TECHNICAL BULLETIN TO SUPPLEMENT TM 1-1670-260-12&P

FOR

UNIT MAINTENANCE AERIAL RECOVERY KIT (UMARK) PEACETIME AND NON-DAMAGED AIRCRAFT RECOVERY OPERATIONS

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HEADQUARTERS, DEPARTMENT OF THE ARMY
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TECHNICAL BULLETIN **HEADQUARTERS**
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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) located in the back of this manual, directly to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via e-mail, fax, or the World Wide Web. Our fax number is: DSN 788-6546 or Commercial 256-842-6546. Our e-mail address is: 2028@redstone.army.mil. Instructions for sending an electronic 2028 may be found at the back of this manual immediately preceding the hard copy 2028. For the World Wide Web use: https://amcom2028.redstone.army.mil.

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GENERAL INFORMATION

1.1 PURPOSE To complement the UMARK Technical Manual and provide Engineering recommendations concerning damage to victim aircraft during recovery operations. Recommendations are incorporated or addressed on recovery issues to ensure minimal damage in aerial recovery of victim helicopters and to instruct procedures for post-recovery checks to ensure helicopter flight safety in return to operations after recovery.

1.2 BACKGROUND The UMARK has successfully lifted/performed recovery operations on 30 Helicopters in testing with no damage to current aircraft directed rigging points. Eleven of these Flights were on AH-64 A/D aircraft with blades on and off at speeds from 50 to 80 KIAS. Five Flights were on OH-58 A/C/D aircraft with blades on and off at speeds from 60 to 80 KIAS.

2.0 OBJECTIVES Identify and resolve issues captured during the helicopter User, AMRDEC and Platform PM reviews on UMARK rigging and recovery and add procedures when applicable to supplement the UMARK TM for pre and post recovery operations.

2.1 GENERAL The requirement in combat to recover a damaged aircraft with a crew rigging the victim helicopter in 15 minutes should follow the TM procedures and then perform post recovery checks and maintenance required to safely return the aircraft to fight. For aircraft recovered in a peacetime setting the following warnings and cautions are added to anticipate worst-case flight conditions and minimize any further damage to the recovered aircraft.

3.0 PEACETIME RECOVERY PROCEDURES

3.1 AH-64 SERIES

3.1.1 The AH-64 SERIES supplemental data compliments Chapter 3 of the UMARK TM and provides the following recommendations prior to aircraft recovery operations utilizing the UMARK. The intent is to ensure that all limitations described in reference A analysis are incorporated for recovery operations.

3.1.2 Additional emphasis/wording is required in the UMARK TM Work Packages. The following emphasis/wording is added to preclude damage to the AH-64 during recovery operations:

3.1.3 The review determined the following concerns that could compromise the airworthiness of a recovered helicopter returned to flight status based on the analysis supplied by Boeing.

3.1.3.1 Add **"and main rotor support**" to main rotor assembly in current paragraph 6a. References affected 1b - 1g.

3.1.3.2 Insert the following Note, **"A short line recovery of an AH-64 helicopter with the blades on in bad weather or high winds could result in main rotor blade damage."** between current paragraph 6c and 7. References affected 1b, 1d, 1e, and 1g.

3.1.3.3 Modify current paragraph 7c(1) to read: **"Position the mid-point of the green/white sling (1) View A, under the 2 o'clock position main rotor blade retention assembly by threading the green/white sling (1) through the opening above the Droop Stop Ring and Droop Stop Follower Spring (see views to be inserted from reference 1i, Figures 5 and 36) ensuring that the sling passes inboard of the inboard strap pack hub bolts."** References affected 1b-1g.

3.1.3.4 Modify current paragraph 7c(2) to read: **"Position the mid-point of the green/white sling (2) View A, under the 4 o'clock position main rotor blade retention assembly by threading the green/white sling (2) through the opening above the Droop Stop Ring and Droop Stop Follower Spring (see views to be inserted from reference 1i, Figures 5 and 36) ensuring that the sling passes inboard of the inboard strap pack hub bolts.**" References affected 1b-1g.

3.1.3.5 Modify current paragraph 7c(3) to read: **"Position the mid-point of the green/white sling (3) View A, under the 8 o'clock position main rotor blade retention assembly by threading the green/white sling (3) through the opening above the Droop Stop Ring and Droop Stop Follower Spring (see views to be inserted from reference 1i, Figures 5 and 36) ensuring that the sling passes inboard of the inboard strap pack hub bolts."** References affected 1b-1g.

3.1.3.6 Modify current paragraph 7c(4) to read: **"Position the mid-point of the green/white sling (4) View A, under the 10 o'clock position main rotor blade retention assembly by threading the green/white sling (4) through the opening above the Droop Stop Ring and Droop Stop Follower Spring (see views to be inserted from reference 1i, Figures 5 and 36) ensuring that the sling passes inboard of the inboard strap pack hub bolts."** References affected 1b-1g.

3.1.3.7 Change wording in the Note following current paragraphs 7e (references 1b-1d) and 7f (References 1e-1g) from "secured to an appropriate airframe point" to read **"secured to a defined airframe point in Figure 2."**

3.1.3.8 Change wording in current paragraphs 7e(17) (references 1b-1d) and 7f(17) (references 1e-1g), from "appropriate area of airframe" to read **" areas of the airframe defined by Figure 2."**

3.1.3.9 Note, "Improper rigging of the tailboom sling at the FS 450.66 Jack Fitting can result in damage to the tailboom."

3.1.3.10 For procedures concerning tying the lower tail rotor blades to the airframes contact AMSAM-RD-AE-I-P-A (Mr. Lee Bumbicka). Basically tie the lower blade from the tail rotor to the disabled AH-64 helicopter using a fixed length tie-down (without snap hook). Wrap tie-down to preclude blade flapping during flight- -if further clarification is required or procedures for tying the lower
tail rotor blade to the airframe of the disabled helicopter contact Mr. Lee Bumbicka AMCOM Engineering for a sketch or picture.

3.1.3.11 Use of Drogue Chute for disabled aircraft recovery may compromise the airworthiness of the recovered aircraft, therefore perform phase maintenance inspection prior to the return of the aircraft to flight status."

3.1.3.12 Ensure that the recovery parameters (limitations) listed in Figure 1 are not exceeded. If Table 4 parameters are exceeded or it cannot be determined that Figure 1 parameters were met, then contact AMSAM-RD-AE-I-P-A (Mr. Lee Bumbicka) for corrective action or disposition.

Figure 1. Recovered Helicopter Recovery Parameters (Limitations)

Parameter	**Value**	**Units**
Max victim vehicle weight	20,000	LB
Maximum speed	40	KIAS
Maximum bank angle	20	Degrees
Maximum rate of climb	1000	FPM
Maximum rate of descent	1000	FPM
Center of gravity location	201 - 207	Inches (Sta)
Maximum landing sink rate (note 1)	5.6	FPS
Angle of attack	-2 to 3	Degrees
Terrain Lifting Limits –Fore/Aft Slope	±12	Degrees
Terrain Lifting Limits –Lateral Slope	±15	Degrees
Use of Drogue Chute	No	-

Note:
1. If maximum sink rate cannot be determined then perform Harding Landing inspection per Figure 3.

2. Verify that the recovered helicopter utilized the main rotor blade tiedown attachment points listed in Figure 2. If the recovered helicopter used main rotor blade tiedown attachment points other than those listed in Figure 2 or did not use any main rotor blade tiedown attachment points, then contact AMSAM-RD-AE-I-P-A (Mr. Lee Bumbicka) for corrective action or disposition.

Figure 2. Recovered Helicopter Main Rotor Blade Tiedown Attachment Points

Blades	**Attachment Location**	**Rating**
Forward	MLG trailing arm-mooring ring	Excellent
Forward	Pylon rack	Good
Forward right	Upper MLG shock strut	Poor
Aft	MLG jack pad	Excellent
Aft	FS 450 jack fitting	Good
Aft	Pylon rack	Good
Forward and aft	Wing tip lugs	Excellent

3.1.3.13 Perform the following inspections listed in Figure 3 on the recovered helicopter after a UMARK aerial recovery and before returning a recovered helicopter to flight status:

3.1.3.14 If Figure 3 is not incorporated then the following complete inspections must be performed instead. It should be noted that these inspections would be more manpower intensive than Figure 3.

3.1.3.14.1 Hard Landing Inspection per TM 1-1520-238-23-1

3.1.3.14.2 The 10 hr /14 day PMS per TM 1-1520-238-PMS

3.1.3.15 Add the following to the non-flyable damage classification in Introduction, paragraph 1.(1),:

3.1.3.15.1 Main rotor base.

3.1.3.15.2 Main rotor support truss legs.

3.1.3.15.3 Main rotor support truss leg attachments.

3.1.3.15.4 Frames at FS 176 and FS 230.

Figure 3. Post-recovery inspection list prior to release for flight

Structure	**Inspection Type**	**Criteria**	**Corrective action**
Droop stop hardware	Visual	Bent or broken pieces	**Replace**
Hub lower shoe	Visual	Abrasion	Replace or repair per DMWR 1-1615-312, paragraph 4-17.5
Landing gear	Hard Landing	Hard landing evidence	Replace or repair per DMWR 1-1620-248
Tailboom	Visual	Damage or abrasion	Repair per TM 1-1500-204-23-10 Vol. 10
Tailboom (if tail sling is improperly rigged)	Internal Visual	Cracks in #4,6,&7 stringers between FS 436.5 and 450	Repair per TM 1-1500-204-23-10 Vol. 10
Fuselage between and including frames at FS 176 and FS 230 (include skin/stringers, deck and struts	Visual	Cracks or deformation. Missing, sheared, or loose fasteners	Repair per TM 1-1500-204-23-10 Vol. 10
M/R blade (if recovered w/blades on)	Visual and cheesecloth*	Damage, cracks, abrasion	Repair or replace per DMWR 55-1615-313
Main Rotor blade tiedown points	Visual	Damage, cracks, abrasion	Repair per TM 1-1500-204-23-10 Vol. 10

Tail Rotor Hub	Visual	Bumper stop condition	Repair or replace as necessary per TM 1-1520-238-23-3
Tail Rotor Blade	Visual and cheesecloth*	Damage, cracks	Repair or replace per TM 1-1520-238-23-3

* Wipe blade with cheesecloth, NSN 8305-00-205-3558. Cloth snagging indicates possible crack.

3.1.4 Recovery of Damaged AH-64 Helicopters may further compromise the structural integrity of the victim helicopter. The damaged helicopter may not be approved for return to flight status without additional engineering evaluation and possible depot level inspections. Post recovery personnel should visually identify the areas of damage, record recovery flight data, and contact AMSAM-RD-AE-I-P-A (Mr. Lee Bumbicka) for corrective action to return the recovered helicopter to flight status or for deposition of the recovered damaged helicopter.

References: A. Unit Maintenance Aerial Recovery Kit (UMARK) Analysis Report, STN 01-015 Revision A, dated 15 May 2001.

3.2 OH-58 SERIES

3.2.1 The OH-58 SERIES supplemental data compliments Chapter 4 of the UMARK TM and provides the following recommendations prior to aircraft recovery operations utilizing the UMARK. The intent is to ensure that all limitations described in reference A analysis are incorporated for recovery operations.

3.2.2 Additional emphasis is required in Work Packages to preclude victim aircraft possible damage, especially fragile is the OH-58 tailboom. The following emphasis/wording is added to preclude damage to the OH-58:

3.2.2.1 Figure 4, Recovery Helicopter Flight Parameters (limitations), incorporates the required flight parameters for a recovered helicopter in a "Blades On/Off Condition" and identifies each condition. Highly recommended is the use of a 2g accelerometer to ensure a 2g event did not occur during transport possibly damaging the tailboom; non-use will nullify Bell Helicopter's analysis and require extensive inspections for bringing rotorcraft back to flight status.

3.2.2.2 The use of the Droque Parachute is "Not recommended" by reference A, Use of Drogue Chute may cause damages to the tailboom and require extensive post aircraft recovery inspections.

3.2.2.3 Warning, The recovery helicopter should take care to ensure that the disabled OH-58 helicopter is lifted first from the Main Rotor Hub before lifting the tailboom to

prevent excessive loading on the tailboom. Reference A recommends that the published rigging should ensure an initial nose up attitude of approximately 5 degrees prior to hoisting the helicopter.

3.2.2.4 Reference A further states that the tail rotor blades be removed prior to recovery to ensure airworthiness of the Tail Rotor system; to prevent damage to the tail rotor system during recovery.

3.2.2.5 If removal of tail rotor blades from disabled helicopter prior to recovery is not possible then tie the lower blade from the tail rotor to the disabled OH-58 helicopter using a fixed length tie-down (without snap hook). Wrap tie-down to preclude blade flapping during flight- -if further clarification is required or procedures for tying the lower tail rotor blade to the airframe of the disabled helicopter contact AMSAM-RD-AE-I-D-O (Mr. Gerald Johnson Jr.) for a sketch
or picture.

3.2.2.6 Prior to disabled helicopter recovery, remove engine to transmission drive shaft flex frame (K-Flex) coupling. Install a "trip" accelerometer on a rigid component of the rotor head to detect a 2g or excess vertical acceleration.

3.2.2.7 Ensure that the recovery parameters (limitations) listed in Figure 4 are not exceeded. If Figure 1 parameters are exceeded or it cannot be determined that parameters were met, then contact AMSAM-RD-AE-I-D-O (Mr. Gerald Johnson Jr.) for corrective action or deposition.

Figure 4. Recovered Helicopter Recovery Parameters (Limitations)

Parameter	**Blades On**	**Blades Off**
Maximum Vertical Load Factor (see Note 1)	2 g	2 g
Max victim vehicle weight	5100 Lbs	5100 Lbs
Maximum speed	30 KIAS	60 KIAS
Maximum bank angle	20 Degrees	30 Degrees
Maximum rate of climb	1000 FPM	3000 FPM
Maximum rate of descent	1000 FPM	3000 FPM
Initial Attitude for Hoisting (Rigging)	+5 Degrees	+5 Degrees
Terrain Lifting Limits –Fore/Aft Slope	-10 Degrees	-10 Degrees
Terrain Lifting Limits –Lateral Slope	-10 Degrees	-10 Degrees
Tail Rotor Blades (see Note 2)	Removed	Removed
Drive Shaft Flex Frame (K-Flex) (see Note 3)	Removed	Removed
Use of Drogue Chute	No	No

3.2.2.8 Remove and return the engine to transmission drive shaft flex frame (K-Flex) coupling to the manufacturer for inspection if the transmission drive shaft flex frame (K-Flex) coupling is not removed prior to recovery.

3.2.3 Perform the following inspections listed in Figure 5 on the recovered helicopter after every UMARK aerial recovery.

Figure 5. Post-Recovery Inspection List Prior to Release for Flight

Structure	Inspection	Criteria	Corrective action
Tail Rotor Blades	Visual	Blades Left on for recovery	Replace TR Blades
Engine to Transmission drive Shaft Flex Frame (K-Flex)	Visual	K-Flex Coupling Left on for recovery	Replace K-Flex Coupling and sent to manufacturer for inspection
Tail Rotor Hub Assembly	Visual	Cracks, distortion, bent linkages, missing, sheared, or loose fasteners	Inspect per TM 1-1520-248-23 Task 5-4-1
Landing Skids and Airframe	Visual	Hard Landing Evidence	Inspect per TM 1-1520-248-23
Vertical Fin and Soft Mounts	Visual	Cracks, distortion, buckled skin, missing, sheared, or loose fasteners	Inspect per TM 1-1520-248-23
Tail Rotor Gearbox Support and Adjacent Skin	Visual	Cracks, distortion, buckled skin, missing, sheared, or loose fasteners	Inspect per TM 1-1520-248-23
Drive Shaft Cover at sling contact points	Visual	Damage, dents, cracks, abrasion	Inspect per TM 1-1520-248-23
Horizontal Stabilizer Surrounding Skin	Visual	Damage, cracks, deformation, and security	Inspect per TM 1-1520-248-23
Airframe Tailboom Joining Area, Attachment Fittings, Bulkhead Webs and Skins	Visual	Distortion, deformation, buckled skin, cracks, missing, sheared, or loose fasteners	Inspect per TM 1-1520-248-23
Tailboom Attachment Bolt Torque	Verify Torque	Loss of Preload	Inspect per TM 1-1520-248-23 Chapter 1
Remove Cowlings	Visual	Damage, cracks, deformation, and security	Inspect per TM 1-1520-248-23
Pylon Support Structure on Cabin Roof and Surrounding Airframe	Visual	Cracks, Deformation, loss of attachment hardware, loose or broken fasteners	Inspect per TM 1-1520-248-23
Main Rotor Blade *	Visual and cheesecloth*	Damage, cracks, de-bonding	Inspect per TM 1-1520-248-23

* Wipe blade with cheesecloth, NSN 8305-00-205-3558. Cloth snagging indicates possible crack.

3.2.3.1 Recovery of Damaged OH-58A/C and D Model Helicopters may further compromise the structural integrity of the victim helicopter. The damaged helicopter may not be approved for return to flight status without additional engineering evaluation and possible depot level inspections. Post recovery personnel should visually identify the areas of damage, record recovery flight data, and contact AMSAM-RD-AE-I-D-O (Mr. Gerald Johnson Jr.) for corrective action to return the recovered helicopter to flight status or for deposition of the recovered damaged helicopter.

References: A. Engineering Analysis of the OH-58DUnit Maintenance Aerial Recovery Kit (UMARK) By Bell Helicopter Textron Inc (BHTI), Contract DAAH 10-00-C-0055, dated 16 April 2001.

3.3 UH-60 SERIES

3.3.1 The UH-60 SERIES supplemental data compliments Chapter 6 of the UMARK TM and provides the following recommendations prior to aircraft recovery operations utilizing the UMARK. The intent is to ensure that all limitations described in reference A analysis are incorporated for recovery operations.

3.3.2 Additional emphasis/wording is required in Work Packages 0022, 0023, and 0024. The following emphasis/wording is underlined and bolded to preclude damage to the inboard damper brackets and supplements paragraph 7 b.:

3.3.2.1 Position mid-point of green/white sling (1), View A, under 2 o'clock position main rotor blade retention assembly **inboard of dampener bracket and** as close to main rotor mast as possible. (View C)

3.3.2.2 Position mid-point of green/white sling (2), View A, under 4 o'clock position main rotor blade retention assembly **inboard of dampener bracket and** as close to main rotor mast as possible. (View C)

3.3.2.3 Position midpoint of green/white sling (3), View A, under 8 o'clock position main rotor blade retention assembly **inboard of dampener bracket and** as close to main rotor mast as possible. (View C)

3.3.2.4 Position midpoint of green/white sling (4), View A, under 10 o'clock position main rotor blade retention assembly **inboard of dampener bracket and** as close to main rotor mast as possible. (View C)

3.3.2.5 Add to Paragraph 12, Post Recovery Disabled Helicopter Procedures additional checks as follows:

3.3.2.5.a Perform main rotor blade Sudden Stoppage inspection in accordance with TM 1-1520-237-23.

3.3.2.5.b Airframe Inspections - Using Aircraft Weight and Balance Record calculate the weight and center of gravity of the aircraft at time of recovery. Plot resulting point on graph below.

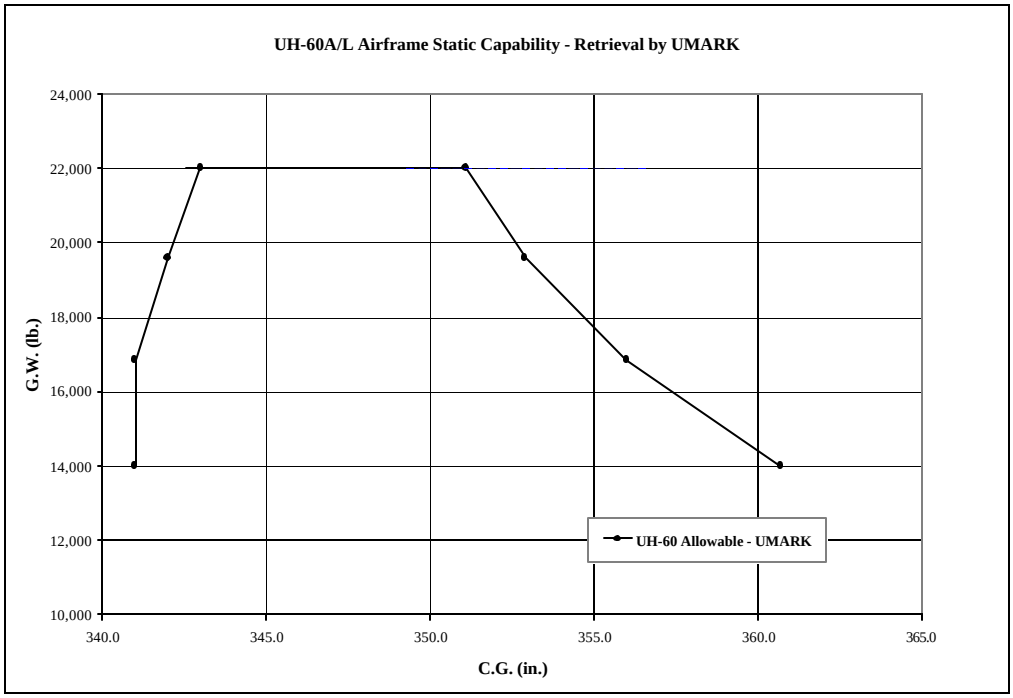

Figure 6. Airframe Static Capability

3.3.2.5.c If point is below the line above no airframe inspections are required.

3.3.2.5.d If point is above the line perform the following airframe inspections:

3.3.2.6 Inspect cabin area for cracks, permanent deformation, and loose or missing fasteners in the following areas:

3.3.2.6.1 Inspect Frame at Station 327.115

3.3.2.6.2 Inspect Beams at Buttline 16.5 from Station 308.0 to Station 343.5

3.3.2.6.3 Inspect Forward absorber supports from Station 308.0 to 327.115

3.3.2.7 The following empennages are inspected for cracks, permanent deformation, and loose or missing fasteners:

3.3.2.7.1 Lower deck caps, webs, and panel breakers.

3.3.2.7.2 Side skins, lower to upper shear deck.

3.3.2.7.3 Stringers, lower to upper shear deck.

3.3.2.7.4 Forward spar, lower to upper shear deck.

3.3.2.7.5 Fold bulkhead tension joints and associated hardware.

3.3.3 Transmission Capability – Plot the same point on the graph below.

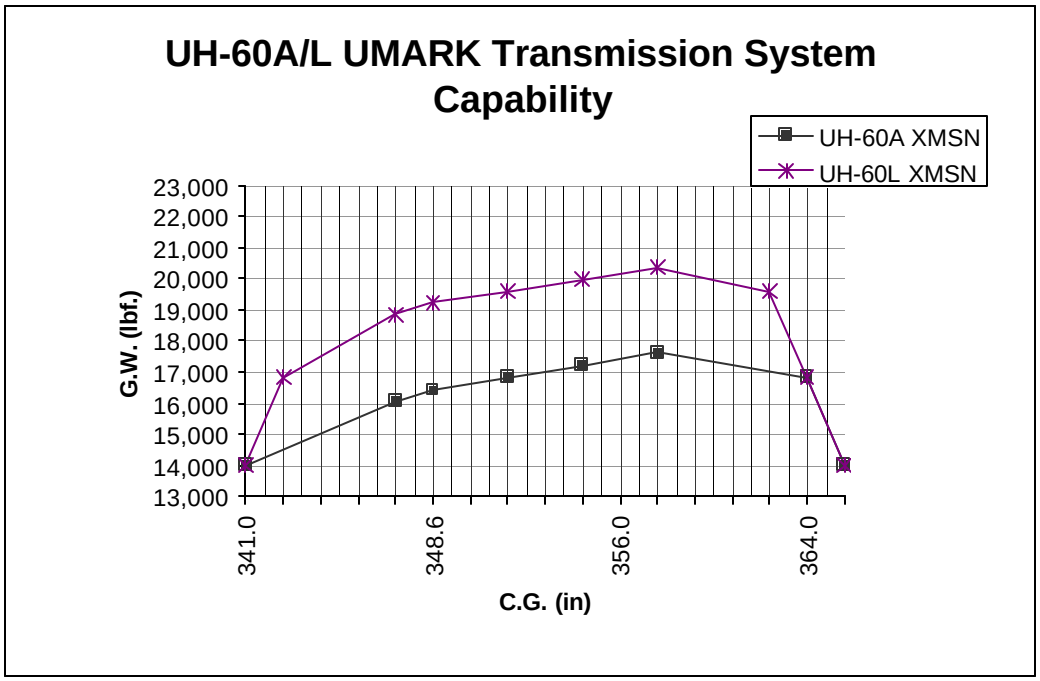

Figure 7. UMARK Transmission System Capability

3.3.3.1 If the point is below the appropriate line for the model of aircraft recovered no corrective action is required.

3.3.3.2 If the point is above the appropriate line for the model of aircraft recovered the gearbox must be removed and returned to depot for inspection.

3.3.4 Additional emphasis/wording is required in Work Packages 0025, and 0026 paragraph 11, Post Recovery Damaged Helicopter Procedures as follows:

3.3.4.1 This is a structurally damaged aircraft. Before returning helicopter to flight status inspect and repair in accordance with appropriate technical manuals and depot repair procedures.

3.3.5 The points of contact for above engineering data and recommendations are Mr. Thom Brown, AMSAM-RD-AE-F-T, or Edwin D. Martin, Chief, Structural Technology Branch, Structures and Materials Division.

References: A. SER-702724, Titled, Static Analysis of the UH-60 Airframe Dynamic Components for Aerial Recovery with the UMARK System dated 27 July 2001.

4.0 SUMMARY

The majority of peacetime recovery operations are not aerial recovery of non-damaged victim helicopters. This Technical Bulletin is provided for the Commander and his Unit to limit or preclude further aircraft damage during recovery operations in a peacetime aerial recovery operation. The TM also attempts to preclude damage to the victim aircraft by limiting loads lifted and slowing recovery speeds. The Drouge Parachute is recommended for damaged aircraft in the TM to enhance stable flight of combat damaged aircraft, but not recommended in peacetime due to stresses placed on the tailboom of the OH-58 series helicopters. The AMCOM Engineering is always available for questions and assistance in helicopter recovery to preclude further damage and ensure safe recovery operations.

By Order of the Secretary of the Army:

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