Passenger car – light trailer combinations – Pylon slalom test procedure

1. Scope

This standard specifies the pylon course slalom test procedure for combination vehicles of passenger cars or passenger car-type vehicles (hereinafter referred to as the "towing vehicles") and light trailers (hereinafter referred to as the "combination vehicles").

The light trailer herein refers to a trailer having a vehicle total mass of 750 kg or less, and is specified in the Camping Trailers Structure Standards stipulated by the Japan Automobile Manufacturers Association (JAMA) and the Japan Auto-Body Industries Association inc (JABIA). The light trailer herein also includes other equivalent trailers.

2. Normative reference

The following standards contain which, thorough reference in this Standard, constitute provisions of this Standard. The most recent editions of the standard indicated below shall be applied.

JASO Z117-1 Automobile – Steerability and safety test procedure – Part 1:Passenger car standard test conditions

3. Definitions

Definitions of main terms used in this standard shall be as follows.

a) Steering wheel angle

A rotation angle of a steering wheel of the towing vehicle, when the steering wheel is rotated from a straight driving condition. This angle is indicated by δ_H (°).

b) Towing vehicle and trailer lateral acceleration speed

A lateral acceleration speed at a position of the gravity center of the towing vehicle and trailer. These speeds are indicated by a_Y (m/s^2) and a_Y' (m/s^2), respectively.

c) Slalom driving speed

A mean value of the vehicle speed of the combination vehicle during slalom driving. This is calculated by dividing a distance between the first and last signs (sign intervals multiplied by the number of sign intervals) by a time required for the combination vehicle to pass through the zone. The mean vehicle speed is indicated by V_X (km/h).

d) Reference vehicle speed

A vehicle speed that is used as a reference when obtaining characteristic values (lateral acceleration speeds of the towing vehicle and trailer, steering wheel angle, and the like) during slalom driving. This speed is indicated by $V_{X,0}$ (km/h) wherein $V_{X,0}$ is 50 km/h.

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4. Test conditions

4.1 Vehicle conditions

The vehicle condition during testing shall be as follows.

a) A mass and an axial load of the towing vehicle in a non-hitched condition shall be as close as to a value specified in the specification under a condition in which test subjects and test equipment are onboard.

b) The total mass and axial load (such as a hitch load) of the trailer during testing shall be as close as to a value specified in the specification.

c) A condition of tyres shall comply with 5.4.2 (Tyre) of **JASO Z117-1**.

d) Wheel alignment and play of a steering system of the towing vehicle shall be set to a value specified in the specification.

4.2 Test course and course form

A test course and course form shall be as follows.

a) Test course

A test course shall comply with 5.2 (Test course) of **JASO Z117-1**.

b) Test course form

The driving course shall have signs placed on a straight line at constant intervals as shown in **Attached Figure 1**. The number of the signs (*N*) shall be six (accordingly, the number of intervals for sign placement is five). The interval (*L*) shall be 30 m and a guide sign shall be placed at a position of distance *L* at the start and finish points the course, respectively.

4.3 Test equipment

Test equipment shall be as follows.

a) Steering wheel angle measuring device

A device for measuring a steering wheel angle of the towing vehicle.

b) Lateral acceleration measuring device

A device that is set at a position of the gravity center of the towing vehicle and trailer to measure a lateral acceleration speed of the vehicle.

c) Vehicle speed measuring device or timer

A device for measuring a slalom driving vehicle speed or a test course pass time of the test vehicle.

d) Sign

A fixture required for defining the test course.

e) Other

Equipment necessary for taking measurements and recording data.

4.4 Wind speed

The test driving shall be conducted under a natural wind condition in which the wind speed is 3 m/s or less to minimize measurement variance.

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5. Test procedure

5.1 Measurement preparation

Approximate values for the characteristics values to be measured shall be checked, and the measuring equipment shall be adjusted and set. A towing vehicle shall be warmed up in accordance with **6.1** (Warming up) in **JASO Z117-1**.

5.2 Test driving procedure

At a constant vehicle speed to the extent possible and with a smooth steering wheel operation, the vehicle shall be slalom-driven between the signs located at constant intervals as shown in **Attached Figure 1**. The test vehicle speed shall be 30, 40, and 50 km/h and even higher speed, if possible. The test shall be conducted two times for each speed.

Remark: If the maximum speed of the combination vehicle is equivalent to or lower than the test vehicle speed specified above, the test shall be conducted up to the maximum speed of the combination vehicle.

5.3 Measurement

a) A steering wheel angle and a lateral acceleration speed in a zone between the guide signs set at the start and finish points of the measurement zone shall be measured.

b) A pass time T_i (s) of the measurement zone shall be measured and recorded in **Attached Table 1**.

5.4 Course pass judgment

When the vehicle touches or knocks down a sign, the relevant driving is considered invalid. When the slalom driving speed exceeds a target test vehicle speed by ±3 km/h, and when a difference between the vehicle speeds at the entry zone and the finish zone exceeds 5 km/h by the visual measurement using a speedometer of the towing vehicle, the relevant driving shall be considered invalid.

6. Test results evaluation and representation

6.1 Record creation

Each item in **Attached Table 2** shall be checked and filled out prior to the test.

6.2 Data organization and representation procedure

a) Slalom driving speed calculation

The slalom driving speed ($V_{X,i}$) shall be calculated by the following equation based on the sign intervals (L), the number of the signs (N), and the measurement zone pass time (T_i). The speed shall be recorded in **Attached Table 1**.

$$V_{X,i} = 3.6L(N\text{-}1)/T_i \qquad \text{(km/h)} \qquad (1)$$

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b) Calculation of steering wheel angle and lateral acceleration of towing vehicle and trailer

For each vehicle speed ($V_{X,i}$), a mean value of the steering wheel angle ($\delta_{H,ij}$) and lateral acceleration of the towing vehicle and trailer (a_{ij}, $a_{i}'_{j}$) shall be calculated and recorded in **Attached Table 1**. To calculate each mean value, four absolute values of the amplitude on the both sides as shown in the data processing of **Attached Figure 2** excluding data obtained during pass-through of the first and last signs shall be read, and then each mean value shall be calculated by the following equation.

$\delta_{H,i} = 1/4(\delta_{H,i1}+\delta_{H,i2}+\delta_{H,i3}+\delta_{H,i4})$ ·····(°) (2)

$a_i = 1/4(a_{i1}+a_{i2}+a_{i3}+a_{i4})$ ·····(m/s^2) (3)

$a_i' = 1/4(a_{i}'_{1}+a_{i}'_{2}+a_{i}'_{3}+a_{i}'_{4})$ ·····(m/s^2) (4)

c) Relation of vehicle speed and steering wheel angle

A relation of $V_{X,i}$ and $\delta_{H,i}$ as shown in **Attached Table 1** shall be recorded on the horizontal axis $V_{X,i}$ (km/h) and the vertical axis $\delta_{H,i}$ (°) in **Attached Table 3 (a)**.

d) Relation of vehicle speed and lateral acceleration of towing vehicle and trailer

A relation of $V_{X,i}$ and (a_i, a_i') as shown in **Attached Table 1** shall be recorded on the horizontal axis $V_{X,i}$ (km/h) and the vertical axis a_i, a_i' (m/s^2) in **Attached Table 3** (b).

6.3 Record

The steering wheel angle (δ_{H0}), the lateral acceleration of towing vehicle and trailer (a_0 and a_0') while driving at the reference speed ($V_{X,0}$) shall be schematically obtained from **Attached Table 3**, and the obtained values shall be recorded on **Attached Table 4**. In addition, if any behaviours of the combination vehicle and phenomena specific to the towing vehicle and trailer that should be noted are identified, they should be entered in the remarks column.

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