
**Ophthalmic optics — Visual acuity
testing — Standard and clinical
optotypes and their presentation**

*Optique ophtalmique — Mesure de l'acuité visuelle — Optotype
normalisé et optotypes cliniques et leur présentation*

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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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 7, *Ophthalmic optics and instruments*.

This third edition cancels and replaces the second edition (ISO 8596:2009), which has been technically revised.

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

- a) restructuring of technical content into the [Clauses 4](#) and [6](#) has been applied;
- b) terms and definitions with the terms standard optotype, clinical optotype, visual acuity, and the systems decimal visual acuity, Snellen fraction, LogMAR acuity, and visual acuity grade have been added;
- c) Snellen fraction values in [Table 1](#) have been added;
- d) [Figure 2](#) has been added;
- e) [Annex A](#) has been added.

Ophthalmic optics — Visual acuity testing — Standard and clinical optotypes and their presentation

1 Scope

This document specifies a range of Landolt ring optotypes and describes a method for measuring distance visual acuity under photopic conditions for the purposes of certification or licensing.

This document is neither intended as a standard for clinical measurements nor for the certification of blindness or partial sight.

Other optotypes used for clinical investigations are described in [Annex A](#) for information.

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 3:1973, *Preferred numbers — Series of preferred numbers*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1

standard optotype

Landolt ring

Note 1 to entry: The Landolt ring is specified in [Table 1](#) and [Figure 1](#).

3.2

clinical optotype

optotype other than the *standard optotype* ([3.1](#)) used for measuring *visual acuity* ([3.3](#))

Note 1 to entry: This definition does not exclude the standard optotype from being used for the same purposes as a clinical optotype.

Note 2 to entry: Since clinical optotypes can differ greatly in legibility, it is crucial to refer to the standard optotype whenever the comparability of the results is important. ISO/TR 19498 provides a method for correlation of clinical optotypes to the standard optotype.

3.3

visual acuity

number characterizing the ability of the visual system to recognize optotypes

Note 1 to entry: Currently, three different scaling systems are used to describe the visual acuity of a patient. These are decimal visual acuity, Snellen fraction, LogMAR acuity. See [Table 1](#).

3.3.1

decimal visual acuity

reciprocal of the minimum recognizable gap width of a Landolt ring measured in minutes of arc

EXAMPLE A visual acuity of 1,0 is assigned when the smallest Landolt ring recognized by a patient has a gap width of 1 min of arc measured from the patient's viewing distance.

3.3.2

Snellen fraction

notation for specifying the angular subtense of an optotype, expressed as a fraction with the numerator (test distance) being the distance at which *visual acuity* (3.3) is tested, commonly in m or ft, and the denominator (normal distance) being the distance at which the critical detail (limb) of the smallest recognizable optotype subtends 1 min of arc

$$V_{Sn} = \frac{D_t}{D_n}$$

where

V_{Sn} is the visual acuity, measured as Snellen fraction;

D_t is the test distance, measured in m or ft;

D_n is the normal distance, measured in m or ft.

EXAMPLE A Snellen fraction of 6/6 is assigned to the visual resolving power of a patient, when the smallest recognizable Landolt ring has a gap size of 1 min of arc from a viewing distance of 6,0 m.

Note 1 to entry: The decimal visual acuity can be calculated from the Snellen fraction by evaluating the above quotient (e.g. Snellen fraction 6/6 = decimal visual acuity 1,0).

3.3.3

LogMAR acuity

logarithm (base 10) of the minimum angle of resolution measured in minutes of arc

Note 1 to entry: LogMAR acuity can be converted to *decimal visual acuity* (3.3.1) by:

$$\text{Decimal visual acuity} = 10^{(-\text{LogMAR acuity})}$$

3.4

visual acuity grade

number assigned to an optotype that is equal to the minimum visual acuity of a patient necessary to recognize the optotype from a specified distance

Note 1 to entry: The standardized visual acuity grades used in the three different scaling systems are given in [Table 1](#).

4 Requirements

4.1 Specifications of the standard optotype

The Landolt ring is detailed in [Table 1](#) and shown in [Figure 1](#).

The decimal visual acuity grade 1 shall be represented by a Landolt ring whose outer diameter, d , subtends an angle of 5 min of arc and whose width, as well as the gap in its continuity, subtends an angle of 1 min of arc at the designated viewing distance.

The Landolt ring shall be capable of being presented with eight different gap orientations, including left and right horizontal orientations, upper and lower vertical orientations, and the four principal diagonal orientations.

4.2 Visual acuity grades and standard optotype grades

The visual acuity grades shall be as given in Table 1. The gap size of the standard optotype shall be graduated logarithmically. The quotient of the size of the optotype and that of the next smaller one shall be

$$\sqrt[10]{10} = 1,2589 \text{ (series of preferred numbers R10 from ISO 3:1973)}$$

Optotypes of decimal acuity grades 0,05, 0,06, 0,08 and 2,0 may be omitted if necessary. Use of additional decimal acuity grades, either larger or smaller than those listed in Table 1 is permitted.

Table 1 — Visual acuity grades, Landolt ring sizes and minimum number of presentations

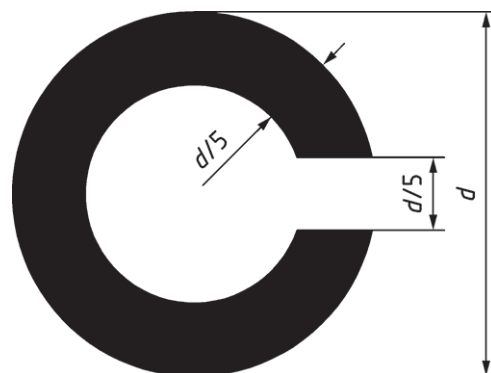
Visual acuity grades (nominal values) ^d			Gap size of Landolt ring (minutes of arc)	Minimum number of presentations ^d
Decimal visual acuity ^a	LogMAR acuity	Snellen fraction for test distance 6 m		
0,05	+1,30	6/120	20,0 ^b	2
0,063 (0,06)	+1,20	6/95	15,8 ^b	2
0,08	+1,10	6/75	12,6 ^b	2
0,10	+1,00	6/60	10,0 ^b	2
0,125	+0,90	6/48	7,94 ^b	3
0,16	+0,80	6/38	6,31 ^b	3
0,20	+0,70	6/30	5,01 ^b	3
0,25	+0,60	6/24	3,98 ^b	5
0,32 (0,30)	+0,50	6/19	3,16 ^b	5
0,40	+0,40	6/15	2,51 ^b	5
0,50	+0,30	6/12	2,00 ^b	5
0,63 (0,60)	+0,20	6/9,5	1,58 ^b	5
0,80	+0,10	6/7,5	1,26 ^b	5
1,00	0	6/6,0	1,00 ^b	5
1,25	−0,10	6/4,8	0,794 ^b	5
1,60	−0,20	6/3,8	0,631 ^b	5
2,00	−0,30	6/3,0	0,501 ^c	5

^a The values in parentheses shall be used only for the purpose of identifying the acuity grade.

^b The gap size is accurate to 1 %. The permissible deviation is 5 %.

^c The permissible deviation is 10 %.

^d The recommended number of presentations is at least 5 presentations.

**Key** d diameter**Figure 1 — Landolt ring****Table 2 — Spacing between standard optotypes (border to border)**

Decimal visual acuity grades	Minimum spacing between standard optotypes
less than 0,06	$0,4 \times$ diameter of Landolt ring
0,06 to 0,125	$1,0 \times$ diameter of Landolt ring
0,16 to 0,32	$1,5 \times$ diameter of Landolt ring
0,40 to 1,00	$2 \times$ diameter of Landolt ring
greater than 1,00	$3 \times$ diameter of Landolt ring

4.3 Test area and spacing between standard optotypes

The field shall extend at least $0,5^\circ$ in all directions from the contour of the optotypes to the border of the test field. If more than one standard optotype is used in the same test area, the spacings given in [Table 2](#) shall apply. If more than one acuity grade is used on the test area, the spacing for the largest optotype shall apply.

[Table 2](#) applies to both horizontal and vertical spacing.

The background to the optotypes shall appear uniformly bright and without any variation of colour or texture which could indicate the orientation of the symbols. If the different orientations are achieved by rotation of the optotypes, this rotary movement shall not be observed by the subject.

4.4 Positions of the optotype

The optotype shall be presented in at least the number of different positions per acuity grade as shown in [Table 1](#). In 50 % of these positions, the gap shall be either vertical or horizontal but, in the case when an odd number of presentations is used, this value shall be rounded to the next larger integer. The sequence of presentations shall be as diversified as possible and shall be randomly ordered. If the standard optotype is presented singly, this fact shall be specifically mentioned in the test report.

4.5 Quality of presentation

The standard optotype as presented shall appear with sharply defined contours to an observer with a binocular visual acuity of at least 1,0 at an observation distance of $1/3$ of the distance at which the optotypes are designed to be used.

The optotypes in a series shall not differ noticeably in contrast and contour.

Test types presented in instruments shall be observed with a magnification of $3\times$ in order to verify the quality of presentation.

4.6 Luminance

The luminance in the immediate surround of the optotypes (chart background, see L_v in Figure 2) shall be within the range of 80 cd/m^2 to 320 cd/m^2 , and shall apply to all methods of presentation.

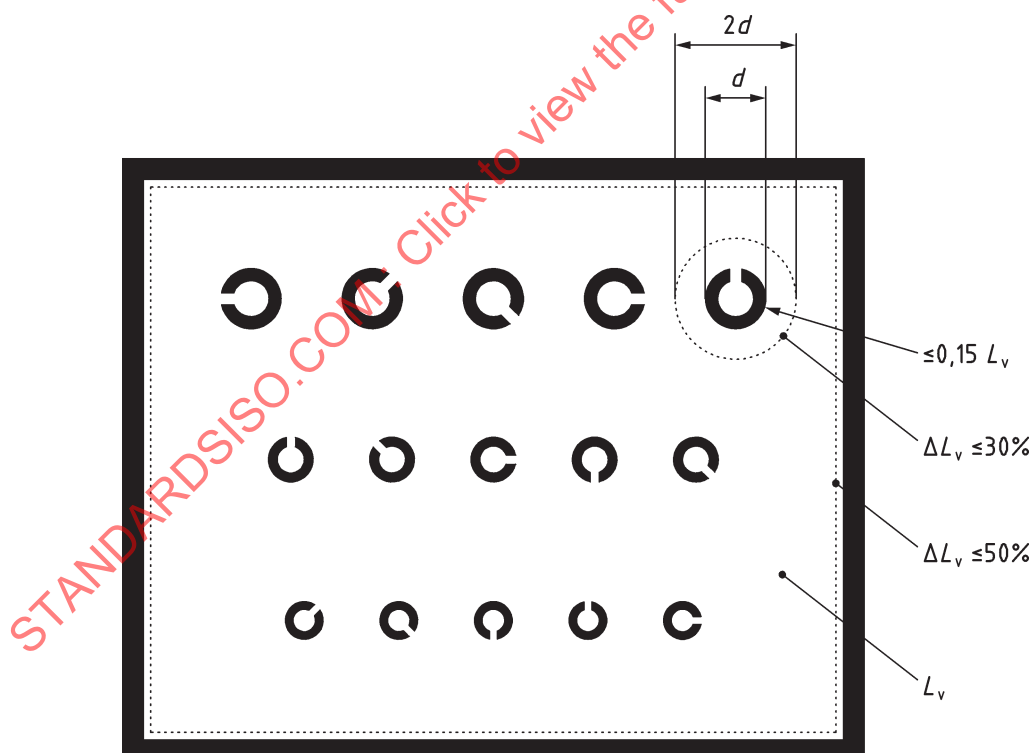
The luminance of the standard optotype shall be not more than 15 % of the surrounding field, when measured in a darkened room. All light sources and reflective surfaces in the visual field of the patient shall be not brighter than the chart from the vantage point of the test subject. In addition, no light source shall illuminate the chart in a way that alters the chart luminance or the optotype contrast from the vantage point of the test subject. There shall be no direct or indirect glare source (e.g. light source, reflected image of a light source, glossy or very bright matt surface) within the field of view.

NOTE 1 The recommended luminance is 200 cd/m^2 .

NOTE 2 The luminance requirements of the optotypes and chart background are shown in Figure 2.

The luminance of the chart background extending for $0,5 d$ (where d = optotype diameter) beyond the optotype edge should not vary by more than $\pm 30 \%$ of the mean luminance of the background. The luminance meter should measure an area of diameter not greater than $0,05 d$.

Across the entire area of the chart background, the luminance should not vary by more than $\pm 50 \%$. See Figure 2.



Key

d diameter of the Landolt ring

L_v luminance of immediate surround of the optotypes

ΔL_v variability of luminance in the denoted area

Figure 2 — Specification of luminance

5 Test methods

5.1 Viewing distance for distance visual acuity testing

The test shall be performed with a minimum viewing distance of 4,0 m between the entrance pupil of the subject and the optotype.

5.2 Criteria for determination and assignment of visual acuity grade

When testing for visual acuity, the performance level at which the presentation of optotypes shall be terminated is dependent upon the number of optotypes used for each size.

Preferred numbers of presentation are five or 10. In each case, the minimum called correctly represents approximately 60 % of the total.

For a “Pass” assessment:

- at least three shall be called correctly if the total number of optotypes used is five, and
- at least six shall be called correctly if the total number of optotypes used is 10.

For clinical use, at least four shall be called correctly if the total number of optotypes used is six or seven, or at least five shall be called correctly if the total number of optotypes used is eight or nine;

The test shall be terminated at the first acuity grade for which the number correctly identified falls below the required number for a “Pass” assessment. The visual acuity grade shall be assigned, as one grade lower (see [Table 1](#)) than that at which the test was terminated.

6 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 8596:2017;
- b) the identification of the acuity grades of the optotypes used in the test (see [Table 1](#));
- c) the instrument used, if any;
- d) the number of different positions for each acuity grade (see [4.4](#));
- e) the viewing distance used (see [5.1](#));
- f) the assigned visual acuity grade (see [5.2](#));
- g) the date and location site of the test;
- h) name and address of examiner.

Annex A (informative)

Optotypes for clinical investigations

A.1 General

There are various frequently used clinical optotypes. This annex provides information on these optotypes and how to apply them in clinical use.

NOTE Measurements with other optotype than the standard optotype can result in different visual acuity values. ISO/TR 19498 gives a guideline on how to compare and, if applicable, how to adapt clinical optotypes to the Landolt ring.

A.2 Types of optotypes for clinical use

Clinical optotype charts can be distinguished by

- a) the method of presentation, e.g. optically projected charts, electronically generated charts or printed optotype charts,
- b) the optotypes used, e.g. letters, numbers, 4-position Landolt ring,
- c) Snellen-E, or symbols for children, and
- d) the spacing of optotypes and lines.

Two examples of the characteristic features are as follows.

Optically projected charts or electronically generated charts normally present only very few clinical optotypes at a time. The spacing of the individual optotypes is large and often does comply to [Table 2](#) of this document. The large letter spacing aims at avoiding a contour interaction effect between adjacent optotypes due to the crowding phenomenon.

Bailey-Lovie-charts and ETDRS-charts present a large number of optotype lines at the same time. Each line contains five letters. The inter-letter spacing is equal to the letter width and the inter-row spacing is equal to the letter height of the lower row, resulting in the characteristic wedge-shaped appearance. Due to the construction principle, the letter spacing does not comply to [Table 2](#). Visual acuity measured with these charts is smaller than for Landolt ring charts constructed according to [Table 2](#) especially for high acuity grades due to the crowding effect and the small letter separation. An advantage of the wedge-shaped construction is the “self-similarity” of the chart. The charts can be used in different distances without changing the effect of the contour interaction.

A.3 Size of optotypes

Each size of a set of optotypes is specified in terms of the size of some critical dimension common to that set of optotypes, e.g. for the Landolt ring, the critical detail is the gap size.

If letters or figures are used for visual acuity measurement, then it should be acknowledged that these normally show large differences in legibility, even if the size and width of stroke are identical. The impact of this variability can be reduced by choosing a subset letters or figures that are better comparable to one another. Comparability can be established for each letter or figure by showing that its effective resolution is equivalent to that of the standard optotype in a direct comparative test.

NOTE See ISO/TR 19498 for description of a method for the correlation of optotypes.

It is acceptable to use the four position Landolt ring (with gap up or down vertically or left or right horizontally) for clinical measurements.

A.4 Logarithmic progression of optotype sizes

If logarithmic progression of optotype sizes is used, the progression is developed in steps of $1:(10)^{0,1}$, equal to 1:1,258 9. Table A.1 lists the resulting optotype sizes together with the corresponding visual acuity notations. In these acuity sequences, numbers have been rounded. Charts are prepared so that the 20/20 row (6/6 or 1,0) is precisely specified. The other sizes are prepared to comply with the exact size progression, but the labelled size may be rounded off as in Table 1.

Table A.1 — Progression of acuity grades, in terms of gap size of the equivalent Landolt ring

Decimal visual acuity	LogMAR acuity	Snellen fraction for test distance				Gap size of Landolt ring (minutes of arc)
		6 m	5 m	4 m	6,1 m (20 ft)	
0,050	+1,3	6/120	5/100	4/80	20/400	20,0 ^a
0,063 (0,06)	+1,2	6/95	5/80	4/63	20/320	15,8 ^a
0,08	+1,1	6/75	5/63	4/50	20/250	12,6 ^a
0,10	+1,0	6/60	5/50	4/40	20/200	10,0 ^a
0,125	+0,9	6/48	5/40	4/32	20/160	7,94 ^a
0,16	+0,8	6/38	5/32	4/25	20/125	6,31 ^a
0,20	+0,7	6/30	5/25	4/20	20/100	5,01 ^a
0,25	+0,6	6/24	5/20	4/16	20/80	3,98 ^a
0,32 (0,30)	+0,5	6/19	5/16	4/12,5	20/63	3,16 ^a
0,40	+0,4	6/15	5/12,5	4/10	20/50	2,51 ^a
0,50	+0,3	6/12	5/10	4/8,0	20/40	2,00 ^a
0,63 (0,60)	+0,2	6/9,5	5/8,0	4/6,3	20/32	1,58 ^a
0,80	+0,1	6/7,5	5/6,3	4/5,0	20/25	1,26 ^a
1,00	+0,0	6/6,0	5/5,0	4/4,0	20/20	1,00 ^a
1,25	-0,1	6/4,8	5/4,0	4/3,2	20/16	0,794 ^a
1,60	-0,2	6/3,8	5/3,2	4/2,5	20/12,5	0,631 ^a
2,00	-0,3	6/3,0	5/2,5	4/2,0	20/10,0	0,501 ^b

^a The permissible deviation is 5 %.

^b The permissible deviation is 10 %.

A.5 Criteria for determination and assessment of visual acuity using ETDRS or Bailey Lovie Charts

The following alternative method for determining visual acuity grade can be used with charts for which optotypes within the display are equally legible and for which there are five optotypes per line.

- The presentation of optotypes shall be terminated only when none of the optotypes on a line are called correctly.
- Each optotype shall be assigned a LogMAR value of 0,02.
- The sum of the values of all correctly called optotypes shall be calculated and subtracted from the LogMAR value of the top line of the chart. The resulting LogMAR value indicates the assigned visual acuity for the test.