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SERVICE TEST OF SELECTED LIGHTWEIGHT AVIONIC EQUIPMENT (SLAE).(U)
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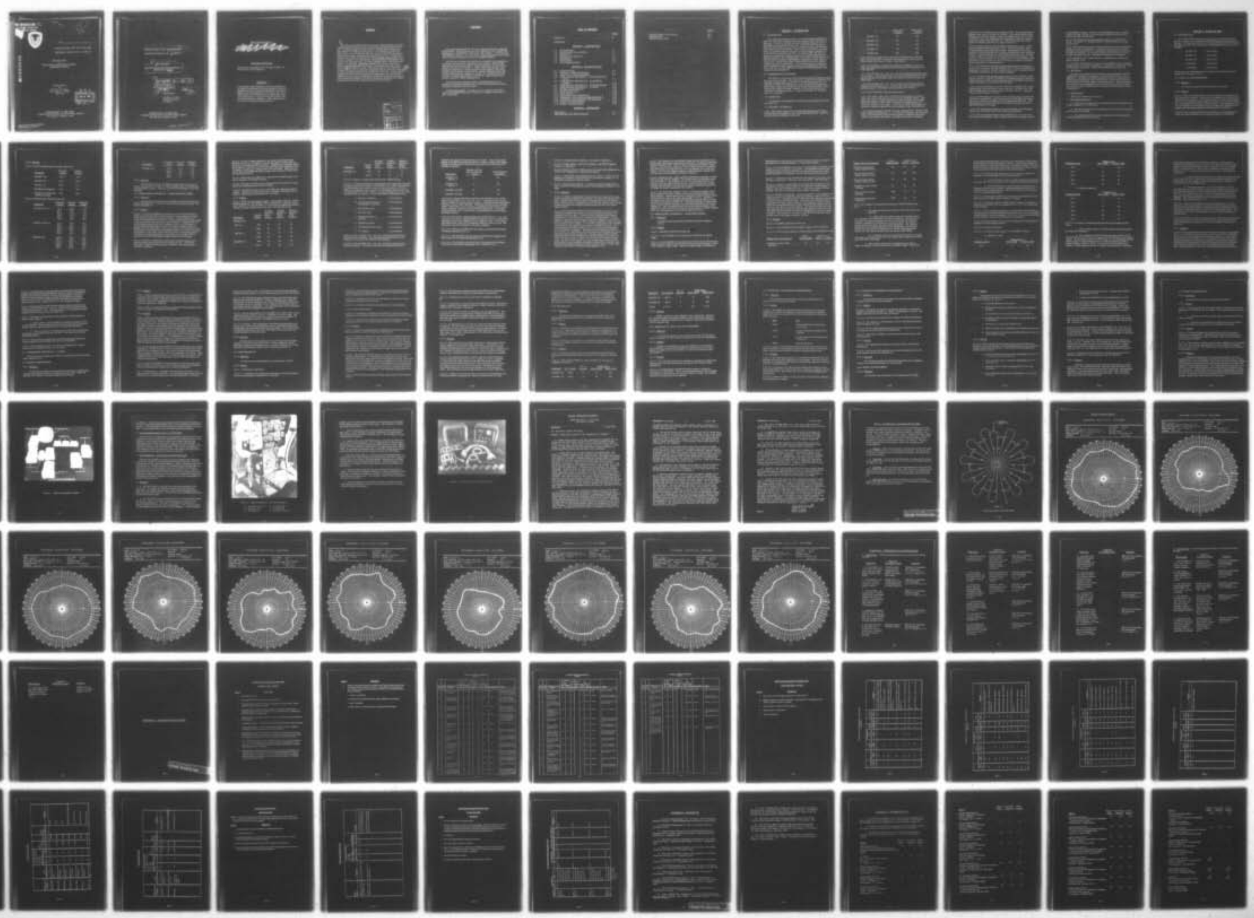

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RDT&E PROJECT NO. 1X1-79191-D168

USATECOM PROJECT NO. 4-7-3651-02

SERVICE TEST
of
SELECTED LIGHTWEIGHT AVIONIC EQUIPMENT (SLAE)

Partial Report
by
MAJ Paul F. Bolam
Mr. Edward J. Dutton
May 1969

DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36360

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APPROVED:

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ABSTRACT

The US Army Aviation Test Board service tested the Selected Lightweight Avionic Equipment (SLAE) to determine its suitability for Army use. The SLAE consists of two AN/ARC-114 VHF-FM Transceivers, one AN/ARC-115 VHF-AM Transceiver, one AN/ARC-116 UHF-AM Transceiver, one AN/ARN-89 ADF Set, three C-6533/ARC Communications Control Units, and associated antennas and cables. Testing was conducted in two OH-6A Helicopters during January - April 1969 at Fort Rucker, Alabama, and Apalachicola, Florida. Sixteen deficiencies were found in the following areas: technical characteristics, operational suitability, compatibility, reliability, human factors design, and safety. Sixteen shortcomings were also found. Each major component except the C-6533/ARC had two or more deficiencies and two or more shortcomings. X-mode test results are classified and not reported herein. It was concluded that SLAE is not suitable for Army use. It was recommended that SLAE not be considered for operational use until the deficiencies are corrected, that the shortcomings be corrected if technically and economically feasible, and that the production SLAE and its installation be check tested after deficiencies have been corrected.

FOREWORD

The Commanding General, US Army Test and Evaluation Command (USATECOM), directed the service test of SLAE by letter, AMSTE-BG, Headquarters, USATECOM, 8 November 1966, subject: "Test Directive, USATECOM Project No. 4-7-3651-01/02, Engineering and Service Tests, Light Observation Helicopter Avionics Package (LOHAP)."

The US Army Aviation Test Board was responsible for planning and conducting the test and for reporting the test results. USAAVNTBD personnel, other than the authors, closely associated with the project include LTC James W. Jarvis, Jr. (Chief, Electronic Systems Test Division); MAJ Wiley W. Walker (Senior Project Officer, Electronic Systems Test Division); LTC Lowell F. Baltzell (Planning); MAJ Max B. Hoyt (Planning); Mr. Charles L. Martin, Jr. (Project Pilot); Mr. William H. Grady (Project Pilot); CW3 Pat W. Jones (Project Pilot and Mr. Russell E. Sharp (Maintenance).

Human Resourses Research Office (HumRRO) Division No. 6 (Aviation) conducted a human factors review of the SLAE and provided results for inclusion in the test report.

All data (photographs, test plan, etc.) are on file at this Board under USATECOM Project No. 4-7-3651-02. RDT&E Project No. is 1X1-79191-D168.

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SECTION 1. INTRODUCTION

1.1 BACKGROUND

The Light Observation Helicopter Avionics Package (LOHAP) program was initiated in January 1964 at the request of the LOH Project Manager. A need for LOHAP was established and a Request for Proposal (RFP) was issued in March 1965. This RFP was cancelled in May 1965 after Department of Defense decided to enter a development production contract for LOHAP. This decision was made to speed delivery of LOHAP production equipment to the airframe manufacturer. A new RFP was issued in July 1965. In January 1966, the US Army entered a development production contract for LOHAP with Sylvania Electric Products, Inc., Williamsville, New York. The US Army Test and Evaluation Command (USATECOM), in November 1966, directed the US Army Aviation Test Board (USAAVNTBD) to service test the LOHAP in an OH-6A Helicopter. A decision was made to expand the use of LOHAP into other aircraft, and in the fourth quarter of fiscal year 1968, the acronym LOHAP was changed to SLAE (Selected Lightweight Avionics Equipment).

1.2 DESCRIPTION OF MATERIEL

The SLAE is an airborne communication/navigation system designed for use in Army aircraft. The test system consists of two AN/ARC-114 VHF-FM Transceivers; one AN/ARC-115 VHF-AM Transceiver; one AN/ARC-116 UHF-AM Transceiver; three C-6533/ARC Communications Control Units; one AN/ARN-89 Automatic Direction Finder (ADF) utilizing the standard Homing, Heading, and Bearing Indicator; and associated antennas and cables. A detailed description is contained in part A, appendix I.

1.3 OBJECTIVE

To determine the suitability of SLAE and its maintenance package for Army use.

1.4 SUMMARY OF RESULTS

1.4.1 SLAE radios experienced 26 repairable failures and 21 intermittent unresolved failures. Mean times between failures, computed at a 90-percent confidence level, were:

	Lower Limit (hours)	Upper Limit (hours)
AN/ARC-114	53	165
AN/ARC-115	49	330
AN/ARC-116	32	148
AN/ARN-89	48	326
C-6533/ARC	430	7,750

1.4.2 SLAE met weight, size, and volume requirements. The AN/ARC-115 and AN/ARC-116 failed to meet input power criteria in the receive mode by 0.4 and 5.1 watts, respectively.

1.4.3 The AN/ARC-114 experienced extreme variations in maximum range and intermittent unresolved failures which were considered mission degrading.

1.4.4 The AN/ARC-114, -115, and -116 did not have preset guard transmit capability. Guard transmission could be accomplished only by dialing the appropriate frequency using the megahertz (mhz) and kilohertz (khz) knobs.

1.4.5 The AN/ARC-114, -115, and -116 did not have preset channel capability for operational use. A control knob was not provided to adjust the squelch. The volume control settings were critical.

1.4.6 The C-6533/ARC operated satisfactorily.

1.4.7 The usable range of the AN/ARN-89 was limited by excessive audio noise which overrode the ground-station identifier signal. This noise was greatest at higher speeds and reduced slightly as helicopter speed was reduced. ADF needle oscillations of magnitudes of $\pm 10^{\circ}$ occurred randomly at all ranges. Tracking and ADF compensation during these conditions required use of the average of these oscillations.

1.4.8 Homing using the AN/ARC-114 was unsatisfactory. Homing range was a function of frequency; i.e., the lower the frequency, the lower the range. The sensitivity of the steering pointer increased as the range to the ground station decreased. At ranges of less than 10 nautical miles (n.m.), the needle was too sensitive to use. The homing station passage meter did not function as intended. The needle dropped to the bottom of the indicator during reception of signals on the No. 1 and No. 2 AN/ARC-114 in both homing and communications mode and during reception of signals on the AN/ARC-115. When the signals were interrupted, the needle returned to its original position.

1.4.9 Average maximum retransmission ranges were 37 n.m. at 500 feet above ground level (AGL) and 70 n.m. at 3,000 feet AGL, which is only slightly greater than line of sight. Adjustment of the volume controls on the two AN/ARC-114's during retransmission was extremely critical. If adjustment was just below normal listening level, retransmission range was reduced or communications were non-existent. Distortion occurred if adjustment was slightly above normai listening level. Helicopter angles of bank in excess of 16 degrees resulted in unintelligible retransmission communications.

1.4.10 The ADF needle wandered indiscriminately while retransmissions were in progress with two AN/ARC-114's. When the AN/ARC-115 transmitter was keyed, the ADF needle either locked or became erratic, depending on proximity to a low frequency station.

1.4.11 The OH-6A fuel quantity gauge would move to a full fuel indication when the No. 1 and No. 2 AN/ARC-114 transmitters were keyed on frequencies from 39.90 to 55.00 mhz and when the AN/ARC-115 transmitter was keyed from 140.000 to 147.000 mhz.

1.4.12 During transmission on 226.0 mhz on the AN/ARC-116, a loud rushing noise was heard on 54.0 mhz on the No. 1 AN/ARC-114. The same rushing noise was heard on 226.0 mhz when the No. 1 AN/ARC-114 was transmitting on 74.0 mhz.

1.4.13 Crewmembers in the test-bed aircraft were able to operate the AN/APX-72 transponder control head and the C-8157/ARC voice security control indicator in flight only with considerable difficulty. This equipment was mounted on the top of the bulkhead between the pilot's and copilot/observer's seats.

1.4.14 The identification labeling of the three SLAE communications radios was technically correct but confusing to operators.

1.4.15 The audio control knobs of the AN/ARC-114, -115, and -116 did not have an indication of their position relative to full high, full low, or intermediate settings. The face of the AN/ARN-89 was not marked to show full high, full low, or intermediate positions relative to the mark on the audio control knob.

1.4.16 The intensity of the panel lighting of the two C-6533/ARC's, the No. 1 AN/ARC-114, the AN/ARN-89, and the AN/ARC-116 could not be varied.

1.4.17 The maintenance characteristics of SLAE at direct- and general-support levels were satisfactory. Equipment location in the test-bed helicopter caused difficulty at organizational maintenance level and durint ADF compensation. Special test equipment was required at direct- and general-support levels. Maintenance manuals were adequate.

1.4.18 Results of the X-mode tests are classified and are submitted under separate cover.

1.4.19 Sixteen deficiencies were found in the following areas: technical characteristics, operational suitability, compatibility, reliability, human factors design, and safety. Sixteen shortcomings were also found.

1.5 DISCUSSION

The test-bed helicopters were furnished with nonstandard antenna configurations (reference paragraph 5 of Detailed Description, part A, appendix I). Although the antenna configuration was not constructed to production specifications, only a small number of the deficiencies and shortcomings of the SLAE relate to antenna problems. Proper operation of an avionics system depends on antennas and their installation; therefore, future testing of SLAE should be conducted with production antenna configurations.

1.6 CONCLUSION

SLAE is not suitable for Army use.

1.7 RECOMMENDATIONS

a. SLAE not be considered for operational use until the deficiencies listed in appendix II are corrected.

b. The shortcomings listed in appendix II be corrected if technically and economically feasible.

c. The production SLAE and its installation be check tested after the deficiencies have been corrected.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

The USAAVNTBD conducted this Category I service test at Fort Rucker, Alabama, and the USAAVNTBD Test Facility at Apalachicola, Florida. Testing was conducted in two OH-6A Helicopters from January through April 1969. The following in-flight operating times were accumulated:

AN/ARC-114	894.8 hours
AN/ARC-115	445.6 hours
AN/ARC-116	383.9 hours
AN/ARN-89	440.0 hours
C-6533/ARC	2,712.0 hours

The X-mode test methodology and results are classified and are presented under separate cover.

2.2 PHYSICAL CHARACTERISTICS

2.2.1 Objective

To determine physical characteristics of the SLAE.

2.2.2 Method

2.2.2.1 Each component of the SLAE was weighed and measured and the volume was computed. Two sets of dimensions were made and two volumes were computed. The dimensions shown in line a of paragraph 2.2.3.1 are measurements including protrusions such as knobs, plugs, etc. The volume shown is the installed volume. The dimensions in line b do not include any protrusions, and were obtained to determine compliance with appropriate Standard Classification Lists (SCL's).

2.2.2.2 Each component of SLAE was inspected to ascertain any obvious structural weakness in the equipment design or installation.

2.2.2.3 Throughout the conduct of this test, failures that could be attributed to vibration, shock, or aircraft environmental conditions were noted and recorded.

2.2.3 Results

2.2.3.1 Dimensions, Weight, and Volume.

Component		Height (in.)	Depth (in.)	Width (in.)		Volume (cu. in.)	Weight (lb./oz.)	
AN/ARC-114 No. 1	a.	4 1/8	8 1/2	5 3/4		201.61	5	5
	b.	3 15/16	6 1/2	5		127.97		
AN/ARC-114 No. 2	a.	4 1/8	8 1/2	5 3/4		201.61	5	5
	b.	3 15/16	6 1/2	5		127.97		
AN/ARC-115	a.	4 7/8	8 1/2	5 3/4		238.27	6	6 1/2
	b.	4 13/16	6 1/2	5		156.41		
AN/ARC-116	a.	4 7/8	8 1/2	5 3/4		238.27	7	9
	b.	4 13/16	6	5		144.38		
C-6533/ARC	a.	2 5/8	4 1/2	5 3/4		67.92	1	12
	b.	2 1/2	3 1/2	5		43.75		
C-7392(XC-2)/ARN-89	a.	3 3/4	7 3/16	5 1/2		148.24	3	2
	b.	3 9/16	6	5		106.88		
AS-2108	a.	1 3/8	11 3/4	11 3/4		189.84	2	2
	b.	1	11 3/4	11 3/4		138.06		
R-1496/ARN-89		5 1/2	11 1/2	6		379.50	6	12
			TOTALS		a.	1,665.26	38	5 1/2
					b.	1,224.92		

2.2.3.2 Inherent Structural Weakness.

2.2.3.2.1 The antenna for the No. 2 FM radio was an extremely fragile installation. It consisted of two elements, one mounted on each of the two vertical stabilizers. One end of each element was attached to a block mounted aft of the tail-rotor transmission. The outer extremes of each element were welded to support fins which were in turn riveted to the stabilizer. An intermediate support fin was provided to each element of the antenna and was attached to the element using an "Adel" cable clamp. One failure occurred when the lower antenna broke away from its support fin at the weld point. This non-standard installation presented an ideal handhold for personnel engaged in ground-handling and maintenance operations. The antenna could easily be broken by such use.

2.2.3.2.2 The AT-450/ARC antenna used with the UHF radio was installed on the right skid directly below the pilot's door. This antenna was frequently kicked and stepped on accidentally during crew ingress and egress and during maintenance operations.

2.2.3.3 Failures. There were no failures noted that could be attributed to vibration, shock, or the aircraft's environmental conditions.

2.2.4 Analysis

The AN/ARC-114, -115, and -116 and the C-6533/ARC met all specifications regarding physical size. The weight of the AN/ARN-89 with installed cabling was not determined because the test-bed aircraft was delivered with the installation complete.

2.3 TECHNICAL CHARACTERISTICS

2.3.1 Objective

To determine the technical characteristics of the SLAE.

2.3.2 Method

2.3.2.1 The equipment was operated in conjunction with a TS-352/U multimeter to determine the voltage and current required to operate the SLAE during receive and transmit conditions.

2.3.2.2 The equipment was operated in conjunction with a BIRD 43 wattmeter to determine the forward power output and the reflected power of each communications transmitter. All measurements were made with SLAE installed in the OH-6A Helicopter using a power source adjusted to 28.5 volts direct current (v.d.c.).

2.3.3 Results

2.3.3.1 Power requirements for SLAE radios were:

Component	Transmit (watts)	Receive (watts)
AN/ARC-114	30.8	8.8
AN/ARC-115	41.2	10.4
AN/ARC-116	20.6	15.1
AN/ARN-89 (compass)	N/A	17.8
AN/ARN-89 (LOOP slew switch operating)	N/A	16.0

2.3.3.2 Forward and reflected power was:

Component	Frequency (mhz)	Forward (watts)	Reflected (watts)
AN/ARC-114 No. 1	31.5	14.0	1.0
	36.9	11.0	1.0
	40.5	9.0	1.6
	52.4	15.5	0.5
	54.0	9.0	4.0
	69.3	16.5	4.5
AN/ARC-114 No. 2	31.5	19.0	2.0
	36.9	19.5	3.3
	40.5	12.0	4.0
	52.4	10.0	5.0
	54.0	9.5	5.0
	69.3	10.5	4.8
AN/ARC-115	119.5	18.0	4.5
	121.5	17.0	4.0
	126.2	18.0	4.0
	135.3	17.0	4.5
	145.8	19.0	1.5
	149.7	21.5	0.0

Component	Frequency (mhz)	Forward (watts)	Reflected (watts)
AN/ARC-116	226.8	6.5	1.0
	241.0	6.5	1.0
	249.9	6.5	1.0
	336.3	5.0	1.5
	346.5	5.0	1.0

2.3.4 Analysis

The AN/ARC-115 and -116 failed to meet criteria for receive-power consumption by 0.4 and 5.1 watts, respectively. Ten watts was the established criteria. No power criteria were available for the AN/ARN-89.

2.4 OPERATIONAL SUITABILITY - COMMUNICATION RADIOS

2.4.1 Objective

To determine the operational suitability of SLAE Communication Radios (AN/ARC-114, -115, and -116) and Communication System Control (C-6533/ARC).

2.4.2 Method

2.4.2.1 Two sets of SLAE were operated in two OH-6A Helicopters at 500 and 3,000 feet AGL to determine the average maximum reliable communication range for each type of radio. Ground stations were three fixed stations and one vehicle-mounted standard Army radio peaked to operating efficiencies dictated by specifications. Flight profiles employed during range checks were designed to place the helicopter in several flight attitudes and to insure 360-degree antenna orientation relative to the ground station. Maximum reliable communication range for all radios was defined as the greatest distance over which 90-percent intelligible two-way voice communications could be conducted between the test items and ground-based, compatible Army standard radios operating at normal efficiency through omnidirectional antennas.

2.4.2.2 Unusual or undesirable performance characteristics on all communication radios were noted throughout the test. Test operations were conducted during daylight, darkness, and varying meteorological conditions.

2.4.2.3 Antenna radiation patterns were made to determine which aircraft orientation, in respect to the ground station, would result in the worst communication for each radio. Patterns were obtained during level flight at 1,500 feet over a fixed ground point with repetitions every 15 degrees of heading on 3 frequencies with each radio. Data were collected using an AN/URM-85 field strength meter located 15 miles from the fixed ground point.

2.4.2.4 Each radio was inspected to determine its tunable range, number of channels, and channel spacing.

2.4.2.5 The warm-up time or time required for each radio to be capable of full operation was noted and recorded.

2.4.2.6 Throughout the test, the C-6533/ARC was used in its normal manner. Instances of noise introduction, improper switching, and unusual or undesirable performance were recorded.

2.4.3 Results

2.4.3.1 *Radio Communication Ranges.* The average maximum communication ranges for the AN/ARC-114's in the FM No. 1 and No. 2 position, AN/ARC-115, and AN/ARC-116 as well as the longest and shortest maximum ranges obtained at 500 feet and 3,000 feet AGL were:

Component	Altitude (feet)	Average Maximum Range (n.m.)	Longest Maximum Range (n.m.)	Shortest Maximum Range (n.m.)
AN/ARC-114				
FM No. 1	500	24	33	10
	3,000	50	65	29
FM No. 2	500	28	33	26
	3,000	50	65	14
AN/ARC-115	500	38	45	32
	3,000	68	80	57

Component	Altitude (feet)	Average Maximum Range (n.m.)	Longest Maximum Range (n.m.)	Shortest Maximum Range (n.m.)
AN/ARC-116	500	32	35	30
	3,000	69	91	57

2.4.3.2 Unusual or Undesirable Performance Characteristics.

2.4.3.2.1 Random performance degradations were experienced throughout the communication testing of the AN/ARC-114. These degradations or malfunctions were serious enough to limit the mission. In all instances, maintenance action revealed no discrepancy and the radio met or exceeded all bench-test criteria. During subsequent use of the radio, the fault would not reoccur. These performance degradations were:

a.	Receiver distortion	2 occurrences
b.	Intermittent operation of transmitter or receiver	2 occurrences
c.	Transmitter weak	2 occurrences
d.	Receiver weak	3 occurrences
e.	Background noise in receiver	4 occurrences
f.	Garbled reception	2 occurrences
g.	Transmitter would not key	4 occurrences
h.	No sidetone	2 occurrences

2.4.3.2.2 The AN/ARC-114, -115, and -116 did not have a preset guard transmit capability. The desired guard frequency had to be manually set using the mhz and khz control knobs.

2.4.3.2.3 The AN/ARC-114, -115, and -116 did not have a preset channel capability. All desired transceiver frequencies had to be manually set using the mhz and khz control knobs. The average pilot seated in the OH-6A with the helicopter in a static condition and dialing through the entire band of each radio set required the following wrist movement and time:

Component	Number of Wrist Movements/Hand Turns	Time Required (seconds)
AN/ARC-114 FM No. 1	14	23
AN/ARC-114 FM No. 2	17	29
AN/ARC-115 UHF	16	26
AN/ARC-116 VHF	11	24

2.4.3.2.4 A squelch adjustment knob was not provided on the control head of the AN/ARC-114, -115, and -116. A recessed screw was furnished to adjust the squelch of each receiver. Operational flight experience indicates a need to adjust squelch. Helicopter crewmembers used knife blades, finger nails, screw drivers, aeronautical charts folded several times, and other material to accomplish the adjustment. It was physically impossible for a crewmember to adjust squelch while operating the flight controls.

2.4.3.2.5 The volume control setting for the AN/ARC-114, -115, and -116 was too critical. Approximately 210 degrees of knob rotation were required to go from the maximum to the minimum stops. For comfortable audio levels, only 10 to 15 degrees of this arc could be used. Settings below this point resulted in no audio reception.

2.4.3.2.6 When the AN/ARC-115 was keyed, the AN/ARN-89 became unreliable (paragraph 2.8.3.1).

2.4.3.2.7 The AN/ARC-115 was subject to distortion at regular intervals during the test period (paragraph 2.9.4).

2.4.3.2.8 The AN/ARC-114 and AN/ARC-115 interfered with proper fuel quantity indications (paragraphs 2.8.3.3 and 2.8.3.4).

2.4.3.3 Antenna Radiation Patterns. See part D, appendix I.

2.4.3.4 Tunable Range, Number of Channels, and Channel Spacing. See part A, appendix I.

2.4.3.5 Warm-Up Time. Warm-up time was practically instantaneous and therefore negligible for operational purposes.

2.4.3.6 C-6533/ARC Communication System Control. There were no instances of excessive noise introduction, improper switching, or undesirable performance characteristics.

2.4.3.7 Meteorological Effects. No adverse effect on SLAE performance resulted from operation in various meteorological conditions or at night.

2.4.4 <u>Analysis</u>

2.4.4.1 A positive explanation for the extremes of range performance or the irregular operation of the AN/ARC-114 radios has not been developed. Performance of these radios during this test was unacceptable. The 21 failures cited in paragraph 2.4.3.2 not only compromised the test mission but would have seriously degraded performance of an operational mission.

2.4.4.2 The standard AN/ARC-51BX UHF transceiver has a function switch that permits easy selection of the preset guard frequency in a negligible amount of time. Current avionics installations frequently incorporate a T-366/ARC (a five-channel VHF transmitter). In both instances, the crew can select guard transmit frequencies with relative ease in a negligible amount of time compared to dialing in guard frequencies using mhz and khz knobs. Aircraft FM radios prior to the AN/ARC-114 have never had separate guard channel capability; however, they were introduced into the inventory prior to the world-wide assignment of an FM distress frequency. Considering SLAE radios individually, the AN/ARC-116 represents a step backward in providing aircraft crews with rapid guard-channel selection; a separate guard channel function should be build into the AN/ARC-115; and the AN/ARC-114 should now include the same feature to utilize the new distress frequency assignment. All three radios should have the identical guard-channel selection feature to insure adequate redundancy to preclude loss of this capability in installations that do not include all three radios. Further discussion of this subject is included in paragraph 2.15.4.

2.4.4.3 The absence of an operational preset channel capability in the SLAE radios compromises operational flexibility, comparing unfavorably with the AN/ARC-51BX. The increases in aircraft complexity, traffic densities, and tactical employment require rapid selection of commonly used frequencies to reduce diversion of crew attention from inside the cockpit. In instrument flight conditions, rapid frequency selection permits maximum concentration on flying the aircraft.

2.4.4.4 During the test, communication degradation frequently resulted from improper squelch settings. Solo pilots found it impossible to correct the problem. The addition of a copilot or qualified observer did not help, since the degree of turbulence, airframe vibrations, maneuvering of the helicopter, and the type and size of implement being used to change the squelch compounded the problem.

2.4.4.5 The extremely sensitive volume controls that changed volume levels dramatically with a minute movement proved frustrating to use. This condition, coupled with the lack of adequate relative position marks on knobs and the face of the radio (paragraph 2.14.3.4), resulted in trial-and-error volume settings that generally produced either no audio or extreme distortion on initial use. The minute latitude of comfortable volume range required excessive concentration and attention for proper adjustment. Test personnel painted dots on the knobs and faces of the radios as a guide, but this is an interim solution and is a classic example of the use of imagination to overcome design deficiencies.

2.5 OPERATIONAL SUITABILITY - NAVIGATION RADIOS

2.5.1 Objective

To determine the operational suitability of SLAE navigation radios.

2.5.2 Method

2.5.2.1 AN/ARN-89 Direction Finder Set.

2.5.2.1.1 The AN/ARN-89 was inspected to determine its tunable range.

2.5.2.1.2 The AN/ARN-89 was operated at 500 feet and 3,000 feet AGL within reception range of selected low frequency ground stations to determine maximum usable range. Maximum usable range was defined as that distance at which use of the AN/ARN-89 was limited by excessive oscillation of the bearing indicator or loss of aural signal.

2.5.2.1.3 The AN/ARN-89 was utilized in the compass and manual loop modes during low frequency approaches. Its capability to position the helicopter along selected ground tracks during low approaches without needle oscillation or erroneous reversal was observed and recorded.

2.5.2.1.4 Operation of the AN/ARN-89 was checked in the lower (100 - 500 khz), middle (501 - 1605 khz), and upper (1606 - 3000 khz) bands.

2.5.2.1.5 Unusual or undesirable performance characteristics of the AN/ARN-89 and any adverse effects of the airframe on ADF signal reception were noted throughout the test. Tests were conducted during daylight, darkness, and varying meteorological conditions.

2.5.2.2 AN/ARC-114 Homing. The homing feature of the AN/ARC-114 radio was operated to determine maximum effective range at 500 and 3,000 feet AGL. The ground station utilized for this test was a stationary vehicle-mounted AN/VRC-46 radio. Observations during the test indicated that two ranges could be derived. The maximum usable homing range was the greatest range at which reliable homing signals could be received regardless of aircraft heading. The absolute maximum reception range was that distance at which homing signals could be received only when careful orientation of the aircraft permitted maximum signal reception. The absence of red flags on the FM homing warning indicator was used as the signal reception criterion.

2.5.3 Results

2.5.3.1 AN/ARN-89 Direction Finder Set

2.5.3.1.1 The AN/ARN-89 had a tunable range of 100 to 3,000 khz.

2.5.3.1.2 The average maximum reliable range of the AN/ARN-89 was:

Station Type and Frequency	Power Output (watts)	Range (n.m.) 500 ft.	3,000 ft.
Compass Locator (LOM) (212 khz)	10	25	27

Station Type and Frequency	Power Output (watts)	Range (n. m.) 500 ft.	3,000 ft.
Non-Directional Radio Beacon (MH) (308 khz)	25	34	36
Non-Directional Radio Beacon (MH) (374 khz)	25	48	50
Non-Directional Radio Beacon (MH) (410 khz)	30	40	44
Compass Locator (LOM) (379 khz)	50	46	55
Commercial Broadcast (600 khz)	1000	39	53
Commercial Broadcast (1450 khz)	1000	46	55

2.5.3.1.3 Unusual or undesirable performance characteristics noted were:

a. Two types of noise were received in the audio of the AN/ARN-89:

(1) A high intensity rushing noise that sounded similar to a waterfall occurred in direct relation to airspeed. The intensity of this noise was greatest at maximum safe air speed and decreased in relation to airspeed to 60 knots plus or minus 5 knots. As airspeed decreased below 60 knots, the noise again intensified. The intensity of this noise overrode the identifier of the transmitting station and in almost all cases was the limiting factor in usable range (paragraph 2.5.3.1.2). The source of this noise has not been determined.

(2) A clicking sound was caused by the opening or closing of a relay in the flasher unit of the anticollision light located on the underside of the OH-6A fuselage.

b. Slow needle oscillations of magnitudes up to plus or minus 10 degrees occurred randomly at all usable ranges. There was no correlation between these oscillations and the degree of fine tuning of the receiver or any other known condition. Pilots were required to use the average of these oscillations to accomplish tracking. This condition occurred occasionally during ADF compensation and the average of the oscillations had to be used to determine bearings.

2.5.3.1.4 Station passage indications were normal and reasonably accurate, but exhibited the following characteristics:

a. At 500 feet AGL or below, needle reversal occurred late, but never more than 0.4 nautical mile beyond the transmitting antenna.

b. Above 500 feet AGL, needle reversal occurred prior to crossing the transmitter antenna. Station passage was tested up to 3,000 feet AGL and revealed that premature reversal occurred within 0.5 n.m. of the ground station.

2.5.3.1.5 No unusual or additional performance degradation resulted from operation during adverse weather or at night.

2.5.3.1.6 No adverse effects on ADF signal reception or needle performance except that cited in paragraph 2.5.3.1.3.a. were attributed to the airframe.

2.5.3.1.7 The positioning capability of the AN/ARN-89 was adequate with exception of needle oscillation (paragraph 2.5.3.1.3.b) and slightly erratic needle reversal (paragraph 2.5.3.1.4). Use of the manual loop during tracking, homing, and approaches was adequate.

2.5.3.1.8 Warm-up time was practically instantaneous and therefore negligible for operational purposes.

2.5.3.2 AN/ARC-114 Homing.

2.5.3.2.1 Average homing ranges of the AN/ARC-114 were:

a. Maximum usable

	Range (n.m.)	
Frequency (mhz)	500 ft. AGL	3,000 ft. AGL
31.5	5	22

Frequency (mhz)	Range (n.m.) 500 ft. AGL	3,000 ft. AGL
36.9	5	25
52.4	15	41
53.6	18	39
54.0	15	43
74.0	23	53

b. Absolute maximum

Frequency (mhz)	Range (n.m.) 500 ft. AGL	3,000 ft. AGL
31.5	6	30
36.9	7	37
52.4	15	46
53.6	24	43
54.0	22	51
74.0	31	62

2.5.3.2.2 Unusual or undesirable performance characteristics noted were:

a. The reception range of reliable homing signals increased as frequency increased.

b. The sensitivity of the FM homing steering pointer on the ID-1351/ARN was a function of the range from the helicopter to the ground station. At the extreme ranges of FM homing, the steering pointer moved slowly enough to permit determination of steering information and to permit holding a centered needle. As range to the ground station decreased, needle displacement and movement became quicker, requiring increasingly rapid control movements to keep the steering pointer centered. At ranges of 10 n.m. or less, the movement of the steering pointer became so rapid that the needle was either at its left or right limit or in rapid transit. Under these conditions, homing to the unknown location of a ground-based transmitter became impractical or impossible.

c. False on-course indications were presented during homing on 31.5 and 36.9 mhz. These false on-course signals resulted in left turns away from the station, which subsequently led the helicopter beyond homing signal reception range.

d. The station passage meter on the left side of the ID-1351/ARN did not indicate when the aircraft was passing over a ground-based FM transmitter. When FM signals were received with the No. 1 AN/ARC-114 in the homing mode, the station passage needle moved down and remained in that position until the ground station keying was stopped. This condition occurred on all frequencies tested and at all altitudes. (See paragraph 2.8.3.5.)

2.5.3.2.3 Voice communication from the ground station to the AN/ARC-114 in the homing function was possible with no effect on homing. The squelch frequently required adjustment when the AN/ARC-114 was changed from the homing mode to the T/R or T/R GUARD mode. Homing signals to the ID-1351/A indicator were lost when transmitting in homing mode.

2.5.3.3 ID-1351/A. There were no unusual or undesirable performance characteristics that could be attributed directly to the indicator when used individually or in combination with the AN/ARN-89 and the AN/ARC-114.

2.5.4 Analysis

2.5.4.1 The magnitude of the background noise referred to in paragraph 2.5.3.1.3.a(1) renders the performance of the AN/ARN-89 unsatisfactory except at close range to the transmitting station. In areas where the ground station's identifier is not completely masked by the noise, proper identification and tuning are still time-consuming and difficult. The limited reception range of station identifiers caused by this noise will result in prolonged voids in enroute navigation and force dependence on ADF bearings of uncertain origin and questionable accuracy.

2.5.4.2 Facilities did not permit an analysis of the unreliable ADF performance during VHF transmission and FM retransmission (paragraphs 2.8.3.1 and 2.8.3.2). These problems must be corrected before the performance of the AN/ARN-89 can be considered satisfactory.

2.5.4.3 The random needle oscillations that occurred throughout the usable range of the AN/ARN-89 are not conducive to accurate tracking. Aviators frequently were distracted by the apparent need to fine-tune the receiver, which did not improve the condition. Using the average of these oscillations during ADF air-swing (compensation) results in highly questionable accuracy and tends to compound rather than eliminate any system errors.

2.5.4.4 The premature or late needle reversals associated with station passage are considered within acceptable limits.

2.5.4.5 The homing capability of the AN/ARC-114 is unsatisfactory in all respects. Practical use of the FM homing is restricted to the higher frequencies and higher altitudes which may not be operationally feasible. Homing to a low power survival radio on 40.5 mhz would be possible only at close range to individuals in peril. The use of visual search and pyrotechnic or visual signals would be more practical at such close ranges. The extreme sensitivity of the steering pointer limits its practical application to higher altitudes and higher frequencies. The system is also subject to false on-course signals, particularly in the lower frequencies. The station passage meter not only fails to indicate overflight of the ground station, but is confusing since it is subject to frequent movement that could be interpreted as true station passage.

2.6 OPERATIONAL SUITABILITY - RETRANSMISSION

2.6.1 Objective

To determine the suitability of retransmission capabilities of the AN/ARC-114.

2.6.2 Method

2.6.2.1 The average maximum reliable retransmission range at 500 feet and 3,000 feet AGL was determined using two AN/VRC-46 radios as ground stations. Flight profiles employed during retransmission tests were designed to place the helicopter in several flight attitudes and to insure 360-degree antenna orientation relative to the ground stations. Retransmission range was defined as the total distance from Station "A" through the helicopter to Station "B."

2.6.2.2 The effects of retransmission on FM communication or homing capability were noted. The capability of the flight crew to interrupt and monitor retransmission traffic was noted.

2.6.3 Results

2.6.3.1 Retransmission ranges were random without regard to frequency. During 49 retransmission tests, ranges varied from 15 n.m. to 60 n.m. at 500 feet AGL and from 40 n.m. to 120 n.m. at 3,000 feet AGL. The average maximum reliable retransmission ranges derived from all test flights were:

500 feet AGL	3,000 feet AGL
37 n.m.	70 n.m.

2.6.3.2 Volume control adjustment during retransmission was critical. When the volume controls were adjusted just below normal listening level, retransmission range was reduced or no retransmissions were accomplished. When the volumes were adjusted above normal listening level, the retransmissions were distorted. When the volumes were set at or slightly above normal listening level, the retransmissions were optimum.

2.6.3.3 Retransmission voice quality was unaffected in angles of bank up to 16 degrees. Angles of bank in excess of 16 degrees caused the AN/ARC-114 receiver to be squelched erratically, resulting in a "bla-bla-bla" sound being received in the helicopter and frequently at the receiving ground station.

2.6.3.4 Aircraft heading relative to the ground stations did affect retransmission ranges (antenna radiation patterns, part D, appendix I). The two FM antennas on the helicopter were not perfectly omnidirectional. As the helicopter was maneuvered, the orientation of the two FM antennas relative to the two ground stations was changed, allowing the areas of maximum and minimum antenna efficiency to be variably exposed to the ground stations.

2.6.3.5 Communication range degradation with AN/ARC-114 retransmission was experienced as compared to point-to-point communication between the airborne AN/ARC-114 and a ground station. At the extremes of retransmission range, placing the AN/ARC-114 function switch in either T/R or T/R GUARD and continuing communications with a ground station resulted in a 4 to 7 n.m. increase in range.

2.6.3.6 Retransmission traffic between ground stations could be monitored by the helicopter crew; however, volume control adjustment was critical (paragraph 2.6.3.2). Any degradation in retransmission traffic could also be monitored by the helicopter crew.

2.6.3.7 Helicopter crewmembers could interrupt retransmission by either of two methods:

a. Place either or both AN/ARC-114 function switches in T/R or T/R GUARD. This immediately interrupted retransmission and permitted communication from the helicopter to either ground station.

b. Wait for a pause in retransmission traffic and communicate with either ground station with the AN/ARC-114 function switch in the RETRANS position.

2.6.3.8 Simultaneous retransmission and FM homing was beyond the design capability of the AN/ARC-114 and was not possible.

2.6.3.9 The AN/ARC-115 and -116 were not configured for retransmission in this installation and were not tested.

2.7 OPERATIONAL SUITABILITY - X-MODE

All X-mode test methods and results are classified and are presented under separate cover.

2.8 SYSTEM COMPATIBILITY

2.8.1 Objective

To determine whether all components of the SLAE are physically, operationally, and electrically compatible with each other, other subsystems of the OH-6A, and other standard Army radios.

2.8.2 Method

2.8.2.1 Each component of SLAE was operated both on the ground and in the air with all other SLAE components active and all installed aircraft electrical systems operating to determine whether interference occurred. Tests for compatibility of SLAE with armament subsystems were not required or conducted.

2.8.2.2 Each component of SLAE was operated with appropriate standard Army radios to determine compatibility.

2.8.3 Results

2.8.3.1 During periods of transmission over the AN/ARC-115, the ADF needle became unreliable with the AN/ARN-89 function switch set in the compass mode. When the AN/ARC-115 transmitter was keyed, the needle "locked" at the instant of keying and remained in that position without regard to maneuvering of the helicopter until keying was stopped. However, when the AN/ARC-115 transmitter was keyed while passing over a low frequency station, the ADF needle reaction was wild and erratic, but usually partially reversed. Keying the AN/ARC-115 transmitter with the helicopter on the ground near a low frequency station displaced the ADF needle 10 to 15 degrees from its correct position. In all cases when keying was stopped the needle became directional. This condition existed with all VHF communication frequencies and all ADF low frequencies selected concurrently.

2.8.3.2 During periods when AN/ARC-114 retransmission was actually in progress, the ADF needle would not remain directional with the AN/ARN-89 in the compass mode. The needle wandered indiscriminately and occasionally remained fixed while the helicopter was turning. When retransmission was discontinued, the needle became directional. This condition existed on all FM frequencies and all ADF low frequencies selected concurrently.

2.8.3.3 When the AN/ARC-115 transmitter was keyed on frequencies from 140.000 to 147.000 mhz, the fuel quantity gauge needle displaced from its proper position toward or to a full fuel indication.

2.8.3.4 When the No. 1 AN/ARC-114 transmitter was keyed on frequencies from 39.90 to 55.00 mhz, the fuel quantity gauge needle moved rapidly from its proper position to a full fuel indication. This same event occurred when the No. 2 AN/ARC-114 was keyed in the identical frequency range; however, the fuel quantity gauge movement was slower.

2.8.3.5 The FM Homing Station Passage Meter was affected by transmission and reception of the No. 1 or No. 2 AN/ARC-114. With the transceiver's function switches in the T/R or T/R GUARD position and the transmitter of the AN/ARC-114 or a distant station keyed, the station passage needle moved down. The station passage meter responded identically when the AN/ARC-115 was keyed.

2.8.3.6 During transmission on the AN/ARC-116 on 226.0 mhz, a loud rushing noise was heard in the No. 1 AN/ARC-114 on 54.0 mhz. The same loud rushing noise was heard on 226.0 mhz in the AN/ARC-116 during transmission on the No. 1 AN/ARC-114 on 74.0 mhz.

2.8.3.7 Although SLAE compatibility with armament subsystems was not tested, an obvious incompatibility between the XM70E1 Helicopter Reflex Sight and the avionics installation was noted. The location of the C-6280A(P)/APX Control and the C-8157/ARC Control Indicator prevented installation of the gun sight.

2.8.4 Analysis

Determination of the specific cause of the numerous incompatibilities is beyond the scope of this test. These conditions must be thoroughly understood by using aviators to avoid confusion, since their presence constitutes potentially serious operational problems.

2.9 MAINTAINABILITY

2.9.1 Objective

To determine the maintainability characteristics of SLAE.

2.9.2 Method

2.9.2.1 Maintenance Operations

2.9.2.1.1 Scheduled and unscheduled maintenance was performed and the time and manpower expended were recorded.

2.9.2.1.2 All maintenance operations were observed to qualitatively determine their ease and simplicity. Instances of repeated performance or duplication of effort were noted.

2.9.2.1.3 Qualitative comments on maintenance under extreme environmental conditions were recorded.

2.9.2.1.4 A record of failures and maintenance was maintained.

2.9.2.2 Parts Replacement

2.9.2.2.1 Components of SLAE were examined to determine whether maximum use of modular construction was incorporated into their design.

2.9.2.2.2 Maintenance activities were evaluated to determine spare parts requirements, and a parts analysis log was maintained.

2.9.3 Results

2.9.3.1 Details of scheduled and unscheduled maintenance performed during the test period are contained in appendix III.

2.9.3.2 Component replacement at the aircraft by organizational maintenance personnel was difficult. There was no cable slack to allow the radios to be removed from the helicopter console before removing the Bendix-type connector at the rear of the radio. The clearance between this connector and the floor of the helicopter was not sufficient to allow easy removal of the No. 1 AN/ARC-114 and the two C-6533's. In some instances other radios had to be removed to gain access to the radio that required maintenance.

2.9.3.3 The AN/ARN-89 ADF receiver was located under the floor of the OH-6A Helicopter. To compensate the ADF, the receiver cover had to be removed to gain access to the compensation screws. The cover could not be removed until the receiver mounting screws were removed and the receiver repositioned. After compensation was completed, the cover had to be reinstalled on the receiver and the receiver reinstalled in its original position. This procedure had to be repeated after the required air-swing was accomplished, if any additional compensation was required.

2.9.3.4 The SLAE incorporated modular construction to the maximum extent.

2.9.3.5 The parts and modules allocation specified in the maintenance manuals was sufficient to fulfill the maintenance requirements.

2.9.3.6 A detailed list of spare parts used is contained in appendix III.

2.9.3.7 Accessibility for performing maintenance at direct- and general-support categories was adequate; however, module extender cards were required for maintenance operations.

2.9.3.8 The method for ADF compensation was not satisfactory. The compensation network was physically located in the ADF receiver unit. Each loop antenna had amplifier units molded inside. These amplifiers and other helicopter variables required the ADF to be compensated for each aircraft.

2.9.3.9 The procedure for the ADF air-swing was inaccurate and time-consuming. The procedure of flying two circles nine miles in diameter at sixty miles from the ground station required approximately two hours flight time and introduced approximately eight degrees of error on the outer edge of the circle. Maintaining a circle nine miles in diameter was difficult, if not impossible.

2.9.4 Analysis

2.9.4.1 The current Army standard ADF uses a compensation network that is separate from the other ADF components. This network is installed at the time of aircraft manufacture and allows ADF component exchange without additional compensation. Since the SLAE is programmed for a number of different types of aircraft, using a network of this type will be more advantageous from a maintenance and logistical standpoint.

2.9.4.2 The detailed procedure used for ADF air-swings during the test to reduce flight time and errors is contained in part C, appendix I. This procedure used a fixed ground point located approximately 30 miles from the transmitting station. The helicopter was flown over the fixed ground point in a clover leaf pattern. Readings were taken each fifteen degrees as the helicopter passed over the fixed ground point. This procedure required approximately 45 minutes' flight time.

2.9.4.3 In addition to the maintenance recorded in the Maintenance and Reliability Charts in appendix III, numerous malfunctions occurred that were not resolved. In some instances the modules were removed, connections cleaned, and the modules reinstalled and the equipment would operate satisfactorily. The module or connector causing the problem could not be determined. In other instances a failure would occur on one flight and, without a maintenance action being performed, the equipment would operate satisfactorily on a subsequent flight.

2.10 RELIABILITY

2.10.1 Objective

To assess the reliability of components of SLAE under actual operational and simulated tactical conditions to determine expected failure rates.

2.10.2 Method

2.10.2.1 Scheduled and unscheduled maintenance was recorded throughout the test. Using these records and the reliability computations contained in reference 16 (appendix IV) with a 90-percent confidence factor, a Mean Time Between Failure (MTBF) for each type of SLAE radio was computed.

2.10.2.2 Failures were defined as a malfunction that affected the performance of a SLAE component to the extent that mission performance was degraded.

2.10.3 Results

2.10.3.1 Details of repair parts used and scheduled and unscheduled maintenance performed during the test period are contained in appendix III.

2.10.3.2 The computed MTBF for each subsystem at a 90-percent confidence level was:

Subsystem	Hrs. Tested	No. of Failures	MTBF (Hrs.) Lower Limit	MTBF (Hrs.) Upper Limit
AN/ARC-114	894.8	10	53	165
AN/ARC-115	445.6	4	49	330

Subsystem	Hrs. Tested	No. of Failures	MTBF (Hrs.) Lower Limit	MTBF (Hrs.) Upper Limit
AN/ARC-116	383.9	6	32	148
AN/ARN-89	440.0	4	48	326
C-6533	2,712.0	2	430	7,750

2.10.4 Analysis

MTBF criterion for this equipment was 1,000 hours. Based on the computed maximum probable MTBF for each individual subsystem, none has a capability of achieving this essential requirement except the C-6533 intercom unit.

2.11 ADEQUACY OF TOOLS AND TEST EQUIPMENT

2.11.1 Objective

To determine whether common and special tools and test equipment are adequate for their intended purpose and echelon of maintenance.

2.11.2 Method

Common and special tools and test equipment were utilized in the performance of prescribed maintenance procedures at all levels to determine whether they were adequate. A special tool analysis chart was prepared.

2.11.3 Results

2.11.3.1 The TK-100G tool kit was adequate to maintain the SLAE when supplemented with the tools listed in the Special Tool Analysis Chart, appendix III.

2.11.3.2 The Maintenance Kit MK-994 did not provide a means of slewing the compass card. Time-consuming interpolation of the settings was required, and when the test set was bumped or moved, the complete alignment procedure had to be repeated.

2.12 PERSONNEL AND TRAINING REQUIREMENTS

2.12.1 Objective

To determine the personnel and training requirements for operation and maintenance of SLAE.

2.12.2 Method

2.12.2.1 The SLAE was maintained using personnel as listed below to determine whether the training received was adequate or whether additional training was required to facilitate maintenance in the appropriate category.

MOS	Title
35P40	Avionics Equipment Maintenance Supervisor
35M20	Avionics Navigation Equipment Repairman
35L20	Avionics Communication Equipment Repairman
35K20	Avionics Mechanic

2.12.2.2 Aviators of varying background and experience were given a basic orientation on the operation of SLAE and then placed in the operational environment to determine operator training requirements.

2.12.3 Results

2.12.3.1 The training given avionics maintenance personnel by the New Equipment Training Team (NETT) was not adequate. The lack of training aids, test equipment, and SLAE for instructional purposes detracted from the training received.

2.12.3.2 A minimum of 30 days' formal training and 90 days' on-the-job training (OJT) were required for direct- and general-support maintenance of the SLAE. Seven days' OJT was required for organizational maintenance.

2.12.3.3 A basic orientation on the operation of the SLAE was adequate for pilot/operator training.

2.13 TECHNICAL MANUSCRIPTS AND MANUALS

2.13.1 Objective

To determine whether the instructions and information contained in maintenance literature are adequate.

2.13.2 Method

2.13.2.1 Throughout the test all maintenance literature was used and analyzed to determine simplicity, clarity, completeness, accuracy, and logical sequencing of step-by-step procedures.

2.13.2.2 Literature was examined for adequacy of safety instructions.

2.13.2.3 The adequacy of serviceability criteria was examined periodically throughout the test.

2.13.2.4 Parts listings used during the test were examined for errors or omissions in nomenclature and identification.

2.13.2.5 Maintenance Package Literature Charts and DA Forms 1598 were prepared.

2.13.3 Results

2.13.3.1 The Maintenance Package Literature Chart is contained in appendix III.

2.13.3.2 DA Forms 1598 submitted to recommend changes to the technical manuals are listed in appendix III.

2.13.4 Analysis

The technical manuals furnished with the SLAE will be adequate when the recommended changes are incorporated.

2.14 HUMAN FACTORS DESIGN

2.14.1 Objective

To determine the acceptability of the human factors design.

2.14.2 Method

Throughout the test the human engineering aspects of the components of SLAE and the SLAE installation in the OH-6 were evaluated. Particular attention was given to:

a. Ease and simplicity of operation.

b. Hindrances to operator efficiency by virtue of equipment location.

c. Functional and clear marking of radios and controls.

d. Potential causes or actual instances of accidental control manipulation.

e. Operation of controls with flight gloves.

f. Ease of access to all components by maintenance personnel.

g. Any compromise of maintenance procedures as a result of human factors design.

2.14.3 Results

2.14.3.1 Several human factors design aspects of the SLAE, its installation in the test aircraft, and its maintainability have been reported in other areas of this document. These specific human engineering subjects are as follows:

a. Lack of preset guard transmitter (paragraphs 2.4.3.2.2, 2.4.4.2, 2.15.3.2, and 2.15.4).

b. Lack of preset channel capability (paragraphs 2.4.3.2.3 and 2.4.4.3).

c. Sensitive volume control (paragraphs 2.4.3.2.5 and 2.4.4.5).

d. Lack of squelch control knob (paragraphs 2.4.3.2.4 and 2.4.4.4).

e. Removal and installation of No. 1 FM and two C-6533's (paragraph 2.9.3.2).

f. Location of AN/ARN-89 receiver (paragraph 2.9.3.3).

2.14.3.2 It was difficult for helicopter crewmembers to operate the AN/APX-72 transponder (C-6280A(P)/APX Control) and the Voice Security Control Indicator (C-8157/ARC) while in flight. These two devices were located between the pilot's and copilot/observer's heads on a bulkhead that is a vertical extension of the forward crew seats.

2.14.3.3 The labeling of the control heads of the AN/ARC-114, -115, and -116 was confusing to operators. The AN/ARC-114 was labeled as VHF-FM and the AN/ARC-115 and -116 were labeled VHF-AM and UHF-AM, respectively.

2.14.3.4 The audio control knobs of the AN/ARC-114, -115, and -116 did not have an indication of their position relative to full high, full low, or intermediate settings. The face of the AN/ARN-89 was not marked to show full high, full low, or intermediate positions relative to the mark on the audio control knob.

2.14.3.5 Intensity of the panel lighting of the pilot's and copilot's C-6533's, the No. 1 AN/ARC-114, the AN/ARN-89, and the AN/ARC-116 could not be controlled in either of the test-bed helicopters. Investigation revealed that the lights for these components were connected directly to 28 v.d.c. and bypassed the rheostat light intensity controls.

2.14.3.6 Additional human factors data collected during this test by HumRRO Division No. 6 are contained in part B, appendix I.

2.14.4 Analysis

Although the labeling of SLAE communication radios is technically correct, the symbols VHF-FM, VHF-AM, and UHF-AM are confusing to aviators not closely associated with avionics or communication equipment. Aviators habitually use the terms FM, VHF, and UHF to refer to different radios and different frequencies. These commonly used terms cannot be related to SLAE.

2.15 SAFETY CONFIRMATION

2.15.1 Objective

To determine the safety characteristics of SLAE.

2.15.2 Method

2.15.2.1 Throughout the test the safety aspects of SLAE and the SLAE installation in the OH-6A were evaluated. Particular attention was given to:

a. Hazards encountered during normal operation and maintenance activities.

b. Features and capabilities of SLAE that present a hazard or potential hazard to aircraft crew or maintenance personnel.

2.15.3 Results

2.15.3.1 No unusual hazards to personnel occurred during normal operation and maintenance. Maintenance personnel and operators encountered no limitation of action or operation that could be attributed to a hazardous condition.

2.15.3.2 The absence of guard transmit preset capability in the AN/ARC-114, -115, and -116 has been addressed in some detail in paragraphs 2.4.3.2.3 and 2.4.4.2. The implications of this condition are discussed in paragraph 2.15.4.

2.15.4 Analysis

Inflight emergencies are characterized principally by a total insufficiency of time to adequately perform all necessary steps to insure passenger and crew survivability. Any of the numerous functions required of the aviator to maximize survivability must necessarily be simple and capable of rapid accomplishment. Time during an emergency will rarely permit the concentration required for manual selection of specified radio frequencies. If distress calls are not made on appropriate channels, the location of a forced landing may go undetected for prolonged periods of time. Subsequent recovery of personnel may be further delayed until extensive search and rescue efforts are concluded.

SECTION 3. APPENDICES

APPENDIX I. TEST DATA

Part A. Detailed Description

1. Communication Radios.

a. AN/ARC-114 VHF-FM Transceiver. The AN/ARC-114 is a multichannel, airborne radio set capable of transmitting and receiving VHF-FM voice communications on any one of 920 discrete channels spaced at 50-khz intervals through the frequency range of 30.00 to 75.95 mhz. A fixed, tuned guard receiver capable of monitoring 40.5 mhz is also provided. This radio has the capability of X-mode operation, retransmission of clear voice or X-mode communications, and homing. In the homing mode, a steering pointer on the Heading - Radio Bearing Indicator ID-1351/A presents a relative heading to the station. The ID-1351/A also incorporates a station passage meter to indicate over-flight of the station. Retransmission capability is provided in this SLAE configuration by incorporating a second AN/ARC-114 transceiver.

b. AN/ARC-115 VHF-AM Transceiver. The AN/ARC-115 is a multichannel, airborne radio set capable of transmitting and receiving VHF-AM voice communications on any one of 1,360 discrete channels spaced at 25-khz intervals in the 116.000 to 149.975 mhz frequency range. A fixed, tuned guard receiver capable of monitoring 121.5 mhz is also provided. The radio has X-mode, retransmission, and VHF direction finding (DF) capabilities, although provisions for these functions were not included in the test SLAE configuration.

c. AN/ARC-116 UHF-AM Transceiver. The AN/ARC-116 is a multichannel, airborne radio set capable of transmitting and receiving UHF-AM voice communications on any one of 3,500 discrete channels spaced at 50-khz intervals in the 225.00 to 399.95 mhz frequency range. A fixed, tuned guard receiver capable of monitoring 243.00 mhz is also provided. The radio has X-mode, retransmission, and UHF-DF capabilities, although provisions for these functions were not included in the test SLAE configuration.

2. Navigation Radio - AN/ARN-89 Automatic Direction Finder.

The AN/ARN-89 is a lightweight, low frequency, airborne automatic direction finder (ADF) which provides an automatic or manual compass bearing on any radio signal within the frequency range of 100

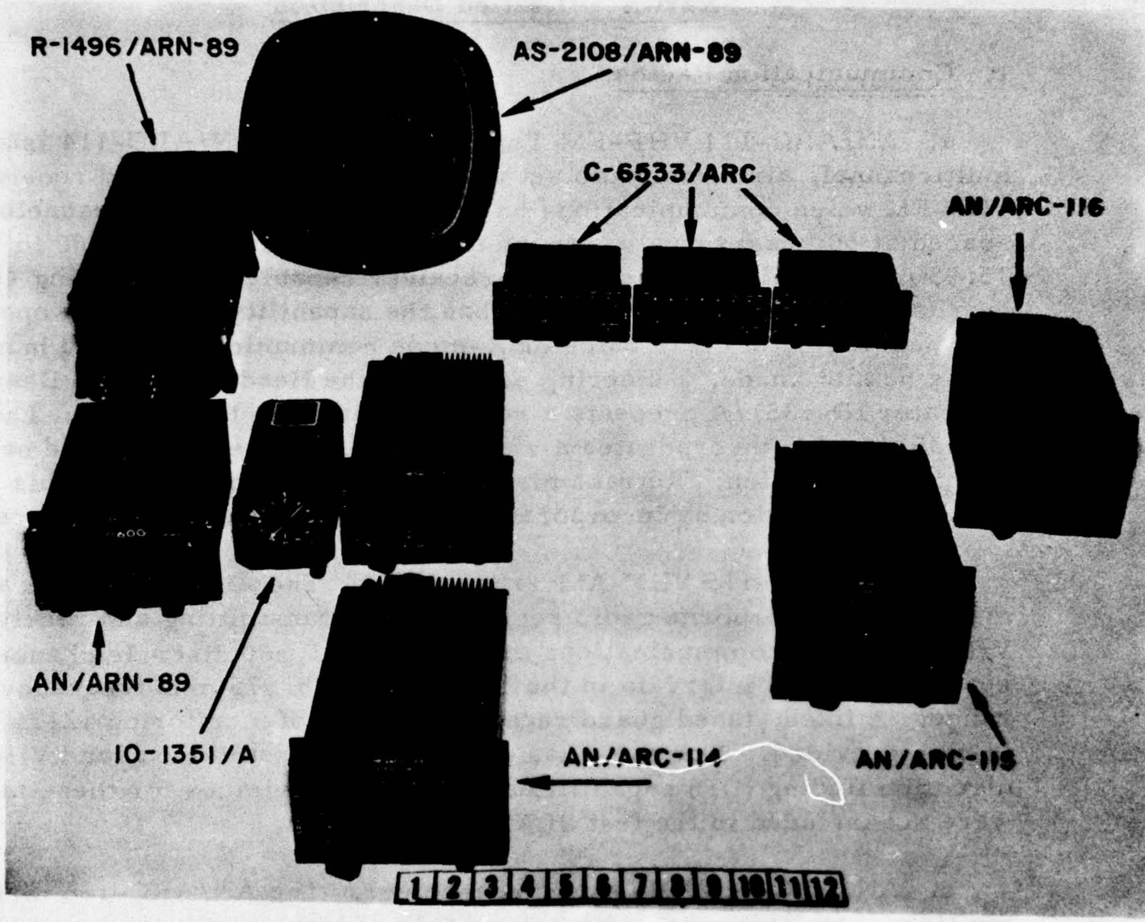


Figure 1. Major components of SLAE.

to 3000 khz. Three modes of operation enable the system to operate as an ADF, a manual direction finder (loop), or as a radio communication receiver. The total AN/ARN-89 consists of a radio receiver, a control unit, a sense preamplifier, and associated cables and antennas.

3. Communication System Control - C-6533/ARC.

The C-6533 is a multipurpose communication system control device. It provides a means by which the operator(s) may select any one of five radios for voice transmission, monitor up to eight receivers and communicate with other crewmember stations within the aircraft. A "hot mike" feature, when selected, eliminates the use of a push-to-talk switch for intra-aircraft communication. One C-6533 per operating crew station must be incorporated in each installation, and three were incorporated in each aircraft provided for this test.

4. Test Equipment - Test Facilities Kit MK-994( )/AR.

The MK-994 interfaces between SLAE and standard test equipment to provide a facility for troubleshooting and isolating faults. This kit is also used during calibration alignment, repair, and operational check of SLAE items. The kit consists of a Heading-Radio Bearing Indicator ID-1351/A, a Communication System Control C-6533( )/ARC and a front panel and chassis assembly housed in a plastic case. The front panel and chassis assembly contains the control and termination devices necessary to apply power and connect SLAE to standard test equipment. Associated test cables, adapters, and extractor tools are provided and stored in the front cover.

5. Antennas.

a. AS-1963( )/ARC-114 is the communications antenna for the No. 1 FM. It consists of a dipole formed by the upper and lower segments of the center vertical spar of the canopy installation and is part of the aircraft structure. The AS-1963 is the standard FM antenna for the OH-6A Helicopter.

b. The FM Dipole (no nomenclature) is the communications antenna for the No. 2 FM. It consists of two elements, one on each of the two vertical stabilizers. One end of each element is attached to a block mounted aft of the tail-rotor transmission. The outer extremes of each element are in turn riveted to the stabilizer. An intermediate

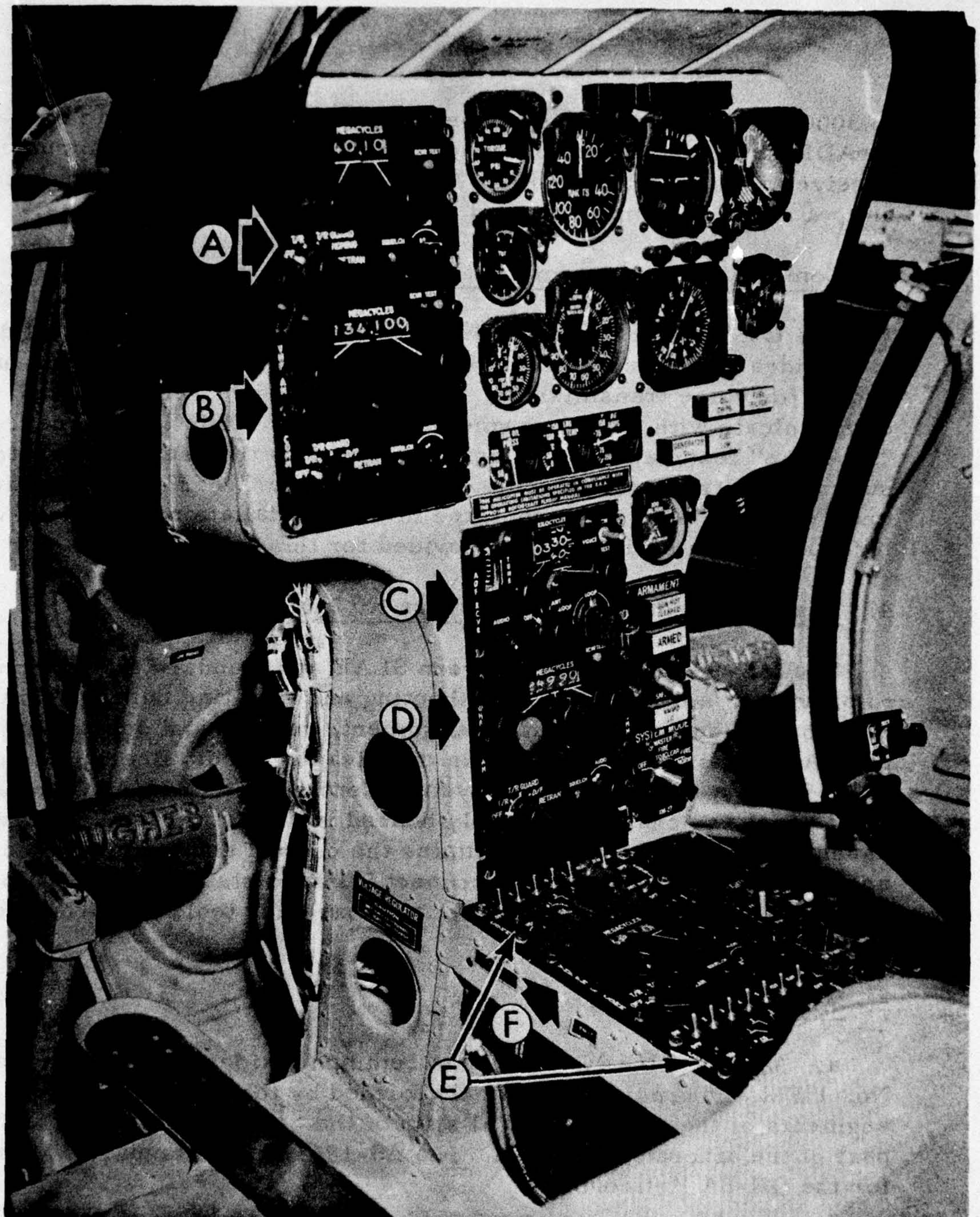


Figure 2. SLAE Installation in OH-6A Helicopter.

A - AN/ARC-114 No. 1	D - AN/ARC-116
B - AN/ARC-115	E - C-6533/ARC
C - AN/ARN-89	F - AN/ARC-114 No. 2

support fin is provided to each element of the antenna and is attached to the element using an "Adel" cable clamp. This antenna is a SLAE-developed interim device.

c. The AT-450/ARC is the communications antenna used with the UHF radio. It is a standard A antenna strapped on the right skid of the helicopter directly below the pilot's door. This antenna is a SLAE-installed interim device.

d. The AS-1965 is the VHF/UHF antenna used with the VHF radio set in the test-bed installation. It is an integral part of the aft engine inlet fairing and consists of triangular shaped aluminum sheet, approximately 17 inches long and 8 inches wide. In post-service test installations, this antenna is augmented with a UHF/VHF matching unit permitting both UHF and VHF communications through this one antenna.

e. The AS-1962( )/ARC-114 serves as the FM homing antenna. It is formed by four tapes bonded to the inside upper and lower, right and left sections of the canopy, with appropriate connections to a homing coupler which is in turn connected to the No. 1 FM transceiver. The AS-1962 is the standard FM homing antenna previously developed for the OH-6A.

f. The AS-2108( )/ARN-89 is the loop antenna for the ADF receiver. This fixed loop antenna contains four coils mounted on a metal base that is encased in a fiberglas molding. The entire assembly is filled with polyurethane foam. The antenna is paired with a goniometer located in the receiver.

g. The sense antenna for the ADF receiver is an end-fed, long wire antenna mounted from the aft portion of the tail boom to the rear of the aft engine inlet fairing.

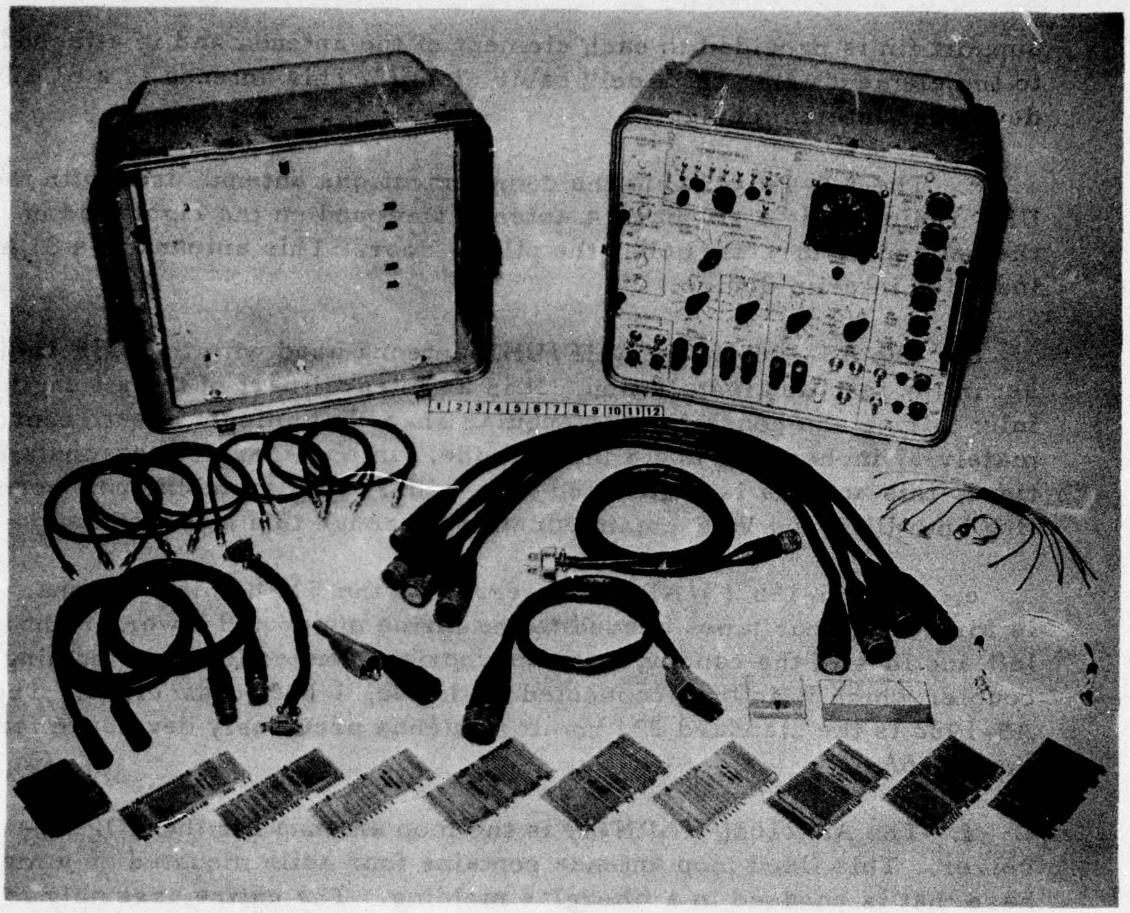


Figure 3. MK-994( )/AR Test Facilities Kit.

Part B. Human Factors Review

HumRRO Division No. 6 (Aviation)
Fort Rucker, Alabama

MEMORANDUM 11 April 1969

TO: MAJ Bolam, Aviation Test Board

SUBJECT: Human Factors Review of OH-6 Communications Equipment

1. Human factors review of the OH-6 communications equipment has confirmed that the deficiencies already noted by Board evaluation project officers do, in fact, reflect human factors design deficiencies that fail to meet minimum human factors design criteria. This is evidence of a gross failure to comply with the relevant human factors design standards and specifications that should have applied to this procurement.

2. Volume controls did not have sufficient adjustment range. The full-off to highest tolerable volume covered only a few degrees of the total travel of the volume control, requiring finer adjustments than humanly and mechanically possible. Reference marks for setting volume to a desired level without trial and error were not provided and should be incorporated. The labels on the panel, AUDIO and arrow indicating volume increase direction, would best be incorporated on the end of the control knob. The use of the label AUDIO on the transceiver control heads and VOL on the COMM control head is undesirable. A single label on all units, VOL, would be preferable. Reference marks for setting volume level should be provided around the volume control on the upper side, and a reference mark on the volume control knob directly adjacent to the panel face should be provided. Preferably, this reference mark would be a slight pointer extending from the knob. The range of travel of the volume control should be left approximately as it now is, the intensity adjusted so that the maximum setting is near the maximum tolerable intensity while in flight, and the lowest setting just below hearing range with the aircraft on the ground without the engine or rotor running. These settings should be obtained with the comm control unit volume setting at the maximum setting that does not introduce objectionable noise.

3. Squelch controls. The screwdriver squelch control on the VHF and UHF control heads is entirely unacceptable. Control provision for this function appears to have been the result of unrealized performance optimism and should be corrected by an accessible control provided on the control panel. Finding and using the screwdriver does not even closely approach the operating convenience that is essential for this control. Since using a normal control would violate control separation criteria, use of a top serrated very flat fingertip-operated control is recommended as the fix in this situation. This control should extend from the panel only 1/8th to 1/4th inch. Consideration should be given to extending the length of the

VOL-AUDIO control knob adjacent to this squelch control, although it is doubted that this would be necessary if the squelch fingertip control can be kept sufficiently flat.

4. The skirted function select control knobs used have an abrupt vertical rise to the top of the knob, resulting in blockage of view of the actual selected position. A style of knob with a slope on the pointer side should be used in place of this type of knob. A relatively thin sloped pointer knob without skirting should be considered in lieu of the skirted knob in order to permit reconfiguration of the frequency select knobs without the probability of feel confusion.

5. Several of the frequency select knobs fail to meet the minimum separation criteria either from other frequency select knobs or from other rotary controls or toggle switches. Extensive mechanical redesign would now be required to cover this fault, particularly on the ADF receiver. If such mechanical redesign is not accomplished, straight side bar knobs similar to those now used for function select on the panels should be considered to minimize the actual distance that fingers would have to extend from the controls when operating them. Another option would be a round base control sloping off to a straight side bar at its top.

6. The location of the frequency select knobs for the VHF FM control panel interferes with view of labeling of the function select control. Repositioning these controls in conformance with the positioning used on the VHF AM and UHF panels would be desirable.

7. Serious consideration should be given to complete redesign of the ADF receiver control panel. It is in gross violation of miminum human factors design standards. Had proper attention been paid to human factors design standards during the design of this unit, however, fully compliant design in the same panel size could have been attained. The volume control labeled AUDIO should be at the right side of the panel as it is upon all the other panels. The loop control knob should be of a different type than that used for the adjacent function select control knob to reflect its continuous control function. It is too close to the function select control knob and to the right-hand frequency select control knob. The right-hand frequency control knob is too close to the CW-VOICE-TEST toggle switch. The recommended fix for this panel would include complete reconfiguration with the frequency indicator providing separation between the frequency select controls and the controls at the bottom of the panel. The frequency control knobs have been reduced to less than minimum recommended diameter, yet still are too close to the adjacent controls to permit "twirling." The recommendations regarding these knobs above apply especially for this panel.

8. The labels of "COMM CONT" on the comm control panel should be placed together on the left side of the panel rather than split on the left and right sides.

9. An immediately available guard select switch is necessary for access to emergency frequencies. The current configuration requiring movement through the frequency band from current setting will, in many cases, preclude any transmissions in emergencies due to the very substantial time that would be required to reach emergency frequencies.

10. The lack of a manual setting of the ADF compass card in the Mark 994 test set for this communications equipment precludes certain performance checks that should be available during maintenance.

11. The installation of these communications equipments in the OH-6 entails several installations that involve unacceptable access to controls or installation removal components. This is particularly severe for the VHF FM transceiver. Repackaging of this unit from the standpoint of location of the plug for external cable connection should be accomplished. Installation of the remote unit in the right side floor board well is such as to virtually preclude access to components required for removal and replacement of this unit. A change of the mounting structure or positioning on it should provide necessary access.

12. Location of the forward comm control panel on the center console and its location for the rear compartment fails to provide minimum acceptable clearance between toggle switches and adjacent structures in ON position. In both cases, tilting these units so the top of the panel is higher than the bottom of the panel should minimize the problem.

13. In view of the fact that most major functional sections of these units, including power amplifiers, are now available off-the-shelf in IC form at very minimal costs, the wisdom of standardizing on this now obsolete communications equipment is seriously questioned. Very substantial reductions in package size and very substantial improvements in reliability should now be available through a new development program that would entail very minimal costs. Insistence on standardizing on obsolete equipment simply because it is "Army developed" has several serious installation penalties in the aircraft. A good example is the inability in the OH-6 to locate cryptographic control equipment in any acceptable location from the human factors standpoint. The smaller package sizes possible by utilizing the very substantial technological improvements now on the market should probably permit satisfactory solutions to the present cockpit configuration problems that are now impossible to resolve.

Robert H. Wright

ROBERT H. WRIGHT
Senior Scientist

RHW/mvc

Part C. Procedure for Conducting ADF Air Swing

An effective compensation data curve can be accomplished only if the variables affecting the data are held to a minimum. Variables such as weather and normal equipment instability cannot be completely controlled. The controllable variables, such as operator technique, flight technique, and data recording must be held to a minimum. Erroneous and inconsistent data compilation must be reduced through proper orientation of personnel and standardization of methods. The procedures outlined below are designed to effect this orientation and standardization:

a. General. Flight for the purpose of conducting the ADF air swing must be performed over a predetermined ground fix. The ground fix should be recognizable from an altitude of 1,000 feet and be in an area of sparse air traffic.

b. Personnel. The aircraft conducting the air swing should contain two persons: one to fly the aircraft, the other to act as safety observer and data recorder.

c. Operation. Upon arrival at the established ground fix, the pilot will maintain one flight level (normally 1,000 feet m.s.l.) and follow the flight course outlined in figure 4. The data recorder will observe and record the ADF bearing each time the aircraft passes over the ground fix.

d. Data Reduction. The relative bearing from the fixed ground point to the ADF transmitter used will be determined and a compensation data curve plotted in the normal manner.

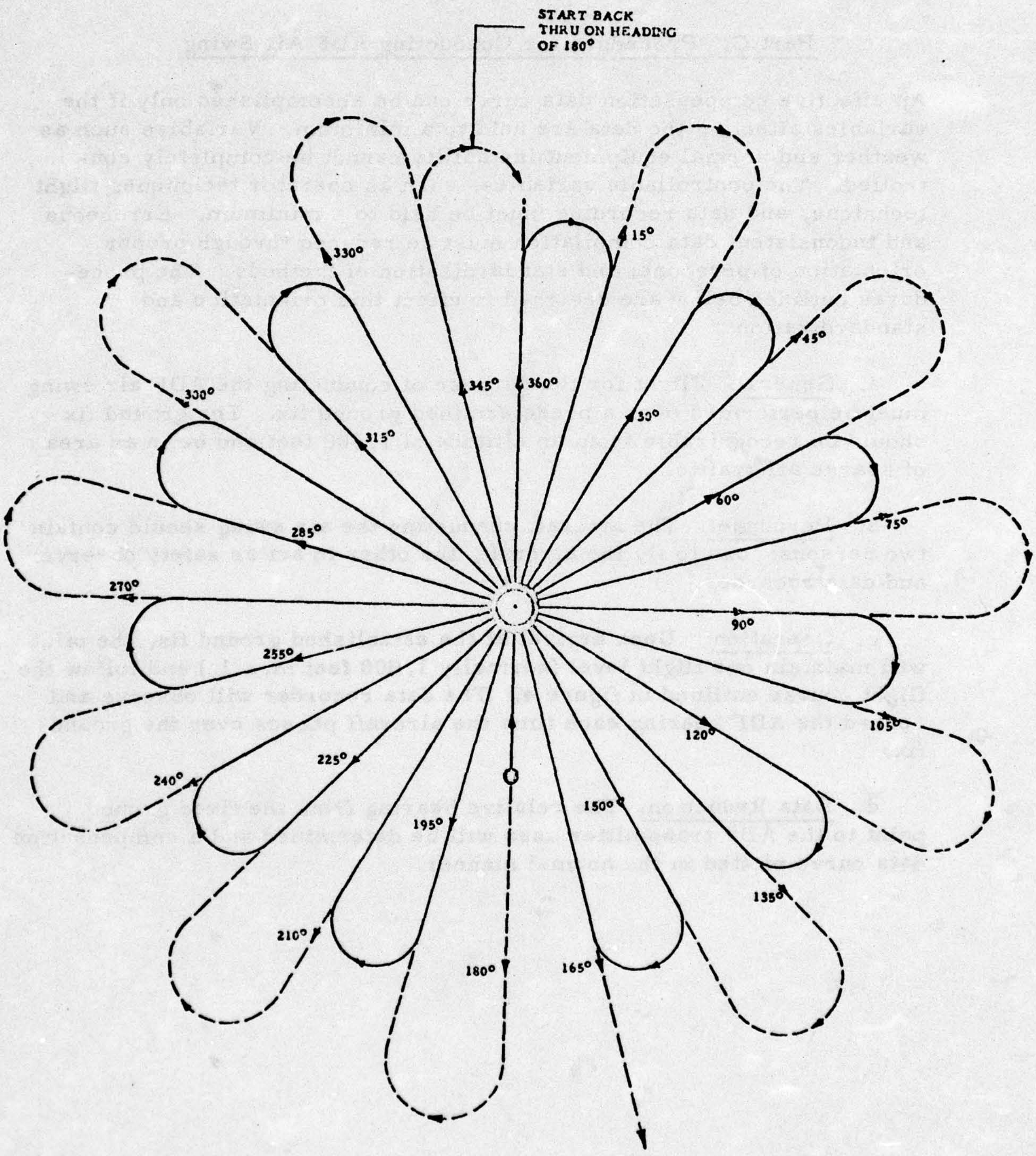
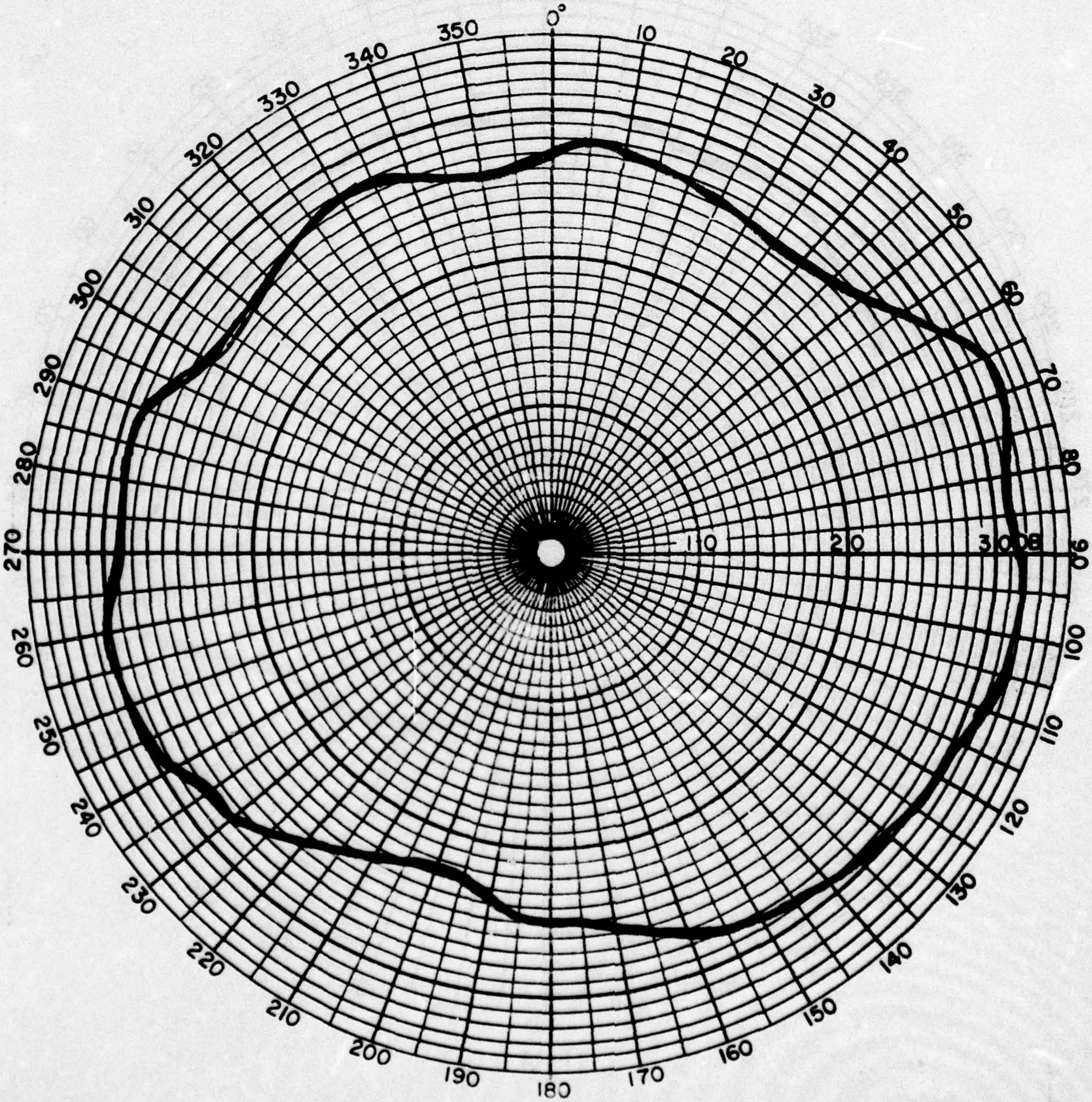


Figure 4

Flight Courses for ADF Air Swing

ANTENNA RADIATION PATTERN

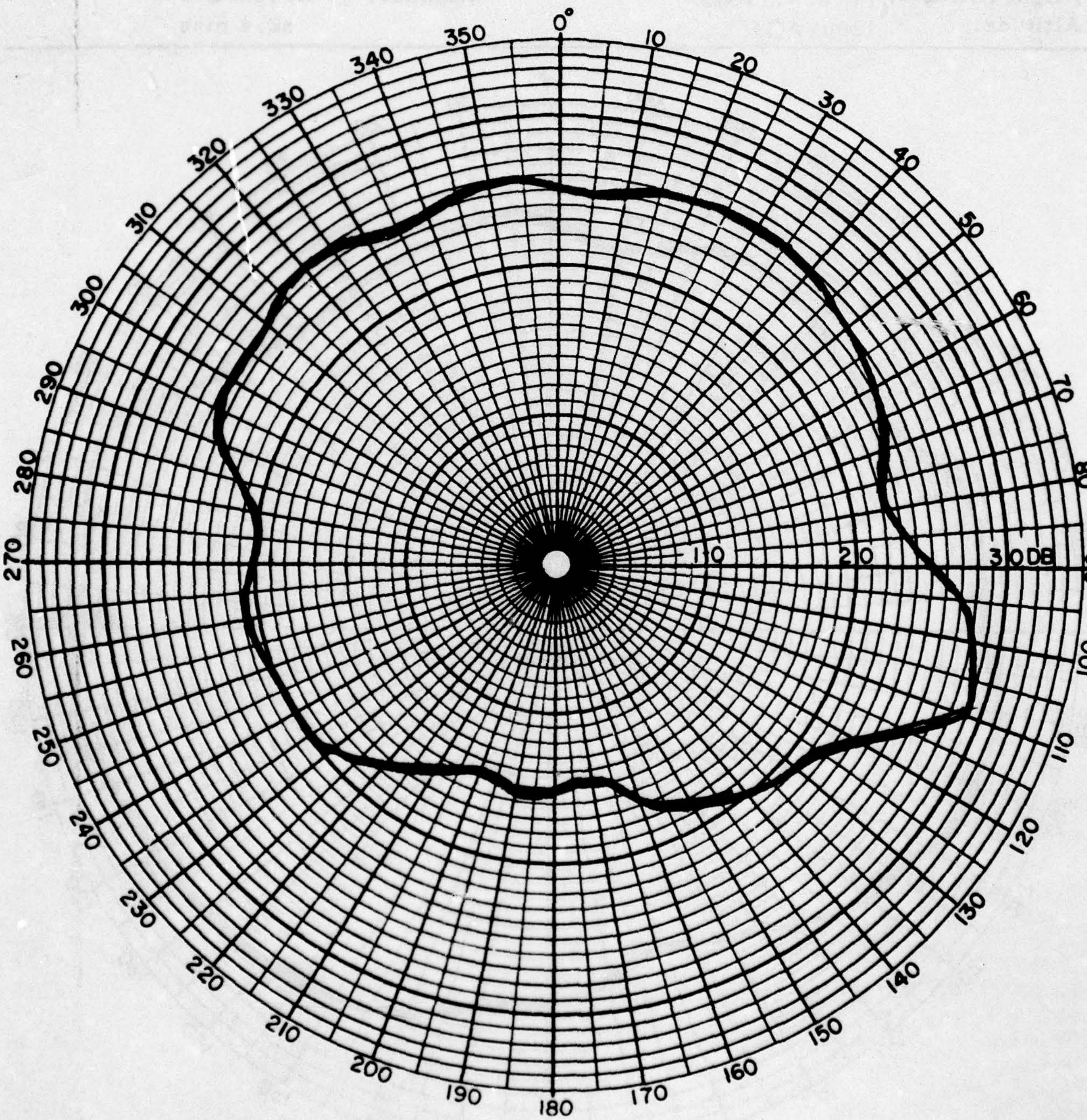
Date:	21 Jan 69	**A/C Type:**	OH-6A
A/C Location:	Bridge, White City, Fla.	**Number:**	979
Gnd. Sta. Location:	Apalachicola Apt, Fla.	**Antenna Type:**	
Flight Attitude:	Level - 90 kts	**Number:**	#1 AN/ARC-114
Altitude:	1200' AGL		52.4 mhz



ANTENNA RADIATION PATTERN

Date: 30 Jan 69
A/C Location: Bridge, White City, Fla.
Gnd. Sta. Location: Apalachicola Apt, Fla.
Flight Attitude: Level - 90 kts
Altitude: 1200' AGL

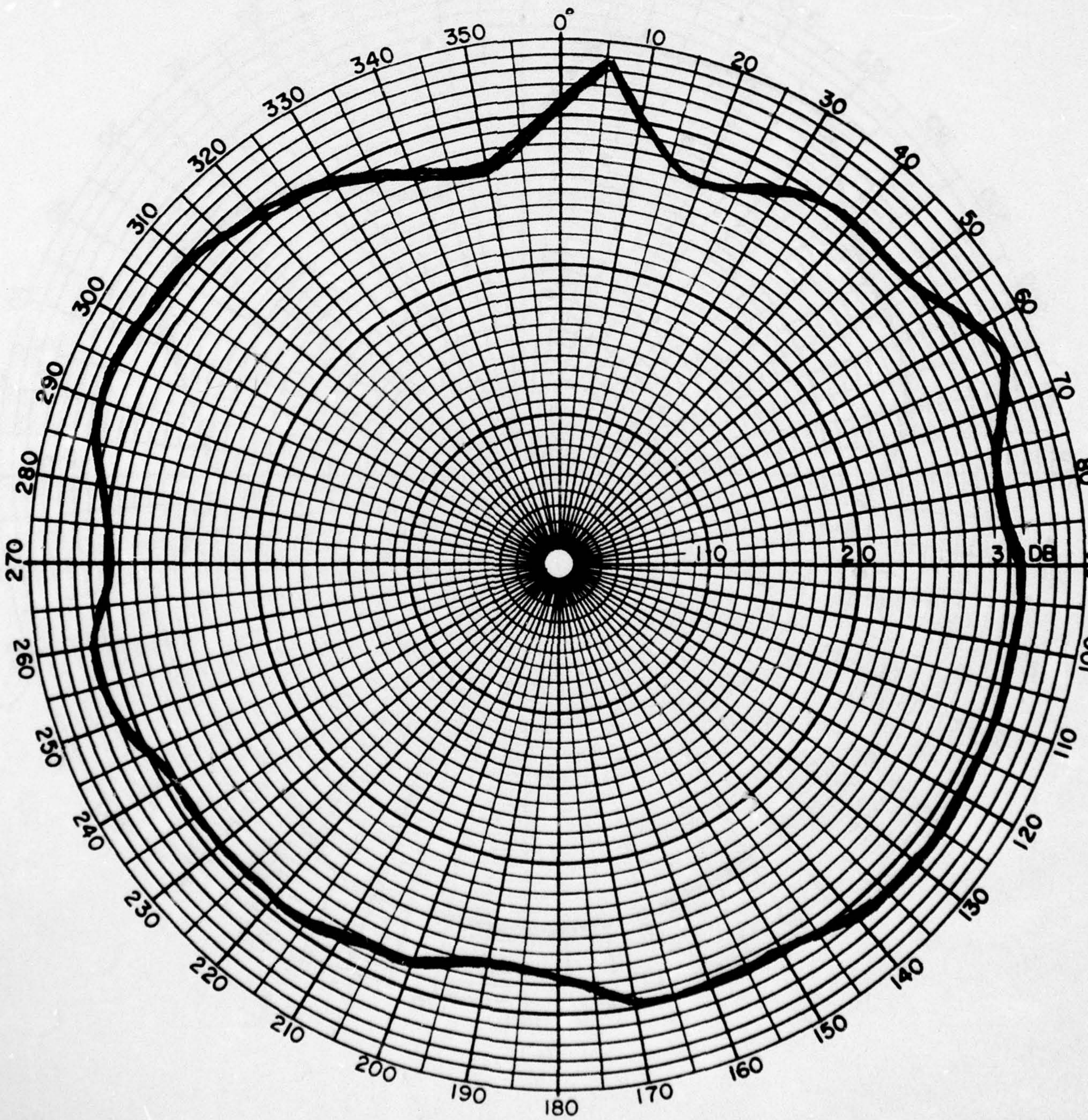
A/C Type: OH-6A
Number: 897
Antenna Type:
Number: #1 AN/ARC-114
74.0 mhz



ANTENNA RADIATION PATTERN

Date: 21 Jan 69
A/C Location: Bridge, White City, Fla.
Gnd. Sta. Location: Apalachicola Apt, Fla.
Flight Attitude: Level - 90 kts
Altitude: 1200' AGL

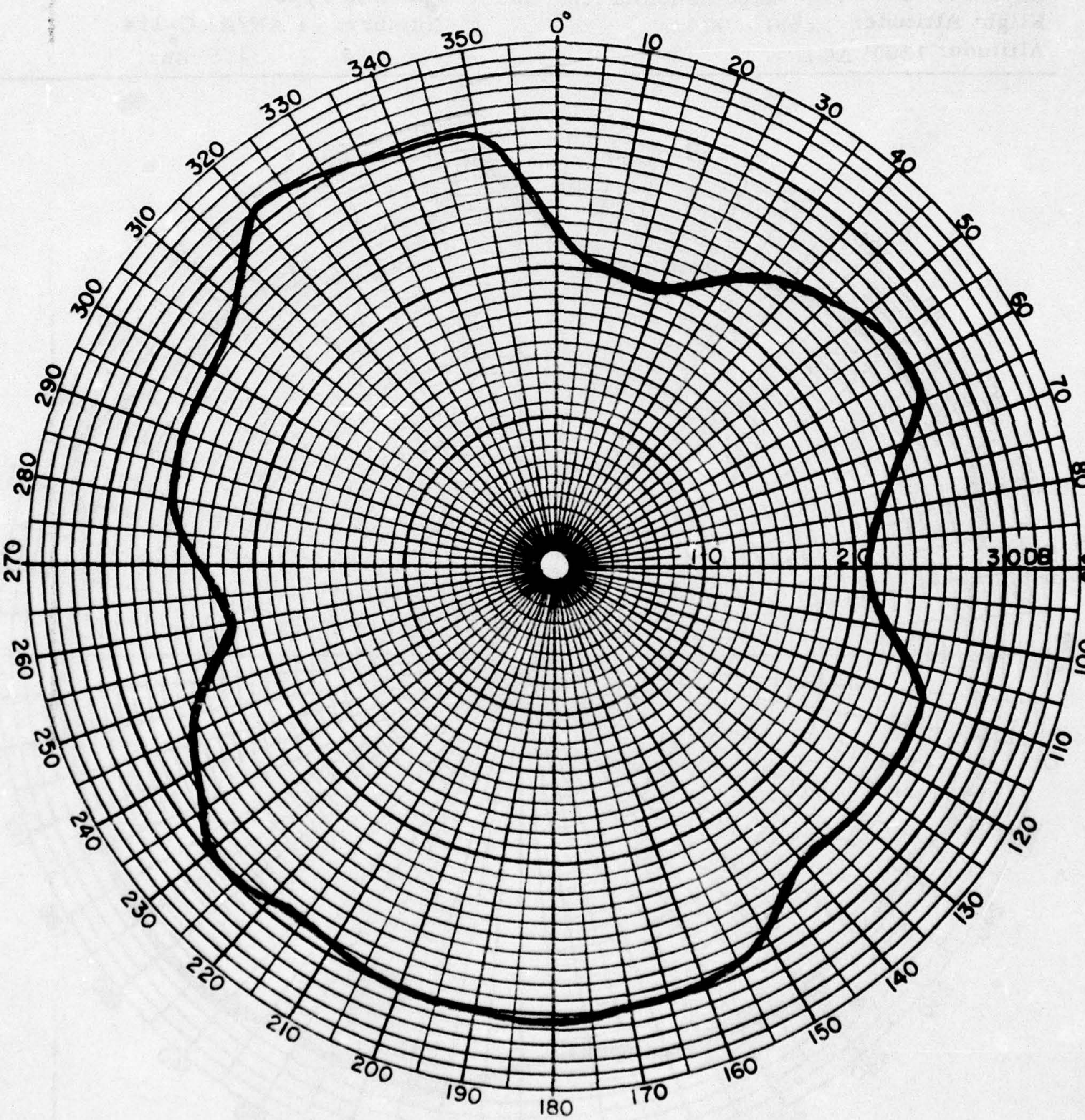
A/C Type: OH-6A
Number: 979
Antenna Type:
Number: #1 AN/ARC-114
31.5 mhz



ANTENNA RADIATION PATTERN

Date: 21 Jan 69
A/C Location: Bridge, White City, Fla.
Gnd. Sta. Location: Apalachicola Apt, Fla.
Flight Attitude: Level - 90 kts
Altitude: 1200' AGL

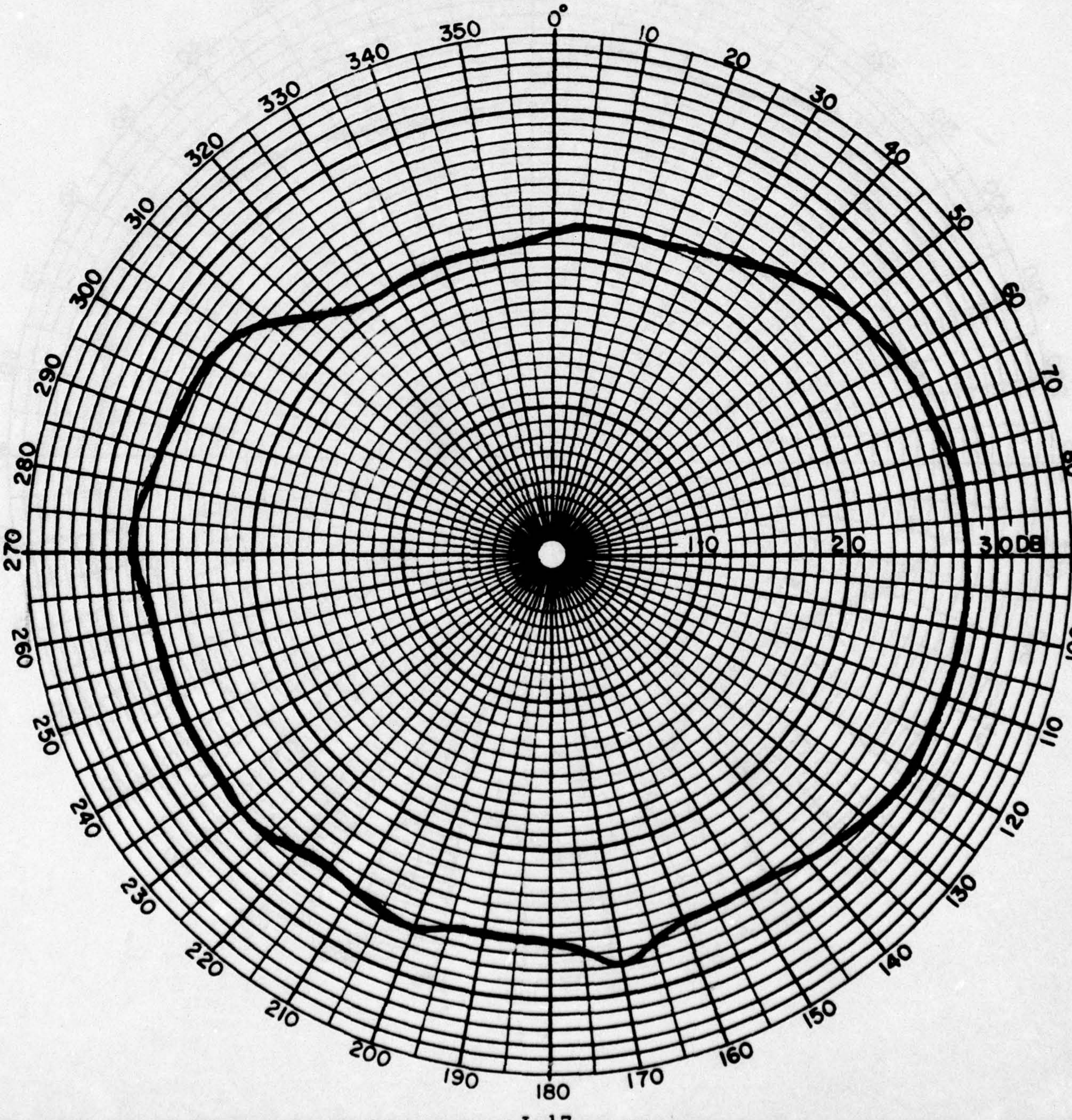
A/C Type: OH-6A
Number: 979
Antenna Type:
Number: #2 AN/ARC-114
52.4 mhz



ANTENNA RADIATION PATTERN

Date: 30 Jan 69
A/C Location: Bridge, White City, Fla.
Gnd. Sta. Location: Apalachicola Apt, Fla.
Flight Attitude: Level - 90 kts
Altitude: 1200' AGL

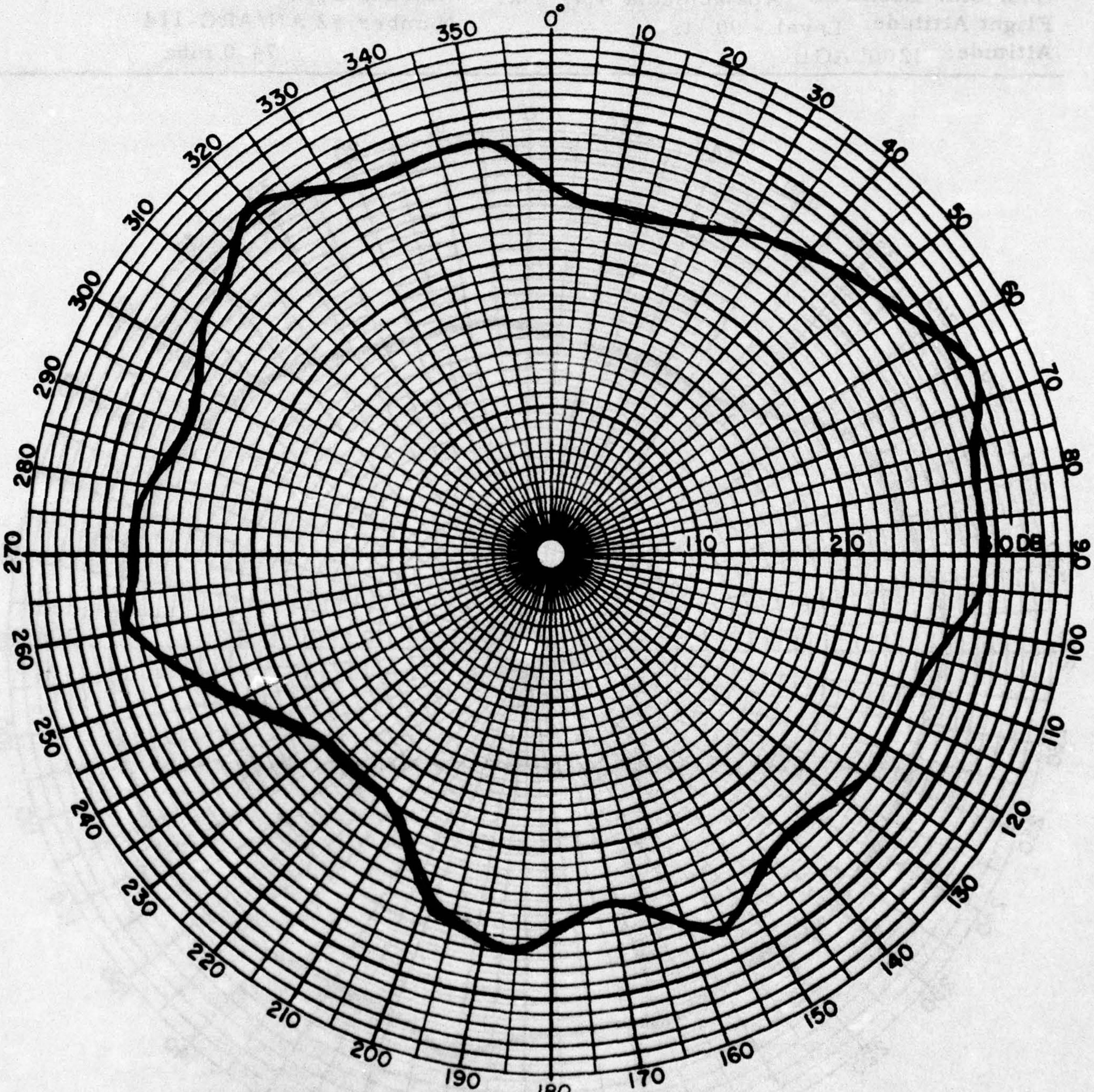
A/C Type: OH-6A
Number: 897
Antenna Type:
Number: #2 AN/ARC-114
74.0 mhz



ANTENNA RADIATION PATTERN

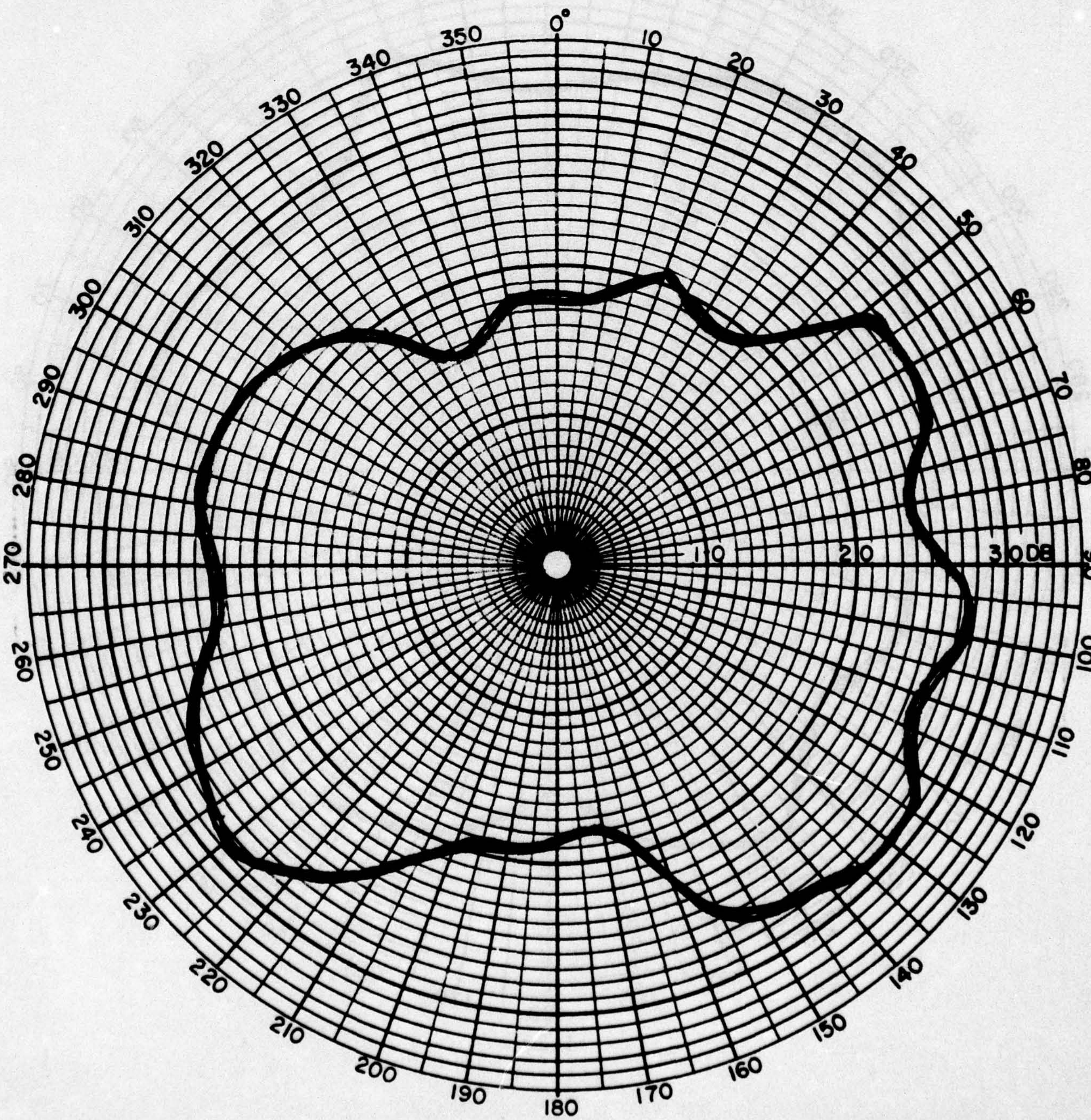
Date: 21 Jan 69
A/C Location: Bridge, White City, Fla.
Gnd. Sta. Location: Apalachicola Apt, Fla.
Flight Attitude: Level - 90 kts
Altitude: 1200' AGL

A/C Type: OH-6A
Number: 979
Antenna Type:
Number: #2 AN/ARC-114
31.5 mhz



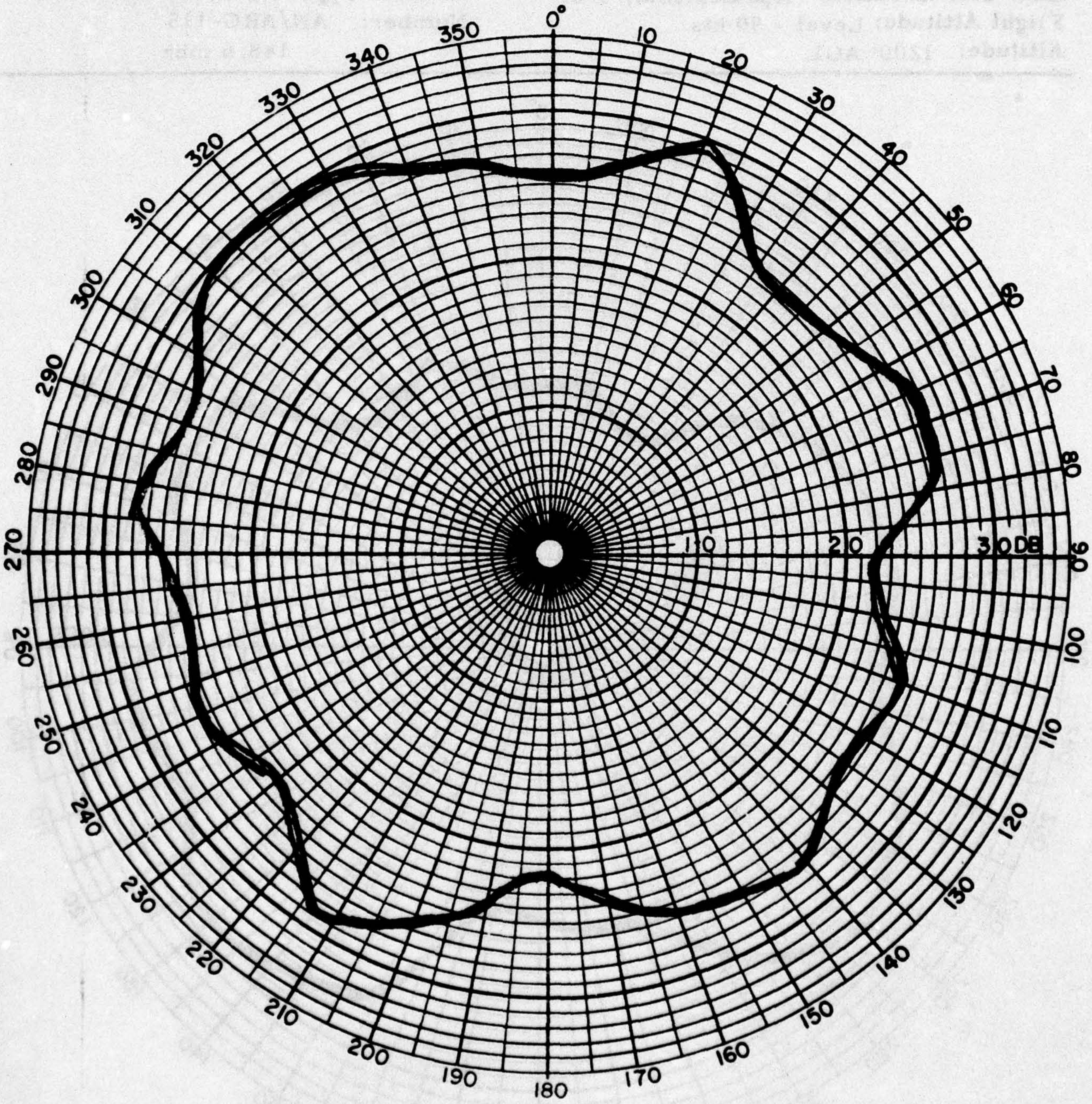
ANTENNA RADIATION PATTERN

Date: 3 Feb 69	**A/C Type:** OH-6A
A/C Location: Bridge, White City, Fla.	**Number:** 897
Gnd. Sta. Location: Apalachicola, Fla.	**Antenna Type:** AS-1965/ARC
Flight Attitude: Level - 90 kts	**Number:** AN/ARC-115
Altitude: 1200' AGL	148.6 mhz



ANTENNA RADIATION PATTERN

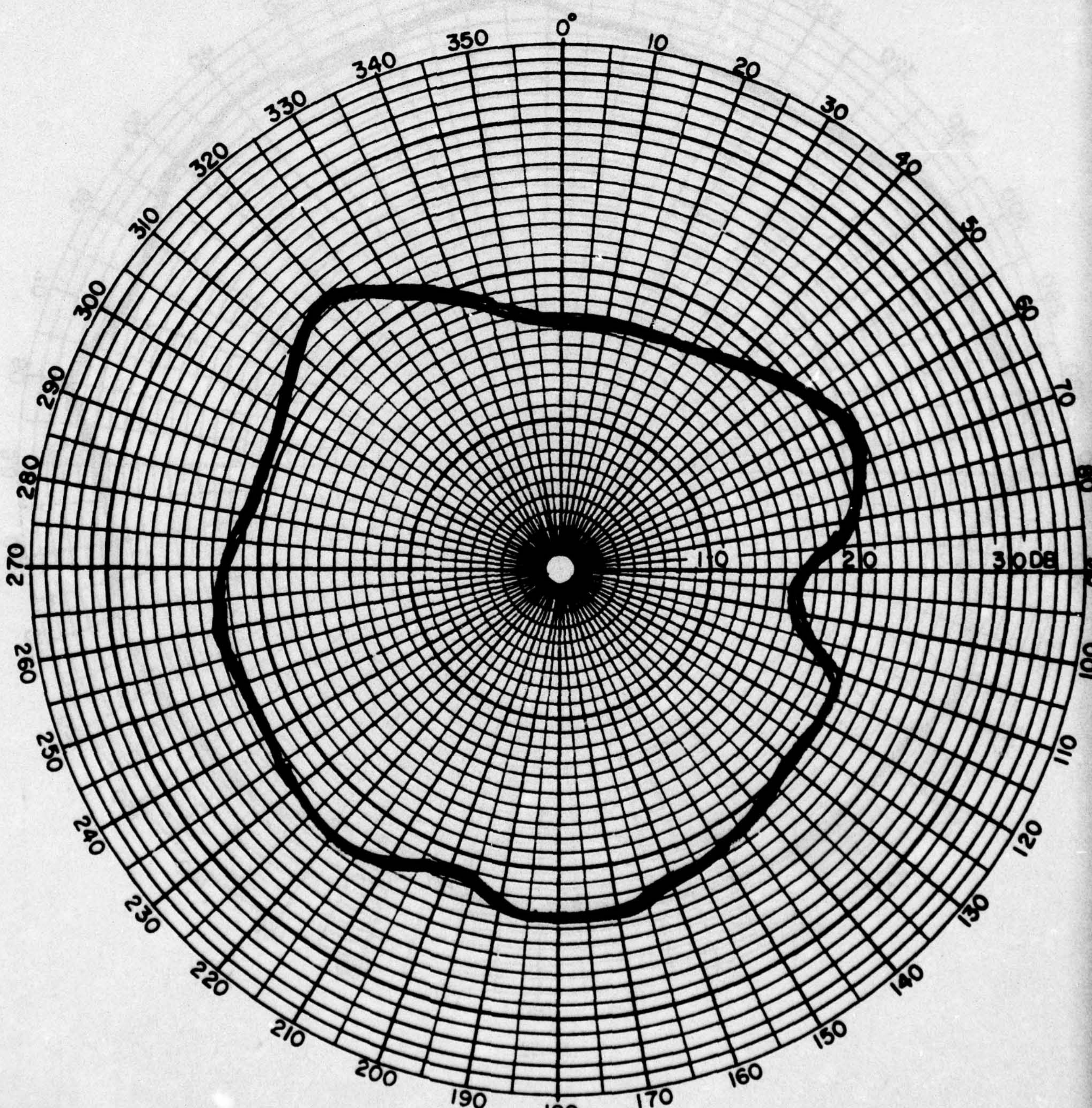
Date:	29 Jan 69	**A/C Type:**	OH-6A
A/C Location:	Bridge, White City, Fla.	**Number:**	897
Gnd. Sta. Location:	Apalachicola Apt, Fla.	**Antenna Type:**	AS-1965/ARC
Flight Attitude:	Level - 90 kts	**Number:**	AN/ARC-115
Altitude:	1200' AGL		119.5 mhz



ANTENNA RADIATION PATTERN

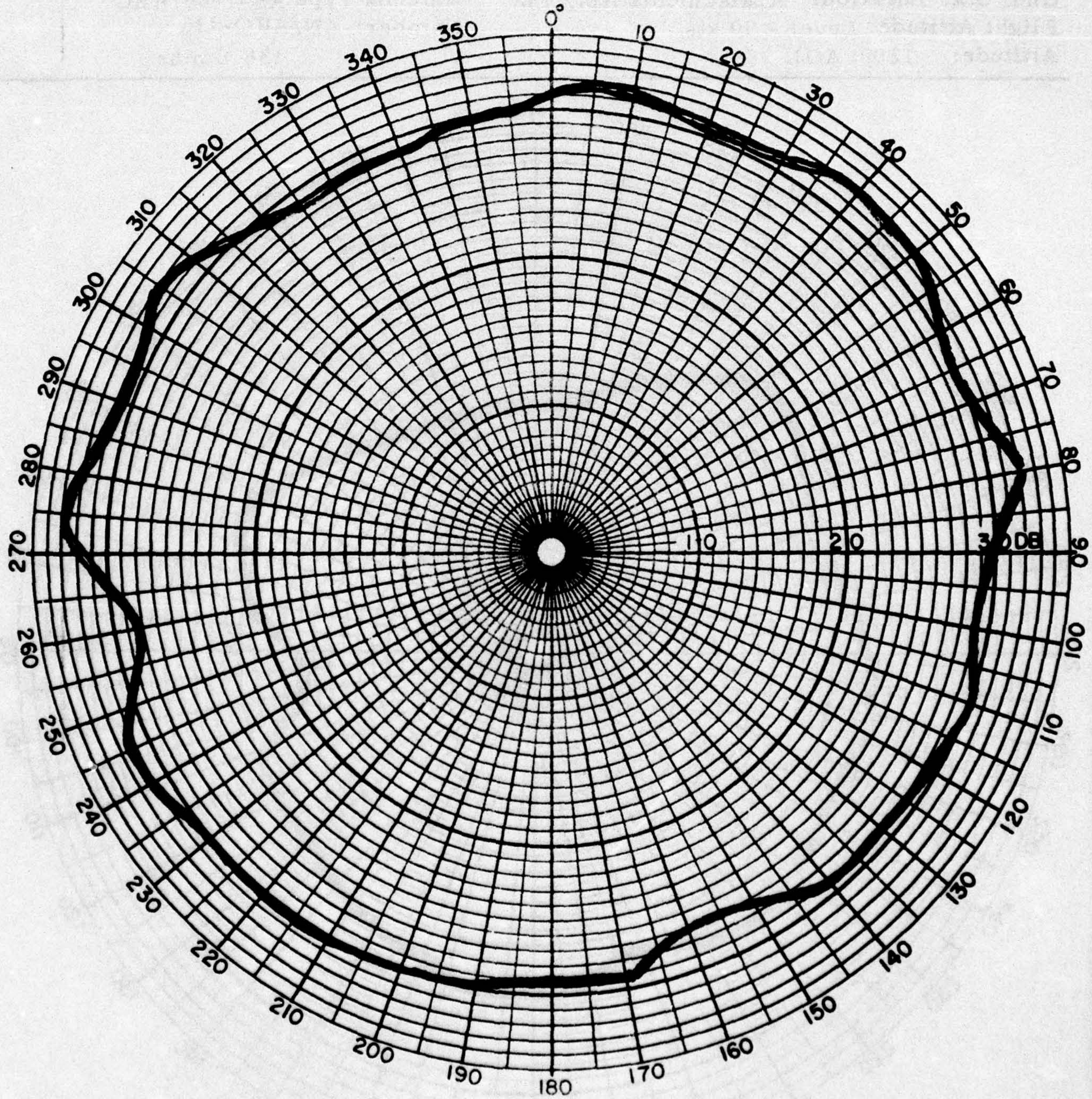
Date: 27 Jan 69
A/C Location: Bridge, White City, Fla.
Gnd. Sta. Location: Apalachicola Apt, Fla.
Flight Attitude: Level - 90 kts
Altitude: 1200' AGL

A/C Type: OH-6A
Number: 979
Antenna Type: AS-1965/ARC
Number: AN/ARC-115
138. 8 mhz



ANTENNA RADIATION PATTERN

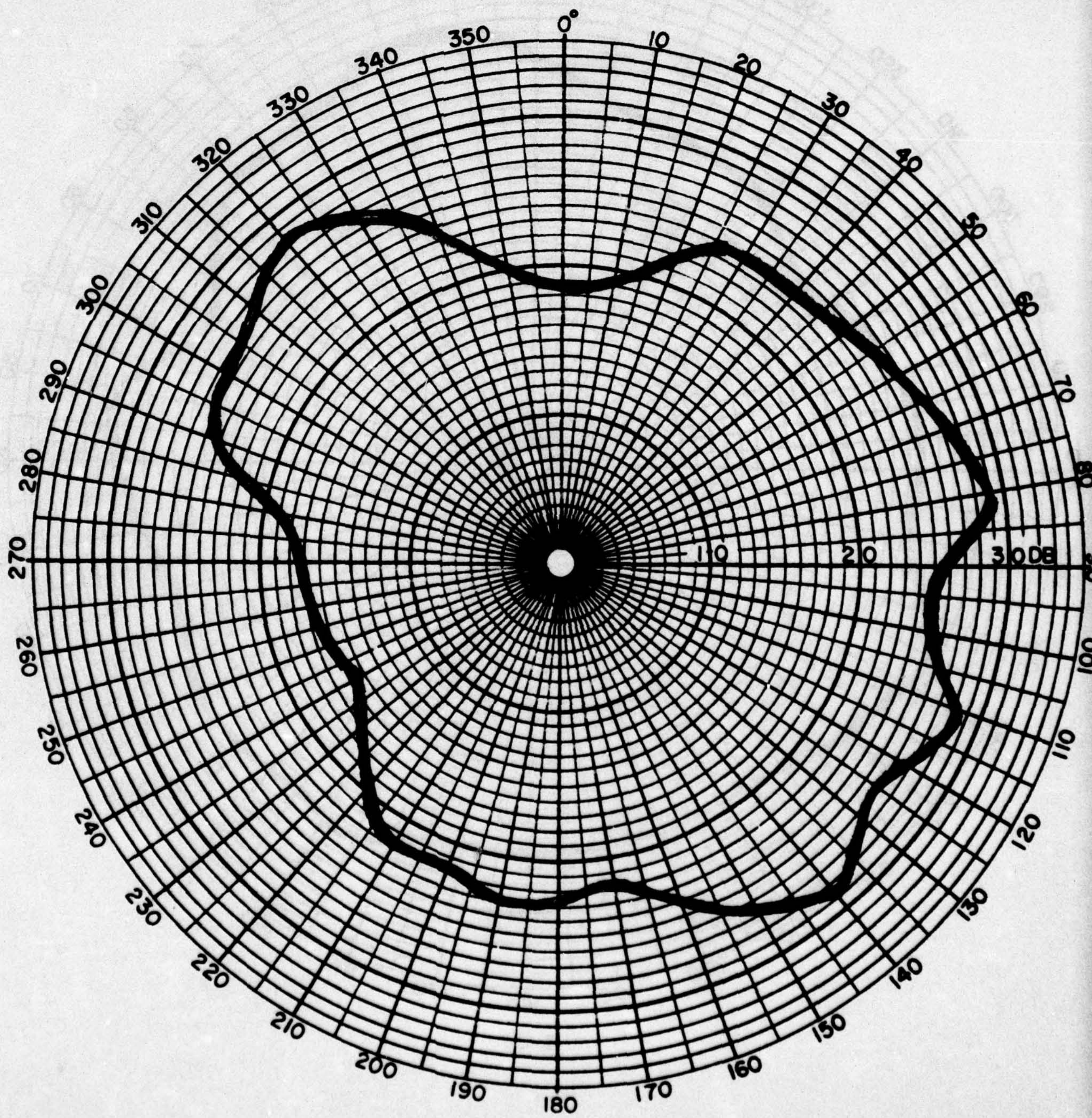
Date: 30 Jan 69	**A/C Type:** OH-6A
A/C Location: Bridge, White City, Fla.	**Number:** 897
Gnd. Sta. Location: Apalachicola Apt, Fla.	**Antenna Type:**
Flight Attitude: Level - 90 kts	**Number:** AN/ARC-116
Altitude: 1200' AGL	262.5 mhz



ANTENNA RADIATION PATTERN

Date: 3 Feb 69
A/C Location: Bridge, White City, Fla.
Gnd. Sta. Location: Apalachicola Apt, Fla.
Flight Attitude: Level - 90kts
Altitude: 1200' AGL

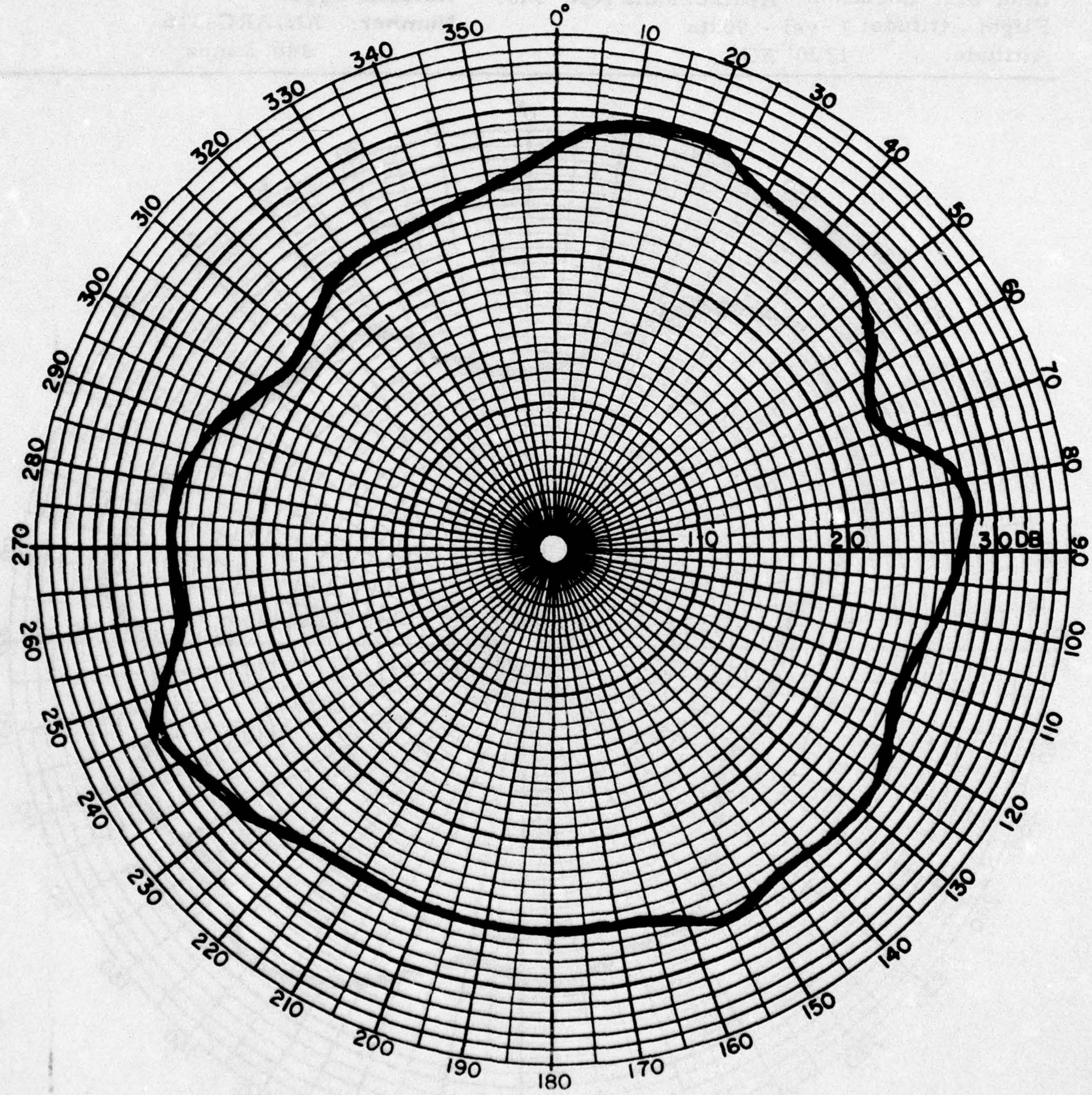
A/C Type: OH-6A
Number: 897
Antenna Type:
Number: AN/ARC-116
346.3 mhz



ANTENNA RADIATION PATTERN

Date: 29 Jan 69
A/C Location: Bridge, White City, Fla.
Gnd. Sta. Location: Apalachicola Apt, Fla.
Flight Attitude: Level - 90 kts
Altitude: 1200' AGL

A/C Type: OH-6A
Number: 897
Antenna Type:
Number: AN/ARC-116
226.0 mhz



APPENDIX II. DEFICIENCIES AND SHORTCOMINGS

A. Deficiencies. The following deficiencies were discovered during the test.

Deficiency	Suggested Corrective Action	Remarks
1. The AN/ARC-114, -115, and -116 did not have separate preset guard transmit capability.	Provide preset guard transmit capability in all SLAE communication radios.	EPR KF-31 submitted. See paragraphs 2.4.3.2.2, 2.4.4.2, 2.15.3.2, and 2.15.4.
2. The AN/ARC-114, -115, and -116 did not have a knob for squelch control.	Replace the recessed screw with a protruding knob to control squelch.	EPR KF-32 submitted. See paragraphs 2.4.3.2.4 and 2.4.4.4.
3. The AN/ARC-114 experienced 21 random failures that subsequent maintenance failed to resolve. Bench testing after each instance revealed that the radio met specifications.		EPR KF-37 submitted. See paragraphs 2.4.3.2.1 and 2.4.4.1.
4. Maximum communication ranges as low as 10 n.m. at 500 feet AGL and 14 n.m. at 3000 feet AGL were experienced with the AN/ARC-114's.		EPR KF-37 submitted. See paragraphs 2.4.3.1 and 2.4.4.1.
5. Background noise in the audio of the AN/ARN-89 was excessive and restricted the usable range of the ADF.	Suppress noise to tolerable limits.	EPR KF-43 submitted. See paragraphs 2.5.3.1.3 and 2.5.4.1.

Deficiency	Suggested Corrective Action	Remarks
6. FM homing range decreased as frequency decreased.	Provide an FM homing system that can be received at a reasonably uniform range without regard to frequency.	EPR KF-46 submitted. See paragraphs 2.5.3.2.1, 2.5.3.2.2, and 2.5.4.5.
7. FM Homing Steering Pointer was too sensitive for use at ranges less than 10 n.m.	Damp oscillations of FM Homing Steering Pointer so that it is usable at all ranges.	EPR KF-48 submitted. See paragraphs 2.5.3.2.2 and 2.5.4.5.
8. FM homing station passage meter indicated strength of signal reception but failed to indicate station passage.	Provide a station passage device that is not subject to erroneous indications.	EPR KF-47 submitted. See paragraphs 2.5.3.2.2 and 2.5.4.5.
9. The ADF needle wandered indiscriminately during retransmission with AN/ARC-114 radios.		EPR KF-45 submitted. See paragraph 2.8.3.2.
10. The ADF needle "locked" during transmission with the AN/ARC-115.		EPR KF-44 submitted. See paragraph 2.8.3.1.
11. Erroneous fuel quantity indications were presented during AN/ARC-114 transmission from 39.90 to 55.00 mhz.		EPR KF-50 submitted. See paragraph 2.8.3.4.

Deficiency	Suggested Corrective Action	Remarks
12. Erroneous fuel quantity indications were presented during AN/ARC-115 VHF transmissions from 140.000 to 147.000 mhz.		EPR KF-49 submitted. See paragraph 2.8.3.3.
13. Volume control of the two AN/ARC-114's during retransmission was extremely critical. Improperly set volume controls reduced range or created distortion.		EPR KF-57 submitted. See paragraph 2.6.2.1.2.
14. The AN/ARC-114, AN/ARC-115, AN/ARC-116, and AN/ARN-89 failed to meet the MTBF criteria of 1,000 hours.		EPR KF-66 submitted. See paragraphs 2.10.3.2 and 2.10.4.
15. The FM homing station passage meter dropped to the bottom of the indicator during transmission and reception on the No. 1 and No. 2 AN/ARC-114's and the AN/ARC-115.		EPR KF-71 submitted. See paragraph 2.8.3.5.
16. The AN/ARC-116 failed to meet receive-power consumption criteria by 5.1 watts.		EPR KF-64 submitted. See paragraphs 2.3.3.1 and 2.3.4.

B. Shortcomings. The following shortcomings were discovered during the test.

Shortcoming	Suggested Corrective Action	Remarks
1. The AN/ARC-114, -115, and -116 did not have preset channel capability.	Provide preset channels for all three SLAE communication radios.	EPR KF-30 submitted. See paragraphs 2.4.3.2.3 and 2.4.4.3.
2. The volume control adjustment on the AN/ARC-114, -115, and -116 was critical.		EPR KF-35 submitted. See paragraphs 2.4.3.2.5 and 2.4.4.5.
3. The control face labels that identify the AN/ARC-114, -115, and -116 were confusing.	Relabel the three SLAE communication radios: FM, VHF, UHF.	EPR KF-51 submitted. See paragraphs 2.14.3.3 and 2.14.4.
4. The volume control knobs of the AN/ARC-114, -115, and -116 were not marked to show position relative to full high, full low, or intermediate settings.	Etch the control knobs with a white line that can be correlated with the audio arrow on the face of the radio and include several marks on the arc of the arrow.	EPR KF-33 submitted. See paragraph 2.12.3.4.
5. The face of the AN/ARN-89 was not marked to show position of the volume control relative to full high, full low, or intermediate settings.	Mark the face of the AN/ARN-89 with several marks that can be correlated with the volume control knob.	EPR KF-34 submitted. See paragraph 2.14.3.4.

Shortcoming	Suggested Corrective Action	Remarks
6. The location of the transponder control head and the voice security control indicator made their use virtually impossible during flight.	Relocate these two items.	EIR (69-1) 962198 submitted. See paragraph 2. 14. 3. 2.
7. The panel light intensity of two C-6533's, No. 1 AN/ARC-114, the AN/ARN-89, and the AN/ARC-116 could not be reduced from full bright.	Incorporate provisions in the airframe wiring to permit adjustment of light intensity.	EIR (69-4) 235773 submitted. See paragraph 2. 14. 3. 5.
8. False *on-course* indications occurred on 31. 5 and 36. 9 mhz during homing with the AN/ARC-114.		EPR KF-65 submitted. See paragraphs 2. 5. 3. 2. 2 and 2. 5. 4. 5.
9. Retransmission communications were degraded when the OH-6A exceeded a 16-degree angle of bank.		EPR KF-69 submitted. See paragraph 2. 6. 3. 1. 3.
10. When transmitting on 226. 0 mhz on the AN/ARC-116, a loud rushing noise was produced on 54. 0 mhz on the No. 1 AN/ARC-114.	Conduct engineering testing throughout the frequency range of these radios to determine the cause and corrective action.	EPR KF-58 submitted. See paragraph 2. 8. 3. 6.

Shortcoming	Suggested Corrective Action	Remarks
11. Transmitting on 74.0 mhz on No. 1 AN/ARC-114 produced a loud rushing noise on 226.0 mhz on the AN/ARC-116.	Conduct engineering testing throughout the frequency range of these radios to determine the cause and corrective action.	EPR KF-58 submitted. See paragraph 2.8.3.6.
12. The AN/ARN-89 receiver must be re-compensated when it is changed from one type aircraft to another or when it is installed in an aircraft from maintenance float stock.	Incorporate a separate compensation network that is not a part of a major component of the AN/ARN-89.	EPR KF-56 submitted. See paragraphs 2.9.3.9, 2.9.4.1, and 2.9.4.2.
13. Establishment of a compensation data curve for the AN/ARN-89 was difficult because of the receiver location in the helicopter.	Relocate the receiver of the AN/ARN-89.	EPR KF-56 submitted. See paragraph 2.9.3.3.
14. The AN/ARC-115 failed to meet receive-power consumption criteria by 0.4 watt.		EPR KF-63 submitted. See paragraphs 2.3.3.1 and 2.3.4.
15. The location of the C-6280A(P)/APX Control and the C-8157/ARC Control Indicator prevented installation of the Helicopter Sight, Reflex XM70E1.	Relocate the C-6280A(P)/APX and the C-8157/ARC.	EIR (69-5) 235753 submitted. See paragraph 2.14.3.2.

Shortcoming	Suggested Corrective Action	Remarks
16. Maintenance Kit MK-994( )/AR did not provide a means of slewing the compass card.		EPR KF-72 submitted. See paragraph 2.11.3.2.

APPENDIX III - MAINTENANCE EVALUATION

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MAINTENANCE AND RELIABILITY ANALYSIS CHART

INSTRUCTION SHEET - SECTION 1

COLUMN	DESCRIPTION
1	Entry number of each item.
2	Group number as indicated in the Maintenance Allocation Chart.
3	Component and related operations as indicated in the Maintenance Allocation Chart. Operations indicated as in Depot Category are not shown.
4	Maintenance Level, Prescribed. Category prescribed by the Maintenance Allocation Chart is indicated by utilizing the letters O/C, O, DS, or GS. O/C - Operator or crew; O - Organizational; DS - Direct Support; GS - General Support.
5	Maintenance Level, Recommended. Letters O/C, O, DS, or GS indicate the category recommended by the test agency.
6	TM Instructions, Adequate. An X in this column indicates the TM instructions are considered adequate.
7	TM Instructions, Inadequate. The test agency reference number used on DA Forms 1598/2028 is indicated in this column, if the instructions are considered inadequate.
8	Active Maintenance Time. Man-hours used to the closest tenth. If the operation was not actually performed but was reviewed, the estimated active maintenance time is indicated by using the prefix E. Average active maintenance time is used if the operation was performed more than once.
9	Life. Number of hours, miles, or rounds accumulated before or since this operation was performed. An entry is made each time this operation is performed, followed by the appropriate life unit; i.e., M, H, or R. An "S" will be placed in this column if the operation was performed on a sampling basis and not because of an actual failure.
10	Reason performed. The symbol "Unsched" will be shown in this column if the operation was performed as a result of unscheduled maintenance. If the operation was performed as a result of scheduled maintenance, it is indicated by the symbol "Sched" in this column. If the operation was performed only to verify procedures and tools, not as a result of breakdown, it is indicated by the symbol "Sim" in this column.

COLUMN	DESCRIPTION
11	Remarks. If the operation is related to any other sub-test covered in the body of the test report, the paragraph number is inserted for cross reference. If the operation was not performed as a result of using the sampling technique authorized by AR 750-6, one of the following remarks is entered as appropriate. a. Reviewed - not performed. b. Neither reviewed nor performed due to (No TM's) or (insufficient service test time). c. Other, as appropriate. If an EPR is related to a maintenance operation, the EPR number will be inserted.

MAINTENANCE AND RELIABILITY ANALYSIS CHART
(SECTION 1)

ENTRY NO	GROUP NO	COMPONENT AND RELATED OPERATIONS	O/C - Oper/Crew O - Orgzn DS - Direct GS - General: Pre-scribed	Recom-mended	TM INSTRUCTIONS: Ade-quate	Inade-quate 1598/2028	ACTIVE MAINT TIME	LIFE M - Miles H - Hours R - Rounds	REASON PERFORMED	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1		SLAE - Initial Acceptance Inspection	O	O		X	1.4	0.0H	Sched	Maintenance package not received (EPR KF-1). Test equipment not received (EPR KF-2).
2		AN/ARC-114 (SN 23) - Troubleshooting power supply subassembly A2	DS	DS	X		8.2	0.0H	Unsched	Power supply failure during initial acceptance inspection (EPR KF-3). No replacement parts available. (See Entry No. 5.)
3		AN/ARC-114 (SN 23) - Repair A2J13 Module Connector Wiring	DS	DS	X		1.1	0.0H	Unsched	Wiring found broken during initial acceptance inspection (EPR KF-4). Could not test after repair. (See Entry No. 2.)
4		AN/ARC-115 (SN 22) - Troubleshooting power supply subassembly A2	DS	DS	X		11.5	0.0H	Unsched	Main and guard receivers excessively noisy during initial acceptance inspection (EPR KF-5). No replacement parts available. (See Entry No. 7.)
5		AN/ARC-114 (SN 23) - Replace power supply subassembly A2	DS	DS	X		11.5	0.0H	Unsched	See Entry No. 2. EPR KF-7.
6		AN/ARC-116 (SN 7) - Alignment	O	O	X		1.5	7.3H	Unsched	Transmitter - receiver weak on 248.2 mhz (EPR's KF-8 and KF-21).
7		AN/ARC-115 (SN 22) - Replace power supply subassembly A2; alignment	DS	DS	X		11.5	0.0H	Unsched	See Entry No. 4. EPR's KF-9 and KF-20. Additional troubleshooting required. (See Entry No. 8.)
8		AN/ARC-115 (SN 22) - Replace A1A2A3 VCO and D-A converter circuit card assembly	DS	DS	X		4.0	0.0H	Unsched	Card failure caused by power supply failure (EPR's KF-10 and KF-20). (See Entry No.'s 4 and 7.)
9		AN/ARC-114 (SN 23) - Troubleshooting	O	O	X		0.5	19.6H	Unsched	Homing unreliable (EPR KF-11). Not corrected due to lack of test equipment. See Entry No. 16.
10		AN/ARC-116 (SN-7) - Alignment	O	O	X		1.0	20.6H	Unsched	Would not receive on frequencies below 240.0 mhz (EPR's KF-12 and KF-21). See Entry No. 6.
11		AN/ARN-89 (SN 188) - Replace 1A1 mixer/IF amplifier module	O	O	X		2.5	21.8H	Unsched	ADF weak below 410 khz (EPR KF-13).
12		AN/ARN-89 (SN 188) - Attempt to establish data curve for loop compensation	O	O		X	31.0	29.8H	Unsched	Unable to obtain accurate loop compensation (EPR KF-15). ADF needle moved 10° from loop heading when receiver cover housing was removed.

MAINTENANCE AND RELIABILITY ANALYSIS CHART
(SECTION 1)

ENTRY NO	GROUP NO	COMPONENT AND RELATED OPERATIONS	O/C - Oper/Crew O - Organ DS - Direct GS - General: Pre-scribed	Recom-mended	TM INSTRUCTIONS: Ade-quate	Inade-quate 1598/2028	ACTIVE MAINT TIME	LIFE M - Miles H - Hours R - Rounds	REASON PERFORMED	REMARKS
1	2	3	4	5	6	7	8	9	10	11
13		SLAE - Periodic Inspection (PEI)	O	O	X		70.6	29.8H	Sched	OH-6A, SN 65-12979.
14		AS-1962 FM Homing Antenna - Replace left metal tape dipole	O	O	X		1.4	38.0H	Unsched	Left metal tape dipole found broken during PEI (EPR KF-16).
15		C-6533/ARC (SN 32) - Replace VR-1 protection device and filter assembly	O	O	X		4.9	39.0H	Unsched	C-6533 found inoperative during PEI (EPR KF-19).
16		AN/ARC-114 (SN 23) - Align Receiver-Transmitter and replace main guard receiver assembly A1A4	DS	DS	X		4.0	69.2H	Unsched	EPR KF-22. See Entry No. 9.
17		AN/ARN-89 (SN 188) - Bench alignment	DS	DS	X		2.5	40.0H	Unsched	Excessive background noise and erratic needle pointer (EPR KF-23).
18		AN/ARC-116 (SN 7) - Replace power supply subassembly A2A4	DS	DS	X		1.5	20.6H	Unsched	Self-test inoperative and no transmit sidetone (EPR KF-24).
19		AN/ARC-116 (SN 7) - Replace Q-1 surge protector transistor and driver power amplifier	DS	DS	X		5.8	21.0H	Unsched	Radio set failed when tuned to 248.2 mhz during bench test (EPR's KF-25 and KF-62).
20		AN/ARC-115 (SN 108) - Replace power supply subassembly A2	DS	DS	X		3.0	6.0H	Unsched	Power supply failed during bench test (EPR KF-26).
21		C-6533/ARC (SN 32) - Replace AR-1 microphone audio card	DS	DS	X		4.9	48.0H	Unsched	Control noticeably weak and sidetone noisy (EPR KF-27).
22		AN/ARC-114 (SN 105) - Replace A1A5A18 spectrum generator and switch filter card	DS	DS	X		7.0	71.2H	Unsched	Radio set failed during bench test (EPR KF-28).
23		AN/ARC-114 (SN 2) - Replace F1 fuse in A2A1 subassembly	DS	DS	X		6.1	125.2H	Unsched	No transmit sidetone (EPR KF-36).
24		AN/ARC-114 (SN 3) - Adjust A1A5MP119R3 guard receiver squelch control on A1A5A9 card in A1 subassembly	DS	DS	X		1.5	128.1H	Unsched	Excessive background noise on guard receiver (EPR KF-38).

MAINTENANCE AND RELIABILITY ANALYSIS CHART
(SECTION 1)

ENTRY NO	GROUP NO	COMPONENT AND RELATED OPERATIONS	O/C - Oper/Crew, O - Organ, DS - Direct, GS - General: Pre-scribed	Recom-mended	TM INSTRUCTIONS: Ade-quate	Inade-quate 1598/2028	ACTIVE MAINT TIME	LIFE M - Miles H - Hours R - Rounds	REASON PERFORMED	REMARKS
1	2	3	4	5	6	7	8	9	10	11
25		AN/ARC-114 (SN 105) - Replace A1A5A16 VCO circuit card	DS	DS	X		2.6	144.8H	Unsched	Radio set inoperative (EPR KF-39).
26		AN/ARN-89 (SN 188) - Replace 1A4 goniometer module	DS	DS	X		4.8	100.3H	Unsched	ADF would not "home" in compass mode (EPR KF-40).
27		AN/ARC-114 (SN 2) - Replace A2A1 and A2A2 regulator circuit card assemblies.	DS	DS	X		12.3	125.2H	Unsched	EPR KF-41. See Entry No. 23.
28		AN/ARC-116 (SN 47) - Replace Q7 and Q8 transistors	DS	DS	X		3.7	129.0H	Unsched	Radio set would not transmit or receive (EPR's KF-42 and KF-61).
29		AN/ARC-116 (SN 32) - Complete bench alignment; adjust A1A1R44 main receiver squelch control; clean and inspect all circuit cards.	DS	DS	X		4.6	220.1H	Unsched	Sidetone weak (EPR KF-59).
30		AN/ARC-115 (SN 22) - Clean and inspect all circuit card assemblies; complete bench alignment	DS	DS	X		3.0	39.5H	Unsched	"Motor boating" noise in transmit (EPR KF-63).

MAINTENANCE AND RELIABILITY ANALYSIS CHART

INSTRUCTION SHEET - SECTION 2

COLUMN	DESCRIPTION
1	Entry number which will correspond to the same item entry in Section 1.
2-5	Appropriate man-hours used to the closest tenth. If man-minutes are a more appropriate unit of measure, so stipulate in Column 8, Remarks.
6	Total man-hours as recorded in Columns 2 through 5.
7	Man-hours used to the closest tenth.
8	Remarks as appropriate.

MAINTENANCE AND RELIABILITY ANALYSIS CHART
(SECTION 2)

ENTRY NO	PREPARATION TIME	FAULT CORRECTION TIME	ADJUSTMENT AND CALIBRATION TIME	FINAL TEST TIME	TOTAL TIME	FAULT LOCATION TIME	REMARKS
1	2	3	4	5	6	7	8
2	0.2	--	--	--	0.2	8.0	AN/ARC-114 (SN 23). EPR KF-3 - Trouble-shooting only--replacement parts not available. See Entry No. 5.
3	0.2	0.7	--	0.2	1.1	--	AN/ARC-114 (SN 23). EPR KF-4.
4	0.2	--	--	--	0.2	1.3	AN/ARC-115 (SN 22). EPR KF-5. Trouble-shooting only--replacement parts not available. See Entry No. __.
5	0.5	1.0	1.5	0.5	3.5	8.0	AN/ARC-114 (SN 23). EPR KF-7. Replace-ment of parts found defective previously (Entry No. 2).
6	0.2	0.3	0.5	0.2	1.2	0.3	AN/ARC-116 (SN 7). EPR's KF-8 and KF-21.
7	0.5	1.0	1.5	0.5	3.5	8.0	AN/ARC-115 (SN 22). EPR's KF-9 and KF-20.
8	0.5	1.5	--	0.5	2.5	1.5	AN/ARC-115 (SN 22). EPR's KF-10 and KF-20.

MAINTENANCE AND RELIABILITY ANALYSIS CHART
(SECTION 2)

ENTRY NO	PREPARATION TIME	FAULT CORRECTION TIME	ADJUSTMENT AND CALIBRATION TIME	FINAL TEST TIME	TOTAL TIME	FAULT LOCATION TIME	REMARKS
1	2	3	4	5	6	7	8
9	0.2	--	--	--	0.2	0.3	AN/ARC-114 (SN 23). EPR KF-11.
10	0.2	--	--	--	0.2	0.8	AN/ARC-116 (SN 7). EPR's KF-12 and -21. See Entry No. 6.
11	0.2	0.5	0.2	0.1	1.0	1.5	AN/ARN-89 (SN 188). EPR KF-13.
12	1.5	--	29.0	--	30.5	0.5	AN/ARN-89 (SN 188). EPR KF-15.
14	0.2	0.8	--	0.3	1.3	0.1	AS-1962 FM Homing Antenna. EPR KF-16.
15	0.5	1.5	--	0.9	2.9	2.0	C-6533/ARC (SN 32). EPR KF-19.
16	0.5	2.5	--	0.5	3.5	0.5	AN/ARC-114 (SN 23). EPR KF-22. See Entry No. 9.
17	0.5	--	1.5	0.5	2.5	--	AN/ARN-89 (SN 188). EPR KF-23.
18	0.5	--	--	--	0.5	1.0	AN/ARC-116 (SN 7). EPR KF-24.
19	0.5	2.5	--	0.5	3.5	2.3	AN/ARC-116 (SN 7). EPR's KF-25 and KF-62.

MAINTENANCE AND RELIABILITY ANALYSIS CHART
(SECTION 2)

ENTRY NO	PREPARATION TIME	FAULT CORRECTION TIME	ADJUSTMENT AND CALIBRATION TIME	FINAL TEST TIME	TOTAL TIME	FAULT LOCATION TIME	REMARKS
1	2	3	4	5	6	7	8
20	0.5	1.0	--	0.5	2.0	1.0	AN/ARC-115 (SN 108). EPR KF-26.
21	0.2	1.0	0.2	0.5	1.9	3.0	C-6533/ARC (SN 32). EPR KF-27.
22	0.5	2.5	--	0.5	3.5	3.5	AN/ARC-114 (SN 105). EPR KF-28.
23	0.5	4.0	--	0.6	5.1	1.0	AN/ARC-114 (SN 2). EPR KF-36.
24	0.5	0.2	--	0.5	1.2	0.3	AN/ARC-114 (SN 3). EPR KF-38.
25	0.3	1.0	0.5	0.5	2.3	0.3	AN/ARC-114 (SN 105). EPR KF-39.
26	0.5	0.5	0.5	0.8	2.3	2.5	AN/ARN-89 (SN 188). EPR KF-40.
27	0.5	6.0	--	1.0	7.5	4.8	AN/ARC-114 (SN 2). EPR KF-41. See Entry No. 23.
28	0.5	1.0	--	1.5	3.0	0.7	AN/ARC-116 (SN 47). EPR's KF-42 and KF-61.
29	0.5	1.0	1.1	1.0	3.6	1.0	AN/ARC-116 (SN 32). EPR KF-59.

MAINTENANCE AND RELIABILITY ANALYSIS CHART
(SECTION 2)

ENTRY NO	PREPARATION TIME	FAULT CORRECTION TIME	ADJUSTMENT AND CALIBRATION TIME	FINAL TEST TIME	TOTAL TIME	FAULT LOCATION TIME	REMARKS
1	2	3	4	5	6	7	8
30	0.5	1.0	--	0.5	2.0	1.0	AN/ARC-115 (SN 22). EPR KF-63.

PARTS ANALYSIS CHART

INSTRUCTION SHEET

GENERAL: Parts will be assembled on this chart by functional groups and in numerical order within groups.

COLUMN	DESCRIPTION
1	Record one of the following: Federal Stock Number, Technical Service Part Number, Manufacturer's Part Number, or Drawing Number in this order of preference.
2	Noun Nomenclature. Self-explanatory.
3	Maintenance Level, Prescribed. Maintenance level as prescribed by the parts list under review: O/C - Operator/Crew; O - Organizational; DS - Direct Support; GS - General Support.
4	Maintenance Level, Recommended. O/C, O, DS, or GS indicate Maintenance Level recommended by the test agency.
5	Life. The number of hours, miles, or rounds accumulated before or since this part was replaced. An entry in this column is made for each part used followed by the appropriate life unit; i.e., M, H, or R.
6	Reason Used. The symbol "Unsched" will be shown in this column if the part was used as a result of unscheduled maintenance. If the part used was the result of scheduled maintenance, the symbol "Sched" will be used. If the part was consumed to verify procedures or tools, not as a result of breakdown, the symbol "Sim" will be used.
7	Group Number, Cross Reference. Parts usage by maintenance operation is indicated by cross referencing to the group number from Column 2 of the Maintenance and Reliability Analysis Chart.
8	Remarks. If the part usage is related to any other subtest covered in the body of the test report, the paragraph number for cross reference is indicated. If an EPR is related to the part used, the EPR number will be inserted in this column.

PARTS ANALYSIS CHART

FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL O/C - Operator/Crew O - Orgzn DS - Direct GS - General		LIFE M - Miles H - Hours R - Rounds	REASON USED	GP NO CROSS REFERENCE	REMARKS
		Pre-scribed	Recom-mended				
1	2	3	4	5	6	7	8
5821-689-6271	Power Supply Sub-assembly A2A1	DS	DS	0.0H	Unsched		KF-7
SM-B-618315	Power Supply Sub-assembly A2	DS	DS	0.0H	Unsched		KF-9
SM-B-596107	Power Supply Cir-cuit Card A2A2	DS	DS	0.0H	Unsched		KF-5 AN/ARC-115
SM-B-618113	VCO & DA Con-verter Card A1A2A3	DS	DS	0.0H	Unsched		KF-10
5826-058-1111	Mixer/IF Amplifier Model A1	DS	DS	20.6H	Unsched		KF-13
8030-806-4669	AS-1962 Metal Tape	O	O	38.0H	Unsched		KF-16
5821-871-7262	VR-1 Protective Dev. & Filter Assy	DS	DS	39.0H	Unsched		KF-19

PARTS ANALYSIS CHART

FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL O/C - Operator/Crew O - Orgzn DS - Direct GS - General		LIFE M - Miles H - Hours R - Rounds	REASON USED	GP NO CROSS REFERENCE	REMARKS
		Pre-scribed	Recom-mended				
1	2	3	4	5	6	7	8
5821-575-0798	Main Guard Rec. A1A4	DS	DS		Unsched		KF-22
5961-926-0220	Replaced Q1 of A2 power supply	DS	DS	21.0H	Unsched		KF-25
5965-868-8790	AR-1 Microphone Audio Card	DS	DS	48.0H	Unsched		KF-27
5821-689-6265	Spectrum Gen & Switch Filter	DS	DS	71.2H	Unsched		KF-28 AN/ARC-114 (A1A5A18)
75915; 275004	F1 (Fuse on A2A1) Subassembly	DS	DS	125.2H	Unsched		KF-36 AN/ARC-114
SM-B-596107	Power Supply Sub-assembly A2	DS	DS		Unsched		KF-26 AN/ARC-115
5826-883-1628	Goniometer, Module 1A4	DS	DS	100.3	Unsched		KF-40 AN/ARN-89

PARTS ANALYSIS CHART

FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL O/C - Operator/Crew O - Orgzn DS - Direct GS - General		LIFE M - Miles H - Hours R - Rounds	REASON USED	GP NO CROSS REFERENCE	REMARKS
		Pre-scribed	Recom-mended				
1	2	3	4	5	6	7	8
5821-689-6271	Regulator Circuit Card A2A2	DS	DS	125.2H	Unsched		KF-41 AN/ARC-114
5821-689-6264	Voltage Controlled Osc. Card	DS	DS	144.8H	Unsched		KF-39 AN/ARC-114 (A1A5A16)
SM-B-61837	Transistor Q7, 2N4918, Q8, 2N4923	DS	DS	129.0H	Unsched		KF-61 (42)S AN/ARC-116

SPECIAL TOOL ANALYSIS CHART

INSTRUCTION SHEET

GENERAL: All special tools provided with the test item will be evaluated to determine their function, adequacy, category of use and desirability. Any requirement for additional special tools or recommendation for deletion of special tools will also be reported.

COLUMN	DESCRIPTION
1	List all special tools, their noun nomenclature, and identifying part number.
2	Give function of special tool.
3,4	List maintenance category that special tool was designed to be used at in column 3. In column 4 indicate confirmation or recommendation for usage.
5,6	Indicate the adequacy/inadequacy of the special tool in relation to its intended use.
7	Include information as to change in category of use (column 4) or inadequacy of the tool (column 6). Refer to paragraph in report that contains substantiating data.

SPECIAL TOOL ANALYSIS CHART

SPECIAL TOOL	FUNCTION	MAINTENANCE LEVEL O - Orgzn DS - Direct GS - General		EVALUATION		REMARKS
		Pre-scribed	Recom-mended	Ade-quate	Inade-quate	
1	2	3	4	5	6	7
Soldering Iron, 25-watt, FSN 3439-294-9009	Work on printed circuit cards	DS	DS	X		TK-100G Tool kit does not contain a low wattage soldering iron.
Screwdriver, Jewelers, FSN 5120-288-8739	To adjust squelch on main and guard receivers	DS	DS	X		TK-100G, Tool kit does not contain a set of jewelers screwdrivers.

MAINTENANCE PACKAGE LITERATURE CHART

INSTRUCTION SHEET

COLUMN	DESCRIPTION
1	Give Army publication or draft manual number.
2	Number of copies received. Insert "O" if none were supplied. Use Para IIIi, Chapter 9, of AR 310-3 as a guide to determine those manuscripts and publications that should accompany the test item. Manuscripts and publications contained in the maintenance package should cover operation functions through general support maintenance and should specify the categories involved.
3	Complete title.
4	Fill in date manuscript (MSS) or publication was received.
5	Fill in date test item or materiel was received.
6,7	Insert "X" in appropriate block. Minor errors on 1598/2028 forms are not in themselves sufficient reason to term a manuscript inadequate. Evaluation may be omitted if fewer than 25 percent of the specified maintenance operations were performed.
8	Insert date 1598 form was forwarded.
9	In addition to appropriate remarks, explain if manuscript was not evaluated.

MAINTENANCE PACKAGE LITERATURE CHART

MANUSCRIPT			DATE RECEIVED		EVALUATION		FORM 1598/2028	
NUMBER	QNTY	TITLE	LIT	MATERIEL	ADQT	INADQT	DATE FWD'D	REMARKS
1	2	3	4	5	6	7	8	9
POMM 11-5821-260-34	4	"Direct and General Support Maintenance Manual, Radio Set AN/ARC-115 (XC-2)," dated May 1968	June 68	17 Oct 68	X		4 Nov 68	KF-6
POMM 11-5821-260-34	4	"Direct and General Support Maintenance Manual, Radio Set AN/ARC-115, (XC-2)," dated April 1968	June 68	17 Oct 68	X		8 Apr 69	KF-52
POMM 11-5821-261-34	4	"Direct and General Support Maintenance Manual, Radio Set AN/ARC-116 (XC-2)," dated April 1968	June 68	17 Oct 68	X		8 Apr 69	KF-53
POMM 11-5821-259-34	4	"Direct and General Support Maintenance Manual, Radio Set AN/ARC-114 (XC-2)," dated June 1968	June 68	17 Oct 68	X		8 Apr 69	KF-54

APPENDIX IV. REFERENCES

1. Technical Memorandum 2-59, "A Guide to Color Banding for Indicators (Meters)," Human Engineering Laboratories, March 1959.

2. USATECOM Regulation No. 108-3, "Pictorial Services," 26 February 1963.

3. "Human Factors Check List for Evaluating Interim Panel," Missile Branch, Systems Research Laboratory, Human Engineering Laboratories, September 1963.

4. Electronics Command Technical Requirements, SCL-8012C, "Direction Finder, Automatic Light-Weight, Airborne," 8 September 1964.

5. Electronics Command Technical Requirements, SCL-4664A, "Radio Set AN/ARC-116," 7 December 1964.

6. Electronics Command Technical Requirements, SCL-4662A, "Radio Set AN/ARC-114," 7 December 1964.

7. Electronics Command Technical Requirements, SCL-4663A, "Radio Set AN/ARC-115," 7 December 1964.

8. USATECOM Regulation No. 750-15, "Maintenance of Supplies and Equipment - Maintenance Portion of the Service Test," 16 July 1965.

9. Military Standard 781A, "Reliability Tests Exponential Distribution," 10 December 1965.

10. USAAVNTBD Memorandum No. 750-2, "Maintenance of Supplies and Equipment - Maintenance Portion of Service Tests (Phase E) (Implementation of USATECOM Regulation 750-15)," 25 January 1966.

11. USAAVNTBD Memorandum No. 108-1, "Pictorial Services - Photographic Coverage," 17 February 1966.

12. Letter, AMSTE-CG, Headquarters, US Army Test and Evaluation Command, 6 October 1966, subject: "Reliability Emphasis - FY 1967," with two inclosures.

13. Letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 8 November 1966, subject: "Test Directive, USATECOM Project No. 4-7-3651-01/02, Engineering and Service Tests, Light Observation Helicopter Avionics Package (LOHAP)."

14. Electronics Command Technical Requirements, SCL-4674B, "Control, Communication System C-6533( )/ARC," 14 December 1966.

15. Plan of Test, "Service Test of Light Observation Helicopter Avionics Package (LOHAP)," USATECOM Project No. 4-7-3651-02, US Army Aviation Test Board, 14 April 1967, with Change 1, 23 September 1968, and Change 2, 24 March 1969.

16. Letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 4 January 1968, subject: "Reliability Test Management Charts," with inclosures.

APPENDIX V. DISTRIBUTION LIST

1. Distribution denoted by an asterisk (*) will be furnished from those copies forwarded to Headquarters, USATECOM. Distribution to be accomplished by this Headquarters will be indicated on this list.

2. Distribution denoted by a double asterisk (**) will be furnished from those copies furnished to the USACDC LnO, USATECOM.

3. Coordination of the Plan of Test and Test Reports will be effected with those agencies indicated by a "C" in the appropriate column.

Agency	Plans of Test	Non-Final Reports	Final Reports
Commanding General US Army Test & Evaluation Command Aberdeen Proving Ground, Maryland 21005 21005	38	37	62
ACSFOR Hqs, DA Systems Staff Officers Pentagon Washington, D. C. 20301	2*	2*	2*
Commanding General US Army Materiel Command ATTN: AMCRD-H Washington, D. C. 20315	2*	2*	2*
Commanding General US Army Materiel Command ATTN: AMCPM-LH Washington, D. C. 20315	2*	2*	2*
Commanding General US Army Materiel Command ATTN: AMCAD-S Washington, D. C. 20315			1*

Agency	Plans of Test	Non-Final Reports	Final Reports
Commanding General US Army Materiel Command ATTN: AMCPP Washington, D. C. 20315			1*
Commanding General US Army Materiel Command ATTN: AMCMI-ES Washington, D. C. 20315	1*	1*	1*
Commanding General US Army Materiel Command ATTN: AMCSU Washington, D. C. 20315	1*	1*	1*
Commanding General US Army Materiel Command ATTN: AMCMA Washington, D. C. 20315	1*	1*	1*
Commanding General US Army Materiel Command ATTN: AMCQA Washington, D. C. 20315			1*
Commanding General US Army Combat Developments Command ATTN: USACDC LnO Aberdeen Proving Ground, Maryland 21005	12*	12*	12*
Commanding General US Army Combat Developments Command ATTN: CDCMR-E Fort Belvoir, Virginia 22060	1**	1**	1**
Commanding General US Army Combat Developments Command Combat Arms Group Fort Leavenworth, Kansas 66027	1**	1**	1**

Agency	Plans of Test	Non-Final Reports	Final Reports
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Commanding Officer US Army Arctic Test Center APO Seattle 98733	1	1	1
Commanding General US Army Electronic Proving Ground ATTN: STEEP-T Fort Huachuca, Arizona 85613	1C (ST)	1	1
Commanding General White Sands Missile Range Las Cruces, New Mexico 88002	1C (ET)	1	1C (ET)
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AD-A032 840 ARMY AVIATION TEST BOARD FORT RUCKER ALA F/G 17/2.1
SERVICE TEST OF SELECTED LIGHTWEIGHT AVIONIC EQUIPMENT (SLAE).(U)
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Director Marine Corps Landing Force Development Center MCDEC Quantico, Virginia 22134	1	1	1
US Marine Corps LnO, USATECOM Aberdeen Proving Ground, Maryland 21005	1	1	1

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Commanding General US Army Combat Developments Command Experimentation Command Fort Ord, California 93941	2	2	2
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Fort Rucker, Alabama 36360

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2b. GROUP

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DUTTON, Edward J., DAC

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11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

US Army Materiel Command
Washington, D.C. 20315

13. ABSTRACT

The US Army Aviation Test Board service tested the Selected Lightweight Avionic Equipment (SLAE) to determine its suitability for Army use. The SLAE consists of two AN/ARC-114 VHF-FM Transceivers, one AN/ARC-115 VHF-AM Transceiver, one AN/ARC-116 UHF-AM Transceiver, one AN/ARN-89 ADF Set, three C-6533/ARC Communications Control Units, and associated antennas and cables. Testing was conducted in two OH-6A Helicopters during January - April 1969 at Fort Rucker, Alabama, and Apalachicola, Florida. Sixteen deficiencies were found in the following areas: technical characteristics, operational suitability, compatibility, reliability, human factors design, and safety. Sixteen shortcomings were also found. Each major component except the C-6533/ARC had two or more deficiencies and two or more shortcomings. X-mode test results are classified and not reported herein. It was concluded that SLAE is not suitable for Army use. It was recommended that SLAE not be considered for operational use until the deficiencies are corrected, that the shortcomings be corrected if technically and economically feasible, and that the production SLAE and its installation be check tested after deficiencies have been corrected.

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14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Selected Lightweight Avionic Equipment (SLAE)						
AN/ARC-114						
AN/ARC-115						
AN/ARC-116						
AN/ARN-89						
C-6533/ARC						
OH-6A Helicopter						
Technical characteristics						
Operational suitability						
Compatibility						
Reliability						
Safety						
Human factors design						
Deficiencies						
Shortcomings						

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