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INITIAL PRODUCTION TEST OF THE AN/ARN-82 OMNI-RANGE RADIO RECEI--ETC(U)
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(16) USATECOM ~~PROJECT~~ NO 4-6-3461-02

(6) INITIAL PRODUCTION TEST

OF THE

AN/ARN-82 OMNI-RANGE RADIO RECEIVING SET

RDT&E PROJECT NO. None

AD _____

(9) Final Report of Test

(10) Edward J. Dutton

(11) 24 March 1966

(12) 19 p.

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

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

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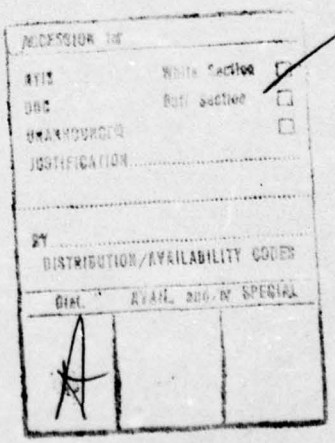

ABSTRACT

The USAAVNTBD conducted the Initial Production Test of the AN/ARN-82 Omni-Range Receiving Set in the vicinity of Fort Rucker, Alabama, from 3 January to 23 February 1966. The sets were installed in a U-8D Airplane and a UH-1D Helicopter and were operated in flight for 54 hours. The general concept of the test was to verify adequacy and quality of the production AN/ARN-82 by performing the same operational and flight tests on the AN/ARN-82 as those conducted on the off-the-shelf omni-range receiver. Additional tests were conducted to determine whether the deficiencies and shortcomings reported on the off-the-shelf set had been corrected. The installation characteristics were adequate and were the same as those of the previously-tested off-the-shelf equipment. The in-flight performance of the AN/ARN-82 was adequate and was comparable to that of the previously-tested off-the-shelf equipment. Maintenance and support requirements reported for the off-the-shelf set remained unchanged. Three of the six deficiencies previously reported were satisfactorily corrected. Internal lighting of the course indicator and two modifications to the control panel were not provided as previously recommended. No new deficiencies were discovered. One additional shortcoming was noted. It was concluded that the adequacy and the quality of the production AN/ARN-82 have been improved by the correction of three of the six previously-reported deficiencies, that the AN/ARN-82 will be suitable for Army use when the three remaining deficiencies are corrected, and that correction of the shortcoming would enhance the suitability of the set. It was recommended that the deficiencies be corrected and that the shortcoming be corrected as economically and technically feasible.

FOREWORD

The Commanding General, US Army Test and Evaluation Command, directed the initial production test of the AN/ARN-82 in letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 28 September 1965, subject: "Test Directive, Initial Production Test (IP), Receiving Set, Radio, Omni-Range, AN/ARN-82, USATECOM Project No. 4-6-3461-01/02."

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

"INITIAL PRODUCTION TEST

OF THE

AN/ARN-82 OMNI-RANGE RADIO RECEIVING SET"

USATECOM PROJECT NO. 4-6-3461-02

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SELECTED BIBLIOGRAPHY

1. Letter, AMSEL-AV-E, Headquarters, US Army Electronics Command, 24 February 1964, subject: "Modernization Program for OMNI-Range Receivers, Automatic Direction Finding Equipment and Lightweight HF Aircraft Radio Sets," with one inclosure.

2. Technical Requirement SCL-8014 with Amendment No. 2, dated 12 August 1964, "Receiving Set, Radio, Units of," US Army Electronics Command.

3. Letter, AMSEL-PP-ESD-4, Headquarters, US Army Electronics Command, 9 July 1965, subject: "Request for Test of Receiving Set, Radio AN/ARN-82."

4. Plan of Test, USATECOM Project No. 4-6-3461-02, "Plan of Test for AN/ARN-82, Receiving Set, Radio, OMNI-Range," US Army Aviation Test Board, 8 November 1965.

5. Message, AMCPM-IR-P AMC20627, Commanding General, US Army Materiel Command, 3 February 1966, subject: "Compatibility Testing of AN/ARN-82 and AN/ARN-83 Radio Sets in UH-1 Helicopters, TECOM Project 4-6-3461 & 4-6-3471."

SECTION 1 - GENERAL

1.1. OBJECTIVES.

1.1.1. Purpose.

To verify the adequacy and quality of the production AN/ARN-82 Omni-Range Receiver.

1.1.2. Test Objectives.

a. To verify installation characteristics.

b. To verify in-flight performance.

c. To determine maintenance and support requirements.

d. To determine the adequacy of corrective action on previously-reported deficiencies. [1]

1.2. RESPONSIBILITIES.

1.2.1. The US Army Aviation Test Board (USAAVNTBD) was responsible for preparing the test plan, conducting the test, and reporting of operational and flight tests of the AN/ARN-82 (USATECOM Project No. 4-6-3461-02).

1.2.2. The US Army Electronic Proving Ground (USAEPG) was responsible for the engineering-type test (USATECOM Project No. 4-6-3461-01).

1.3. DESCRIPTION OF MATERIEL.

The AN/ARN-82 is an airborne navigational radio set designed to operate in the very high-frequency (VHF) range of 108 to 126.95 megacycles (mc.). It receives signals transmitted by visual omni-ranges (VOR) or localizer (LOC) stations which are part of the Instrument Landing System (ILS). The received signal is displayed on a visual indicator to provide the operator with navigation information. The system may also be used to receive voice radio communications within

[1] Report of Test, USATECOM Project No. 4-4-4315-01, "Military Potential Test (Comparative Evaluation) of Omni-Range Receiver Sets," US Army Aviation Test Board, 4 February 1965.

its frequency range. The AN/ARN-82 is completely transistorized, uses electro-diode tuning, weighs 14.5 pounds, and consists of a control panel, a course indicator, and a navigation unit (receiver, converter, and radio-magnetic indication converter).

1.4. BACKGROUND.

1.4.1. In the interest of obtaining the most modern equipment for the Army, the Assistant Secretary of the Army (Installation and Logistics) directed in November 1963[2] that available off-the-shelf omni-range receiver equipment be comparatively evaluated to select candidates for replacement of the AN/ARN-30. The US Army Electronics Command (USAECOM) selected three different omni-range receiver designs which later were evaluated by the USAAVNTBD, the USAEPG, and the US Army Human Engineering Laboratory (USAHEL). Formal tests started 1 October 1964 and were concluded 15 December 1964.

1.4.2. The off-the-shelf set equivalent to the AN/ARN-82 was selected as the most suitable for Army use. The report of test[3] concluded that the deficiencies found during the test must be corrected prior to type classification and recommended that the system undergo a complete engineering/service test prior to acceptance as a standard item.

1.4.3. The AN/ARN-82 was type classified Standard A in September 1965. The US Army Test and Evaluation Command (USATECOM) has recommended that engineering and service tests be conducted on the AN/ARN-82, but approval has not yet been received.

1.5. FINDINGS.

1.5.1. The installation characteristics were adequate and were the same as those of the previously-tested off-the-shelf equipment.

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[2]Letter, Assistant Secretary of the Army (ASA), Installation and Logistics (Mr. Ignatius), 13 November 1963, subject: "FY 64 Procurement of Avionics Equipment," with five indorsements.

[3]Report of Test, USATECOM Project No. 4-4-4315-01, "Military Potential Test (Comparative Evaluation) of Omni-Range Receiver Sets," US Army Aviation Test Board, 4 February 1965.

1.5.2. The in-flight performance of the AN/ARN-82 was adequate and was comparable to that of the previously-tested off-the-shelf equipment. Because of the lack of internal lighting of the bearing indicator, the navigation information was difficult to read during darkness.

1.5.3. The nature of the production modifications was such that the maintenance and support requirements reported for the off-the-shelf set remained unchanged.

1.5.4. Three of the six deficiencies previously reported were satisfactorily corrected. Internal lighting of the course indicator and two modifications to the control panel were not provided as previously recommended. No new deficiencies were discovered. One additional shortcoming was noted.

1.6. CONCLUSIONS.

1.6.1. The adequacy and the quality of the production AN/ARN-82 have been improved by the correction of three of the six previously-reported deficiencies.

1.6.2. The AN/ARN-82 will be suitable for Army use when the three remaining deficiencies listed in paragraph 2.4.3, section 2, are corrected.

1.6.3. Correction of the shortcoming listed in paragraph 2.4.3, section 2, would enhance the suitability of the AN/ARN-82.

1.7. RECOMMENDATIONS.

It is recommended that:

1.7.1. The deficiencies listed in paragraph 2.4.3, section 2, be corrected.

1.7.2. The shortcoming listed in paragraph 2.4.3, section 2, be corrected if economically and technically feasible.

SECTION 2 - DETAILS AND RESULTS OF SUBTESTS

2.0. INTRODUCTION.

The AN/ARN-82 Omni-Range Radio Receiving Set was evaluated in the vicinity of Fort Rucker, Alabama, from 3 January 1966 to 23 February 1966. The sets were installed in a U-8D Airplane and a UH-1D Helicopter and were operated in flight for 54 hours. The general concept of the test was to verify adequacy and quality of the production AN/ARN-82 by performing the same operational and flight tests on the AN/ARN-82 as those conducted on the off-the-shelf omni-range receiver. Additional tests were conducted to determine whether the deficiencies and shortcomings reported on the off-the-shelf set had been corrected.

2.1. INSTALLATION CHARACTERISTICS.

2.1.1. Objective.

To verify that the installation characteristics of the AN/ARN-82 are equal to or better than those of the off-the-shelf equipment previously tested.

2.1.2. Method.

2.1.2.1. The AN/ARN-82 was weighed and measured. The weight and dimensions were compared with those of the off-the-shelf equipment to determine any difference.

2.1.2.2. The AN/ARN-82 was installed in the test-bed aircraft to verify the adequacy of the installation instructions, drawings, and diagrams.

2.1.3. Results.

2.1.3.1. The weight and dimensions were the same as those of the off-the-shelf equipment.

2.1.3.2. The installation instructions, drawings, and diagrams were not in the prescribed Army technical-manual format; however, they were adequate for test purposes.

2.1.4. Analysis.

The installation characteristics of the AN/ARN-82 were the same as those of the off-the-shelf equipment previously tested.

2.2. IN-FLIGHT PERFORMANCE.

2.2.1. Objective.

To verify that the in-flight performance of the AN/ARN-82 is adequate and comparable to that of the previously-tested off-the-shelf equipment.

2.2.2. Method.

2.2.2.1. Maximum Range.

Each aircraft with the AN/ARN-82 installed was flown at 1500 feet mean sea level (m.s.l.) on several radials from omni-range stations until the flag appeared.

2.2.2.2. Track Following.

Each aircraft was flown over four or more selected ground tracks to and from an omni station to determine:

a. Track-following capability of the AN/ARN-82.

b. Capability of the AN/ARN-82 to position the aircraft consistently over the same ground fix.

c. Adequacy of station passage indication at minimum reception altitude (MRA).

d. Unusual equipment performance.

2.2.2.3. Operational Accuracy.

Each aircraft was flown over airborne checkpoints certified by the Federal Aviation Agency (FAA) and the radial indicated by the test item was noted. The AN/ARN-82 was ground checked at airfields equipped with FAA-certified ground checkpoints.

2.2.2.4. Holding.

Each aircraft was flown over selected omni intersections and ground stations to determine the capability of the AN/ARN-82 to provide valid intersection and omni-holding information.

2.2.2.5. Approaches.

VOR, terminal VOR, and ILS approaches were made using approved FAA procedures.

2.2.2.6. Orientation and Time-Distance Calculations.

Each aircraft was flown at MRA to verify the adequacy of the AN/ARN-82 in the areas of:

a. Performance of time-distance calculations.

b. Omni orientation.

c. Station identification.

d. Voice reception (clarity, tone).

2.2.2.7. Effects of Meterological Conditions.

Each aircraft was flown during the hours of daylight and darkness and in all available weather conditions to observe the effects of meteorological conditions on the performance of the AN/ARN-82.

2.2.2.8. Electronic Interference.

In the U-8D Airplane, in which two AN/ARN-82's were installed, both receivers were operated jointly to determine the existence of any interference and the effects on one receiver when changing frequency on the other receiver.

2.2.3. Results.

2.2.3.1. Maximum Range.

At 1500 feet m.s.l. (approximately 1250 feet absolute), the AN/ARN-82 had an average maximum range of 67.8 nautical miles.

2.2.3.2. Track Following.

The AN/ARN-82 provided reliable navigation information and an adequate indication of station passage at MRA on all flight tests. There was no unusual equipment performance.

2.2.3.3. Operational Accuracy.

The AN/ARN-82 had errors from 0 to 4 degrees at the airborne and ground checkpoints. The average error at the airborne checkpoints was 1.2 degrees and at the ground checkpoints 2.5 degrees.

2.2.3.4. Holding.

The AN/ARN-82 provided intersection and omni-range holding information within the accuracies stated in paragraph 2.2.3.3 above.

2.2.3.5. Approaches.

The AN/ARN-82 performed satisfactorily when it was used as an approach aid.

2.2.3.6. Orientation and Time-Distance Calculations.

The ability of the AN/ARN-82 to receive voice and identification signals was acceptable and the information presented was adequate for time-distance calculations and omni orientation.

2.2.3.7. Effects of Meteorological Conditions.

2.2.3.7.1. The pilot had difficulty reading the radials and seeing the TO/FROM indicator during darkness because of a lack of internal lighting of the course indicator. No difficulties were encountered during daylight.

2.2.3.7.2. Weather during the test flights did not include IFR conditions. Therefore, the effects of severe meteorological conditions were not determined.

2.2.3.8. Electronic Interference.

2.2.3.8.1. No electronic interference was noted when the two receivers were operated jointly.

2.2.3.8.2. No unusual equipment performance was noted when the AN/ARN-82 was operated with other installed avionic equipment.

2.2.3.8.3. Performance was degraded when two receivers (dual omni installation) were connected to a common antenna.

2.2.4. Analysis.

The in-flight performance of the AN/ARN-82 was adequate and was comparable to that of the previously-tested off-the-shelf equipment. Because of the lack of internal lighting of the bearing indicator, the navigation information was difficult to read during darkness.

2.3. MAINTENANCE AND SUPPORT.

2.3.1. Objective.

To determine maintenance and support requirements.

2.3.2. Method.

2.3.2.1. Maintenance History.

For each AN/ARN-82 installation, the following were recorded:

a. Total operating time.

b. Total number of failures.

c. Time of failure.

d. Cause of failure.

e. Time required for repair.

f. Parts required for repair.

2.3.2.2. Ease of Maintenance.

The AN/ARN-82 was examined and the following ease-of-maintenance features were noted:

a. Packaging.

b. Density of components.

c. Ease of component exchange.

d. Ease of failure isolation.

e. Availability and accessibility of test points.

2.3.2.3. Support Requirements.

2.3.2.3.1. The AN/ARN-82 was maintained as required using standard avionic maintenance tool kits. Any additional tool requirements were noted.

2.3.2.3.2. The components of the AN/ARN-82 were examined and any requirement for nonstandard parts, high-cost items, critical replacement parts, and other parts not normally available in Army supply channels were noted.

2.3.2.4. Training Requirements.

Skill levels required for maintenance were compared to those of current avionic MOS skill levels.

2.3.2.5. Routine Maintenance.

The time and number of personnel required to identify malfunctions were recorded. The time interval between inspections and between equipment alignment was compared to that of existing procedures.

2.3.3. Results.

The AN/ARN-82 was operated a total of 54 hours with no failures. No parts were replaced. The nature of the production modifications was such that the maintenance and support requirements reported for the off-the-shelf set remained unchanged.

2.3.4. Analysis.

Not applicable.

2.4. DEFICIENCIES.

2.4.1. Objective.

To determine the adequacy of corrective action on previously-reported deficiencies.

2.4.2. Method.

2.4.2.1. The course indicator was inspected to determine whether blue-yellow markings had been added, whether reciprocal bearing numerals had been enlarged to the standard contained in the USAHEL report, and whether internal lighting had been provided.

2.4.2.2. The UH-1D was operated from minimum to maximum rotor r.p.m. to determine whether rotor modulation problems had been eliminated.

2.4.2.3. The control panel was inspected to determine whether control knob spacing and functions had been rearranged according to USAHEL recommendations.

2.4.3. Results.

2.4.3.1. Deficiencies.

The status of each of the previously-reported deficiencies is as follows:

Previously-Reported Deficiency	Suggested Corrective Action	Findings This Test
a. Blue-yellow markings (used as an approach aid) were not provided on the course indicator.	Provide blue-yellow markings.	Deficiency has been satisfactorily corrected.
b. Control knobs on control panel were located too close together.	Comply with applicable standards contained in USAHEL report.	Deficiency has been satisfactorily corrected.
c. Excessive rotor modulation occurred when equipment was installed in a helicopter.	Provide filters to remove rotor modulation.	Deficiency has been satisfactorily corrected in the UH-1D.

Previously-Reported Deficiency	Suggested Corrective Action	Findings This Test
d. Reciprocal bearing numerals on the course indicator were too small.	Increase size of numerals.	Deficiency still exists.
e. Lack of internal lighting of the course indicator caused difficulty in interpreting navigation information at night.	Provide internal lighting.	Deficiency still exists.
f. Ganged controls did not have similar functions and knobs were too small for use by operators wearing gloves.	Combine whole megacycle and tenth megacycle controls. Combine ON/OFF and volume controls. Increase size of control knobs to standard.	Deficiency still exists.

2.4.3.2. Shortcomings.

No shortcomings were previously reported. The following shortcoming was discovered during this test:

Shortcoming	Suggested Corrective Action	Remarks
The manufacturer's publications provided were not in the Army format.	Provide manuals in the proper Army format.	

2.4.4. Analysis.

Not applicable.