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Development, Testing, and Evaluation of Visual Landing Aids

Consolidated Progress Report
to the

Airborne Equipment Division
Bureau of Aeronautics
Department of the Navy

For the Period
October 1 to December 31, 1955

for
Bureau of Aeronautics Projects

TED No. NBS-AE-10002
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NBS

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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Development, Testing, and Evaluation of Visual Landing Aids

October 1 to December 31, 1955

I. REPORTS ISSUED

Report No.	Title
4343	Photometric Tests of 21 Colored Retroreflective Samples
4368	Development, Testing, and Evaluation of Visual Landing Aids, Consolidated Progress Report for the Period July 1 to September 30, 1955
4463	Current-Intensity, Voltage-Intensity, and Current-Voltage Characteristics of Runway- and Approach-Light Lamps
21A-6/55	Type II Angle-of-Approach Light (Letter Report)
21P-17/55	Photometric Tests, Type M-1 Elevated Runway Marker Lights
	Purpose, Requirements, and Installation Instructions for the Identification Lighting System for Tall Towers
	Procurement Specifications for Identification Beacons for Tall Towers
	Purpose, Requirements, and Installation Instructions for the Obstruction Lighting System for Tall Towers
	Procurement Specifications for Hazard Beacons for Tall Towers
	Procurement Specification for Lighting Suit Equipment, Landing Signal Officer
	Malfunctions of Type NC-3 Constant Current Regulators (Memo Report)

II. RESEARCH AND DEVELOPMENT, LABORATORY TESTING, AND CONSULTATION SERVICES IN CONNECTION WITH VISIBILITY, AIRFIELD LIGHTING, AND FOG MODIFICATION PROBLEMS (TED NBS-AE-10002).

a. Visibility Meters and Their Application.

Transmissometers. An experimental phototube similar in construction to those described in Report No. 4368 but having a modified S-4 surface has been received from the Continental Electric Company and is being tested. The spectral response of the S-4 surface is preferable to that of the S-1 surface now being used since the S-4 response is closer to the spectral response of the human eye.

The report "Theory of the Transmissometer Photometric System" has been completed and is being edited. This report provides a more complete theoretical background than it was possible to include in the instruction manual.

Checks have been made of the second order effects of deviations from linearity of the photocells used in the 100%-setting calibrator and a method of calibrating and correcting for these effects has been developed. It was found that the Weston photronic cells had insignificant deviations.

Brightness Meters. An illuminometer for obtaining the ratio of the indirect illumination to the total illumination incident on the horizontal plane has been constructed. This ratio is obtained by rotating a shadow bar periodically so that the illuminometer will be momentarily shielded from the sun, thus giving a measurement of the indirect illumination. The unit has been sent to Arcata for use.

b. Airfield Lighting and Marking.

Runway Marking. Sample material for runway marking has been obtained from J. W. Neff Laboratories, Inc. Tests on this material are being delayed until materials from other manufacturers are received.

Runway Lighting. An experimental retractable runway light manufactured by Miller Research Laboratory has been delivered for test.

Taxiway Lighting. A study has been made of the intensity distribution of the Type M-1 light with clear asymmetric and blue

symmetric lenses and of the intensity-current characteristics. The results are reported in NBS Test Report 21P-17/55.

Runway Distance Markers. PAR 38 lamps of several voltages and wattages have been obtained for study as possible lights for distance markers. A study will be made of the intensity of these lamps when operated singly or in series or parallel combinations from 30/45-watt and 200-watt, 6.6-ampere isolating transformers. Particular attention will be given to the change in intensity as the primary current is varied in order to determine the combination of lamp(s) and transformer which will provide the highest illumination at low brightness settings and satisfactory life at high brightness settings.

Control of Constant-Current Regulators. The control relays for a safety circuit which will put constant-current regulators on brightness step 4 instead of step 5 whenever the current on step 5 exceeds 6.8 amperes have been received. The relays have been assembled into a control unit. The unit has been sent to Arcata where it will be installed for service testing.

Heliport Lighting. A preproduction sample of an approach-angle light was received from the Forways Industries Inc. for tests to determine if it complied with the requirements of the specification. The tests showed that it complied except for specific deficiencies which the manufacturer can readily correct. The results were summarized in a letter report under Test No. 21A-6/55.

Intensity-Current-Voltage Characteristics of Lamps. The increasing complexity of the problems of intensity control has increased the need for information on the relative intensity characteristics of lamps used in approach, runway, and taxiway lighting as a function of the applied voltage or current. In addition more information on the effects of color filters is required. Therefore, a study has been made of the intensity-current-voltage characteristics of lamps of the types generally used in airfield-lighting systems and of the effect of color filters upon the relative intensity of these lamps. The results of this study have been reported in NBS Report 4463.

c. Seadrome Lighting.

Norfolk Installation. Arrangements have been made with the General Electric Company to obtain experimental 500-watt, 20-ampere, PAR 56 sealed-reflector lamps for test. The beam pattern of these lamps will be similar to that of the 399PAR approach-light lamps.

Development of High Intensity Seadrome Lights. As indicated in Report 4368, a combination of mercury lamp and filter was being tested as a possible source for the cable-fed seadrome light. The filter which was then undergoing tests proved to be inefficient and a second filter is now being tested.

An improved starting circuit has been designed for battery-operated seadrome lights. The new circuit utilizes rectifiers to channel the starting and extinguishing signals to the correct relays which take the place of the switches in the present circuit. The necessary holding time required for starting and extinguishing has been provided by the use of capacitors. The circuit has been tested with the lamp at 0°F in a cold chamber and gave about the same proportion of starts as the present circuit. The effect of wave action on the relays should be tested and, if possible, the size of the components of the circuit should be reduced so that it will not be necessary to increase the size of the circuit box in order to use the new circuit in the buoys now in service. With the use of this circuit, a virtually instantaneous contact from a very light rod can be utilized in place of the present cumbersome and somewhat prolonged boathook manipulation. It should, therefore, decrease considerably the time required for starting, or extinguishing, a line of lights since it may make it unnecessary to stop the boat at each buoy.

d. Carrier Lighting.

Two sets of controls for wave-off lights for the mirror landing aids system have been assembled and shipped to the U.S.S. Bennington. When the wave-off switch is closed, these controls turn off the source lights and as many of the inboard datum lights as desired and flash the wave-off lights 90 times a minute. Adams and Westlake mercury relays are used as the primary controls.

Intensity distribution measurements were made on a breadboard night field carrier landing practice light unit constructed by the Falge Engineering Corporation. The results, which were reported directly to the manufacturer, indicated that the plastic spread-lenses which were installed could not be made to produce the specified intensity distribution. Use of a glass spread-lens designed for this light was recommended.

e. Lighted Suit for Landing Signal Officer.

An experimental specification has been prepared for use in procurement of lighted suit equipments, and has been issued by BuAer under the title, "Lighted Suit Equipment, Landing Signal Officer," XAE-127, 4 November 1955. Negotiations are under way for procurement.

At the suggestion of an LSO in the fleet, the use of a reel-fed wire to connect the LSO to the control box is being investigated.

f. General Laboratory and Consultive Services.

Specific Intensity Measurements of Retroreflectors. NBS Report 4343, Photometric Tests of 21 Colored Retroreflective Samples, has been completed and released. This completes the present program of study of the characteristics of retroreflectors.

Color Specifications. A report comparing the requirements of the United States and International Specifications and Standards for Signal-Light Colors has been drafted in accordance with a request of the Airport Lighting and Marking Panel. This report contains two tables and four diagrams and is now in process of being reproduced.

Kinorama. There has been no activity in connection with the kinorama during the past quarter because no funds have been available for this purpose, but the problem of utilizing this potentially very valuable equipment remains.

III. VISIBILITY AND BRIGHTNESS TESTS, SURVEYS, EVALUATION AND ANALYSIS OF VISUAL LANDING AIDS, BASIC TESTS AND EQUIPMENT AS A FIELD SERVICE AT ARCATA, CALIFORNIA (TED NBS-AE-10011).

a. Airport Lighting and Marking.

Approach Beacons. An approach beacon was installed at the end of runway 13 and with the assistance of CAA maintenance and flight personnel the effects of this installation upon the ILS localizer pattern were checked. Because of the bluff at the north end of the field, it was necessary to install the approach beacon only 75 feet behind the localizer antenna shelter. Even at this distance from

from the antenna, a rather extensive structure was required to support the beacon since the antenna shelter is only 25 feet from the edge of the bluff. Although the supporting structure near and above the level of the top of the bluff was made of wood, excessive changes in the localizer pattern were produced. The magnitude of these changes varied with the moisture content of the soil and the wood in the supporting structure. The time available for adjusting the antenna lines and flight checking was limited by the weather. Satisfactory adjustment of the localizer beam pattern was not obtained so the beacon and its tower were temporarily removed. It is believed that satisfactory adjustment can be made if sufficient time is available. The installation and testing could not have been accomplished without the excellent cooperation of the Humboldt County Department of Aviation who provided and installed the tower and of CAA personnel, especially Mr. Cimmery, the Maintenance-Technician in Charge, who put in many extra hours adjusting the localizer pattern.

Airfield Lighting Maintenance Manual. The draft of the General Trouble-Shooting Section of the Airfield Lighting Maintenance Manual has been completed. The Trouble-Shooting Chart has been revised and a tentative final diagram is nearly complete. The Step-by-Step Procedure is nearly complete, but some revisions required because of the revisions in the Trouble-Shooting Chart are being made.

Regulators. Three type NC-3 regulators were received and have been installed on the runway circuits, replacing 5-kilowatt regulators. The additional capacity of these regulators makes possible tests of threshold lighting systems, runway turnoff markers, etc., which require more power than had been available previously. Also, it is now possible to operate the high-intensity runway lights at the designed brightness settings so that measurements of runway brightness and optimum intensity settings will be more meaningful.

Two of the regulators were found to have broken connections within the lower tank. The units were removed from the tanks and the breaks repaired. During the time the units were removed from the tanks, a check of the general workmanship showed that at one place the spacing between the high-voltage wiring and the control wiring was too small. These deficincies have been reported in a memorandum report.

Over-current Protection. The controls for a safety control unit for constant-current regulators have been received and assembled. This unit is designed to put constant-current regulators automatically on brightness step 4 instead of step 5 whenever the current on step 5 would exceed 6.8 amperes. The control unit has been installed in the control circuit of one of the new NC-3 regulators. Functional operation of the unit has not been determined yet.

b. Electrical Engineering.

Cable-Fault Finding. Some tests of the TSM-11 Cable Test-Detecting Set have been made under conditions very unfavorable for its good performance in order to determine its limitations. These tests have included tracing ungrounded shielded cable, checking for grounds in shielded telephone cable, checking parkway-type cable in conduit and in close proximity to power lines. The pick-up from the power lines was greater than expected, indicating that the amplifier-indicator may have become detuned. The unit will be returned to Washington for checking.

c. Research on Visibility Measurements and Visibility.

Sky Brightness. Equipment for measuring horizon sky brightness illumination on the horizontal surface, and illumination on a vertical surface, has been installed in the approach zone, using an old AGA tripod tower installed for this purpose about 1500 feet from the runway threshold. The instrument for determining the ratio of indirect to total horizontal illumination has also been installed. The signals from these instruments have been brought into the Laboratory where they will be recorded. Only part of the measurements can now be recorded as two of the self-balancing potentiometers intended for this use were damaged in shipment from Washington and are now being repaired. The scan drive for the horizon sky brightness meter has caused some difficulty. The original gear reducer has been replaced with a more rugged gear box. The causes of spurious reversing and starting in the wrong direction of the type SMY motor driving the scan are being investigated.

Slant Visibility Meter. This unit has operated satisfactorily during most of the period. Considerable data have been obtained in periods of fog, low ceilings and low visibilities. Late in the quarter the slip-ring carrying the current to the projector lamp

arced over and burned out. It is being repaired. Lamp life has been very short. Checks are being made to determine if the fault is in the projector or in the lamps.

Transmissometry. The linearity of the 100%-setting calibrator has been checked and found satisfactory. The calibrator has been checked against the transmissometers on the field with very satisfactory results. These results indicate that by using the calibrator, a transmissometer can be adjusted so that the error in the 100% setting will be less than 1% without the necessity of waiting for a period of very clear weather.

Measurements of the errors introduced by scattered light have continued. The red-sensitive phototube in the receiver has been replaced by a blue-sensitive phototube to determine what effect spectral sensitivity has on the errors.

Equivalent Intensity of Flashing Lights and of Composite Units. Replacement parts for the Westinghouse Krypton light have been ordered.

Facilities. During this quarter control and power cables abandoned by LAES were further salvaged and utilized by the installation of test equipment.

During late December the Humboldt County area experienced the worst floods in its history. Neither the floods nor the heavy rainfall which preceded them caused any damage to the facilities or installation of the Field Laboratory. However, the homes of many of the residents of this area were washed away or inundated. Extensive air rescue operations were conducted from the Arcata and Rohnerville Airports by helicopters and fixed wing aircraft to pick up flood victims from the floating houses and other locations accessible only by air, and to drop medical supplies and food. During the period December 23 to 27 a "Rescue Center" from which the air rescue operations were coordinated was set up in our Laboratory office. NBS radio equipment provided the only communication link between this Rescue Center, the Coast Guard cutter "Balsam" and the Rohnerville Airport. Throughout this period NBS personnel operated and maintained the radios at Rohnerville and Arcata Airports, established temporary interphone circuits at Arcata Airport between the Rescue Center, the CAA Insac Station, and the refueling area, and assisted the operation of the Rescue Center in every way possible, working virtually around the clock.