This is a translation to English for reference purpose of JNCAP test method which is originally prescribed in Japanese language.
Please be sure to refer to the Japanese test method if you need to be precisely correct.

Autonomous Emergency Braking System [car to bicycle] performance test method

Created: April 1, 2022
Revised: April 25, 2023

1. Effective Date

This test method shall come into effect on April 1, 2022. However, the new regulations set on April 25, 2023 will go into effect starting April 25, 2023.

2. Scope of Application, etc.

This test method applies to vehicles with a seating capacity of less than 10 passengers used exclusively for passenger use and vehicles with a gross vehicle weight of 2.8 tons or less used for freight transportation, which are equipped with Autonomous Emergency Braking System [car to bicycle], as part of the New Car, etc. Assessment Information Provision Project provided by the National Agency for Automotive Safety & Victims' Aid (hereafter referred to as "NASVA").

3. Definition of Terms

Throughout this test procedure, the following terms are used:

(1) **"AEBS (Autonomous Emergency Braking System)"** refers to a device that automatically operates the brakes of a motor vehicle to avoid or reduce the speed of collision with a bicycle traveling ahead or crossing the road.

(2) **"FCWS (Forward Collision Warning System)"** refers to the warning system that uses a combination of either "auditory and visual information" or "auditory and haptic information" to alert the driver of a potential collision with a bicycle crossing.

(3) **"AEBS Activation Point"** refers to the time when the deceleration by AEBS first crossed $0.3m/s^2$.

(4) **"FCWS Activation Point"** refers to the time when the warning using audio information by FCWS started.

(5) **"Test target"** means a test device that simulates a bicycle with an adult rider as shown in Appendix A.

(6) **"CBL (Car to Bicyclist Longitudinal)"** means a test scenario in which the test vehicle pursues a test target moving straight ahead in the same direction as the direction of travel of the test vehicle.

(7) **"CBF (Car to Bicyclist Farside)"** means a test scenario in which the test target crosses from the right side with respect to the direction of travel of the test vehicle.

(8) **"CBNO (Car to Bicyclist Nearside Obstructed)"** means a test scenario in which the test target crosses from the left in the direction of travel of the test vehicle, with the shielding wall shown in Appendix B in front of it.

(9) **"Reference running line"** means, in CBL, the target course through which the rear end of the test target passes.

(10) **"Reference crossing line"** means, in CBF and CBNO, the target course through which the

side edge of the test target (the side approached by the test vehicle) passes.

(11) **"Reference runway"** means the target course for the test vehicle to travel.

(12) **" TTC (Time To Collision)"** means, for CBL, the time remaining before collision when the test vehicle and the test target maintain their current speed, and for CBF and CBNO, the time remaining before test vehicle reaches the reference crossing line when the test vehicle maintains its current speed.

(13) **"Target interference area"** means a virtual polyhedron surrounding the outermost portion of the test target that is established for use in determining collision with the test vehicle. (Figure 1)

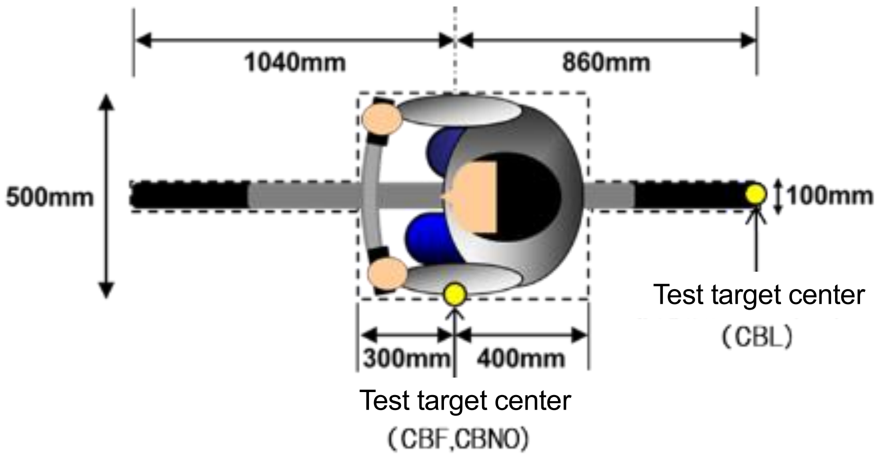


Figure 1: Definition of target interference area

(14) **"Approximate bumper line"** means a line approximating the shape of the front bumper of the test vehicle to be established for use in determining collision with the test target. The approximate bumper line is represented by a line segment that divides the overall vehicle width of the test vehicle minus 50 mm on each side into six equal parts and connects each division line with an intersection point on the front bumper. (Figure 2)

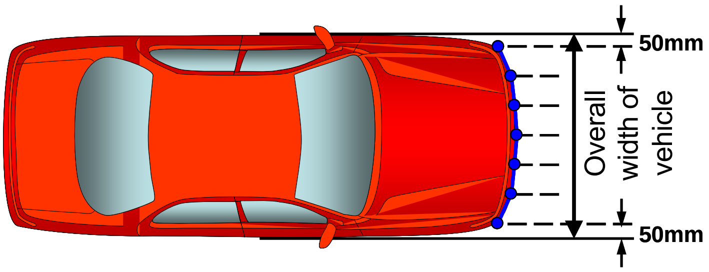


Figure 2: Definition of approximate bumper line

(15) **"Collision"** refers to a condition under which the approximate bumper line of the test vehicle enters the target interference area.

(16) **"Crash speed"** means the travel speed at the moment of collision between the test vehicle and the test target in CBF and CBNO.

(17) **"Relative velocity at impact"** means the relative velocity of the test vehicle at the moment of impact with the test target in the CBL.

(18) **"Initial velocity"** means the driving speed of the test vehicle at the time of AEBS activation for CBF and CBNO AEBS tests and at the time of FCWS activation or AEBS activation,

whichever occurs first, for FCWS tests.

(19) **"Initial velocity difference"** means the relative velocity difference between the test vehicle and the test target at the time of AEBS activation for the CBL AEBS test and at the time of FCWS activation or AEBS activation for the FCWS test, whichever is earlier.

(20) **"Velocity reduction"** means the initial velocity difference minus the relative velocity at impact for CBL, and the initial velocity minus the impact velocity for CBF and CBNO.

(21) **"Rate of velocity reduction"** means the amount of velocity reduction divided by the initial velocity difference for CBL and by the initial velocity for CBF and CBNO.

(22) **"Lateral position"** means the lateral distance to the reference runway at each of the leading edge center of the test vehicle and the trailing edge center of the test target. (Figure 3)

(23) **"Offset amount"** refers to the difference between the horizontal position of the test vehicle and the test target. (Figure 3)

(24) **"Lateral deviation of the test target"** means the difference between the center of the test target and the reference crossing line. (Figure 3)

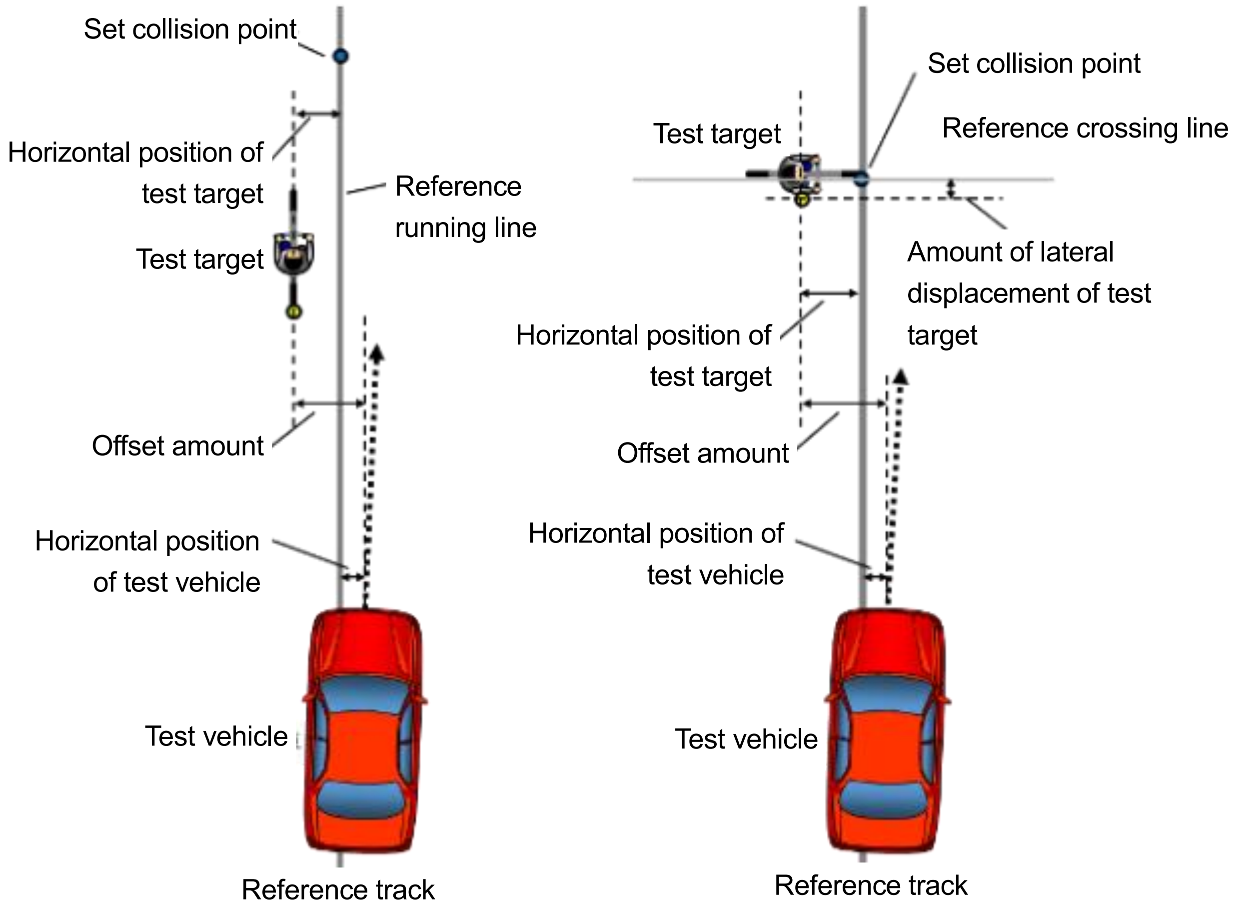


Figure 3: Definition of lateral position and offset amount

(25) **"Wrap rate"** means the difference between the lateral position of the left or right end of the vehicle and the lateral position of the test target of the test vehicle divided by the overall width of the test vehicle, expressed as a percentage.

(26) **“Set collision point”**, which is set for each test scenario, refers to a value obtained by converting the lateral position of the test target when the test vehicle running in the standard track reaches the reference crossing line without the AEBS activated into the wrap rate.

(27) **"Predicted impact point"** means the lateral position of the test target at 4.0 seconds after

the start of the measurement (when the TTC reaches 4.0 seconds), converted to a wrap rate.

(28) **"Pedal stroke"** means the amount of stroke of the brake pedal of the test vehicle.

(29) **"Accelerator operating volume"** means the amount of operation of the accelerator pedal of the test vehicle.

(30) **"Mass at vehicle delivery"** refers to the condition of the test vehicle loaded with the fuel, lubricants, coolants and the like in the engine and the fueling system, and equipped with onboard tools, a spare tire and standard accessories.

(31) **"Brake temperature before braking"** refers to the higher of the average temperature of the left wheel or the right wheel of each axle when the temperature of the brake lining or pad of each wheel is measured, pursuant to the procedures of JIS D 0210, immediately before the start of each run for braking with the vehicle in fixed position.

(32) **"Brake temperature check unit"** refers to a device to check the brake temperature before braking of the test vehicle by thermocouple measurement.

4. Test conditions

4.1 Provision of data from vehicle manufactures, etc.

Vehicle manufacturers, etc shall provide NASVA with the following data required for test preparation (Attached Table 1).

4.2. Test vehicle's condition

The test vehicle shall be in the following status.

(1) Loading condition: With one driver in the vehicle, the mass of the test vehicle including measuring equipment, etc., shall be the delivered mass + 200 kg (within ±1%). The load distribution between the front and rear axles shall be equal (within ±5%) to the load distribution (%) of the delivered mass.

If the aforementioned requirements are not met, the component may be removed or installed without affecting performance. Parts to increase weight shall be securely attached.

(2) Tires: Tires shall be those installed on the test vehicle at the time of purchase. Tire break-in runs shall also be used for the break-in runs defined in Section 5.1. In addition, the tire pressure shall be adjusted on a level surface before driving (at room temperature) to the value for normal driving described in the specifications, etc.

(3) Braking system: Discs, drums and friction materials shall be those installed on the test vehicle at the time of purchase. The braking system shall be duly adjusted and shall not be affected by abnormal thermal history or water damage.

(4) Drive axle: For vehicles with selectable drive shafts, the drive shaft normally used shall be selected.

(5) AEBS and FCWS settings: If the driver can set the activation start timing of AEBS or FCWS, it shall be the median value within a configurable range. If there is (an even number of possible settings) with no median value, the value closest to the median value is set on the side where the activation start timing is later.

(6) Protection devices: In vehicles equipped with occupant protection devices and pedestrian protection devices, such devices shall be left inoperative.

4.3 Test track

The test track shall meet the following requirements:

(1) The test track shall be flat, clean paved road surface without any leaves, dirt or the like, and dry.

(2) The coefficient of friction of the test track shall be about 0.9 in dry condition. In this case, the

measurement method shall be in accordance with ASTM E1337, the test tire shall be ASTM E1136, the test load shall be 4586±67 N, the tire pressure shall be 241±3 kPa, and the speed shall be 64±0.8 km/h.

(3) There shall be no other obstacles within 3 m on either side of the reference runway at the time of the test and within 30 m in front of the test end point. In addition, there shall be no road paints or markings at the points where deceleration due to AEBS activation or braking after FCWS is expected.

4.4 Weather conditions

The test shall be executed in the following weather conditions.

(1) At the time of test, air temperature is within the range of -5°C to 40°C.

(2) At the time of test, average wind speed is 5 m/s or less.

(3) Visibility during testing shall be 1km or more.

(4) A declaration by a vehicle manufacturer might allow the following tests under sunlight conditions to be avoided.

① When illumination during testing is 2000 lx or less.

② When there is a strong shadow near the reference runway other than the shadow of the test vehicle and the test target.

③ Direct sunlight shines on the test vehicle from the front or the rear.

④ Temperature at time of testing below 5°C.

4.5 Measurement items

The measurement items in the test shall be as follows, and the sampling frequency shall be 100 Hz or higher. For yaw rate and front/rear acceleration, high-frequency components shall be removed at a cutoff frequency of 10 Hz.

(1) AEBS activation time

(2) FCWS activation time

(3) Collision time

(4) Test vehicle and test target positions

(5) Test vehicle and test target speeds

(6) Yaw rate of test vehicle

(7) Front/rear acceleration of test vehicle

(8) Steering angle speed of test vehicle

(9) Pedal stroke

(10) Accelerator operation amount

(11) Brake temperature before braking

4.6. Measuring equipment

The following measuring instruments used in the test shall be able to smoothly handle the measurement data of the measurement items specified in Section 4.5. In addition, the position of the test vehicle shall be verified prior to the test, and the accuracy of other measuring instruments shall be confirmed by the results of calibration by the manufacturer of the measuring instruments, etc.

(1) Test vehicle position measuring device: The accuracy of the test vehicle position for each test shall be within ±0.03 m.

(2) Test vehicle speed measuring device: The accuracy of the test vehicle speed for each test shall be within ±0.1 km/h.

(3) Yaw rate measuring device: Yaw rate accuracy for each test shall be within ±0.1°/s.

(4) Longitudinal acceleration measurement device: Accuracy of longitudinal acceleration for each

test shall be within ±0.1m/s^2.

(5) Steering wheel velocity measurement device: Accuracy of steering wheel velocity for each test shall be within ±1°/s.

(6) Brake pedal stroke measurement device: Accuracy of brake pedal stroke for each test shall be within ±1mm.

(7) Accelerator operation measurement device: Accuracy of accelerator stroke for each test shall be within ±1%.

(8) Brake temperature check unit: Accuracy of temperature of each test shall be within ±3%.

(9) Test target position measurement device: Accuracy of test target position of each test shall be within ±0.03m.

(10) Test target speed measurement device: Accuracy of test target speed of each test shall be within ±0.01km/h.

5. Pre-test run

5.1 Break-in run

To break-in the disc, drum, and friction material of the brake system of the test vehicle, 200 operations shall be performed in which the vehicle is accelerated to 64 km/h and then stopped by operating the brakes to generate a deceleration of 3.7 m/s^2 (except for other tests in which similar break-in runs were performed). The interval between the first brake operation and the next brake operation shall be the time required to reduce the brake temperature between 110°C and 132°C or the distance traveled to reach 1.6 km, whichever is earlier. After each stop, the vehicle shall accelerate to 64 km/h and maintain that speed until the next braking. (Break-in runs are equivalent to those specified in FMVSS105 S7.4.1.1.)

If requested by the vehicle manufacturer, etc., the vehicle may be driven on general roads (not highway), etc., for up to 100 km for initialization work of the sensor device. If the conditions necessary for initialization are met, the initialization process may be performed in conjunction with the break-in run described above.

5.2 Re-break-in, etc.

In the case of a braking system test that is the first for the test vehicle (the generic term for a test in which a break-in is performed in accordance with Section 5.1), the vehicle shall undergo 35 re-break-in runs in accordance with Section 5.1. However, if more than 2 weeks have elapsed since the mortise run, the re-break-in run may be performed up to 50 times.

If this is the second or subsequent braking system test (the same applies if multiple days are required in the same test), the test may be re-run 35 times if more than one week has elapsed since the previous test date, and up to 50 times if more than two weeks have elapsed.

If re-brake conditioning test is not carried out on the day of test, warm up run should be carried out until the brake temperature exceed 100°C by the procedure of the Section 5.1

6. Test method

6.1 Testing

(1) Test scenarios: Testing shall be performed using three different test scenarios for each of the AEBS and FCWS tests, including CBL, CBF, and CBNO. The set collision points will be conducted with a 50% wrap rate for all test scenarios, and the target speed for the test will be set at 15 km/h for CBL and CBF, and 10 km/h for CBNO. The initial position of the test target shall be the position where the target is in a constant speed state by 4 seconds before TTC in CBL, and in CBF and CBNO it shall be the position where the target is in a constant speed

state while it is shielded by the shielding wall. (See Figures 4-1,2,3)

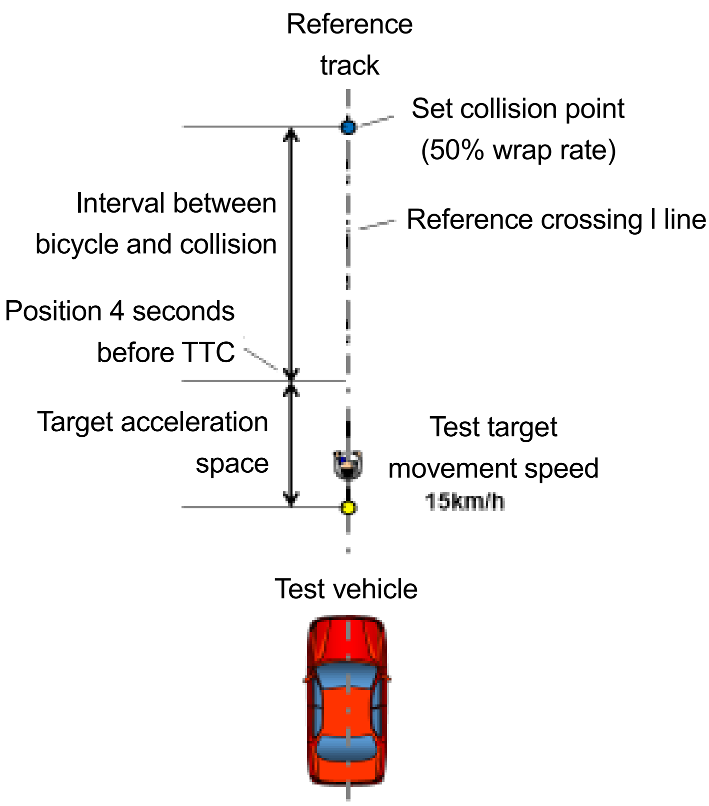


Figure 4-1 CBL

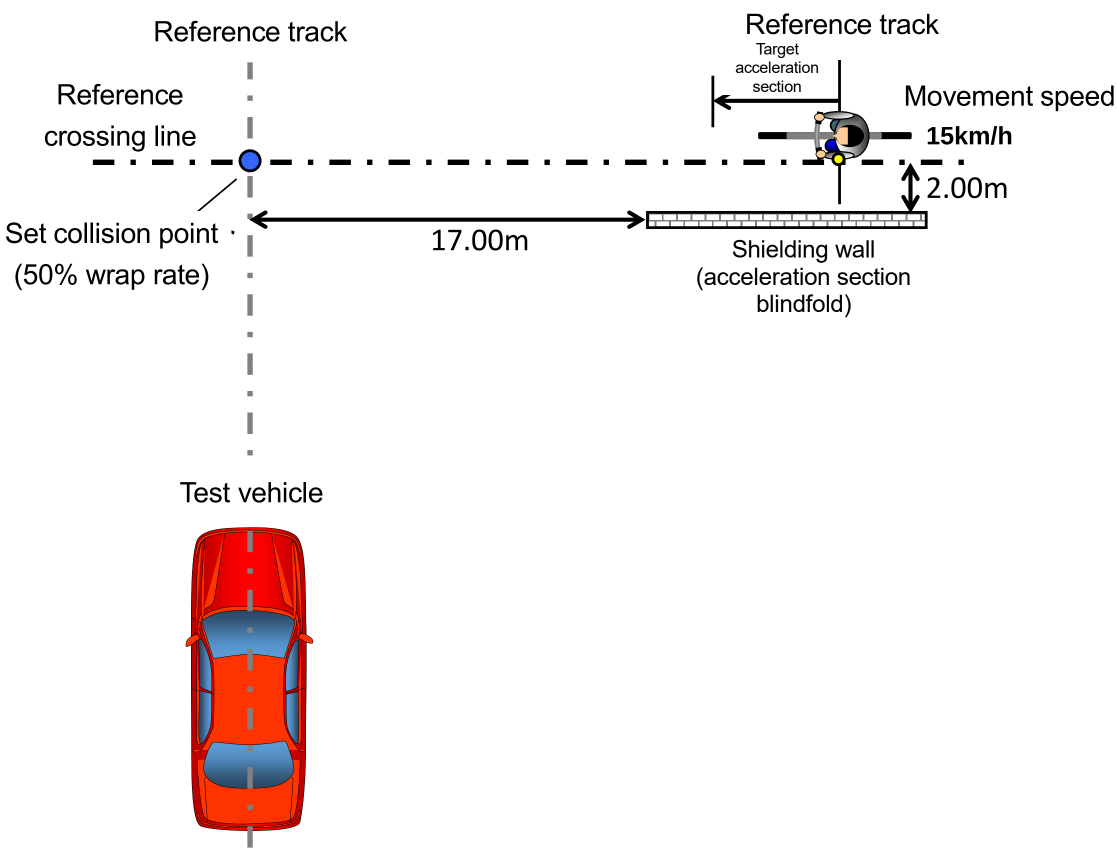


Figure 4-2 CBF

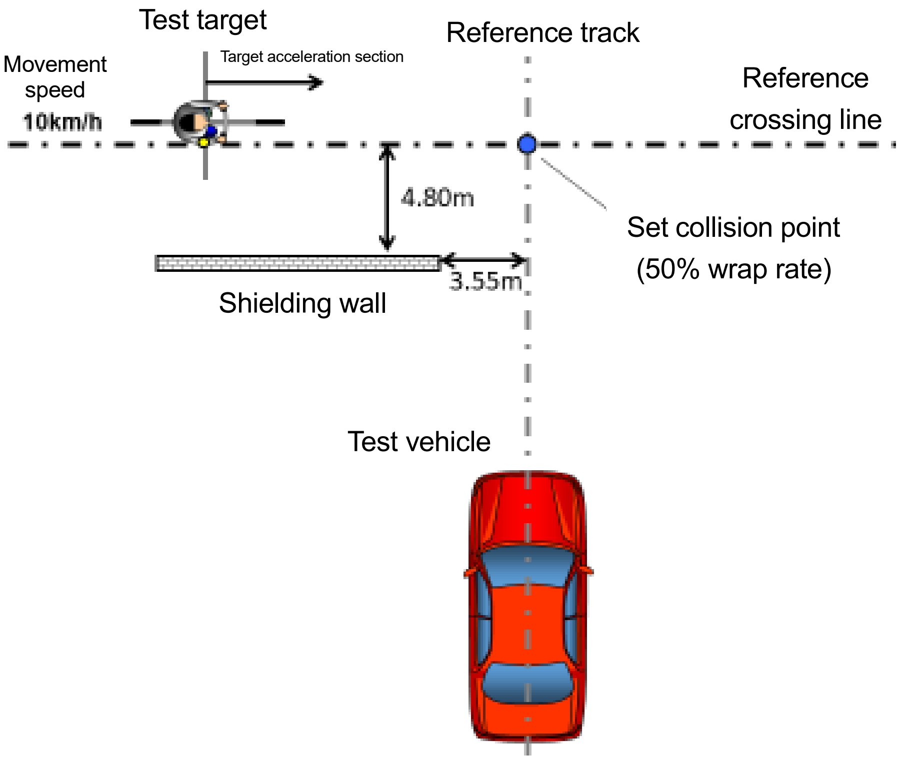


Figure 4-3 CBNO

(2) Test vehicle speed: The test speed of the test vehicle shall be within the range shown in Table 1. The test shall be conducted starting from the lowest speed condition and increasing the test speed in steps of 10 km/h intervals for CBL and 5 km/h or 10 km/h intervals for CBF and CBNO. The speed requirement to start the test may be raised upon declaration by the vehicle manufacturer, etc. Similarly, the speed requirement to complete the test may be lowered upon declaration by the vehicle manufacturer, etc. In any case, however, the test results for unexecuted speed conditions shall be treated as if the device did not operate.

Table 1: Test speed

	AEBS test	FCWS test
CBL	40 to 60 km/h	40 to 60 km/h
CBF	10 to 60 km/h	10 to 60 km/h
CBNO	10 to 50 km/h	10 to 50 km/h

(3) Transmission: If the transmission of the test vehicle is an automatic transmission, the gear position shall be D range. For manual transmissions, the highest gear position in which the engine speed is greater than 1500 rpm while running at the test speed shall be used, and the clutch shall not be disengaged during the test.

(4) Measurement section of the test: Measurement shall begin when the test vehicle approaches the test target and the TTC reaches 4.0 seconds. The measurement ends when one of the following conditions is reached.

① When the test vehicle is stopped.

② For CBL, when the speed of the test vehicle falls below the speed of the test target; for CBF and CBNO, when the rear edge of the target interference area exceeds the side edge of the approximate bumper line.

③ When the test vehicle collides with the test target.

(5) Conditions for test validity: If a given measurement item deviates from the tolerances shown in Table 2 from the start of measurement until the initial speed difference is obtained for CBL and the initial speed is obtained for CBF and CBNO, or if the test image in Section 6.3 is not obtained (except in cases where the driving condition of the test vehicle, the operation of the test target, and the collision/avoidance condition can be confirmed by the video images inside or outside the vehicle), it shall be considered invalid (foul) and not included in the test count. The measured values shall be rounded to the nearest unit for each item. (The same applies hereinafter in this test method.)

If any abnormality is found in the operating conditions of the test target, the recorded measurement data and test video shall be analyzed, and if any of the following abnormalities are revealed, the target shall be considered as a foul and shall not be included in the number of tests.

① When the posture of the test target changes significantly.

② When the rotation of the front and rear wheels of the test target has apparently stopped.

Table 2-1 Tolerance of test conditions (CBL)

Test condition	Permissible range
Test vehicle speed	Test speed + within 0.5 km/h
Test target speed	Set speed within ±0.5 km/h (except for the target acceleration section)
Horizontal position of test vehicle	Reference runway within ±0.05 m
Offset amount	Within ±0.15 m
Yaw rate	Within ±1.0°/s
Steering angle velocity	Within ±15.0°/s
Temperature of brakes before braking	65-100°C

Table 2-2 Tolerance of test conditions (CBF,CBNO)

Test condition	Permissible range
Test vehicle speed	Test speed + within 0.5 km/h
Test target speed	Set speed within ±0.5 km/h (except for the target acceleration section)
Horizontal position of test vehicle	Reference runway within ±0.05 m
Amount of lateral displacement of test target	Within ±0.10 m of reference crossing line
Expected collision point	Within ±10% of set collision point (only at the start of measurement)
Yaw rate	Within ±1.0°/s
Steering angle velocity	Within ±15.0°/s
Temperature of brakes before braking	65-100°C

(6) Number of tests: The number of tests shall be 3 per test speed. However, the third test may be omitted in the following cases.

① When a collision is avoided twice in a row

② If the same rate of velocity reduction is achieved twice in a row

(7) Test procedure: The test shall start from the lowest speed condition or the speed condition declared by the vehicle manufacturer, etc. for each test scenario. The test speed increase interval for CBF and CBNO shall be 5 km/h, but if a collision is avoided in any two or more of the three tests, the test speed may be increased by 10 km/h (the 5 km/h increase condition is passed). If a collision is similarly avoided under the 10 km/h raised condition, the passed 5 km/h increased condition shall also be treated as a collision avoided. However, if a collision cannot be avoided in any two or more of the three tests, the test speed must be reduced by 5 km/h and the passed 5 km/h increase must also be conducted.

Thereafter, the test is conducted in the same manner up to the highest speed condition or the speed condition declared by the vehicle manufacturer, etc. However, the relevant test scenario shall be terminated when the relative velocity at the time of the collision during the test under the same speed conditions for CBL, and when the collision speed exceeds 40 km/h twice during the test under the same speed conditions for CBF and CBNO.

The order in which the test scenarios are conducted shall be the order reported by the vehicle manufacturer, etc., and the next test scenario shall not be started until the test scenario currently being conducted is completed.

(8) Accelerator operation during AEBS test: The amount of gas pedal operation shall be kept constant during the measurement section so as not to affect the operation of the AEBS. In test vehicles where the accelerator pedal is controlled in accordance with the operation of the AEBS, the amount of gas pedal operation during the operation of the AEBS may be adjusted upon consultation with the vehicle manufacturer, etc.

(9) Accelerator/brake operation during FCWS test: The accelerator pedal of the test vehicle shall be released 1.0 second after the FCWS is activated. The brake pedal shall begin to be depressed 1.2 seconds after the FCWS is activated and shall reach the depressed amount that generates a deceleration of 4.0 (+0.25) m/s^2 under normal conditions in 0.2 seconds (however, the maximum depressed speed is 400 mm/s) and maintain the preset pedal force. For these brake operation settings (pedal stroke amount, depressing speed, and pedal force), the values declared by the vehicle manufacturer, etc., are used. If there is no declaration of the set value from the vehicle manufacturer, etc., or if the deceleration that normally occurs exceeds the allowable range (4.00 to 4.25 m/s$^{2)}$, the mechanism shall set the value by the method described in Appendix C.

In order to conduct this test with high accuracy, it is desirable that the test vehicle be equipped with an automatic driving device or other operation input device.

(10) If it is clear that the FCWS test yields the same results as the AEBS test with or without the FCWS function, the results of the AEBS test may be used as the results of such test. Similarly, in the AEBS test, if the time taken from FCWS activation to impact is 1.2 seconds or less, the AEBS test result shall be the relevant test result.

6.2 Measurement data and recording

(1) Confirmation of completion of testing: For each test, confirm whether the test conditions meet the permissible range of Table 2.

(2) Avoidance of collision: For each test, check whether or not a collision was avoided, and record in Attached Table 2 whether or not a collision was avoided. In the event of a collision, record the measured data from the next issue onward.

(3) Initial speed difference: Record in 0.1 km/h increments.

(4) Initial speed: Record in 0.1 km/h increments.

(5) Velocity reduction: Record in 0.1 km/h increments.

(6) Velocity reduction ratio: Find and record the velocity reduction ratio to second decimal places, rounding off to the third decimal place.

6.3 Recording of test images

(1) In-vehicle video: A video camera installed in the interior of the test vehicle shall be used to record the conditions in front of the test vehicle, near the driver's seat, and the operation of the FCWS. (If it is difficult to photograph the interior of a vehicle due to sunlight or other reasons, the photographing may be stopped after consultation with the vehicle manufacturer, etc.)

(2) Exterior video: A video camera installed at the side of the test track and in front of the test track at the point where a collision between the test vehicle and the test target is expected to occur will record the driving conditions of the test vehicle and the operation and collision/avoidance conditions of the test target.

7. Arrangement of test results

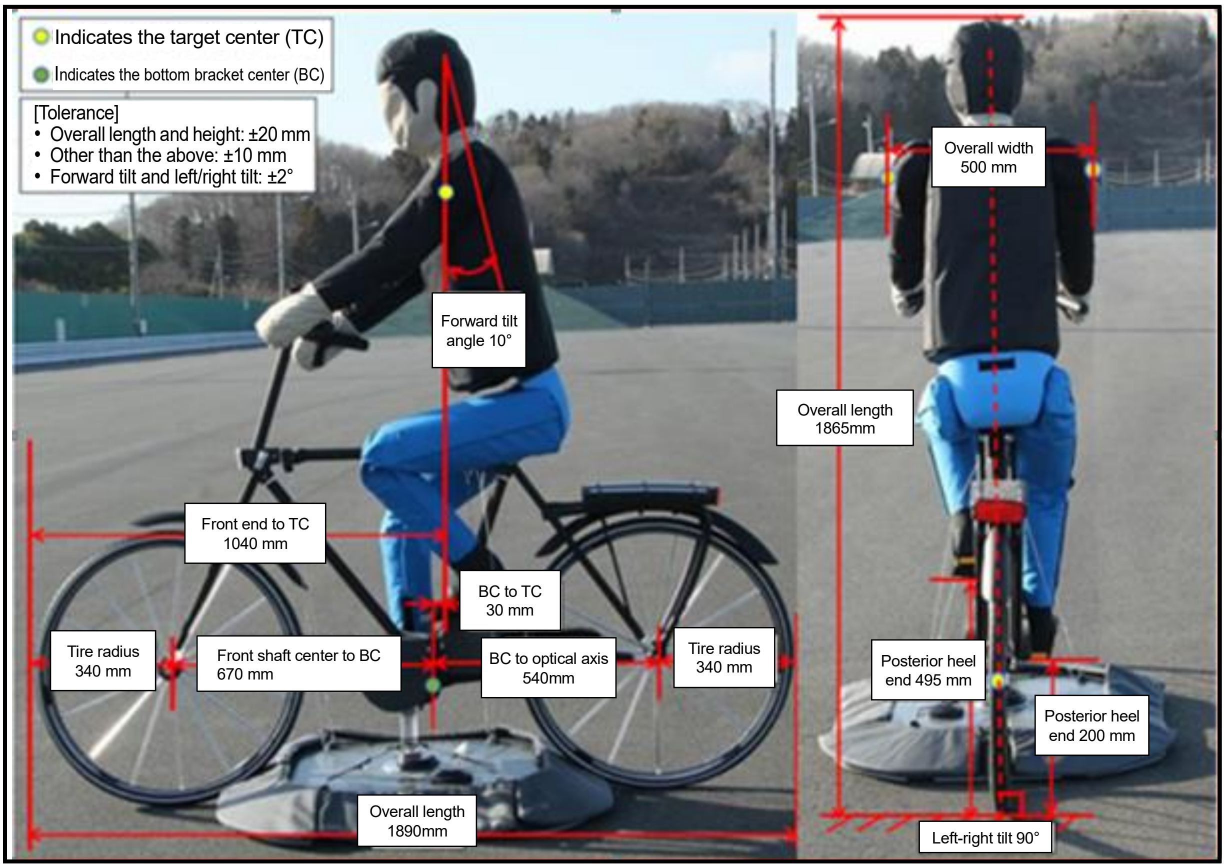
Record test results, etc. in Attached Table 2.

The rate of velocity reduction for each test speed shall be the median value of three valid test results. However, the velocity reduction ratio for the condition where collision is avoided shall be 1.00.

Further, when testing is ended after conducting 2 tests in accordance with the proviso of sections 6.1 (6) and (7), the rate of reduction in the case of 6.1 (6) shall be the Velocity Reduction Rate obtained and the rate of reduction in the case of 6.1 (7) shall be the lower value of the test results.

Appendix A. Test target specifications

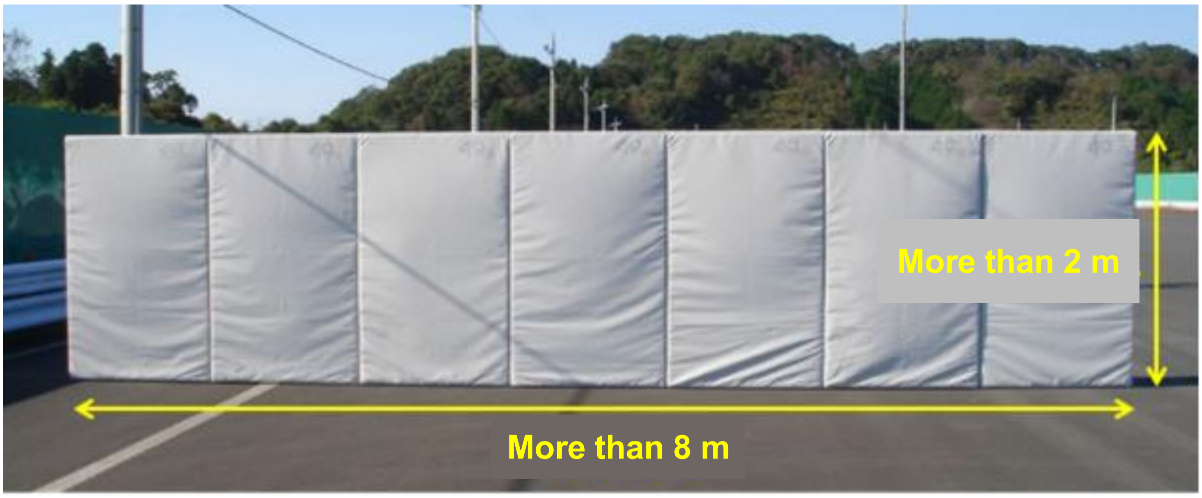
Test targets shall be in accordance with the specifications given in ISO 19206-4 : 2020 Road vehicles - Test devices for target vehicles, vulnerable road users and other objects, for assessment of active safety functions — Part 4 : Requirements for bicyclist targets. Attached Figure A shows the appearance and dimensional specifications of the test target. The test targets will be designed to exhibit detection characteristics similar to those of bicycles and bicyclists for sensors such as laser radar, millimeter wave radar and cameras. The platform will also be designed so as not to affect the detection of test targets by various sensors. Note that the top cover is not installed for the evaluation test.



Attached Figure A. Appearance and dimensional specifications of the test target

Appendix B. Specification of blindfolds and shields for the target acceleration interval used in the test

The target acceleration section shall be blindfolded and shielded with a barrier wall that meets the appearance and dimensions shown in Attached Figure B. The shielding wall shall be designed to exhibit reflective characteristics similar to a brick wall to sensors such as laser radar and millimeter wave radar.



Attached Figure B. Appearance and required dimensions of shielding wall

Appendix C. How to set up brake operation in FCWS test

C.1 Definitions

(1) $T_{BRAKE:}$ When brake pedal stroke exceeds 5 mm

(2) $T_{2m/s}{}^{2:}$ The point in time when the filtered deceleration data exceeds 2 m/s^2 for the first time.

(3) $T_{6m/s}{}^{2:}$ The point in time when the filtered deceleration data exceeds 6 m/s^2 for the first time.

C.2 Measurement method

The measurement methods and filters described in Section 4 of this rule shall be applied.

C.3 How to set brake input characteristics

C.3.1 Preparation for setup

After first performing a warm-up run as described in the notes to Section 5.2 of this rule, the brake input characteristic settings shall be implemented immediately prior to conducting the FCWS test.

C.3.2 Setting brake input characteristics:

(1) Accelerate the test vehicle to 85 km/h or more. If the transmission of the test vehicle is an automatic transmission, the gear position shall be in D range. For manual transmissions, use the highest gear position in which the engine speed is greater than 1500 rpm while running at the test speed.

(2) Release the accelerator pedal, and when the speed falls below 80 (±1) km/h, start braking at a pedal stroke speed of 20 (±5) mm/s until the deceleration rate is 7 m/s^2. For manual transmission, disengage the clutch as soon as possible before the engine speed drops below 1500 rpm. When the deceleration reaches 7 m/s^2, the driving is terminated, and the amount of pedal stroke and pedal force during braking are measured.

(3) Conduct the above runs three times in succession. The interval between each run shall be between 90 seconds and 10 minutes. If the interval exceeds 10 minutes, the driver shall warm up the car again before resuming the run.

(4) Using the deceleration data corresponding to pedal stroke between $T_{2m/s}{}^2$ and $T_{6m/s}{}^2$, a quadratic curve approximation using the least-squares method is used to calculate the pedal stroke corresponding to a deceleration of $4_{m/s}{}^2$ (which is "D4", unit m). The same method is used for the pedal force to obtain the pedal force value corresponding to a deceleration of $4_{m/s}{}^2$ (this is "F4", unit N).

C.3.3 How to set brake pedal force and repetition procedure

(1) The test vehicle is driven at a constant speed of 80 (+1) km/h. The gear position of the test vehicle shall be the same as in C.3.2.

(2) Apply the brake according to the brake operation method described in C.4, not according to FCWS but by manual triggering. Using the measured deceleration data, determine the average deceleration for the interval from T_{BRAKE} + 1 second to T_{BRAKE}+ 3 seconds. If the average deceleration deviates from 4 (+0.25)m/s^2, then the following correction formula is used to correct the value of F4

$F4_{new=}$ $F4_{original}$ * (4 / average deceleration)

(For example, if the average deceleration was 5 m/s^2, then $F4_{new}$ = $F4_{original}$ * 4 / 5)

Repeat the braking operation in C.4 using the modified F4 so that the average deceleration is within the range of 4 (+0.25) m/s^2.

C.4 Brake operation method in FCWS test

(1) The activation of FCWS is detected and the time at which it occurs is T_{FCW}.

(2) Release the accelerator in T_{FCW} + 1 second.

(3) Brake pedal depression control starts at $T_{FCW\ +}$ 1.2 seconds, and the depression speed is D4 x 5 mm/s or 400 mm/s, whichever is smaller. (i.e., the speed to reach the pedal stroke D4 in 200 ms, with an upper limit of 400 mm/s.)

(4) The pedal force value, secondarily filtered at a cutoff frequency of 20 Hz or moving averaged at 50 ms, is monitored and switched to pedal force control with F4 as the target value when either of the following is reached The time at this time is recorded as $T_{switch.}$

① When the pedal stroke D4 defined in C.3 is exceeded for the first time.

② When the tread force value F4 defined in C.3 is exceeded for the first time.

If, even with filtering, etc., the control switches to tread force control before a sufficient amount of tread pressure is reached, the timing of T_{switch} can be adjusted after consultation with the vehicle manufacturer, etc. (For example, measures should be taken to prevent switching to tread force control until a certain amount of tread is reached.)

(5) After T_{switch}, the brake pedal is controlled so that the pedal force is within F4 ± 25%. Stable tread force control should be achieved within 200 ms from T_{switch}, but even if the tread force value exceeds F4 ± 25% due to AEBS intervention, the duration is still acceptable as long as the duration is less than 200 ms.

(6) The average pedal force between TFCW + 1.4 seconds and the end of the test preferably should fall within the range of F4 ± 10 N.

Attached Table 1: Conditions and specifications of the test vehicle for Autonomous Emergency Braking System [car to bicycle] performance test

[To be filled out by the vehicle manufacturer, etc.]

1. Test vehicle specifications

(1) Model/Type (Model Name):____________/________________(_______________)

(2) Sensor system:____________________

(3) Installed Tire

	Front	Rear
Size		
Brand/Type		
Air pressure (kPa)		

2. Declarations, etc by vehicle manufacturer, etc.

(1) AEBS test start speed CBL: km/h CBF: km/h CBNO: km/h

(2) AEBS test end speed CBL: km/h CBF: km/h CBNO: km/h

(3) FCWS function availability: Available / Not Available

(4) FCWS test start speed CBL: km/h CBF: km/h CBNO: km/h

(5) FCWS test end speed CBL: km/h CBF: km/h CBNO: km/h

(6) Specifications of FCWS function: “Auditory and visual information” and “auditory and haptic information”

Frequency of auditory information: Hz Hz

Attach a document stating the location of the provision of such information (speaker location, display location, etc.).

(7) Set value of brake operation during FCWS test:

Pedal stroke amount: mm Depression speed: mm/s Pedal force: N

(8) Manual setting of activation start timing: Yes ( ) / No

(9) Restrictions on sunlight conditions during the test: Yes/No (No need to consider shadows, backlighting, etc.)

(10) Limit on the number of AEBS operations: Yes (up to times per trip) / No

(11) Approximate bumper line setting [mm]:

Overall width of vehicle:

A = (,)

B = (,)

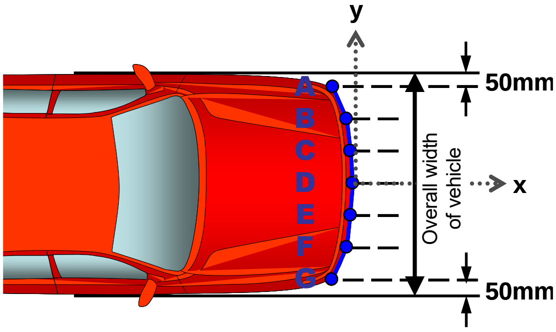
C = (,)

D = (0 , 0)

E = (,)

F = (,)

G = (,)



(12) Protective devices: A written statement describing the method of deactivation of occupant and pedestrian protective devices, or a written statement outlining the modifications to be made to deactivate them.

(13) Advance data submission: Yes (Appendix Table 3 or equivalent)/No

(14) Order of test scenarios ① ② ③

(15) Other special notes, etc.

3. Functions and notes about the system to support users, etc.

Documents shall be attached relating to the subjects and conditions of activation under the environment determined by the vehicle manufacturer, etc and the idea of functions of the system.

Attached Table 2 Test results of Autonomous Emergency Braking System [car to bicycle] performance test

[To be filled out by examining officer]

Test date (YYYY/MM/DD):____________________ Place:_______________

1. Test vehicle specifications

(1) Model/Type (Model Name):__________/______________(______________)

(2) Frame number:____________________

(3) Sensor system:____________________

(4) Installed Tire

	Front	Rear
Size		
Brand/Type		
Air pressure (kPa)		

(5) Test vehicle load distribution

		Left wheel	Right wheel	Subtotal	Grand Total	Front-rear Distribution
Load distribution at vehicle delivery (daN)	Front axle					%
	Rear axle					%
Load distribution at testing time (daN)	Front axle					%
	Rear axle					%

(Note) Indicated as 1daN = 1kgf

2. Setting of conditions for testing, etc.

(1) AEBS test start speed CBL: km/h CBF: km/h CBNO: km/h

(2) AEBS test end speed CBL: km/h CBF: km/h CBNO: km/h

(3) FCWS function availability: Available / Not Available

(4) FCWS test start speed CBL: km/h CBF: km/h CBNO: km/h

(5) FCWS test end speed CBL: km/h CBF: km/h CBNO: km/h

(6) Specifications of FCWS function: “Auditory and visual information” and “auditory and haptic information”

(7) Set value of brake operation during FCWS test:

Test implemented or not: Yes/No

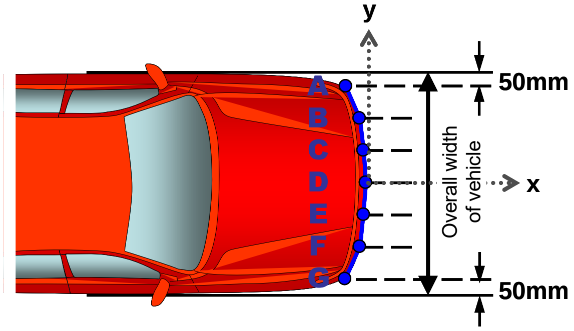
Pedal stroke amount: mm Depression speed: mm/s Pedal force: N

(8) Manual setting of activation start timing: Yes ( )/No

(9) Approximate bumper line setting [mm]:

Overall width of vehicle:

A = (,)
B = (,)
C = (,)
D = (0 , 0)
E = (,)
F = (,)
G = (,)



3. Environmental conditions

Day 1 Test date (YYYY/MM/DD):_______________ Place:____________

Start Time:__________ Weather:______ Temp.________ Wind Speed:_____

End Time:___________ Weather:______ Temp.:_______ Wind Speed:_____

Remarks:____

Day 2 Test date (YYYY/MM/DD):_______________ Place:____________

Start Time:__________ Weather:______ Temp.________ Wind Speed:_____

End Time:___________ Weather:______ Temp.:_______ Wind Speed:_____

Remarks:____

Day 3 Test date (YYYY/MM/DD):_______________ Place:____________

Start Time:__________ Weather:______ Temp.________ Wind Speed:_____

End Time:___________ Weather:______ Temp.:_______ Wind Speed:_____

Remarks:____

4. Test results

(1) AEBS test for CBL

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity Difference	(b) Relative Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
40km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						
60km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented

(2) FCWS test for CBL

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity Difference	(b) Relative Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
40km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						
60km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented

(3) AEBS test for CBF

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity	(b) Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
10km/h	1st						
	2nd						
	3rd						
15km/h	1st						
	2nd						
	3rd						
20km/h	1st						
	2nd						
	3rd						
25km/h	1st						
	2nd						
	3rd						
30km/h	1st						
	2nd						
	3rd						
35km/h	1st						
	2nd						
	3rd						
40km/h	1st						
	2nd						
	3rd						
45km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						
55km/h	1st						
	2nd						
	3rd						
60km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented

(4) FCWS test for CBF

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity	(b) Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
10km/h	1st						
	2nd						
	3rd						
15km/h	1st						
	2nd						
	3rd						
20km/h	1st						
	2nd						
	3rd						
25km/h	1st						
	2nd						
	3rd						
30km/h	1st						
	2nd						
	3rd						
35km/h	1st						
	2nd						
	3rd						
40km/h	1st						
	2nd						
	3rd						
45km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						
55km/h	1st						
	2nd						
	3rd						
60km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented

(5) AEBS test for CBNO

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity	(b) Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
10km/h	1st						
	2nd						
	3rd						
15km/h	1st						
	2nd						
	3rd						
20km/h	1st						
	2nd						
	3rd						
25km/h	1st						
	2nd						
	3rd						
30km/h	1st						
	2nd						
	3rd						
35km/h	1st						
	2nd						
	3rd						
40km/h	1st						
	2nd						
	3rd						
45km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented

(6) FCWS test for CBNO

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity	(b) Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
10km/h	1st						
	2nd						
	3rd						
15km/h	1st						
	2nd						
	3rd						
20km/h	1st						
	2nd						
	3rd						
25km/h	1st						
	2nd						
	3rd						
30km/h	1st						
	2nd						
	3rd						
35km/h	1st						
	2nd						
	3rd						
40km/h	1st						
	2nd						
	3rd						
45km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented

Attached Table 3 Test results of Autonomous Emergency Braking System [car to bicycle] performance test

[For advance data as defined in the detailed regulations of the New Car, etc. Assessment Information Provision Project]

***Only the results of tests conducted on the same type of vehicle as the assessment test vehicle (with optional equipment similar to that of the test vehicle) using the test methods specified by NASVA may be submitted.**

Test date (YYYY/MM/DD):____________________ Place:_______________

1. Test Vehicle Specification

(1) Model/Type (Model Name):__________/_____________(_____________)

(2) Frame number:____________________

(3) Sensor system:____________________

(4) Installed Tire

	Front	Rear
Size		
Brand/Type		
Air pressure (kPa)		

(5) Test vehicle load distribution

		Left wheel	Right wheel	Subtotal	Grand Total	Front-rear Distribution
Load distribution at vehicle delivery (daN)	Front axle					%
	Rear axle					%
Load distribution at testing time (daN)	Front axle					%
	Rear axle					%

(Note) Indicated as 1daN = 1kgf

2. Setting of conditions for testing, etc.

(1) AEBS test start speed CBL: km/h CBF: km/h CBNO: km/h

(2) AEBS test end speed CBL: km/h CBF: km/h CBNO: km/h

(3) FCWS function availability: Available / Not Available

(4) FCWS test start speed CBL: km/h CBF: km/h CBNO: km/h

(5) FCWS test end speed CBL: km/h CBF: km/h CBNO: km/h

(6) Specifications of FCWS function: “Auditory and visual information” and “auditory and haptic information”

(7) Set value of brake operation during FCWS test:

Test implemented or not: Yes/No

Pedal stroke amount: mm Depression speed: mm/s Pedal force: N

(8) Manual setting of activation start timing: Yes ( )/No

(9) Accelerator/brake operation input: Automatic driving system, etc./Driver

[If the driver performs the accelerator/brake operation input, a written record of the actual measured values for each of the accelerator/brake operation input provisions in Section 6.1 (9) of the test method shall be submitted.]

(10) Approximate bumper line setting [mm]:

Overall width of vehicle:

A = (,)

B = (,)

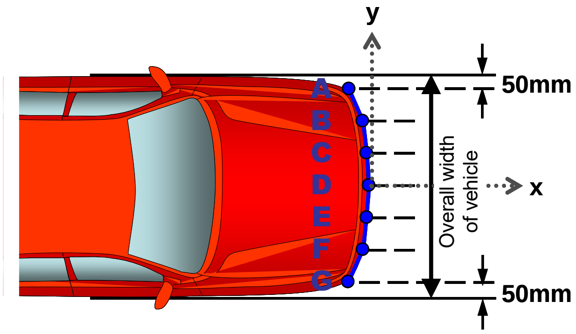
C = (,)

D = (0 , 0)

E = (,)

F = (,)

G = (,)



3. Environmental conditions

Day 1 Test date (YYYY/MM/DD):______________ Place:__________

Start Time:_________ Weather:_____ Temp.________ Wind Speed:____

End Time:_________ Weather:_____ Temp.:_______ Wind Speed:____

Remarks:____

Day 2 Test date (YYYY/MM/DD):______________ Place:__________

Start Time:_________ Weather:_____ Temp.________ Wind Speed:____

End Time:_________ Weather:_____ Temp.:_______ Wind Speed:____

Remarks:____

Day 3 Test date (YYYY/MM/DD):______________ Place:__________

Start Time:_________ Weather:_____ Temp.________ Wind Speed:____

End Time:_________ Weather:_____ Temp.:_______ Wind Speed:____

Remarks:____

4. Test results

(1) AEBS test for CBL

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity	(b) Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
40km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						
60km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented

(2) FCWS test for CBL

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity	(b) Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
40km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						
60km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented

(3) AEBS test for CBF

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity	(b) Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
10km/h	1st						
	2nd						
	3rd						
15km/h	1st						
	2nd						
	3rd						
20km/h	1st						
	2nd						
	3rd						
25km/h	1st						
	2nd						
	3rd						
30km/h	1st						
	2nd						
	3rd						
35km/h	1st						
	2nd						
	3rd						
40km/h	1st						
	2nd						
	3rd						
45km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						
55km/h	1st						
	2nd						
	3rd						
60km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented

(4) FCWS test for CBF

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity	(b) Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
10km/h	1st						
	2nd						
	3rd						
15km/h	1st						
	2nd						
	3rd						
20km/h	1st						
	2nd						
	3rd						
25km/h	1st						
	2nd						
	3rd						
30km/h	1st						
	2nd						
	3rd						
35km/h	1st						
	2nd						
	3rd						
40km/h	1st						
	2nd						
	3rd						
45km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						
55km/h	1st						
	2nd						
	3rd						
60km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented

(5) AEBS test for CBNO

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity	(b) Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
10km/h	1st						
	2nd						
	3rd						
15km/h	1st						
	2nd						
	3rd						
20km/h	1st						
	2nd						
	3rd						
25km/h	1st						
	2nd						
	3rd						
30km/h	1st						
	2nd						
	3rd						
35km/h	1st						
	2nd						
	3rd						
40km/h	1st						
	2nd						
	3rd						
45km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented

(6) FCWS test for CBNO

Velocity Conditions	Number of Tests	Avoided or Not (*)	(a) Initial Velocity	(b) Speed at Collision	(c)=(a)-(b) Velocity Reduction Amount	(d)=(c)/(a) Velocity Reduction Rate	Velocity Reduction Rate Median
10km/h	1st						
	2nd						
	3rd						
15km/h	1st						
	2nd						
	3rd						
20km/h	1st						
	2nd						
	3rd						
25km/h	1st						
	2nd						
	3rd						
30km/h	1st						
	2nd						
	3rd						
35km/h	1st						
	2nd						
	3rd						
40km/h	1st						
	2nd						
	3rd						
45km/h	1st						
	2nd						
	3rd						
50km/h	1st						
	2nd						
	3rd						

(*)○: Collision avoidance, P: Pass (treated as avoidance), △: Velocity reduction, ×: Not activated, -: Not implemented