
Microscopes — Vocabulary for light microscopy

Microscopes — Vocabulaire relatif à la microscopie optique

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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 5, *Microscopes and endoscopes*.

This first edition cancels and replaces ISO 10934-1:2002 and ISO 10934-2:2007, which have been combined and technically revised.

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

- update of the title;
- added new terms for light microscopy: focal length of normal tube lens, objective field number, pixel, pixel size, Airy unit, excitation wavelength, excitation wavelength band, detection wavelength band, OSTD added as new terms;
- added new terms for advanced techniques in light microscopy: coherent anti-stokes Raman scattering microscopy, stimulated Raman scattering microscopy, structured illumination microscopy, super-resolution microscopy, localization microscopy, stimulated emission depletion microscopy, super-resolution structured illumination microscopy, light sheet microscopy, digital holographic microscopy, optical coherence microscopy;
- terms amended: diffraction limit of resolving power, resolution;
- editorially revised.

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.

Microscopes — Vocabulary for light microscopy

1 Scope

This document specifies terms and definitions to be used in the field of light microscopy and advanced techniques in light microscopy.

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 <http://www.electropedia.org/>

3.1 Terms and definitions relating to light microscopy

3.1.1

Abbe test plate

device for testing the *chromatic* (3.1.4.2) and *spherical aberration* (3.1.4.7) of *microscope* (3.1.99) *objectives* (3.1.106)

Note 1 to entry: When testing for spherical aberration, the cover glass thickness for which the objective is best corrected is also found. The test plate consists of a slide on which is deposited an opaque metal layer in the form of parallel strips arranged in groups of different width. The edges of these strips are irregularly serrated to allow the aberrations to be judged more easily. In its original and most common form, the slide is covered with a wedge-shaped cover glass, the increasing thickness of which is marked on the slide. Additional versions without the cover glass and/or with reflective stripes are also in use.

3.1.2

Abbe theory of image formation

explanation of the mechanism by which the *microscope* (3.1.99) *image* (3.1.75) is formed

Note 1 to entry: It assumes coherent illumination and is based on a three-step process involving diffraction.

- a) First step: the object diffracts light coming from the source.
- b) Second step: the objective collects some of the diffracted beams and focuses them, according to the laws of geometrical optics, in the back focal plane of the objective to form the primary diffraction pattern of the object.
- c) Third step: the diffracted beams continue on their way and are reunited; the result of their interference is called the primary image of the microscope.

This explains the necessity for the maximum number of rays diffracted by the object to be collected by the objective, so that they may contribute to the image. Fine detail will not be resolved if the rays it diffracts are not allowed to contribute to the image.

3.1.3

aberration

<material and geometric form> deviation from perfect imaging by an optical system, caused by the properties of the material of the *lenses* (3.1.87) or by the geometric forms of the refracting or reflecting surfaces

3.1.4

aberration

<optical system> failure of an optical system to produce a perfect *image* (3.1.75)

3.1.4.1

astigmatism

aberration (3.1.4) which causes rays in one plane containing an off-axis *object* (3.1.104) point and the *optical axis* (3.1.107) to focus at a different distance from those in the plane at right angles to it

3.1.4.2

chromatic aberration

aberration (3.1.4) of a *lens* (3.1.87) or *prism* (3.1.119), due to *dispersion* (3.1.47) by the material from which it is made

Note 1 to entry: This defect may be corrected by using a combination of lenses made from glasses or other materials of different dispersion.

3.1.4.2.1

axial chromatic aberration

aberration (3.1.4) by which *light* (3.1.88) of different wavelengths is focused at different points along the *optical axis* (3.1.107)

3.1.4.2.2

lateral chromatic aberration

chromatic difference of magnification

aberration (3.1.4) by which the *images* (3.1.75) formed by *light* (3.1.88) of different wavelengths, although they may be brought to the same *focus* (3.1.65) in the *optical axis* (3.1.107), are of different sizes

3.1.4.3

coma

aberration (3.1.4) in which the *image* (3.1.75) of an off-axis point *object* (3.1.104) is deformed so that the image is shaped like a comet

3.1.4.4

curvature of image field

aberration (3.1.4) resulting in a curved *image field* (3.1.54.4) from a plane *object field* (3.1.54.5)

Note 1 to entry: Curvature of the image field is particularly obvious with objectives of high magnification and large numerical aperture, which have a restricted depth of field. It may largely be eliminated by additional correction.

3.1.4.5

distortion

aberration (3.1.4) in which *lateral magnification* (3.1.90.8) varies with distance from the *optical axis* (3.1.107) in the *image field* (3.1.54.4)

3.1.4.5.1

barrel distortion

negative distortion

difference in *lateral magnification* (3.1.90.8) between the central and peripheral areas of an *image* (3.1.75) such that the lateral magnification is less at the periphery

EXAMPLE A square object in the centre of the field thus appears barrel shaped (i.e. with convex sides).

3.1.4.5.2**pincushion distortion**

positive distortion

difference in *lateral magnification* (3.1.90.8) between the central and the peripheral areas of an *image* (3.1.75) such that the lateral magnification is greater towards the periphery

EXAMPLE A square object in the centre of the field thus appears pincushion shaped (i.e. with concave sides).

3.1.4.6**monochromatic aberrations**

collective term for all *aberrations* (3.1.4) outside the Gaussian space which appear for *monochromatic* (3.1.123.2) *light* (3.1.88)

Note 1 to entry: The monochromatic aberrations are: spherical aberration, coma, astigmatism, curvature of image field and distortion.

3.1.4.7**spherical aberration**

aberration (3.1.4) resulting from the spherical form of the wavefront arising from an *object* (3.1.104) point on the *optical axis* (3.1.107), on its emergence from the optical system

Note 1 to entry: As a consequence, the rays emanating from an object point on the optical axis at different angles to the axis, or rays entering the lens parallel to the optical axis but at differing distances from it, intersect the optical axis in the image space before (undercorrection) or behind (overcorrection) the ideal image point formed by the paraxial rays.

3.1.5**achromat**

<lens element> *lens* (3.1.87) in which the *axial chromatic aberration* (3.1.4.2.1) is corrected for two wavelengths

EXAMPLE Usually the correction is made for a wavelength below 500 nm and for a wavelength above 600 nm.

3.1.6**achromat**

<microscope objective> *microscope objective* (3.1.99) in which *chromatic aberration* (3.1.4.2) is corrected for two wavelengths and *spherical aberration* (3.1.4.7) and other aperture-dependent defects are minimized for one other wavelength which is usually about 550 nm

EXAMPLE Usually the correction is made for a wavelength below 500 nm and for a wavelength above 600 nm.

Note 1 to entry: This term does not imply any degree of correction for curvature of image field; coma and astigmatism are minimized for wavelengths within the achromatic range.

3.1.7**Airy pattern**

image (3.1.75) of a primary or secondary *point source* (3.1.135.1) of *light* (3.1.88) which, due to *diffraction* (3.1.41) at a circular *aperture* (3.1.10) of an aberration-free *lens* (3.1.87), takes the form of a bright disc surrounded by a sequence of concentric dark and bright rings

3.1.7.1**Airy disc**

diffraction disc

central area bounded by the first dark ring of the *Airy pattern* (3.1.7)

Note 1 to entry: The Airy disc contains 84 % of the energy of the Airy pattern.