### **Pacific University**

## CommonKnowledge

College of Optometry

Theses, Dissertations and Capstone Projects

12-1965

## Prism contact lens effectivity as related to vertical phoria and duction testing

Maurice L. Olson Pacific University

John E. Peterson Pacific University

#### **Recommended Citation**

Olson, Maurice L. and Peterson, John E., "Prism contact lens effectivity as related to vertical phoria and duction testing" (1965). *College of Optometry*. 268. https://commons.pacificu.edu/opt/268

This Thesis is brought to you for free and open access by the Theses, Dissertations and Capstone Projects at CommonKnowledge. It has been accepted for inclusion in College of Optometry by an authorized administrator of CommonKnowledge. For more information, please contact CommonKnowledge@pacificu.edu.

## Prism contact lens effectivity as related to vertical phoria and duction testing

#### **Abstract**

Prism contact lens effectivity as related to vertical phoria and duction testing

## Degree Type

Thesis

#### **Degree Name**

Master of Science in Vision Science

#### **Committee Chair**

Don C. West

## **Subject Categories**

Optometry

#### Copyright and terms of use

If you have downloaded this document directly from the web or from CommonKnowledge, see the "Rights" section on the previous page for the terms of use.

If you have received this document through an interlibrary loan/document delivery service, the following terms of use apply:

Copyright in this work is held by the author(s). You may download or print any portion of this document for personal use only, or for any use that is allowed by fair use (Title 17, §107 U.S.C.). Except for personal or fair use, you or your borrowing library may not reproduce, remix, republish, post, transmit, or distribute this document, or any portion thereof, without the permission of the copyright owner. [Note: If this document is licensed under a Creative Commons license (see "Rights" on the previous page) which allows broader usage rights, your use is governed by the terms of that license.]

Inquiries regarding further use of these materials should be addressed to: CommonKnowledge Rights, Pacific University Library, 2043 College Way, Forest Grove, OR 97116, (503) 352-7209. Email inquiries may be directed to:.copyright@pacificu.edu

# PRISM CONTACT LENS EFFECTIVITY AS RELATED TO VERTICAL PHORIA AND DUCTION TESTING

Presented to

College of Optometry

Pacific University

In Partial Fulfillment
of the Requirements for the
Degree of Doctor of Optometry

Ву

Maurice L. Olson

John E. Peterson

December, 1965

#### ACKNOWLEDGMENTS

The authors wish to express their appreciation to Dr. Don C. West, Professor of Contact Lenses, for his guidance in this study.

The authors also wish to thank Dr. Elizabeth G. Brody for her assistance in the statistical analysis of the data.

M.L.O.

J.E.P.

#### TABLE OF CONTENTS

	Page
Introduction	1
Review of Literature	2
Procedure	4
Formulae Utilized	11
Tabulated Statistics	12
Possible Sources of Error	33
Summary	34
Bibliography	35
Appendix	36
Appendix A: Contact Lens Specifications	37
Appendix B: Summary of Computations	38

Figur	re	Page
1.	Near Duction Target	8
2.	Near Phoria Target	9
3.	Near Phoria Target	10
4.	Von Graefe Phoria @ 20'	13
5.	Von Graefe @ 20*: Plot of Three Diopter Effect Against Five Diopter Effect	15
6.	Von Graefe @ 20': Percent Effectivity	16
7.	Maddox Rod Phoria @ 20	17
8.	Maddox Rod @ 20': Plot of Three Diopter Effect Against Five Diopter Effect	19
9.	Maddox Rod @ 20°: Percent Effectivity	20
10.	Duction Balance @ 20'	21
11.	Duction Balance @ 20*: Plot of Three Diopter Effect Against Five Diopter Effect	23
12.	Duction Balance @ 20*: Percent Effectivity	24
13.	Von Graefe Phoria @ 16"	25
14.	Von Graefe @ 16": Plot of Three Diopter Effect Against Five Diopter Effect	27
15.	Von Graefe @ 16": Percent Effectivity	28
16.	Duction Balance @ 16"	29
17.	Duction Balance @ 16": Plot of Three Diopter Effect Against Five Diopter Effect	31
18.	Duction Balance @ 16": Percent Effectivity	32

#### INTRODUCTION

To date very little research has been done on the relationship of vertical prism in contact lenses to the measured effect on vertical phoria and duction testing. Although several authors state an opinion as to the vertical effectivity of a prism contact lens, there has been little systematic study to support their position.

It is the purpose of this study to investigate the effect of vertical prism in contact lenses on vertical phorias and ductions, both near and far.

#### REVIEW OF THE LITERATURE

Mandell states in his text that "a phoria of sufficient magnitude to cause subjective symptoms with spectacle lenses will probably cause the same difficulty with contact lenses. Vertical phorias up to 3 prism diopters can be corrected with prism corneal contact lenses." Grosvenor and several other authors have also stated that 3 prism diopters seem to be the maximum amount of prism which can be used in a corneal contact lens for correcting a vertical imbalance.

#### Girard further states:

"The use of these lenses to secure a prismatic effect optically has met with little success. First, a thin ophthalmic prism with a given power in air has only about one fourth of the original deviating power when placed in contact with a medium having an index of refraction equal to that of tears.

Consequently, a corneal contact lens that has six diopters of deviation power as measured with a lensometer in air would theoretically have approximately one and one half diopters of potential deviating power when in contact with the eye.

Second, when the lens is in contact with the eye, a new optical condition is established for lens-eye combination. When the prism is combined with the eye in order for a constant prismatic deviating effect to result, not only is it necessary for these separate optical units to have their optic axis decentered by a constant amount, but also the prism must maintain a constant angular orientation about its axis. Since these conditions are not feasible with corneal contact lenses, there will be a highly variable optical prismatic effect ranging from a fraction of the indicated power in air to two or three times this value, depending upon the orientation of this prism on the eye." 2

In a very limited study, Filderman tested two subjects to determine the effects of surrounding media on prismatic contact lenses.

<sup>1</sup> Mandell, Robert B. Contact Lens Practice: Basic and Advanced, p. 67.

<sup>2</sup> Girard, Louis J. Corneal Contact Lenses, p. 290-291.

From this study he concluded that:

"...the prismatic effect of a contact lens is affected by the indices of the surrounding media. A contact lens when bordered on each side by precorneal fluid has about 25% of the prismatic effect of the same lens when bordered on each side by air. A contact lens bordered on the front surface by air and the rear surface by precorneal fluid has about 63% of the prismatic value of the same lens bordered on each side by air. Considering only indical factors, the effective power on the eye of a given prism is always less than the effective power in air." 3

A Clinic year thesis at the Pacific University College of Optometry,

A Study of the Effect of Vertical Prism in Contact Lenses as Related to

Changes in Vertical Testing, was submitted to the faculty by Gregory,

Hehn, and Milton in January, 1965. The experimenters concluded that with

distance Von Graefe and Maddox Rod phorias "all responses of the two

tests were less than the prism worn and only the mean responses of the

Von Graefe method indicated a possible proportional progression."4

<sup>3</sup> Filderman, Irving P. "The Effect of Surrounding Media on Prismatic Contact Lenses." Optometric Weekly, (July 1, 1965) p. 19.

<sup>4</sup> Gregory, R., Hehn, R., Milton, D. A Study of the Effect of Vertical Prism in Contact Lenses as Related to Changes in Vertical Testing, unpublished clinic year thesis, Pacific University College of Optometry, January, 1965.

#### PROCEDURE

Twenty-six habitual contact lens wearers were tested in this study. The majority of the subjects selected were Pacific University students, while a small number were young adults living in the Forest Grove community.

The lenses used were plano prism contact lenses with base curves ranging from 42.00 to 45.50 diopters in one half diopter steps. Prism values in each of these base curves were approximately three, four, and five prism diopters.

A bite-board was used in the testing in order to minimize the induced prismatic effect from a subject changing head posture relative to the measuring prisms and lenses. The bite-board consisted of two disposable wooden tongue depressors clamped to an adjustable metal stand.

For the phoria measurements a Stevens Phorometer was selected. This phorometer is calibrated in 0.2 prism diopter steps, providing finer graduations than the Risley prism.

The phorometer also enabled the examiners to observe the centering and possible rotation of the contact lenses during the testing sequence. The base-apex line on the three prism diopter lenses was dotted with red ink, insoluble in water and easily seen by the examiner. In no cases was there observed more than a five degree base rotation as compared to the cylinder axis indicator. With the four and five prism diopter lenses, the weight of the base kept rotation to a negligible amount.

In an effort to minimize the effect of lateral heterophoria on the vertical measurements, a fused vertical component was used for the near test targets. For the vertical ductions, the subject fused one vertical line

and reported when the horizontal line doubled and then become one again.

(See figure 1) The vertical phorias were taken by first breaking the two vertical lines into four by the introduction of large amounts of base-in prism. (See figure 2) This prism was gradually reduced until the two inner vertical lines became fused. Vertical phorias were then measured by aligning the two horizontal lines. (See figure 3)

Prior to any testing sequence, the dominant eye of the subject was determined. At this time the subject was instructed to remove the lens from the dominant eye and a keratometer reading was taken. While one experimenter was taking the keratometer reading, the other neutralized the subject's contact lens. Three, four, and five prism diopter lenses with base curves paralleling the flattest keratometer finding were selected from the trial lens set.

Each subject inserted his habitual lens and was seated in the refracting chair. The bite-board was positioned and the subject instructed to bite down on it. The phorometer was then moved into position and adjusted for the subject's interpupillary distance. The subject was centered relative to the optical centers of the lenses with a pin hole disc.

First a series of Von Graefe phorias were taken at eighteen feet with the subject fixating a 20/40 line of letters. Ten measurements were taken: five with the left eye fixating and five with the right eye fixating. The first two measurements in each series were used to familiarize the subject with the procedure and only the last three were recorded.

The same procedure was repeated for the Maddox Rod phorias, OD measuring and OS measuring, with the subject fixating a spot of light on the wall.

Next, both supra and infra ductions for right and left eye were measured

using the standard Risley prisms.

Following the far testing, the interpupillary distance was adjusted for near and the near target swung into place.

A series of Von Graefe phorias were taken at sixteen inches with the subject fixating the horizontal line. As in the previous tests, a series of ten measurements were taken: five with left eye fixating and five with right eye fixating. Only the last three measurements of each series were recorded.

Near duction testing was done by using the standard Risley prisms. Both supra and infra ductions were measured for right and left eye.

This completed the testing through the habitual contact lens. The phorometer was moved away and the subject removed the habitual lens from the dominant eye, and placed the three prism diopter lens on this eye. The testing procedure was repeated for the three, four, and five prism diopter lenses.

In nearly every case, when the subject's wearing four and five prism diopter lenses were tested, the measured hyperphoria was equal to, or above, the limits of the measuring capability of the Stevens phorometer. In such a situation, a loose prism base down was added in the lens well before the non-dominant eye. Since the lens well was four centimeters closer to the center of rotation of the eye than was the measuring prism, the effective prism power at the measuring plane was calculated. Using the formula  $E = \frac{d-T'}{d}$  (Prism); where E is effective prism; prism is the prismatic effect measured in a lensometer; d is the target distance from the center of rotation of the eye; and T' is the distance of the measuring prism from the center of rotation. The difference in effective prism at the

measuring plane was negligible when testing at eighteen feet, but was considered at the sixteen inch testing distance. This difference in effective prism was considered negligible for the near ductions since the planes of the Risley prism and the loose prism were nearly coincident.

The experimenters were aware of the tendency for some subjects to readily adapt to vertical prism. To minimize this adaption, the testing was started as soon as excessive lacrimation subsided. Since the subjects were habitual contact lens wearers, this delay in testing was generally under one minute.

On a small minority of the subjects, monocular diplopia was caused by the poor centering of the prism contact lens. Due to the presence of these images during the phoria testing, two subjects became confused as to which images to align. These two cases were excluded from the final population considered in the statistical analysis.

The third subject excluded from the population was troubled with an alternate suppression, especially during the near testing.

8

Figure I

9

Figure 2

Figure 3

## Formulae Utilized

1) Mean 
$$\overline{X} = X/n$$

2) Variance 
$$S^2 = \sum y^2/n$$

3) Standard Deviation 
$$S = \sqrt{\sum y^2/n}$$

4) 
$$\xi x^{2} = \xi X^{2} - (\xi X)^{2}/n$$
  
 $\xi y^{2} = \xi Y^{2} - (\xi Y)^{2}/n$   
 $\xi xy = \xi XY - (\xi X)(\xi Y)/n$ 

5) Correlation Coefficient

$$r = \frac{\xi xy}{\sqrt{\xi x^2 \xi y^2}}$$

6) Standard Error of Estimate

$$\sum (y - \widetilde{y})^{2} = \sum (\sum xy)^{2} / \sum x^{2}$$

$$= \sum (y - \widetilde{y})^{2}$$

$$= \sum (y - \widetilde{y})^{2}$$

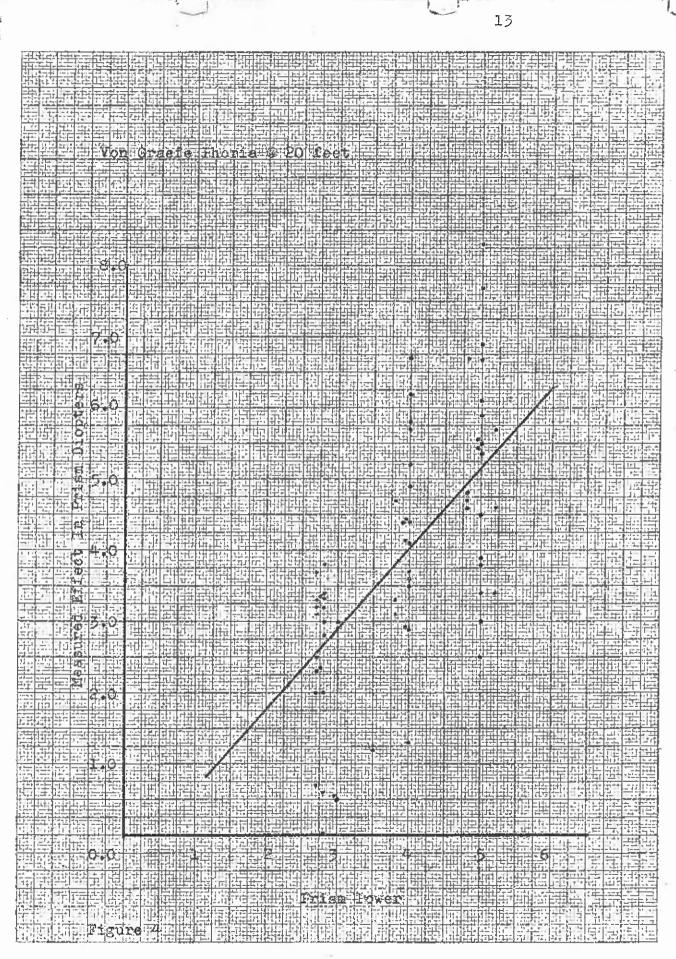
$$= 2$$

7) Regression Line

$$b_{x,y} = \xi xy/\xi y^2$$

## TABULATED STATISTICS

Measure	Y	X	S	by.x	b <sub>x.y</sub>	sy.x	r3 <b>^ -</b> 5
3 <sup>4</sup> , VG <sub>20</sub> ,	2.393	2.771	1.136	_	_	_	• 335
4 VG <sub>20</sub>	4.021	3.741	1.403	_	-	-	-
5 vg <sub>20</sub> ,	5.185	4.988	1.690	.498	.225	•756	
3 MR <sub>20</sub>	2.326	2.771	1.218	-	-	-	.01
4 MR <sub>20</sub>	4.197	3.714	0.990	-	-	••	-
5 MR <sub>20</sub> ,	5.290	4.988	1.240	.011	.01	1.30	
3 VG 16*	2.325	2.771	1.510	-	-		.184
4 <sup>4</sup> VG <sub>16"</sub>	4.049	3.741	1.480	-	<del></del>	-	
5 VG 16"	5.561	4.988	1.850	.224	.150	1.62	-
Duction Ba	alance						
3 <b>&amp;</b>	2.290	2.771	0.796	_	-	_	•525
4 •	3.926	3.741	1.118	-	-	_	_
5 <sup><b>A</b></sup>	5.063	4.988	0.840	• 555	•498	0.74	· •
Duction Ba							
3 <sup>&amp;</sup>	3.092	2.771	0.935	-	-	_	.133
4 🏝	4.613	3.741	1.00	-	_	_	
5 <sup>*</sup>	5.611	4.988	1.485	.211	.084	1.510	_



## Von Graefe Phoria @ 20 feet

- 1) Line of Best Fit  $\widetilde{Y} = a + bX$   $\widetilde{Y} = -.464 + (1.126)X$
- 2) Regression Line
  - a)  $b_{X,y}$   $Y_3 = b(Y_5 - \overline{Y}_5) + \overline{Y}_3$  $Y_3 = 2.25(Y_5 - 5.19) + 2.39$
  - b)  $b_{y.x}$   $Y_5 = b(Y_3 \overline{Y}_3) + \overline{Y}_5$   $Y_5 = .498(Y_3 2.39) + 5.19$

		*	**
		(1)	
The Won-Graef	e Phoria 8 20 feet	-13 effect of	otted egginst
		是15年9季中60季1年	
	[부분] 경우부 (이 [1] (마리) 22 (부분) (교육) (교육) (22 (부분)		
可用害怕 星型 医胃管			
123   126	42.556.655 (0.650) (371) 2 m; 52.156;		#14###################################
	四形的 网络阿利斯氏结后		
[현대] 구기 전문 (12 No. 12 No.			
三型			
		5	
<b>建型压制 连甲甲斯科尼亚</b>			
医超离黑沙斑 能低調服			
平原市 建氯甲基酚酯			
	4:13:012:05   30:013:00   4:00:00   7:30:05   3:30:05   3:30:05   3:30:05   3:30:05   3:30:05   3:30:05   3:30 3:13:01:31:01   1:10:05   1:10:05   1:10:05   1:10:05   3:30:05   3:30:05   3:30:05   3:30:05   3:30:05   3:30		eller (Balera de la
但到在學生學學學學學學學學學學			
<b>建新超温电影阻温</b> 温			
	期20月11日11日11日20日11月11		
		46 ( fe 4) = -44 4; 4 4 4 4 5 7 4 7 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6	
EPT-1111-11-11-12-12-12-12-12-12-12-12-12-1		Unitaritation (1994)	



	<u></u>											1, (3)	
											THE		
	-	HEREN TO HE											
				100 pt 100		7-1-6		4 4 4			1-1-1	7	17-1
The state of the s	Gree	91.6 L L U.C	) Y 3- 9 (2-)		3 E L 3	Fere	ent.	1111	CCIV	Table V	1		투글
						1		14-1-14-1	+114111				
						115-11-15							
							11111					1111	
													4-11-
	Fire										1		
						HIH					465		
										£G.			
					1000								
												E I	
											7 177		
140					+++++	72 (1905) (1905)							
								1				1	71 711
				ote He							H-E		
								111111			-1 F F		
遊運叫出學習								<b>常正兴</b>			11:4		52 II.
												描語	理理
	<b>B</b>				55						15		
			17 25 13	415		12/11/	11 1 11			11111		11-11-1	47.5
2 PCC			Jan 1								1 1	Litter	
	1 1 2 2										11.11		
	11 2 4 4											1 1	7-1-1-
													1
80						H + + 2 7 7 2 2 2				H	: htt	37 36 30 11 11 1	
	- 17			4-1317-14									
										11 22 1		7-71-1	111
	1.5										712		
	出面证									#####		H. T. T.	1-1-1-1
					型声型						計製	77 5	
黑墨斯库斯瓦特								5115.4		444			性加
											腊	444.	
	11 11 11	1:4:14:51		11.11.11.15			第基本	11 11 11					Helite
											11:11:		
			F 1 1 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			摆調							- 1
	717-11-1										11331. 1101	11 11	
		T PAR	n					445					1:11:11
	1 11	H-HSts	ndara	Devi	artor								
			HILITERI								11.5		
									1411		1 -	111-12	
				1711'S E					151				물리님
<b>使用的图画中的</b>										时数据		計:	10-12
	514912			The state of					1111				
		HEATE IS				Hairal,	THE P		1 - 1 - 1				-
W torry	e 6		251 - 121			1.4.4				1515		-7	1
First Carly The Carly	40.7	-1201-1403-1403	1 1 - 1 - 1 - 1 - 1			11114-414	+ 7-1-4-			i berida	r 6		1-12-1-5

1

## Mador Red Shorts 8 20 Test  ## 80				414444444	99 <del>231331</del> 921922	क्रमस्याम् स्थित	
Factor Red From C 20 Civit							
Factor Roll Florit C 20 deet  7.00  8.00  8.00  9.00							
RACONTROLENDING 20 Seet.  BYOUR SERVICE STATE OF THE SERVICE S							
Fig. 1.0  S. C.							
Maddow Red Rhoute & 20 deet  7.00  8.00  8.00  8.00  9			() 사내 (목록 목록 14월 14일 (목록 E) () 수명 (목록 E) 지기수로 (국도 기)				
7:0 : 1							
7:0		addox Roc	Phoris @ 20	Ifeet Fill			
7.0 1 7.0 1							
7.0 G							
8.0 8.0 8.0 8.0 8.0 8.0 8.0 8.0		17 1-11 11 11 11 11 11 11 11 11 11 11 11 1					
3.0 7.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3							
7,0							
8.0 7.0 6.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7							
				स्य कार्य कार्यक्रम्य कार्य । स्था स्था इतिहास विभिन्न स्थान स्थानित स्थानित ।			
	田田田田田						
	<b>联片即用加</b>					PLY/III	
						/	
		O	╘┪╎╒╬┧╏┇╏┇╧┹╅╬┸╬══╧╧┩┸╬╩╏╧╧╒ ╾╢╼╏╟┇┋╘┸┇╸══╼┇═┑╾╇╧╛┰┷╏╒┞┖				
		西西西田縣					
	4 5	O THE S					
	111111111111111111111111111111111111111	5 宝田田田常					
			의 (11년 (2) (11년 (11년 ) (12년 ) (2) (11년 ) 12 (11년 ) (11년 (11년 ) (12년 ) (12년 ) (12년 )				
	9-1						
				是识别手面可			
						到增品特色	
	ding in O.	O HELLIN				31 HISTORY	
				The latest of The street			
				<b>表式工品班</b> 李 <b>自</b> MG工			
		<b>新生世間報</b>					
	PHEN FIRM	gure 744					<b>新工业工作</b>

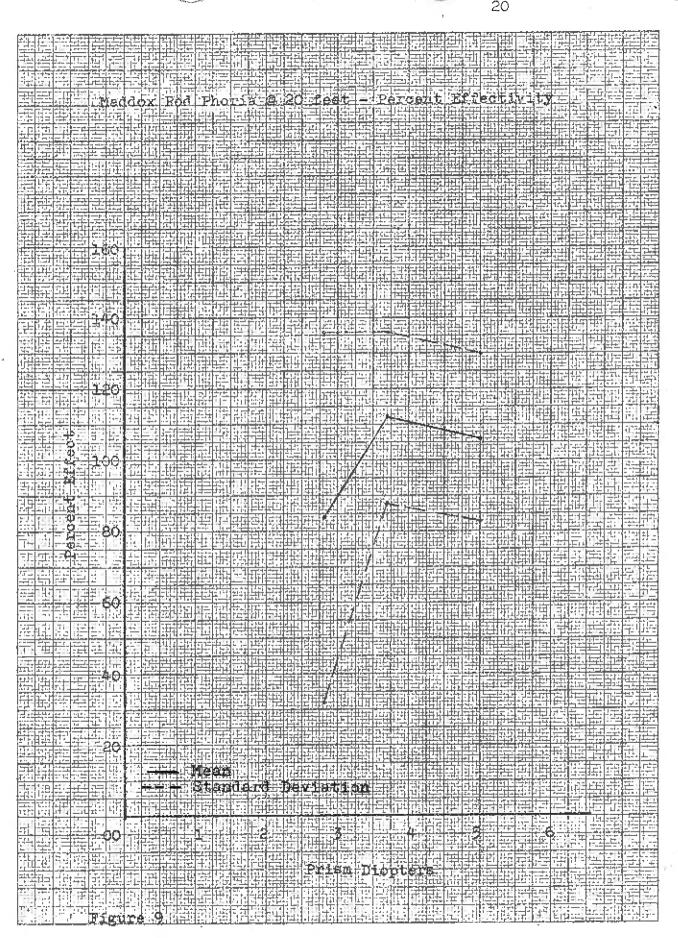
## Maddox Rod Phoria @ 20 feet

- l) Line of Best Fit  $\widetilde{Y} = a + bX$   $\widetilde{Y} = -2.91 + (1.78)X$
- 2) Regression Line
  - a)  $b_{X.y}$   $Y_3 = b(Y_5 - \overline{Y}_5) + \overline{Y}_3$  $Y_3 = .01(Y_5 - 5.29) + 2.33$
  - b)  $b_{y.x}$   $Y_5 = b(Y_3 - \overline{Y}_3) + \overline{Y}_5$  $Y_5 = .01(Y_3 - 2.33) + 5.29$



Madaca sod Phoris ( Coline 3, elfect plotted against black).  (19)  (19)  (19)  (20)  (20)  (3)  (4)  (4)  (4)  (4)  (4)  (4)  (4		भा <del>ग्य प्रदेश संस्</del> रतिकार						HELER				
Madox Roll Horiz @ Coffee 3. effect plotted against befrech.  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5									1111151	4 0 10		1 1
Madox Sol Homis (C Fee ) effect plotted against buffer in the second of			residential in									1
Madox Ros home ( O See ), electricited against perfect the second of the								4-1-1-1		- II	4-1	-14
Nadox so vioria e zo feet se a sec potred acanat per					<b>国国际</b>	性學可能是						5
Radiox so, Front C. 20 Soit S. 10 Sign of C. 20 Soit S. 10 Sign of C. 20 Soit S. 10 Sign of C. 20 Soit S. 20 S												FH
	Man	307 BOOT	horns 6	20-5		5 enfe	221-57	ottea	aga	nst		
			5 12 2			5 Telle	e in					- b L
												=
												- 1
										-1-1-1-1		=1
												77
	<b>原料基础</b>											
											拉語出	1
			11714	[1]			HULL			理描		1-1-1
				基訊院								
				121 2 1 1 1			3.100		141111	45		7.
	四年中国578									1221	121	T 2
			7:45				THE P				-, 7-1	扭
	<b>建工程工程工程</b>	酒品面料		보호 · 즉(						排計画		誹
			到阿州特	THE THE								#
		西語節國						#125		7-11		菜
					120年12				111111	HE III	THE R	퍞
	AT 12 14 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	BATTER BATTER								11.11		
					74 min 12							
								21-11-11-11-1				74
	5.0								114411	irtin iifi		퍜
			围回, 用品									I
	<b>建型 对</b> 证明证									当世		盐
					<b>新产油</b>							7
	温度使温度及										; "- 1" :	57
	5 4.0											
											-11	턴
							71:17		144-144	Hald Test		
		127 362 25 1972 3 11.0 231 112 323 2									1.0	讄
										1=1-1		当
				過學症				41111111			-1	垂
	到自計型法				四四周					32		
	阿哥特朗国際		<b>Hamilton</b>	湖西湖								#
			可能溶解								出生主	F-2
												=
								7 7 7		11 7		
												듺
										- THE		国
									111111			큮
	<b>国国中国</b>			1							TIT THE	17.
			指手計劃部			当中中中国				11111		-3
	<b>建性時間開業</b>			田中田							韓亞區	闘
	陸高野田島前島								即用	出岩		7. 7. £
				40 414 614	開助達			nda si E			提出	
	<b>性 明显 0,0</b>			心量器					-			13
									11 7 7 7 7	7 2 1 2	11.1-1-1.	#
					Tiem I	Trect						+
医眼腺性 医乳腺病 机全性抗性抗能性抗抗性 医神经性性 医神经性 医神经神经 医神经神经神经神经神经神经神经神经神经神经神经神经神经神经神经神经								####	<b>护理</b> 智	H-1 1-1	21444	
	<b>對國門第一節</b>				地位			4155	17 144	1. 1.	100	H
日明日日日日15.614(1915年19月1日日15日) 1915年 1916年 191	HILL Figu	ire 18 191			相相關			HELLIN		4	FFIgure	5





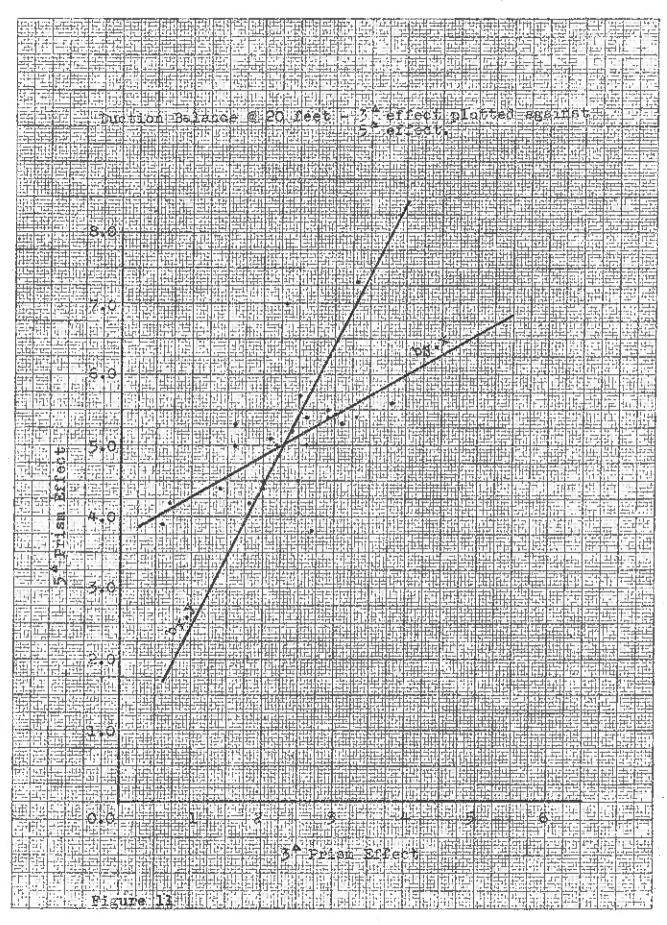


Duction Balance 型 电电阻 电电阻 电电阻电阻 电电阻 rei gert 部地址 712 Figure 10

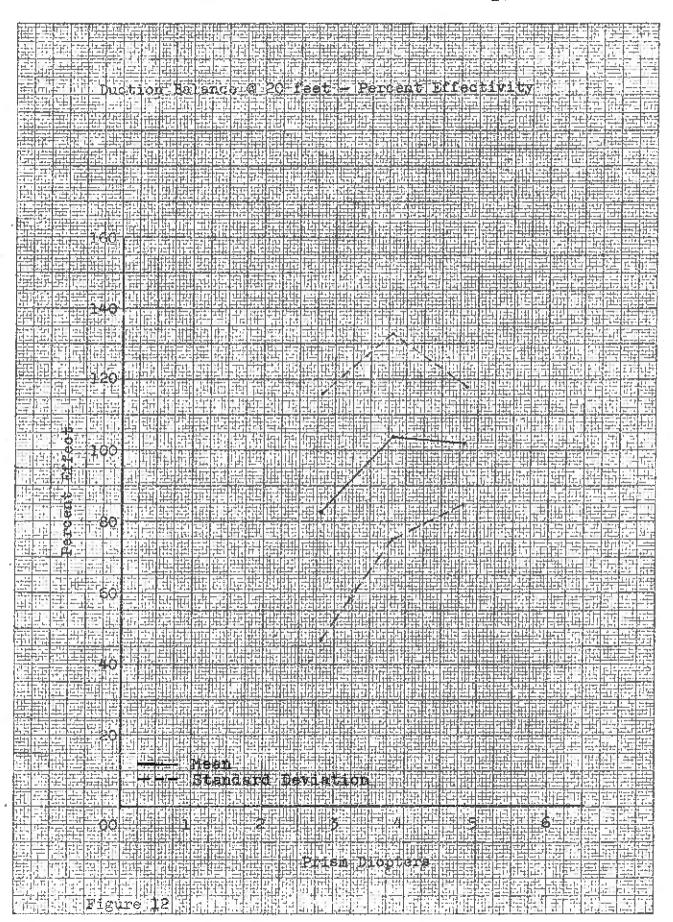
## Duction Balance @ 20 feet

- l) Line of Best Fit  $\widetilde{Y} = a + bX$   $\widetilde{Y} = -1.1 + (1.26)X$
- 2) Regression Line
  - a)  $b_{x,y}$   $Y_3 = b(Y_5 \overline{Y}_5) + \overline{Y}_3$   $Y_3 = .498(Y_5 5.06) + 2.29$
  - b)  $b_{y.x}$   $Y_5 = b(Y_3 - \overline{Y}_3) + \overline{Y}_5$  $Y_5 = .555(Y_3 - 2.29) + 5.05$









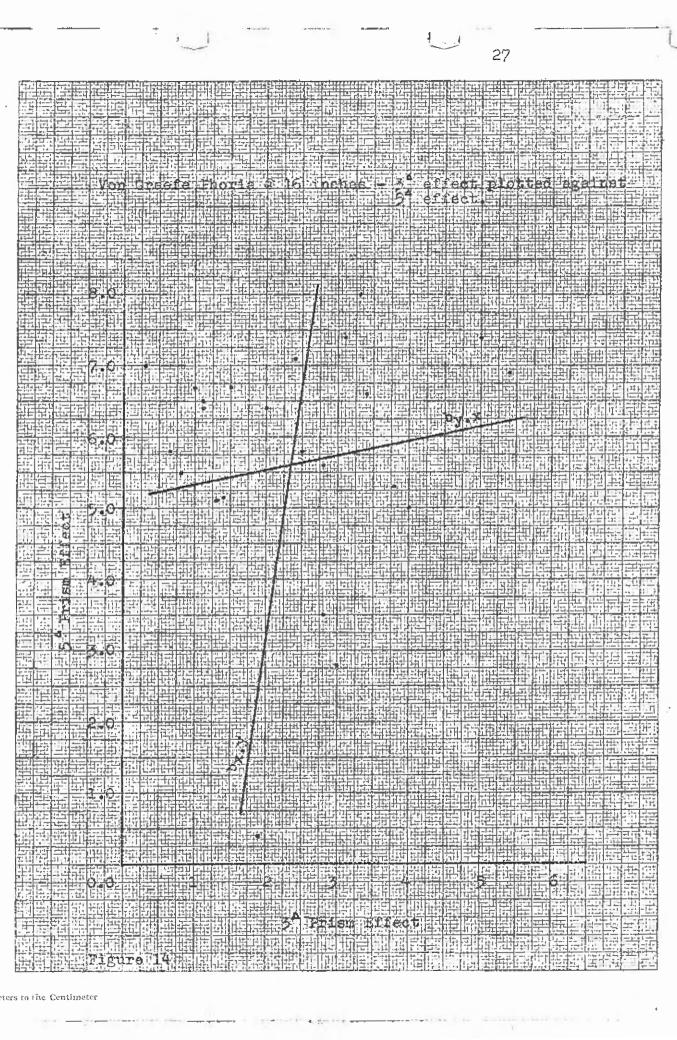


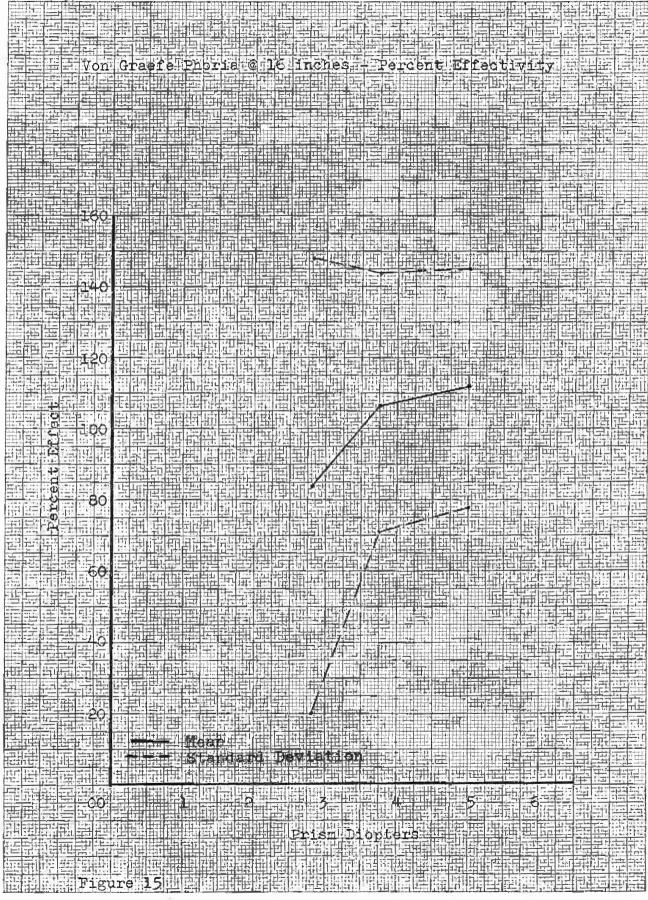
i vor	FOTHER FINGETS WELL		
	)		
6.0			
星期野雪雪剛快報			
假进型型站置			
四十二年9世三			
具品质型制度			
語話是短輪槍			
esens en sie.			
		( pr	
- 현기(부) 구역 인터 관광생 - 유명 한국 영화 (부) 등 현 (부)			
			ta liitet laabaakka jalet jalet kiroliilii laja maalaeta seksi 1997. Historia veeleste jalet valta ja en olimenteet kiroliilii ja suudistella jalet jalet ja jalet ja jalet ja jalet
		型性型组织 使用出版	
史學與自己記述			
三十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二			
		HO AR PERSON HOLLING	
			<b>元史信息出到四国古者是</b> 随风
		Terrien Fover	
Figure 1	religization		
10:11:11 11:1:11 TQ)		<u>, nemárka műlősőső, kidát filmasátulsét és</u>	

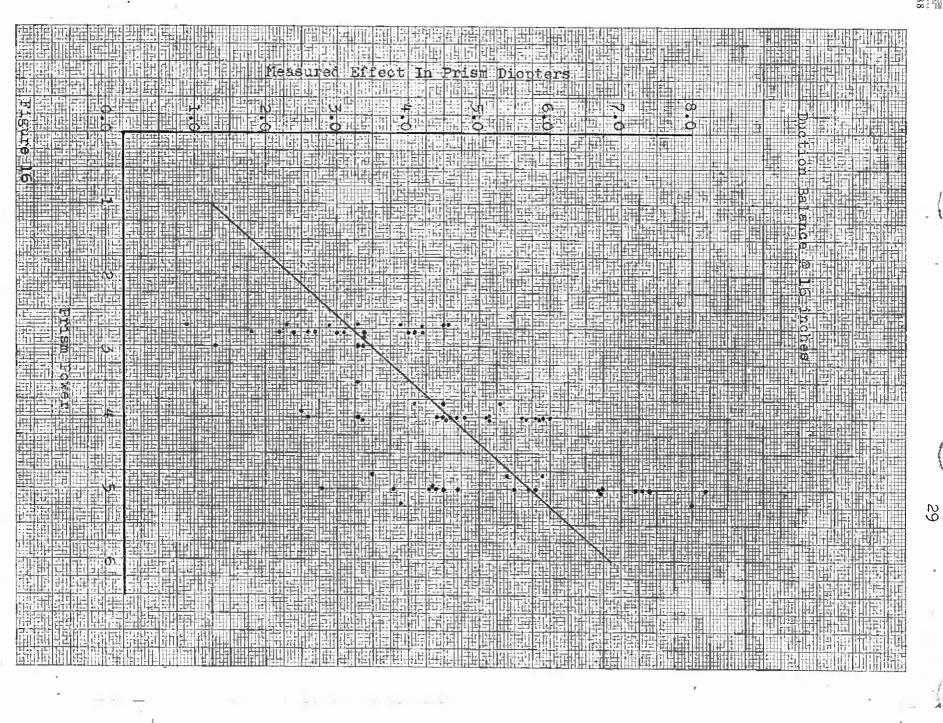
## Von Graefe Phoria @ 16 inches

- 1) Line of Best Fit  $\widetilde{Y} = a + bX$   $\widetilde{Y} = -1.49 + (1.42)X$
- 2) Regression Line
  - a)  $b_{x,y}$   $Y_3 = b(Y_5 - \overline{Y}_5) + \overline{Y}_3$  $Y_3 = .15(Y_5 - 5.56) + 2.35$
  - b)  $b_{y.X}$   $Y_5 = (b(Y_3 - \overline{Y}_3) + \overline{Y}_5)$ Y = 2.24(Y - 2.35) + 5.56



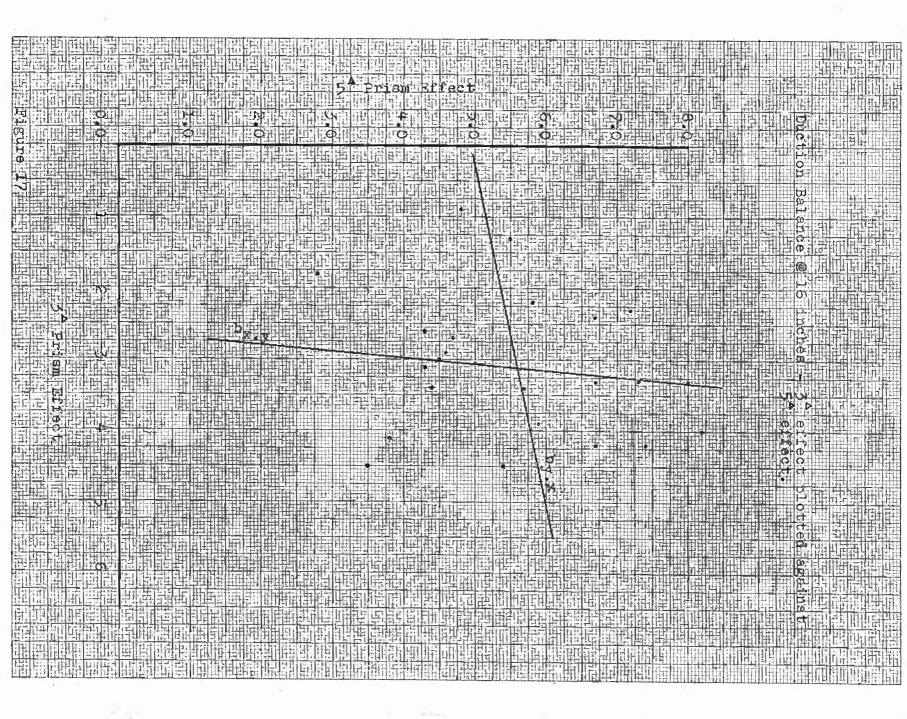




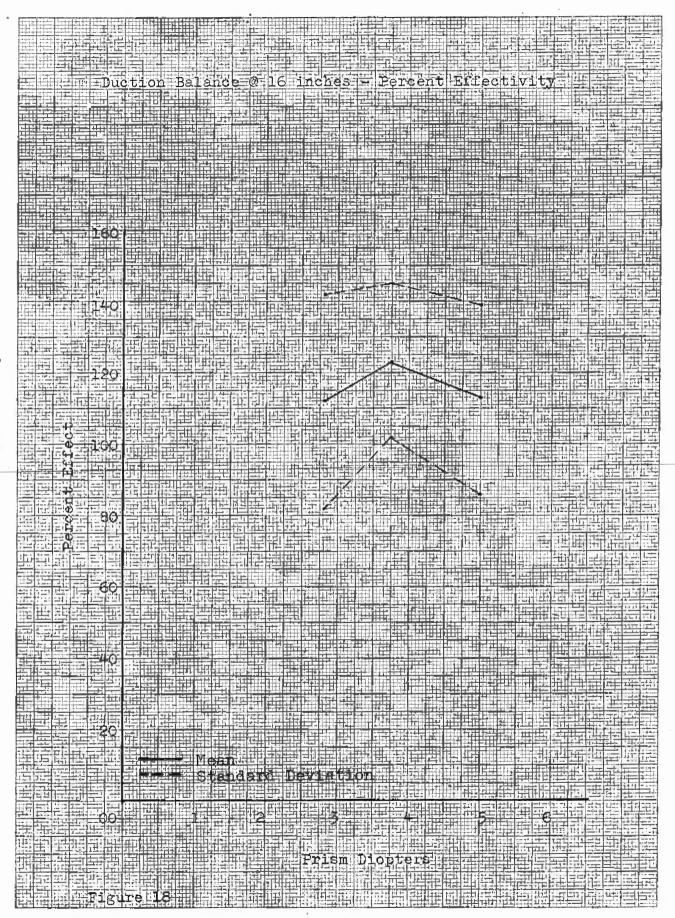


## Duction Balance @ 16 inches

- l) Line of Best Fit  $\widetilde{Y} = a + bX$   $\widetilde{Y} = .173 + (1.109)X$
- 2) Regression Line
  - a)  $b_{x.y}$   $Y_3 = b(Y_5 - \overline{Y}_5) + \overline{Y}_3$  $Y_3 = .084(Y_5 - 5.61) + 3.09$
  - b)  $b_{y.x}$   $Y_5 = b(Y_3 - \overline{Y}_3) + \overline{Y}_5$  $Y_5 = .211(Y_3 - 3.09) + 5.61$







#### POSSIBLE SOURCES OF ERROR

A source of error could have been the inferior centering of lenses. It is possible that on occasion a subject aligned undeviated images due to the decentering of the lenses; giving a reading of little or no effect from the prism. All patients should have been definately instructed to immediately report if they experienced monocular diplopia. The phorometer, with its lack of lens banks, enabled the examiner to objectively check lens position by looking at the lens over the measuring prisms.

Although an effort was made to keep the binocular exposure to a minimum during the testing, a certain amount of adaption to the vertical prism may have taken place.

In a future study, the examiners should consider pre-testing the subjects for adaption to vertical prism with vertical prism in the spectacle plane.

#### SUMMARY

There has been little written in the literature about the effect of prism in contact lenses on vertical testing. This study was conducted to determine if there is a consistent relationship between the amount of vertical prism worn in a contact lens and the amount of change in the subject's vertical phorias and ductions. Dominant eyes of twenty-six habitual contact lens wearers were fitted with three, four, and five prism diopter contact lenses. Vertical phorias were run at eighteen feet using the Von Graefe and Maddox Rod techniques and at sixteen inches using the Von Graefe technique. Vertical ductions were taken at both eighteen feet and sixteen inches.

For the three, four, and five prism diopter contact lens, there was a relation between the amount of prism worn and the measured effect. In three of the five tests, the mean effect of the three prism diopter lens was slightly less than the amount worn. The mean effect of the four and five prism diopter lenses was slightly in excess of the amount worn. On the duction balance at eighteen feet, in which the standard deviation was under 1.10 prism diopters, the amount of prism worn very closely approximated the effect measured. The near duction balance and near Von Graefe phoria measured considerably more effect than the prism in the contact lens.

#### BIBLIOGRAPHY

- Filderman, Irving P. "The Effect of Surrounding Media on Prismatic Contact Lenses" The Optometric Weekly, 56:26, July 1, 1965.
- Girard, Louis J. (Editor); Soper, Joseph Ward and Sampson, Whitney G. (Assistant Editors) Corneal Contact Lenses St. Louis, The C. V. Mosby Company, 1964.
- Gregory, Richard R., Hehn, Richard D., Milton, Duane G. A Study of the Effect of Vertical Prism in Contact Lenses as Related to Changes in Vertical Testing unpublished clinic year thesis at Pacific University College of Optometry, January, 1965.
- Grosvenor, Theodore P. <u>Contact Lens Theory and Practice</u> Chicago, The Professional Press, Inc., 1963.
- Mandell, Robert B. <u>Contact Lens Practice</u>: <u>Basic and Advanced</u>
  Springfield, Charles C. Thomas, Publisher, 1965.

APPENDIX

				APP	ENDIX A	*		
Lad.	R. Veryfes	Period			TO T	7 108	Bloom	Back Vertex
	THE RESERVE OF THE PROPERTY OF	COLUMN TO THE PARTY OF THE PART	P C C C C C C C C C C C C C C C C C C C			0.4	7	+ 95
17	7.43	3	dans de la constante de la con	.4/10.0		9.0	B/	
18	7.50	3		.4/10.33		9.0	18/	4.12
19	7.58	2 <b>.75</b>	7.7	.4/10.30	_	9.0	2/	+.12
20	7.67	· Oat	7.7	.4/10.4		9.0	3/	+.25
21	7.76	1.7	7.7	.4/10.4	. weste	9.0	В/	+.37
22	7.84	2.75	Section 19 19 19 19 19 19 19 19 19 19 19 19 19	.4/10.6	vilney	0.0	B/	++37
23	7.94			4/10.7	SIMSh	9.C	₽/	ma & S
24	8.04	2.75	7.7	4/10.75	CANS	9.0	-1/	4.00
14	7.38	20	6.5	4/9.75.	.4/8.50	8.7	3/3.0 3/9.0	+.50
7	7.55	4.0	6.5	4/9.75	.4/8.50	8.7	B/G.0 B/G.0	म्प्र
2	7.63	4.0	6.5	4/9.75	.4/8.50	8.7	3/8.0	pl
13	7.65	3.9	7.0	.4/10.0	.4/8.75	9,2	3/3.20 3/9,25	+,62
4	7 73	3,75	7.0	4/10.0	<b>.</b> 4/8 <b>.75</b>	9,2	B/3.25 5/0.25	İc
3	7.89	4.0	7.0	4/9.0	.4/10.2	9.2	D/8.50 D/9.50	+.25
6 `	7,94	4.0	7.0	4/9.0	.4/10.23	0.2	B/8.50 B/9.50	pl
16	8.0I	4.0	7.5	4/3.0	.4/10.20	9.7	3/3.50 3/9.50	4-65
5	7.40	5.0	6,5	4/9.75	.4/8.50	8.7	3/8.0 3/9.0	+,25
15	A CA	5,2	6,5	4/6.75	.4/8.50	8.7	B/8.0 B/6.0	+1.00
de de la constante de la const	7.61	4.8	7.0	4/10.0	.4/8.75	9.2	8/8.85 8/8.85	+.50
************************************	and the second	4.8	8.5	4/10.D	.4/8.76	8.7	3/8.25 3/8.30	ŢŢ
8	7.73	4.75	7.0	4/10.0	.4/8.75	9.2	3/0.25 3/9.25	+.12
10	Programmer Co.	5.0	7.0	4/10.28	.4/9.0	9.2	D/G.58 B/G.50	+.60
9:	Page 1	() *	7.0	4/10.20	.4/9.0	.9.2	3/3.60 3/9.50	+1.00
12	8.03	S & O	7 <b>s</b> 5	4/10.20	.4/0.0	9.7	3/8.30 3/9.50	+ 62
Contraction that the the track of our age to take the	MANAGEMENT AND A SECURITION OF THE PARTY OF	Samuel Serventer a some automorphism and a source	PT-PO-PT-PT-PT-PT-PT-PT-PT-PT-PT-PT-PT-PT-PT-	tion on an internation, or in an internation of the			Complete on relative to the com-	mountains of 12 to Ontolet 14 months and 1

Figure 19

APPENDIX B
SUMMARY OF COMPUTATIONS

		•	•	•	•	' -
Measure	X.3	<b>Z</b> Y	<b>E</b> X2	<b>£</b> Y <sup>2</sup>	<b>£</b> XY	<b>E</b> Y3Y5
3 <sup>4</sup> vG <sub>20</sub> ,	€6 <b>3°,7</b> 5	55.05	176.904	160.234	152.569	_
4 VG <sub>20</sub> ,	90.80	96.54	358.02	413.929	366.330	_
54 VG <sub>20</sub> ,	114.70	119.26	572.32	667.415	594.315	298.10
3 MR <sub>20</sub>	63.75	53.50	176.904	157.133	144.299	_
4 MR <sub>20</sub>	90.80	96.54	358.02	426.691	381.226	-
5 MR <sub>20</sub>	114.70	121.69	572.32	677.677	606.107	281.73
3 <sup>4</sup> 7VG <sub>16"</sub>	63.75	53.49	176.904	175.193	147.552	-
4 VG <sub>16"</sub>	90.80	93.14	358.02	416.03	361.644	-
5 VG <sub>16"</sub>	114.70	127.92	572.32	787.154	639.466	308.968
Duction Bal @ 20 feet	lance					
3 <sup>4</sup>	63.75	52.69	176.904	134.561	145.849	
4.4	90.80	90.32	358.02	381.980	354.532	-
5	114.70	116.45	572.32	605.137	581.744	273.47
Duction Bal @ 16 inches						
3 <b>b</b>	63.75	71.12	176.904	241.241	196.919	-
4 4	90.80	106.12	358.02	513.216	420.04	-
5 <b>A</b>	114.70	129.07	572.32	761.186	629.893	402.80