

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

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## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN 62282-3-200:2012 sisaldab Euroopa standardi EN 62282-3-200:2012 ingliskeelset teksti.	This Estonian standard EVS-EN 62282-3-200:2012 consists of the English text of the European standard EN 62282-3-200:2012.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 13.01.2012.	Date of Availability of the European standard is 13.01.2012.
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ICS 27.070

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English version

**Fuel cell technologies -  
Part 3-200: Stationary fuel cell power systems -  
Performance test methods  
(IEC 62282-3-200:2011)**

Technologies des piles à combustible -  
Partie 3-200: Systèmes à piles à  
combustible stationnaires -  
Méthodes d'essai des performances  
(CEI 62282-3-200:2011)

Brennstoffzellentechnologien -  
Teil 3-2: Stationäre Brennstoffzellen-  
Energiesysteme -  
Leistungskennwerteprüfverfahren  
(IEC 62282-3-200:2011)

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Comité Européen de Normalisation Electrotechnique  
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**Management Centre: Avenue Marnix 17, B - 1000 Brussels**

## Foreword

The text of document 105/340/FDIS, future edition 1 of IEC 62282-3-200, prepared by IEC/TC 105 "Fuel cell technologies" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62282-3-200:2012.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2012-08-23
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2014-11-23

This document supersedes EN 62282-3-2:2006.

The principal changes in EN 62282-3-200:2012 as compared with EN 62282-3-2:2006 aim to harmonize with ASME PTC-50. They are as follows:

- the equations for efficiency calculation are changed from power-base to average powerbase, which is obtained by dividing energy by test duration;
- the duration of the test and frequency of reading are changed;
- the efficiency test at partial load is no longer mandatory. Whether or not to conduct the test at partial load should be determined by the parties conducting the tests;
- the flow rate measurement method is modified. Both mass flow rate and volume flow rate are used for calculations of efficiency;
- the thermal energy input and mechanical energy input are incorporated into efficiency calculations.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

## Endorsement notice

The text of the International Standard IEC 62282-3-200:2011 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

ISO 6976:1995 + corrigendum 1:1997 + corrigendum 2:1997 + corrigendum 3:1999	NOTE Harmonized as EN ISO 6976:2005 (not modified).
ISO 8041	NOTE Harmonized as EN ISO 8041.

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60051	Series	Direct acting indicating analogue electrical measuring instruments and their accessories	EN 60051	Series
IEC 60359	-	Electrical and electronic measurement equipment - Expression of performance	EN 60359	-
IEC 60688	-	Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals	EN 60688	-
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	EN 61000-4-7	-
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	EN 61000-4-13	-
IEC 61028	-	Electrical measuring instruments - X-Y recorders	EN 61028	-
IEC 61143	Series	Electrical measuring instruments - X-t recorders	EN 61143	Series
IEC 61672-1	-	Electroacoustics - Sound level meters - Part 1: Specifications	EN 61672-1	-
IEC 61672-2	-	Electroacoustics - Sound level meters - Part 2: Pattern evaluation tests	EN 61672-2	-
IEC 62052-11	-	Electricity metering equipment (AC) - General requirements, tests and test conditions - Part 11: Metering equipment	EN 62052-11	-
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)	EN 62053-22	-
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	-	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO 3744	-	Acoustics - Determination of sound power levels of noise sources using sound pressure - Engineering method in an essentially free field over a reflecting plane	EN ISO 3744	-
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	Series	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full	EN ISO 5167	Series
ISO 5348	-	Mechanical vibration and shock - Mechanical mounting of accelerometers	-	-
ISO 6060	-	Water quality - Determination of the chemical oxygen demand	-	-
ISO 6326	Series	Natural gas - Determination of sulfur compounds	EN ISO 6326	Series
ISO 6974	Series	Natural gas - Determination of composition with defined uncertainty by gas chromatography	EN ISO 6974	Series
ISO 6975	Series	Natural gas - Extended analysis - Gas-chromatographic method	EN ISO 6975	Series
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 - Fuels (class F) - Specifications of marine fuels	-	-
ISO 9000	-	Quality management systems - Fundamentals and vocabulary	EN ISO 9000	-
ISO 9096	-	Stationary source emissions - Manual determination of mass concentration of particulate matter	-	-
ISO 10101	Series	Natural gas - Determination of water by the Karl Fischer method	EN ISO 10101	Series
ISO 10396	-	Stationary source emissions - Sampling for the automated determination of gas concentrations	-	-
ISO 10523	-	Water quality - Determination of pH	-	-
ISO 10707	-	Water quality - Evaluation in an aqueous medium of the "ultimate" aerobic biodegradability of organic compounds - Method by analysis of biochemical oxygen demand (closed bottle test)	EN ISO 10707	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO 10780	-	Stationary source emissions - Measurement of velocity and volume flow rate of gas streams in ducts	-	-
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	EN ISO 11541	-
ISO 11564	-	Stationary source emissions - Determination of the mass concentration of nitrogen oxides - Naphthylethylenediamine photometric 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	-	-
ASTM D4809-00	-	Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)	-	-
ASTM F260208e1	-	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)	-	-
ASME PTC 50	-	Performance Test Code 50 - Fuel Cell Power Systems Performance	-	-

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## 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.

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;
- electric and thermal efficiency under specified operating conditions;
- environmental characteristics; for example, gas emissions, noise, etc. under specified operating and transient conditions.

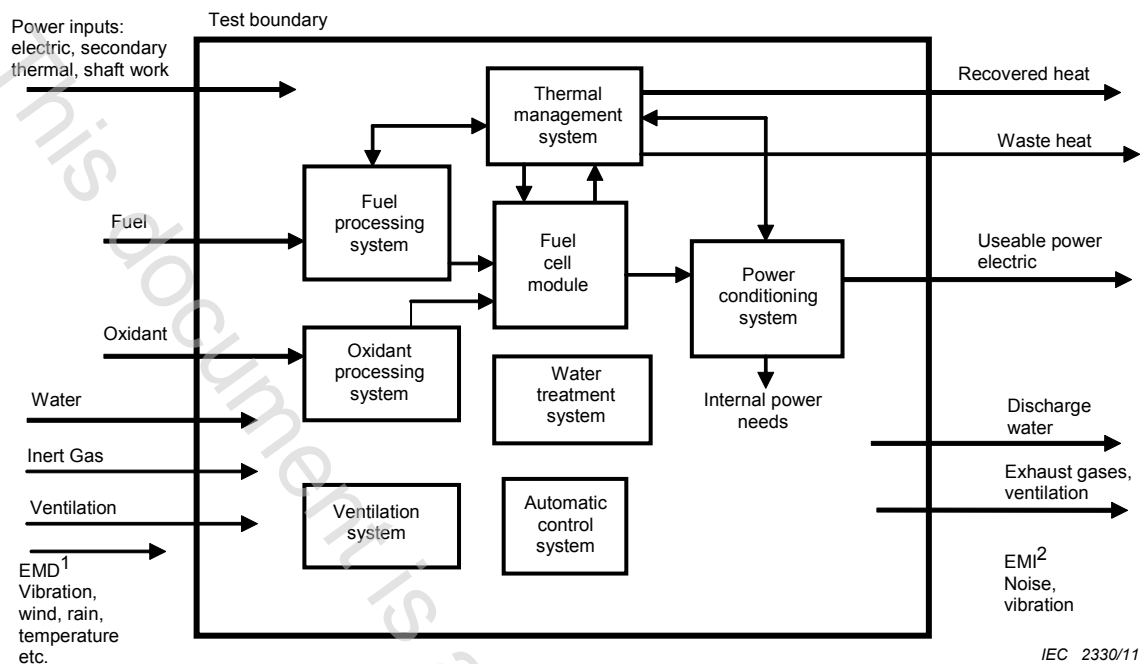
This standard does not provide coverage for electromagnetic compatibility (EMC).

This standard does not apply to small stationary fuel cell power systems with electric power output of less than 10 kW which will be dealt with in the future 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 test boundary of the fuel cell power system:

- all energy recovery systems are included within the test boundary;
- all kinds of electric energy storage devices are considered outside the test 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 referenced documents are indispensable for the application 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 equipment – Expression of performance*

IEC 60688, *Electrical measuring transducers for converting a.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)*

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 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 with defined 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 9000, *Quality management systems – Fundamentals and vocabulary*

ISO 9096, *Stationary source emissions – Manual determination of mass concentration of particulate matter*

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 concentrations for permanently installed monitoring systems*

ISO 10523, *Water quality – Determination of pH*

ISO 10707, *Water quality – Evaluation in an aqueous medium of the "ultimate" aerobic biodegradability of organic compounds – Method by analysis of biochemical oxygen demand (closed bottle test)*

ISO 10780, *Stationary source emissions – Measurement of velocity and volume flowrate of gas streams in ducts*

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 14687, *Hydrogen fuel – Product specification*

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

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

ASTM D4809-00, *Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)*

ASTM F2602-08e1, *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)*

ASME PTC 50, *Performance Test Code 50 – Fuel Cell Power Systems Performance*

### **3 Terms, definitions and symbols**

#### **3.1 Terms and definitions**

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