NATIONAL BUREAU OF STANDARDS REPORT

6501

Development, Testing, and Evaluation of Visual Landing Aids
Consolidated Progress Report for the Period April 1 to June 30, 1959

By
Photometry and Colorimetry Section
Optics and Metrology Division

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the back cover.

Reports and Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers and reports. Reports are issued to the sponsoring agency of a particular project or program. Published papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three monthly periodicals, available from the Government Printing Office: The Journal of Research, which presents complete papers reporting technical investigations; the Technical News Bulletin, which presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions, which provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: The Applied Mathematics Series, Circulars, Handbooks, Building Materials and Structures Reports, and Miscellaneous Publications.

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 ($0.75), available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Inquiries regarding the Bureau's reports should be addressed to the Office of Technical Information, National Bureau of Standards, Washington 25, D. C.

NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT
0201-20-2301
0201-20-2327

August 1959

NBS REPORT
6501

Development, Testing, and Evaluation of Visual Landing Aids

Consolidated Progress Report
to
Ship Installations Division
and
Aerology Division
Bureau of Aeronautics
Department of the Navy
Washington 25, D. C.

For the Period
April 1 to June 30, 1959

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Development, Testing, and Evaluation of Visual Landing Aids
April 1 to June 30, 1959

I. REPORTS ISSUED

Report No.	Title
6407	A Modification of the Metering-Bridge Circuits of Transmissometer Indicators
6410	Development, Testing, and Evaluation of Visual Landing Aids, Consolidated Progress Report for the Period January 1 to March 31, 1959
6413	Background and Objectives of the U. S. Standard for the Colors of Signal Lights
6419	A Modification of the Type MB-1 Light for Sealane Marker Service
21P-8/59	Photometric Tests of Three Types of Flush-Mounted Runway Lights
	Tentative U.S. Standard for the Colors of Signal Lights

II. VISIBILITY METERS AND THEIR APPLICATION

Visibility Meter for Shipboard Use. In preparation for the construction of a feasibility model of a back-scatter type visibility meter of the type described in the Progress Report for the previous quarter, a study has been made of the design details of the various sections of the proposed instrument. Further consideration has been given to the design of the output section of the instrument in an effort to find a simpler method of obtaining an output proportional to the logarithm of the back-scattered light.

Measurement of Illumination and Sky Brightness. Tests were made on 10 occasions of the effect of high-intensity runway and approach lights on horizon sky brightness and horizontal illumination. These tests provided much information for ranges of transmission which had not been obtained previously. The newer data confirmed the results reported last quarter. Some additional work was done on the report of this work but the report is being delayed because of other higher priority tasks. With the early completion of the centerrow approach-light installation, the effects of this system on the brightness and illumination will be included in the report.

Slant Visibility Meter. The projector compressor has continued to give trouble. During his recent visit to Arcata, Mr. Halversen of the Weather Bureau recommended the use of smaller orifices of the jets, running the compressor at a slower speed, and relieving pressure in the upper and lower chambers of the crankcase by venting. These changes are now being accomplished.

Transmissometers.

Modification of Indicator Metering Circuit. NBS Report 6407 describing modification of the metering (bridge) circuit of the transmissometer indicator was completed and released. It was found that the replacement of the voltage-regulating tube in the bridge with a triode-amplifier tube reduced the number of shifts in the zero of the bridge, decreased the time required for the indicator to stabilize, and increased the useful life of the critical tubes. An evaluation of service experience of present equipment is required to determine if the modification of existing units or a change in the design of future units is needed.

Non-linear Indicator. The response of the present transmissometer indicators is directly proportional to the pulse rate of the input signal and hence to the transmission. Consequently, when the transmittance falls below 0.05 (1/8-mile daylight visibility), it is necessary to increase the sensitivity of the indicator by a factor of 5 in order to obtain transmission measurements with an accuracy sufficient for the satisfactory determination of the visibility. The installation of remote meters which indicate visibility directly in the control tower makes the use of two sensitivity ranges undesirable, while the use of reduced minimums makes the measurement of lower transmissions necessary. One solution of this problem is the use of a non-linear indicator. The use of a logarithmic amplifier is attractive from the design viewpoint since the principles of design of circuits of this type are well developed. However, a logarithmic output would expand the low end of the scale too much and would crowd the upper end of the scale. In addition, the use of such a circuit would require considerable modification of the circuitry. Therefore, the possibility of substituting for the sensitivity resistors (R205, R205A and R206) a resistive element whose resistance decreases as the current through it is increased was investigated. Varistor discs made by the Globar Division of the Carborundum Company were found to give a satisfactory expansion of the low end of the scale. Moreover, present indicators could be modified easily. Examples of the present scales, scales for logarithmic outputs, and the new expanded scale are shown in figure 1. Additional varistors have been ordered for test to determine if the characteristics of these elements are sufficiently similar so they can be adjusted to the same scale.

Transmissometer Specification (MIL-T-4663A USAF). This specification has been reviewed. A number of desirable changes and corrections were noted. It is suggested that before this specification is coordinated it be reviewed by a conference of those concerned.

Errors in Transmissometer Measurements Resulting from Scattered Light from the Source. Measurements of the scattered-light error were made on three occasions using field stops of several sizes in the receiver. A few more measurements in fogs of low transmission are needed to complete this study. Data obtained previously have been reduced. A draft of a report of this work has been started.

III. DEVELOPMENT OF AIRFIELD LIGHTING AND MARKING COMPONENTS

Runway Distance Markers. One of the internally illuminated runway distance markers received from Cecil Field has been installed at the 2000-foot point on the west side of runway 31. Power for the marker is supplied from the runway lighting circuit through a 200-watt, 6.6/6.6-ampere transformer. A limited number of tests of this marker have been made in day and night fogs. During daylight the detection, recognition, and conspicuous ranges (see NBS Report #5466 for definitions of terms) were slightly less than the corresponding ranges of the markers previously tested. In one night fog, visibility 3/16 mile, the ranges of the new internally illuminated marker were about 80% greater than the ranges of the conventional externally floodlighted marker. Comments of the FAA communicators indicate that the intensity of the new, internally illuminated marker may be too low when the runway lights are operated on intensity steps 1 and 2.

Taxiway Lighting and Marking. (TED NBS SI-5007) A study is being made of the requirements of taxiway lighting and marking so that a draft of a standard for the installation of taxi lights and taxi guidance signs can be prepared. As a part of this study a plan for the installation of a taxi lighting system is being prepared for NAS Miramar, using the criteria developed in this study. Drawings of the installation at Miramar have been obtained. A carefully determined location and plot for all taxiway lights for this field has been completed. Except for a few minor changes in spacing of lights, the present criteria as given by the Navy air installation Planning Standards seem to be adequate and much better than standards that are now being used by other agencies. The more important suggested changes in these criteria are:

1. Place the entrance-exit lights or runway turnoff signs at the point of tangency to the runway. This change probably would not aid appreciably in the effectiveness of the system but would simplify design and installation.

2. The maximum spacing between lights for curves with the longer radii should be not greater than 50 feet when the length of the arc of the curve is less than 300 feet. Perhaps this spacing should be used for arcs longer than 300 feet if there is appreciable possibility of confusion in the area.

3. Use flush or semiflush lights in areas which now require long spaces without taxiway lights.

4. Modify taxiway markings to include wider centerline markings, use of edge markings, and extension of centerline markings onto the runway.

Data on proposed location and priority for installation of taxiway guidance signs has been prepared for NAS Miramar. A total of 116 signs would be of some use, but only about 75 are essential. About 50 of these signs are made necessary by present runway turnoff and refueling lane requirements. A taxiway guidance sign of the CAA type has been ordered for investigation of its effectiveness, especially in low visibility conditions.

Approach Beacons. A draft of a specification for approach beacons was reviewed. Since this specification is considered too restrictive, a revision is being drafted which will allow the manufacturer some freedom of design but which will insure obtaining approach beacons having the desired performance characteristics. The preliminary report of service tests at MCAS El Toro indicating the need for a third intensity step is very interesting. Original NBS plans called for three intensity steps, but the use of a third step could not be justified by the pilot comments obtained during the service tests at Arcata, possibly because the intensity could be changed immediately from high to low at the request of the pilot.

Flush-Type Lights. Intensity distribution measurements have been made of feasibility models of three flush-type lights manufactured by the Outlook Engineering Corporation. These lights are of three types projecting 0.0, 0.5, and 1.0 inch above the runway surface. The results of these measurements, reported in NBS Test Report 21P-8/59, indicated the need for improved design of the reflecting mirror and its mount.

Transformer Characteristics. Additional measurements are being made of the electrical characteristics of 200-watt, 6.6/6.6-ampere, series-series transformers with 30-, 60-, and 75-volt multiple lamps as loads. The results of these measurements will be reported as a supplement to NBS Report 6337 which gave the results of tests in which 120-volt lamps were used as loads.

Automatic Intensity Control. (TED NBS SI-5004) An analysis has been made to determine if an indicator with a non-linear output, similar to that described in Section I, would be useful in an automatic intensity control system. The analysis indicated that the expansion of the lower end of the scale shown in figure 1 would probably be sufficient. The expansion can easily be increased if the present degree of expansion is not sufficient.

IV. DEVELOPMENT OF SEADROME LIGHTING COMPONENTS

Transistorized Inverter for Battery-Operated Sealane Lights. The feasibility model inverter manufactured by Lincoln Electronics was returned to the manufacturer for modification last quarter. Delivery of the modified inverter is expected in August.

Battery-Operated Sealane Lights. A technical review has been made of drawings prepared by the Naval Air Engineering Facility of a revised design of a type FMF 6-watt, fluorescent, dry-battery-operated channel marker light designed to use the switching mechanism described in NBS Report 5781 and of a lead-acid battery-operated sealane marker light designed to use the photoelectric switching mechanism described in NBS Report 6225. It is suggested that a conference be called to discuss proposed revisions of these drawings.

Modification of Type MB-1 Light. (TED NBS SI-5005) NBS Report 6419 describing the modification of the type MB-1 light to adapt it for use on a self-orienting channel light support and to improve the efficiency of the light by reducing leakage currents which would occur if the light were wet by salt water has been completed and released. This task is now completed.

V. DEVELOPMENT OF CARRIER LIGHTING AND MARKING COMPONENTS

Lights for Carrier Deck Personnel. (TED NBS SI-5001) Reports from the fleet indicate that the taxi-guidance wand designed for use with a flashlight using two C-size dry cells is preferable to the present wand. However, because of the length of time required to equip the service with the new size taxi-guidance wands, as an interim measure a polyethylene wand has been designed as a direct replacement for the present wand. Sample wands and design drawings have been prepared for use in the next procurement.

Photometric Tests of Optical Landing Systems, and Consulting Services. (TED NBS SI-5005) The joint Navy-Contractor meetings held at Burroughs Research Center, Paoli, Pennsylvania, on April 14 and June 9 were attended.

Night-Vision Floodlights. A light from a production run was received for test. The peak intensity of the light as received was about 50% of the peak intensity of the light tested in NBS Test 21P-13/58. Therefore, an investigation was made to determine the causes of the low intensity. The primary causes were a change in the design of the filament of the PAR-46 lamp from a 6-coil to a 4-coil filament and the adjustment of the reflectors in the light. Secondary causes were the orientation of the specular reflector so the grain of the metal was horizontal instead of vertical, and the "haze" in this reflector. When these deficiencies were corrected, the peak intensity was comparable to that obtained in test 21P-13/58.

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

Connectors for Airfield Lighting Cable. No excessive leakage has occurred in any of the connectors and splices being service tested. It is doubtful that any leakage will be indicated during the summer months because of local soil conditions. The operation of the Joy vulcanizer and splicing compound was checked and found very satisfactory. Generally one splice can be prepared while another is being vulcanized. It is important to use sufficient compound on the splice so that voids are prevented.

Filters for PAR-56 Approach Light Lamps. Following reports of excessive breakage of the green roundels used on the datum lights of the mirror landing system, an investigation has been made of the resistance of the filters to thermal shock. It was found that the roundels met the specification but not the service requirements. Samples of tempered roundels are being obtained for test.

VII. MISCELLANEOUS TECHNICAL AND CONSULTIVE SERVICES

The work done to date in the specification of signal light colors has been summarized in NBS Report 6413, "Background and Objectives of the U. S. Standard for Signal Light Colors" by F. C. Breckenridge. A draft of Parts I, II, and III of the Proposed U. S. Standard for the Colors of Signal Lights has been distributed for information and comment.

NAEF(SI) Report "Standards for the Control and Distribution of Electrical Power used in connection with Visual Landing Aids at Naval Stations" has been reviewed by both Field Laboratory and Washington personnel. A number of modifications to the proposed standards have been noted for consideration.

Technical assistance has been given Technical Group No. 14, ACC/AGA National Standards Section, in the preparation of revisions of the National Standards of runway lighting and marking to cover cases of displaced thresholds.

VIII. MISCELLANEOUS

Personnel. Mrs. Evelyn Fritz has entered on duty as a part time clerk-typist. Mr. J. E. Freiheit is on full time for this summer. This has relieved our shortage of personnel for the present.

Weather. During this spring there has been very limited rainfall at Arcata and the fog has been limited to short periods.

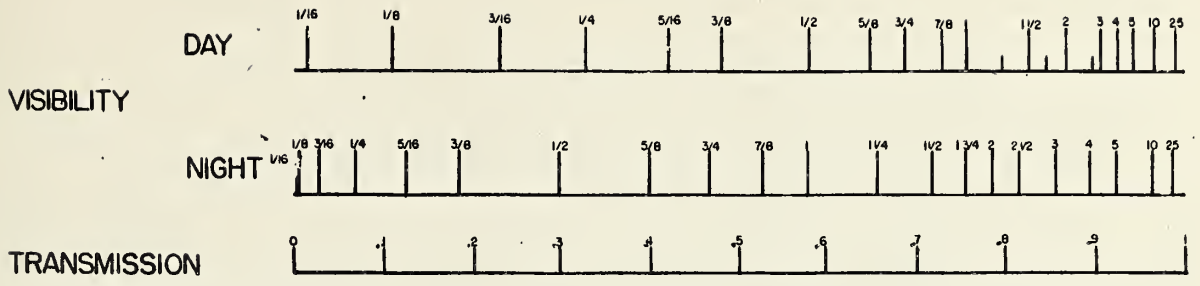
Fog Dispersal Testing. The Atmospheric Research Group has established a group at the Arcata Airport for fog dispersal testing for the Cambridge Research Center for this fog season. Testing is expected to start about July 15 or August 1.

Approach Lights. The FAA installation of the centerrow approach light system at Arcata is approximately 80 percent complete. This installation is in the area of several of our test installations. During the installation trenching and digging has been checked with the Field Inspector and our cable and equipment has not been damaged. Hand digging has been required in several instances. The Field Inspector has cooperated very well at all times.

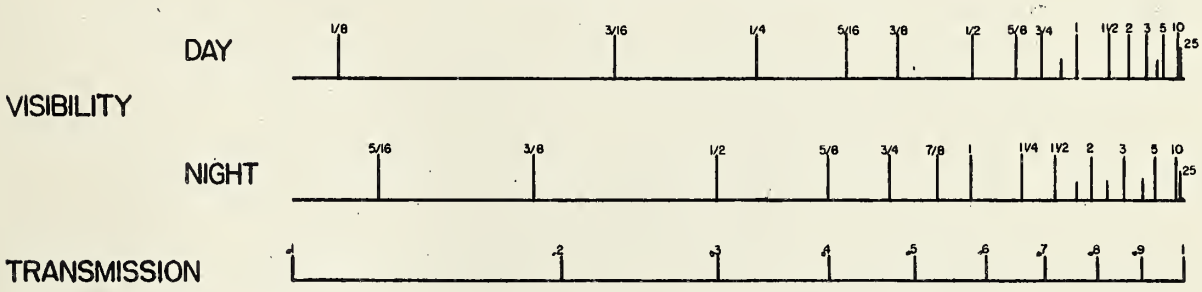
August 1959

US COMM NBS DC

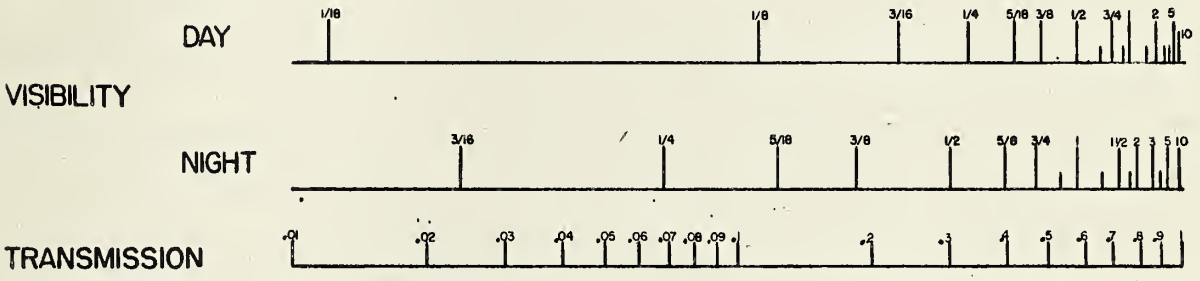
LINEAR SCALE



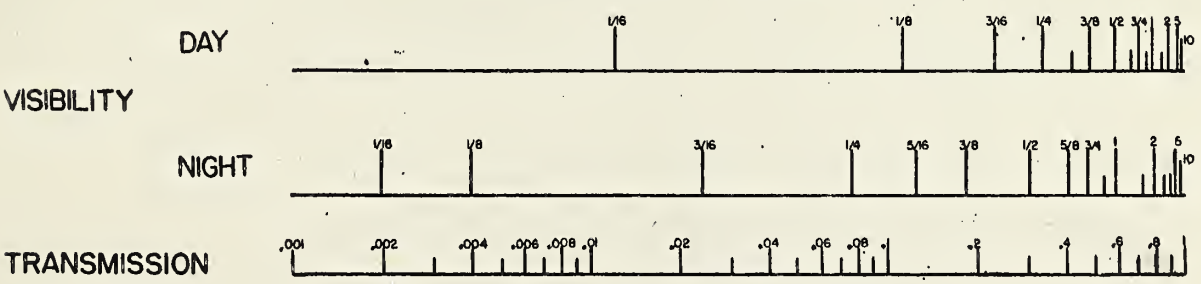
ONE CYCLE LOG SCALE



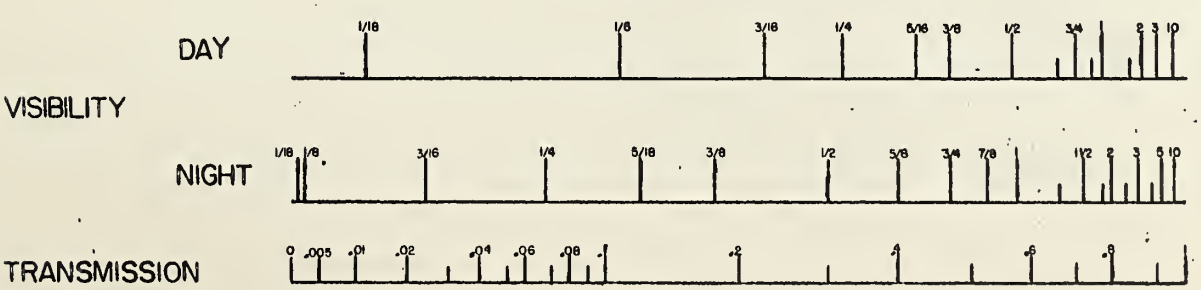
TWO CYCLE LOG SCALE



THREE CYCLE LOG SCALE



N.B.S. EXPANDED SCALE



U.S. DEPARTMENT OF COMMERCE
Frederick H. Mueller, 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 headquarters in Washington, D.C., and its major laboratories in 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 and Electronics. Resistance and Reactance. Electron Devices. Electrical Instruments. Magnetic Measurements. Dielectrics. Engineering Electronics. Electronic Instrumentation. Electrochemistry.

Optics and Metrology. Photometry and Colorimetry. Optical Instruments. Photographic Technology. Length. Engineering Metrology.

Heat. Temperature Physics. Thermodynamics. Cryogenic Physics. Rheology. Engine Fuels. Free Radicals Research.

Atomic and Radiation Physics. Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics. Neutron Physics. Radiation Theory. Radioactivity. X-rays. High Energy Radiation. Nucleonic Instrumentation. Radiological Equipment.

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

Mechanics. Sound., Mechanical Instruments. Fluid Mechanics. Engineering Mechanics. Mass and Scale. Capacity, Density, and Fluid Meters. 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. Concreting Materials. 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.

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

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

• Office of 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. Ionospheric Research. Regular Propagation Services. Sun-Earth Relationships. VHF Research. Radio Warning Services. Airglow and Aurora. Radio Astronomy and Arctic Propagation.

Radio Propagation Engineering. Data Reduction Instrumentation. Modulation Systems. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Radio Systems Application Engineering. Radio Meteorology. Lower Atmosphere Physics.

Radio Standards. High Frequency Electrical Standards. Radio Broadcast Service. High Frequency Impedance Standards. Electronic Calibration Center. Microwave Physics. Microwave Circuit Standards.

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


NBS