

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



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

**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**



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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## FUEL CELL TECHNOLOGIES –

**Part 3-201: Stationary fuel cell power systems –  
Performance test methods for small fuel cell power systems**

## FOREWORD

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International Standard IEC 62282-3-201 has been prepared by IEC technical committee 105: Fuel cell technologies.

This second edition cancels and replaces the first edition published in 2013. This edition constitutes a technical revision.

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

- a) Revision of definitions
- b) Revision of symbols (Clause 4, in accordance with ISO/IEC 80000 series and ISO/IEC Directives Part 2);
- c) Revision of Figures 2, 5 and 6;
- d) Revision of test set-up (Clause 9);



- e) Revision of measurement instruments (Clause 10);
- f) Introduction of ramp-up test (14.6);
- g) Introduction of rated operation cycle efficiency (14.11);
- h) Introduction of electromagnetic compatibility (EMC) test (14.12);
- i) Revision of exhaust gas test (15.3);
- j) Introduction of typical durations of operation cycles (Annex F).

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

CDV	Report on voting
105/564/CDV	105/623/RVC

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

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

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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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- amended.

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## INTRODUCTION

This part of IEC 62282 provides consistent and repeatable test methods for the electrical, thermal and environmental performance of small stationary fuel cell power systems.

This document limits its scope to small stationary fuel cell power systems (electrical power output below 10 kW) and provides test methods specifically designed for them in detail. It is based on IEC 62282-3-200, which generally describes performance test methods that are common to all types of fuel cells.

This document is intended for manufacturers of small stationary fuel cell power systems and/or those who evaluate the performance of their systems for certification purposes.

Users of this document may selectively execute test items that are suitable for their purposes from those described in this document. This document is not intended to exclude any other methods.

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## FUEL CELL TECHNOLOGIES –

### Part 3-201: Stationary fuel cell power systems – Performance test methods for small fuel cell power systems

#### 1 Scope

This part of IEC 62282 provides test methods for the electrical, thermal and environmental performance of small stationary fuel cell power systems that meet the following criteria:

- output: rated electric power output of less than 10 kW;
- output mode: grid-connected/independent operation or stand-alone operation with single-phase AC output or 3-phase AC output not exceeding 1 000 V, or DC output not exceeding 1 500 V;

NOTE The limit of 1 000 V for alternating current comes from the definition for "low voltage" given in IEC 60050-601:1985, 601-01-26.

- operating pressure: maximum allowable working pressure of less than 0,1 MPa (gauge) for the fuel and oxidant passages;
- fuel: gaseous fuel (natural gas, liquefied petroleum gas, propane, butane, hydrogen, etc.) or liquid fuel (kerosene, methanol, etc.);
- oxidant: air.

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

This document covers fuel cell power systems whose primary purpose is the production of electric power and whose secondary purpose may be the utilization of heat. Accordingly, fuel cell power systems for which the use of heat is primary and the use of electric power is secondary are outside the scope of this document.

All systems with integrated batteries are covered by this document. This includes systems where batteries are recharged internally or recharged from an external source.

This document does not cover additional auxiliary heat generators that produce thermal energy.

#### 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.

CISPR 11, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

IEC 61000-3-2, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-6-1:2005, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*

IEC 62282-3-200:2015, *Fuel cell technologies – Part 3-200: Stationary fuel cell power systems – Performance test methods*

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### **3 Terms and definitions (standards.iteh.ai)**

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### **3.1**

##### **noise level**

sound pressure level produced by the fuel cell power system

Note 1 to entry: Expressed as decibels (dB) and measured as described in 15.2.

#### **3.2**

##### **background noise level**

sound pressure level of ambient noise at the measurement point

Note 1 to entry: This measurement is taken as described in 15.2 with the fuel cell power system in the cold state.

#### **3.3**

##### **battery**

electrochemical energy storage device that provides energy input to auxiliary machines and equipment necessary to operate the fuel cell power system and/or provides electric energy output

Note 1 to entry: Back-up batteries for control software memory and similar applications are not included.

#### **3.4**

##### **cold state**

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

[SOURCE: IEC TS 62282-1:2013, 3.110.1, modified — "ready for start-up" added.]

### 3.5

#### **mass discharge rate**

mass of discharged exhaust gas component per unit of time

### 3.6

#### **discharge water**

water that is discharged from the fuel cell power system including waste water and condensate

Note 1 to entry: Discharge water does not constitute part of a thermal recovery system.

[SOURCE: IEC TS 62282-1:2013, 2.2, modified — Note 1 to entry added.]

### 3.7

#### **electrical efficiency**

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

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

[SOURCE: IEC TS 62282-1:2013, 3.30.1, modified — "average" added to "net electric power output"; "average fuel power input" instead of "total enthalpy flow".]

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### 3.8

#### **electric energy input**

integrated value of electric power input at the electric input terminal

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### 3.9

#### **electric energy output**

integrated value of electric power output at the electric output terminal

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### 3.10

#### **electric power input**

electric power input at the electric input terminal of the fuel cell power system

### 3.11

#### **electric power output**

electric power output at the electric output terminal of the fuel cell power system

### 3.12

#### **fuel cell power system**

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

[SOURCE: IEC TS 62282-1:2013, 3.49, modified — Note 1 to entry deleted.]

### 3.13

#### **fuel input**

amount of natural gas, hydrogen, methanol, liquid petroleum gas, propane, butane, or other material containing chemical energy entering the fuel cell power system while it is working at the specified operating conditions

### 3.14

#### **fuel power input**

fuel energy input per unit of time

**3.15****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”; Note 1 to entry deleted.]

**3.16****heat recovery fluid**

fluid circulating between the fuel cell power system and a heat sink for recovering the thermal energy output

**3.17****inert purge gas**

inert gas or dilution gas, not containing chemical energy, supplied to the fuel cell power system during specific conditions to make it ready for operation or shutdown

Note 1 to entry: Dilution gas containing chemical energy shall be considered as fuel.

**3.18****integrated fuel input**

volume or mass of fuel consumed by the fuel cell power system under specified operating conditions

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**3.19****interface point**

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

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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 2) to be assessed should be determined by agreement of the parties.

[SOURCE: IEC TS 62282-1:2013, 3.65]

**3.20****mass concentration**

concentration of mass of exhaust gas component per unit of volume

**3.21****minimum electric power output**

minimum net power output, at which a fuel cell power system is able to operate continuously at a steady state

**3.22****net electric power output**

power generated by the fuel cell power system available for external use

[SOURCE: IEC TS 62282-1:2013, 3.85.3, modified — “output” added to the term, Notes 1 and 2 to entry deleted.]

**3.23****rated electric power output**

maximum continuous electric power output that a fuel cell power system is designed to achieve under normal operating conditions specified by the manufacturer

[SOURCE: IEC TS 62282-1:2013, 3.85.4, modified — “electric” and “output” added to the term, Note 1 to entry deleted.]

**3.24**  
**operation cycle**

complete sequence of successive operation phases of a fuel cell power system comprising start-up, ramp-up, rated operation and shutdown

**3.25**  
**operation cycle electrical efficiency**

ratio of the net electric energy output of a fuel cell power system to the fuel energy fed to the same fuel cell power system during a complete operation cycle comprising start-up, ramp-up, rated operation and shutdown

**3.26**  
**overall energy efficiency**

ratio of total usable power output (net electric power and recovered thermal power) to the average total power input supplied to the fuel cell power system

[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”; Note 1 to entry deleted.]

**3.27**  
**pre-generation state**

state of a fuel cell power system being at sufficient operating temperature and in such an operational mode, with zero electric power output, that the fuel cell power system is capable of being promptly switched to an operational state with substantial electric active power output

<https://standards.iteh.ai/catalog/standards/sist/1cac4eac-9acc-4c71-987c-51f1910f17/iec-62282-3-201-2017>

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[SOURCE: IEC TS 62282-1:2013, 3.110.4]

**3.28**  
**ramp-up energy**

electric and/or chemical (fuel) energy required for transitioning from positive net electric power output after start-up to rated net electric power output

**3.29**  
**ramp-up time**

duration required for transitioning from positive net electric power output after start-up to rated net electric power output

**3.30**  
**recovered heat**

thermal energy that has been recovered for useful purpose

Note 1 to entry: The recovered heat is measured by determining the temperatures and flow rates of the heat recovery fluid (water, steam, air or oil, etc.) entering and leaving the thermal energy recovery subsystem at the interface point of the fuel cell power system.

[SOURCE: IEC TS 62282-1:2013, 2.2, modified — Note 1 to entry added.]

**3.31**  
**recovered thermal power**

recovered heat per unit of time

**3.32**  
**shutdown energy**

sum of electric and/or chemical (fuel) energy required during the shutdown time