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Bell 407 N496AE Accident Investigation – Contacts List

FAA
Arnold W. Scott, Senior Air Safety Investigator, NTSB
Jesse Sanchez, Airworthiness Aviation Safety Inspector, San Antonio FSDO
Mark Pritchett, Aviation Safety Inspector, Scottsdale FSDO

Air Evac
Tony Bonham, Senior Director of Flight Operations
Jason Hodges, Director of Maintenance Support Services
Jay Hefferman, Director Field Maintenance

Able Engineering
Tony Mitteer, Business Development Manager
Dan Rose, Chief Design Engineer
Troy Nault, Rotorwing Lead
Tom Chenausky, Rotorwing Chief Technician
Scott Gross, Chief Inspector

Bell
Tony Randall, Manager Continued Operational Safety
Aaron Slager, Field Investigation Laboratory Engineer
Michael Vautour, Product Support Engineer

ARTL Metallurgical Lab
Keith Bailey, Owner

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Date: Nov 20, 2015

Written by: Dan Rose, Able Engineering

Summary of Preliminary Investigation, Air Evac N496AE, Bell 407

On Nov 2, 2015, Air Evac pilot Rocky Whitely was forced to land a Bell 407, tail number N496AE, while on duty. The force landing was a result of mechanical failure in the tail rotor drive train. The write-up provided by Mr. Whitely is included at Attachment 1.

The failed component was the #3 Tail Rotor Shaft and Bearing Hanger Assembly. This component was provided by Air Evac to Mr. Jesse Sanchez (FAA) for review.

Discussion between Jesse Sanchez and Tony Bonham (Air Evac) resulted in the following agreement for the investigation.

Mr. Sanchez would send all components in his possession directly to Able Engineering, so long as Able Engineering does not open the shipping boxes until FAA and other parties are present at Able.

Air Evac EMS, Inc. would send the remainder of the driveshaft (basically from the transmission to tail rotor gearbox) directly to Able Engineering, so long as Able Engineering does not open the shipping boxes until FAA and other parties are present at Able.

As soon as Able Engineering has completed their analysis, all components would then be sent directly to Bell Helicopter for Bell's specific analysis that they would like to conduct.

The parts that were sent to Able Engineering are listed in Table 1. These arrived at Able Engineering during the week of Nov 9 thru 13. Coordination of schedules resulted in the participants meeting at Able Engineering at 8:00 am on Nov. 18.

The persons present for the initial investigation at Able Engineering were Mark Pritchett, Tony Bonham, Jason Hodges, Jay Hefferman, Tony Mitteer, Dan Rose, Scott Gross, Tony Nault, Tom Chenausky, Aaron Slager, and Keith Bailey.

A tabular summary of the initial examination of the parts is presented in Table 2 and as follows. The item numbers are based on Bell-407-IPB Figure 65-1, which is included in Attachment 2 for reference.

The N496AE #3 shaft was the failed component. The shaft and coupling splines were worn away leaving smeared surfaces. The item 31 washer had substantial wear on the faying surface. The item 30 washer was deformed into a cup shape. There was also damage on the threads of item 39 stud, which appeared to be secondary.

Based on the results of the initial examination, Jason Hodges directed Air Evac field technicians to inspect other 407 rotorcraft in the Air Evac fleet with respect to the segmented shafts. The #3 shaft on aircraft N512MT exhibited some abnormal movement. This shaft was removed and shipped overnight to Able Engineering for examination.

The N512MT #3 shaft arrived at Able on the morning of Nov. 19. The shaft and coupling splines, as well as the item 31 washer had incipient wear. In addition, torque measurements on the item 29 Nut showed that the torque was below the maintenance manual limit of 30-50 in-lbs, and was noticeably less than that of the other shafts examined on Nov. 18.

Initial Conclusions

The cause of failure of the #3 shaft is believed to be spline wear and deformation. The nut looses torque over time in-service, which allows relative movement of the shaft spline and adapter spline. The wear causes additional loss of torque on the item 29 Nut, which allows additional movement and wear. The relative axial movement between splines may also cause frictional heating, which softens the aluminum base metal and reduces hardness and strength. In addition as the nut torque is reduced, the length of spline engagement is reduced. The combination of spline wear, softening, and reduced contact length ultimately leads to the splines becoming disengaged

and ceasing to transfer the torque of the drive train. This failure mode is consistent with the "pop" and subsequent "high pitch whine" reported by the pilot on N496AE accident.

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Table 1 - INVESTIGATION ITEMS N496AE

IPC Item	Description	Part Number	Serial Number
	FREE WHEELING ASSY	406-040-500-147	
17	FORWARD SHAFT	406-040-315-111 (CHECK)	UNKNOWN
49	OIL COOLER FAN SHAFT ASSY	407-040-303-135	UNKNOWN
21	AFT SHAFT ASSY	407-040-325-105	UNKNOWN
28 (#1)	SHAFT AND BEARING HANGER ASSY, TAIL ROTOR	407-040-302-107	A-1566
38 (#1)	SEGMENTED SHAFT ASSEMBLY	407-040-330-105	A3802
28 (#2)	SHAFT AND BEARING HANGER ASSY, TAIL ROTOR	407-040-302-107	A-1564
38 (#2)	SEGMENTED SHAFT ASSEMBLY	407-040-330-105	A3800
28 (#3)	SHAFT AND BEARING HANGER ASSY, TAIL ROTOR	407-040-302-107	A-1568
38 (#3)	SEGMENTED SHAFT ASSEMBLY	407-040-330-105	A3804
28 (#4)	SHAFT AND BEARING HANGER ASSY, TAIL ROTOR	407-040-302-107	A-1569
38 (#4)	SEGMENTED SHAFT ASSEMBLY	407-040-330-105	A3805
43	TAIL ROTOR GEARBOX	407-040-400-117	A-757

Table 2 - INVESTIGATION ITEMS N496AE

Inspecton Method	Item Inspected	N496AE Shaft 1	N496AE Shaft 2	N496AE Shaft 3	N496AE Shaft 4	N512MT Shaft 3
Visual	Item 31 Washer correct orientation	yes	yes	yes	yes	yes
Visual	Item 29 Nuts are self-locking	yes	yes	yes	yes	yes
Visual	Hanger bearing axial play	normal	normal	normal	normal	normal
Visual	Male coupling wear	neglibible	neglibible	failure	neglible	wear evident
Visual	Female coupling wear	neglibible	neglibible	failure	neglible	wear evident
Measurement	Tightening torque (30-50 in-lbs)	85 in-lbs	50 in-lbs	not measured	not measured	25 in-lbs
Measurement	Breaking torque	85 in-lbs	80 in-lbs	not measured	not measured	20 in-lbs
Measurement	Tare or drag torque (30-50 in-lbs)	40 in-lbs	60 in-lbs	not measured	not measured	5-10 in-lbs
Measurement	Stud height (0.63-0.65 inch)	0.643	0.642	0.677-0.682	0.652	0.646

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Attachment 1

Pilot Report for N496AE Forced Landing

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Subject: Fwd: AE093 Uncommanded Rapid Right Yaw

Pilot report from Rocky Whitely.

Begin forwarded message:

From: Rocky Whitely <[redacted]>
Date: November 2, 2015 at 9:47:15 PM CST
To: Mark Fisher <[redacted]>
Cc: Steven Morris <[redacted]>
Subject: FW: AE093 Uncommanded Rapid Right Yaw

Mark,

Thank you for your help tonight. Just wanted to send an email detailing tonight's chain of events for the record.

AC: B407, N496AE, AE93

Crew: Whitely, Ronald (Pilot); Hall, Bonnie (RN); Burns, Matthew (PM)

Time of event: 1923 CST

Card # 537053

Summary: Transferred a patient from LMC to KSAT, with follow on ground transport to St. Luke's San Antonio from 1540-1723. I stayed with Aircraft at KSAT during ground transport. Crew arrived back to KSAT approx 1900. Just before we were about to RTB to Laredo, we received a short patient transfer request from Cencom, pickup from NE Methodist to Methodist Main. I quickly consulted with the crew making sure we had plenty of duty day and verified weather. We accepted the flight and went to the helicopter.

I conducted the walk-around before getting in. It was my 4th engine start of the day, so I used the abbreviated checklist for run-up. The med crew was outside the helicopter as usual during the run-up procedure. Everything was normal from starting through accelleration to fly, at 100%. ATIS was calling for winds 150 at 5 kts. We were parked approx 240. We conducted our before takeoff checks and called Cencom "lifted" at 1722. I increased collective, applied a normal amount of left pedal and aft cyclic as I picked the helicopter up to a 3 ft. hover. It felt normal for approx 1-2 seconds. We heard a "Pop" and a high pitched whine, and the aircraft immediately started yawing to the right. I applied full left pedal, which did not stop the rotation. We spun what we believe was 1 full rotation at 3 feet, and I realized we were safe to come straight down, as we didn't hit anything. I slowly lowered the collective and kept the a/c level until I felt both skids contact the ground. As soon as I felt contact, I quickly lowered the collective to the full down position to get the a/c weight on the ground, which allowed friction to stop the rotation. It spun approx. 1/2 to 3/4 turn on the concrete, as denoted by the skid marks. I heard both crewmembers say they were ok, and I told them to get out while I shut the aircraft off. I closed the throttle fully off and shut the fuel valve switch off. It was an abnormally long shutdown, and the high-pitched whine continued throughout. I shut off the generator, avionics, a/c, used the rotor brake below 40%, then shut off the battery and got out quickly after the rotor stopped. We were all safe, so I performed a walk-around to see if there was anything blatantly wrong (specifically the tail rotor and

XMSN), but didn't see anything out of place. I decided not to open up any panels or compartments just in case an investigation needed to take place.

We called Cencom, who transferred us to Maintenance Control, and said they would send a Mechanic to come look at it.

These are the events as best we can recall. If you have any further questions or require additional explanation, please feel free to call. I appreciate your help and understanding. Have a great night,

Sincerely,

Ronald "Rocky" Whitely III

Line Pilot

AE 093, Laredo, TX

C: [redacted]

God is Good!

From: Operations Control Center
Sent: Monday, November 02, 2015 20:59
To: Tim Jenkins; Tony Bonham
Cc: Alan Willis; Rocky Whitely
Subject: AE093 Uncommanded Rapid Right Yaw

No injuries..... Rocky Whitely (Pilot at AE093) picked up to a 3 foot hover to complete a hover power check at KSAT. He stabilized for 1-2 seconds then heard a pop followed by a wine. The aircraft immediately began an un-commanded rapid right yaw that would not subside with left pedal input. Pilot set the aircraft on the ground within 1-2 second and after about 1 rotation. After aircraft was on the ground, ground friction stopped the aircraft within ¾ rotation. The aircraft wine continued through the emergency engine shut down. Pilot also noted that it took longer than normal shutdown. Pilot was Rocky Whitely

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Attachment 2

BHT-407-IPB Figure 65-1

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CHAPTER 65 — TAIL ROTOR DRIVE SYSTEM

CONTENTS — ILLUSTRATED PARTS BREAKDOWN

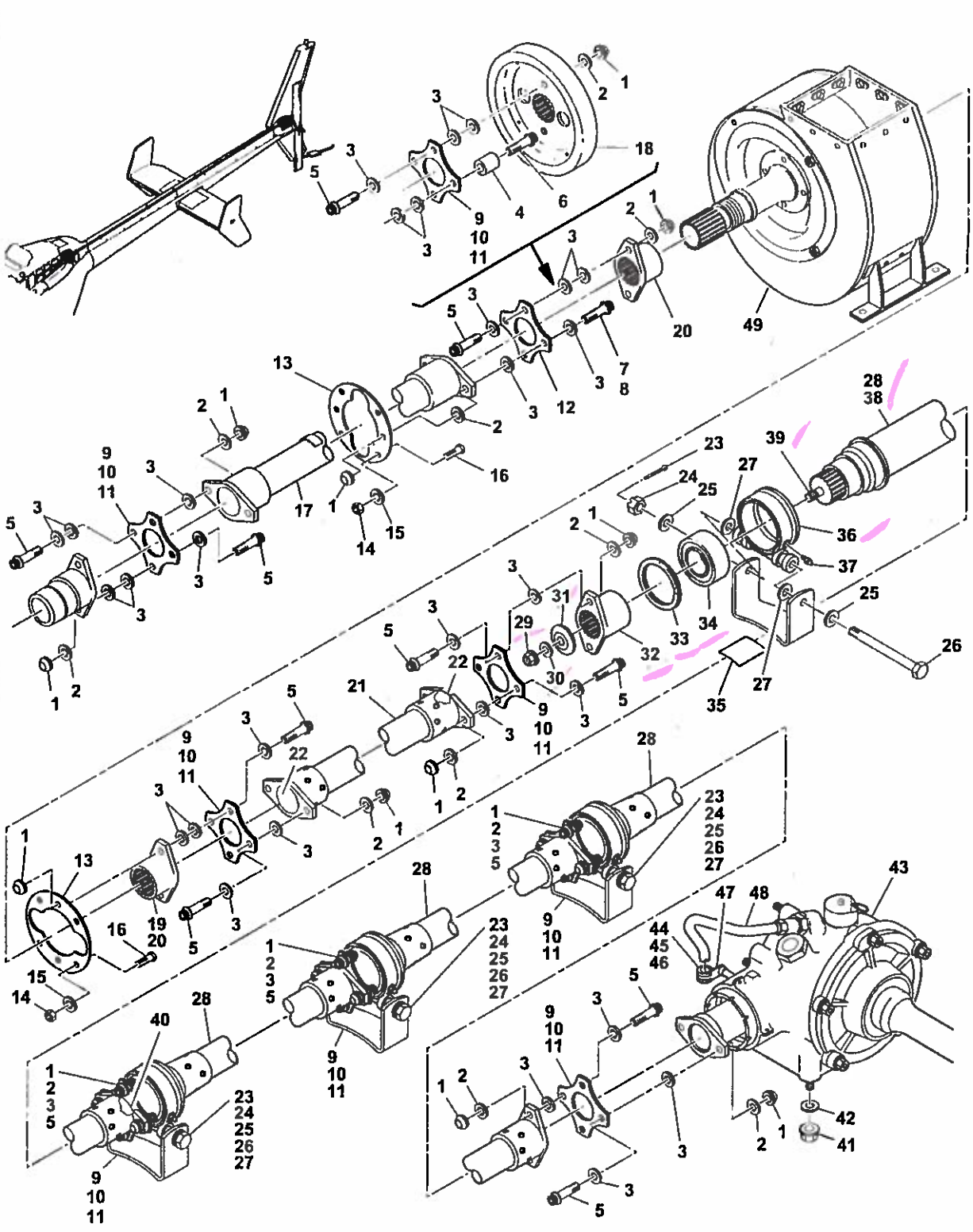

Figure 65-1. Drive System Installation, Tail Rotor (S/N 53000 Thru 54299, 54300 and Subsequent)

(1) INDEX NUMBER	(2) PART NUMBER	(3) ITEM NAME	(4) UNIT PER ASSY	(5) AVAIL	(6) UOC
		Figure 65-1. Drive System Installation, Tail Rotor (S/N 53000 Thru 54299, 54300 and Subsequent)			
	407-040-001-101	DRIVE SYSTEM INSTL (S/N 53000, 53002 THRU 53066) (SEE FIG. 65-2 FOR BALANCE OF BREAKDOWN)	1	NP	
	407-040-001-103	DRIVE SYSTEM INSTL (S/N 53001, 53067 THRU 53292) (SEE FIG. 65-2 FOR BALANCE OF BREAKDOWN)	1	NP	
	407-040-001-105	DRIVE SYSTEM INSTL (S/N 53293 THRU 53321) (SEE FIG. 65-2 FOR BALANCE OF BREAKDOWN)	1	NP	
	407-040-001-107	DRIVE SYSTEM INSTL (S/N 53322 THRU 53400) (SEE FIG. 65-2 FOR BALANCE OF BREAKDOWN)	1	NP	
	407-040-001-109	DRIVE SYSYEM INSTL (S/N 53401 THRU 53442) (SEE FIG. 65-2 FOR BALANCE OF BREAKDOWN)	1	NP	
	407-040-001-111	DRIVE SYSTEM INSTL (S/N 53443 THRU 53483) (SEE FIG. 65-3 FOR BALANCE OF BREAKDOWN)	1	NP	
	407-040-001-113	DRIVE SYSTEM INSTL (S/N 53484 THRU 53497) (SEE FIG. 65-3 FOR BALANCE OF BREAKDOWN)	1	NP	
	407-040-001-115	DRIVE SYSTEM INSTL (S/N 53498 THRU 53504) (SEE FIG. 65-3 FOR BALANCE OF BREAKDOWN)	1	NP	
	407-040-001-117	DRIVE SYSTEM INSTL (S/N 53505 THRU 53554) (SEE FIG. 65-3 FOR BALANCE OF BREAKDOWN)	1	NP	
	407-040-001-119	DRIVE SYSTEM INSTL (S/N 53555 THRU 54159, 54300 THRU 54499) (SEE FIG. 65-3 FOR BALANCE OF BREAKDOWN)	1	NP	
	407-040-001-121	DRIVE SYSTEM INSTL (S/N 54160 THRU 54299, 54500 THRU SUB) (SEE FIG. 65-3 FOR BALANCE OF BREAKDOWN)	1	SP	
1	EWSN26M-5	. NUT	32	SP	
		(ALTERNATE PARTS)			
1	RMLH6521-054	. NUT	32	P	
1	VN408A054	. NUT	32	P	
2	140-007-20-19-2	. WASHER, FLAT, CHAMFERED BOTH SIDES	30	SP	
3	214-040-611-003	. WASHER	74	SP	
4	407-040-317-101	. SPACER (USBL ON 407-040-001-101 AND -103) (REPLACED BY 407-040-317-103)	2	NP	
4	407-040-317-103	. SPACER (USBL ON 407-040-001-105, -107 AND -109) (REPLACES 407-040-317-101)	2	SP	
5	20-065-05008	. BOLT (REPLACED BY MS21250-05008)	30	NP	
5	MS21250-05008	. BOLT (REPLACES 20-065-05008)	30	SP	
6	20-065-05012	. BOLT (USBL ON 407-040-001-101 AND -103) (REPLACED BY MS21250-05012)	2	P	
6	MS21250-05012	. BOLT (REPLACES 20-065-05012)	2	SP	
7	20-065-05008	. BOLT (USBL ON 407-040-001-105, -107 AND -109) (REPLACED BY MS21250-05008)	2	NP	
7	MS21250-05008	. BOLT (USBL ON 407-040-001-111 AND -113) (REPLACES 20-065-05008)	2	SP	
8	20-065-05010	. BOLT (USBL ON 407-040-001-115, -117, -119 AND -121) (REPLACED BY MS21250-05010)	2	P	
8	MS21250-05010	. BOLT (USBL ON 407-040-001-115, -117, -119 AND -121) (REPLACES 20-065-05010)	2	SP	
9	406-040-340-101	. DISC PACK, COUPLING (PRE TB 407-99-18) (NOTE 3) (USBL ON 407-040-001-101 AND -103) (REPLACED BY 407-340-340-103)	8	SP	
10	406-040-340-103	. . DISC COUPLING (INDIVIDUAL DISC) (NOTE 3, 4)	12	NP	
11	407-340-340-101	. DISC PACK, COUPLING (POST TB 407-99-18) (USBL ON 407-040-001-105, -107 AND -109) (REPLACED BY 407-340-340-103)	8	NP	
12	407-340-340-103	. DISC PACK, COUPLING (USBL ON 407-040-001-111, -113, -115, -119 AND -121) (REPLACES 406-040-340-101, 407-340-340-101)	8	SP	

(1) INDEX NUMBER	(2) PART NUMBER	(3) ITEM NAME	(4) UNIT PER ASSY	(5) AVAIL	(6) UOC
		Figure 65-1. Drive System Installation, Tail Rotor (S/N 53000 Thru 54299, 54300 and Subsequent) (Cont'd)			
13	407-040-305-101	. PLATE, BALANCE (NOTE 7) (USBL ON 407-040-001-115, -117, -119 AND -121)	2	SP	
14	MS21042L3	. NUT, SELF-LOCKING (NOTE 7) (USBL ON 407-040-001-115, -117, -119 AND -121)	8	SP	
15	NAS1149F0363P	. WASHER, FLAT (NOTE 5, 7, 9) (USBL ON 407-040-001-115, -117, -119 AND -121)	AR	SP	
15	NAS1149F0316P	. WASHER, FLAT (NOTE 5, 9) (USBL ON 407-040-001-115, -117, -119 AND -121)	AR	SP	
15	NAS1149F0332P	. WASHER, FLAT (NOTE 5, 9) (USBL ON 407-040-001-115, -117, -119 AND -121)	AR	SP	
16	NAS1351-3-14	. SCREW (NOTE 6, 7) (USBL ON 407-040-001-115, -117, -119 AND -121)	8	SP	
17	406-040-315-111	. SHAFT, FORWARD	1	SP	
18	407-040-316-101	. FLYWHEEL, ADAPTER (PRE BHT-407-II-30) (USBL ON 407-040-001-101, -103, -105, -107 AND -109)	1	SP	
19	406-040-316-101	. ADAPTER, SPLINED (PRE BHT-407-II-30) (USBL ON 407-040-001-101, -103, -105, -107 AND -109)	1	SP	
20	406-040-316-101	. ADAPTER, SPLINED (POST BHT-407-II-30) (NOTE 8) (USBL ON 407-040-001-111, -113, -115, -117, -119 AND -121)	2	SP	
21	407-040-325-101	. SHAFT ASSY, AFT (USBL ON 407-040-001-101 AND -103) (REPLACED BY 407-040-325-105)	1	NP	
21	407-040-325-105	. SHAFT ASSY, AFT (S/N 53293 THRU 53769) (REPLACES 407-040-325-101) (REPLACED BY 407-040-325-107)	1	NP	
21	407-040-325-107	. SHAFT ASSY, AFT (S/N 53770 THRU 54299, 54300 THRU SUB) (REPLACES 407-040-325-105)	1	SP	
22	120-179-26A	. . CORK, STOPPER	2	SP	
23	MS24665-134	. PIN, COTTER (REPLACED BY MS24665-136)	4	P	
23	MS24665-136	. PIN, COTTER (REPLACES MS24665-134)	4	SP	
24	AN310-4	. NUT, CASTELLATED	4	SP	
25	MS25440-4	. WASHER	8	SP	
26	NAS6604D65	. BOLT	4	SP	
27	120-008C24E9	. SHIM, LAMINATED (POST ASB 407-97-7) (NOTE 4)	16	SP	
28	407-040-302-101	. SHAFT AND BEARING HANGER ASSY, TAIL ROTOR DRIVESHAFT (NOTE 2) (S/N 53000 THRU 53219) (REPLACED BY 407-040-302-109)	4	NP	
28	407-040-302-103	. SHAFT AND BEARING HANGER ASSY, TAIL ROTOR DRIVESHAFT (NOTE 2) (S/N 53220 THRU 53292) (REPLACED BY 407-040-302-109)	4	NP	
28	407-040-302-105	. SHAFT AND BEARING HANGER ASSY, TAIL ROTOR DRIVESHAFT (NOTE 2) (USBL ON 407-040-001-105) (REPLACED BY 407-040-302-109)	4	NP	
28	407-040-302-107	. SHAFT AND BEARING HANGER ASSY, TAIL ROTOR DRIVESHAFT (NOTE 2) (USBL ON 407-040-001-107 AND -109) (REPLACED BY 407-040-302-109)	4	NP	
28	407-040-302-109	. SHAFT AND BEARING HANGER ASSY, TAIL ROTOR DRIVESHAFT (NOTE 2) (USBL ON 407-040-001-111) (REPLACES 407-040-302-101, -103, -105 AND -107) (REPLACED BY 407-040-302-113)	4	NP	
28	407-040-302-111	. SHAFT AND BEARING HANGER ASSY, TAIL ROTOR DRIVESHAFT (NOTE 2) (S/N 53484 THRU 53519, 53521) (REPLACED BY 407-040-302-113)	4	NP	
28	407-040-302-113	. SHAFT AND BEARING HANGER ASSY, TAIL ROTOR DRIVESHAFT (NOTE 2) (S/N 53520, 53522 THRU 53579) (REPLACES 407-040-302-109 AND -111) (REPLACED BY 407-040-302-115)	4	NP	

(1) INDEX NUMBER	(2) PART NUMBER	(3) ITEM NAME	(4) UNIT PER ASSY	(5) AVAIL	(6) UOC
		Figure 65-1. Drive System Installation, Tail Rotor (S/N 53000 Thru 54299, 54300 and Subsequent) (Cont'd)			
28	407-040-302-115	. SHAFT AND BEARING HANGER ASSY, TAIL ROTOR DRIVESHAFT (NOTE 2) (S/N 53580 THRU 53769) (REPLACES 407-040-302-113) (REPLACED BY 407-040-302-117)	4	P	
28	407-040-302-117	. SHAFT AND BEARING HANGER ASSY, TAIL ROTOR DRIVESHAFT (NOTE 2) (S/N 53770 THRU 54299, 54300 THRU SUB) (REPLACES 407-040-302-115)	4	SP	
29	MS21042L4	. . NUT, SELF LOCKING	1	SP	
30	NAS1149F0432P	. . WASHER, FLAT	1	SP	
31	406-040-327-101	. . WASHER, SHAFT ASSEMBLY	1	SP	
32	406-040-328-103	. . ADAPTER, COUPLING (USBL ON 407-040-302-101, -103, -105, -107, -109, -111, -113 AND -115) (REPLACED BY 406-040-328-105)	1	SP	
32	406-040-328-105	. . ADAPTER, COUPLING (USBL ON 407-040-302-117) (REPLACES 406-040-328-103)	1	SP	
33	M27426-3164B	. . RING, RETAINING (REPLACED BY M2742630164B)	1	NP	
33	M2742630164B	. . RING, RETAINING (REPLACES M27426-3164B)	1	SP	
34	406-040-339-105	. . BEARING, BALL, HANGER, TAIL ROTOR (USBL ON 407-040-302-101) (REPLACED BY 406-040-339-109, 407-340-339-107) (ALTERNATE PART)	1	NP	
34	406-040-339-101	. . BEARING, BALL, HANGER, TAIL ROTOR (REPLACED BY 407-340-339-107)	1	SP	
34	406-040-339-111	. . BEARING, BALL, HANGER, TAIL ROTOR (USBL ON 407-040-302-103 AND -105) (REPLACED BY 407-340-339-107) (ALTERNATE PART)	1	NP	
34	406-040-339-109	. . BEARING, BALL, HANGER, TAIL ROTOR (REPLACED BY 407-340-339-107)	1	NP	
34	407-340-339-107	. . BEARING, BALL, HANGER, TAIL ROTOR (POST ASB 407-04-63) (NOTE 2) (USBL ON 407-040-302-115 AND -117) (REPLACES 406-040-339-101, -105, -109 AND -111)	1	SP	
35	31-116-1	. . . DECAL, WARNING, MOBILE 28 GREASE PER MIL-PRF-81322..... (NOTE 2)	1	SP	
36	407-040-322-103	. . HANGER BEARING, AFT FAN SHAFT (S/N 53443 THRU 53722) (REPLACED BY 407-040-322-107)	1	NP	
36	407-040-322-107	. . HANGER BEARING, AFT FAN SHAFT (S/N 53723 THRU SUB) (REPLACES 407-040-322-103)	1	SP	
37	MS15001-1	. . FITTING, LUBRICATION (REPLACED BY AS15001-1)	1	P	
37	AS15001-1	. . FITTING, LUBRICATION (REPLACES MS15001-1) (REPLACED BY AS15001-1C)	1	NP	
37	AS15001-1C	. . FITTING, LUBE (REPLACES AS15001-1) (REPLACED BY AS15001-1P)	1	P	
37	AS15001-1P	. . FITTING, LUBE (REPLACES AS15001-1C)	1	SP	
38	407-040-330-101	. . SHAFT ASSY, SEGMENTED (USBL ON 407-040-302-101 AND -103)	1	NP	
38	407-040-330-105	. . SHAFT ASSY, SEGMENTED (USBL ON 407-040-302-105, -107, -109, -111, -113 AND -115) (REPLACED BY 407-040-330-107)	1	P	
38	407-040-330-107	. . SHAFT ASSY, SEGMENTED (USBL ON 407-040-302-117) (REPLACES 407-040-330-105)	1	SP	
39	AN128381	. . . STUD, .003 UNDERSIZE (NOTE 1)	1	NP	
39	AN128382	. . . STUD, STANDARD	1	SP	
39	AN128383	. . . STUD, .003 OVERSIZE (NOTE 1)	1	NP	
39	AN128384	. . . STUD, .006 OVERSIZE (NOTE 1)	1	NP	
39	AN128385	. . . STUD, .009 OVERSIZE (NOTE 1)	1	SP	
39	AN128386	. . . STUD, .012 OVERSIZE (NOTE 1)	1	SP	
40	120-179-26A	. . . CORK, STOPPER	1	SP	

(1) INDEX NUMBER	(2) PART NUMBER	(3) ITEM NAME	(4) UNIT PER ASSY	(5) AVAIL	(6) UOC
		Figure 65-1. Drive System Installation, Tail Rotor (S/N 53000 Thru 54299, 54300 and Subsequent) (Cont'd)			
41	MS21042L5	. NUT, SELF-LOCKING	4	SP	
42	140-009D21C35	. WASHER	4	SP	
43	406-040-400-115	. GEARBOX ASSY, TAIL ROTOR (PRE TB 407-99-18) (SEE FIG. 65-4 FOR BREAKDOWN) (USBL ON 407-040-001-101 AND -103) (REPLACED BY 406-040-400-119)	1	NP	
43	406-040-400-117	. GEARBOX ASSY, TAIL ROTOR (POST TB 407-99-18) (S/N 53293 THRU 53391) (SEE FIG. 65-4 FOR BREAKDOWN) (REPLACED BY 406-040-400-119)	1	NP	
43	406-040-400-119	. GEARBOX ASSY, TAIL ROTOR (S/N 53392 THRU 53504) (SEE FIG. 65-4 FOR BREAKDOWN) (REPLACES 406-040-400-115 AND -117) (REPLACED BY 406-040-400-121)	1	NP	
43	406-040-400-121	. GEARBOX ASSY, TAIL ROTOR (SEE FIG. 65-4 FOR BREAKDOWN) (USBL ON 407-040-001-117, -119 AND -121) (REPLACES 406-040-400-119)	1	SP	
	33-001-106-1	. SUPPORT INSTL	1	NP	
44	MS27039-1-12	. . SCREW	1	SP	
45	AN960JD10L	. . WASHER, FLAT (REPLACED BY NAS1149D0332J)	1	NP	
45	NAS1149D0332J	. . WASHER, FLAT (REPLACES AN960JD10L)	1	SP	
46	NAS43DD3-16	. . SPACER (REPLACED BY NAS43DD3-16N)	1	NP	
46	NAS43DD3-16N	. . SPACER (REPLACES NAS43DD3-16)	1	SP	
47	MS21919WDG6	. CLAMP	1	SP	
48	406-040-450-101	. TUBE ASSY, BREATHER	1	SP	
49	407-040-303-101	. SHAFT ASSY, FAN (S/N 53000 THRU 53109) (SEE FIG. 65-2 FOR BREAKDOWN) (REPLACED BY 407-040-303-103)	1	NP	
49	407-040-303-103	. SHAFT ASSY, FAN (S/N 53110 THRU 53219) (SEE FIG. 65-2 FOR BREAKDOWN) (REPLACES 407-040-303-101) (REPLACED BY 407-040-303-105)	1	NP	
49	407-040-303-105	. SHAFT ASSY, FAN (S/N 53220 THRU 53321) (SEE FIG. 65-2 FOR BREAKDOWN) (REPLACES 407-040-303-103) (REPLACED BY 407-040-303-107)	1	NP	
49	407-040-303-107	. SHAFT ASSY, FAN (SEE FIG. 65-2 FOR BREAKDOWN) (USBL ON 407-040-001-107) (REPLACES 407-040-303-105) (REPLACED BY 407-040-303-109)	1	NP	
49	407-040-303-109	. SHAFT ASSY, FAN (SEE FIG. 65-2 FOR BREAKDOWN) (USBL ON 407-040-001-109) (REPLACES 407-040-303-107) (REPLACED BY 407-040-303-115)	1	NP	
49	407-040-303-115	. SHAFT ASSY, FAN (POST BHT-407-II-30) (SEE FIG. 65-3 FOR BREAKDOWN) (REPLACES 407-040-303-109) (REPLACED BY 407-040-303-121)	1	NP	
49	407-040-303-121	. SHAFT ASSY, FAN (POST BHT-407-II-33) (SEE FIG. 65-3 FOR BREAKDOWN) (REPLACES 407-040-303-115) (REPLACED BY 407-040-303-131)	1	NP	
49	407-040-303-131	. SHAFT ASSY, FAN (NOTE 10) (SEE FIG. 65-3 FOR BREAKDOWN) (REPLACES 407-040-303-121)	1	SP	
49	407-040-303-113	. SHAFT ASSY, FAN (SEE FIG. 65-3 FOR BREAKDOWN) (USBL ON 407-040-001-111) (REPLACED BY 407-040-303-111)	1	NP	
49	407-040-303-111	. SHAFT ASSY, FAN (NOTE 11, 12) (SEE FIG. 65-3 FOR BREAKDOWN) (USBL ON 407-040-001-111) (REPLACES 407-040-303-113) (REPLACED BY 407-040-303-117)	REF	NP	
49	407-040-303-119	. SHAFT ASSY, FAN (S/N 53484 THRU 53518) (SEE FIG. 65-3 FOR BREAKDOWN) (REPLACES 407-040-303-113) (REPLACED BY 407-040-303-117 AND -125)	1	NP	
49	407-040-303-117	. SHAFT ASSY, FAN (NOTE 11, 13) (S/N 53484 THRU 53518) (SEE FIG. 65-3 FOR BREAKDOWN) (REPLACES 407-040-303-119) (REPLACED BY 407-040-303-123)	REF	NP	

(1) INDEX NUMBER	(2) PART NUMBER	(3) ITEM NAME	(4) UNIT PER ASSY	(5) AVAIL	(6) UDC
		Figure 65-1. Drive System Installation, Tail Rotor (S/N 53000 Thru 54299, 54300 and Subsequent) (Cont'd)			
49	407-040-303-129	. SHAFT ASSY, FAN (S/N 53519 THRU 53551) (SEE FIG. 65-3 FOR BREAKDOWN)	1	NP	
49	407-040-303-127	. SHAFT ASSY, FAN (NOTE 11, 15) (S/N 53519 THRU 53551) (SEE FIG. 65-3 FOR BREAKDOWN)	REF	NP	
49	407-040-303-125	. SHAFT ASSY, FAN (S/N 53552 THRU 53579) (SEE FIG. 65-3 FOR BREAKDOWN) (REPLACES 407-040-303-119) (REPLACED BY 407-040-303-123 AND -135)	1	NP	
49	407-040-303-123	. SHAFT ASSY, FAN (NOTE 10, 11, 14) (S/N 53552 THRU 53579) (SEE FIG. 65-3 FOR BREAKDOWN) (REPLACES 407-040-303-119 AND -125) (REPLACED BY 407-040-303-133)	REF	NP	
49	407-040-303-135	. SHAFT ASSY, FAN (NOTE 10) (S/N 53580 THRU 54299, 54300 THRU SUB) (SEE FIG. 65-3 FOR BREAKDOWN) (REPLACES 407-040-303-125)	1	SP	
49	407-040-303-133	. SHAFT ASSY, FAN (NOTE 10, 11, 16) (S/N 53580 THRU 54299, 54300 THRU SUB) (SEE FIG. 65-3 FOR BREAKDOWN) (REPLACES 407-040-303-123)	REF	SP	
		NOTE 1: SIZE TO BE DETERMINED AT INSTALLATION (BHT-407-MM-7, CHAPTER 65).			
		NOTE 2: WHEN ORDERED, DECAL 31-116-1 WILL ALSO BE SUPPLIED WITH INSTRUCTIONS FOR USAGE.			
		NOTE 3: FOR SPARE PART REPLACEMENT OF DISC PACK 406-040-340-101, USE INDIVIDUAL DISCS 406-040-340-103.			
		NOTE 4: REFER TO BHT-407-MM-7, CHAPTER 65 FOR USAGE.			
		NOTE 5: IT IS PERMITTED TO INCREASE THE AMOUNT OF WASHERS PER SCREW TO A MAXIMUM OF SEVEN WASHERS FOR PROPER BALANCE.			
		NOTE 6: IT IS PERMITTED TO REMOVE ONE OR MORE SCREWS TO ALLOW FOR PROPER BALANCE.			
		NOTE 7: ALSO APPLICABLE TO S/N 53000 THRU 53442 POST BHT-407-II-30 AND S/N 53443 THRU 53497 POST TB 407-02-35.			
		NOTE 8: ALSO APPLICABLE TO S/N 53000 THRU 53442 POST BHT-407-II-30.			
		NOTE 9: IT IS PERMITTED TO INSTALL ANY COMBINATION OF WASHERS ON EACH SCREW PROVIDED THAT A MINIMUM OF THREADS EXTEND BEYOND THE NUT.			

(1) INDEX NUMBER	(2) PART NUMBER	(3) ITEM NAME	(4) UNIT PER ASSY	(5) AVAIL	(6) UOC
		Figure 65-1. Drive System Installation, Tail Rotor (S/N 53000 Thru 54299, 54300 and Subsequent) (Cont'd)			
		NOTE 10: WHEN FAN SHAFT ASSEMBLY 407-040-303-131 IS USED AS A SPARE PART REPLACEMENT FOR HELICOPTERS S/N 53000 TO 53518, THE DELTA P SHIELD MOD 407-540-005 AND THE COWLING MOD 407-799-057 MUST BE IMPLEMENTED (ASB-407-02-54).			
		NOTE 11: TO BE INSTALLED WITH AIR COMM AIR CONDITIONING KIT STC SR00222DE.			
		NOTE 12: FAN SHAFT ASSEMBLY 407-040-303-111 MAY BE MADE FROM FAN SHAFT ASSEMBLY 407-040-303-113 BY REMOVING THE WEIGHT 407-340-002 AND ADDING THE AIR COMM AIR CONDITIONER COMPONENTS AS DEFINED BY STC SR00222DE AND DRAWING 407EC-300.			
		NOTE 13: FAN SHAFT ASSEMBLY 407-040-303-117 MAY BE MADE FROM FAN SHAFT ASSEMBLY 407-040-303-119 BY REMOVING THE WEIGHT 407-340-002 AND ADDING THE AIR COMM AIR CONDITIONER COMPONENTS AS DEFINED BY STC SR00222DE AND DRAWING 407EC-300.			
		NOTE 14: FAN SHAFT ASSEMBLY 407-040-303-123 MAY BE MADE FROM FAN SHAFT ASSEMBLY 407-040-303-125 BY REMOVING THE WEIGHT 407-340-002 AND ADDING THE AIR COMM AIR CONDITIONER COMPONENTS AS DEFINED BY STC SR00222DE AND DRAWING 407EC-300.			
		NOTE 15: FAN SHAFT ASSEMBLY 407-040-303-127 MAY BE MADE FROM FAN SHAFT ASSEMBLY 407-040-303-129 BY REMOVING THE WEIGHT 407-340-002 AND ADDING THE AIR COMM AIR CONDITIONER COMPONENTS AS DEFINED BY STC SR00222DE AND DRAWING 407EC-300.			
		NOTE 16: FAN SHAFT ASSEMBLY 407-040-303-133 MAY BE MADE FROM FAN SHAFT ASSEMBLY 407-040-303-135 BY REMOVING THE WEIGHT 407-340-002 AND ADDING THE AIR COMM AIR CONDITIONER COMPONENTS AS DEFINED BY STC SR00222DE AND DRAWING 407EC-300.			

(1) INDEX NUMBER	(2) PART NUMBER	(3) ITEM NAME	(4) UNIT PER ASSY	(5) AVAIL	(6) UOC
		Figure 65-1. Drive System Installation, Tail Rotor (S/N 53000 Thru 54299, 54300 and Subsequent) (Cont'd) **AVAIL CODE** **DEFINITION** P Procurable NP Non Procurable SP Normal Stock/Procurable Please see Chapter 1 for additional information on availability codes as well as general use of the Illustrated Parts Breakdown Manual.			

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BHT-407-MM-7

Tail Rotor Driveshaft Segmented Shaft Assembly

Figure 65-32

Figure 65-33

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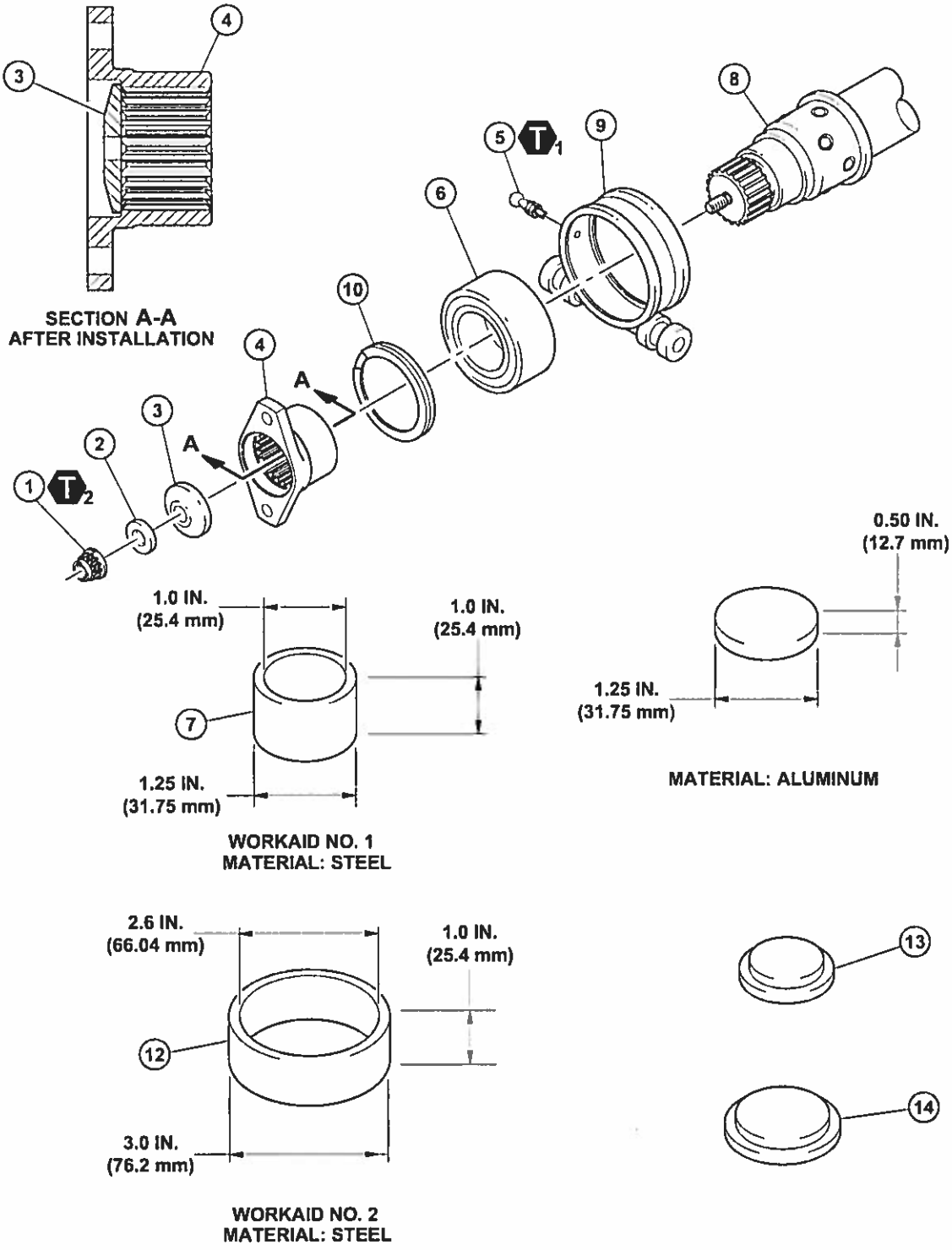
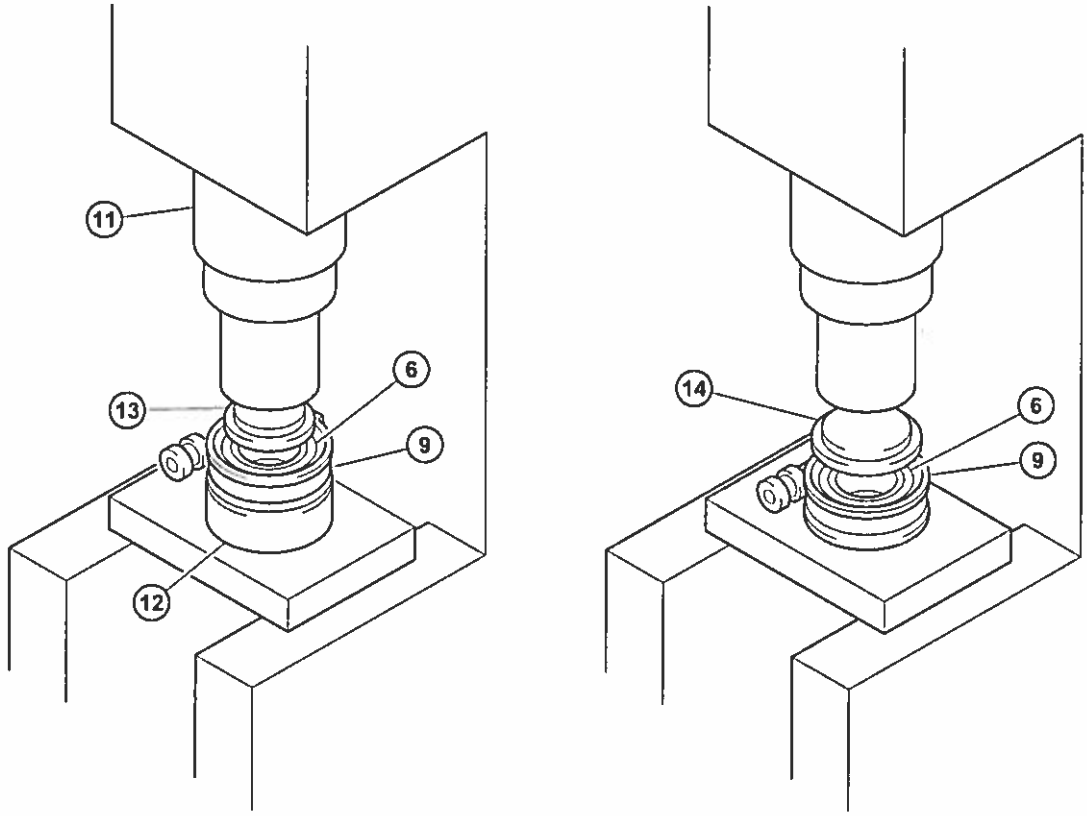


Figure 65-32. Tail Rotor Driveshaft Segment Assembly — Disassembly/Assembly (Sheet 1 of 2)



DISASSEMBLY ASSEMBLY

1. Nut
2. Washer
3. Washer
4. Coupling adapter
5. Grease fitting
6. Bearing
7. Workaid No.1
8. Tail rotor driveshaft segment assembly
9. Bearing hanger
10. Retaining ring
11. Arbor press
12. Workaid No.2
13. Step plate adapter, OTC 8062
14. Step plate adapter, OTC 8068

T1 5 TO 10 IN-LBS (0.56 TO 1.13 Nm)

T2 30 TO 50 IN-LBS (5.7 TO 7.9 Nm)

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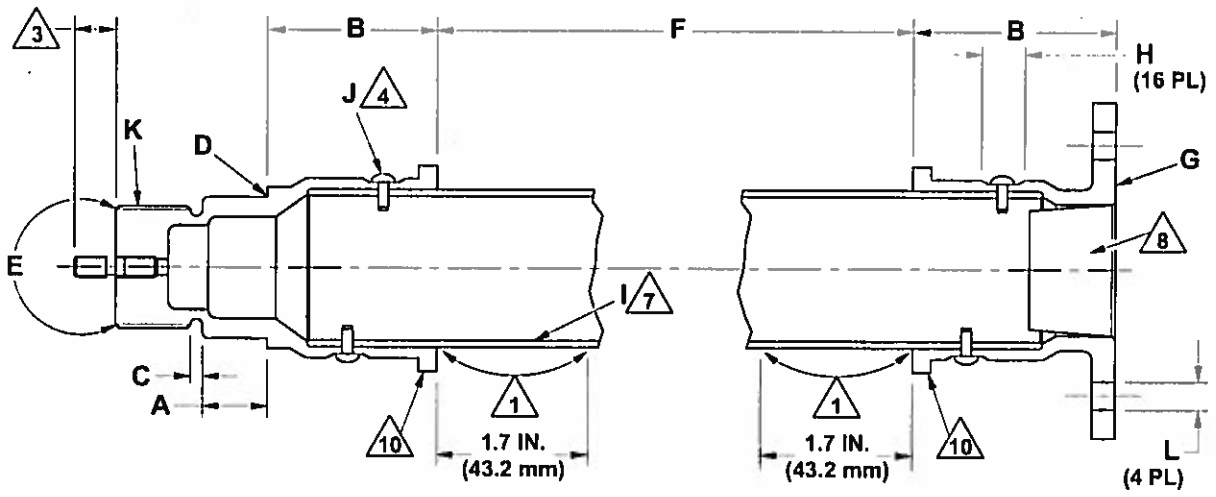
Figure 65-32. Tail Rotor Driveshaft Segment Assembly — Disassembly/Assembly (Sheet 2 of 2)



REF LTR	DESCRIPTION	TYPE OF DAMAGE	LIMIT
A	Bearing journal	Corrosion/mechanical	0.001 inch (0.025 mm) up to 100% of the circumference.
A	Bearing journal	Wear	1.5744 inches (39.9898 mm) minimum diameter.
B	Adapter outside diameter	Corrosion/mechanical	0.005 inch (0.127 mm) deep, up to 100% of the circumference.
B	Adapter flange	Corrosion/mechanical	Maximum chamfer to remove damage is to be 0.030 inch (0.762 mm) x 40 to 50° up to 0.50 inch (12.70 mm). No more than two per quadrant.
C	Spline relief	Corrosion/mechanical	0.001 inch (0.025 mm) up to 100% of the circumference.
D	Shoulder	Corrosion/mechanical	0.001 inch (0.025 mm) up to 100% of the circumference.
E	Spline adapter and face	Corrosion/mechanical	0.010 inch (0.250 mm) up to 100% of the area.
F	Tube outside diameter	Corrosion/mechanical	0.005 inch (0.127 mm) up to 1 square inch (645.2 mm^2). 0.005 inch (0.127 mm) deep up to 25% of the circumference, 0.850 inch (21.59 mm) wide. 0.002 inch (0.051 mm) up to 100% of the circumference, 0.210 inch (5.334 mm) wide.
F	Shaft tube	Straightness	With the use of a 12-inch (304.8 mm) straight edge, the maximum gap is 0.005 inch (0.127 mm).
G	Flange adapter end face	Corrosion/mechanical	0.001 inch (0.025 mm) up to 100% of the area.

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Figure 65-33. Tail Rotor Driveshaft Segmented Shaft Assembly — Inspection and Repair (Sheet 1 of 3)

REF LTR	DESCRIPTION	TYPE OF DAMAGE	LIMIT
A, B, C, D E, F, G		Number of repairs	Five per area.
H	Rivet spotface	Corrosion/mechanical	None allowed.
I	Tube interior	Corrosion	None allowed.
J	Rivet	Loose rivet	None allowed.
K	Spline - measure over 0.120 inch (3.050 mm) diameter pin	Wear	1.5525 inches (39.4335 mm) minimum diameter. (5)
K	Spline - sides and roots of teeth	Corrosion/mechanical	Light, superficial that can be polished out by hand with the use of a fine stainless steel wool or Scotchbrite.
K	Spline - tops and end of teeth	Corrosion/mechanical	0.010 inch (0.254 mm) maximum up to 0.25 inch (6.35 mm) long on all teeth. One area of damage per tooth. (6) 0.001 inch (0.025 mm) maximum up to 100% of the surface of all teeth. One area of damage per tooth. (6)
L	Fastener hole	Wear	0.315 inch (8.001 mm) maximum diameter.

NOTES

(1) Mount the driveshaft in the V blocks between the two indicated areas. Measure the Total Indicator Runout at the bearing seat shoulder and the adapter flange. The shaft must be discarded if the measurement exceeds one of the dimensions that follow:

A	Bearing seat	0.005 inch (0.13 mm) Total Indicator Runout
D	Bearing seat shoulder	0.006 inch (0.15 mm) Total Indicator Runout
G	Adapter flange	0.004 inch (0.102 mm) Total Indicator Runout

2. The surface of the tube must be smooth and unmarred. Scratches can be polished out so that the wall thickness is not less than 0.068 inch (1.727 mm) and the minimum outside diameter is not less than 1.738 inch (44.145 mm).

(3) Replace a stud that is distorted, loose, or with threads that are damaged. If the stud is loose, replace it with an oversize stud. Examine the threaded stud hole and the stud for corrosion. No corrosion is permitted. Discard the shaft if corrosion is present in the threaded stud hole. Discard the stud if it is corroded. Install the replacement stud with unreduced zinc chromate primer (C-201) or polyamide primer (C-204). The height of the stud as measured in the figure is 0.630 to 0.650 inch (16.00 to 16.51 mm) when it is torqued at 50 to 95 inch-pounds (5.65 to 10.74 Nm).

(4) Replacement of rivet is not permitted.

(5) Examine the spline teeth for signs of a wear step. Discard the shaft if you can feel a wear step with a 0.020 inch (0.508 mm) spherical radius probe.

(6) When you remove nicks, dents, and scratches, only remove the raised material until it is flush with all sides of the surface. Use a fine India stone.

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Figure 65-33. Tail Rotor Driveshaft Segmented Shaft Assembly — Inspection and Repair (Sheet 2 of 3)