

94 Blind spot information system

Refer to: R151 00-S2

94.1 Effective date and Scope

- 94.1.1 Effective date from 2025/1/1, new vehicle types of category N2 and N3 with technically permissible maximum mass exceeding 8 tons, and from 2027/1/1, all vehicle types of category N2 and N3 with technically permissible maximum mass exceeding 8 tons, shall equip with blind spot information system complied with this regulation.
- 94.1.2 Effective date from 2025/7/1, new vehicle types of category N2 (with technically permissible maximum mass exceeding 8 tons),M2 and M3, and from 2027/7/1, all vehicle types of category N2 (with technically permissible maximum mass exceeding 8 tons),M2 and M3, shall equip with blind spot information system complied with this regulation.
- 94.1.3 Technical Service can carry out test according to UN Regulations that this direction harmonized with: UN R151 00 Series of amendments and following amendments of above-mentioned regulations.

94.2 Definitions

- 94.2.1 "Blind Spot Information System (BSIS)" means a system to inform the driver of a possible collision with a bicycle near side.
- 94.2.2 "Reaction time" means the time between the information signal is given and a driver reaction has occurred.
- 94.2.3 "Ocular reference point" means the middle point between two points 65 mm apart and 635 mm vertically above the reference point on the driver's seat. The straight line joining the two points runs perpendicular to the vertical longitudinal median plane of the vehicle. The centre of the segment joining the two points is in a vertical longitudinal plane which shall pass through the centre of the driver's designated seating position, as specified by the vehicle manufacturer.
- 94.2.4 "Stopping distance" means the distance required by the vehicle to come to a full stop after the Blind Spot Information Signal has been given, taking into account reaction time and brake deceleration.

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- 94.2.5 "Collision point" means the position where the trajectory of any vehicle point would intersect with any bicycle points if a turn by the vehicle is initiated.
- 94.2.6 The theoretical collision point as referred to in Figure 1 of Appendix 1 is the point where a collision would occur in the respective test condition if the vehicle would turn towards the bicycle, e.g. starting with a counter-steer manoeuvre at the last point of information. Note that the actual turning manoeuvre is not tested since the information is required to be given before turn initiation.
- 94.2.7 "Last Point of Information (LPI)" means the point at which the information signal shall have been given. It is the point preceding the expected turning motion of a vehicle towards a bicycle in situations where a collision could occur.
- 94.2.8 "Near side" means the side of the vehicle near the bicycle. The near side of the vehicle is the right side for right-hand traffic.
- 94.2.9 "Information signal" means an optical signal with the purpose of informing the vehicle driver about a nearby moving bicycle.
- 94.2.10 "Vehicle Trajectory" means the connection of all positions where the vehicle front right corner has been or will be during the test run.
- 94.2.11 "Bicycle" means a combination of a bicycle and cyclist. This is simulated in test cases as specified in paragraphs 94.6.5. and 94.6.6. below with a test device according to ISO [CD] 19206-4. The reference point for the location of the bicycle shall be the most forward point on the centreline of the bicycle.
- 94.2.12 "Common space" means an area on which two or more information functions (e.g. symbols) may be displayed, but not simultaneously
- 94.2.13 "Lateral separation" means the distance between the vehicle and the bicycle at the near side of the vehicle where the vehicle and bicycle are parallel to each other. The distance is measured between the plane parallel to the median longitudinal plane of the vehicle and touching its lateral outer edge, disregarding the projection of devices for indirect vision, and the median longitudinal plane of the bicycle minus half of the bicycle width being 250 mm. The lateral outer edge of the vehicle is only to be regarded in the area between the vehicle's foremost point and up to 6 m rearward.
- 94.2.14 "First point of information" means the most forward point at which the information signal can be given. It is the last point of information

and a distance corresponding to a travel time of 4 seconds, taking into account the moving speed of the vehicle plus an additional distance if the impact position is lower than 6 m.

94.2.15 "Vehicle front right corner" means the projection of the point that results from the intersection of the vehicle side plane (not including devices for indirect vision) and the vehicle front plane (not including devices for indirect vision and any part of the vehicle which is more than 2.0 m above the ground) on the road surface.

94.2.16 "Impact Position" means the location of impact of the bicycle on the right side of the vehicle with respect to the vehicle front right corner, when both vehicles have reached the collision point, as specified in paragraph 94.6.10, Figure 3.

94.2.17 "Vehicle Master Control Switch" means the device by which the vehicle's on-board electronics system is brought, from being switched off, as in the case where a vehicle is parked without the driver being present, to normal operation mode.

94.3 The principles of applicable type and scope of blind spot information system shall be as follows:

94.3.1 If use completed vehicle for testing, the principles of applicable type and scope of blind spot information system shall be as follows :

94.3.1.1 Same vehicle brand;

94.3.1.2 Same vehicle features which significantly influence the performances of the Blind Spot Information System;

94.3.1.3 Same type and design of the Blind Spot Information System.

94.3.2 If use chassis vehicle instead of completed vehicle for testing, the principles of applicable type and scope of blind spot information system shall be as follows:

94.3.2.1 Same vehicle brand;

94.3.2.2 Same vehicle features which significantly influence the performances of the Blind Spot Information System;

94.3.2.3 Same type and design of the Blind Spot Information System.

94.4 Applicants applying for certification test shall provide at least one representative vehicle and submit the documents as below:

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94.4.1 Documents of vehicle specification, drawings and / or photographs of vehicle described in paragraph 94.3.

94.4.2 A description of the vehicle type with regard to the items mentioned in paragraph 94.5. below, together with dimensional drawings and the documentation as referred to in paragraph 94.6.1. below..

94.5 Specifications

94.5.1 Any vehicle fitted with a BSIS complying with the definition of paragraph 94.2.1. above shall meet the requirements contained in paragraphs 94.5.2. to 94.5.7. of this Regulation.

94.5.2 General requirements

94.5.2.1 The effectiveness of the BSIS shall not be adversely affected by magnetic or electrical fields. This shall be demonstrated by compliance with the technical requirements of VSTD “Electromagnetic Compatibility”.

94.5.2.2 With the exception of BSIS external elements which are part of another device subject to specific protrusion requirements, BSIS external elements may protrude up to 100 mm beyond the width of the vehicle.

94.5.3 Performance requirements

94.5.3.1 The BSIS shall inform the driver about nearby bicycles that might be endangered during a potential turn, by means of an optical signal, so that the vehicle can be stopped before crossing the bicycle trajectory.

It shall also inform the driver about approaching bicycles while the vehicle is stationary before the bicycle reaches the vehicle front, taking into account a reaction time of 1.4 seconds. This shall be tested according to paragraph 94.6.6.

The BSIS shall warn the driver, by means of an optical signal, acoustical signal, haptic signal or any combination of these signals, when the risk of a collision increases.

An optical information signal shall be maintained only for as long as the conditions specified in paragraph 94.5.3.1.4. below are fulfilled. For vehicles of categories N2 with a technically permissible maximum mass exceeding 8 tonnes, N3 and M3 the

deactivation of the information signal as a result of the vehicle turning away from the bicycle trajectory is not allowed as long as a collision between vehicle and bicycle is still possible, in case the driver would steer back towards the bicycle trajectory.

- 94.5.3.1.1 The information signal shall meet the requirements as defined in paragraph 94.5.4. below.
- 94.5.3.1.2 The warning signal shall meet the requirements of paragraph 94.5.5. below. It may be deactivated manually. In the case of a manual deactivation, it shall be reactivated upon each activation of the vehicle master control switch.
- 94.5.3.1.3 The BSIS shall at least operate for all forward vehicle speeds from standstill to 30 km/h, for ambient light conditions above 15 Lux.
- 94.5.3.1.4 The BSIS shall give an information signal at last point of information, for a bicycle moving with a speed between 5 km/h and 20 km/h, at a lateral separation between bicycle and vehicle of between 0.9 and 4.25 metres, which could result in a collision between bicycle and vehicle with an impact position 0 to 6 m with respect to the vehicle front right corner, if typical steering motion would be applied by the vehicle driver.

However, the information signal is not required when the relative longitudinal distance between bicycle and front right corner of the vehicle is more than 30 m to the rear or 7 m to the front.

- 94.5.3.1.4.1 For vehicles of categories N2 with a technically permissible maximum mass not exceeding 8 tons and M2, the Blind Spot Information signal shall be activated for a bicycle target moving longitudinally forward with a speed between 5 km/h and 20 km/h, entering in the zone as specified in paragraph 94.6.5.11. when the vehicle is moving forward.
- 94.5.3.1.4.2 In addition, the Blind Spot Information signal shall be activated for a bicycle target moving longitudinally forward with a speed between 5 km/h and 20 km/h from the rear entering the zone as specified in paragraph 94.6.6.3. when the vehicle is stationary. In such case, the information signal shall be maintained as long as the bicycle is in the defined zone or as long as it would be in the zone considering a constant speed of the bicycle target until it reaches the front right corner of

the vehicle. The constant speed is based on the speed of the bicyclist when entering the zone.

94.5.3.1.5 The vehicle manufacturer shall ensure that the number of false-positive warnings due to the detection of static non-VRU objects such as cones, traffic signs, hedges and parked cars shall be minimized. However it may give an information signal when a collision is imminent.

94.5.3.1.6 The BSIS shall automatically deactivate if it cannot operate properly due to its sensing devices being contaminated by ice, snow, mud, dirt or similar material or due to ambient light conditions below those specified in paragraph 94.5.3.1.3. This shall be indicated as specified in paragraph 94.5.6.2. It shall automatically reactivate when the contamination disappears and normal function has been verified. This shall be tested in accordance with the provisions of paragraph 94.6.9. below.

94.5.3.1.7 The BSIS also shall provide the driver with a failure warning when there is a failure in the BSIS that prevents the requirements of this Regulation from being met. The warning shall be as specified in paragraph 94.5.6.1. This shall be tested in accordance with the provisions of paragraph 94.6.8. below (failure detection test).

94.5.3.2 The manufacturer shall demonstrate, to the satisfaction of the Technical Service and Type Approval Authority, through the use of documentation, simulation or any other means, that the BSIS is performing as specified also for smaller bicycles and smaller bicyclists, differing by not more than 36 per cent from the values detailed in ISO [CD] 19206-4:2018.

94.5.4 Information signal

94.5.4.1 The blind spot information referred to in paragraph 94.5.3.1.1. above shall be an information signal that is noticeable and easily verifiable by the driver from the driver's seat. This information signal shall be visible by daylight and at night.

94.5.4.2 The device emitting the information signal shall be located at the near side at a horizontal angle greater than 30° towards an axis parallel to the longitudinal median plane of the vehicle and going through the ocular reference point. If the driver's seating position is located on the near side of the vehicle, this value may be reduced.

94.5.5 5.5. Warning signal

- 94.5.5.1 The warning signal referred to in paragraph 94.5.3.1.2. above shall be a signal differing, e.g. in mode or activation strategy, from the information signal specified in paragraph 94.5.4.
- 94.5.5.2 It shall be easily understandable for the driver to relate the warning signal to the potential collision. In case the warning signal is an optical signal this signal shall also be visible by daylight and at night.
- 94.5.5.3 The warning signal shall be activated at the earliest when the system detects a potential collision, e.g. by the intention of a turn towards the bicycle, e.g. by evaluating the distance between or trajectory intersection of vehicle and bicycle, direction indicator activation or similar. The strategy shall be explained in the information referred to in paragraph 94.6.1. It shall not depend solely on the activation of the direction indicator.

The Technical Service shall verify the operation of the system according to the strategy.
- 94.5.5.4 The warning signal referred to in paragraph 94.5.3.1. is not required for vehicles of categories N2 with a technically permissible maximum mass not exceeding 8 tonnes and M2.

94.5.6 5.6. Failure warning signals

- 94.5.6.1 The failure warning referred to in paragraph 94.5.3.1.7. above shall be a yellow optical warning signal, and shall be other than or clearly distinguishable from the information signal. The failure warning signal shall be visible by daylight and night, and shall be easily verifiable by the driver from the driver's seat.
- 94.5.6.2 The optical warning signal referred to in paragraph 94.5.3.1.6. shall indicate that the BSIS is temporarily not available. It shall remain active as long as the BSIS is not available. The failure warning signal specified in paragraph 94.5.3.1.7. above may be used for this purpose.
- 94.5.6.3 The BSIS optical failure warning signals shall be activated with the activation of the vehicle master control switch. This requirement

does not apply to warning signals shown in a common space.

94.5.7 Provisions for inspection

94.5.7.1 It shall be possible to confirm the correct operational status of the BSIS by a visible observation of the failure warning signal status.

94.6 Test procedure

94.6.1 The manufacturer shall provide a documentation package which gives access to the basic design of the system and, if applicable, the means by which it is linked to other vehicle systems. The function of the system including its sensing and warning strategy shall be explained and the documentation shall describe how the operational status of the system is checked, whether there is an influence on other vehicle systems, and the method(s) used in establishing the situations which will result in a failure warning signal being displayed. The documentation package shall give sufficient information for the Type Approval Authority to identify the type of and to aid the decision-making on the selection of worst-case conditions.

94.6.2 Test conditions

94.6.2.1 The test shall be performed on a flat, dry asphalt or a concrete surface.

94.6.2.2 The ambient temperature shall be between 0° C and 45° C.

94.6.2.3 The test shall be performed under visibility conditions that allow safe driving at the required test speed.

94.6.3 6.3. Vehicle conditions

94.6.3.1 Test weight

The vehicle may be tested at any condition of load, the distribution of the mass among the axles shall be stated by the vehicle manufacturer without exceeding any of the maximum permissible mass for each axle. No alteration shall be made once the test procedure has begun. The vehicle manufacturer shall demonstrate through the use of documentation that the system works at all conditions of load.

- 94.6.3.2 The vehicle shall be tested at the tyre pressures for normal running conditions.
- 94.6.3.3 In the case where the BSIS is equipped with a user-adjustable information timing, the test as specified in paragraphs 94.6.5. and 94.6.6. below shall be performed for each test case with the information threshold set at the settings that generate the information signal closest to the collision point, i.e. worst case setting. No alteration shall be made once the test run has started.
- 94.6.4 Optical failure warning signals verification test
- 94.6.4.1 With the vehicle stationary check that the warning signals comply with the requirements of paragraph 94.5.6. above.
- 94.6.4.2 With the vehicle stationary, activate the information and warning signals as specified in paragraphs 94.5.4. and 94.5.5. and verify that the signals comply with the requirements specified in those paragraphs.
- 94.6.5 Blind Spot Information Dynamic Test
- 94.6.5.1 Using markers and the bicycle dummy, form a corridor according to Figure 1 in Appendix 1 to this Regulation and the additional dimensions as specified in Table 1 of Appendix 1 to this Regulation.
- 94.6.5.2 Position the bicycle target at the appropriate starting position as shown in Figure 1 of Appendix 1 to this Regulation.
- 94.6.5.3 Position a local traffic sign corresponding to sign C14 as defined in the Vienna convention on road signs and signals³ (speed limit 50 km/h) or the local sign closest to this sign in meaning on a pole at the entry of the corridor which as shown in Figure 1 of Appendix 1 to this Regulation. The lowest point of the sign shall be located at 2 m above the test track surface.
- 94.6.5.4 Drive the vehicle at a speed as shown in Table 1 of Appendix 1 to this Regulation with a tolerance of ± 2 km/h through the corridor.
- 94.6.5.5 Do not operate the direction indicators during the test.
- 94.6.5.6 Put the dummy on the starting point as showed in Figure 1 of Appendix 1 to this Regulation. The dummy shall be moved along a straight line as showed in Figure 1 of Appendix 1. The acceleration of the dummy shall be such that the dummy shall have reached the speed for the actual test case, as shown in Table 1, after a distance of not more than 5.66 m and after the acceleration the

dummy shall move in a steady pace for at least 8 seconds with a speed tolerance of ± 0.5 km/h. The dummy shall cross line A (Figure 1 of Appendix 1) with a tolerance of ± 0.5 m at the same time as the vehicle cross line B (Figure 1 of Appendix 1) with a tolerance of ± 0.5 m.

If the acceleration distance cannot be achieved, adjust bicycle starting position and vehicle corridor length by the same amount.

The lateral deviation of the dummy with respect to a straight line connecting initial starting position and theoretical collision point (as defined in Figure 1 of Appendix 1) shall be maximum ± 0.2 m.

94.6.5.7 Verify if the Blind Spot Information signal has been activated before the vehicle crosses line C in Figure 1 of Appendix 1 to this Regulation, and if the Blind Spot Information signal has not been activated before the vehicle crosses line D in Figure 1.

94.6.5.8 Verify that the Blind Spot Information signal has not been activated when passing the traffic sign and any markers as long as the bicycle dummy is still stationary.

94.6.5.9 Repeat paragraphs 94.6.5.1. to 94.6.5.8. for test cases shown in Table 1 of Paragraph 94.6.10 to this Regulation.

Where this is deemed justified, the Technical Service may select additional test cases different than shown in Table 1 of Paragraph 94.6.10, within the range of vehicle speed, bicycle speed and lateral clearance as indicated in paragraphs 94.5.3.1.3. and 94.5.3.1.4.

The Technical Service shall check that the parameter combination in the selected test cases would lead to a collision between the bicycle and the vehicle with an impact position in the range as specified in paragraph 94.5.3.1.4. and shall assure that the vehicle is moving with the selected speed when crossing line C in Figure 1 paragraph 94.6.10 by appropriately adjusting starting distances and corridor length for the vehicle and the bicycle.

The criterium “first point of information” is deemed to be complied with when test cases other than those from table 1 in paragraph 94.6.10 to this regulation are carried out.

94.6.5.10 The test is passed when the Blind Spot Information signal has been activated in all test cases as shown in Table 1 of Paragraph

94.6.10 to this Regulation before the foremost point of the vehicle has reached line C but not before the foremost point of the vehicle has reached line D (see paragraph 94.6.5.7. above, where line D is only relevant for test cases taken from Table 1 of Paragraph 94.6.10) and the Blind Spot Information signal has not been activated in any test run when the vehicle passes the traffic sign (see paragraph 94.6.5.8. above). However, the information signal is not required when the relative longitudinal distance between bicycle and front right corner of the vehicle is more than 30 m to the rear or 7 m to the front.

For vehicle speeds up to 5 km/h, it is deemed satisfactory if the information signal is activated 1.4 seconds before the bicycle has reached the theoretical collision point as specified in Paragraph 94.6.10, Figure 1.

For vehicle speeds above 25 km/h, where the stopping distance is higher than 15 m, d_c as specified in Paragraph 94.6.10, Figure 1 shall be as specified in Paragraph 94.6.10, Table 2.

- 94.6.5.11 Vehicles of categories N2 with a technically permissible maximum mass not exceeding 8 tonnes and M2 are deemed to meet the requirements of paragraph 94.6.5. if the Blind Spot Information signal has been activated when the bicycle target is moving forward as specified in paragraph 94.5.3.1.4.1. and entering a zone on the nearside of the moving vehicle. In such case, the specification of the relevant zone and the activation of the information signal shall be in accordance with the manufacturer's specifications. These specifications shall however cover both the entry from the front and from the rear of the manufacturer defined zone.

94.6.6 Blind Spot Information Static Tests

94.6.6.1 Static Test Type 1

Leave the vehicle under test stationary. Then manoeuvre the bicycle dummy perpendicular to the longitudinal median plane of the vehicle with an impact position 1.15 m in front of the most forward point of the vehicle, with a speed of 5 ± 0.5 km/h and a lateral tolerance of 0.2 m, as shown in Figure 2 in Paragraph 94.6.10.

The test is passed if the Blind Spot Information signal is activated at the latest when the distance between bicycle and vehicle is 2

m.

94.6.6.2 Static Test Type 2

Leave the vehicle under test stationary. Then manoeuvre the bicycle dummy parallel to the longitudinal median plane of the vehicle, with a lateral separation of 2.75 ± 0.2 m, with a bicycle speed of 20 ± 0.5 km/h, as shown in Figure 2 of Paragraph 94.6.10.

The bicycle should be at constant speed at least 44 m before passing the most forward vehicle point.

The test is passed if the Blind Spot information signal is activated at the latest when the bicycle is 7.77 m away from the projection of the vehicle's most forward point to the bicycle line of movement.

94.6.6.3 Vehicles of categories N2 with a technically permissible maximum mass not exceeding 8 tonnes and M2 are deemed to meet the requirements of paragraph 94.6.6. if the Blind Spot Information signal has been activated when the bicycle target is entering longitudinally forward from the rear into a zone adjacent to the vehicle. The zone shall cover a lateral separation between bicycle and vehicle of 0.9 to 3.0 meters and from the vehicle front right corner to the rear of the vehicle. In such case the activation shall occur before the entire bicycle target has entered the zone.

94.6.7 The manufacturer shall demonstrate, to the satisfaction of the Technical Service and Type Approval Authority, through the use of documentation, simulation or any other means, that the Blind Spot Information signal is not activated, as described in paragraph 94.6.5.10., when the vehicle passes any other usual stationary object than the traffic sign. In particular, parked cars and traffic cones shall be addressed.

94.6.8 Failure detection test

94.6.8.1 Simulate a BSIS failure, for example by disconnecting the power source to any BSIS component or disconnecting any electrical connection between BSIS components. The electrical connections for the failure warning signal of paragraph 94.5.6.1. above shall not be disconnected when simulating a BSIS failure.

94.6.8.2 The failure warning signal mentioned in paragraph 94.5.3.1.7. above and specified in paragraph 94.5.6.1. shall be activated and remain activated while the vehicle is being driven and be reactivated upon each activation of the vehicle master control switch as long as the simulated failure exists.

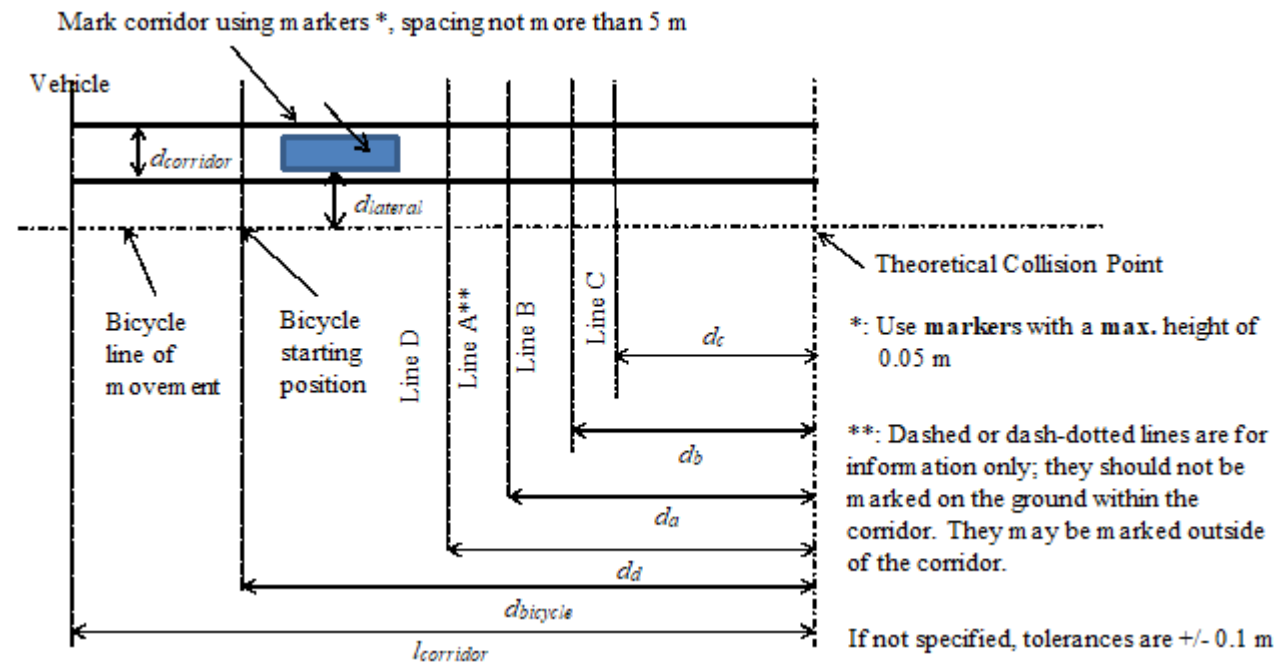
94.6.9 Automatic deactivation test

94.6.9.1 Contaminate any of the system's sensing devices completely with a substance comparable to snow, ice or mud (e.g. based on water). The BSIS shall automatically deactivate, indicating this condition as specified in paragraph 94.5.6.2.

94.6.9.2 Remove any contamination from the system's sensing devices completely and perform a reactivation of the vehicle master control switch. The BSIS shall automatically reactivate after a driving time not exceeding 60 seconds.

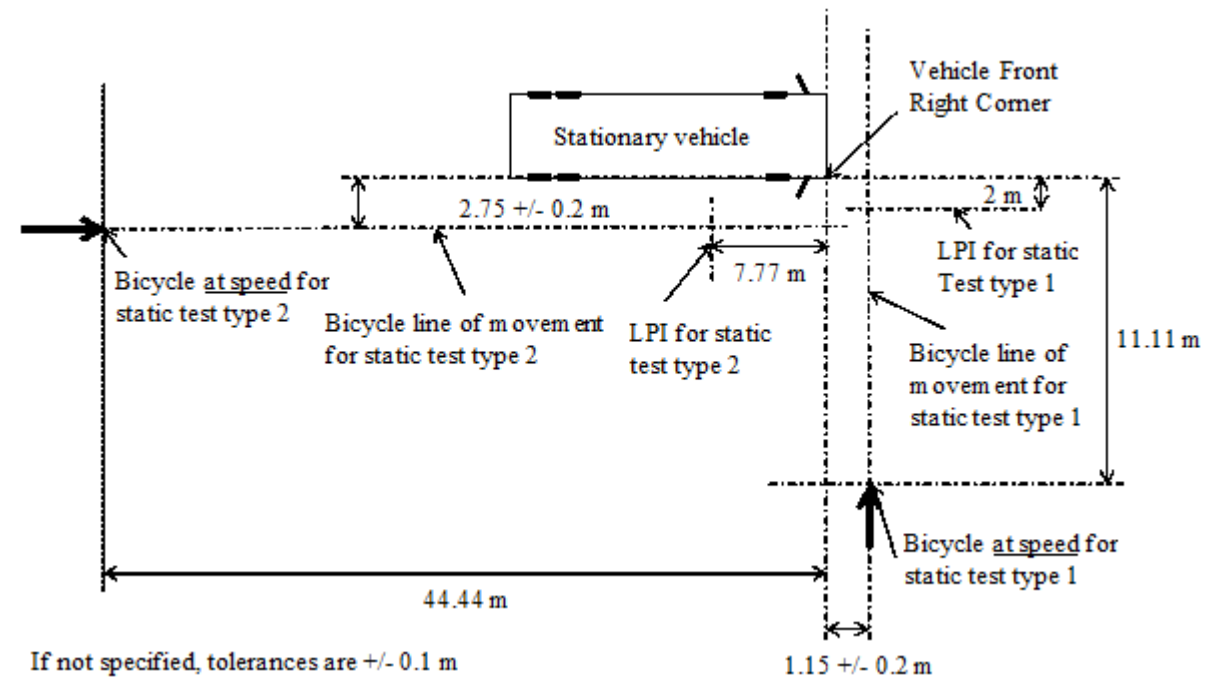
94.6.10 Appendix 1

Figure 1
Dynamic tests



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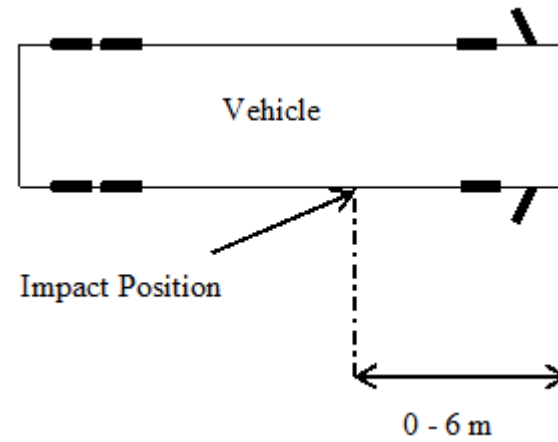
Figure 2
Static tests



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Figure 3

Impact location



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Table 1

Test cases

The following table details the test cases, using the following variables:

V_{vehicle} = steady-state velocity of vehicle

V_{bicycle} = steady-state velocity of bicycle

d_a = bicycle position when vehicle crosses line b

d_b = vehicle position when bicycle crosses line a

d_c = vehicle position at last point of information

d_d = vehicle position at first point of information

$(d_c + (6\text{m-Impact Position}) + 11.11 \text{ m})$ for vehicle speeds of 10 km/h and $(d_c + (6\text{m-Impact Position}) + 22.22 \text{ m})$ for vehicle speeds of 20 km/h)

d_{bicycle} = starting position of bicycle

l_{corridor} = length of vehicle corridor

d_{corridor} = width of vehicle corridor

d_{lateral} = lateral separation between bicycle and vehicle

The following variables do not specify test cases, but are given for information only (not influencing test parameters):

(a) Impact position [m], this specifies the impact position for which the values of d_a and d_b in Table 1 have been calculated (d_d is always calculated for either an impact position of 6 m or start of synchronized movement, in case of same speeds for vehicles and bicycle);

(b) Turn radius [m], this specifies the turn radius for which the values of d_a and d_b in Table 1 have been calculated.

Test Case	V _{bicycle} [km/h]	V _{Vehicle} [km/h]	d _{lateral} [m]	d _a [m]	d _b [m]	d _c [m]	d _d [m]	d _{bicycle} [m]	l _{corridor} [m]	d _{corridor} [m]	For information only (not influencing test parameters)	
											Impact Position [m]	Turn Radius [m]
1	20	10	1.25	44.4	15.8	15	26.1	65	80	vehicle width + 1 m	6	5
2	20	10			22	15	32.3				0	10
3	20	20			38.3	38.3	-				6	25
4	10	20	4.25	22.2	43.5	15	43.2				0	25
5	10	10			19.8	19.8	-				0	5
6	20	10		44.4	14.7	15	26.1				6	10
7			17.7		29.1		3				10	

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Table 2

d_c for speeds above 25 km/h

Vehicle Speed [km/h]	d_c [m]
25	15
26	15.33
27	16.13
28	16.94
29	17.77
30	18.61

94.7 Procedure to define performance requirements for test cases other than those shown in the test case table

According to paragraph 94.6.5.9., the Technical Service may test other test cases than those shown in Table 1, Paragraph 94.6.10.

In this case, the Technical Service is obliged to verify that the selected parameter combination would lead to a critical situation.

As a guidance for this, the following procedure assists in specifying the performance requirements.

d_a – the value d_a is used for synchronization between vehicle and bicycle movement. It is computed by multiplying 8 seconds of constant speed travel with the bicycle speed as specified in the table:

$$d_a = 8s \cdot v_{Bicycle}$$

d_b – the value d_b is used for synchronization between vehicle and bicycle movement. It is composed of three parts. The first part corresponds to 8 seconds of constant travel of the truck:

$$d_{b,1} = 8s \cdot v_{Vehicle}$$

The second part shifts the synchronization by taking into account the impact position of the bicycle. It is given using the Impact Location L:

$$d_{b,2} = L$$

The third part then takes into account the longer travel of the truck due to negotiating a constant radius turn towards the collision point rather than just going straight ahead as the bicycle does.

The turn segment is approximated by a constant radius circle that ends as soon as the desired lateral displacement is achieved. Therefore d_b needs to be shifted by the difference distance between straight and turning.

It can be calculated using the turn radius R, the lateral displacement $Y = d_{lateral} + 0.25$ m (distance bicycle centreline to vehicle edge) and the impact location L.

$$d_{b,3} = R \cdot \cos^{-1} \left(\frac{R - Y}{Y} \right) - \sqrt{R^2 - (R - Y)^2}$$

The final value for d_b is $d_{b,1}$ minus the other two parts $d_{b,2}$ and $d_{b,3}$:

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$$d_b = 8s \cdot v_{Vehicle} - L - R \cdot \cos^{-1} \left(\frac{R - Y}{Y} \right) - \sqrt{R^2 - (R - Y)^2}$$

The value d_c defines the last point of information. For vehicle speeds of 10 km/h and higher, it is the maximum of two values:

the first value has been derived from physical test runs and characterizes at what distance from the collision point the heavy vehicle turn is started at the earliest and by turning towards the outside, the value is: 15 m.

The second value is the stopping distance, considering reaction time and the brake deceleration a , using the parameters deceleration and reaction time (5 m/s² and 1.4 seconds, respectively):

$$d_{Stop} = v_{Vehicle} \cdot t_{react} + \frac{v_{Vehicle}^2}{2|a|}$$

Therefore, d_c is defined by

$$d_c = \text{MAX} \left(15 \text{ m}; v_{Vehicle} \cdot t_{react} + \frac{v_{Vehicle}^2}{2|a|} \right)$$

For vehicle speeds below 5 km/h, it is sufficient if the information signal is given at a distance corresponding to a TTC value of 1.4 seconds (similar to the static tests).

Finally, d_d is the first point of information. It can be calculated by adding the distance corresponding to 4 seconds of vehicle travel time to d_c and correcting for the impact position in case the impact position is not 6 m:

These formulas allow to completely populate Table 1 in Paragraph 94.6.10 for test cases other than those defined there.