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Road vehicles — Environmental conditions and testing for electrical and electronic equipment —

Part 3: Mechanical loads

Véhicules routiers — Spécifications d'environnement et essais de l'équipement électrique et électronique —

Partie 3: Contraintes mécaniques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 32, *Electrical and electronic components and general system aspects*.

This fourth edition cancels and replaces the third edition (ISO 16750-3:2012), which has been technically revised.

The main changes are as follows:

— integrating and harmonizing content from ISO 19453-3:2018;

— distinction between small and lightweight versus large and heavy DUTs;

— revising vibration profiles where necessary due to extended datasets of and experience from vehicle measurements;

— addition of vibration test for rotating machines on combustion engines and Annex C;

— addition of vibration tests for hybrid-electric/fully-electric commercial vehicles;

— addition of guided fall test description and Annex D;

— addition of Annex E as guidance for 3D shaker testing;

— test order appearing in the document has been changed for a logical grouping depending on test type, however test numbers have been kept for backwards compatibility.

A list of all parts in the ISO 16750 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Road vehicles — Environmental conditions and testing for electrical and electronic equipment —

Part 3: Mechanical loads

1 Scope

This document applies to electric and electronic systems and components for vehicles including electric propulsion systems and components with maximum working voltages according to voltage class B. It describes the potential environmental stresses and specifies tests and requirements recommended for the specific mounting location on/in the vehicle.

This document describes mechanical loads.

This document is not intended to apply to environmental requirements or testing for systems and components of motorcycles and mopeds.

Systems and their components released for production, or systems and their components already under development prior to the publication date of this document, can be exempted from fulfilling the changes in this edition compared to the previous one.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16750-1:2023, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 1: General*

ISO 16750-4:2023, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment— Part 4: Climatic loads*

IEC 60068-2-6, *Environmental testing — Part 2-6: Testing, Test Fc: Vibration (Sinusoidal)*

IEC 60068-2-14, *Environmental testing — Part 2-14: Tests — Test N: Change of temperature*

IEC 60068-2-27, *Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock*

IEC 60068-2-31, *Environmental testing — Part 2-31: Tests — Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-64, *Environmental testing — Part 2-64: Tests — Test Fh: Vibration, broadband random and guidance*

IEC 60068-2-80, *Environmental testing — Part 2-80: Tests — Test Fi: Vibration — Mixed mode*

UL 969:2017, *Standard for Marking and Labeling Systems*

ISO 20567-1:2017, *Paints and varnishes — Determination of stone-chip resistance of coatings — Part 1: Multi-impact testing*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16750-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Tests and requirements

4.1 Vibration

4.1.1 Testing conditions during the vibration test

4.1.1.1 General

The vibration test methods specified consider various levels of vibration severities applicable to on-board electrical and electronic equipment. The customer and the supplier should choose the test method, environmental temperature and vibration parameters depending on the specific mounting location.

A clear dependence of the typical vibration load on the size and mass of the DUT is evident from vehicle measurements. This applies to all mounting locations due to dynamic system coupling. That is why in this document a distinction is made between small and lightweight E/E components (typically <2 kg, unless stated otherwise in the individual test description, e.g. sensors, ECUs or fuel injection equipment), mostly belonging but not limited to ICE vehicles, and much larger and heavier components (typically ≥2 kg, unless stated otherwise in the individual test description, e.g. electric motors, inverters, DC/DC converters or alternators), mostly belonging but not limited to electric powertrains in electric propulsion vehicles. In each application the applicability of the intended vibration profile should be verified with a vehicle measurement. See a mass classification example in ISO 16750-1:2023, Annex C. For further information and guidance please refer to Tables 38-40 (code letters).

The following basic idea of environmental test methods is expressed in the Foreword of Reference [7].

When applied properly, the environmental management and engineering processes described in this document can be of enormous value in generating confidence in the environmental worthiness and overall durability of the tested equipment. However, it is important to recognize that limitations inherent in laboratory testing make it imperative to use proper caution and engineering judgment when extrapolating these laboratory results to results that can be obtained under actual service conditions. In many cases, real world environmental stresses (singularly or in combination) cannot be duplicated practically or reliably in test laboratories. Therefore, users of this document should not assume that a system or component that passes laboratory tests of this document would also pass field/fleet verification trials.

The specified values are the best estimation that can be obtained up to the moment when results from measurements in the vehicle are received, but they do not replace a vehicle measurement.

The specified values apply to direct mounting in defined mounting locations. The specified vibration profiles apply to direct mounting in defined mounting locations. Since the use of an installation support (e.g. mounting bracket) can influence test vibration loads on the shaker to be much higher or much lower than actual vehicle loads, in principle, each vibration test should be carried out with only DUT itself. If using an installation support, the applied loads on the shaker should be checked to reproduce the actual vehicle loads as realistically as possible.

Carry out the vibration with the DUT rigidly mounted on a vibration table for reasons of comparability and reproducibility (see also IEC 60068-2-47:2005, Clauses 5 and 6). If using a bracket is technically unavoidable in order to fix the DUT to the shaker instead of a rigid mounting, then the transfer functions

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