NATIONAL BUREAU OF STANDARDS REPORT

7519

Development, Testing, and Evaluation of Visual Landing Aids
Consolidated Progress Report for the Period October 1 to December 31, 1961

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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NBS REPORT

7519

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
Washington 25, D. C.

For the Period
October 1 to December 31, 1961

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U. S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

Development, Testing, and Evaluation of Visual Landing Aids
October 1, 1961 to December 31, 1961

I. REPORTS ISSUED

Report No.	Title
7182 Supplementary.	Temperature Measurements of a 500-watt Flush Runway Light Installation
7384	Development, Testing, and Evaluation of Visual Landing Aids, Consolidated Progress Report for the Period April 1 to September 30, 1961
21P-44/61	Intensity Distribution Measurements of a Sealed-Reflector Flashtube and Power Supply Unit

II. VISIBILITY METERS AND THEIR APPLICATION

Slant Visibility Meter. The slant visibility meter functioned very well during this period with one exception. This exception was an intermittent instability in the detector gain control. To fix definitely the location of the instability, considerable testing and investigation has been required. The instability may occur on any detector gain setting although it occurs more frequently on some steps than on others and more often on one set of contact fingers than on the other set. The instability may occur when the input signal is from the phototube or from the receiver calibrator signal.

The new lamps are operating satisfactorily. They have good intensity and the life of most of these lamps is well over 100 hours. The lamp in use at this time has lasted well over 1000 hours. Our air compressor has been repaired and the Weather Bureau compressor has been returned. The calibration of the receiver decreased only a small percentage after three months of operation.

Data were collected throughout most of this quarter. Many tests of visual observations of slant visibility for comparison with the recorded data were made during periods of dense fog. The recorded data have not yet been analyzed for relationship to the observed data. The observations indicate that usually the visibility is greatest near the ground and decreases with height up to 100 feet, but at times the visibility is nearly the same for all heights. Occasionally the targets at 100 feet above the ground will have the greatest visibility. The data will be analyzed and compared during the next quarter.

All of the records obtained since the units were put back into operation have been reviewed to obtain data for determining the effect of transmission on the slant visibility when the conditions are relatively stable. For each of these conditions, the transmission over the 500-foot baseline, the transmission over the 60-foot baseline, and the slant visibility meter reading with the light beam near horizontal are obtained. The slant visibility meter readings are adjusted for gain setting, light source intensity, and changes in calibration to determine the equivalent input voltages to the preamplifier. These data agree reasonably well with similar data obtained earlier.

The Effects of High-Intensity Airfield Lighting on Background Luminance and Horizontal Illumination. The revised draft for a paper on this topic for Illuminating Engineering magazine and for an official report has been prepared. This draft is now being reviewed editorially prior to publishing.

Transmissometer. A transmission-visual range converter scale is being designed for use with the expanded scale indicator.

Shipboard Visibility Meter. Construction of a breadboard model of the shipboard visibility meter has been completed and an operational test has been given. The performance was satisfactory at night but the signal-to-noise ratio was too low during daylight to permit satisfactory operation. The equipment is being rebuilt to provide a source of higher intensity continuous exposure of the phototube rather than gated exposure, and generally improved light shielding.

III. DEVELOPMENT OF AIRFIELD LIGHTING AND MARKING COMPONENTS

Taxiway Lighting and Marking (TED NBS SI-5007). As a part of a study of the effects of closer spacing of taxiway lights upon the guidance provided by the system, type M-1 taxiway light units were installed at one taxiway intersection of runway 13-31 at the Arcata, California, airport as shown on figure 1. This intersection was chosen because it is frequently used and is not at a right angle to the runway. No comments on these lights have yet been received from pilots using the field.

Sealed-Reflector Flash Tube and Power Supply Unit. NBS Test Report 21P-44/61 was issued giving the results of photometric tests of a sealed-reflector flashtube demonstration unit with a self-contained power supply and timing motor. The manufacturer was the General Electric Company, Lamp Division, Nela Park, Cleveland, Ohio. The 17,000-candle effective axial intensity was within the limits of experimental error of the maximum effective axial intensity of FAA specifications of 17,000 candles for a unit for a sequenced flashing light system. The unit was well above the minimum requirements of the specification for points 12.5° from the axis at the four points measured.

Experimental Taxiway Lighting Arrangement

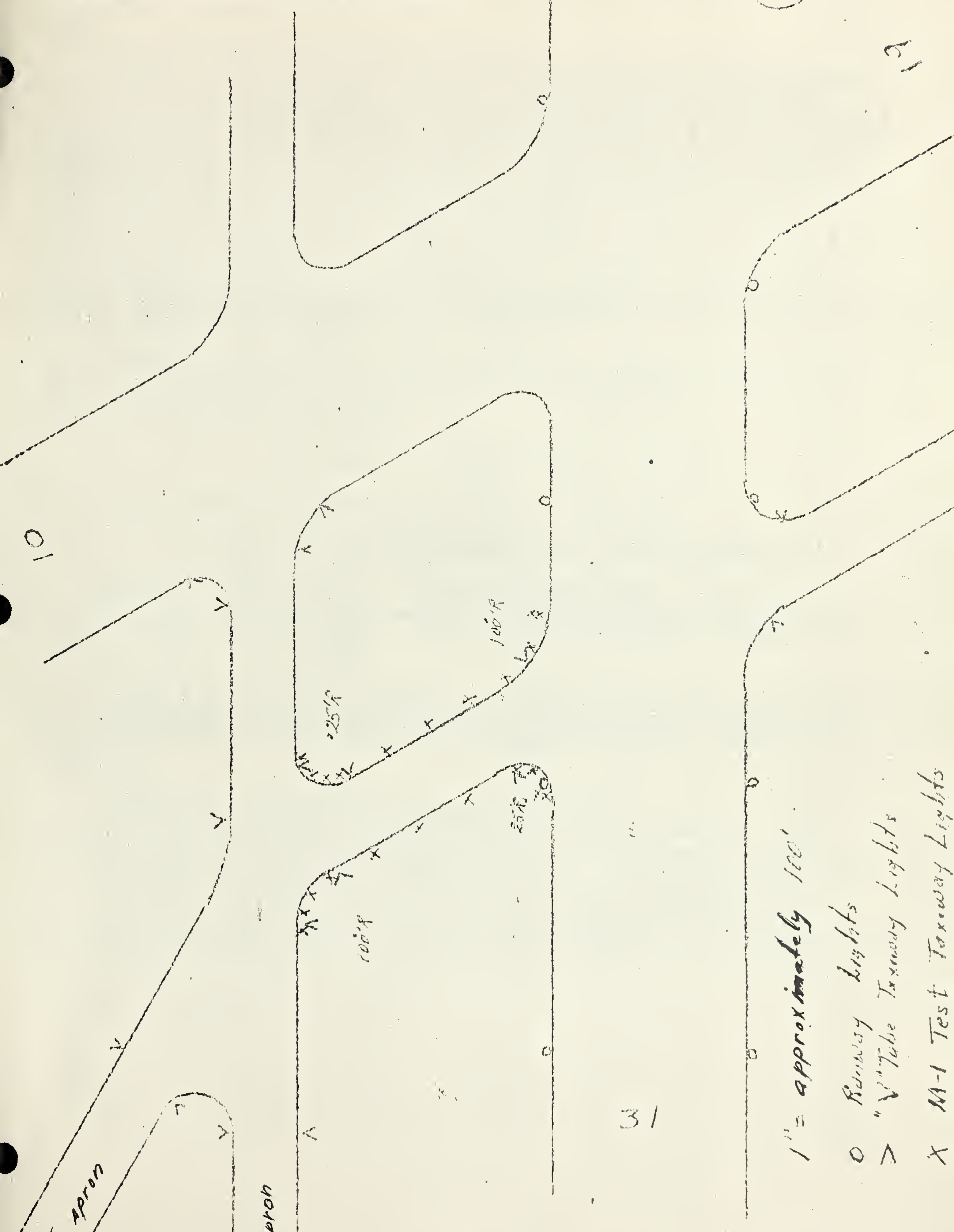

Figure 1

Intensity Control of Shore Based Optical Landing System (TED NBS SI-5005). A circuit modification has been designed to provide continuous independent "trimming" of the intensities of the datum and source lights of the shore based optical landing system. The design provides for the addition of bucking transformers into the circuits of these lights. The input voltages to the bucking transformers are controlled by continuously variable autotransformers which are in turn supplied from the output of the original intensity control system. This design provides sufficient trimming adjustment to reduce the intensity from the design intensity at any step to the design intensity of the next lower step. Furthermore, a given setting of the variable autotransformers will produce approximately the same percentage reduction in intensity at all steps. The transformers required for this modification have been ordered.

Suggested Improvements of Fittings. During the course of tests at the Arcata Field Laboratory, the need for improvements in runway distance markers and in the installation of type MC-2 lights (see Appendix A) was noted and forwarded to cognizant authorities.

IV. DEVELOPMENT OF SEADROME LIGHTING COMPONENTS

No work has been done on seadrome lighting this quarter.

V. DEVELOPMENT OF CARRIER LIGHTING AIDS (TED NBS RSSH-32001)

Intensity Distributions of a Flush Carrier-Deck Light. Intensity distribution measurements are being made of a flush carrier-deck light designed to be welded to the deck surface. The unit is manufactured by Sylvania Electric Products Incorporated.

Lights for Carrier Deck Personnel. A review has been made of the design of a goggle-mounted light assembly proposed by the contractor. Minor modifications to decrease the projection of the assembly above the goggles were suggested.

Stabilization of Shipboard Optical Landing Systems. A review has been made of the equations used by the contractor in developing the point stabilization of the shipboard optical landing system. It was found that although various editions of the Technical Order defined the variables used differently on different issues of the defining figure, the equations developed and the roll and pitch correction factors shown were not changed. The correction factors given were not consistent with the correct equation or with the principle that stabilization should be accurate at a point 2500 feet aft of the ship.

VI. PHOTOMETRIC AND ELECTRICAL TESTS OF AIRFIELD AND SEADROME LIGHTING COMPONENTS (TED NBS SI-5003)

Intensity Distributions of a Flush Carrier-Deck Guide Light. An analysis of the data taken on a flush carrier-deck light manufactured by the Oxford Corporation, Buffalo, New York, indicated a malfunction of the test equipment. The trouble was located and corrected but the resumption of the test was delayed to accommodate some more urgent tests.

Intensity Distributions of Several Semiflush-Mount Pancake Lights.

(1) NBS Test Report 21P-43/61 Supplementary was drafted giving the results of photometric tests made on an improved prototype of a semiflush-mount pancake light manufactured by Newport Electronics, Inc., Costa Mesa, California. The newer model showed an improvement in beam placement but was still deficient in intensity at the points named in the specification.

(2) NBS Test Report 21P-63/61 was drafted giving the results of photometric and electrical performance tests made on a semiflush-mount pancake light with a self-contained transformer manufactured by the Strong Electric Corporation, Toledo, Ohio. The tests showed that the transformer was operating at an apparent efficiency of 56% (84% required by the specifications) and provided only 34 watts of power to the lamp, which requires 45 watts for design operation. The unit did not meet the photometric requirements of the specifications.

(3) NBS Test Report 21P-74/61 was drafted giving the results of photometric tests of a semiflush-mount pancake light manufactured by Molco Drilling Machines,Inc., Portland, Oregon. The unit did not meet the requirements of the specifications.

(4) NBS Test Report 21P-64/61 was drafted giving the results of photometric tests of a semiflush-mount pancake light manufactured by Stillman Rubber Co., Englewood, N.J. with a retracting component containing the lamp. The unit did not conform to the specifications.

Lenses for Visual Glide-Slope Indicators. Measurements are being made of the transmittance, chromaticity, and spread of lenses being supplied with visual glide-slope indicators to determine conformance to FAA specification requirements.

Lamps for Two-Color Visual Glide-Slope Indicator. Life test data were accumulated on two groups of off-focus PAR-64 lamps for use in two-color VGSI. When the tests are completed the results will be issued as supplements to NBS Test Reports 21P-31/61 and -36/61.

Temperature Rise of Semiflush Lights (TED NBS SI-5009). The results of measurements of the temperature rise made at Willow Creek of a 500-watt semiflush light installation (see the previous progress report, NBS Report 7384) have been reported in NBS Report 7182, Supplementary. Although the soil surrounding the base was very dry and the soil temperature was in the range 60° - 70°F, the transformer was not damaged when it was protected by a sheet of aluminum foil placed between it and the 500-watt lamp.

Approach Beacons. The FAA at Arcata reports that they have received several requests, including some from the airline pilots, for use of the approach beacons. Apparently they were especially useful for circling approaches to runway 13 although the installation was made for approaches to runway 31. This installation was removed last spring after the new approach lights were installed.

Waveforms of 45- and 200- watts, 6.6-ampere Isolating Transformers. In order to obtain design data required in the development of low-voltage replacements for the present film cutouts, measurements are being made of the voltage and current waveforms of currently used 6.6-ampere isolating transformers for both full load and open circuit conditions.

VII. MISCELLANEOUS TECHNICAL AND CONSULTIVE SERVICES

Review of NAEF (SI) Standard Airfield Lighting Drawings and Information. An equipment list of visual landing aids components prepared by NAEF (SI) was reviewed. Comments and suggested additional items were forwarded for consideration.

Draft Specification of 6.6-ampere Series Lighting Relay Assembly. This draft was reviewed and the comments were forwarded.

Fluorescent Samples. Measurements have been made of the chromaticity and reflectance of three "blaze orange" and three "fire orange" panels supplied by Switzer Brothers Inc. Additional measurements will be made after the samples have been exposed in varied climatic conditions. The samples are being held pending shipping instructions.

Review of Literature. The draft of a supplementary report of operational tests and human factors research prepared under FAA contract by Human Sciences Research Inc. has been reviewed and discussed with representatives of the contractor.

Lighting and Marking of TV Towers. Technical advice and assistance has been given the project officer and the contractor in the planning of field tests of lighting and marking systems for tall towers. The analyses made several years ago for the Air Coordinating Committee were reviewed.

Fog Simulator. A visit was made to Link Aviation, Binghamton, N.Y. to assist in determining the fog densities and runway visual ranges to be simulated by the fog screen of an airborne fog simulator. Measurements are being made of the transmittance of sample fog screens to assist the contractor in developing the design parameters for graded density screens.

VIII. MISCELLANEOUS

Personnel. Mr. Gary P. Gillum entered on duty at Washington as a physicist on September 25, 1961.

Operation "Pea Soup". At present the Air Force is planning to transfer this operation to Vandenberg Air Force Base. This will require some changes in arrangements of our installations at Arcata but the effect will be minor.

Arcata Airport Installations. The visual glide slope installation is scheduled for completion early in January.

APPENDIX I

Suggested Improvements of Fittings

Improvements of Runway Distance Markers. The runway distance markers received from Cecil Field for tests had several of the sockets broken loose in shipment. Two factors contributed to this difficulty; (1) porcelain sockets were mounted on metal by means of machine screws without adequate locknuts and, (2) wiring to the sockets was supported only by the screw terminals of the socket. Prohibition of the use of porcelain sockets would eliminate this difficulty. The distance markers sent to us were drilled for mounting the sockets in different positions for testing, which probably was the reason the wiring was not secured between sockets. Specifications for runway distance markers should include requirements to cover these points.

Installation of Type MC-2 Lights. Installation of these lights leaves a space approximately one inch wide and three-quarters inch deep between the top assembly and the adjacent concrete. This space fills with water, snow, ice and/or dirt creating maintenance problems. In snow areas, when the snow melts and ice is formed in this groove, removal of the top assembly may be difficult. In areas where dirt and sand accumulates, removal of the dirt and sand can be time consuming after a rain. This groove accumulates small gravel, bolts, nuts, nails etc., which, if drawn into a jet engine could be deterimental to the engine's operation.

Use of a suitable substance to fill the void between the top assembly and concrete adjacent to the light appears desirable.

Addition of crevises in the concrete for water run-off is not a satisfactory solution to this problem in snow or dust areas, as neither of these "run-off."

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U. S. DEPARTMENT OF COMMERCE
Luther H. Hodges, *Secretary*

NATIONAL BUREAU OF STANDARDS
A. V. Astin, *Director*

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. High Voltage.

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

Heat. Temperature Physics. Heat Measurements. Cryogenic Physics. Equation of State. Statistical Physics.

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

Analytical and Inorganic Chemistry. Pure Substances. Spectrochemistry. Solution Chemistry. Standard Reference Materials. Applied Analytical Research. Crystal Chemistry.

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

Polymers. Macromolecules: Synthesis and Structure. Polymer Chemistry. Polymer Physics. Polymer Characterization. Polymer Evaluation and Testing. Applied Polymer Standards and Research. Dental Research.

Metallurgy. Engineering Metallurgy. Microscopy and Diffraction. Metal Reactions. Metal Physics. Electrolysis and Metal Deposition.

Inorganic Solids. Engineering Ceramics. Glass. Solid State Chemistry. Crystal Growth. Physical Properties. Crystallography.

Building Research. Structural Engineering. Fire Research. Mechanical Systems. Organic Building Materials. Codes and Safety Standards. Heat Transfer. Inorganic Building Materials. Metallic Building Materials.

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

Data Processing Systems. Components and Techniques. Computer Technology. Measurements Automation. Engineering Applications. Systems Analysis.

Atomic Physics. Spectroscopy. Infrared Spectroscopy. Solid State Physics. Electron Physics. Atomic Physics.

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

Physical Chemistry. Thermochemistry. Surface Chemistry. Organic Chemistry. Molecular Spectroscopy. Molecular Kinetics. Mass Spectrometry.

Office of Weights and Measures.

BOULDER, COLO.

Cryogenic Engineering Laboratory. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Cryogenic Technical Services.

CENTRAL RADIO PROPAGATION LABORATORY

Ionosphere Research and Propagation. Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services. Vertical Soundings Research.

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

Radio Systems. Applied Electromagnetic Theory. High Frequency and Very High Frequency Research. Modulation Research. Antenna Research. Navigation Systems.

Upper Atmosphere and Space Physics. Upper Atmosphere and Plasma Physics. Ionosphere and Exosphere Scatter. Airglow and Aurora. Ionospheric Radio Astronomy.

RADIO STANDARDS LABORATORY

Radio Physics. Radio Broadcast Service. Radio and Microwave Materials. Atomic Frequency and Time-Interval Standards. Millimeter-Wave Research.

Circuit Standards. High Frequency Electrical Standards. Microwave Circuit Standards. Electronic Calibration Center.


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