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RDTE PROJECT NO. 1X141806D133.06
USAAVSCOM PROJECT NO. 67-29
USAASTA PROJECT NO. 67-29

ENGINEERING FLIGHT TEST OF THE PRODUCTION OH-6A HELICOPTER WITH FAIRINGS REMOVED

FINAL REPORT

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JULY 1969

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US ARMY AVIATION SYSTEMS TEST ACTIVITY
EDWARDS AIR FORCE BASE, CALIFORNIA 93523

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ABSTRACT

Flight tests were conducted to determine the effects on performance and flying qualities of the OH-6A helicopter with various fairings removed. The fairings removed were the lower anticollision light cover, the main rotor blade root end fairings, the main rotor center hub fairing and the landing gear strut fairings. Individually removing the lower anticollision light cover, the main rotor blade root end fairings and the main rotor center hub fairing did not significantly affect the performance of the helicopter; however, removing the landing gear strut fairings resulted in a definite decrease in performance. The performance in the all fairings removed configuration was also significantly decreased. Stability and control tests were conducted in the all fairings removed configuration. Slight changes in control positions were evident but no major effects on flying qualities were observed. From a performance and flying qualities standpoint, it is feasible to operate the helicopter with these fairings removed. Although the performance changes are relatively small, allowances should be made in mission planning for all fairings removed and skid strut fairings removed configurations. If normal operations are to be conducted in these configurations, the data contained in this report should be included in TM 55-1520-214-10.

TABLE OF CONTENTS

INTRODUCTION

BACKGROUND

1. The detail specification for the production contract awarded to the contractor in May 1965 for the OH-6A helicopter incorporated significant changes to the airframe and engine of the prototype OH-6A tested by the US Army Aviation Systems Test Activity (USA-ASTA).

2. Differences between the prototype and production OH-6A helicopter were extensive enough to require a complete performance and stability and control test program which was conducted in 1967. A directive was received from the US Army Aviation Systems Command (USAAVSCOM) in December 1967 which required that a test be conducted to evaluate the OH-6A helicopter with various fairings removed (ref 1, app I).

TEST OBJECTIVES

3. Objectives of these tests were to determine the effects on performance and handling qualities of operating the OH-6A with fairings removed individually and collectively.

DESCRIPTION

4. The OH-6A helicopter, built by the Aircraft Division of Hughes Tool Co., has a single, four-bladed, fully articulated main rotor and a two-bladed, teetering, antitorque tail rotor. The cockpit configuration is a two place (pilot and observer/gunner), and the cargo area has provisions for two collapsible canvas passenger seats. Cyclic, collective and antitorque rotor pedal controls are conventional and unboosted. Skid-type landing gear with air-oil dampened shock struts is installed. The helicopter is powered by a T63-A-5A free turbine, turboshaft engine, derated to 260 shaft horsepower (shp) for takeoff and 221 shp for continuous operation.

5. Fairings removed were those covering the lower anticollision light, the landing gear struts, the main rotor blade root ends and the center of the main rotor hub. The removed fairings are shown in photographs 1 through 4, appendix VII. A detailed description of the OH-6A is contained in TM 55-1520-214-10 (ref 2, app I). Further information can be obtained from the manufacturer's Detail Specification HTC-AD-369-Y-8011 (ref 3).

SCOPE OF TEST

6. Twenty productive test flights were performed in the vicinity of Edwards Air Force Base, California, to evaluate performance characteristics and handling qualities. Twelve level flight performance tests were conducted at a 2400-pound gross weight (grwt), 5,000- and 10,000-foot density altitudes (H_D), a mid center of gravity (cg) location (100.0 in.) and a 483 rpm rotor speed. The tests were conducted in the following configurations: standard aircraft (clean configuration), lower anticollision light fairing removed, main rotor blade root fairings removed, main rotor center hub fairing removed, landing gear strut fairings removed and all fairings removed. Eight flights were made to evaluate stability and control characteristics with all fairings removed and in the standard configuration for comparison purposes.

METHOD OF TEST

7. Since this test was performed to determine effects of configuration changes, the method used was to conduct the required tests in the desired configurations and to compare the results directly with data available for the standard configuration. Where appropriate, data obtained during the OH-6A Phase D test were used. In the case of qualitative comparisons of handling qualities, specific tests were conducted by the same pilot in both the standard configuration and in the desired test configuration.

8. Data were recorded both manually from sensitive cockpit instrumentation and on a photopanel. In addition, an oscillograph was used to record stability and control parameters. Fuel flow data specified in Engine Model Specification No. 580-F (ref 4, app I) were used to derive the specific ranges.

9. Dynamic stability and controllability characteristics were evaluated qualitatively; however, quantitative data were recorded.

10. A detailed description of the test methods is presented in appendix III, and a complete list of the test instrumentation is presented in appendix IV.

CHRONOLOGY

11. The chronology of the tests is as follows:

Test Directive received	27 December 1967
Test aircraft received	16 February 1968
Test started	21 March 1968
Flight tests completed	16 May 1968
Draft report submitted	10 March 1969

RESULTS & DISCUSSION

GENERAL

12. Individually removing the lower anticollision light cover, the main rotor blade root end fairings and the main rotor center hub fairing had a negligible effect on the performance of the helicopter. Removal of the landing gear strut fairings resulted in a significant decrease in performance as did the removal of all fairings collectively. Slight changes in control positions were evident, but no major effect on flying qualities was observed with the fairings removed. Based on the results of this test it is feasible to operate the OH-6A helicopter with these fairings removed.

PERFORMANCE

Airspeed

13. An airspeed calibration, which was performed on the test aircraft by USAASTA in November, 1967, was used during this test (fig. 1, app II). The position error varies linearly from +3 knots at low speeds to +4 knots at high speeds.

Level Flight

14. Level flights were conducted according to the test conditions in paragraph 6. The results of these flights are presented in figures 2 through 13, appendix II, and are summarized in table 1.

15. The clean-aircraft performance curves superimposed on figures 4 through 13, appendix II, were adjusted to allow comparison with the specific fairing configuration at the same thrust coefficient (C_T). This adjustment was derived from data contained in the OH-6A Phase D Final Report (ref 5, app I).

16. The curves through the data points were based on the differences in equivalent flat plate areas. These differences were originally determined for the different configurations from a trial fit through the data points and were then averaged between their two values at the different density altitudes.

17. Although airspeeds in all configurations are limited by never exceed airspeed (V_{NE}), there is a difference in the maximum airspeed based on power available and power required. Removing all fairings resulted in a 12-knot (9.6 percent) decrease in the maximum

TABLE 1. PERFORMANCE CHANGES FROM THE STANDARD CONFIGURATION.

Aim Gross Weight [illegible]
Rotor Speed [illegible] rpm
CG Location [illegible]

Density Altitude (ft):	Thrust Coefficient[1] (C_T) (5000)	Thrust Coefficient[1] (C_T) (10,000)	Increase in Equiv. Flat Plate Area (sq ft)	Test Climb Speed (5000)	Test Climb Speed (10,000)	Recommended Cruise Speed[2] (5000)	Recommended Cruise Speed[2] (10,000)	Power for Recommended Cruise Speed (5000)	Power for Recommended Cruise Speed (10,000)	Range[3] (5000) NM	Range[3] (10,000) NM	99% Maximum Specific Range (5000) (NAMPP)	99% Maximum Specific Range (10,000) (NAMPP)
CONFIGURATION													
All Fairings Removed	.004865	.005648	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	254	0.722	0.752
Standard	.004865	.005648	N/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	274	0.800	0.811
Skid Strut Fairings Removed	.004858	.005640	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	258	0.742	0.762
Standard	.004858	.005640	N/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	274	0.801	0.812
Blade Root Fairings Removed	.004871	.005649	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	269	0.792	[illegible]
Standard	.004871	.005649	N/A	[illegible]	[illegible]	111	[illegible]	[illegible]	[illegible]	[illegible]	274	0.798	0.811
Center Hub Fairing Removed	.004839	.005658	0.20	63.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	269	0.785	[illegible]
Standard	.004839	.005658	N/A	63.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	274	0.805	[illegible]
Lower Light Fairing Removed	.004853	.005611	0.15	63.0	[illegible]	[illegible]	[illegible]	[illegible]	171.0	273	[illegible]	[illegible]	[illegible]
Standard	.004853	.005611	N/A	63.0	[illegible]	111.5	[illegible]	[illegible]	169.0	278	[illegible]	[illegible]	0.813

[1]Variations in C_T values are due to small variations in average gross weight.
[2]Recommended cruise speed is defined as the highest airspeed which results in 99 percent of the maximum range. Range calculations were made at this airspeed.
[3]Range calculations are based on the following: 400 pounds of usable fuel; 10 percent of fuel reserve at landing; 13 pounds of fuel for start, taxi, takeoff and climb to 5000 ft. 22 pounds of fuel for start, taxi, takeoff and climb to 10,000 ft.

power limit airspeed on a standard day at 5000 feet and a 7-knot (6.2 percent) decrease at 10,000 feet.

18. Individually removing the lower anticollision light cover, the cover for the center of the main rotor hub and the fairings on the main rotor root ends did not produce any significant changes in performance. Removal of the skid strut fairings resulted in a significant decrease in performance.

STABILITY AND CONTROL

Trim Stability

19. Figure 15, appendix II, shows the variation in control positions between the clean configuration and the all fairings off configuration. These trim curves were taken from the 5000-foot H_D level-flight tests. The most significant variation shows up on collective stick position. The increase in blade angle of attack necessary to compensate for the additional drag caused by removing the fairings is shown by the increase in collective stick position.

20. The longitudinal stick-position trim curve shows a more forward stick position required for the fairings off configuration at speeds above 80 knots calibrated airspeed (KCAS).

Static Longitudinal Collective-Fixed Stability

21. Static longitudinal collective-fixed stability tests were conducted at a 5000-foot H_D. The trim airspeeds flown were 53 KCAS, 80 KCAS (.8V_{NE}) and 99 KCAS (V_{NE}). Results are shown in figure 17, appendix II.

22. The slopes of the curves were not changed by removing all fairings which indicated that the static longitudinal collective-fixed stability was unchanged. Removal of the fairings resulted in increased collective control and more forward cyclic control for a given airspeed.

Static Lateral-Directional Stability

23. Static lateral-directional stability flights were conducted in the clean configuration and with all four fairings removed at a density altitude of approximately 5000 feet. The trim airspeeds flown were 53, 80 and 99 KCAS. Tests were conducted at sideslip angles from approximately 10 degrees at high speed to 25 degrees at low speed. Test results are presented in figure 19, appendix II.

24. The most significant difference between the two configurations is the difference in lateral-stick requirement. More lateral stick is required for a given sideslip angle in the fairings removed configuration. This indicates an increase in dihedral effect with the fairings removed. The bank angles remain approximately the same for both configurations despite the increase in lateral-stick position for the fairings removed configuration. The variations in longitudinal stick position and pedal position were not significant.

Dynamic Stability and Controllability

25. Dynamic stability and controllability tests were flown in both the clean and all fairings off configurations. The controllability flights were conducted at a 6000-foot H_D, and the dynamic stability flights were made at a 5000-foot H_D. The trim airspeeds flown were approximately 50, 80 and 95 KCAS.

26. The qualitative results of these flights indicate no significant change in the stability and control characteristics with the fairings removed. Blade stall limits were reached at lower airspeeds, but no unusual tendencies were observed with all of the fairings removed.

CONCLUSIONS

27. It is feasible to operate the OH-6A helicopter with fairings removed individually and collectively (para 12).

28. Removal of all fairings reduced the recommended cruise speed by 5 knots (5 percent) at a 5000-foot H_D and decreased the range approximately 27 nautical air miles (10 percent) (table 1).

29. Removal of the skid strut fairings reduced the recommended cruise speed by 5 knots (5 percent) at a 5000-foot H_D and decreased the range approximately 21 nautical air miles (7 percent) (table 1).

30. The lower anticollision light cover, the center hub fairing and the blade root fairings did not significantly affect the performance of the OH-6A when removed individually (para 18).

31. The stability and control characteristics of the OH-6A helicopter were not degraded by removal of all fairings (paras 19-26).

RECOMMENDATIONS

32. It is recommended that the data pertaining to the reduced performance of the OH-6A with fairings removed be included in TM 55-1520-214-10.

APPENDIX I. REFERENCES

1. Message, USAAVSCOM, AMSAV-ER, unclas, subject, Test Directive, "OH-6A Evaluation Tests with Fairings Removed," 27 December 1967.

2. Technical Manual, TM 55-1520-214-10, *Helicopter Observation OH-6A (Hughes)*, January 1967.

3. Specification, HTC-AD-369-Y-8011, Hughes Tool Company, Aircraft Division, *Detail Specification for a Single Engine, Single-Main-Rotor, Light Observation Helicopter Army Model Designation OH-6A*, 25 September 1967.

4. Specification, Allison Division of General Motors Corporation, *Model Specification No. 580-F, Amendment No. 1, Model T63-A-5A*, 18 August 1965.

5. Final Report, USAAVNTA, Project Nos 65-37 and 65-41, *Engineering Flight Test (Product Improvement Test) of Production OH-6A Helicopter, Unarmed and Armed with XM-27E1 Weapon System, Phase D*, March 1968.

6. Final Report, USAASTA, Project No. 67-13, *Engineering Flight Test of the Light Observation Helicopter (LOH) OH-6A*, December 1967.

7. Military Specification, MIL-H-8501A, *Helicopter Flying and Ground Handling Qualities, General Requirements For*, 3 April 1962.

APPENDIX II. TEST DATA

FIGURE 1
AIRSPEED CALIBRATION
OH-6A S/N 65-12927
CLEAN CONFIGURATION
BOOM SYSTEM

DENSITY ALTITUDE FT	GROSS WEIGHT LB	ROTOR SPEED RPM	C.G. LOCATION LONG IN	C.G. LOCATION LAT	FLIGHT CONDITION
2320	2260	483	100.3 (Mid)	0 (Mid)	Level Flight

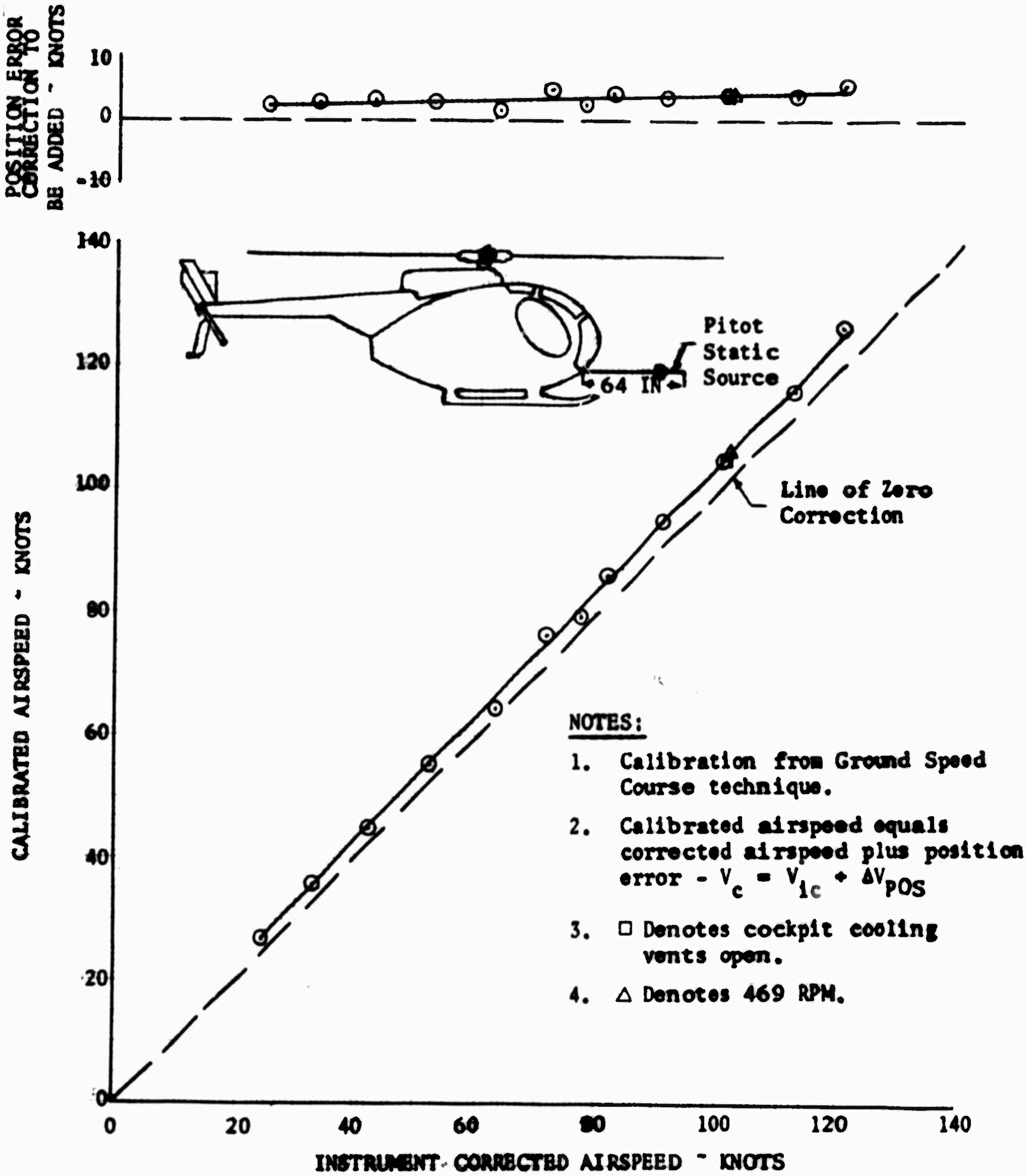
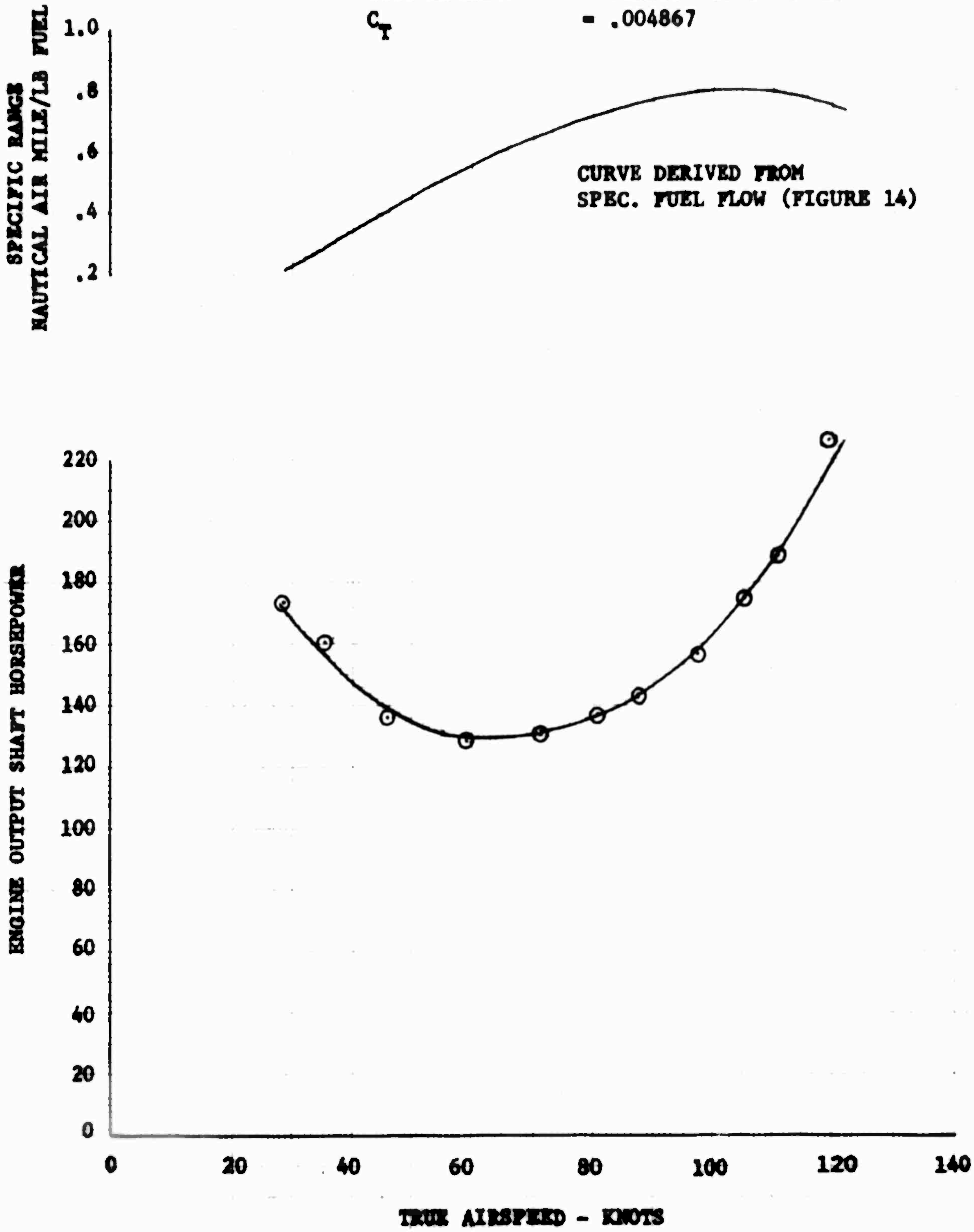


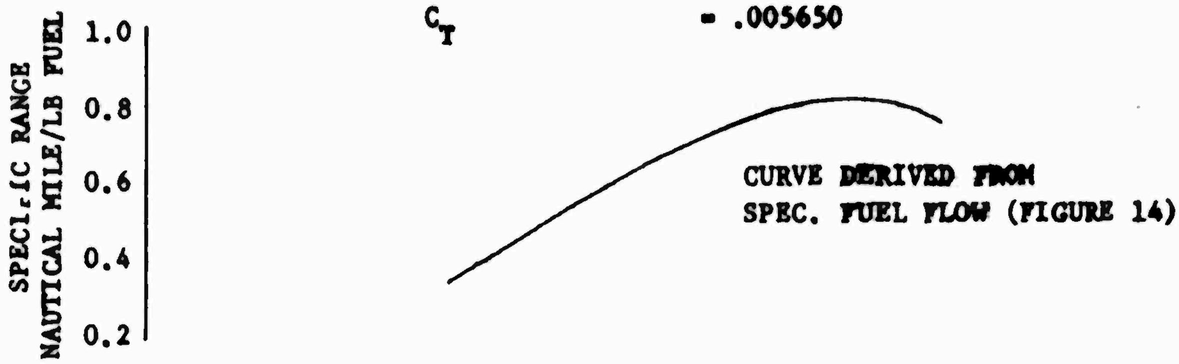
FIGURE 2
LEVEL FLIGHT PERFORMANCE
OH-6A S/N 65-12927
CLEAN CONFIGURATION

GROSS WEIGHT = 2410 LB
DENSITY ALTITUDE = 5000 FT
ROTOR SPEED = 483 RPM
C.G. LOCATION = STATION 100.0 (MID)
C_T = .004867



LEVEL FLIGHT PERFORMANCE
OH-6A S/N 65-12927
CLEAN CONFIGURATION

GROSS WEIGHT	= 2398 LB
DENSITY ALTITUDE	= 10,000 FT
ROTOR SPEED	= 483 RPM
C.G. LOCATION	= STATION 100.0 (MID)
C_T	= .005650



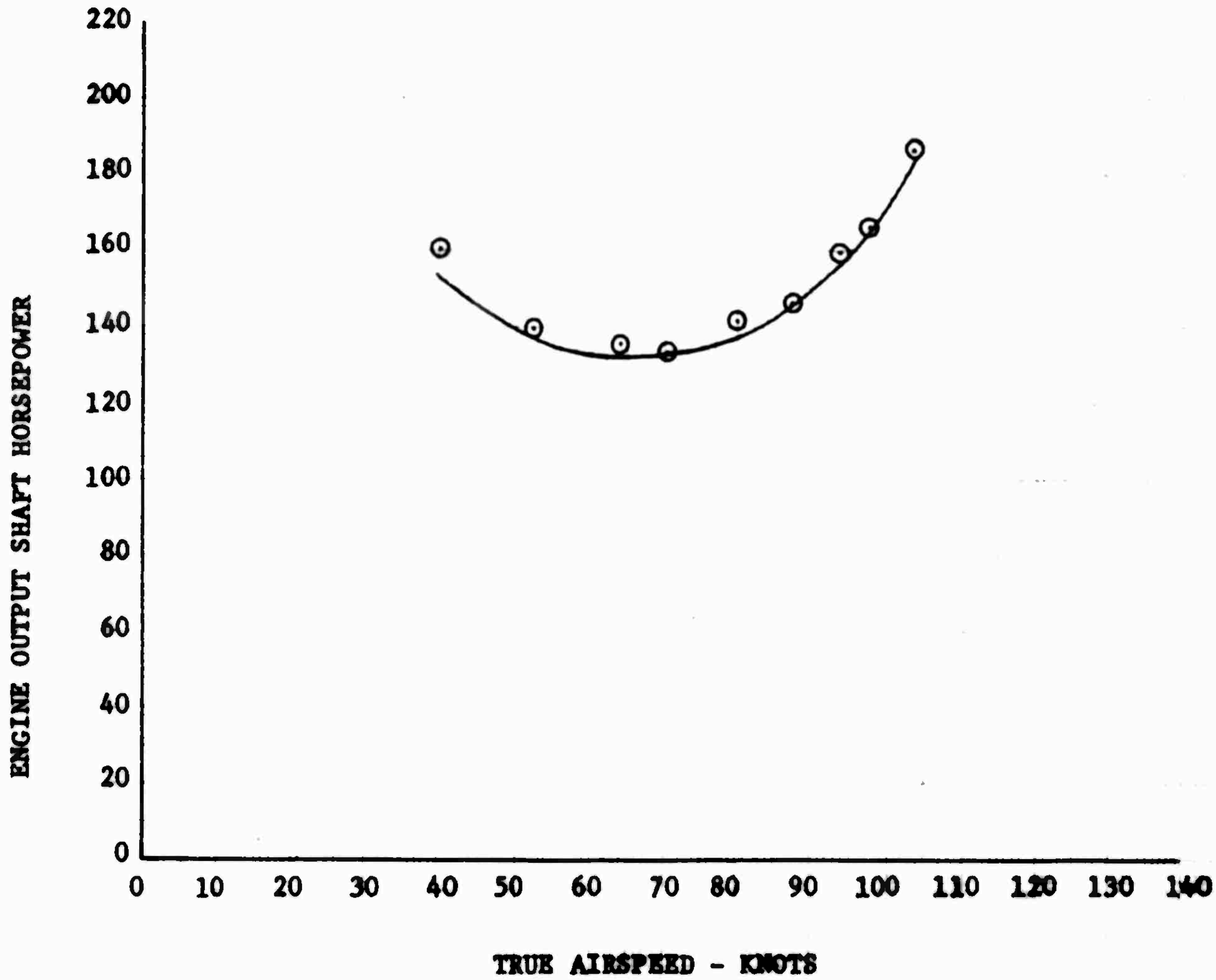


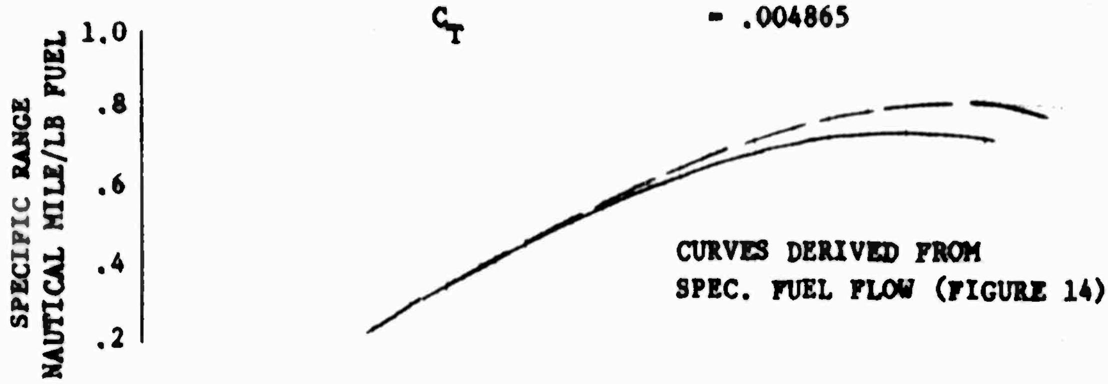
FIGURE 4

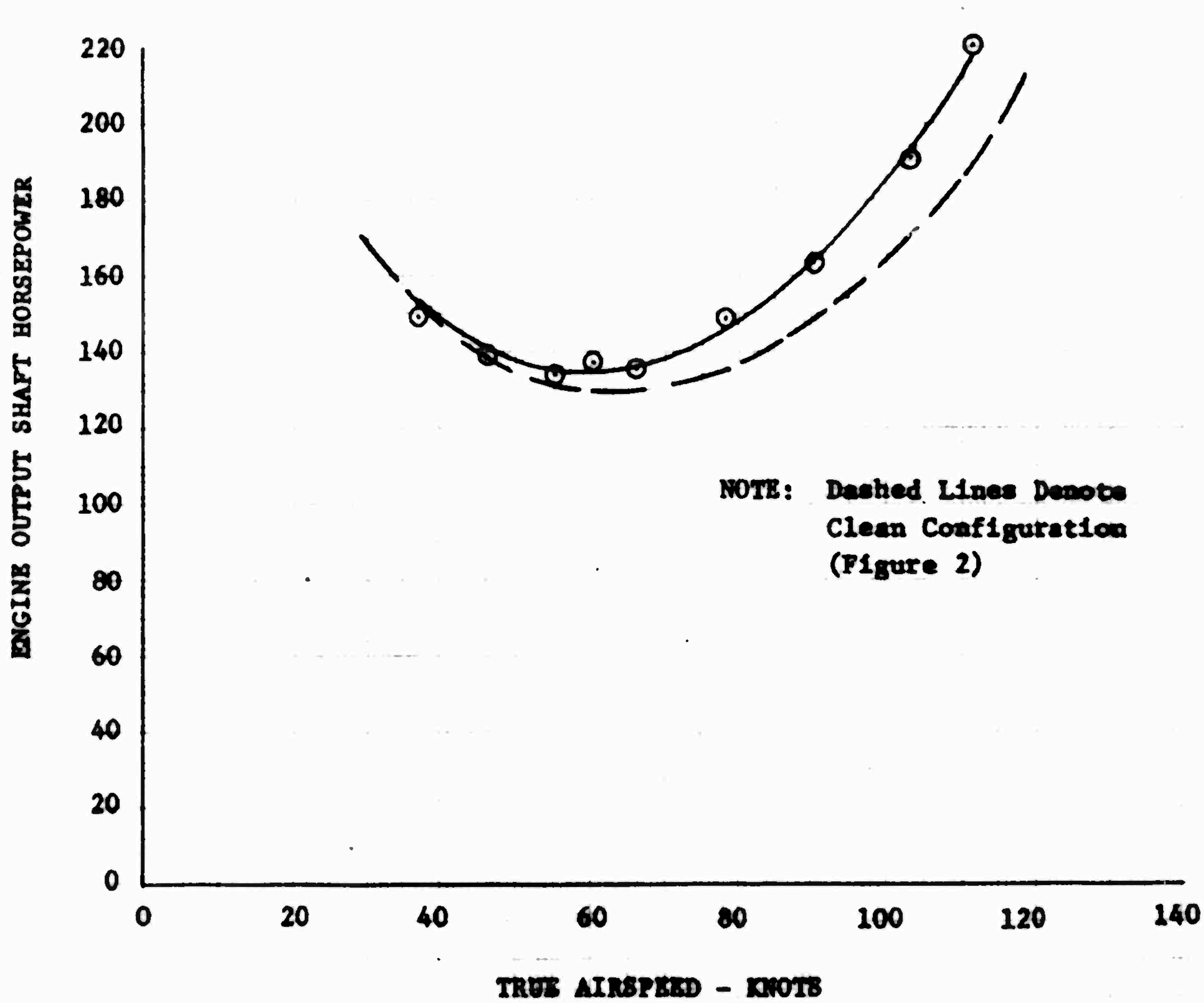
LEVEL FLIGHT PERFORMANCE

OH-6A S/N 65-12927

ALL FAIRINGS REMOVED

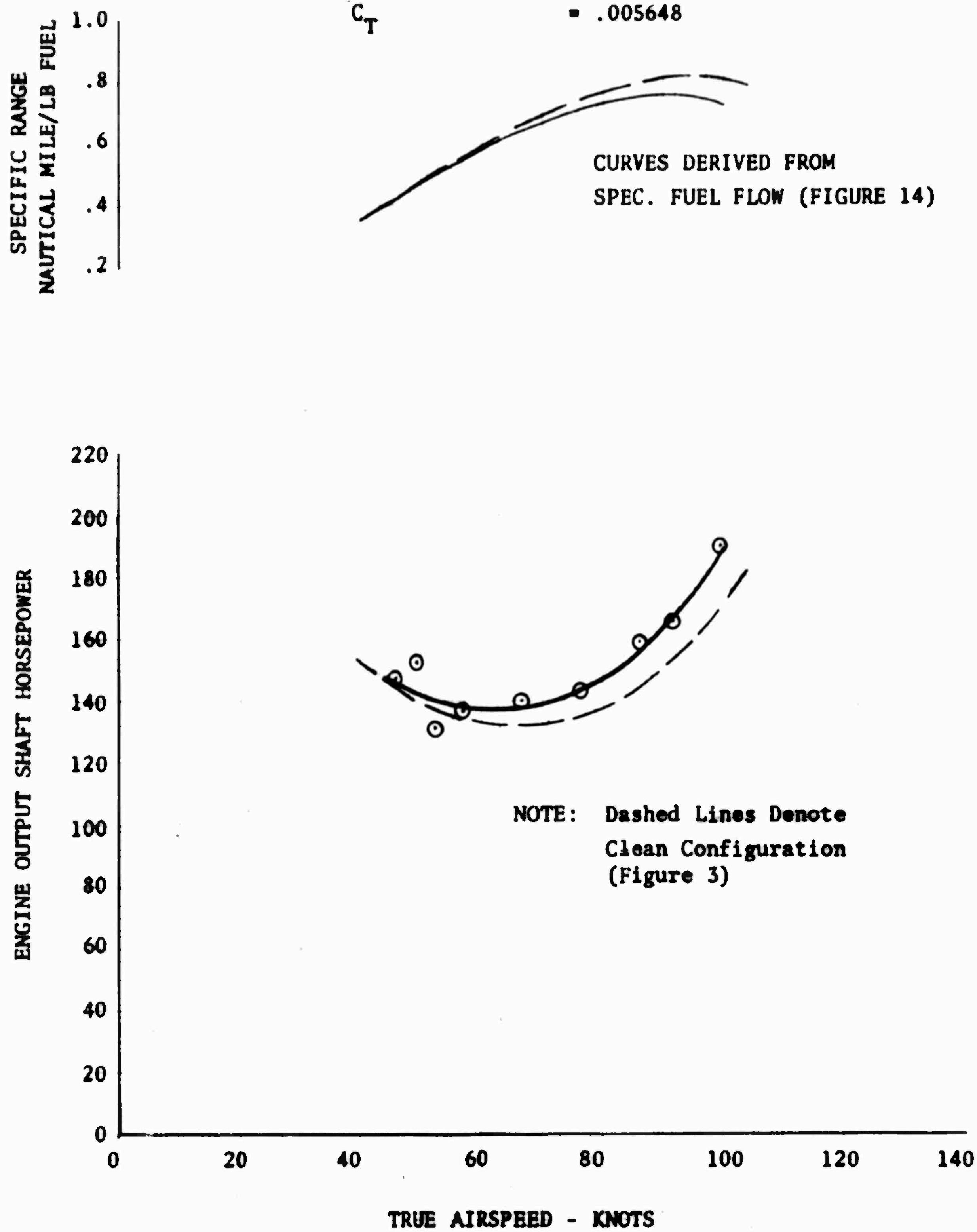
GROSS WEIGHT	=	2409 LB
DENSITY ALTITUDE	=	5000 FT
ROTOR SPEED	=	483 RPM
C.G. LOCATION	=	STATION 100.0 (MID)
C_T	=	.004865





LEVEL FLIGHT PERFORMANCE
OH-6A S/N 65-12927
ALL FAIRINGS REMOVED

GROSS WEIGHT = 2397 LB
DENSITY ALTITUDE = 10,000 FT
ROTOR SPEED = 483 RPM
C.G. LOCATION = STATION 100.0 (MID)
C_T = .005648



LEVEL FLIGHT PERFORMANCE

OH-6A S/N 65-12927

LOWER ANTI-COLLISION LIGHT COVER REMOVED

GROSS WEIGHT = 2403 LB
DENSITY ALTITUDE = 5000 FT
ROTOR SPEED = 483 RPM
C.G. LOCATION = STATION 100.0 (MID)
C_T = .004853

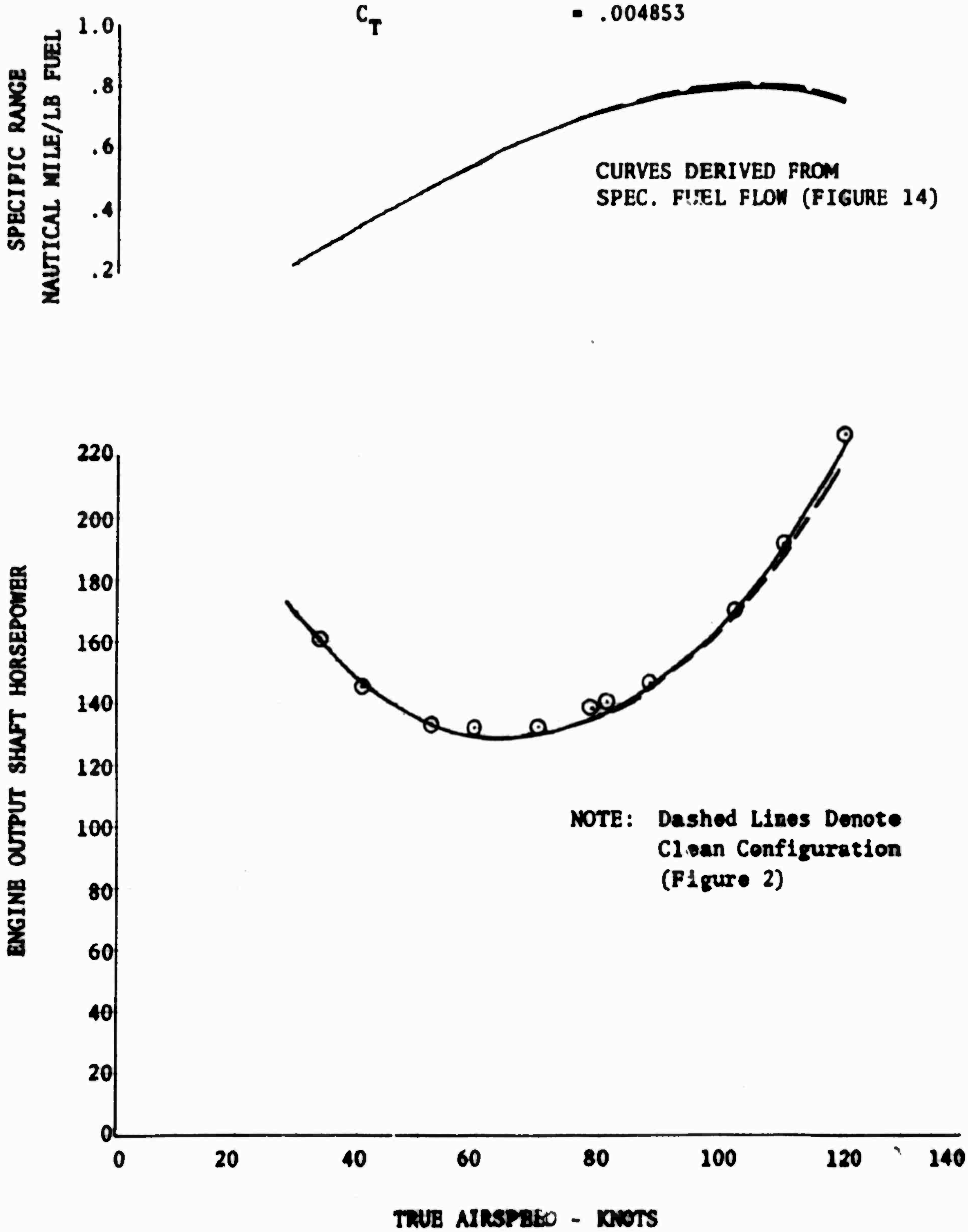


FIGURE 7
LEVEL FLIGHT PERFORMANCE
OH-6A S/N 65-12927
LOWER ANTI-COLLISION LIGHT COVER REMOVED

GROSS WEIGHT = 2381 LB
DENSITY ALTITUDE = 10,000 FT
ROTOR SPEED = 483 RPM
C.G. LOCATION = STATION 100.0 (MID)
C_T = .005611

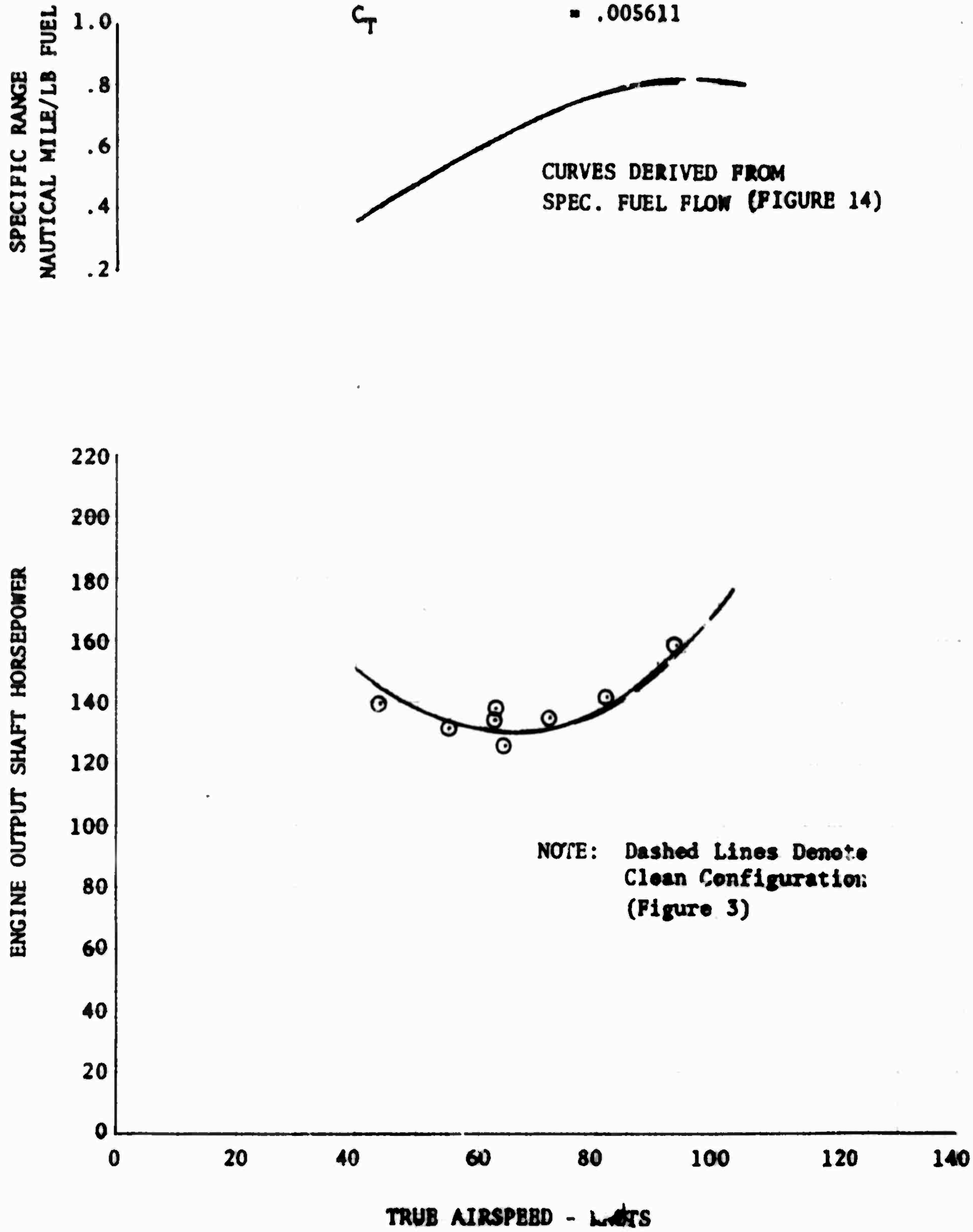
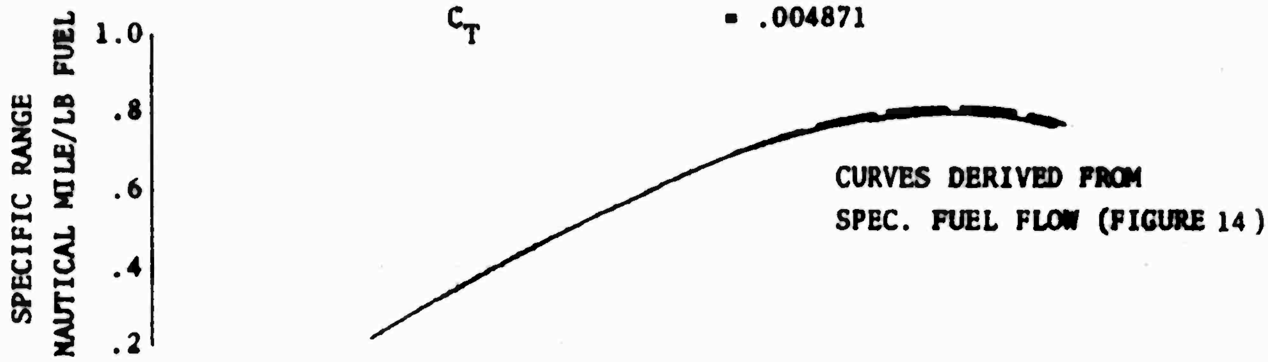


FIGURE 8
LEVEL FLIGHT PERFORMANCE
OH-6A S/N 65-12927
MAIN ROTOR BLADE ROOT END FAIRINGS REMOVED

GROSS WEIGHT = 2412 LB
DENSITY ALTITUDE = 5000 FT
ROTOR SPEED = 483 RPM
C.G. LOCATION = STATION 100.0 (MID)
C_T = .004871



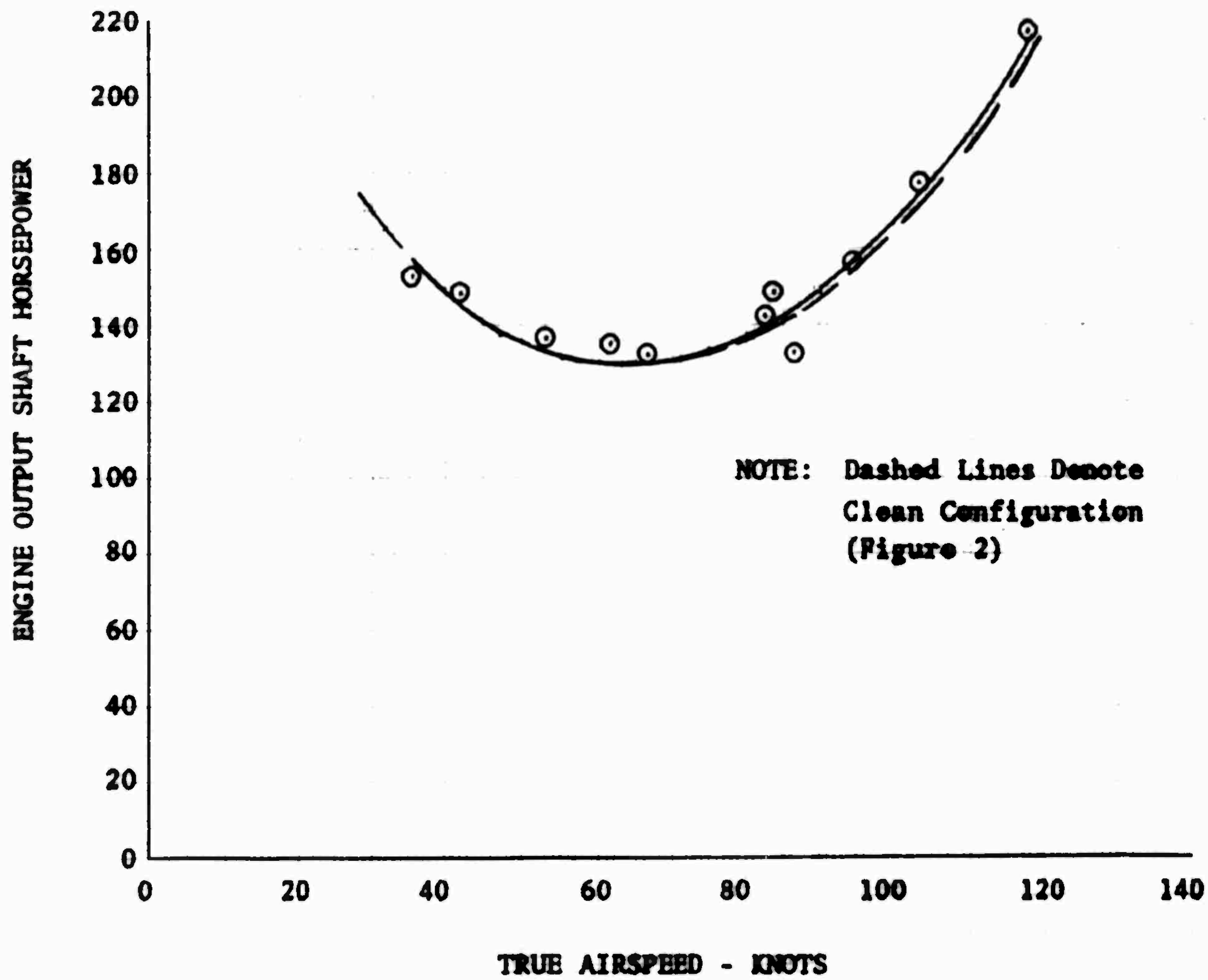


FIGURE 9

LEVEL FLIGHT PERFORMANCE

OH-6A S/N 65-12927

MAIN ROTOR BLADE ROOT END FAIRINGS REMOVED

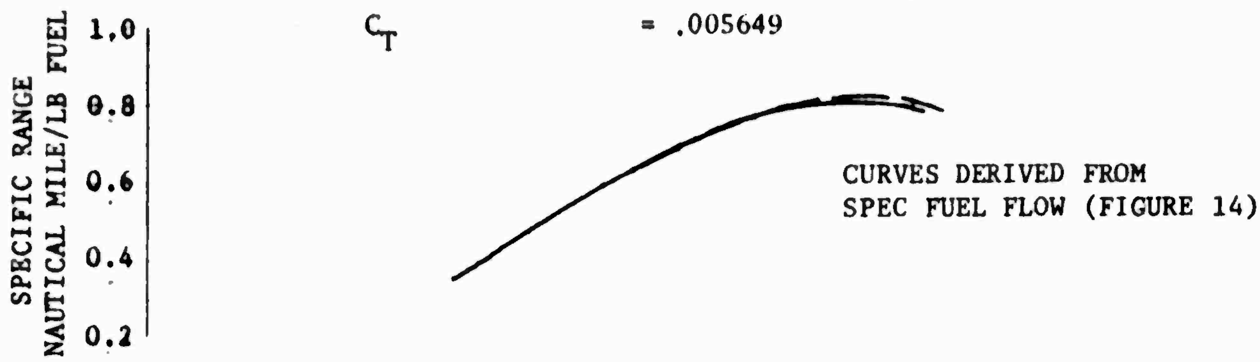
GROSS WEIGHT = 2397 lb

DENSITY ALTITUDE = 10,000 ft

ROTOR SPEED = 483 rpm

C. G. LOCATION = STATION 100.0 (MID)

C_T = .005649



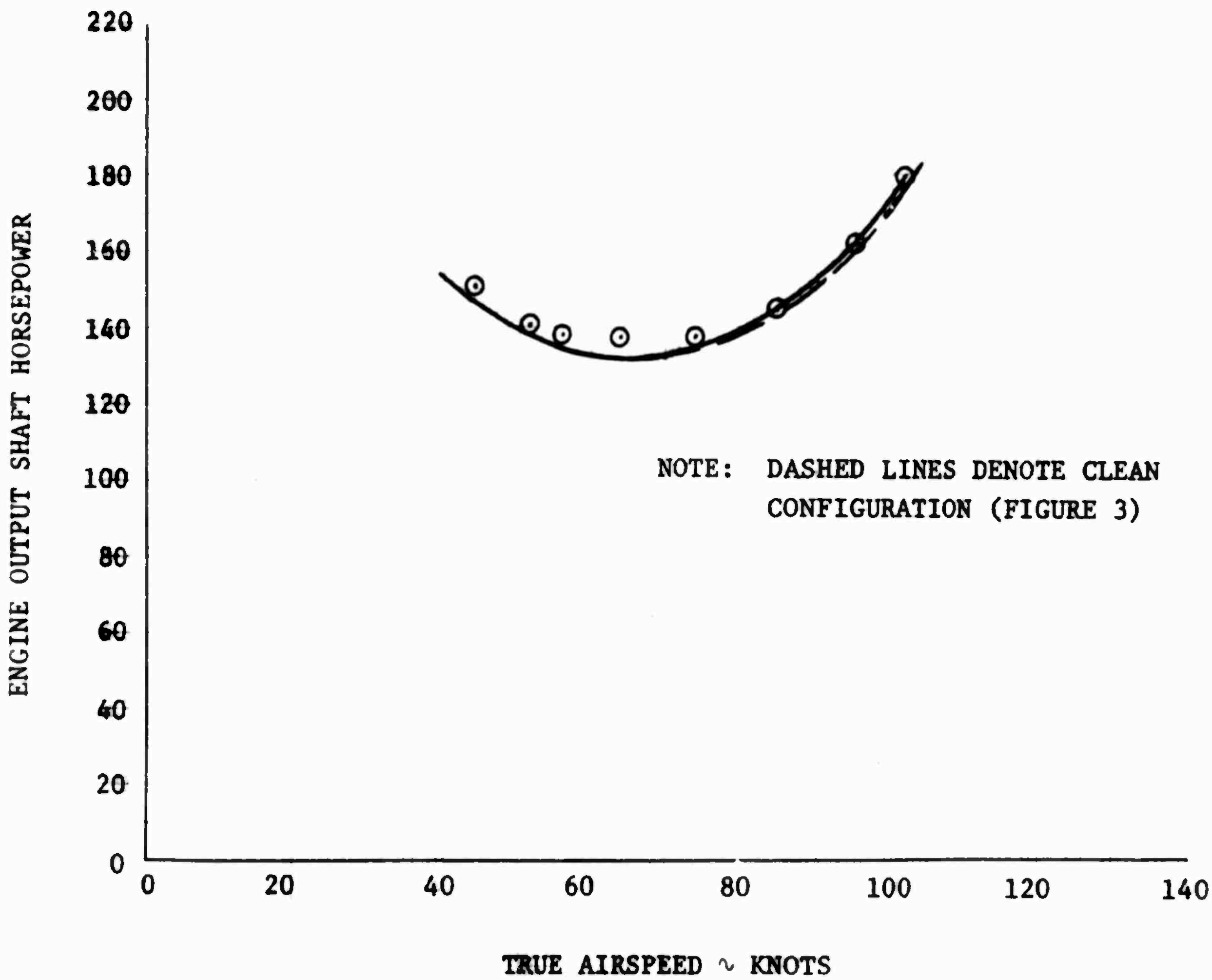


FIGURE 10
LEVEL FLIGHT PERFORMANCE
OH-6A S/N 65-12927
MAIN ROTOR CENTER HUB FAIRING REMOVED

GROSS WEIGHT = 2396 LB
DENSITY ALTITUDE = 5000 FT
ROTOR SPEED = 483 RPM
C.G. LOCATION = STATION 100.0 (MID)
C_T = .004839

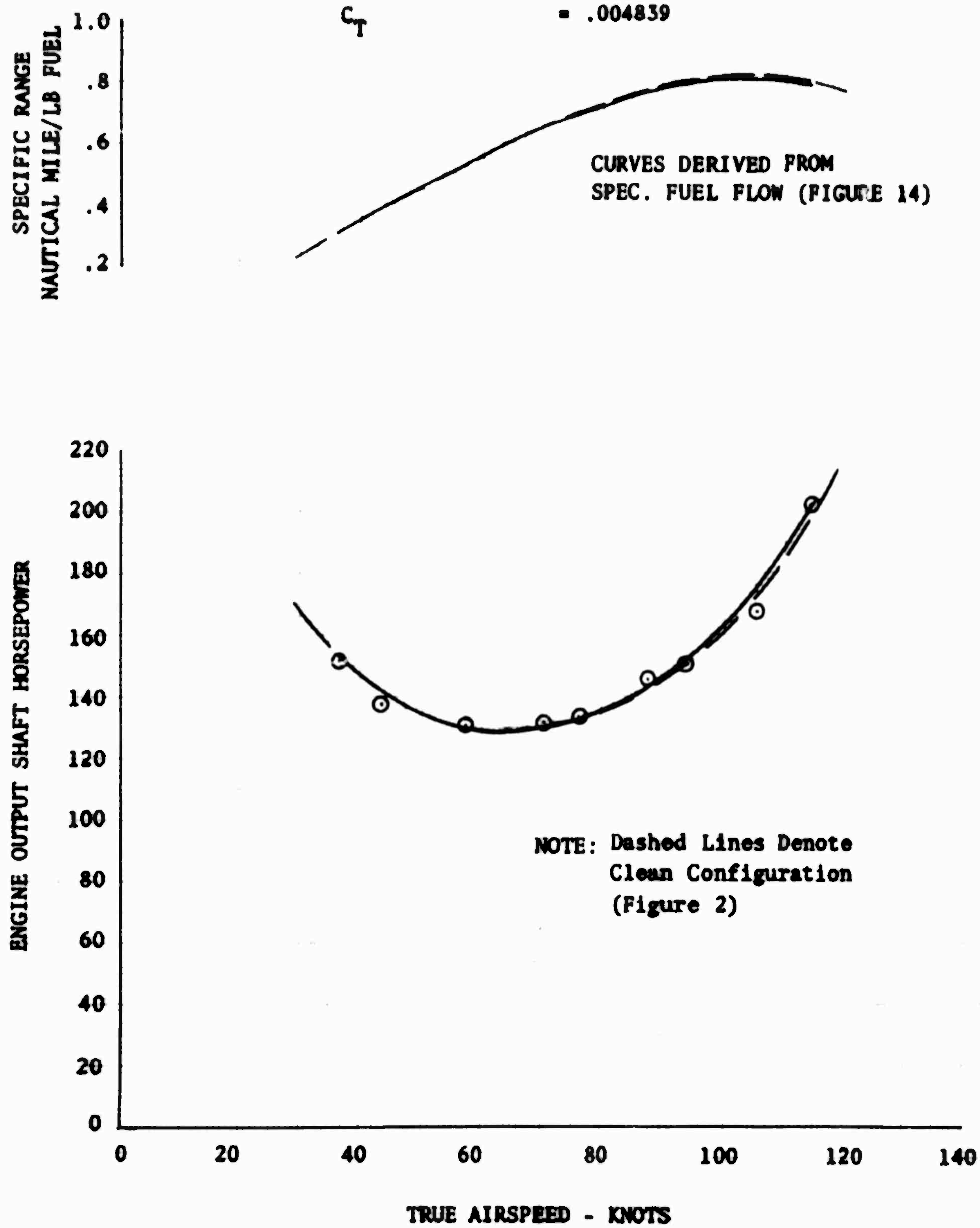
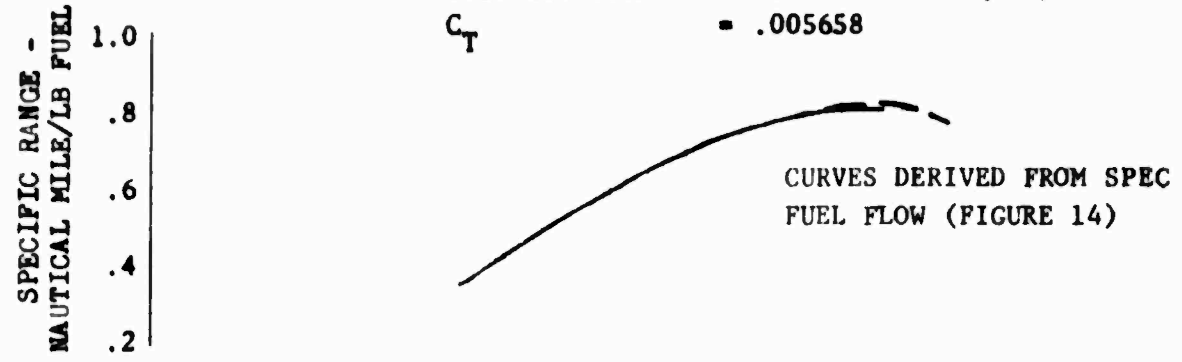


FIGURE 11
LEVEL FLIGHT PERFORMANCE
OH-6A S/N 65-12927
MAIN ROTOR CENTER HUB FAIRING REMOVED

GROSS WEIGHT = 2401 LB
DENSITY ALTITUDE = 10,000 FT
ROTOR SPEED = 483 RPM
C.G. LOCATION = STATION 100.0 (MID)
C_T = .005658



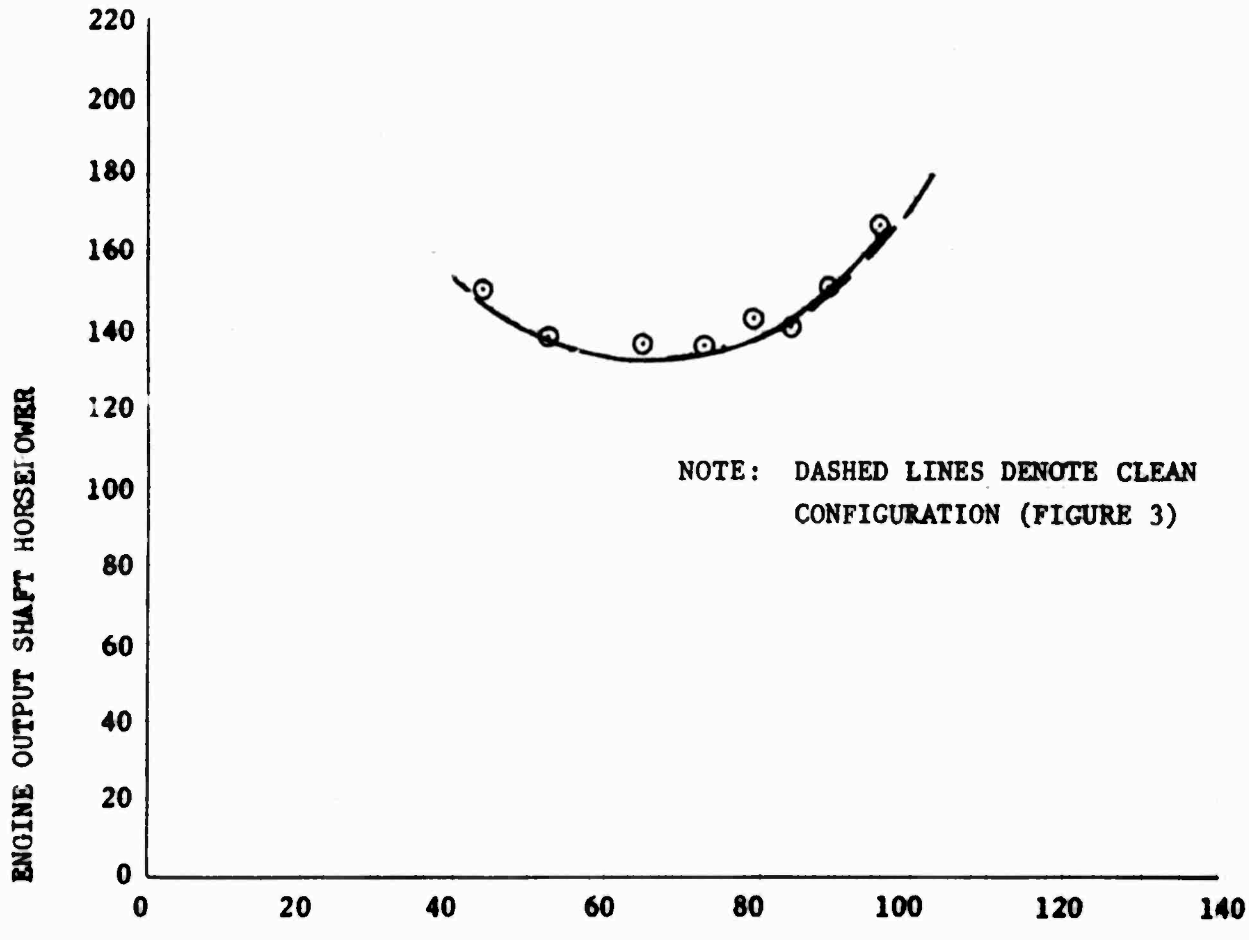


FIGURE 12

LEVEL FLIGHT PERFORMANCE

OH-6A S/N 65-12927

LANDING GEAR STRUT FAIRINGS REMOVED

GROSS WEIGHT = 2406 lb
DENSITY ALTITUDE = 5000 ft
ROTOR SPEED = 483 rpm
C. G. LOCATION = STATION 100.0 (MID)
C_T = .004858

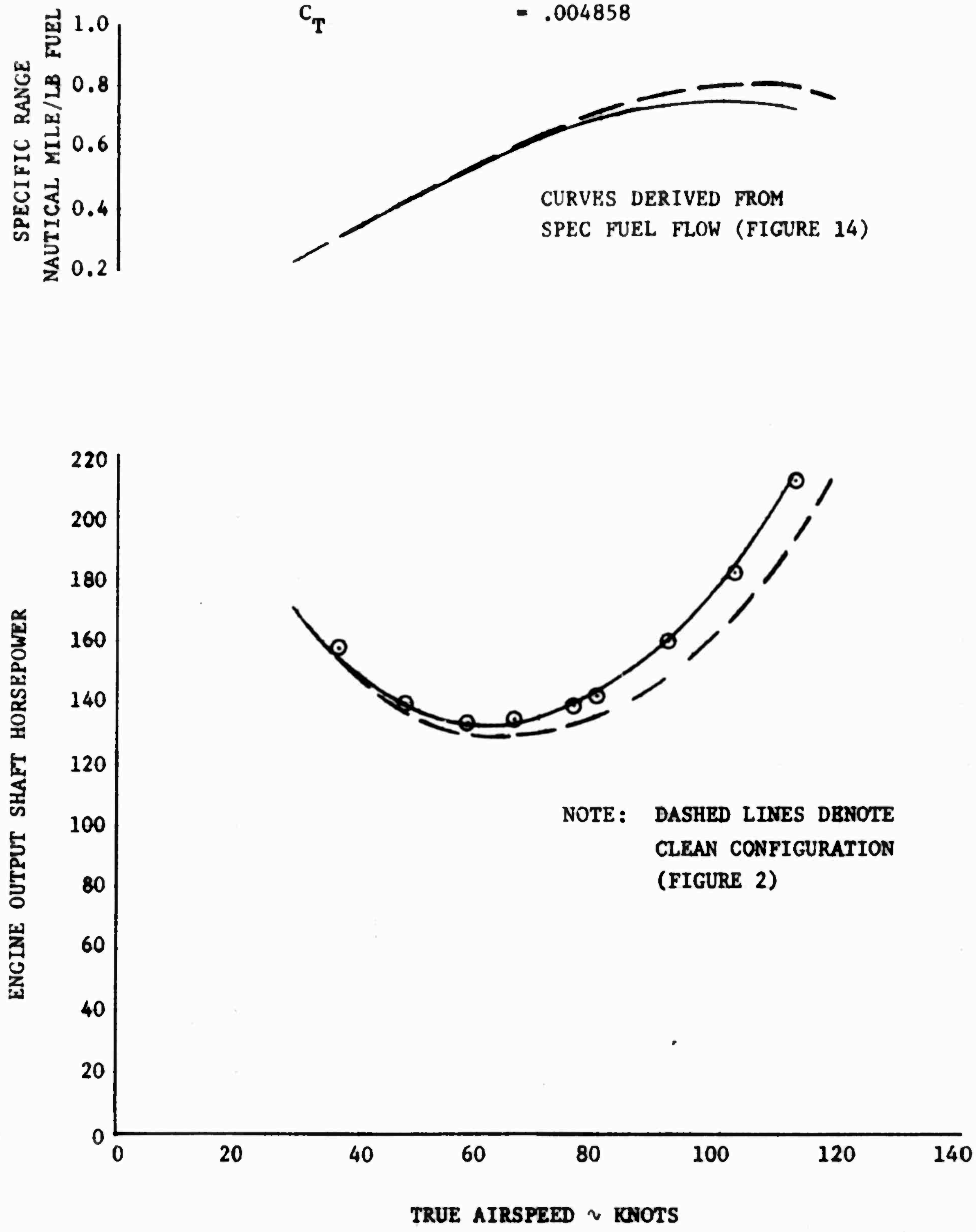


FIGURE 15

LEVEL FLIGHT PERFORMANCE

OH-6A S/N 65-12927

LANDING GEAR STRUT FAIRINGS REMOVED

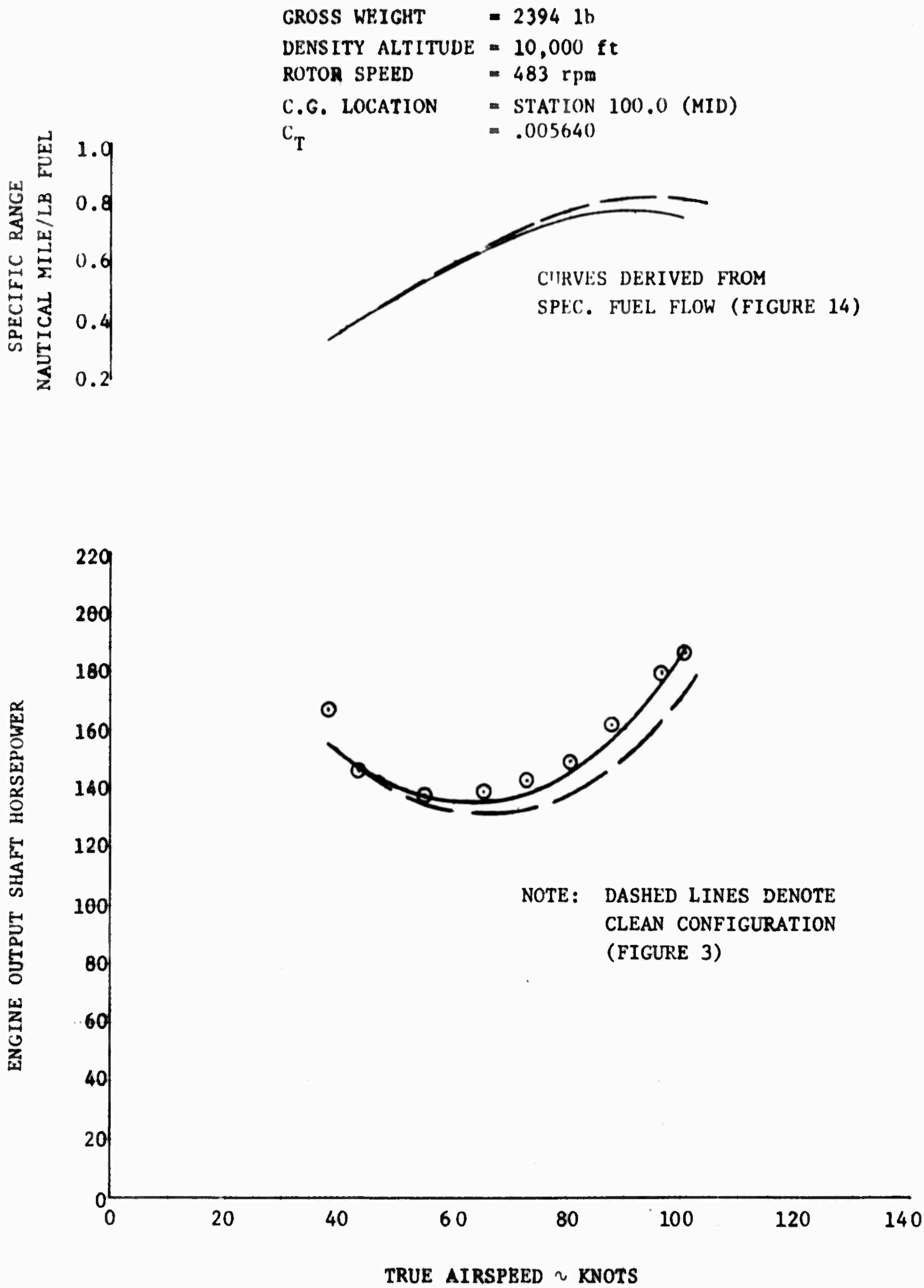
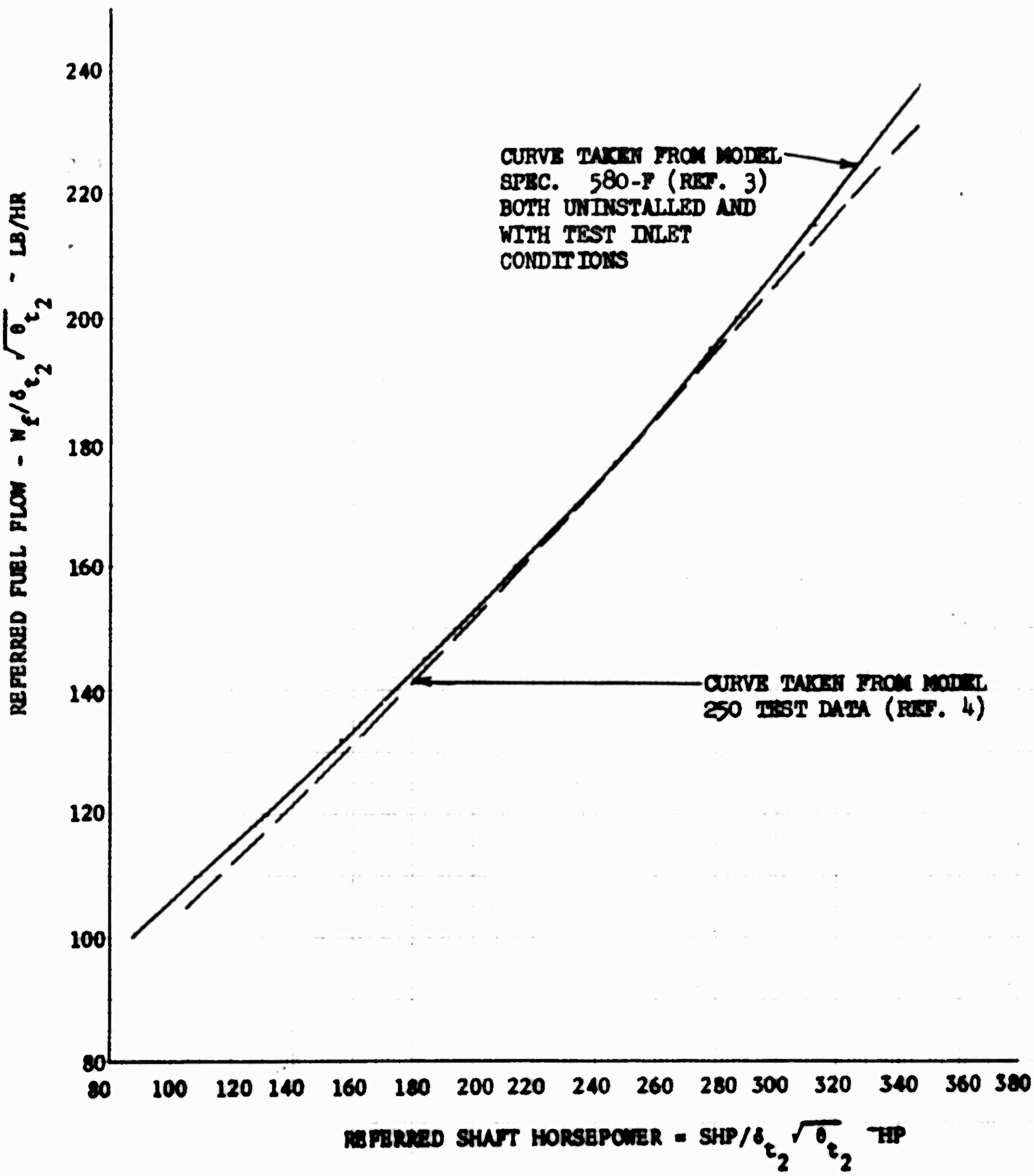
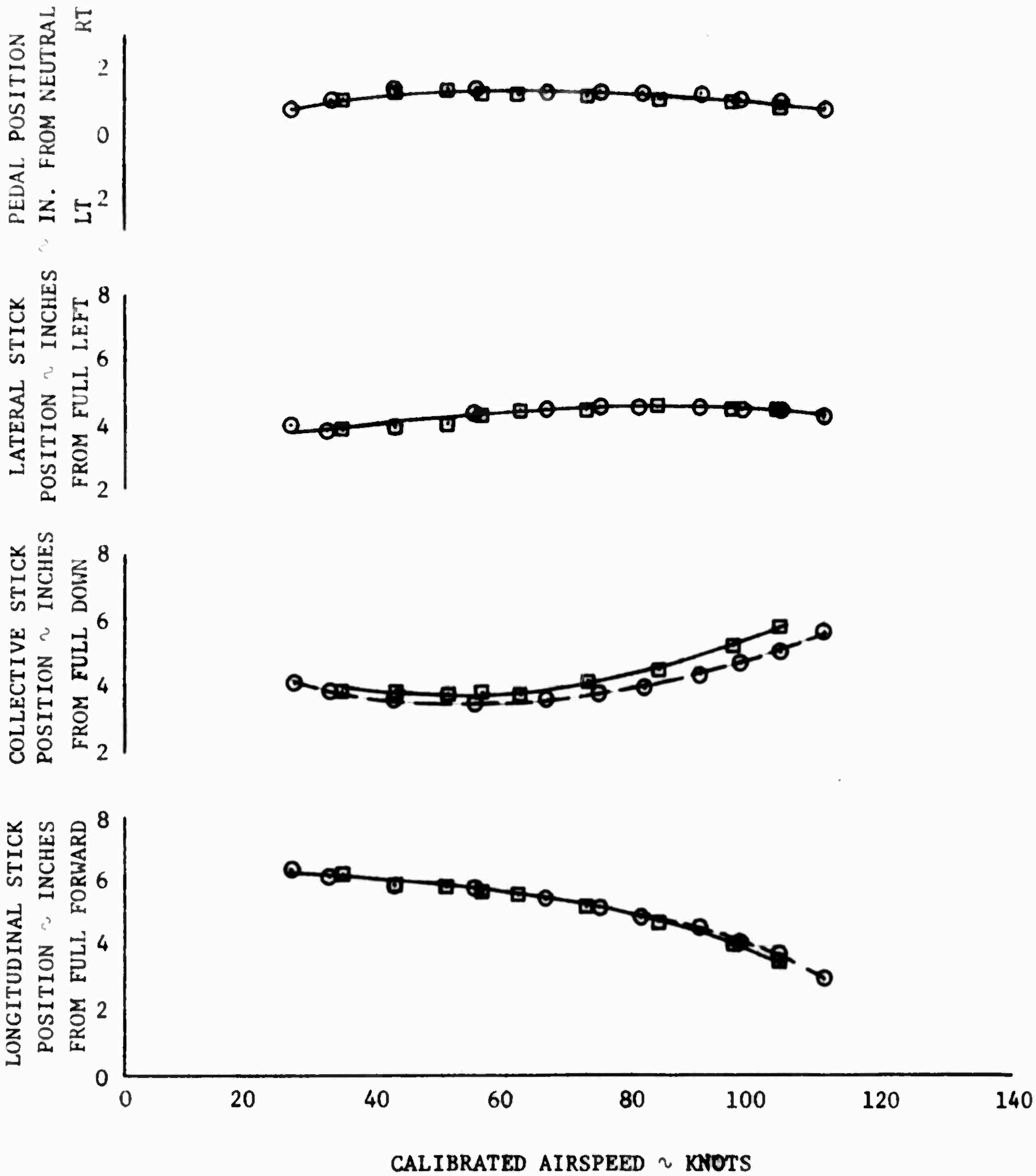


FIGURE 24
ENGINE CHARACTERISTICS
OH-6A S/N 65-12927
T63-A-5A



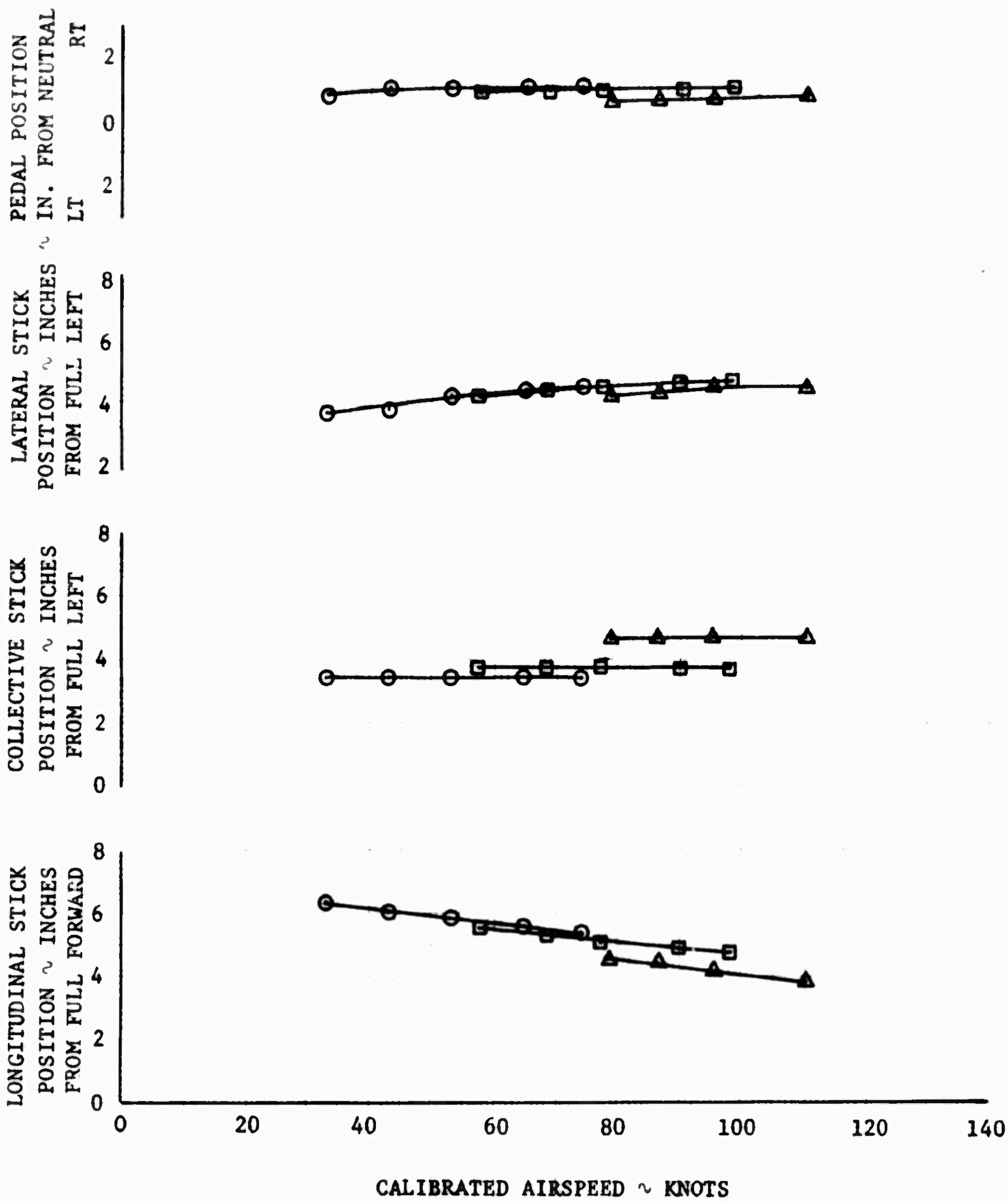
CONTROL POSITIONS IN FORWARD FLIGHT
OH-6A S/N 65-12927
LEVEL FLIGHT

SYMBOL	DENSITY ALTITUDE (FT)	GROSS WEIGHT (LB)	ROTOR SPEED (RPM)	C.G. LOCATION (IN.)	CONFIGURATION
○	4870	2410	483	100.0 (MID)	CLEAN
□	4980	2400	483	100.0 (MID)	ALL FAIRINGS REMOVED



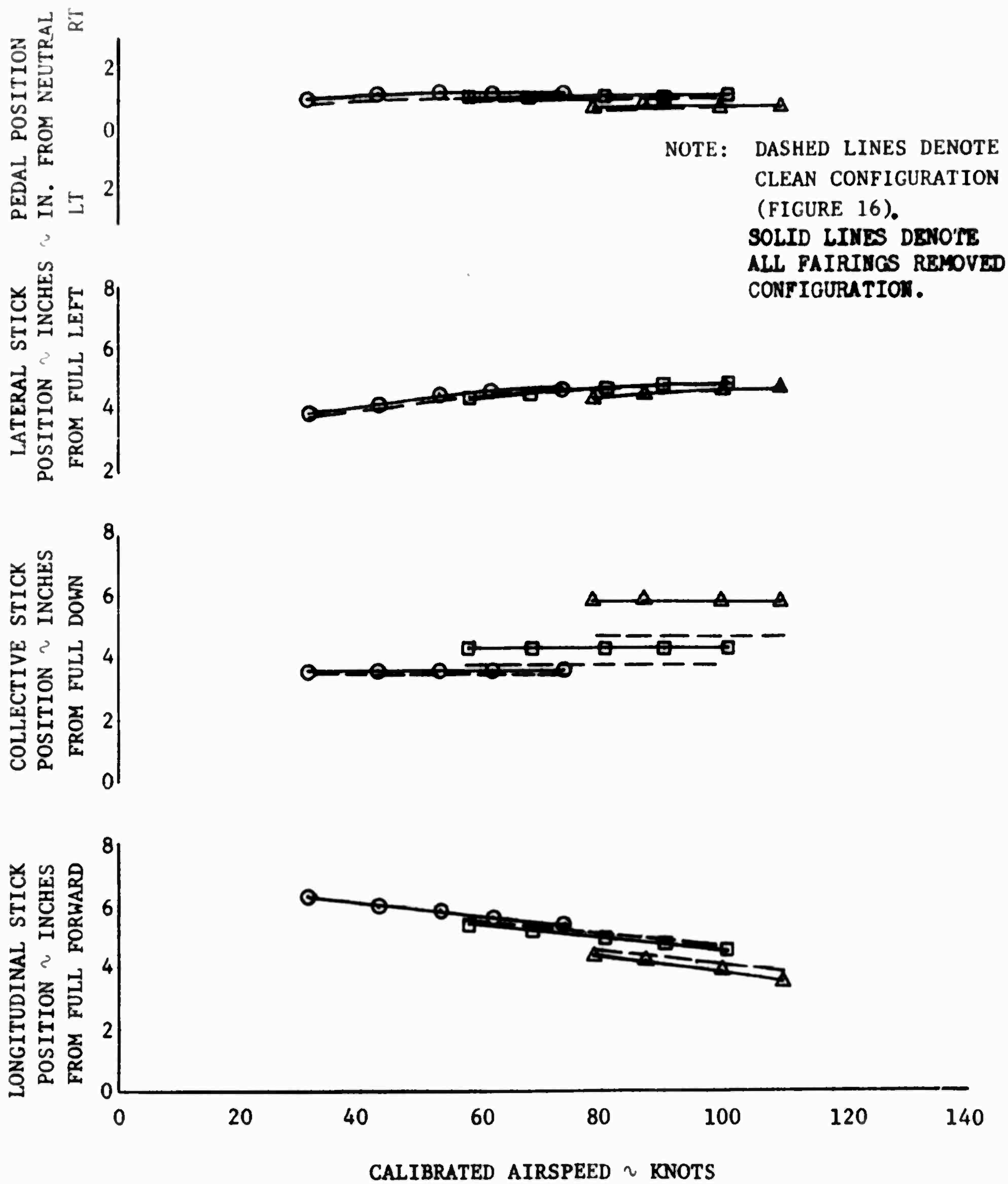
STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY
OH-6A S/N 65-12927
CLEAN CONFIGURATION

SYMBOL	TRIM AIRSPEED (KCAS)	DENSITY ALTITUDE (FT)	GROSS WEIGHT (LB)	ROTOR SPEED (RPM)	C.G. LOCATION (IN.)
O	53.0	5050	2410	483	100.0 (MID)
□	77.3	5090	2430	483	100.0 (MID)
△	95.3	5480	2390	483	100.0 (MID)



STATIC LONGITUDINAL COLLECTIVE-FIXED STABILITY
OH-6A S/N 65-12927

SYMBOL	TRIM AIRSPEED (KCAS)	DENSITY ALTITUDE (FT)	GROSS WEIGHT (LB)	ROTOR SPEED (RPM)	C.G. LOCATION (IN.)
O	53.0	5220	2350	483	100.0 (MID)
□	80.5	4800	2410	483	100.0 (MID)
△	99.3	5360	2380	483	100.0 (MID)



STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A S/N 65-12927
CLEAN CONFIGURATION

SYMBOL	TRIM AIRSPEED (KCAS)	DENSITY ALTITUDE (FT)	GROSS WEIGHT (LB)	ROTOR SPEED (RPM)	C.G. LOCATION (IN.)
○	52.9	5210	2410	483	100.0 (MID)
□	78.0	5290	2430	483	100.0 (MID)
△	99.1	5300	2380	483	100.0 (MID)

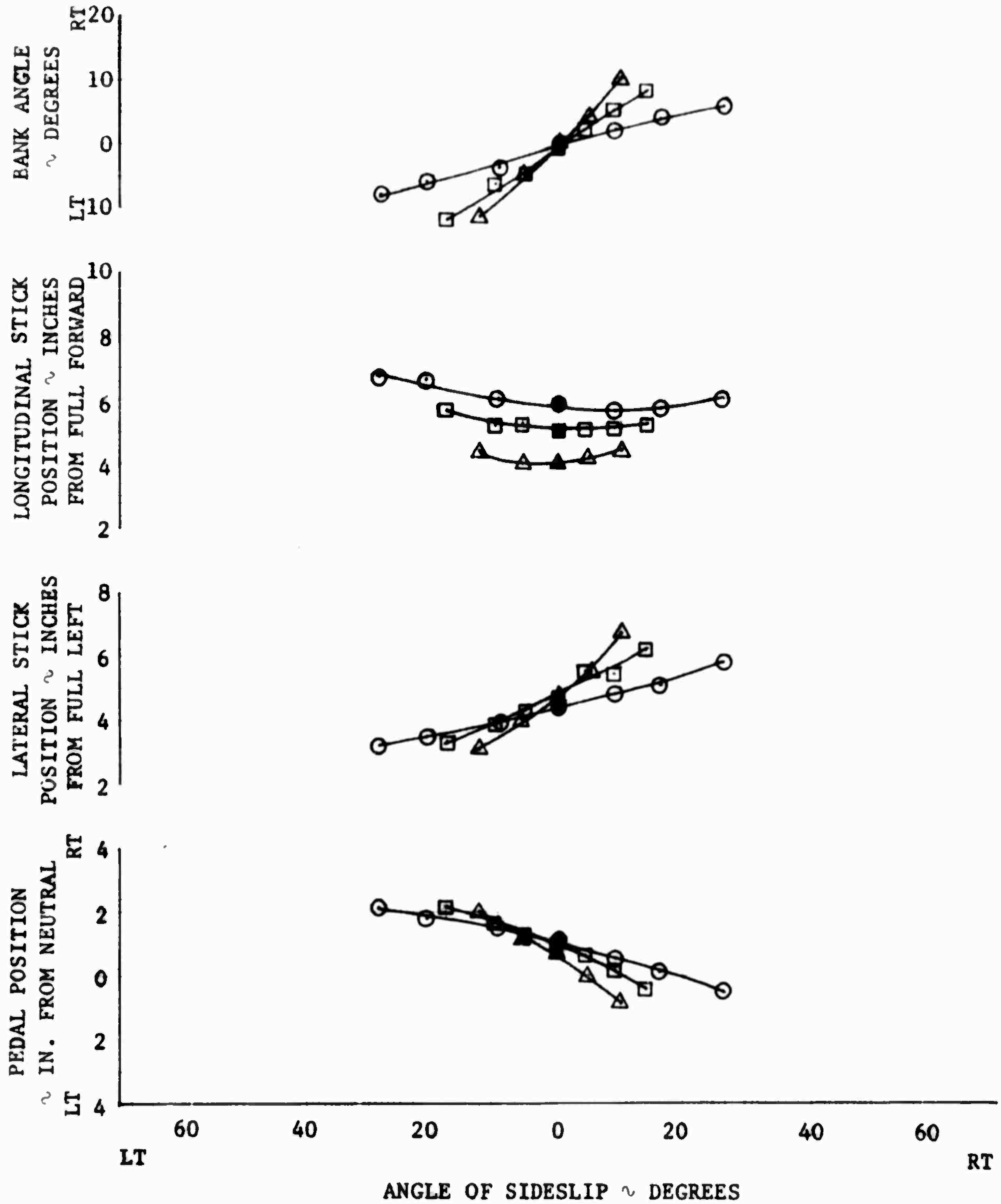
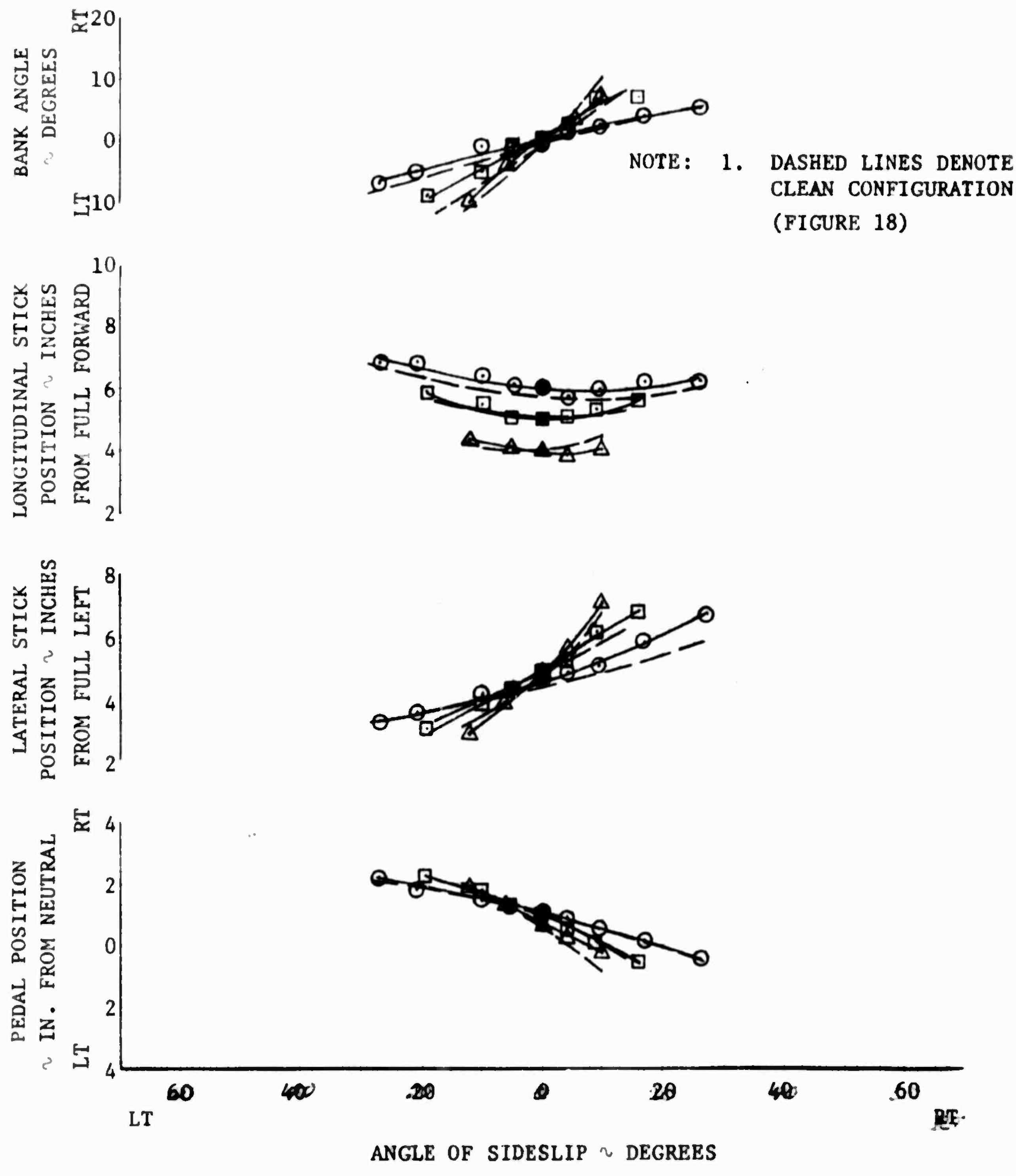


FIGURE 19
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A S/N 65-12927
ALL FAIRINGS REMOVED

SYMBOL	TRIM AIRSPEED (KCAS)	DENSITY ALTITUDE (FT)	GROSS WEIGHT (LB)	ROTOR SPEED (RPM)	C.G. LOCATION (IN.)
O	54.1	5230	2330	483	100.0 (MID)
□	76.3	5220	2420	483	100.0 (MID)
Δ	98.7	5310	2390	483	100.0 (MID)



APPENDIX III. METHODS OF TEST

AIRSPEED CALIBRATION

A level flight airspeed calibration was accomplished over a measured ground course to determine the position error of the test boom and standard airspeed system. Reciprocal headings were flown at the same indicated airspeed, and the average lapsed time was used to correct for wind velocity and direction. Pressure and temperature measurements were used to obtain the air density ratio. The basic calibration was conducted at the normal-operating rotor speed and checked at the minimum rotor speed. Variations with ground proximity, gross weight, cg location and flight region were not determined.

LEVEL FLIGHT

Level flight power required tests were conducted in the six different configurations. During each speed power flight as fuel was consumed, the altitude was adjusted so that a constant ratio of weight to density (W/ρ) was maintained. Rotor speed was also held constant so that all points on a specific curve were flown at a constant C_T. Pressure altitude, free air temperature, rotor speed, engine torque, turbine outlet temperature and fuel used were manually recorded at each stabilized level flight speed. Speed was varied incrementally throughout the allowable speed range for each flight condition. The photopanel was used to record engine characteristics, and the oscillograph data were used to establish the trim control positions.

STATIC TRIM STABILITY

Tests were conducted to determine the static longitudinal trim stability and flying qualities at a series of trim airspeeds in level flight. When the aircraft was stabilized at a given speed during level flight testing, stick positions were recorded on an oscillograph.

STATIC LONGITUDINAL COLLECTIVE-FIXED STABILITY

Static longitudinal collective-fixed stability tests were conducted to quantitatively measure the static stability characteristics and flying qualities as airspeed was varied about a trim airspeed at a fixed collective setting. The aircraft was trimmed at the desired airspeed and the collective was locked in position. Airspeed was then incrementally varied through a specified range. Cyclic and directional control was used as required to achieve the necessary airspeed changes. The control positions were recorded on an oscillograph while atmospheric data, airspeed and rotor speed were recorded manually and by a photopanel.

STATIC LATERAL-DIRECTIONAL STABILITY

The static lateral-directional stability tests were conducted to determine the static directional stability and effective dihedral characteristics at various airspeeds and sideslip angles. The aircraft was trimmed at a desired airspeed, and the collective stick was locked in position. The heading and airspeed were maintained constant while the sideslip angle was varied both right and left. Control positions and aircraft attitudes were recorded on an oscillograph for each sideslip angle. Airspeed, atmospheric data and rotor speed were also recorded.

DYNAMIC STABILITY

The dynamic stability characteristics were determined from the aircraft motions resulting from a dynamic disturbance. An external disturbance was simulated by introducing a control pulse into the individual axis being investigated. Control position was fixed on all other axes. The pulse was initiated from a trim condition and consisted of a control input of approximately 1 inch which was then maintained for ½ to 1 second. The control was then returned to the trim position and held fixed until the motion had been established or recovery action was necessary.

CONTROLLABILITY

The controllability was determined by the resulting maximum angular rates and accelerations per inch of control input. The step input was accomplished by rapidly displacing the control and maintaining this control position until the maximum rates and accelerations were reached. All other controls were held fixed during the step input. The longitudinal, lateral and directional axes were evaluated with control inputs of approximately three-quarters of an inch.

APPENDIX IV. TEST INSTRUMENTATION

A swivel-mounted pitot-static airspeed head was installed on a boom which extended approximately 5 feet in front of the nose of the helicopter. This airspeed head was used as a source for the sensitive altitude and airspeed systems. Vanes attached to the boom were used to measure angles of attack and sideslip. Sensitive instrumentation was installed to measure the following parameters:

Pilot/Engineer Panel

Boom system airspeed
Ship airspeed
Boom altitude
Outside air temperature
Rotor speed
Torquemeter pressure
Turbine outlet temperature
Turbine compressor speed
Fuel counts

Photopanel

Boom airspeed
Boom altitude
Outside air temperature
Rotor speed
Torquemeter pressure
Compressor inlet temperature
Compressor inlet pressure
Fuel counts

Oscillograph

Pitch angle
Pitch rate
Yaw angle
Yaw rate
Roll angle
Roll rate
Collective stick position
Cyclic stick position
Pedal position
Angle of attack
Angle of sideslip
CG normal acceleration
Main rotor speed

APPENDIX V. SYMBOLS & ABBREVIATIONS

Abbreviation	Definition	Unit
GRWT, grwt	Gross weight	Pounds
KCAS	Knots calibrated airspeed	Knots
KTAS	Knots true airspeed	Knots
NAMPP	Nautical air miles per pound of fuel	
RPM, rpm	Revolutions per minute	
SHP, shp	Shaft horsepower	

Symbol	Definition	Unit
CG, cg	Center of gravity	Inches
C_T	Thrust coefficient	Dimensionless
H_D	Density altitude	Feet
V_C	Knots calibrated airspeed	Knots
V_{IC}	Instrument corrected airspeed	Knots
V_{NE}	Never exceed airspeed	Knots
V_T	Knots true airspeed	Knots
W_f	Fuel flow	lb/hr
δ_{t_2}	Pressure ratio	Ratio
ΔV_{POS}	Airspeed position error	Knots
θ_{t_2}	Temperature ratio	Ratio
ρ	Density	$lb/sec^2/ft^4$

APPENDIX VI. WEIGHT & BALANCE

The test aircraft was weighed in the standard configuration (no fairings removed) after the installation of the test instrumentation. The weight and balance was conducted in a closed hangar using an electronic weighing kit. The basic weight of the aircraft with no fuel was 1528 pounds, and the center of gravity was 103.9 inches to the rear of the reference line which is 100 inches forward of the rotor center line.

Removal of the fairings did not significantly affect the weight and balance of the test aircraft. Total weight of the removed fairings was approximately 10 pounds.

APPENDIX VII. PHOTOGRAPHS

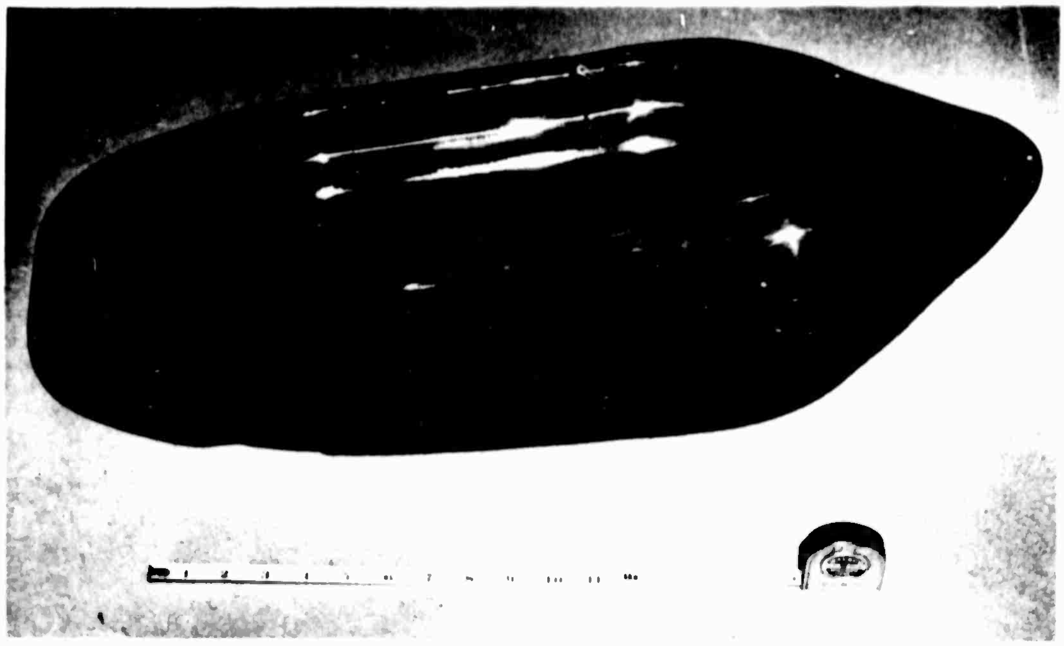


Photo 1. Lower Anti-collision Light Fairing.

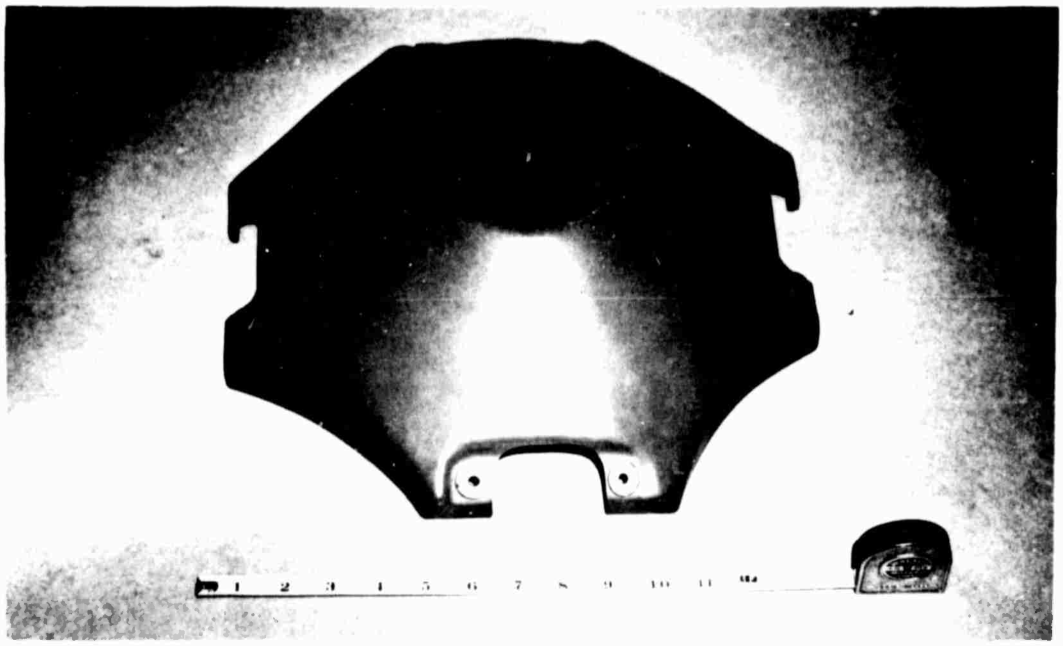


Photo 2. Main Rotor Hub Center Fairing.

Photo 3. Landing Gear Strut Fairings.

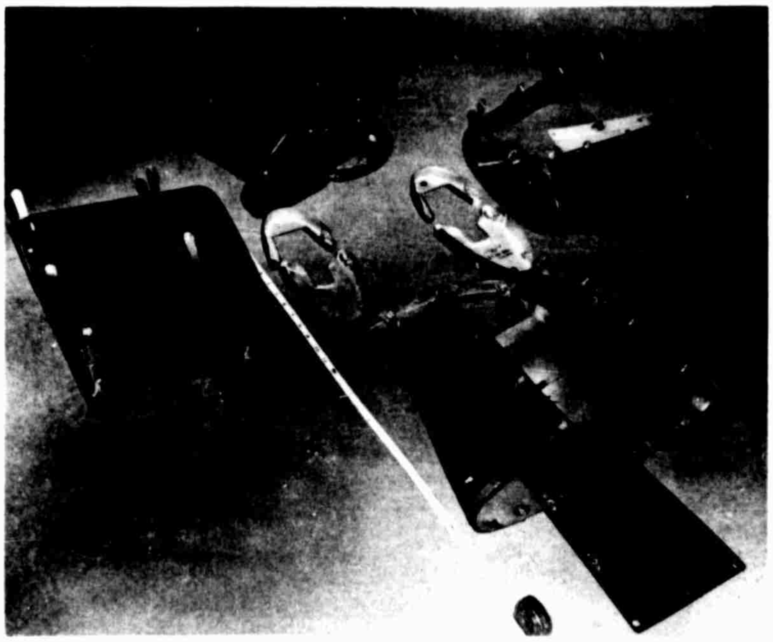


Photo 4. Main Rotor Blade Root End Fairings.

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13. ABSTRACT

Flight tests were conducted to determine the effects on performance and flying qualities with various fairings removed from the OH-6A helicopter. The fairings removed were the lower anticollision light cover, the main rotor blade root end fairings, the main rotor center hub fairing and the landing gear strut fairings. Individually removing the lower anticollision light cover, the main rotor blade root end fairings and the main rotor center hub fairing did not significantly affect the performance of the helicopter; however, removing the landing gear strut fairings resulted in a definite decrease in performance. The performance in the all fairings removed configuration was also significantly decreased. Stability and control tests were conducted in the all fairings removed configuration. Slight changes in control positions were evident but no major effects on flying qualities were observed. From a performance and flying qualities standpoint, it is feasible to operate the helicopter with these fairings removed. Although the performance changes are relatively small, allowances should be made in mission planning for all fairings removed and skid strut fairings removed configurations. If normal operations are to be conducted in these configurations, the data contained in this report should be included in TM 55-1520-214-10.

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KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Determine effects						
Performance						
Flying qualities						
Fairings removed						
OH-6A helicopter						
Lower anticollision light cover						
Blade root end						
Center hub						
Landing gear strut						
Performance decreased						
Fairings removed operation feasible						