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Optics and photonics — Medical endoscopes and endotherapy devices —

Part 5: Determination of optical resolution of rigid endoscopes with optics

Optique et photonique — Endoscopes médicaux et dispositifs d'endothérapie —

Partie 5: Détermination de la résolution optique des endoscopes optiques rigides

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
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Foreword

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ISO 8600-5 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 5, *Microscopes and endoscopes*.

ISO 8600 consists of the following parts, under the general title *Optics and photonics — Medical endoscopes and endotherapy devices*:

— *Part 1: General requirements*

— *Part 2: Particular requirements for rigid bronchoscopes*

— *Part 3: Determination of field of view and direction of view of endoscopes with optics*

— *Part 4: Determination of maximum width of insertion portion*

— *Part 5: Determination of optical resolution of rigid endoscopes with optics*

— *Part 6: Vocabulary*

Optics and photonics — Medical endoscopes and endotherapy devices —

Part 5: Determination of optical resolution of rigid endoscopes with optics

1 Scope

This part of ISO 8600 specifies a test method for determining the optical resolution of endoscopes for type testing. It is applicable to rigid endoscopes with optics designed for use in the practice of medicine for type testing. It is not applicable to endoscopes having a fibre-optic or opto-electronic imaging system.

2 Terms and definitions

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

2.1
working distance
d
distance between object and distal end of endoscope

NOTE For the purposes of the test specified in this part of ISO 8600, the "object" will be the resolution target specified in 3.1.1.

2.2
optical resolution
$r(d)$
maximum number of line pairs per millimetre which can be just perceived at a given working distance d of the endoscope

2.3
angular resolution
α
smallest angle whose vertex is at the distal window surface of the endoscope at which a line pair at a given working distance d can just be identified; it is calculated as follows:

$$\alpha = \arctan \frac{1}{d \times r(d)}$$

2.4
maximum image height

2.4.1
maximum image height
⟨circular field of view⟩ radius of the field circle

2.4.2
maximum image height
〈non-circular field of view〉 radius of a circle which circumscribes the maximum field of view

EXAMPLE If the field of view is rectangular, the maximum image height is half of the diagonal.

2.5
on-axis resolution
resolution at the centre of the image (optical or angular)

2.6
off-axis resolution
resolution at an image point at 70 % of the maximum image height (optical or angular)

3 Test method

3.1 Apparatus

3.1.1 **Resolution target**, having adequately graduated resolution test patterns arranged at least in two directions, preferably in the horizontal and vertical direction, in the range of 1 line-pair/mm to 100 line-pairs/mm.

3.1.2 **Optical bench/optical rail**, with mounting apparatus for endoscope and resolution target.

3.1.3 **Video camera,** with monitor and video printer or photo camera.

3.1.4 **Light source**, with a recommended colour temperature of 3 500 K to 8 000 K, unless the endoscope is specifically designed for a specific wavelength, in which case this specific wavelength should be used.

3.2 Procedure

3.2.1 Mount the endoscope on the optical bench.

3.2.2 Attach the target to a diffusive plate and mount it on the optical bench at the working distance d. Align the target at an angle perpendicular to the endoscope's direction of view. Adjust the suitable test pattern on the target to the image points to be tested (see Figure 1). It is recommended to illuminate the target from behind.

3.2.3 Attach the camera to the endoscope. Adjust the magnification of the system endoscope/camera to maximize resolution. On-axis and off-axis measurement shall be made at the same focus. It shall be assured that the endoscope's resolution is determined and not the resolution of the camera equipment.

3.2.4 Take a videoprint or a photograph.

3.2.5 Determine the on-axis resolution of the endoscope in line-pairs/mm (Point A in Figure 1).

Determine the off-axis resolution of the endoscope in line-pairs/mm. For this the image is to be divided into four congruent quadrants, each of them containing one image point to be tested (see 2.6; Points B1 to B4 in Figure 1). The optical resolution shall be determined for all image points Points B1 to B4. At each image point, the resolution target group that enables the detection of all pattern directions shall be determined. The results of all image points shall be averaged.

3.2.6 Calculate the angular resolution for both on-axis and off-axis resolution.

NOTE Within the depth of focus of the endoscope, the angular resolution does not depend on the distance.

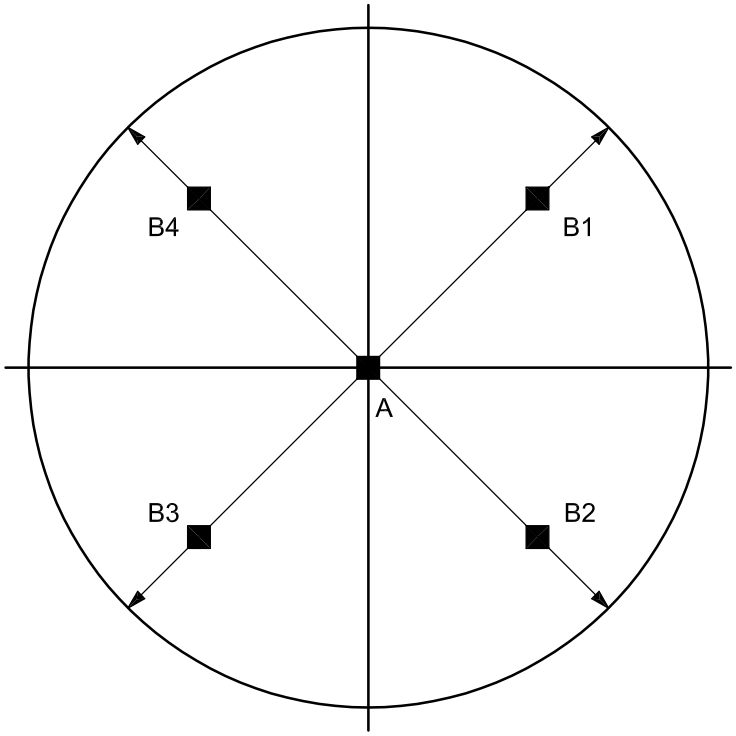

Figure 1 — Image points to be tested for optical resolution

4 Test report

Any test report resulting from following the test method described in Clause 3 shall contain at least the following details:

a) type of endoscope, manufacturer, catalogue and serial numbers;

b) resolution target used;

c) distance between target and distal end of endoscope;

d) light source used;

e) camera equipment used;

f) if photo camera has been used: shutter time, f-number, film type, size of print;

g) value of on-axis optical and angular resolution;

h) single values and averaged value of off-axis optical resolution and angular resolution;

i) laboratory or company carrying out the test;

j) name of the testing engineer;

k) place and date of test.

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