
**Optics and photonics — Optical
transfer function — Application —**

**Part 3:
Telescopes**

*Optique et instruments d'optique — Fonction de transfert optique —
Application —*

Partie 3: Télescopes



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Published in Switzerland

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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 second edition cancels and replaces the first edition (ISO 9336-3:1994), which has been technically revised.

The main changes compared to the previous edition are as follows:

- update of the document based on the latest technical developments;
- [Annex A](#) regarding tests on components and sub-assemblies using azimuth scanning systems removed, due to lack of practical relevance;
- two new Annexes added regarding test methods using detector arrays and deriving an objective image quality criterion from the MTF.

A list of all parts in the ISO 9336 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

Methods of assessing the imaging quality of telescopic systems can be found in ISO 14490-7. The methods described in this document are basically subjective, relying as they do on the judgement of the observer and the quality of his vision. The technique of measuring the “limit of resolution” is relatively easy and quick to perform and provides a single figure of merit for each orientation of the test pattern. However, being a subjective measurement, it can be open to significant variations in its results. Measuring the optical transfer function (OTF), or more usually just its modulus, the modulation transfer function (MTF), provides a completely objective means of evaluating imaging quality that can be compared directly with the theoretical assessment done by the optical system designer.

Integration of the system MTF over a certain domain of spatial frequencies and normalised to the diffraction limited MTF will provide a single figure of merit that is a reasonable representation of the system performance without relying on any subjective assessment. When the spatial frequency domain is selected in accordance with the properties of the detector system the method can be applied to telescopic systems operating with any detector type, thus not limiting the method to visual observation. This is of importance as in state-of-the-art telescopes the same optical path can be used for visual observation as well as for wavelengths outside the visual range (using appropriate detector systems).

As a special case, an “objective limit of resolution”, providing a single figure of merit, can be derived from a measurement of MTF by using the latter in combination with a “contrast sensitivity” curve for the eye and a measurement of MTF may also be used as the basis for several other image quality criteria (see [Annex B](#)).

Optics and photonics — Optical transfer function — Application —

Part 3: Telescopes

1 Scope

This document specifies a method of testing telescopes in terms of imaging states aimed at making valid optical transfer function (OTF) measurements.

This document includes two annexes ([Annex A](#) and [B](#)) that provide information on the more recent techniques for measuring optical transfer function and methods of deriving image quality criteria from such measurements.

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 9334, *Optics and photonics — Optical transfer function — Definitions and mathematical relationships*

ISO 9335, *Optics and photonics — Optical transfer function — Principles and procedures of measurement*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9334 and ISO 14132-1 apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 General description of test specimen types and the relevance of OTF tests

The specimens considered are telescopic observational instruments with direct view used for viewing remote objects and include many instruments such as telescopes, binoculars, telescopic sights or spotting scopes.

Ideally, instruments would be best with no astigmatism and no field curvature coupled with good chromatic correction but frequently compromises as mentioned above shall be tolerated.

Many optical systems include roof prisms to give a compact instrument. However, the image produced by such systems is basically made up of two superimposed images and the accuracy with which they match will depend on the accuracy with which the roof edge has been constructed. In such cases the orientation of the roof edge shall be noted (see [5.5](#)).