NATIONAL BUREAU OF STANDARDS REPORT

4441

PERFORMANCE CHARACTERISTICS

OF

THREE WASHINGTON STATE COLLEGE

NEON OBSTRUCTION LIGHTS

by

Robert T. Vaughan

to

Airways Engineering Division

Office of Federal Airways

Civil Aeronautics Administration

NBS

U. S. DEPARTMENT OF COMMERCE

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Robert T. Vaughan
Photometry and Colorimetry Section
Optics and Metrology Division

NBS Test No. 21A-2/55

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Performance Characteristics
of
Three Washington State College
Neon Obstruction Lights

by
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1. SCOPE

This report presents the results of a study of the candlepower and color characteristics of three neon obstruction lights developed at the State College of Washington. Two of these are designed for use on the catenaries of transmission lines. The third is operated by low voltage power.

Calculations of the visual range of the largest unit were verified by observations in clear weather.

2. DESCRIPTION OF UNITS TESTED

The units tested are samples of three lamps developed in the laboratories of the Division of Industrial Research at the State College of Washington. Two are identified by nameplates bearing the legend:

"Catenary Obstruction Light
State College of Washington
Pullman, Wash."

No identifying marking was found on the third unit.

Figures I and II show the large catenary unit; Figure III shows the small catenary unit at the top with the low voltage unit below it. The large catenary unit was accompanied by two sheets of typewritten description and data. The third unit was accompanied by a brochure describing it as a "Model 300 Neon Obstruction Light".

Each of the two catenary units consists essentially of a cylindrical framework containing a neon lamp and supporting a specially designed transformer. Each of these units is designed to be suspended on a transmission line which passes along the axis of the unit thereby acting as the one-turn primary of the transformer.

In the large unit there is a second lamp which serves as a "stand-by" and operates in event the service lamp fails. The neon tubing of this unit is approximately 9 feet in length and 9/16 inches in outside diameter. The transformer

of the large unit consists of a laminated core housed in the rectangular case shown on the nearer end of the unit in Figure II. The secondary is the large coil, imbedded in what is described as epoxy waterproof resin, which surrounds the lower horizontal side of the core. The smaller coil on the rear vertical side of the core is a special auxiliary primary provided for the purpose of energizing the secondary under circumstances in which it would not be practicable to simulate a transmission line current. A production unit would not be supplied with this coil. To facilitate the installation of this unit the core is made with a gate which may be opened to admit the transmission line without parting the line. A motor driven trolley may be used to push the unit into position on the span and clamp it to the line. It was assumed that the side of the transformer core on which the secondary is wound, being the heavier, would be located, in service, directly beneath the line. The bar which passes through the center of the unit as shown in Figures I and II simulates the transmission line.

In the small unit, shown in Figure III, the neon tubing is approximately 5 1/2 feet in length and 1/2 inches in outside diameter. The transformer is made in four sections, two at each end of the unit. Each of these sections presumably contains a core and a secondary winding encased in a compound which is apparently the same as that used on the secondary of the large unit. The secondary windings are connected in series to supply the voltage necessary for the operation of the lamp. For the installation of this unit, the transmission line must be parted and threaded through a tube along the axis of the unit.

The low voltage unit, "Model 300", shown in Figure III contains a helical neon tube similar to that used in the small catenary unit. The brochure specifies that the unit will operate satisfactorily on voltages ranging from 135 volts to somewhat below 90 volts.

3. RELATIVE CANDLEPOWER AS A FUNCTION OF LINE CURRENT

It was not practicable to simulate a transmission line current while making candlepower distribution measurements on the large catenary unit. For this reason a separate laboratory procedure was used to measure the relative candlepower of each lamp, in turn, at a fixed distance and direction from the unit as a function of the current passing through an aluminum bar running axially through the unit. This bar was 8 feet in length and 1 1/4 inches in diameter.

To distinguish between the two lamps of the large catenary unit, the lamp further from the transmission line (see Figure II) has been designated as lamp "A", the nearer one as lamp "B". To distinguish between the two sides of the unit, the term "unobstructed side" is used when the lamps are between the observer and the transmission line, and the term "obstructed side" indicates that the transmission line is between the observer and the lamps.

With both lamps connected across the secondary of the transformer, lamp "B" did not operate. The minimum simulated transmission line current at which lamp "A" would operate without "excessive" flicker was approximately 62 amperes. The criterion for "excessive" flicker was that flicker which made photometric measurements impracticable. In order for lamp "B" to operate it was necessary to interrupt the connecting leads between lamp "A" and the transformer. The minimum simulated transmission line current at which lamp "B" would then operate without "excessive" flicker was approximately 65 amperes. In order to measure lamps "A" and "B" under similar conditions, lamp "A" was remeasured, this time with lamp "B" removed from the secondary of the transformer. Under these conditions lamp "A" operated without "excessive" flicker at a minimum line current of approximately 48 amperes as compared with 62 amperes when both lamps were connected across the secondary of the transformer.

4. CANDLEPOWER DISTRIBUTION OF UNITS

To provide measured horizontal and vertical rotations of the test lamps, the units were mounted in special fixtures on the table of a goniometer. The primary axis of rotation was horizontal and normal to the photometric axis.

It was not practicable to mount the large catenary unit with its axis horizontal, as in service. It was, therefore, mounted with its axis coincident with the secondary axis of the goniometer. With the goniometer at its "0.0" position, this axis is vertical. The transformer end of the unit was mounted uppermost, and the transmission line was represented by a steel bar 1-5/8 inches in diameter running the full length of the supporting framework. During the candlepower distribution measurements, the special auxiliary coil was used to operate the lamps at the intensity which would be produced by a transmission line current of 1000 amperes. To do this the photocell and meter which had been used for the relative candlepower measurements was set up with the cell at the same distance and direction from the test unit at which it had been used previously. The current in the auxiliary coil on the transformer of the test unit was then adjusted to give the photometric reading indicated by the previous measurements extrapolated to 1000 amperes.

The measurements were made with an automatic photometer, the recording element of which is a Leeds & Northrup recording potentiometer driven in synchronism with the goniometer table on which the unit under test was mounted. The photometric distance was 10.0 meters.

The photometer was calibrated with standard filter No. 3639 and with standard lamp No. NBS6794 at a distance of 2.0 meters. The calibration has been recorded on the candlepower distribution chart as a line showing the candlepower of the test unit which would give an illumination at the photocell equivalent to that given by the standard lamp.

The candlepower distribution charts, Figures 1 to 4, show, for the large unit, a peak of approximately 73 candles for lamp "A" and 95 candles for lamp "B" on the unobstructed side of the unit. On the obstructed side the peak was 51 candles for lamp "A" and 65 candles for lamp "B". It should be noted that the candlepower on the obstructed side of the unit depends somewhat on the diameter of the transmission line, in this case a bar 1-5/8 inches in diameter.

Following the measurements on the large unit, the small catenary unit was mounted in a special fixture on the table of the goniometer with the axis of the unit on the primary axis of rotation. The element of the cage which carries the connecting leads between the sections of the transformer was located directly under the lamp. The energizing current of 150 amperes was passed through an aluminum bar, simulating a transmission line, which ran axially through the unit. The photometer was recalibrated, and measurements were made as before.

The minimum simulated transmission line current at which the lamp would operate without "excessive" flicker was approximately 57 amperes. The candlepower distribution charts, Figures 5 to 8, show a peak of 32 candles.

A similar procedure was followed in making the measurements on the Model 300 unit. This unit was mounted on the table of the goniometer with its axis on the secondary axis of rotation, and power was supplied to it from a regulated, 117-volt source. The candlepower distribution charts, Figures 9 to 11, show relatively little change in candlepower as a function of horizontal angle; the candlepower ranging between a minimum of 31 and a maximum of 36 candles on a 360° horizontal traverse.

5. COLOR COMPARISONS

Using a Lummer-Brodhun photometer head, trained observers compared the chromaticity of the light from each test unit with that transmitted from a standard lamp at 2350°K through a standard filter whose chromaticity coordinates for light of that color temperature are known. In the case of each of the two catenary units the comparisons were made at simulated rated maximum transmission line current and at the minimum simulated transmission line current at which the lamp would operate without "excessive" flicker. The comparisons on the Model 300 unit were made with the unit operating from a regulated 117-volt source.

The color of all three units was found to be within the limits prescribed for aviation red as defined in specifications AN-C-56, Fed. Std. No. 3, and MIL-C-25050 (ASG).

6. PERFORMANCE CHARACTERISTICS

The variation in the candlepower of the large catenary unit as a function of the simulated transmission line current is shown in Figure 12. These curves were plotted using the relative candlepower values of Section 3 and values taken from the curves of Figure 1. The curves of Figure 12 show that the candlepower of the unit is very nearly a linear function of the transmission line current, varying from about 3 candles to 70 candles for lamp "A" and from about 2-1/2 candles to 54 candles for lamp "B" as the transmission line current increases from about 60 amperes to 1000 amperes. At 1000 amperes the candlepower of lamp "B" is approximately 20% less than that of lamp "A" in the direction of measurement.

As shown in Figure 1, the peak candlepower of the large unit is approximately 95 candles; enough for a point source to be visible at 0.3 mile in the daytime, assuming a threshold of visibility in daylight of about 1000 mile-candles. Making allowance for the 25-inch length of the light source, it was established that the lamp at a distance of 1000 feet should be nearing the limit of its visual range on a reasonably clear day.

The unit was mounted on an outdoor range and observed against a sky background in the daytime from a distance of approximately 1000 feet at a time when the visual range was about six miles. The ring of the goniometer on which the

lamp was mounted was clearly visible, as was a strip of black cloth about 2-1/2 inches wide. The frame of the unit was visible but was not as conspicuous as a 1-1/4 inch diameter mast nearby. Since the mast was somewhat darker than a transmission line probably would be, a 1-1/4 inch aluminum bar was observed and found to be possibly a little less conspicuous than the mast but just as visible as the unit.

When the lamp was lit a faint glow appeared in the unit, but, in the opinion of the observers, this did not add to the conspicuity of the unit under the conditions of observation. A black-cloth background increased the visibility of the lamp but not to a marked degree.

From these observations it was concluded that the unit would be of doubtful value when viewed against a sky background in the daytime. Allowing for a size factor of 3, the visual range of the unit at night should be about 1/4 mile when the visibility is 1/4 mile. Under this condition the unit would be about as effective as a 25 candlepower lamp. With an atmosphere sufficiently clear, the visual range will be such that the unit may be considered a point source at its extreme range. Under such conditions, the visual range will be limited by the candlepower alone, as in the case of the usual incandescent unit. With the most favorable conditions, the maximum candlepower of the unit, 95 candles, will give a visual range at night of more than 10 miles.

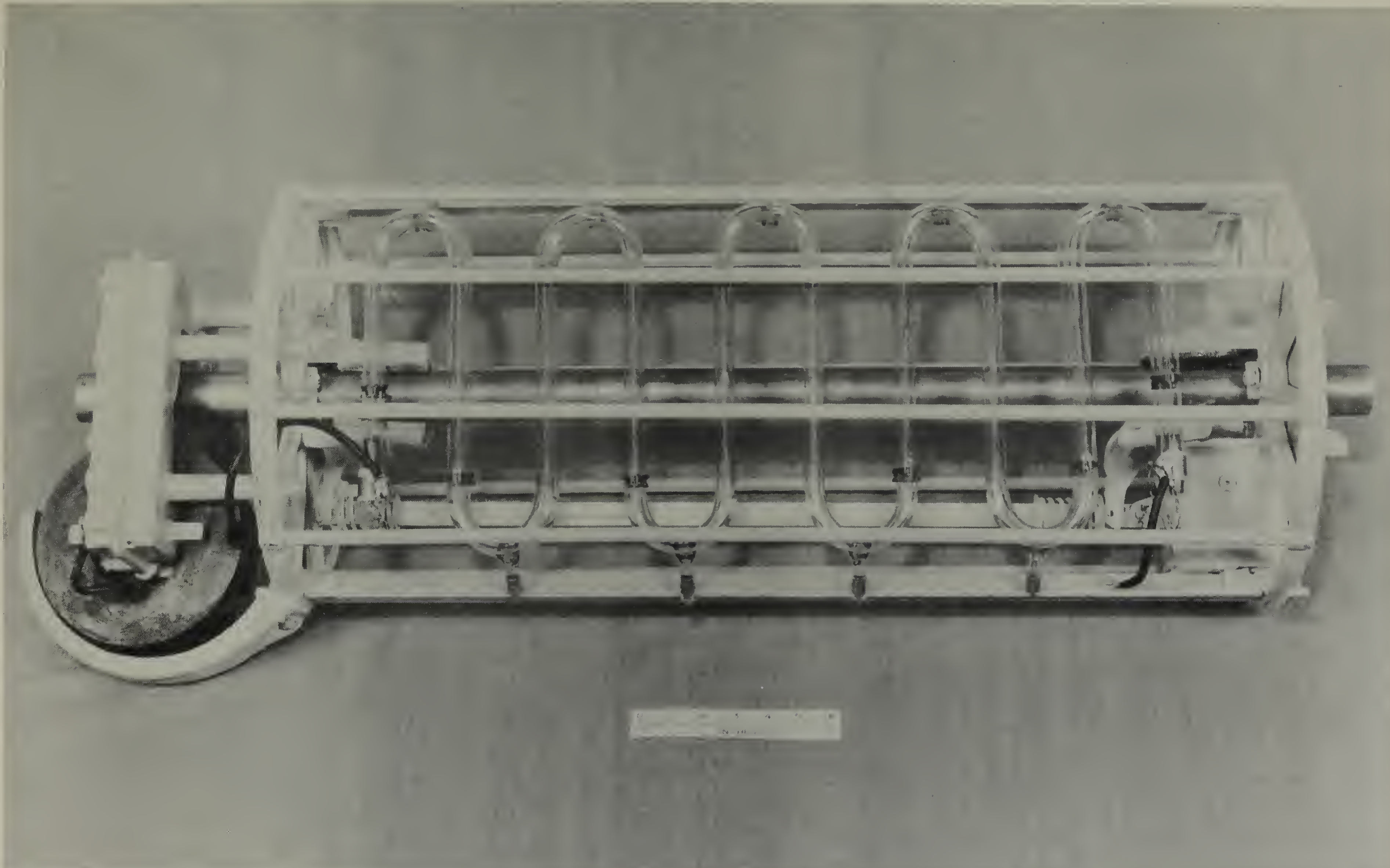

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Figure I

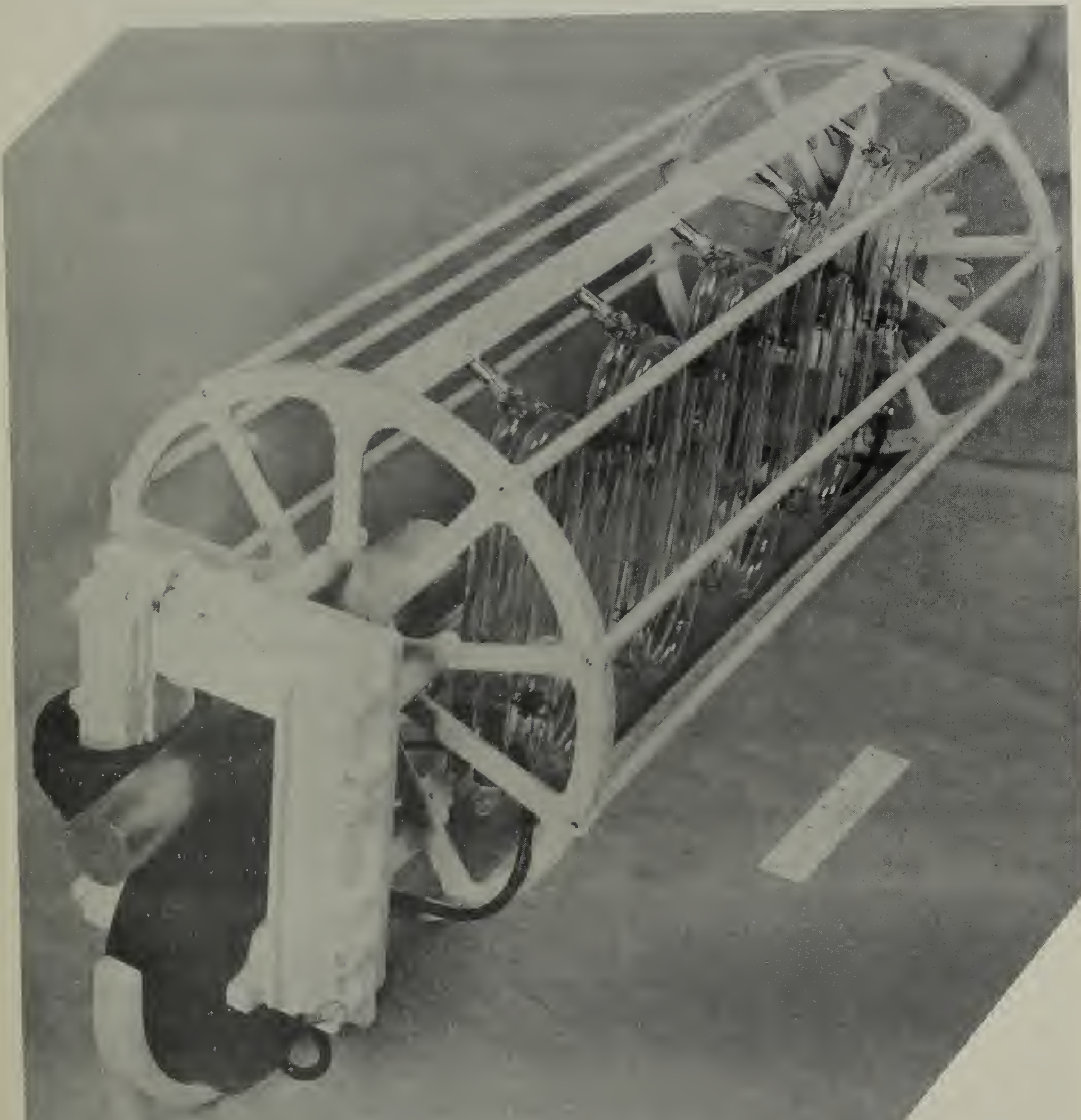

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Figure II

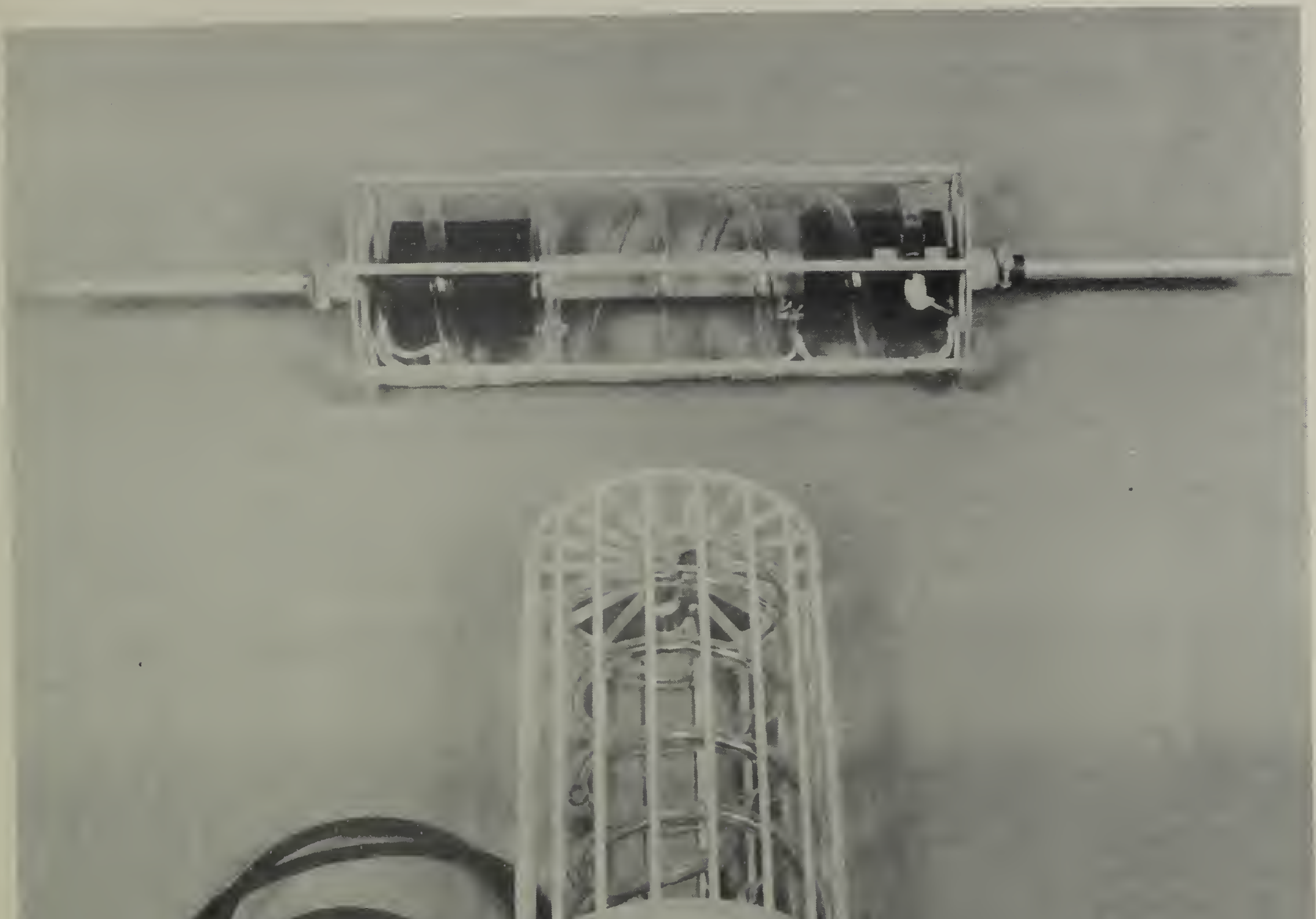

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Figure III

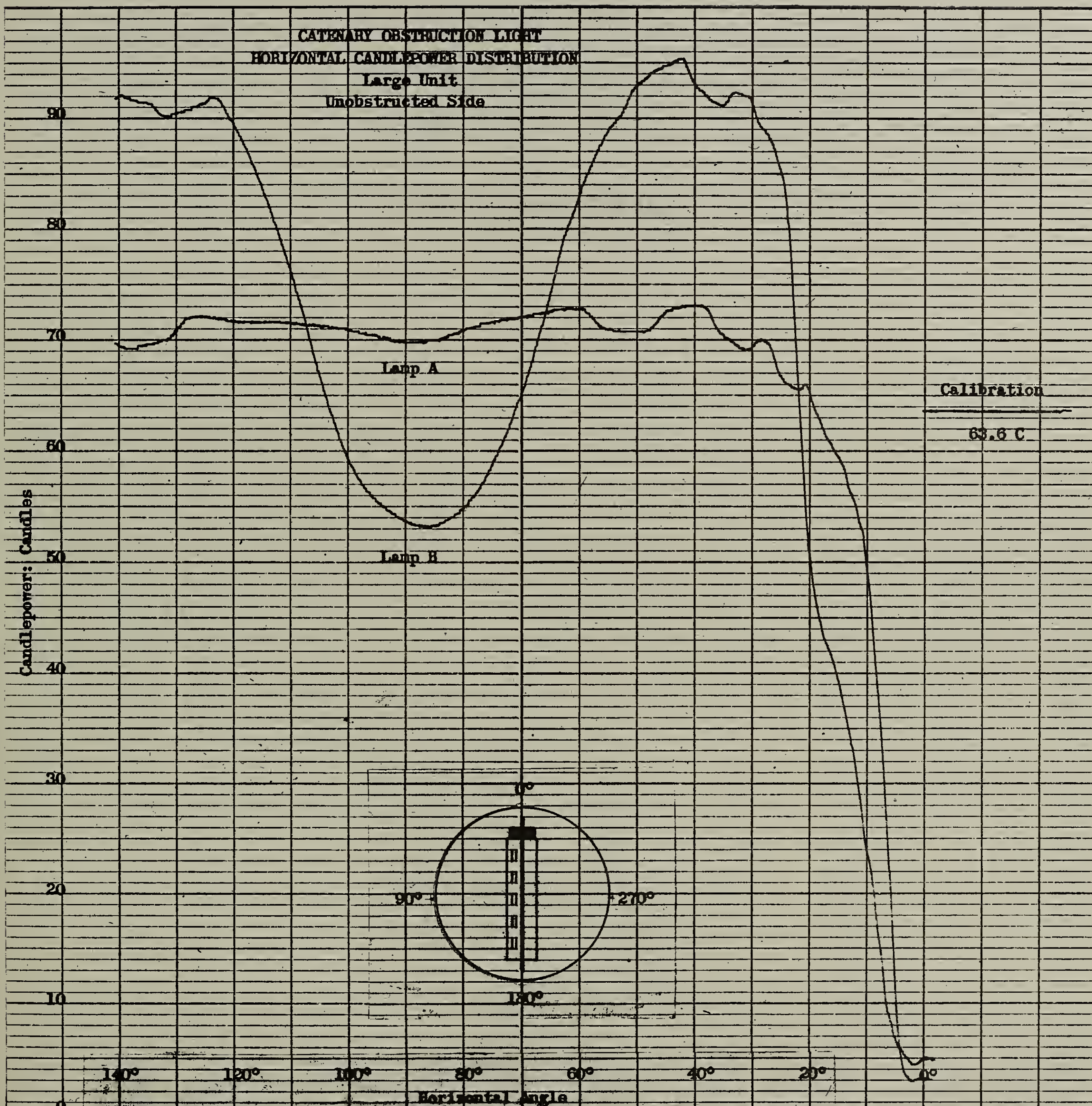

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Figure 1

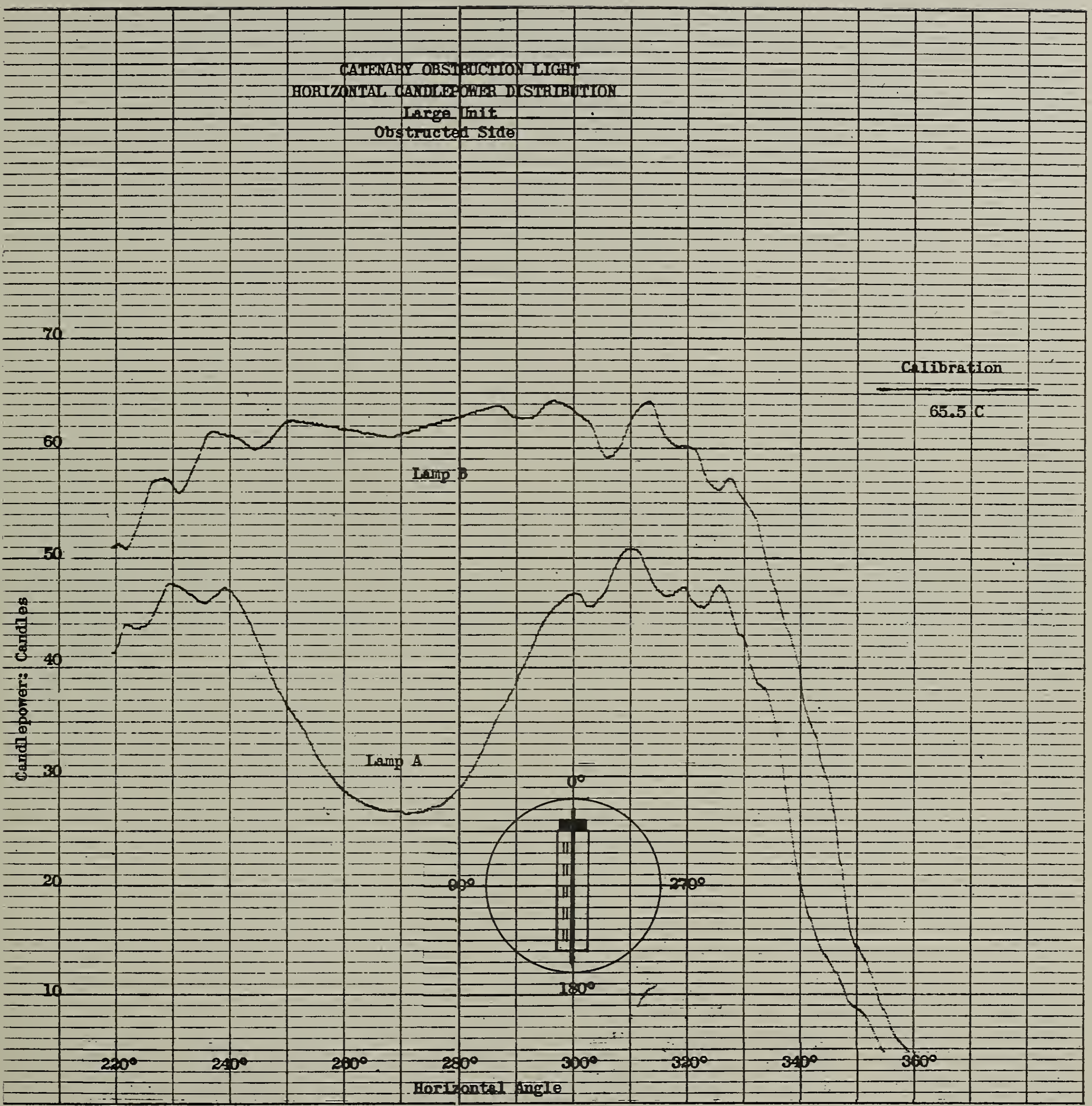

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Figure 2

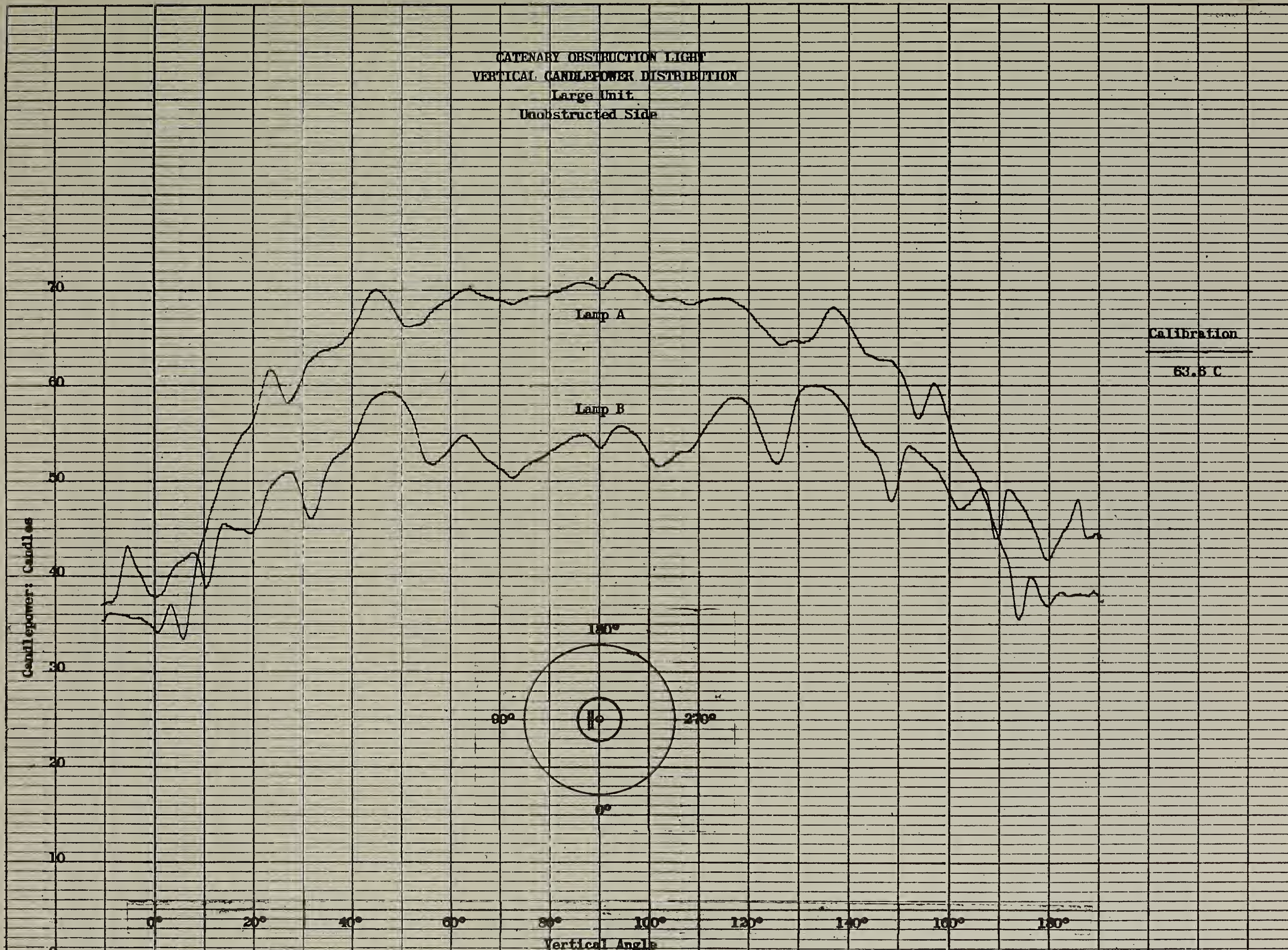

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Figure 3

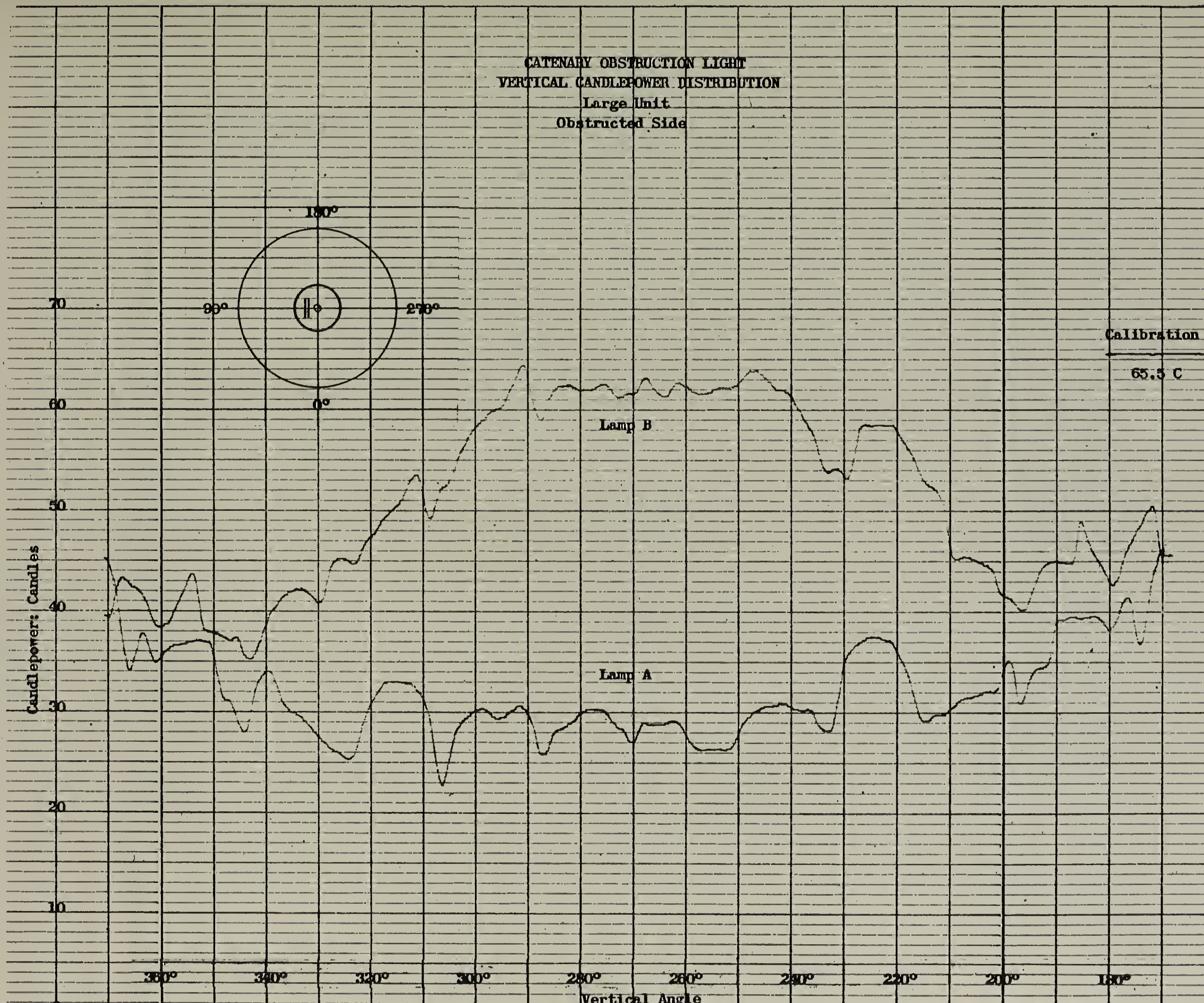

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Figure 4

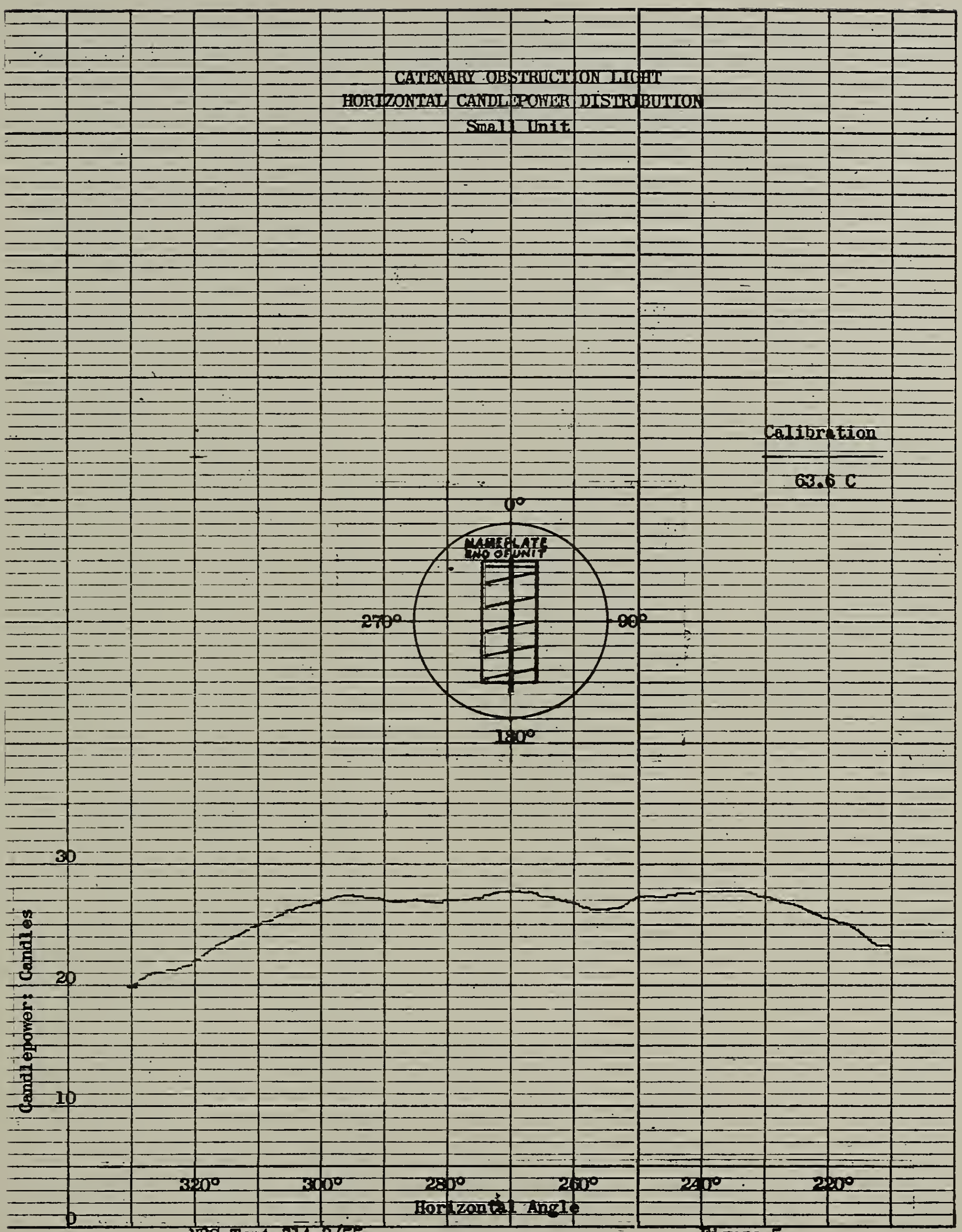

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Figure 5

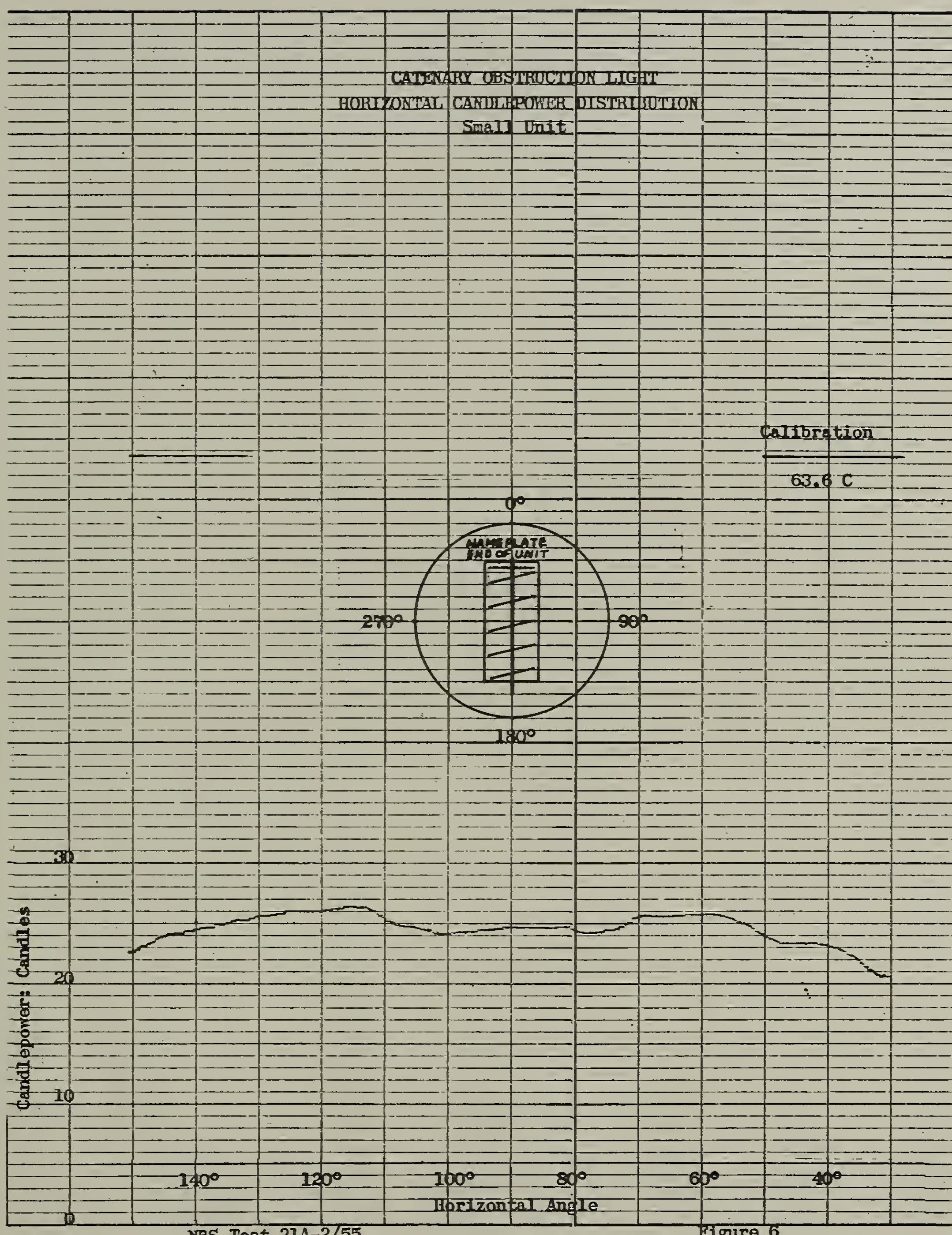

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Figure 6

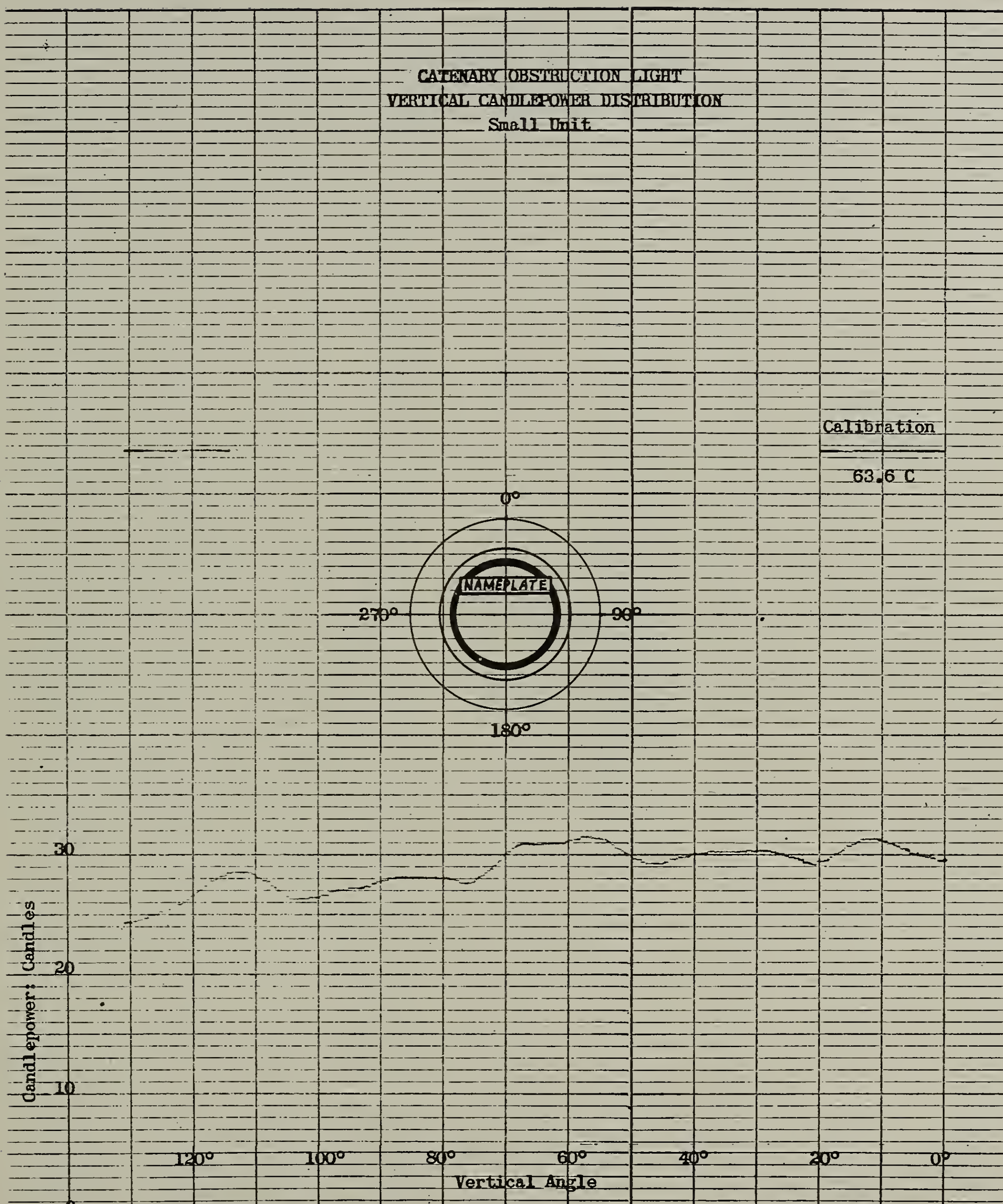

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Figure 7

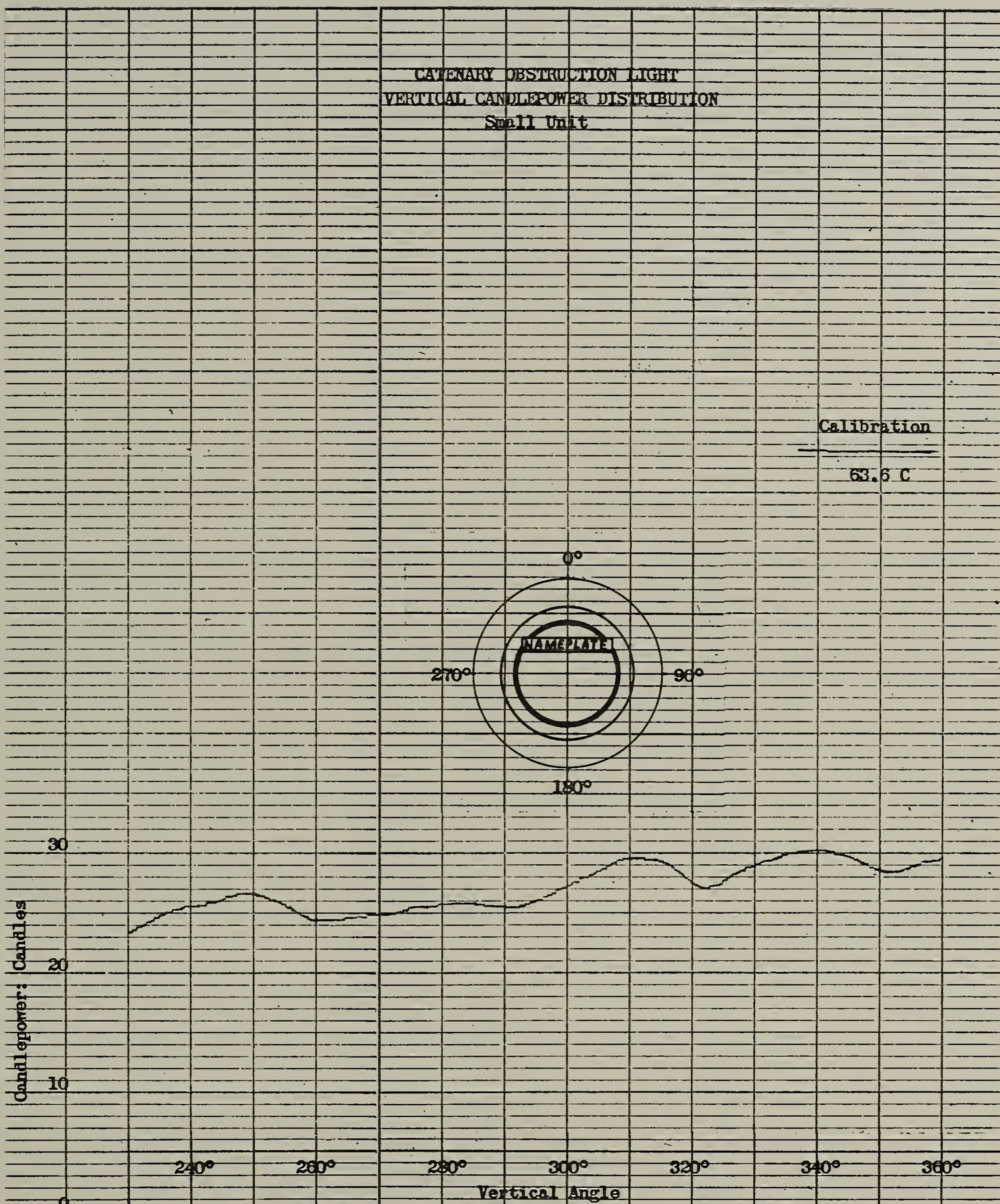

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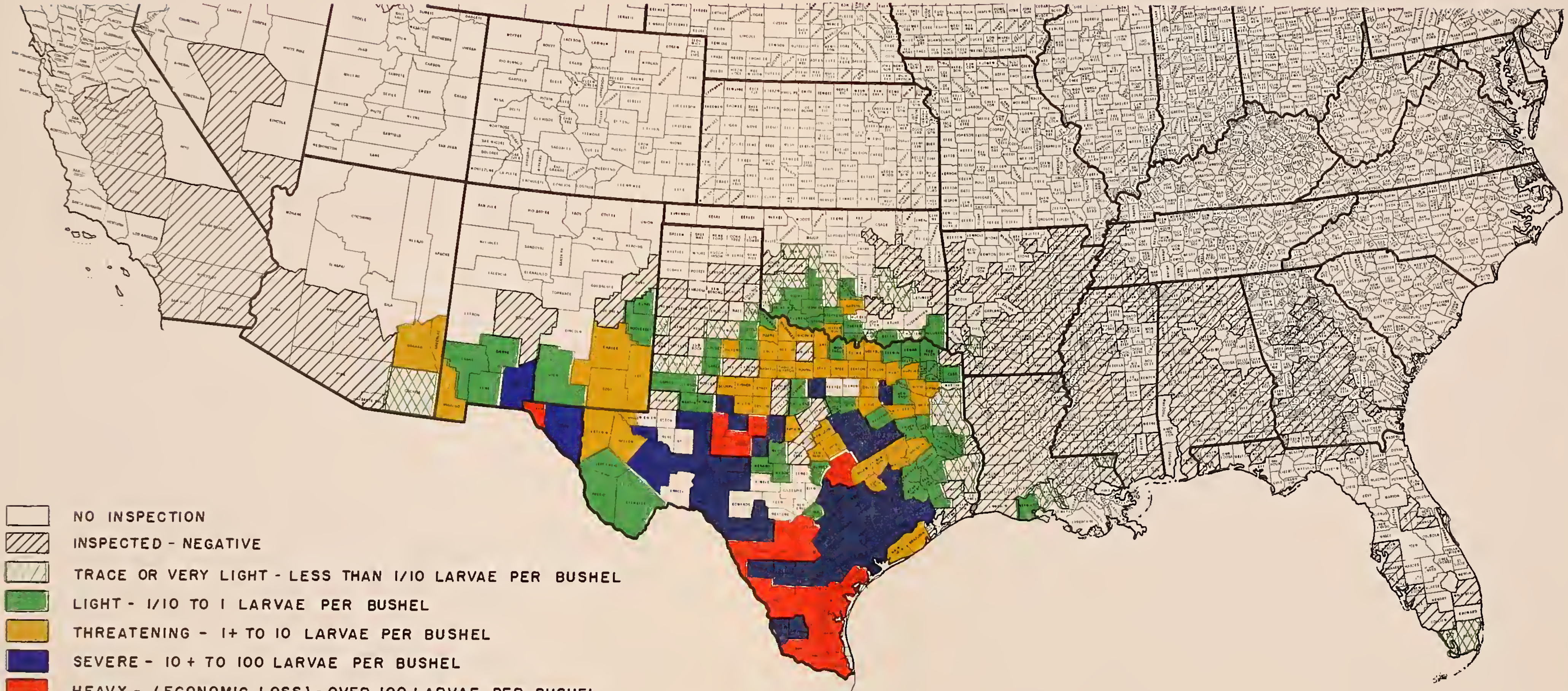
Figure 8

STATUS OF PINK BOLLWORM INFESTATIONS AS OF JAN. 1958



NO INSPECTION

INSPECTED - NEGATIVE

TRACE OR VERY LIGHT - LESS THAN 1/10 LARVAE PER BUSHEL

LIGHT - 1/10 TO 1 LARVAE PER BUSHEL

THREATENING - 1+ TO 10 LARVAE PER BUSHEL

SEVERE - 10+ TO 100 LARVAE PER BUSHEL

HEAVY - (ECONOMIC LOSS) - OVER 100 LARVAE PER BUSHEL

BASED ON GIN TRASH SAMPLINGS OR EQUIVALENT

Prepared at Gulfport, Miss 4-4-58 LAB

Agriculture - Specialized Printing Co., Gulfport, Miss.

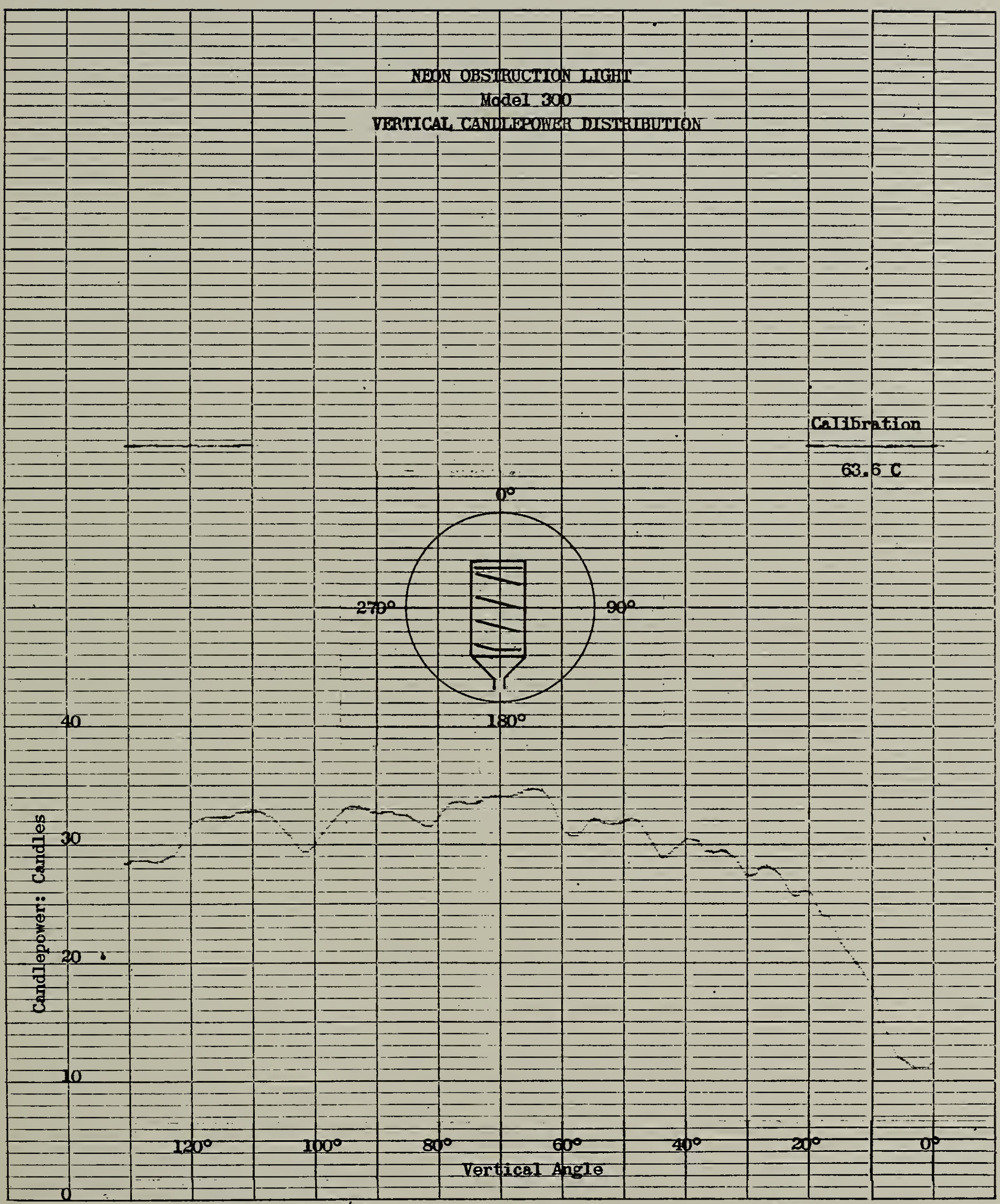


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Figure 10

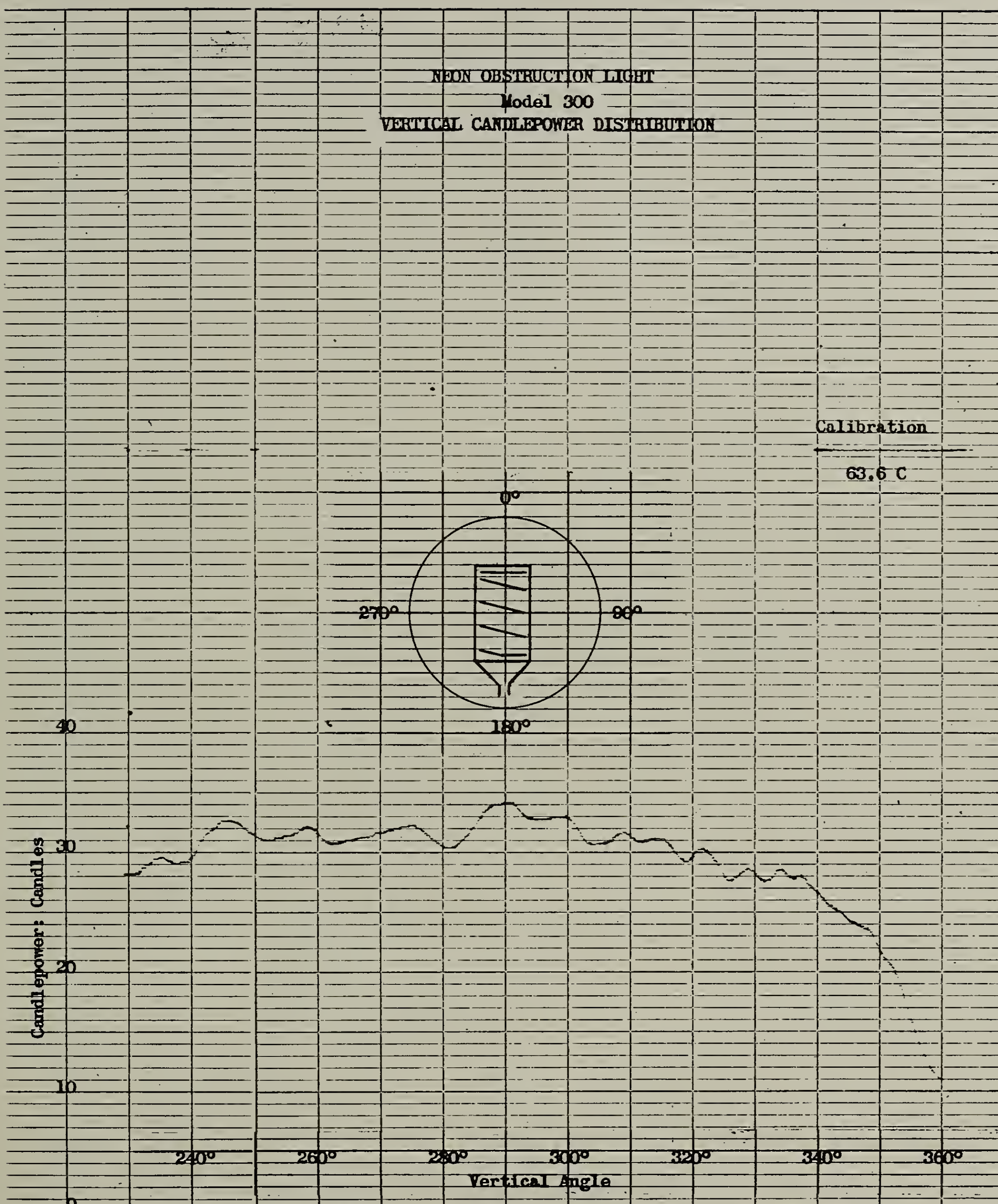

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Figure 11

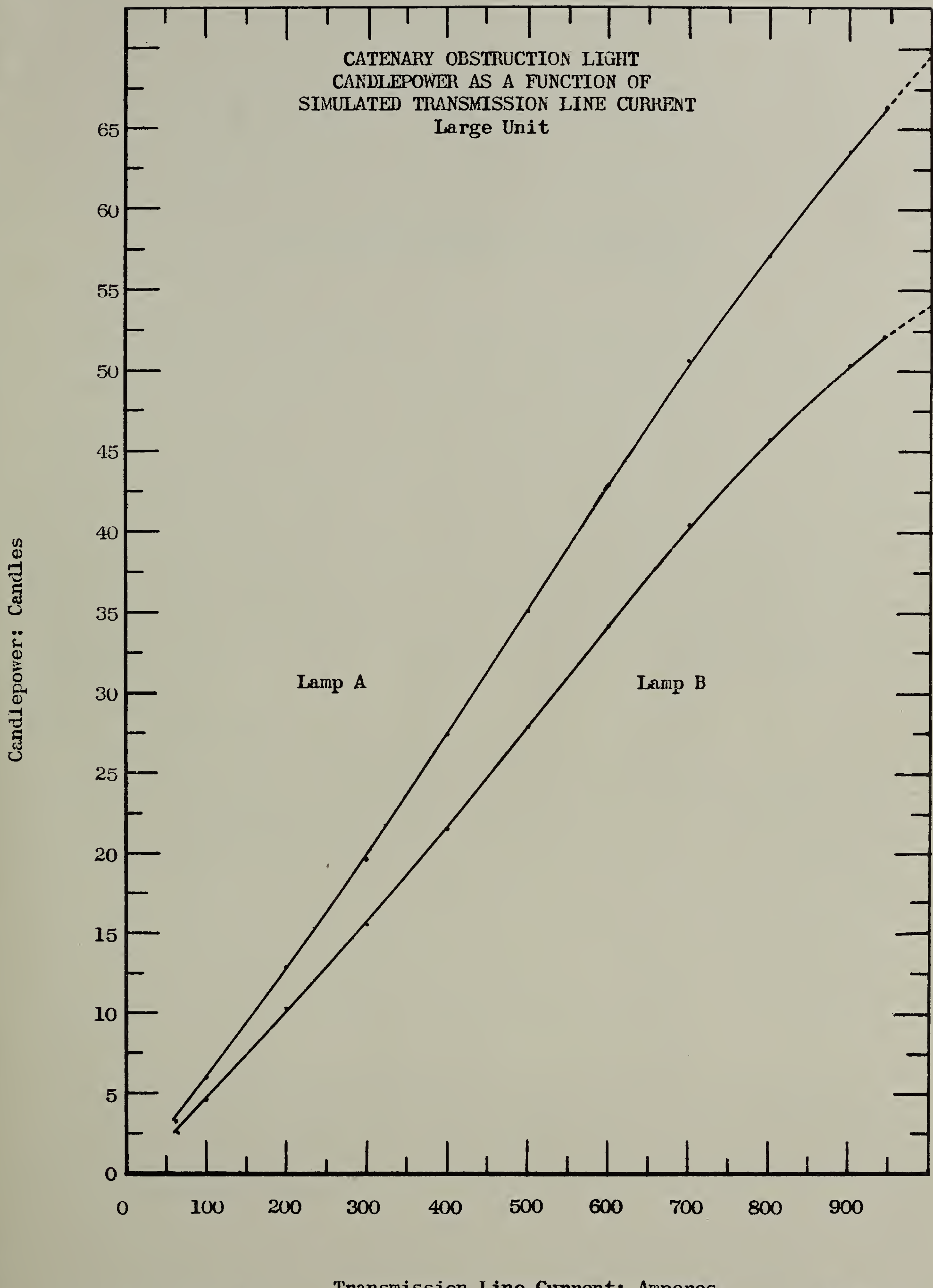
CATENARY OBSTRUCTION LIGHT
CANDLEPOWER AS A FUNCTION OF
SIMULATED TRANSMISSION LINE CURRENT
Large Unit
Lamp A
Lamp B
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
100
200
300
400
500
600
700
800
900
Candlepower: Candles
Transmission Line Current: Amperes

Figure 12

THE NATIONAL BUREAU OF STANDARDS

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The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the front cover.

Reports and Publications

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Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards ($1.25) and its Supplement ($0.75), available from the Superintendent of Documents, Government Printing Office. Inquiries regarding the Bureau's reports and publications should be addressed to the Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C.

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