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**Optics and optical instruments — Test  
methods for telescopic systems —**

**Part 2:  
Test methods for binocular systems**

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

*Partie 2: Méthodes d'essai pour systèmes binoculaires*

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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.

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 14490-2 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*

The following part is under preparation:

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



# Optics and optical instruments — Test methods for telescopic systems —

## Part 2: Test methods for binocular systems

### 1 Scope

This part of ISO 14490 is applicable to binocular telescopic systems and specifies the test methods for determination of the following characteristics:

- non-parallelism of the axes of bundles of rays emergent from the eyepieces;
- interpupillary distance;
- relative difference in magnification;
- focusing difference between telescopes of binocular systems.

### 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 14132-2:2002, *Optics and optical instruments — Vocabulary for telescopic systems — Part 2: Terms for binoculars, monoculars and spotting scopes*

ISO 14490-1:2005, *Optics and optical instruments — Test methods for telescopic systems — Part 1: Test methods for basic characteristics*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14132-1 and ISO 14132-2 apply.

### 4 Measurement of non-parallelism of axes

#### 4.1 General

The optical axes of both telescopes of the instrument shall be parallel so as to ensure normal binocular vision during observation through the instrument. The acceptable degree of non-parallelism of optical axes of the telescopes is based on the physiological properties of the human eye.

The measurement of the non-parallelism of axes shall be carried out at the following interpupillary distances:

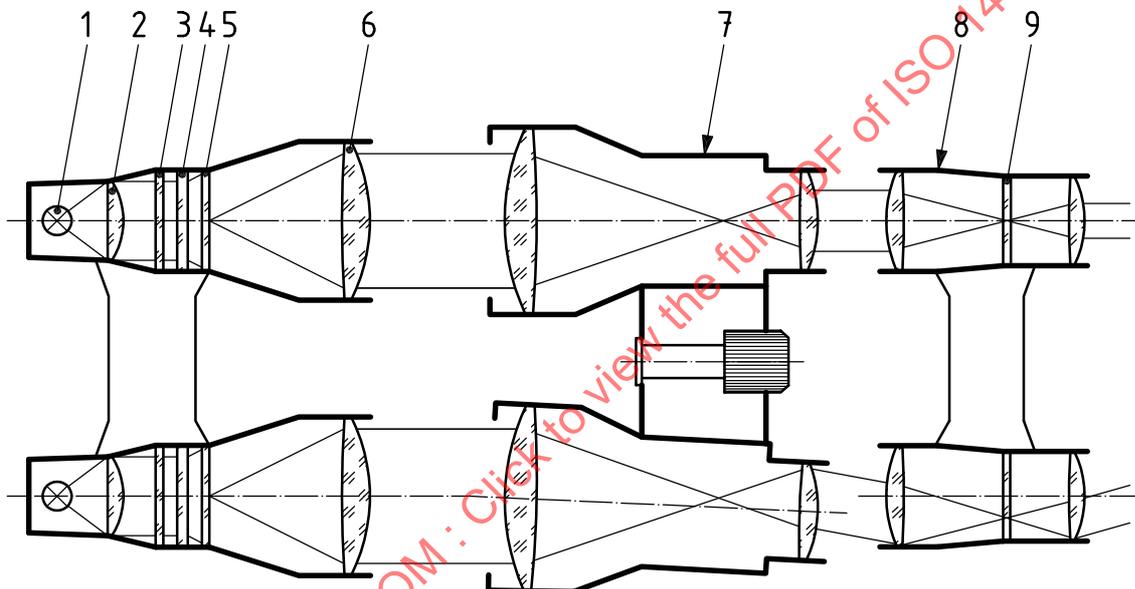
- 60 mm,
- 65 mm,
- 70 mm.

**4.2 Test equipment**

**4.2.1** The measurements should be made by means of the test arrangement shown in Figure 1.

**4.2.2** The visual axes of the collimators and measuring telescopes shall be parallel. The deviation from parallelism should not exceed 20" of arc.

It is permissible to use a single collimator if the diameter of the collimator lens is at least 160 mm.



**Key**

- 1 light source
- 2 condenser
- 3 filter (approx. 0,55 μm)
- 4 diffusing plate
- 5 reticle
- 6 collimator lens
- 7 test specimen with deviation "divergence"
- 8 measuring telescope
- 9 scale

**Figure 1 — Test arrangement for measuring non-parallelism of axes of bundles emergent from the eyepieces in binocular instruments**

**4.2.3** The test targets in the form of cross-lines shall be placed in the focal planes of the collimator objectives.

**4.2.4** The focal planes of parallel measuring telescopes shall be provided with reticles that have cross-lines and measuring scales.

### 4.3 Preparation and carrying out of measurements

4.3.1 The eyepieces of each measuring telescope shall be adjusted to obtain the sharp image of its own reticle.

4.3.2 When the test specimen is removed, the images of the centres of cross-lines in both collimators shall coincide with the centres of cross-lines of the parallel measuring telescope reticles. The permissible displacement between centres of cross-lines shall not exceed 20" of arc.

4.3.3 After the test specimen has been introduced into the test arrangement in accordance with Figure 1, the image of reticle (5 in Figure 1) produced by one monocular of the test specimen shall be brought into coincidence with the cross-line of the scale (9 in Figure 1) of the corresponding measuring telescope. From the scale (9) of the other measuring telescope the number of divisions should be read out which defines the shift of the image of reticle (5) from the centre of the scale (9) produced by the other telescope of the test specimen both in the horizontal direction and in the vertical direction.

4.3.4 Instead of two telescopes arranged parallel to each other, the use of only one telescope that travels from one monocular to the other, is acceptable. The design of the telescope should provide for its travelling without any shift of the direction of the optical axis.

### 4.4 Test results

4.4.1 The test result for inclusion into the test report in accordance with Clause 8 shall state the interpupillary distances at which the measurement was carried out.

4.4.2 The precision of measurements shall be within  $\pm 3'$  of arc.

## 5 Measurement of interpupillary distance

5.1 The interpupillary distance indicated at the appropriate scale of the test specimen shall be measured by means of callipers, or special gauge, or else by means of the dedicated test apparatus that consists of two parallel low magnification microscopes with eyepiece reticles.

5.2 The distance between the axes of the microscopes shall be adjusted and a reading shall be taken by means of the scale that the test apparatus should be provided with.

5.3 The precision of measurements shall be within 1 mm.

## 6 Measurement of relative difference in magnification

6.1 The difference of magnifications between the two telescopes of a binocular system is assessed by calculation of the difference of values of magnifications in each monocular, measured in accordance with ISO 14490-1:2005, Clause 4.

6.2 The relative error of measurement of magnifications shall be within  $\pm 0,5\%$ .

## 7 Measurement of focusing difference

### 7.1 General

The focusing difference of both telescopes of the instrument encountered during focusing shall be within certain limits so as to ensure normal binocular vision during observation through the binoculars.

Only binoculars provided with central focusing mechanism are subject to this test.

## 7.2 Test equipment

The test equipment shall consist of a dioptic tester having an objective, reticle and eyepiece. The objective or the eyepiece of the dioptic tester can be moved along the axis while the amount of this movement is read out as convergence or divergence of the bundle that enters the tester, expressed in diopters.

## 7.3 Procedure

### 7.3.1 General

The focusing difference shall be assessed in two positions:

- a) at infinity;
- b) at a measurement point in the close distance range, which shall be chosen to be  $2\text{ m}^{-1}$  from the mechanical close focus stop.

### 7.3.2 Measurement

For both measuring positions the focusing difference shall be determined in consideration of the two available focusing directions of the central focusing mechanism (from negative powers via infinity to close distance range and vice versa). It is important that the direction of focusing not be reversed during the measurement except for the required change of focusing direction at the mechanical close focus stop.

Set the specimen to the initial position for making the measurement, i.e. set the central focusing mechanism and, in addition, the dioptre adjustment mechanism to about  $-2\text{ m}^{-1}$ . With the aid of the dioptic tester, set both telescopes to infinity using the central focusing and the dioptre adjustment mechanisms. Do not reverse the direction of focusing during this procedure.

Using the central focusing mechanism, focus both telescopes further until the measurement point in the close distance range [see 7.3.1 b)] is reached, again without reversing the direction of focusing. Determine and record the focus difference between the two telescopes by use of the dioptic tester.

Further focus both telescopes by use of the central focusing mechanism until the mechanical close distance stop is reached. At this point (and only at this point) the direction of focusing is reversed.

Focus the two telescopes to the measurement point in the close distance range. As before, determine and record the focus difference between the two telescopes.

Using the central focusing mechanism, and without reversing the direction of focusing, focus the telescopes to infinity. Again determine and record the focus difference between the two telescopes.

## 7.4 Test results

7.4.1 From the three determinations made during the measurement procedure the greatest value shall be taken as the measurement result.

NOTE When using the dioptre scale for dioptre adjustment, instead of adjusting optically, the error of the dioptre scale will form part of the measurement result as determined by this procedure.

7.4.2 The precision of measurements shall be within  $\pm 0,25\text{ m}^{-1}$ .