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GB/T 40499-2021

General condition of vehicle dynamics test for heavy vehicles and buses

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1 Scope

This document specifies methods of vehicle dynamics test for heavy vehicles and buses.

This document applies to M1, M2, M3, N2, N3 vehicles whose total mass is more than 3 500 kg.

2 Normative references

The contents of the following documents constitute the indispensable clauses of this document through normative references in the text. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 12549-2013, Terms and Definitions for Vehicle Controllability and Stability (ISO 8855:2011, NEQ)

3 Terms and definitions

The following terms and definitions are applicable to this document.

3.1 Vehicle unit A unit of vehicles that are connected by a yaw articulation.

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Note: The number of vehicle units is one more than the number of yaw articulations.

4.1 Reference frame

The motion variables recorded in the test shall meet the definition of coordinate system in GB/T 12549-2013. The origin of the coordinate is usually taken at the Hz. In the frequency range of 0 Hz ~ 2 Hz, the amplitude error shall be less than +/-0.5%. All analog signals shall be processed with filters of the same phase characteristics, so as to ensure that the time delay caused by filtering is the same.

Note: In order to save the low frequency signal, DC coupling shall be adopted as the signal. Since the analog signal filtering process of different frequency components will be phase shifted, it is recommended to use the digital signal processing method that is described in 5.3.3.

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5.3.3.1 Preparations for analog signal processing include: selecting the

sampling frequency and filter amplitude attenuation characteristics to avoid aliasing errors, and the phase lag and time delay characteristics of the filter.

5.3.3.2 Contents to be considered for sampling and digitization:

a) The pre-sampling amplification ratio that ensures the smallest digitization error;

b) The number of bits per sampling;

c) The number of samples per cycle;

d) Sampling and holding amplifier;

e) Sample space;

f) For other digital filters without phase shift, the selection of passband, stopband, attenuation, allowable ripple, and the correction of filter phase lag shall be considered.

5.3.3.3 In order to achieve an acquisition accuracy of +/-0.5% for the overall data, the above influencing factors shall be considered comprehensively.

5.3.3.4 For the attenuation and phase shift information of the Butterworth filter, see Appendix D. In order to avoid uncorrectable aliasing errors, the analog signal shall be properly filtered before sampling and digitization. The filter order and its passband shall be selected according to the frequency range of interest and the signal flatness requirements at the corresponding sampling frequency.

The minimum filtering characteristics and minimum sampling frequency shall meet:

a) In the frequency range of 0 Hz ~ 2 Hz, the maximum attenuation of the analog signal shall be less than the resolution of signal digitization;

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b) At half the sampling frequency (i.e., Nyquist frequency or folding frequency), the size of all frequency components of the signal and noise shall be reduced to less than the digital resolution.

Example: For a resolution of 0.05%, the filter attenuation is less than 0.05% in the 2 Hz range. For all frequencies above one-half the sampling frequency, the attenuation is greater than 99.95%.

Appendix D. Anti-aliasing filter shall be used; excessive analog signal filtering

shall also be avoided. In addition, all filters shall have the same phase characteristics, so as to ensure that the time delay difference between the signals meets the requirements of time domain measurement accuracy.

Note: Because when the measured variable amplitude is multiplied, the phase shift and the corresponding time delay will increase, so, when the measured variable is multiplied to form a new variable, the phase shift shall be paid special attention. By increasing the cutoff frequency f0 of the filter, the phase shift and time delay can be reduced.

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5.3.4.1 At 2 Hz, the amplitude change of the signal per millisecond can reach

3%. In order to limit the dynamic error that is caused by the analog input change exceeding 0.1%, the sampling or digitization time shall be less than 32 us. The data of each pair or group of to-be-compared samples shall be collected at the same time or in a short enough time.

5.3.4.2 Digitization shall adopt a system, of which the resolution is 12-bit or

higher (+/-0.05%) and the accuracy is 2 LSB (+/-0.1%). The amplification of the analog signal before digitization shall be guaranteed: in the digitization process, the comprehensive error caused by the limited resolution and the inaccuracy of digitization shall be less than 0.2%.

5.3.5 Digital filter without phase shift

For the filtering that is used to evaluate the data, the digital filter without phase shift (zero phase shift) shall have the following characteristics (see Figure 1):

-- The range of the passband shall be 0 Hz ~ 2 Hz;

-- The stop band shall start between 6 Hz ~ 10 Hz;

-- The passband filter gain shall be 1 +/- 0.005;

-- The stop band filter gain shall be +/-0.01.

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The wind speed of the surrounding environment during the test shall not exceed

5 m/s. For each test, the test report shall record the climatic conditions during the test; see Appendix E.

6.4 Test vehicle

The basic data information of the test vehicle shall be recorded in the test report in Appendix B. For any changes in vehicle parameters (such as load), the basic data information shall be recorded again.

6.5.1 The tires shall be selected and installed on the test vehicle according to

the manufacturer's instructions. If the tire manufacturer does not clearly indicate, the tire shall be run-in at least 150 km on the tested car or similar car, but it must be ensured that there is no excessive use, such as emergency braking, rapid acceleration, sharp turns, road shoulder pressure. After running-in, the tire shall be kept in the same position for testing.

6.5.2 The tire tread depth (including the entire width of the tire contacting the

ground and the entire tire surface) shall be more than 90% of the initial tire tread depth.

6.5.3 The production date of the tire shall be recorded in the test conditions;

see Appendix E; the test tire shall not exceed one year from the production date.

6.5.4 The tires shall be inflated according to the pressure corresponding to the

test environment temperature that is specified by the automobile manufacturer.

The tire cold inflation pressure shall meet the technical requirements of the vehicle; the error shall not exceed 10 kPa.

6.5.5 The tire pressure and the depth of the tire tread pattern before preheating

shall be recorded in the test report; see Appendix E.

6.5.6 In addition to the basic tire conditions, tests can also be carried out under

other conditions. The specific details shall be recorded in the test report; see

6.6.1 The model and type of key components that affect the performance test

of the entire vehicle and the design parameters that affect the test (such as shock absorber parameters and suspension geometric parameters) shall meet the manufacturer's instructions. Any data that deviates from the manufacturer's instructions shall be recorded

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