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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

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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).

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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 4, *Telescopic systems*.

This third edition cancels and replaces the second edition (ISO 14490-3:2016), which has been technically revised. The main changes compared to the previous edition are as follows:

— critical eye relief added in the test method according to ISO 14135 series and ISO 14132-3.

A list of all parts in the ISO 14490 series can be found on the ISO website.

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.

Optics and photonics — Test methods for telescopic systems —

Part 3:
Test methods for telescopic sights

1 Scope

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

— axial parallax;

— parallax;

— eye relief range, eye relief, critical eye relief;

— reticle tracking;

— line of sight shift due to zooming;

— line of sight shift due to focusing.

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

ISO 14135-2:—, *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

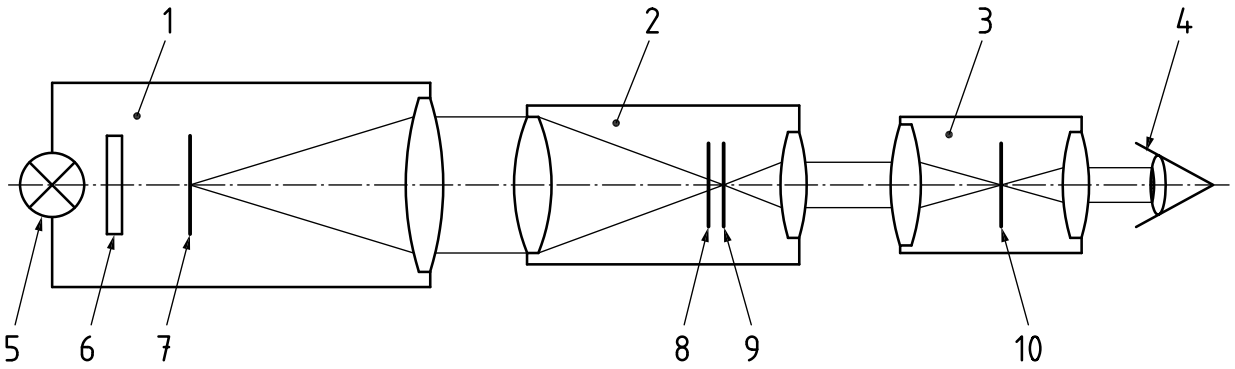
plane). The distance between the reticle of the telescopic sight and image plane of the collimator reticle along the optical axis, p'_{ax}, is expressed in dioptres (m^{-1}) and measured with the auxiliary telescope.

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
2 telescopic sight
3 dioptric tester
4 observer's eye
5 illumination unit
6 filter
7 reticle of collimator
8 reticle of telescopic sight
9 image plane of collimator reticle
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 (~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 a 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):

$$\text{uncertainty } p'_{ax} \leq \frac{2{,}7}{10^6 \cdot D'^2}\ \text{m}^{-1} \tag{1}$$

where

p'_{ax} is the axial parallax in the image space in m^{-1};

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):

$$p_{ax} = \frac{p'_{ax}}{\Gamma^2} \tag{2}$$

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.

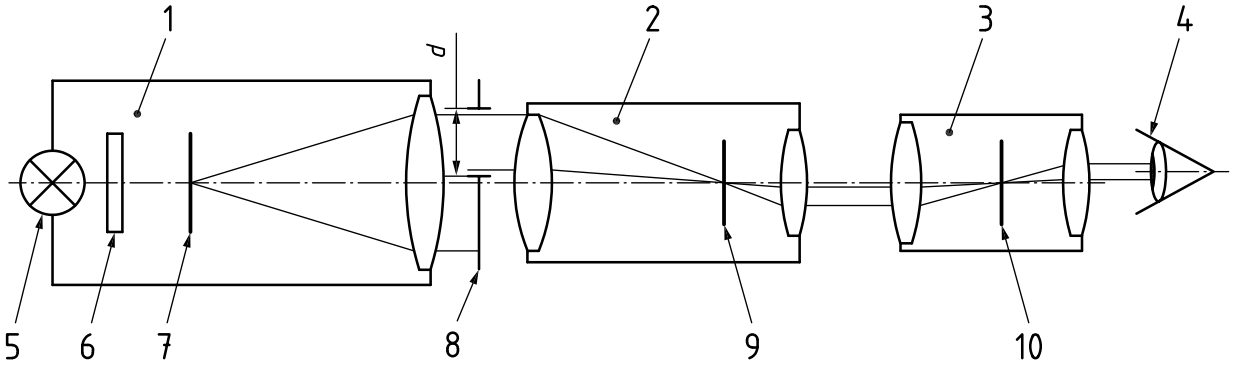
NOTE For exit pupil diameters of approximately 2 mm or less, only the test method for axial parallax is appropriate.

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 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 (~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 $d = (1{,}2 \pm 0{,}1)\ \Gamma$ 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 min of arc (MOA).

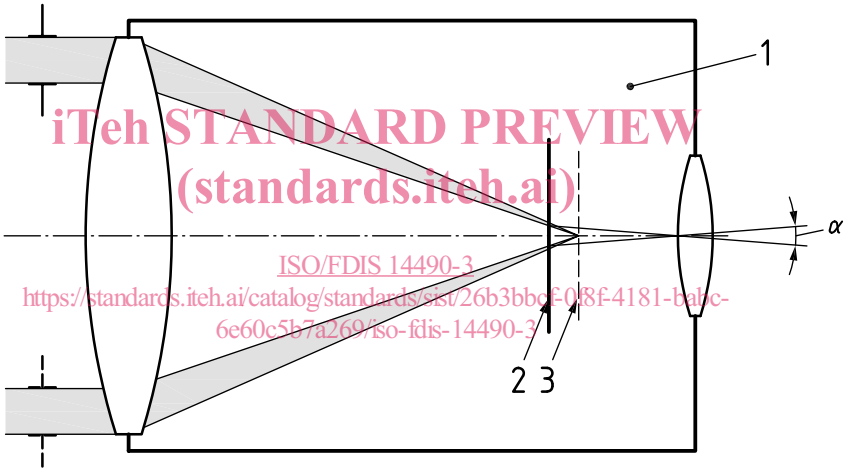
The auxiliary telescope shall be focused to infinity.

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.