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An American National Standard

# Standard Specification for Ski and Snowboard Goggles[1]

This standard is issued under the fixed designation F659; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers the minimal requirements of ski and snowboard goggles (intended for nonmotorized use) to provide a reasonable degree of protection against snow and moisture striking or lodging in the eye or surrounding soft tissue.

1.2 The scope of this specification shall include requirements for materials, optical properties, lens strength and retention, labeling, identification, and testing procedures.

1.2.1 Contact lenses, sunglasses, and corrective dress eye wear are not included within the scope of this specification. (**Warning—**Impact resistant prescription spectacles that conform to the standard specifications of ANSI Z87.1 should be used if spectacles are to be worn under goggle-type eyewear as covered by this specification.)

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only. Metric units of measurement in this specification are in accordance with the International System of Units (SI). If a value for measurement as given in this specification is followed by an equivalent value in other units, the first stated is to be regarded as the requirement. A given equivalent value may be approximate.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics

2.2 *ANSI Standards:*[3]

ANSI Z80.3 Opthalmics—Nonprescription Sunglasses and Fashion Eyewear

ANSI Z87.1 Occupational and Educational Eye and Face Protection Devices

2.3 *CEN Standard:*[4]

EN 168 Personal eye protection—Non-optical test methods

## 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *astigmatism, n*—condition in a lens that creates two axially separated line foci of each object point, the lines being mutually perpendicular; in other words, the lens has two different refractive powers in meridians that are 90° apart.

3.1.2 *base-down, adj*—refers to the type of prism that causes a horizontal beam of light to bend down causing objects to appear higher than their true position.

3.1.3 *base-in, adj*—refers to the type of prism imbalance that tends to cause parallel rays of light passing through a protector, spaced apart by the interpupillary distance, to converge.

3.1.4 *base-out, adj*—refers to the type of prism imbalance that tends to cause parallel rays of light passing through a protector, spaced apart by the interpupillary distance, to diverge.

3.1.5 *base-up, adj*—refers to the type of prism that causes a horizontal beam of light to bend upward causing objects to appear lower than their true position.

3.1.6 *binocular, adj*—relating to the field of view that is shared by both eyes simultaneously; also, any simultaneous activity of the two eyes.

3.1.7 *central viewing zone, n*—that part of the eye of a protector that has its center in line with the wearer's normal line of sight.

3.1.7.1 *Discussion*—The zone is circular and 40 mm in diameter. The center of the central viewing zone shall be the point of intersection of the line of sight with the lens as mounted on the head form.

[1] This specification is under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and is the direct responsibility of Subcommittee F08.57 on Eye Safety for Sports.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, http://www.cenorm.be.

3.1.8 *coverage, n*—characteristic of a protective device that obstructs straight line paths that are coincident with the wearer's eyes.

3.1.9 *cleanable, adj*—ability of a protective device to be made readily free of dirt or grime without being damaged with a cleaning process, such as the use of soap and water.

3.1.10 *eye, n*—relating to the eye of a test head form or the eye of a person wearing a protector.

3.1.11 *eye of the head form, n*—all structures contained within the orbital rim of the head form.

3.1.12 *fracture, n*—separation, as a result of impact, of a lens or frame into two or more separate pieces.

3.1.13 *haze, n*—fraction of the total transmitted light from a normally incident beam that is not transmitted in a focused condition but scattered by inclusions or surface defects.

3.1.13.1 *Discussion*—Excessive haze will reduce contrast and visibility.

3.1.14 *horizontal imbalance, n*—difference in prismatic deviation of incident parallel light beams on the two eyes of a protective device in the horizontal meridian (see base-in and base-out).

3.1.15 *impact resistance, n*—ability of a device to afford protection from impact as required by this specification.

3.1.16 *lens, n*—transparent part or parts of a protective device through which the wearer normally sees.

3.1.17 *normal lines of sight, n*—straight ahead horizontal lines that intersect the center of the eyes of the appropriate head-form.

3.1.18 *power imbalance, n*—relates to the condition in which the refractive power of the lens or lenses of a protector is different as presented to the two eyes.

3.1.19 *prism, prismatic effect, n*—prism bends a beam of light as a result of the lack of parallelism of the two surfaces of a lens through which the beam of light traverses and the amount of bending is a function of the curvatures, thickness, and index of refraction of the material and the angle of approach of the line of sight to the optical surface.

3.1.19.1 *Discussion*—In this specification, the word prism refers to the amount of bending that is imposed upon the line of sight of a wearer of an eye protector for the standard viewing position. Prism is expressed in diopters. The deviation of the line of sight by 1 cm/m is 1 prism diopter.

3.1.20 *protective device (or protector), n*—device that provides protection to the wearer's eye against snow and moisture encountered in non-motorized snow sports.

3.1.21 *refractive power, n*—focusing effect of a lens expressed in diopters.

3.1.22 *spherical power, n*—average of the maximum meridian astigmatic power and the minimum meridional astigmatic power of a lens.

3.1.23 *test head form, n*—for the purpose of this specification, the reference head forms shall conform to EN 168 (current revision).

3.1.23.1 *Discussion*—The two sizes of head forms are medium, which approximates a 50th percentile adult male, and small, which approximates a 60th percentile twelve-year-old child, and both should be of the polyurethane-covered version.

3.1.24 *vertical imbalance, n*—difference in prismatic deviation between parallel light beams incident on the two eyes of a protective device in the vertical meridian.

## 4. General Requirements

4.1 *Materials and Design:*

4.1.1 Materials coming into contact with the wearer's face shall not be of a type known to cause skin irritation.

4.1.2 Materials coming into contact with the wearer's face shall not undergo significant change of hardness, loss of strength or flexibility, or other physical change as a result of perspiration, oil from the wearer's skin and hair, or sunscreen lotion.

4.1.3 Goggles shall be free of sharp edges or projections that could cause harm or discomfort to the wearer.

4.1.4 Facial contact surfaces shall be of sufficient softness and flexibility to minimize body surface injury in case of hard impacts.

4.1.5 Headbands shall be capable of holding the goggle securely under normal operating conditions and be capable of ease adjustment.

4.1.6 Materials shall be of durable quality and shall not undergo appreciable alterations under the influence of aging and environmental conditions as occur in the intended field of use (sun, moisture, or cold).

4.1.7 Goggles shall be capable of being cleaned to the degree that, when cleaned in accordance with the method described in 9.1, they shall remain compliant with the requirements of this specification.

4.1.8 The goggle shall be constructed in such a manner as to prevent components of the protector from contact with the eye of the head form, detachment, or dislodgment when tested in accordance with Section 8 of this specification.

4.1.9 Finishes and coatings as used on the protector shall not delaminate from the base surface of the protector such that they dislodge, detach, or delaminate when tested in accordance with Section 8 of this specification.

## 5. Performance Requirements

5.1 *Optical Requirements:*

5.1.1 *Refractive Tolerances*—When tested in accordance with 7.7, the refractive power in any meridian shall not exceed 0.12 diopters.

5.1.2 *Astigmatic Power*—When tested in accordance with 7.7, the astigmatic power (absolute power difference in extreme meridians) shall not exceed 0.12 diopters.

5.1.3 *Prismatic Power*—When tested in accordance with 7.6, prismatic power shall not exceed 0.50 prism diopters.

5.1.4 *Prismatic Imbalance*—When tested in accord with 7.6, prismatic imbalance shall not exceed 0.25 Δ base-in or vertical and 0.75 Δ base-out.

5.1.5 *Ultraviolet Transmittance*—Ultraviolet A (UVA) and ultraviolet B (UVB) transmittance of lenses shall comply with ANSI Z80.3 for both clear and tinted protectors when measured at any point within the central viewing zone.

5.1.6 *Haze*—When tested in accordance with 7.5, total angle forward scattered light (haze) shall not exceed 3 %.

5.1.7 *Optical Quality*—When tested in accordance with 7.2.2, striae warpage, surface ripples, lenticulations, or abrupt optical changes that are discernible under the test conditions of 7.2 shall constitute a failure.

5.1.8 *Surface and Internal Defects*—Pits, scratches, bubbles, grayness, specks, cracks, and watermarks that are discernible under the test conditions of 7.2 shall constitute a failure.

5.1.9 *Resistance to Fogging*—A goggle that is described as being resistant to fogging shall pass the test specified in Annex A1.

NOTE 1—To claim or describe a goggle as being resistant to fogging is optional.

5.1.10 *Field of View*—As tested in accordance with 8.4.

5.1.10.1 *Temporal Field*—50°.

5.1.10.2 *Nasal Field*—30°.

5.1.10.3 *Superior*—30°.

5.1.10.4 *Inferior*—30°.

5.2 *Mechanical Requirements:*

5.2.1 All interchangeable lenses recommended by the manufacturer shall pass the mechanical strength requirements as specified in this specification when tested in the specified protector.

5.2.2 All goggles that permit interchangeable lenses shall be tested with plano interchangeable lenses, made of the same material, with the same coatings, of the specified minimum thickness, and with the same edge configuration as the interchangeable lenses recommended by the manufacturer.

5.2.3 *Mechanical Strength:*

5.2.3.1 When tested in accordance with 8.1, any displaced fragments, separated delaminations, or complete fracture of the frame or lenses constitute a failure.

5.2.3.2 When tested in accordance with 8.1, any displacement or dislodgment of the lens from its original position within the frame constitutes failure.

5.2.3.3 When tested in accordance with 8.1, no contact with the eye of the head form shall be permitted either by the lens of the protector or the projectile itself.[5]

5.2.3.4 A protector that is dislodged from the test headform when tested in accordance with 8.1 shall not constitute a failure provided all of the above mechanical requirements are met.

5.2.4 *Lens Strength and Retention:*

5.2.4.1 When tested in accordance with 8.1, a single lens goggle that allows the missile to rupture the lens shall constitute a failure.[5]

5.2.4.2 When tested in accordance with 8.1, a single lens goggle that allows the frame or lens to fracture shall constitute a failure.

5.2.4.3 When tested in accordance with 8.1, a thermal (dual) lens goggle that allows the missile to penetrate or fracture the inner lens shall constitute a failure.

5.2.4.4 When tested in accordance with 8.1, any displacement or dislodgment of any lens by more than 25 % in single or thermal (dual) lens goggles from its original position within the frame constitutes a failure.

5.3 *UV Stability*—Goggle lenses shall be conditioned in accordance with 8.3. Luminous transmittance of conditioned lenses shall not vary by more than 20 % of their original value. In addition, the product shall meet the requirements of 5.1.7 after conditioning.

5.4 *Water and Snow Protection*—The goggle shall be designed to limit snow or water from entering the goggle and contacting the eyes. When tested in accordance with 8.2 the goggle shall not allow liquid to enter and contact the eye of the head form.

## 6. Specimen Preparation

6.1 Only new and complete eye protectors as offered for sale shall be tested.

6.2 Protectors shall be preconditioned at 23 ± 2°C (73 ± 3.5°F) and 50 ± 5 % relative humidity for a minimum period of 24 h before the commencement of any test or further temperature preconditioning.

## 7. Test Methods

7.1 *Samples Quantity*—Unless otherwise stated, a sample quantity of three devices shall be tested for each requirement and corresponding test method as defined in this section.

7.2 *Optical Quality, Surface, and Internal Defects*—A high-contrast illuminated grid pattern of dark and white lines shall be viewed through the lens, scanning it area by area and moving it about. The grid pattern should be at least 46 by 46 cm (18 by 18 in.) and constructed of high-contrast black lines on a white background (the white separations being equal to the black lines, both being approximately 0.6 cm (¼ in.) wide). The target should be at least 1.8 to 2.4 m (6 to 8 ft) from the observer, and the lens should be held at least 46 to 61 cm (18 to 24 in.) from the eye. Dual lens goggles shall be measured as complete devices assessing the combined effect of both lenses.

7.2.1 Any pits, scratches, bubbles, grayness, specks, cracks, and watermarks that are discernable that would impair the function of the lens shall be cause for failure.

7.2.2 Ripples in the lens detected by this test method should be further examined. Localized power errors or aberrations that are detected are permissible if no measurable or gross focimeter or telescope target distortion or blur is found when the localized area is examined in accord with 7.2.2.1.

7.2.2.1 The referee method of detecting optical defects and local aberrations or to evaluate further aberrations or both detected in 7.2 is to scan the central viewing zone, especially any areas of suspicion arising from the visual test of 7.2. The lens or shield should be scanned with a precision focimeter or an 8 to 10× telescope using the targets and arrangements described in 7.7. The aperture should be 5 to 7 mm for this examination. Areas outside the central viewing zone or within 6 mm of the edge need not be tested. When the central viewing area is scanned, there shall be no sudden jump, doubling, or blurring of the image greater than 0.08 diopter change in power. Gradual variations in the central viewing zone shall be within the power imbalance tolerances. An optical focimeter

[5] Zinc oxide ointment has been shown to facilitate this purpose well.

with electronic readout repeatable to 0.02 diopters is a satisfactory alternate method. These scanning procedures may be made by scanning across the lens surface not necessarily in the "as-worn" mode. Dual lens goggles requiring such assessment shall, if possible, be disassembled such that each lens can be assessed individually.

7.3 *Luminous Transmittance*—Luminous transmittance is a function of the spectral transmittance of the lens weighted by the corresponding ordinates of the photopic luminous efficiency distribution of the International commission on Illumination (CIE) (1931) standard colorimetric observer and the spectral intensity of standard Illumination C (see ANSI Z80.3, Paragraph 3.9.1).

7.4 *Ultraviolet Transmittance*—UVA and UAB transmittance as corresponding to their measured luminous category (see Table 4 of ANSI Z80.3). Dual lens goggles shall be measured as complete devices measuring the combined transmittance of both lenses.

7.5 *Haze*—Measure the protector for percent haze within the central viewing zones in accordance with Test Method D1003 with the protector positioned so that the passing beam of light is as perpendicular to the testing surface as is practicable. Dual lens goggles shall be measured as complete devices measuring the combined haze of both lenses.

7.5.1 The referee method of measuring haze shall be a spectrophotometer with the geometry conforming to Test Method D1003. Commercial "hazemeters" may be used as an alternate method for clear lens samples only.

7.6 *Prismatic Imbalance:*

7.6.1 *Purpose*—The test presented here is intended to measure the prismatic power and imbalance (angular devitation of light rays as they pass through the lens(es)) of the protector.

7.6.2 *Apparatus*—This apparatus shall consist of the head form defined in 3.1.23. The head form shall be placed in an optical system. The telescope lens, L2, shall be located at a distance of 1.0 m (39.4 in.) in front of the image plane IP. The pinhole aperture plate, p, shall be located approximately 10 m (394 in.) from the collimator lens. L1, and shall be adjusted so that one image is formed on the image plane, IP, when no protector is on the head form. The position of that image shall be marked or noted and will be called Po.

7.6.3 *Test Procedure*—The protector shall be mounted on the head form in the as-worn position. The image(s) on the image plane shall be identified as coming from the right eye, Pr, or the left eye Pl, by blocking the beams of each eye. The distance in centimetres between the centers of Pl and Po and the Pr and Po shall be measured. The prismatic power of the protector in prism diopters (Δ) shall be calculated the distances between Po and Pl, or Pr, whichever is greater. The horizontal and vertical distances in centimetres between the centers of Pl and Pr shall be measured. The horizontal and vertical prism imbalance of the protector in prism diopters (Δ) shall be calculated as the horizontal and vertical distances, respectively. The base of the horizontal prism imbalance shall be determined by analysis of the right and left ocular images as viewed on the image plane. Diverging images (rays) are base out; converging images (rays) are base in.

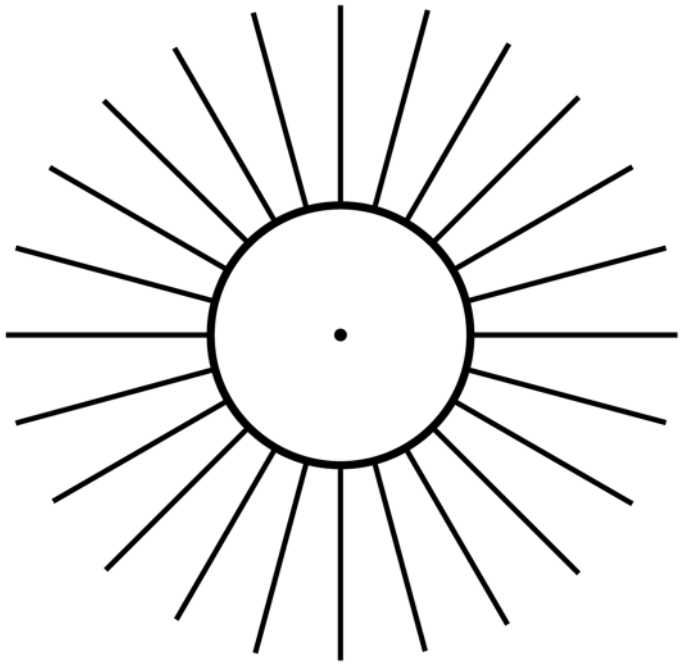

**FIG. 1 Test Pattern: "Sunburst"**

7.7 *Refractive Power Measurements:*

7.7.1 *Apparatus*—An 8-power telescope with an effective aperture of 19 mm (0.75 in.) shall be used in conjunction with the illuminated sunburst test target (Fig. 1) located a distance of 10.67 m (35 ft) from the telescope objective. The focus adjustment of the telescope shall be calibrated in at least 0.01-diopter increments. The test target shall be specified by ANSI Z87.1-2003, Fig. C5.

7.7.2 *Test Procedure:*

7.7.2.1 Adjust the telescope by setting the calibrated focus adjustment to zero power, and then adjust the eyepiece so that the test target is clearly resolved without the protective device in front of the telescope. The quality of the telescope and the observer's vision should be such that Pattern 40 of the High Contrast Test Chart of the National Institute of Standards and Technology (NIST) Special Publication 374 is clearly resolved in both orientations.[6]

7.7.2.2 Mount the protective device in front of the telescope in the as-worn position such that the telescope axis passes through either one of the central viewing zones in the principle direction of gaze. The distance between the objective lens of the telescope and the lens of the protector shall not exceed 38 mm (1.5 in.).

7.7.2.3 Focus the telescope on the radial lines of the test target until they appear as sharp as possible. Two possibilities may occur. If all radial lines appear equally well focused (sharp) at the same telescope power setting, the eye protective device has no measurable astigmatism and the power reading

[6] Washer, Francis E. and Gardner, Irvine C., *Method for Determining the Resolving Power of Photographic Lenses*, Special Publication 374, National Institute of Standards and Technology, Washington, DC, 1973.

of the telescope at that position is the refractive power of the lens for the respective viewing zone (right or left eye) measured.

7.7.2.4 If lines in only one meridian appear sharpest at a given focus, the telescope shall be refocused to determine the best focus for the lines in the meridian that yield an extreme (maximum or minimum) power reading. The power reading shall be noted as the refractive power of the lens for the respective viewing zone (right or left eye). Measure the maximum meridional power for each eye. The power reading shall be noted. The telescope shall then be refocused for lines in the meridian that yield the opposite extreme power reading. This value shall be noted. The astigmatism is calculated as the absolute value of the algebraic difference between the two power readings.

7.7.2.5 Repeat the test as in 7.7.2 for the remaining viewing zone (opposite eye) of the protector.

## 8. Mechanical Tests

8.1 *Lens Strength and Retension:*

8.1.1 *Apparatus:*

8.1.1.1 The test headform of appropriate size to the goggle to be tested shall be used to hold the protective device. It shall be rigidly mounted in the horizontal position, face up, on a base that has a mass of 30 kg (66 lb) or greater.

8.1.1.2 The missile for impacting the goggle shall have a 30 ±1° included angle conical tip with a 3.175 ± 0.1 mm (0.125 ± 0.004 in.) spherical radius, polished heat-treated steel to 54 HRC or harder to be a 2.54 ± 0.25-mm (1 ± 0.1-in.) diameter and shall have a mass not less than 500 g (17.7 oz). A guide tube shall be provided for the projectile.

8.1.1.3 *Procedure*—Place the goggle on the head form as it would be worn by the user. Drop the projectile through the guide tube from a height (measured from the bottom of the projectile) of 127 + 3.8 – 0 cm (50 + 1.5 – 0 in.) above the exterior surface of the goggle. Impact the goggle aligned vertically above the center of the eye of the head form. Four devices shall be tested. Two impacts shall be on the left viewing area and two on the right viewing area. The samples and the test are to be conducted at standard ambient temperature of 23 ± 5.0ºC (73 ± 9ºF).

8.2 *Water and Snow Test:*

8.2.1 *Apparatus:*

8.2.1.1 A head form of appropriate size for the goggle to be tested shall be used to hold the protective device.

8.2.1.2 Hand-operated atomizer producing fine droplets (not mist).

8.2.1.3 White blotting paper of sufficient size to protrude at least 20 mm (0.79 in.) from the goggle under test.

8.2.1.4 Detection solution prepared by dissolving 5.0 ± 0.5 g of phenolphthalein in 500 ± 50 mL of ethanol and adding 500 ± 50 mL of water, stirring constantly (filter if precipitate forms), to obtain 1.0 ± 0.1 L of solution.

8.2.1.5 Absorbent cotton lint (surgical dressing), mass per unit area of approximately 185 g/m$^2$.

8.2.1.6 Spray solution of 0.1-mol/L solution of sodium carbonate in water.

8.2.2 *Procedure:*

8.2.2.1 Cover the ocular region of the head form with layers of cotton lint and then blotting paper previously dipped in the detecting solution.

8.2.2.2 Fit the protector onto the headform in the normal wearing position so that the blotting paper protrudes all around the periphery by at least 20 mm (0.79 in.). Adjust the headband to a normal degree of tension. Adjust the number of layers of lint, as necessary, to insure a good seal between the protector and the head form.

8.2.2.3 Spray the mounted protector with the spray solution (8.2.1.6) holding the atomizer at a distance of approximately 600 mm (23.6 in.) from the head forms spraying onto the front of the protector. Spraying shall be continuous and continued until the blotting paper around the periphery of the protector turns a uniform crimson color.

8.3 *UV Stability Test:*

8.3.1 *Apparatus*—Fused silica high-pressure 450-W xenon arc lamp.

NOTE 2—Suitable lamp references are the XBO-450 W/4 and CSX-450 W/4. These lamps produce UV radiation with an appreciable amount of ultraviolet C (UVC) radiation (100 to 280 nm). (**Warning—**Precautions should be taken against potential generation and buildup of ozone.)

8.3.2 *Procedure:*

8.3.2.1 The lens(s) of the protector shall be exposed to UV radiation from a conditioned (150-h) xenon lamp with a spectral transmittance of at least 30 % (of peak) at 200 nm (7.9 in.). The distance from the axis of the lamp to the nearest point on the sample shall be 300 mm (11.8 in.). The exposure time (ref.) shall be 24 h for a lamp power of 450 W.

8.3.2.2 The lamp current shall be stabilized at 25 ± 0.2 A.

8.3.2.3 The protector shall be exposed for duration of 24 ± 1 h.

8.4 *Field-of-View Test (*Figs. 2-4*):*

8.4.1 *Apparatus:*

8.4.1.1 The head form of appropriate size of the goggle to be tested shall be used to hold the protective device.

8.4.1.2 A laser-equipped goniometric stage with a laser beam diameter of 1.0 ± 0.5 mm (0.04 ± 0.02 in.).

8.4.2 *Procedure*—The goggle shall be mounted on the appropriate size head form in the as-worn position.

## 9. Cleaning

9.1 Follow the manufacturer's instructions for cleaning. If none are available, clean with a mild soap and warm water solution by soaking the device in the soap solution maintained at 43 ± 5°C (109 ± 9°F) for 10 ± 1 min. Rinse thoroughly and allow to air dry. Any characteristics of the device that would impair the functionality of the protector are cause for failure.

## 10. Product Marking

10.1 All eye protectors shall bear the following visible permanent marking:

10.1.1 Manufacturer's identity.

10.2 A label or tag bearing the following information shall be securely attached to, or accompany, each eye protector at time of sale:

10.2.1 Designation number of this specification;

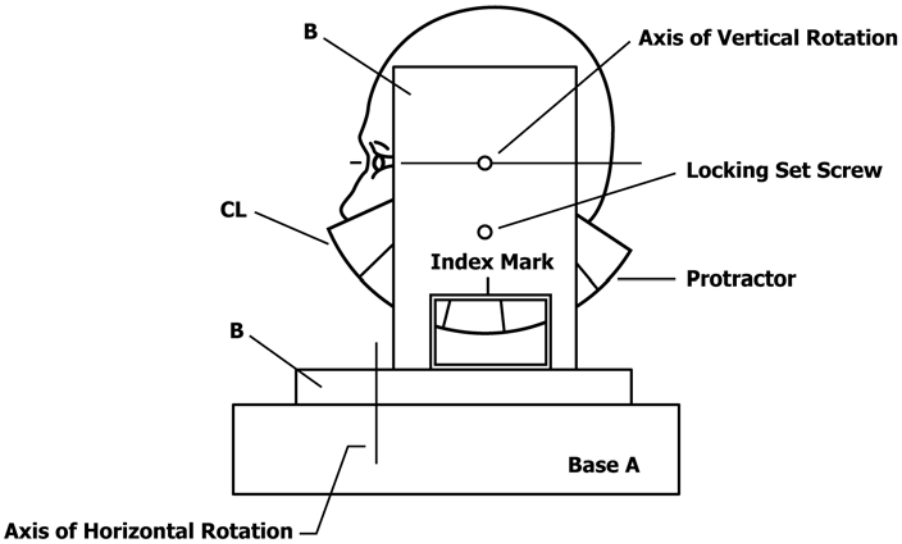


FIG. 2 Side View of Gimbal

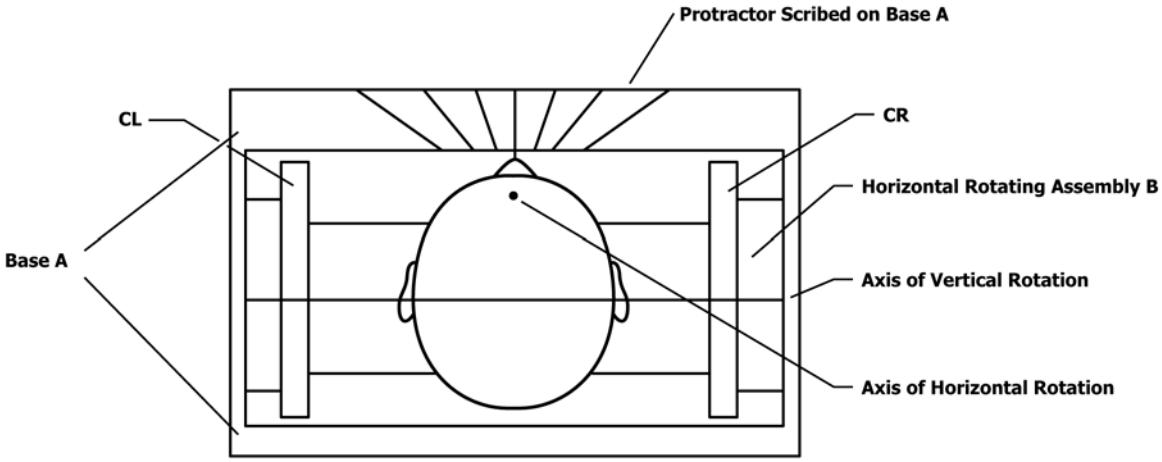


FIG. 3 Top View Showing Base for Horizontal Rotation

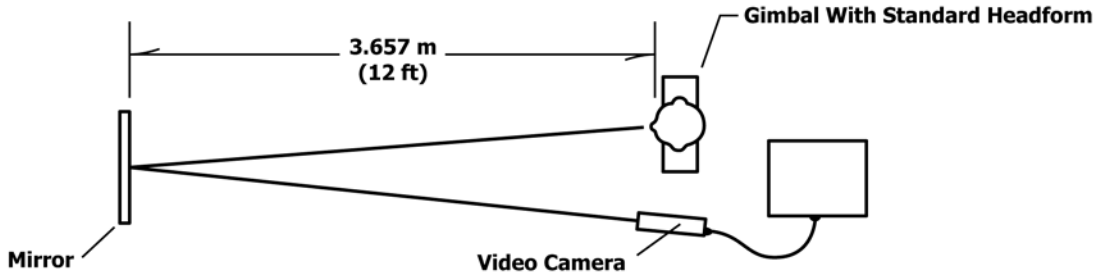


FIG. 4 Bench-Top Field-of-View Setup

10.2.2 The size range and instructions that shall clearly cover proper fit;

10.2.3 A warning stating the cleaning and antifog agents that may be used with eye protectors incorporating plastic lenses and further stating that the lenses should be replaced when scratches become troublesome or if cracks appear at the edges; and

10.2.4 A warning stating that if the eye protector is severely impacted, short of failure, then the degree of protection provided may be reduced and the eye protector lens must be replaced. Failure to do so may result in permanent injuries to the eye.

## 11. Keywords

11.1 eye protection; labeling; lens strength; optical properties; ski and snowboard goggles

## ANNEX

**(Mandatory Information)**

## A1. TEST METHOD FOR FOGGING RESISTANCE OF SNOW SPORT GOGGLES

A1.1 *Summary of Test Method*—The lens of a goggle is equilibrated at room temperature and its inner (toward the face) side is exposed to moisture-saturated air at an elevated temperature. Condensation of moisture (fogging) on the surface of the lens scatters light from a collimated beam passing through the lens, thereby reducing the regular transmittance of the goggle. The time for the (two-pass) transmittance to decrease by 20 % is an indication of the resistance to fogging of the goggle. An alternative indicator is the time required for the transmittance of a fully fogged lens to recover to 80 % of the dry transmittance.

A1.2 *Significance and Use*—Fogging of a goggle can impair vision enough to be a serious hazard. The amount of fogging that occurs depends on several factors, in particular, ventilation and air flow between the lens and the face of the wearer, and the effectiveness of an anti-fogging coating, if present. Ventilation and air flow depend on the design of the goggle and some of the immediate conditions of use, for which no general test is available. The present test method determines whether a minimal level of effectiveness of an applied anti-fogging coating is achieved and therefore whether a goggle can be described as being fogging-resistant by the criteria of this specification.

A1.3 *Apparatus*:

A1.3.1 The apparatus is depicted schematically in Fig. A1.1. Not shown are: (*1*) a temperature controlled heater and circulator for the water bath, (*2*) a readout for the photosensor, (*3*) mountings for the components, and (*4*) shielding to block extraneous light from the photosensor.

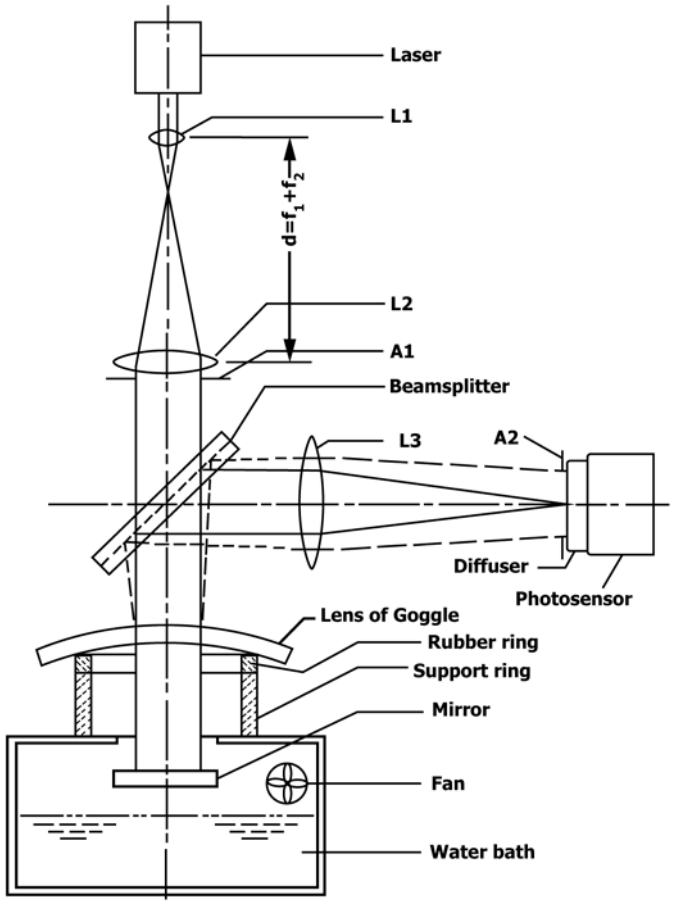


**FIG. A1.1 Apparatus for Test of Resistance to Fogging**

A1.3.2 The light source is a laser with a wavelength of 600 ± 70 nm. Lenses L1 and L2 expand and collimate the laser beam. Aperture-diaphragm A1 limits the diameter of the projected beam to 10 mm (0.4 in.). Suitable focal lengths of the lenses are L1: $f_1$ = 10 mm; L2: $f_2$ = 100 mm.

A1.3.3 The volume of the container for the water bath shall be large enough that the volume of water is sufficient to be maintained at a constant temperature and that the volume of air above the water is at least 4 L. The air is kept in circulation with the fan. The temperature of the water bath is 50 ± 0.5°C (122 ± 1°F).

A1.3.4 The nominal inside diameter of the support ring is 35 mm (1.4 in.), and its maximum height is 24 mm (0.95 in.) above the inner (lower) surface of the deck of the water bath container. A soft rubber ring, 3 mm (0.12 in.) wide and 3 mm (0.12 in.) thick in cross section is cemented to the top of the support ring. The contour of the mounted rubber ring shall be such as to contact the goggle test lens uniformly.

A1.3.5 The beam splitter transmits the collimated laser beam through the test lens onto the first-surface mirror that is mounted in the airspace above the water bath and deflects the reflected beam through the lens L3 onto the translucent diffuser and photosensor. The aperture-diaphragm A2 is to be in the focal plane of lens L3. A suitable focal length for L3 is $f_3$ = 400 mm (15.7 in.), and the corresponding distance from L3 to the aperture-diaphragm A2 shall then be 400 mm (15.7 in.). The diameter of L3 shall be large enough to intercept light that is scattered from the goggle lens into angles up to 0.75°. The diameter of A2 is 10 mm (0.4 in.). Unscattered light and the light scattered into angles up to 0.75° will impinge on the diffuser and be detected by the photosensor. Light scattered into angles larger than 0.75° will be blocked by A2 and will not be detected.

A1.4 *Procedure*:

A1.4.1 *Sample Size*—At least four representative units shall be tested.

A1.4.2 *Conditioning the Test Piece*—Before testing for resistance to fogging, a test piece shall be immersed for 1 h in distilled water (at least 5 $cm^3$ (2 $in.^3$) of water for each square centimetre of the surface to be tested) at 23 ± 5°C (73 ± 9°F). Dab dry with a soft lintless cloth. It shall then be held in air at 23 ± 5°C (73 ± 9°F) for at least 12 h and 50 % relative humidity.

A1.4.3 *Preparation of Water Bath Chamber*—Heat the water bath and maintain its temperature at 50 ± 0.5°C (122 ± 1°F). Closely cover the support ring and circulate air in the chamber with the fan until the air is saturated with moisture. Continue the air circulation until ready to make transmittance measurements. The room temperature during the measurement process shall be 23 ± 5°C (73 ± 9°F).

A1.4.4 *Transmittance Measurements*—A transmittance measured is two passes through the test lens and so is the square of a single pass transmittance. Use a stopwatch to time the decrease of the indicated (two-pass) transmittance to 80 % of the clear, dry lens transmittance (Criterion No. 1) or to the time of clearing of the lens from fully fogged to the 80 % (two-pass) transmittance level (Criterion No. 2).

NOTE A1.1—Initial fogging that dissipates within 0.5 s is not considered in the evaluation.

A1.4.4.1 When ready to start a transmittance test, turn the air circulation fan to the OFF position, uncover the support ring, immediately place the test piece on the support ring, start the timing, and record the signal from the photosensor. When the signal from the photosensor has decreased to 80 % of its initial value, record the time. Evaluate the resistance to fogging by Criterion No. 1.

A1.4.4.2 To evaluate resistance to fogging by Criterion No. 2, proceed as in A1.4.4.1 but let the test piece remain on the support ring until it has become fully fogged (having recorded the initial, clear-lens, photosensor signal). Remove the test piece from the support ring. The time to recovery to 80 % transmittance may be estimated by visual observation of the lens, provided that the recovery to clarity occurs in significantly less than 30 s.

A1.4.4.3 Cover the support ring and turn the air circulation fan to the ON position as needed to maintain the saturation of the air in the chamber.

A1.5 *Interpretation of Results*:

A1.5.1 *Criterion No. 1*—If the time for the transmittance to decrease to 80 % of its value for the dry lens is used as the criterion for evaluating the performance, the goggle may be described as resistant to fogging if that time was greater than or equal to 30 s. The goggle passes the anti-fogging test if this criterion is met.

A1.5.2 *Criterion No. 2*—If the time for the transmittance of a highly fogged lens to increase to 80 % of its value for the dry goggle is used as the criterion for evaluating the performance, the goggle may be described as resistant to fogging if that time was less than or equal to 30 s. The goggle passes the anti-fogging test if this criterion is met.

A1.6 *Report*—State which method of evaluating performance was used and whether the goggle passed or failed the anti-fogging test. Reporting the measured time to reach the 80 % transmittance level is optional. This reporting is for use by the manufacturer and is not included in statements for labeling.

A1.7 *Labeling* —Ski goggles may be labeled as resistant to fogging if they pass either of the antifogging tests of this specification.

A1.8 *Precision and Bias*—Determinations of precision and bias are not required for this test because the result indicates only whether or not there is conformance with the criterion specified for success.