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Raw optical glass — Vocabulary

Verre d'optique brut — Vocabulaire

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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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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 3, *Optical materials and components*.

This second edition cancels and replaces the first edition (ISO 9802:1996), which has been technically revised.

The main changes are as follows:

— Updates and additions in the terms and definitions clause.

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.

Raw optical glass — Vocabulary

1 Scope

This document defines terms relating to raw optical glass and related manufacturing processes. The list is not complete and only comprises those terms for which the definition is considered necessary for correct and adequate understanding of the terminology.

It is understood that the interpretations given are those corresponding to the practical usage in this field and that they do not necessarily coincide with those used in other fields.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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 https://www.electropedia.org/

3.1 General terms

3.1.1
light beam
beam
bundle of rays

Note 1 to entry: It may consist of parallel, converging or diverging rays.

3.1.2
light ray
ray
line perpendicular to the wavefronts of waves of light indicating its direction of propagation

Note 1 to entry: This definition assumes the common case of light propagating in an isotropic medium and not in caustic regions.

3.1.3
electromagnetic radiation
energy that emanates from a source in the form of electromagnetic waves or photons and is transferred through space

Note 1 to entry: The term “electromagnetic radiation” is also used for the phenomenon producing the electromagnetic waves or photons (see IEV 702-02-07).

Note 2 to entry: The physical concepts of photons and electromagnetic waves are used to describe the same phenomenon of transmission of radiant energy in different ways, depending on the nature of the interaction of the energy with the physical world (wave-particle dualism).

Note 3 to entry: The French term “radiation électromagnétique” applies preferably to a single element of any electromagnetic radiation, characterized by one frequency or by one wavelength in vacuum.

[SOURCE: IEV 705-02-01]

3.1.3.1
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: For the purposes of this document, only optical radiation from the vacuum ultraviolet (100 nm) to the mid-infrared (50 µm) is considered.

[SOURCE: CIE S 017:2020, 17-21-002/IEV 845-21-002, modified — Deletion of Notes 1 and 2 to entry.]

3.1.3.1.1
visible radiation
optical radiation 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 flux 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.

[SOURCE: IEV 845-21-003, modified — Deletion of Note 2 to entry that refer to the term numbers in previous editions.]

3.1.3.1.2
infrared radiation
IR radiation
IRR
optical radiation for which the wavelengths are longer than those of visible radiation

Note 1 to entry: For infrared radiation, the band from 780 nm to 50 um is typically broken up into:

IR-A 780 nm to 1,4 µm;

IR-B 1,4 µm to 3 µm;

IR-C(MIR) 3 µm to 50 µm.

Note 2 to entry: See ISO 20473:2007 Table 1.

3.1.3.1.3
ultraviolet radiation
UV radiation
UVR
optical radiation for which the wavelengths are shorter than those of visible radiation

Note 1 to entry: For ultraviolet radiation, the range between 100 nm and 400 nm is commonly subdivided into:

UV-A 315 nm to 400 nm;

UV-B 280 nm to 315 nm;

UV-C 100 nm to 280 nm.

Note 2 to entry: For the purposes of this document, the upper limit for UV-A is 380 nm.

[SOURCE: IEV 845-21-008, modified — Deletion of Notes to entry 2 to 5 and the addition of a new Note 2 to entry.]

3.1.4
spectrum
display or specification of the monochromatic components of the radiation considered

Note 1 to entry: These are line spectra, continuous spectra and spectra exhibiting both of these characteristics.

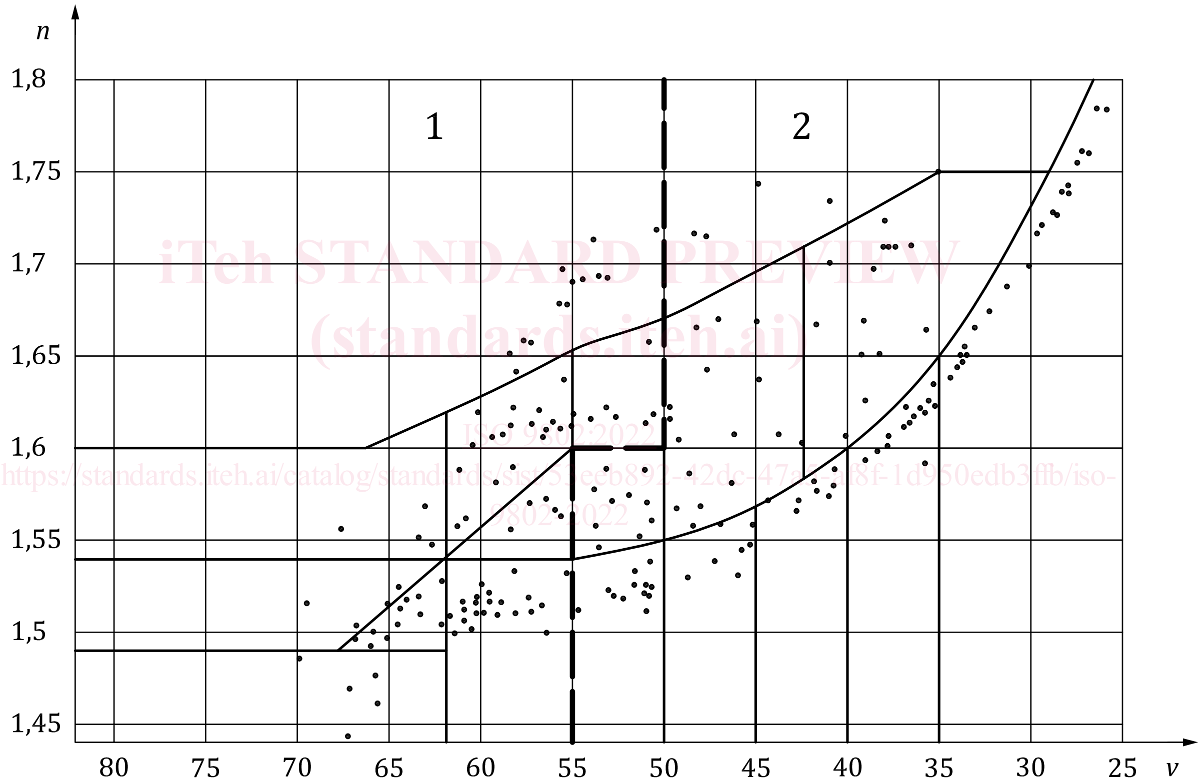
Note 2 to entry: The term “spectrum” is also used for spectral efficiencies (excitation spectrum, action spectrum).

[SOURCE: IEV 845-21-015]

3.2 Type of optical glasses

3.2.1
raw optical glass
inorganic product, usually obtained after melting, cooling and annealing without crystallization; including the solid state glass before production and the glass strip obtained in production; which is to a large extent free from imperfections such as bubbles, knots, stones and inhomogeneities such as striae and strains; which is characterized by specified optical properties such as refractive indices and dispersion; and dispersion and transparent to at least a part of the spectrum of light

Note 1 to entry: Optical glasses are classified into glass-groups according to their position in the refractive index Abbe number diagram. The main groups are crown glasses and flint glasses (see Figure 1).



Key

ν	Abbe number	1	crown glasses
n	refractive index	2	flint glasses
		Dashed line	boundary between crown glass and flint glass

Figure 1 — Refractive index Abbe number diagram

3.2.2
glass type
glass type letter/number designation used in the manufacturer's catalogue to designate or characterize the glasses offered

Note 1 to entry: An alphanumeric designation is the manufacturer's option and is usually a proprietary trade name, and therefore indeterminate. For example, borosilicate crown glass is designated N-BK by one manufacturer, but S-BSL and BSC by others.

Note 2 to entry: An alternative way to specify a glass type is the glass code (defined in 3.2.3).

[SOURCE: ISO 12123:2018, 3.8, modified — Note 2 to entry was replaced.]

3.2.2.1
crown glass
optical glass type with an Abbe number greater than 55 for glasses with refractive indices less than 1,60 or with an Abbe number greater than 50 for glasses with refractive indices greater than 1,60

3.2.2.2
flint glass
optical glass type with an Abbe number less than 50 for glasses with refractive indices greater than 1,60 and with an Abbe number less than 55 for glasses with refractive indices less than 1,60

3.2.3
glass code
six-digit number representing the refractive index and Abbe number of a glass

Note 1 to entry: The first three digits represent the three decimal places of the refractive index, and the last three digits represent the upper three digits of Abbe number. For N-BK7 e.g. it is 517642. This glass code, however, does not denominate a glass type unequivocally. The same glass code can be valid for glass types of very different chemical compositions and hence other properties can also differ very significantly.

3.3 Process and media for fabrication and surface treatment

3.3.1
slumping
deformation of a glass piece under its own weight at high temperatures

3.3.2
pressing
forming glass to a shape close to that of a final product, by reheating and applying a load

Note 1 to entry: The final product can be, for example, a lens, a prism, a rod and etc.

3.3.3
moulding
shaping of a glass piece with tools under pressure at high temperatures

3.3.4
annealing
heat-treatment process in which the refractive index of glass is stabilized at a value close to its desired value, and in which the birefringence is minimized by holding the glass for specified periods of time at a temperature near its annealing point and subsequently cooling the glass at a specified rate to make it strain-free

3.3.5
generating
roughing process whereby glass is removed quickly in order to produce a surface form close to that required for its final form

3.3.6
surfacing
process of grinding, lapping and polishing a surface of an optical element

3.3.7
grinding
process in the fabrication of an optical element whereby optical glass is mechanically removed using bonded abrasives in order to reduce surface roughness

3.3.8
lapping
process in the fabrication of an optical element whereby optical glass is mechanically removed using loose abrasives in order to reduce surface roughness

3.3.9
polishing
process of generating a smooth and shiny surface without visible roughness of an optical element

Note 1 to entry: The treatment of the glass surface by either mechanical, chemical, thermal or any combination of processes can result in such shine.

3.3.10
chamfering
process of removing sharp edges by grinding or polishing

3.3.11
edging
finishing process of the edge of an optical element using a grinding wheel

3.3.12
etching
removal of the upper layers of a glass surface by dissolving in chemical agents, normally acids or by bombardment with energetic ions or neutral particles

3.3.13
leaching
extraction of mobile (soluble) constituents from a glass body by chemical reactions, preferably by aqueous solution

3.3.14
ultrasonic cleaning
cleaning of optical surfaces in a liquid by means of ultrasonic force

3.3.15
abrasive
media such as diamond, silica, silicon carbide, emery, cerium oxide, zirconia or rouge used in the optical industry for grinding or polishing of optical elements

Note 1 to entry: The media can be divided into loose abrasive and bonded or bound abrasive.

3.3.16
pellet
bonded abrasive such as diamond or boron carbide

3.3.17
detergent
synthetic liquid or solid substance, containing small amounts of an organic surface active agent and larger amounts of an inorganic builder, normally polyphosphates

Note 1 to entry: It can also contain monophosphate, sodium carbonate, sodium hydrogen carbonate and etc. It is dissolved in water and used for cleaning surfaces, particularly of glass.

3.4 Optical properties

3.4.1
refraction
process by which the direction of propagation of an electromagnetic wave is changed as a result of changes in its velocity of propagation in passing through an optically non-homogeneous medium, or in crossing a surface separating media with different refractive indexes

[SOURCE: IEV 845-24-108, modified — Deletion of four Notes to entry and the addition of two Notes to entry.]

3.4.2
refractive index
$n(\lambda)$
ratio of the velocity of the electromagnetic waves in vacuum to the phase velocity of the waves of the monochromatic radiation in the medium

Note 1 to entry: For technical applications, the refractive index in air is given instead of the refractive index in a vacuum. The wavelength is characterized by a letter, which is added to the symbol *n* for the refractive index.

Note 2 to entry: Wavelengths to be used for the characterization of optical glasses, all kinds of optical systems and instruments, together with spectacle lenses, are specified in ISO 7944.

Note 3 to entry: The value of the refractive index can depend on the frequency, polarization, and the direction of light travel.

Note 4 to entry: The refractive index is expressed by $n = c_0/c$, where c_0 is the velocity of light in vacuum and c is the velocity of light in the medium.

[SOURCE: CIE S 017:2011, 17-1074]

3.4.2.1
absolute refractive index
$n_{abs}(\lambda)$
ratio of the velocity of an electromagnetic wave of a specific wavelength in vacuum to the velocity of its transmission through the optical glass, represented by $n_{abs}(\lambda) = \frac{c}{v_\lambda}$, where $n_{abs}(\lambda)$ is absolute refractive index of arbitrary wavelength

c is velocity of light in vacuum

v_λ is velocity of light at arbitrary wavelength in optical glass

λ is arbitrary wavelength of light

3.4.2.2
relative refractive index
$n_{rel}(\lambda)$
ratio of (absolute) refractive index of the optical glass to the (absolute) refractive index of the medium in contact at a specific wavelength

3.4.2.3
absolute temperature coefficient of refractive index
$\Delta n_{abs}/\Delta T$
ratio of refractive index change in vacuum to temperature change at a selected wavelength

Note 1 to entry: The absolute temperature coefficient of refractive index is expressed by the formula $\Delta n_{abs}/\Delta T$ where Δn_{abs} is the change in refractive index for the change ΔT in temperature.

Note 2 to entry: See also ISO 23584-2.

3.4.2.4
relative temperature coefficient of refractive index
$\Delta n_{rel}/\Delta T$
ratio of refractive index change at a given air pressure to temperature change at a selected wavelength

Note 1 to entry: The relative temperature coefficient of refractive index is expressed by the formula $\Delta n_{rel}/\Delta T$ where Δn_{rel} is the change in refractive index for the change ΔT in temperature.

Note 2 to entry: See also ISO 23584-2.

3.4.2.5
principal refractive index
refractive index either at the reference wavelength 546,07 nm (green mercury e-line) or at the reference wavelength 587,56 nm (yellow helium d-line)

Note 1 to entry: These principal refractive indices are denoted by n_e and n_d respectively.

3.4.3
dispersion
change of the refractive index with wavelength

[SOURCE: ISO 12123:2018, 3.4, modified — "measure of the" was removed.]

3.4.3.1
principal dispersion
difference of refractive indices at F-line and at C-line represented by $n_F - n_C$, where

n_F is the refractive index at the F-line (486,13 nm)

n_C is the refractive index at the C-line (656,27 nm)

or $n_{F'} - n_{C'}$, where

$n_{F'}$ is the refractive index of at the F'-line (479,99 nm)

$n_{C'}$ is the refractive index of at the C'-line (643,85 nm)

3.4.3.2
Abbe number
DEPRECATED: constringence
ν
mathematical expression for determining the correction for chromatic aberration of optical glasses or components

EXAMPLE 1 The Abbe number for the d-line is defined as

$$\nu_d = \frac{n_d - 1}{n_F - n_C}$$

where

n_d is the refractive index of the d-line (587,56 nm);

n_F is the refractive index of the F-line (486,13 nm);

n_C is the refractive index of the C-line (656,27 nm).

EXAMPLE 2 The Abbe number for the e-line is defined as