27 Devices for indirect vision

Refer to: R46 02-S5, R81 00-S1

27.1 Effective date and Scope:

27.1.1 Effective date from 2006/7/1, the new variants of devices for indirect vision installed used in L1 and L3 vehicle, and from 2008/7/1 all variants of devices for indirect vision installed used in L1, L2, L3 and L5 shall comply with this Direction.

27.1.2 Effective date from 2011/1/1, new variants of devices for indirect vision installed used in M and N vehicle, and from 2013/1/1 all variants of devices for indirect vision installed used in M and N shall comply with this Direction.

27.1.3 The applicants applying for low volume safety approval could exempt from Direction of “devices for indirect vision” except large passenger vehicle and child-only vehicle.

27.1.4 Applying for vehicle-by-vehicle low volume safety approval, the vehicle could exempt from Direction of “devices for indirect vision”.

27.2 Definitions:

27.2.1 Devices for indirect vision: means devices to observe the traffic area adjacent to the vehicle which cannot be observed by direct vision. These can be conventional mirrors, camera-monitors or other devices able to present information about the indirect field of vision to the driver. The category symbols L use mirror（rear-view mirror）to provide the field of vision.

27.2.1.1 Mirror: means any device intended to give a clear view to the rear and side of the vehicle（usually from rear-view mirror provide this function）or front （usually from front-view mirror provide this function, except for the category symbols L）,excluding complex optical systems such as periscopes.

27.2.1.2 Interior mirror: means a device , which can be fitted in the passenger compartment of a vehicle.

27.2.1.3 Exterior mirror: means a device ,which can be mounted on the external surface of a vehicle.

27.2.1.4 Rear-view mirror of the category symbols L: means any mirror device can provide for the category symbols L with clear view to the rear and side of the vehicle ; excluding complex optical systems such as periscopes.

27.2.2 Vision support system: means a system to enable the driver to detect and/or see objects in the area adjacent to the vehicle.

27.2.3 r: means the average of the radii of curvature measured over the reflecting surface.

27.2.4 ri: means the values measured on the arc of the reflecting surface passing through the center of the mirror parallel to the segment b, and on the arc perpendicular to this segment.

27.2.5 rp: means the arithmetic average of the principal radii of curvature ri and r'i, i.e.:

$$rp = \frac{\mathrm{ri} + \mathrm{r'i}}{2}$$

27.2.6 The principal radii of curvature shall be measured at three points situated as close as possible to positions at 1/3, 1/2 and 2/3 of the distance along the arc of the reflecting surface passing through the center of the mirror and parallel to segment b, or of the arc

passing through the curve of the mirror which is perpendicular to it if this arc is the longest. rp1 is the radius of curvature of the first measuring point, rp2 at the second and rp3 at the third.

27.2.7 Direct calibration method: In the direct calibration method, air is used as the reference standard. This method is applicable for those instruments, which are so constructed as to permit calibration at the 100% point by swinging the receiver to a position directly on the axis of the light source. It may be desired in some cases (such as when measuring low-reflectivity surfaces) to use an intermediate calibration point (between 0 and 100% on the scale) with this method. In these cases a neutral density filter of known transmittance shall be inserted in the optical path, and the calibration control shall then be adjusted until the meter reads the percentage transmission of the neutral density filter. This filter shall be removed before making reflectivity measurements.

27.2.8 Indirect calibration method: The indirect calibration method is applicable for those instruments with fixed source and receiver geometry. A properly calibrated and maintained reflectance standard is required. This reference standard should preferably be a flat mirror with a reflectance value as near as possible to that of the test samples.

27.2.9 "Camera-monitor device for indirect vision" means a device as defined in paragraph 27.2.1., where the field of vision is obtained by means of a camera-monitor combination as defined in paragraphs 27.2.10 and 27.2.11.

27.2.10 "Camera" means a device that renders an image of the outside world and then converts this image into a signal (e.g. video signal).

27.2.11 "Monitor" means a device that converts a signal into images that are rendered into the visual spectrum.

27.2.12 "Surveillance camera-monitor-recording device" means a camera and either a monitor or recording equipment other than the camera-monitor device defined in paragraph 27.2.9. which can be fitted to the inside or outside of the vehicle in order to provide fields of vision other than those specified in paragraph 23.7. or to provide a security system within or around the vehicle.

27.3 The principle of applicable type and scope and of Mirrors shall be as below：

27.3.1 The M and N category of vehicles:

27.3.1.1 Brand.

27.3.1.2 Mirrors’ radii of curvature (r) for the reflecting surface and dimensions.

27.3.1.3 Mirrors’ design, shape and materials.

27.3.1.4 In case of camera-monitor devices the detection distance and the range of vision.

27.3.2 The L category of vehicles:

27.3.2.1 Brand.

27.3.2.2 Mirrors’ radii of curvature (r) for the reflecting surface and dimensions.

27.3.2.3 Mirrors’ design、shape and materials，including way of connection with vehicles.

27.4 General specifications

27.4.1 The edge of the reflecting surface shall be enclosed in a protective housing (holder, etc.) which, on its perimeter, must have a value 'c' greater than or equal to 2.5 mm at all points and in all directions. If the reflecting surface projects beyond the protective housing, the radius of curvature 'c' on the edge of the projecting part shall be not less than 2.5 mm and the reflecting surface must return

into the protective housing under a force of 50 N applied to the point of greatest projection, relative to the protective housing, in a horizontal direction, approximately parallel to the longitudinal median plane of the vehicle.

27.4.2 When the mirror is mounted on a plane surface, all parts, irrespective of the adjustment position of the device, including those parts remaining attached to the support after the test, which are in potential, static contact with a sphere either 165 mm in diameter in the case of an interior mirror or 100 mm in diameter in the case of an exterior mirror, must have a radius of curvature 'c' of not less than 2.5 mm.

27.4.3 Edges of fixing holes or recesses of which the diameter or longest diagonal is less than 12 mm are exempt from the radius requirements of paragraph 27.4.2. provided that they are blunted.

27.4.4 The device for the attachment of mirrors to the vehicle must be so designed that a cylinder with a 70 mm radius, having as its axis the axis, or one of the axes, of pivot or rotation which ensures deflection of the mirror in the direction of impact concerned, passes through at least part of the surface to which the device is attached.

27.4.5 The parts of exterior mirrors referred to in paragraphs 27.4.1. and 27.4.2 which are made of a material with a Shore A hardness not exceeding 60 are exempt from the relevant provisions.

27.4.6 In the case of those parts of interior mirrors which are made of a material with a Shore A hardness of less than 50 and which are mounted on a rigid support, the requirements of paragraphs 27.4.1 and 27.4.2 shall only apply to the support.

27.5 Dimensions

27.5.1 In the case of vehicles of category symbols M and N:

27.5.1.1 Interior mirrors (Class I): The dimensions of the reflecting surface shall be such that it is possible to inscribe thereon a rectangle having 4 cm in height and the of length "a":

$$a = 15cm \times \frac{1}{1 + \frac{1000}{r}}$$

27.5.1.2 Exterior r mirrors (Class II): The dimensions of the reflecting surface shall be such that it is possible to inscribe thereon: a rectangle of a height of 4 cm and of base length, in centimetres, "a", and a segment parallel to the height of the rectangle

$$a = \frac{17cm}{1 + \frac{1000}{\mathrm{r}}}$$

and of length, in centimetres, "b". The minimum values of "a" and "b" are: , b= 20 cm

27.5.1.3 Exterior rear-view mirrors (Class III): The dimensions of the reflecting surface shall be such that it is possible to inscribe thereon: a rectangle of a height of 4 cm and of base length, in centimetres, "a", and a segment parallel to the height of the

$$a = 13cm \times \frac{1}{1 + \frac{1000}{r}}$$

rectangle and of length, in centimetres, "b". The minimum values of "a" and "b" are: , b= 7 cm.

27.5.1.4 Wide-angle exterior mirrors (Class IV): If it is connected with Class II exterior mirror, the dimension shall be able to provide the field of vision of wide-angle exterior mirrors (Class IV).

27.5.1.5 Close-proximity exterior mirrors (Class V): The contours of the reflecting surface must be of simple geometric form and its dimensions such that the mirror provides the field of vision.

27.5.1.6 Front mirrors (Class VI): The contours of the reflecting surface must be of simple geometric form and its dimensions such that the mirror provides the field of vision.

27.5.2 In the case of vehicles of category symbol L:

27.5.2.1 The minimum dimensions of the reflecting surface must be such that:

27.5.2.1.1 The area shall not be less than 69 cm2.

27.5.2.1.2 In the case of circular mirrors, the diameter shall not be less than 94 mm,

27.5.2.1.3 In the case of non-circular mirrors, the dimension will permit the inscription of a circle with a diameter of 78 mm on the reflecting surface.

27.5.2.2 The maximum dimensions of the reflecting surface must be such that:

27.5.2.2.1 In the case of circular mirrors, the diameter shall not be greater than 150 mm,

27.5.2.2.2 In the case of non-circular mirrors, the reflecting surface shall fit into a rectangle measuring 120 mm by 200 mm.

27.6 Radii of curvature (r) for the reflecting surface:

27.6.1 The reflecting surface of a mirror must be either flat or spherically convex. Exterior mirrors may be equipped with an additional aspherical part provided that the main mirror fulfils the requirements of the indirect field of vision.

27.6.2 In the case of vehicles of category symbols M and N:

27.6.2.1 1,200 mm for interior rear-view mirrors (Class I);

27.6.2.2 1,200 mm for Class II and III main exterior rear-view mirrors;

27.6.2.3 300 mm for "wide-angle" exterior mirrors (Class IV) and "close-proximity" exterior mirrors (Class V);

27.6.2.4 200 mm for front mirrors (Class VI).

27.6.2.5 r is calculated using the formula (unit: mm):

27.6.2.5.1 $$r = \frac{r_{p1} + r_{p2} + r_{p3}}{3}$$

27.6.2.5.2 Difference between ri or r′i and rp at each reference point:

27.6.2.5.2.1 When r is less than 3000 mm, the difference shall not exceed 0.15 r.

27.6.2.5.2.2 When r is not less than 3000 mm, the difference shall not exceed 0.25 r.

27.6.2.5.3 Difference between any of the radii of curvature (rp) and r:

27.6.2.5.3.1 When r is less than 3000 mm, the difference shall not exceed 0.15 r.

27.6.2.5.3.2 When r is not less than 3000 mm, the difference shall not exceed 0.25 r.

27.6.3 In the case of vehicles of category symbol L:

27.6.3.1 r shall not be less than 1000 mm nor greater than 1500 mm.

27.6.3.2 r is calculated using the formula (unit: mm):

$$r = \frac{r_{p1} + r_{p2} + r_{p3}}{3}$$

27.6.3.3 The difference between ri or r'i and rp at each reference point shall not exceed 0.15 r.

27.6.3.4 The difference between any of the radii of curvature (rp) and r of shall not exceed 0.15 r.

27.6.4 Requirements for aspherical parts of mirrors

27.6.4.1 Aspherical mirrors shall be of sufficient size and shape to provide useful information to the driver. This normally means a minimum width of 30 mm at some point.

27.6.4.2 The radius of curvature ri of the aspherical part shall not be less than 150 mm.

27.7 Reflectivity:

27.7.1 Measuring method:

27.7.1.1 Flat mirror measurement: the reflectance of flat mirror samples can be measure on instruments employing either the direct or indirect calibration method. The reflectance value is read directly from the indicating meter.

27.7.1.2 Non-flat (convex) mirror measurement: The measurement of the reflectance of non-flat (convex) mirrors requires the use of instruments which incorporate an integrating sphere in the receiver unit. If the instrument indicating meter indicates ne divisions with a reference standard mirror of E% reflectance, then, with a mirror of unknown reflectance, nx divisions will correspond to a reflectance of X%, given by the formula: $X = E\frac{nx}{ne}$

27.7.2 Requirements:

27.7.2.1 The value of the normal coefficient of reflection shall not be less than 40%.

27.7.2.2 If the mirror has two positions ("day" and "night"), the value of the normal coefficient of reflection in the "day" position shall not be less than 40%; the value of the normal coefficient of reflection in the "night" position shall not be less than 4%.

27.7.2.3 The reflecting surface must retain the characteristics laid down in paragraph 27.7.2.1 and 27.7.2.2 in spite of prolonged exposure to adverse weather conditions in normal use.

27.8 Impact test:

27.8.1 The test shall not be required in the case of any exterior mirror of which no part is less than 2 m from the ground, regardless of the adjustment position, when the vehicle is under a load corresponding to its maximum technically permissible mass. This

derogation also applies to the attachments of mirrors (attachment plates, arms, swivel joints, etc.) which are situated less than 2 m from the ground and which do not project beyond the overall width of the vehicle, measured in the transverse plane passing through the lowest mirror attachments or any other point forward of this plane if this configuration produces a greater overall width. In such cases, a description specifying that the mirror must be mounted so as to conform to the above-mentioned conditions for the positioning of its attachments on the vehicle must be provided. To comply with this requirement, the arm shall be indelibly marked with the symbol

27.8.2 Test method:

27.8.2.1 The test device shall consist of a pendulum capable of swinging about two horizontal axes at right angles to each other, one of them is perpendicular to the front plane containing the "release" trajectory of the pendulum.

27.8.2.2 The end of the pendulum shall comprise a hammer formed by a rigid sphere with a diameter of 165 +/- 1 mm and having a 5 mm-thick rubber covering of Shore A 50 hardness.

27.8.2.3 The centre of percussion of the pendulum shall coincide with the centre of the sphere which forms the hammer. It is at a distance "1" from the axis of oscillation in the release plane which is equal to 1 m +/- 5 mm. The reduced mass of the pendulum to its center of percussion is mo = 6.8 +/- 0.05 kg The test consists in allowing the hammer to fall from a height corresponding to a pendulum angle of 60 degrees from the vertical so that the hammer strikes the rear-view mirror at the moment when the pendulum reaches the vertical position.

27.8.2.4 The rear-view mirrors are subjected to impact in the following different conditions:

27.8.2.4.1 Interior mirrors are subjected to impact in the following conditions:

27.8.2.4.1.1 The impact shall be such that the hammer strikes the rear-view mirror on the reflecting surface side.

27.8.2.4.1.2 On the edge of the protective housing in such a way that the impact produced makes an angle of 45 degrees with the plane of the mirror and is situated in the horizontal plane passing through the center of the mirror. The impact is directed in the reflecting surface side.

27.8.2.4.2 Exterior mirrors:

27.8.2.4.2.1 The impact must be such that the hammer strikes the mirror on the reflecting surface side.

27.8.2.4.2.2 The impact must be such that the hammer strikes the mirror on the side opposite to the reflecting surface.

27.8.3 Requirements:

27.8.3.1 In the tests the pendulum must continue to swing after impact in such a way that the projection of the position taken by the

arm on the release plane makes an angle of at least 20 degrees with the vertical. This requirement is not applicable to interior mirrors stuck to the windscreen.

27.8.3.2 The required angle to the vertical is reduced from 20 degrees to 10 degrees for all Class II and Class IV mirrors and for Class III mirrors which are attached to the same mounting as Class IV mirrors.

27.8.3.3 Should there be a breakage of the mounting of the mirror during the tests for interior mirrors stuck to the windscreen, the part remaining shall not project from the base by more than 1 cm.

27.8.3.4 The mirror shall not break during the tests. However, breakage of the mirror shall be allowed if one of the following conditions is fulfilled:

27.8.3.4.1 The fragments of glass still adhere to the back of the protective housing or to a surface firmly attached to the protective housing, except that partial separation of the glass from its backing is permitted, provided this does not exceed 2.5 mm either side of the crack. It is permissible for small splinters to become detached from the surface of the glass at the point of impact.

27.8.3.4.2 The mirror is made of safety glass.

27.9 Bending test:

27.9.1 Test method:

27.9.1.1 The mirrors of categories M and N are not required to do the bending test.

27.9.1.2 The protective housing shall be placed horizontally in a device in such a way that the adjustment parts of the mounting can be clamped securely. In the direction of the greatest dimension of the protective housing, the end nearest the point of fixing on the adjustment part shall be immobilized by means of a fixed stop 15 mm wide, covering the entire width of the protective housing. At the other end, a stop identical to the one described above shall be placed on the protective housing so that the specified test load can be applied to it.

27.9.1.3 The test load shall be 25 kg applied for one minute.

27.9.2 Requirements: The mirror shall not break during the tests. However, breakage of the mirror shall be allowed if one of the following conditions is fulfilled:

27.9.2.1 The fragments of glass still adhere to the back of the protective housing or to a surface firmly attached to the protective housing, except that partial separation of the glass from its backing is permitted, provided this does not exceed 2.5 mm either side of the crack. It is permissible for small splinters to become detached from the surface of the glass at the point of impact.

27.9.2.2 The mirror is made of safety glass.

27.10 Devices for indirect vision other than mirrors

27.10.1 General requirements

27.10.1.1 If adjustment by the user is needed, the device for indirect vision shall be adjustable without the use of tools.

27.10.1.2 If a device for indirect vision can only render the total prescribed field of vision by scanning the field of vision, the total process of scanning, rendering and reset to its initial position together shall not take more than 2 seconds.

27.10.2 Camera-monitor device or indirect vision

27.10.2.1 General requirements

27.10.2.1.1 When the camera-monitor device for indirect vision is mounted on a plane surface, all parts, irrespective of the adjustment position of the device which are in potential, static contact with a sphere either 165 mm in diameter in the case of a monitor or 100 mm in diameter in the case of a camera, must have a radius of curvature "c" of not less than 2.5 mm.

27.10.2.1.2 Edges of fixing holes or recesses of which the diameter or longest diagonal less than 12 mm are exempt from the radius requirements of paragraph 27.10.2.1.1. provided that they are blunted.

27.10.2.1.3 For parts of the camera and the monitor which are made of a material with a Shore A hardness of less than 60 and which are mounted on a rigid support, the requirements of 27.10.2.1.1 shall only apply to the support.

27.10.2.2 Functional requirements

27.10.2.2.1 The camera should function well under low sunlight conditions. The camera shall provide a luminance contrast of at least 1:3 under low sun condition in a region outside the part of the image where the light source is reproduced (condition as defined in EN 12368: 8.4). The light source shall illuminate the camera with 40,000 lx. The angle between the normal of the sensor plane and the line connecting the midpoint of the sensor and the light source shall be 10 degrees.

27.10.2.2.2 The monitor shall render a minimum contrast under various light conditions as specified by international standard ISO 15008:2003.

27.10.2.2.3 It shall be possible to adjust the average luminance of the monitor either manually or automatically to the ambient conditions.

27.10.2.2.4 The measurements for the luminance contrast shall be carried out according to ISO 15008:2003.

27.10.2.3 Other device for indirect vision

It has to be proved that the device meets the following requirements:

27.10.2.3.1 The device shall perceive the visual spectrum and shall always render this image without the need for interpretation into the visual spectrum.

27.10.2.3.2 The functionality shall be guaranteed under the circumstances of use in which the system shall be put into service. Consideration shall be made entirely or partly depending on the technology used in obtaining images and presenting them according to paragraph 27.10.2.2.. In other cases this can be achieved by establishing and demonstrating by means of

system sensitivity analogous to paragraph 27.10.2.2 that a function is ensured that is comparable to or better than what is required for and by demonstrating that a functionality is guaranteed that is equivalent or better than that required for mirror- or camera-monitor type devices for indirect vision.