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## CATEGORY II PERFORMANCE AND FLYING QUALITIES TESTS OF THE HH-53C HELICOPTER -SUPPLEMENT-COLD WEATHER HOVER

ERFORMÁNCE

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TECHNICAL REPORT No. 70-8

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# DEPARTMENT OF THE AIR FORCE HEADQUARTERS AERONAUTICAL SYSTEMS DIVISION (AFSC) WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433



REPLY TO

ASD/SDQH 5-10 (Maj Thompson/54921/cal/H-53/R&D 9-2)

SUBJECT

ASD Addendum to FTC-TR-70-8 Supplement H-53 Cold Performance

Recipients of FTC-TR-70-8 Supplement

This report is a part of and should remain attached to FTC-TR-70-8 Supplement, evaluation of the H-53 "Cold Weather Hover Performance". Paragraph numbers below correspond to the recommendations in the AFFTC Technical Report.

- 1. Concur. However, the data obtained in this program is presented in such a form that further data analysis is an unavoidable requirement in the process of updating the flight manual. ASD/SDQH has negotiated a commercial contract to accomplish this task. All other performance data available will be reduced concurrently, to update the entire appendix simultaneously.
- 2. Concur with intent. With the test data available, the range of the hover chart can be extended to minus 5,000 feet density altitude. In the data analysis process, every effort will be made to extend the hover performance prediction capability, possibly as far as minus 10,000 feet density altitude. In addition, cruise data will be extended downward to the extent feasible for operations in extreme cold.

FOR THE COMMANDER

WILLIAM D. EASTMAN, JR., LE COI, USAF

Chief, Helicopter Program Office Directorate of Combat Systems

Deputy for Systems



PRIDE IN THE PAST

FAITH IN THE FUTURE

### CATEGORY II PERFORMANCE AND FLYING QUALITIES TESTS OF THE HH-53C HELICOPTER -SUPPLEMENT-COLD WEATHER HOVER PERFORMANCE

ROUNEY L. RITTER Captain, USAF Project Engineer SYDNEY E. GURLEY Major, USAF Pilot CLARK E. LOVRIEN, JR. Major, USAF Project Officer and Project Pilet

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(SDQH), Wright-Patterson AFB, Ohio 45433.

### **FOREWORD**

This report presents the results of the cold weather hover performance tests of the HH-53C helicopter, USAF serial number 68-10354. Testing was conducted between 8 January and 26 February 1971 at Eielson Air Force Base, Alaska, and Fort Greeley, Alaska in conjunction with the HH-53C cold weather tests, under the authority of AFFTC Project Directive 71-24.

The authors of this report wish to express their appreciation to Mr. Edward I. Seto for his assistance with the engineering analysis.

Foreign announcement and dissemination by the Defense Documentation Center are not authorized because of technology restrictions of the U.S. Export Control Acts as implemented by AFR 400-10.

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Reviewed and approved by:

22 MARCH 1971

Colonel, USAF

Commander, 6510th Test Wing

ROBERT M. WHITE Brigadier General, USAF

Commander

### **ABSTRACT**

The cold weather hover performance tests were conducted in conjunction with the cold weather tests of the HH-53C helicopter. Interpretation of the results of this test along with previous Category II tests resulted in an adjustment to the hover performance data presented in FTC-SD-70-8. The results of this report should be used to update the Flight Manual.

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# list of abbreviations and symbols

<u> Item</u>	<u>Definition</u>	<u>Units</u>
A	rotor disk area	ft <sup>2</sup>
$c_p$	power coefficient	
$C_{\mathbf{T}}^{-}$	thrust coefficient	
$^{\rm M}_{ m TIP}$	advancing blade tip Mach number	dimensionless
R	rotor radius	ft
SHP	shaft horsepower	550 ft-lb sec
W	gross weight	lb
ρ	air density	slug per $ft^2$
Ω	rotor angular velocity	rad per sec

### INTRODUCTION

Previous HH-53C hover performance testing (FTC-TR-70-8) partially defined rotor blade compressibility and resulted in the recommendation that additional testing be conducted to more completely define this effect.

The HH-53C is a rescue-equipped, twin-engine, six-bladed, fully articulated rotor helicopter, manufactured by Sikorsky Aircraft, Division of United Aircraft Corporation, at Stratford, Connecticut. The aircraft is powered by two General Electric T64-7 engines with an uninstalled, non-flow limited, rating of 3,925 SHP at sea level standard day. Design rescue mission gross weight is 37,399 pounds with a maximum gross weight of 40,750 pounds.

### TEST AND EVALUATION

Hover performance was evaluated at wheel heights of 100, 80, 47, 22 and 10 feet. Performance tests at two different  $M_{\rm TIP}$  values were flown at all wheel heights except 80 feet. Both tethered and free flight hovering techniques were used during testing. No testing was accomplished in winds above 2 knots.

Previous data for the HH-53C (FTC-SD-70-8, reference 1) were presented without a plot of wheel height versus  $C_{\rm p}$  for lines of constant  $C_{\rm T}$ . In correlating the data acquired during the cold weather tests with the previously published data (FTC-SD-70-8), it was necessary to construct a crossplot combining data from both tests.

The Flight Manual's Indicated Torque Required to Hover chart (A-7) was in error. It showed torque up to 11-pt. Let higher than was actually required. Interpretation of the results of this set along with previous Category II tests resulted in an adjustment to the hover performance curves presented in FTC-SD-70-8, figures a through of appendix I. The data presented in this report (figures 1 through 12) should be used to update the Flight Manual. (R 1)1

Minus 6,000 feet density altitude days were a frequent occurrence during the test program and density altitudes below minus 9,000 feet were encountered. In such cases the Indicated Torque Required To Hover chart (A-7) in the Flight Manual did not have sufficient range to be used for the conditions encountered. The range of this char: should be increased to minus 10,000 feet density altitude to provide adequate range for lowaltitude, cold weather operation. (R 2)

Numbers indicated as (R 1), etc., represent the corresponding recommendation numbers as tabulated in the Conclusions and Recommendations section of this report.

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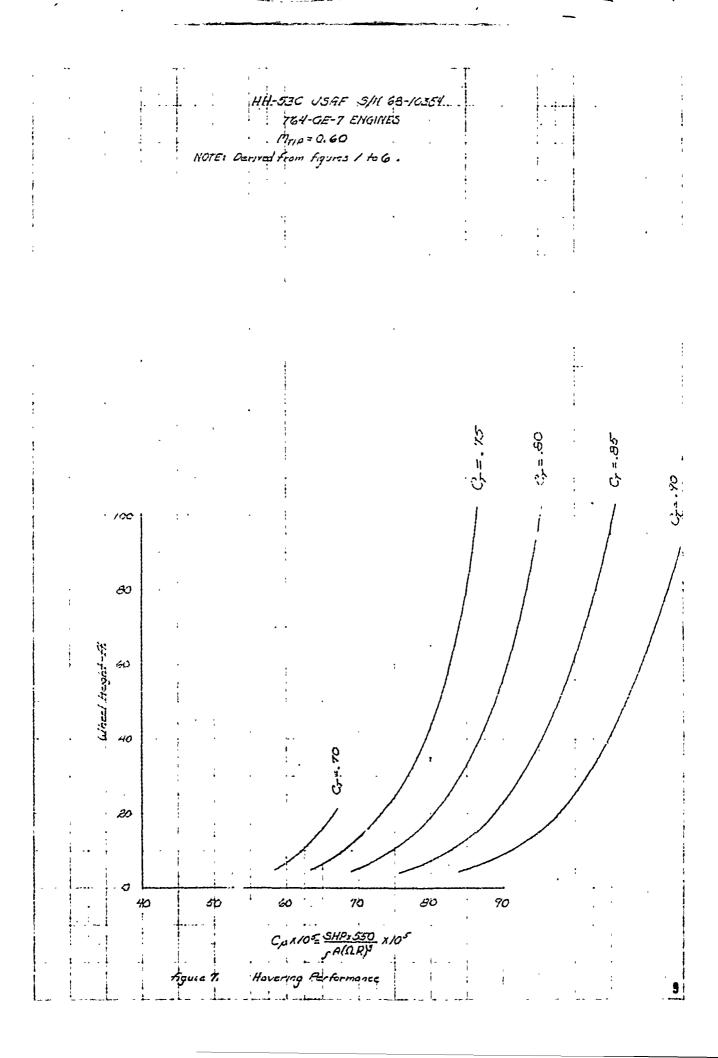
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# CONCLUSIONS AND RECOMMENDATIONS

The Flight Manual's Indicated Torque Required to Hover chart (A-7) was in error. It showed torque up to ll-percent higher than was actually required. Interpretation of the results of this test along with previous Category II tests resulted in an adjustment to the hover performance curves presented in FTC-SD-70-8, appendix I, figures 1 through 6.

1. The data presented in this report should be used to update the Flight Manual (page 2).

The Flight Manual Indicated Torque Required to Hover chart (A-7) did not have sufficient range of density altitude to define the performance of the helicopter.

2. The range of this chart should be increased to minus 10,000 feet density altitude (page 2).

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13. ABSTRACT	<u> </u>									

The cold weather hover performance tests were conducted in conjunction with the cold weather tests of the HH-53C helicopter. Interpretation of the results of this test along with previous Category II tests resulted in an adjustment to the hover performance data presented in FTC-SD-70-8. The results of this report should be used to update the Flight Manual.

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