

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Technologies des piles à combustible –

Partie 4-101: Systèmes à piles à combustible pour la propulsion, autres que les véhicules routiers et groupes auxiliaires de puissance (GAP) – Sécurité pour chariots de manutention électriques



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2014 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 14 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 55 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 14 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

Plus de 55 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.



IEC 62282-4-101

Edition 1.0 2014-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Technologies des piles à combustible –

Partie 4-101: Systèmes à piles à combustible pour la propulsion, autres que les véhicules routiers et groupes auxiliaires de puissance (GAP) – Sécurité pour chariots de manutention électriques

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

XA

ICS 27.070

ISBN 978-2-8322-1811-2

Warning! Make sure that you obtained this publication from an authorized distributor.

Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	9
3 Terms and definitions	12
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 Over-pressure and thermal protection	20
4.4 Regulators	22
4.5 Operating and shut-off valves	22
4.6 Filters	22
4.7 Pumps and compressors	23
4.8 Electrically operated pressure sensing and controlling devices	23
4.9 Ventilation to prevent the build up of flammable gases and vapours.....	23
4.10 Electrostatic discharge (ESD).....	24
4.11 Discharges including methanol emissions and waste materials	25
4.12 Enclosures.....	25
4.13 Fuel cell power system electrical components.....	25
4.13.1 General	25
4.13.2 Internal wiring.....	26
4.13.3 External wiring.....	27
4.13.4 Emergency switching off requirements (disconnection) for connections for fuel cell power system	27
4.13.5 Switches and motor controllers	28
4.13.6 Transformers and power supplies	28
4.13.7 Inverters, converters and controllers.....	28
4.13.8 Lamps and lampholders.....	28
4.13.9 Energy storage components	28
4.13.10 Electrical insulation	29
4.13.11 Limited power circuit.....	29
4.13.12 Electrical spacings.....	30
4.13.13 Separation of circuits	31
4.14 Control circuits.....	32
4.14.1 Safety controls	32
4.14.2 Start	32
4.15 Safety/hazard analysis.....	32
5 Performance requirements for safety and type tests	32
5.1 General.....	32
5.2 Vibration test	32
5.2.1 General	32

5.2.2	Vertical axis test	33
5.2.3	Longitudinal and lateral axes tests	33
5.3	Fuel container securement test	33
5.4	Endurance test	33
5.5	External leakage test	33
5.5.1	External leakage – Hazardous gas containing portions (determination of dilution boundary)	33
5.5.2	External leakage – Hazardous liquid containing portions	34
5.6	Ultimate strength test	34
5.6.1	Ultimate strength – Hazardous liquids and pressurized parts	34
5.6.2	Ultimate strength – Hazardous gas and pressurized parts	34
5.6.3	Ultimate strength – Fuel cell modules	34
5.7	Potential failure modes test	34
5.8	Temperature test	35
5.9	Continuity test	37
5.10	Touch current test	37
5.11	Dielectric voltage – Withstand test	38
5.12	Non-metallic tubing test for accumulation of static electricity	39
5.12.1	Passing criteria	39
5.12.2	Test method	39
5.13	Limited power circuit test	39
5.14	Maximum VA test	40
5.15	Abnormal operation test – Electric equipment failures	40
5.16	Emission of effluents test (only for methanol fuel cells)	41
5.17	Environmental test	41
5.17.1	General	41
5.17.2	Rain test	41
5.17.3	Test of equipment – Exposure to wind	42
5.18	Enclosure tests	42
5.18.1	Enclosure loading test	42
5.18.2	Test for thermoplastic enclosures	42
5.19	20 mm moulded part needle flame test for thermoplastic materials	42
5.20	Marking plate adhesion test	43
5.21	Test for elastomeric seals, gaskets and tubing	43
5.21.1	General	43
5.21.2	Accelerated air-oven aging test	43
5.21.3	Cold temperature exposure test	43
5.21.4	Immersion test	43
5.22	Test for permeation of non-metallic tubing and piping	44
5.23	Test for electrical output leads	44
6	Routine tests	44
6.1	Dielectric voltage-withstand test	44
6.2	External leakage	44
7	Markings	44
8	Instructions	45
8.1	General	45
8.2	Maintenance instructions	45
8.3	Operating instructions	46
8.4	Installation instructions	46

Annex A (informative) Comparison of pressure terms.....	47
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	21
Figure 3 – Example of a diagram with vent system covering all components	21
Figure 4 – Example of a diagram with vent system covering all components in a multiple storage tank system.....	22
Figure 5 – Measuring network, touch current weighted for perception or reaction.....	38
Figure 6 – Diagram for touch current measurement test.....	38
Table 1 – Appliance-wiring material	26
Table 2 – Spacings	31
Table 3 – Temperature rise limits.....	35
Table 4 – Limits for inherently limited power sources	40
Table 5 – Limits for power sources not inherently limited (overcurrent protection required).....	40
Table 6 – Emission rate limits	41
Table A.1 – Comparison table of pressure terms.....	47

iteh STANDARD PREVIEW
(standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/sist/0ed095b1-13af-4bff-86b2-88de16118373/iec-62282-4-101-2014>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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

The text of this standard is based on the following documents:

FDIS	Report on voting
105/506/FDIS	105/513/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 62282 series, published under the general title *Full cell technologies*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC 62282-4-101:2014](#)

<https://standards.iteh.ai/catalog/standards/sist/0ed095b1-13af-4bff-86b2-88de16118373/iec-62282-4-101-2014>

INTRODUCTION

IEC 62282-4 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 standard, IEC 62282-4-101, focuses on safety of industrial electric trucks with fuel cell power systems because such an application is urgently demanded in the world. The future standards in the Part 4 series will deal with other applications related to onboard vehicles other than road vehicles and auxiliary power units (APU).

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC 62282-4-101:2014](https://standards.iteh.ai/catalog/standards/sist/0ed095b1-13af-4bff-86b2-88de16118373/iec-62282-4-101-2014)

<https://standards.iteh.ai/catalog/standards/sist/0ed095b1-13af-4bff-86b2-88de16118373/iec-62282-4-101-2014>

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

1 Scope

1.1 This part of IEC 62282 covers safety requirements for fuel cell power systems intended to be used in electrically powered industrial trucks.

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

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

1.4 The following fuels are considered within the scope of this standard:

- gaseous hydrogen;
- methanol.

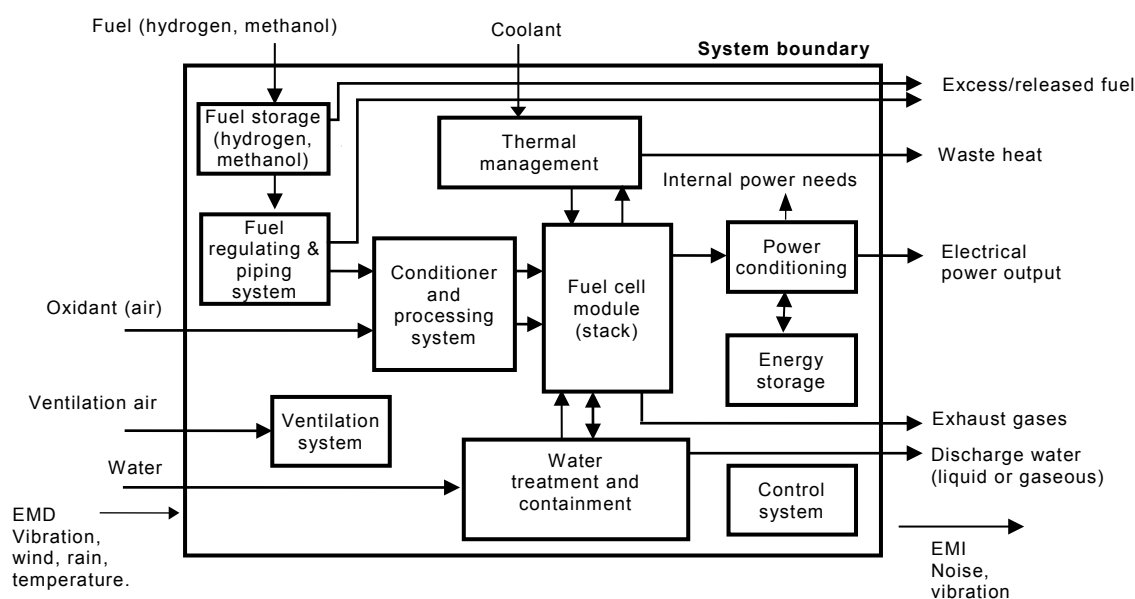
1.5 This standard covers the fuel cell power system as defined in 3.8 and Figure 1.

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

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

1.8 The following are not included in the scope of this standard:

- 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.



IEC

Key

EMD electromagnetic disturbance.

EMI electromagnetic interference.

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

Figure 1 – Fuel cell power systems for industrial trucks

<https://standards.iteh.ai/catalog/standards/sist/0ed095b1-13af-4bff-86b2-88de16118373/iec-62282-4-101-2014>

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 60584-1, *Thermocouples – Part 1: Reference tables*

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*

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*

<https://standards.iteh.ai/catalog/standards/sist/0ed095b1-13af-4bff-86b2-88de16118373/iec-62282-4-101-2014>

IEC 60730-1:2013, *Automatic electrical controls for household and similar use – Part 1: General requirements*

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 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 61204-7, *Low-voltage 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 61558-1, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*

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

IEC 62133, *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*

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

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

ISO 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 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 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 14113, *Gas welding equipment – Rubber and plastic hose and hose assemblies for use with industrial gases up to 450 bar*

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 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, *Transportable gas storage devices – Hydrogen absorbed in reversible metal hydride*

ISO 17268, *Compressed hydrogen surface vehicle refuelling connection devices*

ISO 21927-3, *Smoke and heat control systems – Part 3: Specification 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 valves*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

abnormal operation

operation of the fuel cell power system with any one electrical or control component malfunction or failure, in any failure mode regarded as reasonably probable in the FMEA; but

excluding accidental rupture or breakdown of the containers of flammable liquids, vapours and/or gases

3.2 bonding

permanent joining of metallic parts to form a positive electrically conductive path that provides electrical continuity between non-current carrying metal parts and is capable of conducting any fault current that may occur

Note 1 to entry: This applies to bonding within the fuel cell power system and between the fuel cell power system and truck and does not refer to the means to ground the truck itself, such as with a grounding strap or with tyres. Acceptable methods of bonding shall be by any positive means, such as by a clamp, rivet, bolt, screw, welded joint, soldered or brazed joint, or a bonding jumper with a closed loop connector secured by a screw.

3.3 check-valve

fluid control device that allows fluids to flow in only one direction

3.4 circuit, limited power

circuit involving a potential greater than 42,4 V peak (30 V r.m.s.) or 60 V d.c. and power after 60 s of operation comply with the values outlined in Tables 2B and 2C of IEC 60950-1:2005

Note 1 to entry: A circuit that is low voltage under both normal and single fault conditions is referred to in IEC 60950-1 as a safety extra low voltage (SELV).

3.5 low-voltage circuit

circuit involving a peak open-circuit potential of not more than 42,4 V (30 V r.m.s.) or 60 V d.c. supplied by a battery, a fuel cell, a transformer having a maximum volt-ampere (VA), rating of less than 100 VA and a maximum secondary output of 30 V a.c. or by a combination of a transformer and a fixed impedance that as a system, complies with IEC 61558-1

Note 1 to entry: A circuit derived by connecting a resistance in series with a voltage supply circuit as a means of limiting the voltage and current, is not considered to be a low-voltage circuit.

3.6 dilution boundary

extent of a flammable area or zone created by a limited release of flammable gas or vapour, internal to the fuel cell power system or truck in which it is mounted, and controlled by mechanical ventilation or other effective means

Note 1 to entry: This is outlined in IEC 60079-10.

3.7 electrostatic discharge

ESD

discharge created by static electricity

3.8 fuel cell power system

generator system that uses one or more fuel cell module(s) to generate electric power and heat

Note 1 to entry: See Figure 1 for a block diagram of a fuel cell power system. A fuel cell power system may contain all or some of the components shown in Figure 1. The fuel cell power system for use with industrial trucks will be in one of the forms as outlined in 3.9 and 3.10.

[SOURCE: IEC TS 62282-1:2013, 3.49, modified – Addition of second sentence to the Note to entry]