Testing by the National Bureau of Standards

Policy, General Information, Fee Schedule

National Bureau of Standards Circular 483

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NATIONAL BUREAU OF STANDARDS • E. U. Condon, *Director*

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POLICY AND GENERAL INFORMATION

Functions of the Bureau. The National Bureau of Standards is the principal agency of the Federal Government for fundamental research in physics, mathematics, chemistry, and engineering. The Bureau has custody of the national standards of physical measurement in terms of which working standards in research laboratories and industry are calibrated. The necessary research leading to improvements in such standards and measurement methods is one of the basic responsibilities of the Bureau. In addition, the Bureau undertakes for the Federal Government specific research and development programs, develops improved methods for testing materials and equipment, determines physical constants and properties of materials, tests and calibrates standard measuring apparatus, develops specifications for federal purchasing, and serves in an advisory capacity on matters relating to the physical sciences.

Testing Policy

Testing and Calibration. The testing and calibration activities of the National Bureau of Standards stem from its custody of the Nation's basic physical standards. Accuracy and uniformity in measurements throughout the Nation depend on these standards, and Congress has accordingly authorized the Bureau to engage in testing and calibrating services for the Nation in those cases where the devices or materials must be checked with the Bureau's standards or where sufficient accuracy cannot be obtained elsewhere than at the Bureau.

The types of test which the National Bureau of Standards undertakes are restricted, in general, to the following. 1. Tests involving comparison of laboratory standards or instruments with the national standards. 2. Tests of other devices and materials which are critical in laboratory or industrial operations and for which suitable testing and calibration facilities are not available elsewhere. The Bureau does not compete with qualified commercial testing laboratories, nor does it have the authorization, funds or facilities for general testing for the public. (A list of commercial laboratories engaged in this type of work is available: *Directory of Commercial and College Laboratories,* M187, Superintendent of Documents, Washington 25, D. C., 30 cents a copy). 3. Referee tests or investigations where private laboratories are unable to agree on the method of measurement, the results of tests, or the interpretation of these results, provided that the problem is of national interest, that there is prior agreement to accept and abide by the Bureau's findings, and that the cost is borne by the groups at issue.

The National Bureau of Standards does not undertake tests of the following types. 1. General tests, as discussed above, where commercial testing laboratories are available. 2. Trivial tests, where the test or calibration has only incidental value in terms of laboratory or industrial operations. 3. Duplications of previous work—for example, further tests of a given class already studied and where there is no clear indication that additional new information might be obtained. 4. Tests of inadequately described materials, devices, or processes. 5. Tests or investigations of secret processes or tests of materials or devices made by such processes. 6. Tests where the objective is one of public relations, advertising, or sales promotion.

The test results of the National Bureau of Standards are intended solely for the use of the organization requesting the test. The results of such tests are pertinent only to the particular device or specimen tested and cannot be applied to others of the same lot or type. The use of these results or of the name of the Bureau, either explicitly or implicitly, for advertising or sales promotion is expressly forbidden. The National Bureau of Standards does not "approve," recommend, or endorse any proprietary product or material.

The National Bureau of Standards reserves the right to decline any request for testing or calibration temporarily or permanently in accordance with its determination of the relative importance of such work and in view of the other functions of the Bureau.

General Information

Tests in accord with the policies of the National Bureau of Standards, outlined in the previous section, and of the types indicated in the fee schedules, presented in the following sections, will be undertaken. If need arises for a special test, not listed in the regular fee schedule but of similar nature, the Bureau should be consulted. If the required measurements appear feasible, and, in the opinion of the Bureau, sufficiently important to justify the work, such tests will be undertaken for a special fee determined by the nature of the work. In all requests, the following procedures and information are pertinent.

Initial Arrangements. A letter or purchase order, stating the tests desired and referring to the appropriate sections and subsections of the fee schedule, should be sent to the Bureau prior to any shipment. The purpose of this requirement is to determine whether or not the Bureau can undertake the test and to insure correct procedure in reporting, shipping and billing. In the case of routine or periodic tests, of a type made in the past for the requestor, this letter may be sent at the time shipment is made. In general, the purpose of the test and the manner in which the results are to be used should be stated. If the apparatus submitted has been previously calibrated by the Bureau, reference should be made to the former test number. A test number will be assigned by the Bureau to each project, and this test number must be referred to in all subsequent communications.

Shipping and Packing. Shipping charges, both to and from the Bureau, must be assumed by the applicant. Return shipments are made by the Bureau in accordance with its judgment of the best method of shipping

unless specific instructions are received. Such instructions should be supplied at the time that arrangements are being made for the test. If a test number has been assigned prior to the shipment, this number should appear on the shipping container. If a test number has not been assigned at this time, an invoice, purchase order or letter should be enclosed in the shipment for identification purposes.

All possible care will be taken in handling apparatus at the Bureau, but the risk of damage either in shipment or in testing must be assumed by the applicant. Proper packaging is a responsibility of the applicant. In some sections of the fee schedule, suggestions are made on packing and shipping. In any case, however, the applicant should consider the nature of the equipment he is shipping and pack it accordingly. Shipments containing fragile instruments or materials, glass, etc. should be clearly labeled. Attention is called to the availability of security express in shipping delicate instruments.

Condition of Apparatus. All apparatus submitted for test must be in good operating condition. Repairs and adjustments should be attended to by the applicant prior to shipment. Apparatus not in good condition cannot be tested, nor can the Bureau undertake the repair or adjustment of any equipment. If it is evident that equipment has been abused or has not received proper care, a test will not ordinarily be conducted. If defects are found at the Bureau after the test has begun, the test will be terminated, a report issued summarizing such information as has been found, and a fee charged in accordance with the amount of work done.

Identification. The data certified or reported in the Bureau's tests pertain only to the individual piece of apparatus tested. It is therefore essential that this piece be identified uniquely by an appropriate number or symbol. In most cases, the manufacturer's name and serial number are used. When such a number is lacking, the applicant should provide an alternative identifying mark. If none is found, the Bureau will apply an appropriate one, usually the Bureau's test number.

Precedence. In general, tests are undertaken in the order in which the requests are received, provided that the proper arrangements have been made and provided that the information necessary for the test performance has been received by the time the test is scheduled to start. Information as to the scheduling of the test should be secured in the initial correspondence with the Bureau in which arrangements for the test are made. When it is desired that apparatus be out of normal service for a minimum time, arrangements should be made in advance for the setting of a specific date for the test; shipment can then be made in accordance with this date.

Deviations from this procedure may be necessary at times, particularly if there is urgent need for particular tests by the Government itself. In those cases—for example, in the field of metrology (fee schedule 202), where a large number of tests are continually underway—certain priorities are necessary. The fee schedule provides this information.

Test Time. The time for the completion of tests depends on a number of factors. Some tests require considerable time in themselves, and this is indicated in the fee schedules. The condition of submitted equipment, the test load in the Bureau's laboratories, and emergency work for the Gov-

ernment are other factors which enter into consideration. Time estimates made by the Bureau are therefore tentative.

Witnessing of Tests. The Bureau permits scientists and engineers to visit its laboratories and discuss test methods. However, visitors will not ordinarily be permitted to witness the actual carrying out of highly precise measurements because their presence introduces distraction that may lead to errors or delays. This policy is waived in those cases where the visitor can be of service in setting up apparatus of a new or unusual nature, in the case of special referee tests, or in other cases in which the legal validity of the result may require the presence of duly authorized representative witnesses.

Reports of Tests. Results of tests and calibrations are issued in one of two forms: "certificates" and "reports." A certificate is usually issued if the test has the nature of a calibration, if the results have relatively permanent validity, and if the object tested meets certain standards of precision and tolerance. Reports are issued for all other types of tests and also in lieu of certificates where the requirements for a certificate are not met.

Miscellaneous. The minimum billing charge for any test request accepted by the Bureau is $3.00, unless otherwise indicated in a particular fee schedule. Fees for tests include the cost of preparation of an original certificate or report. Copies of certificates and reports are not ordinarily issued; if the applicant desires copies, he must show a technical need for them. The charge for carbon copies is $0.25 for each of the first three copies and $1.00 for each additional set of one to five carbon copies. Copies of certificates or reports requested subsequent to the date of the test will be supplied at a minimum cost of $1.00.

FEE SCHEDULE 201: ELECTRICITY

201.1 Resistance Measurements
- 201.101 Precision Standard Resistors
- 201.102 Precision Resistance Apparatus
- 201.103 Standards and Check Samples for Conductivity Bridges

201.2 Inductance and Capacitance
- 201.201 Inductors: Tests at Low Frequencies
- 201.202 Two-terminal Resistors: Determination of Effective Inductance or Time Constant
- 201.203 Capacitors: Tests with Direct Voltage
- 201.204 Capacitors: Tests with Low-frequency Alternating Current
- 201.205 Insulation Resistance
- 201.206 Dielectric Constant and Power Factor of Dielectric Materials
- 201.207 Resistors above 1 Megohm

201.3 Electrical Instruments
- 201.301 Standard Resistors for Current Measurements
- 201.302 Direct-current Ammeters
- 201.303 Direct-current Voltmeters and Millivoltmeters

Fee Schedule 201: Electricity

The tests covered by this section include the determination of the corrections for the standard resistors, inductors, capacitors and standard cells used in precise measurements; bridges, potentiometers and similar measuring apparatus; indicating instruments such as ammeters, voltmeters and wattmeters; integrating devices such as watthour meters; and specimens used as standards in magnetic testing. Of particular importance are the transfer tests of electrodynamic wattmeters by means of which measurements of power and energy in a-c circuits are correlated with the fundamental d-c standards. Also included are tests of the shunts, voltage dividers and instrument transformers by which the ranges of the other instruments are extended. These tests are made at power and audio frequencies.

The National Bureau of Standards does not test, except occasionally for other Government agencies, electrical devices not directly related to the field of measurement. Tests of power transformers, motors, generators, relays, insulators, etc., should not be requested.

The types of test listed in section 201 do not involve measurements at frequencies above 10 kilocycles per second (except in the case of measurements of dielectric constant and power factor of dielectric materials for which tests up to 100 kilocycles are included in 201.206 and tests of the direct capacitance of very small capacitors which may be tested at 465 kilocycles per second in 201.204.) Fees for such tests are listed in schedule 214.

201.1 Resistance Measurements

Precision Resistance Apparatus (201.101 and 201.102). The following features are considered essential in the best precision resistance apparatus:

The resistance material should have a low temperature coefficient, should not change its resistance with time, and for low-valued coils should have a small thermoelectric power against copper.

All wire standard resistors and the more important sections of resistance apparatus for use in d-c circuits should be wound on metal supports, preferably in a single layer. Electrical connections to the resistance material should be brazed in all cases in which the total resistance is less than 1,000 ohms. The resistance material should be protected against oxidation and other chemical action and should be annealed or aged by baking after winding.

Precision standard resistors and resistance apparatus should be so adjusted as to give an accuracy of at least 0.1 percent without corrections.

Because comparatively rapid changes in resistance take place in new apparatus, it is not advisable to test new or repaired apparatus until at least two months after the resistors have been annealed and adjusted. Precision apparatus, known to be new, will be held in the laboratory (in the absence of other instructions) for several months when the measurements will be repeated to determine the drift in value, if any. No extra charge is made for these later measurements.

Unless otherwise stated, the tests listed are generally made using a direct current of such magnitude as to cause only a negligible heating of the resistance material. Tests of standard resistors, bridges and rheostats consist in determinations of the resistance of the standards or of the resistance of the elements of the bridges or similar apparatus from which values corresponding to all possible readings can be computed. Tests of potentiometers consist in determinations from which the ratios of the resistances corresponding to all possible readings can be computed.

201.101 Precision standard resistors. Standards of precision type, closely adjusted to nominal values bearing simple ratios to the unit, with amalgamated terminals, and designed for oil immersion. Standards of 0.1 ohm and less must be of four-terminal type, that is, have both current and potential terminals.

Item	Description	Fee
201.101a	Determination of resistance in oil bath at 25.0° C. (Results certified to 0.001 percent when apparatus justifies this.) For standards of 0.1 ohm and below	$7.50
201.101b	Same, for standards of 1.0 ohm and above	6.00
201.101c	Same, for standards not a decimal multiple or submultiple of 1.0 ohm	10.00
201.101d	Determination of resistance at three temperatures: 20, 25, and 30° C. This test is made only when it is shown that the small changes in resistance resulting from necessary variations of the temperature from 25° are of importance	30.00

201.102 Precision resistance apparatus. For all the items in this schedule, if the apparatus is of suitable quality, corrections will ordinarily

be determined to such an accuracy that results obtained with it may be relied upon to 0.01 percent.

Item	Description	Fee
201.102a	Precision rheostats and variable low resistances—calibration and certification of corrections 3 decades or less	$50.00
	For each additional decade	10.00
201.102b	Megohm box, 10 sections each 100,000 ohms—calibration and certification of corrections	25.00
201.102c	Megohm box, unequal sections—calibration and certification of corrections	40.00
201.102d	Precision wheatstone and calorimetric bridges of all kinds—calibration and certification of corrections	80.00
201.102e	Potentiometers, minimum steps 10 microvolts or more—calibration and certification of corrections	60.00
201.102f	Potentiometers minimum steps less than 10 microvolts—calibration and certification of corrections	90.00
201.102g	Ratio arms for Thomson bridges and similar apparatus	35.00

201.103 Standards and check samples for conductivity bridges. Standards and wires submitted for test should be kept straight and be packed in substantial containers for shipment. When the properties covered by items 201.103b, 201.103c, or 201.103d are determined, the report will include a statement of the resistivity, and for copper, the percentage conductivity as compared with the standard value for annealed copper will also be stated.

In general the accuracy of the measurements is as high as can readily be obtained with the samples submitted, but in no case are the results given in the reports to be considered as having an accuracy higher than 0.05 percent.

Item	Description	Fee
201.103a	Determination of resistance per unit length, or between potential terminals, each sample	$25.00
201.103b	Determination of resistance per unit length, total length, and mass	27.50
201.103c	Determination of resistance per unit length, and cross section	30.00
201.103d	Determination of resistance per unit length, total length, mass and density	30.00

201.2 Inductance and Capacitance

201.201 Inductors: Tests at low frequencies. An inductor should be tested under conditions as nearly as possible the same as those under which it is to be used. Requests for test should give the frequency at which tests are desired. Inductors for use in a-c bridge work are ordinarily

tested at 60, 100, or 1,000 cycles per second (schedule 201.201). Inductors of 10 mh and smaller are usually measured only at 1,000 cycles per second because the inductance does not vary appreciably with frequency below 1,000 cycles per second. Mutual inductors used in magnetic testing for calibrating ballistic galvanometers should be tested by direct current under 201.403.

Inductors should, if possible, be sealed against the penetration of moisture because seasonal variations in inductance due to this cause have been found. Inductors can usually be shipped safely by express but should be carefully packed because the coil fastenings and terminals are sometimes broken in shipment.

Item	Description	Fee
201.201a	Determination of the inductance of a fixed self or mutual inductor or the first point on a variable inductor at either 60 of 1,000 cycles per second	$7.00
201.201b	Determination at additional points on the same inductor, per point	2.00

201.202 Two-terminal resistors: Determination of effective inductance or time constant. The effective inductance is defined as the quotient of the reactance of the coil at any frequency divided by 2π times the frequency. The reactance is due to the inductance of the coil which is in series with the resistance, and to the capacitance between its windings, which is in parallel with the resistance. The effective inductance may be either positive or negative, according as the effect of the inductance or of the capacitance predominates.

For a determination of the d-c resistance, see 201.101.

Item	Description	Fee
201.202a	Determination of effective inductance or time constant of the resistor of 1 ohm, 10 ohms, 100 ohms, 1,000 ohms or 10,000 ohms at frequencies up to 10,000 cycles per second	$10.00

201.203 Capacitors: Tests with direct voltage. Tests will ordinarily be made with the setting approached in the direction of increasing scale readings to avoid errors due to backlash. Since the measured value of capacitance depends on the position of the leads with respect to the terminals, the difference in capacitance between two scale settings taken with the terminals in a fixed position can be measured with greater accuracy than the capacitance at a given setting.

Variable air capacitors should be packed as carefully as instruments with delicate pivots. If the highest accuracy is desired, they should be sent by messenger. All instruments submitted for test should be examined for backlash or any looseness in bearings and adjusted to minimize these before being shipped.

Item	Description	Fee
201.203a	Determination of capacitance of a fixed air capacitor, or one point of a variable air capacitor, with 100 and with 1,000 charges and discharges per second	$6.00
201.203b	Determination of capacitance at additional points of the same variable air capacitor, as in 201.203a, each	1.50

201.204 Capacitors: Tests with low-frequency alternating current. A capacitor should be calibrated under conditions as nearly as possible like those under which it is to be used. Consequently the conditions of use should be stated in the request for test.

Mica Capacitors (201.204 a and b). Mica capacitors can ordinarily be shipped by mail or express without serious risk. The frequency at which measurements are desired should be stated. Tests are ordinarily made at 60,100, or 1,000 cycles per second at room temperature of 24°C. Tests at other frequencies or temperatures may be made subject to a special fee.

Standards of Direct Capacitance (201.204 c and d). These are usually of low value—i.e., less than 100 $\mu\mu$f. Standards submitted should have coaxial terminals of a well established make, or adaptors should be furnished which will fit either Western Electric jack D157789 or Amphenol No. 83.

Measurements on such capacitors will normally be made at 465 kilocycles per second. Measurements at 1 or 10 kilocycles per second can also be had on the larger sizes (5 $\mu\mu$f up). If the highest accuracy is desired, the capacitors should not differ from the following nominal values by more than two percent: 0.001, 0.01, 0.1, 1.0, 2.0, 5.0, 10.0, and 100.0 $\mu\mu$f.

For tests at frequencies above 10 kilocycles, see 214.804.

Item	Description	Fee
201.204a	Determination of capacitance and power factor of a 2-terminal capacitor, or one section of a sub-divided capacitor, at room temperature and at any frequency between 25 and 3,000 cycles per second	$6.00
201.204b	Determination of capacitance and power factor of additional capacitors (or additional sections of a capacitor) having the same nominal value and tested at the same time and same frequency as in 201.204a, each	2.00
201.204c	Determination of direct capacitance of a 3-terminal capacitor	5.00
201.204d	Determination of direct capacitance of each additional unit of the same 3-terminal capacitor	4.00

201.205 Insulation resistance.

NOTE: Tests of insulating materials are normally made only on new materials which are considered of possible use by the Bureau or for other Government agencies or in connection with cooperative work in the development of improved methods of measurement.

Item	Description	Fee
201.205a	Determination of the insulation resistance of a single-valued capacitor, one section of a subdivided capacitor or a specimen having fixed electrodes at room temperature (about 25° C) and humidity (50% RH or less)	$6.00
201.205b	Determination of the insulation resistance of a single-valued capacitor, one section at a subdivided capacitor or a specimen having fixed electrodes at a specified temperature (15° to 50° C) and humidity (30% to 95% RH) after preconditioning in accordance with ASTM Procedure D618, first item	10.00
201.205c	Measurement of additional items under same conditions and at the same time as 201.205a and b each item	3.00
201.205d	Determination of insulation resistance, volume resistivity or surface resistivity of one sample of material according to ASTM Procedure D257 at a specified temperature (15° to 50° C) and humidity (30% to 95% RH)	13.00
205.205e	Measurement of additional items under the same conditions and at the same time as 201.205d each item	5.00
201.205f	Additional measurements on items prepared and measured under 201.205b - 201.205c - 201.205d and 201.205e to determine effect of time under those conditions, each measurement	5.00

201.206 Dielectric constant and power factor of dielectric materials.

NOTE: Tests of insulating materials are normally made only on new materials which are considered of possible use by the Bureau or for other Government agencies or in connection with cooperative work in the development of improved methods of measurement.

Item	Description	Fee
201.206a	Determination of the dielectric constant and power factor of one sample of sheet material (about 6 inches in diameter or square and $\frac{1}{32}$ to $\frac{3}{8}$ inch thick) at one frequency (100 to 10^5 cycles per second) at room temperature (about 25° C) and humidity (50% RH or below)	$10.00
201.206b	Same as 201.206a but at an additional frequency on the same sample and at the same time	5.00
201.206c	Determination of capacitance and power factor of one cable soaked in water at room temperature at one frequency (60 to 3,000 cycles per second) not over 75 volts, first measurement	7.50
201.206d	Same as 201.206c but for additional measurements at later times on the same cable under same conditions	3.00

201.207 Resistors above 1 megohm. Standards of high resistance should be made of such materials that their resistances do not change with time. They should be so constructed and treated that the effect of relative humidity is minimized. As the resistance of these resistors usually depends upon the voltage, the voltage to be applied to the resistor during

test should be specified. Each resistor should have an identifying number engraved on, or permanently attached to it.

Item	Description	Fee
201.207a	Calibration of a resistor at room temperature (about 25° C) and humidity (50% RH or less) when the voltage divided by the resistance is greater than 5×10^{-9}, accuracy 0.5% each	$6.00
201.207b	Calibration of a resistor at a fixed temperature (15° to 50°) and humidity (30% to 95% RH) when the voltage divided by the resistance is greater than 5×10^{-9}, accuracy, 0.5% each	10.00
201.207c	Calibration of additional resistors under the same conditions as 201.207a or b and at the same time, each	3.00

201.3 Electrical Instruments

Tests of an instrument usually consist of determinations of the values of the measured quantity required to deflect the instrument pointer to specified scale marks. Normally at least two determinations, with increasing and decreasing values respectively, are made at each specified scale mark, and the average of these results is reported in tabular form. Unless otherwise requested, all tests are made at room temperature and after the instrument pointer has been set to the zero mark on open circuit. Voltmeters and the voltage circuits of wattmeters are energized for at least 20 minutes before tests are begun.

Unless otherwise requested, single-range instruments are tested at five scale marks, which should preferably be selected from those that the maker used as cardinal calibration points in laying out the scale. Multirange instruments are tested at five such marks on one range and two on each other range. From the ratios of the tabulated results, a multiplying factor can be determined by which the values stated for the five points on the base range can be used to determine the values for the corresponding points on other ranges. Only in exceptional cases will such computed values be in error by more than the certified accuracy.

High-quality instruments which are intended for use as laboratory standards in testing other instruments should preferably be tested on the base range at each cardinal scale mark used by the maker in laying out the scale, so that suitable corrections may be applied by linear interpolation to readings at intermediate points.

Unless otherwise specifically requested, instruments which can equally well be used with direct and alternating current will first be tested with direct current at five points on one range and two points on each other range. Determinations of the difference of indication on reversed direct current and on alternating current of the specified frequency will then be made at one or two scale points on each range of the instrument. The mean values for the two directions of current flow through the instrument (reversed dc) best represents the performance of the instrument on direct current since it minimizes the effect of the local magnetic field and of

residual magnetism in the instrument shield. The results obtained by these procedures (tests on reversed dc followed by a transfer test) are more accurate than those obtained from a test on alternating current only. They are also of greater value since the a-c—d-c differences are relatively permanent for an instrument so that subsequent tests will generally need to be made only on reversed direct current.

Instruments Used with Transformers. Alternating-current instruments used with externally connected transformers should preferably be tested separately, as the transformers will probably have a very constant ratio over a long period of time while the instruments are more liable to change with time and use. When an instrument and a separate transformer are so tested, they will be counted as two pieces of apparatus, and fees will be charged accordingly. After separate tests of the instrument and transformer, it is sufficient thereafter to test the instrument alone at suitable intervals, provided that the transformer is well constructed of good material and is properly used.

Electrical measuring instruments such as ammeters, voltmeters, wattmeters and watthour meters contain extremely delicate jewels and pivots, upon which the operation of each instrument depends. These delicate parts must be carefully protected from mechanical shocks and jars during shipment. Sensitive instruments will not arrive in satisfactory operating condition unless great care is taken in packing. Every effort is made to handle and to repack these instruments carefully at the Bureau, and whenever possible the return shipment is made in the original container.

Before each instrument is packed, all binding posts should be tightened, and any externally operated clamping device for the moving system should be switched to the "clamp" or "transit" position. Plugs and other small accessories should be enclosed in a small separate container tied to the instrument. Glass windows of instruments lacking protective cases should be protected by pieces of thin wood or heavy cardboard before wrapping. Each instrument should then be wrapped in heavy manila paper or similar covering and sealed with gummed tape to exclude dust and excelsior.

Boxes in which instruments are packed should be strong, preferably of wood, with screwed-on tops to avoid damage to pivots or jewels, which may be caused by a hammer or nail puller.

Clean, fresh excelsior or its equivalent in special packaging material should be used as the shock-absorbing material. A layer of excelsior at least 3 to 4 inches deep, pressing it down firmly, should surround each wrapped instrument. Instruments having pivoted components should be packed upside down.

High-grade pivoted instruments of the laboratory standard type, which have comparatively heavy moving systems without clamping devices, should be packed with special care and should always be individually shipped in wooden boxes with 4 to 6 inches of excelsior around the wrapped instrument. Portable standard watthour meters (rotating standards) should also be individually packed.

Certain heavy accessories used with instruments, such as ammeter shunts, current transformers, and voltage (potential) transformers, should be packed in separate boxes to avoid possible damage to the instruments. Heavy pieces should always be shipped in wooden boxes and held in

place, if necessary, by checks or cleats. Large transformers, especially those having oil-filled iron cases, should be crated singly and arranged whenever possible so that the terminals can be made accessible for tests without removing the entire crate.

The tops of boxes and crates must be marked "This Side Up." Boxes containing delicate instruments should be marked "Fragile, Handle With Care." Those containing any glass parts should be marked "Glass." Failure to use such markings precludes recourse in the event of loss or damage in shipping.

201.301 Standard resistors for current measurements. Standard resistors used to measure large currents are often heated by the passage of the current to such an extent that their resistance while in use is materially different from that at room temperature. Such resistors when first submitted for test should be tested both with small test current and with full rated current (201.301 a, and b or c). The change in resistance between these two conditions, if not excessively large, is a fairly definite property of the standard, and in later tests determinations need be made only with small test current (201.301 a). Resistors of very large current capacity are often so constructed that the temperature rise and distribution in them is dependent to a large extent upon the heat generated at the current-terminal contacts and on the cooling effects of the bus-bars to which they may be connected. When this is the case, resistance determinations made in the laboratory even with rated current cease to be of value because the working temperature conditions cannot be duplicated. The best experimental procedure to use in such cases is to place the standard in a temperature-controlled enclosure and measure its resistance with a comparatively low test current when it is heated uniformly to temperatures approximating that at which it will operate in service (201.301 d and e). From data at two or more elevated temperatures combined with that at room temperature, a curve can be plotted from which the resistance at the operating temperature can be read off, provided this temperature is determined by the user with the standard under the actual operating conditions.

Results of tests in this schedule are ordinarily certified to an accuracy of 0.01 percent if the apparatus is of suitable quality.

Item	Description	Fee
201.301a	Determination of resistance at room temperature with 10 or 20% of rated current	$8.00
201.301b	Additional determination of resistance with another test current not exceeding 300 amperes	5.00
201.301c	Additional determination of resistance with another test current exceeding 300 amperes, but not exceeding 3,000 amperes	15.00
201.301d	Additional determination of resistance at temperatures above room temperature, for first elevated temperature	20.00
201.301e	Additional determination of resistance at each additional elevated temperature	5.00

201.302 Direct-current ammeters.

NOTE: The combination of a millivoltmeter and a shunt will be tested as an ammeter, and the fee will be the same as that given in 201.302 for an ammeter of the same range. If the millivoltmeter is also to be tested separately, the additional fee will be that given in 201.303.

Item	Description	Fee
201.302a	Test at not more than 5 scale points on one range not to exceed 100 amperes	$8.00
201.302b	Test at not more than 5 scale points on one range greater than 100 amperes but not to exceed 3,000 amperes	15.00
201.302c	Test at one scale point on an additional range not to exceed 100 amperes	3.00
201.302d	Test at one scale point on an additional range greater than 100 amperes but not to exceed 3,000 amperes	5.00
201.302e	Test according to 201.302a, b, c, or d having been made, for each additional scale point on the same range	.50

201.303 Direct-current voltmeters and millivoltmeters.

NOTE: For millivoltmeter and shunt, see 201.302.

Item	Description	Fee
201.303a	Test at not more than 5 points on one range, not to exceed 500 volts	$8.00
201.303b	Test at one scale point on an additional range, not to exceed 500 volts	3.00
201.303c	Test according to 201.303a or 201.303b having been made, for each additional scale point on the same range, not to exceed 500 volts	.50
201.303d	Determination of the instrument resistance (with low test voltage), for each range measured	2.00

201.304 Alternating-current ammeters. Unless otherwise specified, ammeters equally suitable for use on direct and alternating currents and with ranges of 1 to 10 amperes will be tested by the procedures of items 201.304a-c and 201.304g-i, as the accuracy and information thus obtained materially exceed those given by the procedures of items 201.304d-f.

Item	Description	Fee
201.304a	Test at not more than 5 scale points on one range, using reversed direct current not exceeding 100 amperes.	$10.00
201.304b	Test with reversed direct current at one scale point on an additional range, not to exceed 100 amperes	3.00

Item	Description	Fee
201.304c	Test according to item 201.304a or 201.304b having been made, for each additional scale point on the same range	$1.00
201.304d	Test at not more than 5 scale points on one range and frequency, using alternating current	17.00
201.304e	Test at one scale point on an additional range or frequency, using alternating current	4.00
201.304f	Test according to item 201.304d or 201.304e having been made, for each additional scale point on the same range and frequency	1.00
201.304g	Determination of the difference between the reading on reversed direct current and the reading on alternating current at the first scale point at which this difference is determined, current not to exceed 10 amperes	4.00
201.304h	Determination of this difference at the first scale point on an additional range or frequency, current not to exceed 10 amperes	2.00
201.304i	Determination according to 201.304g or 201.304h having been made, determination at an additional scale point with the same combination of range and frequency, current not to exceed 10 amperes	1.00

201.305 Alternating-current voltmeters. Unless otherwise specified, voltmeters equally suitable for use on direct and alternating voltages, and with ranges between 15 and 500 volts, will be tested by the procedures of items 201.305a–e and 201.305m–o, as the accuracy and information thus obtained materially exceed those given by the procedures of items 201.305 g–k.

Item	Description	Fee
201.305a	Test at not more than 5 scale points on one range, using reversed direct voltage, not to exceed 500 volts	$10.00
201.305b	Test at not more than 5 scale points on one range, using direct voltage of either polarity to ground, more than 500 volts but not to exceed 50,000 volts	30.00
201.305c	Test at one scale point on an additional range, using reversed direct voltage, not to exceed 500 volts	3.00
201.305d	Test at one scale point on an additional range, using direct voltage of either polarity to ground, more than 500 volts but not to exceed 50,000 volts	5.00
201.305e	Test according to item 201.305a or 201.305c having been made, for each additional scale point on the same range, not to exceed 500 volts	1.00
201.305f	Test according to item 201,305b or 201.305d having been made, for each additional scale point on the same range, more than 500 volts but not to exceed 50,000 volts	2.00
201.305g	Test at not more than 5 scale points on one range and frequency, using alternating voltage not to exceed 500 volts.	17.00

Item	Description	Fee
201.305h	Test at not more than 5 scale points on one range and frequency, using alternating voltage more than 500 volts but not to exceed 50,000 volts	$20.00
201.305i	Test at one scale point on an additional range or frequency, using alternating voltage not to exceed 500 volts	4.00
201.305j	Test at one scale point on an additional range or frequency, using alternating voltage more than 500 volts but not to exceed 50,000 volts	5.00
201.305k	Test according to item 201.305g or 201.305i having been made, for each additional scale point on the name combination of range and frequency, not to exceed 500 volts	1.00
201.305L	Test according to item 201.305h or 201.305j having been made, for each additional scale point on the same combination of range and frequency, more than 500 volts but not to exceed 50,000 volts	1.00
201.305m	Determination of the difference between the reading on reversed direct voltage and the reading on alternating voltage at the first scale point at which this difference is determined, not to exceed 500 volts	4.00
201.305n	Determination of this difference at the first scale point on an additional range or frequency, not to exceed 500 volts.	2.00
201.305o	Determination according to item 201.305m or 201.305n having been made, determination at an additional scale point with the same combination of range and frequency, not to exceed 500 volts	1.00

201.306 Wattmeters. Electrodynamic wattmeters on current ranges of 10 amperes or less will be tested only by the procedures of items 201.306a–c and 201.306g–i as the accuracy and information thus obtained materially exceed those given by the procedure of items 201.306d–f.

Single Phase. When single-phase wattmeters are submitted for test without specific instructions and are of a type which may be operated on direct current and on alternating current, they will be tested with reversed direct current at five points on a base range and at two points on each other combination of ranges. They will then be given an a-c–d-c transfer test at two scale points (the determination of the difference in indication between the mean of results obtained with the two directions of direct current and the results with alternating current constitutes an a-c–d-c transfer test). This transfer test should be made at a low power factor (50 percent) on each voltage range, as the percentage errors resulting from inductance in the voltage circuit are much greater at low than at high power factor. A transfer test at unity power factor is generally necessary only on one range.

Polyphase. Unless otherwise specified polyphase wattmeters will be tested first for interaction by applying alternating voltage to the voltage circuit of one element and alternating current to the current circuit of the other element and vice versa. If the interaction is sufficiently small the wattmeter will then be tested on reversed direct current with the current coils of the two elements in series and the voltage coils in parallel. A further test will be made to determine the departure from equality of

the two elements at zero by opposition and at two other points on the scale by reversed d-c tests on the separate elements. In computing the fee, the normal rating of one element will be taken as the normal rating of the wattmeter.

Item	Description	Fee
201.306a	Test at not more than 5 scale points on one range using reversed direct current, not to exceed 100 amperes and 500 volts	$15.00
201.306b	Test at one scale point on each additional range using reversed direct current, not to exceed 100 amperes and 500 volts	3.00
201.306c	Test according to item 201.306a or 201.306b having been made, for each additional scale point on the same range, not to exceed 100 amperes and 500 volts	1.00
201.306d	Test at not more than 5 scale points on one range, frequency and power factor, using alternating current at frequencies not to exceed 70 cycles per second, current not to exceed 100 amperes and voltages not to exceed 500 volts	35.00
201.306e	Test at one scale point on an additional range, frequency or power factor, using alternating current at frequency not to exceed 70 cycles per second, current not to exceed 100 amperes and voltage not to exceed 500 volts	10.00
201.306f	Test according to item 201.306d or 201.306e having been made, for each additional scale point on the same combination of range, frequency and power factor, not to exceed 100 amperes and 500 volts	5.00
201.306g	Determination of the difference between the reading on reversed direct current and the reading on alternating current at the first scale point at which this difference is determined, at currents not to exceed 10 amperes	4.00
201.306h	Determination of this difference at one scale point on an additional range, frequency or power factor, at currents not to exceed 10 amperes	2.00
201.306i	Determination according to item 201.306g or 201.306h having been made, determination at each additional scale point with the same combination of range frequency and power factor, at currents not to exceed 10 amperes	1.00
201.306j	Determination of the resistance, with low test voltage, of the voltage circuit, for each range measured	2.00
201.306k	Determination of interaction between elements of a polyphase wattmeter at zero, and equality of the elements at zero and at 2 other scale points, current not to exceed 100 amperes and voltage not to exceed 500 volts	8.00

201.307 Direct-current watthour meters. Tests of watthour meters consist of determinations of their percentage registration "as received." Before tests can be started the test conditions must be completely specified as regards current and voltage ranges to be tested and the applied voltage and current. It is recommended that meters be cleaned and well adjusted before being submitted for tests, as the Bureau cannot undertake the cleaning or adjustment of meters. Unless otherwise speci-

fied, test runs on portable standard watthour meters (rotating standards) are of 100-second duration, after an initial warm-up period of 30 minutes with the rotor stationary and with the test voltage only applied.

Item	Description	Fee
201.307a	Test at one voltage on one range at not more than 5 loads, namely, 10, 25, 50 per cent, full load, and 50 percent overload unless otherwise ordered, not to exceed 100 amperes and 500 volts	$15.00
201.307b	Test at one load on an additional range or at another voltage, not to exceed 100 amperes and 500 volts	4.00
201.307c	Test according to item 201.307a or 201.307b having been made, for an additional load on the same combination of range and voltage, not to exceed 100 amperes and 500 volts.	1.00

201.308 Alternating-current watthour meters. Tests of watthour meters consist of determination of their percentage registration "as received." Before tests can be started the test conditions must be completely specified as regards current and voltage ranges to be tested, frequency, applied voltage and current, and power factor. It is recommended that meters be cleaned and well adjusted before being submitted for tests, as the Bureau cannot undertake the cleaning or adjustment of meters. Unless otherwise specified, test runs on portable standard watthour meters (rotating standards) are of 100-second duration, after an initial warm-up period of 30 minutes with the rotor stationary and with the test voltage only applied.

Item	Description	Fee
201.308a	Test at one frequency, one power factor, one voltage and one range, on not more than 5 loads, namely, 10, 25, 50 percent, full load, and 50 percent overload, unless otherwise ordered, current not to exceed 100 amperes and voltage not to exceed 500 volts	$15.00
201.308b	Test at one load on an additional frequency, power factor, voltage or range	4.00
201.308c	Test according to item 201.308a or 201.308b having been made, for an additional load on the same combination of frequency, power factor, voltage and range	1.00

201.309 Frequency meters for power frequencies.

Item	Description	Fee
201.309a	Test at one voltage of not more than 5 reeds or not more than 5 scale points	$20.00
201.309b	Test of one reed or scale point at another voltage	2.00
201.309c	Test according to item 201.309a or 201.309b having been made, for an additional reed or scale point at the same voltage	2.00

201.310 Current transformers. Tests cannot be started until information is furnished concerning the following test conditions: (1) test frequency; (2) secondary test currents; (3) secondary burdens; (4) ranges to be tested. It is customary to make tests at 0.5, 1, 2, 3, 4, and 5 amperes (secondary), and the specification of other values within this range should be avoided if possible.

Only well-designed transformers of good construction should be submitted for test. The Bureau reserves the right to decline to make extended tests on transformers which show unduly large errors in ratio or phase angle or which fail to repeat their performance. The Bureau's equipment is suitable for testing only those current transformers whose rated secondary current is 5 amperes. The results will, in general, be certified to 0.05 percent in ratio and to 1 minute in phase angle.

Current transformers should be tested with burdens which approximate those with which they are to be used. The "standard burdens" listed in the "American Standard for Instrument Transformers, C57.13" are *for rating purposes only*, and do not correspond to actual instrument burdens. The ASA standard burdens differ so greatly from the usual instrument burdens that tests made using them do not provide values of ratio and phase angle sufficiently accurate for use with actual instrument loads. Hence the inclusion of tests at ASA burdens is not recommended. The test apparatus regularly used at the Bureau imposes a minimum test burden of about 0.16 ohm with a minimum inductance of about 10 μh. In the advance planning of tests, the burden should if possible be chosen larger than this minimum burden (preferably 0.2 ohm). The difference between an *actual* instrument burden and 0.2 ohm can easily be made up as series resistance (or lead resistance). Generally there is very little to be gained in transformer performance by making the burden less than 0.2 ohm, because the resistance of the secondary winding of the transformer is itself usually several tenths of an ohm. Tests with lower burdens may be made with special equipment when necessary, but arrangements for such tests must be made in advance and higher fees must be charged. If the burden is specified in terms of measured resistance and inductance, the leads used to connect the instruments to the transformer should be included in the measurement. If it is not convenient to make this measurement, it will suffice in most cases to state the maker's name, type, range, and serial number of each instrument used in the burden, and the size and length of wire used in the secondary circuit.

Multiple-range current transformers, in which the same sections of primary windings are used in series and in parallel, usually have phase angles and ratio factors which are equal on the several ranges to within the accuracy needed for almost any measurement purpose. Hence a test at six values of secondary current on one range is nearly always sufficient to determine the characteristics of the transformer. Further tests, often made at 0.5 and 5 secondary amperes on each additional range, merely serve as a safeguard by means of which mistakes in winding may be detected. When the various ranges of a multirange transformer are obtained by taps on either winding, this relation does not necessarily hold, particularly in the case of secondary taps; and tests in addition to the initial six-point test on one range should be made using at least two values of secondary current on each of the ranges so obtained. Transformers of some designs, however, show very little difference in ratio factor and

phase angle on the various ranges, and the Bureau should be consulted before tests on a large number of ranges are ordered.

Unless otherwise specified, current transformers will be demagnetized before being tested. If it is desired to have a transformer tested as submitted (without demagnetization), this fact should be specifically stated.

Item	Description	Fee
201.310a	Test for ratio of transformation and phase angle of a current transformer at one frequency and one burden (not less than 0.2 ohm resistance) at not more than 6 values of secondary current, namely, 0.5, 1, 2, 3, 4, and 5 amperes unless otherwise ordered; primary current not to exceed 500 amperes	$20.00
201.310b	Test for ratio of transformation and phase angle of a current transformer at one frequency and one burden (not less than 0.2 ohm resistance) at not more than 6 values of secondary current, namely, 0.5, 1, 2, 3, 4, and 5 amperes unless otherwise ordered; primary current greater than 500 amperes but not to exceed 8,000 amperes	30.00
201.310c	Test for ratio and phase angle at one value of secondary current on an additional frequency range or burden (not less than 0.2 ohm resistance); primary current not to exceed 500 amperes	4.00
201.310d	Test for ratio and phase angle at one value of secondary current on an additional frequency, range or burden (not less than 0.2 ohm resistance); primary current greater than 500 amperes but not to exceed 8000 amperes	6.00
201.310e	Test according to item 201.310a, b, c or d having been made, determinations of ratio and phase angle at an additional value of secondary current with the same combination of frequency, range and burden, primary current not to exceed 8000 amperes	1.00

201.311 Voltage (potential) transformers. Tests cannot be started until information is furnished concerning the following test conditions: (1) test frequency; (2) secondary test voltages; (3) secondary burdens; (4) ranges to be tested.

Only well-designed transformers of good construction should be submitted for test. The Bureau reserves the right to decline to make extended tests on transformers which show unduly large errors in ratio or phase angle, or which fail to repeat their performance. The results will, in general, be certified correct to 0.05 percent in ratio and to 1 minute in phase angle.

The ratio and phase angle of a voltage transformer change linearly with changes in secondary current at constant voltage, frequency and power factor within its rating. Hence, if values of ratio and phase angle are determined for two secondary burdens having the same power factor, values for intermediate currents may be found by interpolation. It is also possible to compute with good accuracy the performance of a voltage transformer at any burden within its rating from data obtained at open circuit and at one noninductive load (preferably the full load indicated by the name plate rating of the transformer) at the same secondary

voltage and frequency. Formulas for this purpose are printed on the back of the Bureau's certificate form for voltage transformers. When a secondary burden of fixed impedance is used, the ratio and phase angle of a voltage transformer are nearly independent of the secondary voltage within its normal operating range. Hence a test at one secondary voltage is generally sufficient, unless the transformer is to be used over a considerable range of secondary voltages. The "standard burdens" of the American Standard for Instrument Transformers, ASA C57.13, are *for rating purposes only*, and their inclusion as specified burdens is not recommended. The performance of a voltage transformer with such burdens may readily be computed from values taken at unity power-factor burdens, using the formulas printed on the back of the Bureau's certificate form.

Multirange voltage transformers, n which the same sections of the primary winding are used in series and in parallel to obtain several ranges, usually have phase angles and ratio factors on the various ranges which are equal to within the accuracy needed for most measurement purposes. Hence a test on one range at all the desired burdens is usually sufficient to determine the performance of the transformer for all such ranges. In addition, tests on each of the other ranges at some one burden may also be desirable in cases where extreme accuracy is required.

When a voltage transformer is submitted with fuses in the primary circuit, the test will be made (in the absence of instructions to the contrary) with the fuses considered as part of the primary winding.

Item	Description	Fee
201.311a	Test for ratio of transformation and phase angle of a voltage transformer at one frequency, one range and one secondary voltage with not more than 4 values of secondary burden; namely those giving zero, half and full rated non-inductive load at rated voltage, and with one instrument burden to be specified by the customer; primary voltage not to exceed 25,000 volts	$20.00
201.311b	Test for ratio of transformation and phase angle of a voltage transformer at one frequency, one range and one secondary voltage with not more than 4 values of secondary burden, namely those giving zero, half and full rated non-inductive load at rated voltage, and with one instrument burden to be specified by the customer; primary voltage greater than 25,000 volts but not to exceed 100,000 volts	30.00
201.311c	Test for ratio of transformation and phase angle of a voltage transformer at one frequency, one range and one secondary voltage with not more than 4 values of secondary burden, namely those giving zero, half and full rated non-inductive load at rated voltage, and with one instrument burden to be specified by the customer; primary voltage greater than 100,000 volts but not to exceed 250,000 volts	60.00
201.311d	Determination of ratio and phase angle at one value of secondary voltage on an additional range or frequency, and with one of the burdens used in tests performed according to item 201.311a, b, or c; primary voltage not to exceed 25,000 volts	5.00

Item	Description	Fee
201.311e	Determination of ratio and phase angle at one value of secondary voltage on an additional range or frequency, and with one of the burdens used in tests performed according to item 201.311a, b, or c; primary voltage greater than 25,000 volts, but not to exceed 100,000 volts	$6.00
201.311f	Determination of ratio and phase angle at one value of secondary voltage on an additional range or frequency, and with one of the burdens used in tests performed according to item 201.311a, b, or c; primary voltage greater than 100,000 volts but not to exceed 250,000 volts	10.00
201.311g	Tests according to item 201.311a, b, c, d, e, or f having been made, determination of ratio and phase angle with a second burden used in item 201.311a, b or c, and with the same combination of range, frequency and voltage used in item 201.311d, e or f	2.00
201.311h	Tests according to item 201.311a, b, c, d, e or f having been made, determination of ratio and phase angle at an additional burden other than those used in tests made in accordance with item 201.311a, b or c, primary voltage not to exceed 250,000 volts	10.00
201.311i	Test according to item 201.311a, b, c, d, e, f, g, or h having been made, for determination of ratio and phase angle at an additional value of secondary voltage on the same combination of range, frequency and burden; primary voltage not to exceed 250,000 volts	1.00

201.312 Volt boxes. A measurement voltage divider is a tapped resistor used to extend the voltage range of a potentiometer or other voltage-measuring device. Its ratio is defined as the ratio of the total applied voltage to the voltage drop in the tapped section across which the measuring device is connected, no current being withdrawn at the tap point. Both self-heating and humidity effects may cause changes of several hundredths per cent in the value of ratio. Measurement voltage dividers should therefore be tested at rated voltage. A further test at 20 per cent rated voltage is often desirable because at this voltage any self-heating effect should be negligible. From the two values the extent of the self-heating effect at rated voltage can be determined and an estimate can be made of effects at intermediate voltages. Tests having once been made on a measurement voltage divider at rated voltage and at 20 percent of rated voltage, later tests need be made only at rated voltage since the self-heating effect should not change with time.

Item	Description	Fee
201.312a	Test for ratio on one range at rated voltage, not to exceed 750 volts	$15.00
201.312b	Test at one value of voltage on an additional range, not exceeding 750 volts	4.00
201.312c	Test according to item 201.312a or 201.312b having been made, for test at an additional voltage on the same range, not exceeding 750 volts	1.00

201.313 Instrument transformer testing sets (portable).

Item	Description	Fee
201.313a	Determination of the values of current ratio and phase angle for settings of the dials of a portable current transformer testing set at 60 cycles per second	$70.00
201.313b	Determinations according to 201.313a having been made, for corresponding determinations at 25 cycles per second	10.00
201.313c	Determination of values of the voltage ratio and phase angle for settings of the dials of a portable voltage transformer testing set at 60 cycles per second	70.00
201.313d	Determinations according to item 201.313c having been made, for corresponding determinations at 25 cycles per second	5.00

201.4 Magnetic Measurements

A general discussion of magnetic principles and methods used in magnetic testing is given in NBS Circular 456, *Magnetic Testing*, issued in 1946. Copies can be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., price 10 cents.

Tests in this field are for the most part made on standard samples which serve to coordinate work in various laboratories and thus secure uniformity in commercial testing. For this purpose it is essential that the standard bars be very uniform in their magnetic properties. The Bureau does not normally make routine acceptance tests of magnetic materials unless these specimens are to be used, at least temporarily, as standards. The standard dimensions of magnetic test specimens are given in the notes preceding 201.401 and 201.402. It is occasionally possible to test specimens of unusual materials or shapes where the services of the Bureau are needed in the development of new test procedures which are likely to be of importance in the industry. In such a case a full understanding of the problem should be developed by correspondence, or preferably by a visit which will permit direct discussion between the engineers concerned and our staff.

201.401 Magnetic materials: Normal induction and hysteresis. Specimens submitted for test should be of rectangular cross section, width not to exceed 3.8 cm (1½ in.); thickness not to exceed 1.9 cm (¾ in.); for magnetizing forces in the ranges 0 to 300 or 0 to 5000 oersteds, length to be not less than 25.4 cm (10 in.); for magnetizing forces in the range 100 to 5,000 oersteds, length to be not less than 7 cm (2⅝ in.).

Item	Description	Fee
201.401a	Determination of data for normal induction curve in the range 0–300 oersteds	$10.00
201.401b	Determination of data for normal induction curve in the range 100–5000 oersteds	10.00
201.401c	Determination of data for normal induction curve in the range 0–5000 oersteds	17.50
201.401d	Determination of data for demagnetization curve, one value of maximum magnetizing force	15.00
201.401e	Same as 201.401d, each additional value of maximum magnetizing force	10.00

201.402 Magnetic materials: A-C permeability and core loss. Test specimens should consist of the proper number of strips 3 cm ($1\frac{3}{16}$ in.) wide and either 50 cm ($19\frac{11}{16}$ in.) or 28 cm ($11\frac{1}{32}$ in.) prepared in accordance with the specifications of the American Society for Testing Materials, A-34.

Item	Description	Fee
201.402a	Determination of total core loss at 60 cycles per second at one value of maximum induction not exceeding 15 kilogausses	$7.00
201.402b	Same as 201.402a, each additional value of maximum induction	2.00

201.403 Magnetic testing apparatus: Mutual inductors and search coils.

Item	Description	Fee
201.403a	Determination of mutual inductance by direct-current	$10.00
201.403b	Same as 201.403a, each additional value for variable or tapped inductors	3.50
201.403c	Determination of the area-turns of a search coil	10.00

201.8 Electrochemistry

201.801 Standard cells. Normally about 2 weeks are required to complete a test of a standard cell of the unsaturated type. The cells are kept in a thermally insulated cabinet and readings of their emf are taken daily for a period of ten days after the values have become reasonably constant. If the emf continues to fluctuate, or is abnormally low, or if the cell shows other indications of poor quality, a report is issued in lieu of a certificate and the nature of the failure is indicated. Cells should be carefully packed and if this is done, cells of the unsaturated type are not likely to be injured by normal transportation by mail or express. Shipment during very cold weather should preferably be avoided because of the possible hazard from freezing.

Cells of the saturated type should be transported by messenger because they should not be inverted. It is desirable that such cells be kept in our temperature-controlled baths for a period of several weeks or months in order to make sure that the final average values are truly representative of the high accuracy of which such saturated cells are capable.

Item	Description	Fee
201.801a	Cadmium standard cell (unsaturated type)—determination of electromotive force with accuracy of 0.01 per cent first cell	$7.50
201.801b	Each additional unsaturated cell submitted at the same time	5.00
201.801c	Cadmium standard cell (saturated type). Measurement at a fixed temperature in thermostatically controlled oil bath	10.00
201.801d	Each additional saturated cell submitted at same time	7.50

FEE SCHEDULE 202: METROLOGY

202.1	Length	
	202.101	Reference Line Standards of Length
	202.102	Working Line Standards of Length
	202.103	Commercial Line Standards of Length
	202.104	Steel Tapes
	202.105	Invar Base-Line Tapes
	202.106	Surveyors Measuring Instruments (Other than Tapes)
	202.107	Sieves and Sieve Cloth
	202.108	Haemacytometers
	202.109	Areas and Area-measuring Instruments
	202.110	Interferometry
	202.111	Precision Circles and Precision Line Standards of Length
202.2	Mass	
	202.201	"Class A" Standard Weights (new)
	202.202	"Class A" Standard Weights (not new)
	202.203	"Class B" Standard Weights
	202.204	"Class C" Standard Weights (except cast iron 50-lb. weights)
	202.205	"Class M" Laboratory Standards of Mass
	202.206	"Class S" Laboratory Weights
	202.207	"Class S2" Laboratory Weights
	202.208	Balances
202.3	Time	
	202.301	Timepieces
202.4	Capacity, Density, and Fluid Meters	
	202.401	Volumetric Apparatus
	202.402	Metal Capacity Standards
	202.403	Hydrometers and Thermohydrometers
	202.404	Density of Solids and Liquids
	202.405	Fluid Meters, including Gas-Measuring Instruments
202.6	Thermal Expansion	
	202.601	Thermal Expansion of Solids
202.8	Scales	
	202.801	Large-Capacity Scales and Weights
202.9	Gages	
	202.901	Gage Blocks and End Standards of Length
	202.902	Plain and Taper Plug and Ring Gages
	202.903	Thread Plug and Ring Gages
	202.904	Instruments and Components
	202.905	Gill Net Gages

Fee Schedule 202: Metrology

Priority is given to material submitted as standards to be used in precision research or testing, in the production of new standards, and in law enforcement.

In general, work will be discontinued when a substantial number of items in a lot fail to comply with a specification or are found to be unsuitable for use as standards. The sorting of acceptable items from lots not properly graded for certification as standards cannot be undertaken.

Material should be packed with care. Much damage and loss have resulted from failure to pack weights so that they cannot move about or crush partitions in containers. The lightweight laboratory handling cases are seldom suitable for shipping cases. Weights of 1 pound or more should be wrapped separately and so placed that they cannot injure containers or other weights. Small weights should be held in place by pieces of felt pressed against the top of each weight. Metal length standards may push out the ends of containers if not well packed. Thread gages, not protected by grease, waxed paper or strippable coating, and rigidly fastened in place, may be injured to a degree which will make them useless as standards. Glassware must be given particular protection. Cracks or chipped areas may appear in glassware when cleaning solutions are applied. The Bureau cannot be responsible for injury or breakage of material submitted for standardization.

202.1 Length

202.101 Reference line standards of length.

Item	Description	Fee
202.101a	Yard or meter reference line standard—determination of the total length by comparison with the primary working standards of the Bureau at room temperature, with a probable error of about 0.3 μ	$40.00
202.101b	Yard or meter reference line standard—determination of the total length at an additional temperature to obtain the coefficient of expansion	30.00
202.101c	Yard or meter reference line standard—determination of equal sub-multiples of a length, each	6.00
202.101d	Yard or meter reference line standard—determination of any other single interval	9.00

202.102 Working line standards of length.

Item	Description	Fee
202.102a	Yard or meter working line standard—determination of the total length at room temperature to an accuracy of 0.001 mm if the character of the graduation justifies	$17.50
202.102b	Yard or meter working line standard—determination of the total length at an additional lower tempertaure to obtain the coefficient of expansion	14.50
202.102c	Yard or meter working line standard—determination of equal sub-multiples of a length, each	3.00
202.102d	Yard or meter working line standard—determination of any other single interval	5.00

202.103 Commercial line standards of length.

Item	Description	Fee
202.103a	Yard or meter commercial line standard—determination of the total length at room temperature to an accuracy of 0.01 mm if the character of the graduation justifies	$8.00
202.103b	Yard or meter commercial line standard—determination of the total length at an additional lower temperature to obtain the coefficient of expansion	6.00
202.103c	Yard or meter commercial line standard—determination of the corrections of equal submultiples of a length, each	2.00
202.103d	Yard or meter commercial line standard—determination of any other single length	4.00
202.103e	Yard or meter commercial line standard—examination of intervening graduations of a bar, done in connection with item (a) only, and certification of their degree of accuracy to not more than 0.001 inch or 0.1 mm without giving the individual corrections of the points examined, for each 10 points examined	2.50

202.104 Steel tapes. Tapes conforming to the specifications given below will be certified by the Bureau of Standards and a precision seal showing year of test will be placed on each tape. For tapes not conforming to the specifications a report will be issued but the tape will not be sealed. The Bureau's serial number on a tape simply signifies that it has been tested by the Bureau and either a certificate or a report issued. The lengths of steel tapes will be given to the nearest 0.001 foot or 0.1 mm and the temperature of comparison will be stated to the nearest degree.

A steel tape is standard when it conforms to the following specifications: It shall be made of a single piece of metal ribbon, and none of the graduations shall be on pieces of solder or on sleeves attached to the tape or on wire loops, spring balances, tension handles, or other attachments liable to be detached or changed in shape. The error in the total length of the tape, when supported horizontally throughout its length at the standard temperature of 68°F (20°C) and at standard tension, shall not be more than 0.1 inch per 100 feet (2 mm per 25 m). The standard tension is 10 pounds (4.5 kg) for tapes 25 to 100 feet or from 10 to 30 m in length and 20 pounds (9 kg) for tapes longer than 100 feet or 30 m. For testing of invar tapes and wires, see 202.105.

Item	Description	Fee
202.104a	Steel tapes—determination of correction to the total length of the tape when supported throughout at standard tension and at standard temperature, for each 150 feet or 50 meters or fraction thereof This is the regular standard test which will be made and charged for in each case to determine whether or not the tape is entitled to certification. To this amount must be added the fees for any additional tests made, and for item (m), if applicable, in accordance with the following schedule.	$3.75

Item	Description	Fee
202.104b	Steel tapes—determination of the correction to the total length when supported throughout at any tension other than standard tension, for each 150 feet or 50 meters or fraction thereof Tension desired must be specified.	$0.50
202.104c	Steel tapes—determination of the correction to the total length when supported at the ends only The Bureau is not prepared to make this test on tapes having a greater length than 150 feet or 50 meters. Standard tension will be used in this test unless another tension is specified.	.75
202.104d	Steel tapes—determination of the correction to the total length when supported at the ends and one or more intermediate points, for each 150 feet or 50 meters or fraction thereof Standard tension will be used unless another tension is specified.	.75
202.104e	Steel tapes—determination of the correction to the length of a subinterval under the same conditions as to tension, and points of support as for the total length The points at which these measurements are made must be points at which the tape is supported. The Bureau is not prepared to test tapes supported at points more than 150 feet or 50 meters apart.	.50
202.104f	Steel tapes—determination of the correction to the length of a subinterval under different specified conditions as to tension and points of support from those used for the total length. See item (e) above	.75
202.104g	Steel tapes—determination of the tension to the nearest integral half pound or quarter kilogram at which the correction to the length of an interval is most nearly zero, under a specified condition of support, for each 150 feet or 50 meters or fractions thereof	.75
202.104h	Steel tapes—determination of the correction to a subinterval at the tension at which the correction to the total length is most nearly zero and under the conditions of support used in the test under item (g)	.50
202.104i	Steel tapes—determination of the coefficient of expansion of a tape, for each 150 feet or 50 meters or fraction thereof for the first tape The above fee of $48.00 includes a charge of $42.00 to cover the cost of cooling the tape testing laboratory and $6.00 for the test of the tape. Additional tapes up to a total of four may be submitted at a cost of $6.00 for each additional tape. All four tapes need not be from the same source.	48.00
202.104j	Steel tapes—determination of Young's modulus of elasticity, for each 150 feet or 50 meters or fraction thereof	2.50
202.104k	Steel tapes—determination of the weight per foot or per meter of a tape	1.75
202.104L	Spring balance—testing in horizontal position	3.00
202.104m	Steel tapes—additional charge for each tape sent without a reel	1.25
202.104n	Steel tapes—determination of AE	2.00
202.104o	Steel tapes—computed values (this does not include charge for necessary measurements)	2.00

202.105 Invar base-line tapes. For testing of steel tapes, see 202.104. The test of an invar base-line tape of any length less than 50 meters on our geodetic-tape comparator will, in general, be made for the same fee as a 50-meter invar base-line tape. Attention is called to the fact that only invar base-line tapes of certain lengths can be tested on this comparator.

Invar tapes not tested on the geodetic-tape comparator will be tested on our bench standard. Fees will be arranged for each test but may be approximately estimated by multiplying the corresponding fees of 202.104 for steel tapes by the factor four.

Item	Description	Fee
202.105a	Invar 50-meter base-line tape—determination of total length on the geodetic comparator with a probable error not greater than ±0.050 mm	$27.50
202.105b	Invar 50-meter base-line tape—determination of total length on the geodetic comparator at an additional tension and/or method of support, with a probable error not greater than ±0.050 mm	5.00
202.105c	Invar 50-meter base-line tape—determination of total length supported throughout, by computation from the observed length when supported at the ends and one or more intermediate points	2.00
202.105d	Invar 50-meter base-line tape—determination of length of a subinterval to the nearest 0.1 mm, using the steel bench standard, for each tension and/or method of support	2.00
202.105e	Invar 50-meter base-line tape—determination of the coefficient of expansion on the teodetic comparator with an accuracy of at least 0.000001 per degree centigrade, and certification of its total length at one temperature, tension, and method of support with a probable error not greater than ±0.050 mm	75.00
202.105f	Invar 50-meter base-line tape—determination of Young's modulus of elasticity	4.00
202.105g	Invar base-line tape—determination of the weight per meter (or per foot)	2.50
202.105h	Spring balance—testing in horizontal position	3.00
202.105i	Invar base-line tape—additional charge for each tape sent without a reel	1.25
202.105j	Invar base-line tape—determination of A E	3.00
202.105k	Invar base-line tape—computed values	2.00

202.106 Surveyors measuring instruments (other than tapes).

Item	Description	Fee
202.106a	Level rods—testing principal intervals	$4.50

202.107 Sieves and sieve cloth.

NOTE: The precision seal of the National Bureau of Standards on any sieve indicates that the sieve has been tested at the National Bureau of Standards and found to conform to the specification.

Item	Description	Fee
202.107a	Sieve—test of any one sieve to determine conformity to specification, but not including the sieving test, each	$5.00
202.107b	Sieve—same as in item 202.107a above, additional sieves submitted at the same time, each	3.00
202.107c	Sieve cloth—test of a piece of sieve cloth, each square foot or fraction thereof (cloth larger than 1 foot by 3 feet accepted by agreement only and at increased fees)	3.50

202.108 Haemacytometers. Each haemacytometer chamber and each cover glass which passes the specification is marked with a National Bureau of Standards precision seal.

The fees have been computed for testing instruments having the Neubauer rulings (original or improved). An extra charge will be made for the testing of instruments having Fuchs-Rosenthal or other rulings which require more time in testing.

Item	Description	Fee
202.108a	Single haemacytometer chamber—testing single chamber and two cover glasses for conformity with specification	$5.00
202.108b	Same, for each additional chamber submitted at the same time	.75
202.108c	Double haemacytometer chamber—testing double chamber and two cover glasses for conformity with specification	5.50
202.108d	Same, for each additional chamber submitted at the same time	1.25
202.108e	Quadruple haemacytometer chamber—testing quadruple chamber and two cover glasses for conformity with specification	6.00
202.108f	Same, for each additional chamber submitted at the same time	1.75
202.108g	Cover glasses—testing cover glasses when not accompany-chamber, each	.10

202.109 Areas and area-measuring instruments. Special tests only are conducted in this category and fees will be charged dependent upon the nature of the test.

202.110 Interferometry.

Item	Description	Fee
	Precision gages—calibration of master precision gages using light waves and interference methods, accuracy 0.000001 inch.	
202.110a	Light wave calibration 0.1 to 0.4 inch	$7.50
202.110b	Light wave calibration 0.5 to 2.0 inches	12.00
202.110c	Light wave calibation 3.0 to 4.0 inches	27.50
	Optical true planes—tested by interference methods using standard optical true planes of fused quartz 11 inch diameter, accuracy 0.000001 inch.	
202.110d	Test for 1 to 4 inches in diameter	7.00
202.110e	Test for 4 to 6 inches in diameter	9.00
202.110f	Test for 6 to 8 inches in diameter	12.00
202.110g	Test for 8 to 10 inches in diameter	20.00
	Microhardness of metals and minerals.	
202.110h	Test with diamond indenter apparatus	5.00

202.111 Precision circles and precision line standards of length.

Item	Description	Fee
202.111a	Graduation and verification of precision circles, minimum fee	$150.00
202.111b	Graduation and testing of precision line standards of length, minimum fee	50.00
202.111c	Shaping, polishing, and testing of ruling-diamond tools, minimum fee	75.00

202.2 Mass

The Bureau tests and certifies the accuracy of standards submitted, but it does not manufacture or sell such standards nor does it, except in rare instances, correct those that are not sufficiently accurate. Weights used in ordinary commercial transactions should be tested by the local or State weights and measures officials. They are accepted for test by this Bureau only in exceptional circumstances.

Weights may be submitted for test by the manufacturer or the owner. When the purchase of weights intends that they be tested by the Bureau, the purchaser should specify as a requirement in his purchase that they conform to the National Bureau of Standards requirements for weights of the desired class. Such weights may be shipped to the Bureau directly from the factory or warehouse and can be forwarded by the Bureau to the purchaser.

A written request for the testing should be sent when the weights are shipped. This should always indicate the class of weights submitted, and

if two different tests are available in that class, the character of test desired. Sufficient information should also be given to enable the Bureau to identify the package. If weights have already been used as standards in exacting work and it is important to know what their corrections were at the close of such work, this fact should be stated; otherwise, weights are carefully cleaned before being tested.

When weights conform to the specifications and tolerances of one of the recognized classes of standards, a "certificate" is issued on completion of the test, and each weight of the commercial group is impressed with a seal, unless this is impracticable or inadvisable. For weights not conforming to the requirements a "report" is issued.

As a rule each set is treated as a whole, but when a few weights of a set are not sufficiently accurate the set may be split, a certificate being issued for the satisfactory portion and a report for the incorrect weights.

When certified weights are shipped from the Bureau, either the inner wrappings or the shipping case will be sealed, and will bear the National Bureau of Standards test number, together with any other numbers or letters that may be necessary for identification.

202.201 "Class A" standard weights (new). Class A standards must be made of a single piece of metal. The larger weights of this class are, at the present time, usually made of bronze, gold-plated. They are intended for such purposes as primary State standards. The value for each weight, given to a high degree of precision, is included in the certificate. New weights are given a three months' test for constancy.

Item	Description	Fee
	New class A standards, or sets or groups containing such standards. Inspecting, cleaning, handling, etc. (but not including test for accuracy):	
202.201a	For a single weight not greater than 50 lb or 25 kg	$5.00
202.201b	For each set or group of weights submitted as a unit, when the largest weight is not greater than 2 lb or 1 kg	5.00
202.201c	For each set or group of weights submitted as a unit, when the largest weight is not greater than 20 lb or 10 kg but is greater than 2 lb or 1 kg	7.00
202.201d	For each set or group of weights submitted as a unit, when the largest weight is not greater than 50 lb or 25 kg but is greater than 20 lb or 10 kg	10.00
	NOTE: To the appropriate item above there will be added, in the case of a full regular test, an amount computed from one or more of the following items—the item or items used depending on the size of the weights.	
	For weights given the complete inspection, cleaning, etc., but not tested for accuracy, on account of defects discovered or for some other cause, the fee is only the appropriate one of the items above.	

Item	Description	Fee
	Testing for accuracy and constancy, sealing, certifying or reporting the value of each weight:	
202.201e	For each weight not greater than 2 lb or 1 kg	$5.00
202.201f	For each weight not greater than 20 lb or 10 kg but greater than 2 lb or 1 kg	5.50
202.201g	For each weight not greater than 50 lb or 25 kg but greater than 20 lb or 10 kg	6.00

202.202 "Class A" standard weights (not new). This schedule applies to standards that have been in use several years, or that have been given the 3 months "age" test for constancy. For description of "Class A" standards, see 202.201.

Item	Description	Fee
	Inspecting, cleaning, handling, etc. (but not including test for accuracy)	
202.202a	For a single weight up to 50 lb or 25 kg	$3.00
202.202b	For each set or group of weights submitted as a unit, when the largest weight is not greater than 2 lb or 1 kg	3.00
202.202c	For each set or group of weights submitted as a unit, when the largest weight is not greater than 20 lb or 10 kg but is greater than 2 lb or 1 kg	3.50
202.202d	For each set or group of weights submitted as a unit, when the largest weight is not greater than 50 lb or 25 kg but is greater than 20 lb or 10 kg	5.00
	NOTE: To the appropriate item above there will be added, in the case of a full regular test, an amount computed from one or more of the following items—the item or items used depending on the size of the weights.	
	For weights given the complete inspection, cleaning, etc., but not tested for accuracy, on account of defects discovered, or for some other cause, the fee is only the appropriate one of the items above.	
	Testing for accuracy, certifying or reporting correction for each weight:	
202.202e	For each weight not greater than 2 lb or 1 kg	3.00
202.202f	For each weight not greater than 20 lb or 10 kg but greater than 2 lb or 1 kg	3.50
202.202g	For each weight not greater than 50 lb or 25 kg but greater than 20 lb or 10 kg	4.00

202.203 "Class B" standard weights. Class B standards must be just as accurate as those of Class A (202.201), but the requirements as to structure are not so severe, and they are certified merely as correct within the required tolerances.

Item	Description	Fee
	Inspecting, cleaning, handling, etc. (but not including test for accuracy):	
202.203a	For a single weight not greater than 50 lb or 25 kg	$3.50
202.203b	For each set or group of weights submitted as a unit, when the largest weight is not greater than 2 lb or 1 kg	3.50
202.203c	For each set or group of weights submitted as a unit when the largest weight is not greater than 20 lb or 10 kg but is greater than 2 lb or 1 kg	4.00
202.203d	For each set or group of weights submitted as a unit when the largest weight is not greater than 50 lb or 25 kg but is heavier than 20 lb or 10 kg	5.50
	NOTE: To the appropriate item above there will be added, in the case of a full regular test, an amount computed from one or more of the following items—the item or items used depending on the size of the weights.	
	For weights given the complete inspection, cleaning, etc., but not tested for accuracy, on account of defects discovered or for some other cause the fee is only the appropriate one of the items above.	
	Testing for accuracy, sealing, certifying or reporting whether the value of each weight is correct within the specified tolerance:	
202.203e	For each weight not greater than 2 lb or 1 kg	.50
202.203f	For each weight not greater than 20 lb or 10 kg but greater than 2 lb or 1 kg	.75
202.203g	For each weight not greater than 50 lb or 25 kg, but greater than 20 lb or 10 kg	1.00

202.204 "Class C" standard weights (except cast iron 50-lb. weights). Class C includes high grade "test weights," such as are intended primarily for testing the scales and weights used in ordinary commercial transactions. The errors allowable on these weights are five times those of Class B (202.203), but only one-tenth of the errors recommended for weights in use for ordinary trade. They are certified as correct within the prescribed tolerances.

Item	Description	Fee
	Inspecting, cleaning, handling, etc. (but not including test for accuracy):	
202.204a	For a single weight not greater than 50 lb or 25 kg	$3.50
202.204b	For each set or group of weights submitted as a unit when the largest weight is not greater than 2 lb or 1 kg	3.50
202.204c	For each set or group of weights submitted as a unit when the largest weight is not greater than 20 lb or 10 kg but is greater than 2 lb or 1 kg	4.00

Item	Description	Fee
202.204d	For each set or group of weights submitted as a unit when the largest weight is not greater than 50 lb or 25 kg but is greater than 20 lb or 10 kg	$5.50
	NOTE: To the appropriate item above there will be added, in the case of a full regular test, an amount computed from one or more of the following items—the item or items used depending on the size of the weights.	
	For weights given the complete inspection, cleaning, etc., but not tested for accuracy, on account of defects discovered or for some other cause, the fee is only the appropriate one of the items above.	
	Testing for accuracy, sealing, certifying or reporting the value of each weight within the specified tolerance.	
202.204e	For each weight not greater than 2 lb or 1 kg	.50
202.204f	For each weight not greater than 20 lb or 10 kg but greater than 2 lb or 1 kg	.75
202.204g	For each weight not greater than 50 lb or 25 kg but greater than 20 lb or 10 kg	1.00
202.204h	Readjusting a weight within Class C tolerances, including the final test for accuracy (optional with NBS)	1.50

202.205 "Class M" laboratory standards of mass. Class M standards must be one-piece weights. They are suitable either for laboratory weighings of extreme precision, such as one part in a million or better, or for very reliable reference standards. Either of two tests may be given them: the high precision test or the moderate precision test. In both cases the correction for each weight is certified, but in the former test the corrections are certified to a higher degree of precision. To obtain this it is necessary to determine the volume of each of the larger weights by hydrostatic weighings. In the Moderate precision test the values are certified only to the same precision as for weights of Class S (202.206), with the result that the density of the weights may generally be assumed from the average density of the material of which they are made.

Item	Description	Fee
	NOTE: Item b applies to weights which are boiled in distilled water to remove traces of plating salts as completely as possible, and also as a test of the adequacy of the plating. Item a applies to weights which are not given this treatment, particularly to those that are not electroplated or that have been in use for some years.	
202.205a	Class M standards that are not new or not plated: for each set, or single weight, or group that is submitted as a unit—for regular inspection, cleaning, handling, etc. (but not including test for accuracy)	$3.00

Item	Description	Fee
202.205b	New plated Class M standards and sets or groups containing such standards: for each set, or single weight, or group of weights that is submitted as a unit—for regular inspection, cleaning, handling, etc. (but not including test for accuracy)	$4.00
	NOTE: To the appropriate item above there will be added, in the case of a full regular test, an amount computed from one or more of the following items—the item or items used depending on the nature of the test. For weights given the complete inspection, cleaning, etc. but not tested for accuracy, on account of defects discovered or for some other cause, the fee is only the appropriate one of the items above.	
202.205c	Moderate precision test of each weight—testing accuracy and certifying or reporting the value of each weight	1.00
202.205d	High precision test of each weight—testing accuracy and certifying or reporting the value of each weight (as a rule this test requires also the determination of the volume of each weight above 1 g) (see item e)	2.50
202.205e	For each weight for which the actual volume must be determined—determination of actual volume by hydrostatic weighings	2.25
202.205f	Reference standards and weights whose constancy over a long period of time must be assured—determination of change that occurs during 3 months under good atmospheric conditions. The fee for this test of constancy with "age" will be equal to (and in addition to) that computed from item c or d.	

202.206 "Class S" laboratory weights. Class S includes high-grade "analytical" and similar laboratory weights. The larger weights are commonly made with a knob merely screwed into the body. These weights must not show excessive variations in value under ordinary variations in the humidity of the air. Either of two tests may be given these weights: the calibration or the tolerance test. In the former the values are certified; in the latter the Bureau certifies merely that the errors are not more than the prescribed tolerances.

Item	Description	Fee
202.206a	Class S laboratory weights that are "one-piece" weights, or screw knob weights that are not plated or lacquered, or in general, weights that do not need to be given a test for the effect of changes in atmospheric humidity; for each set or single weight, or group that is submitted, tested and certified or reported as a unit—for regular inspection, cleaning, handling, etc. (but not including test for accuracy)	$3.00

Item	Description	Fee
202.206b	Plated or lacquered screw knob weights or sets or groups that include such weights; or in general, weights that are tested for the effect of variations in atmospheric humidity; for each set, or single weight, or group that is submitted, tested, and certified or reported as a unit—for regular inspection, cleaning, handling, etc. (but not including test for accuracy)	$4.00
	NOTE: To the appropriate item above there will be added, in the case of a full regular test, an amount computed from either item d or item c depending on the nature of the test.	
	For weights given the complete inspection, cleaning, etc., but not tested for accuracy, on account of defects discovered or for some other cause, the fee is only the appropriate one of the items above.	
202.206c	Determination of actual value for each weight—testing and certifying or reporting of actual correction for each weight	1.00
202.206d	Tolerance test for each weight—testing and certifying or reporting whether the value of each weight is correct within the specified tolerance	.50
202.206e	Readjustment of screw-knob weights—Readjusting within Class S tolerance for one weight. This operation requires an additional test under "c" or "d" above. Readjusting is to be done at the option of the NBS	1.25

202.207 "Class S2" laboratory weights. Class S2 includes laboratory weights of the grade commonly recognized as "second quality analytical" or "students' sets." The allowable errors are five times those of Class S (202.206), but the structure of the weights is generally about the same as in Class S. These weights are certified as correct within the prescribed tolerances.

Item	Description	Fee
202.207a	Class S2 laboratory weights, for each set or single weight, or group that is submitted, as a unit: for regular inspection, cleaning, handling, test report, etc. (but not including tests for accuracy)	$3.00
	NOTE: To the item above there will be added, in the case of a full regular test, an amount computed from item b.	
	For weights given the complete inspection, cleaning, etc., but not tested for accuracy, on account of defects discovered or for some other cause, the fee is only item a.	
202.207b	Tolerance test of each weight—testing each weight for accuracy within the specified tolerance	.50

202.208 Balances.

Item	Description	Fee
	Tests of balances frequently involve work specially suited to the individual balance or of unusual importance in the work for which the balance is used. Fees for such special tests, as well as for tests not provided for in the items below, are computed according to the time and expense involved. In general the test involves determining: (1) Ratio of the arms of the beam and constancy of this ratio with change in load. (2) Change in sensitiveness with load. (The sensitiveness will not be changed unless instructions to this effect are received and agreed to.) (3) Reliability of the balance (i. e., its ability to repeat results) in so far as this is indicated by a few repetitions under (1) and (2) with skillful handling under good conditions. (4) Accuracy of graduation of rider scale. (5) Accuracy of quick weighing attachments. For scales having overhead platforms, and for all types in which this is of primary importance. (6) Effect of shifting load from center toward edge of platform. (7) Such other features as are of primary importance, such as accuracy of indications of sliding poise, or equality of water buckets of gas calorimeter balances. The preliminary inspection covers, in general, such points as (1) obvious looseness or imperfections in knife edges and bearings, (2) improper looseness or "wabbling" of arrestment arms, (3) stability of central pillar, (4) operation and adjustment of arrestments and rider carrier, (5) any other features essential to the proper operation of the balance.	
202.208a	Analytical balance, 50 to 200 g capacity, precision of test about 0.1 mg	$22.50
202.208b	Same as 202.208a except for balances equipped with quick weighing devices such as direct reading scales, chain, or beam notched for special rider, and damping attachments.	27.50
202.208c	Same as (a) or (b) above but precision of test about 0.01 mg.	35.00
202.208d	Assay balance, 1 g. capacity, precision of test about 0.001 mg	32.50
202.208e	Microchemical balance of 20 g. capacity, precision of test about 0.01 mg	32.50
202.208f	Same as in item (e) above but precision of test 0.001mg	55.00
202.208g	"Bates sugar balance" and "pulp" balances of similar capacity and sensitiveness	17.50
202.208h	Portable inspector's balance, capacity 10 lb. precision of test about 0.1 g. or 1 grain	16.50
202.208i	Gas calorimeter balance, precision of test about 0.001 lb. or 0.5 grain	12.50

202.3 Time

202.301 Timepieces.

Item	Description	Fee
202.301a	Watches (5 positions, temperature and isochronism) test under Class A program (54 days), whether granted a Class A certificate, or a report of performance, each	$15.00
202.301b	Same as (a) above, but submitted in groups of 5 or more at the same time, each	12.50
203.301c	Watches (5 positions and temperature) test under the "Railroad Precision" test program (19 days), whether granted a certificate or a report, each	6.00
202.301d	Same as (c) above, but submitted in groups of 5 or more at the same time, each	5.00
202.301e	Watches (3 positions and temperature) test under "Business Precision" program (15 days), whether granted a certificate or a report, each	5.00
202.301f	Same as (e) above, but submitted in groups of 5 or more at the same time, each	4.00
202.301g	Chronometers (Marine) test under the "Chronometer Test" program (30 days), whether granted a certificate or a report, each	12.00
202.301h	Same as (g) above, but submitted in groups of 5 or more at the same time, each	11.00
202.301i	Stop watches—test under the "Stop Watch Test" program (1 to 6 days), whether granted a certificate or a report, each	7.50
202.301j	Same as (i) above, but submitted in groups of 5 or more at the same time, each	7.00
202.301k	Watches—test of pocket or wrist watch in 5 positions at room temperature only (11 days), no certificate to be issued, a report of performance only issued, each	5.00
202.301L	Same as (k) above, but submitted in groups of 5 or more at the same time, each	4.00
202.301m	Watches—test of pocket or wrist watch in 3 positions at room temperature only (7 days), no certificate to be issued, a report of performance only issued, each	4.50
202.301n	Same as (m) above, but submitted in groups of 5 or more at the same time, each	4.00

202.4 Capacity, Density, and Fluid Meters

202.401 Volumetric apparatus.

Item	Description	Fee
202.401a	Flasks, capacities up to and including 250 ml.—testing and stamping, each flask	$1.25

Item	Description	Fee
202.401b	Flasks, capacities exceeding 250 ml.—testing and stamping, each flask	$1.75
202.401c	Flasks, capacities exceeding 500 ml.—When bearing more than one capacity mark, testing for each capacity	1.25
202.401d	Transfer pipettes and Babcock test bottles—testing and stamping, each capacity tested	1.00
202.401e	Cylindrical graduates—testing and stamping, each capacity tested	1.00
202.301f	Flasks—specific gravity—testing at four capacities and stamping	3.50
202.401g	Certificates of capacity for any test, items (a) to (d) above when requested, minimum fee	1.00
202.401h	Burettes—testing and certifying five intervals	5.00
202.401i	Measuring pipettes—testing five intervals, and stamping	3.50
202.401j	Burettes—testing capacity of intervals in excess of the five covered by item (h) above	.75
202.401k	Dillution pipettes (haemacytometers)—testing two ratios, and marking each pipette	.75
202.401L	Automatic (Trenner) pipettes (haemacytometers)—testing and stamping, each pipette	.70
202.401m	Apparatus intended for use at a temperature other than 20° C, between 15° and 30° C.—testing, additional charge for each piece	.60
202.401n	Apparatus of indicated capacity other than in milliliters—testing, additional charge for each piece	.60
202.401o	Apparatus disqualified for test—preliminary examination, charge for each piece	.50
202.401p	Missing identification numbers—for supplying, charge each number	.65

202.402 Metal capacity standards.

Item	Description	Fee
202.402a	Half-bushel and 5-gallon measures—testing, marking, and certifying capacity, each	$10.00
202.402b	Measures of capacity less than ½ bushel and 5 gallons—testing, marking, and certifying capacity, each	8.00
202.402c	Cubic-foot bottles for use in testing gas meter provers—testing, marking and certifying capacity, each	14.00
202.402d	1/10 cubic-foot bottles for use in testing gas meters—testing, marking, and certifying capacity, each	10.00
202.402e	5-gallon field standards (Seraphin neck type)—testing, sealing and reporting, each	10.00
202.402f	Field standards of capacity less then 5 gallons (Seraphin neck type)—testing, sealing, and reporting, each	8.00
202.402g	Field standards in excess of 5-gallon capacity, calibrated to deliver; testing, sealing and reporting; for the first 10-gallons	10.00
202.402h	Field standards exceeding 10-gallons capacity, calibrated to deliver; testing, sealing and reporting; for each 5-gallon increment in excess of the first 10 gallons covered in item (g) above, but not exceeding 18 5-gallon increments	3.00

202.403 Hydrometers and thermohydrometers.

Item	Description	Fee
202.403a	Hydrometers—general inspection, testing at three points, and marking where there is compliance with Bureau requirements for precision stamp	$3.00
202.403b	Thermo-hydrometers—same as in item (a) above	3.00
	NOTE: Thermometer testing—charges for testing between 32° and 212° F. or between 0° and 100° C. will be made in accordance with test fee schedule 203.101 titled "Laboratory Thermometers" at $1.50 for each point tested.	
202.403c	Hydrometers—certificate or report of correction at three points, additional fee	1.00
202.403d	Hydrometers—testing, certifying or reporting corrections at more than three points, each such point	1.00
202.403e	Hydrometers—determination of weight in air, additional fee	.75
202.403f	Supplying missing identification numbers on hydrometers, charges per number	.50

202.404 Density of solids and liquids.

Item	Description	Fee
202.404a	Density of solids and liquids—determination at room temperature, each	$5.00
202.404b	Density of solids and liquids—determination at a specified temperature between 0° and 50° C, each	7.50
202.404c	Coefficient of thermal expansion of liquids—determination between any two temperatures between 0° and 50° C	19.00
202.404d	Coefficient of thermal expansion of liquids—determination between any two temperatures additional to item 202.404c, each	7.00

202.405 Fluid meters, including gas measuring instruments.

Item	Description	Fee
202.405a	Portable cubic foot standards (Stillman type)—testing, adjusting, sealing, and certifying	$50.00
202.405b	Gas meter provers not exceeding 5 cubic feet capacity—testing and certifying or reporting	44.00
202.405c	Gas meter provers more than 5 cubic feet capacity—testing and certifying or reporting each 5 cubic feet capacity additional to item 202.405b above	11.00

Item	Description	Fee
	NOTE ON b AND c: Gas meter provers must be tested in the place of use: hence all travel expenses and haulage of equipment will be in addition to the test fee and arranged for separately. This applies also to tests of large meters and other special meters where the test work must be done in the field.	
202.405d	Laboratory wet gas meters—testing and reporting as received	$28.00
202.405e	Laboratory wet gas meters—testing at one rate, adjusting index for zero correction and reporting	32.50
202.405f	Laboratory wet gas meters—testing at several rates within operating range, adjusting index and reporting	50.00
202.405g	Dry gas meters—rated capacity 600 cubic feet per hour, or less—testing with prover in laboratory at two rates of flow and reporting	12.50
202.405h	Orifices, flow nozzles and other rate-of-flow meters, self-contained—or for use in pipes up to and including 3-inch pipe:	
	Calibration with water or air at 5 rates of flow	40.00
202.405i	Additional fee for meter in 4-inch pipe	12.50
202.405j	Additional fee for meter in 6-inch pipe	37.50
202.405k	Additional fee for meter in 8-inch pipe	90.00
202.405L	Orifices, flow nozzles and other rate-of-flow meters, self-contained or for use in pipes up to and including 8-inch pipe: for each rate in excess of the five covered by item 202.405h above	4.50
202.405m	Orifices, flow nozzles and other rate-of-flow meters for use in pipes up to and including 8-inch pipe, when two or more are used interchangeably in the same mounting: calibration with water or air at five rates of flow, in addition to the first covered by item 202.405h above	22.50
202.405n	Fabric permeability apparatus—determining the rate of flow-pressure drop relation on one orifice or nozzle thereof and reporting	17.00
202.405o	Fabric permeability apparatus—for each orifice or nozzle thereof in excess of the initial one covered by item 202.405n	5.00

202.6 Thermal Expansion

202.601 Thermal expansion of solids. Each specimen submitted should be in the form of a straight rod or bar of uniform crosssection. The length should be at least 320 mm (12⅝ inches), and the diameter (or diagonal, if the rod has a rectangular or irregular crosssection) should be between 5 and 10 mm (between 3/16 and ⅜ inch). Sizes other than these may be tested, but applicants wishing tests on special sizes should communicate with the Bureau before preparing specimens. Each sample accepted for test, is cut to an exact length at the Bureau, and the ends of the sample are also shaped and highly polished. After the tests, specimens are usually retained at the Bureau.

The Bureau requires a complete record of the chemical composition, previous heat treatment, and method of manufacture—whether cast, drawn, rolled, etc. These data should accompany the request for test. Specimens liable to break in shipment or in cutting should be sent in duplicate.

Unless otherwise specified all reports on expansion will be based on observations made at four temperatures, including room temperature. Average coefficients of expansion for several temperature ranges will usually be reported. If necessary, expansion equations will also be derived by the method of least squares for materials that show regular expansion. An extra fee will be charged for the derivation of each expansion equation.

Item	Description	Fee
	202.601a to 202.601i comprise the shaping of the ends of specimens and the determinations of the thermal expansion for the temperature ranges specified:	
202.601a	From 20° C (or higher) to 100° C (or lower)	$60.00
202.601b	From 20° C (or higher) to 300° C (or lower)	62.50
202.601c	From 20° C (or higher) to 500° C (or lower)	68.00
202.601d	From 20° C (or higher) to 700° C (or lower)	72.50
202.601e	From 20° C (or higher) to 900° C (or lower)	82.50
202.601f	From 20° C (or higher) to 1,000° C (or lower)	100.00
202.601g	From —20° C (or higher) to 20° C (or lower)	80.00
202.601h	From —20° C (or higher) to 300° C (or lower)	105.00
202.601i	From —140° C (or higher) to 20° C (or lower)	135.00
202.601j	Determination of thermal expansion at each additional temperature within the range tested	6.50
202.601k	For the derivation of an expansion equation, an extra fee will be charged dependent upon the amount of work required (minimum charge)	10.00
202.601L	Determinations of thermal expansion by reference to fused quartz or other material as a standard (accurate to about 3% in value of coefficient) for all items above except e, f, and i at ½ the above fees.	

202.8 Scales

202.801 Large capacity scales and weights. Weights shall be clean, suitably protected, and shipped in wooden boxes having covers screwed in place, not more than five weights to a box. Shipments from the West and Mid-West shall be made to the National Bureau of Standards, Master Scale Depot, 5800 West 69th Street, Chicago 38, Ill. Shipments from the East may be made to the National Bureau of Standards, Connecticut Avenue and Van Ness Street, Washington 25, D.C.

For certification as Class C weights, the following requirements must be met: (1) the surfaces of the weights shall be reasonably smooth and free from any holes or other depressions in which foreign matter may accumulate. (2) The surfaces of the weights shall have a suitable protective coating. (3) Each weight shall have a single adjusting cavity opening on a side or on the top of the weight, but not on the bottom. The closure for the cavity must conform to Class C requirements (see Circular 3 of the National Bureau of Standards, entitled "Design and Test of Standards of Mass" available in State and technical libraries) and be sealed by a cap, as of lead or aluminum, upon which the impression of the Bureau seal may be made. (4) New or reconditioned weights shall be accurate within the regular tolerance of ±10 grains; weights "in use" shall be accurate within the maintenance tolerance of ±40 grains. New weights found to be inaccurate will be adjusted upon request, provided new sealing caps are furnished. Reconditioned weights found to be inaccurate will be adjusted without special request, provided new sealing caps are available. Weights found to be in conformance with Class C requirements will be appropriately marked on the sealing caps with symbols including the letters "NBS" and figures showing the year in which the test was made. A "certificate" will be issued with respect to each set of weights found to be in conformance with Class C requirements; a "report" will be issued with respect to each set of weights that fails to meet these requirements.

Item	Description	Fee
	Class C, cast iron, 50-lb. test weights:	
	NOTE: A minimum handling charge of $2.50 will be made for each group of 50-lb. cast iron, Class C test weights submitted in groups not exceeding ten in number; an additional handling charge of 25¢ will be made for each weight in the group in excess of 10.	
202.801a	For tolerance test when no readjustments are required, per weight	$0.75
202.801b	For tolerance test, adjustment and retest, per weight	1.50
	Test weights, 51 to 2,500 lb.:	
	NOTE: A minimum handling charge of $2.50 will be made for each group of test weights submitted in groups not exceeding 10 in number; an additional charge of 25¢ will be made for each weight in excess of 10.	
202.801c	Standardization of test weights larger than 50 lb. and not exceeding 2,500 lb. per weight	5.50
202.801d	Test weights, 2,501 to 10,000 lb.: Standardization and handling, test weights larger than 2,500 lb. and not exceeding 10,000 lb. fee per weight	10.50
202.801e	Scale test cars: Standardization at Clearing master scale depot	7.50

202.9 Gages

Test fee schedules 202.901 to 202.905 include a statement of the relative accuracy to which measurements are ordinarily made. However, if the character of the defining surface of a gage or other article is not such as to warrant the certification to this accuracy, the report will show the accuracy actually obtained. If a greater accuracy is requested and the defining surfaces are such as to permit measurements to the accuracy requested, the necessary measurements will be made and a special fee will be charged.

In the shipment of gages, extreme precautions should be taken both against corrosion and damage by contact with other gages during transit. All defining steel surfaces should be greased and protected with waxed paper or a suitable strippable plastic coating. A greased steel surface coming in contact with newspaper, wrapping paper (unwaxed) or excelsior is very likely to corrode. Small gages suitably wrapped may be separated by newspapers, excelsior, etc. Heavy gages should be rigidly fastened in place in a strong rigid container so that no movement is possible. Plug and ring gages should ordinarily not be shipped mated. In the case of large-sized threaded plugs and rings, however, matting is permissable as a means of protecting the plug threads. In such case a grease must be used that will prevent electrolytic corrosion between the mating gages.

202.901 Gage blocks and end standards of length.

Item	Description	Fee
	Gage blocks of standard commercial sizes, English or metric, with plane parallel contact surfaces, area of contact surface $\frac{1}{3}$ square inch or greater; lengths up to and including 1 inch:	
202.901a	Determination length to $\pm 0.000005''$, parallelism to $\pm 0.000005''$, and planesness of both gaging surfaces to $0.000005''$, each. Application: "B" or "C" quality sets or used "A" quality sets (not including master sets) in good condition. See items (c), (ae), and (r) below.	$0.85
202.901b	Determination length to $\pm 0.000004''$, parallelism to $\pm 0.000002''$, planeness across width of both gaging surfaces of rectangular blocks to $0.000002''$, planesness across width of square blocks to $0.000003''$, and planesness along length of gaging surfaces to $0.000003''$. Application: "A" quality sets. See items (c), (bf), and (r) below.	1.00
202.901c	Determination of length to $\pm 0.000003''$, parallelism to $\pm 0.000002''$, and planeness of both gaging surfaces to $0.000002''$, each. Application: "AA," "A" or "B" quality, or master sets, when requested. Also, all blocks tested under item (a) or (b) found to be outside of length tolerance. This is the highest accuracy to which blocks shorter than $0.100''$, or longer than $0.200''$, are tested.	1.25

Item	Description	Fee
202.901d	Determination of length to ±0.000002″, parallelism to 0.000002″, and planeness of both gaging surfaces to 0.000002″, each	$2.50
	Application: "AA" quality, or master blocks used as reference standards for precision gage blocks, from 0.100″ to 0.200″, inclusive, when requested.	
	Gage blocks of standard commercial sizes, English or metric, —lengths greater than 1 inch, but not exceeding 4 inches:	
202.901e	Determination of length to ±0.000005″ per inch of length, parallelism to ±0.000005″, and planeness of both gaging surfaces to 0.000005″, each	2.50
	Application: Same as item (a). See items (g), (ae) and (r).	
202.901f	Determination of length to ±0.000004″ per inch of length, parallelism to ±0.000002″, and planeness across width of both gaging surfaces of rectangular blocks to 0.000002″, planeness across width of square blocks to 0.000003″, and planeness along length of gaging surfaces to 0.000003″, each	3.00
	Application: Same as item (b). See items (g), (bf), and (r).	
202.901g	Determination of length to ±0.000003″ per inch of length, parallelism to ±0.000002″ and planeness of both gaging surfaces to 0.000002″, each	4.00
	Application: "AA", or "B" quality, or master sets, when requested. Also, all blocks tested under item (e) or (f) found to be outside of length tolerance.	
202.901h	Determination of length to ±0.000002″ per inch of length, parallelism to ±0.000002″, and planeness of both gaging surfaces to 0.000002″, each	7.50
	Application: "AA" quality, or master blocks used as reference standards for precision gage blocks, when requested.	
	Gage blocks, usual 81 block set including 2, 3, and 4-inch blocks:	
202.901ae	Measurements as described under items (a) and (e)	70.00
202.901bf	Measurements as described under items (b) and (f)	88.00
202.901cg	Measurements as described under items (c) and (g)	115.00
202.901dch	Measurements as described under items (d), (c), and (h)	195.00
	Gage blocks of standard commercial sizes. English or metric —lengths greater than 4 inches but not exceeding 8 inches:	
202.901i	Determination of length to ±0.000003″ per inch of length, parallelism to ±0.00001 inch, and planeness of both gaging surfaces to 0.000005″ each	4.00
202.901j	Determination of length to ±0.000001″ per inch of length, parallelism to ±0.000005 inch, and planeness of both gaging surfaces to ±0.000002 inch, each	.50
	Gage blocks of standard commercial sizes, English or metric —lengths greater than 8 inches but not exceeding 12 inches:	

Item	Description	Fee
202.901k	Determination of length to ±0.000003″ per inch of length, parallelism to ±0.00001 inch and planeness of both gaging surfaces to 0.000005 inch, each	$5.25
202.901L	Determination of length to ±0.000001″ per inch of length, parallelism to ±0.000005 inch and planeness of both gaging surfaces to 0.000002 inch, each	9.00
	Gage blocks of standard commercial sizes, English or metric —lengths greater than 12 inches but not exceeding 20 inches:	
202.901m	Determination of length to ±0.000003″ per inch of length, parallelism to ±0.00001 inch, and planeness of both gaging surfaces to 0.000005 inch, each	9.00
202.901n	Determination of length to ±0.000001″ per inch of length, parallelism to ±0.000005 inch, and planeness of both gaging surfaces to 0.000002 inch, each	15.00
	Gage blocks, eight-block set composed of 5, 6, 7, 8, 10, 12, 16, and 20-inch blocks:	
202.901ikm	Measurement as described under items (i), (k), and (m)	42.00
202.901jln	Measurements as described under items (j), (l), and (n)	75.00
	Gage blocks, odd sizes not regularly stocked by manufacturers and for which standards of equal nominal length are not available, lengths up to 4 inches:	
	Determination of length to ±0.000002 inch or 0.000002 inch per inch for blocks longer than 1 inch, parallelism to ±0.000002″, and planeness of both gaging surfaces to 0.000002″:	
202.901p	First block, less than 1 inch in length, each	7.00
	For additional blocks in same lot of same nominal size, test fees in items (a) to (d), inclusive, apply depending on the accuracy requested.	
202.901q	First block, more than 1 inch and not over four inches in length, each	12.00
	For additional blocks in same lot of same nominal size, test fees in items (e) to (h), inclusive, apply depending on the accuracy requested.	
	Gage blocks and gage block accessories, measurements of microflatness (surface finish), one gaging surface:	
202.901r	Determination of errors of one surface in microflatness in microinches rms (root mean square), by Profilometer or equivalent test, each	1.50
	Application: All gage blocks, or gage block accessories, when requested. Also, all blocks tested under items (a), (b), (e) or (f), selected by visual examination, which when measured are found to be outside of established tolerances for microflatness errors.	
202.901s	Determination of errors of one surface in microflatness by a Brush Surface Analyzer, including chart, and root mean square value derived from chart, each	7.00
202.901t	Gage block accessories: Set of 9 gage attachments, Hoke List No. 1000 or equivalent, determinations of lengths, flatness, angles, per set	21.50

Item	Description	Fee
202.901u	Set of 19 gage block accessories, Johannson Set No. 47 or equivalent, determinations of lengths, flatnesses, angles, per set	$37.50
	End standards with spherical or pointed ends, or flat ends with area of contact less than ⅓ inch:	
202.901aa	End standards—determination of length to ±0.00004″ for lengths up to and including 8 inches	5.00
202.901bb	End standards—determination of length to ±0.000005″ per inch of length for lengths over 8 inches up to and including 20 inches	7.50
202.901cc	End standards—determination of length to ±0.000005″ per inch of length for lengths over 20 inches up to and including 40 inches	9.50
202.901dd	End standards—determination of length to ±0.000005″ per inch of length for lengths over 40 inches up to and including 72 inches	$16.00

202.902 Plain and taper plug and ring gages.

Item	Description	Fee
202.902a	Plain plug gages—determination of diameter, taper, and roundness to ±0.00003″ for sizes up to and including 2 inches	$5.00
202.902b	Plain plug gages—determination of diameter, taper, and roundness to ±0.00001″ for sizes up to and including 2 inches	8.50
202.902c	Plain plug gages—determination of diameter, taper, and roundness to ±0.00005″ for sizes over 2 inches up to and including 10 inches	6.00
202.902d	Plain ring gages—determination of diameter, taper, and roundness to ±0.00003″ for sizes ¼″ up to and including 2 inches	5.50
202.902e	Plain ring gages—determination of diameter, taper, and roundness to ±0.00001″ for sizes ¼″ up to and including 2 inches	14.50
202.902f	Plain ring gages—determination of diameter, taper, and roundness to ±0.00005″ for sizes over 2 inches up to and including 10 inches	8.50
202.902g	Taper plug gages—determination of taper over total length to ±0.00003″ and diameter at any specified point to 0.00003″ for sizes up to and including 3 inches	13.00

Item	Description	Fee
202.902h	Taper plug gages—determination of taper over total length to ±0.00005″ and diameter at any specified point to ±0.00005″ for sizes over 3 inches up to and including 6 inches	$17.50
202.902i	Taper ring gages—determination of fit and standoff from mating plug gage	4.00

202.903 Thread plug and ring gages.

Item	Description	Fee
202.903a	Straight thread plug gages—determination of angle to 2′ to 8′ depending on pitch; lead error and pitch diameter to 0.0001″; major diameter to 0.0002″; thread form as to clearance, for sizes up to and including 4 inches	$6.00
202.903b	Straight thread plug gages—determination of pitch diameter to 0.0001″ for sizes up to 4 inches	3.50
202.903c	Straight thread ring gages—determination of angle to 5′ to 10′ depending on pitch, lead error to 0.0001″, minor diameter to 0.0002″, thread form as to clearance, and fit on mating plug, for sizes 3/16″ to 12 inches	4.50
202.903d	Taper thread plug gages—determination of half angles to 3′ to 10′ depending on pitch; lead error, pitch diameter and taper to 0.0001″; major diameter to 0.0003″; and thread form as to clearance, for sizes up to and including 10 inches	14.00
202.903e	Taper thread plug gages—determination of half angles to 3′ to 10′ depending on pitch; lead error and taper to 0.0001″; pitch diameter to 0.0002″; major diameter to 0.0004″; and thread form as to clearance, for sizes from 10 inches to 24 inches, incl.	16.50
202.903f	Taper thread ring gages—determination of angle to 5′ to 10′ depending on pitch; lead error to 0.0001″; taper to 0.0002″; minor diameter to 0.0003″ or truncation of thread crest; thread form as to clearance; and standoff from mating plug to 0.001″, for sizes up to 24 inches	10.00
202.903g	API cable and rotary tool joint gages—determination of mating standoff and standoff from Grand Master gages, per set	6.00
202.903h	API sucker rod plug gages designated as P1 and B2—determination of dimensions specified in API Std. No. 11-B	7.00
202.903i	API sucker rod plug gages designated as P3 and B4—determination of dimensions specified in API Std. No. 11-B	13.50
202.903j	API sucker rod plug gages designated as P5 and B6—determination of dimensions specified in API Std. No. 11-b	6.50
202.903k	API sucker rod ring gages designated as P2 and B1—determination of dimensions specified in API Std. No. 11-B	5.50
202.903L	API sucker rod ring gages designated as P4 and B3—determination of dimensions specified in API Std. No. 11-B	6.50

Item	Description	Fee
202.903m	API sucker rod ring gages designated as P6 and B5—determination of dimensions specified in API Std. No. 11-B	$4.50
202.903n	API sucker rod gages—determination of dimensions of complete set (P1 to P6 and B1 to B6) of new gages of any one size	80.00
202.903o	API sucker rod gages—determination of dimensions specified in API Std. No. 11-B for the inspection of used gages, per set of any one size	29.00

202.904 Instruments and components.

Item	Description	Fee
202.904a	Micrometer calipers—determination of errors at ten points selected to test uniformity of graduations as well as lead errors. Also determination of planeness and parallelism errors of contact surfaces	$7.50
202.904b	Dial micrometers—determination of errors in each tenth revolution of the pointer for one revolution and each half revolution up to five revolutions	7.50
	NOTE: In the case of dial micrometers, the accuracy obtainable depends on the value of the smallest division on the dial and on the mechanical condition of the instrument as evidenced by the degree to which it will repeat its indications.	
202.904c	Thread wires—determination of diameter, straightness, and roundness of each of three wires in a set in accordance with specification for wires in Handbook H28, Screw Thread Standards for Federal Services, and certification of mean diameter and C correction on an approved type of container label supplied by the manufacturer. For the following best sizes of wires for standard 60° screw threads: 4, 4½, 5, 5½, 6, 7, 7½, 8, 9, 10, 11, 11½, 12, 13, 14, 16, 18, 20, 22, 24, 26, 27, 28, 30, 32, 36, 40, 44, 48, 50, 56, 64, 72, and 80 threads per inch and the following best sizes for acme standard threads: 1, 1⅓, 1½, 2, 2½, 3, 4, 5, 6, 8, 10, 12, 14, and 16 threads per inch	1.50
202.904d	Thread wires—for sizes not included in schedule 202.904c, per set of three wires	10.25
202.904e	Penetration needles—test for compliance with ASTM specification D5-47T without reporting actual dimensions, each	.60
	NOTE: To obtain test at this fee, the needles or individual containers must be numbered and the manufacturer furnish a blank certificate in a form acceptable to this Bureau.	
202.904f	Penetration needles—determination of diameter of body and point, length of needle and angle of point, with actual dimensions reported, each	1.00
202.904g	Polariscope tubes—determination of the average length of polariscope observation tube and marking with NBS serial number if length is within ±0.03 mm of nominal length for 100 and 200 mm tubes and ±0.04 mm for 400 mm tubes	5.00

202.905 Gill net gages.

Item	Description	Fee
202.905a	Gill net gages—test for compliance with specification noted below, for any lot tested, up to 25 gages (minimum charge $5.00)	$5.00
202.905b	Additional gages beyond 25 submitted at the same time (approved gages are marked with the letters "NBS" and the year of the test), each	.20

NOTE: Gill net gages shall comply with the following specification:

A gage shall be made of tempered carbon steel or tempered stainless steel, as specified. Sharp edges or burrs at ends shall be removed and the ends rounded, but ends shall not be sharpened to make a knife edge. A gage shall not be graduated and any necessary marking, such as length, shall be placed near the end of the gage.

The mean length shall be as specified within ± 0.002 inch and shall be marked on the gage. The gage shall be straight and ends shall be parallel within 0.002 inch. The width of the gage shall be $\frac{1}{2} \pm \frac{1}{16}$ inch.

The thickness of the gage shall be such that when set vertically on a solid anvil, with the upper end of the gage loaded as follows, the gage will deflect at its middle 0.1 of its length:

Length of gages	*Dead weight*
$1\frac{3}{4}$ inch or less	$7\frac{1}{4}$ to $8\frac{3}{4}$ ounces
Over $1\frac{3}{4}$ inch	$7\frac{1}{2}$ to $8\frac{1}{2}$ ounces

FEE SCHEDULE 203: HEAT AND POWER

203.1 Temperature Measurements
- 203.101 Laboratory Thermometers
- 203.102 Thermocouples, Thermocouple Materials, and Pyrometer Indicators
- 203.103 Resistance Thermometers
- 203.104 Clinical Thermometers
- 203.105 Certain types of Industrial Thermometers
- 203.106 Optical Pyrometers and Ribbon-Filament Lamps

203.2 Thermodynamics
- 203.201 Gas Calorimeters

203.4 Lubrication
- 203.401 Oil Filters
- 203.402 Viscometers
- 203.403 Standard Viscosity Samples

203.5 Automotive
- 203.501 Internal Combustion Engine Fuels

203.1 Temperature Measurements

203.101 Laboratory thermometers. Only thermometers identified by serial numbers will be accepted for test.

Item	Description	Fee
203.101a	Thermometers, testing at points from 0 to 100° C, inclusive, or from 32 to 212° F, inclusive, for each point tested	$1.50
203.101b	Thermometers, testing at points from 101 to 300° C, inclusive, or from 213 to 600° F, inclusive, for each point tested	3.50
203.101c	Thermometers, testing at points above 300° C, or 600° F., for each point tested	7.00
203.101d	Thermometers, testing at points from —1 to —140° C, inclusive, or from 31 to —220° F, inclusive, for each point tested	5.00
203.101e	Thermometers, testing in liquid oxygen, liquid air, or liquid nitrogen (−183° to −196° C), for each point tested	5.00
203.101f	Calorimetric thermometers, testing at intervals of 2° C, or 5° F	15.00
203.101g	Beckmann thermometers, with 5° or 6° C scale, testing at 1° intervals by comparison with precision standards	18.00
203.101h	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

203.102 Thermocouples, thermocouple materials, and pyrometer indicators. Thermocouples, thermocouple materials and pyrometer indicators submitted for calibration and test should be accompanied by an order requesting the test and specifying the Fee Schedule Item Number. A bill will be rendered at the completion of the work. It is preferable to send only the thermocouple wires in order to avoid the possible breakage of the insulating and protecting tubes. Length requirements are exclusive of lead wire. Lead wire need not be sent with thermocouples.

The calibration or test of an article will not be undertaken if, in our opinion, the article will not yield the specified accuracy, or if it possesses such unusual characteristics as to prevent the carrying out of the calibration or test, it is found that the article is inferior to its general class, a report will be issued giving the results obtained. In such cases, a fee covering the cost of the work performed, will be charged.

Item	Description	Fee
203.102a	High temperature thermocouples and thermocouple materials. Minimum length 24 inches. Certification of corresponding values of temperature and emf of a thermocouple material against the platinum standard of the NBS or of temperature and emf of a thermocouple at 4 to 15 points within the range 0° to 1,450° C (32° to 2,650° F.)	$22.00

Item	Description	Fee
	Certified accuracy of platinum to platinum-rhodium thermocouples 0.5° in the range 0° to 1,100° C and from 0.5° at 1,100° C to 2° at 1,450° C. Certified accuracy of base-metal thermocouples 0.5° to 1° C., depending upon the type of thermocouple and the highest temperature at which it is calibrated. Results above 1,100° C are obtained by extrapolation.	
203.102b	High temperature thermocouples and thermocouple materials. Certification as per Item 203.102a at less than 4 points, per point	$6.00
	Minimum charge per thermocouple or material	12.00
203.102c	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	22.00
	Freezing points of zinc, antimony, silver and gold. Accuracy of certification 2 microvolts (about 0.2° C).	
203.102d	Standard platinum to platinum-rhodium thermocouples. Minimum length 24 inches. Primary calibration at all of the fixed points listed in Item 203.102c and certification of not more than 15 corresponding values of emf and temperature to an accuracy of 0.3° in the range 0° to 1,100° C. and from 0.3° at 1,100° C. to 2° at 1,450° C. Accuracy of certification at fixed points 2 microvolts.	90.00
203.102e	High temperature thermocouples and thermocouple materials. Certification of interpolated corresponding values of emf and temperature as per item (a) or (d) above, per point	.50
203.102f	Thermocouples. Minimum length 36 inches. Certification of corresponding values of emf. and temperature to an accuracy of about 0.1° in the range 0° to −70° C, per point	6.00
	Minimum charge per thermocouple	12.00
203.102g	Thermocouples. Minimum length 36 inches. Certification of corresponding values of emf. and temperature to an accuracy of about 0.1° in the range 0° to 500° C., per point	8.00
	Minimum charge per thermocouple	16.00
203.102h	Thermocouples. Minimum length 36 inches. Certification of corresponding values of emf. and temperature to an accuracy of about 0.1° in the range −140° to −70° C., per point	8.00
	Minimum charge per thermocouple	16.00
203.102i	Thermocouples. Minimum length 36 inches. Certification of corresponding values of emf. and temperature to an accuracy of about 0.1° in the range −183° to −196° C., per point	8.00
	Minimum charge per thermocouple	16.00
203.102j	Pyrometer Indicators. Calibration of single scale of meter or single dial of potentiometer (reference junction compensator counting as a dial)	6.00
203.102k	Pyrometer Indicators. Calibration of each additional dial of a multi-dial instrument (reference junction compensator counting as a dial) or of each additional range of each dial or scale of a multirange instrument	2.50
	Calibration of a thermocouple and pyrometer indicator as a unit will be charged for as if the thermocouple and indicator were separately calibrated.	

203.103 Resistance thermometers.

Item	Description	Fee
203.103a	Standard platinum resistance thermometers—calibration at the ice, steam and sulfur points	$42.00
203.103b	Standard platinum resistance thermometers—calibration under 203.103a and at the oxygen point	56.00
203.103c	Calorimetric platinum resistance thermometers—calibration at the ice and steam points and one intermediate point	42.00
203.103y	When instruments submitted are found by preliminary tests to be unsuitable for calibration, a charge will be made to cover the cost of the preliminary work. Minimum fee	1.00

203.104. Clinical thermometers. Clinical thermometers marked "Government Tested" or its equivalent will not be accepted for test. Only thermometers identified by serial numbers will be accepted for test.

Item	Description	Fee
203.104a	For any number of thermometers (not exceeding ten) tested for compliance with the current edition of the Commercial Standard for Clinical Thermometers, total fee	$1.50
203.104b	For any number of thermometers (greater than ten) tested for compliance with the current edition of the Commercial Standard for Clinical Thermometers, fee for each thermometers tested	0.15

203.105 Certain types of industrial thermometers. Thermometers having a depth of immersion of not less than 6 inches above the top of the bulb and not more than a total immersion of 24 inches will be accepted for test.

Item	Description	Fee
203.105a	Industrial thermometers, testing at points in the interval 0° to 100° C. (32° to 212° F), for each point tested	$3.00
203.105b	Industrial thermomcters, testing at points above 100° C and up to 300° C or above 212° F and up to 600° F., for each point tested (Thermometers will not be tested at less than 2 points nor more than 5 points on the scale.)	5.00

203.106 Optical pyrometers and ribbon filament lamps. Optical pyrometers and ribbon filament lamps submitted for calibration and test should be accompanied by an order requesting the test and specifying the Fee Schedule Item Number. If desired, the calibration points may be specified. A bill will be rendered at the completion of the work.

Limit of error of the below calibrations is usually 4° at 800° C, decreasing to 3° at 1063° C, and then increasing to 8° at 2800° C.

The calibration or test of an article will not be undertaken if, in our opinion, the article will not yield the specified accuracy, or if it possesses such unusual characteristics as to prevent the carrying out of the calibration or test at a reasonable cost. If, in the course of a calibration or test, it is found that the article is inferior to its general class, a report will be issued giving the results obtained. In such cases, a fee covering the cost of the work performed will be charged.

Item	Description	Fee
203.106a	Optical pyrometers: Calibration of low range 800° to 1,400° C. 15 or fewer certified values	$28.00
203.106b	Optical pyrometers: Additional ranges. 15 or fewer certified values in each range, per range	20.00
203.106c	Ribbon filament lamps: Certified values of direct current versus brightness temperature at 20 or fewer points in the range 800° to 2,300° C	25.00
203.106d	Additional interpolated values as per 203.106a, 203.106b, 203.106c per point	0.50

203.2 Thermodynamics

203.201 Gas calorimeters.

Item	Description	Fee
203.201a	Test gas calorimeter, water flow type, calorimeter only	$76.00

203.4 Lubrication

203.401 Oil filters. Oil filters are tested only in connection with procurement operations of Government agencies, and the results of such tests are made available only to the manufacturer and Government procurement agencies, and may be used by the manufacturer only for the purpose of demonstrating to a Federal Government procurement official that the product has met the requirements of the applicable procurement specification.

The amount of the fee cannot be determined prior to completion of the test. The manufacturer shall supply, without cost to the Government, the necessary filter elements and filter case. Normally, two filter elements should be supplied for each test condition (i.e., test at 180°F or at 110° and with mineral oil or additive treated oil). After completion of the test, the filter case and any unused filter elements will be returned at the manufacturers expense, if desired.

Item	Description	Fee
203.401a	Determination of efficiency of automotive oil filters for 1 day of testing, per element	$30.00
203.401b	For each additional day of testing, per day, per element	10.00

203.402 Viscometers. Saybolt viscometers and capillary tube instruments of the suspended level type and of the ASTM modified Ostwald (Fenske routine) type are accepted for calibration in accordance with the fees below.

Packages of instruments to be tested should be marked "Viscometers for Test," in addition to the usual markings required for shipment.

To be acceptable for test, Saybolt viscometers must be in good condition, reasonably clean, provided with a nut and gasket for mounting in the test bath, and both the outlet tube and the oil container must bear suitable identifying numbers. In some cases a special outlet tube wrench may be required if a suitable wrench is not available at the Bureau. Viscometers of the suspended level type should be accompanied by a metal holder of the type commonly used with these instruments for mounting them in the test bath.

Item	Description	Fee
	Complete standardization of a Saybolt viscometer or an extra outlet tube requires both dimensionsal and flow tests. Flow tests are made only with instruments which meet the dimensional requirements. Reports on the dimensional tests alone, are made only on instruments which do not meet the dimensional requirements for a standard instrument.	
	Standardization of Saybolt viscometer provided with one outlet tube:	
203.402a	(1) Dimensional tests	$5.50
203.402b	(2) Flow tests	11.00
	Standardization of extra outlet tube for Saybolt visometers provided with two outlet tubs:	
203.402c	(1) Dimensional tests	2.50
203.402d	(2) Flow tests	11.00
203.402e	Calibration of ASTM modified Ostwald viscometer (Fenske routine type)	15.00
203.402f	Calibration of ASTM suspended level viscometer (Ubbelohde or FitzSimon type) except series 1 capillaries, per capillary	15.00
203.402g	Calibration of ASTM suspended level viscometer (Ubbelohde or FitzSimon type) series 1 capillaries, per capillary	20.00

203.403 Standard viscosity samples. These oils are not intended for use as permanent viscosity standards and should be ordered only for immediate use. They are not suitable for stock room items. The oils are supplied only in containers of nominal 1-pint capacity. Requests for larger quantities (or duplicate samples) must be supported by a detailed statement of the need for the larger quantity.

All available liquids are hydrocarbon oils and are listed in the following tables. Samples of castor oil, glycerine, or sucrose solutions are not supplied. The fees listed in the last column on the right include the cost of a 1-pint sample plus an accurate report on the viscosity of the oil at the temperature or temperatures for which approximate values are listed. Reports for oils D through P include values for density.

Item	Description	Fee
203.403a	1-pint sample of standard viscosity oil D, H, I, J, K, L, M, or N with report on its absolute viscosity, kinematic viscosity, and density at 20° C, 25° C, and 100° F, per 1-pint sample	$10.00
203.403b	Determination of absolute or kinematic viscosity of standard viscosity oil D, H, I, J, K, L, M, or N at temperatures other than covered by Item 203.403a, additional fee, per sample per temperature	10.00
203.403c	1-pint sample of standard viscosity oil OB with report on absolute viscosity, kinematic viscosity, and density at 20°, 25°, and 40° C, per 1-pint sample	25.00
203.403d	1-pint sample of standard viscosity oil P with report on absolute viscosity, kinematic viscosity, and density at 30°, 40°, and 50° C, per 1-pint sample	25.00
203.403e	Determination of absolute or kinematic viscosity of oil OB or oil P at temperatures other than those covered by Item 203.403c and Item 203.403d, respectively, additional fee, per sample per temperature	16.00
203.403f	1-pint sample of standard viscosity oil SB with report on Saybolt Universal viscosity at 100° F, per 1-pint sample	5.00
203.403g	1-pint of standard viscosity oil SC with report on Saybolt Universal viscosity at 130° F, per 1-pint sample	5.00
203.403h	1-pint sample of standard viscosity oil SF with report on Saybolt Furol viscosity at 122° F, per 1-pint sample	5.00

203.5 Automotive

203.501 Internal combustion engine fuels. The purpose of detonation tests is to determine approximately the relative merits of fuels for use in internal combustion engines. These tests are made according to the following standard test methods.

Item a: Includes three types; (1) Knock Characteristics of Motor Gasoline (Motor Method) ASTM D 357-48 (equivalent to Federal Specification 600.1.4) or latest revision. The minimum amount of sample required is one quart, (2) Knock Characteristics of Motor Gasoline (Research Method) ASTM D 908-48 T or latest revision. This method is similar to (1) above, except that operating conditions are less severe, and is useful to determine fuel sensitivity. The minimum amount of sample required is one quart, (3) Knock Characteristics of Aviation Gasoline (Lean Mixture) ASTM D 614-48 T (equivalent to Federal Specification 601.1.1). The minimum amount of sample required is 2 quarts.

Item b: Knock Characteristics of Aviation Gasoline (Supercharge) ASTM D 909-48 T (equivalent to Federal Specification 601.2). The minimum amount of sample required is 5 gallons.

Item c: Cetane (Ignition Quality) of Diesel Fuels, ASTM D 613-48 T (equivalent to Federal Specification 605.1.2). The minimum amount of sample required is 2 quarts.

NOTE: For these tests to be of maximum significance, it is recommended that the sampling procedure used follow that designated as Federal Specification 800.1.1 insofar as practicable.

Item	Description	Fee
203.501a	Knock-rating of motor fuels and lean mixture rating of aviation fuels	$25.00
203.501b	Comparison of power-development and specific fuel consumption	40.00
203.501c	Cetane rating of diesel fuels	25.00
203.501d	Supercharge rating of aviation fuels	40.00

FEE SCHEDULE 204: ATOMIC AND MOLECULAR PHYSICS

204.2 Radiometry
- 204.201 Radiometry

204.3 Mass Spectrometry
- 204.301 Chemical and Isotope Analyses by Mass Spectrometer

204.4 Radioactivity
- 204.401 Preparations of Radium and Mesothorium
- 204.402 Radioactive Standards
- 204.403 Standard Rock and Ore Samples
- 204.404 Calibration and Test of Instruments
- 204.405 Luminosity of Self-luminous Materials

204.5 X-Rays
- 204.501 X-ray Protective Materials
- 204.502 X-ray Instruments
- 204.503 X-ray Inspections

204.2 Radiometry

204.201 Radiometry.

Item	Description	Fee
	Eye protective glasses:	
204.201a	Test for compliance with safety code, covering transmission of ultraviolet, visible and total radiation, per sample	$11.50
204.201b	Test for luminious transmittance by comparison with standard filters	7.00
	Transmittance of radiant energy:	
204.201c	Measurement of percentage ultraviolet spectral transmittance at regular intervals or selected points in the spectrum	9.00
204.201d	Measurement of percentage infrared spectral transmittance at regular intervals, using an infrared spectrophotometer	14.00
204.201e	Standards of radiation—lamps seasoned and calibrated for intensity of radiant energy per lamp	22.00
	Calibration of ultraviolet lamps and radiant energy meters:	
204.201f	Calibration of radiant energy meter for energy of 2537A.	7.50
205.201g	Measurement of radiant flux of 2537A, from germicidal or sterilamp	8.00
204.201h	Laminated safety glass—determination of effect on exposure to ultraviolet radiant energy	6.75
204.201i	Calibration of photocell—determination of spectral response	26.75
204.201z	For special tests not covered by the above schedule, fees will be charged dependent upon the nature of the test	

204.3 Mass Spectrometry

204.301 Chemical and isotope analyses by mass spectrometer. In addition to the items listed below, analyses of more complicated hydrocarbons and substituted hydrocarbons can be made on a research basis at a cost depending on the work involved when samples of the pure compounds involved in the mixture are available.

Item	Description	Fee
	Chemical analyses of common gases and hydrocarbon mixtures with no important components heavier than C fives:	
204.301a	One analysis $5 per component—minimum charge	$50.00
204.301b	Additional analyses of similar samples $3 per component—minimum charge	30.00
	Isotope analyses involving measurement of isotope ratios such as C^{13}/C^{12} in CO_2 and N^{15}/N^{14} in pure N_2:	
204.301c	Fee, one sample	15.00
204.301d	For additional similar samples, each	10.00
	Additional charges will be made where isotope analysis requires a complete or partial chemical ayanlsis at a rate depending on man-hours of work required	
	Reduced rates will be made on simple chemical analyses and isotope analyses when 5 or more similar samples are submitted depending on actual man-hours of work required.	

204.4 RADIOACTIVITY

204.401 Preparations of radium and mesothorium. Radioactive preparations submitted to the Bureau for test are subject to the following conditions:

(a) *Financial Responsibility.* The Bureau assumes no responsibility for loss or damage to radioactive preparations while in its possession. The risk should be covered by insurance.

(b) *Period of Measurement.* Since measurements must extend over a time sufficient to test equilibrium, at least 10 days are required for measurement of radioactive preparations in equilibrium with their product. At least 30 days are required for preparations not in equilibrium.

(c) *Sealing of Specimens.* Radioactive preparations submitted for test must be carefully sealed so that *no* radon (radium emanation) can escape. Leaking preparations cannot be measured and may cause considerable loss of time and injury to measuring instruments.

(d) *Packaging for Shipment* Regulations of the Interstate Commerce Commission regarding the shipment of radioactive substances by rail must be complied with when shipping radium or mesothorium. These regulations are enforceable by law and prospective shippers of these substances need to be familiar with them. Copies of the regulations can be obtained from the Interstate Commerce Commission, Washington 25, D.C.

Postal regulations, as outlined in a notice which appeared in the Postal Bulletin of May 17, 1949, prohibit in the mails radioactive materials which require a caution label under ICC regulations. This effectively prohibits placing any medical preparation of radium in the mails.

Item	Description	Fee
	Gamma-ray measurements of radium preparations in equilibrium:	
204.401a	0+ to 8.0 mg of radium	$5.00
204.401b	8.+ to 18.0 mg of radium	6.00
204.401c	18.+ to 28.0 mg of radium	7.00
204.401d	28.+ to 40.0 mg of radium	8.50
204.401e	40.+ to 60.0 mg of radium	10.00
204.401f	60.+ to 80.0 mg of radium	11.50
204.401g	80.+ to 110.0 mg of radium	13.00
204.401h	110.+ to 150.0 mg of radium	15.00
204.401i	150.+ to 200.0 mg of radium	17.50
204.401j	200.+ to 250.0 mg of radium	20.00
204.401k	250.+ to 350.0 mg of radium	22.50
203.401L	350.+ to 500.0 mg of radium	25.00

Item	Description	Fee
204.401m	The fee will be double that given in the above table, if the material of a specimen is not practically in equilibrium when measurements are begun.	
204.401n	For measurements in groups not exceeding 10 preparations, double the fee for radium preparations of same content as the total content of the group.	
	Radium preparations which are in equilibrium, and are returned under National Bureau of Standards' seal:	
204.401o	Recertification of, without measurement	$3.00
204.401p	Recertification of, with remeasurement	5.00
204.401q	Report, without certification	5.00
204.401r	Fees for mesothorium preparations will be charged as for matured radium preparations on the basis of the radium equivalent of the mesothorium, items (a) to (l) above.	
	Measurements of radium ores and similar weakly radioactive specimens:	
204.401s	Comparison of activity of pulverized sample with standard sample of uranium oxide by means of alpha ray electroscope	18.00
204.401t	Comparison of gamma-ray activity of pulverized sample with gamma-ray activity of a sample of uranium oxide or dilute radium standard	17.00
	Determination of radon content of sample by emanation methods:	
204.401u	Samples in solution or completely soluble in nitric acid	15.00
204.401v	Samples partly insoluble in nitrec acid	25.00
204.401w	Air samples	14.00
204.401z	For special tests not covered by the above schedule, fees will be charged dependent upon the nature of the test.	

204.402 Radioactive standards.

Item	Description	Fee
	Radon Standards, 100 milliliters sealed in glass containing:	
204.402a	10^{-9} gram of radium	$2.00
204.402b	10^{-11} gram of radium	2.00
204.402c	Blank solution	2.00
	Radium Gamma-Ray Standards, 5 ml. solution sealed in glass containing:	
204.402d	0.1×10^{-6} gram of radium	3.00
204.402e	0.2×10^{-6} gram of radium	3.00
204.402f	0.5×10^{-6} gram of radium	3.00
204.402g	1.0×10^{-6} gram of radium	3.00
204.402h	2.0×10^{-6} gram of radium	3.00

Item	Description	Fee
204.402i	5.0×10^{-6} gram of radium	$3.00
204.402j	10.0×10^{-6} gram of radium	3.00
204.402k	20.0×10^{-6} gram of radium	3.00
204.402L	50.0×10^{-6} gram of radium	4.00
204.402m	100.0×10^{-6} gram of radium	5.00
	Cobalt^{60} Gamma-Ray Standards, 5 ml. of solution sealed in glass containing, on the date of calibration, approximately:	
204.402n	10^6 disintegrations per second—value furnished with certificate	5.00
204.402o	10^5 disintegrations per second—value furnished with certificate	5.00
	Beta-Ray Standards, consisting of RaD+E in equilibrium, deposited on a silver disk 1 inch in diameter and faced with 2 mil of palladium, having on date of preparation:	
204.402p	100, 200, 500 disintegrations per second	10.00
204.402q	Blank silver disks for preparing working standards or deposits of other isotopes, each	2.00
204.402z	For special standards not covered by the above schedule, fees will be charged dependent upon the nature of the standard.	

204.403 Standard rock and ore samples.

Item	Description	Fee
	Rock sample 100 grams of pulverized rock analyzed for radium content with petrographic data and chemical analysis:	
204.403a	Dunite: average radium content $0.009 \pm 0.004 \times 10^{-12}$ g of Ra/g rock	$3.00
204.403b	Carthage limestone: average radium content $0.15 \pm 0.03 \times 10^{-12}$ g of Ra/g rock	3.00
204.403c	Berea sandstone: average radium content $0.24 \pm 0.02 \times 10^{-12}$g of Ra/g rock	3.00
204.403d	Columbia River basalt: average radium content $0.33 \pm 9.03 \times 10^{-12}$ g of Ra/g rock	3.00
204.403e	Chelmsford granite: average radium content $2.96 \pm 0.08 \times 10^{-12}$ g of Ra/g rock	3.00
204.403f	Quartzite: average radium content $0.06 \pm 0.01 \times 10^{-12}$ g of Ra/g rock	3.00
204.403g	Graniteville granite: average radium content $3.3 \pm 0.2 \times 10^{-12}$ g of Ra/g rock	3.00
204.403h	Gabbro-diorite: average radium content $0.18 \pm 0.0210 \times$ ^{12} g of Ra/g rock	3.00
204.403i	Milford granite: average radium content $0.23 \pm 0.02 \times 10^{-12}$ g of Ra/g rock	3.00
204.403j	Triassic diabase: average radium content $0.18 \pm 0.03 \times 10^{-12}$ g of Ra/g rock	3.00
204.403k	Deccan trap: average radium content $0.21 \pm 0.0410 \times ^{-12}$ g of Ra/g rock	3.00
204.403L	Kimberlite: average radium content $0.59 \pm 0.04 \times 10^{-12}$ g of Ra/g rock	3.00

204.404 Calibration and test of instruments.

Item	Description	Fee
	Calibration of Geiger- Müller counters with associated indicating circuits:	
204.404a	Calibration of gamma ray counters for use with radium radiations in roentgens	$15.00
204.404b	Calibrations of beta-ray counters to determine effective response in a given geometry for a particular type source	15.00
204.404c	Calibration of portable ionization chambers for measurement of radioactive radiations	20.00
204.404d	Test of Geiger-Müller counters to determine threshold voltage, length and slope of plateau and resolving time	10.00
204.404e	Test of scaler for use with Geiger-Müller counter to determine compliance with specifications	25.00
204.404f	Test of rate meter for use with Geiger-Müller counter to determine compliance with specifications	25.00
204.404g	Test of portable ionization chambers with associated indicating devices to determine compliance with specifications	25.00

204.405 Luminosity of self-luminous materials.

Item	Description	Fee
	Luminous measurements of self-luminous materials or surface:	
204.405a	Minimum charge, 1 to 10 samples	$13.50
204.405b	Per sample, after first 10 and up to 100	.75
204.405c	Per sample over 100	.50

204.5 X-Rays

204.501 X-ray protective materials.

Item	Description	Fee
204.501a	Determination of opacity of one sample—ionization method	$12.00
204.501b	Determination of each additional sample—ionization method	2.50
204.501c	Determination of opacity of one sample—radiographic method	15.00
204.501d	Determination of each additional sample—radiographic method	2.50
204.501z	For special tests not covered by the above schedule, fees will be charged dependent upon the nature of the test.	

204.502 X-ray instruments.

Item	Description	Fee
204.502a	X-ray ionometer—calibration in international roentgens for 1 voltage and 1 filtration	$27.50
204.502b	X-ray ionometer calibration—each additional voltage and filtration for the same instrument	3.00
204.502z	For special tests not covered by the above schedule, fees will be charged dependent upon the nature of the test.	

204.503z X-ray inspections. X-ray inspections—For special tests including the radiographic inspection of metal objects; measurement of X-ray fluorescence; calibration of fluorescent screens; inspection and testing of complete X-ray equipments; other special tests not covered by the above schedule. Fees will be charged dependent upon the nature of the test.

FEE SCHEDULE 205: CHEMISTRY

205.6 Electrodeposition

205.601 Calibration of magnetic thickness gage (Magne-gage) for electroplated coatings.

Item	Description	Fee
205.601a	Calibration of Magne-gage, first calibration, including new standard samples	$10.00
205.601b	Calibration of Magne-gage, each additional calibration, including new standard samples (Each instrument can be calibrated for A, B, C, D, E, F, H ranges)	7.50
205.601c	Recalibration of Magne-gage, first calibration	5.00
205.601d	Recalibration of Magne-gage, each additional calibration	3.75
205.601e	Standard samples (no calibration) each card of samples	5.00
205.601f	Calibration M of special composite Magne-gage for copper plus nickel coatings on steel, including new standard samples	35.00

FEE SCHEDULE 206: MECHANICS

206.1 Sound
- 206.101 Acoustic Measurements

206.2 Mechanical Instruments
- 206.201 Pressure Gages
- 206.202 Mercurial Barometers and Manometers
- 206.203 Aneroid Barometers, Barographs, Altimeters, and Altigraphs

206.1 Sound

206.101 Acoustic measurements.

Item	Description	Fee
206.101a	Sound absorption coefficient, 72 square feet of material at frequencies of 128, 256, 512, 1024, 2048, and 4096 cycles per second	[1]$105.00
206.101b	Sound absorption coefficient, box tests, on 3 square feet of material at 512 cycles per second	16.00
206.101c	Sound transmission loss, wall panel 71″ x 88½″ at frequencies of 128, 192, 256, 384, 512, 768, 1024, 2048 and 4096 cycles per second	[1] 127.00
206.101d	Sound transmission loss, floor panel, same as item c above, plus tapping loss for impact sounds	[1] 154.00
206.101e	Pressure calibration of condenser microphones, 50 to 10,000 cycles per second, reciprocity method	61.00
206.101f	Free field calibration of microphones and sound level meters, 100 to 10,000 cycles per second, single orientation of microphone	113.00
206.101g	Free field calibration of microphones and sound level meters, 100 to 10,000 cycles per second, microphone oriented at angles 0°, ±30°, ±60°, ±90°, ±120°, ±150°, ±180° relative to sound wave	142.00
206.101h	Calibration of audiometers at frequencies of 128, 256, 512, 1024, 2048, 4096, and 8192 cycles per second	168.00
206.101i	Calibration of earphones, 100 to 10,000 cycles per second	52.00
206.101j	Calibration of tuning forks, per fork	12.00

[1] Plus cost of construction.

206.2 Mechanical Instruments

206.201 Pressure gages.

Item	Description	Fee
	Pressure gages, mechanical type. (Only those with a rated accuracy of at least ½% will be accepted.) Calibration test at room temperature, up to 10 test points.	
206.201a	Gage range, suction up to 30 in. of mercury or gage range up to 50 pounds per square inch	$10.50
206.201b	Gage range 50 to 200 pounds per square inch	14.50
206.201c	Gage range 200 to 30,000 pounds per square inch	9.00
206.201d	Oxygen gages 100 to 5,000 pounds per square inch	14.50
	Each extra test point	.50
206.201e	Dead weight gages:	
	1. Calibration against pressure standard	27.00
	2. Calibration of weights, fee based on cost	
	3. Measurement of piston diameter, fee based on cost.	

206.202 Mercurial barometers and manometers.

Item	Description	Fee
206.202a	Barometers, range 28 to 31 inches of mercury, calibration test at 25° C	$20.00
206.202b	Barometers, altitude type, calibration test at 25° C, 10 test points	25.00
	For each additional barometer when all are tested as a unit	15.00
	Each additional test point	1.00
	Mercury manometers, for use at standards, calibration test at 25° C, 10 test points:	
206.202c	Range up to 300 mm of mercury	14.00
206.202d	Range above 300 mm of mercury	23.00
	Each additional test point	1.00

206.203 Aneroid barometers, barographs, altimeters, and altigraphs.

Item	Description	Fee
206.203a	Aneroid barometers, barographs, altimeters and altigraphs, calibration test at room temperature (+20° C) (includes hysteresis and after effect test):	
	First 10 test points	$15.00
	Each additional test point	.50
206.203b	Determination of flight duration and intermediate landing from barograph indications	15.00
206.203c	Item (b) including pressure-altitude determination at specified points from barograph indications only	30.00
206.203d	Maximum altitude determination from air pressure and air temperature measurements, including all necessary calibration of instruments	150.00
206.203e	Maximum altitude determination from barograph indications only	30.00
206.203f	Maximum altitude determinations from a combination of indications of pressure-recording and other instruments, not including air temperature indications	50.00

206.3 Aerodynamics

206.301 Aerodynamical measurements.

Item	Description	Fee
206.301a	Wind speed indications-calibration of pitot tubes, venturi tubes, cup, vane and thermal type anemometers at wind speed within the range 2 to 80 miles per hour or (optional) 10 to 190 miles	$24.00

206.4 Engineering Mechanics

206.405 Hardness tests.

Item	Description	Fee
206.405a	Determination of Brinell number of a block to be used for calibration purposes, three separate indentations on each specimen	$10.00

206.407 Calibration of load measuring devices other than proving rings, including Amsler boxes, tension bars, etc.

Item	Description	Fee
	These fees apply to calibration for 10 different loads For each test load in excess of 10 an additional fee equal to one-tenth of the applicable fee for calibration is charged. Calibration of elastic devices, capacity not exceeding 10,000 lb:	
206.407a	Tension	$25.00
206.407b	Compression	25.00
	Calibration of elastic devices, capacity exceeding 10,000 lb but not exceeding 50,000 lb :	
206.407c	Tension	41.00
206.407d	Compression	27.00
	Calibration of elastic devices, capacity exceeding 50,000 lb but not exceeding 100,000 lb :	
206.407e	Tension	46.00
206.407f	Compression	29.00
206.407g	Calibration of elastic devices, capacity exceeding 100,000 lb but not exceeding 200,000 lb : Compression only	82.00
206.407h	Calibration of elastic devices, capacity exceeding 200,000 lb but not exceeding 300,000 lb : Compression only	94.00

206.408 Special mechanical tests of materials and structures.

Item	Description	Fee
	These fees apply to all mechanical tests of materials and structures performed in the Mechanics Division not covered by other fee schedules. The charge for special mechanical tests is made on the basis of the hours of service furnished by members of the staff. Where the tests require travel outside the limits of 15 miles from the District of Columbia, transportation and subsistence charges will be added to the service charge. The time shall be computed as the number of official working hours from the time the members of the staff leave the National Bureau of Standards until they return to it plus any overtime spent on the tests.	
206.408a	Service of a staff member of associate professional grade or any higher grade, per hour	$5.00
206.408b	Service of a staff member of grades below associate professional grade, per hour	3.00

206.409 Calibration of proving rings.

Item	Description	Fee
	These fees apply to calibration and recalibration for ten different loads. For each test load in excess of 10, an additional fee equal to one-tenth of the applicable fee for complete calibration or recalibration is charged. Fees for complete calibration apply to the following proving rings: 1. Rings submitted for initial calibration. 2. Rings not certified at their last calibrations. 3. Rings not certified since Apr. 4, 1934. 4. Rings which have been repaired or modified since their last calibration. Fees for recalibration apply to rings which received certificates at the times of their last calibrations, provided that such calibrations have been made since April 4, 1934, and provided that the rings have not been repaired or modified since their last calibrations. Complete calibration of proving rings, capacity not exceeding 10,000 lb.:	
206.409a	Tension	$35.00
206.409b	Compression	35.00

Item	Description	Fee
	Recalibration of proving rings, capacity not exceeding 10,000 lb.:	
206.409c	Tension	$19.00
206.409d	Compression	19.00
	Complete calibration of proving rings, capacity exceeding 10,000 lb. but not exceeding 50,000 lb.:	
206.409e	Tension	48.00
206.409f	Compression	36.00
	Recalibration of proving rings, capacity exceeding 10,000 lb. but not exceeding 50,000 lb.:	
206.409g	Tension	25.00
206.409h	Compression	20.00
	Complete calibration of proving rings, capacity exceeding 50,000 lb. but not exceeding 100,000 lb.:	
206.409i	Tension	52.00
206.409j	Compression	38.00
	Recalibration of proving rings, capacity exceeding 50,000 lb. but not exceeding 100,000 lb.:	
206,409k	Tension	27.00
206.409l	Compression	20.00
206.409m	Complete calibration of proving rings, capacity exceeding 100,000 lb. but not exceeding 200,000 lb.: Compression only	98.00
206.409n	Recalibration of proving rings, capacity exceeding 100,000 lb. but not exceeding 200,000 lb.: Compression only	67.00
206.409o	Complete calibration of proving rings, capacity exceeding 200,000 lb. but not exceeding 300,000 lb.: Compression only	104.00
206.409p	Recalibration of proving rings, capacity exceeding 200,000 lb. but not exceeding 300,000 lb.: Compression only	71.50

206.410 Knoop indenter tests.

Item	Description	Fee
206.410a	Measurement of mounting, included longitudinal edge angle, included transverse edge angle, and half angles	$8.00
206.410b	Inspection of edges for nicks, offset at the point, and application of proof load	15.00

206.5 Hydraulics

206.501 Water current meters.

Item	Description	Fee
206.501a	Water current meters—routine rating of usual types, not in excess of 7 velocities	$15.00
206.501b	Water current meters—routine rating of usual types in excess of 7 velocities but not in excess of 11 velocities	17.00

206.502 Pitot tubes. Pitot tubes for use in water, determination of calibration constant. Fee charge will depend on nature of test and range of velocities.

FEE SCHEDULE 214: RADIO PROPAGATION

214.8 High-frequency Standards
- 214.801 Radio Field Intensity Meters
- 214.802 Vacuum Tube Voltmeters
- 214.803 Power Factor and Dielectric Constant of Electrical Insulating Materials
- 214.804 Capacitance and Power Factor of Capacitors (from 10 kc to 75 Mc)

214.9 Microwave Standards
- 214.901 Frequency Meters above 300 Mc/s

Fee Schedule 214: Radio Propagation

For tests of radio and microwave equipment which have no fees published below, such as ammeters, attenuators, bridges, frequency meters (including cavity-type meters), inductors, power level meters, Q-meters, quartz crystal units, radio receivers, resistors, voltage (signal) generators, and other devices, arrangements should be made in advance. Fees for such tests will be determined by the nature of the tests required.

In general, except for tests required in the Bureau's research and development work, the radio-frequency and microwave calibrations and tests made by the Bureau are limited to precision instruments and devices used as standards by manufacturers and testing laboratories, tests for Government departments and agencies, tests of radio field intensity meters, and a few other special tests. For tests at low frequencies and dc, see schedule 201.

Instruments in the above classifications, unless delivered to the Bureau by special messenger, should be packed in a strong container which will be used by the Bureau in returning the instrument after calibration. Adequate shock-absorbing material should be used, to prevent receipt in condition such that calibration cannot be made and delays the return of the apparatus.

214.8 High Frequency Standards

214.801 Radio field intensity meters. Two types of calibration service are available for portable field intensity meters, the abridged calibration and the complete calibration. The former gives sufficient data

for practical use of a field intensity meter in the field. The latter includes the former short calibration and other tests that apply to some instruments, such as the linearity of the receiver output indicating instrument, linearity of the first detector, i-f amplifier and output indicator, and the relation between field intensity and voltage input to the grid of the first detector.

Field intensity calibrations of meters mounted in automobiles are not made by the Bureau. Field intensity meters thus mounted can be calibrated in terms of a portable instrument to obtain the loop antenna coefficients. Internal characteristics (attenuator ratios, linearity, etc.) of such meters are made by the Bureau.

Field intensity meters are not accepted for calibration unless they are in perfect working condition. Before sending an instrument for calibration, it should be thoroughly inspected and tested, new tubes installed if necessary; or if in need of repairs, it should be sent to the manufacturer.

Item	Description	Fee
214.801a	Determination of loop antenna coefficients throughout broadcast band (535 to 1605 kilocycles per second) 12 frequencies or less	$55.00
214.801b	Determination of loop antenna coefficients at other frequencies below or above broadcast band if in addition to item 214.801a, per frequency	5.00
214.801c	If item 214.801a is not included, minimum fee for 10 frequencies or less	55.00
214.801d	Determination of attenuator ratios, resistance type, in terms of one setting, at one input frequency (7 ratios maximum)	35.00
214.801e	Determination of attenuator ratios, mutual inductance type, in terms of one setting, at one input frequency	40.00
214.801f	Determination of attenuator ratios, capacitance type, in terms of one setting, at one input frequency	30.00
214.801g	Determination of attenuating ratios, any type, at each additional frequency	15.00
214.801h	Determination of linearity of output meter	35.00
214.801i	Determination of linearity of first detector, i-f amplifier and output system at one frequency	35.00
214.801j	Determination of linearity of first detector, i-f amplifier and output system, at each additional frequency	35.00
214.801k	Determination of relation between input in volts per meter and input volts to grid of first detector, at one frequency	5.00

214.802 Vacuum tube voltmeters. Vacuum tube voltmeters are accepted for calibration in the voltage and frequency ranges indicated below. The calibrations are in two general classes: (1) Those of highest accuracy against primary voltage standards, (2) those of lower accuracy against secondary voltage standards.

The fees given below are based on the voltmeter submitted being equipped with either type N or General Radio types 274 or 774 terminals. If the voltmeter is not so equipped, an additional charge up to $50 may be made to cover cost of making a suitable adaptor.

Item	Description	Fee
214.802a	Calibration in terms of primary standard within the following ranges, 0.1 to 0.5 volt, 50 kc. to 300 Mc., 5 voltage points at 1 frequency	$80.00
214.802b	Additional voltage points at same frequency (maximum of 7 points), per point	3.50
214.802c	Calibration in terms of primary standard within the following ranges 0.5 to 1.5 volts, 50 kc. to 300 Mc., 5 voltage points at 1 frequency	70.00
214.802d	Additional voltage points at same frequency (maximum of 7 points), per point	2.00
214.802e	Calibration in terms of primary standard within the following ranges 5.0 to 150 volts, 50 kc. to 50 Mc., 5 voltage points at one frequency	55.00
214.802f	Additional voltage points at same frequency (maximum of 7 points), per point	2.00
214.802g	Calibration in terms of secondary standard within the following ranges, 0.1 to 1.5 volts, 50 kc. to 300 Mc., 5 voltage points at one frequency	45.00
214.802h	Additional voltage points at same frequency, per point	1.00
214.802i	Calibration in terms of secondary standard within the following ranges, 5.0 to 150 volts, 50 kc. to 50 Mc., if calibration of 214.802g not included, 5 voltage points at one frequency	45.00
214.802j	Additional voltage points at same frequency, per point	1.00
214.802k	Each voltage point at additional frequencies, per frequency	1.00

214.803 Power factor and dielectric constant of electrical insulating materials.

Item	Description	Fee
214.803a	Power factor and dielectric constant at 1 temperature and one relative humidity, 3 frequencies in range up to 40 Mc., per sample	$35.00
214.803b	Each additional frequency in same range, per sample	5.00
214.803c	Each additional temperature at same rh, per sample	5.00
214.803d	Each additional rh at same temperature, per sample	5.00
214.803e	Each additional sample	5.00
214.803f	Power factor and dielectric constant at one temperature and one relative humidity, 3 frequencies in range 40 Mc. to 300 Mc., per sample	40.00
214.803g	Each additional frequency in same range, per sample	6.00
214.803h	Each additional temperature at same rh, per sample	6.00
214.803i	Each additional rh at same temperature, per sample	6.00
214.803j	Each additional sample	6.00

214.804 Capacitance and power factor of capacitors (from 10 kc to 75 Mc).

Item	Description	Fee
214.804a	Capacitance calibration of variable capacitor at 25° C. and 50% relative humidity, 10 points at 1 frequency	$30.00
214.804b	Each additional capacitance point at same frequency	1.00
214.804c	Each additional capacitance point at different frequency	1.00
214.804d	Power factor of capacitor at 25° C. and 50% relative humidity, 10 points at 1 frequency	10.00
214.804e	Power factor, 10 points at each additional frequency	10.00
214.804f	Capacitance of fixed capacitor at 25° C. and 50% relative humidity, at 1 frequency	5.00
214.804g	Capacitance at each additional frequency	1.00
214.804h	Capacitance at each additional temperature and humidity	5.00
214.804i	Power factor of fixed capacitor at 25° C. and 50% relative humidity, at 1 frequency	5.00
214.804j	Power factor at each additional frequency	1.00
214.804k	Power factor at each additional temperature and humidity	5.00

214.9 Microwave Standards

214.901 Frequency meters above 300 Mc/s.

Item	Description	Fee
	Calibration of cavity-type frequency meter (wave meter) of the adjustable type:	
214.901a	At a prescribed frequency	$25.00
214.901b	At one point (or initial point)	20.00
214.901c	At each additional point (after initial point) within required range	3.50
214.901d	At each additional point (after initial point) at a prescribed frequency	6.00
214.901e	Calibration of cavity-type frequency meter (wave meter) of the fixed type	25.00

FEE SCHEDULE 215: OPTICS

215.5 Photometry and Colorimetry
- 215.501 Lamp Standards of Candlepower or Luminous Flux
- 215.502 Calibration of Photometric Instruments and Accessories
- 215.503 Miscellaneous Photometric Measurements and Tests
- 215.504 Rating and Life Testing of Incandescent Lamps
- 215.505 Spectrophotometric Standards
- 215.506 Spectrophotometric Measurements

215.507 Colorimetry
215.508 Reflectometry
215.509 Opacimetry
215.510 Glossimetry
215.511 Lovibond Glasses
215.512 Signal Glasses
215.513 Enamel Standards for Raw Silk
215.514 Transmittance Standards for Petroleum Products

215.6 Optical Instruments
215.601 Optical Instruments
215.602 Photographic Objectives
215.603 Optical Components, Spectacle Lenses, Goggle lenses etc.
215.604 Refractometric Instruments and Sextants
215.605 Refractive Indices

215.7 Photographic Technology
215.701 Photography

215.5 Photometry and Colorimetry

215.501 Lamp standards of candlepower or luminous flux. The Bureau is prepared to standardize incandescent filament lamps which have been properly seasoned, or to season and standardize lamps when necessary, or to furnish lamps (of the more common types and sizes) that have been seasoned and standardized, the respective fees being as given in 215.501, a–r.

A normal incandescent lamp when operated at constant voltage usually increases slightly in candlepower for a short time, the length of which depends upon the temperature of the filament. A stationary period is then reached, after which there is a progressive drop in the candlepower. The initial rise in candlepower is due to a gradual decrease in the resistance of the filament, while the subsequent decrease in candlepower is due chiefly to blackening, caused by a deposit on the inside of the bulb. Therefore, in order that a lamp may be useful as a photometric standard, it should be seasoned by a preliminary burning sufficient to bring its resistance to a steady state. This seasoning is usually done by operating the lamp at a voltage somewhat higher than the normal operating voltage of the lamp.

Lamps with coiled filaments are not usually satisfactory as standards unless they have been specially constructed for this purpose. In particular, lamps of this type are not suitable for standards of horizontal candlepower unless they are of the monoplane-filament projection type. This type of gas-filled lamp has been found to be satisfactory as a standard of horizontal candlepower when standardized with a diaphragm in front of the lamp. This diaphragm is slightly larger than the filament and allows only the light coming directly from the filament to reach the photometer. When standardized without such a diaphragm, the calibration is valid only at the photometric distance used during the standardization of the lamp.

TESTING BY THE NATIONAL BUREAU OF STANDARDS

When lamps are submitted for standardization *it is necessary that they be accompanied by a statement as to whether they have been seasoned or not.* If they have been seasoned, the voltage at which they were burned and the number of hours should be given if known. *It should be stated also whether at a given luminous flux (lumens), candlepower, voltage, current, or efficiency.* In the reports or certificates which are issued with standard lamps the voltage and the corresponding current and flux or candlepower are given. The Bureau cannot guarantee the permanence of these values, since all lamps change gradually with use.

Item	Description	Fee
	Incandescent lamps issued as standards of luminous intensity or luminous flux	
215.501a	Vacuum tungsten-filament lamps, 25 to 100 watts, clear bulbs, approximately 110-volt lamps, horizontal candles in a fixed direction, each	$10.00
215.501b	Same, mean horizontal candles, lamp rotating, each	10.00
215.501c	Gas-filled tungsten-filament lamps, 100,200, and 500 watts, projection type, horizontal candles in a fixed direction, each	10.00
215.501d	Vacuum tungsten-filament lamps, 25 to 100 watts, luminous flux (lumens), each	10.00
215.501e	Gas-filled tungsten-filament lamps, 40 to 200 watts, luminous flux (lumens), each	10.00
	Standardization of seasoned incandescent lamps submitted for calibration	
215-501f	Determination of horizontal candles in a fixed direction, at 1 voltage or current, 1 lamp	15.00
215.501g	Same, each additional lamp of the same size and type	8.00
215.501h	Same, 2 or more voltages, or currents, each additional voltage or current	8.00
215.501i	Determination of mean horizontal candles, lamp rotating, at 1 current or voltage, 1 lamp	15.00
215.501j	Same, each additional lamp of same size and type	8.00
215.501k	Same, at 2 or more voltages or currents, each additional voltage or current	8.00
215.501L	Determination of luminous flux (lumens) at one voltage or current, 1 lamp, all sizes to 1,000 watts	15.00
	(Double-filament automobile headlamps are charged for as two lamps.)	
215.501m	Same, each additional lamp of same size and type	8.00
215.501n	Same, at two or more voltages or currents, each additional voltage or current	8.00
215.501o	Same, 3,000 and 5,000 watt, multiple lamps and 15 and 20 ampere series lamps, at 1 voltage or current, 1 lamp	25.00
215.501p	Same, each additional lamp of same size and type	15.00
215.501q	Seasoning of incandescent lamps for standardization, and preliminary measurements, 15 to 200 watts, each lamp	3.00

Item	Description	Fee
215.501r	Same, other sizes and types up to 5,000 watts and all series lamps, each lamp	$5.00
	Standardization of seasoned fluorescent and mercury lamps submitted for calibration	
215.501s	Determination of luminous flux (lumens) of "white" or "daylight" fluorescent lamps, 1 lamp	15.00
215.501t	Same, each additional lamp	8.00
215.501u	Determination of luminous flux (lumens) of mercury vapor lamps, 1 lamp	25.00
215.501v	Same, each additional lamp	15.00

215.502 Calibration of photometric instruments and accessories.

Item	Description	Fee
215.502a	Calibration of portable photometers and illuminometers, one point on scale	$15.00
215.502b	Same, each additional point	4.00
215.502c	Calibration of reference standard for Macbeth illuminometer	15.00
215.502d	Same, each additional standard	8.00
215.502e	Calibration of neutral filter	15.00
215.502f	Same, each additional neutral filter	8.00
215.502g	Calibration of luminance (photometric brightness) standard at one luminance	15.00
215.502h	Same, each additional setting	8.00

215.503 Miscellaneous photometric measurements and tests. For special tests not covered below, fees will be charged dependent upon the nature of the test. These include tests on projectors, globes, lenses, mirrors, and lighting units of various kinds, including determinations of candlepower distribution curves, beam candlepower, chromaticity, etc.

Item	Description	Fee
215.503a	Determination of luminous flux (lumens) versus time of photographic flash lamps, 1 lamp	$15.00
215.503b	Same, each additional lamp of same size and type	2.00
215.503c	Determination of luminous transmittance of colored filter, 1 sample	15.00
215.503d	Same, each additional sample	8.00
215.503e	Candlepower measurements on distress lights, fusees and flares (not less than 2 samples), each	10.00

Item	Description	Fee
215.503f	Candlepower measurements on parachute flares (not less than 2 samples), each	$25.00
15.503g	Chromaticity determinations on above (215.503e or 215.503f) each sample	3.00
215.503h	Candlepower measurements on automobile-headlamps, 8-point test, 1 or 2 pairs of devices	85.00
215.503i	Same, on automobile signal devices, 1 or 2 samples	85.00
215.503j	Same, on automobile rear lamp devices, 1 or 2 samples	85.00
215.503k	Candlepower distribution measurements on luminaires, 1 sample	85.00
215.503L	Same, each additional sample, same size	40.00
215.503m	Measurement of luminance (photometric brightness) of above luminaires (215.503k or 215.503L) each point	1.00

215.504 Rating and life testing of incandescent lamps.

Item	Description	Fee
	Rating tests on lamps. These are routine photometric rating tests of the type made initially on lamps to be life-tested, the same standards and equipment being used. The purpose of these tests is to afford a rough quick check of the photometric values assigned to lamps by various lamp life-test laboratories. Lamp standards of candlepower or luminous flux are issued or calibrated under 215.501.	
215.504a	Rating of seasoned lamps, 15 to 1,000 watts, 1 lamp	$10.00
215.504b	Same, each additional lamp of same size and type	2.00
	Life tests of lamps—Not less than 5 lamps of 1 type are accepted for life test at 1 time.	
215.504c	10- to 1,000-watt lamps, at normal life, each lamp	10.00
215.504d	Miniature lamps, all sizes, each lamp	10.00

215.505 Spectrophotometric standards.

NOTE ON ITEM a: Transmittances of these disks at wavelengths from 365 to 390 mμ and from 750 to 1,000 mμ will also be determined on request in accordance with item c of NBS test fee schedule 215.505. Values will be obtained for a temperature of 25°C. The effect of change of temperature has not been determined for these glasses outside the range from 390 to 750 mμ. It is known, however, that for all four types of glass the temperature effects are very small from 750 to 1,000 mμ, probably negligible for the usual room temperature variations. On the other hand, temperature effects are always large for these kinds of glass when the transmittance curve is decreasing rapidly towards shorter wavelengths, so that increasingly large temperature effects may be expected for these filters in the ultraviolet.

NOTE ON ITEMS i, j, AND k: Item i refers to data taken with the earlier model of the recording spectrophotometer where the radiant energy is incident upon the sample in a slightly diverging beam whose axis is perpendicular to the sample. The specular component of the reflected energy from the polished surface thus returns toward the

entrance aperture, part of it passing out through this aperture and being lost, and part being intercepted by the sphere and contributing to the measurements. The values obtained and reported are strictly valid on another spectrophotometer only if the same fraction of the specular component of the reflected energy is intercepted by the sphere.

In the later models of the spectrophotometer the design is such that the radiant energy is incident in a slightly diverging beam whose axis is at 6° to the perpendicular to the surface. The specular component of the reflected energy is thus diverted away from the entrance aperture towards a port on the side. This port may be filled with MgO or with a black material, so that the spedular component may be respectively "included" in, or (for plane surfaces) "excluded" from, the measurements. This is covered in test fee items j and k.

Only one Vitrolite working standard is needed for the measurement of spectral directional reflectance on the General Electric recording spectrophotometer. This calibrated Vitrolite standard and the samples to be tested are in turn placed at the sample aperture of the integrating sphere, and any highly reflecting substance such as MgO or $MgCO_3$ may be used at the comparison aperture provided the material to be tested does not reflect more than the comparison material. The directional reflectances of the test samples relative to freshly prepared MgO are then obtained by multiplying (at the respective corrected wavelengths) the values for these samples read from the curve sheet, by the ratios of (a) the standard Vitrolite values reported to (b) the values for the Vitrolite read from the curve sheet.

Item	Description	Fee
	Standards of spectral transmittance for checking the photometric scale of spectrophotometers; these consist of polished disks of glass, 2 to 3 mm thick and 30 mm in diameter or 25 mm square, designated as cobalt blue, copper green, carbon yellow, selenium orange; report includes (1) values of transmittance at 25° C at certain wavelengths from 390 to 750 mμ, (2) estimated uncertainty of each value, (3) effect of temperature change on transmittance at each wavelength:	
215.505a	Each disk	$35.00
	Transmittance, 365 to 1,000 mμ for standardizationpurposes; samples submitted must be in good optical condition, measurements at room temperature. (If the sample is a disk 29.7 ± 0.2 mm in diameter, the measurements can be made at a specified temperature):	
215.505b	One sample at one wavelength	15.00
215.505c	Each additional wavelength on the same sample	5.00
	Didymium glass standards for checking the wavelength calibration of General Electric recording spectrophotometers; these consist of Corning 5120 glass, 2 by 2 inches, 3.0 mm thick, polished; report includes table of wavelengths of minimum transmittance:	
215.505d	400 to 750 mμ, slits equivalent to approximately 4 mμ of spectrum, each standard	15.00
215.505e	400 to 750 mμ, 8 μ slits, each standard	15.00
215.505f	400 to 750 mμ, 10 mμ slits, each standard	15.00
215.505g	730 to 1000 mμ, 20 mμ slits, each standard	15.00
215.505h	For two calibrations on the same glass, items (215.505d and 215.505e) or items (215.505f and 215.505g) each standard	25.00

Item	Description	Fee
	Working standards of spectral directional reflectance for use on General Electric recording spectrophotometers with nearly perpendicular irradiation and diffuse reception; standards consist of white structural Vitrolite glass, 4 by 4 inches, 5/16 inch thick; report includes table of spectral directional reflectances relative to freshly prepared magnesium oxide at every 10 mμ:	
215.505i	400 to 750 mμ, specular component of reflectance partly included, partly excluded, slits equivalent to 4 or 8 mμ or spectrum, each standard	$25.00
215.505j	400 to 750 mμ, specular component both included and excluded (on same glass), 10 mμ slits, each standard	30.00
215.505k	730 to 1000 mμ, specular component both included and excluded (on same glass), 20 mμ slits, each standard	30.00
	Working standards of spectral directional reflectance for use on the Beckman quartz spectrophotometer with nearly perpendicular irradiation and approximately 45° circular reception; standards consist of white structural Vitrolite glass, 1½ by 2 inches, 5/16 inch thick; report includes table of spectral directional reflectances relative to freshly prepared magnesium oxide at every 10 mμ:	
215.505L	380 to 770 mμ, each standard	25.00
215.505m	350 to 1,000 mμ, each standard	50.00

215.506 Spectrophotometric measurements. The tests described in this schedule are primarily made for informational purposes, and samples so tested should not be accepted as "standards" certified by the National Bureau of Standards. All measurements are made at room temperatures. For various types of spectrophotometric standards, see 215.505.

Item	Description	Fee
	Spectral transmittance, 210 to 1,000 mμ:	
215.506a	1 sample at 1 wavelength	$15.00
215.506b	Each additional wavelength on the same sample	1.00
215.506c	Each additional sample, each wavelength	1.00
	Spectral directional reflectance relative to MgO, normal irradiation and 45° circular reception, as obtained with the Beckman spectrophotometer, 254 to 1,000 mμ:	
215.506d	1 sample at 1 wavelength	15.00
215.506e	Each additional wavelength on the same sample	2.00
215.506f	Each additional sample, each wavelength	2.00
	Spectral transmittance or transmittancy curves obtained on General Electric recording spectrophotometer, including 100% and zero calibration curves and didymium glass curve for checking the wavelength calibration; report includes ozalids of tracings.	
215.506g	Testing a single sample, 400 to 750 mμ, or 730 to 1,000 mμ, with slits approximating 10 mμ or 20 mμ (respectively) of spectrum, either spectral range	15.00
215.506h	Each additional curve or each additional sample	3.00

Item	Description	Fee
215.506i	Same as 215.506g but both spectral ranges, 400 to 1000 mμ	$25.00
215.506j	Each additional pair of curves or each additional sample	5.00
	Spectral directional reflectance curves obtained on General Electric recording spectrophotometer, including (1) Vitrolite calibration curve for correcting values relative to fresh MgO as 100%, (2) zero curve, (3) didymium glass curve for checking the wavelength calibration; report includes ozalids of tracings:	
215.506k	One sample, 400 to 750 mμ, or 730 to 1000 mμ, with slits approximating 10 mμ or 20 mμ (respectively) of spectrum, with specular component of reflected energy included or excluded; either spectral range, and either condition of specular reflection	15.00
215.506L	Each additional curve; or each additional sample, each curve	3.00
215.506m	Same as 215.506k, but both spectral ranges, 400 to 1080 mμ	25.00
215.506n	Each additional pair of curves; or each pair of curves on each additional sample	5.00
	Spectral transmittance, transmittancy or directional reflectance curves obtained on General Electric recording spectrophotometer, including 100% (or Vitrolite) and zero calibration curves and didymium glass curve for checking the wavelength calibration; specular component of reflected energy partly included, partly excluded:	
215.506o	One sample, 400 to 750 mμ, with slits approximating 4 or 8 mμ of spectrum	15.00
215.506p	Each additional curve or each additional sample	3.00
215.506q	For reduction of data obtained as in 215.506g to 215.506p, giving table of values of transmittance, transmittancy, or directional reflectance relative to MgO for every 10 mμ, for each curve	5.00

215.507 Colorimetry.

Item	Description	Fee
	Colorimetric computations:	
215.507a	Computing chromaticity coordinates and luminous directional reflectance or transmittance from spectrophotometric data for certain specified illuminants, per illuminant per sample	$5.00
215.507b	Computing luminous directional reflectance or transmittance from spectrophotometric data for certain specified illuminants, per illuminant per sample	2.00
215.507c	Computing dominant wavelength and purity from chromaticity coordinates for certain specified illuminants and heterogeneous stimuli, per illuminant per stimulus per sample	2.00

Item	Description	Fee
	Conformity to chromaticity of standard, sample and standard illuminated normally by artificial daylight or by incandescent-lamp light and viewed at 45°, chromaticity differences expressed in terms of chromaticity coordinates on fundamental colorimetric coordinate system:	
215.507d	One sample relative to a standard	$15.00
215.507e	Each additional sample relative to the same standard	5.00
	Conformity to color of standard within a tolerance, by visual comparison under a specified illuminant with a standard sample and a limit sample:	
215.507f	Inspecting 1 sample	15.00
215.507g	Same, each additional sample	1.00
	Color temperature of incandescent lamps, voltage for specified color temperature, current for neighboring specified voltage to check permanence:	
215.507h	1 color temperature, each lamp	15.00
215.507i	1 color temperature, each lamp, including cost of 500-watt projection lamp	17.00
215.507j	Each additional color temperature on the same lamp	6.00
215.507k	Equation giving any color temperature from 2,000° to 2,850° K., each lamp, fee includes cost of 500-watt projection lamp	35.00
	Determination of the Munsell book notation of an opaque specimen by visual interpolation along the scales of the 40-hue-chart edition of the Munsell Book of Color, specimen and scales illuminated by light from the north sky centering approximately on 45 degrees and viewed approximately along the perpendicular to the surfaces:	
215.507L	One specimen	15.00
215.507m	Same, each additional specimen	2.00

215.508 Reflectometry. Standards issued: Standards have been prepared for use in the measurement of 45°0° luminous directional reflectance (45° illumination, normal viewing) of paints, papers, textiles, ceramic products and other opaque materials. The standards may be used with any reflectometer designed to measure 45°0° directional reflectance, such as the multipurpose reflectometer developed at this Bureau. See Journal of Research NBS **25**, 581 (1940) RP1345.

These standards may also be used for the tristimulus colorimetry of reflecting specimens of nearly the same spectral character; that is, those that are essentially nonselective. A detailed discussion of the method of photoelectric tristimulus colorimetry, its capabilities and limitations, is contained in NBS Circular C429 (1942).

Each set consisted of one white Vitrolite plaque with black backing and ten porcelain-enameled-iron panels having essentially nonselective spectral characteristics. The standards are 4¼ inch squares; the iron panels have a 90° fold about ¼ inch wide at each edge. The nominal 45°0° directional reflectances of the standards contained in the sets cover the range from ½ to 90%.

Item	Description	Fee
	STANDARDS ISSUED	
215.508a	Set of 11 standards in box	$85.00
	SAMPLES SUBMITTED FOR CALIBRATION	
	Directional reflectance relative to magnesium oxide or other standard, for visual or photoelectric instrument, angles and apertures of illumination and observation as restricted by available instruments, for incandescent lamp or artificial-daylight illumination, or for certain spectral regions isolated by filters:	
215.508b	1 standard or sample under 1 set of experimental conditions	15.00
215.508c	Each additional standard under same conditions	8.00
215.508d	Each additional sample under same conditions, for informational purposes	2.00
215.508e	Each additional set of experimental conditions for 215.508b, 215.508c or 215.508d	2.00
	Luminous or photoelectric reflectance (total) as determined on the Taylor or Generl Electric (Baumgartner) reflectometers, respectively.	
215.508f	1 sample on either instrument	15.00
215.508g	Each additional sample on the same instrument	3.00

215.509 Opacimetry. Opacity of opal glass by contrast-ratio method defined as ratio of directional reflectance with black backing to directional reflectance with white backing, approximately diffuse illumination and nearly normal viewing or equivalent.

Item	Description	Fee
	Reflectance of white backing taken so as to accord with the opacimeter correctly adjusted to read contrast ratio for thin samples with a white backing reflecting 0.915 relative to MgO (Technical Association of the Pulp and Paper Industry test method T425m-36), samples prepared by Bureau:	
215.509a	Each opal-glass standard, for National Bureau of Standards type visual opacimeter, opacity between 0.60 and 0.80, as specified	$15.00
215.509b	Each opal-glass standard for Bausch & Lomb type photoelectric opacimeter, opacity between 0.50 and 0.96 as desired	15.00
215.509c	Set of 4 opal-glass standards for Bausch & Lomb type photoelectric opacimeter, opacities approximately equal to 0.65, 0.75, 0.85, and 0.95	50.00
	Reflectance of white backing taken as 0.70 relative to MgO, opacity measured via Priest-Lange reflectometer with film of water over sample and between sample and backings (see American Dental Association specification for dental silicate cement), samples not prepared by Bureau:	
215.509d	Opal-glass samples, opacity approximately 0.35 and 0.55, respectively, each pair	15.00
	Reflectance of white backing taken at any desired value:	
215.509e	One sample under one set of experimental conditions	15.00
215.509f	Each additional sample under the same experimental conditions	3.00

215.510 Glossimetry.

Item	Description	Fee
	STANDARDS ISSUED	
	Set of ten 60° specular gloss standards consisting of 8 glazed ceramic tiles and 2 pieces of white Vitrolite glass, each approximately 4¼ inches square, in box. The gloss of these standards ranges from approximately 1 to 100 on the ASTM scale; they are calibrated in accordance with ASTM Method D523:	
215.510a	Set of ten 60° specular gloss standards in box	$70.00
	Standard of 60° specular gloss for certain nominal values between 1 and 100 on the ASTM scale calibrated in accordance with ASTM Method D523; standard of glazed ceramic tile or vitrolite glass approximately 4¼ inches square furnished in box:	
215.510b	1 standard	15.00
215.510c	Each additional standard	8.00
	SAMPLES SUBMITTED FOR CALIBRATION	
	60° specular gloss of sample submitted; values reported on ASTM scale, measured in accordance with ASTM Method D523:	
215.510d	1 standard or sample	15.00
215.510e	Each additional standard	8.00
215.510f	Each additional sample, for informational purposes	2.00
	Contrast gloss, defined as the fraction whose denominator is the directional reflectance of the sample illuminated unidirectionally and viewed in the direction of regular reflection, and whose numerator is the same directional reflectance minus the directional reflectance of the sample similarly illuminated and viewed normally; angle of illumination 60°, angular apertures as restricted by available instruments:	
215.510g	1 sample	15.00
215.510h	Each additional sample	3.00
	(For specular or contrast gloss at other than the above angles, or for distribution curves of directional reflectance, the fees will be as given in test free schedule 215.508b to e.)	
	Distinctness-of-image gloss, tested by visual resolution of lines of illuminated target of concentric rings, image of target viewed at approximately 45° to surface of sample; for conformity to standard within a tolerance by comparison with a standard sample and a limit sample, or for arrangement of samples in order of distinctness-of-image gloss:	
215.510i	1 sample	15.00
215.510j	Each additional sample	1.00

215.511 Lovibond glasses. Lovibond red glasses, determination of numeral on the additive (N″) scale established (by Priest and Gibson's adjustment of set BS 9940) at the Bureau in 1927, the value given being

the effective value when the given red glass is used in combination with a 35-yellow glass, each glass to be marked with the NBS test number and the numeral found for the glass. (Lovibond yellow and blue glasses are not accepted for routine calibration. Test has shown that discrepancies among the 35-yellow glasses are not important in the vegetable oil trade and at present their calibration is, therefore, considered unnecessary. The standardization of the Bureau's own set of yellow glasses from 0.01 to 20.0 has not been completed. Until this set is satisfactorily standardized, the Bureau cannot accept Lovibond yellow glasses for calibration. There has been no demand for standardization of the blue glasses.)

Item	Description	Fee
215.511a	For testing a single red glass	$15.00
215.511b	For each additional red glass	3.00

215.512 Signal glasses. Railroad signal glasses, duplicates of standard limit glasses selected by Association of American Railroads (A. A. R.) Signal Section and conforming in color to A. A. R. Signal Section specifications; 2-inch polished squares for testing pressed ware designated as red, yellow, green, blue, purple, or lunar white, or for testing kerosene lantern ware designated as red, yellow, green, or blue; or 1-inch diameter polished disks for testing disk ware designated as red, green, or purple, or 1-inch diameter disks with one surface ground and one surface polished for testing disk ware designated as yellow; in all cases there are two limit glasses for each color designation for each kind of ware. The Bureau does not prepare these glasses, its fee including only the cost of measurement and certification. Certificate includes (1) a statement of conformity to the chromaticity requirements of the respective A. A. R. specification, for all glasses, (2) the value of luminous transmittance on the A. A. R. scale, for all except disk yellow glasses, (3) a statement as to the uniformity of transmittance of the glass, for all except disk glasses, and (4) the value of the ratio of red to total luminous transmittance, for blue and purple glasses only.

For traffic signal glasses, aviation signal glasses, and special tests not covered by the above schedule, fees will be charged dependent upon the nature of the test.

Item	Description	Fee
215.512a	Testing and certification, each glass	$15.00
215.512b	Each glass rejected	10.00

215.513 Enamel standards for raw silk.

Item	Description	Fee
	Conformity in color and gloss to the master standards, designated as raw-silk white, raw-silk ivory, and raw-silk cream, selected by the National Association of Hosiery Manufacturers, within tolerances as follows:	
	Luminous directional reflectance for daylight incident perpendicularly and for 45° viewing, ±0.03; chromaticity coordinates (x, y) on the 1931 I. C. I. colorimetric coordinate system, same illuminating and viewing conditions, ±0.0010; distinctness-of-image gloss, must be intermediate between the master standards:	
215.513a	Testing and certification in groups of 9 or more, each sample	$5.00
215.513b	Each sample rejected from a group submitted as above	3.00
	For samples submitted in groups smaller than 9, fees will be charged as in schedules 215.507d and e, 215.508d and 215.510j.	

215.514 Transmittance standards for petroleum products. Two-inch squares of glass for calibration of photoelectric colorimeters in accord with Proposed ASTM Method for Determination of Color Index of Petroleum Products, Photoelectric Method, Committee D-2 Report, Proc. ASTM, 47, 307 (1947), as amended by further action of Subcommittee VI, Committee D-2, at their meeting of February 11, 1948. Five standards (Nos. 12, 13, 14, 15 and 16) are intended to duplicate essentially the spectral transmittances typical of petroleum products; two standards (Nos. 21 and 22), a red and a green, are intended for use in conjunction with the above-listed five to check the spectral sensitivity of the photocell and afford a basis for disqualification of photocells too far different in spectral sensitivity from that specified in the method; and one standard (No. 10) of clear glass is used to set 100% relative transmittance on the colorimeter scale for each of the other standards. Glass standards are prepared by the Bureau and certified as to relative transmittance ($100T/T_{10}$) for the "North Sky," Violet, and Red filters specified in the method and also for tristimulus green, blue, and amber filters. That is, certified values of $100Y/Y_{10}$, $100Z/Z_{10}$, and $100\ (X-0.17Z)/(X-0.17Z)_{10}$ are also supplied, where X, Y, and Z are tristimulus values in accord with the standard observer and coordinate system for colorimetry recommended in 1931 by the International Commission on Illumination (ASTM Designation D307-44).

Item	Description	Fee
215.514a	Set of 8 glass standards together with certified values of relative transmittance	$140.00
215.514b	Any single glass of the set	20.00

215.6 Optical Instruments

215.601 Optical instruments.

Item	Description	Fee
	TELESCOPES	
215.601a	Complete test of telescope for conformity with type specifications comprising measurement of resolving power, true angular field, apparent angular field, diameter of entrance pupil, diameter of exit pupil, magnification, and transmittance	$30.00
215.601b	Determination of resolving power, true angular field, diameter of entrance pupil, diameter of exit pupil, and magnification	18.00
215.601c	Determination of transmittance	12.00
215.601d	General purpose test comprising measurement of resolving power and general comments on image quality	5.00
	BINOCULARS	
15.601e	Complete test of a binocular for conformity with type specifications comprising measurement of resolving power, true angular field, apparent angular field, diameter entrance pupil, diameter of exit pupil, magnification, parallelism of axes, relative orientation of field, and transmittance	45.00
215.601f	Measurement of resolving power, diameter of entrance pupil, diameter of exit pupil, magnification and, true angular field	20.00
215.601g	Measurement of transmittance	15.00
215.601h	General purpose test comprising measurement of resolving power, parallelism of axes, relative orientation of fields, and general comments on image quality	15.00

215.602 Photographic objectives. The following information is pertinent to the tests a to o in this schedule:

a. This test is applied to photographic objectives that are mounted in a lens barrel or shutter. A visual or a photographic method is used depending upon the probable use of the lens. The back focal length determines the lens position with respect to the focal plane for an airplane camera or other fixed focus camera focussed for an infinitely distant object. The equivalent focal length determines the scale factor for the interpretation of aerial photographs.

b. This test is given to the photographic objectives that are to be used in precision copying cameras. The information is used in calibrating the camera scales that enable the user to obtain the proper settings of lens, object plane, and image plane for any desired magnification without visual focussing.

c,d. This test includes the information obtained in 215.602b, together with information on the distortion. It is applied to photographic objectives that are to be used in precision copying cameras where the user

wishes to be certain that the relative proportions of the image are not significantly different from those of the object. Since the distortion changes with magnification, it is advisable to specify a ratio for test that corresponds to the magnification most commonly used.

e. This is a general purpose test to determine the suitability of a lens so far as its definition characteristics are concerned. It is performed photographically. In general, if a lens yields satisfactory results when subjected to this test, it is probable that no additional test for lateral chromatic aberration is necessary, and the lens will doubtless perform satisfactorily for either black-and-white or color photography.

f. This is the qualifying test for photographic objectives intended for use in airplane mapping cameras that are to be used in governmental mapping projects. It is a photographic test and the determinations are made for the plane of best average definition.

g, h. The f-number may be obtained by dividing the equivalent focal length of the lens by the diameter of the effective aperture. These tests are primarily of value in determining the accuracy of the geometric f-number markings at maximum aperture and at additional specified apertures.

i, j. The first of these tests (i) is a photometric calibration of the marked f-number graduation of a lens in terms of the f-numbers of a lens having 100 percent transmittance. (These are also referred to as T-numbers). The second test (j) is a complete calibration and includes the information obtained in tests g, h, and i. It is a standardization test of a lens for transmittance. It enables a user to compare coated and uncoated lenses. It permits evaluation of the errors in the marked f-numbers and indicates their source.

k, l. This test is applied to photographic objectives mounted in cameras. As the test is a photographic one requiring a time exposure, it is necessary that the stop be open when the lens is submitted for test. This is a useful test for *nonprecision* type airplane cameras where the collimation index markers are located in a detachable magazine.

m. This test is applied to photographic objectives mounted in cameras. It gives the same information as test 215.602f except for back focal length. It is preferable that these lens characteristics be determined for the lens as mounted in a barrel or shutter, but occasionally it is desirable to determine these quantities for the lens mounted in a camera. The shutter of the lens should be open when the camera is submitted for test.

n. This test is applied to a lens-camera combination that is to be used in photogrammetric mapping. It gives the departure of the principal point from the center of collimation which is the intersection point of lines joining opposite pairs of collimation index markers. Since it is necessary to determine the shift of the principal point resulting from prism effect in the lens, the equivalent focal length of the lens as mounted in the camera is incidentally determined in this test which checks whether the lens has been properly mounted to yield best average definition throughout the image field.

This test cannot be performed on a camera having a detachable magazine which bears the collimation index markers. This is the preliminary test on a precision type camera to determine compliance with specifica-

tions. If no provision has been made for ready adjustment of the collimation index markers and the 90° condition is not satisfied, the camera is returned to the firm or agency submitting the camera with recommendations regarding the necessary adjustments. If the 90° condition is satisfied, but no provision has been made for ready adjustment of the principal point with respect to the center of collimation, the camera is returned with recommendations regarding the necessary adjustments.

0. If provision has been made for ready adjustment of the lens in a transverse direction to properly position the principal point with respect to the center of collimation, or if this can be done by ready movement of the collimation index markers, this task is done in the course of this test. Following adjustment, the camera is checked and if satisfactory, dowels are set to insure preservation of the space relations between collimation index markers and principal point.

When a camera is submitted for test, it is mandatory that the drill holes for the dowels be already present in one of the members that move with respect to one another. In addition, a proper sized drill and reamer and a sufficient number of dowel pins to perform the doweling must accompany the camera.

Item	Description	Fee
	Photographic objectives not mounted in cameras:	
215.602a	Determination of focal length and back focal length	$8.00
215.602b	Determination of equivalent focal length, back focal length, separation of nodal points, and thickness	12.00
215.602c	Determination of equivalent focal length, back focal length, separation of the nodal points, and distortion at 5° intervals from the center to edge of field for one specified ration of object to image size	30.00
215.602d	Fee for each additional ratio	15.00
215.602e	Determination of resolving power at 5° intervals from center to edge of field for parallel light at one aperture	10.00
215.602f	Determination of back focal length, equivalent focal length, distortion and resolving power at 5° intervals from the center to edge of the field	25.00
	NOTE: This is the test usually required for lenses that are to be mounted in precision airplane mapping cameras.	
215.602g	Determination of equivalent focal length and true geometric f-number for 1 marked stop	10.00
215.602h	Fee for each additional stop	2.00
215.602i	Calibration of the f-numbers in terms of the f-numbers of a lens having 100% transmittance	30.00
215.602j	Calibration of the f-numbers in terms of the f-numbers of a lens having 100% transmittance, determination of the equivalent focal length, true geometric f-numbers and, transmittance	50.00
	Photographic objectives mounted in cameras:	
215.602k	Determination of focal length for lens mounted in camera	11.00
215.602L	Fee for each extra magazine	5.00

Item	Description	Fee
215 602m	Determination of equivalent focal length, distortion and resolving power at 5°intervals from center to edge of field for lens mounted in camera	$30.00
215.602n	Location of the principal point, and check of 90° condition for lens mounted in camera	26.00
215.602o	Setting the principal point and 90° condition, checking and doweling for lens mounted in camera	17.00
215 602p	Certification of precision airplane mapping camera equipped with lens of 8¼-inch focal length, in accordance with U. S. Department of Agriculture Specification No. A-APC-1102	75.00
215.602q	Certification of precision airplane mapping cameras, equipped with lens of 8¼-inch focal length that has performed satisfactorily under test No. 215.602f or 215.602m in accordance with U. S. Department of Agriculture Specification No. A-APC-1102	40.00
	Photographic objectives, telescope objectives, eyepieces, etc.:	
215.602r	Determination of back focal length, equivalent focal length, and curvature of field	25.00
215.602s	Determination of back focal length, equivalent focal length, and longitudinal spherical aberration by a visual method	25.00
215.602t	Determination of axial chromatic aberration for three colors	25.00
251.602u	Determination of lateral chromatic aberration for three colors	50.00

215.603 Optical components, spectacle lenses, goggle lenses, etc.

Item	Description	Fee
	Optical components:	
215.603a	Determination of equivalent focal length of single component lens	$8.00
215.603b	Fee for each additional lens	7.00
215.603c	Determination of a single radius of curvature	12.00
215.603d	Fee for each additional determination	10.00
	Spectacle lenses:	
215.603e	Determination of spherical and cylindrical power, axis of sphere, and axis of cylinder for a single spectacle lens	3.00
215.603f	Fee for each additional lens	1.00
215.603g	Determination of spherical and cylindrical powers, axis of sphere, and axis of cylinder for a single spectacle lens with bi-focal segment	4.00
215.603h	Fee for each additional lens	2.00

Item	Description	Fee
	Sunglass lenses:	
215.603i	Determination of refractive power, surface quality, and definition to determine compliance of a single sunglass lens with commercial standards	$3.00
215.603j	Fee for each additional lens	2.00
	Goggle lenses:	
215.603k	Determination of lens dimensions, refractive power, prismatic power and definition; and making drop test on a single hardened goggle lens to determine compliance with Federal Specification GGG-G-501b	3.00
215.603L	Fee for each additional lens	2.00
215.603m	Determination of lens dimensions, refractive power, prismatic power, and definition; and making strength tests on a single welder's goggle lens to determine compliance with Federal Specification GGG-G-511a	3.00
215.603n	Fee for each additional lens	2.00

215.604 Refractometric instruments and sextants. Every instrument submitted for test should be in good working order. The test slab or standard supplied by the maker, and the tables, if any, must accompany each refractometer. Upon request, special attention will be given to such portions of the scale as may be of particular importance in the contemplated use of the instrument. Refractometers with compensators will be tested with "white" light unless otherwise specified. Refractometers without compensators will be tested only with sodium light unless otherwise specified.

Item	Description	Fee
	Abbe refractometer:	
215.604a	Test and calibration at 4 or more scale readings, including test of compensator for determining dispersion	$25.00
215.604b	Test and calibration at 4 or more scale readings, including test of compensator only as used in determining index (to $\pm 1 \times 10^{-4}$)	12.00
	PrecisionAbbe refractometer reading (by estimation or use of tables) to 5th decimal place of index:	
215.604c	Test and calibration at 4 or more scale readings for each spectral-line, including test of compensator only as used in determining index (to $\pm 5 \times 10^{-5}$)	15.00
	Immersion refractometer:	
215.604d	Test and calibration at 4 or more scale readings	12.00
	Butter, or fat, refractometer:	
215.604e	Test and calibration at 4 or more scale readings	12.00
	Pulfrich refractometer:	
215.604f	Test and calibration at 4 or more scale readings for each spectrum line—each prism of the refractometer	12.00
215.604g	Marine sextants: (See NBS Circular 110)	18.00

215.605 Refractive indices. When submitting media for refractive-index measurement, the temperature, wavelength of light (or spectral line), and approximate degree of desired precision should be specified. Liquid samples should usually be as large as 10 ml. Solids must be in the form of test slabs or prisms with optical surfaces of suitable quality.

Item	Description	Fee
	Index of refraction (approximately $\pm 1 \times 10^{-4}$) for D spectrum line for one liquid by precision Abbe refractometer:	
215.605a	Determination of, for single temperature	$10.00
215.605b	For each additional sample submitted at the same time for same temperature, or for each determination on additional spectral lines for same temperature	4.00
215.605c	For 1 determination at each additional temperature	8.00
	Index of refraction ($\pm 1 \times 10^{-4}$) for D spectrum line for 1 solid by precision Abbe refractometer:	
215.605d	Determination of, for 1 sample	5.00
215.605e	For each additional sample submitted at the same time	2.00
	Index of refraction ($\pm 1 \times 10^{-4}$) for D spectrum line for 1 solid by Pulfrich refractometer:	
215.605f	Determination of, for 1 sample	6.00
215.605g	For each additional sample submitted at same time	3.00
215.605h	For each additional spectrum line, C, F, or G′	1.00
	Index of refraction ($\pm 1 \times 10^{-5}$) of solid submitted in form of 60° prism:	
215.605i	Determination for one spectrum line	12.00
215.605j	Determination for each additional spectrum line	5.00
215.605k	Optical glass: determination of transmissivity	5.00

215.7 Photographic Technology

215.701 Photography. The following information is pertinent to the tests a to k in this schedule:

a. Determination of characteristic D log E curves and a time-gamma curve for one sample, for three times of development. Values of fog, speed, gamma, maximum density and scale from the resulting four curves submitted in report. Samples submitted must be complete, unopened, factory packages of sheet film not smaller than 8-by 10-in., roll or motion-picture film.

b. The relative spectral response of film is determined by exposing in a spectrograph. Print of wedge spectrogram submitted with report. Samples submitted must be complete, unopened factory packages of the material. (The size of the smallest piece of material that can be used in this test is 5 by 7 in.)

c. Densitometric readings are made on step wedges of 21 steps or less, with densitometer calibrated to give approximately contact printing density.

d. The test for determining the residual sodium thiosulphate content of processed photographic film is made according to the method given in "A method of testing for the presence of sodium thiosulfate in motion picture films," J. I. Crabtree and J. F. Ross, *Journal of the Society of Motion Picture Engineers* 14, 419 (1930).

For permanent records it is recommended that the "hypo" content of permanent record film not exceed 0.005 mg per square inch. Hypo content of less than 0.005 mg per square inch is reported as "nil." When present in amounts of 0.005 mg per square inch or over, it is reported to one significant figure.

Each sample submitted (preferably with an image) should be 6 to 8 inches in length, properly identified, and attached securely to request letter by stapling.

e. The test for determining the residual sodium thiosulphate content of processed photographic paper is made according to the method given in "The quantitative determination of hypo in photographic prints with silver nitrate." J. I. Crabtree, G. T. Eaton, and L. E. Muehler, *Journal Franklin Institute* 235, 351-360 (1943).

Each sample submitted should be properly identified, containing no image (slight fog permissible); from which 6 strips, 1 by 4 in. can be cut for test.

f. The silver content of used fixing baths is reported in terms of grams per liter or ounces per gallon. The size sample submitted should be no less than 100 cm^3, properly identified.

g. The dimensional change of photographic papers and film caused by changes in relative humidity (14, 34, 52, and 76 percent) is reported in terms of percentage change in crosswise and lengthwise directions.

Each sample submitted should be properly identified; from which 4 strips, 2 by 8 in. can be cut in each direction.

h, i. The dimensional change of film caused by processing is reported in terms of percentage change in crosswise and lengthwise directions. Usual processing method used, with special processing for special papers. Conditioning is at 50- or 65-percent relative humidity, plus or minus 3 percent, and at 70° F,± 2°. (preconditioning at 15-percent relative humidity below conditioning relative humidity).

Each sample submitted should be properly identified, from which 5 strips 2 by 8 in. can be cut in each direction.

j. Permanent record film base test includes tests on change in pH, relative viscosity, and flexibility, caused by oven-aging at 100° C for 72 hours; the quantitative determination of nitrogen content in film base after removal of gelatin, and other tests described in ASA Standard, Z38.3.2–1945, "Specifications for films for permanent records," or the latest revision thereof. Each sample submitted should be properly identified and should be equivalent in area to 50 feet of 16-mm film.

k. The NBS microcopy resolution test chart, made photographically, for use in testing the resolving power of microcopying cameras, consists of a series of line-patterns, the lines and spaces being of equal width. Each pattern contains two sets of lines, one set at right angles to the other. The patterns range from 1 to 10 lines per millimeter. Upon request, instructions for the use of the test chart will be supplied free of charge.

Item	Description	Fee
215.701a	Determination of characteristic curve and rate of development curve (1 sample, 4 sensitometric curves)	$35.00
215.701b	Spectrographic tests (relative spectral sensitivity), 1 to 3 samples (additional samples at prorated fees)	25.00
215.701c	Calibration of photographic step wedges (1 sample—21 steps)	6.00
215.701d	Residual sodium thiosulphate content of processed permanent record film, 1 to 3 samples (additional samples at prorated fees)	9.00
215.701e	Residual sodium thiosulphate content of processed photographic paper, 1 to 3 samples (additional samples at prorated fees)	12.50
215.701f	Determination of silver content in fixing bath, 1 to 3 samples (additional samples at prorated fees)	15.00
215.701g	Dimensional change of film or paper caused by changes in relative humidity, 1 to 3 samples (additional samples at prorated fees)	40.00
215.701h	Film processing shrinkage, 1 to 10 samples (additional samples at prorated fees)	20.00
215.701i	Paper processing shrinkage, 1 to 10 samples (additional samples at prorated fees)	30.00
215.701j	Test on permanent record film base (1 sample)	80.00
215.701k	Microcopying resolution charts each	.20

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