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A PILOT QUESTIONNAIRE STUDY OF COCKPIT VISIBILITY REQUIREMENTS FOR ARMY HELICOPTERS

FOR LIMITED DISTRIBUTION

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SUMMARY

A questionnaire concerning problems of visibility from helicopter cockpits was distributed to 1,341 military helicopter pilots as a part of a broad study relating to helicopter cockpit windscreen outlines, 535 of these questionnaires were completed and returned. The questionnaire included both specific evaluation of visual characteristics of present helicopters for various maneuvers and differing directions of sight, and a general evaluation of different visual problems. The results of the questionnaire study seem to indicate that the pilots have not developed a general awareness or concern for the visual characteristics of helicopter cockpits. This probably is due, at least in part, to the generally good visibility from present helicopters. Most pilots rate the visibility from the helicopter they fly as satisfactory.

Analysis of the questionnaire data shows that visual cutoff angles for the different directions of sight may be defined in terms of windscreen outlines which correspond to pilot ratings of adequate or excellent. In the determination of these visual cutoff angles, the attitude of the helicopter in various maneuvers must be considered. Reasonable accuracy appears to be obtained by this method.

The results of the analysis of the questionnaire data are presented in relation to various specific visual problems and are combined into a general set of requirements which include visual cutoff angles and post arrangements. The results are not considered to be a final solution to the problem of visibility from helicopter cockpits, but offer a useful guide to the amount and quality of visibility which will be considered satisfactory by pilots.

INTRODUCTION

During the past several years, the problem of visibility from aircraft cockpits, as determined by window size, type, and location, has been receiving increased attention. Such attention has arisen as a result of midair collisions in which the pilots involved did not see the colliding aircraft until the instant of impact and also as a result of large variations in visual characteristics of modern aircraft due to a lack of basic standards.

The Department of the Army, cognizant of the problem already existing in fixed-wing aircraft and realizing that this same problem easily could become a serious defect in helicopters, decided to sponsor a study of the cockpit visual characteristics of helicopters. During 1955, the Civil Aeronautics Administration (CAA) Technical Development Center (TDC) commenced this investigation for the Department of the Army. Its purpose was to establish, upon some reasonable basis, definite standards which would insure adequate visibility for the safe operation of helicopters during the performance of all normal flight and military maneuvers. In this broad investigation, several different lines of approach are under way. The pilot questionnaire and supporting data presented in this report represent one line of approach, supplying contributory data but not a final solution to the problem.

While the evaluation of specific windscreen outlines is based on pilot opinion as expressed in the questionnaire, the angular measurements discussed herein were made with a binocular cockpit visibility camera[1] developed at TDC for this purpose. Some information derived from a study of helicopter flight path performances is presented here in support of various data derived from the questionnaire.

HELICOPTER DATA

Cockpit Visibility.

The quality of existing visibility from the H-13G, H-19, H-21, H-23, H-25A, H-31, H-34, H-37, XH-40, HOK-1, HRS-3, and CH-1 helicopters was recorded with the Center's binocular cockpit visibility camera. The photographs, as well as front and profile photographs of each helicopter, are presented in Appendix I. Data contained in the photographs were reduced further to tabular form and are presented in Table I with supplementary information concerning lineal relationships of the pilot to the cockpit and the ground. The eye-level position in a cockpit will vary with each individual pilot, depending on his height and the type of seat. This variation will be greater in those helicopters which do not have adjustable seats. All binocular vision photographs were obtained at the eye-level location of a pilot of average height, namely, 5 feet 10 1/2 inches. In reducing the photographic data to tabular form, any obstruction to vision over an arc equal to or greater than 10° was considered significant, and cutoff angles were measured to this point. When the copilot obscured portions of the cockpit

[1] Thomas M. Edwards, "Development of an Instrument for Measuring Aircraft Cockpit Visibility Limits," CAA Technical Development Report No. 153, January 1952.

windows or openings, the cutoff angles were measured to the copilot's body. All binocular cockpit visibility measurements were made with the copilot's seat occupied so that actual, rather than theoretical, openings were recorded.

True appreciation of the binocular cockpit visibility photographs shown in Appendix I requires a knowledge of the limitations of the instrumentation. The binocular cockpit visibility camera records the true field of view, including binocular effect, of a pilot scanning the horizon with simple head rotation. The resulting outlines can be used to describe cockpit visibility limitations based on simple head rotation in a horizontal plane and eye movement. The binocular cockpit visibility photographs in Appendix I should not be used to determine absolute limits of foveal vision in any direction since the pilot's viewpoint and visual cutoff angle will change with vertical head rotation as shown in Fig. 1. Normally, a pilot can be expected to use eye movement only to 15° in any direction from the centroveal position. Beyond 15°, head movement must be considered. The difference between the true and apparent visual cutoff angles is a function of the elevation angle from the horizon and the distance from the pilot's viewpoint to the windshield. The true cutoff angle will always be smaller than the angles given in the binocular cockpit visibility photographs. When judging areas of visibility, it must be remembered that the spherical limits are projected on a grid similar to a Mercator projection. The true solid angle of visibility therefore decreases with increasing elevation angle above and below the horizon.

Another factor which influences the visibility limits is head movement. The increase in visibility resulting from movement of the head toward a particular window is inversely proportional to the distance from the pilot's eyes to the window. The closer the window, the greater is the increase in visibility with a given amount of head movement. This is particularly important during use of the side window, which generally is very close to the pilot.

Flight Characteristics.

A knowledge of the flight characteristics of helicopters, that is, flight-path angles, helicopter attitudes, and so forth, is essential in the consideration of cockpit visibility requirements. This information was obtained through a photographic study of various helicopter maneuvers. Three special-purpose cameras were located as shown in Fig. 2 to record the necessary data. A Fairchild flight analyzer, Fig. 3A, was used to record a straight flight path, Fig. 3B, of approximately 1,200 feet including the touchdown point. A Varitron camera, Fig. 4A, operating at 2 frames per second, was used to record the touchdown area and approximately 200 feet of the

adjacent flight path, as shown in Fig. 4B. A Traid camera, Fig. 5A, remotely controlled to expose one frame, Fig. 5B, each time the Fairchild flight analyzer exposed a segment, was used to detect crab or yaw.

The flight analyzer must track a subject aircraft along a portion of the flight path equal to one-fortieth of the offset distance before the shutter will trip and expose a strip of the negative. Originally, this caused some concern lest critical attitudes occur during the period of generally vertical flight that occurs after the flare but before touchdown and remain undetected. The Varitron sequence camera was used to study this period of flight. This phase of the study indicated that critical attitudes exceeding those being recorded with the flight analyzer were not occurring in this area, therefore, the data obtained with the Fairchild flight analyzer as presented herein are considered complete.

The flight analyzer was used to record the performance of five maneuvers. cruise, normal approach, normal takeoff, steep approach, and autorotation. Due to the characteristics of the camera described above and the offset distance as indicated in Fig. 2, this camera was not used to secure confined area data or maneuvers involving near-vertical performance. A summary of the data obtained is presented in Appendix II.

QUESTIONNAIRE STUDY

Procedure.

The questionnaire was developed from a similar one used by this Center to study problems of visibility from the cockpits of transport aircraft.[2] This questionnaire was discussed with individual pilots at Fort Rucker, Ala., to determine whether or not. (a) it could be easily understood, (b) the pilots' answers could be easily interpreted, and (c) the questionnaire included all information these pilots believed pertinent to this study. As a result of these discussions with pilots, some minor changes were made in the original questionnaire.

Later, 20 pilots completed the questionnaire during five group interviews. At this time, Question 9, dealing with visual references, was added. The questionnaire, as it was distributed to the entire group of pilots, is reproduced in Appendix III. The questionnaire was distributed to pilots in the field directly and also by mail through Post and various

[2] George L. Pigman and Thomas M. Edwards, "Airline Pilot Questionnaire Study on Cockpit Visibility Problems," CAA Technical Development Report No. 123, September 1950.

Continental Army Commands. An addressed return envelope was included for mailing the completed questionnaire directly to the CAA Technical Development Center, Indianapolis, Ind.

Five hundred and thirty-five completed questionnaires were returned, representing 39.9 per cent of the original distribution. The data contained in these questionnaires were transferred to punchcards, and the final tabulation, classification, and totalization of data were carried out by machine. Prior to the final machine analysis, a preliminary investigation of various groupings was conducted with 135 completed questionnaires. Answers to Questions 4 to 9, inclusive, were grouped according to the pilots' experience as determined by their answers to Questions 2 and 3. Those groupings which evidenced no definte pattern were eliminated. The remaining groupings then were used as the basis for the machine analysis of the 535 completed questionnaires that were returned.

General Presentation and Limitations of Basic Data.

Answers to the questionnaire were received for each of the eight helicopters listed in Table II. The number of pilots answering the questionnaire for each of these helicopters varied considerably. The number of completed questionnaires returned for the H-31 and H-37 helicopters was considered, in each case, to be too small to be significant. The answers of the H-25 pilots were included, however, the small sampling must be considered when applying these data.

Most of the helicopters covered by this study have visual cutoff angles that the pilots as a group consider adequate. Because of this fact, it is difficult to determine accurately, based on pilot opinion, the exact areas in which visual cutoff angles become critical.

The data obtained for the various fixed-choice questions are presented either in terms of the percentage of all pilots or the percentage of each group of pilots answering. Where quantitative estimates were on an unrestricted basis, the mean value was used.

DISCUSSION OF QUESTIONNAIRE DATA

Question 1 - Pilot Height.

Early field work indicated a possible correlation between pilot height and pilot opinion. Subsequent work has not supported this belief and these data are not presented here.

Question 2 - Pilot Experience - General.

Here, as in Question 1, early work indicated a possible relationship between various kinds of pilot experience and pilot opinions. The questionnaire results and the flight-path studies have not revealed any definite relationship between the number of years a pilot has been flying or the total number of hours flying time in various types of aircraft and his opinions of the quality of visibility from the helicopter; therefore, these data are not presented here.

A trend was evidenced in Question 6 concerning the amount of obstruction acceptable when compared to the pilots' total helicopter experience; therefore, the distribution of total flying experience in helicopters has been included, and is given in Table III.

Pilots who had 50 hours more in all aircraft than their total hours in helicopters were considered to have both fixed-wing and helicopter experience. This definition is based on the fact that the minimum requirement for a private pilot's license is 40 hours' total flying time. The pilot distribution according to type of experience is indicated in Table IV. A further discussion of data where type of experience is a consideration is found under Question 7.

Question 3 - Pilot Experience - Specific.

Considerable use was made of a breakdown of answers based upon the type of helicopter considered. A distribution of pilots according to the type of helicopter most frequently used is contained in Table II. The preliminary analysis indicated that the experience in parts "b" and "c" of Question 3 had no influence on the remaining questionnaire data, therefore, this information is not presented here.

Question 4 - External Portions of Aircraft Visible from Cockpit.

The replies to this question show that 88 per cent of the pilots answering the questionnaire desire to see some external portion of the helicopter. These results are shown graphically in Fig. 6. Eighty-three per cent of the pilots wish to see the main rotor tips, 71 per cent of the pilots wish to see the main wheels or skids, and 20 per cent of the pilots wish to see the tail rotor. A relatively small number of pilots desire to see the main rotor head. This does not necessarily mean that this location is unimportant, when compared with the other two locations. The main rotor tips and main wheels or skids were listed in the questionnaire and merely needed a check mark to answer, whereas the other locations were suggested spontaneously by the pilots.

The fact that the particular model helicopter in which a pilot currently does most of his flying has a strong influence on the pilot's desire to see the wheels or skids is shown in Fig. 7. Pilots of H-21 and H-25 helicopters who cannot see the wheels readily are much less desirous of seeing this visual clue than pilots flying helicopters where the wheels are more easily seen.

Several other portions of the aircraft, including the tail wheel, running lights, position lights, passenger door, swash plate, litter pods, transmission, and the cooling fan, were specified by pilots under Question 4, but in each case, these represented less than one per cent of the pilots answering.

Question 5 - Maneuvers for Which Maximum Visibility is Required.

The data from this question are presented in Fig. 8. It can be seen that the pilots believe that the maneuver in which good visibility is most urgently required is landing in a confined area. The autorotation landing is their next choice, while hovering for rescue or similar ground work placed third in their preference.

Question 6 - Obstructions to Visibility.

The results of the replies to Question 6 are shown in Fig. 9, which gives the arithmetical mean of numerical ratings for each azimuthal segment specified in the question. It was assumed that the pilot was seated on the right side of the helicopter.

The mean values can vary from 1.00 to 3.00. If it is assumed that a mean value of 1.50 or less corresponds to Condition (1) on the rating scale, indicating a desire for no visual obstructions, then it may be concluded that the pilots desire to have clear vision over a range of azimuth angles extending from 30° left to 40° right. Similarly, if it is assumed that a mean rating value between 1.50 and 2.50 corresponds to Condition (2) on the rating scale, and a mean rating value greater than 2.50 corresponds to Condition (3) on the rating scale, then it may be concluded that the pilots desire no obstruction greater than 1 1/2 inches in projected width between the azimuth angles 30° left to 105° left and 40° right to 110° right, but will accept greater obstructions beyond these limits. The greater importance of visibility on the near side of the helicopter is apparent.

Question 7 - Downward Visibility.

This question was included as an additional means of securing data relating to downward cutoff angles. The pilots were requested to give the desired minimum horizontal distances along four directions of sight under two flight conditions, coming to a hover prior to landing and at the instant

of touchdown. The four directions of sight are shown in Fig. 10. The mean values of the distances in each direction, by helicopter of prime use, are contained in Table V, with a comparison of available and desired downward cutoff angles.

The results also are presented in Table VI, with relation to the type of flight experience recorded by the pilots. Pilots with only helicopter experience generally desired greater visibility than pilots with fixed-wing aircraft experience. The only answers of smaller mean values for fixed-wing aircraft experience were those of H-23 pilots. In this case, the sampling is subject to question, since only ten answers, or two per cent of the total response, were from H-23 pilots. A larger and more representative group of answers might not have supported this variation.

Question 8 - Evaluation of Specific Helicopter Being Flown by Pilot.

The distribution of responses to Question 8 by helicopter of prime use is shown in Table VII, expressed as a percentage of the total response for the group judging the particular aircraft. Since the pilots in the H-25 are seated to the left as opposed to the normal right-side seating for helicopters, the columns for response to the quality of visibility sideward are reversed in Table VII to reflect the normal near- and far-side comparison. As specified in the question, Class 1 signifies excellent visibility, Class 2 signifies adequate visibility, and Class 3 signifies inadequate visibility. There also is shown in Table VII the mean estimation value (M) for each helicopter and for each maneuver. This is the weighted mean value for the three numerical ratings. These mean values can vary from 1.00 to 3.00. A mean value of 2.00 would correspond to adequate visibility, and the amount of variation of the mean value from 2.00 corresponds to the degree of superiority or inferiority of visibility compared to adequate visibility.

None of the helicopters considered were rated inadequate in visibility on an average rating basis although visibility was rated more critically in connection with specific maneuvers.

The proximity of the pilot to the windshield in a given direction appears to be reflected in the pilots' ratings. For example, the H-25 helicopter has a smaller cutoff angle forward and up than the H-19, yet it is rated superior to the H-19 in this respect. The design of the windscreen apparently permits the pilot to increase materially the available visibility in the H-25 with acceptable head and body movement.

Question 9 - External References During Maneuvers.

Insufficient replies were received to Question 9 to warrant inclusion of these data.

Pilot Comment on Miscellaneous Visibility Problems.

A total of 56 pilot comments, received with the questionnaires, were of such a nature that they could not be included under any specific question. These comments dealt with specific visibility problems, and, in some instances, the pilots proposed correction. Some of these comments are presented below.

Fifteen H-34 pilots commented on poor visibility during formation flying. Through interviews with H-34 pilots, it was determined that they were concerned with the visibility obstruction caused by the magnetic compass during turns while flying echelon right formations.

Thirteen pilots mentioned visibility to the rear. Two of these pilots specifically recommended rear-view mirrors. During July 1957, H-34, H-19, and XH-40 helicopters were observed operating at Fort Rucker, Ala., with rear-view mirrors.

Three H-13 pilots and three H-21 pilots wanted the instrument console lowered. Two H-13 pilots recommended that the console be set at a 45° angle to reduce its height.

Two H-23 pilots noted a need for windshield wipers.

A need for improvement in defroster equipment also was noted.

GENERAL DISCUSSION

Visibility Forward and Downward.

Three questions, Nos. 4, 7, and 8, relate to visibility forward and downward from the helicopter.

In the discussion of Question 4, it was stated that the pilots consider good visibility is most urgently required for landing in a confined area. The maximum restriction for a confined area would require a vertical descent from a hover to accomplish a successful landing. It is therefore assumed that the helicopter would be in an essentially level attitude at the instant of touchdown.

In Fig. 11, the maximum mean rating for all conditions forward and downward in each helicopter, as determined by replies to Question 8 and shown in Table VII, has been plotted against the available visual angles below the horizon shown in Table I. A smooth curve has been drawn to represent the average value of these ratings. This curve crosses the adequate rating line discussed in Question 8 at a cutoff angle of 29°.

In Table V, where the actual visual angles forward and downward available from a level attitude at instant of touchdown were compared with the desired angles, the H-21, H-23, and H-34 helicopters were listed as having less than the desired downward vision. These same helicopters were rated inadequate in Fig. 11.

Visibility Forward and Upward.

In Fig. 12, the maximum mean rating for the visual cutoff angle forward and upward under various conditions has been plotted against the actual cutoff angle. Since all of these points fall far below the minimum adequate rating line, it is apparent that the pilots do not consider any of the helicopters listed as having a visual problem forward and upward. A smooth curve drawn through these points intersects the minimum adequate rating line at a cutoff angle of 26°.

Visibility in the Left Sector.

The visibility in the left sector was rated as a whole in the questionnaire rather than being separated into individual components. For this reason, it is not possible to make the direct comparison such as was made for visibility forward. The over-all rating for visibility to the left, however, has been plotted against the individual cutoff angles that comprise visibility in the left sector.

Figure 13 gives a comparison of the maximum mean rating for visibility to the left with the upward cutoff angle at 90° to the left. A smooth curve representing the average of these points crosses the minimum adequate rating line at a cutoff angle of 15°.

In the discussion of Question 4, it was pointed out that 71 per cent of the pilots wanted to see the main rotor tips. Table VIII lists the cutoff angle 90° to the left and upward that is required to the tip plane path at that point. These angles all are less than the 15° determined in Fig. 13. The 15° angle leaves some latitude in all the helicopters listed in Appendix I.

Table VIII was computed without considering the coning angle of the various helicopters. The pilot opinion expressed in replies to Question 4, however, places sufficient emphasis on seeing the rotor tips to warrant reevaluation of this angle to meet the specific need if the coning action of the blade makes it impossible to see the rotor tips.

Figure 14 shows a comparison of the maximum mean rating for visibility to the left with the downward cutoff angle 90° to the left for

various helicopters. A smooth curve representing the average of these points intersects the minimum adequate rating line at a point representing a cutoff angle of 29°.

In Fig. 15, the maximum mean ratings for visibility to the left are plotted against the azimuth cutoff angle to the left. It is apparent that the H-13 data are inconsistent with the other data. This rating may reflect the influence of the greater visibility available to the H-13 pilot a short distance above the horizontal reference plane used to measure these cutoff angles. If the H-13 data are disregarded, a straight line representing the average of the remaining points crosses the minimum adequate rating line at a point representing a visual cutoff angle of 90.5°.

Visibility in the Right Sector.

Figure 16 gives a comparison of the maximum mean ratings for visibility to the right with the upward cutoff angle 90° to the right. The distribution indicated by this graph varies so slightly from a common horizontal line that no conclusion can be made from these data concerning the minimum adequate cutoff angle.

If, however, this angle is designed to provide an adequate visibility area to comply with the pilots' stated desire to see the rotor tips, Table VIII can be used to determine this minimum adequate visual angle. If the coning action of the rotor blade is disregarded, the minimum adequate angle to satisfy this requirement is 15°. In three instances, however, this angle would permit no blade coning. This condition is unrealistic. To provide for an average coning angle of 5° to 7°,[3] the cutoff angle 90° to the right and upward should be 20°.

In Fig. 17, the ratings for visibility to the right are plotted against the downward visual cutoff angles to the right. Again, a curve has been used to represent the average of these points. This curve intersects the minimum adequate rating line at a point representing a cutoff angle of 40.5°.

The maximum mean ratings for visibility to the right have been plotted against the azimuth cutoff angle to the right in Fig. 18. A smooth curve representing the average of these points intersects the minimum adequate rating line at a point representing an azimuth cutoff angle of 100°.

[3] Raymond A. Young, "Helicopter Engineering," The Ronald Press Company, New York, N. Y., 1949, p. 177.

Combined Vision Requirements.

The conclusions that have been drawn from the pilot estimates made in answering the different questions concerning visibility from the cockpit along various directions of sight have been combined into one general and coordinated set of requirements in Fig. 19. This windscreen outline should be acceptable throughout the range of cockpit measurements listed in Table I, with the possible exception of the H-37. Helicopters of this larger size were not in general use at the time the questionnaire was distributed; therefore, sufficient data are not available to permit reliable predictions concerning the applicability of this windscreen outline to helicopters of this and larger sizes.

The vertical post arrangements presented in Fig. 19 have been translated from the reference planes of Fig. 9 to those of Fig. 19 based on the cockpit measurements listed there. The data in Fig. 9 are applicable throughout the range of cockpit measurements presented in Table I because they have been derived independently from the cockpit measurements.

The data presented here are based on the requirements of the several helicopters. Obvious differences in flight characteristics are shown in Appendix II. Helicopters with such a wide variation in flight characteristics will have varying visual requirements however slight these differences might be. To provide one universal solution, the extreme case has been considered in each instance.

CONCLUSIONS

1. The data secured from the 535 questionnaires completed by helicopter pilots are reasonably consistent. In general, very little difference exists between pilots having different amounts of experience. More disagreement on general problems is found between pilots flying different models of helicopters. This difference of opinion probably is associated with visibility and operating characteristics of the helicopter to which the pilot is accustomed.

2. Visibility in a forward and downward direction, which is critical during all landing maneuvers, is adequate if it extends 29° below the horizon.

3. Visibility in a forward and upward direction is critical during maximum performance takeoffs and, to a lesser extent, in other takeoff maneuvers. Visibility in this area is adequate if it extends 26° above the horizon.

4. Visibility to the side is the most critical during confined area operations. To be rated adequate, visibility to the left must be provided through an azimuth angle of 92°. The azimuth angle to the right should be 100°.

Visibility upward at 90° to the left should extend 15° above the horizontal, whereas visibility at 90° to the right should extend 20° above the horizontal.

Visibility downward at 90° to the left should extend 30° below the horizontal, and visibility downward at 90° to the right should extend 40° below the horizontal.

5. A majority of pilots desire to see the rotor tips and the main wheels or skids. They want to see the rotor tips with moderate head and eye movement but are almost evenly divided concerning the amount of movement required to see the wheels or skids.

6. The requirements illustrated in Fig. 19 are not considered in any sense a final answer to the helicopter cockpit visibility problem. The questionnaire method of investigation has basic weaknesses which lead to lack of precision and need for arbitrary interpretation. This method cannot reveal basic principles which are necessary for complete understanding of the visual cues unconsciously used by the pilot in the performance of various maneuvers. It is believed that the results of the questionnaire, however, have strong provisional validity, and, in particular, that a helicopter cockpit windscreen outline, in agreement with that presented in Fig. 19, would be classified by the average pilot as providing satisfactory visibility from the cockpit.

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TABLE I

GENERAL DATA RELATING TO HELICOPTERS

Helicopter	H-13	H-19	Wide Console H-21	Narrow Console H-21	H-23C
Normal Pilot Seating	Right	Right	Right	Right	Center
Total Visibility (steridians)	8.1	4.9	5.5	5 8	7.4
Per Cent of Total Steridians	65	39	44	46	59
Monocular Visibility, in Steridians	1.0	1.3	1.7	1 9	1.1
Binocular Visibility, in Steridians	7.2	3.6	3.8	3.9	6.3
Up and Forward Visibility Cutoff Angle, in Degrees	158	70	85	82	113
Down and Forward Visibility Cutoff Angle, in Degrees	50	21	16	42	20
Left-Side Azimuth Cutoff Angle, in Degrees	85	91[1]	107	80	83[1]
Right-Side Azimuth Cutoff Angle, in Degrees	151	172	136	141	128
Left Upper Vision Cutoff Angle at 90°	Unlimited*4		31	31	Unlimited
Left Lower Vision Cutoff Angle at 90°	37*	28*	30*	25*	42*
Right Upper Vision Cutoff Angle at 90°	Unlimited	22	51	61	Unlimited*
Right Lower Vision Cutoff Angle at 90°	66	69	77	72	47
Pilot Eye Level Above Ground in Inches	62.5	122.25	115.5	115.5	60.75
Pilot Eye Distance to Windscreen at 90° Left in Inches	8	15	20	20	25.5
Pilot Eye Distance to Windscreen at 0° in Inches	42.5	25.5	25.5	25.5	39.75
Pilot Eye Distance to Windscreen at 90° Right in Inches	38	42	52.5	52.5	85.5

TABLE I (continued)

GENERAL DATA RELATING TO HELICOPTERS

Helicopter	H-25	H-31	H-34	H-37	XH-40	HOK-1
Normal Pilot Seating	Left	Right	Right	Right	Right	Right
Total Visibility (steridians)	3.7	5.5	5.5	5.0	4.9	5.7
Per Cent of Total Steridians	30	44	44	40	39	45
Monocular Visibility, in Steridians	0.9	1.6	1.6	1 2	1 3	1.6
Binocular Visibility, in Steridians	2.8	3.9	3.9	3.8	3.6	4.1
Up and Forward Visibility Cutoff Angle, in Degrees	38	88	70	126	35	43
Down and Forward Visibility Cutoff Angle, in Degrees	43	42	24	17	55	55
Left-Side Azimuth Cutoff Angle, in Degrees	130	87	112	123	125	136
Right-Side Azimuth Cutoff Angle, in Degrees	84[3]	98	148	162	113	162
Left Upper Vision Cutoff Angle at 90°	38	112	20	16[1]	22	32
Left Lower Vision Cutoff Angle at 90°	58*	30*	33*	20*	22*	26*
Right Upper Vision Cutoff Angle at 90°	9	42	1	3.4	22	42
Right Lower Vision Cutoff Angle at 90°	24	66	70	51	58	60
Pilot Eye Level Above Ground in Inches	72.25	94	130 5	135 5	--	--
Pilot Eye Distance to Windscreen at 90° Left in Inches	43 5	13.5	15 25	21 25	--	--
Pilot Eye Distance to Windscreen at 0° in Inches	41 75	39.75	20.5	24	--	--
Pilot Eye Distance to Windscreen at 90° Right in Inches	14.5	40.5	48.25	67 25	--	--

TABLE I (continued)

GENERAL DATA RELATING TO HELICOPTERS

Helicopter	HRS-3	CH-1
Normal Pilot Seating	Right	Right
Total Visibility (steridians)	4.3	5 8
Per Cent of Total Steridians	34	46
Monocular Visibility, in Steridians	1.1	1 4
Binocular Visibility, in Steridians	3 2	4.4
Up and Forward Visibility Cutoff Angle, in Degrees	60	53
Down and Forward Visibility Cutoff Angle, in Degrees	27	21
Left-Side Azimuth Cutoff Angle, in Degrees	88[3]	80
Right-Side Azimuth Cutoff Angle, in Degrees	180	269[2]
Left Upper Vision Cutoff Angle at 90°	1	8**
Left Lower Vision Cutoff Angle at 90°	30*	25*
Right Upper Vision Cutoff Angle at 90°	9	54
Right Lower Vision Cutoff Angle at 90°	69	77
Pilot Eye Level Above Ground in Inches	--	--
Pilot Eye Distance to Windscreen at 90° Left in Inches	--	--
Pilot Eye Distance to Windscreen at 0° in Inches	--	--
Pilot Eye Distance to Windscreen at 90° Right in Inches	--	--

Note Any obstruction 10° in width or greater is considered the visual limit.
1 - Vision obstructed between 10° and 6° above horizontal plane.
2 - Copilot is not included.
3 - Copilot is considered an obstruction
* - 90° obstruction by copilot. Angle measured to lower window edge immediately in front of copilot or copilot's legs.
** - Angle measured to front of rotor shaft.

TABLE II

DISTRIBUTION OF PILOTS PARTICIPATING IN THE QUESTIONNAIRE STUDY ACCORDING TO THE TYPE OF HELICOPTER MOST FREQUENTLY USED

Type of Helicopter	No. of Pilots
Not Specified	6
H - 13	171
H - 19	48
H - 21	65
H - 23	87
H - 25	11
H - 31	1
H - 34	143
H - 37	3

TABLE III

DISTRIBUTION OF RETURNED QUESTIONNAIRES
COMPARED WITH TOTAL HELICOPTER EXPERIENCE

Helicopter Hours	No. of Pilots
Not Specified	5
0 to 299	154
300 to 499	131
500 to 999	148
1000 to 1999	72
2000 to 2999	14
3000 to 4999	5

TABLE IV

PILOTS ANSWERING THE QUESTIONNAIRE
GROUPED ACCORDING TO TYPE OF EXPERIENCE

Type of Experience	No. of Pilots
Not Specified	6
Helicopter Experience Only	158
Helicopter and Fixed-Wing Experience	365

TABLE V

A COMPARISON OF DESIRED VISUAL CUTOFF ANGLES WITH AVAILABLE CUTOFF ANGLES

Maneuver	Direction of Sight	Minimum Desired Ground Distance (feet)				Cutoff Angle Downward (degrees)							
						Desired				Available			
		A	B	C	D								
Coming to a Hover	H-13	24	22	16	22	Extremely variable.				The same as below.			
	H-19	23	22	17	19								
	H-21	34	20	17	17								
	H-23	17	12	14	17								
	H-25	56	30	23	30								
	H-34	19	18	11	15								
	Direction of Sight	A	B	C	D	A	B	C	D	A	B	C	D
During Landing at Instant of Touchdown	H-13	15	14	10	13	18	19	25	19	50	37	66	55
	H-19	20	20	16	18	21	22	24	22	32	34	83	58
	H-21	19	15	13	17	24	28	30	25	16*	30	77	65
	H-23	11	8	9	11	27	36	32	27	20*	42	47	47
	H-25	12	13	14	13	27	25	23	25	43	38	9*	33
	H-34	15	14	9	11	38	33	47	47	24*	33	70	52

* Available downward angle less than desired.

Note. Directions of sight are shown in Fig. 10.

TABLE VI

A COMPARISON OF
DESIRED VISIBLE GROUND DISTANCES
BY TYPE OF EXPERIENCE

Direction of Sight	H-13		H-19		H-21		H-23		H-25[2]		H-34	
	Helicopter Only	Both	Helicopter Only	Both	Helicopter Only	Both	Helicopter Only	Both	Helicopter Only	Both	Helicopter Only	Both
Direction of Sight	Maneuver - When Coming to a Hover											
A	14	27	14	30	19	46	58	15	--	56	19	18
B	14	24	13	28	15	22	21	11	--	30	18	17
C	10	19	6	24	14	19	23	13	--	23	12	10
D	14	25	8	26	15	19	22	16	--	30	13	18
Direction of Sight	Maneuver - During Landing at Instant of Touchdown											
A	12	16	12	26	17	22	24	10	--	12	15	14
B	10	15	12	25	12	18	15	7	--	13	13	17
C	8	11	5	23	10	17	16	8	--	14	8	10
D	11	15	7	25	12	21	22	10	--	13	11	10

Note: 1. Type of aircraft flown - helicopter only or helicopter and fixed-wing aircraft.

2. H-25 pilots participating in this study had fixed-wing experience, therefore, no comparison was possible.

3. Directions of sight are shown in Fig. 10.

TABLE VII

EVALUATION OF VISIBILITY
AS PROVIDED BY SPECIFIC HELICOPTERS

Visibility Upward to Front

	H-13				H-19				H-23			
	1	2	3	M	1	2	3	M	1	2	3	M
Takeoff Run	97	2	1	1.04	65	33	2	1.38	84	13	3	1.19
Straight Climb	98	2	0	1.02	63	31	6	1.44	88	11	1	1.14
Cruise	98	1	1	1.02	75	21	4	1.29	89	9	2	1.13
Level Turns	97	2	1	1.04	63	33	4	1.42	84	14	2	1.17
Final Approach	98	2	0	1.02	79	19	2	1.23	75	17	8	1.33
Hover	98	1	1	1.03	75	23	2	1.27	88	10	2	1.37
Landing	96	3	1	1.04	81	17	1	1.21	84	8	8	1.23
Autorotation Glide	99	1	0	1.01	79	19	2	1.22	84	11	5	1.20
Autorotation Landing	98	1	1	1.02	77	23	0	1.23	75	16	9	1.34
Maximum Performance Takeoff	95	5	0	1.03	61	17	12	1.51	83	14	3	1.20
Landing in a Confined Area	98	1	1	1.03	73	25	2	1.29	72	15	13	1.41
Average	97	2	1	1.03	72	24	4	1.32	82	13	5	1.31

Note: In terms of the percentage of pilots who rated in each of three categories.

1 - Excellent

2 - Adequate

3 - Inadequate

Evaluation (M) is a weighted average of categories 1, 2, and 3

TABLE VII (continued)

EVALUATION OF VISIBILITY
AS PROVIDED BY SPECIFIC HELICOPTERS

Visibility Upward to Front

	H-23				H-25				H-34			
	1	2	3	M	1	2	3	M	1	2	3	M
Takeoff Run	80	17	3	1.22	91	9	0	1.09	82	15	3	1.20
Straight Climb	81	18	1	1.21	91	9	0	1.09	80	18	2	1.23
Cruise	78	21	1	1.24	91	9	0	1.09	82	16	2	1.19
Level Turns	84	16	0	1.16	80	20	0	1.20	74	23	3	1.30
Final Approach	79	21	0	1.21	82	18	0	1.18	80	20	0	1.20
Hover	81	17	2	1.20	91	9	0	1.09	84	15	1	1 18
Landing	81	19	0	1.19	91	9	0	1.09	87	13	0	1.13
Autorotation Glide	85	15	0	1.20	91	9	0	1.09	85	13	2	1.18
Autorotation Landing	83	17	0	1.17	91	9	0	1.09	84	15	1	1.18
Maximum Performance T keoff	80	17	3	1.22	73	18	9	1.36	74	19	7	1.33
Landing in a Confined Area	83	17	0	1.17	100	0	0	1.00	82	15	3	1.21
Average	81	18	1	1.20	88	11	1	1.12	81	17	2	1.21

TABLE VII (continued)

EVALUATION OF VISIBILITY
AS PROVIDED BY SPECIFIC HELICOPTERS

Visibility Downward to Front

	H-13				H-19				H-21			
	1	2	3	M	1	2	3	M	1	2	3	M
Takeoff Run	87	13	-	1.13	52	42	6	1.54	41	25	34	1.95
Straight Climb	90	9	1	1 11	58	38	4	1.46	49	28	23	1.74
Cruise	94	6	0	1.07	71	25	4	1.33	52	31	17	1.65
Level Turns	91	8	1	1.09	60	35	5	1.44	54	29	17	1.63
Final Approach	76	21	2	1.28	38	44	18	1.81	17	25	58	2.42
Hover	85	14	1	1.16	50	33	17	1.67	37	35	28	1.91
Landing	82	17	1	1.18	31	50	19	1.88	31	20	49	2 17
Autorotation Glide	78	21	1	1.22	44	43	13	1.72	34	23	43	2.09
Autorotation Landing	77	20	3	1.26	23	38	39	2 17	17	23	60	1.83
Maximum Performance Takeoff	91	9	0	1.09	58	33	9	1.50	50	25	25	1.73
Landing in a Confined Area	71	23	6	1.36	73	25	2	1.29	72	15	13	1.41
Average	84	15	1	1.19	51	37	12	1.62	41	25	33	1.87

TABLE VII (continued)

EVALUATION OF VISIBILITY
AS PROVIDED BY SPECIFIC HELICOPTERS

Visibility Downward to Front

	H-23				H-25				H-34			
	1	2	3	M	1	2	3	M	1	2	3	M
Takeoff Run	33	49	18	1.85	91	9	0	1.09	63	34	3	1.47
Straight Climb	40	52	8	1.68	91	9	0	1.09	65	32	3	1.37
Cruise	49	44	7	1.58	91	9	0	1.09	73	26	1	1.27
Level Turns	52	41	7	1 55	90	10	0	1.10	69	30	1	1.32
Final Approach	22	33	45	2 21	73	27	0	1.27	40	51	9	1.69
Hover	29	51	20	1.92	100	0	0	1.00	48	42	10	1.63
Landing	20	50	30	2.10	100	0	0	1.00	39	46	15	1.61
Autorotation Glide	27	46	27	2.00	91	9	0	1.09	54	37	9	1.55
Autorotation Landing	14	44	42	2.28	82	18	0	1.18	27	45	28	1.23
Maximum Performance Takeoff	41	45	14	1.70	91	0	9	1.18	61	33	6	1.47
Landing in a Confined Area	20	32	48	2.27	82	18	0	1.18	32	44	24	1.91
Average	32	44	24	1.92	89	9	1	1.12	52	38	10	1 65

TABLE VII (continued)

EVALUATION OF VISIBILITY
AS PROVIDED BY SPECIFIC HELICOPTERS

Visibility in Left Sector*

	H-13				H-19				H-21			
	1	2	3	M	1	2	3	M	1	2	3	M
Takeoff Run	94	6	0	1.06	46	48	6	1.60	69	25	6	1.38
Straight Climb	96	3	1	1.05	46	50	4	1 58	75	19	6	1.31
Cruise	96	4	0	1.04	54	44	2	1.48	70	25	5	1.34
Level Turns	88	10	2	1.14	29	50	21	1.92	59	33	8	1.48
Final Approach	95	5	0	1.05	44	48	8	1.65	58	38	4	1.52
Hover	90	9	1	1.10	42	46	12	1.71	63	30	7	1.45
Landing	96	3	1	1.05	42	42	16	1.75	63	25	12	1 42
Autorotation Glide	95	4	1	1.06	44	42	14	1.71	59	39	2	1.42
Autorotation Landing	94	5	1	1.06	27	44	29	2.02	58	36	6	1.48
Maximum Performance Takeoff	94	5	1	1.06	46	48	6	1.60	69	30	1	1.33
Landing in a Confined Area	87	11	2	1.15	29	38	33	2 04	47	41	12	1.66
Average	93	6	1	1.08	41	45	13	1.73	63	31	6	1.44

*Evaluations apply to visibility requirements in both the horizontal and vertical directions.

TABLE VII (continued)

EVALUATION OF VISIBILITY
AS PROVIDED BY SPECIFIC HELICOPTERS

Visibility in Left Sector

	H-23				H-25				H-34			
	1	2	3	M	1	2	3	M	1	2	3	M
Takeoff Run	59	36	5	1.46	18	64	18	2.00	54	42	4	1.51
Straight Climb	79	21	0	1.21	36	55	9	1 73	51	42	7	1.55
Cruise	82	18	0	1.18	82	18	0	1.18	59	35	6	1.47
Level Turns	56	34	10	1.53	20	70	10	1.90	37	43	20	1.52
Final Approach	73	26	1	1.28	36	55	9	1.73	53	41	6	1 54
Hover	73	24	3	1.31	36	64	0	1 64	45	47	8	1.62
Landing	75	22	3	1.27	36	64	0	1.64	50	43	7	1 57
Autorotation Glide	72	28	0	1.29	36	56	8	1.72	48	44	8	1.60
Autorotation Landing	40	35	25	1.85	36	0	64	2.24	40	48	12	1.70
Maximum Performance Takeoff	76	23	1	1 25	46	54	0	1.55	48	46	6	1.58
Landing in a Confined Area	41	34	25	1.27	18	55	27	2.09	34	45	21	1.87
Average	66	27	7	1.50	36	50	14	1.77	47	43	10	1.59

TABLE VII (continued)

EVALUATION OF VISIBILITY
AS PROVIDED BY SPECIFIC HELICOPTERS

Visibility in Right Sector

	H-13				H-19				H-21			
	1	2	3	M	1	2	3	M	1	2	3	M
Takeoff Run	64	31	5	1.41	79	17	4	1.29	95	5	0	1.05
Straight Climb	68	29	3	1.35	81	15	4	1.19	95	5	0	1.05
Cruise	72	24	4	1.31	90	10	0	1.10	95	5	0	1.05
Level Turns	54	35	11	1.53	71	27	2	1.31	89	11	0	1.11
Final Approach	62	34	4	1.34	81	19	0	1.19	86	13	1	1.21
Hover	57	35	8	1.58	79	21	0	1.21	91	8	1	1.11
Landing	66	28	6	1.39	79	21	0	1 21	91	9	0	1.09
Autorotation Glide	61	33	6	1.46	85	13	2	1.17	92	6	2	1.09
Autorotation Landing	60	33	7	1.47	79	19	2	1.23	88	9	3	1.10
Maximum Performance Takeoff	61	35	4	1.44	92	8	0	1.08	92	8	0	1.08
Landing in a Confined Area	46	40	14	1.67	77	23	0	1.23	80	14	6	1 27
Average	61	32	7	1.45	81	18	1	1.20	90	9	1	1.11

TABLE VII (continued)

EVALUATION OF VISIBILITY
AS PROVIDED BY SPECIFIC HELICOPTERS

Visibility in Right Sector

	H-23				H-25				H-34			
	1	2	3	M	1	2	3	M	1	2	3	M
Takeoff Run	68	31	1	1.33	73	17	0	1.27	85	13	2	1.18
Straight Climb	49	44	7	1.58	82	18	0	1.18	82	17	1	1.18
Cruise	76	21	3	1.26	82	18	0	1.18	59	35	6	1.47
Level Turns	53	36	11	1 58	40	50	10	1.70	73	23	4	1.31
Final Approach	72	26	2	1.31	82	18	0	1.18	84	15	1	1.17
Hover	69	27	4	1.34	82	18	0	1.18	84	14	2	1.16
Landing	73	25	2	1.17	91	9	0	1.09	85	14	1	1.17
Autorotation Glide	73	24	3	1 30	91	9	0	1.09	85	13	2	1.16
Autorotation Landing	71	25	4	1.34	91	9	0	1.09	84	14	2	1.18
Maximum Performance Takeoff	75	23	2	1.27	91	9	0	1 09	87	13	0	1.14
Landing in a Confined Area	62	27	11	1.48	73	27	0	1.27	78	15	5	1.29
Average	67	28	5	1.36	80	18	2	1.21	81	17	2	1.22

TABLE VIII

A COMPARISON OF AVAILABLE AND NECESSARY VISION CUTOFF ANGLES SIDEWARD AND UPWARD TO SEE THE MAIN OR FRONT ROTOR TIPS

Helicopter	Required Angle (deg.)	Available Angle (deg.)	Required Angle (deg.)	Available Angle (deg.)
	Near Side*		Far Side*	
H-13	14.8	Unlimited	12.9	Unlimited
H-19	4.9	24 4	4.4	7.8
H-21	14.2	51.3	12.6	28.8
H-23	14.0	81.1	14.0	81.1
H-25	9.3	9.8	10.1	34.1
H-34	8.8	1.0	8.0	19.8

* Due to side-by-side seating arrangement where applicable

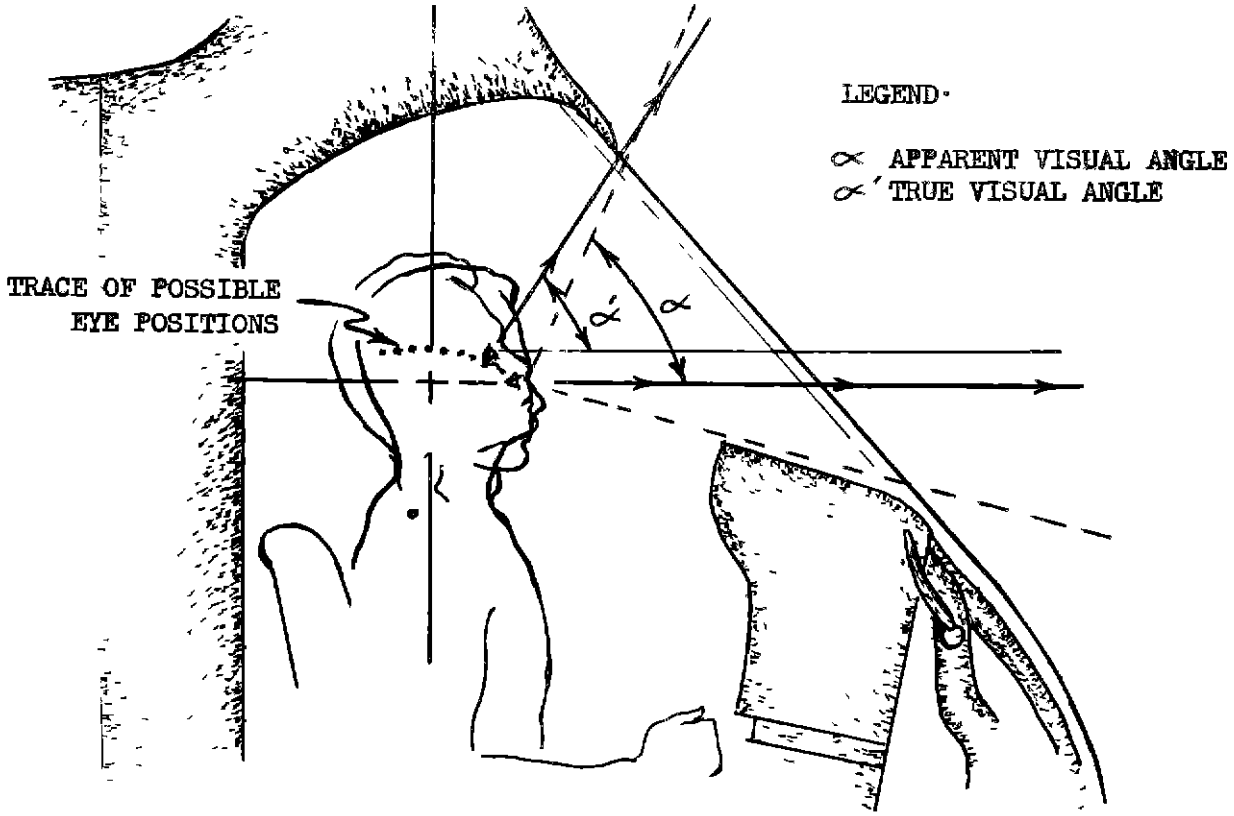


FIG. 1 EFFECT OF HEAD ELEVATION ON ANGULAR VISIBILITY LIMITS

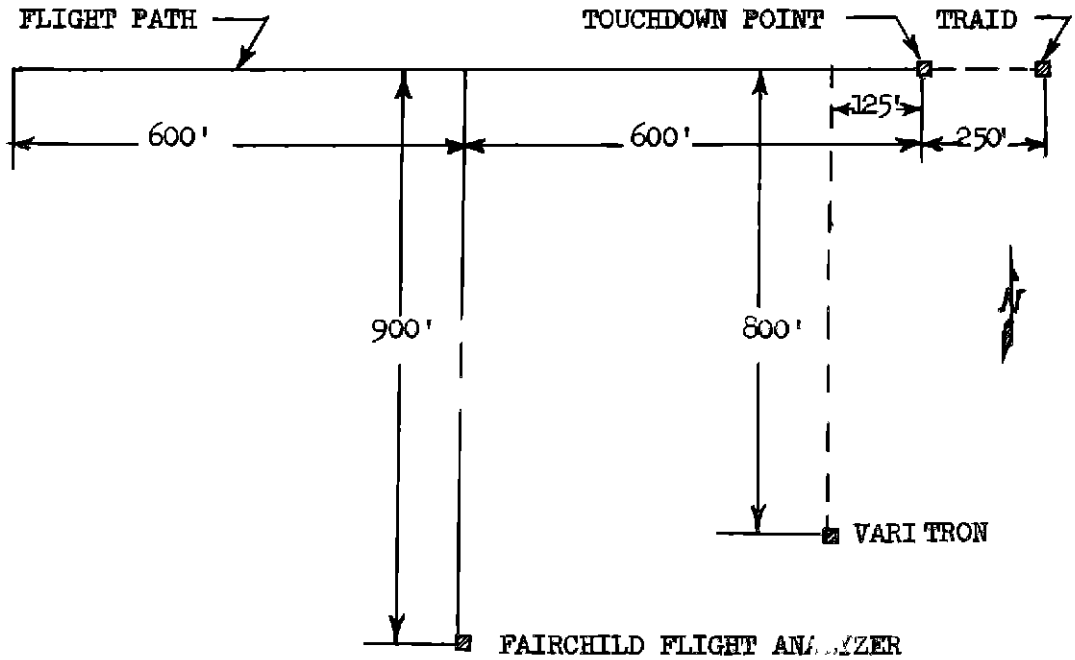


FIG. 2 CAMERA ARRANGEMENT FOR FLIGHT PATH PHOTOGRAPHS

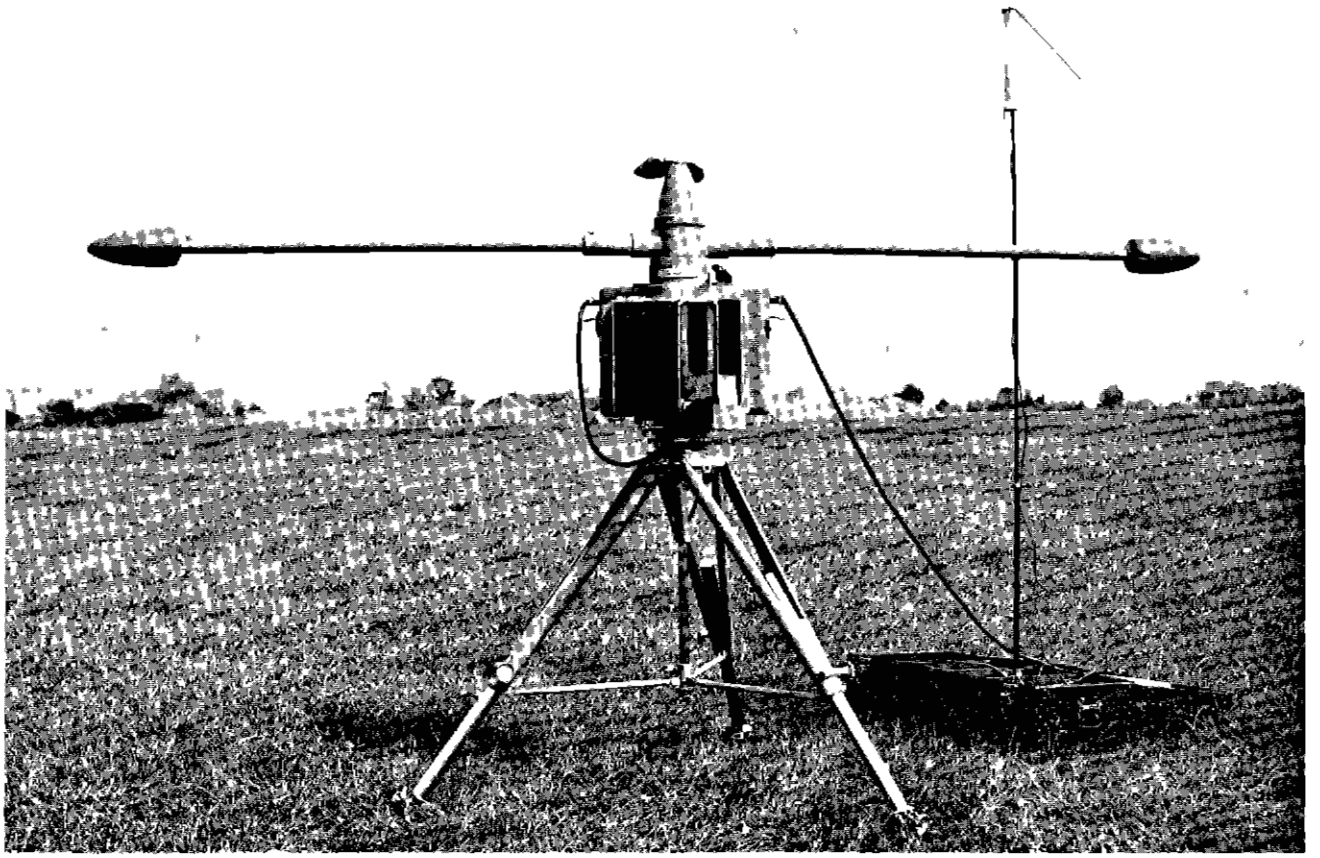


FIG. 3A THE FAIRCHILD FLIGHT ANALYZER

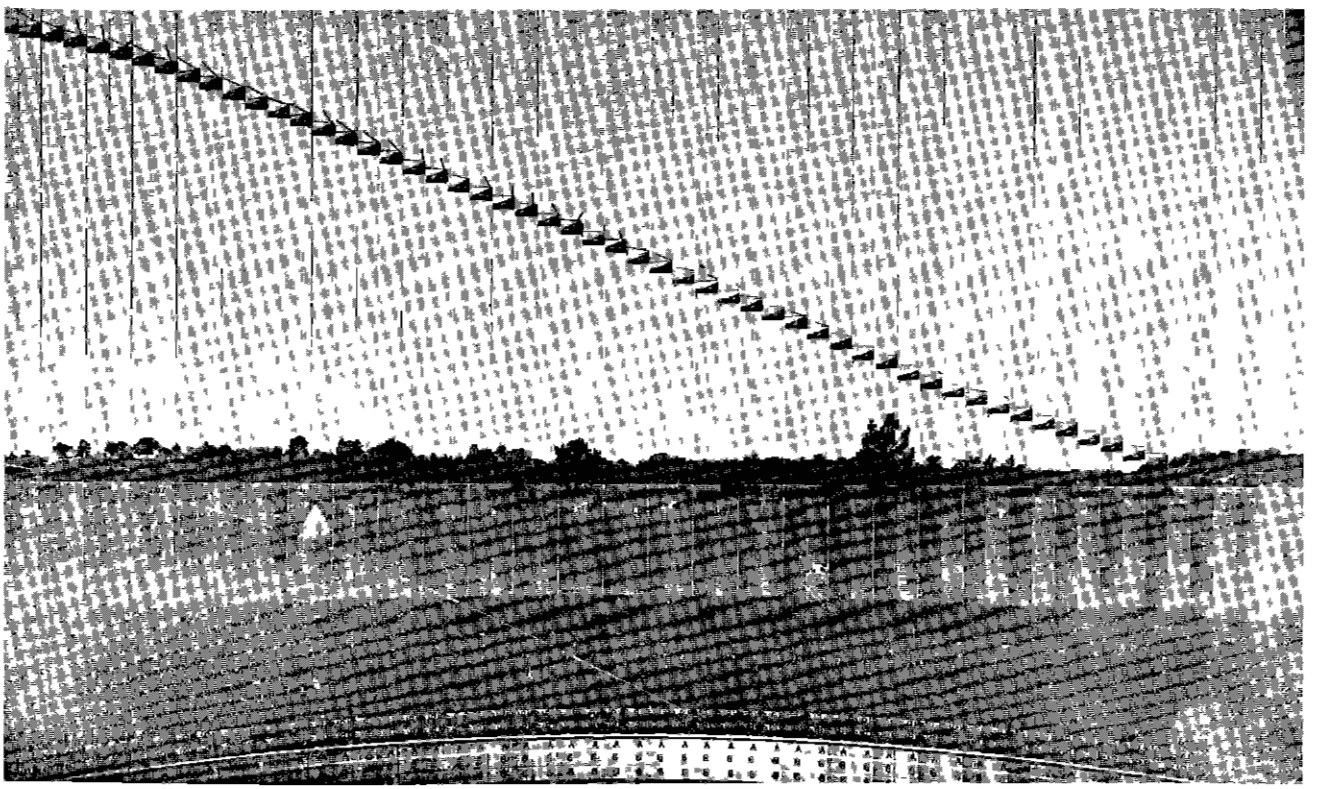


FIG. 3B TYPICAL FLIGHT PATH RECORDED WITH FAIRCHILD FLIGHT ANALYZER

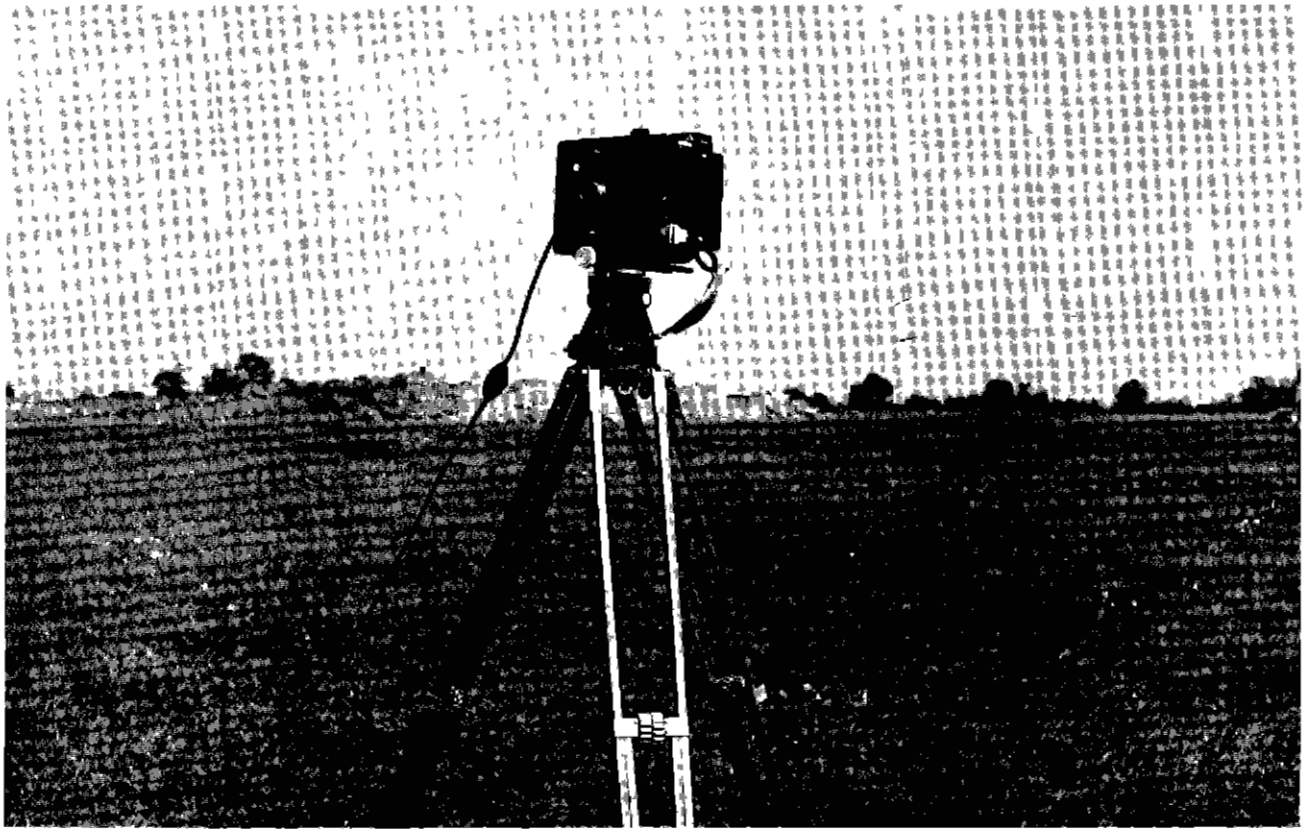


FIG 4A THE VARITRON CAMERA

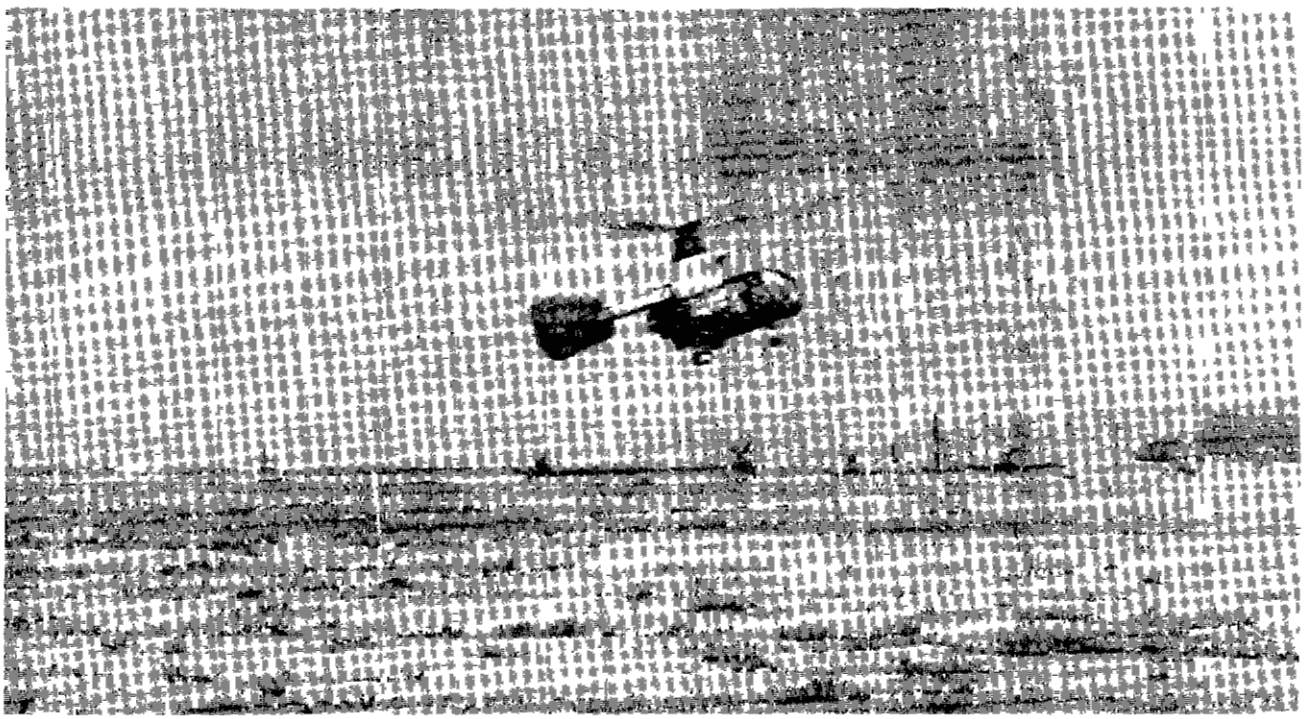


FIG. 4B TYPICAL PICTURE RECORDED WITH VARITRON CAMERA

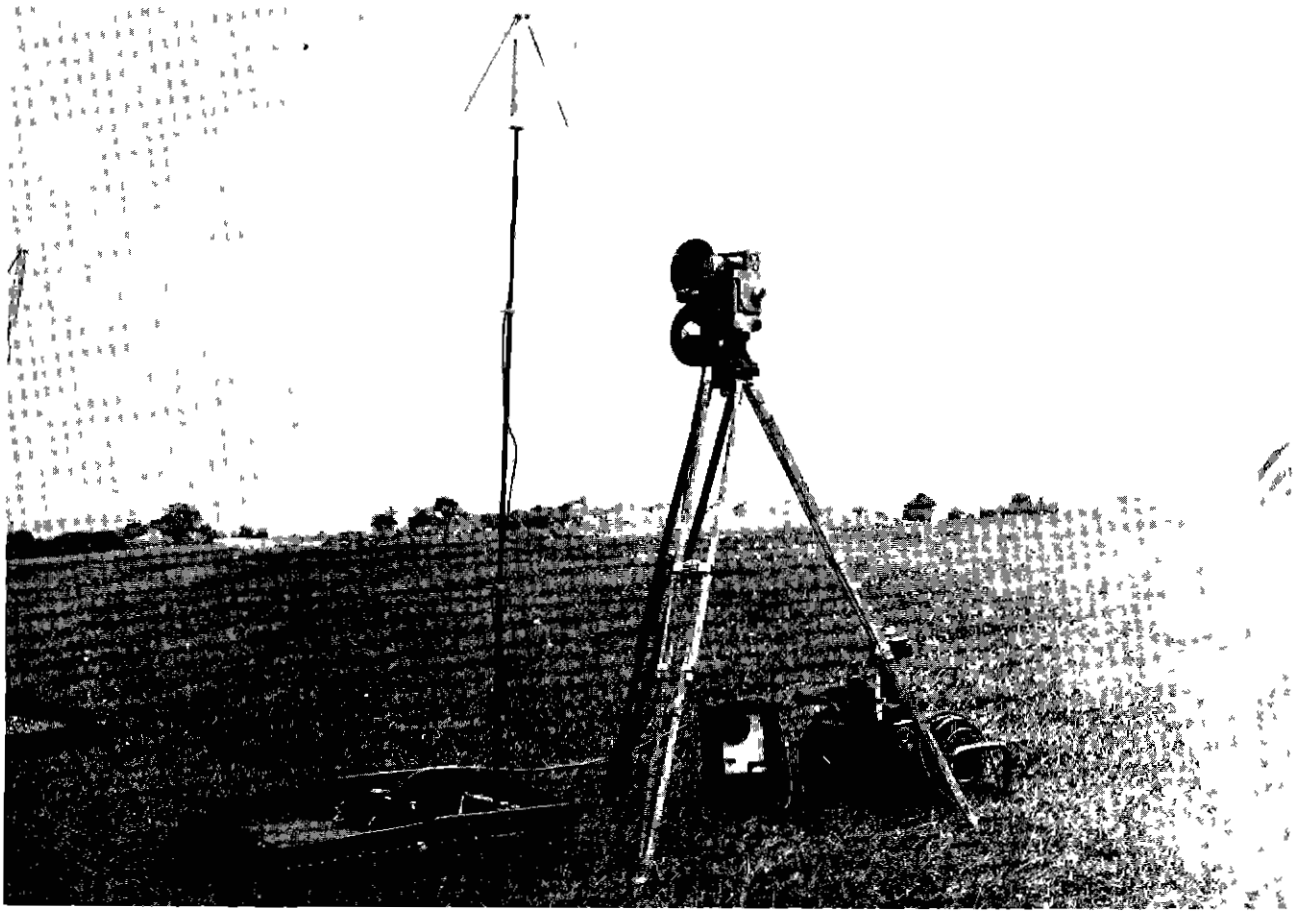


FIG. 5A THE TRAID CAMERA

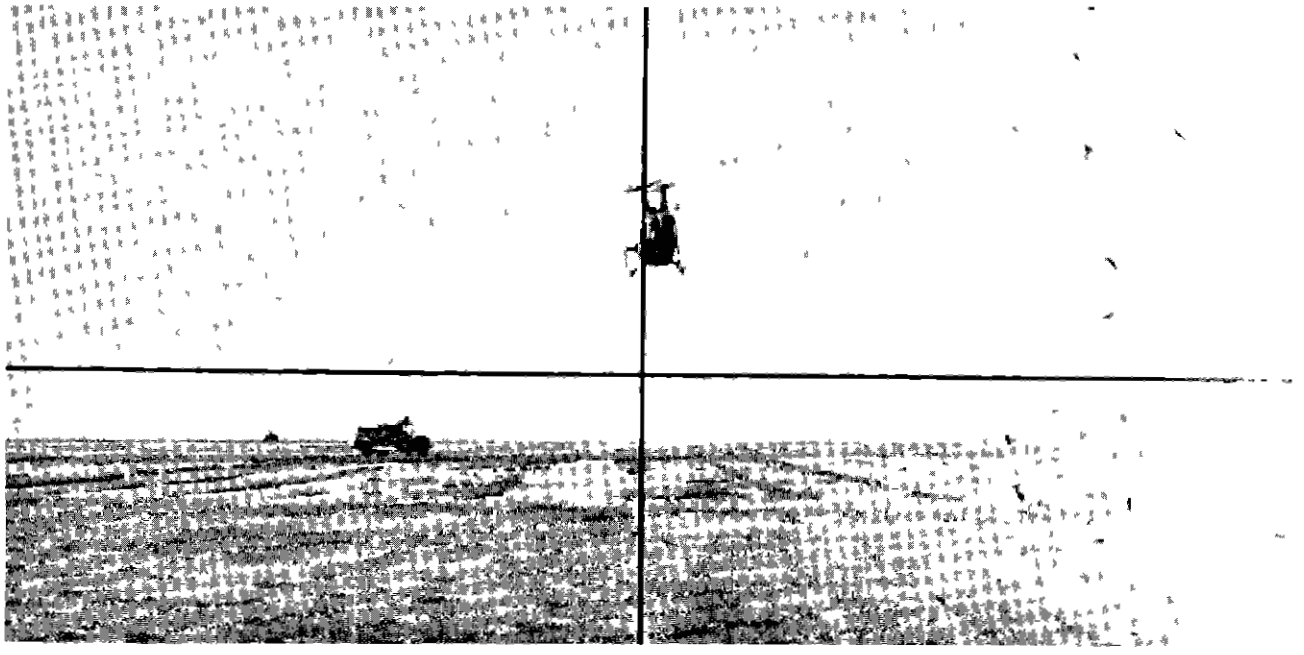


FIG 5B TYPICAL PICTURE TAKEN WITH TRAID CAMERA

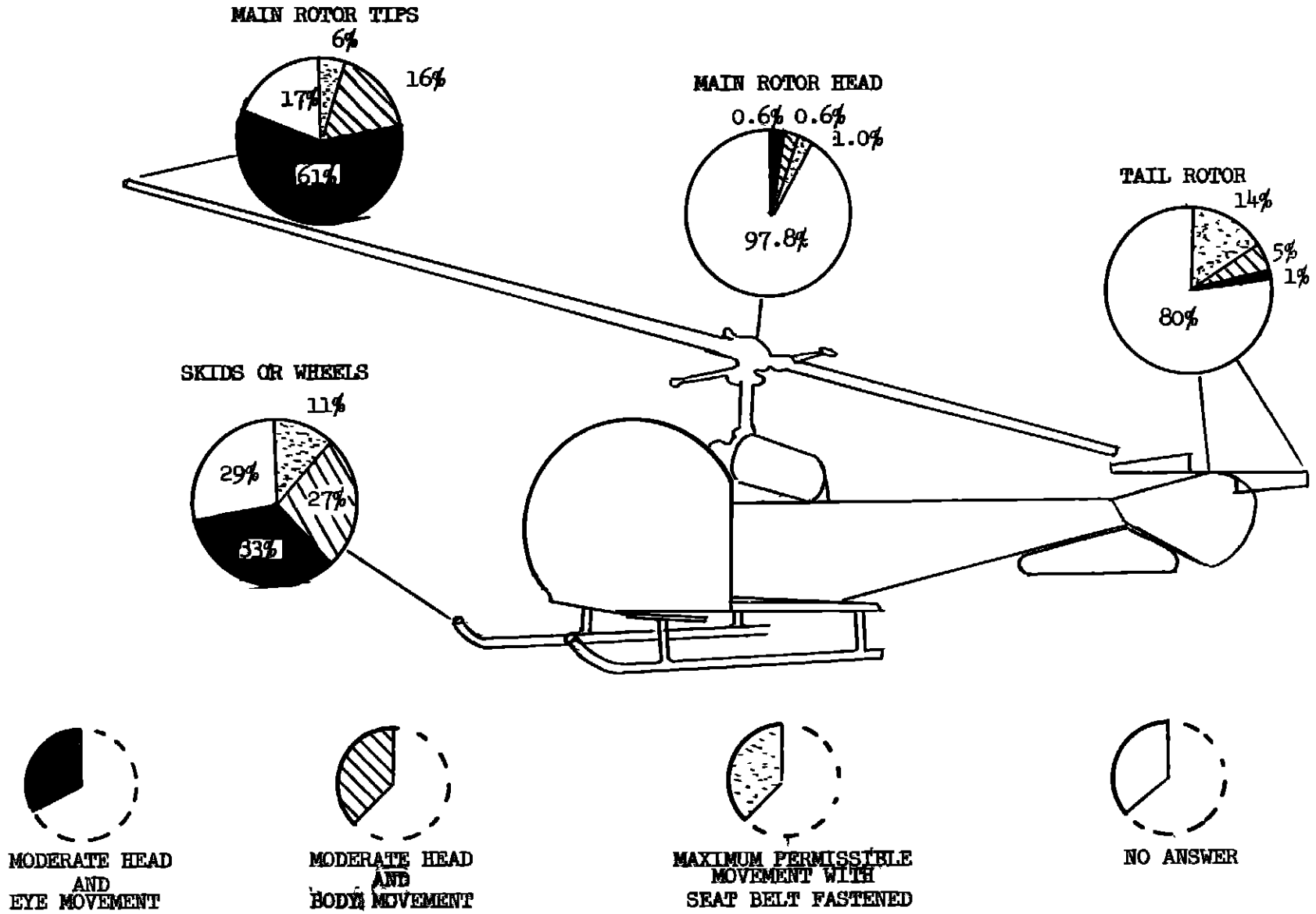


FIG. 6 PERCENTAGE OF PILOTS DESIRING TO SEE EXTERNAL PORTIONS OF THE HELICOPTER

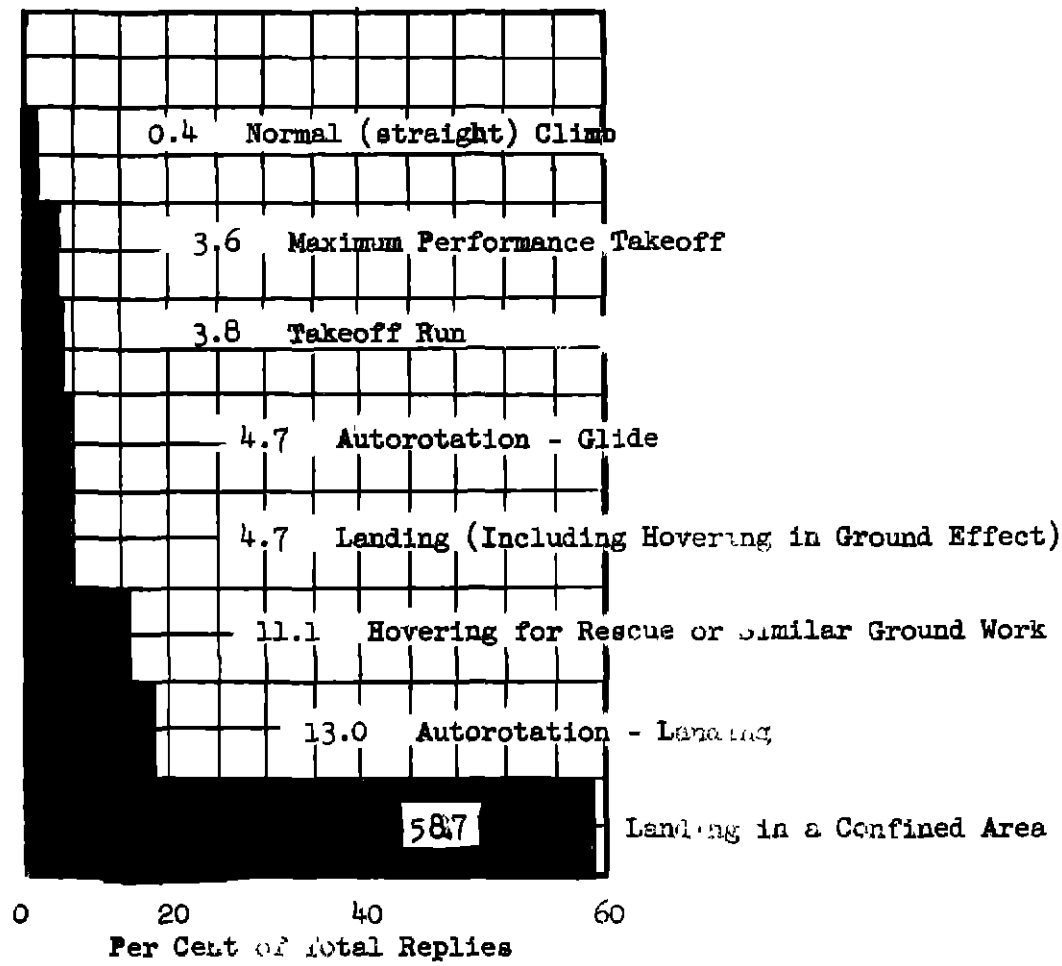


FIG. 8 RELATIVE IMPORTANCE OF VISIBILITY DURING COMMON MANEUVERS SHOWN IN PERCENTAGE OF TOTAL REPLIES

ESTIMATION RATING SCALE·

1. NO OBSTRUCTION PERMISSIBLE
2. MINOR OBSTRUCTION PERMISSIBLE $\leq$ 1 1/2" WIDE
3. MORE OBSTRUCTION PERMISSIBLE $>$ 1 1/2" WIDE

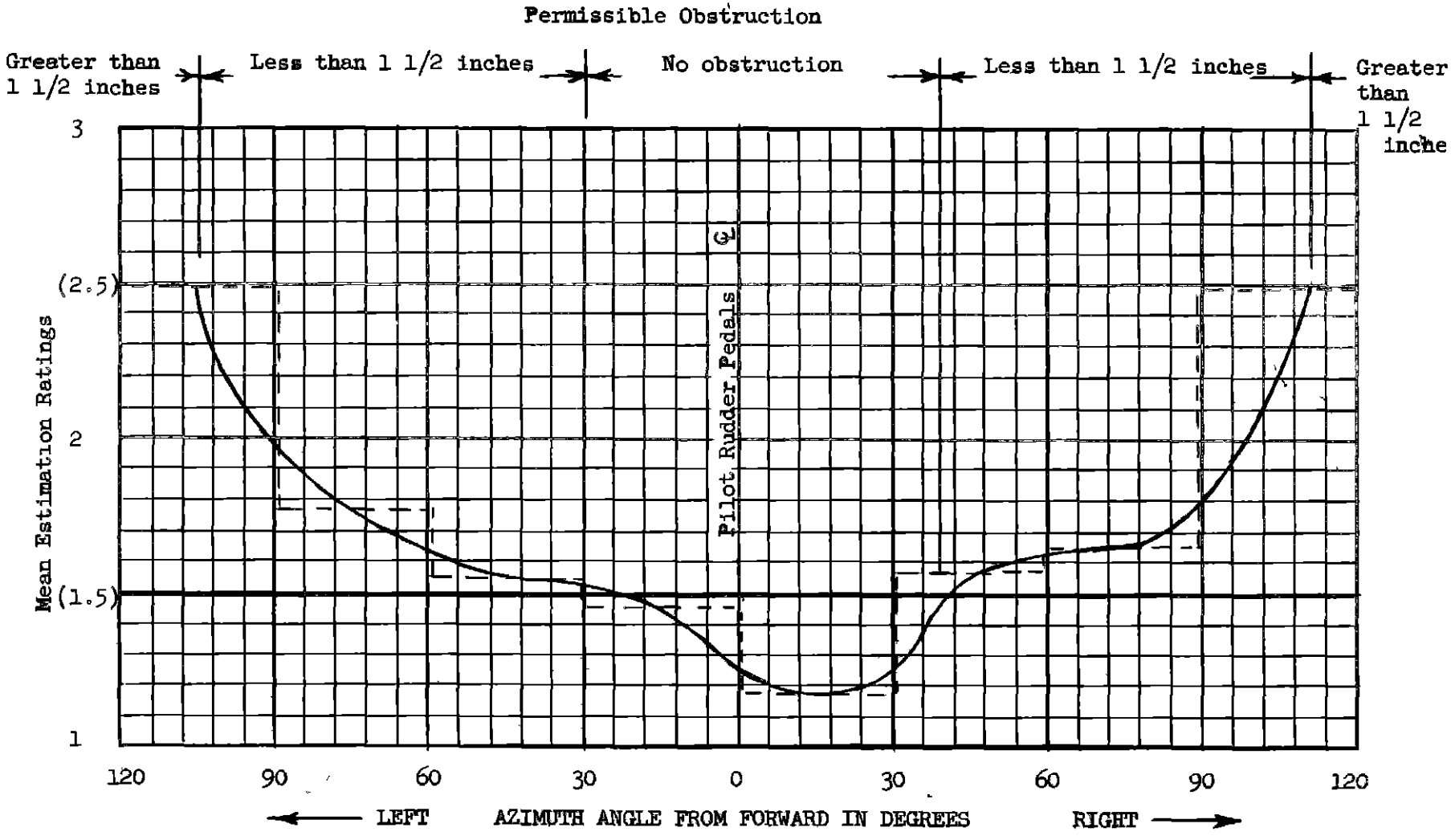
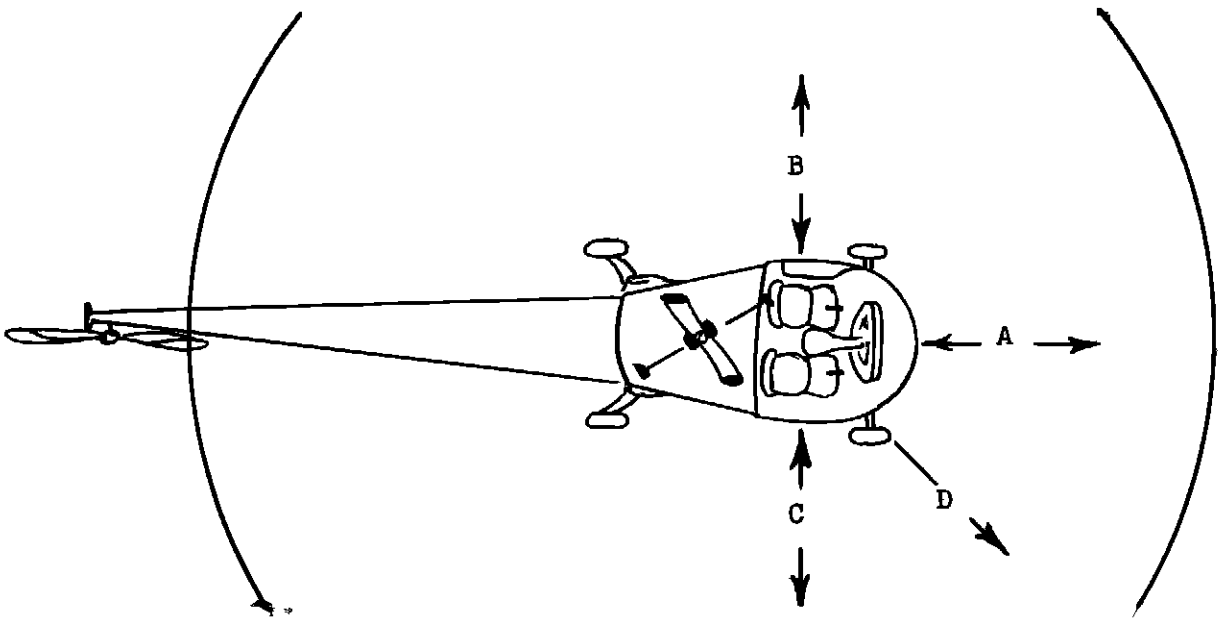


FIG. 9 VARIATION OF MEAN ESTIMATION VALUES OF OBSTRUCTION RATINGS WITH AZIMUTH ANGLE



NOTE THIS IS A PLAN VIEW OF A HELICOPTER. DISTANCES ARE TO BE GROUND (OR HORIZONTAL) DISTANCES.

NOTE: IF THE HELICOPTER YOU ARE CONSIDERING HAS THE NORMAL PILOT'S SEAT ON THE LEFT, CONSIDER DIMENSION D AS BEING BETWEEN A AND B.

NOTE. DISTANCE "C" IS CONSIDERED AS THE EXTERNAL DISTANCE IMMEDIATELY ADJACENT TO THE PILOT AND ALL QUESTIONNAIRES WERE INTERPRETED IN THIS MANNER CAUSING "B" AND "C" TO BE TRANSPOSED FOR PILOTS SEATED LEFT.

FIG. 10 LINES OF SIGHT FOR QUESTION 7

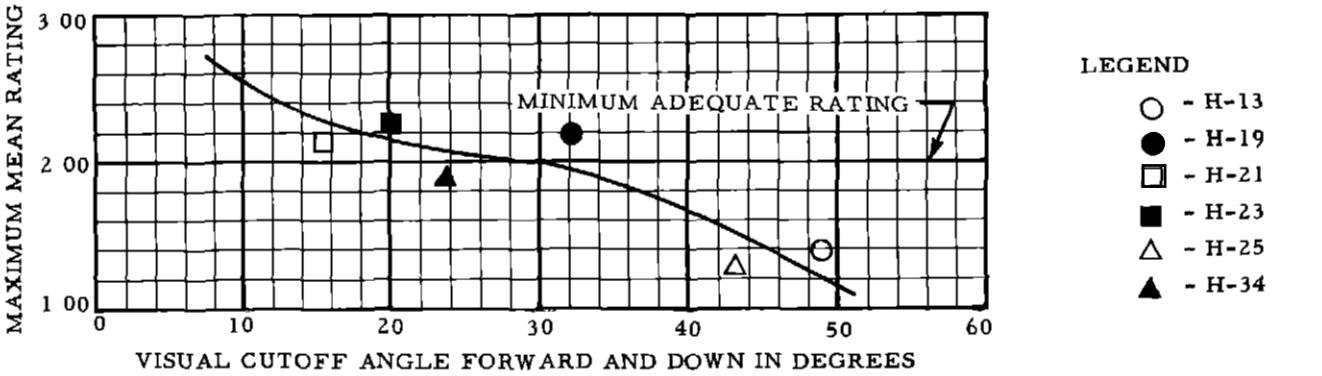


FIG 11 A COMPARISON OF THE MAXIMUM MEAN RATINGS (TABLE VII) FOR VISIBILITY FORWARD AND DOWN WITH THE VISUAL CUTOFF ANGLE FORWARD AND DOWN (TABLE I)

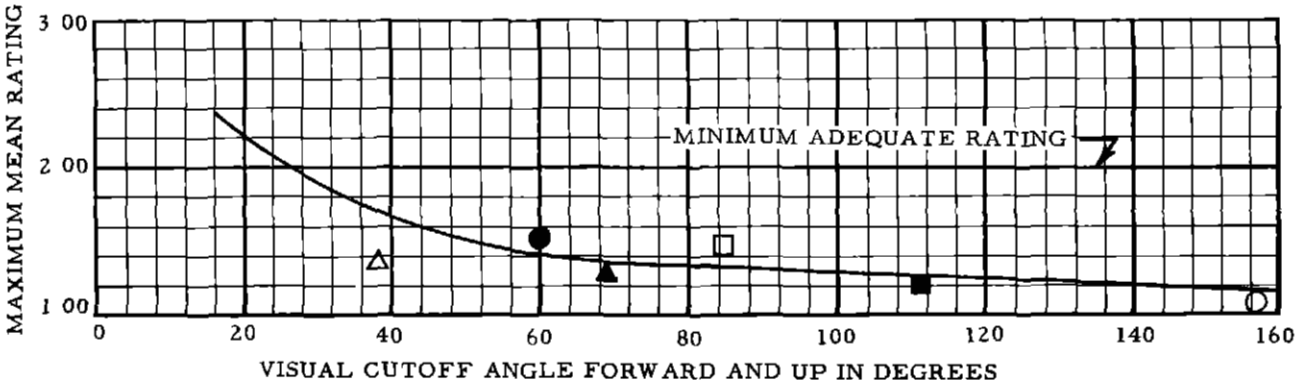


FIG 12 A COMPARISON OF THE MAXIMUM MEAN RATINGS (TABLE VII) FOR VISIBILITY FORWARD AND UP WITH THE VISUAL CUTOFF ANGLE FORWARD AND UP

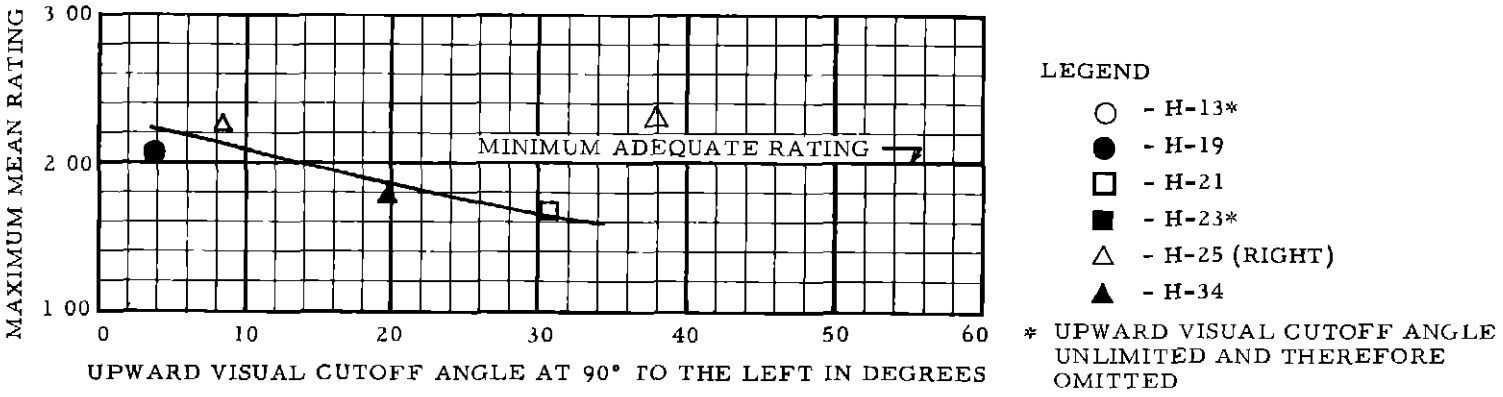


FIG 13 A COMPARISON OF THE MAXIMUM MEAN RATING FOR VISIBILITY TO THE LEFT WITH THE UPWARD CUTOFF ANGLE AT 90° TO THE LEFT

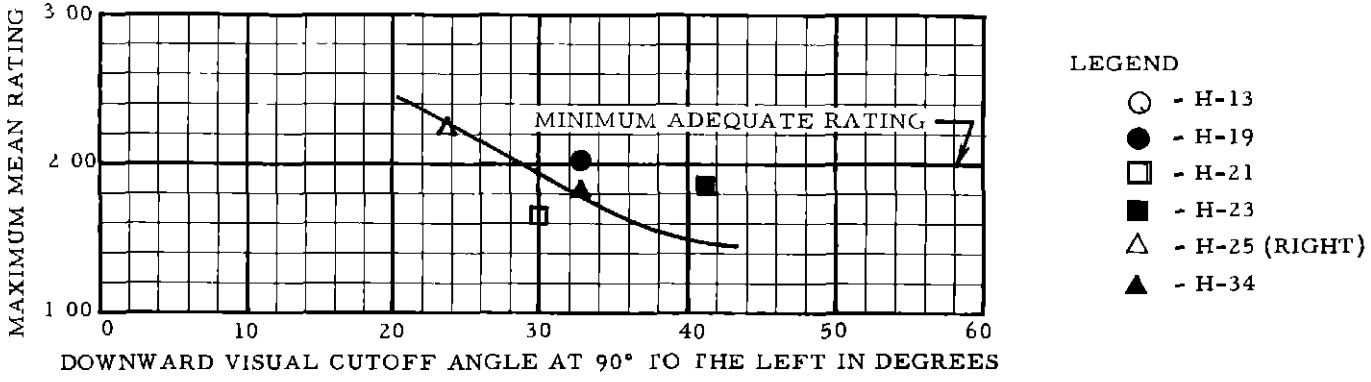


FIG 14 A COMPARISON OF THE MAXIMUM MEAN RATING FOR VISIBILITY TO THE LEFT WITH THE DOWNWARD VISUAL CUTOFF ANGLE AT 90° TO THE LEFT

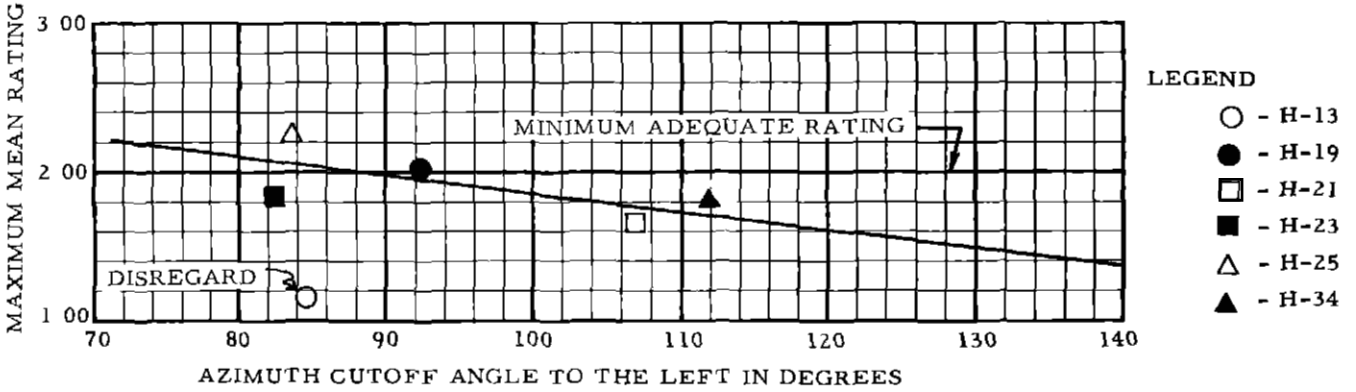


FIG 15 A COMPARISON OF THE MAXIMUM MEAN RATING FOR VISIBILITY TO THE LEFT WITH THE AZIMUTH CUTOFF ANGLE TO THE LEFT

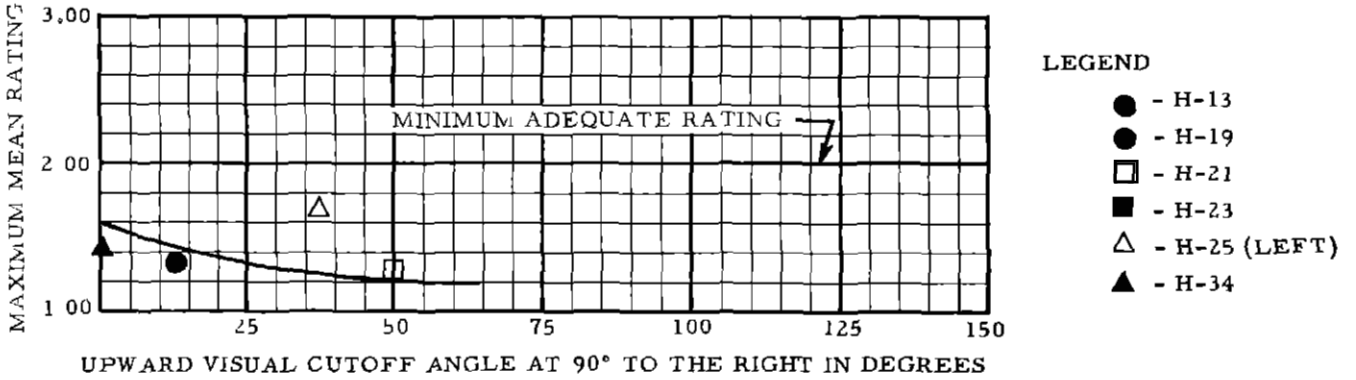


FIG 16 A COMPARISON OF THE MAXIMUM MEAN RATING FOR VISIBILITY TO THE RIGHT WITH THE UPWARD CUTOFF ANGLE AT 90° TO THE RIGHT

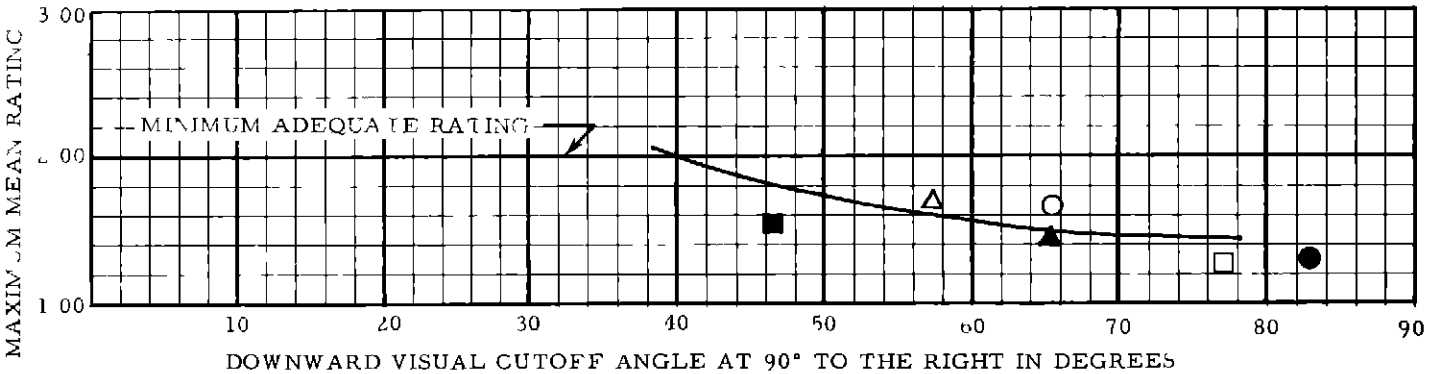


FIG 17 A COMPARISON OF THE MAXIMUM MEAN RATING FOR VISIBILITY TO THE RIGHT WITH THE DOWNWARD CUTOFF 90° TO THE RIGHT

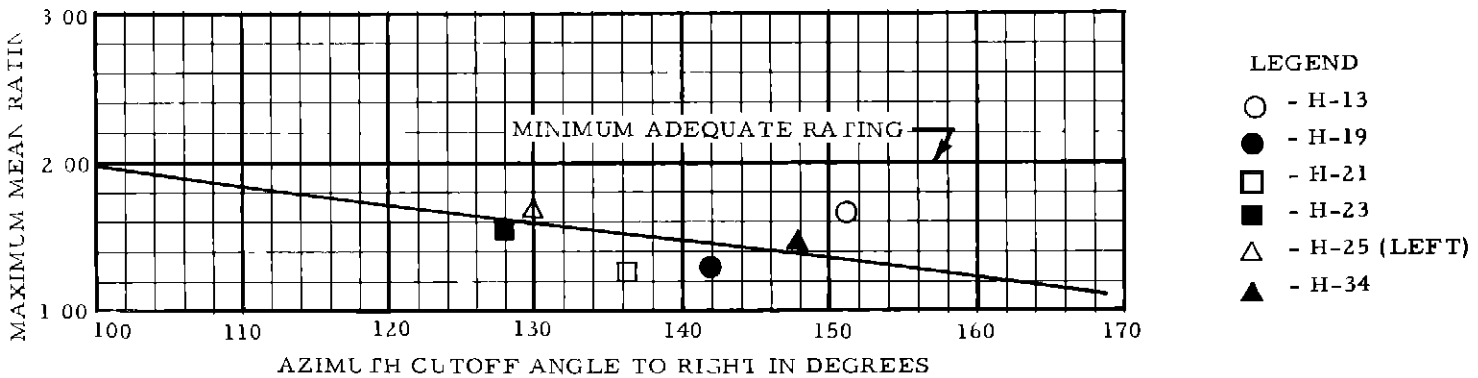


FIG 18 A COMPARISON OF THE MAXIMUM MEAN RATING FOR VISIBILITY TO THE RIGHT WITH THE AZIMUTH CUTOFF ANGLE TO THE RIGHT

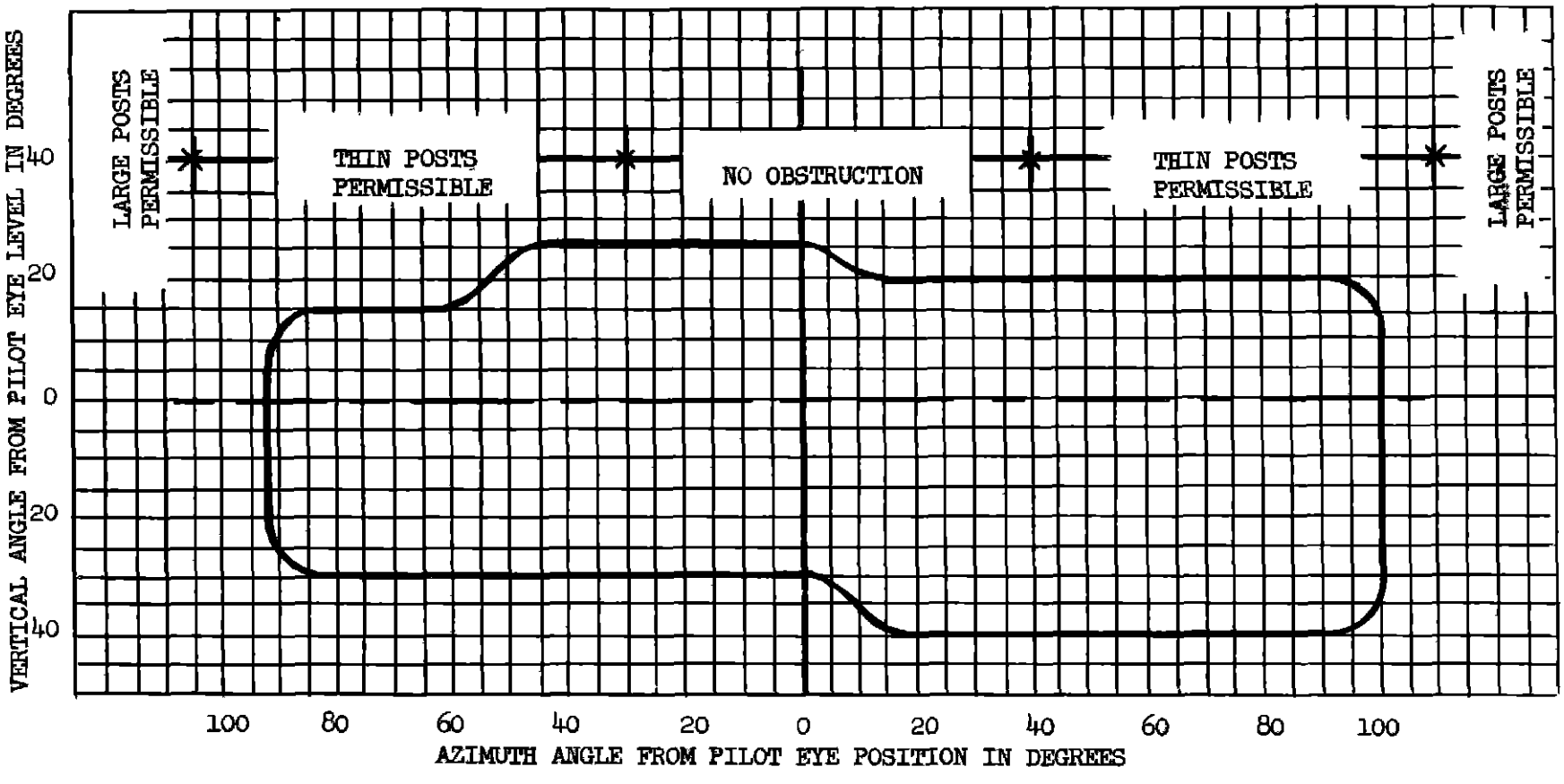


FIG. 19 RECOMMENDED HELICOPTER MINIMUM WINDSCREEN OUTLINE AS DETERMINED FROM PILOT QUESTIONNAIRE STUDY

APPENDIX I

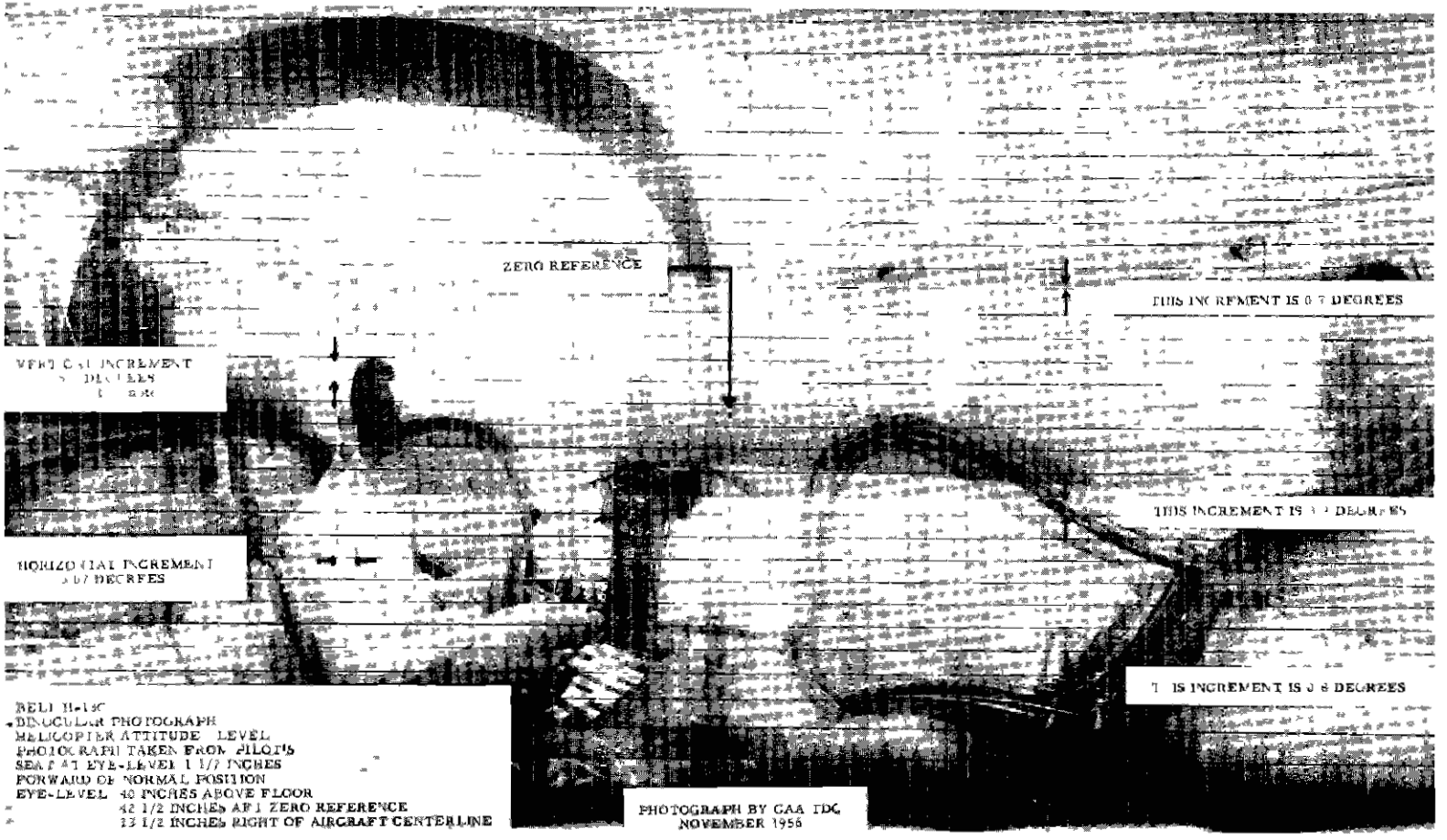


FIG 20 BELL H-13G BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

FIG 21 BELL H-13G FRONT VIEW

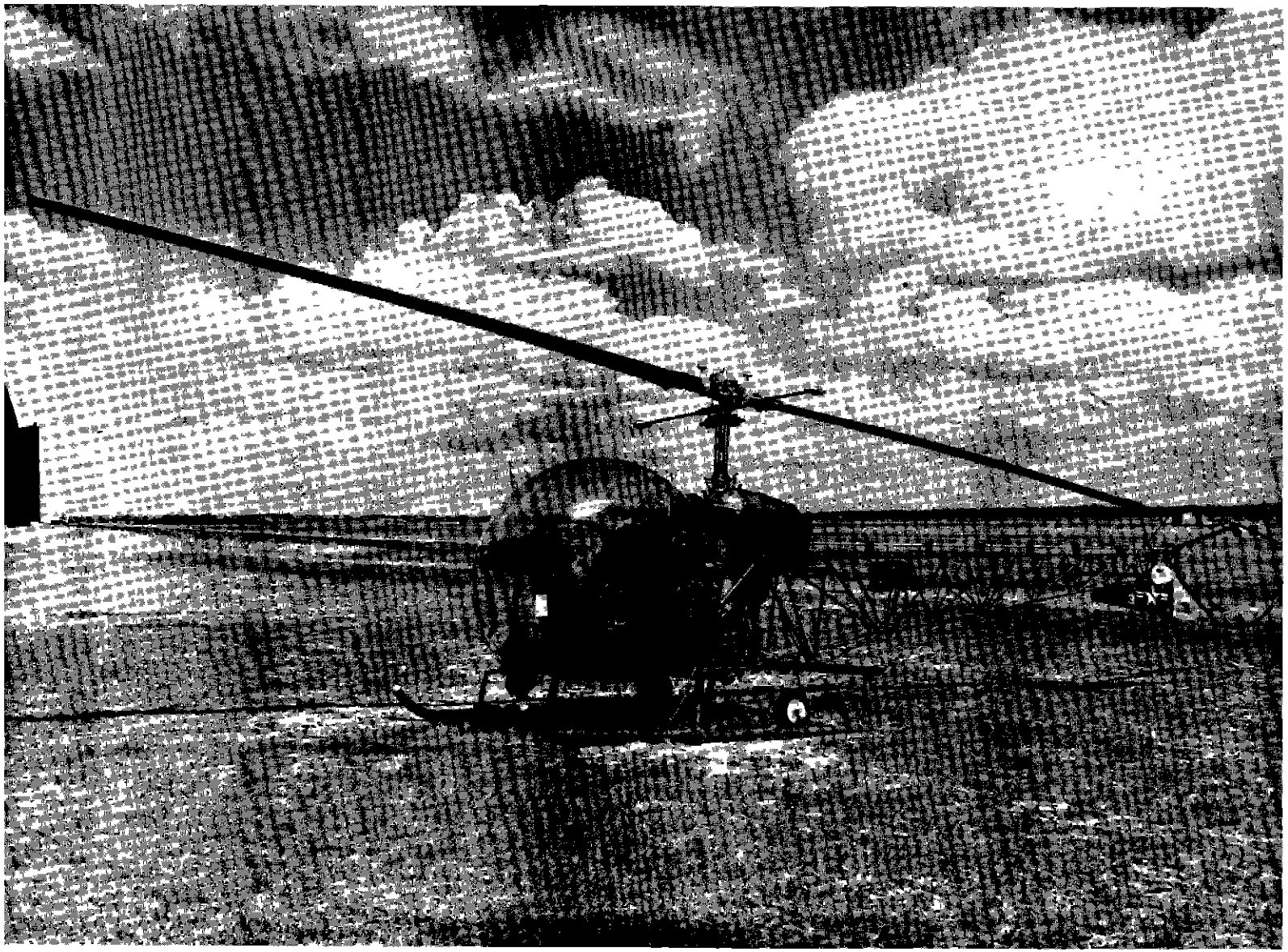


FIG 22 BELL H-13G SIDE VIEW

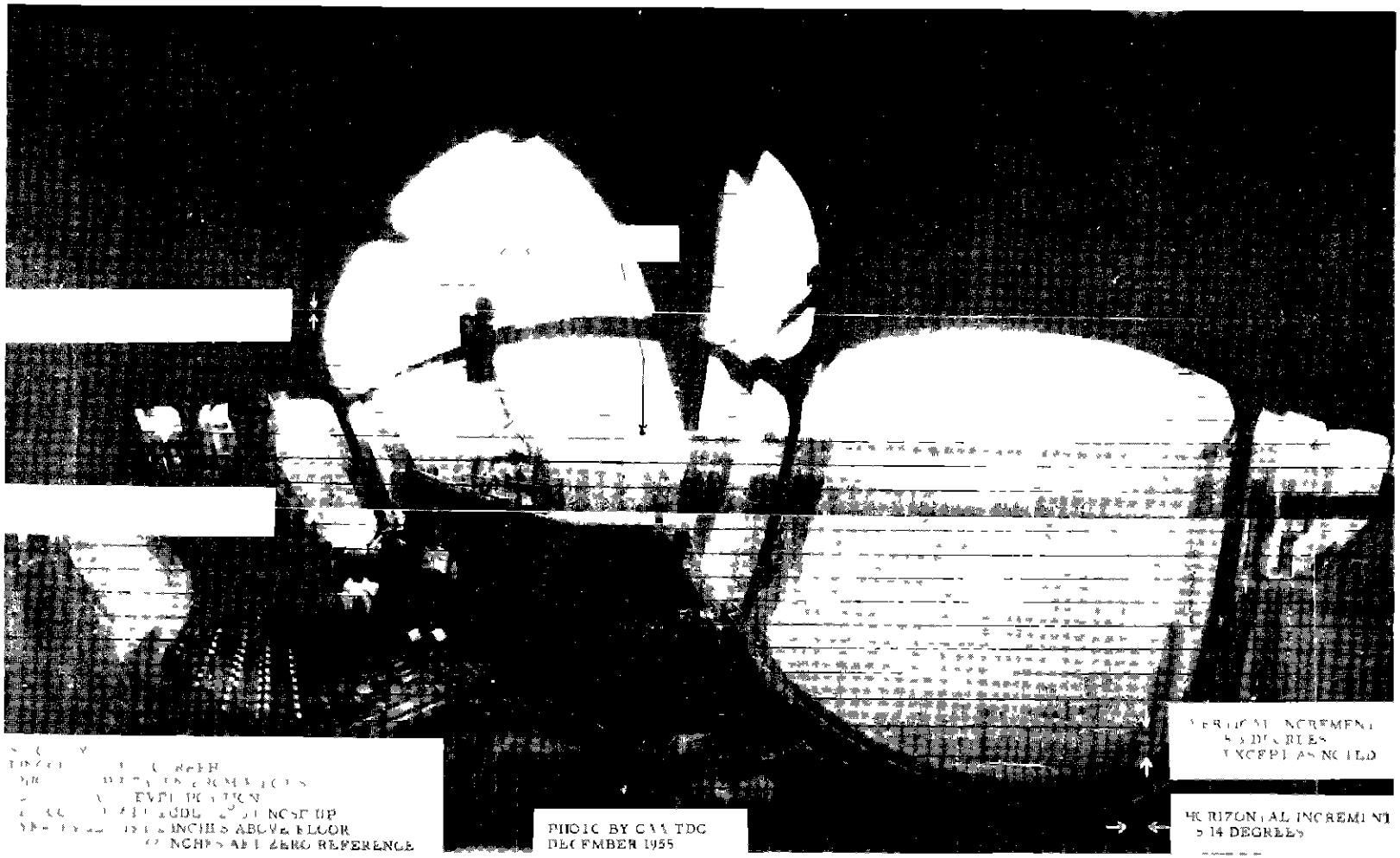


FIG 23 SIKORSKY H-19 BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

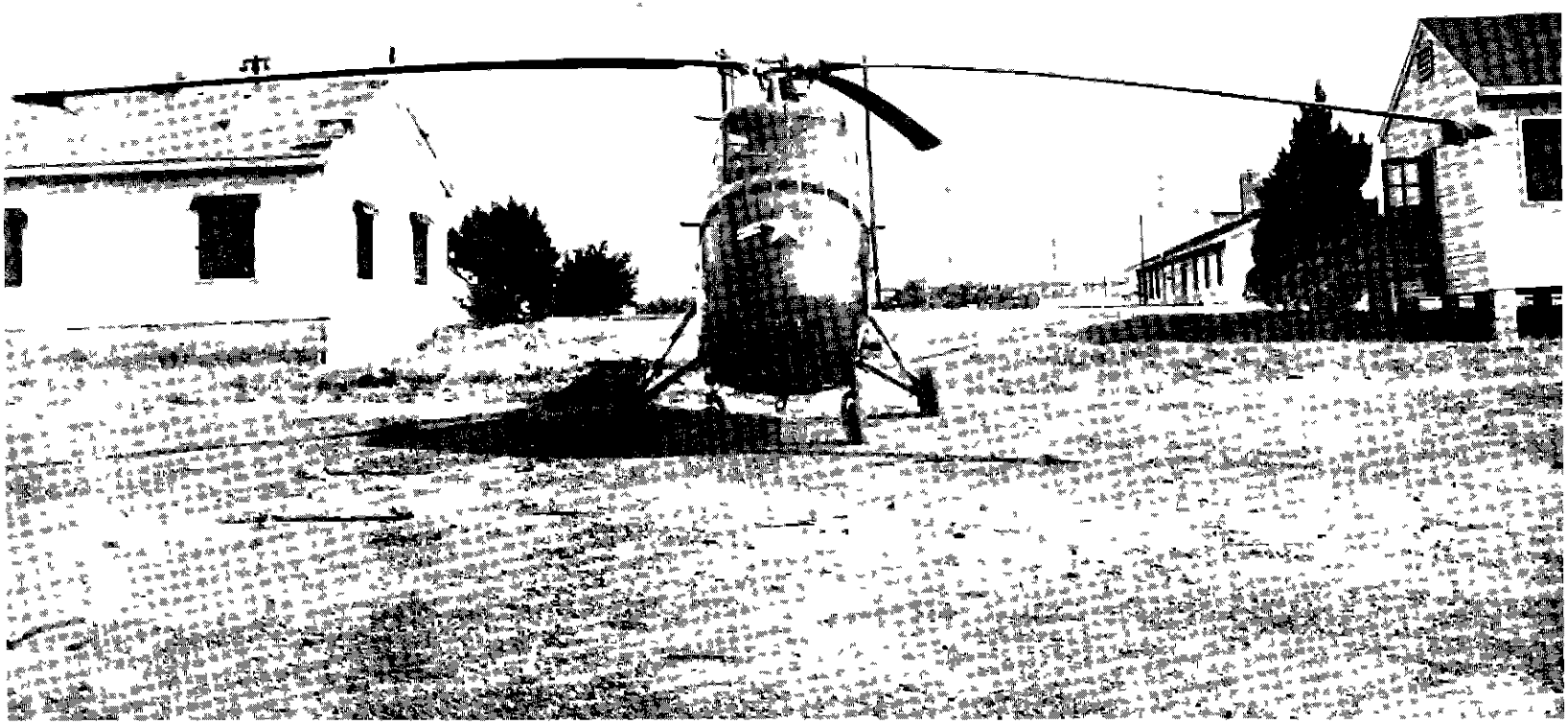


FIG. 24 SIKORSKY H-19 FRONT VIEW

FIG 25 SIKORSKY H-19 SIDE VIEW

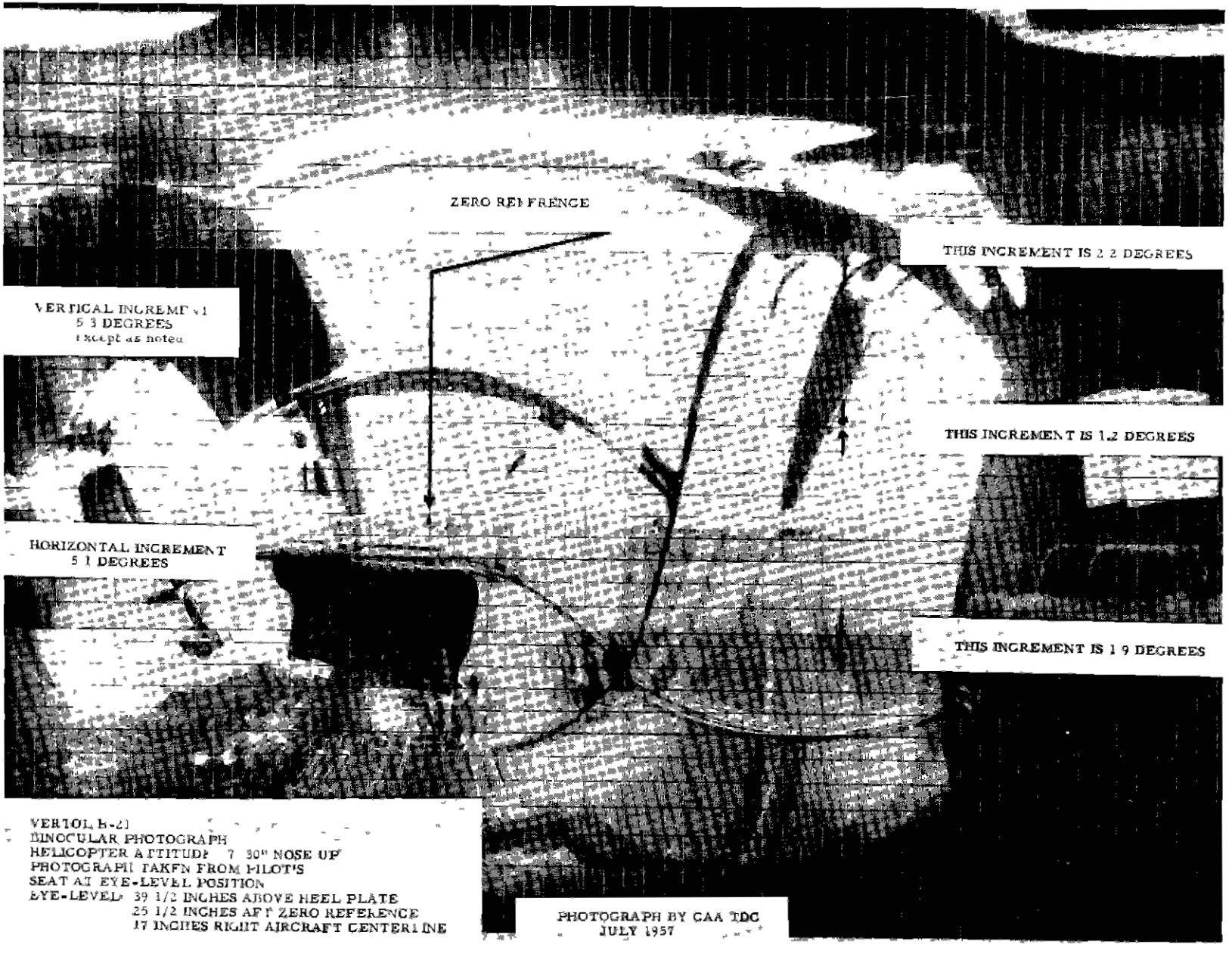


FIG 26 VERTOL H-21 WIDE CONSOLE BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

FIG. 27 VERTOL H-21 FRONT VIEW

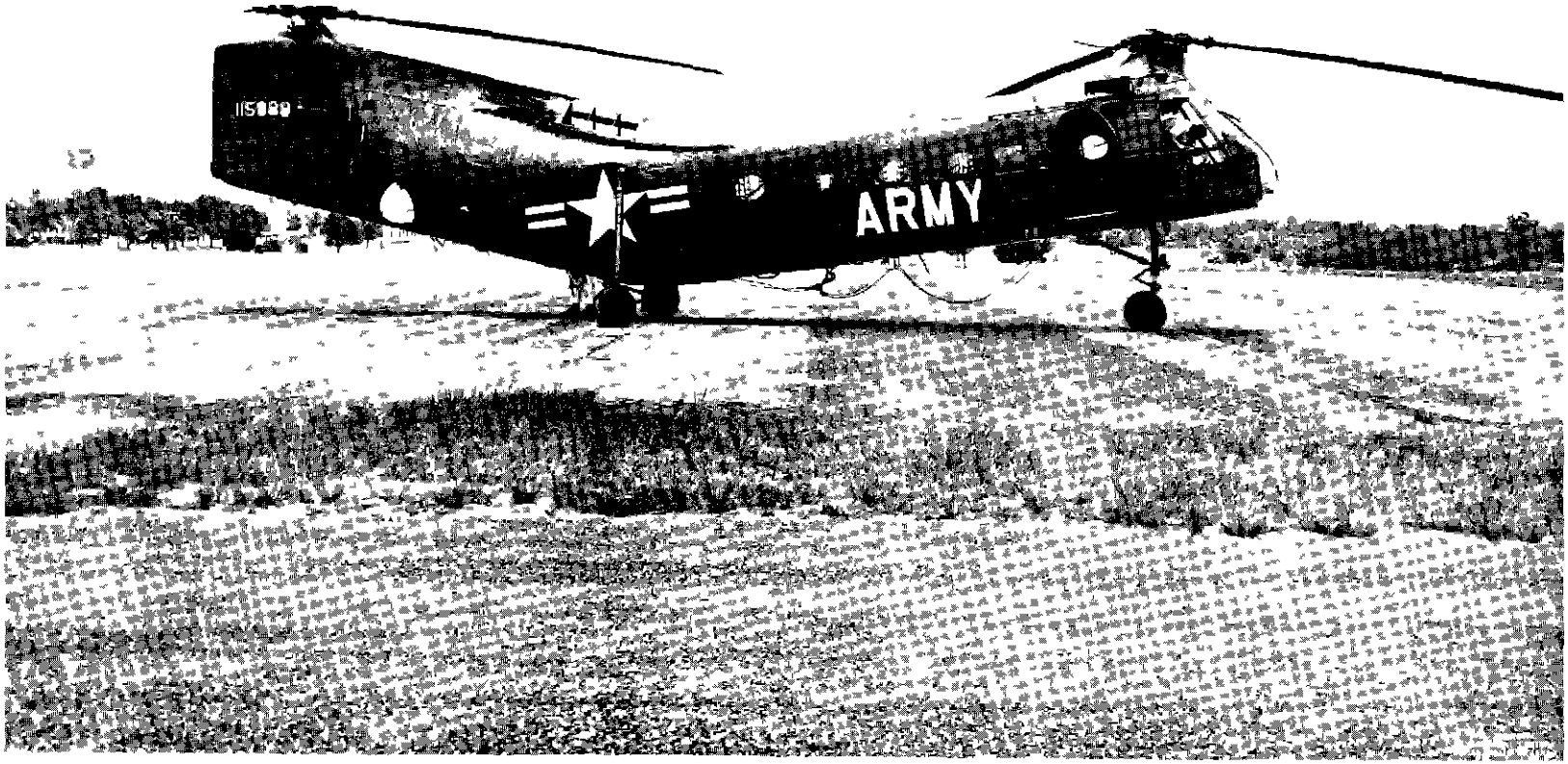


FIG 28 VERTOL H-21 SIDE VIEW

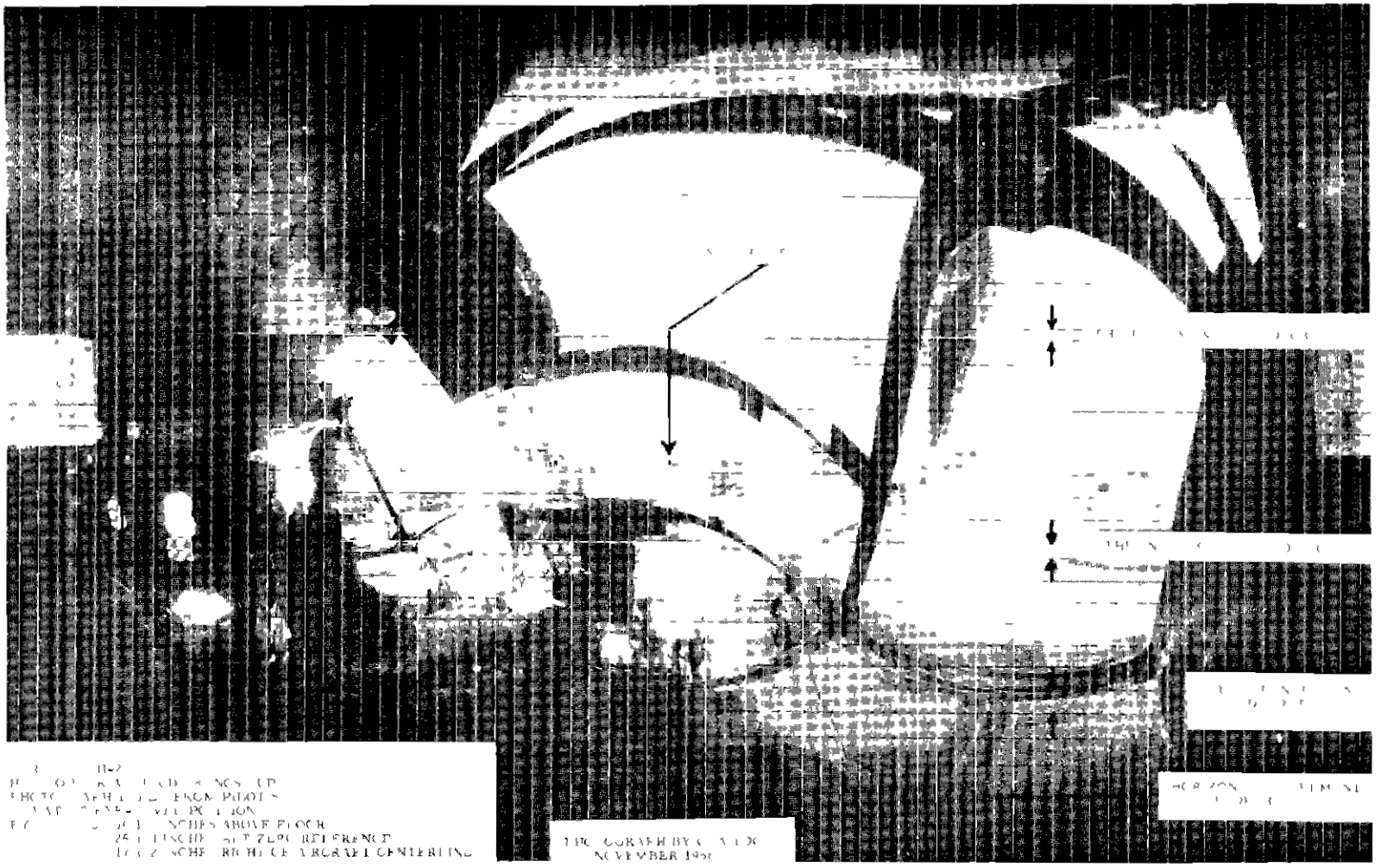


FIG 29 VERTOL H-21 NARROW CONSOLE BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

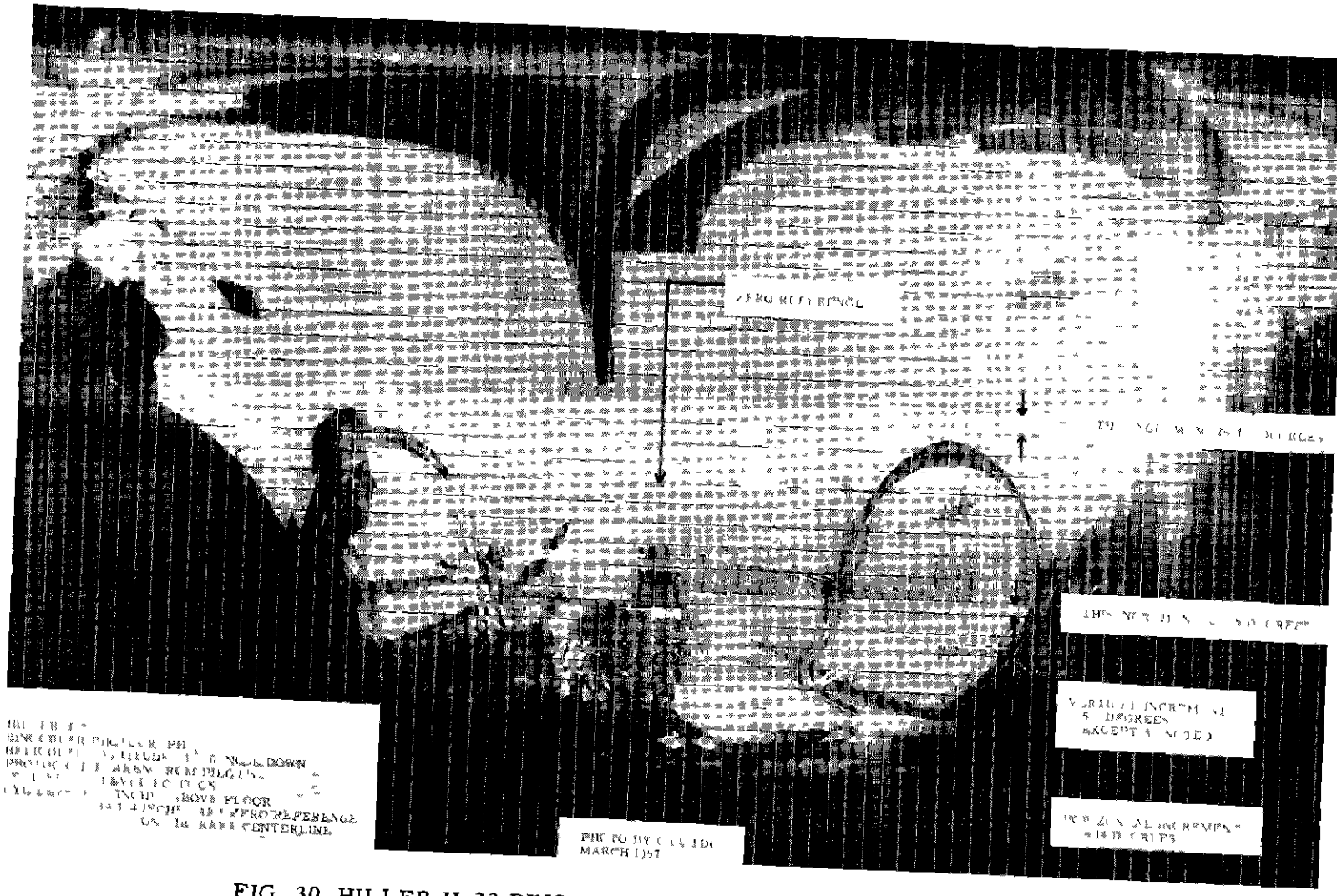


FIG. 30 HILLER H-23 BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

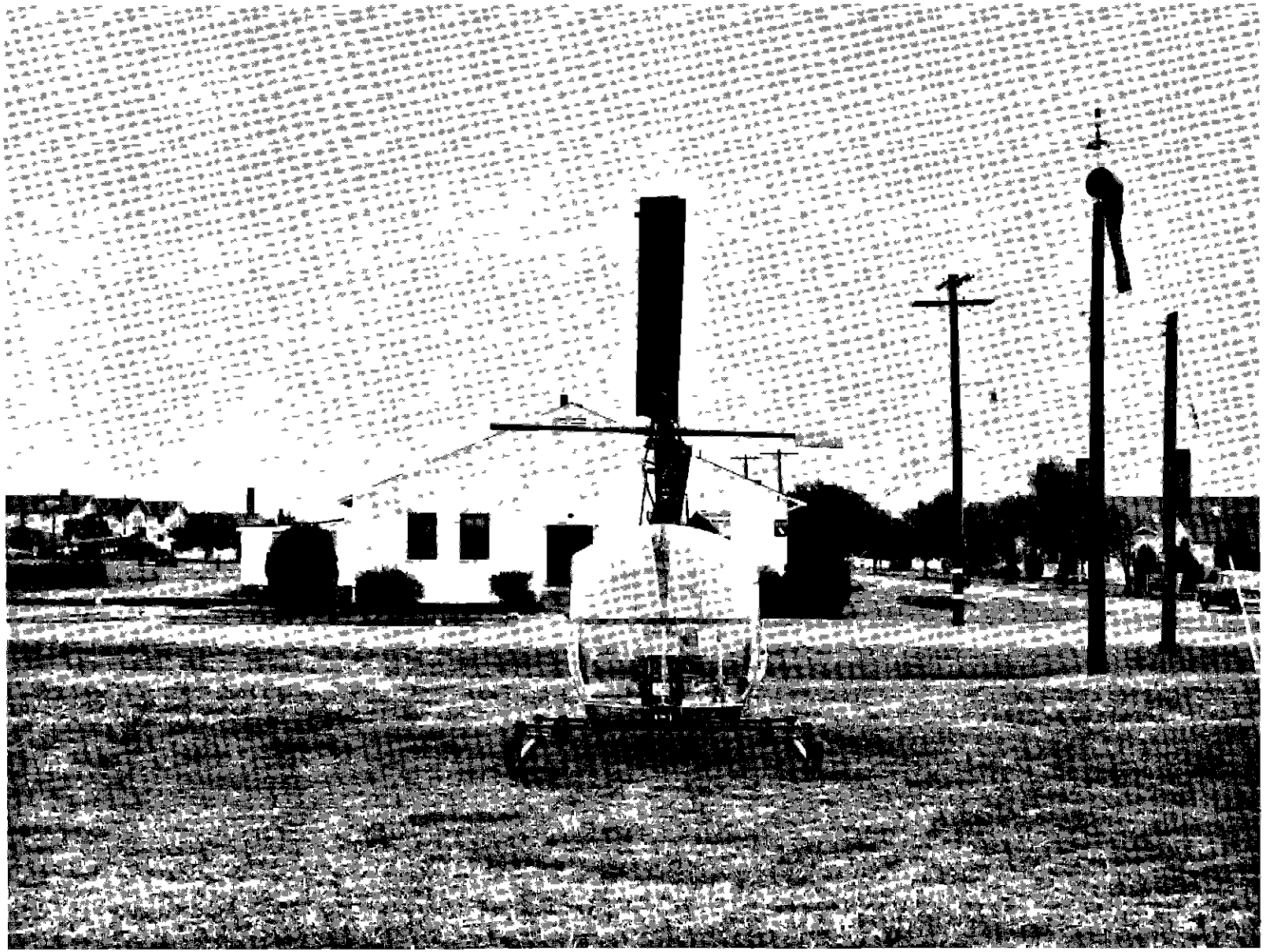


FIG 31 HILLER H-23 FRONT VIEW

FIG. 32 HILLER H-23 SIDE VIEW

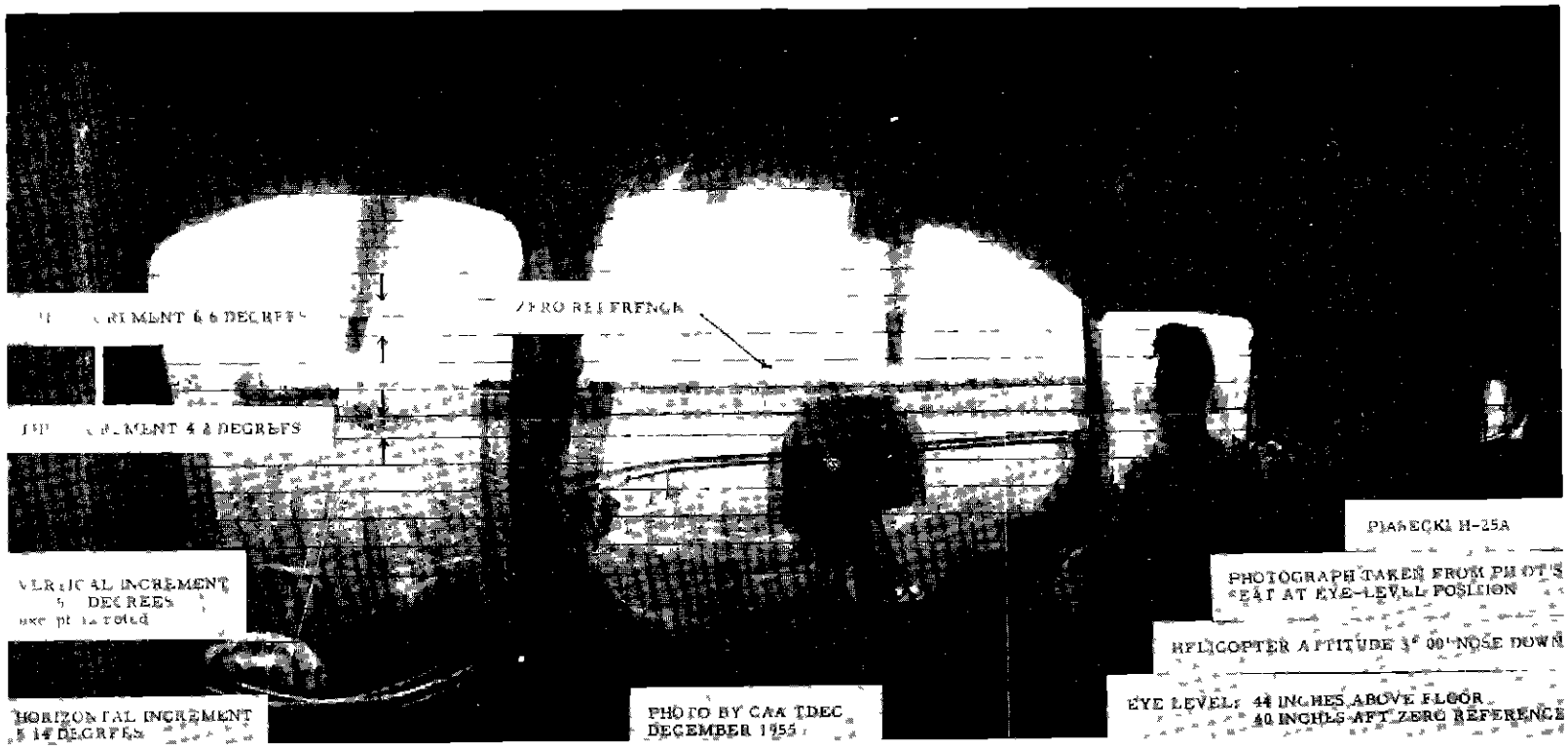


FIG 33 PIASECKI H-25A BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

FIG 34 PIASECKI H-25A FRONT VIEW

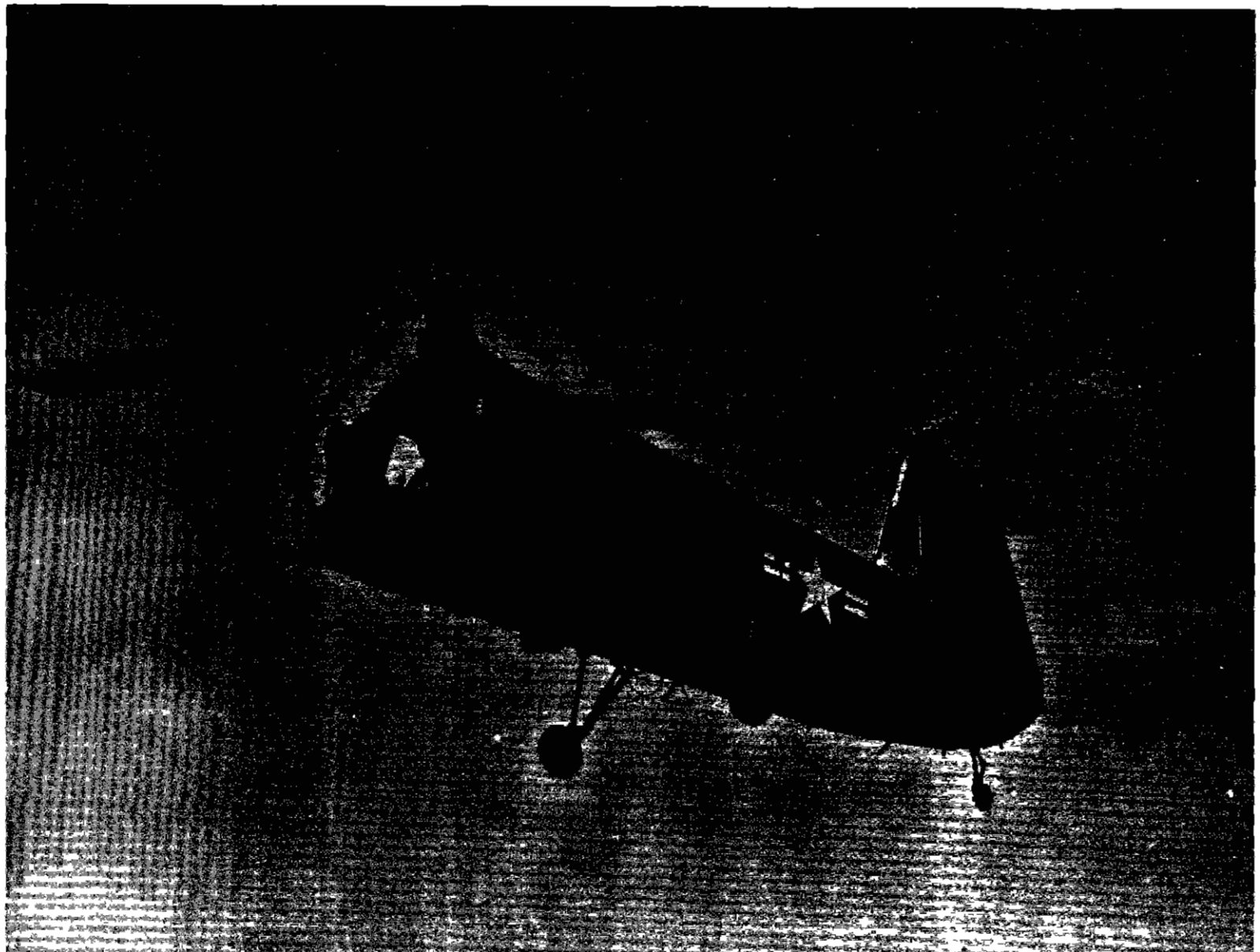


FIG. 35 PIASECKI H-25A SIDE VIEW

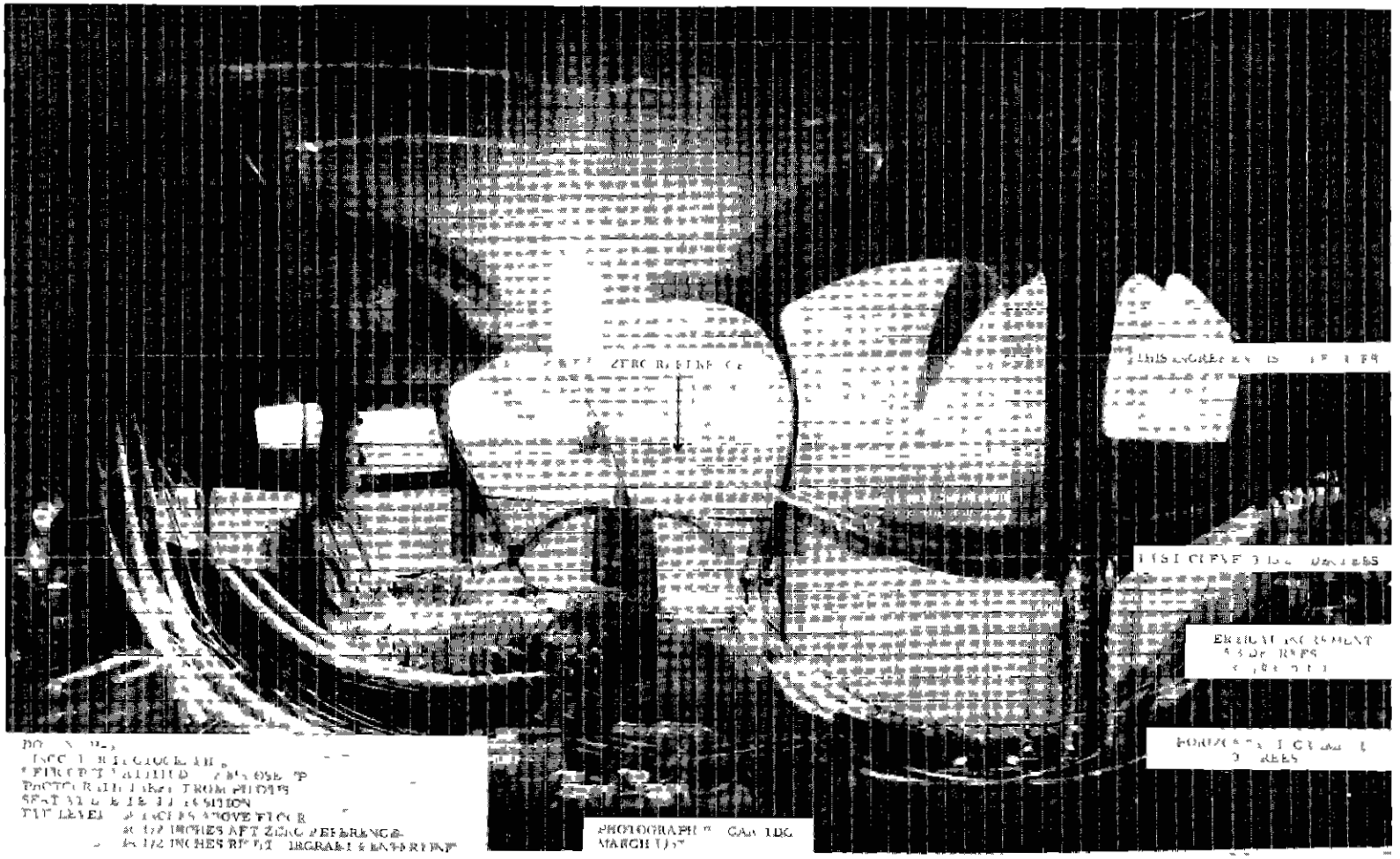


FIG. 36 DOMAN H-31 BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

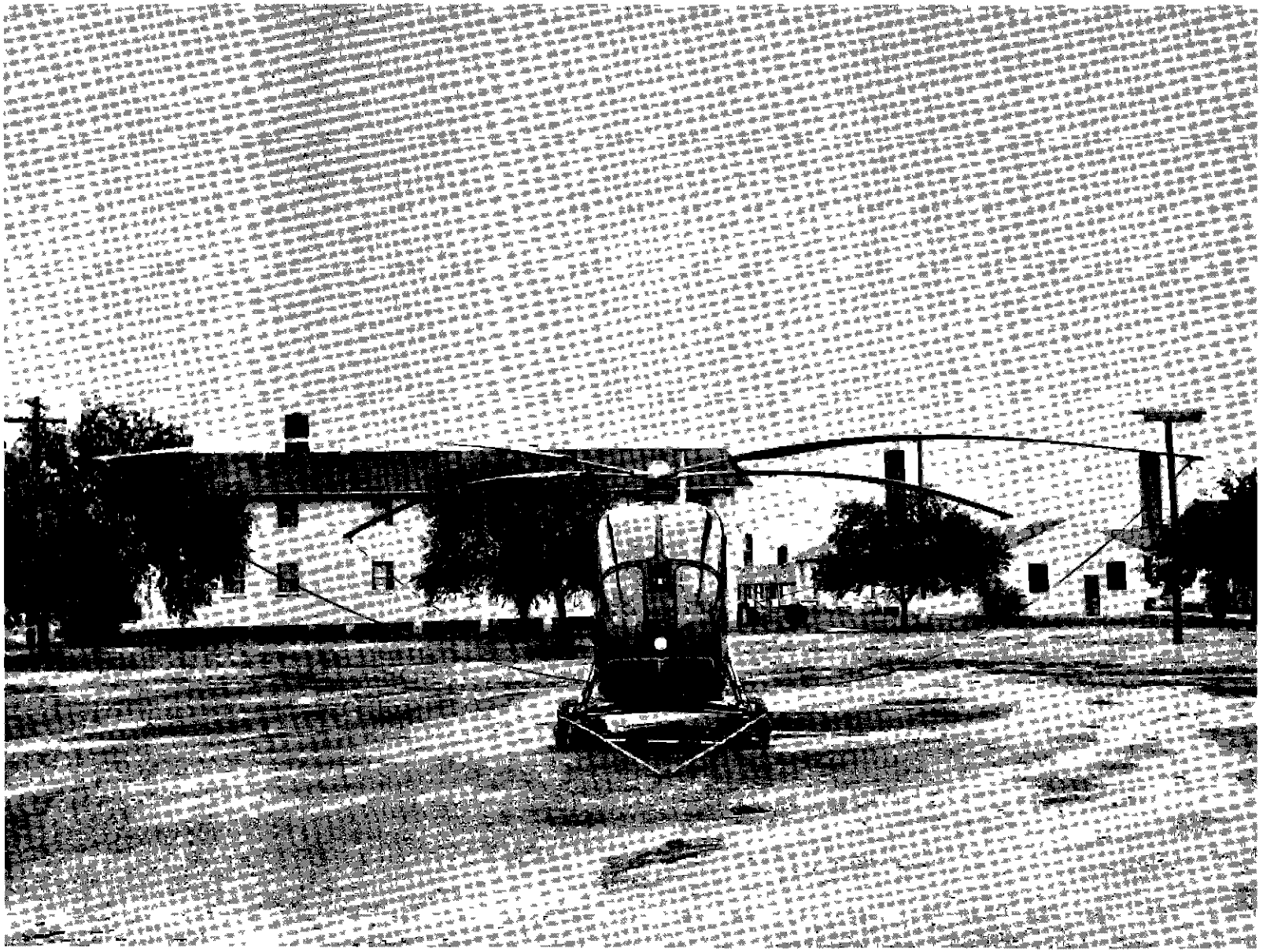


FIG. 37 DOMAN H-31 FRONT VIEW

FIG 38 DOMAN H-31 SIDE VIEW

FIG 39 SIKORSKY H-34 BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

FIG 40 SIKORSKY H-34 FRONT VIEW

FIG. 41 SIKORSKY H-34 SIDE VIEW

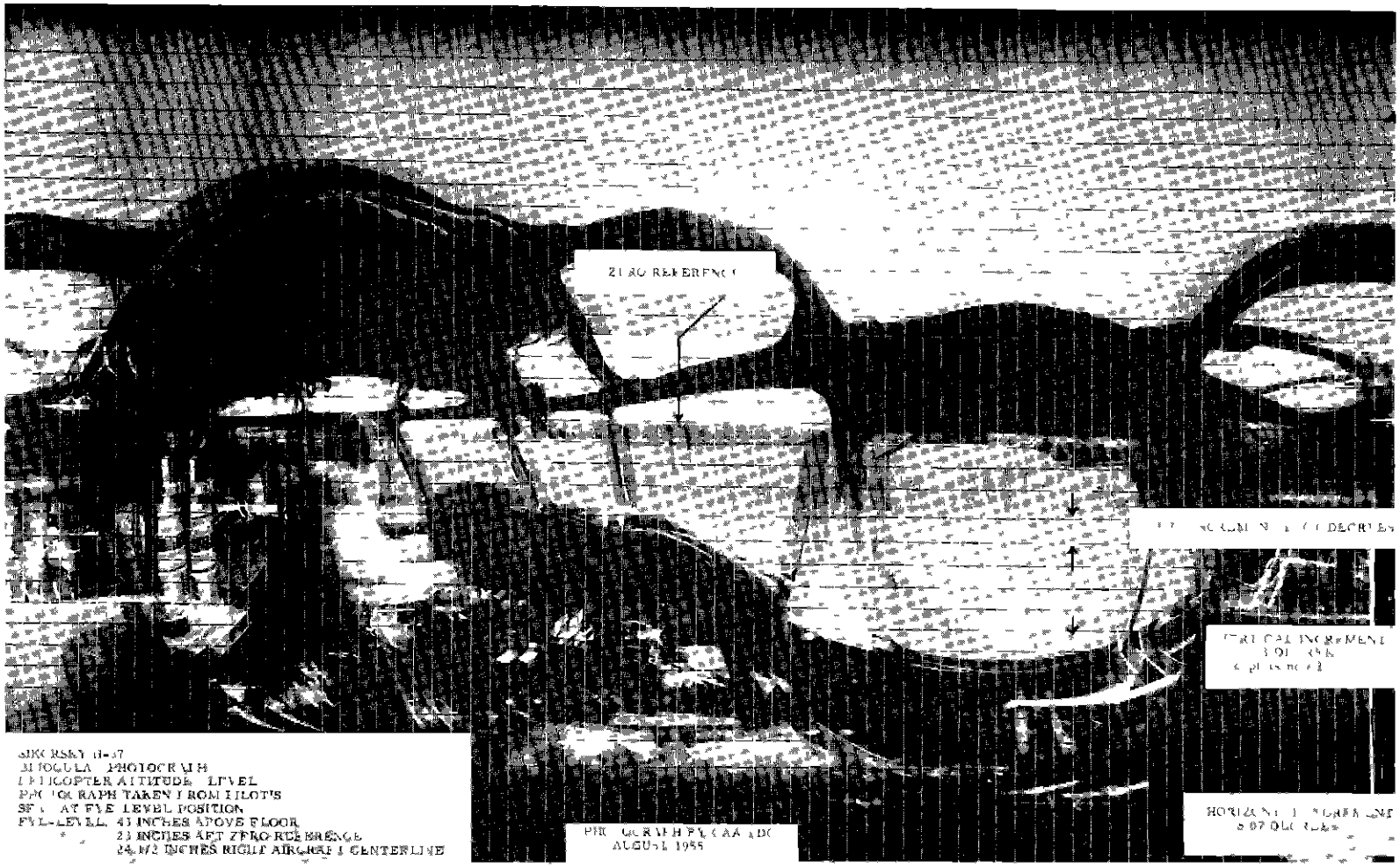


FIG. 42 SIKORSKY H-37 BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

FIG 43 SIKORSKY H-37 FRONT VIEW

FIG 44 SIKORSKY H-37 SIDE VIEW

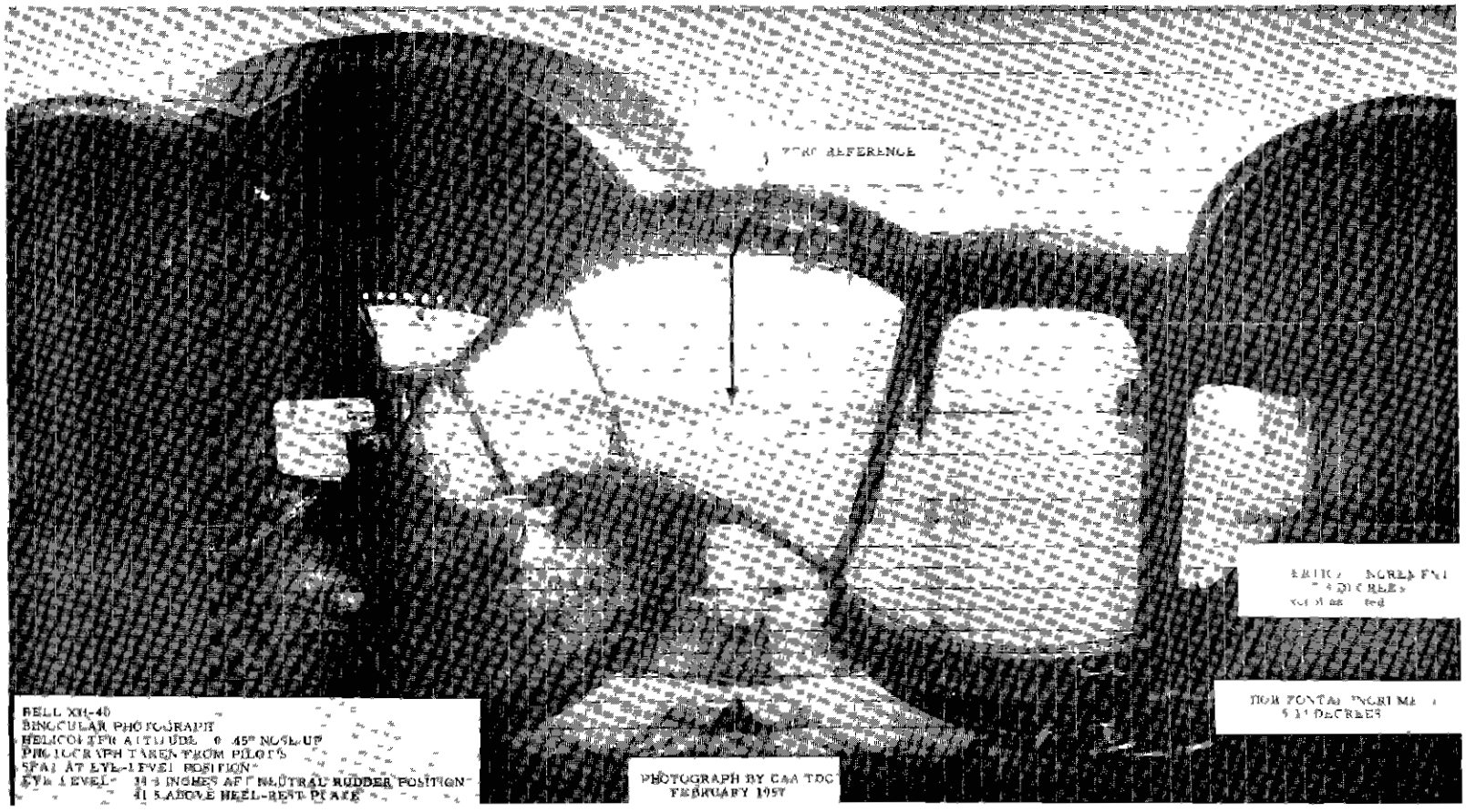


FIG 45 BELL XH-40 BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

FIG. 46 BELL XH-40 FRONT VIEW

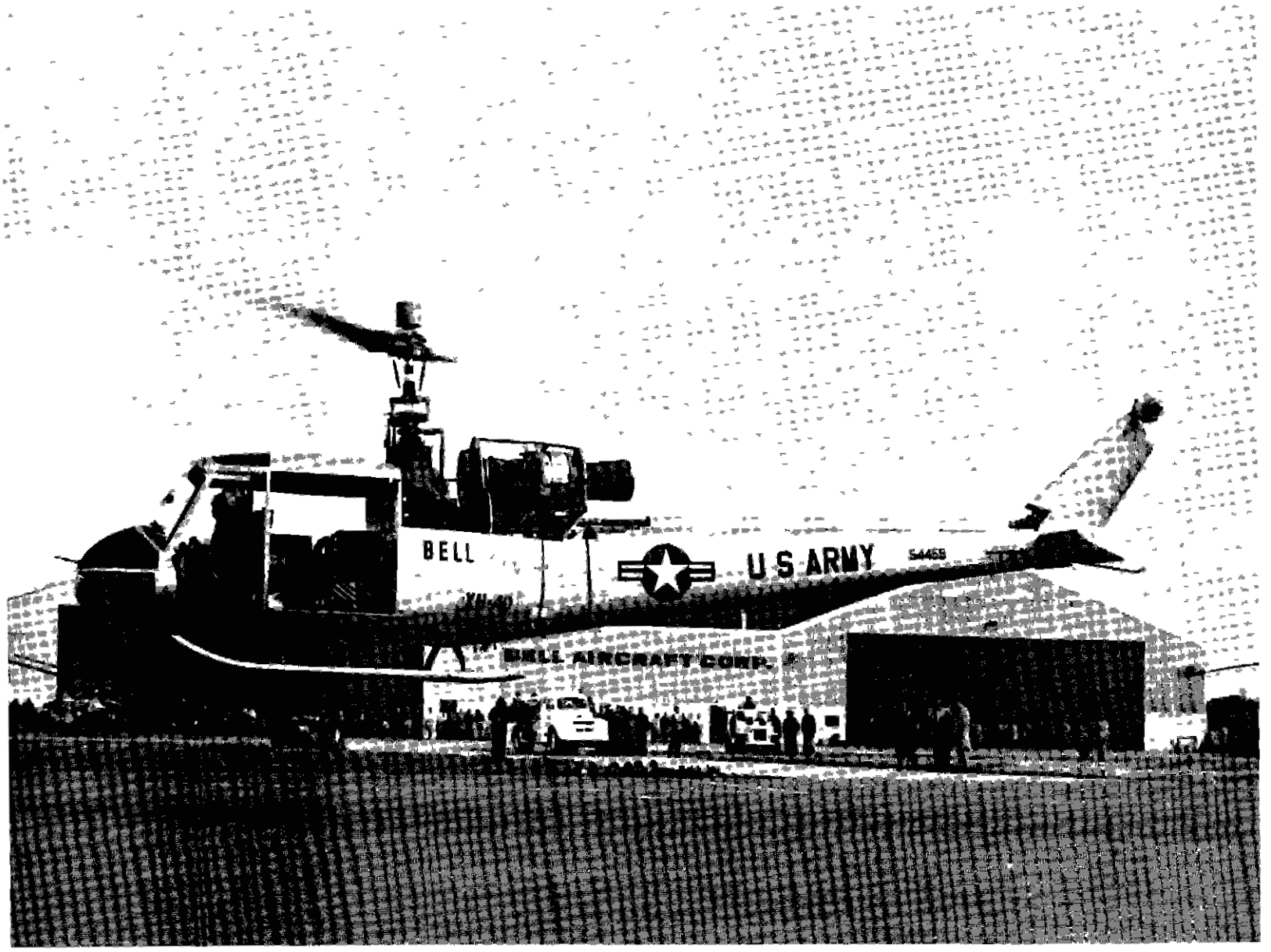


FIG 47 BELL XH-40 SIDE VIEW

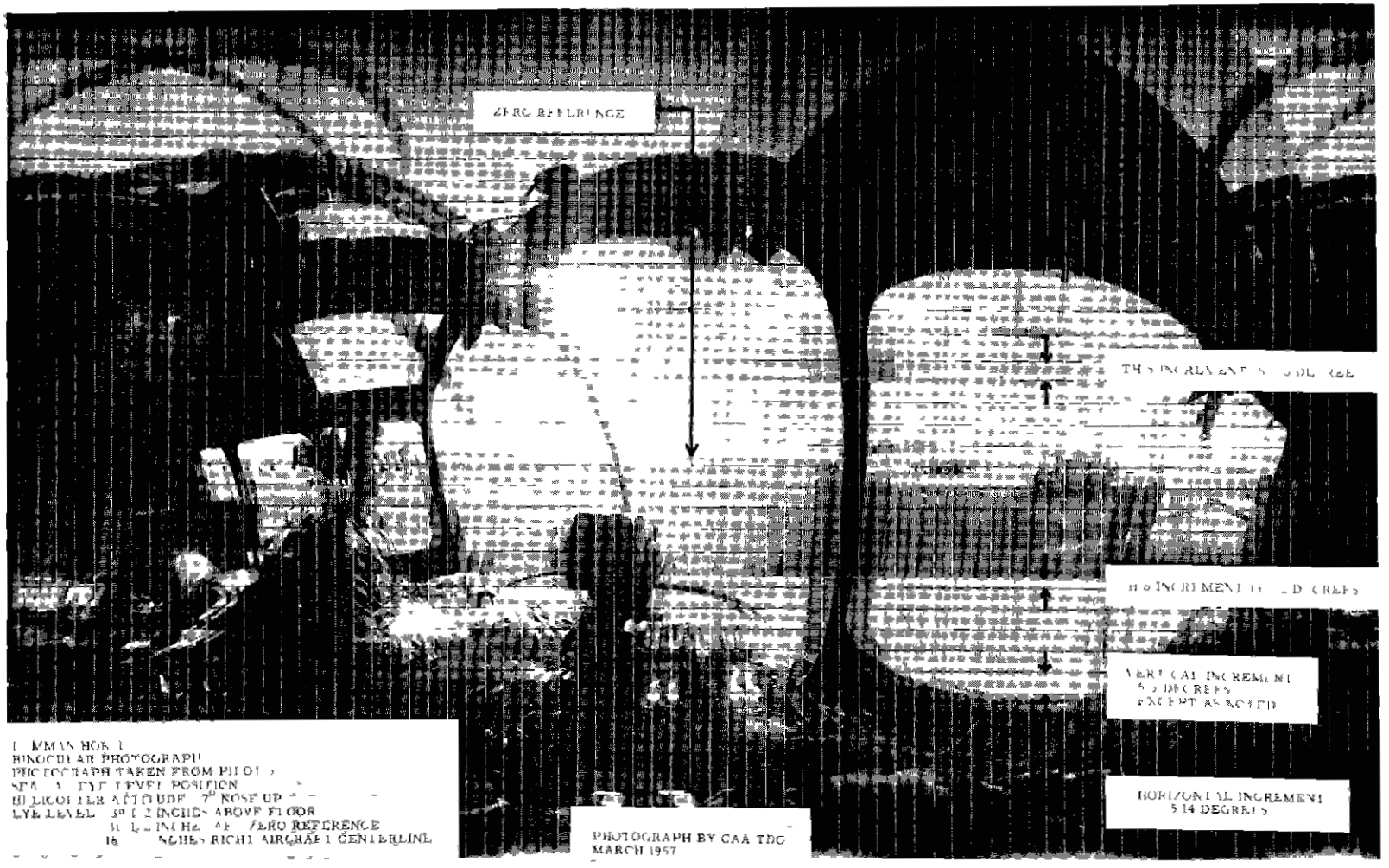


FIG 48 KAMMAN HOK-1 BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

FIG 49 KAMMAN HOK-1 SIDE VIEW

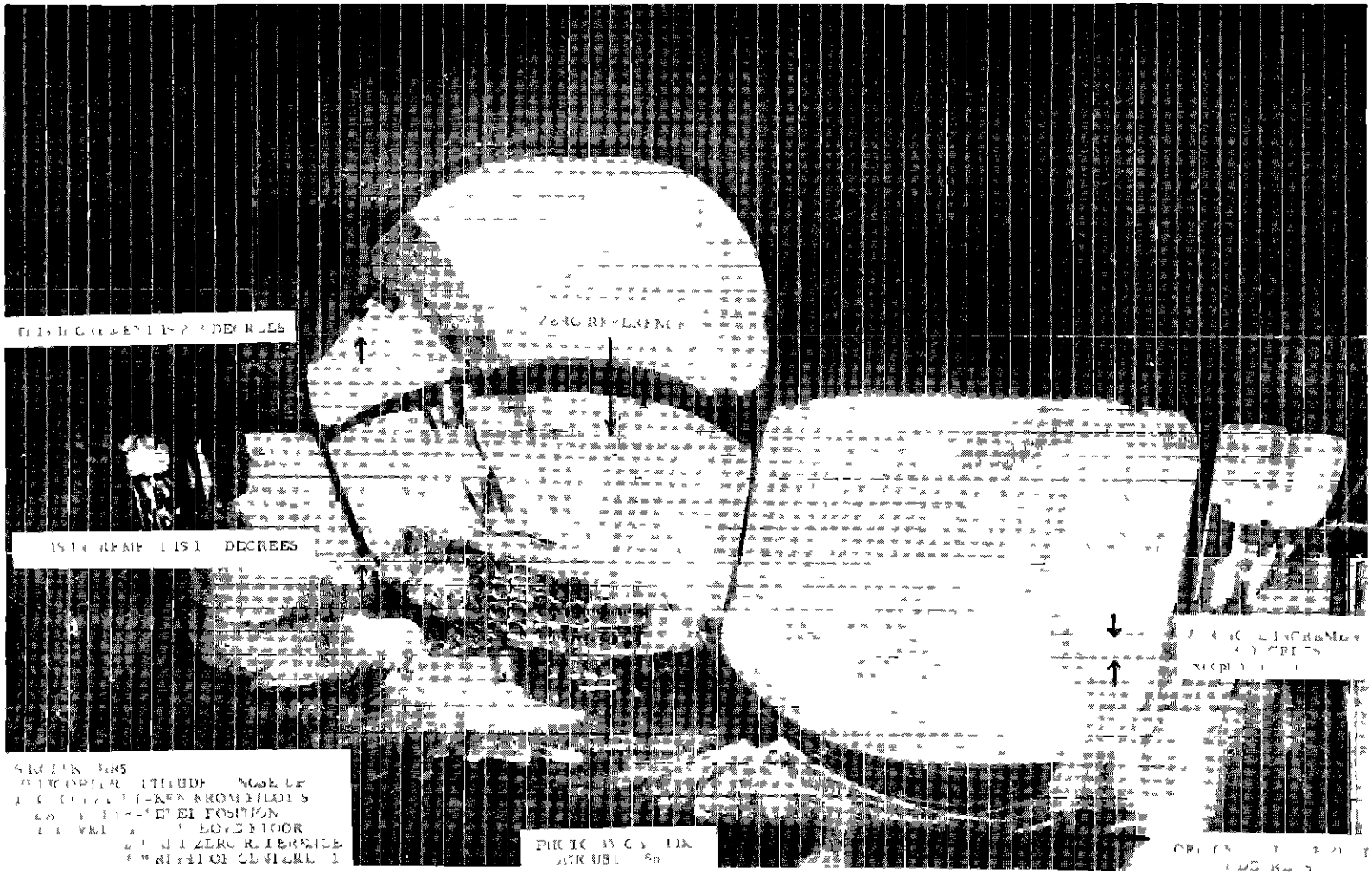


FIG 50 SIKORSKY HRS-3 BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

FIG 51 SIKORSKY HRS-3 SIDE VIEW

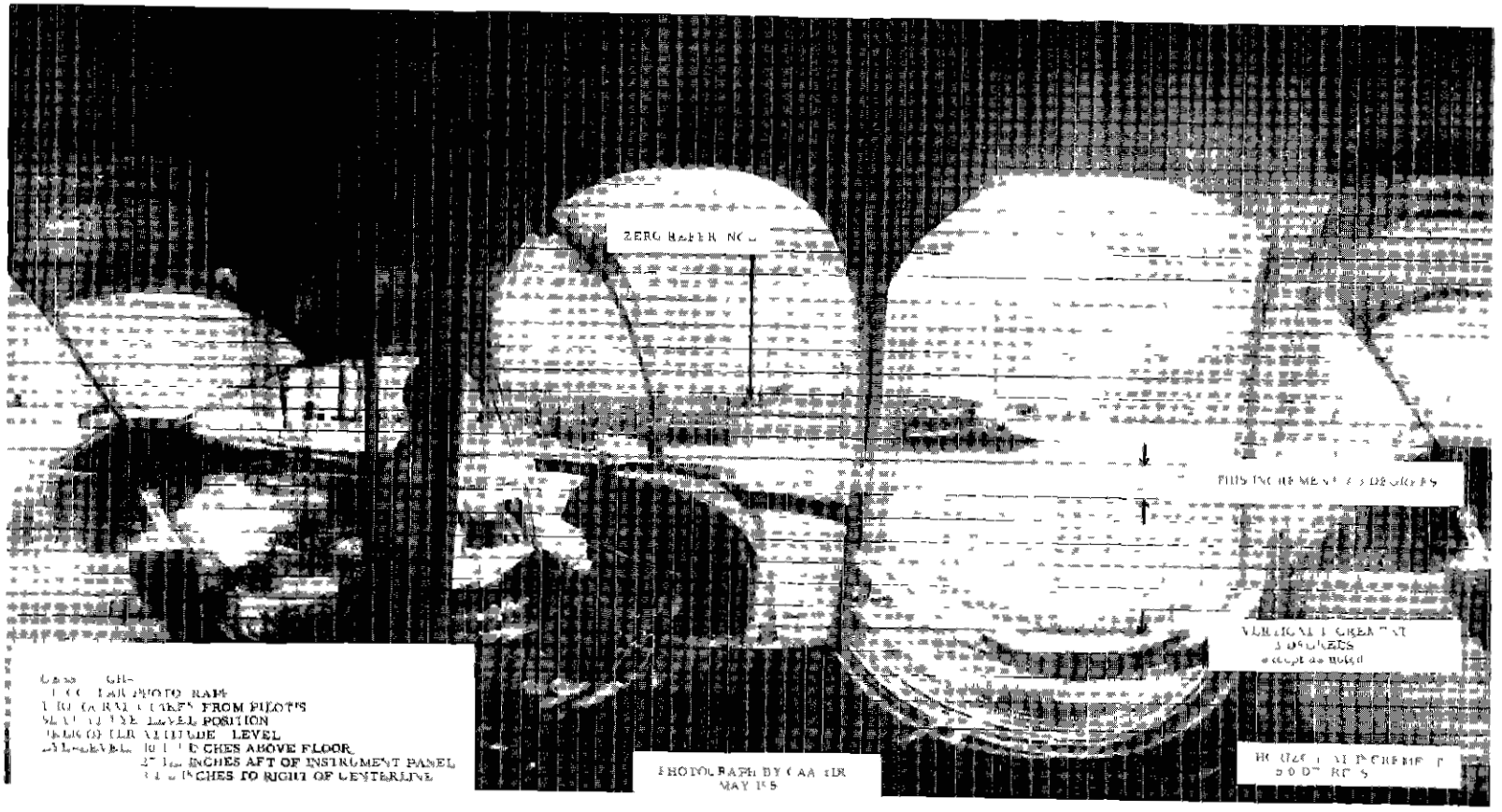


FIG 52 CESSNA CH-1 BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH

FIG 53 CESSNA CH-1 SIDE VIEW

FIG 54 CESSNA CH-1 FRONT VIEW

APPENDIX II

HELICOPTER FLIGHT CHARACTERISTICS

Data herein relate to the flight characteristics of the HOK-1, HRS-3, H-13, H-21, and H-34 helicopters. All data presented have been reduced from photographic records obtained with the Fairchild flight analyzer, as discussed in this report. Typical flight-path pictures for each type of maneuver recorded are shown in Figs. 55 to 59 of this appendix. The manner in which pertinent information was derived is indicated on each figure.

The length of flight path being considered is determined by the formula

$$L = \frac{nd}{40}$$

where

L = length of flight path (feet)
n = number of frames on the picture to the touchdown point
d = perpendicular distance from the camera to the flight path (feet).

Wherever flight attitudes are referred to in this appendix, positive values indicate nose up and negative values indicate nose down. Positive flight-path angles indicate that the helicopter is ascending and negative values, descending.

In a normal takeoff maneuver, a nose-down attitude is experienced during the first portion of the recorded flight path, while a nose-up attitude occurs during the latter portion. For this reason, the "average attitude" for takeoff maneuvers has been broken down into "average nose-up attitude" and "average nose-down attitude."

The sight angle is the visual angle required to see a touchdown target during approach. This angle is defined by the intersection of a line parallel to the helicopter centerline extended from and forward of the pilot-eye position with a line through the pilot-eye position and the touchdown target. This angle is determined by adding the target-sight angle indicated in Figs. 55, 57, and 58, and the helicopter attitude. The target-sight angle, in turn, is the angle formed by the intersection of a line through the pilots' eye position and the touchdown target with the artificial horizon (horizontal markings placed on the photograph by the camera).

HOK-1 NORMAL TAKEOFF

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 FROM (deg)	5 LENGTH OF FLIGHT PATH	6 MAXIMUM ATTITUDE	7 DISTANCE COL 6 AFTER TAKEOFF	8 MINIMUM ATTITUDE	9 DISTANCE COL 8 AFTER TAKEOFF	10 AVERAGE NOSE-UP ATTITUDE	11 AVERAGE NOSE-DOWN ATTITUDE	12 AVERAGE FLIGHT PATH
1	200	---	---	945'	3°00'	790'	- 6°30'	115'	1°30'	-2°30'	3°30'
2	200	---	---	1260'	5°30'	1060'	-16°00'	70'	3°00'	-6°00'	6°30'
3	200	---	---	1285'	4°30'	1035'	-13°30'	45'	3°00'	-6°30'	5°00'
4	200	---	---	1305'	4°00'	1105'	-10°00'	315'	2°30'	-3°00'	4°00'
5	200	---	---	1305'	4°30'	970'	- 8°00'	70'	2°30'	-3°30'	4°30'
6	200	---	---	1240'	5°30'	700'	- 9°30'	115'	3°00'	-2°30'	7°00'
7	200	---	---	1305'	3°30'	1240'	- 6°30'	45'	1°30'	-3°00'	6°00'
8	200	---	---	1240'	4°30'	880'	- 3°00'	70'	2°30'	-1°00'	7°00'
9	200	---	---	1215'	3°30'	1080'	- 5°30'	405'	1°30'	-3°00'	2°30'
10	200	---	---	1170'	3°00'	655'	- 9°00'	90'	2°00'	-6°00'	2°30'
11	200	---	---	1240'	3°30'	225'	-12°30'	25'	2°00'	-2°50'	5°30'
12	200	---	---	1285'	6°00'	745'	0°30'	205'	3°30'	None	8°00'
13	200	---	---	1215'	9°00'	655'	-10°00'	70'	4°00'	-5°30'	9°00'
14	200	---	---	1285'	7°30'	1240'	-15°30'	70'	2°30'	-3°00'	5°30'
15	200	---	---	1195'	4°30'	610'	- 7°30'	70'	2°00'	-2°00'	5°00'
16	200	---	---	1215'	4°30'	630'	-11°30'	135'	2°30'	-4°30'	4°00'
17	200	9 mph	180	1305'	8°30'	1285'	- 8°00'	45'	3°30'	-3°30'	3°30'
18	200	9 mph	180	1305'	7°30'	1105'	- 2°00'	700'	4°00'	-1°00'	8°00'
19	200	9 mph	180	1260'	7°30'	1150'	- 5°00'	45'	4°30'	-3°00'	8°00'
20	200	9 mph	180	1240'	4°30'	810'	- 4°00'	360'	3°00'	-2°00'	4°00'
21	200	9 mph	180	1305'	3°30'	1285'	- 4°30'	295'	2°00'	-1°30'	3°30'
AVERAGE					5°00'	965'	- 8°00'	180'	3°00'	-3°00'	5°30'

HOK-1 AUTOROTATION TO A PANEL WITH POWER RECOVERY

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 FROM (deg)	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL 13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL 15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	020	---	---	1240'	25'	23°00'	225'	- 3°00'	945'	2°00'	-16°00'	30°00'	225'	8°30'	630'	13°00'
2	020	---	---	1240'	70'	20°00'	270'	-10°00'	1195'	1°00'	-16°30'	24°30'	270'	3°30'	970'	10°00'
3	020	---	---	1215'	0'	20°30'	295'	- 0°30'	835'	5°30'	-15°00'	36°00'	295'	14°30'	835'	20°30'
4	020	---	---	1170'	45'	19°30'	225'	0°00'	1105'	4°30'	-13°00'	30°00'	225'	12°30'	790'	16°00'
5	020	---	---	1035'	0'	23°00'	315'	- 5°00'	720'	4°00'	-20°30'	47°00'	315'	17°00'	720'	27°00'
6	020	---	---	1215	25'	28°30'	180'	- 6°30'	1080'	7°00'	-10°30'	36°00'	180'	3°30'	1080'	14°00'
7	020	---	---	1240'	25'	17°00'	205'	- 3°30'	1105'	2°00'	-19°08'	27°00'	205'	12°30'	495'	17°00'
8	020	---	---	745'	45'	23°30'	250'	- 2°00	655'	7°00'	-14°00'	30°30'	250'	16°00'	655'	20°30'
9	020	---	---	1125'	0'	16°00'	250'	2°00'	700'	7°00'	-22°00'	34°00'	790'	17°30'	475'	25°30'
10	020	---	---	1215'	0'	24°00'	270'	- 3°00'	925'	5°30'	-19°30'	37°30'	270'	14°00'	925'	21°00'
11	020	9 mph	180	1260'	0'	15°00'	360'	- 2°30'	1105'	4°30'	-14°30'	42°00'	295'	15°30'	1240'	27°30'
12	020	9 mph	180	1215'	25'	18°00'	135'	- 2°00'	430'	3°00'	-19°00'	38°00'	135'	19°00'	430'	24°00'
13	020	9 mph	180	1215'	25'	18°30'	160'	- 0°30'	855'	4°30'	-18°00'	36°00'	160'	16°30'	855'	21°00'
14	020	9 mph	180	1330	0'	27°00'	250'	- 2°30'	1285'	5°00'	-15°30'	38°00'	250'	12°00'	1125'	18°00'
Average					20'	21°00'	235'	- 3°00'	935'	4°30'	-16°30'	35°00'	275'	13°00'	850'	19°30'

HOK-1 STEEP APPROACH TO A PANEL

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 FROM (deg)	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL 13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL 15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	020	---	---	1215'	25'	16°00'	115'	0°00'	900'	4°00'	-16°00'	32°00'	115'	16°30'	900'	20°30'
2	020	---	---	1170'	45'	23°00'	70'	-1°00'	1080'	6°00'	-20°00'	40°00'	70'	18°30'	1080'	24°00'
3	020	---	---	1240'	45'	17°00'	270'	0°00'	990'	8°00'	- 7°00'	33°30'	25'	8°00'	990'	18°30'
4	020	---	---	1105'	25'	21°00'	90'	3°30'	880'	8°00'	-17°00'	39°30'	90'	20°30'	880'	25°30'
5	020	---	---	1240'	45'	20°30'	70'	3°00'	1080'	9°00'	-14°30'	38°30'	70'	19°00'	1080'	28°00'
6	020	---	---	1215'	70'	19°00'	25'	5°00'	945'	9°30'	- 9°30'	31°00'	70'	16°00'	945'	22°30'
7	020	---	---	1125'	25'	21°00'	90'	5°00'	945'	8°30'	-12°30'	32°00'	90'	18°00'	945'	21°00'
8	020	---	---	1105'	45'	18°30'	90'	0°00'	1060'	7°30'	-15°00'	29°00'	90'	13°30'	1060'	21°00'
9	020	---	---	1125'	45'	14°30'	25'	5°00'	360'	7°30'	-13°00'	27°30'	70'	19°00'	1035'	22°30'
10	020	---	---	1125'	45'	18°00'	45'	3°30'	900'	7°00'	-13°25'	30°00'	45'	16°30'	1035'	21°00'
11	020	---	---	1080'	45'	14°00'	70'	6°00'	385'	8°30'	-17°00'	30°30'	70'	18°30'	25'	28°00'
12	020	---	---	1060'	25'	13°30'	270'	6°30'	765'	9°00'	-19°30'	37°00'	270'	28°30'	810'	31°30'
13	020	---	---	1080'	70'	13°30'	540'	5°00'	765'	9°30'	-19°00'	35°30'	340'	22°30'	25'	30°30'
14	020	---	---	1150'	45'	14°00'	25'	1°30'	745'	8°00'	-14°30'	33°30'	270'	17°00'	765'	25°00'
15	020	9 mph	180	1240'	0'	10°00'	270'	4°30'	855'	7°00'	-19°00'	44°00'	70'	25°00'	1215'	33°30'
16	020	9 mph	180	1170'	70'	00°00'	45'	0°00'	970'	7°00'	-15°30'	34°30'	205'	16°00'	990'	24°30'
17	020	9 mph	180	1240'	0'	17°00'	25'	2°30'	855'	8°30'	-15°30'	36°00'	25'	18°00'	1215'	26°00'
18	020	9 mph	180	1240'	25'	14°30'	45'	4°30'	790'	9°00'	-16°30'	30°00'	270'	19°30'	25'	25°00'
19	020	9 mph	180	1240'	70'	18°30'	160'	3°00'	1195'	8°30'	- 7°30'	28°30'	160'	11°00'	1195'	18°30'
20	020	9 mph	180	1285'	25'	16°00'	675'	4°30'	1195'	9°30'	- 9°30'	28°30'	585'	14°30'	1195'	22°30'
AVERAGE					40'	16°30'	145'	3°00	890'	8°00'	-14°30'	33°30'	265'	18°00'	950'	24°30'

HOK- 1 NORMAL LANDING TO A PANEL

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 FROM (deg)	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL 13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL 15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	020	---	---	1170'	45'	30°00'	70'	0°00'	970'	9°00'	- 7°00'	43°30'	70'	6°00'	970'	16°30'
2	020	---	---	1170'	45'	22°30'	90'	0°00'	900'	8°30'	- 8°30'	35°30'	90'	7°30'	1125'	16°30'
3	020	---	---	1060'	45'	17°00'	270'	0°30'	1035'	7°00'	- 7°30'	25°30'	270'	6°30'	1035'	14°00'
4	020	---	---	1240'	45'	24°00'	70'	0°30'	1215'	9°00'	- 7°30'	33°00'	70'	7°30'	1215'	15°30'
5	020	---	---	1125'	25'	23°30'	115'	1°00'	1060'	10°30'	-11°00'	39°00'	115'	12°00'	1060'	22°00'
6	020	---	---	1150'	70'	21°30'	135'	1°30'	1060'	9°30'	-13°00'	33°30'	135'	14°00'	1060'	20°30'
7	020	---	---	1240'	0'	23°00'	160'	0°00'	970'	8°30'	-15°30'	44°00'	135'	14°30'	720'	23°30'
8	020	---	---	1215'	25'	26°30'	180'	-2°00'	1060'	11°00'	- 4°30'	31°30'	180'	2°30'	1060'	15°00'
9	020	---	---	990'	45'	19°00'	90'	1°30'	900'	10°00'	- 7°30'	31°00'	45'	8°30'	900'	18°00'
10	020	---	---	1195'	70'	19°00'	90'	3°00'	1015'	9°30'	- 4°30'	25°30'	90'	7°30'	1015'	14°30'
11	020	---	---	1240'	25'	12°30'	115'	3°00'	990'	8°30'	-11°00'	25°30'	135'	14°00'	990'	20°00'
12	020	---	---	1170'	70'	23°00'	25'	0°30'	1035'	10°30'	- 4°00'	27°00'	25'	3°30'	1035'	14°00'
13	020	---	---	1035'	90'	14°30'	115'	3°00'	990'	9°00'	- 9°30'	24°30'	135'	11°30'	990'	17°00'
14	020	9 mph	180	1195'	45'	23°00'	90'	3°00'	990'	9°00'	- 8°30'	30°00'	135'	10°30'	990'	15°30'
15	020	9 mph	180	1285'	45'	22°30'	45'	0°00'	945'	8°00'	-12°30'	33°00'	45'	11°00'	925'	17°00'
16	020	9 mph	180	1285'	45'	20°00'	45'	4°30'	1240'	10°30'	- 5°30'	27°00'	45'	10°30'	1240'	17°00'
17	020	9 mph	180	1240'	25'	18°30'	340'	0°30'	1080'	9°00'	-11°00'	30°00'	70'	10°30'	1035'	18°30'
18	020	9 mph	180	1195'	70'	15°30'	270'	3°00'	1170'	10°00'	- 6°30'	20°00'	250'	9°00'	1170'	14°30'
19	020	9 mph	180	1305'	25'	17°00'	160'	3°00'	1150'	10°00'	- 7°30'	25°00'	160'	10°00'	1150'	17°30'
AVERAGE					45'	20°30'	155'	1°30'	1090'	9°30'	- 8°30'	30°30'	125'	9°30'	1065'	17°30'

HRS-3 AUTOROTATION TOWARD A PANEL WITH POWER RECOVERY

1 FLIGHT NO.	2 HEADING (deg.)	3 WIND VELOCITY	4 FROM (deg.)	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL. 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL. 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL.13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL.15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	020	8-10 knots	310	1125'	25'	14°00'	160'	-8°00'	450'	0°30'	-21°00'	31°00'	160'	12°30'	385'	21°00'
2	020	8-10 knots	310	1195'	45'	15°30'	270'	-2°30'	180'	1°30'	-14°00'	24°00'	270'	4°00'	180'	12°30'
3	020	8-10 knots	310	1240'	0'	24°00'	115'	-5°00'	565'	2°00'	-14°30'	55°00'	25'	9°00'	540'	18°00'
4	020	8-10 knots	310	1150'	0'	14°30'	225'	-6°30'	1060'	2°30'	-15°00'	30°30'	225'	8°30'	1060'	16°30'
5	020	8-10 knots	310	1215'	45'	12°30'	430'	-7°30'	1035'	1°30'	-14°00'	17°30'	25'	5°00'	1035'	11°00'
AVERAGE					23'	16°00'	240'	-6°00'	710'	1°30'	-15°30'	31°30'	140'	8°00'	595'	16°00'

HRS-3 NORMAL TAKEOFF

1 FLIGHT	2 HEADING (deg.)	3 WIND VELOCITY	4 FROM (deg.)	5 LENGTH OF FLIGHT PATH	6 MAXIMUM ATTITUDE	7 DISTANCE COL. 6 AFTER TOUCHDOWN	8 MINIMUM ATTITUDE	9 DISTANCE COL. 8 AFTER TAKEOFF	10 AVERAGE NOSE-UP ATTITUDE	11 AVERAGE NOSE-DOWN ATTITUDE	12 AVERAGE FLIGHT PATH
1	200	8-10 knots	310	1260'	1°00'	900'	-11°00'	90'	1°00'	-4°00'	6°00'
2	200	8-10 knots	310	970'	-3°00'	495'	-13°00'	135'	None	-6°30'	6°00'
3	200	8-10 knots	310	1240'	-2°00'	1195'	-12°30'	25'	None	-8°30'	3°30'
4	200	8-10 knots	310	1305'	0°00'	1285'	-14°30'	115'	None	-6°30'	6°00'
5	200	8-10 knots	310	1260'	0°00'	900'	- 5°30'	205'	None	-3°00'	7°30'
6	200	8-10 knots	310	1305'	-3°00'	295'	- 7°30'	925'	None	-5°30'	3°30'
7	200	8-10 knots	310	1285'	-3°30'	1080'	-11°30'	70'	None	-5°30'	2°00'
8	200	8-10 knots	310	1305'	-4°30'	1260'	-11°00'	25'	None	-7°00'	1°00'
AVERAGE					-2°00'	925'	-11°00'	365'	None	-6°00'	4°30'

HRS-3 NORMAL LANDING TO A PANEL

1 FLIGHT NO.	2 HEADING (deg.)	3 WIND VELOCITY	4 FROM (deg.)	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL. 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL. 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL.13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL.15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	020	8-10 knots	310	1170'	70'	7°30'	610'	-2°30'	1080'	3°30'	- 9°00'	17°00'	610'	6°30'	1080'	12°30'
2	020	8-10 knots	310	1195'	45'	7°30'	115'	0°00'	1170'	2°30'	-10°00'	19°00'	115'	11°30'	585'	14°00'
3	020	8-10 knots	310	1125'	45'	15°30'	205'	-2°30'	1015'	5°00'	- 8°00'	90°00	0'	5°30'	1015'	15°00'
4	020	8-10 knots	310	1195'	45'	8°30'	225'	-1°30'	990'	3°00'	- 7°30'	17°00'	45'	6°30'	1035'	11°00'
5	020	8-10 knots	310	1170'	45'	8°00'	360'	-2°30'	1035'	3°00'	- 8°30'	16°30'	115'	6°00'	1035'	11°30'
6	020	8-10 knots	310	1150'	70'	6°30'	315'	0°00'	1035'	3°00'	- 4°00'	16°00'	25'	4°30'	1035'	9°00'
7	020	8-10 knots	310	1195'	0'	10°00'	45'	-0°30'	1125'	5°00'	- 1°30'	27°00'	45'	1°30'	1125'	9°00'
AVERAGE					45'	9°00'	275'	-1°30'	1085'	3°30'	- 7°00'	29°00'	125'	6°00'	1040'	12°00'

HRS-3 STEEP APPROACH TO A PANEL

1	020	8-10 knots	310	1215'	25'	5°00'	70'	-2°00'	520'	0°30'	-17°00'	27°30'	25'	16°30'	1170'	21°00'
2	020	8-10 knots	310	1260'	0'	4°30'	25'	-5°30'	1240'	0°00'	-15°30'	29°00'	25'	10°30'	1240'	18°30'
3	020	8-10 knots	310	1240'	45'	9°00'	90'	-0°30'	585'	3°00'	-13°00'	24°30'	25'	13°30'	585'	17°00'
4	020	8-10 knots	310	1105'	160'	3°00'	970'	-1°30'	810'	1°00'	-17°00'	19°30'	970'	14°30'	295'	17°00'
5	020	8-10 knots	310	1195'	45'	5°30'	25'	-3°30'	1060'	0°30'	-16°30'	21°30'	25'	13°30'	1060'	18°00'
6	020	8-10 knots	310	1215'	70'	6°00'	90'	-4°00'	970'	0°30'	-16°00'	21°00'	610'	9°00'	25'	16°00'
7	020	8-10 knots	310	1240'	45'	8°00'	160'	-4°30'	540'	0°30'	-11°30'	26°30'	115'	12°30'	540'	16°00'
8	020	8-10 knots	310	1170'	70'	4°00'	70'	-2°00'	610'	0°30'	-13°30'	18°00'	70'	12°30'	1125'	16°00'
9	020	8-10 knots	310	1240'	0'	3°30'	70'	-3°00'	700'	-1°00'	-14°30'	36°30'	25'	13°00'	1215'	18°00'
AVERAGE					55'	5°30'	175'	-3°00'	775'	0°30'	-15°00'	25°00'	210'	13°00'	885'	17°30'

H-13 CRUISE

CRUISE SPEED - 40 KNOTS

1 FLIGHT NO.	2 HEADING (deg.)	3 WIND VELOCITY	4 FROM (deg.)	5 LENGTH OF FLIGHT PATH	6 MAXIMUM ATTITUDE	7 MINIMUM ATTITUDE	8 AVERAGE ATTITUDE	9 AVERAGE FLIGHT PATH
1	180	10-12	247.5	1285'	-0°30'	- 8°00'	- 5°00'	-0°30'
2	180	0-5	180	1285'	0°00'	- 5°30'	- 3°00'	-2°00'
3	180	0-5	225	1305'	-3°00'	- 7°30'	- 5°30'	-1°00'
4	180	0-5	225	1240'	-0°30'	- 6°30'	- 3°00'	-2°30'
5	180	0-5	225	1260'	-3°30'	- 9°30'	- 6°00'	-1°00'
6	180	0-5	225	1260'	2°00'	-11°00'	- 6°30'	-0°30'
AVERAGE					-1°00'	- 8°00'	- 5°00'	-1°30'

CRUISE SPEED - 60 KNOTS

1	180	10-12	247.5	1260'	2°00'	- 7°30'	- 3°30'	-3°30'
2	180	0-5	180	1195'	-4°30'	-11°00'	- 8°00'	-1°00'
3	180	0-5	225	1285'	-2°00'	-12°00'	- 8°30'	0°30'
4	180	0-5	225	1060'	0°30'	- 9°00'	- 4°30'	-2°00'
5	180	0-5	225	1125'	-4°30'	-12°00'	- 8°30'	-0°30'
6	180	0-5	225	1260'	-7°00'	-13°00'	-10°00'	-1°30'
AVERAGE					-2°30'	-10°30'	- 7°00'	-1°30'

CRUISE SPEED - 80 KNOTS

1	180	10-12	247.5	1215'	-6°00'	-12°30'	- 9°30'	0°30'
2	180	0-5	180	1260'	-3°30'	-12°30'	- 8°00'	1°30'
3	180	0-5	225	1305'	-8°30'	-13°00'	-11°00'	-0°30'
4	180	0-5	225	1240'	-3°00'	- 9°00'	- 6°00'	-1°30'
5	180	0-5	225	1260'	-8°00'	-13°00'	-10°00'	-1°30'
6	180	0-5	225	1240'	0°00'	-12°00'	- 9°30'	-1°00'
AVERAGE					-5°00'	-12°00'	- 9°00'	-0°30'

R-21 CRUISE

CRUISE SPEED - 70 KNOTS

1 FLIGHT NO.	2 HEADING (deg.)	3 WIND VELOCITY	4 FROM (deg.)	5 LENGTH OF FLIGHT PATH	6 MAXIMUM ATTITUDE	7 MINIMUM ATTITUDE	8 AVERAGE ATTITUDE	9 AVERAGE FLIGHT PATH
1	---	10-12	180	1305'	5°00'	-1°00'	3°30'	0°30'
2	---	10-12	180	1305'	5°00'	0°00'	4°00'	0°30'
3	180	0-8	225	1305'	7°00'	0°30'	4°00'	0°00'
4	180	0-8	225	1305'	12°00'	1°00'	6°00'	-1°00'
5	180	0-8	225	1305'	6°00'	2°00'	3°30'	2°00'
6	180	0-8	225	1305'	5°30'	0°00'	3°30'	2°30'
7	180	0-8	225	1330'	4°30'	-0°30'	2°00'	0°30'
8	180	0-8	225	1305'	9°30'	2°30'	5°00'	0°00'
9	180	0-8	225	1260'	7°30'	3°00'	5°00'	2°30'
10	180	0-8	225	1305'	6°00'	1°00'	3°00'	-0°30'
AVERAGE					7°00'	1°00'	4°00'	0°30'

CRUISE SPEED - 90 KNOTS

1	---	10-12	180	1305'	5°00'	2°00'	3°30'	0°00'
2	---	10-12	180	1305'	2°30'	-1°00'	1°30'	-0°30'
3	180	0-8	225	1305'	4°30'	0°30'	1°30'	1°00'
4	180	0-8	225	1305'	2°30'	-0°30'	1°00'	-1°30'
5	180	0-8	225	1305'	1°30'	-0°30'	0°30'	-0°30'
6	180	0-8	225	1305'	2°00'	0°30'	1°30'	1°00'
7	180	0-8	225	1305'	1°30'	-0°30'	0°00'	1°00'
8	180	0-8	225	1305'	4°30'	2°00'	3°00'	0°00'
9	180	0-8	225	1260'	2°00'	0°00'	1°30'	-1°00'
10	180	0-8	225	1305'	2°30'	0°30'	1°30'	0°00'
AVERAGE					3°00'	0°30'	1°30'	0°00'

CRUISE SPEED - 110 KNOTS

1	---	10-12	180	1305'	0°00'	-0°30'	0°00'	0°00'
2	---	10-12	180	1305'	0°00'	-2°00'	-1°00'	0°30'
3	180	0-8	225	1305'	2°00'	-0°30'	0°30'	0°00'
4	180	0-8	225	1305'	-1°30'	-3°30'	-2°30'	1°00'
5	180	0-8	225	1305'	-1°00'	-5°30'	-3°00'	0°00'
6	180	0-8	225	1285'	0°00'	-4°30'	-2°30'	-0°30'
7	180	0-8	225	1305'	-1°00'	-3°00'	-2°00'	-1°00'
8	180	0-8	225	1305'	2°00'	-2°00'	0°30'	1°00'
9	180	0-8	225	1305'	-1°00'	-4°30'	-2°00'	-2°00'
AVERAGE					0°00'	-3°00'	-1°30'	0°00'

H-34 CRUISE

CRUISE SPEED - 70 KNOTS

1 FLIGHT NO.	2 HEADING (deg.)	3 WIND VELOCITY	4 FROM (deg.)	5 LENGTH OF FLIGHT PATH	6 MAXIMUM ATTITUDE	7 MINIMUM ATTITUDE	8 AVERAGE ATTITUDE	9 AVERAGE FLIGHT PATH
1	---	10-12	180	1305'	2°00'	0°30'	1°30'	0°00'
2	---	10-12	180	1305'	3°30'	0°00'	2°30'	1°00'
3	---	10-12	180	1215'	1°30'	-1°00'	0°30'	1°30'
4	---	10-12	180	1305'	3°30'	0°00'	2°00'	2°30'
5	---	10-12	180	1305'	4°30'	2°30'	3°30'	1°30'
6	180	0-8	225	1305'	1°30'	-1°00'	0°30'	1°00'
7	180	0-8	225	1305'	2°00'	0°30'	1°30'	0°30'
8	180	0-8	225	1305'	3°30'	-0°30'	2°00'	2°00'
9	180	0-8	225	1080'	2°30'	0°00'	1°30'	0°00'
AVERAGE					2°30'	0°00'	1°30'	1°00'

CRUISE SPEED - 90 KNOTS

1	---	10-12	180	1305'	1°30'	0°30'	1°00'	2°00'
2	---	10-12	180	1305'	1°30'	-0°30'	1°00'	3°00'
3	---	10-12	180	1305'	1°00'	0°00'	0°00'	1°00'
4	---	10-12	180	1305'	2°30'	-1°30'	1°00'	2°00'
5	---	10-12	180	1305'	2°00'	0°00'	0°30'	3°00'
6	---	10-12	180	1305'	4°00'	0°00'	2°00'	3°00'
7	180	0-8	225	1305'	0°00'	-3°00'	1°00'	0°30'
8	180	0-8	225	1305'	1°00'	-3°30'	-1°00'	1°00'
9	180	0-8	225	1305'	1°30'	-1°30'	0°00'	3°00'
10	180	0-8	225	1305'	1°30'	-2°00'	0°30'	0°30'
AVERAGE					1°30'	-1°00'	0°30'	2°00'

CRUISE SPEED - 110 KNOTS

1	---	10-12	180	1240'	1°30'	-3°00'	-0°30'	4°00'
2	---	10-12	180	1305'	2°00'	-3°00'	-1°00'	3°00'
3	---	10-12	180	1305'	-1°00'	-3°00'	-2°00'	0°00'
4	---	10-12	180	1285'	1°30'	-1°00'	0°00'	3°00'
5	---	10-12	180	1195'	-1°00'	-2°30'	-1°30'	1°30'
6	---	10-12	180	1305'	0°30'	-2°30'	-0°30'	1°00'
7	180	0-8	225	1305'	-1°30'	-4°00'	-3°00'	-0°30'
8	180	0-8	225	1305'	0°00'	-2°00'	-1°00'	-1°00'
9	180	0-8	225	1240'	-1°00'	-3°30'	-2°00'	0°30'
10	180	0-8	225	1305'	-1°30'	-4°30'	-3°00'	-0°30'
AVERAGE					0°00'	-3°00'	-1°30'	1°00'

H-13 NORMAL LANDING TO A PANEL

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 FROM (deg)	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL 13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL 15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	180	18/g-36	330	1285'	0'	2°00'	450'	-2°00'	925'	0°30'	-14°30'	23°30'	90'	13°00'	925'	16°30'
2	360	18/g-36	330	1240'	0'	7°00'	180'	-4°30'	855'	-1°00'	-19°00'	19°30'	1215'	4°30'	45'	14°30'
3	180	18/g-36	330	945'	0'	2°30'	115'	-4°00'	675'	-1°00'	-11°30'	14°30'	90'	6°30'	675'	9°30'
4	180	18/g-36	330	1105'	0'	4°00'	90'	0°00'	970'	2°00'	-12°00'	21°00'	25'	12°30'	990'	16°00'
5	360	18/g-36	330	925'	0'	5°30'	70'	-1°30'	655'	1°00'	-13°00'	47°30'	45'	13°00'	655'	18°00'
6	---	0-5	360	700'	0'	4°30'	70'	-2°00'	610'	0°30'	-15°30'	26°00'	45'	13°00'	360'	15°00'
7	---	0-5	360	790'	25'	2°00'	45'	-3°00'	360'	-0°30'	-22°00'	28°00'	45'	21°30'	360'	24°30'
8	---	0-8	180	675'	0'	5°00'	90'	-2°30'	360'	0°30'	-15°30'	41°00'	25'	13°30'	250'	17°00'
9	---	0-2	360	1240'	0'	11°00'	70'	-0°30'	810'	2°00'	-10°30'	82°30'	25'	10°30'	810'	15°30'
10	---	0-2	360	1015'	0'	3°00'	135'	-3°00'	630'	-0°30'	-12°00'	23°00'	45'	8°30'	250'	11°00'
11	---	0-2	360	1240'	0'	8°30'	45'	0°30'	475'	2°00'	-13°30'	90°00'	25'	15°00'	1035'	20°00'
12	--	Wind steadying toward 10 with gusts to 19		1195'	25'	6°30'	70'	1°00'	630'	2°30'	-11°30'	17°30'	430'	11°00'	115'	14°00'
13	180	0-5	225	1305'	0'	2°00'	90'	-3°30'	180'	-1°30'	-13°00'	90°00'	25'	10°00'	1080'	14°00'
14	180	0-5	247 5	1260'	0'	2°00'	25'	-6°00'	1060'	-2°30'	-12°30'	90°00'	25'	7°00'	1080'	14°00'
15	180	0-5	225	1215'	25'	2°30'	45'	-5°30'	585'	-3°00'	-18°00'	19°30'	655'	10°30'	70'	17°00'
AVERAGE					05'	4°30'	105'	-2°30'	650'	0°00'	-14°00'	42°00'	185'	11°30'	580'	15°30'

H-13 STEEP APPROACH TO A PANEL

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 FROM (deg)	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN - PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL. 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL 13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL 15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	---	0-5	360	1170'	0'	5°00'	70'	-3°00'	1080'	-0°30'	-14°00'	33°00'	25'	13°00'	1080'	18°30'
2	---	0-5	360	925'	0'	7°30'	90'	-2°30'	765'	0°00'	-14°30'	21°30'	70'	12°00'	925'	15°00'
3	---	0-5	360	810'	0'	4°00'	45'	-3°00'	450'	-0°30'	-23°00'	32°00'	45'	21°30'	450'	24°30'
4	---	0-5	360	745'	0'	2°00'	70'	-2°00'	655'	0°00'	-20°30'	30°00'	45'	19°30'	655'	24°00'
5	---	0-2	360	1170'	0'	7°30'	45'	-2°30'	675'	0°00'	-17°30'	87°00'	25'	16°30'	160'	21°30'
6	---	0-2	360	1015'	0'	6°00'	45'	0°00'	585'	2°30'	-16°00'	74°30'	25'	18°30'	970'	24°30'
7	---	0-2	360	1035'	0'	5°00'	70'	0°30'	495'	2°30'	-16°30'	32°30'	70'	19°00'	585'	21°30'
8	Wind steadying toward 10 with gusts to 19			1150'	0'	3°00'	70'	1°30'	225'	2°00'	-14°00'	31°30'	45'	16°30'	1035'	19°00'
9	180	10-12	247 5	1260'	0'	2°00'	720'	-5°30'	1080'	-2°30'	-18°30'	89°00'	25'	16°00'	1240'	29°00'
10	180	0-5	180	1260'	0'	0°00'	25'	-4°30'	700'	-3°00'	-15°30'	90°00'	25'	12°30'	1240'	20°00'
11	180	0-5	247 5	700'	0'	0°30'	25'	-5°00'	610'	-2°30'	-17°00'	90°00'	25'	13°30'	610'	21°30'
12	180	0-5	225	1215'	25'	1°00'	45'	-4°00'	475'	-2°30'	-18°30'	17°30'	565'	12°30'	45'	16°00'
13	180	0-5	225	1195'	70'	0°00'	250'	-6000'	945'	-3°00'	-18°00'	20°30'	250'	6°00'	45'	16°30'
AVERAGE					10'	3°30'	120'	-3°00'	675'	-0°30'	-17°00'	50°00'	95'	15°00'	695'	21°00'

H-13 AUTOROTATION TO A TOUCHDOWN

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 FROM (deg)	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL 13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL 15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	L-360	18/g-36	330	945'	0'	2°00'	180'	- 3°30'	360'	-0°30'	-23°30'	88°00'	25'	3°00'	70'	18°30'
2	L-360	18/g-36	330	1240'	25'	2°00'	790'	- 6°30'	1215'	-1°00'	-21°00'	27°00'	675'	14°30'	1215'	23°00
3	L-360	18/g-36	330	1035'	0'	3°00'	205'	- 1°00'	610'	0°30'	-16°30'	17°00'	990'	2°30'	135'	11°00'
4	---	0-5	360	1170'	25'	6°00'	70'	- 2°30'	675'	1°00'	-18°30'	22°00'	340'	12°00'	115'	18°00'
5	---	0-5	360	520'	0'	4°30'	45'	- 2°00'	180'	0°00'	-25°00'	90°00'	25'	20°30'	70'	27°30'
6	---	0-5	360	1240'	0'	6°00'	160'	- 4°00'	250'	-1°00'	-19°00'	27°00'	45'	8°00'	115'	18°30'
7	---	0-2	360	1080'	70'	6°30'	160'	- 1°00'	450'	1°00'	-21°30'	23°00'	900'	5°30'	45'	18°30'
8	---	0-2	360	1125'	70'	5°30'	45'	- 6°30'	970'	-1°00'	-19°00'	17°30'	585'	7°30'	25'	13°00'
9	---	10-12	247 5	925'	0'	0°00'	90'	-11°30'	925'	-3°00'	-25°00'	89°30'	25'	14°00'	925'	24°00'
10	---	0-5	180	990'	0'	2°00'	25'	-12°30'	835'	-4°00'	-24°30'	90°00'	25'	11°30'	810'	19°00'
AVERAGE					20'	3°30'	180'	- 5°00'	630'	-1°00'	-21°00'	49°00'	365'	10°00'	355'	18°30'

H-13 NORMAL TAKEOFF

1 FLIGHT NO.	2 HEADING (deg.)	3 WIND VELOCITY	4 FROM (deg.)	5 LENGTH OF FLIGHT PATH	6 MAXIMUM ATTITUDE	7 DISTANCE COL. 6 AFTER TAKEOFF	8 MINIMUM ATTITUDE	9 DISTANCE COL. 8 AFTER TAKEOFF	10 AVERAGE NOSE-UP ATTITUDE	11 AVERAGE NOSE-DOWN ATTITUDE	12 AVERAGE FLIGHT PATH
1	R-180	18/g-36	330	1305'	3°00'	1305'	-12°30'	45'	2°00'	- 3°30'	7°00'
2	R-180	80/g-18	330	1215'	0°30'	405'	- 4°00'	45'	0°30'	- 2°00'	4°30'
3	R-180			1305'	0°30'	495'	- 8°00'	90'	0°30'	- 2°30'	6°00'
4	R-180	80/g-18	330	1125'	2°00'	1060'	- 4°00'	295'	1°00'	- 2°30'	7°00'
5	---	0-5	360	1260'	-3°30'	45'	-10°00'	405'	----	- 7°30'	7°30'
6	---	0-5	360	880'	-2°00'	115'	-12°30'	405'	----	- 9°00'	8°00'
7	---	0-8	180	675'	-8°00'	675'	-13°00'	225'	----	-11°00'	3°00'
8	---	0-2	360	1080'	-6°00'	160'	-12°30'	810'	----	- 9°00'	9°00'
9	---	0-2	360	1195'	-7°30'	270'	-12°30'	115'	----	- 9°00'	6°00'
10	---	0-2	360	1285'	-6°30'	45'	-14°30'	540'	----	-10°00'	7°30'
11	---	0-2	360	1260'	0°00'	1215'	- 9°30'	70'	----	- 5°00'	10°30'
12	---	0-2	360	1195'	-1°00'	1105'	-12°30'	180'	----	- 6°30'	16°30'
13	Wind steady 10 with gusts to 19			1195'	-2°00'	1125'	-10°30'	430'	----	- 7°00'	11°30'
AVERAGE				1150'	-2°30'	615'	-10°30'	280'	1°00'	- 6°30'	8°00'

H-21 NORMAL TAKEOFF

1 FLIGHT NO.	2 HEADING (deg.)	3 WIND VELOCITY	4 FROM (deg.)	5 LENGTH OF FLIGHT PATH	6 MAXIMUM ATTITUDE	7 DISTANCE COL. 6 AFTER TAKEOFF	8 MINIMUM ATTITUDE	9 DISTANCE COL. 8 AFTER TAKEOFF	10 AVERAGE NOSE-UP ATTITUDE	11 AVERAGE NOSE-DOWN ATTITUDE	12 AVERAGE FLIGHT PATH
1	285	15-20 mph	275	700'	4°30'	610'	-2°00'	315'	2°30'	-1°00'	4°30'
2	285	15-20 mph	275	585'	4°00'	430'	-3°00'	160'	3°00'	-1°30'	3°30'
3	285	15-20 mph	275	810'	8°30'	115'	0°00'	475'	3°30'	None	1°30'
4	285	15-20 mph	275	565'	4°00'	0'	0°00'	270'	2°00'	None	1°50'
5	285	15-20 mph	275	475'	1°00'	430'	-3°00'	45'	1°00'	-1°30'	1°00'
6	285	15-20 mph	275	540'	1°00'	520'	-3°30'	205'	1°00'	-2°00'	2°00'
7	285	5-10 mph	275	630'	4°00'	45'	-1°00'	295'	2°00'	-0°30'	1°30'
8	285	5-10 mph	275	765'	10°30'	70'	-3°00'	385'	4°30'	-1°30'	1°00'
9	285	5-10 mph	275	700'	2°00'	675'	-3°00'	430'	0°30'	-1°30'	1°30'
10	285	5-10 mph	275	745'	7°00'	0'	-3°00'	405'	2°30'	-1°30'	2°00'
11	285	5-10 mph	275	675'	5°00'	0'	-2°30'	495'	2°30'	-1°30'	2°00'
12	285	5-10 mph	275	765'	2°00'	0'	-1°30'	205'	1°00'	-0°30'	2°00'
13	285	5-10 mph	275	765'	3°30'	0'	-0°30'	205'	1°00'	-0°30'	2°00'
AVERAGE					4°30'	280'	-2°00'	315'	2°00'	-1°30'	2°00'

H-21 AUTOROTATION LANDING TO TOUCHDOWN

1 FLIGHT NO	2 HEADING (deg.)	3 WIND VELOCITY	4 FROM (deg)	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL 13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL 15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	285	15-20 mph	275	1350'	45'	22°00'	20'	11°30'	1240'	17°30'	-14°30'	46°30'	20'	25°30'	1285'	37°00'
2	285	15-20 mph	275	1215'	45'	20°00'	90'	11°00'	450'	15°30'	-13°30'	35°00'	0'	25°00'	450'	29°00'
3	285	15-20 mph	275	1215'	25'	23°30'	45'	7°30'	1170'	13°30'	-14°30'	58°30'	0'	21°30'	880'	27°00'
4	285	15-20 mph	275	1150'	25'	20°00'	115'	11°30'	1015'	14°00'	-17°00'	40°00'	0'	28°30'	1035'	32°30'
5	285	5-10 mph	275	1305'	0'	24°00'	360'	9°30'	1285'	16°30'	- 9°00'	73°00'	45'	20°00'	1215'	31°30'
6	285	5-10 mph	275	1305'	0'	18°30'	675'	7°30'	970'	14°30'	-14°30'	90°00'	0'	24°00'	970'	37°00'
7	285	5-10 mph	275	1240'	90'	18°00'	45'	5°00'	1150'	13°30'	-10°00'	27°00'	45'	14°00'	1150'	21°00'
8	285	5-10 mph	275	1105'	0'	28°00'	45'	1°00'	700'	8°30'	-22°30'	90°00'	0'	24°00'	700'	35°30'
9	285	5-10 mph	275	1170'	0'	21°00'	90'	4°00'	1080'	9°30'	-19°30'	54°30'	90'	24°00'	1080'	31°30'
10	285	5-10 mph	275	1215'	45'	23°30'	45'	2°00'	1060'	9°30'	-20°30'	44°00'	20'	22°00'	1060'	28°00'
11	285	5-10 mph	275	1150'	25'	21°30'	90'	4°00'	1035'	13°30'	-14°00'	38°00'	45'	18°00'	1035'	26°00'
12	285	5-10 mph	275	1195'	115'	28°00'	45'	6°30'	520'	11°00'	-14°00'	39°00'	45'	18°30'	520'	23°00'
13	285	5-10 mph	275	1195'	115'	22°30'	20'	8°30'	810'	13°30'	-11°00'	33°30'	20'	17°30'	495'	22°00'
AVERAGE					41'	22°30'	120'	7°00'	920'	13°00'	-15°00'	51°30'	25'	21°30'	930'	29°30'

H-21 NORMAL LANDING TO A PANEL

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 FROM (deg)	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL 13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL 15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	285	15-25 mph	275	1285'	45'	22°30'	0'	9°00'	1035'	13°30'	- 8°00'	46°30'	0'	17°30'	1080'	24°30'
2	285	15-25 mph	275	1260'	25'	17°00'	0'	7°00'	1190'	12°30'	- 9°00'	70°00'	0'	16°30'	1190'	23°00'
3	285	15-25 mph	275	1285'	25'	19°00'	20'	6°00'	1260'	12°30'	- 7°00'	57°30'	0'	13°00'	1220'	23°00'
4	285	5-10 mph	275	1215'	25'	22°00'	0'	13°00'	1010'	15°30'	- 7°30'	90°00'	0'	22°00'	1010'	29°00'
5	285	5-10 mph	275	1150'	70'	20°00'	70'	7°30'	1125'	13°00'	- 7°00'	32°00'	70'	14°30'	1125'	21°30'
6	285	5-10 mph	275	1195'	0'	19°30'	90'	8°30'	1170'	13°00'	- 7°00'	86°00'	20'	16°30'	1170'	26°00'
7	285	5-10 mph	275	925'	0'	23°30'	70'	7°00'	900'	14°00'	-11°00'	70°30'	20'	19°30'	900'	31°00'
8	285	5-10 mph	275	1305'	0'	17°00'	50'	8°30'	1100'	12°00'	-11°30'	90°00'	0'	20°30'	1100'	28°30
AVERAGE					24'	20°00'	40'	8°30'	1135'	13°00'	- 8°30'	68°00'	15'	18°00'	1100'	25°30'

H-21 STEEP APPROACH TO A PANEL

1	285	10-15 mph	275	970'	45'	15°30'	90'	11°00'	945'	13°30'	-13°30'	37°00'	90'	25°30'	945'	32°00'
2	285	10-15 mph	275	1285'	0'	20°30'	1190'	11°00'	540'	14°30'	-15°00'	90°00'	0'	27°00'	520'	33°00'
3	285	10-15 mph	275	1260'	25'	16°30'	20'	9°30'	1035'	13°30'	-13°00'	51°30'	0'	23°00'	1035'	28°00'
4	285	10-15 mph	275	1305'	0'	18°00'	200'	9°00'	1240'	13°00'	-12°00'	90°00'	0'	21°00'	1240'	30°00'
5	285	5-10 mph	275	1260'	25'	21°30'	90'	10°00'	1080'	14°00'	-14°30'	39°00'	45'	25°30'	1125'	30°00'
6	285	5-10 mph	275	1240'	0'	22°00'	1215'	11°30'	585'	15°30'	-12°30'	90°00'	0'	27°30'	585'	34°30'
7	285	5-10 mph	275	1240'	25'	16°00'	610'	10°00'	1150'	13°00'	- 9°00'	49°30'	0'	19°30'	1170'	26°00'
8	285	5-10 mph	275	970'	0'	17°00'	20'	5°30'	855'	11°00'	-16°00'	90°00'	0'	22°30'	855'	33°83'
9	285	5-10 mph	275	1170'	0'	17°00'	90'	5°30'	1125'	10°00'	-19°30'	83°00'	0'	26°30'	1125'	35°30'
10	285	5-10 mph	275	1305'	0'	20°00'	70'	9°00'	1010'	12°00'	-17°00'	67°00'	20'	28°00'	1010'	33°30'
11	285	5-10 mph	275	1305'	0'	15°00'	135'	9°30'	900'	12°00'	-16°30'	90°00'	0'	28°00'	900'	35°30'
AVERAGE					11'	18°00'	325'	9°00'	1020'	13°00'	-14°30'	70°30'	15'	25°00'	960'	32°00'

H-34 STEEP APPROACH TO A PANEL

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 FROM	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL 13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL 15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	180	0	--	1125'	90'	9°30'	115'	4°30'	700'	7°00'	-11°00'	19°00'	225'	14°30'	675'	16°30'
2	180	0	--	1125'	135'	16°00'	135'	6°00'	720'	9°30'	- 7°00'	22°30'	135'	11°30'	720'	15°30'
3	180	0	--	1150'	115'	11°30'	115'	5°30'	990'	8°30'	- 8°00'	17°30'	135'	12°30'	990'	15°30'
4	180	0	--	1150'	70'	11°00'	45'	4°30'	475'	7°00'	-14°00'	22°00'	205'	17°00'	1125'	19°30'
5	180	0	--	1195'	70'	13°30'	90'	7°30'	745'	9°00'	- 7°30'	25°00'	25'	15°30'	990'	18°30'
6	180	0	--	1125'	70'	11°00'	205'	6°30'	25'	8°30'	-10°00'	21°00'	160'	16°30'	945'	19°00'
7	180	0	--	1150'	115'	9°50'	90'	7°00'	810'	8°00'	- 7°30'	16°00'	405'	13°30'	810'	14°30'
8	180	0	--	1150'	90'	12°00'	855'	4°30'	1125'	8°30'	-13°00'	26°00'	855'	17°00'	1125'	22°00'
9	180	0	--	1015'	205'	14°00'	205'	5°30'	990'	10°30'	- 9°00'	19°30'	205'	14°00'	990'	17°00'
10	180	0	--	1015'	90'	15°30'	90'	6°00'	855'	10°00'	-12°00'	26°30'	90'	18°00'	855'	22°00'
11	180	0	--	1170'	115'	11°00'	25'	6°30'	430'	8°00'	-12°30'	21°00'	900'	17°00'	430'	19°00'
12	180	0	--	1195'	70'	12°00'	160'	4°00'	720'	8°00'	-13°30'	23°30'	540'	16°30'	25'	20°30'
13	180	0	--	1080'	45'	10°30'	160'	4°30'	45'	7°30'	- 8°00'	19°30'	160'	13°30'	855'	16°00'
14	180	0	--	1060'	90'	9°30'	0'	3°30'	70'	5°30'	-17°30'	23°30'	405'	16°00'	70'	20°30'
15	180	0	--	1170'	45'	9°00'	25'	4°00'	1035'	6°30'	-10°00'	25°30'	25'	14°00'	1035'	17°30'
16	180	0	--	1195'	25'	9°30'	160'	2°30'	1125'	7°00'	-18°30'	48°30'	0'	21°00'	1125'	28°30'
17	180	0	--	1215'	25'	9°00'	70'	4°00'	925'	6°30'	-19°00'	28°30'	70'	24°00'	270'	26°30'
18	180	0	--	1080'	70'	11°00'	90'	8°00'	700'	9°30'	- 9°00'	21°30'	90'	17°00'	700'	19°00'
19	180	0	--	1105'	45'	10°30'	900'	6°30'	90'	9°00'	-14°30'	26°10'	0'	21°00'	565'	23°30'
20	180	0	--	1060'	205'	12°30'	225'	4°30'	450'	8°00'	-10°00'	18°30'	835'	11°30'	450'	15°30'
21	180	0	--	1215'	45'	12°00'	515'	6°30'	225'	8°30'	-11°30'	25°30'	25'	16°30'	430'	20°00'
AVERAGE					85'	11°30'	250'	5°30'	690'	8°00'	-11°30'	23°30'	420'	16°00'	715'	19°30'

H-34 LANDING OVER 60-FOOT TREES WITHIN 250 FEET OF THESE TREES

1 FLIGHT NO	2 HEADING	3 4 WIND VELOCITY FROM	5 MAXIMUM ATTITUDE	6 MINIMUM ATTITUDE	7 AVERAGE ATTITUDE	8 AVERAGE FLIGHT PATH	9 MAXIMUM SIGHT ANGLE	10 MINIMUM SIGHT ANGLE	11 AVERAGE SIGHT ANGLE
1	Communications failed between operator and aircraft		11°30'	3°30'	8°00'	14°00'	26°00'	16°30'	21°00'
2			14°30'	7°30'	10°30'	12°00'	27°00'	18°30'	22°30'
3			11°30'	4°00'	7°00'	14°30'	26°30'	17°30'	21°00'
4			13°00'	8°00'	10°00'	12°30'	25°30'	19°30'	22°30'
5			12°30'	3°30'	7°00'	14°30'	27°30'	17°30'	21°00'
6			13°30'	8°00'	11°00'	14°00'	27°00'	21°30'	24°00'
7			10°00'	2°30'	7°00'	13°00'	24°00'	14°30'	20°00'
8			11°00'	6°30'	8°00'	10°30'	23°30'	17°30'	19°30'
9			10°00'	6°00'	8°00'	13°00'	24°30'	19°30'	21°30'
10			10°30'	6°30'	8°00'	9°00'	35°30'	18°30'	23°30'
11			14°00'	2°00'	9°00'	10°00'	58°00'	18°00'	34°30'
12			10°30'	6°00'	9°00'	14°00'	54°00'	22°00'	32°30'
13			11°00'	4°30'	7°30'	10°30'	36°30'	18°30'	23°90'
14			13°30'	5°00'	9°30'	13°00'	50°00'	20°30'	29°30'
15			9°00'	7°30'	8°30'	13°00'	27°30'	21°00'	24°00'
16			9°00'	2°00'	5°00'	11°00'	23°00'	14°00'	17°30'
17			11°30'	7°00'	9°00'	12°00'	61°00'	23°30'	31°30'
18			10°00'	6°00'	7°30'	11°30'	52°30'	21°30'	27°30'
19			10°30'	3°30'	6°30'	15°00'	22°00'	15°30'	18°24'
20			12°30'	8°30'	10°30'	16°30'	45°30'	28°30'	35°00'
21			12°00'	7°00'	8°00'	13°30'	24°30'	20°30'	21°30'
22			9°30'	5°30'	7°30'	14°30'	25°00'	19°00'	22°30'
23			10°00'	6°30'	8°30'	12°30'	25°30'	20°30'	23°00'
24			10°30'	7°30'	9°00'	12°00'	68°30'	22°00'	31°30'
25			13°00'	9°00'	11°00'	12°00'	90°00'	24°30'	39°00'
26			10°30'	6°30'	8°30'	13°00'	26°30'	19°30'	22°00'
AVERAGE			11°30'	6°00'	8°30'	13°00'	37°00'	19°30'	25°00'

H-34 AUTOROTATION TO A PANEL

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 WIND FROM	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL 13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL 15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	180	0	--	1170'	90'	16°30'	1150'	6°00'	340'	11°30'	-14°00'	30°30'	990'	20°00'	70'	25°30'
2	180	0	--	1240'	0'	23°30'	270'	3 00'	1170'	10°00'	- 9°30'	50°30'	25'	12°30'	1170'	21°00'
3	180	0	--	1215'	25'	17°30'	90'	5°30'	295'	10°30'	-11°00'	55°30'	0'	19°30'	1080'	24°30'
4	180	0	--	1105'	135'	19°00'	45'	7°30'	495'	11°30'	-12°30'	28°00'	990'	17°30'	180'	23°00'
5	180	0	--	1215'	45'	18°00'	25'	6°30'	945'	11°00'	- 9°30'	45°30'	0'	16°30'	945'	22°30'
6	180	0	--	1260'	0'	15°00'	1015'	0°00'	225'	7°30'	-15°30'	38°30'	45'	16°30'	1215'	26°00'
7	180	0	--	1035'	225'	18°30'	45'	4°30'	810'	9°00'	- 7°30'	24°00'	45'	10°30'	655'	14°30'
8	180	0	--	1170'	70'	19°00'	1080'	3°00'	430'	11°00'	-17°00'	38°30'	90'	25°00'	430'	31°30'
9	180	0	--	1195'	70'	22°00'	0'	7°00'	520'	11°00'	- 7°30'	40°00'	0'	13°30'	520'	18°30'
10	180	0	--	1195'	70'	18°00'	90'	4°30'	1195'	9°30'	-10°00'	29°00'	90'	14°30'	970'	19°30'
11	180	0	--	1080'	180'	18°30'	25'	3°30'	855'	9°30'	- 7°00'	26°00'	25'	10°00'	855'	16°00'
AVERAGE					85'	18°30'	360'	4°30'	745'	10°30'	-11°00'	37°00'	285'	16°00'	800'	22°30'

H-34 NORMAL LANDING TO A PANEL

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 FROM	5 LENGTH OF FLIGHT PATH	6 DISTANCE TOUCHED DOWN BEFORE TOUCHDOWN PANEL	7 MAXIMUM ATTITUDE	8 DISTANCE COL 7 BEFORE ACTUAL TOUCHDOWN	9 MINIMUM ATTITUDE	10 DISTANCE COL 9 BEFORE ACTUAL TOUCHDOWN	11 AVERAGE ATTITUDE	12 AVERAGE FLIGHT PATH	13 MAXIMUM SIGHT ANGLE	14 DISTANCE COL 13 BEFORE ACTUAL TOUCHDOWN	15 MINIMUM SIGHT ANGLE	16 DISTANCE COL 15 BEFORE ACTUAL TOUCHDOWN	17 AVERAGE SIGHT ANGLE
1	180	0	--	1150'	90'	12°00'	90'	5°30'	45'	8°00'	- 3°30'	28°30'	90'	10°30'	565'	13°00'
2	180	0	--	1195'	70'	13°00'	160'	5°30'	1080'	9°00'	- 6°30'	22°00'	160'	12°00'	990'	16°00
3	180	0	--	1015'	135'	15°30'	160'	8°00'	520'	11°00'	- 4°30'	Not Available		Not Available		
4	180	0	--	1150'	90'	12°00'	135'	5°30'	45'	8°00'	- 6°30'	18°30'	135'	6°00'	25'	14°30'
5	180	0	--	1170'	45'	15°00'	135'	5°00'	1080'	9°00'	- 7°00'	25°00'	135'	12°30'	925'	18°00'
6	180	0	--	1035'	205'	13°00'	225'	7°30'	790'	10°30'	- 4°00'	17°30'	225'	12°00'	1015'	15°00'
7	180	0	--	1105'	135'	14°00'	25'	6°00'	970'	10°00'	- 6°00'	21°00'	25'	12°00'	970'	16°00'
8	180	0	--	1080'	90'	11°00'	160'	5°30'	1060'	9°00'	- 5°00'	17°30'	70'	11°00'	1060'	14°30'
9	180	0	--	1150'	90'	13°00'	225'	3°30'	1105'	8°00'	- 5°30'	19°30'	250'	9°30'	1105'	14°30'
10	180	0	--	990'	160'	16°00'	205'	7°00'	25'	11°30'	- 4°30'	20°30'	180'	14°30'	540'	16°00'
11	180	0	--	1125'	90'	13°00'	250'	6°30'	1060'	9°30'	- 7°00'	21°00'	250'	14°00'	1060'	17°30'
12	180	0	--	1150'	90'	11°30'	250'	2°00'	1060'	8°00'	- 7°30'	20°00'	270'	10°00'	1060'	16°30'
13	180	0	--	1080'	205'	14°00'	115'	7°00'	900'	9°30'	- 6°30'	18°00'	160'	13°00'	1105'	15°00'
14	180	0	--	1125'	90'	8°40'	315'	5°00'	25'	7°00'	- 7°30'	16°00'	45'	12°30'	1060'	14°00'
15	180	0	--	1060'	205'	10°30'	135'	4°00'	945'	6°30'	- 4°30'	14°30'	135'	8°30'	945'	10°30'
16	180	0	--	1105'	45'	10°30'	180'	6°00'	340'	9°00'	- 7°30'	36°30'	25'	15°30'	340'	19°30'
17	180	0	--	1150'	45'	11°30'	90'	5°00'	835'	7°00'	-12°30'	22°30'	90'	17°00'	835'	19°00'
18	180	0	--	1170'	45'	10°30'	225'	4°00'	1150'	7°30'	-12°30'	22°30'	225'	16°00'	1150'	19°30'
19	180	0	--	1170'	90'	11°30'	70'	3°30'	1080'	8°00'	- 4°30'	19°30'	0'	8°00'	1080'	13°30'
20	180	0	--	1215'	45'	16°00'	180'	4°30'	1150'	10°00'	- 9°00'	25°00'	180'	14°00'	1150'	19°30'
21	180	0	--	1015'	205'	8°00'	115'	4°00'	655'	5°30'	-10°00'	14°00'	925'	7°30'	115'	12°30'
AVERAGE					108'	12°30'	170'	5°30'	805'	8°30'	- 7°00'	21°00'	215'	12°30'	860'	15°30'

H-34 NORMAL TAKEOFF

1 FLIGHT NO	2 HEADING (deg)	3 WIND VELOCITY	4 WIND FROM	5 LENGTH OF FLIGHT PATH	6 MAXIMUM ATTITUDE	7 DISTANCE COL 6 AFTER TAKEOFF	8 MINIMUM ATTITUDE	9 DISTANCE COL 8 AFTER TAKEOFF	10 AVERAGE NOSE-UP ATTITUDE	11 AVERAGE NOSE-DOWN ATTITUDE	12 AVERAGE FLIGHT PATH
1	360	0	--	1260'	5°00'	1240'	- 4°00'	115'	1°00'	- 1°30'	5°00'
2	360	0	--	1260'	4°00'	385'	- 5°30'	790'	1°30'	- 2°30'	4°00'
3	360	0	--	1260'	6°30'	1240'	- 9°00'	45'	4°00'	- 4°30'	6°00'
4	360	0	--	1260'	5°00'	1240'	- 8°00'	70'	2°30'	- 5°00'	6°00'
5	360	0	--	1260'	0°00'	1105'	- 8°30'	225'	None	- 4°30'	3°30'
6	360	0	--	1260'	1°00'	855'	- 9°30'	115'	0°30'	- 3°30'	5°30'
7	360	0	--	1240'	0°00'	1015'	- 6°30'	90'	None	- 2°30'	5°00'
8	360	0	--	1260'	0°30'	1125'	- 6°30'	25'	0°00'	- 3°00'	3°30'
9	360	0	--	1215'	0°00'	0'	- 8°30'	70'	None	- 3°30'	3°30'
10	360	0	--	1305'	0°00'	610'	-10°00'	25'	None	- 3°00'	4°30'
11	360	0	--	1260'	4°00'	745'	-16°30'	115'	3°00'	-11°00'	6°30'
12	360	0	--	1260'	0°00'	45'	- 7°00'	90'	None	- 3°30'	4°00'
13	360	0	--	1260'	1°30'	700'	-13°30'	135'	1°00'	- 5°30'	6°30'
14	360	0	--	1240'	1°00'	1125'	-11°30'	115'	1°00'	- 5°00'	6°00'
15	360	0	--	1195'	1°30'	855'	-11°00'	160'	1°00'	- 6°00'	8°00'
16	360	0	--	1260'	4°30'	1060'	- 9°30'	25'	2°30'	- 6°00'	6°30'
18	360	0	---	790'	-2°30'	540'	- 8000'	180'	None	- 5°00'	7°00'
19	360	0	--	1240'	1°30'	970'	-10°30'	70'	0°30'	- 6°30'	5°00'
20	360	0	--	1260'	0°00'	25'	-15°30'	115'	None	- 7°00'	7°00'
21	360	0	--	1260'	1°30'	925'	-16°30'	90'	1°30'	- 6°30'	6°00'
22	360	0	--	1260'	-1°30'	810'	-13°30'	270'	None	- 5°30'	5°00'
AVERAGE					1°30'	800'	-10°00'	145'	2°00'	- 4°30'	5°30'

NOTE WHERE NO INFORMATION IS GIVEN IN COLUMNS 2, 3, AND 4, COMMUNICATIONS FAILURE BETWEEN THE FAIRCHILD OPERATOR AND PILOT OF THE AIRCRAFT CONCERNED OCCURRED

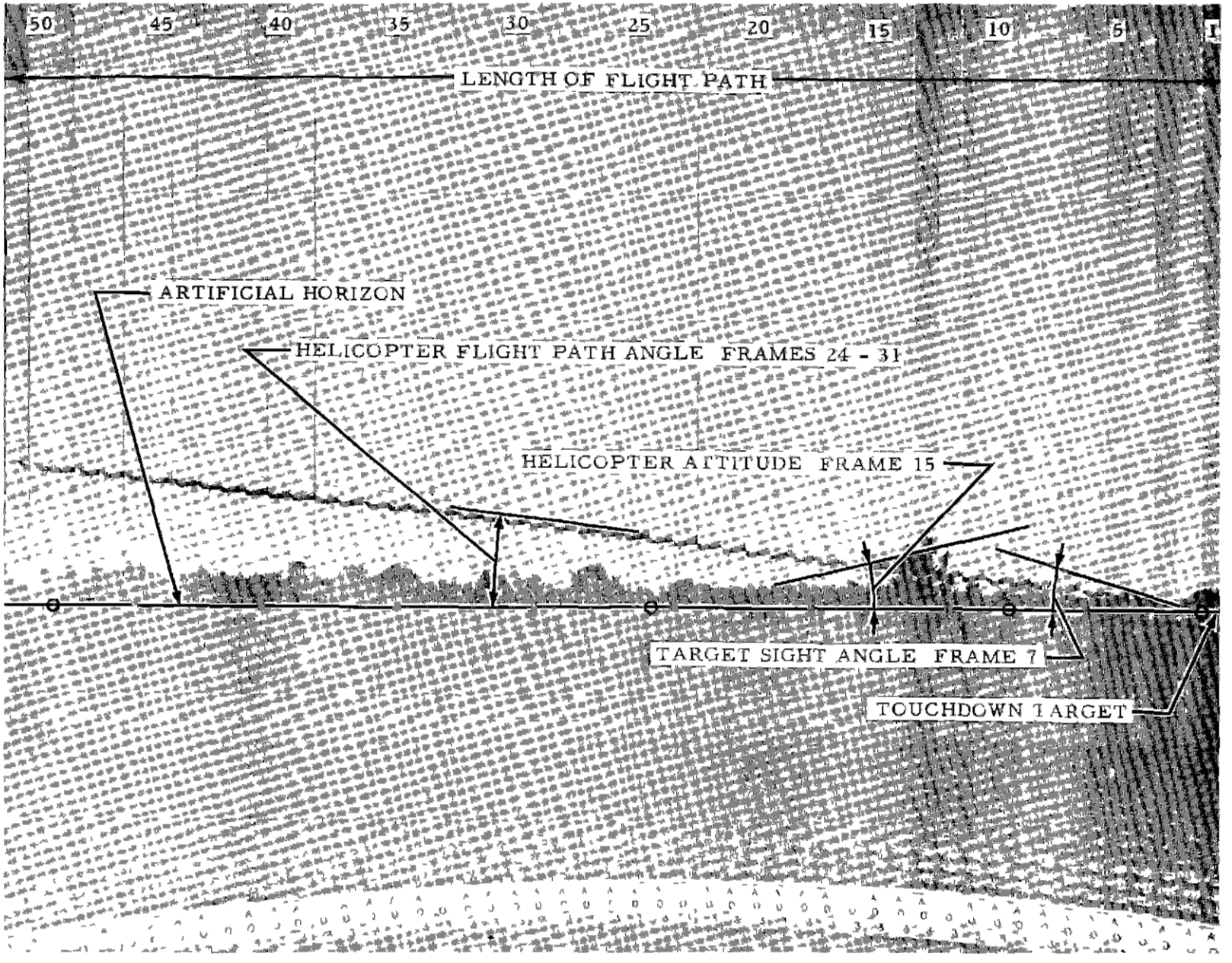


FIG 55 METHOD OF ANALYSIS FOR A NORMAL LANDING H-34

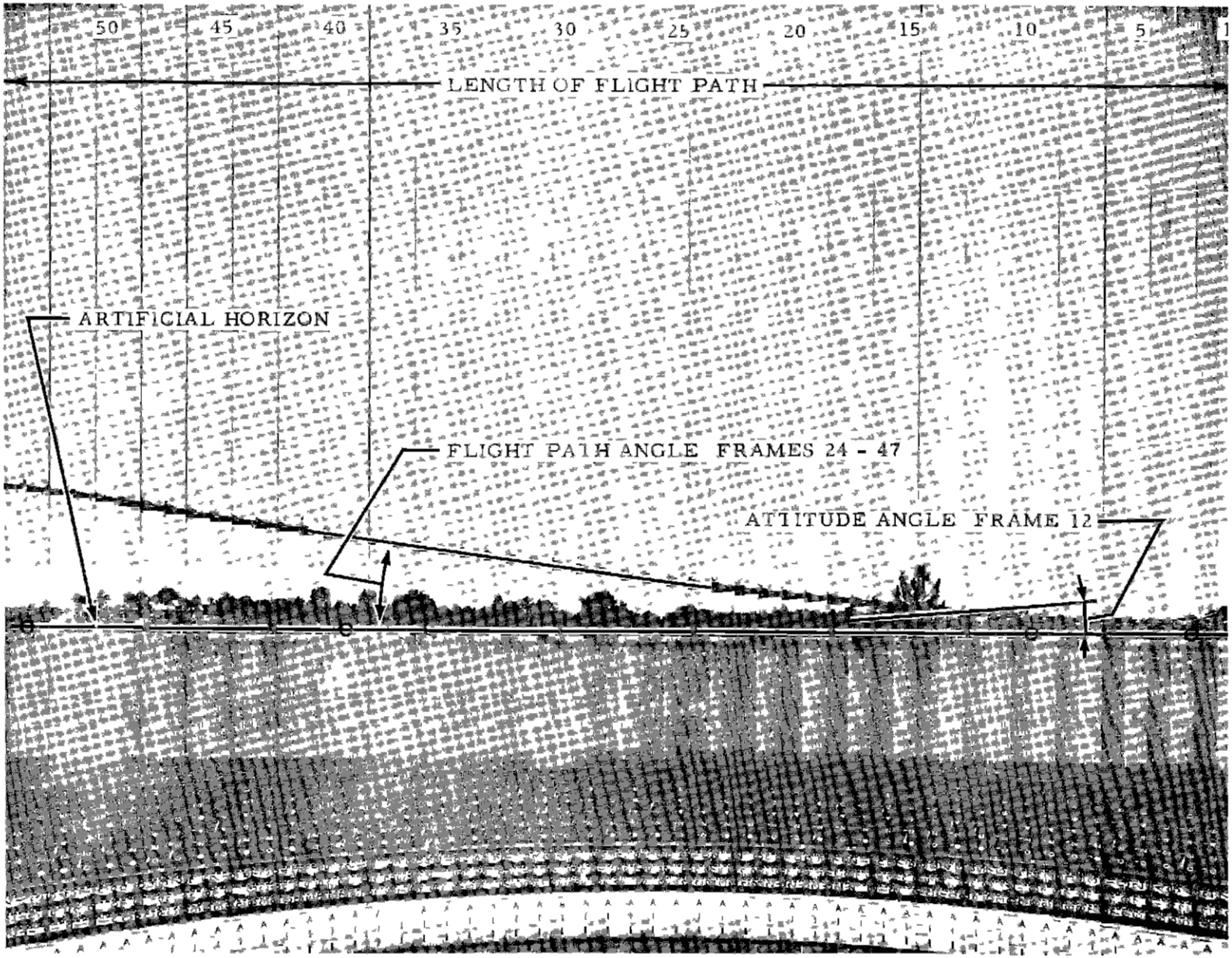


FIG 56 METHOD OF ANALYSIS FOR A NORMAL TAKEOFF H-34

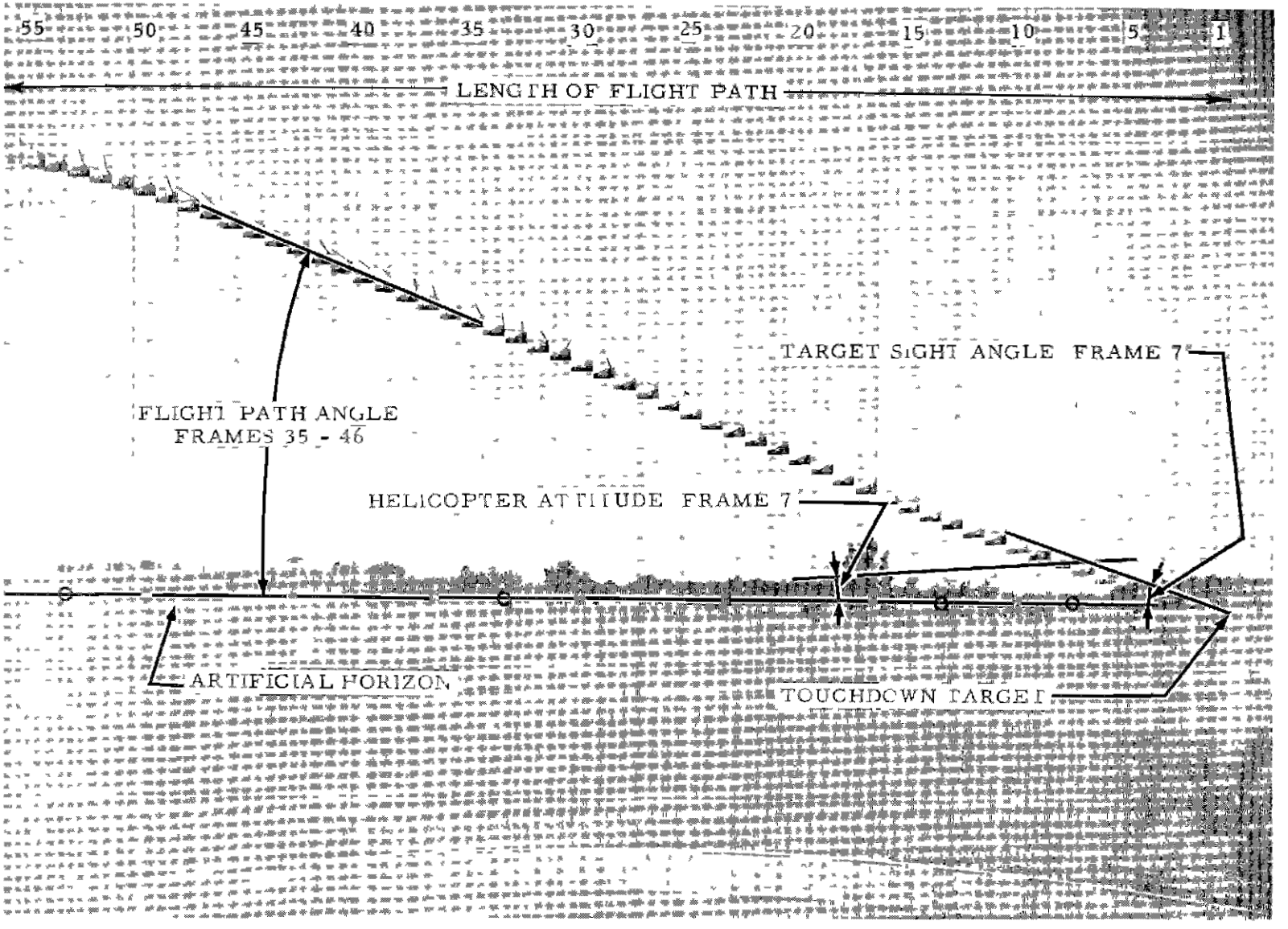


FIG 57 METHOD OF ANALYSIS FOR A STEEP APPROACH H-34

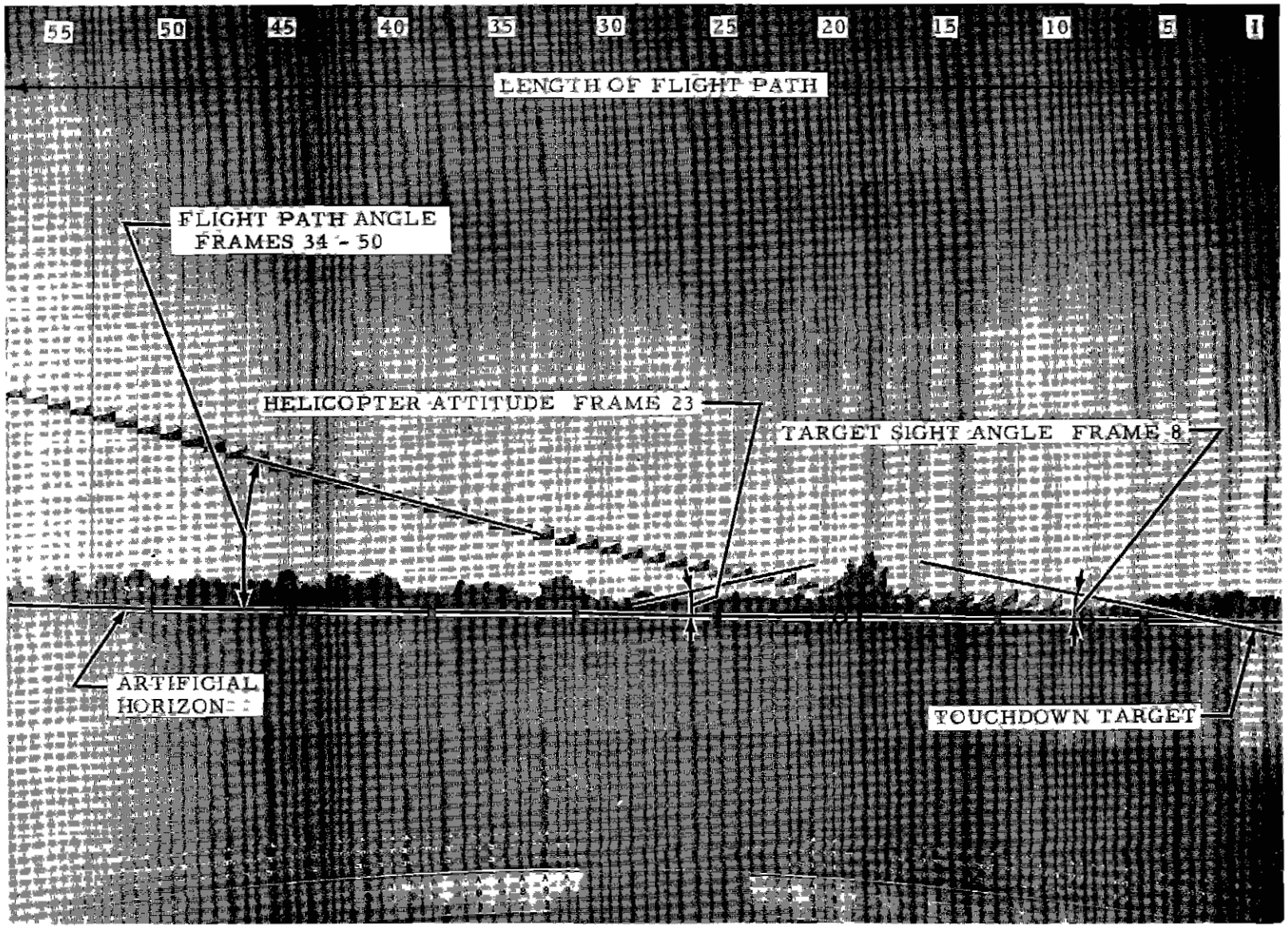


FIG. 58 METHOD OF ANALYSIS FOR AN AUTOROTATION H-34

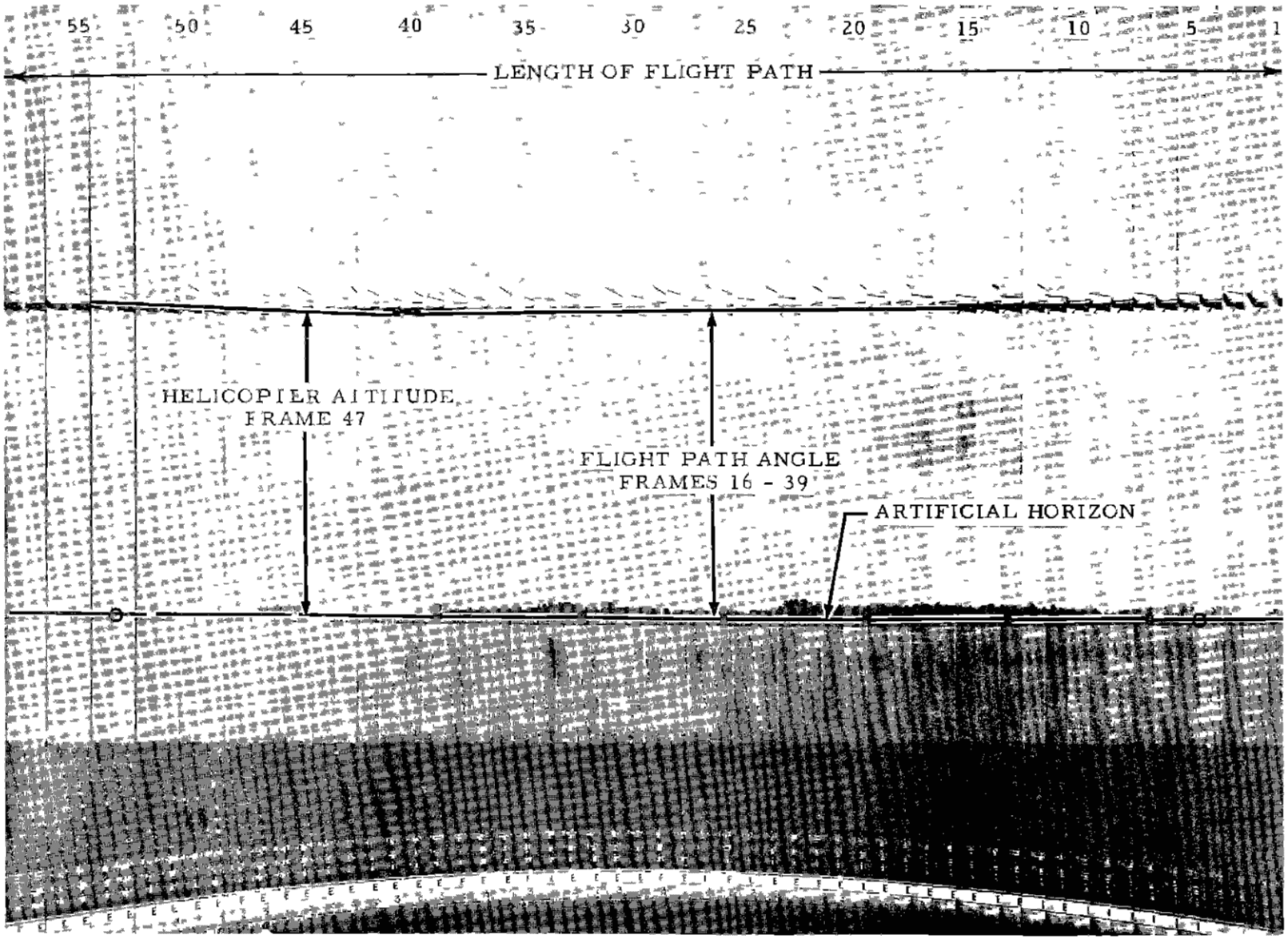


FIG 59 METHOD OF ANALYSIS FOR CRUISE FLIGHT H-34

APPENDIX III

U. S. DEPARTMENT OF COMMERCE
CIVIL AERONAUTICS ADMINISTRATION
Technical Development Center
P. O. Box 5767
Indianapolis, Indiana

PILOT QUESTIONNAIRE
ON
COCKPIT VISIBILITY IN HELICOPTERS

The CAA Technical Development Center is conducting a project to determine the cockpit visibility requirements for helicopters. The ultimate objective of the project is to establish standards of cockpit visibility which will be consistent with adequate operating safety.

The present phase of the program calls for the determination of helicopter operating characteristics during certain maneuvers, particularly landings and takeoffs, and the visibility requirements necessary for the safe and satisfactory accomplishment of these maneuvers.

Cockpit visibility requirements are directly related to the field of vision required to perform various maneuvers. This field of vision is being investigated not only to determine how it affects the limits of the windshield but also to determine how much obstruction is acceptable within the windshield area.

Some helicopters have excellent visibility. As the helicopter is developed and adapted to a wide range of uses, instruments will be added and structural requirements increased. Both of these requirements will tend to reduce visibility. In some instances this is already a fact.

Since the best judges of the cockpit visibility needed for safe flight are the pilots themselves, we are asking you to supply us with the necessary basic information from which an analysis can be made. Such an analysis will permit a quantitative evaluation of the present designs and the establishment of quantitative standards for future designs.

The success of this cockpit visibility study is dependent upon your returning this questionnaire as soon as possible with all questions answered. Your response will be strictly confidential and will be used only for analytical purposes by the CAA. No one else is authorized to see your answers or to use the information for any other purpose.

Name _____

1. Height _____

2. a. How many years have you been flying aircraft? _____

   b. How many total hours do you have in aircraft? _____

   c. How many hours do you have in helicopters? _____

3. a. In what model helicopter are you now doing most or all of your flying? _____

   b. How many hours do you have in this helicopter? _____

   c. How many hours flying time in this helicopter do you now get per month? _____

4. a. Do you consider it necessary, from an over-all safety standpoint, to be able to see any external portion of the aircraft from the cockpit? Yes____ No____

   b. If you answered "Yes" to part a, check the boxes below indicating the portions of the helicopter which you feel must be seen and the amount of head and body movement which you feel is permissible in each case.

	Moderate Head & Eye Movement	Moderate Head & Body Movement	Maximum Permissible Movement with Seat Belt Fastened
Skids or Wheels	☐	☐	☐
Main Rotor Tips	☐	☐	☐
Other (Specify)	☐	☐	☐

5. Place a check mark in <u>one</u> of the boxes below indicating the particular maneuver for which you feel maximum visibility from the cockpit is most urgently required. Do <u>not</u> consider limited visibility due to atmospheric conditions.

   ☐ 1. Takeoff run

   ☐ 2. Normal (straight) climb

   ☐ 3. Landing (*including hovering in ground effect*)

   ☐ 4. Autorotation - glide

☐ 5. Autorotation - landing

☐ 6. Maximum performance takeoff

☐ 7. Landing in a confined area

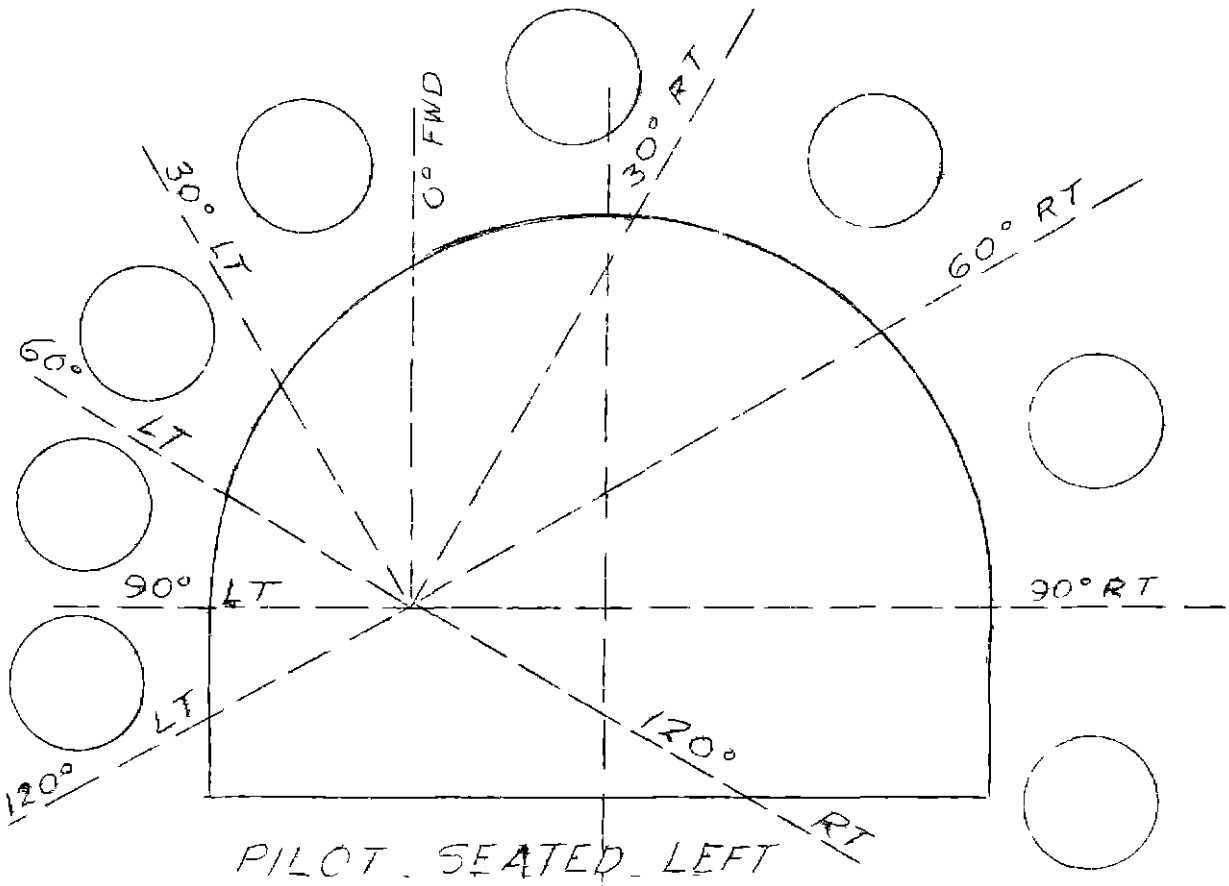
☐ 8. Hovering for rescue purposes or similar ground operations.

6. Two charts to be used for estimating the obstruction to vision at different lateral directions of sight which you feel is permissible for safe operation of the aircraft during all maneuvers are shown below. One chart provides for the pilot seated in the left seat, the other chart provides for the pilot in the right seat. These charts are provided with radial lines emitting every 30 degrees from the indicated cockpit seat. Between each radial line is a box in which your evaluation of that region should be entered. Rating scales to be used for your evaluation follow

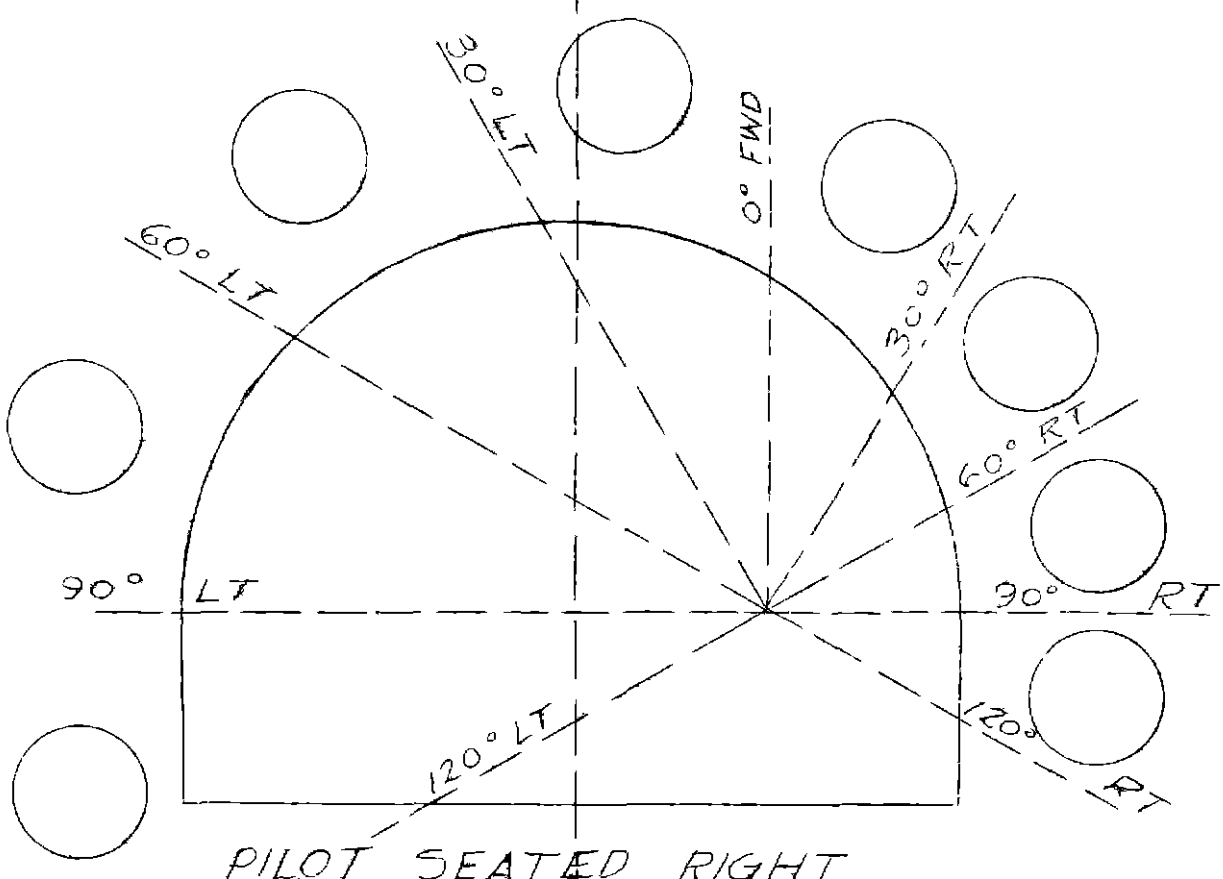
1. No obstruction permissible.

2. Minor obstructions permissible, such as thin posts (1-1/2" wide or smaller), etc.

3. More obstruction permissible, such as wide posts (greater than 1-1/2"), etc.



PILOT SEATED LEFT



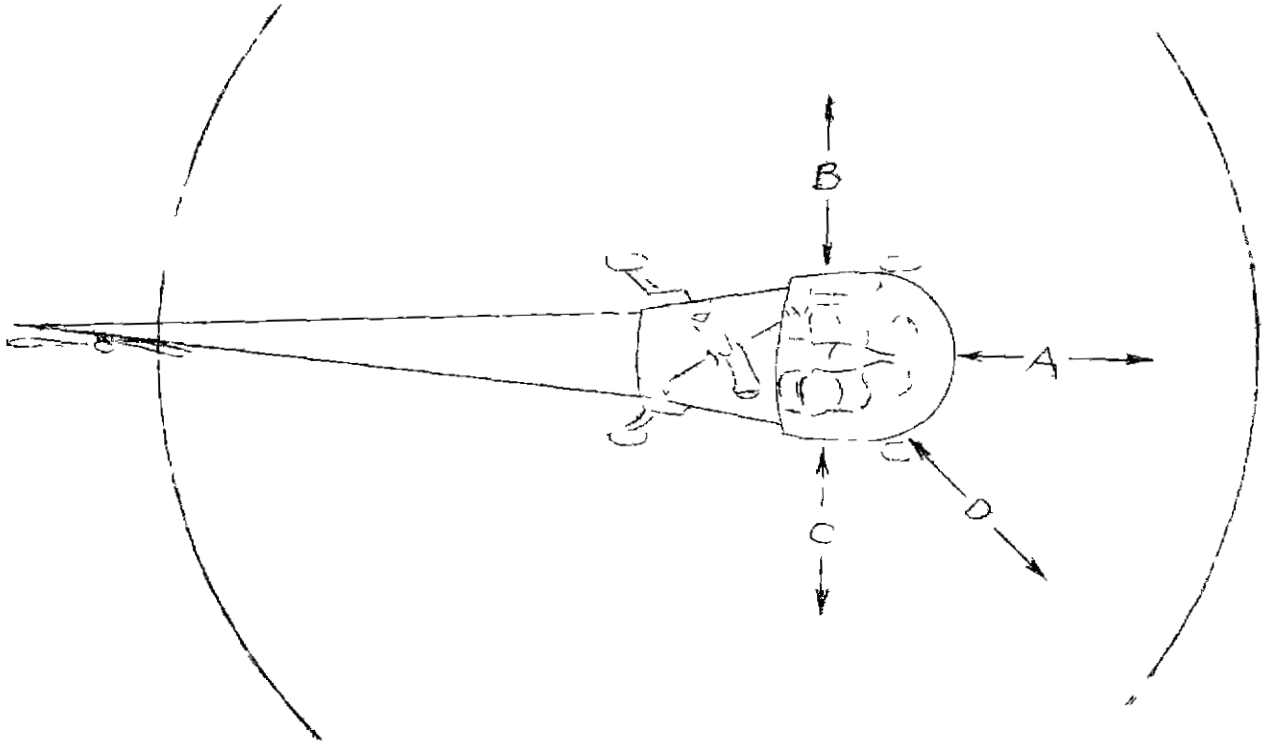
PILOT SEATED RIGHT

7. How close to the helicopter (in feet) do you desire to see the ground along each of the sight planes indicated under the given conditions.

   a. When coming to a hover.
   Distance A_____ Distance B _____ Distance C _____ Distance D _____

   b. During landing at instant of touchdown:
   Distance A_____ Distance B _____ Distance C _____ Distance D _____

   c. Other (specify) where such vision is critical
   Distance A_____ Distance B _____ Distance C _____ Distance D _____



Note: This is a plan view of a helicopter. Distances are to be ground (or horizontal) distances.

Note: If the helicopter you are considering has the normal pilot's seat on the left, consider dimension D as being between A and B.

8. For the model you have indicated in Question 3, please classify the visibility for the maneuvers and directions shown in the following table. This classification should be made on the basis of adequacy of windshield area and angles of sight from the normal pilot seat in the cockpit. The numbers of classifications to be used are:

    1. Visibility excellent, no improvement desired.
    2. Visibility adequate, some improvement desirable, but not mandatory.
    3. Visibility not adequate, improvement strongly desired.

    Fill in every space in the table below with the number you think classifies the visibility of this aircraft for each maneuver and direction indicated.

MANEUVER	VISIBILITY UPWARD TO FRONT	VISIBILITY DOWNWARD TO FRONT	VISIBILITY SIDEWARD TO LEFT	VISIBILITY SIDEWARD TO RIGHT
Takeoff run				
Straight climb				
Cruising				
Level turns				
Final approach				
Hovering				
Landing				
Autorotation - glide				
Autorotation - landing				
Other (specify)				
Maximum performance takeoff				
Landing in a confined area				

9. Please indicate the external reference, or references, you utilize in flying a helicopter during each of the maneuvers indicated below. (If a portion of the cockpit is referenced to some external reference, please indicate this fact.)

A. Cruising

B. Normal takeoff

C. Maximum performance takeoff

D. Normal approach

E. Steep approach

F. Touch down to a point

G. Autorotation