AIRPORT BEACON L-801A
PHOTOMETRIC TEST

TESTING AND RESEARCH DIVISION
RESEARCH LABORATORY SECTION

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Research Laboratory Section
Testing and Research Division
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Michigan Transportation Commission
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Lamps from the Capital City Airport beacon were tested for intensity and intensity distribution. A method for estimating the effective intensity of rotating beacons was applied. Results indicate that the lamps have intensity and intensity distribution deficiencies.

In accordance with W. E. Gehman's December 29, 1980 memo, R. E. Addy delivered two lamps on January 16, 1981 which were identified as shown below. The lamps were also described as the light from the white and green colors of the Capital City Airport beacon.

Lamp Identification

Manufacturer:	Sylvania
Type:	1000 W PAR 6410/NS
Lamp No.:	C-14 (from white color)
	C-19 (from green color)

Each lamp was mounted on a Type A goniometer with the center of the lamp face on the optical axis. The lamps were operated as shown below.

Lamp Test Operation

Lamp No.	Volts	Amp
C-14	120	8.15
C-19	120	8.11

Intensity measurements were made with a Pacific Instrument's Photometer fitted with an IP 22 multiplier phototube which was corrected to the human eye response. The measurements are based on a standard lamp intensity which is traceable to the National Bureau of Standards intensity standard. The test distance was 100 ft.

Measurements were made traversing the horizontal axis with the lamp at a 0-degree vertical angle. Measurements were also made along the vertical axis with the lamp at a 0-degree horizontal angle. Additional measurements were made as necessary on each axis to obtain the maximum intensity distributions. These horizontal and vertical distributions are shown in the attached figures.

The vertical distribution for lamp C-14 shows that the maximum peak occurs 3 degrees above the horizontal axis and at the lamp center. For lamp C-19 the peak is 5 degrees above the horizontal axis and about 3

degrees to the left of the lamp center. Since lamp C-14 was identified as a lamp examined on October 10, 1980 for information purposes, it was assumed that the filament may be sagging. On October 10th peak intensity for lamp C-14 occurred on the horizontal axis.

Effective intensity was calculated according to a method reported by Wohlers and Leupp (1). The method assumes a Gaussian form of distribution and relies on transforming angular width of the intensity beam into time units that are related to the rotational speed of the beacon. This method allowed a trial and error calculation of an intensity maximum that is also the effective intensity. A graphical method reported in the "IES Guide for Calculating the Effective Intensity of Flashing Signal Lights" (2) was not as sensitive as the direct calculation. Both methods are based on the same assumptions.

Horizontal distribution of maximum intensities were used to calculate the effective intensity and flash duration of each lamp. Data obtained during the October 1980 test on lamp C-14 were also used to calculate an effective intensity. A constant 12 rpm rotational speed was assumed. Effective intensities and flash durations at those intensities are listed below.

Lamp	Effective Intensity, candela	Flash Duration, seconds
C-14 (white color)	44,200	0.264
C-19 (green color)	25,100	0.287
C-14 (October 10, 1980 test)	43,000	0.234

The specification for L-801 beacons states that "with the light beam center set at 5 degrees above the horizontal" the minimum effective intensity of the white flash must be 50,000 candela for an elevation angle between 2 and 8 degrees (3). Minimum effective intensity for the green must be 7,500 candela. Since the "light beam center" can be identified as an optical axis through the physical center of the lamp or as the center of the photometric maximum, the aiming instructions are ambiguous. However, because of the difficulty in identifying the photometric maximum during installation, a physical center must be assumed. The maximum beam for the C-14 lamp would then be 8 degrees above the horizontal and for the C-19 lamp, 10 degrees above the horizontal.

It should be noted that an additional transmission factor (T) correction for the white and green cover glasses on the beacon would lower the above effective intensity values. From previous tests, transmission factors of

89.5 percent for a white cover glass and 30.1 percent for green were obtained. The transmission factor for the white glass may be slightly low but the above effective intensity values for the lights when color is considered would become:

Lamp	Cover Glass, percent T	Effective Intensity, candela
C-14	90.0	White - 40,000
C-19	30.1	Green - 7,500

For informational purposes the effective intensity of each lamp was estimated assuming a 6 rpm rotational speed. The results, not corrected for cover glass transmission factors, are as follows:

Lamp	Effective Intensity, candela	Flash Duration, seconds
C-14 (white color)	56,500	0.433
C-19 (green color)	32,500	0.490

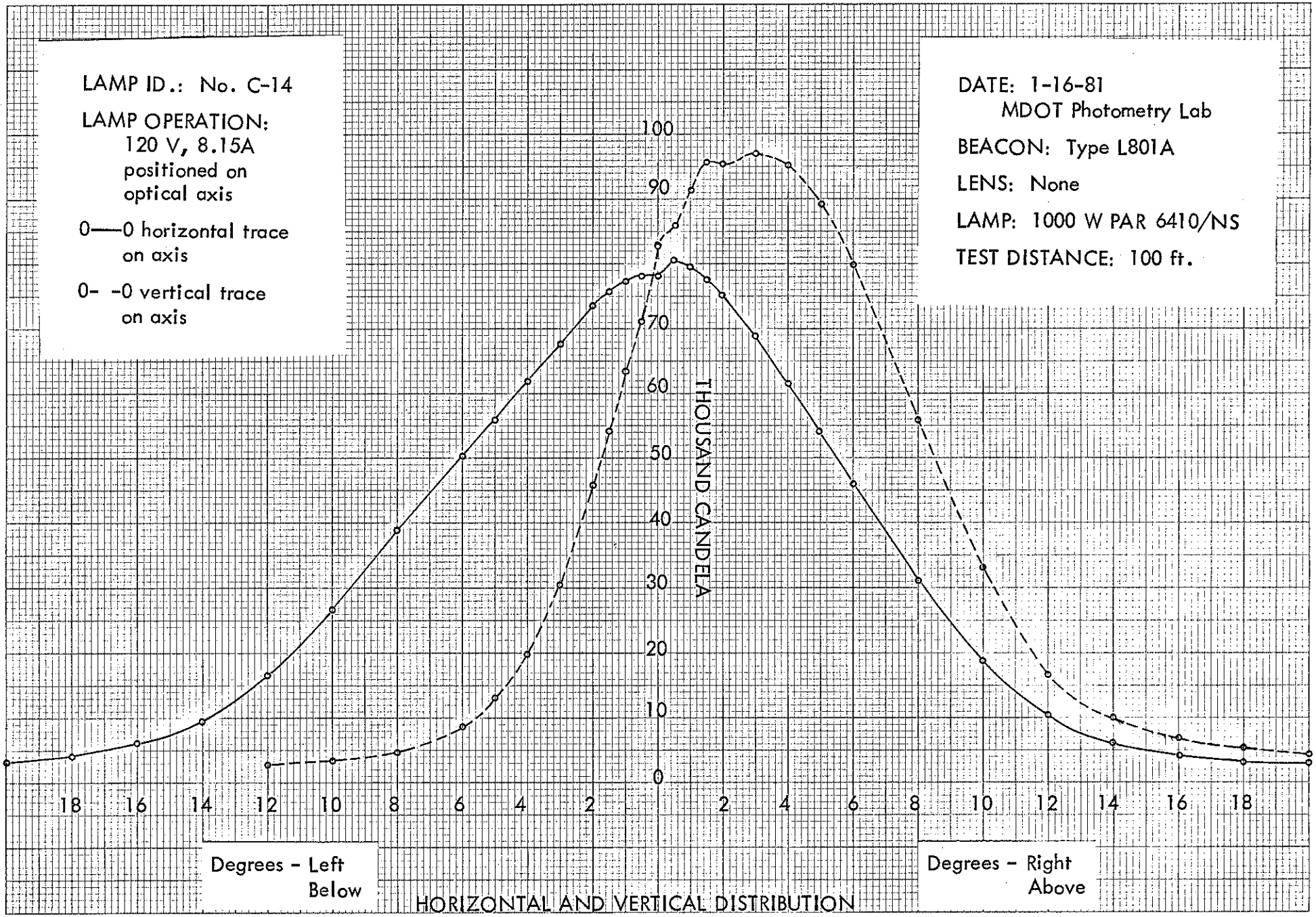
It should be noted again that the reported effective intensities were calculated from maximum intensity distributions. These distributions are at the specified upper 8-degree angle limit for the C-14 lamp and 2 degrees above the upper 8-degree angle limit for the C-19 lamp. Should the filament of the C-14 lamp continue to sag, the maximum will also be above the specified upper limit.

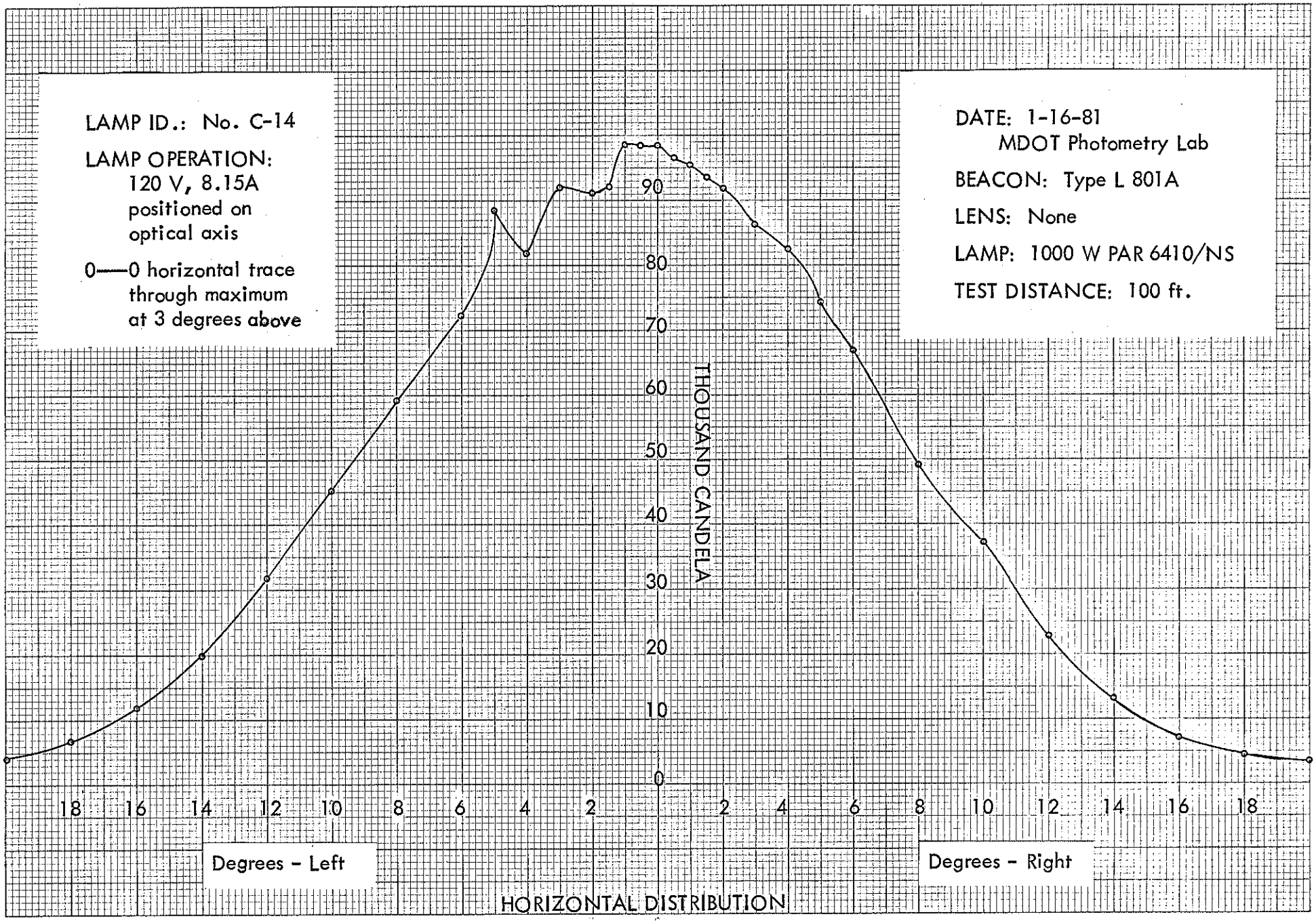
REFERENCES

1. Wohlers, M. R. and Leupp, H. A., "Effective Intensity of Certain Types of Rotating Beacons," Illuminating Engineering, July 1959, pp. 412-414.

2. Illuminating Engineering Society, "Guide for Calculating the Effective Intensity of Flashing Signal Lights," Illuminating Engineering, November 1964, pp. 747-753.

3. Federal Aviation Administration, "Specification for L-801 Beacons," Advisory Circular 150/5345-12B, September 8, 1977.





LAMP ID.: No. C-14

LAMP OPERATION:
120 V, 8.15A
positioned on
optical axis

0——0 horizontal trace
on axis

0- -0 vertical trace
through maximum
at 1 degree left

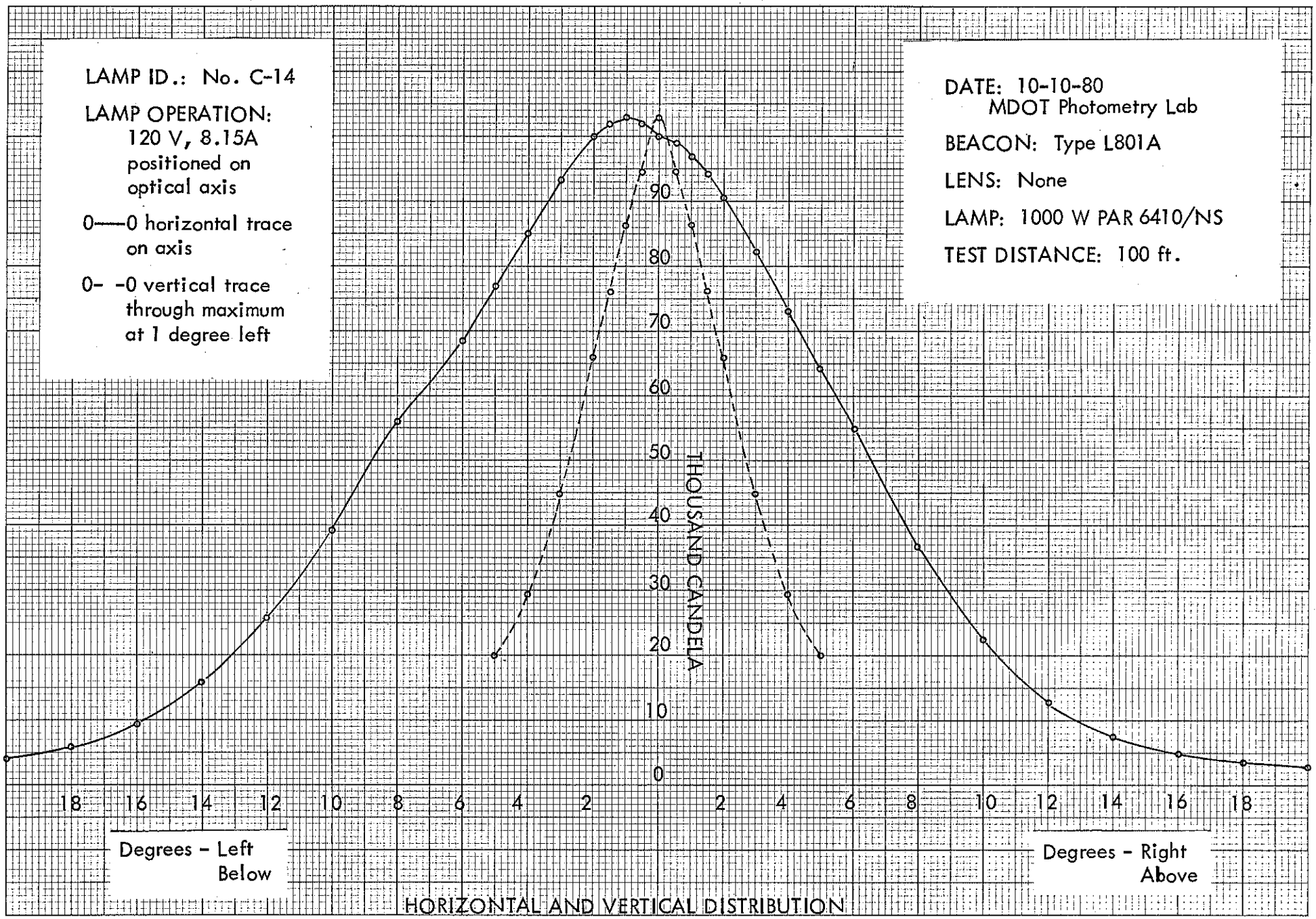
DATE: 10-10-80
MDOT Photometry Lab

BEACON: Type L801A

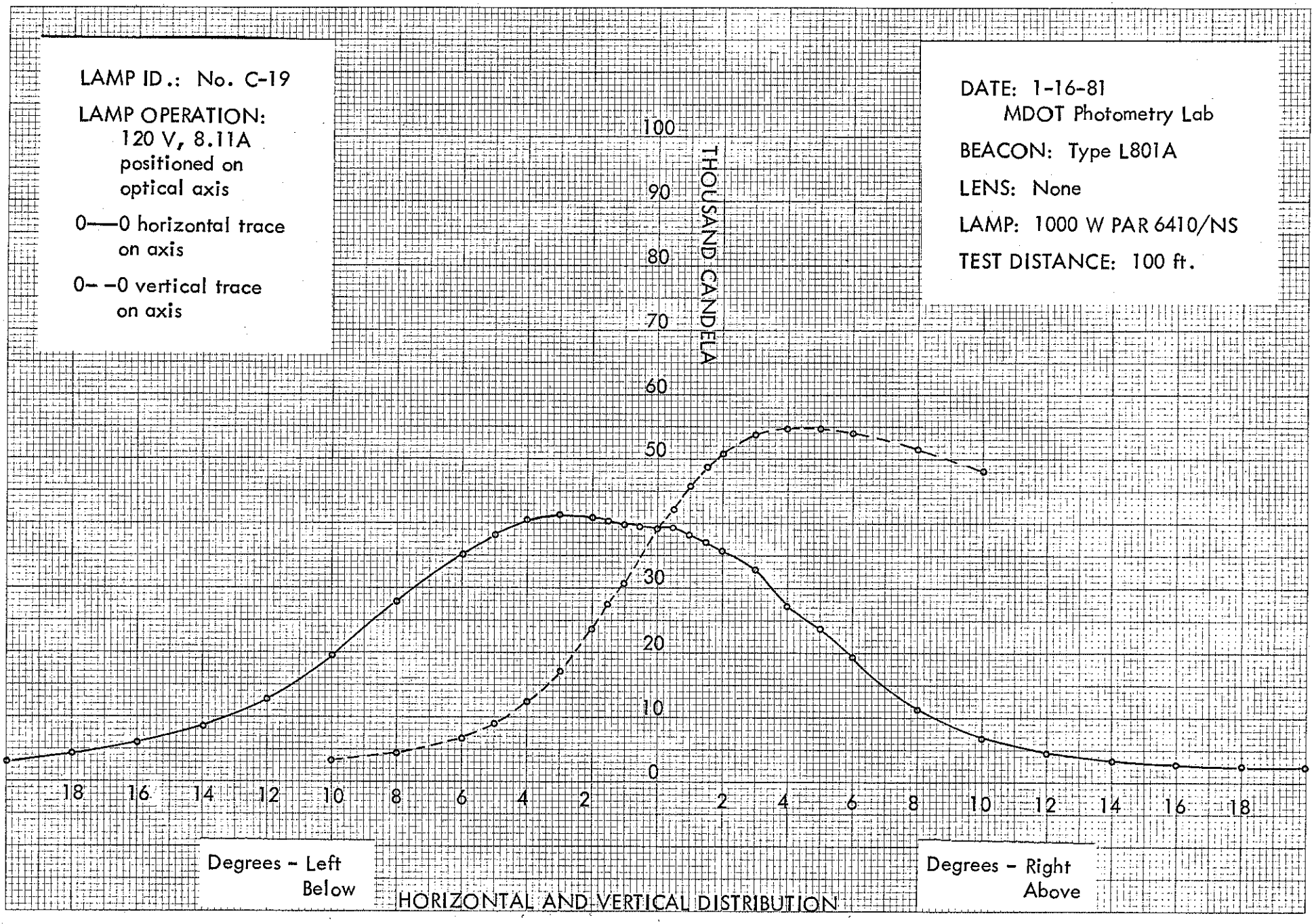
LENS: None

LAMP: 1000 W PAR 6410/NS

TEST DISTANCE: 100 ft.



HORIZONTAL AND VERTICAL DISTRIBUTION



LAMP ID.: No. C-19

LAMP OPERATION:
120 V, 8.11A
positioned on
optical axis

0——0 horizontal trace
through maximum
at 5 degrees above

0– –0 vertical trace
through maximum
at 3 degrees left

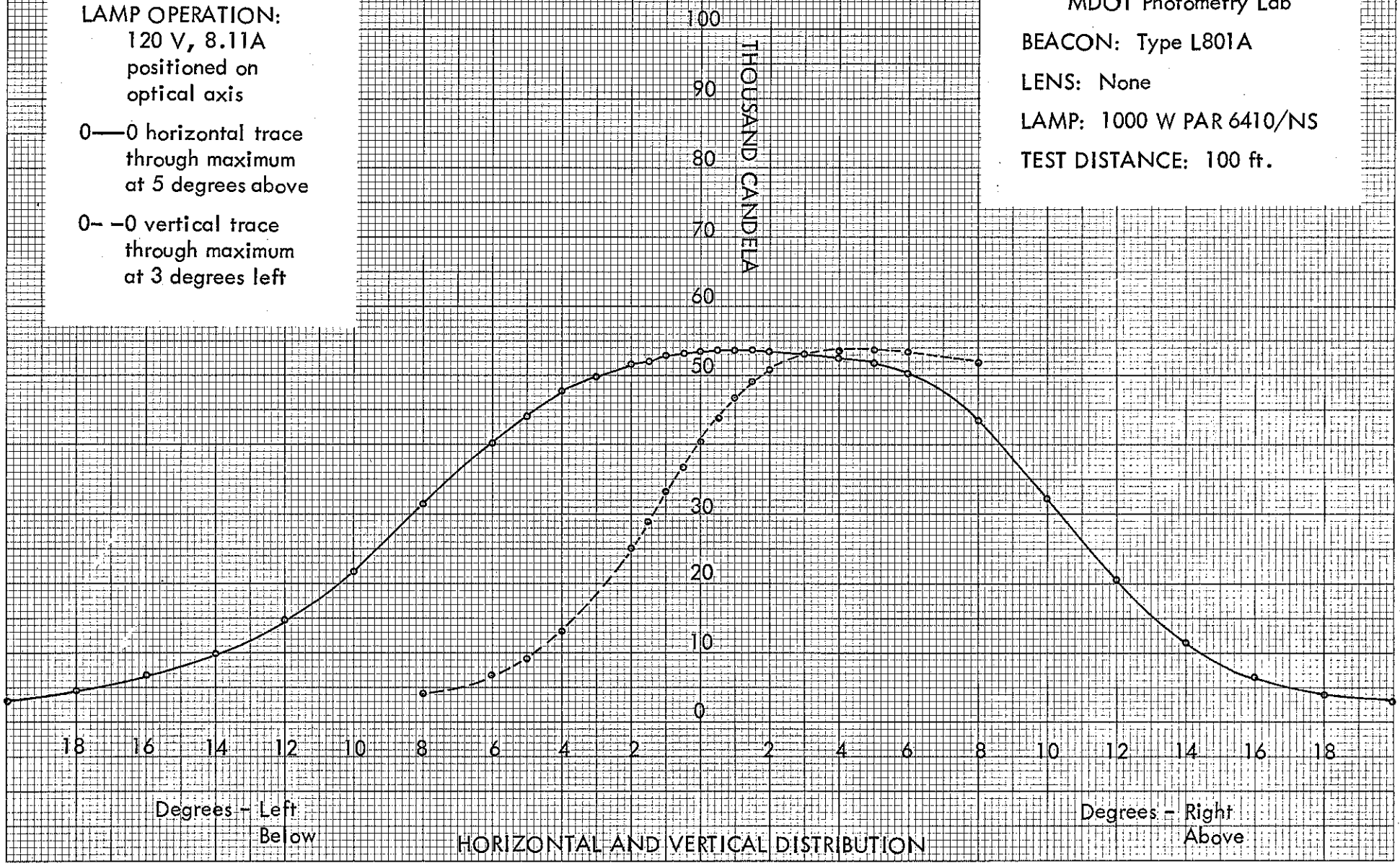
DATE: 1-16-81
MDOT Photometry Lab

BEACON: Type L801A

LENS: None

LAMP: 1000 W PAR 6410/NS

TEST DISTANCE: 100 ft.



HORIZONTAL AND VERTICAL DISTRIBUTION