

February 5, 1944

TEMPERATURE MEASUREMENTS:

Publications by Members of the Staff of the
National Bureau of Standards

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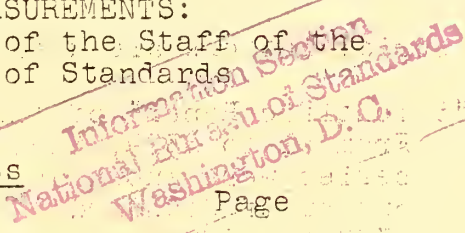
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GENERAL INFORMATION

This Letter Circular is a list of selected publications on temperature measurements by members of the staff of the National Bureau of Standards, and, in addition, contains a list of standard samples available and schedules of test fees. Some of the papers were printed in the regular series of publications of the Bureau and others in the various scientific and technical journals. Copies can usually be consulted at the leading libraries of the larger cities.

For ready reference and convenience in ordering the separate papers of the Bureau, these have been listed with the serial letter and number in one column, and the price in the second column. "OP" indicates that the paper is out of print, but may be consulted in libraries as stated in the first paragraph. See also paragraph on "Scientific Papers" below. A list of our publications (Circular No. C24 and Supplements) is also generally available at such libraries.

Where the price is stated, the publication can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. The prices quoted are for delivery to addresses in the United States and its territories and possessions and in certain foreign countries which extend the franking



privilege. In the case of all other countries, one-third the cost of the publication should be added to cover postage. Remittances should be made either by coupons (obtainable from the Superintendent of Documents in sets of 20 for \$1.00 and good until used), or by check or money order payable to the "Superintendent of Documents, Government Printing Office" and sent to him with order.

Serial letters are used to designate Bureau publications:

S = "Scientific Paper" of the National Bureau of Standards. From S1 to S329, inclusive, the separate papers of this series were known as reprints from the "Bulletin of the Bureau of Standards" (Bul. BS). Subsequently, from S330 to S572, the separates were known as reprints from the "Scientific Papers of the Bureau of Standards" (Sci. Pap. BS). This series was superseded by the "Bureau of Standards Journal of Research" in 1928. Each volume of the Bulletin was published in four parts called the Quarterly of the Bulletin of the Bureau of Standards. Most of the Scientific Papers, S1 to S329, which are no longer obtainable as separates, may still be secured by purchasing the Quarterly of the Bulletin which contains the paper or papers desired. The Quarterly of the Bulletin sells at 25 cents per number.

T = "Technologic Paper" of the National Bureau of Standards. T1 to T202 were issued each independent of the other with individual pagination. Later they were assembled to make the first 15 volumes of this series, and subsequent separates were given volume pagination (Tech. Pap. BS). This series was superseded by the "Bureau of Standards Journal of Research" in 1928.

RP = "Research Paper". These are reprints of articles appearing in the "Bureau of Standards Journal of Research" (BS J. Research) and the "Journal of Research of the National Bureau of Standards" (J. Research NBS), the latter being the title of this periodical since July 1934 (volume 13, number 1).

C = "Circular" of the National Bureau of Standards.

CS = "Commercial Standard" of the National Bureau of Standards.

For papers in other scientific or technical journals, the name of the journal or of the organization publishing the article is given in abbreviated form, with address in parentheses, together with the volume number (underscored), page, and year of publication, in the order named. The Bureau can not supply copies of these journals, or reprints from them, and it is unable to furnish information as to their availability or price.

THERMOMETRY AND PYROMETRY

Liquid-in-glass Thermometry

| <u>Series</u> | <u>Price</u> | <u>Title</u> |
|---------------|--------------|--|
| S13 | OP | The testing of clinical thermometers. C. W. Waidner and L. A. Fischer. Bul. BS <u>1</u> , 275 (1904-05). |
| S32 | OP | Heat treatment of high-temperature mercurial thermometers. Hobart C. Dickinson, Bul. BS <u>2</u> , 189 (1906). |
| S170 | OP | The correction for "emergent stem" of the mercurial thermometer. Edgar Buckingham. Bul. BS <u>8</u> , 239 (1912). |
| C8 | 10¢ | Testing of thermometers. (Contains general information of interest to those who desire to submit thermometers to the Bureau for test.) Cir. BS, C8 (4th ed.) (1926). |
| CS1 | 10¢ | Clinical thermometers. Com. Std. BS, CS1 (1932). |

Liquid-in-Glass Thermometers. Johanna Busse. "Temperature, Its Measurement and Control in Science and Industry". p. 228 (Reinhold Publishing Corp. New York, N. Y. 1941).

Resistance Thermometry

| | | |
|------|----|---|
| S124 | OP | Platinum resistance thermometry at high temperatures. C. W. Waidner and G. K. Burgess. Bul. BS <u>6</u> , 149 (1909-10). |
| S288 | OP | Wheatstone bridges and some accessory apparatus for resistance thermometry. E. F. Mueller. Bul. BS <u>13</u> , 547 (1916-17). |
| S407 | OP | Recent modifications in the construction of platinum resistance thermometers. T. S. Sligh, Jr., Sci. Pap. BS 17, 49 (1922). |

Note on platinum resistance thermometry at low temperatures. M. S. Van Dusen, J. Am. Chem. Soc. (Mills Bldg., Washington, D. C.), 47, 326 (1925).

| | | |
|-------|----|--|
| RP508 | 5¢ | Coiled-filament resistance thermometers. C. H. Meyers. BS J. Research 9, 807 (1932). |
|-------|----|--|

| <u>Series</u> | <u>Price</u> | <u>Title</u> |
|-----------------------------------|--------------|--|
| RP1188 | 10¢ | Establishment of a Temperature Scale for the Calibration of Thermometers between 14° and 83°K. Harold J. Hoge and Ferdinand G. Brickwedde. J. Research NBS <u>22</u> , 351 (1939). |
| | | Precision Resistance Thermometry. E. F. Mueller. "Temperature, Its Measurement and Control in Science and Industry" p. 162 (Reinhold Publishing Corp, New York, N. Y. 1941). |
| RP1454 | 10¢ | Intercomparison of platinum Resistance Thermometers between -190° and 445°C. Harold J. Hoge and Ferdinand G. Brickwedde. J. Research NBS <u>28</u> , 217 (1942). |
| <u>Thermoelectric Thermometry</u> | | |
| RP354 | OP | The passage of gas through the walls of pyrometer protection tubes at high temperatures. Wm. F. Roeser. BS J. Research <u>7</u> , 485 (1931). |
| RP530 | OP | Reference tables for platinum to platinum-rhodium thermocouples. Wm. F. Roeser and H. T. Wensel BS J. Research <u>10</u> , 275 (1933). |
| RP573 | OP | An international comparison of temperature scales between 660° and 1,063°C. Wm. F. Roeser, F. H. Schofield, and H. A. Noser. BS J. Research <u>11</u> , 1 (1933). |
| RP767 | 5¢ | Standard tables for chromel-alumel thermocouples. Wm. F. Roeser, A. I. Dahl, and G. J. Gowens. J. Research NBS <u>14</u> , 239 (1935). |
| RP768 | 10¢ | Methods of testing thermocouples and thermocouple materials. Wm. F. Roeser and H. T. Wensel. J. Research NBS <u>14</u> , 247 (1935). Also in "Temperature, Its Measurement and Control in Science and Industry" p. 284 (Reinhold Publishing Corp. New York, N. Y. 1941). |
| RP1080 | 5¢ | Reference Tables for Iron-Constantan and Copper-Constantan Thermocouples. Wm. F. Roeser and Andrew I. Dahl. J. Research NBS <u>20</u> , 337 (1938). |
| RP1278 | 10¢ | Stability of Base-Metal Thermocouples in Air from 800° to 2200°F. Andrew I. Dahl. J. Research NBS <u>24</u> , 205 (1940). Also in "Temperature, Its Measurement and Control in Science and Industry" p. 1238 (Reinhold Publishing Corp. New York, N. Y. 1941). |

Series Price Title

- RP1339 5¢ Calibration of Thermocouples at Low Temperatures. Russell B. Scott. J. Research 25, 459 (1940). Also in "Temperature, Its Measurement and Control in Science and Industry" p. 206. (Reinhold Publishing Corp. New York, N. Y. 1941)
- Thermoelectric Thermometry. Wm. F. Roeser. Jour. Applied Physics 11, 388 (1940). Also in "Temperature, Its Measurement and Control in Science and Industry" p. 180. (Reinhold Publishing Corp. New York, N. Y. 1941).

Optical and Radiation Pyrometry

- S224 OP The emissivity of metals and oxides. I. Nickel oxide (NiO) in the range 600° to 1,300°C. G. K. Burgess and P. D. Foote, Bul. BS 11, 41 (1915).
- S242 OP The emissivity of metals and oxides. II. Measurements with the micropyrometer. G. K. Burgess and R. G. Waltenberg. Bul. BS 11, 591 (1915).
- S243 OP The emissivity of metals and oxides. III. The total emissivity of platinum and the relation between total emissivity and resistivity. Paul D. Foote. Bul. BS 11, 607 (1915).
- S249 5¢ The emissivity of metals and oxides. IV. Iron oxide. George K. Burgess and Paul D. Foote. Bul. BS 12, 83 (1915-16).
- S250 OP Characteristics of radiation pyrometers. George K. Burgess and Paul D. Foote. Bul. BS 12, 91 (1915-16).
- S260 OP "Center of gravity" and "effective wave length" of transmission of pyrometer color screens, and the extrapolation of the high temperature scale. Paul D. Foote. Bul. BS 12, 483 (1915-16).

The proper type of an absorption glass for an optical pyrometer. Paul D. Foote, F. L. Mohler, and C. O. Fairchild. J. Wash. Acad. Sci. (450 Ahnaip St., Menasha, Wis.), 7, 545 (1917).

Disappearance of the filament and diffraction effects in improved forms of an optical pyrometer. C. O. Fairchild and W. H. Hoover, J. Opt. Soc. Am. & Rev. Sci. Insts. (Cornell Univ., Ithaca, N. Y.), 7, 543 (1923).

Temperature measurements of molten cast iron. H. T. Wensel and W. F. Roeser. Trans. Am. Foundrymen's Assn. (222 W. Adams St., Chicago, Ill.), 36, 191 (1928).

Series Price Title

Spectral Emissivity (at 0.65 μ) of Some Alloys for Electrical Heating Elements. Wm. F. Roeser. Proc. A.S.T.M. 39, 780 (1939) (260 S. Broad St. Phila. Pa.).

Miscellaneous

- S57 OP On the establishment of the thermodynamic scale of temperature by means of the constant-pressure gas thermometer. Edgar Buckingham. Bul. BS 3, 237 (1907).
- S185 OP Thermometric lag. D. R. Harper 3d. Bul. BS 8, 659 (1912).
- S520 10¢ Nonflammable liquids for cryostats. C. W. Kanolt. Sci. Pap. BS 20, 619 (1924-26).
- RP22 OP The international temperature scale. George K. Burgess. BS J. Research 1, 635 (1928).
- RP222 OP Thermometric lag of aircraft thermometers, thermographs, and barographs. H. B. Henrickson, BS J. Research 5, 695 (1930).
- RP284 5¢ A precision cryostat with automatic temperature regulation. R. B. Scott and F. G. Brickwedde. BS J. Research 6, 401 (1931).
- RP452 5¢ An optical method for measuring temperature distribution and convective heat transfer. R. B. Kennard. BS J. Research 8, 787 (1932).
- RP658 5¢ Reproducibility of the ice point. James L. Thomas BS J. Research 12, 323 (1934).
- Pyrometry of molten brass. W. F. Roeser and C. O. Fairchild. Trans. Am. Foundrymen's Assn. (222 W. Adams St., Chicago, Ill.), 34, 675 (1926).
- Characteristics of pyrometric cones. C. O. Fairchild and M. F. Peters. J. Am. Ceram. Soc. (2525 N. High St., Columbus, Ohio), 9, 701 (1926).
- A comparison of the softening points of some foreign and American pyrometric cones. R. F. Geller and E. E. Pressler, J. Am. Ceram. Soc. (2525 N. High St., Columbus, Ohio), 9, 744 (1926).

| <u>Series</u> | <u>Price</u> | <u>Title</u> |
|--|--------------|--|
| T170 | 60¢ | Pyrometric practice. Paul D. Foote, C. O. Fairchild, and T. R. Harrison. Tech. Pap. BS, T170 (1921). |
| RP231 | OP | Measurement of surface temperatures. Wm. F. Roeser and E. F. Mueller. BS J. Research <u>5</u> , 793 (1930). |
| RP327 | OP | Special refractories for use at high temperatures. Wm. H. Swanger and Frank R. Caldwell. BS J. Research <u>6</u> , 1131 (1931). |
| RP677 | OP | Establishment of a scale of color temperature. H. T. Wensel, D. B. Judd, and Wm. F. Roeser. BS J. Research <u>12</u> , 527 (1934). |
| M126 | 5¢ | Temperature Interconversion Tables ($^{\circ}\text{C} \leftrightarrow ^{\circ}\text{F}$) and Melting Points of the Chemical Elements. NBS Miscellaneous Pub. (1937). |
| N.A.C.A. Report No. 606 | 10¢ | Electrical Thermometers for Aircraft. John B. Peterson and S. H. J. Womack. N.A.C.A. Report No. 606. |
| Temperature. H. T. Wensel. Jour. Applied Physics <u>11</u> , 373 (1940). Also in "Temperature, Its Measurement and Control in Science and Industry", p. 3 (Reinhold Publishing Co., New York, N. Y. 1941). | | |
| Precise Measurement of the Freezing Range as a Means of Determining the Purity of a Substance. F. W. Schwab and Edward Wichers. "Temperature, Its Measurement and Control in Science and Industry", p. 256. (Reinhold Publishing Co., New York, N. Y. 1941). | | |
| Control and Measurement of Temperature under the Microscope. Charles Proffer Saylor. "Temperature, Its Measurement and Control in Science and Industry", p. 673. (Reinhold Publishing Co., New York, N. Y. 1941). | | |

THERMOMETRIC FIXED POINTS

| | | |
|------|----|---|
| S212 | OP | Melting points of some refractory oxides. C. W. Kanolt. Bul. BS <u>10</u> , 295 (1914). |
| S294 | OP | Freezing point of mercury. R. M. Wilhelm. Bul. BS <u>13</u> , 655 (1916-17). |

| <u>Series</u> | <u>Price</u> | <u>Title</u> |
|--|--------------|--|
| S339 | 5¢ | Standardization of the sulphur boiling point. E. F. Mueller and H. A. Burgess. Sci. Pap. BS <u>15</u> , 163 (1919-20). |
| S340 | OP | A standardized method for the determination of solidification points, especially of naphthalene and paraffin. R. M. Wilhelm and J. L. Finkelstein. Sci. Pap. BS <u>15</u> , 185 (1919-20). |
| RP65 | 10¢ | A new determination of the melting point of palladium. C. O. Fairchild, W. H. Hoover, and M. F. Peters. BS J. Research <u>2</u> , 931 (1929). |
| RP258 | 5¢ | The freezing point of nickel as a fixed point on the international temperature scale. H. T. Wensel and W. F. Roeser. BS J. Research <u>5</u> , 1309 (1930). |
| RP326 | 5¢ | The freezing point of platinum. Wm. F. Roeser, F. R. Caldwell, and H. T. Wensel. BS J. Research <u>6</u> , 1119 (1931). |
| RP557 | OP | Conditions affecting the freezing temperature of silver. Wm. F. Roeser and A. I. Dahl. BS J. Research <u>10</u> , 661 (1933). |
| RP568 | 5¢ | The freezing point of iridium. F. Henning and H. T. Wensel. BS J. Research <u>10</u> , 809 (1933). |
| RP676 | 5¢ | The freezing point of rhodium. Wm. F. Roeser and H. T. Wensel. BS J. Research <u>12</u> , 519 (1934). |
| A Practical Temperature Scale below the Oxygen Point and a Survey of Fixed Points in this Range. Harold J. Hoge. "Temperature, Its Measurement and Control in Science and Industry" p. 141 (Reinhold Publishing Corp. New York, N. Y. 1941). | | |
| RP1375 | 5¢ | Freezing Temperatures of High-Purity Iron and of some Steels. Wm. F. Roeser and H. T. Wensel. J. Research NBS <u>26</u> , 273 (1941). |

STANDARD SAMPLES AVAILABLE

The following standards are obtainable from the Bureau at the prices indicated. Remittance must accompany order. Money orders, etc. should be payable to the "National Bureau of Standards".

FREEZING POINT STANDARDS.

| Standard Sample Number | Material | Freezing Temperature | Approximate Weight | Price per Sample |
|------------------------|----------|----------------------|--------------------|------------------|
| | | °C | Grams | |
| 44c | Aluminum | 660.15 | 200 | \$2.00 |
| 45b | Copper | 1083.2 | 450 | 2.00 |
| 49b | Lead | 327.40 | 1650 | 2.00 |
| 42d | Tin | 231.90 | 350 | 2.00 |
| 43d | Zinc | 419.52 | 350 | 2.00 |

THERMOELECTRIC STANDARDS

- 118 Alumel wire No. 8 gage..... emf vs NBS Pt no. 27,
0 to 1,300°C.....3 ft.....\$2.00
- 119 Chromel wire No. 8 gage..... emf vs NBS Pt no. 27,
0 to 1,300°C.....3 ft.....\$2.00

A copy of Circular C398, which contains general information concerning the above and other standard samples, and a copy of the Supplement to C398, which is a list of the standard samples obtainable from the Bureau, may be had free on request to the Bureau. The temperatures given above apply only for the standard samples being issued on February 5, 1944.

TESTS FOR THE PUBLIC

Temperature measuring instruments or thermocouple materials submitted for calibration or test should be accompanied by an order or a letter requesting the test. The following schedules will serve as a means of indicating the kinds of tests which are regularly made at the Bureau. These schedules should be consulted before sending instruments to the Bureau for test. If these schedules do not cover the tests desired, inquiry should be made as to whether this Bureau is prepared to make the desired tests, before the material is shipped.

The tests for clinical thermometers are completely standardized so that no instructions concerning the kind of test are required. The number and choice of test points for liquid-in-glass laboratory thermometers are preferably decided upon by the testing laboratory, after examination of the instruments. The laboratory will require special instructions only in exceptional circumstances, for example, if only a partial rather than a complete test, is desired. Thermocouples and thermocouple materials and optical pyrometers may be used over such a wide range of temperatures, with various degrees of accuracy, that it is advantageous to include in the request for test, information concerning the number of test points, calibration range, the accuracy of certification desired. The schedules for platinum resistance thermometers cover instruments of the high precision, laboratory types. If other types are submitted, information concerning the accuracy expected will be useful to the testing laboratory.

If the instrument or material submitted is found on examination to be unsuitable for test, it will be returned untested. If during the course of a test, an instrument is found to be unsuitable, the test will be discontinued, and a fee covering the cost of the work performed, will be charged.

DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Test Fee Schedule 301 - Laboratory Thermometers

Effective April 11, 1942, superseding all previous schedules for the items covered.

| Item | Description | Fee |
|------|--|---------|
| 301a | Thermometers, testing at points from 0 to 100°C inclusive or from 32 to 212°F inclusive, for each point tested..... | \$.50* |
| 301b | Thermometers, testing at points from 101 to 300°C inclusive or from 213 to 600°F inclusive, for each point tested..... | \$.75* |
| 301c | Thermometers, testing at points above 300°C or 600°F, for each point tested..... | \$ 2.00 |
| 301d | Thermometers, testing at points from -1 to -40°C inclusive or from 31 to -40°F inclusive, for each point tested..... | \$ 2.50 |
| 301e | Thermometers, testing at points from -41 to -70°C, inclusive or from -41 to -94°F inclusive, for each point tested..... | \$ 4.00 |
| 301f | Thermometers, testing at points from -71 to -140°C inclusive or from -95 to -220°F inclusive, for each point tested..... | \$ 5.00 |
| 301g | Thermometers, testing in liquid air (-188 to -191°C)..... | \$ 5.00 |
| 301h | Calorimetric thermometers, testing at intervals of 2°C or 5°F..... | \$ 5.00 |
| 301i | Beckmann thermometers, with 5° or 6°C scale, testing at 1° intervals by comparison with precision standards..... | \$ 6.00 |
| 301j | Beckmann thermometers, calibration by means of mercury threads and comparison with precision standards, with the highest accuracy warranted by the construction and action of the thermometer..... | \$12.00 |

| Item | Description | Fee |
|-------|---|---------|
| | <p>Unless the request for test of a Beckmann thermometer specifies test under 30lj the instrument will be tested under item 30li. Thermometers so constructed that unusual difficulty is encountered in separating mercury threads for calibration will be eligible for test only under item 30li. There is somewhat greater danger of breakage in tests under 30lj than in tests under 30li. Beckmann thermometers with scales longer than 6° will be subject to special fees.</p> | |
| | <p>Items (h), (i), and (j) apply particularly to the types of thermometers listed in table 5 of Circular #8.</p> | |
| 30lm | <p>When instruments submitted are found by preliminary tests to be unsuitable for test, a charge will be made to cover the cost of the preliminary work. Minimum fee.....</p> | \$1.00 |
| 30lx | <p>Copies of certificates or reports previously issued or re-issue of certificates or reports returned - each.....</p> | \$0.25* |
| 30ly* | <p>Minimum fee on any test or transaction.....</p> | \$1.00 |
| 30lz | <p>If a test, not covered by any schedule item, is undertaken, it will be subject to a special fee depending upon the nature and cost of the test.</p> | |

U. S. DEPARTMENT OF COMMERCE
 NATIONAL BUREAU OF STANDARDS
 Washington, D.C.

Test Fee Schedule 302 - Thermocouples, Thermocouple materials, and Pyrometer Indicators.

Effective February 5, 1944, superseding all previous schedules for the items covered.

| Item | Description | Fee |
|------|--|---------|
| 302a | High Temperature Thermocouples and Thermocouple Materials. Certification of corresponding values of temperature and the Emf of a thermocouple or of temperature and the Emf of a thermocouple material against the platinum standard of the NBS at 5 to 15 points within the range 0° to 1450°C (32° to 2650°F)..... | \$10.00 |
| | Certified accuracy of platinum to platinum-rhodium thermocouples 0.5 degree C in the range 0° to 1100°C and from 0.5 degree C at 1100°C to 2 degrees C at 1450°C. Certified accuracy of base-metal thermocouples 0.5 degree C to 1 degree C depending upon the type of thermocouple and the highest temperature at which it is calibrated. | |
| 302b | High Temperature Thermocouples and Thermocouple Materials. Certification as per Item 302a at less than 5 points, per point..... | \$ 2.00 |
| 302c | Standard Platinum to Platinum-Rhodium Thermocouples. Minimum length 24 inches. Certification of the Emf of a thermocouple at any of the following thermometric fixed points, per point..... | \$10.00 |
| | Boiling Point of Water, freezing point of Tin, Lead, Zinc, Antimony, Aluminum, Silver, Gold or Copper. Accuracy of certification 2 Microvolts (about 0.2 degree C) | |
| 302d | Standard Platinum to Platinum-Rhodium Thermocouples. Minimum length 24 inches. Primary calibration at sufficient of the fixed points listed in Item 302c to permit certification of not more than 15 corresponding values of Emf and temperature to 0.3 degree C in the range 0° to 1100°C and from 0.3 degree C at 1100°C to 2 degrees C at 1450°C..... | \$40.00 |

| Item | Description | Fee |
|------|---|--------------------|
| | The particular points used in any test will be selected from those available within the range to be covered. | |
| 302e | High Temperature Thermocouples and Thermocouple materials. Certification of additional corresponding values of Emf and temperature as per Items 302a or 302d, per point..... | \$.50 |
| 302f | Thermocouples. Minimum length 36 inches. Certification of corresponding values of Emf and temperature to an accuracy of about 0.1 degree C in the range -35° to 500°C, per point..... Minimum charge per thermocouple..... | \$ 3.00 \$10.00 |
| 302g | Thermocouples. Minimum length 30 inches. Certification of corresponding values of Emf and temperature to an accuracy of about 0.1 degree C in the range -70° to -35°C, per point..... | \$ 4.00 |
| 302h | Thermocouples. Minimum length 30 inches. Certification of corresponding values of Emf and temperature to an accuracy of about 0.1 degree C in the range -140° to -70°C, or in liquid air (-191° to -188°C), per point..... | \$ 5.00 |
| 302i | Pyrometer Indicators. Calibration of single range.. | \$ 4.00 |
| 302j | Pyrometer Indicators. Calibration of each additional range..... | \$ 3.50 |
| 302k | Thermocouple and Pyrometer Indicator. Calibration as a unit, (including items 302a and 302i)..... | \$17.50 |
| 302x | Replacement of Bureau reports and certificates (with minimum charge of \$1.00)..... | \$.25 |
| 302z | If a test not covered by any schedule item is undertaken, it will be subject to a special fee depending upon the nature and cost of the test. | |

Thermocouples and thermocouple materials submitted for calibration and test should be accompanied by an order or a letter requesting the test and specifying the number of calibration points, temperature range, and accuracy of certification desired. It is preferable to send only the thermocouple wires in order to avoid the possible breakage of the insulating and protecting tubes. Tests will be carried out as requested provided the material submitted is sufficiently stable and homogeneous and provided the facilities available permit carrying out the calibration or test at a reasonable cost.

The calibration or test of a thermocouple or thermocouple material will not be undertaken if, in our opinion, the thermocouple or material will not yield the accuracy requested at the temperatures specified. If, in the course of a calibration or test, it is found that the thermocouple or thermocouple material is inferior to the general class of such material, a report will be issued giving the results obtained and the conditions under which they were obtained. In such cases, a fee covering the cost of the work performed, will be charged.

The calibrations and tests which have been found to meet most of the requests received, are given in Fee Schedule 302.

DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Test Fee Schedule 303 - Resistance Thermometers

Effective April 11, 1942, superseding all previous schedules for the items covered.

| Item | Description | Fee |
|------|--|---------|
| 303a | Platinum resistance thermometers - standardization at the ice, steam and sulphur-boiling points..... | \$30.00 |
| 303b | Platinum resistance thermometers - standardization under 303a and at the oxygen boiling point (-183°C)..... | \$40.00 |
| 303c | Calorimetric platinum resistance thermometers - standardization..... | \$25.00 |
| | Items (a) to (c) inclusive refer to tests described in Bureau of Standards Circular No. 8. | |
| 303m | When instruments submitted are found by preliminary tests to be unsuitable for test, a charge will be made to cover the cost of the preliminary work Minimum fee..... | \$ 1.00 |
| 303x | Replacement of Bureau reports and certificates (with minimum charge of \$1.00)..... | \$.25 |
| 303z | If a test, not covered by any schedule item, is undertaken, it will be subject to a special fee depending upon the nature and cost of the test. | |

DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Test Fee Schedule 312 - Clinical Thermometers

Effective August 1, 1932, superseding all previous schedules for the item covered.

| Item | Description | Fee |
|------|--|--------|
| 312a | For any number of thermometers tested, not exceeding ten, total fee..... | \$1.00 |
| 312b | For any number of thermometers greater than ten, for each thermometer tested..... | \$.10 |
| 312z | If thermometers submitted are of a form such that they cannot be tested in the usual manner, a fee will be charged depending upon the cost of making the test. | |

Note - Clinical thermometers marked "Government Tested" or its equivalent will not be accepted for test.

DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Test Fee Schedule 313 - Certain Types of Industrial

Thermometers - Effective August 1, 1932.

| Item | Description | Fee |
|------|--|--------|
| 313a | Industrial thermometers, testing at points in the interval 0° to 100°C (32° to 212°F), for each point tested, or minimum fee for each thermometer submitted..... | \$1.00 |
| 313b | Industrial thermometers, testing at points above 100°C and up to 300°C or above 212°F and up to 600°F, for each point tested..... | \$1.50 |
| | (Thermometers will not be tested at less than 2 points nor more than 5 points on the scale.) | |
| 313z | If a test, not covered by the above schedule items is undertaken, it will be subject to a special fee depending upon the nature and cost of the test. | |

Notes on the testing of industrial thermometers.

1. For the present, thermometers having a depth of immersion of not less than six inches above the top of the bulb and not more than twenty four inches immersion will be accepted for test. The test will be made in an oil bath of the type now in use in the laboratory. Tests are limited to the types of thermometers specified because it is considered reasonably certain, if the immersion is as much as 6 inches, that the indications will be sensibly the same under the conditions of test and of use. The limit of 24 inches is determined by the equipment now available.

U. S. DEPARTMENT OF COMMERCE
 NATIONAL BUREAU OF STANDARDS
 Washington, D. C.

Test Fee Schedule 322 - Optical Pyrometers

Effective February 5, 1944, superseding all previous schedules for the items covered.

| Item | Description | Fee |
|------|---|---------|
| 322a | Direct reading Optical Pyrometer. Calibration of low range to 1400°C, 25 or fewer certified values..... | \$17.50 |
| 322b | Direct reading Optical Pyrometer. Additional range - calibration to 2000°C..... | \$10.00 |
| 322c | Direct reading Optical Pyrometer. Additional range - calibration above 2000°C..... | \$15.00 |
| 322d | Optical pyrometer - Telescope and lamp only. Calibration of low range to 1400°C, 25 or fewer certified points Additional ranges as per 322b and 322c | \$15.00 |
| 322e | Optical pyrometer indicator..... | \$ 2.50 |
| 322f | Red glass filter - Determination of effective wave length..... | \$10.00 |
| 322g | Ribbon filament lamp - Certified values of current versus temperature at 25 or fewer points up to 2300°C..... | \$15.00 |
| 322h | Additional Interpolated Values - Interpolated values computed and certified, each 50 points or fraction thereof..... | \$ 5.00 |
| 322x | Copies of certificates or reports previously issued, or reissue of certificates or reports returned, each..... | \$ 1.00 |
| 322z | If a test not covered by any schedule item is undertaken, it will be subject to a special fee depending upon the nature and the cost of the test. | |