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Fuel cell technologies -
Part 3-200: Stationary fuel cell power systems - Performance test methods

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Fuel cell technologies - Part 3-200: Stationary fuel cell power systems - Performance test methods

FOREWORD

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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 62282-3-200:2025. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 62282-3-200 has been prepared by IEC technical committee 105: Fuel cell technologies. It is an International Standard.

This third edition cancels and replaces the second edition published in 2015. This edition constitutes a technical revision.

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

a) revision of the Introduction, Scope and Clause 3;
b) revision of the symbols in Table 1;
c) revision of Figure 2 (symbol diagram);
d) revision of measurement methods (8.3);
e) revision of the efficiency test (10.2);
f) revision of the electric power and thermal power response characteristics test (10.3);
g) revision of the start-up and shutdown characteristics test (10.4);
h) revision of Annex C.

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

Draft	Report on voting
105/1124/FDIS	105/1134/RVD

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

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

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

A list of all parts in the IEC 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- withdrawn, or
- revised.

INTRODUCTION

This part of IEC 62282 describes how to measure the performance of stationary fuel cell power systems for residential, commercial, agricultural and industrial applications.

This document describes type tests and their test methods only. In this document, no routine tests are required or identified, and no performance targets are set.

~~The following fuel cell types have been considered:~~

- ~~alkaline fuel cells (AFC);~~
- ~~phosphoric acid fuel cells (PAFC);~~
- ~~polymer electrolyte fuel cells (PEFC);~~
- ~~molten carbonate fuel cells (MCFC);~~
- ~~solid oxide fuel cells (SOFC).~~

A related but independent standard IEC 62282-3-201 on the performance test methods of small stationary fuel cell power systems has been aligned with this document.

1 Scope

This part of IEC 62282 covers operational and environmental aspects of the stationary fuel cell power systems performance. The test methods apply as follows:

– power output under specified operating and transient conditions;
– electrical and heat recovery efficiency under specified operating conditions;
– environmental characteristics, for example, exhaust gas emissions, noise, under specified operating and transient conditions.

This document applies to all kinds of stationary fuel cell technologies, such as:

– alkaline fuel cells (AFC);
– phosphoric acid fuel cells (PAFC);
– polymer electrolyte fuel cells (PEFC);
– molten carbonate fuel cells (MCFC);
– solid oxide fuel cells (SOFC).

This document does not provide coverage for electromagnetic compatibility (EMC).

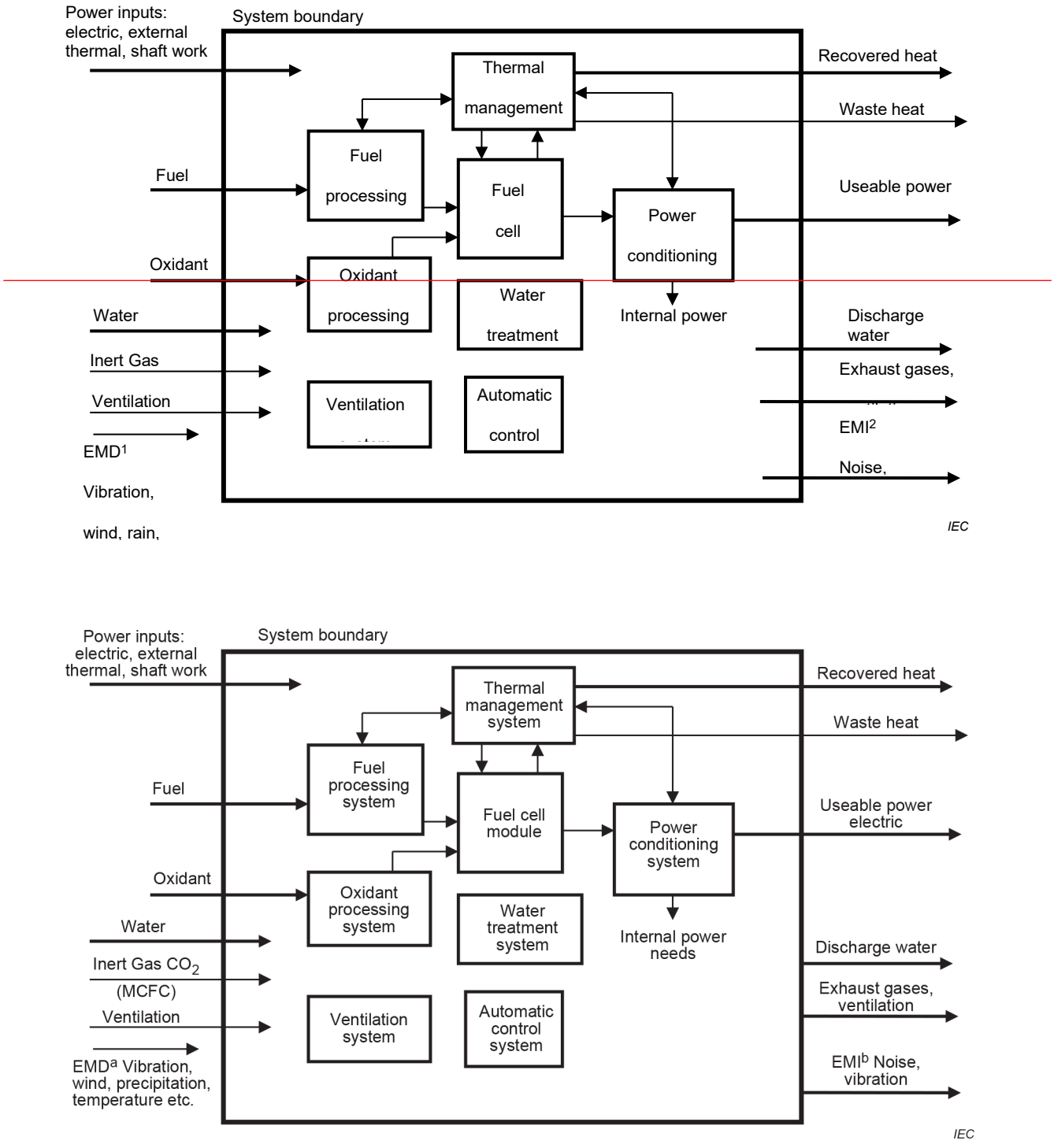
This document does not apply to small stationary fuel cell power systems with rated electric power output of less than 10 kW which are dealt with in IEC 62282-3-201.

Fuel cell power systems ~~may~~ can have different subsystems depending upon types of fuel cell and applications, and they have different streams of material and energy into and out of them. However, a common system diagram and boundary has been defined for evaluation of the fuel cell power system (see Figure 1).

The following conditions are considered in order to determine the system boundary of the fuel cell power system:

– all energy recovery systems are included within the system boundary;
– all kinds of electric energy storage devices are considered outside the system boundary;
– calculation of the heating value of the input fuel (such as natural gas, propane gas and pure hydrogen gas) is based on the conditions of the fuel at the boundary of the fuel cell power system.

The document does not provide safety requirements for the testing of stationary fuel cell power systems. Details on safe operation of the tested system can be obtained from the manufacturers instructions.



Key

Fuel cell power system including subsystems. The interface is defined as a conceptual or functional one instead of hardware such as a power package.

Subsystems: fuel cell module, fuel processor, etc. These subsystem configurations depend on the kind of fuel, type of fuel cell or system.

→ The interface points in the boundary to be measured for calculation data.

[a] EMD electromagnetic disturbance

[b] EMI electromagnetic interference

Figure 1 – Fuel cell power system diagram

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 60051 (all parts), *Direct acting indicating analogue electrical measuring instruments and their accessories*

IEC 60359, *Electrical and electronic measurement equipment - Expression of performance*

IEC 60688, *Electrical measuring transducers for converting AC and DC electrical quantities to analogue or digital signals*

IEC 61000-4-7, *Electromagnetic compatibility (EMC) - Part 4-7: Testing and measurement techniques - General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*

~~IEC 61000-4-13, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests*~~

IEC 61028, *Electrical measuring instruments - X-Y recorders*

IEC 61143 (all parts), *Electrical measuring instruments - X-t recorders*

IEC 61672-1, *Electroacoustics - Sound level meters - Part 1: Specifications*

IEC 61672-2, *Electroacoustics - Sound level meters - Part 2: Pattern evaluation tests*

IEC 62052-11, *Electricity metering equipment ~~(AC)~~ - General requirements, tests and test conditions - Part 11: Metering equipment*

IEC 62053-22, *Electricity metering equipment ~~(a.c.)~~ - Particular requirements - Part 22: Static meters for AC active energy (classes 0,1S, 0,2S and 0,5S)*

IEC 62282-3-201, *Fuel cell technologies - Part 3-201: Stationary fuel cell power systems - Performance test methods for small fuel cell power systems*

~~ISO/IEC Guide 98-3, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM: 1995)*~~

ISO 3648, *Aviation fuels - Estimation of net specific energy*

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

ISO 4677-1, *Atmospheres for conditioning and testing - Determination of relative humidity – Part 1: Aspirated psychrometer method*

ISO 4677-2, *Atmospheres for conditioning and testing - Determination of relative humidity – Part 2: Whirling psychrometer method*[1]

ISO 5167 (all parts), *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full*

ISO 5348, *Mechanical vibration and shock - Mechanical mounting of accelerometers*

ISO 5815-2, *Water quality - Determination of biochemical oxygen demand after n days (BODn) - Part 2: Method for undiluted samples*

ISO 6060, *Water quality - Determination of the chemical oxygen demand*

~~ISO 6326 (all parts), *Natural gas – Determination of sulfur compounds*~~

ISO 6974 (all parts), *Natural gas - Determination of composition and associated uncertainty by gas chromatography*

ISO 6975~~ (all parts)~~, *Natural gas - Extended analysis - Gas chromatographic method*

ISO 7934, *Stationary source emissions - Determination of the mass concentration of sulfur dioxide - Hydrogen peroxide/barium perchlorate/Thorin method*

ISO 7935, *Stationary source emissions - Determination of the mass concentration of sulfur dioxide in flue gases - Performance characteristics of automated measuring ~~methods~~ systems*

ISO 8217:2024, ~~*Petroleum products*~~ *Products from petroleum, synthetic and renewable sources - Fuels (class F) - Specifications of marine fuels*

ISO 10101 (all parts), *Natural gas - Determination of water by the Karl Fisher method*

ISO 10396, *Stationary source emissions - Sampling for the automated determination of gas emission concentrations for permanently-installed monitoring systems*

ISO 10523, *Water quality - Determination of pH*

ISO 11626, *Natural gas - Determination of sulfur compounds - Determination of hydrogen sulfide content by UV absorption method*

ISO 10849, *Stationary source emissions - Determination of the mass concentration of nitrogen oxides in flue gas - Performance characteristics of automated measuring systems*

ISO 11042-1, *Gas turbines - Exhaust gas emission - Part 1: Measurement and evaluation*

ISO 11042-2, *Gas turbines - Exhaust gas emission - Part 2: Automated emission monitoring*

ISO 11541, *Natural gas - Determination of water content at high pressure*

ISO 11564, *Stationary source emissions - Determination of the mass concentration of nitrogen oxides - Naphthylethylenediamine photometric method*

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[1] This publication was withdrawn.

ISO 11632, *Stationary source emissions - Determination of mass concentration of sulfur dioxide - Ion chromatography method*

ISO 14687, *Hydrogen fuel - Product specification*

~~ISO 14687-1, *Hydrogen fuel – Product specification – Part 1: All applications except proton exchange membrane (PEM) fuel cell for road vehicles*~~

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

ISO 16622, *Meteorology - Sonic anemometers/thermometers - Acceptance test methods for mean wind measurements*

ISO 16960, *Natural gas - Determination of sulfur compounds - Determination of total sulfur by oxidative microcoulometry method*

ISO 19739, *Natural gas - Determination of sulfur compounds using gas chromatography*

ISO 20729, *Natural gas - Determination of sulfur compounds - Determination of total sulfur content by ultraviolet fluorescence method*

ASTM D4809, *Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)*

~~ASTM F2602, *Standard Test Method for Determining the Molar Mass of Chitosan and Chitosan Salts by Size Exclusion Chromatography with Multi-angle Light Scattering Detection (SEC-MALS)*~~

3.1.4
cold state
state of a fuel cell power system, which is entirely at ambient temperature with no power input or output, ready for start-up

Note 1 to entry: Power input to a control device for monitoring the fuel cell power system during cold state is not taken into consideration.

[SOURCE: IEC 60050-485:2020, 485-21-01, modified – "which is entirely" and "ready for start-up" added; Note 1 to entry added.]

3.1.5
discharge water
water discharged from the fuel cell power system including waste water and condensate

3.1.6
electrical efficiency
ratio of the average net electric power output produced by a fuel cell power system to the average total power input supplied to the fuel cell power system

Note 1 to entry: Lower heating value (LHV) is assumed unless otherwise stated.

Note 2 to entry: Any electric power that is supplied to auxiliary machines and equipment of a fuel cell power system from an external source is deducted from the electric power output of the fuel cell power system.

[SOURCE: ~~IEC TS 62282-1:2013, 3.30.1, modified – "average " added to "net electric power output"; "average total power input" instead of "total enthalpy flow"; Note 2 to entry" added~~ IEC 60050-485:2020, 485-10-02, modified – "electrical" instead of "electric" in the preferred term; "average net electric power output" instead of "net electric power"; "average total power input" instead of "total enthalpy flow"; "Note 2 to entry added.]

3.1.7
external thermal energy
additional thermal energy input from outside the system boundary~~, such as cycle make-up and process condensate return~~

Note 1 to entry: External thermal energy can be supplied e.g. by make-up water or process condensate return.

3.1.8
fuel cell module
assembly incorporating one or more fuel cell stacks and, if applicable, additional components, that is intended to be integrated into a power system

Note 1 to entry: A fuel cell module comprises the following main components: one or more fuel cell stack(s), a piping system for conveying fuels, oxidants and exhausts, electric connections for the power delivered by the stack(s), and means for monitoring, control or both. Additionally, a fuel cell module ~~may~~ can comprise: means for conveying additional fluids (e.g. cooling media, inert gas, CO_2 (MCFC)), means for detecting normal and~~/or~~ abnormal operating conditions, enclosures or pressure vessels and module ventilation systems, and the required electronic components for module operation and power conditioning.

[SOURCE: ~~IEC TS 62282-1:2013, 3.48, modified – "or a vehicle" deleted~~ IEC 60050-485:2020, 485-09-03, modified – In the definition "or a vehicle" deleted and in the Note to entry, "CO_2 (MCFC)" added.]

3.1.9
fuel cell power system
generator system that uses one or more fuel cell modules to generate electric power and heat

Note 1 to entry: A fuel cell power system is composed of all or some of the systems shown in Figure 1.

[SOURCE: IEC 60050-485:2020, 485-09-01, modified – Note 1 to entry added.]

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Part 3-200: Stationary fuel cell power systems - Performance test methods

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g) revision of the start-up and shutdown characteristics test (10.4);

h) revision of Annex C.

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

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

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

A list of all parts in the IEC 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, or
- revised.

INTRODUCTION

This part of IEC 62282 describes how to measure the performance of stationary fuel cell power systems for residential, commercial, agricultural and industrial applications.

This document describes type tests and their test methods only. In this document, no routine tests are required or identified, and no performance targets are set.

A related but independent standard IEC 62282-3-201 on the performance test methods of small stationary fuel cell power systems has been aligned with this document.

1 Scope

This part of IEC 62282 covers operational and environmental aspects of the stationary fuel cell power systems performance. The test methods apply as follows:

– power output under specified operating and transient conditions;
– electrical and heat recovery efficiency under specified operating conditions;
– environmental characteristics, for example, exhaust gas emissions, noise, under specified operating and transient conditions.

This document applies to all kinds of stationary fuel cell technologies, such as:

– alkaline fuel cells (AFC);
– phosphoric acid fuel cells (PAFC);
– polymer electrolyte fuel cells (PEFC);
– molten carbonate fuel cells (MCFC);
– solid oxide fuel cells (SOFC).

This document does not provide coverage for electromagnetic compatibility (EMC).

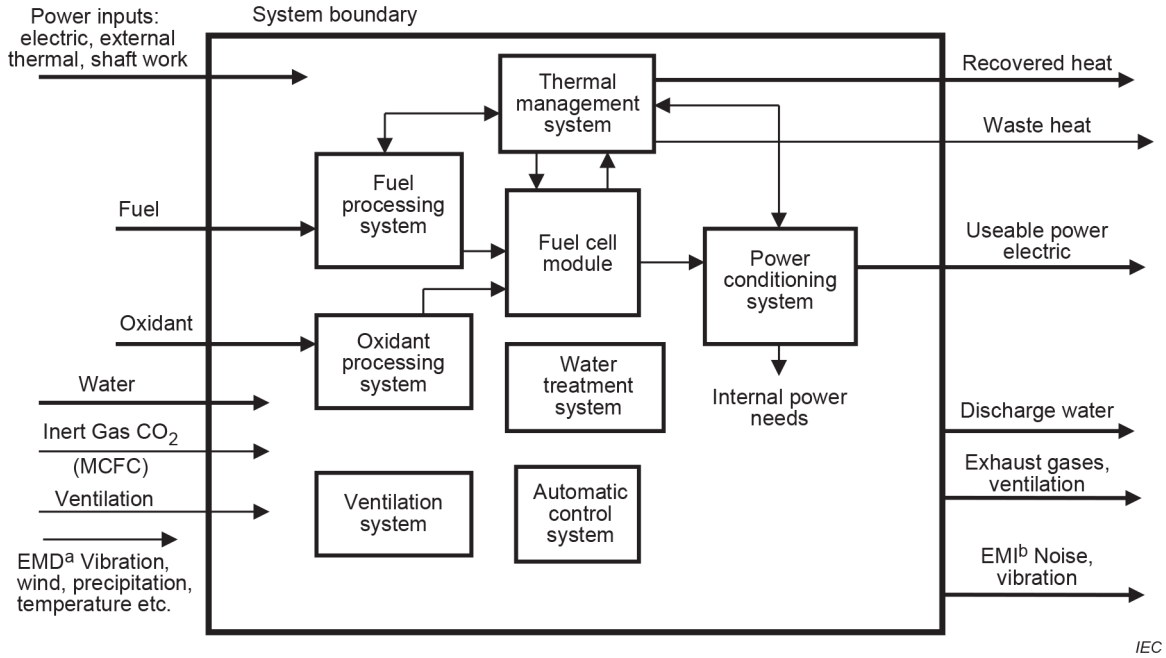
This document does not apply to small stationary fuel cell power systems with rated electric power output of less than 10 kW which are dealt with in IEC 62282-3-201.

Fuel cell power systems can have different subsystems depending upon types of fuel cell and applications, and they have different streams of material and energy into and out of them. However, a common system diagram and boundary has been defined for evaluation of the fuel cell power system (see Figure 1).

The following conditions are considered in order to determine the system boundary of the fuel cell power system:

– all energy recovery systems are included within the system boundary;
– all kinds of electric energy storage devices are considered outside the system boundary;
– calculation of the heating value of the input fuel (such as natural gas, propane gas and pure hydrogen gas) is based on the conditions of the fuel at the boundary of the fuel cell power system.

The document does not provide safety requirements for the testing of stationary fuel cell power systems. Details on safe operation of the tested system can be obtained from the manufacturers instructions.



Key

Fuel cell power system including subsystems. The interface is defined as a conceptual or functional one instead of hardware such as a power package.

Subsystems: fuel cell module, fuel processor, etc. These subsystem configurations depend on the kind of fuel, type of fuel cell or system.

The interface points in the boundary to be measured for calculation data.

[a] EMD electromagnetic disturbance

[b] EMI electromagnetic interference

Figure 1 – Fuel cell power system diagram

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 60051 (all parts), *Direct acting indicating analogue electrical measuring instruments and their accessories*

IEC 60359, *Electrical and electronic measurement equipment - Expression of performance*

IEC 60688, *Electrical measuring transducers for converting AC and DC electrical quantities to analogue or digital signals*

IEC 61000-4-7, *Electromagnetic compatibility (EMC) - Part 4-7: Testing and measurement techniques - General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*

IEC 61028, *Electrical measuring instruments - X-Y recorders*

IEC 61143 (all parts), *Electrical measuring instruments - X-t recorders*

IEC 61672-1, *Electroacoustics - Sound level meters - Part 1: Specifications*

IEC 61672-2, *Electroacoustics - Sound level meters - Part 2: Pattern evaluation tests*

IEC 62052-11, *Electricity metering equipment - General requirements, tests and test conditions - Part 11: Metering equipment*

IEC 62053-22, *Electricity metering equipment - Particular requirements - Part 22: Static meters for AC active energy (classes 0,1S, 0,2S and 0,5S)*

IEC 62282-3-201, *Fuel cell technologies - Part 3-201: Stationary fuel cell power systems - Performance test methods for small fuel cell power systems*

ISO 3648, *Aviation fuels - Estimation of net specific energy*

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

ISO 4677-1, *Atmospheres for conditioning and testing - Determination of relative humidity – Part 1: Aspirated psychrometer method*

ISO 4677-2, *Atmospheres for conditioning and testing - Determination of relative humidity – Part 2: Whirling psychrometer method*[1]

ISO 5167 (all parts), *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full*

ISO 5348, *Mechanical vibration and shock - Mechanical mounting of accelerometers*

ISO 5815-2, *Water quality - Determination of biochemical oxygen demand after n days (BODn) - Part 2: Method for undiluted samples*

ISO 6060, *Water quality - Determination of the chemical oxygen demand*

ISO 6974 (all parts), *Natural gas - Determination of composition and associated uncertainty by gas chromatography*

ISO 6975, *Natural gas - Extended analysis - Gas chromatographic method*

ISO 7934, *Stationary source emissions - Determination of the mass concentration of sulfur dioxide - Hydrogen peroxide/barium perchlorate/Thorin method*

ISO 7935, *Stationary source emissions - Determination of the mass concentration of sulfur dioxide in flue gases - Performance characteristics of automated measuring systems*

ISO 8217:2024, *Products from petroleum, synthetic and renewable sources - Fuels (class F) - Specifications of marine fuels*

ISO 10101 (all parts), *Natural gas - Determination of water by the Karl Fisher method*

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1 This publication was withdrawn.

ISO 10396, *Stationary source emissions - Sampling for the automated determination of gas emission concentrations for permanently-installed monitoring systems*

ISO 10523, *Water quality - Determination of pH*

ISO 11626, *Natural gas - Determination of sulfur compounds - Determination of hydrogen sulfide content by UV absorption method*

ISO 10849, *Stationary source emissions - Determination of the mass concentration of nitrogen oxides in flue gas - Performance characteristics of automated measuring systems*

ISO 11042-1, *Gas turbines - Exhaust gas emission - Part 1: Measurement and evaluation*

ISO 11042-2, *Gas turbines - Exhaust gas emission - Part 2: Automated emission monitoring*

ISO 11541, *Natural gas - Determination of water content at high pressure*

ISO 11564, *Stationary source emissions - Determination of the mass concentration of nitrogen oxides - Naphthylethylenediamine photometric method*

ISO 11632, *Stationary source emissions - Determination of mass concentration of sulfur dioxide - Ion chromatography method*

ISO 14687, *Hydrogen fuel - Product specification*

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

ISO 16622, *Meteorology - Sonic anemometers/thermometers - Acceptance test methods for mean wind measurements*

ISO 16960, *Natural gas - Determination of sulfur compounds - Determination of total sulfur by oxidative microcoulometry method*

ISO 19739, *Natural gas - Determination of sulfur compounds using gas chromatography*

ISO 20729, *Natural gas - Determination of sulfur compounds - Determination of total sulfur content by ultraviolet fluorescence method*

ASTM D4809, *Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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Technologies des piles à combustible - Partie 3-200: Systèmes à piles à combustible stationnaires - Méthodes d'essai des performances

AVANT-PROPOS

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L'IEC 62282-3-200 a été établie par le comité d'études 105 de l'IEC: Technologies des piles à combustible. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2015. Cette édition constitue une révision technique.

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

a) révision de l'Introduction, du Domaine d'application et de l'Article 3;
b) révision des symboles énumérés dans le Tableau 1;

c) révision de la Figure 2 (schéma des symboles);

d) révision des méthodes de mesure (8.3);

e) révision de l'essai de rendement (10.2);

f) révision de l'essai des caractéristiques de réponse de puissance électrique et de puissance thermique (10.3);

g) révision de l'essai des caractéristiques de démarrage/d'arrêt (10.4);

h) révision de l'Annexe C.

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

Projet	Rapport de vote
105/1124/FDIS	105/1134/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/publications.

Une liste de toutes les parties de la série IEC 62282, publiée 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. À cette date, le document sera

- reconduit,
- supprimé, ou
- révisé.

INTRODUCTION

La présente partie de l'IEC 62282 décrit la manière de mesurer les performances des systèmes à piles à combustible stationnaires pour les applications résidentielles, commerciales, agricoles et industrielles.

Le présent document décrit uniquement les essais de type et leurs méthodes d'essai. Dans le présent document, aucun essai de série n'est exigé ou identifié, et aucune valeur cible de performance n'est prévue.

Une norme connexe, mais indépendante (IEC 62282-3-201), sur les méthodes d'essai des performances des petits systèmes à piles à combustible stationnaires, a été alignée avec le présent document.

1 Domaine d'application

La présente partie de l'IEC 62282 couvre les aspects de fonctionnement et d'environnement des performances des systèmes à piles à combustible stationnaires. Les méthodes d'essai s'appliquent comme suit:

– puissance de sortie dans des conditions de fonctionnement spécifiées y compris les conditions transitoires;
– rendement électrique et rendement de l'énergie thermique récupérée dans des conditions de fonctionnement spécifiées;
– caractéristiques d'environnement, par exemple émissions de gaz d'échappement, bruit, dans des conditions de fonctionnement spécifiées y compris les conditions transitoires.

Le présent document s'applique à toutes sortes de technologies des piles à combustible stationnaires, telles que:

– piles à combustible alcalines (AFC);
– piles à combustible à acide phosphorique (PAFC);
– piles à combustible à électrolyte polymère (PEFC);
– piles à combustible à carbonates fondus (MCFC);
– piles à combustible à oxyde solide (SOFC).

Le présent document n'aborde pas la compatibilité électromagnétique (CEM).

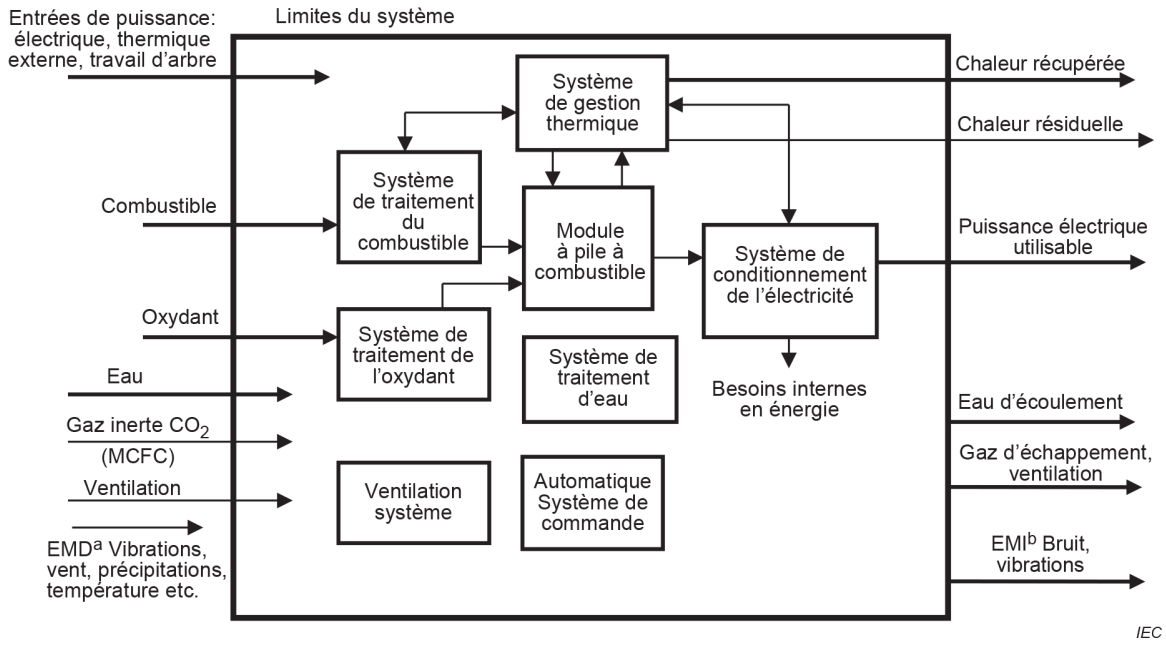
Le présent document ne concerne pas les petits systèmes à piles à combustible stationnaires de sortie de puissance électrique assignée inférieure à 10 kW qui sont traités dans l'IEC 62282-3-201.

Les systèmes à piles à combustible peuvent avoir différents sous-systèmes en fonction des types de piles à combustible et d'applications et ils subissent différents flux de matière et d'énergie en entrée et en sortie. Toutefois, un schéma commun de système et de ses limites a été défini pour l'évaluation du système à pile à combustible (voir Figure 1).

Les conditions suivantes sont prises en compte pour déterminer les limites du système du système à pile à combustible:

– tous les systèmes de récupération d'énergie sont inclus dans les limites du système;
– toutes sortes de dispositifs de stockage d'énergie électrique sont considérées comme étant en dehors des limites du système;
– le calcul de la valeur calorifique du combustible entrant (tel que le gaz naturel, le propane et l'hydrogène pur) est fondé sur les conditions du combustible à la limite du système à pile à combustible.

Le présent document n'aborde pas les exigences de sécurité relatives aux essais des systèmes à piles à combustible stationnaires. Des détails concernant la sécurité d'exploitation du système soumis à essai peuvent être consultés dans les instructions des fabricants.



Légende

Système à pile à combustible composé de sous-systèmes. L'interface est définie comme étant une interface conceptuelle ou fonctionnelle, plutôt qu'un élément matériel comme une centrale énergétique.

Sous-systèmes; module à pile à combustible, système de traitement de combustible, etc. Ces configurations de sous-systèmes dépendent du type de combustible, du type de pile à combustible ou du système.

Points d'interface de la limite à mesurer pour obtenir les données calculées.

[a] EMD perturbation électromagnétique

[b] EMI interférence électromagnétique

Figure 1 – Schéma du système à pile à combustible

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 60051 (toutes les parties), *Appareils de mesure électriques indicateurs analogiques à action directe et leurs accessoires*

IEC 60359, *Appareils de mesure électriques et électroniques - Expression des performances*

IEC 60688, *Transducteurs électriques de mesure convertissant les grandeurs électriques alternatives ou continues en signaux analogiques ou numériques*

IEC 61000-4-7, *Compatibilité électromagnétique (CEM) - Partie 4-7: Techniques d'essai et de mesure - Guide général relatif aux mesures d'harmoniques et d'interharmoniques, ainsi qu'à l'appareillage de mesure, applicable aux réseaux d'alimentation et aux appareils qui y sont raccordés*

IEC 61028, *Appareils électriques de mesure - Enregistreurs X-Y*

IEC 61143 (toutes les parties), *Appareils électriques de mesure - Enregistreurs X-t*

IEC 61672-1, *Électroacoustique - Sonomètres - Partie 1: Spécifications*

IEC 61672-2, *Électroacoustique - Sonomètres - Partie 2: Essais d'évaluation d'un modèle*

IEC 62052-11, *Équipement de comptage de l'électricité - Exigences générales, essais et conditions d'essai - Partie 11: Équipement de comptage*

IEC 62053-22, *Équipement de comptage de l'électricité - Exigences particulières - Partie 22: Compteurs statiques d'énergie active en courant alternatif (classes 0,1 S, 0,2 S et 0,5 S)*

IEC 62282-3-201, *Technologies des piles à combustible - Partie 3-201: Systèmes à piles à combustible stationnaires - Méthodes d'essai des performances pour petits systèmes à piles à combustible*

ISO 3648, *Carburants aviation - Estimation de l'énergie spécifique inférieure*

ISO 3744, *Acoustique - Détermination des niveaux de puissance acoustique et des niveaux d'énergie acoustique émis par les sources de bruit à partir de la pression acoustique - Méthodes d'expertise pour des conditions approchant celles du champ libre sur plan réfléchissant*

ISO 4677-1, *Atmosphères de conditionnement et d'essai - Détermination de l'humidité relative - Partie 1: Méthode utilisant un psychromètre à aspiration*

ISO 4677-2, *Atmosphères de conditionnement et d'essai - Détermination de l'humidité relative - Partie 2: Méthode utilisant un psychromètre fronde*[1]

ISO 5167 (toutes les parties), *Mesure de débit des fluides au moyen d'appareils déprimogènes insérés dans des conduites en charge de section circulaire*

ISO 5348, *Vibrations et chocs mécaniques - Fixation mécanique des accéléromètres*

ISO 5815-2, *Qualité de l'eau - Détermination de la demande biochimique en oxygène après n jours (DBOn) - Partie 2: Méthode pour échantillons non dilués*

ISO 6060, *Qualité de l'eau - Détermination de la demande chimique en oxygène*

ISO 6974 (toutes les parties), *Gaz naturel - Détermination de la composition et de l'incertitude associée par chromatographie en phase gazeuse*

ISO 6975 (toutes les parties), *Gaz naturel - Analyse étendue - Méthode par chromatographie en phase gazeuse*

ISO 7934, *Émissions de sources fixes - Détermination de la concentration en masse de dioxyde de soufre - Méthode au peroxyde d'hydrogène/perchlorate de baryum/Thorin*

ISO 7935, *Émissions de sources fixes - Détermination de la concentration en masse de dioxyde de soufre - Caractéristiques de performance des systèmes de mesurage automatiques*

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1 Cette publication a été retirée.

ISO 8217:2024, *Produits d'origine pétrolière, synthétique ou renouvelable - Combustibles (classe F) - Spécifications des combustibles pour la marine*

ISO 10101 (toutes les parties), *Gaz naturel - Dosage de l'eau par la méthode de Karl Fischer*

ISO 10396, *Émissions de sources fixes - Échantillonnage pour la détermination automatisée des concentrations d'émission de gaz pour des systèmes fixes de surveillance*

ISO 10523, *Qualité de l'eau - Détermination du pH*

ISO 10849, *Émissions de sources fixes - Détermination de la concentration en masse des oxydes d'azote dans les effluents gazeux - Caractéristiques de performance des systèmes de mesurage automatiques*

ISO 11042-1, *Turbines à gaz - Émissions de gaz d'échappement - Partie 1: Mesurage et évaluation*

ISO 11042-2, *Turbines à gaz - Émissions de gaz d'échappement - Partie 2: Surveillance automatisée des émissions*

ISO 11541, *Gaz naturel - Dosage de l'eau à haute pression*

ISO 11564, *Émissions de sources fixes - Détermination de la concentration en masse des oxydes d'azote - Méthode photométrique à la naphtyléthylène diamine (NEDA)*

ISO 11626, *Gaz naturel - Détermination des composés soufrés - Détermination de la teneur en sulfure d'hydrogène par la méthode d'absorption UV*

ISO 11632, *Émissions de sources fixes - Détermination de la concentration en masse de dioxyde de soufre - Méthode par chromatographie ionique*

ISO 14687, *Qualité du carburant hydrogène - Spécification de produit*

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

ISO 16622, *Météorologie - Anémomètres/thermomètres soniques - Méthodes d'essai d'acceptation pour les mesurages de la vitesse moyenne du vent*

ISO 16960, *Gaz naturel - Détermination des composés soufrés - Détermination de la teneur totale en soufre par microcoulométrie oxydante*

ISO 19739, *Gaz naturel - Détermination des composés soufrés par chromatographie en phase gazeuse*

ISO 20729, *Gaz naturel - Détermination des composés soufrés - Détermination de la teneur en soufre total par la méthode par fluorescence UV*

ASTM D4809, *Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)*