

TECHNICAL MANUAL

**AVIATION UNIT AND INTERMEDIATE
MAINTENANCE MANUAL**

VOLUME 4 OF 9

**HELICOPTER, ATTACK,
AH-64A APACHE
(NSN 1520-01-106-9519)
(EIC: RHA)**

**CHAPTER 6
DRIVE SYSTEM**

**CHAPTER 7
HYDRAULIC AND PNEUMATIC
SYSTEMS**

DRIVE SHAFT AND COUPLING MAINTENANCE
ENGINE NOSE GEARBOX MAINTENANCE
MAIN TRANSMISSION MAINTENANCE
INTERMEDIATE GEARBOX MAINTENANCE
TAIL ROTOR GEARBOX MAINTENANCE
PRIMARY HYDRAULIC SYSTEM MAINTENANCE
UTILITY HYDRAULIC SYSTEM MAINTENANCE
PRESSURIZED AIR SYSTEM MAINTENANCE

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CHAPTER 6 DRIVE SYSTEM

CHAPTER OVERVIEW

Chapter 6 contains the maintenance instructions for the drive system. Drive system description, operation, and troubleshooting information is contained in TM 1-1520-238-T.

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SECTION I. DRIVE SHAFT AND COUPLING MAINTENANCE

6.1. DRIVE SHAFT INSPECTION

6.1.1. Description

This task covers: Inspection.

6.1.2. Initial Setup

Tools:

- Aircraft mechanic's tool kit (item 376, App H)
- Light duty laboratory apron (item 27, App H)
- Industrial faceshield (item 129, App H)
- Fluorescent inspection kit (item 138, App H)
- 0.000 - 0.125-inch dial indicator depth gage (item 145, App H)
- Nutation/torque reactor tool (Figure D-483, App D)
- Chemical protective gloves (item 154, App H)
- Adjustable air filtering respirator (item 262, App H)
- 1 - 100 inch-ounce 1/4-inch hexagon drive click type torque wrench (item 437, App H)

Personnel Required:

- 67R Attack Helicopter Repairer
One person to assist
- 67R3F Attack Helicopter Repairer/Technical Inspector

References:

- TM 1-1500-204-23
- TM 55-1500-335-23

Equipment Conditions:

<u>Ref</u>	<u>Condition</u>
1.57	Helicopter safed
2.2	Access doors T250L, T250R, T290L, T290R, and L325 opened; cover L540 removed; fairings R410, R475, L510, R510, and L530 removed

Materials/Parts:

- Brush (item 34, App F)
- Methyl ethyl ketone (item 124, App F)

6.1.3. Inspection

- a. **Check components for damage and loose mounting.**
- b. **Check for loose, missing, or damaged mounting hardware.**



- c. **Check drive shaft for cracks.** Use magnifier where needed.

- (1) Clean suspected areas. Use brush (item 34, App F) and methyl ethyl ketone (item 124, App F). Discard brush in suitable container after use.
- (2) Check for cracks. None allowed. Use fluorescent inspection kit (TM 55-1500-335-23).

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6.1. DRIVE SHAFT INSPECTION – continued

d. Check shaft tubes for dents.

- (1) Dents are considered “negative” material displacement, material moved below surrounding surface. Use depth gage for dent check on straight surfaces.
- (2) Sharp dents are not acceptable.
 - (a) Sharp dents are defined as those depressions that initiate or terminate in a discernible discontinuity or interruption in smooth flow of metal.
 - (b) Sharp dents are considered to be **0.250 INCH** or less deep.
 - (c) A sharp dent can be detected by tracing a nonmetallic pointed instrument across surface of tube and noting abrupt change in direction of instrument tip.
- (3) Non-sharp dents are acceptable, provided they meet following dimensional criteria.
 - (a) The width dimensions signify shortest distance across dent.
 - (b) The length dimensions signify longest distance across dent.

DENT WIDTH	DENT LENGTH	DENT DEPTH	DISPOSITION
Less than 0.250 INCH	Not Applicable	Not Applicable	Reject Tube
0.250 - 0.375 INCH	2.0 INCH Maximum	0.024 INCH Maximum	Accept Tube
0.375 - 0.500 INCH	2.5 INCH Maximum	0.036 INCH Maximum	Accept Tube
0.500- 0.875 INCH	3.0 INCH Maximum	0.048 INCH Maximum	Accept Tube
More than 0.875 INCH	Not Applicable	Not Applicable	Reject Tube

- (4) Drive shaft tubes may show circumferential lines indicating a slight change in cylindrical surface (a smooth step).
 - (a) These lines have been referred to as “ripples”. Ripples are a result of manufacturing process.
 - 1 Ripples are considered a “positive” material displacement condition, material raised above surrounding surface.
 - 2 Ripples are acceptable, provided they do not exceed **0.024 INCHES** in step height or **7.50 INCH** in circumferential arc length (190 degrees).

e. Check shaft tube circumference for scratches. Use magnifier.

- (1) Longitudinal scratches deeper than **0.006 INCH**, radial scratches deeper than **0.004 INCH**, 45-degree longitudinal/radial scratches deeper than **0.002 INCH**, and scratches within 15 degrees of lengthwise axis deeper than **0.005 INCH** are not acceptable.
- (2) The following criteria apply only to raised diameters (**4.655/4.750 INCH**) at extreme ends of tubes. All scratches deeper than **0.015 INCH** are not acceptable.

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6.1. DRIVE SHAFT INSPECTION – continued

f. Check No. 4 and No. 5 tail rotor drive shaft with nickel plated wear sleeves for movement and broken paint stripe.

- (1) Perform both initial and recurring inspection after aircraft has been in coolest possible ambient temperature for **30 MINUTES** or more.
- (2) Check for broken paint stripe on all four wear sleeves. If broken paint stripe is detected check wear sleeves for damage or movement per the following steps. If no damage or movement is found, reapply paint stripe.
- (3) Locate two wear sleeves attached to No. 4 and No. 5 tail rotor drive shaft. Wear sleeves are located within damper and anti-flail supports. For wear sleeves located within anti-flail supports, remove anti-flail supports and support brackets from tailboom and slide anti-flail supports forward far enough to obtain an unobstructed view of wear sleeve (para 6.8 and para 6.11).
- (4) While preventing drive shaft movement, attempt to move all four wear sleeves attached to drive shaft in both axial and radial direction. One person holds drive shaft and other attempts to move wear sleeves. If any of wear sleeves rotate with respect to shaft or have horizontally displaced down shaft, replace tail rotor drive shaft(s) (para 6.8 and/or para 6.11).
- (5) Wear sleeve distress, which does not penetrate the nickel plating (**0.001-0.002 INCH** thick), is acceptable. Check wear sleeves for rust or exposed base metal (missing nickel plating). If detected, replace tail rotor drive shaft(s) (para 6.8 and/or para 6.11).
- (6) Check diameter of wear sleeves. If wear sleeve is less than **4.740 INCHES** in diameter, replace tail rotor drive shaft(s) (para 6.8 and/or para 6.11).
- (7) Install anti-flail supports on tailboom (para 6.8 and para 6.11).
- (8) Check for scratches through nickel. None allowed.

g. Check No. 4 and No. 5 tail rotor drive shafts with black hard coat aluminum wear sleeves.

- (1) Wear sleeve surface distress such as scratches, pits, nicks, etc. are acceptable up to a maximum depth of **0.010 INCH**. If surface distress exceeds this limit, replace tail rotor drive shaft(s) (para 6.8 and/or para 6.11).
- (2) Check diameter of wear sleeves. If wear sleeve is less than **4.740 INCHES** in diameter, replace tail rotor drive shaft(s) (para 6.8 and/or para 6.11).

h. Check couplings, flanges, and diaphragms for cracks.

- (1) Use magnifier where needed. Clean suspected areas with brush (item 34, App F) and methyl ethyl ketone (item 124, App F). Check with fluorescent inspection kit (TM 55-1500-335-23).
- (2) Check for elongated bolt holes, bends or abrasions. None allowed. Use brush (item 34, App F) and methyl ethyl ketone (item 124, App F). Discard brush in suitable container.

i. Check diaphragms for nicks, scratches, dents, flaking paint, or distortion. None allowed.**j. Check coupling flanges for peeling or other failure of aluminum bronze (plasma) coating.**

- (1) Check aluminum-bronze (plasma) coating for gouges, nicks, and/or scratches. Minor nicks, gouges, and scratches can be blended out; however, damage through coating to bare metal is **not** allowed. Damage cannot exceed **20 PERCENT** of surface area.
- (2) Check for peeling of aluminum-bronze (plasma) coating. None allowed.
- (3) Discoloration due to oxidation or minor chipping around bolt holes is acceptable.

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6.1. DRIVE SHAFT INSPECTION – continued

k. Check coupling faces for nicks or scratches.

- (1) Nicks or scratches, excluding diaphragms, are acceptable to a maximum depth of **0.005 INCH** without repair except for touch up of exterior.
- (2) Nicks or scratches, excluding diaphragms, are acceptable to a maximum depth of **0.015 INCH** without repair when polished out with a fine abrasive cloth.

l. Check couplings for compression or stretching.

- (1) Not less than **3.338 INCH** or greater than **3.350 INCH** flange to flange dimension at any point.

m. Check nutplates for wear.

- (1) Starting torque less than **54 INCH-OUNCES**. Replace. Use torque wrench.

n. Check coupling for stripped nutplates or loose rivets. None allowed.

- (1) Repair by replacing nutplate (TM 1-1500-204-23).

o. Check drive shaft dampers for cracks.

- (1) Check visibly or with fluorescent inspection kit (TM 55-1500-335-23). None allowed.
- (2) Check inside diameter for wear or nicks deeper than **0.040 INCH**.

NOTE

Do not use wire brush on damper inside diameter while on aircraft or near the drive shaft.

- (3) Check inside diameter for accumulation of dirt or debris.

(a) Remove dirt or debris with wire brush to a maximum of **0.020 INCH**.

p. Check drive shaft dampers and for inside diameter wear or nicks deeper than 0.125 INCH.**q. Check drive shaft for stripped nutplates or rivets.**

- (1) Repair by replacing nutplate (TM 1-1500-204-23). Use solid rivets when replacing nutplate.

r. Check hanger bearings for cracks, dents, bearing looseness, rough rotation, nicks, grease seal leakage, overheated bearings.

- (1) Check for cracks detected visibly or with fluorescent inspection kit (TM 55-1500-335-23). None allowed.
- (2) Non-sharp dents are acceptable to a maximum depth of **0.040 INCH**.
- (3) Non-sharp dents on edges and mounting flanges are not acceptable.

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6.1. DRIVE SHAFT INSPECTION – continued

- (4) Check hanger assembly bearing for smooth rotation. Replace hanger bearing assembly if rotation is not smooth.
- (5) Check for nicks deeper than **0.020 INCH**.
- (6) Check for grease seal leakage. None allowed.
- (7) Check bearings for evidence of overheating (discoloration of bearing area seals or housing paint). None allowed. Replace bearings (para 6.7 or 6.10).

s. Check all anti-flail and intermediate gearbox diffuser for cracks.

- (1) Check visibly or with fluorescent inspection kit. None allowed.
- (2) Check for deformation (out of round). None allowed.
- (3) Check for nicks deeper than **0.020 INCH**. None allowed.

t. Check APU anti-flail for wear on its inside diameter.

- (1) Radial wear is acceptable to **0.040 INCH** maximum depth measured at any point.
- (2) Check for scratches or gouges in aluminum-bronze coating. Can not exceed **20 PERCENT** of surface area.
- (3) Check for flaking or peeling of aluminium-bronze coating. None allowed.

u. Check aft hanger support.

- (1) Dents and scratches up to **0.032 INCH** deep are allowable but must be blended out.
- (2) Triple bolt/bearing arrangement must prevent all radial play.
- (3) Replace individual loose bushings and bearings to eliminate play.

v. Inspect all mounting flange bolt holes.

- (1) Using plug gauges **0.2505 INCH** and **0.2517 INCH**, inspect all mounting bolt holes for proper size. Replace units with bolt holes that exceed **0.2517 INCH** diameter.
- (2) Inspect couplings/shafts for elongated or damaged bolt holes. None allowed.

w. Nutation check.

- (1) Remove No. 3 tail rotor shaft (para 6.5) and forward hanger bearing coupling (para 6.6) from forward hanger bearing.

NOTE

Nutation is the angular movement of a bearing from its center axis. This movement is not rotation.

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6.1. DRIVE SHAFT INSPECTION – continued

NOTE

Ensure that the small flange points inward toward the hanger bearing.

- (2) Install hanger bearing (1) on hanger bearing support (2), and install nutation/torque reactor tool (3) on flange of hanger bearing using bolt (4) and nut (5) (Figure D-483, App D).
- (3) Position torque wrench on small flange with 3/8-inch attachment hole.
- (4) Check breakaway nutation torque in three planes (12, 4 and 8 o'clock positions) from centered starting position. Ensure that breakaway torque is between 10 and 300 inch pounds in all three planes.
- (5) If breakaway torque is less than 10 inch pounds in any of three planes, replace hanger bearing.
- (6) If breakaway torque exceeds 300 inch pounds in any of three planes, clean hanger bearing (para 6.1A).
- (7) Record initial torque value(s) on maintenance checklist.

x. Nut torque check.

- (1) Visually inspect nut for broken or missing torque stripe. If torque stripe is intact, inspection is complete.

NOTE

When checking torque use AH-64 nutation/torque reactor tool and 1/2 drive breaker bar to restrain hanger bearing flange.

- (2) If torque stripe is missing or broken, verify 700-800 inch pounds torque by rotating nut in clockwise direction. If nut moves before reaching 700 inch pounds, replace nut.

y. Check drive shafts and components for corrosion (para 1.49).

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6.1A. AFT HANGER BEARING ASSEMBLY/DISASSEMBLY

6.1A.1. Description

This task covers: Disassembly. Cleaning. Assembly.

6.1A.2. Initial Setup

Tools:

Aircraft maintenance tool kit (item 372, App H)
 7/16 x 3/8-inch drive torque wrench adapter (item 22, App H)
 Light duty laboratory apron (item 27, App H)
 Chemical protective gloves (item 154, App H)
 Adjustable air filtering respirator (item 262, App H)
 30 - 150 inch-pound 3/8-inch drive click type torque wrench (item 441, App H)

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
 67R3F Attack Helicopter Repairer/Technical Inspector

References:

TM 1-1500-204-23

Materials/Parts:

Scotch Brite Pad (item 130, App F)
 Alcohol (item 25, App F)
 Cheesecloth (item 51, App F)

Equipment Conditions:

<u>Ref</u>	<u>Condition</u>
1.57	Helicopter safed Aft Hanger Bearing removed

CAUTION

Ensure that outer diffuser being installed is same outer diffuser that was removed. Do not intermix or swap diffuser components or damage to diffuser will occur.

6.1A.3. Removal

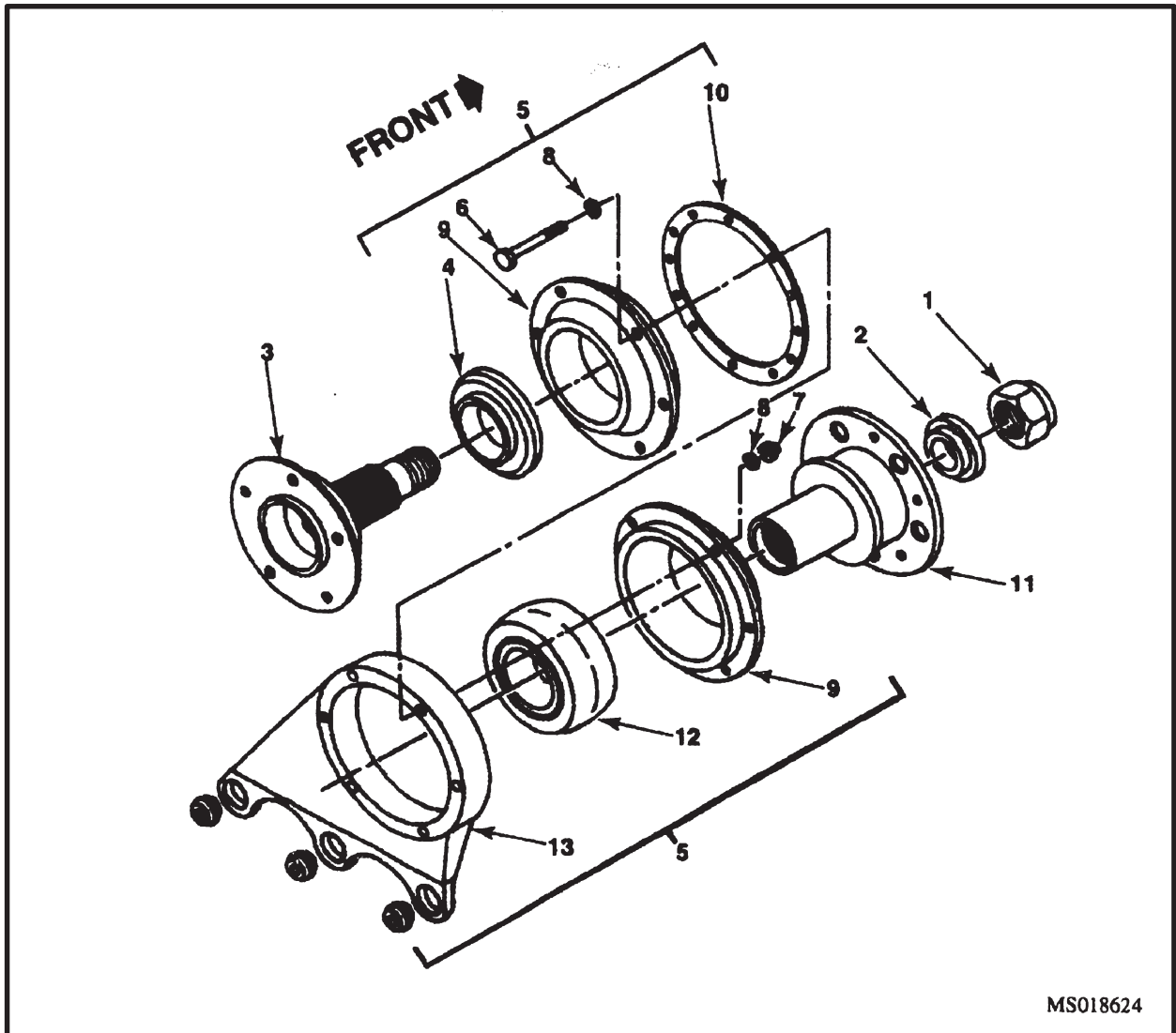
- a. Disassemble hanger, and secure hanger bearing to work bench.
- b. Install AH-64 nutation/torque reactor tool.

NOTE

The small flange must point toward the hanger bearing prior to beginning the removal of parts and components from hanger bearing.

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6.1A. AFT HANGER BEARING ASSEMBLY/DISASSEMBLY – continued



MS018624

- (1) Remove self-locking nut (1), pilot (2), input flange (3) and bearing spacer (4) from hanger bearing subassembly (5). Use 1/2 inch breaker bar attached to nutation tool as torque reactor.
- (2) Remove six bolts (6), self-locking nuts (7), and 12 washers (8) from two bearing retainers (9).
- (3) Discard old self-locking nut (1).
- (4) Remove and tag spacer shims (10).

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6.1A. AFT HANGER BEARING ASSEMBLY/DISASSEMBLY – continued

NOTE

The output flange, one bearing retainer, and the ball bearing are removed as an assembly.

- (5) Remove output flange (11), two bearing retainers (9) and ball bearing (12).

6.1A.4. Inspection

- (1) Inspect bearing (12) for nicks, pits and scratches (none allowed). If damage is noted, replace hanger bearing (13).
- (2) Inspect bearing for corrosion. Remove any corrosion and debris from surface using Scotchbrite pad (item 130, App F).
- (3) Clean Teflon races using cheesecloth (item 51, App F) and alcohol (item 25, App F).

6.1A.5. Installation

CAUTION

After hanger bearings have been in use, they exhibit particular wear patterns. Mismatching of parts will result in excessive wear.

a. Assemble hanger bearing (13).

- (1) Install spacer shims (10), output flange (11), two bearing retainers (9), and ball bearing (12) onto hanger bearing (13) in the same order and orientation as removed.
- (2) Install six bolts (6) 12 flat washers (8), and six **new** self-locking nuts (7).

CAUTION

Bolt heads shall be on the side as spacer shims. Improper installation can often damage equipment.

- (3) Torque six self-locking nuts to 65-75 inch pounds above running torque, and apply torque seal using torque wrench (item 441, App H).
- (4) Install bearing spacer (4), with flat side in, over output flange (3) and against ball bearings (12).
- (5) Install spacer shims (10), output flange (11), two bearing retainers (9), and ball bearing (12) into hanger bearing (13) in same order and orientation as removed.
- (6) Install pilot spacer (2) over input flange (3), with flat side facing out.
- (7) Install self-locking nut (1) onto threaded end of input shaft (3) and tighten until finger-tight.

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6.1A. AFT HANGER BEARING ASSEMBLY/DISASSEMBLY – continued

CAUTION

The self-locking nut shall have a minimum run-on torque of 70 inch pounds.

NOTE

The output flange, one bearing retainer, and the ball bearing are removed as an assembly.

- (8) Torque self-locking nut (1) to 700-800 inch pounds and apply torque seal using torque wrench (item 441, App H).
- (9) Check the breakaway nutation torque in accordance with paragraph 6.1.w.
- (10) If torque is above 300 inch pounds, replace hanger bearing (10) with new or undamaged hanger bearing of same type.
- (11) If torque is 10-300 inch pounds, record value as final nutation torque on Maintenance Inspection Checklist.
- (12) Install hanger bearing (13) on aircraft.

END OF TASK

6.2. ENGINE INPUT DRIVE SHAFT AND OUTER DIFFUSER (ONE-PIECE) REMOVAL/INSTALLATION

6.2.1. Description

This task covers: Removal. Cleaning. Inspection. Installation.

6.2.2. Initial Setup

Tools:

Aircraft maintenance tool kit (item 372, App H)
 7/16 x 3/8-inch drive torque wrench adapter (item 22, App H)
 Light duty laboratory apron (item 27, App H)
 Chemical protective gloves (item 154, App H)
 Adjustable air filtering respirator (item 262, App H)
 30 - 150 inch-pound 3/8-inch drive click type torque wrench (item 441, App H)

References:

TM 1-1520-238-T

Materials/Parts:

Corrosion preventive compound (item 62A, App F)

Equipment Conditions:

<u>Ref</u>	<u>Condition</u>
1.57	Helicopter safed
2.123	Engine nose gearbox fairings and shrouds removed
6.32	Engine nose gearbox two-section outer diffuser removed (if a two-section outer diffuser is installed in place of a one-piece outer diffuser)

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
 67R3F Attack Helicopter Repairer/Technical Inspector



FLIGHT SAFETY PART

The input drive shaft is a flight safety part. Failure to follow maintenance instructions may result in serious injury or death of crewmembers and/or serious damage to the helicopter.



- Do not intermix outer diffusers (one-piece or two-section), inlet diffusers, or vaneaxial fans. Intermixing or swapping these components will result in damage to components.
- Exercise care and undertake protective measures when handling or performing any type of maintenance on the engine input drive shaft. All surface areas are critical. Accidental dents or scratches caused by improper handling may render part unserviceable.
- To prevent damage to engine input drive shaft, ensure that work area is clean and that part is placed on a soft and adequately protected working surface.

NOTE

This task is typical for either No. 1 or No. 2 engine input drive shaft.

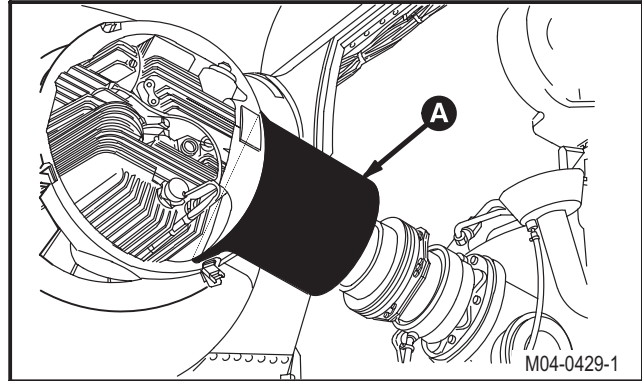
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**6.2. ENGINE INPUT DRIVE SHAFT AND OUTER DIFFUSER (ONE-PIECE)
REMOVAL/INSTALLATION – continued**

6.2.3. Removal

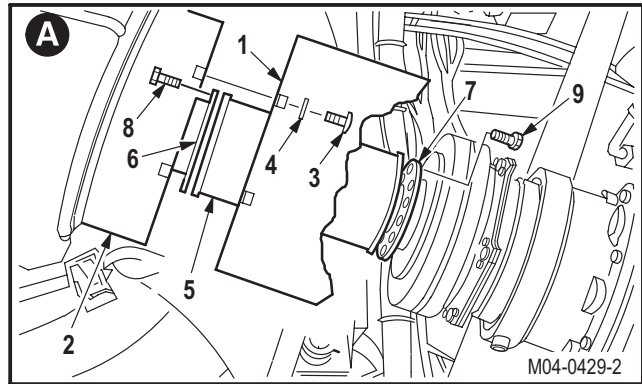
NOTE

If a two-section engine nose gearbox outer diffuser is installed in place of a one-piece outer diffuser, skip step a. and remove two-section outer diffuser (para 6.32).



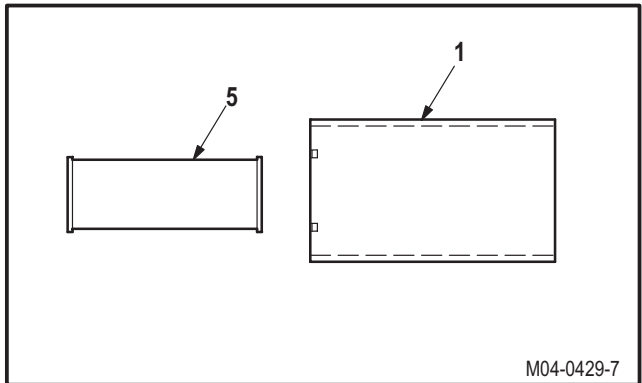
a. Remove outer diffuser (1) from inlet diffuser (2).

- (1) Remove four screws (3) and washers (4) from diffuser (1).
- (2) Detach and slide diffuser (1) free from diffuser (2).



b. Remove engine input drive shaft (5) from coupling flanges (6) and (7).

- (1) Remove five bolts (8) from flange (6).
- (2) Remove five bolts (9) from flange (7).
- (3) Remove shaft (5) with diffuser (1).
- (4) Slide shaft (5) out of diffuser (1).



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**6.2. ENGINE INPUT DRIVE SHAFT AND OUTER DIFFUSER (ONE-PIECE)
REMOVAL/INSTALLATION**

6.2.4. Cleaning

- a. **Clean removed and attaching parts or surfaces** (para 1.47).

6.2.5. Inspection**NOTE**

Unless otherwise specified, following inspection procedures apply to engine input drive shaft, outer diffuser, couplings, and coupling flanges.

- a. **Check for cracks** (para 6.1).
- b. **Check for corrosion** (para 1.49).
- c. **Check for nicks, scratches, and dents** (para 6.1).
- d. **Check couplings for compression or stretching** (para 6.1).
- e. **Check coupling flanges for elongated bolt holes** (para 6.1).
- f. **Check diffuser for loose or missing dowel pins.** None allowed.
 - (1) Replace diffuser.
- g. **Check diaphragms for cracks, nicks, scratches, dents, and distortion.** None allowed.
- h. **Check coupling flanges for peeling or erosion of aluminum bronze coating** (para 6.1).
- i. **Check drive shaft and coupling nutplates for stripped, crossed, or flattened threads** (para 6.1).
- j. **Check drive shaft and coupling for loose rivets and for any other evidence of damage** (para 6.1).

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**6.2. ENGINE INPUT DRIVE SHAFT AND OUTER DIFFUSER (ONE-PIECE)
REMOVAL/INSTALLATION – continued**

6.2.6. Installation

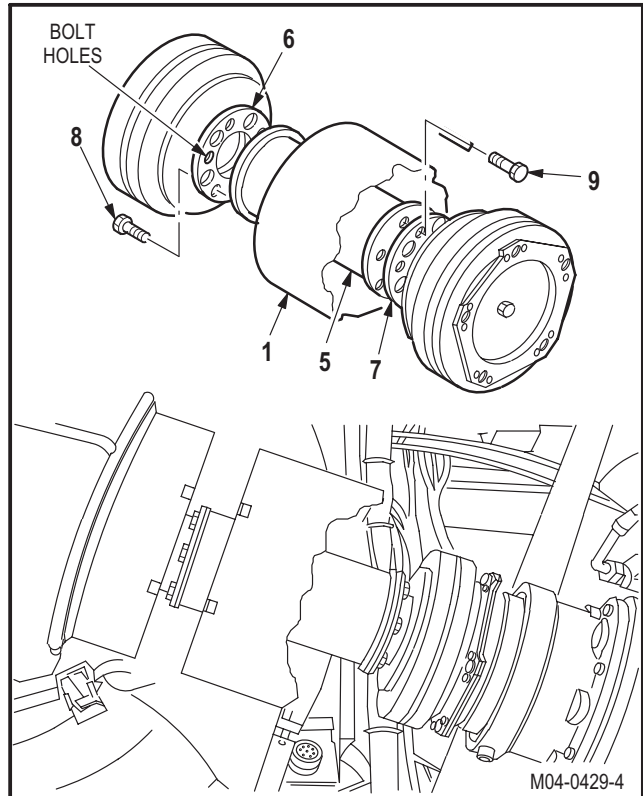


CAUTION

When installing drive shaft to coupling flanges, ensure that bolts are installed through **0.250 INCH** coupling flange holes and not through **0.500 INCH** holes. Installation of bolts through lightening holes will result in failure of drive shaft and/or couplings.

a. **Install drive shaft (5) on flanges (6) and (7).**
Torque bolts (8) and (9) to **125 INCH-POUNDS**.

- (1) Slide drive shaft (5) in diffuser (1).
- (2) Position drive shaft (5) with diffuser (1) between flanges (6) and (7).
- (3) Aline mounting holes.
- (4) Install five bolts (9) through flange (7) and shaft (5).
- (5) Install five bolts (8) through flange (6) and shaft (5).
- (6) Torque bolts (8) and (9) to **125 INCH-POUNDS**. Use torque wrench adapter and torque wrench.
- (7) Apply corrosion preventive compound to bolts (8) and (9). Use corrosion preventive compound (item 62A, App F).



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b. **Inspect (QA).**

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**6.2. ENGINE INPUT DRIVE SHAFT AND OUTER DIFFUSER (ONE-PIECE)
REMOVAL/INSTALLATION – continued**

CAUTION

Ensure that outer diffuser being installed is same outer diffuser that was removed. Do not intermix or swap diffuser components or damage to diffuser will occur.

NOTE

Skip step c. if installing a two-section outer diffuser in place of a one-piece outer diffuser. Install two-section outer diffuser (para 6.32).

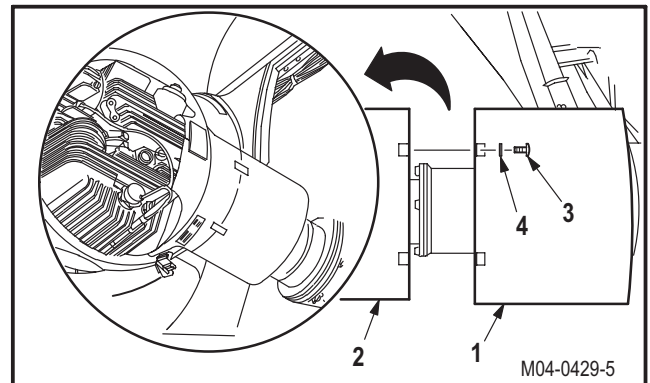
c. Install diffuser (1) on diffuser (2).

- (1) Position diffuser (1) on diffuser (2).
- (2) Aline mounting holes.
- (3) Install four screws (3) and washers (4) through diffusers (1) and diffuser (2).

d. Inspect (QA).

e. Perform drive system vibration maintenance operational check (TM 1-1520-238-T).

f. Install engine nose gearbox fairings and shrouds (para 2.123).



END OF TASK