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U.S. ARMY TEST & EVALUATION COMMAND

AD________________

RDT&E PROJECT NO. 1W543312D41431
USATECOM PROJECT NO. 4-4-6516-05
USAAVNTA PROJECT NO. 65-22

ENGINEERING FLIGHT TEST OF UH-1B HELICOPTER EQUIPPED WITH XM-47 ANTIPERSONNEL MINE DISPENSING SUBSYSTEM

FINAL REPORT

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AND
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PROJECT PILOTS

NOVEMBER 1966

U. S. ARMY AVIATION TEST ACTIVITY
EDWARDS AIR FORCE BASE, CALIFORNIA

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DEPARTMENT OF THE ARMY
U. S. ARMY AVIATION TEST ACTIVITY
EDWARDS AIR FORCE BASE, CALIFORNIA 93523

SAVTE-PO 24 March 1967

SUBJECT: Approved Engineering Test Report for Engineering Flight Test of UH-1B Helicopter Equipped With Antipersonnel Mine Dispensing Subsystem, RDT&E Project No. 1W543312D41431, USATECOM Project No. 4-4-6516-05

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RDT&E PROJECT NO. 1W543312D41431
USATECOM PROJECT NO. 4-4-6516-05
USAAVNTA PROJECT NO. 65-22

ENGINEERING FLIGHT TEST OF UH-1B HELICOPTER EQUIPPED WITH XM-47 ANTIPERSONNEL MINE DISPENSING SUBSYSTEM

TEST REPORT

MANFRED REIF
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NOVEMBER 1966

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ABSTRACT

A limited engineering flight test was conducted to provide sufficient engineering data for a safety-of-flight release for the UH-1B helicopter equipped with the XM-47 antipersonnel mine dispensing subsystem. An additional objective was to provide sufficient performance and stability and control data to update the operator's manual data to be used for UH-1B helicopters equipped with the XM-47 subsystem. The test was conducted by the U. S. Army Aviation Test Activity (USAAVNTA) at Edwards Air Force Base, California. Testing consisted of 42 productive flight hours and was conducted from 8 February 1966 through 27 March 1966. The USAAVNTA was responsible for preparation of test plan, conduct of test, and submission of final report.

When the XM-47 mine dispensing subsystem was installed on the UH-1B helicopter, antipersonnel mines could be safely dispersed within the recommended flight envelopes. In cases of emergency the dispensers could be safely jettisoned within the recommended envelopes. Jettisons during entry into autorotation and in close proximity to the ground should be avoided. The flying qualities of the UH-1B were essentially unaffected by the installation of the XM-47 mine dispensing subsystem. The installation resulted in a restriction of hovering operations to tailwinds below 17 knots true airspeed (KTAS). The drag penalty caused by the installation of the XM-47 subsystem amounted to approximately 10- to 13-percent range reduction, depending on gross weight. The recommended cruise airspeed decreased to 99 KTAS or lower. Seven shortcomings were recommended for correction. Correction of these shortcomings should result in better dispersion and jettison capability for the UH-1B equipped with the XM-47 antipersonnel mine dispensing subsystem.

FOREWORD

The U. S. Army Aviation Test Activity (USAAVNTA) was responsible for preparation of test plan, conduct of test, and submission of final report.

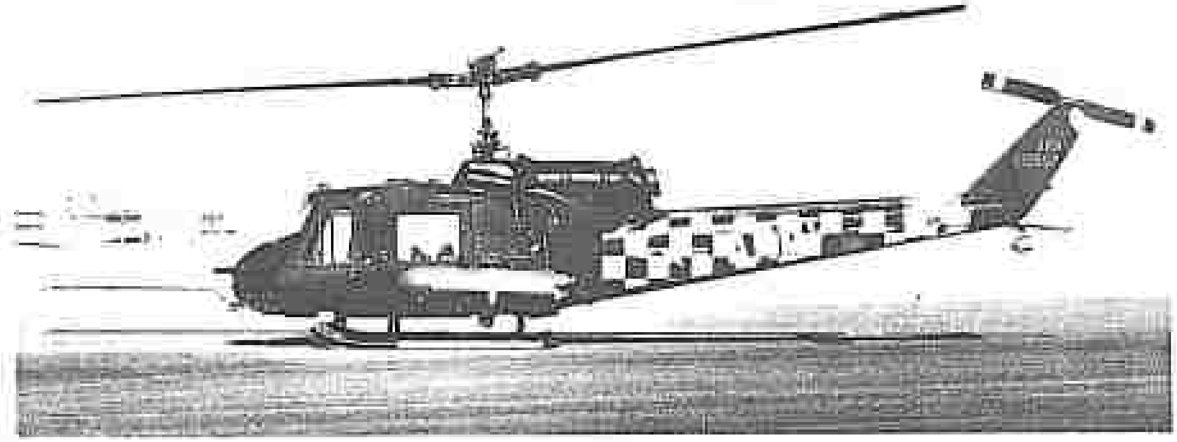


PHOTO 1 - Left side view of UH-1B with XM-3 Dispenser

PHOTO 2 - Left rear view of UH-1B having left XM-3 Dispenser loaded with four XM-2 Antipersonnel Mines and tail skid camera

Section 1. Introduction

1.1 BACKGROUND

A safety release for the testing of the UH-1B helicopter equipped with the XM-3 antipersonnel mine dispenser was issued by the U.S. Army Aviation Materiel Command (USAAVCOM) to the U.S. Army Test and Evaluation Command (USATECOM) on 2 April 1965. On 13 November 1965, the U.S. Army Materiel Command (USAMC) expressed an urgent need to type-classify the XM-3 antipersonnel mine dispenser and issued a requirement for sufficient testing by USATECOM to grant a safety release. USATECOM issued a test directive to the U.S. Army Aviation Test Activity (USAAVNTA), on 13 October 1965, to conduct airworthiness and performance tests, Phase D. A test plan was prepared by USAAVNTA to meet these objectives in January 1966 and was approved by USATECOM on 9 February 1966. This report presents the results of the engineering flight test of the XM-47 antipersonnel mine dispensing subsystem, which is composed of two XM-3 mine dispensers mounted one on each side of the helicopter.

Testing consisted of 42 productive flight hours and was conducted at Edwards Air Force Base, California, from 8 February 1966 through 27 March 1966. Interim reports, references f and g, were submitted by USAAVNTA on 9 March and 16 March 1966 respectively.

1.2 DESCRIPTION OF MATERIEL

The XM-47 antipersonnel mine dispensing subsystem consists of two cylindrical XM-3 mine dispensers 93 inches long and 18.5 inches in diameter. The weight of one dispenser when fully loaded with four XM-2 canisters containing mines is approximately 540 pounds and the weight of one dispenser when empty is 167 pounds. One XM-3 mine dispenser is mounted on each side of the helicopter. The dispensers are attached to Kellett mounts on standard universal external pylons. For further detailed information see appendix IV and classified reference h, appendix VII.

A detailed description of the UH-1B test helicopter, Serial Number 62-12552, is contained in appendix IV.

1.3 TEST OBJECTIVES

The objectives of these tests were to provide sufficient data for a safety-of-flight release of the UH-1B helicopter equipped with the XM-47 antipersonnel mine dispensing subsystem and to establish performance and stability and control data for the operator's manual.

1.4 SUMMARY OF RESULTS

1.4.1 Dispersion and Jettison

The dispersion and jettison tests of the UH-1B equipped with the XM-47 subsystem established envelopes for safe dispersion and jettison. These envelopes are presented and discussed in paragraphs 2.2.4, 2.3.4, section 2 of this report.

1.4.2 Stability and Control

The flying qualities of the UH-1B/XM-47 were essentially the same as those of a clean UH-1B. paragraphs 2.4.1.4, 2.4.2.4, 2.4.3.4, 2.4.4.4, 2.4.5.4.

The autorotational entry characteristics of the UH-1B/XM-47 were satisfactory from hover to limit airspeed. paragraph 2.4.5.4.

1.4.3 Performance

The installation of the XM-47 subsystem on the UH-1B helicopter produced a drag increase resulting in a 10-to 13-percent reduction in specific range. The recommended cruise airspeed decreased to 99 knots true airspeed (KTAS) or lower, depending on gross weight. paragraph 2.5.1.4.

When the XM-47 mine dispensing subsystem was installed on the UH-1B, the minimum rate of descent in autorotation increased at optimum autorotational airspeeds by approximately 100 feet per minute (fpm). paragraph 2.5.2.4.

1.5 CONCLUSIONS

The UH-1B equipped with the XM-47 antipersonnel mine dispensing subsystem was suitable for operation over a wide flight envelope.

Antipersonnel mines could safely be dispersed in various flight conditions within the sideslip and airspeed envelopes recommended in paragraph 2.2.4.

In tests simulating cases of emergency (active mines in the dispensers or engine failure), the dispensers could successfully be jettisoned within the envelopes recommended in paragraph 2.3.4.

Lateral controllability problems during inadvertent releases of one full dispenser could occur in turning flight.

The flying qualities of the UH-1B due to the XM-47 subsystem installation were essentially unchanged.

The XM-47 subsystem installation decreased the specific range of the UH-1B.

Correction of the shortcomings listed in paragraph 1.6 will result in an improved dispersion and jettison capability for the UH-1B equipped with the XM-47 subsystem.

1.6 RECOMMENDATIONS

Correction of the following shortcomings will improve the XM-47 subsystem:

a. The red warning light of the dispersion control panel should be relocated. (paragraph 2.2.4)

b. The time delay between depression of the "fire" button and ejection of the mines should be eliminated. (paragraph 2.2.4)

c. The mine ejection rate should be standardized. (paragraph 2.2.4)

d. The failure of two intervalometers should be investigated to determine the cause of the malfunctions. (appendix V)

e. An electrical jettison system should be installed as the primary release system. This system should provide the capability of jettisoning one dispenser at a time as well as two dispensers simultaneously. The manual release should be retained as the secondary release system. (paragraph 2.3.4)

f. A positive down stop should be provided for the external stores release handle to prevent lowering the release handle below the normal position. (paragraph 2.3.4)

g. The wiring that leads from the helicopter to the dispenser should be protected to prevent it from being damaged. (appendix V)

h. Studies should be initiated by the contractor to improve the timing of the firing operation for various intervalometer settings. (paragraph 2.2.4)

i. The operator's manual should be amended to include:

(1) The recommended dispersion and jettison envelopes. (paragraphs 2.2.4, 2.3.4)

(2) A restriction limiting hovering in tailwinds to winds not exceeding 17 KTAS. (paragraph 2.4.4.4)

(3) The sentence: "Do not jettison during entries into autorotation." (paragraph 2.3.4)

(4) The revised level flight performance data based on XM-47 subsystem installation. (paragraphs 2.5.1.3, 2.5.1.4)

(5) The airspeed calibration in autorotational descents. (paragraph 2.5.3.4)

Section 2. Details of Test

2.1 INTRODUCTION

This report presents the results of an engineering flight test of the UH-1B helicopter (S/N 62-12552) equipped with the XM-47 antipersonnel mine dispensing subsystem.

The objectives of this test were to provide engineering data for a safety-of-flight release and to establish performance and stability and control data for the operator's manual. This evaluation consisted of dispersion tests, jettison tests, qualitative and quantitative stability and control tests, and level flight and autorotation performance tests.

The XM-47 mine dispensing subsystem is one of several armament subsystems to be used on rotary- or fixed-wing aircraft. The XM-47 subsystem consists primarily of two XM-3 antipersonnel mine dispensers which are attached to Kellett mounts on standard external universal pylons one on each side of the helicopter. The total weight of the installation with two full dispensers is approximately 1280 pounds.

During this test program 15 tests were conducted in which 4800 inert mines were dispersed and 29 tests were conducted in which both full and empty dummy dispensers were jettisoned.

All tests were conducted in non-turbulent air. All airspeeds in this report were taken from the test boom airspeed system.

Stability and control test results were compared with the requirements of Military Specification MIL-H-8501A (reference i).

2.2 DISPERSION

2.2.1 Objective

The objective of these tests was to determine a safe flight envelope for dispersion of the XM-47 antipersonnel mines.

2.2.2 Method

The XM-47 antipersonnel mines were in all cases dispersed from stabilized flight conditions. Airspeed and/or sideslip angles were gradually increased from one test condition to the next, with each test condition more critical than the preceding one.

Four high-speed motion picture cameras were used to collect test data. Three cameras were mounted on the test helicopter. Two of these cameras were mounted on the forward ends of the left and right skids and the third camera was mounted on the tail skid (see photographs 1, 2, 3, appendix VI). With the fourth camera, pictures of the dispersed mines were taken from a chase helicopter. The photographic data were analyzed prior to proceeding to more critical flight conditions.

Because the aerodynamic behavior of the dispersed mines in descents was unknown, some precautionary tests were conducted before proceeding to high rates of descent. Partial-power descents were flown prior to the autorotational descents. Fifteen dispersions were conducted. In most of the tests only the upper canister of the left dispenser was fired. The dispersion of antipersonnel mines from this canister was considered to be the most critical because of its proximity to the tail rotor. During one dispersion, two upper canisters were fired together to assure that the simultaneous dispersion of mines from the two upper canisters of one dispenser was no more critical than the firing of only the upper inner canister.

Dispersions were made during hover in ground effect (IGE) and in level flight under various sideslip conditions at airspeeds up to 100 KCAS. One dispersion was conducted in a partial-power descent at an airspeed of 63 KCAS and a rate of descent (R/D) of 1000 fpm. Dispersions in autorotation were made in various sideslip angles at airspeeds between 43 KCAS and 103 KCAS. One dispersion was made during a quick stop from level flight. All dispersions were conducted at a mid center of gravity (C.G.) and an average gross weight of 7600 pounds. In level flight the mines were dispersed 300 feet above the ground and in autorotation the mines were dispersed approximately 700 feet above the ground. The dispenser elevation angle was 1 degree nose up with respect to the aircraft waterline.

2.2.3 Results

The end points of the dispersion tests conducted and the test conditions at which mine-helicopter interference occurred are listed in table 1:

TABLE 1

	Dispersion Condition			Sideslip Condition		
Flight Condition	Cans Fired No.	Side of A/C	Calibrated Airspeed kt	deg	Direction	Remarks
Hover (IGE)	1	Rt	0	-	-	-
Level Flight	1	Lt	62	32	Lt	-
	1	Lt	84	18	Rt	-
	1	Rt	100	11	Rt	-
Quick Stop From Level Flight	1	Lt	-	-	-	Right Pedal Input During Dispersion in Quick Stop
Autorotation	1	Lt	43	36	Lt	R/D = 2000 fpm
	1	Lt	67	34	Lt	R/D = 2100 fpm
	1	Lt	83	21	Lt	R/D = 2500 fpm
	2	Lt	103	11	Lt	R/D = 2900 fpm Mine Interference With Horizontal Stabilizer

The dispersion in an IGE hover was made to insure that downwash recirculation would not cause the mines to strike the main or tail rotor. The dispersed mines were not picked up by the rotor downwash and no problem occurred.

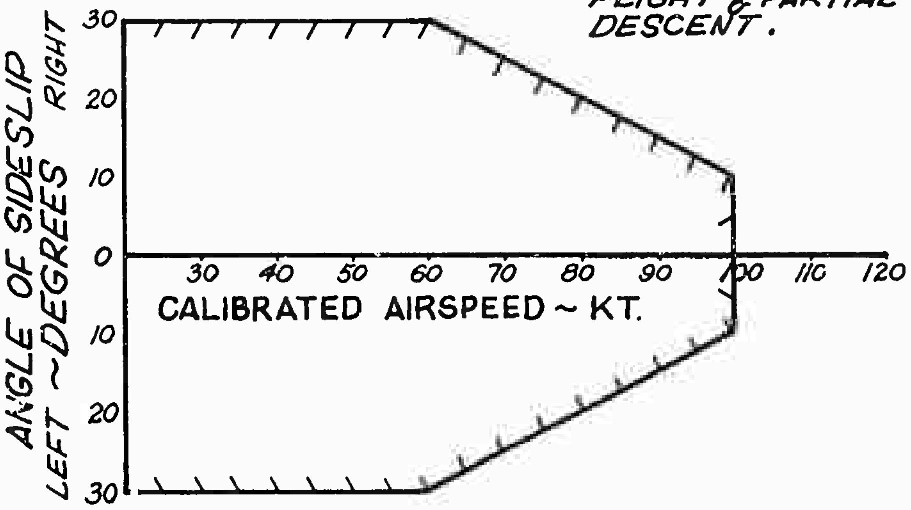
The dispersion in a quick stop from level flight was conducted to simulate the reaction of a pilot surprised by ground fire during a dispersion. A right pedal input was made during the flare (35-degree nose-up aircraft attitude) to move the tail rotor toward the region of the dispersed mines. The mines remained well clear of the aircraft.

2.2.4 Analysis

The recommended envelopes are based on the end points of the tests conducted. Analysis of high-speed motion picture test data and pilot qualitative comments established the sideslip limit for the end points. The recommended envelopes are for safe dispersion of the XM-47 antipersonnel mines. The recommended dispersion envelope that is valid for climb, level flight, maneuvering flight, and partial-power descent is presented in figure A.

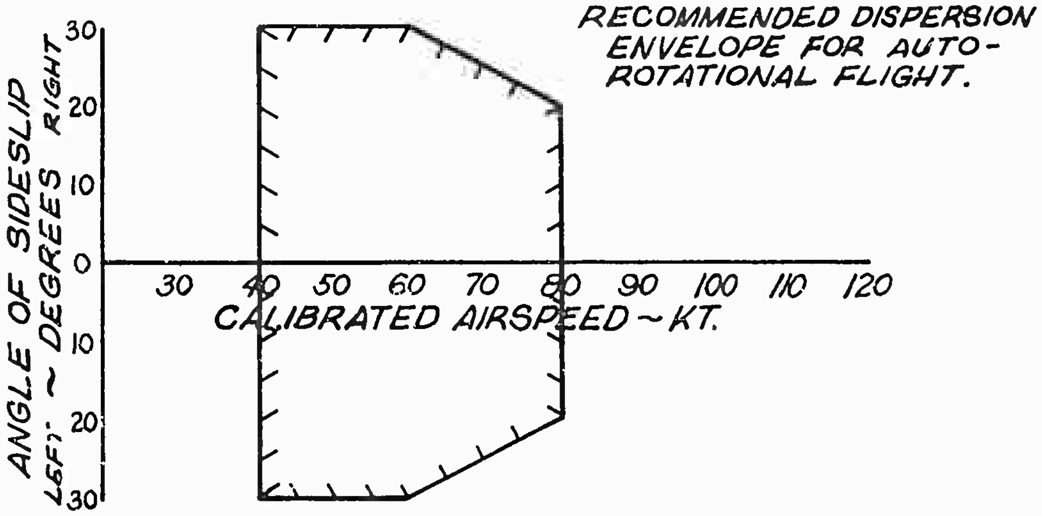
FIGURE A

RECOMMENDED DISPERSION ENVELOPE FOR CLIMB, LEVEL FLIGHT, MANEUVERING FLIGHT & PARTIAL-POWER DESCENT.



The dispersion envelope that is valid for autorotation is presented in figure B.

FIGURE B


RECOMMENDED DISPERSION ENVELOPE FOR AUTO-ROTATIONAL FLIGHT.

During ejection the dispersed mines did not tend to float. In being ejected the mines were forced against the opened aft closure of the canister and were ejected downward and away from the aircraft. After ejection of the mines, the degree of float depended on the relative wind and increased with increasing angle of attack (i.e., the mines floated more in autorotation than in level flight at the same airspeed). During one of the 15 dispersion tests, mine-helicopter interference was encountered during an autorotational descent at 103 KCAS (see photograph 4). Based on analysis of all the data, it is recommended that dispersions during autorotations should be restricted to an airspeed of 80 KCAS. During most dispersion tests, the mines that came closest to striking the horizontal stabilizer did not float higher than the height of the fired canister.

During each dispersion the aft inner metal hermetic seal of the canister was released with the ejected mines. The trajectory of this seal was especially analyzed during all dispersion tests. The seal did not float more than the mines. When the inert mines were picked up from the ground after the test, the seal was always found among them. No danger of the seal's striking the tail section of the aircraft exists during dispersion if the dispersions are conducted within the recommended envelopes.

A noticeable but not objectionable yaw acceleration occurred during firing of a single canister. A time delay of zero to 4 seconds was noticed between depression of the "fire" button and ejection of the mines. Time delays of zero and 4 seconds, however, were extreme values, and in most cases a time delay of approximately 2 seconds was observed. It was also observed during all the dispersion tests that the rate of ejection of the mines varied with each dispersion. Since a time delay between pushing the "fire" button and ejection of the mines has an important influence in accurately laying a mine pattern on the ground, it is recommended that the time delay be eliminated.

Because of the limited amount of hardware available only one test was conducted firing two canisters of one dispenser simultaneously. During this test, the intervalometer setting was in "manual fire 1/pair pulse" (i.e., two canisters fired each time the "fire" button was depressed). The photographic data showed that both aft-end closures of the canisters opened at the same time although the canisters did not fire at the same time. One of the canisters fired approximately 1 second later than the other. The timing of the firing operations should be determined and improved.

The dispersion control panel located on the center console was not readily visible to the pilot. When the red warning light in this control panel comes on before firing, it means that the hermetic seal of the mines is lost and the mines are more sensitive to detonation. If the red warning light remains on 10 seconds after firing, it means that all the mines have been ejected. The red warning light alerts the pilot to jettison the mine dispenser. Since it is very important for the crew to notice immediately when the red warning light comes on, it is recommended that the red warning light of the dispersion control panel be connected to the warning light on the pilot's caution panel.

2.3 JETTISON

2.3.1 Objective

The objective of these tests was to determine a safe flight envelope for jettison of the XM-47 antipersonnel mines.

2.3.2 Method

XM-47 jettison tests were performed from stabilized flight conditions. Airspeed and/or sideslip angles were gradually increased from one test to the next with each test condition more critical than the preceding one.

During each jettison test, photographic data were collected using four high-speed motion picture cameras. Three of the cameras were mounted on the test helicopter, one camera on the tail and the other two cameras one on the front end of each skid. The fourth camera was located in a chase helicopter. The photographic data were analyzed prior to proceeding to more critical flight conditions.

Twenty-eight of the 29 jettison tests were conducted at a mid C.G. and one was conducted at an aft C.G. Empty or weighted dummy dispensers that simulated the weight, C.G., roll, pitch, and yaw moments of inertia of the standard dispenser were used.

In the test helicopter, USA S/N 62-12552, only manual jettison was possible. No secondary independent method was provided for jettison of the dispensers. Both dispensers were released simultaneously by manually lifting the external stores release handle. To simulate asymmetric jettisons, extra handles were installed for test purposes to provide for the release of one dispenser. Jettison tests of only one dispenser were conducted to evaluate the controllability of the helicopter should only one dispenser be released during a jettison operation.

To save hardware for re-use, a recovery parachute was rigged and deployed during most of the jettison tests. Weighted dummy dispensers could not be re-used.

To insure that the parachute had no influence on the trajectory of the dispenser, one jettison was repeated. This dispenser was first jettisoned without a parachute and the same test was repeated dropping the dispenser with a parachute. The analyzed photographic data showed that no influence was caused by the parachute on the dispenser trajectory in the immediate vicinity of the aircraft.

Twenty-nine jettisons were made from the left, right, and both sides of the helicopter simultaneously with both full and empty dispensers. In most cases, two dispensers were carried and only one dispenser was jettisoned. The jettison characteristics of a dispenser that did not release during the first jettison attempt were also simulated and tested by carrying and jettisoning only one dispenser.

Level flight jettisons were conducted under various sideslip conditions up to 104 KCAS. Jettisons were also conducted during out-of-ground-effect (OGE) hovering flight, turning flight, partial-power descents, and in autorotations between 42 KCAS and 107 KCAS. The dispensers were released in level flight 300 feet above the ground and in autorotation approximately 700 feet above the ground. The average aircraft gross weight was 7600 pounds. The dispenser elevation angle was 1 degree nose up from the aircraft waterline.

2.3.3 Results

The end points of the jettison tests and the test points at which dispenser-helicopter contact was encountered are listed in tables 2 and 3:

TABLE 2

	Dispenser Configuration				Sideslip Condition		Jettison Condition		
Flight Condition	No.	Side of A/C	Loading	Calibrated Airspeed kt	deg	Direction	No.	Side	Remarks
Hover(OGE)	2	Both	Full	0	-	-	1	Rt	--
Level Flight	2	Both	Empty	63	28	Lt	1	Rt	--
	1	Lt	Empty	65	27	Rt	1	Lt	--
	2	Both	Empty	82	20	Rt	1	Lt	*
	2	Both	Empty	82	18	Rt	1	Lt	*
	2	Both	Empty	83	7	Lt	1	Rt	*
	2	Both	Empty	101	5	Rt	1	Lt	*
	2	Both	Empty	101	2	Rt	1	Lt	*
	1	Lt	Empty	102	9	Rt	1	Lt	*
	2	Both	Full	102	0	-	1	Lt	--
	1	Lt	Empty	104	0	-	1	Lt	--
Turning Flight	2	Both	Full	102	0	-	1	Rt	30-deg Lt Bank

* Dispenser - Skid Contact

TABLE 3

Flight Condition	Dispenser Configuration No.	Side of A/C	Loading	Calibrated Airspeed kt	Sideslip Condition deg	Direction	Jettison Condition No.	Side	Rate of Descent fpm
Autorotation	2	Both	Full	42	27	Lt	1	Rt	2000
	2	Both	Empty	43	32	Lt	1	Lt	2000
	2	Both	Empty	63	32	Lt	1	Lt	2100
**	2	Both	Empty	63	30	Rt	1	Lt	2900
	2	Both	Empty	83	15	Rt	1	Lt	2500
	2	Both	Full	85	15	Lt	2	Both	2500
	2	Both	Empty	107	5	Lt	1	Rt	3100

** Aft C.G. Loading

In hovering flight, turning flight, partial-power descents, and autorotations, dispenser-skid contact did not occur under the conditions tested. In level flight, the helicopter skid tube was hit by the jettisoned dispenser at the flight conditions asterisked in table 2. All dispenser-skid contacts were at approximately the same point of the aft skid tube behind the aft strut. It should be noted that only empty dispensers exhibited the tendency to float into the skid. Dispenser-skid contact did not occur during jettisons of the full dispensers. At no time were crew or aircraft in danger when dispenser-skid contact was made. The dispenser bounced back from the skid and away from the aircraft and did not float into the tail, stabilizer, or tail-rotor region (figure 2, appendix I).

Several dispenser jettison trajectories are presented in figures 1 through 4, appendix I. Photographs of jettisons as seen from skid and tail cameras are shown in figure C.

FIGURE C.1a

LEVEL FLIGHT: 63-KT, 28-DEG RIGHT SIDESLIP
TWO EMPTY DISPENSERS
LEFT DISPENSER JETTISONED

TIME FROM JETTISON

26-1

0.08 SEC

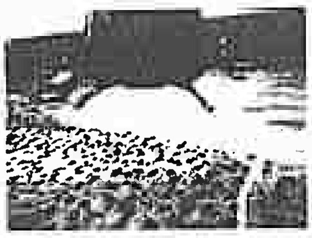
26-2

0.16 SEC

FIGURE C.1b

LEVEL FLIGHT: 63-KT, 28-DEG RIGHT SIDESLIP
TWO EMPTY DISPENSERS
LEFT DISPENSER JETTISONED

TIME FROM JETTISON



26-3

0.24 SEC

26-4

0.32 SEC

FIGURE C.2a

LEVEL FLIGHT: 101-KT, 5-DEG LEFT SIDESLIP
TWO EMPTY DISPENSERS
RIGHT DISPENSER JETTISONED

TIME FROM JETTISON

36-1

0.08 SEC

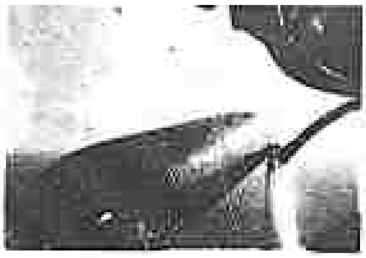
36-2

0.16 SEC

FIGURE C.2b

LEVEL FLIGHT: 101-KT, 5-DEG LEFT SIDESLIP
TWO EMPTY DISPENSERS
RIGHT DISPENSER JETTISONED

TIME FROM JETTISON



0.24 SEC

36-3

0.32 SEC

36-4

FIGURE C.3a

AUTOROTATION: 43-KT, 32-DEG RIGHT SIDESLIP
TWO EMPTY DISPENSERS
RIGHT DISPENSER JETTISONED

37-1

TIME FROM JETTISON
0.08 SEC

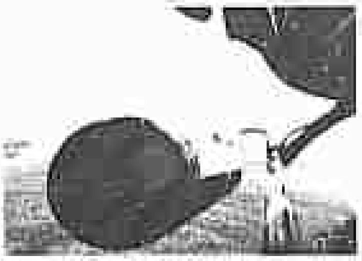
37-2

0.16 SEC

FIGURE C.3b

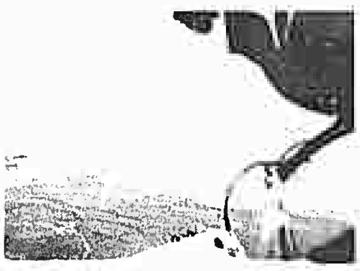
AUTOROTATION: 43-KT, 32-DEG RIGHT SIDESLIP
TWO EMPTY DISPENSERS
RIGHT DISPENSER JETTISONED

TIME FROM JETTISON



37-3

0.24 SEC

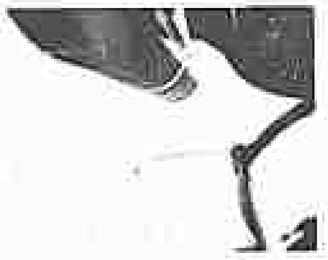


37-4

0.32 SEC

FIGURE C.4a

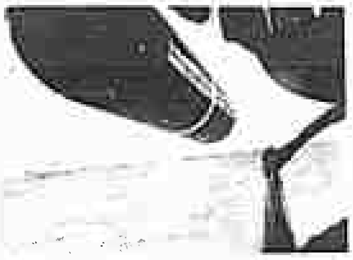
AUTOROTATION: 83-KT, 15-DEG LEFT SIDESLIP
TWO EMPTY DISPENSERS
RIGHT DISPENSER JETTISONED



25-1

TIME FROM JETTISON

0.08 SEC

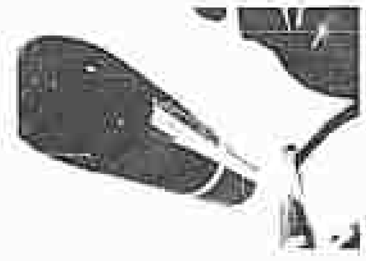


25-2

0.16 SEC

FIGURE C.4b

AUTOROTATION: 83-KT, 15-DEG LEFT SIDESLIP
TWO EMPTY DISPENSERS
RIGHT DISPENSER JETTISONED



TIME FROM JETTISON
0.24 SEC

25-3

0.32 SEC

25-4

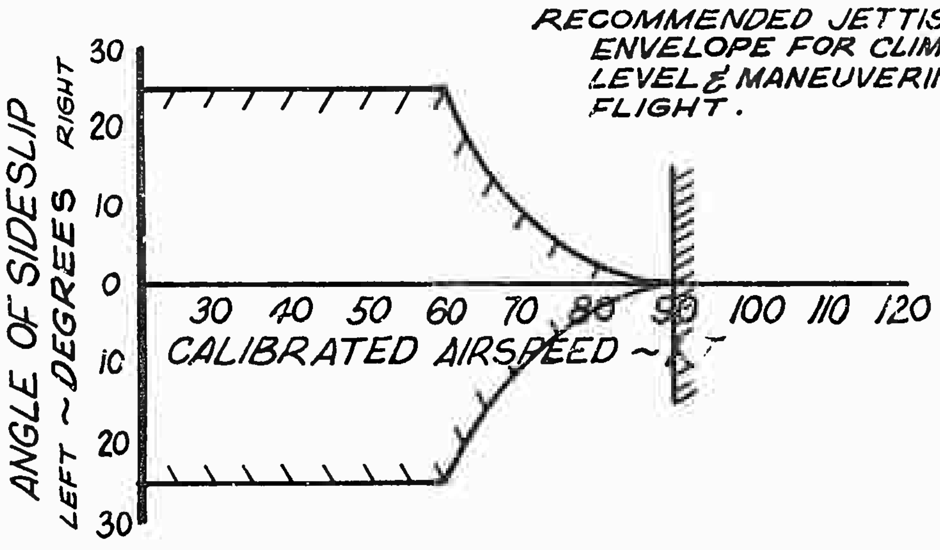
The controllability during jettisons was evaluated by simulating inadvertent releases of empty and full dispensers. Jettison time histories of simulated inadvertent releases of full dispensers in maneuvering flight and autorotation are presented in figures 5 and 6, appendix I. Asymmetric jettisons of full dispensers were also conducted in level flight and during OGE hovering flight.

2.3.4 Analysis

The recommended envelopes are based on the end points of the tests conducted. Analysis of engineering test data and qualitative pilot comments determined the sideslip limit for the end points. The recommended envelopes are for safe jettison of the XM-47 mine dispensers.

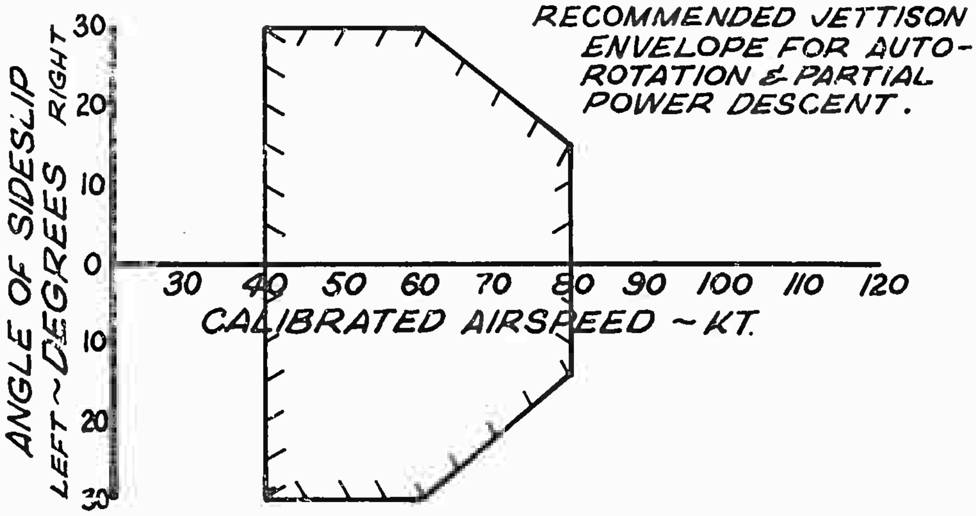
The recommended jettison envelope for climb, level flight, and maneuvering flight is presented in figure D.

FIGURE D



Jettison envelope for autorotation and partial-power descent is presented in figure E.

FIGURE E



Empty and full dispensers were jettisoned during buildup tests up to and including the limit jettison conditions listed in tables 2 and 3, paragraph 2.3.3. Full dispensers were used to substantiate the envelope established by the jettison characteristics of the more critical empty dispensers.

During jettisons in level flight and autorotation it was observed that after release the dispenser began to yaw. The nose of the dispenser always moved away from the aircraft. This meant that the clearance between the rear of the dispenser and the skid of the helicopter was the criterion for the establishment of a jettison envelope. The rate of the yawing motion was determined to be a function of airspeed and sideslip angle. Higher airspeed and/or sideslip angles imposed more drag on the jettisoned dispenser, thereby causing a larger yaw angle which reduced the clearance between the rear of the dispenser and the skid tube. Because of their smaller moments of inertia the empty dispensers tended to yaw more readily than the full dispensers. With empty dispensers, dispenser-skid contact occurred under the asterisked conditions listed in table 2, paragraph 2.3.3.

It was also observed that when dispensers were jettisoned in sideslip conditions, less clearance between dispenser and skid occurred on the side which was opposite to the sideslip side. The "critical side" for jettison in sideslip conditions, therefore, was determined to be the "high side," i.e., in a left sideslip, the right side. The dispenser-skid clearance decreased with increasing sideslip angle.

During asymmetric jettisons of empty dispensers the roll attitude of the helicopter did not change before the jettisoned dispenser had dropped below the skid. During asymmetric jettisons of full dispensers, however, a slight change in roll angle was observed before the dropped dispenser passed the skid.

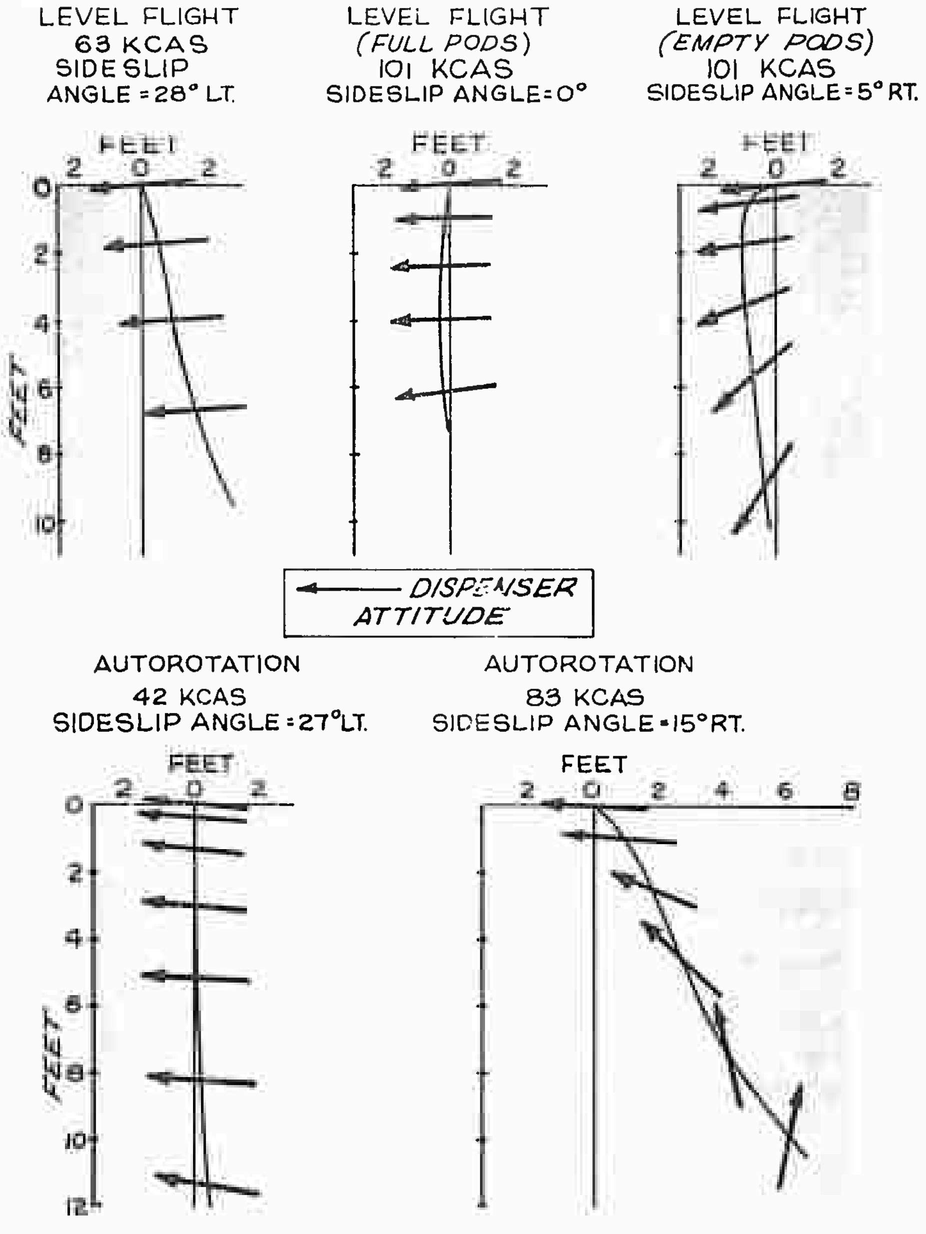
The pitch attitude of a dropped dispenser did not change in the immediate aircraft vicinity during jettison operations in level flight (figure 1, appendix I). The jettisoned dispensers did not move significantly aft or forward before falling below the landing skid. The time for both full and empty dispensers to pass below the skids was less than 1/2 second after release.

When dispensers were jettisoned in autorotation at 42 KCAS and 63 KCAS no change in pitch attitude occurred in the immediate aircraft vicinity. The jettisoned dispensers dropped below the landing skid vertically (figure 3, appendix I). A pitch-up of the dropped dispensers was noticed at higher airspeeds. The dispensers tumbled and fell away from the helicopter. The jettisoned dispensers did not move significantly aft during jettisons in autorotation at 32 KCAS (figure 4, appendix I). Empty dispensers, because of their smaller moments of inertia, assumed a nose-up position faster than full dispensers. The dispensers moved significantly aft when jettisoned in autorotations at 103 KCAS. The tumbling dispensers passed approximately 3 feet below the horizontal stabilizer. Jettisons in autorotations, therefore, should be restricted to airspeeds at 80 KCAS and below. Figure F shows a comparison of these dispenser jettison trajectories with the arrow representing dispenser attitude and location from the initial drop point.

During asymmetric jettisons of full dispensers a lateral cyclic trim change of about 3 inches was required, whereas during asymmetric jettisons of empty dispensers a trim change of only approximately 1 inch was necessary. The pilot could control the aircraft easily during simulated asymmetric jettisons of a full dispenser in hover, level flight and autorotation. In turning flight, however, over-correction during inadvertent releases of a full dispenser could lead to extreme aircraft attitudes.

No tests were conducted to determine the behavior of jettisoned dispensers during entries into autorotation. Jettison, therefore, should not be initiated during entry into autorotation because of the unknown effects of the rapidly changing angles of attack and accelerations.

FIGURE F
COMPARISON OF DISPENSER
JETTISON TRAJECTORIES



LEVEL FLIGHT
63 KCAS
SIDESLIP
ANGLE = 28° LT.

LEVEL FLIGHT
(FULL PODS)
101 KCAS
SIDESLIP ANGLE = 0°

LEVEL FLIGHT
(EMPTY PODS)
101 KCAS
SIDESLIP ANGLE = 5° RT.

AUTOROTATION
42 KCAS
SIDESLIP ANGLE = 27° LT.

AUTOROTATION
83 KCAS
SIDESLIP ANGLE = 15° RT.

In the test helicopter only manual jettison was possible. In all UH-1B helicopters that are equipped with the XM-47 anti-personnel mine dispensing subsystem, two independent systems for jettisoning the dispensers should be installed: an electrical release system and a manual release system. The electrical release system should be the primary release system for the dispensers. This system should provide the capability of jettisoning only one dispenser as well as two dispensers simultaneously. When the hermetic seal of the mines in one dispenser is lost, the pilot should have the capability to jettison the damaged dispenser. The manual release system should be retained as the secondary release system.

The external stores release handle of the manual release system was in an inconvenient position because of its proximity to the collective stick and center console. This was especially awkward for jettisons in autorotation. Normally, the external stores release handle had to be lifted approximately 1 inch to release the dispensers. It was possible, however, to lower the handle approximately 4 inches below the normal position. In this case, the pilot had to lift the handle a greater distance to jettison the dispensers. A positive down stop should be provided to prevent the handle from moving below the normal position.

2.4 STABILITY AND CONTROL

The objectives of these tests were to examine the flight envelope for the existence of any safety-of-flight limitations and to define changes in the flying qualities of the UH-1B helicopter that result from the installation of the XM-47 antipersonnel mine dispensing subsystem. The requirements of Military Specification MIL-H-8501A (reference i) were used as a guide for the stability and control portion of the evaluation.

2.4.1 Static Longitudinal Stability

2.4.1.1 Objective

The objective of these tests was to define the longitudinal stick position with respect to calibrated airspeed gradient in trimmed level flight.

2.4.1.2 Method

The static longitudinal stability was determined by using two methods. The first method consisted of recording the control positions in trimmed level flight at various airspeeds during the level flight performance tests. The second method consisted of fixing the collective at various flight trim conditions and varying the airspeed with longitudinal control about these trim conditions. The flight techniques that were used are described in paragraph 2.1.1, appendix II.

The control positions required to maintain trimmed level flight were recorded at gross weights varying from 6300 pounds to 8500 pounds at density altitudes varying from 5000 feet to 10,000 feet. Six flights were made at a mid C.G. and one flight was made at a forward C.G. During all these tests two dispensers were installed.

The static longitudinal speed stability tests were conducted at the trim flight conditions recommended in MIL-H-8501A. Most tests were flown at an aft C.G., the most critical C.G. location. Tests were conducted at a symmetric lateral C.G. loading (two dispensers), as well as at an asymmetric lateral C.G. loading (one full dispenser). Gross weight ranged from 7900 pounds to 8100 pounds at density altitudes varying from 4300 feet to 6300 feet.

2.4.1.3 Results

Control position trim curves in level flight are presented in figures 7 through 13, and results of the static longitudinal speed stability tests are presented in figures 14 through 18, appendix I.

2.4.1.4 Analysis

The control position trim curves show that the apparent static longitudinal stability was positive at calibrated airspeeds above 40 knots. Below approximately 40 KCAS the static longitudinal stability was neutral to slightly negative in some cases but was still in accordance with MIL-H-8501A. This neutral to negative static longitudinal stability was also noted during the static longitudinal stability evaluation of the clean UH-1B (references j and k). There were no significant differences between the gradients of the longitudinal stick position versus calibrated airspeed curves for the clean UH-1B and those for the UH-1B with the XM-47 antipersonnel mine dispensing subsystem installed. This was true for both forward and mid C.G. loadings.

The static longitudinal speed stability was investigated at the various trim airspeeds in level flight, climb, and autorotation recommended in MIL-H-8501A. The low-speed level flight negative stability previously described was also apparent during these tests. This negative stability, however, was not considered objectionable and was not increased by the XM-47 subsystem installation. Under all other conditions tested the static longitudinal speed stability was positive for both symmetric lateral C.G. loadings and asymmetric lateral C.G. loadings (one full dispenser). No significant change was found in the static longitudinal speed stability gradients of the UH-1B equipped with the XM-47 subsystem compared with those of the clean UH-1B (reference k).

Adequate longitudinal control margin was available at limit airspeed and an aft C.G. Qualitatively, a deterioration of the flying qualities at an aft C.G. when compared with those at a forward C.G. was noticed by the pilot.

2.4.2 Static Lateral-Directional Stability

2.4.2.1 Objective

The objective of these tests was to evaluate the static lateral-directional flying qualities of the test aircraft.

2.4.2.2 Method

The helicopter was stabilized at a zero sideslip trim point. Angle of sideslip was varied while a constant airspeed and collective pitch setting were maintained. The control positions required for each stabilized sideslip test point were recorded.

Tests with two dispensers installed were conducted in level flight at a mid and an aft C.G. and in autorotation at a mid C.G. Tests were also flown at an asymmetric lateral C.G. loading (one full dispenser) in level flight at a mid C.G. Gross weight ranged from 7900 pounds to 8100 pounds and density altitude varied from 4400 feet to 5700 feet.

2.4.2.3 Results

The test results are presented graphically in figures 19 through 25, appendix I.

2.4.2.4 Analysis

The UH-1B equipped with the XM-47 subsystem had strong positive static directional stability. The pedal position curves for level flight show that directional stability was nearly linear. The pedal position curve in autorotation indicates that the static directional stability approached neutral at sideslip angles above 20 degrees.

The lateral control positions for a symmetric loading (two dispensers) indicated a neutral to slightly positive dihedral effect in level flight at mid C.G., which approached positive dihedral effect at an aft C.G. At all C.G. loadings, dihedral effect decreased with increasing airspeed. The test results showed a difference in handling qualities between a left and a right sideslip which was especially apparent for sideslip angles greater than 15 degrees. The dihedral effect at sideslip angles greater than 15 degrees was slightly positive for left sideslip and negative during right sideslip at 5000 feet density altitude, 7810 pounds gross weight and 88.5 KCAS. This condition, however, was reversed at sideslip angles greater than 20 degrees at 5450 feet density altitude, 8100 pounds gross weight, and 72.5 KCAS; i.e., the dihedral effect became slightly negative at high left sideslip angles and positive during high right sideslip angles. Static lateral-directional instability (negative dihedral) was not in accordance with the requirements of MIL-H-8501A. This instability was not objectionable to the pilot, however, since it occurred at high angles of sideslip, which are not usually experienced in level flight. The lateral control displacement required during sideslips during autorotations indicated positive dihedral effect at sideslip angles less than 20 degrees which approached neutral dihedral effect at higher sideslip angles.

An asymmetric lateral C.G. loading (one full dispenser on the left side) did not significantly affect the static lateral-directional characteristics of the UH-1B compared with the symmetric lateral C.G. loading characteristics.

No significant changes were observed when the static lateral-directional stability of a clean UH-1B was compared with that of a UH-1B equipped with the XM-47 subsystem.

2.4.3 Dynamic Stability

2.4.3.1 Objective

The objective of these tests was to evaluate the response of the UH-1B equipped with the XM-47 antipersonnel subsystem to control pulse-type disturbances.

2.4.3.2 Method

Tests were conducted in level flight at an average gross weight of 8000 pounds and an average density altitude of 7000 feet. Two full dispensers were installed and a mid C.G. condition was investigated at calibrated airspeeds of 62 knots and 82 knots. Tests were also conducted in climb (maximum power) at 54 KCAS. At each test condition a disturbance was introduced about each axis in both directions. The disturbance was generated with a 1-inch control input which was held for 1 second, then returned to the original trim position. The ensuing aircraft motion was allowed to persist until it damped out or recovery became necessary. A control fixture was used to insure precise inputs.

2.4.3.3 Results

The dynamic stability test results were qualitatively evaluated by the pilot. The results are discussed in paragraph 2.4.3.4.

2.4.3.4 Analysis

No apparent changes were noticed in the dynamic stability characteristics of the UH-1B with the XM-47 subsystem compared with those of a clean UH-1B. The analysis of the limited dynamic stability tests resulted in the decision that no further tests than those mentioned in paragraph 2.4.3.2 were required. Qualitative pilot comments were that the dynamic stability of the UH-1B/XM-47 was satisfactory. Based on the results of the dynamic stability tests and the qualitative comments of the pilot that no controllability problems existed, controllability tests were not conducted.

2.4.4 Asymmetric Loading/Sideward and Rearward Flight

2.4.4.1 Objective

The objective of these tests was to determine if sufficient control power was available during sideward and rearward flight while the helicopter was carrying only one fully loaded dispenser.

2.4.4.2 Method

The hovering characteristics of the UH-1B/XM-47 in crosswinds and tailwinds were simulated by recording control positions in sideward and rearward flight. Tests were conducted IGE and OGE at speeds from zero to 30 miles per hour (mph). The speed was recorded by using a calibrated pacer vehicle.

The helicopter was flown rearward and sideward at a forward longitudinal C.G. and an asymmetric lateral C.G. to evaluate the aircraft control under these critical C.G. positions.

Tests were conducted both IGE and OGE at a left lateral C.G. of 5.5 inches (corresponding to a service loading with one full dispenser on the left and a crew of two) and at a right lateral C.G. of 6.0 inches (corresponding to a service loading with one full dispenser on the right and a crew of one). Average test gross weight was 8000 pounds.

2.4.4.3 Results

The results of the asymmetric loading/sideward and rearward flight tests are presented in figures 26 through 29, appendix I.

2.4.4.4 Analysis

The longitudinal control margin available in rearward flight was not adequate for the placard airspeed of 30 knots true airspeed (KTAS). At the forward longitudinal C.G. loading, a difference in longitudinal control margin was noticed when comparing rearward flight with a left dispenser (5.5 inches left lateral C.G.) with that of a right dispenser (6.0 inches right lateral C.G.).

At the same airspeed less longitudinal control margin was available in the UH-1B/XM-47 when carrying a left dispenser. The rigging of swashplate and elevator were in accordance with the requirements of reference s.

Adequate control was available during sideward flight to fly to 30 KTAS to the left or to the right with the UH-1B/XM-47 carrying either a left or right dispenser.

There were no significant differences in the control positions required, IGE and OGE, as would be expected.

It is recommended that hovering operations of a UH-1B equipped with one or two antipersonnel mine dispensers be restricted to a tailwind below 17 KTAS. The UH-1B/XM-47 could hover in a crosswind of 30 KTAS.

Flying characteristics in sideward and rearward flight were acceptable and essentially unchanged from those of a clean UH-1B.

2.4.5 Autorotational Entry

2.4.5.1 Objective

The objective of these tests was to determine if the helicopter with the XM-47 subsystem installed could make a safe entry into autorotation at all speeds from a hover to a limit airspeed following an engine failure.

2.4.5.2 Method

The helicopter was stabilized in level flight and partial-power descents and an engine failure was simulated by rapidly reducing power with the collective twist grip (gas producer speed control), followed by an approximate 2-second delay in lowering the collective pitch after the failure. The control movements required for the initiation and establishment of autorotation flight at the speed for minimum rate of descent were recorded.

Autorotational entries from level flight and partial-power descents were performed at a gross weight of 8000 pounds, a density altitude of 6000 feet and an aft C.G. Two dispensers were installed. The airspeeds varied from hover to limit airspeed.

2.4.5.3 Results

The results of the simulated engine-failure tests were based on the qualitative opinions of an experienced engineering test pilot and are discussed in paragraph 2.4.5.4.

2.4.5.4 Analysis

The response of the UH-1B equipped with the XM-47 subsystem to simulated engine failures was not considered to be a problem. No dangerous aircraft attitudes developed during autorotational entries.

2.5 PERFORMANCE

Level flight and autorotational descent tests were conducted to provide data for the operator's manual. The climb performance of the UH-1B equipped with the XM-47 antipersonnel mine dispensing subsystem was not tested since the climb schedule and approximate performance could be calculated from level flight performance. Hover data were not collected because little change in hovering performance was expected.

2.5.1 Level Flight

2.5.1.1 Objective

The objective of these tests was to define the power required as a function of airspeed. This in turn was used to determine specific range (nautical air miles per pound of fuel (NAMPP)) as a function of true airspeed and maximum airspeed performance penalties due to the installation of the XM-47 subsystem.

2.5.1.2 Method

The constant thrust coefficient (C_T) method was used.

It required flying at a constant ratio of gross weight to air density at a constant rotor rpm. This method is further explained in paragraph 2.2.2, appendix II.

Various combinations of gross weight and density altitude were used to cover a wide C_T range. A rotor rpm of 324 was used for these tests. Seven level flight performance tests were flown at density altitudes ranging from 5000 feet to 10,000 feet and gross weights from 6300 pounds to 8500 pounds. All data were taken with both mine dispensers installed at a dispenser elevation angle of 1-degree nose up. Five tests with the cargo doors on and two tests with the cargo doors off were conducted. One of the two latter tests was flown at a mid C.G. and one was flown at a forward C.G. The other level flight performance tests were flown at a mid (station 131) C.G.

2.5.1.3 Results

The individual test results of the level flight performance are presented graphically in figures 33 through 39, appendix I. For a mid C.G., with the cargo doors on, test results are summarized graphically in nondimensional form in figures 30 through 32. Insufficient data were obtained to summarize level flight performance with cargo doors off.

Table 4 presents limited standard-day cruise performance conditions of the UH-1B equipped with the XM-47 subsystem obtained during this evaluation:

TABLE 4

Density Altitude ft	Gross Weight lb	Recommended Cruise Airspeed KTAS	Nautical Air Miles Per lb of Fuel NAMPP	Factor Determining Recommended Cruise Airspeed	Remarks
4770	6330	100	0.196	0.99 NAMPP	Mid C.G. Cargo doors on
4910	8470	91	0.170	Placard Airspeed Limit	Mid C.G. Cargo doors on
5160	7520	99	0.184	0.99 NAMPP	Mid C.G. Cargo doors on
7970	8390	82	0.160	Placard Airspeed Limit	Mid C.G. Cargo doors on
9990	8450	74	0.135	Placard Airspeed Limit	Mid C.G. Cargo doors on
6440	7680	98	0.184	Placard Airspeed Limit	Mid C.G. Cargo doors off
6040	7760	97	0.176	0.99 NAMPP	Mid C.G. Cargo doors off

2.5.1.4 Analysis

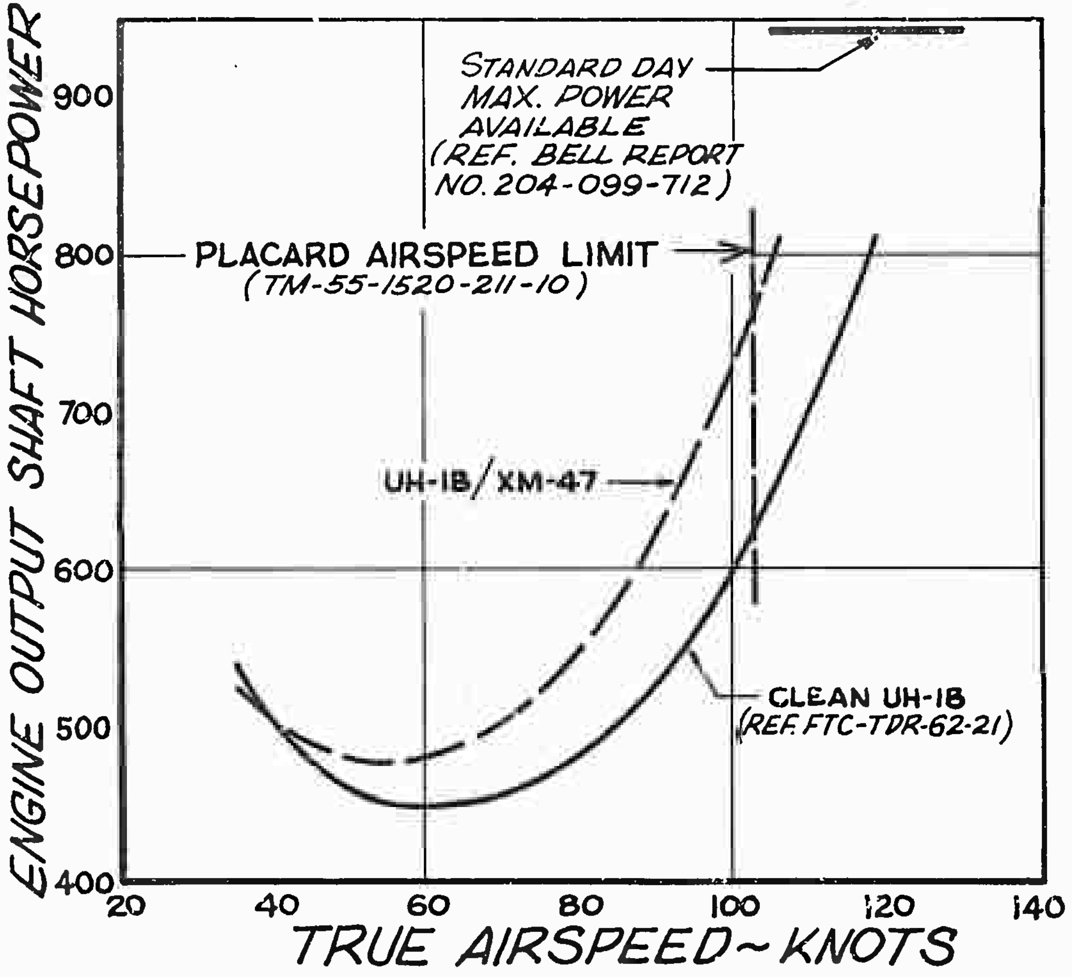
The level flight performance of the UH-1B/XM-47 and that of a clean UH-1B at 7600 pounds gross weight, 5000 feet density altitude, and 324 rotor rpm are compared in figure G. The performance penalty is presented to compare the difference in power required for the test helicopter equipped with the mine dispensing subsystem (derived from figures 30 through 32) with the power required for a clean UH-1B (derived from reference 1). The UH-1B

FIGURE G

PERFORMANCE COMPARISON

WEIGHT - 7600 LB

ALTITUDE 5000 FT. • ROTOR SPEED - 324 RPM



equipped with the XM-47 mine dispensing subsystem required 135 SHP (21.6 percent) more than the clean UH-1B for the conditions shown in figure G at the placard airspeed limit. At the power level required to cruise the clean UH-1B at 102 KTAS for the conditions shown, the installation of the XM-47 subsystem had the effect of reducing the airspeed 12 KTAS. At the airspeed for minimum power required the UH-1B equipped with the XM-47 subsystem required 25 SHP (5.5 percent) more than the clean UH-1B.

The range summary presentation (figure H) compares the specific range of a clean UH-1B and that of a UH-1B equipped with the XM-47 subsystem. The specific range for the clean UH-1B was calculated from reference 1 using engine specification fuel flow (figure 43, appendix I). The specific range for the UH-1B/XM-47 was calculated from the power-required curves obtained during level flight tests (figures 30 through 32, appendix I) and from engine specification fuel flow. The engine specification fuel flow of the T53-L-11 engine was used instead of that of the installed T53-L-9A engine because the T53-L-11 engine will replace the T53-L-9A engine in future production UH-1B helicopters. The range summary was based on a 5-percent conservative factor and was valid only in smooth, non-turbulent air. Turbulence would reduce these figures. The range comparison shows a specific range loss between 10 and 13 percent depending upon gross weight when the XM-47 subsystem was installed on the UH-1B. Recommended cruise speed was the highest speed at which it was possible to obtain 99 percent of the maximum specific range (reference MIL-C-5011A) for a given weight, altitude and rotor speed condition. It can be seen in figure H that under certain conbinations of gross weight, altitude and RPM 0.99 NAMPP occurred beyond the placard airspeed limit. Placard airspeed would then be used as recommended cruise airspeed (dashed lines in the range summary plot).

The radius of action was calculated for an assault mission. The mission calculated assumed that two mine dispensers fully loaded with antipersonnel mines were carried to the point of maximum radius of action. The most critical case was assumed; i.e., the mission had to be aborted, thus requiring the full ordnance load to be flown back. The exact conditions for the radius-of-action calculation are presented in table 5. The radius of action of this mission was calculated to be 71 nautical miles at an average airspeed of 99 KTAS. A clean UH-1B at the same gross weight would have a radius of action of 81 nautical miles at an average airspeed of 110 KTAS. This was a decrease in range of 12.5 percent.

FIGURE H
RANGE SUMMARY

324 ROTOR RPM • 5000 FT. • MID C.G. • U.S. STANDARD DAY

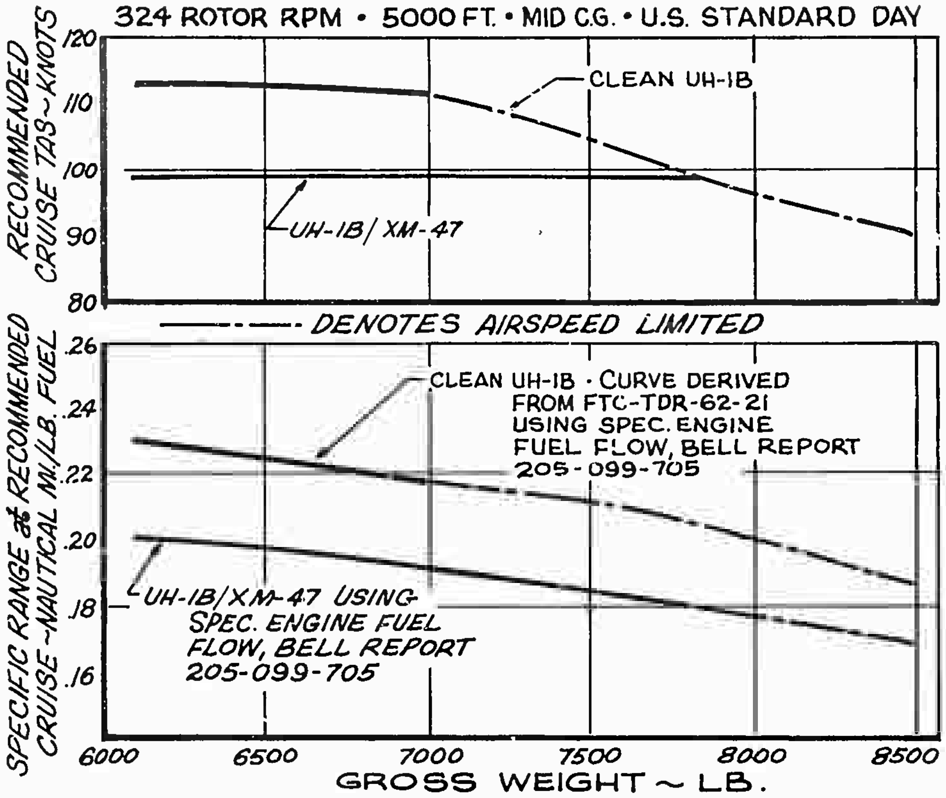


Figure 38, appendix I, shows power required in level flight at 7680 pounds gross weight, 6440 feet density altitude, and mid C.G., with the cargo doors off. A loss of approximately 1 percent was experienced in range performance when the cargo doors were removed. No significant changes in flying characteristics were noted with the cargo doors off.

Figure I shows power required when comparing level flight at forward and mid C.G.'s. Both tests were flown with the cargo doors off, at approximately the same C_T value; the results are shown in figures 38 and 39, appendix I. At a forward C.G. (figure 39) the results show that at an airspeed of 100 KTAS power required was increased by about 37 SHP (5.8 percent) and the specific range was decreased by approximately 4 percent.

Quantitative vibration data were not recorded. The vibration level as qualitatively evaluated was acceptable to 100 KCAS at 8000 pounds gross weight and sea-level standard day. This speed decreased to 90 KCAS at 5000 feet and 65 KCAS at 10,000 feet density altitude.

TABLE 5

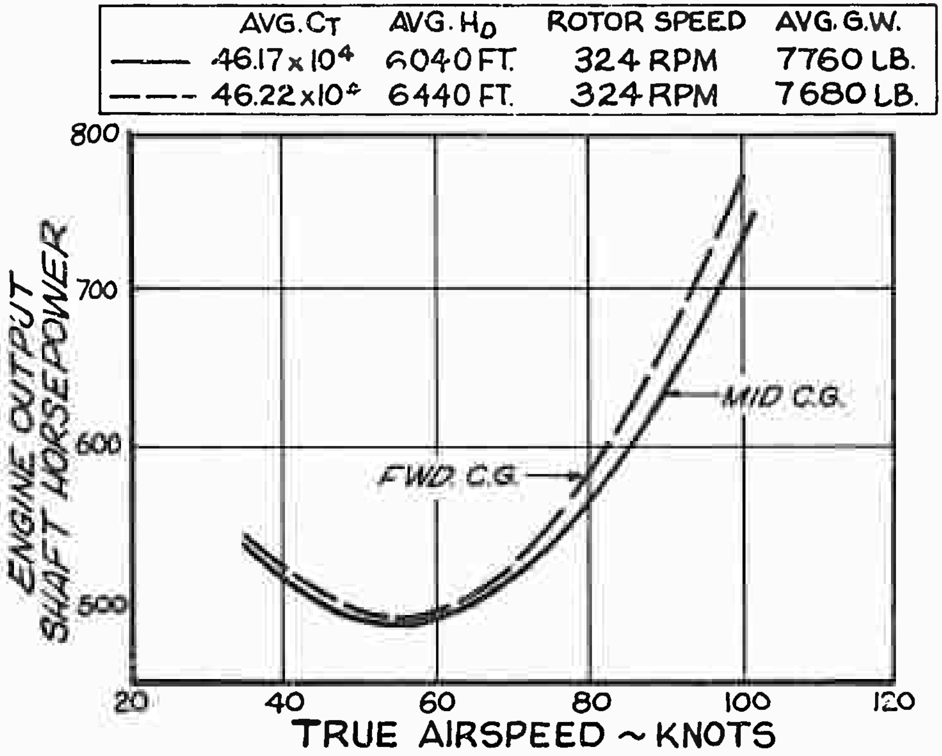
RADIUS OF ACTION

Condition

Two dispensers fully loaded with antipersonnel mines
Engine start mission weight = 7476 pounds with a crew of two
Initial fuel = 1008 pounds (155 gal at 6.5 pounds/gallon)
Mid center of gravity
Cruise at 5000 feet on a zero-wind U. S. standard day
Rotor speed = 324 rpm
Cargo doors on

Flight Conditions	Fuel - lb		Gross Weight lb	Distance Traveled NAM
	Used	Remaining		
5 minutes at normal rated power (NRP) at sea level for engine start, ground taxi, acceleration and climb to altitude of 5000 feet.	56	952	7420	0
Cruise at 5000 feet (0.99 NAMPP) at recommended average speed of 99 KTAS.	378	574	7042	71
Loiter 10 minutes at target area at NRP at 5000 feet.	107	467	6935	0
Mission: Critical case assumed where ordnance is not expended.	0	467	6935	0
Cruise back at 5000 feet (0.99 NAMPP) at recommended average speed of 99 KTAS.	366	101	6569	71
Land at takeoff point with 10-percent usable fuel remaining (no distance allowance or fuel used assumed).	0	101	6569	0
RADIUS OF ACTION				71

FIGURE I
PERFORMANCE COMPARISON
(CARGO DOORS OFF)



2.5.2 Autorotation

2.5.2.1 Objective

The objective of these tests was to define the airspeed for minimum rate of descent and the rate of descent variation as a function of rotor speed during stabilized autorotations of the UH-1B equipped with the XM-47 subsystem.

2.5.2.2 Method

Autorotational sawtooth descents were conducted at a constant rotor speed while the airspeed was varied. For each airspeed the time to pass through a selected increment of altitude was recorded.

Rate of descent as a function of rotor speed was found by varying rotor rpm while holding airspeed constant.

Tests were conducted at average gross weights of 6300 pounds and 8000 pounds at 5000 feet density altitude and mid C.G. Two dispensers were installed and positioned with a pod angle of 1-degree nose up.

2.5.2.3 Results

The autorotational characteristics are presented graphically in figure 40, appendix I.

2.5.2.4 Analysis

The minimum rate of descent for the UH-1B equipped with the XM-47 subsystem was determined to be 1780 fpm at an airspeed of 52 KCAS and an average rotor speed of 323 rpm (figure 40). This value was valid for the two gross weights tested at a density altitude of 5000 feet. The minimum rate of descent for a clean UH-1B was 1660 fpm at 54 KCAS at a gross weight of 6400 pounds and density altitudes of 5000 and 10,000 feet (reference 1). For the UH-1B/XM-47 a calibrated airspeed of 52 knots produced the minimum rate of descent during autorotations at a rotor speed of 323 rpm. The rate of descent as a function of rotor speed (figure 40) showed that the rate of descent was approximately constant for rotor speeds between 310 rotor rpm and 325 rotor rpm. The flying qualities in autorotations at an aft C.G. were acceptable.

2.5.3 Airspeed Calibration

2.5.3.1 Objective

The objective of these tests was to determine the position error of the standard ship and test boom airspeed systems with the XM-47 subsystem installed on the UH-1B helicopter.

2.5.3.2 Method

A calibrated trailing airspeed bomb was used to calibrate the airspeed systems in level flight and autorotations. The position error was calculated as the difference between the instrument-corrected airspeed indicator readings of the standard or test system and the trailing bomb system. The trailing bomb had a zero position error and, compared with the instrument-corrected ship and boom systems airspeed indicator readings, yielded position error directly.

2.5.3.3 Results

The results of the airspeed calibration for the standard ship system are presented graphically in figure 41, appendix I.

2.5.3.4 Analysis

All calibrated airspeeds in this report were obtained from the test boom airspeed system.

The position error of the standard ship airspeed system of the UH-1B/XM-47 varied throughout the speed range. The position error in level flight was 5 knots at 20 knots indicated airspeed (KIAS) with a minimum of 1 knot at 40 KIAS, increased to 4 knots at 65 KIAS, and decreased to 2 knots at 100 KIAS. This position error curve agrees reasonably well, especially for airspeeds higher than 60 KIAS, with that of a clean UH-1B. It is recommended, therefore, that the position error tabulated in the operator's manual (reference n) be used for the UH-1B equipped with the XM-47 subsystem.

The position error in autorotation increased from 5 knots at 40 KIAS to 7 knots at 95 KIAS. This position error curve does not agree with the values for a clean UH-1B presented in the operator's manual. The position error for a clean UH-1B in the comparable speed range is 6 knots to 3 knots higher than for the UH-1B/XM-47. In autorotation, therefore, it is recommended that the position error curve of figure 41 be used when the XM-47 subsystem is installed on the UH-1B.

Section 3.

Appendix I

TEST DATA

FIGURE NO. 1
JETTISON TEST

UH-1B/XM-47

S/N 62-12552

LEVEL FLIGHT
ARMAMENT CONFIGURATION
TWO EMPTY DISPENSERS
POD ANGLE 1° UP

ANGLE OF ATTACK : 5 DEG. N.D.
ANGLE OF SIDESLIP = 28 DEG. LT.
ROTOR SPEED = 324 RPM

AVG. WEIGHT = 7660 LB. (BEFORE JETTISON)
AVG. C.G. LOC. = 130.8 IN. (MID)
AVG. ALTITUDE = 2280 FT. (DENSITY ALT.)

CALIBRATED AIRSPEED = 63 KT.

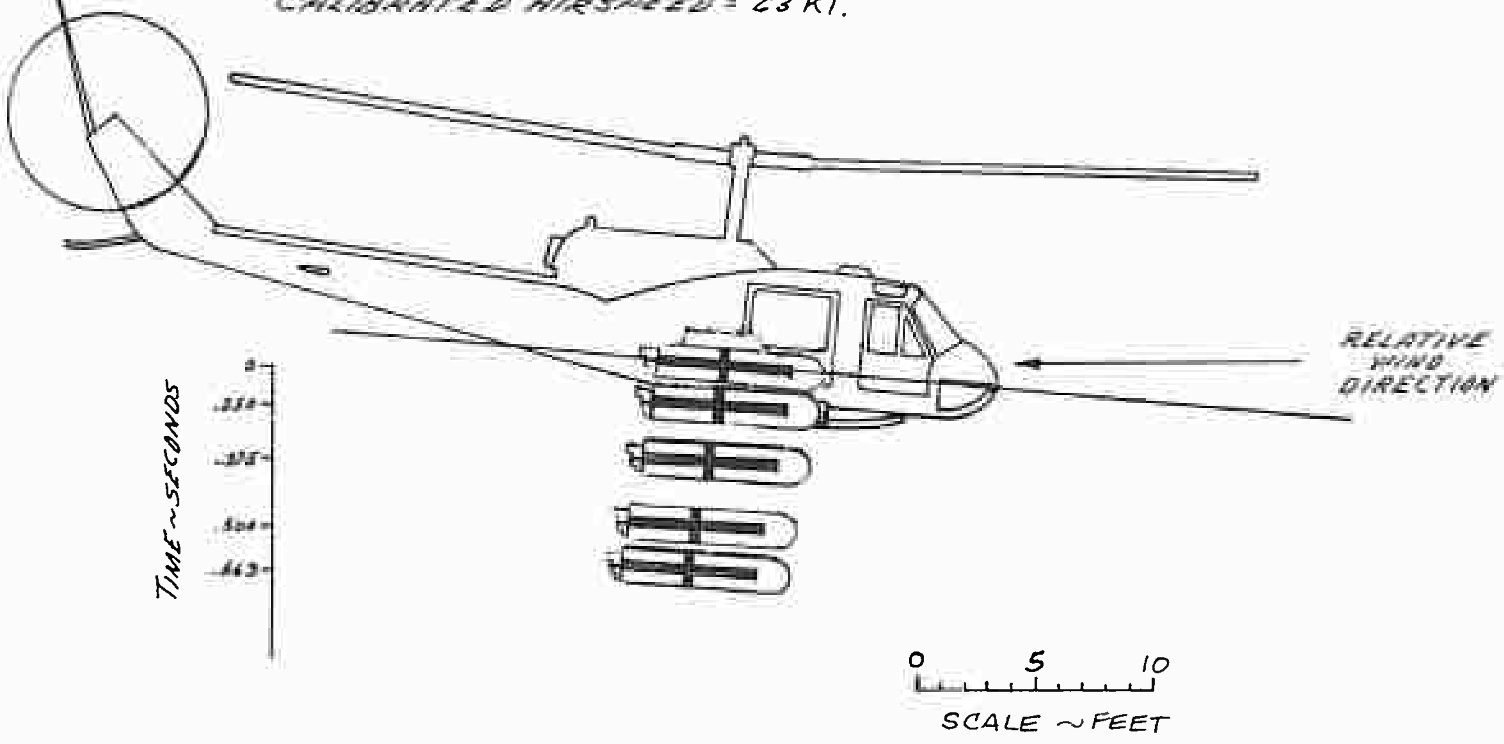


FIGURE No. 2
JETTISON TEST

UH-1B/XM-47

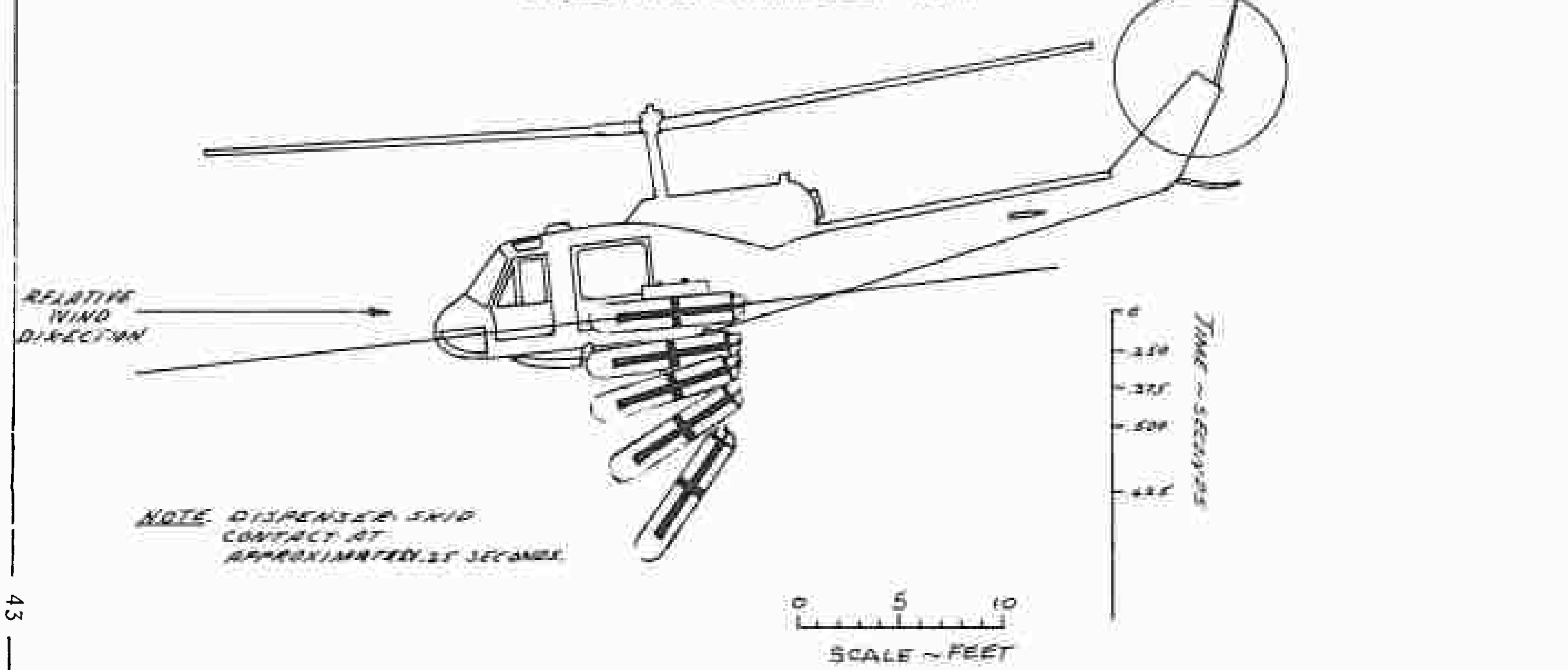
S/N 62-12552

LEVEL FLIGHT
ARMAMENT CONFIGURATION
TWO EMPTY DISPENSERS
POD ANGLE 1 ° UP

ANGLE OF ATTACK = 6 DEG N.D.
ANGLE OF SIDESLIP = 5 DEG. RT.
ROTOR SPEED = 324 RPM

AVG. WEIGHT = 7670 LB. (BEFORE JETTISON)
AVG. C.G. LOC. = 131.1 IN. (MID)
AVG. ALTITUDE = 1980 FT. (DENSITY ALT.)

CALIBRATED AIRSPEED = 101 KT.



NOTE: DISPENSER SKID CONTACT AT APPROXIMATELY .25 SECONDS.

FIGURE NO. 3
JETTISON TEST

UH-1B / XM-47
S/N 62-12552

AUTOROTATION
ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP

ANGLE OF ATTACK = 33 DEG. N.U.
ANGLE OF SIDESLIP = 27 DEG. LT.
ROTOR SPEED = 324 RPM
AVG. WEIGHT = 7650 LB. (BEFORE JETTISON)
AVG. C.G. LOC. = 131.3 IN. (MID)
AVG. ALTITUDE = 3150 FT. (DENSITY ALT.)
CALIBRATED AIRSPEED = 92 KT.
RATE OF DESCENT = 2000 FT/MIN

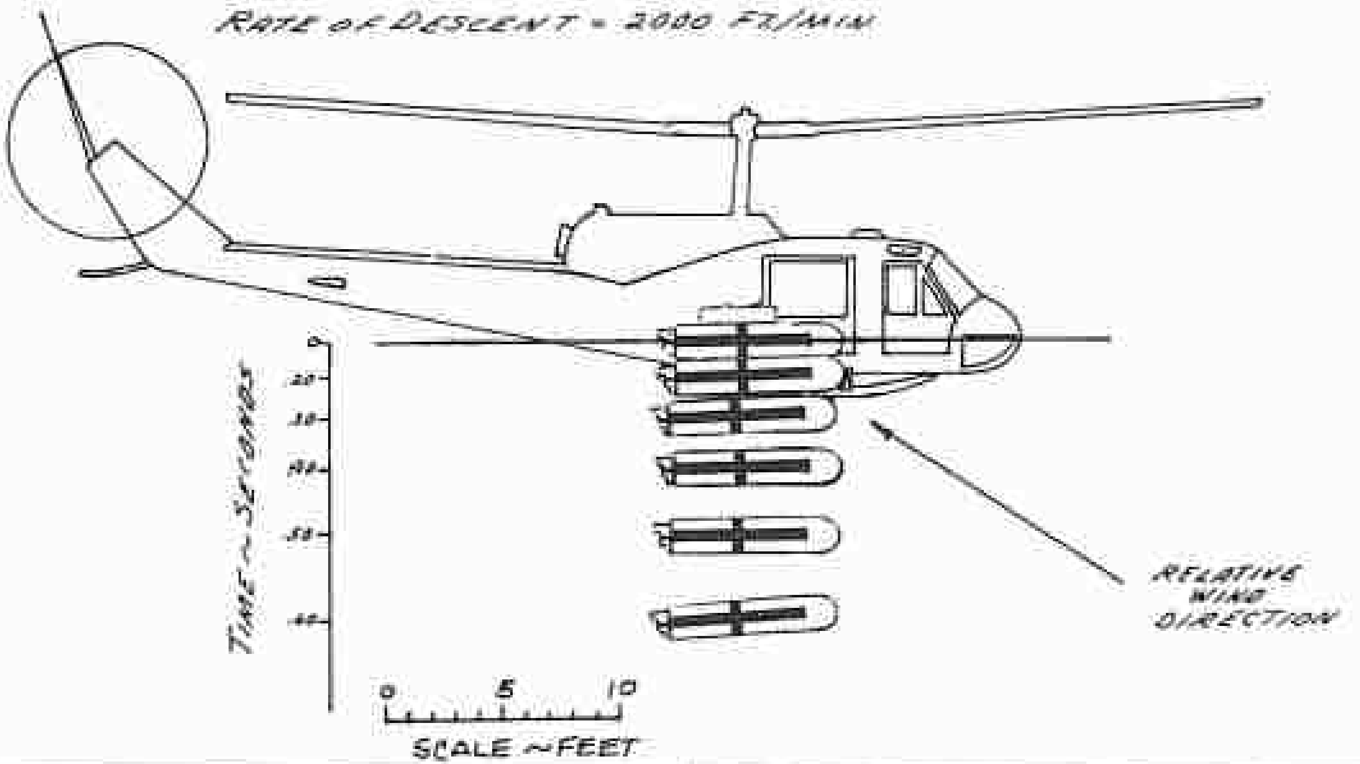


FIGURE NO. 4
JETTISON TEST

UH-1B/XM-47

S/N 62-12552

AUTOROTATION
ARMAMENT CONFIGURATION
TWO EMPTY DISPENSERS
POD ANGLE 1° UP

ANGLE OF ATTACK = 17 DEG. N.U.
ANGLE OF SIDESLIP = 15 DEG. RT.
ROTOR SPEED = 324 RPM

AVG. WEIGHT = 7650 LB. (BEFORE JETTISON)
AVG. C.G. LOC. = 130.8 IN. (MID)
AVG. ALTITUDE = 3720 FT (DENSITY ALT.)

CALIBRATED AIRSPEED = 82 KT.
RATE OF DESCENT = 2500 FT./MIN.

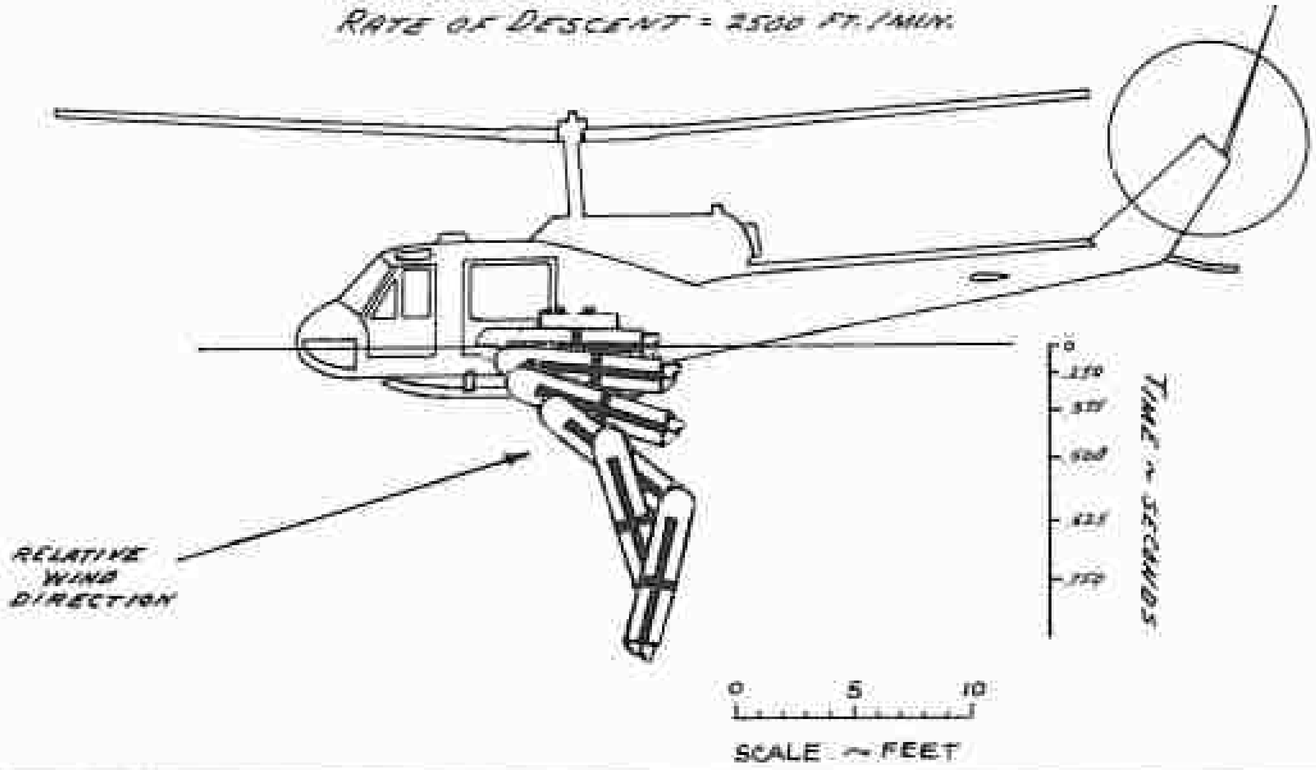
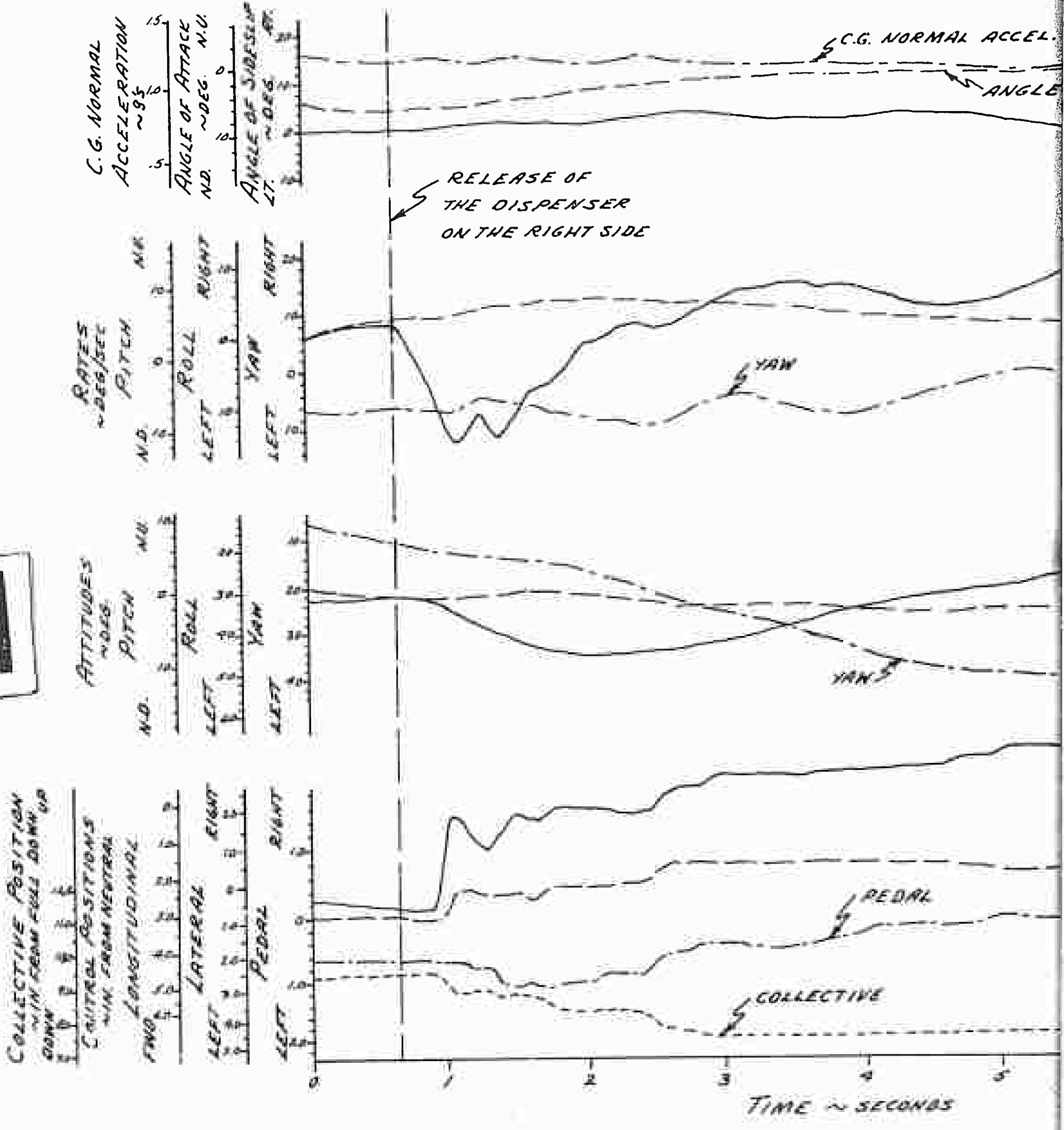


FIGURE NO. 5
JETTISON TIME HISTORY
UH-1B/XM-47 S/N 62-125
MANEUVERING FLIGHT
ARMAMENT CONFIGURATION: TWO FULL DISPENS
TRIM CONDITIONS:
CALIB. AIRSPEED = 102 KT. WEIGHT = 7640 LB.
DENSITY ALTITUDE = 3000 FT. C.G. LOC. = 131.0 IN. (M
SIDESLIP ANGLE = 0° POD ANGLE = 1° U



5
ISTORY
S/N 62-12552

GHT
TWO FULL DISPENSERS
NS:
WEIGHT = 7640 LB.
C.G. LOC. = 131.0 IN. (MID)
POD ANGLE = 1° UP

2

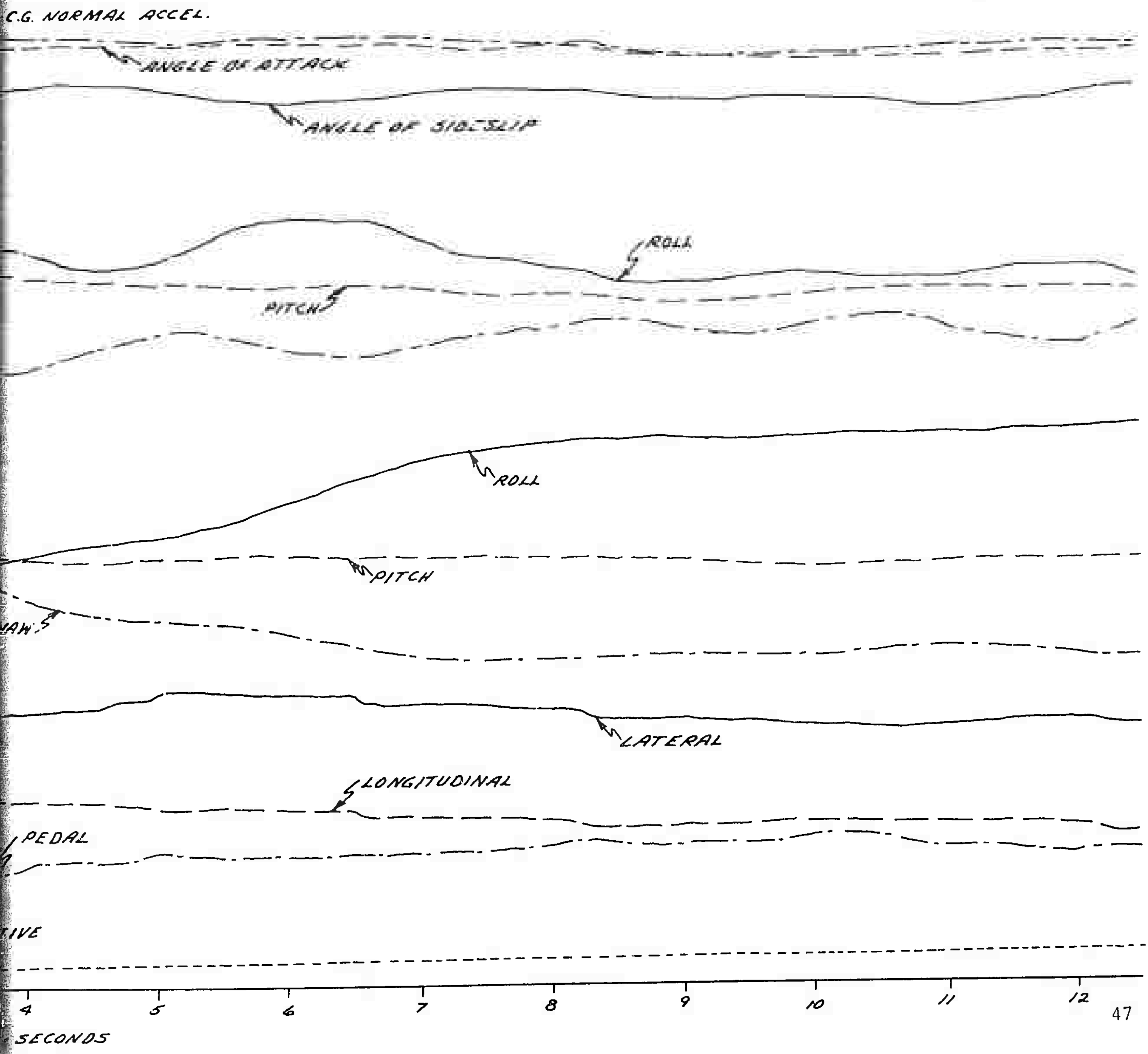


FIGURE NO. 6

JETTISON TIME HISTORY

S/N

UH-1B/XM-47

AUTOROTATION

ARMAMENT CONFIGURATION: TWO FU

TRIM CONDITIONS:

CALIB. AIRSPEED = 42 KT.
POD A

DENSITY ALTITUDE = 3150 FT.
WEIG

SIDESLIP ANGLE = 27° LEFT
C.G. LO

AUTOROTATION: RATE OF DESCENT

1

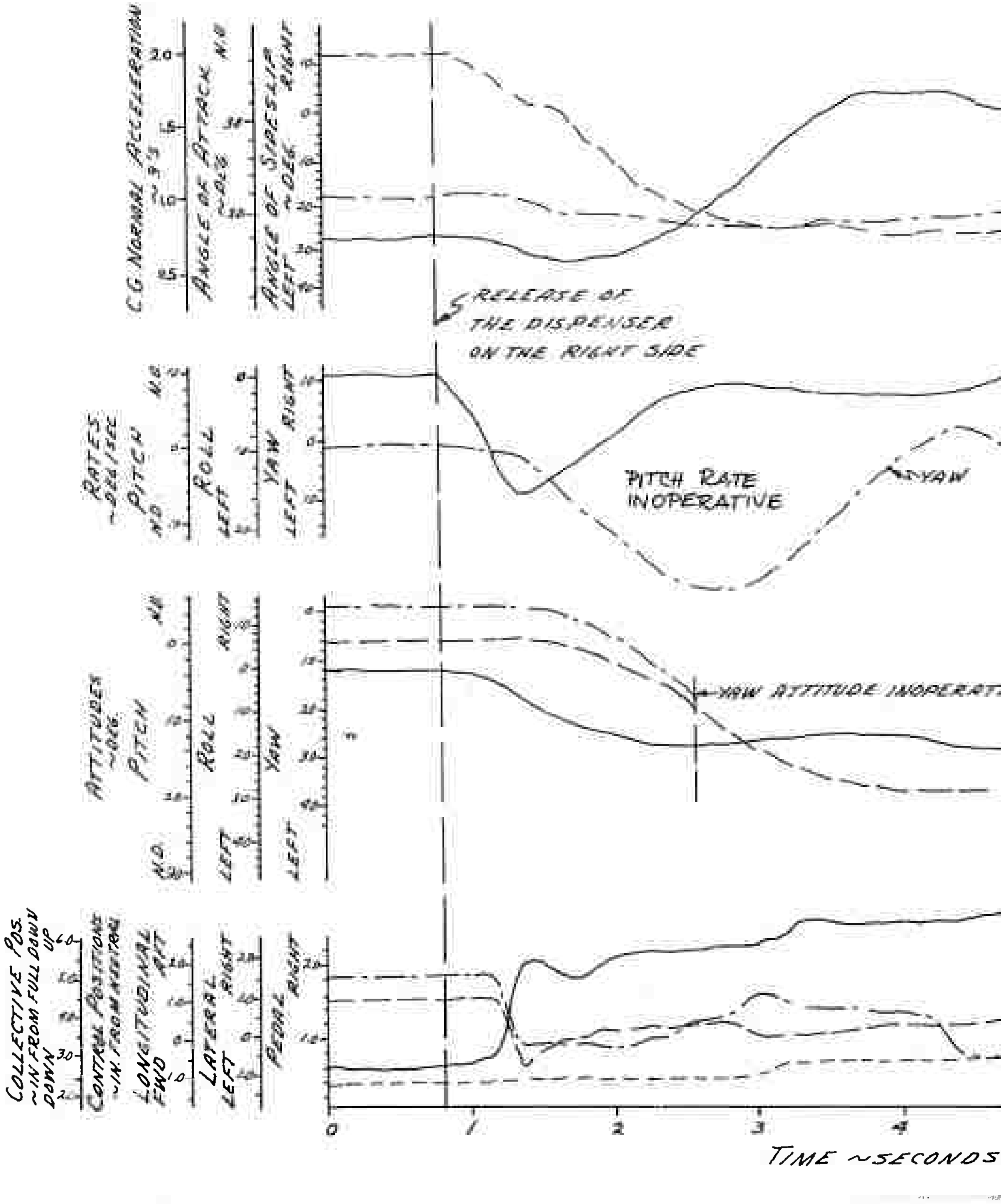
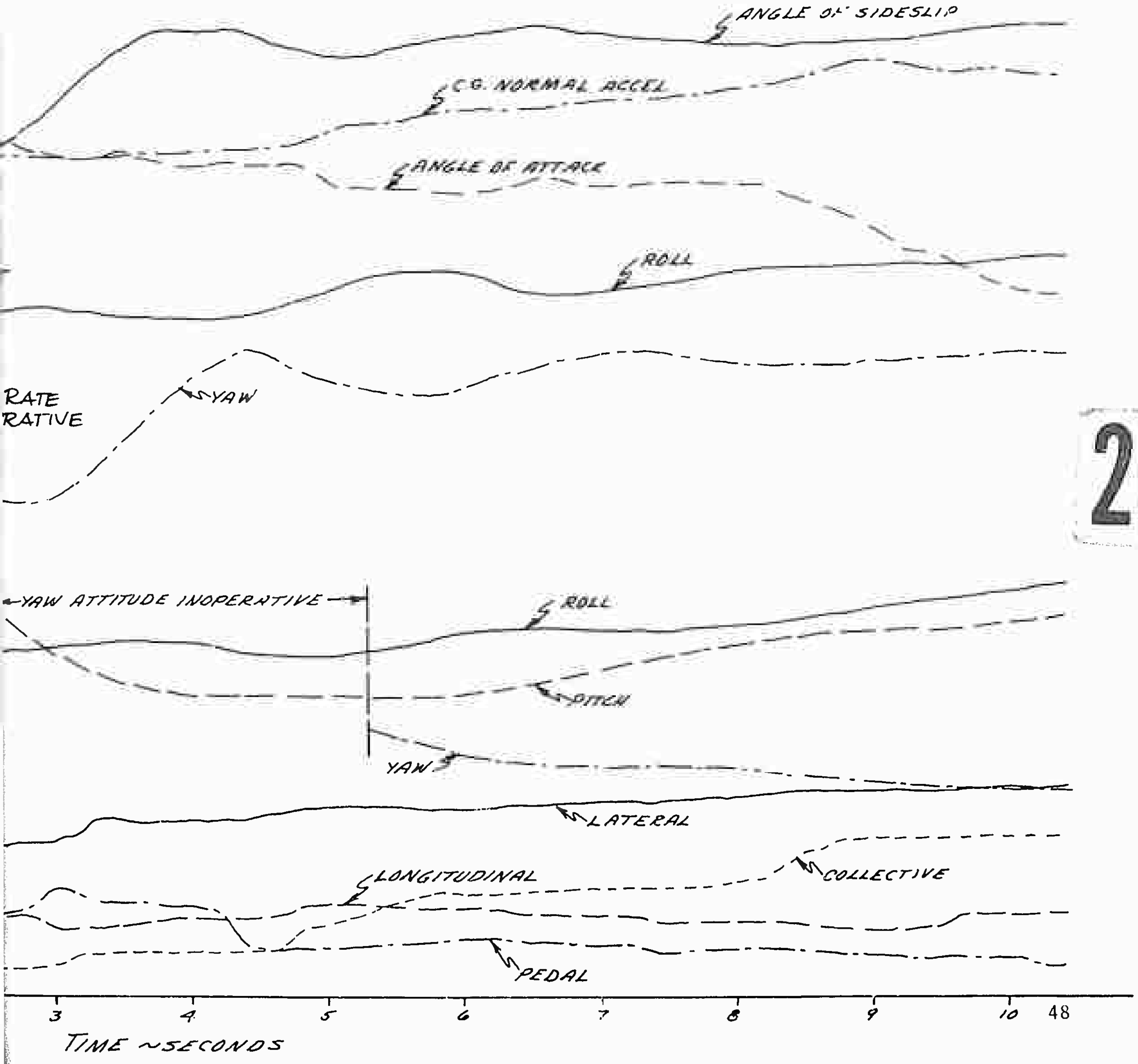


FIGURE 10.6
ISON TIME HISTORY
S/N 62-12552

AUTOROTATION
NFIGURATION: TWO FULL DISPENSERS
RIM CONDITIONS:
ED = 42 KT.　POD ANGLE = 1° UP
UDE = 3150 FT.　WEIGHT = 7650 LB.
LE = 27° LEFT　C.G. LOC. = 131.3 IN. (MID)
N: RATE OF DESCENT = 2000 FT/MIN.



2

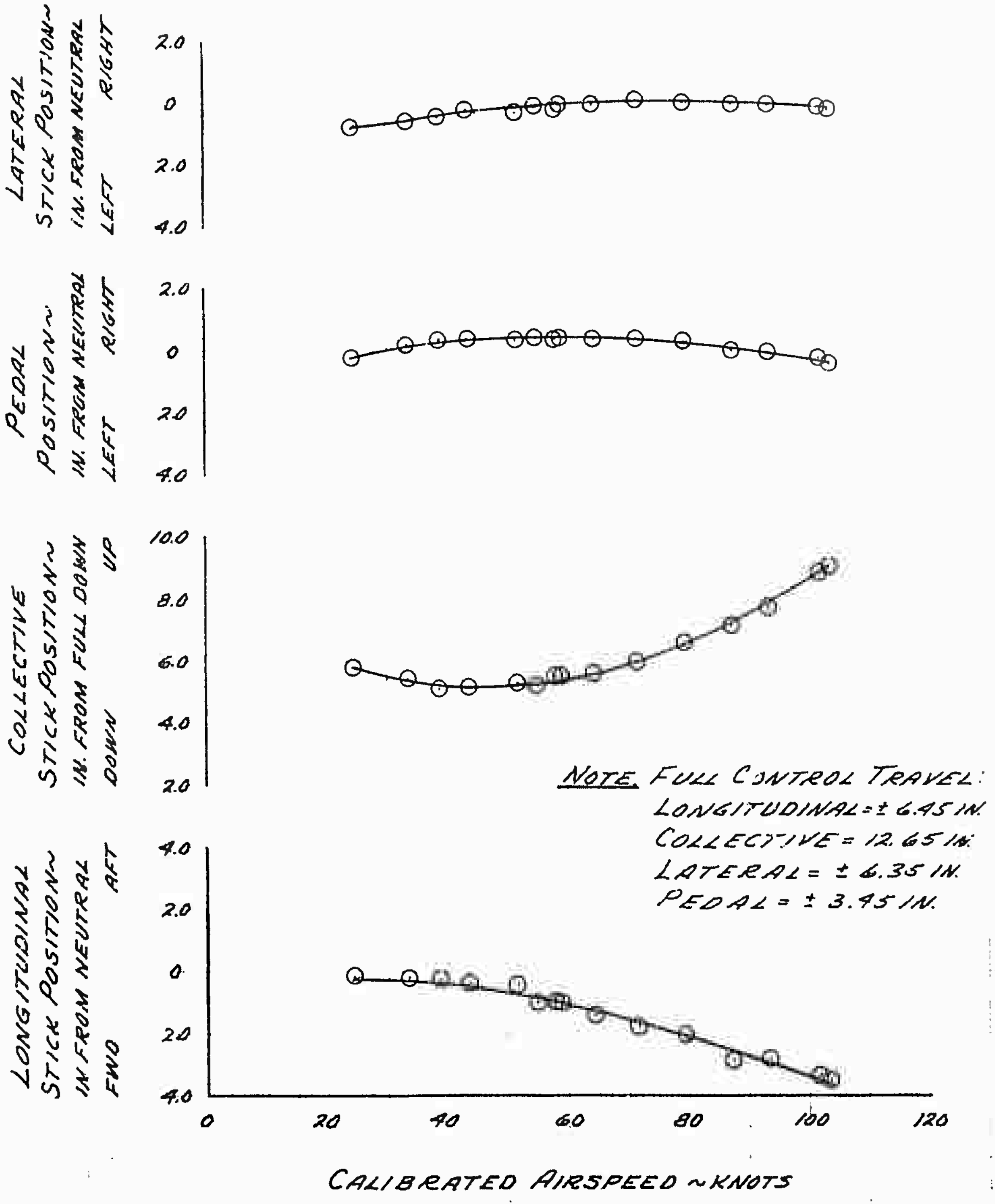
FIGURE NO. 7

CONTROL POSITIONS IN LEVEL FLIGHT

UH-1B / XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO EMPTY DISPENSERS
POD ANGLE 1° UP

AVG. HD = 4750 FT. AVG. C.G. = 131.0 IN. (MID)
AVG. G.W. = 6330 LB. ROTOR SPEED = 324 RPM

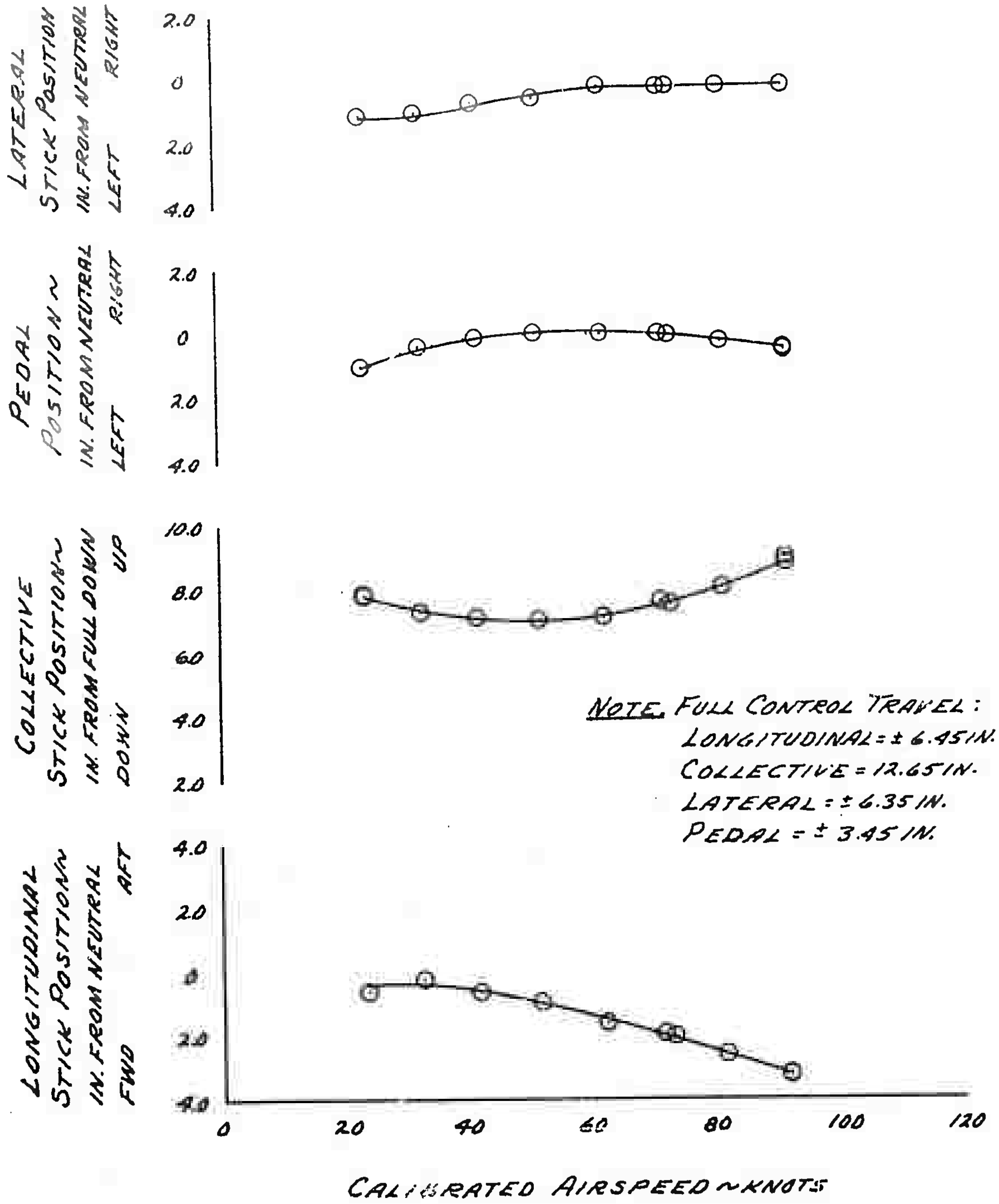


NOTE. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

FIGURE NO. 8
CONTROL POSITIONS IN LEVEL FLIGHT
UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP

AVG. HD = 4900 FT. AVG. C.G. = 131.0 IN. (MID)
AVG. G.W. = 8470 LB. ROTOR SPEED = 324 RPM



NOTE, FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

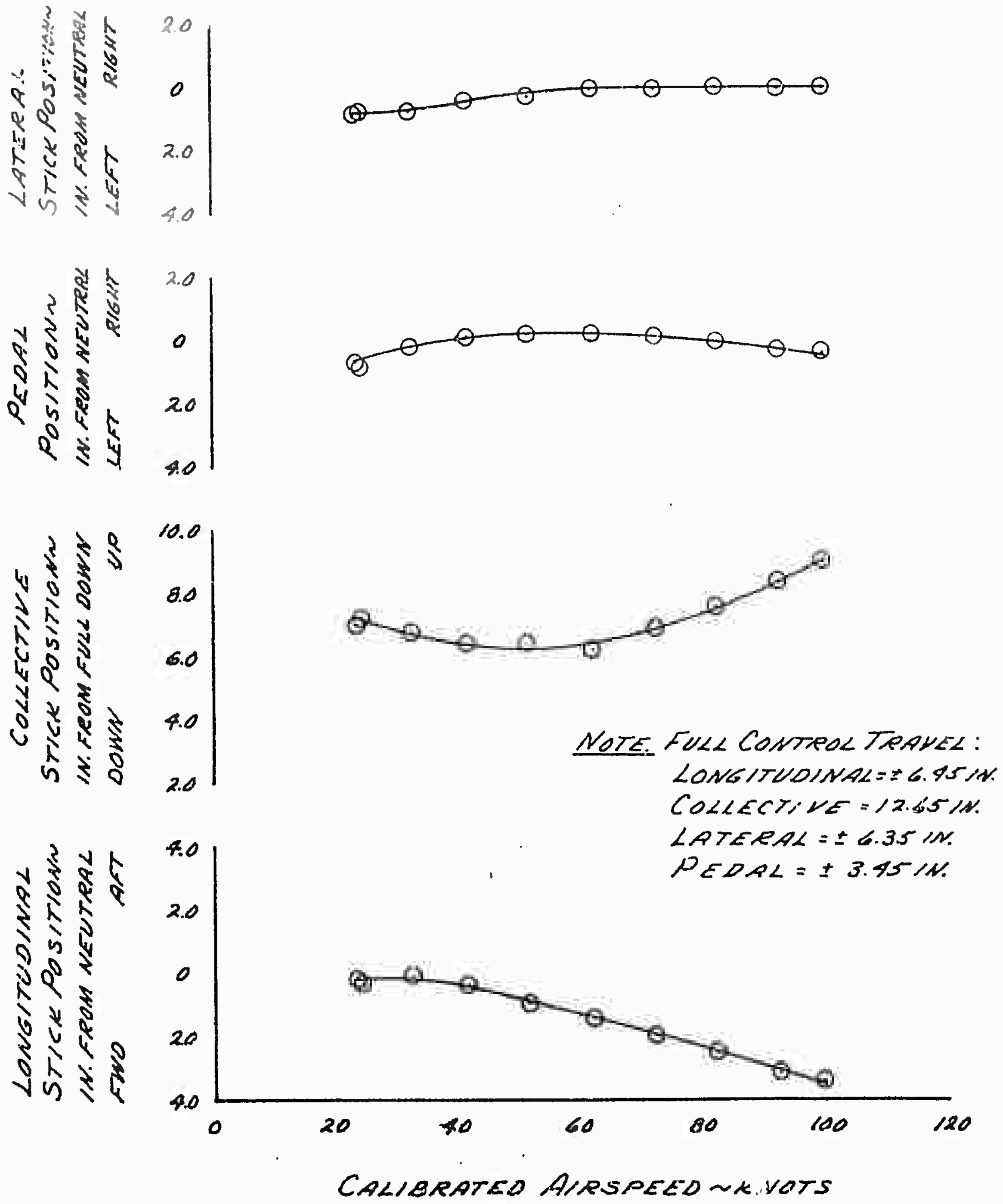
FIGURE NO. 9

CONTROL POSITIONS IN LEVEL FLIGHT

UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP

AVG. HD = 5150 FT.
AVG. G.W. = 7520 LB.
AVG. C.G. = 131.0 IN(MID)
ROTOR SPEED = 324 RPM

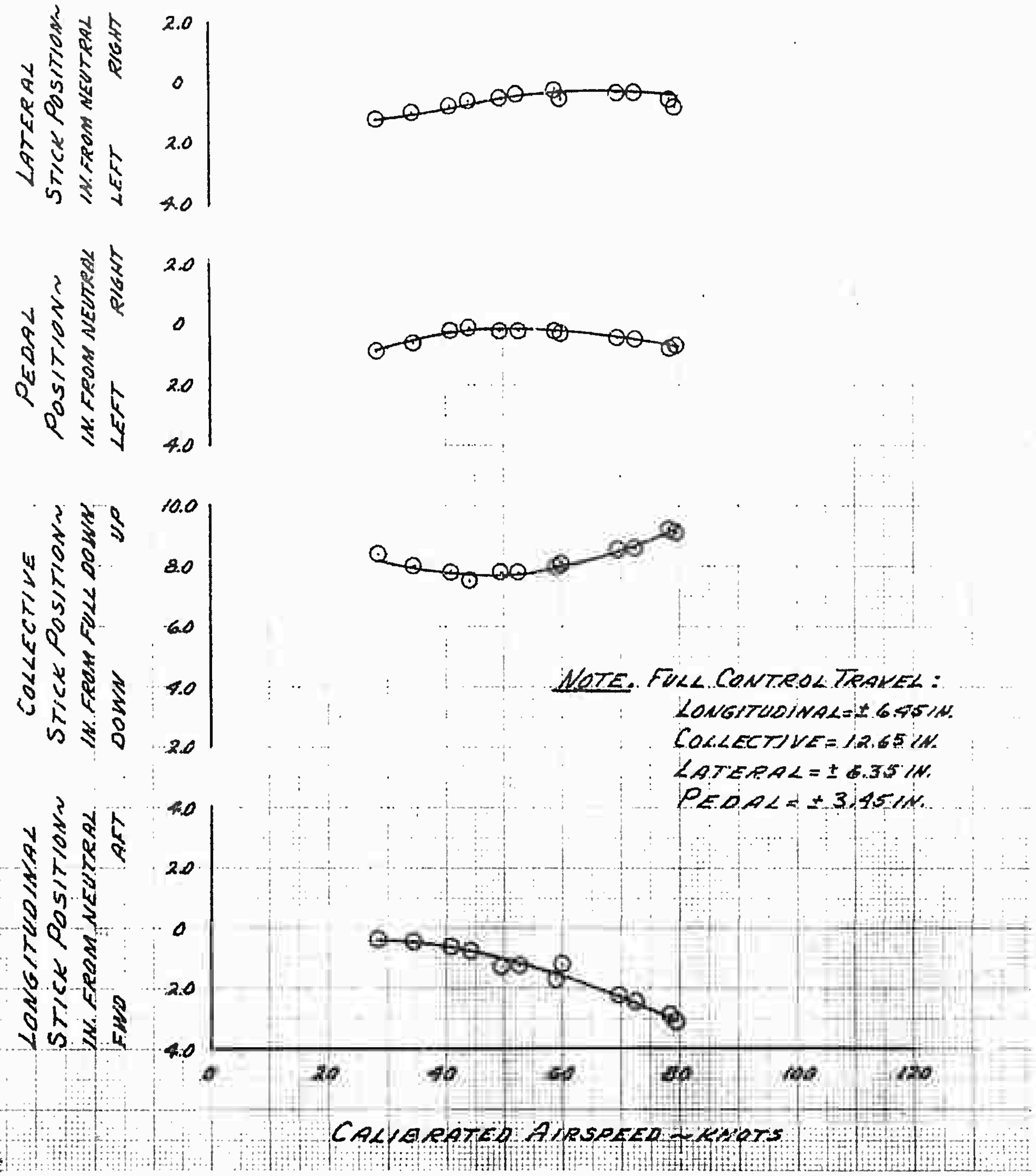


NOTE. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

FIGURE NO. 10
CONTROL POSITIONS IN LEVEL FLIGHT
UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP

AVG. Ho = 7950 FT. AVG. C.G. = 131.0 IN. (MID)
AVG. G.W. = 8390 LB. ROTOR SPEED = 324 RPM



NOTE. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

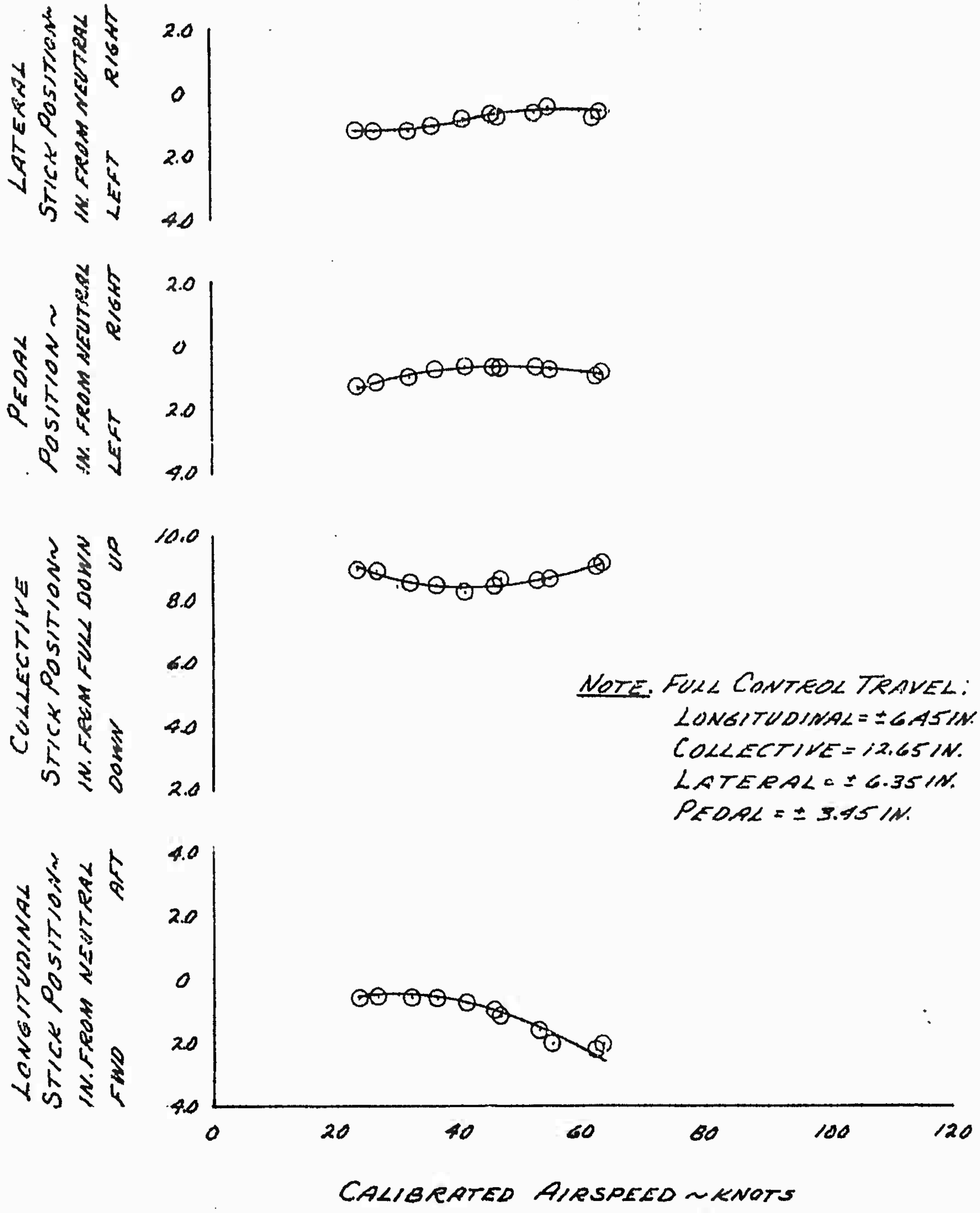
FIGURE NO. 11

CONTROL POSITIONS IN LEVEL FLIGHT

UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP

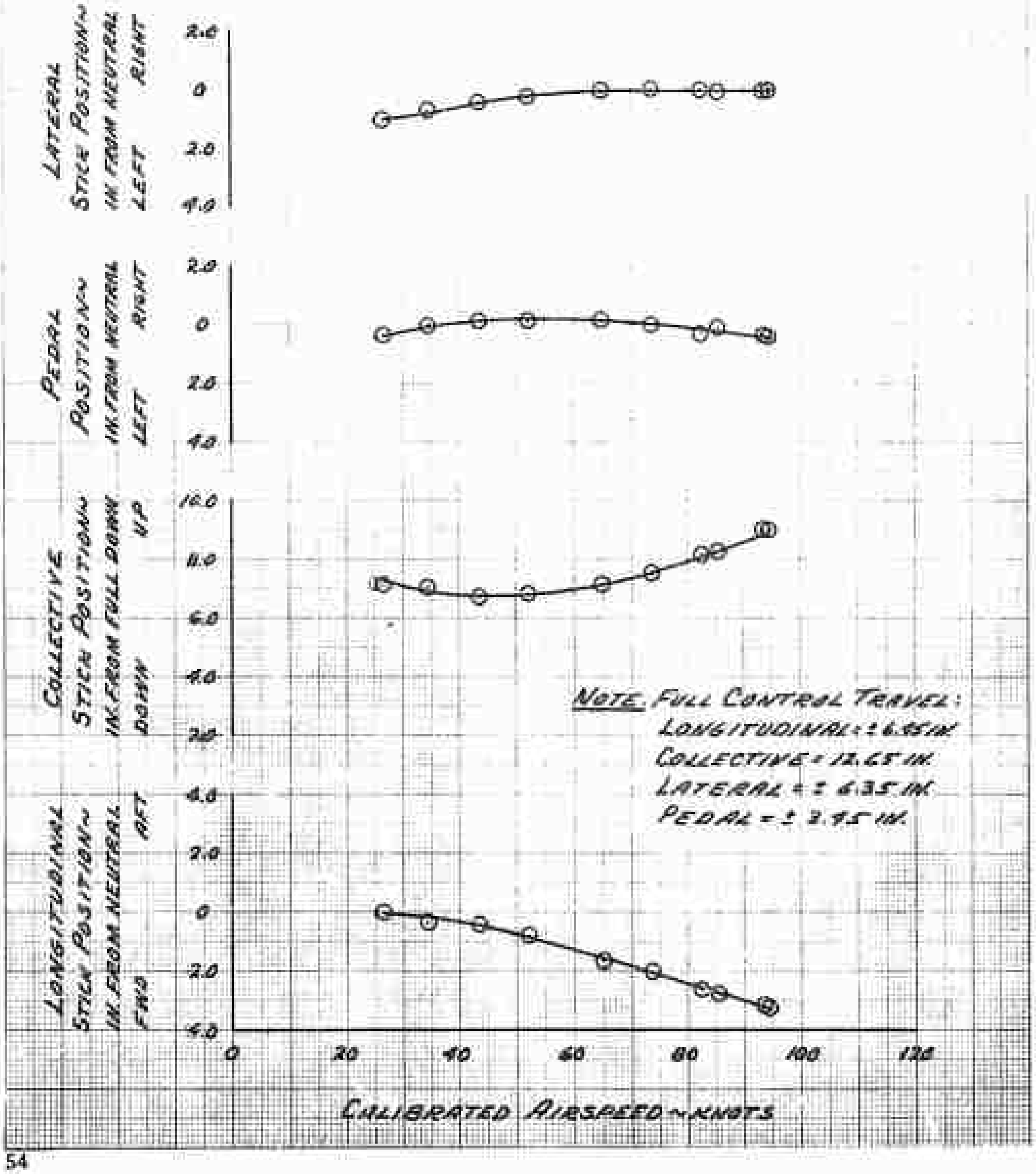
AVG. Ho = 10,000 FT. AVG. C.G. = 131.0 IN. (MID)
AVG. G.W. = 8450 LB. ROTOR SPEED = 324 RPM



NOTE. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

FIGURE NO. 12
CONTROL POSITIONS IN LEVEL FLIGHT
UH-1B / XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP
CARGO DOORS OFF
AVG. Hd = 6950 FT. AVG. C.G. = 131.0 IN (MID)
AVG. G.W. = 7680 LB. ROTOR SPEED = 324 RPM



NOTE: FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.95 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

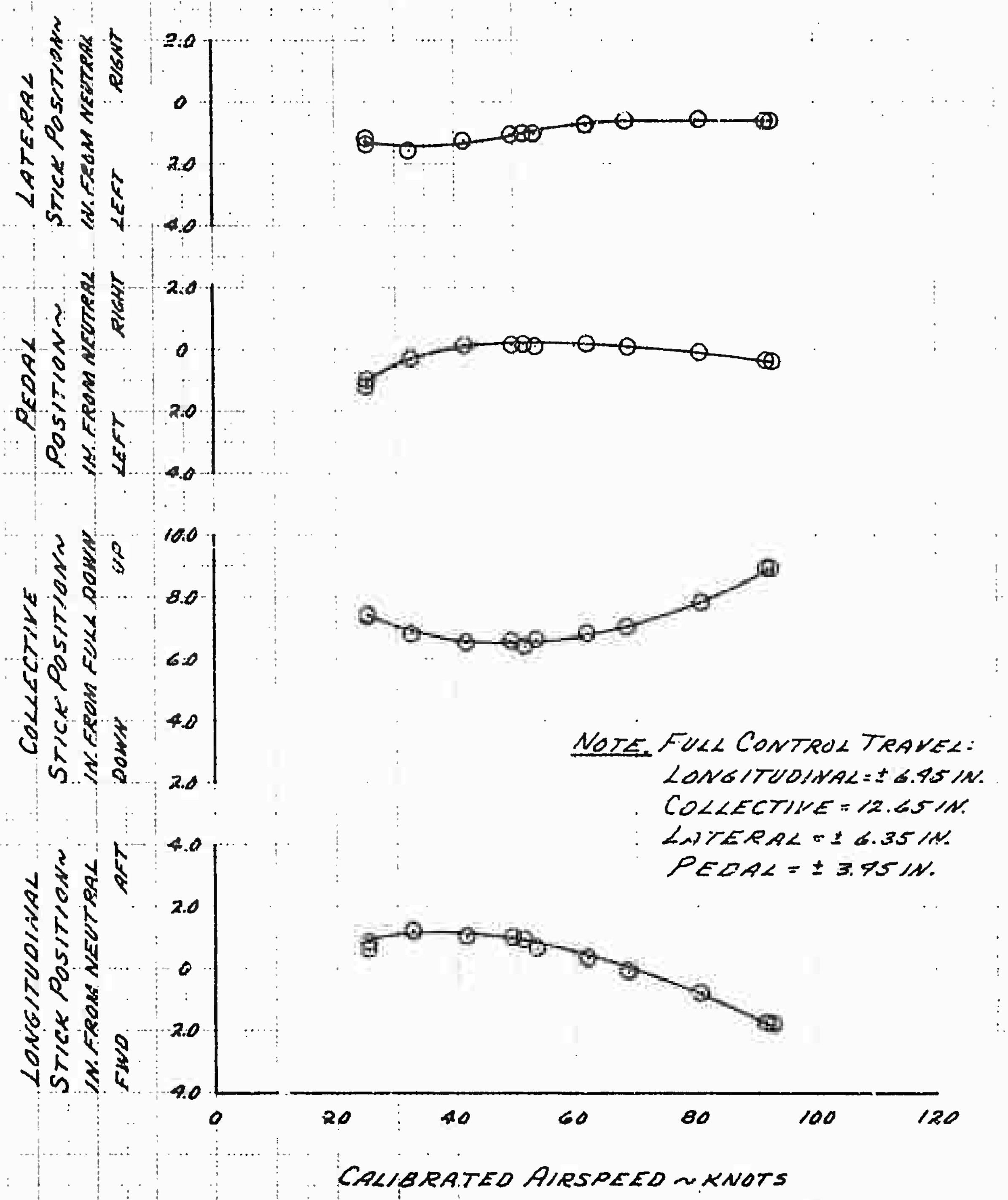
FIGURE NO. 13

CONTROL POSITIONS IN LEVEL FLIGHT

UH-1B/XM-47 S/N 62-12552

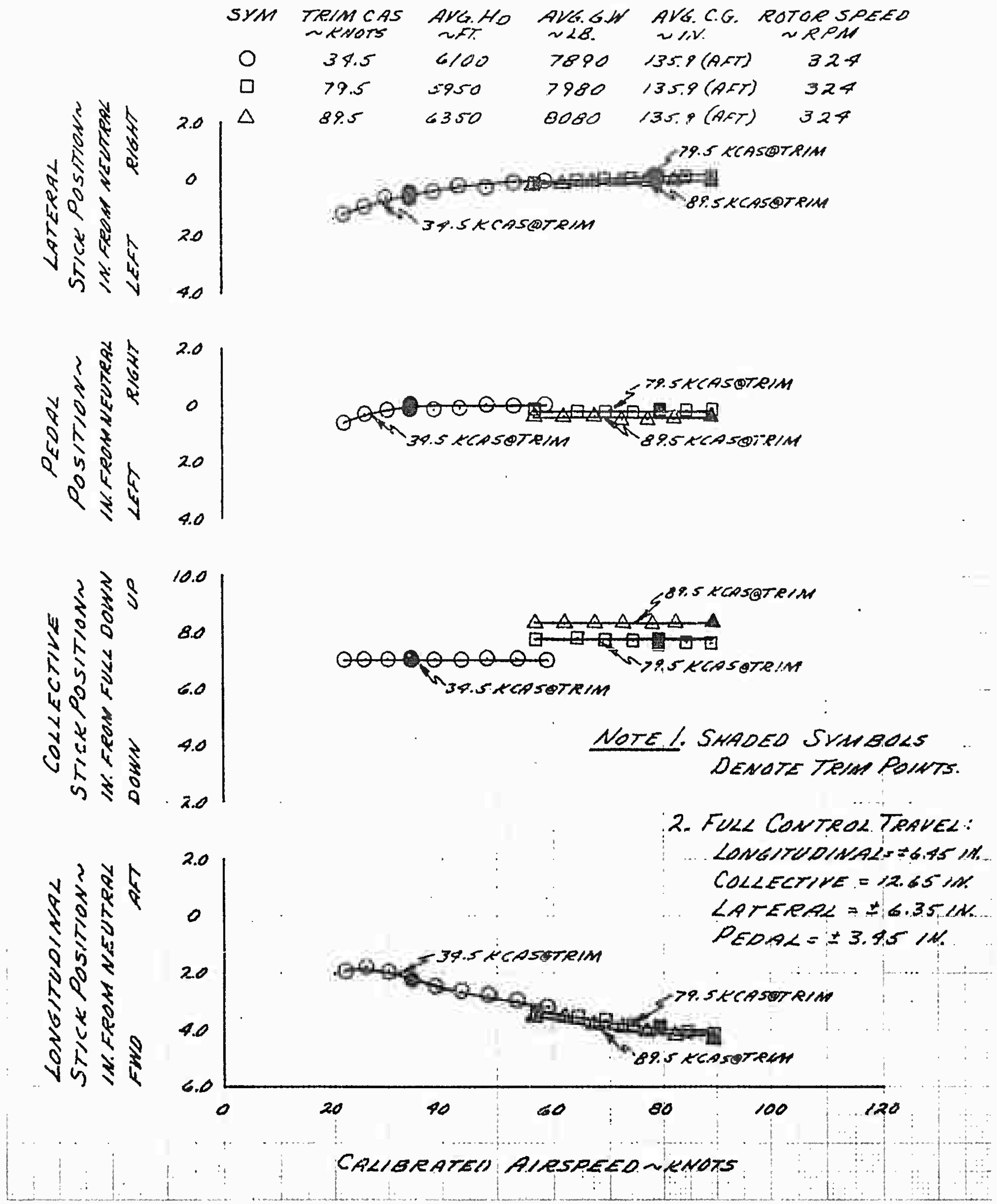
ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP
CARGO DOORS OFF

AVG. H_D = 6450 FT. AVG. C.G. = 126.4 IN. (FWD)
AVG. G.W. = 7660 LB. ROTOR SPEED = 324 RPM



NOTE. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.95 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.95 IN.

FIGURE NO. 14
STATIC LONGITUDINAL SPEED STABILITY
UH-1B/XM-47 S/N 62-12552
LEVEL FLIGHT
ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP



SYM	TRIM CAS ~KNOTS	AVG. Ho ~FT.	AVG. G.W ~LB.	AVG. C.G. ~IN.	ROTOR SPEED ~RPM
○	34.5	6100	7890	135.9 (AFT)	324
□	79.5	5950	7980	135.9 (AFT)	324
△	89.5	6350	8080	135.9 (AFT)	324

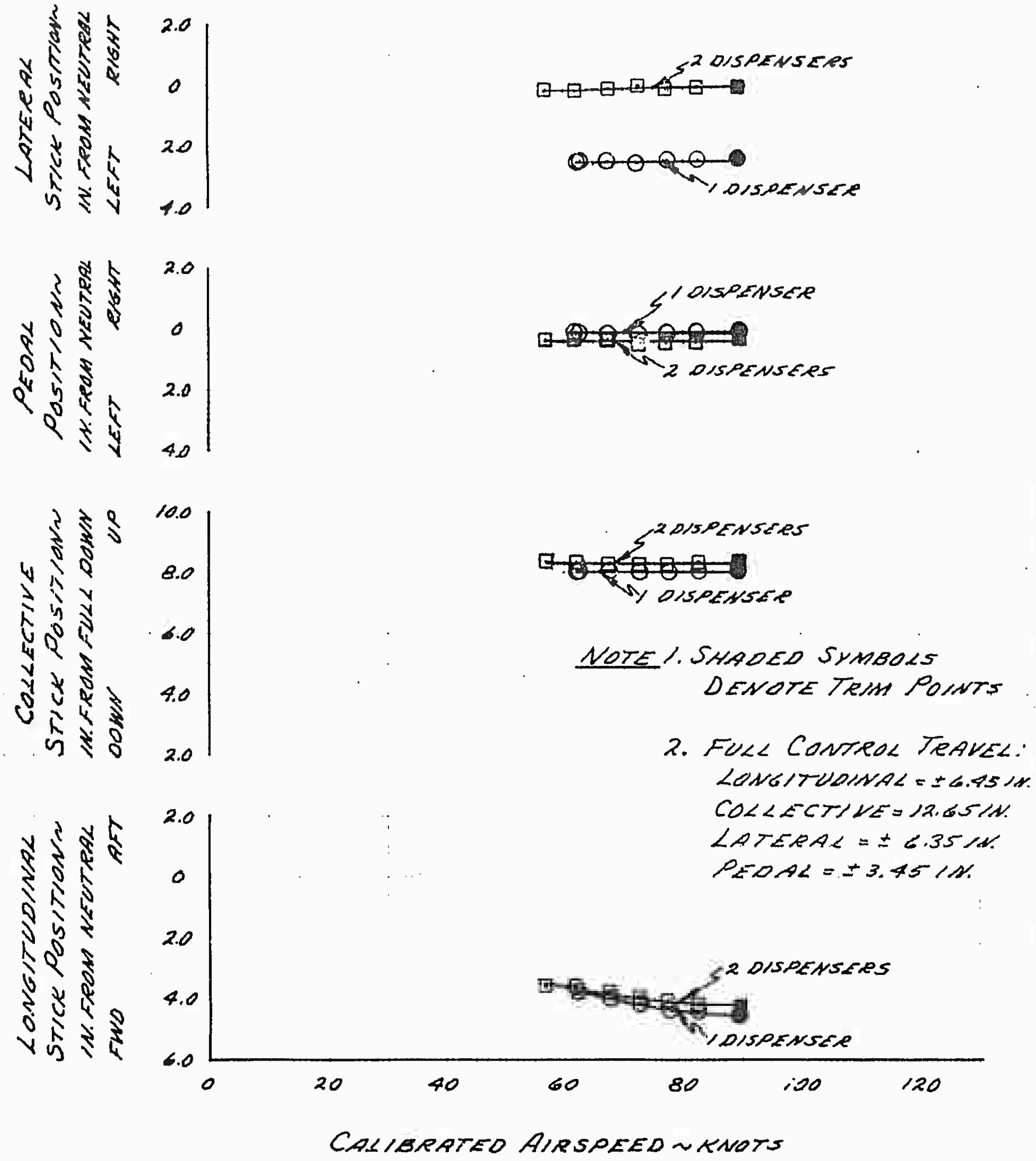
NOTE 1. SHADED SYMBOLS DENOTE TRIM POINTS.

2. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

FIGURE NO. 15
STATIC LONGITUDINAL SPEED STABILITY

UH-1B/XM-47 S/N 62-12552
LEVEL FLIGHT
ARMAMENT CONFIGURATION
POD ANGLE 1° UP

SYM	TRIM CAS ~KNOTS	AVG. HD ~FT.	AVG. G.W. ~LB.	AVG. C.G. ~IN.	ROTOR SPEED ~RPM	EXTERNAL CONFIG.
○	89.5	5700	8110	135.8 (AFT)	324	1 FULL DISP. (RT. SIDE)
□	89.5	6350	8080	135. (AFT)	324	2 FULL DISP.



NOTE 1. SHADED SYMBOLS DENOTE TRIM POINTS

2. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

FIGURE NO. 16

STATIC LONGITUDINAL SPEED STABILITY

UH-1B/XM-47 S/N 62-12552

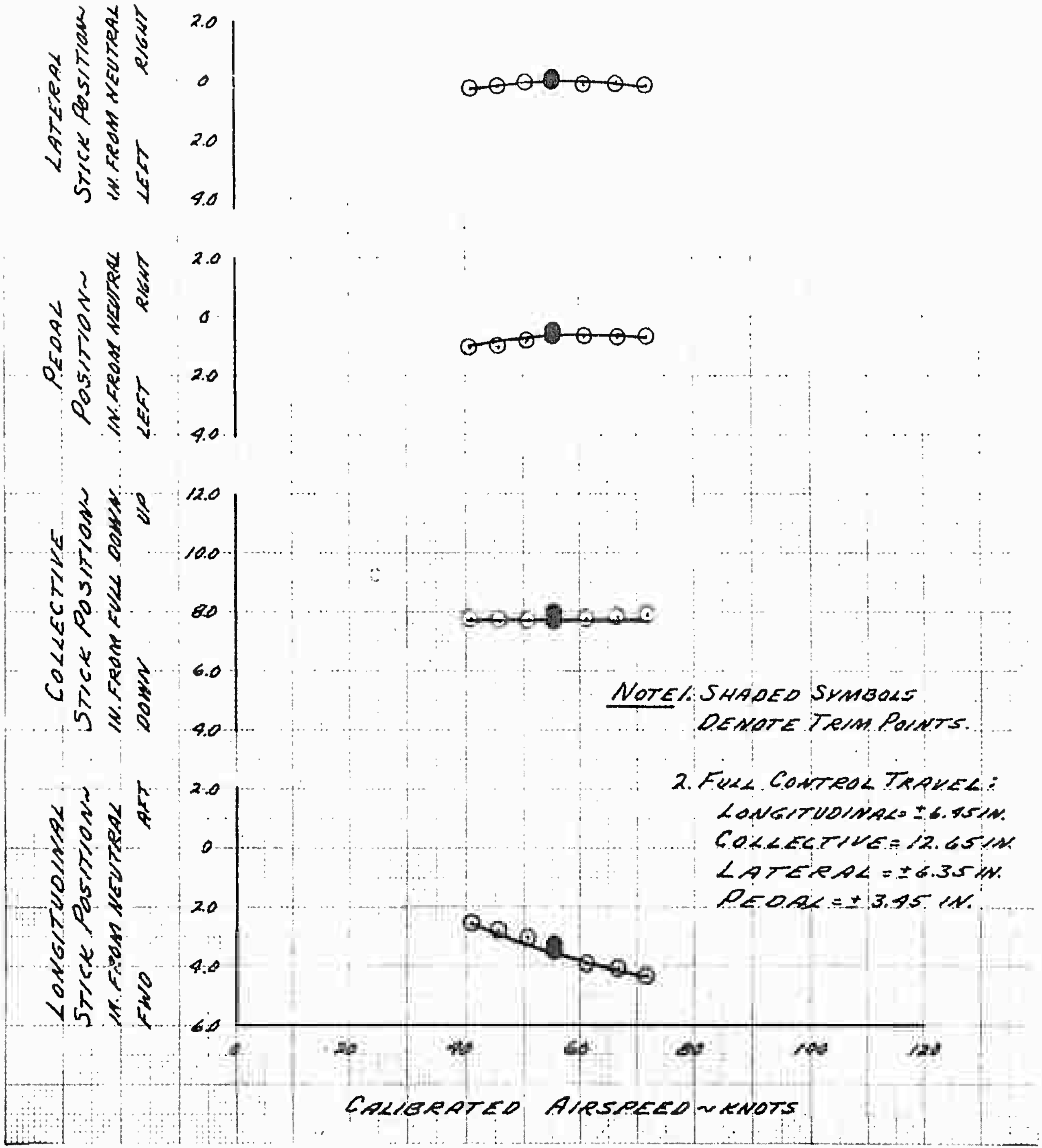
CLIMB

ARMAMENT CONFIGURATION

TWO FULL DISPENSERS

POD ANGLE 1° UP

SYM	TRIM CAS ~KNOTS	AVG. Hd ~FT	AVG. G.W. ~LB	AVG. C.G. ~IN.	ROTOR SPEED ~RPM
○	55.5	6350	7980	1360 (AFT)	324



NOTE 1. SHADED SYMBOLS DENOTE TRIM POINTS.

2. FULL CONTROL TRAVEL:
LONGITUDINAL = ±6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ±6.35 IN.
PEDAL = ±3.45 IN.

FIGURE NO. 17

STATIC LONGITUDINAL SPEED STABILITY

UH-1B/XM-47 S/N 62-12552

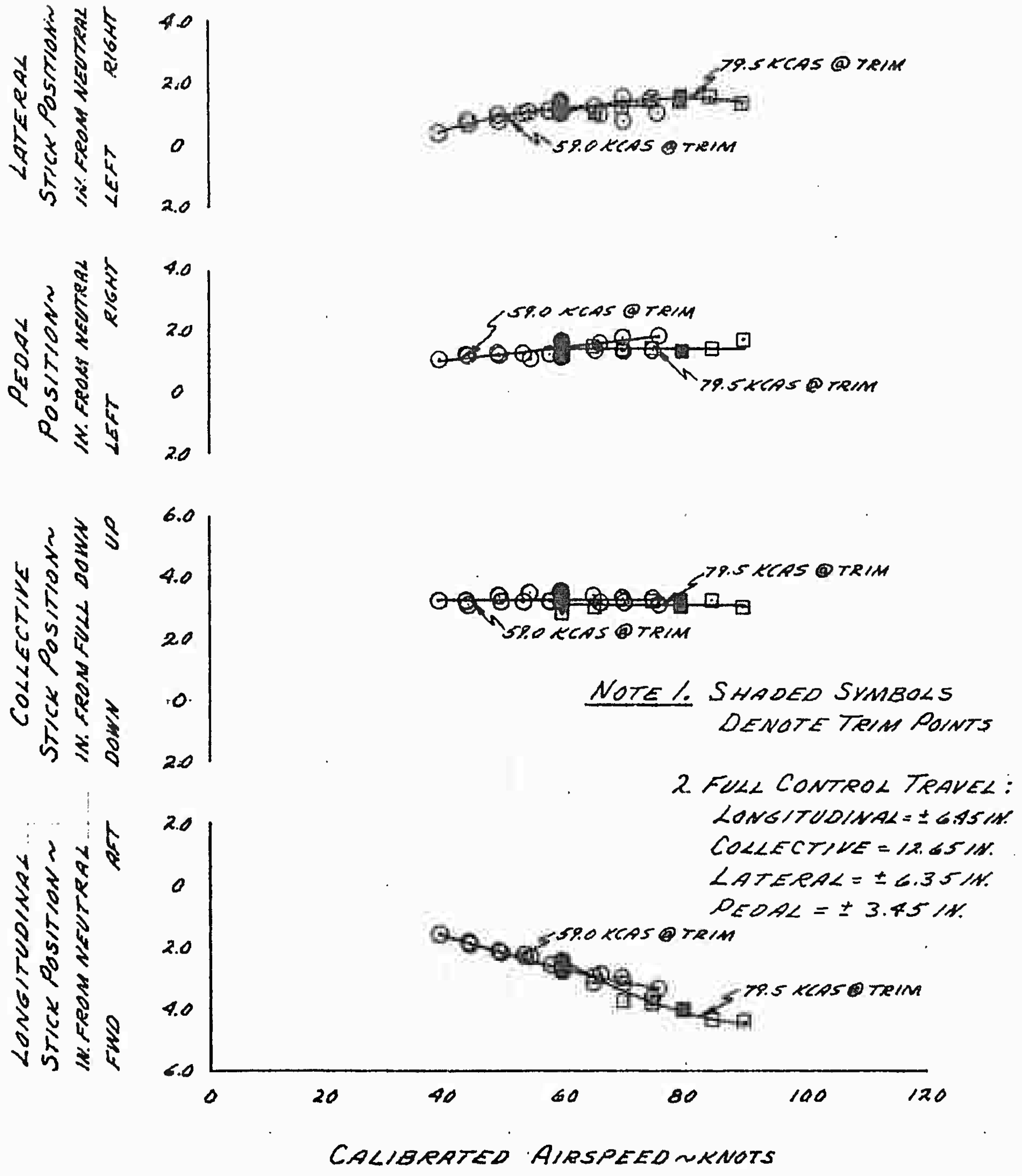
AUTOROTATION

ARMAMENT CONFIGURATION

TWO FULL DISPENSERS

POD ANGLE 1° UP

SYM	TRIM CAS ~KNOTS	AVG. Hd ~FT.	AVG. G.W. ~LB.	AVG. C.G. ~IN.	ROTOR SPEED ~RPM
○	59.0	5300	8070	136.0 (AFT)	324
□	79.5	5350	8040	136.0 (AFT)	324



NOTE 1. SHADED SYMBOLS DENOTE TRIM POINTS

2. FULL CONTROL TRAVEL:

LONGITUDINAL = ± 6.45 IN.

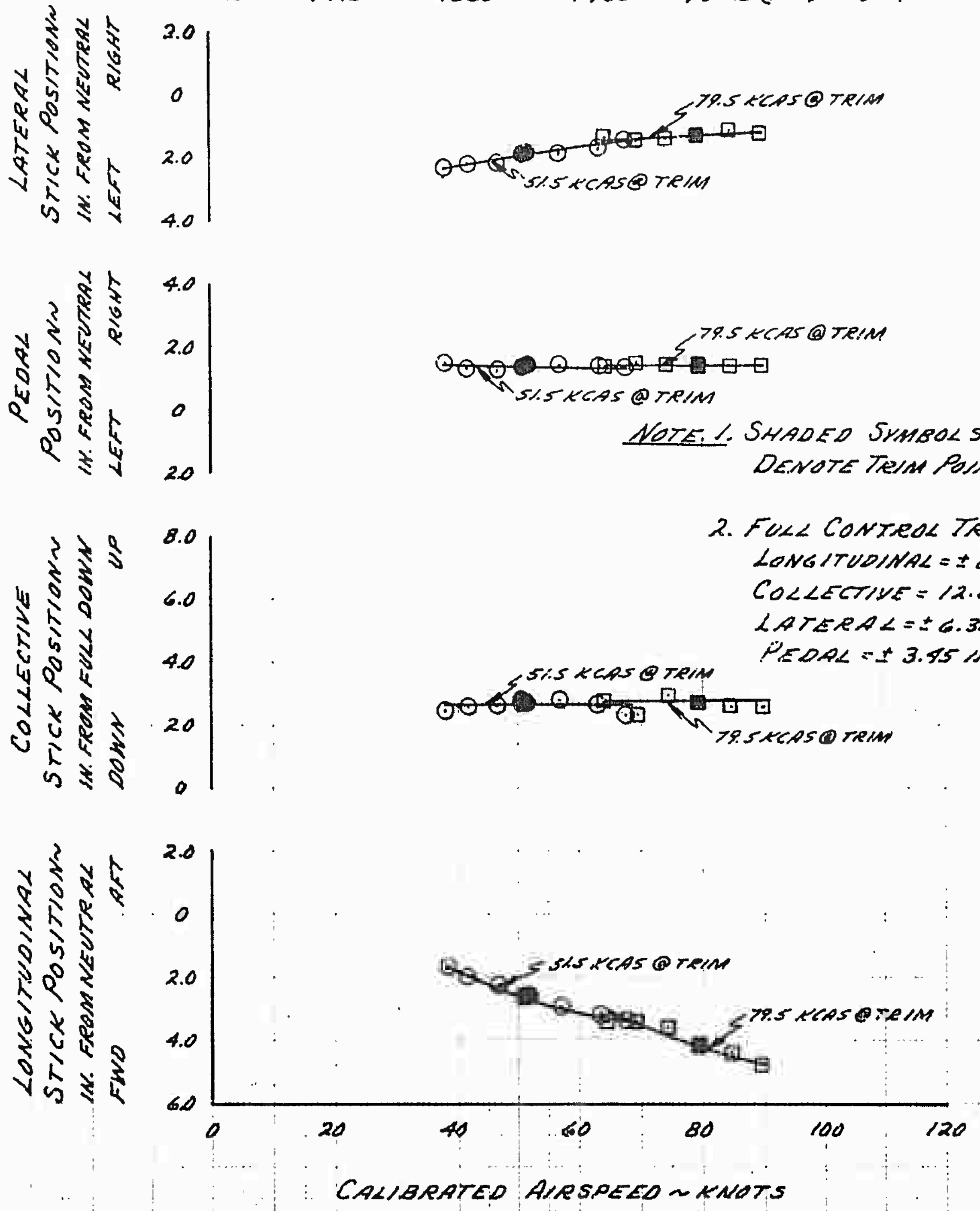
COLLECTIVE = 12.65 IN.

LATERAL = ± 6.35 IN.

PEDAL = ± 3.45 IN.

FIGURE NO. 18
STATIC LONGITUDINAL SPEED STABILITY
UH-1B/XM-47 S/N 62-12552
AUTOROTATION
ARMAMENT CONFIGURATION
ONE FULL DISPENSER (RIGHT SIDE)
POD ANGLE 1° UP

SYM	TRIM CAS ~KNOTS	AVG. Ho ~FT.	AVG. G.W. ~LB.	AVG. C.G. ~IN.	ROTOR SPEED ~RPM
○	51.5	4350	8050	135.8 (AFT)	324
☐	79.5	4550	7960	135.8 (AFT)	324



NOTE: 1. SHADED SYMBOLS DENOTE TRIM POINTS

2. FULL CONTROL TRAVEL
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

FIGURE NO. 19

STATIC LATERAL-DIRECTIONAL STABILITY

UH-1B/XM-47 S/N 62-12552

LEVEL FLIGHT

ARMAMENT CONFIGURATION

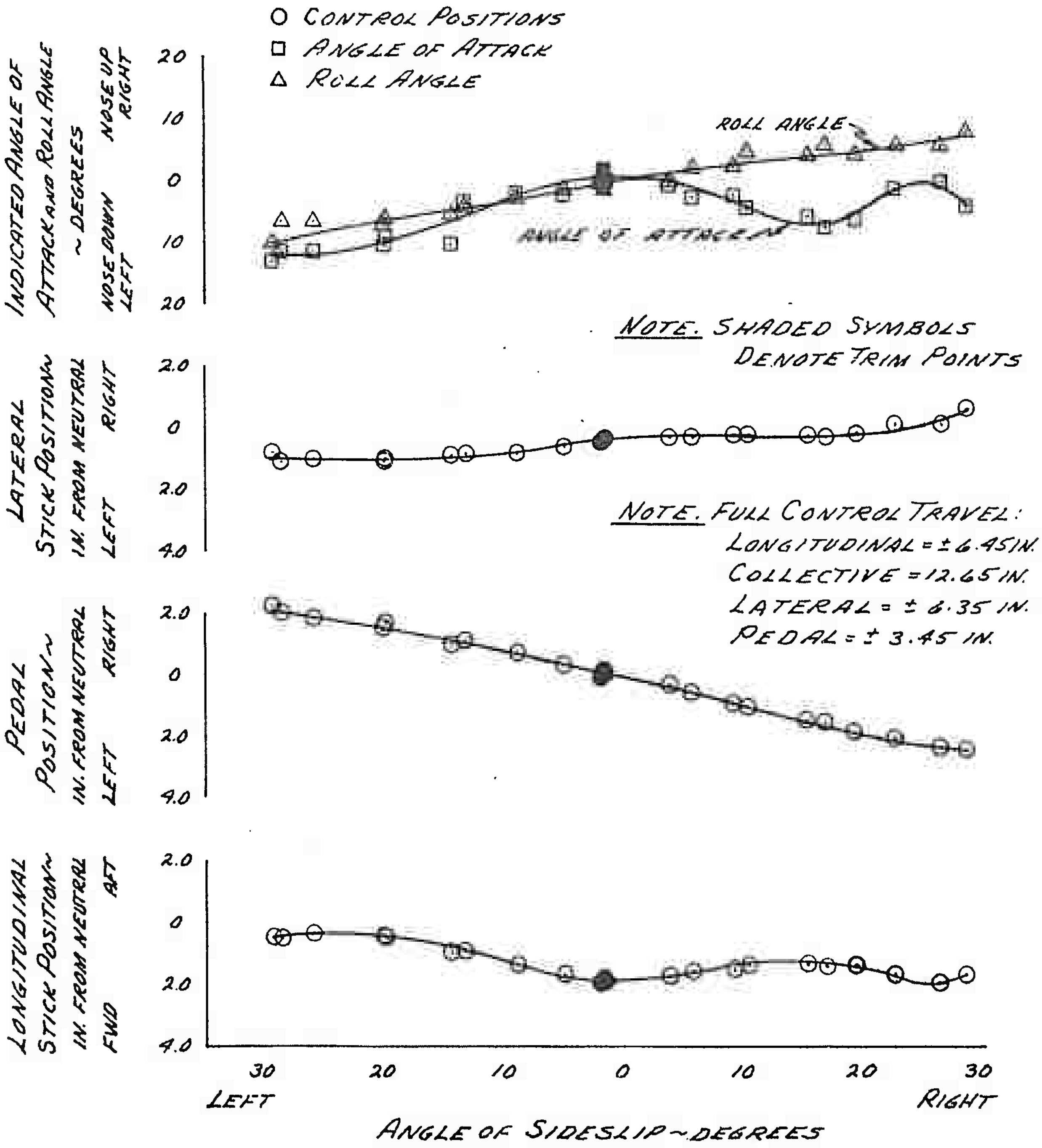
TWO FULL DISPENSERS

POD ANGLE 1° UP

AVG. HD = 4900 FT. AVG. C.G = 131.3 IN. (MID)

AVG. G.W. = 7990 LB. ROTOR SPEED = 324 RPM

CALIBRATED AIRSPEED = 71.5 KNOTS



NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

NOTE: FULL CONTROL TRAVEL:
LONGITUDINAL = ±6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ±6.35 IN.
PEDAL = ±3.45 IN.

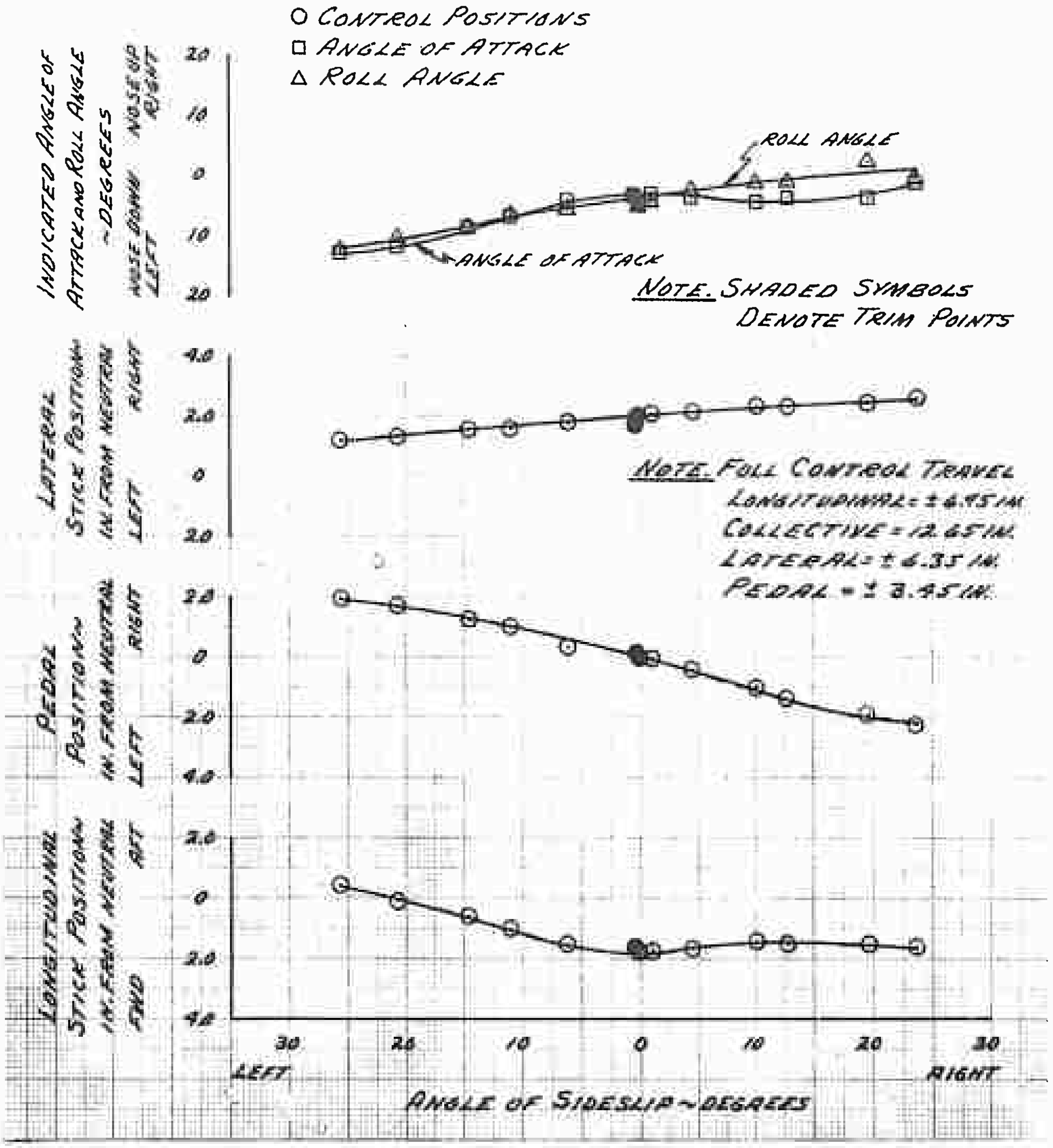
FIGURE NO. 20

STATIC LATERAL - DIRECTIONAL STABILITY

UH-1B/XM-47 S/N 62-12552

LEVEL FLIGHT
ARMAMENT CONFIGURATION
ONE FULL DISPENSER (LEFT SIDE)
POD ANGLE 1° UP

AVG. HD = 5680 FT AVG. C.G. = 131.0 IN. (MID)
AVG. G.W. = 8000 LB ROTOR SPEED = 324 RPM
CALIBRATED AIRSPEED = 71.5 KNOTS



NOTE. SHADED SYMBOLS DENOTE TRIM POINTS

NOTE. FULL CONTROL TRAVEL
LONGITUDINAL = ± 6.95 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

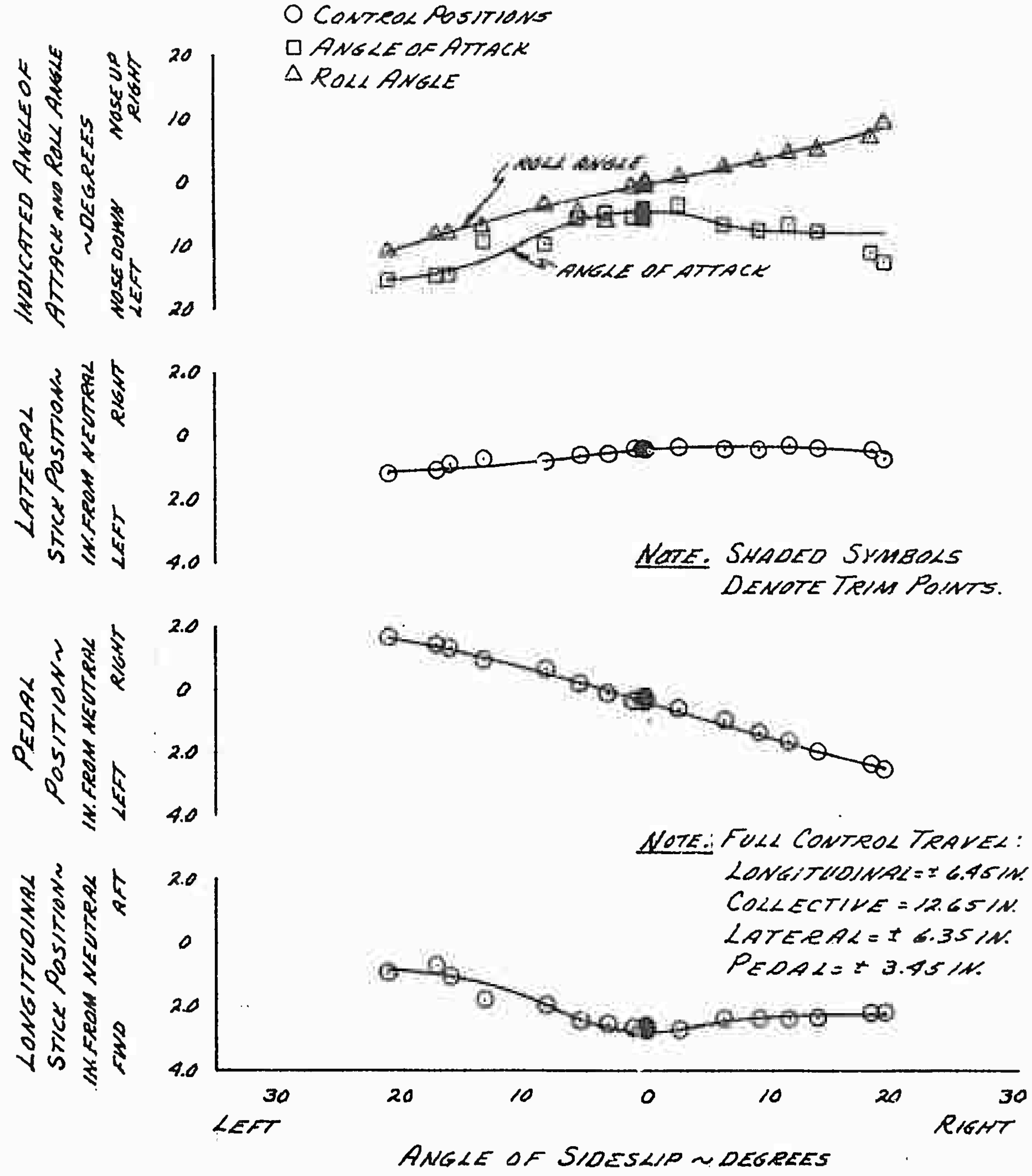
FIGURE NO. 21

STATIC LATERAL-DIRECTIONAL STABILITY

UH-1B/XM-47 S/N 62-12552

LEVEL FLIGHT
ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP

AVG. HD = 5000 FT. AVG. C.G. = 131.3 IN. (MID)
AVG. G.W. = 7810 LB. ROTOR SPEED = 324 RPM
CALIBRATED AIRSPEED = 88.5 KNOTS



NOTE. SHADED SYMBOLS DENOTE TRIM POINTS.

NOTE: FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

FIGURE NO. 22

STATIC LATERAL-DIRECTIONAL STABILITY

UH-1B/XM-47 S/N 62-12552

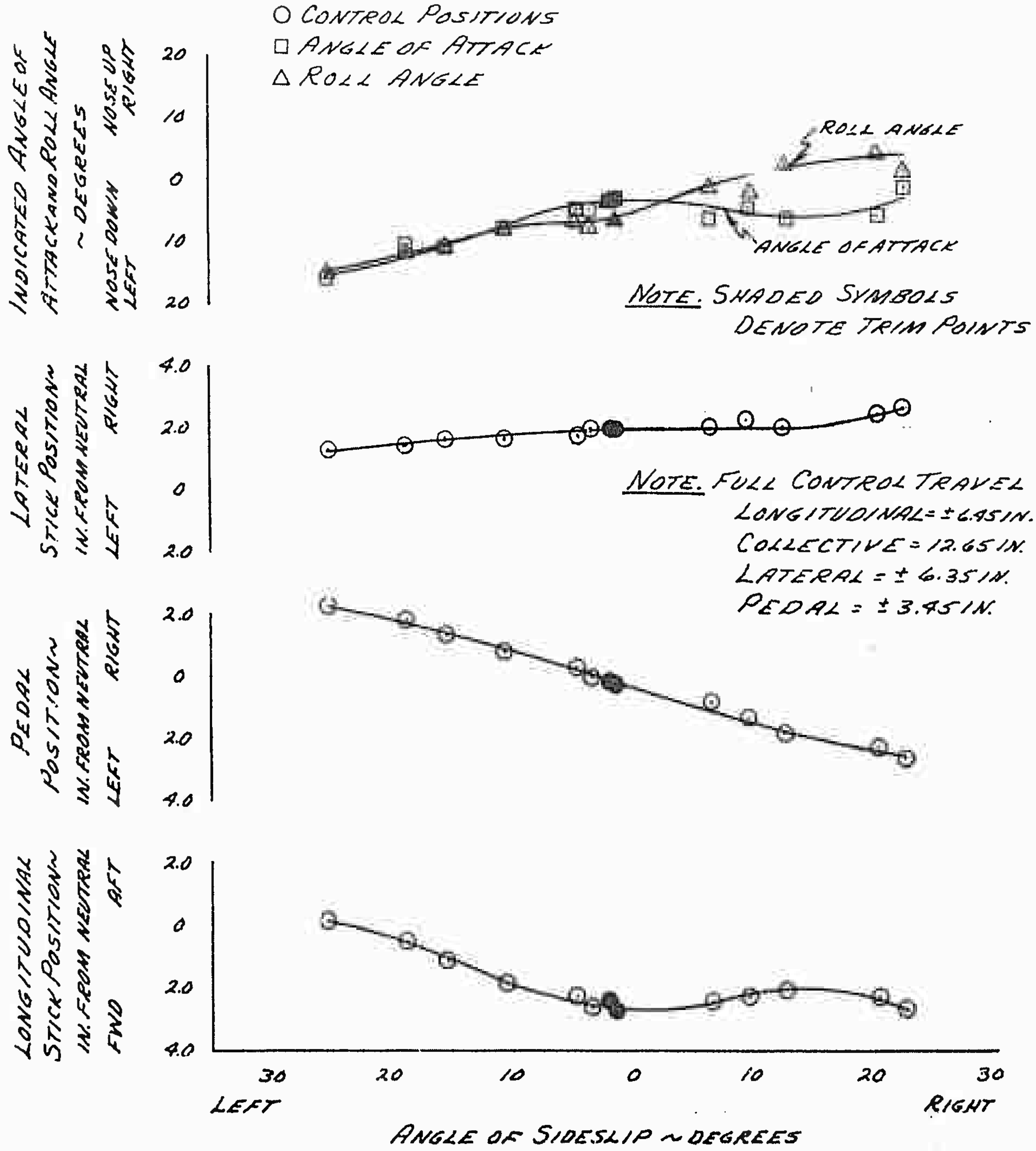
LEVEL FLIGHT

ARMAMENT CONFIGURATION

ONE FULL DISPENSER (LEFT SIDE)

POD ANGLE 1° UP

AVG. HD = 4750 FT.
AVG. C.G. = 131.0 IN. (MID)
AVG. G.W. = 8100 LB.
ROTOR SPEED = 329 RPM
CALIBRATED AIRSPEED = 88.5 KNOTS



NOTE. SHADED SYMBOLS DENOTE TRIM POINTS

NOTE. FULL CONTROL TRAVEL
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

FIGURE NO. 23

STATIC LATERAL-DIRECTIONAL STABILITY

UH-1B/XM-47 S/N 62-12552

LEVEL FLIGHT

ARMAMENT CONFIGURATION

TWO FULL DISPENSERS

POD ANGLE 1° UP

AVG. H_D = 5450 FT. AVG. C.G. = 135.9 IN. (AFT)

AVG. G.W. = 8100 LB. ROTOR SPEED = 324 RPM

CALIBRATED AIRSPEED = 72.5 KNOTS

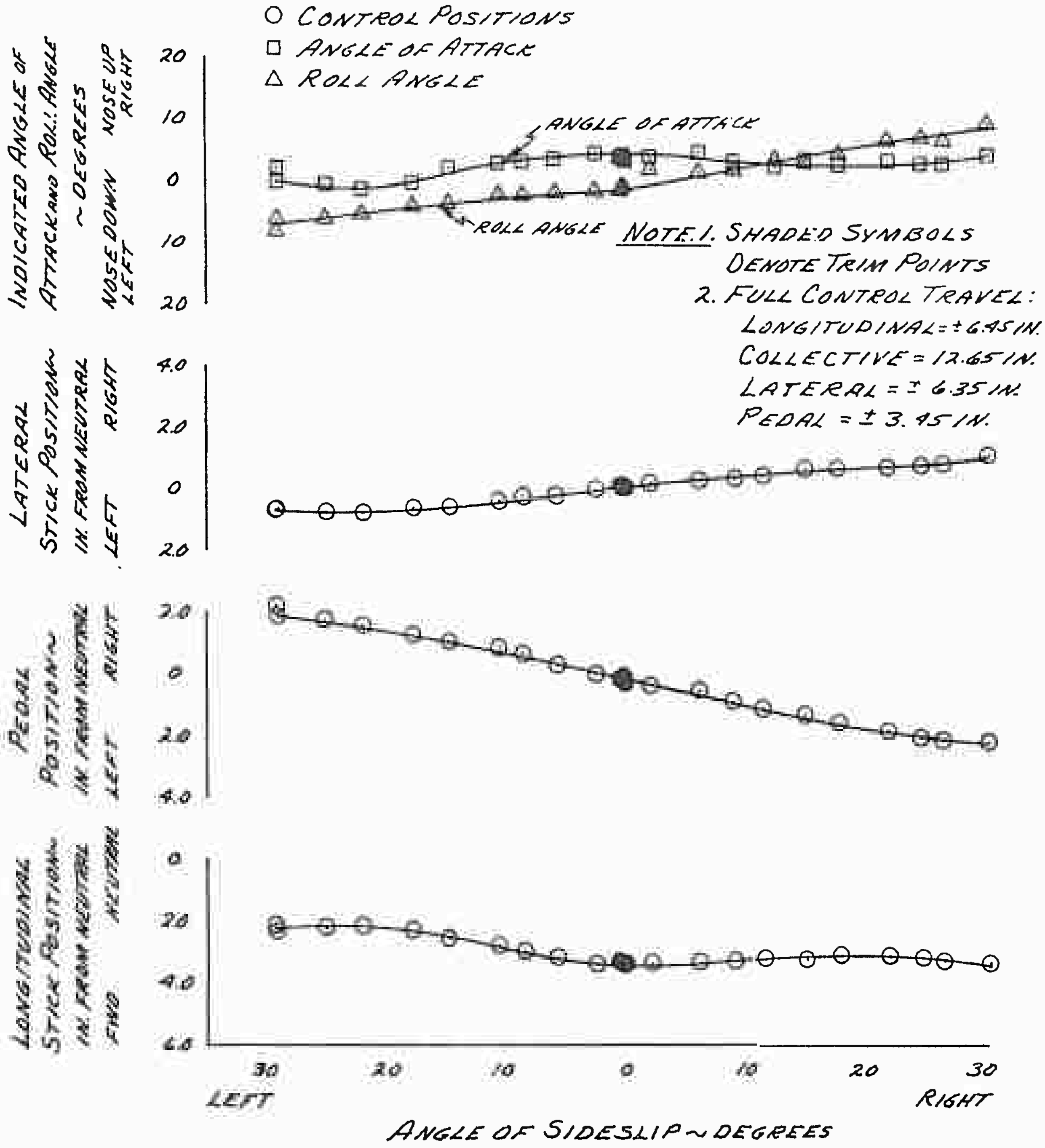


FIGURE NO. 2A

STATIC LATERAL-DIRECTIONAL STABILITY

UH-1B/XM-47 S/N 62-12552

LEVEL FLIGHT

ARMAMENT CONFIGURATION

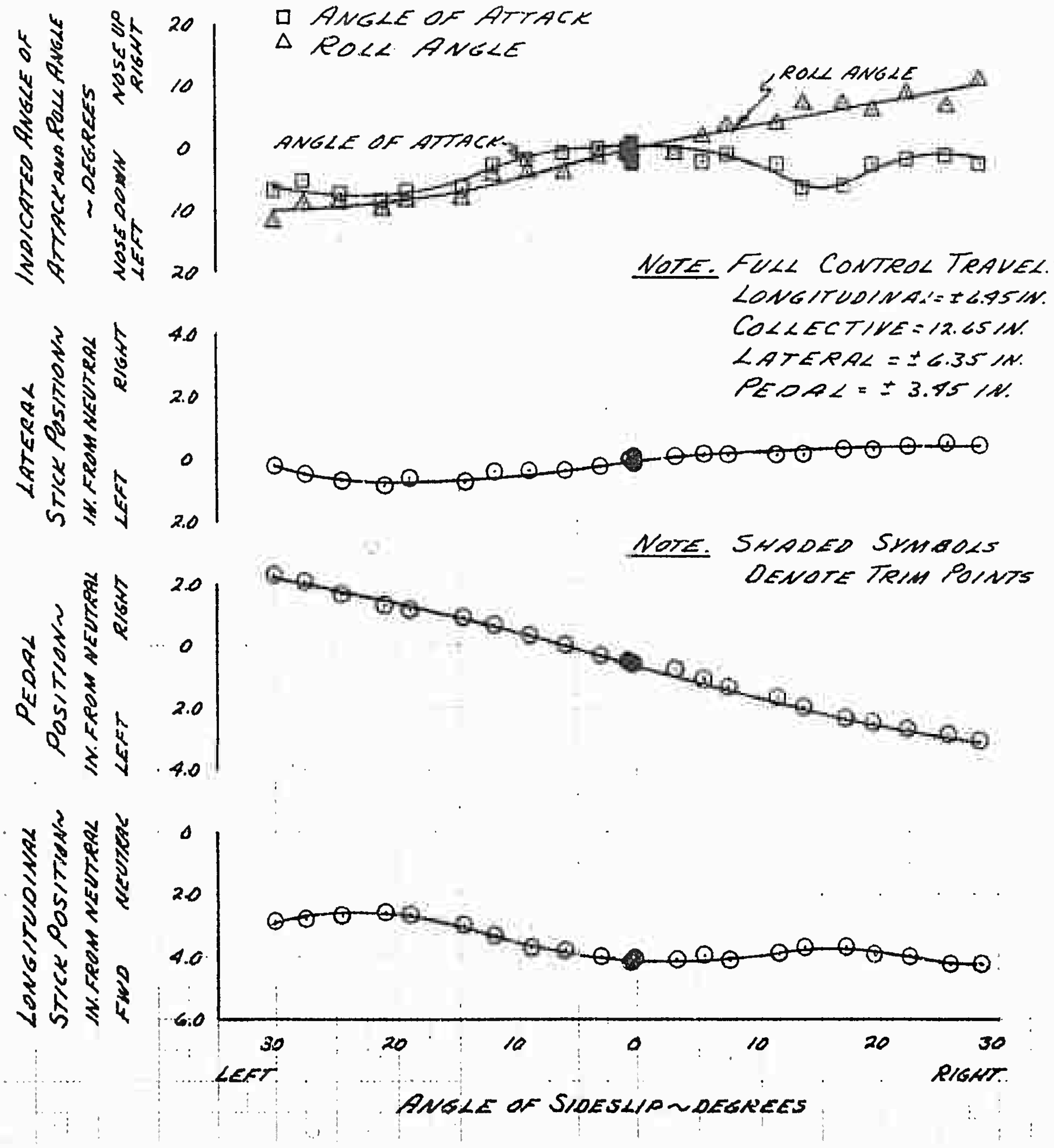
TWO FULL DISPENSERS

POD ANGLE 1° UP

AVG. HD = 5400 FT. AVG. C.G. = 135.4 IN. (AFT)

AVG. G.W. = 7970 LB. ROTOR SPEED = 324 RPM

CALIBRATED AIRSPEED = 89.0 KNOTS



NOTE. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.95 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

NOTE. SHADED SYMBOLS DENOTE TRIM POINTS

FIGURE NO. 25

STATIC LATERAL-DIRECTIONAL STABILITY

UH-1B/XM-47 S/N 62-12552

AUTOROTATION

ARMAMENT CONFIGURATION

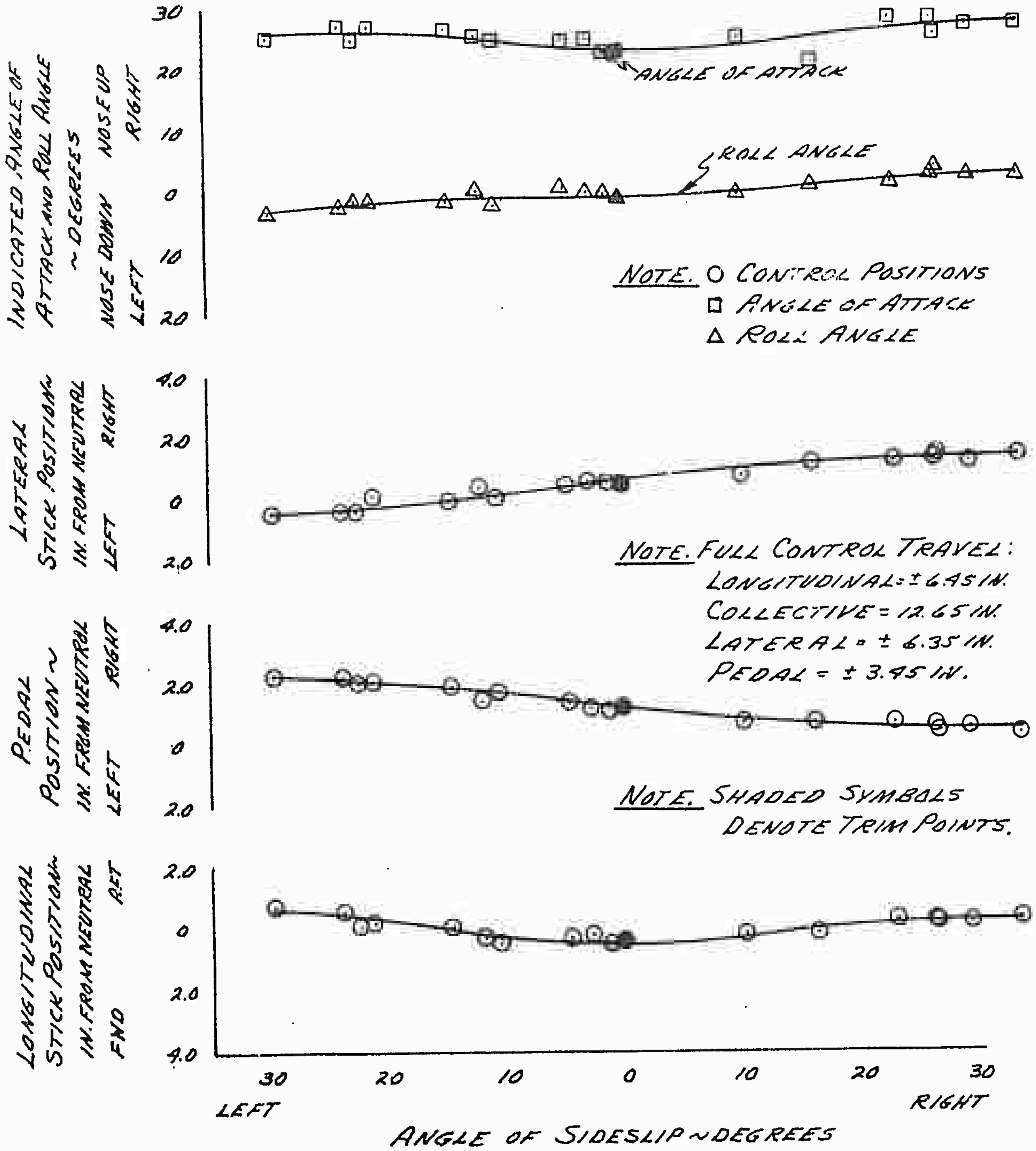
TWO FULL DISPENSERS

POD ANGLE 1° UP

AVG. H_D = 4450 FT. AVG. C.G. = 131.0 IN. (MID)

AVG. G.W. = 8050 LB. ROTOR SPEED = 324 RPM

CALIBRATED AIRSPEED = 51.5 KNOTS



NOTE. ○ CONTROL POSITIONS
□ ANGLE OF ATTACK
△ ROLL ANGLE

NOTE. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

NOTE. SHADED SYMBOLS DENOTE TRIM POINTS.

FIGURE NO. 26

CONTROL POSITIONS IN SIDEWARD FLIGHT

UH-1B/XM-47 S/N 62-12552

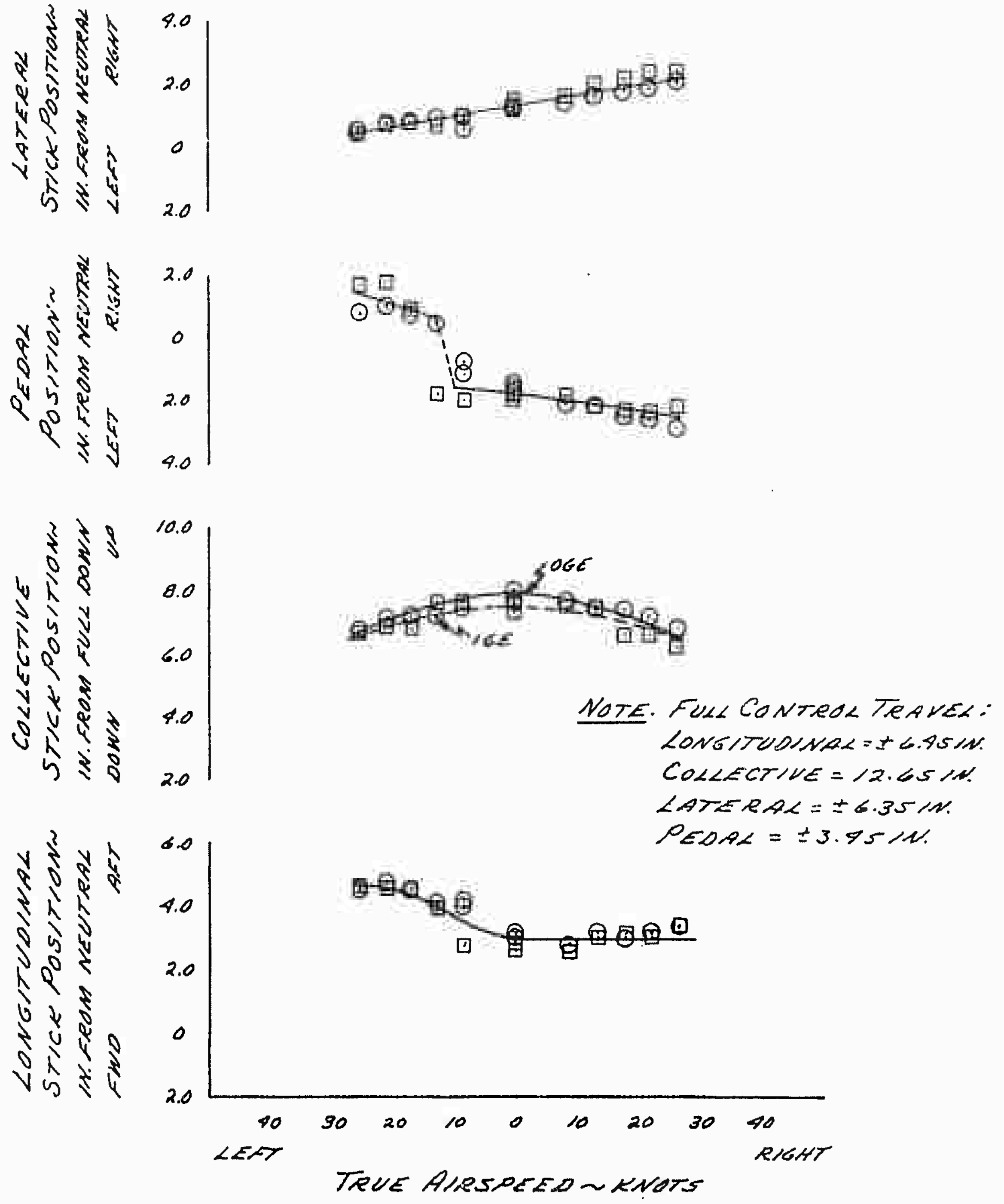
ASYMMETRIC LATERAL C.G. = 5.5 IN. (LT.)

ARMAMENT CONFIGURATION

ONE FULL DISPENSER (LEFT SIDE)

POD ANGLE 1° UP

SYM	AVG. HD ~FT.	AVG. G.W. ~LB.	AVG. C.G. ~IN.	ROTOR SPEED ~RPM	FLIGHT CONDITION
□	1770	8090	125.4 (FWD)	324	IN GROUND EFFECT (IGE)
○	1920	8000	125.4 (FWD)	324	OUT OF GROUND EFFECT (OGE)

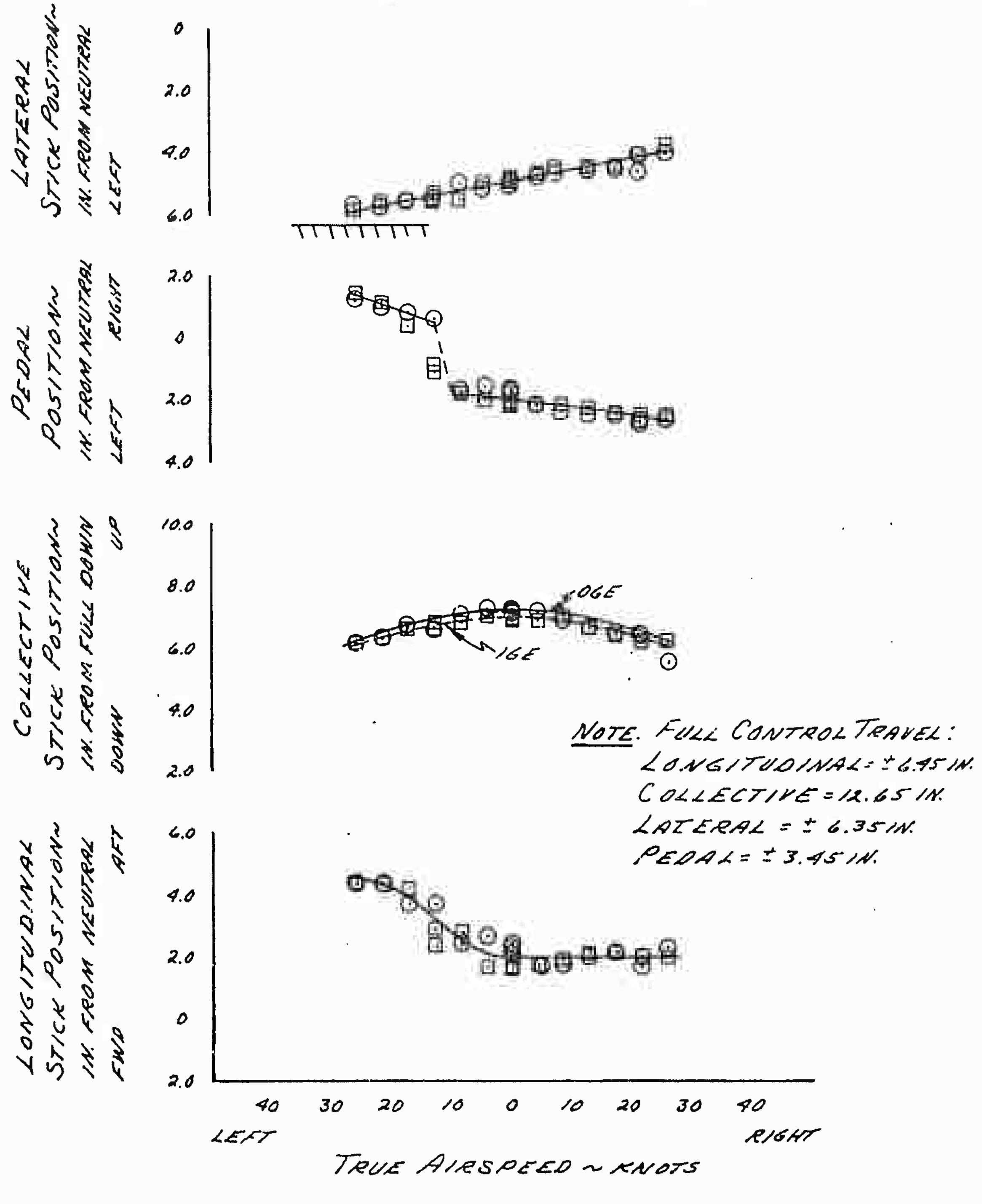


NOTE. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.95 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.95 IN.

FIGURE NO. 27
CONTROL POSITIONS IN SIDEWARD FLIGHT

UH-1B/XM-47 S/N 62-12552
ASYMMETRIC LATERAL C.G. = 6.6 IN. (RT.)
ARMAMENT CONFIGURATION
ONE FULL DISPENSER (RIGHT SIDE)
POD ANGLE 1° UP

SYM	AVG. Ho ~FT.	AVG. G.W. ~LB.	AVG. C.G. ~IN.	ROTOR SPEED ~RPM	FLIGHT CONDITION
□	2190	8090	125.4 (FWD)	324	IN GROUND EFFECT (IGE)
○	2190	7980	125.3 (FWD)	324	OUT OF GROUND EFFECT (OGE)



NOTE. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

FIGURE NO. 28

CONTROL POSTIONS IN REARWARD FLIGHT

UH-1B/XM-47 S/N 62-12552

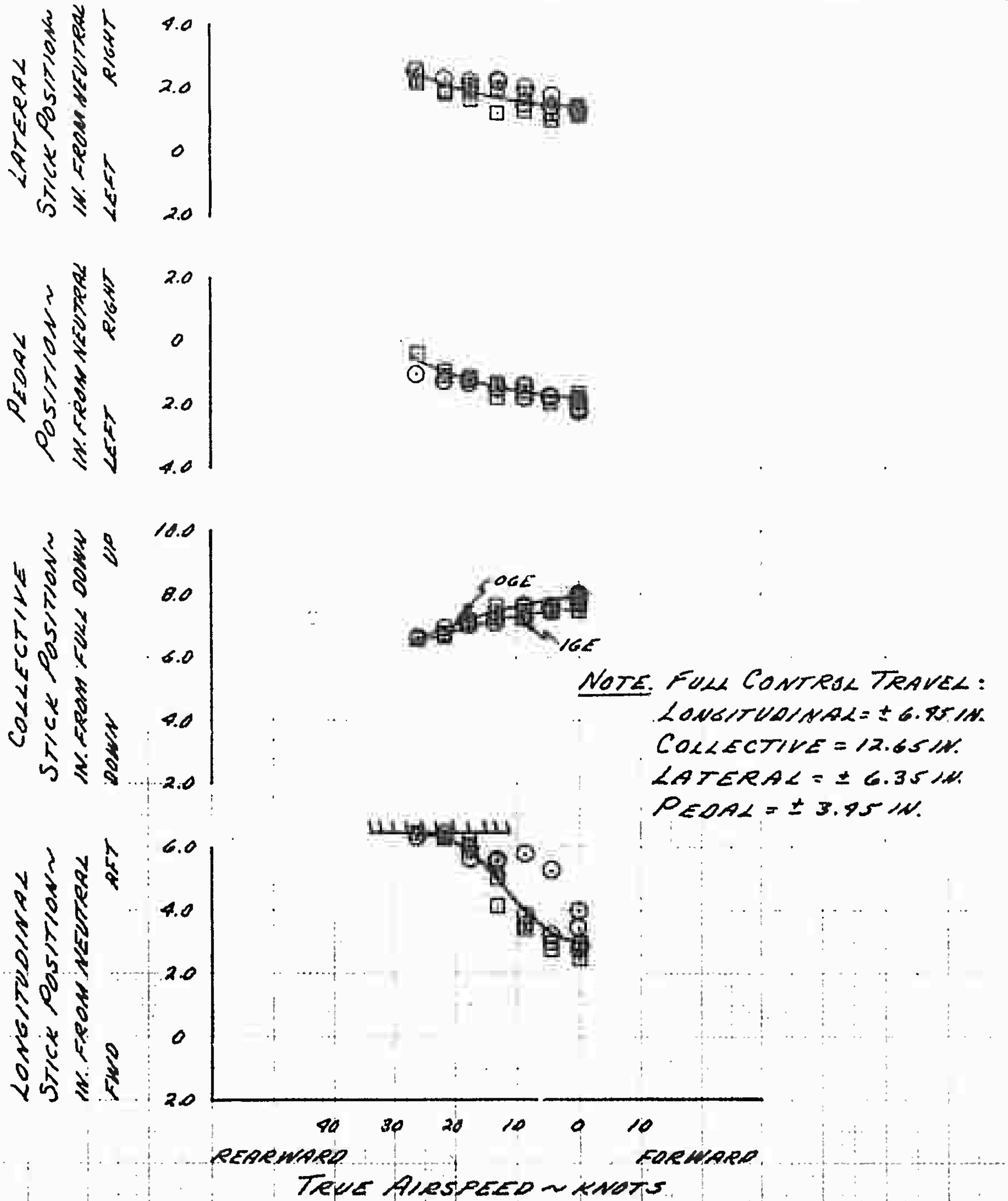
ASYMMETRIC LATERAL C.G. = 5.5 IN. (LT)

ARMAMENT CONFIGURATION

ONE FULL DISPENSER (LEFT SIDE)

POD ANGLE 1° UP

SYM	AVG. H_D ~FT.	AVG. G.W. ~LB.	AVG. C.G. ~IN.	ROTOR SPEED ~RPM	FLIGHT CONDITION
□	1760	8030	125.2 (FWD)	324	IN GROUND EFFECT (IGE)
○	1790	8000	125.2 (FWD)	324	OUT OF GROUND EFFECT (OGE)



NOTE. FULL CONTROL TRAVEL:

LONGITUDINAL = ± 6.95 IN.

COLLECTIVE = 12.65 IN.

LATERAL = ± 6.35 IN.

PEDAL = ± 3.95 IN.

FIGURE NO. 29

CONTROL POSITIONS IN REARWARD FLIGHT

UH-1B/XM-47 S/N 62-12552

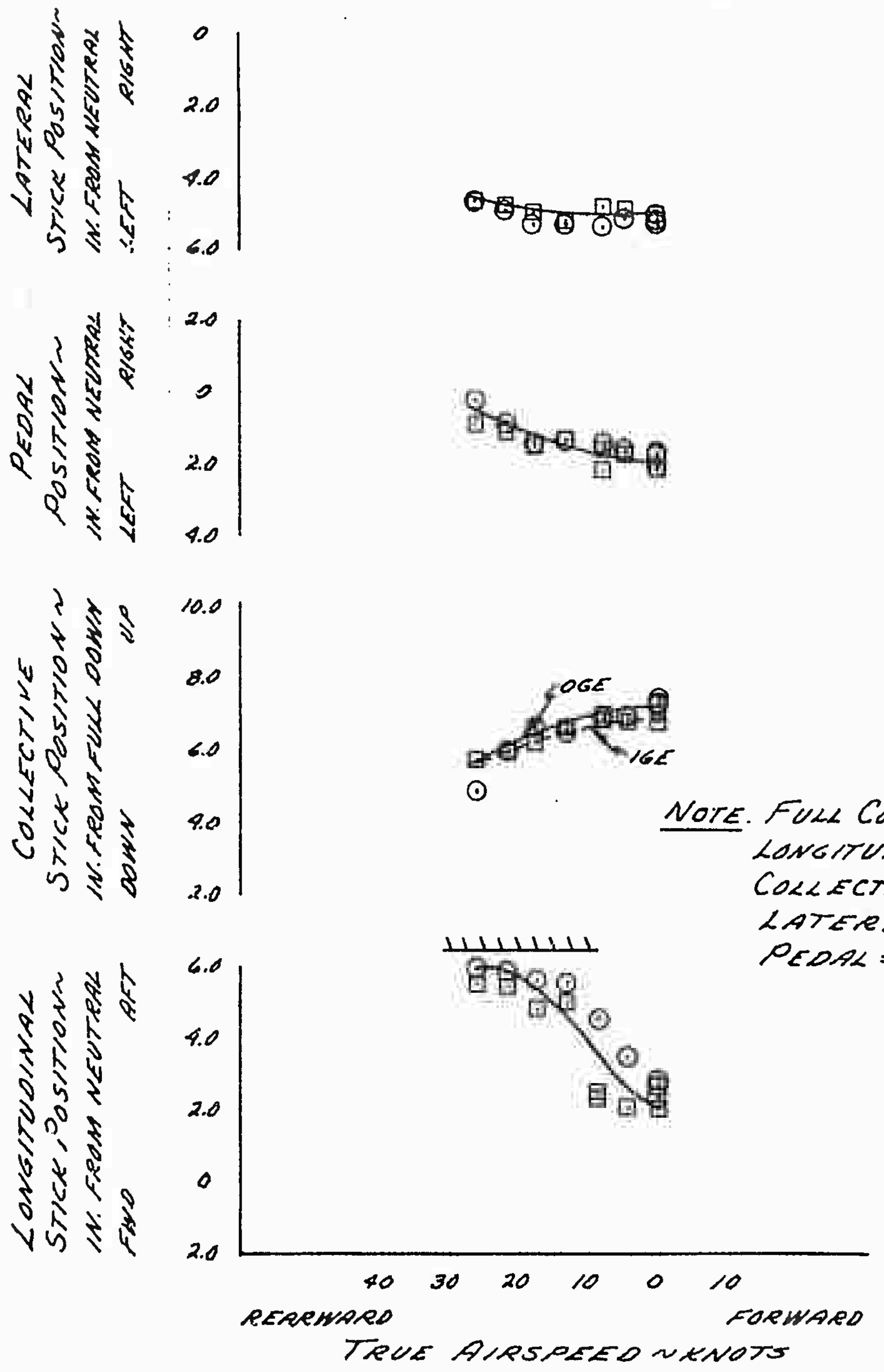
ASYMMETRIC LATERAL C.G. = 6.0 IN. (RT)

ARMAMENT CONFIGURATION

ONE FULL DISPENSER (RIGHT SIDE)

POD ANGLE 1° UP

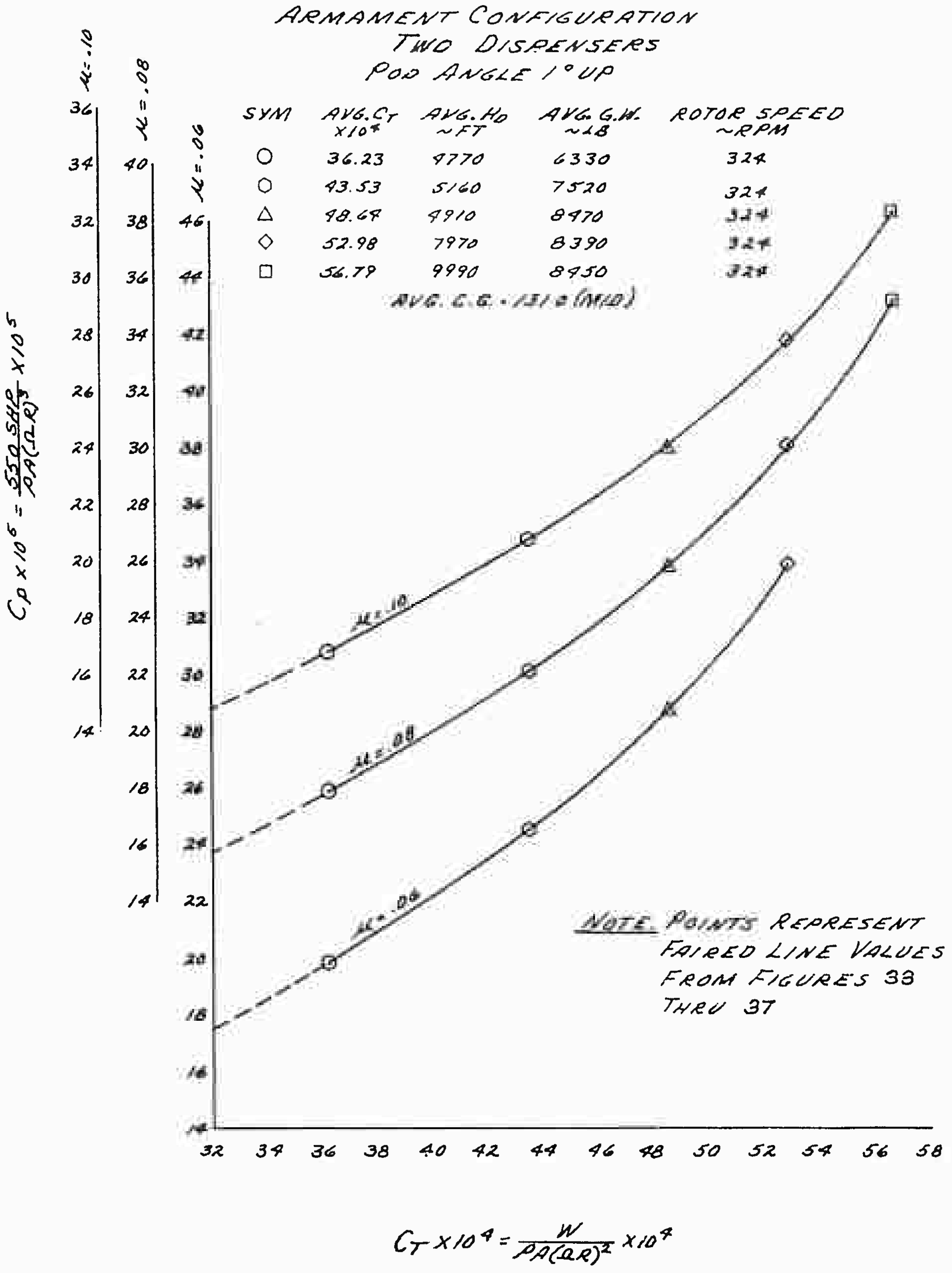
SYM	AVG. Hd ~FT.	AVG. G.W. ~LB.	AVG. C.G. ~IN.	ROTOR SPEED ~RPM	FLIGHT CONDITION
☐	2280	7990	125.2 (FWD)	324	IN GROUND EFFECT (IGE)
○	2920	7920	125.2 (FWD)	324	OUT OF GROUND EFFECT (OGE)



NOTE. FULL CONTROL TRAVEL:
LONGITUDINAL = ± 6.45 IN.
COLLECTIVE = 12.65 IN.
LATERAL = ± 6.35 IN.
PEDAL = ± 3.45 IN.

FIGURE NO. 30
NONDIMENSIONAL LEVEL FLIGHT PERFORMANCE

UH-1B/XM-47 S/N 62-12552



ARMAMENT CONFIGURATION
TWO DISPENSERS
POD ANGLE 1° UP

SYM	AVG. C_T $\times 10^4$	AVG. H_D ~FT	AVG. G.W. ~LB	ROTOR SPEED ~RPM
○	36.23	4770	6330	324
⬡	43.53	5160	7520	324
△	48.64	4910	8470	324
◇	52.98	7970	8390	324
□	56.79	9990	8450	324

AVG. C.G. - 131.0 (MID)

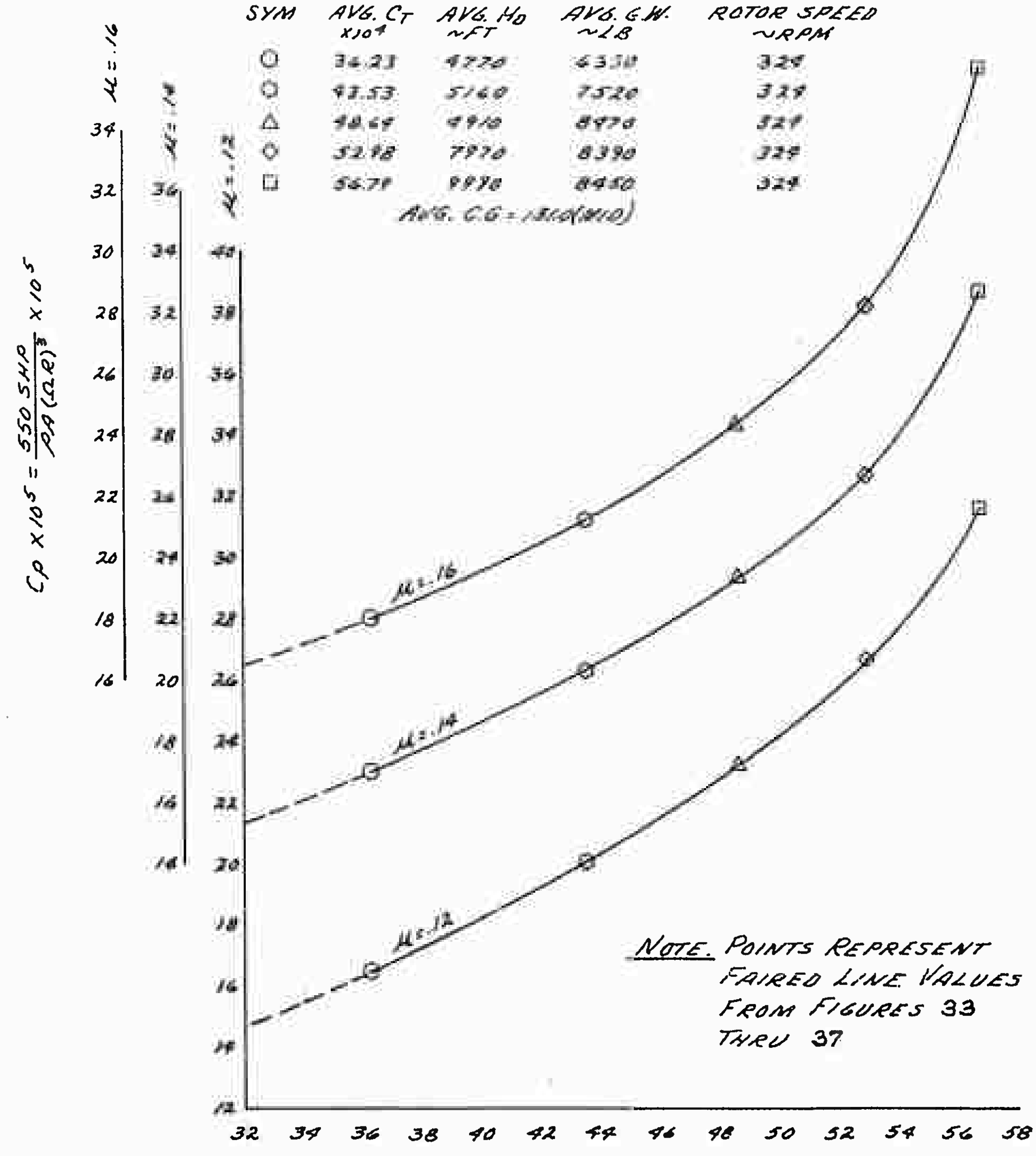
NOTE. POINTS REPRESENT
FAIRED LINE VALUES
FROM FIGURES 33
THRU 37

FIGURE NO 31

NONDIMENSIONAL LEVEL FLIGHT PERFORMANCE

UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO DISPENSERS
POD ANGLE 1° UP



SYM	AVG. C_T $\times 10^4$	AVG. H_D ~FT	AVG. G.W. ~LB	ROTOR SPEED ~RPM
○	34.23	4770	6330	324
⬡	43.53	5160	7520	324
△	48.64	4910	8470	324
◇	52.48	7970	8390	324
□	56.79	9970	8450	324

AVG. C.G. = 131.0(MID)

$$C_P \times 10^5 = \frac{550\ SHP}{\rho A(\Omega R)^3} \times 10^5$$

$$C_T \times 10^4 = \frac{W}{\rho A(\Omega R)^2} \times 10^4$$

NOTE. POINTS REPRESENT FAIRED LINE VALUES FROM FIGURES 33 THRU 37

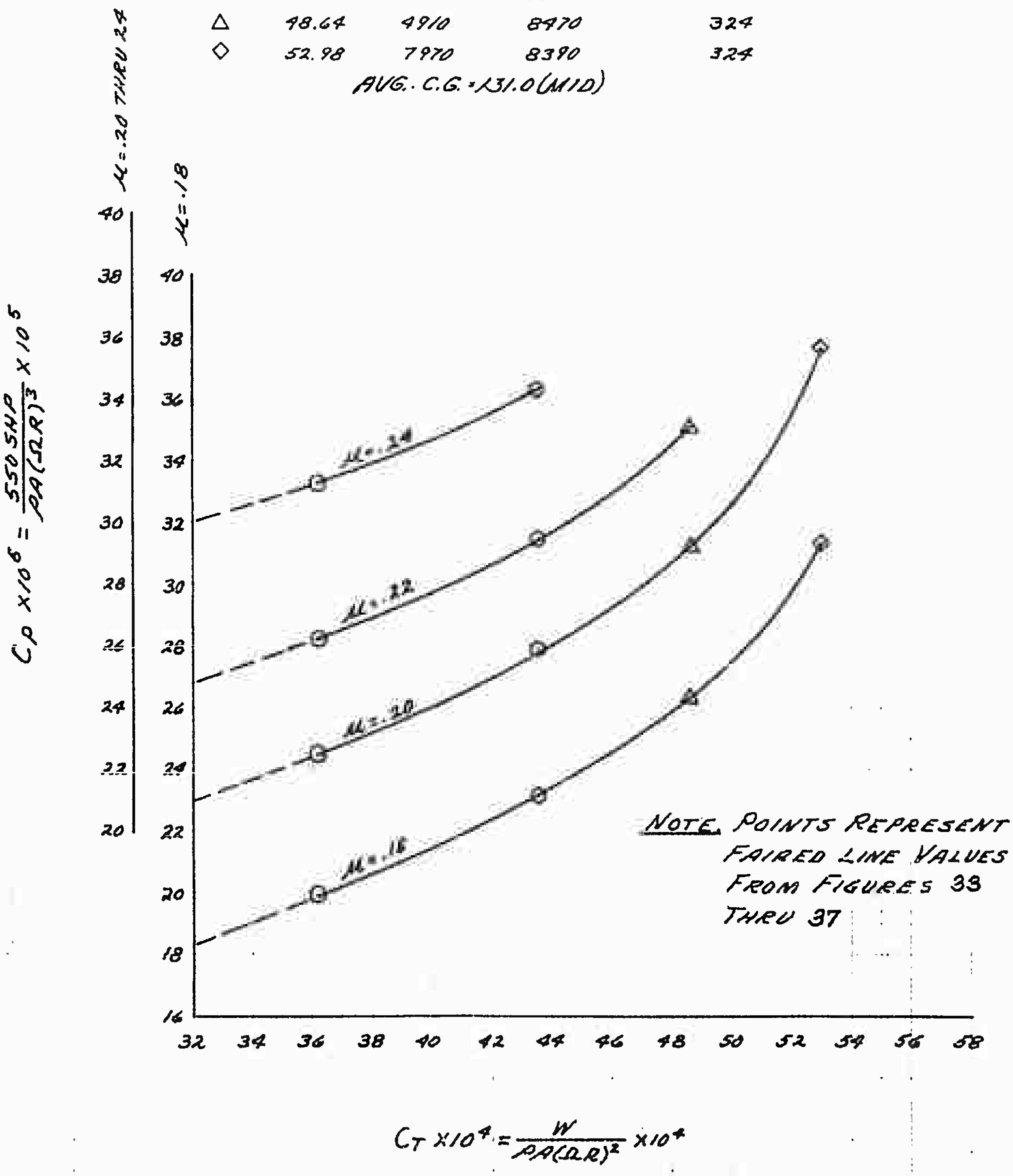
FIGURE NO 32
NONDIMENSIONAL LEVEL FLIGHT PERFORMANCE

UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO DISPENSERS
POD ANGLE 1°UP

SYM	AVG. C_T $\times 10^4$	AVG. H_D ~FT	AVG. G.W. ~LB	ROTOR SPEED ~RPM
○	36.23	4770	6330	324
⬡	43.53	5160	7520	324
△	48.64	4910	8470	324
◇	52.98	7970	8390	324

AVG. C.G. = 131.0 (MID)



NOTE. POINTS REPRESENT
FAIRED LINE VALUES
FROM FIGURES 33
THRU 37

FIGURE NO. 33
LEVEL FLIGHT PERFORMANCE
UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO EMPTY DISPENSERS
POD ANGLE 1° UP

AVG. H_D = 4770 FT. AVG. C.G = 131.0 IN. (MID)
AVG. G.W. = 6330 LB. AVG. $C_T = 36.23 \times 10^{-4}$
ROTOR SPEED = 324 RPM

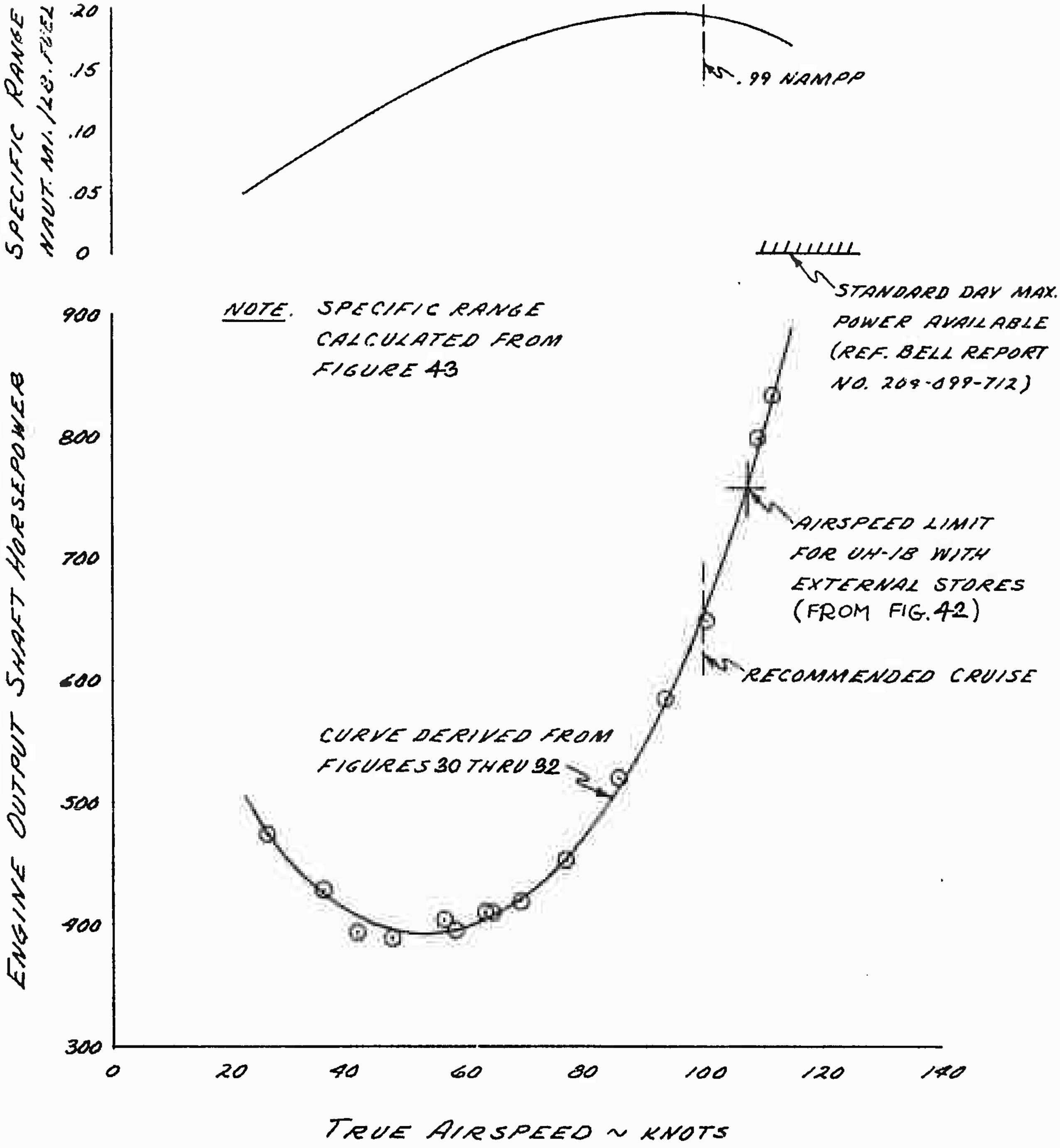


FIGURE No. 34
LEVEL FLIGHT PERFORMANCE

UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP

AVG. H_D = 5160 FT AVG. C.G. = 131.0 IN. (MID)
AVG. G.W. = 7520 LB AVG. C_T = 43.53 X 10^{-4}
ROTOR SPEED = 324 RPM

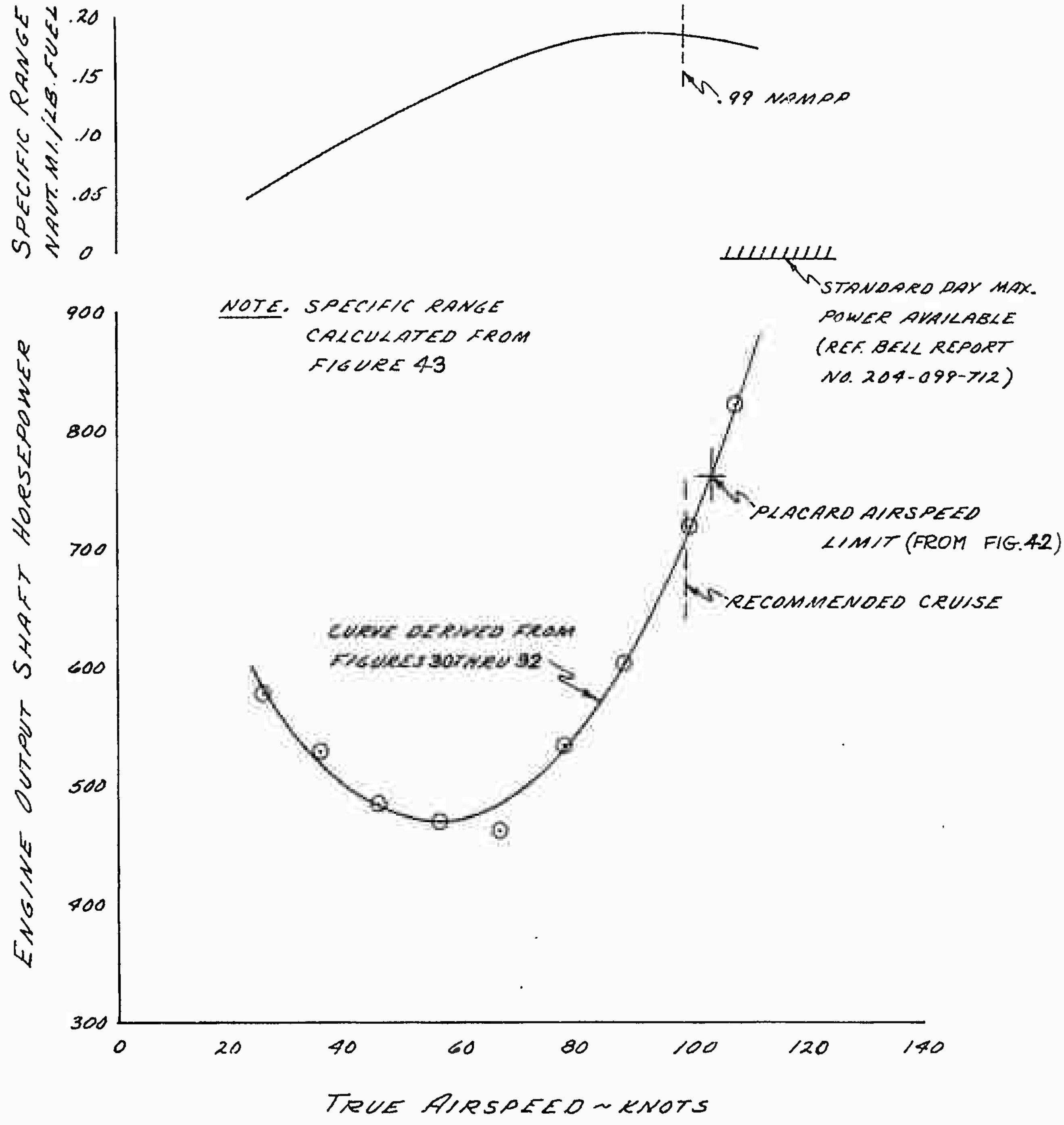


FIGURE NO. 35
LEVEL FLIGHT PERFORMANCE

UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1°UP

AVG. H_D = 4910 FT. AVG. C.G. = 131.0 IN. (MID)
AVG. G.W. = 8470 LB. AVG. C_T = 48.64×10^{-4}
ROTOR SPEED = 324 RPM

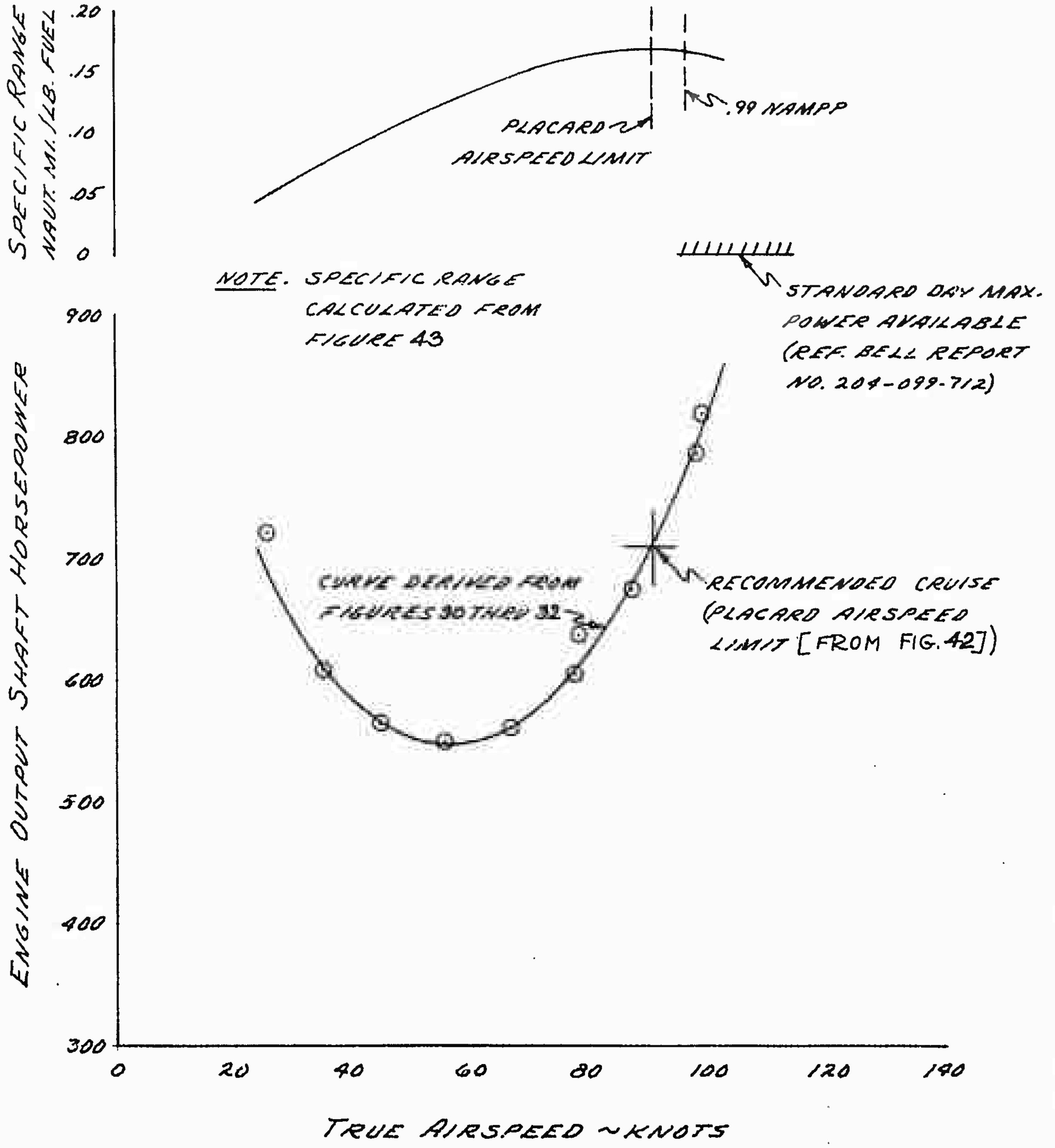


FIGURE NO. 36

LEVEL FLIGHT PERFORMANCE

UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP

AVG. H_D = 7970 FT. AVG. C.G. = 131.0 IN. (MID)
AVG. G.W. = 8390 LB. AVG. C_T = 52.98×10^{-4}
ROTOR SPEED = 324 RPM

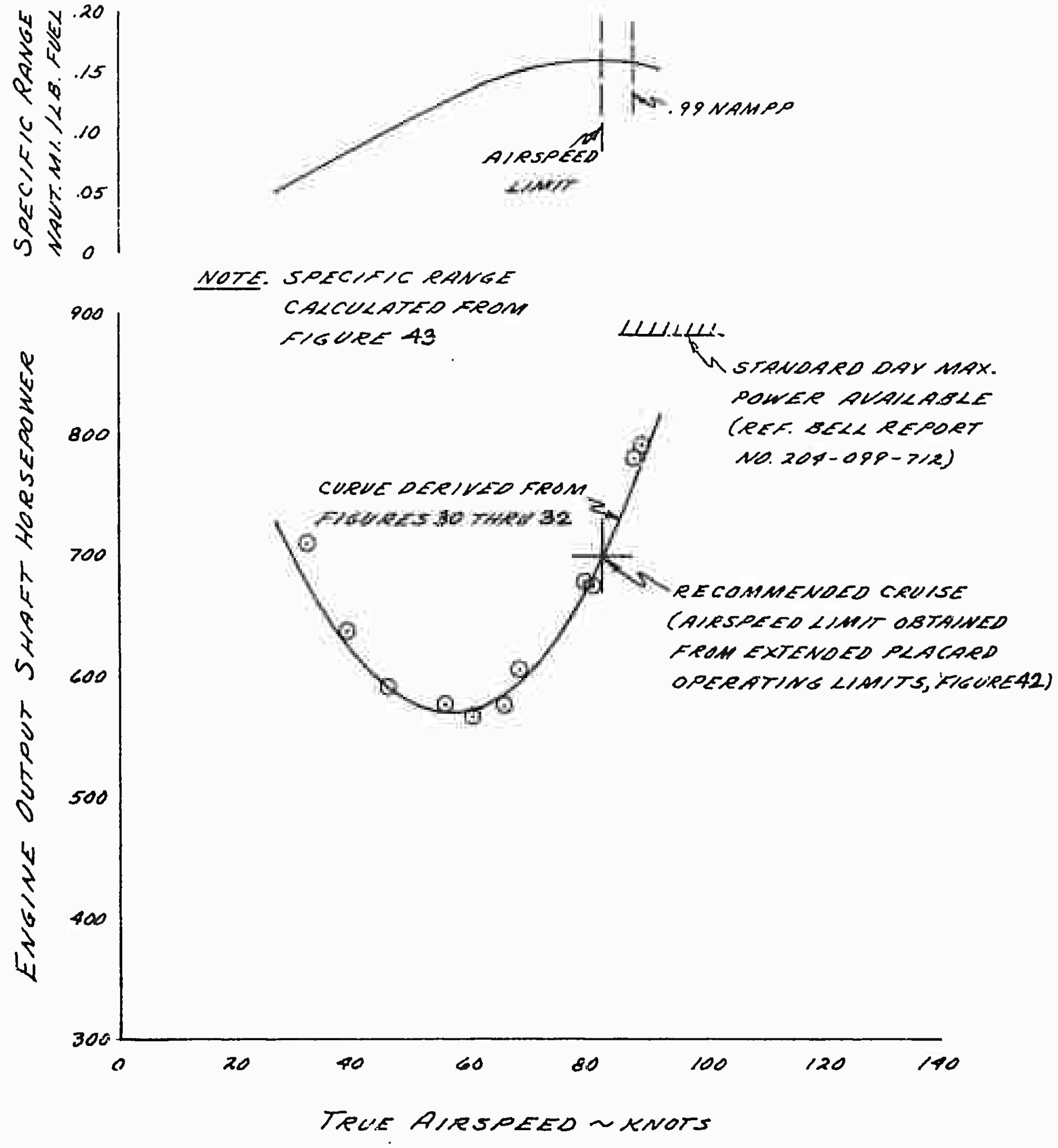


FIGURE NO. 37

LEVEL FLIGHT PERFORMANCE

UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP

AVG. H_D = 9990 FT. AVG. C.G. = 131.0 IN. (MID)
AVG. G.W. = 8950 LB. AVG. $C_T = 56.79 \times 10^{-4}$
ROTOR SPEED = 324 RPM

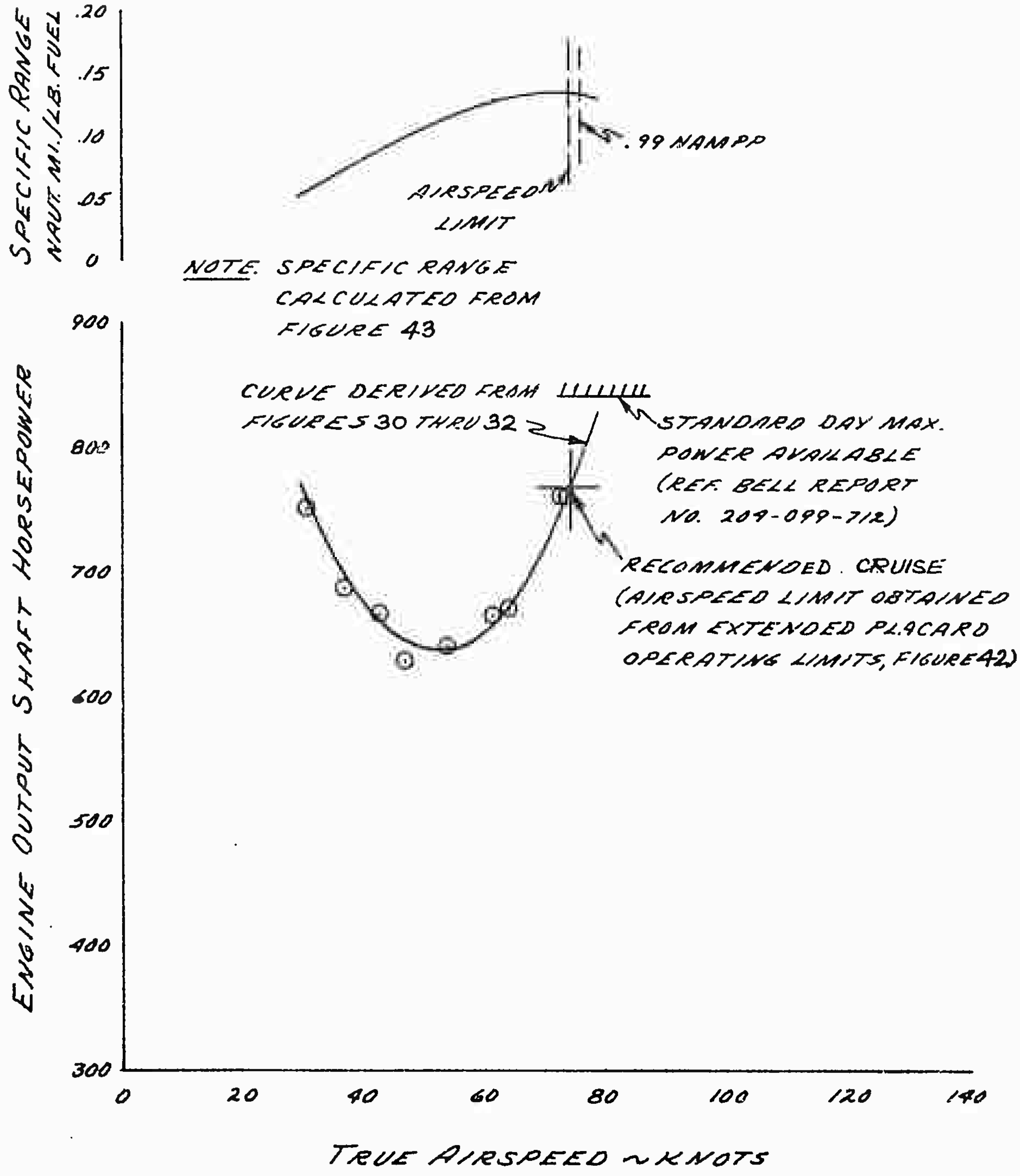


FIGURE No. 38

LEVEL FLIGHT PERFORMANCE

UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP
CARGO DOORS OFF
AVG. H_D = 6440 FT. AVG. C.G. = 132.0 IN. (MID)
AVG. G.W. = 7680 LB. AVG. $C_T = 46.22 \times 10^{-4}$
ROTOR SPEED = 324 RPM

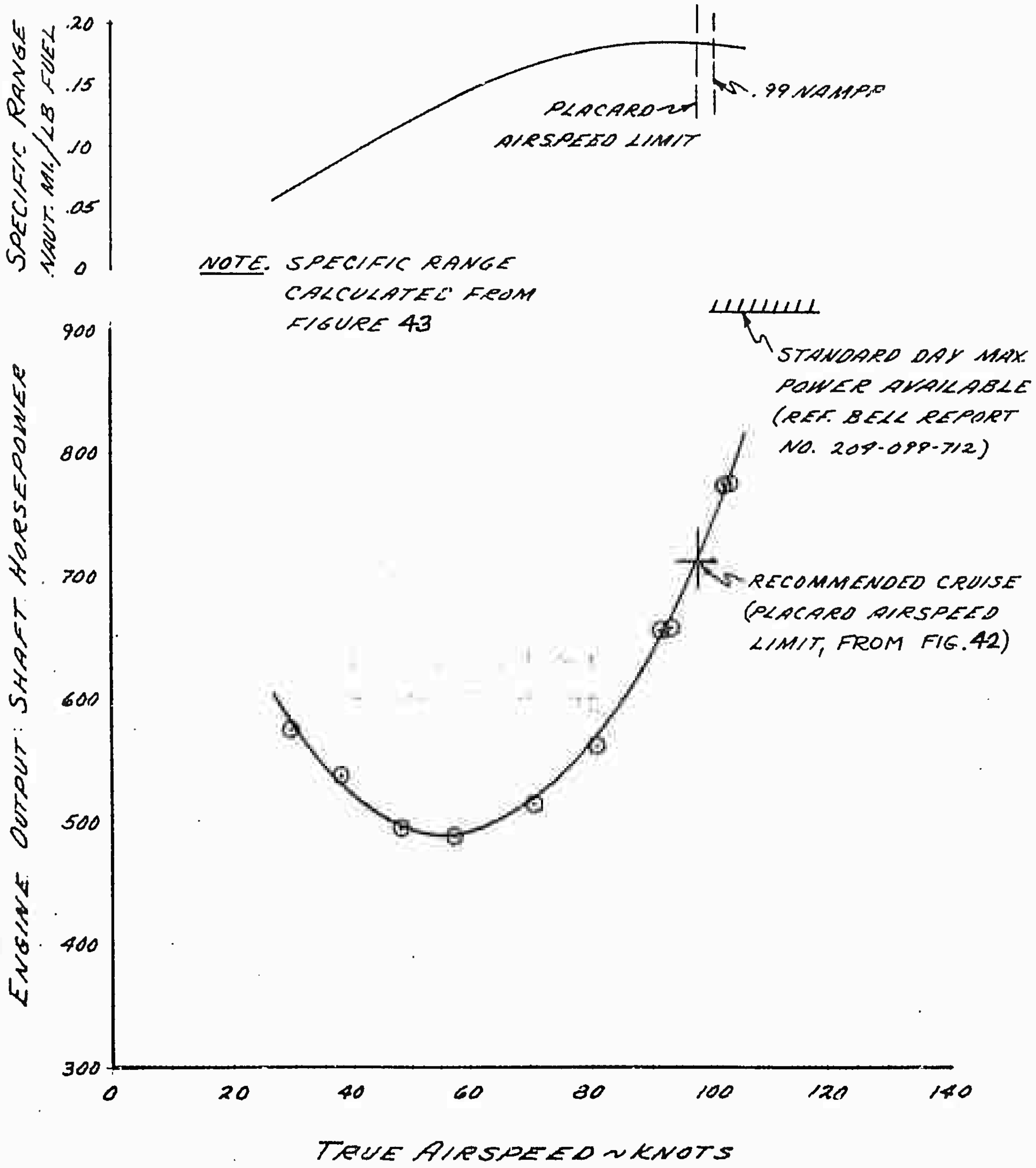
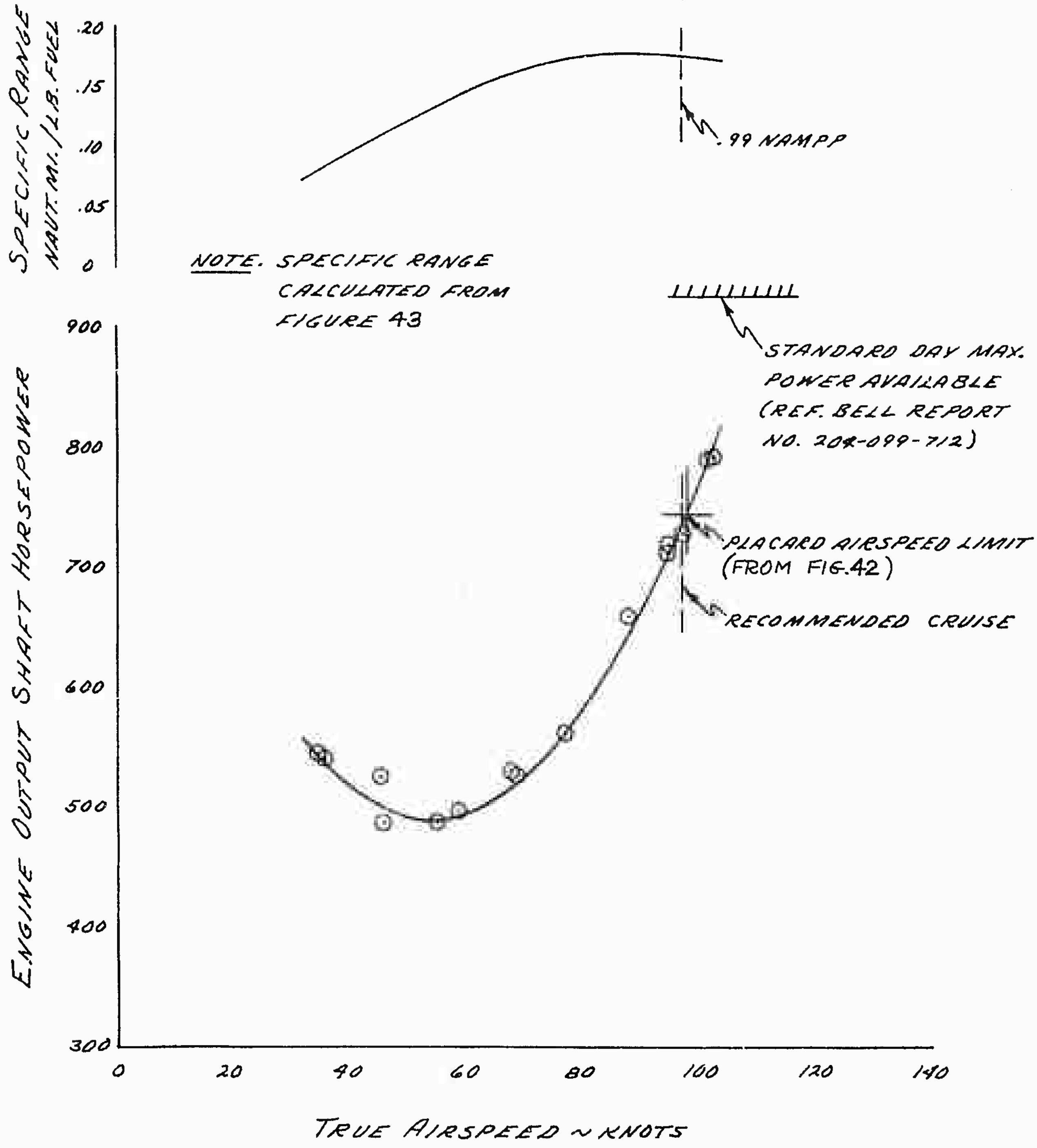


FIGURE NO. 39

LEVEL FLIGHT PERFORMANCE

UH-1B/XM-47 S/N 62-12552

ARMANENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP
CARGO DOORS OFF
AVG. H_D = 6040 FT AVG. C.G. = 125.7 IN. (FWD)
AVG. G.W. = 7760 AVG. $C_T = 46.17 \times 10^{4}$
ROTOR SPEED = 324 RPM



.99 NAMPP

NOTE. SPECIFIC RANGE CALCULATED FROM FIGURE 43

STANDARD DAY MAX. POWER AVAILABLE (REF. BELL REPORT NO. 204-099-712)

PLACARD AIRSPEED LIMIT (FROM FIG. 42)

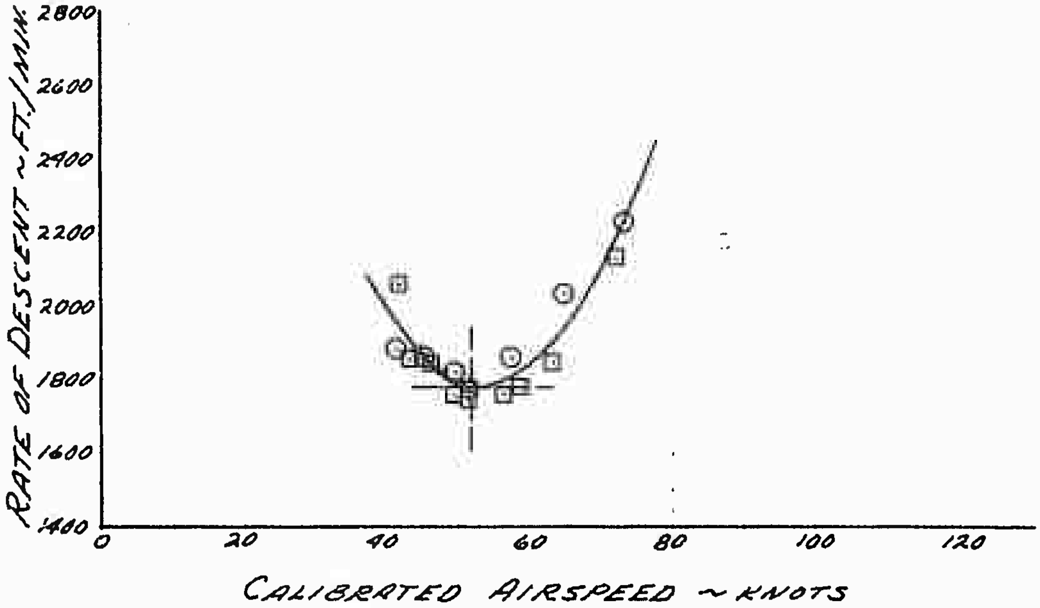
RECOMMENDED CRUISE

FIGURE NO. 40
AUTOROTATIONAL CHARACTERISTICS

UH-1B/XM-47 S/N 62-12552

ARMAMENT CONFIGURATION
TWO DISPENSERS
POD ANGLE 1° UP

SYM	AVG. HD ~FT.	AVG. G.W. ~LB.	AVG. C.G. ~IN.	ROTOR SPEED ~RPM	DISPENSERS
○	5160	6430	131.2 (MID)	323	EMPTY
☐	4870	8190	131.1 (MID)	323	FULL



SYM	AVG. VCAL. ~KT.	AVG. HD ~FT.	AVG. G.W. ~LB.	AVG. C.G. ~IN.
○	49	5190	6270	131.0 (MID)
☐	51	4870	7890	131.0 (MID)

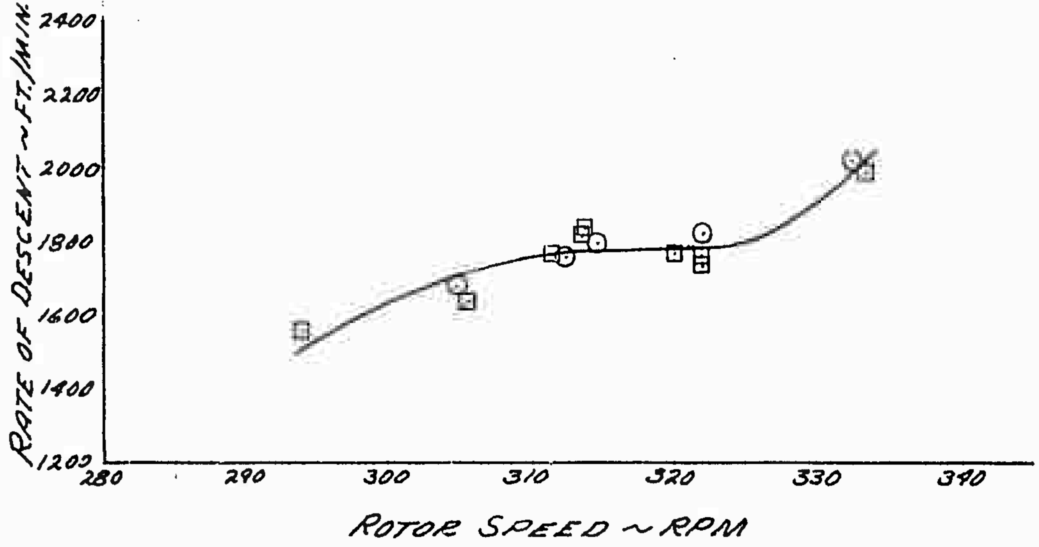
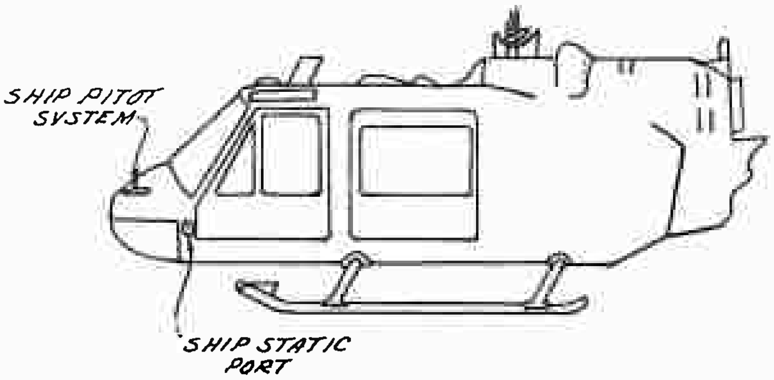
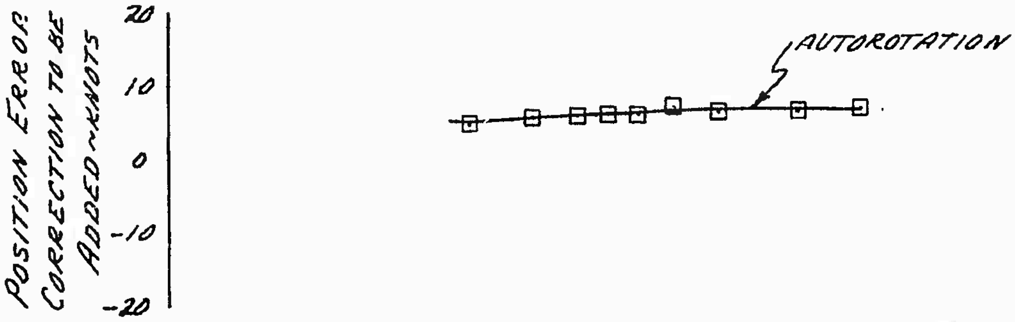


FIGURE NO. 41
AIRSPEED CALIBRATION
UH-1B/XM-47 S/N 62-12552
SHIP SYSTEM
ARMAMENT CONFIGURATION
TWO FULL DISPENSERS
POD ANGLE 1° UP

SYM	AVG. Hp ~FT.	AVG. G.W. ~LB.	AVG. C.G. ~IN.	ROTOR SPEED ~RPM
○	3990	7890	131.6 (MID)	324
☐	4620	7760	131.6 (MID)	324





NOTE: CALIBRATION METHOD
TRAILING BOMB

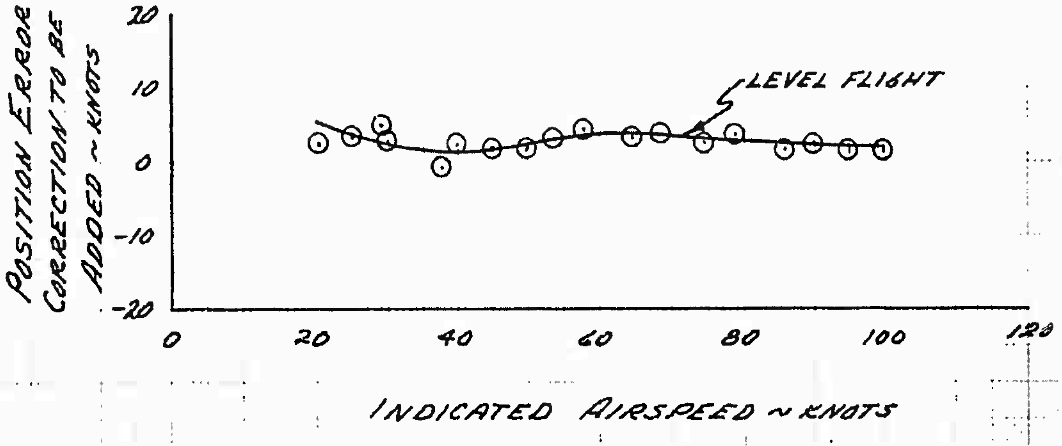
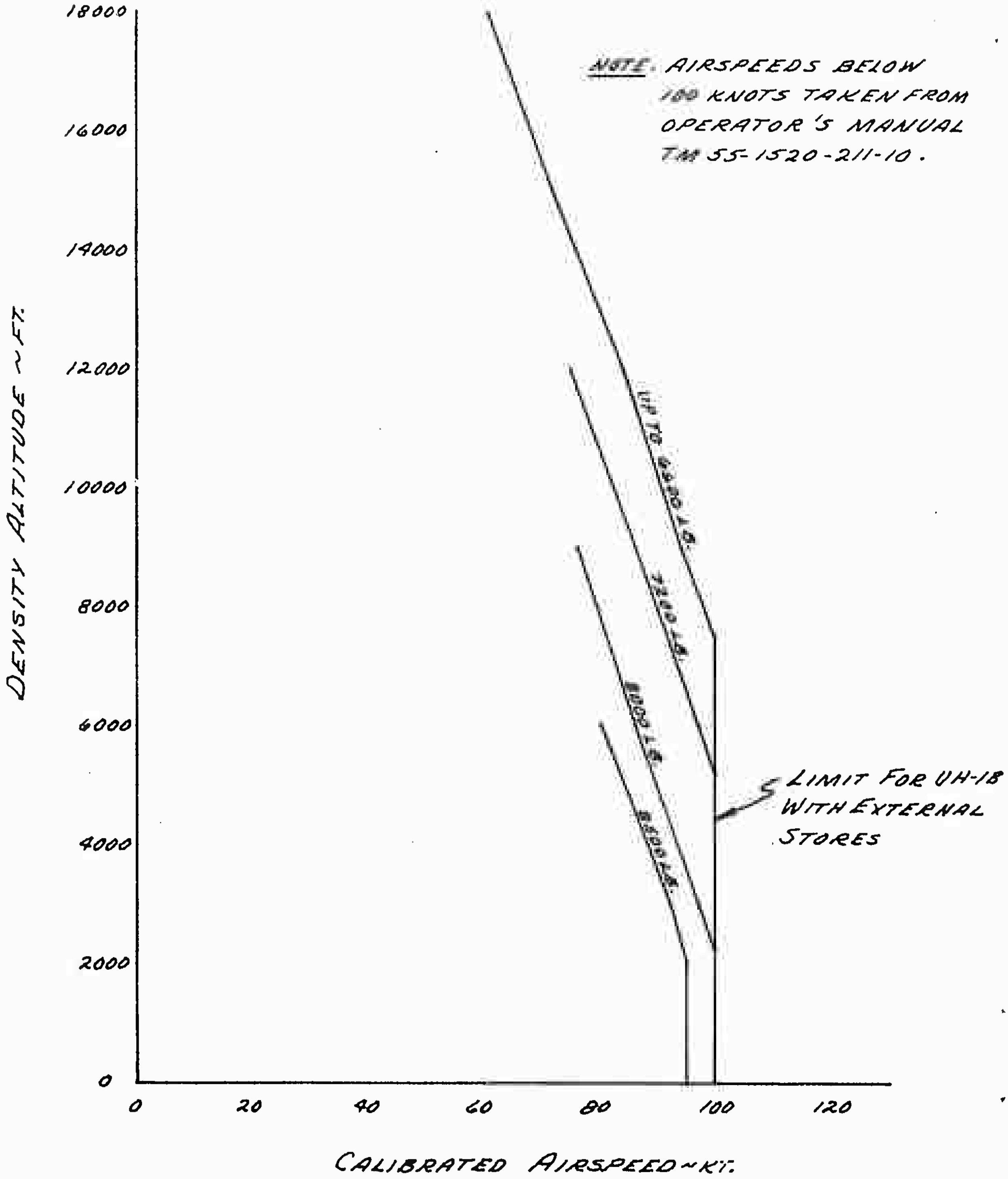


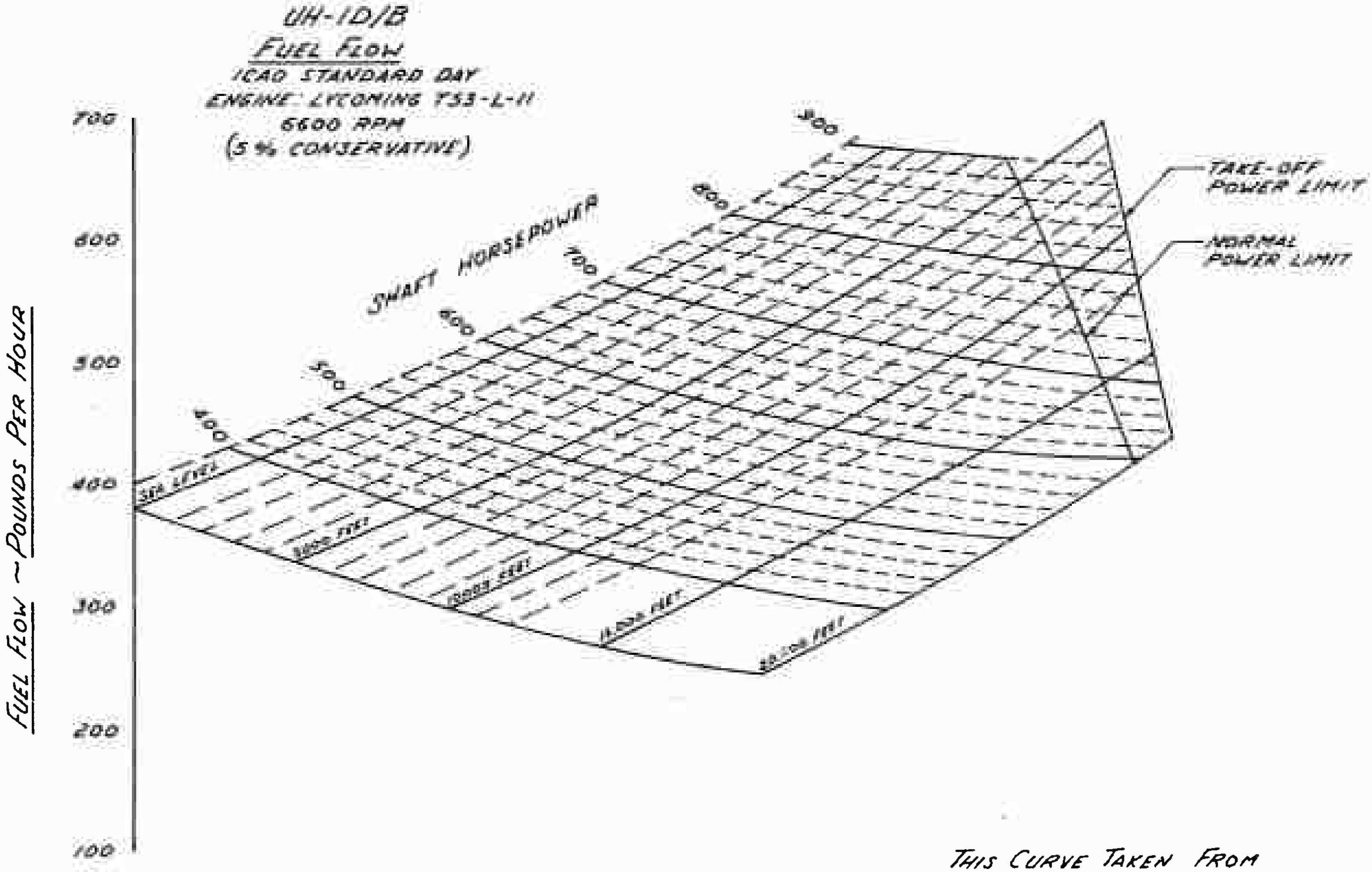
FIGURE NO. 42
OPERATING LIMITS FOR UH-1B
WITH EXTERNAL STORES

ROTOR SPEED = 324 RPM



NOTE: AIRSPEEDS BELOW 100 KNOTS TAKEN FROM OPERATOR'S MANUAL TM 55-1520-211-10.

FIGURE No. 43
SPECIFICATION FUEL FLOW

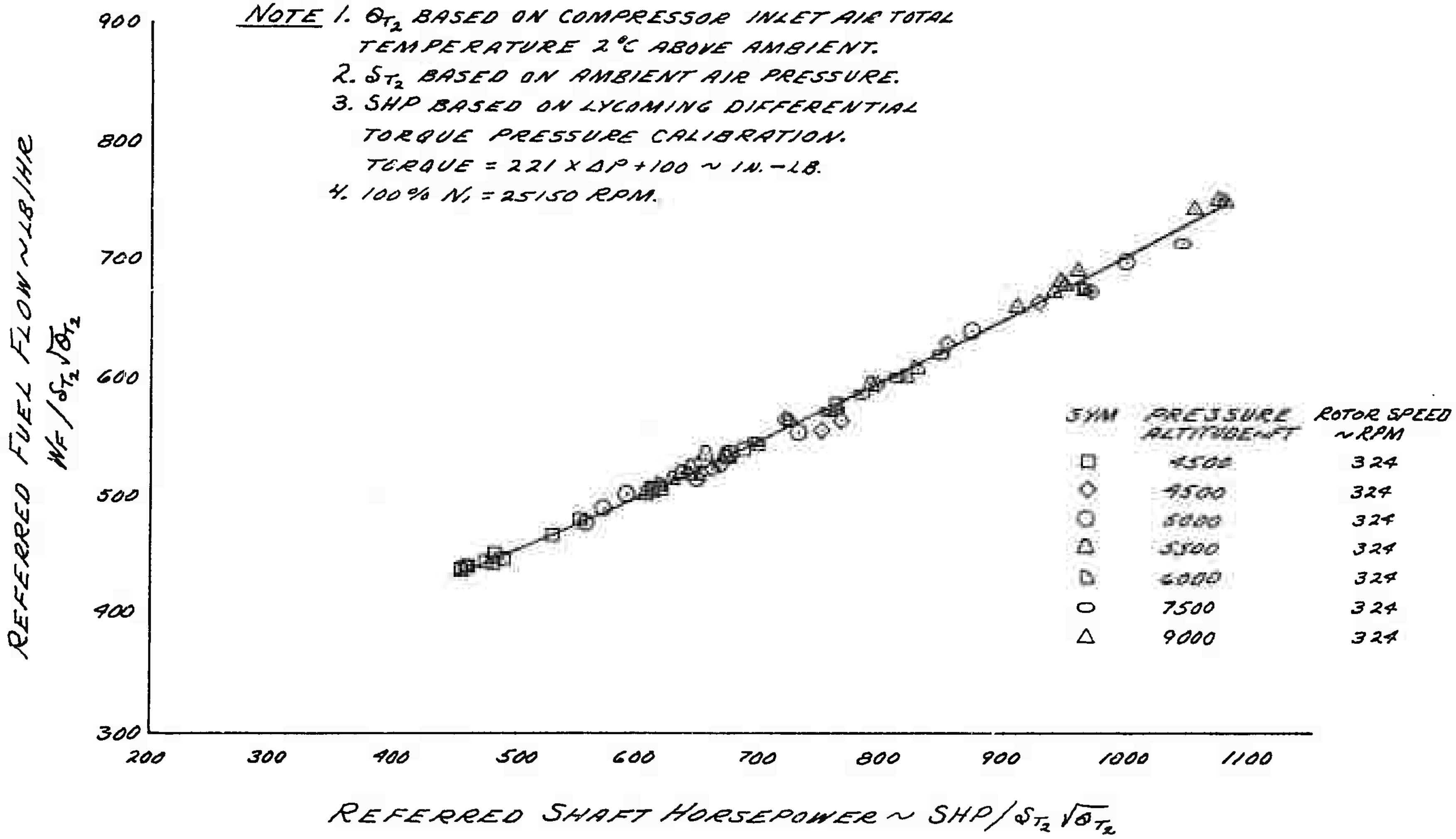


THIS CURVE TAKEN FROM
BELL REPORT 205-099-705

FIGURE NO. 44
ENGINE CHARACTERISTICS

UH-1B/XM-47 S/N 62-12552

ENGINE T53-L-9A S/N LEO 6509



NOTE 1. θ_{T_2} BASED ON COMPRESSOR INLET AIR TOTAL TEMPERATURE 2°C ABOVE AMBIENT.
2. δ_{T_2} BASED ON AMBIENT AIR PRESSURE.
3. SHP BASED ON LYCOMING DIFFERENTIAL TORQUE PRESSURE CALIBRATION.
TORQUE = 221 × ΔP + 100 ~ IN.-LB.
4. 100% N_1 = 25150 RPM.

SYM	PRESSURE ALTITUDE~FT	ROTOR SPEED ~RPM
□	4500	324
◇	4500	324
○	5000	324
△	5500	324
⌂	6000	324
⬭	7500	324
△	9000	324

FIGURE NO. 45

ENGINE CHARACTERISTICS

UH-1B/XM-47 S/N 62-12552

ENGINE T53-L-9A S/N LEO 6509

NOTE 1. θ_{T_2} BASED ON COMPRESSOR INLET AIR TOTAL TEMPERATURE 2°C ABOVE AMBIENT.

2. δ_{T_2} BASED ON AMBIENT AIR PRESSURE.

3. SHP BASED ON LYCOMING DIFFERENTIAL TORQUE PRESSURE CALIBRATION
TORQUE = 221 × ΔP + 100 ~ IN.-LB.

4. 100 % N_1 = 25150 RPM.

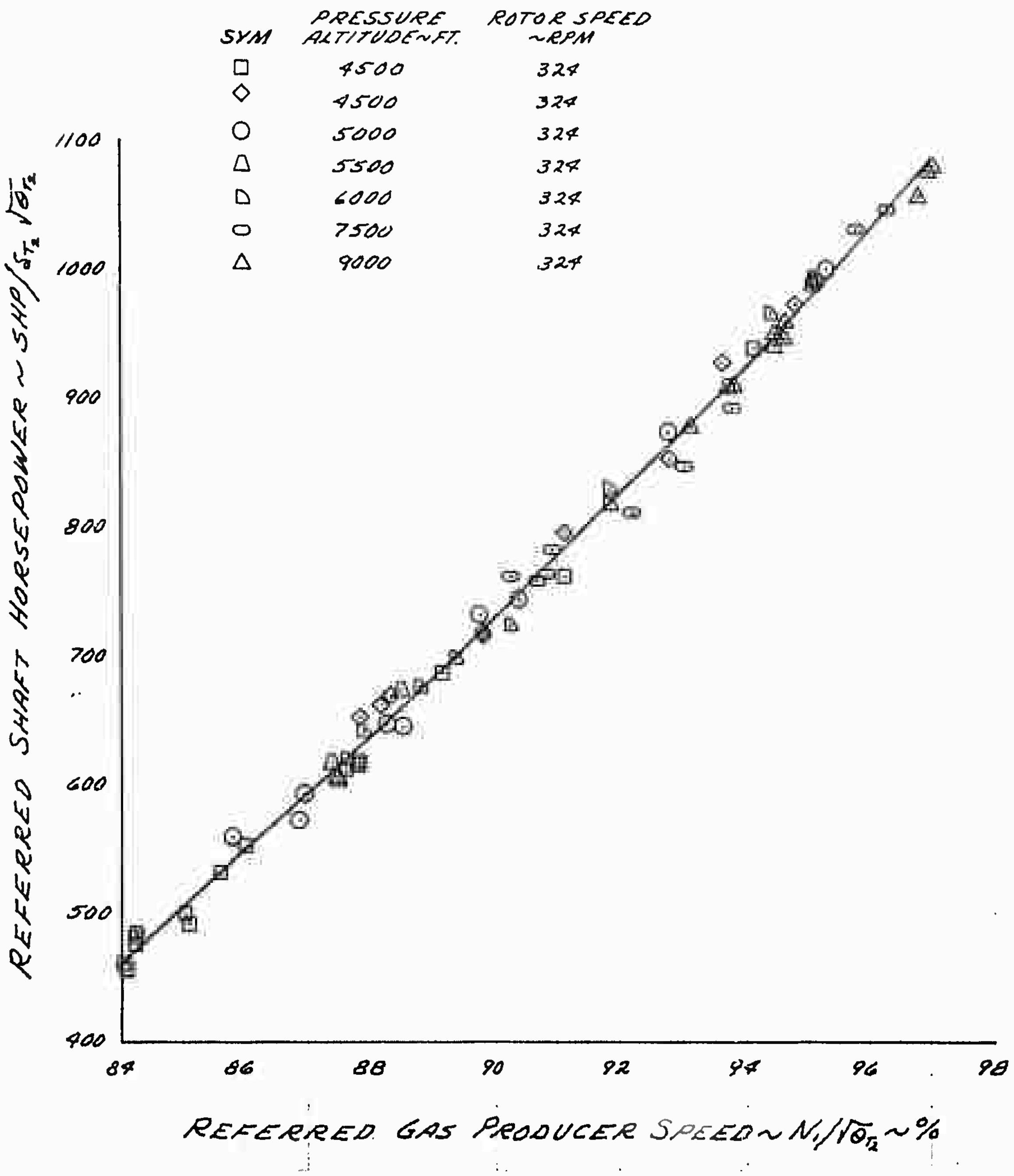
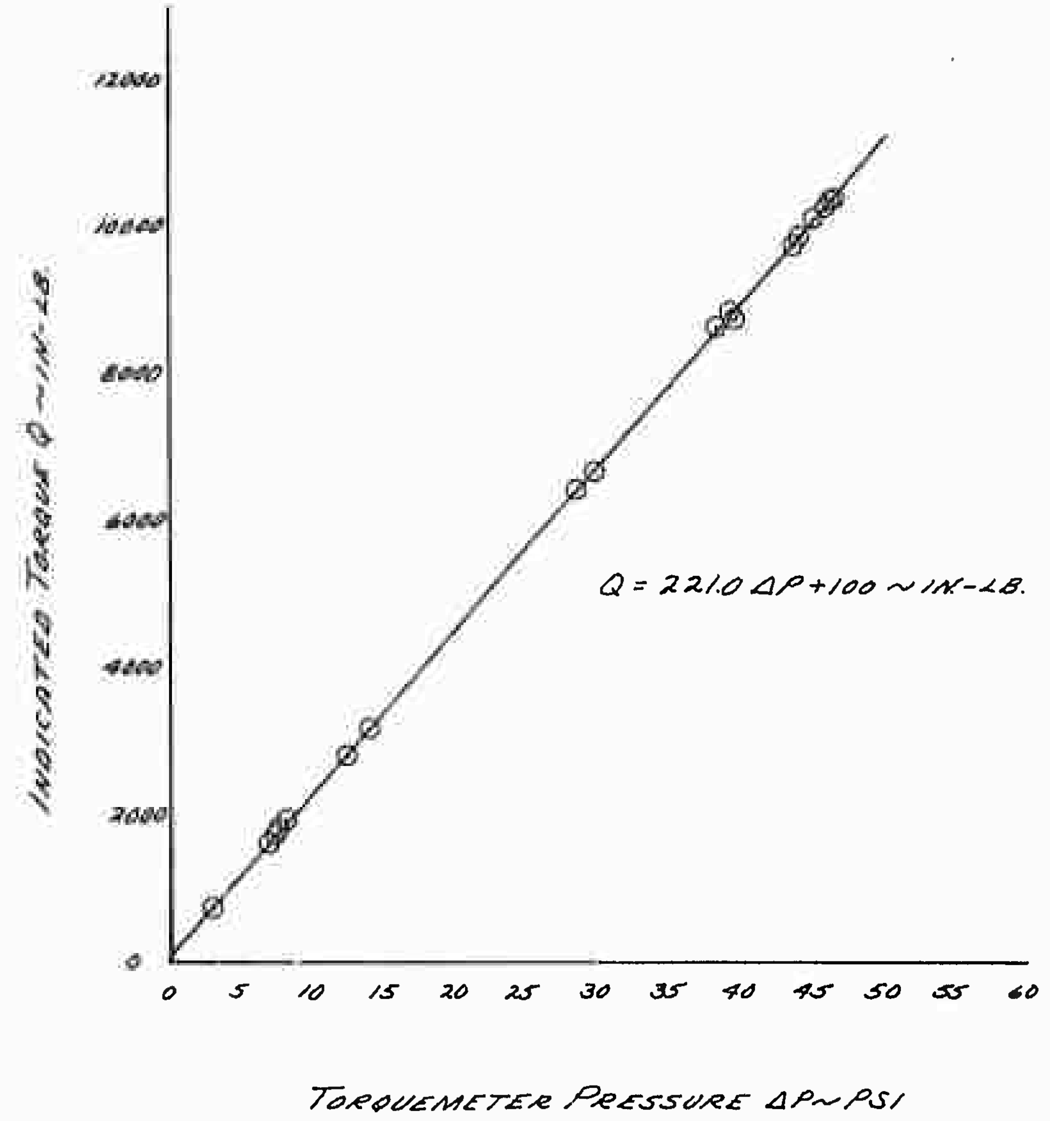


FIGURE NO. 46
ENGINE CHARACTERISTICS
T53-L-9A S/N LE06509

NOTE. DATA POINTS TAKEN
FROM LYCOMING TEST
STAND CALIBRATION
RUNS.



APPENDIX II. NOMENCLATURE AND DATA ANALYSIS METHODS

1.0 NOMENCLATURE

SYMBOLS AND ABBREVIATIONS	DEFINITION	UNITS
A	Rotor Disc Area	ft^2
AVG	Average	
CAS, V_{cal}	Calibrated Airspeed	kt
C.G.	Center of Gravity	in
deg	Degree	--
dH_p/dt	Slope of Pressure Altitude versus Time Plot	fpm
H_D	Density Altitude	ft
H_p	Pressure Altitude	ft
K	Temperature Probe Recovery Factor	--
KCAS	Knots Calibrated Airspeed	kt
KIAS	Knots Indicated Airspeed	kt
KTAS	Knots True Airspeed	kt
M	Free Stream Mach Number	--
NAMPP	Nautical Air Miles Per Pound of Fuel	--
N_1	Gas Producer Speed	rpm
N_2	Power Turbine Speed	rpm
N_E	Output Shaft Rotational Speed	rpm

SYMBOLS AND ABBREVIATIONS	DEFINITION	UNITS
N_R	Rotor Rotational Speed	rpm
Q	Output Shaft Torque	in-lb
R	Rotor Radius	ft
R/D	Rate of Descent	fpm
SHP	Shaft Horsepower	550 ft-lb/sec
T	Temperature	deg
TAS, V_T	True Airspeed	kt
W, GW	Gross Weight	lb
W_f	Fuel Flow	lb/hr
δ	Pressure Ratio	
ΔP	Torquemeter Pressure	psi
θ	Temperature Ratio	
ρ	Atmospheric Density	slugs/ft^3
σ	Atmospheric Density Ratio	--
Ω	Rotor Angular Velcoity	radians/sec

SUBSCRIPT	DEFINITION
t	Test Condition
s	Standard Condition
a	Ambient Condition
Δ	Increment to be Added
2	Readings at Bellmouth

2.0 DATA ANALYSIS METHODS

2.1 STATIC STABILITY

The static stability characteristics of the UH-1B equipped with the XM-47 antipersonnel mine dispensing subsystem were analyzed using the definitions and methods described in the following paragraphs.

2.1.1 Static Longitudinal Stability

Static longitudinal stability was evaluated in terms of control positions as well as static longitudinal speed stability.

Control position tests were conducted to evaluate the longitudinal stick position variation as a function of trim airspeeds. These tests were done concurrently with level flight performance tests. Collective pitch was set as required for each level flight trim airspeed. The gradient of longitudinal stick position versus airspeed obtained in this manner determines whether the static longitudinal stability is positive, neutral or negative. The control positions in level flight were recorded through the entire speed range. Control positions at stabilized airspeeds were also recorded in rearward and sideward flight. Static longitudinal speed stability tests were conducted by trimming the helicopter at a predetermined airspeed in level flight. Airspeed was then varied about the trim airspeed by changing longitudinal stick position. Collective pitch remained fixed in its original trim condition. The gradient of longitudinal control position versus airspeed is an indication of the static longitudinal speed stability of the helicopter.

2.1.2 Static Lateral-Directional Stability

The static lateral-directional stability was evaluated by conducting constant-heading, steady-state sideslip tests about various trim speeds while collective pitch setting remained constant. The gradients of pedal position and lateral stick position versus sideslip angle indicated whether the directional stability and dihedral effect were positive, neutral or negative.

2.2 PERFORMANCE

The equations and procedures used to correct the performance from test day to U. S. standard atmosphere conditions are described in this paragraph.

Dimensional analysis of the major items affecting helicopter performance yielded dimensionless variables which were used to present performance data in nondimensional form. These dimensionless variables are defined as follows:

$$C_P = \frac{550 \times SHP}{\rho A(\Omega R)^3} = \text{Power Coefficient}$$

$$C_T = \frac{W}{\rho A(\Omega R)^2} = \text{Thrust Coefficient}$$

$$\mu = \frac{V_T}{\Omega R} = \text{Tip Speed Ratio}$$

where:

SHP = Output shaft horsepower

ρ = Air density - slugs/ft^3

A = Rotor disc area - ft^2

Ω = Rotor angular velocity - rad/sec

R = Rotor radius - ft

W = Gross weight - lb

V_T = True airspeed - ft/sec

2.2.1 Power Determination

The T53-L-9A engine had a hydromechanical torquemeter installed as an integral part of the reduction gearing. Torque was measured as the difference between the pressure on the hydraulic oil contained by the torquemeter and the inlet housing pressure. The conversion from torquemeter pressure to torque was obtained from the production acceptance cell run of engine S/N LEO 6509. This torquemeter calibration, presented in figure 46, appendix I indicates that the engine output was the following function of torque pressure:

$$Q = 221 \times \Delta P + 100 \sim \text{in-lb}$$

where:

ΔP = Torquemeter pressure minus inlet hoursing pressure ~ PSI

Engine output shaft horsepower was determined from inflight torquemeter readings using the following equation:

$$SHP = \frac{2\pi}{12 \times 33{,}000} \times N_E \times Q$$

where:

SHP = Output shaft horsepower

N_E = Output shaft rotational speed ~ rpm

Q = Output shaft torque ~ in-lb

During the test program, torque pressure (ΔP) from which SHP was calculated was measured by recording the hydraulic oil pressure (high torque) and the oil vapor pressure (low torque).

Engine output shaft speed was determined from rotor speed by the following expression:

$$N_E = 20.37 \times N_R$$

where:

N_R = Rotor Rotational Speed - RPM

Engine characteristics were defined by curves of the following:

$$W_f/\delta_{T_2} \quad \theta_{T_2} \quad \text{versus} \quad SHP/\delta_{T_2} \quad \theta_{T_2} \quad \text{and} \quad SHP/\delta_{T_2} \quad \theta_{T_2} \quad \text{versus} \quad N_1/ \quad \theta_{T_2}$$

where:

W_f = Measured fuel flow ~ lb/hr

SHP = Output shaft horsepower

N_1 = Gas producer speed ~ %

δ_{T_2} = Ratio of bellmouth inlet total pressure to standard pressure at sea level. Since no inlet pressure probes were installed total pressure was assumed to be static pressure (reference 1).

θ_{T_2} = Ratio of bellmouth inlet total temperature to standard temperature at sea level. No inlet temperature instrumentation was installed in the test helicopter. From previous tests of the T53 engine a compressor inlet temperature rise of 2 degrees Centigrade (C) was established (reference 1). In this report, therefore, the inlet temperature was assumed to be 2 degrees C above the test ambient temperature.

2.2.2 Level Flight Performance

Level flight performance tests were conducted to determine power required and range performance in level flight.

Level flight tests were flown at C_T values to provide data for the entire practical C_T range. Each flight was flown at a constant C_T. This technique requires that for one constant rotor speed W/ρ be held constant by increasing altitude as gross weight decreases for each stabilized test point high and low torque, airspeed, engine parameters, and fuel used; and atmospheric conditions were hand-recorded since no photo panel was installed.

Power required was based on the installed torquemeter and rotor speed utilizing the engine calibration. Horsepower was corrected to standard horsepower by using the average density altitude for standard altitude:

$$SHP_s = SHP_t \times \rho_s/\rho_t$$

The standard gross weight was calculated at the standard density and average C_T using the equation:

$$W_s = C_{T_{avg}} \times \rho_s \times A(\Omega R)^2 \sim \text{lb}$$

Free air temperature was calculated from the equation

$$T_a = \frac{T_{ic}}{1 + 0.2K\,M^2}$$

where:

T_a = Free stream static temperature ~ °K

T_{ic} = Indicated temperature corrected for instrument error - °K

M = Free stream mach number

K = Temperature probe recovery factor ($K = 0.92$ assumed)

True airspeed was found using the expression:

$V_T = 38.967 \text{ x } M \text{ x } T_a$ ~ kt

V_T = True airspeed ~ kt

Each level flight speed power was reduced to the nondimensional variables C_P, C_T and μ. First, C_P was plotted as a function of μ with the average C_T values as the variable. Then faired line values of this plot were used to construct a carpet plot of C_P versus C_T. Smooth curves of constant μ were then faired through the test curves. This C_P-C_T plot with μ as parameter defines power required for any combinations of gross weight, altitude, rotor RPM and airspeed. Figures 30 through 32, appendix I, present this summary of the nondimensional level flight performance of the test aircraft equipped with the XM-47 mine dispensing subsystem.

A summary of the nondimensional level flight performance could be made only for the tests conducted with the cargo doors on (mid C.G.). Sufficient data were not obtained to summarize level flight performance when the cargo doors were removed.

Level flight fuel flow values were obtained from the engine model specification of the T53-L-11 engine (reference o). This fuel flow summary was based on 5 percent conservative. At each standardized altitude fuel flow was obtained using the shaft horsepower required values calculated from the nondimensional level flight performance (figures 30 through 32, appendix I). The standard-day specific range NAMPP (nautical air miles per pound of fuel) was calculated with the formula:

$$\text{NAMPP} = \frac{\text{TAS}}{W_f}$$

The T53-L-11 engine model specification fuel flow was used instead of that of the installed T53-L-9A engine since all new production UH-1B's will be equipped with the T53-L-11 engine.

Fuel flow was measured during each speed-power run. These values were reduced to referred conditions at the compressor inlet. A plot of fuel flow referred ($W_f/\delta_{T_2}\ \Theta_{T_2}$) versus shaft horsepower referred ($SHP/\delta_{T_2}\ \Theta_{T_2}$) is presented in figure 44, appendix I. From this plot fuel flow can be calculated when the faired curve is entered at the referred shaft horsepower value. The obtained value of $W_f/\delta_{T_2}\ \Theta_{T_2}$ is then reduced to fuel flow by multiplying by $\delta_{T_2}\ \Theta_{T_2}$. Specific range was calculated from these values and was compared against the specific range obtained from engine model specification fuel flow. The specific range obtained from the referred curve of W_f versus SHP was approximately 4 - 8 percent better than that obtained from the engine model specification fuel flow of the T53-L-11 engine.

A radius-of-action mission was calculated. This mission assumed was similar to the assault mission in which a described target area is "softened up" by armed helicopters prior to the arrival of troop transport helicopters. This mission was based on the weight breakdown given in paragraph 1.3, appendix IV. Cruising at recommended cruise speed was assumed. For assumed increments of fuel used, the inbound and outbound distances were found. The radius of action was then determined graphically as the intersection of the inbound and outbound distances when these distances were plotted against assumed fuel load outbound.

2.2.3 Autorotational Descent

Observed rate of descent was corrected to tapeline rate of descent by the following equation:

$$R/D = \frac{dHp}{dt} \times \frac{T_t}{T_s} \sim \text{fpm}$$

where:

$\frac{dHp}{dt}$ = Slope at pressure altitude versus time curve at a given pressure altitude ~ fpm

T_t = Test temperature for pressure altitude at which slope is taken ~ °K

T_s = Standard temperature for pressure altitude at which slope is taken ~ °K

Data are presented in figure 40, appendix I.

2.2.4 Airspeed Calibration

The standard ship system and the test boom system were calibrated by using the trailing bomb method. Data are presented in figure 41, appendix I.

APPENDIX III. TEST INSTRUMENTATION

Test instrumentation was installed, calibrated and maintained in the UH-1B, S/N 62-12552, by the Logistics Division of USAAVNTA. The following parameters were recorded:

a. Oscillograph

(1) Pilot's Event

(2) Engineer's Event

(3) Camera Operation Mark

(4) Bridge Balance Voltage

(5) Roll Rate

(6) Pitch Rate

(7) Yaw Rate

(8) Angle of Attack

(9) Angle of Sideslip

(10) Roll Angle

(11) Pitch Angle

(12) Yaw Angle

(13) Pedal Position

(14) Collective Pitch Position

(15) Lateral Stick Position

(16) Longitudinal Stick Position

(17) Yaw Angular Acceleration

(18) C.G. Normal Acceleration

b. Cockpit Instrument Panel (Hand-Recorded)

(1) Boom System Airspeed

(2) Boom System Altitude

(3) Ship System Airspeed

(4) Ship System Altitude

(5) Rotor Speed

(6) Gas Producer Speed

(7) High Torque

(8) Low Torque

(9) Outside Air Temperature

(10) Fuel Total

APPENDIX IV. GENERAL AIRCRAFT AND MINE DISPENSING SUBSYSTEM INFORMATION

1.0 AIRCRAFT

1.1 DIMENSIONS AND DESIGN DATA

a. Overall Dimensions

(1)	Aircraft length (nose to tail skid)	39.5 ft
(2)	Aircraft length (rotor turning)	54.0 ft
(3)	Width of skids	8.4 ft
(4)	Height (to top of turning tail rotor)	14.7 ft
(5)	Height (to top of rotor mast)	12.5 ft

b. Main Rotor

(1)	Number of blades	2
(2)	Rotor diameter	44 ft
(3)	Rotor solidity	0.0506
(4)	Swept area	1520.5 ft^2
(5)	Blade area (each)	38.5 ft^2
(6)	Blade chord (root to tip)	21 in
(7)	Blade airfoil (root to tip)	NACA 0012
(8)	Blade twist	0 deg
(9)	Flapping angle	±12 deg

c. Tail Rotor

(1)	Number of blades	2
(2)	Rotor diameter	8.5 ft
(3)	Rotor solidity	0.105

(4)	Swept area	56.5 ft^2
(5)	Blade chord (root to tip)	0.7 ft
(6)	Blade airfoil (root to tip)	NACA 0015
(7)	Blade twist	0 deg
(8)	Flapping angle	±8 deg

d. Gear Ratios

(1)	Power turbine to engine output shaft	3.22 to 1
(2)	Engine output shaft to rotor	20.37 to 1
(3)	Engine output shaft to tail rotor	3.97 to 1

e. Flight Limits

(1)	Forward C.G. limit	sta 125.0
(2)	Aft C.G. limit (below 6600 pounds gross weight)	sta 138.0
(3)	Aft C.G. limit (above 6600 pounds gross weight)	sta 136.0
(4)	Design gross weight	6600 lb
(5)	Design alternate gross weight	7600 lb
(6)	Maximum overload gross weight	8500 lb
(7)	Design minimum rotor speed (power on and power off)	285 rpm
(8)	Design maximum rotor speed for continuous operation (power on)	330 rpm
(9)	Maximum rotor speed for authorotation	339 rpm
(10)	Structural limit rotor speed (power on and power off)	356 rpm
(11)	Limit dive speed	168 KTAS
(12)	Design maximum sideward speed	30 KTAS

(13)	Design maximum rearward speed	30 KTAS

f. Control Travel

(1)	Cyclic, full forward to full aft	12.9 in (neutral=6.45 in)
(2)	Cyclic, full left to full right	12.7 in (neutral=6.35 in)
(3)	Pedal, full left to full right	6.9 in (neutral=3.45 in)
(4)	Collective, full down to full up	12.65 in

1.2 POWER PLANT

The test aircraft was equipped with a T53-L-9A gas turbine engine, Serial Number LEO 6509. This engine was designed to produce 1100 shaft horsepower for takeoff at 6600 rpm (engine output shaft speed) at sea level standard-day conditions.

1.3 WEIGHT AND BALANCE

The test aircraft was weighed and balanced in a closed hangar after the instrumentation was installed. The aircraft was weighed clean and with the universal mounts and Kellett pylons installed. Weight and C.G. location were controlled for specific tests by placing lead bags in appropriate locations in the helicopter. For the calculation of the radius-of-action mission (paragraph 2.5.1.3) the following weight breakdown was used (operating weight and usable internal fuel are model specification numbers):

Operating weight	4787 lb
Crew of two	400 lb
Usable internal fuel (155 gal at 6.5 lb/gal)	1008 lb
Universal mounts + Kellett pylons + cables + control panel	201 lb
Two dispensers fully loaded with mines	1080 lb
Engine Start Mission Weight	7476 lb

2.0 XM-47 ANTIPERSONNEL MINE DISPENSING SUBSYSTEM

2.1 POWER REQUIREMENT

The minimum power requirement for operation is 28 volts DC with 2 AMPS.

A pressure gage at the forward end of the XM-2 canister provides a positive visual indication that the gas pressure is at an acceptable functional level.

2.2 WEIGHT AND DIMENSIONS OF THE XM-3 MINE DISPENSER:

Length	93 in
Diameter	18.5 in

Weight

Empty	167 lb
Fully loaded with four XM-2 canisters containing antipersonnel mines	540 lb (approx)

Detailed information appears in classified reference h.

APPENDIX V. MAINTENANCE EVALUATION

1.0 The reliability of the XM-47 antipersonnel mine dispensing subsystem was satisfactory. No misfiring occurred during the 15 conducted dispersion tests. Two intervalometers, which controlled the firing sequence of the canisters, had to be replaced after the firing tests. The cause of the malfunctions should be determined and the intervalometer should be redesigned if necessary.

2.0 A manual jettison system was installed in the test helicopter. The reliability of this jettison system was excellent. The dispensers were jettisoned successfully during each jettison test without any malfunctions.

3.0 The wiring which leads from the aircraft to the dispenser was outside of the fuselage and was exposed and unprotected. The wiring should be protected to prevent damage.

APPENDIX VI. PHOTOGRAPHS

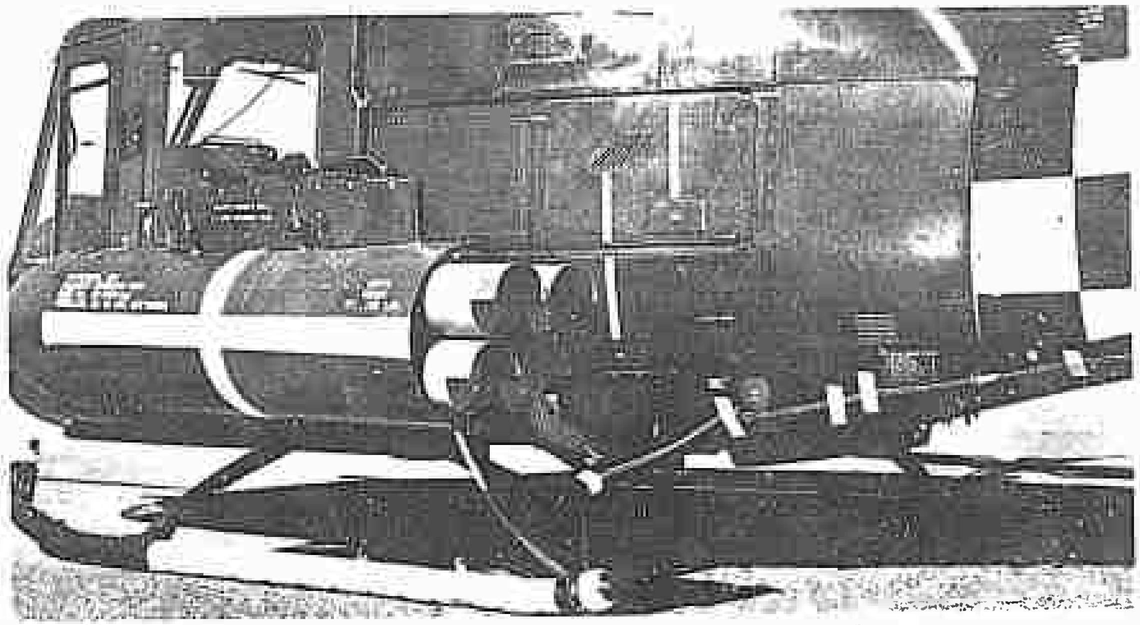


Photo 1 - Left side view of UH-1B with XM-3 Dispenser.

Photo 2 - Left rear view of UH-1B showing left XM-3 Dispenser loaded with four XM-2 Antipersonnel Mines and tail skid camera.

Photo 3 UH-1B with Kellet Mounts on standard universal external pylons, unmounted XM-3 Dispenser and skid camera.

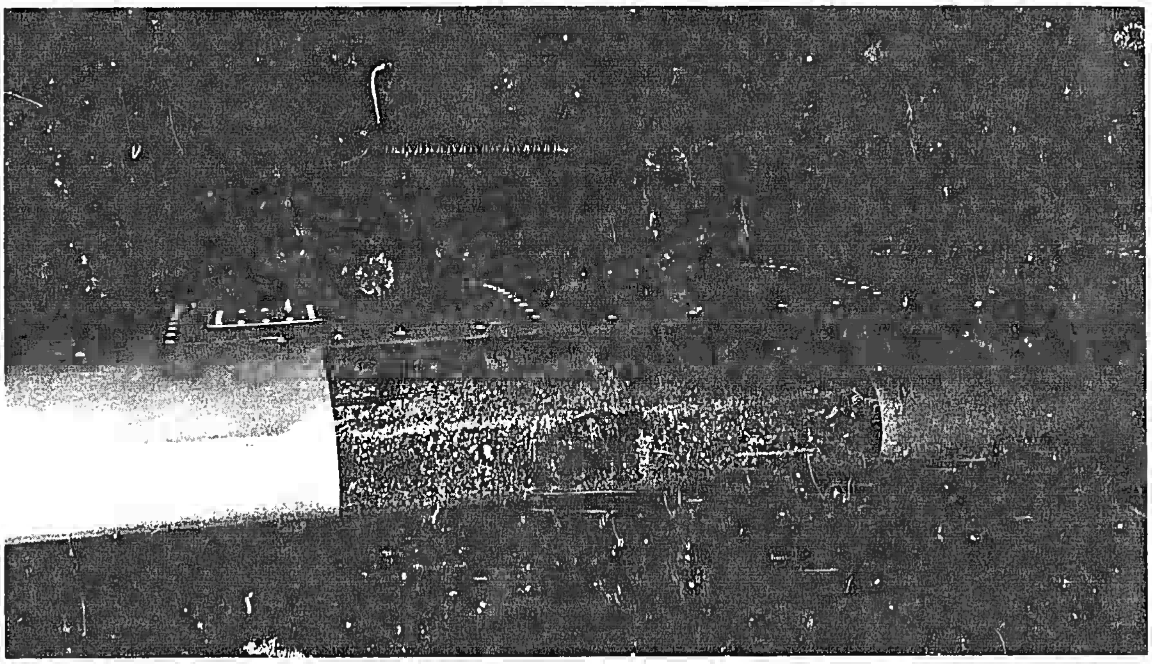


Photo 4 - Mine helicopter interference during Autorotational ~~Ascent~~ DESCENT at 103 KCAS.

Photo 5 - Two XM-3 Dispensers jettisoned simultaneously.

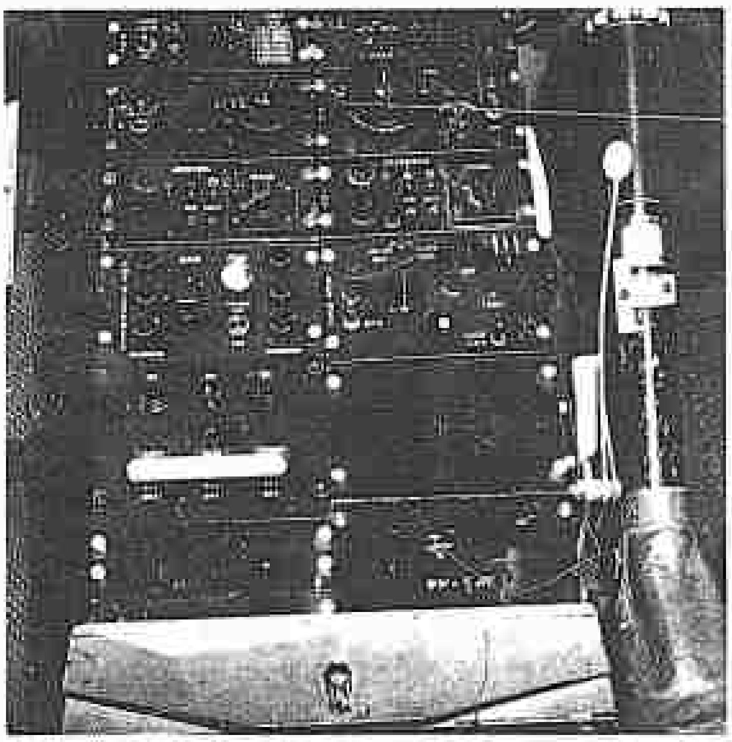


Photo 6 - Lower view of UH-1B/XM-47 Center Console with Dispersion Control Panel.

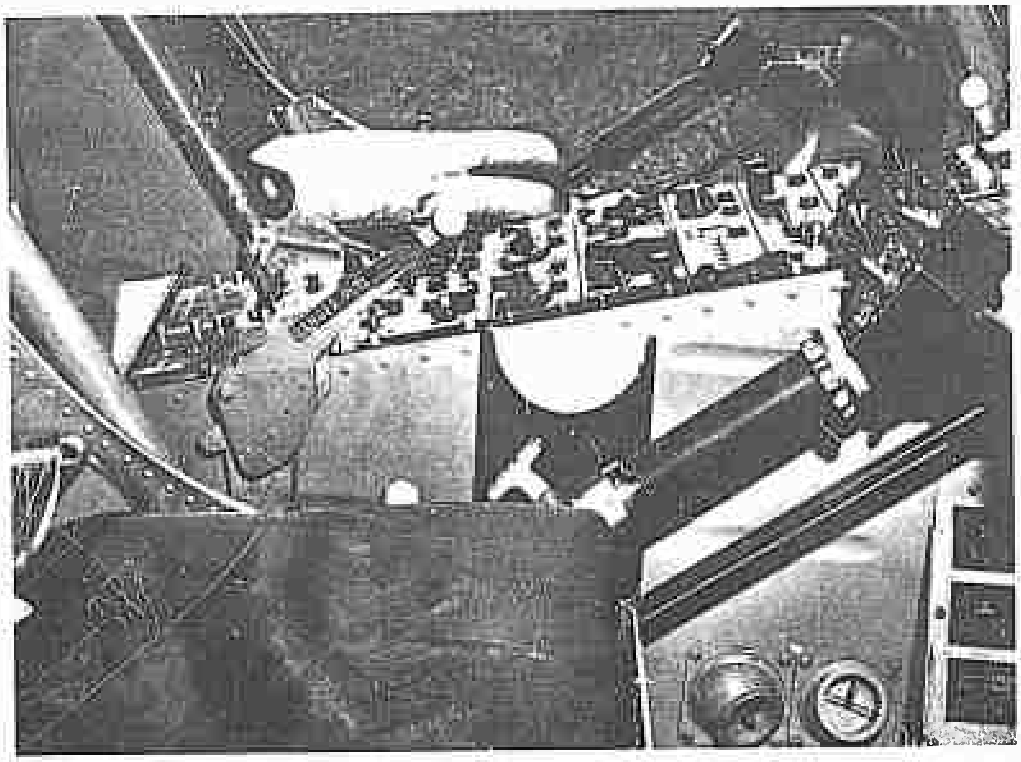


Photo 7 - Side view of UH-1B/XM-47 Center Console.

Photo 8 - UH-1B with left XM-3 Dispenser and cameras on front ends of skids.

APPENDIX VII. REFERENCES

a. Unclassified Message EELUH-1-19-4-1307, SMOSM, Hq, U. S. Army Aviation Materiel Command (USAAVCOM), 2 April 1965, subject: Safety of Flight Release, XM-3 Antipersonnel Mine Dispenser.

b. Unclassified Message AMC 15366, AMCPM AI, Hq, U. S. Army Materiel Command (USAMC), 13 November 1965, subject: "XM-3/XM-27 Mine Dispenser Subsystem."

c. Letter, AMSTE-BG, Hq, U. S. Army Test and Evaluation Command (USATECOM), 13 October 1965, subject: "Test Directive, USATECOM Project No. 4-4-6516-05, Phase D - Airworthiness and Performance Tests, UH-1B w/ XM-3 Antipersonnel Mine Dispenser."

d. "Plan of Test for Engineering Test of UH-1B Helicopter Equipped with XM-3 Antipersonnel Mine Dispenser," U. S. Army Aviation Test Activity (USAAVNTA), January 1966.

e. Letter, AMSTE-BG, Hq, USATECOM, 9 February 1966, subject: "Test Plan Approval, Engineering Test of the XM-3 Antipersonnel Mine Dispenser on UH-1B Helicopter, RDT&E Project No. 1W5433120-41431."

f. Unclassified Message STEAV-OP 00108, USAAVNTA, 9 March 1966, subject: "Jettison Provisions for XM-47 Mine Dispenser."

g. Unclassified Message STEAV-EN 00125, USAAVNTA, 16 March 1966, subject: "UH-1B/XM-47 Mine Dispenser."

h. (C) Technical Manual TM-9-1345-201-15, "Draft Equipment Manual Mine Dispersing Subsystem, Aircraft: XM-47 (U)," Department of the Army, Navy and Air Force, March 1966.

i. Military Specification MIL-H-8501A, "General Requirements for Helicopter Flying and Ground Handling Qualities," Revised January 1961 and Amended 3 April 1962.

j. Report FTC-TDR-62-13, "YHU-1B Stability and Control Tests," U. S. Air Force Flight Test Center (AFFTC), August 1962 (AD281795).

k. Report FTC-TR-61-39, "YHU-1B Category I Performance, Stability and Control Tests (FOUO)," U. S. AFFTC, July 1961 (AD263413).

l. Report FTC-TDR-62-21, "YHU-1B Category II Performance Tests," U. S. AFFTC, December 1962 (AD296012).

m. Military Specification MIL-C-5011A, "Charts, Standard Aircraft Characteristics and Performance, Piloted Aircraft," 5 November 1951.

n. Technical Manual TM-55-1520-211-10, "Operator's Manual, Army Models UH-1A and UH-1B Helicopters," Department of the Army, 29 July 1964.

o. Model Specification, T53-L-11 Engine, Lycoming Division of AVCO Corporation.

UNCLASSIFIED
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DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)* U.S. Army Aviation Test Activity (USAAVNTA) Edwards Air Force Base, California 93523	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP

3. REPORT TITLE
Engineering Flight Test of UH-1B Helicopter Equipped with XM-47 Antipersonnel Mine Dispensing Subsystem.

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Final Report, 8 February 1966 through 27 March 1966

5. AUTHOR(S) *(Last name, first name, initial)*
Manfred Reif, Project Engineer
Norman A. Mattmuller, Major, U.S. Army, TC and
John J. Shapley, Project Pilots

6. REPORT DATE November 1966	7a. TOTAL NO. OF PAGES 116	7b. NO. OF REFS 15

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S) N/A
b. PROJECT NO. RDT&E Project Number 1W543312D41431	
c. USATECOM PROJECT No. 4-4-6516-05	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)* N/A
d. USAAVNTA Project No. 65-22	

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Iroquois Project Manager U.S. Army Materiel Command

13. ABSTRACT

A limited engineering flight test was conducted to provide sufficient engineering data for a safety-of-flight release for the UH-1B helicopter equipped with the XM-47 antipersonnel mine dispensing subsystem. An additional objective was to provide sufficient performance and stability and control data to update the operator's manual data to be used for UH-1B helicopters equipped with the XM-47 subsystem. The test was conducted by the U. S. Army Aviation Test Activity (USAAVNTA) at Edwards Air Force Base, California. Testing consisted of 42 productive flight hours and was conducted from 8 February 1966 through 27 March 1966. The USAAVNTA was responsible for preparation of test plan, conduct of test, and submission of final report. When the XM-47 mine dispensing subsystem was installed on the UH-1B helicopter, antipersonnel mines could be safely dispersed within the recommended flight envelopes. In cases of emergency the dispensers could be safely jettisoned within the recommended envelopes. Jettisons during entry into autorotation and in close proximity to the ground should be avoided. The flying qualities of the UH-1B were essentially unaffected by the installation of the XM-47 mine dispensing subsystem. The installation resulted in a restriction of hovering operations to tailwinds below 17 knots true airspeed (KTAS). The drag penalty caused by the installation of the XM-47 subsystem amounted to approximately 10- to 13-percent range reduction, depending on gross weight. The recommended cruise airspeed decreased to 99 KTAS or lower. Seven shortcomings were recommended for correction. Correction of these shortcomings should result in better dispersion and jettison capability for the UH-1B equipped with the XM-47 antipersonnel mine dispensing subsystem.

DD FORM 1 JAN 64 1473

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Engineering Flight Test						
Stability and Control Test						
Performance Test						
Dispersion Test						
Jettison Test						
Safety-of-Flight Release						
UH-1B Helicopter/XM-47 Antipersonnel Mine Dispensing Subsystem						

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