DEPARTMENT OF COMMERCE

CIRCULAR

OF THE

BUREAU OF STANDARDS

S. W. STRATTON, DIRECTOR

No. 13

STANDARD SPECIFICATIONS FOR INCANDESCENT ELECTRIC LAMPS

[6th Edition]
Issued January 1, 1914

[Superseding 5th Edition, issued May 25, 1912]

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INTRODUCTION

An informal conference called by the engineers of the various Government departments, and attended by them, by representatives of the manufacturers of incandescent lamps in the United States, and by representatives of the Bureau of Standards and the Electrical Testing Laboratories, was held in Washington, February 25 to 27, 1907, at which specifications for electric incandescent lamps were adopted. At a meeting held at the Bureau of Standards, May 13, 1908, various modifications were adopted, and at a third conference at the bureau, May 14, 1909, the specifications were again revised and metallized filament, tantalum, and tungsten lamps were included in the specifications and separate schedules prepared for each class of lamp.

The fourth annual conference was held in Washington, April 28, 1910, and, in addition to revising all the general specifications and all the lamp schedules, a radical change was made in the method of rating carbon lamps, putting them on the same basis as metallized filament, tantalum, and tungsten lamps, namely, rating them by watts and three voltages instead of candlepower, voltage, and watts per candle. The specifications were not revised in 1911, owing to the important changes then in progress in the manufacture of tungsten lamps.

No general conference of the lamp manufacturers and Government engineers has been held since that of 1910, but the specifications and schedules were thoroughly revised April, 1912, after informal conferences between representatives of the Bureau of Standards and representatives of various departments of the Government, and after consulting with representatives of various lamp manufacturers; and again in the autumn of 1913, for the present (sixth) edition of this circular.

Criticisms and suggestions concerning the specifications and lamp ratings are invited from both manufacturers and the users of lamps. All such suggestions will be carefully considered when the specifications are again revised.

Although these specifications have been prepared primarily for the use of the departments of the Government in purchasing incandescent

lamps, it seems desirable, on account of the thoroughness with which the subject has been studied and discussed, that the specifications should be available to the general public.

The Bureau of Standards indorses these specifications and has therefore published them for distribution. In circulating them freely, however, it desires to call attention to the necessity of extreme caution in the application of the tests described in the specifications. Only those thoroughly instructed in the art of lamp manufacture and in the science of photometry should undertake to determine upon the acceptability of lamps under the terms of the specifications.

S. W. STRATTON,
Director.

Approved:
E. F. SWEET,
Assistant Secretary.

STANDARD SPECIFICATIONS FOR INCANDESCENT ELECTRIC LAMPS

[TUNGSTEN (OR MAZDA), METALLIZED FILAMENT (GEM), AND CARBON]

Specifications for incandescent lamps purchased under contract dated ....., 191.., by ..... of ..... (hereinafter called the "purchaser"), from ..... (hereinafter called the "manufacturer"), at .....

The complete specifications for incandescent electric lamps which the manufacturer proposes to furnish to the purchaser under specifications shall consist of the "General Specifications" given below and the schedules attached thereto.

I. GENERAL SPECIFICATIONS

1. GENERAL CONDITIONS

Incandescent lamps to be furnished under this contract shall be new lamps and shall conform to the following specifications.

The provisions of these specifications shall apply to all lamps specifically mentioned herein, and to no other lamps, except by mutual written agreement.

These specifications shall not apply to any frosted or colored lamps or to lamps other than those with the usual clear glass bulbs, unless otherwise specifically included. Lamps to be frosted may be inspected after frosting, but shall not be represented on life test by frosted lamps.

All tests shall be made in a competent and expert engineering manner at the expense of the purchaser, excepting that when initial tests and inspections are made at the factory the manufacturer will be required to supply the necessary equipment, assistance, current, and facilities for making such initial tests and inspection. The manufacturer shall have the privilege of

witnessing and verifying all tests of his lamps made hereunder, and shall also have the privilege of obtaining copies of the results of the tests of his lamps and to have access to the records of such tests at all reasonable times. Prompt notice of the result of lamp tests will be given the manufacturer.

2. DEFINITIONS AND STANDARDS

(*a*) *Electrical Units.*—The values of the electrical units in these specifications are those which have been in force since January 1, 1911.

(*b*) *Unit of Candlepower.*—The unit of candlepower shall be the international candle as maintained by the Bureau of Standards at Washington, D. C.

(*c*) *Photometric Measure.*—The basis of comparison for all lamps shall be total flux expressed in lumens or mean spherical candlepower. The candlepower referred to in these specifications for each class of lamp shall be the mean horizontal candlepower based on initial spherical reduction factors given in Tables 1 of the schedules for the several classes of lamps.

Allowance shall be made for such changes as may occur in spherical reduction factors during life tests of all lamps.

For lamps having filaments giving an initial ratio of mean spherical to mean horizontal candlepower different from the values given in the schedules the horizontal candlepower measurements will be corrected by an initial spherical reduction factor determined by the Bureau of Standards or other authority mutually agreed upon, and the life-test values shall be equivalent to those given in Tables 1 of the schedules.

(*d*) *Test Quantity.*—The test quantity shall consist of 5 per cent of each lot of lamps inspected of any one type, size, and voltage range of any class, and in no case shall be less than 10 lamps.

The inspector may select as a lot of lamps to be inspected any individual package or any group of packages containing one type, size, and voltage range of any one class.

The lamps comprising the test quantity shall be selected proportionately from the several packages composing the lot, and shall be known as the test lamps.

(*e*) *Class.*—The term "class" refers to the name distinguishing lamps of different filament materials (tungsten, or Mazda, class; metallized filament, or Gem, class; carbon class).

(*f*) *Style.*—Lamps are classified under two styles, namely, large and miniature. "Large style" designates broadly lamps regularly fitted with other than miniature bases. All lamps covered by these specifications are "large style."

(*g*) *Type.*—The shape of the bulb determines the type ("straight-side type," lamps having straight-side bulbs, such as S–19 or S–21; "round type," lamps having round bulbs, such as G–56 or G–64).

(*h*) *Size of Lamp.*—The size of incandescent electric lamps is expressed in nominal watts or nominal candlepower.

(*i*) *Size of Bulb.*—The size of bulb is expressed by a letter indicating the shape and a number defining the maximum diameter in eighths of an inch (S–17, straight-side bulb, $\frac{17}{8}$ or $2\frac{1}{8}$ inches maximum diameter; G–64, round bulb, 8 inches in diameter).

(*j*) *Base.*—There are four groups of bases—miniature, candelabra, medium, and mogul. The last two only are used on lamps covered by these specifications.

(*k*) *Voltage Range.*—Voltage range is the total range of voltage within which lamps are supplied at each individual voltage. These specifications include two voltage ranges, 100 to 130 and 200 to 260.

(*l*) *Rated Voltage or Rated Current.*—The rated voltage or rated current of a lamp is the voltage or current indicated on the label. The rated voltage of a lamp bearing a three-voltage label shall be the highest of the three voltages shown thereon, which is technically known as the "voltage for high operating efficiency."

(*m*) *Regular Lamps.*—Regular lamps are lamps whose construction conforms to that regarded as standard by the manufacturer. There are regular lamps of each style, but large style regular lamps only are covered by these specifications.

3. MECHANICAL AND PHYSICAL CHARACTERISTICS

(*a*) *Bulbs.*—All bulbs shall be uniform in size and shape, clear, clean, and free from flaws and blemishes detrimental to service.

(*b*) *Bases.*—Moisture-proof medium screw bases, fitted with glass buttons, shall be used on all lamps, unless otherwise specified, and when bases have extended skirts the latter shall be insulated from the screw shell. The bases shall be firmly and accurately fitted to the bulbs with moisture-proof cement. The shells and skirts of the bases shall be of brass of good quality.

(*c*) *Filaments.*—The filaments shall be uniform and free from imperfections, spots, and discolorations detrimental to service, and shall be symmetrically disposed in the bulbs.

(*d*) *Leading-in Wires.*—Leading-in wires shall be securely attached to the ends of the filaments, and shall be securely attached, without excess of

solder, to the terminals of the base which make contact with the socket. The threads of the base shall be free from solder.

(*e*) *Vacuum.*—The lamps shall have suitable vacuum, showing the characteristic glow for each class, size, and voltage range when tested on an induction coil.

(*f*) *General.*—The lamps shall be well made and free from all defects and imperfections, so as to meet satisfactorily the conditions of the lighting service.

All lamps shall conform to the manufacturer's standard shapes and sizes of bulbs, to the manufacturer's standard forms of filament, and to the manufacturer's standard ratings.

(*g*) *Marking.*—One or more printed labels, showing the rating and the manufacturer's name or trade-mark, shall be placed on the bulb or the base of each lamp.

4. METHOD OF INITIAL INSPECTION AND TESTS

(*a*) *Selection of Lamps for Initial Test.*—From each lot of lamps there shall be selected at random the test quantity for the purpose of determining the mechanical and physical characteristics of the lamps, the individual limits as provided in the schedules, and, finally, the life and the candlepower maintenance.

The manufacturer may present for initial test tungsten (or Mazda) lamps which have not been sufficiently burned, or "aged," to have reached stable values of wattage or candlepower. The manufacturer shall arrange for the proper "aging" of such lamps as are selected for initial limits test.

(*b*) *Rejection for Mechanical and Physical Defects.*—The test quantity of lamps selected from any lot of lamps shall be inspected for physical defects, and when so inspected, if the number of lamps showing physical defects incompatible with good workmanship, good service, or with any clause of these specifications (except as specified in paragraph (*c*) of this section) is equal to or in excess of the percentage or quantity necessary for rejection given in their respective schedules, the entire lot of lamps from which the test quantity was selected may be rejected without further test, unless the individual schedules provide otherwise.

(*c*) *Rejection for Defective Rating.*—Lamps shall be tested at rated voltage, current, or candlepower as shown in the schedules, and when so tested if the number of lamps in any lot falling beyond the limits given in Tables 1 equals or exceeds the percentage or quantity necessary for rejection as given in the schedules, the entire lot of lamps from which the test quan-

tity was selected may be rejected without further test, unless the individual schedules provide otherwise.

(*d*) *Selection of Lamps for Life Test.*—For the purpose of selecting lamps for life test, accepted packages containing 100 lamps or less may be grouped to aggregate not more than 250 lamps. From such groups and from accepted standard packages containing more than 100 lamps each, at least one sample shall be selected which approximates most closely to the average of the test quantity. The lamp thus selected shall be designated as the life-test lamp, and will be subjected to a life test. A second or duplicate lamp may be reserved to replace this life-test lamp, in case of accidental breakage or damage during life test. The life-test lamps shall be rated and operated on life test as shown in their respective schedules.

5. LIFE AND CANDLEPOWER MAINTENANCE

(*a*) *Life-Test Voltages.*—Life-test lamps shall be operated on the life-test rack at voltages (or currents) corresponding to the test watts per candle given in the tables under the heading "average performance" or to the test watts per candle agreed upon, as provided in the schedules.

(*b*) *Candlepower Measurements.*—During life test, carbon and metallized filament (Gem) lamps shall be read for candlepower and current at the test voltage at approximately 50 hours, and at least every 100 hours thereafter until the candlepower shall have fallen 20 per cent [1] below the initial candlepower, or until the lamp breaks, if within that period. Tungsten (or Mazda) lamps shall be read for candlepower and current at the test voltage at approximately one-twentieth of the test-life period corresponding to the test watts per candle, and thereafter at such intervals as shall afford approximately five determinations until the average candlepower shall have fallen 20 per cent below the initial candlepower, or until the lamp breaks, if within that period.

(*c*) *Test Life.*—The number of hours each lamp burns until the candlepower has decreased to 80 per cent [1] of its initial value, or until the lamp breaks, if within that period, is known as the test life.

Lamps which are accidentally broken, but not burned out on test, shall not be counted to diminish the average performance.

In case any life-test lamps are broken or damaged before the life test is completed, the average performance of all lamps of the same class size, etc., tested under the same contract shall be assigned to the package represented.

[1] Eighty per cent is taken as a convenient point for testing purposes, but the trend of the art, as well as theoretical considerations, indicates that some percentage less than 80 per cent of the initial candlepower will ultimately be adopted as a basis for lamp evaluation.

On all life tests for determining test life and candlepower each package or group of packages which will be affected by the results of the test shall have at least one lamp on such test.

(*d*) *Voltage Regulation.*—Accurate recording voltmeter records shall be obtained during the life test on lamps to show the variation of the voltage on the circuit.

Variations of voltage are not to exceed one-quarter of 1 per cent above and below the test voltage.

6. REJECTIONS AND CANCELLATION OF CONTRACT

(*a*) *Conditions for Rejection.*—The failure of the lamps to conform to the specifications as to mechanical and physical characteristics, or to initial limits, may cause their rejection.

Any group of the lamps initially inspected may be rejected, provided such group is represented on life test by at least four lamps which give an average test-life value less than the test-life value specified in Tables I of their respective schedules, except that for carbon lamps 90 per cent of this value will be used.

(*b*) *Return of Rejected Lamps.*—Lamps which have not been used and are rejected under the terms of these specifications may be returned to the manufacturer at his expense, and no payment made therefor. All lamps placed in service shall be considered as accepted.

(*c*) *Cancellation of Contract.*—The contract for lamps furnished under these specifications may be canceled in the event that the average actual test-life values determined up to any given time are less than the test-life values given in the schedules, except that for carbon lamps 90 per cent of these values will be used.

Under paragraphs (*a*) and (*c*) of this section the allowance of 10 per cent on carbon lamps is made because the present initial rating of carbon lamps in watts per candle is probably a limiting value.

The foregoing paragraphs provide specifications that are general to tungsten (or Mazda), metallized filament (Gem), and carbon lamps, and, when accompanied by the schedule for any of these classes of lamps, form the complete specifications for that class of lamps.

Signed by.....
(Purchaser.)

Accepted by.....
(Manufacturer.)

Date.....

II. LAMP SCHEDULES

Schedule A.—TUNGSTEN (OR MAZDA) LAMPS

This schedule applies to large, clear, tungsten (or Mazda) lamps of from 100 to 130 volts and from 200 to 260 volts for multiple burning, and, with the General Specifications for incandescent electric lamps, forms complete specifications for lamps of such sizes and in such bulbs as are specifically mentioned herein.

QUANTITY NECESSARY FOR REJECTION

When tested at the factory, any package or lot may be rejected in the event of failure of 20 per cent or more of the test lamps to conform to the initial limits, or in the event of 20 per cent or more of the test lamps showing physical defects.

When tested elsewhere, any package or lot may be rejected when 30 per cent or more of the test lamps fail as above.

TABLES A–1

Limits, Rating, and Life Performance

(a) Values for Clear 100- to 130-Volt Tungsten (or Mazda) Lamps for Multiple Burning

Size of lamp in watts	Bulb designation		Rated initial w. p. m. h. c.[2]	Limiting values for rated initial w. p. m. h. c. which are to apply until further notice from the manufacturer	Initial limits at rated voltage		Average performance: Test life in hours to 20 per cent drop in candlepower at rated initial w. p. m. h. c.[3]
	Straight side	Round			Individual w. p. m. h. c. maximum and minimum (per cent)	Individual total watts maximum and minimum (per cent)	
15	S–17	.....	1.25	1.20	8	20	1000
20	S–17	.....	1.17	1.10	8	20	1000
25	S–19	.....	1.14	1.05	8	15	1000
40	S–19	.....	1.10	1.05	8	15	1000
60	S–21	.....	1.07	1.00	8	15	1000
100	S–30	.....	1.02	0.95	8	15	1000
150	S–35	.....	0.90	0,80	8	15	1000
250	S–40	.....	0.90	0.80	8	15	1000
400	.....	G–56[4]	0 90	0.80	8	15	1000
500	.....	G–64[4]	0.90	0.80	8	15	1000

[2] Upon notice from the manufacturer any or all of the rated initial w. p. m. h. c. shown in the Tables A–1 may be numerically decreased within the limits imposed by the column showing "Limiting values for rated initial w. p. m. h. c. which are to apply until further notice from the manufacturer." The initial limits and test-life period specified in Tables A–1 shall apply to the lamps at the decreased w. p. m. h. c.

[3] At the option of the purchaser life tests may be made at special efficiencies (w. p. m. h. c.) mutually agreed upon by the manufacturer and the purchaser.

[4] Mogul screw base.

Average initial spherical reduction factors for lamps in the above table: 15 to 250 watts, inclusive, 78 per cent; 400 to 500 watts, 81 per cent.

(b) Values for Clear 200- to 260-Volt Tungsten (or Mazda) Lamps for Multiple Burning

Size of lamp in watts	Bulb designation		Rated initial w. p. m. h. c.[5]	Limiting values for rated initial w. p. m. h. c. which are to apply until further notice from the manufacturer	Initial limits at rated voltage		Average performance: Test-life in hours to 20 per cent drop in candle-power at rated initial w. p. m. h. c.[6]
	Straight side	Round			Individual w. p. m. h. c. maximum and minimum (per cent)	Individual total watts maximum and minimum (per cent)	
25	S–19	.....	1.33	1.23	12	20	1000
40	S–19	.....	1.28	1.18	12	20	1000
60	S–21	.....	1.23	1.15	12	20	1000
100	S–30	.....	1.15	1.10	12	20	1000
150	S–35	.....	1.12	1.05	12	20	1000
250	S–40	.....	1.10	1.00	12	20	1000
500	.....	[7] G–64	1.10	1.00	12	20	1000

[5] Upon notice from the manufacturer any or all of the rated initial w. p. m. h. c. shown in the Tables A–1 may be numerically decreased within the limits imposed by the column showing "Limiting values for rated initial w. p. m. h. c. which are to apply until further notice from the manufacturer." The initial limits and test-life period specified in Tables A–1 shall apply to the lamps at the decreased w. p. m. h. c.

[6] At the option of the purchaser life tests may be made at special efficiencies (w. p. m. h. c.) mutually agreed upon by the manufacturer and the purchaser.

[7] Mogul screw base.

Average initial spherical reduction factors for lamps in the above table: 25 to 250 watts, inclusive, 79 per cent; 500 watts, 81 per cent.

(c) Values for Excepted Voltages.—Lamps in this schedule of 100- to 130-volt range and of rated voltages 105 and below, 110, 121, and above, may have the following numerical increase in initial limits at rated voltage over those of Table A–1 (*a*): w. p. m. h. c., 2 per cent; watts, 2 per cent.

Lamps in this schedule of 200- to 260-volt range and of rated voltages 215 and below, 220, 250, and above, may have the following numerical increase in initial limits at rated voltage over those of Table A–1 (*b*): w. p. m. h. c., 3 per cent; watts, 3 per cent.

The "Initial limits at rated voltage" given in Tables A–1 can be secured on lamps ordered to be of these excepted voltages at the option of the purchaser, provided that the manufacturer is allowed to furnish a range of voltage equivalent to the increased limits.

For the excepted voltages in the 100- to 130-volt range the increased limits correspond to 1 volt above and 1 volt below the voltage ordered.

For the excepted voltages in the 200- to 260-volt range the increased limits correspond to 2 volts above and 2 volts below the voltage ordered.

For lamps of rated voltages between 126 and 130, inclusive, the test-life values shall be 90 per cent of those given in Table A–1 (*a*).

For lamps of rated voltages between 250 and 260, inclusive, the test-life values shall be 90 per cent of those given in Table A–1 (*b*).

(*d*) Lamps in this schedule shall be operated on life test in a vertical position, tip downward.

All lamps burned out during life test must have burned out with current on them and without shock in order to be included in the test and be counted to reduce the average life-test performance.

Lamps broken in handling or when current is not on them shall not be counted to reduce the average life-test performance.

(*e*) The labels on the lamps shall show the nominal total watts and voltage.

Schedule B.—METALLIZED FILAMENT (GEM) LAMPS

This schedule applies to large, clear, metallized filament (Gem) lamps of from 100 to 130 volts for multiple burning, and, with the General Specifications for incandescent electric lamps, forms complete specifications for lamps of such sizes and in such bulbs as are specifically mentioned herein.

QUANTITY NECESSARY FOR REJECTION

When tested at the factory, any package or lot may be rejected in the event of failure of 20 per cent or more of the test lamps to conform to the initial limits, or in the event of 20 per cent or more of the test lamps showing physical defects.

When tested elsewhere, any package or lot may be rejected when 30 per cent or more of the test lamps fail as above.

TABLE B–1

Initial Limits, Rating, and Performance

(*a*) *Values for Clear, Oval-Anchored, 100- to 130-Volt Regular Metallized Filament (Gem) Lamps for Multiple Burning*

Size of lamp, in watts	Bulb designation	Initial candlepower at rated voltage	Initial limits at rated voltage				Average performance	
			Candlepower limits above and below		Total watt limits above and below		Test life in hours to 20 per cent drop in candlepower at rated initial w.p.m.s.c.	
			Individual (per cent)	Average (per cent)	Individual (per cent)	Average (per cent)	Rated initial w.p.m.s.c.	Test life
30	S–17	10.0	10.0	6	10	7	3.64	700
40	S–19	15.6	7.5	5	7	5	3.11	500
50	S–19	20.0	7.5	5	7	5	3.03	500
60	S–19	24.0	7.5	5	7	5	3.03	500

The average initial spherical reduction factor which applies to the above table is 82.5 per cent.

(*b*) *Values for Excepted Voltages.*—Lamps in this schedule of voltages 105 and below, 110, 121, and above, may have the following numerical increase of per cent limits over those of Table B–1: Candlepower, 5 per cent; watts, 2 per cent.

The "Initial limits at rated voltage" given in Table B–1 can be secured on lamps ordered to be of these excepted voltages at the option of the purchaser, provided that the manufacturer is allowed to furnish a range of voltage equivalent to the increased limits.

For the excepted voltages the increased limits correspond to 1 volt above and 1 volt below the voltage ordered.

For lamps of rated voltages between 126 and 130, inclusive, the test-life values shall be 90 per cent of those given in Table B–1.

(*c*) Lamps in this schedule should burn on life test in one horizontal position, without excessive drooping of filament, at a voltage corresponding to the initial watts per mean spherical candle shown in Table B–1 in column headed "Average performance."

(*d*) The labels on the lamps shall show the nominal total watts and voltage.

Schedule C.—CARBON MULTIPLE LAMPS

This schedule applies to large, regular, clear, carbon lamps of from 100 to 130 volts and from 200 to 260 volts, for multiple burning, and, with the General Specifications for incandescent electric lamps, forms complete specifications for lamps of such sizes as are specifically mentioned herein.

QUANTITY NECESSARY FOR REJECTION

When tested at the factory, any package or lot may be rejected in the event of failure of 20 per cent or more of the test lamps to conform to the initial limits, or in the event of 20 per cent or more of the test lamps showing physical defects.

When tested elsewhere, any package or lot may be rejected when 30 per cent or more of the test lamps fail as above.

TABLES C–1

Initial Limits, Rating, and Performance

(a) Values for Clear, Oval-Anchored, 100- to 130-Volt Regular Carbon Lamps for Multiple Burning

Size of lamp in watts	Initial candlepower at rated voltage	Initial limits at rated voltage				Average performance
		Individual candlepower limits	Mean candlepower limits	Individual watt limits	Mean watt limits	Test life in hours to 20 per cent drop in candlepower at 3.70 w. p. m. s. c.
20	4.8	1 cp above and 1 cp below	0.6 cp above and 0.6 cp below	12 per cent above and 12 per cent below	6 per cent above and 6 per cent below	300
25	8.1	.....do.....	.....do.....	10 per cent above and 10 per cent below	5 per cent above and 5 per cent below	300
30	9.3	.....do.....	.....do.....	.....do.....	.....do.....	350
50	16.8	7.5 per cent above and 7.5 per cent below	2.5 per cent above and 2.5 per cent below	5.5 per cent above and 5.5 per cent below	2.5 per cent above and 2.5 per cent below	450
60	20.2	.....do.....	.....do.....	.....do.....	.....do.....	420

The average spherical reduction factor which applies to the above table is 82.5 per cent.

(b) Values for Clear, Double Oval-Anchored, 200- to 260-Volt Regular Carbon Lamps for Multiple Burning

Size of lamp in watts	Initial candlepower at rated voltage	Initial limits at rated voltage				Average performance
		Individual candlepower limits	Mean candlepower limits	Individual watt limits	Mean watt limits	Test life in hours to 20 per cent drop in candlepower at 3.70 w. p. m. s. c.
35	8.0	2 cp above and 2 cp below	1 cp above and 1 cp below	15 per cent above and 15 per cent below	7.5 per cent above and 7.5 per cent below	120
60	16.3	15 per cent above and 15 per cent below	7.5 per cent above and 7.5 per cent below	12 per cent above and 12 per cent below	6 per cent above and 6 per cent below	160

The average spherical reduction factor which applies to the above table is 82.5 per cent.

NOTE.—*Excepted voltages.*—It is recommended that every effort be made to avoid ordering lamps of actual rated voltages 105 and below, 109, 110 and 111, 121, and above, and from 218 to 222, inclusive.

(*c*) *Values for Excepted Voltages.*—Lamps in this schedule, of rated voltages 105 and below, 110, 121, and above, and also 220 may have double the limits of variation in the initial limits at rated voltage specified for their respective sizes.

For lamps of rated voltages between 120 and 125, inclusive, the test-life values shall be 95 per cent of those given in Tables C–1, and for lamps of rated voltages between 126 and 130, inclusive, the test-life values shall be 90 per cent of those given in Tables C–1.

(*d*) Lamps in this schedule should burn on life test in one horizontal position at a voltage corresponding to an initial specific consumption of 3.70 watts per mean spherical candle without excessive drooping of the filament.

(*e*) The labels on the lamps shall show the nominal total watts and voltage.

Schedule D.—CARBON SERIES (RAILWAY) LAMPS

This schedule applies to large, regular, clear, carbon lamps for street-railway series burning, and, with the General Specifications for incandescent electric lamps, forms complete specifications for lamps of such sizes as are specifically mentioned herein.

QUANTITY NECESSARY FOR REJECTION

When tested at the factory any package or lot may be rejected in the event of failure of 20 per cent or more of the test lamps to conform to the initial limits, or in the event of 20 per cent or more of the test lamps showing physical defects.

When tested elsewhere, any package or lot may be rejected when 30 per cent or more of the test lamps fail as above.

INITIAL LIMITS, RATING, AND PERFORMANCE

(*a*) *Values for Clear, Oval-Anchored, 100- to 130-Volt, Regular Carbon Lamps for Series-Burning Railway Service when Tested at Initial Candlepower.*—These lamps shall be rated at the following voltages:

105 volts for use 5 in series on 525 volts
110 volts for use 5 in series on 550 volts
115 volts for use 5 in series on 575 volts
120 volts for use 5 in series on 600 volts
125 volts for use 5 in series on 625 volts
130 volts for use 5 in series on 650 volts

Each voltage shall embrace a range in current 5 per cent above and 5 per cent below the nominal ampere value obtained by dividing the product of the initial candlepower and actual initial watts per mean horizontal candlepower by the voltage. The lamps will be marked and packed in 0.01-ampere steps through this range.

When the value of any order for any voltage and size is not over $300, the manufacturer shall supply lamps of one of the 0.01-ampere steps.

When the value of any order for any voltage and size exceeds $300, the manufacturer shall have the privilege of supplying at least two of the 0.01-ampere steps.

Each 0.01-ampere step shall be within the limits shown in Table D–1.

TABLE D–1

Tested at Initial Candlepower

Size of lamp in watts	Initial candlepower	Initial individual limits (above and below)			Initial average limits (above and below)			Average performance
		Amperes (per cent)	Watts (per cent)	Volts (per cent)	Amperes (per cent)	Watts (per cent)	Volts (per cent)	Test life in hours to 20 per cent drop in candlepower at 3.70 w. p. m. s. c.
42	10.4	3.0	6.5	4.0	1.0	3.0	2.0	450
64	16.3	2.0	5.5	4.0	0.7	2.5	2.0	400

(*b*) If the purchaser so elects, the following table of initial limits may be substituted for Table D–1:

TABLE D–1A

Tested at Rated Current

Size of lamp in watts	Initial candlepower	Initial individual limits (above and below)		Initial average limits (above and below)		Average performance
		CP (per cent)	Watts (per cent)	CP (per cent)	Watts (per cent)	Test life in hours to 20 per cent drop in candlepower at 3.70 w. p. m. s. c.
42	10.4	16.0	6.5	5.3	3.0	450
64	16.3	12.0	5.5	4.0	2.5	400

The average spherical reduction factor which applies to the above tables D–1 and D–1A is 82.5 per cent.

(*c*) For the 105-volt and the 125-volt lamps the limits of variation in the initial limits shall be double those given in Tables D–1 and D–1A.

For the 120-volt and the 125-volt lamps the test-life values shall be 95 per cent of those given in Tables D–1 and D–1A, and for the 130-volt lamps the test-life values shall be 90 per cent of those given in Tables D–1 and D–1A.

(*d*) Lamps in this schedule should burn on life test in one horizontal position at a voltage corresponding to an initial specific consumption of 3.70 watts per mean spherical candle without excessive drooping of the filament.

(*e*) The labels on the lamps shall show the nominal total watts and the lamp voltage, or the voltage of the circuit on which a stated number of lamps are to burn in series.