

20-2 Retro-reflective markings: Effective from 2011/1/1

Refer to: R104 00-S7

20-2.1 Effective date and Scope:

- 20-2.1.1 As for the reverse triangle yellow portion of right and left sides and rear for vehicle of child-only vehicle and school bus, the new variants of retro-reflective markings from 2011/1/1, shall comply with this regulation.
- 20-2.1.2 As for the reverse triangle yellow portion of right and left sides and rear for vehicle of child-only vehicle and school bus, all variants of retro-reflective markings, which were confirmed to '20-1 Retro-reflective markings' regulated in "Directions", shall comply with paragraph 3-2.7.7 and 3-2.7.8 in addition, from 2011/1/1.
- 20-2.1.3 As for the vehicles of category symbols M, N and O (except the above-mentioned vehicles), the new variants of retro-reflective markings from 2011/1/1, shall comply with this regulation.
- 20-2.1.4 As for the vehicles of category symbols M, N and O (except the above-mentioned vehicles), all variants of retro-reflective markings, which were confirmed to '20-1 Retro-reflective markings' regulated in "Directions", shall comply with paragraph 3-2.7.7 and 3-2.7.8 in addition, from 2013/1/1.

20-2.2 Definitions :

- 20-2.2.1 Marking: means a rectangular strip or a series of such strips intended to be placed in such a way that it identifies the entire length and width of a motor vehicle and its trailer when viewed from the side (side marking) or rear (rear marking).
- 20-2.2.2 Contour marking: means a series of strips intended to be placed in such a way that it shows the contour of the vehicle to the side (side marking) and to the rear (rear marking).
- 20-2.2.3 Class C material: material for contour / strip marking.
- 20-2.2.4 Class D material: material for distinctive markings/graphics intended for a limited area.
- 20-2.2.5 Class E material: material for distinctive markings/graphics intended for extended area.

20-2.3 Retro-reflective markings shall according to suitable variant and range of principle :

- 20-2.3.1 Brand.
- 20-2.3.2 The characteristics of the retro-reflective material (category of C/D/E).
- 20-2.3.3 The parts affecting the properties of the retro-reflective materials or devices.

20-2.4 Test Procedure:

- 20-2.4.1 Five test samples representing either strips or planes of retro-reflective marking materials have to be submitted to the test laboratory. In the case of strips, at least a length of 3 meters shall be provided, in the case of planes, at least a surface of 500 x 500 mm² shall be provided.
- 20-2.4.2 The samples shall be subjected to the heat resistance test described in paragraph 20-1.7.4 to this Regulation prior to the tests set forth in this regulation.
- 20-2.4.3 The photometric and colorimetric measurements may be made on five samples. The mean values should be taken.
- 20-2.4.4 For other tests regulated in paragraph 20-1.7, samples which have not undergone any testing should be used.

20-2.5 General specifications :

- 20-2.5.1 Retro-reflective marking materials shall be that way constructed that they function satisfactorily and will continue to do so in normal use. In addition, they shall not have any defect in design or manufacture.
- 20-2.5.2 The outer surface of the retro-reflective marking materials shall be easy to be cleaned. The surface shall therefore not be

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rough and any protuberances they may exhibit shall not prevent easy cleaning.

20-2.6 Special specifications :

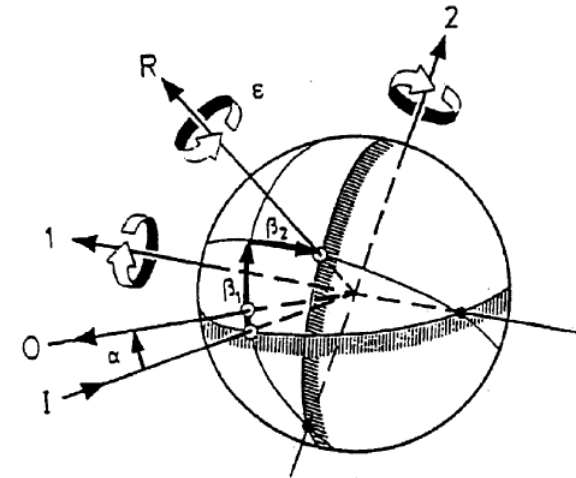
20-2.6.1 Colorimetric specifications :

20-2.6.1.1 Retro-reflective marking materials (class C) shall be white, yellow or red. Retro-reflective distinctive markings and/or graphics (class D and E) may be of any color.

20-2.6.1.2 When illuminated by the CIE Standard illuminant A at entrance angle $\beta_1 = \beta_2 = 0$ degrees, or, if this produces a colourless surface reflection, angle $\beta_1 = 0$ degrees, $\beta_2 = +5$ degrees, and measured at an observation angle of $\alpha = 20'$, the colour of the material in new condition shall be located within the area defined by the chromaticity coordinates in table 1.

Table 1: Chromaticity coordinates

Color		1	2	3	4
Yellow	x	0.585	0.610	0.520	0.505
	y	0.385	0.390	0.480	0.465
White	x	0.373	0.417	0.450	0.548
	y	0.402	0.359	0.513	0.414
Red	x	0.720	0.735	0.665	0.643
	y	0.258	0.265	0.335	0.335



1: First Axis is fixed perpendicular to the plane containing the observation and illumination axis.

2: Second Axis is perpendicular both to the first axis and to the reference axis.

I: Illumination Axis is the principle fixed axis.

Alpha: Observation angle

O: Observation Axis

beta1, beta2: Entrance angles

R: Reference Axis is fixed in the retro-reflective material and moveable with beta1 and beta2.

Epsilon: Rotation angle

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Fig.1 THE CIE CO-ORDINATE SYSTEM

20-2.6.2 Photometric specifications:

20-2.6.2.1 Minimum values for the coefficient of retro-reflection

Photometric specifications for retro-reflective marking of Class C materials are shown in Table 2 :

Table 2 Minimum values for the coefficient of retro-reflection $R'[\text{cd.m}^{-2}.\text{lux}^{-1}]$

Observation angle α (degrees)	Entrance angle β (degrees)					
$\alpha=0.33$ degrees (20')	β_1	0	0	0	0	0
	β_2	5	20	30	40	60
Color						
Yellow		300		130	75	10
White		450		200	95	16
Red		120	60	30	10	

20-2.6.2.2 Maximum values for the coefficient of retro-reflection

Photometric specifications for distinctive markings or graphics of Class D material are shown in Table 3 :

Table 3 Maximum values for the coefficient of retro-reflection $R'[\text{cd.m}^{-2}.\text{lux}^{-1}]$

Observation angle α (degrees)	Entrance angle β (degrees)				
$\alpha=0.33$ degrees (20')	β_1	0	0	0	0
	β_2	5	30	40	60
Any color		150	65	37	5

20-2.6.3 For class "E" marking materials the maximum values of the coefficient of retro-reflection are less or equal to 33 % of the values defined in Table 3.

20-2.7 Resistance to external agents :

20-2.7.1 Resistance to weathering :

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- 20-2.7.1.1 The specimen shall be subjected to a source of illumination of Xenon arc lamp; the retro-reflective material shall be exposed until blue standard No. 7 has faded to No. 4 on the grey scale. After the test, the specimen shall be examined for conformity with the requirements specified in the following regulations :
- 20-2.7.1.1.1 Visual appearance : No area of the exposed specimen shall show any evidence of cracking , scaling, splitting, blistering, delamination, distortion, chalking, staining or corrosion.
- 20-2.7.1.1.2 The color of the exposed specimen shall still meet the requirements in Table1.
- 20-2.7.1.1.3 Effect on the coefficient of retro-reflection of the retro-reflective material: For this check, measurement shall be made only at an observation angle of $\alpha=20'$ and an entrance angle of $\beta_2=5^\circ$ by the method given in paragraph 20-1.6.2. The coefficient of retro-reflection of the exposed specimen when dry shall be not less than 80% of the values in Table 2.
- 20-2.7.2 Resistance to corrosion:
- 20-2.7.2.1 A specimen of the sample unit shall be subjected to the action of a saline mist for 48 hours comprising two periods of exposure of 24 hours each, separated by an interval of 2 hours during which the specimen is allowed to dry. The saline mist shall be produced by atomizing at a temperature of $35 \pm 2^\circ\text{C}$ a saline solution obtained by dissolving 5% by weight of sodium chloride in 95% of distilled water containing not more than 0.02% of impurities.
- 20-2.7.2.2 Immediately after completion of the test, the sample shall show no sign of corrosion liable to impair the efficiency of the marking. The coefficient of retro-reflection R' of the retro-reflective areas, when measured after a recovery period of 48 hours as specified in paragraph 20-1.6.2, at an entrance angle of $\beta_2 = 5$ degrees and an observation angle of $\alpha = 20'$, shall be not less than the value in Table 2 or more than the value in Table 3 respectively.
- 20-2.7.3 Resistance to fuels : A section of a sample unit not less than 300mm long shall be immersed in a mixture of n-heptane and toluol, 70% and 30% by volume, for one minute. After removal, the surface shall be wiped dry with a soft cloth and shall not show any visible change which would reduce its effective performance.
- 20-2.7.4 Resistance to heat:
- 20-2.7.4.1 A section of a sample unit not less than 300mm long shall be kept for 12 hours (in the case of retro-reflective specimen, this time shall be 48 hours) in a dry atmosphere at a temperature of $65 \pm 2^\circ\text{C}$ after which the sample shall be allowed to cool for 1 hour at $23 \pm 2^\circ\text{C}$. It shall then be kept for 12 hours at a temperature of $-20 \pm 2^\circ\text{C}$. The sample shall be examined after a recovery time of 4 hours.
- 20-2.7.4.2 After this test, no cracking or appreciable distortion of the surface particularly of the optical units, shall be evident.
- 20-2.7.5 Resistance to cleaning
- 20-2.7.5.1 Manual cleaning :A test sample smeared with a mixture of detergent lubricating oil and graphite shall be easily cleaned without damage to the retro-reflective surface when wiped with a mild aliphatic solvent such as n-heptane, followed by washing with a neutral detergent.
- 20-2.7.5.2 Power washing
- 20-2.7.5.2.1 When subjected to a continuous spraying action for 60 seconds on the test component in its normal mounting conditions, a test sample shall show no damage to the retroreflective surface or delamination from the substrate or separation from the sample mounting surface under the following set-up

parameters:

- 20-2.7.5.2.1.1 Water/wash solution pressure 8 +/- 0.2 MPa;
 - 20-2.7.5.2.1.2 Water/wash solution temperature 60 degrees - 5 degrees C;
 - 20-2.7.5.2.1.3 Water/wash solution flow rate 7 +/- 1 l/min;
 - 20-2.7.5.2.1.4 The tip of the cleaning wand to be positioned at distance of 600 +/- 20 mm away from the retro-reflective surface;
 - 20-2.7.5.2.1.5 Cleaning wand to be held at no greater angle than 45 degrees from perpendicular to the retro-reflective surface;
 - 20-2.7.5.2.1.6 40 degree nozzle creating wide fan pattern.
- 20-2.7.6 Resistance to penetration of water
- 20-2.7.6.1 Sample unit of retro-reflective marking shall be immersed for 10 minutes in water at a temperature of 50 +/- 5 °C with the highest point of the upper part of the retro-reflective surface 20mm below the surface of the water. This test shall be repeated after turning the sample unit through 180 degrees, so that the retro-reflection surface is at the bottom and the rear face is covered by about 20mm of water. The sample unit(s) shall then be immediately immersed in the same conditions in water at a temperature of 25 +/- 5 °C.
 - 20-2.7.6.2 No water must penetrate to the reflecting surface of the sample unit.
 - 20-2.7.6.3 If visual inspection does not reveal the presence of water, the coefficient of retro-reflection R' shall be measured in conformity with paragraph 20-1.6.2, the sample unit being first lightly shaken to remove excess water from the outside.
- 20-2.7.7 Bonding strength (in the case of adhesive materials)
- 20-2.7.7.1 The adhesion of retro-reflective materials shall be determined after hardened for 24 hours, then utilizing a 90 degree peel on a tensile strength testing machine.
 - 20-2.7.7.2 The retro-reflective materials shall not be easily removable without damaging the material.
 - 20-2.7.7.3 The retro-reflective materials shall need a force of at least 10 N per 25 mm width at a constant speed of 300 mm per minute to be removed from their substrate.
- 20-2.7.8 Flexing
- 20-2.7.8.1 For samples that are to be adhered to a flexible substrate (i.e. tarpaulin) , the following shall apply:
 - 20-2.7.8.1.1 A specimen of the sample unit that measures 50 mm by 300 mm shall be bent once lengthwise, around a 3.2 mm mandrel with adhesive contacting the mandrel for a period of 1 second. Talc powder may be used to avoid adhesion. The test temperature shall be 23 degrees C +/- 2 degrees C.
 - 20-2.7.8.1.2 After this test, specimen shall not have cracking of the surface and shall not show any visible change that would reduce its reflective performance.