Motorcycles - Lateral transient response test procedure

1. Scope

This standard specifies the lateral transient response test procedure for motorcycles (including bicycles with motors).

2. Normative references

The following standards, when referenced in this standard, constitute a part of the specifications of this standard. As required, the most recently updated version of the applicable standard (including addenda) shall be applied.

JASO T803: Glossary of terms relating to motorcycle and moped stability and controllability

JASO Z117-1: Automobiles - controllability and stability test procedure, Part 1: Standard test conditions for passenger cars

3. Terms

Definitions of terms used in this standard shall be as defined in **JASO T803**. The main terms defined in **JASO T803** and used in this standard are stated as follows.

a) Steer torque

Torque applied around the steer axis.

b) Steer angle

Rotation angle of the steering assembly in relation to the steer axis. The angle is 0° when the front wheel centre plane is parallel to the motorcycle longitudinal centre plane.

c) Yaw velocity

Angular velocity about the Z[(1)] axis.

Note[(1)]: X, Y, and Z are a right-hand orthogonal coordinate system fixed on the road surface.

d) Roll velocity

Angular velocity about the x'[(2)] axis.

Note[(2)]: x', y', and z' are a right-hand orthogonal coordinate system with its origin positioned at the motorcycle centre of gravity.

4. Test conditions

4.1 Conditions of test motorcycle

4.1.1 Tyres

The conditions of the tyres shall be as described below. The measured values and set values used here shall be recorded in **Attached Table 1**.

a) The standard condition of the tyres shall be as specified in the specifications of the test motorcycle, having 90% or more of the tread groove depth and being within 1 year of production.

b) In the case of a brand new tyre, the tyre shall be used after running-in of 20 km or more is conducted without severe braking or steering on a paved road or on a test road as specified in 4.2.

c) The inflation pressure of the tyre (when cold) shall be adjusted to the value specified in the specification of the test motorcycle, to within a tolerance of +/-5 kPa, while a measuring device is attached to the tyre.

Remark: Because tread groove depth and abnormal wear can influence the test results, it is desirable to take these factors into account when comparing results between motorcycles or between tyres.

4.1.2 Load condition

The load condition of the test motorcycle shall be set so that it is between the gross vehicle weight and the sum of the curb mass plus the mass of the driver, and it shall not exceed the maximum load

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capacity[3] of the tyres. The position of the centre of gravity and the moment of inertia shall be within the normal usage range when a measuring device is attached, whether or not the fuel tank is full or an additional passenger is on board. The total mass of the driver and the measuring device shall be 105 kg or less. The load measurement results shall be recorded in **Attached Table 1**.

Note: [3] **Maximum load capacity**: The value specified in the Japan Automobile Tyre Manufacturers Association standards (**JATMA Year Book**).

4.1.3 Condition of operating parts

The operating parts that influence the test results shall be in a state where they have been adjusted to the values specified by the manufacturer of the test motorcycle. Where the values deviate from the manufacturer's specified values, they shall be recorded under Special Notes in **Attached Table 1**.

Remark: The operating parts that influence the test results are steering system parts, suspension system parts, and driving system parts.

4.2 Test road

It is desirable for the test road to have an asphalt-paved, concrete-paved, or other high-friction surface that is flat, clean, uniformly hard, and dry. The gradient of the road shall not exceed 2.5% in any direction.

4.3 Weather conditions

The wind velocity shall not exceed 5 m/sec. The velocity of the wind component that is perpendicular to the path of the test motorcycle shall not exceed 4 m/sec. The weather conditions at the time of the test, including the maximum wind velocity, shall be recorded in **Attached Table 1**.

4.4 Steering input method

One of the steering input methods below shall be selected to determine the transient response characteristics. The steering input method that is used for the test shall be recorded in **Attached Table 1**.

a) Method that inputs a single steering pulse (hereafter called the pulse steering input method)

b) Method that inputs continuous steering (hereafter called the random steering input method)

5. Measurement items

The measurement items for the test are the steer torque, steer angle, yaw velocity, roll velocity, and forward velocity.

Remark: For the yaw velocity, the angular velocity about the z' axis shall be used.

6. Measuring devices

Table 1 shows the recommended values for the measurement ranges and tolerances of the measuring devices for the measurement items listed in 5. When the data are recorded, the bandwidth (the frequency range necessary to determine the transfer function) of the measuring device in combination with the transformer and recording device shall be 10 Hz or greater.

Table 1 Recommended values for measurement ranges and tolerances of measuring devices

Measurement item		Measurement range	Tolerance[4]
Steer torque	N·m	±100	±1
Steer angle	°	±10	±0.1
Yaw velocity	°/s	±100	±1
Roll velocity	°/s	±100	±1
Forward velocity	km/h	0 to 110	±1.1

Note[4]: Tolerances include the totals from transformer to recording device. Where the tolerances shown in the table above are exceeded, the actual tolerances shall be recorded under Special Notes in **Attached Table 1** for reference purposes.

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7. Test method

7.1 Test preparation

To measure each measurement item in 5, a measuring device having the characteristics listed in **Table 1** shall be attached to the test motorcycle in a manner that does not interfere with normal running. The inflation pressure of the tyres (when cold) shall be adjusted under the test environment. Warming-up shall then be conducted for at least 10 minutes in order to stabilize the tyres and the measuring device. The warming-up shall be conducted within the test velocity range, but the road is not explicitly specified.

7.2 Running method of test motorcycle

The running method shall be as follows.

7.2.1 Test velocity

The running velocity for the test (hereafter called the test velocity) shall be a standard velocity of 80 km/h, but in order to check for changes in characteristics according to the velocity, it is also desirable to test at both 60 km/h and 100 km/h. The standard velocity for a motorcycle not capable of attaining a maximum velocity of 60 km/h shall be 40 km/h. The accuracy of the velocity setting shall be within +/- 5 km/h for each test velocity. Note that even if the velocity changes after a steering input, no acceleration or deceleration shall be conducted.

7.2.2 Steering methods

a) Pulse steering input method

After the test motorcycle has run straight ahead for 3 to 5 seconds at the test velocity, a single pulse of steering shall be input that either pushes or pulls one side of the handlebar. The pulse width shall be 0.2 seconds or less, as shown in **Figure 1**. The steering shall also be of a magnitude that generates a target yaw velocity of 20°/sec., but within a range that does not pose a risk for running. In order to reduce the effect on the movement, the handlebar shall be held as lightly as possible after the steering input.

Remark: In order to reduce the effect on velocity, it is desirable for the steering pulse input to be made on the left side of the handlebar. 5. Structure

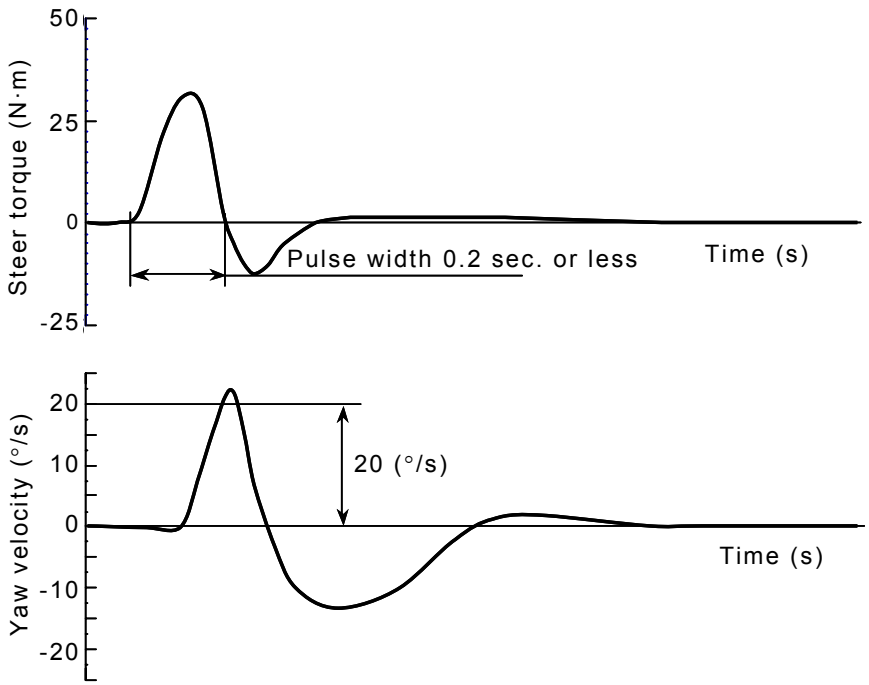

Figure 1 Pulse steering input (Example)

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b) Random steering input method

After the test motorcycle has run straight ahead for 3 to 5 seconds at the test velocity, a continuous steering input with a fixed steer angle amplitude shall be input at a random frequency in the range of 1 to 5 Hz for at least 10 seconds, as shown in **Figure 2**. The steering shall also be of a magnitude that generates a target yaw velocity of 20°/sec., but within a range that does not pose a risk for running.

Remark: For the steering input, it is necessary to employ a technique such as sweeping (gradual shortening of the input cycle) in order to prevent a single cycle from becoming dominant.

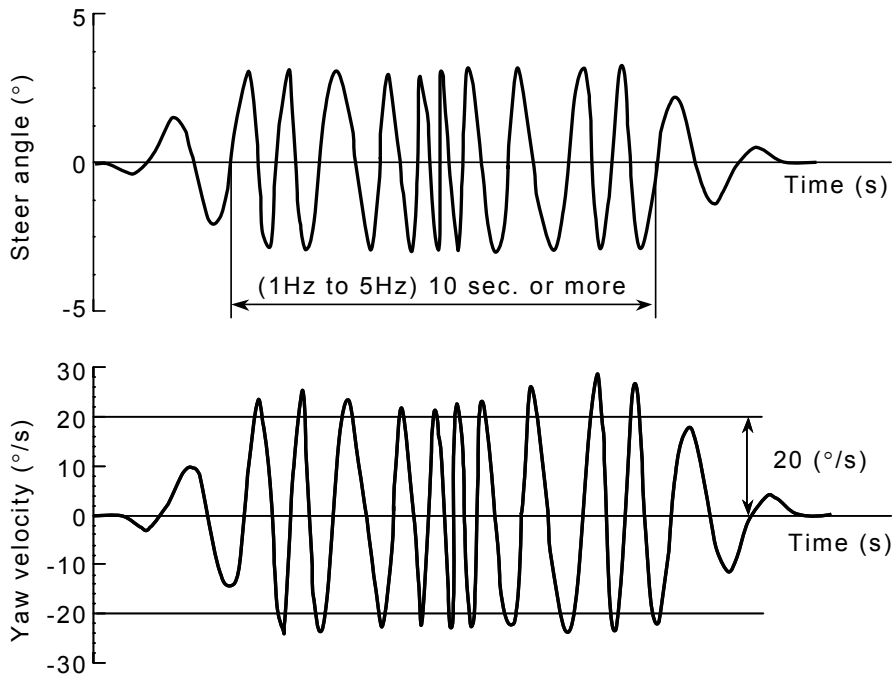

Figure 2 Random steering input (Example)

7.3 Number of test rounds

The number of test rounds shall be 3 or more for each test velocity.

7.4 Recording of measurement data

Measurement data shall be recorded for at least 10 seconds for each test velocity.

8. Method of analysing measurement data

8.1 Analysis device

In consideration of the motorcycle vibration modes (weave, wobble), the required frequency range for this test shall be from 0 Hz to 10 Hz, and an appropriate device for this analysis shall be used. Where digital processing is done, an appropriate sampling rate shall be set.

Remark: The sampling rate shall be in accordance with **JASO Z117-1**, and it is desirable that it not be set to less than twice the measurement frequency.

8.2 Data analysis method

8.2.1 Pulse steering input method

a) Pre-processing of measurement data

The Fourier analysis that is done as the pre-processing shall be calculated based on time series data for the steer torque. The results shall be shown in the form of **Attached Figure 1**. When the Fourier analysis is conducted, it shall be confirmed that the frequency range of 1 to 7 Hz that is used in the test is being input. If any data do not satisfy the requirements, a note to that effect shall be entered in **Attached Figure 1**.

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