



Optics and optical instruments — Test methods for telescopic systems —

Part 6: Test methods for veiling glaze index

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

Partie 6: Méthodes d'essai de l'indice de lumière parasite diffuse

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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 14490-6 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, 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

Annex A of this part of ISO 14490 is for information only.

Optics and optical instruments — Test methods for telescopic systems —

Part 6:

Test methods for veiling glare index

1 Scope

This part of ISO 14490 specifies the test methods for the determination of the veiling glare index of telescopic systems and observational telescopic instruments.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 14490. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 14490 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 9358:1994, *Optics and optical instruments — Veiling glare of image forming systems — Definitions and methods of measurement*

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

ISO 14490—1:¹⁾, *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 part of ISO 14490 the terms and definitions given in ISO 14132-1 apply.

4 General

The veiling glare test methods are generally described in ISO 9358:1994. ISO 9358:1994 deals with arbitrary optical instruments and contains two basic approaches to measuring the veiling glare, namely integral (or black patch) method and analytical (or glare spread function) method.

For terrestrial telescopes that this part of ISO 14490 deals with, the black patch method is more adequate while the glare spread function may prove to be better for astronomical telescopes. For the moment consideration in this part of ISO 14490 is given only to the black patch method. If need of measuring the glare spread function arises the reference should be made directly to appropriate clauses of ISO 9358:1994.

1) To be published.

From the classification in clause 4 of ISO 9358:1994 the case where both the object and the image are at infinity will usually apply to telescopic systems. The clauses below give detailed and more specific description of the general test method given in 5.1 of ISO 9358:1994 and of test conditions given in 6.1 of ISO 9358:1994.

5 Principle

The determination of the veiling glare index S is based upon the measurement of the illumination of the image of a black surface in diffuse scattered white light and the measurement of the illumination of the image of the white background.

The veiling glare of an optical instrument is determined by the ratio of the illumination E_1 of the image of a black surface within a white illuminated wide surface to the illumination E_2 of an image of a totally white surface.

NOTE In both cases the white surface ensures a homogenous distribution of the illumination across the whole entrance pupil of the test specimen.

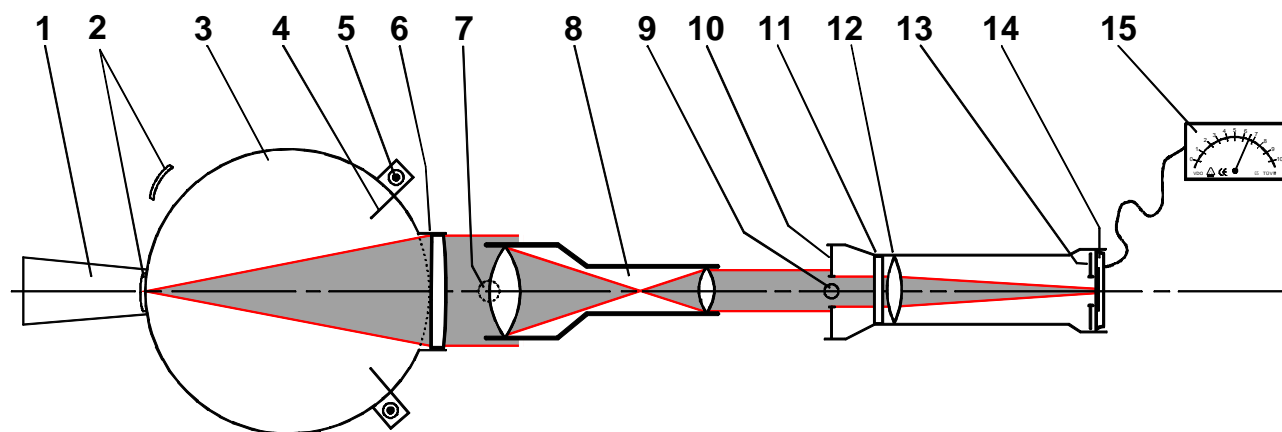
$$S = \frac{E_1}{E_2} \quad (1)$$

6 Test arrangement

6.1 General

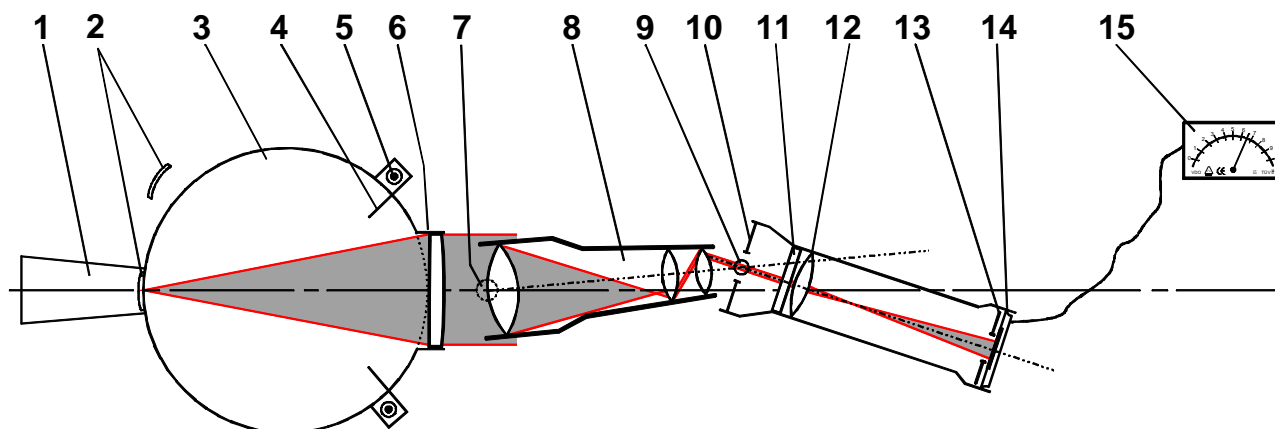
The measuring set-up consists of an integrating sphere, an object-side collimator, the test specimen mounting, the limiting stop, the image-side collimator, and the measuring and evaluation unit.

See figures 1 and 2.



1 — black object simulator; 2 — selectable segments; 3 — integrating sphere; 4 — baffle; 5 — light source; 6 — object—side collimator lens; 7 — slewing point I; 8 — test specimen; 9 — slewing point II; 10 to 15 — measuring and evaluation unit, consisting of: 10 — limiting stop; 11 — filter; 12 — image—side collimator lens; 13 — measuring stop; 14 — radiation detector; 15 — indicator

Figure 1 — Test arrangement for on-axis measurement (schematic)



1 — black object simulator; 2 — selectable segments; 3 — integrating sphere; 4 — baffle; 5 — light source; 6 — object—side collimator lens; 7 — slewing point I; 8 — test specimen; 9 — slewing point II; 10 to 15 — measuring and evaluation unit, consisting of: 10 limiting stop; 11 — filter; 12 — image—side collimator lens; 13 — measuring stop; 14 — radiation detector; 15 — indicator

Figure 2 — Test arrangement for off-axis measurement (schematic)

6.2 Integrating sphere

The integrating sphere should have a diameter 15 times the diameter of the entrance pupil of the test specimen, but at least 1 m.

It has two opposite openings. In the first opening, the collimating lens is inserted. In the second opening, removable circular elements adapted to the interior surface of the sphere are inserted to act as white and black reference surfaces.

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The white reference surface is composed of a disk that entirely fills the second opening in the sphere. The black reference surface is composed of a disk with an aperture of the desired diameter (i.e. an annulus) that is fitted into the second opening in the sphere. It is followed by a light trap outside the sphere. The luminance of the light trap shall be less than 0,1 % of the luminance of the illuminated interior surface of the sphere

NOTE See informative Annex A for background information about the black patch method.

The interior surface of the sphere and the annular and circular elements shall be white and opaque. The reflectivity across the whole spectral range from 380 nm to 780 nm should be at least 85 %.

The light source shall emit a constant radiant flux. The radiant flux shall not change more than 1 % during the measurement of one pair of values. The light source shall correspond to a black body source with a colour temperature between 2800 K and 3200 K.

6.3 Object-side collimator

For the purpose of a collimator an achromatic lens with a maximum f-number of 10 is appropriate, but the aperture shall exceed 1,2 times the diameter of the objective lens of the test specimen.

The focal length of the collimator and the interior diameter of the sphere shall be identical. All glass-air surfaces need an antireflection coating.

The object-side collimator is being fixed in the opening so that the collimator with its frame closes the interior of the sphere and the lens is located outside the sphere.

6.4 Test specimen mounting

The test specimen mounting shall be constructed in a way that the combination of the test specimen and the measuring and evaluation unit can be adjusted and held stable and turned around the entrance pupil for off-axis measurements.

Additionally, the test specimen mounting shall be constructed in a way that the measuring and evaluation unit can be turned around the exit pupil for off-axis measurements.

6.5 Limiting stop

In the plane of the test specimen's exit pupil a limiting stop of 8 mm diameter shall be attached. This limiting stop prevents the light that should not reach the observer's eye from entering the radiation detector.

NOTE A limiting stop of 8 mm diameter is assumed to match the eye's maximum pupil diameter.

6.6 Measuring and evaluation unit

The measuring and evaluation unit consists of the limiting stop, the filter, the image-side collimator, the radiation detector, and the indicator.

The image-side collimator (achromatic lens with antireflection coatings) images the white or black reference surface at the surface of the radiation detector.

It shall be positioned directly behind the test specimen's exit pupil. The clear aperture shall be at least 10 mm.

At the image surface in front of the radiation detector a measuring stop with a diameter of 20 % to 50 % of the diameter of the image of the black surface is arranged.

The filter serves to convert the spectral sensitivity curve of the detector to the photopic response curve of the human eye for the radiation source used.

The size and aperture of the radiation detector shall be sufficient to collect all radiation which is transmitted by the measuring stop.

7 Procedure

7.1 Adjustment of the measuring set-up

Thoroughly clean the optical surfaces of the collimators and of the test specimen.

The size of the black surface corresponds to a 1° object-side field of view; this is valid for test specimens with at least 2° field of view. If the test specimen has a smaller field of view, then the object-side angle of the black surface should correspond to approximately half the test specimen's field of view.

Attach the test specimen as closely as possible to the object-side collimator and centre it to the optical axis. This ensures that the light enters the test specimen with the maximum solid angle.

7.2 Determination of results

First, measure the illumination in the image of the white surface, then measure the illumination in the image of the black surface.

For the determination of the veiling glare index of off-axis object points slew the test specimen around the entrance pupil and slew the measuring and evaluation unit around the exit pupil.

For the measurement off-axis object points of 0,5 and 0,7 of half the field of view should be chosen.

Because the veiling glare index of non rotationally-symmetric erecting systems (prisms) is not equal at corresponding azimuths, determine the maximum value.

8 Presentation of results

The veiling glare index S is given in percent.

The measuring results shall be presented in tabular and in graphical form, as follows:

- a) in the presentation in tabular form the measurements and the calculated values of the veiling glare index shall be given; the values shall be given in percent with one decimal digit.

NOTE The measurement of the veiling glare index depends on the measurement environment, which is determined in detail by the black surface, the diameter of the limiting stop at the test specimen's exit pupil and the collimating lens.

- b) in the graphical presentation the values of the veiling glare index shall be plotted over the angles of the field of view.

9 Repeatability

The relative error of the measurement repeatability of the veiling glare index shall not exceed 10 %.

10 Test report

A test report shall be presented and shall include the general information specified in clause 13 of ISO 14490-1 and the result of the test as specified in clause 8 above.