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Optics and photonics — Test methods for telescopic systems —

Part 10:
Test methods for axial colour performance

Optique et photonique — Méthodes d'essai pour systèmes télescopiques —

Partie 10: Méthodes d'essai pour la performance de couleur axiale

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Foreword

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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

ISO 14490-7 mentions several characteristics to determine image quality of telescopic systems besides the limit of resolution evaluation. One unmentioned characteristic in ISO 14490-7 is the "axial colour performance" which may be noted by the user as a coloured halo around objects or even a hue of objects in the centre of the field of view. Typically, the axial colour performance also affects the colour performance in the entire field of view.

The axial colour performance of a telescopic system is mainly determined by two major intrinsic contributions. These are spherical aberration and axial chromatic aberration. According to ISO 10934 axial chromatic aberration is defined as the aberration of a lens, by which light of different wavelengths is focused at different points along the optical axis. The axial chromatic aberration originates from the intrinsic difference of the refractive index of glass as a function of the incident wavelength of light, i.e. the dispersion. For a singlet (positive) lens the axial chromatic aberration yields different focal lengths for different wavelengths, which may also be called chromatic focal shift. Multi-lens groups or assemblies are designed to reduce and compensate this focal shift to go below the intrinsic dispersion of singlet systems. The footprint of the axial chromatic correction of lenses is partially classified by terms like "achromatic" or "apochromatic" lenses.

Axial chromatic aberration originates from the dispersion of the lens material. In contrast, spherical aberration is related to the geometry of a lens and is classified as a monochromatic aberration. Spherical aberration causes rays in the image space to intersect the optical axis before or after the image point formed by the paraxial rays (see also ISO 10934). As a consequence the "best focus" is not well defined even for a monochromatic evaluation of a system. From that it is obvious that the measurement of a pure axial chromatic aberration may be influenced by spherical aberration.

This document thus describes the measurement of the joint effect of these two major contributions since in practical use an observer will not be able to separate these two effects. However, for deeper analysis in the laboratory the two effects may be analysed separately.

In the case of afocal systems, such as telescopes, the axial chromatic aberration as well as the spherical aberration of the objective lens is imaged to infinity by the eyepiece (looked at by the user) and can be measured in dioptres. The measurement of the axial colour performance as described in this document may be combined with a monochromatic evaluation of the modulation transfer function (MTF, see ISO 9336-3) to obtain an overall figure for the imaging performance of a telescopic system.