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DEPARTMENT OF THE ARMY  
UNITED STATES ARMY AVIATION TEST BOARD  
Fort Rucker, Alabama 36360

STEBCG-TD

SUBJECT: Final Report of Product-Improvement Test (TBO Extension) of 42-Degree Gearbox (Part Number 284-848-873-23).

USATECOM Project No. 4-5-8101-13 ✓

SEE DISTRIBUTION

1. REFERENCES

See Inclosure 1.

2. BACKGROUND

a. The majority of the UH-1( ) dynamic components are removed for overhaul or retirement at 1,100-hour intervals. Extension of the time between overhaul (TBO) of major dynamic components of the UH-1( ) helicopters would improve the worldwide supply posture and availability rate, and would provide a substantial savings.

b. On 1 October 1965, the US Army Test and Evaluation Command (USATECOM) directed the US Army Aviation Test Board (USAAVNTBD) to conduct a product improvement test of the 42-degree gearbox to determine the feasibility of extending the 1,100-hour authorized TBO and retirement schedule to 1,300 hours (reference 2). It was found that the TBO of the gearbox could be extended to 1,300 hours and that it was suitable for further TBO advancement (reference 3).

c. On 7 February 1967, USATECOM directed the USAAVNTBD to conduct another product improvement test of the 42-degree gearbox and to operate to 1,500 hours six gearboxes available at the USAAVNTBD (reference 5). Subsequent direction extended the test to 1,700, 1,800, and 2,200 hours (references 6, 9, and 10, respectively).

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### 3. DESCRIPTION OF MATERIEL

The intermediate (42-degree) gearbox, part number 204-040-003-23, is installed on the top of the tail boom at station 392.4 at the base of the vertical fin and provides a 42-degree change in direction of the tail-rotor drive shaft with no speed reduction. The assembly consists of a case with gear quills at each end. The case is fitted with an oil filler cap, a vent breather, an oil-level sight gauge, and a drain plug equipped with a magnetic insert. The input and output quills incorporate flexible couplings for attachment of the input and output drive shaft sections.

### 4. OBJECTIVE

To determine if it is feasible to extend the authorized TBO of the 42-degree gearbox.

### 5. SCOPE AND METHOD

a. The USAAVNTBD conducted this Category II product-improvement test during the period February 1967 through December 1968.

b. Six 1,300-hour 42-degree gearboxes were selected to operate to 1,500 flight hours each on UH-1( ) helicopters.

c. Three 1,500-hour gearboxes were selected to operate to 1,700 flight hours each.

d. Two 1,700-hour gearboxes were selected to operate to 1,800 flight hours each.

e. Two 1,800-hour gearboxes were selected to operate to 2,200 flight hours each.

f. The gearboxes were disassembled by USAAVNTBD personnel at 100-flight-hour intervals, and the gears visually inspected for unusual wear patterns. The input and output quill shafts were rotated to check for bearing roughness. At the end of each day's flying, oil samples were collected and analyzed, and magnetic plugs were visually inspected.

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## 6. SUMMARY OF RESULTS

a. The following table shows the hours accumulated and condition of each gearbox:

<u>Gearbox Serial Number</u>	<u>Hours</u>	<u>Condition</u>
B13-1127	1,301.5	Inadvertently returned to depot
B13-2931	1,353.8	Rejected; crash damage
B13-1277	1,400.0	Rejected; rough input bearing
B13-1371	1,709.8	Rejected; scuffing of gear teeth
B13-1431	2,205.0	Serviceable
B13-1411	2,207.7	Serviceable

b. Because of seal deterioration, oil leakage occurred occasionally.

## 7. DISCUSSION

a. Of the six gearboxes, serial numbers (S/N) B13-1127 and B13-2931 can be discounted in any decision relative to assigning a TBO in excess of 1,300 hours.

b. The input bearing roughness, for which gearbox S/N B13-1277 was rejected, was very slight, and was detected only after removing the quills from the housing and carefully rotating the input quill gear. Flushing the gearbox did not cause the roughness to vanish. The gearbox was sent to the aircraft manufacturer for teardown analysis; however,

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results of the analysis were not received by the USAAVNTBD. The roughness present was not of such a degree as to have compromised the serviceability of the gearbox. No bearing problems were experienced with the remaining three gearboxes.

c. The gear tooth scuffing for which gearbox S/N B13-1371 was rejected appeared very similar to that associated with gear tooth overloading experienced on the AH-1G with the pusher-type tail rotor installed. It was decided to operate gearboxes S/N B13-1411 and B13-1431 to determine whether such scuffing would occur on those gearboxes as operating time increased. No such scuffing occurred during 500 additional hours of operation on each gearbox.

d. In light of the total test, the discrepancies which occurred on gearboxes S/N B13-1277 and B13-1371 are considered as isolated phenomena. The fact that two gearboxes achieved 2,200 hours and were still serviceable could be justification for a 2,200-hour TBO. It is therefore a corollary that an increase in the TBO from 1,500 to 1,800 hours can be achieved with a high degree of confidence.

#### 8. CONCLUSIONS

- a. An 1,800-hour TBO is feasible for the 42-degree gearbox.
- b. The gearbox appears suitable for further TBO advancement.

#### 9. RECOMMENDATIONS

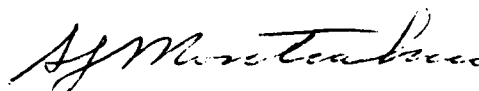
- a. The TBO of the 42-degree gearbox be extended to 1,800 hours.

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b. Further testing of the 42-degree gearbox be conducted to determine the feasibility of extending the TBO.

FOR THE PRESIDENT:



A. J. MONTCALMO  
1LT, AGC  
Acting Adjutant

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## REFERENCES

1. Letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 1 June 1965, subject: "Product Improvement Test, UH-1B Items, USATECOM Project Number 4-5-0101-( )."
2. Letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 1 October 1965, subject: "Product Improvement Test (Component TBO Extension) UH-1B Helicopter, USATECOM Project No. 4-5-0101-13."
3. Letter Report, "Product Improvement Test of Component TBO Extension," USATECOM Project Number 4-5-0101-03, US Army Aviation Test Board, 28 December 1966.
4. Letter, AMSAV-EAA, Headquarters, US Army Aviation Materiel Command, 24 January 1967, subject: "UH-1 TBO Extension, USATECOM Project Number 4-5-0101-03, 42-Degree Gearbox."
5. Letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 7 February 1967, subject: "Test Directive, Product Improvement Test (TBO Extension), 42-Degree Gearbox, USATECOM Project No. 4-5-0101-13."
6. Letter, AMCPM-IRFO-T, Headquarters, US Army Materiel Command, 24 August 1967, subject: "Product Improvement Test (TBO Extension), 42-Degree Gearbox, USATECOM Project No. 4-5-0101-13."
7. Letter Report, "Product Improvement Test (TBO Extension) 42-Degree Gearbox, Part No. 204-040-003-23," USATECOM Project No. 4-5-0101-13, US Army Aviation Test Board, 25 September 1967.
8. Errata, Letter Report of Test, "Product Improvement Test (TBO Extension) 42 Degree Gearbox, Part No. 204-040-003-23," USATECOM Project No. 4-5-0101-13, US Army Aviation Test Board, 9 October 1967.
9. Message, AMCPM-IRFO-T 1-13736, Director, US Army Aviation Materiel Command Field Office, 16 January 1968, subject: "Continuation of UH-1 Test, USATECOM Project Number 4-5-0101-13."
10. Letter, AMCPM-IRFO-T, US Army Materiel Command Field Office, 25 June 1968, subject: "Continuation of UH-1 Test, USATECOM

INCLOSURE

Project No. 4-5-0101-13, " with first indorsement, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 10 July 1968.