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THE REFRACTIVE POWER TESTS FOR CLEAR FLEXIBLE FITTING GOGGLE LENSES

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Preface

The National Institute for Occupational Safety and Health (NIOSH), Testing and Certification Branch (TCB), in addition to its certification programs, has been conducting tests of personal protective equipment, such as hard hats, safety spectacles, welder's filter plates, safety-toe shoes, and linemen's gloves. The results of these tests have been published as an information service by NIOSH.

At the request of several interested parties, NIOSH has made the test procedures, used by TCB, available through NTIS. This test procedure is a part of that series.

This procedure is only intended to inform interested parties of the procedures used by NIOSH to determine the extent that clear flexible fitting goggle lenses comply with the refractive power requirements of the ANSI Z87.1 Standard. It is not intended to imply that only these techniques or instruments can be used to perform these tests.

Mention of company or product names is not to be considered an endorsement by NIOSH.

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1. Introduction

This procedure presents the method used by the Testing and Certification Branch (TCB), Appalachian Laboratory for Occupational Safety and Health (ALOSH), National Institute for Occupational Safety and Health (NIOSH) to test a model of flexible fitting goggles with clear lenses for prismatic power, refractive power, and definition.

2. Reference to Test Requirements

The test requirements are taken from ANSI Z87.1-1968, paragraphs 6.3.2.2, 6.3.4.1, 6.3.4.1.1, 6.3.4.1.2, and 6.3.4.1.3.¹

3. Equipment Requirements

- 3.1 Gaertner Telescope, model M626-522 with a 14 power eyepiece, 200mm objective focal length, and a 19mm objective aperture diameter.
- 3.2 Target mounting with light source.
- 3.3 Prismatic power target.
- 3.4 Definition target, NBS circular C533.²
- 3.5 Refractive power target.
- 3.6 Auto-collimating alignment system.
 - 3.6.1 Light source.
 - 3.6.2 Optical flat.
 - 3.6.3 Gaussian eyepiece and draw tube.
- 3.7 Staticmaster brush.
- 3.8 Lens tissue.
- 3.9 Distilled water.

4. Special Precautions

- 4.1 Care should be taken to avoid scratching the lens surfaces during handling and washing.
- 4.2 After the telescope system has been aligned, be careful not to touch or move anything that would change the alignment.
- 4.3 Notify the laboratory supervisor when a lens fails.

5. Calibration Procedure

- 5.1 Place the NBS target 35'3" in front of the telescope's objective lens.
- 5.2 Focus the telescope and eliminate parallax between the crosshairs and the target.
- 5.3 Mark the position of the telescope focusing dial corresponding to the fixed mark on the telescope body.
- 5.4 Repeat steps 5.2 and 5.3, first with the target at 21'3" and then at 105'3".
- 5.5 The center mark is the zero setting while the outer marks represent plus and minus 1/16 diopter. Mark additional lines on the telescope focusing dial to divide the two areas between the center mark and the outer marks into 10 equal increments.

6. Tabulation of Data (See data sheet in Appendix)

- 6.1 Control Number - The control number identifies the manufacturer, model, and specific sample to be tested.
- 6.2 Visible Defects - A checkmark in the appropriate column indicates the presence of a localized defect, slight distortion or severe distortion.

6.3 Prismatic Power Test

6.3.1 P = Pass, the sample's prismatic power $\leq 1/16$ diopter.

6.3.2 F = Fail, the sample's prismatic power $> 1/16$ diopter.

6.4 Definition Test

6.4.1 P = Pass, the number 20 pattern is resolved.

6.4.2 F = Fail, the number 20 pattern is not resolved.

6.5 Refractive Power Survey - A survey conducted to identify those samples whose spherical and cylindrical powers are significantly less than the maximum allowed: $1/16$ diopter. (Those lenses identified by the survey will be marked passing and, therefore, will not be subjected to the more time-consuming Refractive Power Test).

6.5.1 P = Pass, the refractive power $\leq 3/5$ of $1/16$ diopter.

6.5.2 I = Inconclusive, the refractive power $> 3/5$ of $1/16$ diopter or the pattern was not resolvable.

6.6 Refractive Power Test - A test conducted when samples are marked inconclusive for either part of the Refractive Power survey.

6.6.1 R_0 is the refractive power reading without the sample in place.

6.6.2 R_{\parallel} is the refractive power reading when parallax is eliminated along the axis of cylinder or in the vertical direction if an axis of cylinder cannot be identified.

6.6.3 R_{\perp} is the refractive power reading when parallax is eliminated perpendicular to the axis of cylinder or in the horizontal direction if an axis of cylinder cannot be identified.

6.6.4 S is the spherical power of the sample.

$S = (R_{\parallel} - R_o)$ or $(R_{\perp} - R_o)$, whichever has the greater absolute value.

6.6.5 C is the cylindrical power of the sample, $C = |R_{\parallel} - R_{\perp}|$.

7. Operating Procedure

7.1 Specimen Preparation

Wash the samples with soap and water. Rinse with distilled water.

To avoid scratching, do not rub or clean a dry lens. Some lenses covered with an anti-fog coating scratch very easily. Extra care should be taken in handling them.

7.2 Equipment Preparation

7.2.1 Adjust the sample holder such that it is 35' from the target holder.

7.2.2 Position the telescope so that the objective lens is approximately 7 cm from the sample holder.

7.2.3 Use the auto-collimating alignment system to align the sample holder so that it is perpendicular to the telescope's optical axis. Recheck the alignment after testing has been completed.

7.2.4 Select the appropriate target and adjust it so that the center of the target coincides with the intersection of the crosshairs in the telescope. During the Prismatic Power Test, check this alignment after every sample.

7.2.5 Use the Staticmaster brush to remove any dust from the telescope lenses and mirror. Also, brush each sample prior to placing it in the holder.

7.2.6 All samples will be tested for prismatic power first. Then the samples will be tested for definition and finally refractive power.

7.3 Testing

- 7.3.1 Visible Defects - Hold each sample at arms length and look at a straight-edged surface 6 to 8 feet away. Place a checkmark on the data sheet in the appropriate column for any defects noticed. Mark the position of any localized defects on the lens. Do not include any localized defects that are within 13 mm (1/2") of the samples edge.
- 7.3.2 Samples without localized defects will be tested by looking through their centers. Samples with localized defects will be tested by looking through the defect. In the latter case the sample should be marked to indicate how it was positioned. Whenever a lens fails or gives inconclusive results, its exact position in the sample holder should be marked. This same position will be used for any remaining tests.
- 7.3.3 Prismatic Power Test
- 7.3.3.1 Place the sample in the holder and observe how far the center of the crosshairs is displaced on the prismatic power target (see Appendix).
- 7.3.3.2 If the center of the crosshairs is on or inside of the smallest circle, record P on the data sheet. If the center of the crosshairs is outside of the smallest circle, record F on the data sheet. (If necessary, adjust the telescope dial to compensate for any refractive power present, by eliminating parallax).
- 7.3.4 Definition Test
- 7.3.4.1 Place the sample in the holder and observe the number 20 pattern on the NBS target. Turn the telescope dial to focus on the target.

- 7.3.4.2 If the number 20 pattern is resolved, record P on the data sheet; otherwise, record F. (The number 20 pattern is considered resolved when each of the three lines is individually distinguishable. The observer should be able to confidently determine the number of lines in the pattern. Both horizontal and vertical patterns should be resolved, but not necessarily at the same focus dial setting.)
- 7.3.5 Refractive Power Survey.
- 7.3.5.1 Place the sample in the holder and attempt to locate an axis of cylinder. If an axis of cylinder is not observed, proceed to step 7.3.5.3; otherwise, continue.
- 7.3.5.2 If an axis of cylinder is observed, determine the two positions of the telescope dial for which the spokes of the target (see Appendix) along the axis and perpendicular to the axis are the clearest.
- 7.3.5.2.1 If the two readings are between +6 and - 6 inclusive (corresponding to $\pm 60\%$ of the maximum allowable), record P for the spherical power on the data sheet. If either of the readings is $> + 6$ or $< - 6$, record I.
- 7.3.5.2.2 If the difference between the two readings is ≤ 6 increments, record P for the cylindrical power on the data sheet. If the difference is > 6 increments, record I.
- 7.3.5.3 If an axis of cylinder is not observed, perform the following steps; otherwise proceed to step 7.3.5.4
- 7.3.5.3.1 Determine the single position of the telescope dial for which the spokes of the target are the clearest.

7.3.5.3.2 If this reading is between + 6 and - 6 inclusive, record P for the spherical power. If the reading is $> + 6$ or $< - 6$, record I.

7.3.5.3.3 Record P for the cylindrical power.

7.3.5.4 If a sample received P's for both parts of the refractive power survey, testing is completed. However, if either part of the survey was found to be inconclusive, the complete Refractive Power Test will be performed immediately, before the sample is removed.

7.3.6 Refractive Power Test

7.3.6.1 If an axis of cylinder was observed, perform the following; otherwise proceed to step 7.3.6.2.

7.3.6.1.1 Rotate the draw tube until one of the crosshairs is parallel to the axis.

7.3.6.1.2 Eliminate parallax along the axis of cylinder and record R_{\parallel} .

7.3.6.1.3 Eliminate parallax perpendicular to the axis of cylinder and record R_{\perp} .

7.3.6.2 If an axis of cylinder was not observed, perform the following; otherwise, proceed to step 7.3.6.3.

7.3.6.2.1 Set the crosshairs in a vertical/horizontal position.

7.3.6.2.2 Eliminate parallax between the vertical crosshair and spokes.
Record R_{\parallel} .

7.3.6.2.3 Eliminate parallax between the horizontal crosshair and spokes.
Record R_{\perp} .

7.3.6.3 Record R_0 .

8. Analysis of Data

- 8.1 Prismatic Power Test - Indicate the number of samples passing and the number of samples failing at the bottom of the data sheet.
- 8.2 Definition Test - Indicate the number of samples passing and the number of samples failing at the bottom of the data sheet.
- 8.3 Refractive Power
- 8.3.1 Compute and record the spherical power, S, and the cylindrical power, C, for any samples that have results recorded under R_{\parallel} and R_{\perp} . Both S and C must be ≤ 10.0 in order to pass.
- 8.3.2 Indicate the number of samples passing and the number of samples failing at the bottom of the data sheet. The passing or failing of samples for which the values R_{\parallel} and R_{\perp} were recorded will be determined solely by the values S and C.

9. Glossary

- 9.1 Axis of Cylinder - When a lens has cylindrical power, all of the spokes on the refractive power target will not focus simultaneously for any single setting on the telescope dial. The axis of cylinder is represented by the two groups of spokes (180° apart) that come into focus first when turning the telescope dial from an out-of-focus position toward an in-focus position.
- 9.2 Sample - The lens or lens portion of a flexible fitting goggle used for testing purposes.

10. References

- 10.1 U.S.A Standard Practice for Occupational and Educational Eye and Face Protection. American National Standards Institute, 1430

Broadway, New York, New York 10018.. Standard No. Z87.1-1968. 1968.

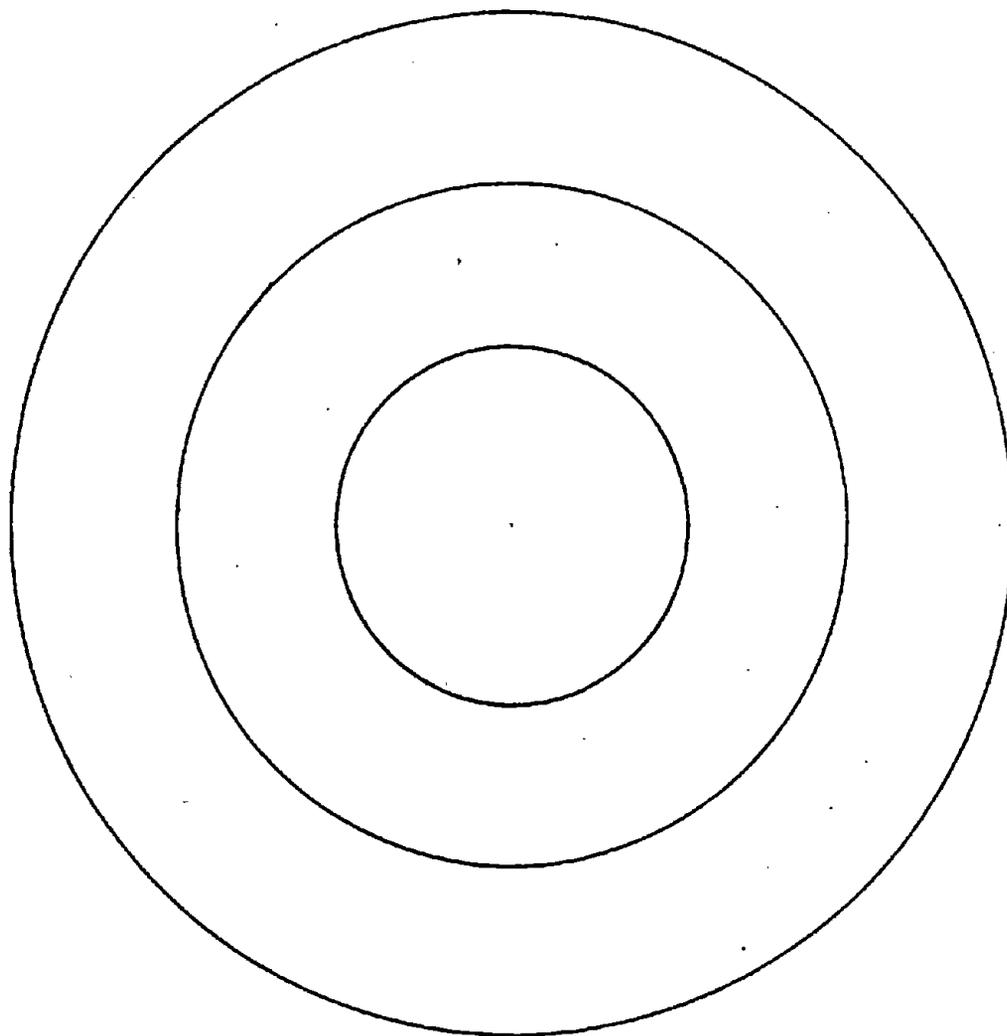
32 pages.

10.2 NBS Circular C533, available from the National Bureau of Standards,
Washington, D.C.

Appendices

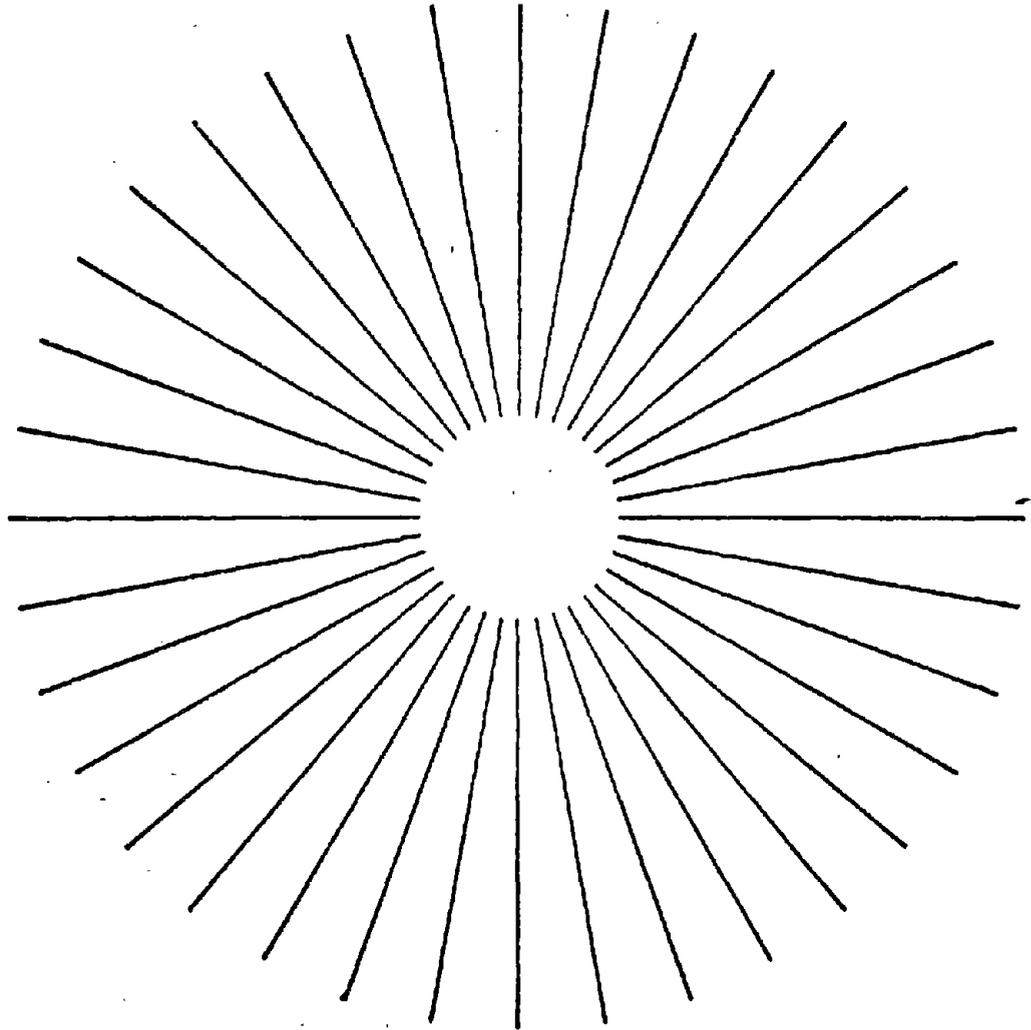
1. Prismatic Power Target
2. Refractive Power Target
3. Data Sheets.

PRISMATIC POWER TARGET



Target is shown oversize: Actual diameters are 13.33mm, 26.67mm, 40.00mm.

REFRACTIVE POWER TARGET



Target is shown oversize: Actual outer diameter is 80mm.

