

AN EXPANDED GUIDE TO THE KEYSTONE STEREOGRAM CARDS



MICHELE LAXER, O.D. ■ JAY COHEN, O.D. ■ LEONARD J. PRESS, O.D.

ABSTRACT

The Keystone Telebinocular is, in all probability, the instrument which is most common to vision therapy practices. Paradoxically, the therapist usually has little, if any, idea of the prismatic demand of each card. Although this information is available to some extent, the sources are inconsistent, incomplete and obscure. Each card in a series is identified by two letters and a number, but the corresponding prismatic values do not always appear. The purpose of this paper is to present a concise guide to the card series which will serve as a centralized source of information on prismatic values.

KEY WORDS

Keystone Stereogram, telebinocular, stereoscope, vision training, vision therapy, binocular vision

There are many instruments which may be used for fusional training. The Bernell-O-Scope,^a Bioptr,^a Cheiroscope,^b Correct-Eye-Scope,^b and the Telebinocular^b are stereoscopic instruments for fusional stimuli, some of which may be used for testing as well as training.

The Keystone Telebinocular is one instrument which is well suited to both testing and training. It is a Brewster Stereoscope which, in contrast to a Wheatstone Stereoscope, uses a true septum rather than a mirror to dissociate the corresponding halves of the stereogram. The instrument has eyepieces consisting of +5.00 diopter spherical lenses. The optical centers are separated by 95mm, which induces base-out prism because of the wider separation than the average patient interpupillary distance. The viewing distance from the eyepiece to the stereogram card is 20cm. The ortho demand point at infinity is a 95mm separation between corresponding points on the stereogram cards, ie. when the points are 95mm apart, an ortho vergence demand is created. Any other separation distance induces a different vergence demand. At the infinity setting, the "rule of thumb" is that a 2mm separation is equivalent to a 1 prism diopter vergence demand. Lesser separation between corresponding points induces a base-out/convergence demand, while divergence is stimulated by a separation greater than 95mm. Griffin¹ provides a concise summary of these calculations.

The telebinocular creates an instrument-induced proximal vergence (eso

shift) of 4.5 prism diopters. A person who demonstrates orthophoria in real space will project 4.5 pd BO in the instrument, representing an eso shift of 9mm. To compensate for this change, the corresponding points on the stereogram card considered to represent orthophoria at infinity are separated by 86mm, rather than 95mm. Consequently, an 86mm separation between corresponding points represents clinical orthophoria, but an actual prismatic demand of 4.5 prism diopters base-out.

The card holder itself is movable, and allows for changing accommodative/vergence demands. The shaft is calibrated so that the practitioner knows the amount of accommodation stimulated at a given point. The vergence demand at each point, however, cannot be indicated since it varies with the separation of corresponding points on the stereogram. One of the purposes of this paper is to indicate the vergence demand at the two primary reference locations—infinity and 40 cm. It should be noted that in order to maintain fusion, the tromboning of the stereograms inward creates "BIM" (increased divergence demand as accommodation is stimulated), and that movement outward creates "BOP" (increased convergence demand as accommodation is relaxed).²

The Keystone hand-held stereoscope designed for home training differs from the telebinocular in that its +5.00 diopter lenses are separated optically by 85mm rather than 95mm.³ Therefore, the prismatic demand of any stereogram card is 5 prism diopters more base-in (or 5 less base-out) when used in the hand-held

stereoscope as compared with the telebinocular. As an aside, the Titmus Biotop and the Bernell-O-Scope, two stereoscopes commonly used for home training are equivalent optically to the Keystone hand-held stereoscope.

We calculated the vergence demand in prism diopters at infinity for each of the Keystone cards using the following formula:⁴

$$V = (P \times LS) - TS/TD$$

V = Vergence demand in prism diopters (positive value represents convergence; negative value represents divergence)

P = Power of stereoscope lenses in diopters

LS = Separation of optical centers of stereoscope lenses in centimeters

TS = Separation of corresponding points of stereogram half-views in centimeters

TD = Distance of stereogram from stereoscope lenses in meters

For Example: AN Series Card #10 (see Figure 1) is a picture of a mountain scene with 10 numbers in a circular array. Measurement of the distance between corresponding numbers in each half of the stereogram reveals that the minimum separation occurs between the numbers "1" (62mm), and the maximum separation between the numbers "10" (82mm). Let us calculate the vergence demand when the patient is able to fuse the numbers "1", with the card positioned at the infinity point on the telebinocular shaft.

$$V = (P \times LS) - TS/TD$$



Figure 1.

$$V = (5 \times 9.5) - 6.2/(.2)$$

$$V = 47.5 - 31$$

$$V = 16.5$$

Since the positive V values represent convergence, the vergence demand is 16.5 prism diopters base-out.

For the same card used in a hand-held stereoscope in which the optical centers are separated by 85mm, the value of LS

becomes 8.5. The calculation of the prismatic demand is as follows:

$$V = (P \times LS) - TS/TD$$

$$V = (5 \times 8.5) - 6.2/(.2)$$

$$V = 42.5 - 31$$

$$V = 11.5$$

If we wish to calculate the vergence demand for points on the shaft other than infinity, we must specify the point in terms of its accommodative demand. This enables us to mathematically determine the TD (distance of stereogram from stereoscope lenses in meters) by use of the following formula:

$$A = 1/TD - P$$

Where:

A = Accommodation in diopters

TD = Distance of the stereogram from stereoscope lenses in meters

P = Power of stereoscope lenses in diopters

Returning to our example of AN series card #10, point #1 (separation 62mm), let us calculate the demand when the patient fuses the target at 40cm (2.5 diopters) in the telebinocular:

$$A = 1/TD - P \quad V = (P \times LS) - TS/TD$$

$$2.5 = 1/TD - 5 \quad V = (5 \times 9.5) - (6.2)(7.5)$$

$$1/TD = 7.5 \quad V = 47.5 - 46.5$$

$$V = 1$$

Remembering that positive V values represent convergence, the vergence demand therefore is 1 prism diopter base out. The demand changed from 16.5 prism diopters BO to 1 prism diopter BO when the card moved from infinity to the 2.5 D setting.

The reader who is familiar with the Keystone stereogram cards will note that prismatic values for infinity and near shaft settings are given on the reverse side of the AN Series cards. However, these values are not uniformly consistent with the values calculated using the formula presented above. Furthermore, prismatic values do not appear on the reverse side of the EC and BU series cards.

Some of the Keystone card series discussed in this paper may no longer be available from the manufacturer. It is our belief that these cards are still available in many vision therapy practices and optometric institutions. We have selected those cards which we believe to be most commonly used in vision therapy programs. Since the stereogram cards do

not "wear out," the tables in this paper should be relevant and useful. These tables are best used when the practitioner or therapist has the stereogram card at hand. Abbreviations have been used because of space limitations in the tables. These abbreviations are clarified by using the table and card together.

Each series of cards has its own unique features. Prior to presenting the tables of calculated prismatic values, we will overview the respective Keystone Stereogram Cards. Within each discussion we will explain certain features of our calculations and the cards themselves so that the tables can be maximally understood and utilized. All calculations are based on a 95mm separation of corresponding points of the card halves representing zero vergence demand. In other words, the vergence demands presented here do not take proximal vergence into account.

BU SERIES

The Basic Unit series consists of 38 cards developed by Dr. Frederick Brock for binocularity development (Figure 2). The cards progress from luster to normal retinal rivalry to peripheral stereopsis to macular awareness. Most of the cards are meant to be used with a training ring, such as a Russell Ring. This ring may be constructed from a pipe-cleaner which has a loop bent around one end and maintains a straight shaft on the other which can then be held by the patient. The ring stabilizes fusion and specifies foveal projection.



Figure 2.

On the BU 5-8 cards, separation is measured between the number on the one half of the card and the object of regard on the other. Accurate projection of the number on the picture represents clinical orthophoria. For the BU 17-35 cards, the numeric values in Appendix A represent the millimeters of minimum to maximum

separation of corresponding points, and a description of the picture details the location of the target float within the picture itself when stereopsis is present.

The BU series may be broken down as follows:

- Card 1-4 Luster targets
- 5-8 Normal retinal rivalry
- 9-15 Peripheral stereo with macular rivalry
- 16-38 Float is present, used to reduce phorias and establish fusional hold
- 9-20 Have peripheral stereo targets
- 21-34 Introduce linear stereo targets
- 22-29 Have specific foveal targets of decreasing size
- 35-38 Not designed for treatment, used to measure quality of stereopsis

Appendix A contains the values for the BU card series.

AN SERIES

The Ann Nichols Series consists of 86 cards which were developed by Ann Sutton Nichols. They were designed to develop visual skills, including eye-hand coordination, fusional reserves, accommodation and stereopsis.

The values listed are for use with the telebinocular. If the card is to be used on a home stereoscope, then the vergence demand is altered by 5 prism diopters base-in. Separation of the targets is the measured disparity of the stereogram in millimeters. The calculated values occasionally differed from the values printed on the back of the card. These printed values are indicated in parentheses when necessary.

There have been several re-issues of the AN series, and although the stereograms are identical in all, the values differ on some cards from one series to the next.

The AN series may be subdivided into 9 units of primary utilization as follows:

Unit I Cards 1-4 Version and suppression

Used for pointer training; stars have minimal fusional demand; 3 & 4 have stereopsis

Unit II 5-10 Version and suppression, moderate BO

Unit III 11-18 Fusion amplitude, strong base-out

Used with pointers; has fairly high BO and

BI demand; develops fusional amps; alternate cards have BI and BO demand; odd numbers have intermediate/near range; even numbers have intermediate/far range

Unit IV 19-32 Jump duction

Used for increasing stereoscopic projection; similar demand for fusional jump in each pair (2prism diopters)

Unit V 33-46 Moderate/strong BI and BO (Jump duction)

Similar to Unit IV but has higher vergence demands

Unit VI 47-56 Farpoint stereopsis

Set card at infinity

Unit VII 57-66 Intermediate point stereopsis

Set card at 1.25

Unit VIII 67-76 Nearpoint stereopsis

Set card at 2.50

Unit IX 77-86 High BO and BI (Jump duction)

High level jump vergence BO and BI on each card (4-24 prism diopters)

Appendix B contains the values of the AN card series.

HOME TRAINING SERIES (EC CARDS)

These cards are designed for the hand-held telebinocular or correct-eye-scope (distance between lenses = 85mm) (Figure 3). If they are utilized with a regular telebinocular, the base-out demand is increased by 5 prism diopters (distance between lenses = 95mm). The series is designed for use in home therapy.

The cards may be used at infinity or at near (2.50 on the shaft), and are good for the tromboning technique. In general, the base-in demand increases on the order of 15 to 25 prism diopters when the card is shifted from the infinity setting to the near setting.

The EC cards may be divided into



Figure 3.

base-in and base-out training series. The Eta and the Zeta Units are composed of specific Ann Nichols cards, and not the EC cards.

These series may be summarized as follows:

SERIES	RANGE OF PRISM DEMANDS		USE
	At Infinity	At Near	
Alpha (EC1-12)	30 BO-0 BI	23 BO-21 BI	Exophoria
Delta (EC41-52)	33 BO-5 BI	27 BO-29 BI	High level exotropia training
Gamma BO(EC21-32)	31 BO-12 BI	25 BO-41 BI	Children, exotropes
Eta (AN 7,14,15,19) (17,18,49,77-82)	19 BO-11 BI	6BO-38 B6	Basic fusion skills
Beta (EC101-112)	17.5 BO-15 BI	2 BO-45 BI	Convergence excess
Gamma BI(EC141-152)	31 BO-13 BI	25 BO-41 BI	Esophoria in children, advanced esotropia training
Epsilon (EC121-132)	10 BO-14 BI	2 BO-43 BI	Fusion and stereo with esophores
Zeta (AN 9-13,16,24,31,35,36,47,48)	16 BO-5 BI	1 BO-30BI	Mild esophoria
Theta	17.5 BO-15 BI	2 BO-45 BI	Supplements Beta Unit

Appendix C contains the values of the EC card series.

ADULT EYE COMFORT SERIES

This series contains 24 cards of text which are used for home therapy of the patient with convergence insufficiency, including symptomatic presbyopes. Each card is 1 prism diopter more base-out than the previous card and is designed for use in the hand-held stereoscope (separation between the lenses = 85mm). The difference in base-out demand from the top to the bottom of the card is an increase of 4 prism diopters base-out. If the patient has difficulty at infinity, move the card toward the patient until he or she is able to fuse. Card #23 is for the building of ranges and recovery.

The paired numbers under the infinity and near columns represent the demand at the top of the card as compared to the demand at the bottom of the card.

Appendix D contains the values of the Adult Eye Comfort cards.

CHILDREN'S STORIES

There are two series of Children's Stories with 24 cards in each series. The base-out series consists of the following stories: *Cinderella*, *The Three Billy Goats*, *Bobby's Christmas*, and *The Three Bears*. The base-in series is comprised of *The Ugly Duckling*, *The First Thanksgiving*, *The Three Pigs*, and *Peter Rabbit*. Each story consists of six cards. The range of the entire set is 21 prism diopters base-out to 35 prism diopters base in.

The numbers are calculated for use in the hand-held stereoscope in a home therapy situation. The paired numbers under the infinity and near columns represent the demand at the top of the card as

compared with the demand at the bottom of the card.

Appendix E contains the values of the Children's Story cards.

NOTE

This paper was written for partial fulfillment of the requirements for the Residency in Vision Therapy at SUNY, State College of Optometry.

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Corresponding author:

Michele Laxer, O.D.

SUNY State College of Optometry

100 E 24th St.

New York, NY 10010

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APPENDIX A

BU SERIES:

CARD	TARGETS	SEPARATION OF CORRESPONDING POINTS	VERGENCE DEMAND*
1-3	LUSTRE/DOT	86mm	4.5BO
4	"+" FORMED W/LUSTRE	86mm	4.5BO
5	1/FLOOR LAMP	86mm	4.5BO
	2/LEFT HALF OF CHANDELIER	86mm	4.5BO
	3/ANGEL ON ARCH	86mm	4.5BO
	4/STND'G FIGURE RIGHT	86mm	4.5BO
	5/BACK OF ARM CHAIR	86mm	4.5BO
	6/SMALL RT CIRCLE ON RUG	86mm	4.5BO
	7/BETW CLOCK AND VASE ON MANTLE	86mm	4.5BO
6	1/IN SECOND ARCH ON LEFT	86mm	4.5BO
	2/BETW DOOR AND DBLE COLUMN	86mm	4.5BO
	3/TO RIGHT OF FIGURE	86mm	4.5BO
	4/ON 2ND FRNT COLUMN FROM RT	86mm	4.5BO
	5/ON LEFT CHANDELIER	86mm	4.5BO
	6/ON RIGHT CHANDELIER	86mm	4.5BO
	7/LEFT MARGIN OF PICTURE	86mm	4.5BO
	8/ON STRIPE ON FLOOR	86mm	4.5BO
7	1/ABOVE SAIL	86mm	4.5BO
	2/BODY OF SAILBOAT	86mm	4.5BO
	3/ON MOUNTAINS	86mm	4.5BO
	4/ABOVE MASTS OF BOATS ON LT	86mm	4.5BO
	5/TO RIGHT OF ROWBOAT	86mm	4.5BO
	6/TO LEFT OF ROWBOAT	86mm	4.5BO
	7/IN WATER	86mm	4.5BO
	8 & 9/IN SKY	86mm	4.5BO
8	1/ON CENTRAL HANGING BRANCH	86mm	4.5BO
	2/CLEARING BETW. BRANCHES	86mm	4.5BO
	3/ABOVE LEFT HANGING BRANCH	86mm	4.5BO
	4/CLRING IN FLD (BY LEFT BARE TREES)	86mm	4.5BO
	5/ON MOUNTAIN	86mm	4.5BO
	6/BELOW RIGHT HANGING BRANCH	86mm	4.5BO
	7/ON CENTRAL BARE TREES	86mm	4.5BO
	8/RIGHT BRANCHES	86mm	4.5BO
9	MOUNTAIN SCENE	86mm	4.5BO
10	RIVER SCENE (WITH COWS)	86mm	4.5BO

*The vergence demand column represents the calculated vergence prism demand.

APPENDIX A cont'd

CARD	TARGETS	SEPARATION OF CORRESPONDING POINTS	VERGENCE DEMAND*
11	AMSTERDAM SCENE	86mm	4.5 BO
12	AERIAL STREET VIEW	87mm	4 BO
13	RIVER SCENE W/BOAT & MTN	87mm	4 BO
14	BANANA PLANTATION	85-86mm	5-4.5 BO
15	CHURCH SCENE	86-87mm	4.5-4 BO
16	BALL (A/B)	86.5mm	5-4 BO
	CROSS	87 mm	4BO
	MAN	87.5 mm	3.5BO
17	LARGE ARC (IN FOREGROUND)-83mm	83-86mm	5.5-4 BO
	SMALL ARC -85.5mm -(BEHIND RIGHT FIGURE)		
18	CIRCLE (FOREGRND)- 82mm	82-85mm	6.5-4 BO
	ARC (BEHIND TREES)- 85mm		
19	LARGE CIRCLE (FOREGRND)-80mm	79-87mm	8-4 BO
	RT. SMALL CIRCLE- 86.5mm-(IN FRONT OF REAR TREE)		
	LFT. SMALL CIRCLE- 86mm -(EVEN WITH MIDDLE TREE)		
20	LG CIRCLE - 84mm (IN FRNT OF FLOCK)	83-86mm	6-4.5 BO
	MED. CIRCLE - 85mm (OVER FLOCK)		
	SM. CIRCLE - 86mm (CENTRAL BUSH)		
21	CIRCLE- 84mm (FOREGRND)	82-87mm	6.5-4 BO
22	RING - 84.5mm (EVEN W/WKR ON ROPE)	81-87mm	7-4 BO
	CIRCLE- 84mm (BEHIND FOREGRND CLIFF)		
	LINE - 81-87mm (FOREGRND - BKGRND)		
23	RING - 84mm (FOREGRND)	84-87mm	5.5-4 BO
	CIRCLE - 83mm (FOREGRND)		
	LINE - 86-87mm (FOREGRND - BKGRND)		
24	ARC - 86mm (BEHIND CART)	83-88mm	6-3.5 BO
	CIRCLE - 84mm (FOREGRND)		
	LINE - 84-88mm (FOREGRND-BKGRND)		
25	DOT - 84mm (FOREGRND)	81.5-88mm	5.5-3.5 BO
	LINE 81.5-88mm (FOREGRND-BKGRND)		
26	ARC - 80mm (OVER CHILDREN)	78-80mm	8.5-7.5 BO
	DOT - 78mm (MIDGRND)		
27	RT LINE - 83-87mm (FOREGRND-BKGRND)	83-87mm	6-4 BO
	LFT LINE END IN DOT - (FOREGRND - MIDGRND)	82-84mm	6.5-5.5BO
28	TOP & BOTM LINES - 80-85mm (FORE-MIDGRND)	80-87mm	7.5-4 BO
	RING IN MIDDLE OF TROUGH - 85mm (MIDGRND)		
	DOT - 82.5mm (FOREGRND)		
29	LGE RING - 83.5mm (BEHIND MOTHER & CHILD)	80-85mm	7.5-5 BO
	SM. RING - 84mm (IN FRONT OF MOTHER & CHILD)		
	DOT - 82mm (FOREGRND)		
30	LINE - 55-72mm (FOREGRND - SOLE OF SHOE)	55-86mm	20-4.5 BO
	DOT - 69mm (FOREGRND)		
31	RT LINE - 85.5mm (VERT. - MIDGRND)	82.5-86mm	6.5-4.5 BO
	LFT LINE - 82.5-86.5mm (FOREGRND - BKGRND)		
32	RT LINE - 77.5-82.5mm (FORE-MIDGRND)	77.5-86mm	8.5-4.5 BO
	LFT LINE - 82-85mm (MID-BKGRND)		
33	TOP RING - 85mm (BY WORKER)	73.5-85mm	10.5-5 BO
	BOTTOM RING - 82mm (FOREGRND)		
	LINE - 73.5-82.5mm (FREGRND-BSKT)		
34	RING - 81.5mm (FOREGRND)	81.5-87mm	6.5-4 BO
	LINE - 85-87mm (FRG/UPR-MIDGRND)		
35	RING - 76mm (BEHIND BARRELS)	73.5-78mm	10.5-8.5 BO
	DOT - 73.5mm (FOREGRND)		
36	TOP ARC - 82.5mm (BETW FAWNS)	79-85mm	8-5 BO
	BOTTOM ARC - 80mm (FOREGRND)		
	DOT - 84mm (BKGRND)		
37	#1(BKGRND LT)	87mm	4.0BO
	#2(CTR STDM)	85mm	5.0BO
	#3(BKGRND RT)	88mm	3.5 BO
	#4(FRGRND MID)	86mm	4.5BO
	#5(MIDGRND RT)	84mm	5.5BO
38	RT LINE: BOT'M SEG(85-86.5mm) (FORE-MIDGRND)	82-86mm	6.5-4.5 BO
	TOP SEG (85.5-86mm) (MID-BKGRND)		

LFT LINE - 82-85mm
 SERIES OF SHORT SEGS, PROGRESSIVELY FURTHER AWAY

*The vergence demand column represents the calculated vergence prism demand.

APPENDIX B

AN SERIES:

CARD	TB* PRISM DEMAND	MIN/MAX SEP'N**	TOTAL VERGENCE CHANGE***	CARD	TB* PRISM DEMAND	MIN/MAX SEP'N**	TOTAL VERGENCE CHANGE***
Unit I:				Unit VI:			
1,2	9BO (9.5)	77mm (76)	0	47	8.5BO	78mm	
3,4	8BO (8.5)	#1-79mm(80)	3	48	7.0BO	81mm	
	11BO (11.5)	#9-73mm(74)		49	9(8.5)BO	77mm(78mm)	
Unit II:				Unit VII:			
5,6	9 (9.5)-11BO	#1-77mm	2(7)	50	8.5BO	77mm	
		#7-73mm		51	10BO	75mm	
7,8	10(9.5)-17BO	#1-75mm(76)	7	52	10BO	75mm	
		#7-61mm(62)		53	9.0BO	79mm	
9	19.25-9.25BO	#1-56.5mm(62)	10	54	8.0BO	79mm	
	(17-6BO)	#10-76.5mm(83)		55	9.5BO	76mm	
10	16.5-6.5BO	#1-61mm	10	56	10BO	76mm	
		#10-82mm		Unit VIII:			
Unit III:				57	13.5BO	69mm	
11	7-11BO	#6-81mm(82)		58	13.5BO	68mm	
	(6.5BO)	#5-73mm	4.5	59	12.5BO/16BO	T-69mm/B-63mm	2.5
12	9-11BO	#6-77mm(78)	2	60	13BO	T-68mm/B-68mm	
	(8.5-10.5)	#1-73mm(74)		61	13BO	69mm	
13	7-14BO	#6-81mm(82)	7	62	13BO	69mm	
	(6.5BO)	#5-67mm(7.5)		63	13BO	69mm	
14	8-9.5BO	#10-76.5mm	2	64	13BO	69mm	
		#1-74mm(75)	(1.5)	65	14BO	68mm (69)	
15	7-14.5BO	#1-81mm(82)	7.5	66	13BO	69mm	
	(6.5BO)	#10-66mm	(8)	Unit IX:			
16	6.25-11.5BO	#10-82.5mm(84)	5.25	67	17.5BO	60mm	
	(5-11BO)	#1-72mm(72.5)	(6)	68	17BO	59mm	
17	6.5-21BO	#1-82mm(83)	14.5	69	17.5(16.5)BO	61mm (62)	
	(6-20.5)	#6-53mm(54)		70	17.5(17)BO	60mm (61)	
18	3.5-11.5BO	#10-88mm(89)	8	71	17BO	61.5mm	
	(3-11BO)	#7-72mm(73)		72	16.5BO	62mm	
Unit IV:				73	16BO/18.5BO	T-63mm/B-58mm	2.5
19	3-5BO	T-89mm/B-85mm	2	74	17BO/18.5BO	T-61mm(59)	1.5
20	3.5(3)-5.5(5)BO	T-88mm(89)/B-84(85)	2		(10BO/18BO)	B-58mm(59)	
21	5.5-7.5BO	T-84mm/B-80mm	2	75	T-16BO	T-63mm	1.5
22	5.5(5)-7.5(7)BO	T-84mm(85)/B-80(81)	2		M-17.5BO	M-61mm	
23,24	7.5(7)-9.5(9)BO	T-80mm(81)/B-76(77)	2		B-17BO	B-61.5mm	
25	9-11BO	T-76.5mm/B-72.5	2	76	#1-16BO	#1-63mm	2.0
26	9.5(9)-11.5(11)BO	T-76mm(77)/B-72(73)	2		#2-16.25BO	#2-62.5mm	
27	11-13BO	T-73mm/B-69mm	2		#3-17BO	#3-61.5mm	
28	11-13BO	T-72.5mm/B-68.5mm	2		#4-15.5BO	#4-63.5mm	
29,30	13-15BO	T-69mm/B-65mm	2				
31	15.5(15)-17.5(17)BO	T-64mm(65)/B-60(61)	2	77	16-23.5 (23)BO	T-63mm/B48(49)	7.5(7)
32	15-17BO	T-65mm/B-61mm	2	78	14-18.5 (18)BO	T-67mm/B-58(59)	4.5(4)
Unit V:				79	7.5(8)-18BO	T-80mm(79)/B-69	5.5(5)
33	17.5(17)-19.5(19)BO	T-60mm(61)/B-56(57)	2	80	1(0)BO-14.5(14)BO	T-93mm(95)/B-66(67)	13.5(14)
34	2(1) BO-4(3) BO	T-91mm(93)/B-87(89)	2	81	4.5 BI-13 BO	T-104mm/B-69mm	17.5
35	19-21BO	T-57mm/B-53mm	2		4BI-14BO)	(T-103mm/B-67)	(18)
36	0.5 BO-2.5 BO	T-94mm(97)/B-90(93)	2	82	5 BI-11.5 BO	T-105mm/B-72mm	16.5
	(1 BI-1 BO)				4 BI-9 BO)	(T-103mm/B-77)	(13)
37	21.5(21)-23.5(23)BO	T-52mm(53)-B-48(49)	2	83	3(4)BI-8 BO	T-101mm(103)/B-79	11(12)
38	2.5 BI-0.5 BI	T-100mm/B-96mm	2	84	6.5 BI-14.5BO	T-108mm/B-66mm	21
	(3 BI-0)	(T-101/B-95)	(3)		(6 BI-14BO)	(T-107mm/B67)	(20)
39	23.5(23)-25.5(25)BO	T-48mm(49)/B-44(45)	2(3)	85	6 BI-16 BO	T-107mm/B-63mm	22
40	4(5) BI-2 BI	T-103mm(105)/B-992	(3)	86	5.5 BI-18.5 BO	T-106mm/B-58mm	24
41	26.5(25)-28.5(27)BO	T-42mm(45)/B-38(41)	2		(6 BI-18 BO)	(T-107mm/B59)	
42	6.5(7) BI-4.5(5)BI	T-108mm(109)/B-104(105)	2				
43	27-29BO	T-41mm/B-37mm	2				
44	8.5(9) BI-6.5(7)BI	T-112(113)/B-108(109)	2				
45	29-31BO	T-37mm/B-33mm	2				
46	10.5(11)BI-8.5(9)BI	T-116(117)/B-112(113)	2				

* Telebinocular

** The separation column represents the total millimeter separation from the point of least to the point of most demand.

*** This column indicates the total change in vergence demand from the point of least to the point of most demand.

The number in parentheses is the value given on the back of the stereogram card when different from the value actually measured.

"T" indicates the top stereogram value, and "B" is the value of the bottom target.

APPENDIX C*

HOME TRAINING SERIES (EC CARDS)

CARD	INFINITY	NEAR	MIN/MAX SEP'N
<i>ALPHA BO</i>			
EC 1	3 BO-0.5 BO	16.75BI-20.5BI(#4-#1)	79mm/84mm
2	6 BO-3 BO	12.25BI-17.125BI(#4-#7)	73mm/79.5mm
3	6 BO-0 BO	12.25BI-21.25BI (#3-#8)	73mm/85mm
4	8.5 BO-2.5BO	8.5BI-18.625BI(#6-#2)	68m/81.5mm
5	3.5 BO-8.5 BO	16BI-8.5 BI	78mm/68mm
6	5 BO-13 BO	13BI-1.75 BI	74mm/59mm
7	6 BO-20 BO	12.25BI-8.75BO	73mm/45mm
8	11BO-26BO	4.75BI-17.75BI	63mm/33mm
9	11BO-33.5BO	4.75BI-24.5BO	63mm/24mm
10	12.5BO-2 BO	3BI-18.25BO (#1-#10)	60.5mm/81mm
11	4 BO	14 BI	76mm/76mm
12	4 BO	14 BI	76mm/76mm

DELTA BO:

EC 41	12BO- 5BI	19BI- 29BI (G-E)	81mm/95mm
42	7BO- 3BO	11BI- 17BI (I-W)	71mm/79mm
43	13BO- 2BO	2BI- 19BI (Crest-Mts)	61mm/81mm
44	10BO- 5BO	7BI- 14BI (A-N)	65mm/75mm
45	3.5BO- 14BO	16BI-1BI	78mm/58mm
46	6BO- 14BO	13BI- 1BI	73mm/57mm
47	7BO- 20BO	11BI- 8BO	71mm/45mm
48	8BO- 23BO	10BI- 13BO	69mm/39mm
49	10BO- 28BO	7BI- 20BO	65mm/29mm
50	33BO- 16BO	27BO- 2BO (1-5)	19mm/53mm
51	4 BO-2BO	14BI-16BI	76mm/80mm
52	5BO-4BO	14BI-15BI	75mm/76mm

GAMMA BO:

EC 21	15BO- 5BI	1BO-29BI(squirrel-plane)	55mm/95mm
22	13BI- 10BI	47BI- 37BI	111mm/105mm
23	9BI- 4BI	35BI-28BI	103mm/93mm
24	5BI- 0BI	29BI- 21BI	95mm/85mm
25	0BI- 6BO	21BI- 13BI	85mm/73mm
26	7BO- 12BO	11BI- 4BI	71mm-61mm
27	15BO- 12BO	1BO- 4BI	55mm/61mm
28	16BO- 20BO	2BO- 8BO	53mm/45mm
29	22BO- 25BO	11BO- 16BO	41mm/35mm
30	24BO- 31BO	14BO- 25BO	37mm/23mm
31	8BI- 28BO	34BO- 20BI	101mm/29mm
32	27BO- 2BI	19BO- 25BI	31mm/89mm

ETA BO: SEE AN SERIES #7, 14, 15, 17, 18, 49, 77-82

BETA BI

EC101	1.5BO-6BO	19BI-12.25BI (1-4)	82mm/73mm
102	0.5BO-8BO	20.5BI-9.25BI (5-9)	84mm/69mm
103	9BO-2.5BO	7.75BI-25BI (1-4)	67mm/90mm
104	3.5BI-7.5BO	26.5BI-10BI (1-4)	92mm/70mm
105	18BO-13BO	5BO-1.75BI	50mm/59mm
106	10BO-5BO	6.25BI-13.75BI	65mm/75mm
107	2.5BO-1.5BI	16.375BI-23.5BI	78.5mm/88mm
108	4.5BI-9.5BI	28BI-35.5BI	94mm/104mm
109	10BI-15BI	37BI-44.5BI	106mm/116mm
110	12.5BO-1.5BO	2.5BI-19BI (1-10)	60mm/82mm
111	4BO	16BI	76mm/76mm
112	6BO-3BO	13BI-16BI	72mm/78mm

CARD	INFINITY	NEAR	MIN/MAX SEP'N
<i>GAMMA BI:</i>			
EC141	15BO-5BI	1BO-21BI(squirrel-plane)	55mm/95mm
142	31BO-24BO	25BO-15BO	23mm/37mm
143	25BO-22BO	16BO-12BO	35mm/41mm
144	20BO-16BO	8BO-2BO	45mm/53mm
145	15BO-12BO	1BO-2.5BI	55mm/60mm
146	12BO-7BO	4BI-11BI	60mm/71mm
147	6BO-0 BO	13BI-21BI	72mm/85mm
148	0BO-5BI	21BI-29BI	85mm/95mm
149	4BI-9BI	28BI-35BI	93mm/103mm
150	10BI-13BI	37BI-41BI	105mm/111mm
151	27BO-8BI	19BO-34BI	31mm/101mm
152	3BI-26BO	26BI-17BO	90mm/33mm

EPSILON BI:

EC12113BO-3BO	1BI-17BI (U-E)	58mm/78mm	
122	14BO-9BO	0BO-7BI (U-C)	56mm/66mm
123	5BO-3BI	14BI-26BI (L-N)	74mm/91mm
124	16BO-6BO	2BO-13BI	52mm/73mm
125	10BO-3BO	7BI-17BI	64mm/78mm
126	4BO-3BI	16BI-26BI	76mm/90mm
127	2BI-6BI	25BI-31BI	89mm/97mm
128	4BI-12BI	27BI-39BI	93mm/109mm
129	7BI-11BI	32BI-38BI	99mm/107mm
130	10BI-14BI	37BI-43BI	105mm/113mm
131	5BO-3BO	14BI-16BI	74mm/78mm
132	1.5BO-0 BO	19BI-21BI	82mm/85mm

THETA BI:

EC 1	10BO-5BO	6BI-14BI	65mm/75mm
2	5BO-3BI	14BI-26BI	75mm/91mm
3	5BI-10BI	29BI-36BI	95mm/105mm
4	17.5BO-12.5BO	5BO-2.5BI	50mm/60mm
5	0BO-5BI	21BI-29BI	85mm/95mm
6	11BI-16BI	38BI-45BI	107mm/117mm
7	4BO-5BO	15BI-14BI (1-6)	77mm/75mm
8	5BO-0BO	14BI-21BI (1-2)	75mm/85mm
9	9BO-1.5BI	8BI-23.5BI (3-6)	67mm/88mm
10	12BO-1.5BO	3.25BI-19BI (1-10)	61mm/88mm
11	2.5BO	17.5BI	80mm
12	3.5BO	16BI	78mm

ZETA BI: SEE AN SERIES #9-13, 16, 24, 31, 35, 36, 47, 48

*If the cards are to be used in the telebinocular, add 5 prism diopters base-out to the vergence value. The "near" setting is at 2.50 on the telebinocular shaft.

APPENDIX D*

ADULT EYE COMFORT SERIES

CARD	INFINITY	NEAR
1	5BO/9BO	14BI/8BI
2	6BO/10BO	13BI/7BI
3	7BO/11BO	12BI/5BI
4	8BO/12BO	10BI/4BI
5	8BO/13BO	10BI/2BI
6	9BO/13BO	8BI/2BI
7	9BO/14BO	8BI/1BI
8	9BO/14BO	8BI/1BI
9	10BO/15BO	7BI/1BO
10	11BO/15BO	5BI/1BO
11	12BO/16BO	4BI/2BO
12	13BO/17BO	2BI/4BO
13	14BO/18BO	1BI/5BO
14	15BO/19BO	1BO/7BO
15	16BO/20BO	2BO/8BO
16	17BO/21BO	4BO/10BO
17	18BO/22BO	5BO/11BO
18	19BO/23BO	7BO/13BO
19	20BO/25BO	8BO/16BO
20	21BO/26BO	10BO/17BO
21	22BO/26BO	11BO/17BO
22	23BO/27BO	13BO/19BO
24	24BO/28BO	14BO/20BO

23 SEE ACCOMPANYING TABLE TO THE RIGHT

ADULT EYE COMFORT SERIES/CARD #23:

	INFINITY	NEAR
O	4BO	16BI
P	5BO	14BI
B	6BO	13BI
1	7BO	11BI
V	8BO	10BI
K	9BO	8BI
D	10BO	7BI
E	11BO	5BI
Y	12BO	4BI
T	13BO	2BI
F	14BO	1BI
M	15BO	1BO
R	16BO	2BO
U	17BO	4BO
H	18BO	5BO
N	19BO	7BO
W	20BO	8BO
A	21BO	10BO
J	22BO	11BO
G	23BO	13BO
Z	24BO	14BO
S	25BO	17BO
L	26BO	18BO
X	28BO	20BO
Q	30BO	23BO
C	32BO	26BO

APPENDIX E*

CHILDREN'S STORIES

BASE-OUT SERIES:

CARD	INFINITY	NEAR
1	0BO/1BO	21BI/20BI
2	0BO/2BO	21BO/19BI
3	0BO/3BO	21BI/17BI
4	1BO/4BO	20BI/16BI
5	2BO/5BO	19BI/14BI
6	3BO/6BO	17BI/13BI
7	4BO/7BO	16BI/11BI
8	5BO/8BO	14BI/10BI
9	6BO/9BO	13BI/8BI
10	7BO/10BO	11BI/7BI
11	8BO/11BO	10BI/5BI
12	9BO/12BO	8BI/4BI
13	10BO/13BO	7BI/2BI
14	11BO/14BO	5BI/1BI
15	12BO/15BO	4BI/1BO
16	13BO/16BO	2BI/2BO
17	14BO/17BO	1BI/4BO
18	15BO/18BO	1BO/5BO
19	16BO/19BO	2BO/7BO
20	17BO/20BO	4BO/8BO
21	17BO/20BO	4BO/8BO
22	7BO/20BO	4BO/8BO
23	18BO/21BO	5BO/10BO
24	18BO/21BO	5BO/10BO

BASE-IN SERIES:

INFINITY	NEAR
10BO/9BO	7BI/8BI
10BO/8BO	7BI/10BI
9BO/7BO	8BI/11BI
8BO/6BO	10BI/13BI
8BO/5BO	10BI/14BI
7BO/4BO	11BI/16BI
6BO/3BO	13BI/17BI
5BO/2BO	14BI/19BI
4BO/1BO	16BI/20BI
3BO/0BO	17BI/21BI
1BO/2BI	20BI/25BI
1BO/2BI	20BI/25BI
0BI/3BI	21BI/26BI
1BI/4BI	23BI/28BI
1BI/4BI	23BI/28BI
2BI/5BI	25BI/29BI
2BI/5BI	25BI/29BI
3BI/6BI	26BI/31BI
3BI/6BI	26BI/31BI
4BI/7BI	28BI/32BI
4BI/7BI	28BI/32BI
5BI/8BI	29BI/34BI
5BI/8BI	29BI/34BI
6BI/9BI	31BI/35BI

*If the cards are to be used in the telebinocular, add 5 prism diopters base-out to the vergence value. The "near" setting is at 2.50 on the telebinocular shaft.