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Guide to selection, use and maintenance of occupational eye and face protectors

Leitfaden für Auswahl, Gebrauch und Wartung von beruflichen Augenschutzgeräten

Guide de sélection, d'utilisation et d'entretien des protecteurs de l'oeil et du visage a usage professionnel

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Guide to selection, use and maintenance of occupational eye and face protectors

Guide de sélection, d'utilisation et d'entretien des protecteurs de l'oeil et du visage à usage professionnel

Leitfaden für Auswahl, Gebrauch und Wartung von beruflichen Augenschutzgeräten

This CEN Report was approved by CEN on 2 December 1998. It has been drawn up by the Technical Committee CEN/TC 85.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This CEN Report has been prepared by the Convenor of Working Group 10 of the Technical Committee CEN/TC 85 "Eye-protective equipment" the secretariat of which is held by AFNOR.

The first draft document, CEN/TC 85 WG10/N8 was discussed at a meeting of WG10 on 20 September 1995. The comments and proposals emanating from this meeting were used to prepare a second draft document which was further discussed at a meeting of WG10 on 18 September 1996. Following this meeting, the agreed changes were incorporated into a third draft document, CEN/TC 85 WG10/N17. This final draft has been prepared following receipt of comments on the third draft, as detailed in document CEN/TC 85 WG10/N18.

In preparing this Technical Report the following documents have been referenced :

- British Standard BS7028 :1988 - Guide to the Selection, Use and Maintenance of Industrial Eye-Protectors ;
- Fourth Draft Standards /Australia/Standard New Zealand : May 1994 - Recommended Practices for Occupational Eye-Protection.

1 Scope

This technical report is intended for information and guidance only. It relates to all types of personal eye and face protectors used against various hazards as encountered in industry, commerce, laboratories, educational establishments, etc. which may damage the eye or impair vision with the exception of ionising radiation such as X-rays and low temperature infra-red (IR) radiation. This report does not include specific guidance on the use of sport, leisure or vehicular eye- and face-protectors, but gives useful information also for other than occupational activities where a risk for eye and/or face exists.

The purpose of this report is (a) to detail and explain the relevant European standards relating to occupational eye and face protectors, (b) to provide a basic understanding of the classification of hazards to the eye encountered in industrial and other occupational situations, (c) to explain and classify the various types of eye and face protectors and to list their various characteristics and protection capabilities, and (d) to give guidance on the selection, care and maintenance of occupational eye and face protectors.

This report must not be used as a whole or partial substitute for a professional risk assessment which is an essential element of any safety eyewear selection exercise.

2 References

The following documents relating to occupational eye-protectors are included within the scope of this report and referenced by it.

EN 165, *Personal eye-protection - Vocabulary.*

EN 166, *Personal eye-protection - Specifications.*

EN 167, *Personal eye-protection - Optical test methods.*

EN 168, *Personal eye-protection - Non-optical test methods.*

EN 169, *Personal eye-protection - Filters for welding and related techniques - Transmittance requirements and recommended utilisation.*

EN 170, *Personal eye-protection - Ultraviolet filters - Transmittance requirements and recommended use.*

EN 171, *Personal eye-protection - Infra-red filters -Transmittance requirements and recommended Use.*

EN 172, *Personal eye-protection - Sunglare filters for industrial use.*

EN 175, *Personal protection - Equipment for eye and face protection during welding and allied processes (excluding hoods).*

EN 207, *Personal eye-protection - Filters and eye-protection against laser radiation.*

EN 208, *Personal eye-protection - Eye-protectors for adjustment work on lasers and laser systems.*

EN 379, *Specification for welding filters with switchable luminous transmittance and welding filters with dual luminous transmittance.*

EN 1731, *Mesh type eye and face protectors for industrial and non-industrial use against mechanical hazards and/or heat.*

EN 60825, *Security of laser products.*

ISO/DIS 8980-1, *Ophthalmic optics – Uncut finished spectacle lenses – Part 1 : Specifications for single vision and multifocal lenses.*

ISO/DIS 8980-2, *Ophthalmic optics – Uncut finished spectacle lenses – Part 2 : Specifications for progressive power lenses.*

A brief description of the scope and content of the foregoing standards is given in table 1.

Table 1 - Scope and content of european occupational eye-protection standards

Standard	Scope and content
EN 165 Vocabulary	Provides a list of optical and technical terms found in European eye-protection standards and gives a brief informative definition of each term
EN166 Specifications	Contains construction and performance specifications together with marking requirements for industrial/occupational eye-protectors, including protective spectacles, goggles, eyeshields and faceshields. Performance requirements are given for optical properties such as refractive powers, transmittance and diffusion of light, and mechanical properties such as robustness, temperature stability, ignition resistance, and resistance to molten metals, dust, liquid splashes, gases, short circuit electric arc and high speed particles
EN 167 Optical test methods	Describes the various optical test methods specified in EN166 and other eye-protection performance standards
EN168 Non-optical test methods	Describes the various non-optical test methods specified in EN166 and other eye-protection performance standards
EN 169 Filters for welding and related techniques - Transmittance requirements and recommended utilisation	Details transmittance requirements for welding filters against UV, visible and IR radiation. Contains recommendations for the selection of filters when using the various different types of welding equipment
EN 170 Ultraviolet filters. Transmittance requirements and recommended use	Details transmittance requirements for filters against UV radiation. Contains recommendations for the selection of UV filters against the various sources and types of UV radiation
EN 171 Infra-red filters. Transmittance requirements and recommended use	Details transmittance requirements for filters against IR radiation. Contains recommendations for the selection of IR filters against the various sources and types of IR radiation.

"continued"

Table 1 *(end)*

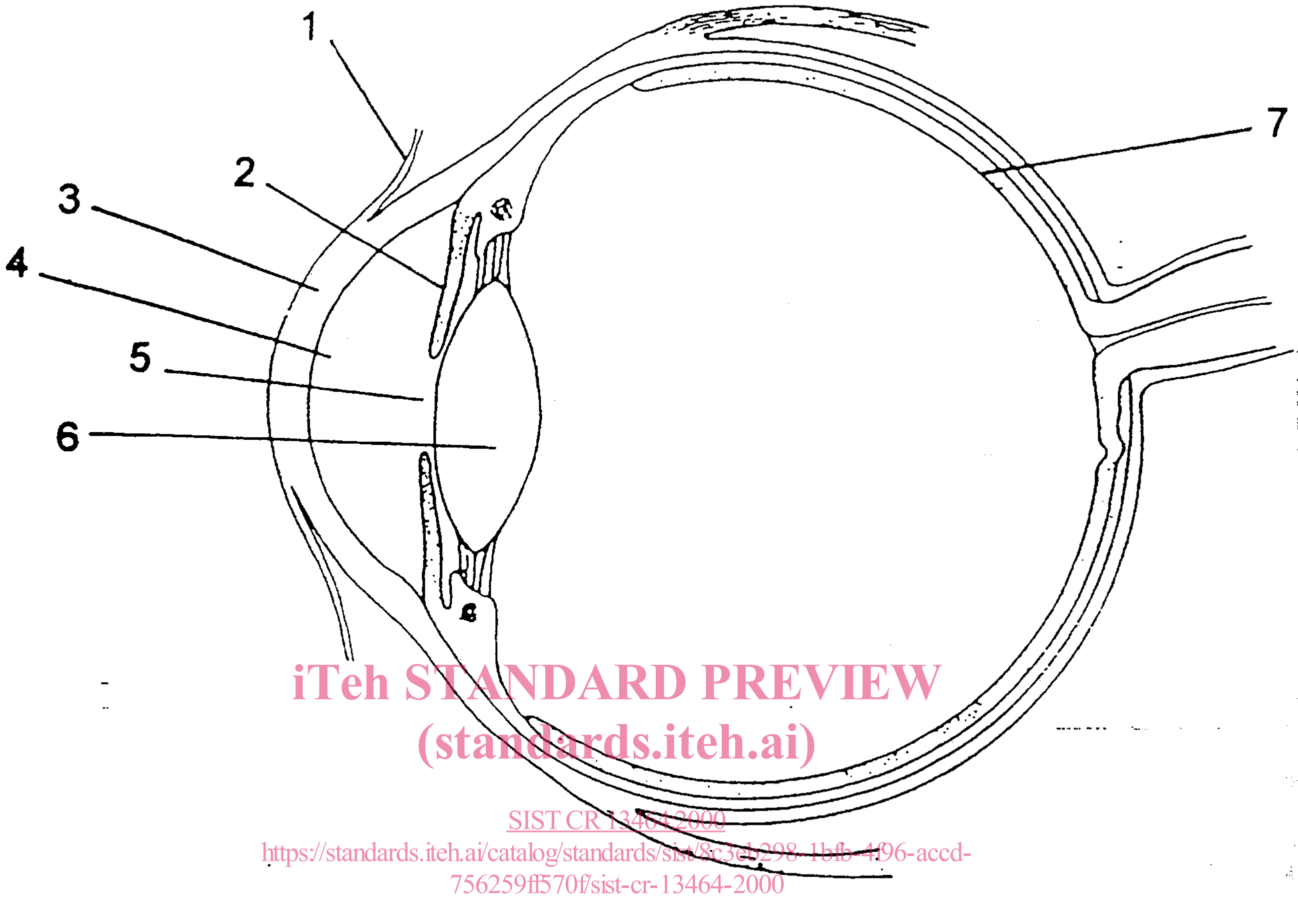
EN 172 Sunglare filters for industrial use	Details transmittance and other requirements for filters against sunglare (visible glare) radiation
EN 175 Equipment for eye and face protection during welding and allied processes	Contains construction and performance specifications for welding protectors, including spectacles, goggles, faceshields and hand-held shields. Performance requirements are given for area of coverage, heat resistance, robustness, etc. The welding equipment described is intended for use with welding filters defined in EN 169 and EN 379
EN 207 Filters and eye-protectors against laser radiation	Details transmittance requirements and mechanical requirements for filters and mechanical requirements for complete eye-protectors for use against the various types of laser radiation
EN 208 Eye-protectors for adjustment work on lasers and laser systems	Details transmittance and other requirements for eye-protectors for use when adjusting or servicing visible lasers and laser systems
EN 379 Specification for welding filters with switchable luminous transmittance and dual luminous transmittance	Details transmittance and other requirements for welding filters which have two components (light and dark) and opto-electric filters which can be switched from one shade to another, either manually or automatically
EN 1731 Mesh type eye and face protectors for industrial and non-industrial use against mechanical hazards and/or heat	Contains construction and performance specifications for mesh type eye-protectors as used principally in the forestry, metal processing and steel industries. Types of mesh type eye-protectors are defined (spectacles, goggles and faceshields). Performance requirements are given for area of coverage, mesh size, heat resistance, robustness, etc.

3 Hazards to the eye encountered in occupational environments

3.1 Introduction

The fragile and vulnerable human eye is particularly prone to damage from three main hazard classifications encountered in occupational applications, these being, mechanical, chemical and radiation. There may well be circumstances where two or more of these hazards are present either simultaneous or concurrently and thus it is essential to gain an appreciation of all the potential hazards that may be encountered in the working environment.

The effects on the human eye from damage by the various hazards are numerous and complex and range in severity from minor irritation to total blindness. To help explain these effects, discussed in the following clauses, a sectional diagram of the eye, highlighting the principal components, is shown in figure 1 below



Key

1 conjunctiva
2 iris
3 cornea
4 aqueous humour
5 pupil
6 lens
7 retina

Figure 1 - The human eye

3.2 Mechanical hazards

3.2.1 Sources

Mechanical operations offer the most obvious sources of danger where damage to the eye may occur from flying debris, collision with static objects, ingress of fine particles, abrasion from fibrous materials or foliage and burns from hot liquids and molten solids.

In engineering machinery operations sharp swarf from the component or a broken tool tip can readily become airborne at significantly high velocities. In metal foundries and steel working the potential for molten metal splash is ever present, and in most working environments there are risks of falling objects and encounters with sharp corners which present further opportunity for damaging the eye.

In quarrying work and the construction industry there are obvious risks from flying chippings, and dust clouds. Similar hazards exist in mining operations, stone-masonry, sculpturing and building repair.

Forestry and landscaping operations also present a host of potential hazards from sharp foliage, "kick-back" from chain saws and flying fragments from broken power tools and machinery.

Exploding flasks in laboratories, dust clouds generated during automobile sanding operations and grit generated by shot blast operations are other examples of mechanical hazards which are common causes of eye injury.

3.2.2 Effects

The damage to the eye that can be caused by mechanical hazards ranges from mild irritation from ingress of fine dust to total loss of sight from high velocity/high mass impacts or major, direct encounter with molten metals.

The cornea of the eye can easily be scratched by fine dust particles. This can result in discomfort or soreness which may last for a few minutes or several days depending on the severity of the abrasion. More severe damage to the cornea will result in clouded vision.

Sharp flying objects of sufficient mass and speed can easily penetrate the cornea to injure the iris and the lens itself. Physical damage to the lens and its associated muscles may result in permanent loss of focus.

Minor ingress of foreign matter may be readily dispersed by fluid secreted by the tear ducts whereas larger amounts will require dispersal by eye-baths or other more intensive remedies conducted within a specialised medical environment.

3.3 Chemical hazards

3.3.1 Sources

As with mechanical hazards the sources of chemical hazards are numerous and manifest themselves in the form of very fine powders, aerosols, liquids, fumes, vapours and gases.

Chemical hazards are potentially less obvious than mechanical hazards; for example, fine cement dust entering the eye in small quantities may not present a serious mechanical hazard but the strong alkaline bias of such materials can cause severe corneal burns.

Many insecticides used in crop spraying and generated in aerosol form present an obvious hazard to agricultural workers. Paint spraying, varnishing and many other lacquering and treatment processes involve chemicals generated in aerosol form and even if the base substance itself is harmless it may well be carried by a more damaging chemical solvent.

The hazards associated with liquid chemicals are usually more obvious than from aerosols, fumes or gases and principally relate to splashes from containers during decanting and mixing, particularly where uncontrolled mixing leads to boiling by exothermic reaction.

Fumes generated by combustion are another potential cause of eye irritation and other more serious damage whereas the number of vapours and gases which can have a harmful effect on the eye is extensive and includes such common industrial use substances as acetone, chlorine, formaldehyde, hydrogen sulphide, sulphur dioxide and toluene.

Fume hazards are visible and thus warn of their presence whereas many of the harmful vapours and gases are invisible. Apart from leakages from containers and pipework, hazards also exist from vaporisation of liquid chemicals during decanting, mixing and disposal.

Finally, biological hazards in the medical and dental environment related to splashes of blood and body tissue containing virus are another obvious danger which may be broadly classified as a chemical hazard.

3.3.2 Effects

Liquid splashes of strong acids and alkalis can cause serious eye burns ; even minute splashing or fine aerosols of such substances can cause irritation or conjunctivitis.

Fuel vapours and certain hydrocarbons can cause a reduction of the oxygen content in the natural fluids in the eye leading to a condition known as corneal dystrophy which manifests as inflammation of eye and inner surface of the eye-lids.

Exposure to certain other chemicals can give rise to inflammation of the optic nerve paths, a condition known as optical neuritis.

Conjunctivitis can also be caused by allergic reactions to many chemical substances, pollens, and biological agents.

3.4 Radiation hazards

3.4.1 The electromagnetic spectrum

Figure 2 shows a diagrammatic representation of the electromagnetic spectrum, which is broken down into a number of component parts or radiation bands. Each band merges into the next and cannot be separated as rigidly as the diagram suggests. The effect that the differing types of radiation produce depends significantly on the wavelength of the radiated wave.

Laser beams are not separately identified on the diagram as these fall at various wavelengths within the optical radiation spectrums and are high energy beams of very narrow bandwidth.

This report covers only eye-protectors against optical radiation (UV, Visible and IR).

Cosmic Rays	Gamma and X-Rays	OPTICAL RADIATION							Microwaves and UHF	VHF Rays
		UV-C	UV-B	UV-A	Visible	IR-A	IR-B	IR-C		
10^{-4}	100	280	315	380	780	1 400	3 000	10^{6}	10^{9}	

Wavelength in nanometres (nm)

Figure 2 - The electromagnetic spectrum

3.4.2 Sources

Optical radiation hazards encountered in industry and commerce are numerous, the most basic being visible glare from strong sunlight or artificial light. Outside the visible spectrum optical radiation hazards include infrared (IR) radiation, ultraviolet (UV) radiation, and laser beams.

Welding operations, both gas and electric, are a potent source of UV and IR radiation as well as visible glare.

Processes and plant which generate heat, such as steel making furnaces, glass blowing and welding all generate potentially harmful infra-red radiation.

At the other end of the visible spectrum short wave UV emissions are associated with such sources as dental curing lamps, welding operations and mercury or xenon discharge lamps.

Lasers are also finding increasing usage in commerce and industry, for such applications as metal processing, optical alignment and medical surgery. Hazards arise from accidental exposure to direct radiation or to stray radiation (diffused or reflected) during repair or servicing.

Much concern has been expressed in recent years on the potential radiation hazards of VDU screens ; it is now accepted that there is no reliable evidence to suggest that such units present any serious risk to the structure or functioning of the human eye. Any problems from use of VDU's relate principally to ergonomic factors.

3.4.3 Effects

Due to natural mechanisms of defence (tears, lid closure reflex,...), low overexposure to IR radiation has no harmful effects on the eyes.

Prolonged periods of time and repetitive high, overexposure to IR-A rays have a long term effect on the lens (glassblowers cataract, for example).

Exposure to sufficiently intense sources (solar viewing, laser, etc) results in burns in the cornea (IR-B and C) or in the retina and the lens (IR-A)

Exposure to certain levels of UV rays results in an acute effect and painful inflammation of the cornea and conjunctivitis. This effect is typically associated with exposure to electric arc welding and is thus commonly known as arc-eye.

3.5 Summary of hazards and sources

The following table provides a brief summary of some of the common types and sources of industrial eye protection hazards, no list could be comprehensive and thus it should not be used as a substitute for a professional risk assessment of the working environment.