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SERVICE TEST OF THE PATHFINDER BEACON LIGHT.(U)
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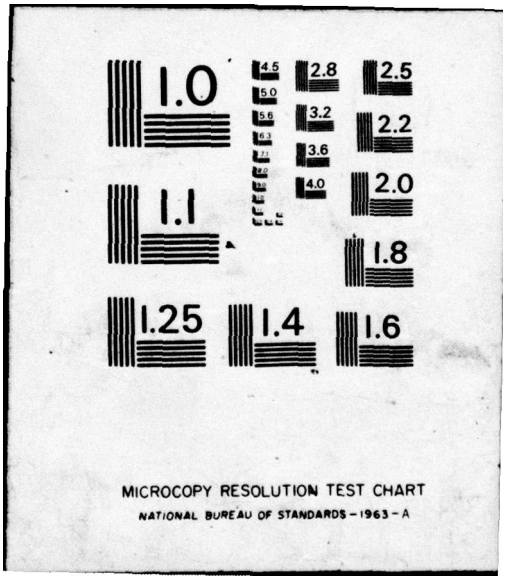
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UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36362

STEBG-TD

24 April 1964

SUBJECT: Service Test of the Pathfinder Beacon Light, USATECOM Project No. 4-3-7020-02

TO: President
US Army Airborne, Electronics and Special Warfare Board
ATTN: STEBF-AB
Fort Bragg, North Carolina 28307

1. Reference:

a. Letter, AMSTE-BG, U. S. Army Test and Evaluation Command, 30 January 1964, subject: "Directive for Service Test of Beacon Light, Pathfinder for Air Drop and Air Transport Operations, USATECOM Project No. 4-3-7020-01(D)."

b. Plan of Test, "Service Test of Beacon Light, Pathfinder for Air Drop and Air Transport Operation," U. S. Army Airborne, Electronics and Special Warfare Board, 8 May 1963.

c. Support Plan, "USATECOM Project No. 4-3-7020-02, Service Test of the Beacon Light, Pathfinder," U. S. Army Aviation Test Board.

2. The Pathfinder Beacon Light was evaluated by U. S. Army Aviation Test Board (USAAVNTBD) personnel during the period 5-19 March 1964 to determine its suitability as a terminal aid for Army aircraft in air transport operations. Details and results of this test are forwarded for your information and retention.

A. J. RANKIN
Colonel, Armor
President

2 Incl
1. Details and Results of Test
2. Deficiencies and Shortcomings

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DETAILS AND RESULTS OF TEST NO. 5

1.0. INTRODUCTION.

1.0.1. The Pathfinder Beacon Light was evaluated by US Army Aviation Test Board (USAAVNTBD) personnel during the period 5-19 March 1964. Six beacon lights were operated under various meteorological conditions during the hours of dusk (sunset to end evening nautical twilight (EENT)), dawn (begin morning nautical twilight (BMNT) to sunrise), and darkness (EENT to BMNT). The beacons were operated at various heights above the ground using continuous and coded light settings, various color lenses, and shielded light settings. USAAVNTBD personnel observed the beacon lights for approximately 25 flight hours from fixed-wing and rotary-wing aircraft.

1.0.2. In addition to the test conducted by the USAAVNTBD, data were obtained from the Department of Tactics, US Army Aviation School, Fort Rucker, Alabama. During the test conducted by the Department of Tactics, six beacon lights were erected at five widely separated sites in the vicinity of Fort Rucker. These lights were used to mark check-points and a drop zone in a simulated tactical night operation of Army aircraft. Each of the color lenses, except red, was used. Results of this test revealed that while the white, amber, and green lights were useful for navigation and marking of a drop zone, the blue and near-infrared lights could not be used successfully. Detection ranges were generally less than those obtained by USAAVNTBD personnel because it was difficult for the student pilot to detect the test beacon lights from the numerous lights in the same general area.

1.1. SUB-TEST A - MAXIMUM VISUAL DETECTION RANGE FOR COLOR LIGHT EMISSION.

1.1.1. Objective.

To determine maximum detection range (air-to-ground) for color light emission.

1.1.2. Method.

Beacon light units were installed, with all color lenses provided, in a location free of obstructions. Aircraft were flown to determine maximum detection ranges at altitudes of 500, 1000, 2000, 4000, and 6000 feet above the terrain during dusk, dawn, and hours of darkness.

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1.1.3. Results.

1.1.3.1. Maximum Detection and Identification Ranges for Each Color Emission.

The average detection range in nautical miles for the color lenses, both omni-directional and shielded, coded and continuous beam, during clear weather and visibility of approximately 15 miles was as follows:

Color Lens	Dusk		Night	Dawn	
	Sunset	EENT		BMNT	Sunrise
White	1	5	10	6	1
Amber	1	4	10	5	1
Red	1	2	5	5	1 1/2
Green	1/2	2	4 1/2	4	2
Blue	-	1 1/2	2 1/2	2	1/2

During dusk (sunset to EENT) and dawn (BMNT to sunrise) detection of the beacon light was best at altitudes of 500 to 1000 feet above the terrain. Detection ranges generally deteriorated at altitudes above 3000 feet.

Identification of the color emission of the beacons varied depending upon the time of test and altitude flown. The order of identification of the beacon lights as the aircraft approached the test site was as follows:

a. Dusk - red, amber, clear, green, and blue.

b. Darkness - clear, amber, red, green, and blue.

c. Dawn - green, red, amber, clear, and blue.

1.1.3.2. Effect of Meteorological Conditions on Detection Range.

The average detection range in nautical miles for the color lenses, both omni-directional and shielded, coded and continuous beam, under various weather conditions was as follows:

Weather: Overcast, visibility 15 miles.

Color Lens	Dusk		Night	Dawn	
	Sunset	EENT		BMNT	Sunrise
Clear	1	5	12	6	1 1/2
Amber	1	4	10	6	1
Red	1 1/2	3	6	5	1 1/2
Green	1	2 1/2	5	4	2
Blue	-	1 1/2	3	1 1/2	-

Weather: Haze, light fog, visibility 8 miles.

Color Lens	Dusk		Night	Dawn	
	Sunset	EENT		BMNT	Sunrise
Clear	1	3	7	3	1
Amber	1	3	7	3	1
Red	1	2	4	4	1
Green	1	2	4	4	1 1/2
Blue	-	1	2 1/2	2	-

1.1.3.3. Effect of Ambient Light Conditions on Detection Range.

Continuous light was difficult to distinguish from other lights in the area. Location and identification of all beacon lights were improved by the use of a flashing code. Pauses in excess of two seconds in the emission of the code signal caused difficulty in locating the beacon light.

1.1.4. Analysis.

The Pathfinder Beacon Light using white, red, amber, and green light emission is suitable as a terminal aid to navigation in air transport operations. Under the same operations, the blue light emission is not

satisfactory and should not be considered suitable as a terminal aid to navigation in transport operations.

1.2. SUB-TEST B - SUITABILITY OF BEACON LIGHT IN INFRARED MODE.

1.2.1. Objective.

To determine suitability of the Beacon Light, Pathfinder, when operated in the near-infrared mode.

1.2.2. Method.

Beacon light units equipped with near-infrared lenses were installed in a location free of obstructions. Aircraft were flown to determine detection ranges at 500, 1000, 2000, and 4000 feet altitude during dusk, dawn, and hours of darkness. A metascope (Model 9902A) was used for detection of the beacon lights.

1.2.3. Results.

1.2.3.1. Maximum Detection Range.

In the near-infrared operation (during clear weather and visibility of approximately 15 miles), the usable range of detection at night was approximately one mile, but only then if the location of the beacon lights was known. At dusk and dawn the infrared beacon was not detected until the aircraft was very near or directly over the test site.

1.2.3.2. Effect of Meteorological Conditions on Detection Range.

With an overcast sky and visibility of approximately 15 miles (at night), the infrared detection range was 1 1/2 miles. With visibility restricted to approximately 8 miles, because of haze and light fog, the beacon detection range was 1/2 mile. At dusk and dawn (under both weather conditions), the beacon was not detected until the aircraft was very near or directly over the test site.

1.2.3.3. Suitability of Utilizing a Metascope from Army Aircraft.

The use of a metascope to detect infrared light from Army aircraft was unsuitable because the instrument panel light reflections reduced the efficiency of the metascope.

1.2.3.4. Advantages and Disadvantages of Infrared Operation.

Advantage of infrared operation is its concealment from enemy view.

The disadvantages are as follows:

a. Detection range of the infrared light when viewed from the air is unsatisfactory.

b. Use of the metascope 9902A in Army aircraft is unsatisfactory.

1.2.3.5. Effect of Ambient Light Conditions on Detection Ranges.

See paragraph 1.1.3.3.

1.2.4. Analysis.

The near-infrared light emission is not satisfactory and should not be considered for use as a terminal navigation aid for air transport operations.

1.3. SUB-TEST C - SUITABILITY OF BEACON LIGHT IN SHIELDED MODE.

1.3.1. Objective.

To determine suitability of the Beacon Light to emit light at a preselected angle.

1.3.2. Method.

Beacon lights were installed as in Sub-Tests A and B and adjusted to emit colored and near-infrared light at various angles. Aircraft were flown at various altitudes from 500 to 6000 feet to intercept the sector of light emitted during dusk, dawn, and hours of darkness.

1.3.3. Results.

1.3.3.1. Sector (Angle) of Light Emitted.

Use of the 180-degree shield provided with the test item did not provide adequate shielding of the emitted light when viewed from

the air. The approximate sector of light emitted using the 180-degree shield was as follows:

a. White 275 degrees

b. Amber 260 degrees

c. Red 210 degrees

d. Green 200 degrees

e. Blue 190 degrees

Additional shielding was improvised and the following data were obtained:

a. White light with 270 degrees of shielding emitted an arc of approximately 195 degrees.

b. Amber light with 270 degrees of shielding emitted an arc of approximately 180 degrees.

c. Green light with 315 degrees of shielding emitted an arc of approximately 90 degrees.

1.3.3.2. Aircraft Angle of Intercept.

Aircraft intercept of the light emitted in a sector presented no problem when the beacon was operated in a coded mode within the limits of the maximum detection ranges.

1.3.3.3. Maximum Detection Range for each Color and Type of Light Emission.

The use of either the 180-degree shield provided as a part of the beacon light or the improvised shields did not affect the visual detection ranges of the beacon lights when viewed from the unshielded side.

1.3.3.4. Suitability of Beacon Lights for Air Transport Operations when Emitting Light at Preselected Angles.

Because of the limited detection ranges, the blue and near-infrared lights were not suitable for air transport operations.

1.3.3.5. Aligning Beacon Light to a Predetermined Heading.

No means was provided on the test item to assist ground personnel in aligning the beacon light to a predetermined heading. This, in addition to the "spill-over" from the 180-degree shield, made it difficult to properly align the beacon light beam on a desired heading using a hand-held compass.

1.3.4. Analysis.

A 180-degree shield does not provide adequate restriction of the light source when viewed from the air. Therefore, a shield adjustable at 180, 270, 315, and 330 degrees of closure should be provided.

1.4. SUB-TEST D - EFFECT OF ALTITUDE ON DETECTION RANGE.

1.4.1. Objective.

To determine effect of altitude upon detection range.

1.4.2. Method.

Beacon lights were installed and positioned for viewing from aircraft at various altitudes and ranges during dawn, dusk, and hours of darkness so that sun, sky, trees, and ground formed backgrounds for the Beacon Light.

1.4.3. Results.

1.4.3.1. Effect of Selected Altitude upon Maximum Detection Range when Viewed with Sun, Sky, Trees, and Ground as Background During Dusk, Dawn, and Hours of Darkness.

The maximum detection range for all lenses and modes of operation generally decreased as the altitude flown increased.

1.4.3.2. Effect of Meteorological Conditions on Detection Range.

The maximum detection range deteriorates in proportion to the weather conditions except in the case of overcast sky conditions with no haze, fog, or precipitation. As sky cover increased, to the exclusion of overhead light, the brilliance of the light appeared to increase, due to contrast.

1.4.3.3. Maximum Detection Range by Color and Type of Light Emitted.

See paragraphs 1.1.3.1 and 1.2.3.1.

1.4.4. Analysis.

Detection ranges of unobstructed beacon lights were noticeably greater at altitudes below 3000 feet above the terrain.

1. DEFICIENCIES

Deficiency	Suggested Corrective Action	Remarks
a. The 180-degree shield does not provide an adequate "black-out" arc.	Provide a shield adjustable at 180, 270, 315, and 330 degrees of closure.	The sector of light emitted using the 180-degree shield varied from 190 to 275 degrees depending on color of lens used.
b. Locking pin assembly used to secure mast sections to each other bind and break when subjected to dirt, mud, corrosion, etc.	Provide locking pin assembly that will not bind when subjected to dirt, mud, corrosion, etc.	Considerable mast failure was encountered during the test period. These failures were due to the following: (1) Dirt binding the inner tubing pins, used to secure mast sections together. (2) Breaking of shafts used to position the inner tubing pins.

2. SHORTCOMINGS

Shortcoming	Suggested Corrective Action	Remarks
a. Detection range of blue light is not sufficient for air transport operations.	Improve blue light emission for air transport operation.	None
b. Detection range of near-infrared light is not sufficient for air	Improve near-infrared light emission and provide a more suitable	The detection range of the near-infrared light varied from 0

Shortcoming	Suggested Corrective Action	Remarks
transport operations.	airborne means of near-infrared detection.	to 1 1/2 miles depending on the time of night and weather condition. See paragraph 1.2., Sub-test B.
c. It is difficult to align light along a predetermined azimuth when using the light shield.	Provide alignment points on the base section of the mast, on the light base, and key the light base to the mast.	No means was provided on the test item to assist ground personnel in aligning the beacon light to a predetermined azimuth.