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Optics and photonics — Test methods for telescopic systems —

Part 9: Test methods for field curvature

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Foreword

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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*.

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.

Introduction

As mentioned in ISO 14490-7, there are several characteristics which determine image quality, besides the limit of resolution. One unmentioned characteristic there is field curvature which can be noted by the user as a field dependent defocus, which however could be refocused using the test specimen's focusing facility.

The intermediate image surface of a telescopic system (except Galilean systems) usually exhibits a curvature instead of being a plane surface, depending on the optical characteristics of the objective lens system. In addition, the surface can be split into two separate surfaces, the sagittal and tangential image surfaces.

This surface, in turn, is being imaged by the eyepiece onto a virtual image surface (looked at by the user) which also can be split into two separate surfaces. Due to the optical characteristics of the eyepiece, the slope of the curvature of these surfaces might be different from those of the intermediate image surfaces.

Optics and photonics — Test methods for telescopic systems —

Part 9: Test methods for field curvature

1 Scope

This document specifies the test method for the determination of the deviation from a flat image surface, i.e. the sagittal and tangential field curvature of telescopic systems and observational telescopic instruments.

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 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 defined in ISO 14132-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following address:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
field curvature
aberration of a lens resulting in a curved image field from a plane object field

Note 1 to entry: The image field could be spherical or non-spherical.

[SOURCE: ISO 10934-1:2002, 2.4.4, modified – Note 1 to entry has been added.]

4 Requirements

4.1 General

Field curvature of a telescopic system is a field dependent defocus value, usually increasing towards the edge of the field of view, which can degrade image resolution because the eye might not be able to accommodate to the defocus. Field curvature can be split into a sagittal and a tangential image surface which are measured with a radially or tangentially arranged test pattern, respectively.

If there is a field curvature, the user, by refocusing the objective lens system, can see a clear picture only for a part of the field (from centre to edge).

If the system has a great depth of field, the observer can clearly perceive the field as a curved surface.

4.2 Test arrangement

The field curvature of the virtual image surfaces under consideration is measured in dioptres.

A test target according to the test targets described in ISO 14490-7 is suitable (see also Figure 1). Just the vertical and the horizontal test pattern of a group should be used as radial and tangential test patterns.

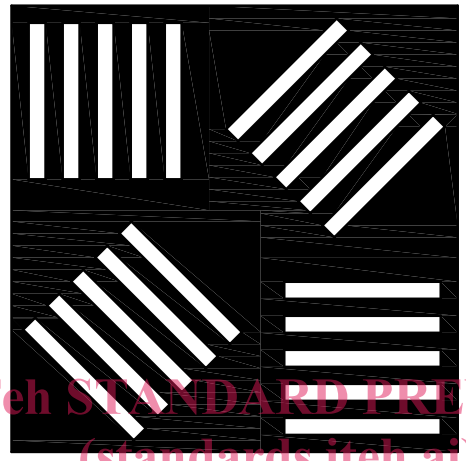


Figure 1 — Example of a group of the test target

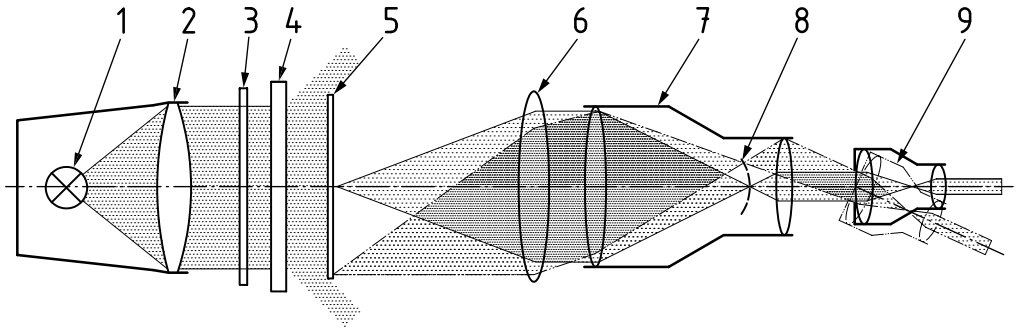
It is not necessary to use the smallest resolvable test pattern at each field point. Rather it is necessary to be able to determine the best defocus value at each field point, which gives the clearest view of the chosen test pattern behind the dioptric tester, so the test pattern should only be about half of the limit of resolution at the current field point.

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

For systems for which the field curvature is to be measured under a focus setting other than infinity, the collimator distance to the test target screen shall be adjusted to form a virtual image of the screen at the specified distance from the test specimen.

The test arrangement should be provided with a preferably green optical filter to avoid any chromatic effects of the image. The maximum transmittance of the green filter shall be at a wavelength of 546 nm ± 20 nm.

It is also possible to use a filter with a different central wavelength, e.g. to determine the field curvature for other colors than green. The filter should also have a spectral bandwidth of ±20 nm. If the system operates in the IR-B or IR-C range according to ISO 20473 the user may specify a different spectral bandwidth.



Key

1 light source
2 condenser
3 filter
4 diffusing plate
5 test target screen with test target groups
6 collimator lens
7 test specimen
8 image surface
9 pivotable dioptric tester with aperture stop

Figure 2 — Test arrangement for the measurement of field curvature

Instead of using a large test target screen along with light source, condenser, filter, and diffusing plate, it is also possible to use a small backlit test target box at various subsequent locations during the measurement.

The collimator shall have a sufficiently large field of view without affecting the measured field curvature by more than 0,1 m^{-1}.

4.3 Preparation and carrying out of measurements

Before starting the measurements, adjust the eyepiece of the test specimen to 0 m^{-1} by focusing the test specimen with the aid of the dioptric tester set to 0 m^{-1} onto a test target located in the centre of the field of view. This adjustment shall not be changed during the whole measurement procedure.

Place appropriate test patterns subsequently at different locations of the test target screen, preferably at at least 5 equidistant field points across the whole field of view in object space, alternatively at field points corresponding to 5 equidistant angles behind the eyepiece across the field of view in image space.

Alternatively, use a test target box placed subsequently at the chosen locations.

Alternatively, place a test target box on the axis of the collimator lens and rotate the test specimen about the entrance pupil to get the test target box placed subsequently at the chosen locations.

At each field point, the maximum possible ray bundle shall enter the test specimen in order to be measured by choosing a sufficiently small distance between collimator and test specimen.

As a simulation of the user's eye pupil, use an aperture stop of 5 mm diameter in front of the dioptric tester. The dioptric tester shall be pivotable around the test specimen's exit pupil to always centre the observed virtual image of the test pattern in the dioptric tester.

From any field point, the ray bundle exiting the test specimen could be divergent, parallel or convergent with different angles in radial and tangential directions with respect to the centre of the test specimen's field of view.

The dioptric tester shall initially be set to 0 m^{-1} and 0° rotation to give a sharp view of the complete test pattern at the centre of the test specimen's field of view.