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Optics and optical instruments — Test methods for telescopic systems —

Part 3: Test methods for telescopic sights

Optique et instruments d'optique — Méthodes d'essai pour systèmes télescopiques —

Partie 3: Méthodes d'essai pour viseurs de tir

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 14490-3 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 4, *Telescopic systems*.

ISO 14490 consists of the following parts, under the general title *Optics and optical instruments — 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*

Optics and optical instruments — 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 the determination of the following optical characteristics of telescopic sights:

— axial parallax;

— parallax;

— eye relief range;

— reticle tracking.

2 Normative references

The following referenced documents are indispensable for the application 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 14132-1:2002, *Optics and optical instruments — Vocabulary for telescopic systems — Part 1: General terms and alphabetical indexes of terms in ISO 14132*

ISO 14132-3:2002, *Optics and optical instruments — Vocabulary for telescopic systems — Part 3: Terms for telescopic sights*

3 Terms and definitions

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

4 Test methods

4.1 Axial parallax

4.1.1 General

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. The distance p'_{ax} is expressed in dioptres (m^{-1}).

4.1.2 Requirements for measuring equipment (See Figure 1)

4.1.2.1 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 10 times the diameter of the collimator lens.

The reticle of the collimator shall be a cross-hair. The axial position of this reticle shall be correctly adjusted to form a virtual 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.

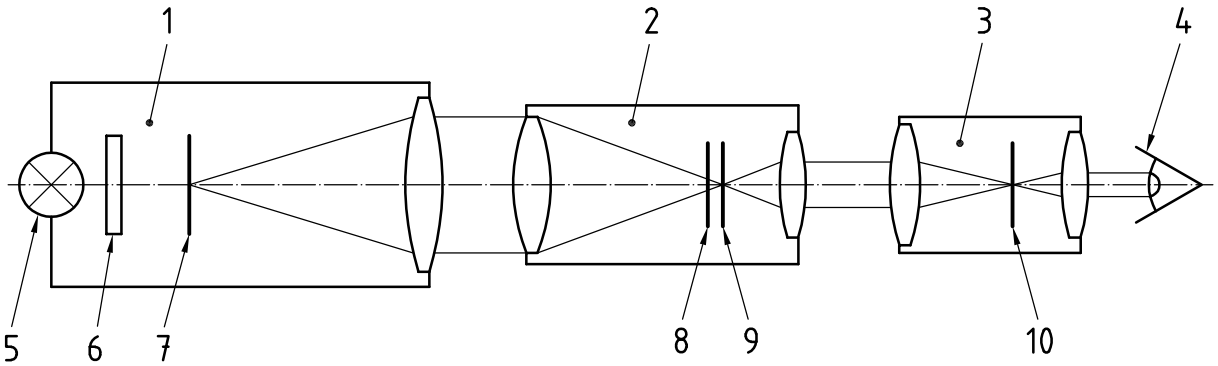
4.1.2.2 Telescopic sight

The telescopic sight shall be adjusted parallel to the optical axis of the collimator in such a position that the objective lens of the telescopic sight is completely illuminated.

The reticle of the telescopic sight shall be in the centre of the total adjustment range.

4.1.2.3 Dioptric tester

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



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 of collimator reticle
10 reticle of dioptric tester

Figure 1 — Schematic test set up: axial parallax

4.1.3 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 measurement error for p'_{ax} shall not exceed

$$\frac{2{,}7\ \text{mm}}{D'^2}$$

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

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 by

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

NOTE The image quality of the telescopic sight influences the measurement error.

4.2 Parallax

4.2.1 General

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.

4.2.2 Requirements for measuring equipment (See Figure 2)

4.2.2.1 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 10 times the diameter of the collimator lens.

The reticle of the collimator shall be a cross-hair. The axial position of this reticle shall be correctly adjusted to form a virtual 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.

4.2.2.2 Telescopic sight

The telescopic sight shall be adjusted parallel to the optical axis of the collimator in such a position that the objective lens of the telescopic sight is completely illuminated.

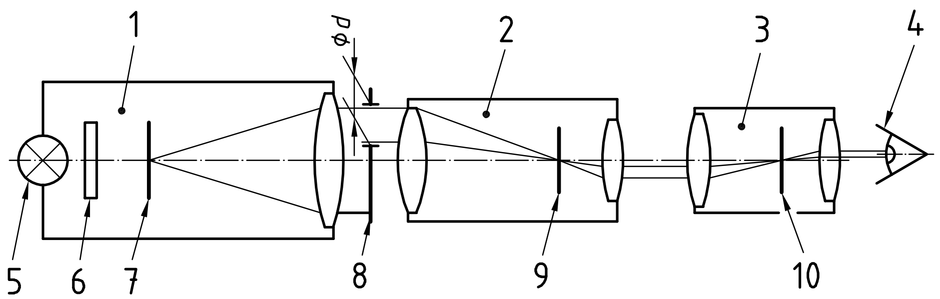
The reticle of the telescopic sight shall be in the centre of the total adjustment range.

4.2.2.3 Light stop

The light stop shall have a diameter d, in millimetres, (see Figure 2) of $d = (1{,}2 \pm 0{,}1) \times \Gamma$

where Γ is the magnification 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.



Key

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

Figure 2 — Schematic test set up: parallax

4.2.2.4 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 2 minutes of angle (moa).

The auxiliary telescope shall be focused to infinity.

4.2.2.5 Measurement procedure

The eyepiece of the telescopic sight shall be focused on its own reticle 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 a, in moa, of the angular deviation between the images of the collimator reticle and the telescopic sight reticle in the two light stop positions.

The parallax p' in the image space is calculated by

$$p' = \frac{a}{2}$$

The maximum parallax in the object space p is calculated by

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

The measurement error for p' shall not exceed 1,0 moa.

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

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

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

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

4.3 Eye relief range

4.3.1 General

This method describes the determination of that eye position range along the optical axis of a telescopic sight, which still allows observation of the full field of view.

For this method, a mean daylight eye pupil of 3 mm in diameter is assumed.

For an illustration of eye relief range, see Figure 3 where “a” to “c” is the eye relief range.