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Road vehicles — Environmental conditions and testing for electrical and electronic equipment for drive system of electric propulsion vehicles —

Part 6: Traction battery packs and systems

Véhicules routiers — Spécifications d'environnement et essais de l'équipement électrique et électronique pour les véhicules à propulsion électrique —

Partie 6: Packs et systèmes de batterie de traction

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Foreword

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

A list of all parts in the ISO 19453 series can be found on the ISO website.

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Introduction

For over fifty years, traction batteries for electric vehicles have been developed to achieve high energy density and high power output. Specifically, lead-acid battery, Ni-Cd battery and Ni-MH battery with aqueous electrolyte were most applied to electric vehicles in the early days. Thermal activated batteries, such as molten salt batteries like sodium sulphur battery and Zebra battery were also examined. Lithium ion battery penetrated the consumer market in portable battery application from 1991. Currently, it is the most promising candidate of traction battery for electric vehicles. ISO 6469-1 specifies safety requirement of RESS (Rechargeable Energy Storage System) and the ISO 12405 series has been published to specify performance and reliability tests. This document focuses on environmental and endurance tests of lithium ion battery systems.

The ISO 19453 series specifies the test conditions on environment and reliability for electrical and electric equipment for the drive system of electric propulsion vehicles. The battery pack or system is the electric system which charges and discharges electricity through the converter. The test condition for mechanical load in ISO 19453-3 is too severe to apply to the battery pack or system from the standpoint of frequency range and amplitude of vibration in the test input spectrum. The test conditions for climatic load in ISO 19453-4 is also excessive to apply to the battery pack or system, because lithium ion battery pack is designed to control temperature within adequate operational range. That is the reason why appropriate conditions for the lithium ion battery are specified in this document.

The purpose of this document is to assist its user in systematically defining and/or applying a set of internationally accepted environmental conditions, tests and operating requirements, which are based on the anticipated actual environment in which the equipment will be operated and exposed to during its life cycle. This document has been developed based on fundamental investigations and vehicle measurements on voltage class A and B battery pack/system. The following environmental factors have been considered in the development of the ISO 19453 series.

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— World geography and climate

Electric propulsion vehicles are operated in nearly all terrestrial regions of the earth. Significant variation in environmental conditions due to climatic environment, including diurnal and seasonal cycles, can therefore be expected. Consideration has been given to worldwide ranges in the temperature, humidity, precipitation and atmospheric conditions including dust, pollution and altitude.

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— Type of electric propulsion vehicle

Operating environment in an electric propulsion vehicle can depend on its electric powertrain architecture as well as its mass, size, supply voltage and so on. Consideration has been given to typical types of series production electric propulsion vehicle architectures such as hybrid electric vehicles, battery electric vehicles, range extender hybrid electric vehicles and fuel cell vehicles, but not including equipment specific for fuel cell system.

— Vehicle use conditions and operating modes

Environmental conditions in and on the vehicle vary significantly with vehicle use (e.g. driving, charging during parking, etc.). Operating modes, such as starting, driving, braking, stopping and so on, have been considered, in particular, for traction battery system.

— Battery durability

For battery system, it is necessary to be resistant to environmental conditions experienced during manufacture, shipping, handling, storage, vehicle assembly, vehicle usage and vehicle maintenance and repair.

— Component mass and volume

The mass of battery pack is generally in the range of around 20 kg up to 60 kg for HEV, 80 kg to 150 kg for PHEV, more than 200 kg for BEV (weight assumptions from year 2020). The battery pack has generally

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a large volume and thermal capacity. It is necessary not only to prepare a large chamber but it will also take a long time to keep the thermal equivalent when performing a thermal shock test.

— Mounting location in the vehicle

HEV battery packs are generally installed inside the vehicle, PHEV battery packs are installed both outside and inside, and BEV battery packs are generally installed outside. The environmental condition such as water splashing, dust, salt spray, humidity or corrosion for battery packs installed outside vehicle interior is more severe than for battery packs installed inside. In this document, test conditions are specified according to mounting location.

a) Applicability to manufacturers' responsibility

Due to technology limitations or variations in vehicle design, the vehicle manufacturer may be required to place a component in a location where it cannot withstand the environmental conditions described in the ISO 19453 series. Under these circumstances, it is the responsibility of the vehicle manufacturer to provide the necessary environmental protection.

b) Applicability to wiring harnesses, cables and electrical connectors

Although some environmental conditions and tests in the ISO 19453 series may be relevant to vehicle wiring harnesses, cables and connectors, its scope is not sufficient to be used as a complete standard. It is therefore not recommended that the ISO 19453 series is directly applied to such devices and equipment.

c) Applicability to parts or assemblies inside equipment

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The ISO 19453 series describes environmental conditions and tests to be applied to electrical and electronic equipment directly mounted in or on the vehicle. It is not intended for direct application to parts or assemblies that are part of the equipment. For example, the ISO 19453 series should not be directly applied to integrated circuits (ICs) and discrete components, electrical connectors, printed circuit boards (PCBs), gauges, etc. that are attached in or on the equipment. Electrical, mechanical, climatic and chemical loads for such parts and assemblies can be quite different from those described in the ISO 19453 series. Therefore, for those sub-components applying test conditions of the ISO 16750 series can be considered as a reference.

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On the other hand, it is desirable to use the ISO 19453 series to help derive environmental conditions and test requirements for parts and assemblies that are intended for use in road vehicle equipment.

d) Applicability relative to system integration and validation

The user of the ISO 19453 series is cautioned to understand that its scope is limited to conditions and testing at the equipment level and therefore does not represent all conditions and testing necessary for complete verification and validation of the vehicle system, for example cold water shock tests were omitted from this document. Environmental and reliability testing of equipment parts and vehicle systems may be required. For example, the ISO 19453 series does not necessarily ensure that environmental and reliability requirements for solder joints, solderless connections, integrated circuits and so on are met. Such items are assured at the part, material or assembly level. Additionally, vehicle and system level testing might be required to validate the equipment in the vehicle application.

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