IEC 62282-3-200

Edition 2.0 2015-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

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

IEC 62282-3-200:2015-11(en-fr)

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FUEL CELL TECHNOLOGIES –

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

FOREWORD

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

This second edition cancels and replaces the first edition of IEC 62282-3-200, published in 2011. This edition constitutes a technical revision.

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

a) a stabilization zone of ± 10 % for thermal output of 100 % response time is provided instead of the tests for thermal output of 90 % response time, while the tests for electric output of 90 % response time remain as an option;

b) the calculations for the ramp rate in kW/s are deleted and only the calculations for the response time (s) remain;

c) the procedures, criteria and figures of 9.3, Electric power and thermal power response characteristics test, are modified to ensure they produce accurate and consistent results;

d) maximum acceptable instantaneous electric power output transient is moved to informative Annex D.

IEC has published a related but independent standard IEC 62282-3-201 on performance test methods of small stationary fuel cell power systems which is harmonized with this standard.

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

FDIS	Report on voting
105/547/FDIS	105/555/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 the 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 publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

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 standard describes type tests and their test methods only. In this standard, 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).

FUEL CELL TECHNOLOGIES –

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

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, etc. under specified operating and transient conditions.

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

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

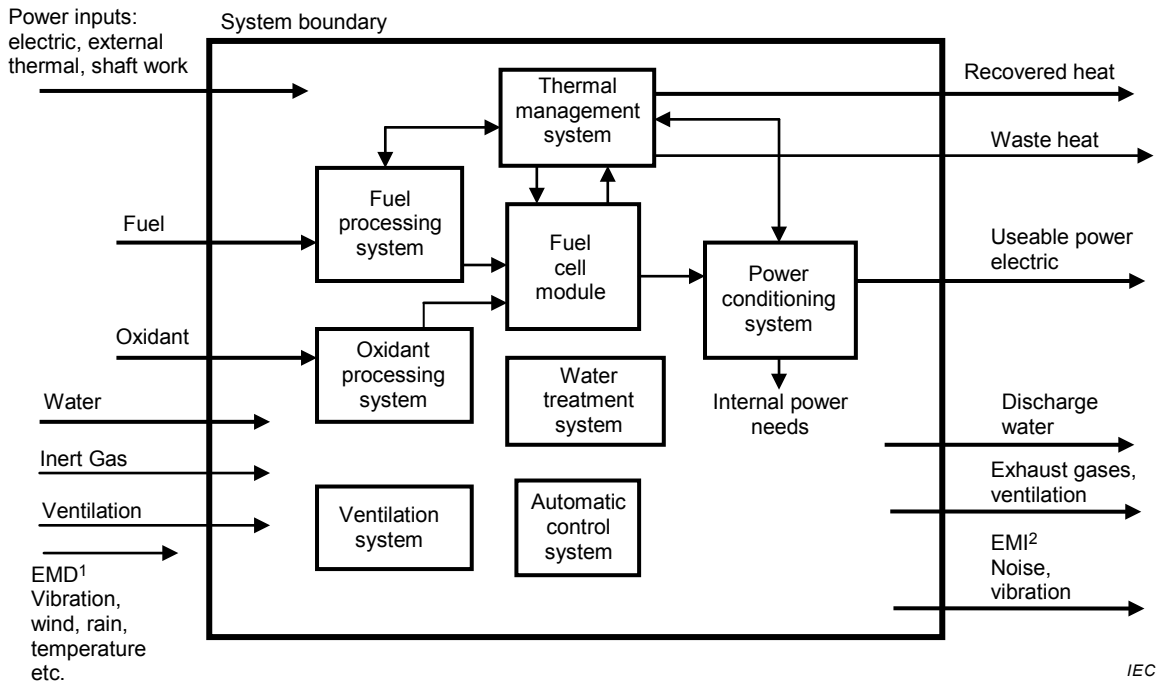
Fuel cell power systems may have different subsystems depending upon types of fuel cell and applications, and they have different streams of material and energy into and out of them. However, a common system diagram and boundary has been defined for evaluation of the fuel cell power system (see Figure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



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.

[1] EMD electromagnetic disturbance

[2] EMI electromagnetic interference

Figure 1 – Fuel cell power system diagram

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 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 A.C. and D.C. 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 active energy (classes 0,2 S and 0,5 S)*

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*

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 – Performance characteristics of automated measuring methods*

ISO 8217, *Petroleum products – Fuel (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 10849, *Stationary source emissions – Determination of the mass concentration of nitrogen oxides – 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 14687-1, *Hydrogen fuel – Product specification – Part 1: All applications except proton exchange membrane (PEM) fuel cell for road vehicles*

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

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

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 Terms, definitions, operating process and symbols

3.1 Terms and definitions

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

3.1.1
auxiliary electric power input
electric power for auxiliary machines and equipment supplied from outside the system boundary

3.1.2
background noise level
sound pressure level of ambient noise at the measurement point

Note 1 to entry: This measurement is taken as described in this standard with the fuel cell power system in the cold state.

3.1.3
background vibration level
mechanical oscillations caused by the environment that affect vibration level readings

Note 1 to entry: In this standard, background vibration is measured with the fuel cell power system in the cold state.

3.1.4
cold state
state of a fuel cell power system at ambient temperature with no power input or output

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]

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

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

Note 1 to entry: A fuel cell module is comprised of the following main components: one or more fuel cell stack(s), piping system for conveying fuels, oxidants and exhausts, electric connections for the power delivered by the stack(s) and means for monitoring and/or control. Additionally, a fuel cell module may comprise: means for conveying additional fluids (e.g. cooling media, inert gas), 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]

3.1.9
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: A fuel cell power system is composed of all or some of the systems shown in Figure 1.

3.1.10
fuel input
amount of natural gas, hydrogen, methanol, liquid petroleum gas, propane, butane, or other substance containing chemical energy introduced to the fuel cell power system during specified operating conditions

3.1.11
heat recovery efficiency
ratio of the average recovered thermal power output of a fuel cell power system to the average total power input supplied to the fuel cell power system

[SOURCE: IEC TS 62282-1:2013, 3.30.3, modified – "average recovered thermal power output" instead of "recovered heat flow"; "average total power input" instead of "total enthalpy flow"]

3.1.12
interface point
measurement point at the boundary of a fuel cell power system at which material and/or energy either enters or leaves

Note 1 to entry: This boundary is intentionally selected to accurately measure the performance of the system. If necessary, the boundary or the interface points of the fuel cell power system (Figure 1) to be assessed should be determined by agreement of the parties.

3.1.13
minimum power
minimum net electric power output at which a fuel cell power system is able to operate continuously in a stable manner

[SOURCE: IEC TS 62282-1:2013, 3.85.2, modified – "output" added, "Note 1 to entry" deleted]

3.1.14
noise level
sound pressure level produced by a fuel cell power system

Note 1 to entry: Expressed in decibels (dB) and measured at a specified distance and in all operation modes as described in this standard.

3.1.15
operating temperature
temperature at which fuel cell power system operates and is specified with a measuring point by the manufacturer

3.1.16
overall energy efficiency
ratio of total useable power output (net electrical power and recovered thermal power) to the average total power input supplied to the fuel cell power system

Note 1 to entry: The supplied total power input of the fuel should be related to lower heating value (LHV) for a better comparison with other types of energy conversion systems.

Note 2 to entry: Refer to 4.3 regarding reporting based on LHV or HHV.

[SOURCE: IEC TS 62282-1:2013, 3.30.4, modified – alternative expression "or total thermal efficiency" deleted; "power output" instead of "energy flow"; "average total power input" instead of "total enthalpy flow"]

3.1.17
oxidant input
amount of oxidant (air) input into the inside of the fuel cell module during specified operating conditions

Note 1 to entry: The oxidant is usually air, but other oxidants (e.g., oxygen) can be used.