STANDARD SPECIFICATIONS FOR THE PURCHASE OF CARBON-FILAMENT INCANDESCENT LAMPS

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BUREAU OF STANDARDS
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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 the purchase of electric incandescent lamps were adopted. At this conference a permanent committee was appointed, to which was intrusted those further modifications in the specifications which might become necessary or desirable in future years.

At a meeting of this committee, held at the Bureau of Standards, May 13, 1908, various modifications were suggested, and the revised specifications were finally adopted in the form printed in the following pages.

Although these specifications were written primarily with the view that they would be recommended to the Departments of the Government, to be used by them in purchasing their annual supplies of incandescent lamps, it seemed desirable, both on account of the representative character of the conference and the thoroughness with which the subject was discussed, that the results of the conference should be available for the general public.

The Bureau of Standards indorses these specifications and has therefore undertaken to publish 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.

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SPECIFICATIONS

FOR

CARBON-FILAMENT ELECTRIC LAMPS.

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1. Samples.

To show construction, bidders must, if requested, submit two samples of each type of lamp proposed to be furnished. All lamps must conform to the samples submitted, in shape of bulb, mechanical construction, and type of filament, and no departure from the sample lamps will be permitted without the written consent of _____
(Name of purchaser.)

2. Standard Incandescent Lamps.

Incandescent lamps to be furnished under this contract shall be new lamps and shall be guaranteed to be in accordance with the following specifications:

3. General Conditions.

The provisions of these specifications shall be binding upon all lamps specifically mentioned herein, and upon 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. Frosted lamps shall be represented in initial tests, inspection, and life tests by bare lamps selected from the lots before frosting.

All tests shall be made in a competent and expert engineering manner at the expense of _____, excepting that when initial tests and inspection are made at the factory the contractor will be required to supply the necessary equipment, assistance, current, and facility for making such initial tests and inspection. The manufacturer, or his agent, shall have the privilege of witnessing and verifying all tests of his lamps made hereunder, and shall also be privileged to obtain copies of the tests of his lamps and have access to the records of such tests at all reasonable times.
(Name of purchaser.)

With the consent of the contractor, the method of test procedure may be modified in any particular, whenever such change is desirable to secure test results in a more practicable, representative, or accurate manner.

4. Definitions and Standards.

Unit of candlepower.—The unit of candlepower shall be the candle as determined by the Bureau of Standards at Washington, D. C.

Photometric measure.—The basis of comparison of all lamps shall be the mean spherical candlepower. The nominal candlepower referred to in these specifications shall be the mean horizontal candlepower of lamps having a mean spherical candlepower value of 82.5 per cent of the mean horizontal candlepower, which is the standard value for filaments of the oval anchored type.

For lamps having filaments giving a different ratio of mean spherical to mean horizontal candlepower, the horizontal candlepower measurement will be corrected by a reduction factor determined by the Bureau of Standards or other authority mutually agreed upon.

Test quantity.—The test quantity shall consist of the percentages shown in Table 1 for each lot of lamps inspected, 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 or more types of lamps.

TABLE 1.

Total quantity of lamps in any lot selected for inspection.	Number necessary for test quantity—	
	When test is made at factory of manufacturer.	When test is made elsewhere.
Under 1,000	20 per cent...	40 per cent.
1,000 to 1,999	15 per cent...	30 per cent.
2,000 to 4,999	12 per cent...	24 per cent.
5,000 and over	10 per cent...	20 per cent.

5. Method of Test.

From each lot of lamps there will be selected at random the test quantity for the purpose of determining the mechanical and physical characteristics of the lamps, the individual limits of candlepower and watts, and finally the life and candlepower maintenance. The lamps shall be selected proportionately from the several packages composing the lot, and shall be known as the test lamps.

6. Mechanical and Physical Characteristics.

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

7. Bulbs.

All bulbs shall be uniform in size and shape, clear, clean, and free from flaws and blemishes.

8. Bases.

All lamps, unless otherwise specified, shall be made with moisture-proof standard Edison screw bases, fitted with glass buttons. The shells of the bases shall be of good quality brass, firmly and accurately fitted to the bulb with moisture-proof cement, and in length to conform to the Electric Code of the National Board of Fire Underwriters.

9. Filaments.

The lamp filament must be symmetrically disposed in the bulb and shall not droop excessively during the life of the lamp, when the lamp is burned on test in one horizontal position at a voltage corresponding to an initial specific consumption of 3.76 watts per mean spherical candle.

All filaments must be uniform and free from imperfections, spots, and discolorations.

10. Leading-in Wires.

Leading-in wires must be fused into the glass with the joints between the copper and platinum wires bedded well within the glass, and must be straight, well separated, and securely soldered to the base and cap, without excess of solder. The threads of the base must be free from solder.

11. Vacuum.

All lamps must have first-class vacuum, showing the characteristic glow of good vacuum when tested on an induction coil.

12. Marking.

A printed label, showing manufacturer's name or trade-mark, voltage, and candlepower, must be placed on each lamp near base.

13. In General.

The lamps must be well made and free from all defects and imperfections, so as satisfactorily to meet the conditions of the lighting service.

14. Rejection for Defects.

(*a*) The test quantity of lamps selected from any lot of lamps will 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, is equal to, or in excess of, the percentages given in Table 2, the entire lot of lamps from which the test quantity was selected may be rejected without further test.

(*b*) If any quantity of lamps selected as a lot to be inspected is acceptable as a whole in accordance with paragraph (*a*) of this section, but the test lamps indicate an excessive number of defective lamps in any individual package or packages, these packages may be withdrawn and reinspected as individual lots in accordance with Tables 1 and 2.

TABLE 2.

Total quantity of lamps in any lot selected for inspection	Percentage of test quantity necessary for rejection of the lot.
Under 1,000	10 per cent.
1.000 to 1,999	8 per cent.
2,000 to 4,999	6 per cent.
5,000 and over	5 per cent.

15. Initial Limits.

(*a*) Lamps shall be tested at rated voltage, and when so tested if the number of lamps in any lot falling beyond the limits given in Table 3 equals or exceeds the percentage of test quantity necessary for rejection as given in Table 2, the entire lot of lamps may be rejected.

(*b*) If any quantity of lamps selected as a lot to be tested is acceptable as a whole in accordance with paragraph (*a*) of this section, but the test lamps indicate an excessive number of lamps in any individual package or packages which lie without the prescribed limits given in Table 3, these packages may be withdrawn and reinspected as individual lots in accordance with Tables 1 and 2.

16. Life and Candlepower Maintenance.

Life tests shall be made as follows: From each accepted package of lamps, two sample lamps shall be selected which approximate most closely to the average of the *test quantity*. One of the two lamps thus selected will be subjected to a life test and designated as the *life-test lamp*, the second or duplicate lamp being reserved to replace this *test lamp* in case of accidental breakage or damage during the life test. The *test lamps* shall be operated for candlepower performance at constant potential, average variations of voltage not to exceed one-fourth of 1 per cent, either side.

The voltage for each lamp shall be that corresponding to an initial specific consumption of 3.76 watts per mean spherical candle, or if tested upon a different basis, the results shall be corrected to a basis of 3.76 watts per mean spherical candle. If desired, the life tests may be made at such other watts per candle as may be mutually agreed upon.

Readings for candlepower and wattage shall be taken during life at the marked voltage of the lamps at approximately fifty hours, and at least every one hundred hours afterwards until the candlepower shall have fallen 20 per cent below the initial candlepower, or until the lamp breaks, if within that period. The number of hours the lamp burns until the candlepower has decreased to 80 per cent of its initial value, or until the lamp breaks, if within that period, is known as the useful or effective life.

The average candlepower of lamps during life shall not be less than 91 per cent of their initial candlepower. In computing the results of life test of any number of lamps the average candlepower during life shall be taken as the arithmetical mean of the values for the individual lamps of any type of the number tested.

Lamps selected for the life test, which for any reason do not start on such test, shall be replaced by others.

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

In case both test and duplicate lamps are broken or damaged before the life test is completed, the average performance of all lamps of the same class previously tested under the same contract shall be assigned to the package represented.

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

Accurate recording voltmeter records will be obtained during the test on lamps to show the average variation on the circuit.

When so tested the average useful life values of the lamps shall be at least as great as those given in Table 3.

(*a*) VALUES FOR OVAL ANCHORED PLAIN STANDARD LIGHTING LAMPS.

Lamps of this type, of voltages 105 and below, 110, 121 and above, and also 220, may have double the limits of variation in the initial limits specified for their respective classes.

The limits given in Table 3 can be secured on lamps of these excepted voltages at the option of the purchaser, provided the contractor is allowed to furnish a range of voltage equivalent to the double limits. The double limits in the 110-volt class would correspond to 1 volt above and 1 volt below the normal, and in the 220-volt class to 2 volts above and 2 volts below the normal.

For lamps between 120 and 125 volts, inclusive, the useful life values shall be 95 per cent of those given in Table 3, and for lamps between 126 and 130 volts, inclusive, the useful life values shall be 90 per cent of those given in Table 3.

Lamps of other types of filaments shall give equivalent performances.

TABLE 3.

*For 100–130 volt lamps.**

Rating.		Initial limits.				Average performance.
Rated candlepower, mean horizontal.	Initial watts per mean horizontal candle.	Individual candlepower limits.	Mean candlepower limits.	Individual watt limits.	Mean watt limits.	Useful or effective life in hours to 20 per cent drop in candlepower at 3.1 watts per candle.
4	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
6	3.7	do	do	do	do	300
8	3.1	do	do	10 per cent above and 10 per cent below.	5 per cent above and 5 per cent below.	300
	3.6	do	do			350
10	3.1	do	do	do	do	350
	3.6	do	do	do	do	400
12½	3.1	do	do	do	do	400
	3.6	do	do	do	do	450
16	3.1	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
	3.5					420
20	3.05	do	do	do	do	420
	3.5	do	do	do	do	400
24	3.1	do	do	do	do	400
25	3.6	do	do	do	do	430
32	3.1	do	do	do	do	430
	3.6	do	do	do	do	400

*For 200–250 volt lamps.**

8	4.4	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
16	3.8	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
20	3.8	do	do	do	do	160
24	3.8	do	do	do	do	150
32	3.8	do	do	do	do	150
50	3.8	do	do	do	do	120

*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.

(*b*) VALUES FOR ROUND-BULB, TUBULAR, AND OTHER IRREGULAR TYPES OF LAMPS.

The individual limits for irregular types of lamps, such as round-bulb and tubular lamps, shall be twice the individual limits given in Table 3 for regular lamps of corresponding candlepowers.

The limits given in Table 3 can be secured on round-bulb, tubular, and other irregular types of lamps at the option of the purchaser, provided the contractor is allowed to furnish a range of voltage equivalent to the double limits. The double limits in the 110-volt class would correspond to 1 volt above and 1 volt below the normal, and in the 220-volt class to 2 volts above and 2 volts below the normal.

The individual limits for metalized filament and round-bulb prismo types of lamps shall be 15 per cent above and 15 per cent below the mean candlepower rating, and 15 per cent above and 15 per cent below the mean total watts rating. The candlepower ratings referred to are the mean horizontal candlepower ratings of clear lamps without reflectors.

17. Rejections and Penalties.

The failure of the lamps to conform to the specifications as to mechanical and physical characteristics, or to initial limits, may cause their rejection.

The failure of the lamps to give within 90 per cent of the values of useful life given in Table 3 may cause the cancellation of the contract.

The failure of any lot of 1,000 or more lamps to give an average useful life value equal to the useful life value given in Table 3 of these specifications, may cause the rejection of all unused lamps of said lot.

Lamps which have not been used and are rejected under the terms of these specifications will be returned to the manufacturer at his expense, and no payment will be made therefor.

Prompt notice will be served upon the contractor of the test results on lamps that are rejected, or that fail to meet the specified requirements.

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