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**AUTHORITY**
USAAVSCOM ltr, 12 Nov 1973
ARMY PRELIMINARY EVALUATION

PROTOTYPE HUGHES
MODEL 369C (OH-6C) HELICOPTER

FINAL REPORT

GARY L. SKINNER
PROJECT ENGINEER

RANDY D. McCLELLAN
ENGINEER

ARLIN DEEL
LTC, CE
US ARMY
PROJECT OFFICER/PILOT

FEBRUARY 1972

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

The Army Preliminary Evaluation (APE) of the Hughes Tool Company -- Aircraft Division (HTC-AD) prototype Model 369C (OH-6C) helicopter was conducted at the Hughes facility in Culver City, California. A total of 34.6 productive flight hours were accumulated during the period 26 August to 22 September 1971. Engineering flight tests were conducted to evaluate the performance, handling qualities, and contractor-proposed flight envelope and to provide data for future use in the evaluation of the HTC-AD New Initiatives -- Aerial Scout Program proposal. The data indicate that, in comparison with the OH-6A, the Hughes Model 369C can hover out of ground effect on a 35°C day at 4000 feet with a 207-pound increase in payload. The Model 369C can achieve a maximum level flight airspeed of 141 knots calibrated airspeed (KCAS) with a 660-pound payload -- an increase of 14 percent over the 124-KCAS never-exceed velocity of the OH-6A. One deficiency, inadequate longitudinal control during sideward and rearward flight at a forward center-of-gravity (cg) loading, and 12 shortcomings were observed in the handling qualities evaluation. In the OH-6A speed range, the static and dynamic stability and controllability of the Model 369C are generally unchanged. At the airspeeds that exceeded the envelope of the OH-6A, handling qualities were degraded, and five shortcomings were observed. These shortcomings were neutral maneuvering stability, neutral static longitudinal stability, excessive longitudinal control response and sensitivity, excessive roll response following a simulated directional gust disturbance, and excessively rapid buildup of normal acceleration following a simulated longitudinal gust disturbance. If procurement of the helicopter is planned, the cited deficiency should be corrected prior to any airworthiness release for flight at a forward cg loading by operational pilots. The shortcomings should be corrected prior to production. Additional testing should be conducted to determine a safe operational cg envelope, to develop a height-velocity curve, and to evaluate the effects of altitude, weight, and cg variations.
FOREWORD

Throughout the preliminary evaluation, instrumentation calibration, photography, and some technical assistance were provided by the airframe manufacturer, Hughes Tool Company – Aircraft Division, Culver City, California, and more specifically by Project Engineer John Bardell. Flight support was provided by CWO George Karcher of the US Army Hughes Plant Activity, through permission of the Commanding Officer, LTC D. J. Amaral.
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DISTRIBUTION
INTRODUCTION

BACKGROUND

1. The Hughes Tool Company – Aircraft Division (HTC-AD) developed a derivative of the OH-6A helicopter intended to improve performance. Designated by Hughes as the Model 369C, the helicopter has been unofficially referred to as the OH-6C. The Model 369C represents the basic airframe for the HTC-AD proposal for the New Initiatives – Aerial Scout Program. The US Army Aviation Systems Command (AVSCOM) directed the US Army Aviation Systems Test Activity (USAASSTA) to conduct an Army Preliminary Evaluation (APE) of the prototype Model 369C (ref 1, app A).

TEST OBJECTIVES

2. The primary objective of this test was to evaluate the performance and handling qualities of the Model 369C for future use in the evaluation of the New Initiatives – Aerial Scout Program proposal. A second objective was to verify that the recommended flight envelope was safe for subsequent test programs and demonstration flights.

DESCRIPTION

3. The Model 369C helicopter flown during the APE was a modified OH-6A, serial number (S/N) 65-12951, manufactured and modified by the Hughes Tool Company – Aircraft Division. A detailed description of the OH-6A is found in reference 2, appendix A. A general aircraft and component description of the Model 369C is presented in appendix B, with photographs 1 through 3 illustrating the major configuration changes. The Model 369C incorporates the following major changes to the OH-6A.

   a. Five-bladed main rotor.

   b. Four-bladed tail rotor.

   c. "T" tail.

   d. Main transmission uprated to a maximum of 355 shaft horsepower (shp).

   e. New tail rotor gearbox.

   f. Strengthened canopy and tail boom.

   g. Allison 250-C20 engine rated at 400 shp, sea-level, standard-day conditions (with CECO fuel control).
SCOPE OF TEST

4. Performance and handling qualities were evaluated throughout the flight envelope and were compared against estimated performance presented in HTC-AD report number 369-X-8032A (ref 3, app A), performance and handling qualities of the OH-6A (ref 4), and military specification MIL-H-8501A (ref 5). Particular attention was paid to those capabilities outside the OH-6A flight envelope (gross weights of 2700 to 3150 pounds and airspeeds of 124 to 150 knots calibrated airspeed (KCAS)). The test conditions are presented in tables 1 and 2, appendix C.

5. Operating procedures and limitations were in accordance with the OH-6A operator's manual (ref 2, app A), except as modified by the AVSCOM safety-of-flight release (app D) and operating procedures provided by HTC-AD. A total of 40 flights were conducted for 34.6 productive test hours during the period 26 August to 22 September 1971 at the Hughes facility at Culver City, California. A majority of the tests were conducted under nonturbulent atmospheric conditions to preclude uncontrolled disturbances from influencing the helicopter characteristics. A limited number of flights were accomplished in turbulent air conditions in order to evaluate the stability and control of the helicopter under representative operating conditions.

METHODS OF TEST

6. Test methods used are described in detail in references 6 and 7, appendix A, and are described briefly in the Results and Discussion section of this report. A Handling Qualities Rating Scale (HQRS) was used to augment pilot comments relative to handling qualities (app E).

7. Weight and balance was conducted by HTC-AD. Because of erroneous weight and balance determination provided by the contractor, some test data were collected at a center of gravity (cg) up to 0.2 inch outside of the operational envelope due to fuel burn-off. This error was discovered after completion of flying. Considering the allowable cg range of the helicopter (7 inches), the effect of 0.2 inch is considered to be negligible.

8. The test helicopter was equipped with sensitive calibrated instruments to gather the data presented in this report. A list of the test instrumentation is included in appendix F.
CHRONOLOGY

9. The chronology of the Hughes Model 369C APE is as follows:

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test directive received by telephone</td>
<td>20 August</td>
<td>1971</td>
</tr>
<tr>
<td>Test aircraft received</td>
<td>24 August</td>
<td>1971</td>
</tr>
<tr>
<td>Tests started</td>
<td>26 August</td>
<td>1971</td>
</tr>
<tr>
<td>Test directive received</td>
<td>7 September</td>
<td>1971</td>
</tr>
<tr>
<td>Tests completed</td>
<td>22 September</td>
<td>1971</td>
</tr>
<tr>
<td>Contractor debriefing</td>
<td>30 September</td>
<td>1971</td>
</tr>
</tbody>
</table>
RESULTS AND DISCUSSION

GENERAL

10. Engineering flight tests were conducted to evaluate the performance, handling qualities, and the contractor-proposed flight envelope of the Hughes Model 369C helicopter. Compared to the OH-6A, the Model 369C had increased hover ceiling and/or payload capability as well as a higher maximum speed. One deficiency, inadequate longitudinal control during sideward and rearward flight at a forward cg loading, and 12 shortcomings were observed in the handling qualities evaluation. In the OH-6A speed range, the static and dynamic stability and controllability of the Model 369C are generally unchanged. Handling qualities are degraded at airspeeds that exceed the envelope of the OH-6A. If procurement of the helicopter is planned, the cited deficiency should be corrected prior to any airworthiness release for flight at a forward cg loading by operational pilots. The shortcomings should be corrected prior to production. Additional testing should be conducted to determine a safe operational cg envelope, to develop a height-velocity (H-V) curve, and to evaluate the effects of altitude, weight, and cg variation.

PERFORMANCE

General

11. Tests were conducted to determine hover, level flight, and autorotational descent performance characteristics of the Model 369C helicopter. Hover results indicate that, in comparison with the OH-6A, the Model 369C, using takeoff power, can hover out of ground effect (OGE) on a hot (35°C) day at 4000 feet with a 207-pound increase in payload. Level flight performance was also improved. The Model 369C has a maximum level flight airspeed of 141 KCAS with a 660-pound payload – an increase of 14 percent over the 124-KCAS never-exceed velocity (VNE) of the OH-6A. Autorotational descent characteristics were satisfactory, although the rate of descent of the Model 369C was greater than the OH-6A.

Hover

12. Hover performance tests were conducted at skid heights of 4 feet in ground effect (IGE) and 60 feet OGE under the conditions listed in table 1, appendix C. Skid height was measured from the bottom center of the left skid. The tethered hover method, employing a calibrated load cell in series with a cable attached to the helicopter cargo hook and a ground tie-down, was used to determine main rotor thrust. Data were obtained at various power settings up to the 355 shp transmission (XMSN) limit at rotor speeds of 505 and 510 rpm. Specification fuel flow and installed power available for the Allison 250-C20 engine are shown in
figures 1 through 4, appendix G, and were used to determine aircraft performance. Nondimensional hover performance data are presented in figure 5. Both IGE and OGE hover performance were derived from figure 5. Hover ceiling plots are presented in figures 6 and 7.

13. Hover capability for both a standard day (15°C at sea level) and a hot day (35°C at all altitudes) were determined from figures 6 and 7, appendix G. The data indicate that at the maximum design gross weight of 3150 pounds, the Model 369C helicopter can hover IGE at 6700 feet on a standard day and 1500 feet on a hot day. At 3150 pounds, the standard-day OGE hover ceiling is 2350 feet, while on a hot day the gross weight must be reduced to 3040 pounds to hover OGE. Although testing was not conducted at altitudes higher than the test density altitude of 600 feet, it appears that the contractor hover performance predictions, as presented in reference 3, appendix A, were all met. A comparison of the hover capability of the Model 369C and the OH-6A is shown in table 1. The Model 369C can hover OGE on a hot day at 4000 feet with a 207-pound increase in payload. This increased capability of the Model 369C helicopter enhances its operational value. Further testing should be conducted to determine high-altitude performance.

Table 1. Hovering capability Comparison.

<table>
<thead>
<tr>
<th>Pressure Altitude: 4000 feet</th>
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<td>Outside Air Temperature: 35°C</td>
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<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Hughes Model 369C</th>
<th>OH-6A</th>
<th>Difference</th>
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</thead>
<tbody>
<tr>
<td>Basic weight (lb)</td>
<td>1344</td>
<td>1146</td>
<td>198</td>
</tr>
<tr>
<td>Rotor speed (rpm)</td>
<td>510</td>
<td>483</td>
<td>27</td>
</tr>
<tr>
<td>Operating weight (lb)</td>
<td>1950</td>
<td>1752</td>
<td>198</td>
</tr>
<tr>
<td>IGE hover performance:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum hover weight (lb)</td>
<td>2850</td>
<td>2395</td>
<td>455</td>
</tr>
<tr>
<td>Payload (lb)</td>
<td>650</td>
<td>443</td>
<td>207</td>
</tr>
<tr>
<td>OGE hover performance:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum hover weight (lb)</td>
<td>2600</td>
<td>2105</td>
<td>405</td>
</tr>
<tr>
<td>Payload (lb)</td>
<td>650</td>
<td>443</td>
<td>207</td>
</tr>
</tbody>
</table>

1Includes helicopter airframe and engine plus full hydraulic fluid and trapped fuel.
2Power turbine speed (N2) equals 103 percent.
3Includes basic weight plus engine oil, full fuel, and a 200-pound pilot.
4Four-foot skid height.
14. Level flight performance tests were conducted to determine power required as a function of airspeed under the conditions listed in table 1, appendix C. The results of the individual tests are presented in figures 8 through 14, appendix G. Data were obtained in stabilized level flight at airspeed increments of 10 knots from 30 knots indicated airspeed (KIAS) to the maximum level flight airspeed (V_H) while flying at the desired ratio of gross weight to density altitude and at a constant 510 rpm. A comparison of nondimensional data of the OH-6A and the Model 369C indicates that for the Model 369C larger power coefficients (C_p's) are required at low thrust coefficients (C_T's) while lower C_p's result at higher C_T's. It was concluded that the Model 369C with the larger engine becomes more efficient in terms of power required as weight and airspeed are increased. A comparison of the level flight performance capability of the OH-6A and the Model 369C at an equal payload for each helicopter is shown in figure A. The OH-6A has a V_Ne of 124 KCAS, which is a structural limitation. The Model 369C is limited by power available and not by structural considerations. Using takeoff power, the Model 369C has a level flight airspeed of 141 KCAS – an increase of 14 percent over the 124-KCAS V_Ne of the OH-6A. This increased airspeed of the Model 369C enhances its operational value. Figure A illustrates a V_H of 141 knots true airspeed (KTAS) but a maximum cruise airspeed of only 126 KTAS due to the maximum-continuous transmission limit of 278 shp. Removing the maximum-continuous transmission limit will enable the helicopter to achieve substantially higher airspeeds in level flight at sea level.

15. Range performance of the Model 369C helicopter was calculated from the level flight performance data for sea-level, standard-day conditions presented in figure 15, appendix G. An average cruise airspeed of 121.5 KTAS was employed, and the range of 238 nautical miles was computed as follows:

a. Takeoff conditions:

<table>
<thead>
<tr>
<th>Weight Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic weight (Model 369C)</td>
<td>1344 lbs</td>
</tr>
<tr>
<td>Oil, engine</td>
<td>6 lbs</td>
</tr>
<tr>
<td>Fuel</td>
<td>400 lbs</td>
</tr>
<tr>
<td>Pilot</td>
<td>200 lbs</td>
</tr>
<tr>
<td>Payload</td>
<td>1200 lbs</td>
</tr>
</tbody>
</table>

Total: 3150 pounds

b. Range calculations:

<table>
<thead>
<tr>
<th>Weight Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine start gross weight</td>
<td>3150 lbs</td>
</tr>
<tr>
<td>Warm-up (2 minutes)</td>
<td>2 lbs</td>
</tr>
<tr>
<td>Cruise fuel</td>
<td>358 lbs</td>
</tr>
<tr>
<td>Landing gross weight</td>
<td>2790 lbs</td>
</tr>
<tr>
<td>Ten-percent fuel reserve</td>
<td>40 lbs</td>
</tr>
</tbody>
</table>
c. Range = average nautical air miles per pound of fuel x cruise fuel

\[ \frac{0.654 + 0.673}{2} \times 358 = 238 \text{ nautical air miles} \]

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>GROSS WEIGHT ~LB</th>
<th>ROTOR SPEED ~RPM</th>
<th>THRUST COEFFICIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>369C</td>
<td>2610</td>
<td>510</td>
<td>0.004029</td>
</tr>
<tr>
<td>OH-6A</td>
<td>2412</td>
<td>483</td>
<td>0.004197</td>
</tr>
</tbody>
</table>

Figure A. Level Flight Power Required Comparison at Equal Payload.

Autorotational Descent

16. Autorotational descent performance tests were conducted under the conditions listed in table 1, appendix C, and the test results are presented in figures 16 and 17, appendix G. Autorotational descent performance was determined by timing stabilized autorotational descent through a 1000-foot altitude band. Under
test conditions, the airspeed for a minimum rate of descent of 1720 feet per minute (ft/min) was 60 KCAS at a rotor speed of 510 rpm. The airspeed for maximum glide distance was extrapolated to be 102 KCAS with a rate of descent of 2200 ft/min. Approximately 0.79 nautical air miles could be traversed for every 1000 feet of descent. In comparison with the OH-6A at its alternate mission gross weight of 2400 pounds, the Model 369C at 3050 pounds exhibited an increase in rate of descent and a decrease in maximum glide distance. At an airspeed of 60 KCAS, tests were conducted at various rotor speeds in the autorotational range of 462 to 526. The test results in figure 17 show that the low rotor rpm (462) produced a rate of descent of 1590 ft/min, while the high rotor rpm (526) had a rate of descent of 1810 ft/min. Within the scope of this test, the autorotational descent performance of the Model 369 helicopter is satisfactory. Further testing should be conducted to evaluate autorotational performance during high density altitude operations.

STABILITY AND CONTROL

General

17. Stability and control tests were conducted at the conditions listed in table 2, appendix C. One deficiency and 12 shortcomings were observed. The deficiency and 7 of the shortcomings occurred within the speed range of the OH-6A. The remaining shortcomings occurred within the expanded airspeed envelope of the Model 369C. The deficiency was inadequate longitudinal control to counteract the effects of longitudinal disturbance during left sideward and rearward flight at a forward cg. The most serious shortcomings of the Model 369C were in the expanded flight envelope and represented a degradation from the OH-6A handling qualities. These shortcomings were neutral maneuvering stability, neutral static longitudinal stability, excessive longitudinal control response and sensitivity, excessive longitudinal control response and sensitivity, excessive roll response following a simulated directional gust disturbance, and excessively rapid buildup of normal acceleration following a simulated longitudinal gust disturbance.

Trim Control Position Characteristics

18. The trim control position characteristics of the Model 369C helicopter were evaluated under the conditions listed in table 2, appendix C, and were determined by recording the control positions at various coordinated flight conditions. Test results are presented in figures 18 and 19, appendix G. During both level flight and maximum power climbs, consistently forward longitudinal control trim positions were required at increased forward speeds. Trim control position variations with airspeed were essentially linear, and adequate control margins were available for all controls. During climbs at maximum power, a noticeable increase in left pedal was observed but was not considered excessive. Within the scope of this test, the trim control position characteristics of the Model 369C helicopter are satisfactory.
19. Sideward and rearward flight were evaluated under the conditions listed in table 2, appendix C. The helicopter was stabilized at a hover and at 5-knot increments up to the sideward and rearward airspeed limits. A ground pace vehicle with a calibrated fifth wheel was used as a speed and position reference during the test. With the aircraft maintained at a skid height of approximately 5 feet, control positions were recorded at each stabilized point. Test results are presented in figures 20 and 21, appendix G.

20. During sideward flight, increasing lateral cyclic control was required in the direction of flight up to 15 knots in either direction. At higher speeds, no further lateral control was required. Increasing left directional control in right sideward flight and right directional control in left sideward flight were required throughout the speed range. Forward longitudinal control was required in right sideward flight, and aft longitudinal control was required in left sideward flight to approximately 15 knots in either direction. At higher speeds, essentially no additional longitudinal control was required. The task of stabilizing in left sideward flight in the 5- to 20-knot band was very difficult because the motion of the helicopter was characterized by random yaw oscillations which required large and rapid movements of the directional control (HQRS 4). This directional instability in left sideward flight is a shortcoming, correction of which is desired if the helicopter is procured.

21. Control margins were satisfactory for lateral and directional controls but were less than 10 percent for aft longitudinal control in left lateral flight above 10 knots at the forward cg. The position of the longitudinal control during this flight condition was uncomfortable to the pilot, and the control available to counteract a longitudinal disturbance was considered insufficient to meet the requirements of paragraph 3.2.1 of MIL-H-8501A. The inadequate longitudinal control margin during left sideward flight at a forward cg loading may result in loss of control in gusty wind conditions and is a deficiency. If the helicopter is procured, correction of this deficiency is mandatory prior to release of the Model 369C for flight at a forward cg.

22. Considerable difficulty was encountered while attempting to stabilize between hover and 15 knots rearward. While in this airspeed band, random yaw oscillations occurred, requiring large and rapid movements of the pedals to prevent loss of directional control (HQRS 4). From 15 knots rearward to the limit, the aircraft was much easier to stabilize (HQRS 2). The directional instability in rearward flight is a shortcoming, correction of which is desirable if the helicopter is procured.

23. Control margins were satisfactory for both lateral and directional controls but were less than 10 percent for aft longitudinal control in rearward flight above 13 knots. The remaining control available to counteract a longitudinal disturbance was considered insufficient to meet the requirement of paragraph 3.2.1 of MIL-II-8501A. The inadequate longitudinal control margin during rearward flight at a forward cg loading may result in loss of control in gusty wind conditions and is a deficiency. If the helicopter is procured, correction of this deficiency
is mandatory prior to release of the Model 369C for flight at a forward cg. Further testing in sideward and rearward flight conditions at different altitudes should be conducted to determine a safe operational cg envelope.

Critical Wind Azimuth Determination

24. The critical wind azimuth of the Model 369C helicopter was determined under the conditions listed in table 2, appendix C. Critical wind azimuth is defined as that relative wind direction which results in the least remaining control margin while attempting to hover over a spot on the ground. The helicopter was hovered at an approximate 3-foot skid height in a known wind condition (10 to 16 knots) and rotated through a 360-degree turn. Control positions were recorded at stabilized increments of turn relative to the wind azimuth. Test results are presented in figure 22, appendix G. Adequate control margin was available in all axes for conditions tested. The critical control was directional and occurred during pedal excursions required to stabilize with a left quartering wind between 172 and 285 degrees clockwise from the nose of the aircraft.

Hovering Flight Characteristics

25. Hovering flight characteristics of the Model 369C helicopter were evaluated throughout the test program. Takeoffs to a hover at approximately 3200 pounds with both a forward and aft cg were accomplished with adequate control margin for all controls. Power management was satisfactory; however, the fuel control system of the 400-horsepower Allison engine overcompensates for rotor droop, resulting in an increase of approximately 1.5-percent power turbine speed (N2) as the helicopter is brought to a hover. This characteristic was not objectionable. However, if this engine/fuel control combination is bought for Army use, the following "NOTE" should be included in the appropriate operator's manual:

NOTE

The fuel control system overcompensates for rotor droop as collective pitch is increased and may result in overspeeding the engine.

26. In a hover, approximately 25 pounds of left pedal force was required. This excessive pedal force was objectionable to the pilot (HQRS 4) and limits the operational suitability of the helicopter. The excessive left pedal force of the Model 369C during hover failed to meet the requirements of paragraph 3.3.12 of MIL-H-8501A by 10 pounds, or 67 percent, and is a shortcoming, correction of which is desired if the helicopter is procured.

27. During hover, lateral control vibrations at 8.5 and 42.5 hertz corresponding to one per rotor revolution (1/rev) and 5/rev were observed. These vibrations were very objectionable, added to the workload of the pilot, and contributed to pilot-induced oscillations (HQRS 4). After testing was complete, the contractor installed different main rotor dampers, and two test flights were conducted at light conditions.
and heavy gross weights. Lateral control vibrations were reduced to a satisfactory level. The new main rotor dampers were identified as HTC-AD part number 369ASK1933. These dampers should be installed on the Model 369C helicopter if considered for procurement.

28. In a hover, the Model 369C helicopter at maximum gross weight is less affected by wind than the standard OH-6A. This improvement in hovering stability was noteworthy; however, in winds greater than 5 knots or under gusty wind conditions, pilot workload required to perform precision hovering tasks was still excessive. During critical wind azimuth determination, pedal excursions up to 2.2 inches were measured (fig. 22, app G). In addition to pedal excursions, collective and cyclic control were continually moving in a maximum performance effort to stabilize (HQRS 5). The excessive pilot workload required to perform precision hovering tasks is a shortcoming, correction of which is desirable if the helicopter is procured.

**Static Longitudinal Collective-Fixed Stability**

29. Static longitudinal collective-fixed stability tests were conducted under the conditions listed in table 2, appendix C. Static longitudinal stability was determined by initially stabilizing at selected trim airspeeds, and recording data to determine control positions. Airspeed was then increased and decreased to stabilized points while keeping the collective control unchanged and control positions were again recorded. These data are presented in figure 23, appendix G.

30. As evidenced by the variation about trim of the longitudinal control position, the Model 369C was statically stable (increasing longitudinal control with increasing airspeed) at the lower of the three trim airspeeds (54 KCAS), but became increasingly less stable as airspeed increased. Pilot workload increased while attempting to maintain a desired airspeed approaching \( V_H \) (HQRS 5). In contrast, the OH-6A data in reference 4, appendix A, revealed a slightly stable trend at a trim airspeed of 54 KCAS and became more stable as airspeed was increased. A comparison of the static longitudinal stability characteristics of the two helicopters is presented in figure B. The flight conditions for this comparison were similar, except for the higher gross weight of the Model 369C. The OH-6A data in reference 4, appendix A, indicate that the effects of increased altitude and gross weight were negligible. The neutral static longitudinal stability of the Model 369C in the airspeed band of 130 KCAS to \( V_H \) failed to meet the requirement of paragraph 3.2.10 of MIL-H-8501A and is a shortcoming, correction of which is desired if the helicopter is procured. Additional testing should be accomplished to determine the effect of altitude, weight, and cg change on the static longitudinal stability of the Model 369C.
Static Lateral-Directional Stability

31. The static lateral-directional stability tests of the Model 369C were conducted under the conditions listed in table 2, appendix C. The test helicopter was first stabilized at the trim airspeeds, and then sideslip angle was increased in increments from zero to the envelope limits in both directions while maintaining a straight flight path over the ground. At each increment of sideslip, control positions and
sideslip angle were recorded while holding collective fixed and maintaining trim airspeed. The test results are presented in figures 22 through 26, appendix G.

32. The Model 369C helicopter exhibited positive static lateral-directional stability, in that left directional and right lateral control displacements were required for right sideslip. Increasing stability was noted as trim airspeed increased. One flight was conducted at an average gross weight of 2440 pounds for comparison with OH-6A data (ref 4, app A). The static lateral-directional stability characteristics of the two helicopters appear to be essentially the same. Within the scope of this test, the static lateral-directional stability of the Model 369C helicopter is satisfactory.

**Dynamic Stability**

33. Dynamic stability characteristics of the Model 369C helicopter were determined under the conditions listed in table 2, appendix C. The objective of the dynamic stability tests was to evaluate the helicopter response characteristics following a gust disturbance. Gust disturbances were simulated by making pulse-type control inputs for 0.5 second. Following the input, the control was returned to trim, and all controls were held fixed until either the helicopter motions damped or recovery action was required. Releases from maximum steady-heading sideslips were also evaluated. Representative time histories of the dynamic stability characteristics of the Model 369C helicopter at 137 KCAS are presented in figures 29 through 31, appendix G.

**Longitudinal:**

34. Testing was accomplished in calm air, and the longitudinal pulse was used to simulate a gust disturbance. The dynamic longitudinal stability characteristics of the Model 369C were similar to the OH-6A at 105 KCAS. Pitch oscillations were damped within 10 seconds for an aft input and within 7 seconds for a forward input. Pitch-roll coupling was observed, but the roll oscillations damped at approximately the same time as the pitch oscillations. At 137 KCAS, dynamic longitudinal stability could not be determined for aft control inputs due to the rapid buildup of normal acceleration (g). As illustrated in figure C and as presented in figure 29, appendix G, longitudinal control was returned to trim for 0.8 second, but normal acceleration continued to build to 1.5g within 1.5 seconds. Flight in turbulent air at 137 KCAS required extensive pilot compensation for adequate performance (HQRS 6). The excessively rapid buildup of normal acceleration following a simulated longitudinal gust disturbance is a shortcoming, correction of which is desirable if the helicopter is considered for procurement. Further testing is recommended to evaluate the effects of cg and altitude changes.

**Lateral:**

35. The oscillations created by the lateral pulse inputs were well damped at 105 KCAS, and lateral stability characteristics of the Model 369C and the OH-6A appear to be similar at this airspeed. As in the OH-6A, yaw and pitch rates were generated by the lateral input, and these rates increased as airspeed was increased.
to 137 KCAS. A representative time history is presented in figure 30. This coupling about the helicopter's three axes at 137 KCAS, due to a lateral gust disturbance, increased pilot workload in turbulent wind conditions (HQRS 3) but was not objectionable. Within the scope of this test, the dynamic lateral stability of the Model 369C is satisfactory.

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Figure C. Aircraft Response Following an Aft Longitudinal Pulse.

FOR OFFICIAL USE ONLY
Directional:

36. The oscillations created by directional pulses and releases from maximum sideslips were satisfactorily damped at 105 KCAS. A yaw-pitch-roll coupling was experienced, but the resulting oscillations were damped within 5 seconds. The dynamic directional stability of the Model 369C and the OH-6A at 105 KCAS appear to be similar with yaw-pitch-roll coupling an undesirable characteristic during flights in turbulence.

37. At 137 KCAS, the initial coupled response of the helicopter became more severe as illustrated in figure 31, appendix G. A right directional pulse of approximately 1 inch held for 0.5 second produced a right yaw rate of 18 degrees per second (deg/sec) and a right roll rate of 20 deg/sec. A nose-down pitch rate was also generated but was not severe. The high roll rate caused the pilot to take corrective action with left lateral control approximately 0.3 second after applying the pulse. Corrective inputs of lateral control were required for 3 seconds before the roll and yaw rates had subsided, and the pilot felt he could hold all three controls fixed and let the oscillations dampen. This action resulted in the residual oscillations damping within 3 seconds. The dynamic directional stability of the Model 369C helicopter could not be determined at 137 KCAS due to the severity of the coupled response. Flight at this airspeed in turbulent wind conditions required extensive pilot compensation for adequate performance (HIORS 6). The excessive roll response of the Model 369C at 137 KCAS following a simulated directional gust disturbance is a shortcoming, correction of which is desirable if the helicopter is considered for procurement. Further testing should be conducted to evaluate the effect of cg and altitude change.

Controllability

38. Controllability characteristics of the Model 369C helicopter were evaluated under the conditions listed in table 2, appendix C, and the test results are presented in figures 32 through 37, appendix G. The helicopter was stabilized at the test conditions and single-axis control step inputs were applied to the longitudinal, lateral, and directional controls using a mechanical fixture to obtain the desired control input size. The step inputs were held steady and the helicopter response recorded for a specified time or until recovery action was initiated by the pilot. There was no objectionable delay in the development of angular velocity, and angular acceleration was in the direction commanded and occurred within 0.2 second after control displacement.

Longitudinal:

39. Longitudinal controllability characteristics are presented in figures 32 and 33, appendix G. In a hover, the longitudinal control response (maximum rate per inch of control displacement) could not be determined because the pitch rate had not peaked when recovery was initiated. Recovery was dictated by excessive nose-high and nose-low attitudes in close proximity to the ground. Pitch rate was measured at 0.8 second and was 13 deg/sec/in., nose down, and 17 deg/sec/in., nose up.
At 105 KCAS, maximum pitch rate was attained at approximately 0.9 second at the light gross weight (2360 pounds), and control response was 12 deg/sec/in., nose down, and 14 deg/sec/in., nose up. These control response values are essentially the same as the OH-6A data presented in reference 4, appendix A. An increase in gross weight to 2990 pounds at the same airspeed (105 KCAS) resulted in the same control response for a forward input: 12 deg/sec/in., nose down. Longitudinal control response for aft inputs could not be achieved because recovery was necessary prior to attaining maximum pitch rate. Recovery was dictated by blade stall which was characterized by a 5/rev vibration of the entire aircraft and an increase in longitudinal pitch rate, nose up (pitch up). Pitch rate was measured at 1.0 second and was 10 deg/sec for a maximum aft input of 0.8 inch. Because of excessive response, an aft input greater than 0.8 inch was not attempted. At 137 KCAS, longitudinal control response could not be attained for either a forward or aft input. Recovery was again dictated by blade stall, and the pitch rate was measured at 0.8 second. The maximum pitch rate attained at 0.8 second was 14 deg/sec for an 0.80-inch forward input and 9 deg/sec for a 0.55-inch aft step input. The longitudinal control response of the Model 369C helicopter was satisfactory in a hover but at the forward flight conditions was excessive and contributed a tendency to overcontrol and to drive the aircraft into blade stall. Combined with the neutral static longitudinal stability and neutral maneuvering stability discussed in paragraphs 30 and 46, the longitudinal control response increased the pilot workload considerably (HQRS 5).

40. Control sensitivity (maximum angular acceleration per inch of control displacement) in a hover was 24 deg/sec2/in., nose down and nose up. At 105 KCAS and light gross weight (2360 pounds), control sensitivity was 20 deg/sec2/in., nose down, and 23 deg/sec2/in., nose up. These values were essentially the same as the OH-6A data presented in reference 4, appendix A. At the heavier gross weights and at 105 KCAS and 137 KCAS, control sensitivity at 1 inch could not be ascertained due to blade stall, as explained in the previous paragraph. Within the scope of this test, the excessive longitudinal control response and sensitivity of the Model 369C at high airspeeds is a shortcoming, correction of which is desirable if the helicopter is considered for procurement. Further testing should be conducted to determine the effects of altitude and cg changes.

Lateral:

41. Lateral controllability characteristics are presented in figures 34 and 35, appendix G. In a hover, the lateral control response was 24 deg/sec/in., left, and 22 deg/sec/in., right. At 105 KCAS, control response was approximately the same for both the heavy (2990 pounds) and the light (2360 pounds) gross weight at 24 deg/sec/in., left, and 24 to 28 deg/sec/in., right. Lateral control response of the Model 369C helicopter appears to have increased slightly in comparison with the OH-6A but is satisfactory. At 137 KCAS, lateral control response had increased to 31 deg/sec/in., left, and approximately 40 deg/sec/in., right. As with the OH-6A, the Model 369C failed to meet the requirements of paragraph 3.3.15 of MIL-H-8501A but was satisfactory.
42. Lateral control sensitivity in a hover was 80 deg/sec²/in., left, and 74 deg/sec²/in., right. At 105 KCAS and at both gross weights, control sensitivity was approximately 70 deg/sec²/in., left, and 63 deg/sec²/in., right. Lateral control sensitivity appears to have also increased slightly in comparison with the OH-6A but is satisfactory. At 137 KCAS, control sensitivity had increased to approximately 84 deg/sec²/in., left, and 98 deg/sec²/in., right. Both the lateral control response and sensitivity of the Model 369C helicopter caused some overcontrolling of the helicopter (HQRS 3). The tendency to overcontrol due to the response of the Model 369C to lateral control deflection failed to meet the requirement of paragraph 3.3.15 of MIL-H-8501A, but was satisfactory. Within the scope of these tests, the lateral control response and sensitivity of the Model 369C are satisfactory.

**Directional:**

43. Directional controllability characteristics are presented in figures 36 and 37, appendix G. In a hover, the directional control response could not be determined because the yaw rate had not peaked when recovery was initiated. Recovery was initiated after approximately 1.5 seconds. Yaw rate was measured at 1.0 second and was 32 deg/sec/in., left and right. At 105 KCAS and light gross weight (2360 pounds), maximum yaw rate was attained at approximately 0.6 second and was 24 deg/sec/in., left, and 20 deg/sec/in., right. These control response values are essentially the same as those of the OH-6A. Directional control response was not attained for control displacements larger than 0.75 inch at 105 KCAS at the heavy gross weight (2990 pounds) due to a control fixture malfunction, but it appears that the values at 1 inch would not have changed as a result of the additional weight. At 137 KCAS, control response could not be attained for control displacements larger than 0.8 inch without exceeding helicopter sideslip limits, but it appears the values would not have changed as a result of increased speed above 105 KCAS.

44. Directional control sensitivity at a hover was 34 deg/sec²/in., left and right. At 105 KCAS and at both gross weights, control sensitivity was approximately 50 deg/sec²/in., left, and 41 deg/sec²/in., right, and is essentially the same as the OH-6A. At 137 KCAS, these values appear to have been unchanged. The directional controllability of the Model 369C helicopter was high and caused some overcontrolling, especially in high or gusty winds (HQRS 3). The tendency to overcontrol due to the response of the Model 369C to directional control deflections failed to meet the requirement of paragraph 3.3.7 of MIL-H-8501A but was satisfactory. Within the scope of these tests, the directional response and sensitivity of the Model 369C helicopter are satisfactory.

**Maneuvering Stability**

45. Maneuvering stability tests were conducted to determine the variation of longitudinal control position with normal acceleration for the conditions listed in table 2, appendix C. Test results are presented in figure 38, appendix G. The test technique was to perform collective-fixed steady turns. The aircraft was first
stabilized at the desired trim airspeed in level flight, and then airspeed was maintained at increasing increments of bank angle in coordinated turns, left and right.

46. The helicopter exhibited positive maneuvering stability at 105 KCAS up to 1.8g. As the load factor was increased, increasing aft longitudinal control was required. At 135 KCAS, however, maneuvering stability was neutral, and maximum load factor could not be obtained since blade stall was encountered at approximately 1.2g, left and right. Extensive pilot effort would be required during operational maneuvers at this airspeed (HQRS 6). The effects of neutral maneuvering stability can be seen in figure C, where normal acceleration continued to build after the longitudinal control was returned to the trim condition. A control reversal was required to stop the buildup, and an even greater reversal was required to arrest the overshoot in the opposite direction. Neutral maneuvering stability of the Model 369C helicopter and tendency to encounter blade stall at airspeeds approaching $V_h$ required extensive pilot compensation during maneuvering tasks at high airspeeds (HQRS 6) and is a shortcoming, correction of which is desirable if the helicopter is procured. The following "CAUTION" should be included in the appropriate operator's manual:

CAUTION

 Abrupt longitudinal control movement or roll attitudes in excess of 30 degrees, left and right, at airspeeds approaching maximum level flight may cause blade stall and should be avoided.

Additional testing should be conducted to determine the effects of altitude, weight, and cg change on the maneuvering stability characteristics of the Model 369C helicopter.

Autorotational Entry and Descent Characteristics

47. Simulated engine failure tests (throttle chops) were conducted to determine the adequacy of pilot cues, identify the recovery techniques required to establish autorotation, and to determine the safe delay time prior to corrective action. The tests were conducted under the conditions listed in table 2, appendix C. Time histories for two representative flight conditions are presented in figures 39 and 40, appendix G. The tests were conducted by first stabilizing the helicopter in coordinated level flight and then rapidly rotating the throttle to the ground-idle position. All controls were held fixed for a specified time or until recovery action was dictated by a critical parameter.

48. Engine failure cues were evaluated at all test conditions. These cues were a change in engine sound, a decrease in rotor rpm, and a change in the helicopter attitude. The initial aircraft response was an immediate yaw to the left, followed closely by left roll and a very slight pitch down. An engine-out warning light was available but not evaluated because actual engine failures were not tested. The engine failure cues of the Model 369C helicopter are satisfactory.
49. The recovery technique following throttle chops was similar for all conditions. The collective control was smoothly lowered, and right lateral cyclic and right pedal were applied. Upon lowering the collective stick, a pitch down occurred, and aft cyclic was required. The downward pitching rate and amount of aft cyclic required were functions of airspeed and not power, as indicated in figures 39 and 40, appendix G. The excessive pitch and roll attitudes that occurred in the OH-6A (ref 4, app A) at airspeeds in excess of 110 KCAS were not found to be present in the Model 369C helicopter. Recovery techniques following a simulated engine failure are considered to be satisfactory.

50. In the OH-6A, variations in trim of up to 4 inches of aft longitudinal control and 5 inches of right lateral control were required for transition from level flight to autorotational descent. In the Model 369C helicopter, the trim changes were found to be reduced to approximately 2 inches of aft longitudinal control and 1 inch of right lateral control. This reduction in control trim change is a significant improvement in the Model 369C relative to the OH-6A. Cyclic control position changes during autorotational entry and descent in the Model 369C are satisfactory.

51. The time available for pilot recognition and reaction to sudden engine failure (delay time) was determined for all test conditions. The critical parameter was rotor rpm. The contractor would not define a safe minimum transient rotor rpm, therefore, the pilot, in a buildup program, selected 450 as recovery rpm. The minimum transient rotor rpm encountered was approximately 445 due to the quick response of the rotor to recovery action. A drop in engine torque was the only available cue for determination of the throttle chop from the onboard data acquisition system. Delay times for maximum power climbs averaged 1 second, while delay times in level flight ranged from 1.8 seconds at 60 KCAS to 1 second at 137 KCAS. Because of a possible error in recorded delay time due to inadequate instrumentation and slow engine torque bleed-off, further testing should be conducted to develop height-velocity curves and to evaluate the effect of the rate of decrease of engine torque on autorotational entry characteristics. A qualitative throttle chop was performed at 150-KIAS descending flight but recovered as soon as possible to minimize the chance of exceeding VNE. The delay time available following a simulated engine failure of the Model 369C helicopter is satisfactory.

52. Autorotational descent characteristics were evaluated during both the autorotational descent performance (para 16) and simulated engine failure testing (paras 47 through 50). At the high gross weights tested, full-down collective resulted in a rapid buildup of rotor rpm. This rapid buildup of rpm required considerable pilot attention to prevent overspeeding the rotor during the initial entry phase of the autorotation (HQRS 4). During descent, collective pitch was continually adjusted to maintain a desired rpm since small variations in airspeed and/or altitude resulted in large variations in rotor rpm. This characteristic is identical to the OH-6A and increases pilot workload (HQRS 4). The excessive pilot workload required to control rotor speed in autorotation is a shortcoming, correction of which is desirable if the helicopter is procured.
Takeoff Characteristics

53. Takeoff characteristics were evaluated throughout the test. During transition and acceleration from hover to forward flight, a nose-up pitching moment was produced by upward motion of the collective control. This coupling was not objectionable, but the pilot was unable to trim out the longitudinal control forces required to maintain the desired takeoff flight path for approximately 5 seconds (HQRS 3). This characteristic was present in the OH-6A. Although the Model 369C trim system incorporated a faster trim motor than the OH-6A trim system, this trim motor did not provide a trim rate large enough to equal the longitudinal trim requirement of the Model 369C during takeoff. This slow rate in trimming longitudinal control forces encountered during takeoff is only mildly unpleasant (HQRS 3). Within the scope of this test, takeoff flight characteristics of the Model 369C are satisfactory.

Decelerating Flight Characteristics

54. Decelerating flight characteristics of the Model 369C helicopter were evaluated throughout the test program. During deceleration from high airspeeds (100 to 140 KIAS) to a hover, both the engine and rotor exceeded the upper limit of the normal power-ON operating speed range (103 percent). A level deceleration from 120 KIAS at 103-percent N2 to a hover was conducted to further evaluate this characteristic. During this deceleration, the engine governor beeper trim switch was not used, in order to duplicate normal operational technique. The rotor and engine speed increased to 107-percent N2 before the pilot took corrective action to prevent a further increase which could have resulted in damage to the aircraft. This minor but annoying aircraft characteristic requires moderate pilot compensation for desired engine and rotor control during deceleration (HQRS 4). This engine and rotor overspeed characteristic during deceleration from high airspeeds is a shortcoming, correction of which is desirable if the helicopter is procured.

55. During deceleration from any airspeed to a hover, a 5/rev vibration was felt throughout the entire aircraft and was most noticeable in the directional pedals. This vibration was uncomfortable and distracting to the pilot and is a shortcoming, correction of which is desirable if the helicopter is procured.

High-Speed Flight Characteristics

56. Flights at 137 KCAS (VH) and 150 KCAS (VNE) were evaluated at the maximum design gross weight of 3150 pounds at both an aft and slightly forward cg at a density altitude of 2400 feet. Two qualitative flights were conducted with an operational Army pilot who was experienced in the OH-6A helicopter. This pilot either contributed or concurred with the qualitative comments in the following paragraphs.

57. At VH, the neutral maneuvering stability (para 46), the neutral static longitudinal stability (para 30), the excessive longitudinal control response and
sensitivity (paras 39 and 40), and the poor flying qualities in turbulence (paras 35 through 39) created an unusually high pilot workload (HQRS 5). Reducing the airspeed to approximately 133 KCAS and ballasting to a cg location of fuselage station (FS) 99.0 (forward) improved the flying qualities to an acceptable level and is the airspeed and cg combination recommended for high speed operation. This airspeed, however, cannot be maintained longer than 5 minutes due to the transmission limitation. Flight above 133 KCAS should be performed only when warranted, as considerable pilot compensation is necessary for adequate performance (HQRS 5). Further testing at different altitudes and cg conditions should be conducted to fully evaluate the Model 369C flight characteristics at V_H.

58. Flight at 150 KCAS (V_{NE}) required maximum-allowable power and a rate of descent varying from 500 to 700 ft/min. The adverse handling qualities exhibited at 137 KCAS were worse at 150 KCAS. Moving the cg forward to FS 99.0 improved flying qualities, but they were still marginal. Blade stall was encountered at this airspeed at bank angles of 30 degrees (1.2g), left and right. Flight at 150 KCAS (V_{NE}) requires extensive pilot compensation for adequate performance (HQRS 6). The limited maneuvering capability and the objectionable handling qualities at 150 KCAS limit the operational capability of the helicopter. Further testing should be conducted to evaluate the effect of altitude and cg change on the flying qualities of the Model 369C at V_{NE}.

MISCELLANEOUS

Airspeed Calibration

59. The standard airspeed system was not installed on the aircraft. An airspeed calibration was performed on the boom system at the conditions listed in table 1, appendix C, and the test results are presented in figure 41, appendix G. A measured ground course was flown in calm air from 30 KIAS to V_{H}. Calibration should be performed on the helicopter standard airspeed system when installed.

Weight and Balance

60. The test helicopter, S/N 65-12951, was weighed by HTC-AD prior to starting the test program. The weighing was accomplished in a closed hangar with mechanical weighing scales placed under the aircraft skids. The basic weight (empty aircraft plus full hydraulic fluid and trapped fuel) was 1344 pounds. After the instrumentation was installed and fuel and oil added, the test aircraft weighed 2155 pounds, and the cg location was FS 106.85.
CONCLUSIONS

GENERAL

61. The following conclusions were reached at the completion of the Army Preliminary Evaluation of the Hughes Model 369C helicopter:

a. Hover performance is improved as compared to the OH-6A (para 13).

b. Level flight speed capability is improved as compared to the OH-6A (para 14).

c. Removing the maximum-continuous transmission limit of 278 shp will enable the Model 369C to achieve substantially higher airspeeds in level flight at sea level (para 14).

d. Within the OH-6A speed range, the static and dynamic stability and controllability of the Model 369C and OH-6A are essentially the same (paras 30, 32, 34, 35, 36, 39, 40, 41, 42, 43, and 44).

e. Handling qualities of the Model 369C are degraded at airspeeds that exceed the envelope of the OH-6A (paras 30, 34, 37, 39, 40, and 46).

f. Autorotational entry characteristics and trim changes between level flight and autorotation are improved compared to the OH-6A (paras 49 and 50).

g. The limited maneuvering capability and the objectionable handling qualities at 150 KCAS limit the operational capability of the Model 369C helicopter (para 58).

h. There was one deficiency and 12 shortcomings identified during the evaluation.

DEFICIENCY AND SHORTCOMINGS

62. Correction of the inadequate longitudinal control margin deficiency observed during left sideward and rearward flight at a forward cg loading is mandatory if the helicopter is procured (paras 21 and 23).

63. Correction of the following shortcomings is desirable if the helicopter is procured:

a. Directional instability in left sideward flight (HQRS 4) (para 20).

b. Directional instability in rearward flight (HQRS 4) (para 22).
c. Excessive left pedal force during hover (HQRS 4) (para 26).

d. Excessive pilot workload required to perform precision hovering tasks (HQRS 5) (para 28).

e. Neutral static longitudinal stability in the airspeed band of 130 KCAS to maximum level flight (HQRS 5) (para 30).

f. Excessively rapid buildup of normal acceleration following a simulated longitudinal gust disturbance (HQRS 6) (para 34).

g. Excessive roll response of the helicopter at 137 KCAS following a simulated directional gust disturbance (HQRS 6) (para 37).

h. Excessive longitudinal control response and sensitivity at high airspeeds (HQRS 5) (paras 39 and 40).

i. Neutral maneuvering stability and tendency to encounter blade stall at airspeeds approaching maximum level flight (HQRS 6) (para 46).

j. Excessive pilot workload required to control rotor speed in autorotation (HQRS 4) (para 52).

k. Unsatisfactory engine and rotor overspeed characteristic during deceleration from high airspeeds (HQRS 4) (para 54).

l. Excessive 5/rev vibration of the aircraft during deceleration to a hover (para 55).

MILITARY SPECIFICATION COMPLIANCE

64. Within the scope of this test, the Hughes Model 369C helicopter failed to meet the following requirements of the military specification, MIL-H-8501A:

a. Paragraph 3.2.1 – Inadequate control remains to counteract longitudinal disturbances (paras 21 and 23).

b. Paragraph 3.3.12 – Maximum left pedal force of 15 pounds was exceeded by 10 pounds, or 67 percent (para 26).

c. Paragraph 3.2.10 – The helicopter did not, at all forward speeds, exhibit positive static longitudinal stability (para 30).

d. Paragraph 3.3.15 – The maximum rate of roll per inch of sudden control deflection exceeded 20 deg/sec by 100 percent (para 41).

e. Paragraph 3.3.15 – The tendency to overcontrol due to the response of the Model 369C to lateral control deflection (para 42).
f. Paragraph 3.3.7 – The tendency to overcontrol due to the response of the Model 369C to directional control deflection (para 44).
RECOMMENDATIONS

65. If procurement is planned, the deficiency, correction of which is mandatory, should be corrected prior to any airworthiness release of the Hughes Model 369C helicopter for flight at a forward cg by operational pilots (para 62).

66. If procurement is planned, the shortcomings, correction of which is desirable, should be corrected prior to production (para 63).

67. The following "CAUTION" should be included in the operator's manual (para 46):

CAUTION

Abrupt longitudinal control movement or roll attitudes in excess of 30 degrees, left and right, at airspeeds approaching maximum level flight will cause blade stall and should be avoided.

68. The following "NOTE" should be included in the operator's manual (para 25):

NOTE

The fuel control system overcompensates for rotor droop as collective pitch is increased and may result in overspeeding the engine.

69. Main rotor dampers, HTC-AD part number 369ASK1933, should be installed if considered for procurement (para 27).

70. The helicopter standard airspeed system should be calibrated when installed (para 59).

71. Further testing should be conducted to:

   a. Evaluate the effects of altitude, weight, and cg variation (paras 13, 16, 23, 30, 34, 37, 40, 46, 57, and 58).
   
   b. Determine a safe operational cg envelope for hovering in winds (para 23).
   
   c. Develop height-velocity curves (para 51).
   
   d. Evaluate the effect of the rate of decrease of engine torque on autorotational entry characteristics (para 51).
APPENDIX A. REFERENCES


### APPENDIX B. GENERAL AIRCRAFT AND COMPONENT DESCRIPTION AND PHOTOGRAPHS

**FUSELAGE AND LANDING GEAR DIMENSIONS**

Same as the OH-6A helicopter

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</thead>
<tbody>
<tr>
<td>Horizontal Stabilizer</td>
<td>5.15 ft</td>
<td>0.71 ft</td>
<td>1.40 ft</td>
<td>5.43 ft²</td>
<td>NACA 6518</td>
<td>NACA 6515</td>
<td>25-percent chord, T.E. left 3 deg</td>
</tr>
<tr>
<td>Upper Vertical Stabilizer</td>
<td>3.52 ft</td>
<td>0.83 ft</td>
<td>1.18 ft</td>
<td>3.54 ft²</td>
<td>NACA 0021</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Vertical Stabilizer</td>
<td>2.50 ft</td>
<td>0.53 ft</td>
<td>1.18 ft</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Photo 1. Five-Blade Main Rotor Hub.

Photo 2. Four-Blade Tail Rotor and Gearbox.
Photo 3. T-Tail.
Area 2.14 ft$^2$
Airfoil (tip) NACA 0012

**TAIL BOOM STRUCTURE**

Basic boom skin thickness 0.040 in.
Upper and lower boom centerlines Additional hat-section stringers
Boom to aft fuselage junction External brackets added
Landing gear Strengthened over OH-6A (includes a swivel feature to reduce pitching velocity)

**MAIN ROTOR CHARACTERISTICS**

Number of blades 5
Rotor diameter 26.41 ft
Rotor disc area 547.94 ft$^2$
Blade chord (constant) 0.562 ft
Blade twist (root to tip) 9 deg
Blade area (total blades x c x R) 37.13 ft$^2$
Solidity ratio 0.068
Airfoil section NACA 0015
Delta three Zero deg
Droop stop flapping -6 deg
Droop stop coning (static) Zero deg
Droop stop coning (rotating) -2 deg
Built-in collective pitch at 3/4R (straps untwisted) 8 deg
Equivalent flapping hinge offset 6 in.

**TAIL ROTOR CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of blades</td>
<td>4 (two 2-bladed rotors)</td>
</tr>
<tr>
<td>Rotor diameter</td>
<td>4.83</td>
</tr>
<tr>
<td>Rotor disc area</td>
<td>18.34 ft²</td>
</tr>
<tr>
<td>Blade chord (constant)</td>
<td>0.40 ft</td>
</tr>
<tr>
<td>Blade twist (root to tip)</td>
<td>8 deg</td>
</tr>
<tr>
<td>Blade area (total blades x c x R)</td>
<td>3.872 ft²</td>
</tr>
<tr>
<td>Solidity ratio</td>
<td>0.204</td>
</tr>
<tr>
<td>Airfoil section</td>
<td>NACA 63-415 modified</td>
</tr>
<tr>
<td>Delta three</td>
<td>30 deg</td>
</tr>
<tr>
<td>Droop stop flapping limits</td>
<td>10 deg, soft 15 deg, hard</td>
</tr>
</tbody>
</table>

**MAIN ROTOR BLADE MOVEMENTS** (Blade angles measured on pitch housing)

Average range of cyclic pitch blade angles from neutral rigging position (collective pitch, mid position)

<table>
<thead>
<tr>
<th>Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.90 deg, forward</td>
</tr>
<tr>
<td>8.00 deg, aft</td>
</tr>
<tr>
<td>9.00 deg, left</td>
</tr>
<tr>
<td>6.85 deg, right</td>
</tr>
</tbody>
</table>

Average range of collective pitch blade angles from neutral collective

<table>
<thead>
<tr>
<th>Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.80 deg, up</td>
</tr>
<tr>
<td>7.80 deg, down</td>
</tr>
</tbody>
</table>
TAIL ROTOR BLADE MOVEMENTS

Average range of directional pitch blade angles from neutral
- 12.52 deg, right
- 28.55 deg, left

FLIGHT CONTROLS GROUP

(Same as OH-6A helicopter below the rotating swashplate except for a minor modification in the collective bungee)

CONTROL TRAVEL

(Same as OH-6A helicopter)

TRANSMISSION DRIVE SYSTEM RATIOS

- Engine to main rotor: 12.121:1
- Engine to tail rotor: 2.9703:1
- Engine to tail rotor drive shaft: 2.765:1
- Allison turboshaft engine (model 250-C20): 400 shp
### APPENDIX C. TEST CONDITIONS

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Indicated Airspeed (kt)</th>
<th>Average Density Altitude (ft)</th>
<th>Average Outside Air Temperature (°C)</th>
<th>Average Center-of-Gravity Location (in.)</th>
<th>Rotor Speed (rpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Flight performance</td>
<td>31 to 131</td>
<td>3,080</td>
<td>19.8</td>
<td>100,0 (mid)</td>
<td>510</td>
</tr>
<tr>
<td>(CT = 0.004088)</td>
<td>30 to 122</td>
<td>3,070</td>
<td>19.5</td>
<td>600</td>
<td>505 and 510</td>
</tr>
<tr>
<td>(CT = 0.004832)</td>
<td>35 to 105</td>
<td>11,540</td>
<td>18.5</td>
<td>101.0 (mid)</td>
<td>510</td>
</tr>
<tr>
<td>(CT = 0.006752)</td>
<td>30 to 137</td>
<td>3,090</td>
<td>24.0</td>
<td>101.0 (mid)</td>
<td>510</td>
</tr>
<tr>
<td>Hover performance</td>
<td>29 to 100</td>
<td>3,050</td>
<td>18.0</td>
<td>104.0 (aft)</td>
<td>510</td>
</tr>
<tr>
<td>OGE hover performance</td>
<td>29 to 100</td>
<td>3,050</td>
<td>18.0</td>
<td>104.0 (aft)</td>
<td>510</td>
</tr>
<tr>
<td>Autorotational descent</td>
<td>60</td>
<td>3,100</td>
<td>24.0</td>
<td>21.0</td>
<td>465 to 428</td>
</tr>
</tbody>
</table>

Note: Minimum gross weight plus varying cable tension.
Table 2. Handling Qualities Test Conditions of the Hughes Model 369C, S/N 65-1251.

Rotor Speed: 510 rpm

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Flight Condition</th>
<th>Indicated Airspeed (kt)</th>
<th>Average Gross Weight (lb)</th>
<th>Average Density Altitude (ft)</th>
<th>Average Outside Air Temperature (°C)</th>
<th>Average Center-of-Gravity Location (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trim control characteristics</td>
<td>Level</td>
<td>40 to 140</td>
<td>3100</td>
<td>3180</td>
<td>30.0</td>
<td>104.0 (aft)</td>
</tr>
<tr>
<td></td>
<td>Climb</td>
<td>30 to 90</td>
<td>3050</td>
<td>1900</td>
<td>18.0</td>
<td>104.0 (aft)</td>
</tr>
<tr>
<td></td>
<td>Sideward IGE</td>
<td>35 left to 35 right</td>
<td>3120</td>
<td>860</td>
<td>20.5</td>
<td>96.9 (fwd)</td>
</tr>
<tr>
<td></td>
<td>Rearward IGE</td>
<td>Zero to 30</td>
<td>3160</td>
<td>900</td>
<td>21.0</td>
<td>96.9 (fwd)</td>
</tr>
<tr>
<td>Static longitudinal stability</td>
<td>Level</td>
<td>51, 109, and 140</td>
<td>3100</td>
<td>2400</td>
<td>25.0</td>
<td>104.1 (aft)</td>
</tr>
<tr>
<td>Static lateral-directional stability</td>
<td>Level</td>
<td>52, 81, 106, and 139</td>
<td>3100</td>
<td>2370</td>
<td>25.0</td>
<td>104.1 (aft)</td>
</tr>
<tr>
<td>Critical wind determination</td>
<td>Level</td>
<td>Hover</td>
<td>3160</td>
<td>980</td>
<td>22.5</td>
<td>103.9 (aft)</td>
</tr>
<tr>
<td>Maneuvering stability</td>
<td>Level</td>
<td>106 and 138</td>
<td>3050</td>
<td>1850</td>
<td>20.0</td>
<td>104.1 (aft)</td>
</tr>
<tr>
<td>Longitudinal control response and dynamic stability</td>
<td>Level</td>
<td>Hover</td>
<td>3100</td>
<td>1080</td>
<td>22.0</td>
<td>104.1 (aft)</td>
</tr>
<tr>
<td></td>
<td>Level</td>
<td>105 and 140</td>
<td>3050</td>
<td>2450</td>
<td>29.0</td>
<td>104.1 (aft)</td>
</tr>
<tr>
<td></td>
<td>Level</td>
<td>105</td>
<td>2360</td>
<td>2400</td>
<td>19.0</td>
<td>104.0 (aft)</td>
</tr>
<tr>
<td>Lateral control response and dynamic stability</td>
<td>Level</td>
<td>Hover</td>
<td>3060</td>
<td>1080</td>
<td>22.0</td>
<td>104.1 (aft)</td>
</tr>
<tr>
<td></td>
<td>Level</td>
<td>105 and 140</td>
<td>3050</td>
<td>2400</td>
<td>29.0</td>
<td>104.1 (aft)</td>
</tr>
<tr>
<td></td>
<td>Level</td>
<td>105</td>
<td>2360</td>
<td>2400</td>
<td>19.0</td>
<td>104.0 (aft)</td>
</tr>
<tr>
<td>Directional control response and dynamic stability</td>
<td>Level</td>
<td>Hover</td>
<td>3170</td>
<td>500</td>
<td>19.0</td>
<td>103.9 (aft)</td>
</tr>
<tr>
<td></td>
<td>Level</td>
<td>105 and 140</td>
<td>3050</td>
<td>2450</td>
<td>26.0</td>
<td>104.1 (aft)</td>
</tr>
<tr>
<td></td>
<td>Level</td>
<td>105</td>
<td>2360</td>
<td>2400</td>
<td>19.0</td>
<td>104.0 (aft)</td>
</tr>
<tr>
<td>Simulated engine failure</td>
<td>Level</td>
<td>30 to 150</td>
<td>3100</td>
<td>3260</td>
<td>22.0</td>
<td>104.1 (aft)</td>
</tr>
<tr>
<td></td>
<td>Climb</td>
<td>30 to 90</td>
<td>3050</td>
<td>2810</td>
<td>18.0</td>
<td>104.0 (aft)</td>
</tr>
</tbody>
</table>

*Maximum power.*
APPENDIX D. SAFETY-OF-FLIGHT RELEASE

AUG 25 02 38 '71

NNNPNTUZUW RUWTFFA2752 2362251-UUUU--RUWJBDA.

ZNR UUUU

PR 242200Z AUG 71

FM CG USAAVSCOM ST LOUIS MO

TO RUWJBDA/CO USAASTA EDWARDS AFB CALIF

INFO RUEBBNA/CG USAMC WASH DC

BT

UNCLAS

AMSAV-EFI

ACTION FOR SAVTE-P AMC FOR AMCRD-FQ AND AMCF-S-FA

IN REPLY REFER TO: Ø8-15

SUBJECT: SAFETY OF FLIGHT RELEASE FOR 369C DEMONSTRATION

A. HUGHES TOOL CO, REPORT NO 369-X-8Ø32A, OH-6C DEMONSTRATION

PROTOTYPE SAFETY OF FLIGHT REVIEW, DATED 2Ø AUG 71.

1. THIS CONSTITUTES A SAFETY OF FLIGHT RELEASE FOR USAASTA TO

CONDUCT AN EVALUATION OF THE HUGHES TOOL CO., AIRCRAFT DIV (HTC-AD)

MODEL 369C.

2. THE OPERATING PROCEDURES AND LIMITATIONS OF THE MODEL 369C SHALL

BE IN ACCORDANCE WITH THE TM 55-152Ø-214-1Ø EXCEPT AS MODIFIED BY

THIS SAFETY OF FLIGHT RELEASE AND OPERATING PROCEDURES TO BE

PROVIDED BY HTC-AD. HELICOPTER OPERATING LIMITATIONS ARE AS FOLLOWS:

A. INSTRUMENT MARKINGS - THE AIRCRAFT INSTRUMENT MARKINGS HAVE BEEN

35
CHANGED FROM A STANDARD OH-6A TO CONFORM TO THE APPLICABLE LIMITATIONS.

B. MAXIMUM TAKEOFF GROSS WEIGHT 3200 POUNDS.


D. MAXIMUM LOAD FACTORS - REFERENCE HTC-AD REPORT 369-X-8032A, FIGURE 3.

E. AIRSPEED LIMITATIONS

VNE - 150 KCAS, SEA LEVEL, STANDARD DAY FOR PRESSURE ALTITUDE VARIATIONS (REFERENCE HTC-AD REPORT 369-X-8032A, FIGURE 5)

F. MAIN ROTOR LIMITATIONS

(1) NORMAL POWER-ON OPERATING RANGE IS 102 to 103 PERCENT N2.

(2) POWERED FLIGHT, MAXIMUM 510 RPM, MINIMUM 505 RPM.

(3) AUTOROTATION, MAXIMUM 528 RPM, MINIMUM UNDER 2400 LBS GW 400 RPM, OVER 2400 LBS GW 465 RPM.

G. ENGINE OUTPUT SHAFT SPEED (N2), 103 PER CENT N2EQUALS 6180 RPM.

H. TORQUE PRESSURE, TAKEOFF POWER (5 MINUTES) 82.4 PSIG MAX, CONTINUOUS 64.5 PSIG MAX.

I. TURBINE OUT TEMPERATURE, TAKEOFF POWER (5MINUTES) 793 DEGREE C, CONTINUOUS 757 DEGREE C.

J. SIDESLIP ANGLE LIMITATIONS- REFERENCE HTC-AD REPORT 369-X-8032A,
FIGURE 6. SIDEWARD FLIGHT IS LIMITED TO 35 KNOTS. REARWARD FLIGHT IS LIMITED TO 30 KNOTS.

K. FLIGHT OF THE HTC-AD MODEL 369C IS LIMITED TO AMBIENT TEMPERATURES OF LESS THAN 46 DEGREE C BECAUSE OF ENGINE OIL COOLING LIMITATIONS.

1. TOTAL FLIGHT HOURS OF THE HTC-AD MODEL 369C SHALL BE LIMITED TO 200 HOURS BECAUSE OF LIMITATIONS ON THE FATIGUE LIFE OF CERTAIN CRITICAL COMPONENTS.

3. THE FOLLOWING MAINTENANCE INSTRUCTIONS APPLY AS RESTRICTIONS TO THE OPERATION OF THE HTC-AD 369C.

A. THE TRIM TABS ON THE VERTICAL AND HORIZONTAL STABILIZERS SHALL NOT BE ADJUSTED UNLESS AUTHORIZED BY THE HTC-AD FLIGHT TEST PROJECT ENGINEER.

B. THE FOLLOWING COMPONENTS SHALL BE INSPECTED VISUALLY FOR EVIDENCE OF IMPENDING FAILURE SUCH AS UNUSUAL DISTORTION, CRACKS IN SHEET METAL, ENLARGED ATTACHMENT HOLES AND CRACKED MACHINED OR FORGED PARTS. SUSPICION OF POSSIBLE FAILURE OF THE PART(S) SHALL BE CAUSE FOR HALTING OF TEST FLIGHTS UNTIL A POSITIVE IDENTIFICATION CAN BE MADE.

(1) "T" TAIL ATTACHMENT FITTINGS AT THE JUNCTION OF OPERATION)
(2) "T" TAIL ATTACHMENT FITTINGS TO TAIL BOOM (DAILY)
(3) TAIL ROTOR FORK, PITCH LINKS AND ATTACHMENT HARDWARE (PREFLIGHT)
(4) TAIL BOOM ASSEMBLY, AFT, AT THE TAIL ROTOR GEARBOX ATTACHMENT
BULKHEAD. ALONG STIFFENERS AND AT TAIL BOOM SPLICES (DAILY)
(5) ALL LOAD CARRYING STRUCTURE (SKIN AND FRAMES) ON THE AFT
FUSELAGE (DAILY)
(6) MAIN ROTOR HUB, BLADE ATTACHMENT FITTINGS, PITCH ARMS,
DAMPER ARMS AND BLADE RETENTION STRAPS. ANY SINGLE LAMINATE FAILURE
SHALL HALT TESTING (PREFLIGHT)

4. A VERIFICATION COPY OF THIS MESSAGE WILL BE FORWARDED BY MAIL

BT

2752
APPENDIX E

HANDLING QUALITIES RATING SCALE

ADEQUACY FOR SELECTED TASK OR REQUIRED OPERATION*

Is It Satisfactory Without Improvement?

Yes

Is It Adequate Performance Attainable With A Tolerable Pilot Workload?

Yes

Is It Controllable?

Yes

PILOT DECISIONS

Shortcomings Warrant Improvement

Deficiencies Require Improvement

Improvement Mandatory

Based Upon Cooper-Harper Handling Qualities Rating Scale (Ref. NASA TN D-5153) And Definitions In Accordance With AR 310-25.

AIRCRAFT CHARACTERISTICS

EXCELLENT - HIGHLY DESIRABLE
GOOD - DESIRABLE
FAIR - SOME MILDLY UNPLEASANT
MINOR BUT ANNOYING SHORTCOMINGS
MODERATELY OBJECTIONABLE SHORTCOMINGS
VERY OBJECTIONABLE BUT TOLERABLE SHORTCOMINGS
MAJOR DEFICIENCIES
MAJOR DEFICIENCIES
MAJOR DEFICIENCIES

DEMANDS ON THE PILOT IN SELECTED TASK OR REQUIRED OPERATION*

Pilot compensation not a factor for desired performance.
Pilot compensation not a factor for desired performance.
Minimal pilot compensation required for desired performance.
Desired performance requires moderate pilot compensation.
Adequate performance requires considerable pilot compensation.
Adequate performance requires extensive pilot compensation.
Adequate performance not attainable with maximum tolerable pilot compensation. Controllability not in question.
Considerable pilot compensation required for control.
Intense pilot compensation required to retain control.
Control will be lost during some portion of required operation.

PILOT RATING

1
3
3
4
5
6
7
8
3
10

*Definition of REQUIRED OPERATION involves designation of flight phase and/or subphases with accompanying conditions.
APPENDIX F. TEST INSTRUMENTATION

OSCILLOGRAPH

Main rotor rpm
Longitudinal cyclic control position
Lateral cyclic control position
Directional pedal position
Collective control position
Angle of attack
Pitch rate
Roll rate
Yaw rate
Center-of-gravity normal acceleration
Engine torque pressure
Six-volt reference

COCKPIT

Rotor speed
Wet compass
Boom airspeed indicator
Altimeter indicator
Free air temperature
Exhaust gas temperature
Sensitive torque pressure
Power turbine speed
Gas producer speed
Center-of-gravity normal accelerometer
Fuel totalizer (available only during hover and level flight performance tests)

INSTRUMENT LOCATION

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Fuselage Station</th>
<th>Water Line</th>
<th>Buttline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinal cyclic control position</td>
<td>57.36</td>
<td>17.50</td>
<td>4.00 right</td>
</tr>
<tr>
<td>Lateral cyclic control position</td>
<td>61.36</td>
<td>20.00</td>
<td>8.00 right</td>
</tr>
<tr>
<td>Directional pedal position</td>
<td>43.60</td>
<td>18.50</td>
<td>3.75 right</td>
</tr>
<tr>
<td>Collective control position</td>
<td>74.50</td>
<td>23.10</td>
<td>24.00 left</td>
</tr>
<tr>
<td>Rate gyro</td>
<td>100.00</td>
<td>13.00</td>
<td>Zero</td>
</tr>
<tr>
<td>Center-of-gravity acceleration</td>
<td>105.00</td>
<td>23.25</td>
<td>Zero</td>
</tr>
<tr>
<td>Engine torque pressure</td>
<td>119.00</td>
<td>25.25</td>
<td>16.00 left</td>
</tr>
<tr>
<td>Airspeed</td>
<td>85.50</td>
<td>25.25</td>
<td>8.50 left</td>
</tr>
</tbody>
</table>
APPENDIX G. TEST DATA

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<th>Figure Number</th>
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<td>Level Flight Performance</td>
<td>8 through 15</td>
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<td>Autorotational Descent Performance</td>
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<td>18 through 21</td>
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<td>Static Lateral-Directional Stability</td>
<td>24 through 28</td>
</tr>
<tr>
<td>Dynamic Stability</td>
<td>29 through 31</td>
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<tr>
<td>Longitudinal Controllability</td>
<td>32 and 33</td>
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<td>Lateral Controllability</td>
<td>34 and 35</td>
</tr>
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<td>Directional Controllability</td>
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<td>38</td>
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<td>Autorotational Entry</td>
<td>39 and 40</td>
</tr>
<tr>
<td>Airspeed Calibration</td>
<td>41</td>
</tr>
</tbody>
</table>
Figure 1
Specification Fuel Flow
250-C20 Engine

Notes:
1. Supplied by Airframe Manufacturer
2. Standard day
3. Uninstalled
4. $N_2 \cdot 10^4$
NOTES:
1. All data supplied by airframe manufacturer.
2. $N_2 = 103\%$
3. Inlet pressure loss = 2.2 in. of H$_2$O
4. Temperature rise = 2.0°C
5. Exhaust pressure = std atm pressure + 0.05 in. of Hg
6. Broken line denotes extrapolation.
Figure 3
ENGINE SHAFT HORSEPOWER AVAILABLE
OUT OF GROUND EFFECT
TAKE-OFF POWER
250-C 20 ENGINE

NOTES:
1. ALL DATA SUPPLIED BY AIRFRAME MANUFACTURER
2. $N_2 = 0.1039$ atm
3. INLET PRESSURE LOSS = 2.2 IN. OF H$_2$O
4. EXHAUST PRESSURE = STD ATM PRESSURE
   + 0.65 IN. OF H$_2$O

PRESURE ALTITUDE ~ FEET

SHAFT HORSEPOWER ~ SHP

STANDARD DAY

TRANSMISSION TORQUE LIMIT

CONSTANT 35°C OAT
NOTES:
1. ALL DATA SUPPLIED BY AIRFRAME MANUFACTURER
2. N₂ = 103%
3. INLET PRESSURE LOSS = 2.2 in. of H₂O
4. EXHAUST PRESSURE = STD ATM PRESSURE + 0.65 IN. OF Hg
**Figure 5**

**Non-dimensional Hovering Performance**

369C

**Notes:**
1. Tethered hovering method
2. Wind less than 2 knots
3. Density altitude = 600 ft
4. OAT = 19.5°C
5. Height from bottom of skid to rotor hub = 8.46 ft

○ ~ 510 RPM
□ ~ 505 RPM
NOTE: 1. SHP OBTAINED FROM FIG. 2
2. CURVES DERIVED FROM FIG. 5
3. BROKEN LINE DERIVED FROM EXTRAPOLATED PORTION OF FIG. 5
4. ROTOR SPEED = 510 RPM (N2 = 103%)
5. WIND LESS THAN 2 KNOTS
6. HEIGHT FROM BOTTOM OF SKID TO ROTOR HUB = 8.46 FT
NOTES:
1. SHP Obtained from Fig. 3
2. Curves derived from Fig. 5
3. Broken line derived from extrapolated portion of Fig. 5
4. Rotor speed = 510 RPM ($N_e = 103\%$)
5. Wind less than 2 knots
6. Height from bottom of skid to rotor hub = 6.46 ft

**Figure 7**
Out of Ground Effect Hovering Ceiling

Take-off Power

Pressure Altitude ~ Feet

Gross Weight ~ Pounds

Design Gross Weight

Standard Day

Constant 35°C Day
Figure 8
Non-dimensional Level Flight Performance
369C

NOTES:
1. Rotor Speed = 510 RPM
2. Points derived from faired curves of Fig. 11 thru Fig. 14

For Official Use Only
FIGURE 9
NON-DIMENSIONAL LEVEL FLIGHT PERFORMANCE
369 C
NAGS-12951

NOTES:
1. ROTOR SPEED = 510 RPM
2. POINTS DERIVED FROM FAIRED
   CURVES OF FIG. 11, THRU FIG. 14.

\[ C_{T} \times 10^{6} = \frac{\text{GRWT} \times 10^{9}}{\text{PA}(\text{AR})^{2}} \]
Figure 10
NON-DIMENSIONAL LEVEL FLIGHT PERFORMANCE

SEE Page 129 for details.

NOTES:
1. ROTOR SPEED = 510 RPM
2. POINTS DERIVED FROM FAIRED CURVES OF FIG. 11 THRU FIG. 14.
**Figure II**

**LEVEL FLIGHT PERFORMANCE**

3695 C. 460-2951

<table>
<thead>
<tr>
<th>AVG DENSITY ALTITUDE - FT</th>
<th>AVG. GRWT.-LB</th>
<th>AVG. OAT.-°C</th>
<th>AVG. LONG. C.G.-IN.</th>
<th>AVG ROTOR SPEED.-RPM</th>
<th>AVG Ct.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3100</td>
<td>2420</td>
<td>25.5</td>
<td>101.1 (MID)</td>
<td>510</td>
<td>0.004088</td>
</tr>
</tbody>
</table>

- 0.99 MAX. WAMFP
- CURVE BASED ON SPEC FUEL FLOW FIG. 1
- TAKE-OFF POWER AVAILABLE
- CONTINUOUS POWER AVAILABLE (TRANSMISSION LIMITED)
- CURVE DERIVED FROM FIGURES 8 THRU 10
Figure 12
Level Flight Performance
3696 ft  3/65 (395)

<table>
<thead>
<tr>
<th>Avg Density Altitude (FT)</th>
<th>Avg Gross Weight (LB)</th>
<th>Avg OAT (°C)</th>
<th>Avg Long CG (IN)</th>
<th>Avg Rotor Speed (RPM)</th>
<th>Avg Ct</th>
</tr>
</thead>
<tbody>
<tr>
<td>2290</td>
<td>2950</td>
<td>24.5</td>
<td>104.1 (RFT)</td>
<td>510</td>
<td>0.004838</td>
</tr>
</tbody>
</table>

0.99 Max NAMPP
Curve based on spec fuel flow Fig. 1.

Take-off Power Available
(5 min transmission limit)

Continuous Power Available
(Transmission Limited)

Curve derived from Figures 8 thru 10

Engine Output Shaft Horsepower

Specific Range - NMP

True Airspeed - Knots
Figure 13
Level Flight Performance

<table>
<thead>
<tr>
<th>AVG DENSITY ALTITUDE-FT</th>
<th>AVG GRWT-LB</th>
<th>AVG OAT-°C</th>
<th>AVG LONG. CG-IN.</th>
<th>AVG ROTOR SPEED-RPM</th>
<th>AVG Ct</th>
</tr>
</thead>
<tbody>
<tr>
<td>7190</td>
<td>3090</td>
<td>24.0</td>
<td>101.0(MID)</td>
<td>510</td>
<td>0.005920</td>
</tr>
</tbody>
</table>

- Curve derived from figures 8 thru 10
- 0.99 Max. NAMPB
- Curve based on spec fuel flow fig. 1
**Figure 14**

**LEVEL FLIGHT PERFORMANCE**

<table>
<thead>
<tr>
<th>AVG DENSITY ALTITUDE-FT</th>
<th>AVG GRWT-LB</th>
<th>AVG OAT-°C</th>
<th>AVG LONG C.G.-1.M.</th>
<th>AVG ROTOR SPEED-RPM</th>
<th>AVG Ct</th>
</tr>
</thead>
<tbody>
<tr>
<td>11540</td>
<td>3070</td>
<td>1875</td>
<td>12.0 (HIGH)</td>
<td>510</td>
<td>0.006752</td>
</tr>
</tbody>
</table>

- MAX. NAMPP CONTINUOUS POWER
- CURVE BASED ON SPEC FUEL FLOW FIG. 1
- TAKE-OFF POWER AVAILABLE
- CONTINUOUS POWER AVAILABLE
- CURVE DERIVED FROM FIGURES 8 THROUGH 10
Figure 13
Level Flight Range Performance

Notes:
1. Standard Day
2. Rotor Speed - 510 RPM
3. Curves derived from Fig. 8 through Fig. 10 and Fig. 1

Long Range Cruise Speed at 0.99 Max. NAMP - KTAS

Specific Range at Long Range Cruise Speed ~ NAMP

Gross Weight ~ LBS

5000 FT
SEA LEVEL
<table>
<thead>
<tr>
<th>AVG DENSITY ALTITUDE</th>
<th>AVG GRNT WT</th>
<th>AVG OAT °C</th>
<th>AVG LONG. CG</th>
<th>ROTOR SPEED ~RPM</th>
<th>AVG Ct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>305.0</td>
<td>18.0</td>
<td>104.0 (AFD)</td>
<td>510</td>
<td>0.004980</td>
</tr>
</tbody>
</table>

**Figure 16**

**AUTOROTATIONAL DESCENT PERFORMANCE**

NG-5-12951

**Rate of Descent vs. Calibrated Airspeed**

- Rate of Descent: FPM
- Calibrated Airspeed: Knots
<table>
<thead>
<tr>
<th>AVG DENSITY</th>
<th>AVG GRWT</th>
<th>AVG OAT</th>
<th>AVG LONG. CG</th>
<th>AVG TRIM AIRSPEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALTITUDE</td>
<td>GRWT</td>
<td>OAT</td>
<td>CG</td>
<td>AIRSPEED</td>
</tr>
<tr>
<td>~FT</td>
<td>~LB</td>
<td>~°C</td>
<td>~IN.</td>
<td>~KCAS</td>
</tr>
<tr>
<td>2240</td>
<td>3100</td>
<td>21.0</td>
<td>104.1 (AFT)</td>
<td>60</td>
</tr>
</tbody>
</table>

**NOTE:** BROKEN LINES DENOTE STEADY STATE AUTOROTATIONAL ROTOR SPEED LIMITS
**Figure 18**

**Trim Control Positions in Level Flight**

<table>
<thead>
<tr>
<th>AVG DENSITY ALTITUDE</th>
<th>AVG GRWT</th>
<th>AVG OAT</th>
<th>AVG LONG. CG</th>
<th>Rotor Speed</th>
<th>AVG Ct</th>
</tr>
</thead>
<tbody>
<tr>
<td>~FT</td>
<td>~LB</td>
<td>~°C</td>
<td>~IN.</td>
<td>~RPM</td>
<td></td>
</tr>
<tr>
<td>2380</td>
<td>3100</td>
<td>30.0</td>
<td>104.6(AFT)</td>
<td>510</td>
<td>0.005134</td>
</tr>
</tbody>
</table>

**Note:** Total control displacement

- Longitudinal = 12.55 inches
- Lateral = 11.55 inches
- Directional = 7.60 inches
**Figure 19**

**Trim Control Positions in Maximum Power Climb**

<table>
<thead>
<tr>
<th>AVG Density Altitude</th>
<th>AVG Gross Weight</th>
<th>AVG OAT</th>
<th>AVG CG</th>
<th>Rotor Speed</th>
<th>AVG Ct</th>
</tr>
</thead>
<tbody>
<tr>
<td>~FT</td>
<td>~LB</td>
<td>~°C</td>
<td>~IN.</td>
<td>~RPM</td>
<td></td>
</tr>
<tr>
<td>1900</td>
<td>3060</td>
<td>19.0</td>
<td>10.4</td>
<td>510</td>
<td>0.00498</td>
</tr>
</tbody>
</table>

**Total Control Displacement**

- **Longitudinal** = 12.55 inches
- **Lateral** = 11.55 inches
- **Directional** = 7.60 inches
Figure 20
TRIM CONTROL POSITIONS IN SIDeward FLIGHT 360C
3455-12951

<table>
<thead>
<tr>
<th>AVG DENSITY ALTITUDE</th>
<th>AVG WT OAT CG IN</th>
<th>AVG LON. RPM C1</th>
</tr>
</thead>
<tbody>
<tr>
<td>86C.</td>
<td>320 20.5 4.6 (FW)</td>
<td>510 0.004440</td>
</tr>
</tbody>
</table>

NOTE: TOTAL CONTROL DISPLACEMENT
LONGITUDINAL = 12.55 INCHES
LATERAL = 11.55 INCHES
DIRECTIONAL = 7.60 INCHES

10% CONTROL MARGIN
Figure 21
Trim Control Positions in Rearward Flight
369 C

<table>
<thead>
<tr>
<th>Avg Density</th>
<th>Avg Grnt</th>
<th>Avg Oat</th>
<th>Avg Long.</th>
<th>Rotor</th>
<th>Avg Cn</th>
</tr>
</thead>
<tbody>
<tr>
<td>~Ft</td>
<td>~Lb</td>
<td>~°C</td>
<td>~In.</td>
<td>RPM</td>
<td>~</td>
</tr>
<tr>
<td>900</td>
<td>3160</td>
<td>21.0</td>
<td>95.9(FWD)</td>
<td>510</td>
<td>0.005609</td>
</tr>
</tbody>
</table>

Note: Total control displacement
Longitudinal = 12.55 inches
Lateral = 11.55 inches
Directional = 7.60 inches
FIGURE 22
CRITICAL AZIMUTH DETERMINATION
369C 5/AG5-1295
APPROXIMATE 3 FOOT SKID HEIGHT

<table>
<thead>
<tr>
<th>AVG DENSITY</th>
<th>AVG GRIT</th>
<th>AVG OAT</th>
<th>AVG LONG. CG</th>
<th>ROTOR SPEED</th>
<th>AVG CT</th>
<th>WIND VELOCITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALTITUDE</td>
<td>GRIT</td>
<td>OAT</td>
<td>CG</td>
<td>RPM</td>
<td></td>
<td>VELOCITY</td>
</tr>
<tr>
<td>~FT</td>
<td>~LB</td>
<td>~°C</td>
<td>~IN.</td>
<td>~RPM</td>
<td>~KTS</td>
<td></td>
</tr>
<tr>
<td>980</td>
<td>3160</td>
<td>22.5</td>
<td>103.9 (AFT)</td>
<td>510</td>
<td>0.005021</td>
<td>10-16</td>
</tr>
</tbody>
</table>

NOTES:
1. TOTAL CONTROL DISPLACEMENT
   LONGITUDINAL = 12.55 INCHES
   LATERAL = 11.55 INCHES
   DIRECTIONAL = 7.60 INCHES
2. BROKEN LINES DENOTE CONTROL EXCURSIONS WHILE ATTEMPTING TO STABILIZE

WIND AZIMUTH = DEGREES FROM NOSE OF AIRCRAFT
### Figure 23

**Static Longitudinal Collective Fixed Stability**

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>AVG DENSITY</th>
<th>AVG ALTITUDE ~FT</th>
<th>AVG WT ~LB</th>
<th>AVG OAT ~°C</th>
<th>AVG CG ~IN.</th>
<th>ROTOR SPEED ~RPM</th>
<th>AVG CT</th>
<th>AVG AIRSPEED ~KIAS</th>
<th>FLT COND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ Δ</td>
<td>2540</td>
<td>3080</td>
<td>24.0</td>
<td>104.1 (AFT)</td>
<td>610</td>
<td>0.005605</td>
<td>55</td>
<td>LEVEL</td>
<td></td>
</tr>
<tr>
<td>Δ Δ</td>
<td>2490</td>
<td>3120</td>
<td>25.0</td>
<td>104.1 (AFT)</td>
<td>610</td>
<td>0.005184</td>
<td>108</td>
<td>LEVEL</td>
<td></td>
</tr>
<tr>
<td>Δ Δ</td>
<td>2300</td>
<td>3120</td>
<td>26.0</td>
<td>104.1 (AFT)</td>
<td>610</td>
<td>0.005155</td>
<td>137</td>
<td>LEVEL</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. Shaded symbols denote trim point.
2. Total control displacement:
   - Longitudinal = 12.55 inches
   - Lateral = 11.55 inches
   - Directional = 7.60 inches

---

Graphs showing changes in control положения with calibrated airspeed.
Figure 24

Static Lateral - Directional Stability

<table>
<thead>
<tr>
<th>AVG DENSITY</th>
<th>AVG ALTITUDE</th>
<th>AVG GRWT</th>
<th>AVG OAT</th>
<th>AVG LONG</th>
<th>AVG SPEED</th>
<th>CT</th>
<th>AVG AIRSPEED</th>
<th>FLTR</th>
<th>AVG</th>
<th>AVQ</th>
<th>LFT</th>
<th>COND</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVG ALTITUDE</td>
<td>FT</td>
<td>2320</td>
<td>8090</td>
<td>23.5</td>
<td>104.1(AFT)</td>
<td>510</td>
<td>0.005108</td>
<td>55</td>
<td>LEVEL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Collective control position held fixed during test.
2. Shaded symbols denote trim point.
3. Total control displacement:
   - Longitudinal = 12.55 inches
   - Lateral = 11.55 inches
   - Directional = 7.50 inches
4. Broken lines denote level flight side slip limits.
Figure 25

Static Lateral - Directional Stability

AVG DENSITY = 369.8 ft
AVG ALTITUDE = 2400 ft
AVG GRWT = 3090 lb
AVG OAT = 23.0°C
AVG CG = 104.1 in (AFT)
AVG Rotor Speed = 1100 RPM
AVG CT = 450
AVG AFT = 0.005/20° B 3 LEVEL

NOTES:
1. COLLECTIVE CONTROL POSITION HELD FIXED DURING TEST
2. SHADED SYMBOLS DENOTE TRIM POINT
3. TOTAL CONTROL DISPLACEMENT
   LONGITUDINAL = 12.55 INCHES
   LATERAL = 11.55 INCHES
   DIRECTIONAL = 7.60 INCHES
4. BROKEN LINES DENOTE LEVEL FLIGHT SIDE SLIP LIMITS
# Figure 26

## Static Lateral-Directional Stability

<table>
<thead>
<tr>
<th>AVG DENSITY ALTITUDE</th>
<th>AVG GRWT</th>
<th>OAT °F</th>
<th>AVG CG</th>
<th>AVG SPEED</th>
<th>AVG CY</th>
<th>AVG TRIM</th>
<th>FLT COND</th>
</tr>
</thead>
<tbody>
<tr>
<td>2370</td>
<td>3080</td>
<td>25.5</td>
<td>104.1(AFT)</td>
<td>510</td>
<td>0.005099</td>
<td>107 LEVEL</td>
<td></td>
</tr>
</tbody>
</table>

### Notes:

1. Collective control position held fixed during test.
2. Shaded symbols denote trim point.
3. Total control displacement:
   - Longitudinal = 12.55 inches
   - Lateral = 11.55 inches
   - Directional = 7.60 inches
4. Broken lines denote level flight side slip limits.
### Figure 27

**Static Lateral-Directional Stability**

<table>
<thead>
<tr>
<th>AVG DENSITY ALTITUDE NET (lb/sq ft)</th>
<th>AVG GRMT WTS (lb)</th>
<th>AVG OAT °C</th>
<th>AVG LONG (ft)</th>
<th>ROTOR RPM</th>
<th>AVG CY CL (°)</th>
<th>AVG AIRSPEED (KCAS)</th>
<th>FLT COND</th>
</tr>
</thead>
<tbody>
<tr>
<td>2240.0</td>
<td>5110.0</td>
<td>26.0</td>
<td>154.1 (AFT)</td>
<td>810.0</td>
<td>0.0053 (G)</td>
<td>187.0</td>
<td>LEVEL</td>
</tr>
</tbody>
</table>

**Notes:**
1. Collective control position held fixed during test.
2. Shaded symbols denote trim point.
3. Total control displacement:
   - Longitudinal = 12.55 inches
   - Lateral = 11.55 inches
   - Directional = 7.60 inches
4. Broken lines denote level flight side slip limits.

![Graph showing lateral-directional stability data with points indicating control positions and their effects on angle of sideslip.]
Figure 28

Static Lateral-Directional Stability

369c

3465-12951

<table>
<thead>
<tr>
<th>AVG DENSITY</th>
<th>AVG ALTITUDE</th>
<th>AVG OAT</th>
<th>AVG CG</th>
<th>AVG ROTOR SPEED</th>
<th>AVG Ct</th>
<th>AVG TRIM FLIGHT</th>
<th>AVG OAT</th>
<th>AVG CG</th>
<th>AVG ROTOR SPEED</th>
<th>AVG Ct</th>
<th>AVG TRIM FLIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ft</td>
<td>ft</td>
<td>°C</td>
<td>°L</td>
<td>°R</td>
<td></td>
<td>°K</td>
<td>°L</td>
<td>°C</td>
<td>°R</td>
<td></td>
<td>°K</td>
</tr>
<tr>
<td>2400</td>
<td>2400</td>
<td>19.0</td>
<td>103.9 (AFL)</td>
<td>510 0.004643</td>
<td>108</td>
<td>LEVEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Collective control position held fixed during test.
2. Shaded symbols denote trim point.
3. Total control displacement
   Longitudinal = 12.55 inches
   Lateral = 11.55 inches
   Directional = 7.60 inches
4. Broken lines denote level flight sideslip limits.
### Aircraft Response Following a Right Lateral Pulse

<table>
<thead>
<tr>
<th>Density</th>
<th>Altitude (ft)</th>
<th>Avg Gravit-Lbs</th>
<th>OAT (°C)</th>
<th>Avg Long</th>
<th>Rotor Speed (RPM)</th>
<th>Ct</th>
<th>Airspeed (KCAS)</th>
<th>Trim Cond</th>
<th>FLT Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2490</td>
<td>30 TO</td>
<td>300</td>
<td>1091</td>
<td>650</td>
<td>0.005101</td>
<td>137.0</td>
<td>LEVEL</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 30**

- **CG Normal Acceleration**
- **Side Slip Angle**
- **Roll**
- **Yaw**
- **Pitch**

**Control Positions**
- Directional (Left) = Full Left
- Lateral (Left) = Full Left
- Longitudinal (Fwd) = Full Fwd

**Rates**
- Roll (deg/sec) = 0.5
- Yaw (deg/sec) = 0.5
- Pitch (deg/sec) = 0.5

**Time (sec)**
- 0 to 9
**Figure 33**

**Longitudinal Controllability**

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>AVG DENSITY</th>
<th>AVG ALTIMETER</th>
<th>AVG LONG. ROTOR C.G.</th>
<th>AVG SPEED</th>
<th>AVG AIRSPEED</th>
<th>AVG TRIM</th>
<th>FLT COND</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1200</td>
<td>500</td>
<td>25.0</td>
<td>104.1(AFT)</td>
<td>510</td>
<td>0.004440</td>
<td>LOWER LEVEL</td>
</tr>
<tr>
<td>0</td>
<td>2400</td>
<td>300</td>
<td>30.0</td>
<td>104.1(AFT)</td>
<td>510</td>
<td>0.005113</td>
<td>137 LEVEL</td>
</tr>
</tbody>
</table>

**NOTE:** TOTAL LONGITUDINAL CONTROL TRAVEL = 12.56 INCHES

**PITCH RATE MEASURED AT 0.8 SEC**

MAXIMUM RATE WAS NEVER REACHED

**TIME TO MAX ACCEL**

- **MAXIMUM ACCELERATION**
  - Degrees/Second
  - Up
  - Down

**TIME TO MAX RATE**

- **PITCH RATE**
  - Degrees/Second
  - Up
  - Down

- **FWD**
  - 0
  - 1

- **AFT**
  - 0
  - 1

**CONTROL DISPLACEMENT**

- Inches from Trim

- **FWD**
  - 0
  - 1

- **AFT**
  - 0
  - 1

74
Figure 34
Lateral Controllability
364C 8M69-12961

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>AVG DENSITY ALTITUDE ~FT</th>
<th>AVG WT ~LB</th>
<th>AVG OAT ~°C</th>
<th>AVG LONG. C.G ~IN.</th>
<th>ROTOR SPEED RPM</th>
<th>AVG VM TRIM</th>
<th>FLT LEVEL</th>
<th>AVG AIRSPEED KCAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400</td>
<td>2360</td>
<td>19.0</td>
<td>104.0(AFT)</td>
<td>510</td>
<td>0.00391</td>
<td>105</td>
<td>LEVEL</td>
<td>105 LEVEL</td>
</tr>
<tr>
<td>2300</td>
<td>2490</td>
<td>20.5</td>
<td>104.1(AFT)</td>
<td>510</td>
<td>0.00440</td>
<td>105</td>
<td>LEVEL</td>
<td>105 LEVEL</td>
</tr>
</tbody>
</table>

NOTE: TOTAL LATERAL CONTROL TRAVEL = 11.55 INCHES
Figure 35
Lateral Controllability
364C  Aug-312451

AVG ALTITUDE GRMT OAT CG SPEED CT AIRSPEED COND

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Altitude</th>
<th>Density</th>
<th>Avg Grmt</th>
<th>Avg Oat</th>
<th>Avg CG</th>
<th>Avg Speed</th>
<th>Avg Ct</th>
<th>Avg Airspeed</th>
<th>Cond</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1000</td>
<td>0.68</td>
<td>22.0</td>
<td>104.1</td>
<td>510</td>
<td>0.0045</td>
<td>0.06</td>
<td>137</td>
<td>Level</td>
</tr>
<tr>
<td>2</td>
<td>900</td>
<td>0.60</td>
<td>30.0</td>
<td>104.1</td>
<td>510</td>
<td>0.0061</td>
<td>0.06</td>
<td>137</td>
<td>Level</td>
</tr>
</tbody>
</table>

Note: Total lateral control travel = 11.55 inches
**Figure 36**

**Directional Controllability**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Altitude (FT)</th>
<th>Average Density (LB/FT^3)</th>
<th>Average Temperature (°C)</th>
<th>Average CG (IN)</th>
<th>Rotor Speed (RPM)</th>
<th>Average CT</th>
<th>Average Airspeed (KCAS)</th>
<th>Flight Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>2400</td>
<td>2360</td>
<td>20.0</td>
<td>104.0 (AFT)</td>
<td>510</td>
<td>0.003911</td>
<td>105</td>
<td>Level</td>
</tr>
<tr>
<td>D</td>
<td>2300</td>
<td>2490</td>
<td>28.5</td>
<td>104.1 (AFT)</td>
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<td>0.004940</td>
<td>105</td>
<td>Level</td>
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</tbody>
</table>

**Note:** Total directional control travel = 7.60 inches
### Figure 37

**Directional Controllability**

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>AVG DENSITY</th>
<th>ALTITUDE</th>
<th>GENT</th>
<th>OAT</th>
<th>AVG LONG. ROTOR</th>
<th>AVG TRIM</th>
<th>FLT COND</th>
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<tbody>
<tr>
<td>O</td>
<td>500</td>
<td>1170</td>
<td>40.0</td>
<td>103.9 (AFT)</td>
<td>510</td>
<td>0.004966 Hover</td>
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<td>□</td>
<td>2490</td>
<td>5060</td>
<td>24.0</td>
<td>104.1 (AFT)</td>
<td>510</td>
<td>0.005084 137 Level</td>
<td>LEVEL</td>
</tr>
</tbody>
</table>

**Note:** Total directional control travel = 7.60 inches.
Figure 30
MANEUVERING STABILITY

D69C

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>AVG. DENSITY</th>
<th>AVG. ALTITUDE</th>
<th>AVG OAT</th>
<th>AVG LONG. COG</th>
<th>ROTOR SPEED</th>
<th>AVG CY</th>
<th>AVG. TRIM</th>
<th>AIRSPEED</th>
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<td>0</td>
<td>15.00</td>
<td>3200</td>
<td>20.0</td>
<td>104.1 (AFT)</td>
<td>510</td>
<td>0.00444</td>
<td>0.106</td>
<td>136</td>
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<tr>
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<td>19.00</td>
<td>3080</td>
<td>20.5</td>
<td>104.1 (AFT)</td>
<td>510</td>
<td>0.00504</td>
<td>0.136</td>
<td></td>
</tr>
</tbody>
</table>

NOTES:
1. OPEN SYMBOLS DENOTE LEFT WIND-UP TURNS
2. SHADeD SYMBOLS DENOTE RIGHT WIND-UP TURNS
3. TOTAL CONTROL DISPLACEMENT
   LONGITUDINAL = 12.55 INCHES
   LATERAL = 11.55 INCHES

C.G. NORMAL ACCELERATION ~ G'S

LATeRAl CONTROL POSITI0N
7 INCHES FROM FULL LEFT

LONGITUDINAL CONTROL POSITION
4 INCHES FROM FULL FORWARD

KIF

GRAVITY

IN LB

IN C

IN IN

IN RPM

IN KCAS

0 0.5 1.0 1.5 2.0

0 0.5 1.0 1.5 2.0
FIGURE 39
AIRCRAFT RESPONSE FOLLOWING A SIMULATED ENGINE FAILURE

<table>
<thead>
<tr>
<th>INITIAL DENSITY</th>
<th>AVG</th>
<th>INITIAL</th>
<th>AVG LONG.</th>
<th>INITIAL ROTOR</th>
<th>Initial</th>
<th>RPM</th>
<th>Initial</th>
<th>Initial</th>
<th>Initial</th>
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<tbody>
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<td>ALTITUDE-FT</td>
<td>3260</td>
<td>3100</td>
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<td>104.2(AFT)</td>
<td>540</td>
<td>1260</td>
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<tr>
<td>CG NORMAL ACCELERATION</td>
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<td></td>
</tr>
</tbody>
</table>
Figure 41
Airspeed Calibration

<table>
<thead>
<tr>
<th>Avg Density Altitude</th>
<th>Avg Gravit</th>
<th>Avg OAT</th>
<th>Avg Long Gravit</th>
<th>Rotor Speed</th>
<th>F.L.T. Cond</th>
</tr>
</thead>
<tbody>
<tr>
<td>~ft 800</td>
<td>~lb 3080</td>
<td>20.0</td>
<td>104.0 (AF)</td>
<td>510</td>
<td>Level</td>
</tr>
</tbody>
</table>

Note: Data collected using ground speed course method.
The Army Preliminary Evaluation (APE) of the Hughes Tool Company - Aircraft Division (HTC-AD) prototype Model 369C (OH-6C) helicopter was conducted at the Hughes facility in Culver City, California. A total of 34.5 productive flight hours were accumulated during the period 26 August to 22 September 1971. Engineering flight tests were conducted to evaluate the performance, handling qualities, and contractor-proposed flight envelope and to provide data for future use in the evaluation of the HTC-AD New Initiatives - Aerial Scout Program proposal. The data indicate that, in comparison with the OH-6A, the Hughes Model 369C can hover out of ground effect on a 35°F day at 4000 feet with a 207-pound increase in payload. The Model 369C can achieve a maximum level flight airspeed of 141 knots calibrated airspeed (KCAS) with a 660-pound payload - an increase of 14 percent over the 124-KCAS never-exceed velocity of the OH-6A. One deficiency, inadequate longitudinal control during sideward and rearward flight at a forward center-of-gravity (cg) loading, and 12 shortcomings were observed in the handling qualities evaluation. In the OH-6A speed range, the static and dynamic stability and controllability of the Model 369C are generally unchanged. At the airspeeds that exceeded the envelope of the OH-6A, handling qualities were degraded, and 5 shortcomings were observed. These shortcomings were neutral maneuvering and static longitudinal stability, excessive longitudinal control response and sensitivity, excessive roll response following a simulated directional gust disturbance, and excessively rapid buildup of normal acceleration following a simulated longitudinal gust disturbance. If procurement of the helicopter is planned, the cited deficiency should be corrected prior to any airworthiness release for flight at a forward cg loading by operational pilots. The shortcomings should be corrected prior to production. Additional testing should be conducted to determine a safe operational cg envelope, to develop a height-velocity curve, and to evaluate the effects of altitude, weight, and cg variations.
Army Preliminary Evaluation
HTC-AD
Model 369C (OH-6C) helicopter
Evaluate performance, handling qualities, and
contractor-proposed flight envelope
Provide data
Data indicate
One deficiency
12 shortcomings
Handling qualities evaluation
Deficiency should be corrected prior to release
Shortcomings should be corrected prior to production
Additional testing should be conducted
SAVTE-T


SEE DISTRIBUTION

1. Table 1, Hovering Capability Comparison, as shown on page 5 of the subject report is herewith changed for correction of typed errors. The corrected table is included as Inclosure 1.

2. The last sentence of paragraph number 31 and 13 of the subject report is herewith changed to read, "The test results are presented in figures 24 through 28, appendix G."

3. Included within appendix F, Test Instrumentation, after page 40 of the subject report for clarification of instrumentation location should be a side-view of the 369C that was previously omitted. The diagram is included as Inclosure 2.

4. After the above changes have been posted, this letter will be filed with the subject report.

FOR THE COMMANDER:

GLEB D. KASHIN
Major, TC
Adjutant

2 Incl
1. Table 1, Hovering Capability Comparison
2. Diagram - 369C Helicopter
Table 1. Hovering Capability Comparison.

Pressure Altitude: 4000 feet
Outside Air Temperature: 35°C

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Hughes Model 369C</th>
<th>OH-6A</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic weight (lb)</td>
<td>1344</td>
<td>1146</td>
<td>198</td>
</tr>
<tr>
<td>Rotor speed (rpm)</td>
<td>510</td>
<td>483</td>
<td>27</td>
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<tr>
<td>Operating weight (lb)</td>
<td>1950</td>
<td>1752</td>
<td>198</td>
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<td>ICE hover performance:</td>
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<tr>
<td>Maximum hover weight (lb)</td>
<td>2850</td>
<td>2395</td>
<td>455</td>
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<tr>
<td>Payload (lb)</td>
<td>900</td>
<td>643</td>
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<tr>
<td>OGE hover performance:</td>
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<tr>
<td>Maximum hover weight (lb)</td>
<td>2600</td>
<td>2195</td>
<td>405</td>
</tr>
<tr>
<td>Payload (lb)</td>
<td>650</td>
<td>443</td>
<td>207</td>
</tr>
</tbody>
</table>

1 Includes helicopter airframe and engine plus full hydraulic fluid and trapped fuel.
2 Power turbine speed (Np) equals 103 percent.
3 Includes basic weight plus engine oil, full fuel, and a 200-pound pilot.
4 Four-foot skid height.