NATIONAL BUREAU OF STANDARDS REPORT

6979
Supplement-1

Recheck of Lamps Used for International Intercomparisons

Carried out at Bureau International Des Poids et Mesures

by

Ray P. Teele

Velma I. Burns

Marshall J. McDonald

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. Research projects are also performed for other government agencies when the work relates to and supplements the basic program of the Bureau or when the Bureau's unique competence is required. The scope of activities is suggested by the listing of divisions and sections on the inside of the back cover.

Publications

The results of the Bureau's research are published either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three periodicals available from the Government Printing Office: The Journal of Research, published in four separate sections, presents complete scientific and technical papers; the Technical News Bulletin presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: Monographs, Applied Mathematics Series, Handbooks, Miscellaneous Publications, and Technical Notes.

A complete listing of the Bureau's publications can be found in National Bureau of Standards Circular 460, Publications of the National Bureau of Standards, 1901 to June 1947 ($1.25), and the Supplement to National Bureau of Standards Circular 460, July 1947 to June 1957 ($1.50), and Miscellaneous Publication 240, July 1957 to June 1960 (Includes Titles of Papers Published in Outside Journals 1950 to 1959) ($2.25); available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT
0201-20-02113

January 1962

NBS REPORT
6979

Supplement-1

Recheck of Lamps Used for International Intercomparisons Carried out at Bureau International Des Poids et Mesures

by

Ray P. Teele
Velma I. Burns
Marshall J. McDonald

Photometry and Colorimetry Section

Metrology Division

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

RECHECK OF THE LUMINOUS INTENSITY OF 16 LAMPS AND THE LUMINOUS FLUX OF 8 LAMPS USED FOR INTERCOMPARISONS CARRIED OUT AT BUREAU INTERNATIONAL DES POIDS ET MESURES

1. PURPOSE

This report gives the results of measurements made on the lamps returned from the BIPM after intercomparisons there with photometric standards from other National Laboratories.

The values assigned prior to sending the lamps to BIPM were given in NBS Report 6979, dated October 1960.

2. STANDARDS AND METHODS

The various groups of lamps were measured in terms of the same groups of standards as outlined in NBS Report 6979. The same methods described in that report were used in rechecking the lamps.

3. RESULTS

The results of the recheck and the originally reported values are given in Tables A, B, C, D, and E.

Table A. Luminous Intensity at 2042°K (BIPM 1951 Scale)
(2039°K NBS Scale)

Lamp No.	Volts (set)	Amperes Before	Amperes After	Candelas Before	Candelas After	Average
NBS3757	97.200	0.5541	0.5541	11.85 ± .04	11.87 ± .04	11.86
NBS3759	97.900	.5595	.5591	11.90 ± .03	11.91 ± .09	11.90
NBS3761	98.200	.5380	.5379	11.64 ± .03	11.65 ± .06	11.65
NBS3762	98.200	.5586	.5585	12.08 ± .06	12.11 ± .02	12.09
TS1522	9.956	5.2814	5.2781	13.74 - .03	13.70 ± .03	13.73
				12.24 ± $.02_7$	12.25 ± $.02_9$	12.25

(Note: Lamps TS1525 and TS1539 listed in Report 6979 were broken in shipment)

Table B. Luminous Intensity at 2353°K (BIPM 1951 Scale)
(2352°K NBS Scale)

Lamp No.	Volts (set)	Amperes Before	Amperes After	Candelas Before	Candelas After	Average
NBS3764	92.300	0.3399	0.3399	22.68 ± .06	22.62 ± .02	22.66
NBS3767	90.900	.3434	.3436	21.95 ± .07	22.04 ± .09	21.98
NBS3769	91.800	.3403	.3402	22.34 ± .08	22.39 ± .00	22.36
NBS3771	90.900	.3463	.3466	22.22 ± .05	22.32 ± .08	22.26
TS3019	13.065	3.1552	3.1555	29.34 ± .09	29.36 ± .03	29.34
TS3020	12.800	3.2554	3.2550	29.63 ± .06	29.69 ± .08	29.65
TS3032	12.882	3.2652	3.2645	29.40 ± .12	29.46 ± .08	29.41
				$25.36_5 \pm .05_7$	$25.41 \pm .02_9$	25.38

Table C. Luminous Intensity at 2854°K (NBS Scale)

Lamp No.	Volts (set)	Amperes Before	Amperes After	Candelas Before	Candelas After	Average
NBS5612	107.700	3.822_7	3.824_6	643.6 ± 2.1	643.7 ± 1.9	643.6
NBS5613	107.400	3.807_1	3.806_6	638.7 ± 2.4	634.9 ± 4.6	636.8
NBS5617	107.600	3.799_6	3.802_8	633.2 ± 2.3	633.6 ± 2.5	633.4
NBS5619	106.800	3.818_6	3.816_3	629.4 ± 5.0	627.7 ± 4.1	628.6
				$636._2 \pm 2._0$	$635._0 \pm 2._0$	$635._6$

Table D. Luminous Flux at 2353°K (BIPM 1951 Scale)
(2356°K NBS Scale)

Lamp No.	Volts (set)	Amperes Before	Amperes After	Lumens Before	Lumens After	Average
NBS3780	99.000	0.3206	0.3206	232.2 ± 0.6	231.5 ± 1.7	231.8
NBS3782	98.500	.3206	.3208	231.2 ± 0.5	230.5 ± 1.4	230.8
NBS3783	98.200	.3195	.3200	226.1 ± 0.7	225.2 ± 1.2	225.6
NBS3784	99.100	.3218	.3219	233.5 ± 0.3	233.2 ± 2.6	233.4
				230.8 ± 0.4	230.1 ± 1.9	230.4

Table E. Luminous Flux at 2788°K (BIPM 1951 Scale)
(2811°K NBS Scale)

Lamp No.	Volts (set)	Amperes Before	Amperes After	Lumens Before	Lumens After	Average
NBS3772	108.90	1.7377	1.7382	2738 ± 14	2760 ± 18	2749
NBS3773	110.00	1.7582	1.7587	2795 ± 8	2814 ± 9	2804
NBS3775	109.00	1.7337	1.7336	2750 ± 18	2759 ± 10	2754
NBS3776	108.90	1.7427	1.7422	2745 ± 8	2759 ± 12	2752
				2757 ± 6.0	2773 ± 9.2	2765

4. DISCUSSION

A. Intensity at 2042°K, 2353°K, and 2854°K. Statistical analysis indicates no change in the intensity of these lamps and the averages of the "before" and "after" values given in the last column of Tables A, B, and C should be used to represent our assignments of luminous intensity to these lamps at the time they were at the BIPM.

B. Flux at 2353°K and 2788°K. Statistical analysis indicates that the luminous flux of the lamps at 2353°K have not certainly changed, while those at 2788°K may have increased slightly. The averages of the "before" and "after" values, given in the last column of Tables D and E, should be used to represent our assignments of luminous flux to these lamps at the time they were at the BIPM.

(Superseding page 3 as originally issued)

Table E. Luminous Flux at 2788°K (BIPM 1951 Scale)
(2811°K NBS Scale)

Lamp No.	Volts (set)	Amperes Before	Amperes After	Lumens Before	Lumens After	Average
NBS3772	108.90	1.7377	1.7382	2724±14	2746±18	2735
3773	110.00	1.7582	1.7587	2781± 8	2800± 9	2790
3775	109.00	1.7337	1.7336	2736±18	2745±10	2740
3776	108.90	1.7427	1.7422	2731± 8	2745±12	2738
				2743± 6.0	2759± 9.2	2751

4. DISCUSSION

A. Intensity at 2042°K, 2353°K, and 2854°K. Statistical analysis indicates no change in the intensity of these lamps, and the averages of the "before" and "after" values given in the last column of Tables A, B, and C should be used to represent our assignments of luminous intensity to these lamps at the time they were at the BIPM.

B. Flux at 2353°K. Statistical analysis indicates no change in the luminous flux of these lamps and the averages of the "before" and "after" values given in the last column of Table D should be used to represent our assignments of luminous flux to these lamps at the time they were at the BIPM.

C. Flux at 2788°K. Statistical analysis indicates that the luminous flux of the lamps at 2788°K may have increased slightly. However, in view of past experience of lack of reproducibility of results on lamps of this size and type, it is recognized that the difference of 0.6% between the "before" values based on measurements made about September 1960 and the "after" values based on measurements made in December 1961 may result more from measurement differences than from changes in the lamps. Accordingly, a series of experiments to extend over a period of time, and designed to locate the source of the difficulty, is being undertaken. Meanwhile, the assignment of the average values of luminous flux to these lamps in Table E, and to our standards of luminous flux at 2788°K, are made on the basis of having them embody a unit of luminous flux equal to the unified unit listed as the 1952-1957 (x) mean at the bottom of Table X, Procès-Verbaux CIPM, 26-B, 1958, Annex P8.

January 25, 1962

USCOMM-NBS-DC

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.

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.

Mechanics. Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Rheology. 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. Electrolysis and Metal Deposition.

Mineral Products. Engineering Ceramics. Glass. Refractories. Enameled Metals. Crystal Growth. Physical Properties. Constitution and Microstructure.

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

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

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

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

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

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

Radio Standards. High Frequency Electrical Standards. Radio Broadcast Service. Radio and Microwave Materials. Atomic Frequency and Time Interval Standards. Electronic Calibration Center. Millimeter-Wave Research. Microwave Circuit Standards.

Radio Systems. 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.


NBS