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**Road vehicles - Towing vehicles coupling device to tow
caravans or light trailers - Mechanical strength test**

牵引旅居挂车或轻型挂车牵引连接装置 机械强度试验

(ISO 3853:1994, IDT)

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Road vehicles - Towing vehicles coupling device to tow caravans or light trailers - Mechanical strength test

1 Scope

This standard specifies the test methods for the mechanical strength of coupling devices.

This standard applies to the coupling device, which is installed on the towing vehicle, for towing the category O₁ and O₂ caravans or light trailer (excluding semi-trailer).

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard; however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 3730.2 Road vehicle - Masses - Vocabulary and codes (GB/T 3730.2-1996, idt ISO 1176:1990)

GB/T 22552 Caravans - Masses and dimensions - Vocabulary (GB/T 22552-2008, ISO 7237:1993, IDT)

GB/T 25980 Road vehicles - Coupling balls for caravans and light trailers - Dimensions (GB/T 25980-2010, ISO 1103:2007, IDT)

3 Terms and definitions

The terms and definitions, as established in GB/T 22552, as well as the following terms and definitions, apply to this standard.

3.1

Coupling device

A device, which is equipped with towing bracket and coupling ball.

Note: Its common terms are as shown in Figure 1.

F_{res} - Test resultant force, in Newton (N);

α - Test angle, which is composed of the test resultant F_{res} and the reference line, indicating the degree of the angle;

F_{stat} - The maximum allowable static load of the trailer, on the coupling point of the towing vehicle, which is determined by the towing vehicle manufacturer;

h - The vertical distance, between the center of the coupling ball and the center of the support;

l - The horizontal distance, between the center of the coupling ball and the connection point of the ball support OR between the connection point of the ball attachment.

5 General conditions

5.1 The size of the coupling device shall comply with the provisions of GB/T 25980.

It shall provide the detailed design information of the coupling device, including information the data that may affect the strength of its components or assemblies (such as electrical connector socket plates, markings, etc.).

5.2 The test range is from the coupling ball to the fixed point or assembly point. The geometrical position of the coupling ball and the fixed point of the connection device, as corresponding to the reference line, shall be marked by the manufacturer AND quoted in the test report.

5.3 The strength test in Chapter 6 is a dynamic test, which is performed on a test rig (e.g., a vibration pulse test rig).

5.4 The test load does not take into account the lateral loads, which are generated by the front and rear axles of the trailer and their supporting devices.

5.5 The test angle is determined by the force distribution diagram, as shown in Figure 2, which is the result of road tests by various vehicle combinations.

To simplify the test procedure, two different test angles can be selected, for vertical static and dynamic loads.

If the center of the coupling ball is lower than the parallel line, which passes through the reference line closest to the highest point of the fixed point (see Figure 3), THEN, the test angle $\alpha = +15^\circ \pm 1^\circ$ [see Figure 4a)].

If the center of the coupling ball is higher than the parallel line, which passes through the reference line closest to the highest point of the fixed point (see Figure 3), THEN, the test angle $\alpha = -15^\circ \pm 1^\circ$ [see Figure 4b)].

it shall determine whether the test is appropriate or whether other tests are required, as necessary.

6 Strength test of coupling device

6.1 Installation on the test bench

The towing bracket shall be connected to the rigid test bench. Its fixed position on the test bench is the same as the installation position on the towing vehicle, OR has the same characteristics.

6.2 Fixed points and reference lines

For the installation of the coupling device on the test bench, it shall keep the position of all fixed points, as relative to the reference line, be consistent with the position of the fixed point, as relative to the reference line, which is provided by the towing vehicle manufacturer to the coupling device manufacturer.

If the towing vehicle manufacturer does not provide a fixed point or reference line, the coupling device manufacturer may choose its own fixed point and reference line, BUT shall bear the consequences, which are caused by its selected fixed point and reference line, especially be responsible for the maximum allowable towing mass. In order to make the position of the coupling ball correct, the towing vehicle manufacturer shall generally specify the maximum towing mass of the towing vehicle (see code M16 of GB/T 3730.2).

6.3 Test method

Under the conditions of complying with the requirements of 6.1 and 6.2, the coupling device, which is installed on the test bench, will be tested, using an alternating load tensile testing machine. When securing components and applying forces on the test bench, it shall be ensured that additional movements ¹⁾ or other forces ²⁾ are as small as possible.

The test load shall be applied, at a selected frequency, in an approximate sinusoidal manner; the frequency shall not exceed 35 Hz and avoid the resonance frequency of the test device, including the towing device.

The amplitude of the test resultant force F_{res} is $0.6D \pm 3\%$; the number of cycles is 2×10^6 .

Note: The test device, that connects the force sensor with the ball of the towing device, shall have a larger mass. The measurement force includes the inertial force, that accelerates the mass. The applied inertial force can be adjusted, by measuring the acceleration of the coupling ball.

¹ For example, it can be realized by relying on the double connection points, which have a spacing of ≥ 300 mm.

² For example, the force which is generated by large acceleration.

shall be within the following range, namely:

$$\Delta h = h_{\max} - h_{\min} = 100 \text{ mm}$$

$$\Delta l = l_{\max} - l_{\min} = 130 \text{ mm}$$

Strength tests for such towing brackets (see Figure 10) shall be in accordance with the requirements of Chapter 6.

In order to cover all possible positions of the coupling ball, the following two towing brackets shall be tested:

- Towing bracket, when the ball is at $h_{\max}$ and $l_{\max}$;
- Towing bracket, when the ball is at $h_{\min}$ and $l_{\min}$.

7.2.6 The dimensions of the installation surface of the coupling ball support, which is connected to the test bench or the towing bracket, shall comply with the provisions of GB/T 25980.

8 Evaluation criteria of strength

During the entire test period, the coupling device and its components (brackets, balls, supports, fixtures) shall not have permanent deformation, cracks or visible external quality degradation.

9 Welding of coupling device

Welding procedures for coupling devices (including welding machinery, welding conditions, welding consumables, welding consumption) shall be consistent with the approved manufacturing process.

10 Marks

The marks shall comply with the provisions of GB/T 25980. It shall be marked with the following contents:

- a) The factory name and address of the coupling device manufacturer or the vehicle manufacturer (if the coupling device is produced by a vehicle manufacturer);
- b) Approval number. However, if there is no approval number, mark the test number;
- c) For the h and l values of the removable coupling ball, it is the determined h and l values;
- d) The $h_{\max}$, $l_{\max}$, $h_{\min}$, $l_{\min}$ values for different h and l .

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