

DEPARTMENT OF COMMERCE  
BUREAU OF STANDARDS  
WASHINGTON

July 1, 1926

FEEES FOR ELECTRICAL TESTING

This letter circular lists the fees established for electrical tests of the classes regularly handled by the Bureau of Standards. The schedules given herein supersede those published in the seventh edition of Circular No. 6 and in previous letter circulars covering parts of the work.

Schedule 191. - Standard Cells

(Accuracy 0.01 per cent)

Determination of electromotive force of cadmium standard cells, each ..... \$4.00

Saturated cells (Weston Normal cells) will be measured at a fixed temperature in a thermostatically controlled oil bath. Unsaturated cells (the ordinary form for laboratory use) will be measured at room temperature.

RESISTANCE APPARATUS

Condition of Apparatus - To be accepted for test and certification, precision resistance standards and resistance apparatus must be of good design, workmanship and material, must have clean contacts, clean and good insulation, and must be in good working condition. If it is evident that the apparatus has been kept in rancid oil, used with excessive test currents or otherwise abused, or has not received proper care, a test will be made only in case it is shown that there is a special need for it.

Precision Resistance Apparatus - The following features are considered essential in the best precision resistance apparatus:

(a) Resistance material - 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 thermoelectromotive force against copper.

(b) Construction - All wire resistance standards and the more important sections of resistance apparatus 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 1000 ohms. The resistance material should be protected against oxidation and other chemical action, and after winding should be annealed and aged.

(c) Adjustments. - Resistance standards and apparatus should be so adjusted as to give an accuracy of at least 0.1 per cent without corrections.

(d) Design - Terminals should be so arranged as to give definite values to the resistances. Provision for dissipating heat should be such that the errors caused by heating under conditions of test or use will not prevent measurements to a precision somewhat higher than that desired in the test.

New Apparatus - Because of the comparatively rapid changes in resistance which take place in new apparatus, it is not advisable to test new or repaired apparatus until at least two months after it has been annealed and adjusted.

Test current - Unless otherwise stated, the tests listed below are generally made using a direct current of such magnitude as to cause only a negligible heating of the resistance material.

Nature of test - Unless otherwise stated, tests of resistance standards, 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 corresponding to all possible readings. Tests of potentiometers and volt boxes (or potential dividers) consist in determinations of the ratios of the resistances corresponding to all possible readings.

### Schedule 113. Precision Resistance Standards

Resistance standards of the precision type only are accepted for test under this schedule. These include standards made according to accepted designs, using the best materials having nominal values which are related in a simple way to the unit, adjusted very nearly to these nominal values, having amalgamated terminals, and intended for oil immersion. They should be capable of maintaining values over a reasonable period at least to an accuracy of 0.01 per cent.

Standards of 0.1 ohm and less must be of the 4-terminal type, that is, be provided with both current and potential terminals.

Measurements are regularly made in an oil bath kept at



a temperature of 25°C.

- (a) Precision resistance standards, each.....\$6.00  
 (b) Precision resistance standards measured at three  
 temperatures: 20, 25, and 30°C, each.....20.00

Tests are made at 20, 25, and 30°C only when it is shown that the small changes in resistance resulting from necessary variations of the temperature from 25°C are of importance in the work in which the standards are used.

When the apparatus is of the best quality the results of the measurements are usually given to 1 part in 100,000, and certified to 1 part in 20,000.

Schedule 131. Resistance Standards for Current Measurements  
(Accuracy 0.025 per cent)

Resistance standards used to measure large currents are often heated by the passage of the current to such an extent as to cause a material change in their resistance. Such standards when first submitted for test should be tested both with light test current and with full rated current. (Schedule 131 (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 light test current (Schedule 131 (a) ). Standards of large current capacity are often so constructed that the temperature 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 can not be duplicated. The best experimental procedure to use in such cases is to place the standard in a thermostat and measure its resistance when it is heated uniformly to temperatures approximating that at which it will operate in service. (Schedule 131 (d) ). 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 actual operating temperature can be read off, provided this actual temperature is by the user with the standard under the actual operating conditions.

- (a) Determination of resistance at room temperature with  
 light test current.....\$5.00  
 (b) For an additional determination of resistance at  
 another test current not exceeding 150 amperes the  
 additional fee will be ..... 1.00



- (c) The same at a test current exceeding 150 amperes but not exceeding 1500 amperes.....\$3.00
- (d) For additional determinations of the resistance at temperatures higher than room temperature, the additional fee will be:  
for the first elevated temperature.....15.00
- (e) For each other elevated temperature..... 5.00
- (f) For resistance standards having values not decimal submultiples of 1 ohm, the fee will be  $\frac{1}{2}$  times that given above.

#### Schedule 114. Precision Resistance Apparatus

Only bridges, potentiometers, precision rheostats and similar apparatus, which are of good quality will be accepted for test under this schedule.

- (a) Precision rheostats, and variable low resistances, each.....\$20.00
- (b) Calorimetric bridges, each ..... 40.00
- (c) Potentiometers and bridges, each..... 30.00

#### Volt Boxes and Ratio Sets

- (d) Test with low voltage, each..... 15.00
- (e) Test with service voltage not exceeding 150 volts, each..... 20.00

If practicable, and the apparatus is of the best quality corrections will be determined to such an accuracy that the results obtained in the use of the apparatus may be relied upon to 0.01 per cent.

#### Schedule 117. Standards for Conductivity Bridges

This schedule covers such tests as are regularly made by the Bureau on standards for conductivity bridges, and wires used in checking conductivity apparatus and measurements in other laboratories. These tests include the determination of the resistance and resistance temperature formula of standards; and resistance of specified lengths, resistivity and resistance-temperature formula of wires. Standards and wires submitted for test should be kept straight and should be packed in substantial containers for shipment.

- (a) Resistance per unit length, or between potential terminals, each sample.....\$8.00
- (b) Resistance per unit length, total length, and mass .....10.00
- (c) Resistance per unit length and cross section.....12.00
- (d) Resistance per unit length, total length, mass and density.....12.00
- (e) Resistance-temperature formula (20-30°C).....30.00





Certificates are not furnished but reports are made giving the results obtained. In case the resistance per unit length, mass and total length; the resistance per unit length and cross section; or the resistance per unit length, mass, total length, and density are measured the resistivity will be stated, and, for copper, the per cent conductivity as compared with the annealed copper standard 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 .05 per cent.

### INDUCTORS

An inductor should be tested as nearly as possible under the same conditions as those under which it is to be used. Hence these conditions should be clearly set forth in the request for the test.

#### Schedule 121. Inductors: Tests at Low Frequencies

- |  |        |
|--|--------|
| (a) Self inductance of a coil, or mutual inductance between two coils, at either 60 or 1000 cycles per second.....                       | \$4.00 |
| (b) Self inductance of a coil, or mutual inductance between two coils, at any other frequency between 25 and 3000 cycles per second..... | 6.00   |
| (c) Each additional coil of the same nominal value tested at the same time and at the same frequency as (a) or (b) .....                 | 2.00   |
| (d) Variable self or mutual inductance: per point, (minimum charge \$5.00).....  | 1.00   |

#### Schedule 122. Effective Inductance of Two-Terminal Resistors

- |   |        |
|---|--------|
| (a) Effective inductance of a resistor.....                                 | \$4.00 |
| (b) Each additional resistor of the same resistance, tested as in (a) ..... | 1.00   |

The effective inductance is defined as the quotient of the reactance of the coil at any frequency divided by  $2\pi$  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. The measurement is made using an alternating current of a frequency not exceeding 3000 cycles per second.

For a determination of the resistance see schedule 113.



Schedule 161. Inductors: Tests at Radio Frequencies(1)Fixed Inductors

(a) Apparent inductance at one radio frequency .....	\$2.00
(b) Apparent inductance, each additional radio frequency.....	1.00
(c) Fundamental frequency (wave length).....	2.00
(d) Effective capacitance.....	14.00
(e) Pure inductance and effective capacitance.....	16.00
(f) Apparent resistance at one radio frequency.....	6.00
(g) Apparent resistance, each additional radio frequency.....	4.00
(h) Complete test of one coil including, unless otherwise specified, effective capacitance, pure inductance, fundamental frequency, and resistance at five radio frequencies.....	36.00

Variable Inductors

(i) Apparent inductance of a variable inductor at one radio frequency or over range of radio frequencies corresponding to range of inductance variation, per point (minimum charge \$5.00).....	1.00
(Frequency at one point may be specified).....	
(j) Apparent resistance, one point at one radio frequency.....	6.00
(k) Apparent resistance at each additional point at same radio frequency.....	4.00
(l) Apparent resistance at each additional radio frequency at same point.....	4.00
(m) Calibration curves, each.....	2.00

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(1) Note: The Bureau's radio tests are necessarily limited to tests for the Government, tests of instruments which are in turn used as standards for considerable numbers of other instruments, tests of importance to the Bureau as a matter of research, and a few other tests for which special reasons arise.



CONDENSERS

A condenser should be tested as nearly as possible under the same conditions as those under which it is to be used. Hence the conditions of use should be clearly set forth in the request for the test.

Schedule 123. Condensers - Tests with Direct Voltage

- (a) Capacitance of a fixed air condenser or one point of a variable air condenser measured with 100 or 1000 charges and discharges per second.....\$3.00
- (b) Additional points of an air condenser tested as in (a), each..... .50
- (c) Insulation resistance at room temperature and humidity..... 2.00
- (d) Additional measurements as in (c) made at the same time, each..... .50

Schedule 124. Condensers - Tests with Low-Frequency

Alternating Current

- (a) Capacitance and power factor of a condenser at room temperature and at any requested frequency between 25 and 3000 cycles..... 3.00
- (b) Additional condensers of the same nominal value, or additional sections of a subdivided condenser having the same nominal value, tested at the same time and at the same frequency as in (a), each..... 1.00
- (c) Temperature coefficient of a condenser between 20° and 30°C at one frequency..... 5.00
- (d) Temperature coefficient of additional condensers of the same nominal value, each..... 1.00
- (e) Capacitance and power factor of a condenser or cable measured at 1000 cycles per second with commercial accuracy..... 1.00
- (f) Additional condensers or cables of the same nominal values, tested as in (e), each..... .50
- (g) Capacitance of a variable air condenser, per point (Minimum charge \$5.00)..... .50

Schedule 162. Condensers - Tests with Radio-Frequency <sup>(1)</sup>

Alternating Current

Fixed Condensers

- (a) Capacitance at one radio frequency.....\$2.00
- (b) Capacitance at additional frequencies, each..... 1.00
- (c) Capacitance and power factor (or equivalent resistance) at one radio frequency.....10.00
- (d) Capacitance and power factor at each additional frequency..... 4.00

(1) Note: The Bureau's radio tests are necessarily limited to tests for the Government, tests of instruments which are in turn used as standards for considerable numbers of other instruments and tests of importance to the Bureau as a matter of research, and a few other tests for which special reasons arise.



## Variable Condensers

- |   |        |
|---|--------|
| (e) Capacitance of variable condenser over range of radio frequencies corresponding to range of capacitance variation, per point (minimum charge \$5.00)..... | \$1.00 |
| Frequency at one point may be specified.  |        |
| (f) Capacitance and power factor at one point at one frequency.....   | 10.00  |
| (g) Capacitance and power factor, each additional point at same frequency.....  | 4.00   |
| (h) Capacitance and power factor, each additional frequency at same point.....  | 4.00   |
| (i) Calibration curves, each.....   | 2.00   |

Test results will be furnished in the form of tables unless it is shown by the applicant that his needs justify the additional work entailed in the preparation of calibration curves.

Schedule 163. Standards of Radio Frequency.

The Bureau's radio tests are necessarily limited to special tests for the Government, tests of instruments which are in turn used as standards for considerable numbers of other instruments, tests of importance to the Bureau as a matter of research, and a few other tests for which special reasons arise. The devices covered in schedules (a), (b), and (c), however, when used to maintain a radio transmitting station on its licensed frequency, are tested by the Bureau upon request of the owner of the station.

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|--|---------|
| (a) Measurement of a fundamental frequency of a piezo oscillator or resonator or mounted quartz plate. (Plate will not be tested unless it operates readily nor unless mounted in the holder in which it is used).....   | \$10.00 |
| (b) Adjustment to specified frequency of a quartz plate cut to approximate frequency (not more than 1% below the specified frequency). (Plate will not be adjusted unless it operates readily nor unless mounted in the holder in which it is to be used)..... | 20.00   |
| (c) Adjustment of frequency indicator, Bureau of Standards type B, to licensed frequency of a transmitting station .....   | 5.00    |
| (d) Frequency meter (wavemeter), per point.....  | 1.50    |

(Minimum charge, each coil - \$9.00)





INSULATING MATERIALS: VOLUME AND SURFACE RESISTIVITY

For the insulation resistance of condensers and other instruments, see the section on condensers.

When possible, samples of insulating material submitted for resistivity measurements should be about 10 centimeters square and not over 1 centimeter thick.

Schedule 125. Resistivity of Insulating Materials

(a) Volume resistivity of one sample at room temperature and humidity.....	\$2.00
(b) Volume resistivity of additional samples, tested at same time, each.....	1.00
(c) Surface resistivity of one sample at one temperature and humidity.....	4.00
(d) Surface resistivity at additional temperatures or humidities, for the first sample, each condition....	2.00
(e) Surface resistivity of additional samples tested at the same time and at the same temperature and humidity, each.....	1.00

ELECTRICAL INSTRUMENTS, METERS, AND INSTRUMENT TRANSFORMERS.

The following points should be carefully noted before sending electrical instruments, meters, or transformers to the Bureau for test.

(a) Plan of fee schedules - The plan of schedules 132 to 1311 is to charge a "base fee" for the test of a piece of apparatus at a definite number of points (usually five); that is, at five values of current, voltage, power, etc., as the case may be. The amount of this base fee varies with the kind of apparatus and its range. Each additional determination on the same instrument is then charged for at a specified fraction of this base fee.

When an instrument is submitted for test at fewer points than are called for in the base fee, the base fee will be charged. In other words, the base fee is also the minimum fee for a test of the given instrument.

The fee for a multiple-range piece of apparatus, tested on more than one range, will be computed by taking as base fee that for the highest point tested.

The fees given in Schedules 132 to 136 inclusive apply to regular commercial instruments as used in practical work. These instruments are understood to be of the deflection type, requiring no special manipulation to get a reading. When the instruments submitted for test are of the balance type (such as Kelvin



balances and other instruments on this principle) and hence require more time to secure readings, or when the instruments have any unusual characteristics which increase the difficulty of making the required tests, the fees will be greater, depending on the amount of labor required.

(b) Wave form and frequency - The alternating-current tests at usual power and lighting frequencies are regularly made with currents and voltages which closely approximate to the sine wave form. Tests at such frequencies will be made with other wave forms when practicable, and will be subject to special fees. Determinations may be made of the wave forms used in the test. Tests made at frequencies between those used for power and lighting and the usual radio frequencies will be subject to special fees. All special tests should be arranged for in advance of shipment of the apparatus.

(c) Alternating-current to direct-current transfer tests - When ammeters, voltmeters, or wattmeters of the electrodynamic type which may be operated on reversed direct current<sup>(1)</sup> and on alternating current are submitted for test on alternating current, they will first be tested on reversed direct current at the desired points, after which a determination will be made of the difference between the readings on reversed direct current and on alternating current. This "transfer test" will usually be made at two points. The results of such a test are more accurate and valuable than those of a direct test on alternating current.

(d) Millivoltmeter and Shunt - The combination of a millivoltmeter and a shunt will be tested as an ammeter and the fee will be the same as for an ammeter of the corresponding range. If the millivoltmeter is also to be tested separately, the additional fee will be as given in schedule 133.

(e) Instruments used with transformers - Alternating-current instruments used with transformers should preferably be tested separately, as the transformers will in all probability have a very constant ratio over a long period of time while the instruments are more liable to change with time and use. When

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(1) Note: The expression "reversed direct current" is used to signify the regular procedure in the use of instruments of this kind on direct current in order to avoid error caused by local magnetic field. For example, in using an electrodynamic voltmeter on direct current, two readings are taken, the direction of current flow through the instrument being reversed before taking the second reading. The mean of the two readings gives a result independent of the local magnetic field.



a transformer and an instrument are so tested, they will be counted as two pieces of apparatus, and fees will be charged accordingly. When transformer and instrument are tested separately, it is thereafter sufficient to test the instrument alone, at suitable intervals, provided that the transformer is well constructed of good materials and is properly used.

(f) Wattmeters - When single-phase wattmeters are submitted for test without specific instructions, and are of such types as may be operated on reversed direct current and on alternating current, they will be tested with reversed direct current at five points and will then be given an a.c.- d.c. transfer test (see above) at two points. If they have more than one range, they will be tested at five points on one range, and at two points on each of the other ranges.

(g) Polyphase instruments - 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 not excessive they 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 degree of 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 rating of the wattmeter so tested will be taken as the normal rating of one element.

(h) Current transformers must be accompanied by full instructions covering the following points: frequency at which test is to be made, primary current range, and the resistance and reactance of the secondary burden. The wires used to connect the secondary instruments to the transformer should be included in the measurement of resistance and reactance. If it is not convenient to make this measurement, it will suffice for most purposes to state the maker's name, type, and serial number of each instrument, and the size and length of wire used in the secondary circuit. When the most accurate results are required, it is necessary to send the secondary instruments with the transformer. It is desirable to make the test at the particular values of secondary current given in schedule 1310, and the specifying of other values within the given range should be avoided. When a current transformer has more than one primary range obtained solely by series or parallel connections of the cam coils, a test on one range at 6 values of current and each of the other ranges at 0.5 and at 5 amperes secondary current is sufficient. Unless otherwise specified, current transformers will be demagnetized before being tested. If it is desired to have the transformer tested as submitted without demagnetization, this fact should be plainly stated in the request for the test.



(i) Voltage transformers (potential transformers) must be accompanied by full instructions covering the following points: Frequency at which test is to be made, secondary voltage (or voltages), and values of secondary burden. If the transformer has more than one primary or secondary range, the application must also state with what range or ranges the test is to be made. The ratio and the phase angle of a voltage transformer change linearly as the non-inductive secondary burden increases, and hence, if their values are determined for two non-inductive burdens, values for intermediate burdens may be found by interpolation. When voltage transformers are used with a secondary burden of fixed impedance, their ratio and phase angle are almost independent of the secondary voltage. Hence a test at one voltage is usually sufficient. When the voltage circuits (potential circuits) of instruments operated from the transformer are practically noninductive, as is often the case, it is necessary only to measure the resistance of the voltage circuit of each instrument in order to calculate the burden which it puts on the transformer. If the voltage circuits are inductive, or if doubt exists about them, the maker's name, type, and serial number of each instrument may be given, but when the most accurate results are required, it is necessary to send such secondary instruments with the transformer. When a voltage transformer has more than one primary range obtained solely by series or parallel connection of the same coils, a test on one range with four burdens and on each of the other ranges with zero and full rated burden is sufficient.

(j) Condition of instruments - The Bureau can not undertake the repair or adjustment of apparatus received in poor condition. Those submitting instruments for tests should make sure that the contacts are clean, that the resistances of the instrument circuits are definite and constant, that the pointer is not bent and does not show pivot friction amounting to as much as 0.2 division at any part of the scale, that the zero indication is good, that the balance is good, and that there are no obvious defects. Instruments provided with a zero adjuster will be set to indicate zero on open circuit at the beginning of the test unless there is a definite request to test them "as received".

(k) Circular No. 20 of the Bureau of Standards entitled "Electrical Measuring Instruments," contains information on the principles of operation of electrical measuring instruments, the advantages and limitations of the various types, sources of error and their avoidance, and discusses some points of design which are of interest to the user. A brief discussion of current and voltage transformers, and an outline of the equipment required for the precision testing of electrical instruments are also given. A copy of this circular may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 15 cents.





Schedule 132. Direct-Current Ammeters

- (a) Test at five points, not exceeding 150 amperes (base fee).....\$3.00
- (b) The same, exceeding 150 and not exceeding 1000 amperes, (base fee)..... 6.00
- (c) The same, exceeding 1000 and not exceeding 5000 amperes (base fee).....12.00
- (t) Per additional point above 5, 1/10 of the base fee
- (u) Test at first scale point on each additional range, 1/5 of the base fee.
- (v) Test as per item (u) having been made, per extra scale point on the same range, 1/10 of the base fee.

Schedule 133. Direct-Current Voltmeters and Millivoltmeters

- (a) Test at five points;not exceeding 300 volts, (base fee).....\$3.00
- (b) The same, exceeding 300 volts and not exceeding 750 volts (base fee)..... 4.50
- (t) Per additional scale point above 5, 1/10 the base fee
- (u) Test at first scale point on each additional range, 1/5 of the base fee.
- (v) Test as per item (u) having been made, per extra scale point on the same range, 1/10 of the base fee.

Schedule 134. Alternating-Current Ammeters

If the ammeter is of electrodynamic type the test will consist of a reversed direct-current test at 5 points followed by an a.c.-d.c. transfer test at two points; if it is of the moving-iron type, test will be made on alternating current.

- (a) Test at 5 scale points on one range, using reversed direct current not exceeding 150 amperes (base fee).\$4.00
- (l) Test at 5 scale points, using alternating current at one frequency; not exceeding 150 amperes (base fee)..... 6.00
- (t) Per additional scale point above 5 on the same range and frequency, 1/10 the base fee
- (u) Test at first scale point on each additional range or frequency, 1/5 of the base fee.
- (v) Test as per item (u) having been made, per extra scale point on the same range or frequency, 1/10 of the base fee.
- (w) Determination of the difference in readings on reversed direct current and on alternating current:
- (1) First scale point tested, 4/10 the base fee (a).
  - (2) Additional scale points on the same range and frequency, each 1/10 the base fee (a).
  - (3) First scale point tested on another range or frequency, 1/5 the base fee (a).

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Dear Sir,  
I have the honor to acknowledge the receipt of your letter of the 10th inst. in relation to the above mentioned matter. I am sorry that I cannot give you a more definite answer at this time, but I am sure that you will understand my position. I will be glad to discuss this matter further with you at any time that may be convenient to you.

I am, Sir, very respectfully,  
Yours truly,  
[Signature]

Very truly yours,  
[Signature]

Very truly yours,  
[Signature]

I have the honor to acknowledge the receipt of your letter of the 10th inst. in relation to the above mentioned matter. I am sorry that I cannot give you a more definite answer at this time, but I am sure that you will understand my position. I will be glad to discuss this matter further with you at any time that may be convenient to you.

I am, Sir, very respectfully,  
Yours truly,  
[Signature]

- (4) Additional scale points on such other range or frequency, 1/10 the base fee (a).

Schedule 135. Alternating-Current Voltmeters

If the voltmeter is of the electrodynamic type the test will consist of a reversed direct-voltage test at 5 points, followed by an a.c.-d.c. transfer test at two points; if it is of the moving-iron type, test will be made on alternating current.

- (a) Test at 5 points on one range using reversed direct current, voltage not exceeding 300 volts (base fee)..... \$4.00
- (b) The same, exceeding 300 volts and not exceeding 750 volts (base fee)..... 6.00
- (l) Test at 5 points, using alternating current at one frequency, not exceeding 300 volts (base fee)..... 6.00
- (m) The same, exceeding 300 volts and not exceeding 750 volts (base fee)..... 9.00
- (t) Per additional scale point above 5, 1/10 of the base fee.
- (u) Test at first scale point on each additional range or frequency, 1/5 of the base fee.
- (v) Test as per item (u) having been made, per extra scale point on the same range or frequency, 1/10 of the base fee.
- (w) Determination of the difference in readings on reversed direct current and on alternating current:
- (1) First scale point tested, 4/10 the base fee (a) or (b).
  - (2) Additional scale points on the same range and frequency, each 1/10 the base fee (a) or (b).
  - (3) First scale point tested on another range or frequency, 1/5 the base fee (a) or (b)
  - (4) Additional scale points on such other range or frequency, 1/10 the base fee (a) or (b).

Schedule 136. Wattmeters

- (a) Test at 5 scale points on one range, using reversed direct current, voltage not exceeding 300 volts and current not exceeding 25 amperes (base fee)....\$5.00
- (b) The same, voltage exceeding 300 volts and not exceeding 750 volts or current exceeding 25 amperes and not exceeding 150 amperes (base fee)...10.00
- (t) Per additional scale point above 5, 1/10 of the base fee.
- (u) Test at first scale point on each additional range or frequency, 1/5 of the base fee.
- (v) Test as per item (u) having been made, per extra scale point on the same range or frequency, 1/10 of the base fee.



- (w) Determination of the difference in readings on reversed direct current and on alternating current:
- (1) First scale point tested,  $4/10$  the base fee.
  - (2) Additional scale points on the same range, frequency and power factor, each  $1/10$  of the base fee.
  - (3) First scale point tested on another range, frequency or power factor,  $1/5$  the base fee.
  - (4) Additional scale points on such other range, frequency or power factor,  $1/10$  the base fee.
- (y) For the determination of interaction between elements of a polyphase wattmeter at zero deflection and of equality of elements at zero and two other scale points, the additional fee will be  $1/2$  the base fee.

Schedule 137. Direct-Current Watthour Meters

- (a) Test at one voltage on five loads, namely, 10 per cent, 25 per cent, 50 per cent, full load, and 50 per cent overload, unless otherwise ordered; current not exceeding 50 amperes, voltage not exceeding 300 volts (base fee).....\$12.00
- (b) The same, current exceeding 50 amperes and not exceeding 150 amperes or voltage exceeding 300 volts and not exceeding 750 volts (base fee)..... 18.00
- (t) Per additional load above 5, on the same range and voltage,  $1/10$  the base fee.
- (u) Test at first load on each additional range or at another voltage,  $1/5$  the base fee.
- (v) Test as per (u) having been made, per extra load on the same range and voltage,  $1/10$  the base fee.

Schedule 138. Alternating-Current Watthour Meters

- (a) Test at one frequency, one power factor, and one voltage, on five loads, namely 10 per cent, 25 per cent, 50 per cent, full load, and 50 per cent overload, unless otherwise ordered; current not exceeding 25 amperes, voltage not exceeding 300 volts, (base fee)..... \$12.00
- (b) The same, current exceeding 25 amperes and not exceeding 150 amperes, or voltage exceeding 300 volts and not exceeding 750 volts, (base fee)..... 18.00
- (t) Per additional load above 5 on the same range frequency and power factor,  $1/10$  of the base fee.
- (u) Test at first load on each additional range, frequency, voltage or power factor,  $1/5$  the base fee.
- (v) Test as per (u) having been made, per extra load on the same range, frequency, voltage or power factor,  $1/10$  the base fee.



Schedule 130. Frequency Meters

- (a) Test at 5 points at one voltage (base fee).....\$6.00
- (t) Per additional point above 5 on the same voltage range, 1/10 the base fee.
- (u) Test at first point on each additional voltage, 1/5 the base fee.
- (v) Test as per item (u) having been made, per extra point on the same voltage, 1/10 the base fee.

Schedule 1310. Current Transformers

- (a) Test for ratio of transformation and phase angle at one frequency, with one secondary burden, at 6 values of secondary current, viz., 0.5, 1, 2, 3, 4, and 5 amperes, primary current not exceeding 250 amperes (base fee).....\$8.00
- (b) The same, exceeding 250 amperes and not exceeding 1000 amperes(base fee).....15.00
- (t) Per additional determination of ratio and phase angle above six on the same range, frequency, and burden, 1/10 the base fee.
- (u) Determination of ratio and phase angle at first value of secondary current on each additional range, frequency, or burden, 1/5 the base fee.
- (v) Test as per item (u) having been made, per determination at each extra value of secondary current on the same range, frequency or burden, 1/10 the base fee.

Schedule 1311. Voltage (Potential) Transformers

- (a) Test for ratio of transformation and phase angle at one frequency and one secondary voltage, and with four values of secondary burden (i.e. those giving zero, half, and full rated noninductive load at rated voltage, and one inductive burden approximately equivalent to the voltage circuit of an induction wattour meter, unless otherwise ordered); primary voltage not exceeding 2500 volts (base fee).....\$8.00
- (b) The same, exceeding 2500 volts and not exceeding 25,000 volts (base fee).....15.00
- (c) The same, exceeding 25,000 volts and not exceeding 100,000 volts (base fee).....30.00
- (t) Per additional determination of ratio and phase angle with the same burden and frequency but at a different voltage, 1/10 of the base fee.
- (u) Determination of ratio and phase angle at first value of secondary voltage on each additional range, frequency, or burden 1/5 the base fee.
- (v) Test as per item (u) having been made, per determination at each extra value of secondary voltage on the same range, frequency, or burden, 1/10 the base fee.







