

NATIONAL BUREAU OF STANDARDS REPORT

6940

Development, Testing, and Evaluation of Visual Landing Aids
Consolidated Progress Report for the Period January 1 to March 31, 1960

By
Photometry and Colorimetry Section
Metrology Division



U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards (\$1.25) and its Supplement (\$1.50), available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

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NBS REPORT

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Development, Testing, and Evaluation of Visual Landing Aids

Consolidated Progress Report
to
Ship Aeronautics Division
and
Meteorological Division
Bureau of Naval Weapons
Department of the Navy
and to
Federal Aviation Agency

For the Period
January 1 to March 31, 1960

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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Development, Testing, and Evaluation of
Visual Landing Aids
January 1 to March 31, 1960

I. REPORTS ISSUED

<u>Report No.</u>	<u>Title</u>
6337 Supplementary	Output Characteristics of Series-Series Transformers with Multiple Lamps as Loads. (1)
6669	Development, Testing, and Evaluation of Visual Landing Aids, Consolidated Progress Report for the Period October 1 to December 31, 1959. (1)
21P-18/59	Photometric Evaluation of a Night Vision Floodlight. (1)
21P-7/60	A Study to Determine the Effect of Slit Width and Position on the Intensity Distribution of an RAE-Type Angle-of-Approach Indicator. (2)
21P-10/60	Photometric and Life Tests of Seven Type 20A/PAR56 Approach Light Lamps. (2)
21P-11/60	Photometric and Life Tests of Four Type 20A/PAR56/2 Approach Light Lamps. (2)
21P-12/60	Physical Tests of Twelve Connection Pins. (1)
21P-13/60	Photometric Measurements of Four Experimental PAR-Type Lamps. (2)
	Draft, Military Specification, Airport Approach Beacon, General Requirements for (1)
Letter	Review of Three Papers Relating to Seeing Through Fog (2)

(1) For Bureau of Naval Weapons

(2) For Federal Aviation Agency

Note: In addition to the work done on projects sponsored by the Bureau of Naval Weapons, on occasion the Photometry and Colorimetry Section also makes studies and tests for various organizations of the Federal Aviation Agency and the Air Force. Since the results of these tasks are often of interest to the recipients of these Progress Reports, summaries of this work will be included in the Quarterly Progress Reports starting with this Report.

II. VISIBILITY METERS AND THEIR APPLICATION

Measurement of Sky Brightness and Runway Illumination from High Intensity Lights. Only a few tests of sky brightness and runway illumination were made using the centerrow approach lights during this period. This task should be completed and reported during the next quarter.

Slant Visibility Meter. Plans for further testing of the slant visibility meter during the coming fog season are being formulated. The slant visibility meter installation will be moved to the vicinity of one of the test sites for the Air Force Cambridge Research Center's Operation Pea Soup. Their towers will be used to aid in visually determining the slant visibility. Planning of the new installation will await the selection of sites by the Air Force.

In response to an inquiry from Headquarters, Air Weather Service, a brief description was prepared of the instrument and its principles of operation.

Transmissometers.

Instruction Book for Transmissometer Set AN/GMQ-10. A rerun of NBS Report 2588 has been completed. Three hundred copies of the report have been supplied to the Aerology Division, Bureau of Naval Weapons and one hundred copies have been supplied to the Weather Bureau.

A conference at Bedford, Massachusetts, attended by representatives of Cambridge Research Center, Fleet Weather Facility, Bureau of Naval Weapons, Kling Publications Inc., and the National Bureau of Standards, was held to review and edit an Air Force draft of the Operation and Service Manual of the Transmissometer, AN/GMQ-10, Model B and C. Later this draft was studied in detail. A set of maintenance cards for the transmissometer prepared by the Air Force was edited.

Expanded Scale Indicator. The resistance-voltage characteristics of ten "Glo-bar" varistors have been studied in detail. By properly adjusting the resistance of a compensating resistor connected in parallel with the varistors it is possible to obtain the desired resistance-voltage characteristic with each of the ten varistors. As a check on the reproducibility of the expanded scale transmission calibration curve, two five-milliampere and one one-milliampere indicator were converted to expanded scale indicators. The output currents of these indicators as a function of input pulse rate were then determined using a precision potentiometer to measure the output current.

The differences in output currents were well within operational limits, being less than the errors in the calibration of the meters and the recorders of the indicators.

Errors in Transmissometer Measurements Resulting from Scattered Light. The first draft of a report, and figures, giving the results of this study have been prepared.

Fog Simulator. Technical assistance has been given the Human Factors Branch of the Bureau of Research and Development, FAA, in their development of a fog simulator for use within the aircraft cockpit. In this connection a project report prepared by Link Aviation was reviewed and two trips were made to the National Aviation Facilities Experimental Center.

Papers on Visibility in Fog. Three papers by D. E. Spencer pertaining to vision through fog were reviewed and comments reported by letter.

Review of NBS Activities in Visual Range Determination. The work of the NBS Visual Landing Aids Field Laboratory at Arcata since its establishment was reviewed at the First Fog Research and Modification Planning Session held in Boston on January 25 and 26. Particular emphasis was placed on the work involved in visual range determination in natural fogs. Following the Planning Session, some of the present work being done on determination of visual range and equipment was discussed with personnel of the Cambridge Research Center, Federal Aviation Agency, and the Weather Bureau.

III. DEVELOPMENT OF AIRFIELD LIGHTING AND MARKING COMPONENTS

Investigation of the Use of 500-Watt Transformer in Marker-Light Base Assembly (TED NBS SI-5009). The light and base required for this task have been received.

Runway Distance Markers. The field tests of the Cecil Field runway distance markers have been completed. This report will be prepared during the next quarter.

Taxiway Lighting and Marking. The first draft of the proposed taxi guidance system for Miramar Naval Air Station was revised after discussions with personnel of Bureau of Naval Weapons, National Bureau of Standards at Washington, El Toro MCAS, Federal Aviation Agency, and Port of New York Authority and observation of the experimental lighting installations at Atlantic City, the runway and taxiway lighting and taxiway guidance signs at Idlewild Airport, and the taxiway lighting, guidance signs, and markings used at several civilian airports.

The revisions of the drawings and draft of the text have been completed. Most revisions have been concerned primarily with the details of the installation. One change is the use of taxiway guidance signs marked "HOLD" as holding post signs at intersections of taxiways and runways.

Characteristics of Series Transformers with Multiple Lamps as Loads. Tests were completed and the results reported.

The data obtained from these tests indicate that the 60- and 75- volt lamps of certain loads may be useful for some special visual lighting aids if the transformer can be selected by manufacturer. If lamps of these voltages are used, care will have to be exercised in the selection of the number of lamps used to prevent exceeding the rated voltage of the lamps. With certain loads a single lamp failure will cause rapid failure of the rest of the lamps on the particular transformer. The maximum light output which can be obtained without exceeding rated lamp voltage with a given transformer when 75-volt lamps are used is about 1.5 times the maximum light output that can be obtained when 120-volt lamps are used. The maximum output when 60-volt lamps are used is about twice the maximum output when 120-volt lamps are used. (NBS Report 6637)

Approach Beacons. The draft specification for the approach beacon was completed and released. The El Toro MCAS was visited to discuss the approach beacons. Their beacons were performing very satisfactorily with only routine maintenance required. Operations would like to make an installation on the approach to runway 7. Now that the high-intensity approach lights are installed on the approach to runway 34, runway 7 is the alternate instrument runway. They feel that a third beacon may be desirable on this approach if adequate distance is available on the station property. Also they stated a need for a third intensity step between the high and low intensity for use during part of the period between daylight and dark.

Maintenance Manual. Because of the urgent nature of the taxiway lighting and guidance task, no work was accomplished on this task during this period. Work will be resumed in the near future.

Airfield Beacon Lamps. El Toro MCAS was visited and Moffett Field NAS was contacted in regard to the cause of bulb bulging and failure of the 1200-watt lamps used in the beacons. These failures occurred in lamps procured from one manufacturer, excessive failures or bulb bulging were not noted for lamps by other manufacturers.

Over-current Protector for NC-3. The test data, a wiring diagram, and the protector unit were returned to Washington for preparation of a report describing the unit and giving the results of service tests.

Automatic Intensity Control (TED NBS SI-5004). The relays and related components required for the automatic intensity control which uses an expanded scale type transmissometer indicator have been received.

Visual Glide Path Indicators. An investigation has been made of the effects of several design parameters on the performance of RAE type, two color, visual glide path indicators. A study was made of the effects of slit width and slit position on the intensity distribution and on the width of the transition zone of the light. The results of this study are reported in NBS Test Report 21P-7/60. In addition measurements are being made of the intensity

distributions of three types of lamps designed for use in this light. The results of measurements of four lamps manufactured by the General Electric Company are reported in NBS Test Report 21P-13/60.

Louvers for Type CD-1 Lights. A preliminary photometric study was made of the effects of using horizontal louvers in front of part or all of the reflector of a condenser-discharge approach light to restrict the vertical beam spread of the light. The results were reported informally.

IV. DEVELOPMENT OF SEADROME LIGHTING COMPONENTS

Sealane (Runway) Identification Light. A preproduction sample of a sealane, or runway, identification light has been received from Mink-Dayton, Inc. for tests for conformance to the requirements of specification MIL-L-21703 (Aer). A number of discrepancies in the drive mechanism have been observed and referred to the manufacturer. Tests have been suspended pending correction of these difficulties.

Transistorized Inverter for Battery Operated Seadrome Lights. A service test quantity of inverters is being obtained by the Naval Air Material Center. Of this group several are to be sent to NBS for laboratory tests. These inverters have not been received.

Static Switch for Type FMF-6 Seadrome Lights. An analysis was made of a proposal to substitute a static switch for the relay in the photoelectric-controlled seadrome light. In view of the greater cost of the static switch and the losses from the voltage drop across this switch, the use of a static switch for this purpose was not recommended.

Photoelectric Switch for Seadrome Lights. The assembly of the switch using continuous strip photocells, described in the Progress Report for the previous quarter, has been completed.

V. DEVELOPMENT OF CARRIER LIGHTING AND MARKING COMPONENTS

Lights for Carrier Deck Personnel

Goggle Lights (TED NBS SI-5001). Lamps for these lights have been received and the lights have been completed. Eight sets of these lights have been delivered to the Visual Landing Aids Branch for testing aboard the USS Saratoga. Three manufacturers have been loaned sets of these lights as aids to preparation of a quotation for a service test quantity of sets.

LSE Suit (TED NBS SI-5008). Modification of the second LSO suit to a battery operated LSE suit was completed upon receipt of the material requisitioned through Navy supply channels.

Fouled Deck Warning Light. The flashing mechanism for operating fouled deck warning lights, described in the Progress Report for the previous quarter, has been shipped to NAS North Island.

Feasibility Tests of Proposed Carrier Lighting Systems. Technical assistance has been given the Visual Landing Aids Branch, Bu Weps, in the design of the experimental lighting systems which are to be installed on the USS Saratoga. Several planning conferences were attended. A Pyle-National "Cyra-Lite" has been shipped to New York Naval Shipyard for installation as a homing beacon. Eight sets of taxi guidance wands and eight sets of goggles equipped with "eye-ball" lights have been delivered to the Visual Landing Aids Branch for use aboard the Saratoga. Retro-reflective paint for use in the catapult area has been ordered. Intensity distribution measurements are being made of a General Electric floodlight.

VI. PHOTOMETRIC AND ELECTRICAL TESTS OF AIRFIELD AND SEADROME LIGHTING COMPONENTS

"Night-Vision Flood Lights". NBS Test Report 21P-18/59 giving the results of an evaluation of a "night-vision flood light" manufactured by the L. C. Doane Company has been prepared and issued. The results of this study emphasize the need for long hoods and increased mounting heights when wide areas are to be lighted.

Tests of Airfield Lighting Connectors

Field Tests. All buried cable connectors check satisfactorily. Several Joy vulcanized splices were buried in November 1959. Six AGA and three Scotchcast splices were buried a year ago. There has been no appreciable reduction in insulation resistance since they have been placed in the ground.

Connector Kits. Three kits of connectors made by Joy Manufacturing Company have been received for testing for use in airfield lighting. Tests will be made during the next quarter.

Connection Pins. Twelve preproduction connection pins submitted by the Molded Insulation Company were tested for conformance to Specification MIL-C-7192B. The pins were satisfactory (NBS Test 21P-12/60).

Qualification Tests. Twenty preproduction sample connectors, five of each of the types shown in figures 9A, 9B, 10A, and 10B of Specification MIL-C-7192B, have been submitted by the Woodside Screw Machine Company and tests have been started.

Approach Light Lamps. Photometric and life tests were made of seven type 20A/PAR56 and four type 20A/PAR56/2 approach light lamps to determine conformance to the requirements of CAA drawing C-5407. These lamps are 300-watt, 20-ampere PAR-56 lamps intended for use in elevated and semiflush approach lights respectively. The lamps met the requirements except for minor discrepancies which are not considered serious. (NBS Test Reports 21P-10/60 and 21P-11/60.)

Photometric and life tests of six type 20A/PAR56/3 approach light lamps have been started. These lamps are 499-watt PAR-56 lamps intended for use in semiflush approach and runway lights.

VII. MISCELLANEOUS TECHNICAL AND CONSULTIVE SERVICES

Review of Specifications and Drawings

General Requirements for Flush Approach, Runway, and Taxiway Lights. The proposed ASG draft of Specification MIL-L-26202B is being reviewed. Photometric measurements will be made of a number of the class BB lights covered in this specification to obtain data to check the intensity distribution requirements.

Portable Airfield Lights. A draft of the specification for portable, emergency, dry-battery powered, airfield lights was reviewed and numerous changes were suggested.

Yards and Docks Drawings. Current Y and D drawings 505165-178 and 529375-381 for airfield and taxiway lighting have been received and a preliminary review has been made.

Standard MS 24348. The proposed ASG Revision B of Drawing MS 24348, Lamp, Incandescent, PAR-56 Bulb, Airport Approach was reviewed. A change in the intensity maintenance requirement to 70% of the specified initial intensity was recommended.

VIII. MISCELLANEOUS

Fog Modification. Representatives of the Air Force, Aeronautical Icing Research Laboratories, and Armour Research Foundation consulted us regarding feasible sites both on the Arcata airport and at some distance from the airport for testing during the next fog season by Operation Pea Soup. Present plans are to make the Air Force site and facilities on the airport available for our slant visibility installation.

Foreign Visitors. At the request of the Office of International Cooperation, FAA, a day was spent in reviewing the work of NBS in aviation lighting and visibility with two representatives of the government of Thailand.

Personnel. Mr. R. T. Vaughan is on extended sick leave and is expected to be absent for several months.

July 1960

JS NBS COMM DC



THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its major laboratories in Washington, D.C., and Boulder, Colorado, is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section carries out specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant publications, appears on the inside of the front cover.

Washington, D.C.

Electricity. Resistance and Reactance. Electrochemistry. Electrical Instruments. Magnetic Measurements. Dielectrics.

Metrology. Photometry and Colorimetry. Refractometry. Photographic Research. Length. Engineering Metrology. Mass and Scale. Volumetry and Densimetry.

Heat. Temperature Physics. Heat Measurement. Cryogenic Physics. Rheology. Molecular Kinetics. Free Radicals Research. Equation of State. Statistical Physics. Molecular Spectroscopy.

Radiation Physics. X-ray. Radioactivity. High Energy Radiation. Radiological Equipment. Nucleonic Instrumentation. Neutron Physics. Radiation Theory.

Chemistry. Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Molecular Structure and Properties of Gases. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

Mechanics. Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Combustion Controls.

Organic and Fibrous Materials. Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Plastics. Dental Research.

Metallurgy. Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion. Metal Physics.

Mineral Products. Engineering Ceramics. Glass. Refractories. Enameled Metals. Constitution and Microstructure.

Building Technology. Structural Engineering. Fire Protection. Air Conditioning, Heating, and Refrigeration. Floor, Roof, and Wall Coverings. Codes and Safety Standards. Heat Transfer. Concreting Materials.

Applied Mathematics. Numerical Analysis Computation. Statistical Engineering. Mathematical Physics.

Data Processing Systems. SEAC Engineering Group. Components and Techniques. Digital Circuitry. Digital Systems. Analog Systems. Applications Engineering.

Atomic Physics. Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics.

Instrumentation. Engineering Electronics. Electron Devices. Electronic Instrumentation. Mechanical Instruments. Basic Instrumentation.

- Office of Weights and Measures.

Boulder, Colorado

Cryogenic Engineering. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Gas Liquefaction

Radio Propagation Physics. Upper Atmosphere Research. Ionosphere Research. Regular Prediction Services. Sun-Earth Relationships. VHF Research. Radio Warning Services. Airglow and Aurora. Radio Astronomy and Arctic Propagation.

Radio Propagation Engineering. Data Reduction Instrumentation. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Propagation-Terrain Effects. Radio-Meteorology. Lower Atmospheric Physics.

Radio Standards. High-Frequency Electrical Standards. Radio Broadcast Service. Radio and Microwave Materials. Electronic Calibration Center. Microwave Circuit Standards.

Radio Communication and Systems. Low Frequency and Very Low Frequency Research. High Frequency and Very High Frequency Research. Modulation Systems. Antenna Research. Navigation Systems. Systems Analysis. Field Operations.

