INTERNATIONAL STANDARD

ISO 14132-1

Second edition
2015-11-15

Optics and photonics — Vocabulary for telescopic systems —

Part 1: General terms and alphabetical indexes of terms in ISO 14132

Optique et photonique — Vocabulaire relatif aux systèmes télescopiques —
Partie 1: Termes généraux et index alphabétiques des termes dans l'ISO 14132

Reference number
ISO 14132-1:2015(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 172, *Optics and photonics*, Subcommittee SC 4, *Telescopic systems*.

This second edition cancels and replaces the first edition (ISO 14132-1:2002), which has been technically revised with the following changes:

a) the term "telescopic system" has been introduced replacing the term "telescope" where appropriate;

b) the useful magnification (4.2.12) is now identified by Γ';

c) telescopic acuity of vision ν' is now given in minutes of arc;

d) two new symbols were added to the term veiling glare index (4.2.27): Φ_B (luminous flux of black object on the white background) and Φ_W (luminous flux caused by the white background);

e) two new terms were added: "zoom ratio" (4.2.30) and "zoom range" (4.2.31);

f) the term "teleobjective" (4.3.5) has been replaced by "telephoto lens".

ISO 14132 consists of the following parts, under the general title *Optics and photonics — Vocabulary for telescopic systems*:

— *Part 1: General terms and alphabetical indexes of terms in ISO 14132*

— *Part 2: Terms for binoculars, monoculars and spotting scopes*

— *Part 3: Terms for telescopic sights*

— *Part 4: Terms for astronomical telescopes*

— *Part 5: Terms for night vision devices*

Optics and photonics — Vocabulary for telescopic systems —

Part 1: General terms and alphabetical indexes of terms in ISO 14132

1 Scope

This part of ISO 14132 gives terms, definitions and letter symbols of common notions that are typical for all types of telescopic systems.

The alphabetical indexes of terms that are common for all published parts of ISO 14132 are published in this part of ISO 14132. See Annex A.

2 Normative references

There are no normative references in this document.

3 Symbols and abbreviated terms

Letters symbols of common values that are typical for telescopic systems are given in Table 1.

Table 1 — Symbols

Symbol	Description	Reference part and clause in ISO 14132
b	distance between centres of eyepieces	ISO 14132-2:2015, 3.1.14
b'	interpupillary distance	ISO 14132-2:2015, 3.1.11
B	distance between centres of objectives	ISO 14132-2:2015, 3.1.14
D	entrance pupil diameter; clear aperture of objective	4.2.9, ISO 14132-4:2015, 3.2
D'	exit pupil diameter	4.2.10
L	efficiency of telescopic system	4.2.15
L_H	daylight efficiency when the telescope is hand-held	4.2.16
L_s	daylight efficiency when the telescope is fixed against a support	4.2.16
L_t	geometric twilight number	4.2.17
l	distance from the objective of the instrument to the object plane	4.2.5
P	plasticity	ISO 14132-2:2015, 3.1.15
P_l	specific plasticity	ISO 14132-2:2015, 3.1.14
R	distance to the object that defines the depth of stereoscopic vision	ISO 14132-2:2015, 3.1.17
R_0	range of stereoscopic vision	ISO 14132-2:2015, 3.1.16
ΔR	threshold depth of stereoscopic vision	ISO 14132-2:2015, 3.1.17
w	angular subtense of the object	4.2.1
w'	angular subtense of the image	4.2.1
$2y$	linear field of view in object space	4.2.5

Table 1 *(continued)*

Symbol	Description	Reference part and clause in ISO 14132
Γ	magnification; power	4.2.1
Γ'	useful magnification	4.2.12
ε	limit of angular resolution	4.2.13, ISO 14132-4:2015, 3.3.2
η_e	threshold of stereoscopic vision of the unaided eye	ISO 14132-2:2015, 3.1.16
λ	wavelength of optical radiation	ISO 14132-4:2015, 3.3.2
ν	acuity of vision of an unaided eye	4.2.15
ν'	telescopic acuity of vision	4.2.14
2ω	angular field of view in object space	4.2.2
$2\omega'$	angular field of view in image space	4.2.3
Φ_B	Luminous flux of black object on the white background	4.2.27
Φ_W	Luminous flux caused by the white background	4.2.27

4 Terms and definitions

4.1 General definitions

4.1.1
telescopic system
afocal system
optical system which, having received a bundle of rays coming from an infinitely distant object incident upon its objective, forms a conjugate emergent bundle of parallel rays

4.1.2
Keplerian telescopic system
Keplerian telescope
telescopic system which includes an objective lens and an eyepiece, both having positive focal lengths

4.1.3
Galilean telescopic system
Galilean telescope
telescopic system which includes an objective lens having positive focal length and an eyepiece having negative focal length

4.1.4
telescopic observational instrument
telescope
optical instrument which includes a telescopic system and is used for watching remote objects

EXAMPLE Binoculars, monoculars, spotting scopes, amateur astronomical telescopes, telescopic sights and night-vision devices.

4.2 Basic characteristics of telescopic systems and observational instruments

4.2.1
magnification
magnifying power
Γ
ratio of the paraxial angular subtense (w') of the image of an infinitely distant object as seen through the telescopic system, to the paraxial angular subtense (w) of the same object viewed by the unaided eye

Note 1 to entry: The magnification is defined in accordance with the following formulae:

$$\Gamma = \frac{\tan w'}{\tan w} \approx \frac{w'}{w} \text{ or } \Gamma = \frac{D}{D'}$$

4.2.2
angular field of view in object space
2ω
angular size of the field of view observable through the telescopic system seen without the telescopic system

4.2.3
angular field of view in image space
$2\omega'$
size of the field of view at the exit of the telescopic system

Note 1 to entry: This dimension is expressed in angular units.

Note 2 to entry: In the absence of distortion, the angular fields of view in the object space and image space are related by the formula

$$\tan \omega' = \tan \omega \cdot \Gamma$$

where Γ is the magnification of the telescopic system.

4.2.4
wide angle telescopic system
telescopic system with an angular field of view in image space greater than 60° for Keplerian telescopes and greater than 50° for Galilean telescopes

4.2.5
linear field of view in object space
$2y$
maximum linear dimension perpendicular to the optical axis in the object plane being imaged by the telescopic system and assessed in accordance with the formula

$$2y = 2\tan \omega \cdot l$$

where l is the distance from the objective of the instrument to the object plane

4.2.6
entrance pupil
paraxial image of the aperture stop in object space or the aperture stop itself, if it is located in object space

4.2.7
exit pupil
paraxial image of the aperture stop in image space or the aperture stop itself, if it is located in image space

4.2.8
eye relief
distance from the vertex of the last optical surface to the exit pupil of the telescopic system measured along the optical axis

4.2.9
entrance pupil diameter
D
in object space, the largest diameter of an incident parallel bundle of rays, the axis of said bundle being parallel to the optical axis, that passes unrestricted through the optical system

Note 1 to entry: For non-circular entrance pupil shape, the diameter of a circle of equivalent area applies.

4.2.10
exit pupil diameter
D'
diameter of the image of the aperture stop formed by the telescopic system in image space

Note 1 to entry: In the case of a Galilean telescope the image is virtual.

Note 2 to entry: The exit pupil diameter is related to the entrance pupil diameter by the formula

$$D' = \frac{D}{\Gamma}$$

Note 3 to entry: For non-circular pupil shape, the diameter of a circle of equivalent area applies.

4.2.11
normal magnification
magnification of a telescopic system subject to the condition that the diameter of its exit pupil is equal to the diameter of the observer's eye entrance pupil

Note 1 to entry: The normal magnification of the instrument occurs when its exit pupil diameter is 2 mm, which corresponds to an angular resolution limit of a matched eye entrance pupil of 60 seconds of arc.

4.2.12
useful magnification
magnification of a telescopic system subject to the condition that the limit of resolution of the instrument and that of the eye coincide

Note 1 to entry: The useful magnification is defined in accordance with the formula

$$0{,}2\ D \leq \Gamma' \leq 0{,}75\ D$$

where *D* is the diameter of the entrance pupil in millimetres.

4.2.13
limit of angular resolution
ε
minimum angular separation between the centres of two points or lines of an infinitely distant object that are still discernible through the optical system

Note 1 to entry: The limit of resolution, ε, in seconds of arc is defined, for an ideal system, by the following formula:

$$\varepsilon = \frac{120}{D}$$

where *D* is the diameter of the entrance pupil in millimetres.

4.2.14
telescopic acuity of vision
v'
acuity of recognition by the eye of an object observed through a telescopic system which is the inverse of the limit of resolution (in minutes of arc) of the eye/telescopic system combination

4.2.15
efficiency of telescopic system
L
ability of a telescopic system to enhance the ability of an observer to separate small details of an object relative to that of an unaided eye; defined by the ratio of the telescopic acuity of vision to that of an unaided eye

Note 1 to entry: The acuity of vision, v, of an unaided eye is understood to be reciprocal of the limit of resolution of the eye expressed in minutes of arc.

4.2.16
daylight efficiency
efficiency of a telescopic system at daylight illumination when the adaptational luminance of the background exceeds 3,2 cd/m^2

Note 1 to entry: It should be distinguished between the daylight efficiency when the telescopic system is hand-held, L_H, and that when it is fixed against a support, L_S, whereby

$$L_H = 0,8(1 - 0,03\Gamma) \cdot \Gamma$$

$$L_S = 1,06\sqrt{1 - \frac{1,65}{D'}} \cdot \Gamma$$

where D' is the diameter of the exit pupil in millimetres. The diameter of the exit pupil D' should be approximately greater than 2.

4.2.17
geometric twilight number
L_t
relative measure for the efficiency of a telescopic system in twilight conditions of observation that is defined in accordance with the formula

$$L_t = \sqrt{D \cdot \Gamma}$$

where D is the diameter of the entrance pupil in millimetres

4.2.18
convergence of rays
amount by which rays of a bundle converge on emergence from the eyepiece of a telescopic system

4.2.19
divergence of rays
amount by which rays of a bundle diverge on emergence from the eyepiece of a telescopic system

4.2.20
dioptre adjustment range
range of focusing of the eyepiece or focusing device of a telescopic system expressed in dioptres (m^{-1})

4.2.21
image defocusing
shift of focus that occurs during magnification change of a variable power telescopic system

4.2.22
axial parallax
lack of coincidence of the image plane of an object formed by the objective of the telescopic system with the plane of the reticle

4.2.23
periscopicity
separation between the optical axes of the objective and the eyepiece

4.2.24
minimum distance of observation
close distance
shortest distance for which an object may be brought into focus by a telescopic system yielding a parallel exit ray bundle measured from the first optical surface of the objective to the object

4.2.25
transmittance
ratio of the luminous flux emergent from the telescopic system to that entering the system

Note 1 to entry: Generally, the value of the transmittance depends upon the angle of incidence and the spectral composition of the incident light.

4.2.26
veiling glare
unwanted light at the exit pupil plane caused, for example, by scatter or unwanted reflections

[SOURCE: ISO 9358:1994, 2.1, modified]

4.2.27
veiling glare index
ratio of two luminous fluxes that leave a telescopic system:

— the flux from the image produced by the telescopic system focused, in conjunction with an auxiliary optical system, onto a black object, Φ_B, situated on a uniformly illuminated white background;

— the flux caused by the white background, Φ_W

[SOURCE: ISO 9358:1994, 2.3, modified]

4.2.28
vignetting
partial obscuration of off-axis ray bundles entering the optical system while travelling through the optical system

4.2.29
image rotation
angular displacement in the plane normal to the optical axis, of the image relative to the object itself, that appears in viewing through a monocular telescopic system that contains prisms or mirrors

4.2.30
zoom ratio
zoom factor
magnification ratio
ratio between highest and lowest magnification of a telescopic system with continuously variable magnification

EXAMPLE Zoom ratio for a 3-12×56 riflescope is 12:3 = 4.

4.2.31
zoom range
magnification range
minimum and maximum magnification of a telescopic system with a continuously or discretely variable magnification

EXAMPLE Zoom range for a continuously variable magnification 3-12×56 riflescope is 3x to 12x.

4.3 Optical parts and components of telescopic systems

4.3.1
objective
part of a telescopic system which forms an image of a remote object

4.3.2
refracting objective
objective that uses only lenses to form an image

4.3.3
reflecting objective
objective that uses only mirrors to form an image

4.3.4
catadioptric objective
objective that uses both lenses and mirrors to form an image

4.3.5
telephoto lens
objective of a telescopic system where the distance from the first optical surface to the back focus is less than the focal length of the objective

Note 1 to entry: The term "telephoto" is not restricted to photography.

4.3.6
erecting system
optical system used to erect the image formed by an objective

Note 1 to entry: An "erecting system" is commonly used when the image is inverted around two axes.

4.3.7
prism erecting system
erecting system which consists of a group of prisms

4.3.8
lens inverting system
erecting system which consists of a group of lenses that erects the image by relaying it from one plane to another

4.3.9
eyepiece
optical system designed for observing the image formed by the objective lens or inverting system

4.3.10
dioptre scale
scale associated with the dioptre adjustment mechanism that serves to evaluate the convergence or divergence of rays emergent from the eyepiece

4.3.11
field lens
lens that is placed in or near an image plane for modifying the path of off-axis ray bundles by inclining them towards the optical axis to reduce the size of subsequent optical components