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INITIAL PRODUCTION TEST OF AN/ASN-64 DOPPLER NAVIGATION SET.(U)
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RDT&E PROJECT NO. _____

USATECOM ~~PROJECT NO.~~ 4-6-3481-04

INITIAL PRODUCTION TEST

OF

AN/ASN-64 DOPPLER NAVIGATION SET

Final ~~Report of Test~~ 3 Jan - 13 May 66,

by

Major Cecil E. Wroten
Mr. Virgil R. Rogers
Mr. Charles L. Martin, Jr.

10 June 1966

39 P.

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

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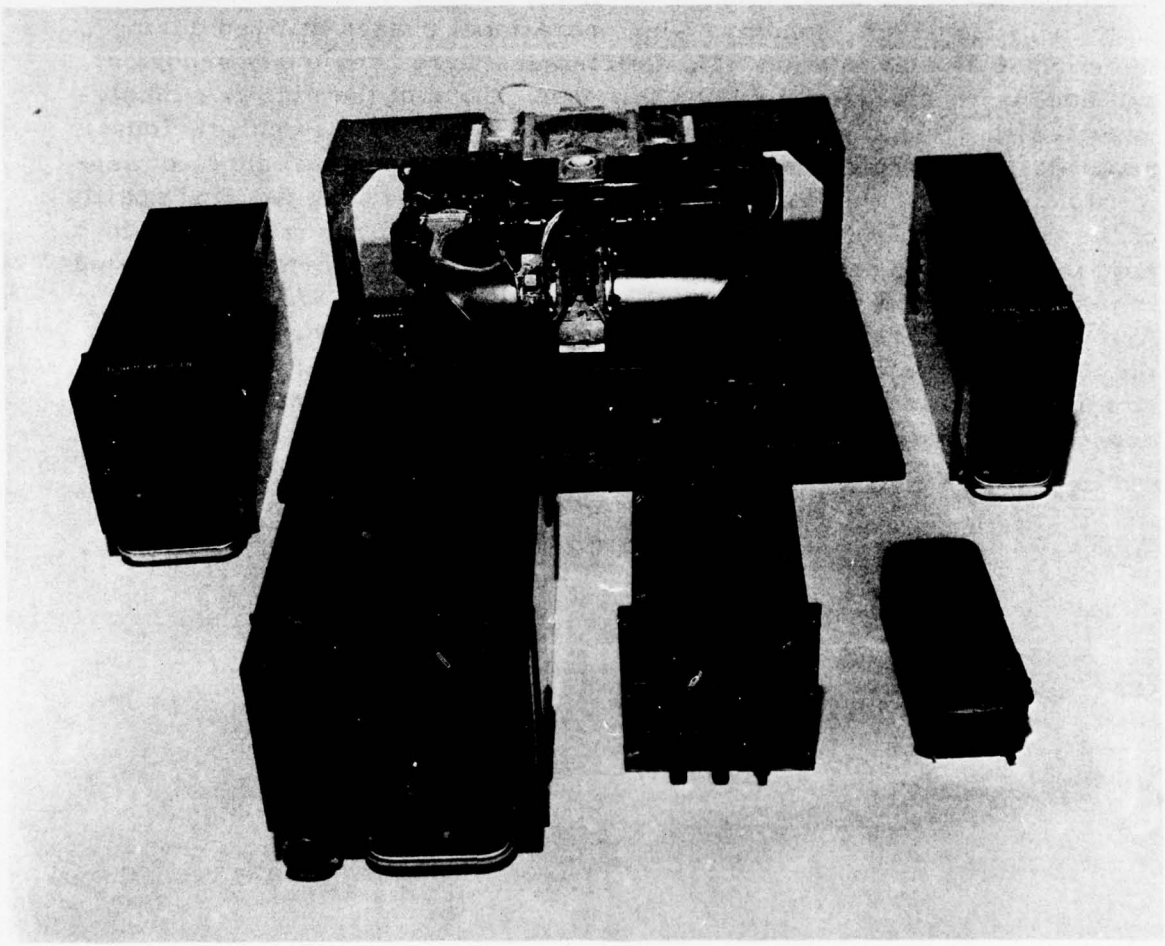
ABSTRACT

As the result of a comparative evaluation (military potential test) of off-the-shelf systems, the AN/ASN-64( ) Doppler Navigation Set was type classified "Limited Production Type." The US Army Aviation Test Board was then directed to conduct an initial production test to verify the adequacy and quality of the production AN/ASN-64. The equipment was installed and tested in an OV-1B Airplane during the period 3 January to 13 May 1966, encompassing operational phases utilized during the comparative evaluation. No deficiencies were previously reported, and none were discovered during this test. Four of the nine previously-reported shortcomings had been corrected; four remained as previously reported; and one did not occur during this test. Five new shortcomings were noted during this test. It is concluded that the adequacy and quality of the AN/ASN-64 have not been adversely affected by modifications incorporated during production, and that correction of shortcomings listed in paragraph 2.6.3 will improve the suitability of the AN/ASN-64 for Army use. It is recommended that the AN/ASN-64 be service tested in the type of aircraft in which it is to be employed, and that the shortcomings listed in paragraph 2.6.3 be corrected as technically and economically feasible.



FOREWORD

This test was authorized by the Commanding General, US Army Test and Evaluation Command (USATECOM), in letter, AMSTE-BG, Headquarters, USATECOM, 8 October 1965, subject: "Test Directive, Initial Production (IP) Test, Doppler Navigation Set, AN/ASN-64, USATECOM Project No. 4-6-3481-02/03/04."

The US Army Aviation Test Board was responsible for planning, conducting, and reporting this test.

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SECTION 1 - INTRODUCTION

INTRODUCTION

1.1. BACKGROUND.

1.1.1. The US Army has established two separate airborne navigation requirements. One requirement cites a self-contained Doppler radar navigator (paragraph 533c(5), reference 2, appendix III, section 3). The second requirement specifies a need for a lightweight, self-contained navigator (paragraph 533c(6), reference 2, appendix III, section 3). The contents of the second requirement are classified CONFIDENTIAL.

1.1.2. Following the failure of an Army-developed Doppler navigator system to meet Army requirements, the US Army Electronics Command (USAECOM) proposed an evaluation of commercial off-the-shelf Doppler navigator systems. The US Army Materiel Command (USAMC) concurred in the proposed evaluation and directed an expedited program to furnish a comparative evaluation report by 30 November 1963.

1.1.3. Industry was solicited to determine the available off-the-shelf systems having military potential. Five manufacturers subsequently submitted their proposals to the Army for review. Three of these proposals were accepted on 24 June 1963.

1.1.4. The US Army Aviation Test Board (USAAVNTBD) and the US Army Electronics Proving Ground (USAEPG) conducted a military potential test (comparative evaluation) of the selected systems and the USAAVNTBD report of test was submitted 7 April 1964 (reference 3, appendix III, section 3). As a result of this evaluation, a Doppler Navigation System was selected, nomenclatured the AN/ASN-64( ), and type classified "Limited Production Type (LP)" on 29 December 1964 (reference 4, appendix III, section 3).

1.1.5. An AN/ASN-64( ) Doppler Navigation Set was installed in an OV-1B Airplane, serial number 62-5864, assigned to the USAAVNTBD as support equipment for the service test of the AN/ASN-62 Gyromagnetic Compass Set. This installed system was subsequently modified to incorporate changes required by USAECOM, and the USAAVNTBD was instructed to use it for an initial production test. This was not a production-type installation.

1.1.6. Headquarters, USATECOM, has recommended that an engineering service test be conducted on the AN/ASN-64( ) in an OV-1( ) airplane,

but approval was not received before completion of this test. Therefore, testing was limited to that outlined in the plan (reference 8, appendix III, section 3).

1.1.7. A service test is being conducted on an AN/ASN-64 in a UH-1( ) helicopter (reference 9, appendix III, section 3).

1.2. DESCRIPTION OF MATERIEL.

1.2.1. The AN/ASN-64 Doppler Navigation Set is a self-contained, airborne navigation system, providing maximum security under all weather conditions without depending on ground-based navigation aids.

1.2.2. The system consists of a Doppler radar, an airborne navigation computer system, and a true airspeed sensor. Components are as follows:

1.2.2.1. Radar Navigation Set, AN/APN-168:

a. Antenna assembly.

b. Receiver-transmitter with mount.

c. Frequency tracker with mount.

1.2.2.2. Doppler Computer Group, AN/AYA-3:

a. Navigational computer with mount.

b. Control indicator computer.

c. Velocity steering indicator.

1.2.2.3. True Airspeed Transmitter, T-992/A.

1.2.3. The system permits navigation to two preselected destinations without reprogramming. Present position and destination information is displayed on the control indicator by counter-type readouts as north/south, east/west rectangular coordinates. The selected destination is displayed by the horizontal and vertical bars of the velocity and steering indicator.

1.3. TEST OBJECTIVES.

1.3.1. Purpose.

To verify the adequacy and quality of the production AN/ASN-64 Doppler Navigation Set.

1.3.2. Objectives.

a. To verify the test item's:

(1) Physical characteristics.

(2) Operational characteristics.

(3) Maintenance and support requirements.

(4) Safety characteristics in accordance with USATECOM Regulation 385-7.

b. To determine whether previously-reported shortcomings have been corrected, and whether modifications adversely affect the operation of the test set.

c. To determine the extent to which the test item meets the requirements of the Military Characteristics (MC's) (reference 1, appendix III, section 3).

1.4. SUMMARY OF RESULTS.

1.4.1. The AN/ASN-64, as tested, weighed 92 pounds and 0.5 ounce and had a volume of 2.94 cubic feet. This exceeded the desired weight stated in the MC's.

1.4.2. Operational characteristics were generally the same as those reported previously and were satisfactory except for excessive system warm-up time.

1.4.3. System position accuracy was approximately one percent of distance traveled.

1.4.4. No maintenance support package was provided. All maintenance was performed by the contractor. Nine malfunctions were experienced

in 239 hours of equipment operation. No pattern of failure was noted which could be attributed to any specific design weakness of the system.

1.4.5. No physical characteristics or features were noted which could be considered hazardous to operator or maintenance personnel. One human factor engineering characteristic was noted which would, under certain conditions, constitute a safety-of-flight hazard.

1.4.6. Four of the nine previously-reported shortcomings have been corrected; four remained as previously reported; and one did not occur during this test. Five new shortcomings were noted during the test.

1.4.7. Correction of the four shortcomings did not adversely affect operation in any manner.

1.4.8. The AN/ASN-64 met the primary functions stated by the MC's but failed to meet the exact requirements in certain areas.

1.5. CONCLUSIONS.

1.5.1. The adequacy and quality of the AN/ASN-64 have not been adversely affected by modifications incorporated during production.

1.5.2. Correction of shortcomings listed in paragraph 2.6.3 will improve the suitability of the AN/ASN-64 for Army use.

1.6. RECOMMENDATIONS.

It is recommended that:

1.6.1. The AN/ASN-64 be service tested in the type of aircraft in which it is to be employed.

1.6.2. The shortcomings listed in paragraph 2.6.3 be corrected as technically and economically feasible.

SECTION 2 - DETAILS OF TEST

DETAILS OF TEST

2.1. INTRODUCTION.

The AN/ASN-64, installed in an OV-1B Airplane (serial number 62-5864), was evaluated by USAAVNTBD personnel in the vicinity of Fort Rucker, Alabama, during the period 3 January to 13 May 1966. A flight test of 50 hours, encompassing operational phases utilized during the original evaluation (reference 3, appendix III, section 3), was conducted. Data from 189 hours of operation of the system during compass system tests were used for maintenance and reliability purposes. See paragraph 1.1.5.

2.2. PHYSICAL CHARACTERISTICS.

2.2.1. Objective.

To verify the basic physical characteristics of the AN/ASN-64 (paragraph III, MC's, appendix II, section 3).

2.2.2. Method.

2.2.2.1. The AN/ASN-64 Doppler Navigation Set was removed from the OV-1B Airplane and each subcomponent of the set was weighed and measured.

2.2.2.2. The total system volume and weight were calculated using the sum of the individual component weights and volumes.

2.2.3. Results.

Total weight of the AN/ASN-64 system as tested was 92 pounds and 0.5 ounce. Total volume of the system, with components installed in mounts, was 5082.5 cubic inches (2.94 cubic feet). Individual component size and weight were as follows:

Item	Size			Weight	
	H (in.)	W (in.)	L (in.)	Lb.	Oz.
Antenna assembly	7 3/4	12 5/8	15 5/8	15	15.5
Receiver-transmitter	7 3/4	3 3/4	15 1/4	13	3.0

Item	Size			Weight	
	H (in.)	W (in.)	L (in.)	Lb.	Oz.
Shockmount base	10 1/4	4 7/8	16 7/8	3	4.0
Frequency tracker	7 3/4	7 3/4	15 1/4	21	2.0
Shockmount base	6 1/2	8 1/4	16 1/2	3	7.0
Navigational computer	7 3/4	5	15 1/4	19	10.0
Mount	6 7/8	5 7/8	16 1/2	2	6.0
Control indicator computer	6	5 3/4	8 1/4	7	12.5
Velocity steering indicator	3 1/4	3 1/4	8	2	12.0
True airspeed transmitter	3 1/4	3 1/4	7 1/4	2	8.5

2.2.4. Analysis.

System weight has increased approximately one pound ten ounces over the system previously tested (reference 3, appendix III, section 3). This is considered insignificant when compared to total system installation weight.

2.3. OPERATIONAL CHARACTERISTICS.

2.3.1. Objective.

To verify the operational characteristics and performance of the AN/ASN-64 (paragraphs II 1, 2, 3, 5, and 7, MC's, appendix II, section 3).

2.3.2. Method.

2.3.2.1. The airplane engines were started, the installed avionic and electrical equipment was turned on, and the Doppler main control was turned to LAND. The operation of the memory light, any flag action, and the time required for the set to reach operating condition were recorded.

2.3.2.2. The Doppler preflight check list as outlined in the operation manual furnished for this test was followed, and any variation between

equipment operation and that specified in the test procedure was recorded. Difficulties encountered by the pilot or observer in performing the pre-flight checks were recorded.

2.3.2.3. The computer was programmed for the intended flight and difficulties encountered were recorded.

2.3.2.4. A navigation course over land and sea, consisting of easily-recognizable marker points whose geographic locations were known, was selected. Each leg of this course was flown at least three times in each direction. The aircraft was flown over these markers under visual flight conditions and when the airplane was over these known points, the indicated present position coordinates were noted. For details, see part A, appendix I, section 3.

2.3.2.5. The above courses were flown at altitudes which allowed visual positioning of the airplane within 300 feet. In order to produce consistent results, the course was flown at a constant barometric altitude and turns faster than standard rate (three degrees per second) were avoided. The installed autopilot was used to maintain heading and barometric altitude, except during turns and during periods when manual steering was required. The displacement storage (press-to-store) function was used to facilitate the taking of present position readings.

2.3.2.6. The airplane was flown at an altitude of 2,000 feet mean sea level (m.s.l.) in an area where wind information was available. The indicated wind speed and wind direction were recorded. This procedure was repeated on four cardinal headings.

2.3.2.7. The airplane was flown at an absolute altitude of 20,000 feet over land and water. Observations were made of the time the Doppler was in the memory mode (when over water, the sea state was Beaufort "2" or rougher), and the indicated groundspeed and track were noted for flights conducted straight and level and for flights involving changes of $\pm$10 degrees in pitch and 30 degrees in bank.

2.3.2.8. The airplane was flown at an altitude and over terrain as indicated in paragraph 2.3.2.7 above. The main control was switched to Air Data (AIR), the Doppler groundspeed (G/S) and DRIFT switches were held up or down simultaneously for about two seconds, the main control was switched to LAND (or SEA, as appropriate), and the time required to reacquire and to lock on the correct groundspeed and track was recorded.

2.3.3. Results.

2.3.3.1. Operation of the Doppler was normal as described in the "Pilots Operating Instructions" (reference 5, appendix III, section 3). Difficulty was experienced in determining when the equipment was ready for use since no form of ready indication is provided. After application of power to the system, the Doppler became operational in 4-10 minutes. Warm-up was slow on cool days (35-45°F.).

2.3.3.2. Preflight procedures (reference 5, appendix III, section 3) were satisfactory.

2.3.3.3. No unusual difficulties were experienced in programming the computer on the ground. Location of the control and method of inserting destinations made in-flight programming inconvenient and constituted a safety hazard at the nap of the earth when operated by a pilot flying alone.

2.3.3.4. Results of the accuracy flights over land and water are shown in part B, appendix I, section 3. The overland portion of the test indicated that the Doppler had a mean distance error of 0.64 percent and an estimated standard deviation of 0.5 percent. Average position error (a combination of distance and angular error) for the 18 overland legs of the accuracy flights was 1.16 percent before correction of the mean distance error and 0.9 percent after allowance for correction of the 0.64 percent distance error. (The mean distance error of 0.64 percent can be removed by calibration adjustment within the Doppler set.) The average accuracy over water was found to be 4.3 percent (uncorrected). These figures represent combined system errors of the AN/ASN-50 compass and the AN/ASN-64 Doppler.

2.3.3.5. Wind data were collected at 2,000 feet altitude in an area reporting wind conditions of 20 knots from 70 degrees. Results were as follows:

Heading	Airspeed	Groundspeed	Wind
0°	200	200	90°, 10 knots
90°	210	201	90°, 9 knots
180°	200	202	90°, 9 knots
270°	201	210	90°, 11 knots

2.3.3.6. During climb to 20,000 feet, pitch and roll maneuvers at 20,000 feet, and descent from 20,000 feet, no periods of memory operation were encountered.

2.3.3.7. Time required to reacquire correct groundspeed and track data from an incorrect setting was found to average 10 seconds over land and 13 seconds over water.

2.3.4. Analysis.

2.3.4.1. Operation of the Doppler was as outlined in the operator's manual and presented no unusual problems.

2.3.4.2. Accuracy of the Doppler was considerably better over land than over water. This was attributed, in part, to the surface movement and wave action in the water caused by a strong crosswind.

2.3.4.3. Actual wind conditions differed from the reported conditions (20 knots at 70 degrees). Since nearly identical results were obtained on each of four headings and the differences in ground and airspeeds were of the proper values, the reported wind information is considered to have been in error. Pilot reports on cross-country flights indicated that the wind data provided by the Doppler was exceptionally accurate.

2.4. MAINTENANCE AND SUPPORT REQUIREMENTS.

2.4.1. Objectives.

a. To verify the maintenance and support requirements of the AN/ASN-64 Doppler Navigation Set and that using personnel can perform the required maintenance* (paragaphs IV 2 and 3, MC's, appendix II, section 3).

b. To accumulate repair parts usage data and man-hours expended for maintenance both organizational and direct support.*

2.4.2. Method.

2.4.2.1. The AN/ASN-64 Doppler was maintained, calibrated, repaired, and operated during the test period in accordance with commercial publications provided (references 5 and 6, appendix III, section 3).

*It was noted in the plan of test that these objectives could be accomplished only if a maintenance package was provided.

2.4.2.2. A log was maintained of all maintenance and repairs performed and spare parts used to keep the test item operational. The time required to perform each maintenance function, the time required to repair the fault, and the replacement parts required were recorded.

2.4.3. Results.

2.4.3.1. No maintenance package was provided for use in conducting a maintenance evaluation. All maintenance was performed by the manufacturer.

2.4.3.2. Total operating time during test was 239 hours with nine malfunctions. Three of these were the result of poor quality control during equipment modification. Of 63 missions flown, only one mission was aborted as a result of a failure.

2.4.3.3. Total maintenance time to repair equipment malfunctions was 32 hours. A log of maintenance actions and times required is contained in part C, appendix I, section 3.

2.4.3.4. Commercial manuals were available but not evaluated because all work was performed by the manufacturer.

2.4.4. Analysis.

No pattern of failure was noted which could be attributed to any specific design weakness of the system. Three failures were caused by improper quality control during modification. This is not considered significant, since this equipment was among the first modified and the problem should be corrected on production equipment.

2.5. SAFETY.

2.5.1. Objective.

To verify, in accordance with USATECOM Regulation 385-7, that the AN/ASN-64 is safe for its intended use.

2.5.2. Method.

2.5.2.1. Operator and maintenance personnel were interviewed regarding possible safety hazards, and any condition which presented a safety hazard was recorded.

2.5.2.2. The installation of the AN/ASN-64 in the OV-1B was examined for areas of possible safety hazards.

2.5.2.3. The system was observed and inspected to insure that all safety hazards were properly marked.

2.5.3. Results.

2.5.3.1. The pilot was required, when flying without the assistance of a trained observer or copilot, to divert his attention for extended periods to the computer control indicator to insert destinations. During flight at nap-of-the-earth altitudes, this diversion constituted a safety-of-flight hazard.

2.5.3.2. No physical characteristics or features were noted which were considered hazardous to operator or maintenance personnel. The test item required only normal maintenance electrical safety procedures.

2.5.4. Analysis.

2.5.4.1. The MC's contain no safety requirements.

2.5.4.2. The requirement to insert many destinations during flight at nap-of-the-earth altitudes is considered a shortcoming and could be eliminated by the use of a multiple-destination storage unit.

2.6. CORRECTION OF SHORTCOMINGS.

2.6.1. Objective.

a. To determine whether previously-reported shortcomings have been corrected and whether the modifications adversely affect the operation of the test set.

b. To report shortcomings or deficiencies discovered during this test.

2.6.2. Method.

2.6.2.1. The findings and results of this test were compared with those of the military potential test (reference 3, appendix III, section 3) to determine whether the previously-reported shortcomings had been corrected. (No deficiencies were reported.)

2.6.2.2. Instances where modifications incorporated into the test set have adversely affected its operation were recorded.

2.6.2.3. Any new shortcomings or deficiencies not previously reported were recorded.

2.6.3. Results.

2.6.3.1. The status of previously-reported shortcomings was as follows:

Previously-Reported Shortcoming	Recommended Corrective Action	Status This Test
a. Excessive edge lighting is required in order to adequately light the center of the bearing-distance indicator.	Mask the edge lighting and reflect it toward the center.	Not corrected.
b. The 30-degree bearing radiacs cause instrument clutter.	Remove the 30-degree radiac.	Corrected.
c. A digital distance-to-go readout was not provided.	Provide a digital readout for distance-to-go.	Not corrected.
d. A digital wind velocity readout was not provided.	Provide a digital readout for wind velocity.	Not corrected.
e. The magnetic variation did not have an index marking to designate a tenth of a degree.	Provide an index marking.	Corrected.
f. No velocity/height computer capability was provided.	Provide velocity/height computer capability.	Capability has been provided but will be tested separately.

Previously-Reported Shortcoming	Recommended Corrective Action	Status This Test
g. Present position data cannot be updated without crossing a point twice.	Provide capability to update position data without loss of flight data or necessity of crossing a point twice.	Corrected.
h. No course-select feature provided.	Provide means to select a desired track through a Doppler destination, and display the resulting command or error signal on a suitable instrument.	Not corrected.
i. Doppler-derived wind-memory circuit malfunctioned intermittently.	*Correct wind memory* circuit malfunction.	*Shortcoming* did not occur during this test.

2.6.3.2. Modifications to correct previously-reported shortcomings did not adversely affect operation of the equipment.

2.6.3.3. No deficiencies were discovered during this test. The following shortcomings were discovered:

Shortcomings This Test	Suggested Corrective Action	Remarks
a. No "equipment-ready" indication is provided.	None.	Difficulty was experienced in determining when equipment is ready for use.

Shortcomings This Test	Suggested Corrective Action	Remarks
b. Construction of the velocity steering indicator results in excessive parallax when viewed from a slight angle and material used for faceplate is subject to excessive glare.	None.	Difficulty was experienced in reading track information.
c. Velocity steering indicator illumination system allows excessive white light to leak into the cabin area, which interferes with the pilot's night vision and is very distracting.	None.	
d. The N-S and E-W wind set controls can be inadvertently left or placed in the slew position.	Spring-load switches to center position.	
e. Limited destination storage capability requires pilot to concentrate attention within the aircraft on nap-of-the-earth flights, in order to program the next destination.	Provide a multiple destination storage unit.	Prototype unit will be available for future tests.

2.6.4. Analysis.

Not applicable.

2.7. COMPARISON WITH MC'S.

2.7.1. Objective.

To determine the extent to which the test set meets the applicable requirements of the MC's (reference 1, appendix III, section 3).

2.7.2. Method.

The test set was compared with the applicable portions of the MC's.

2.7.3. Results.

See appendix II, section 3, for results of this comparison presented in tabular form.

2.7.4. Analysis.

The AN/ASN-64 met the primary function stated by the MC's but failed to meet the exact requirements in certain areas.

SECTION 3 - APPENDICES

APPENDIX I - TEST DATA

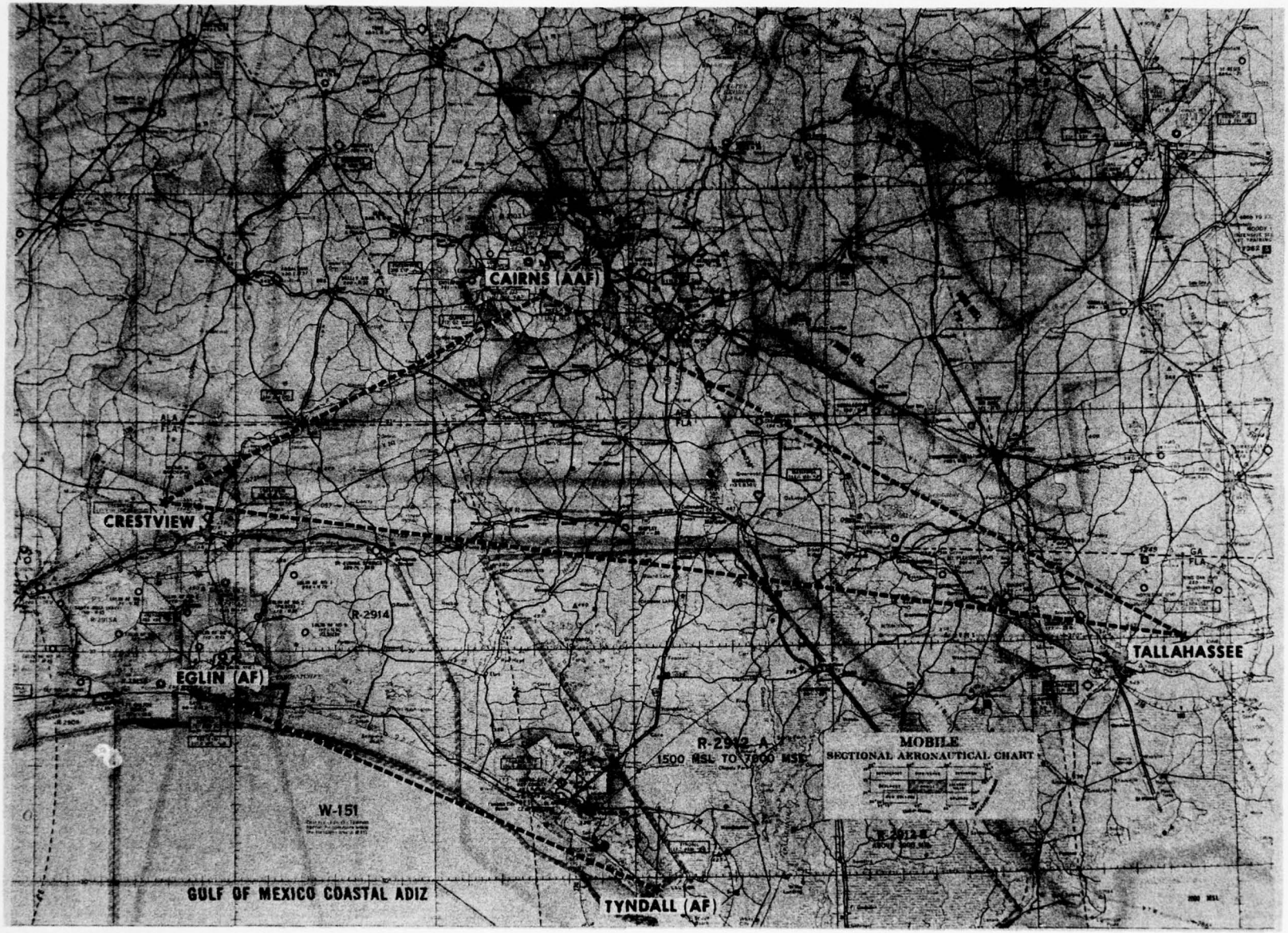
Part A

Method Used to Collect Doppler Accuracy Data

An accuracy test was conducted as outlined in paragraph 2.3.2 of this report. Procedures and calculation formula provided in Technical Instructions SCL-T-0031 (Draft) (reference 9, appendix III) were used for data reduction. The selected course consisted of a triangle formed by the OMNI stations at Cairns Army Airfield, Alabama; Crestview, Florida; and Tallahassee, Florida, for the overland portion of the test. A single straight course between the OMNI stations at Eglin Air Force Base and Tyndall Air Force Base constituted the overwater portion of the test. (See map.) Location and programming data for these flight courses are shown below:

Station	Latitude	Longitude
Cairns OMNI	31° 16' 10"	85° 43' 36"
Crestview OMNI	30° 49' 33.6"	86° 40' 45.1"
Tallahassee OMNI	30° 30' 05.1"	84° 06' 49"
Eglin OMNI	30° 23' 38.6"	86° 32' 15"
Tyndall OMNI	29° 58' 18.1"	85° 27' 02.4"

Flight Leg	Dist N-S (km.)	Dist E-W (km.)	Dist (km.)	True Bearing
Cairns - Crestview	49.3	90.7	103.2	241.5°
Crestview - Tallahassee	36.1	245.2	247.9	98.4°
Tallahassee - Cairns	85.3	153.8	175.9	299.0°
Eglin - Tyndall	46.9	104.4	114.5	114.2°


CAIRNS (AAF)
CRESTVIEW
R-2914
EGLIN (AF)
TALLAHASSEE
R-2912-A
1500 MSL TO 7000 MSL
MOBILE
SECTIONAL AERONAUTICAL CHART
W-151
GULF OF MEXICO COASTAL ADIZ
TYNDALL (AF)

Part B

Doppler Accuracy Data

Course Leg	Flight Number	Flight Direction	Doppler Distance N-S	Doppler Distance E-W	Percent Distance Error	Percent Position Error	Error Angle
Cairns - Tallahassee	1	CW*	87.2	155.0	1.1	1.3	+0.3°
	2	CCW**	87.4	154.8	1.0	1.3	+0.4°
	3	CCW	86.9	156.0	1.5	1.5	+0.1°
	4	CCW	87.1	154.3	0.7	1.1	+0.4°
	5	CW	87.1	155.7	1.4	1.5	+0.2°
	6	CW	86.5	154.8	0.8	0.9	+0.2°
Tallahassee - Crestview	1	CW	38.1	246.1	0.4	0.9	+0.4°
	2	CCW	37.3	249.0	1.6	2.0	+0.1°
	3	CCW	36.2	247.0	0.7	0.7	+0.1°
	4	CCW	36.2	246.8	0.6	0.6	-0.1°
	5	CW	39.8	244.0	0.3	2.2	+0.8°
	6	CW	39.5	246.4	0.6	1.5	+0.7°
Crestview - Cairns	1	CW	48.5	91.8	0.6	1.3	+0.7°
	2	CCW	47.8	91.6	0.1	1.7	+0.9°
	3	CCW	49.2	90.3	0.4	0.4	-0.1°
	4	CCW	49.0	91.1	0.2	0.5	+0.2°
	5	CW	48.7	91.6	0.5	1.1	+0.5°
	6	CW	49.4	91.1	0.4	0.4	0.0°

*Clockwise

**Counterclockwise

Course Leg	Flight Number	Flight Direction	Doppler Distance N-S	Doppler Distance E-W	Percent Distance Error	Percent Position Error	Error Angle
Eglin - Tyndall	7	E-W	41.9	101.3	4.2	4.4	+1.8
	8	W-E	42.1	101.8	3.7	4.8	+1.7
	9	W-E	43.2	100.3	4.5	4.8	+0.9
	10	W-E	43.2	104.8	1.0	3.3	+1.8

Part C - Maintenance Data

AN/ASN-64 Initial Production Test

Equipment Flight Hours:	150:40	Total Number of Missions:	63
Equipment Ground Hours:	88:20	Total Number of Landings	
Total Equipment Hours:	239:00	on Perforated Steel Plate:	200

AN/ASN-64 Failures Requiring Mission to be Aborted: 1
AN/ASN-64 Equipment Failures: 9
Total Time Required for Repair: 32 Hours

AN/ASN-64 Equipment Failures

Date	Unit	Unit Elapsed Time (hr.)	Flight Hours	Environment	Effect	Fault	Corrective Action	Cause	Repair Time (hr.)
28 Dec 1965	Control Indicator No. 93	N/A	None	Flight	Mission completed	Stage switch intermittent; destination mask interfering with stage switching.	Destination mask filed slightly to prevent binding.	Faulty assembly* during ASN-64 modification (quality control).	3.0
4 Jan 1966	Frequency Tracker No. 93	77	7:05	Ground check		Tracker fuse F06 blowing continuously. Tracker fan switch capacitor shorted fan 155 v.-a.c. to ground.	Tracker fan switch capacitor, CO3, relocated to correct position.	Faulty assembly* during ASN-64 modification (quality control).	1.5
4 Jan 1966	Frequency Tracker No. 93	77	None	Ground check		Tracker fuse F04 blowing continuously. Transistor QO2 shorted in tracker power supply, CMC 404-270.	Transistor QO2 2N1890 in tracker power supply replaced.	Tracker power supply overheated as a result of blown fuse F06 in the tracker fan supply (quality control). *	2.5

*Systems No. 5 and No. 93 were the first two systems modified. These faults were not on subsequent modified systems.

Date	Unit	Unit Elapsed Time (hr.)	Flight Hours	Environment	Effect	Fault	Corrective Action	Cause	Repair Time (hr.)
11 Jan 1966	Frequency Tracker No. 5	249	7:50	Flight	Mission aborted	Tracker fuse FO4 blowing continuously. Transistor QO5 shorted in tracker power supply, CMC 404-270.	Transistor QO5 2N1724 replaced.	Random failure.	3.0
24 Jan 1966	Navigational Computer No. 5	427	24:40	Bench check		-28 v. was -50 v., QO1, 2N17 shorted in computer power supply, CMC 434-535. VR05, 1N3031B and QO1, 2N1040 on power supply board 34, CMC 454-698 open. Continuous range switching Photocell holder assembly, CMC 327-929 faulty.	Transistor QO1, 2N174 in computer power supply replaced. Zener, VR05, 1N3031B and Transistor, QO1, 2N1040 on power supply board 34 replaced. Photocell holder assembly replaced.		4.0
24 Jan 1966	Velocity Steering Indicator No. 93	N/A	None	Ground check		Continuous range switching; Photocell holder assembly CMC 327-929 faulty.	Photocell holder assembly replaced.	Computer No. 5 power supply over-voltage resulted in the failure of the Photocell holder assembly.	3.0
24 Jan 1966	Navigational Computer No. 5	427	24:40	Bench check		Erratic present position slew. Shorted transistor QO8, 2N404, found on actuator 18, CMC 454-493.	Transistor QO8 replaced.	Random failure.	2.0
15 Feb 1966	Navigational Computer No. 5	473	38:15	Flight	Mission completed	Incorrect wind solution. Faulty servo amplifier	Servo amplifier AR02 replaced.	Random failures.	4.5

Date	Unit	Unit Elapsed Time (hr.)	Flight Hours	Environment	Effect	Fault	Corrective Action	Cause	Repair Time (hr.)
(continued)						AR02, 454-420, in transmitter, wind data, CMC 434-477.			
15 Apr 1966	Frequency Tracker No. 5	443	117:40	Flight	Mission completed	Incorrect memory indication (memory flag but no memory light). Faulty relay KO3 found on control operating mode, CMC 404-226.	Relay KO3 replaced.	Random failure.	3.5
15 Apr 1966	Frequency Tracker No. 5	443	117:40	Bench check		System would not lock on. Faulty transistor QO5, 2N1724 in tracker power supply, CMC 404-270.	Transistor QO5 replaced.	Random failure.	3.0
28 Apr 1966	Control Indicator No. 5	N/A	139:05	Flight	Mission completed	Continuous groundspeed slewing. Sticking groundspeed slew switch, SO2.	Groundspeed slew switch SO2 replaced.	Random failure.	2.0

APPENDIX II - FINDINGS

(Comparison with the Approved Military Characteristics)

This appendix is classified CONFIDENTIAL and is submitted under separate cover.

APPENDIX III - REFERENCES

1. SCTC Meeting No. 599CS, Item 4731, 31 August 1959, subject: "Recording of Approved Military Characteristics for Lightweight Self-Contained Navigator (U)."

2. Combat Developments Objectives Guide, paragraphs 533c(5) and 533c(6), revised 1 May 1962.

3. Report of Test, USATECOM Project No. 4-3-3600-( )-G, "Military Potential Test (Comparative Evaluation) of Doppler Navigation System," US Army Aviation Test Board, 6 January 1964.

4. AMCTC Meeting No. 14-64, Item 2797, 29 December 1964, subject: "Recording Type Classification of Navigation Set, Radar AN/APN-( ) as Limited Production Type (LP)."

5. "Pilots Operating Instructions, CMA-681, Airborne Navigation Computer System," Canadian Marconi Company, 1964.

6. Technical Manual (Parts 1 and 2), "Doppler Navigation Set, AN/ASN-64," Canadian Marconi Company, January 1965.

7. Letter, AMSEL-PP-ESD-4, Headquarters, US Army Electronics Command, 29 July 1965, subject: "Request for Test of Doppler Navigation Set, AN/ASN-64."

8. Plan of Test, USATECOM Project No. 4-6-3481-04, "Plan of Test for AN/ASN-64, Doppler Navigation Set," US Army Aviation Test Board, 11 February 1966.

9. Plan of Test, USATECOM Project No. 4-6-3481-06, "Service Test of AN/ASN-64 Doppler Navigation Set in UH-1D Helicopter," US Army Aviation Test Board, 20 May 1966.

10. Technical Instructions, SCL-T-0031, "Testing of Doppler Navigator Set AN/ASN-64 for Army Aircraft," US Army Electronics Command.

APPENDIX IV - DISTRIBUTION

USATECOM PROJECT NO. 4-6-3481-04

Agency	Final Report
Commanding General US Army Test and Evaluation Command ATTN: AMSTE-BG Aberdeen Proving Ground, Maryland 21005	2
Commanding General US Army Electronics Command ATTN: AMSEL-PP-ESD-4 Fort Monmouth, New Jersey 07703	25
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3. REPORT TITLE

INITIAL PRODUCTION TEST OF AN/ASN-64 DOPPLER NAVIGATION SET (U)

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Final Report of Test, 3 January to 13 May 1966

5. AUTHOR(S) *(Last name, first name, initial)*

Wroten, Cecil E., Major, SigC

Rogers, Virgil R.

Martin, Charles L., Jr.

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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8a. CONTRACT OR GRANT NO. b. PROJECT NO. None c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) USATECOM Project No. 4-6-3481-04 9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*

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13. ABSTRACT

As the result of a comparative evaluation (military potential test) of off-the-shelf systems, the AN/ASN-64( ) Doppler Navigation Set was type classified "Limited Production Type." The US Army Aviation Test Board was then directed to conduct an initial production test to verify the adequacy and quality of the production AN/ASN-64. The equipment was installed and tested in an OV-1B Airplane during the period 3 January to 13 May 1966, encompassing operational phases utilized during the comparative evaluation. No deficiencies were previously reported, and none were discovered during this test. Four of the nine previously-reported shortcomings had been corrected; four remained as previously reported; and one did not occur during this test. Five new shortcomings were noted during this test. It is concluded that the adequacy and quality of the AN/ASN-64 have not been adversely affected by modifications incorporated during production, and that correction of shortcomings listed in paragraph 2.6.3 will improve the suitability of the AN/ASN-64 for Army use. It is recommended that the AN/ASN-64 be service tested in the type of aircraft in which it is to be employed, and that the shortcomings listed in paragraph 2.6.3 be corrected as technically and economically feasible. (U)

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14. KEY WORDS		LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
AN/ASN-64 Doppler Navigation Set	Safety						
US Army Aviation Test Board	Shortcomings						
Initial production test	Military characteristics						
OV-1B Airplane							
Self-contained navigation system							
Adequacy							
Quality							
Size							
Weight							
Operational characteristics							
System position accuracy							
Malfunctions							

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