INTERNATIONAL STANDARD

ISO 22576

First edition
2020-04

Optics and photonics — Optical materials and components — Specification of calcium fluoride used in the infrared spectrum

Optique et photonique — Matériaux et composants optiques — Spécification de fluorure de calcium utilisé dans le spectre infrarouge

Reference number
ISO 22576:2020(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

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.

Introduction

This document applies to the classification of calcium fluoride used in the infrared spectrum.

Calcium fluoride is used for infrared optical systems such as optical windows and lenses. The specifications for its use in the infrared spectrum are different than those used in the visible range.

The crystal structure of calcium fluoride is referred to as the fluorite structure. A single crystal of calcium fluoride is composed of the crystal lattice with no grain boundaries. The birefringence of the crystal depends on the light propagation direction with respect to the crystal axis.

Optics and photonics — Optical materials and components — Specification of calcium fluoride used in the infrared spectrum

1 Scope

This document specifies calcium fluoride used in the infrared spectral range from 0,78 µm to 10 µm.

The material specified in this document can also transmit light in other spectral domains (ultraviolet and visible).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10110-18, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 18: Stress birefringence, bubbles and inclusions, homogeneity, and striae*

ISO 12123, *Optics and photonics — Specification of raw optical glass*

ISO 80000-7, *Quantities and units — Part 7: Light and radiation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 80000-7 and the following 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 http://www.electropedia.org/

3.1
regular transmittance
ratio of the regularly transmitted part of the (whole) transmitted flux to the incident flux

[SOURCE: ISO 11382:2010, 3.1]

3.2
internal transmittance
ratio of the radiation flux reaching the internal exit surface of the layer to the flux that enters into the layer after crossing the entry surface

[SOURCE: ISO 15368:2001, 3.3]

3.3
optical homogeneity
measure of the refractive index variation within a single piece of optical material and being the difference between the maximum and minimum values of the refractive index within the optical glass

[SOURCE: ISO 12123:2018, 3.16]

3.4
impurity
material other than calcium fluoride

3.5
bubble
gaseous void in the bulk optical material of generally circular cross section

Note 1 to entry: Bubbles and solid inclusions are treated the same in assessing the quality of optical glass.

[SOURCE: ISO 12123:2018, 3.19]

3.6
inclusion
localized bulk material imperfections

EXAMPLE Bubbles, striae knots, small stones, sand and crystals.

Note 1 to entry: These terms are also applicable in the given wavelength range.

[SOURCE: ISO 12123:2018, 3.18]

3.7
single crystal
solid with a regular polyhedral shape without grain boundaries

3.8
polycrystal
many crystalline parts that are randomly oriented with respect to each other

3.9
crystal lattice
regular pattern of atoms, ions or molecules in a crystalline substance

3.10
grain boundary
interface between two crystalline parts

3.11
sub grain boundary
interface between two crystalline parts, but its influence is equivalent to the single crystal

4 Tolerances

4.1 Refractive index variation

The terms and definitions of ISO 10110-18 and ISO 12123 are appropriate and shall be used.

Six classes are defined depending on the maximum difference between measured refractive index, n_{ms}, and the nominal refractive index, n_{nom}, as shown in Table 1.

Table 1 — Refractive index variation classes

Grade (λ = 4 µm)[a]	NP 0001	NP 0010	NP 0100	NP 0500	NP 1000	—
$\lvert n_{ms} - n_{nom} \rvert$[b]	≤0,000 01	≤0,000 1	≤0,001	≤0,005	≤0,01	>0,01
[a] Wavelength shall be reported for a specific case (e.g. 4 µm in the case shown).						
[b] n_{ms} shall be measured under the same conditions (temperature, etc.), as specified for n_{nom}.						
NOTE See Annex A.						

4.2 Optical homogeneity (homogeneity of refractive index)

The terms of ISO 12123:2018, 4.6 are appropriate and shall be used.

The homogeneity of the refractive index across the volume of the material is important. It is assumed that the material temperature is uniform across the volume.

The homogeneity may depend on the size and the form of the piece.

Seven classes of index homogeneity are defined, depending on the variation d*n* inside the volume of the piece, as shown in Table 2.

Table 2 — Homogeneity of refractive index

Grade	NH 0004	NH 0010	NH 0040	NH 0100	NH 0400	NH 1000	—
d*n*	≤0,000 004	≤0,000 01	≤0,000 04	≤0,000 1	≤0,000 4	≤0,001	>0,001

4.3 Bubbles and inclusions

The terms of ISO 12123:2018, 4.8 are appropriate and shall be used.

Five classes of bubbles and inclusions are defined, depending on the cross section or numbers, as shown in Tables 3 and 4.

Table 3 — Bubbles and inclusions: maximum permissible cross section

Grade	IC 03	IC 10	IC 25	IC 50	—
Maximum permissible cross section (mm^2 per 100 cm^3)	0,03	0,1	0,25	0,5	>0,5

Table 4 — Bubbles and inclusions: maximum number

Grade	IN 010	IN 030	IN 070	IN 140	—
Maximum number (per 100 cm^3)	10	30	70	140	>140

5 Indications

Table 5 gives classifications of calcium fluoride used in the infrared spectrum.

Table 5 — Classifications of calcium fluoride used in the infrared spectrum

Grade	Minimum absorption[a] a1/a2/a3	Refractive index variation	Optical homogeneity	Bubbles and inclusions
A	OK/OK/OK	Specify the grade	Specify the grade	Specify the grade
B	OK/OK/—	Specify the grade	Specify the grade	Specify the grade
C	OK/OK/—	—	—	Specify the grade
D	OK/OK/—	—	—	—
E	—/—/—	—	—	—

NOTE —: not specified.

[a] No unusual absorption in wavelength range, from 0,78 µm to 3 µm (a1), from 3 µm to 5 µm (a2); and from 5 µm to 10 µm (a3).