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Replacing GB 11551-2003

The protection of the occupants in the event of a frontal collision for motor vehicle

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Standardization Administration Committee.

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Foreword

All technical content of this Standard are mandatory.

This Standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This Standard replaces GB 11551-2003 *The protection of the occupant in the event of a frontal collision for passenger car*.

The main differences between this Standard and GB 11551-2003 are as follows:

- modified the standard name to “The protection of the occupants in the event of a frontal collision for motor vehicle”;
- modified the standard application scope which was expanded from “M_1 category vehicle” to “M_1 category vehicle and N_1 category vehicle of which the maximum design total mass is not greater than 2500 kg as well as multipurpose goods vehicle” (see Clause 1);
- added the definition of “multipurpose goods vehicle” (see 3.10);
- added information about airbag and warning information to child restrain system after airbag information is used at the seat with airbag protection (see 4.1.4 and 4.1.5);
- added and modified part of the technical requirements (see 4.2);
- added the change and expansion of vehicle type (see Clause 6);
- added pulley test program (see Annex E).

This Standard was proposed by Ministry of Industry and Information Technology of the People 's Republic of China.

This Standard was proposed by and shall be under the jurisdiction of National Technical Committee on Road Vehicles of Standardization Administration of China (SAC/TC 114).

Main drafting organizations of this Standard: China Automotive Technology and Research Center, Hafei Automobile Company Limited, Beiqi Foton Motor Company Limited.

The drafting organizations of this Standard: SAIC-GM-Wuling Automobile Co., Ltd., National Automobile Quality Supervision and Inspection Center (Xiangyang), Chongqing Changan Automobile Company Limited, Zhejiang

The protection of the occupants in the event of a frontal collision for motor vehicle

1 Scope

This Standard specifies terms and definitions, requirements and test methods for occupant protection of front seats for frontal seating in frontal collision of vehicles.

This Standard is applicable to vehicles of M_1 category and N_1 vehicles of which the maximum total mass is not greater than 2500 kg as well as multipurpose goods vehicle.

2 Normative references

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

GB/T 3730.1 *Motor vehicles and trailers - Types - Terms and definitions*

GB 14166 *Safety-belts, restraint systems, child restraint systems and ISOFIX child restraint systems for occupants of power-driven vehicles*

GB 14167 *Safety-belt anchorages, ISOFIX anchorages systems and ISOFIX top tether anchorages for vehicles*

GB/T 15089 *Classification of power-driven vehicles and trailers*

GB/T 20913-2007 *The protection of the occupants in the event of an off-set frontal collision for passenger car*

3 Terms and definitions

For the purposes of this document, the following terms and definitions defined in GB/T 20913-2007 apply.

3.1 protective system

internal mounting parts and devices for restraining occupants

3.2 type of protective system

protective devices which have no differences in the following main aspects:

- manufacturing technology;
- dimensions;
- material.

3.3 angle of impact

the angle between the line perpendicular to the front surface of the barrier and the direction of travel of the longitudinal direction of the vehicle

3.4 barrier face

the part of face of which the barrier is against the plywood

3.5 vehicle type

vehicles which have no differences in the following main aspects:

- the length and width of the vehicle that adversely affect by the crash test results;
- the structure, dimensions, profile and material of the vehicle part in front of the transverse plane passing through the driver seat "R" point adversely affecting the results of the crash test;
- the shape and internal dimensions as well as the type of protection system of the passenger compartment that adversely affect the results of the crash test;
- the layout of the engine (front, rear or center) and the direction of the arrangement (horizontal or vertical);
- unladen kerb mass of vehicle that adversely affect the results of the crash test;
- optional equipment or devices provided by the manufacturer hat adversely affect the results of the crash test.

3.6 passenger compartment

space for occupants which is enclosed by roof, floor, side wall, door, glass window and front, rear or rear seat back support plate

3.7 R point

warning label shall contain the information shown in 4.1.5.

4.1.5 For vehicle equipped with one or more frontal protective airbags, the information should be prompted that extreme risk shall be generated after rear-facing child restraint system is used on the seat protected by a front airbag:

- this information should contain at least the style and content of the warning label shown in Figure 1; the minimum overall size is 120 mm × 60 mm or the same area. the above-mentioned label may take other forms but the text should follow the warnings in Figure 1;

- the warning label should contain warnings in Chinese;

- for front passenger seats protected by frontal airbags, the warning label should be durably retained on each surface of the passenger side sunshade panel, regardless of whether the sun visor is in the open or closed position, at least one warning label on the sun visor is visible at all times. Or, a warning label is affixed to the visible surface of the visor, another warning label should be attached to the ceiling behind the sun visor, at least one warning label is visible at all times, the text of the warning label should be easily readable by the user at the seat; for other vehicles protected by front airbags, the warning label shall be affixed directly in front of the associated seat; for user who wants to install a rear-facing child restraint system in this seat, it should be clearly visible at all times; the text of the warning label should be easily readable by the user at the seat; when this provision is not applicable to when the child restraint system is installed, it shall have the seat with automatic release of frontal airbag protection;

- the following information should be displayed in the vehicle manual: “Do not use the rear-facing child restraint system on a seat that is protected by the front airbag (activated)”, and with warning illustration.

4.2.6 During the collision, the fuel supply system should not leak.

4.2.7 After the impact test, if there is continuous liquid leakage in the fuel supply system, the average leakage rate shall not be greater than 30 g/min for the first 5 minutes after the collision; if the liquid from the fuel supply system is mixed with liquid from other systems, and different liquids are not easily separated and identified, then all liquid collected shall be included in the assessment of continuous leakage.

5 Test methods

5.1 Facilities and vehicle preparation

5.1.1 Test site

The test site should be large enough to accommodate runways, barriers and the necessary technical facilities for testing. At least 5 m of the runway before the barrier shall be level, flat and smooth.

5.1.2 Barrier

The barrier is made of reinforced concrete. The front width is not less than 3 m and the height is not less than 1.5 m. Barrier thickness should ensure that its mass is not less than 7 × 104 kg. The front surface of the barrier should be plumb. The normal line should form a 0° angle with the straight direction of the vehicle. And the barrier surface should be covered with a plywood of 20 mm ± 1 mm thickness and in good condition (as shown in Figure 5). If necessary, it should use a secondary positioning device to secure the barrier to the floor so as to limit its displacement.

5.1.3 Barrier positioning

The orientation of the barrier shall make the angle of impact 0°.

5.1.4.2.4 If the mass of the on-board measuring device exceeds 25 kg, it can be compensated by reducing the number of parts that have no significant effect on the 5.6 measurement.

5.1.4.2.5 The on-board measuring device makes the change of the axle load of each axis not more than 5%. The change of each axis shall not exceed 20 kg.

5.1.4.2.6 The vehicle mass specified in 5.1.4.2.1 should be indicated in the test report.

5.1.4.3 Adjustment of passenger compartment

5.1.4.3.1 Steering wheel position

If the steering wheel is adjustable, it shall be adjusted to the position specified by the manufacturer. If not specified by the manufacturer, it should be adjusted to the middle of the adjustable range. At the end of the acceleration process, the steering wheel should be in a free state, and in the position specified by the manufacturer when the vehicle is running straight.

5.1.4.3.2 Glass

The moving glass on the vehicle should be in the closed position. In order to facilitate the test measurement, agreed by the manufacturer, the moving glass can be put down, as long as the position of the handle at this time is equivalent to the position where the glass is closed.

5.1.4.3.3 Shift lever

The shift lever should be in the neutral position.

5.1.4.3.4 Pedal

The pedal should be in the normal position. If the pedal is adjustable, it should be placed in the middle position, unless the manufacturer has special requirements for this position.

5.1.4.3.5 Door

The door should be closed but not locked.

5.1.4.3.6 Sliding roof

If fitted with a sliding roof or removable roof, it should be in the proper position and closed. In order to facilitate the test measurement, with the consent of the manufacturer, the door can be opened.

5.1.4.3.7 Sun visor

At the moment of collision, the vehicle speed should be at 50^{0}_{-2} km/h. If the test is carried out at a higher collision speed and the vehicle meets the requirements, it shall be considered as a qualified test.

5.5 Measurement of front seat dummy

5.5.1 In order to determine all measurements required by performance indicators, it shall use the measurement system which complies with requirements of Annex D.

5.5.2 The different parameters shall be recorded by means of an independent data channel with the following CFC (channel frequency class).

5.5.2.1 Measurement of dummy head

The acceleration at the center of gravity (a) is calculated from the three-dimensional component of the acceleration. For the acceleration component measurement, CFC is 1000.

5.5.2.2 Measurement of dummy neck

5.5.2.2.1 For the axial tension and the anteroposterior shear force measured at the junction of the head and neck, CFC is 1000.

5.5.2.2.2 For the bending moment on the Y axis measured at the junction of the head and neck, CFC is 600.

5.5.2.3 Measurement of dummy chest

For chest deformation measurement, CFC is 180.

5.5.2.4 Measurement of dummy thigh

For axial compressive force measurement, CFC is 600.

5.6 Measurements made on vehicle

5.6.1 During the simplified test specified in Annex E, the deceleration time history of the torso structure shall be determined on the basis of the reading of the longitudinal acceleration sensor at the lower end of the "B" column on the left side of the vehicle. Use a data channel that complies with Annex D and has a CFC of 180.

5.6.2 The speed-time curve used in the simplified test procedure specified in Annex E shall be obtained from the longitudinal acceleration sensor at the lower end of the "B" column on the left side of the vehicle.

Annex A

(Normative)

Determination procedure of riding position H point and actual seat back angle

A.1 Overview

The procedure described in this appendix is used to determine the H point and actual seat-back angle for one or more seating positions in the vehicle, as well as to verify the measurement data and the relationship between the design requirements given by the vehicle manufacturer.[1]

A.2 Terminology

A.2.1 reference data

One or more of the following characteristics of a seating position:

- H point and R point as well as their relationship;
- actual back angle and design backrest angle as well as their relationship.

A.2.2 three-dimensional H point machine; 3-D H machine

The device used to determine the H point and the actual seat-back angle (see Figure A.1). For a description of the device, see A.5.

[1] In any non-front seat seating position, if the H point can not be determined with a three-dimensional H point machine or procedure, as long as it is recognized by testing agency, the R point indicated by the manufacturer may be used as a reference.

A.3.2.1 The H point coordinates and the actual back-rest angle obtained by the procedure specified in A.4 shall be compared with the R point coordinates and the design back-angle values, respectively, given by the manufacturer.

A.3.2.2 If the H point determined by the coordinates is 50 mm in both the horizontal and vertical directions, the diagonal intersects the square of the R point, and actual back rest angle deviates from the design backrest angle less than 5°, for the seating position mentioned above, it should be considered that the relative position of R point and H point , the relative relationship between design back rest angle and actual seat back angle satisfy the requirement.

A.3.2.3 If the above conditions are met, the R point and the design back rest angle shall be used to demonstrate the compliance with the requirements of this Standard.

A.3.2.4 If H point or the actual seatback angle does not comply with the requirements of A.3.2.2, it shall re-determine for 2 (3 times). If the results of these two times meet the requirements, the conditions specified in A.3.2.3 shall apply.

A.3.2.5 If at least two of the three operations described in A.3.2.4 do not meet the requirements of A.3.2.3, or because the vehicle manufacturer does not provide data on the location of R point or the design of the seat back angle which makes the test unable be carried out, the average of the centroids of the three measuring points or the average of the three measuring angles shall be taken for all occasions where this Standard involves R point or the design of the seat back angle.

A.4 Determination procedure of H point and actual backrest angle

A.4.1 According to the requirements of the manufacturer, the vehicle shall be pre-treated at 20°C ± 10°C, so as to ensure that the seat material reaches room temperature. If the seat being tested has never been taken, 70 kg ~ 80 kg person or device shall be allowed to sit on the seat twice for testing, 1 min for each time, so as to make the seat cushion and back produce necessary deformation. If required by the manufacturer, all seat assemblies shall be left un-laden for at least 30 min before placing the 3-D H machine.

A.4.2 The vehicle shall be in the measurement state as defined in A.2.11.

A.4.3 Firstly, the seat should be adjusted (if adjustable) to the final normal driving or seating position specified by the vehicle manufacturer. Only the longitudinal adjustment of the seat shall be considered, excluding the seat travel for purposes other than normal driving or riding position. If there are other seat adjustment methods (such as verticality, angle, seat back, etc.), they shall be transferred to the position specified by the vehicle manufacturer.

A.4.7.3 Other specified seating position

The general procedure specified in A.4.7.1 shall be followed, but the placement of the feet shall be in accordance with the provisions of the vehicle manufacturer.

A.4.8 Install the calf and thigh weights then level the 3-D H machine.

A.4.9 Slide the rear plate forward into the front stop and pull the 3-D H machine away from the seat back by using a T-bar. Then, use one of the following methods to replace the 3-D H machine on the seat.

A.4.9.1 If the 3-DH machine has a tendency to slide backwards, use the following procedures: allowing the 3-DH unit to slide backwards, till it is not necessary to apply a horizontally forward holding force on the T-bar (i.e. until the back plate comes into contact with the backrest). If necessary, reposition the lower leg.

A.4.9.2 If the 3-D H machine does not slide backwards, use the following procedures: a horizontal rearward force is applied to the T-bar to cause the 3-D H machine to slide rearward till the seat plate contacts the seat back (see Figure A.2).

A.4.10 At the intersection of the hip angle protractor and the T-bar housing, apply a force of 100 N ± 10 N to the back-plate and seat-plate assembly of the 3-D H machine. The direction in which the force is applied should be along a straight line passing through the intersection to the upper surface of the thigh bar housing (see Figure A.2). Then carefully place the back panel back into the backrest. Care should be taken in the following steps to prevent the 3-D H machine from sliding forward.

A.4.16.1 For the first row: the driver's seat;

A.4.16.2 For other rows: one of the outboard seats.

A.5 3-D H point machine description[3] (3-D H machine)

A.5.1 Backplane and base plate

The backplane and seat panel are made of reinforced plastic and metal. They simulate the torso and thighs of the human torso, both mechanically hinged at H point. A protractor is fixed to the probe rod hinged at H point, used to measure the actual seat back angle. An adjustable thigh bar fixed to the base plate not only defines the thigh centerline, but also is used as a hip angle protractor **baseline.**

A.5.2 Torso and calf parts

The lower leg member is attached to the seat plate assembly at the T-bar connecting the knee. The T-bar is a lateral extension of the adjustable thigh bar. A protractor is attached to the lower leg to measure the knee angle. Foot and foot assembly engraved with degrees, are used to measure foot angle. The two levels determine the spatial position of the machine. The weights of torso are put on the corresponding parts of the center of gravity, used to provide a pressure same as a 76 kg man to the seat. All joints of the 3-DH machine should be checked for free movement and no significant frictional resistance.

A.6 Three-dimensional coordinate system

A.6.1 The three-dimensional coordinate system is defined by three orthogonal planes established by the vehicle manufacturer (see Figure A.3).[4]

A.6.2 The vehicle measurement posture is determined by the placement of the vehicle on the support surface. When placing the vehicle, make the coordinates of the reference mark coincide with the value given by the manufacturer.

A.6.3 Determine the coordinates of R and H points with respect to the reference marks given by the vehicle manufacturer.

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[3] Detailed information on the structure of the 3-D H machine can be obtained from the Society of Automotive Engineers (SAE). 400 Commonwealth Drive, Warrendale., Pennsylvania 15096, U.S.A.

[4] This standard is based on ISO 4130-1978.

Annex B

(Normative)

Determination of performance criterions

B.1 Head performance criterion (HPC)

B.1.1 During the test, if the head does not come into contact with any part of the vehicle, it shall be considered to meet the requirements.

B.1.2 If the head contacts with the vehicle component, it shall, in accordance with the acceleration measured in 5.5.2.1 (a, expressed in g), calculate HPC value according to equation (B.1).

$$\mathrm{HPC}=(t_2-t_1)\left[\frac{1}{t_2-t_1}\int_{t_2}^{t_1} a\,\mathrm{d}t\right]^{2.5} \qquad \cdots\cdots(\mathrm{B.1})$$

where,

a - the resultant acceleration measured in accordance with 5.5.2.1, in g (1 g = 9.81 m/s^2);

$t_2 - t_1$ - if it is possible to determine the head starting contact time, then t_1 and t_2 are two moments, in seconds (s), which indicates a certain period of time between the head contact starting point and the end time of recording. The HPC value during this time interval should be the maximum. If the head starting contact time cannot be determined, then t_1 and t_2 are two moments, in seconds (s), which indicates a certain period of time between the start of recording and the end of recording. The HPC value during this time interval should be the maximum. $t_2 - t_1 \leq 36$ ms.

B.1.3 The resultant acceleration of the head in the head-on collision is accumulated over a value of 3 ms calculated from the combined head acceleration measured in accordance with 5.5.2.1.

B.2 Neck injury criterion (NIC)

B.2.1 It shall be determined by axial pressure, tension (F_Z) and front to rear shear force (F_X) measured at the head and neck junction, in kilonewtons (kN). Measure according to 5.5.2.2. The time shall be calculated in ms.

B.2.2 The neck bending moment index (M_Y) is determined by the bending moment measured at 5.5.2.2 around the Y-axis at the junction of head and neck, in newton meter (N·m).

Annex C

(Normative)

Dummy arrangement and restraint system adjustment

C.1 Dummy arrangement

C.1.1 Single seat

The plane of symmetry of the dummy should coincide with the middle plane of the seat plumb.

C.1.2 Front row of long seats

C.1.2.1 Driver

The plane of symmetry of the dummy shall lie on a vertical plane passing through the center of the steering wheel and parallel to the longitudinal center plane of the vehicle. If the seating position is determined by the shape of the long seat, such seats shall be considered as single seats.

C.1.2.2 Outside passengers

The symmetry plane of the dummy's symmetry plane and the driver's side dummy should be symmetrical with respect to the longitudinal center plane of the vehicle. If the seating position is determined by the shape of the long seat, such seats shall be considered as single seats.

C.1.3 Front passenger (not including driver) long seat

The symmetry plane of the dummy shall coincide with the intermediate plane of the seating position specified by the manufacturer.

C.2 Dummy placement

C.2.1 Head

The mounting surface of the head sensor shall be horizontal with an angle of less than 2.5°. In order to level the dummy's head on a vehicle equipped with an upright seat which is not adjustable, it shall operate in the following sequence: first, adjust the H point position within the limits specified in B.2.4.3.1, so that the dummy head sensor mounting plane is horizontal; if the sensor installation plane of head is still not level, adjust the pelvic angle of the dummy within the limits specified in C.2.4.3b). If not yet level, adjust the dummy neck support to make the volume as small as possible, so that the

the last point of heel resting on the floor surface. The left heel should be placed as forward as possible and rested on the floor. The left foot should be placed on the pedal as far as possible. The longitudinal centerline of the left foot should be as parallel as possible to the longitudinal centerline of the vehicle.

C.2.6.2 The dummy's feet at passenger's side should be placed as forward as possible on the heel and rested on the floor. The feet should be placed on the pedal as far as possible. The longitudinal centerline of the feet should be as parallel as possible to the longitudinal centerline of the vehicle.

C.2.7 Dummy's movement

During the collision, the measuring instrument installed on the vehicle should not affect the movement of the dummy.

C.2.8 Dummy's temperature

Before test, the temperature of the dummy and the measuring instrument system should be stable and be maintained in the range of 19°C ~ 22°C.

C.2.9 Dummy clothing

C.2.9.1 The dummy should wear a fitted cotton short-sleeved shirt and shorts.

C.2.9.2 The dummy should wear shoes on each foot. Each shoe weighs 570 g ± 100 g.

C.3 Adjustment of restraint system

According to the provisions of C.2.1 ~ C.2.6, place a dummy on the designated seating. Fasten the seat belt to the dummy and buckle. Eliminate all slack of the belt. Pull the strap webbing from the retractor. Then make it roll back. Repeat the procedure four times. Apply a 9N to 18N pulling force to the belt. If the belt system is with tension-relaxation device, the maximum amount of slack shall be applied to the shoulder strap in the manner recommended by the manufacturer for normal use in the vehicle user's manual. If the belt system is without tension-relaxation device, the shoulder strap with extra ribbon shall be allowed to automatically roll back with the help of the retracting force of the retractor.

the ratio of the maximum difference between the nominal value and the corresponding reading on the straight line defined in D.1.6 to the channel amplitude level, expressed in percentage

D.1.9 cross sensitivity

the ratio of the output signal to the input signal when an excitation is applied to the sensor perpendicular to the measuring axis; this value, expressed in percentage, is the lateral sensitivity of the main measuring axis

D.1.10 phase delay time

the phase delay time of the data channel is equal to the phase lag of a sinusoidal signal [expressed in rad (radian)] divided by the angular frequency of the signal [expressed in rad/s (radians per second)]

D.1.11 environment

at a given time, the general term of external conditions in which the data channel is located and the effects

D.2 Performance requirements

D.2.1 Linearity error

The absolute value of the linearity error of the data channel, at any frequency in the CFC, shall be equal to or less than 2.5% of the CAC value over the entire measuring range.

D.2.2 Amplitude versus frequency

The frequency response of data channel should be within the limits given in Figure D.1. The 0 dB line is determined by the scaling factor.

D.2.3 Phase lag time

The phase delay time between the input and output signals of the data channel, between 0.03 F_H and F_H, should not exceed 1/(10 F_H)s.

D.2.4 Time

D.2.4.1 Time base

The time base shall be recorded and at least 1/100 s with an accuracy of 1%.

D.2.4.2 Relative time delay

The relative time delay between two or more data channel signals, regardless of frequency class, should not exceed 1 ms, eliminating the hysteresis due to

The error of the reference acceleration is expressed as a percentage of the channel amplitude level, requiring:

- it shall not exceed ± 1.5% when it is less than 400 Hz;
- it shall not exceed ± 2% when it is between 400 Hz ~ 900 Hz.
- it shall not exceed ± 2.5% when it is greater than 900 Hz.

D.2.6.2.3 Time

The relative error of the reference time shall not exceed 10^{-5}.

D.2.6.3 Sensitivity coefficient and linearity error

The relationship between the output signal of the measurement data channel and the input signal of known change amplitude can be used to determine the sensitivity coefficient and the linearity error. The calibration of the data channel should cover the entire amplitude level.

For bidirectional amplitude channels, both positive and negative values should be calibrated.

If the calibration equipment can not produce the required input, the calibration shall be carried out within the limits of the corresponding standard, and the limits shall be recorded in the test report.

Between F_L and $F_H/2.5$, the entire data path should be calibrated at a frequency that has significant values or over a range of frequencies.

D.2.6.4 Calibration of frequency response

The amplitude-frequency and phase-frequency characteristics are determined by the relationship between the output signal of the data path and the known input signal. The input signal varies between F_L and 10 times CFC or 3000 Hz, whichever is smaller.

D.2.7 Environmental impact

Periodic inspections should be carried out to determine the effects of the environment (such as electrical or magnetic flux, etc.). This can usually be done by logging the output of the standby data path of the analogue sensor. If the output signal is too large, corrective action should be taken, such as replacing the wiring.

D.2.8 Selection and determination of data acquisition

The data channel is determined by the CAC and the CFC.

Annex E

(Normative)

Pulley test program

E.1 Test equipment and procedures

E.1.1 Pulley

The structure of pulley shall ensure that permanent deformation does not occur after the test. During the course of the collision, the guide device shall ensure that the pulley offset is no more than 5° in the vertical plane, while not more than 2° in the horizontal plane.

E.1.2 Condition of test pieces

E.1.2.1 Overview

The test pieces shall represent relevant vehicle series. If it is determined that there is no impact on the test results, some parts may be replaced or removed.

E.1.2.2 Adjustment

The adjustment shall comply with the provisions of 5.1.4.3 and take into account the provisions of E.1.2.1.

E.1.3 Fixation of test pieces

E.1.3.1 The test pieces shall be securely fastened to the trolley to ensure that no relative displacement occurs during the test.

E.1.3.2 The method of fixing the test piece to the trolley shall not have a reinforcing effect on the seat fixing point or the restraining device, nor shall the test specimen be deformed abnormally.

E.1.3.3 The preferred fixture is to support the test piece on a support that is located approximately at the axis of the wheel. If possible, the test pieces are fastened to the pulley by the fastening system of the suspension system.

E.1.3.4 The angle between the longitudinal axis of the vehicle and the longitudinal axis of the carriage is 0° ± 2°.

E.1.4 Dummy

Dummy and its placement shall comply with the provisions of 5.2.

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