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Microscopes — Minimum requirements for binocular tubes

Microscopes — Exigences minimales pour tubes binoculaires

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

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Foreword

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The committee responsible for this document is ISO/TC 172, *Optics and photonics*, Subcommittee SC 5, *Microscopes and endoscopes.*

Microscopes — Minimum requirements for binocular tubes

1 Scope

This International Standard specifies the minimum requirements regarding image quality and viewing ergonomics for binocular tubes for compound microscopes when used with eyepieces as specified by the manufacturer. This International Standard makes a distinction between binocular tubes with and without dioptre adjustment.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15227:2000, *Optics and optical instruments — Microscopes — Testing of stereomicroscopes*

3 Terms and definitions

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

3.1
interpupillary distance
IPD
distance between the exit pupils of the left and right optical system

3.2
optical axis
axis given by the central ray of the pencil exiting the eyepiece for an object point in the centre of the object plane

3.3
convergence
describes the situation when the optical axis for the left and right optical systems meet at a position further away from the eye than the eyepiece

Note 1 to entry: Binocular tubes for compound microscopes usually have parallel optical axes for the left and right optical systems.

3.4
imaging rotation
orientation of the image with respect to the optical axis as the axis of rotation

3.5
relative brightness
brightness of the darker of the two optical systems divided by the brightness of the lighter of the two optical systems

Note 1 to entry: The requirement in Table 3 shall be fulfilled for any state of polarization.

Note 2 to entry: It is expressed in percentage (%).

4 Requirements

The requirements specified in Tables 1, 2, and 3 are the minimum requirements for opto-mechanical and radiation specifications of binocular tubes.

Table 1 makes a distinction between tubes for general use and high-performance tubes.

NOTE Tubes for general use fulfil the basic criteria for microscopic applications. High-performance tubes provide increased viewing ergonomics when used over prolonged time periods.

The values shall be met by any individual tube which claims compliance with this International Standard.

For the specified minimum adjustment range for IPD, all requirements shall be met.

Tubes with dioptre adjustment shall meet the requirements in Table 1, 2, and 3.

Tubes without dioptre adjustment shall meet the requirements in Table 1 and Table 3.

Table 1 — Opto-mechanical requirements

Criterion			Requirement for general use	Requirement for high performance tubes	Test method
Minimum adjustment range for IPD			55 mm to 75 mm		A.1
Indication error of IPD scale			±1 mm		A.2
Difference in optical axis between left and right optical systems	Vertical		≤ 15’		ISO 15227:2000, 6.3.3.1
	Horizontal	Convergence	≤ 45’		
		Divergence	≤10’	≤3’	
Difference in centres between left and right image	Vertical		≤0,20 mm		A.3
	Horizontal	Convergence	≤0,40 mm		
		Divergence			
Difference in axial position between left and right image			±0,3 mm		A.4
Difference in imaging rotation between left and right image			≤2°		ISO 15227:2000, 6.3.5
Difference in exit pupil position between left and right optical system			≤1 mm		A.5

Table 2 — Additional opto-mechanical requirements for tubes with dioptre adjustment

Criterion	Requirement	Test method
Minimum range of dioptre adjustment	−5 *D* to +5 *D*	ISO 15227:2000, 6.3.13
Difference in axial position between left and right image at 0 *D*	±0,5 mm	A.6

Table 3 — Radiation requirements

Criterion	Requirement	Test method
Relative brightness	≥65 %	A.7

Annex A
(normative)

Test methods for binocular tubes

A.1 Minimum adjustment range for IPD

The IPD shall be measured as the distance of the centres of the exit pupils of the two eyepieces.

A.2 Indication error of IPD scale

The indication error is the difference between the quantity measured in A.1 and the marked IPDs on the binocular tube.

A.3 Difference in centres between left and right image

A reference eyepiece with crosshairs is inserted into the left eyepiece sleeve and a specimen with crosshairs is focused. The specimen is laterally adjusted so the crosshairs of the eyepiece and the specimen are aligned.

The reference eyepiece is then inserted into the right sleeve and the distance between the eyepiece crosshairs and the specimen crosshairs in vertical and horizontal direction is measured.

A.4 Difference in axial position between left and right image

A focusable reference eyepiece set to its nominal focus position is inserted in the left eyepiece sleeve and a specimen is focused.

The reference eyepiece is then inserted into the right sleeve. The eyepiece is axially adjusted until the specimen is focused and the resulting axial adjustment is measured.

A.5 Difference in exit pupil position between left and right optical system

The exit pupil position shall be measured perpendicular to the surface defined by the eyepiece location flange of the left optical system.

For tubes with dioptre adjustment, this quantity shall be measured at 0 *D* at the dioptre scale.

A.6 Difference in axial position between left and right image at 0 *D*

The eyepiece sleeve with dioptre adjustment is set to 0 *D* and the same measurement as in A.4 is performed.

A.7 Relative brightness

The brightness shall be measured with a light source of type D65 located in the nominal entrance pupil of the tube. The light source shall be of circular shape and be at least 8 mm in diameter. The measurements shall be carried out in the exit pupils of the eyepieces.