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Optics and photonics — Test methods for telescopic systems —

Part 3: Test methods for telescopic sights

Optique et photonique — Méthodes d'essai pour systèmes télescopiques —
Partie 3: Méthodes d'essai pour viseurs de tir

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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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 172, *Optics and photonics*, Subcommittee SC 4, *Telescopic systems*.

This second edition cancels and replaces the first edition (ISO 14490-3:2004), which has been technically revised with the following changes:

a) Clause 9 "Method of measurement of line of sight shift due to focusing" was added;

b) the term "magnification" was replaced by "magnifying power" in various instances.

ISO 14490 consists of the following parts, under the general title *Optics and photonics — Test methods for telescopic systems*:

— *Part 1: Test methods for basic characteristics*

— *Part 2: Test methods for binocular systems*

— *Part 3: Test methods for telescopic sights*

— *Part 4: Test methods for astronomical telescopes*

— *Part 5: Test methods for transmittance*

— *Part 6: Test methods for veiling glare index*

— *Part 7: Test methods for limit of resolution*

— *Part 8: Test methods for night-vision devices*

Optics and photonics — Test methods for telescopic systems —

Part 3: Test methods for telescopic sights

1 Scope

This part of ISO 14490 specifies test equipment and test procedures for determination of the following optical characteristics of telescopic sights:

— axial parallax;

— parallax;

— eye relief range;

— reticle tracking;

— line of sight shift due to zooming;

— line of sight shift due to focusing.

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 14132–1, *Optics and photonics — Vocabulary for telescopic systems — Part 1: General terms and alphabetical indexes of terms in ISO 14132*

ISO 14132–3, *Optics and photonics — Vocabulary for telescopic systems — Part 3: Terms for telescopic sights*

ISO 14135–1:2014, *Optics and photonics — Specifications for telescopic sights — Part 1: General-purpose instruments*

ISO 14135–2:2014, *Optics and photonics — Specifications for telescopic sights — Part 2: High-performance instruments*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14132-1 and ISO 14132-3 apply.

4 Method of measurement of axial parallax

4.1 Principle

This test method describes the measurement of the axial distance between the reticle of a telescopic sight and an image, formed by the objective lens of this telescopic sight (where the reticle is in the first image plane) or by the objective lens and erecting system (where the reticle is in the second image

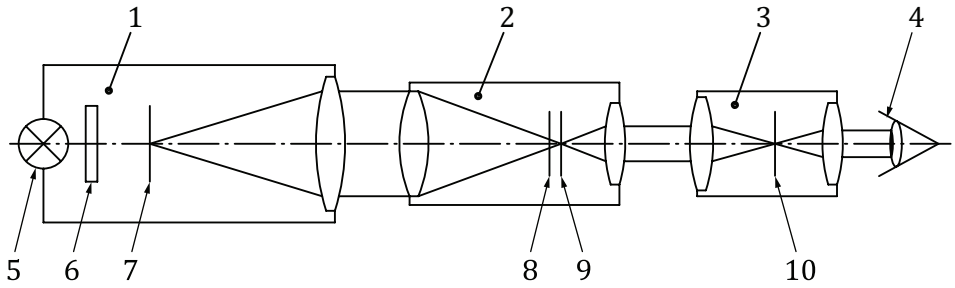
plane). The distance between the reticle of the telescopic sight and image plane of the collimator reticle along the optical axis p'_{ax} is expressed in dioptres (m^{-1}) and measured with the auxiliary telescope.

4.2 Test arrangement

4.2.1 General

Measurement of the axial parallax shall be carried out with the test arrangement shown in Figure 1.

It shall be possible to adjust the alignment of the collimator and the telescopic sight relative to each other. This can be achieved by adjusting the collimator and/or the telescopic sight.



Key

1	collimator	6	filter
2	telescopic sight	7	reticle of collimator
3	dioptric tester	8	reticle of telescopic sight
4	observer's eye	9	image plane of collimator reticle
5	illumination unit	10	reticle of dioptric tester

Figure 1 — Test arrangement for measuring axial parallax

4.2.2 Collimator

The collimator shall have a useful diameter larger than the objective lens diameter of the telescopic sight under test and a focal length of at least ten times the diameter of the collimator lens.

The reticle of the collimator should have geometric features appropriate to assess the offset, e.g. a cross-hair. The axial position of this reticle shall be correctly adjusted to form an image at the specified parallax-free distance of the telescopic sight under test.

The illumination unit shall create a uniform brightness over the aperture of the collimator.

To avoid chromatic aberrations, a green filter (approximately 0,55 µm) shall be used.

4.2.3 Telescopic sight

The telescopic sight and/or the collimator shall be adjusted relative to each other so that both optical axes are parallel and in such a position that the objective lens of the telescopic sight is completely illuminated.

The centre of the reticle of the telescopic sight shall be near the optical axis of the sight.

4.2.4 Dioptric tester

The dioptric tester shall have an aperture larger than the exit pupil of the telescopic sight and a magnifying power sufficient to ensure a precise measurement (i.e. ×3 to ×6).

4.3 Measurement procedure

Set the dioptric tester to zero with its eyepiece adjusted to obtain a sharp image of its own reticle.

The eyepiece of the telescopic sight shall be focused on the reticle of the telescopic sight to obtain a sharp image while viewing through the dioptric tester.

For telescopic sights with fixed eyepiece, use the dioptric tester to focus on the reticle of the telescopic sight.

The dioptre setting of the dioptric tester shall be adjusted to obtain a sharp image of the collimator reticle.

The axial parallax in the image space, p'_{ax}, shall be determined by the difference of the two readings on the dioptric tester.

The uncertainty of measurement for p'_{ax} (expressed in m^{-1}) shall not exceed Formula (1):

$$\frac{2{,}7\ \mathrm{m}}{10^6 \cdot D'^2} \qquad (1)$$

where D' is the exit pupil diameter of the telescopic sight expressed in metres.

For exit pupil diameters larger than 7 mm, the value in the formula shall be D' = 7 mm.

The axial parallax in the object space, p_{ax}, is calculated as given in Formula (2):

$$p_{ax} = \frac{p'_{ax}}{\Gamma^2} \qquad (2)$$

where Γ is the magnifying power of the telescopic sight under test.

NOTE The image quality of the test setup (including the telescopic sight under test) influences the measurement error.

4.4 Test report

A test report shall be presented and shall include the general information specified in Clause 10 and the result of the test as specified in 4.3.

5 Method of measurement of parallax

5.1 Principle

This method describes the determination of the angular deviation between the aiming lines for on-axis and off-axis observation.

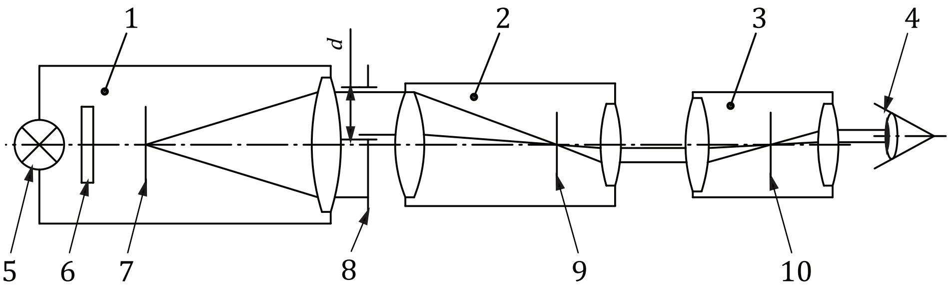
NOTE For exit pupil diameters of approximately 2 mm or less, only the test method for axial parallax is appropriate.

5.2 Test arrangement

5.2.1 General

Measurement of the parallax shall be carried out with the test arrangement shown in Figure 2.

It shall be possible to adjust the alignment of the collimator and the telescopic sight relative to each other. This can be achieved by adjusting the collimator and/or the telescopic sight.



Key

1 collimator	6 filter
2 telescopic sight	7 reticle of collimator
3 auxiliary telescope	8 light stop, off-axis
4 observer's eye	9 reticle of telescopic sight
5 illumination unit	10 reticle of auxiliary telescope

Figure 2 — Test arrangement for measuring parallax

5.2.2 Collimator

The collimator shall have a useful diameter larger than the objective lens diameter of the telescopic sight under test and a focal length of at least ten times the diameter of the collimator lens.

The reticle of the collimator should have geometric features appropriate to assess the offset, e.g. a cross-hair. The axial position of this reticle shall be correctly adjusted to form an image at the specified parallax-free distance of the telescopic sight under test.

The illumination unit shall create a uniform brightness over the aperture of the collimator. To avoid chromatic aberrations, a green filter (approximately 0,55 µm) shall be used.

5.2.3 Telescopic sight

The telescopic sight and/or the collimator shall be adjusted relative to each other so that both optical axes are parallel and in such a position that the objective lens of the telescopic sight is completely illuminated.

The centre of the reticle of the telescopic sight shall be near the optical axis of the sight.

5.2.4 Light stop

The light stop shall have a diameter, d, in millimetres, (see Figure 2) of d = (1,2 ± 0,1) Γ where Γ is the magnifying power of the telescopic sight under test.

The light stop shall be adjustable in a horizontal direction over the whole diameter of the entrance pupil of the telescopic sight.

5.2.5 Auxiliary telescope

The auxiliary telescope shall have an aperture larger than the exit pupil of the telescopic sight and a magnification sufficient to ensure a precise measurement.

The auxiliary telescope reticle shall have a scale in minutes of arc on its horizontal axis, with subdivisions of at most 2 minutes of arc (MOA).

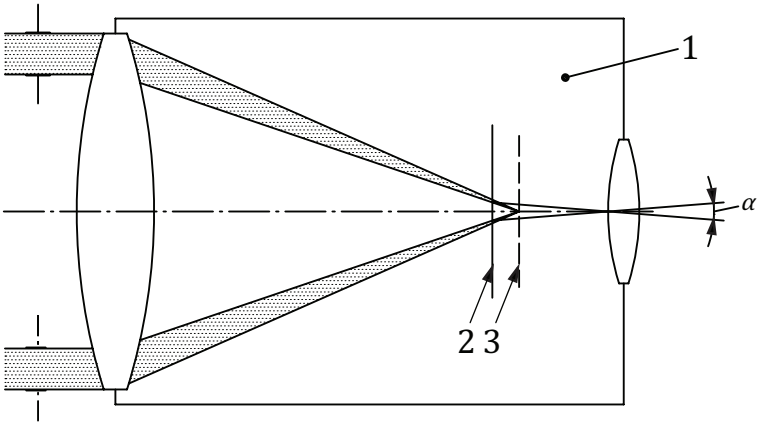
The auxiliary telescope shall be focused to infinity.

5.3 Measurement procedure

The eyepiece of the telescopic sight shall be focused on the reticle of the telescopic sight to obtain a sharp image while viewing through the auxiliary telescope.

Adjust the light stop to two opposite positions, so that in each of them, its outer edge corresponds to the edge of the entrance pupil of the telescopic sight.

Use the auxiliary telescope to determine the change, α, in MOA, of the angular deviation between the images of the collimator reticle and the telescopic sight reticle in the two light stop positions (see Figure 3).



Key

1 telescopic sight

2 reticle of telescopic sight

3 image plane of collimator reticle

α change, in MOA, of the angular deviation between the images of the collimator reticle and the telescopic sight reticle in the two light stop positions

Figure 3 — Explanation of measurement of quantity α

The parallax p' in the image space is calculated as given in Formula (3):

$$p' = \frac{\alpha}{2} \tag{3}$$

The maximum parallax in the object space p is calculated as given in Formula (4):

$$p = \frac{p'}{\Gamma} \tag{4}$$

where Γ is the magnifying power of the telescopic sight under test.

The uncertainty of measurement for p' shall not exceed 1,0 MOA.

NOTE For practical purposes, the relations between parallax and axial parallax are given by the following formulae:

$p' = p'_{ax} \frac{D'}{2}$, expressed in milliradians

$p' = p'_{ax} \frac{D'}{2} \times 3{,}438$, expressed in minutes of arc

where D' is the exit pupil diameter, expressed in millimetres.