Designation: F659 – 10

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.

Current edition approved Feb. 1, 2010. Published March 2010. Originally approved in 1980. Last previous edition approved in 2006 as F659 – 06. DOI: 10.1520/F0659-10.

[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 ± 3.5ºF) 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.

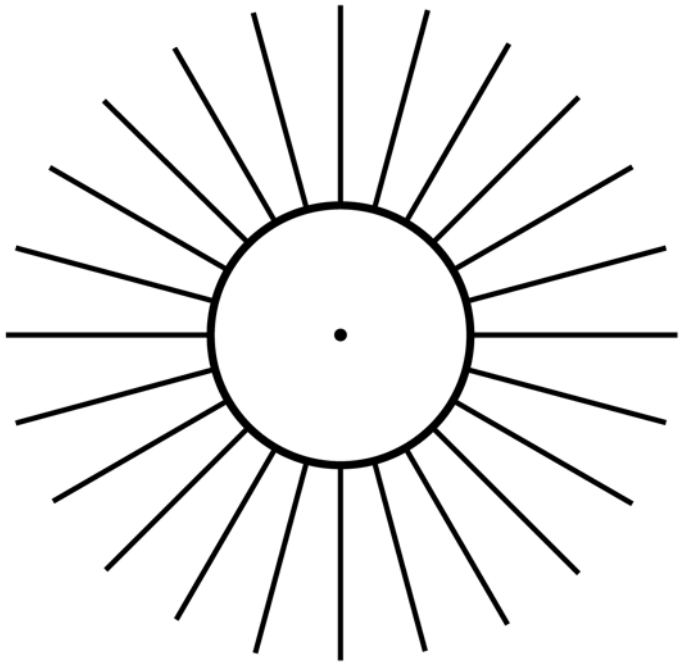

FIG. 1 Test Pattern: "Sunburst"

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.