

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 d'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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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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- withdrawn,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 –

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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.