4-26-1970

The simultans test vs. the near cylinder test

Russell Guisti
Pacific University

Duane Kaneshiro
Pacific University

William Turk
Pacific University

The simultans test vs. the near cylinder test

Abstract
The simultans test vs. the near cylinder test

Degree Type
Thesis

Degree Name
Master of Science in Vision Science

Committee Chair

Subject Categories
Optometry

TITLE: THE SIMULTANS TEST VS.
THE NEAR CYLINDER TEST

AUTHORS: RUSSELL GUISTI
DUANE KANESHIRO
WILLIAM TURK

DATE: APRIL 26, 1970

Submitted in Partial Fulfillment of the Requirement for the Degree Doctor of Optometry.

Approved ______________________________

____

THE SIMULTANS TEST

VS.

THE NEAR CYLINDER TEST

Submitted to the faculty of the College of Optometry, Pacific University, in partial fulfillment of the requirements for the degree Doctor of Optometry by Russell Guisti, Duane Kaneshiro, and William Turk.

April 26, 1970

TABLE OF CONTENTS

PURPOSE

The purpose of this thesis was to determine the clinical significance of, and the correlation between the Near Cylinder and the Simultan Test methods of measuring cylinder correction power and axis.

Since time is a critical factor in optometric testing procedures, and often limits the number of tests performed, for the above two mentioned methods which were investigated, a record of the time for each was made so that a determination of which was the quickest to use was obtained.

HISTORY

The Near Cylinder Test was developed by Dr. C.B. Pratt in 1937, as a result of his emphasis on near point refraction techniques. This was a technique similar to the Four-ball Cylinder Test at far.

An important consideration in the Near Cylinder Method is that in rocking the axis from its original position, as determined by the rule of 30, the total deviation for the cylinder axis rock in either direction should not exceed 22 1/2° before reversal is reported. This limit is due to the Sine Squared Law, governing cylindrical effectivity.

The Simultan Test device was invented by W.J. Biessels, manufactured by Carl Zeiss Co., and placed on the market in 1967. Essentially it is based upon the Jackson Cross-Cylinder Technique; the difference between the two is that the Simultans allows the patient a simultaneous view of the cross-cylinder images, whereas the Jackson Cross-Cylinder presents successive viewing of the images.

The Simultans device utilized lenses, prisms, and half-silvered mirrors to produce a separation of the doubled images equal to approximately 2/3 . (See Appendix for the optical basis.) As with the Pratt Near Cylinder Method, this is a monocular astigmatic test, but also can be used to determine the best spherical correction, at distance.

TESTING PROCEDURES

Testing Procedures for the Simultan Test:

I. Target: black O, outer diameter 22.5mm, inner diameter 11.3mm, illuminated with A.O. Projector light with no slide at 20'.

II. Room illumination: approximately 10-ft. candles.

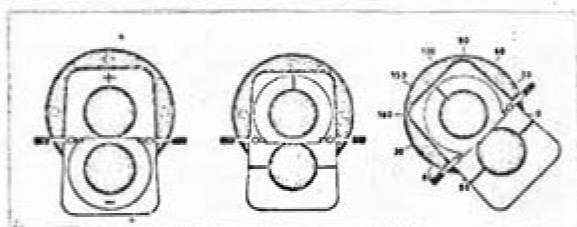
III. Lenses in phoroptor to begin with: none.

IV. Phoroptor used: B & L Green's Refractor; 20mm vertex distance.

V. Examiner: Duane Kaneshiro

VI. Room: #A-3, Pacific University College of Optometry.

VII. Instructions: (to be done monocularly)



Figures 1, 2, and 3

1. "Would you place your forehead firmly against the instrument?"

2. "What do you see on the screen?"

3. "While keeping your forehead firmly against the instrument, move your head just slightly down until you see 2 circles, one being darker and clearer than the other."

(The examiner sets the Simultans lenses for the gross sphere power, orienting the device at the 90-180° axis, while setting the phoroptor cylinder axis at 90°. Sphere power is changed until equality is obtained, then +.25D is added.) (fig. 1)

4. (The examiner switches the Simultans lenses to the cross-cylinder position, (fig. 2), and rotates the Simultans device to the 45° or 135° position, (fig. 3), while leaving the phoroptor cylinder axis at 90°.)

"Which of the circles is clearer and less distorted?"

If the top left hand image is sharper, the cylinder should be rotated to the left until the lower image becomes the sharper one. Axis is determined when balance in sharpness is obtained.

5. The Simultans device then is rotated back to coincide with the phoroptor cylinder axis (e.g. fig. 2).

"Which target is better?"

Minus cylinder power is added until equality of targets is achieved. The spherical equivalent is maintained.

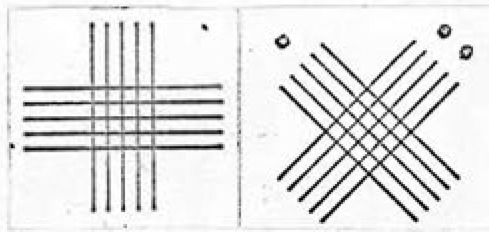
Testing Procedures for the Near Cylinder Test:

1. Targets: 20/20 Reduced Snellen Card at 16", vertical-horizontal cross-grid lines on card for testing at 16", and oblique cross-grid lines with dots on card for testing at 16". These are illuminated with direct illumination from B & L overhead lamp at 3 feet from target.

II. Room illumination: approximately 10-ft. candles.

III, IV, V, and VI: same as given for Simultan Test.

VII. Instructions: (to be done monocularly)



Figures 4 and 5

1. Place the 20/20 Reduced Snellen Card at 16".

"Can you read the bottom row of letters?"

(The examiner changes the sphere power until the 20/20 letters can be distinguished.

"Say 'now,' when you can no longer make out any letters in the bottom line."

(The examiner adds plus sphere until the 20/20 letters blur out.)

2. "And now, tell me when you can first make out all the letters of the bottom line."

(The examiner reduces plus sphere from the 20/20 blur out until the letters are first distinguished.)

3. The vertical-horizontal cross-grid card is then displayed at 16". (fig. 4)

"Which lines are the darkest and clearest, the up and down, or the across?"

(The examiner, using the rule of 30, sets the cylinder axis.)

4. (The examiner then adds minus cylinder power in .50D steps, maintaining the spherical equivalent.)

"Which lines are darkest and clearest now?"

(The examiner adds minus cylinder until he gets a reversal of the clearest lines; he then reduces the cylinder to equality, leaving it on the minus side if equality involves a .12D cylinder interval.)

5. The oblique cross-grid card is then displayed at 16". (fig. 5)

"Which lines are the darkest and clearest here, the lines with one dot, or those with 2 dots?"

(The examiner then rotates the axis toward the least clear lines until the subject reports a reversal, thus the axis is rocked, and refined until equality is obtained.)

Note: If the axis is changed more than 22.5° from the original position, and no reversal occurs, then the examiner must return to the original axis, add -.25D more cylinder power and attempt to re-refine the axis. However, this is not to be taken as the final power of the cylinder, rather the original cylinder power to equality is rechecked and this is recorded as the subjects actual cylinder correction.

Also, it may be necessary to reverse the order of the targets used, for instance, use the oblique cross-grid for power determination, then the vertical-horizontal cross-grid for axis refinement.

VARIABLES

I. The following variables were kept constant for all patients:

1. Instructions
2. Sequence
3. Targets
4. Refractor
5. Illumination
6. Examination Room
7. Testing distance
8. Examiner
9. Patients all college males

II. Uncompensated Variables:

1. Refractive error of patient
2. Preset conditions
3. Time of day

ANALYSIS OF DATA

Correlation Coefficients:

Near Cylinder vs. Simultans - cylinder power: .91
Near Cylinder vs. Simultans - axis: .98
Near Cylinder vs. Simultans - time of testing: .59

Standard Deviations:

Near Cylinder vs. Simultans - cylinder power: .16D
Near Cylinder vs. Simultans - axis: 8.3°
Near Cylinder vs. Simultans - time of testing: 58 sec.

Means, or Average changes per eye:

Near Cylinder vs. Simultans - cylinder power: .02D
Near Cylinder vs. Simultans - axis: 1.6°
Near Cylinder vs. Simultans - time of testing: 14 sec.

Graph #Ia:

When the axis discrepencies between cylindrical components obtained on the Simultans and the Near Cylinder are compared, it becomes apparent that the cylindrical axis are most frequently within 3° of each other when the power differences between each method are within + or -.50D of each other.

In addition, there is a general pattern of decreasing percentage of axis variation between the two methods for increasing differences greater than 3°.

Concurrently there is a decreasing frequency of cylinder power variation with the occurrance of power differences between the two methods.

Graph IIa:

This is a more detailed breakdown of Graph Ia, considering the variation of cylinder axis as a function of the difference in cylinder power obtained between the 2 methods.

Graphs I, II, and III:

The data, as shown here, is plotted according to differences between the two methods; each graph contains a measure of one standard deviation as indicated by a solid bar along the abscissa. The data representation of the power deviation is well centered around the zero value, and is distributed so that there seems to be a slight tendency for the Near Cylinder to have higher cylinder power measures as compared to the Simultans.

The second graph, deviation of cylinder axis, is a widespread distribution, which again shows a greater deviation toward the Near Cylinder axis measure. This simply means the Near Cylinder, over the sample distribution, more frequently measured a higher value, between 0° and 180° than did the Simultans method.

The third graph, the time deviation, is weighted more towards the Simultans method. It is however, of a nature that the distribution is centered around the zero point, although somewhat skewed in the direction of plus, thus indicating less actual testing time being needed on the Near Cylinder to determine cylinder power and axis for the majority of the eyes tested.

Graph IV:

This scattergram is a graphical representation of the results obtained for each individual eye, whereas, the preceding graphs are cumulative representations of the data.

Observation of the distribution of power differences reveals most of the individual samples tested fall in + or -.12D range. Conversely, the cylinder axis variation is a range of greater magnitude, generally within + or -6°.

Graph V:

This graph indicates that there tends to be greater obliquity of axis when using the Simultans instead of the Near Cylinder for cylinder powers obtained on the two methods which are within .12D. The obliquity tendency is greater for the Simultans Test when the axis variation is 9°-15° toward the oblique meridian.

The mode, however, is centered around 0° obliquity difference between the two techniques.

Graph VI:

For cylinder power differences between the 2 procedures of .25D or greater, there appears to be a random obliquity pattern between the two methods.

CONCLUSIONS AND SUMMARY

Although present literature indicates that the Simultans presents a simpler and easier means of testing astigmatic components monocularly than the presently employed procedures, it is the opinion of the authors of this paper that the Near Cylinder Method was not included in this generalization.

Some of the advantages and disadvantages of each procedure are listed below:

Simultans:

1. Special target required for testing, i.e. generally offices use projected targets (a projected Simultans target must be specially constructed and consequently becomes too expensive for general office use), whereby the Simultans target is a pasted black paper target of specified dimensions.
2. In order for the patient to see 2 separate targets, he must align his visual axis with the optical axis of the Simultans device. To accomplish this, most of the time, the patients have to posture themselves in such a manner that they are viewing the target below the optical center of the phoroptor lens. Oftentimes, repositioning becomes necessary during the course of the examination in order to maintain two separate images.
3. The clinicians found that after having encountered approx-

imately a 90° axis difference between the Simultans Test and the Near Cylinder Test for a number of eyes (which are not included in the data used for this study) that it was necessary for the test to be run under light fog to insure that the Interval of Sturm remain anterior to the retina.

4. Monocular diplopia (patients reported 4 images) was experienced by most patients with greater than 1.75D cylinder. This did not allow determination of cylindrical axis nor power for these individuals.

5. Patients oftentimes could not distinguish which of the targets was "clearest or less distorted." This resulted in longer testing and wider axis variation.

6. Limited in use to Green's refractor (consequently cylinder range limited to -2.50D) and A. O. Rx Master.

7. Due to optical requirements and target used, a visual acuity of at least 20/50 is required.

8. Cost is often prohibitive (approximately $130.00).

9. Patient is presented with two targets simultaneously which allows easier discrimination of the two targets.

10. For patients who respond to this device, the testing time is minimal because of less demand on memory.

Near Cylinder:

1. Individuals with small cylindrical magnitudes have problems discriminating which lines are darker. Therefore the

patient becomes confused between which lines are clearest and which lines are darkest.

2. The Near Cylinder Method can be used at varying distances at near depending upon the patient's visual demand.

3. There is no limitation of phoroptor cylinder power regardless of the magnitude of ocular astigmia being tested.

4. The cost factor for the Near Cylinder targets totals approximately $.30.

Although the Simultans represents a quick means of determining cylindrical components, patient positioning is a critical factor since oftentimes he is unable to separate the images when he looks through the optical center of the phoroptor lenses. The Near Cylinder Test however does not present a positioning problem of this order since the patient is able to look through the optical center of the lens.

The monocular diplopia encountered when using the Simultans device with patients having high degrees of stigmia could, according to Dr. Pratt, be overcome by starting the test with the ophthalmometer cylinder, retinoscopic cylinder, or clock dial cylinder in place.

The angular field subtended by each of the methods is significantly different. The Simultans subtends a retinal region corresponding to the fovea; the Near Cylinder however, subtends an angular region which extends out into the periphery of the retina.

The two methods produce obvious differences in cylinder axis. However the differences are not apparent in the correlation data statistics due to the fact that the correlation coefficient allows high correlation between 2 findings even though the actual absolute difference in the findings is large. For example the Standard Deviation of the difference in axis obtained by the two methods is approximately 8°, which represents a clinically significant deviation. The choice of which method prescribed from might depend upon the individual's occupational task requirements.

The authors of this paper are of the opinion that the Near Cylinder Method was faster, less confusing, and a more facile method of testing for a wider range of astigmatic correction than the Simultans.

BIBLIOGRAPHY

Adams, R.L.; Kadet, T.S.; White, D.M.
"A Comparative Study of the Four-Ball Cylinder Test, The Jackson Cross-Cylinder Test, and The Near Cylinder Test," Thesis for Doctor of Optometry, Optometry 515, May 28, 1965.

Better, R.S.
"Simultantest Study, The Optometric Weekly, 19-22, Jan. 22, 1970.

Biessels, W.J.
"The Cross-Cylinder Simultan Test," The Journal of the American Optometric Association, 38: #6, 473-476, June 1967.

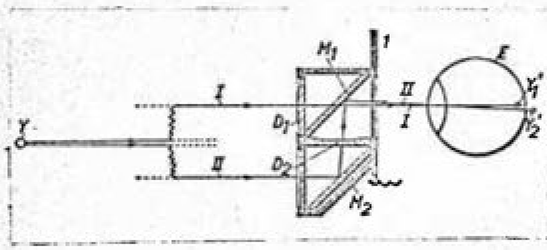
Edwards, A.L.
"Statistical Analysis," Ch. 5: 59, Ch. 6: 66-68, Holt, Rinehart and Winston, San Francisco, Feb., 1965.

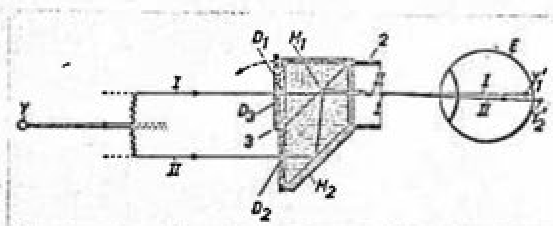
Pratt, C.B.
"Lecture in Optometry Theory V," Optometry 628, Pacific University College of Optometry, Jan. 16, 1970.

APPENDIX

SIMULTANS OPTICS

DIAGRAMS

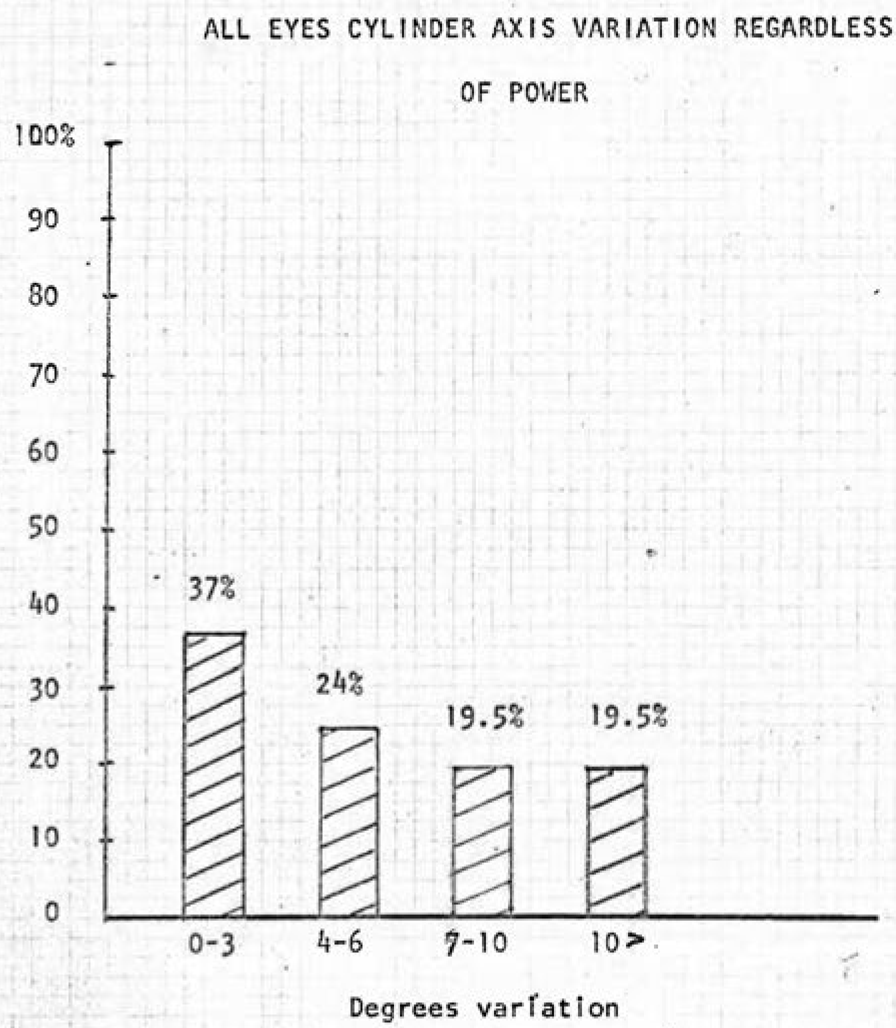




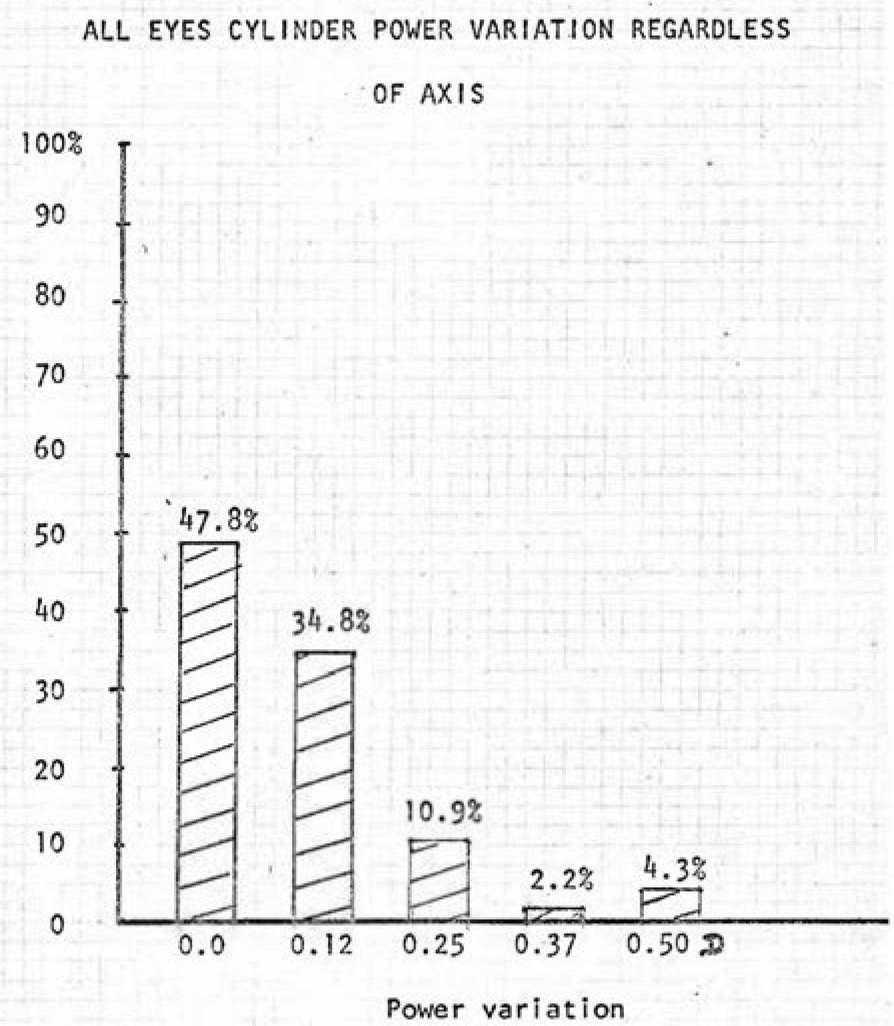
RAW DATA

Eye Number	Cylinder Power Simultans	Cylinder Power Near	Cylinder Axis Simultans	Cylinder Axis Near	Time Simultans	Time Near
1	-1.87	-1.62	95	98	2'6"	2'24"
2	- .62	- .62	95	90	1'15"	2'23"
3	- .12	- .37	18	15	2'7"	2'35"
4	- .12	- .12	167	172	1'20"	1'18"
5	- .37	- .50	87	79	1'32"	1'5"
6	- .87	- .75	100	100	53"	58"
7	- .62	- .62	105	95	1'5"	51"
8	- .62	- .62	55	50	1'4"	1'13"
9	- .75	- .75	10	180	2'11"	44"
10	- .25	- .25	45	45	59"	1'20"
11	- .37	- .87	35	15	2'48"	1'30"
12	- .75	-1.00	165	170	2'5"	59"
13	- .12	- .12	50	50	1'56"	1'16"
14	- .12	- .12	50	50	40"	49"
15	- .62	- .50	75	70	1'42"	2'5"
16	- .50	- .50	70	85	1'17"	49"
17	- .12	-0.00	70	---	1'37"	1'42"
18	- .37	- .25	15	5	1'35"	1'50"
19	- .25	- .25	90	78	1'45"	1'6"
20	- .62	- .50	90	95	1'46"	1'10"
21	- .62	- .62	100	100	1'2"	3'3"
22	- .37	- .25	90	87	3'	1'16"
23	- .50	- .50	22	16	2'19"	50"
24	- .75	- .50	161	165	2'30"	1'47"
25	- .37	- .50	180	180	1'27"	1'
26	- .50	- .50	30	15	1'5"	49"
27	- .37	- .12	58	60	1'8"	52"
28	- .50	- .37	95	107	2'	1'
29	- .62	- .25	90	100	1'50"	1'3"
30	-0.00	- .50	---	95	3'45"	53"
31	- .37	- .37	15	180	1'53"	1'38"
32	- .37	- .25	170	157	1'3"	1'7"
33	- .37	- .25	60	50	1'33"	1'34"
34	- .25	- .25	10	180	57"	56"
35	- .87	- .75	90	97	1'34"	1'16"
36	-1.50	-1.50	90	90	2'18"	3'15"
37	-0.00	-0.00	---	---	2'55"	2'45"
38	- .37	- .37	45	45	1'7"	1'44"
39	- .37	- .37	75	85	1'45"	1'39"
40	- .12	- .12	110	95	1'11"	54"
41	- .37	- .37	75	90	4'33"	1'14"
42	- .50	- .37	135	135	1'38"	1"
43	- .75	- .75	120	125	1'11"	1'39"
44	- .62	- .75	50	44	49"	1'1"
45	-1.00	- .87	80	85	52"	56"
46	- .75	- .62	75	78	40"	53"

GRAPH I a



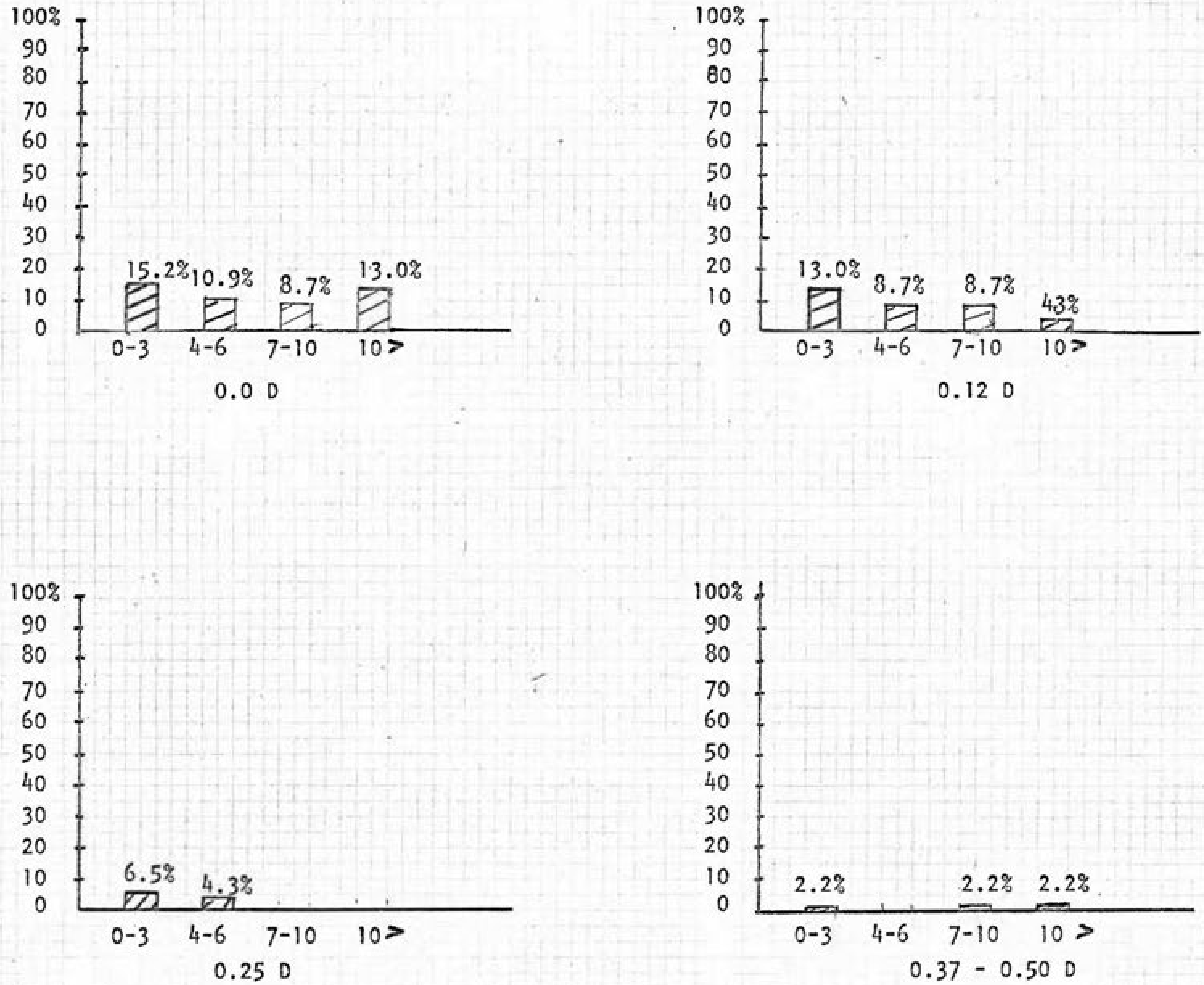
ALL EYES CYLINDER AXIS VARIATION REGARDLESS
OF POWER
100%
90
80
70
60
50
40
30
20
10
0
37%
24%
19.5%
19.5%
0-3
4-6
7-10
10 >
Degrees variation



ALL EYES CYLINDER POWER VARIATION REGARDLESS
OF AXIS
100%
90
80
70
60
50
40
30
20
10
0
47.8%
34.8%
10.9%
2.2%
4.3%
0.0
0.12
0.25
0.37
0.50 D
Power variation

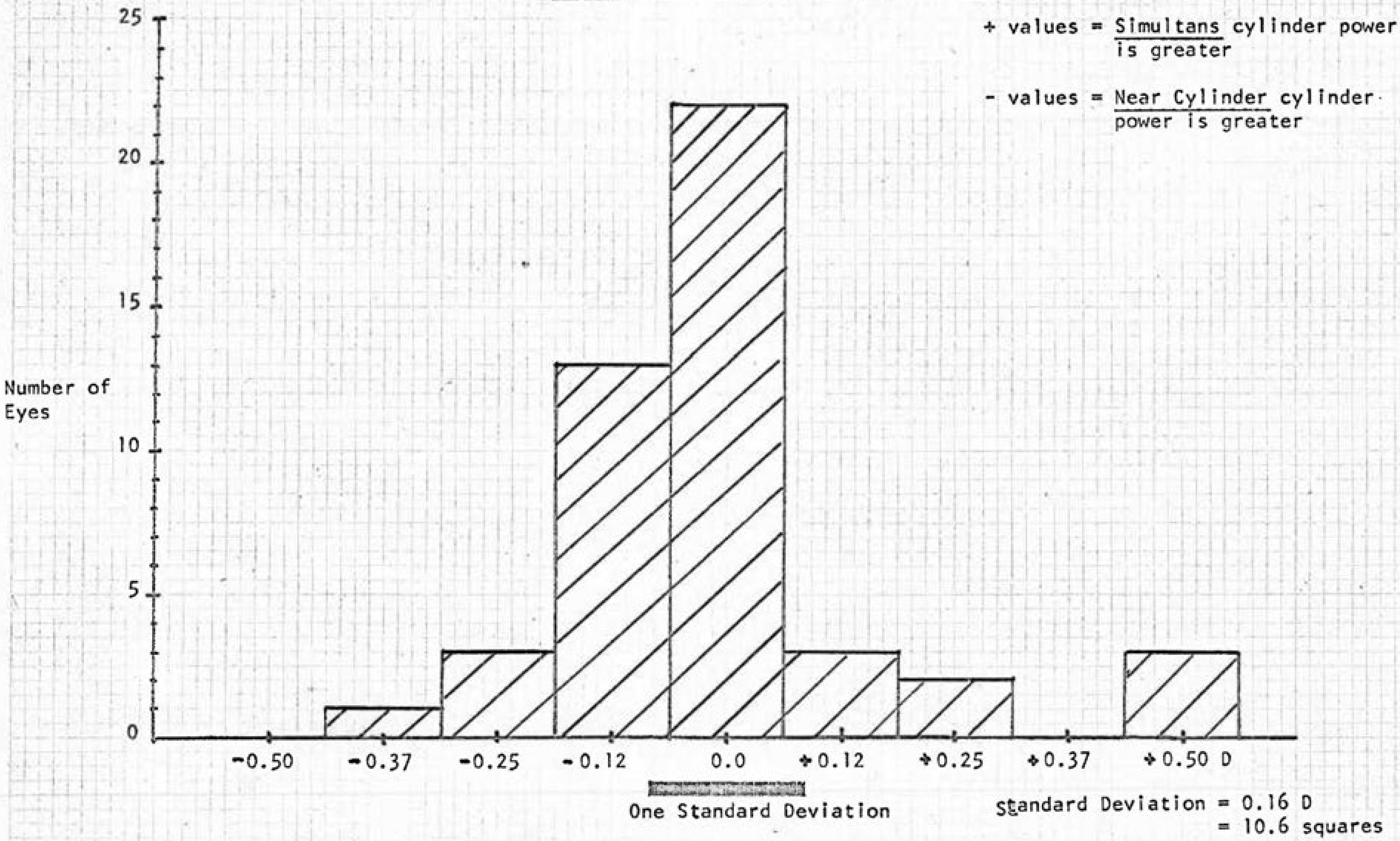
GRAPH II a

THE VARIATION OF THE NEAR CYLINDER AXIS FROM THE SIMULTANS CYLINDER AXIS AS A FUNCTION OF CYLINDER POWER



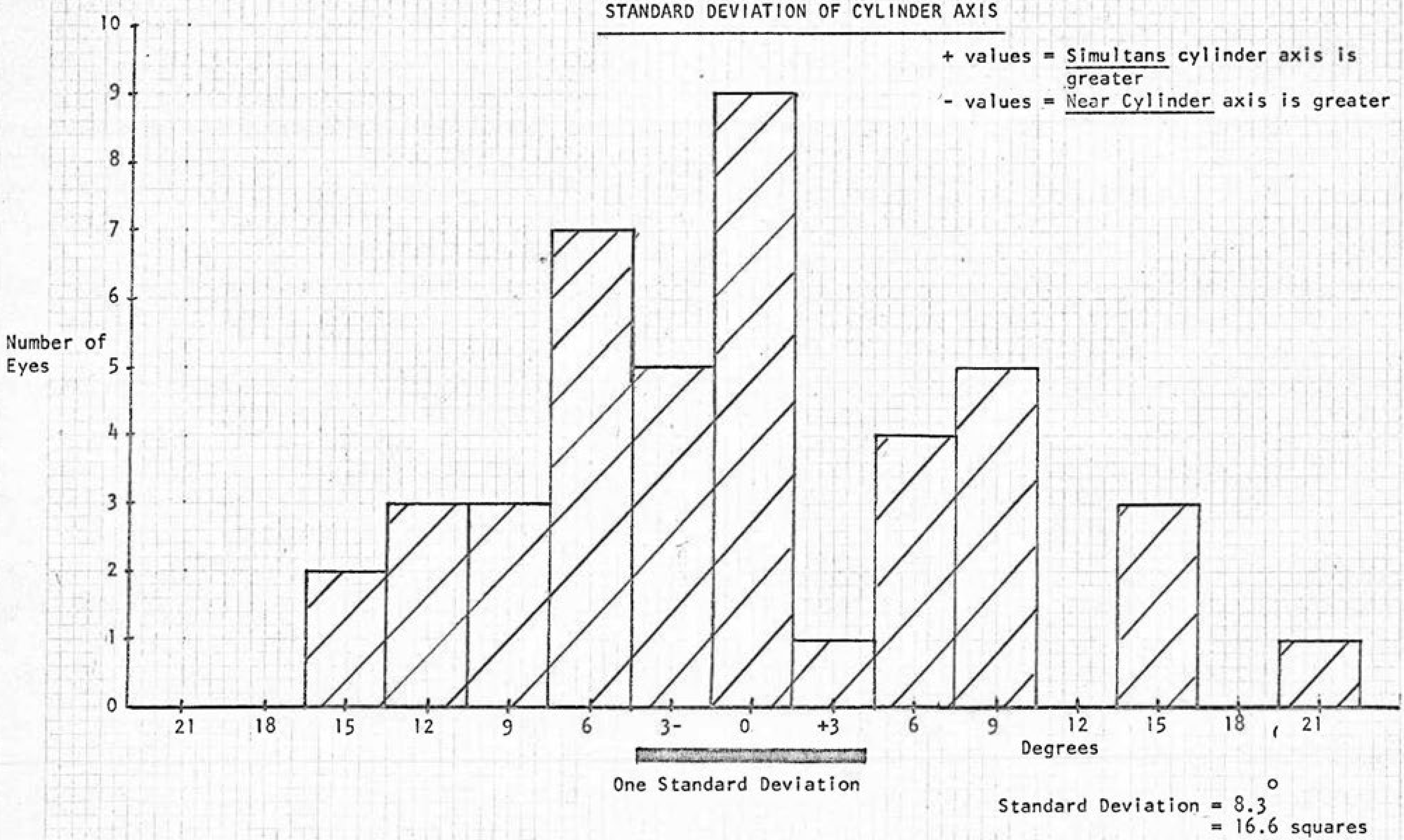
GRAPH I

STANDARD DEVIATION OF CYLINDER POWER



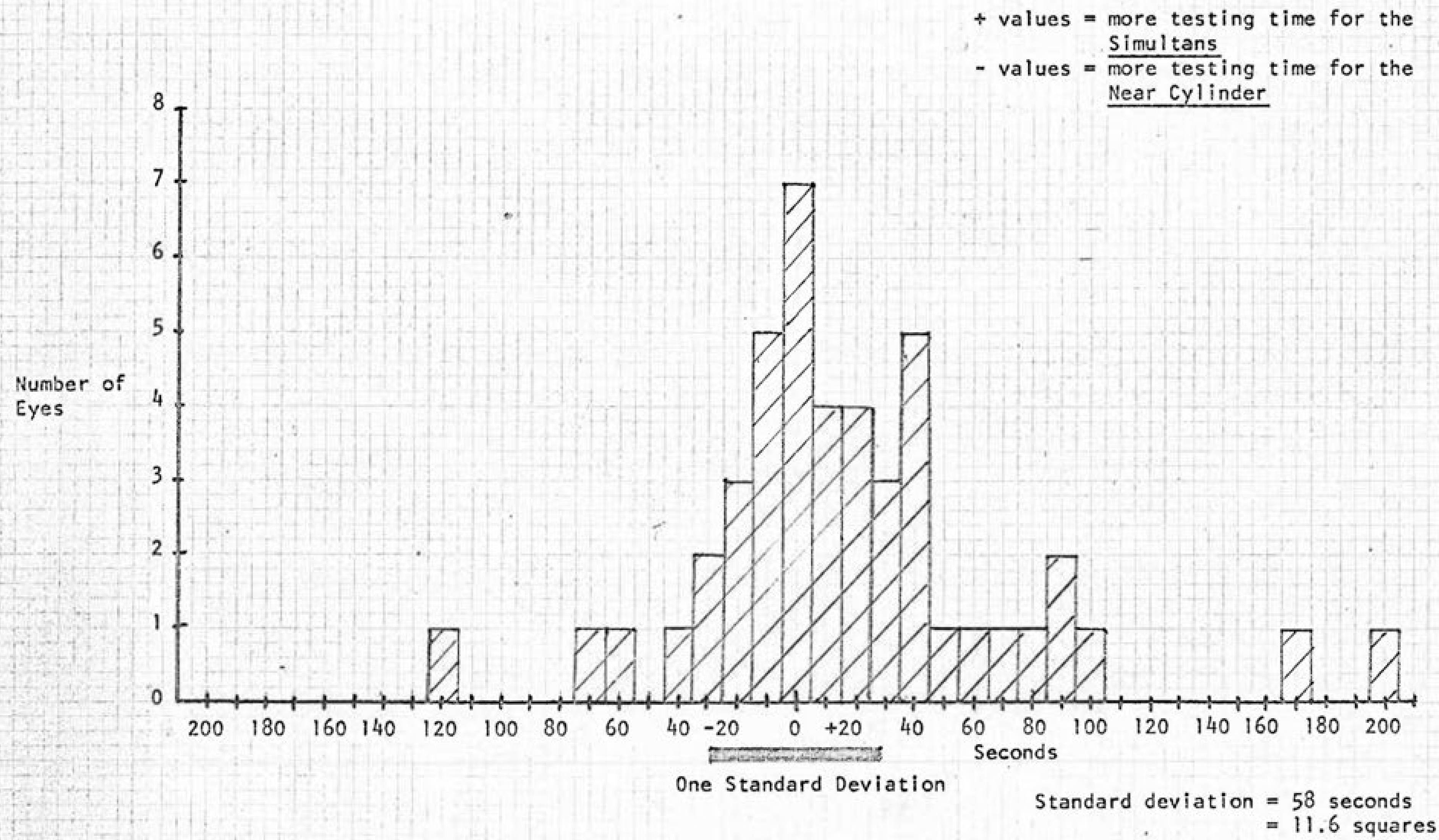
GRAPH II

STANDARD DEVIATION OF CYLINDER AXIS



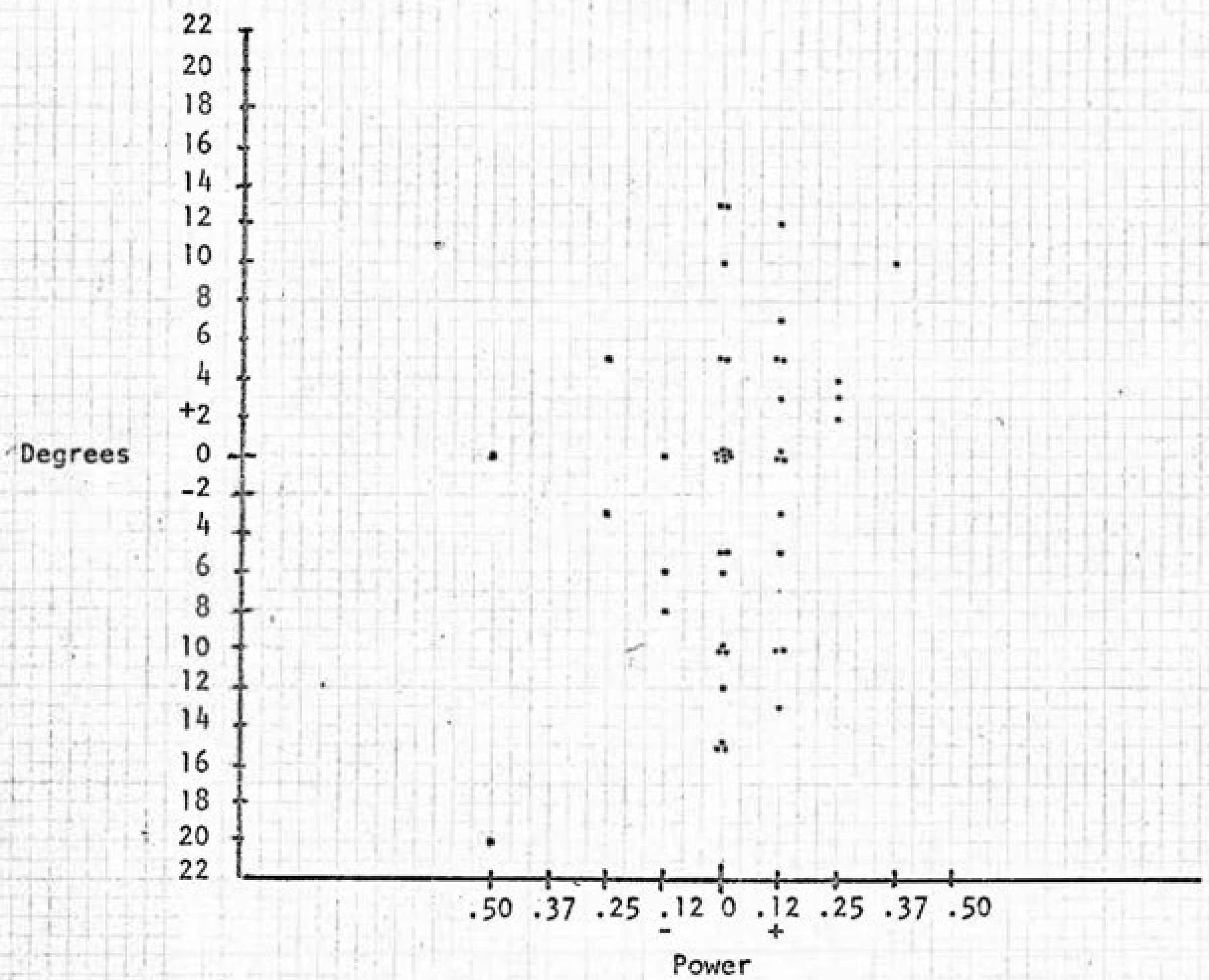
GRAPH III

STANDARD DEVIATION OF TIME OF THE NEAR CYLINDER FROM THE SIMULTANS



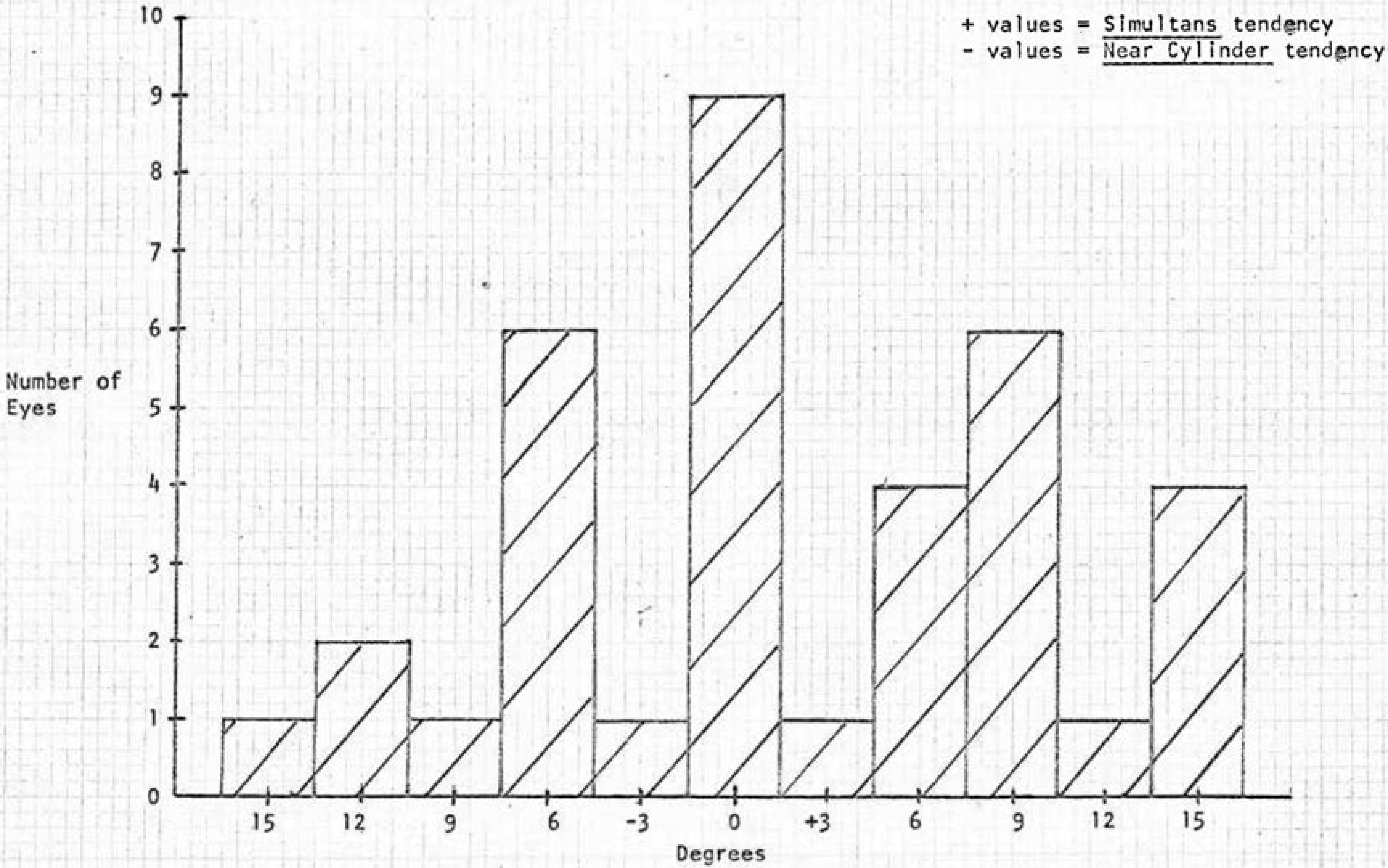
GRAPH IV

SCATTERGRAM OF NEAR CYLINDER POWER AND AXIS DEVIATION FROM THE SIMULTANS CYLINDER POWER AND AXIS



GRAPH V

TENDENCY TOWARD AN OBLIQUE AXIS FOR CYLINDER POWERS (0.0 - 0.12D)



GRAPH VI

TENDENCY TOWARD AN OBLIQUE AXIS FOR CYLINDER POWERS (0.25 and greater)