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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.
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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 (Hp), 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 antitorision 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.
11. The chronology of the tests is as follows:

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Directive received</td>
<td>27 December 1967</td>
</tr>
<tr>
<td>Test aircraft received</td>
<td>16 February 1968</td>
</tr>
<tr>
<td>Test started</td>
<td>21 March 1968</td>
</tr>
<tr>
<td>Flight tests completed</td>
<td>16 May 1968</td>
</tr>
<tr>
<td>Draft report submitted</td>
<td>10 March 1969</td>
</tr>
</tbody>
</table>
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.**

<table>
<thead>
<tr>
<th>CONFIGURATION</th>
<th>Thrust Coefficient 1 (C_f)</th>
<th>Increase in Lift Flat Flat. Area</th>
<th>Test Par.</th>
<th>Recommended Par.</th>
<th>Test Par.</th>
<th>Recommended Par.</th>
<th>Range</th>
<th>50% Maximum Specific Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density Altitude (ft)</td>
<td>(5000) (10,000)</td>
<td>N/A</td>
<td>(w/rd)</td>
<td>(w/rd)</td>
<td>(d/rd)</td>
<td>(w/rd)</td>
<td>(ft)</td>
<td>(ft)</td>
</tr>
<tr>
<td>All Fairings Removed</td>
<td>.004865 .005648</td>
<td>2.96</td>
<td>1.09</td>
<td>1.10</td>
<td>1.09</td>
<td>0.62</td>
<td>0.65</td>
<td>0.62</td>
</tr>
<tr>
<td>Standard</td>
<td>.004865 .005648</td>
<td>2.96</td>
<td>1.09</td>
<td>1.10</td>
<td>1.09</td>
<td>0.62</td>
<td>0.65</td>
<td>0.62</td>
</tr>
<tr>
<td>Skid Strut Fairings Removed</td>
<td>.004858 .005648</td>
<td>1.77</td>
<td>0.69</td>
<td>0.70</td>
<td>0.69</td>
<td>0.62</td>
<td>0.64</td>
<td>0.62</td>
</tr>
<tr>
<td>Standard</td>
<td>.004858 .005648</td>
<td>1.77</td>
<td>0.69</td>
<td>0.70</td>
<td>0.69</td>
<td>0.62</td>
<td>0.64</td>
<td>0.62</td>
</tr>
<tr>
<td>Blade Root Fairings Removed</td>
<td>.004871 .005649</td>
<td>0.25</td>
<td>0.99</td>
<td>1.00</td>
<td>0.99</td>
<td>0.62</td>
<td>0.64</td>
<td>0.62</td>
</tr>
<tr>
<td>Standard</td>
<td>.004871 .005649</td>
<td>0.25</td>
<td>0.99</td>
<td>1.00</td>
<td>0.99</td>
<td>0.62</td>
<td>0.64</td>
<td>0.62</td>
</tr>
<tr>
<td>Center Hub Fairing Removed</td>
<td>.004839 .005658</td>
<td>0.15</td>
<td>0.95</td>
<td>1.00</td>
<td>0.95</td>
<td>0.62</td>
<td>0.64</td>
<td>0.62</td>
</tr>
<tr>
<td>Standard</td>
<td>.004839 .005658</td>
<td>0.15</td>
<td>0.95</td>
<td>1.00</td>
<td>0.95</td>
<td>0.62</td>
<td>0.64</td>
<td>0.62</td>
</tr>
<tr>
<td>Lower Light Fairing Removed</td>
<td>.004853 .005611</td>
<td>0.15</td>
<td>0.95</td>
<td>1.00</td>
<td>0.95</td>
<td>0.62</td>
<td>0.64</td>
<td>0.62</td>
</tr>
<tr>
<td>Standard</td>
<td>.004853 .005611</td>
<td>0.15</td>
<td>0.95</td>
<td>1.00</td>
<td>0.95</td>
<td>0.62</td>
<td>0.64</td>
<td>0.62</td>
</tr>
</tbody>
</table>

1Variations in C_f values are due to small variations in average gross weight.
2Recommended cruise speed is defined as the highest airspeed which results in 90 percent of the maximum range. Range calculations were made at this airspeed.
3Range 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 Hp, and the dynamic stability flights were made at a 5000-foot Hp. 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 altitude 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 altitude 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


APPENDIX II. TEST DATA
FIGURE 1
Airspeed Calibration
G Helicopter S/N 65-12927
Clean Configuration
Boom System

<table>
<thead>
<tr>
<th>Density</th>
<th>Gross Weight</th>
<th>Rotor Speed</th>
<th>C.G. Location</th>
<th>Flight Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude (ft)</td>
<td>(lb)</td>
<td>(rpm)</td>
<td>Long In</td>
<td>Lat</td>
</tr>
<tr>
<td>2320</td>
<td>2260</td>
<td>483</td>
<td>100.3</td>
<td>0</td>
</tr>
<tr>
<td>Level Flight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. Calibration from Ground Speed Course technique.
2. Calibrated airspeed equals corrected airspeed plus position error - \( V_c = V_{ic} + \Delta V_{pos} \)
3. □ Denotes cockpit cooling vents open.
4. △ Denotes 469 RPM.

**Diagram Description:**
- The graph shows the relationship between instrument-corrected airspeed and calibrated airspeed, with a line of zero correction.
- The Pitot static source is indicated, and the Pitot static source is 64 in.
- The diagram includes a table for density, gross weight, rotor speed, C.G. location, and flight condition, along with the corresponding values for altitude, weight, speed, and location.

**Additional Notes:**
- The graph is used to illustrate the calibration process for airspeed, showing how to adjust for position error and various flight conditions.
FIGURE 2
LEVEL FLIGHT PERFORMANCE
OH-6A S/N 63-12927
CLEAN CONFIGURATION

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

CURVE DERIVED FROM SPEC. FUEL FLOW (FIGURE 14)
LEVEL FLIGHT PERFORMANCE
OH-6A  S/N 63-12927
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

CURVE DERIVED FROM SPEC. FUEL FLOW (FIGURE 14)

SPECIFIC RANGE
NAUTICAL MILE/LB FUEL

ENGINE OUTPUT SHFT HORSEPOWER

TRUE AIRSPEED - KNOTS
FIGURE 7
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

CURVES DERIVED FROM
SPEC. FUEL FLOW (FIGURE 14)

NOTE: Dashed Lines Denote
Clean Configuration
(Figure 2)
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

CURVES DERIVED FROM
SPEC. FUEL FLOW (FIGURE 14)

NOTE: Dashed Lines Denote
Clean Configuration
(Figure 3)
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

GROSS WEIGHT
DENSITY ALTITUDE
ROTOR SPEED
C.G. LOCATION
C_T

1.0
.8
.6
.4
.2

2403 LB
5000 FT
483 RPM
STATION 100.0 (MID)
.004853

CURVES DERIVED FROM SPEC. FUEL FLOW (FIGURE 14)

NOTE: Dashed Lines Denote Clean Configuration (Figure 2)

TRUE AIRSPEED - KNOTS

17
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)

\[ C_T = 0.005611 \]

CURVES-derived FROM
SPEC. FUEL FLOW (FIGURE 14)

NOTE: Dashed Lines Denote
Clean Configuration
(Figure 3)
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)
$C_T = .004871$

SPECIFIC RANGE
NAUTICAL MILE/LB FUEL
1.0
0.8
0.6
0.4
0.2

CURVES DERIVED FROM
SPEC. FUEL FLOW (FIGURE 14)

ENGINE OUTPUT SHAFT HORSEPOWER
0
0
20
40
60
80
100
120
140

NOTE: Dashed Lines Denote
Clean Configuration
(Figure 2)

TRUE AIRSPEED - KNOTS
0
20
40
60
80
100
120
140
120
100
80
60
40
20
0

0 20 40 60 80 100 120 140
Figure 9
Level Flight Performance
OH-6 A  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)

$C_T = \frac{1}{0.005649}$

Curves derived from Spec Fuel Flow (Figure 14)

Note: Dashed lines denote clean configuration (Figure 3)
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)

Curves derived from
spec. fuel flow (figure 14)

NOTE: Dashed lines denote
clean configuration
(Figure 2)
FIGURE 11
LEVEL FLIGHT PERFORMANCE
OH-6A S/N 65-12927
MAIN ROTOR CENTER HUB PAIRING REMOVED

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

NOTE: DASHED LINES DENOTE CLEAN
CONFIGURATION (FIGURE 3)

CURVES DERIVED FROM SPEC
FUEL FLOW (FIGURE 14)
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

CURVES DERIVED FROM
SPEC FUEL FLOW (FIGURE 14)

NOTE: DASHED LINES DENOTE
CLEAN CONFIGURATION
(FIGURE 2)
LEVEL FLIGHT PERFORMANCE
OH-6A S/N 65-12927
LANDING GEAR STRUT FAIRINGS REMOVED

GROSS WEIGHT = 2394 lb
DENSITY ALTITUDE = 10,000 ft
ROTOR SPEED = 483 rpm
C.G. LOCATION = STATION 100.0 (MID)

\[ C_T = 0.005640 \]

CURVES DERIVED FROM SPEC. FUEL FLOW (FIGURE 14)

NOTE: DASHED LINES DENOTE CLEAN CONFIGURATION (FIGURE 3)
ENGINE CHARACTERISTICS
OH-6A S/N 65-12927
T63-A-5A

CURVE TAKEN FROM MODEL
SPEC. 580-F (REF. 3)
BOTH UNINSTALLED AND
WITH TEST INLET
CONDITIONS

CURVE TAKEN FROM MODEL
250 TEST DATA (REF. 4)

REFERRED SHAFT HORSEPOWER = SHP/\sqrt{t_2} - HP

REFERRED FUEL FLOW = N^2/t_2 - LB/HR
CONTROL POSITIONS IN FORWARD FLIGHT
OH-6A S/N 65-12927
LEVEL FLIGHT

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DENSITY (FT)</th>
<th>GROSS WEIGHT (LB)</th>
<th>ROTOR RPM</th>
<th>C.G. LOCATION (IN.)</th>
<th>CONFIGURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>4870</td>
<td>2410</td>
<td>483</td>
<td>100.0 (MID)</td>
<td>CLEAN</td>
</tr>
<tr>
<td>□</td>
<td>4980</td>
<td>2400</td>
<td>483</td>
<td>100.0 (MID)</td>
<td>ALL FAIRINGS REMOVED</td>
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CALIBRATED AIRSPEED ~ KNOTS

26
### Static Longitudinal Collective Fixed Stability
**OH-6A S/N 65-12927**  
**Clean Configuration**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Trim Airspeed (KIAS)</th>
<th>Density (KIAS)</th>
<th>Gross Weight (LB)</th>
<th>Rotor Speed (RPM)</th>
<th>C.G. Location (IN.)</th>
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<td>5050</td>
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<tr>
<td>□</td>
<td>77.3</td>
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<td>2430</td>
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<td>100.0 (MID)</td>
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<tr>
<td>△</td>
<td>95.3</td>
<td>5480</td>
<td>2390</td>
<td>483</td>
<td>100.0 (MID)</td>
</tr>
</tbody>
</table>

**Graphs:**
- **Pedal Position:**
- **Lateral Stick Position:**
- **Collective Stick Position:**
- **Longitudinal Stick Position:**

**Calibrated Airspeed ~ Knots**

---

27
STATIC LONGITUDINAL COLLECTIVE-FIXED STABILITY
OH-6A  S/N 65-12927

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>AIRSPEED (KCAS)</th>
<th>ALTITUDE (FT)</th>
<th>WEIGHT (LB)</th>
<th>SPEED (RPM)</th>
<th>LOCATION (IN.)</th>
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NOTE: DASHED LINES DENOTE CLEAN CONFIGURATION (FIGURE 16), SOLID LINES DENOTE ALL FAIRINGS REMOVED CONFIGURATION.

CALIBRATED AIRSPEED ~ KNOTS

28
CLEAN CONFIGURATION

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>TRIM AIRSPEED (KCAS)</th>
<th>DENSITY ALTITUDE (FT)</th>
<th>GROSS WEIGHT (LB)</th>
<th>ROTOR SPEED (RPM)</th>
<th>C.G. LOCATION (IN.)</th>
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<tr>
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<td>2380</td>
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ANGLE OF SIDESLIP ~ DEGREES
FIGURE 19
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A  S/N 65-12927
ALL FAIRINGS REMOVED

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>TRIM AIRSPEED (KCAS)</th>
<th>DENSITY (FT)</th>
<th>GROSS WEIGHT (LB)</th>
<th>ROTOR SPEED (RPM)</th>
<th>C.G. LOCATION (IN.)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>5230</td>
<td>2330</td>
<td>483</td>
<td>100.0 (MID)</td>
</tr>
<tr>
<td>□</td>
<td>76.3</td>
<td>5220</td>
<td>2420</td>
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<td>100.0 (MID)</td>
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<td>5310</td>
<td>2390</td>
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NOTE: 1. DASHED LINES DENOTE CLEAN CONFIGURATION (FIGURE 18)
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. Reciprocating 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/p) was maintained. Rotor speed was also held constant so that all points on a specific curve were flown at a constant Cp. 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 1/2 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

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
<th>Unit</th>
</tr>
</thead>
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<tr>
<td>GRWT, grwt</td>
<td>Gross weight</td>
<td>Pounds</td>
</tr>
<tr>
<td>KCAS</td>
<td>Knots calibrated airspeed</td>
<td>Knots</td>
</tr>
<tr>
<td>KTAS</td>
<td>Knots true airspeed</td>
<td>Knots</td>
</tr>
<tr>
<td>NAMPP</td>
<td>Nautical air miles per pound of fuel</td>
<td></td>
</tr>
<tr>
<td>RPM, rpm</td>
<td>Revolutions per minute</td>
<td></td>
</tr>
<tr>
<td>SHP, shp</td>
<td>Shaft horsepower</td>
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</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CG, cg</td>
<td>Center of gravity</td>
<td>Inches</td>
</tr>
<tr>
<td>C&lt;br&gt;T</td>
<td>Thrust coefficient</td>
<td>Dimensionless</td>
</tr>
<tr>
<td>H&lt;br&gt;D</td>
<td>Density altitude</td>
<td>Feet</td>
</tr>
<tr>
<td>V&lt;br&gt;C</td>
<td>Knots calibrated airspeed</td>
<td>Knots</td>
</tr>
<tr>
<td>V&lt;br&gt;IC</td>
<td>Instrument corrected airspeed</td>
<td>Knots</td>
</tr>
<tr>
<td>V&lt;br&gt;NE</td>
<td>Never exceed airspeed</td>
<td>Knots</td>
</tr>
<tr>
<td>V&lt;br&gt;T</td>
<td>Knots true airspeed</td>
<td>Knots</td>
</tr>
<tr>
<td>W&lt;br&gt;f</td>
<td>Fuel flow</td>
<td>lb/hr</td>
</tr>
<tr>
<td>δ&lt;br&gt;t₂</td>
<td>Pressure ratio</td>
<td>Ratio</td>
</tr>
<tr>
<td>ΔV&lt;br&gt;POS</td>
<td>Airspeed position error</td>
<td>Knots</td>
</tr>
<tr>
<td>θ&lt;br&gt;t₂</td>
<td>Temperature ratio</td>
<td>Ratio</td>
</tr>
<tr>
<td>ρ</td>
<td>Density</td>
<td>lb/sec²/ft⁴</td>
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</table>
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.
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.
<table>
<thead>
<tr>
<th>KEY WORDS</th>
<th>LINK A</th>
<th>LINK B</th>
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<tbody>
<tr>
<td></td>
<td>HOLE 1</td>
<td>HOLE 2</td>
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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