

NATIONAL BUREAU OF STANDARDS REPORT

6976

on

Interlaboratory Intercomparisons

of

40-Watt T 12 White Fluorescent Lamps

by

Velma I. Burns

Photometry and Colorimetry Section
Metrology Division



U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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NBS PROJECT

October 1960

NBS REPORT

0201-20-02113

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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Interlaboratory Intercomparison
of
40-Watt T 12 White Fluorescent Lamps

Abstract

A group of twelve 40-watt T 12 white fluorescent lamps were measured by each of eight laboratories. The luminous flux, current, lamp volts, lamp watts, and the x and y chromaticity coordinates were measured. The line voltage was held constant at 236.0 volts across the lamps in series with a reactor having 439 ohms impedance and 7-8% power factor. 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 40-watt T 12 white fluorescent lamps made at the participating laboratories. The laboratories participating and the order of reading are as follows:

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

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. Measurements in each laboratory were obtained by holding the line voltage at 236.0 volts. A reference ballast adjusted to 439 ohms impedance and 7 to 8% power factor was used. The supply was connected to the marked pins.

II Results of Measurements

The results reported are given in tables 1 through 7. The averages reported for each lamp and for each laboratory are given. The difference between the average for each laboratory and the average for all laboratories for all lamps is also given in the tables.

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 T10 Cool-White Circline Lamps" and 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 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.

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Table 1

Luminous Flux in Lumens

Lamp No.	Syl	Champ	West	Duro	NBS	GE	ETL	Interl	Ave.
1	2720	2683	2691	2672	2687	2750	2640	2619	2682.8
2	2706	2668	2690	2670	2687	2769	2690	2628	2688.5
3	2687	2678	2685	2674	2620	2745	2625	2640	2669.2
4	2715	2680	2688	2690	2692	2773	2640	2660	2692.2
5	2712	2694	2711	2688	2687	2770	2645	2660	2695.9
6	2688	2690	2686	2668	2671	2741	2675	2627	2680.8
7	2694	2715	2696	2694	2702	2768	2660	2649	2697.2
8	2696	2663	2699	2678	2671	2750	2625	2634	2677.0
9	2706	2692	2676	2694	2676	2749	2645	2631	2683.6
10	2703	2706	2716	2686	2692	2767	2615	2650	2691.9
11	2687	2676	2698	2673	2687	2765	2620	2652	2682.2
12	2682	2681	2698	2678	2687	2755	2625	2637	2680.4
Ave.	<u>2699.7</u>	<u>2685.5</u>	<u>2694.5</u>	<u>2680.4</u>	<u>2679.9</u>	<u>2758.5</u>	<u>2642.1</u>	<u>2640.6</u>	<u>2685.1</u>
Δ	+14.6	+ .4	+ 9.4	- 4.7	- 5.2	+73.4	-43.0	-44.5	
% Δ	+ .54%	+ .015%	+ .35%	- .18%	- .19%	+2.73%	-1.60%	-1.66%	

Table 2

Lamp Current in Amperes

Lamp No.	Syl	Champ	West	Duro	NBS	GE	ETL	Interl	Ave.
1	.425	.429	.429	.428	.427	.429	.424	.427	.4272
2	.421	.427	.428	.427	.425	.426	.422	.425	.4251
3	.426	.429	.429	.428	.429	.428	.425	.428	.4278
4	.427	.431	.429	.430	.427	.431	.424	.427	.4282
5	.427	.429	.430	.428	.429	.429	.426	.429	.4284
6	.425	.430	.430	.428	.427	.430	.425	.428	.4279
7	.427	.431	.430	.428	.429	.430	.425	.428	.4285
8	.425	.427	.430	.426	.425	.428	.424	.425	.4262
9	.427	.430	.430	.427	.427	.431	.424	.428	.4280
10	.426	.429	.433	.429	.430	.431	.425	.429	.4290
11	.425	.426	.429	.427	.426	.427	.424	.428	.4265
12	.424	.429	.429	.428	.426	.428	.423	.430	.4271
Ave.	<u>.4254</u>	<u>.4289</u>	<u>.4297</u>	<u>.4278</u>	<u>.4272</u>	<u>.4290</u>	<u>.4242</u>	<u>.4277</u>	<u>.4275</u>
Δ	-.0021	+.0014	+.0022	+.0003	-.0003	+.0015	-.0033	+.0002	
% Δ	-.49%	+ .33%	+ .51%	+ .07%	- .07%	+ .35%	-.77%	+ .05%	

Table 3

Lamp Volts

Lamp No.	Syl	Champ	West	Duro	NBS	GE	ETL	Interl	Ave.
1	102.0	102.4	102.3	102.0	102	101.8	101.8	101.8	102.01
2	104.5	104.1	103.8	104.2	103	103.7	103.7	103.6	103.82
3	102.0	102.7	103.0	102.4	102	102.3	101.8	101.9	102.26
4	101.3	101.1	103.3	101.9	102	100.5	101.0	101.2	101.54
5	102.2	103.3	102.8	102.6	102	102.1	101.4	102.1	102.31
6	101.8	102.8	102.2	102.1	102	101.8	102.0	101.6	102.04
7	101.5	102.5	102.6	102.9	102	101.7	101.4	101.8	102.05
8	103.0	103.9	102.9	103.9	103	103.1	102.9	103.3	103.25
9	100.7	101.4	102.3	101.9	101	100.9	101.4	101.3	101.36
10	102.2	102.8	101.6	102.0	101	101.5	101.6	101.4	101.76
11	102.5	104.0	103.2	102.1	103	103.0	102.8	102.5	102.89
12	103.5	103.2	103.3	102.7	102	102.5	102.7	101.9	102.72
Ave.	<u>102.27</u>	<u>102.85</u>	<u>102.78</u>	<u>102.56</u>	<u>102.08</u>	<u>102.08</u>	<u>102.04</u>	<u>102.03</u>	<u>102.33</u>
Δ	-.06	+.52	+.45	+.23	-.25	-.25	-.29	-.30	
%Δ	-.06%	+.51%	+.44%	+.22%	-.24%	-.24%	-.28%	-.29%	

Table 4

Lamp Watts

Lamp No.	Syl	Champ	West	Duro	NBS	GE	ETL	Interl	Ave.
1	39.7	39.6	39.9	39.8	39.8	40.2	39.8	40.2	39.88
2	40.4	40.5	40.0	40.1	40.1	40.6	39.7	40.9	40.29
3	39.4	39.7	40.0	39.7	39.7	40.5	39.5	40.3	39.85
4	39.5	39.1	40.1	39.1	39.8	39.8	39.6	39.9	39.61
5	39.7	39.9	39.7	39.9	39.6	40.1	39.4	40.2	39.81
6	39.6	39.8	39.9	40.0	39.7	40.2	39.6	40.1	39.86
7	39.6	39.8	39.9	39.9	39.6	40.1	39.5	40.2	39.82
8	40.1	40.1	40.0	40.4	39.9	40.6	39.7	40.9	40.21
9	39.3	39.3	39.8	39.7	39.4	39.9	39.3	39.9	39.58
10	39.7	39.7	39.7	40.0	39.5	40.0	39.6	40.2	39.80
11	39.8	40.1	40.0	40.1	39.9	40.6	40.3	40.7	40.19
12	40.0	40.2	40.1	40.0	39.8	40.4	39.8	40.4	40.09
Ave.	<u>39.73</u>	<u>39.82</u>	<u>39.92</u>	<u>39.89</u>	<u>39.73</u>	<u>40.25</u>	<u>39.65</u>	<u>40.32</u>	<u>39.92</u>
Δ	-.19	-.10	.00	-.03	-.19	+.33	-.27	+.40	
%Δ	-.48%	-.25%	0%	-.08%	-.48%	+.83%	-.68%	+1.00%	

Table 5

Lumens per Watt

Lamp No.	Syl	Champ	West	Duro	NBS	GE	ETL	Interl	Ave.
1	68.5	67.8	67.4	67.1	67.5	68.4	66.3	65.1	67.26
2	67.0	65.9	67.2	66.6	67.0	68.2	67.8	64.3	66.75
3	68.2	67.5	67.1	67.4	66.0	67.8	66.5	65.5	67.00
4	68.7	68.5	67.0	68.8	67.6	69.7	66.7	66.7	67.96
5	68.3	67.5	68.3	67.4	67.9	69.1	67.2	66.2	67.74
6	67.9	67.6	67.3	66.7	67.3	68.2	67.5	65.5	67.25
7	68.0	68.2	67.6	67.5	68.2	69.0	67.3	65.9	67.71
8	67.2	66.4	67.5	66.3	66.9	67.7	66.2	64.4	66.58
9	68.9	68.5	67.2	67.9	67.9	68.9	67.3	65.9	67.81
10	68.1	68.2	68.4	67.2	68.2	69.2	66.1	65.9	67.66
11	67.5	66.7	67.4	66.7	67.3	68.1	65.0	65.2	66.74
12	67.1	66.7	67.3	67.0	67.5	68.2	66.0	65.3	66.89
Ave.	<u>67.95</u>	<u>67.46</u>	<u>67.48</u>	<u>67.22</u>	<u>67.44</u>	<u>68.54</u>	<u>66.66</u>	<u>65.49</u>	<u>67.28</u>
Δ	+ .67	+ .18	+ .20	- .06	+ .16	+ 1.26	- .62	- 1.79	
% Δ	+ 1.00%	+ .27%	+ .30%	- .09%	+ .24%	+ 1.87%	- .92%	- 2.66%	

Table 6

x Coordinate

Lamp No.	Syl	Champ	West	Duro	NBS	GE	ETL	Interl	Ave.
1	.409	.408	.411	.409	.410	.4117	.411	.411	.4101
2	.409	.408	.411	.410	.409	.4110	.411	.411	.4100
3	.409	.406	.411	.409	.409	.4106	.410	.411	.4094
4	.409	.408	.412	.410	.409	.4109	.410	.411	.4100
5	.409	.408	.411	.410	.409	.4105	.409	.412	.4098
6	.409	.408	.411	.410	.409	.4115	.411	.411	.4101
7	.410	.408	.412	.410	.408	.4111	.410	.411	.4100
8	.410	.408	.412	.410	.410	.4105	.410	.411	.4102
9	.410	.408	.412	.410	.409	.4115	.411	.410	.4102
10	.409	.408	.411	.410	.409	.4111	.410	.411	.4099
11	.409	.410	.412	.411	.409	.4108	.410	.412	.4105
12	.410	.408	.412	.410	.409	.4111	.410	.411	.4101
Ave.	<u>.4093</u>	<u>.4080</u>	<u>.4115</u>	<u>.4099</u>	<u>.4091</u>	<u>.4110</u>	<u>.4102</u>	<u>.4111</u>	<u>.4100</u>
Δ	- .0007	- .0020	+ .0015	- .0001	- .0009	+ .0010	+ .0002	+ .0011	

Table 7

y Coordinate

Lamp No.	Syl	Champ	West	Duro	NBS	GE	ETL	Interl	Ave.
1	.397	.401	.401	.399	.398	.3982	.399	.400	.3992
2	.398	.403	.400	.401	.396	.3975	.399	.399	.3992
3	.396	.402	.400	.399	.398	.3976	.398	.400	.3988
4	.397	.400	.400	.401	.398	.3980	.398	.400	.3990
5	.396	.399	.399	.399	.398	.3976	.398	.399	.3982
6	.398	.401	.400	.401	.398	.3992	.399	.401	.3996
7	.397	.401	.400	.401	.397	.3985	.399	.401	.3993
8	.398	.402	.400	.399	.399	.3986	.399	.400	.3994
9	.398	.402	.400	.400	.398	.3988	.399	.401	.3996
10	.398	.401	.399	.400	.398	.3982	.398	.400	.3990
11	.397	.401	.400	.401	.399	.3989	.400	.401	.3997
12	.400	.403	.400	.402	.398	.3987	.398	.401	.4001
Ave.	<u>.3975</u>	<u>.4013</u>	<u>.3999</u>	<u>.4002</u>	<u>.3979</u>	<u>.3983</u>	<u>.3987</u>	<u>.4002</u>	<u>.3992</u>
Δ	-.0017	+.0021	+.0007	+.0010	-.0013	-.0009	-.0005	+.0010	

Figure 1

Lumens

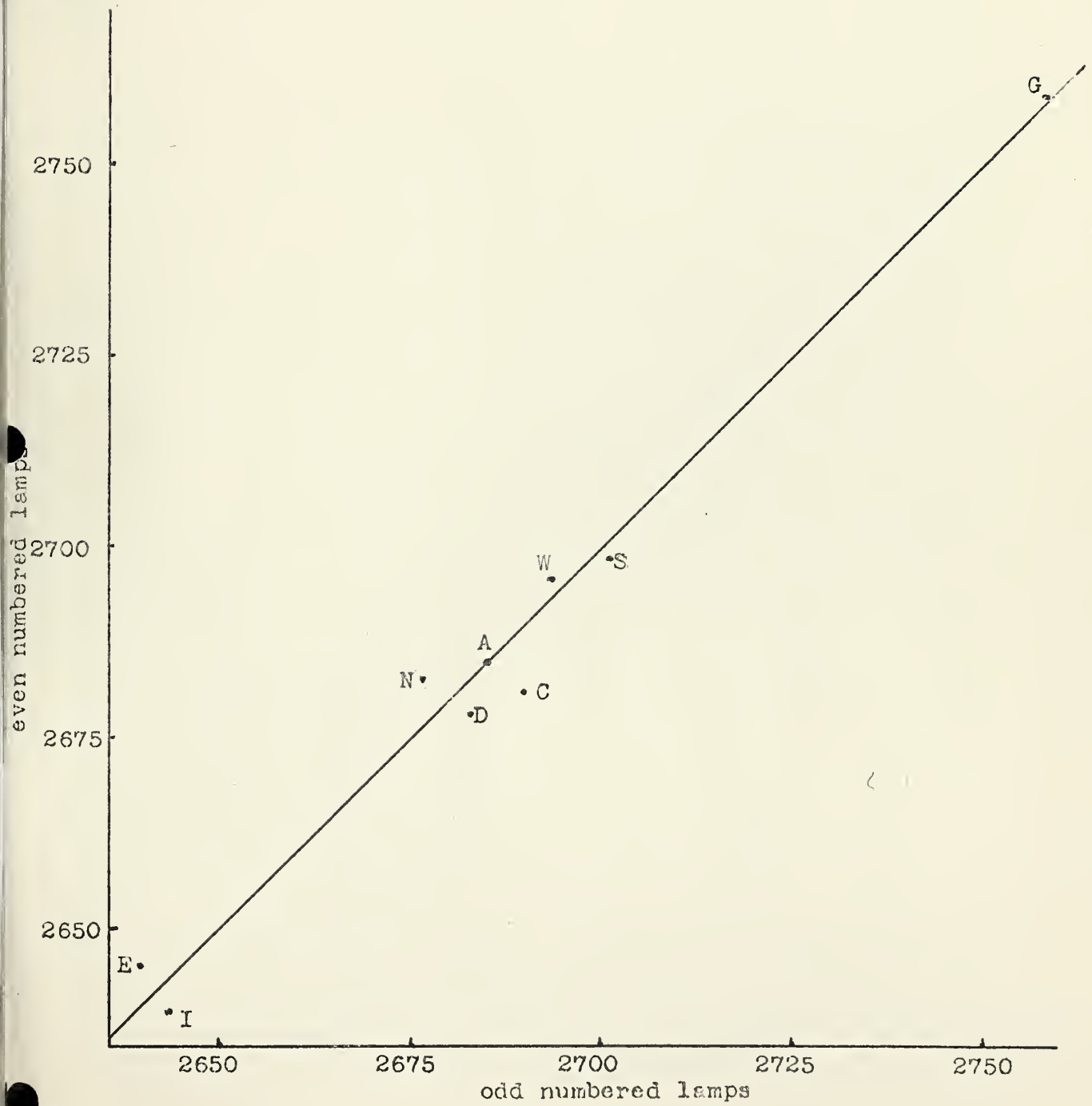


Figure 2

Amperes

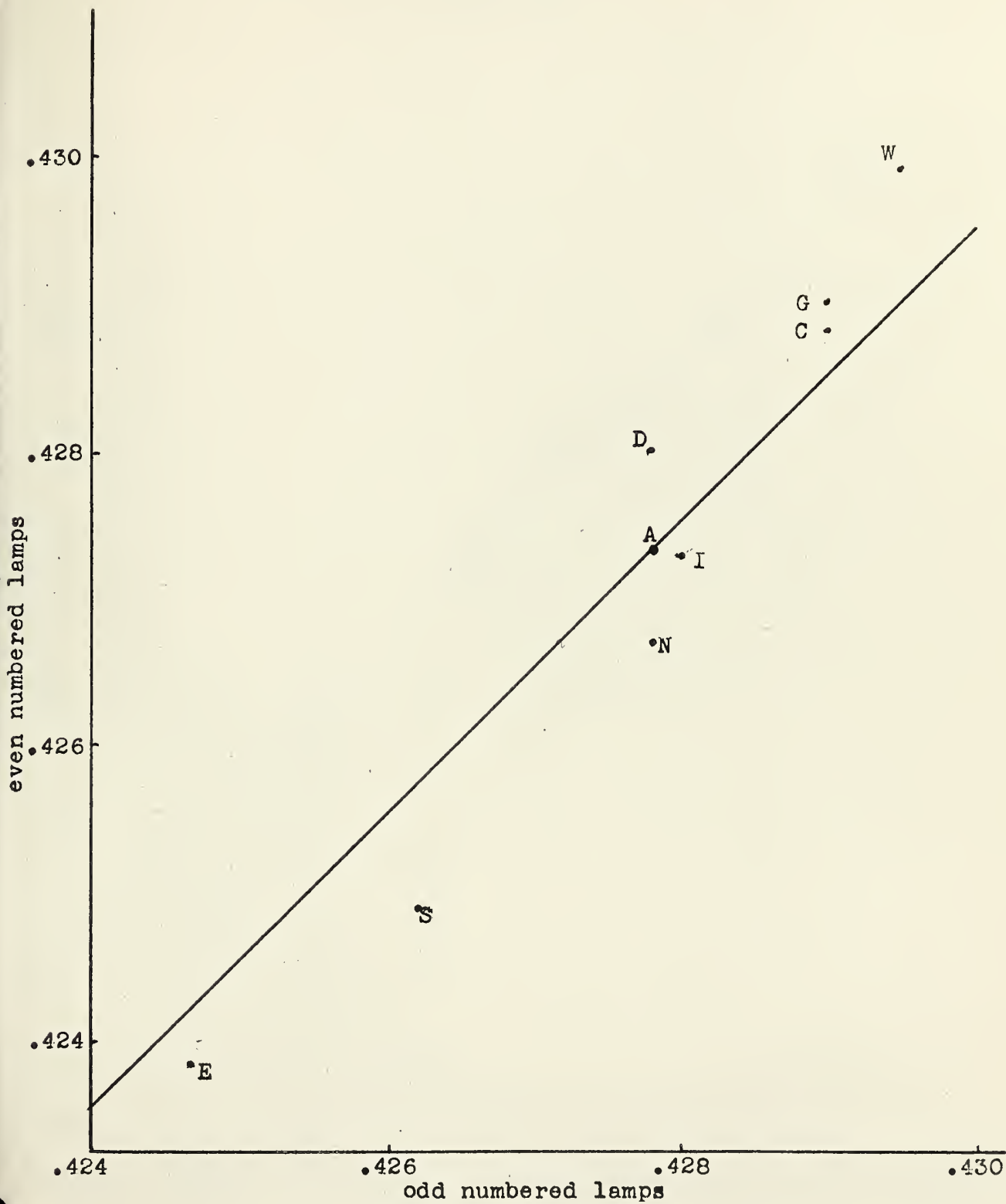


Figure 3
Lamp Volts

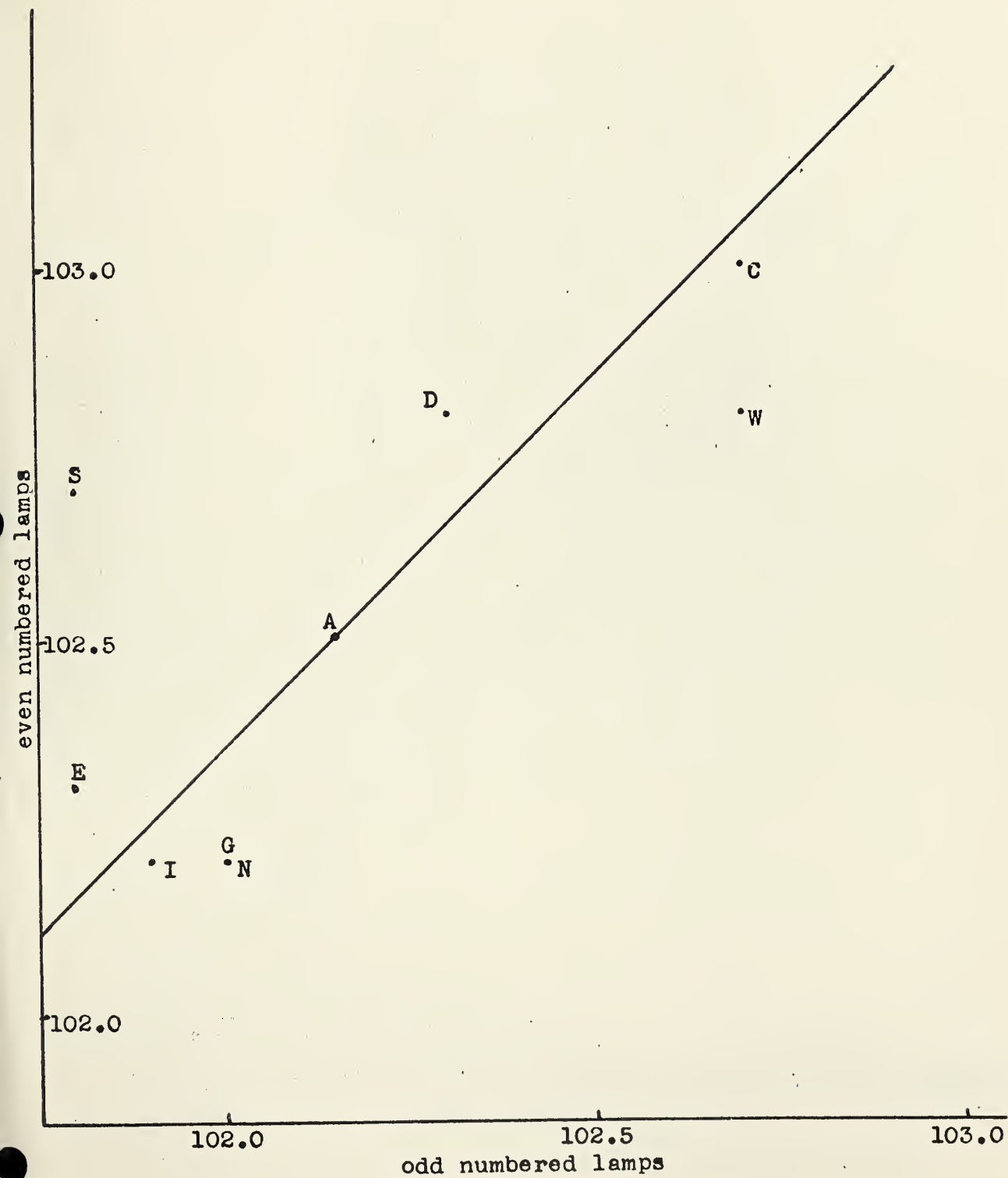


Figure 4
Lamp Watts

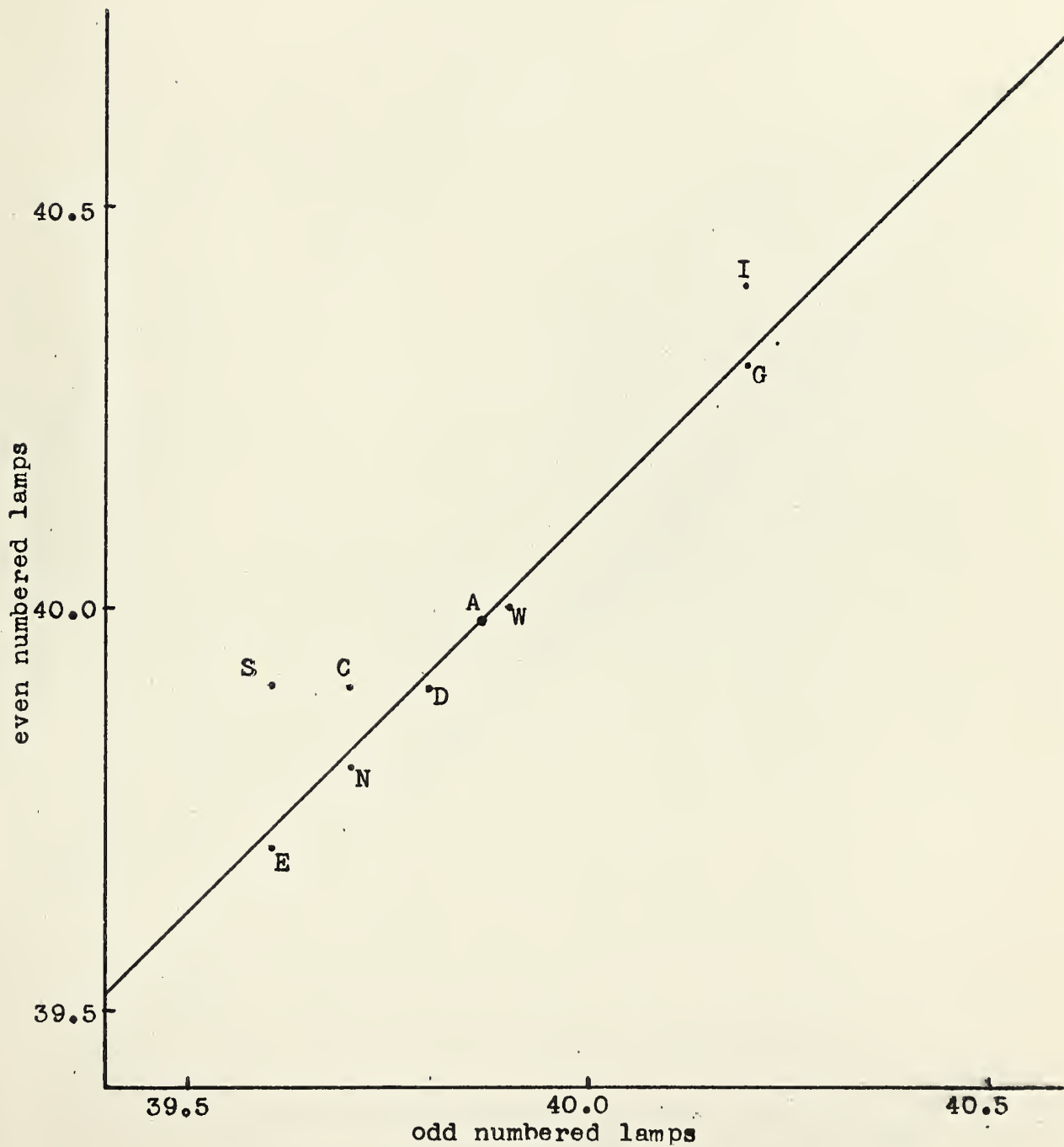


Figure 5
Lumens per Watt

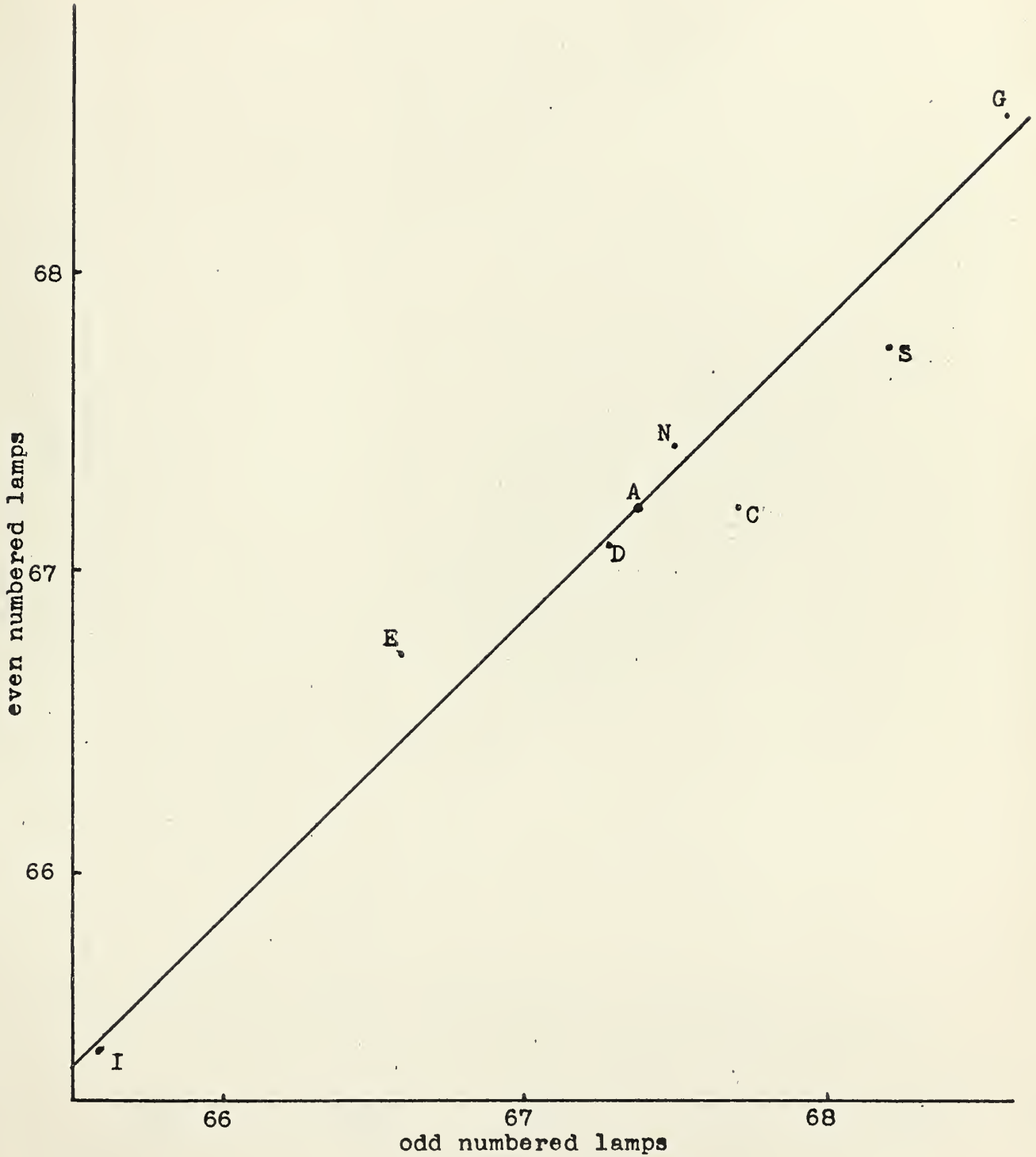


Figure 6
x Coordinate

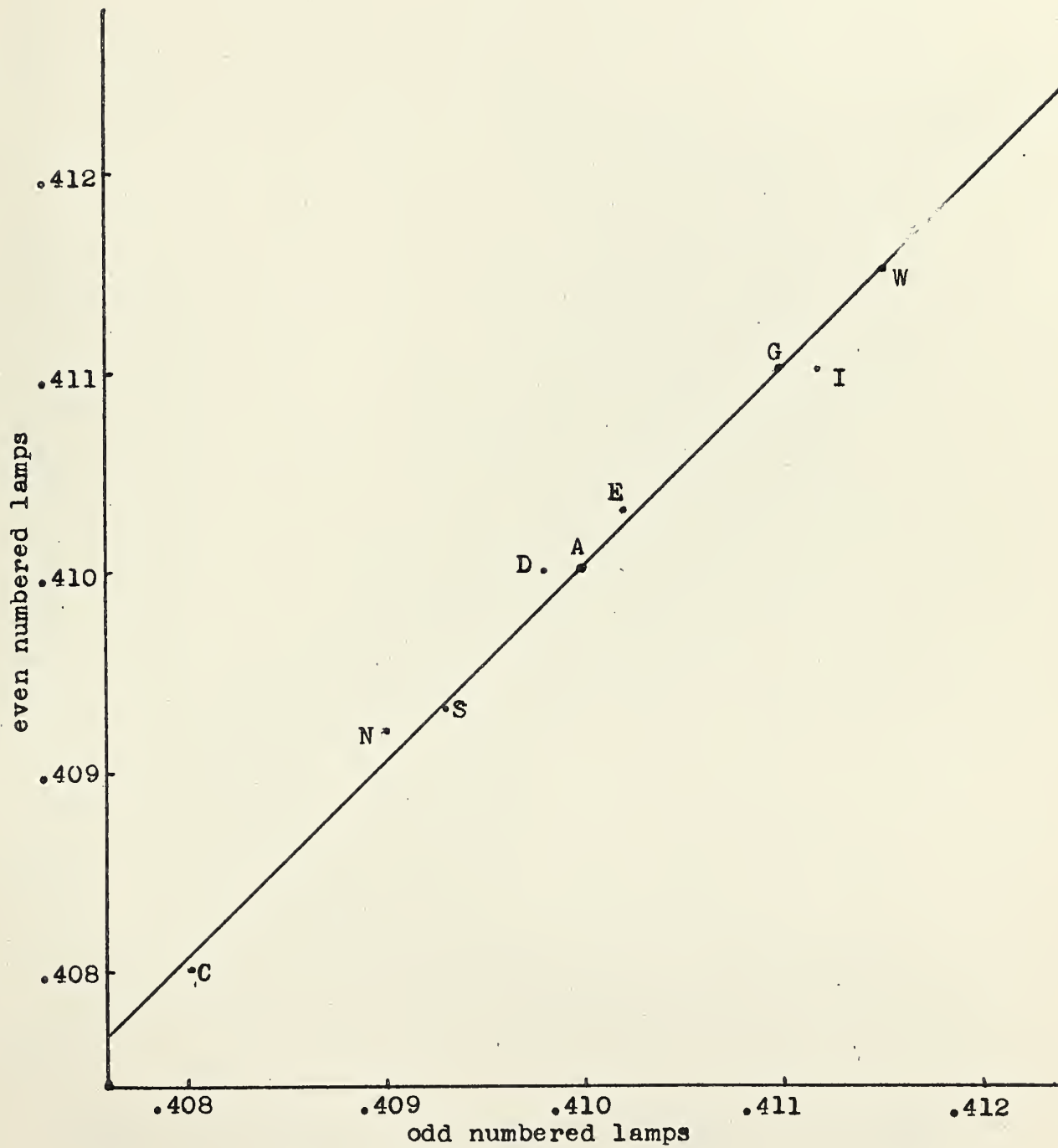


Figure 7
y Coordinate

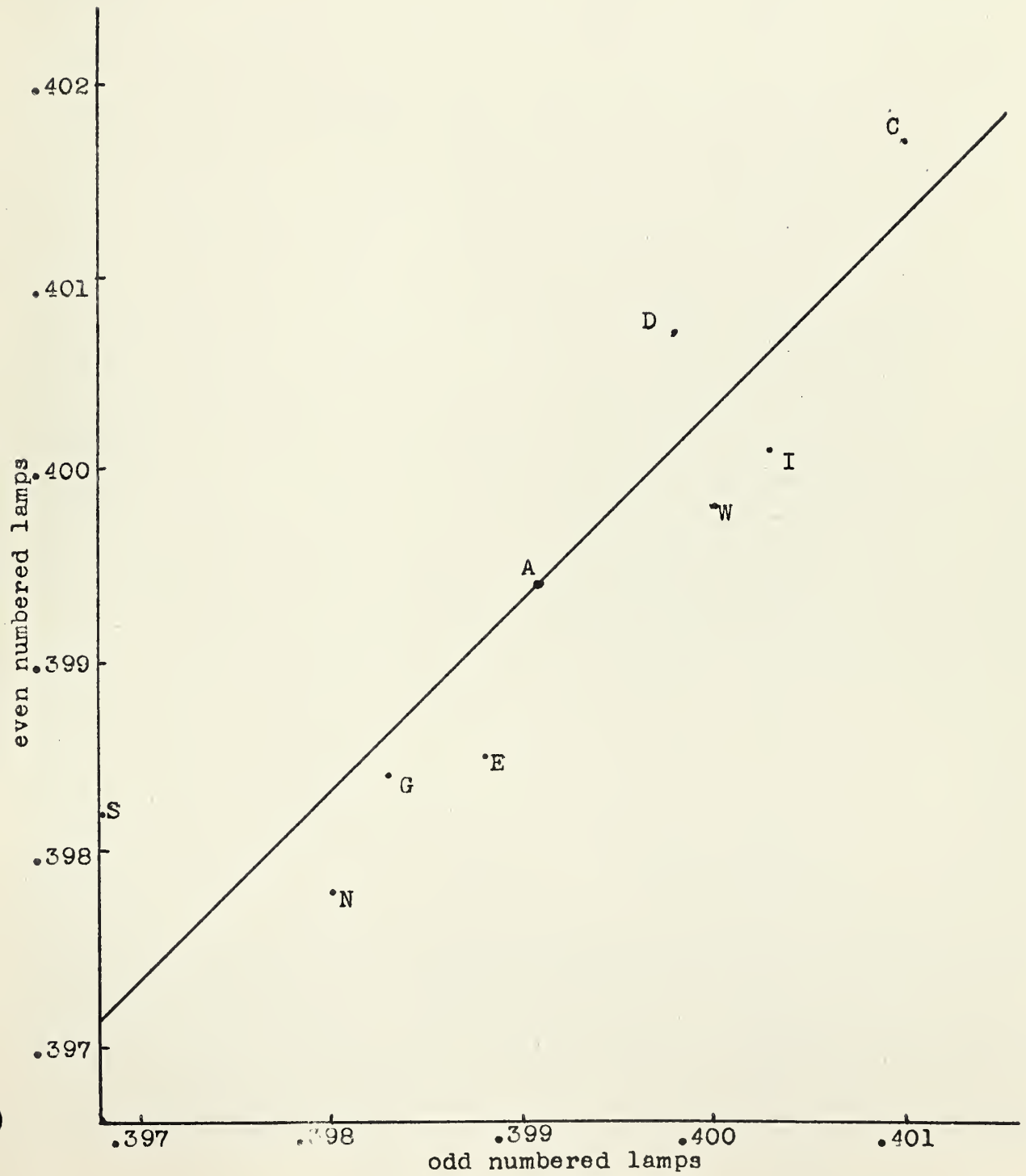
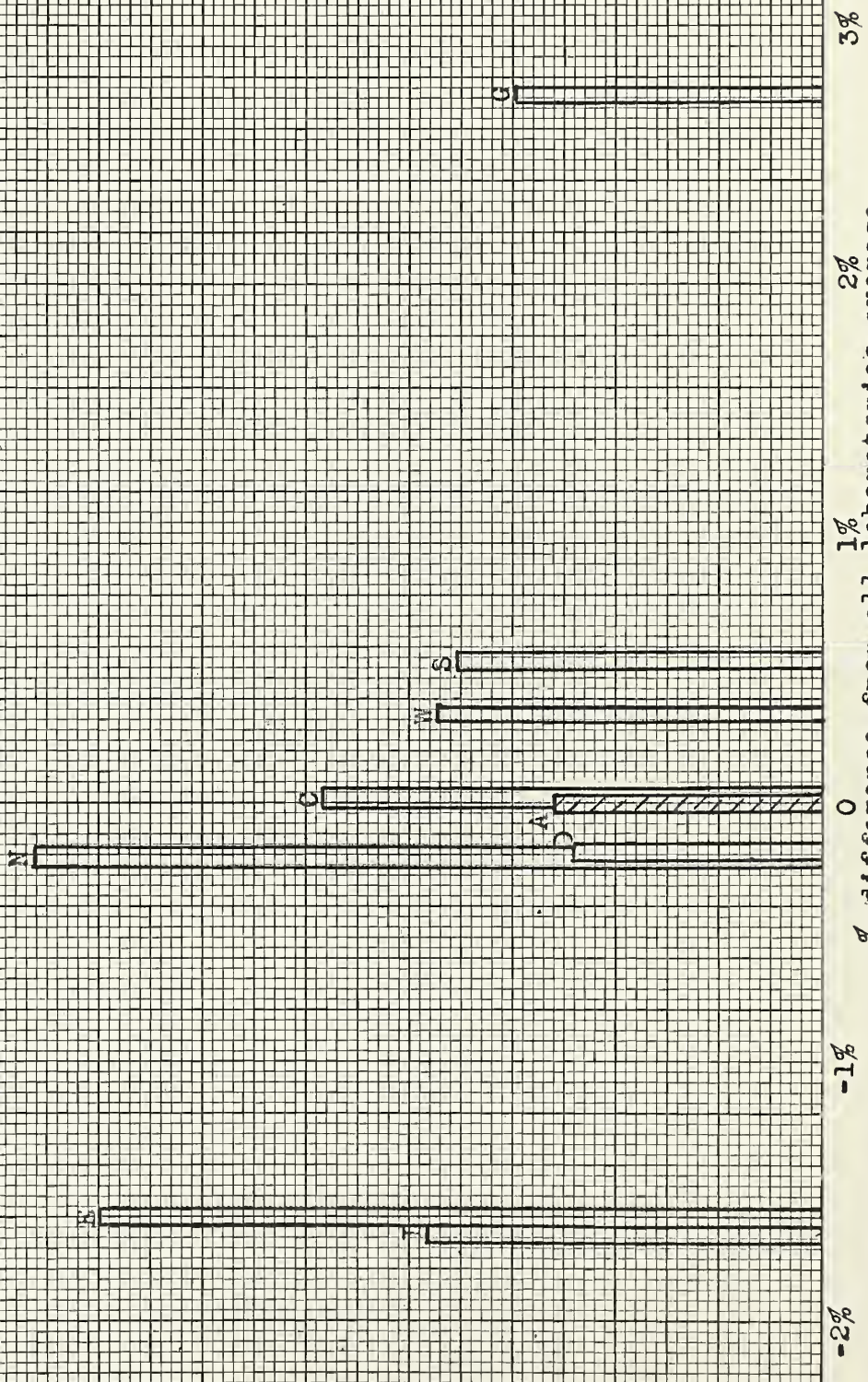


Figure 8

lumens

range of individual readings



% difference from all laboratories average

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U.S. DEPARTMENT OF COMMERCE

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THE NATIONAL BUREAU OF STANDARDS

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

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