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Electronmagnetic Compatibility Measurement Procedure for Vehicle Components - Part 21: Immunity to Electromagnetic Fields, 30 MHz to 18 GHz, Absorber-Lined Chamber		

RATIONALE

After the latest revision of ISO 11452-2 (Road vehicles - Component test methods for electrical disturbances from narrowband radiated electromagnetic energy - Part 2: Absorber-lined shielded enclosure (ALSE) in 2012, the ISO document is now technical identical to the SAE J1113-21.

At the August 16, 2012 SAE EMC Standards Committee meeting, the committee recommended "Cancellation of SAE J1113 Part 21" in favor of using ISO 11452 Part 2.

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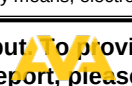

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1. Scope

This part of SAE J1113 specifies test methods and procedures for testing electromagnetic immunity (of vehicle radiation sources) of electronic components for passenger cars and commercial vehicles. To perform this test method, the electronic module along with the wiring harness (prototype or standard test harness) and peripheral devices will be subjected to the electromagnetic disturbance generated inside an absorber-lined chamber. The electromagnetic disturbances considered in this part of SAE J1113 are limited to continuous narrowband electromagnetic fields.

Immunity measurements of complete vehicles are generally only performed at the vehicle manufacturer. The reasons, for example, are high costs of a large absorber-lined chamber, preserving the secrecy of prototypes, or the large number of different vehicle models. Therefore, for research, development and quality control, a laboratory measuring method shall be applied by the manufacturers.

Part 1 of SAE J1113 specifies the general, definitions, practical use, and basic principles of the test procedure

1.1 Rationale

The JAN 1988 version of this standard has been revised to incorporate the latest changes in the International Standards ISO 11452-2. A new section has also been added to incorporate the test procedures for performing the test on a non-metallic bench top (including a new requirement for field uniformity).

2. References

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1113-1—Electromagnetic Compatibility Measurement Procedures and Limits for Components of Vehicles, Boats (up to 15 m), and Machines (Except Aircraft) (50 Hz to 18 GHz)
SAE J1812—Function Performance Status Classification for EMC Immunity Testing

2.1.2 ISO PUBLICATIONS

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ISO 11452-1:3rd Edition 2/2005—Road vehicles—Component test methods for electrical disturbances from narrowband radiated electromagnetic energy—Part 1: General and definitions
ISO 11452-2:2nd Edition 10/2004—Road vehicles—Electrical disturbances by narrowband radiated electromagnetic energy—Component test methods—Part 2: Absorber-lined chamber

3. *Measurement Philosophy*

The objective of an absorber-lined chamber is to create an indoor electromagnetic compatibility testing facility. The shielded chamber is lined with absorbing material on as many surfaces in the chamber as possible to minimize reflections and resonance. The design objective is to reduce the reflectivity in the test area to -10 dB or less.

Typical application for this test method is recommended for frequency range of 30 MHz to 18 GHz.

4. *Test Conditions*

Standard test conditions are given in SAE J1113-1 for the following:

- test temperature;
- supply voltage;
- modulation;
- dwell time;
- frequency step sizes;
- definition of test severity levels;
- test signal quality;
- test severity level.

5. *Test Location*

The tests shall be performed in an absorber-lined shielded enclosure. The objective of an absorber-lined shielded enclosure is to create an isolated electromagnetic compatibility test facility. Basically, an absorber-lined shielded enclosure consists of a shielded room with absorbing material on its internal reflective surfaces, optionally excluding the floor. The design objective is to attenuate the reflected energy in the test area by at least 10 dB compared to the direct energy.

6. Test Instrumentation

Radiated electromagnetic fields are generated using antenna with radio frequency (RF) energy source capable of producing the desired field strengths. A set of antennas and multiple RF amplifiers may be required to cover the range of test frequencies. The field is monitored electrically with small probes to ensure proper test levels. To reduce test error, the operation of the DUT is usually monitored by fiber optic couplers.

The following measuring equipment is used:

- field generating device(s) : antenna(s);
- isotropic field probe;
- AN(s);
- HF generator with internal (or external) modulation capabilities;
- High power amplifier;
- Powermeter (or equivalent measuring instrument) to measure forward power and reflected power.

6.1 Field Generating Device

The field generating device shall be an antenna. Any available antenna (including high power baluns if appropriate) which is capable of radiating the specified field strength at the DUT with the available power may be used.

The construction and orientation of any field generating device shall be such that the generated field can be polarized in the mode specified in the test plan.

6.2 Field Probes

Field probes should be electrically small and isotropic. The transmission lines from the probes should be either fiber optic links or very high resistance.

6.3 Stimulation and Monitoring of the DUT

The DUT shall be operated as required in the test plan by actuators which have a minimum effect on the electromagnetic characteristics, e.g. plastic blocks on the push-buttons, pneumatic actuators with plastic tubes.

Connections to equipment monitoring electromagnetic interference reactions of the DUT may be accomplished by using fiber optics, or high resistance leads. Other type of leads may be used but require extreme care to minimize interactions. The orientation, length and location of such leads shall be carefully documented to ensure repeatability of test results.

Any electrical connection of monitoring equipment to the DUT may cause malfunctions of the DUT. Extreme care shall be taken to avoid such an effect.

7. Test Set-Up – Test Performed with a Ground Plane

7.1 Ground Plane

The ground plane shall be made of 0.5 mm thick (minimum) copper, brass or galvanized steel.

The minimum width of the ground plane shall be 1000 mm. The minimum length of the ground plane shall be 2000 mm, or underneath the entire equipment plus 200 mm, whichever is larger.

The height of the ground plane (test bench) shall be (900 ± 100) mm above the floor. The ground plane shall be bonded to the shielded enclosure such that the D.C. resistance shall not exceed $2.5 \text{ m}\Omega$. In addition, the bond straps shall be placed at a distance no greater than 0.3 m apart.

7.2 Power Supply and Artificial Network

Each DUT power supply lead shall be connected to the power supply through an artificial network.

Power supply is assumed to be negative ground. If the DUT utilizes a positive ground then the test set-ups shown in the figures need to be adapted accordingly. Power shall be applied to the DUT via $5 \text{ }\mu\text{H}$ / $50 \text{ }\Omega$ artificial network (see annex A for artificial network schematic). Depending on the intended DUT installation in the vehicle:

- DUT remotely grounded (vehicle power return line longer than 200 mm): two artificial networks are required, one for the positive supply line and one for the power return line (see Appendix B);
- DUT locally grounded (vehicle power return line 200 mm or shorter): one artificial network is required, for the positive supply (see Appendix B).

The AN(s) shall be mounted directly on the ground plane. The case(s) of the AN(s) shall be bonded to the ground plane.

The power supply return shall be connected to the ground plane (between the power supply and the AN(s))

The measuring port of each AN shall be terminated with a $50 \text{ }\Omega$ load.

7.3 Location of the DUT

The DUT shall be placed on a non-conductive, low relative permittivity (dielectric constant) material ($\epsilon_r \leq 1.4$), at (50 ± 5) mm above the ground plane.

The case of the DUT shall not be grounded to the ground plane unless it is intended to simulate the actual vehicle configuration.

- The face of the DUT shall be located at a distance of (200 ± 10) mm from the edge of the ground plane.

7.4 Location of the Test Harness

The length of test harness parallel to the front edge of the ground plane shall be (1500 ± 75) mm.

The total length of the test harness between the DUT and the AN (or the RF boundary) shall not exceed 2000 mm. The wiring type is defined by the actual system application and requirement.

The test harness shall be placed on a non-conductive, low relative permittivity (dielectric constant) material ($\epsilon_r \leq 1.4$), at (50 ± 5) mm above the ground plane.

The length of test harness parallel to the front edge of the ground plane shall be located at a distance of (100 ± 10) mm from the edge of the ground plane.

7.5 Location of the Load Simulator

Preferably, the load simulator shall be placed directly on the ground plane. If the load simulator has a metallic case, this case shall be bonded to the ground plane.

Alternatively, the load simulator may be located adjacent to the ground plane (with the case of the load simulator bonded to the ground plane) or outside of the test chamber, provided the test harness from the DUT passes through an RF boundary bonded to the ground plane.

When the load simulator is located on the ground plane, the DC power supply lines of the load simulator shall be connected through the AN(s).

7.6 Location of the Field Generating Device (Antenna)

The height of the phase center of the antenna shall be (100 ± 10) mm above the ground plane.

No part of any antenna radiating element shall be closer than 250 mm to the floor. The radiating elements of the antenna shall not be closer than 500 mm to any absorber material, and shall not be closer than 1500 mm to the walls or ceiling of the shielded enclosure.

The distance between the wiring harness and the antenna shall be (1000 ± 10) mm. This distance is measured from:

- the phase center (mid-point) of the biconical antenna; or
- the nearest part of the log-periodic antenna; or
- the nearest part of the horn antenna.

The phase center of the antenna for frequencies from 80 MHz to 1000 MHz shall be in line with the center of the longitudinal part (1500 mm length) of the wiring harness.

The phase center of the antenna for frequencies above 1000 MHz shall be in line with the DUT.

Examples of test configurations are shown in Figures 1 to 3.