IEC 62282-4-101

Edition 2.0 2022-08
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Fuel cell technologies –
Part 4-101: ~~Fuel cell power systems for propulsion other than road vehicles and auxiliary power units (APU) – Safety of electrically powered industrial trucks~~
Fuel cell power systems for electrically powered industrial trucks – Safety

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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CONTENTS

FOREWORD 5
INTRODUCTION 8
1 Scope 9
2 Normative references 11
3 Terms and definitions 15
4 Construction requirements for safety 19
4.1 General 19
4.2 Hydrogen and other fluid containing parts 20
4.2.1 General 20
4.2.2 Piping, hoses, tubing and fittings 20
4.2.3 Hydrogen pressure vessels 21
4.2.4 Metal hydride container 22
4.2.5 Methanol fuel tank 22
4.3 Refueling 23
4.4 Over-pressure and thermal protection 23
4.5 Regulators 26
4.6 Operating and shut-off valves 26
4.7 Filters 27
4.8 Pumps and compressors 27
4.9 Electrically operated pressure sensing and controlling devices 27
4.10 Ventilation to prevent the build up of flammable gases ~~and vapours~~ 27
4.11 Electrostatic discharge (ESD) 28
4.12 Discharges including methanol emissions and waste materials 29
4.13 Enclosures 29
4.14 ~~Fuel cell power system electrical components~~ Electrical system 29
4.14.1 General 29
4.14.2 Internal wiring 30
4.14.3 External wiring 31
4.14.4 Emergency switching off requirements (disconnection) for connections for fuel cell power system 31
4.14.5 Motors 32
4.14.6 Switches and motor controllers 32
4.14.7 Transformers and power supplies 32
4.14.8 Inverters, converters and controllers 32
4.14.9 Lamps and lampholders 32
4.14.10 Energy storage components 32
4.14.11 Electrical insulation 33
4.14.12 Limited power circuit 34
4.14.13 Electrical spacings 34
4.14.14 Separation of circuits 35
4.15 Control circuits 36
4.15.1 Safety controls 36
4.15.2 Start 36
4.15.3 Drive off 36
4.15.4 Emergency stop 36
4.16 ~~Safety/hazard analysis~~ Risk assessment and risk reduction 36

5 Performance requirements for safety and type tests 37
5.1 General 37
5.2 Vibration test 37
5.2.1 General 37
5.2.2 Vertical axis test 37
5.2.3 Longitudinal and lateral axes tests 37
5.3 Fuel container securement test 37
5.4 Endurance test 38
5.5 External leakage test 38
~~5.5.1 External leakage – Hazardous gas containing portions (determination of dilution boundary) .....~~
~~5.5.2 External leakage – Hazardous liquid containing portions .....~~
5.6 Dilution test 38
5.6.1 Releases 38
5.6.2 Setup and operation 39
5.6.3 Exhaust dilution 39
5.6.4 Dilution boundaries 39
5.7 Ultimate strength test 39
~~5.6.1 Ultimate strength – Hazardous liquids and pressurized parts .....~~
~~5.6.2 Ultimate strength – Hazardous gas and pressurized parts .....~~
~~5.6.3 Ultimate strength – Fuel cell modules .....~~
5.8 Potential failure modes test 40
5.9 Temperature test 40
~~5.10 Touch current test .....~~
5.10 Continuity test 42
5.11 Non-metallic tubing test for accumulation of static electricity 44
5.11.1 Passing criteria 44
5.11.2 Test method 44
5.12 Dielectric voltage – Withstand test 44
5.13 Limited power circuit test 44
5.14 ~~Maximum VA test~~ Rated power output test 45
5.15 Abnormal operation test – Electric equipment failures 45
5.16 Emission of effluents test (only for methanol fuel cells) 46
5.17 Environmental test 46
5.17.1 Rain test 46
5.17.2 Test of equipment – Exposure to wind 47
5.18 Enclosure tests 47
5.18.1 Enclosure loading test 47
5.18.2 Test for thermoplastic enclosures 47
5.19 Marking plate adhesion test 48
5.20 Test for elastomeric seals, gaskets and tubing 48
5.20.1 General 48
5.20.2 Accelerated air-oven ageing test 48
5.20.3 Cold temperature exposure test 48
5.20.4 Immersion test 48
5.21 Test for permeation of non-metallic tubing and piping 49
5.22 Test for electrical output leads 49
5.23 Emergency stop 49
6 Routine tests 49

6.1 External leakage 49
6.2 Dielectric voltage-withstand test 49
7 Markings 50
8 Instructions 50
8.1 General 50
8.2 Maintenance instructions 51
8.3 Operating instructions 51
8.4 Installation instructions 52
Annex A (informative) Comparison of pressure terms 53
Annex B (informative) Significant hazards, hazardous situations and events dealt with in this document 54
Bibliography 56

Figure 1 – Fuel cell power systems for industrial trucks 10
Figure 2 – Example of a diagram with vent system covering components downstream of the regulator 24
Figure 3 – Example of a diagram with vent system covering all components 25
Figure 4 – Example of a diagram with vent system covering all components in a multiple storage ~~tank~~ vessel system 26
~~Figure 5 – Measuring network, touch current weighted for perception or reaction .....~~
~~Figure 6 – Diagram for touch current measurement test .....~~

Table 1 – Appliance-wiring material 31
Table 2 – Spacings 35
Table 3 – Temperature rise limits 41
Table 4 – Limits for inherently limited power sources 45
Table 5 – Limits for power sources not inherently limited (overcurrent protection required) 45
Table 6 – Emission rate limits 46
Table A.1 – Comparison table of pressure terms 53

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FUEL CELL TECHNOLOGIES –

Part 4-101: ~~Fuel cell power systems for propulsion other than road vehicles and auxiliary power units (APU) – Safety of electrically powered industrial trucks~~ Fuel cell power systems for electrically powered industrial trucks – Safety

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 62282-4-101:2014. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 62282-4-101 has been prepared by IEC technical committee 105: Fuel cell technologies.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) revision of the title of this document;
b) revision of reference standards;
c) addition of new subclauses (4.3, 4.14.5, 4.15.3, 4.15.4, 4.16, 5.6, and 5.23);
d) previous 4.15 was revised as “4.16 Risk assessment and risk reduction”;
e) revision of 4.6 3), access to the manual shutoff valve;
f) revision of requirements for battery terminals that are threaded (4.14.10.1);
g) revision of requirements for double layer capacitors (4.14.10.2);
h) revision of external leakage test (5.5) and ultimate strength test (5.7);
i) revision of temperature limits on capacitors depending on the temperature rating of the material (Table 3);
j) revision of markings that are not relevant (Clause 7);
k) added “Significant hazards, hazardous situations and events dealt with in this document” as a new informative annex (Annex B).

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

Draft	Report on voting
105/912/FDIS	105/922/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/standardsdev/publications.

A list of all parts of IEC 62282 series, published under the general title *Fuel cell technologies*, 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,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The IEC 62282-4 series deals with categories such as safety, performance and interchangeability of fuel cell power systems for propulsion other than road vehicles and auxiliary power units (APU). Among the categories mentioned above, this document, IEC 62282-4-101, focuses on safety of electrically powered industrial ~~electric~~ trucks with fuel cell power systems because such applications are urgently demanded in the world. Future documents in this part of IEC 62282-4 will deal with other applications related to onboard vehicles other than road vehicles and auxiliary power units (APU).

FUEL CELL TECHNOLOGIES –

Part 4-101: ~~Fuel cell power systems for propulsion other than road vehicles and auxiliary power units (APU) – Safety of electrically powered industrial trucks~~ Fuel cell power systems for electrically powered industrial trucks – Safety

1 Scope

This document deals with safety of fuel cell power systems for propulsion other than road vehicles and auxiliary power units (APU).

This part of IEC 62282 covers safety requirements for fuel cell power systems intended to be used in electrically powered industrial trucks as defined in ISO 5053-1, except for:

– rough-terrain trucks;
– non-stacking low-lift straddle carriers;
– stacking high-lift straddle carriers;
– rough-terrain variable-reach trucks;
– slewing rough-terrain variable-reach trucks;
– variable-reach container handlers;
– pedestrian propelled trucks.

~~This standard is limited to electrically powered industrial trucks and is applicable to material-handling equipment, e.g. forklifts.~~

This document applies to gaseous hydrogen-fuelled fuel cell power systems and direct methanol fuel cell power systems for electrically powered industrial trucks.

The following fuels are considered within the scope of this document:

– gaseous hydrogen;
– methanol.

This document covers the fuel cell power system as defined in 3.8 and Figure 1.

This document applies to DC type fuel cell power systems, with a rated output voltage not exceeding 150 V DC for indoor and outdoor use.

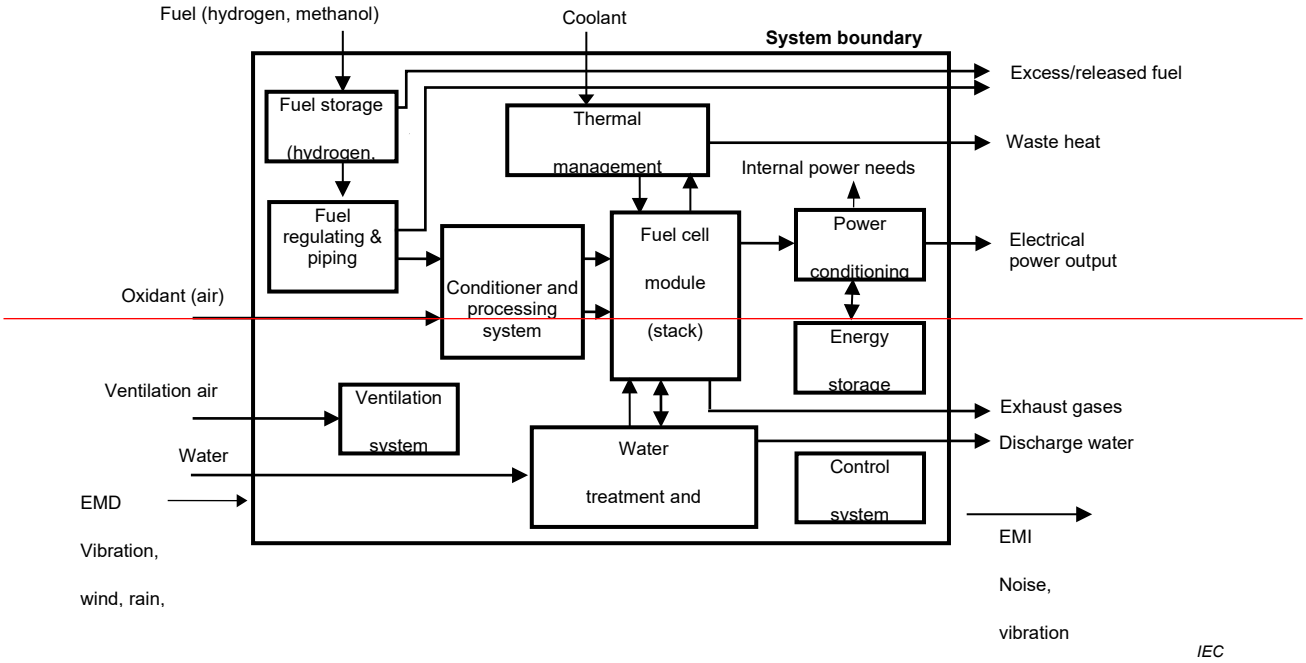
This document covers fuel cell power systems whose fuel source container is permanently attached to either the industrial truck or the fuel cell power system.

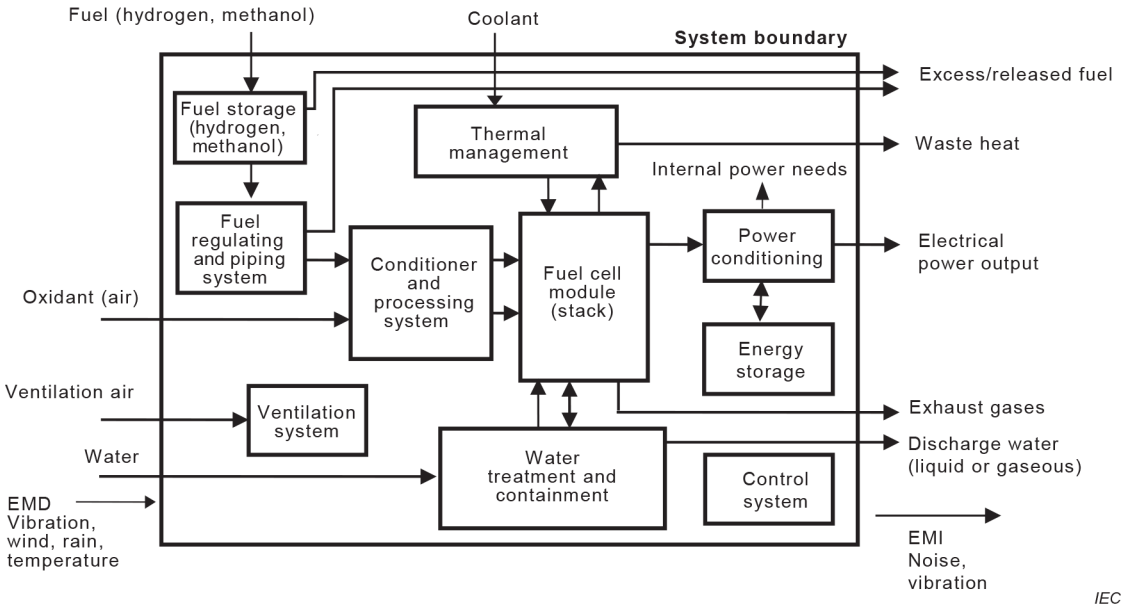
In accordance with IEC Guide 116, significant hazards, hazardous situations and events dealt with in this document are shown in Annex B.

The following are not included in the scope of this document:

– detachable type fuel source containers;
– hybrid trucks that include an internal combustion engine;
– reformer-equipped fuel cell power systems;

– fuel cell power systems intended for operation in potentially explosive atmospheres;
– fuel storage systems using liquid hydrogen.





Key

EMD electromagnetic disturbance

EMI electromagnetic interference

NOTE A fuel cell power system ~~may~~ can contain all or some of the above components.

Figure 1 – Fuel cell power systems for industrial trucks

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 60050-485, *International Electrotechnical Vocabulary (IEV) – Part 485: Fuel cell technologies*

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres*

IEC 60079-29-1, *Explosive atmospheres – Part 29-1: Gas detectors – Performance requirements of detectors for flammable gases*

IEC 60079-29-4, *Explosive atmospheres – Part 29-4: Gas detectors – Performance requirements of open path detectors for flammable gases*

IEC 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60227-3, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 3: Non-sheathed cables for fixed wiring*

IEC 60227-5, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 5: Flexible cables (cords)*

IEC 60335-2-41, *Household and similar electrical appliances – Safety – Part 2-41: Particular requirements for pumps*

IEC 60335-2-80, *Household and similar electrical appliances – Safety – Part 2-80: Particular requirements for fans*

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric* shock
IEC 60364-4-41:2005/AMD1:2017

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

IEC 60584-1, *Thermocouples – Part 1: ~~Reference tables~~ EMF specifications and tolerances*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695 (all parts), *Fire hazard testing*

IEC 60695-1-30, *Fire hazard testing – Part 1-30: Guidance for assessing the fire hazard of electrotechnical products – Preselection testing process – General guidelines*

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60695-11-4, *Fire hazard testing – Part 11-4: Test flames – 50 W flame – Apparatus and confirmational test method*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60730-1:2013, *Automatic electrical controls ~~for household and similar use~~ – Part 1: General requirements*
IEC 60730-1:2013/AMD1:2015
IEC 60730-1:2013/AMD2:2020

~~IEC 60730-2-17, *Automatic electrical controls for household and similar use – Part 2-17: Particular requirements for electrically operated gas valves, including mechanical requirements*~~

IEC 60812, *Failure modes and effects analysis (FMEA and FMECA)*

IEC 60947-3, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 60947-5-1, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*
IEC 60950-1:2005/AMD1:2009
IEC 60950-1:2005/AMD2:2013

IEC 61025, *Fault tree analysis (FTA)*

IEC 61204-7, *Low-voltage switch mode power supplies~~, d.c. output~~ – Part 7: Safety requirements*

IEC TS 61430, *Secondary cells and batteries – Test methods for checking the performance of devices designed for reducing explosion hazards – Lead-acid starter batteries*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61558-1, *Safety ~~os power transformers, power supplies, reactors and similar products~~ of transformers, reactors, power supply units and combinations thereof – Part 1: General requirements and tests*

~~IEC 62103, *Electronic equipment for use in power installations*~~

IEC 62477-1, *Safety requirements for power electronic converter systems and equipment – Part 1: General*

IEC 62133-1, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 1: Nickel systems*

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

IEC 62391-1, *Fixed electric double-layer capacitors for use in electric and electronic equipment – Part 1: Generic specification*

IEC 62391-2, *Fixed electric double-layer capacitors for use in electronic equipment – Part 2: Sectional specfication – Electric double layer capacitors for power application*

IEC 62619, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

IEC/ISO 31010, *Risk management – Risk assessment techniques*

ISO 179 (all parts), *Plastics – Determination of Charpy impact properties*

ISO 180, *Plastics – Determination of Izod impact strength*

ISO 877 (all parts), *Plastics – Methods of exposure to solar radiation*

ISO 1419, *Rubber- or plastics-coated fabrics – Accelerated-ageing tests*

ISO 1421, *Rubber- or plastics-coated fabrics – Determination of tensile strength and elongation at break*

ISO 1798, *Flexible cellular polymeric materials – Determination of tensile strength and elongation at break*

ISO 2440, *Flexible and rigid cellular polymeric materials – Accelerated ageing tests*

ISO 2626, *Copper – Hydrogen embrittlement test*

ISO 3691-1, *Industrial trucks – Safety requirements and verification – Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks*

ISO/TS 3691-7, *Industrial trucks – Safety requirements and verification – Part 7: Regional requirements for countries within the European Community*

ISO/TS 3691-8, *Industrial trucks – Safety requirements and verification – Part 8: Regional requirements for countries outside the European Community*

ISO 3864-1, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings*

~~ISO 3996, *Road Vehicles – Brake hose assemblies for hydraulic braking systems used with a non-petroleum-base brake fluid*~~

ISO 4038, *Road vehicles – Hydraulic braking systems – Simple flare pipes, tapped holes, male fittings and hose end fittings*

ISO 4080, *Rubber and plastics hoses and hose assemblies – Determination of permeability to gas*

ISO 4675, *Rubber- or plastics-coated fabrics – Low-temperature bend test*

ISO 5053-1, *Industrial trucks – Vocabulary – Part 1: Types of industrial trucks*

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

~~ISO 7866:2012, *Gas cylinders – Refillable seamless aluminum alloy gas cylinders – Design, construction and testing*~~

~~ISO 9809-1, *Gas cylinders – Refillable seamless steel gas cylinders – Design, construction and testing – Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa*~~

ISO 10380, *Pipework – Corrugated metal hoses and hose assemblies*

ISO 10442, *Petroleum, chemical and gas service industries – Packaged, integrally geared centrifugal air compressors*

ISO 10806, *Pipework – Fittings for corrugated metal hoses*

ISO 11114-4, *Transportable gas cylinders – Compatibility of cylinder and valve materials with gas contents – Part 4: Test methods for selecting metallic materials resistant to hydrogen embrittlement*

ISO 12100, *Safety of machinery – General principles for design – Risk assessment and risk reduction*

ISO 13226, *Rubber – Standard reference elastomers (SREs) for characterizing the effect of liquids on vulcanized rubbers*

ISO 13849-1, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 13849-2, *Safety of machinery – Safety-related parts of control systems – Part 2: Validation*

ISO 14113, *Gas welding equipment – Rubber and plastics hose and hose assemblies for use with industrial gases up to 450 bar (45 MPa)*

~~ISO/TS 14687-2, *Hydrogen fuel – Product specification – Part 2: Proton exchange membrane (PEM) fuel cell applications for road vehicles*~~

~~ISO 15500-12, *Road vehicles – Compressed natural gas (CNG) fuel system components – Part 12: Pressure relief valve (PRV)*~~

ISO 15649, *Petroleum and natural gas industries – Piping*

~~ISO/TS 15869:2009, *Gaseous hydrogen and hydrogen blends – Land vehicle fuel tanks*~~

ISO/TR 15916, *Basic considerations for the safety of hydrogen systems*

ISO 16010, *Elastomeric seals – Material requirements for seals used in pipes and fittings carrying gaseous fuels and hydrocarbon fluids*

ISO 16111:~~2008~~2018, *Transportable gas storage devices – Hydrogen absorbed in reversible metal hydride*

ISO 17268,~~ *Compressed*~~ *Gaseous hydrogen*~~ *surface*~~ *land vehicle refuelling connection devices*

ISO 19881, *Gaseous hydrogen – Land vehicle fuel containers*

ISO 19882, *Gaseous hydrogen – Thermally activated pressure relief devices for compressed hydrogen vehicle fuel containers*

ISO 20898, *Industrial trucks – Electrical requirements*

ISO 21927-3, *Smoke and heat control systems – Part 3: Specifications for powered smoke and heat exhaust ventilators*

ISO 23551-1, *Safety and control devices for gas burners and gas-burning appliances – Particular requirements – Part 1: Automatic and semi-automatic valves*

UN GTR No. 13, *Global Technical Regulation concerning the hydrogen and fuel cell vehicles*

UN Regulation No. 134, *Uniform provisions concerning the approval of motor vehicles and their components with regard to the safety- related performance of hydrogen-fuelled vehicles (HFCV)*

IEC 62282-4-101

Edition 2.0 2022-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fuel cell technologies – Part 4-101: Fuel cell power systems for electrically powered industrial trucks – Safety

Technologies des piles à combustible – Partie 4-101: Systèmes à pile à combustible pour chariots de manutention électriques – Sécurité



IEC 62282-4-101:2022-08(en-fr)

CONTENTS

FOREWORD 5
INTRODUCTION 7
1 Scope 8
2 Normative references 9
3 Terms and definitions 13
4 Construction requirements for safety 16
4.1 General 16
4.2 Hydrogen and other fluid containing parts 17
4.2.1 General 17
4.2.2 Piping, hoses, tubing and fittings 17
4.2.3 Hydrogen pressure vessels 18
4.2.4 Metal hydride container 19
4.2.5 Methanol fuel tank 19
4.3 Refueling 19
4.4 Over-pressure and thermal protection 19
4.5 Regulators 21
4.6 Operating and shut-off valves 21
4.7 Filters 21
4.8 Pumps and compressors 21
4.9 Electrically operated pressure sensing and controlling devices 22
4.10 Ventilation to prevent the build up of flammable gases 22
4.11 Electrostatic discharge (ESD) 23
4.12 Discharges including methanol emissions and waste materials 23
4.13 Enclosures 23
4.14 Electrical system 24
4.14.1 General 24
4.14.2 Internal wiring 24
4.14.3 External wiring 25
4.14.4 Emergency switching off requirements (disconnection) for connections for fuel cell power system 25
4.14.5 Motors 26
4.14.6 Switches and motor controllers 26
4.14.7 Transformers and power supplies 26
4.14.8 Inverters, converters and controllers 26
4.14.9 Lamps and lampholders 26
4.14.10 Energy storage components 27
4.14.11 Electrical insulation 27
4.14.12 Limited power circuit 28
4.14.13 Electrical spacings 28
4.14.14 Separation of circuits 29
4.15 Control circuits 30
4.15.1 Safety controls 30
4.15.2 Start 30
4.15.3 Drive off 30
4.15.4 Emergency stop 30
4.16 Risk assessment and risk reduction 30

5 Performance requirements for safety and type tests 31
5.1 General 31
5.2 Vibration test 31
5.2.1 General 31
5.2.2 Vertical axis test 31
5.2.3 Longitudinal and lateral axes tests 31
5.3 Fuel container securement test 31
5.4 Endurance test 32
5.5 External leakage test 32
5.6 Dilution test 32
5.6.1 Releases 32
5.6.2 Setup and operation 32
5.6.3 Exhaust dilution 32
5.6.4 Dilution boundaries 32
5.7 Ultimate strength test 32
5.8 Potential failure modes test 33
5.9 Temperature test 33
5.10 Continuity test 35
5.11 Non-metallic tubing test for accumulation of static electricity 35
5.11.1 Passing criteria 35
5.11.2 Test method 35
5.12 Dielectric voltage – Withstand test 36
5.13 Limited power circuit test 36
5.14 Rated power output test 37
5.15 Abnormal operation test – Electric equipment failures 37
5.16 Emission of effluents test (only for methanol fuel cells) 38
5.17 Environmental test 38
5.17.1 Rain test 38
5.17.2 Test of equipment – Exposure to wind 39
5.18 Enclosure tests 39
5.18.1 Enclosure loading test 39
5.18.2 Test for thermoplastic enclosures 39
5.19 Marking plate adhesion test 40
5.20 Test for elastomeric seals, gaskets and tubing 40
5.20.1 General 40
5.20.2 Accelerated air-oven ageing test 40
5.20.3 Cold temperature exposure test 40
5.20.4 Immersion test 40
5.21 Test for permeation of non-metallic tubing and piping 41
5.22 Test for electrical output leads 41
5.23 Emergency stop 41
6 Routine tests 41
6.1 External leakage 41
6.2 Dielectric voltage-withstand test 41
7 Markings 41
8 Instructions 42
8.1 General 42
8.2 Maintenance instructions 43

8.3 Operating instructions 43
8.4 Installation instructions 44
Annex A (informative) Comparison of pressure terms 45
Annex B (informative) Significant hazards, hazardous situations and events dealt with in this document 46
Bibliography 48

Figure 1 – Fuel cell power systems for industrial trucks 9
Figure 2 – Example of a diagram with vent system covering components downstream of the regulator 20
Figure 3 – Example of a diagram with vent system covering all components 20
Figure 4 – Example of a diagram with vent system covering all components in a multiple storage vessel system 21

Table 1 – Appliance-wiring material 25
Table 2 – Spacings 29
Table 3 – Temperature rise limits 34
Table 4 – Limits for inherently limited power sources 37
Table 5 – Limits for power sources not inherently limited (overcurrent protection required) 37
Table 6 – Emission rate limits 38
Table A.1 – Comparison table of pressure terms 45

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FUEL CELL TECHNOLOGIES –

Part 4-101: Fuel cell power systems for electrically powered industrial trucks – Safety

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 62282-4-101 has been prepared by IEC technical committee 105: Fuel cell technologies.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) revision of the title of this document;
b) revision of reference standards;
c) addition of new subclauses (4.3, 4.14.5, 4.15.3, 4.15.4, 4.16, 5.6, and 5.23);
d) previous 4.15 was revised as "4.16 Risk assessment and risk reduction";
e) revision of 4.6 3), access to the manual shutoff valve;
f) revision of requirements for battery terminals that are threaded (4.14.10.1);

g) revision of requirements for double layer capacitors (4.14.10.2);

h) revision of external leakage test (5.5) and ultimate strength test (5.7);

i) revision of temperature limits on capacitors depending on the temperature rating of the material (Table 3);

j) revision of markings that are not relevant (Clause 7);

k) added “Significant hazards, hazardous situations and events dealt with in this document” as a new informative annex (Annex B).

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

Draft	Report on voting
105/912/FDIS	105/922/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/standardsdev/publications.

A list of all parts of IEC 62282 series, published under the general title *Fuel cell technologies*, 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,
- replaced by a revised edition, or
- amended.

INTRODUCTION

The IEC 62282-4 series deals with categories such as safety, performance and interchangeability of fuel cell power systems for propulsion other than road vehicles and auxiliary power units (APU). Among the categories mentioned above, this document, IEC 62282-4-101, focuses on safety of electrically powered industrial trucks with fuel cell power systems because such applications are urgently demanded in the world. Future documents in this part of IEC 62282-4 will deal with other applications related to onboard vehicles other than road vehicles and auxiliary power units (APU).

FUEL CELL TECHNOLOGIES –

Part 4-101: Fuel cell power systems for electrically powered industrial trucks – Safety

1 Scope

This document deals with safety of fuel cell power systems for propulsion other than road vehicles and auxiliary power units (APU).

This part of IEC 62282 covers safety requirements for fuel cell power systems intended to be used in electrically powered industrial trucks as defined in ISO 5053-1, except for:

– rough-terrain trucks;
– non-stacking low-lift straddle carriers;
– stacking high-lift straddle carriers;
– rough-terrain variable-reach trucks;
– slewing rough-terrain variable-reach trucks;
– variable-reach container handlers;
– pedestrian propelled trucks.

This document applies to gaseous hydrogen-fuelled fuel cell power systems and direct methanol fuel cell power systems for electrically powered industrial trucks.

The following fuels are considered within the scope of this document:

– gaseous hydrogen;
– methanol.

This document covers the fuel cell power system as defined in 3.8 and Figure 1.

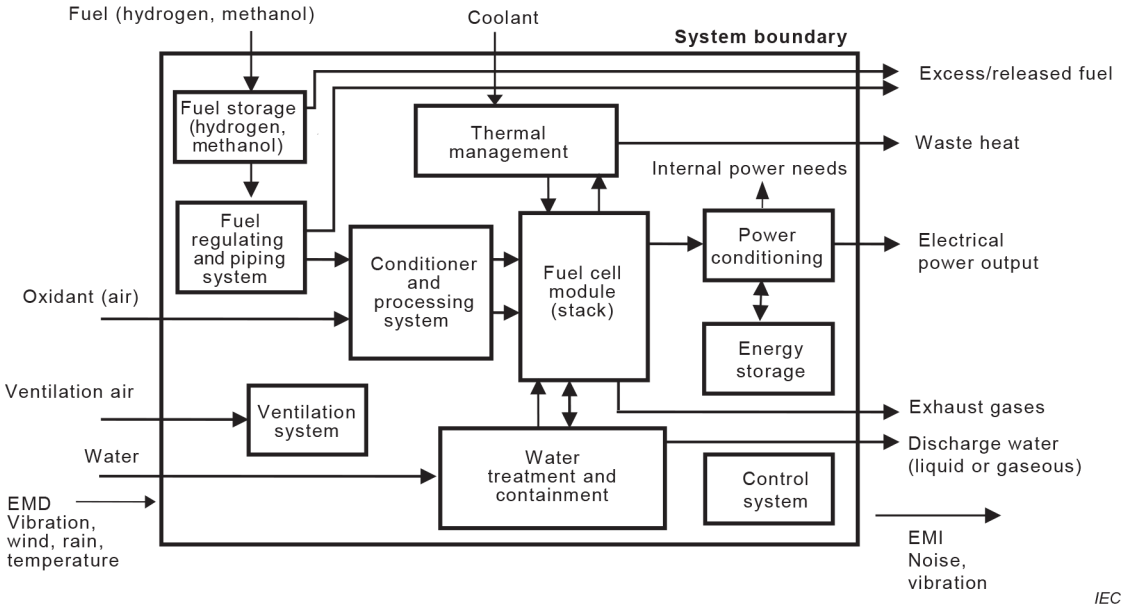
This document applies to DC type fuel cell power systems, with a rated output voltage not exceeding 150 V DC for indoor and outdoor use.

This document covers fuel cell power systems whose fuel source container is permanently attached to either the industrial truck or the fuel cell power system.

In accordance with IEC Guide 116, significant hazards, hazardous situations and events dealt with in this document are shown in Annex B.

The following are not included in the scope of this document:

– detachable type fuel source containers;
– hybrid trucks that include an internal combustion engine;
– reformer-equipped fuel cell power systems;
– fuel cell power systems intended for operation in potentially explosive atmospheres;
– fuel storage systems using liquid hydrogen.



Key

EMD electromagnetic disturbance

EMI electromagnetic interference

NOTE A fuel cell power system can contain all or some of the above components.

Figure 1 – Fuel cell power systems for industrial trucks

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 60050-485, *International Electrotechnical Vocabulary (IEV) – Part 485: Fuel cell technologies*

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres*

IEC 60079-29-1, *Explosive atmospheres – Part 29-1: Gas detectors – Performance requirements of detectors for flammable gases*

IEC 60079-29-4, *Explosive atmospheres – Part 29-4: Gas detectors – Performance requirements of open path detectors for flammable gases*

IEC 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60227-3, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 3: Non-sheathed cables for fixed wiring*

IEC 60227-5, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 5: Flexible cables (cords)*

IEC 60335-2-41, *Household and similar electrical appliances – Safety – Part 2-41: Particular requirements for pumps*

IEC 60335-2-80, *Household and similar electrical appliances – Safety – Part 2-80: Particular requirements for fans*

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric* shock
IEC 60364-4-41:2005/AMD1:2017

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

IEC 60584-1, *Thermocouples – Part 1: EMF specifications and tolerances*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695 (all parts), *Fire hazard testing*

IEC 60695-1-30, *Fire hazard testing – Part 1-30: Guidance for assessing the fire hazard of electrotechnical products – Preselection testing process – General guidelines*

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60695-11-4, *Fire hazard testing – Part 11-4: Test flames – 50 W flame – Apparatus and confirmational test method*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60730-1:2013, *Automatic electrical controls – Part 1: General requirements*
IEC 60730-1:2013/AMD1:2015
IEC 60730-1:2013/AMD2:2020

IEC 60812, *Failure modes and effects analysis (FMEA and FMECA)*

IEC 60947-3, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 60947-5-1, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*
IEC 60950-1:2005/AMD1:2009
IEC 60950-1:2005/AMD2:2013

IEC 61025, *Fault tree analysis (FTA)*

IEC 61204-7, *Low-voltage switch mode power supplies – Part 7: Safety requirements*

IEC TS 61430, *Secondary cells and batteries – Test methods for checking the performance of devices designed for reducing explosion hazards – Lead-acid starter batteries*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61558-1, *Safety of transformers, reactors, power supply units and combinations thereof – Part 1: General requirements and tests*

IEC 62477-1, *Safety requirements for power electronic converter systems and equipment – Part 1: General*

IEC 62133-1, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 1: Nickel systems*

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

IEC 62391-1, *Fixed electric double-layer capacitors for use in electric and electronic equipment – Part 1: Generic specification*

IEC 62391-2, *Fixed electric double-layer capacitors for use in electronic equipment – Part 2: Sectional specfication – Electric double layer capacitors for power application*

IEC 62619, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

IEC/ISO 31010, *Risk management – Risk assessment techniques*

ISO 179 (all parts), *Plastics – Determination of Charpy impact properties*

ISO 180, *Plastics – Determination of Izod impact strength*

ISO 877 (all parts), *Plastics – Methods of exposure to solar radiation*

ISO 1419, *Rubber- or plastics-coated fabrics – Accelerated-ageing tests*

ISO 1421, *Rubber- or plastics-coated fabrics – Determination of tensile strength and elongation at break*

ISO 1798, *Flexible cellular polymeric materials – Determination of tensile strength and elongation at break*

ISO 2440, *Flexible and rigid cellular polymeric materials – Accelerated ageing tests*

ISO 2626, *Copper – Hydrogen embrittlement test*

ISO 3691-1, *Industrial trucks – Safety requirements and verification – Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks*

ISO/TS 3691-7, *Industrial trucks – Safety requirements and verification – Part 7: Regional requirements for countries within the European Community*

ISO/TS 3691-8, *Industrial trucks – Safety requirements and verification – Part 8: Regional requirements for countries outside the European Community*

ISO 3864-1, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings*

ISO 4038, *Road vehicles – Hydraulic braking systems – Simple flare pipes, tapped holes, male fittings and hose end fittings*

ISO 4080, *Rubber and plastics hoses and hose assemblies – Determination of permeability to gas*

ISO 4675, *Rubber- or plastics-coated fabrics – Low-temperature bend test*

ISO 5053-1, *Industrial trucks – Vocabulary – Part 1: Types of industrial trucks*

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

ISO 10380, *Pipework – Corrugated metal hoses and hose assemblies*

ISO 10442, *Petroleum, chemical and gas service industries – Packaged, integrally geared centrifugal air compressors*

ISO 10806, *Pipework – Fittings for corrugated metal hoses*

ISO 11114-4, *Transportable gas cylinders – Compatibility of cylinder and valve materials with gas contents – Part 4: Test methods for selecting metallic materials resistant to hydrogen embrittlement*

ISO 12100, *Safety of machinery – General principles for design – Risk assessment and risk reduction*

ISO 13226, *Rubber – Standard reference elastomers (SREs) for characterizing the effect of liquids on vulcanized rubbers*

ISO 13849-1, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 13849-2, *Safety of machinery – Safety-related parts of control systems – Part 2: Validation*

ISO 14113, *Gas welding equipment – Rubber and plastics hose and hose assemblies for use with industrial gases up to 450 bar (45 MPa)*

ISO 15649, *Petroleum and natural gas industries – Piping*

ISO/TR 15916, *Basic considerations for the safety of hydrogen systems*

ISO 16010, *Elastomeric seals – Material requirements for seals used in pipes and fittings carrying gaseous fuels and hydrocarbon fluids*

ISO 16111:2018, *Transportable gas storage devices – Hydrogen absorbed in reversible metal hydride*

ISO 17268, *Gaseous hydrogen land vehicle refuelling connection devices*

ISO 19881, *Gaseous hydrogen – Land vehicle fuel containers*

ISO 19882, *Gaseous hydrogen – Thermally activated pressure relief devices for compressed hydrogen vehicle fuel containers*

ISO 20898, *Industrial trucks – Electrical requirements*

ISO 21927-3, *Smoke and heat control systems – Part 3: Specifications for powered smoke and heat exhaust ventilators*

ISO 23551-1, *Safety and control devices for gas burners and gas-burning appliances – Particular requirements – Part 1: Automatic and semi-automatic valves*

UN GTR No. 13, *Global Technical Regulation concerning the hydrogen and fuel cell vehicles*

UN Regulation No. 134, *Uniform provisions concerning the approval of motor vehicles and their components with regard to the safety- related performance of hydrogen-fuelled vehicles (HFCV)*

SOMMAIRE

AVANT-PROPOS 55
INTRODUCTION 57
1 Domaine d'application 58
2 Références normatives 59
3 Termes et définitions 63
4 Exigences de construction en matière de sécurité 67
4.1 Généralités 67
4.2 Parties contenant de l'hydrogène et autres fluides 67
4.2.1 Généralités 67
4.2.2 Tuyauteries, flexibles, tubulures et raccords 68
4.2.3 Réservoirs d'hydrogène sous pression 69
4.2.4 Conteneur en hydrure métallique 69
4.2.5 Réservoir de combustible méthanol 70
4.3 Ravitaillement 70
4.4 Protection contre les surpressions et protection thermique 70
4.5 Régulateurs 72
4.6 Robinets de commande et d'arrêt 72
4.7 Filtres 72
4.8 Pompes et compresseurs 73
4.9 Dispositifs électriques de commande et de détection de la pression 73
4.10 Ventilation destinée à éviter l'accumulation de gaz inflammables 73
4.11 Décharges électrostatiques (DES) 74
4.12 Décharges, y compris les émissions de méthanol et les rejets 74
4.13 Enceintes 75
4.14 Système électrique 75
4.14.1 Généralités 75
4.14.2 Câblage interne 75
4.14.3 Câblage externe 76
4.14.4 Exigences de mise hors tension (déconnexion) d'urgence pour les connexions de systèmes à pile à combustible 77
4.14.5 Moteurs 78
4.14.6 Commutateurs et appareils de commande de moteurs 78
4.14.7 Transformateur et alimentations 78
4.14.8 Onduleurs, convertisseurs et appareils de commande 78
4.14.9 Lampes et douilles 78
4.14.10 Organes de stockage d'énergie 78
4.14.11 Isolation électrique 79
4.14.12 Circuit à puissance limitée 80
4.14.13 Espacements électriques 80
4.14.14 Séparation des circuits 82
4.15 Circuits de commande 82
4.15.1 Commandes de sécurité 82
4.15.2 Démarrage 82
4.15.3 Démarrage 82
4.15.4 Arrêt d'urgence 83
4.16 Appréciation du risque et réduction du risque 83

5 Exigences de performances pour les essais de sécurité et de type 83
5.1 Généralités 83
5.2 Essai de vibration 83
5.2.1 Généralités 83
5.2.2 Essai dans l'axe vertical 83
5.2.3 Essais dans les axes longitudinal et latéral 84
5.3 Essais de fixation du conteneur de combustible 84
5.4 Essai d'endurance 84
5.5 Essai de fuites externes 84
5.6 Essai de dilution 84
5.6.1 Dégagements 84
5.6.2 Configuration et fonctionnement 84
5.6.3 Dilution de l'échappement 84
5.6.4 Limites de zone de dilution 85
5.7 Essai de résistance à la rupture 85
5.8 Essai des modes de défaillance potentiels 85
5.9 Essai de température 85
5.10 Essai de continuité 87
5.11 Essai d'accumulation de l'électricité statique pour les tubes non métalliques 88
5.11.1 Critères de réussite 88
5.11.2 Méthode d'essai 88
5.12 Essai de tenue diélectrique en tension 88
5.13 Essai de circuit à puissance limitée 88
5.14 Essai de puissance de sortie assignée 89
5.15 Essai de fonctionnement anormal – Défaillance du matériel électrique 90
5.16 Essai d'émission d'effluents (uniquement pour des piles à combustible méthanol) 90
5.17 Essais d'environnement 91
5.17.1 Essai de résistance à la pluie 91
5.17.2 Essai du matériel – Exposition au vent 91
5.18 Essais de l'enceinte 91
5.18.1 Essai de charge de l'enceinte 91
5.18.2 Essai des enceintes thermoplastiques 91
5.19 Essai d'adhérence de la plaque signalétique 92
5.20 Essais des joints, garniture et tubes en élastomère 93
5.20.1 Généralités 93
5.20.2 Essai de vieillissement accéléré à l'étuve à circulation d'air 93
5.20.3 Essai d'exposition aux basses températures 93
5.20.4 Essai d'immersion 93
5.21 Essai de perméabilité des tuyauteries et canalisations non métalliques 93
5.22 Essai des conducteurs électriques de sortie 93
5.23 Arrêt d'urgence 94
6 Essais individuels de série 94
6.1 Fuites externes 94
6.2 Essai de tenue diélectrique en tension 94
7 Marquages 94
8 Instructions 95
8.1 Généralités 95
8.2 Instructions de maintenance 96

8.3 Instructions d'exploitation 96
8.4 Instructions d'installation 97
Annexe A (informative) Comparaison des termes relatifs à la pression 98
Annexe B (informative) Phénomènes dangereux significatifs, situations et événements dangereux traités dans le présent document 99
Bibliographie 101

Figure 1 – Systèmes à pile à combustible pour chariots de manutention 59
Figure 2 – Exemple schématique d'un système de mise à l'air libre pour des éléments en aval du régulateur 71
Figure 3 – Exemple schématique d'un système de mise à l'air libre pour tous les éléments 71
Figure 4 – Exemple schématique d'un système de mise à l'air libre pour tous les éléments dans un système à plusieurs réservoirs de stockage 72

Tableau 1 – Matériau de câblage d'appareil 76
Tableau 2 – Espacements 81
Tableau 3 – Limites d'échauffement 86
Tableau 4 – Limites pour des sources de puissance intrinsèquement limitées 89
Tableau 5 – Limites pour des sources de puissance non intrinsèquement limitées (protection contre les surintensités exigée) 89
Tableau 6 – Limites du taux d'émission 91
Tableau A.1 – Tableau comparatif des termes relatifs à la pression 98

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

_____

TECHNOLOGIES DES PILES À COMBUSTIBLE –

Partie 4-101: Systèmes à pile à combustible pour chariots de manutention électriques – Sécurité

AVANT-PROPOS

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8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
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La Norme internationale IEC 62282-4-101 a été établie par le comité d'études 105 de l'IEC: Technologies des piles à combustible.

Cette deuxième édition annule et remplace la première édition parue en 2014. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) révision du titre du présent document;
b) révision des normes de référence;
c) ajout de nouveaux paragraphes (4.3, 4.14.5, 4.15.3, 4.15.4, 4.16, 5.6 et 5.23);

d) renumérotation du paragraphe 4.15 de la version précédente en "4.16 Appréciation du risque et réduction du risque";

e) révision de 4.6 3) concernant l'accès au robinet d'arrêt manuel;

f) révision des exigences relatives aux bornes filetées de la batterie (4.14.10.1);

g) révision des exigences relatives aux condensateurs à double couche (4.14.10.2);

h) révision de l'essai de fuites externes (5.5) et de l'essai de résistance à la rupture (5.7);

i) révision des limites de température des condensateurs dépendant des caractéristiques assignées de tenue en température du matériau (Tableau 3);

j) révision des marquages non pertinents (Article 7);

k) ajout d'une nouvelle annexe informative (Annexe B) "Phénomènes dangereux significatifs, situations et événements dangereux traités dans le présent document".

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
105/912/FDIS	105/922/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

Une liste de toutes les parties de la série IEC 62282, publiées sous le titre général *Technologies des piles à combustible*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

INTRODUCTION

La série IEC 62282-4 traite d'aspects tels que la sécurité, les performances et l'interchangeabilité des systèmes à pile à combustible utilisés pour la propulsion, autres que les véhicules routiers et groupes auxiliaires de puissance (GAP). Parmi les catégories mentionnées ci-dessus, le présent document, l'IEC 62282-4-101, porte sur la sécurité des chariots de manutention électriques comportant des systèmes à pile à combustible, car de telles applications sont instamment demandées dans le monde. Les futurs documents de la présente partie de l'IEC 62282-4 traiteront d'autres applications relatives aux véhicules embarqués autres que les véhicules routiers et les groupes auxiliaires de puissance (GAP).

TECHNOLOGIES DES PILES À COMBUSTIBLE –

Partie 4-101: Systèmes à pile à combustible pour chariots de manutention électriques – Sécurité

1 Domaine d'application

Le présent document traite des systèmes à piles à combustible pour la propulsion, autres que les véhicules routiers et groupes auxiliaires de puissance (GAP).

La présente partie de l'IEC 62282 couvre les exigences de sécurité relatives aux systèmes à pile à combustible destinés à être utilisés sur des chariots de manutention électriques, définies dans l'ISO 5053-1, à l'exception des chariots suivants:

– chariots tout-terrain;
– chariots cavaliers élévateurs non gerbeurs;
– chariots cavaliers élévateurs gerbeurs;
– chariots tout-terrain à portée variable;
– chariots tout-terrain rotatifs à portée variable;
– chariots porte-conteneur à portée variable;
– chariots à propulsion manuelle.

Le présent document s'applique aux systèmes à pile à combustible utilisant de l'hydrogène gazeux et à ceux utilisant du méthanol direct pour les chariots de manutention électriques.

Les combustibles suivants relèvent du domaine d'application du présent document:

– hydrogène gazeux ;
– méthanol.

Le présent document couvre le système à pile à combustible défini en 3.8 et à la Figure 1.

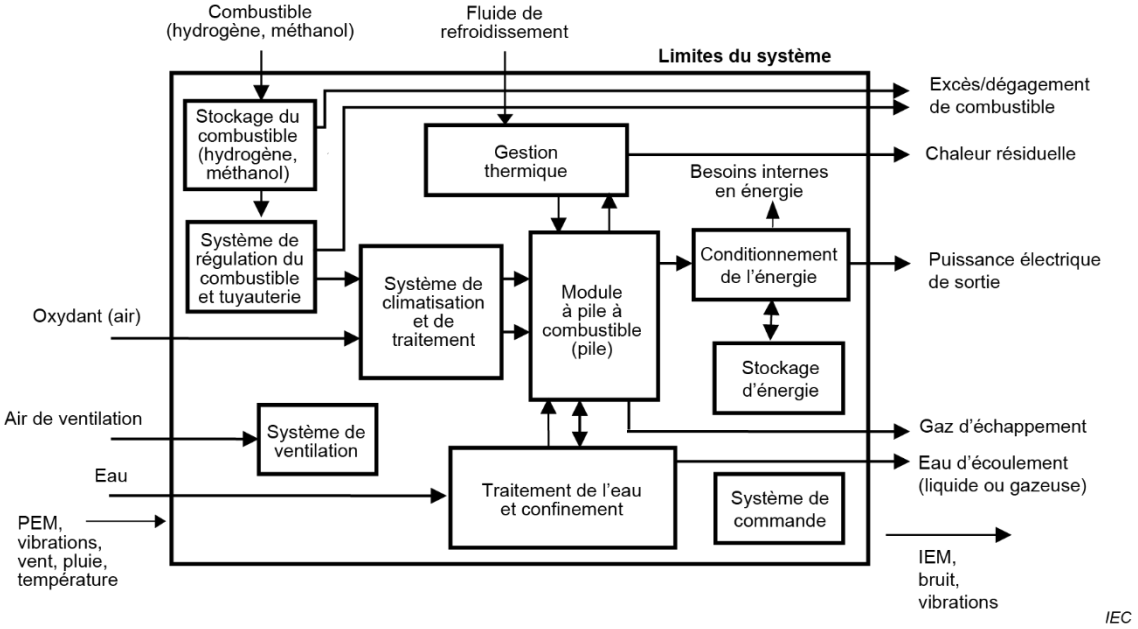
Le présent document s'applique aux systèmes à pile à combustible de type à courant continu, d'une tension de sortie assignée d'au maximum 150 V en courant continu pour utilisation à l'intérieur et à l'extérieur.

Il couvre également les systèmes à pile à combustible dont le conteneur de source de combustible est fixé à demeure, soit au chariot de manutention, soit au système à pile à combustible.

Conformément à l'IEC Guide 116, les phénomènes dangereux significatifs, les situations et événements dangereux traités dans le présent document sont représentés à l'Annexe B.

Les éléments suivants ne sont pas inclus dans le domaine d'application du présent document:

– les conteneurs de source de combustible de type amovible;
– les chariots hybrides qui comprennent un moteur à combustion interne;
– les systèmes à pile à combustible équipés de reformeurs;
– les systèmes à pile à combustible prévus pour être utilisés dans des atmosphères explosibles;
– les systèmes de stockage de combustible utilisant de l'hydrogène liquide.



Légende

EMD perturbation électromagnétique

EMI brouillage électromagnétique

NOTE Un système à pile à combustible peut comporter l'ensemble ou certains des éléments ci-dessus.

Figure 1 – Systèmes à pile à combustible pour chariots de manutention

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-485, *Vocabulaire électrotechnique international (IEV) – Partie 485: Technologies des piles à combustible*

IEC 60079-0, *Atmosphères explosives – Partie 0: Matériel – Exigences générales*

IEC 60079-10-1, *Atmosphères explosives – Partie 10-1: Classification des emplacements – Atmosphères explosives gazeuses*

IEC 60079-29-1, *Atmosphères explosives – Partie 29-1: Détecteurs de gaz – Exigences d'aptitude à la fonction des détecteurs de gaz inflammables*

IEC 60079-29-4, *Atmosphères explosives – Partie 29-4: Détecteurs de gaz – Exigences d'aptitude à la fonction des détecteurs de gaz inflammables à chemin ouvert*

IEC 60204-1, *Sécurité des machines – Equipement électrique des machines – Partie 1: Exigences générales*

IEC 60227-3, *Conducteurs et câbles isolés au polychlorure de vinyle, de tension nominale au plus égale à 450/750 V – Partie 3: Conducteurs pour installations fixes*

IEC 60227-5, *Conducteurs et câbles isolés au polychlorure de vinyle, de tension nominale au plus égale à 450/750 V – Partie 5: Câbles souples*

IEC 60335-2-41, *Appareils électrodomestiques et analogues – Sécurité – Partie 2-41: Exigences particulières pour les pompes*

IEC 60335-2-80, *Appareils électrodomestiques et analogues – Sécurité – Partie 2-80: Exigences particulières pour les ventilateurs*

IEC 60364-4-41:2005*, Installations électriques à basse tension – Partie 4-41: Protection pour assurer la sécurité – Protection contre les chocs électriques*
IEC 60364-4-41:2005/AMD1:2017

IEC 60529, *Degrés de protection procurés par les enveloppes (Code IP)*

IEC 60584-1, *Couples thermoélectriques – Partie 1: Spécifications et tolérances en matière de FEM*

IEC 60664-1, *Coordination de l'isolement des matériels dans les réseaux d'énergie électrique à basse tension – Partie 1: Principes, exigences et essais*

IEC 60695 (toutes les parties), *Essais relatifs aux risques du feu*

IEC 60695-1-30, *Essais relatifs aux risques du feu – Partie 1-30: Lignes directrices pour l'évaluation des risques du feu des produits électrotechniques – Processus d'essai de présélection – Lignes directrices générales*

IEC 60695-10-2, *Essais relatifs aux risques du feu – Partie 10-2: Chaleurs anormales – Essai à la bille*

IEC 60695-11-4, *Essais relatifs aux risques du feu – Partie 11-4: Flammes d'essai – Flamme de 50 W – Appareillage et méthodes d'essai de vérification*

IEC 60695-11-10, *Essais relatifs aux risques du feu – Partie 11-10: Flammes d'essai – Méthodes d'essai horizontal et vertical à la flamme de 50 W*

IEC 60730-1:2013, *Dispositifs de commande électrique automatiques – Partie 1: Exigences générales*
IEC 60730-1:2013/AMD1:2015
IEC 60730-1:2013/AMD2:2020

IEC 60812, *Analyse des modes de défaillance et de leurs effets (AMDE et AMDEC)*

IEC 60947-3, *Appareillage à basse tension – Partie 3: Interrupteurs, sectionneurs, interrupteurs-sectionneurs et combinés-fusibles*

IEC 60947-5-1, *Appareillage à basse tension – Partie 5-1: Appareils et éléments de commutation pour circuits de commande – Appareils électromécaniques pour circuits de commande*

IEC 60950-1:2005, *Matériels de traitement de l'information – Sécurité – Partie 1: Exigences générales*
IEC 60950-1:2005/AMD1:2009
IEC 60950-1:2005/AMD2:2013

IEC 61025, *Analyse par arbre de panne (AAP)*

IEC 61204-7, *Alimentations à découpage basse tension – Partie 7: Exigences de sécurité*

IEC TS 61430, *Accumulateurs – Méthodes d'essai pour la vérification de la performance des dispositifs conçus pour réduire les risques d'explosion – Batteries de démarrage au plomb*

IEC 61508 (toutes les parties), *Sécurité fonctionnelle des systèmes électriques/électroniques/électroniques programmables relatifs à la sécurité*

IEC 61558-1, *Sécurité des transformateurs, bobines d'inductance, blocs d'alimentation et des combinaisons de ces éléments – Partie 1: Exigences générales et essais*

IEC 62477-1, *Exigences de sécurité applicables aux systèmes et matériels électroniques de conversion de puissance – Partie 1: Généralités*

IEC 62133-1, *Accumulateurs alcalins et autres accumulateurs à électrolyte non acide – Exigences de sécurité pour les accumulateurs portables étanches, et pour les batteries qui en sont constituées, destinés à l'utilisation dans des applications portables – Partie 1: Systèmes au nickel*

IEC 62282-2-100, *Technologies des piles à combustible – Partie 2-100: Modules à piles à combustible – Sécurité*

IEC 62391-1, *Condensateurs électriques fixes à double couche utilisés dans les équipements électriques et électroniques – Partie 1: Spécification générique*

IEC 62391-2, *Condensateurs électriques fixes à double couche utilisés dans les équipements électroniques – Partie 2: Spécification intermédiaire – Condensateurs électriques à double couche pour application de puissance*

IEC 62619, *Accumulateurs alcalins et autres accumulateurs à électrolyte non acide – Exigences de sécurité pour les accumulateurs au lithium pour utilisation dans des applications industrielles*

IEC/ISO 31010, *Management du risque – Techniques d'appréciation du risque*

ISO 179 (toutes les parties), *Plastiques — Détermination des caractéristiques au choc Charpy*

ISO 180, *Plastiques – Détermination de la résistance au choc Izod*

ISO 877 (toutes les parties), *Plastiques – Méthodes d'exposition au rayonnement solaire*

ISO 1419, *Supports textiles revêtus de caoutchouc ou de plastique – Essais de vieillissement accéléré*

ISO 1421, *Supports textiles revêtus de caoutchouc ou de plastique – Détermination de la force de rupture et de l'allongement à la rupture*

ISO 1798, *Matériaux polymères alvéolaires souples – Détermination de la résistance à la traction et de l'allongement à la rupture*

ISO 2440, *Matériaux polymères alvéolaires souples et rigides – Essais de vieillissement accéléré*

ISO 2626, *Cuivre – Essai de fragilisation par chauffage dans l'hydrogène*

ISO 3691-1, *Chariots de manutention – Exigences de sécurité et vérification – Partie 1: Chariots de manutention automoteurs, autres que les chariots sans conducteur, les chariots à portée variable et les chariots transporteurs de charges*

ISO/TS 3691-7, *Chariots de manutention – Exigences de sécurité et vérification – Partie 7: Exigences régionales pour les pays de la Communauté européenne*

ISO/TS 3691-8, *Chariots de manutention – Exigences de sécurité et vérification – Partie 8: Exigences régionales pour les pays en dehors de la Communauté européenne*

ISO 3864-1, *Symboles graphiques – Couleurs de sécurité et signaux de sécurité – Partie 1: Principes de conception pour les signaux de sécurité et les marquages de sécurité*

ISO 4038, *Véhicules routiers – Dispositifs de freinage hydraulique – Tuyauteries à simple renflement, logements, raccords mâles et embouts de flexibles*

ISO 4080, *Tuyaux et flexibles en caoutchouc et en plastique – Détermination de la perméabilité au gaz*

ISO 4675, *Supports textiles revêtus de caoutchouc ou de plastique – Essai de flexion à basse température*

ISO 5053-1, *Chariots de manutention – Vocabulaire – Partie 1: Types de chariots de manutention*

ISO 7010, *Symboles graphiques – Couleurs de sécurité et signaux de sécurité – Signaux de sécurité enregistrés*

ISO 10380, *Tuyauteries – Tuyaux et tuyauteries métalliques flexibles onduleux*

ISO 10442, *Industries du pétrole, de la chimie et du gaz naturel – Compresseurs d'air centrifuges assemblés à multiplicateur intégré*

ISO 10806, *Tuyauteries – Raccords pour tuyaux métalliques flexibles onduleux*

ISO 11114-4, *Bouteilles à gaz transportables – Compatibilité des matériaux des bouteilles et des robinets avec les contenus gazeux – Partie 4: Méthodes d'essai pour le choix des aciers résistants à la fragilisation par l'hydrogène*

ISO 12100, *Sécurité des machines – Principes généraux de conception – Appréciation du risque et réduction du risque*

ISO 13226, *Caoutchouc – Elastomères de référence normalisés (SRE) pour la caractérisation de l'effet des liquides sur les caoutchoucs vulcanisés*

ISO 13849-1, *Sécurité des machines – Parties des systèmes de commande relatives à la sécurité – Partie 1: Principes généraux de conception*

ISO 13849-2, *Sécurité des machines – Parties des systèmes de commande relatives à la sécurité – Partie 2: Validation*

ISO 14113, *Matériel de soudage aux gaz – Tuyaux souples et flexibles en caoutchouc et en plastique pour des gaz industriels jusqu'à 450 bar (45 MPa)*

ISO 15649, *Industries du pétrole et du gaz naturel – Tuyauteries*

ISO/TR 15916, *Considérations fondamentales pour la sécurité des systèmes à l'hydrogène*

ISO 16010, *Garnitures d'étanchéité en élastomères – Exigences matérielles pour les joints utilisés dans les canalisations et les raccords véhiculant des combustibles gazeux et des hydrocarbures liquides*

ISO 16111:2018, *Appareils de stockage de gaz transportables – Hydrogène absorbé dans un hydrure métallique réversible*

ISO 17268, *Dispositifs de raccordement pour le ravitaillement des véhicules terrestres en hydrogène gazeux*

ISO 19881, *Hydrogène gazeux – Réservoirs de carburant pour véhicules terrestres*

ISO 19882, *Hydrogène gazeux – Dispositifs limiteurs de pression thermiquement activés pour les conteneurs de carburant de véhicules à hydrogène comprimé*

ISO 20898, *Chariots de manutention – Exigences électriques*

ISO 21927-3, *Systèmes de contrôle de fumée et de chaleur – Partie 3: Spécifications pour les ventilateurs mécaniques d'évacuation des fumées et de la chaleur*

ISO 23551-1, *Dispositifs de commande et de sécurité pour brûleurs à gaz et appareils à gaz – Exigences particulières – Partie 1: Robinets automatiques et semi-automatiques*

RTM ONU n° 13, *Règlement technique mondial sur les véhicules à hydrogène et à pile à combustible*

Règlement ONU n° 134, *Prescriptions uniformes relatives à l'homologation des véhicules automobiles et de leurs composants en ce qui concerne les prescriptions de sécurité des véhicules fonctionnant à l'hydrogène*