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Raubitschek test for astigmatism

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To the students who served as observers and for their suggestions, we are obligated. We are grateful for the materials made available to us by Dr. D. Jans, Professor of Optometry and who assisted us in numerous ways. Finally, we are indebted to the publishers and authors whose works are referred to throughout the following pages.

Raubitschek Test for Astigmatism

The purpose of this experiment was to devise a working model of the Raubitschek arrow test for astigmatism and to make a preliminary study of the accuracy of the test. This study was limited to determining the variation in axis on test-retest of 10 students of Optometry at Pacific University College of Optometry.

Using an overhead projector, the photograph found on page 491 of the American Optometric Association Journal, April, 1954, was projected onto graph paper and diameter of the Raubitschek arrow test chart arranged to equal the size of the clock dial chart projected at 18' by our A. O. projector slides. Figure No. 1 is a sketch illustrating the photograph. The width of the black lines was made equal to the clock dial spokes. The dimensions were later increased to $1\frac{1}{2}$ times the clock dial when it was found that acuity requirements seemed to be higher on the arrow chart. In the preliminary study, the disk was revolved about a marking chart. Two types of disks are described in the literature; black on white and black, white and gray. (See Figures #1 and #2). The curves were constructed over the tracing and inked in by means of drafting pen and French curve. A lens centering machine was redesigned such that an arrow disk could be rotated through 360° and position read to 1° in accuracy. This working model seemed to indicate very good accuracy could be obtained with the arrow and that of the two disks constructed, the black on white seemed to give better results. Shortcomings of the testing instrument were that the patient could not adjust the final position of the dial and, in general, the observers were sure that if they could move it, they could have obtained greater accuracy. The second shortcoming was the time required to move back and forth between patient and wall during testing. With these criteria in mind, a slide was obtained which could be rotated through 180° and could be used with a clason projector. To obtain a negative which would be satisfactory for use in the projector, it was necessary to photograph the chart used with the redesigned lens centering machine. The negative of this was again photographed such that the reverse negative obtained from this process would just fit the clason slide. (See Figure #4). A chart was constructed and photographed and this provided a measuring device which could be worked by the patient and did not require that the experimenter move to and fro from test chart to observer.

Patient was seated in refracting chair. Phoropter was introduced before patient's face and PD set for distance. Initially, the patient was monocularly fogged to 20/40 snellen line of letters. Raubitschek dial was projected upon wall at 18' from patient and if patient complained that the tip of the arrow was still indistinct in all positions, the fog was reduced .25 to .50 diopters. The apparatus was arranged in such manner so as to allow the patient to manipulate adjustment. The patient was instructed to rotate the Raubitschek dial until the narrow tip of the arrow appeared blacker than the wide wings of the arrow. Patient was then instructed to rotate further until a JND* was observed as one side of tip blacker than the other. Then rotate in opposite direction until the point of reversal. This system of bracketing was repeated until the patient reported a shift from one side to the other with a rotation of less than 10°. Patient was then instructed to place the dial in such position that both wings were equally black as well as equal in length from tip of arrow toward center of dial. The position of the arrow tip was then assumed to lay along the astigmatic axis of least curvature, i.e. to indicate the axis of a correcting plus cylinder.

*JND - Just Noticeable Difference

To find the amount of astigmatism, the examiner has to use two angles. These are a "test angle" for the temporary axis of the cylinder, and a "rotation angle" for position of the arrow tip. The "test angle"and the "rotation angle" are obtained in the following way: The test angle may be any angle chosen, and is usually 20°. Where the expected cylinder is high, say 250 D or more, a smaller angle may be used. Where the expected cylinder is low, say under 1.00 D, a larger angle may be used.

The rotation angle is obtained from the test angle in the following way: If "a" stands for the test angle, then the rotation angle equals 90 - a/2. If "a" equal 20°, rotation angle equals 90 - 20/2 or 35°. If "a" equals 10°, rotation angle equals 90 - 10/2 or 40°. If "a" equals 30°, rotation angle equals 90 - 30/2 or 30°. Thus the three pairs of angles are:

	Test Angle	Rotation Angle	
1.	20	30	for most cases, 1 - 250
2.	10	40	for high errors, 2.5 or higher correcting cylinder
3.	30	30	for low errors, to 1.00

To find the amount of the required cylinder, the examiner made use of the two angles, the "test angle" and the "rotation angle". As previously stated, these are usually taken as 20° and 35°. The 20° gives the position of the "temporary axis" and 35° gives the new position of the arrow tip. Both angles are taken within the quadrant I and II. The examiner notes on the scale of the dial (on the upper half of the dial) 20° from the true axis in the direction of the arrow tip, and arrived at the temporary axis. He rotates the arrow tip 35° toward the temporary axis and arrives at the new position of the arrow tip. The two wings of the arrow will now appear unlike. If the examiner knows the approximate around of the cylinder required, he places that cylinder in the refractor. If he does not, he begins with no cylinder and adds cylinder in .25 D steps, at the "temporary axis", until the patient reports the two wings are equally black, especially at the arrow tip. The cylinder should be increased or decreased to point of reversal (first one side darker, then other side darker), until the addition or subtraction of .25 diopter cylinder causes definite reversal. This then gives the correct amount of cylinder power.

The refractor cylinder axis indicator is now rotated to the "True axis" position. The patient is instructed to notice and report any change or shift in equality of wings as the Raubitschek dial is rotated throughout its entire cycle of 360°.

Ten students volunteered to serve as observers for testing accuracy of axis. Whenever cylinder was demonstrated during the first testing period, ten observations were made at different intervals.

The results of eighteen monocular observations were grouped and analyized for the mean, mode and the sigma. This experiment was performed upon ten subjects. A total of 10 observations were recorded for each eye. The data obtained was compiled for mean, mode and sigma values. These data were recorded for both eyes of each observer in tables 1 through 10. Chart #1 presents the variations in the sigmas of tables 1 through 10 in form of a histogram. Chart No. 2 illustrates the variation between sigmas in the form a frequency polygon.

Difficulties encountered with the slide were that observers with minus astigmatic axis at nearly 90° were not likely to get the reversal effect. This was because the excursion of the arrow was limited to an arc of 180° and would not occur in a slide which could be rotated the full 360°. Another problem which although it did not arise during the experimenting period, was yellowing of the slide brought about by the heat of the projector. It was not determined whether the glue or the negative was exhibiting the color change. The discoloration seemed to be progressive, but did not seem to be evident on the projected image. The data presented in this study indicates the test may be useful as a clinical test to obtain the axis of a correcting cylinder in a distance prescription. The test eliminates some undesirable features present in some of the presently accepted tests for axis and power. It doesnot depend upon an acuity judgment of letters for determination of axis or cylinder power; also selection of darker or lighter lines is limited to two adjacent curves and does not involve the confusion involved in charts such as the sunburst and clock dial. The testing device also tends to eliminate any preference for vertical or horizontal.

The results of the testing seem to indicate that the astigmatic axis indicated by this test would normally fall within a range of 4.5 degrees if the observer were to be retested for axis by this method at a later date. The preliminary study seems to indicate that gathering further data concerning the application of the Raubitschek test for astigmatism would be worthwhile. Suggested studys are:

1. Correlating the power found on test-retest of a group of astigmatic observers.

2. Comparing Raubitschek manifest cylinder against a clinically accepted means of determining cylinder and axis.

3. Comparing the variations between a group of myopic astigmats against hyperopic astigmats.

4. Comparing variations on different dioptric levels of manifest cylinder.

References

Journal of American Optometric Association, April, 1954, Vol XXV No. 9, Page 491.

Optometric World, Sept, 1953, Vol. 41, No. 9, Page 22.

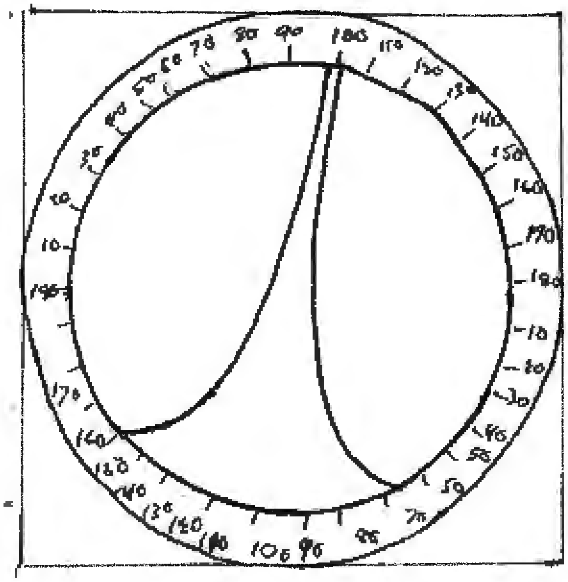


fig 1

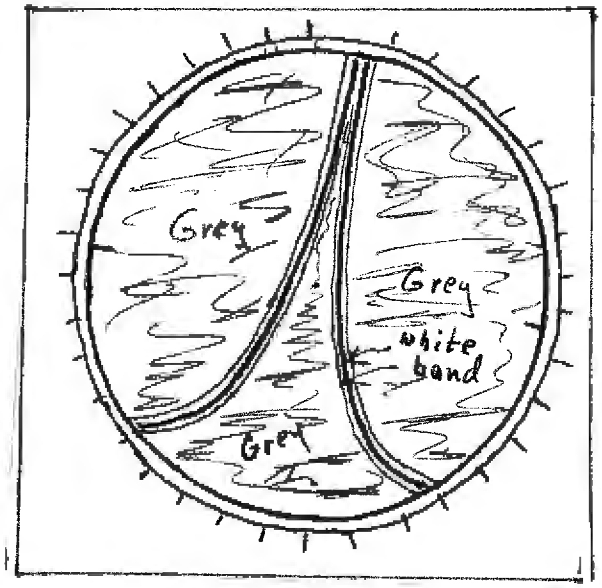


fig 2

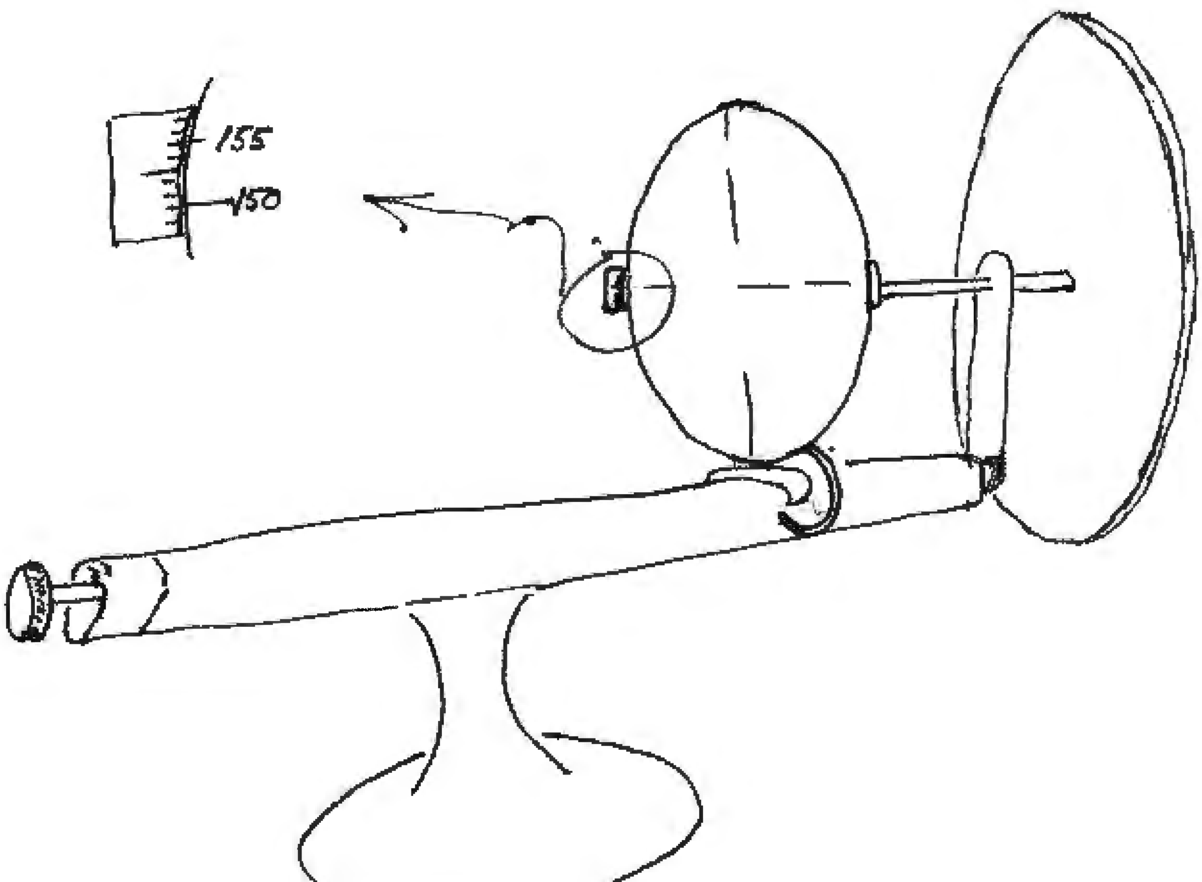
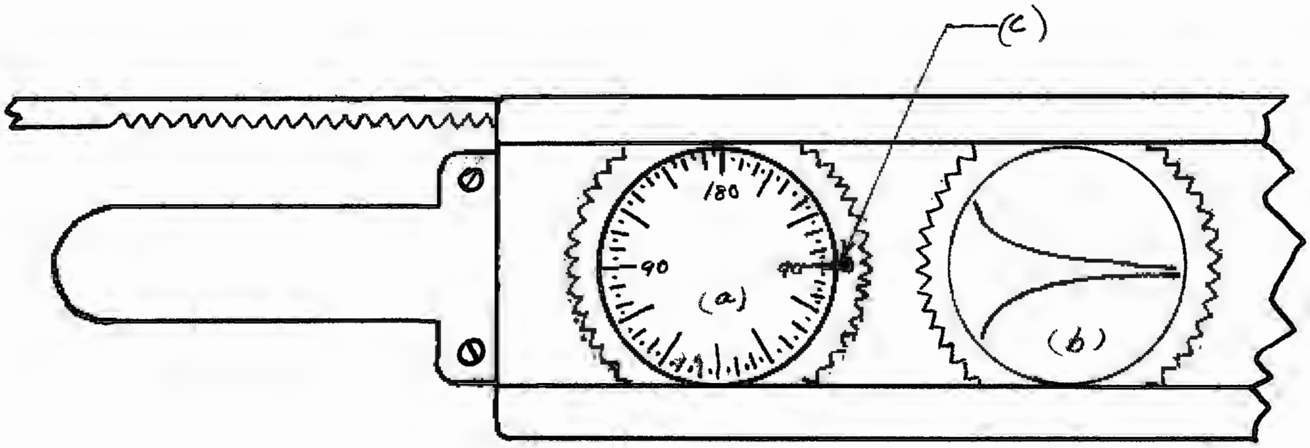


fig 3

fig 4



a - stationary dial 5° intervals

b - movable dial

c - marker moves in equal amount and direction as (b) dial

Table 1

O.D. Subject "A"

Cyl Axis	i	f	d	f·d	f·d²
X 102	104	0	9	0	0
X 96	103	0	8	0	0
X 97	102	2	7	14	98
X 102	101	0	6	0	0
X 100	100	3	5	15	75
X 98	99	2	4	8	32
X 100	98	1	3	3	9
X 99	97	1	2	2	4
X 100	96	1	1	1	1
X 99	95	0	0	0	0
		10		43	219

$M = 98.6$

mode = 100

$\sigma = \frac{1}{10}\sqrt{(10)(219)-(43)^2}$

$\sigma = 1.85$

O.S.

Cyl Axis	i	f	d	f·d	f·d²
X 79	82	0	9	0	0
X 76	81	0	8	0	0
X 75	80	0	7	0	0
X 76	79	1	6	6	36
X 77	78	0	5	0	0
X 74	77	1	4	4	16
X 74	76	3	3	9	27
X 76	75	3	2	6	12
X 75	74	2	1	2	2
X 75	73	0	0	0	0
		10		27	93

$M = 75.7$

Mode = 75.5

$\sigma = 1.42$

Table 2

O.D. Subject "B"

Cyl Axis	i	f	d	f·d	f·d²
x 176	180	0	9	0	0
x 178	179	0	8	0	0
x 174	178	1	7	7	49
x 174	177	2	6	12	72
x 176	176	4	5	20	100
x 172	175	0	4	0	0
x 176	174	2	3	6	18
x 177	173	0	2	0	0
x 176	172	1	1	1	1
x 177	171	0	0	0	0
		10		46	240

M = 175.6

mode = 176.

σ = 1.69

O.S.

Cyl Axis	i	f	d	f·d	f·d²
No Cyl			9		
" "			8		
" "			7		
" "			6		
" "			5		
			4		
			3		
			2		
			1		
			0		

Table 3

O.D. Subject "C"

Cyl. Axis	i	f	d	f.d	f.d²
x 54	62	0	9	0	0
x 55	61	0	8	0	0
x 56	60	0	7	0	0
x 54	59	2	6	12	72
x 59	58	0	5	0	0
x 55	57	1	4	4	16
x 57	56	3	3	9	27
x 56	55	2	2	4	8
x 59	54	2	1	2	2
x 56	53	0	0	0	0
		10		31	125

M = 56.1

mode = 57.

σ = 1.70

O.S.

Cyl. Axis	i	f	d	f.d	f.d²
x 172	177	0	9	0	0
x 169	176	0	8	0	0
x 170	175	0	7	0	0
x 170	174	0	6	0	0
x 171	173	0	5	0	0
x 170	172	2	4	8	32
x 172	171	1	3	3	9
x 120	170	5	2	10	20
x 169	169	2	1	2	2
x 170	168	0	0	0	0
		10		23	63

M = 170.3

mode = 170.

σ = 1.01

Table 4

O.D. Subject "D"

Cyl Axis	i	f	d	f·d	f·d²
x 107	121	1	9	9	81
x 115	119	0	8	0	0
x 120	117	1	7	7	49
x 108	115	1	6	6	36
x 105	113	0	5	0	0
x 110	111	1	4	4	16
x 111	109	2	3	6	18
x 105	107	2	2	4	8
x 109	105	2	1	2	2
x 116	103	0	0	0	0
		10		38	210

M = 110.6

mode = 107.

σ = 2.52

O.S.

Cyl Axis	i	f	d	f·d	f·d²
x 175	2	1	9	9	81
x 173	1	1	8	8	64
x 2	180	2	7	14	98
x 1	179	1	6	6	36
x 180	178	1	5	5	25
x 180	177	0	4	0	0
x 176	176	1	3	3	9
x 178	175	1	2	2	4
x 179	174	0	1	0	0
x 173	173	2	0	0	0
		10		47	317

M = 177.1

σ = 3.1

Table 5

O.D. Subject "E"

Cyl axis		i	f	d	f·d	f·d²
X	64	73	0	9	0	0
X	64	72	2	8	16	128
X	68	71	0	7	0	0
X	66	70	2	6	12	72
X	67	69	0	5	0	0
X	70	68	1	4	4	16
X	67	67	2	3	6	18
X	72	66	1	2	2	4
X	70	65	0	1	0	0
X	72	64	2	0	0	0
			10		40	238

$M = 67.7$

mode =

$\sigma = 2.79$

O.S.

Cyl Axis		i	f	d	f·d	f·d²
X	128	136	0	9	0	0
X	129	135	0	8	0	0
X	129	134	0	7	0	0
X	129	133	0	6	0	0
X	129.5	132	0	5	0	0
X	129	131	0	4	0	0
X	129	130	2	3	6	18
X	130	129	7	2	14	28
X	130	128	1	1	1	1
X	129.5	127	0	0	0	0
			10		21	47

$M = 129.2$

mode = 129

$\sigma = .54$

Table 6

O. D. Subject F

Cyl Axis	i	f	d	fd	fd²
X 129	134	0	9	0	0
X 128	133	0	8	0	0
X 127	132	1	7	7	49
X 129	131	0	6	0	0
X 130	130	1	5	5	25
X 129	129	4	4	16	64
X 128	128	2	3	6	18
X 129	127	1	2	2	4
X 126	126	1	1	1	1
X 132	125	0	0	0	0
/		10		37	161

M = 128.7

mode = 129.

σ = 1.55

O. S.

Cyl Axis	i	f	d	fd	fd²
X 8	14	0	9	0	0
X 9	13	0	8	0	0
X 9	12	0	7	0	0
X 9	11	1	6	6	36
X 6	10	1	5	5	25
X 10	9	3	4	12	48
X 11	8	2	3	6	18
X 6	7	0	2	0	0
X 6	6	3	1	3	3
X 8	5	0	0	0	0
		10		32	130

M = 8.2

σ = 1.66

Table 7

O.D. Subject "G"

Cyl AXIS	i	f	d	fd	fd²
X 155	155	3	9	27	243
X 146	154	1	8	8	64
X 157	153	0	7	0	0
X 156	152	2	6	12	72
X 148	151	1	5	5	25
X 146	150	0	4	0	0
X 154	149	0	3	0	0
X 151	148	1	2	2	4
X 152	147	0	1	0	0
X 152	146	2	0	0	0
		10		54	408

M = 151.7

mode = 155

σ = 3.41

O.S.

Cyl AXIS	i	f	d	fd	fd²
X (no cyl)			9		
X " "			8		
X " "			7		
X " "			6		
X			5		
X			4		
X			3		
X			2		
X			1		
X			0		

Table 8

O.D. Subject H

Cyl AXIS	i	f	d	fd	fd²
x 166	174	1	9	9	81
x 166	173	0	8	0	0
x 168	172	0	7	0	0
x 171	171	2	6	12	72
x 174	170	0	5	0	0
x 167	169	1	4	4	16
x 167	168	1	3	3	9
x 171	167	2	2	4	8
x 169	166	2	1	2	2
x 165	165	1	0	0	0
		10		34	188

$M = 168.3$

$\sigma = 2.69$

O.S.

Cyl AXIS	i	f	d	fd	fd²
x 28	34	0	9	0	0
x 29	33	0	8	0	0
x 30	32	0	7	0	0
x 30	31	1	6	6	36
x 30	30	4	5	20	100
x 31	29	3	4	12	48
x 29	28	1	3	3	9
x 26	27	0	2	0	0
x 30	26	1	1	1	1
x 29	25	0	0	0	0
		10		42	194

$M = 28.2$

mode = 30

$\sigma = 1.32$

Table 9

O.D. Subject I

(y) AXIS	i	f	d	f·d	f·d²
X 24	30	2	9	18	162
X 22	29	0	8	0	0
X 26	28	2	7	14	98
X 25	27	0	6	0	0
X 22	26	1	5	5	25
X 21	25	1	4	4	16
X 28	24	1	3	3	9
X 30	23	0	2	0	0
X 28	22	2	1	2	2
X 30	21	1	0	0	0
		10		46	312

$M = 25.7$

$\sigma = 3.16$

O.S.

(y) AXIS	i	f	d	f·d	f·d²
X 164	172	0	9	0	0
X 166	171	0	8	0	0
X 166	170	0	7	0	0
X 167	169	0	6	0	0
X 167	168	0	5	0	0
X 164	167	3	4	12	48
X 165	166	3	3	9	27
X 166	165	2	2	4	8
X 165	164	2	1	2	2
X 167	163	0	0	0	0
		10		27	85

$M = 165.7$

mode $= 166.5$

$\sigma = 1.10$

Table 10

O.D. Subject "J"

Cyl Axis	I.	f.	d.	f.d	f.d.²
x 48	49	1	9	9	81
x 45	48	2	8	16	128
x 44	47	0	7	0	0
x 44	46	0	6	0	0
x 45	45	2	5	10	50
x 44	44	3	4	12	48
x 48	43	0	3	0	0
x 49	42	1	2	2	4
x 42	41	1	1	1	1
x 41	40	0	0	0	0
		10		50	312

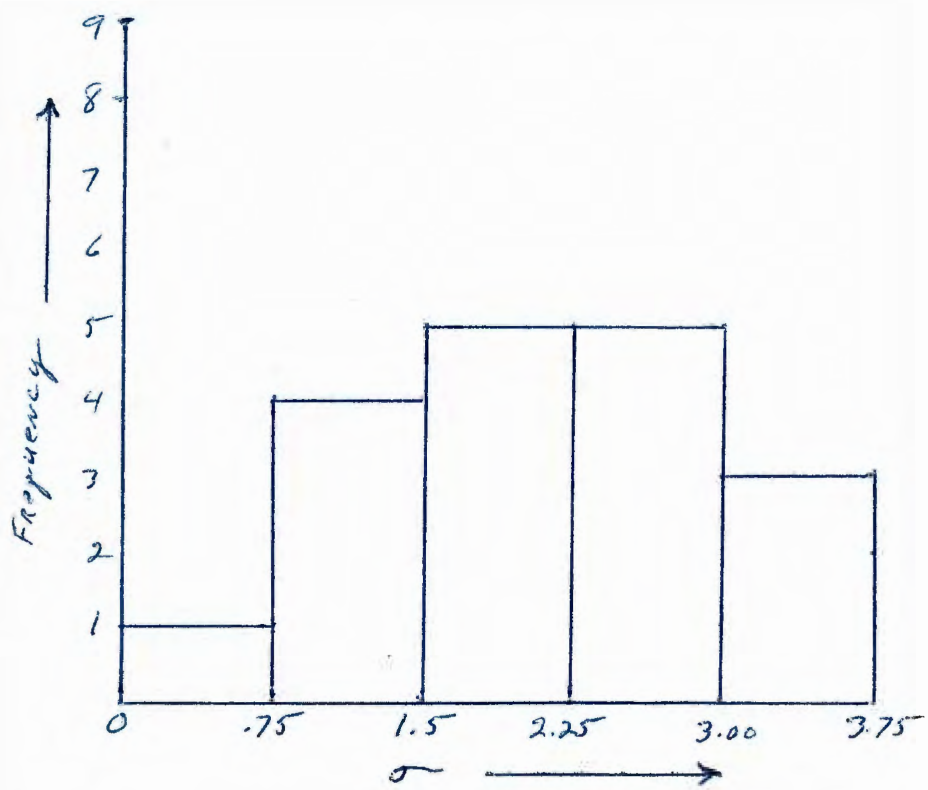
M = 45.0
mode = 44
σ = 2.49

O.S.

Cyl. Axis	I.	f.	d.	f.d.	f.d.²
x 180	182	0	9	0	0
x 180	181	2	8	16	128
x 180	180	3	7	21	147
x 178	179	0	6	0	0
x 174	178	2	5	10	50
x 176	177	0	4	0	0
x 1	176	2	3	6	18
x 1	175	0	2	0	0
x 176	174	1	1	1	1
x 178	173	0	0	0	0
		10		54	344

M = 178.4
mode = 180.
σ = 2.29

GRAPH 1



GRAPH 2