

# NATIONAL BUREAU OF STANDARDS REPORT

7017

on  
Interlaboratory Intercomparisons  
of  
200-Watt Incandescent Lamps

by

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Metrology Division



U. S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS

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U. S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS



Interlaboratory Intercomparisons  
of  
200-Watt Incandescent Lamps

ABSTRACT

Two groups of 200-Watt incandescent lamps were measured by each of ten laboratories. One group consists of eight clear-bulb 120-volt lamps; the other group consists of eight inside-frosted 120 volt lamps. The voltage across the lamps was held at 120-volts while the luminous flux and the current for each lamp were measured. The results of the measurements made by the individual laboratories and an analysis of the results are given in this report.

1. Introduction

This intercomparison was undertaken to determine the uniformity of measurements on 200-Watt incandescent lamps made at the participating laboratories. The laboratories participating and the order of reading are as follows:

- I Sylvania
- II Electrical Testing Laboratories
- III Westinghouse
- IV Champion
- V Duro Test
- VI National Bureau of Standards
- VII General Electric
- VIII Verd-A-Ray
- IX Interlectric
- X Solar

The order in which the laboratories made their measurements was chosen to reduce shipment of the lamps as much as possible. Each laboratory followed its own customary procedure in making the measurements. In each laboratory the lamp voltage was held constant at 120-volts while luminous flux and current were measured.

II Results of Measurements

The results reported are given in tables 1 through 6. The averages reported for each lamp and for each laboratory are given. The difference,  $\Delta$ , between the average for each





laboratory and the average for all laboratories for all lamps is also given in the tables. The number on clear lamp No.10 became so illegible that it was reported by some laboratories as lamp No. 19. In this report it is reported as lamp No.10 for all the laboratories.

### III Analysis of the Results.

An analysis of the results of the measurements has been made following a modification of the method described by W.J. Youden (1), (2), and (3). The modified method is described in National Bureau of Standards Report No. 6605 "Interlaboratory Intercomparisons of 32-Watt T12 Cool-White Circline Lamps" and Report No. 6698 "Interlaboratory Intercomparisons of 40-Watt T12 Cool-White Fluorescent Lamps". The analysis is shown on the following graphs. The point representing the measurements by an individual laboratory is designated by the first or first and second letter in the name of the laboratory. The point representing the average of all laboratories is designated by the letter A.

(1) Graphical Diagnosis of Interlaboratory Test Results, Industrial Quality Control Vol. XV No. 11, May 1959.

(2) Product Specifications and Test Procedures, Industrial and Engineering Chemistry, Vol. 50 page 914, October 1958.

(3) Circumstances Alter the Cases, Industrial and Engineering Chemistry, Vol. 50, page 77A, December 1958.





Luminous Flux in Lumens  
Clear Bulb Lamps

Lamp No.	Syl.	ETL	West	Champ	Duro	NBS	GE	Verd	Interl.	Solar	Ave
4	3667	3615	3638	3676	3640	3666	3640	3647	3587	3684	3646.0
5	3573	3550	3557	3597	3550	3576	3561	3543	3549	3545	3560.1
8	3567	3545	3557	3604	3550	3580	3552	3560	3538	3549	3560.2
9	3560	3545	3559	3591	3523	3613	3581	3613	3586	3565	3573.6
10	3646	3635	3642	3685	3635	3678	3664	3690	3666	3614	3655.5
11	3670	3650	3651	3704	3655	3674	3634	3627	3671	3639	3657.5
12	3653	3610	3640	3691	3638	3656	3629	3633	3681	3645	3647.6
14	3658	3620	3638	3674	3630	3657	3634	3573	3657	3630	3637.1
Ave.	3624.2	3596.2	3610.2	3652.8	3603.6	3637.5	3611.9	3610.8	3616.9	3608.9	3617.2
$\Delta$	+ 7.0	-21.0	- 7.0	35.6	-14.6	+20.3	- 5.3	- 6.4	- 0.3	- 8.3	
% $\Delta$	+ .19%	- .58%	- .19%	+ .98%	- .40%	+ .56%	- .15%	- .18%	- .01%	- .23%	

Table 2.

Luminous Flux in Lumens.  
Inside Frosted Bulb Lamps

Lamp No.	Syl.	ETL	West	Champ	Duro	NBS	GE	Verd	Interl.	Solar	Ave
1	3641	3610	3619	3626	3620	3655	3645	3580	3585	3669	3625.0
2	3566	3545	3547	3573	3555	3589	3573	3503	3542	3549	3554.2
4	3582	3570	3576	3596	3585	3590	3590	3540	3558	3511	3569.8
5	3554	3515	3529	3543	3545	3556	3574	3537	3514	3479	3534.6
7	3612	3620	3603	3642	3600	3671	3639	3590	3629	3636	3624.2
8	3568	3535	3525	3576	3530	3562	3564	3503	3563	3510	3543.6
9	3632	3630	3624	3649	3620	3632	3602	3547	3614	3563	3611.3
10	3647	3620	3629	3675	3650	3627	3624	3573	3640	3628	3631.3
Ave	3600.2	3580.6	3581.5	3610.0	3588.1	3610.2	3601.4	3546.6	3580.6	3568.1	3586.7
$\Delta$	+ 13.5	- 6.1	- 5.2	+ 23.3	+ 1.4	+23.5	+ 14.7	-40.1	- 6.1	- 18.6	
% $\Delta$	+ .38%	- .17%	- .14%	+ .65%	+ .04%	+ .66%	+ .41%	- 1.12%	- .17%	- .52%	



Clear Bulb Lamps

Lamp No.	Syl.	ETL	West	Champ	Duro	NBS	GE	Verd	Interl	Solar	Ave
4	1.679	1.676	1.672	1.690	1.677	1.679	1.680	1.676	1.677	1.680	1.6786
5	1.668	1.670	1.664	1.682	1.667	1.668	1.670	1.661	1.667	1.670	1.6687
8	1.668	1.666	1.663	1.683	1.667	1.668	1.670	1.663	1.665	1.671	1.6684
9	1.665	1.664	1.660	1.677	1.660	1.670	1.670	1.664	1.668	1.670	1.6668
10	1.682	1.684	1.676	1.697	1.683	1.685	1.686	1.680	1.684	1.687	1.6844
11	1.685	1.681	1.675	1.695	1.678	1.680	1.678	1.676	1.684	1.685	1.6817
12	1.677	1.674	1.670	1.692	1.672	1.676	1.676	1.673	1.681	1.685	1.6776
14	1.684	1.685	1.676	1.698	1.682	1.686	1.684	1.679	1.679	1.681	1.6834
Ave	1.6760	1.6750	1.6695	1.6892	1.6732	1.6765	1.6768	1.6715	1.6756	1.6786	1.6762
Δ	- .0002	-.0012	-.0067	+.0130	-.0030	+.0003	+.0006	-.0047	-.0006	+.0024	
%Δ	-.012%	-.072%	-.40%	+.78%	-.18%	+.018%	+.036%	-.28%	-.036%	+.14%	

Table 4.

Current in Amperes  
Inside Frosted Bulb Lamps

Lamp No.	Syl.	ETL	West	Champ	Duro	NBS	GE	Verd	Interl	Solar	Ave
1	1.678	1.679	1.672	1.691	1.675	1.678	1.680	1.673	1.677	1.685	1.6788
2	1.683	1.684	1.676	1.696	1.679	1.682	1.685	1.680	1.682	1.685	1.6832
4	1.683	1.685	1.679	1.696	1.681	1.684	1.684	1.680	1.682	1.684	1.6838
5	1.678	1.676	1.672	1.687	1.673	1.678	1.680	1.676	1.675	1.676	1.6771
7	1.679	1.682	1.672	1.693	1.679	1.686	1.680	1.679	1.681	1.690	1.6821
8	1.668	1.668	1.659	1.681	1.664	1.668	1.669	1.662	1.664	1.669	1.6672
9	1.694	1.668	1.688	1.707	1.689	1.693	1.690	1.686	1.693	1.692	1.6900
10	1.687	1.683	1.677	1.693	1.680	1.682	1.681	1.679	1.682	1.689	1.6833
Ave	1.6812	1.6782	1.6744	1.6930	1.6775	1.6814	1.6811	1.6769	1.6795	1.6838	1.6807
Δ	+.0005	-.0025	-.0063	+.0123	-.0032	+.0007	+.0004	-.0038	-.0012	+.0031	
%Δ	+.03%	-.15%	-.37%	+.73%	-.19%	+.04%	+.02%	-.23%	-.071%	+.18%	





Lumens per Watt  
Clear Bulb Lamps

Lamp No.	Syl.	EFL	West	Champ	Duro	NBS	GE	Verd	Interl	Solar	Ave
4	18.20	17.97	18.13	18.13	18.09	18.20	18.06	18.14	17.82	18.27	18.101
5	17.85	17.71	17.81	17.82	17.75	17.87	17.77	17.78	17.74	17.69	17.779
8	17.82	17.73	17.82	17.85	17.75	17.89	17.72	17.84	17.71	17.70	17.783
9	17.82	17.75	17.87	17.84	17.69	18.03	17.87	18.09	17.92	17.79	17.867
10	18.06	17.99	18.11	18.10	18.00	18.19	18.11	18.30	18.14	17.85	18.085
11	18.15	18.09	18.16	18.21	18.15	18.22	18.04	18.04	18.17	18.00	18.123
12	18.15	17.97	18.16	18.18	18.13	18.18	18.04	18.09	18.25	18.03	18.118
14	18.10	17.90	18.09	18.03	17.98	18.00	17.98	17.73	18.15	18.00	18.004
Ave	18.019	17.889	18.019	18.020	17.942	18.08	17.949	18.001	17.988	17.916	17.982
$\Delta$	+ .037	- .093	+ .037	+ .038	- .040	+ .100	- .033	+ .019	- .006	- .066	
% $\Delta$	+ .21%	- .52%	+ .21%	+ .21%	- .22%	+ .56%	- .18%	+ .11%	- .03%	- .37%	

Table 6.

Lumens per Watt  
Inside Frosted Bulbs

Lamp No.	Syl.	EFL	West.	Champ	Duro	NBS	GE	Verd	Interl	Solar	Ave
1	18.08	17.92	18.04	17.87	18.01	18.15	18.08	17.83	17.81	18.15	17.994
2	17.66	17.54	17.64	17.56	17.64	17.78	17.67	17.38	17.55	17.55	17.597
4	17.74	17.66	17.75	17.67	17.77	17.77	17.76	17.56	17.63	17.37	17.668
5	17.65	17.48	17.59	17.50	17.66	17.66	17.73	17.59	17.48	17.30	17.564
7	17.93	17.93	17.96	17.93	17.87	18.14	18.05	17.82	17.99	17.93	17.955
8	17.83	17.66	17.71	17.73	17.68	17.80	17.79	17.57	17.84	17.53	17.714
9	17.87	18.14	17.89	17.81	17.86	17.88	17.76	17.53	17.79	17.42	17.795
10	18.02	17.92	18.03	18.09	17.11	17.97	17.97	17.62	18.03	17.90	17.966
Ave	17.848	17.781	17.826	17.770	17.825	17.894	17.851	17.612	17.765	17.644	17.782
$\Delta$	+ .066	- .001	+ .044	- .012	+ .043	+ .112	+ .069	- .170	- .017	- .138	
% $\Delta$	+ .37%	- .006%	+ .25%	- .07%	+ .24%	+ .63%	+ .39%	- .96%	- .10%	- .78%	

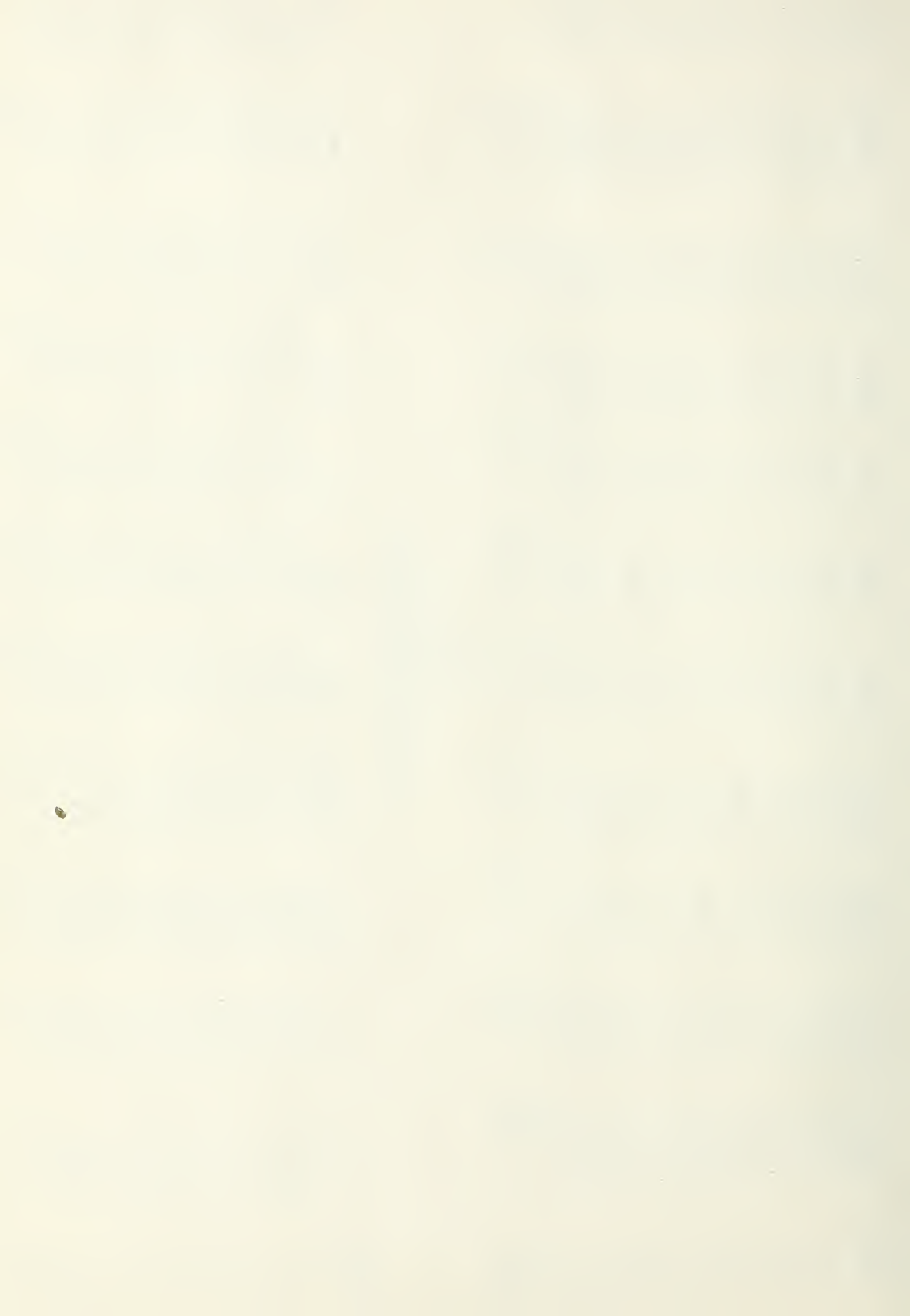


Figure 1  
Lumens  
Clear Bulb Lamps

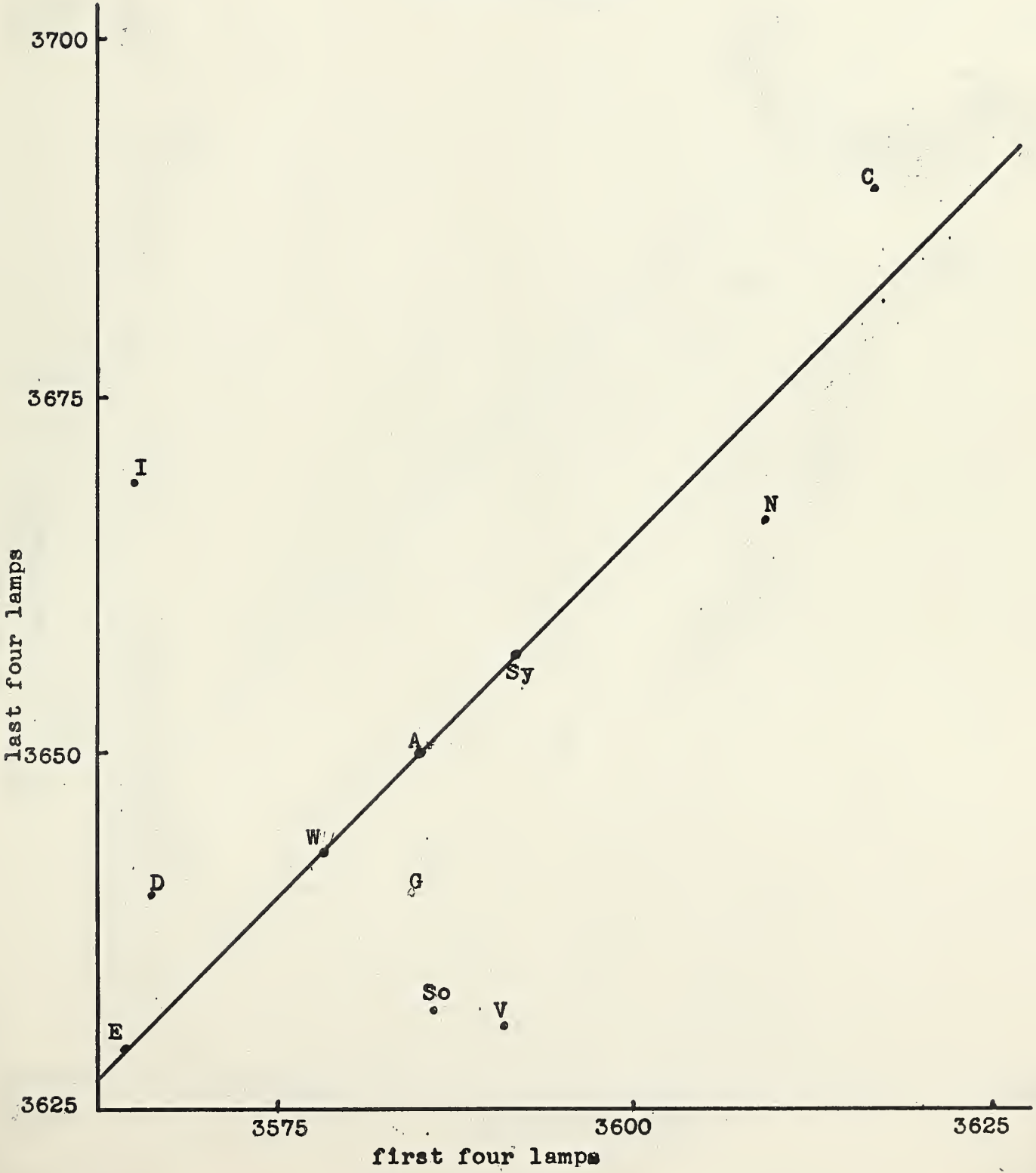






Figure 2

Lumens

Inside Frosted Bulb Lamps

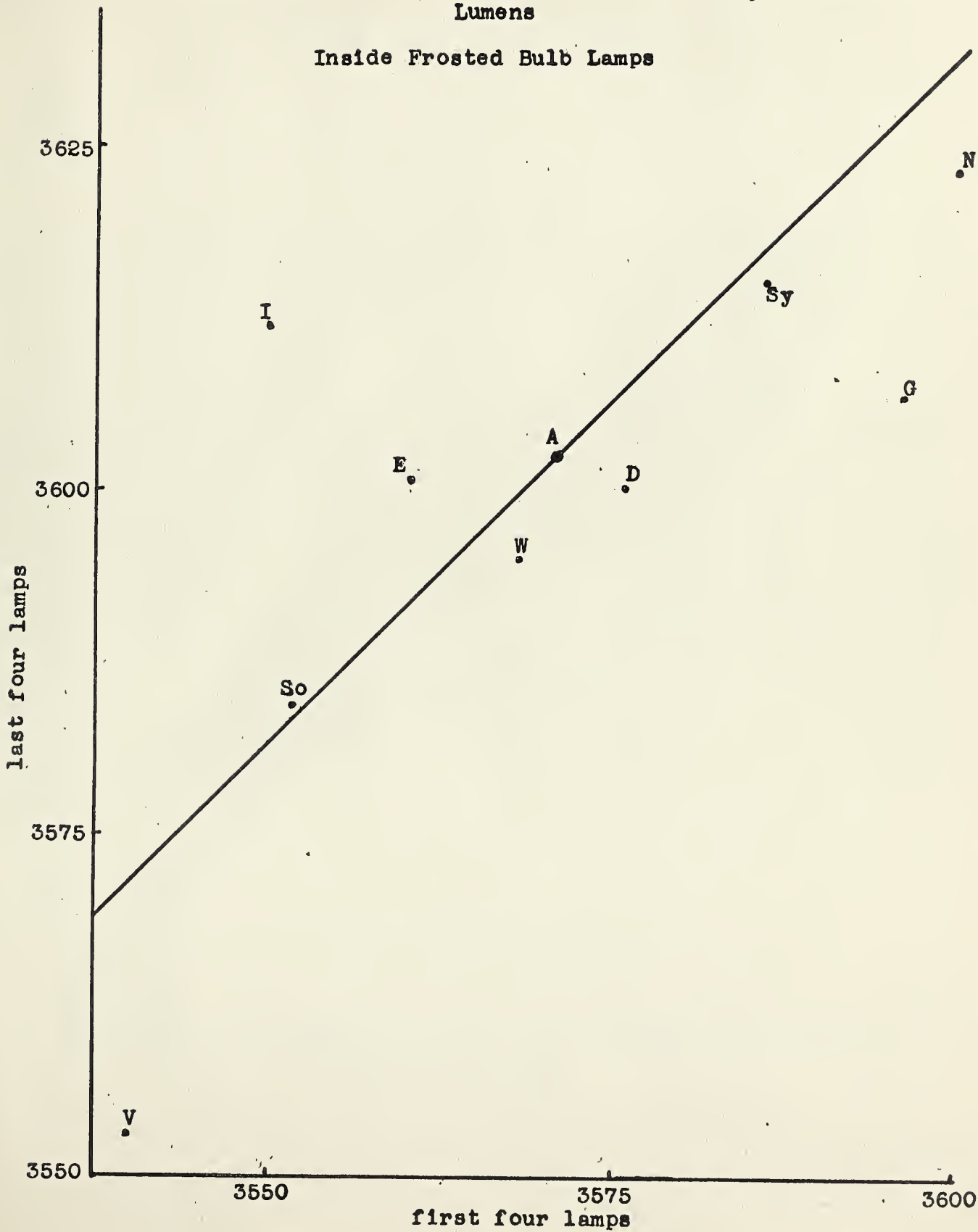




Figure 3  
Amperes  
Clear Bulb Lamps

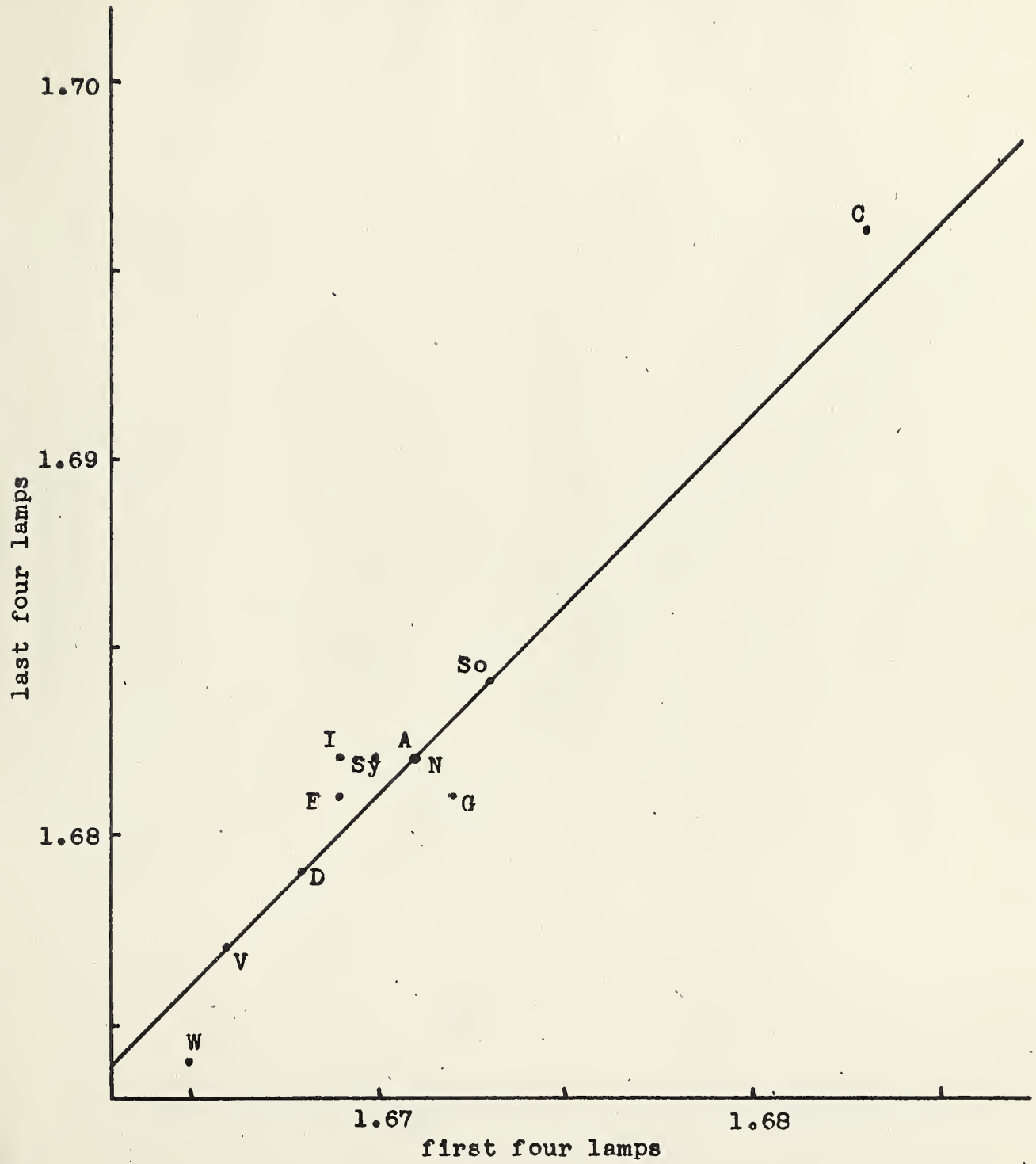




Figure 4  
Amperes  
Inside Frosted Bulb Lamps

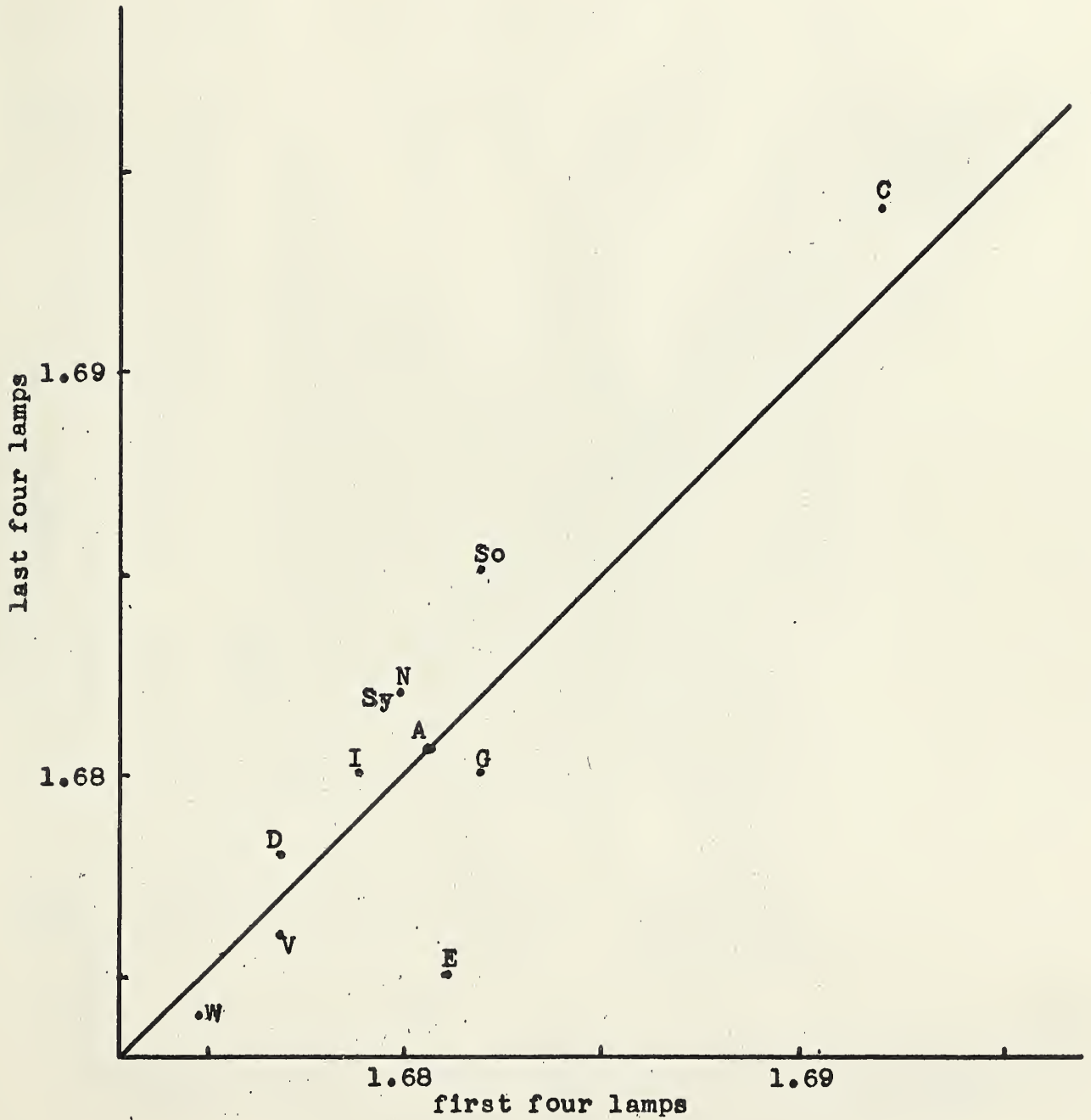






Figure 5  
Lumens per Watt  
Clear bulb Lamps

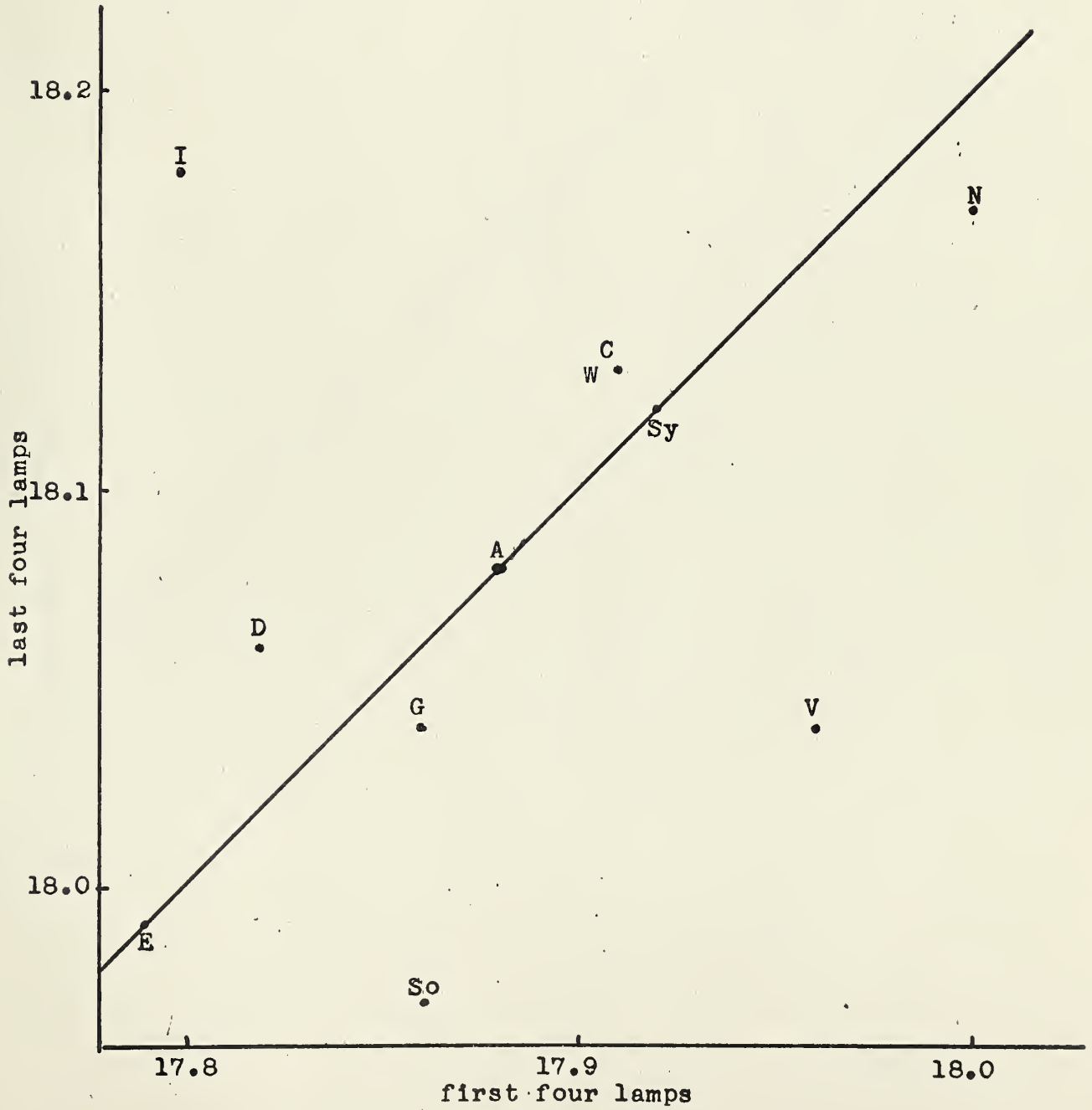
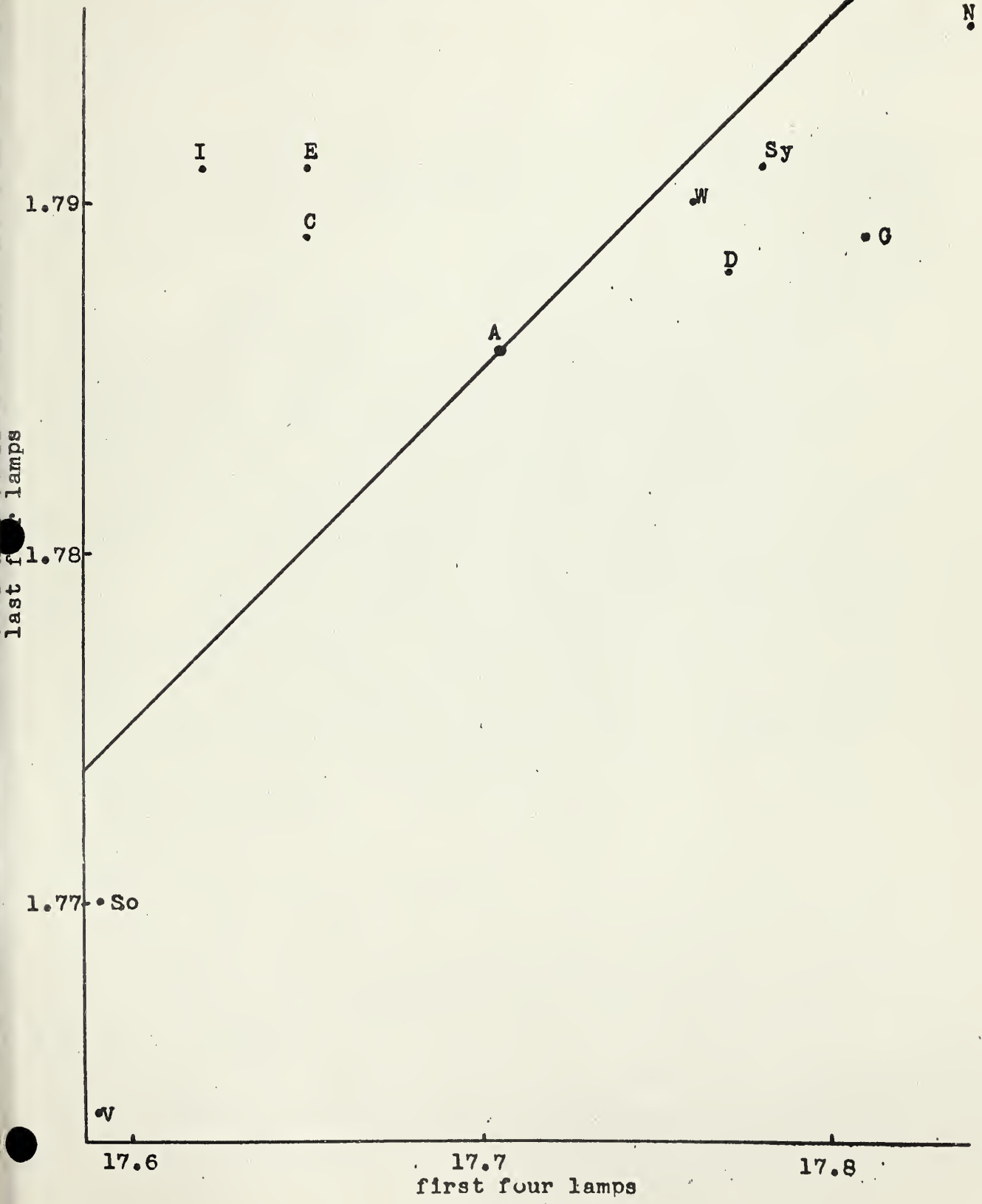




Figure 6

Lumens per Watt  
Inside Frosted Bulb Lamps





U.S. DEPARTMENT OF COMMERCE

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NATIONAL BUREAU OF STANDARDS

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**METROLOGY.** Photometry and Colorimetry. Refractometry. Photographic Research. Length. Engineering Metrology. Mass and Scale. Volumetry and Densimetry.

**HEAT.** Temperature Physics. Heat Measurements, Cryogenic Physics. Rheology. Molecular Kinetics. Free Radicals Research. Equation of State. Statistical Physics. Molecular Spectroscopy.

**RADIATION PHYSICS.** X-Ray. Radioactivity. Radiation Theory. High Energy Radiation. Radiological Equipment. Nucleonic Instrumentation. Neutron Physics.

**CHEMISTRY.** Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Molecular Structure and Properties of Gases. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

**MECHANICS.** Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Combustion Controls.

**ORGANIC AND FIBROUS MATERIALS.** Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Plastics. Dental Research.

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**ATOMIC PHYSICS.** Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics.

**INSTRUMENTATION.** Engineering Electronics. Electron Devices. Electronic Instrumentation. Mechanical Instruments. Basic Instrumentation.

Office of Weights and Measures.

### BOULDER, COLO.

**CRYOGENIC ENGINEERING.** Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Gas Liquefaction.

**IONOSPHERE RESEARCH AND PROPAGATION.** Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services.

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**RADIO STANDARDS.** High frequency Electrical Standards. Radio Broadcast Service. Radio and Microwave Materials. Atomic Frequency and Time Standards. Electronic Calibration Center. Millimeter-Wave Research. Microwave Circuit Standards.

**RADIO SYSTEMS.** High Frequency and Very High Frequency Research. Modulation Research. Antenna Research. Navigation Systems. Space Telecommunications.

**UPPER ATMOSPHERE AND SPACE PHYSICS.** Upper Atmosphere and Plasma Physics. Ionosphere and Exosphere Scatter. Airglow and Aurora. Ionospheric Radio Astronomy.

