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Railway applications - Hydrogen and fuel cell systems for rolling stock - Part 1: Fuel cell power system

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IEC 63341-1 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
9/3212/FDIS	9/3254/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 63341 series, published under the general title *Railway applications – Hydrogen and fuel cell systems for rolling stock*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,

– withdrawn, or

– revised.

INTRODUCTION

This document considers general requirements for all fuel cell power systems installed onboard rolling stock for railway applications.

IEC TC 105 is developing the IEC 62282 series, covering generic fuel cell technologies in different industrial sectors:

– IEC 62282-2 series on fuel cell modules;

– IEC 62282-3 series on stationary fuel cell power systems;

– IEC 62282-4 series on fuel cell power systems for propulsion and auxiliary power units

These documents are often generic and do not cover the specific requirements for railway applications.

Therefore, this document has been developed to specify the requirements for railway applications.

This document is linked to IEC 63341-3, which specifies the performance test method to validate the fuel cell power system performance.

This document with the other parts is used in conjunction with other related IEC standards for auxiliary equipment used for railway rolling stock applications. In addition, IEC TC 9 has developed the following standards for the subsystems, which are related or have interfaces to the fuel cell power system:

- IEC 62864-1:2016, *Railway applications - Rolling stock - Power supply with onboard energy storage system - Part 1: Series hybrid system*
- IEC 61287-1, *Railway applications - Power converters installed on board rolling stock - Part 1: Characteristics and test methods*
- IEC 60349 (all parts), *Electric traction - Rotating electrical machines for rail and road vehicles*
- IEC 62928, *Railway applications - Rolling stock - Onboard lithium-ion traction batteries*

IEC 62864-1:2016 specifies the general requirements for the onboard energy storage system as a system level. The hierarchy of standards is shown in Figure 1. The list is not exhaustive.

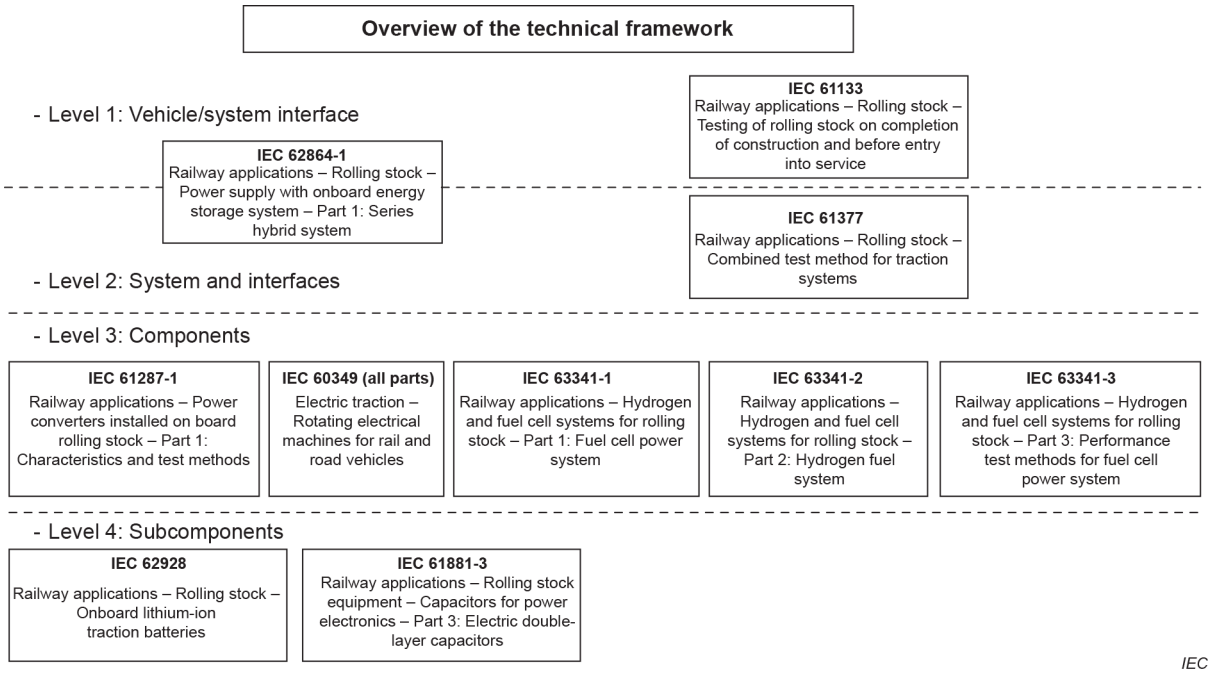

Figure 1 – Hierarchy of standards related to IEC 63341

1 Scope

This part of IEC 63341 applies to fuel cell power systems installed onboard rolling stock for railway applications (e.g. light rail vehicles, tramways, streetcars, metros, commuter trains, regional trains, high speed trains, locomotives). Fuel cell power systems specified in this document are used for the traction power and the auxiliary supply of railway vehicles such as hybrid vehicles, and in case of use as an auxiliary onboard power source.

This document applies to the fuel cell technology called proton exchange membrane fuel cell (PEMFC), with the use of hydrogen as fuel source and the use of air as oxidant source.[1]

This document does not apply for hydrogen fuel system which is specified in IEC 63341-2, as HFS is not within the scope of this document.

This document does not apply for power conversion equipment which is specified in IEC 61287-1 and is not within the scope this document.

This document specifies:

– the scope of supply and the description of the interfaces (fluidic, electrical, thermal and mechanical) of the fuel cell power system;
– the description of the environmental conditions;
– the specification and description of all the requirements to ensure the fuel cell power system conformance with a railway application;
– the process to validate the fuel cell power system sizing required for a specific load profile;
– the safety, reliability and protection requirements to design the fuel cell power system for a railway application;
– the marking and labelling requirements;
– the requirements related to storage, transportation, installation and maintenance;
– the tests (type, routine and investigation) required to validate the fuel cell power system.

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.

IEC 60034-14, *Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity*

IEC 60077-1, *Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

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1 PEM fuel cells are typically limited to less than 120 °C due to stability of the membrane and evaporation of water. More practically, they are limited to 85 °C to 90 °C in high or peak temperature application to limit the electrochemical degradations and preserve their lifetime.

Because of the thin membrane, and low resistance losses, PEM fuel cells tend to deliver high power density and offer the advantages of low mass and volume, compared to other fuel cell types. The low temperature operation also allows them to start quickly (less warm-up time) and to start from freeze condition, which makes them particularly well suited for transportation applications.

IEC 60571, *Railway applications - Electronic equipment used on rolling stock*

IEC 60617, *Graphical symbols for diagrams*, available at http://std.iec.ch/iec60617

IEC 61373, *Railway applications - Rolling stock equipment - Shock and vibration tests*

IEC 61709, *Electric components - Reliability - Reference conditions of failure rates and stress models for conversion*

IEC 61991, *Railway applications - Rolling stock - Protective provisions against electrical hazards*

IEC 62236-3-2, *Railway applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus*

IEC 62282-2-100:2020, *Fuel cell technologies - Part 2-100: Fuel cell modules - Safety*

IEC 62282-3-100:2019, *Fuel cell technologies - Part 3-100: Stationary fuel cell power systems - Safety*

IEC 62282-4-101:2022, *Fuel cell technologies - Part 4-101: Fuel cell power systems for electrically powered industrial trucks - Safety*

IEC 62497-1, *Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment*

IEC 62498-1:2010, *Railway applications - Environmental conditions for equipment - Part 1: Equipment on board rolling stock*

IEC 62635, *Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment*

IEC 63341-3:2025, *Railway applications - Hydrogen and fuel cell systems for rolling stock - Part 3: Performance test methods for fuel cell power system*

IEC 61375-1, *Electronic railway equipment - Train communication network (TCN) - Part 1: General architecture*

ISO 3744, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane*

ISO 3746, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane*

ISO 7010, *Graphical symbols - Safety colours and safety signs - Registered safety signs*, available at https://www.iso.org/obp

ISO 9227, *Corrosion tests in artificial atmospheres - Salt spray tests*

ISO 14687, *Hydrogen fuel quality - Product specification*

ISO 21106, *Railway applications - Recyclability and recoverability calculation method for rolling stock*

ISO 23828, *Fuel cell road vehicles - Energy consumption measurement - Vehicles fuelled with compressed hydrogen*