



**ANSI/ISEA**

**Z87.1-2010**

**American National Standard  
for Occupational and Educational  
Personal Eye and Face  
Protection Devices**

**ANSI/ISEA Z87.1-2010**  
Revision of  
ANSI Z87.1-2003

**American National Standard  
Occupational and Educational  
Personal Eye and Face  
Protection Devices**

Secretariat  
**International Safety Equipment Association**

Approved April 13, 2010  
**American National Standards Institute, Inc.**

## **American National Standard**

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether they have approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review and users are cautioned to obtain the latest editions.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no persons shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute.

**CAUTION NOTICE:** This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Published by

**International Safety Equipment Association  
1901 North Moore Street, Suite 808, Arlington, Virginia 22209 USA**

Copyright 2010 by ISEA

All rights reserved.

No part of this publication (with the exception of Annex I, Selection Chart) may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Printed in the United States of America

## **Foreword** (This Foreword is not a part of ANSI/ISEA Z87.1-2010)

The first version of a document that could be termed a “standard” dates back to 1922 with the first edition of the Z2 standard for head and eye protection. This standard originated from the cooperative work by the War and Navy Departments and the National Bureau of Standards.

Throughout the 1930’s and 1940’s the Z2 standard for eye and face protection was published as part of the initial 1938 National Bureau of Standards Handbook H24 that also included standards for respiratory and head protection. The 1946 revision was the first to recognize advances in materials technology and included criteria for materials other than glass. In 1959, Z2 was approved as the American Standard Safety Code for Head, Eye and Respiratory Protection.

In 1961 the Standards Safety Board split the Z2 project into three separate standards. Z87 for Eye and Face Protection, Z88 for Respiratory Protection and Z89 for head protection. On September 18, 1968 the eye and face protection standard was published with the Z87 designation, Z87.1-1968. Since then Z87.1 has been revised in 1979, 1989, and 2003.

This edition of Z87.1 represents a dramatic change in the way the standard is organized and how users of eye and face protectors will utilize the standard for selecting products for specific hazards. The 2003 edition of the Z87.1 standard and its predecessors were organized by the type of protector. Each type of protector, spectacles, goggles, faceshields and welding helmets had a chapter in the standard. The chapter described the protector, the required testing and optical properties and established product marking requirements. This led to significant repetition within the standard as some products have the same testing, optical and marking requirements.

In the process of revising Z87.1-2003, the Z87 Accredited Standards Committee (ASC) evaluated user needs, product variety and protection in an effort to write a document that is more useful for eye and face protection wearers. This 2010 edition is the product of work on behalf of the Z87 committee to develop a standard that focuses on the hazard and is organized by the nature of the hazard such as droplet and splash, impact, optical radiation, dust, fine dust and mist.

A benefit of this hazard approach to the standard is that it will encourage users and employers to evaluate the specific hazards that they are exposed to in their environment. Selection of appropriate eye and face protection will be based on this hazard evaluation. Because the standard is radically different, the product markings have changed. Users will need to be educated on matching the hazard that they need protection from with the marking on the product. The Z87 ASC also made efforts to parallel other eye and face protection standards used in the world. Many of the tables in this standard reflect this effort to harmonize with global standards.

Suggestions for improvement of this standard are welcome. They should be sent to the International Safety Equipment Association, 1901 N. Moore Street, Suite 808, Arlington, VA 22209, [isea@safetyequipment.org](mailto:isea@safetyequipment.org).

This standard was processed and approved for submittal to ANSI by the Accredited Standards Committee on Safety Standards for Eye Protection, Z87. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the Z87 Committee had the following members:

Daniel Torgersen, Chairman  
Jack B. Hirschmann, Jr., Vice-Chairman

**Organization Represented**

**Name of Representative**

American Optometric Association	Gregory Good, O.D., Ph.D. Neil Hodur, O.D.
American Society of Safety Engineers	Jack B. Hirschmann, Jr.
American Welding Society	Philip M. Johnson
International Safety Equipment Association	John E. Salce Janice Comer Bradley, CSP
Jones and Company	Bruce Hey John Halliburton
3M Company	Nicole Vars McCullough, Ph.D. Robert A. Weber, CIH
National Association of Optometrists and Opticians	Lee Handel Franklin D. Rozak
National Institute for Occupational Safety and Health (NIOSH)	Larry L. Jackson, Ph.D. James R. Harris, Ph.D.,P.E.
Optical Laboratories Association	Daniel Torgersen
Opticians Association of America	John M. Young Daryl Neely
Power Tools Institute	Brett Cohen Wayne Hill
PGRD	Mark Ferin
Prevent Blindness America	Dan Hodge, OHST Christine Bradley, MS
U.S. Department of the Air Force	Anthony Jarecke, Major
U.S. Dept. of the Army	James Elledge, Major David J. Hilber, Lt. Colonel
U.S. Dept. of the Navy	Margaret Read, Lt. Commander
U.S. Safety	J.P. Sankpill
The Vision Council	Jeffrey Endres Kenneth Wood
Younger Optics	Patrick Mumford Nancy L.S. Yamasaki, Ph.D.
ANSI Z80 Committee Ophthalmic Lenses	John McCarthy
ANSI Z88 Committee Respiratory Protection	Daniel Torgersen Richard Harley
Z89 Committee Head Protection	Mili Mavely James K. Byrnes
ICS Laboratories, Inc.	Janice C. Bradley, CSP
Individual Expert	Dale B. Pfriem, Individual Expert
Individual Expert	Michael W. Schaus
Individual Expert	David Sliney William E. Newcomb

## Table of Contents

TOPIC	PAGE
Foreword	
1 Preface .....	1
2 Scope, Purpose, Application, and Interpretations .....	1
2.1 Scope.....	1
2.2 Purpose .....	1
2.3 Application.....	1
2.4 Interpretations .....	2
3 Definitions .....	2
4 Normative References.....	6
5 General Requirements.....	6
5.1 Optical Requirements .....	6
5.2 Physical Requirements.....	7
5.3 Minimum Lens Thickness .....	8
5.4 Marking Requirements .....	8
5.5 Other Requirements .....	8
5.6 Replaceable Lenses.....	11
5.7 Aftermarket Components.....	11
6 Impact Protector Requirements.....	11
6.1 General.....	11
6.2 Impact Requirements .....	12
6.3 Additional Impact Requirements for Specific Protector Types .....	13
7 Optical Radiation Protector Requirements .....	13
7.1 Transmittance of Lenses .....	13
7.2 Transmittance of Housings .....	15
8 Droplet and Splash, Dust, and Fine Dust Protector Requirements .....	17
8.1 Droplet and Splash Hazard .....	17
8.2 Dust Hazard .....	17
8.3 Fine Dust Hazard .....	17
9 Test Methods.....	17
9.1 Optical Quality Test.....	17
9.2 Transmittance Test.....	17
9.3 Haze Test .....	17
9.4 Refractive Power, Astigmatism and Resolving Power Tests.....	17
9.5 Prismatic Power Test .....	18
9.6 Drop Ball Test.....	19
9.7 Ignition Test.....	19
9.8 Corrosion Resistance Test .....	19

9.9	Light Tightness Test .....	20
9.10	Lateral Protection Test.....	20
9.11	High Mass Impact Test .....	20
9.12	High Velocity Impact Test.....	21
9.13	Penetration Test .....	22
9.14	Prescription Lenses Test .....	23
9.15	Switching Index Test .....	23
9.16	Droplet and Splash Test.....	24
9.17	Dust Test.....	25
9.18	Fine Dust Particle Test.....	26
10	Instructions, Use and Maintenance .....	26
10.1	General .....	26
10.2	Instructions.....	27
10.3	Inspections .....	27
10.4	Maintenance.....	27
10.5	Care.....	27
10.6	Training.....	27
 Annexes		
Annex A	Samples for Testing (normative).....	28
Annex B	Reference Headforms (normative) .....	29
Annex C	Spectral Factor Tables (normative) .....	31
Annex D	Lateral (Side) Coverage Illustration (Medium Headform) (informative) .....	35
Annex E	Test Apparatus (informative) .....	36
Annex F	Calibration of Test Telescope (informative) .....	40
Annex G	Sources for Test Apparatus (informative) .....	41
Annex H	Resource Publications (informative) .....	42
Annex I	Selection Chart (informative).....	43
Annex J	Hazard Assessment and Protector Selection (informative) .....	44
 Tables		
Table 1	Tolerance on Refractive Power, Astigmatism and Resolving Power.....	6
Table 2	Tolerance on Prism and Prism Imbalance .....	7
Table 3	Minimum Lens Thickness .....	8
Table 4a	Marking Requirements .....	9
Table 4b	Sequence of Markings .....	10
Table 5	High Velocity Impact Testing .....	12
Table 6	Transmittance Requirements for Welding Filters .....	14
Table 7	Transmittance Requirements for Ultraviolet Filters.....	15
Table 8	Transmittance Requirements for Infrared Filters .....	15
Table 9	Transmittance Requirements for Visible Light Filters .....	16
Table 10	Transmittance Requirements for Special Purpose Lenses.....	16
Table 11	Switching Index Requirements for Automatic Darkening Welding Filter Lenses .....	16

Explanation of Standard

The information and materials contained in this publication have been developed from sources believed to be reliable. However, the International Safety Equipment Association (ISEA) as secretariat of the ANSI accredited Z87 Committee or individual committee members accept no legal responsibility for the correctness or completeness of this material or its application to specific factual situations. By publication of this standard, ISEA or the Z87 Committee does not ensure that adherence to these recommendations will protect the safety or health of any persons, or preserve property.

# American National Standard for Occupational and Educational Personal Eye and Face Protection Devices

## 1. Preface

This standard for personal eye and face protectors is, as far as possible, designed to be performance oriented.

Every effort should be made to eliminate eye and face hazards in occupational and educational settings. Protectors do not provide unlimited protection. In the occupational and educational environment, protectors are not substitutes for machine guards and other engineering controls. Protectors alone should not be relied on to provide complete protection against hazards, but should be used in conjunction with machine guards, engineering controls, and sound safety practices.

In 1992, the U.S. Occupational Safety and Health Administration began regulating occupational exposure to bloodborne pathogens and, as a result, now requires employers to provide personal protective equipment (PPE) including eye and face protection for employees exposed to these hazards. At the time of the publication of this standard, no standards existed for eye and face protection intended to provide protection from bloodborne pathogens. Nevertheless many employers have elected to provide their employees with PPE conforming to the requirements of ANSI/ISEA Z87.1. These products may or may not provide adequate protection against bloodborne pathogens. Extreme caution must be exercised in the selection and use of personal protective equipment in applications for which no performance requirements or standardized testing exist.

## 2. Scope, Purpose, Application, and Interpretations

### 2.1 Scope

This standard sets forth criteria related to the general requirements, testing, permanent marking, selection, care, and use of protectors to minimize the occurrence and severity or prevention of injuries from such hazards as impact, non-

ionizing radiation and chemical exposures in occupational and educational environments including, but not limited to, machinery operations, material welding and cutting, chemical handling, and assembly operations. Certain hazardous exposures are not covered in this standard. These include, but are not limited to: bloodborne pathogens, X-rays, high-energy particulate radiation, microwaves, radio-frequency radiation, lasers, masers, and sports and recreation.

### 2.2 Purpose

This standard provides minimum requirements for protectors including selection, use, and maintenance of these protectors as devices to minimize or prevent eye and face injuries.

### 2.3 Application

**2.3.1** The requirements of this standard apply to protectors when first placed in service.

**2.3.2** Protectors bearing the permanent marking Z87 shall meet all applicable requirements of this standard in its entirety. All components of eye and face protectors shall comply with the requirements of this standard. Accessories installed by the manufacturer shall not cause the protector to fail the requirements of this standard. Manufacturers of components and complete protectors shall ensure that all required tests have been performed to demonstrate conformance.

**2.3.3** Compliance with this standard cannot always be assured when replacement components are used. End users should exercise extreme care in the selection and installation of replacement components to ensure compliance with this standard.

**2.3.4** Non-compliant components shall not be used with ANSI/ISEA Z87-compliant components.

**2.3.5** The protector manufacturer shall provide test results to the purchaser upon request.