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The Bunker Hill Mining Company visual survey

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Abstract

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THE BUNKER HILL MINING COMPANY VISUAL SURVEY

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By

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I. INTRODUCTION

As part of a newly-introduced saftey program, approximately six hundred underground hardrock miners were given visual screening examinations by the Bunker Hill Mining Company of Kellogg, Idaho. The screening was administered by one of the authors of this thesis while employed by the company during the summer of 1962. All the screening was done using the American Optical Company Sightscreener; color screening was tested with American Optical Company's pseudo-isochromatic plates. Of the six hundred men screened, three hundred and fifty were not use for this study because they were uncorrected presbyopes. Approximately fifty of those excluded were due to extreme color deficiencies, amblyopia, and eye-injuries. None of those excluded were left out due to excessive lateral phorias. Twenty-five to thirty percent of the six hundred men screened were referred for private visual care. All of the presbyopic workers were not referred because the company had felt that their job requirements had not necessitated bifocals underground and the other reason being the possible danger factor when scanning back and forth across the bifocal segment line when working in areas of extreme danger.

II. REVIEW OF THE LITERATURE

There has been a gradual evolution in the minds of employers concerning the importance of the vision in the efficient performance of an employee's job. Almost every industrial job requires good visual function of one sort or another. Along with this awareness of the role of vision in industry there has arisen, in many plants, a constant or periodic program of employee testing (or screening) to assure that employees meet minimum standards of visual efficiency required for their jobs.

Hofstetter (1) enumerates nine purposes of visual testing in industry: provision of services available outside of industry; detection of visual disorders requiring immediate professional attention; stimulating visual consciousness and hygiene among employees; designing a proper enviornment for specific jobs; selection of employees for specific jobs; determining the extent of injury compared to the employee's unimpaired status; to facilitate the censusing of visual disorders; measuring the relationship between vision, intelligence, accident proness and other non-visual traits.

Some of the early industrial screeing consisted of selected clinical tests for use in plant testing. Some companies sent the employee to the professional man's

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(1) H. W. Hofstetter, Industrial Vision, 40.

office for periodic clinical testing. However, the bulk of today's industrial testing is being accomplished with instruments specifically designed for, or adapted to, industrial screening. Three of the most commonly used instruments of this type are the American Optical Company Sight-Screener, the Bausch & Lomb Orthro-Rater, the Keystone Company Model 46-A Telebinocular. These instruments are used to test visual performance at an optically simpulated distance of twenty feet called "far", and at a "real" distance thirteen to sixteen inches at near. The performances tested are suppression, acuities, steropsis, lateral and vertical phorias. The Ortho-Rater and the Telebinocular have provisions for color testing.

Tiffin (2) has done estensive research using the Ortho-Rater and has listed four areas of visual skills for a minimum industrial testing battery. These skills are keeness of vision (visual acuity); discrimination of differences in distances (depth perception and stereopsis); discrimination of differences in color; postural characteristics of the eyes (phorias) lateral and vertical. According to Tiffin (3), the most common uses for industrial testing today are employee placement, establishing criteria for hiring, measurement for referral, measurement for compensation purposes.

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(2) Joseph Tiffin, Industrial Psychology, 185.
(3) Ibid., 191-195.

Tiffin(4) has established norms and profiles - using the Ortho-Rater - for specific industries, jobs, and the general industrial population. His results indicate that the distribution of phorias and acuities generally take the shape of a normal distribution curve, and compare favorably with general clinical norms. In addition, he has studied the relationship of the various skills to production rates, earnings, learning speed, efficiency, and accident rate.

In comparing visual accuity and age, Tiffin and Wirt(5) found a low correlation between the near and far acuities in workers over 40. The Pearson correlation co-efficient (r) was ≠0.48. When correlation the near and far acuities in workers under 30, r = ≠0.77. Tiffin(6), in his statistics concerning visual acuity, differentiates between employees wearing their visual correction and those not having corrections. He found that in the prepresbyopic population, those that were not wearing glasses had (as a group) better acuity than those that were wearing glasses. The reason for this was not surprising. A non-clinical population is made up of low hyperopes who will show better performance in an instrument than the corrected population. The clinical population includes those subjects that may have

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(4) Joseph Tiffin, Industrial Psychology, 199-233
(5) Tiffin J., and Wirt S.E., "Near vs. Distance Visual Acuity", Transactions of the American Academy of Ophthalmology and Otolaryngology, June, 1944.
(6) Tiffin, op. cit., 222.

complex visual problems, that even when corrected will not permit a high level of acuity. However, the data changes as the presbyopes are analyzed. In this group of subjects that were corrected had a significantly better visual acuity than those not corrected. The uncorrected group could no longer compensate for the hyperopia at with increasing presbyopia, and showed the expected decrement of acuity at near. Tiffin(7) found that depending on the job, visual acuity was significant factor in production efficiency and the amount of earnings. This was especially evident in those jobs where the acuity was good or poor at the usual working distance for the particular occupation. Poor acuity at far would not necessarily handicap a worker whose job was primarily near; the reverse is also true.

Both Wirt(8) and Tiffin(9) found the distribution of the far phoria to be orthophoria without the far refractive control (7A). Tiffin(10) found that subjects with esophoria had twice as many serious accidents than the subjects with exophoria. At near the opposite is true, the subjects with esophoria have less accidents than those with exophoria. Orthorphoria at far, by the screening technique is not the same as the parallel positioning of the eyes when there is no convergence response. This

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(7) Ibid., 202-206
(8) S.E. Wirt, "Studies in Industrial Vision"., American Journal of Applied Psychology, June, 1943, 217-232.
(9) Tiffin, op. cit., 188.
(10) Ibid, 188.

difference between the relative and the absolute orthophoria is due to the instrumentation. Tiffin (11) found that those subjects who showed a small change in convergence from far to near had more serious accidents than those showing a normal change of convergence. This is analagous to the slope of #3 and #13A. There was also a slight decrease in color vision with age and a slight increase in depth perception towards middle age, ordinarily approaching its peak at approximately age 35 (12) and leveling until age 50 after which there is a slight decline. The better depth perception is this age range may be because this group usually has a better correction than the younger subjects with accommodation more easily controlled.

As a result of the reseaches of Tiffin, Wirt, and others, the manufacturers have introduced a system of grading specific job reuqirements in specific industries. They have classified each group into a job profile. This amounts to a sorting of impairment. Those workers who show performances within the job profile are said to have the minimum visual efficiency for the job. The use of these instruments with their profiles constitues the method of screening being accomplished by many industries in this country; it is gaining greater acceptance.

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(11) Tiffin, op.Cit., 211.
(12) Ibid., 224-225.

III. SURVEY PROCEDURE

A. Description of the Sample

As stated in the introduction, six hundred men were screened, two hundred and fifty are included in this thesis, and the remaining three hundred and fifty were excluded. Of the three hundred and fifty excluded, approximately three hundred were presbyopic to a degree that acuity precluded further testing. The remaining fifty had no simultaneous perception, amblyopia, failing color vision, low stereopsis or eye injuries.

Out test group criteria used subjects who showed simultaneous perception, a minimum of 20/30 acuity at far and near in the weaker eye, a maximum vertical phoria of $\frac{1}{2}$ prism diopter at far or near, and steropsis of 90% or better at far and near using the Shepare-Fry scale. In addition, the test group had no detectable color deficiencies using the American Optical Company's pseudo-isochromatic plates. Because of lowered near acuity due to presbyopia, our sample ranged in age from 18-43 for far phorias, and 18-39 years of age for near phorias. The eleimination of those showing less than 90% stereopsis and more than $\frac{1}{2}$ prism diopter of vertical imbalance may have eliminated some of the extreme phorias and may lessen the variance of the sample.

All of the men work under the same conditions. They work eight hours a day, five days a week. All the subjects work underground 1,700 to 2,800 feet (1500 to 400 feet above sea level). The illumination, on the job, is relatively constant; each worker is equipped with a personal head-battery lantern. Because of the reduced lighting conditions, when looking directly to the front, clear vision is limited to approximately fifteen feet while side vision is limited to approximately ten feet. There is no fine acuity requirement for this work, it is almost completely of a gross nature. The work for the average miner consists of drilling the ores from the walls of the tunnel, blasting the rock loose, and boxing the ores for transportation from the mine shaft. All of the above working techniques involve only gross visual discrimmination.

B. Instrumentation

The American Optical Company Sight Screener is designed for seven tests administered at far and at near. There are: suppression; monocular acuity, right eye; monocular acuity, left eye; binocular acuity; Depth perception; Vertical phoria; Lateral phoria. The target distance is lr inches at near. The instrument contains a flip-type lens and prism combination for use in far testing to simulate the twenty foot testing distance. The same targets are used for the near and far testing. The input to each eye is controlled with the use of polarioid plates. The separation

between the units on thephoria scale is 3.5 mm which is 1 prism diopter at the 14 inch distance. For a 6 centimeter interpupillary distance there are 5.3 prism diopters of base-in prism which gives the scale ortho value and absolute value of 4.3 esophoria. This is no doubt a correction for the proximal effect of the target. All acuities are recorded in terms of Snellen equivalancies. The depth perception (Stereopsis) is graded using the Shepard-Fry scale. A key to all targets is found in the Appendix.

C. Procedure

Each examination and interview required a total time of approximately 10-15 minutes per individual. All questions in the testing were the same for each indivual. All testing was done under standard instrument lighting of 55 candle power. Each individual was screened within about one-half hour after leaving the mine tunnel in the afternoon. All screening was accomplished on the surface and on mine premises. The interview consisted of questioning each individual as to previous visual examinations, visual complaints, previous lenses worn (Rx), age, and title of his job. The above questioning procedure helped to evaluate the individual's necessity for prescription safety lenses.

IV. RESULTS

For the purpose of this paper, we extracted the date of the near and far phorias from each employee's examination. We ordered the data into frequency distributions and did a statistical workup to find the mean, median, mode, and the standard deviation for both the near and the far phoria. In addition, we compared the near phoria to the far phoria, the age of the subjects to the far phoria and then to the near phoria. This data was put into a scattergram and the Pearson correlation co-efficient was calculated.

Frequency Distribution of Far Phoria (In Prism Diopters)

	Scores	Frequency
E	8	1
S	7	0
O	6	2
P	5	6
H	4	4
O	3	20
R	2	31
I	1	86
A		
Ø ----	0	61
	-1	20
E	-2	30
X	-3	1
O		
P		
H		
O		
R		
I		
A		
		235

Frequency Distribution of Near Phoria (In Prism Diopters)

	Scores	Frequency
	13	4
	12	0
	11	1
	10	1
E	9	6
S	8	14
O	7	8
P	6	13
H	5	23
O	4	31
R	3	43
I	2	29
A	1	39
Ø ----	0	34
E	-1	8
X	-2	2
O	-3	2
P	-4	0
H	-5	1
O		
R		
I		
A		
		259

TABLE I.

This table shows distributions for both far and near phoric postures by the scores and the ranges of the scores and the ranges of the escophoric, orthophoric, and exophoric postures and the total number of men in each of the "far" and "near" distributions.

Statistical analysis of the far phorias:

Mean ($\bar{X}$) is 1.04 exophoria using the instrument scale. For a 6 cm interpupillary idstance this amounts to 4.26 esophoria.

Median is 0.877 exophoria using the instrument scale. For a 6 cm interpupillary distance this is 4.42 esophoria.

Mode is 1 exophoria (instrument scale), 4.3 esophoria (absolute scale).

The Standard Deviation (s) is 1.5 prism dioters.

Statistical analysis of the near phorias:

Mean ($\bar{X}$)is 3.15 exophoria

Median is 2.84 exophoria

Mode is 3 exophoria

Standard Deviation (s) is 2.95 prism diotpers.

Correlations:

Far phoria to the near phoria. The Pearson Correlation Co-efficient (r) is /0.28.

Age to the far phoria. The Pearson Correlation Co-efficient (r) is -0.14.

Age to the near phoria. The Pearson Correlation Co-efficient (r) is /0.000053.

For complete frequency distributions showing proportions and calculations, see the tables in the Appendix. Scattergrams (pages 23-25), of the correlations are also included in the Appendix (pages 21-22

V. DISCUSSION

One of the major difficulaties in analyzing the the data of industrial screening is the lack of a refractive control. The usual clinical data with the statistical analysis and norms that are derived, are normally done with a refractive control. The usual industrial screening is done with the subject's habitual Rx. Since the screening is administered by laymen or technicians there usually is no distance refraction at the time of screening. The possible differences that may accure due to this situation will be discussed with statistical discussion.

Tiffin and Wirt, as mentioned in the review of the literature, found almost normal distribution curves for the far phoria. In our data the distribution of the far phoria comes to a peak and then gradually diminishes on either side. It diminishes more quickly in the exophoria direction and there are more escophres, which fall away slower than the exophoria side of the curve. The near phoria distribution peaks and falls away gradually in both directions. However, neither of the two curves (especially the far curve) is a perfect bell shaped curve. Comparing our measures of central tendency to those of Haynes (13) for the Telebinocular stereoscopes, we find an over all agreement with Haynes' data. His norms at far are 0.28 esophoria for the mean with a standard diviation of 4.02. Corrected to an

absolute scale the mean becomes 4.28 esophoria.

In our experiment, we have established a far phoria mean of 1.04 exophoria, and upon correction for the induced prismatic power, the corrected mean is 4.26 esophoria with a standard deviation of 1.5 prism diopters. When comparing the absolute means, we find a difference of only 0.02 prism diopter. Although the two populations are markedly different: Haynes' being a clinical population with the 7A in place and our group being most uncorrected miners with their habitual in place, there seems to be little variation. Clinical experience shows that in most cases the phoria sphere relationship at far is usually a very small amount. Another factor that reinforeces the small amount of difference is the low acuity demand of the phoria target which minimizes the demand for accommodative activity in the experimental group.

Haynes' Telebinocular norms at 16" are 2.69 exophoria with a standard deviation of 5.46. Our mean for a 14" testing distance is 3.15 exophoria with a standard deviation of 2.95. Our calculated absolute posture is also 3.15 exophoria because the lens-prism combination is not use for near testing.

In applying the "F" test of significance to the variances of Haynes' population to our population, the difference is significant to the 1% level. The stereopsis sorting probably accounts for the reduced variance. The smaller standard

deviation in our group may be due to the homogeneity of our population compared to the clinical population. As has been mentioned, we might expect a shift in the esophoric direction due to the uncorrected hyperopia and accommodative convergence. However, the differences in the means is not significant at the 5% level between the two populations. The difference in the two testing distances also accounts for the some of the difference. Since we do not know the correlation between the American Optical Company Sight-Screener and the Telebinocular, we may suggest that much of the differnce in the means may be due to instrumentation alone.

No direct comparison can be made with the standard Von Graefe technique used in taking clinicsl phorias since the correlation between these tests and stereoscope tests is too low.

In comparing the near and far phorias using the Pearson co-efficient, we find $r=/0.28$. This appears consistant with clinical experience. Often we find that the far phoria may be $\emptyset$ or 1 exophoria and the near phoria as high as 15 exophoria. However, in the case of esophoria at far, there is generally a comparable reduction in the near exophoria. In our sample we have excluded the presbyopic age group and have used only those people ranging in age from 18 to 42.

In comparing the far phoria with age (18 to 42) using the Pearson co-efficient, we find r= -0.14. This is in general agreement with clinical evidence. There seems to be very little change in the far phoria among the different age groups and no reliable prediction can be made.

The near phorias were also analyzed in terms of age. This correlation was r= /0.000053. It is known that in general clinical data, phorias show small increases in exophoria between the "stable" years 15 and 37 years of age. Had we included the presbyopic population, it is our expectation that we would have found agreater correlation. Presbyopes usually show increased exophoria with age.

The clinical data which show increasing exophoria are compiled from children to the absolute presbyopes in the population. Much of the increased exophoria comes during the presbyopic years and many children show phoric postures not as high in exophoria, when measured without the #7 or #7A in place. Although, this condition does not hold true for the near posture according to Haynes. (15) Our population consists of young men, all prepresbyopes; it is not surprising that the marked shift towards exophoria with age is not present. The reason we set an upper limit of 39 years of age was because of the lack of refractive control at near for the prebyopic patients.

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15. Ibid., Lecture notes unpublished, 1963

If we used our mean and standard deviation to establish a phoria profile ($\bar{X} \pm s$) for this occupation, we have a suitable range of 0.5 esophoria to 2.5 exophoria for the far phorias. At near, the range would be from $\emptyset$ to 6 exophoria. It is apparent that these ranges (especially at near) coincide very well with the normal clinical ranges. As was mentioned in the review of the literature, Tiffin found that accidents at far were more frequent among those having excessive exophoria and at near amoung those having excessive exophoria. Using this criteria, we might expect a relative good accident-free situation.

According to the Safety Department of the Bunker Hill Mining Company, the accident rate is low and showed a decrease since the visual screening program was instituted. Whether this is due to increased visual efficiency or to the use of safety glasses can not be ascertained.

One of the reasons for undertaking this survey was to ascertain whether or not there is an uniqueness in this group of miners or the occupation itself. Since all came from the same town, from similar backgrounds, and worked at the same type of job with the same visual tasks, we decided to see if this "select" population differed significantly from the general population. In terms of acuity, stereopsis, color vision, the miners have shown standard performance as a group. In this group, it is estimated that less than

twenty-five percent of the individual have ever had a visual examination by a vision specialist nor were wearing perscription lenses upon the visual screening testing. We should assume our biggest rejection factor for the approximate 350 men from the 600 man population was that of presbyopia and the uncontrollable near testing without the necessary refractive aids. In analyzing our statistical data of the phoric findings, we can find no uniqueness in this population which would set it apart from the general prepresbyopic population. We would consider our group unique only from the standpoint of comparing the occupation employing a large percentage of uncorrected presbyopes to that of the general population in which acuity demands at near necessitate the wearing of bifocals.

Information pertaining to the job profiles of different occupations was requested of American Optical Company, but was not available to the authors by submission time of this thesis.

Critique: Had this thesis been contemplated prior to the actual screening of the miners, we would have gathered information pertinant to this study while still on the mine premises. We would have included more definite statistics of referals, percentages of present Rx wearers, accident rates, measures and descriptions of working conditions, illinimation, thus making our theseis more exact and complete.

VI. SUMMARY

A population of underground miners were screened with the American Optical Company Sight-Screener at the Bunker Hill Company in Kellogg, Idaho the summer of 1962. This survey attempts to compare the phoria test results of the sdreening with other standards and to correlate the far and near phorias, the far phoria and the near phoria to age. Measurements of central tendency - mean, mode, median, and standard deviation - were calculated.

A P P E N D I X

	SCORES	F	P	CP	FX	FX^2
	8	1	.0043	.9226	8	64
	7	0	.0000	.9183	0	0
	6	2	.0085	.9183	12	72
	5	6	.0255	.9098	30	150
Esophoria	4	4	.0170	.8843	16	64
	3	20	.0127	.8673	60	180
	2	31	.1320	.8546	62	124
	1	86	.3659	.7226	86	86
Orthophoria	0	61	.2596	.3567	0	0
	-1	20	.0851	.0971	-20	20
	-2	30	.0127	.0170	- 6	12
Exophoria	-3	1	.0043	.0043	- 3	9
	235				245	781

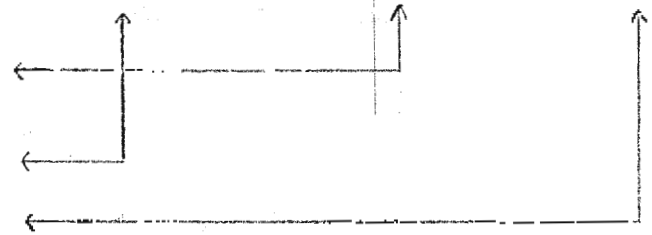
TABLE 1. Frequency distribution of the far phorias.

SCORES	F	P	CP	FX	FX^2
13	4	.01544	.89986	52	676
12	0	.00000	.88442	0	0
11	1	.00386	.88442	11	121
10	1	.00386	.88056	10	100
9	6	.02316	.87670	54	486
8	14	.05406	.85354	112	896
7	8	.03088	.79948	56	392
6	13	.05019	.76860	78	468
5	23	.08885	.71841	115	575
4	31	.11968	.62956	124	496
3	43	.16600	.50988	129	387
2	29	.11190	.34388	58	116
1	39	.15060	.23198	39	39
0	34	.13120	.18138	0	0
-1	8	.03088	.05018	-8	8
-2	2	.00772	.01930	-4	8
-3	2	.00772	.1158	-6	18
-4	0	.00000	.00386	0	0
-5	1	.00386	.00386	-5	25
259				815	4811

TABLE 2. Frequency distribution of the near phorias.

TABLE 3 SCATTERGRAM OF FAR AND NEAR PHORIAS

INTERVAL	-3	-2	-1	0	1	2	3	4	5	6	7	8	F	Y^1	FY^1	FY^2	EX^1Y^1	$Y^1EX^1-Y^1$
13					1				1	1		1	4	18	72	1296	32	576
12													0	17	0	0	0	0
11					1		1	1					2	16	32	512	13	208
10													0	15	0	0	0	0
9					2	3	4		1	1			11	14	154	2156	64	896
8					1	1	6	1					9	13	117	1521	52	676
7					2		2		1				5	12	60	720	28	336
6					10	3		1					14	11	154	1694	62	682
5				5	19	5	4						33	10	330	3300	140	1400
4			1	11	5	8	2						27	9	243	2187	107	963
3			1	7	21	9	2	1					41	8	378	2624	171	1368
2			6	10	7	6							29	7	203	1421	100	700
1			2	15	12								29	6	175	1044	97	602
0			9	17	7								33	5	165	825	97	485
-1	1	1	2	1	3								8	4	32	128	20	80
-2		1			1								2	3	6	18	5	15
-3		1	1										2	2	4	8	3	6
-4													0	1	0	0	0	0
-5			1										1	0	0	0	2	0
F	1	3	23	66	91	35	21	4	3	2	0	1	250		2075	19454	993	8993
X^1	0	1	2	3	4	5	6	7	8	9	10	11						
FX^1	0	3	43	198	364	175	126	28	24	18	0	11	979					
FX^{12}	0	3	92	594	1456	875	756	196	192	162	0	121	4447					
EY^1-X^1	4	9	126	454	767	324	248	48	44	42	0	18	2084					
XEY^1-X^1	0	9	252	1362	3068	1620	1488	336	352	378	0	198	9063					



AGE VS FAR PHORIA

INTERVAL	-3	-2	-1	0	1	2	3	4	5	6	7	8	F	Y^1	FY^1	FY^2	EX^1Y^1	$Y^1EX^1Y^1$
42-43		1	4	8	7								20	12	240	2880	61	732
40-41			-1	5	5	5							16	11	176	1936	62	682
38-39			2	8	17	3	3		1			1	35	10	350	3500	148	1480
36-37			2	3	5	3	1	0	1				15	9	135	1215	62	558
34-35	1		1	3	5	2	1	0	1				14	8	112	896	55	440
32-33			1	8	8	3	1	1					22	7	154	1078	86	602
30-31			1	7	3	4							15	6	90	540	55	330
28-29			3	4	7	1	1						16	5	80	400	57	285
26-27		1	1	3	9	1	3						18	4	72	288	71	284
24-25		1	1	8	6	3	3			1			23	3	69	207	93	279
22-23				6	9	3	7	1		1			27	2	54	108	127	254
20-21			2	3	5	3							13	1	13	13	48	48
18-19				2	3	3	1	1					10	0	0	0	46	0
F	1	3	19	68	89	34	21	3	3	2	0	1	244		1545	13061	971	5978
X^1	0	1	2	3	4	5	6	7	8	9	10	11						
FX^1	0	3	38	204	356	170	126	21	24	19	0	11	971					
FX^{12}	0	3	76	612	1424	850	756	147	192	162	0	121	4343					
EY^1X^1	8	19	142	451	581	200	94	9	27	5	0	10	1545					
$X^1EY^1X^1$	0	19	284	1353	2324	1000	564	63	216	45	0	110	5978					

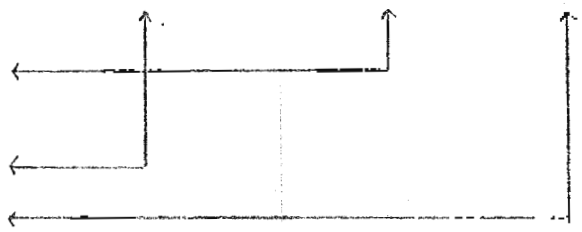


TABLE 4 Scattergram of Age and Far Phoria

AGE VS NEAR

INTERVAL	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	F	Y^1	FY^1	FY^{12}	EX^1Y^1	$Y^1EX^1Y^1$
38-39						3	4	2	8	3	2	2	3		2				1	30	10	300	3000	268	2680
36-36						3	1	0	5	2	2	1							1	15	9	135	1215	128	1152
34-35					1	3	2	2	2	1	0	0	1				1		1	14	8	112	896	116	928
32-33					3	3	1	2	0	3	5	1	1	1	1					21	7	147	1029	174	1218
30-31						2	2	2	1	2	2				4					15	6	90	540	126	756
28-29						1	1	2	3	2	2	1	1	1						14	5	70	350	123	615
26-27			2	0	0	1	2	1	2	1	1	2	2	2	2					18	4	72	288	163	652
24-25				1	1	4	4	0	5	3	2	1							1	22	3	66	198	167	501
22-23						4	4	2	2	2	7	1		8	2					32	2	64	128	305	610
20-21					1	3	3	2	1	3	1	1		1						16	1	16	16	120	120
18-19							1	2	3	1	1		1				1			10	0	0	0	91	0
F	0	0	2	1	6	27	25	17	32	23	25	10	9	13	11	0	2	0	4	207		1072	7660	1781	9232
X^1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18						
FX^1	0	0	4	3	24	135	150	119	256	207	250	110	108	143	154	0	32	0	72	1767					
FX^{12}	0	0	8	9	96	675	900	833	2048	1863	2500	1210	1296	1297	2156	0	512	0	1296	17599					
EY^1X^1	0	0	8	3	33	146	120	82	190	119	120	55	58	37	63	0	8	0	30	1072					
X^1EY^1X	0	0	16	9	132	730	720	574	1520	1071	1200	605	696	481	882	0	128	0	540	9304					

TABLE 5. Scattergram of Age and Near Phoria.

SIGHT-SCREENING ROUTINE

A. Have subject sit down comfortably before the instrument.

B. Explain that "this is just a quick check on how well you see. The test is *not* an eye examination, but just a preliminary checkup. Your score will be analyzed by Dr. _____, and you will be advised on how you made out."

C. Fill in subject's name and other data at top of AO Sight-Screener record card.

D. Ask, "Do you wear glasses?" If answer is "yes," ask, "Do you wear them all the time, or just for close work?" If subject wears glasses all the time, and not just for close work, he should be told "keep them on" or "put them on."

E. Have subject look into instrument and adjust height.

F. Turn adjusting knob to bring eyepiece to proper level.

RED SERIES

Test 1. With knob of instrument on No. 1 (Red) Position, say, "Read this." Subject will report:

a. KR, XR (Check first box), or

b. KR (Check second box), or

c. XR (Check third box), or

d. KR and XR, first one, then the other (Check fourth box)

e. Sees nothing.

Test 2. Turn knob to Position No. 2 (Red) and say, "Read this." Draw *vertical* line through each error in *last* group read, and *horizontal* line through whole groups read incorrectly or missed entirely.

Test 3. Turn knob to Position No. 3 (Red) and repeat as in Position No. 2.

Test 4. Turn knob to Position No. 4 (Red) and repeat as in Position No. 2.

Test 5. Turn knob to Position No. 5 (Red) and say: "In Group A which circle seems to be closer to you?"

a. If the subject cannot decide which one stands out have him look at the Stereopsis Demonstrator and ask, "Now do you see any difference in the circles in any of the groups?" (Do not linger if he cannot decide, but turn to next test.)

b. If the subject names a circle in Group A, ask, "Which one stands out in Group B?" — and repeat for Groups C, D, and E.

c. Draw a line through letters under incorrect groups. If subject misses in all cases this test No. 5 may be repeated after completion of all other tests.

Test 6. Turn knob to Position No. 6 (Red) and ask, "How many dots above the line?" Draw a vertical line on record card corresponding to position named.

Test 7. Turn knob to Position No. 7 (Red) and ask: "At what number does the arrow point?"

If subject complains that the arrow will not stand still, say "Close your eyes for a second; open them and tell me where it is immediately upon opening your eyes." Draw a vertical line on record card in position reported.

This completes the distance tests.

BLACK SERIES

If the subject has stated that he wears glasses for reading or nearpoint work, have him put them on for the near tests (Black Series).

The Black Series of tests is now given, asking the same questions and recording the results in the same manner as in the Red Series.

When color discrimination is to be checked, use the series of color plates provided with the AO Sight-Screener. Follow directions given in the binder containing the color plates.

For purposes of developing a workman's compensation record, the following additional procedure may be used. If for the entire check glasses were worn, the test in its entirety should be repeated without glasses and a separate record card made out, indicating "without glasses." If for distance only, or near only, glasses were worn, that part of the test should be repeated and a separate record card made out indicating "without glasses."

AO SIGHT-SCREENER RECORD

Name _____ Dept. _____ Clock No. _____ Date _____

Job Title _____ Eye Protection Used ☐ Male ☐ Female ☐ Age _____

Wears Glasses: Yes ☐ No ☐ At All Times ☐ Sometimes ☐ Work Only ☐ Reading Only ☐ Bifocals ☐

Dial No.	RED SERIES — If the employee wears glasses at all times, he should be instructed to keep them on for this series.					Prof. Interpretations	Dial No.	BLACK SERIES — If the employee wears glasses at any time, he should keep them on for this series.					Prof. Interpretations
1	Check letters reported	KR XB	KR	XB	Alternation		1	Check letters reported	KR XB	KR	XB	Alternation	
FOR BOTH RED AND BLACK SERIES, IN 2, 3 AND 4 DRAW A LINE THROUGH EACH ERROR IN THE LAST GROUP READ													
2	E F TC DZEN BNEC EHZN FZEC TFED ZNHT						2	E F TC DZEN BNEC EHZN FZEC TFED ZNHT					
3	N F ET CDZE ZBNE NEHZ ECNF ETOF NTZH						3	N F ET CDZE ZBNE NEHZ ECNF ETOF NTZH					
4	Z E CE CNDZ EBNC ZHEC NEDF GEFT THNZ						4	Z E CE CNDZ EBNC ZHEC NEDF GEFT THNZ					
5	Draw line through letter under incorrect groups. 1 2 3 4 5 A; 1 2 3 4 5 B; 1 2 3 4 5 C; 1 2 3 4 5 D; 1 2 3 4 5 E						5	Draw line through letter under incorrect groups. 1 2 3 4 5 A; 1 2 3 4 5 B; 1 2 3 4 5 C; 1 2 3 4 5 D; 1 2 3 4 5 E					
6	Draw line through position reported for horizontal line. (Top of scale) . . . . . (Bottom of scale)						6	Draw line through position reported for horizontal line. (Top of scale) . . . . . (Bottom of scale)					
7	Draw line through position reported for vertical line. 2 4 6 8 10 12 14 16 18 20 22 24 26 28						7	Draw line through position reported for vertical line. 2 4 6 8 10 12 14 16 18 20 22 24 26 28					
COLOR PLATES (DRAW LINE THROUGH ERRORS) 1 2 3 4 5 6 7 8 9 10													

NOTE: Interpretation is to be made by refractionist only.
Technicians are not to give any information about results. They are not to make comments or recommendations.

Referred for Eye Examination: Yes ☐ No ☐ Employee Notified _____ Examined _____ Fitted _____

Chart No. 1219