with screws, clamps, washers and nuts or stand-off (detail D).

(c). After pressure and leak test, secure engine compartment access door.

(3). Center Tube Section (Aluminum Alloy or Corrosion-Resistant Steel):

NOTE: Following procedure is for reinstallation of 1/8 inch OD center tube section. For replacement, a single longer 3/16 inch OD nylon forward tube section replaces both the 1/8 inch OD nylon forward tube section and 1/8 inch OD center tube section.

(a). Locate pressure line in position, connect to bulkhead fittings, and tighten.

(b). Wrap length of aluminum tubing where it is routed past aft corner of mast support structure and into plenum chamber, using tape and activator (56, Table 2-4), to prevent chafing between the tube and structure. Steel tubing has a plastic edging grommet instead of tape.

(c). Secure line along left side of mast support structure and at left side of plenum chamber with screws, clamps, nuts and washers (detail D).

(d). After pressure and leak test, install left forward air intake fairing and left aft bulkhead access cover in cargo compartment.

10. Direct Reading Oil Pressure Indicating System

The direct reading engine oil pressure indicating system utilizes a pressure gage of 0-150 psi (0-1035 kPa) capacity which is mounted near other engine instruments in instrument panel type B (Figure 17-2). The gage is connected to an oil pressure port on the front face of the engine accessory section by 1/8 inch diameter corrosion resistant steel and nylon tubing. The tubing is in two sections, with corrosion resistant steel being used aft of the engine firewall and nylon tubing forward of the firewall. The tubing is routed adjacent to the torque gage tubing from the firewall to the instrument panel and some tie straps and clamping arrangements are common to both (Figure 17-9).

A. Engine Oil Pressure Gage Tubing Replacement

Replace engine oil pressure gage tubing using, in general, the instructions provided for replacement of torque gage tubing. After replacement, service and bleed the system.

B. Torque or Direct Reading Engine Oil Pressure Line Bleeding and Servicing

NOTE: On helicopters equipped with a plunger actuated bleed valve at the torquemeter fitting, gain access to the rear of the torquemeter and attach a 1/4 inch diameter drain hose at the bleed valve. For best access, remove an adjacent instrument or avionics unit not necessary to ground operation of the helicopter. Proceed with bleeding and servicing described below; or service and bleed system with engine operating by depressing valve plunger until clear engine oil flows through the drain hose into a container.

(1). Remove left instrument panel fairing.

(2). Open engine compartment left access door.

(3). Wrap cloth around gage line under fitting at engine and at the back of the instrument.

(4). Loosen, but do not remove, pressure tube fitting at engine.

(5). Disconnect pressure line from fitting at gage.

NOTE: During filling of line, do not introduce any air bubbles into the system. Use a suitable pump with sufficient volume to fill the entire length of the pressure line.

(6). At gage end, pump the pressure line full with new engine oil. Force oil through the line until clean oil flows at the engine end.

(7). Tighten tube fitting at the engine and continue to pump a small amount of oil back into the engine.

(8). Install and tighten gage line fitting at back of instrument. Keep the line as full as possible during connection.

(9). Start and operate engine at idle according to the Owner's Manual and check for visible air bubbles in the forward nylon line.

(10). If air bubbles are present (introduced during connection at instrument), momentarily loosen fitting at back of instrument and bleed system with engine running.

NOTE: A higher power setting may be required to obtain adequate pressure.

11. Instrument Cluster Three-Pack or Four-Pack Indicating System

(Ref. Figure 17-10 and Figure 17-11) The instrument cluster is an instrument assembly built as a single unit with three or four indicators. The instrument clusters are identical except that the 3-pack does not include an engine oil pressure indicator and is not internally illuminated.

Indicators register generator output in amperes, engine oil pressure in pounds-per-square inch (4-pack), engine oil temperature in degrees centigrade and operating fuel weight in pounds.

The helicopter electrical system voltage of 28 Vdc is reduced to a nominal 14.5 Vdc by voltage dropping resistor R1, located on terminal board TB8 mounted on the structure beneath the left side pilot's compartment floor, for instrument circuit power.

The senders for the engine oil pressure (4-pack), engine temperature and fuel

quantity indicators each function as the variable resistance leg of the associated instrument bridge circuit.

As pressure, temperature or float arm position change, the sender resistance changes and causes an imbalance in current flow through the indicator windings to produce pointer movement.

Except for the ammeter, external, fixed value shunt resistors are mounted across the input terminals of each of these instruments and furnished as part of the cluster (Figure 17-11).

An exception is the (4-pack) oil pressure circuit which has a separate adjustable potentiometer for indicator calibration. This potentiometer is used in conjunction with PN 6460013 pressure sender and is located on panel structure forward of and below the 4-pack cluster.

Ammeter pointer deflection is a result of current flow through resistor R3 which is located next to the reverse current relay in the engine compartment. The resistor, installed in the low voltage output (ammeter) circuit of the starter-generator , acts as a calibrating resistance to cause ammeter pointer movement that is proportional to the main power output of the generator.

A plus scale reading on the ammeter indicates the current demand of the helicopter electrical system during normal generator operation. Minus amperage is indicated only during engine starting and shows the current demand of the starter.

Resistor R112, mounted at terminal point 8 on the back of a 4-pack cluster, is an input voltage dropping resistor for the instrument lights circuit and functions only when night lighting is installed.

A. Instrument Cluster Three-Pack or Four-Pack Maintenance

Use the information in Instrument Indicating System Troubleshooting thru Indicating System Instrument Repair for troubleshooting, inspection, replacement and repair of the instrument cluster.

NOTE: The individual indicators of the instrument cluster are not replaceable. If there is an indicator malfunction, the complete unit should be replaced. Remove the wiring harness for reinstallation of a replacement instrument cluster (Figure 17-11 for 4-pack or Figure 17-10 for a 3-pack); resistor R112 is supplied as part of a new 4-pack cluster assembly.

B. Instrument Cluster Three-Pack or Four-Pack Calibration Check

This calibration check is to be performed at a qualified instrument calibration facility. The following calibration information is supplied for reference only, for convenience of the calibration facility. All calibration checks are to be made with precision equipment, carefully observing polarities and with face on instrument cluster positioned approximately vertically.

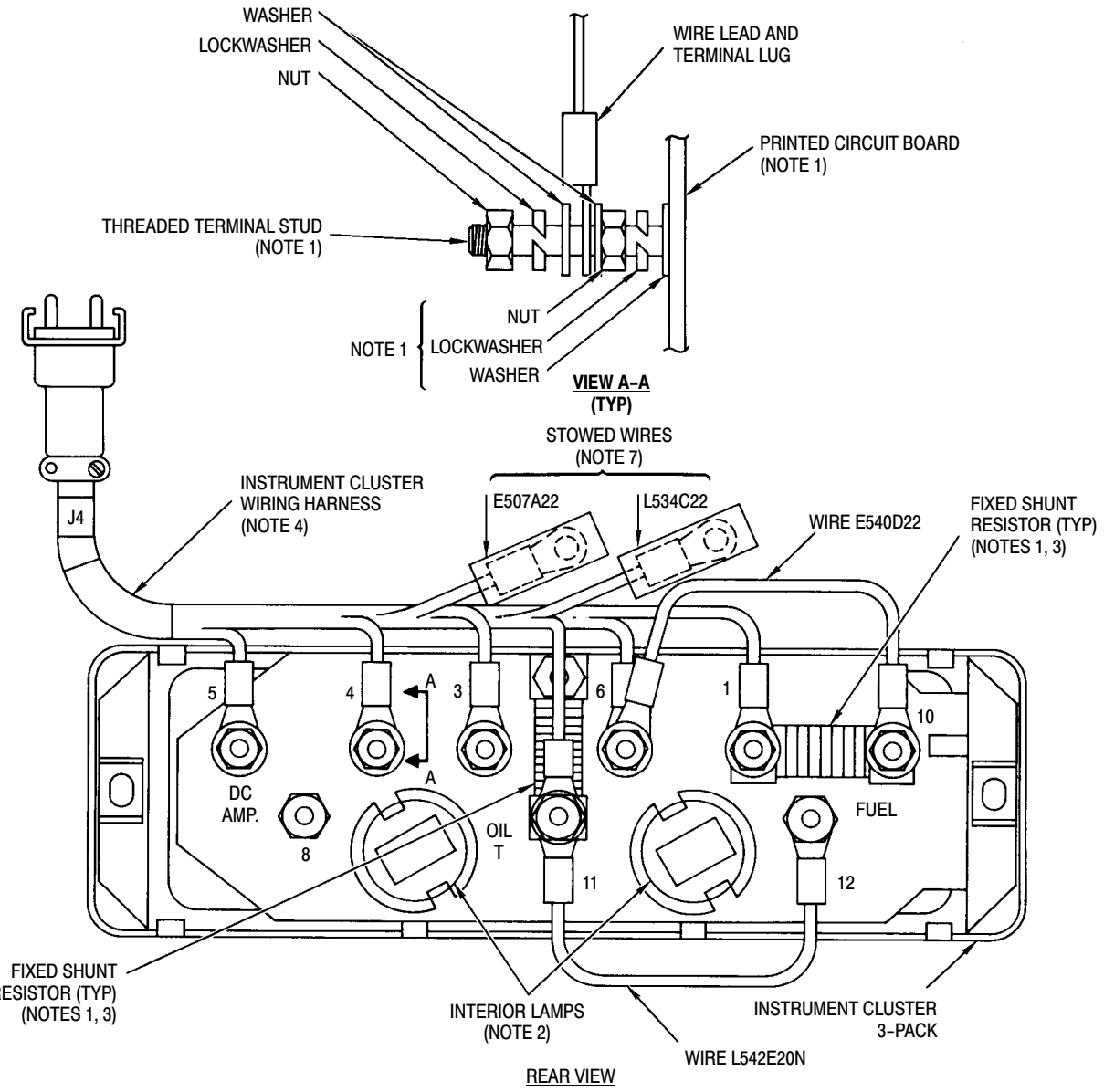
NOTE: Supply voltage is to be 14.5 ±0.3 Vdc for all following checks. To measure and adjust resistance of variable resistor in the checks, supply voltage source and variable resistor must be disconnected from circuits. For information on the specific terminal studs used for individual gages in the cluster, see Figure 17-10 for a 3-pack or Figure 17-11 for a 4-pack. Gages of the instrument cluster should provide indications within the tolerances specified in following checks regardless of cluster position. Vertical position is specified only to approximate the installation position in the helicopter. For a 3-pack, scale error determined at any major graduation that is checked should not exceed 5 percent of the full scale value.

(1). Fuel Quantity Gage:

(a). Obtain a variable resistor that is continuously variable over a minimum range of 0-90 ohms, and adjust it to provide 59 ohms resistance.

(b). Connect the 59 ohm resistance across the terminal studs for the fuel quantity gage and power input ground.

(c). Apply supply voltage to instrument cluster. Note that the gage indicates approximately 200 pounds (2 mark) and keep supply voltage applied approximately 5 minutes.



NOTES:

1. PART OF AND FURNISHED WITH INSTRUMENT CLUSTER.
2. NOT USED.
3. FOR ASSOCIATED INDICATOR INSIDE CLUSTER.
4. FOR INFORMATION ON HARNESS CONNECTION WIRING BETWEEN CONNECTOR J4 AND THREADED TERMINAL STUDS, SEE APPLICABLE ELECTRICAL SYSTEM WIRING DIAGRAM (REF. SEC. 20).
5. THREADED STUDS:

NO.	ITEM
1	FUEL QUANTITY GAUGE
3	OIL TEMPERATURE GAUGE
4	AMMETER – (GND)
5	AMMETER +
6	+14.5 VDC POWER INPUT
8	–POWER INPUT, COMMON GND (NOTE 6)

6. ALSO GND FOR FUEL QUANTITY AND TEMPERATURE GAUGES.
7. WIRE END INSULATED AND SECURED AT STOWED POSITION.

30–193–1

Figure 17-10. Instrument Cluster Three-Pack with Wiring Harness (Instrument Panel Type B) (Sheet 1 of 2)

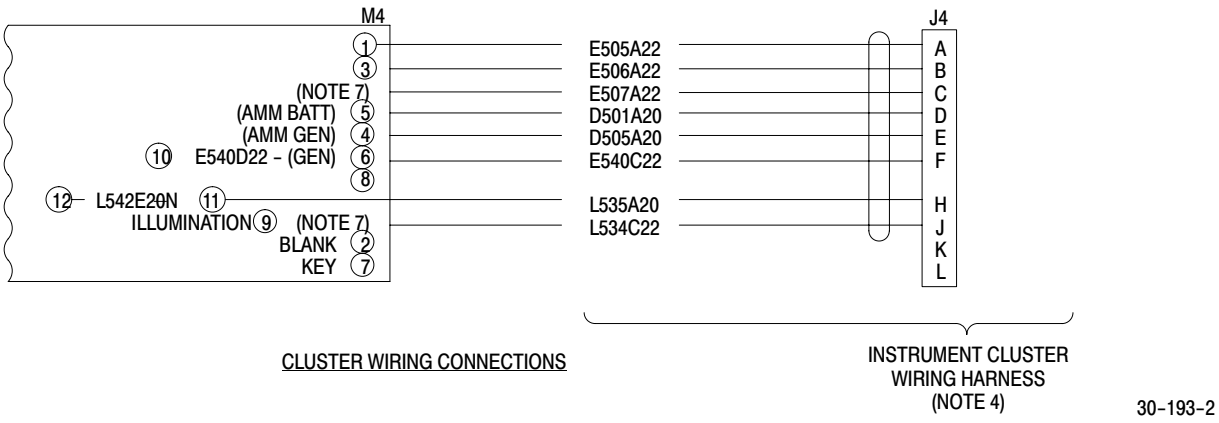


Figure 17-10. Instrument Cluster Three-pack with Wiring Harness (Instrument Panel Type B) (Sheet 2 of 2)

(d). Remove supply voltage and adjust resistance to 88 ohms. Reapply supply voltage and check that pointer ascends and indicates full (F). Centerline of pointer should align with ±4° of centerline of F mark.

NOTE: Checks, steps (e). and (f)., are to be performed with descending pointer.

(e). Remove supply voltage and adjust resistance to 59 ohms. Reapply supply voltage and check that gage indicates 200 pounds (2 mark). Centerline of pointer should align with ±3° of centerline of 2 mark.

(f). Remove supply voltage and adjust resistance to 1 ohm. Reapply supply voltage and check that gage indicates empty (E). Centerline of pointer should align with -2° of centerline of E mark.

(g). Disconnect supply voltage source and variable resistor from terminals of the cluster.

(2). Engine Oil Temperature Gage:

(a). Obtain a variable resistor that is continuously variable over a minimum range of 0-750 ohms, and adjust it to provide 139 ohms resistance.

(b). Connect the 139 ohm resistance across the terminal studs for the engine oil temperature gage and power input ground.

(c). Apply supply voltage to instrument cluster. Note that the gage indicates approximately midrange (mid-range mark) and keep supply voltage applied approximately 5 minutes.

NOTE: Checks, steps (d). thru (f)., are to be performed with ascending pointer.

(d). Remove supply voltage and adjust resistance to 734 ohms. Reapply supply voltage and check that pointer ascends and indicates 15°C. Centerline of pointer should align with ±2° of centerline of 15 mark.

(e). Remove supply voltage and adjust resistance to 139 ohms. Reapply supply voltage and check that pointer indicates mid-range. Centerline of pointer should align with ±3° of centerline of mid-range mark.

(f). Remove supply voltage and adjust resistance to 46.3 ohms. Reapply supply voltage and check that gage indicates 125°C. Centerline of pointer should align within ±2° of centerline of 125 mark.

(g). Disconnect supply voltage source and variable resistor from terminal studs of the cluster.

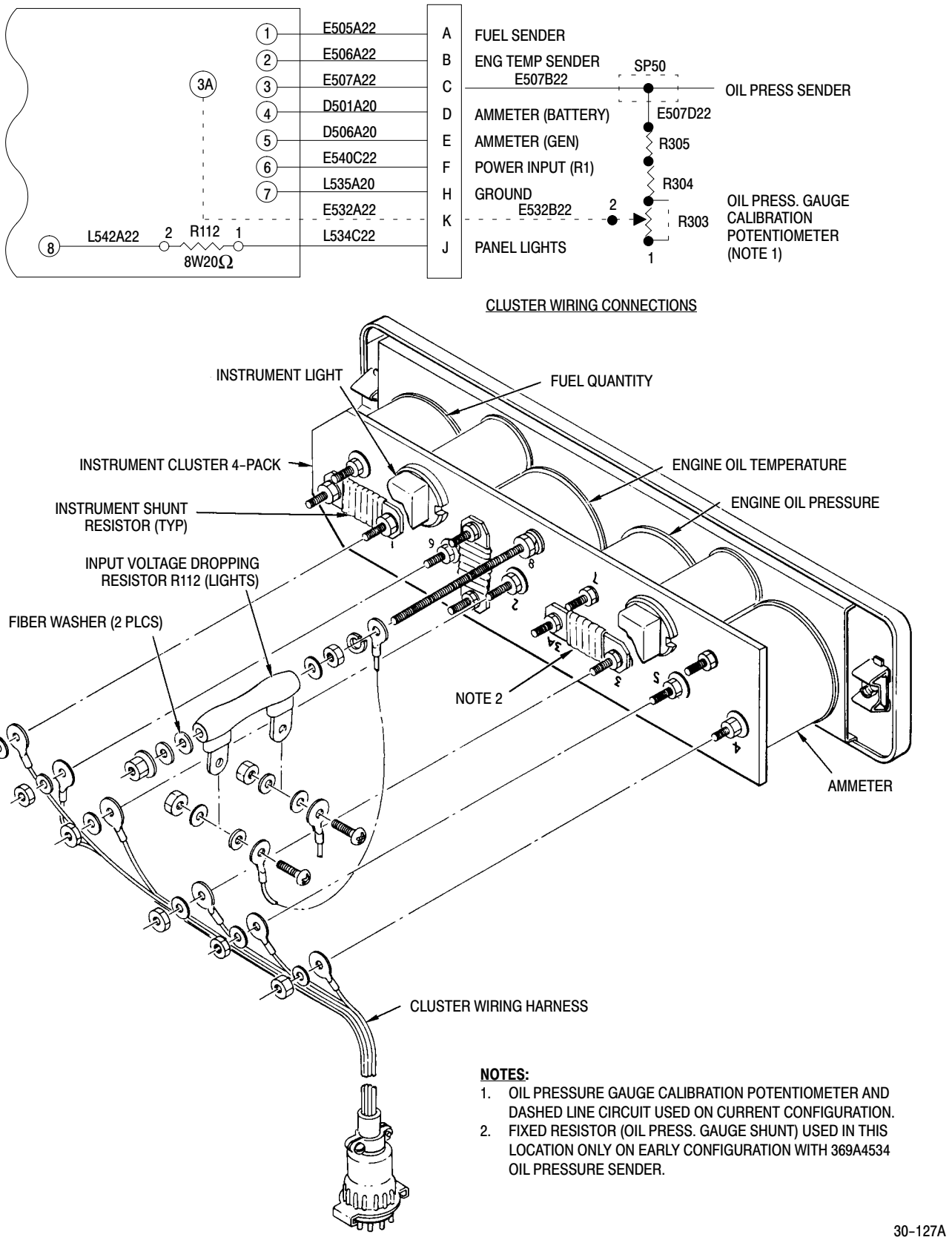


Figure 17-11. Instrument Cluster Four-Pack with Wiring Harness

(3). Ammeter Gage:

WARNING **Comply with applicable electrical safety precautions when checking the ammeter gage.**

(a). Connect a variable resistance load, a test ammeter and the ammeter gage to be tested in a series circuit to a 14.5 ±0.3 Vdc supply source that is capable of supplying 1.38 amperes through the circuit.

NOTE: Variable resistance load must be adjustable to provide either a total current of 0.75 or 1.38 amperes through the combined resistance of the variable load, test ammeter and ammeter gage being tested. Make resistance measurements and/or calculate required values of load resistance for use with the test ammeter in the series circuit as necessary. A current flow of 0.75 ampere through the ammeter gage being tested should result in a 75 ampere indication on the gage.

(b). Set variable load to correct resistance and apply supply voltage with the required polarity to provide a +0.75 ampere current reading on the test ammeter and a +75 ampere indication on the ammeter gage being tested. Centerline of pointer should align within ±4° of centerline of +75 mark.

(c). Remove supply voltage from cluster.

(d). Set variable load to correct resistance and apply supply voltage with the correct polarity to provide a -1.38 amperes current reading on the test ammeter and a negative current indication on the ammeter gage being tested. Pointer on ammeter gage being tested should indicate between -75 and -150.

(e). Remove supply voltage from cluster and check that ammeter gage being tested indicates 0 (zero). Centerline of pointer should return to and align with ±3° of centerline of 0 mark.

(f). Disconnect variable load resistor and test ammeter from ammeter gage being tested.

(4). Engine Oil Pressure Gage (4-Pack):

(a). Obtain a variable resistor that is continuously variable over a minimum range of 0-90 ohms, and adjust it to provide a resistance of 1 ohm.

(b). Connect the 1 ohm resistance across the terminal studs for the engine oil pressure gage and power input ground.

NOTE: Checks steps (c). thru (f). are to be performed with ascending pointer.

(c). Apply supply voltage to instrument cluster. Note that gage indicates approximately 0 pounds per square inch (psi). Centerline of pointer should align within ±2° of 0 psi mark.

(d). Remove supply voltage and adjust resistance to 59 ohms. Reapply supply voltage and check that pointer ascends and indicates 90 psi. Centerline of pointer should align within ±3° of 90 psi mark.

(e). Remove supply voltage and adjust resistance to 88 ohms. Reapply supply voltage and check that pointer ascends and indicates 125 psi. Centerline of pointer should align within ±2° of 125 psi mark.

(f). Disconnect supply voltage source and variable resistor from terminals of the cluster.

(5). All Gages:

Without supply voltage applied to cluster, check that each pointer in the cluster returns to a position at or below the lowest calibration mark of its gage.

12. Engine Oil Temperature Sender

(Ref. Figure 17-7)

A. Engine Oil Temperature Sender Replacement

(1). Check that all electrical power is OFF.

(2). Drain the engine oil tank.

(3). Disconnect electrical wire from oil temperature sender, cut safetywire and remove sender from bushing in oil tank

fitting; keep sender washer for reinstallation if it is serviceable. (Plug tank fitting and insulate wire terminals when replacement sender is not immediately available.

NOTE: 369A4533- BSC sensor is compatible with the 369D296305- 21, -23 and -31 instrument clusters only. 369A4533-3 sensor is compatible with the 369D296305-33, -35 and -37 instrument clusters only.

(4). Install replacement sender with serviceable or new washer or gasket and tighten to **100 - 150 inch-pounds (11.30 - 16.95 Nm)**. Lockwire the sender to oil tank bushing. Connect electrical wire.

(5). Fill the engine oil tank.

(6). Start the engine according to Owner's Manual and check for oil leakage and proper operation of the temperature system indicator.

(7). Reinstall aft bulkhead access cover.

13. Engine Electrical Oil Pressure System

A. Engine Electrical Oil Pressure Sender Replacement

(1). Check that all electrical power is OFF.

(2). Disconnect electrical wire and pressure line from oil pressure sender mounted on right engine mount; use suitable means to catch residual oil from line. (Cap pressure line and sender, and insulate wire terminal when replacement sender is not immediately available).

(3). Observe locations of mounting clamps; then remove clamps, bonding jumper and sender from mount.

(4). Using the two removed support clamps, install replacement sender on engine mount but do not tighten clamps.

NOTE: The small clamp and bonding jumper provides the bonding path between the sender and firewall. Be sure that sender bonding is as specified in Maintenance of Electrical Bonding Connections, Section 19.

(5). Tightly wrap two to three turns of white teflon tape (79, Table 2-4) on sender pipe threads. Connect pressure line and check both ends of tube for security.

(6). Tighten clamp bolts and connect electrical wire.

(7). Start the engine according to Owner's Manual and check for oil leakage and proper operation of the pressure system indicator.

B. Electrical Oil Pressure Gage Calibration

Calibrate oil pressure gage systems having adjustment potentiometer R303 and PN 640013 pressure sender, using one of the following methods.

(1). Method I:

The following equipment is required: A 0-150 psi (0-1035 kPa) pressure gage with 1 percent accuracy, high pressure hose and tee fitting to connect into the engine oil pressure sender inlet line.

(a). Disconnect engine oil pressure inlet line from sender (Figure 17-7) and reconnect with the tee fitting in the line.

(b). Connect master gage to high pressure hose, fill the hose and gage with engine lubricating oil (Table 2-3); then connect to the tee fitting.

(c). Locate potentiometer R303 on instrument panel structure. Loosen adjustment locknut and set potentiometer at approximate mid-range.

(d). Start and operate the engine at idle in accordance with the Owner's Manual. Observe oil pressure indication on the master gage. If indication is erratic, bleed out air by loosening hose fitting at the gage.

(e). Increase engine N_1 to 80 percent. The stabilized oil pressure at this point should be in the 90-130 psi (621-896 kPa) range on the master gage. If oil pressure is not in this range, the engine oil pressure regulator will require adjustment according to engine operation and maintenance manual.

(f). While maintaining 80 percent N_1, adjust potentiometer R303 until four-pack gage indicates the same pressure as the master gage. Tighten potentiometer locknut.

(g). Shut down engine and remove test equipment. Reconnect oil pressure line to sender. Check engine oil level in tank and service if required.

(h). Perform a flight check to ensure that oil pressure regulation at high power settings is in the 120 ±10 psi (827 ±69 kPa) range.

(2). Method II:

The following equipment is required: A 0-150 psi (0-1035 kPa) gage of 1 percent accuracy, a source of regulated pressure (air, inert gas or hydraulic oil), fittings, and necessary lines and hoses to connect gage and pressure source to the oil pressure sender inlet.

(a). Remove oil pressure line at pressure sender (Figure 17-6) and connect pressure source with master gage in the line.

(b). Locate potentiometer R303 on instrument panel structure. Loosen adjustment locknut and set potentiometer at approximate mid-range. Connect 28 Vdc electrical power.

(c). Slowly pressurize the sender until master gage indicates 130 psi (896 kPa). Adjust potentiometer until four-pack gage also indicates 130 psi (896 kPa).

(d). Release pressure and then recheck. With pressure increased to 130 psi (896 kPa), the four-pack gage tolerance is one needle width at the tip.

(e). Tighten locknut on potentiometer, release all pressure and remove test equipment.

(f). Connect engine oil pressure line to sender inlet. Start and operate engine at idle in accordance with the Owner's Manual. Bleed engine oil pressure line at the sender for a stable indication on the four-pack gage.

(g). Perform a flight check to ensure that oil pressure regulation at high power settings is in the 120 ±10 psi (827 ±69 kPa) range.

14. Fuel Quantity System

(Ref. Figure 17-7)

A. Fuel Quantity Transmitter (Tank Unit) Replacement

(1). Check that all electrical power is OFF and that the helicopter is grounded.

CAUTION Use all necessary precautions consistent with safe practice when working in or around the fuel cells. If a replacement tank unit is not available for immediate installation,do not remove the installed unit.

(2). Remove left fuel cell access door.

(3). Disconnect tank unit harness electrical plug from mating connector at fuel shutoff cable support bracket.

(4). Cut the lockwire, remove the five bolts and washers from tank unit and lift unit from fuel cell cover plate. Discard the gasket.

(5). Check the replacement tank unit for the following:

(a). Housing and pivot mechanism for deformation or corrosion.

(b). Float and arm for freedom of movement between stops.

(c). Float arm for sufficient offset so that the float will clear the edge of the cell sump and allow full travel of the arm.

(d). If shaft end play seems excessive, install a washer and clip to limit play to 0.015-0.025 inch (0.381-0.635 mm) clearance between float arm and bushing according to instructions in Hughes Notice HN-89.

(6). Install gasket, tank unit with float inboard, washers and bolts. Torque bolts to **50 - 70 inch-pounds (5.65 - 7.91 Nm)**, and using lockwire (2, Table 2-4), safety boltheads (three and two) together.

(7). Reconnect electrical plug to mating connector.

(8). Check fuel quantity indicator reading against a known quantity of fuel in the cells.

(9). Fill cells to capacity and check for fuel leakage; none is permissible.

(10). Reinstall fuel cell access cover.

B. Fuel Quantity Transmitter and Indicator Operational Check

Perform the following checks to determine that fuel quantity indicator readings are within tolerance. Checks are made at empty, 200 pounds and full fuel loads.

(1). Use the following tolerances when checking fuel quantity indications.

(a). For the single unit type gage:
E = +0 degrees from centerline of marker (not above zero)
2 = +6 degrees from centerline of marker
F = +6 degrees from centerline of marker

(b). For the 3-pack or 4-pack type gage:
E = +0, -2 degrees from centerline marker
2 = ±3 degrees from centerline of marker
F = +4, -0 degrees from centerline of marker

(c). Tank unit circuit resistance (gage disconnected) is as follows:
E = 1 ohm
2 = 59 ohms
F = 88 ohms

(2). In order to check degrees of error, construct a template of thin clear plastic as follows.

(a). For the single unit type gage, cut the template circular to fit flat on the instrument glass, inside the bezel. Scribe two lines, pointer pivot shaft as the center.

(b). For the 3-pack or 4-pack type gage, cut the template rectangular to fit flat on the instrument glass, inside the bezel and covering the fuel quantity gage area. Tape the template in position and scribe lines on the template from center of pointer pivot shaft through the center of graduation marks at E, 2 and F. Scribe maximum tolerance, step (1).(b)., lines on each side of the center lines.

NOTE: During defueling, the helicopter should be as near level as possible and battery or external power voltage should be 24- 28.5 Vdc. Inaccurate readings may result if these conditions are not met.

(3). Defuel the helicopter. Refer to Section 2 for procedure and observe the following.

(a). Stop defueling when the FUEL LOW caution light goes on (Indicator should be passing through the 35 pound position).

(b). Following caution light illumination, drain remaining fuel into a container. There should be approximately 5.4 gallons (20.5 L) of drained fuel.

(c). If conditions in steps (a). and (b). above are not met, check caution light circuitry and/or readjust tank unit as required.

(4). Turn electrical power ON. Check indicator reading. Pointer must be at E or below. Refer to tolerances, step (1).(a). and (b).

NOTE: If indications are not within tolerances, determine whether gage or tank unit is at fault by removing electrical power, disconnecting gage wiring, and checking tank unit circuit resistance, step (1).(c).

(5). Start refueling slowly. Note that the FUEL LOW caution light goes out shortly after the indicator passes the

35-pound position, approximately 5.4 gallons(20.5 L) of fuel in cells.

(6). Continue to fill the cells to 200 pounds, approximately 30.75 gal (116.5 L) of fuel.

NOTE: Density of JP-4 fuel is 6.5 lb/gal (0.78 kg/L) on standard day 59°F (15°C), 29.92 in. Hg, dry air. Fuel density will vary under other ambient conditions and should always be taken into account when indicator accuracy is questionable.

(7). Check that indicator reading at 200 pounds is within scribed tolerance marks on template. For the single unit type gage, rotate the template as required to check that pointer is within 6 degrees of the center of the marker.

(8). Continue to refuel until the tanks are full. Check that indication is within tolerance in the same manner as in step (7).

(9). Remove electrical power and secure the refueling operations. If fuel quantity indications were not within tolerances, test the tank unit.

C. Fuel Tank Sending Unit and Fuel Low Warning Light Indicating System Inspection

This inspection, checks for security and condition of the fuel tank sending unit, and for proper operation of the fuel low warning light indicating system. Bench testing as well as rework of the fuel tank sending unit may be necessary if inspection reveals voids between potting compound and unit mounting plate or dimness/erroneous actuation of the fuel low level warning light.

(1). Remove left side fuel cell access door.

(2). Check fuel tank sending unit, electrical terminals and wiring for security and condition; check wiring harness between tank unit and instrument cluster.

NOTE: Sending units installed on early Model 369H and 369HS helicopters may not have potting compound applied on sending unit mounting plate around terminals. If potting compound has not been applied, pot the tank sending unit as shown in Figure 17-12, detail A or detail C.

(3). Using flashlight and pointed probe (wood or plastic), inspect interface of potting compound and sending unit mounting plate for voids. Pay particular attention to area around terminal screws (detail A, Figure 17-12). If any voids are noted, perform steps (7). thru (14).

NOTE: Troubleshooting is accomplished with electrical power ON, circuit breaker in (reset) and caution and warning lights set at BRT.

(4). If FUEL LOW warning light is on or glows when fuel level is above the low level mark, perform steps (7). thru (14).; otherwise end inspection after step (6).

(5). Apply fault (ground) input to terminal No. 2 on sending unit (Figure 17-12). Check that lamp illuminates properly when fault input is applied. If lamp does not come on or does not illuminate properly, check wiring between terminal No. 2 and CB104-2 circuit breaker and make corrections.

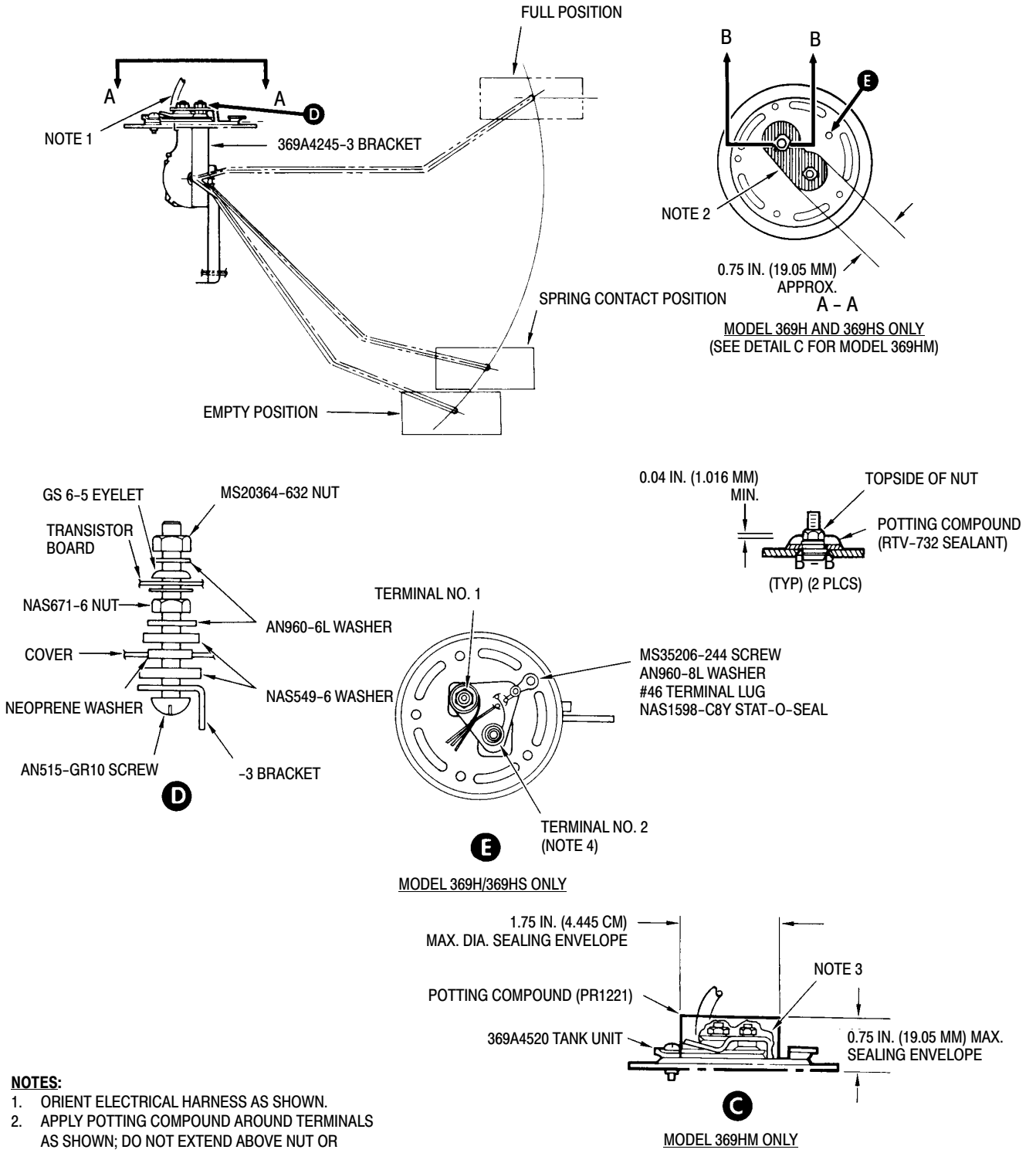
(6). Reinstall fuel cell access door if steps (7). thru (14). are not to be performed.

WARNING **When performing maintenance of fuel system components, comply with all applicable safety precautions to avoid possibility of fuel vapor ignition and fire. Prior to maintenance always turn off all electrical power; make sure helicopter is grounded; disconnect external powersource and disconnect battery.**

(7). Remove fuel tank sending unit; refer to safety precautions noted above.

(8). Dry top of sending unit with heat gun or oven for one hour at 100°F (38°C).

(9). Bench test sending unit (Ref. Tank Unit Testing); replace unit as required.



NOTES:

1. ORIENT ELECTRICAL HARNESS AS SHOWN.
2. APPLY POTTING COMPOUND AROUND TERMINALS AS SHOWN; DO NOT EXTEND ABOVE NUT OR APPLY POTTING COMPOUNDS ON TOP SIDE OF NUT.
3. MINIMUM ENVELOPE OF POTTING COMPOUND (0.60 IN. (15.24 MM) MIN. COVER OVER ELECTRICAL COMPONENTS AND WIRING.
4. APPLY FAULT (GROUND) INPUT TO TERMINAL NO. 2.

30-225A

Figure 17-12. Bench Test and Potting of Fuel Tank Sending Unit

(10). For 369H and 369HS commercial helicopters only, perform the following (Figure 17-12, detail D and detail E):

(a). Tighten NAS671-6 nut to hold 369A4245-3 bracket firmly in position.

(b). Disconnect and lift No. 46 ground terminal lug away from mounting plate flange; hold float arm at full position.

(c). Resistance measured from -3 bracket to flange shall be greater than 2 megohms.

(11). Apply potting compound to seal voids, as applicable.

(12). Reinstall fuel tank sending unit; torque screws to **12 - 15 inch-pounds (1.36 - 1.69 Nm)**. Do not overtighten screws as this may warp mounting plate flange.

(13). Recheck electrical circuitry per steps (4). and (5).

(14). Reinstall fuel cell access door.

D. Tank Unit Testing

(Ref. Figure 17-13)

(1). Set up tank unit on a level platform approximately 9 inches (22.86 cm) above a second level surface, such as a table top.

(2). Obtain a sensitive ohmmeter and set on low range resistance scale.

(3). Allow float arm to rest on the float empty stop. If wiring harness is attached, measure resistance across pins B to H of tank unit connector. Resistance must be 0-3 ohms (1 ohm desired). Adjust (bend) the float empty stop until this resistance is obtained.

(4). Raise the float until arm is in contact with the full stop and observe that resistance increases to approximately 88 ohms.

(5). Measure from the centerline of arm attachment to float when in full position, to the same point when in empty position! This measurement should be 8.99-9.11 inches (22.835-23.140 cm). Bend the float full stop as required to obtain 88-95 ohms (88 ohms desired) within these float travel limits.

(6). Disconnect the ohmmeter. Obtain a 24 Vdc power supply or battery, a No. 328 lamp and the necessary wiring to make connections shown in Figure 17-13.

(7). Apply 24 Vdc power and check that lamp illuminates when centerline of arm-to-float attachment is 1.25 inches (3.175 cm) above its empty position.

(8). Bend the spring attached to tank unit bracket if required and recheck that lamp is illuminated from the empty (rest) position to the 1.25 inch (3.175 cm) raised position.

(9). Disconnect 24 Vdc power and all test equipment.

(10). Seal all connections at top of tank unit with sealant (3, Table 2-4).

15. Outside Air Temperature Indicator

(Ref. Figure 17-14) The outside air temperature indicator consists of a bimetal element (enclosed in a stainless steel thermometer stem) attached through the stem to a dial-type temperature indicator.

The thermometer is installed through the right or left side canopy (as applicable) just forward of the instrument panel, and is secured by a sunshield.

0The temperature dial indicates outside air temperature in both Fahrenheit and centigrade.

NOTE: Left or right side installation dependson model and configuration.

A. Outside Air Temperature Indicator Replacement

(1). Hold indicator dial firmly and remove sun shield from thermometer stem. Remove applicable hardware shown in Figure 17-14 from stem; then remove indicator from canopy.

(2). Remove hardware from replacement indicator and install indicator in canopy as shown.

(3). Rotate indicator dial for correct reading position, install seal and spacer (if

used), outer rubber washer, dished washer and sun shield, and securely hand-tighten the sun shield.

16. Magnetic Compass

The magnetic compass is either installed in the instrument console of type A panels or attached to the center canopy frame on helicopters with a type B panel.

Hughes Notice HN-77 provides optional relocation instructions for canopy frame mounting of a compass mounted in an A type panel.

The magnetic compass continuously indicates the heading of the helicopter relative to the earth's magnetic field.

The compass consists of a liquid-filled case in which a float assembly, incorporating a compass card and magnets, pivots on a jewel post.

The compass card is graduated in 5 degree increments. The card is read against a fixed vertical white line (lubber's line) on the face of the instrument.

A compass correction card is located in the logbook holder.

The compass face is tilted at a downward angle so that the compass is level during normal flight.

A wedge is used for this purpose in the type A panel installation.

The compass is internally illuminated, using dc electrical power, from the night lighting system.

A. Magnetic Compass Maintenance

Use the information in Instrument Indicating System Troubleshooting thru Indicating System Instrument Repair for troubleshooting, inspection, replacement of the magnetic compass.

Operational Check. An operational check of the caution and warning lights indicating system must be performed after maintenance on the caution and warning lights, engine power out warning unit or the indicator lights dimming assembly or disable switch Sl99, if installed.

17. Caution and Warning Lights Indicating System

The caution and warning light indicating system includes the following components.

(1). For instrument panel type A (Figure 17-1), six indicator lights mounted across the top of the panel. For instrument panel type B (Figure 17-2), nine indicator lights mounted in the same location. Early type indicator lights on panel type B are switched from bright to dim when the legend face of the indicator is depressed and remain dim until indicator is depressed a second time for bright illumination.

(2). Senders, detectors and switches associated with the indicators (Figure 17-7).

(3). An indicator light dimming assembly for panel type A that automatically dims the indicator lights when the instrument panel lights are on and furnishes light test circuits. The panel type B dimmer assembly provides light test circuits and a switching regulator for panel and instrument light dimming.

(4). An engine power out (EPO) warning control unit. EPO units manufactured by Autronics include an integral audio amplifier (Figure 17-4) while an external audio amplifier is used with Vapair EPO units (Figure 17-3).

(5). Legend-type signal indicator lights that are interconnected with the PRESS-TO-TEST light test pushbutton switch and EPO solidstate dimmer assembly that isolates the light test circuit from the operational circuits.

(6). With power on, and the engine not running, the red engine power out light and the red transmission oil pressure warning light flash alternately. None of

the amber caution lights flash when they are on.

NOTE:

- The early type indicator lights used in instrument panel type B may be individually switched to dim illumination by pressing the face of the indicator. The light remains dim until the legend face of the indicator is depressed a second time.
- The caution and warning lights indicating system on a current helicopter with instrument panel type B functions with N_l/N_R engine power out warning equipment.
- Helicopters with an early instrument panel type B or panel type A use N_l engine power out sensing equipment only. N_l/N_R sensing equipment senses both low engine N_l and main rotor (N_R) speeds. N_l sensing equipment functions only with low engine N_l speed.
- A helicopter with early panel type B or type A may be modified to incorporate N_1/N_R sensing equipment. For difference information on a caution and warning light system in which the N_l/N_R sensing equipment was installed in this manner.

A. Caution and Warning Lights Indicating System Troubleshooting

When troubleshooting, perform an operational check, step (1)., as necessary. Troubleshoot the caution and warning lights indicating system, using the data in Table 17-2 and Table 17-3.

Refer to Table 17-2 to determine the functional unit associated with each light indicator, the input fault signal that activates each indicator, and the connector pins used in each circuit.

Use Table 17-3 to assist in isolating trouble to a defective unit and component.

Apply the correct input signal to the connector pin(s) to provide a specific light indication, or check for presence of the correct fault input signal for a light indication obtained.

Light indications that are provided by the caution and warning lights, controlled by the engine power out warning control unit and/or the indicator lights dimming assembly, are listed in Table 17-2.

(1). Operational Check. An operational check of the caution and warning lights indicating system must be performed after maintenance on the caution and warning lights, engine power out warning unit or the indicator lights dimming assembly or disable switch Sl99, if installed.

NOTE: Although the procedure outlined below reveals the functional state of only three of the fault input circuits, it will also show whether or not the components common to all circuits function correctly. A check of the other fault input circuits can be made in the same way, when necessary, by bridging the applicable switching device or sender.

(a). Turn on electrical power. Check that WARNING AND PANEL lights and ENG out circuit breakers are in (reset) and that the panel lights dimming control is set at OFF (fully counterclockwise) if installed.

(b). Check that red warning lights indicating engine out and low main transmission oil pressure flash.

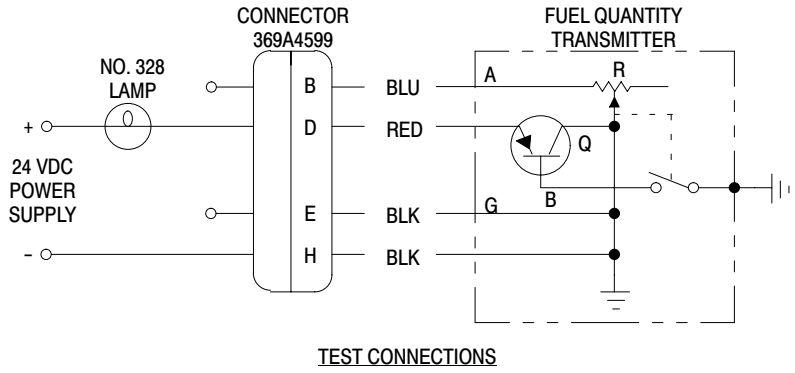
NOTE: These faults are supplied whenever the engine is not operating.

(c). Using a jumper lead, ground the terminal stud of the tail rotor transmission chip detector to produce a fault input.

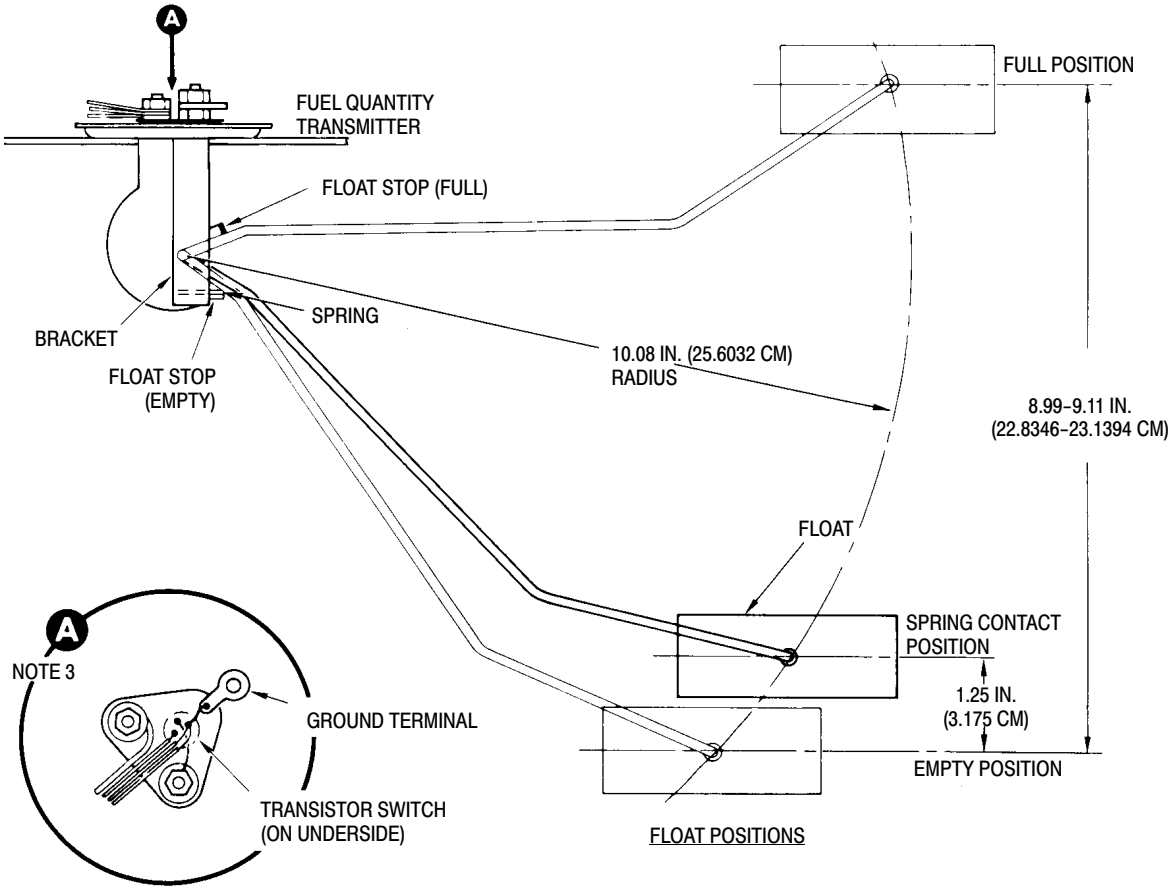
(d). Check that the applicable CHIPS lamps light.

(e). If a panel lights dimming control is installed, check that the control can control the panel instrument and lamp illumination and select bright or dim indicator lamp illumination (for panel type A).

(f). Check that early panel type B light indicators can be switched from bright to dim illumination by depressing the indicator legend face.



TEST CONNECTIONS



FLOAT POSITIONS

NOTES:

1. TRANSMITTER RESISTANCE (POINT A TO GROUND):

FLOAT POSITION	RESISTANCE
EMPTY	0-3 (1 NOMINAL OHMS
FULL	88-95 (88 NOMINAL) OHMS

2. REFER TO TEXT FOR INFORMATION ON CHECKING UNIT IN SYSTEM.
3. CONNECTIONS AT TOP TRANSMITTER ARE POTTED WITH SEALANT (3, TABLE 2-4) ON LATER CONFIGURATION.

30-128C

Figure 17-13. Testing of Tank Unit

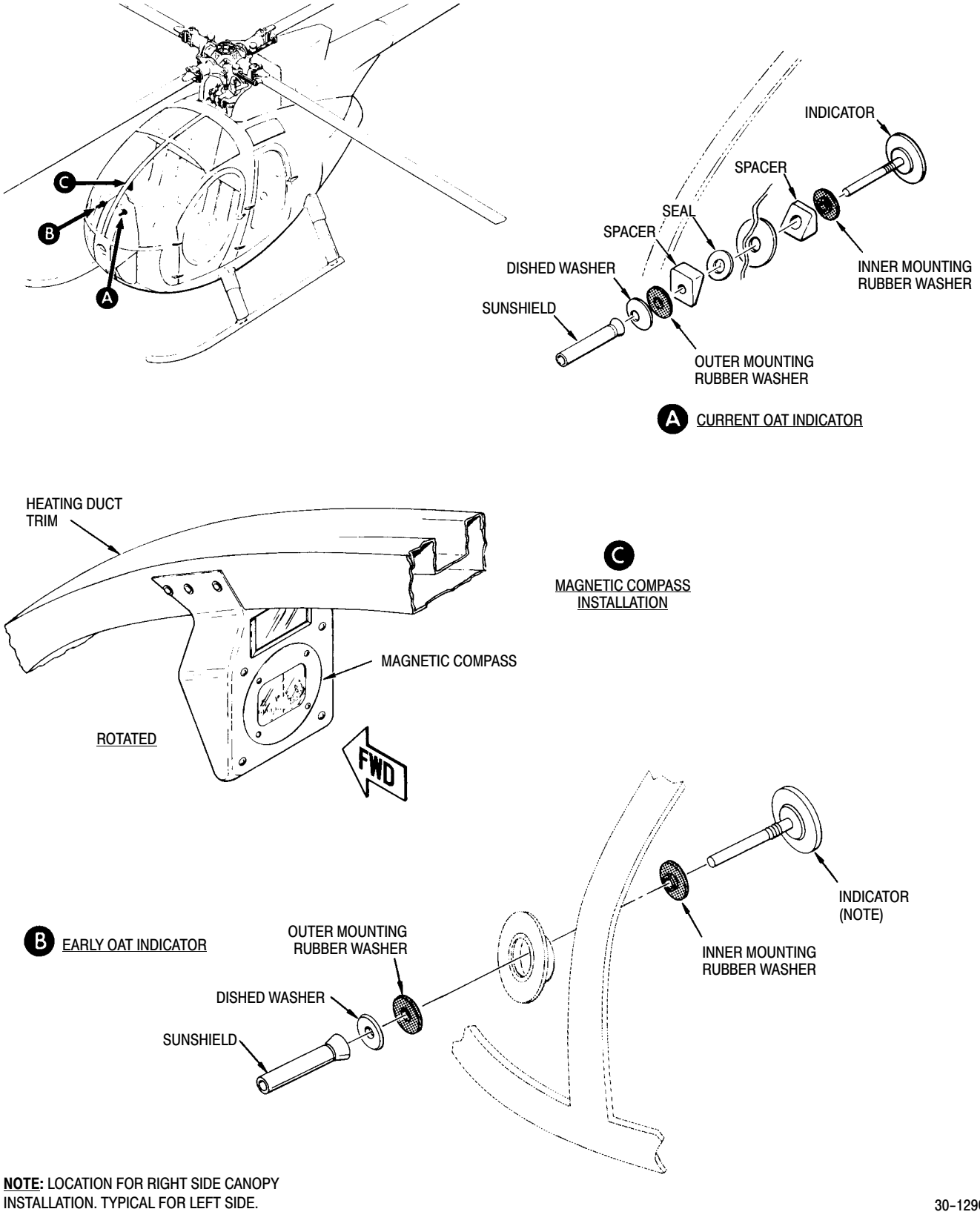


Figure 17-14. Outside Air Temperature Indicator and Magnetic Compass

Table 17-2. Caution and Warning Lights Troubleshooting Data

Light Indicator	Fault Input Signal	Indicator Lights Dimmer Assembly Connector Number and Pin Letter	Engine Power Out Warning Unit Connector Number and Pin Letter	
Instrument Panel Type A		**P8**	**P7**	
Caution Lights				
Chips	Ground	Z	-	
Start Pump On (located near switch)	28 Vdc	N	-	
Fuel Low	Ground	AA	-	
Fuel Filter	Ground	BB	-	
Generator Out	Ground	CC	-	
Warning Lights				
† Engine Out (N_I)	38.2 ±0.7 Hz (at 13.0 ±2 Vac) or less	-	A	
† Xmsn Oil Temp & Press	Ground	Y	-	
Miscellaneous				
* Dim	** Ground	U		
†† Press-to-test	** 28 Vdc	A		
†† Press-to-test	** Ground	B		
Instrument Panel Type B		**P12**	**Pl9**	**P3 (4)**
Caution Lights				
Engine Chips	Ground	Z	-	-
M/R Xmsn Chips	Ground	l	-	-
T/R Xmsn Chips	Ground	R	-	-
Fuel Low	Ground	a	-	-
Gen Out	Ground	c	-	-
Fuel Filter	Ground	b	-	-
Start Pump On (located near switch)	28 Vdc	N	-	-
Bat Temp Amber (140°F)	28 Vdc	P529	-	-
Warning Lights				
† Engine Out (N_I)	Frequency less than 36.75 ±1.75 Hz	-	A	A
† Engine Out (N_R)	Frequency less than 68.6 ±0.7Hz	-	L	-
BAT TEMP Red (160°F)	28 Vdc	P529C	-	-
† Xmsn Oil Temp	Ground	Y	-	-
† Xmsn Oil Press	Ground	j	-	-
Miscellaneous				
* N_1 disable (disables audible tone and horn for N_I only)	** Ground	-	J	H

Table 17-2. Caution and Warning Lights Troubleshooting Data (Cont.)

Light Indicator	Fault Input Signal	Indicator Lights Dimmer Assembly Connector Number and Pin Letter	Engine Power Out Warning Unit Connector Number and Pin Letter
Instrument Panel Type B		**P12**	**Pl9 P3 (4)**
* N_R disable (disables N_R sensing and audible tone for N_R only)	** Ground	-	G -
* Dim to bright	** 0 to +28 Vdc respectively	X	- -
†† Press-to-test	** 28 Vdc	A	- -
†† Press-to-test	** Ground	B	- -

NOTE:

(1) Listed fault input signal causes the associated light indicator to illuminate when input is applied to listed connector number and pin letter.

(2) For a helicopter with early instrument panel type B or A equipped with optional N_1/N_R sensing equipment, for any necessary difference troubleshooting data refer to CSP-H-3.

(3) Wiring harness connectors listed are those that mate with connectors of units listed.

(4) Note that connector number and pin letters on mating connector for EPO warning unit differ according to unit used (Pl9 for N_1/N_R EPO warning unit and P3 for N_1 EPO warning unit).

* Function (not an indicator) for instrument and panel lights.

* * Function input signal (not a fault input signal) for all lights.

† Light indicator flashes with listed input applied; all other light indicators continuously illuminated with listed inputs.

†† Function (not an indicator) for caution and warning light indicators.

Table 17-3. Troubleshooting the Caution and Warning Lights Indicating System

CAUTION: Continuous flashing operation of the EPO warning unit is limited to 10 minutes. Excessive, uninterrupted operation can result in damage to internal flasher circuits.

NOTE: Unless specified otherwise, troubleshooting is accomplished with the engine power out (EPO) warning unit and indicator lights dimmer assembly installed, electrical power on, the WARNING AND PANEL LAMPS and ENG OUT circuit breakers in (reset) and the panel lights dimming control set at BRT.

Symptom	Probable Trouble	Corrective Action
Caution and Warning Light Indicators		
Indicator light erratic or inoperative when checked by PRESS-TO-TEST switch	Circuit wiring loose, shorted, open, or improperly connected	Inspect electrical connections; repair as necessary.
	Indicator defective	Replace defective lamp or indicator socket.
One or more light indicators, but not all, do not light when PRESS-T O-TEST switch is depressed	Indicator lamp filaments open	Replace lamps.
	Open diode in dimmer unit	Replace diode associated with unlighted indicator or replace dimmer unit.
Light indicator on panel type B extinguishes or does not dim or brighten when legend face is depressed, with PRESS-TO-TEST switch held depressed	Indicator lamp filaments open	Replace lamps.
	Defective switch in indicator	Replace indicator.

Table 17-3. Troubleshooting the Caution and Warning Lights Indicating System (Cont.)

Symptom	Probable Trouble	Corrective Action
NOTE: Indicator should alternately dim or brighten each time legend face is depressed for panel type B equipped with N_1 sensing equipment. Light indicators do not dim on panel type B equipped with N_1/N_R sensing equipment.		
Indicator light on; associated system functioning normally	Short-circuit in light circuit	Check light circuit wiring; repair as necessary.
	Sensor/sender unit defective	Replace sensor/sender.
Abnormal light indication(s) peculiar only to caution light indicator(s)	Refer to corrective action column	Refer to caution light indicators information below.
Abnormal light indication(s) common to both caution and warning light indicator(s)	Refer to corrective action column	Refer to warning light indicators information below.
Abnormal light indication(s) peculiar only to warning light indicator(s) and/or audible warning horn	Refer to corrective action column	Refer to warning light indicators information below.
Caution Light Indicators		
NOTE: Panel lights dimming control affects dimming of light indicators only on panel type A. Dimming affects dimming of light indicators on panel type B with N_1 sensing equipment is controlled by depressing legend face of indicator.		
One or more light indicators, but not all, light dimly when panel type A light dimming control is set at BRT and PRESS-TO-TEST switch is held depressed	One indicator lamp has open filament	Replace lamp.
	Defective diode in Grimes dimmer unit	Replace associated diode or dimmer unit.
All light indicators light brightly with panel type A panel lights dimming control at DIM when PRESS-TO-TEST switch is held depressed	Open relay diode, relay winding or shorted Zener diode in Grimes dimmer unit dimming circuit	Repair or replace dimmers unit.
All light indicators do not light with panel type A panel lights dimming control at DIM while PRESS-TO-TEST switch is held depressed	Open Zener diode in Grimes dimmer unit	Replace Zener diode or dimmer unit.
Light indicator does not light with fault input signal applied or when PRESS-T O-TEST switch is depressed	Indicator lamp filaments open	Replace lamps.
	Defective component in dimmer unit	Replace associated component in dimmer unit or dimmer unit.
	Defective switch in indicator on panel type B	Replace indicator.
Lighted indicator without a fault signal applied.	Defective component in dimmer unit	Replace associated component in dimmer unit or dimmer unit.

Table 17-3. Troubleshooting the Caution and Warning Lights Indicating System (Cont.)

Symptom	Probable Trouble	Corrective Action
Warning Light Indicators		
No ENG OUT indication from either warning light indicator or audible warning horn with engine out fault input signal applied (or low main rotor speed fault input signal applied with N_1/N_R sensing equipment)	Disconnected or defective wiring to engine power out warning unit	Reconnect or repair electrical wiring.
	Misadjusted frequency sensing control in Vapair EPO warning control unit, or defective sensing circuit in any EPO unit	For Vapair unit, adjust sensing control. Replace defective EPO warning unit.
	Defective ENG OUT frequency sensor or flasher circuit in EPO warning unit	Repair or replace EPO warning unit.
No ENG OUT warning light indication with engine out fault input signal applied; sound from audible warning horn present (or low main rotor speed fault input signal applied with N_1/N_R sensing equipment)	Indicator lamp filaments open	Replace lamps.
	Defective diode in dimmer unit	Repair or replace dimmer unit.
	Defective ENG OUT flasher in EPO unit	Repair or replace EPO warning unit.
Flashing ENG OUT light indicator with fault input signal applied with sound from audible warning horn; no audible warning tone in headset(s)	Defective audio amplifier or misadjusted tone level control in Autronics EPO warning unit	Repair or replace EPO warning unit.
	Defective pilot's audio tone generator in EPO warning unit	Repair or replace EPO warning unit,
	Defective audio amplifier (used with Vapair EPO warning unit)	Replace audio amplifier.
No flashing XMSN OIL TEMP & OIL PRESS light indication with fault input applied; ENG OUT light indicator functions normally	Defective xmsn oil and temp light flasher in EPO warning unit if indicator lights when PRESS-TO-TEST switch is depressed	Repair or replace EPO warning unit.
	Defective diode in dimmer unit if indicator does not light when PRESS-T O-TEST switch is depressed	Repair or replace dimmer unit.
No flashing warning light indication when any warning fault input signal is applied; all indicators light when PRESS-T O-TEST switch is depressed	Defective voltage regulator in Vapair EPO warning unit	Repair or replace EPO warning unit.
No flashing light indication or audible warning with low main rotor speed fault input signal, for N_1/N_R sensing equipment	Improperly adjusted or defective disable switch	Adjust position of or replace defective switch.
	Defective EPO warning unit	Replace EPO warning unit.
XMSN warning lights flash with fault inputs; no audio tone in headset, ENG OUT light does not flash and audible warning horn does not "beep" with engine off.	Defective voltage regulator in Autronics EPO warning unit	Repair or replace EPO warning unit.

Table 17-3. Troubleshooting the Caution and Warning Lights Indicating System (Cont.)

Symptom	Probable Trouble	Corrective Action
Lighted or flashing light indicator without fault input signal applied	Defective component in EPO warning unit	Replace component in indicator associated circuit in EPO warning unit or replace EPO warning unit.
	Defective component in dimmer unit	Replace component in indicator associated circuit in dimmer unit or replace dimmer unit.
Light indicator on panel type A does not dim when panel lights dimming control is set from BRT to DIM while PRESS-TO-TEST switch is held depressed	Defective component in Grimes dimmer unit	Replace component associated with indicator dimming circuit in dimmer unit or replace dimmer unit. (Refer to information on caution light indicators above.)
Audio Equipment		
No warning tone in pilot's headset; "beeping" audible from audible warning horn and engine out light indicator flashes	Defective tone generator in EPO warning unit	Repair or replace EPO warning unit.
	Misadjusted or defective audio tone circuit in Autronics EPO warning unit	For N_I sensing type EPO unit, adjust audio tone level control. Replace N_I/N_R sensing type EPO unit.
	Defective audio amplifier in Autronics EPO warning unit	Repair or replace Autronics EPO warning unit.
	Defective EPO audio amplifier (used with Vapair EPO warning unit)	Replace EPO audio amplifier.
No "beeping" from EPO audible warning horn with engine off; engine out light indicator flashes and warning tone is present in pilot's headset	Defective EPO audible warning horn	Replace audible warning horn.
No warning tone in pilot's headset, flashing of engine out light indicator of "beeping" from audible warning horn	Defective engine out frequency sensor circuit in EPO warning unit	Repair or replace EPO warning unit.
Panel and Instrument Lights Dimming		
One or more, but not all, panel or instrument lamps will not illuminate	Lamp filament(s) open	Replace lamp(s).
All panel and instrument lamps will not illuminate	Defective component in dimmer unit	Repair or replace dimmer unit.
All panel and instrument lights illuminate; panel lights dimming control does not vary brightness of lights	Defective component in dimmer unit	Repair or replace dimmer unit.
	Defective or disconnected dimming control	Replace or reconnect dimming control.

18. Instrument Panel Type A Caution and Warning Indicator Lights

(Ref. Figure 17-1) The caution and warning indicator lights consist of two warning and four caution indicator lights across the top of the instrument panel and a start pump on light at the left of the instrument cluster.

Each of the upper six indicators are separate removable dual lamp light assemblies. The start pump on light assembly contains a single lamp. The two upper left light indicators are red warning lights. The four indicators at the right of the warning lights are amber caution lights.

Ground inputs, from caution fault sensors, applied directly to negative fault dimming indicator circuits in the indicator lights dimmer assembly, control caution light indicators illumination and dimming.

Warning sensors supply inputs to and cause the EPO warning unit to provide pulsating positive output voltages. The pulsating positive voltages are applied to positive fault input dimming circuits in the dimmer assembly to control flashing of warning light indicators.

The caution and warning lights function as follows:

NOTE: Hughes Notice HN-158 gives a procedure for rewiring the utility light circuit and the transmission oil pressure and temperature warning light circuit. This wiring modification is to eliminate deactuation of the utility light and transmission warning light circuits should the engine power out (EPO) circuit breaker be tripped, thus deactuating the EPO unit.

(1). Engine Out Warning Light

The engine out warning light flashes when engine speed decreases to approximately 55% N_1 rpm or less. With N_1/N_R sensing equipment (optional on panel type A) the light also flashes when NR speed decreases to approximately 98% N_1 rpm or less.

(2). Main Transmission Oil Temperature and Oil Pressure Warning Light

In case of a reduction or loss of transmission oil pressure, below approximately 15 psi, a pressure-sensing sender (Figure 17-5) energizes the oil temperatures and pressure warning light flashing circuit of the EPO warning unit. If the transmission oil supply reaches an abnormally high temperature, a temperature-sensing switch energizes the oil temperature and pressure warning light flashing circuit of the EPO warning unit. Early type senders actuate at 115°C while the current type actuates at 121°C.

(3). Chip Detector Caution Light

The chip detector light will go on whenever loose ferrous metallic matter has been magnetically accumulated by any one of five chip detectors; two are located in the engine oil system, two in the main transmission, and one in the tail rotor transmission.

(4). Fuel Low Caution Light

When the fuel supply has diminished to 35 pounds, a spring wire contact is made by the tank unit float arm at the warning level to complete a ground circuit and energize the caution light.

(5). Fuel Filter Caution Light

When the engine fuel pump filter becomes clogged, the caution light is illuminated by a case-grounded differential pressure switch. The switch is installed across the fuel pump pressure drop ports to measure pressure differential increase across the filter.

(6). Generator Out Caution Light

If generator output voltage should fall below the battery voltage because of engine shutdown, generator failure, or other cause, the reverse current relay disconnects the generator from the 28 Vdc bus and causes the generator out caution light to illuminate.

(7). Start Pump On Caution Light

When the start pump circuit breaker is set to ON, the start pump is turned on and +28 Vdc is applied to the start

pump light circuit and the light illuminates.

A. Instrument Panel Type A Indicator Lights Replacement

(Ref. Figure 17-3)

(1). Check that all electrical power is OFF.

(2). Remove instrument panel fairings, and instruments as necessary, to gain access to defective indicator light.

(3). Remove legend cap by using direct pull, and then remove the screw and saddle clamp from light socket. Loosen light wiring harness ties to release socket; then unsolder wiring and tag for identification.

(4). Using solder (48, Table 2-4), connect wiring to replacement indicator light and remove tags.

(5). Install indicator light in panel with saddle clamp and restore harness ties where removed.

(6). Transfer old lamps to new indicator light or install new lamps. Turn on power and check light circuit by the press-to-test switch.

(7). Reinstall removed instruments and reinstall panel fairings.

(8). Reinstall legend cap.

NOTE: Each light socket and legend cap is a matched assembly. Legend caps cannot be interchanged.

19. Instrument Panel Type B Caution and Warning Indicator Lights

(Ref. Figure 17-2) The caution and warning lights consist of nine modular units mounted across the top of the instrument panel. The left three indicators are red warning lights and the remainder are yellow caution lights. The indicator assemblies contain places for four midget, flange base lamps (Figure 17-4).

The caution light circuits are completed to ground through their respective fault sensors.

The warning light circuits are completed through their fault sensors, an Autronics dimming unit and through an Autronics engine power out (EPO) warning unit which provides a pulsating source of 28 Vdc for light flashing. The dimming unit used with this system provides the indicator lamps test circuits and a dimming regulator for instrument panel and instrument lighting.

Separate battery temperature caution and warning light indicators are mounted in a light-switch and horn housing on the side of the raised top center of the instrument panel center fairing. The amber caution BAT TEMP 140°F light illuminates at a battery temperature of 140°F and the red BAT TEMP light at 160°F. Each light indicator incorporates a press-to-test switch for testing of internal lamps. (For circuit and other information on the light indicators and battery temperature sensing equipment, refer to Section 19.)

The start pump is provided with an indicator light near the startpump switch on the lower left side of the instrument panel. This light does not have a dimming feature and remains on bright whenever the start pump is operating.

For other than battery temperature light indicators, caution and warning light functions are as described in Instrument Panel Type A Caution and Warning Indicator Lights, steps 18.(1). thru 18.(7)., except that separate chip detector indicators are provided as well as separate main transmission oil pressure and oil temperature warning indicators.

Indicators provided are:

Engine Out Warning Light.

Main Transmission Oil Temperature Warning Light.

Main Transmission Oil Pressure Warning Light.

Battery Temperature Caution Light.

Engine Chip Detector Caution Light.

Main Transmission Chip Detector Caution Light.

Tail Rotor Transmission Chip Detector Caution Light.

Fuel Low Caution Light.

Fuel Filter Caution Light.

Generator Out Caution Light.

Start Pump On Caution Light.

Battery Temperature Warning Light.

NOTE:

- For a helicopter equipped with N_1 sensing equipment, each of the nine light indicators across the top of the instrument panel contains a latching type switch. When the legend face of the indicator is depressed, the switch is actuated to dim the light. The indicator remains dim until the legend face is depressed a second time and then brightens. This feature is not incorporated for light indicators used with N_1/N_R sensing equipment.
- Any helicopter not originally equipped with battery temperature sensing equipment requires addition of the equipment, including the battery temperature light indicators.

A. Panel Type B Indicator Lights Replacement

(Ref. Figure 17-4)

(1). Lamp Replacement

(a). Grasp edges of legend face and pull lamp module out of housing.

(b). Allow lamp module to hinge downward for access to base of midget lamps.

(c). Replace faulty lamp and reinstall lamp module in housing.

(d). Check lamp operation by depressing PRESS-TO-TEST switch.

NOTE: If any light does not illuminate and N_1 sensing equipment is used, try pressing the indicator legend face to actuate the internal switch.

(2). Indicator Light Assembly Replacement

(a). Check that electrical power is OFF.

(b). Grasp edges of legend face, pull lamp module from switch housing and allow it to hinge downward.

(c). Inside housing, locate two mounting cam locking screws. Loosen the screws until cams are disengaged from mounting sleeve.

(d). Gain access to forward side of instrument panel and slide mounting sleeve from switch housing.

(e). Move switch housing assembly aft from face of panel until wiring at lamp terminals is accessible.

(f). Note wire and terminal numbers for reinstallation and then unsolder wires at the terminals. Remove switch housing assembly.

(g). Install replacement indicator assembly by essentially reversing the removal procedure above.

(h). Connect electrical power and check indicator operation with PRESS-TO-TEST switch. When N_1 sensing equipment is used, check that indicator dims when legend face is depressed and returns to bright when depressed again.

20. Engine Out Warning System

The engine out warning system consists of an engine power out (EPO) warning control unit, an audible warning horn, interconnecting electrical wiring and functions with the engine out and transmission warning lights of the caution and warning lights system.

One of two types of sensing equipment is used, an early type that senses only engine N_1 low speed and the current type that senses both N_1 and main rotor (N_R) low speeds.

Both provide a visual and audible indication of low speed(s) as follows:

A. N_1 Sensing Equipment

The EPO warning control unit monitors engine N_1 speed, main transmission (low) oil pressure and (high) oil temperature.

Engine low N_1 speed is sensed by the EPO warning control unit monitoring the frequency of the output ac voltage from the N_1 tachometer generator.

When engine speed decreases to approximately 55% N_1 rpm or less, the EPO warning control

unit produces an output to flash the engine out warning light and activates the EPO audible warning horn which produces an audible "beeping" in the pilot's compartment. Simultaneously, the EPO warning control unit provides separate audio tone warning signals for headsets.

The tone warning signals occur and the audible warning horn "beeps" only when the generator (GEN) switch is ON and N_l speed is 55% rpm or less; however, the engine-out warning light flashes regardless of GEN switch position.

NOTE:

- On early N_1 sensing equipment using the Vapair 26530332M EPO warning unit, a separate audio amplifier is also used. When installed, the separate audio amplifier amplifies the audio tone warning signal before application to earphones of headsets.
- The Autronics 2146-5 EPO warning control unit on the later N_1 sensing equipment contains an integral audio amplifier used for the same purpose and the external audio amplifier is not used. A helicopter originally equipped with the N_1 sensing equipment may be modified with the optional N_1/N_R engine sensing equipment described below by installation of the N_1/N_R Engine Out Warning System Kit M50033.

B. N_1/N_R Sensing Equipment

The N_1/N_R sensing equipment uses an Autronics 2200-3 EPO warning control unit, NR disable switch S199 located on the base of the inboard collective pitch stick and resistor and diode board TB106.

N_1/N_R sensing equipment has identical capabilities and functions the same as the N1 sensing equipment described above, except as follows: The N_1/N_R sensing equipment has the additional capabilities of sensing main rotor (N_R) low speed, producing the output for flashing of the engine out warning lights and actuation of the audible warning horn, generating a separate additional audible warning tone for headsets and providing engine restart voltage when low N_R rpm is sensed.

Low N_R rpm is sensed by the EPO warning control unit monitoring the frequency of the output ac voltage from the main rotor (N_R) tachometer generator; N_R sensing occurs at main rotor speed of approximately 98% N_R rpm, or less.

When the inboard collective pitch stick is full down and the throttle is at idle or cutoff position, the N_R disable switch activates to disable N_R sensing to prevent flashing the engine out light and activation of both the warning horn and audible tone during engine idle and cutoff.

A built-in time delay function keeps N_R sensing disabled after N_R disable switch is deactivated for sufficient time to permit N_R to be attained.

N_1 sensing circuits remain operational (are not disabled) while N_R sensing is disabled.

The EPO warning control unit produces the output for flashing the engine out warning light, "beeping" the warning horn and generates the audible warning tone if low N_1 rpm occurs while N_R sensing is disabled.

C. Engine Out Warning System Functioning

Figure 17-15 is a combined simplified block diagram and schematic diagram of the N_1/N_R engine out warning system and shows signal paths and flow for the system.

The EPO warning control unit senses low frequency ac output voltages from the N_1 and N_R tachometer generators to actuate and control warning light and audible indications.

When the GEN-OFF switch is ON, a ground is supplied to a tone interrupt circuit in the EPO warning control unit to enable audio warning tone circuits and to the audible warning horn for 'beeping,' when low N_1 rpm is sensed.

When low N_l rpm is sensed, N_l speed sensing circuits and flasher and tone control circuits actuate engine out flashing light and audio tone No. 1, 2 and 3 generation circuits. N_R sensing circuits, with the flasher and tone control circuits, actuate and control the flashing light and audio tone generation circuits for operation at low N_R rpm. Audio warning tone No. 1 is routed through the ICS system to headsets. The higher amplitude audio warning tone No. 3 is applied directly to headsets so that audible warning is present in

headsets in event of failure of ICS system equipment.

When either N_1 or N_R sensing occurs, the auto reignition +28 Vdc control circuit supplies steady state +28 Vdc for optional automatic reignition equipment. N_R disable switch S199 furnishes a ground to the EPO warning control unit to disable N_R sensing and prevent engine out light flashing and audible warnings at engine idle and cutoff positions.

Diodes in the indicator lights dimmer assembly provide directional paths for flashing light currents, and for test voltages and grounds during press-to-test check of lights.

Resistor and diode board TB106 furnishes isolation and correct termination impedance for audio warning tone No. 3.

NOTE: This information applies to the N_1/N_R engine out warning system. For an N_1 engine out warning system disregard information on N_R sensing functions, since these functions are not applicable.

21. Vapair 26530332M Engine Power Out (EPO) Warning Control Unit

The Vapair 26530332M engine power out (EPO) warning unit is a solid state device that controls warning light indicators flashing and provides drive for the audible warning horn and tone signals for headsets in event of engine failure.

The EPO unit is installed at the lower right interior of the instrument panel console.

A removable cover permits access to interior components of the EPO unit for adjustment, maintenance and repair.

The unit provides pulsating dc voltage through indicator lights dimmer assembly warning lights circuits to flash the warning lights. Figure 17-16 is a schematic diagram of the EPO warning unit. The following information describes EPO unit operation.

A. Engine Power Out Warning Unit Circuit

(Ref. Figure 17-17) The EPO warning unit contains an engine out frequency sensor and flasher circuit, two audio tone generators, a transmission oil and temperature light flasher, and dc voltage regulator circuits.

Figure 17-17 is a breakdown of the EPO warning unit overall schematic diagram and shows the circuits separately by functions. See the electrical system wiring diagram in Section 20 for interconnecting wiring information on the lights indicating system.

B. Engine Out Frequency Sensor and Light Flasher Circuits

(Ref. Figure 17-17) The engine out frequency sensor circuit functions when an N_1 tachometer output ac voltage with a frequency of 28.2 ±0.7 Hz (at approximately 13.0 ±2 Vac) or less is applied to the EPO warning unit. Potentiometer R26 adjusts the frequency at which the sensing circuit operates.

The circuit controls conduction of transistors Q7 and Q6 which alternately open and close the engine out lamp circuit current path through transistor Q5 and the indicator lights dimmer assembly and apply a pulsating dc voltage 150 ±30 times a minute to the engine out lamps and the audible warning horn. The sensing circuit also provides a tone generator control signal to the audio tone signal generators.

C. Dc Voltage Regulator Circuit

(Ref. Figure 17-17) A zener diode CR1 develops a stable reference voltage for transistor Q1. Transistor Q1 conducts with load changes and voltage fluctuations as necessary to maintain a constant regulated positive dc supply voltage across capacitor C8 for application to and use of all other EPO warning unit circuits.

D. Audio Tone Signal Generators

(Ref. Figure 17-17) Dual identical pilot's and copilot's tone signal generators are incorporated into the EPO warning unit. Each tone generator utilizes a unijunction transistor. Only the pilot's tone generator is used.

When the generator switch is set to on, the tone generator control signal is present from the engine out frequency sensor circuit at engine rpm of less than approximately 55% N_1, and the base of Q9 is biased to initiate conduction of Q9.

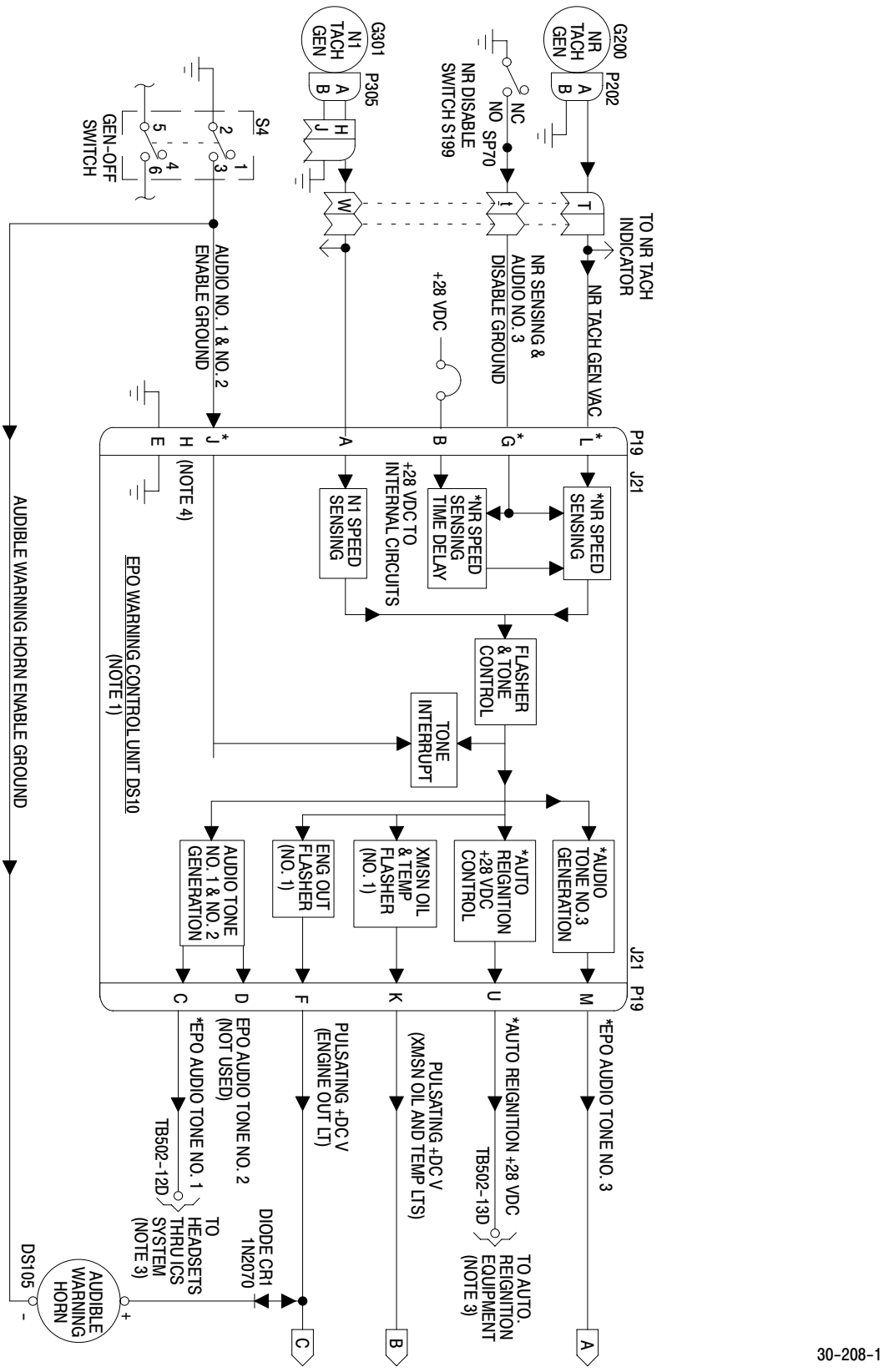


Figure 17-15. N_1/N_R Engine Power Out Warning System Combined Simplified Block and Schematic Diagram (Panel Type B) (Sheet 1 of 2)

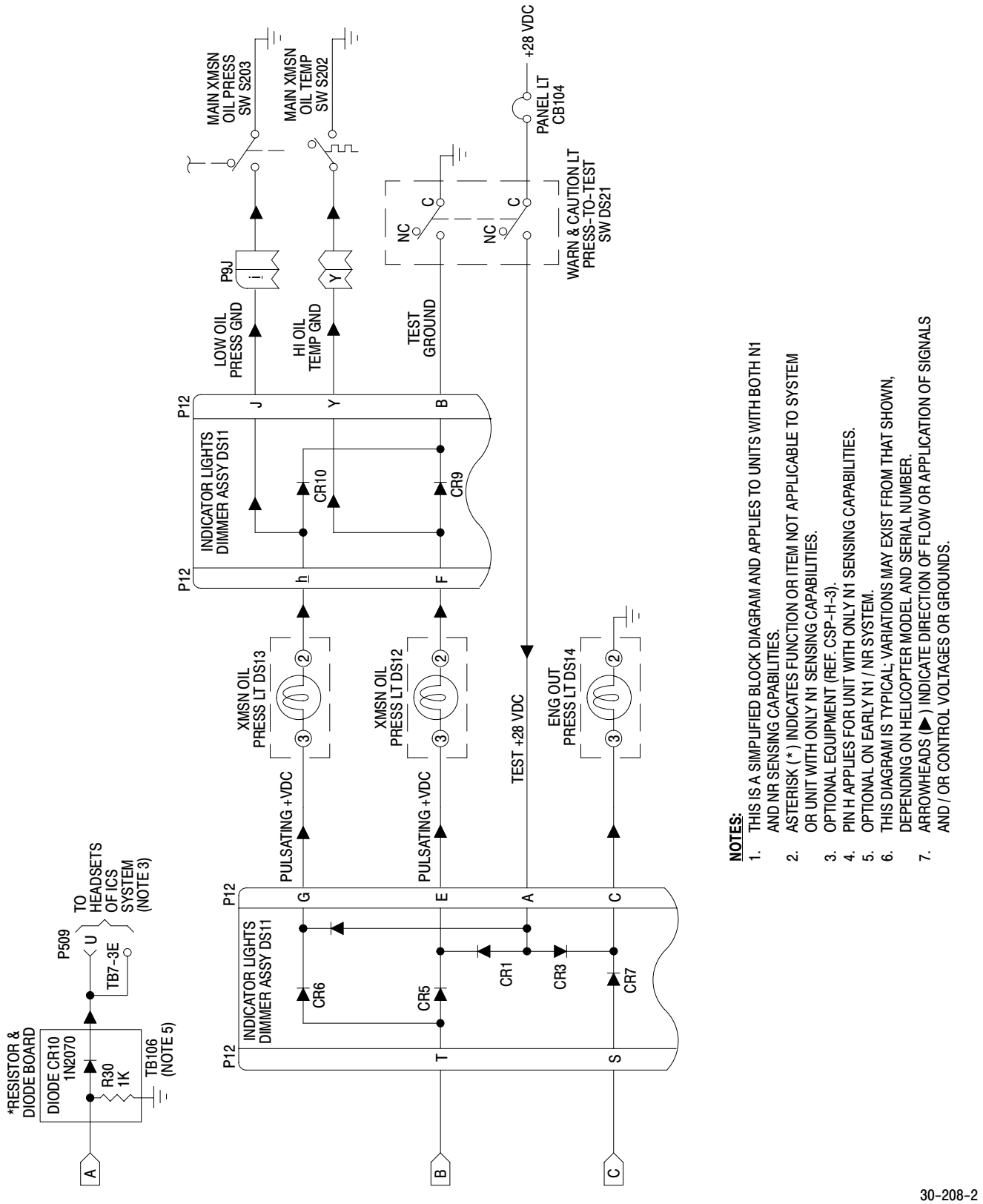


Figure 17-15. N_1/N_R Engine Power Out Warning System Combined Simplified Block and Schematic Diagram (Panel Type B) (Sheet 2 of 2)

Resistance capacitance (RC) charging and discharging circuit components then alternately shut off and turn on Q9 to produce negative output pulses at an audio frequency of 680 to 1700 Hz for application to the external audio amplifier.

The generation of the output pulses is initiated and interrupted at a rate of 150 ±30 times a minute by the tone generator control signal.

Setting the generator switch to off, or an increase of engine rpm above 55% N_1, deactuates the tone control signal and tone generator.

E. Transmission Oil and Temperature Light Flasher

(Ref. Figure 17-17) Transistors Q4, Q3, Q2 and associated components form the transmission oil and temperature light flasher circuit.

Resistance-capacitance (RC) charging and discharging circuit components cause Q2 and Q3 to alternately turn on and turn off Q4. This applies a pulsating dc voltage through the dimmer unit to the lamps to make them flash 150 ±30 times a minute, when the external lamp circuit is closed to ground through the indicator lights dimmer assembly, lamps and fault sensor switch.

The flasher circuit continues to flash the lamps until the input fault ground is removed.

F. Vapair 26530332M EPO Warning Unit Frequency Sensing Adjustment

Use the following procedures to adjust sensing for the engine out warning light and EPO audible warning horn “beeping”.

(1). Turn OFF all electrical power.

(2). Remove the instrument panel right side fairing for access to the EPO warning unit.

(3). Remove the cover from the installed EPO warning unit (Figure 17-3).

(4). Disconnect electrical wiring connector P2 from the N_1 tachometer generator.

(5). With an ac voltage source, capable of being set to provide an ac output voltage at a test frequency of 38.2 ±0.7 Hz (at approximately 13.0 ±2 Vac), connect the output to pins A and B of connector P2.

NOTE: A driven tachometer generator, the equivalent of the N_1 tachometer generator and whose speed is variable and can be correctly regulated, may be used for the input voltage source. Measuring equipment must be sufficiently accurate.

(6). Turn ON the helicopter electrical system.

(7). Set the ENG OUT circuit breaker to ON.

CAUTION Flasher circuits in the EPO warning unit should not be allowed to remain energized for more than 10 minutes of uninterrupted operation to prevent possible internal EPO warning unit damage.

NOTE: The engine out warning light should flash and the engine out audible warning horn should “beep”.

(8). Turn on the ac test voltage source and make sure that the test frequency of the ac voltage is set to the correct value (e above).

NOTE: The engine out indications, noted in step (7)., should cease when the correct test frequency is applied. Any decrease of the input frequency should activate the indications. The indications should not be actuated at any frequency above the input test frequency.

(9). If necessary, adjust the variable potentiometer in the EPO warning unit to the position that the engine out indicator light just goes out with the correct input test frequency, step (5)., applied.

(10). Turn OFF the ac test voltage source.

(11). Set the ENG OUT circuit breaker to OFF.

(12). Turn off the helicopter electrical system.

(13). Disconnect the ac test voltage source electrical leads from connector P2 and reconnect P2 to the EPO warning unit.

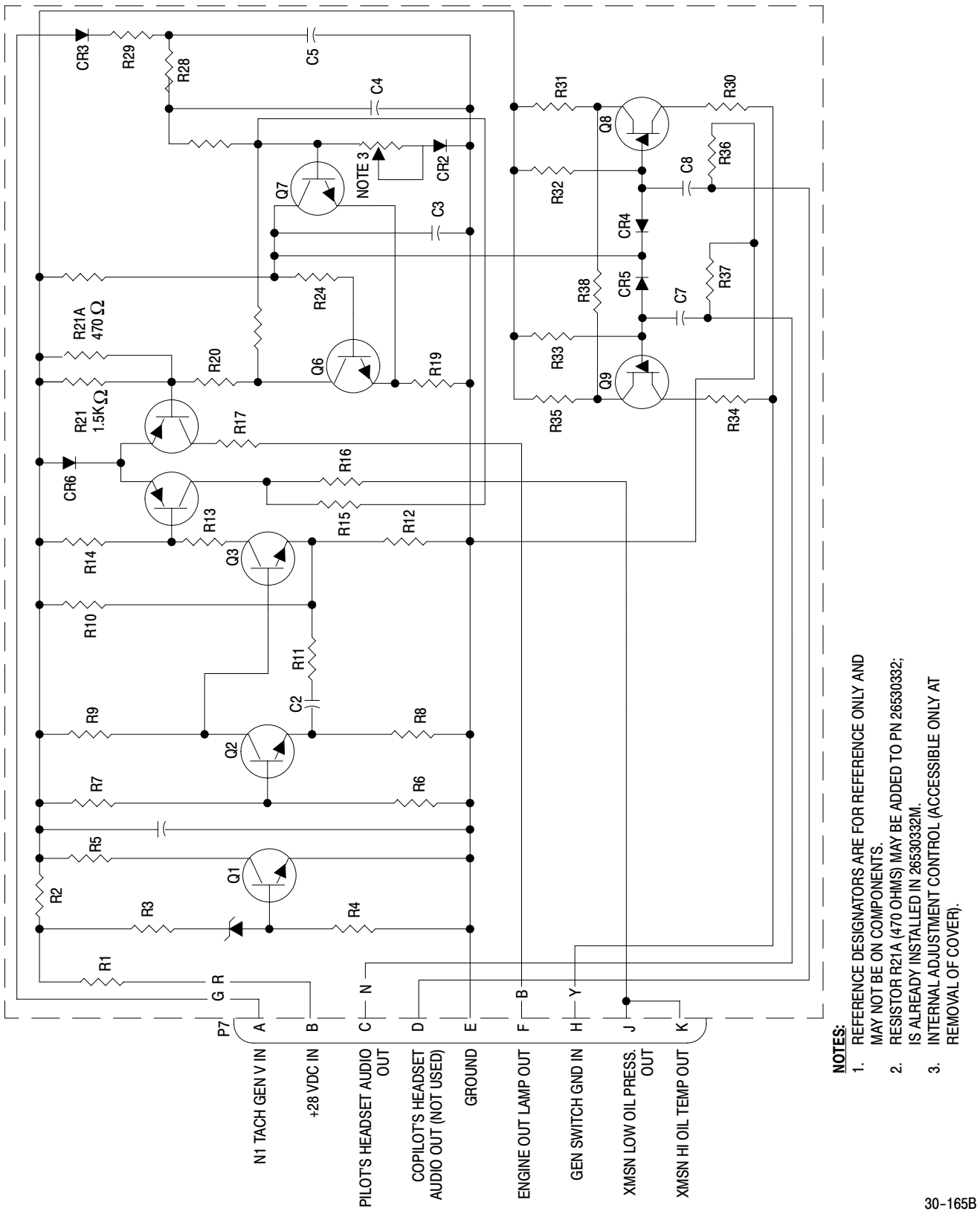
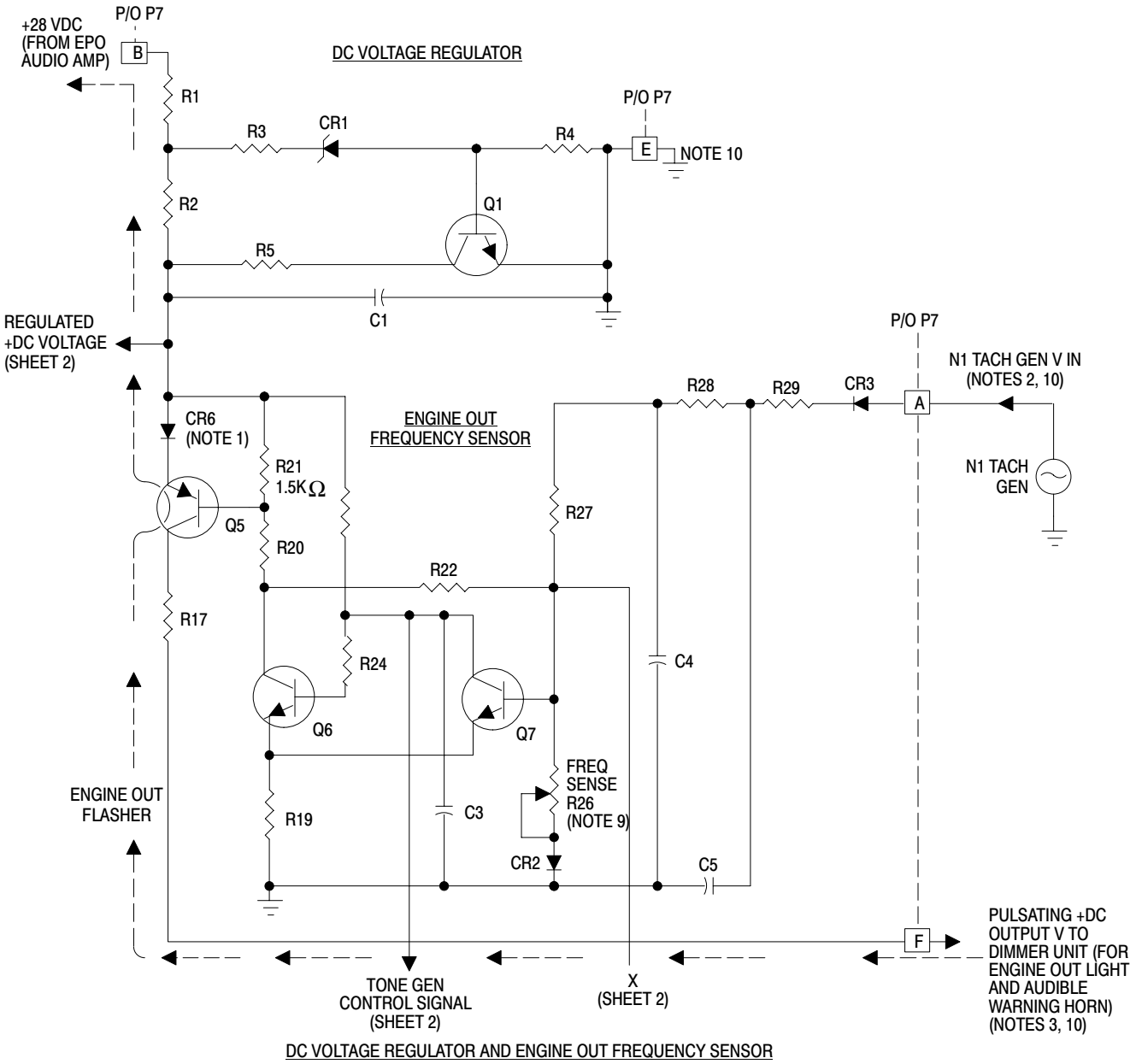


Figure 17-16. Vapair 26530332M Engine Power Out Warning Control Unit Schematic Diagram



DC VOLTAGE REGULATOR AND ENGINE OUT FREQUENCY SENSOR

NOTES:

1. CR6 IS COMMON TO EMITTER CIRCUITS OF BOTH Q4 AND Q5.
2. INPUT FREQUENCY OF 38.2 ±0.8 HZ (AT APPRO 13.0 ±2 VAC) OR LESS ACTIVATES CIRCUIT. THIS FREQUENCY REPRESENTS ENGINE SPEED OF 54.5 ±0.5% N1.
3. PULSATION RATE: 150 ±30/MINUTE.
4. NEGATIVE PULSES, 0.6V PEAK-TO-PEAK ACROSS 15-OHM RESISTIVE LOAD OR 0.7 PEAK-TO-PEAK ACROSS 300-OHM LOAD (FREQUENCY OF 680 - 1700 HZ, INTERRUPTED 150 ±30 TIMES/MINUTE).
5. REFER TO ELECTRICAL SYSTEM WIRING DIAGRAMS (SECTION 20) FOR FAULT INPUT SOURCES AND INTERCONNECTING WIRING INFORMATION.
6. DASHED LINES WITH ARROWHEAD (◀ - -) INDICATES INDICATOR LAMPS CURRENT PATH.
7. ALL COMPONENTS WITH REFERENCE DESIGNATORS ARE PART OF EPO UNIT UNLESS OTHERWISE INDICATED.
8. REFERENCE DESIGNATORS ARE FOR REFERENCE ONLY AND MAY NOT BE ON COMPONENTS.
9. INTERNAL ADJUSTMENT. ADJUST SO THAT ENGINE OUT INDICATOR LIGHT JUST GOES OUT WITH INPUT SPECIFIED IN NOTE 2.
10. PATH COMPLETED BY STRAIGHT-THRU CIRCUITS IN EPO AUDIO AMPLIFIER.

30-166-1

Figure 17-17. Vapair 26530332M Warning Audio and Light Flashing Control Circuit (Sheet 1 of 2)

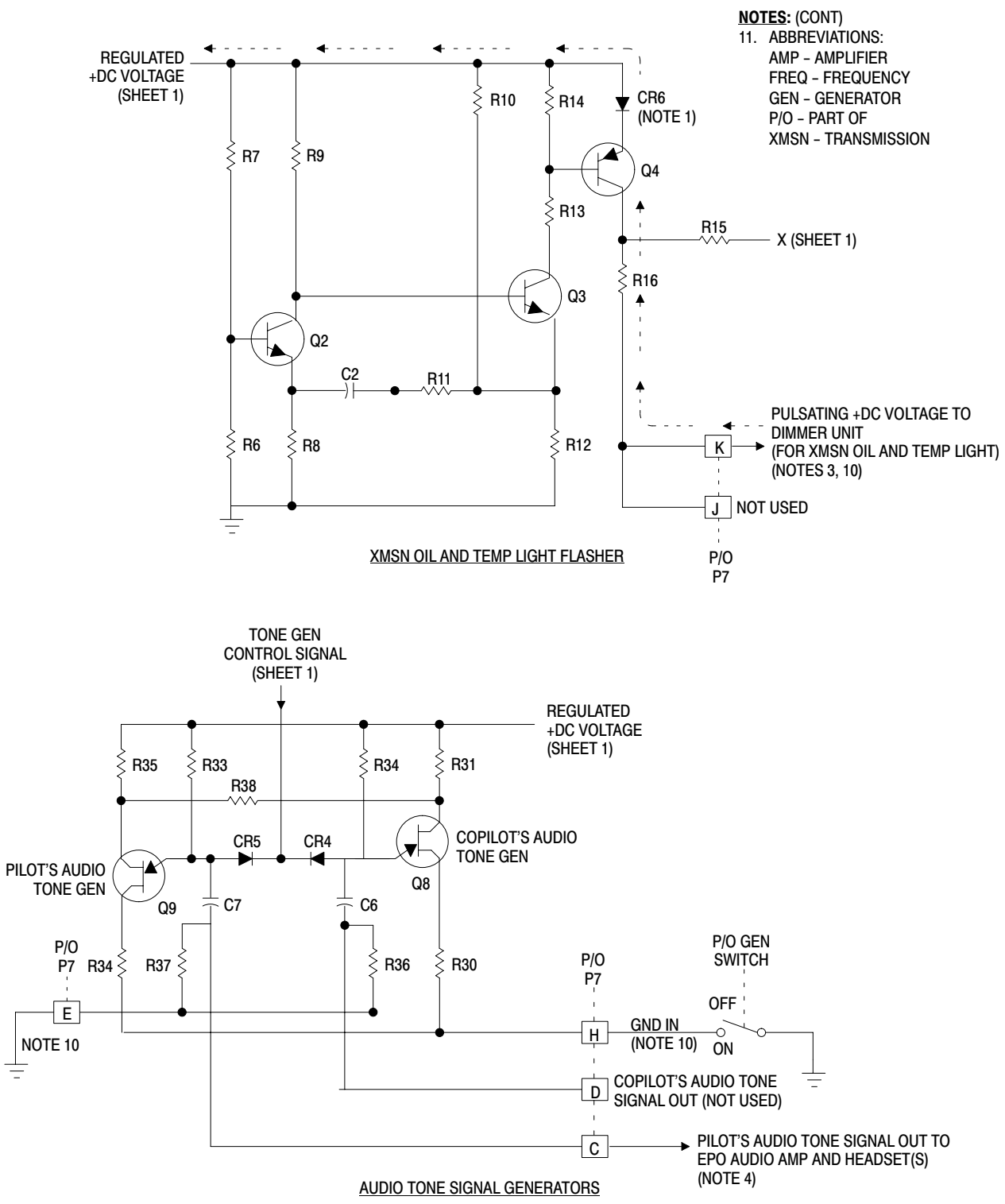


Figure 17-17. Vapair 26530332M Warning Audio and Light Flashing Control Circuit (Sheet 2 of 2)

(14). Reinstall the cover on the EPO warning unit.

(15). Install the instrument panel right side fairing.

G. Vapair 26530332M EPO Warning Unit Repair

Replace defective circuit components as necessary in the EPO warning unit. Refer to the functional information and troubleshooting data for the EPO warning unit to locate and isolate defective internal components.

H. Vapair 26530332M EPO Warning Control Unit Replacement

(1). Check that all electrical power is OFF and remove right instrument panel fairing.

(2). Disconnect electrical plug to control unit from audio amplifier and remove amplifier from control unit case; then remove the four mounting screws and washers, and lift out the control unit.

(3). Position replacement control unit and install attaching hardware. Mount the audio amplifier support clip with the upper aft screw of the control unit case.

(4). Connect electrical plug to control unit, turn on power and check that the red warning lights flash. Turn on generator switch and listen in headset for warning signal beeping. When flashing and audio signals are present, turn off switches and power. When control unit does not function properly, check warning circuits for continuity and proper connection according to Figure 17-16 and to the wiring diagrams, Section 20.

(5). Reinstall instrument panel fairing.

22. Autronics 2146-5 Engine Power Out (EPO) Warning Control Unit

The Autronics 2146-5 engine power out (EPO) warning control unit is a solid state device similar in function to the

Vapair EPO warning control unit's internal circuit differences are as follows:

Internal circuits are located on two circuit boards inside a case under a removable cover.

The unit provides pulsating output dc voltage for the engine out (ENG OUT) warning light indicator and audible warning horn, at engine speed of approximately 55% N_1 rpm (with an ac input frequency less than 36.75 ±1.75 Hz from the N_1 tachometer generator).

The unit does not contain a frequency sensing adjustment control.

The pulsating output dc voltage for flashing the ENG OUT warning lamps and sounding the warning horn is rated at 0.20 ampere, 28 volts, 120-180 pulses per minute with an on time of 50 ±15% of the period.

The unit also furnishes separate pulsating output dc voltages, identical to that for the ENG OUT warning lamps, to flash the main transmission oil pressure and temperature (XMSN OIL PRESS and TEMP) warning lights when associated sensing switches are actuated.

Audio tone generation and amplification circuits provide an audio tone output level sufficient for earphones of headsets without use of an external audio amplifier.

Internal adjustment controls permit setting the level of the audio tone outputs.

Figure 17-18 is a schematic diagram of the Autronics EPO warning unit.

The following information describes differences in EPO operation from the Vapair unit.

A. Engine Power Out Warning Circuits

The EPO warning unit contains engine out frequency sensing, warning lights flasher, audio tone generation and dc voltage regulator circuits.

Figure 17-19 is a breakdown of the Autronics EPO warning unit overall schematic diagram and shows circuits separately by functions.

See the electrical system wiring diagram in Section 20 for interconnection wiring information on the warning lights indicating system.

B. Engine Out Frequency Sensing Circuits

(Ref. Figure 17-19) Engine out frequency sensing circuits consist of input gate and engine speed sensing circuits.

In the input gate circuits, diode CR3 rectifies the positive portion of the input ac voltage from the N_1 tachometer generator for amplification by series connected sense amplifiers Q7 and Q8.

When the time interval of the rectified and amplified input is longer than one-half the period of one cycle of the unijunction speed sensing oscillator Q9, a pulsating output is produced by Q9, is amplified by sensing oscillator amplifier Q11 and is applied to underspeed switch Q10 of the engine speed sensing circuits.

Q10 drives the engine out and transmission lights flasher circuits and supplies dc power to the audio tone circuits.

Sense oscillator and amplifier circuits are supplied dc power from the dc voltage regulator circuit.

C. Engine Out and Transmission Lights Flasher Circuits

(Ref. Figure 17-19) Unijunction flasher oscillator Q1 operates continuously supplying a pulsating signal for amplification by flasher oscillator amplifier Q3 to drive both engine out and transmission lights flasher circuits.

Transmission light flasher driver Q2 applies the pulsating signal to flasher amplifier Q4 that amplifies the pulsating signal to flash parallel connected main transmission oil pressure and temperature warning lights indicators through associated sensing switches.

Engine out flasher driver Q5 and amplifier Q6 function in the same manner to flash the engine out warning lamps and drive the audible engine out warning horn, except Q5 drives Q6 to amplify the pulsating signal only when drive is present from underspeed switch Q10.

D. Audio Tone Circuits

(Ref. Figure 17-19) Audio tone circuits consist of audio generation, interrupter and amplification circuits.

When present, drive current from the underspeed switch Q10 causes unijunction tone oscillator Q12 to provide a tone signal for amplification by tone oscillator amplifier Q13, if a ground is applied to diode CR6 from the external generator switch.

Q10 drive current also causes tone interrupter Q14 to alternately enable and interrupt application of the amplified tone signal from Q13 to audio #1 and #2 amplifiers Q15 and Q16. Q15 and Q16 amplify the interrupted audio tone to a sufficient level for headsets without additional external amplification.

An internal audio tone level control in both the #1 and #2 audio amplifier circuits permits adjustment of output tone audio level.

The amplified interrupted audio tone from Q15 is applied to earphones of headsets.

Turning the generator switch off disables the audio tone circuits.

Output from Q16 is not used in the standard electrical system configuration.

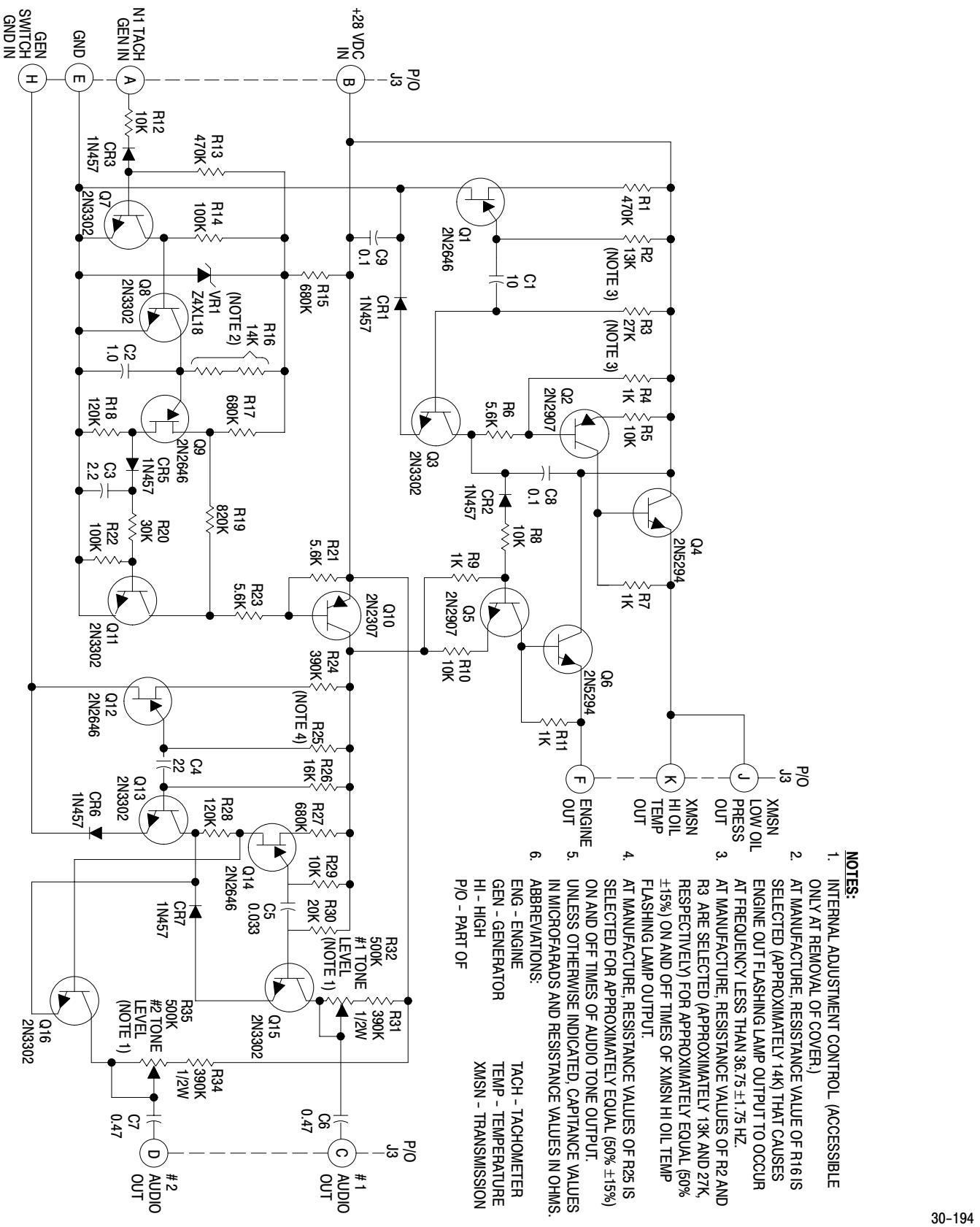
E. Audio Tone Output Level Adjustment - Autronics 2146-5 EPO Warning Control Unit

When necessary, or after replacement of the EPO warning control unit, adjust audio tone output level for earphones of headsets as follows.

(1). Be sure that a headset is connected to a radio/intercom station and that any installed interphone equipment is functioning normally.

(2). Check that all electrical power is OFF.

(3). With right instrument panel fairing removed from instrument console, remove cover from EPO warning control unit and be sure that electrical wiring harness is connected to the warning control unit.



NOTES:

1. INTERNAL ADJUSTMENT CONTROL (ACCESSIBLE ONLY AT REMOVAL OF COVER.)
2. AT MANUFACTURE, RESISTANCE VALUE OF R16 IS SELECTED (APPROXIMATELY 14K) THAT CAUSES ENGINE OUT FLASHING LAMP OUTPUT TO OCCUR AT FREQUENCY LESS THAN 36.75 ±1.75 HZ.
3. AT MANUFACTURE, RESISTANCE VALUES OF R2 AND R3 ARE SELECTED (APPROXIMATELY 13K AND 27K, RESPECTIVELY) FOR APPROXIMATELY EQUAL (50% ±15%) ON AND OFF TIMES OF XMSN HI OIL TEMP FLASHING LAMP OUTPUT.
4. AT MANUFACTURE, RESISTANCE VALUES OF R25 IS SELECTED FOR APPROXIMATELY EQUAL (50% ±15%) ON AND OFF TIMES OF AUDIO TONE OUTPUT.
5. UNLESS OTHERWISE INDICATED, CAPITANCE VALUES IN MICROFARADS AND RESISTANCE VALUES IN OHMS.
6. ABBREVIATIONS:
   - ENG - ENGINE
   - GEN - GENERATOR
   - HI - HIGH
   - P/O - PART OF
   - TACH - TACHOMETER
   - TEMP - TEMPERATURE
   - XMSN - TRANSMISSION

30-194

Figure 17-18. Autronics 2146-5 Engine Power Out Warning Control Unit Schematic Diagram

(4). Turn electrical power ON. Check that WARNING AND PANEL lights and ENG OUT circuit breakers are reset (in) and that generator switch is set to GEN.

(5). Check that red warning light indicators for ENG OUT and low XMSN OIL PRESS are flashing, that audible warning horn is “beeping” and that audible warning tone is present in headset. This should occur when engine is not operating.

(6). Set generator switch OFF to disable the audible warning horn while completing the adjustment.

(7). While listening with a headset, adjust #1 audio tone level control R32 inside the EPO warning unit for adequate and desired warning tone audio level in earphone. Be sure that the tone audio level is present and adequate with controls on any installed interphone audio equipment at normal operating settings.

(8). Set generator switch to GEN to enable the audible warning horn.

(9). Set the generator switch OFF and verify that audible warning horn stops “beeping”, audible warning tone is no longer present in the headset and that ENG OUT and XMSN OIL PRESS warning indicator lights continue to flash.

(10). Turn all electrical power OFF.

(11). Reinstall cover on EPO warning control unit, connect electrical connector to warning control unit and install right instrument panel fairing on instrument console.

F. Autronics 2146-5 EPO Warning Control Unit Repair

Replace defective circuit components as necessary in the EPO warning unit. Refer to the functional information and troubleshooting data for the EPO warning unit to isolate defective internal components.

G. Autronics 2146-5 EPO Warning Control Unit Replacement

(1). Check that all electrical power is OFF.

(2). Remove right instrument panel fairing from instrument console.

(3). Disconnect electrical wiring harness connector from EPO warning unit that is mounted on inboard side of instrument console.

(4). Remove attaching hardware and EPO warning unit from instrument console.

(5). Install replacement EPO warning unit on right panel of instrument console in reverse order of removal.

(6). Turn on electrical power and check that the red ENG OUT and OIL PRESS warning lights flash. Set generator switch to GEN and listen to audible warning horn for audible “beeping” and headset for audible tone signal. When flashing and audio warning signals are present, turn OFF switches and power.

NOTE: If control unit does not function properly, check interconnection wiring for continuity and proper connection according to wiring diagram in Section 20 and check internal circuits according to Figure 17-18.

(7). If necessary, adjust #1 audio tone output level from EPO warning unit for headsets.

(8). Reinstall the right instrument panel fairing.

Application of a disable ground to the unit cause the disable circuits to deactivate N_R sensing which prevents the warning indications while the disable ground is applied.

The time delay keeps N_R sensing disabled for 3.5 ±0.5 seconds after removal of the disable ground.

Engine low N_1 speed sensing, and engine out flashing light and audible warning horn activation, control and generation circuits function similarly for low N_1 rpm sensing similarly to those of the Autronics 2146-5; except low N_1 speed sensing occurs at 55% N_1 rpm (equivalent to tachometer generator ac output voltage with a frequency of 36.75 ±1.75 Hz) or less.

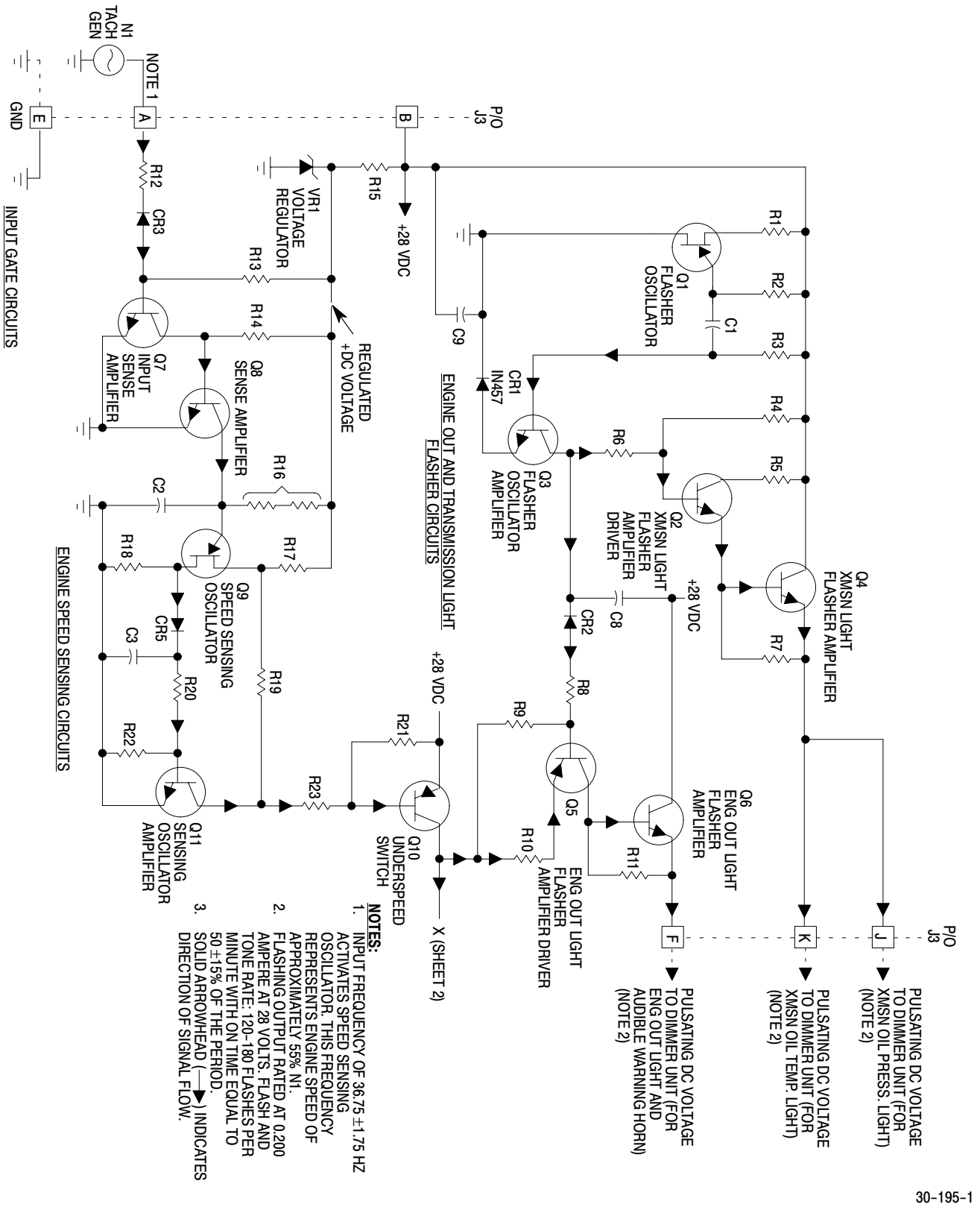
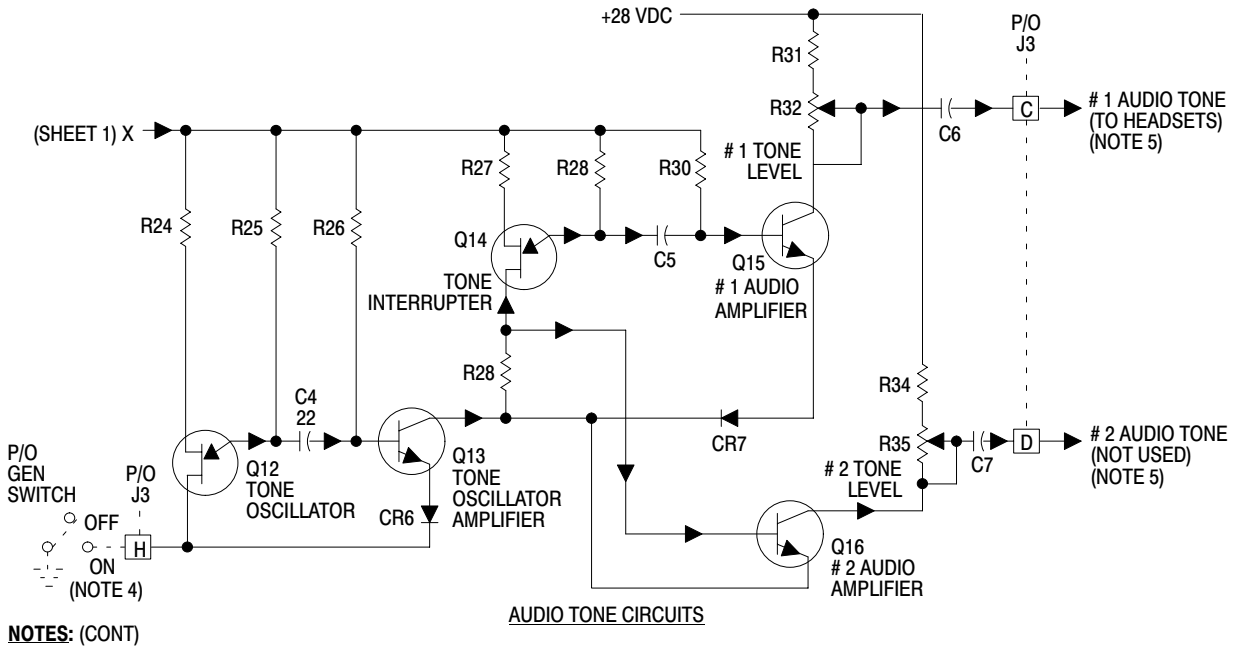


Figure 17-19. Autronics 2146-5 Warning Audio and Lights Flashing Control Circuit (Sheet 1 of 2)



AUDIO TONE CIRCUITS

NOTES: (CONT)

4. REMOVAL OF GROUNDS IN FROM GENERATOR SWITCH DISABLES AUDIO TONE CIRCUITS.
5. AUDIO TONE OF 680–1700 HZ INTERRUPTED AT A RATE OF 150 HZ. MAXIMUM OF 3.0–3.5 VOLTS WITH OUTPUT TERMINATED INTO 100 OHM LOAD. (VOLTAGE MEASURED WITH RMS AC VOLTMETER.)
6. REFER TO ELECTRICAL SYSTEM WIRING DIAGRAM (APPLICABLE PART OF HMI) FOR INTERCONNECTION WIRING INFORMATION.
7. ABBREVIATIONS:
   AMP – AMPLIFIER
   ENG – ENGINE
   GEN – GENERATOR
   OSC – OSCILLATOR
   P/O – PART OFF
   PRESS – PRESSURE
   RMS – ROOT MEAN SQUARE
   TEMP – TEMPERATURE
   XMSN – TRANSMISSION

30–195–2

Figure 17-19, Autronics 2146-5 Warning Audio and Lights Flashing Control Circuit (Sheet 2 of 2)

When activated, either N_1 or N_R sensing circuits activate and control the engine out flashing light, audible warning tones and the audible warning horn.

Audible warning tones No. 1 & 3 are activated and controlled by either N_1 or N_R sensing.

The Autronics 2200-3 is a sealed unit without adjustments; an internal defect requires replacement of the unit.

NOTE: Input, control and output circuits, signals and voltages differ from those of the 2146- 5 unit as described above. Internal schematic diagrams of the unit are not provided; internal maintenance is not practical.

23. Autronics 2200-3 EPO Warning Control Unit

The autronics 2200-3 EPO warning control unit is a sealed, solid state device that functions similarly to the Autronics 2146-5 EPO warning control unit; except as follows: The unit contains additional circuits for sensing low main rotor (N_R) speed to control engine out flashing light and audible warning horn indications, and generation of an additional separate audible warning tone No.3 when low N_R speed is sensed. (For a simplified internal block diagram of the unit, see Figure 17-5.)

The unit senses low N_R speed at approximately 98% N_R rpm (equivalent to tachometer generator output ac voltage with a frequency of 68.6 ±0.7 Hz), or less. Low N_R speed sensing functions incorporate disable and time delay circuits.

A. Autronics 2200-3 EPO Warning Control Unit Maintenance

An internal malfunction requires removal and replacement of the unit. Remove and replace the unit as described for the Autronics 2146-5, except disregard information on adjustment of internal controls. (autronics 2200-3 unit does

not have accessible internal adjustments.) For information on checking operation of the unit, refer to the following data.

(1). For information on troubleshooting the unit installed in the helicopter, refer to Table 17-2 and Table 17-3.

(2). For additional maintenance information on the unit, refer to Table 17-4.

24. Grimes 70-0054-1 Indicator Lights Dimmer Assembly (Panel Type A)

The Grimes 70-0054-1 indicator lights dimmer assembly is a solid state device that is used with the EPO warning unit for caution and warning lights dimming and dims instrument panel lights when the option night lighting system is installed.

The indicator lights dimmer assembly is installed at the lower left interior of the instrument panel console.

A removable cover permits access to two circuit boards and components of the indicator lights dimmer assembly for maintenance and repair.

The indicator lights dimmer assembly contains the following internal circuits.

A. Indicator Lights Dimming Assembly Circuits

The indicator lights dimming assembly contains components for use in for use in four negative input signal fault dimming indicator circuits for the four caution light indicators, three positive input fault and function indicator circuits for three warning light indicators and a panel light dimming circuit (d below) for panel lamps. In addition, test circuits are included for all the circuits.

Figure 17-20 is a schematic diagram of the dimming assembly.

Figure 17-21 is a partial breakdown of the indicator lights dimming assembly overall schematic diagram with associated circuits and shows typical circuits separately by functions.

B. Negative (Ground) Input Fault Dimming Circuits

(Ref. Figure 17-21) Negative input fault dimming circuits function when a ground is applied from external sensing switches to the dimmer unit.

When the ground fault is applied, a current path is completed from the external ground through the associated external caution lamps, diode CR9, and normally closed contacts of dimming relay K1 to +28 Vdc for bright lamp indication.

For a dim lamp indication, the dim-bright switch completes a current path from ground through the winding of dimming relay K1 and diode CR1 to +28 Vdc. This selects a current path or the fault indicator lamps through zener diode VR1 to +28 Vdc.

When selected, zener diode VR1 introduces a constant voltage drop to reduce lamp voltage for simultaneous dim lighting of all caution light indicators that are illuminated.

The dim-bright circuit is common to and functions identically for all negative input fault dimming circuits. is common to and functions identically for all negative input fault dimming circuits.

C. Positive (+28 Vdc) Input Fault and Function Dimming Circuits

(Ref. Figure 17-21) Each of the two positive (+28 Vdc) input fault dimming circuits, and the one +28 Vdc input function dimming circuit, control illumination of separate external warning light indicators on the instrument panel.

When a +28 Vdc input is applied to diode CR15, a current path is completed from ground, through transistor Q3, the external START PUMP lamp and diode CR15 to the +28 Vdc applied for a bright lamp indication.

The + 28 Vdc applied through dimming relay K1 contacts to resistor R4 at the base of transistor Q3 forward biases Q3, so that the lamp current path is through Q3, bypassing parallel resistor R3. For a dim lamp indication, the dim-bright switch energizes K1 removing the positive voltage applied to the base of Q3; Q3 ceases conduction and lamp current must flow through resistor R3. The resulting voltage drop across R3 reduces lamp voltage and dims the lamp.

The circuit for the XMSN OIL TEMP & PRESS lamps functions identically, except a pulsating positive dc voltage input is provided by the transmission oil and temperature light flasher circuit of the EPO warning unit, to flash the associated lamps.

The circuit for the ENG OUT warning light functions in the same manner as the XMSN OIL TEMP & PRESS dimming circuits, except resistor R1 is directly switched in the lamp current path for lamp dimming by dimming relay K1.

D. Panel Lights Dimming Circuit

(Ref. Figure 17-21) When the night lighting system is installed, a variable positive voltage from the panel and instruments light dimming potentiometer R113 is applied to the base of transistor Q1. The variable voltage varies external panel lamps current flowing through transistor Q2 to control panel and instrument lamp illumination.

E. Grimes 70-0054-1 Indicator Lights Dimmer Assembly Repair

Replace circuit component as necessary in the indicator lights dimmer assembly. Refer to the functional information and troubleshooting data for the indicator lights dimmer assembly to locate and isolate defective internal components.

F. Grimes 70-0054-1 Indicator Lights Dimmer Assembly Replacement

(Ref. Figure 17-3)

(1). Check that all electrical power is OFF and remove left instrument panel fairing.

(2). Disconnect the electrical plug from the dimmer assembly, remove the mounting screws and washers, and lift out the dimmer assembly.

(3). Position replacement dimmer assembly and install attaching hardware.

(4). Connect electrical plug to dimmer assembly. Turn on power, push-to-test switch for the indicator lights and check for proper functioning of the lights.

(5). Reinstall instrument panel fairing.

25. Autronics 2245-1 Indicator Lights Dimmer Assembly (Panel Type B)

The Autronics 2245-1 dimmer assembly is a solid state device associated with the caution and warning indicator lights of the type used in instrument panel type B. The unit contains 28 Vdc and ground test circuits, with isolation diodes, which are part of the PRESS-TO-TEST circuit for the lights. The unit also contains a switching regulator to regulate voltage for instrument panel and instrument light dimming. Caution and warning indicator lights may be dimmed by pressing the face of each indicator. See Figure 17-22 for a schematic diagram of the dimmer assembly. The unit contains components used in the following circuits.

A. Dimmer Assembly Associated Circuits

The unit contains 16 diodes and other circuit components used in: six negative fault input indicator circuits for six caution light indicators; two negative fault input signal indicator circuits for main transmission (XMSN) oil temperature (TEMP) and pressure (PRESS) warning light indicator; a positive input signal indicator for the START PUMP light indicator; a circuit for an engine (ENG) OUT warning light indicator; and a panel and instrument lights dimming circuit.

In addition, internal components permit simultaneous press-to-test checking of all the circuits and light indicators.

Figure 17-22 is a partial breakdown of the dimmer assembly overall schematic diagram with associated light circuits and shows typical circuits separately by functions.

Table 17-4. Input/Output Signals - Autronics 2200-3 EPO Unit

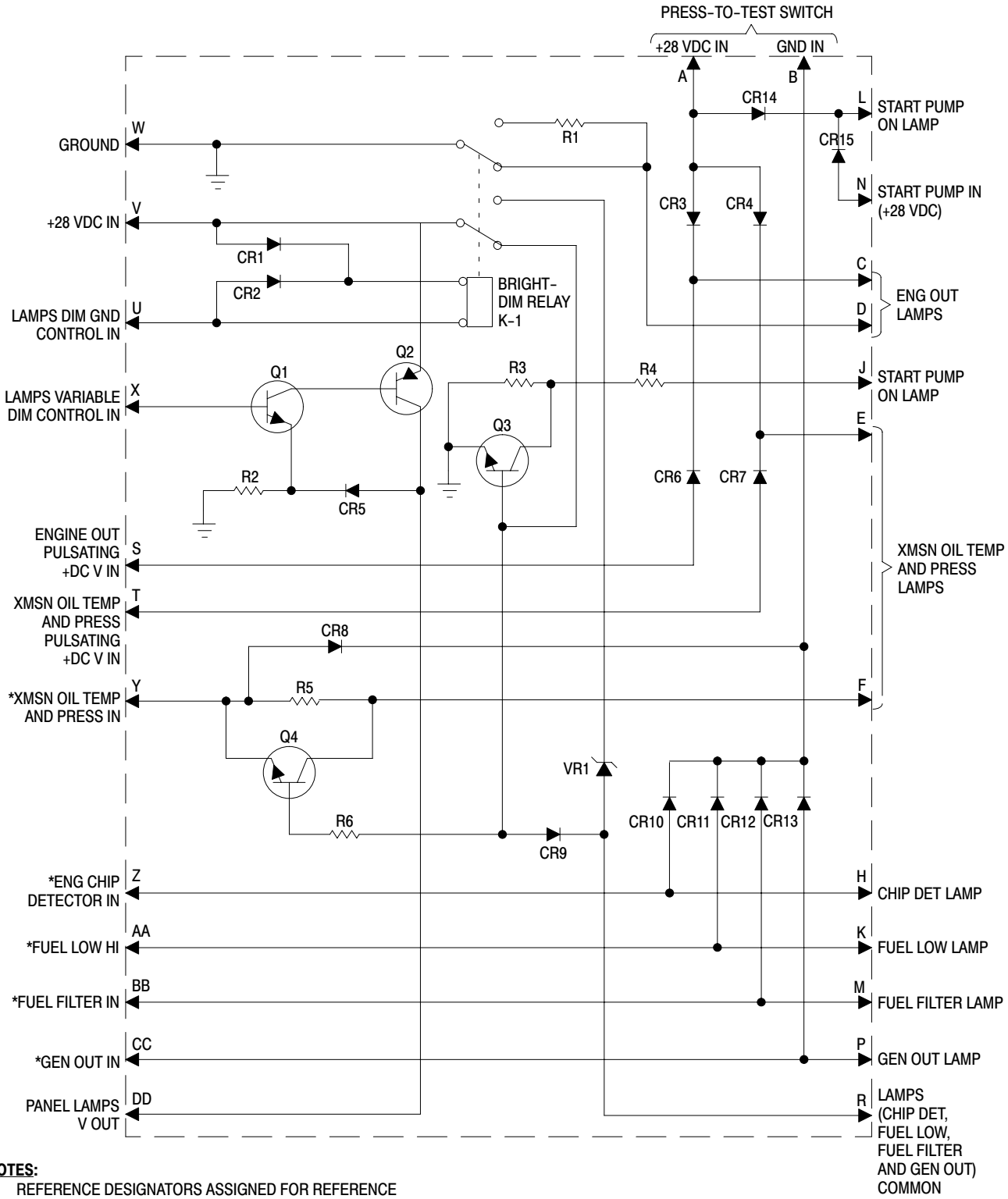
Input			Output		
Connector J21 Pin	**Name**	**Signal or Control**	**Connector J22 Pin**	**Name**	**Signal**
A	N_1 tach gen	Ac voltage, 36.75 ±1.75 Hz, or less	F	Eng out light flasher and audible warning horn	Pulsating 28 Vdc with 3-5 Hz flash rate, 0.2A max., 28 Vdc present for min. 25% - max. 75% of flash rate period.
			K	Xmsn oil & temp flasher	Same as for J21, Pin F
			C	Audio warning tone No. 1	Interrupted 680 to 1700 Hz, 0.9 ±1 Vac into 16K ohm load; interrupted 120 ±40 times/minute, ac voltage present for min. 25% -max. 75% of interrupt rate period.
			D	Audio warning (not used)	Same as J21, pin C.
			M	Audio warning tone No. 3	Same as J21, pin C; except 18.5 ±2 Vac into 100 ohm load.
J	Audio tone enable ground	Airframe ground		Presence of this input is required for outputs at J21, pins C and D.	
B	Supply input voltage	+28 Vdc	Presence of these inputs required for all EPO unit outputs.		
E	Ground	Airframe ground			
L	N_R tach gen	Ac voltage, 68.6 ±0.7 Hz, or less	F	Same as above	Same as above
			K	Same as above	Same as above
			M	Audio warning tone No. 3	Same as J21, pin C; except 18.5 ±2 Vac into 100 ohm load.
			C	Same as above	Same as above
			D	Same as above	Same as above
G	N_R sensing and audio tone No. 3 disable	Airframe ground		Presence of this input is required to prevent outputs at J21, pins F, K and M with input at pin L. (3)	

NOTE:

(1) All ac voltage levels are peak-to-peak on calibrated oscilloscope.

(2) N_1 and N_R sensing inputs produce all associated outputs listed, when other required indicated inputs are present.

(3) At removal and reapplication of input at pin G, output at G, outputs occur 3.5 seconds after reapplication due to internal time-delay circuits.

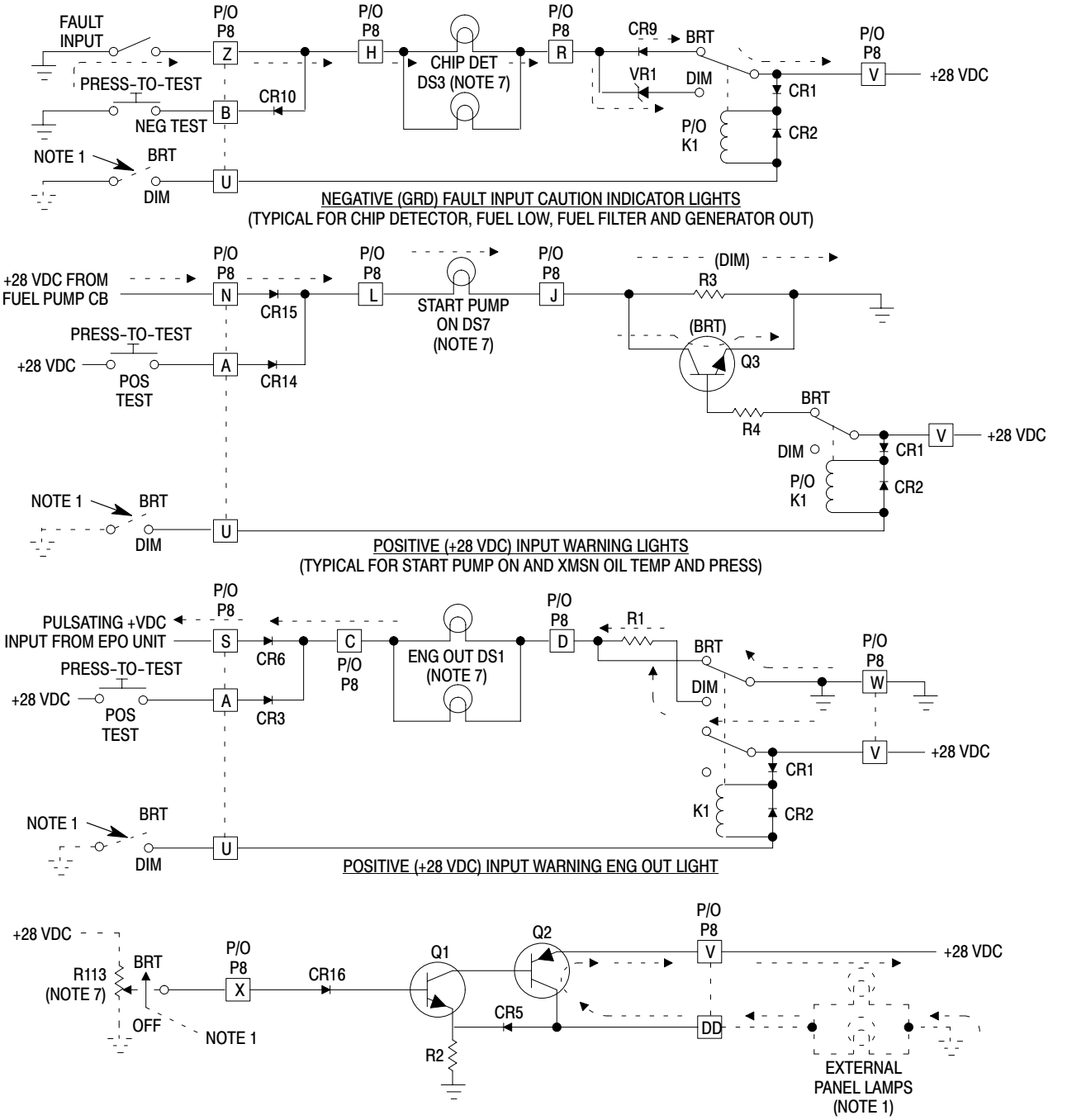


NOTES:

1. REFERENCE DESIGNATORS ASSIGNED FOR REFERENCE ONLY AND ARE NOT ON COMPONENTS.
2. ASTERISK (*) INDICATES NEGATIVE (GROUND) FAULT INPUT.
3. ALL CONNECTOR PINS ARE PART OF SINGLE CONNECTOR ON UNIT.

30-196

Figure 17-20. Grimes 70-0054-1 Indicator Dimming Assembly Schematic Diagram



NOTES:

1. DIM-BRT SWITCH AND R113 ARE MECHANICALLY LINKED. PANEL LAMPS, DIM-BRT SWITCH AND R113 ARE PART OF OPTIONAL NIGHT LIGHTING SYSTEM.
2. REFER TO ELEC SYSTEM SCHEMATIC AND WIRING DIAGRAMS (REF. SEC 20) FOR FAULT AND FUNCTION INPUT SOURCES, INTERCONNECTING WIRING INFORMATION AND DIMMER ASSY SCHEMATIC DIAGRAM.
3. DASHED LINE WITH ARROWHEAD (◄- - -) INDICATES CURRENT PATH (OPPOSITE OF VOLTAGE) THROUGH INDICATOR LAMPS.
4. EACH CIRCUIT SHOWS ONLY COMPONENTS USED FOR FUNCTION INDICATED.
5. ALL COMPONENTS WITH REFERENCE DESIGNATORS ARE PART OF DIMMER ASSY UNLESS OTHERWISE INDICATED.
6. REFERENCE DESIGNATORS ARE FOR REFERENCE ONLY AND ARE NOT ON COMPONENTS.
7. NOT PART OF DIMMER ASSY.

30-167A

Figure 17-21. Caution and Warning Indicating Light System Dimming Circuits (Instrument Panel Type A)

B. Negative (Ground) Input Fault Caution Light Indicator Circuits

(Ref. Figure 17-23) Negative input fault caution light indicator circuits function when a ground is applied from external sensing switch to the dimmer assembly.

When the ground is applied, a current path is completed from the external ground through the associated external caution lamps and PANEL LT circuit breaker CB104 to the +28 Vdc source.

A diode (CR11 or other diode, as applicable) is provided for each individual negative input fault circuit for use in the press-to-test circuits.

C. Negative (Ground) Input Fault Warning Light Indicator Circuits

(Ref. Figure 17-23) Negative input fault warning light indicator circuits for the XMSN high OIL TEMP and/or low OIL PRESS lamps function when a ground is applied from the associated sensor switch to the dimmer assembly.

When the ground is applied, a current path is completed through the external warning indicator lamps and a diode CR5 (or CR6) to the transmission oil and temperature light flasher circuit of the engine power out warning control unit. A pulsating dc voltage is applied to and flashes the warning indicator lamps. A diode CR9 (or CR10) is provided for each of the two negative input fault circuits for use in the press-to-test circuits.

D. Positive (+28 Vdc) Input Start Pump Warning Light Circuit

(Ref. Figure 17-23) The START PUMP warning light circuit functions when an external +28 Vdc input is applied through diode CR8 to the external START PUMP warning lamp.

The input is applied when the start pump is energized by the START PUMP circuit breaker CB 118 on the instrument panel.

Diode CR4 is provided for use in the press-to-test circuits.

E. Engine Out warning Light and Horn Circuit

(Ref. Figure 17-23) The ENG OUT warning light and audible horn functions when the engine out frequency sensor circuit in the engine power out waning control unit is actuated by a decrease of engine speed to a specific value of N_1 rpm.

When this occurs, a pulsating dc voltage input from the sensor circuit is applied through diode CR 7 to and flashes the ENG OUT lamps. Simultaneously, the pulsating dc voltage is applied to and activates the audible warning horn DS105 by means of the circuit through part of the closed generator (GEN) switch S4.

When open, GEN switch, GEN switch S4 disables the audio warning horn. Diode CR3 is provided for use in the press-to-test circuits.

F. Panel and Instrument Lights Dimming Circuit

(Ref. Figure 17-23) When the night lighting system is installed, a variable positive dc voltage (0 to +28 Vdc) from the external FLIGHT instrument light potentiometer R110 is applied to the input of the switching regulator in the dimming assembly.

The variable input voltage causes the switching regulator to vary the positive dc output voltage applied to and current panel and instrument cluster lamps.

The control panel and instrument internal illumination.

Minimum regulator output voltage is +2.5 Vdc with an input o 0 Vdc and +26 Vdc with an input of +28 Vdc.

G. Caution and Warning Lights Press-To-Test Circuits

(Ref. Figure 17-23) Diodes are incorporated in the dimmer assembly for all of the caution and warning light circuits to provide either a required ground or +28 Vdc input for the associated circuit when the external PRESS-TO-Test switch is depressed.

Lamp illumination is constant during press-to-test operation; none of the lamps flash during the check.

H. Autronics 2245-1 Dimmer Assembly Test and Repair

(Ref. Figure 17-22)

(1). Test diodes, using an ohmmeter at electrical connector pins. Check for low forward resistance with positive lead applied to the anode and negative lead applied to the cathode. Read very back resistance when leads are reversed.

(2). Test switching regulator by applying +28 Vdc at electrical connector pin V and ground at pin W. Check output at pin d for 2.5 Vdc minimum. Apply +28 Vdc at pin d for 26 Vdc minimum.

(3). Replace faulty internal components.

I. Autronics 2245-1 Dimmer Assembly Replacement

(Ref. Figure 17-22)

(1). Check that electrical power is OFF.

(2). Locate dimmer assembly mounted forward of the ash tray in the lower switch/circuit breaker panel box.

(3). Disconnect plug at the front of the dimmer assembly.

(4). Remove four screws attaching dimmer to lower surface of panel box and remove dimmer.

(5). Install replacement dimmer by essentially reversing the above procedure.

(6). Connect electrical power and check caution and warning light PRESS-TO-TEST operation.

NOTE: If any single caution or warning light does not illuminate and N_1 sensing equipment is used, try pressing the legend face of the indicator to be sure that the internal switch and lamps are not defective.

(7). Check instrument panel lights for proper dim and bright operation. Turn off electrical power.

26. Engine Power Out (EPO) Audio Amplifier (Used with Vapair EPO Warning Control Unit)

The EPO audio amplifier is a solid state amplifier that amplifies the audio signal from the EPO warning unit for application to radio headset(s).

The amplifier is a sealed in a cylindrical container, with a wiring harness and attached connector secured to each end.

The early type amplifier is an Autronics 2037-1 two-transistor, dual channel amplifier; however, only one channel is used. The power gain ratio of the dual channel amplifier is 3 to 1 greater, when used with the EPO warning unit.

For the current type, two-transistor, single channel amplifier, a 2 milliwatt input input produces a 100 milliwatt minimum output.

Refer to the electrical system wiring diagram (Ref. Sec. 20) for inter-connecting wiring information.

A schematic diagram for both early and current type units is provided in Figure 17-24. Both the single and dual channel amplifier interconnect with the electrical system identically.

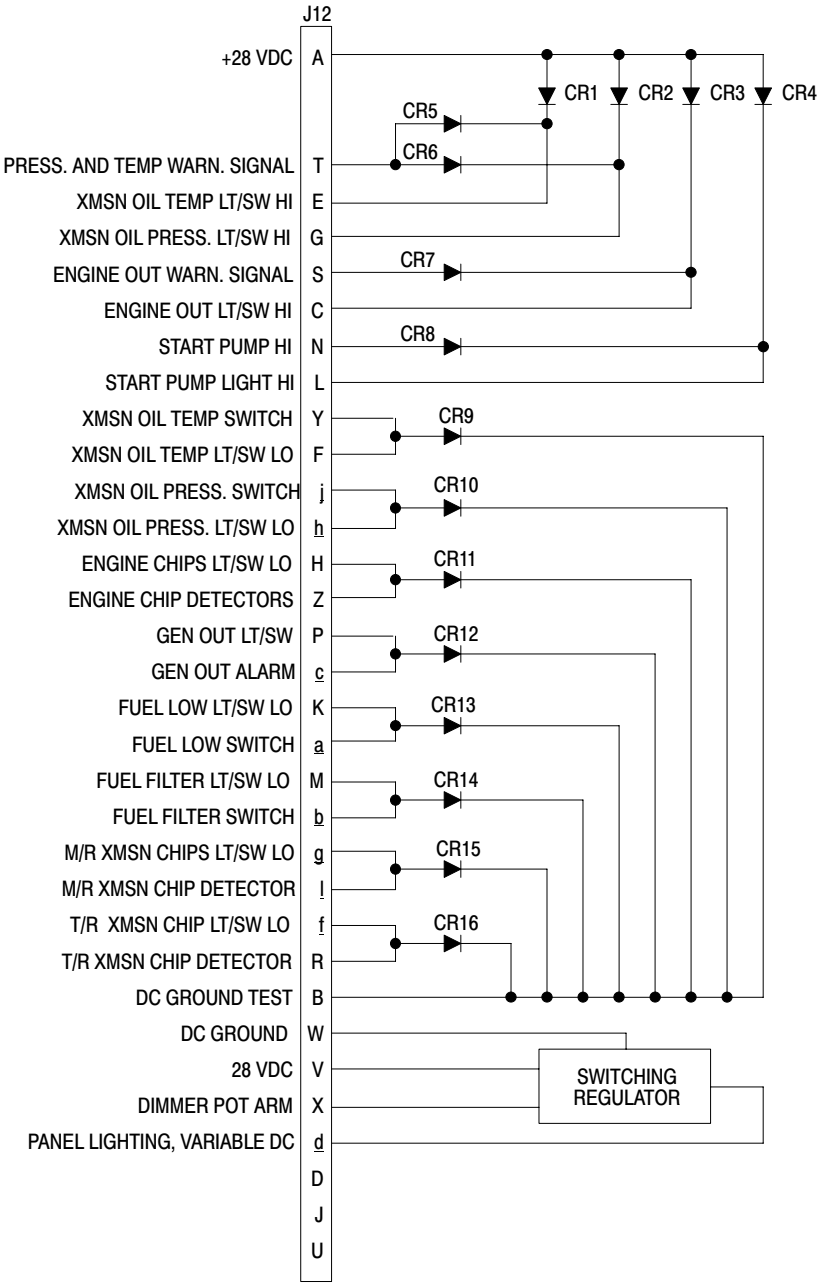
The amplifier also contains straight through circuits, not interconnected to the internal amplifier circuit, that transfer all inputs and outputs to and from the EPO warning unit.

The EPO audio amplifier is installed with the EPO warning unit at the lower right interior of the instrument panel console.

A. EPO Audio Amplifier Replacement

(Ref. Figure 17-3) Accomplish replacement of the audio amplifier according to the instructions in Replacement of Vapair 26530332M EPO Warning Control Unit except disconnect both electrical plugs of the amplifier and remove only the upper aft screw from the engine power out control unit case to release the amplifier.

NOTE: The single channel amplifier is used for replacement and is one- way interchangeable with the dual channel amplifier.

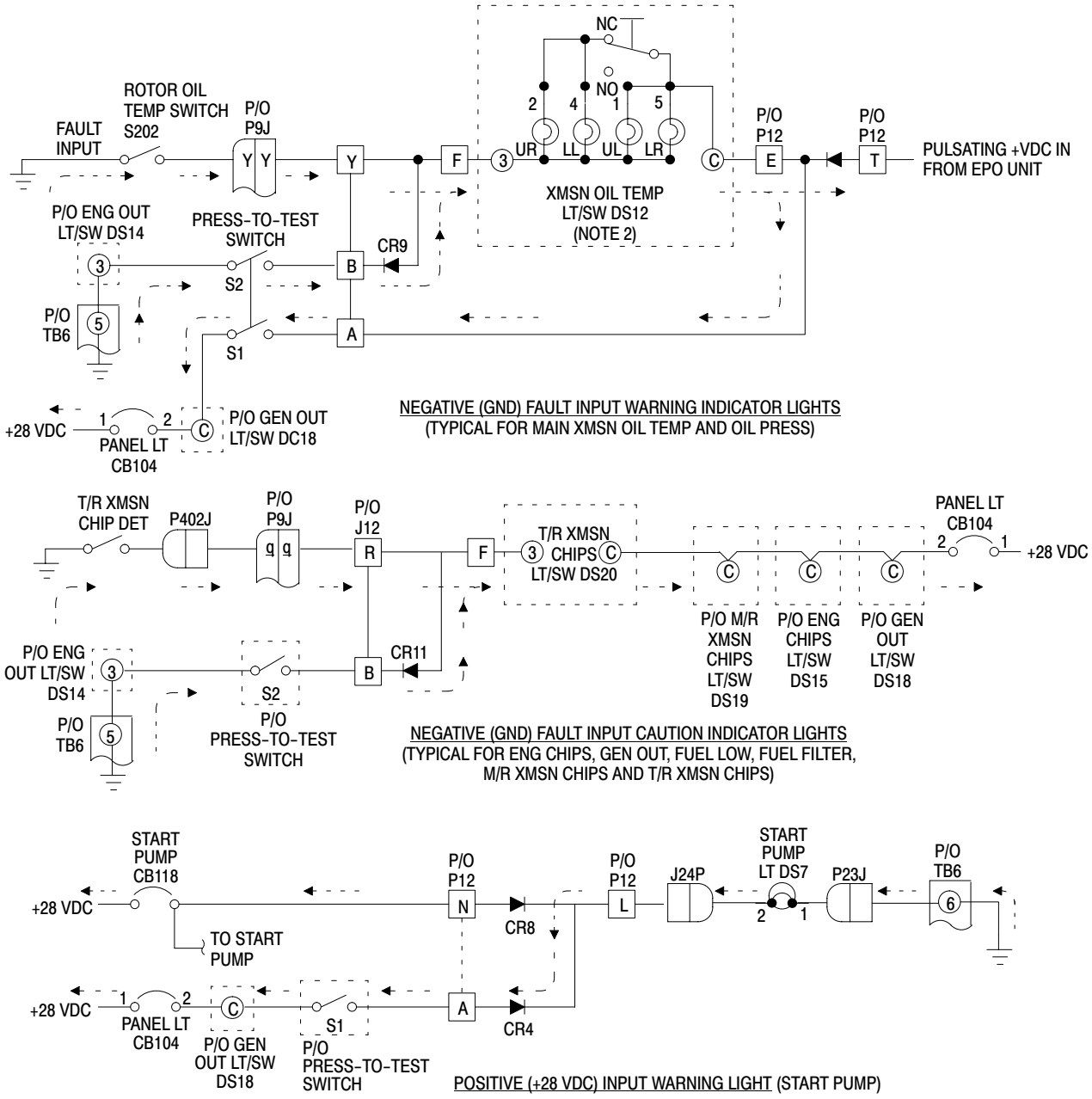


NOTES:

1. TERMINALS NOT DESIGNATED WITH LIGHT SWITCH (LT/SW) ARE INPUTS FROM SENSOR/SENDER UNITS, UNLESS OTHERWISE INDICATED.
2. TERMINALS DESIGNATED WITH LIGHT SWITCH (LT/SW) ARE OUTPUTS TO CAUTION AND WARNING LIGHTS.
3. TERMINALS DESIGNATED DC GROUND TEST AND +28 VDC ARE INPUTS FROM PRESS-TO-TEST SWITCH.
4. TERMINAL DESIGNATED DIMMER POT ARM IS INPUT FROM PANEL LIGHTS DIMMING CONTROL.
5. TERMINAL DESIGNATED PANEL LIGHTING, VARIABLE DC IS OUTPUT TO PANEL AND INSTRUMENT LIGHTS.
6. DIODES CR5 THRU CR8 USED IN WARNING LIGHTS FLASHING CIRCUITS. ALL OTHER DIODES USED ONLY IN PRESS-TO-TEST CIRCUITS FOR LIGHT INDICATORS.

30-187A

Figure 17-22. Autronics 2245-1 Dimmer Schematic Diagram (Instrument Panel Type B)

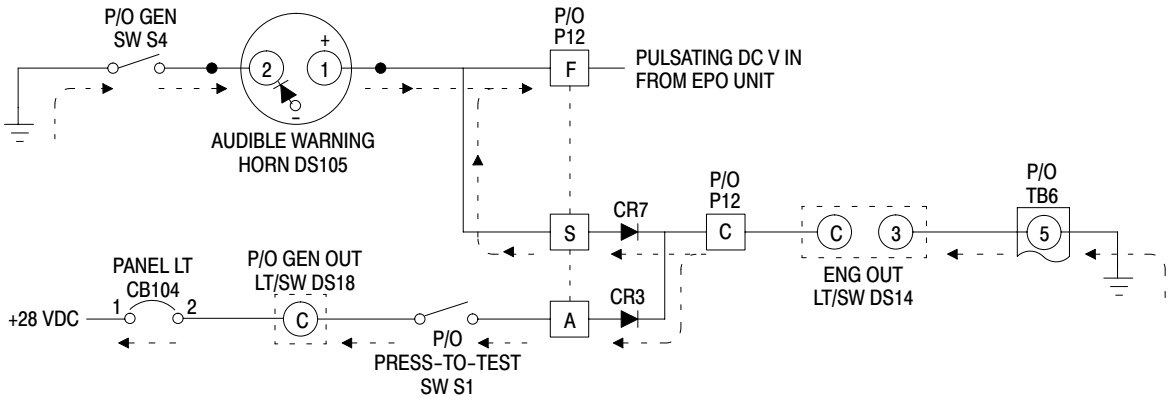


NOTES:

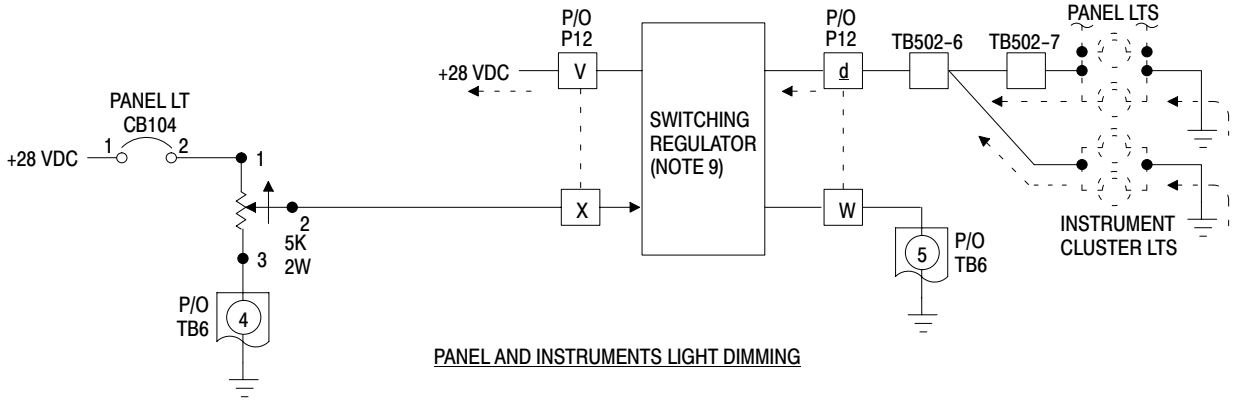
1. CIRCUITS SHOWN ARE TYPICAL. VARIATIONS MAY EXIST FROM THAT SHOWN ACCORDING TO HELICOPTER MODEL AND SERIAL NO. (REF. NOTE 5).
2. FOR INTERNAL CIRCUITS OF ALL LIGHT/SWITCHES, SEE CIRCUIT FOR XMSN OIL TEMP LT/SW DS12. IT IS TYPICAL FOR ALL LIGHT/SWITCHES. LIGHTS WITHOUT SWITCHES DIFFER (REF NOTE 5).
3. EACH CIRCUIT SHOWS ONLY COMPONENTS USED FOR FUNCTION INDICATED.
4. COMPONENTS CONNECTED BETWEEN CONNECTOR P12 PINS ARE PART OF DIMMER ASSEMBLY.
5. FOR FAULT AND FUNCTION INPUT SOURCES NOT SHOWN AND INTERCONNECTING WIRING INFORMATION, SEE APPLICABLE ELECTRICAL SYSTEM SIRING DIAGRAM (REF. SEC. 20).
6. FOR COMPLETE CIRCUIT INFORMATION ON DIMMER ASSEMBLY, SEE SCHEMATIC DIAGRAM FOR DIMMER ASSEMBLY IN THIS SECTION.

30-197-1A

Figure 17-23. Caution and Warning Indicating Lights System Circuits (Instrument Panel Type B) (Sheet 1 of 2)



ENGINE OUT WARNING LIGHT AND HORN



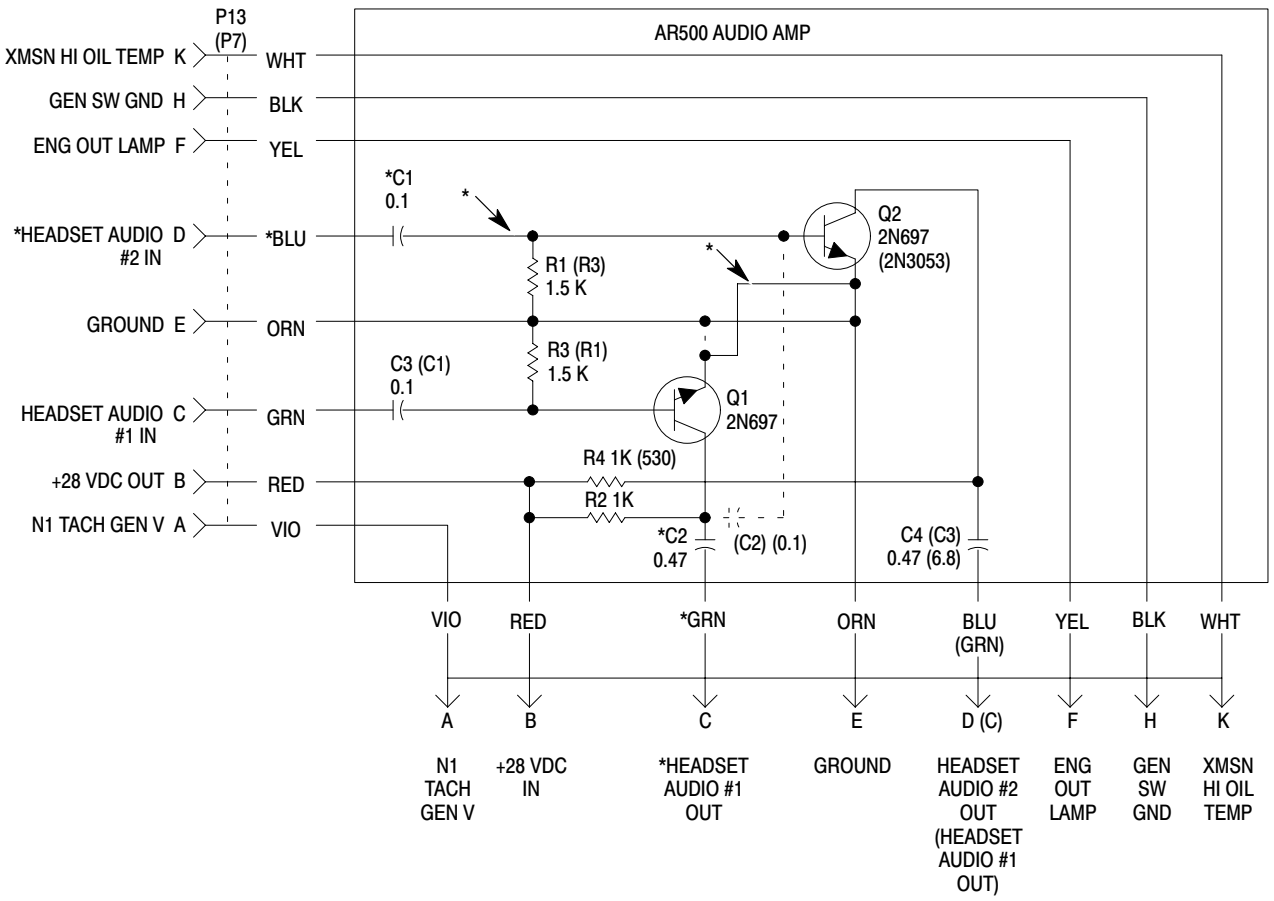
PANEL AND INSTRUMENTS LIGHT DIMMING

NOTES: (CONT)

7. ABBREVIATIONS:
   BRT - BRIGHTNESS
   LL - LOWER LEFT
   LR - LOWER RIGHT
   LT - LIGHT
   M/R - MAIN ROTOR
   P/O - PART OF
   SW - SWITCH
   T/R - TAIL ROTOR
   UL - UPPER LEFT
   UR - UPPER RIGHT
   XMSN - TRANSMISSION
8. DASHED LINES WITH ARROWHEAD (← -) INDICATES CURRENT PATH (OPPOSITE OF VOLTAGE) THROUGH CIRCUITS.
9. INPUT (P12-X): 0 - +28 VDC.
   OUTPUT (P12-d): +2.5 VDC MINIMUM WITH 0 VDC INPUT.
   +26 VDC MINIMUM WITH +28 VDC INPUT.

30-197-2A

Figure 17-23. Caution and Warning Indicating Lights System Circuits (Instrument Panel Type B) (Sheet 2 of 2)



NOTES:

1. ASTERISK (*) INDICATES ITEM APPLIES ONLY TO DUAL CHANNEL AMPLIFIER.
2. UNLESS OTHERWISE NOTED, SOLID LINES APPLY TO BOTH DUAL AND SINGLE CHANNEL AMPLIFIERS.
3. DASHED CIRCUIT LINES (- - -) AND ITEMS IN PARENTHESIS ( ) APPLY ONLY TO SINGLE CHANNEL AMPLIFIER.
4. RESISTANCE VALUES IN OHMS AND CAPACITANCE VALUES IN MICROFARADS.

30-169A

Figure 17-24. Audio Amplifier (Dual and Single Channel) Schematic Diagram

27. Engine Power Out (EPO) Audible Warning Horn

The EPO audible warning horn is an electro-mechanical warning unit that produces an audible "beeping" sound in the pilot's compartment when engine N_1 speed decreases below approximately 55% N_1 rpm, or N_R speed decreases to 98% rpm or less for N_1/N_R sensing equipment.

The audible warning horn is installed at either the upper left or right side of the instrument panel (model difference only).

On instrument panel type A and early type B, mounting of the original audible warning horn (Figure 17-1) is changed to that of the current instrument panel type B shown in Figure 17-2, due to required installation of battery temperature sensing equipment.

The audible warning horn is mounted in a lights/switch and horn housing on the side of the raised top of the center instrument panel fairing, with two battery temperature caution and warning light/switch indicators.

An early type audible warning horn installation uses a modified Edwards 319 horn; current type incorporates a modified Mallory SC628 "Sonalert" unit.

A. Edwards Audible Warning Horn Replacement

(1). Check that all electrical power is off.

(2). Remove instrument panel side fairings as necessary for access to internal wiring.

(3). Loosen and remove attachment hardware securing instrument panel center fairing to free it sufficiently for partial access.

(4). As necessary, remove attaching hardware and disconnect electrical wiring to permit removal of the lights/switch and horn housing (Figure 17-24).

(5). Remove lights/switch and horn housing from center fairing.

(6). Disassemble horn housing; remove horn from housing as shown in Figure 17-1.

(7). Install replacement horn, housing and fairing in reverse order of removal. For electrical wiring interconnect information, refer to Section 19.

(8). Perform an operational check of the audible warning horn.

28. N_R Disable Switch

(Ref. Figure 17-25) N_R disable switch S199 is mounted on the inboard collective stick socket on those helicopters with the N_1/N_R engine power out warning system.

The switch disables N_R (main rotor) speed sensing and prevents engine out warning indications when the pilot's collective pitch stick is in the full down position and the throttle is at idle.

These control positions are normal during engine starting, idling, autorotation flight and engine shutdown when an engine out warning is not desired.

NOTE: On helicopters originally equipped with N_1 sensing equipment that has been modified to N_1/N_R sensing equipment, N_R disable switch installation may differ slightly from that shown. (Refer to CSP-3 for differences and for instructions for modification of such an installation to the current type N_R disable switch installation.)

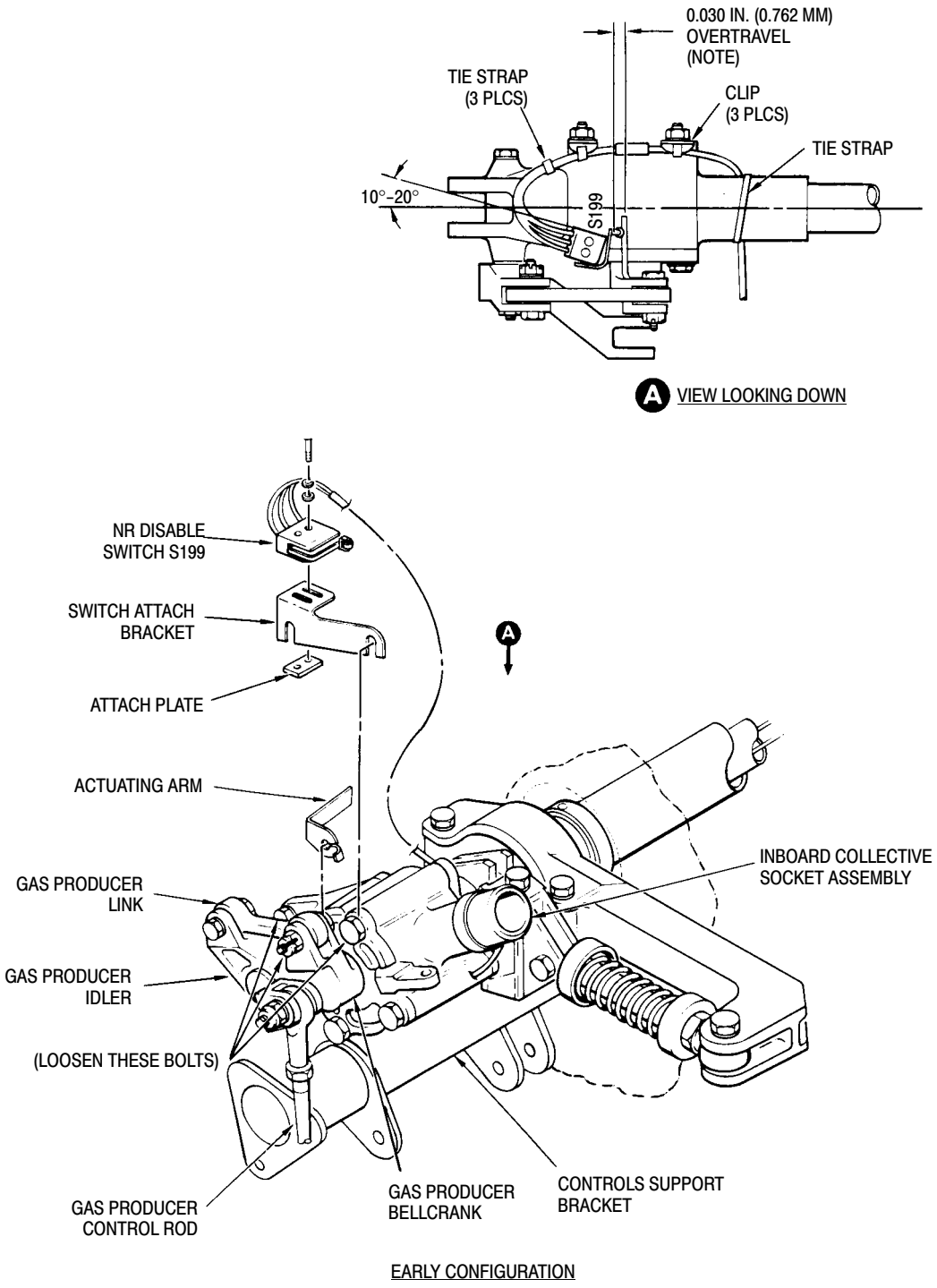
A. N_R Disable Switch Replacement

(1). Remove center seat cover and controls access door.

(2). Check that electrical power is off. Disconnect wire E105B20N at ground terminal and wire E105A20 at splice. Cut all tie straps attaching wires to inboard collective stick socket (Figure 17-25).

(3). Remove the switch by removing the two screws and the threaded attach plate.

(4). Remove the switch attaching bracket by loosening the two upper bolts in the inboard collective stick socket housing cap and slipping out the slotted attaching bracket.



NOTE: FOR ADJUSTMENT OF NR DISABLE SWITCH, REFER TO TEXT. AFTER SWITCH ADJUSTMENT, PERFORM CHECK OF SWITCH OPERATION.

30–209–1A

Figure 17-25. N_R Disable Switch Installation (Sheet 1 of 2)

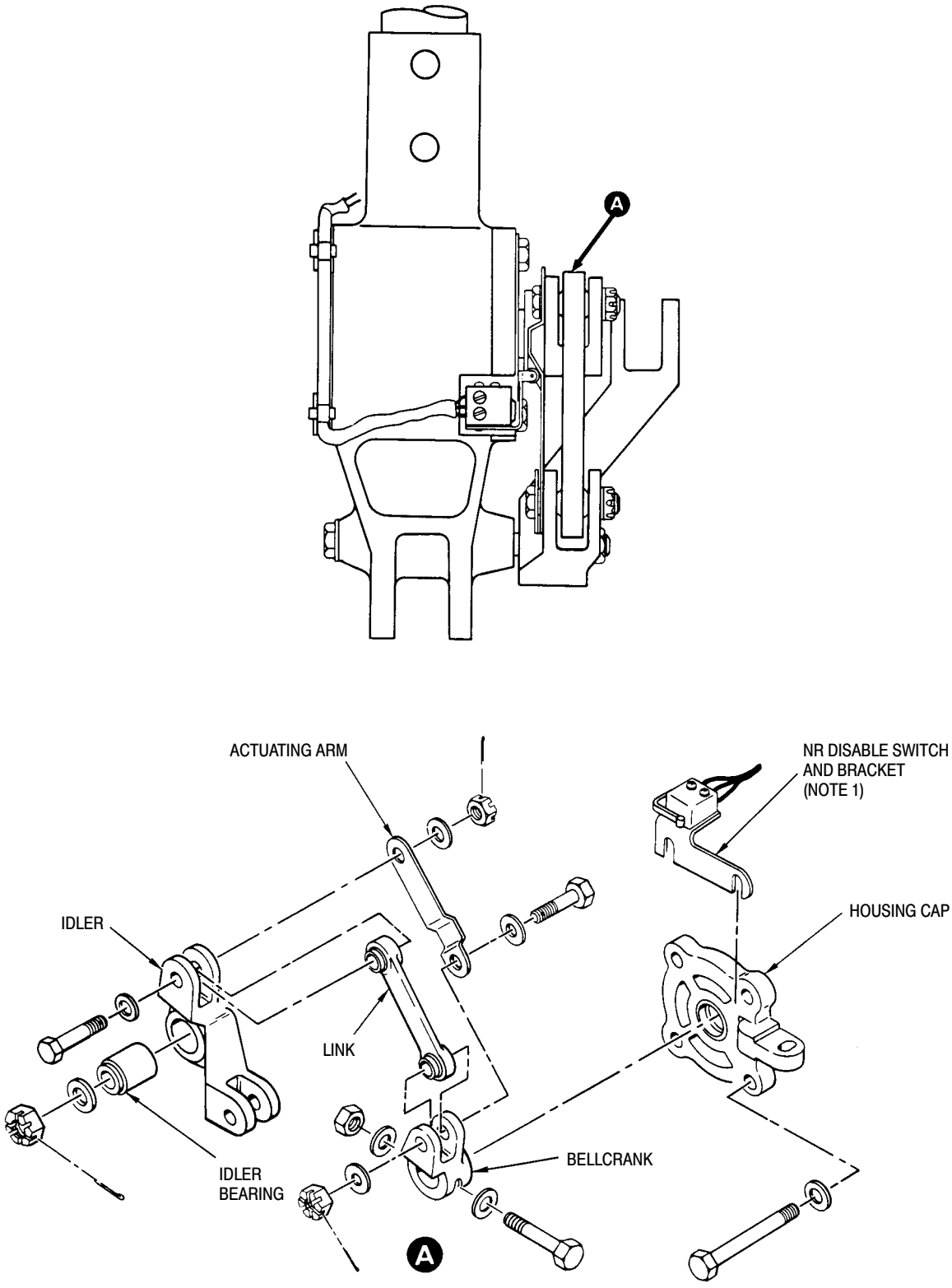


Figure 17-25. N_R Disable Switch Installation (Sheet 2 of 2)

(5). Remove the switch actuating arm by loosening the bolt in the gas producer bellcrank and slipping out the slotted actuating arm. Remove the actuating cam used in current installation by removing the bolts in each end of the gas producer bellcrank.

(6). Install replacement components in essentially reverse order of removal; adjust N_R disable switch.

B. N_R Disable Switch Adjustment

(1). Check that pilot's collective pitch stick is in full down position and throttle grip rotated to idle position.

(2). Position switch so that it activates (clicks) when the switch roller contacts the actuator cam.

(3). Note switch position at point of actuation and move switch toward actuator cam an additional 0.030 inch (0.762 mm). Tighten switch mounting screws to secure switch in position and safetywire.

(4). Check that pilot's throttle grip will rotate to cutoff position. Check pilot's collective pitch stick operation through full range to determine that switch wiring does not interfere with movement.

(5). Perform operational check of N_R disable switch and audible warning horn with collective pitch stick full down and throttle at idle position.

NOTE: Audible warning horn should not be activated when throttle is at idle.

29. Chip Detector Circuits Operational Check

(1). Turn on electrical power; use an external power supply when possible.

(2). Disconnect electrical wiring and temporarily connect a jumper wire from detector connector plug pin or wire terminal to an unpainted (grounding) surface of the airframe or engine.

(3). Observe CHIPS indicator light. If light is on, circuit tests properly; remove jumper wire and reinstall wiring.

(4). If CHIPS indicator light does go on, check that jumper is properly grounded. If so, check circuit components for continuity and replace defective parts.

30. Fuel Pressure Switch

A. Fuel Pressure Switch Operational Check

(1). Check that all electrical power is OFF; disconnect battery.

(2). Gain access to engine accessory section; locate fuel filter (bypass) pressure switch on front of engine driven fuel pump.

(3). Remove protective sleeving and disconnect knife splice on bypass switch wiring.

(4). Disconnect and cap bypass hose assembly at bushing.

(5). Remove switch (with bushing fitting intact) from the after filter port (AF) engine driven fuel pump.

(6). Perform function test of bypass switch as follows:

(a). Remove bushing and O-ring from bypass switch.

(b). Fabricate test set up (Figure 17-26).

NOTE: Switch actuation (closing) pressure should be 24.5-35.0 inches (62.23-88.9 cm) of fuel.

(c). Pressurize inlet port of switch by adding fuel to the tub; watch ohmmeter or continuity tester for indication of switch actuation.

(d). Check switch diaphragm for leakage. Replace switch if leakage is noted.

(e). Reinstall bushing with new O-ring on bypass switch.

(7). Perform operation check of switch as follows:

(a). Remove cap from bypass hose and reconnect bushing (with switch) in hose fitting.

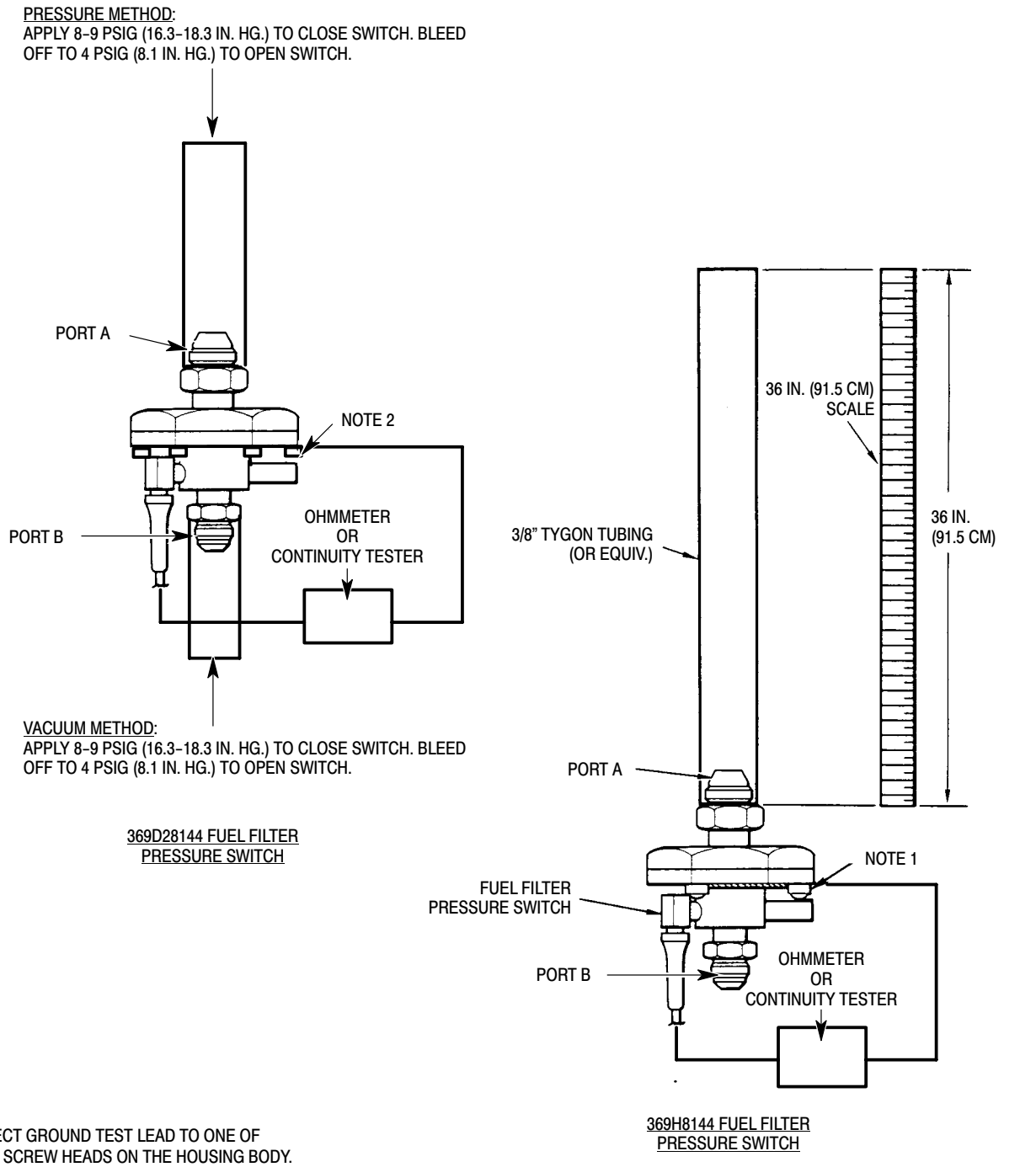


Figure 17-26. Fuel Pressure Switch Test Set-Up

(b). Plug adapter fitting with AN 814-2 in after filter (AF) port. Connect jumper wire to ground bypass switch to aircraft ground (E12).

(c). Have assistant hold switch clear; connect battery or electrical power supply and activate start pump.

(d). Check caution indicator light (fuel bypass) for illumination.

NOTE: If fuel filter bypass caution indicator does not light, perform electrical trouble shooting of caution and warning lights.

(e). Check switch diaphragm through open port for leakage. Replace switch if leakage is noted.

(f). Shut off electrical power, start pump, battery switch; disconnect battery or power supply and jumper wire.

NOTE: If fuel filter bypass caution indicator did not light and electrical system is not faulty, install new fuel filter pressure switch (with new O-ring) at bushing, and repeat operational check of switch.

(8). Remove plug from adapter fitting fuel filter port (AF); install bypass switch with new O-ring on adapter fitting. Torque switch to **40 - 50 inch-pounds (4.52 - 5.65 Nm)**.

(9). Remove plug from bypass hose; reconnect bushing at bypass hose. Torque bushing to **40 - 50 inch-pounds (4.52 - 5.65 Nm)**.

(10). Reconnect knife splice on switch and reinstall protective sleeving.

(11). Bleed fuel filter housing (Ref. Sec. 12 for fuel system bleeding instructions).

(12). Run up engine and perform operational check of engine and fuel system; check for leaks and non-activation of fuel filter bypass caution light when start pump is activated.

B. Fuel Pressure Switch Replacement

(Ref. Figure 17-7)

(1). Disconnect Knife splice in electrical wire at switch.

(2). Remove interconnect tube, fuel pressure switch and O-ring from engine fuel pump filter.

(3). Install replacement switch and serviceable O-ring in the after filter port of the pump filter. Torque the switch to **40 - 50 inch-pounds (4.52 - 5.65 Nm)**, reinstall interconnect tube and connect knife splice.

(4). Operate engine starting pump and check for fuel leakage.

31. Running Time Meter

The running time meter is basically an electric clock that provides an accurate record of engine and/or transmission operating time in hours and tenths of hours.

The meter operates whenever an oil pressure switch in the main transmission is closed by transmission operating oil pressure.

The meter receives 28 Vdc power from the instrument 5 ampere circuit breaker. The circuit is completed to ground through the normally open contacts of the transmission pressure switch (S203).

A second set of normally closed contacts in the switch operates the XMSN oil pressure warning light when below normal operating pressure exists.

The running time is installed in a cover panel on the left side of the instrument panel structure just below floor level and is visible from outside the helicopter.

Section

18

Heating and Ventilation System

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TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 18 Heating and Ventilating System		**18-1**
1.	Heating System	18–1
2.	Ventilating System	18–1
3.	Ventilating Valve Control	18–1
A.	Ventilating Valve Control Replacement	18–1
4.	Cabin Ventilating Valve	18–2
A.	Ventilating Valve Removal	18–2
B.	Ventilating Valve Installation	18–2
C.	Ventilating Valve Inspection	18–2
D.	Ventilating Valve Disassembly	18–2
E.	Ventilating Valve Reassembly	18–2
F.	Ventilating Valve Repair	18–3
5.	Door Window Ventilators (Snapvents)	18–3
A.	Window Snapvent Replacement	18–3
Figure 18–1.	Ventilating System	18–4

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page

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SECTION 18
HEATING AND VENTILATING SYSTEM

1. Heating System

The heating system is not installed as standard equipment. Refer to CSP-H-3 for information on the Cabin Heating Installation.

2. Ventilating System

(Ref. Figure 18-1) The main fresh air source for the cabin interior is a cable-actuated vent control valve located on the fuselage centerline, recessed in the canopy panel forward of the instrument panel.

The vent control valve has a circular 4 inch (10.16 cm) inlet that supports the valve shaft and control matching valve vane assembly.

The valve vane assembly is actuated by a push-pull control cable mounted in the right center of the instrument panel. The control cable knob marked PULL FOR AIR is a friction catch type that locks the cable in any selected position throughout the full stroke when the knob plunger is released.

The vent control valve housing is formed of polycarbonate plastic.

A single cylindrical duct on the rear of the vent control valve directs air outward from both sides of the valve.

On the early configuration, two polycarbonate plastic ducts, attached to the rear of the valve, direct inlet air through holes in sides of console fairings for circulation through-out the cabin interior.

Each pilot's and cargo/passenger compartment door window contains adjustable ventilators that can be opened, closed, and positioned by rotation of the vent cutout, to supplement fresh air intake or provide an air circulation exhaust outlet as desired.

CAUTION Before high speed flight is performed, ensure that all door ventilator cutouts are positioned up, aft, or down (in the aft 120 degree arc). Door damage and vibrations could occur if vent cut outs face airstream.

3. Ventilating Valve Control

(Ref. Figure 18-1) The ventilating valve cable is a flexible, coaxial-wire type that incorporates a push-button locking device in the control housing. This feature allows locking of the ventilating valve in the open, closed, or any intermediate position.

The control assembly is not repairable. Failure of the internal locking device is cause for replacement.

A. Ventilating Valve Control Replacement

(1). Ensure that electrical power is OFF.

(2). Disconnect cable wire from valve arm swivel.

(3). Remove screws, nuts washers and clip securing cable to support bracket.

(4). Remove instrument panel right side fairing.

(5). Loosen and remove hex nut and lockwire securing cable knob to instrument panel and with drawn cable from panel.

(6). Route new cable through instrument panel and secure knob in place with lock washer and nut.

(7). Fasten cable sleeve to support bracket on valve and secure with clip, screws, washers and nuts.

(8). Actuate control knob to align cable wire with hole in valve arm swivel; push knob to cable panel fitting stop.

(9). Position valve to full closed and tighten swivel on cable wire. Install cotter pin.

(10). Check swivel for free rotation by actuating control knob through full stroke.

(11). Inspect valve assembly for complete closure of inlet opening when control knob is pushed forward against cable panel fitting stop.

(12). Check valve door for looseness on shaft and deformation; valve door must be flat, and a firm, snug fit in the inlet.

(13). Reinstall right side fairing on instrument panel.

4. Cabin Ventilating Valve

(Ref. Figure 18-1) The cabin ventilating valve is made of polycarbonate plastic and incorporates a valve vane assembly to control ventilating air flow.

The vane assembly consists of a seal bonded around a circular aluminum vane.

The valve assembly is attached by four screws, washers, and nuts to a duct molded into the fiberglass canopy panel.

On the early configuration, the valve is attached with four rivets.

A. Ventilating Valve Removal

(1). Remove instrument panel left and right side fairings.

(2). On the early configuration, remove ducts from rear of vent control valve.

(3). Remove cable clip.

(4). Pull cable control to open valve door.

(5). Loosen swivel assembly and disconnect control cable.

(6). Remove four screws, washers and nuts that attach valve to canopy panel duct. On the early configuration, drill out the four rivets.

(7). Remove valve assembly.

B. Ventilating Valve Installation

(1). Position valve on canopy panel duct and align screws or rivet holes, as applicable

(2). Install four screws, washers and nuts (or MS20470A rivets, as applicable) with 90 degree spacing to attach valve to duct. On the early configuration, if rivet holes are elongated or over-size, install next larger size rivets (5/32 inch diameter).

(3). Fasten cable sleeve to valve bracket with clip.

(4). Install swivel assembly loosely in arm of shaft.

(5). Insert control wire into swivel assembly.

(6). Position shaft arm so that valve door is fully closed.

(7). Push control knob all the way in then tighten swivel assembly on wire. Install cotter pin.

(8). Operate valve through several open-close cycles to assure ease of operation and to determine that valve locks in any position when control knob is released.

(9). On early configuration, install ducts on rear of vent control valve.

(10). Install instrument panel left and right side fairings

C. Ventilating Valve Inspection

(1). Inspect plastic walls for cracks, secure attachment to the canopy panel and separation of bonded joints. (Very small, widely separated spots or voids in the plastic joints are not separation but air pockets produced during the solvent bonding process.)

(2). Inspect for bent shaft or valve vane assembly and excessive shaft wear in the pivot areas.

(3). Inspect seal on vane assembly for wear.

D. Ventilating Valve Disassembly

(1). Remove two screws from shaft and vane assembly. Slide vane assembly from shaft.

(2). Remove cotter pin and washer and slide shaft from valve body.

E. Ventilating Valve Reassembly

(1). Install cotter pin in hole at control arm end of shaft. Install washer on shaft to bear on cotter pin.

(2). Insert shaft in body of valve.

(3). Insert valve vane assembly into slot in shaft.

(4). Install two screws through vane and shaft using loctite (29, Table 2-4).

(5). Install washer on end of shaft and insert cotter pin.

(6). Operate valve several times to assure freedom and positive closing.

F. Ventilating Valve Repair

(1). Repair polycarbonate valve body cracks by binding a patch according to the criteria and methods specified for acrylic plastic in FAA AC 43.13-1, Aircraft Inspection and Repair. Use dichloromethane (38, Table 2-4) or ethylene dichloride as the bonding agent.

(2). Repair small areas of rib or seam separation by injecting ethylene dichloride (39) into the void area and clamping together under light pressure.

(3). Replace unserviceable seal, using adhesive (69) according to container instructions.

5. Door Window Ventilators (Snapvents)

(Ref. Figure 18-1) Plastic snapvents are installed in each of the four door windows. These units may be rotated in their reinforced window holes for intake or exhaust of ventilating air or may be pulled in ward for completed closure. Damaged snapvents should be replaced; repair is not practical.

A. Window Snapvent Replacement

(1). Push snap vent outward in window (open position).

(2). Grasp the open side of the snapvent and gently squeeze it into an elliptical shape.

(3). Slip snapvent out of window hole at about a 30 degree angle to surface of window.

(4). Hold the open end of the replacement snapvent and gently squeeze it into an elliptical shape.

(5). Slip snapvent flange into window hole at an angle of about 30 degrees to the surface of the window. Be sure the ends of wire stiffener are inside window hole.

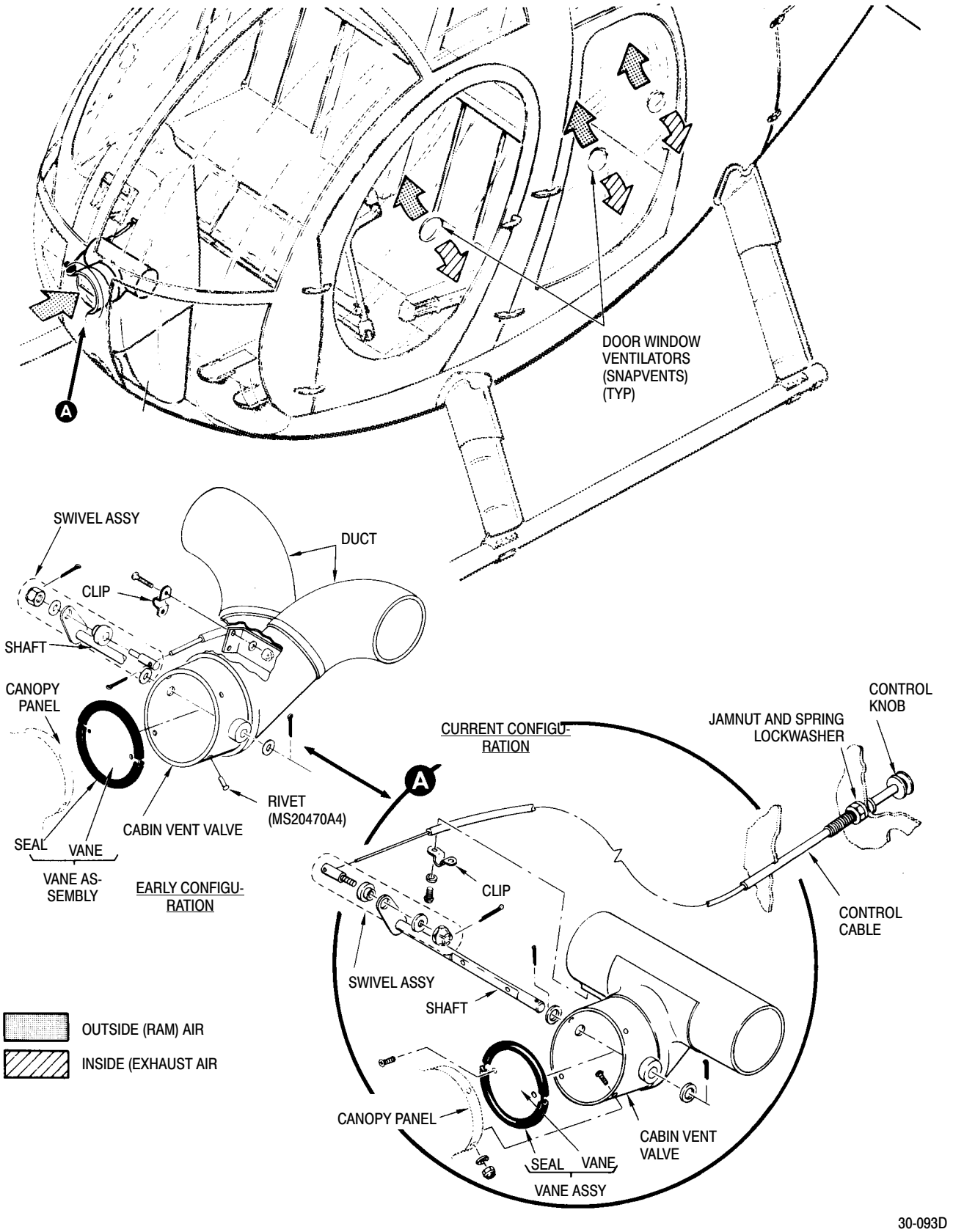


Figure 18-1. Ventilating System

Section

19

Electrical System

TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 19 Electrical System		**19-1**
1.	Power Supply and Distribution	19–1
2.	Power Supply and Distribution System Troubleshooting	19–1
3.	Electrical System Load Chart	19–1
	Figure 19–1. Arrangement of Electrical System Switches and Circuit Breakers	19–2
	Table 19–1. Basic Equipment Electrical Load Analysis Chart	19–3
	Table 19–2. Optional Equipment Electrical Load Analysis Chart	19–6
	Figure 19–2. Electrical System Load Analysis	19–9
	Table 19–3. Troubleshooting Dc Power Distribution	19–11
4.	Wiring Harnesses	19–13
A.	Wire Harness Replacement	19–13
5.	Electrical Connectors	19–13
A.	Plug/Socket Connector Repair or Replacement	19–13
	Figure 19–3. Repair or Replacement of Rectangular Electrical Connectors	19–14
B.	Disconnection/Connection of Wire Mate Connectors	19–15
C.	Minilok and Modulok Terminal Block Contact Tip Replacement	19–15
	Figure 19–4. Identification and Replacement of Burndy Terminal Block Modules	19–16
D.	Minilok and Modulok Terminal Block Replacement	19–17
E.	Electrical Bonding Connector Maintenance	19–17
	Figure 19–5. Typical Requirement for Electrical Bonding Connections	19–18
F.	External Power Receptacle Replacement	19–19
6.	Electrical Equipment	19–19
7.	Voltage Regulator	19–19
A.	Voltage Regulator Replacement	19–19
	Figure 19–6. Electrical Equipment (Cabin Locations)	19–20
B.	Installed Voltage Regulator Adjustment	19–21
	Figure 19–7. Voltage Regulator Test Points	19–21
	Table 19–4. Recommended Voltage Setting	19–21
C.	Voltage Regulator Bench Testing	19–22
8.	Overvoltage Relay	19–22
A.	Overvoltage Relay Replacement	19–22
	Figure 19–8. Test Hookup for Voltage Regulator	19–23
	Figure 19–9. Electrical Equipment Locations (Instrument Panel Type A)	19–24
	Figure 19–10. Electrical Equipment Locations (Instrument Panel Type B)	19–25
9.	Circuit Breaker Panel	19–26
A.	Circuit Breaker Replacement	19–26

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
10.	Control Switches	19–26
A.	Control Switch Replacement	19–26
Table 19–5.	Resistor Reference Designator	19–27
11.	Voltage Reduction and Calibration Resistors	19–27
A.	Voltage Reduction and Calibration Resistor Replacement	19–27
12.	Start Relay	19–27
A.	Start Relay Replacement	19–27
Figure 19–11.	Replacement of Engine Compartment Relays	19–28
13.	Reverse Current Relay	19–29
A.	Reverse Current Relay Replacement	19–29
14.	Battery Relay	19–29
A.	Battery Relay Replacement	19–29
B.	Battery Relay Troubleshooting	19–29
15.	APU Relay	19–29
A.	APU Relay Replacement	19–29
B.	APU Relay Troubleshooting	19–30
16.	Collective Pitch Stick Switches	19–30
A.	Collective Pitch Stick Switch Replacement	19–30
Figure 19–12.	Replace of Collective Pitch Stick Switches	19–31
17.	Battery Temperature Sensing Equipment	19–32
A.	Battery Temperature Sensing Equipment Maintenance	19–32
B.	Battery Temperature Sensing Equipment Operational Check	19–32
Figure 19–13.	Battery Temperature Sensing Equipment	19–33
18.	Battery	19–34
A.	Battery Maintenance	19–34
B.	Battery Replacement	19–34
Figure 19–14.	Replacement of Battery Components	19–35
C.	Battery Inspection	19–36
D.	Testing of Battery Temperature Sensing Switches	19–36
E.	Repair of Battery	19–36
19.	Starter/Generator	19–38
A.	Starter/Generator Removal	19–39
B.	Starter/Generator Inspection	19–39
Figure 19–15.	starter/generator Replacement and Repair	19–40
Figure 19–16.	Starter/Generator Bushing Wear Limits	19–41
C.	Starter/Generator Repair	19–41
Figure 19–17.	Test Hookup for Starter/Generator and Brush Run–in	19–43

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page
D.	Starter/Generator Installation	19–44
20.	Night Lighting System – Instrument Panel Type B	19–44

SECTION 19
ELECTRICAL SYSTEM

1. Power Supply and Distribution

The electrical system consists of all electrical power supply, distribution and control equipment, wiring and miscellaneous associated equipment supplied as standard on the helicopter.

The electrical system is supplied by a 28-volt direct current, 150-ampere, engine-driven generator in conjunction with a 24-volt nickel-cadmium battery and incorporates an external power receptacle. The system is a nominal 28 Vdc, single-wire type installation with helicopter structure used as the ground return.

Control of the electrical system, exclusive of optional intercom controls, is provided by the switches and circuit breakers on the instrument panel (Ref. Figure 19-1). All circuits of the electrical system are protected by push-to-reset or switch-type circuit breakers. All electrical or electronic units or components that produce electromagnetic energy (rf potential) are bonded to the adjacent structure to ensure a continuous, negligible radio frequency (rf) impedance path from the equipment enclosure to the structure. Current path return and static charge bonding jumpers are also installed at appropriate locations.

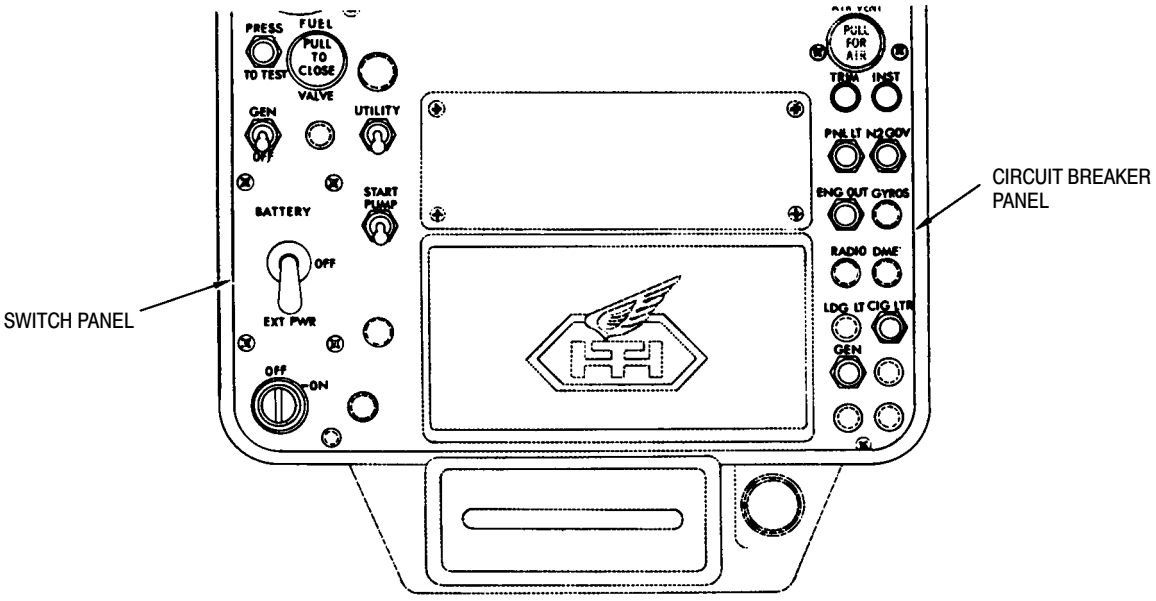
NOTE: On all current models of the 500 Series helicopters, electrical systems are standard and essentially identical, except in instrument/electrical controls console area for different models. (Electrical components, component locations, installation, wiring, etc. throughout the helicopters are basically identical, except for those areas specified.) Any differences that exist in these areas from the electrical system outlined in this section are described in the applicable HMI Supplement for that specific model helicopter.

2. Power Supply and Distribution System Troubleshooting

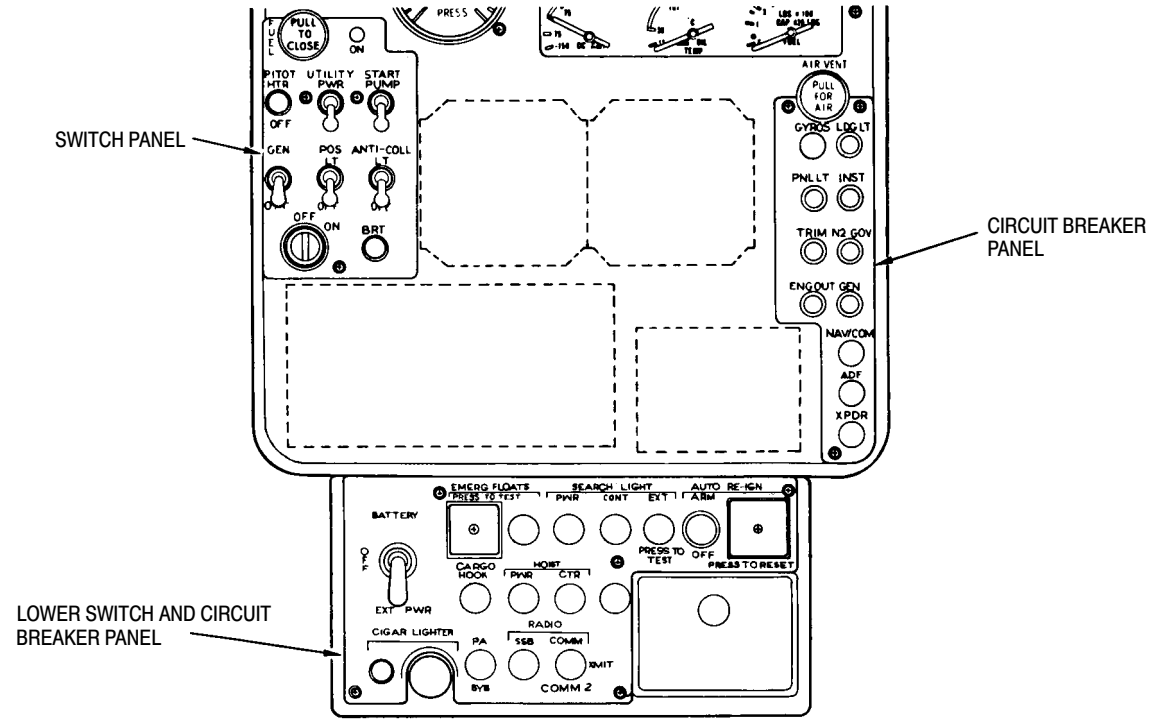
(Ref. Table 19-3)

3. Electrical System Load Chart

Refer to Table 19-1, Table 19-2 and Figure 19-2 for electrical system load analysis data.



PANEL TYPE A
(LOWER HALF)



PANEL TYPE B
(LOWER HALF)

30-099A

Figure 19-1. Arrangement of Electrical System Switches and Circuit Breakers

Table 19-1. Basic Equipment Electrical Load Analysis Chart

EQUIPMENT BASIC SHIP	PART DESIGNATION	NO OF UNITS OR SYS	AMPS PER UNIT OR SYS	OPER TIME IN MIN.	PRE-START AVG. AMPS. 5 SEC.	PRE-START AVG. AMPS. 2 MIN.	START TURBINE AVG. AMPS. 5 SEC.	START TURBINE AVG. AMPS. 2 MIN.	TAKEOFF & CLIMB DAY AVG. AMPS. 5 SEC.	TAKEOFF & CLIMB DAY AVG. AMPS. 2 MIN.	TAKEOFF & CLIMB NIGHT AVG. AMPS. 5 SEC.	TAKEOFF & CLIMB NIGHT AVG. AMPS. 2 MIN.
FLIGHT CONTROLS												
ACT-CYCLIC TRIM (LONG. / LAT.)	369A7001	2	1.0	(6)								
INSTRUMENTS (OTHER THAN ENG. / FLT.)												
HOUR METER	369H90027	1	0.1	15			0.1	0.1	0.1	0.1	0.1	0.1
INSTRUMENTS ENGINE (3 PACK)												
FUEL QUANT.												
OIL TEMP. (2)	369H6417	SYS	0.5	15			0.5	0.5	0.5	0.5	0.5	0.5
AMMETER												
ENGINE-OUT WARNING SYSTEM	369H4540-BSC/-3	1	0.5	15			0.5	0.5	0.5	0.5	0.5	0.5
ENGINE-OUT WARNING LTS.												
ENG. OUT	1041HS7-3	4	0.04	(6/10)								
XMSN OIL PRESS. (14)	1041HS7-4		0.04	(6/10)								
XMSN OIL TEMP. (14)	1041HS7-5		0.04	(6/10)								
CHIP DET. ENG. (15)	1041HS7-6		0.04	(6/10)								
CHIP DET. T/R (15)	1041HS7-7		0.04	(6/10)								
CHIP DET. M/R (15)	1041HS7-8		0.04	(6/10)								
FUEL FILTER	1041HS7-11		0.04	(6/10)								
GEN. OUT	1041HS7-10		0.04	(6/10)								
FUEL LOW	1041HS7-9	4	0.04	(6/10)								
INSTRUMENTS - FLIGHT	SEE OPTIONS											
HEATING & VENTILATION	SEE OPTIONS											
EXCITER (ALLISON)	6870058	1	1.0	2(6)			1.0					
ENGINE CONTROLS												
ACTUATOR - N_2 GOV.	369A7002	1	1.2	2			1.2	1.2				
STARTER (GENERATOR)	369H4550	SYS	-	(12)			(12)	(12)				
LIGHTING												
ANTI-COL (STROBE) LTS.	369H90062-519	SYS	2.8	15			2.8	2.8	2.8	2.8	2.8	2.8
POS. LTS. (L, R & TAIL)	369H90062	SYS	3.0	15							3.0	3.0
INSTR. & PNL LTS. (327)	369H90062	SYS	(17)									
LANDING LT. (MS25241-4581)	369H90062	SYS	16.0	2							16.0	16.0
MAP LT (HE/HS), UTILITY LT (HM) (1309)	369H90062	1	0.3	2	0.3	0.3					0.3	0.3
CONVENIENCE LT. (REAR) (1309)	369H90062	1	0.3	2							0.3	0.3
DIMMER (AUTRONICS)	369H6425	SYS	2.5	15	2.5	2.5	2.5	2.5			2.5	2.5
CIGAR LIGHTER (C75Z1505A2 FORD)	369H6508	2	7.7	(6)								
POWER	369H4115											
BATTERY CHARGING (18)	369A4540	1	(4)	(4)					40.0	30.0	40.0	30.0
OVER VOLTAGE RELAY	369A4557	1	0.2	(5)								
REVERSE CURRENT RELAY	A700xA HARTMAN	1	0.5	15			0.5	0.5	0.5	0.5	0.5	0.5
VOLTAGE REGULATOR	369A4552	1	-	(5)								
GENERATOR (STARTER)	369A4550	1	-	(1)								
START PUMP	369A8143	SYS	3.5	2			3.5	3.5				
BASIC SHIP AMPERES					2.8	2.8	9.3	8.3	44.4	34.4	66.5	56.5

Table 19-1. Basic Equipment Electrical Load Analysis Chart (Cont)

EQUIPMENT BASIC SHIP	PART DESIGNATION	HOVER						CRUISE					
		DAY AVG. AMPS.			NIGHT AVG. AMPS.			DAY AVG. AMPS.			NIGHT AVG. AMPS.		
		5 SEC.	2 MIN.	15 MIN.	5 SEC.	2 MIN.	15 MIN.	5 SEC.	2 MIN.	15 MIN.	5 SEC.	2 MIN.	15 MIN.
FLIGHT CONTROLS													
ACT-CYCLIC TRIM (LONG. / LAT.)	369A7001												
INSTRUMENTS (OTHER THAN ENG. / FLT.)													
HOUR METER	369H90027	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
INSTRUMENTS ENGINE (3 PACK)													
FUEL QUANT.													
OIL TEMP. (2)	369H6417	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
AMMETER													
ENGINE-OUT WARNING SYSTEM	369H4540-BSC/-3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
ENGINE-OUT WARNING LTS.													
ENG. OUT	1041HS7-3												
XMSN OIL PRESS. (14)	1041HS7-4												
XMSN OIL TEMP. (14)	1041HS7-5												
CHIP DET. ENG. (15)	1041HS7-6												
CHIP DET. T/R (15)	1041HS7-7												
CHIP DET. M/R (15)	1041HS7-8												
FUEL FILTER	1041HS7-11												
GEN. OUT	1041HS7-10												
FUEL LOW	1041HS7-9												
INSTRUMENTS - FLIGHT	SEE OPTIONS												
HEATING & VENTILATION	SEE OPTIONS												
EXCITER (ALLISON)	6870058												
ENGINE CONTROLS													
ACTUATOR - N_2 GOV.	369A7002												
STARTER (GENERATOR)	369H4550												
LIGHTING													
ANTI-COL (STROBE) LTS.	369H90062-519	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
POS. LTS. (L, R & TAIL)	369H90062	3.0			3.0	3.0	3.0				3.0	3.0	3.0
INSTR. & PNL LTS. (327)	369H90062												
LANDING LT. (MS25241-4581)	369H90062				16.0	16.0							
MAP LT (HE/HS), UTILITY LT (HM) (1309)	369H90062				0.3	0.3	0.3				0.3	0.3	0.3
CONVENIENCE LT. (REAR) (1309)	369H90062				0.3	0.3	0.3				0.3	0.3	0.3
DIMMER (AUTRONICS)	369H6425				2.5	2.5	2.5				2.5	2.5	2.5
CIGAR LIGHTER (C75Z1505A2 FORD)	369H6508												
POWER	369H4115												
BATTERY CHARGING (18)	369A4540	30.0	23.4	17.0	30.0	23.4	17.0	30.0	23.4	17.0	30.0	23.4	17.0
OVER VOLTAGE RELAY	369A4557												
REVERSE CURRENT RELAY	A700xA HARTMAN	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
VOLTAGE REGULATOR	369A4552												
GENERATOR (STARTER)	369A4550												
START PUMP	369A8143												
BASIC SHIP AMPERES		34.4	27.8	21.4	56.5	49.9	27.5	34.4	27.8	21.4	40.5	33.9	27.5

Table 19-1. Basic Equipment Electrical Load Analysis Chart (Cont)

EQUIPMENT BASIC SHIP	PART DESIGNATION	LANDING				EMERGENCY – GENERATOR OUT					
		DAY AVG. AMPS.		NIGHT AVG. AMPS.		DAY AVG. AMPS.			NIGHT AVG. AMPS.		
		5 SEC.	2 MIN.	5 SEC.	2 MIN.	5 SEC.	2 MIN.	15 MIN.	5 SEC.	2 MIN.	15 MIN.
FLIGHT CONTROLS											
ACT–CYCLIC TRIM (LONG. / LAT.)	369A7001										
INSTRUMENTS (OTHER THAN ENG. / FLT.)											
HOUR METER	369H90027	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
INSTRUMENTS ENGINE (3 PACK)											
FUEL QUANT.											
OIL TEMP. (2)	369H6417	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
AMMETER											
ENGINE–OUT WARNING SYSTEM	369H4540–BSC/–3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
ENGINE–OUT WARNING LTS.											
ENG. OUT	1041HS7–3										
XMSN OIL PRESS. (14)	1041HS7–4										
XMSN OIL TEMP. (14)	1041HS7–5										
CHIP DET. ENG. (15)	1041HS7–6										
CHIP DET. T/R (15)	1041HS7–7										
CHIP DET. M/R (15)	1041HS7–8										
FUEL FILTER	1041HS7–11										
GEN. OUT	1041HS7–10					0.2	0.2	0.2	0.2	0.2	0.2
FUEL LOW	1041HS7–9										
INSTRUMENTS – FLIGHT	SEE OPTIONS										
HEATING & VENTILATION	SEE OPTIONS										
EXCITER (ALLISON)	6870058										
ENGINE CONTROLS											
ACTUATOR – N_2 GOV.	369A7002										
STARTER (GENERATOR)	369H4550										
LIGHTING											
ANTI–COL (STROBE) LTS.	369H90062–519	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
POS. LTS. (L, R & TAIL)	369H90062			3.0	3.0				3.0	3.0	3.0
INSTR. & PNL LTS. (327)	369H90062										
LANDING LT. (MS25241–4581)	369H90062			16.0	16.0				16.0	16.0	
MAP LT (HE/HS), UTILITY LT (HM) (1309)	369H90062			0.3	0.3				0.3	0.3	0.3
CONVENIENCE LT. (REAR) (1309)	369H90062			0.3	0.3				0.3	0.3	0.3
DIMMER (AUTRONICS)	369H6425			2.5	2.5				2.5	2.5	2.5
CIGAR LIGHTER (C75Z1505A2 FORD)	369H6508										
POWER	369H4115										
BATTERY CHARGING (18)	369A4540										
OVER VOLTAGE RELAY	369A4557										
REVERSE CURRENT RELAY	A700xA HARTMAN	0.5	0.5	0.5	0.5						
VOLTAGE REGULATOR	369A4552										
GENERATOR (STARTER)	369A4550										
START PUMP	369A8143										
BASIC SHIP AMPERES		4.4	4.4	26.5	26.5	4.1	4.1	4.1	26.2	26.2	10.2

Table 19-2. Optional Equipment Electrical Load Analysis Chart

EQUIPMENT OPTIONS	PART DESIGNATION	NO. OF UNITS OR SYS	AMPS PER UNIT OR SYS	OPER TIME IN MIN	PRE-START AVG. AMPS. 5 SEC.	PRE-START AVG. AMPS. 2 MIN.	START TURBINE AVG. AMPS. 5 SEC.	START TURBINE AVG. AMPS. 2 MIN.	TAKEOFF & CLIMB DAY AVG. AMPS. 5 SEC.	TAKEOFF & CLIMB DAY AVG. AMPS. 2 MIN.	TAKEOFF & CLIMB NIGHT AVG. AMPS. 5 SEC.	TAKEOFF & CLIMB NIGHT AVG. AMPS. 2 MIN.
ARMAMENT		SYS.										
GYRO												
ATTITUDE	369H90041-501		0.7	15					0.7	0.7	0.7	0.7
DIRECTIONAL	369H90042-BSC		0.7	15					0.7	0.7	0.7	0.7
DIRECTIONAL	369H90042-501		1.8	15					1.8	1.8	1.8	1.8
ANTI-COL-LTS												
(QTZ IODINE 2 LTS)	369H90062		1.5	15							1.5	1.5
BOOM (QTZ 1 LT)	369H90062-515		1.5	15							1.5	1.5
POS-LTS BOOM	369H90062-513		1.8	15							1.8	1.8
CARGO HOOK	369H90065		14.0	(6)								
HOIST (13)	369H90070		35.0	(6)								
RE-IGNITION-ENGINE	369H90118-501/-505			(6)								
EMERGENCY FLOATS	369H92557		2.2	15 (7)								
HEATED PITOT TUBE	369H90034		1.3	15					1.3	1.3	1.3	1.3
HEATING - CABIN	369H90020		1.1	(6)								
HEATING - ANTI-ICE	369H90020		0.3	(6)								
VHF COMM (TRANS) RT-221AE-28	369H90064-3		3.9	(8)								
VHF COMM (REC) RT-221BE-28	369H90064-5		1.1	15					1.1	1.1	1.1	1.1
VOR-VHF (NAV) RN-222AE-28	369H90064-7		0.3	15					0.3	0.3	0.3	0.3
DME NARCO 001-4	369H90064-11		3.5	15					3.5	3.5	3.5	3.5
TRANSPONDER TR611B-28ATC	369H90064-81/-151		0.5	15	0.5	0.5			0.5	0.5	0.5	0.5
NAV RCVR RCA-AVN-211 REC	369H90066-503		0.2	15	0.2	0.2			0.2	0.2	0.2	0.2
TRANSCEIVER RCA-AVC-110 TRANS	369H90066-BSC		4.5	(8)								
NAV/COM KING KX170A REC	369H90071		1.0	15	1.0	1.0			1.0	1.0	1.0	1.0
TRANS			5.0	(8)								
ADF KING												
KR80	369H90064-9		0.4	15					0.4	0.4	0.4	0.4
KR85	369H90067		1.0	15					1.0	1.0	1.0	1.0
SSB SUNAIR ASB/125/60 REC	369H90144		2.5	15					2.5	2.5	2.5	2.5
TRANS			7.5	(8)								
P.A. UNIVERSITY SOUND IDLE	369H90146		0.1	15					0.1	0.1	0.1	0.1
PEAK			8.0	(8)								
ICS INTERCOM												
369H6426 ADP	369H90068		0.2	15					0.2	0.2	0.2	0.2
369H94008 ADP	369H90064	SYS.	0.2	15					0.2	0.2	0.2	0.2
INSTALLED OPTIONS AMPS												
BASIC SHIP AMPS					2.8	2.8	9.3	8.3	44.4	34.4	66.5	56.5
TOTAL SHIP AMPERES												

Table 19-2. Optional Equipment Electrical Load Analysis Chart (Cont)

EQUIPMENT OPTIONS	PART DESIGNATION	HOVER						CRUISE					
		DAY AVG. AMPS.			NIGHT AVG. AMPS.			DAY AVG. AMPS.			NIGHT AVG. AMPS.		
		5 SEC.	2 MIN.	15 MIN.	5 SEC.	2 MIN.	15 MIN.	5 SEC.	2 MIN.	15 MIN.	5 SEC.	2 MIN.	15 MIN.
ARMAMENT													
GYRO													
ATTITUDE	369H90041-501	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
DIRECTIONAL	369H90042-BSC	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
DIRECTIONAL	369H90042-501	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
ANTI-COL-LTS													
(QTZ IODINE 2 LTS)	369H90062				1.5	1.5	1.5				1.5	1.5	1.5
BOOM (QTZ 1 LT)	369H90062-515				1.5	1.5	1.5				1.5	1.5	1.5
POS-LTS BOOM	369H90062-513				1.8	1.8	1.8				1.8	1.8	1.8
CARGO HOOK	369H90065												
HOIST (13)	369H90070												
RE-IGNITION-ENGINE	369H90118-501/-505												
EMERGENCY FLOATS	369H92557	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
HEATED PITOT TUBE	369H90034	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
HEATING - CABIN	369H90020												
HEATING - ANTI-ICE	369H90020												
VHF COMM (TRANS) RT-221AE-28	369H90064-3												
VHF COMM (REC) RT-221BE-28	369H90064-5	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
VOR-VHF (NAV) RN-222AE-28	369H90064-7	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
DME NARCO 001-4	369H90064-11	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
TRANSPONDER TR611B-28ATC	369H90064-81/-151	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
NAV RCVR RCA-AVN-211 REC	369H90066-503	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
TRANSCEIVER RCA-AVC-110 TRANS	369H90066-BSC												
NAV/COM KING KX170A REC	369H90071	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TRANS													
ADF KING													
KR80	369H90064-9	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
KR85	369H90067	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
SSB SUNAIR ASB/125/60 REC	369H90144	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
TRANS													
P.A. UNIVERSITY SOUND IDLE	369H90146	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
PEAK													
ICS INTERCOM													
369H6426 ADP	369H90068	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
369H94008 ADP	369H90064	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
INSTALLED OPTIONS AMPS													
BASIC SHIP AMPS		34.4	27.8	21.4	56.5	49.9	27.5	34.4	27.8	21.4	40.5	33.9	27.5
TOTAL SHIP AMPERES													

Table 19-2. Optional Equipment Electrical Load Analysis Chart (Cont)

EQUIPMENT OPTIONS	PART DESIGNATION	LANDING					EMERGENCY – GENERATOR OUT					
		DAY AVG. AMPS.		NIGHT AVG. AMPS.			DAY AVG. AMPS.			NIGHT AVG. AMPS.		
		5 SEC.	2 MIN.	5 SEC.	2 MIN.	15 MIN.	5 SEC.	2 MIN.	15 MIN.	5 SEC.	2 MIN.	15 MIN.
ARMAMENT												
GYRO												
ATTITUDE	369H90041-501	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
DIRECTIONAL	369H90042-BSC	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
DIRECTIONAL	369H90042-501	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
ANTI-COL-LTS												
(QTZ IODINE 2 LTS)	369H90062			1.5	1.5	1.5				1.5	1.5	1.5
BOOM (QTZ 1 LT)	369H90062-515			1.5	1.5	1.5				1.5	1.5	1.5
POS-LTS BOOM	369H90062-513			1.8	1.8	1.8				1.8	1.8	1.8
CARGO HOOK	369H90065											
HOIST (13)	369H90070											
RE-IGNITION-ENGINE	369H90118-501/-505											
EMERGENCY FLOATS	369H92557	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
HEATED PITOT TUBE	369H90034	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
HEATING - CABIN	369H90020											
HEATING - ANTI-ICE	369H90020											
VHF COMM (TRANS) RT-221AE-28	369H90064-3											
VHF COMM (REC) RT-221BE-28	369H90064-5	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
VOR-VHF (NAV) RN-222AE-28	369H90064-7	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
DME NARCO 001-4	369H90064-11	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
TRANSPONDER TR611B-28ATC	369H90064-81/-151	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
NAV RCVR RCA-AVN-211 REC	369H90066-503	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
TRANSCEIVER RCA-AVC-110 TRANS	369H90066-BSC											
NAV/COM KING KX170A REC	369H90071	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TRANS												
ADF KING												
KR80	369H90064-9	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
KR85	369H90067	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
SSB SUNAIR ASB/125/60 REC	369H90144	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
TRANS												
P.A. UNIVERSITY SOUND IDLE	369H90146	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
PEAK												
ICS INTERCOM												
369H6426 ADP	369H90068	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
369H94008 ADP	369H90064	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
INSTALLED OPTIONS AMPS												
BASIC SHIP AMPS		4.4	4.4	26.5	26.5	---	4.1	4.1	4.1	26.2	26.2	10.2
TOTAL SHIP AMPERES												

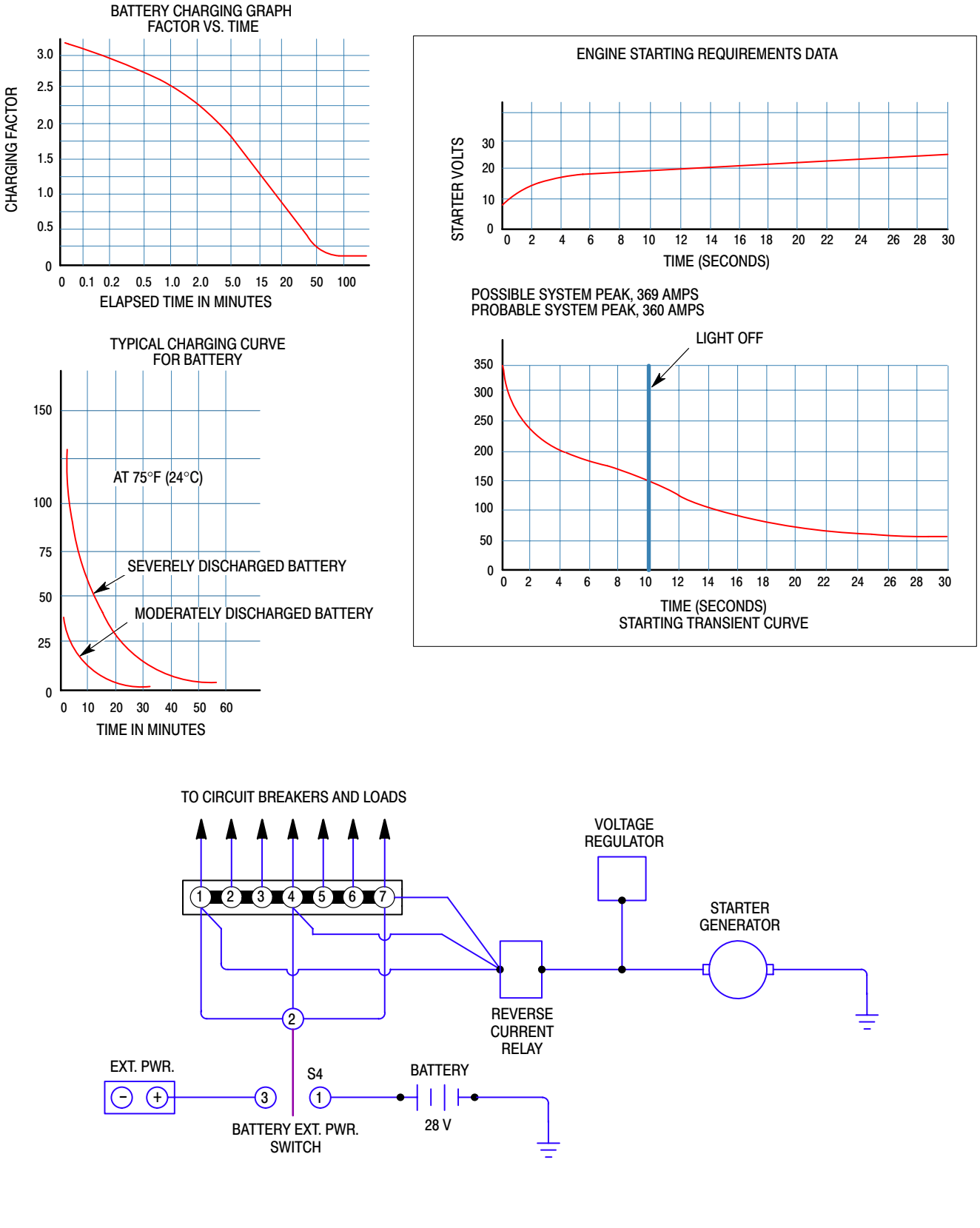


Figure 19-2. Electrical System Load Analysis

NOTE:

(1) The power source consists of:
A. Generator (369A4550) regulated at 26-28.5 Vdc (Ref. Generator Output table).
B. Battery (369A4530) (NI-CAD) 13 AH (19 CELL) Hi-Rate.

Generator Output					
Speed	**Amp Output**	**Volts**	**Altitude**	**Operating Period**	**Ambient Temp. Max.**
7500	85	26.0	Sea Level	Cont.	250°F (121°C)
8100	150	28.5	Sea Level	10 Min.	250°F (121°C)
8100	100	28.5	Sea Level	Cont.	160°F (71°C)
8300 - 12000	150	30.0	Sea Level	Cont.	104°F (40°C)
14000	0	Over-Speed		5 Min.	----

(2) Ships with 369H4560 type console use a 4-Pack which includes an electrical engine oil pressure meter (6).

(3) Manual controls replace electrical controls effective with production ships 0391HS, 0216HE and 0222HM.

(4) Battery charging formula:
Avg. AMPS - (I) = AH X C;
I = Battery charging current;
AH = Ampere-hour capacity of battery, based on the 2-hour discharge rate;
C = Charging factor from the graph above.

(5) This load is considered negligible.

(6) This load is intermittent and is considered negligible.

(7) Valves remain electrically energized after inflation of floats.

(8) Duty cycle is 10% of maximum time interval.

(9) Idle current 1 ampere maximum. average current 5-8 amperes, peak current 18 amperes.

(10) Warning lights are operative during alarm conditions only.

(11) Solenoid valves remain energized during time floats are inflated.

(12) See starting load chart.

(13) The maximum duty cycle for the hoist is 3 complete cycles (approximately 15 minutes total) and then rest 40 minutes before repeating cycle.

(14) Ships with 369H4260 type console have one light only for engine oil pressure and temperature.

(15) Ships with 369H4260 type console have one light only for engine oil, main rotor and tail rotor chip detectors.

(16) Time interval of 15 minutes or over is considered as continuous.

(17) Instrument and panel lights are included with dimmer system.

(18) For longer duration, see typical charging curve. Accumulate time for different operating conditions.

Table 19-3. Troubleshooting Dc Power Distribution

Symptom	Probable Trouble	Corrective Action
WARNING: Before removing or installing components of the electrical systems, check that all electrical power is OFF. If units are not immediately replaced, ensure that all electrical connectors are suitably capped and stowed and all loose cable ends are properly insulated and stowed to prevent the possibility of shorting. Serious injury or death could result from voltages present in the electrical system.		
Battery fails to energize electrical circuits	Defective power selector switch	Replace switch.
	Defective battery relay	Replace battery relay.
	Battery discharged	Install serviceable battery.
Discharged battery	Charging rate incorrectly set	Adjust voltage regulator.
	Battery idle too long	Install serviceable battery.
Excessive corrosion on battery terminal	Exposure to water or corrosive fluids	Clean terminals, coat with non-corrosive grease.
Battery overheats and/or discharges smoke	Charging rate too high	Adjust voltage regulator.
	Loose battery terminal links, straps or screws	Repair battery as necessary.
	Damaged or defective battery	Repair or replace battery.
Starter/generator fails to function when START switch pressed	Circuit breaker out	Reset circuit breaker.
	Start relay defective	Replace start relay.
	Battery relay defective	Replace battery relay.
	APU relay defective	Replace APU relay.
	Discharged battery	Install serviceable battery.
	APU, reverse polarity diode open	Replace diode.
	Start/generator defective	Replace starter/generator.
	START switch or wiring defective	Replace switch or repair defective wiring.

Table 19-3. Troubleshooting Dc Power Distribution (Cont.)

Symptom	Probable Trouble	Corrective Action
Starter/generator fails to supply charging current with engine operating	Circuit breaker out	Reset circuit breaker.
	Reverse current relay defective	Replace reverse current relay.
	Starter/generator defective (Check for sheared armature drive shaft through air inlet screen)	Replace sheared drive shaft.
	Voltage regulator defective	Replace voltage regulator.
	Voltage regulator incorrectly adjusted	Adjust voltage regulator.
	Overvoltage relay defective	Replace overvoltage relay.
	GEN-OFF switch defective	Replace switch.
	Defective wiring	Repair or replace defective wiring.
Ammeter indication off-scale below zero; engine not operating and GEN-OFF switch is on	Defective reverse current relay	Replace reverse current relay.
GEN OUT indicator light on; voltage lower than normal when engine operating	Weak generator field	Replace starter/generator.
	Defective voltage regulator	Replace voltage regulator.
	Defective starter/generator	Replace or repair starter/generator.
	Incorrectly adjusted voltage regulator	Adjust voltage regulator.
Fluctuating current indication on ammeter	Unstable voltage regulator	Replace voltage regulator.
	Brushes excessively worn	Replace starter/generator brushes.
	Defective starter/generator	Replace or repair starter/generator.
	Loose ammeter circuit wiring or defective resistor R3	Check ammeter circuit connections and resister R3. Repair as necessary.
Excessively high or low current indication on ammeter, engine operating; GEN OUT indicator light not on	Incorrectly adjusted voltage regulator	Adjust voltage regulator.
	Defective voltage regulator	Replace voltage regulator.
	Defective starter/generator	Replace or repair starter/generator.
	Defective ammeter	Replace instrument cluster (three pack).
	Incorrect connection of ammeter shunt wire, or defective resistor R3	Check shunt wire connection and resistor R3. Repair as necessary.
Adjustment of voltage regulator has no effect on voltage indication	Defective voltage regulator	Replace voltage regulator.

4. Wiring Harnesses

Components of the electrical system are connected by wiring harnesses, with wire identification as shown in the applicable wiring diagrams.

Wires in a harness are terminated with terminal lugs, electrical connectors (plugs and receptacles), Wire Mate locking type pin connectors, knife splices or snap-in contacts.

Wiring harnesses are held in place by nylon self-clinching loop straps and nylon tying twine. Nylon caterpillar-type grommets provide insulation where harnesses pass through structural openings.

Each electrical wire of a harness is identified by a letter-number code (with the exception of a few color-coded lengths that are integral to a specific component or assembly). The letter-number code identifies the function of the circuit of which the wire is a part, the wire number, segment and wire size (gage), respectively. A description of the wire code is included in Section 20.

NOTE: Electrical wiring that interconnects the optional integrated interphone control unit and terminal blocks for the optional interphone control system is installed in all helicopters on which the electrical system is standard.

A. Wire Harness Replacement

(1). Check that all electrical power is OFF. Accomplish the following steps as applicable.

(2). Remove access doors.

(3). Open panel by removing the fasteners that secure panel to structural support.

(4). Remove component(s) blocking access. (Refer to component coverage in appropriate section of HMI.)

(5). Disconnect and tag-identify wire terminal(s) at applicable panel.

(6). Disconnect wiring harness connectors (plugs or receptacles), Wire Mate connections and/or knife splices and tag-identify any single terminal connections

NOTE: Observe method of wiring harness routing, clamping and tying prior to removal to facilitate reinstallation.

(7). Cut tying twine and cut or loosen nylon straps as necessary to permit removal of harness.

(8). Route replacement harness into position.

(9). Install harness connectors (receptacle, plug or inserts).

(10). Connect any harness single-terminal leads.

(11). Replace tying twine (30, Table 2-4) and reinstall nylon straps, if available. (Substitute tying twine if nylon straps unavailable.)

(12). Install component(s) removed to gain access.

(13). Close panels and reinstall fasteners.

(14). Install access door, where removed.

(15). Connect battery and external power source.

(16). Check operation of all circuits affected by harness replacement. (Refer to applicable wiring diagrams.)

5. Electrical Connectors

Plugs, receptacles, terminal block snap-in type contacts, locking type pin connectors, knife splices and terminal lugs provide the means by which wiring and electrical harness assemblies are connected to individual panels and electrical components.

Each plug-receptacle combination is secured with lockwire or otherwise mechanically locked, to prevent opening of the connection due to vibration.

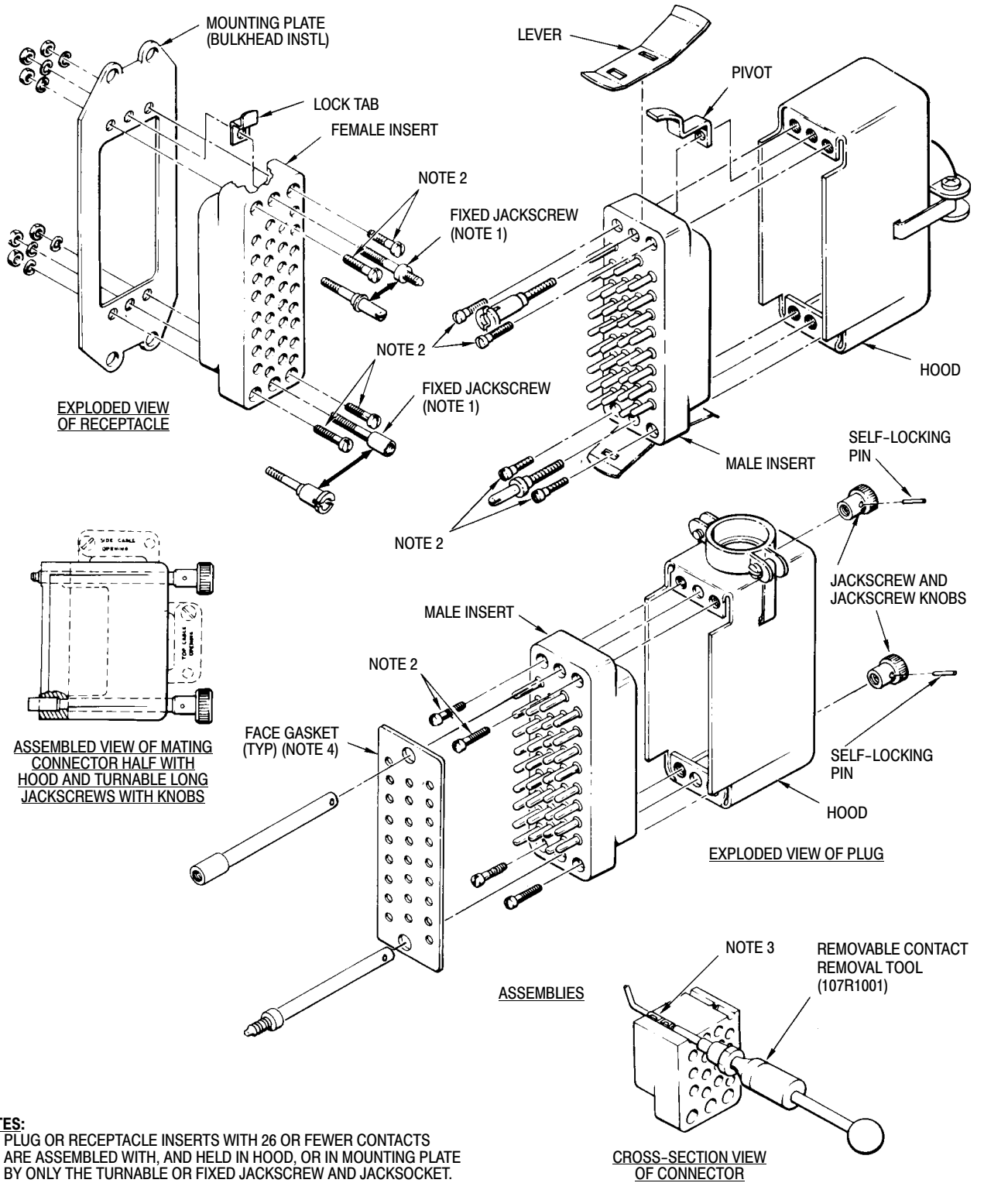
Terminal block snap-in type contacts physically and electrically connect individual harness leads (wires) to terminal block modules.

A. Plug/Socket Connector Repair or Replacement

(Ref. Figure 19-3)

(1). Check that all electrical power is OFF.

(2). Remove any connector bonding or lockwire.



NOTES:
1. PLUG OR RECEPTACLE INSERTS WITH 26 OR FEWER CONTACTS ARE ASSEMBLED WITH, AND HELD IN HOOD, OR IN MOUNTING PLATE BY ONLY THE TURNABLE OR FIXED JACKSCREW AND JACKSOCKET.
2. MACHINE SCREWS (4-40 OR 6-32 UNC THREAD SERIES) ARE USED TO ASSEMBLE PLUG OR RECEPTACLE INSERTS HAVING 34 OR MORE CONTACTS.
3. REMOVABLE CONTACTS INSTALLED ON WIRES WITH HAND-OPERATED CRIMPING TOOL.
4. NOT INSTALLED ON ALL CONNECTORS.

30-101B

Figure 19-3. Repair or Replacement of Rectangular Electrical Connectors

(3). Disconnect electrical connector from mating plug or receptacle by using the applicable following steps:

(a). Loosen strain-relief clamp on connector hood or adapter.

(b). On circular type connectors, loosen hood and disengage plug lock spring from receptacle lock ring by rotating lock spring in either direction.

(c). Disassemble shell or hood from electrical connector to expose terminals.

(d). Disconnect crimp-type removable contacts by using the appropriate contact removal tool (33 or 36, Table 2-2).

(4). Slide insulation sleeves back over wires and unsolder wires from contact inserts, or cut off crimp-type contacts as necessary.

(5). Solder or crimp electrical wires to insert contacts and remove identifying tags, if used. Use a tin-alloy solder (48, Table 2-4) for all soldering operations, and the appropriate crimping tool (34 or 35, Table 2-2) for replacement of removable crimp-type contacts.

(6). Install crimp-type contacts by using the appropriate contact insertion tool (33 or 36).

(7). Check for short circuits. Ensure that resistance between pins is infinite except where pins are interconnected. (Refer to applicable wiring diagrams.)

(8). Join connector halves and secure.

(a). On circular type connectors, rotate plug lock spring to engage receptacle lock ring.

(b). Tighten hood or adapter strain-relief clamp on connector and tighten clamp screws.

(c). Use lockwire and attach connector bonding, as applicable.

B. Disconnection/Connection of Wire Mate Connectors

CAUTION Wire Mate locking type pin connectors will be damaged if pulled apart and disconnected without use of appropriateconnector insertion/extraction tool.

(1). Disconnect Wire Mate pin connectors as follows:

(a). Slide white end of insertion/extraction tool (42 or 43, Table 2-2) on wire with tip end toward male contact terminal.

(b). While holding connector female half, slide tool along wire and fully insert tool around male contact terminal into female half. This disengages retaining clip tines from male contact terminal shoulder.

(c). Pull wire and male contact from female half while holding tool in place.

(2). Connect Wire Mate pin connectors as follows:

(a). Slide colored end of insertion/extraction tool (42 or 43) on wire with tip end behind male contact terminal shoulder.

(b). Insert and push male contact terminal straight into connector female half, using tool end. A click will occur when contact terminal seats and retaining clip tines snap in place behind terminal shoulder.

(c). Remove insertion-extraction tool and gently pull on connected wires to ensure firm seating.

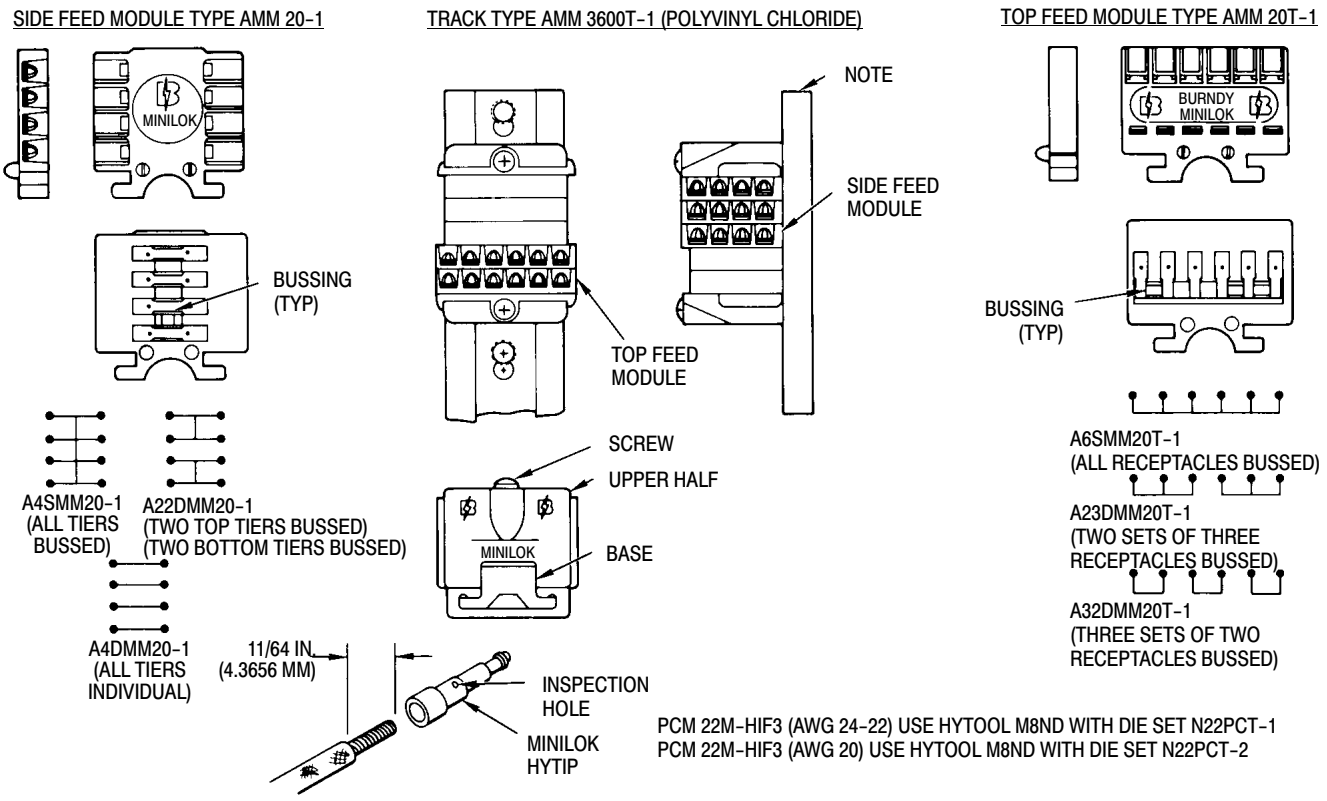
C. Minilok and Modulok Terminal Block Contact Tip Replacement

(Ref. Figure 19-4)

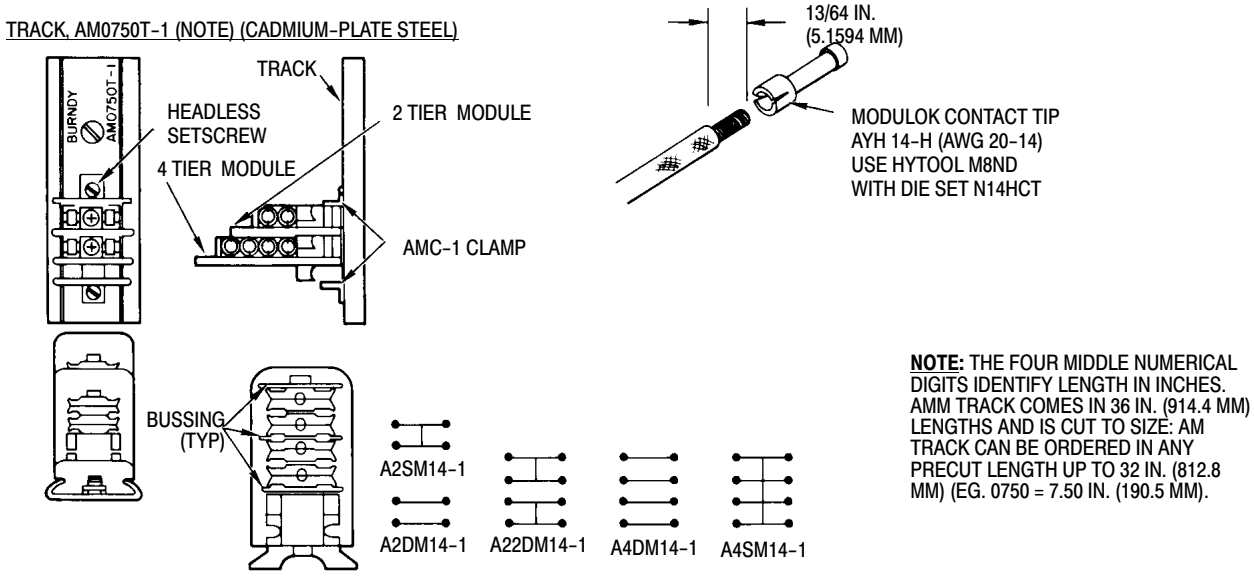
(1). Check that all electrical power is OFF.

(2). Use a Burndy insertion/extraction tool (33, Table 2-2) to pull a HYTIP contact from a MINILOK module.

(3). Strip either 0.17 or 0.20 inch (4.37 or 5.16 mm) of insulation from end of wire, as applicable.



TYPICAL INSTALLATION OF MINILOK TERMINAL BLOCK MODULES
(REF. TB1, TB5, TB7 AND TB502)



TYPICAL INSTALLATION OF MODULOK TERMINAL BLOCK MODULES
(REF. TB3)

30-102A

Figure 19-4. Identification and Replacement of Burndy Terminal Block Modules

(4). MODULOK modules have either two-tier or four-tier spring-loaded connectors. Using a standard screwdriver for recessed head screws, twist the locking screw counterclockwise to the quick-disconnect position of the Screw and spring mechanism to release the contact tips. Pull tips from spring-loaded socket connectors.

(5). Insert stripped end of wire into snap-in contact. On HYTIP (MINILOK) contacts, check that stripped end of wire extends past the inspection hole. Make sure the stripped end of the wire is inserted as far as possible into the contact tip and that the wire insulation extends approximately one-sixteenth of an inch into the contact shoulder (MINILOK) or to end of the contact shoulder notch (MODULOK).

(6). Using the Burndy manual crimping tool and correct die-set (34, Table 2-2), crimp contact on the wire.

(7). Visually inspect contact tip on the wire; check that it is firmly attached to the wire and that the stripped end of the wire blocks inspection hole in HYTIP contacts.

(8). Use a Burndy insertion/extraction tool (33) to push HYTIP snap-in contact into the proper terminal block module of the terminal block assembly. (Refer to applicable wiring diagrams.)

(9). Plug MODULOK contact tips into spring-loaded socket connectors and twist locking screw clockwise to the locked position (spring fully compressed).

NOTE: MODULOK modules may be set in either the quick- disconnect position or the locked position; the spring- loaded socket connectors exert uniform pressure in either position. The quick- disconnect position should only be used to facilitate circuit ring-out.

D. Minilok and Modulok Terminal Block Replacement

(1). Check that all electrical power is OFF.

NOTE: To facilitate reassembly, tag and identify all wires that are to be disconnectedfrom terminal block module to be replaced.

(2). Remove contact tips (Ref. Minilok and Modulok Terminal Block Contact Tip Replacement).

(3). Loosen the screw that secures the end clamp holding the modules on the track. Slide the end clamp away from the modules and separate the module to be replaced by unsnapping it from adjoining modules.

(4). With modules separated for clearance from one another, remove the module by turning it 90 degrees and unsnapping it from the track.

(5). Insert the replacement module into mounting position between or next to the correct adjoining modules, rotate it 90 degrees and snap into place. Press modules together.

(6). Slide the end clamp into place against the outside module. While pressing and holding the clamp against the outside module, tighten the end clamp screw.

(7). Install contact tips.

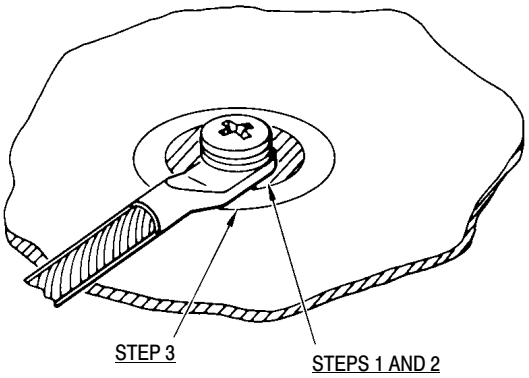
(8). Remove identifying tags from wires.

E. Electrical Bonding Connector Maintenance

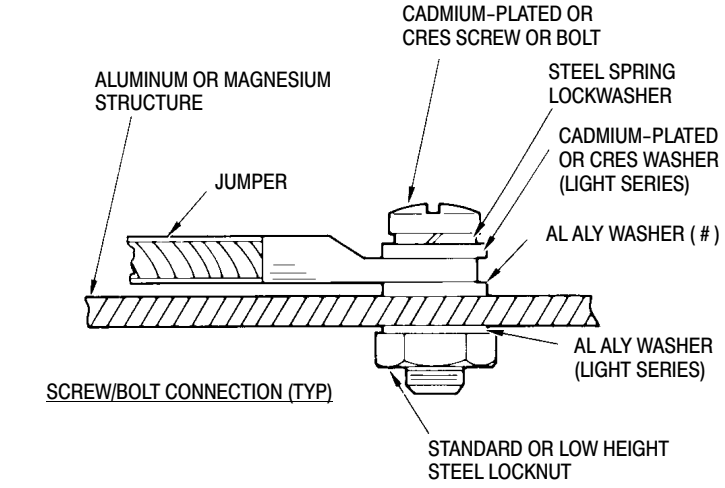
(Ref. Figure 19-5)

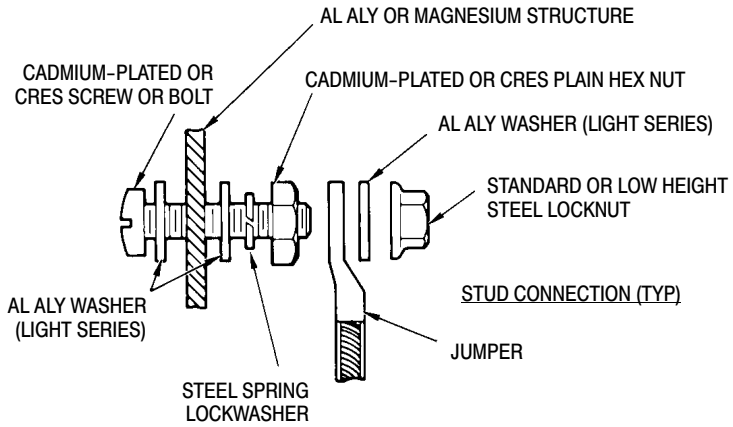
(1). When replacing a bonding jumper, use solvent (1, Table 2-4) to remove all traces of grease, oil or other nonconductive film from the mating surfaces. Nonsoluble films should be removed by sanding and polishing with grade 400 abrasive paper (20), using care to remove only a minimum of the base metal. The polished area should be brushed clean.

(2). After polishing aluminum alloys, apply a brush coating of Iridite No. 14-2, Class 3, chemical film protection (8) to the mating surfaces.

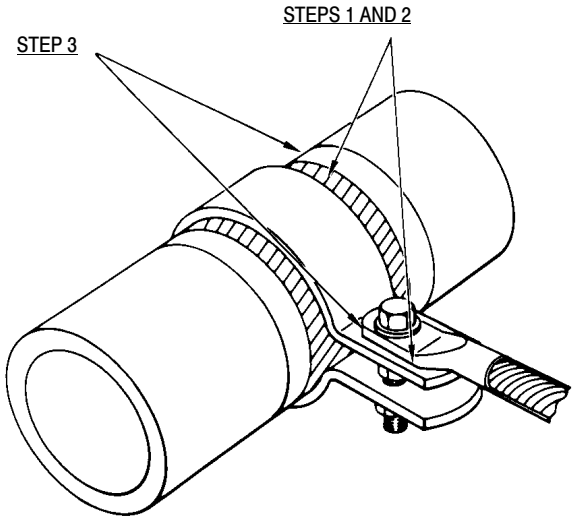


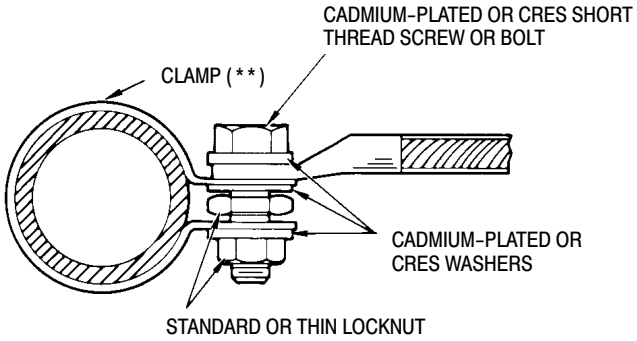
CLEANING, CORROSION PROTECTION AND FINISHING





BONDING JUMPER TO STRUCTURE (*)





BONDING JUMPER TO TUBE (*)

STEP 1. CLEAN TO BASE METAL: AREA 1-1/2 DIA. OF WASHER; AREA 1-1/2 CLAMP WIDTH AND INSIDE SURFACE OF CLAMP. (CLEAN CLAMP EAR-TO-TERMINAL MATING SURFACE.)

STEP 2. BRUSH COAT THE CLEANED AREA OF ALUMINUM WITH CHEMICAL FILM (8, TABLE 2-4).

STEP 3. APPLY CLEAR LACQUER (47) TO 1-1/2 DIA. OF CLEANED AREA.

(#) NOT USED ON PLATED OR CRES STRUCTURE.

(*) USE CADMIUM-PLATED PARTS BELOW 300°F (149°C) USE CRES PARTS ABOVE 300°F (149°C); USE WASHERS AGAINST STRUCTURE AS APPLICABLE TO THE STRUCTURE MATERIAL.

(* *) ALCLAD CLAMP FOR PLATED STEEL, AL ALY FOR MAG ALY STRUCTURE. CADMIUM-PLATED STEEL CLAMP FOR NON-PLATED STEEL STRUCTURE (CRES CLAMPS FOR CRES TUBE).

30-103A

Figure 19-5. Typical Requirement for Electrical Bonding Connections

(3). When removed bonding jumpers are reconnected, check that the clear lacquer finish, originally applied to the cleaned mating surfaces, will not act as an insulator between the mating surfaces. Restore mating surfaces to the cleaned condition, as necessary, according to steps (1). and (2). above.

(4). After connecting a bonding jumper, apply clear lacquer (47) to the exposed area of the cleaned surface.

(5). Ensure that bonding jumpers do not impede the operation of movable components.

F. External Power Receptacle Replacement

(Ref. Figure 19-6)

(1). Check that all electrical power is OFF.

(2). Remove the two attaching screws and pull receptacle outward.

NOTE: It may be necessary to disconnect the ground cable to gain sufficient slack for receptacle removal. If so, open right access door of pilot's compartment floor for access to cabling.

(3). Disconnect cables and remove receptacle.

(4). Attach cables to terminals of replacement receptacle and secure with terminal nuts.

NOTE: The aft terminal is the negative (-) or ground terminal, the center terminal is the positive (+) terminal, and the forward(small polarity pin) terminal is not used.

(5). Install receptacle with two screws.

(6). Reconnect any cabling disconnected to obtain slack for receptacle removal.

6. Electrical Equipment

Electrical equipment consists of the basic power supply, distribution and control components, and other electrical items installed as standard equipment, in all configurations of the 500 Series helicopter.

Such equipment includes the battery, starter/generator, control switches, circuit breakers and power supply and control relays.

A voltage regulator, overvoltage relay and reverse current relay function with the starter/generator to monitor, regulate and control generator dc output voltage, the nominal 28 Vdc voltage for the electrical system, charging of the battery and protect from overvoltage. The starter/generator both starts the engine and generates dc electrical power.

Battery temperature sensing equipment monitors and provides a visual indication of excessive battery temperature.

Voltage reduction and calibration resistors are used for certain instruments and associated equipment.

Miscellaneous switches provide for application of dc power and control of related equipment.

The night lighting system is part of the electrical system on a helicopter with instrument panel type B. Information is provided in Section 17 on electrically actuated instruments, caution and warning indicator lights, engine power out warning equipment, the associated sending units, and the other components installed directly in the instrument panel, excluding the control switches and circuit breakers.

Refer to system coverage for information on the engine starting pump (Section 12), the N2 trim actuator (Section 11), and cyclic trim actuators (Section 7). Maintenance data for optional electrical equipment items such as night lighting kit on a helicopter with instrument panel type A, heated pitot tube, intercommunication systems, etc., can be found in CSP-H-3, HMI Appendix A.

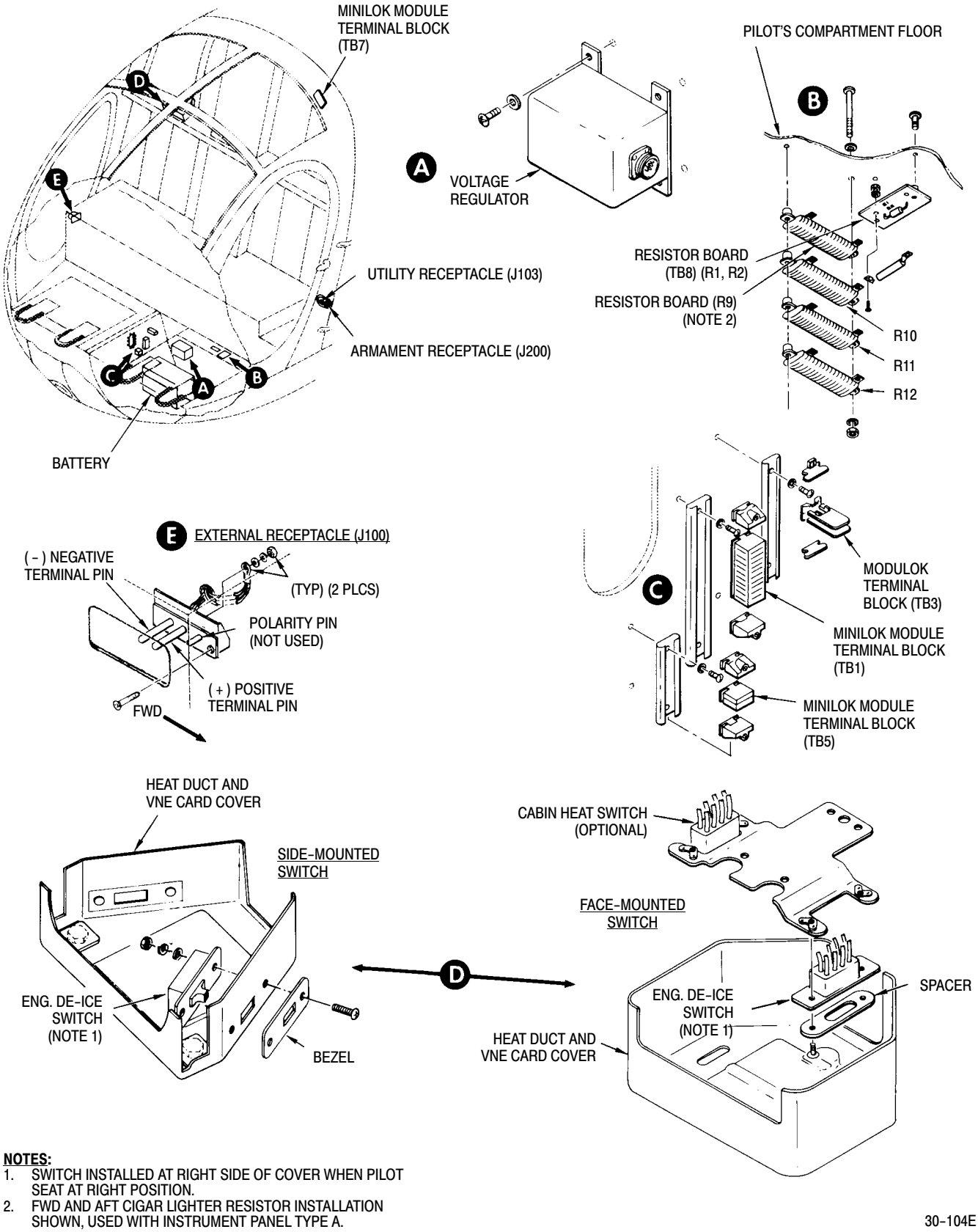
7. Voltage Regulator

(Ref. Figure 19-6) The static voltage regulator maintains a constant generator output voltage under varying speed and load conditions. The regulator has a voltage adjustment range of 26-30 volts and contains an overvoltage circuit.

A. Voltage Regulator Replacement

(1). Check that all electrical power is OFF.

(2). Open pilot's compartment floor left access door, disconnect electrical connector, remove four mounting screws and washers, and lift out voltage regulator.



NOTES:
1. SWITCH INSTALLED AT RIGHT SIDE OF COVER WHEN PILOT SEAT AT RIGHT POSITION.
2. FWD AND AFT CIGAR LIGHTER RESISTOR INSTALLATION SHOWN, USED WITH INSTRUMENT PANEL TYPE A.

30-104E

Figure 19-6. Electrical Equipment (Cabin Locations)

(3). Install replacement voltage regulator with four screws and washers, and attach electrical connector.

(4). Perform an operational check of the new regulator and make adjustment, as necessary.

B. Installed Voltage Regulator Adjustment

(Ref. Table 19-4) The voltage regulator is to be adjusted for a specific generator output voltage according to prevailing ambient temperature.

(1). Connect a precision voltmeter to the voltage regulator test jacks (Ref. Figure 19-7).

NOTE: The voltmeter must be capable of measuring voltage within 0.25% full scale accuracy in the 0-50 Vdc range. A Weston Model 931, or equivalent, is recommended. Commonly available multimeters have a much broader accuracy tolerance and are therefore unsatisfactory for use in setting the voltage regulator.

(2). Start engine, keep collective pitch full down and allow N_1 idle speed to stabilize.

(3). Turn off all unnecessary electrical loads.

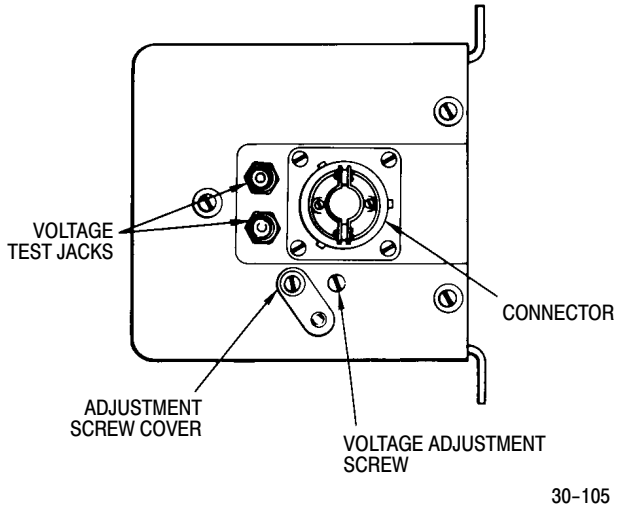


Figure 19-7. Voltage Regulator Test Points

Table 19-4. Recommended Voltage Setting

Battery Ambient Temperature in Degrees F (C)	Voltage Setting
Up to 80 (26.9)	28. 5
81 - 100 (27.4 - 38.1)	28.O
101 - 130 (38.6 - 54.9)	27. 5
131 - 140 (55.5 - 60.5)	27.0

NOTE: Figures in Voltage Setting column represent recommended constant potential charging voltages to which voltage regulator is to be adjusted for listed temperatures.

(4). Increase N_1 rpm to 68-70% and check voltmeter reading. If reading is not as shown in Table 19-4, open the adjustment screw cover, and on the connector end of the voltage regulator, insert a small screwdriver, and turn adjustment screw slowly for incremental voltage increase or decrease as necessary. Increments of 0.5 volt are possible.

(5). While maintaining full down collective pitch, increase N_1 rpm to approximately 77-80 percent.

(6). Check voltmeter to see if voltage remains within the applicable tolerance range. If necessary, readjust voltage to remain within limits at engine speeds specified in steps (4). and (5). above.

(7). Rapidly increase electrical loads by turning on all radio and electrical equipment possible. Except for momentary fluctuations, the regulator must maintain generator output at voltage listed in Table 19-4 as indicated on meter. If the electrical loads cause voltage to vary outside this range, replace voltage regulator and repeat steps (1).thru (6).

(8). Turn off electrical loads, reduce N_1 rpm to 68-70 percent, and repeat step (7). Replace regulator if voltage setting varies from that specified for an increase in electrical load.

(9). Shut down engine.

(10). Disconnect and remove voltmeter, close voltage regulator adjustment screw

cover, and tighten cover retaining screw.

C. Voltage Regulator Bench Testing

(Ref. Figure 19-8 for test equipment and wiring hookup)

(1). Mount generator on vari-drive.

(2). Connect voltage regulator into test circuit.

(3). Adjust potentiometer R2 fully CCW while the load bank is off (switch S5 OFF). Set switch Sl OFF and S3 and S4 ON.

(4). Hold momentary contact switch S2 ON, start vari-drive and adjust to bring generator speed to 7200 rpm or above. Voltage shown on meter M1 must not exceed 10.75 volts; this indicates that the voltage regulator is in the simulated start mode.

(5). Release switch S2. Regulator must regulate voltage to between 26.0-30.0 Vdc as indicated on meter M1.

(6). Check that full range of voltage adjustment potentiometer on voltage regulator is 26.0-30.0 Vdc as indicated on meter M1.

(7). Adjust generator speed to 10,750 rpm. Switch Sl ON and adjust the potentiometer on the voltage regulator to 28.5 ±0.3 Vdc as indicated on meter M1.

(8). Switch S5 ON and adjust the load bank to a 100-ampere load as indicated on meter M2; then switch S1 ON and then OFF. The voltage regulator shall regulate voltage under load surge conditions.

(9). Decrease generator speed to 7200 rpm and apply a 100-ampere load; then switch Sl ON and OFF. The voltage regulator shall regulate voltage under load surge conditions.

(10). Adjust load bank to 10-20 ampere load. Switch S4 OFF. Adjust potentiometer R2 CW until overvoltage relay operates. This should occur at 32.0 ±1.0 volts indicated on meter M1. Return potentiometer to full CCW position.

(11). Reset the overvoltage relay by switching Sl OFF and then ON.

(12). Turn switches OFF in the following order: S1, S3, S5, and S4, Disconnect the voltage regulator.

8. Overvoltage Relay

(Ref. Figure 19-9) The overvoltage relay protects the 28 Vdc system from an overvoltage condition. With the GEN OFF switch on, the normally closed contacts of the overvoltage relay apply generator output to the SW (switch) circuit of the reverse current relay. When an overvoltage occurs in the range of 32.0 ±1.0 volts, the overvoltage relay energizes, removing power from the switch circuit of the reverse current relay to remove generator output from the electrical system.

CAUTION No attempt should be made to adjust the overvoltage circuit in the helicopter. Adjustment is performed only during bench test of the voltage regulator.

A. Overvoltage Relay Replacement

(1). Check that all electrical power is OFF.

(2). Gain access to overvoltage relay on instrument panel structure by removing fairing from left side of instrument panel.

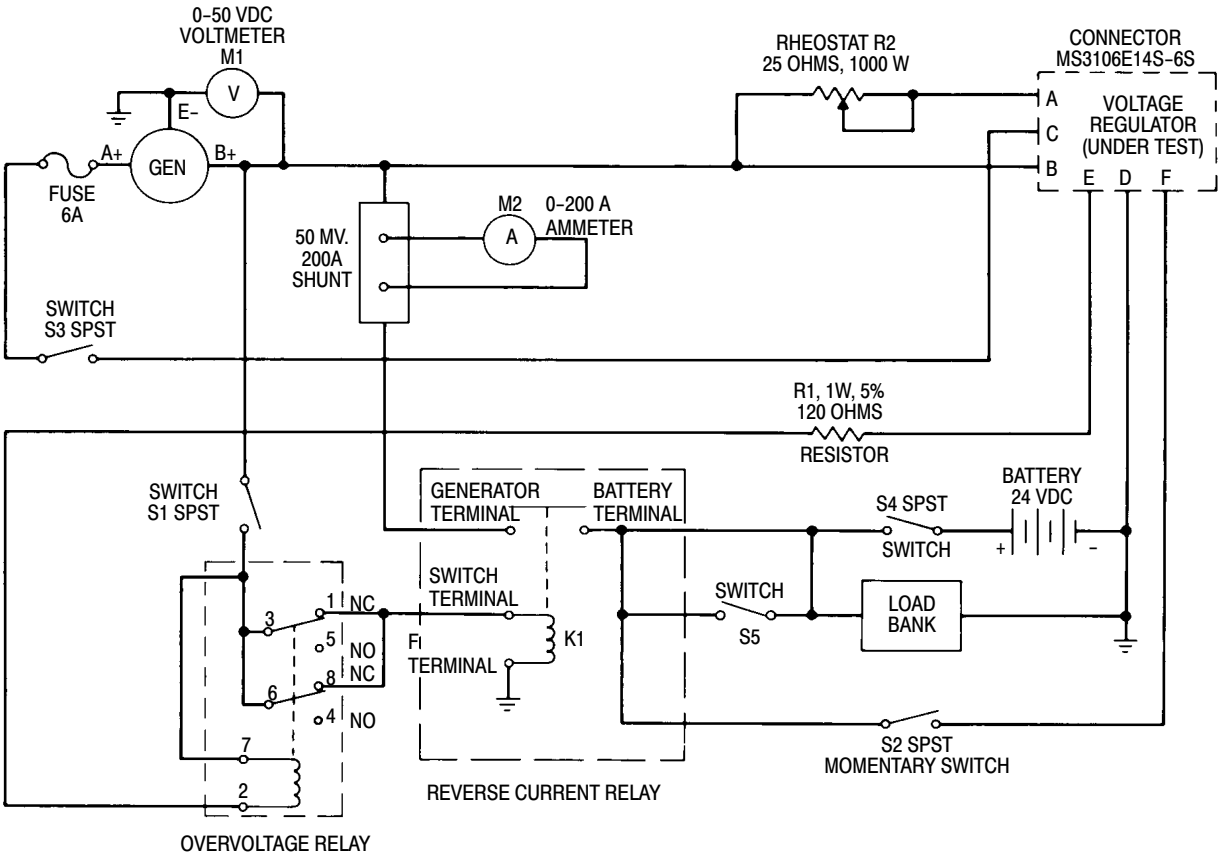
(3). Remove two screws, washers, and nuts that attach relay.

(4). Unsolder electrical wiring from relay terminal lugs.

(5). Be sure insulation sleeving is used over wires and solder wires to terminal lugs of replacement relay. Slide insulation sleeving over relay solder terminals. Remove identifying tags if used.

(6). Locate overvoltage relay on mounting panel and secure with screws, washers and nuts.

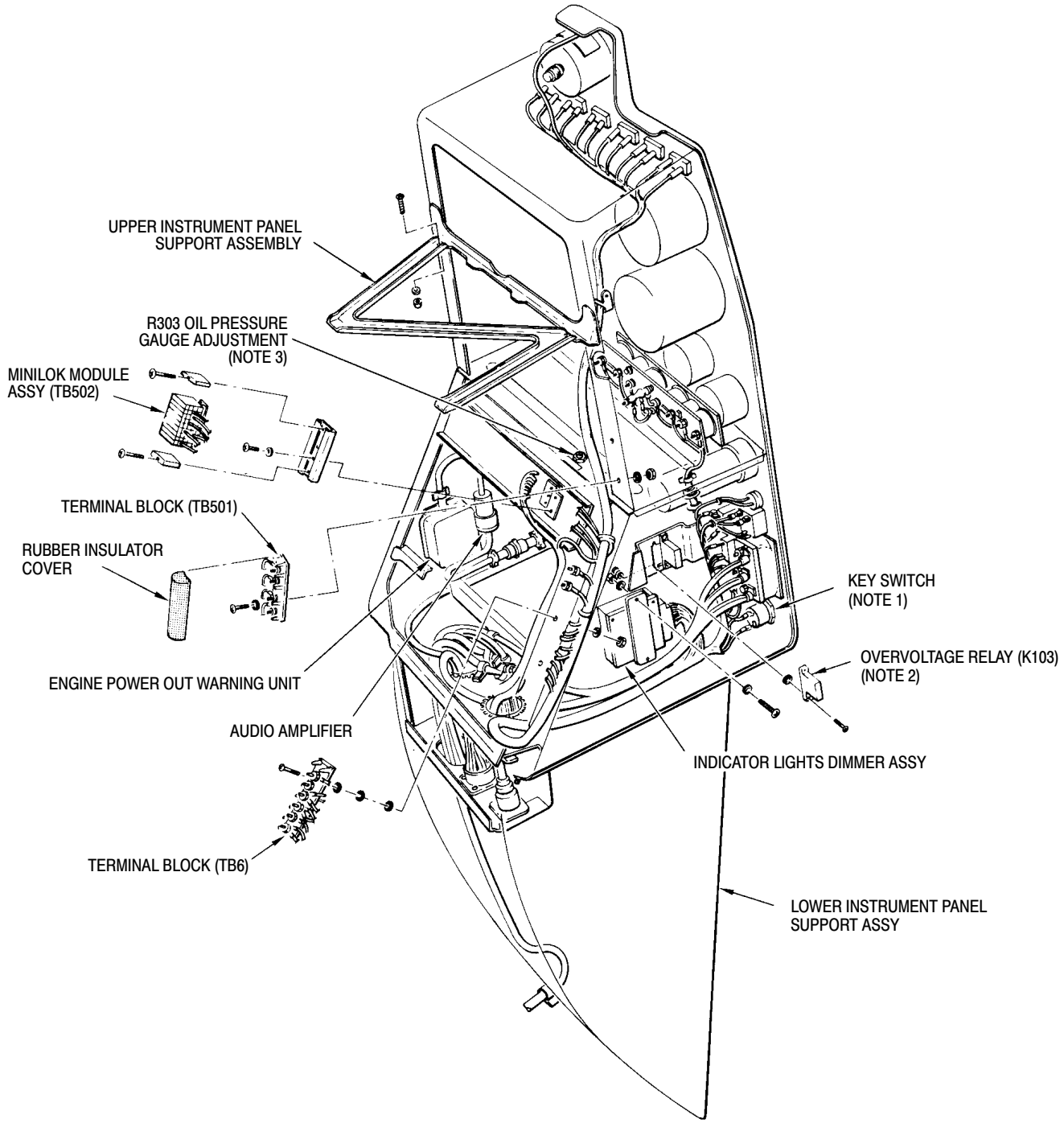
(7). Reinstall instrument panel fairing.



ITEM NO.	EQUIPMENT DESCRIPTION
1	VARI-DRIVE, 3,000-12,000 RPM (U.S. TYPE VEU-GSTD OR EQUIVALENT).
2.	DC GENERATOR, 28 VOLT (369A4550 OR EQUIVALENT).
3	NI-CAD BATTERY, 24 VOLT (369A4530 OR EQUIVALENT).
4	0-200A DC AMMETER (M2), 50 MV FULL SCALE (WESTON MODEL 931 WITH 50 MV, 200 AMPERE SHUNT, OR EQUIVALENT).
5	0-50 VDC VOLTMETER (M1), CALIBRATED WITHIN 0.25%, AT 0-50 VOLTS (WESTON MODEL 931 OR EQUIVALENT).
6	LOAD BANK, 0-150 AMPERES (SUN ELECTRIC COMPANY MODEL GBL OR EQUIVALENT).
7	OVERVOLTAGE RELAY (369A4557 OR EQUIVALENT).
8	REVERSE CURRENT RELAY (HARTMANN A700XA OR EQUIVALENT).
9	SWITCHES AND WIRING AS REQUIRED.

30-106C

Figure 19-8. Test Hookup for Voltage Regulator



NOTES:
1. WHEN REPLACING KEY SWITCH, USE AN3066-6 NUT AND SHAKEPROOF WASHER IN PLACE OF NUT SUPPLIED WITH KEY SWITCH.
2. COVER RELAY SOLDER TERMINALS WITH ELECTRICAL INSULATION SLEEVING (31, TABLE 2-4).
3. PART OF CURRENT CONFIGURATION OIL PRESSURE GAUGE CIRCUIT.

30-107C

Figure 19-9. Electrical Equipment Locations (Instrument Panel Type A)

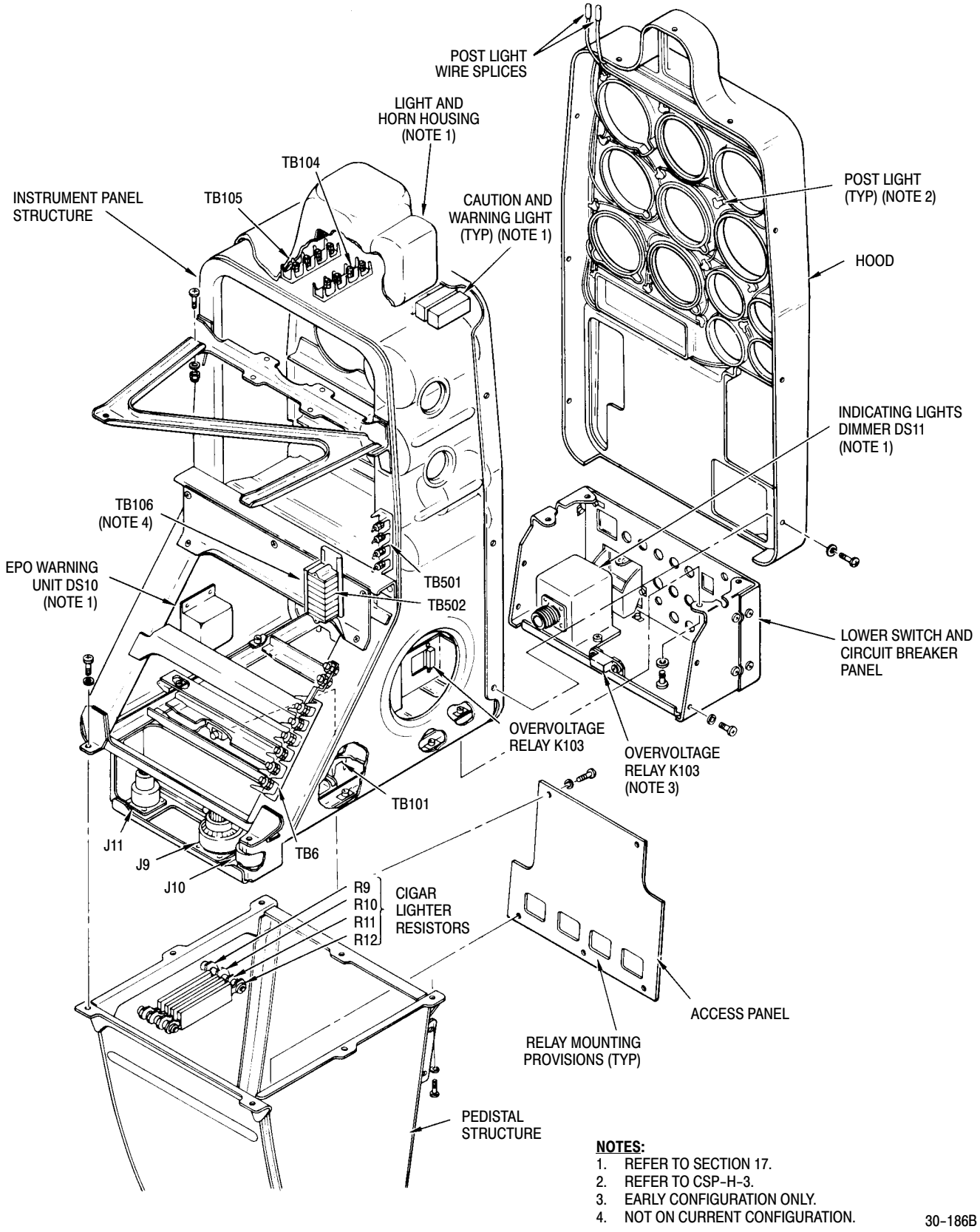


Figure 19-10. Electrical Equipment Locations (Instrument Panel Type B)

9. Circuit Breaker Panel

(Ref. Figure 19-1) The circuit breaker panel, located on the lower right side of the instrument panel, is a removable assembly with provisions for mounting 14 pushbutton-type circuit breakers; 7 breakers are used in the basic configuration.

The circuit breakers are normally depressed (button in) when the associated circuits are energized.

When a circuit is overloaded, the circuit breaker button pops out and de-energizes the circuit.

A. Circuit Breaker Replacement

(1). Check that all electrical power is OFF.

(2). Remove the three screws that attach circuit breaker panel to instrument panel. Pull panel out to expose wiring to circuit breakers.

NOTE: Check the orientation of installed circuit breakers. Observe that each column of breakers has a staggered installation; one horizontal, then one vertical. This orientation is required for installation clearance between breakers and should be maintained.

(3). Disconnect wiring from circuit breaker to be replaced; then remove hex nut and breaker.

(4). Remove and discard the key washer supplied with a new circuit breaker.

(5). Position the replacement breaker for correct orientation and secure with hex nut. Reconnect wiring and reinstall the circuit breaker panel.

(6). Check operation of the new circuit breaker.

10. Control Switches

(Ref. Figure 19-1) Six individually removable control switches are installed in the lower left corner of the instrument panel in the basic configuration. Mounting holes for four optional equipment control switches are also provided at this panel location. The basic control switches are one key type, two circuit breaker type, one pushbutton type, and two toggle type.

Control functions are apparent from adjacent legends; the UTILITY and START PUMP switches are the circuit breaker type that will snap to the off position if the circuit is overloaded. The switch marked UTILITY controls power to the two-wire receptacle at the lower left corner of the forward canted bulkhead (Ref. Figure 19-6).

A. Control Switch Replacement

CAUTION If the main power selector switch is to be replaced, be sure to disconnect the battery and external power.

NOTE: When key switch (Ref. Figure 19-9) is replaced, an AN3066- 6 nut and a shakeproof washer are to be used in place of nut supplied with replacement switch.

(1). Check that all electrical power is **OFF**.

(2). Remove the two rectangular blank panels and left side fairing from the instrument panel to gain access to the switch to be replaced (Section 17).

(3). Remove hex nut or screws and washers as applicable; then remove switch far enough to permit the wiring to be disconnected from the switch.

(4). Position replacement switch and reconnect wiring; install attaching hardware.

(5). Check operation of the new control switch.

(6). Reinstall the left side fairing and blank panels on the instrument panel (Section 17).

Table 19-5. Resistor Reference Designator

Circuit	Purpose	Location
Instrument cluster power supply	R1 (reduce voltage)	Part of TB8 terminal board mounted on structure beneath pilot's compartment floor, left side (Figure 19-6).
Voltage regulator/overvoltage relay sensing circuit	R2 (calibrate sensing circuit sensitivity for correct tripping of overvoltage relay when overvoltage condition occurs)	Same as R1 (mounted on TB 8, (Figure 19-6).
Ammeter	R3 (calibrate low voltage output for indicator deflection proportional to main output)	Engine compartment right side oleo support fitting (Figure 19-11).
TOT indicator	R4 (calibration)	Part of the resistor board TB9 on aft end of TOT indicator in instrument console.
Cigarette lighter	R9, R10, R11, R12 (reduce voltage)	Approximately the same as R1 and R2 (near TB8, Figure 19-6), or in the left side of panel type B mounting structure (Figure 19-10)
Instrument cluster lighting (current 3-pack only)	R112 (reduce voltage)	Mounted on back of instrument cluster in instrument panel.
Oil pressure gage circuit (current 4-pack only)	R303, R304, R305 (calibration)	Forward of instrument cluster on panel structure.

11. Voltage Reduction and Calibration Resistors

(Ref. Table 19-5) Resistors are installed in various circuits of the electrical system to reduce the nominal supply voltage from 24 volts to 12 volts (dropping resistor), and to adjust circuit voltage for proper circuit performance (calibration resistor). These resistors may be identified and located by the following:

A. Voltage Reduction and Calibration Resistor Replacement

(1). Check that all electrical power is OFF.

(2). Gain access to resistor location. Cut nylon straps if necessary to get wire slack, disconnect wiring and remove defective resistor.

NOTE: Terminal board TB8 should be removed from the structure when replacementof either resistor R1 or R2 is necessary.

(3). Use a pencil type soldering iron and tin alloy solder (48, Table 2-4) when installing replacement resistor.

(4). Restore wiring security where nylon straps have been cut; use nylon twine (30) if straps are not available.

(5). Check repaired circuit for correct operation.

12. Start Relay

(Ref. Figure 19-11) The start relay, mounted aft of the reverse current relay on the oleo support fitting at the right side of the engine compartment, is a single-pole, single-throw, normally open relay with enclosed contacts. The relay connects battery or external power to the starter when the START switch on the pilot's collective pitch stick is pressed. Refer to CSP-H-3, HMI Appendix A for information optional engine automatic reignition component used with the start relay.

A. Start Relay Replacement

(1). Check that all electrical power is OFF.

(2). Slide back insulating boots and disconnect cable terminal attaching hardware and wiring from relay. Separately insulate and tie back cable terminals to prevent an inadvertent short circuit.

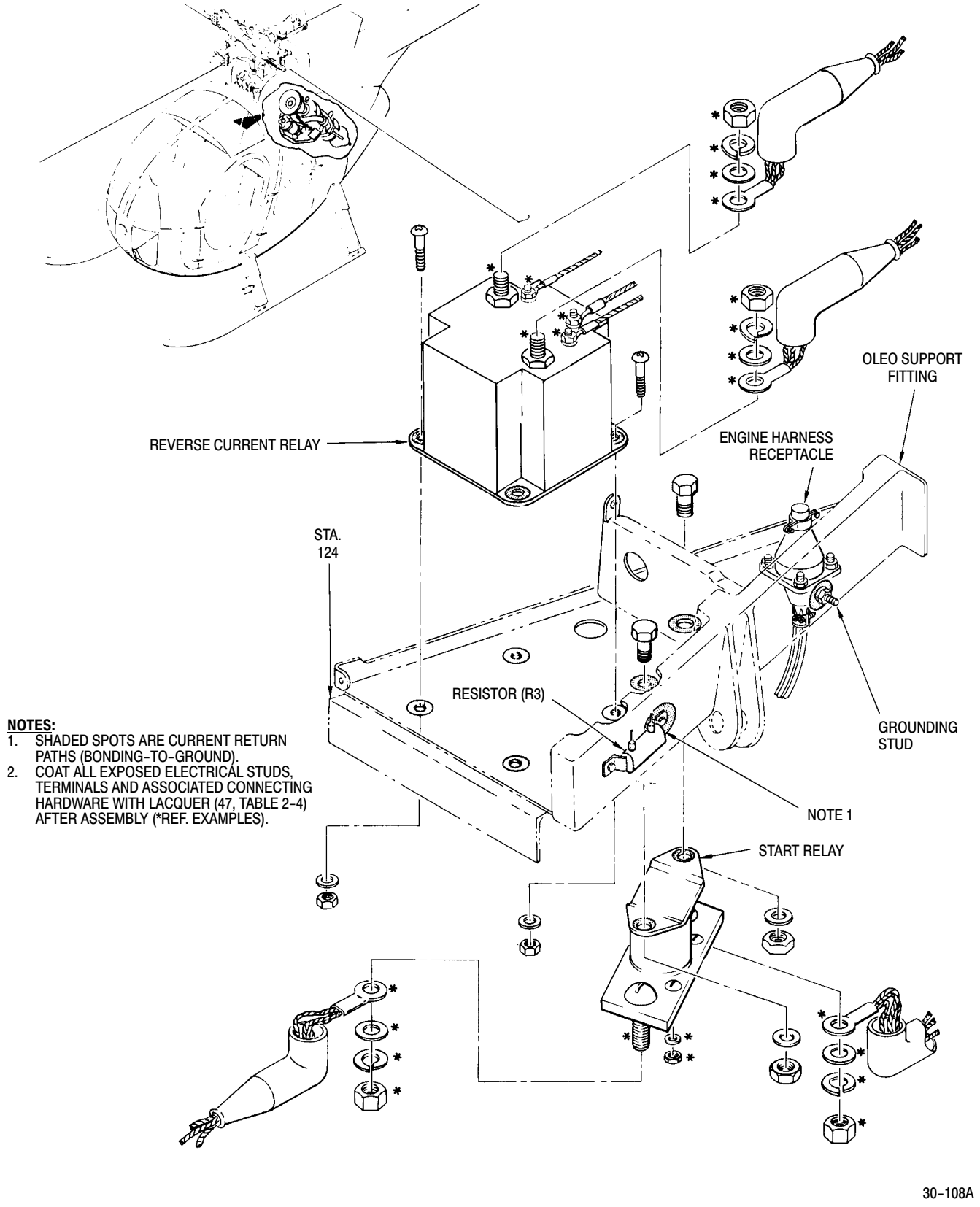


Figure 19-11. Replacement of Engine Compartment Relays

(3). Remove relay mounting hardware and remove start relay.

(4). Check bonding surfaces for good condition. Position replacement relay on mounting surface and secure with attaching hardware.

(5). Connect wiring to terminals with washers and nuts. Slide insulating boots over studs.

(6). Apply a coating of lacquer (47, Table 2-4) to all exposed electrical studs, terminals, and associated connecting hardware.

13. Reverse Current Relay

(Ref. Figure 19-11) The reverse current relay, mounted on the oleo support fitting at the right side of the engine compartment, serves to isolate the battery and the 28 Vdc bus from the generator. The relay will isolate the generator from the 28 Vdc bus (and battery) when the generator switch is off, an overvoltage condition exists, or when the battery voltage is greater than the generator voltage and current flows in the reverse direction.

A. Reverse Current Relay Replacement

(1). Check that all electrical power is OFF.

(2). Remove terminal nuts and washers, and disconnect electrical wiring from reverse current relay. Reinstall terminal nuts and washers.

(3). Insulate cable terminals to prevent inadvertent short circuit.

(4). Remove mounting hardware and reverse current relay.

(5). Check that case bond surfaces are clean on replacement reverse current relay and on mounting surface. Secure relay with screws, washers and nuts.

(6). Connect electrical wiring to terminal studs of reverse current relay. Secure with washers and nuts.

(7). Apply a coating of lacquer (47, Table 2-4) to all exposed electrical studs, terminals and associated connecting hardware.

14. Battery Relay

The battery relay, mounted aft of the battery at Sta. 64.37, is a single-pole, single-throw, normally open relay with enclosed contacts. The relay connects the battery to the main power bus when power selector switch is in battery position.

A. Battery Relay Replacement

(1). Ensure all electrical power is OFF.

(2). If installed, disconnect and remove battery.

(3). Disconnect wires and mark wires for reinstallation.

(4). Remove hardware (two screws, two nuts and two washers) from relay mount.

(5). Replace relay.

(6). Reinstall hardware and reconnect wires.

(7). Reinstall battery, if required.

B. Battery Relay Troubleshooting

(1). Connect battery. Insure instrument panel circuit breaker is in.

(2). Turn power selector switch to BATT position.

(3). Check instrument panel for lights.

15. APU Relay

The APU relay, mounted under the right fwd seat on the right hand bulkhead, is a single-pole, single-throw, normally open relay with enclosed contacts.

A. APU Relay Replacement

(1). Ensure all electrical power is OFF.

(2). Remove right hand passenger footwell.

(3). Disconnect wires and mark for reinstallation.

(4). Remove hardware (2 bolts, 2 nuts and 4 washers) from relay mount.

(5). Replace relay.

(6). Reinstall hardware and reconnect wires.

(7). Reinstall passenger footwell.

B. APU Relay Troubleshooting

(1). Connect auxiliary power source. Ensure instrument panel circuit breaker is in.

(2). Turn power selector switch to APU position.

(3). Check instrument panel for lights.

16. Collective Pitch Stick Switches

(Ref. Figure 19-12) The collective stick contains the START, N_2 GOV and LDG LT switches. Wires from the switches are routed through the center of the collective pitch stick and out through two exit holes just aft of the stick friction gear train. The wires from the collective pitch stick switches are connected to an electrical connector to facilitate removal of the complete stick assembly.

A. Collective Pitch Stick Switch Replacement

(1). Check that all electrical power is OFF.

(2). Cut twine or nylon strap securing wiring to collective pitch stick, and disconnect grounding terminals.

(3). Loosen two setscrews that secure grip switch housing to stick. Feed wire slack into stick while sliding switch housing from end of stick.

(4). Remove four screws and washers to detach switchplate.

(5). To replace either N_2 governor switch or landing light switch:

(a). Use a small knife to cut and remove potting compound from wires and terminals at the base of the switch. Avoid cutting wires and terminals. Unsolder wires and tag-identify to facilitate reconnection.

(b). Loosen knob setscrew and remove knob, panel nut, lockwasher, check nut and switch.

(c). Solder wires to replacement switch and remove tags.

(d). Clean solder terminals and wiring adjacent to terminals with MEK (22, Table 2-4).

(e). Brush or spray switch terminals and adjacent wiring with adhesive (122) to provide bond for potting compound.

(f). Form potting mold with electrical tape (123); Position mold around switch terminals and attach wires as shown; then fill mold with potting compound (124). Allow potting compound to cure for eight hours minimum.

(g). Place check washer on replacement switch and attach switch to switch plate with lockwasher and panel nut. Install knob on switch and secure in place by tightening setscrew.

(h). Attach switch plate to stick housing with four washers and screws.

(6). To replace START switch:

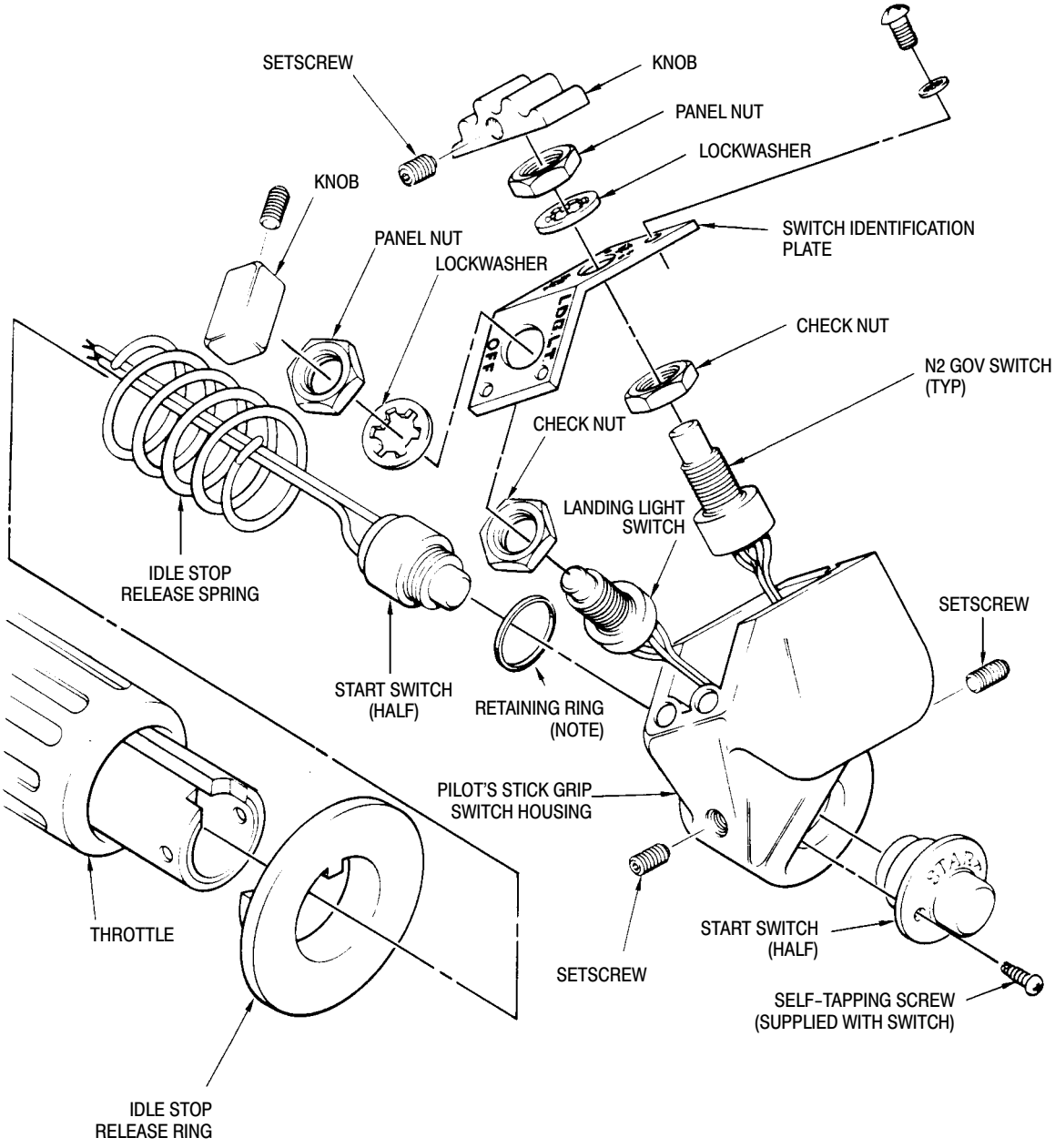
(a). Loosen self-tapping screw in front half of switch, unthread front half of switch from switch body, and remove switch from stick housing.

(b). Unsolder electrical wires attached to switch terminals and tag-identify to facilitate reconnection.

(c). Solder wires to replacement switch and remove tags.

(d). Position switch body in stick housing and secure to housing by threading front half of switch onto switch body. Tighten self-tapping screw to prevent loosening of front half of switch.

(7). Assemble grip switch housing, stop release spring and ring on collective pitch stick. Carefully draw slack wire from stick, then tighten two housing setscrews.



NOTE: NOT USED ON ALL COLLECTIVE PITCH STICKS.

30-109A

Figure 19-12. Replace of Collective Pitch Stick Switches

(8). If nylon strap is not available, secure wiring to collective pitch stick at a point approximately one inch from holes with twine (30).

(9). Connect electrical connector and attach grounding terminal.

(10). Check replacement switch for proper operation by performing the engine starting procedure in the Owner's Manual.

17. Battery Temperature Sensing Equipment

(Ref. Figure 19-13) Battery temperature sensing equipment provides a monitoring system with visual caution and warning light indicators that illuminate at battery over-temperatures.

The battery temperature sensing equipment consists of two temperature indicator light/switches and horn housing, interconnecting wiring and associated attaching and mounting hardware. The equipment provides an amber caution light indication when battery temperature reaches 140°F, and a red warning light indication at 160°F. Both indicator light/switches contain a built-in press-to-test switch for testing internal lamps.

The indicator light/switches are electrically interconnected to low and high temperature sensing switches installed on a buss bar of the ni-cad battery (Ref. Figure 19-14). The switches are part of and are furnished with the battery.

A rise in battery temperature to 140°F causes the low temperature switch to close and apply +dc voltage from the battery to illuminate the amber caution light. An increase of battery temperature to 160°F causes the red warning light to illuminate in the same manner.

When depressed, the press-to-test switch on each indicator applies +28 Vdc from the panel lights circuit breaker CB104 to the associated light indicator for testing internal lamp illumination.

The light/switches are mounted in a light/switch and horn housing installed on the hood of the instrument panel.

NOTE: At intervals specified in CSP-H-4, an operational check of the battery temperature sensing equipment is to be performed.

A. Battery Temperature Sensing Equipment Maintenance

NOTE: For view of light/switches and wiring inside light/switch and horn housing, refer to Section 17.

(1). As required, perform an operational check of battery temperature sensing equipment.

(2). For information on low and high temperature switch limits, Ref. Testing of Battery Temperature Sensing Switches

(3). Troubleshoot battery temperature sensing equipment according to information on troubleshooting caution and warning light indicators.

B. Battery Temperature Sensing Equipment Operational Check

NOTE: This operational check is required at intervals specified in CSP-H-4.

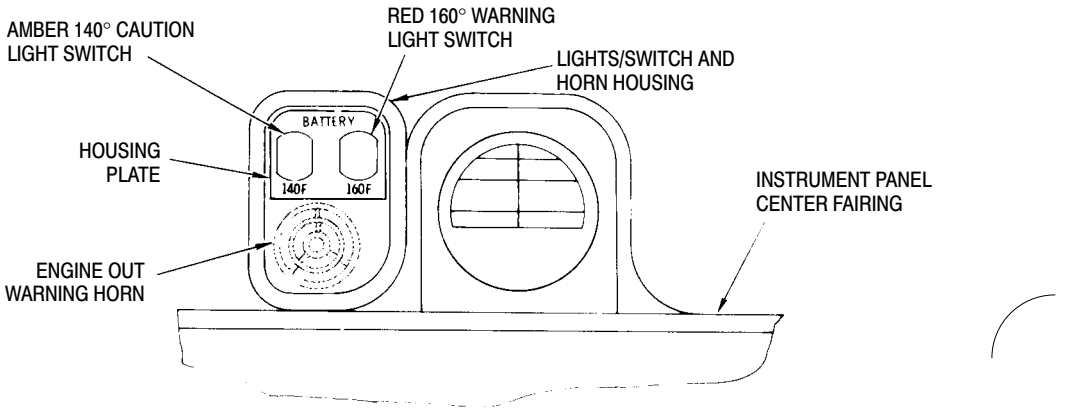
(1). Remove battery from helicopter.

(2). Check low and high temperatures sensing switches on battery bus bar for correct operation at specified temperatures.

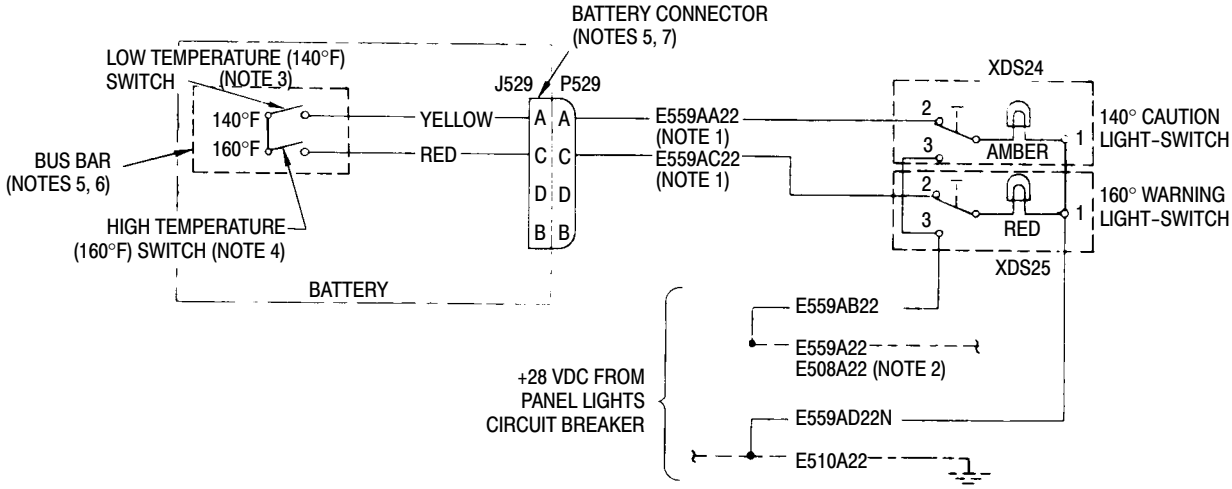
(3). Install battery in helicopter.

(4). Inspect electrical wiring for security, physical damage and continuity.

(5). With electrical power ON and PNL LT circuit breaker CB104 ON, alternately depress and check that both 140°F and 160°F light indicators illuminate. Replace any defective lamps.



LIGHT INDICATORS IN HOUSING



WIRING DIAGRAM (NOTE 4)

NOTES:

1. PART OF WIRING HARNESS: ROUTE WITH EXISTING WIRING.
2. APPLIES ONLY TO 500S WITH TYPE A INSTRUMENT PANEL (REF. SEC. 17) AND INCREASED GROSS WEIGHT CAPABILITY.
3. HIGH TEMPERATURE SWITCH IDENTIFIED BY RED MARK ON BUS BAR; LOW TEMPERATURE SWITCH BY YELLOW MARK.
4. THIS WIRING DIAGRAM SHOULD BE USED WITH APPLICABLE ELECTRICAL SYSTEM WIRING DIAGRAM IN SECTION 20 FOR COMPLETE CIRCUIT IDENTIFICATION.
5. PART OF BATTERY.
6. WHEN SWITCH CLOSES, +VDC IS APPLIED FROM BUS BAR FOR LIGHT.
7. ON LATER BATTERIES, YELLOW CONNECTS TO J108-D AND RED CONNECTS TO J108-B.

30-204A

Figure 19-13. Battery Temperature Sensing Equipment

18. Battery

(Ref. Figure 19-14) The battery is a rechargeable, nominal 24-volt, 13-ampere-hour, l9-cell, nickel cadmium battery capable of starting the engine in temperatures from -25 ° F (-32°C) to +130° F (+54°C).

Early batteries are connected to the electrical system by a two-pin keyed female connector receptacle located at the inboard end of the battery case; the connector is provided with a smaller key pin to prevent polarity reversal between the mating halves of the connector. Later batteries have a five-socket receptacle connecting the battery to the electrical system and temperature sensors to the battery temperature warning lights. The arrangement of pins in this receptacle prevents improper connection of the connector halves.

The 19 identical and individually replaceable battery cells are contained in separate molded nylon cases and interconnected by bus bars.

The cells are equipped with removable filler cap vent plugs that allow gasses from the cell to escape through the vent when the battery is in, or near, the up-right position. The filler cap vent plugs also prevent electrolyte spillage when the battery is tipped or inverted.

A mixture of potassium hydroxide and water is used as the electrolyte; however, only pure distilled water is used for replenishment purposes.

The battery case, cover and end plates are constructed from epoxy-impregnated fiberglass.

The battery is secured to brackets on the pilot's compartment floor structure by four screws and washers installed through the cover and battery case.

Gases generated within the battery are vented from the cells to the inside of the cover and out through the ventilation gap between each upper side edge of the case and cover. Refer to CSP-H-3, HMI Appx A for installation instructions of a battery compartment ventilation scoop.

A. Battery Maintenance

Handling, servicing precautions, servicing, charging and cleaning instructions for the battery are provided in Section 2.

B. Battery Replacement

(1). Check that all electrical power is OFF.

(2). Raise pilot's floor left access door. For better access, hand-press access door pivot pins from hinge points and remove door.

WARNING **If corrosion is present between the plug and receptacle, the plug will be difficult to remove. If excessive force is used to turn the plug on the hex nut-secured receptacle (Figure 19-14), it may rotate and cause the internal leads to short. When normally required hand-pressure will not release the plug, apply hydraulic oil or equivalent, to the threaded connection. Allow enough time for the corrosion deposits to soften so that plug can be removed.**

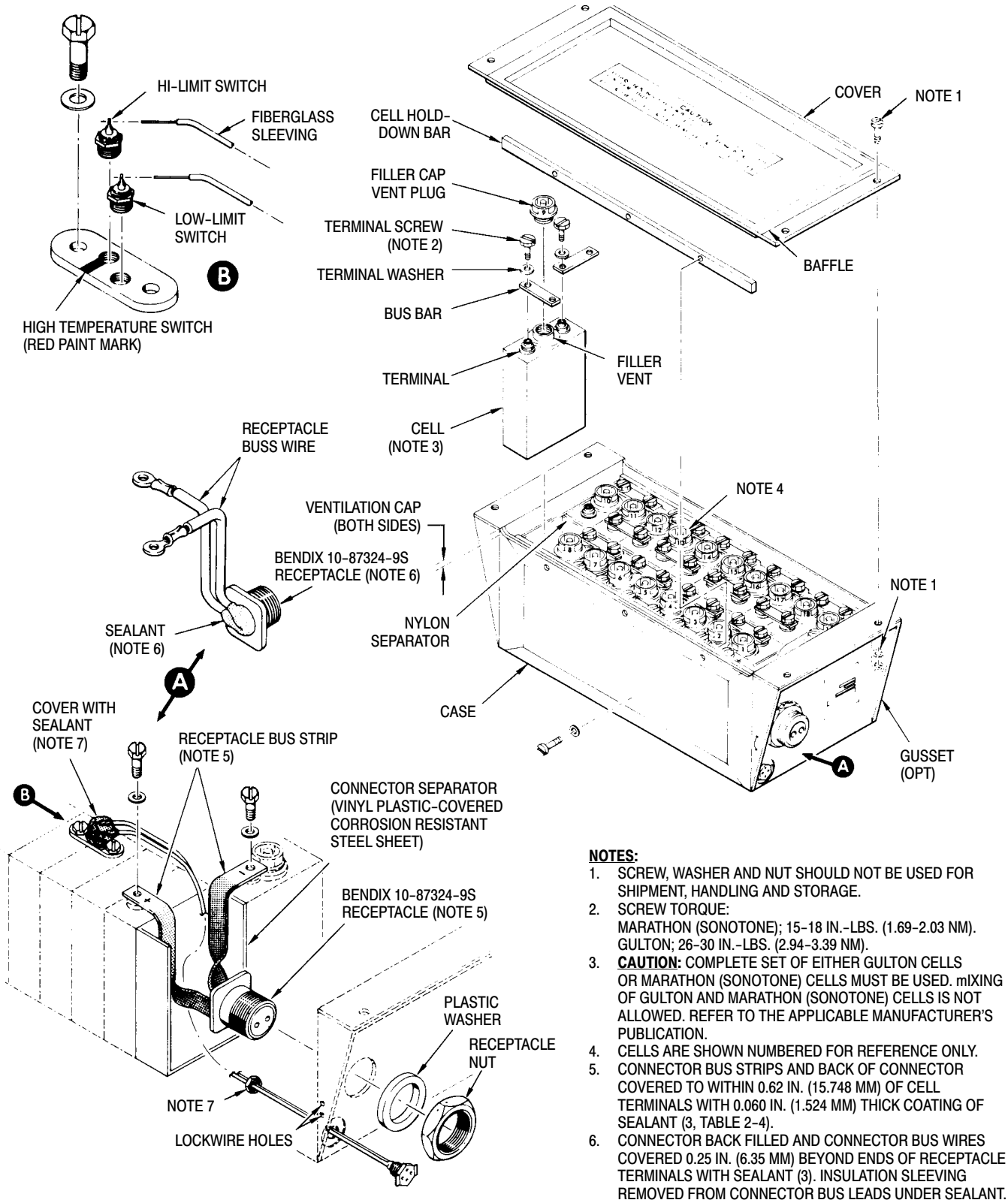
(3). Disconnect battery plug and temperature sensing connector, or single plug if single connector is used.

(4). Remove four screws and washers that secure battery to mounting flanges.

CAUTION Avoid tilting the connector end of the battery downward during the removal and handling after removal. Any water or electrolyte in the battery case will collect at the connector leads and shorting may occur.

(5). Lift battery and cover from the underfloor compartment. Using suitable hardware, secure the cover to the battery case, Place battery in a protected area away from any lead-acid type battery.

(6). Install serviced battery and secure battery and cover to mounting brackets with four mounting screws and washers.



NOTES:

1. SCREW, WASHER AND NUT SHOULD NOT BE USED FOR SHIPMENT, HANDLING AND STORAGE.
2. SCREW TORQUE:
   MARATHON (SONOTONE); 15-18 IN.-LBS. (1.69-2.03 NM).
   GULTON; 26-30 IN.-LBS. (2.94-3.39 NM).
3. **CAUTION:** COMPLETE SET OF EITHER GULTON CELLS OR MARATHON (SONOTONE) CELLS MUST BE USED. mIXING OF GULTON AND MARATHON (SONOTONE) CELLS IS NOT ALLOWED. REFER TO THE APPLICABLE MANUFACTURER'S PUBLICATION.
4. CELLS ARE SHOWN NUMBERED FOR REFERENCE ONLY.
5. CONNECTOR BUS STRIPS AND BACK OF CONNECTOR COVERED TO WITHIN 0.62 IN. (15.748 MM) OF CELL TERMINALS WITH 0.060 IN. (1.524 MM) THICK COATING OF SEALANT (3, TABLE 2-4).
6. CONNECTOR BACK FILLED AND CONNECTOR BUS WIRES COVERED 0.25 IN. (6.35 MM) BEYOND ENDS OF RECEPTACLE TERMINALS WITH SEALANT (3). INSULATION SLEEVING REMOVED FROM CONNECTOR BUS LEADS UNDER SEALANT.
7. COVER WITH SEALANT (3).

30-110E

Figure 19-14. Replacement of Battery Components

(7). Apply a generous coating of dielectric compound (185, Table 2-4) to the male and female connector pins and sockets and also the connector plug and receptacle threads. All surfaces should be coated, Connect battery plug and temperature sensing connector or single plug if used; then wipe away excess compound.

(8). Reinstall floor access door.

C. Battery Inspection

(1). Check that all electrical power is OFF.

(2). Remove screws and washers that secure battery to mounting brackets and remove cover.

WARNING **Review the general battery handling and servicing precautions outlined in Section 2 before performing the following operations.**

(3). Inspect tops of cells for dust, dirt, white powder (potassium carbonate) or spewed electrolyte. Refer to Section 2 for cleaning instructions.

(4). Inspect receptacle bus strips, bus bars and screws for security and evidence of damage.

(5). Inspect cells for cracks, evidence of overheating or other physical damage. Inspect cell bus bars for greenish color indicating acid contamination. Replace battery if any such damage is detected.

CAUTION Electrolyte level inspection should be accomplished only when the battery has been fully charged and then allowed to rest for a period of 1 to 2 hours after charging. If the helicopter has operated for a minimum of one hour or more of continuous flight, the battery may be considered charged.

(6). Reinstall cover and secure with four screws and washers.

D. Testing of Battery Temperature Sensing Switches

NOTE: This test is required at intervals specified in CSP-H-4, HMI Appendix B.

(1). Remove the battery from helicopter.

(2). Remove the bus bar equipped with sensors (sensors and connecting wires attached).

(3). Using a container, oil or water, thermometer and heat source, submerge sensor bus bar and check at battery sensor connector plug, or single connector receptacle pins A and C, for proper heat range.

(a). Low temperature switch -
Closes on temperature rise at 140° ±8°F.
Opens on temperature decrease at 100° ±8°F.

(b). High temperature switch -
Closes on temperature rise at 160° ±8°F.
Opens on temperature decrease at -130° ±8°F.

(4). Clean the bus bar with MEK (22, Table 2-4) and reinstall.

NOTE: The sensors may be removed from the bus bar for testing or replacement by removing the sealant and un-soldering wire connections.

(5). Reinstall battery in helicopter.

(6). Inspect electrical wiring for security, physical damage and continuity.

(7). Perform a power ON operational check of battery temperature sensing equipment.

E. Repair of Battery

NOTE: Complete disassembly and reassembly of battery is covered in the following procedures. Follow the procedures, in sequence, until the part or parts requiring repair or replacement have been removed and reinstalled. Refer to battery manufacturer's maintenance instructions (Ref. Table 2-15) for repairs not covered in the procedures

WARNING **Discharge the battery before attempting disassembly. If the battery bas not been discharged, serious personal burns may result and damage to the battery may occur. Refer to Deep Cycling of Battery, Section 2.**

(1). Removing Bus Bars.

(a). Remove the terminal screw and washer from each end of the bus bar.

NOTE: Refer to Figure 19-14 and note the location of the bus bar with temperature sensing switches. If required, remove sealant, unsolder wire connections and remove switches, according to step (7).

(b). Lift the bus bar from the cell.

(c). Clean bus bar with methyl-ethyl-ketone (22, Table 2-4).

(2). Removing Cells.

NOTE: Each cell is removed from the battery case with a cell puller. Two battery bus bars and a piece of cord may be used to fabricate a puller. Attach the cord to the hole at one end of each bus bar. Initial removal of either cell No. 5 or No. 6 will aid in the removal of other cells.

(a). Remove screws and washers that secure hold-down bars to battery case.

(b). Remove the battery bus bars and/or bus wires or strips from the cells.

(c). Remove nylon separator when required to permit removal of cells.

(d). Attach the cell puller to the cell terminals; use the terminal screws and washers to secure the puller to the cell.

(e). Lift the cell from the battery case. If necessary, slightly rock the cell from side to side to work it loose.

NOTE: Observe the polarity of the removed cell to prevent reinserting the cell in reverse polarity.

(3). Removing Receptacle

(a). Loosen and remove the two terminal screws and washers that secure the two receptacle bus wires or strips to adjacent cells.

(b). Remove the bus bar that connects cells No. 1 and No. 2.

(c). Remove the cell hold-down bar from the same side of the battery as the connector separator.

(d). Remove the nylon separator and cell No. 1.

(e). For batteries with a dual connector, cut and remove the lockwire from the receptacle nut. Remove the receptacle with attached receptacle bus wires or strips from the case.

(f). For batteries with a single connector, remove the four nuts, washers, and screws that secure the receptacle to the battery case and pull the receptacle forward to gain access to attached wires.

(g). Remove sealant, if used, and unsolder wires attached to the receptacle terminals.

(4). Replacing Battery Case

(a). Disassemble the battery, steps (1). thru (3).

(b). Using a stiff nylon brush and a 3-percent boric acid solution, wash the replacement battery case; then flush with clean water (cold if possible) to ensure that the case is clean. Dry the case with a clean cloth, and then air-dry in a warm area for at least 1 hour.

(c). Reassemble battery components into the new case, steps (5). and (6).

(d). Deep cycle the battery (Section 2).

(5). Installing Receptacle

CAUTION Observe correct polarity when connecting the receptacle bus wires or strips to the receptacle. Reversed connections can damage the battery when it is connected to the helicopter electrical system.

(a). Using a tin-alloy solder (48), solder the two receptacle bus wires or strips and the two temperature sensor wires (single connector) to the terminals at the back of the receptacle.

(b). For dual connector batteries, insert the receptacle into the battery case and securely tighten the receptacle nut. Using lockwire (2), safety the nut to the holes in the case.

(c). For single connector batteries, secure the receptacle to the battery case with four screws, washers and nuts.

(d). For dual connector batteries, fill receptacle back and cover bus wires or strips with sealant (3). For receptacle with bus wires, the receptacle back and wires are covered 0.250 inch (6.35 mm) beyond rear of receptacle terminals. Insulation sleeving must be removed from wires under sealant. For receptacle with bus strips, receptacle back and strips are covered to within 0.62 inch (15.748 mm) of cell terminals with 0.060 inch (15.24 mm) thick sealant coating.

(e). Position the connector separator inside the battery case so that open end butts against end of case, enclosing the two receptacle bus wires or strips and the receptacle.

(f). Install the nylon separator and removed cells, step (6).

(6). Installing Cells

CAUTION Do not intermix Gulton and Marathon (Sonotone) cells. Refer to the applicable manufacturer 's publication.

(a). Obtain a new or serviceable cell to replace a defective cell.

(b). Check that the cell is clean and position it in the battery case for correct polarity orientation.

NOTE: When replacing a complete set of cells, install cells in order, No. 1 thru No. 9, the nylon separator, No. 19. and then No. 10 thru No. 18.

(c). Connect the bus bars and/or bus wires or strips with terminal screws and washers; the cup side of the washer must be down. Torque screws to **15 - 18 inch-pounds (1.69 - 2.03 Nm)** for Marathon/ Sonotone or **26 - 30 inch-pounds (2.94 - 3.39 Nm)** for Gulton.

(d). Install the hold-down bars on the case.

(e). Spray a thin film of WD-40 (101) over entire top surface of battery and inside connector receptacle or coat all exposed metal parts with petrolatum (34).

(f). Deep cycle the battery (Section 2), before returning the battery to service.

(7). Replacement of Temperature Sensing Switches

(a). Remove sealant covering switches and unsolder wire connections, remove switch.

(b). Install correct replacement switch in location shown in Figure 19-14 and torque to **5 - 15 inch-pounds (0.56 - 1.69 Nm)**.

(c). Install fiberglass sleeving and solder wire connections; red wire to high temperature switch and yellow to low temperature switch.

(d). Cover the switch connections with sealant (3).

(e). Check that high temperature switch is identified by a red paint mark on the bus bar and renew, if required.

19. Starter/Generator

(Ref. Figure 19-15) A combined starter and generator is used to start the engine and to provide primary 28-volt, direct-current power for operation of the electrical system.

The starter/generator, a self-cooled unit, is clamp-attached to a quick-disconnect mounting flange on the engine power and accessory gearbox.

A shear point is incorporated in the generator drive shaft to protect the engine drive from excessive torque loads.

The starter system consists of the starter/generator, start relay, voltage regulator and a START switch located in the pilot's collective pitch stick.

When pressed, the START switch energizes the solenoid of the start relay and supplies power from the power selector switch bus through the BAT terminal of the reverse current relay and start relay to the start

winding (terminal board stud C) of the starter/generator. During the time the START switch is depressed, the voltage regulator generator field circuit is open, so the starter operates as a series motor.

The generator system consists of the starter/generator, reverse current relay, voltage regulator, an overvoltage relay, GENERATOR OUT light and the ammeter.

Generator operation is controlled by the GEN-OFF switch.

At flight idle rpm and above, the voltage regulator automatically maintains the correct generator output voltage by varying the generator field current.

The generator field circuit is protected by a 15 ampere circuit breaker on the instrument panel.

When an overvoltage condition occurs, an overvoltage relay is energized by the voltage regulator. The overvoltage relay opens the switch circuit of the reverse current relay to remove generator output from the bus.

The reverse current relay prevents the battery from discharging through the generator when the output voltage falls below battery voltage.

Electrical systems operate from the battery when the generator is OFF and the power selector switch is at BATTERY.

A terminal block on the starter/generator provides for connection of electrical wiring and houses a radio frequency-interference filter.

Access to the brushes in the starter/generator is provided by a brush cover that is rotatable in increments of 90 degrees.

When performing as a generator, the starter/generator has a maximum continuous duty rating of 30 volts, 150 amperes, over a range of 7200-13,000 rpm.

NOTE: A similar and alternate starter/generator (Bendix 30B69-15-A) may be installed to replace the standard starter/generator (Lear Siegler (LSI) 23032- 020). Following paragraphs provide maintenance information for the standard starter/generator. Starter limitations for engine compressor cleaning are given in Section 2.

A. Starter/Generator Removal

(1). Check that all electrical power is OFF.

(2). Disconnect electrical wiring from starter/generator terminal block; insulate wiring terminals. Reinstall nuts and washers on studs.

(3). Loosen mounting clamp that secures starter/generator to mounting flange and remove starter/generator.

(4). Remove four nuts and washers; then remove mounting flange with gasket.

(5). Install a suitable protective closure over opening in mounting flange.

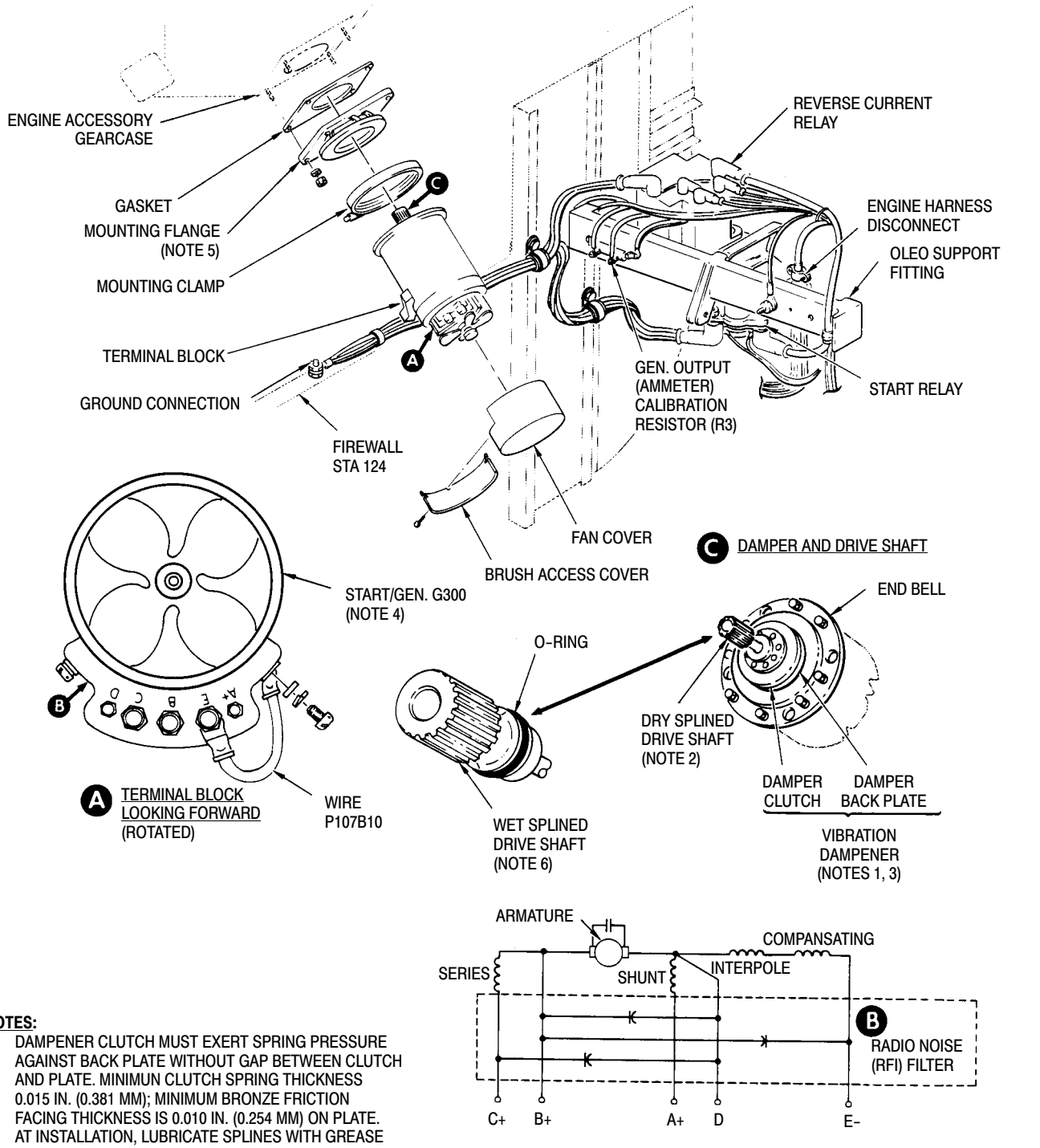
B. Starter/Generator Inspection

(1). Preliminary Procedure

(a). Remove lubricant from splines of drive shaft. Clean vibration dampener.

(b). Remove brush cover and fan cover.

(c). Use clean, dry, compressed air to blow out brush dust.



NOTES:

1. DAMPENER CLUTCH MUST EXERT SPRING PRESSURE AGAINST BACK PLATE WITHOUT GAP BETWEEN CLUTCH AND PLATE. MINIMUN CLUTCH SPRING THICKNESS 0.015 IN. (0.381 MM); MINIMUM BRONZE FRICTION FACING THICKNESS IS 0.010 IN. (0.254 MM) ON PLATE.
2. AT INSTALLATION, LUBRICATE SPLINES WITH GREASE 21, TABLE 2-4).
3. LSI MODEL 23032-20 ONLY.
4. LSI MODEL 23032-20 IS SHOWN ON THIS ILLUSTRATION; BENDIX 30869-15-A IS SIMILAR.
5. PROPER MOUNTING FLANGE MUST BE UTILIZED TO INSURE PROPER SPLINE DEPTH.
6. WET SPLINE STARTER GENERATOR. FOR CONVERSION FROM DRY SPLINE TO WET SPLINE STARTER-GENERATOR, REFER TO MDHI LETTER HL-72.

30-111F

Figure 19-15. starter/generator Replacement and Repair

(2). Exterior Inspection

CAUTION Replacement of a dampener clutch or back plate is required if it does not meet following requirements.

(a). Check that dampener clutch exerts pressure against dampener back-plate. Weak spring on clutch or gap between these parts is not allowed.

(b). Inspect dampener clutch for cracks, warpage, loose rivets and excessive wear on spring surface that mates with dampener back plate. Minimum spring thickness is 0.015 inch (0.381 mm).

(c). Inspect dampener back plate for cracks and bronze friction facing for wear. Minimum facing thickness is 0.010 inch (0.254 mm).

(d). Check splines on drive shaft for wear.

(e). Check fan for looseness on hub and for cracked or bent condition.

(f). Inspect terminal block for cracks, breaks, loose or damaged terminal studs, and loose electrical connections.

(g). Inspect starter/generator housing for any signs of damage, and inlet and outlet blower screens for clogging.

(h). Inspect mounting clamp and mounting flange for condition, and mounting flange attaching hardware for security.

(3). Interior Inspection

(a). Inspect commutator for pitting, scoring or burned areas.

(b). Check brushes for cracks, chips, frayed leads and loose shunt connections. Replace brushes if remaining allowable wear (Ref. Figure 19-16) might be exceeded before next scheduled inspection.

(c). Check brush holder and end bell for cracks and warpage.

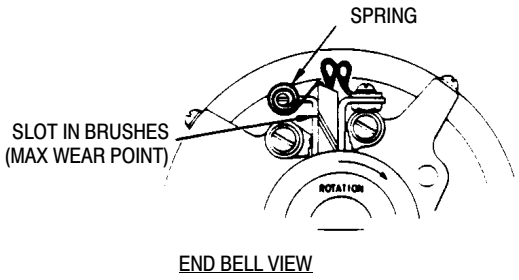


Figure 19-16. Starter/Generator Bushing Wear Limits

C. Starter/Generator Repair

NOTE: Complete overhaul instructions with parts breakdown for the starter/generator is available from the Power Equipment Division of Lear Siegler, Inc. (Ref. Table 2-15). Instructions for maintenance of generator brushes and for testing of a removed starter/generator are the only repair information provided in this paragraph.

(1). Removing Brushes

(a). Remove the four screws that secure the fan cover and brush access cover to the generator end bell; remove fan cover.

(b). Remove the screw from the lead terminal of each brush set and lift out the brush sets.

(2). Checking Brush Spring Tension

(a). Remove brushes from starter/generator.

(b). Cut a groove down the center of both edges and across the bottom of a new brush. When prepared in this manner, the brush will have a continuous groove around three sides.

(c). Place a fine wire around the brush in the groove; then insert the brush in one of the brush holders. Tie the two ends of the wire together to form a loop and attach a fish-type spring scale that is graduated in ounces.

(d). Raise the brush by the scale until the lower end of the brush is even with the bottom edge of the brush holder. When in this position, the brush spring tension should be between 32 and 48 ounces. Take an average of several readings. If the spring tension is out of this range, replace the spring.

(e). Raise the brush by the scale until the lower end of the brush is even with the bottom edge of the brush holder.

(3). Replacing Brushes and Preliminary Seating

NOTE: New brushes must be properly seated on the commutator surface. Although the brushes are of the instant- filming type, they should be sanded and run-in for proper seating before full load is applied to the starter/generator. Failure to properly seat the brushes can result in excessive sparking that will cause burning and pitting of the commutator.

(a). Place a strip of grade 5/0 or finer sandpaper (9, Table 2-4), slightly wider than the combined width of the two brush halves, around the commutator with the sand side out. Cut the sandpaper strip to 0.125 inch (3.175 mm) less than the commutator circumference. Secure one end of the sandpaper strip to the commutator surface with masking tape so that the taped end will lead in the direction of rotation, and the other end will remain loose.

(b). Install the brushes in place against the sandpaper and set the brush springs in position. Carefully rotate the armature by hand in the normal direction of rotation (Ref. Figure 19-16) until a full seat is obtained on each brush. Do not sand excessively.

(c). Lift the brushes, and remove the sandpaper. Remove all carbon dust with dry, compressed air, connect the brush wire terminals, and proceed with the brush run-in operation.

(4). Running-in Brushes and Testing starter/generator

(a). Connect starter/generator and test equipment as shown in Figure 19-17. Mount starter/generator securely in suitable vee blocks.

CAUTION Be sure switch Sl is OFF. Do not exceed 14- 16 volts direct- current input; starter/generator may be damaged.

(b). Start variable direct-current generator and adjust output to 14-16 volts.

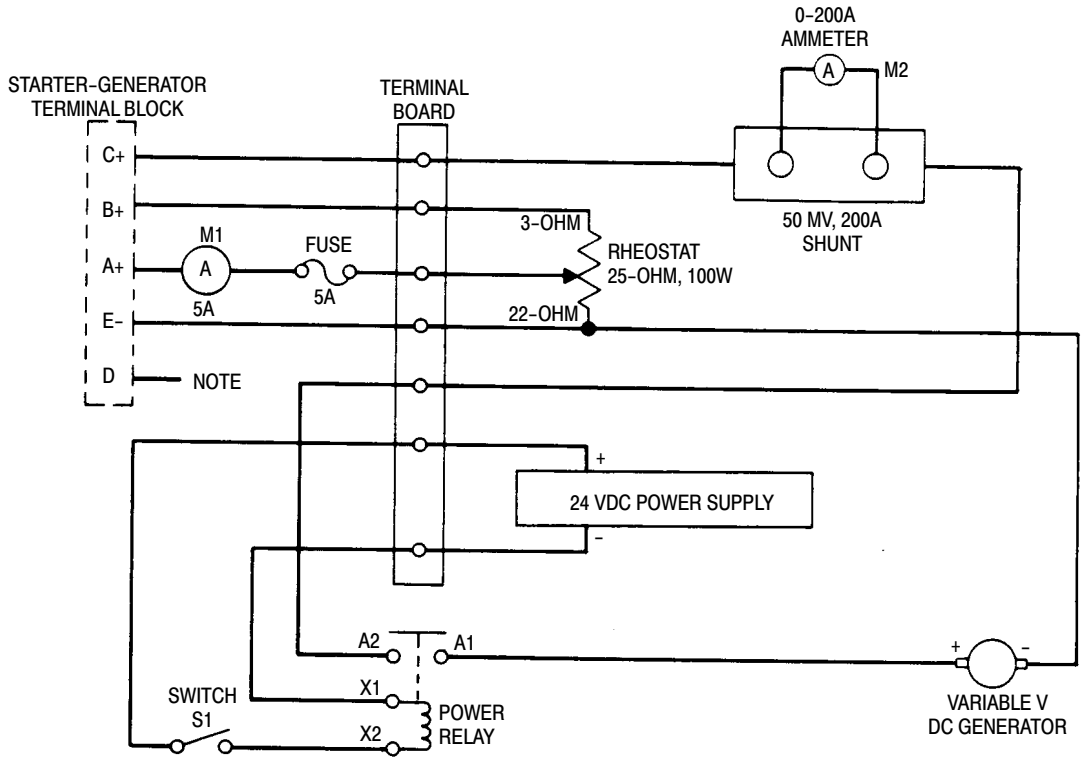
(c). Connect 24 Vdc power supply.

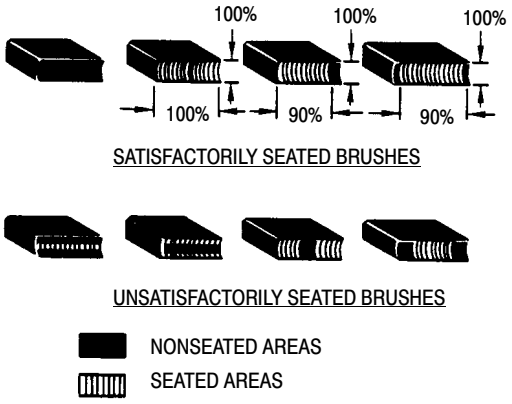
(d). Adjust the 25-ohm potentiometer to 3 ohms using the multimeter; then connect potentiometer into test circuit.

(e). Turn switch S1 momentarily **ON**, and then **OFF**. Observe direction of the starter/generator shaft rotation. Rotation should be CCW when viewing drive end of generator.

(f). Turn switch S1 ON. Note that drive shaft rotates freely and that generator output is indicated on meter M1. Adjust 25-ohm potentiometer until meter M1 indicates approximately 1 ampere. Meter M2 should indicate 25-35 amperes at this time. Continue operation of starter/generator while observing the sparking (commutation) at the brushes. As brushes wear in, the sparking should decrease to pinpoints.

(g). Turn off all electrical power and inspect the brushes for proper seating. Brush faces should show evidence of seating of 90 percent in axial direction and 100 percent of the axial contact should show evidence of contact in the direction of rotation. Blow out all brush dust with clean dry compressed air.





ITEM NO.	EQUIPMENT DESCRIPTION
1	VARIABLE VOLTAGE DC GENERATOR, 15AMPERE CAPACITY.
2	0-5A DC, AMMETER (M1) (WESTON MODEL 931 OR EQUIVALENT).
3	50 MV, 200-AMPERE SHUNT (WESTON OR EQUIVALENT).
4	0-200A DC AMMETER (M2), 50-MV FULL SCALE (GENERAL ELECTRIC TYPE DB13 OR EQUIVALENT).
5	POWER RELAY, 28 VDC, 200-AMPERE CONTACTS, SINGLE-POLE, SINGLE-THROW (AN3371-2 OR EQUIVALENT).
6	SWITCH (S1), SPST, 10 AMPERES AT 28 VDC.
7	RHEOSTAT, 25-OHM, 1000-WATT (OHMITE MODEL U OR EQUIVALENT).
8	POWER SUPPLY, 10-36 VDC (N.J.E. MODEL 36-20 OR EQUIVALENT).
9	MULTIMETER (SIMPSON MODEL 260 OR EQUIVALENT).

NOTE: HELICOPTER AMMETER INDICATOR CIRCUIT TERMINAL.

30-113A

Figure 19-17. Test Hookup for Starter/Generator and Brush Run-in

(h). Reconnect electrical power and repeat step (f). If additional brush run-in is required, continue operation at 1 ampere indication on meter M1; if not, proceed to step (i).

(i). Adjust the 25-ohm potentiometer until meter M1 indicates 4 amperes. Meter M2 should indicate 25-35 amperes.

(j). Turn all power OFF and disconnect starter/generator. Remove from vee blocks and reinstall brush cover.

D. Starter/Generator Installation

(1). Ensure that all electrical power is OFF.

(2). Remove protective cover from opening in engine.

(3). Install mounting flange with four nuts and washers. Torque nuts to **100 - 140 inch-pounds (11.30 - 15.82 Nm)**.

(4). Using a bottle brush and solvent (1, Table 2-4), clean the starter shaft and mating engine splines.

CAUTION Before installation, check condition of seal in accessory drive gearbox. For wet- splined starter/generators, also ensure integrity of packing on starter/generator drive shaft.

(5). Lubricate splines on drive shaft of starter/generator with grease (21).

(6). Install starter/generator.

CAUTION Always support the weight of the starter/generator during removal/installation. Damage can occur if weight is supported by the shear shaft.

(a). Align starter/generator with terminal block down.

(b). Insert shaft end of starter/generator into opening in mounting flange and hold starter/generator tightly against flange.

(c). Install starter/generator V-clamp. Torque clamp nut to **50 inch-pounds (5.65 Nm)**.

(d). Tap around clamp with a rawhide mallet to seat clamp on flange. Retorque clamp nut to **50 inch-pounds (5.65 Nm)**.

(e). Continue tapping around clamp and retorquing clamp nut until nut no longer turns when specified torque is applied.

(7). Install electrical leads, washers and nuts. Tighten nuts and remove identifying tags.

20. Night Lighting System - Instrument Panel Type B

On helicopters with instrument panel type B, the night lighting system is standard equipment as part of the electrical system. The night lighting system is as described in CSP-H-3, except as follows. Upper and lower anti-collision lights are strobe type and instrument panel lights for instruments and indicators are bolt type lights built into the hood. Wiring provision are incorporated for installation of optional incandescent anti-collision lights in place of strobe lights, if desired. Interconnection wiring for the night lighting system, except for instrument panel lights, is shown in the applicable electrical wiring diagram in Section 20. Wiring and other information for the panel lights for instrument and indicators on the hood is contained in CSP-H-3. Dimming circuit information for panel and instrument lights is provided in Section 17. Otherwise, refer to CSP-H-3 for all other information on the night lighting system.

Section

20

Wiring and Schematic Diagrams

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TABLE OF CONTENTS

Para/Figure/Table	Title	Page
Section 20 Wiring and Schematic Diagrams		**20-1**
1.	Wiring and Schematic Diagram	20–1
A.	Wire Identification	20–1
B.	Symbols	20–1
Figure 20–1.	Electrical Symbols	20–2
C.	Diagrams	20–3
D.	Reference Designator List	20–3
Table 20–1.	Reference Designator List	20–3
Figure 20–2.	Fuselage Wiring Diagram (369HS; 0001 – 0100) (369HM; 001 – 100) (Sheet 1 of 6)	20–16
Figure 20–3.	Console Wiring Diagram, Instrument Panel Type A (369HS; 0001 – 0100) (369HM; 001 – 100) (Sheet 1 of 4)	20–22
Figure 20–4.	Fuselage Wiring Diagram (369HS; 0101 – 0200) (369HM; 101 – 200) (Sheet 1 of 7)	20–26
Figure 20–5.	Console Wiring Diagram, Instrument Panel Type A (369HS; 0101 – 0200) (369HM; 101 – 200) (Sheet 1 of 4)	20–33
Figure 20–6.	Fuselage Wiring Diagram (369HS; 0201 – 0410) (369HE; 101 – 215) (369HM; 201 – 247) (Sheet 1 of 7)	20–37
Figure 20–7.	Console Wiring Diagram, Instrument Panel Type A (369HS; 0201 – 0410) (369HE; 101 – 215) (369HM; 201 – 247) (Sheet 1 of 4)	20–44
Figure 20–8.	Fuselage Wiring Diagram (369HS; 0411 – 0625) (Sheet 1 of 7)	20–48
Figure 20–9.	Console Wiring Diagram, Instrument Panel Type B (369HS; 0411 – 0625) (Sheet 1 of 6)	20–55
Figure 20–10.	Fuselage Wiring Diagram (369HS; 0626 & Subs) (Sheet 1 of 6)	20–61
Figure 20–11.	Console Wiring Diagram, Instrument Panel Type B (369HS; 0626 & Subs) (Sheet 1 of 6)	20–67
Figure 20–12.	Fuselage Wiring Diagram (369HM; 248 & Subs) (Sheet 1 of 6)	20–73
Figure 20–13.	Console Wiring Diagram, Instrument Panel Type T, with Center Console (369HM; 248 & Subs) (Sheet 1 of 7)	20–79
Figure 20–14.	Typical Electrical System Schematic, Instrument Panel Type A (Sheet 1 of 6)	20–86
Figure 20–15.	Typical Electrical System Schematic, Instrument Panel Type B (Sheet 1 of 5)	20–92
Figure 20–16.	Typical Electrical System Schematic, Instrument Panel Type T (Sheet 1 of 6)	20–97

TABLE OF CONTENTS (Cont.)

Para/Figure/Table	Title	Page

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SECTION 20
WIRING AND SCHEMATIC DIAGRAMS

1. Wiring and Schematic Diagram

Wiring and schematic diagrams for the electrical system of the helicopter are provided in this section. Wire identification and symbol information for the diagrams are also included.

A. Wire Identification

Wiring in the helicopter is identified by code of numbers and letters at intervals throughout the wire length. The wiring indemnification code is as follows:

(1). The initial number (is used) designates unit number.

(2). The initial letter (or letters) designates the circuit.

(3). The next number (or numbers) is the wire number that separates one section or leg of the circuit from all others.

(4). The following letter indicates segment of wire in a wire number where the wire passes through or branches at a connector or terminal block.

(5). The number (or numbers) following the segment designation is the standard AWG wire size.

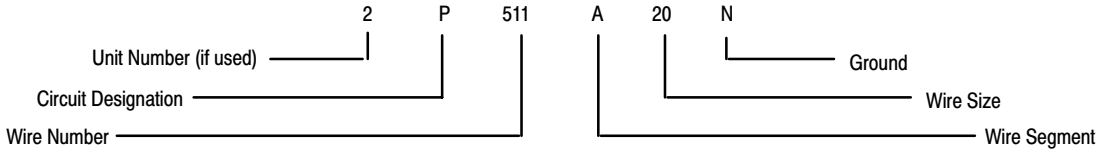
(6). If the wire is a ground portion of a circuit, the suffix N is added to indicate a ground return.

(7). Where a wire code is duplicated, the unit number 1 or 2 is prefixed to differentiate between the two circuits.

B. Symbols

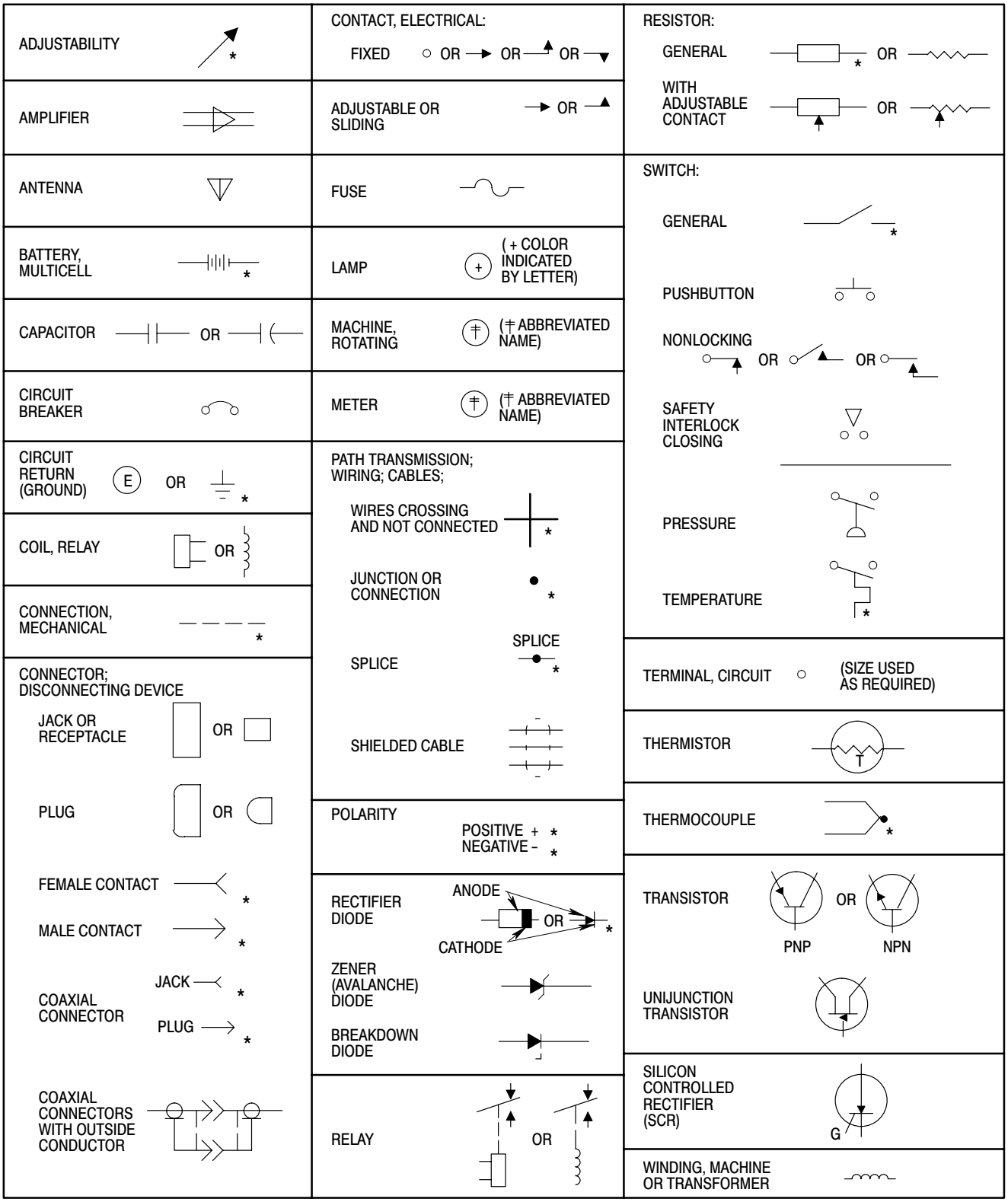
The graphic electrical symbols in the schematic, and in the wiring diagrams where symbols are used for clarity, are shown in Figure 20-1.

EXAMPLE: WIRE NUMBER 2P511A20N



Circuit Designation	Circuit Function
A	Armament Control
C	Flight Control
D	Ammeter and Miscellaneous
E	Engine Instruments
F	Flight Instruments
H	Heating and Associated
J	Engine Reignition
K	Starting
L	Lighting
M	Utility
P	Dc Power Distribution
Q	Fuel and Oil
R V	*Vhf Radio and Intercom
X	Ac Power Distribution

NOTE: Function indicated with an asterisk (*) pertains to avionics equipment. Other miscellaneous circuit designators are used for specific circuits of special equipment configurations and optional avionics and navigation equipment.



NOTE: ASTERISK (*) INDICATES SYMBOL RECOMMENDED BY INTERNATIONAL ELECTROTECHNICAL COMMISSION.

30-130

Figure 20-1. Electrical Symbols

C. Diagrams

The electrical system wiring diagrams, Figure 20-2 thru Figure 20-**1**, provide wiring information for the basic electrical system.

Wiring diagram application versus helicopter model serial number is shown in the title of each diagram and is listed below.

The wiring diagram show complete point-to-point wiring interconnections between all basic electrical system components.

The electrical system schematic diagrams, Figure 20-14 thru Figure 20-16, schematically show typical electrical system for helicopters with instrument panel types A, B and normal version 500M helicopter with instrument panel type T.

Electrical system diagrams for special versions of the 500M are provided in Section 20 of the appropriate part of the 500M HMI Supplement.

Electrical diagrams for optional equipment are furnished in the applicable equipment group of HMI Appendix A.

D. Reference Designator List

Table 20-1 contains a list of electrical equipment items used in the helicopter and shown in the wiring diagrams.

Table 20-1. Reference Designator List

Identification	Reference	End Use
AR500	369H4525	Audio Amplifier
B101	369A7171-9	Long. Trim Motor
B102	368A7170-7	Lat. Trim Motor
B103	368A7002	N_2 Governor Motor
B250	369A8143	Start Pump Motor
B300	369H4533	Deicer Actuator Motor
B600	369H2488	Heater Actuator Motor
BT101	369A4530	Battery
	368H4540	Battery
CB101	2TC12-5	Instrument
CB102	2TC12-5	Cyclic Trim
CB103	2TC12-5	N_2 Governor
CB104	2TC12-5	Warning and Panel Light
CB105	2TC12-15	Gyros
CB106	2TC12-5	Engine Out
CB107	MS26574-2	ADF
CB108	2TC12-7-1/2	NAV/COM
CB109	2TC12-15	Cigar Lighter
CB110	2TC12-15	Landing / Hover Light
CB112	2TC12-15	Generator Field
CB115	MS24509-15	Anti-collision Light
CB117	MS24509-7	Utility Power
CB118	MS24509-7	Start Pump
CB119	MS24509-7	Position Light
CB120	MS24509-7	Pitot Heat

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
CB121	2TC12-5	Emergency Floats
CB122	2TC12-15	Single Sideband
CB124	MS24509-7-1/2	Engine Re-Ignition
CB126	MS26574-1	Transponder
CB127	MS25244-35	Searchlight
CB128	2TC12-5	Searchlight
CB600	MS25244-50	Hoist
CB601	2TC12-7-1/2	Hoist
CB603	2TC12-15	Cargo Hook
DS10	369A4540/369A4540-3/369A4514-3	Engine Power Out Warning Unit
DS11	2245-1 (Autronics) /369H6425	Dimmer Control
DS100	MS25241-4581	Landing Light Lamp
DS105	SC628 (Mallory)	Engine Power Out warning Horn
DS200	30-0777-5	Strobe Light-Lower
DS201	30-0777-7	Strobe Light-Upper
DS201	1309 GE	Map Light-Pilot's
DS202	1495 GE	Map Light
DS250	369A4589-3 / A7512-4	Left Position Light Lamp
DS251	369A4589-5 / A7512-24	Right Position Light Lamp
DS400	1683 (G.E.) 369A4588	Rear Position Light
DS401	4580 (G.E.)	Searchlight Left
DS402	4580 (G.E.)	Searchlight Right
E1	Under Floor, Center Web	Ground Stud
E2	Console, Left Side	Ground Stud
E3	Console, Left Side	Ground Stud
E4	Under Floor, Right Side	Ground Stud
E5	Under Seat, Left Side	Ground Stud
E6	Under Seat, Left Side	Ground Stud
E7	Under Seat, Right Side	Ground Stud
E8	Under Floor, Right Side	Ground Stud
E9	Canted Bulkhead, Left Side	Ground Stud
E10	Engine Compartment	
E12	Engine Compartment, Right Side	
E13	Engine Compartment, Left Side	
E14	Canted Bulkhead, Right Side	Aft Cigar Lighter
E15	Canted Bulkhead, Right Side	
E19	Pilot's Map Light, Right Side	

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
E20	Under Seat, Left Side	
E24	Under Pilot's Floor	Heated pitot Tube
E502	Ant. Disconnect, Upper Air Intake Fairing	
E503	Ant. Transponder	
G200	369A4517	Rotor Tach Generator
G300	369A4550	Starter / Generator
G301	369A4517	N_1 Tach Generator
G302	369A4517	N_2 Tach Generator
HR1	C7SZ15052A (Ford Motor Co.)	Cigar Lighter, Front
HR2	369H6409	Heater-pitot Tube
HR3	C7SZ15052A (Ford Motor Co.)	Cigar Lighter, Rear
J3	MPS-LRH-19C	Audio Amplifier Connector
J4	M9PLSH19C (Winchester)	Instr. Cluster Connector
J9	MS3120F22-41S	Console Connector
J10	MS3120F14-19S	Console Connector
J11	MS3120F-18-1 1S	Console Connector
J12	SEE DS11	Dimmer Control
J13	32445 (AMP)	Compass LT. Splice
J14	32445 (AMP)	Compass LT. Splice
J15	32445 (AMP)	Right Upper Panel LT.
J16	32445 (AMP)	Left Upper Panel LT.
J20	32447 (AMP)	Aft Cigar Ltr.
J21	32447 (AMP)	Aft Cigar Ltr. Splice
J22	32447 (AMP)	Aft Cigar Ltr. Splice
J23	32445 (AMP)	Start Pump Light
J24	32445 (AMP)	Start Pump Light
J31	32445 (AMP)	Lower Panel Lt.
J100	AN2552A3A	Ext. Power Receptacle
J103	JR2/4CP27-CC (Viking)	Utility Power Connector
J109	XAC20SF0016 (Winchester)	Right Cyclic Stick Connector
J112	XAC9SF0016 (Winchester)	Right Collective Stick Connector
J113	XAC9SF0016 (Winchester)	Left Collective Stick Connector
J114	32445 (AMP)	Left Pos. Light Splice
J116	32445 (AMP)	Right Pos. Light Splice
J130	XAC20SF0016 (Winchester)	Left Cyclic Stick Connector
J133	32445 (AMP)	Right Pos. Light Splice
J134	32445 (AMP)	Left Pos. Light Splice

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
J136	32445 (AMP)	Landing Light Relay Splice
J138	32445 (AMP)	Emergency Float Splice
J139	32445 (AMP)	Emergency Float Splice
J140	32445 (AMP)	Emergency Float Splice
J141	32445 (AMP)	Emergency Float Splice
J200	SG3102E28-66S (Bendix)	Armament Connector
J250	MS3116E8-3S	Start Pump Connector
J251	369A4599-3	Fuel Qty. Level Connector
J302	CA3100E10SL-3SF80	Auto-Reign. Kit Connector
J303	CA3100E22-19PF80	Engine Equipment Connector
J400	32445 (AMP)	Rear Position Light Splice
J401	32445 (AMP)	Rear Position Light Splice
J402	32445 (AMP)	T/R Chip Detector Splice
J605	MS3124E12-3S	Cargo Hook Connector
K3	369A4658	Landing Light Relay
K103	BE26-S28 (Babcock)	Overvoltage Relay
K300	A700-XA (Hartman)	Reverse Current Relay
K301	AN3371-2	Start Relay
K302	MS24166D	Searchlight Relay
K303	MS24166D	Searchlight Relay
M1	369H4518	Engine (N_2) and Rotor Tach. Indicator
M2	369A4516	N_1 Tach Indicator
M3	369A4521	Turbine Outlet Temp. Indicator
M4	369H4234-21	Instrument Cluster, 4-Pack
M4	369H6417	Instrument Cluster, 3-Pack
M5	M5600-2 (Hobbs)	Hour Meter
M21	369H4526	Torque Indicator
M27	369H4505	Altimeter
M28	369H90041	Attitude Gyro
M29	(Supplied with Engine	Start Counter
M502	369H90042	Directional Gyro
MP102	369H90042	Directional Gyro
MP501	369H90041	Attitude Gyro
P1	369A4593	Dual Tach Indicator Plug
P2	369A4593	N_1 Tach Plug
P3	369A4595	Audio Amplifier Plug
P4	M9S952RH19C	Instrument Cluster Connector

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
P6	MS3196R16S-6S (C)	Voltage Regulator Connector
P7	369A4595	Audio Amplifier Plug
P8	MRAC26SJT6	Dimmer Control Connector
P9	KPTM06F22A-41P	Console Connector
P10	MS3126-F14-19P	Console Connector
P11	MS3126-F18-1 1P	Console Connector
P12	MS3126-F18-32S	Dimmer Control Connector
P13	32445 (AMP)	Compass Light Splice
P14	32445 (AMP)	Compass Light Splice
P19	KPT06F14-18S	Engine Power Out Warning (2200-3)
P130	MRAC20PJTC6H9	Left Cyclic Stick Connector
P20	32445 (AMP)	Splices
P21	32445 (AMP)	Splices
P22	32445 (AMP)	Splices
P23	32445 (AMP)	Splices
P24	32445 (AMP)	Splices
P105	MS3106R10SL-3S (C)	Longitudinal Trim Motor Connector
P106	MS3106R10SL-3S (C)	Lateral Trim Motor Connector
P107	MS3108R10SL-3S (C)	N_2 Governor Connector
P108	SC06P24-9P (Bendix)	Battery Plug
P109	369A4599	Rotor Tachometer Generator
P112	XAC9PC0306X	Right Collective Stick Connector
P113	XAC9PC0306X	Left Collective Stick Connector
P200	CS3106A28-66P	Hoist
P202	369A4599	Rotor Tach Generator Connector
P250	MS3116E8-3S	Start Pump Connector
P251	369A4593	Fuel Transmitter Connector
P300	369H8144	Upper Engine Chip Detector Connect
P301	369H8144	Lower Engine Chip Detector Connect
P302	CA3106E10SL-3PF80	Auto Re-Ignition Kit Connector
P303	CA3106E22-19SF80	Engine Harness Disconnect Connector
P305	369A4599	N_1 Tach Generator Connector
P306	369A4599	N_2 Tach Generator Connector
P400	32445 (AMP)	Tail Light Splice
P402	32445 (AMP)	Tail Rotor Chip Detector Splice
P605	MS3216F12-3P	Cargo Hook Connector
P609	KPT06F8-4S	Heater Actuator Connector

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
P612	KPT06F8-4S	Deicer Actuator Connector
R1	0200-C (Ohmite) 25Ω25 Watt	Instrument Cluster Resistor
R2	120Ω1 Watt	Over Voltage Relay Resistor
R3	3730 (Ohmite) 1Ω12 Watt	Instrument Cluster Resistor
R4	1006 (Ohmite)	TOT Calibration Resistor (TB9)
R6	50Ω5 Watt W / Wound	Map Light Dimming Resistor
R9 R10 R11 R12	3-1/2 TE57FSI (Ohmite) 1Ω55 Watt W / Wound	Cigar Lighter Resistors
R110	5KΩ2 Watt POT	Instrument Panel Dimming Resistor
R112	1-D-40A-F-20 (Ohmite)	Instrument Cluster Resistor
R251	369H4245-501	Fuel Qty. Level Resistor (Tank Unit)
R302	369A4534	Engine Oil Pressure Resistor (Sender)
R303	RV4LASA-101A (Allen-Bradley)	Eng. Oil Press Ind. Adj. Trim POT
R304	1511 (Ohmite) 30Ω 8 Watt	Eng. Oil Press Ind. Adj. Resistor
R305	1513 (Ohmite) 40Ω 8 Watt	Eng. Oil Press Ind. Adj. Resistor
R501	(Bendix Radio)	Intercom Side Tune POT
RT301	369A4533	Engine Oil Temperature Sender
S1	369A4548	Warn. Light Press-to-Test Switch
S2	MS25106-21	Battery / External Switch
S3	9577	Key Switch
S4	MS35059-22	Generator Switch
S10	369H92040	Auto Re-Ignition Pressure Switch
S11	MS35059-22	Auto Re-Ignition Arm Switch
S13	MS90311-231	Com 1 / Com 2 Switch
S104	369A4580	N_2 Governor Switch
S105	369A4581	Landing Light Switch
S106	369A4582	Start Switch
S107	369A7313	Cyclic Trim
S107	RS36	Rear Map Light Switch
S199	MS27994-1	N_R Disable Switch
S200	B-3707 (Tedeco)	Main Gearbox Chip Det. Switch (Fwd)
S201	B-3148A (Tedeco)	Main Gearbox Chip Det. Switch (Aft)
S202	369A5186 (Tedeco)	Main Gearbox Oil Temp. Switch
S203	M-4013-15 (Hobbs)	Main Gearbox Oil Pressure Switch

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
S300	Furnished with engine	Engine Upper Chip Detector Switch
S301	Furnished with engine	Engine Lower Chip Detector Switch
S303	Furnished with engine	Fuel Filter Switch
S400	369A5160	T/R Gearbox Chip Detector Switch
S601	SS-39 (Stackpole)	Heater Switch
S602	SS-33 (Stackpole)	Deicer Switch
SP1	32445 (AMP)	Float System 369H92557
SP2	32445 (AMP)	Float System 369H92557
SP3	32445 (AMP)	Float System 369H92557
SP4	32445 (AMP)	Float System 369H92557
SP5	32445 (AMP)	Float System 369H92557
SP6	32445 (AMP)	Float System 369H92557
SP7	32445 (AMP)	Float System 369H92557
SP8	32445 (AMP)	Float System 369H92557
SP9	32445 (AMP)	Float System 369H92557
SP10	32445 (AMP)	Float System 369H92557
SP11	32445 (AMP)	Float System 369H92557
SP12	MS25181-2	Float System 369H92557
SP13	MS25181-2	Float System 369H92557
SP14	MS25181-2	Float System 369H92557
SP15	MS25181-2	Float System 369H92557
SP16	32445 (AMP)	Engine Re-Ignition 369H90118
SP17	32445 (AMP)	Engine Re-Ignition 369H90118
SP18	32445 (AMP)	Engine Re-Ignition 369H90118
SP20	32445 (AMP)	Float System 369H92557
SP21	32445 (AMP)	Float System 369H92557
SP22	32445 (AMP)	Float System 369H92557
SP23	32445 (AMP)	Float System 369H92557
SP24	32445 (AMP)	Float System 369H92557
SP25	32445 (AMP)	Float System 369H92557
SP26	32445 (AMP)	Float System 369H92557
SP27	MS25181-2	Chip Detector, Gearbox, 369H4121
SP28	MS25181-2	Caution Warning Unit
SP29	MS25181-2	Gyro
SP30	MS25181-2	Map Light
SP31	MS25181-2	Engine Out
SP32	MS25181-2	Warning Horn-Engine Out

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
SP33	MS25181-2	Position Lights
SP38	32445 (AMP)	Anti-Collision Light Flashers
SP39	32445 (AMP)	Map Light Light Rear
SP40	32445 (AMP)	Map Light Light Rear
SP42	MS25181-2	Hoist
SP43	MS25181-2	Hoist
SP44	D121	Hoist
SP45	D121	Hoist
SP46	32447 (AMP)	Float System 369H92557
SP48	32445 (AMP)	Float System 369H92557
SP49	32445 (AMP)	Float System 369H92557
SP50	MS25181-1	Night Light Kit, 369H6420
SP51	32445 (AMP)	Night Light Kit, 369H90062
SP52	32445 (AMP)	Night Light Kit, 369H90062
SP53	32445 (AMP)	Night Light Kit, 369H90062
SP54	32445 (AMP)	Night Light Kit, 369H90062
SP55	32445 (AMP)	Night Light Kit, 369H90062
SP56	32445 (AMP)	Night Light Kit, 369H90062
SP57	32445 (AMP)	Night Light Kit, 369H90062
SP58	32445 (AMP)	Night Light Kit, 369H90062
SP59	32445 (AMP)	Night Light Kit, 369H90062
SP60	32445 (AMP)	Night Light Kit, 369H90062
SP61	32445 (AMP)	Night Light Kit, 369H90062
SP62	32445 (AMP)	Night Light Kit, 369H90062
SP63	32445 (AMP)	Night Light Kit, 369H90062
SP64	32445 (AMP)	Night Light Kit, 369H90062
SP65	32445 (AMP)	Night Light Kit, 369H90062
SP66	32445 (AMP)	Searchlight Kit, 369H90142
SP67	32445 (AMP)	Searchlight Kit, 369H90142
SP69	32445 (AMP)	Engine Out Warning, M50033
SP70	32445 (AMP)	Engine Out Warning, M50033
SP71	32445 (AMP)	Engine Out Warning, M50033
SP72	32445 (AMP)	Engine Out Warning, M50033
SP73	MS25181-2	Harness, 369H4126
SP74	MS25181	Console, 369H6416
SP75	MS25181	Console, 369H6416
SP76	MS25181	Console, 369H6416

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
SP77	MS25181	Console, 369H6416
SP78	RBB22	Engine Out Warning, M50033
SP79	32445	Engine Start Counter C-20
SP80	32445	Engine Start Counter C-20
SP81	32445 (AMP)	Audio Warning (DS 105)
SP82	32445 (AMP)	Audio Warning (DS 105)
SP83	32445 (AMP)	Battery Temperature Warning
SP84	32445 (AMP)	Battery Temperature Warning
SP85	32445 (AMP)	Battery Temperature Warning
SP86	32445 (AMP)	Battery Temperature Warning
SP91	32445 (AMP)	Cigar Lighter Splice
SP114	32445 (AMP)	Left Skid Light Splice
SP115	32445 (AMP)	Left Skid Light Splice
SP116	32445 (AMP)	Right Skid Light Splice
SP117	32445 (AMP)	Right Skid Light Splice
SP119	32445 (AMP)	Strobe Light Splice
SP131	32445 (AMP)	Right Skid Light Splice
SP132	32445 (AMP)	Left Skid Light Splice
SP133	32445 (AMP)	Right Skid Light Splice
SP134	32445 (AMP)	Left Skid Light Splice
SP136	32445 (AMP)	Landing Light Splice
SP140	32445 (AMP)	Pitot Heater Splice
SP205	32445 (AMP)	Utility Light Splice
SP400	32445 (AMP)	Tail Light Splice
SP401	32445 (AMP)	Tail Light Splice
SP402	32445 (AMP)	Tail Rotor Chips Light Splice
SP1151	32445 (AMP)	Left Skid Light Splice
SP1171	32445 (AMP)	Right Skid Light Splice
SP1311	32445 (AMP)	Right Skid Light Splice
SP1321	32445 (AMP)	Left Skid Light Splice
TB1-1	A22DNN20-1	Module
TB1-2	A22DNN20-1	Module
TB1-3	A22DNN20-1	Module
TB1-4	A22DNN20-1	Module
TB1-5	A22DNN20-1	Module
TB1-6	A22DNN20-1	Module
TB1-7	A22DNN20-1	Module

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
TB1-8	A22DNN20-1	Module
TB1-9	A22DNN20-1	Module
TB1-10	A22DNN20-1	Module
TB1-1 1	A22DNN20-1	Module
TB1-12	A4DNN20-1	Module
TB1-13	A4DNN20-1	Module
TB1-14	A4DNN20-1	Module
TB1-15	A22DNN20-1	Module
TB1-16	A22DNN20-1	Module
TB1-17	A4DNN20-1	Module
TB1-18	A4DNN20-1	Module
TB1-19	A4DNN20-1	Module
TB1-20	A4DNN20-1	Module
TB1-21	A4DNN20-1	Module
TB1-22	A4DNN20-1	Module
TB1-23	A4DNN20-1	Module
TB1-24	A4DNN20-1	Module
TB1-25	A4DNN20-1	Module
TB1-26	A4DNN20-1	Module
TB1-27	A4DNN20-1	Module
TB1-28	A4DNN20-1	Module
TB1-29	A22DNN20-1	Module
TB1-30	A22DNN20-1	Module
TB1-31	A4DNN20-1	Module
TB1-32	A4DNN20-1	Module
TB1-33	A4DNN20-1	Module
TB1-34	A4DNN20-1	Module
TB3-1	A22DNN20-1	Module
TB3-2	A4DNN20-1	Module
TB3-3	A4DNN20-1	Module
TB3-4	A4DNN20-1	Module
TB3-5	A4DNN20-1	Module
TB3-6	A4DNN20-1	Module
TB5-1	A22DNN20-1	Module
TB5-2	A22DNN20-1	Module
TB5-3	A4DNN20-1	Module
TB5-4	A4DNN20-1	Module

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
TB5-6	A4DNN20-1	Module
TB6	MS27212-1-6	Ground Buss
TB7-1	A6SNN20T-1	Module
TB7-2	A6SNN20T-1	Module
TB7-3	A6SNN20T-1	Module
TB7-4	A6SNN20T-1	Module
TB7-5	A6SNN20T-1	Module
TB7-6	A32DNN20T-1	Module
TB7-7	A32DNN20T-1	Module
TB7-8	A32DNN20T-1	Module
TB7-9	A32DNN20T-1	Module
TB7-10	A32DNN20T-1	Module
TB7-11	A32DNN20T-1	Module
TB8	Board	Resistor Board
TB10	MS27212-2-4	Junction
TB11-1	A6SNN20T-1	Module
TB11-2	A6SNN20T-1	Module
TB11-3	A6SNN20T-1	Module
TB12-1	A22DNN20-1	Module
TB12-2	A4DNN20-1	Module
TB12-3	A22DNN20-1	Module
TB12-4	A22DNN20-1	Module
TB101	MS27212-2-2-7	Main 28V Buss
TB104	MS25036-101	Junction
TB105	MS25036-101	Junction
TB106	Ref. 369H6416	Audio Isolator
TB501	MS27212-1-4	28V Buss
TB502-1	A32DNN20T-1	Module
TB502-2	A32DNN20T-1	Module
TB502-3	A6SNN20T-1	Module
TB502-4	A6SNN20T-1	Module
TB502-5	A23DNN20T-1	Module
TB502-6	A32DNN20T-1	Module
TB502-7	A6SNN20T-1	Module
TB502-8	A6SNN20T-1	Module
TB502-9	A6SNN20T-1	Module
TB502-10	A32DNN20T-1	Module

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
TB502-1 1	A32DNN20T-1	Module
TB502-12	A32DNN20T-1	Module
TB502-13	A23DNN20T-1	Module
TB502-14	A23DNN20T-1	Module
TB502-15	A32DNN20T-1	Module
TB502-16	A32DNN20T-1	Module
TB502-17	A32DNN20T-1	Module
TB502-18	A32DNN20T-1	Module
TB502-19	A23DNN20T-1	Module
TB502-20	A23DNN20T-1	Module
TB700-1	A6SNN20T-1	Module
TB700-2	A6SNN20T-1	Module
TB700-3	A6SNN20T-1	Module
TB700-4	A6SNN20T-1	Module
TB700-5	A6SNN20T-1	Module
TB700-6	A6SNN20T-1	Module
TB700-7	A6SNN20T-1	Module
TB700-8	A6SNN20T-1	Module
TC300	Supplied with Engine	Thermocouple
VR1	369H4550	Voltage regulator
W1	369H4232	Buss on S-2
W2	369H6460	Ground Buss (TB6)
W3	(Ref.)	Main Power Buss
XDS1	369A4572-7	Engine Out Warning Light
XDS2	369A4572-27	Eng. Oil Press. & Temp. Light
XDS3	369A4572-13	Chip Detector Light
XDS4	369A4572-15	Fuel Low Light
XDS5	369A4572-25	Fuel Filter Light
XDS6	369A4572-23	Generator Out Light
XDS7	369H4236	Start Pump On Light
XDS12	10410HS7-15	Trans. Oil Temperature Light
XDS13	10410HS7-14	Trans. Oil Pressure Light
XDS14	10410HS7-13	Engine Out Light
XDS15	10410HS7-16	Engine Chips Light
XDS16	10410HS7-19	Fuel Low Light
XDS17	10410HS7-21	Fuel Filter Light
XDS18	10410HS7-20	Generator Out

Table 20-1. Reference Designator List (Cont.)

Identification	Reference	End Use
XDS19	10410HS7-17	M/R Transmission Chip Light
XDS20	10410HS7-18	T/R Transmission Chip Light
XDS21	10410HS7-12	Press-To-Test
XDS24	MS25041-4	Battery Temperature (Amber)
XDS25	MS25041-2	Battery Temperature (Red)

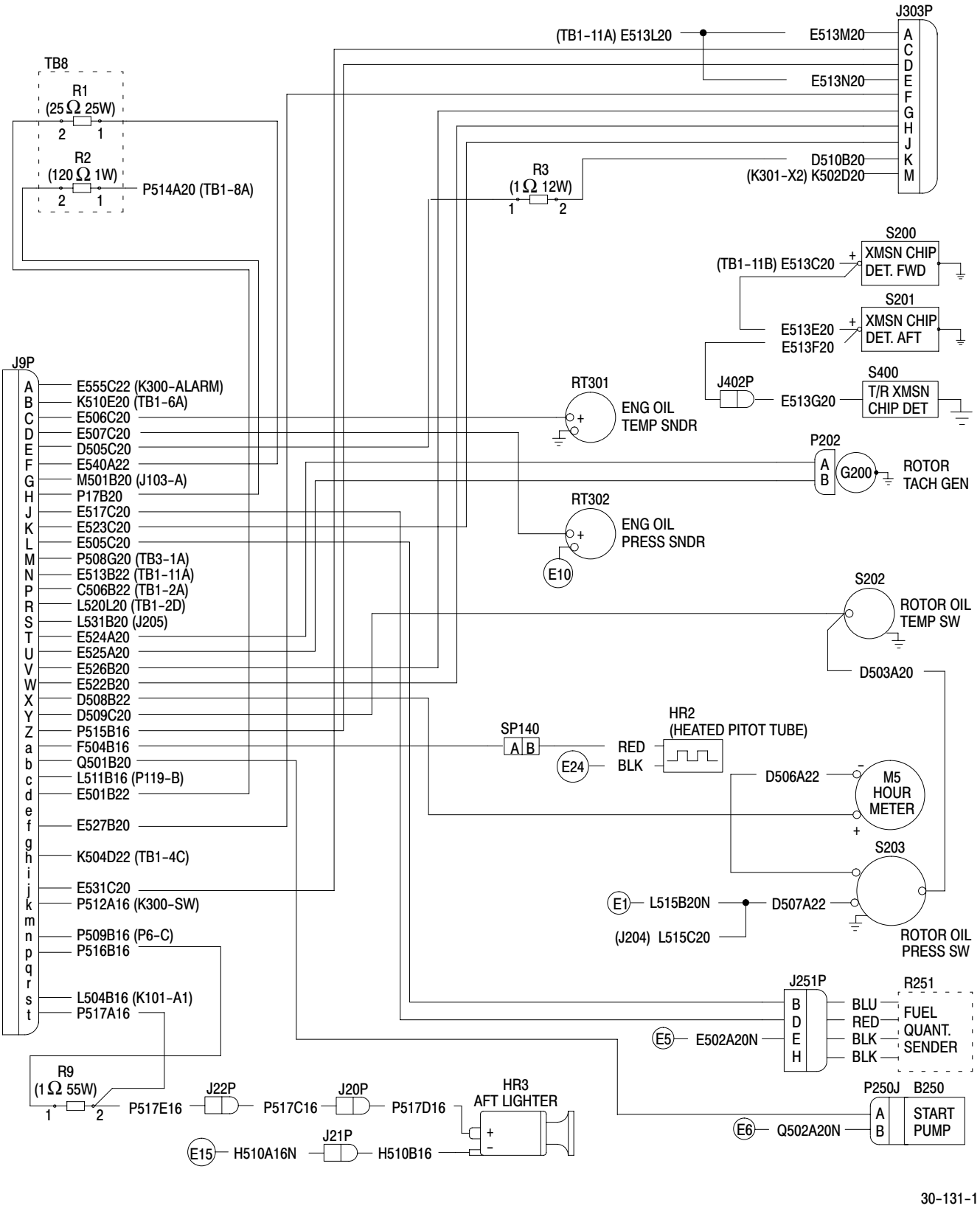


Figure 20-2. Fuselage Wiring Diagram (369HS; 0001 - 0100) (369HM; 001 - 100) (Sheet 1 of 6)

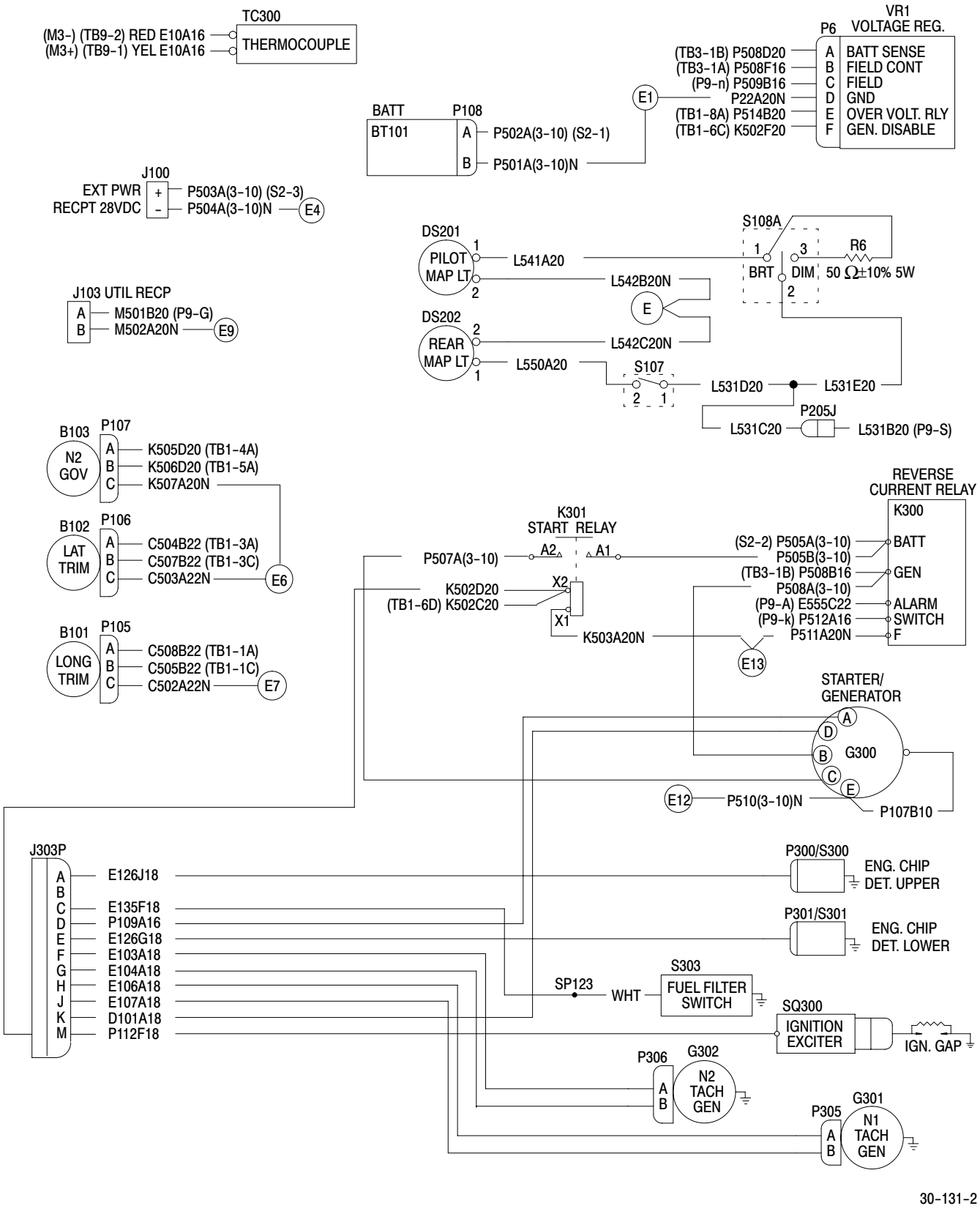


Figure 20-2. Fuselage Wiring Diagram (369HS; 0001 - 0100) (369HM; 001 - 100) (Sheet 2 of 6)

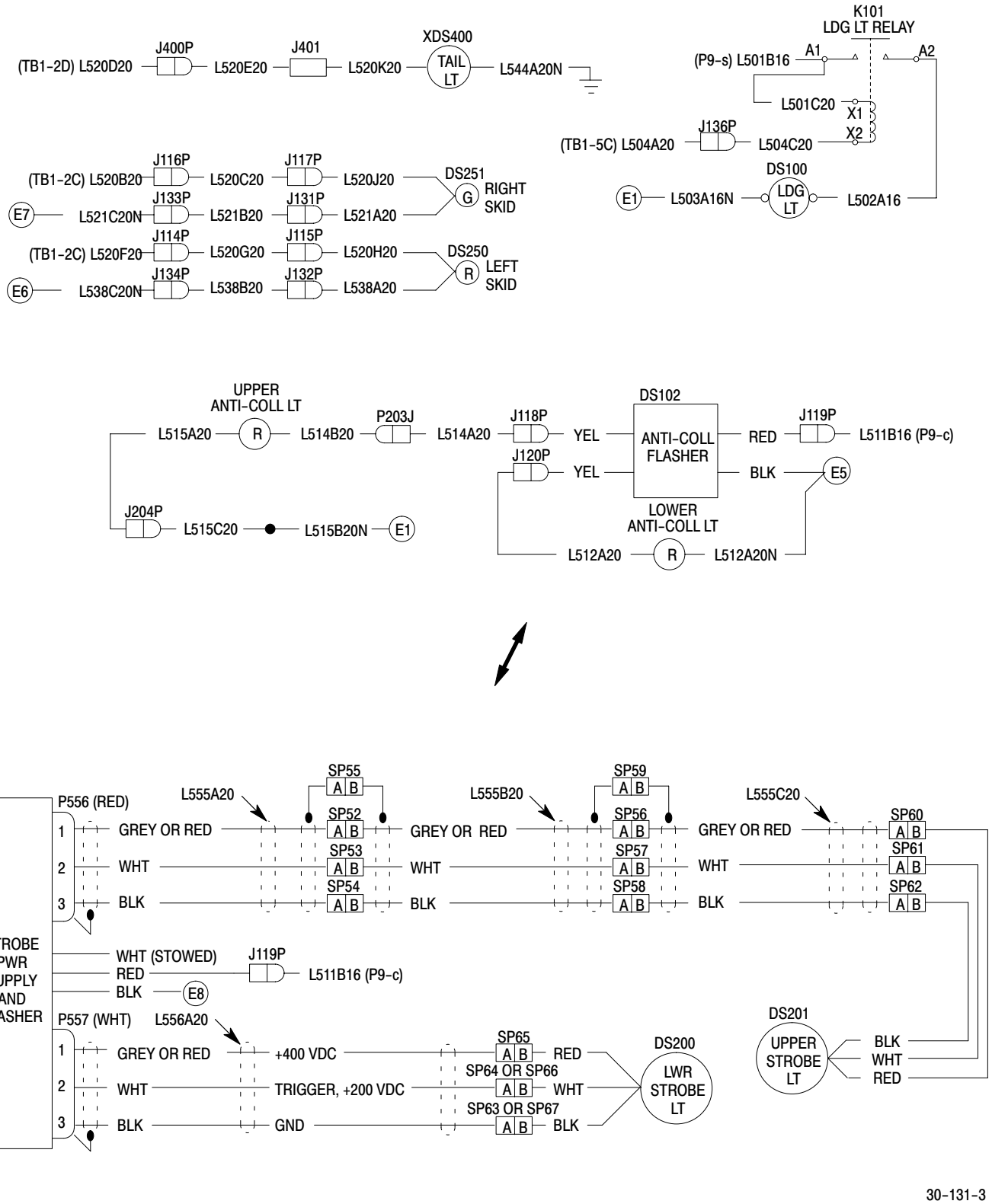


Figure 20-2. Fuselage Wiring Diagram (369HS; 0001 - 0100) (369HM; 001 - 100) (Sheet 3 of 6)

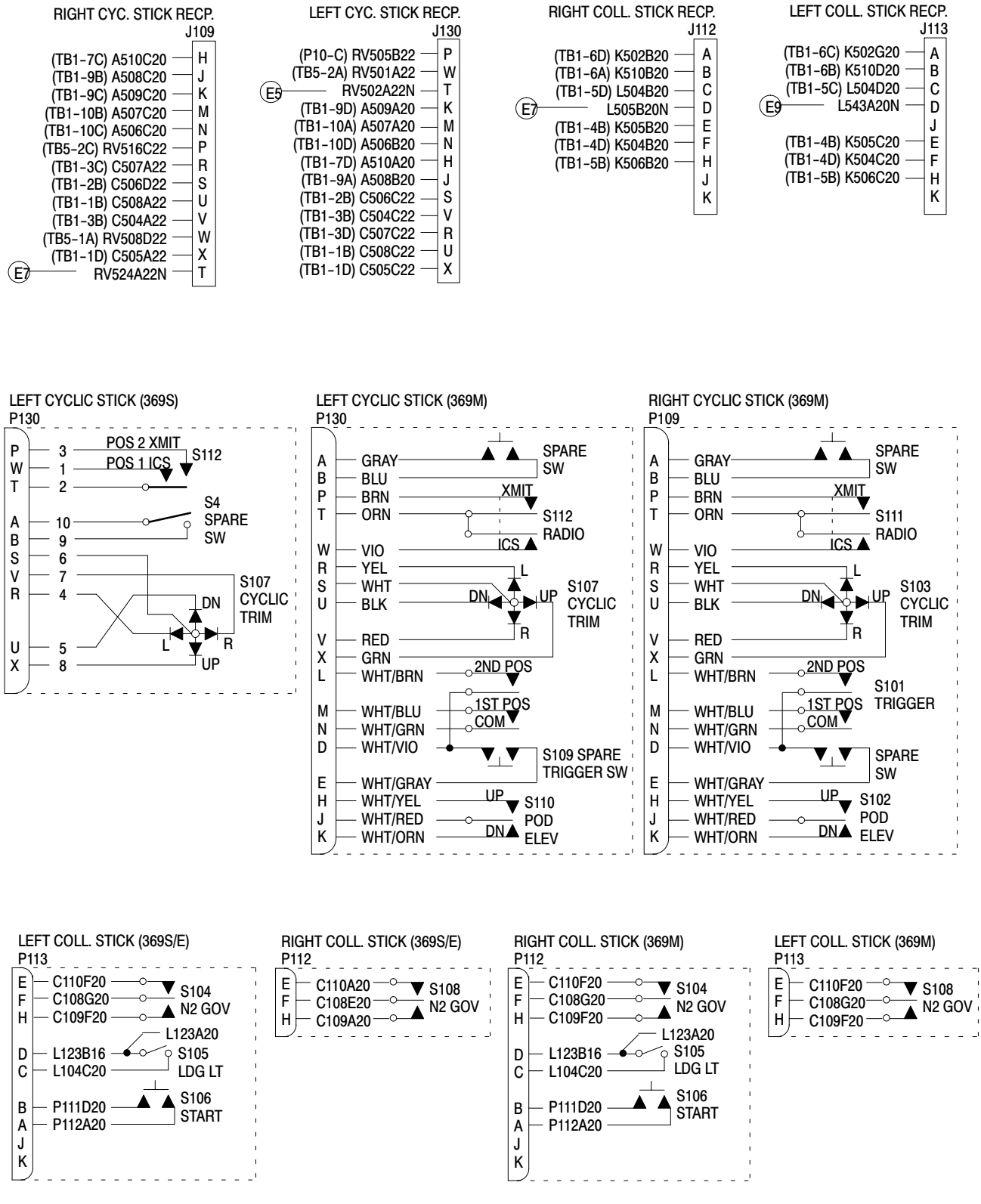


Figure 20-2. Fuselage Wiring Diagram (369HS; 0001 - 0100) (369HM; 001 - 100) (Sheet 4 of 6)

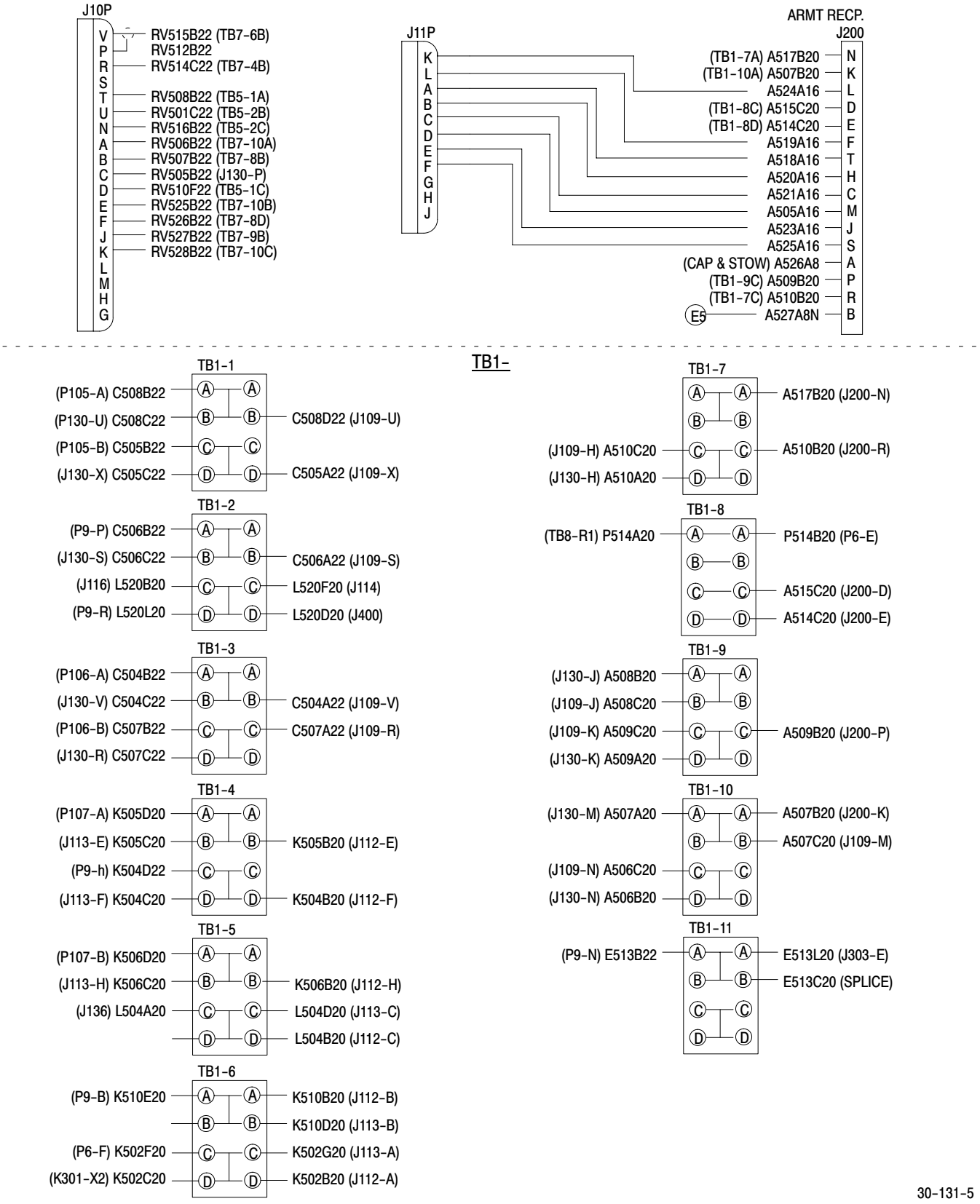


Figure 20-2. Fuselage Wiring Diagram (369HS; 0001 - 0100) (369HM; 001 - 100) (Sheet 5 of 6)

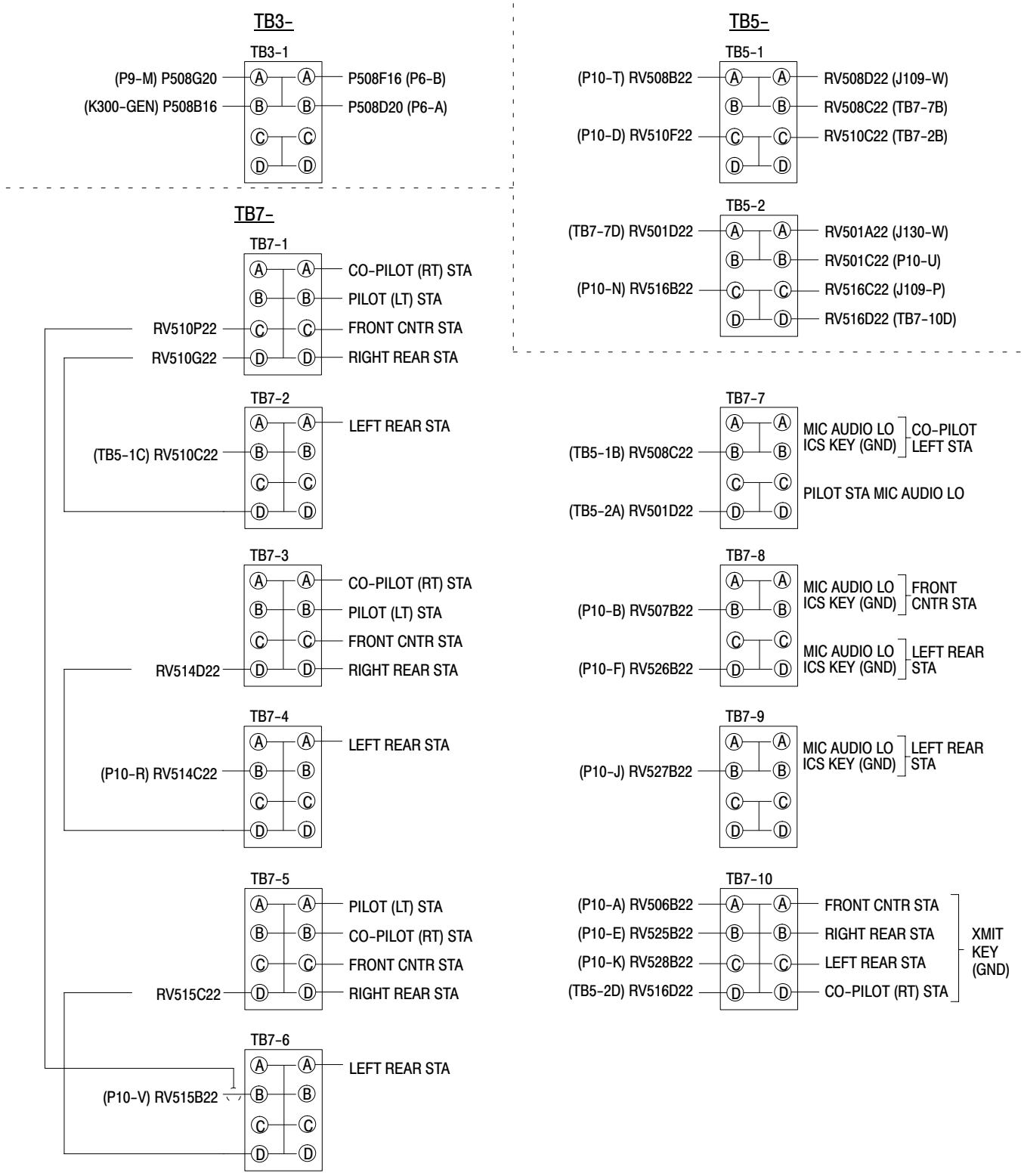
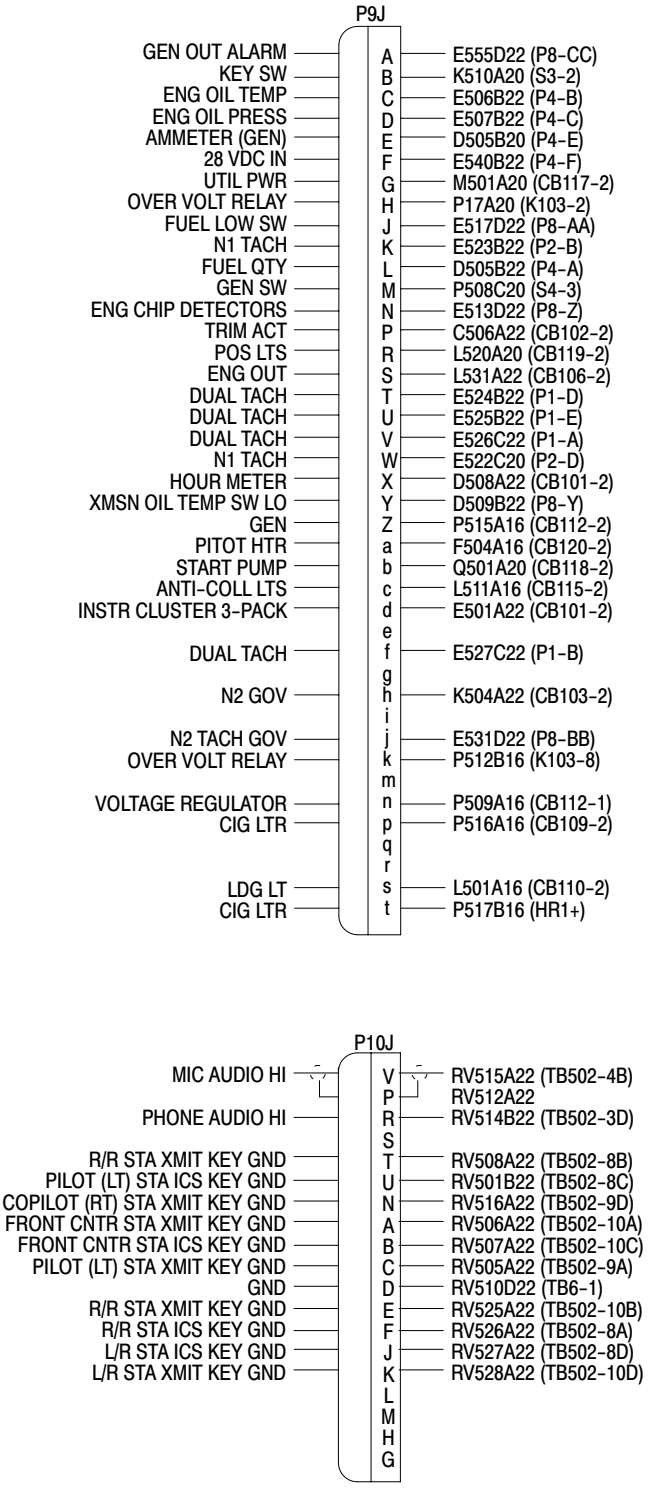


Figure 20-2. Fuselage Wiring Diagram (369HS; 0001 - 0100) (369HM; 001 - 100) (Sheet 6 of 6)



30-131-7

Figure 20-3. Console Wiring Diagram, Instrument Panel Type A (369HS; 0001 - 0100) (369HM; 001 - 100) (Sheet 1 of 4)

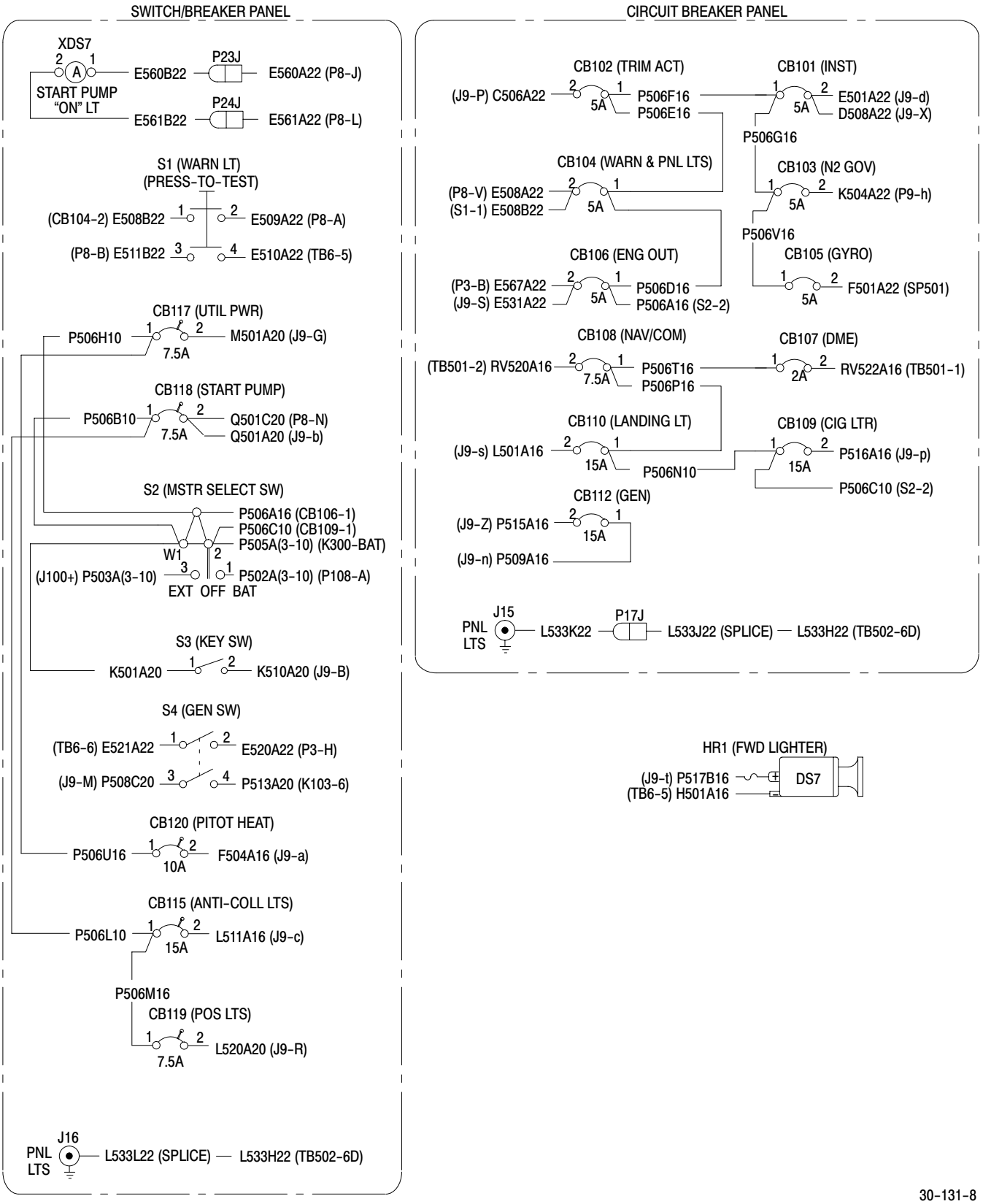


Figure 20-3. Console Wiring Diagram, Instrument Panel Type A (369HS; 0001 - 0100) (369HM; 001 - 100) (Sheet 2 of 4)

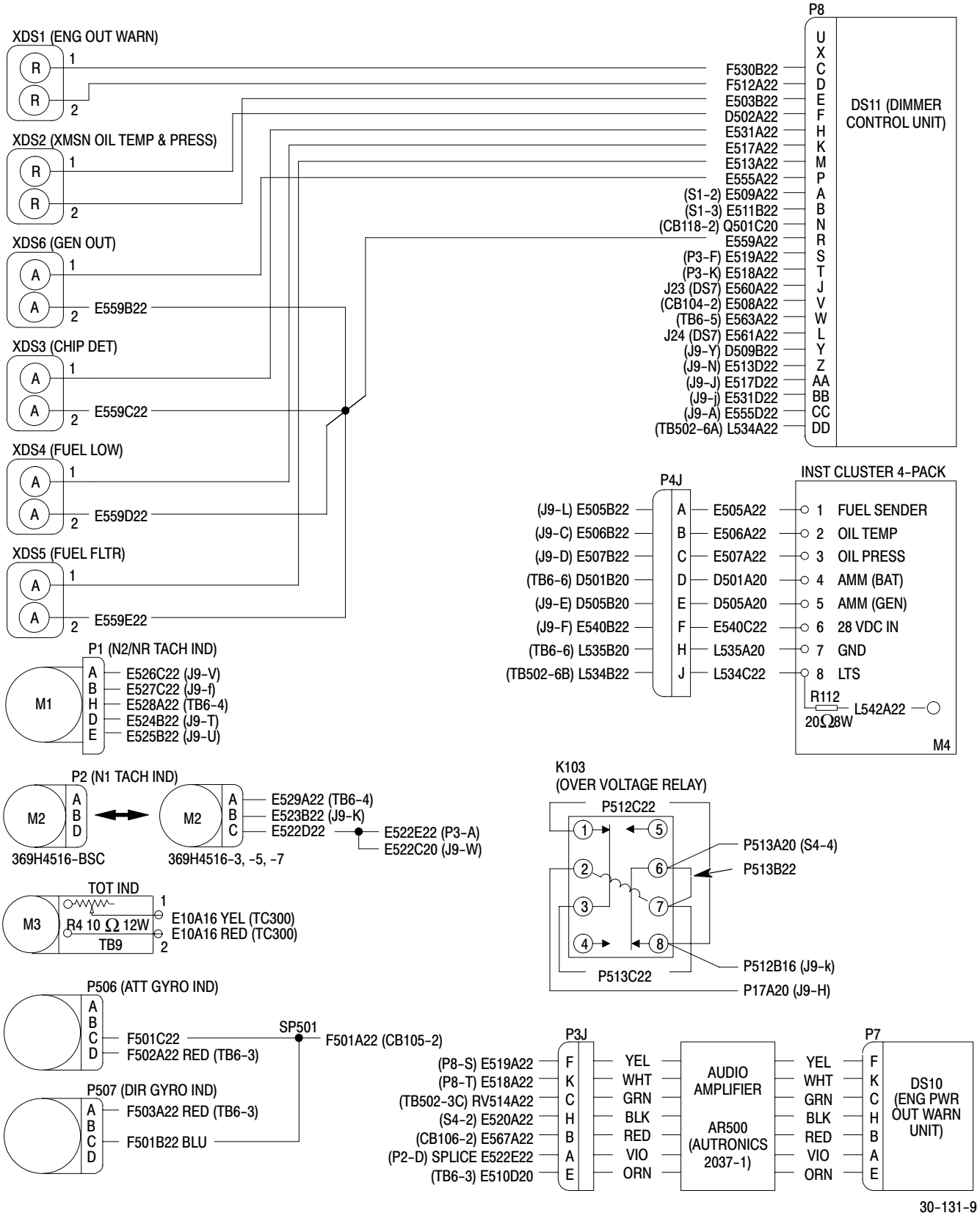


Figure 20-3. Console Wiring Diagram, Instrument Panel Type A (369HS; 0001 - 0100) (369HM; 001 - 100) (Sheet 3 of 4)

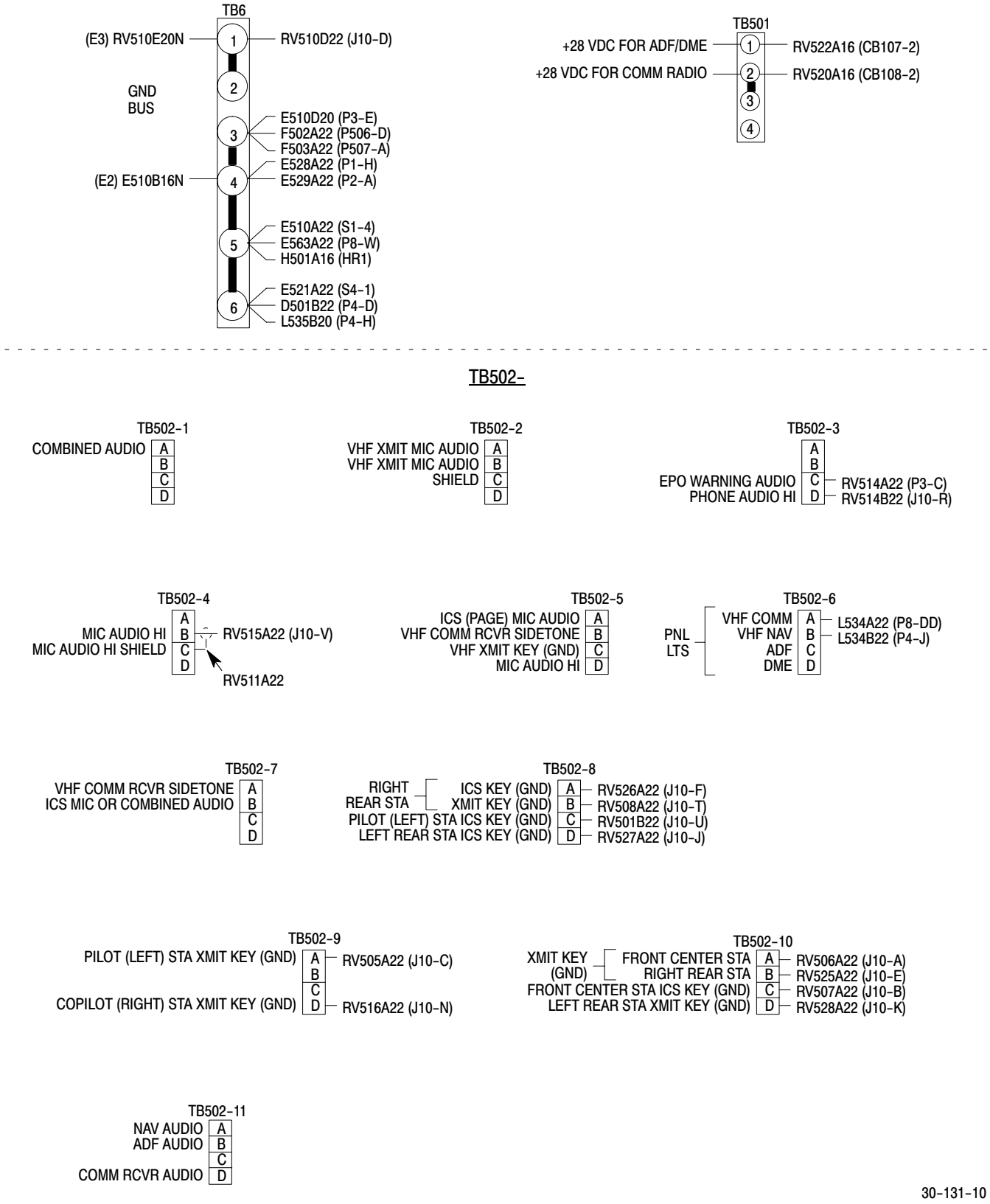


Figure 20-3. Console Wiring Diagram, Instrument Panel Type A (369HS; 0001 - 0100) (369HM; 001 - 100) (Sheet 4 of 4)

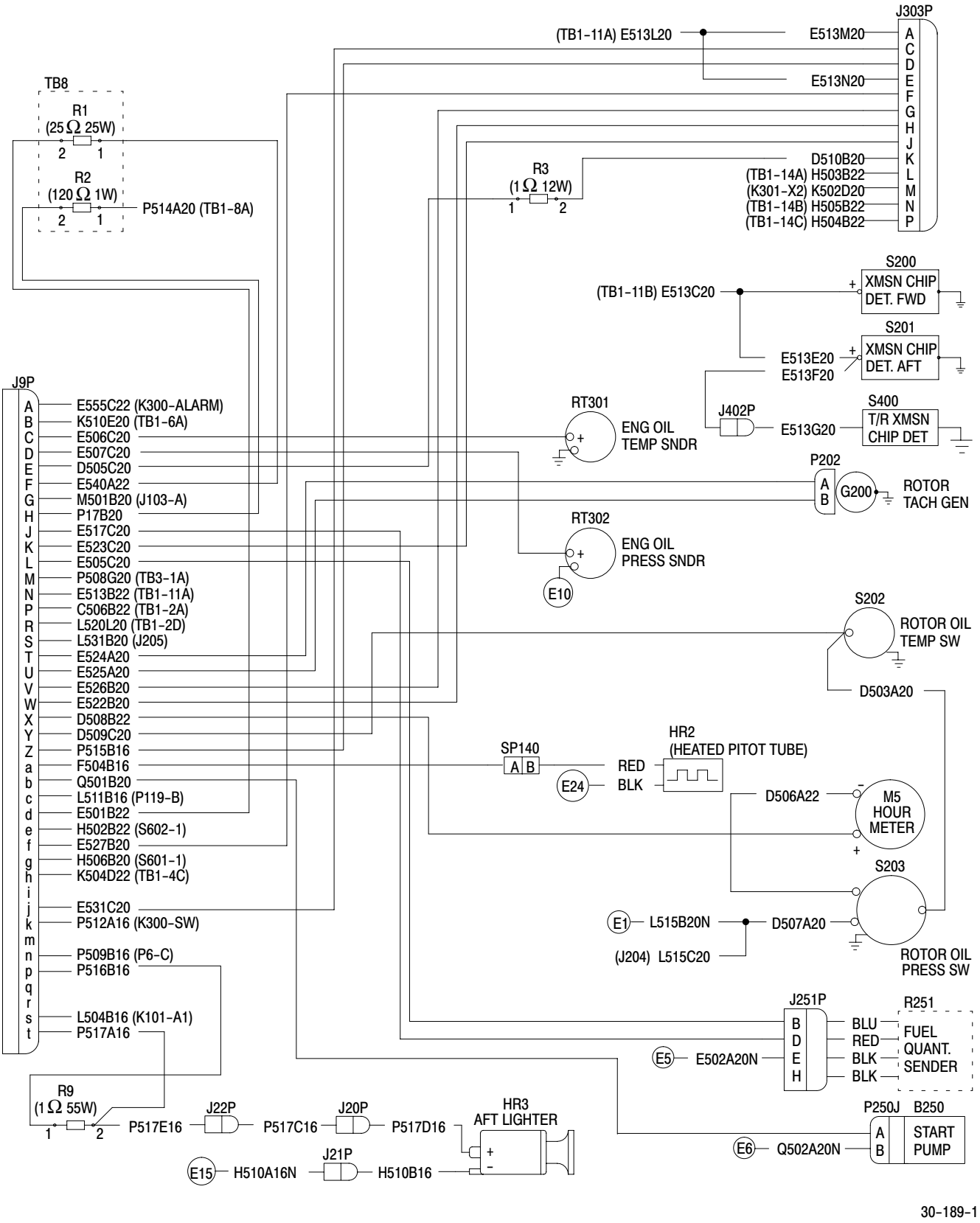


Figure 20-4. Fuselage Wiring Diagram (369HS; 0101 - 0200) (369HM; 101 - 200) (Sheet 1 of 7)

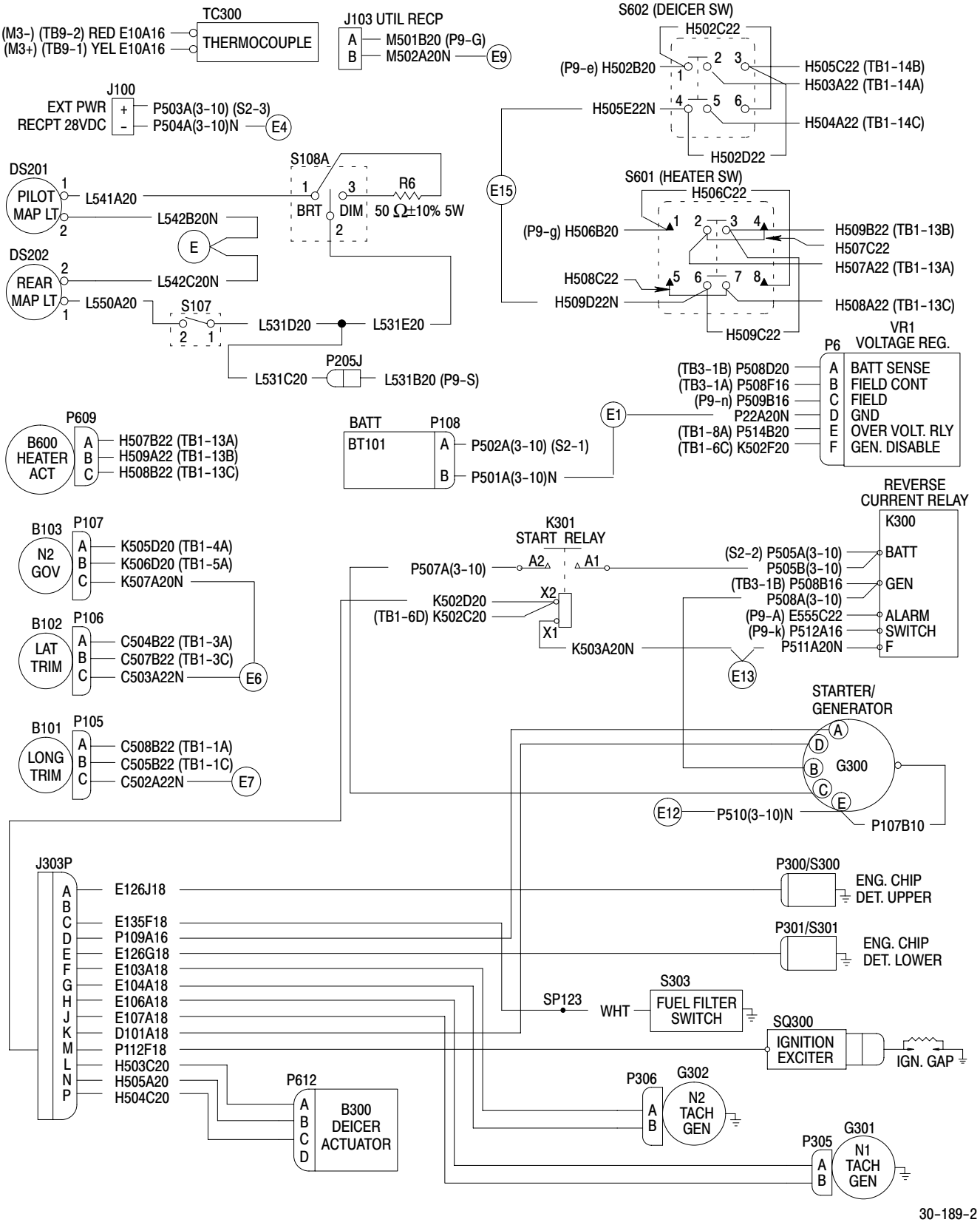


Figure 20-4. Fuselage Wiring Diagram (369HS; 0101 - 0200) (369HM; 101 - 200) (Sheet 2 of 7)

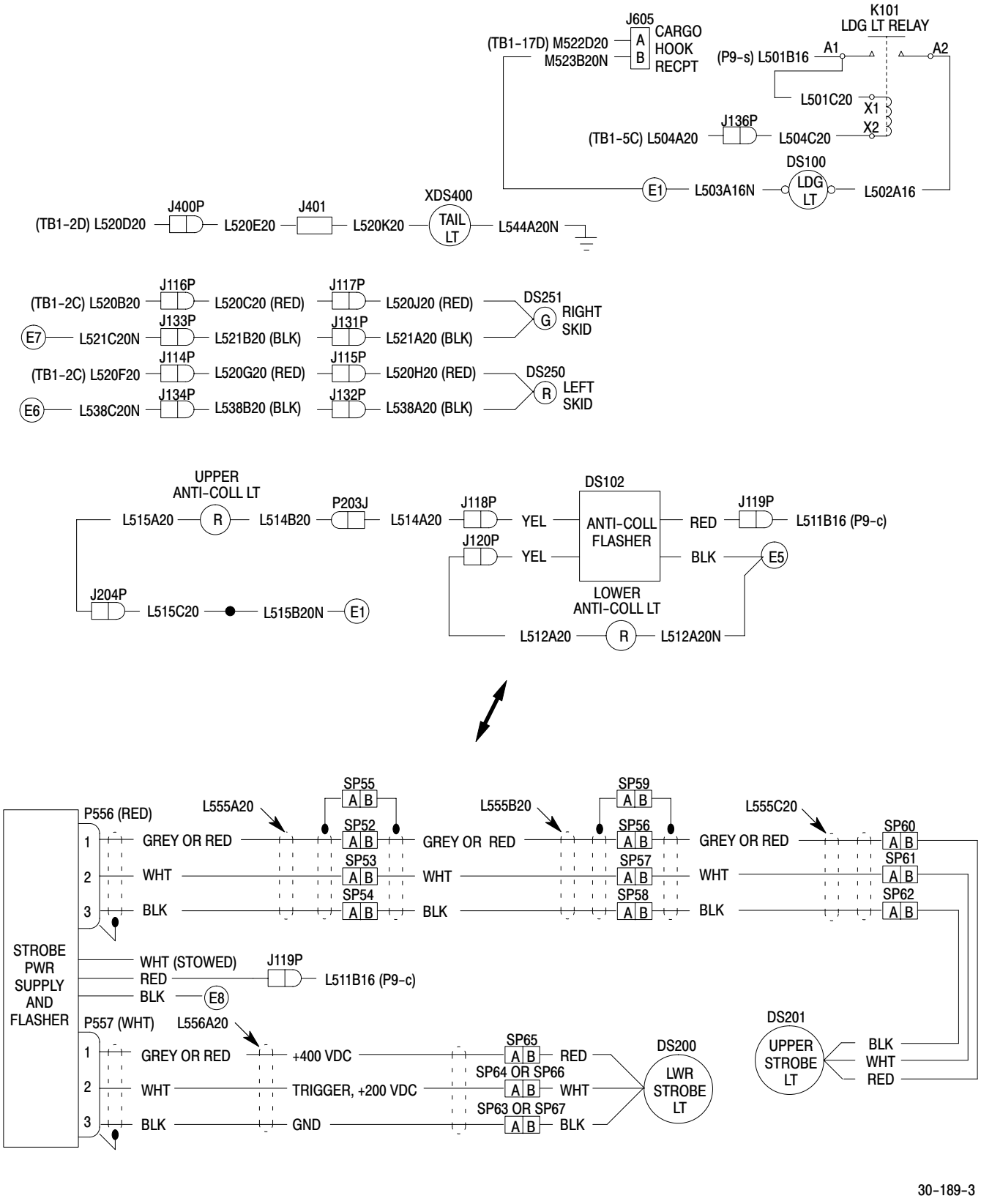
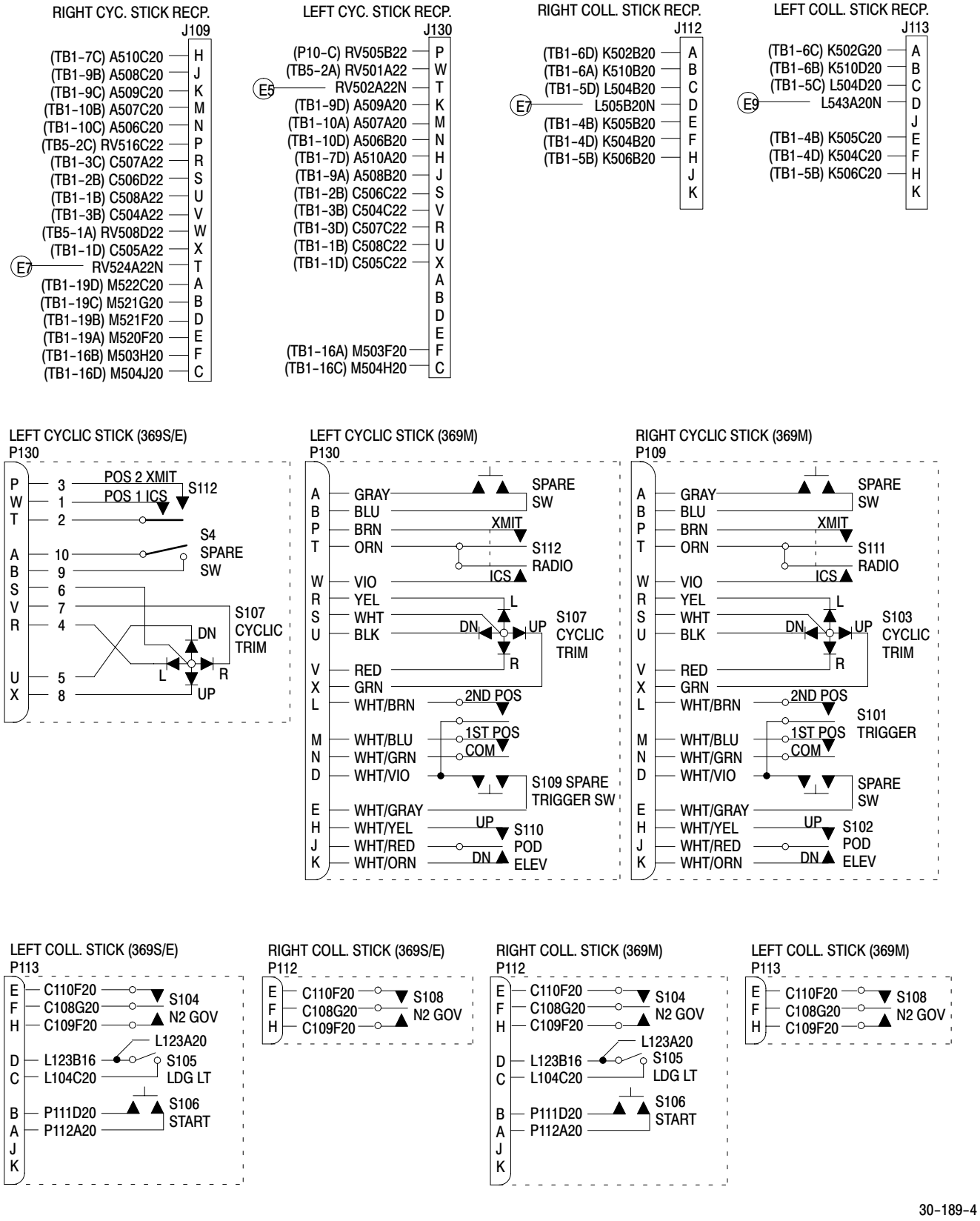


Figure 20-4. Fuselage Wiring Diagram (369HS; 0101 - 0200) (369HM; 101 - 200) (Sheet 3 of 7)



30-189-4

Figure 20-4. Fuselage Wiring Diagram (369HS; 0101 - 0200) (369HM; 101 - 200) (Sheet 4 of 7)

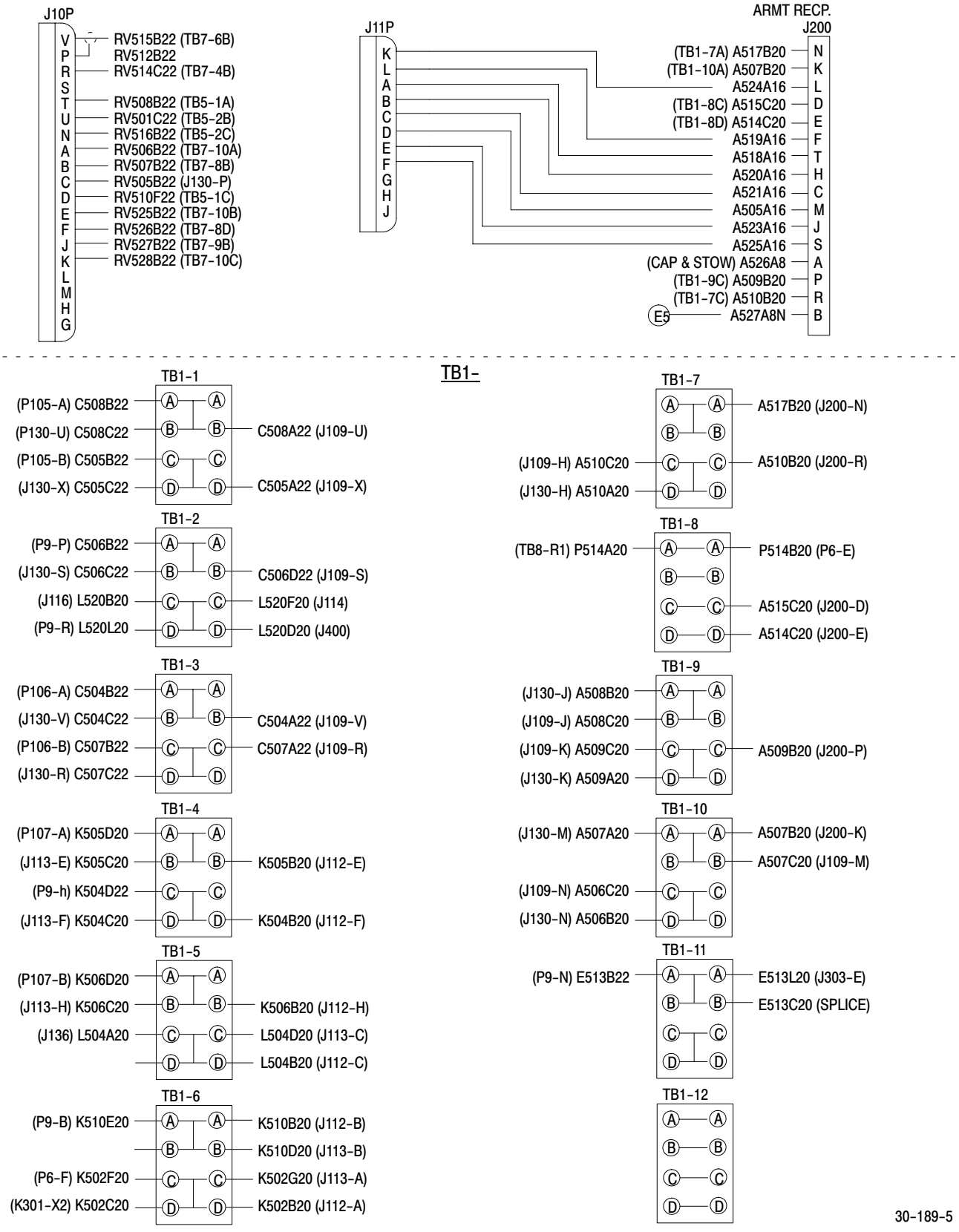


Figure 20-4. Fuselage Wiring Diagram (369HS; 0101 - 0200) (369HM; 101 - 200) (Sheet 5 of 7)

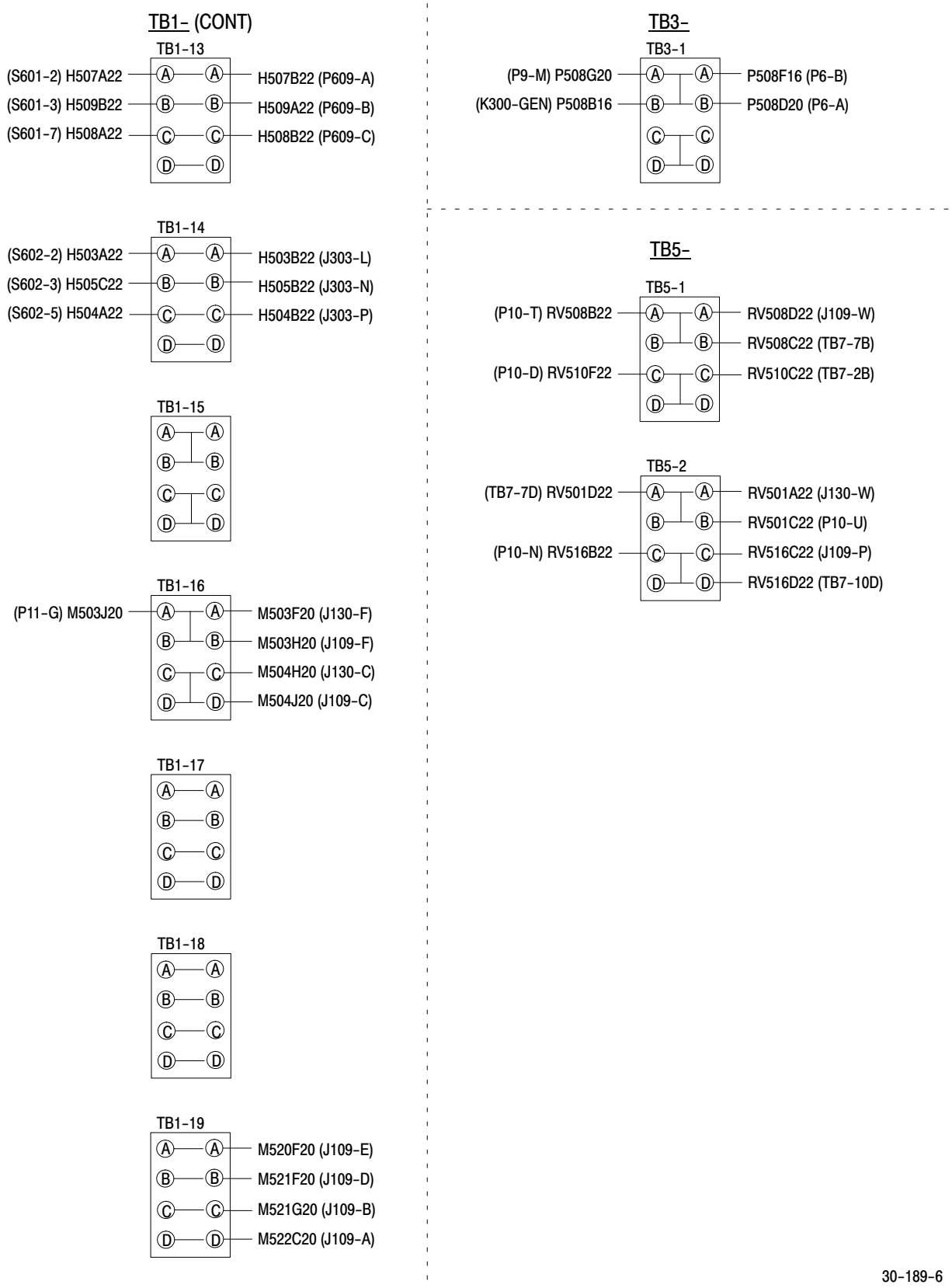


Figure 20-4. Fuselage Wiring Diagram (369HS; 0101 - 0200) (369HM; 101 - 200) (Sheet 6 of 7)

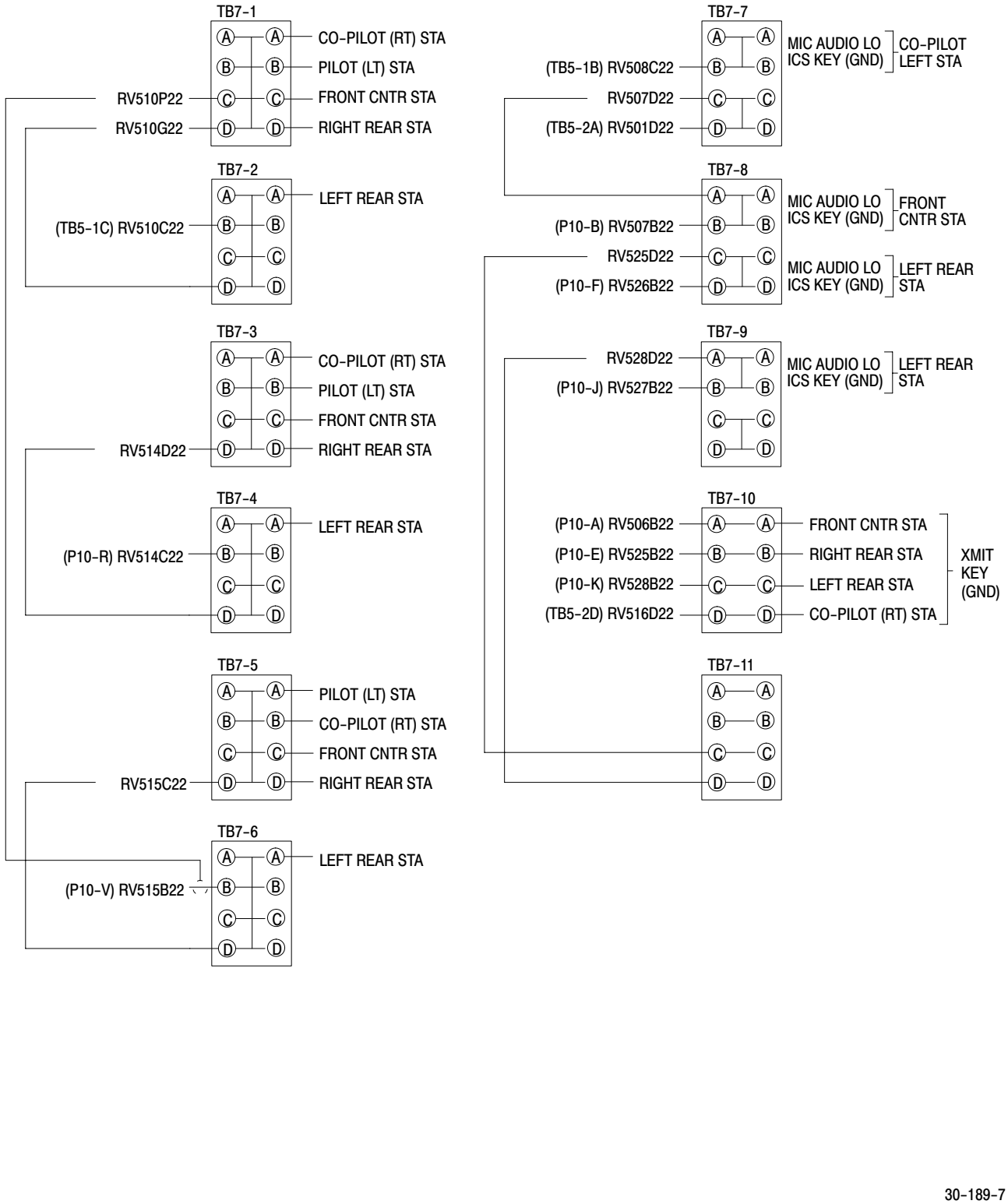
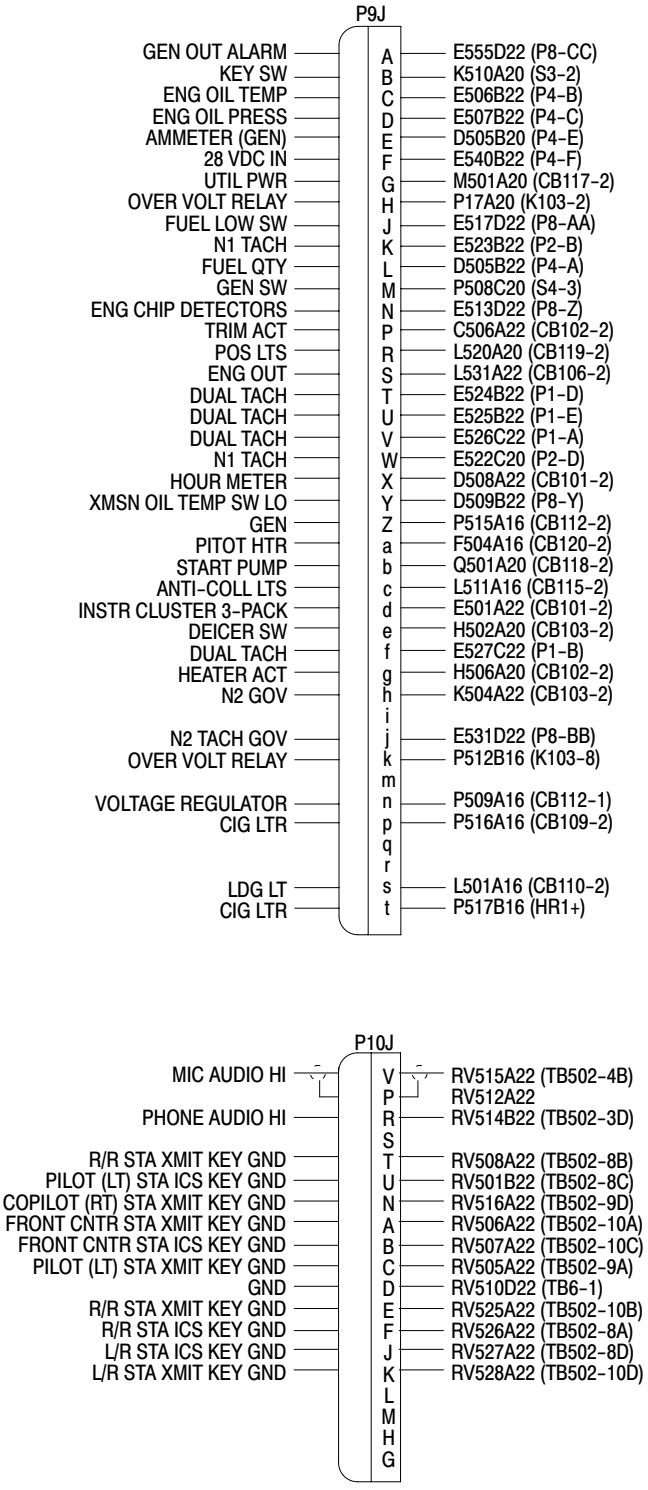


Figure 20-4. Fuselage Wiring Diagram (369HS; 0101 - 0200) (369HM; 101 - 200) (Sheet 7 of 7)



30-189-8

Figure 20-5. Console Wiring Diagram, Instrument Panel Type A (369HS; 0101 - 0200) (369HM; 101 - 200) (Sheet 1 of 4)

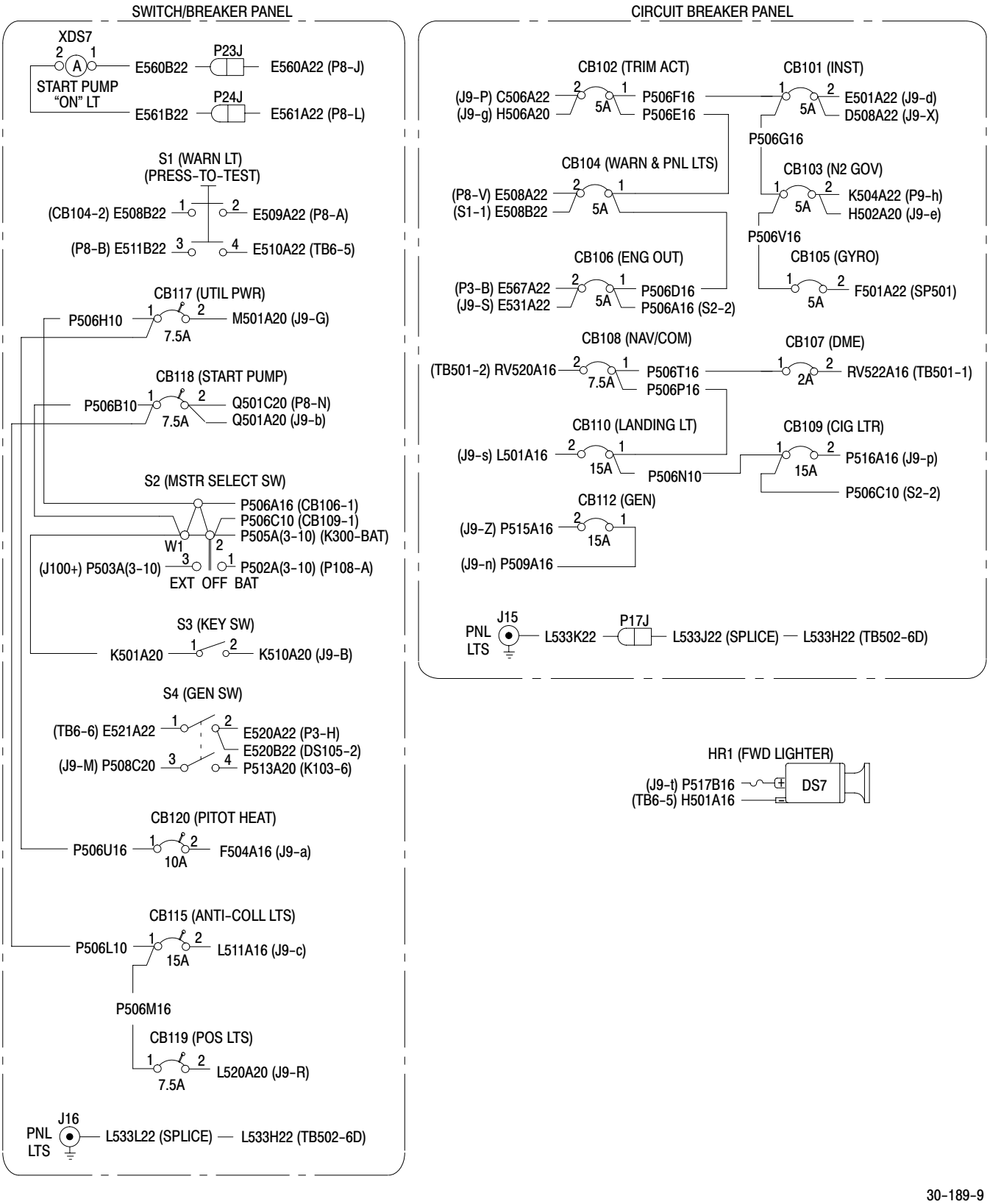


Figure 20-5. Console Wiring Diagram, Instrument Panel Type A (369HS; 0101 - 0200) (369HM; 101 - 200) (Sheet 2 of 4)

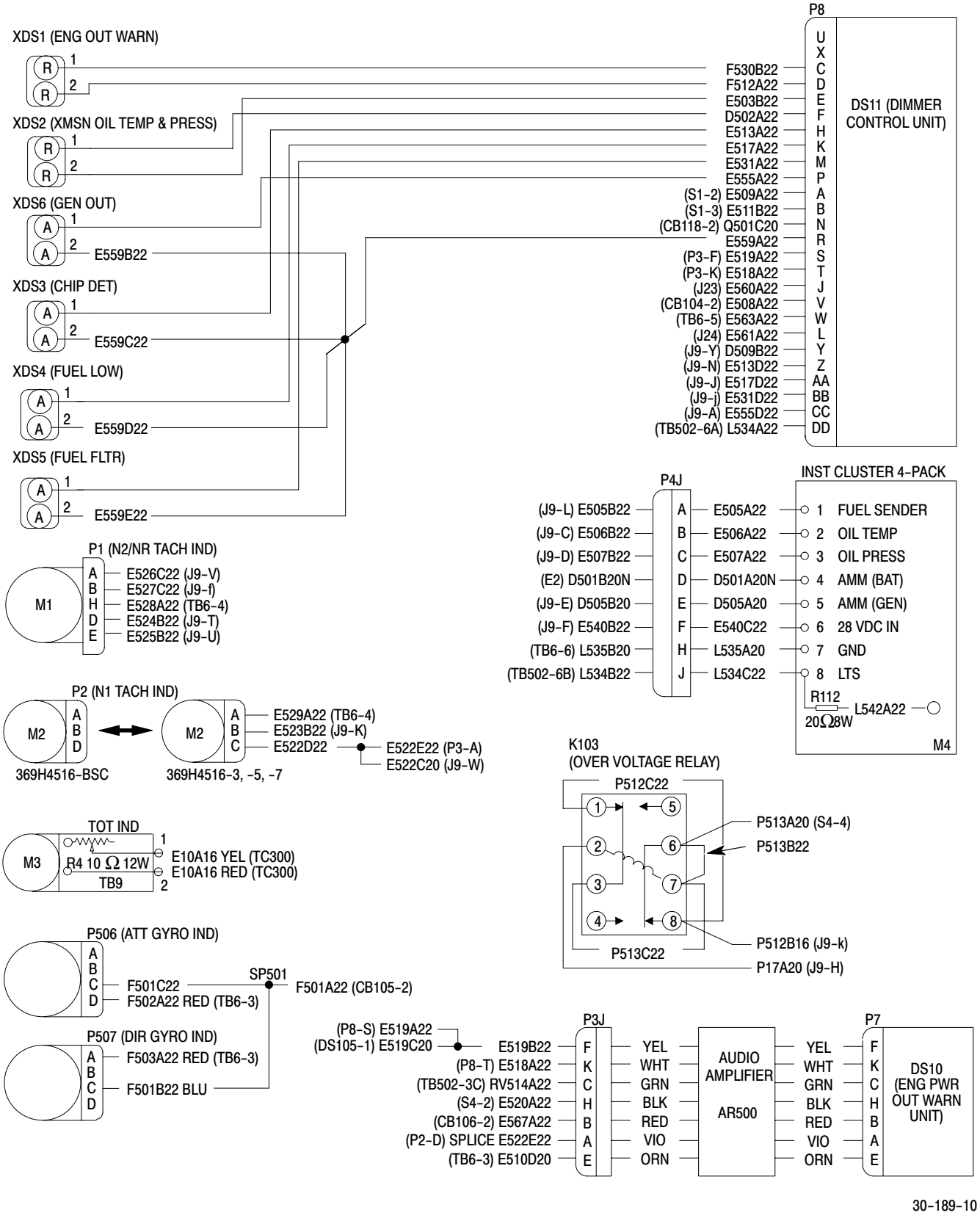


Figure 20-5. Console Wiring Diagram, Instrument Panel Type A (369HS; 0101 - 0200) (369HM; 101 - 200) (Sheet 3 of 4)

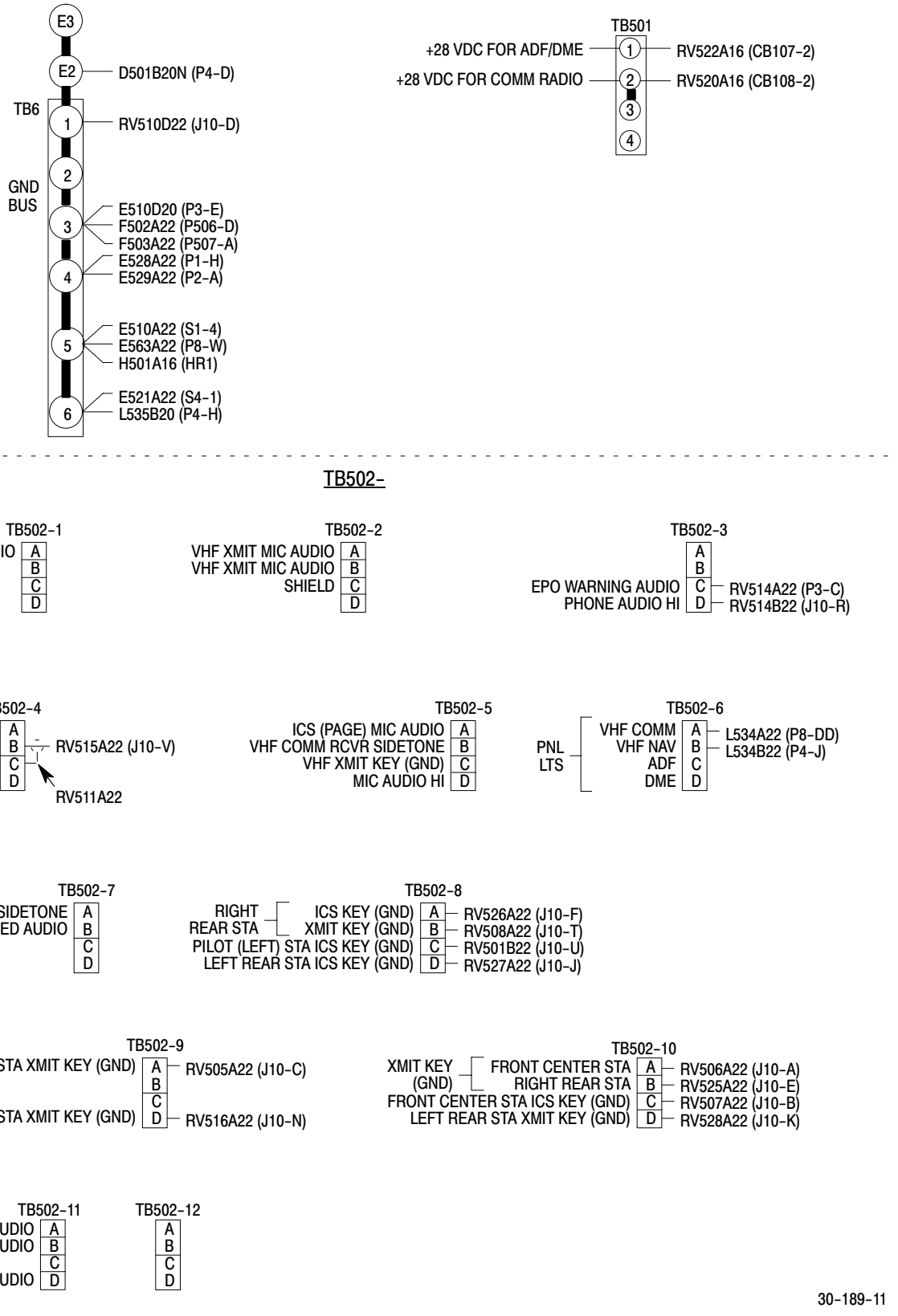


Figure 20-5. Console Wiring Diagram, Instrument Panel Type A (369HS; 0101 - 0200) (369HM; 101 - 200) (Sheet 4 of 4)

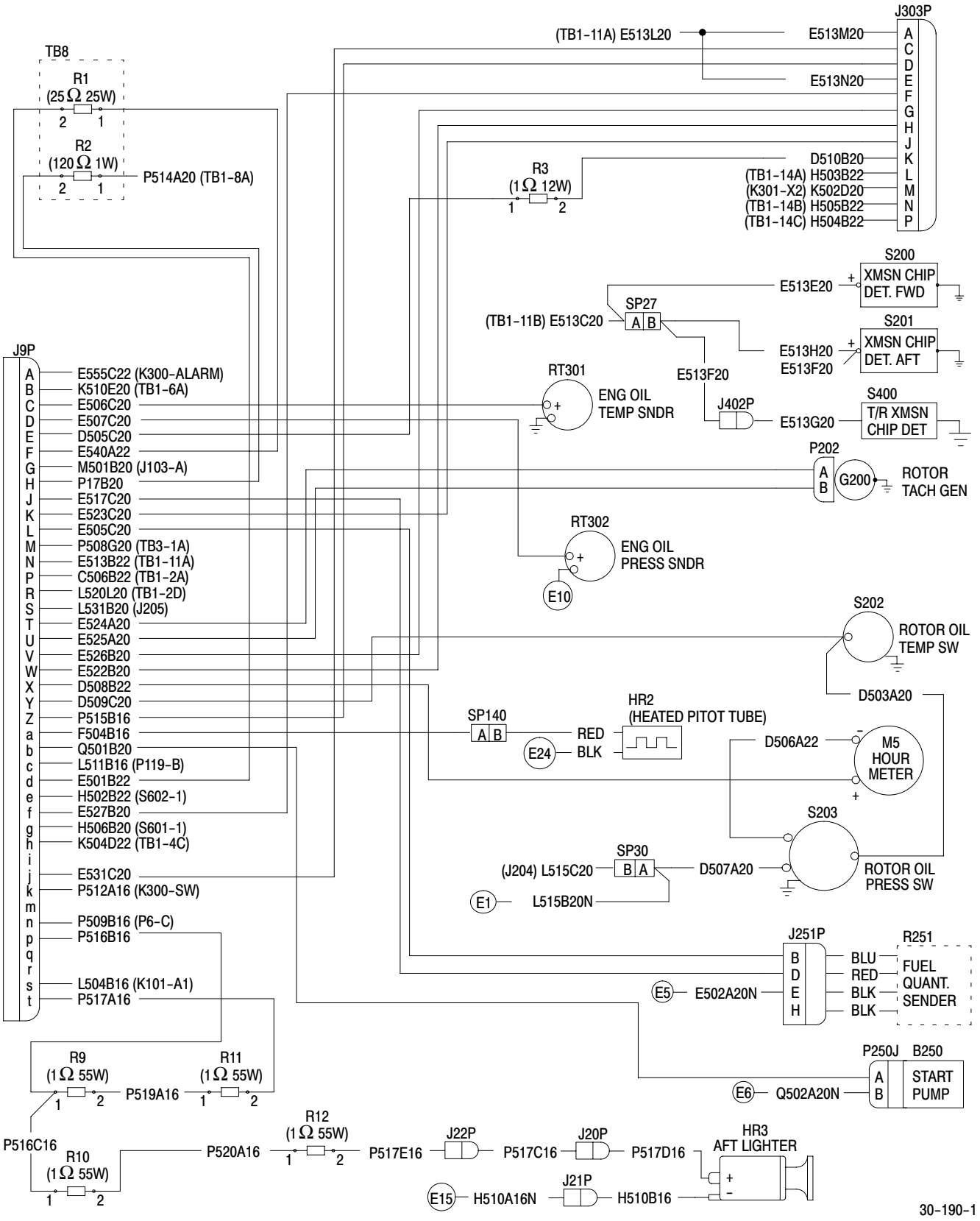


Figure 20-6. Fuselage Wiring Diagram (369HS; 0201 - 0410) (369HE; 101 - 215) (369HM; 201 - 247) (Sheet 1 of 7)

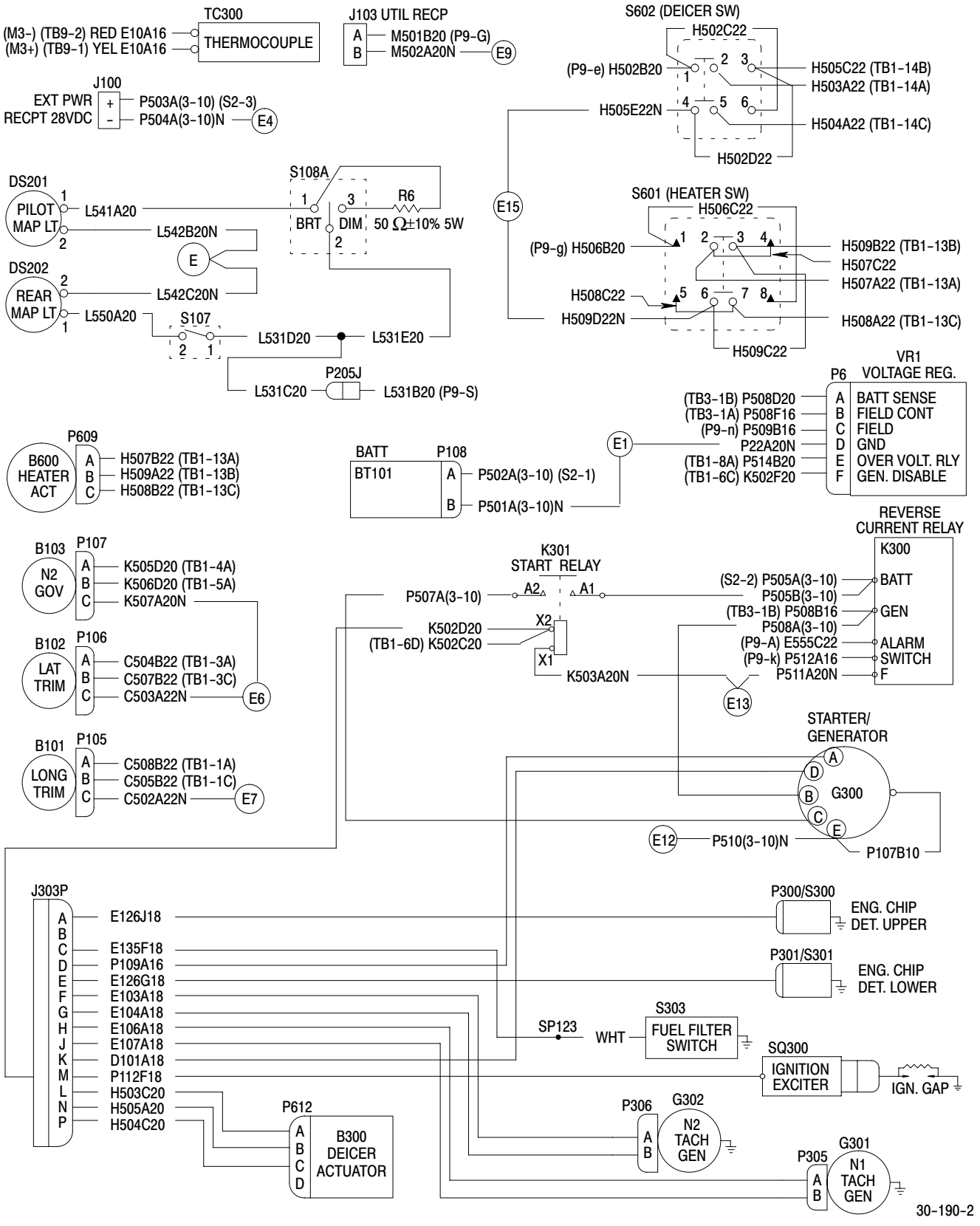


Figure 20-6. Fuselage Wiring Diagram (369HS; 0201 - 0410) (369HE; 101 - 215) (369HM; 201 - 247) (Sheet 2 of 7)

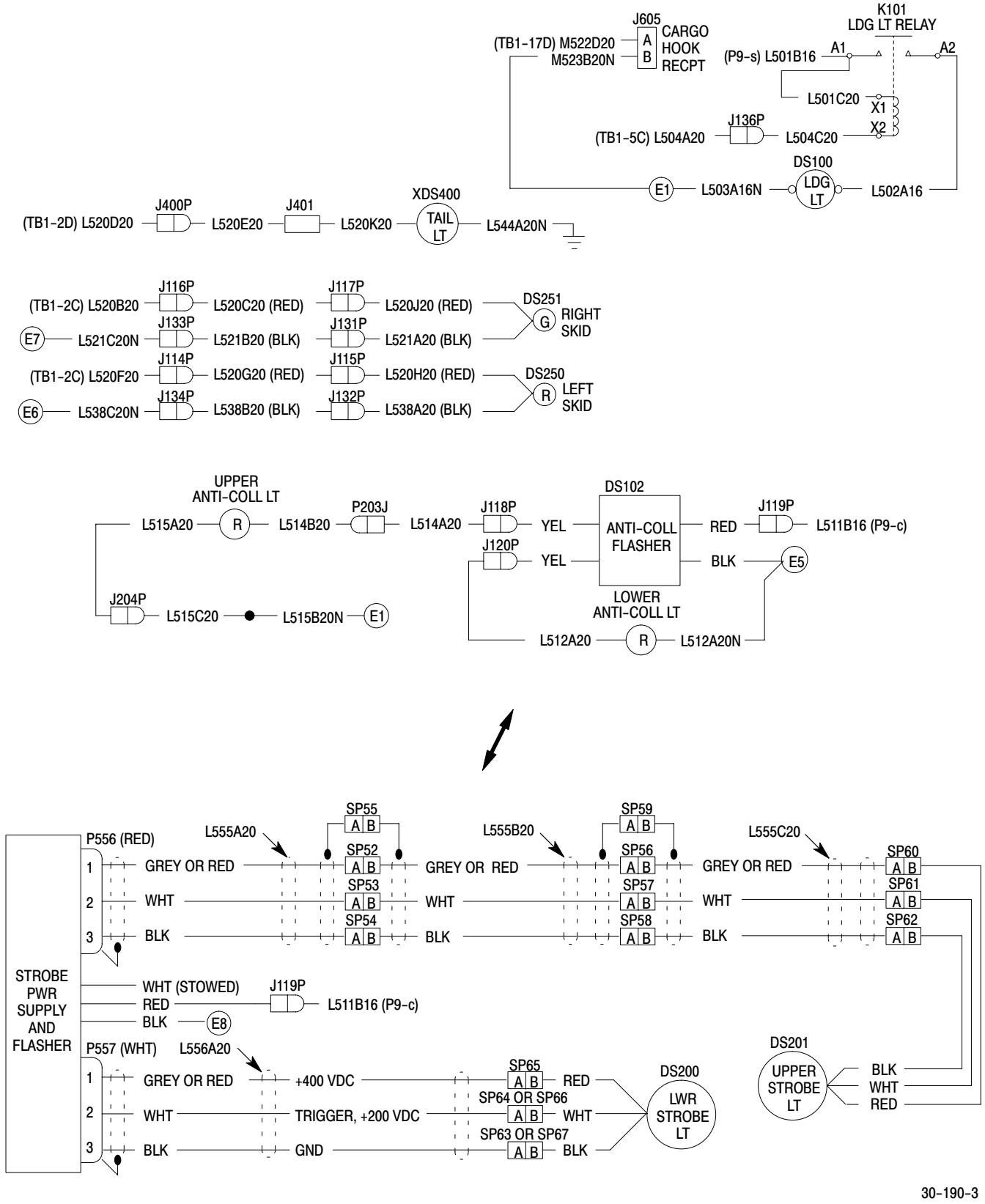


Figure 20-6. Fuselage Wiring Diagram (369HS; 0201 - 0410) (369HE; 101 - 215) (369HM; 201 - 247) (Sheet 3 of 7)

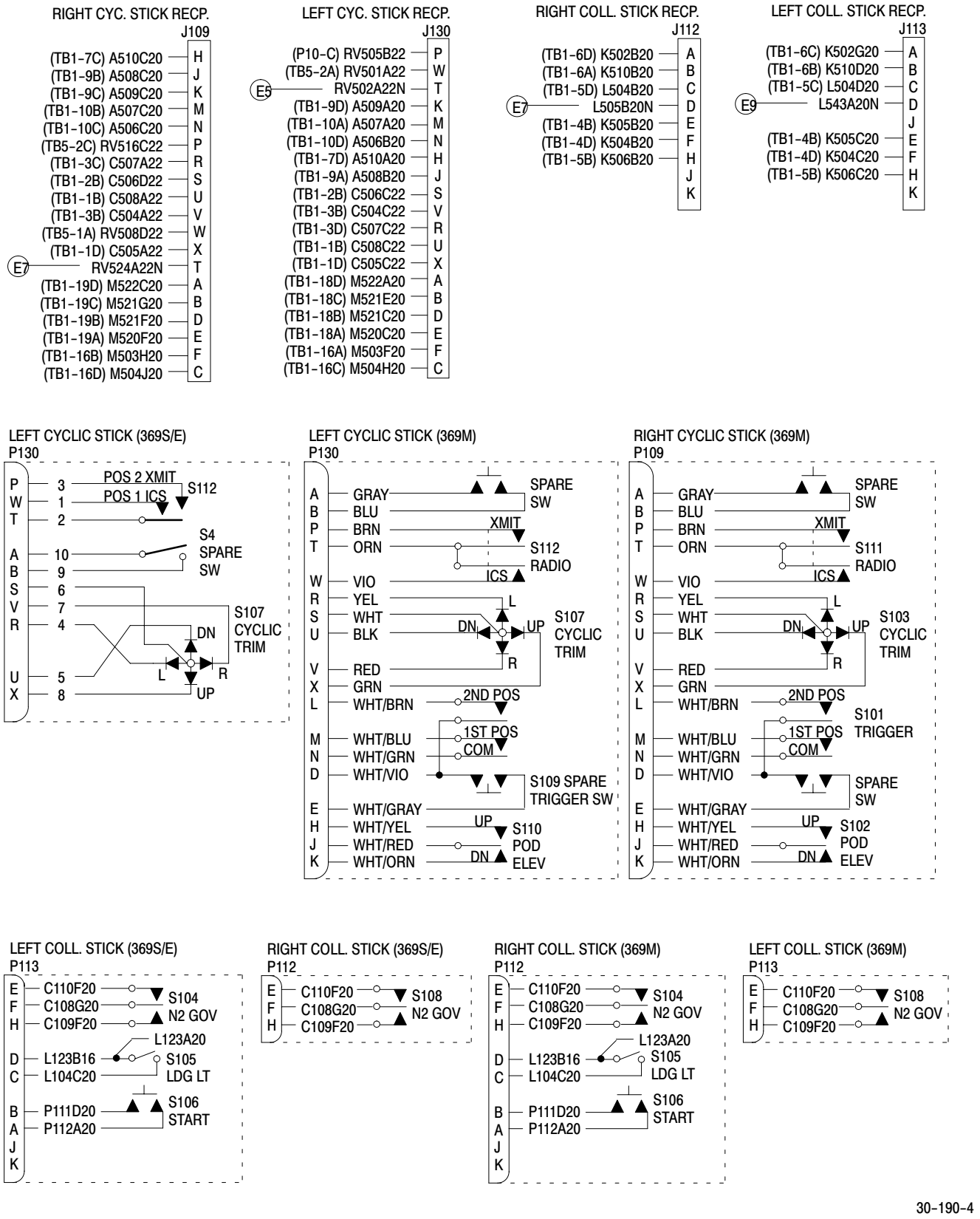


Figure 20-6. Fuselage Wiring Diagram (369HS; 0201 - 0410) (369HE; 101 - 215) (369HM; 201 - 247) (Sheet 4 of 7)

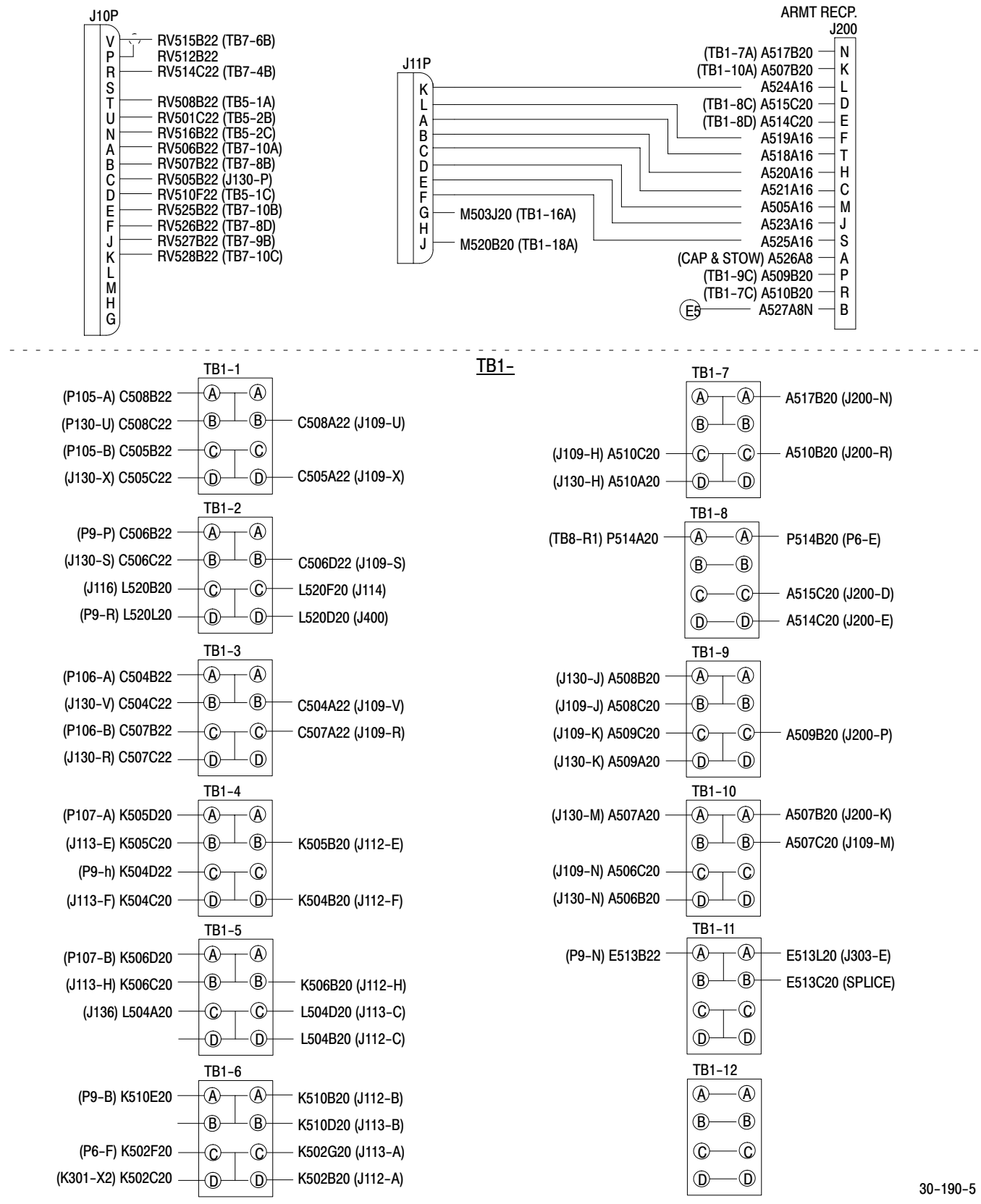


Figure 20-6. Fuselage Wiring Diagram (369HS; 0201 - 0410) (369HE; 101 - 215) (369HM; 201 - 247) (Sheet 5 of 7)

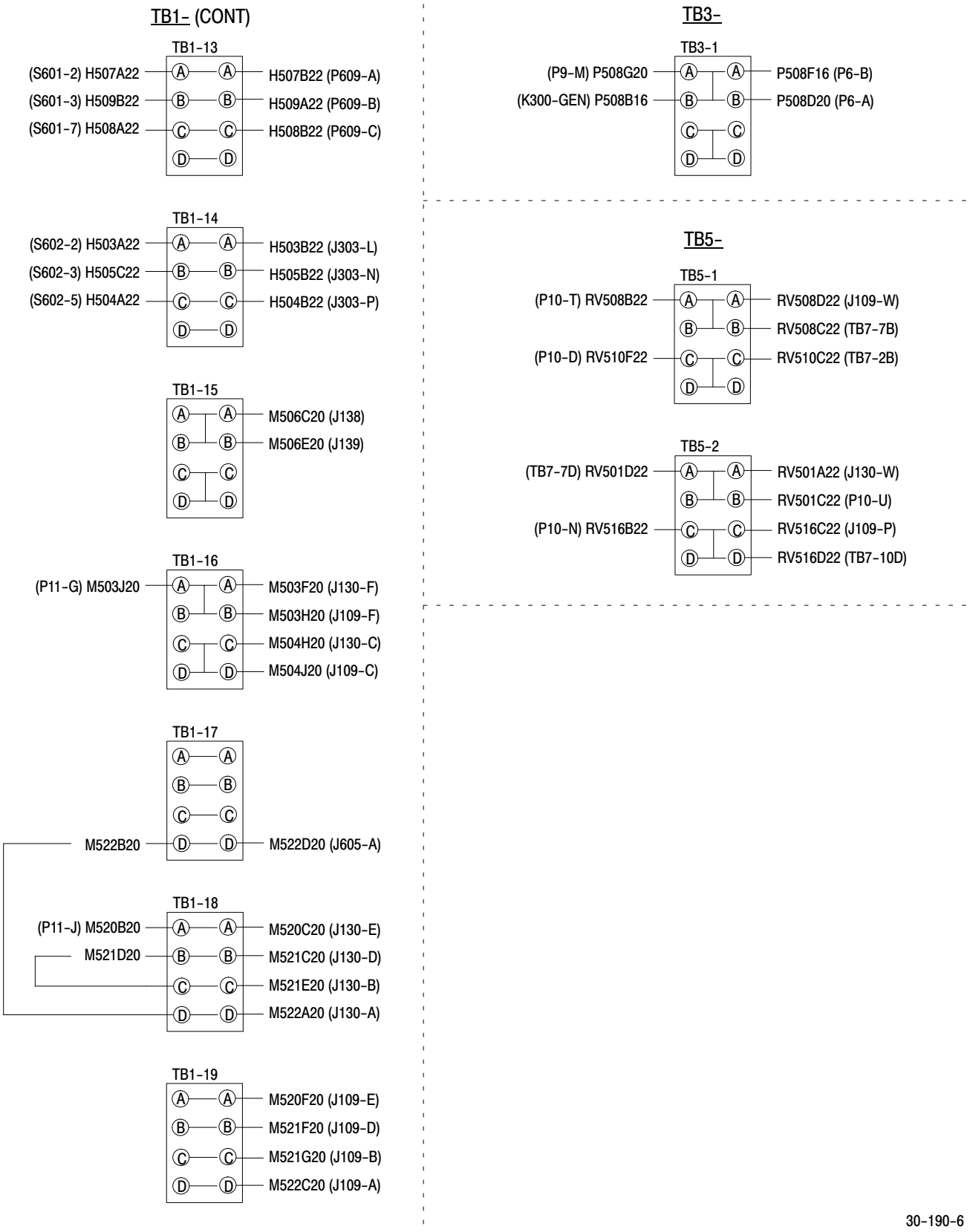


Figure 20-6. Fuselage Wiring Diagram (369HS; 0201 - 0410) (369HE; 101 - 215) (369HM; 201 - 247) (Sheet 6 of 7)

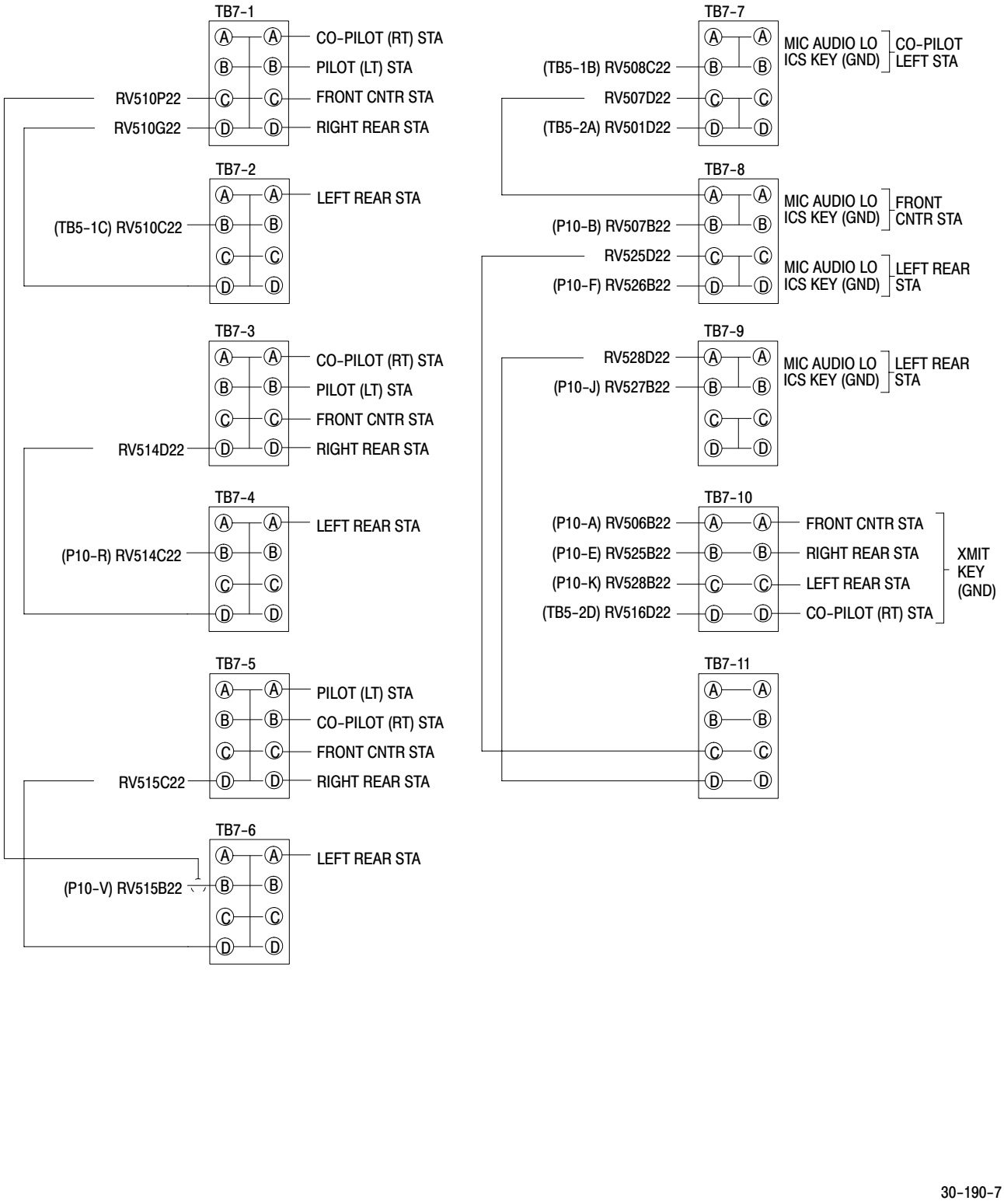
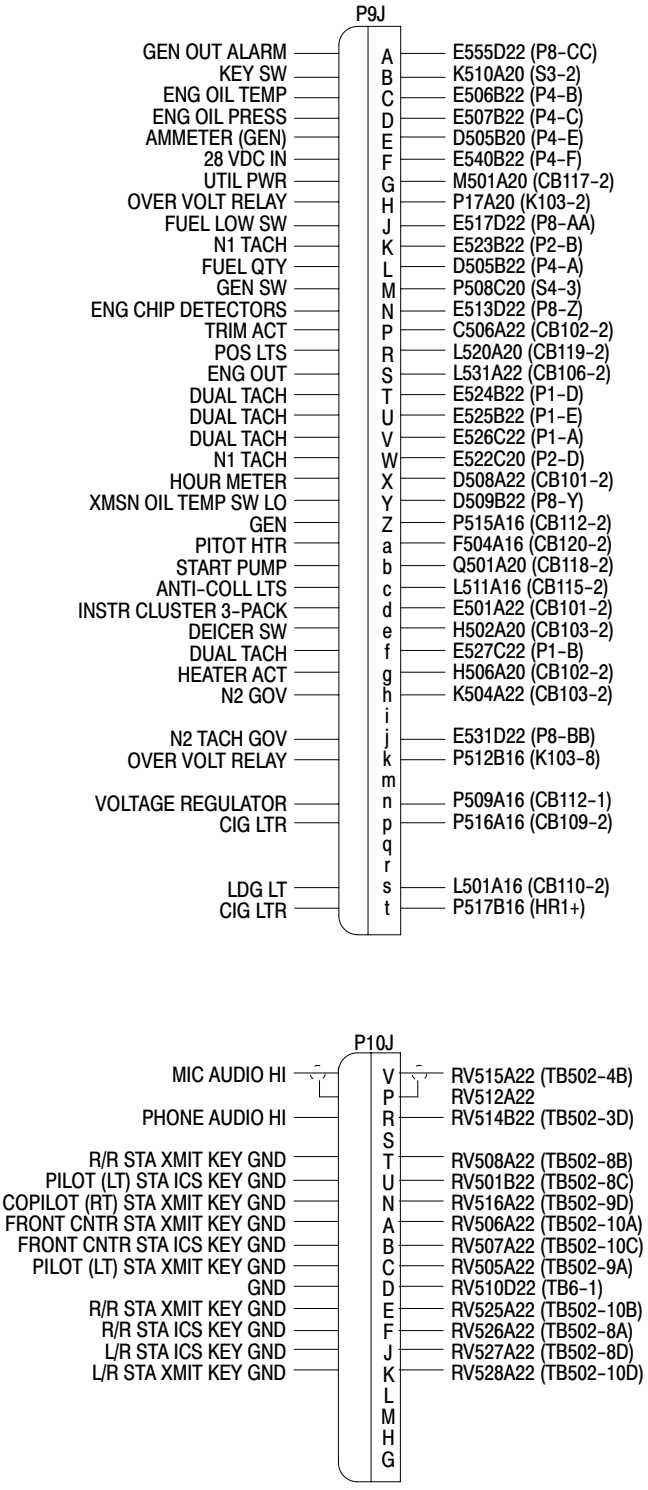


Figure 20-6. Fuselage Wiring Diagram (369HS; 0201 - 0410) (369HE; 101 - 215) (369HM; 201 - 247) (Sheet 7 of 7)



30-190-8

Figure 20-7. Console Wiring Diagram, Instrument Panel Type A (369HS; 0201 - 0410) (369HE; 101 - 215) (369HM; 201 - 247) (Sheet 1 of 4)

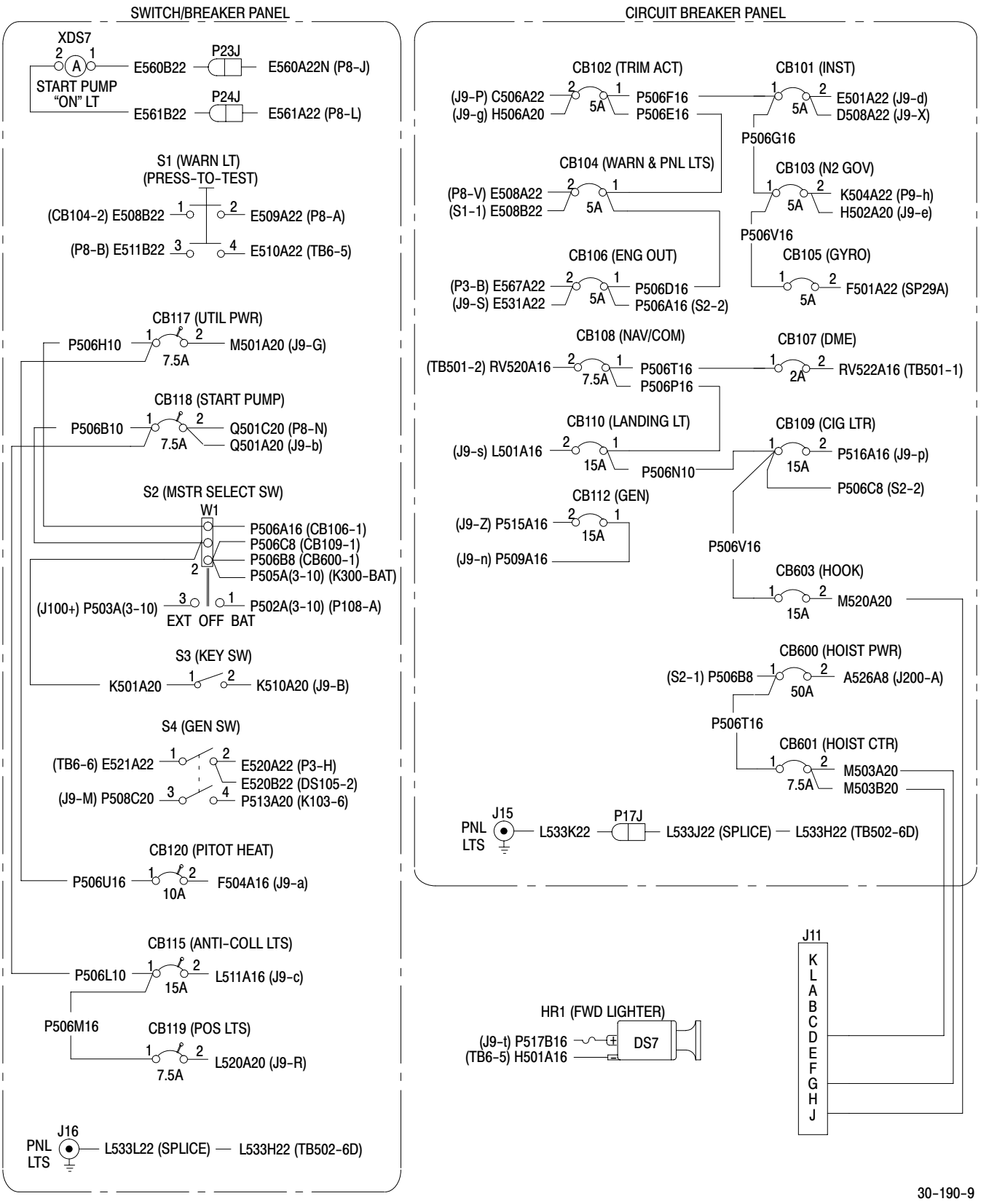


Figure 20-7. Console Wiring Diagram, Instrument Panel Type A (369HS; 0201 - 0410) (369HE; 101 - 215) (369HM; 201 - 247) (Sheet 2 of 4)

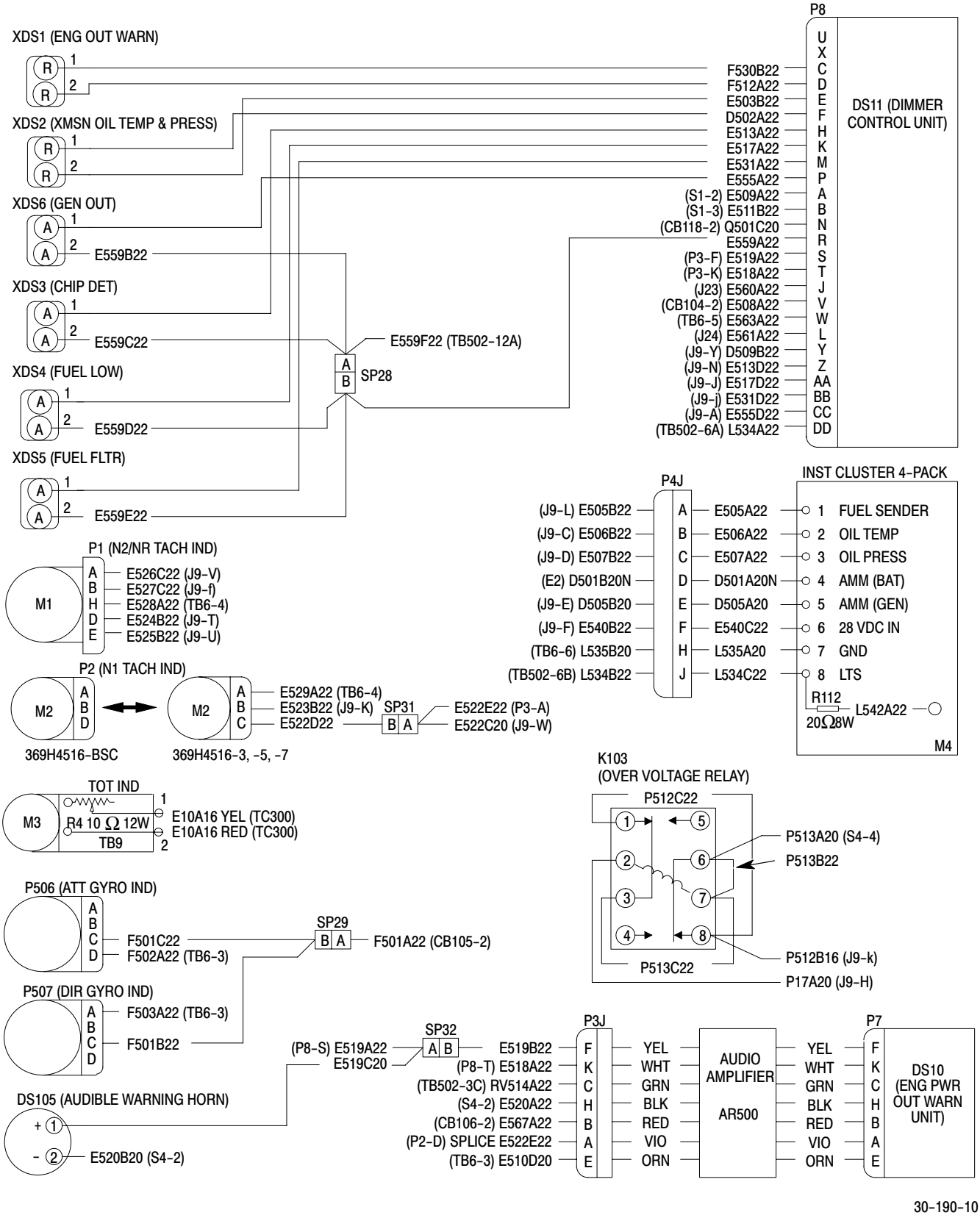


Figure 20-7. Console Wiring Diagram, Instrument Panel Type A (369HS; 0201 - 0410) (369HE; 101 - 215) (369HM; 201 - 247) (Sheet 3 of 4)

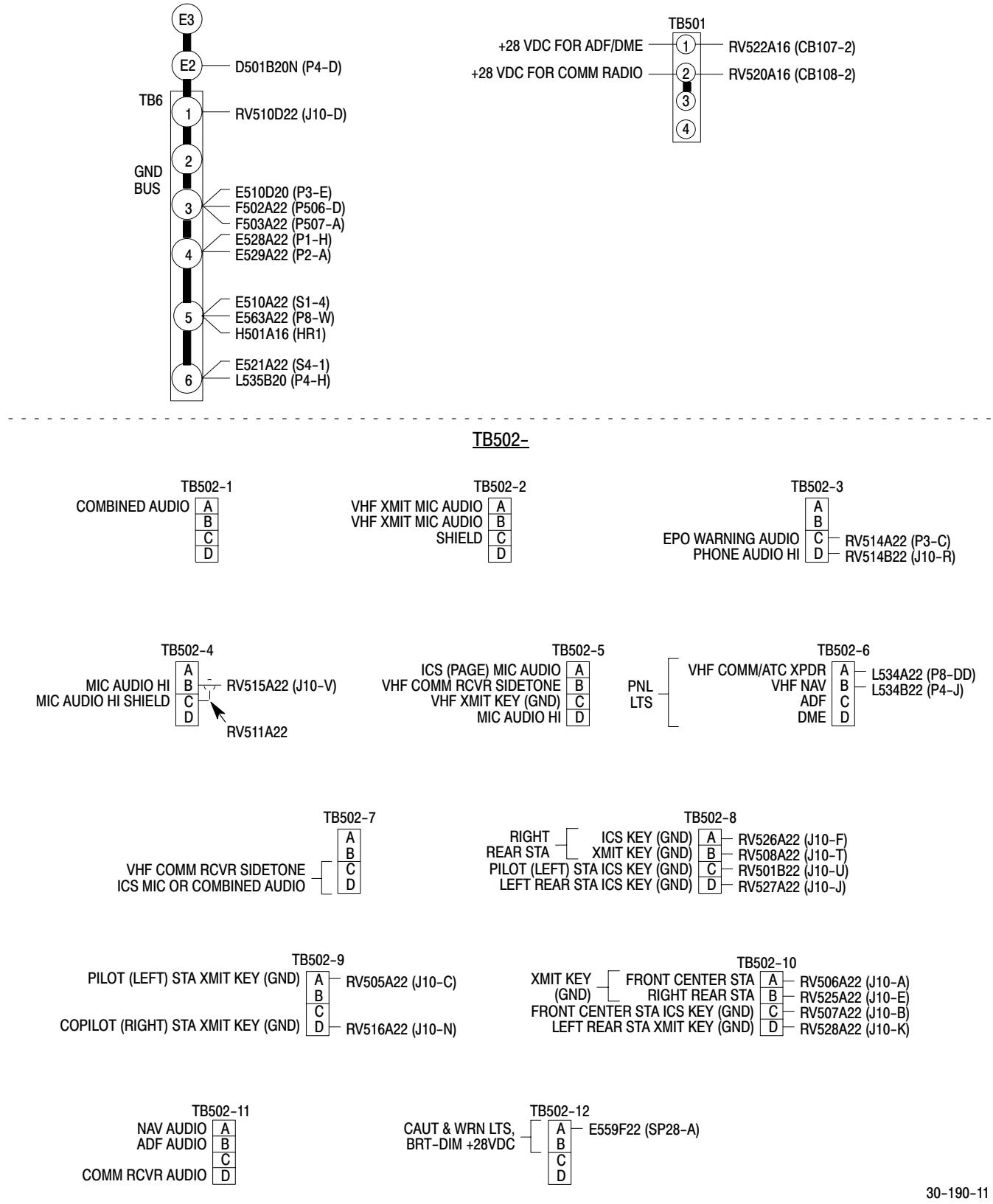


Figure 20-7. Console Wiring Diagram, Instrument Panel Type A (369HS; 0201 - 0410) (369HE; 101 - 215) (369HM; 201 - 247) (Sheet 4 of 4)

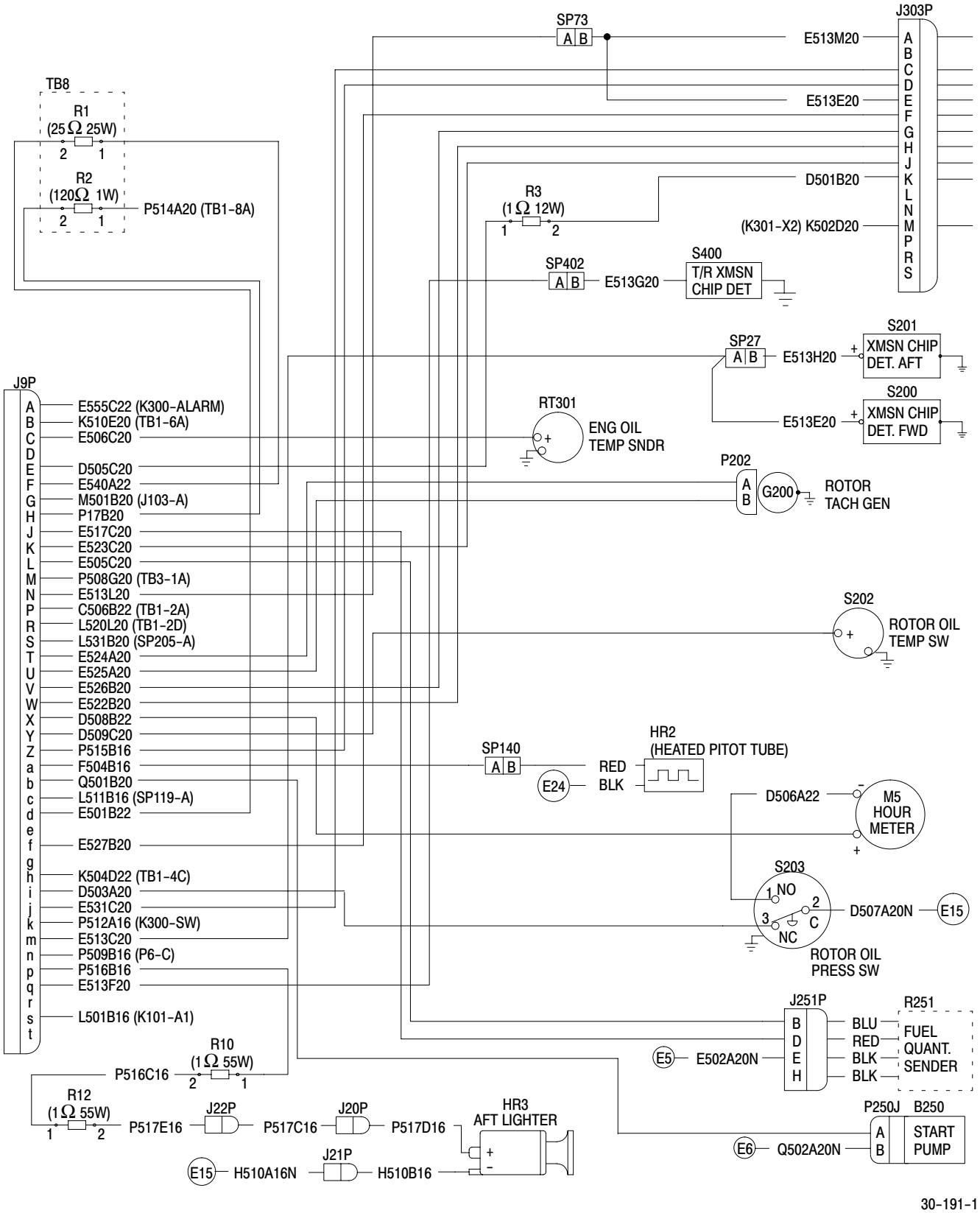


Figure 20-8. Fuselage Wiring Diagram (369HS; 0411 - 0625) (Sheet 1 of 7)

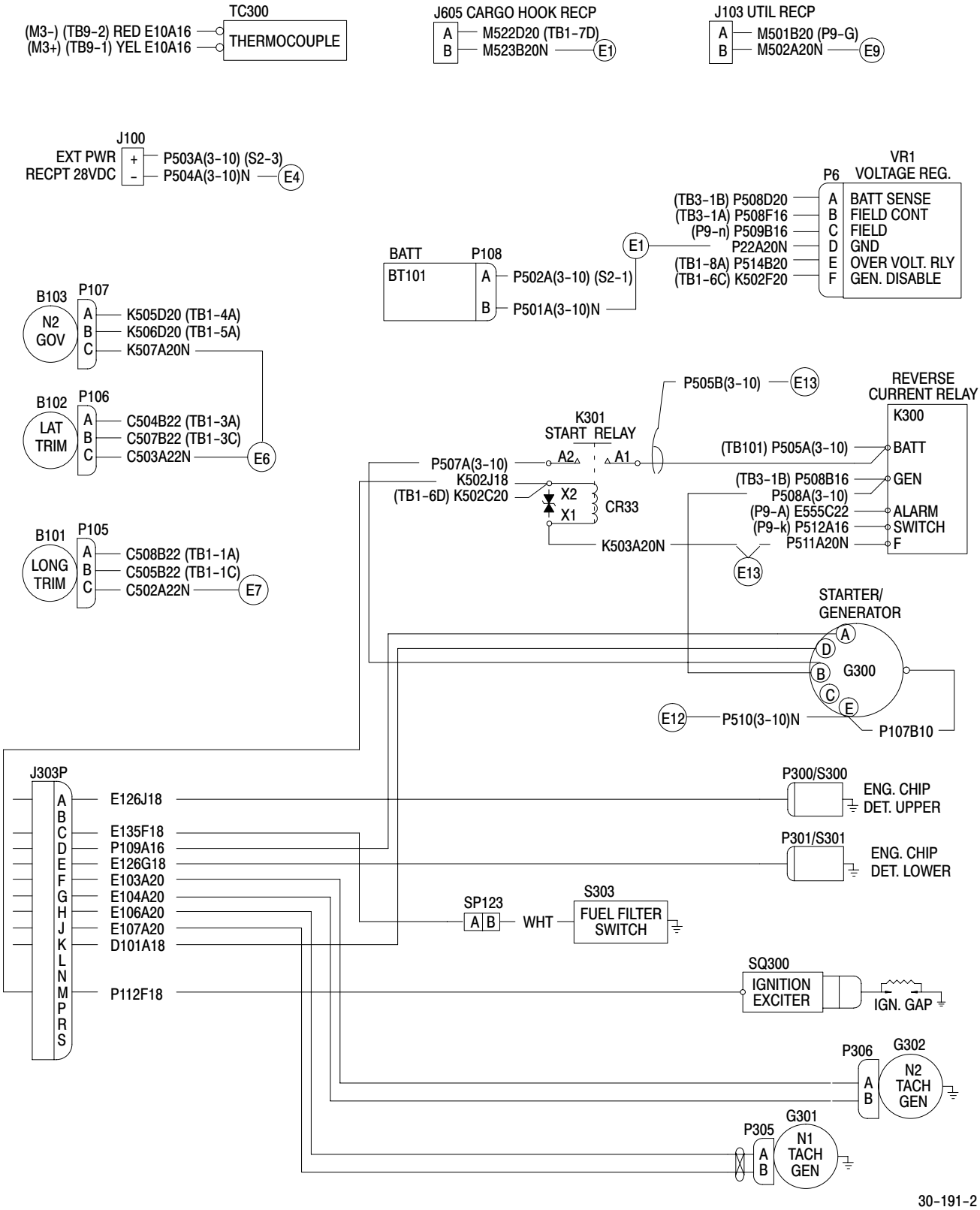


Figure 20-8. Fuselage Wiring Diagram (369HS; 0411 - 0625) (Sheet 2 of 7)

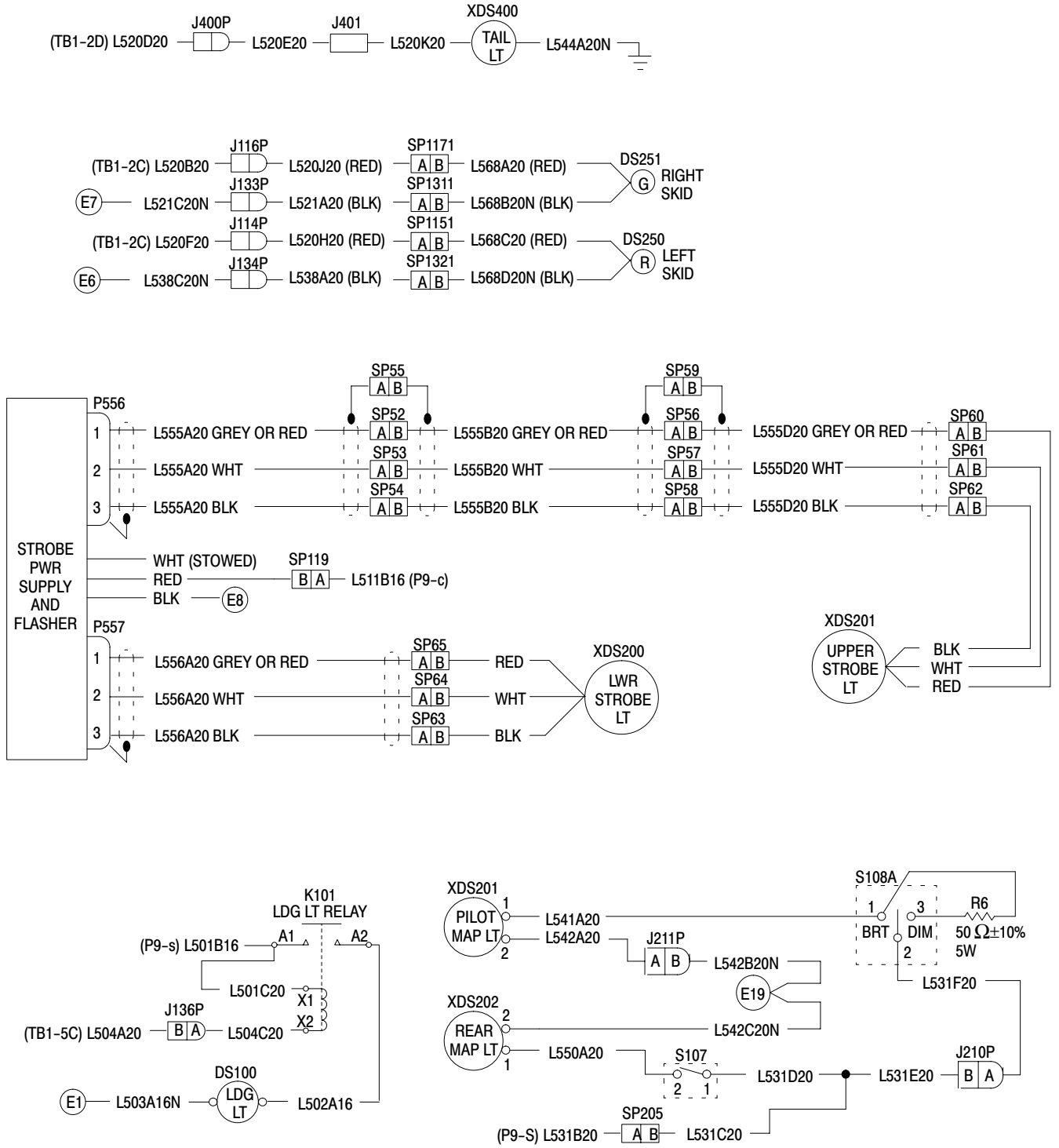


Figure 20-8. Fuselage Wiring Diagram (369HS; 0411 - 0625) (Sheet 3 of 7)

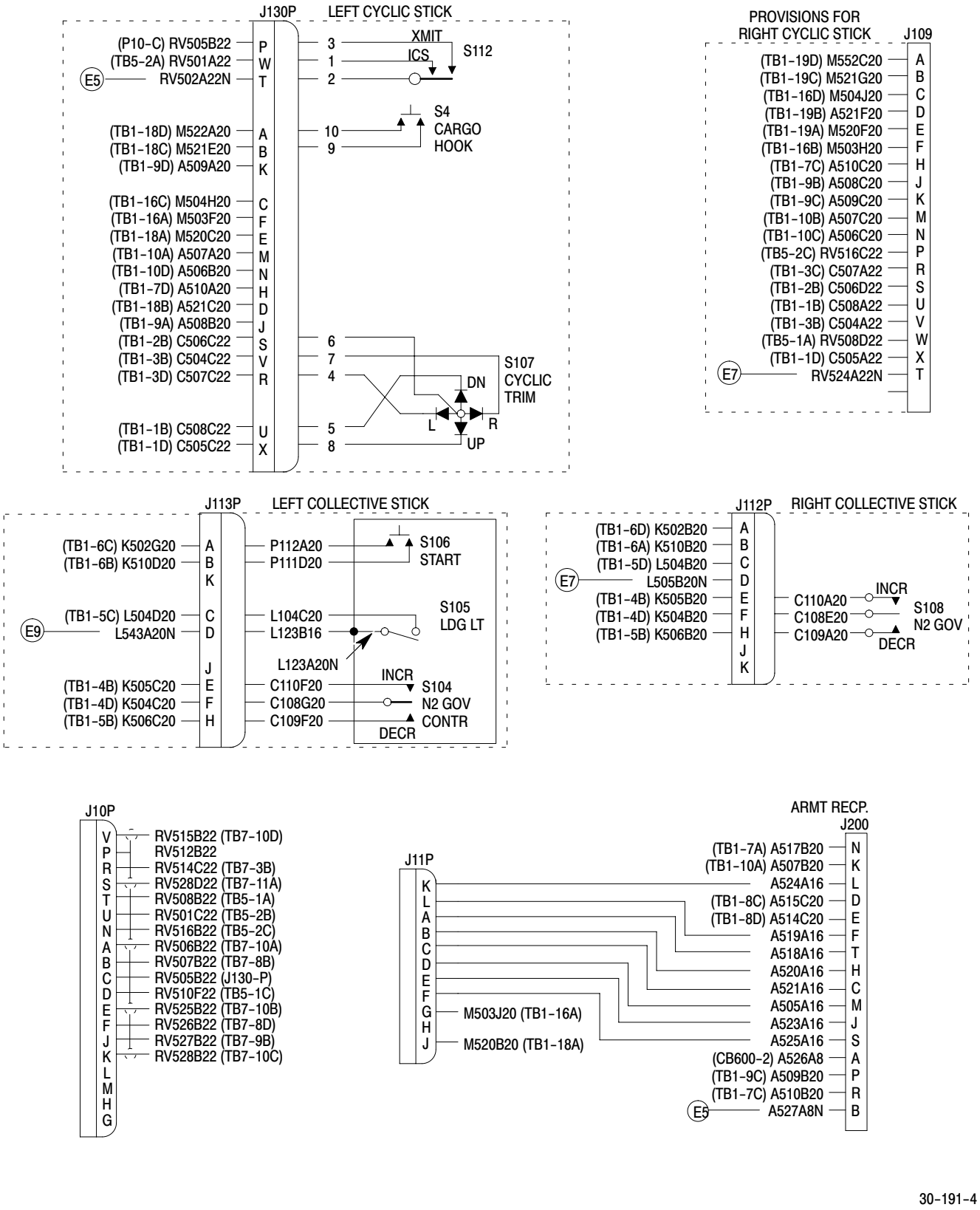


Figure 20-8. Fuselage Wiring Diagram (369HS; 0411 - 0625) (Sheet 4 of 7)

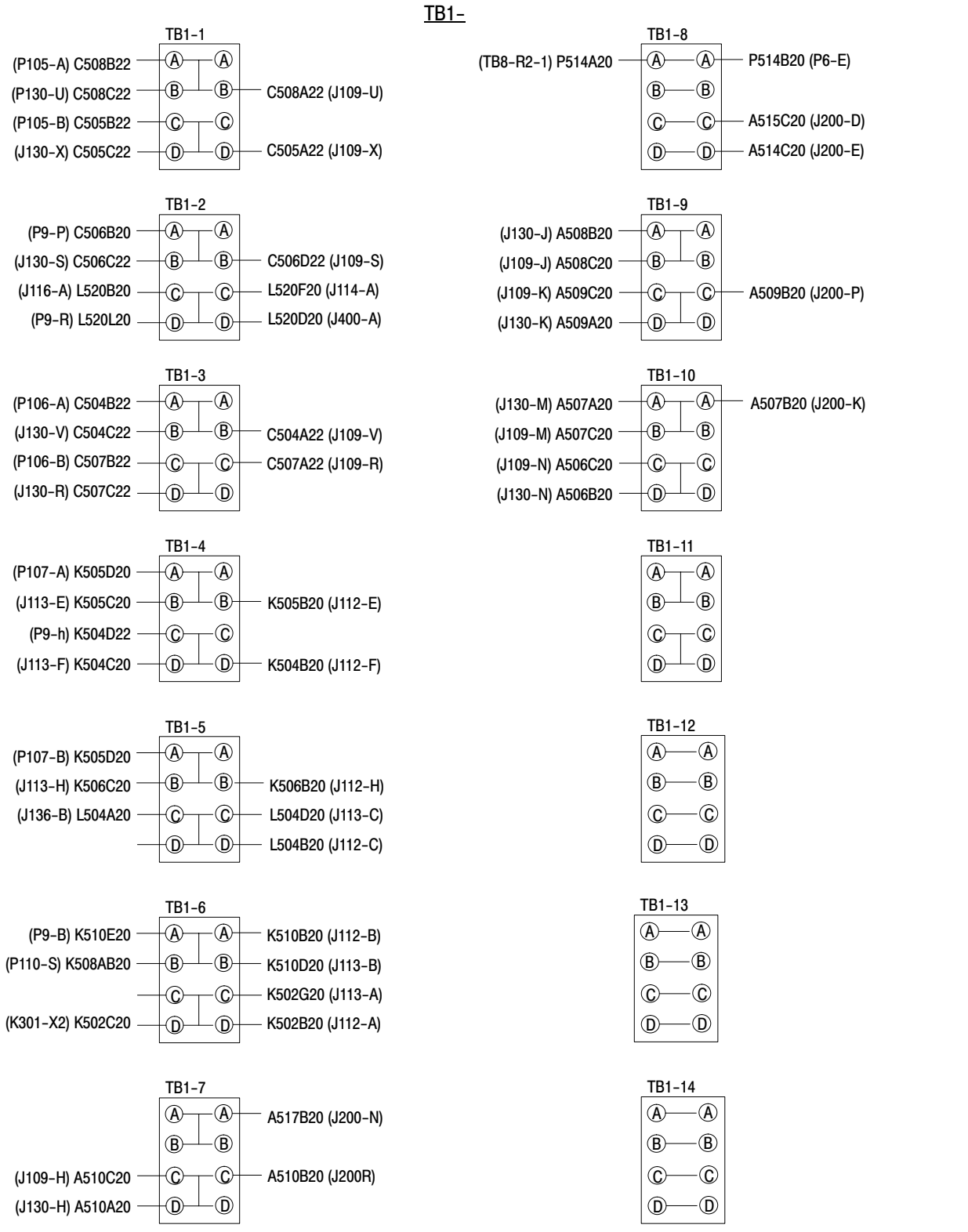


Figure 20-8. Fuselage Wiring Diagram (369HS; 0411 - 0625) (Sheet 5 of 7)

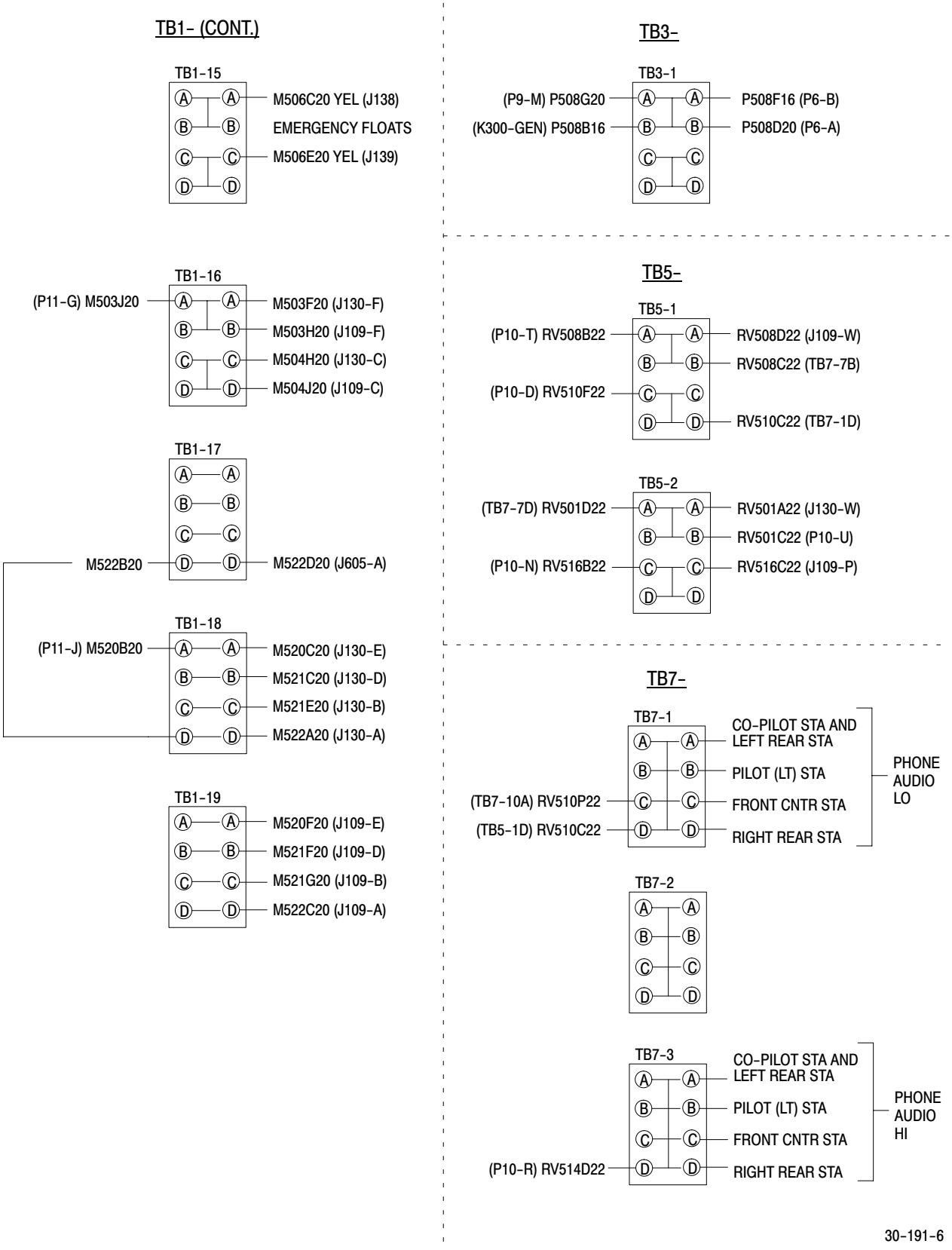
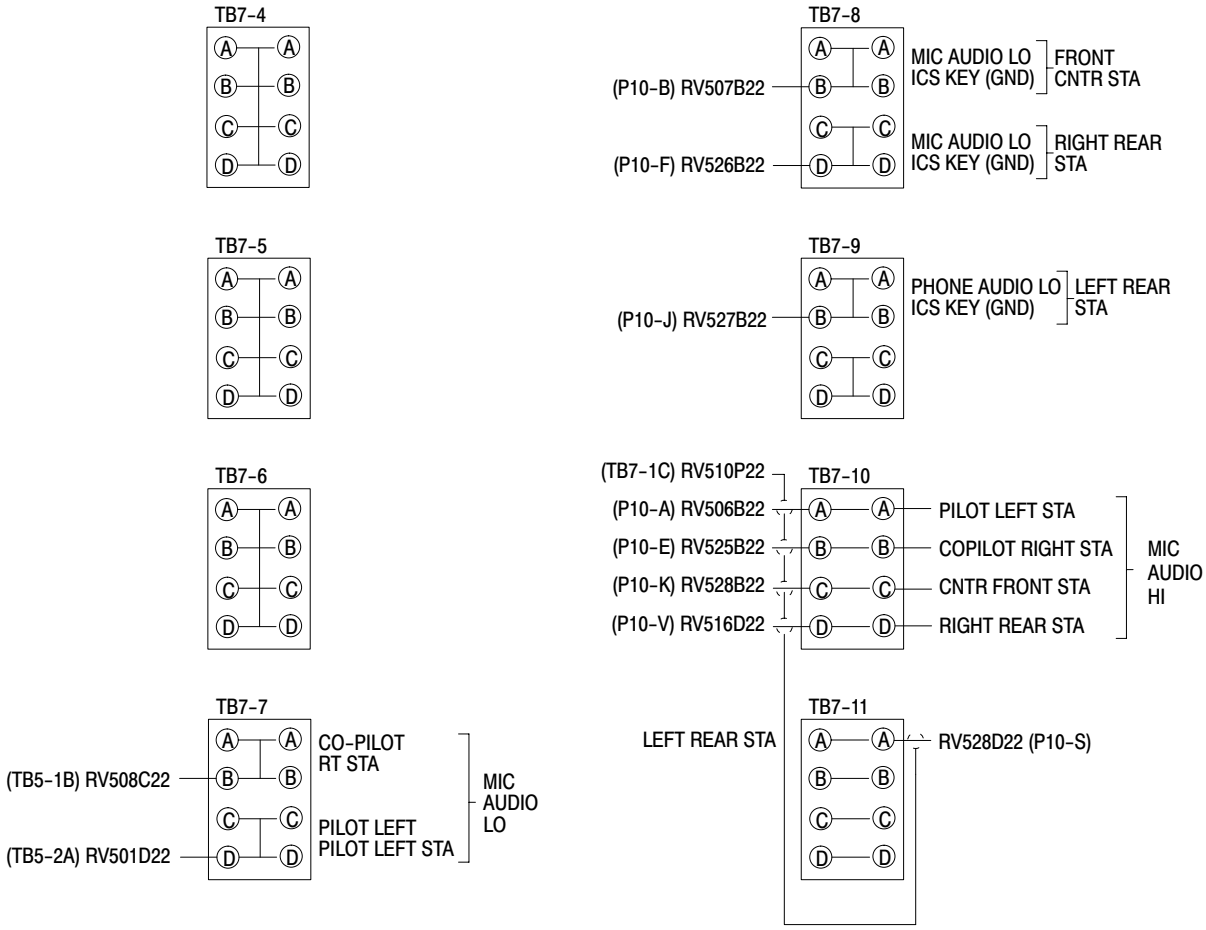


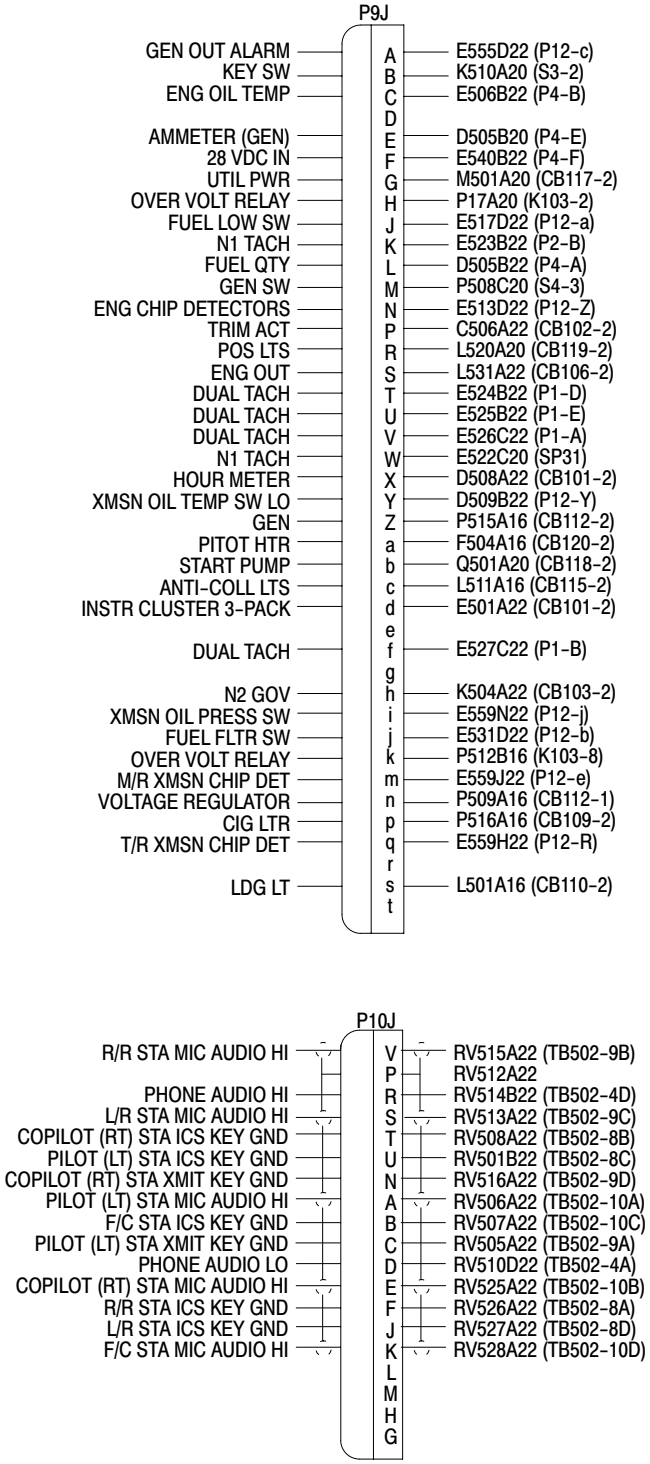
Figure 20-8. Fuselage Wiring Diagram (369HS; 0411 - 0625) (Sheet 6 of 7)

TB7- (CONT)



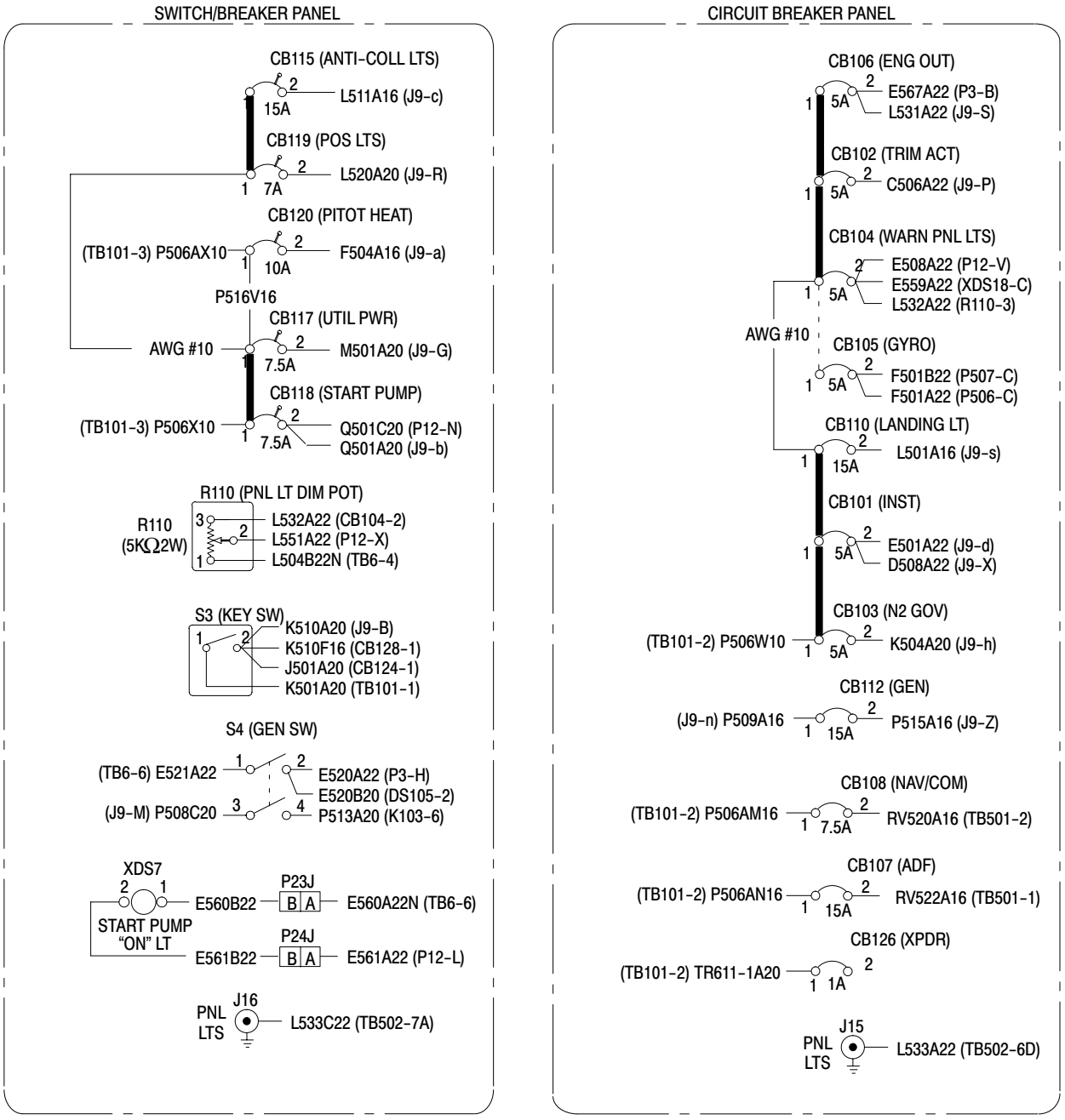
30-191-7

Figure 20-8. Fuselage Wiring Diagram (369HS; 0411 - 0625) (Sheet 7 of 7)



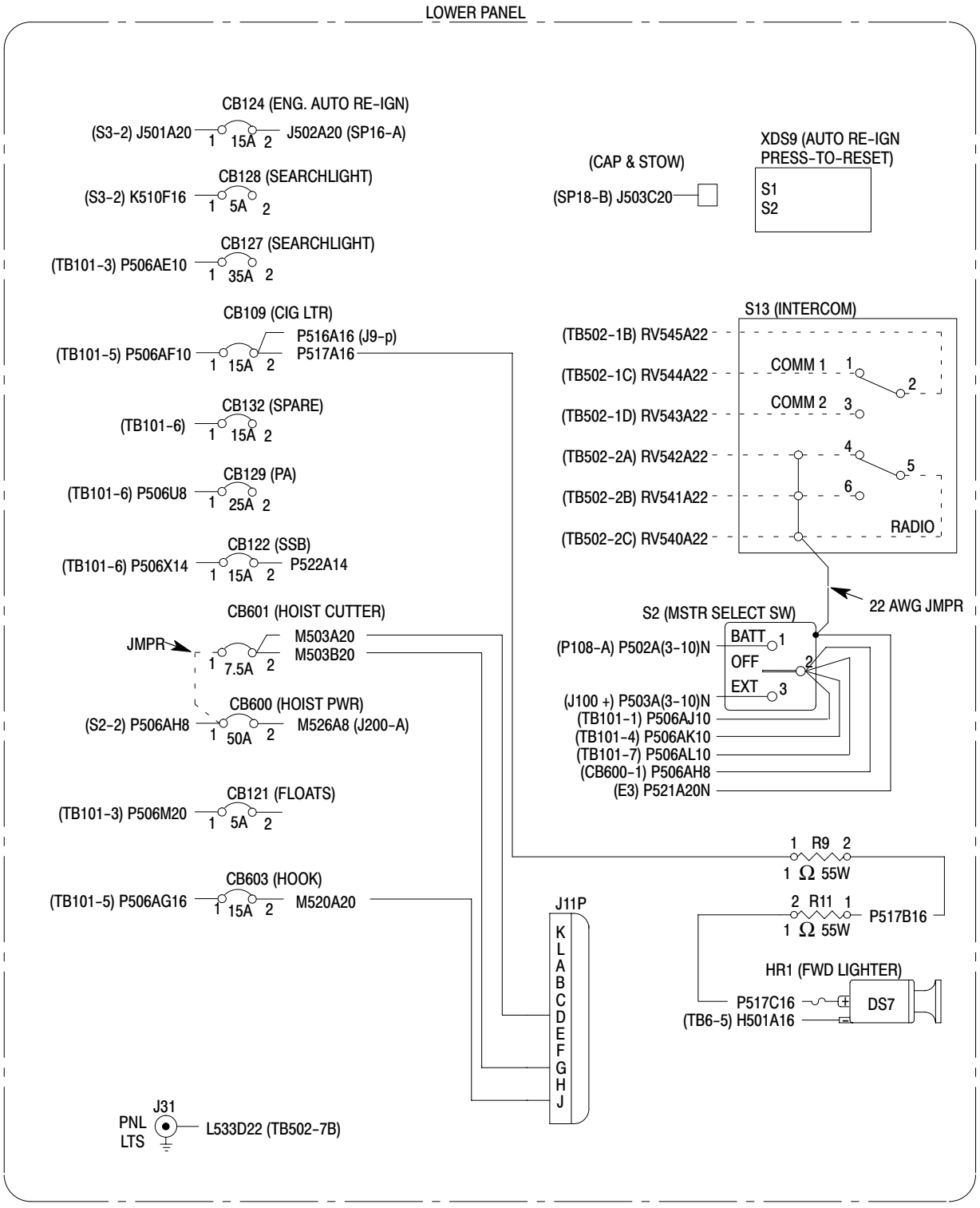
30-191-8

Figure 20-9. Console Wiring Diagram, Instrument Panel Type B (369HS; 0411 - 0625) (Sheet 1 of 6)



30-191-9

Figure 20-9. Console Wiring Diagram, Instrument Panel Type B369HS; 0411 - 0625) (Sheet 2 of 6)



30-191-10

Figure 20-9. Console Wiring Diagram, Instrument Panel Type B (369HS; 0411 - 0625) (Sheet 3 of 6)

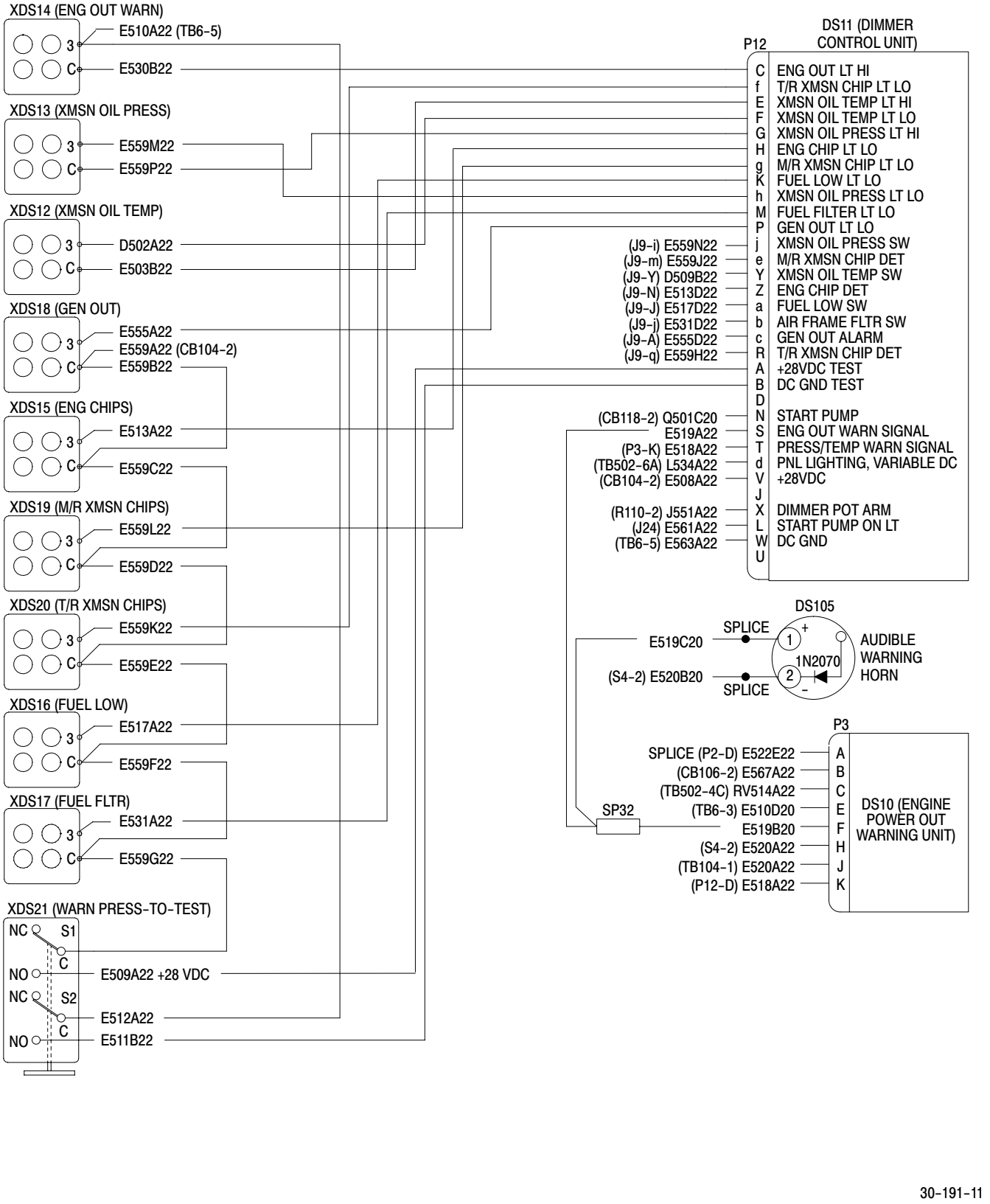


Figure 20-9. Console Wiring Diagram, Instrument Panel Type B (369HS; 0411 - 0625) (Sheet 4 of 6)

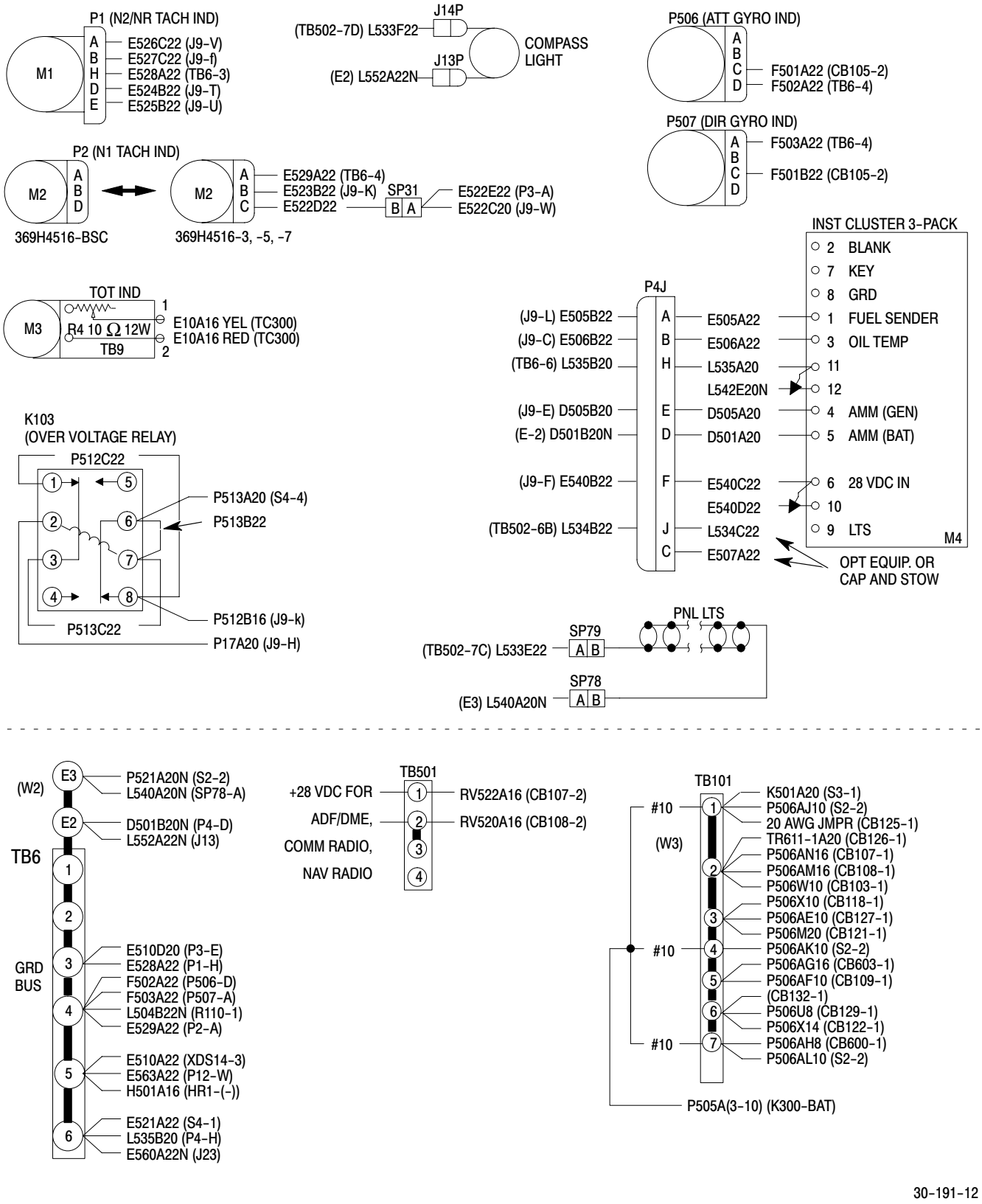
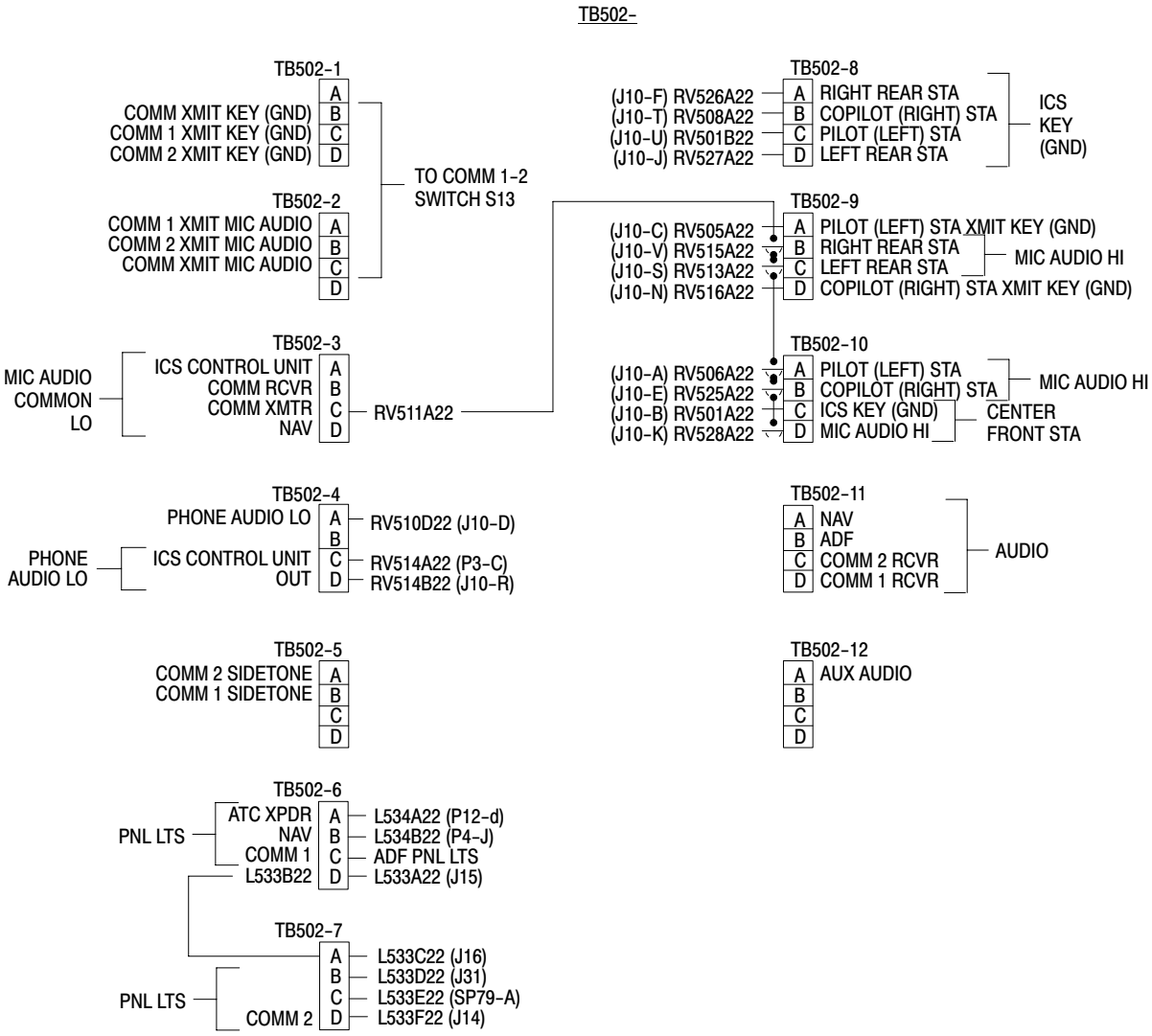


Figure 20-9. Console Wiring Diagram, Instrument Panel Type B (369HS; 0411 - 0625) (Sheet 5 of 6)



30-191-13

Figure 20-9. Console Wiring Diagram, Instrument Panel Type B (369HS; 0411 - 0625) (Sheet 6 of 6)

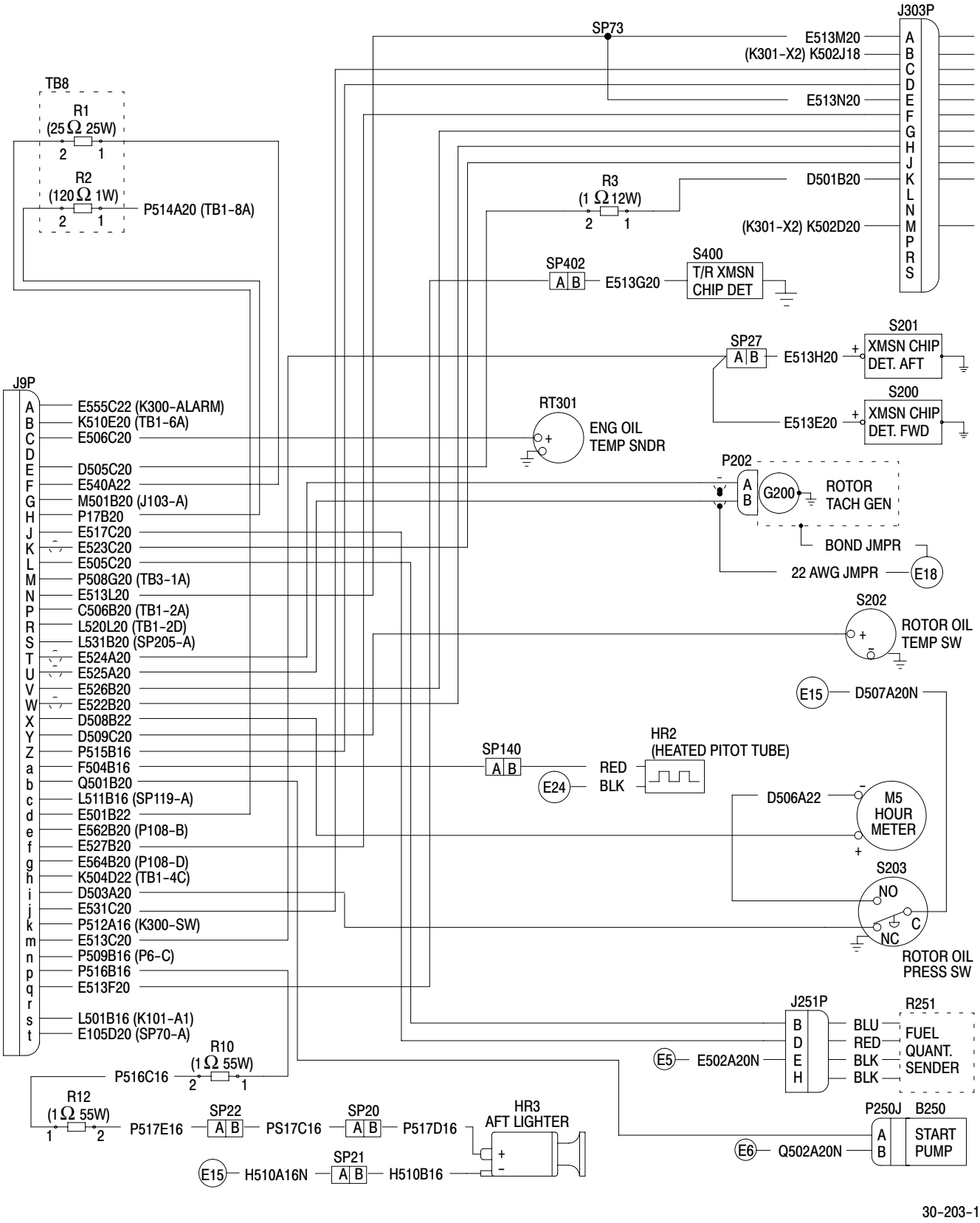


Figure 20-10. Fuselage Wiring Diagram (369HS; 0626 & Subs) (Sheet 1 of 6)

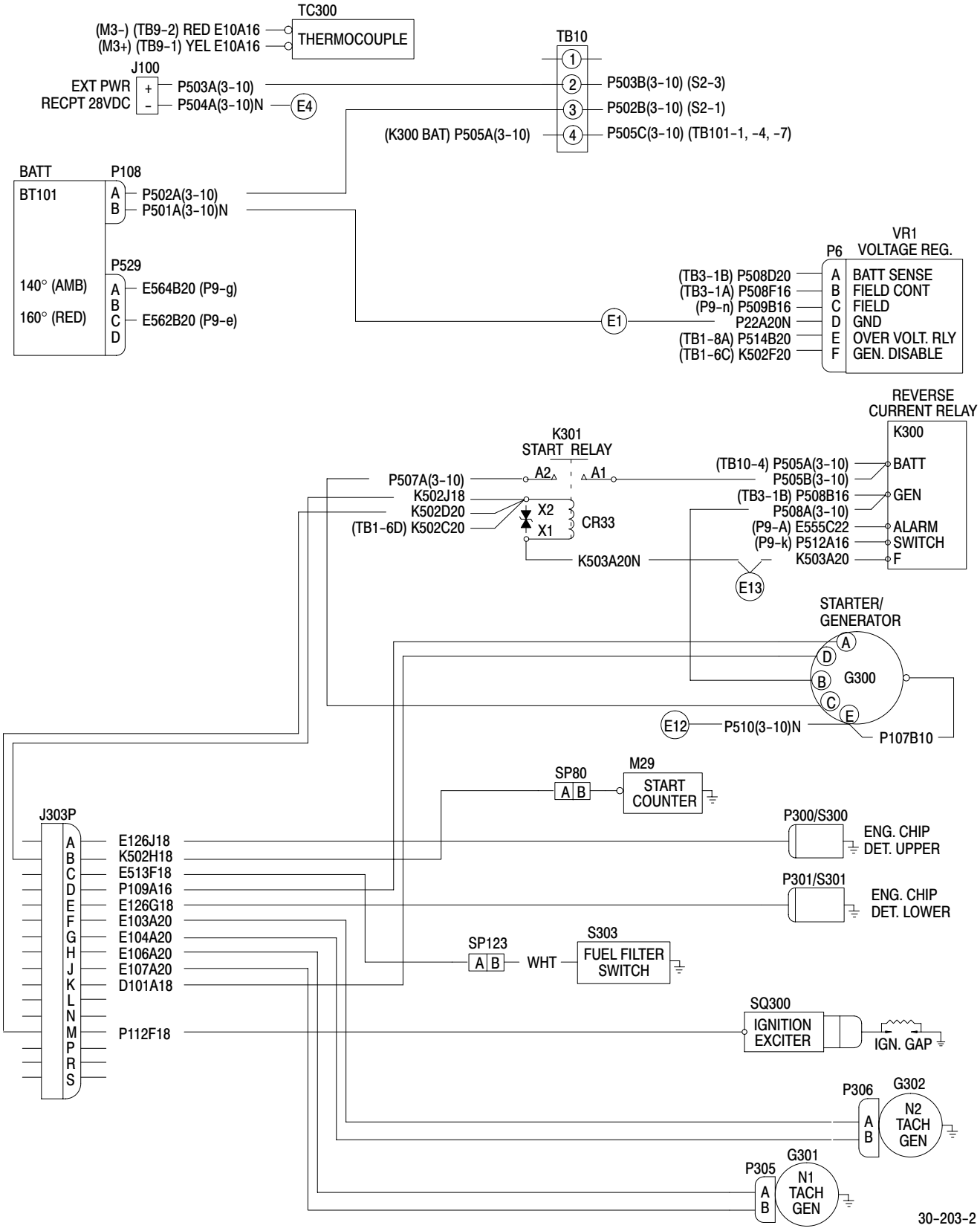


Figure 20-10. Fuselage Wiring Diagram (369HS; 0626 & Subs) (Sheet 2 of 6)

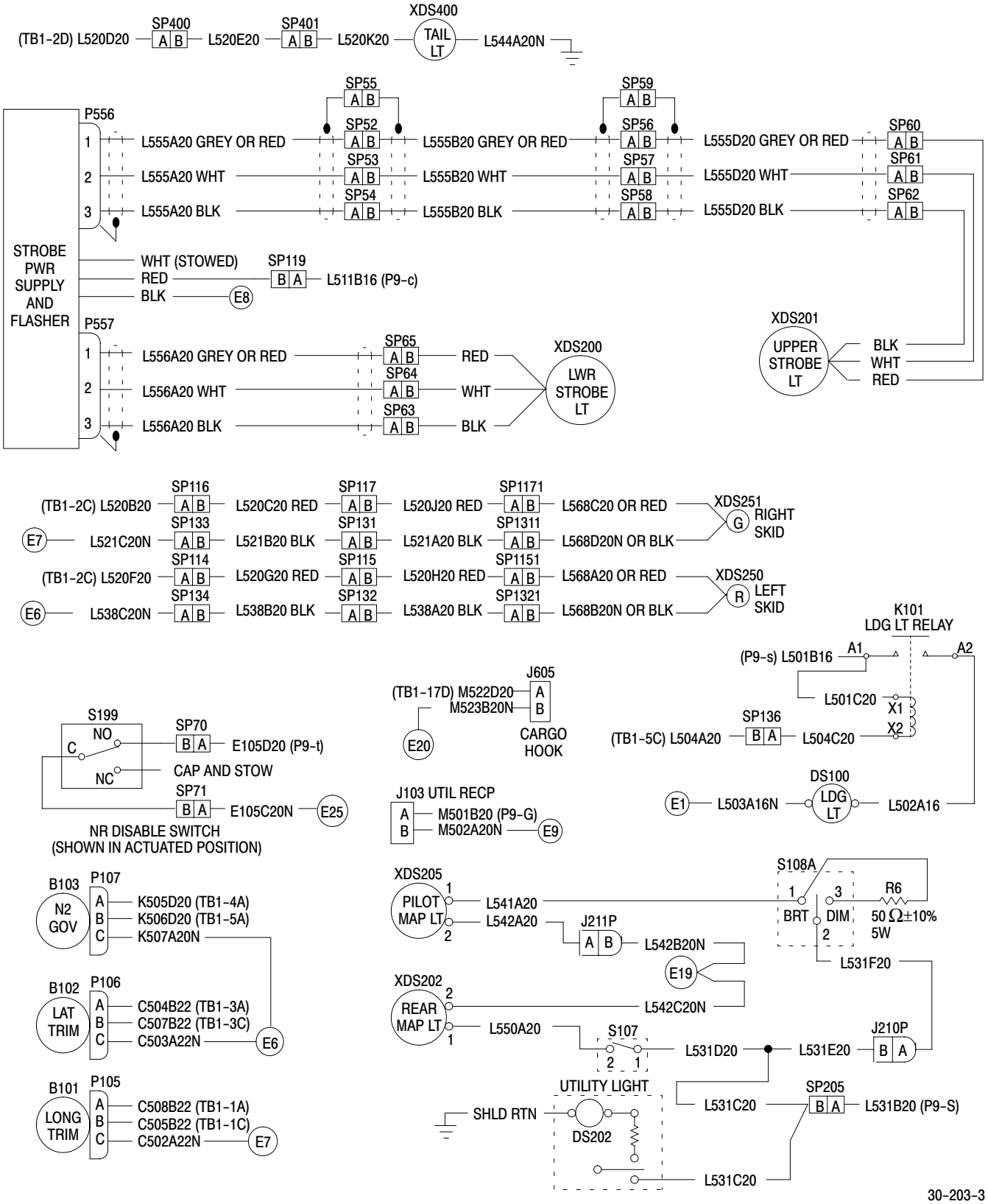


Figure 20-10. Fuselage Wiring Diagram (369HS; 0626 & Subs) (Sheet 3 of 6)

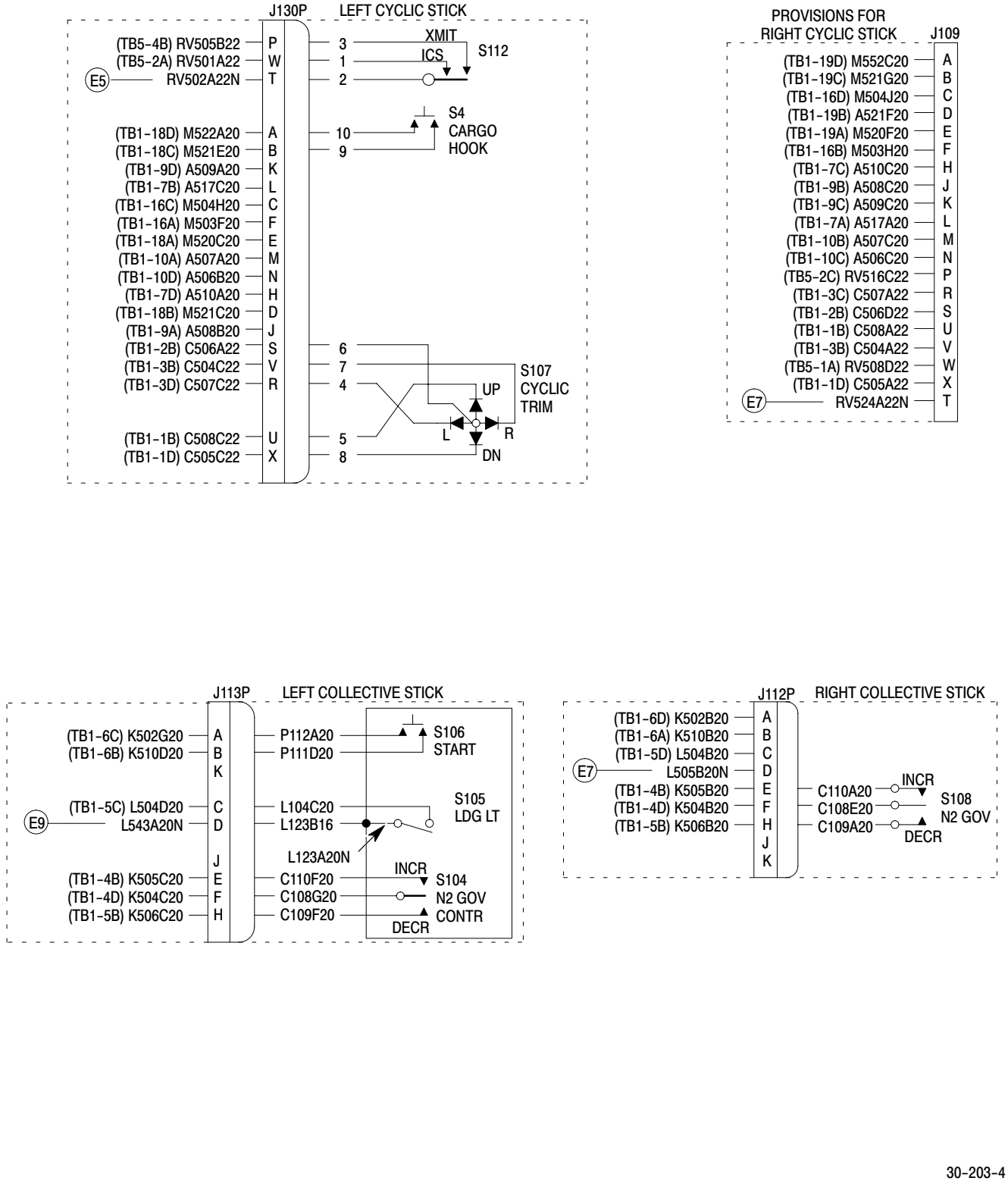
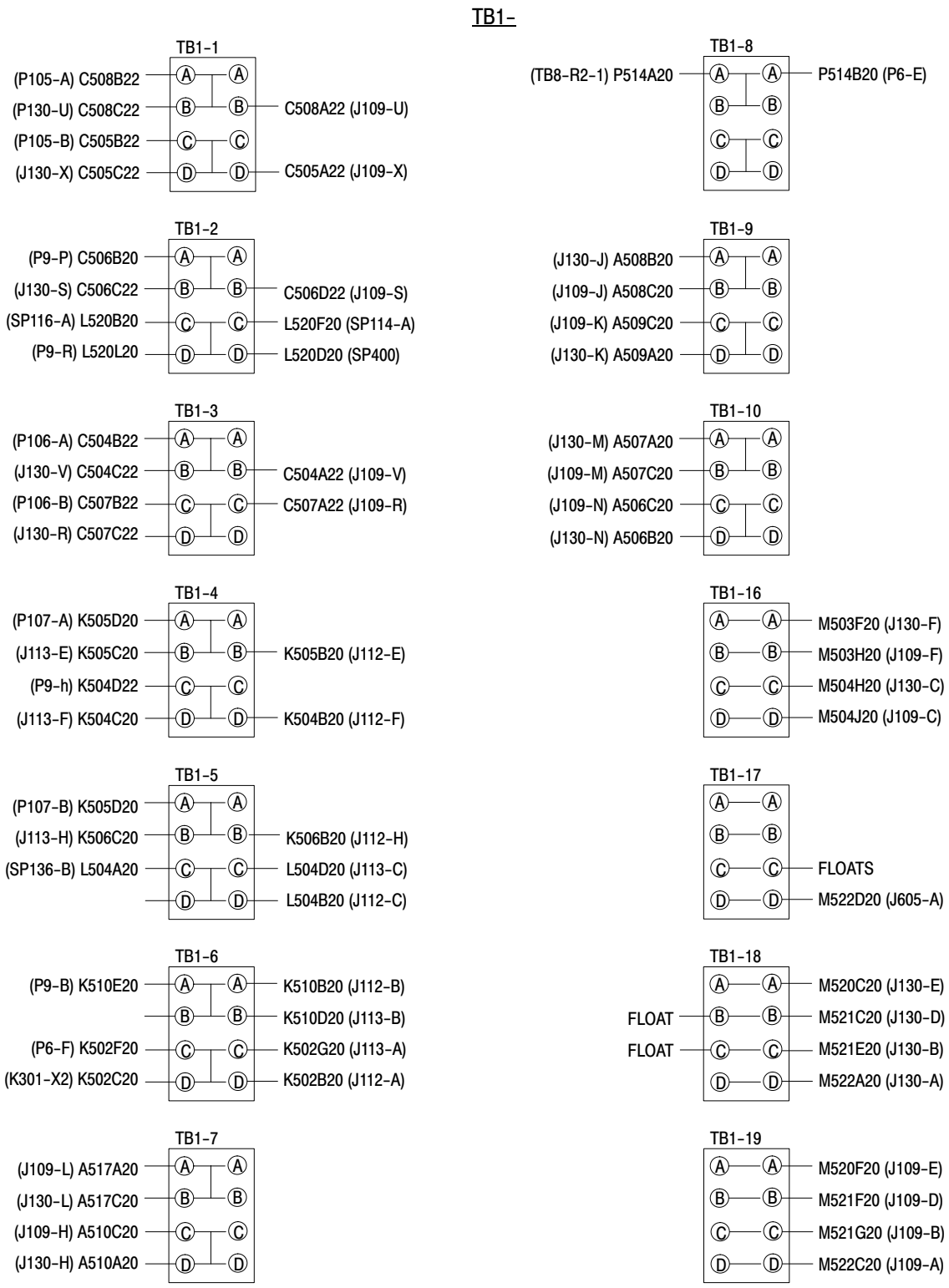


Figure 20-10. Fuselage Wiring Diagram (369HS; 0626 & Subs) (Sheet 4 of 6)



NOTE: TB1-11 THRU TB1-14, TB1-20 THRU TB1-34 BLANK (NOT SHOWN).

30-203-5

Figure 20-10. Fuselage Wiring Diagram (369HS; 0626 & Subs) (Sheet 5 of 6)

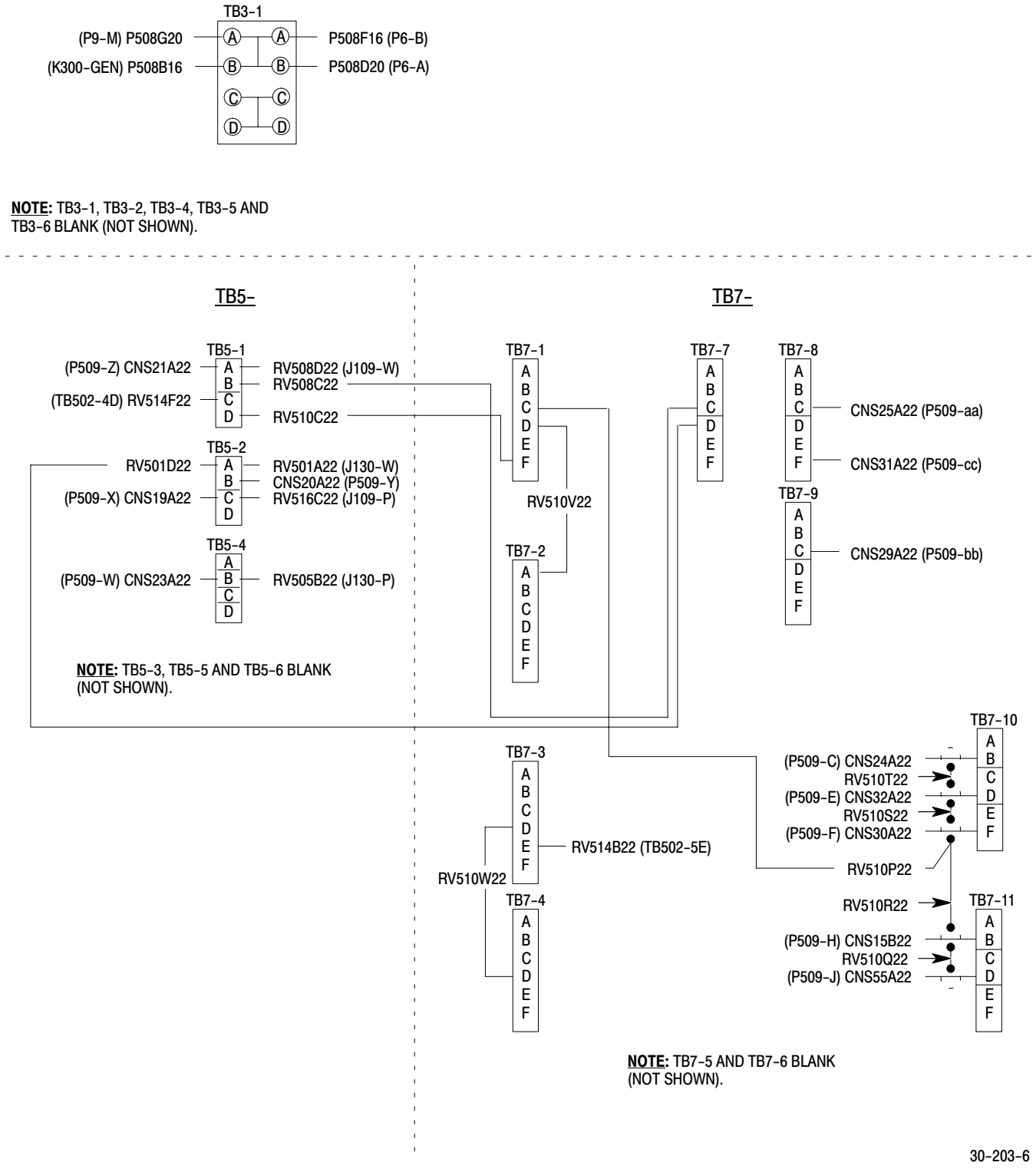
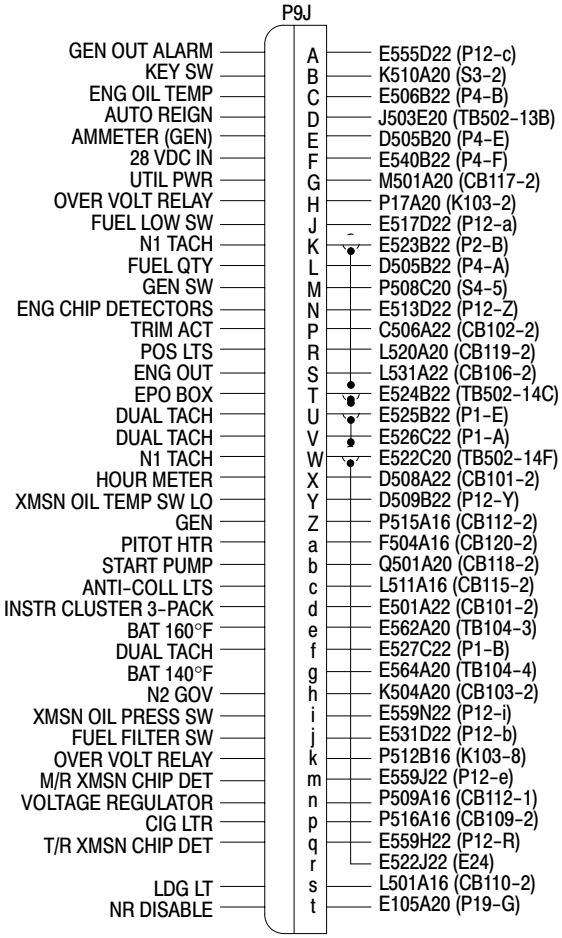
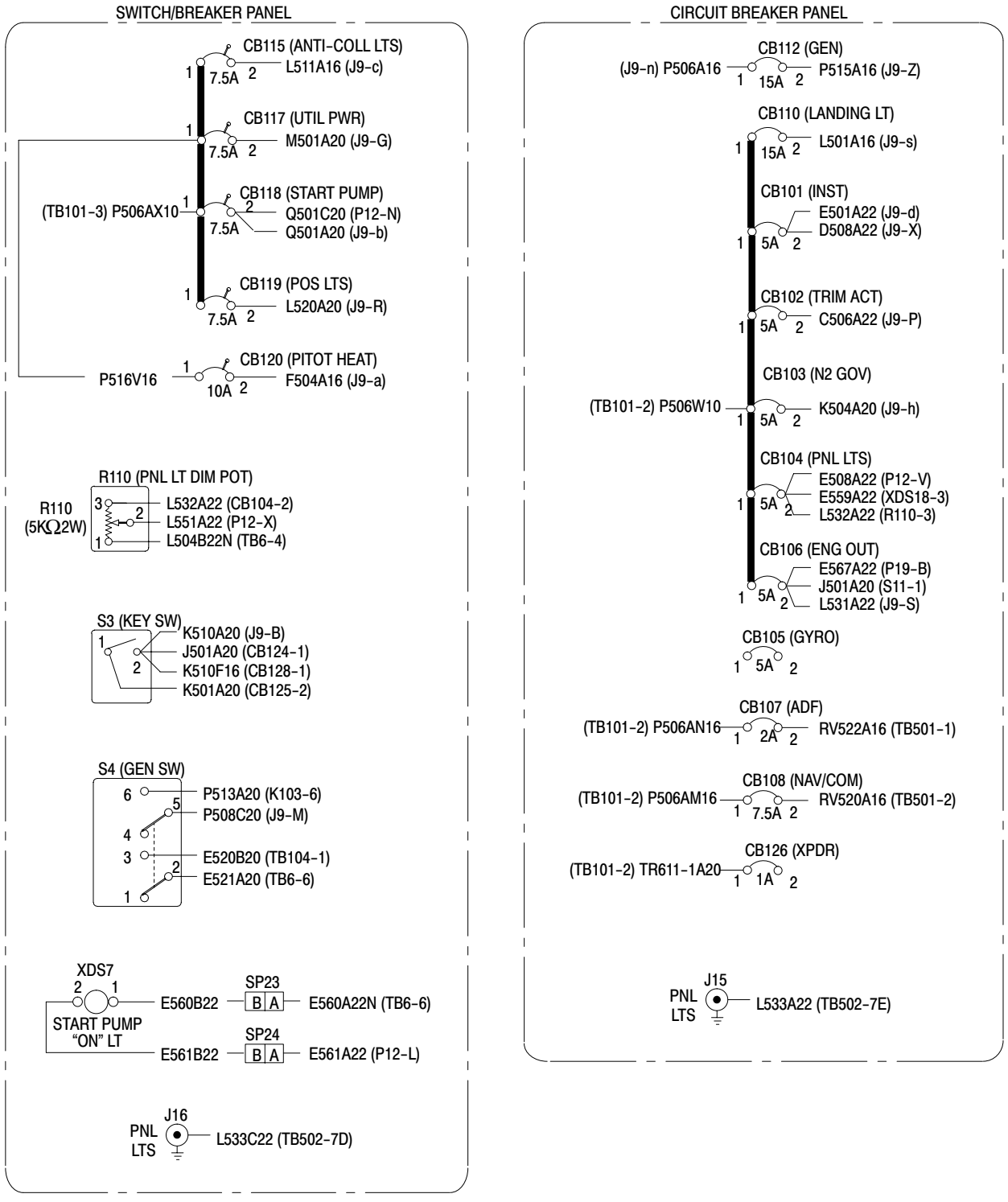


Figure 20-10. Fuselage Wiring Diagram (369HS; 0626 & Subs) (Sheet 6 of 6)



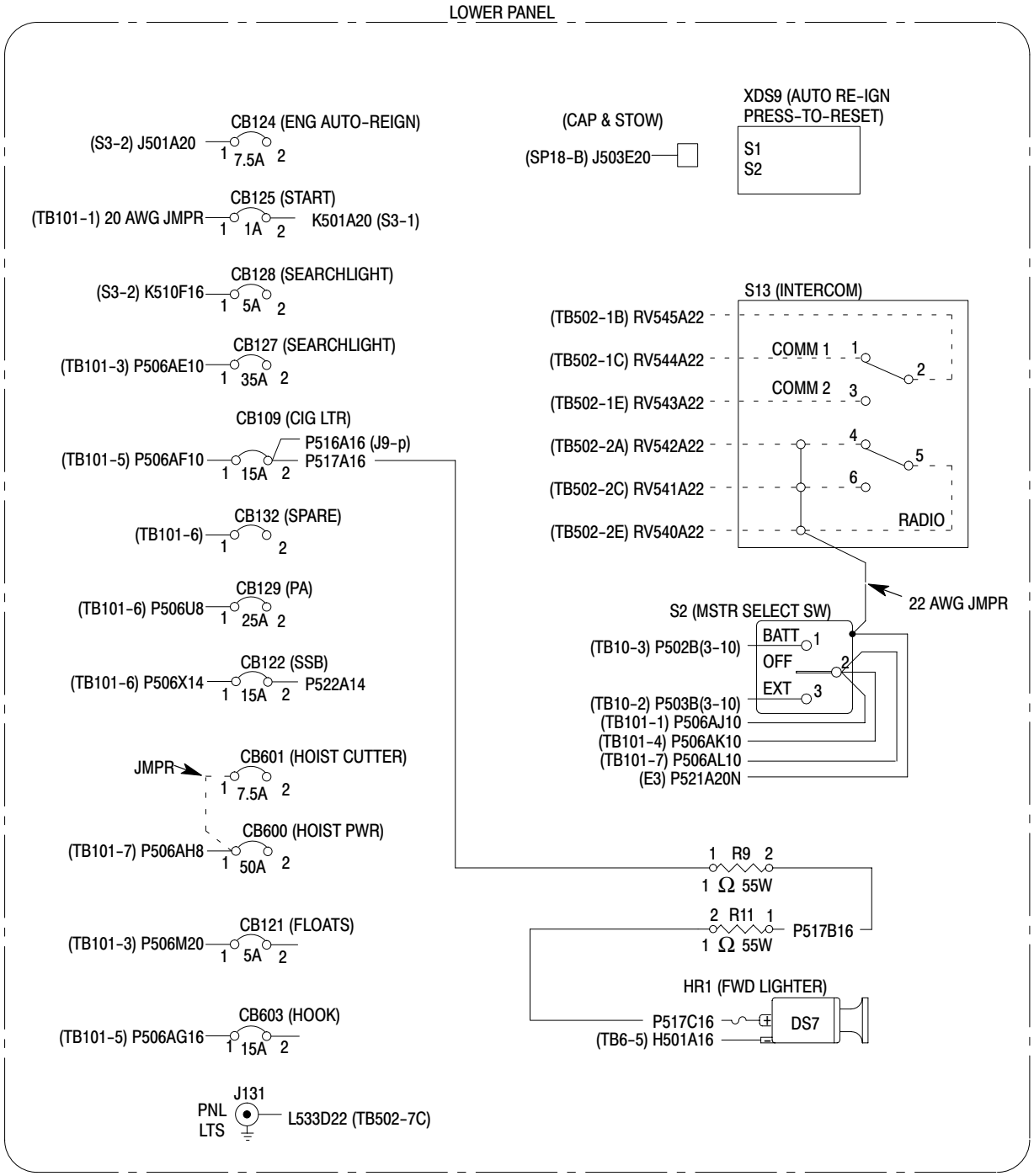
30-203-7

Figure 20-11. Console Wiring Diagram, Instrument Panel Type B (369HS; 0626 & Subs) (Sheet 1 of 6)



30-203-8

Figure 20-11. Console Wiring Diagram, Instrument Panel Type B (369HS; 0626 & Subs) (Sheet 2 of 6)



30-203-9

Figure 20-11. Console Wiring Diagram, Instrument Panel Type B (369HS; 0626 & Subs) (Sheet 3 of 6)

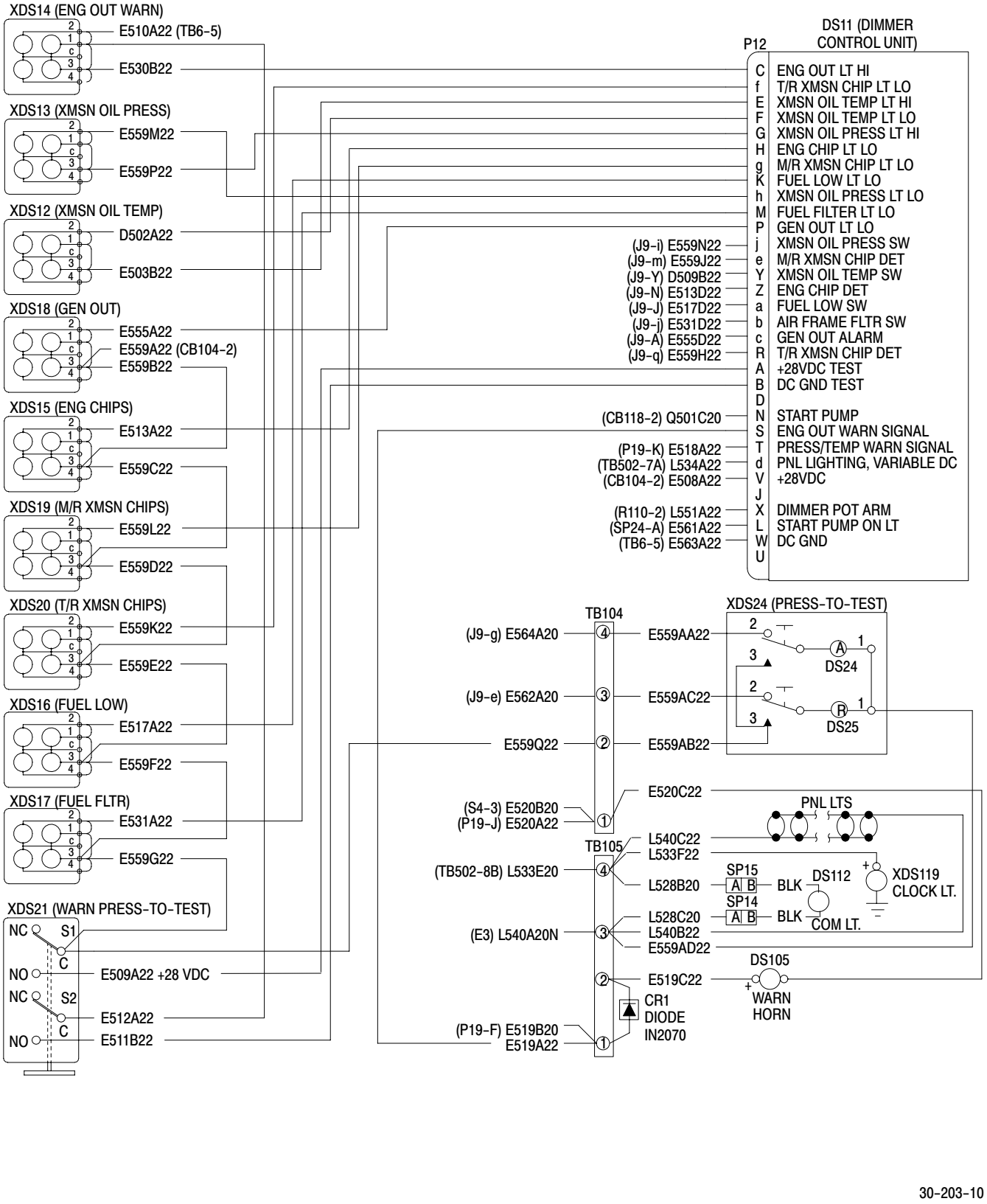


Figure 20-11. Console Wiring Diagram, Instrument Panel Type B (369HS; 0626 & Subs) (Sheet 4 of 6)

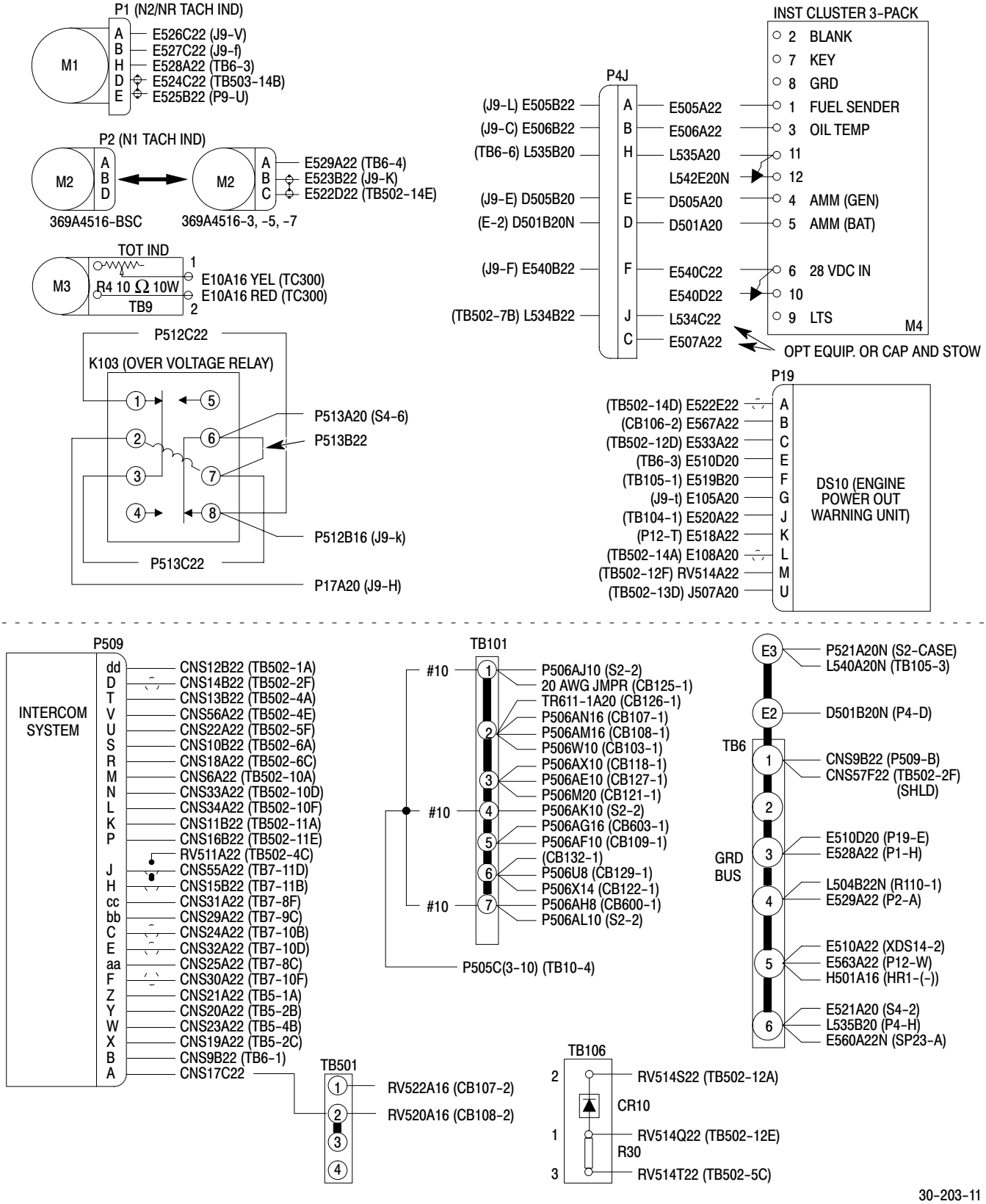


Figure 20-11. Console Wiring Diagram, Instrument Panel Type B (369HS; 0626 & Subs) (Sheet 5 of 6)

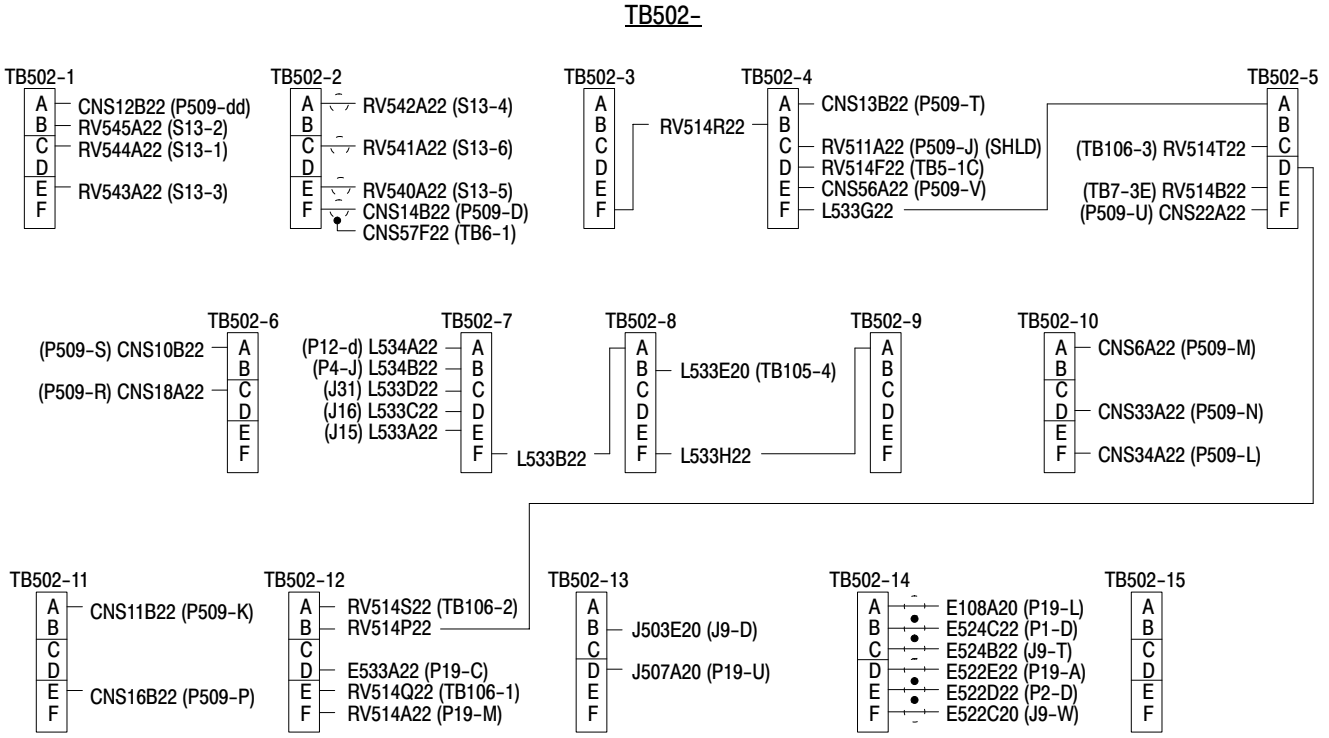


Figure 20-11. Console Wiring Diagram, Instrument Panel Type B (369HS; 0626 & Subs) (Sheet 6 of 6)

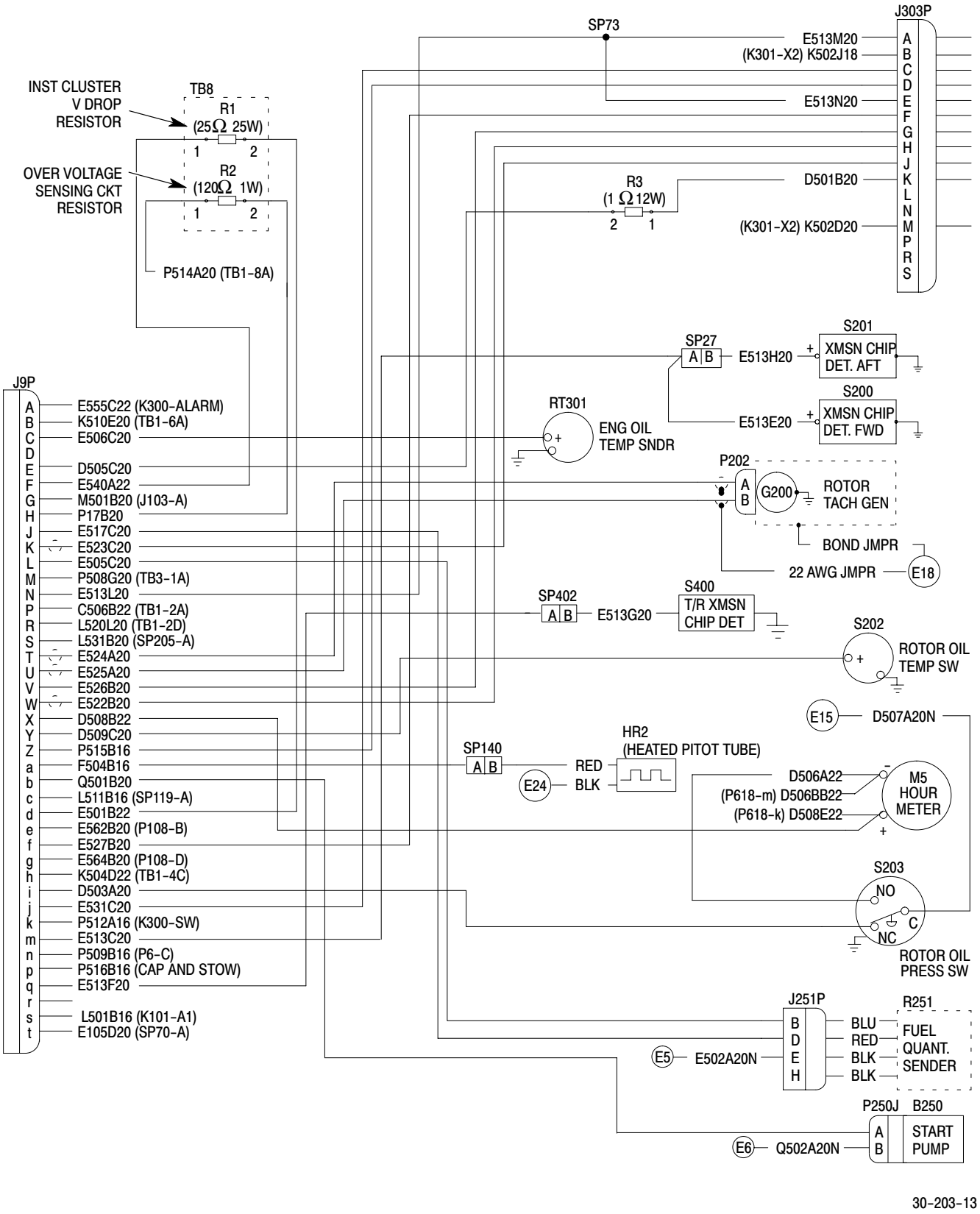


Figure 20-12. Fuselage Wiring Diagram (369HM; 248 & Subs) (Sheet 1 of 6)

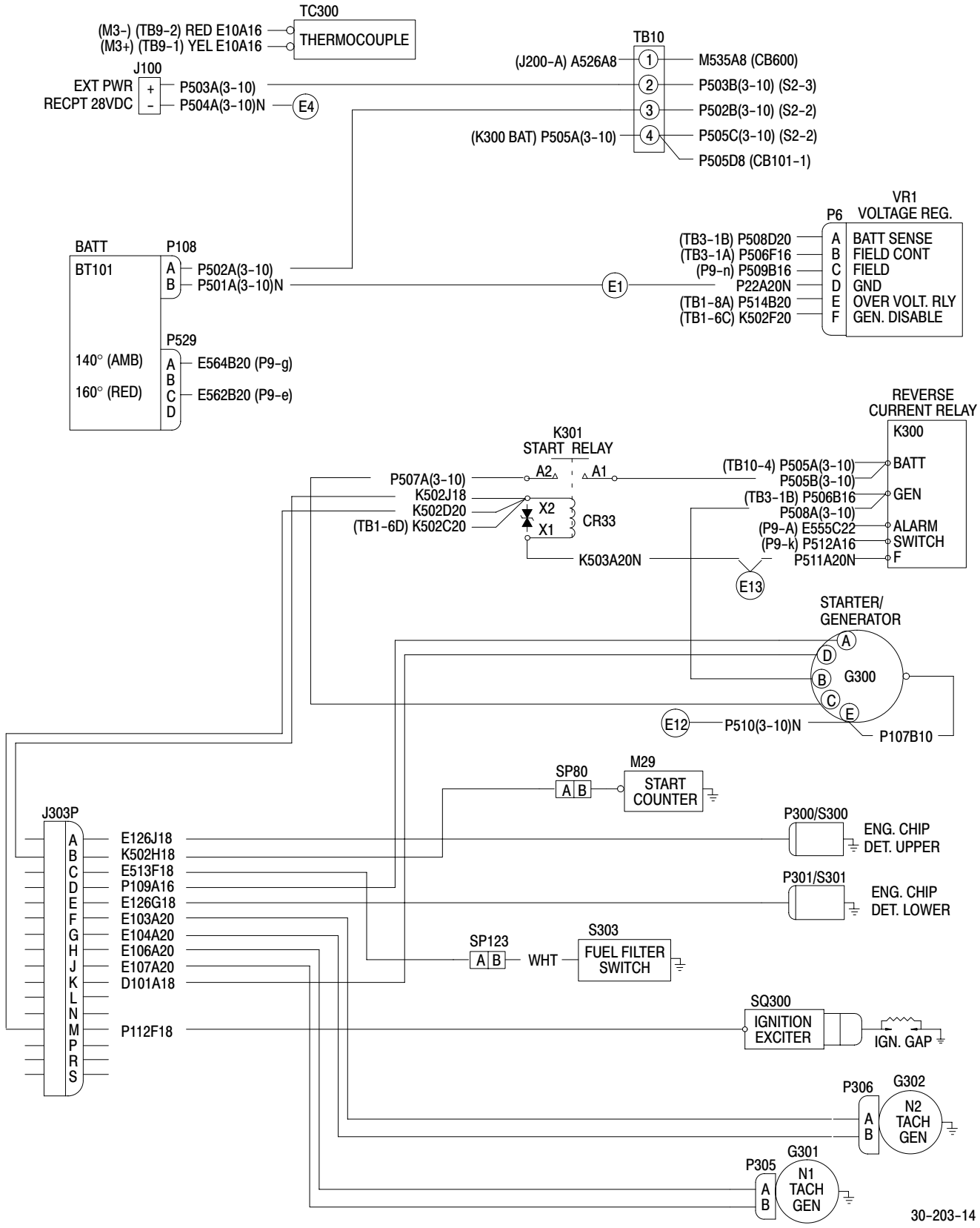


Figure 20-12. Fuselage Wiring Diagram (369HM; 248 & Subs) (Sheet 2 of 6)

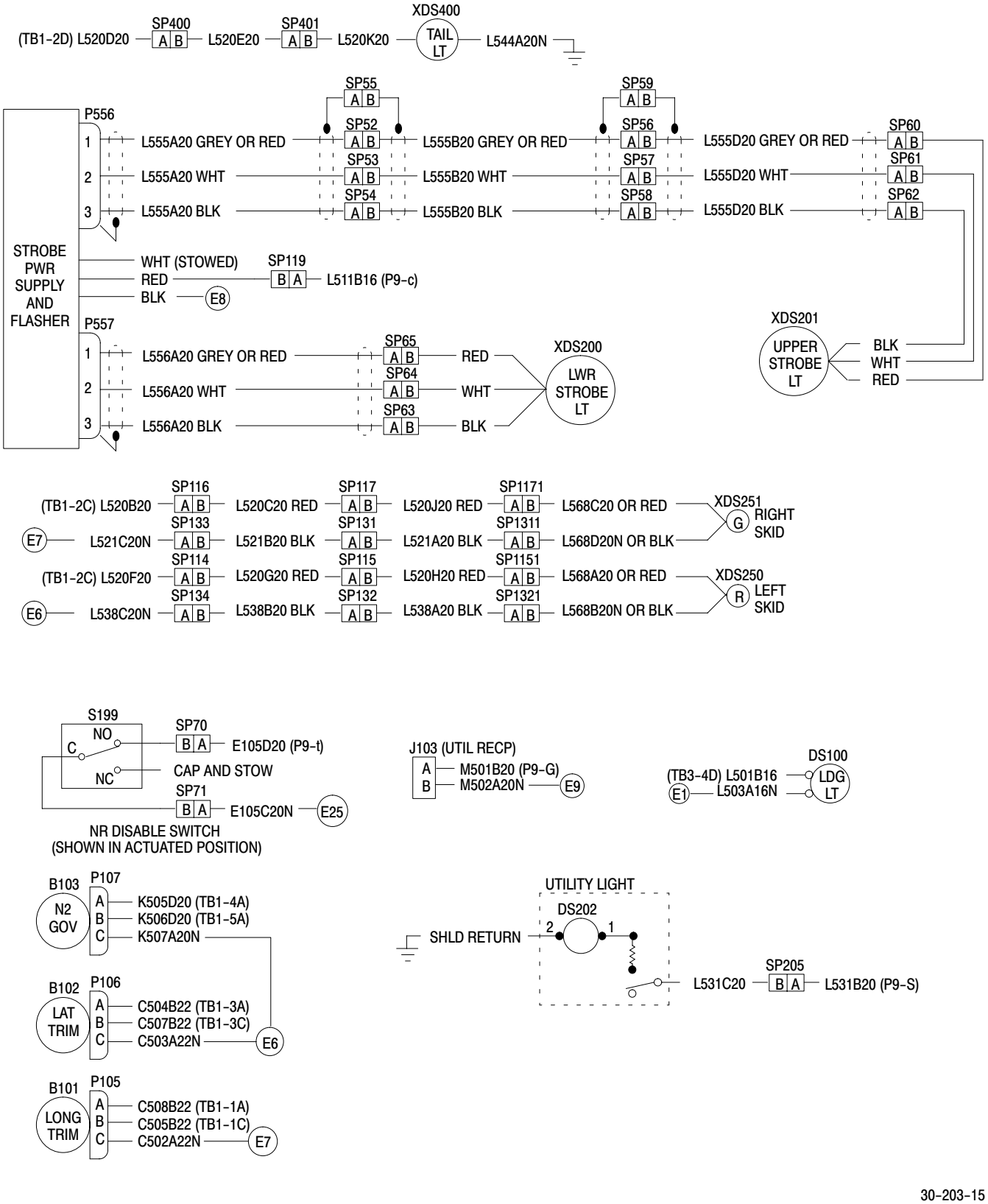


Figure 20-12. Fuselage Wiring Diagram (369HM; 248 & Subs) (Sheet 3 of 6)

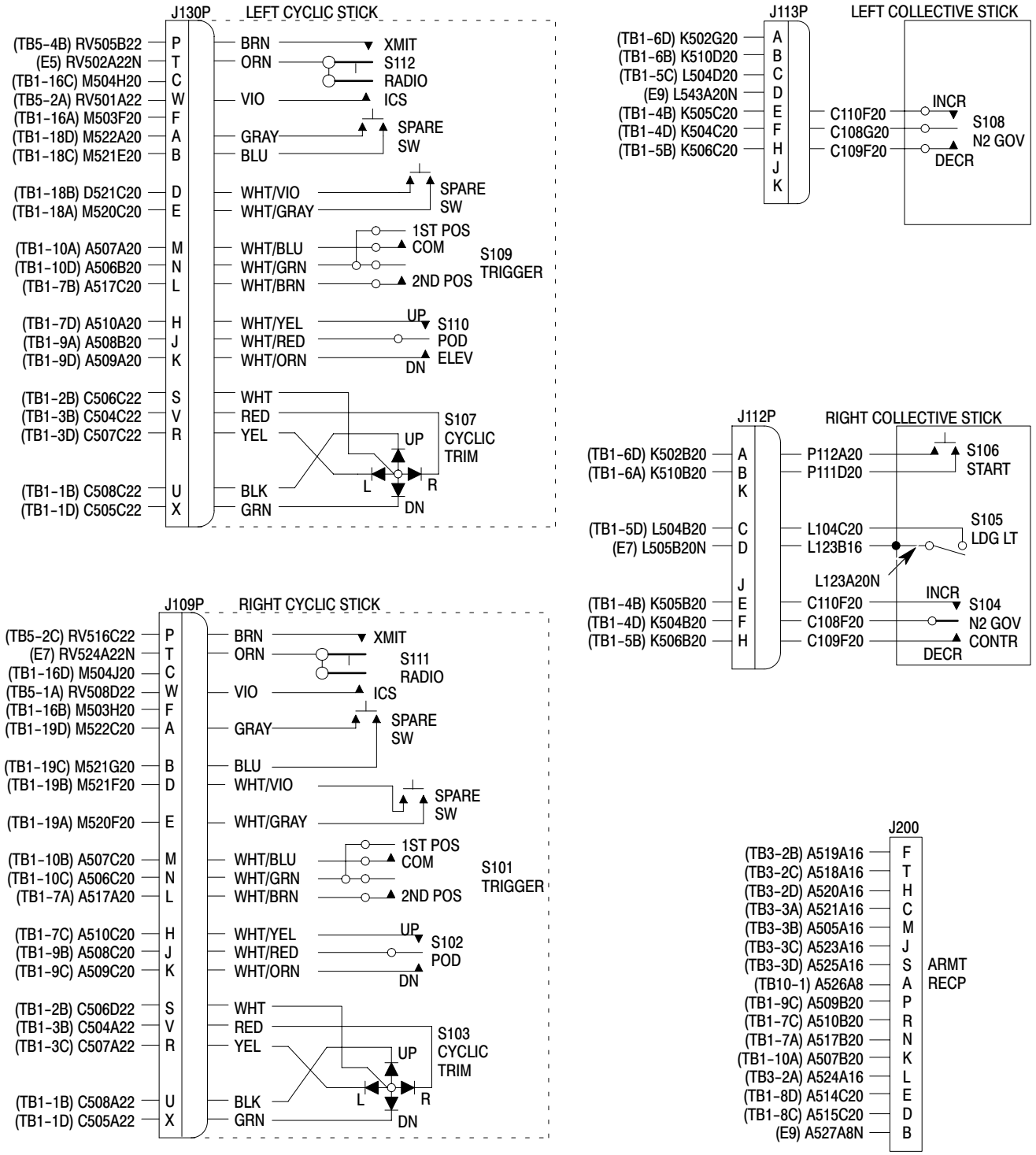


Figure 20-12. Fuselage Wiring Diagram (369HM; 248 & Subs) (Sheet 4 of 6)

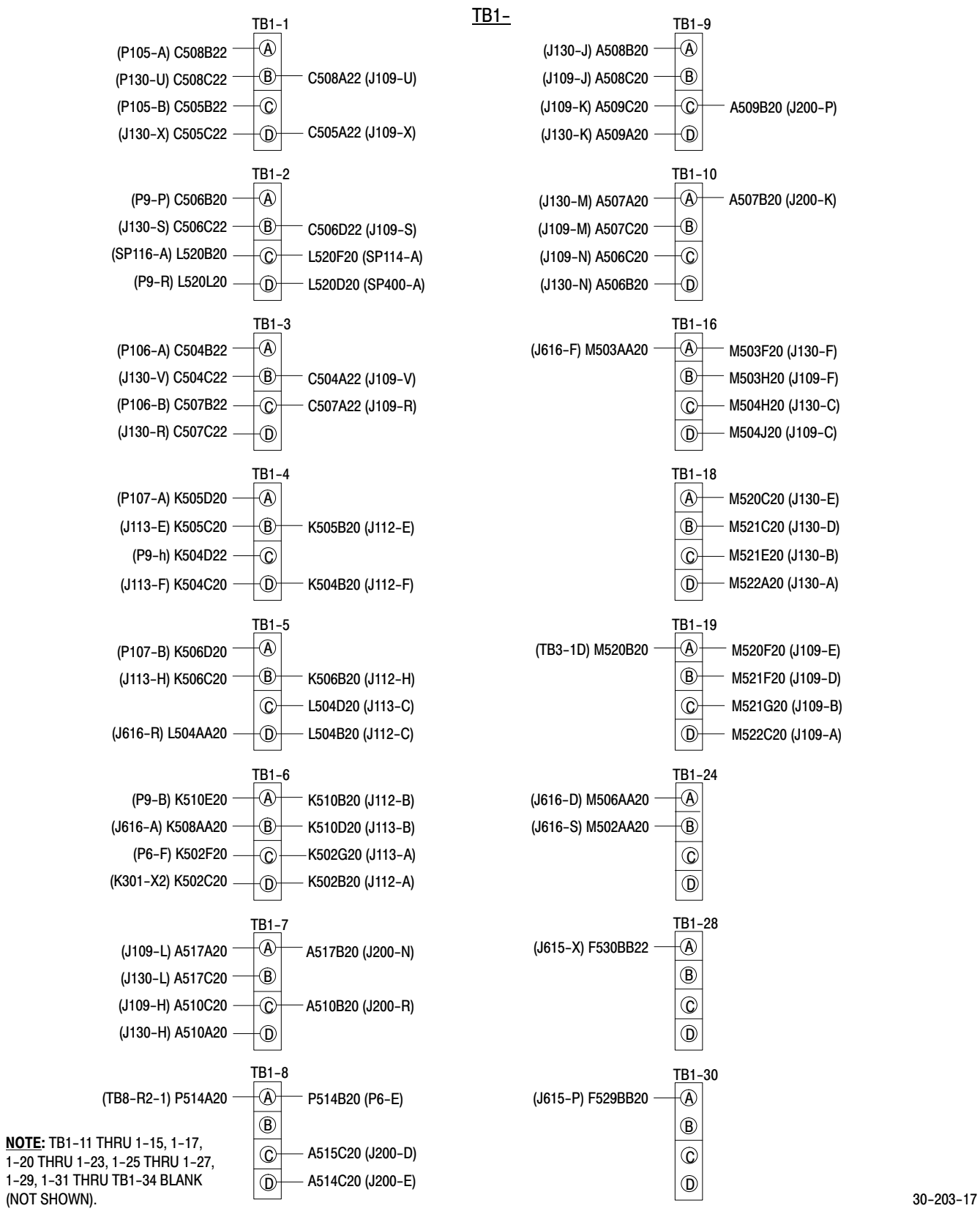


Figure 20-12. Fuselage Wiring Diagram (369HM; 248 & Subs) (Sheet 5 of 6)

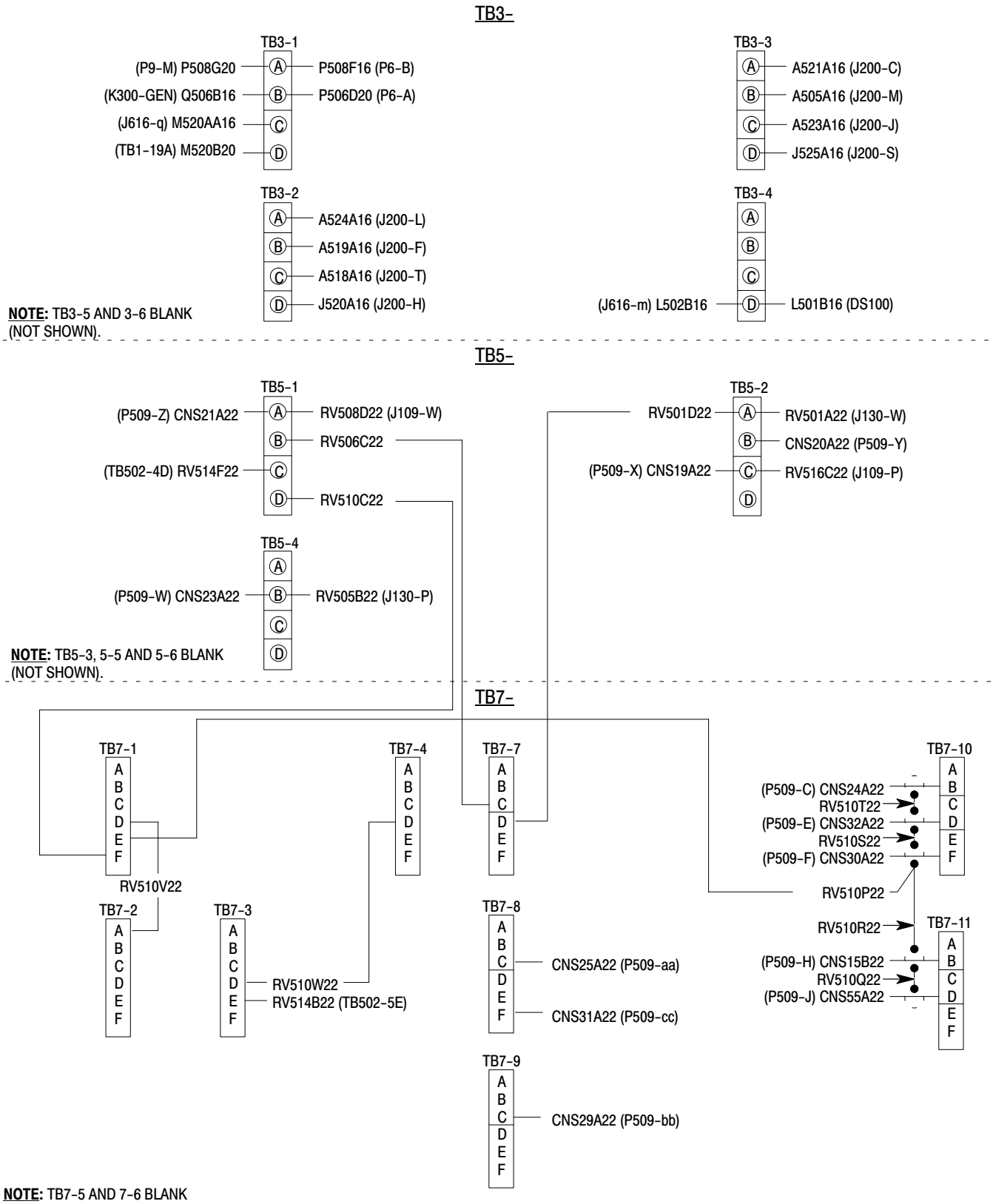


Figure 20-12. Fuselage Wiring Diagram (369HM; 248 & Subs) (Sheet 6 of 6)

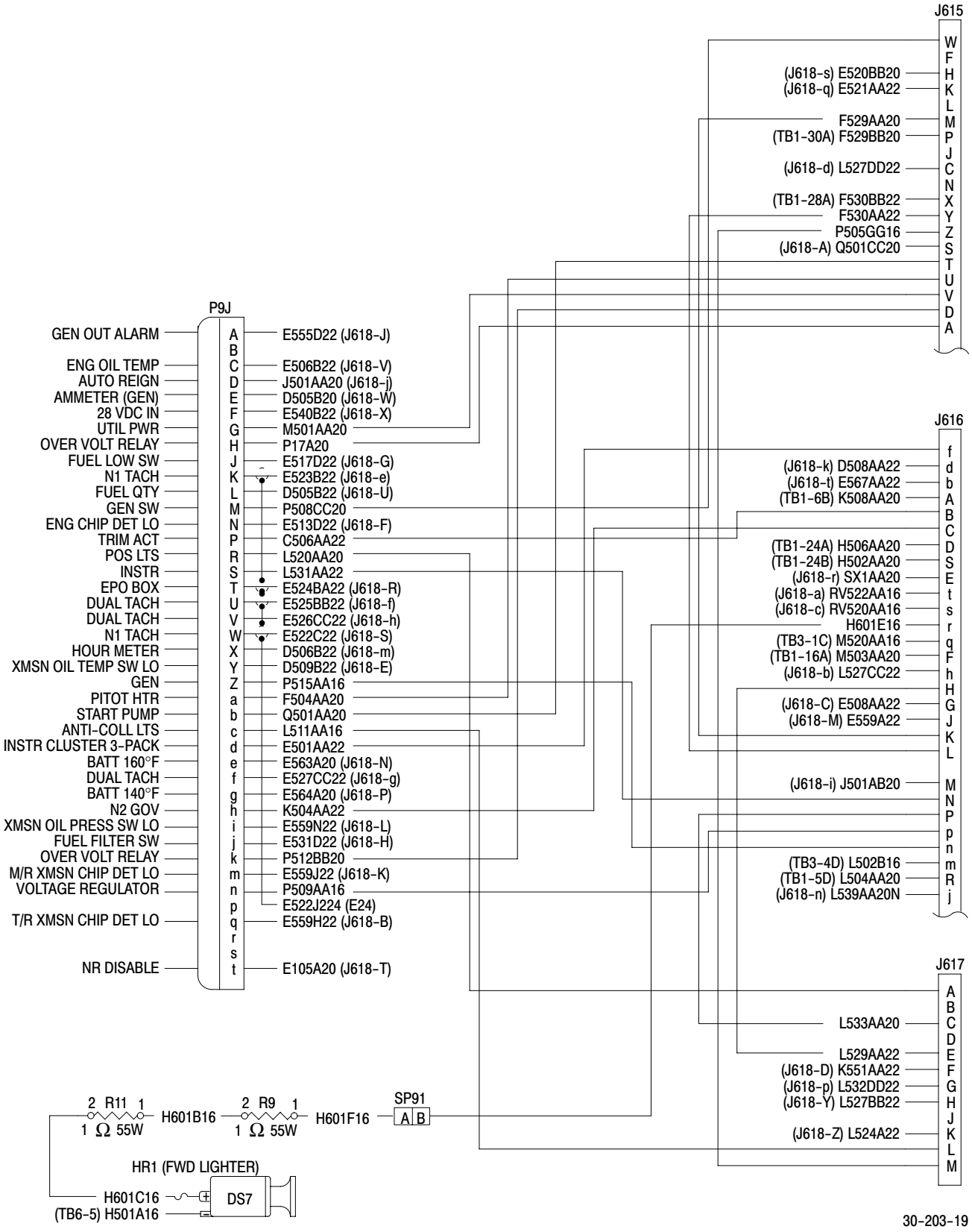


Figure 20-13. Console Wiring Diagram, Instrument Panel Type T, with Center Console (369HM; 248 & Subs) (Sheet 1 of 7)

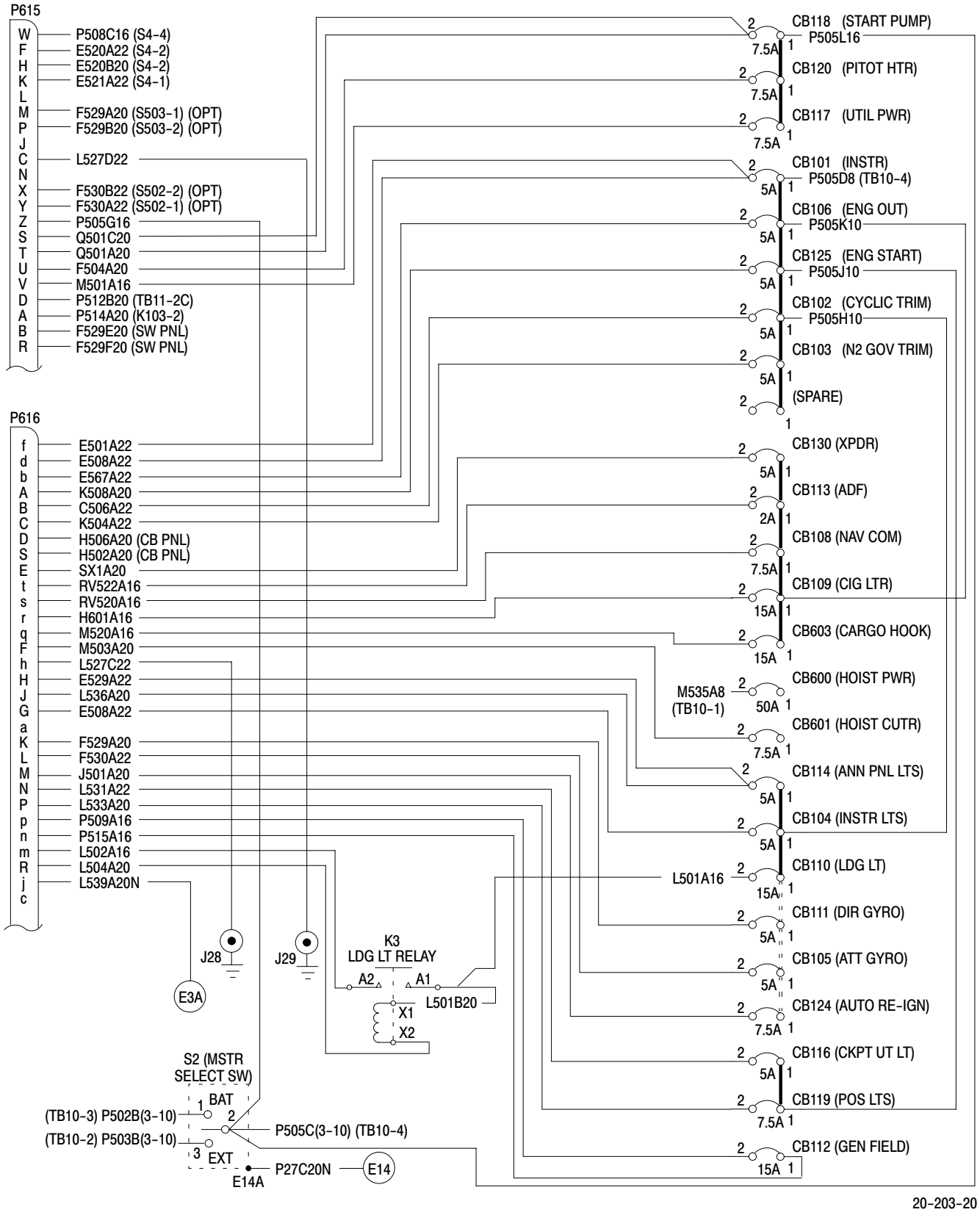


Figure 20-13. Console Wiring Diagram, Instrument Panel Type T, with Center Console (369HM; 248 & Subs) (Sheet 2 of 7)

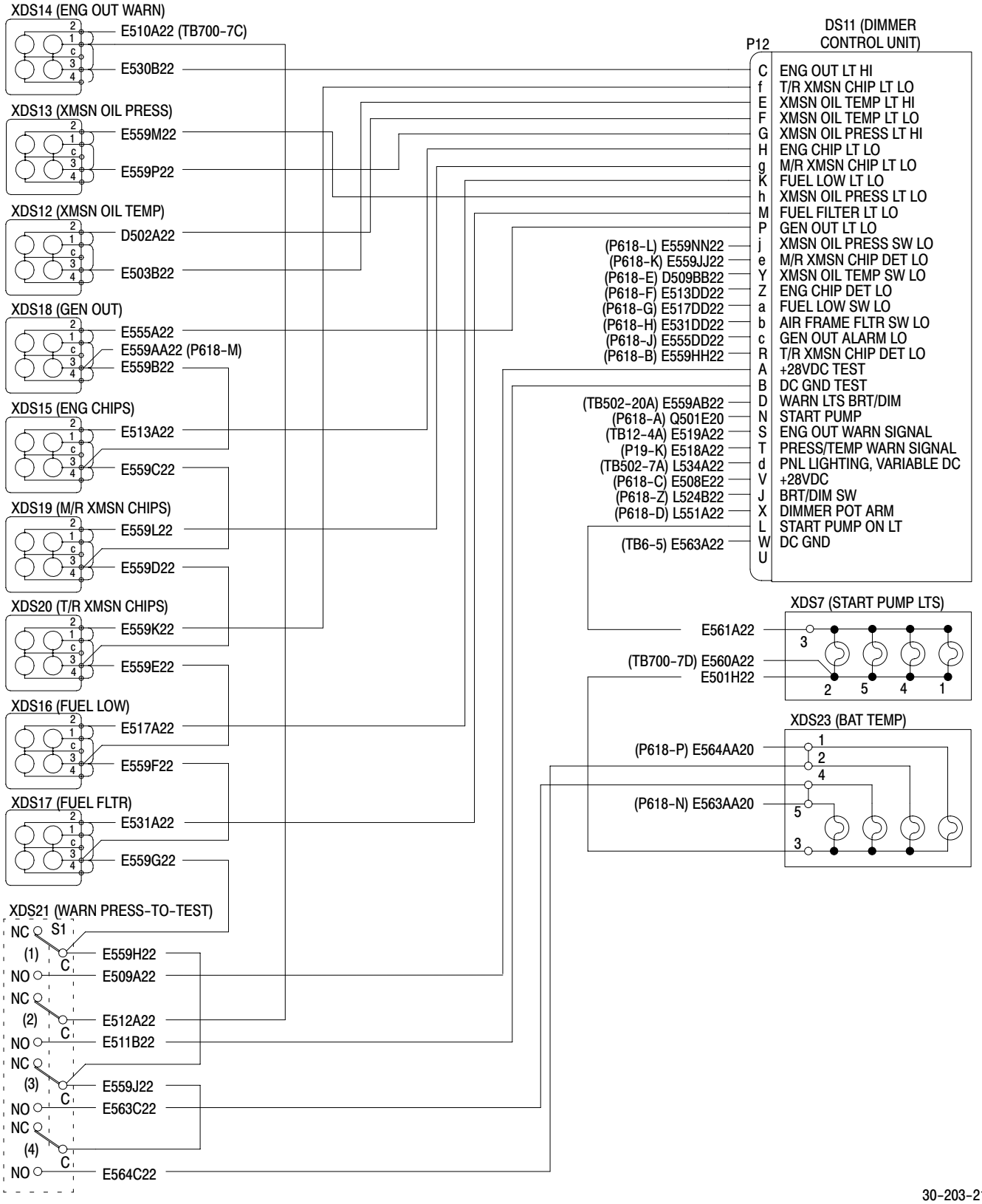


Figure 20-13. Console Wiring Diagram, Instrument Panel Type T, with Center Console (369HM; 248 & Subs) (Sheet 3 of 7)

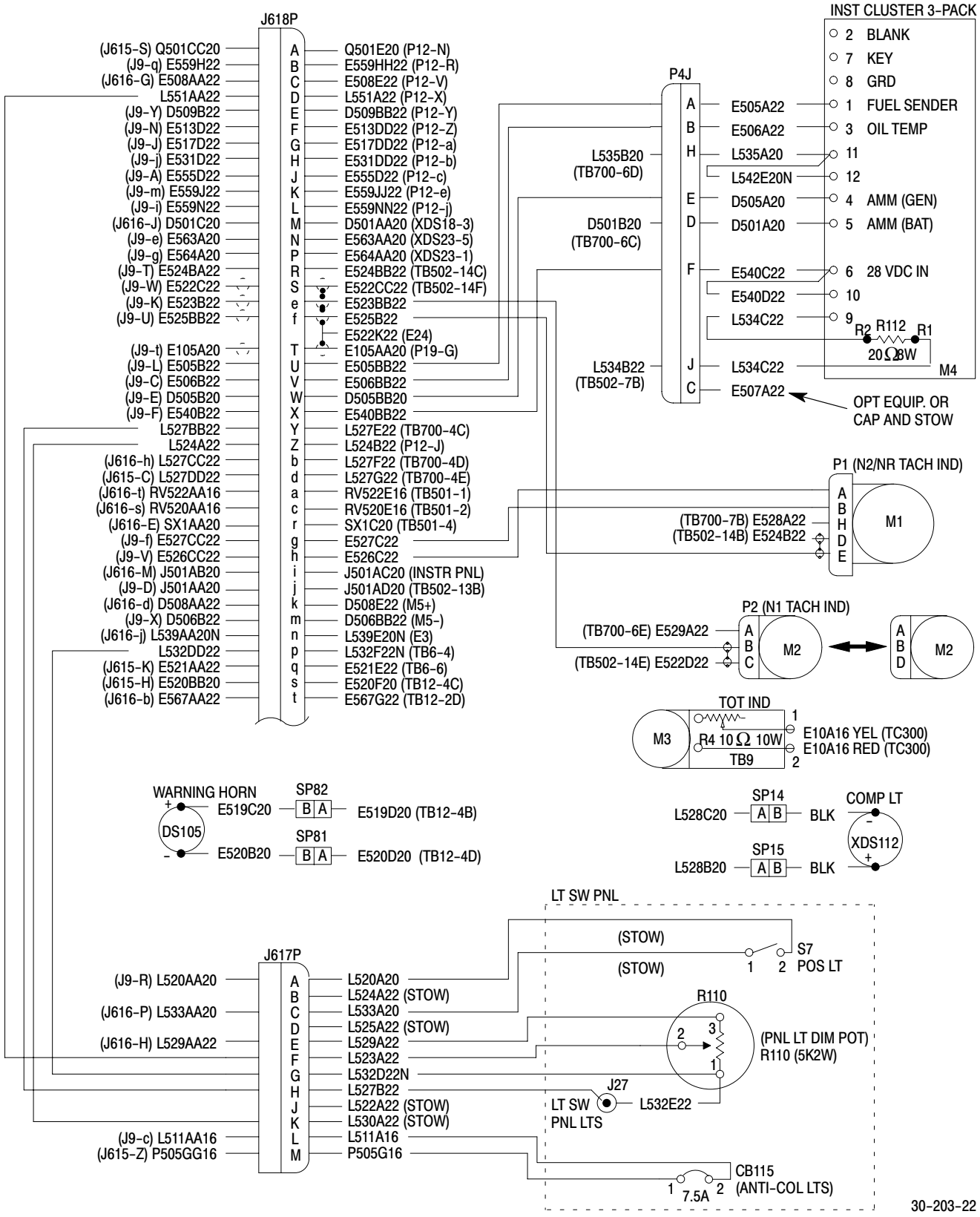
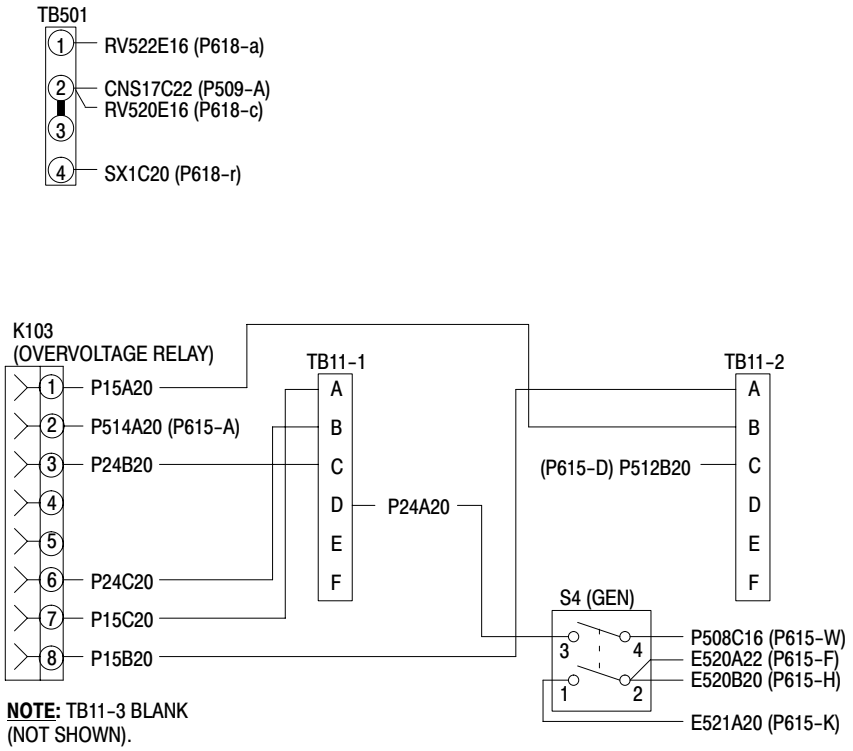


Figure 20-13. Console Wiring Diagram, Instrument Panel Type T, with Center Console (369HM; 248 & Subs) (Sheet 4 of 7)



30-203-23

Figure 20-13. Console Wiring Diagram, Instrument Panel Type T, with Center Console (369HM; 248 & Subs) (Sheet 5 of 7)

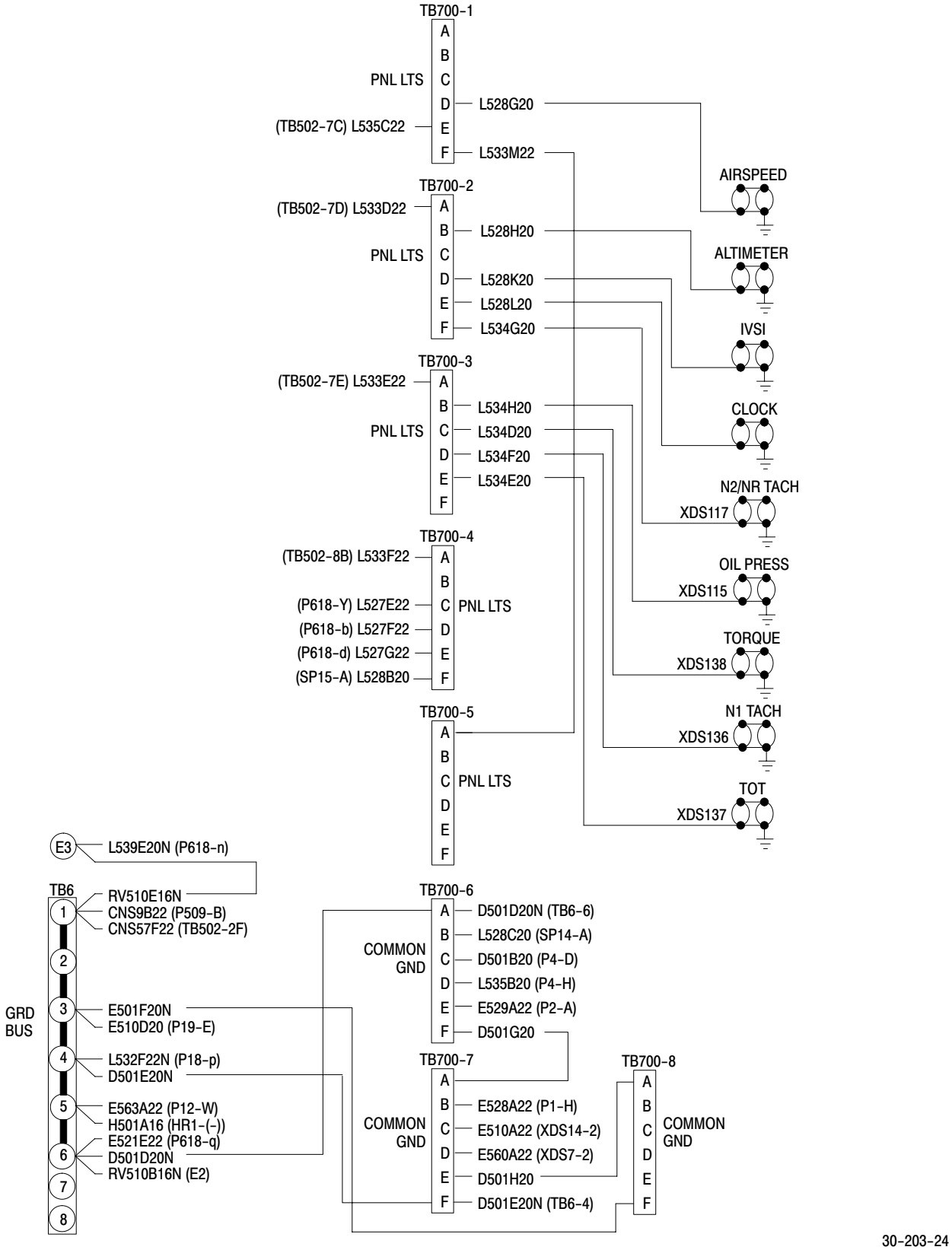
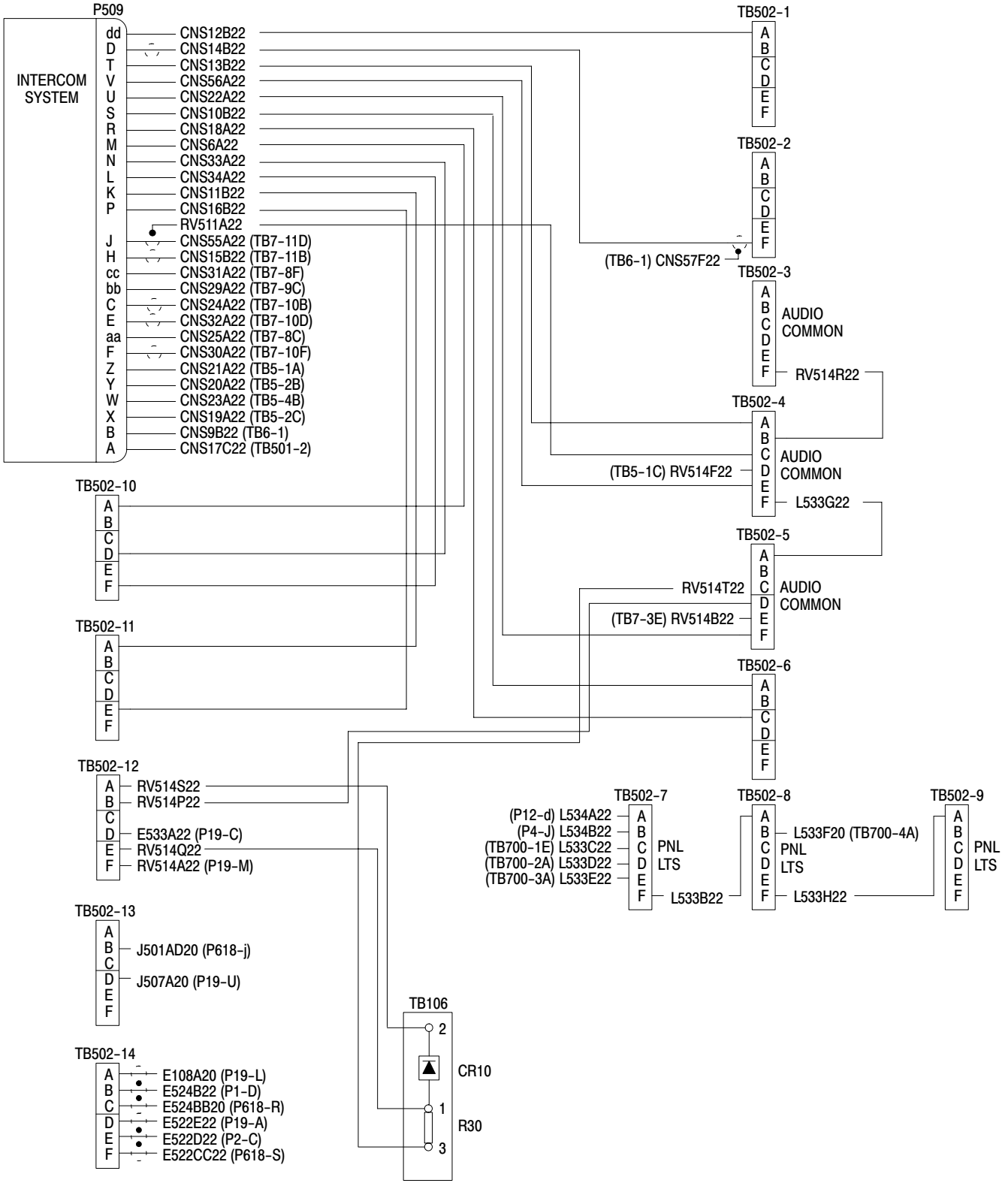


Figure 20-13. Console Wiring Diagram, Instrument Panel Type T, with Center Console (369HM; 248 & Subs) (Sheet 6 of 7)



NOTE: TB502-15 THRU 205-20 BLANK (NOT SHOWN).

30-203-25

Figure 20-13. Console Wiring Diagram, Instrument Panel Type T, with Center Console (369HM; 248 & Subs) (Sheet 7 of 7)

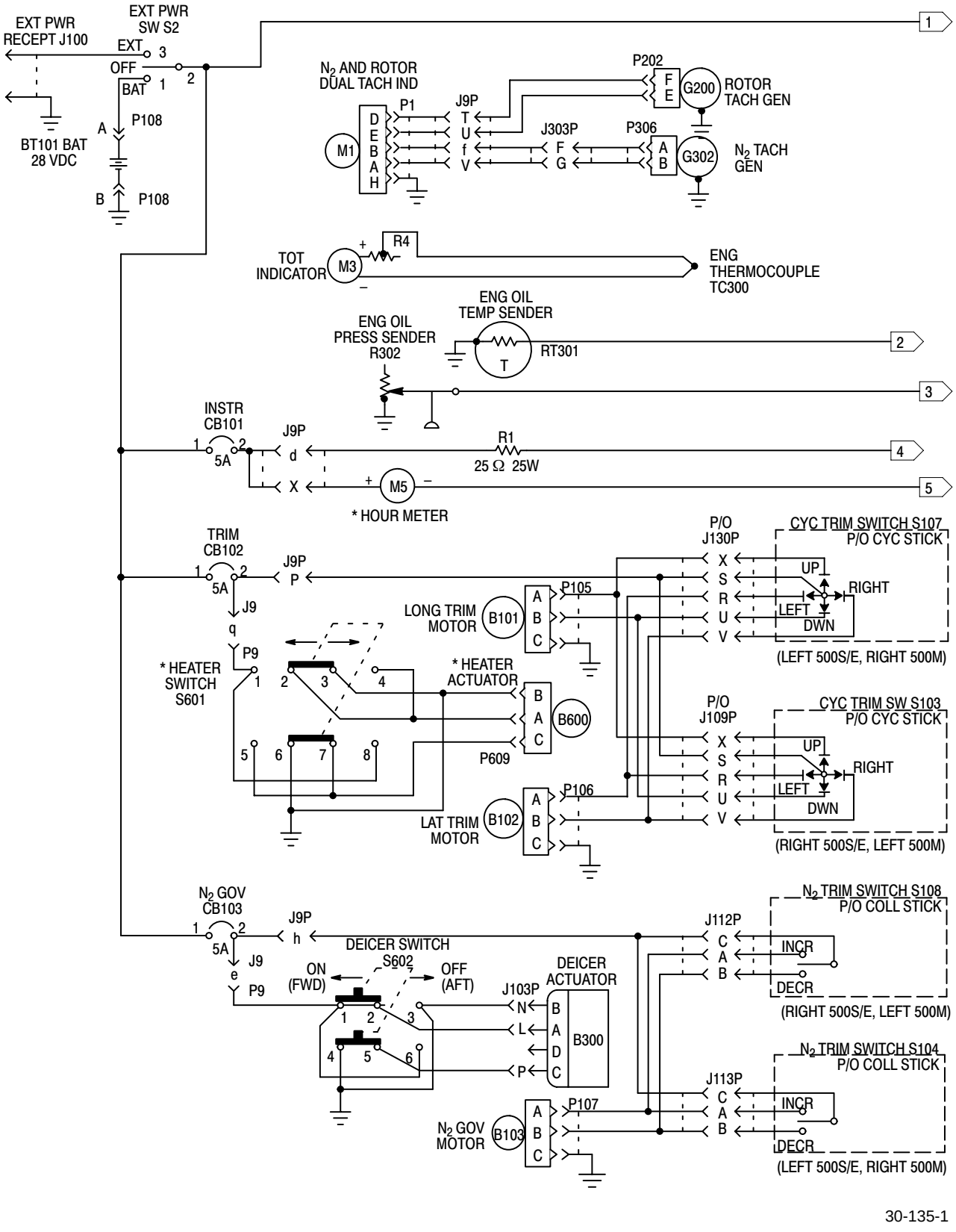


Figure 20-14. Typical Electrical System Schematic, Instrument Panel Type A (Sheet 1 of 6)

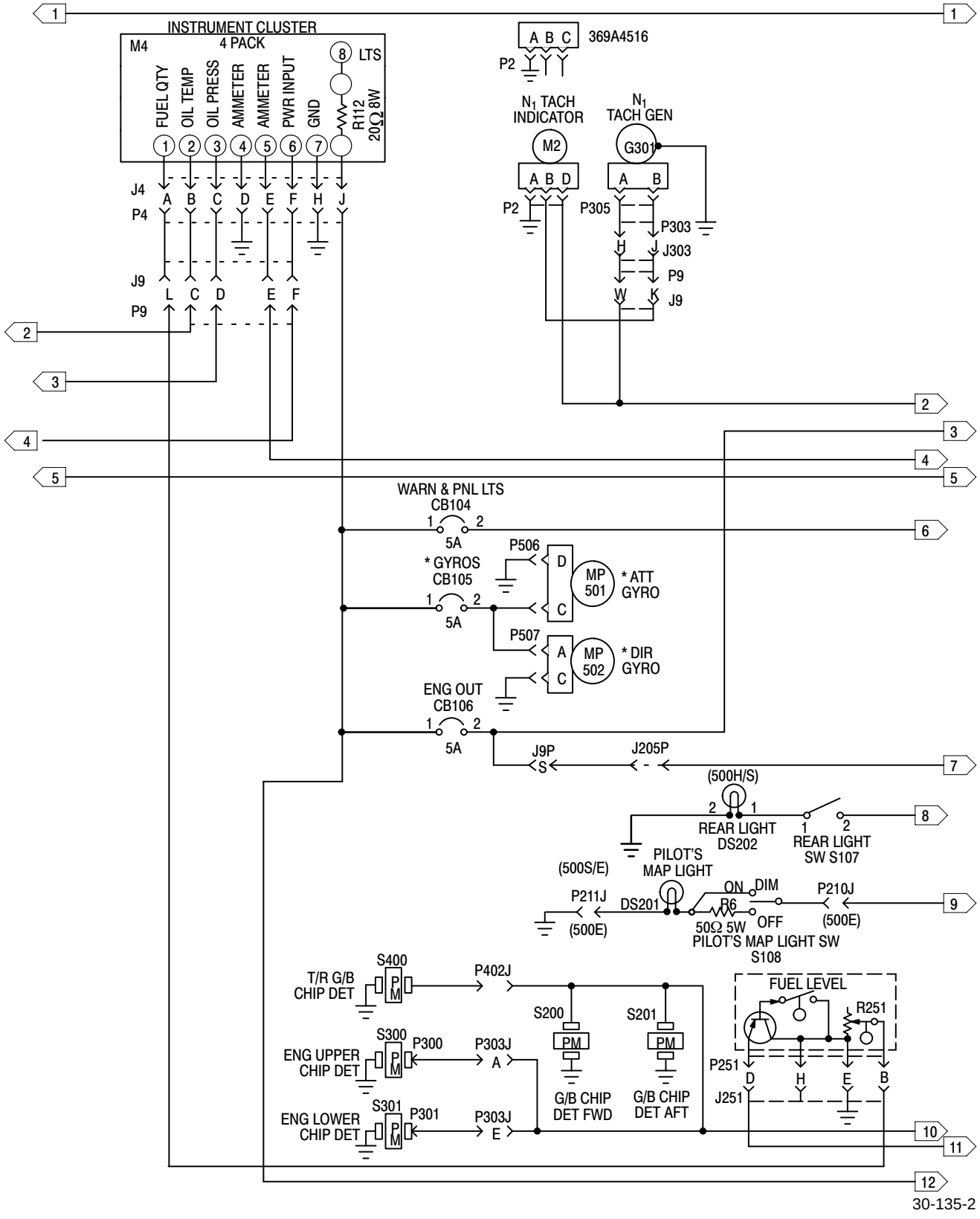


Figure 20-14. Typical Electrical System Schematic, Instrument Panel Type A (Sheet 2 of 6)

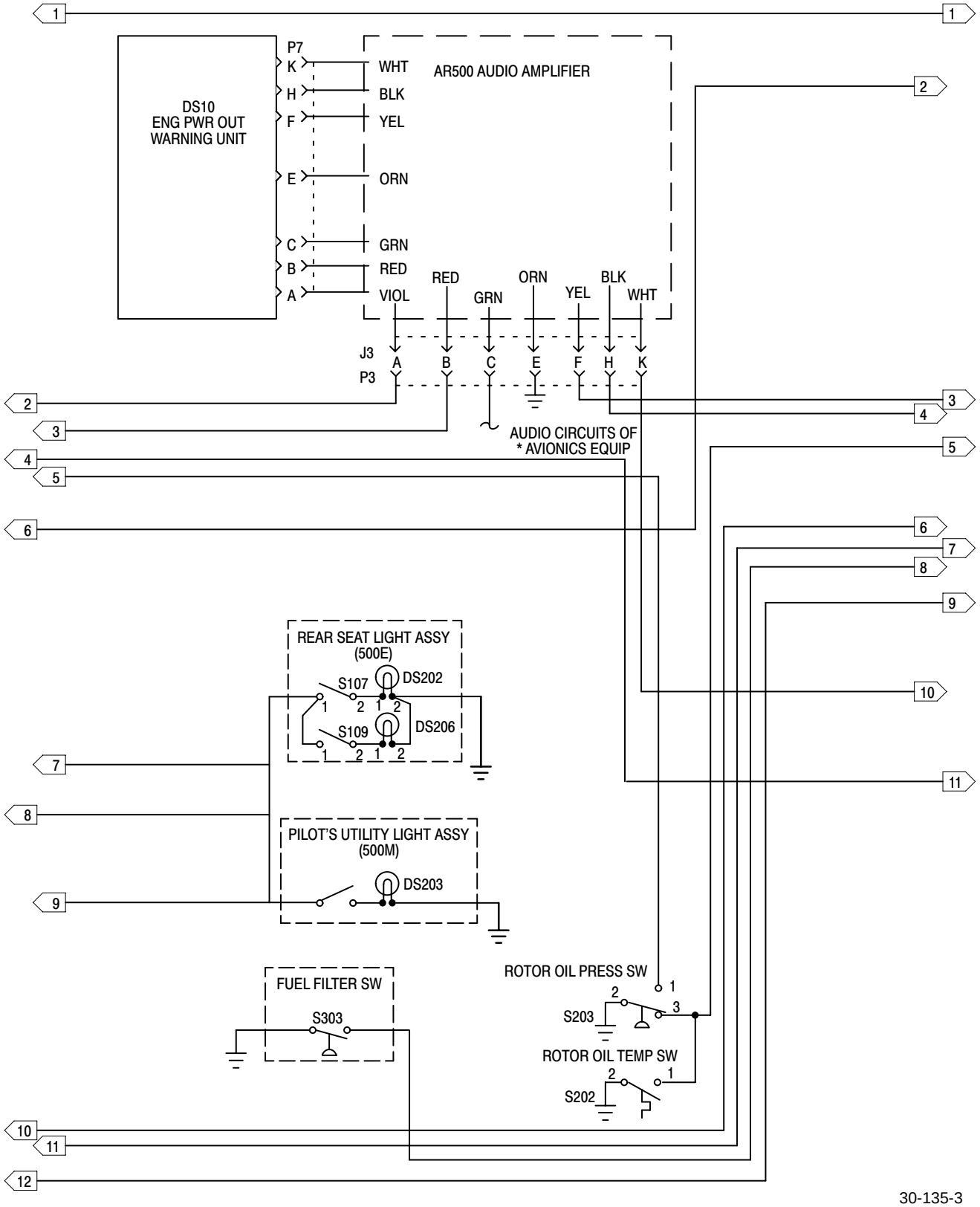
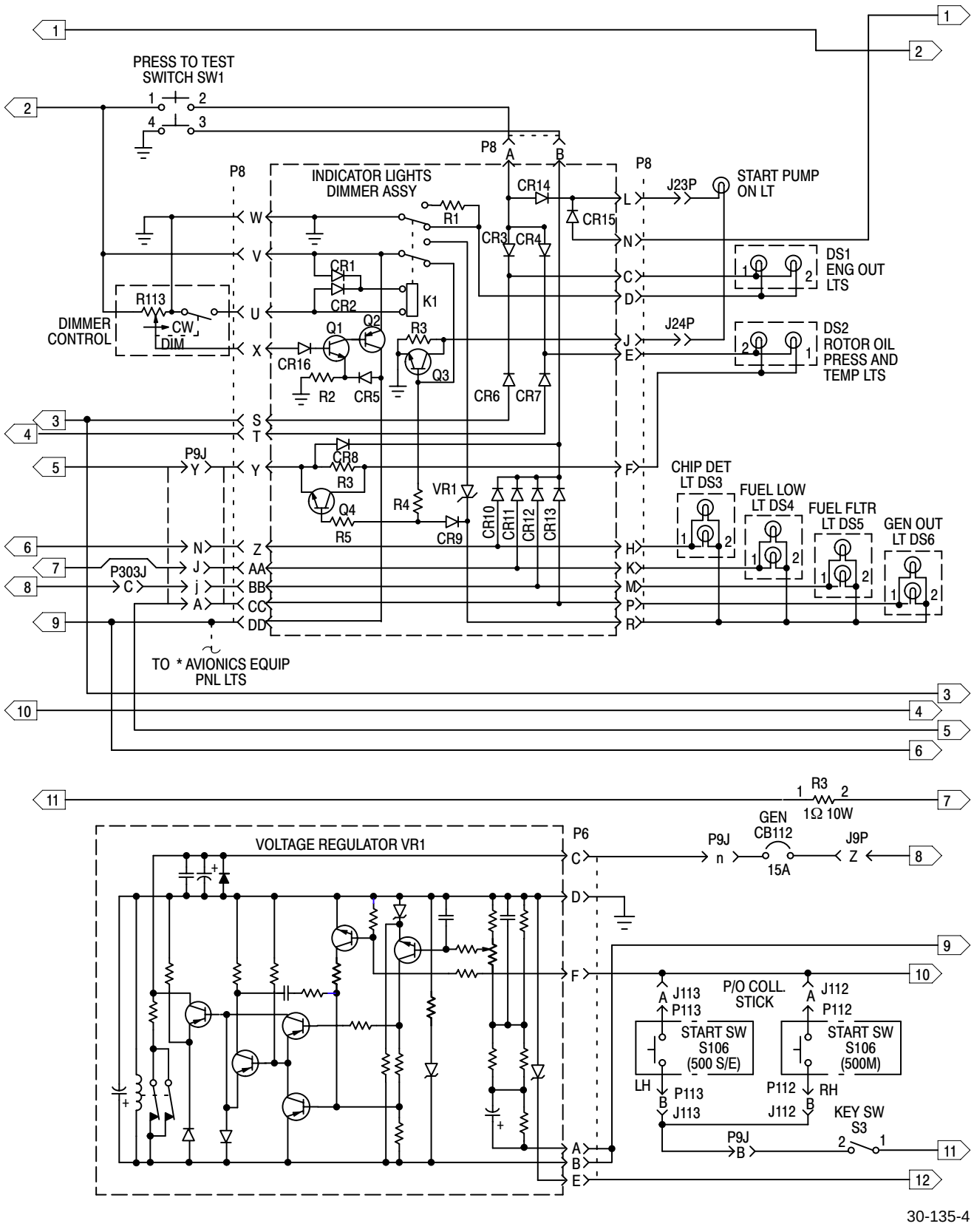


Figure 20-14. Typical Electrical System Schematic, Instrument Panel Type A (Sheet 3 of 6)



30-135-4

Figure 20-14. Typical Electrical System Schematic, Instrument Panel Type A (Sheet 4 of 6)

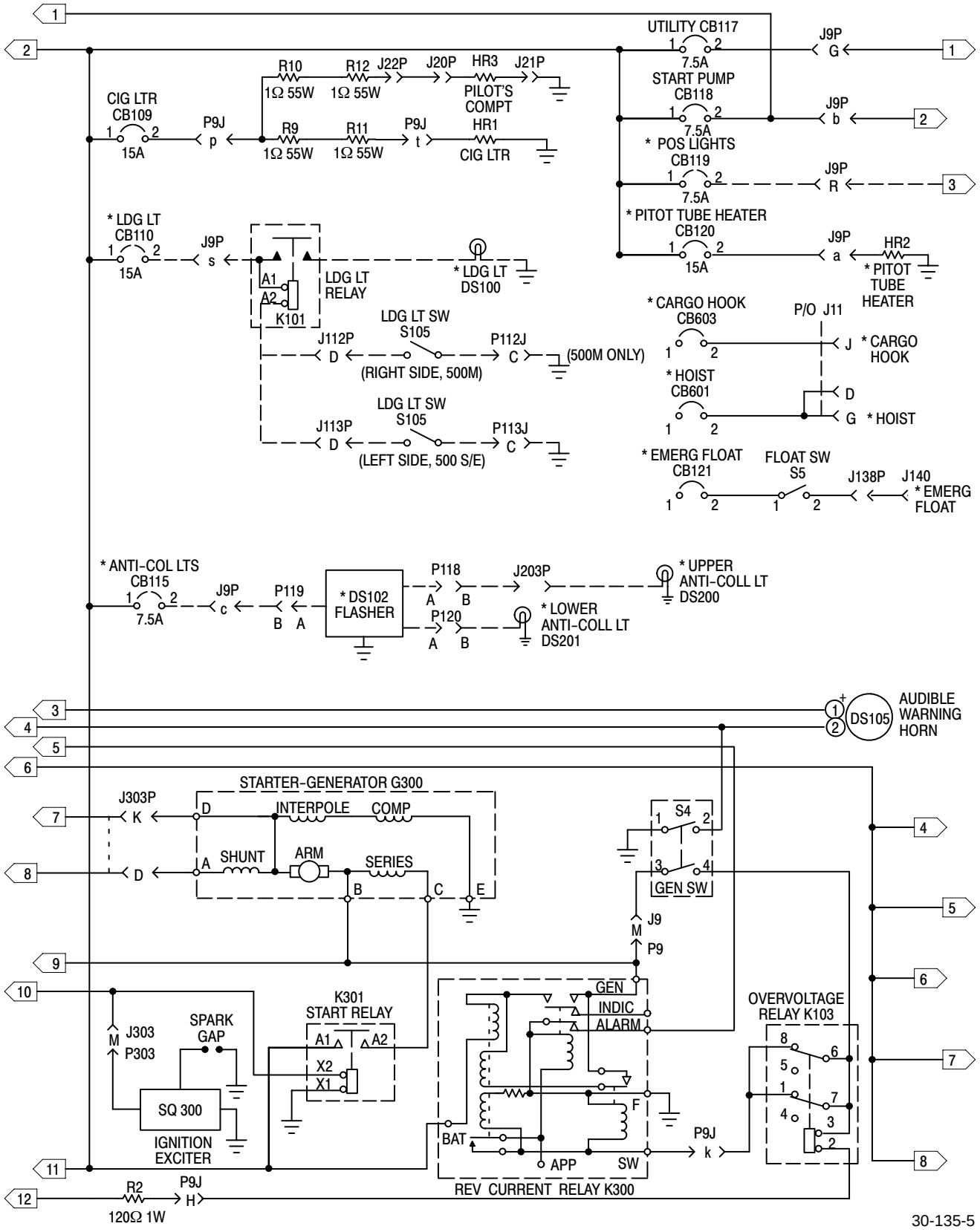
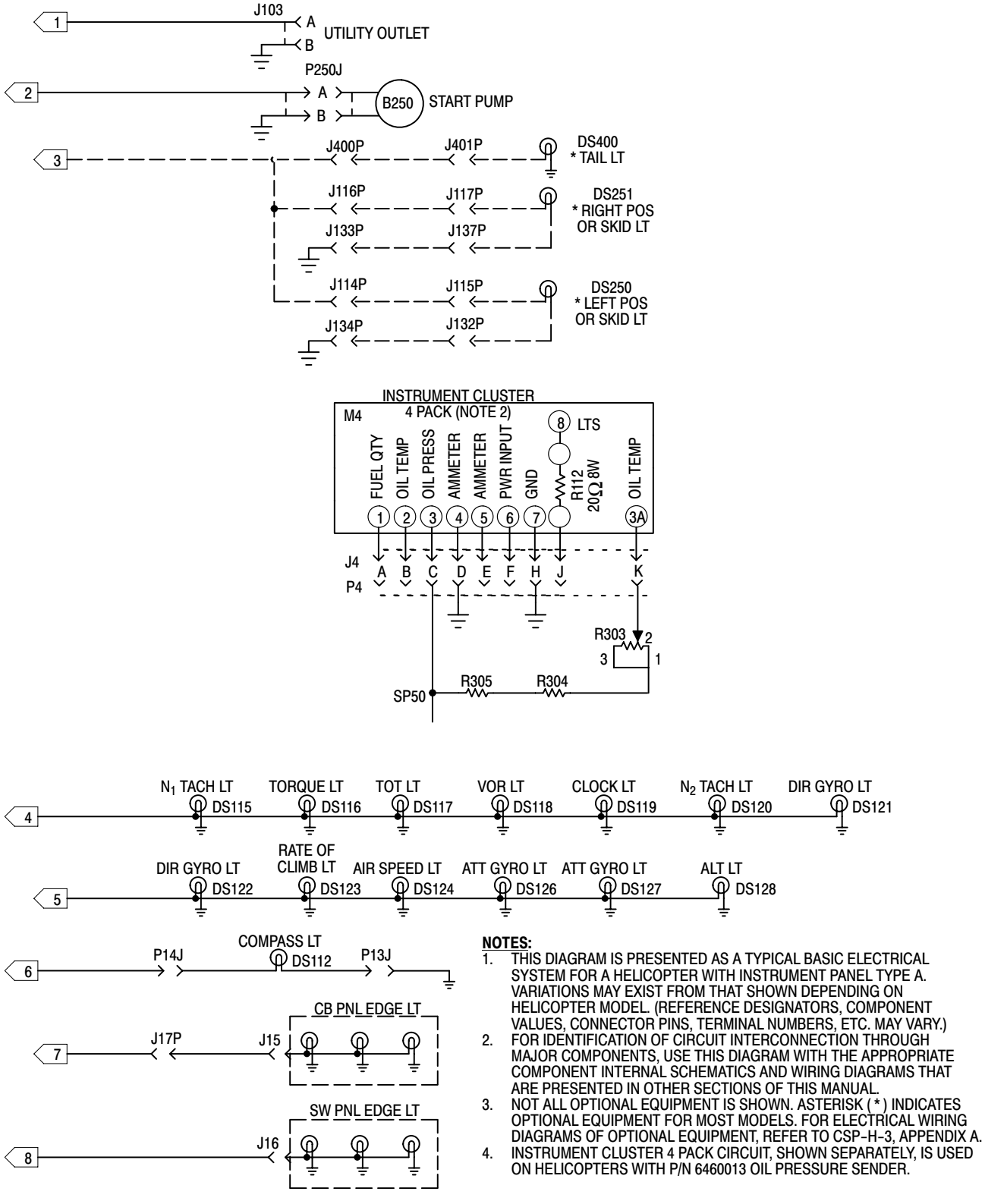


Figure 20-14. Typical Electrical System Schematic, Instrument Panel Type A (Sheet 5 of 6)



NOTES:

1. THIS DIAGRAM IS PRESENTED AS A TYPICAL BASIC ELECTRICAL SYSTEM FOR A HELICOPTER WITH INSTRUMENT PANEL TYPE A. VARIATIONS MAY EXIST FROM THAT SHOWN DEPENDING ON HELICOPTER MODEL. (REFERENCE DESIGNATORS, COMPONENT VALUES, CONNECTOR PINS, TERMINAL NUMBERS, ETC. MAY VARY.)
2. FOR IDENTIFICATION OF CIRCUIT INTERCONNECTION THROUGH MAJOR COMPONENTS, USE THIS DIAGRAM WITH THE APPROPRIATE COMPONENT INTERNAL SCHEMATICS AND WIRING DIAGRAMS THAT ARE PRESENTED IN OTHER SECTIONS OF THIS MANUAL.
3. NOT ALL OPTIONAL EQUIPMENT IS SHOWN. ASTERISK (*) INDICATES OPTIONAL EQUIPMENT FOR MOST MODELS. FOR ELECTRICAL WIRING DIAGRAMS OF OPTIONAL EQUIPMENT, REFER TO CSP–H–3, APPENDIX A.
4. INSTRUMENT CLUSTER 4 PACK CIRCUIT, SHOWN SEPARATELY, IS USED ON HELICOPTERS WITH P/N 6460013 OIL PRESSURE SENDER.

30-135-6

Figure 20-14. Typical Electrical System Schematic, Instrument Panel Type A (Sheet 6 of 6)

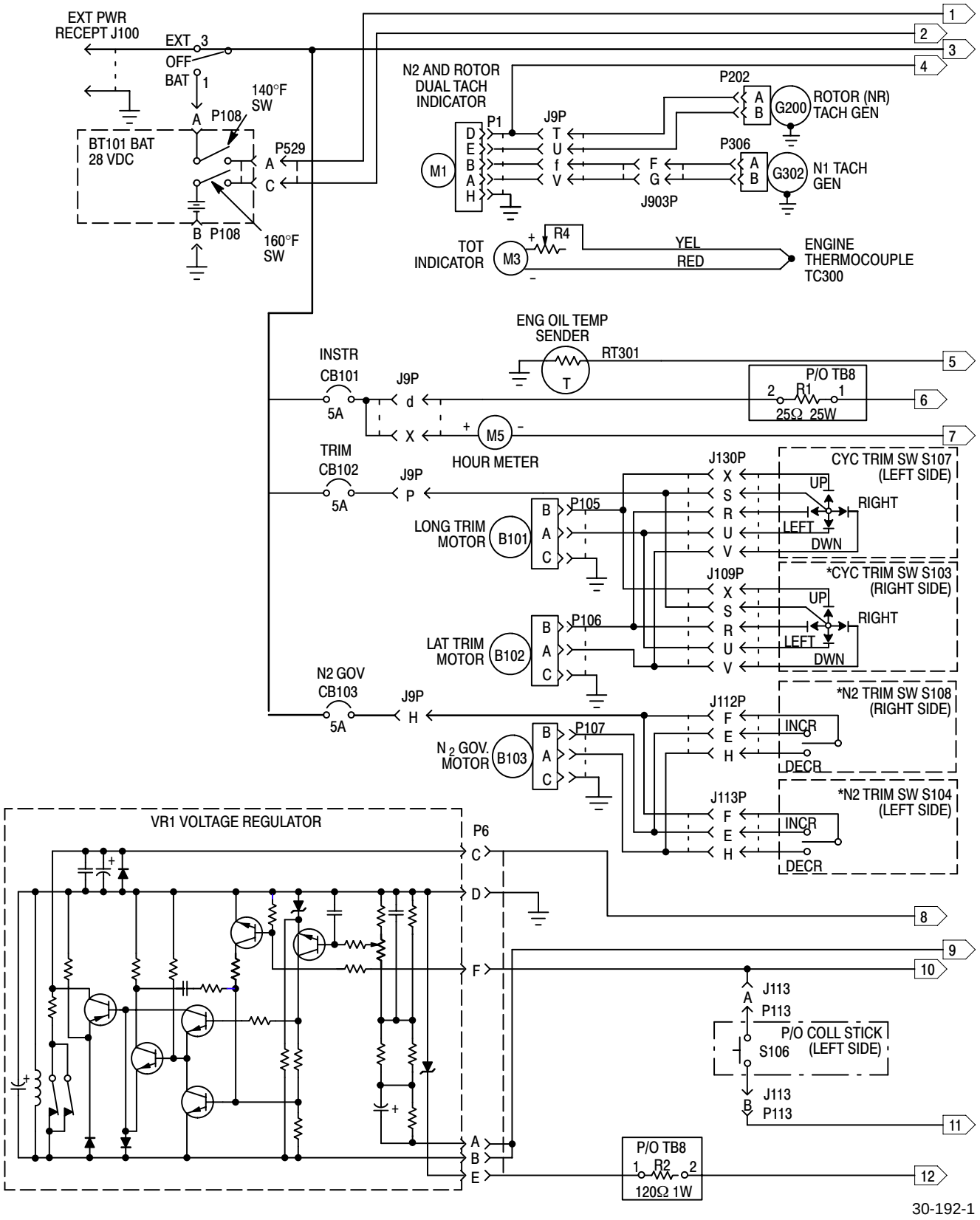
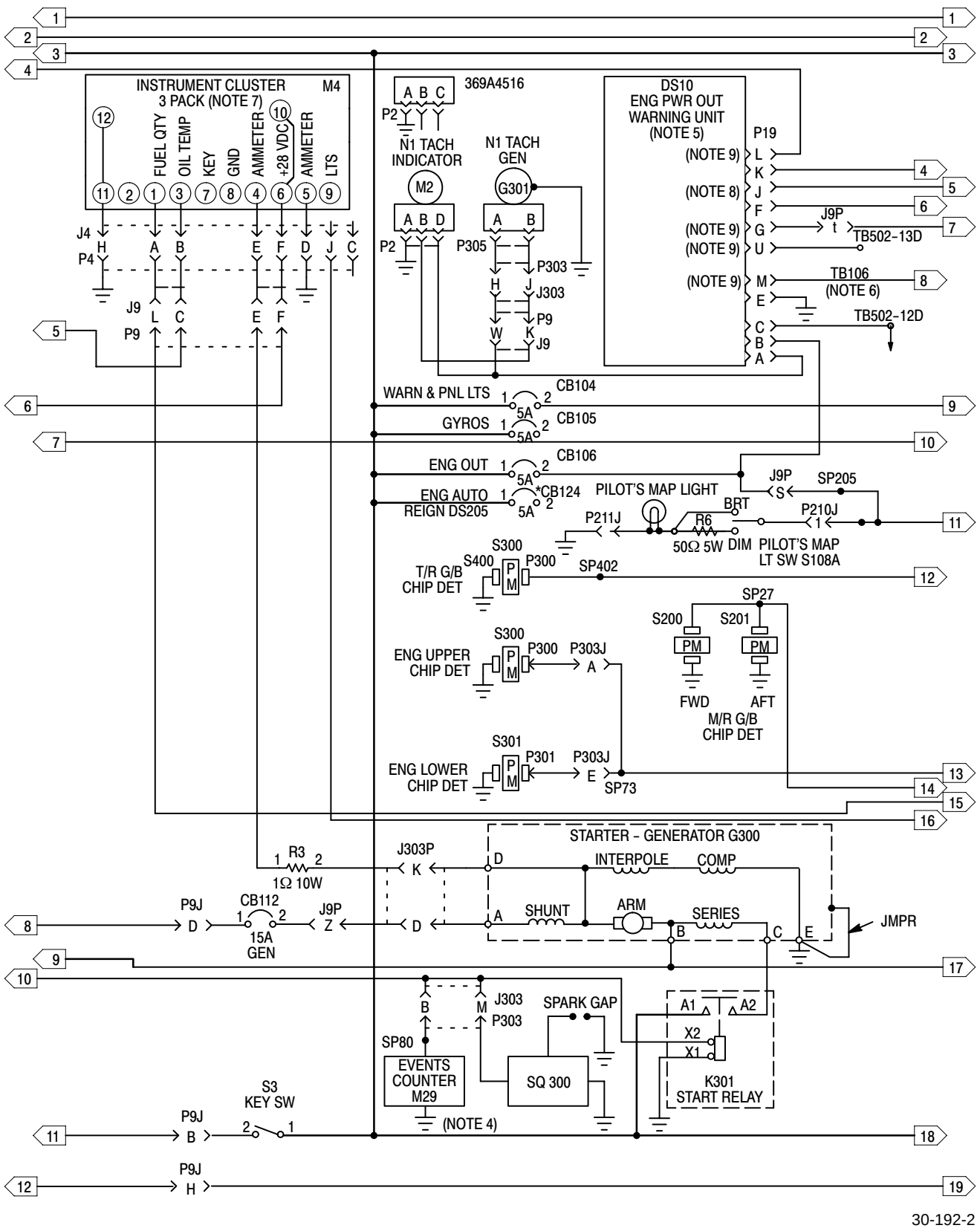


Figure 20-15. Typical Electrical System Schematic, Instrument Panel Type B (Sheet 1 of 5)



30-192-2

Figure 20-15. Typical Electrical System Schematic, Instrument Panel Type B (Sheet 2 of 5)

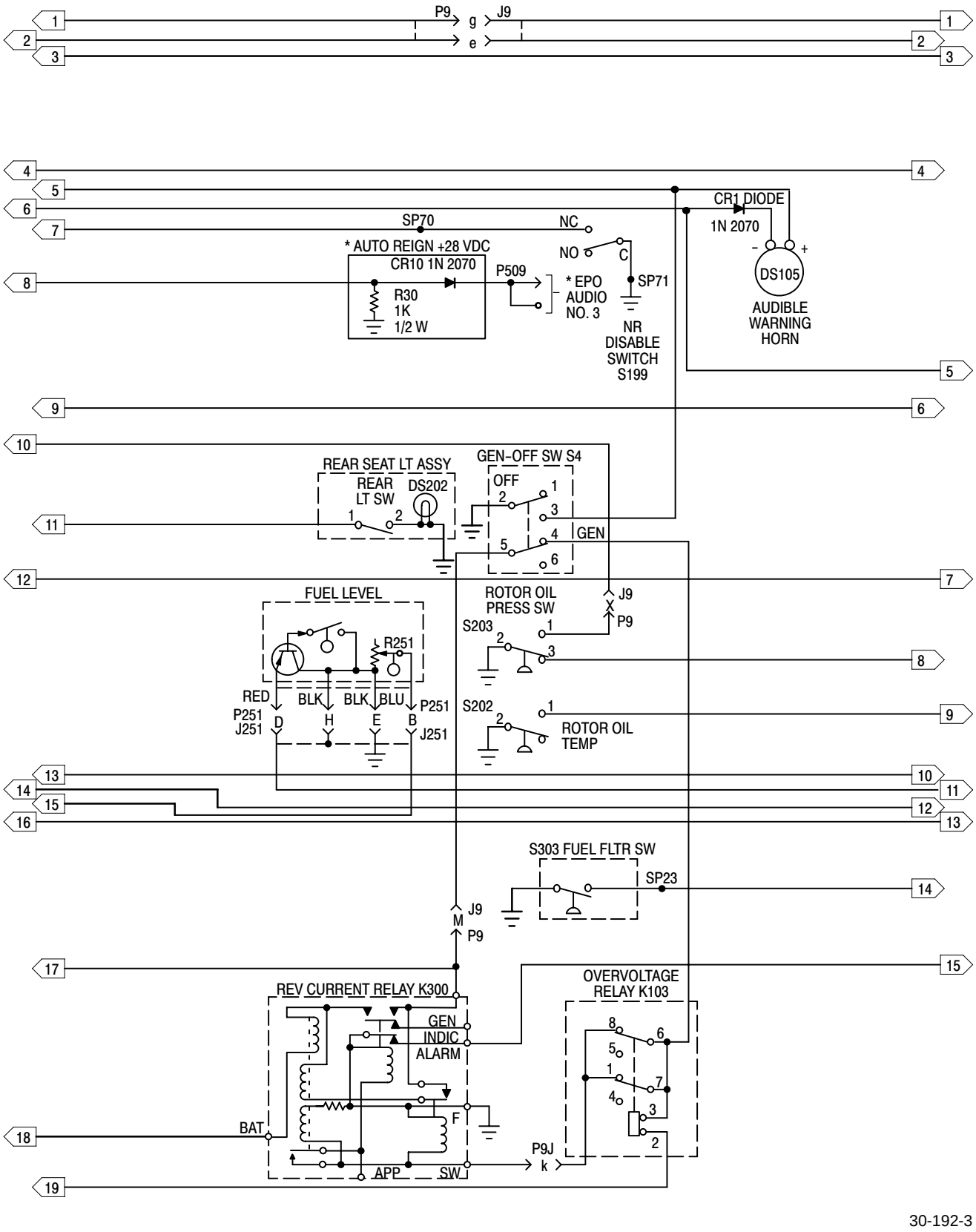


Figure 20-15. Typical Electrical System Schematic, Instrument Panel Type B (Sheet 3 of 5)

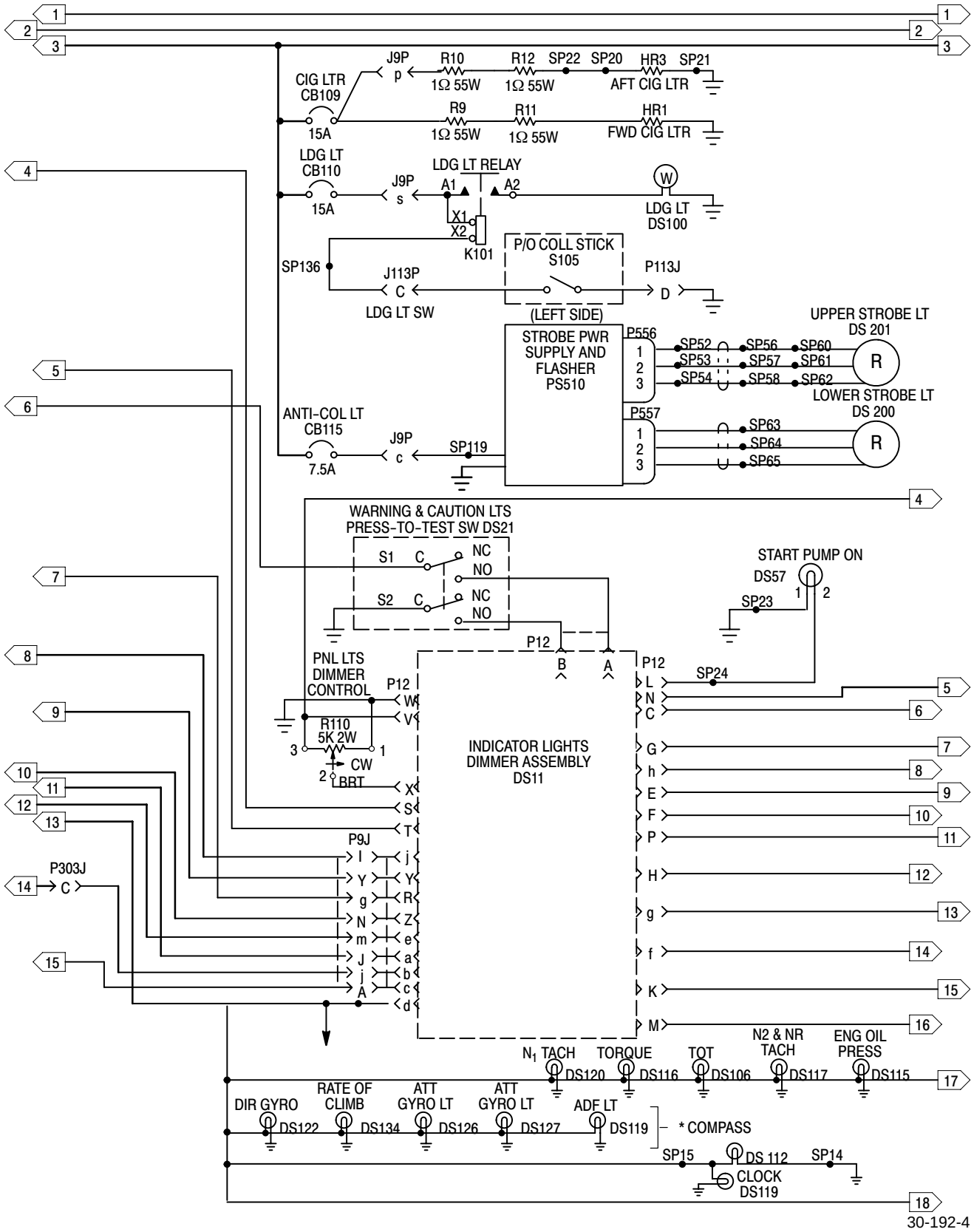


Figure 20-15. Typical Electrical System Schematic, Instrument Panel Type B (Sheet 4 of 5)

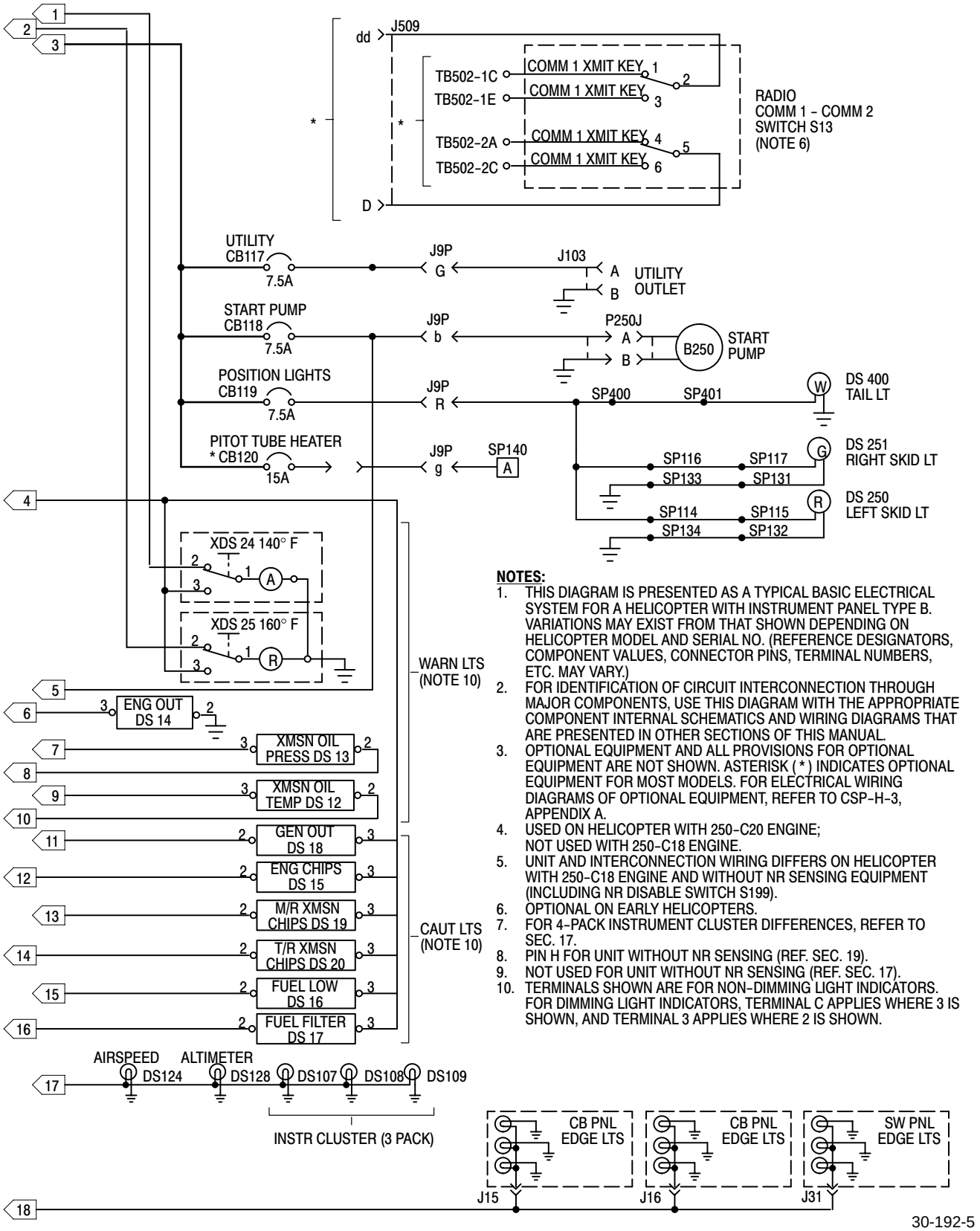


Figure 20-15. Typical Electrical System Schematic, Instrument Panel Type B (Sheet 5 of 5)

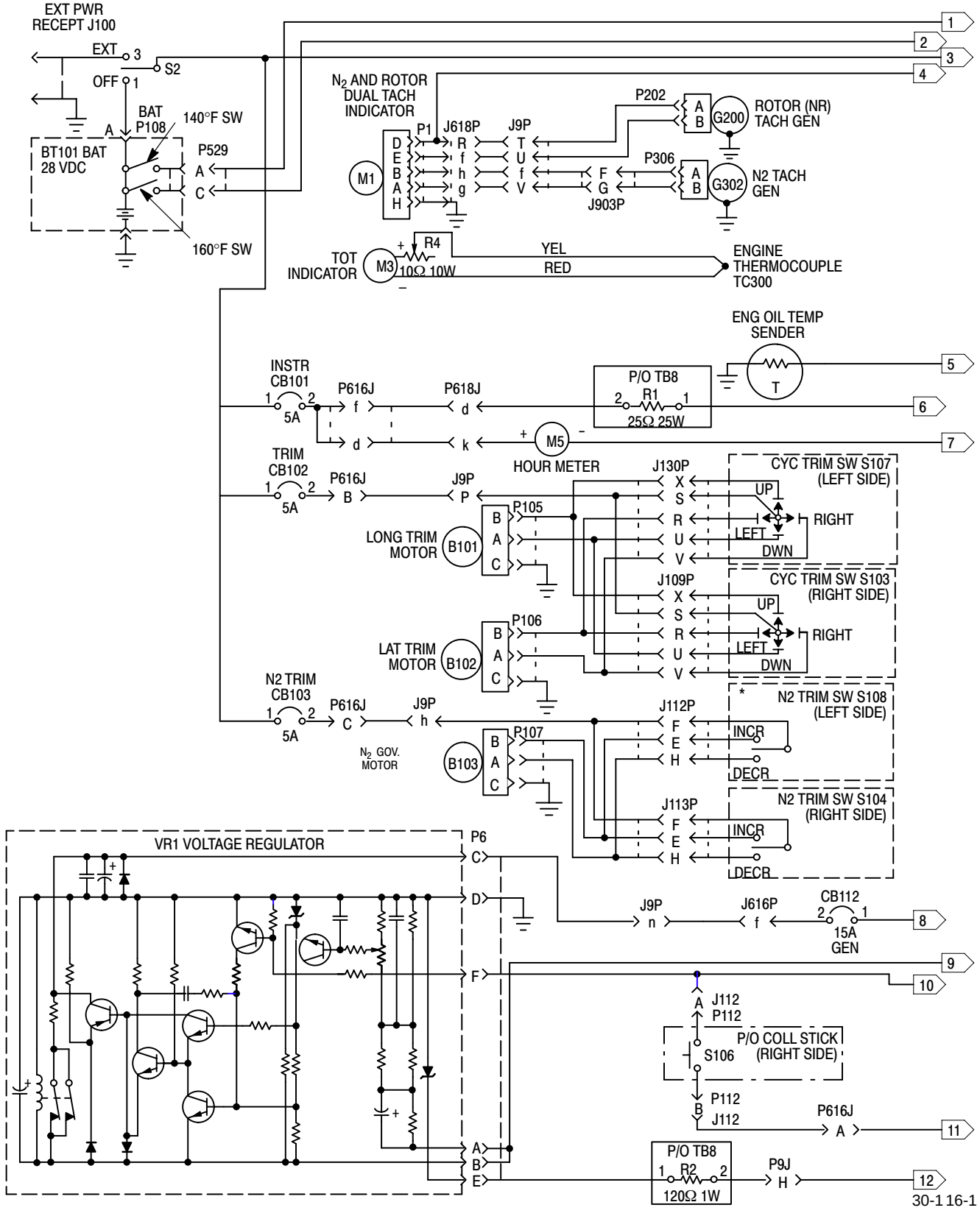


Figure 20-16. Typical Electrical System Schematic, Instrument Panel Type T (Sheet 1 of 6)

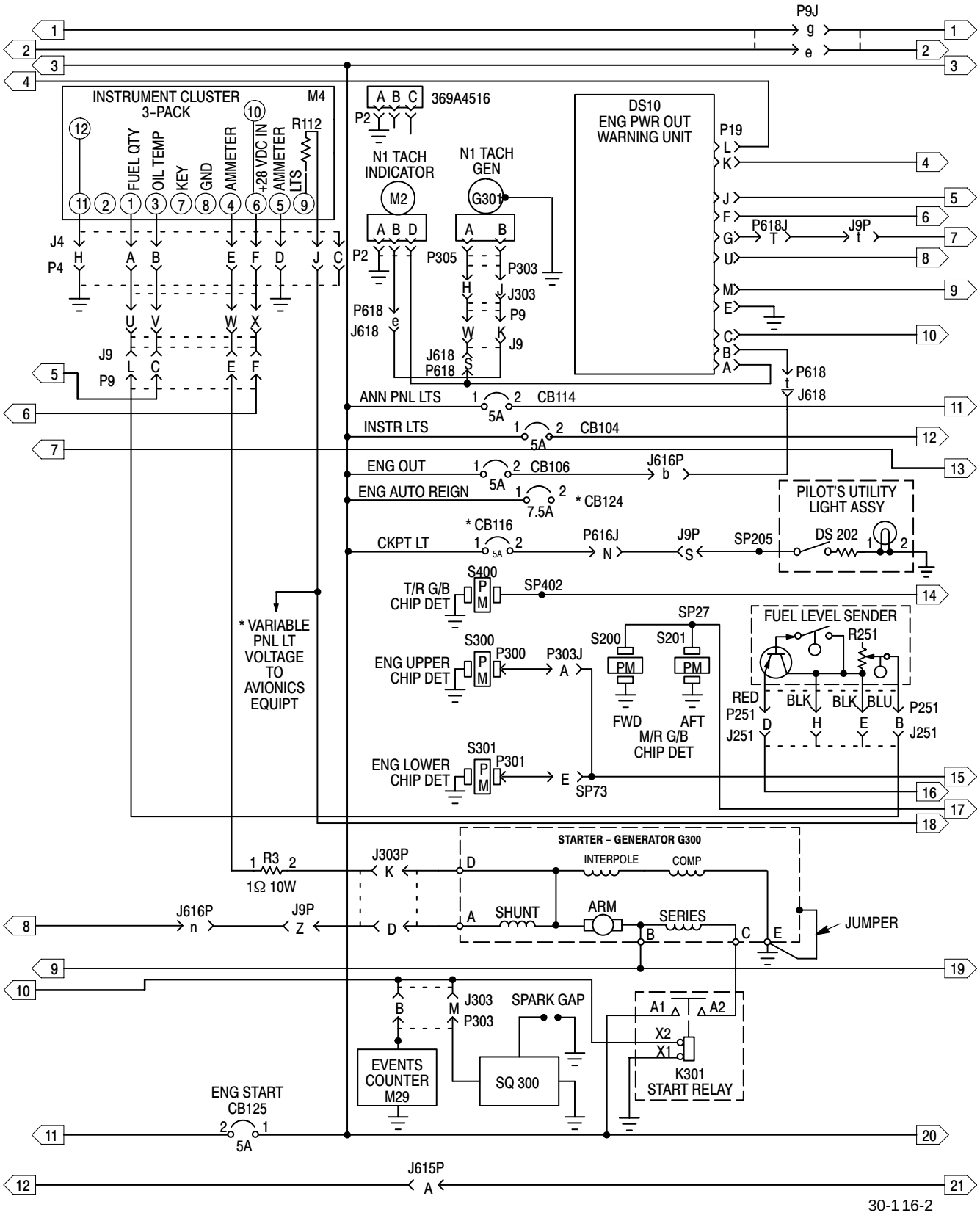


Figure 20-16. Typical Electrical System Schematic, Instrument Panel Type T (Sheet 2 of 6)

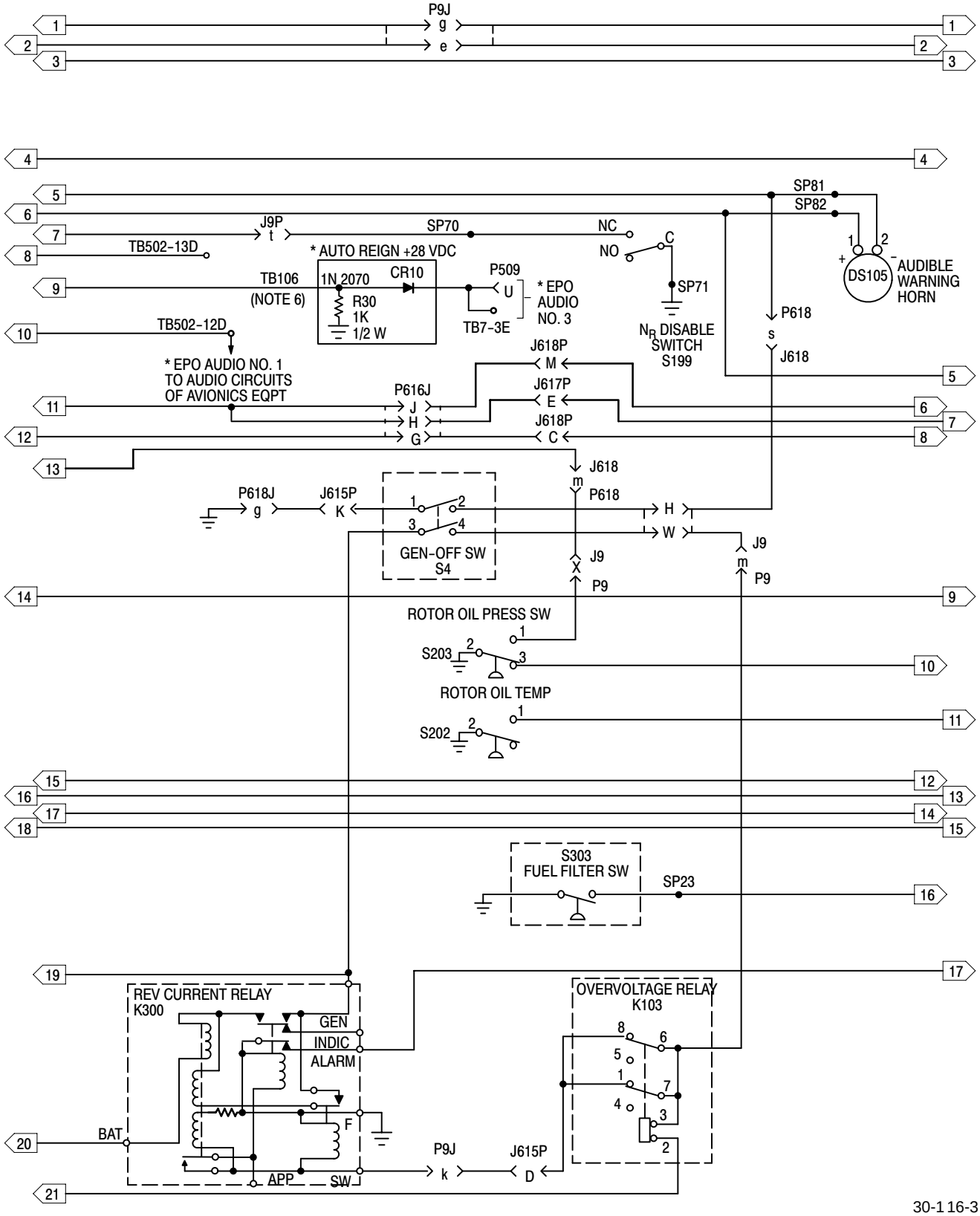


Figure 20-16. Typical Electrical System Schematic, Instrument Panel Type T (Sheet 3 of 6)

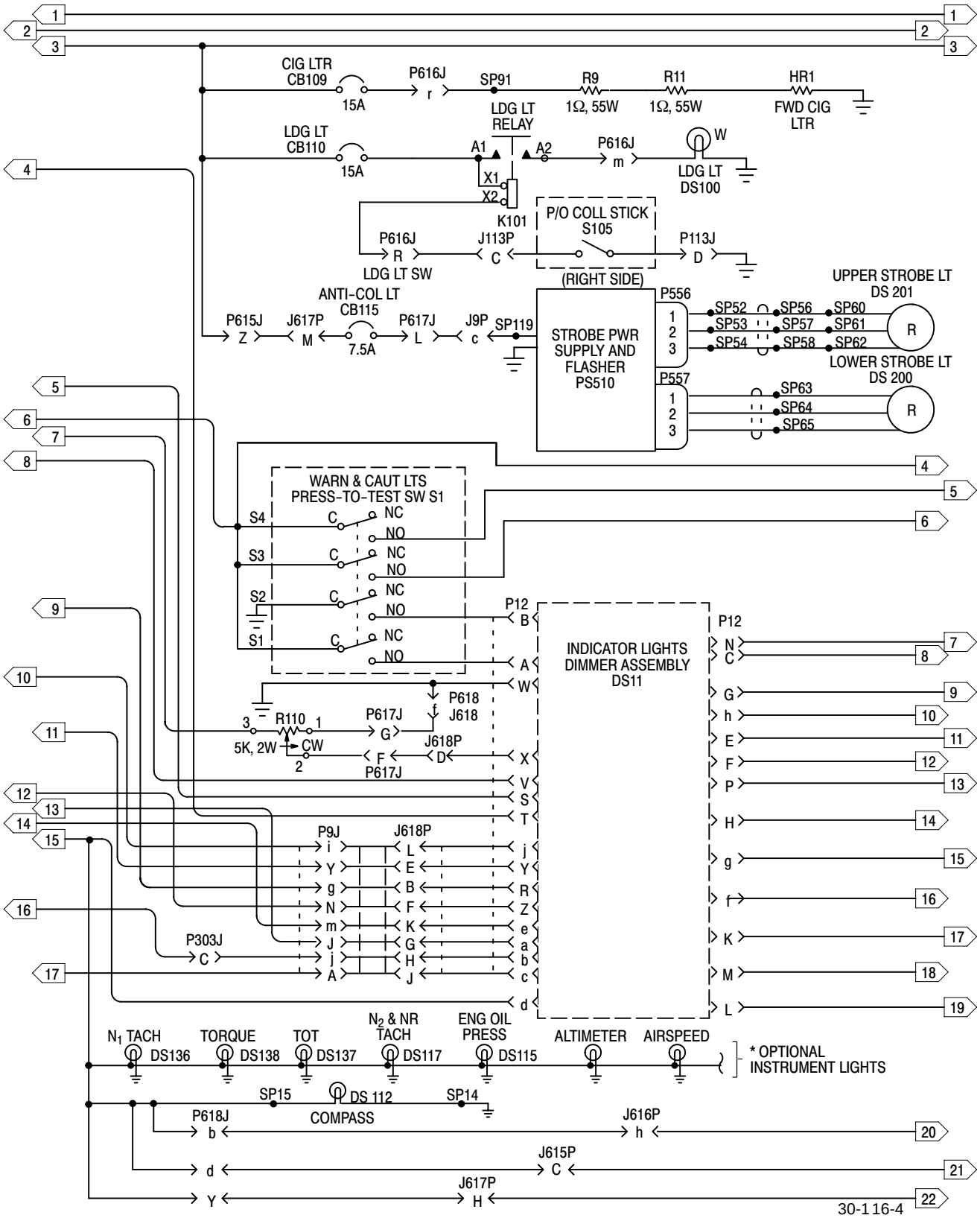


Figure 20-16. Typical Electrical System Schematic, Instrument Panel Type T (Sheet 4 of 6)

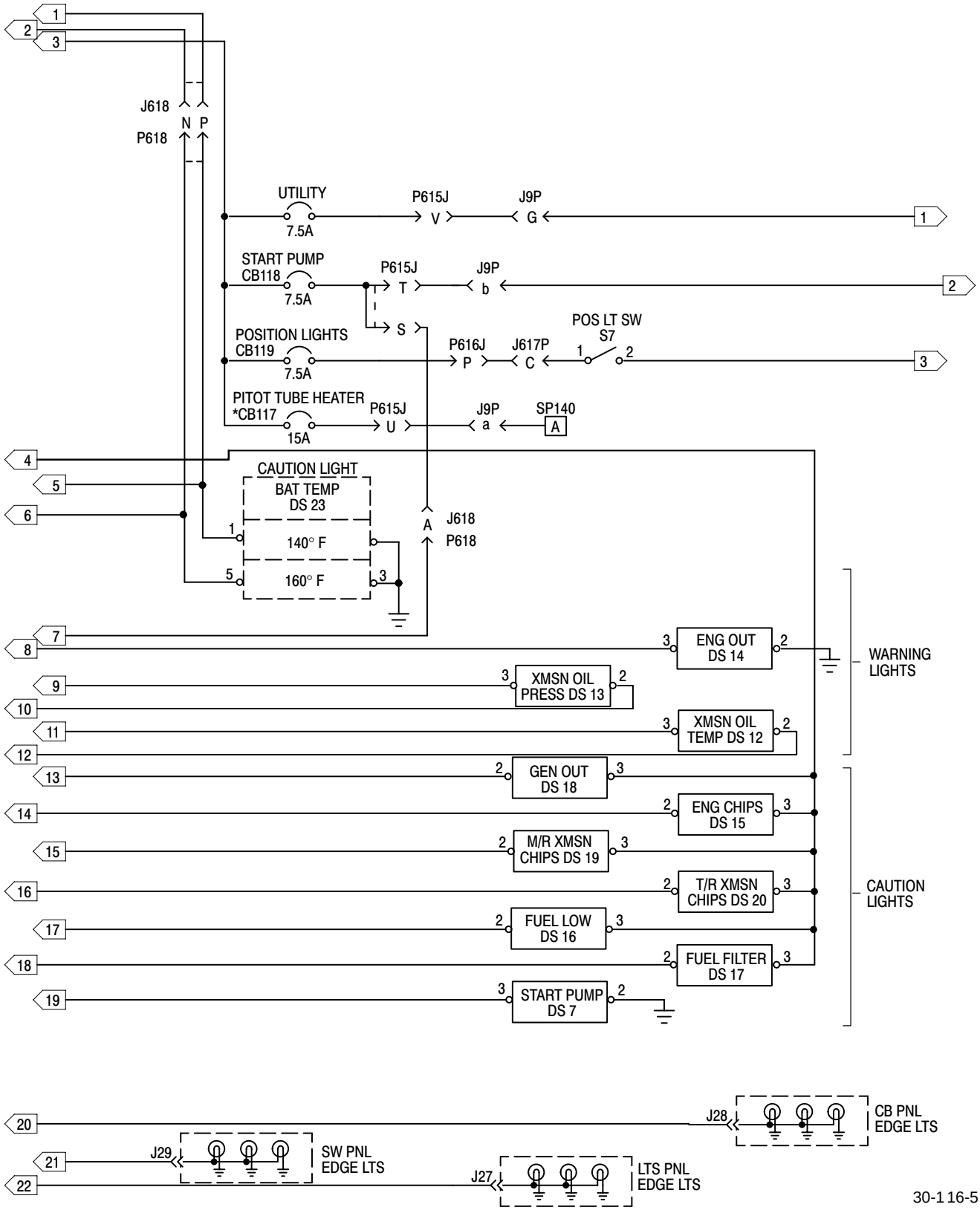
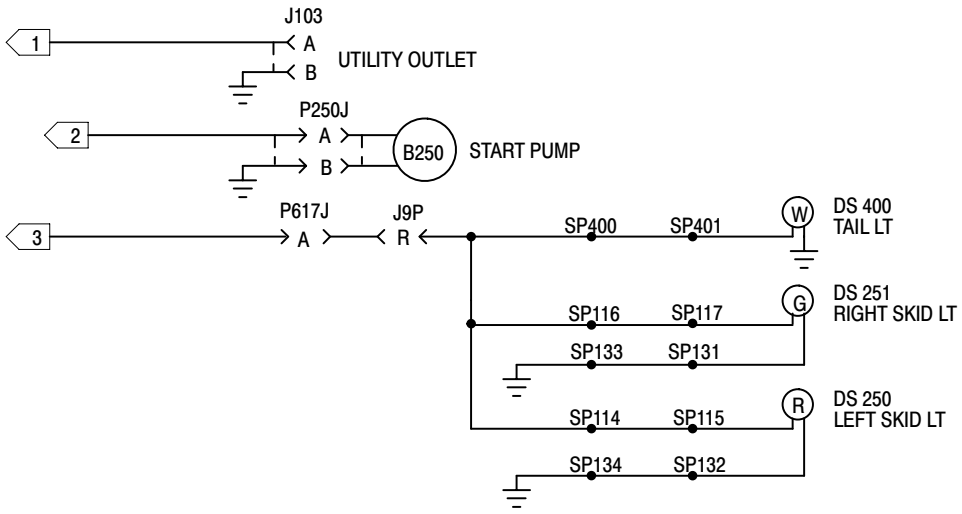


Figure 20-16. Typical Electrical System Schematic, Instrument Panel Type T (Sheet 5 of 6)



NOTES:

1. THIS DIAGRAM IS PRESENTED AS A TYPICAL BASIC ELECTRICAL SYSTEM FOR A NORMAL VERSION 500M HELICOPTER WITH INSTRUMENT PANEL TYPE T. VARIATIONS MAY EXIST FROM THAT SHOWN DEPENDING ON HELICOPTER MODEL AND SERIAL NO. (REFERENCE DESIGNATORS, COMPONENT VALUES, CONNECTOR PINS, TERMINAL NUMBERS, ETC. MAY VARY.)
2. FOR IDENTIFICATION OF CIRCUIT INTERCONNECTION THROUGH MAJOR COMPONENTS, USE THIS DIAGRAM WITH THE APPROPRIATE COMPONENT INTERNAL SCHEMATICS AND WIRING DIAGRAMS THAT ARE PRESENTED IN THIS MANUAL.
3. OPTIONAL EQUIPMENT AND ALL PROVISIONS FOR OPTIONAL EQUIPMENT ARE NOT SHOWN. ASTERISK (*) INDICATES OPTIONAL EQUIPMENT FOR MOST MODELS. FOR ELECTRICAL WIRING DIAGRAMS OF OPTIONAL EQUIPMENT, REFER TO CSP-H-2, APPENDIX A.

30-116-6

Figure 20-16. Typical Electrical System Schematic, Instrument Panel Type T (Sheet 6 of 6)