INTERNATIONAL STANDARD

ISO 4007

Third edition
2018-10

Personal protective equipment — Eye and face protection — Vocabulary

Équipement de protection individuelle — Protection des yeux et du visage — Vocabulaire

Reference number
ISO 4007:2018(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 6, *Eye and face protection*.

This third edition cancels and replaces the second edition (ISO 4007:2012), which has been technically revised. This third edition builds on the second edition, which was partly based on EN 165.

The main changes compared to the previous edition are as follows.

— The word "*ocular*" has been changed to "*lens*" to describe the transparent material through which the wearer looked.

— Some terms have been moved and renumbered to more suitable positions, e.g. some of the terms that were in the "properties of materials" subclause are now in the "transmittance" subclause.

— 52 new terms have been added, over 100 terms or definitions have been modified and sources have been updated. Greater information about the source of definitions is given where these have been copied from other standards.

— The following terms have been deleted: *giant-pulsed laser*, *haze*, *He-Ne laser*, *optical class*, *protective ocular*, *radiation power*, *untinted ocular*, *very-high-pressure (intensity) mercury vapour lamp*.

— A term relating to the transmittance between 380 nm and 400 nm has been added. Although the definition for UV-A continues to take the wavelength limits of 315 nm to 380 nm, many of the terms and definitions relating to UV-A allow the upper limit to be either 380 nm or 400 nm, depending upon the application.

— Terms relating to "*mesh protectors*" and "*additional lenses*" have been added for use in the appropriate standards.

— hyphens have been removed from many terms relative to the second edition, e.g. in "*eye-protector*" and "*dark-state*", but have been kept in "*as-worn*", "*blue-light*" and "*gradient-tinted*", and in those cases where they would generally be used in English.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Personal protective equipment — Eye and face protection — Vocabulary

1 Scope

This document defines and explains the principal terms used in the field of personal eye and face protection.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

NOTE See also the CIE International lighting vocabulary: Available at: http://eilv.cie.co.at/.

3.1 Risks and hazards

3.1.1
safety, noun
freedom from *risk* (3.1.4) that is not tolerable

Note 1 to entry: The term “safe” is often understood by the general public as the state of being protected from all *hazards* (3.1.3). However, this is a misunderstanding: “safe” is rather the state of being protected from recognized hazards that are likely to cause *harm* (3.1.2). Some level of *risk* is inherent in products or systems. The use of the terms “safety” and “safe” as descriptive adjectives should be avoided when they convey no useful extra information. In addition, they are likely to be misinterpreted as an assurance of freedom from risk. The recommended approach is to replace, wherever possible, the terms “safety” and “safe” with an indication of the objective. For example, use “protective helmet” instead of “safety helmet”. See also ISO/IEC Guide 51:2014, Clause 4.

[SOURCE: ISO/IEC Guide 51:2014, 3.14, modified — the term has been identified as a noun, and “which” in the definition has been changed to “that”.]

3.1.2
harm
injury or damage to the health of people, or damage to property or the environment

[SOURCE: ISO/IEC Guide 51:2014, 3.1]

3.1.3
hazard
potential source of *harm* (3.1.2)

[SOURCE: ISO/IEC Guide 51:2014, 3.2]

3.1.4
risk
combination of the probability of occurrence of *harm* (3.1.2) and the severity of that harm

Note 1 to entry: The probability of occurrence includes the exposure to a hazardous situation, the occurrence of a hazardous event and the possibility to avoid or limit the harm.

[SOURCE: ISO/IEC Guide 51:2014, 3.9]

3.1.5
intended use
use in accordance with information provided with a product or system, or, in the absence of such information, by generally understood patterns of usage

[SOURCE: ISO/IEC Guide 51:2014, 3.6]

3.1.6
reasonably foreseeable misuse
use of a product or system in a way not intended by the supplier, but which can result from readily predictable human behaviour

Note 1 to entry: Readily predictable human behaviour includes the behaviour of all types of users, e.g. the elderly, children and persons with disabilities. For more information, see ISO 10377[5].

Note 2 to entry: In the context of consumer *safety* (3.1.1), the term “reasonably foreseeable use” is increasingly used as a synonym for both *intended use* (3.1.5) and reasonably foreseeable misuse.

[SOURCE: ISO/IEC Guide 51:2014, 3.7]

3.1.7
blue-light hazard
potential for a photochemically induced retinal injury resulting from *optical radiation* (3.2.1) exposure in the wavelength range 300 nm to 700 nm

3.1.8
infrared lens hazard
potential for a thermal injury to the crystalline lens (and cornea) of the eye resulting from exposure to *optical radiation* (3.2.1) in the wavelength range 780 nm to 3 000 nm

3.1.9
retinal thermal hazard
potential for a thermal retinal injury resulting from exposure to *optical radiation* (3.2.1) in the wavelength range 380 nm to 1 400 nm

3.1.10
ultraviolet hazard
potential for acute and chronic adverse effects to the skin and eye resulting from exposure to *optical radiation* (3.2.1) in the wavelength range 250 nm to 400 nm

3.2 Optical radiation

3.2.1
optical radiation
electromagnetic radiation at wavelengths between the region of transition to X-rays ($\lambda \approx 1$ nm) and the region of transition to radio waves ($\lambda \approx 1$ mm)

Note 1 to entry: Optical radiation is usually subdivided into the following spectral ranges, with a possible overlap at the longer wavelength limit of the UV spectrum:

— *ultraviolet radiation* (3.2.3);

— *visible radiation* (3.2.2);

— *infrared radiation* (3.2.4).

[SOURCE: CIE S 07:2011, 17-848, modified — Note 1 to entry has been added.]

3.2.2
visible radiation
light
any *optical radiation* (3.2.1) capable of causing a visual sensation directly

Note 1 to entry: There are no precise limits for the spectral range of visible radiation since they depend upon the amount of *radiant power* (3.4.7) reaching the retina and the responsivity of the observer. The lower limit is generally taken between 360 nm and 400 nm and the upper limit between 760 nm and 830 nm.

Note 2 to entry: For the purposes of standards on eye protection, the limits of the visible spectrum are usually taken to be 380 nm to 780 nm. These limits coincide with those in ISO 20473 which specifies the spectral ranges for optics and photonics standards and avoids the overlap at either end of the visible spectrum in the CIE definition.

Note 3 to entry: For lasers, the visible wavelength band is defined as 400 nm to 700 nm. This is because eye protection against low-power visible lasers often relies on the eye's aversion response, which includes the *blink reflex* (3.5.1.17). For this to happen, the *laser beam* (3.3.14) should appear very bright, hence the need to cut off the extremes of the visible band where the *spectral luminous efficiency* (3.4.11) of the eye is quite low.

[SOURCE: CIE S 017:2011, 17-1402, modified — Notes to entry 2 and 3 have been added.]

3.2.3
ultraviolet radiation
UV radiation
UVR
optical radiation (3.2.1) for which the wavelengths are shorter than those for *visible radiation* (3.2.2)

Note 1 to entry: For standards for protection against solar radiation including, for example, sunglasses for general use, the upper limit of UV-A is sometimes taken as 380 nm. For standards on requirements for protection against radiation from artificial sources, the upper limit of UV-A is usually taken as 400 nm, which is consistent with the CIE definition. The 400 nm upper limit is also used by, amongst others, ICNIRP, ACGIH, the World Health Organization and in the European Artificial Optical Radiation Directive.

Note 2 to entry: The limit of 380 nm coincides with ISO 20473 which specifies the spectral range of ultraviolet radiation for standards in optics and photonics and subdivides the UV range into

— UV-A: 315 nm to 380 nm;

— UV-B: 280 nm to 315 nm;

— UV-C: 100 nm to 280 nm.

[SOURCE: CIE S 017:2011, 17-1367, modified — the word "optical" has been added to the definition and the CIE Notes 1, 2 and 3 have been deleted and replaced by Notes 1 and 2 to entry.]

3.2.4
infrared radiation
IR radiation
optical radiation (3.2.1) for which the wavelengths are longer than those for *visible radiation* (3.2.2), from 780 nm to 1 mm

Note 1 to entry: For infrared radiation, the range between 780 nm and 1 mm is typically subdivided into:

— IR-A 780 nm to 1 400 nm, or 0,78 µm to 1,4 µm;

— IR-B 1,4 µm to 3,0 µm;

— IR-C 3 µm to 1 mm.

Note 2 to entry: A precise border between "visible" and "infrared" cannot be defined because visual sensation at wavelengths greater than 780 nm is noted for very bright sources at longer wavelengths.

[SOURCE: CIE S 017:2011, 17-580, modified — the word "commonly" has been replaced by "typically" in the first CIE note to entry, and the third CIE note has been deleted.]

3.2.5
monochromatic radiation
monochromatic light
optical radiation (3.2.1) characterized by a single frequency

Note 1 to entry: In practice, radiation of a very small range of frequencies which can be described by stating a single frequency.

Note 2 to entry: The wavelength in air or in vacuum is also used to characterize a *monochromatic radiation*. The medium shall be stated.

Note 3 to entry: The wavelength in standard air is normally used in photometry and radiometry.

[SOURCE: CIE S 017:2011, 17-788, modified — the word "optical" has been added in front of "radiation" in the definition.]

3.2.6
illuminant
optical radiation (3.2.1) with a relative spectral power distribution defined over the wavelength range that influences object colour perception

Note 1 to entry: In everyday English, this term is not restricted to this sense but is also used for any kind of light falling on a body or scene.

[SOURCE: CIE S 017:2011, 17-554, modified — the word "optical" has been added in front of "radiation" in the definition.]

3.2.7
CIE standard illuminants
illuminants (3.2.6) A and D65, defined by the CIE in terms of relative spectral power distributions

Note 1 to entry: These *illuminants* (3.2.6) are intended to represent:

— A: Planckian radiation with a temperature of 2 856 K;

— D65: The relative spectral power distribution representing a phase of daylight with a correlated colour temperature of approximately 6 500 K (called also "nominal correlated colour temperature of the daylight illuminant").

Note 2 to entry: Illuminants B, C and other D illuminants, previously denoted as standard illuminants, should now be termed CIE illuminants.

Note 3 to entry: See also ISO 11664-2:2007[8] and CIE 015[22].

Note 4 to entry: Tables defining the CIE standard illuminants A and D65 at 5 nm intervals can be viewed in the downloads section at http://www.cie.co.at/.

[SOURCE: CIE S 017:2011, 17-168, modified — the references to other standards in CIE Note 1 to entry have been moved into a new Note 3 to entry, and a new Note 4 to entry has also been added.]

3.3 Sources of non-ionizing radiation

3.3.1
electric arc
self-maintained gas conduction for which most of the charge carriers are electrons supplied by primary-electron emission

Note 1 to entry: During live working, the electric arc is generated by gas ionization arising from an unintentional electrical conducting connection or breakdown between live parts or a live part and the earth path of an electrical installation or an electrical device. During testing, the electric arc is initiated by the blowing of a fuse wire.

[SOURCE: IEC 61482-1-1:2009, 3.1.17]

3.3.2
air-arc cutting
arc gouging
thermal gouging or cutting method for metallic materials that uses an *electric arc* (3.3.1)

Note 1 to entry: This method uses a carbon electrode that forms a groove by melting or burning, while an air jet attached to the electrode removes the molten material. This groove can be deepened using the same thermal method to form a cut.

3.3.3
arc welding
electric welding method that uses an arc that is generated between the rod-shaped metal electrode and the workpiece

Note 1 to entry: The electrode melting in the hot arc is used as the filler metal for the welded joint.

3.3.4
short-circuit electric arc
intensive arc that can occur through switching or a short-circuit in electricity distribution installations

3.3.5
gas cutting
flame cutting
thermal method of cutting metallic material using gas and oxygen

Note 1 to entry: This method does not use an *electric arc* (3.3.1).

3.3.6
plasma arc cutting
thermal cutting method for metallic materials that uses a constricted *electric arc* (3.3.1) and a high-velocity jet of gas issuing from a constricting orifice to give a high-temperature plasma flame that melts and removes the metallic material

3.3.7
blacklight lamp
ultraviolet radiation source
UV-A radiation source, generally a mercury vapour discharge lamp, with the bulb (high-pressure radiation source) or tube (low-pressure radiation source) made from light-absorbing, but UV-A transmitting, filter *glass* (3.6.1)

Note 1 to entry: The filter *glass* appears almost black in colour.

3.3.8
metal halide lamp
high intensity discharge lamp in which the major portion of the *light* (3.2.2) is produced from a mixture of a metallic vapour and the products of the dissociation of metal halides

Note 1 to entry: Metal halide lamps can be clear or phosphor-coated.

[SOURCE: CIE S 017:2011, 17-765, modified — "the term covers" has been replaced by "metal halide lamps can be".]

3.3.9
low pressure mercury (vapour) lamp
discharge lamp of the mercury vapour type, with or without a coating of phosphors, in which during operation, the partial pressure of the vapour does not exceed 100 Pa

Note 1 to entry: In mercury discharge lamps with a fluorescent layer, the layer is excited by the *ultraviolet radiation* (3.2.3) of the discharge to generate *visible radiation* (3.2.2).

[SOURCE: CIE S 017:2011, 17-701, modified — Note 1 to entry has been added.]

3.3.10
medium pressure mercury (vapour) lamp
non-coherent radiation source containing mercury vapour at pressures ranging from 50 kPa to several hundred kPa[1)]

Note 1 to entry: This type of lamp emits mostly from 200 nm to 1 000 nm with the most intense lines approximately at 218 nm, 248 nm, 254 nm, 266 nm, 280 nm, 289 nm, 297 nm, 303 nm, 313 nm, 334 nm, 366 nm, 406 nm, 408 nm, 436 nm, 546 nm and 578 nm.

[SOURCE: IUPAC, modified — the term name has been altered by the deletion of the hyphen in "medium-pressure" and the the addition of (vapour) to align with the CIE definitions of *low pressure mercury* (*vapour*) *lamp* and *high pressure mercury* (*vapour*) *lamp.*]

3.3.11
high pressure mercury (vapour) lamp
high intensity discharge lamp in which the major portion of the *light* (3.2.2) is produced, directly or indirectly, by radiation from mercury operating at a partial pressure in excess of 100 kPa

Note 1 to entry: High-pressure mercury (vapour) lamps can be clear, phosphor coated (mercury fluorescent) and blended lamps. In fluorescent mercury discharge lamps, the *light* is produced partly by the mercury vapour and partly by a layer of phosphors excited by the *ultraviolet radiation* (3.2.3) of the discharge.

[SOURCE: CIE S 017:2011, 17-535]

3.3.12
pulse duration
full duration at half maximum
FDHM
time interval between the half peak power points at the leading and trailing edges of a pulse

[SOURCE: ISO 11145:2016, 3.50]

3.3.13
pulse separation
time between the end of one pulse and the onset of the following pulse, measured at the 50 % trailing and leading edges

[SOURCE: ISO 12609-2:2013, 2.6]

3.3.14
laser beam
optical radiation (3.2.1) from lasers that is generally collimated, directed, monochromatic and coherent

Note 1 to entry: The radiation is correlated in space and time.

3.3.15
laser radiation
coherent electromagnetic radiation with wavelengths up to 1 mm, generated by a laser

[SOURCE: ISO 11145:2016, 3.32]

3.3.16
continuous wave laser
cw laser
laser continuously emitting radiation over periods of time greater than or equal to 0,25 s

[SOURCE: ISO 11145:2016, 3.26]

1) 1 atm = 101,325 kPa.

3.3.17
pulsed laser
laser that emits energy in the form of a single pulse or a train of pulses where the duration of a pulse is less than 0,25 s

[SOURCE: ISO 11145:2016, 3.27, modified — "which" has been changed to "that".]

3.3.18
mode-locked laser
mode-coupled laser
laser that utilizes a mechanism or phenomenon within the laser resonator to produce a train of very short (typically shorter than a nanosecond, e.g. picosecond or femtosecond) pulses

Note 1 to entry: While this can be a deliberate feature of the laser, it can also occur spontaneously as "self-mode-locking". The resulting peak powers can be significantly greater than the mean power.

3.3.19
intense pulsed light source
IPL
compact xenon arc lamp, operated in a pulsed mode, usually filtered to emit *visible radiation* (3.2.2) and near-*infrared radiation* (3.2.4)

Note 1 to entry: Although lasers can provide an intense pulsed source of light, when used in the medical or paramedical field, the term is restricted to xenon arc lamps. These have a broad spectral emission. The radiation emitted can be filtered to restrict the emission to the UV, visible or near-IR regions of the electromagnetic radiation spectrum.

3.4 Radiometry and photometry

3.4.1
illuminance
E_v, E
<at a point on a surface> quotient of the *luminous flux* (3.4.4), $d\Phi_v$, incident on an element of the surface containing the point, by the area, dA, of that element

Note 1 to entry: Equivalent definition: integral, taken over the hemisphere visible from the given point, of the expression $L_v \cos\theta \, d\Omega$, where L_v is the *luminance* at the given point in the various directions of the incident elementary beams of *solid angle* $d\Omega$, and θ is the angle between any of these beams and the normal to the surface at the given point.

$$E_v = \frac{d\Phi_v}{dA} = \int_{2\pi} L_v \cdot \cos\theta \cdot d\Omega$$

Note 2 to entry: *Illuminance* is expressed in lux ($lx = lm \cdot m^{-2}$).

Note 3 to entry: See also *radiation power, irradiance* (3.4.2).

[SOURCE: CIE S 017:2011, 17-550, modified — the second, equivalent, definition has been placed in Note 1 to entry; Note 2 to entry has been modified by replacing the word "unit" with "illuminance is expressed in"; Note 3 to entry has been added.]

3.4.2
irradiance
E_e
<at a point on a surface> quotient of the *radiant flux* (3.4.7), $d\Phi_e$, incident on an element of the surface containing the point, by the area, dA, of that element

Note 1 to entry: Equivalent definition: integral, taken over the hemisphere visible from the given point, of the expression $L_e \cdot \cos\theta \cdot d\Omega$, where L_e is the radiance at the given point in the various directions of the incident elementary beams of *solid angle* $d\Omega$, and θ is the angle between any of these beams and the normal to the surface at the given point.

$$E_e = \frac{d\Phi_e}{dA} = \int_{2\pi} L_e \cdot \cos\theta \cdot d\Omega$$

Note 2 to entry: *Irradiance* is expressed in $W \cdot m^{-2}$.

Note 3 to entry: See also *illuminance* and *power density*.

[SOURCE: CIE S 017:2011, 17-608, modified — the second, equivalent, definition has been made into Note 1 to entry, Note 2 to entry has been modified by replacing the word "unit" with "*irradiance* is expressed in"; Note 3 to entry has been added.]

3.4.3
luminance
L_v; L
<in a given direction, at a given point on a real or imaginary surface> quantity of *light* (3.2.2) emitted by or reflected from an element of the surface containing the point

Note 1 to entry: Quantity is defined by the formula:

$$L_v = \frac{d\Phi_v}{dA \cdot \cos\theta \cdot d\Omega}$$

where

$d\Phi_v$ is the *luminous flux* transmitted by an elementary beam passing through the given point and propagated in the *solid angle* $d\Omega$ containing the given direction;

dA is the area of a section of that beam containing the given point;

θ is the angle between the normal to that section and the direction of the beam.

Note 2 to entry: *Luminance* is expressed in $cd/m^2 = lm \cdot m^{-2} \cdot sr^{-1}$.

Note 3 to entry: Simplified to the standard case, luminance is the quotient of the luminous intensity, I, divided by the surface area projected perpendicular to the direction of radiation as a projected plane ($A \cdot \cos\theta$):

$$L = I / (A \cdot \cos\theta)$$

[SOURCE: CIE S 017:2011, 17-711, modified — a new verbal definition has been provided and the CIE definition has been made into Note 1 to entry. CIE Note 1 and CIE Note 2 have been omitted and new Notes 2 and 3 to entry have been added.]

3.4.4
luminous flux
Φ_v; Φ
quantity derived from the *radiant flux* (3.4.7), Φ_e, by evaluating the radiation according to its action upon the CIE standard photometric observer

Note 1 to entry: For photopic vision:

$$\Phi_v = K_m \int_0^\infty \frac{d\Phi_e(\lambda)}{d\lambda} \cdot V(\lambda) \cdot d\lambda$$

where

$\frac{d\Phi_e(\lambda)}{d\lambda}$ is the spectral distribution of the radiant flux and $V(\lambda)$ is the *spectral luminous efficiency*.

Note 2 to entry: *Luminous flux* is expressed in lumen (lm).

Note 3 to entry: The CIE standard photometric observer assumes photopic vision. CIE S 017:2011 (luminous efficacy of radiation, 17-730) gives the values of K_m (photopic vision) as 683 $lm \cdot W^{-1}$ for $\nu_m = 540 \times 10^{12}$ Hz ($\lambda_m \approx 555$ nm).

[SOURCE: CIE S 017:2011, 17-738, modified — in Note 2 to entry the word "unit" has been replaced by "luminous flux is expressed in", and Note 3 to entry has been added.]

3.4.5
luminance coefficient
q_v; q
<at a surface element of a medium, in a given direction, under specified conditions of illumination> quotient of the *luminance* (3.4.3) of the surface element in the given direction divided by the *illuminance* (3.4.1) on the medium

Note 1 to entry: The luminance coefficient is given by the following formula:

$$q = \frac{L}{E}$$

where

L is the luminance in $cd \cdot m^{-2}$;

E is the illuminance in lx.

Note 2 to entry: In the assessment of eye protective equipment, the *luminance coefficient* is expressed in $(cd \cdot m^{-2})\ lx^{-1}$ rather than the CIE unit of sr^{-1}, and is given by the symbol *l*.

Note 3 to entry: In the assessment of eye protective equipment, this is a measure of the *light* scattered by a *lens*, the *luminance* of the *light* scattered by the *lens* being expressed as a proportion of the amount of *light* falling on the *lens*. See *scattered light* (3.8.14), *wide angle scatter* (3.8.16) and *narrow angle scatter* (3.8.15).

[SOURCE: CIE S 017:2011, 17-712, modified — "divided by" has been added in the definition, the formula has been moved to Note 1 to entry and Notes 2 and 3 to entry have been added.]

3.4.6
reduced luminance coefficient
*l**
<in the assessment of eye protective equipment> *luminance coefficient* (3.4.5) corrected for the *transmittance* (3.10.1.18) of a *filter* (3.10.1.1) or *lens* (3.5.1.3)

Note 1 to entry: The *reduced luminance coefficient* is obtained by dividing the *luminance coefficient*, *l*, by the *luminous transmittance*, τ_v, of the *filter*, i.e. by the formula:

$$l^* = l/\tau_v$$

where

l^* is the *reduced luminance coefficient*;

l is the *luminance coefficient*;

τ_v is the *luminous transmittance*.

Note 2 to entry: Reduced luminance coefficient is expressed in $(cd \cdot m^{-2}) \cdot lx^{-1}$.