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Road vehicles - Requirements and test methods of electromagnetic compatibility

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Table of Contents

Foreword.....	3
1 Scope	4
2 Normative references	4
3 Terms and definitions	5
4 Requirements	6
5 Test methods	13
6 Type inspection	27
7 Product consistency	28
Appendix A (Informative) Judgment method for ESA applicability to the standard	30
Appendix B (Informative) Alternative test method for electromagnetic radiation emission test.....	31

Road vehicles - Requirements and test methods of electromagnetic compatibility

1 Scope

This standard specifies the electromagnetic emission limits, immunity performance and test methods for vehicles and their electrical/electronic components.

This standard applies to category M, N, L vehicles and their electrical/electronic components. Category O and other vehicles can make reference to it.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this standard.

GB/T 6113.104-2008 Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Radiated disturbance

GB/T 18655-2010 Vehicles boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers

GB/T 21437.2-2008 Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only

GB/T 29259 Road vehicle - Electromagnetic compatibility terminology

GB/T 33012.1-2016 Road vehicles - Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy - Part 1: General

GB/T 33012.2-2016 Road vehicles - Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy - Part 2: Off-vehicle radiation sources

GB/T 33012.4-2016 Road vehicles - Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy - Part 4:

Bulk current injection (BCI)

GB/T 33014.1-2016 Road vehicles - Component test methods for electrical/electronic disturbances from narrowband radiated electromagnetic energy - Part 1: General

GB/T 33014.2-2016 Road vehicles - Component test methods for electrical/electronic disturbances from narrowband radiated electromagnetic energy – Part 2: Absorber-lined shielded enclosure

GB/T 33014.3-2016 Road vehicles - Component test methods for electrical/electronic disturbances from narrowband radiated electromagnetic energy - Part 3: Transverse electromagnetic (TEM) cell

GB/T 33014.4-2016 Road vehicles Electrical/electronic components - Test methods for immunity to narrowband radiant electromagnetic energy - Part 4: High current injection (BCI) method

GB/T 33014.5-2016 Road vehicles - Component test methods for electrical/electronic disturbances from narrowband radiated electromagnetic energy - Part 5: Strip line

CISPR 12:2005 Vehicles, ships, and devices driven by internal combustion engines - Radio disturbance characteristics - Limits and measurement methods

3 Terms and definitions

The terms and definitions defined in GB/T 29259 and the following apply to this document.

3.1

Electrical/electronic sub-assembly, ESA

An electrical/electronic device or component that has an associated electrical connection that enables one or more of the specified functions.

3.2

Vehicle wiring harness

Vehicle-mounted power cables, bus systems (e.g. CAN) cables, signals or active antenna cables.

3.3

Immunity related functions

Positive	+ 75 V	+ 150 V
Negative	- 100 V	- 450 V

4.10 Supplementary provisions

4.10.1 Whole-vehicles

4.10.1.1 If the vehicle is not fitted with an ESA with immunity-related functions, the radiation immunity test is not required and may be regarded as meeting the requirements of 4.4.

4.10.1.2 If the vehicle does not contain an electronic oscillation generator operating at a frequency greater than 9 kHz, the narrowband electromagnetic emission test is not required and may be regarded as meeting the requirements of 4.3.

4.10.2 Electrical/electronic components (ESA)

4.10.2.1 It requires considering the ESA for electromagnetic compatibility. Refer to Appendix A for the determination method.

4.10.2.2 If the ESA does not contain an electronic oscillation generator with an operating frequency greater than 9 kHz, the narrowband electromagnetic emission test is not required, and it may be regarded as meeting the requirements of 4.6.

4.10.2.3 ESA without state switching, without switching type load and without inductive loads, it does not require a transient conducted emission test and may be regarded as meeting the requirements of 4.9.

4.10.2.4 The ESA radiated and conducted immunity performance specified in 4.7 and 4.8 is only relevant to the ESA related to immunity-related functions. Other ESA may be implemented by reference or negotiated by both parties.

4.10.3 Other instructions

4.10.3.1 During the immunity test process, when the applied interference signal is within the necessary bandwidth of the on-board receiver, that is, in the frequency band of the specific radio device as specified in the national standard, the function determination of the receiver does not have to follow the failure criterion.

4.10.3.2 Radio frequency transmitters shall be tested in transmission mode. It does not consider the intentional transmission in the necessary bandwidth (such as the emission of radio frequency transmission system) and out-of-band emission. Spurious emissions need to be tested.

Note 1: "Required bandwidth" refers to the bandwidth required for the specified

number of test frequency points. See Appendix B for details.

5.3.5 Data processing and analysis

The maximum readings of the antenna located at the left and right sides of the vehicle with horizontal polarization and vertical polarization at 14 sub-bands (see Appendix B.1) shall be recorded as characteristic values of the measured frequency.

If the test results exceed the limit, analysis shall be performed to ensure that the measured radiation emission is from the vehicle rather than the background noise.

5.4 Vehicle immunity to electromagnetic radiation

5.4.1 General

5.4.1.1 This method is used to test the electrical/electronic system immunity performance of the vehicle. The vehicle shall be fully exposed to the electromagnetic field and the vehicle shall be monitored during the test.

5.4.1.2 If there is no other requirement, it shall be conducted in accordance with the test method specified in GB/T 33012.2-2016.

5.4.1.3 Alternative methods may be selected. Vehicles are tested at an outdoor test field.

5.4.1.4 If the vehicle length is greater than 12 m and/or the width is greater than 2.6 m and/or the height is greater than 4 m, the bulk current injection (BCI) method may be used in accordance with GB/T 33012.4-2016 in the frequency range of 20 MHz ~ 2000 MHz.

5.4.2 Vehicle status

5.4.2.1 Except for the necessary test devices, the vehicle shall be unloaded.

5.4.2.2 The engine shall operate normally with a speed of 50 km/h. The stable speed of category L₁ and L₂ vehicles shall be 25 km/h (if the vehicle cannot reach 25 km/h, it shall run at the maximum speed). The vehicle shall be placed on the dynamometer. If there is no dynamometer, it can be placed on the insulation support and the minimum ground clearance is guaranteed. The drive shafts, belts or chains (e.g. trucks, two-wheel vehicles or three-wheel wheels) can be disconnected.

5.4.2.3 The basic test conditions for the disturbance immunity test of vehicles are shown in Table 9. The test conditions (status) and failure criteria for other systems of the vehicle that may affect the immunity-related functions shall be determined by the manufacturer and the testing institute through negotiation.

- c) Bulk current injection (BCI) method: in accordance with the provisions of GB/T 33014.4-2016;
- d) 150 mm strip line method: in accordance with the provisions of GB/T 33014.5-2016;
- e) 800 mm strip line method: in accordance with the provisions of 5.7.4.5.

5.7.2 ESA status

5.7.2.1 Test conditions shall comply with the provisions of GB/T 33014.1-2016.

5.7.2.2 The ESA shall be in normal working condition and shall be arranged in accordance with the provisions of this standard, except for special test methods.

5.7.2.3 At the time of calibration, all auxiliary equipment needed for ESA operation shall not be placed in the test position, the distance between other equipment and the reference point shall not be less than 1 m.

5.7.2.4 To ensure the reproducibility of the test results, the signal generation equipment and line configuration shall be the same as during calibration.

5.7.2.5 If the ESA contains multiple units, the connection lines between the units shall use the connection harnesses used in the original vehicle. If this cannot be achieved, the length of the connection line between the electronic control unit and the artificial power network (AN) shall comply with the requirements of this standard. The wiring harness shall be terminated in accordance with actual conditions, it shall carry true load and excitation.

5.7.3 General test requirements

5.7.3.1 It shall be carried out in the frequency range of 20 MHz ~ 2000 MHz, the frequency step length shall be in accordance with the provisions of GB/T 33014.1-2016. If there are no other provisions, the modulation of the test signal shall satisfy:

- a) Amplitude modulation (AM): The applicable frequency range is 20 MHz ~ 800 MHz, the modulation frequency is 1 kHz, the modulation depth is 80%;
- b) Pulse modulation (PM): The applicable frequency range is 800 MHz ~ 2000 MHz, the pulse width is 577 μ s, the period is 4600 μ s.

5.7.3.2 The test shall be carried out in accordance with the provisions of GB/T 33014.1-2016 in the full frequency range of 20 MHz ~ 2000 MHz. If manufacturers can provide full-band test data of authorized testing organizations, the number of test frequency points can be reduced. For example, 7 MHz, 45 MHz, 65 MHz, 90 MHz, 120 MHz, 150 MHz, 190 MHz, 230 MHz, 280 MHz, 380 MHz, 450 MHz, 600 MHz, 750 MHz, 900 MHz, 1300 MHz

It is constituted by two parallel metal plates spaced 800 mm apart (see Figures 11 and 12), the tested equipment (ESA) is placed in the middle of the two metal plates. The ESA can be a complete electronic system including sensors, controllers, actuators and harness sheaths.

5.7.4.5.2 Position of strip lines

The strip line shall be placed in a shielded enclosure (to avoid radiation to the outside) and at least 2 m away from the wall and any metal shielded enclosure to avoid electromagnetic reflections. Radio frequency absorber materials can be used to attenuate reflections. The strip line shall be placed on the insulating bracket at least 0.4 m above the ground.

5.7.4.5.3 Strip line calibration

Place a field test probe in the middle 1/3 of the length, width, and height of the two metal parallel plates. The ESA shall not be within the strip line.

Related test equipment shall be placed outside the shielded enclosure. At each required test frequency point, a certain level of power is input to the strip line to produce the required field strength. Record the forward power value or record other parameters that are directly related to the forward power required to produce the specified field strength. The calibration results are used for the ESA test. When the test facility or equipment changes, it needs to be recalibrated.

5.7.4.5.4 ESA installation

The main control unit shall be placed in the center area between the two metal parallel plates and placed on the insulating support.

5.7.4.5.5 Main wiring harness and sensor/actuator cable

The main wiring harness and sensor/actuator cable shall be led vertically from the control unit to the inner surface of the grounded plane (to maximize the electromagnetic field coupling). The cable then follows the inner surface of the ground plane to one of its free faces, where it surrounds the outer surface of the ground plane and extends to the feed end which connects the strip lines. These cables shall then be connected to related equipment placed on a field outside the influence of the electromagnetic field. For example, related equipment on a shielded enclosure floor along the length direction 1 m away from the strip line.

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