
**Cycles — Lighting and retro-
reflective devices —**

**Part 2:
Retro-reflective devices**

*Cycles — Dispositifs d'éclairage et dispositifs rétroréfléchissants —
Partie 2: Dispositifs rétroréfléchissants*



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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 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 149, *Cycles*, SC 1, *Cycles and major sub-assemblies*.

This third edition cancels and replaces the second edition (ISO 6742-2:1985), which has been technically revised.

ISO 6742 consists of the following parts, under the general title *Cycles — Lighting and retro-reflective devices*:

- *Part 1: Lighting and light signalling devices*
- *Part 2: Retro-reflective devices*
- *Part 3: Installation and use of lighting and retro-reflective devices*
- *Part 4: Lighting systems powered by the cycle's movement*
- *Part 5: Lighting systems not powered by the cycle's movement*

Cycles — Lighting and retro-reflective devices —

Part 2: Retro-reflective devices

1 Scope

This part of ISO 6742 is applicable to retro-reflective devices used on cycles intended to be used on public roads and, especially, bicycles complying with ISO 4210 and ISO 8098.

This part of ISO 6742 specifies photometric and physical requirements of retro-reflective devices.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

CIE 15, *Colorimetry: official recommendations of the International Commission on Illumination*

CIE 1931, *XYZ colour space of the International Commission on Illumination*

3 Terms and definitions

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

3.1

retro-reflective device; reflector

assembly ready for use and comprising one or more retro-reflecting optical units

3.2

wide angle reflector

device providing retro-reflection through horizontal entrance angles of not less than 50° on either side of the reference axis

3.3

conventional reflector

device providing retro-reflection through entrance angles of not less than 20° on either side of the reference axis

3.4

high values reflector

red retro-reflective device with high values of reflection e.g. dedicated to be mounted on luggage carrier

3.5

retro-reflective spoke

spoke with retro-reflective surface

3.6

retro-reflective spoke case

device, e.g. cylinder, with retro-reflective surface with or without a gap, providing a secured mounting on a spoke

3.7

retro-reflective tyre

tyre ready for use and comprising retro-reflecting annuli moulded on to each sidewall of the tyre

4 General

4.1 Symbols and units used

Symbols are shown in [Figure 1](#). Their meaning and units used are given in [Table 1](#).

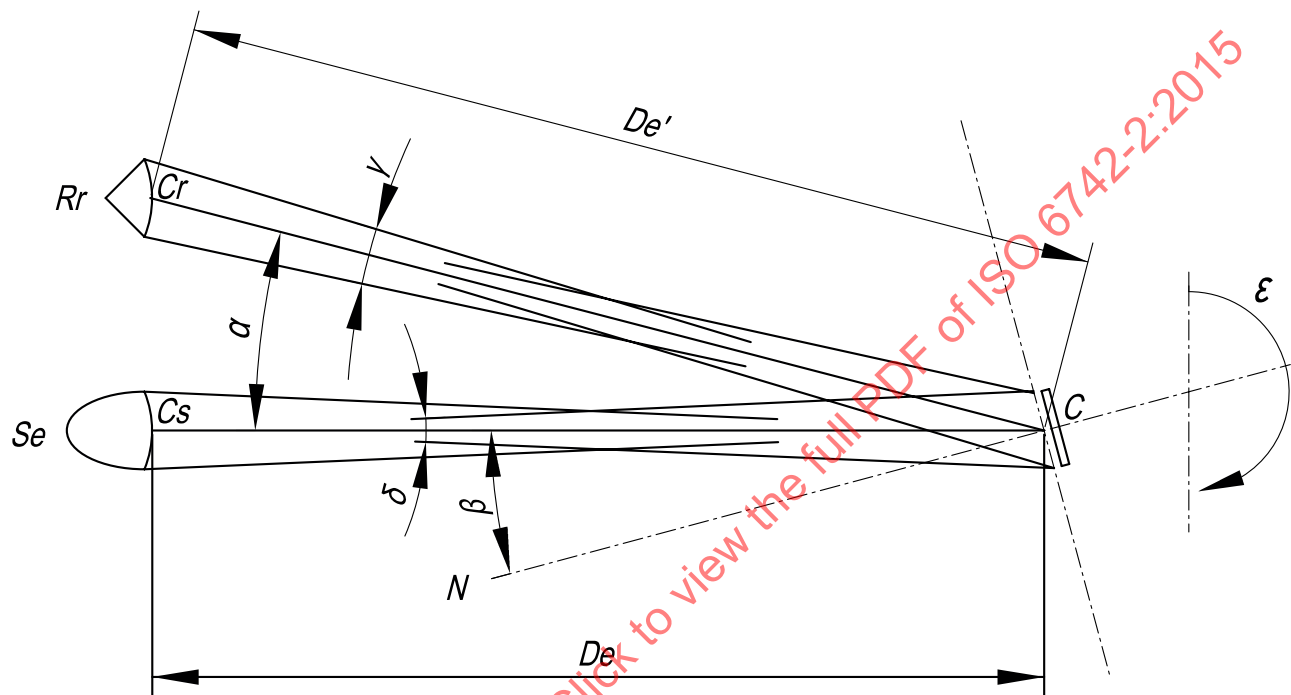


Figure 1 — Symbols

NOTE The following symbols are in accordance with Regulation No.3 of the UN/ECE concerning retro-reflective devices.

Table 1 — Meaning and units of symbols used

Symbol	Meaning	Unit
A	Area of the effective reflex surface of the retro-reflective device	cm^2
C	Reference centre	—
NC	Reference axis	—
R_r	Receiver, observer or measuring device	—
C_R	Centre of receiver	—
$\emptyset_R$	Diameter of receiver R_r , if circular	cm
S_e	Source of illumination	—
C_S	Centre of source of illumination	—
$\emptyset_S$	Diameter of source of illumination	cm
D_e^a	Distance from centre C_S to centre C	m
D'_e^a	Distance from centre C_R to centre C	m
D	Mean diameter of retro-reflective annulus on retro-reflective tyres	mm
α	Observation angle	<i>Degree and minutes</i>
β	Entrance angle. With respect to line $C_S C$ which always considered to be horizontal, this angle is prefixed with signs – (left), + (right), + (up) or – (down), according to the position of the source S_e in relation to the axis NC , as seen when looking towards the retro-reflective device. For any direction defined by two angles, vertical and horizontal, the vertical angle is always given first.	<i>Degree and minutes</i>
γ	Angular subtense of measuring device R_r as seen from point C	<i>Degree and minutes</i>
δ	Angular subtense of the source S_e as seen from point C	<i>Degree and minutes</i>
ϵ	Rotation angle. This angle is positive when the rotation is clockwise as seen when looking towards the illuminated surface. If reflecting device is marked “TOP”, the position thus indicated is taken as origin.	<i>Degree and minutes</i>
E	Illuminance of retro-reflective device	lux
CIL	Coefficient of luminous intensity	<i>millicandelas per lux</i>

^a D_e and D'_e are generally very nearly the same and under normal conditions of observation it may be assumed that $D_e = D'_e$. Furthermore, the effective distances may be used when a collimated system is used in order to obtain an artificially increased measuring distance.

4.2 Chronological order of tests (only for reflectors)

The applicant shall submit for approval samples which shall be tested in the chronological order indicated in [Table 2](#).

Table 2 — Chronological order of tests

Number of paragraph	Tests for retro-reflective devices	Samples					
		a	b	c	d	e	f
7.1.2.2	Temperature resistance test	X	X	X	X	X	X
Clause 6	Colorimetry: visual inspection Trichromatic coordinates in case of doubt	X	X	X	X	X	X
Clause 5	Photometry only at $V = H = 0^\circ$	X	X	X	X	X	X
Clause 5	Photometry at all test points	X	X				
7.1.2.4	Moisture resistance test			X	X		
7.1.2.5	Resistance to fuels			X	X		
7.1.2.6	Resistance to lubricating oils			X	X		
Clause 6	Colorimetry: visual inspection Trichromatic coordinates in case of doubt			X	X		
Clause 5	Photometry only at $V = H = 0^\circ$			X	X		
7.1.2.3	Impact test (only for wide angle reflector and conventional reflector of Group B)					X	X
Clause 6	Colorimetry: visual inspection Trichromatic coordinates in case of doubt					X	X
Clause 5	Photometry only at $V = H = 0^\circ$					X	X

5 Photometrical requirements

In order to follow different requirements in different countries, the photometrical requirements are divided into 2 groups: Group A and Group B.

Table 3 — Tables link with groups

Group A	Group B
Table 4	Table 5
Table 6	Table 7
Table 8	Table 9
Table 10	—
Table 11	Table 12
Table 13	—
Table 14	—

NOTE Groups A or B have to be chosen according to national regulations.

5.1 Reflectors

When tested by the method given in [Clause 8](#), the CIL values for reflectors shall not be less than those specified in [Tables 4, 5, 6, 7, 8, 9](#) or [10](#).

[Tables 4](#) to [7](#) applies to front, side and rear reflectors.

[Tables 8](#) and [9](#) applies to pedal reflectors.

[Table 10](#) applies to high values reflectors. High values reflectors are only applicable in Group A.

Table 4 — Coefficients of luminous intensity, CIL, for conventional reflectors

Colour	Observation angle α	Entrance angle β (in degree)			
		vertical V horizontal H	0 ° 0 °	±10 ° 0 °	±5 ° ±20 °
White	0 °20'		1 200	800	400
	1 °30'		20	11,2	10
Yellow	0 °20'		750	500	250
	1 °30'		12,5	7	6,25
Red	0 °20'		300	200	100
	1 °30'		5	2,8	2,5

Table 5 — Coefficients of luminous intensity, CIL, for conventional reflectors

Colour	Observation angle α	Entrance angle β (in degree)			
		vertical V horizontal H	0 ° 0 °	±10 ° 0 °	0 ° ±20 °
White	0 °12'		2 500	1 650	850
	1 °30'		26	18	11
Yellow	0 °12'		1 560	1 030	530
	1 °30'		21	15	10
Red	0 °12'		625	410	210
	1 °30'		9	6	4

Table 6 — Coefficients of luminous intensity, CIL, for wide angle reflectors

Colour	Observation angle α	Entrance angle β (in degree)						
		vertical V horizontal H	0 ° 0 °	±10 ° 0 °	0 ° ±20 °	0 ° ±30 °	0 ° ±40 °	0 ° ±50 °
White	0 °20'		1 800	1 200	610	540	470	400
	1 °30'		34	24	15	15	15	15
Yellow	0 °20'		1 125	750	380	335	290	250
	1 °30'		21	15	10	10	10	10
Red	0 °20'		450	300	150	135	115	100
	1 °30'		9	6	4	4	4	4

Table 7 — Coefficients of luminous intensity, CIL, for wide angle reflectors

Colour	Observation angle α	Entrance angle β (in degree)						
		vertical V horizontal H	0 ° 0 °	±10 ° 0 °	0 ° ±20 °	0 ° ±30 °	0 ° ±40 °	0 ° ±50 °
White	0 °12'		2 500	1 650	850	750	650	550
	1 °30'		26	18	11	11	11	11
Yellow	0 °12'		1 560	1 030	530	465	405	340
	1 °30'		21	15	10	10	10	10
Red	0 °12'		625	410	210	185	160	135
	1 °30'		9	6	4	4	4	4

Table 8 — Coefficients of luminous intensity, CIL, for pedal reflectors

Colour	Observation angle α	Entrance angle β (in degree)		
		vertical V horizontal H	0 ° 0 °	±10 ° 0 ° ±5 ° ±20 °
Yellow	0 °20'		300	200
	1 °30'		12	9

Table 9 — Coefficients of luminous intensity, CIL, for pedal reflectors

Colour	Observation angle α	Entrance angle β (in degree)		
		vertical V horizontal H	0 ° 0 °	±10 ° 0 ° 0 ° ±20 °
Yellow	0 °12'		450	350
	1 °30'		16,5	11,5

Table 10 — Coefficients of luminous intensity, CIL, for high values reflectors

Colour	Observation angle α	Entrance angle β (in degree)		
		vertical V horizontal H	0 ° 0 °	±10 ° 0 ° ±5 ° ±20 °
Red	0 °20'		1 000	700
	1 °30'		30	20

5.2 Retro-reflective tyres

When tested by the method given in [Clause 8](#), the CIL values for a retro-reflective tyre shall not be less than those specified in [Table 11](#) and [Table 12](#). In case where D is less than 420 mm the minimum photometric value for each observation and entrance angle shall be equal to the value for $D = 420$ mm

Table 11 — Coefficients of luminous intensity, CIL, for retro-reflective tyres

Colour	Observation angle α	Entrance angle β (in degree)				
		horizontal H	5 °	20 °	40 °	50 °
Either White or White/Yellow	0 °20'		1,60 <i>D</i>	1,40 <i>D</i>	0,47 <i>D</i>	0,15 <i>D</i>
	1 °30'		0,11 <i>D</i>	0,10 <i>D</i>	0,065 <i>D</i>	0,020 <i>D</i>

Table 12 — Coefficients of luminous intensity, CIL, for retro-reflective tyres

Colour	Observation angle α	Entrance angle β (in degree)				
		horizontal H	-4 °	20 °	40 °	50 °
Either White or White/Yellow	0 °12'		1,21 <i>D</i>	1,06 <i>D</i>	0,70 <i>D</i>	0,21 <i>D</i>
	1 °30'		0,121 <i>D</i>	0,106 <i>D</i>	0,070 <i>D</i>	0,021 <i>D</i>

5.3 Retro-reflective spokes or spoke cases

Retro-reflective spokes or spoke cases are only applicable in Group A.

When tested by the method given in [Clause 8](#), the CIL values for retro-reflective spokes shall not be less than those specified in [Table 13](#).

Table 13 — Coefficients of luminous intensity, CIL, for retro-reflective spokes

Colour	Observation angle α	Entrance angle β (in degree)						
		vertical V	0 °	0 °	0 °	0 °	0 °	0 °
		horizontal H	±5 °	±10 °	±20 °	±30 °	±40 °	±50 °
White	0 °20'		1 500	1 400	1 300	1 200	1 000	800
	1 °30'		90	80	70	70	60	60

When tested by the method given in [Clause 8](#), the CIL values for retro-reflective spoke cases shall not be less than those specified in [Table 14](#).

Table 14 — Coefficients of luminous intensity, CIL, for retro-reflective spoke cases

Colour	Observation angle α	Entrance angle β (in degree)						
		vertical V	0 °	0 °	0 °	0 °	0 °	0 °
		horizontal H	±5 °	±10 °	±20 °	±30 °	±40 °	±50 °
White	0 °20'		600	450	400	250	220	90
	1 °30'		70	60	50	50	40	12

The colour of the retro-reflecting light is to be determined according to [Clause 9](#) and has to be within the colour range white of this part of ISO 6742.

Retro-reflective spokes or spoke cases which have been coloured with a coat of paint are inadmissible.

6 Colorimetric requirements

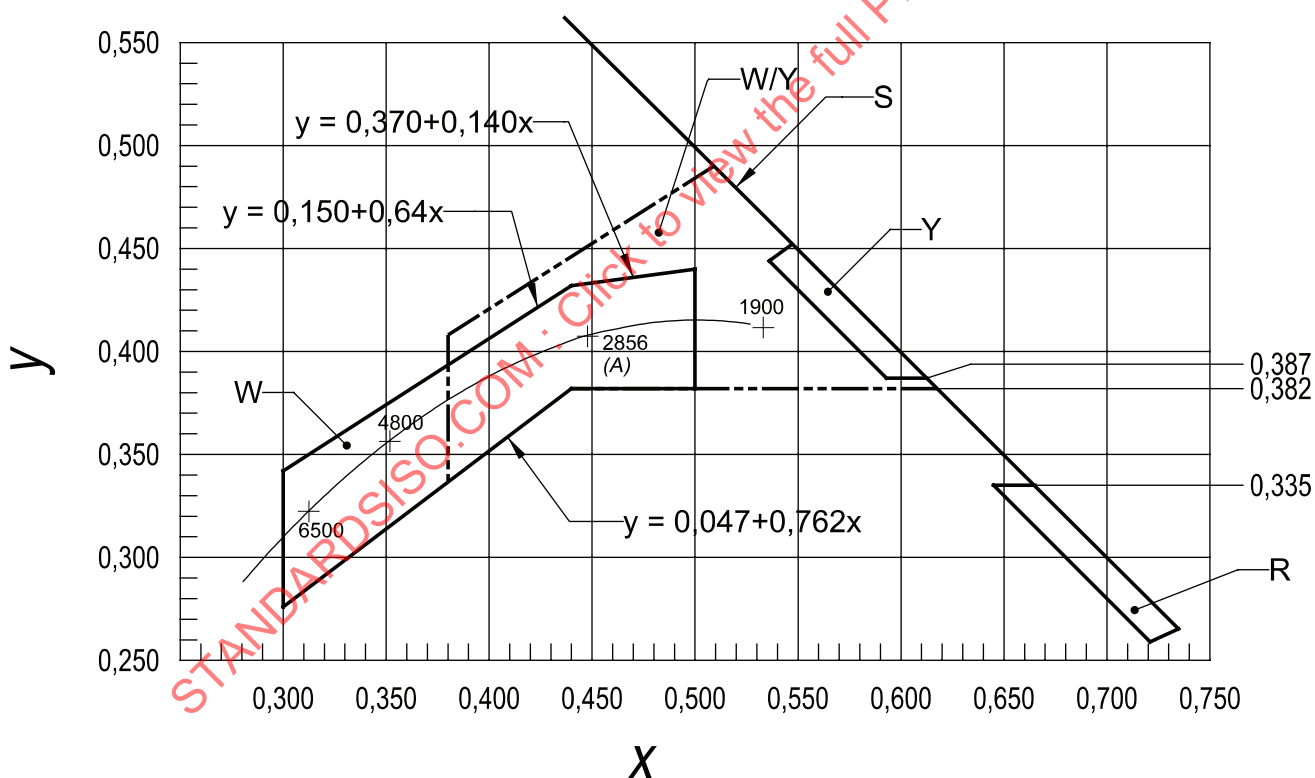
When determined by the method given in [Clause 9](#), the colour of the reflected light shall be located within the appropriate area defined by CIE chromaticity coordinates specified in [Table 15](#).

NOTE For ease of reference these areas are shown graphically in [Figure 2](#).

Table 15 — x-y chromaticity coordinates of the intersection points of colour boundary lines

Colour		Coordinates					
Red	x	0,665	0,645	0,721	0,735		
	y	0,335	0,335	0,259	0,265		
Yellow	x	0,547	0,536	0,613	0,593		
	y	0,452	0,444	0,387	0,387		
White	x	0,300	0,440	0,500	0,500	0,440	0,300
	y	0,342	0,432	0,440	0,382	0,382	0,276
White/Yel- low ^a	x	0,380	0,509	0,618	0,440	0,380	
	y	0,408	0,490	0,382	0,382	0,337	

^a For retro-reflective tyres only



Key

- W white light region
- Y yellow light region
- R red light region
- W/Y white/yellow light region
- S spectrum locus

Figure 2 — Boundaries of colour areas for reflective devices

7 Physical requirements

7.1 Reflectors

7.1.1 Construction

The reflector and/or mount shall incorporate a distinct preferred assembly method to ensure that the reflector can be mounted in its designed orientation with regard to the bicycle.

7.1.2 Test methods

7.1.2.1 General

A reflector shall comply with the photometric and colorimetric requirements of [5.1](#) and [Clause 6](#), and there shall be no loosening of the mounting(s) or distortion of the housing that would affect the performance of the reflector, after being subjected to any or all tests specified in [7.1.2.2](#) to [7.1.2.6](#).

7.1.2.2 Temperature resistance test

When tested by the following method, a reflector shall exhibit no softening, cracks, distortion or luster change of the lens or other visible defects that affect the reflecting function:

a) For Group A

Place the reflector in a pre-heated oven for a period of 48 h at a temperature of $(65 \pm 2) ^\circ\text{C}$;

b) For Group B

Place the reflector in a pre-heated oven for a period of 1 h at a temperature of $(50^{+5}_0) ^\circ\text{C}$.

NOTE A pedal reflector may be tested integrally with its pedal.

7.1.2.3 Impact test (except for conventional reflector of Group A)

When a reflector is tested at room temperature by the following method the lens shall not crack.

Mount the reflector in a manner similar to the way in which it is mounted on the bicycle, but with the lens face horizontal and directed upwards.

Drop a 13 mm diameter polished solid steel ball, once, vertically onto the central part of the lens from a height of 0,76 m. The ball may be guided but not restricted in free fall.

7.1.2.4 Moisture resistance test

Strip all removable parts from the reflective device, whether part of a lamp or not, and immerse for 10 min in water at a temperature of $(50 \pm 5) ^\circ\text{C}$, the highest point of the upper part of the reflective surface being 20 mm below the surface of the water. Repeat this test after turning the reflective device through 180° so that the reflective surface is at the bottom and rear face is covered by about 20 mm of water. Then immediately immerse the optical unit in the same procedure in water with a temperature of $(25 \pm 5) ^\circ\text{C}$.

7.1.2.5 Resistance to fuels

Soak the outer surface of the reflector on a mixture of 70 % of n-heptane and 30 % of toluene (by volume). After 5 min, clean the surface by wiping with a cloth.

7.1.2.6 Resistance to lubricating oils

Wipe the outer surface of the reflex reflector lightly with cotton soaked in detergent lubricating oil. After 5 min, clean the surface by wiping with a cloth.

7.2 Retro-reflective tyres

7.2.1 Form and location

The retro-reflective strip shall be in form of a continuous circle of retro-reflective material on each sidewall of the tyre.

7.2.2 Test methods

7.2.2.1 General

When subject to the test in [7.2.2.2](#) to [7.2.2.8](#) inclusive, the retro-reflective material on the tyre shall comply with the photometric requirements of [5.2](#):

- for $\alpha = 0^\circ 20'$ and $\beta = 5^\circ$ for group A, or
- for $\alpha = 0^\circ 12'$ and $\beta = -4^\circ$ for group B,

and with the colorimetric requirements of [Clause 6](#) as specified in [Table 15](#).

The table also indicates where a portion of a tyre shall be used instead of a complete tyre. The portion shall be cut from a tyre not previously subjected to physical stress of this part of ISO 6742. The requirements of [5.2](#) and [Clause 6](#) do not apply to a portion cut from a tyre.

Table 16 — Applicability of specimens to the photometric and colorimetric requirements

Test in clause	Tyre or portion to be used	Photometric requirements apply	Colourimetric requirements apply
7.2.2.2	Tyre	Yes as in Table 11 and Table 12	Yes
7.2.2.3	Portion	No	No
7.2.2.4	Tyre	Yes as in Table 11 and Table 12	Yes
7.2.2.5	Tyre	Yes as in Table 11 and Table 12	Yes
7.2.2.6	Portion	No	No
7.2.2.7	Portion	No	No
7.2.2.8	Tyre	Yes, see 7.2.2.8	Yes

7.2.2.2 Temperature resistance

When tested by the following method, there shall be no cracking, peeling or blistering of the retro-reflective material that would affect the performance for the intended use.

Subject a test sample to the following conditions in sequence:

- a) 12 h consecutively at a temperature of $(65 \pm 5)^\circ\text{C}$ with a relative humidity of $(10 \pm 5)\%$;
- b) at least 1 h at a temperature of $(23 \pm 5)^\circ\text{C}$ with a relative humidity of $(50 \pm 5)\%$;
- c) 15 h consecutively at a temperature of $(-20 \pm 5)^\circ\text{C}$.

7.2.2.3 Impact resistance

When tested with the following method the retro-reflective material shall show no cracking or separation from the tyre outside a distance of half the width of the material from the point of impact.

Condition the test sample for 1 h at a temperature of $(-20 \pm 5) ^\circ\text{C}$. Immediately after removal from the cold storage, place the sample on a solid support base and subject the retro-reflective area to an impact from a 25 mm diameter solid steel ball dropped from a height of 2 m.

7.2.2.4 Resistance to fuels

Lightly rub the retro-reflective area of the test sample with a cotton cloth soaked in a test fuel composed of 70 % of *n*-heptane and 30 % of toluene (by volume).

After 5 min clean the retro-reflective area by washing a detergent solution and rinsing in clean water.

7.2.2.5 Resistance to lubricating oils

Lightly rub the retro-reflective area of the test sample with a cotton cloth soaked in detergent lubricating oil.

After 5 min wipe the area clean with a mild aliphatic solvent such as heptane and follow by washing with a neutral detergent and rinsing in clean water.

7.2.2.6 Adhesion

The retro-reflective material shall adhere to the tyre in such a way that, when conditioned and tested as described, a greater force than that specified shall be required to remove it from the substrate, or the material shall break when an attempt is made to remove it.

Condition the test sample for 30 min at a temperature of $(50 \pm 5) ^\circ\text{C}$ and then for 30 min at a temperature of $(23 \pm 5) ^\circ\text{C}$.

With a sharp knife, separate a strip of the retro-reflective material from the tyre.

Apply a tensile force of 1 N per millimetre of width of the strip in a direction normal to the strip to attempt to separate it from the substrate.

7.2.2.7 Abrasion resistance

The retro-reflective material shall be as resistant to abrasion as is the adjacent tyre material so that retro-reflective material is removed from the inflated tyre by abrasion with wet, steel-bristle brush, tyre material will be removed with the retro-reflective material.

7.2.2.8 Water test

Immerse the test sample for 1 min in water with a temperature of $(23 \pm 5) ^\circ\text{C}$. Measure the CIL value 30 s after removal:

- for $\alpha = 0 ^\circ 20'$ and $\beta = 5 ^\circ$ for group A, or
- for $\alpha = 0 ^\circ 12'$ and $\beta = -4 ^\circ$ for group B.

The CIL value shall not be less than 50 % of the minimum value in [5.2](#).

7.3 Retro-reflective spokes or spoke cases

7.3.1 Construction

The retro-reflective spokes or spoke cases and/or mount shall incorporate a distinct preferred assembly method to ensure that the retro-reflective spokes or spoke cases can be mounted in its designed orientation with regard to the bicycle.

7.3.2 Test methods

7.3.2.1 General

A retro-reflective spokes or spoke cases shall comply with the photometric and colorimetric requirements of 5.3 and Clause 6, and there shall be no loosening of the mounting(s) or distortion that would affect the performance of the retro-reflective spokes or spoke cases, after being subjected to any or all tests specified in 7.3.2.2 to 7.3.2.5.

When subject to the test in 7.3.2.2 to 7.3.2.5 inclusive, retro-reflective spokes or spoke cases shall comply with the photometric requirements of 5.3 for $\alpha = 0^\circ 20'$ and $\beta = \pm 5^\circ$ and with the colorimetric requirements of Clause 6 as specified in Table 15.

7.3.2.2 Temperature resistance

When tested by the following method, there shall be no cracking, peeling or blistering of the retro-reflective material that would affect the performance for the intended use:

Subject a test sample to the following conditions in sequence:

- a) 12 h consecutively at a temperature of $(65 \pm 5)^\circ\text{C}$ with a relative humidity of $(10 \pm 5)\%$;
- b) at least 1 h at a temperature of $(23 \pm 5)^\circ\text{C}$ with a relative humidity of $(50 \pm 5)\%$;
- c) 15 h consecutively at a temperature of $(-20 \pm 5)^\circ\text{C}$.

7.3.2.3 Resistance to fuels

Lightly rub the retro-reflective area of the test sample with a cotton cloth soaked in a test fuel composed of 70 % of *n*-heptane and 30 % of toluene (by volume).

After 5 min clean the retro-reflective area by washing a detergent solution and rinsing in clean water.

7.3.2.4 Resistance to lubricating oils

Lightly rub the retro-reflective area of the test sample with a cotton cloth soaked in detergent lubricating oil.

After 5 min wipe the area clean with a mild aliphatic solvent such as heptane and follow by washing with a neutral detergent and rinsing in clean water.

7.3.2.5 Resistance to corrosion

After being tested by the method specified in ISO 9227 the retro-reflective spokes or spoke cases shall not exhibit any visible signs of corrosion liable to affect the integrity of the mounting or housing.

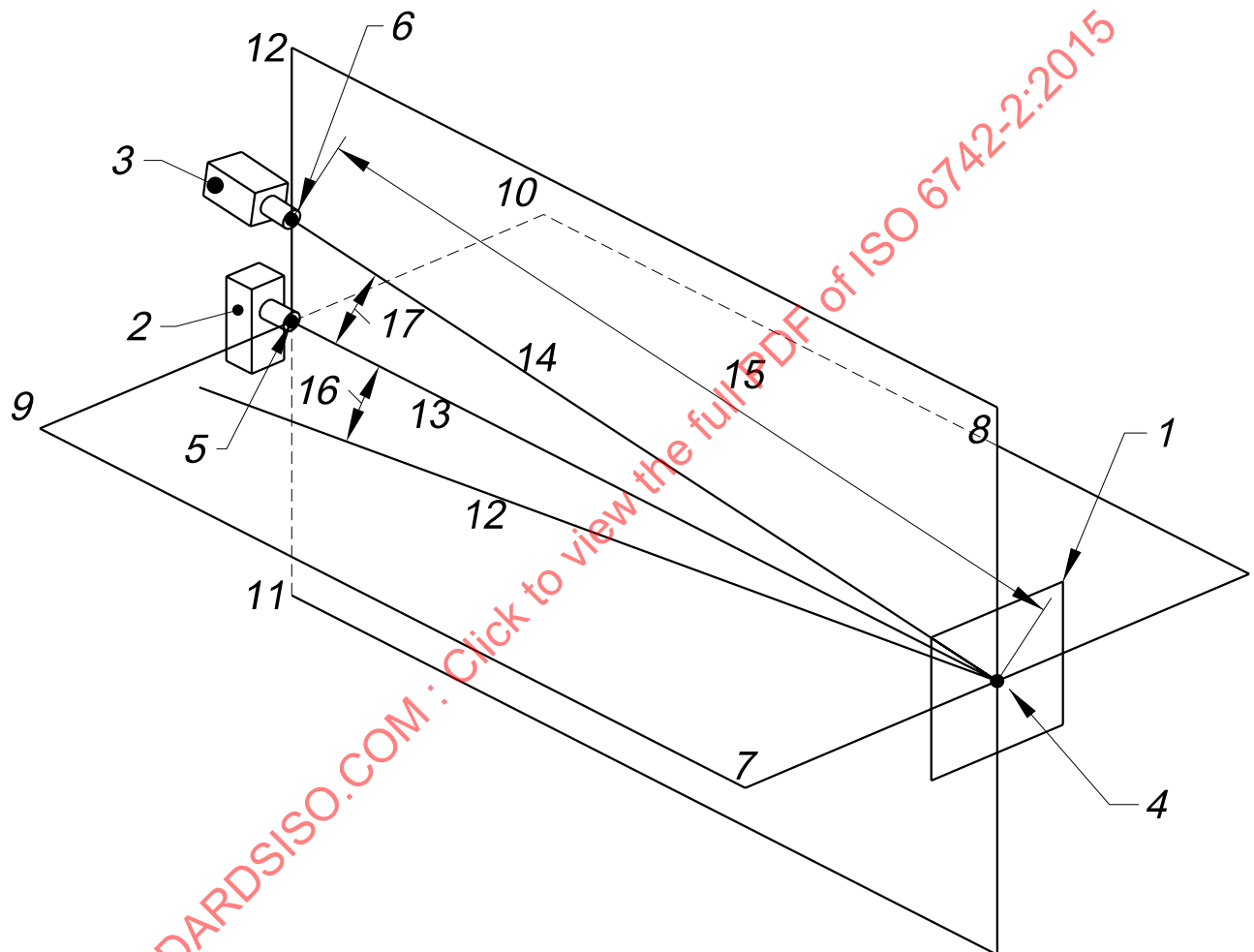
The duration of the test shall be 50 h comprising two periods of exposure of 24 h each, separated by an interval of 2 h during which the sample is allowed to dry.

8 Photometric test

8.1 General

8.1.1 Instrumentation arrangement

For reflectors, for measuring reflective devices the general arrangement of the instrumentation shall be as shown in [Figure 3](#), with the receiver positioned vertically above the light source. However, for measuring the photometric performance of the reflective devices with microspheres the receiver can alternatively be positioned alongside the source in the same horizontal plane.



Key

1	retro-reflective device	10	left
2	source	11	positive or up
3	receiver	12	negative or down
4	retro-reflector centre	13	incident line
5	source aperture	14	observation line
6	receiver aperture	15	observation distance
7	entrance plane	16	entrance angle
8	observation plane	17	observation angle
9	right		

Figure 3 — Retro-reflector test instrumentation arrangement

For retro-reflective tyres and retro-reflective spokes or spoke cases, the receiver may be positioned alongside the source in the same horizontal plane.

8.1.2 Source of illumination

The source of illumination shall approximate to Illuminant A as defined by CIE publication No.15, and shall be stable.

For reflectors, the shape and size of the aperture shall be selected in relation to the receiver aperture, the observation distance and the range of the device to be tested. The angular aperture of the source seen from the reference centre of the reflector shall be 10' maximum.

For retro-reflective tyres and retro-reflective spokes or spoke cases, the effective lens diameter shall not exceed $D_e / 500$, where D_e is the distance from the source to the reflector.

8.1.3 Receiver

The receiver shall have the relative spectral response of CIE 1931.

For reflectors, the angular aperture of the receiver seen from the reference centre of the reflector shall be 10' maximum.

For retro-reflective tyres and retro-reflective spokes or spoke cases, the dimensions of the active area of the receiver shall be such that no point on the perimeter of the receiver is more than $D_e / 1\,000$ from its centre, where D_e is the distance from the source to the reflector.

8.1.4 Observation distance

For reflectors, the observation distance shall be 10 m minimum, or the optical equivalent.

For retro-reflective tyres and retro-reflective spokes or spoke cases, the distance between the source and the centre of the wheel, and between the receiver and the centre of the wheel, shall each be not less than 10 m.

8.1.5 Illuminance at the reflector

For reflectors, illuminance at the reflector shall be uniform within 5 % of the mean of the complete area of the reflector.

For retro-reflective tyres, measure the illuminance incident on the retro-reflective strip at uniform intervals of no more than 45° around the wheel with the receiver in the direction of incident radiation. The average of such reading will be the mean illuminance of the sample. If any one of such reading differs by more than 10 % from the mean illuminance, then a more uniform source shall be obtained.

For retro-reflective spokes or spoke cases, a source of light is required which results in an evenly illuminated surface of a sufficient size to capture the entire diameter of the measurement assembly.

8.2 Reflectors

8.2.1 Principle

The coefficient of luminous intensity, CIL, is determined by the measurement of the illuminance at test piece and the luminous intensity in the direction considered by means of appropriately calibrated photometers.

8.2.2 Reflector mount (or support)

The reflector under test shall be mounted on a goniometer, or other suitable support, to provide the required entrance angles.

The retro-reflector support shall be such that the horizontal entrance angle are obtained by rotating the reflector around a mobile vertical axis; vertical angles by rotating around a fixed horizontal axis.

The centre of the reflex area shall be located at the centre of rotation, and shall lie on the axis passing through the centre of the light source when $\beta = 0/0$.

8.2.3 Test area of reflector

For photometric measurements, the maximum area of the reflector to be exposed and projected on a plane perpendicular to its reference axis shall be 100 cm² contained within a circle of diameter of 200 mm.

8.2.4 Orientation of reflector

Reflectors shall be tested in the orientation in which they are designed to be used.

Spoke reflectors shall be tested in the single orientation that provides the best overall performance.

Should uncoloured reflections from the front surface interfere with the photometric readings at any test point, the reflector may be rotated around its vertical or horizontal axis through an angle not exceeding 4°.

8.3 Retro-reflective tyres

8.3.1 Principle

The coefficient of luminous intensity, CIL, is determined by the measurement of the illuminance at test piece and the luminous intensity in the direction considered by means of appropriately calibrated photometers.

8.3.2 Test method

For testing the retro-reflective material on a tyre, the tyre shall be mounted on a wheel and inflated to the maximum pressure recommended by the manufacturer.

The retro-reflective material on each side of the tyre shall be tested.

Measure the illuminance of the receiver due to retro-reflection for the entrance and observation angles given in [Table 11](#) or [Table 12](#) respectively.

NOTE A positive entrance angle corresponds to the case in which the line of sight to the receiver lies between the line of incidence and the optic axis of the retro-reflective strip, and a negative entrance angle corresponds to the case in which the line of incidence lies between the line of sight of the receiver and the optic axis of the retro-reflective strip.

8.4 Retro-reflective spokes or spoke cases

8.4.1 Testing assemblies for retro-reflective spokes and spoke cases

Minimum retro-reflective items in mcd/lx for retro-reflective spokes or spoke cases measured with the measuring procedure according to [8.4.2](#).

[Figure 4](#) illustrates a typical testing assembly.