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Bränsleceller – Del 8-301: Energilagringssystem med bränslecellsmoduler för reversibel drift – System för produktion av metan baserade på celler med fast oxid inklusive reversibel drift – Testmetoder för prestanda

Fuel cell technologies –

Part 8-301: Energy storage systems using fuel cell modules in reverse mode –

Power to methane energy systems based on solid oxide cells including reversible operation –

Performance test methods

Som svensk standard gäller europastandarden EN IEC 62282-8-301:2023. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 62282-8-301:2023.

Nationellt förord

Europastandarden EN IEC 62282-8-301:2023

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- **IEC 62282-8-301, First edition, 2023 - Fuel cell technologies – Part 8-301: Energy storage systems using fuel cell modules in reverse mode – Power to methane energy systems based on solid oxide cells including reversible operation – Performance test methods**

utarbetad inom International Electrotechnical Commission, IEC.

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English Version

Fuel cell technologies - Part 8-301: Energy storage systems using fuel cell modules in reverse mode - Power-to-methane energy systems based on solid oxide cells including reversible operation - Performance test methods
(IEC 62282-8-301:2023)

Technologies des piles à combustible - Partie 8-301:
Systèmes de stockage de l'énergie utilisant des modules à piles à combustible en mode inversé - Systèmes de conversion de l'énergie en méthane à base de piles à oxyde solide, comprenant le fonctionnement réversible -
Méthodes d'essai des performances
(IEC 62282-8-301:2023)

Brennstoffzellentechnologien - Teil 8-301:
Energiespeichersysteme mit Brennstoffzellenmodulen im reversiblen Betrieb - Power-to-Methane-Energiesysteme auf Basis von Festoxidzellen einschließlich reversiblen Betrieb - Leistungskennwerteprüfverfahren
(IEC 62282-8-301:2023)

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European foreword

The text of document 105/968/FDIS, future edition 1 of IEC 62282-8-301, prepared by IEC/TC 105 "Fuel cell technologies" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62282-8-301:2023.

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) 2024-03-27
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-06-27

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Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 62282-8-301:2023 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 standard indicated:

IEC 62282-3-200 NOTE Approved as EN 62282-3-200

ISO 6976 NOTE Approved as EN ISO 6976

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60584-1	-	Thermocouples - Part 1: EMF specifications and tolerances	EN 60584-1	-
IEC 60584-3	-	Thermocouples - Part 3: Extension and compensating cables - Tolerances and identification system	EN IEC 60584-3	-
IEC 61515	-	Mineral insulated metal-sheathed thermocouple cables and thermocouples	EN 61515	-
IEC 62282-7-2	2021	Fuel cell technologies - Part 7-2: Test methods - Single cell and stack performance tests for solid oxide fuel cells (SOFCs)	EN IEC 62282-7-2	2021
IEC 62282-8-101	2020	Fuel cell technologies - Part 8-101: Energy storage systems using fuel cell modules in reverse mode - Test procedures for the performance of solid oxide single cells and stacks, including reversible operation	EN IEC 62282-8-101	2020
ISO 5167-1	-	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part 1: General principles and requirements	EN ISO 5167-1	-
ISO 5168	-	Measurement of fluid flow - Procedures for - the evaluation of uncertainties		-
ISO 6141	-	Gas analysis - Contents of certificates for calibration gas mixtures	EN ISO 6141	-
ISO 6142-1	-	Gas analysis - Preparation of calibration gas mixtures - Part 1: Gravimetric method for Class I mixtures	EN ISO 6142-1	-
ISO 6143	-	Gas analysis - Comparison methods for determining and checking the composition of calibration gas mixtures	EN ISO 6143	-

EN IEC 62282-8-301:2023 (E)

ISO 6145-7	-	Gas analysis - Preparation of calibration gas mixtures using dynamic methods - Part 7: Thermal mass-flow controllers	EN ISO 6145-7	-
ISO 6974	series	Natural gas - Determination of composition and associated uncertainty by gas chromatography	EN ISO 6974	series
ISO 6975	-	Natural gas - Extended analysis - Gas-chromatographic method	EN ISO 6975	-
ISO 7066-2	-	Assessment of uncertainty in the calibration and use of flow measurement devices - Part 2: Non-linear calibration relationships	-	-
ISO 8573-1	-	Compressed air - Part 1: Contaminants and purity classes	-	-
ISO 8756	-	Air quality - handling of temperature, pressure and humidity data	-	-
ISO 10101	series	Natural gas - Determination of water by the Karl Fischer method	EN ISO 10101	series
ISO 11541	-	Natural gas - Determination of water content at high pressure	EN ISO 11541	-

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fuel cell technologies –

Part 8-301: Energy storage systems using fuel cell modules in reverse mode – Power-to-methane energy systems based on solid oxide cells including reversible operation – Performance test methods

Technologies des piles à combustible –

Partie 8-301: Systèmes de stockage de l'énergie utilisant des modules à piles à combustible en mode inversé – Systèmes de conversion de l'énergie en méthane à base de piles à oxyde solide, comprenant le fonctionnement réversible – Méthodes d'essai des performances

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CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	7
3 Terms, definitions, abbreviated terms and symbols.....	8
3.1 Terms and definitions.....	8
3.2 Abbreviated terms and symbols	13
3.2.1 Abbreviated terms	13
3.2.2 Symbols	13
4 Power-to-methane system based on SOC.....	18
5 Reference conditions	19
5.1 Temperature and pressure	19
5.2 Heating value base	19
6 Instrumentation and measurement methods.....	19
6.1 General.....	19
6.2 Instrument uncertainty	20
6.3 Measurement methods.....	21
6.3.1 Measurement methods for testing the power-to-methane energy system	21
6.3.2 Measurement methods for testing components	24
7 Test methods and procedures.....	27
7.1 General.....	27
7.2 System performance tests.....	27
7.2.1 Start-up test.....	27
7.2.2 Performance tests at rated operation	28
7.2.3 Performance test at power input variation	32
7.2.4 Shutdown test.....	33
7.3 Performance test for components.....	33
7.3.1 SOC cell/stack assembly unit.....	33
7.3.2 Methanation reactor.....	42
8 Test report.....	45
8.1 General.....	45
8.2 Title page.....	45
8.3 Table of contents	45
8.4 Summary report	46
Annex A (informative) Guidelines for the contents of detailed and full reports	47
A.1 General.....	47
A.2 Detailed report	47
A.3 Full report	47
Bibliography.....	48
Figure 1 – Process schematic of the scope of IEC 62282-8-301	7
Figure 2 – Schematic of the physical interfaces of the system.....	20
Figure 3 – Testing system.....	34
Figure 4 – Test environment and interfaces between SOC cell/stack, methanation reactor and experimental set-up.....	36
Table 1 – Symbols	13

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FUEL CELL TECHNOLOGIES –

Part 8-301: Energy storage systems using fuel cell modules in reverse mode – Power-to-methane energy systems based on solid oxide cells including reversible operation – Performance test methods

FOREWORD

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IEC 62282-8-301 has been prepared by IEC technical committee 105: Fuel cell technologies. It is an International Standard.

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

Draft	Report on voting
105/968/FDIS	105/983/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,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This part of IEC 62282 describes performance evaluation methods for electric energy conversion systems based on power-to-methane systems using solid oxide cells (SOCs) and methanation reactors.

A typical application of the power-to-methane systems is an electrolytic production of methane as the energy carrier suitable for a large-scale, long-term storage and transportation.

The combustion heat of methane per mol is about three times larger than that of hydrogen. Methane is easily liquefied, which makes it suitable for storage and transportation via existing infrastructures for natural gas (tanks, pipelines, tankers, or trucks) as well as for being easily utilized by conventional equipment. Also, the use of "green methane" (produced by renewable electricity) or "carbon neutral methane" in place of "fossil methane" is a promising option in the near future.

The IEC 62282-8 series aims to develop performance test methods for power storage and buffering systems based on electrochemical modules (combining electrolysis and fuel cells, in particular reversible cells), taking into consideration both options of re-electrification and substance (and heat) production for the sustainable integration of renewable energy sources.

Under the general title "Energy storage systems using fuel cell modules in reverse mode", the IEC 62282-8 series consists of the following parts:

- IEC 62282-8-101: Test procedures for the performance of solid oxide single cells and stacks, including reversible operation
- IEC 62282-8-102: Test procedures for the performance of single cells and stacks with proton exchange membrane, including reversible operation
- IEC 62282-8-103¹: Alkaline single cell and stack performance including reversible operation
- IEC 62282-8-201²: Test procedures for the performance of power-to-power systems
- IEC 62282-8-202³: Power-to-power systems – Safety
- IEC 62282-8-3xy (all parts): Power-to-substance systems

As a priority dictated by the emerging needs for industry and the opportunities for technological development, IEC 62282-8-101, IEC 62282-8-102 and IEC 62282-8-201 were initiated jointly.

This document is the first of the IEC 62282-8-3xy series.

¹ Under consideration.

² Second edition under preparation. Stage at the time of publication: IEC CDV 62282-8-201:2023.

³ Under consideration.

FUEL CELL TECHNOLOGIES –

Part 8-301: Energy storage systems using fuel cell modules in reverse mode – Power-to-methane energy systems based on solid oxide cells including reversible operation – Performance test methods

1 Scope

This part of IEC 62282 specifies performance test methods of power-to-methane systems based on solid oxide cells (SOCs). Water, CO₂, and electricity are supplied to the system to produce methane and oxygen.

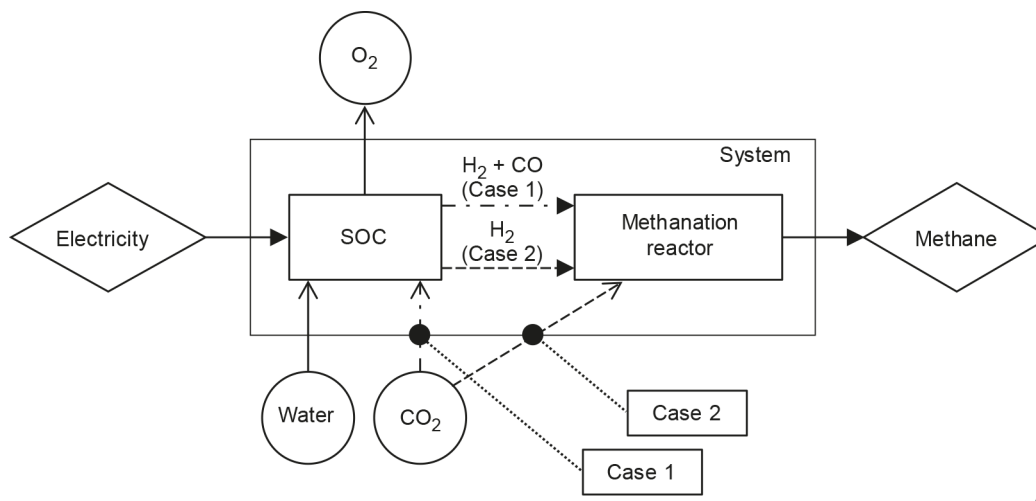
This document is not intended to be applied to solid oxide fuel cell (SOFC) cell/stack assembly units for power generation purposes only, since these are covered in IEC 62282-7-2. In addition, the test methods for SOC cell/stack assembly units including reversible operation (without any methanation reactor) are already described in IEC 62282-8-101. Users can substitute the selected test methods of this document with the equivalent test methods given in IEC 62282-8-101 (solid oxide electrolysis cell (SOEC) to produce H₂ only as well as SOFC operation mode and reversible mode) and in IEC 62282-7-2 (SOFC mode only).

This document covers two types of processes as shown in Figure 1:

- Case 1: Steam and CO₂ are introduced into the SOC (co-electrolysis process), and the product gas (mainly, H₂ + CO) is supplied to a methanation reactor (catalytic reactor);
- Case 2: Steam is introduced into the SOC to generate H₂, which is supplied into a methanation reactor with CO₂.

Besides these two cases, the methanation catalyst can be integrated within the SOC, but this case is not within the scope of this document. This document provides, for testing systems, information on instruments and specifies measurement methods to test the performance of SOC cell/stack assembly units and of the methanation reactor for energy conversion purposes. To produce CH₄ from water and CO₂, the SOC is operated in electrolysis mode (solid oxide electrolysis cell (SOEC)). The SOC can be operated either in fuel cell mode (SOFC) or in reversible operation mode or both. In this document, the system is considered not to have components which store electricity, fluids, or heat.

This document is intended to be used for data exchanges in commercial transactions between the system manufacturers and customers. Users of this document can selectively execute test items suitable for their purposes from those described in this document.



IEC

Figure 1 – Process schematic of the scope of IEC 62282-8-301

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 60584-1, *Thermocouples – Part 1: EMF specifications and tolerances*

IEC 60584-3, *Thermocouples – Part 3: Extension and compensating cables – Tolerances and identification system*

IEC 61515, *Mineral insulated metal-sheathed thermocouple cables and thermocouples*

IEC 62282-7-2:2021, *Fuel cell technologies – Part 7-2: Test methods – Single cell and stack performance tests for solid oxide fuel cells (SOFC)*

IEC 62282-8-101:2020, *Fuel cell technologies – Part 8-101: Energy storage systems using fuel cell modules in reverse mode – Test procedures for the performance of solid oxide single cells and stacks, including reversible operation*

ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full – Part 1: General principles and requirements*

ISO 5168, *Measurement of fluid flow – Procedures for the evaluation of uncertainties*

ISO 6141, *Gas analysis – Contents of certificates for calibration gas mixtures*

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ISO 6145-7, *Gas analysis – Preparation of calibration gas mixtures using dynamic methods – Part 7: Thermal mass-flow controllers*

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 7066-2, *Assessment of uncertainty in the calibration and use of flow measurement devices – Part 2: Non-linear calibration relationships*

ISO 8573-1, *Compressed air – Part 1: Contaminants and purity classes*

ISO 8756, *Air quality – Handling of temperature, pressure and humidity data*

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

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