SLOVENSKI STANDARD
oSIST prEN IEC 62282-8-301:2022

01-oktober-2022

Tehnologije gorivnih celic - 8-301. del: Sistemi za shranjevanje energije, ki uporabljajo module regenerativnih gorivnih celic - Elektroenergetski sistemi za proizvodnjo metana, ki temeljijo na členih s trdim oksidnim elektrolitom, vključno z obrnjenim delovanjem - Metode za preskušanje zmogljivosti

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

Tehnologije gorivnih celic - 8-301. del: Sistemi za shranjevanje energije, ki uporabljajo module regenerativnih gorivnih celic – Elektroenergetski sistemi za proizvodnjo metana, ki temeljijo na členih s trdim oksidnim elektrolitom - Metode za preskušanje zmogljivosti

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

Ta slovenski standard je istoveten z: **prEN IEC 62282-8-301:2022**

ICS:

27.070	Gorilne celice	Fuel cells

oSIST prEN IEC 62282-8-301:2022 **en**

105/916/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: **IEC 62282-8-301 ED1**	
DATE OF CIRCULATION: **2022-07-15**	CLOSING DATE FOR VOTING: **2022-10-07**
SUPERSEDES DOCUMENTS: **105/880/CD, 105/899A/CC**	

IEC TC 105 : FUEL CELL TECHNOLOGIES	
SECRETARIAT: Germany	SECRETARY: Mr David Urmann
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING **Attention IEC-CENELEC parallel voting** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE:

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

PROPOSED STABILITY DATE: 2026

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FUEL CELL TECHNOLOGIES –

Part 8-301: Energy storage systems using fuel cell modulesin reverse mode – Power to methane energy systemsbased 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.

a)

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

Draft	Report on voting
105/XX/FDIS	105/XX/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 http://www.iec.ch/standardsdev/publications.

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 using solid oxide cells (SOCs) and methanation reactor.

A typical targeting 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 is about three times larger than that of hydrogen. Methane is easy to be liquefied, which is suitable for storage and transportation via existing infrastructure for natural gas (tanks, pipelines, tankers, or trucks) as well as easy utilization by conventional equipment. Also, the use of “Green Methane” or “Carbon Neutral Methane” in place of “Fossil Methane” is a promising option in the near future.

IEC 62282-8 (all parts) 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 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 membranes, including reversible operation
- IEC 62282-8-103:[1] Alkaline single cell and stack performance including reversible operation
- IEC 62282-8-201:[2] Test procedures for the performance of power-to-power systems
- IEC 62282-8-202:[3] Power-to-power systems – Safety
- IEC 62282-8-300 (all parts): Power-to-substance systems

As a priority dictated by the emerging needs for industry and 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 one of the IEC62282-8-300 series.

1 Under consideration.

2 Under revision.

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 document specifies the performance test methods of the power-to-methane systems based on solid oxide cells (SOCs). Water, CO_2, and electricity are supplied to the system to produce methane and oxygen.

This document is not intended to be applied to SOFC cell/stack assembly units for power generation purposes only, since this is covered in IEC TS 62282-7-2. It is also noted that test methods for SOC cell/stack including reversible operation (without any methanation reactor) are already described in IEC 62282-8-101. Users can substitute selected test methods of this standard with equivalent test methods of IEC 62282-8-101 (SOEC to produce H_2 only as well as SOFC operation mode and reversible mode) and IEC TS 62282-7-2 (SOFC mode only).

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

- Case 1: Steam and CO_2 are introduced into SOC (co-electrolysis process), and the product gas (mainly, H_2 + CO) is supplied to a methanation reactor (catalytic reactor);
- Case 2: Steam is introduced into SOC to generate H_2, which is supplied into a methanation reactor with CO_2.

Besides two cases, the methanation catalyst can be integrated within the SOC, but it is not in the scope of the present edition of this standard. This document provides for testing systems, instruments and measuring methods to test the performance of SOC cell/stack assembly units and methanation reactor for energy conversion purposes. To produce CH_4 from water and CO_2, SOC is operated in electrolysis mode (solid oxide electrolysis cell, SOEC). SOC can be operated in fuel cell mode (solid oxide fuel cell, SOFC) and/or in reversible operation mode. In the present edition of this standard, the system is considered not to have components which store electricity, media, 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.

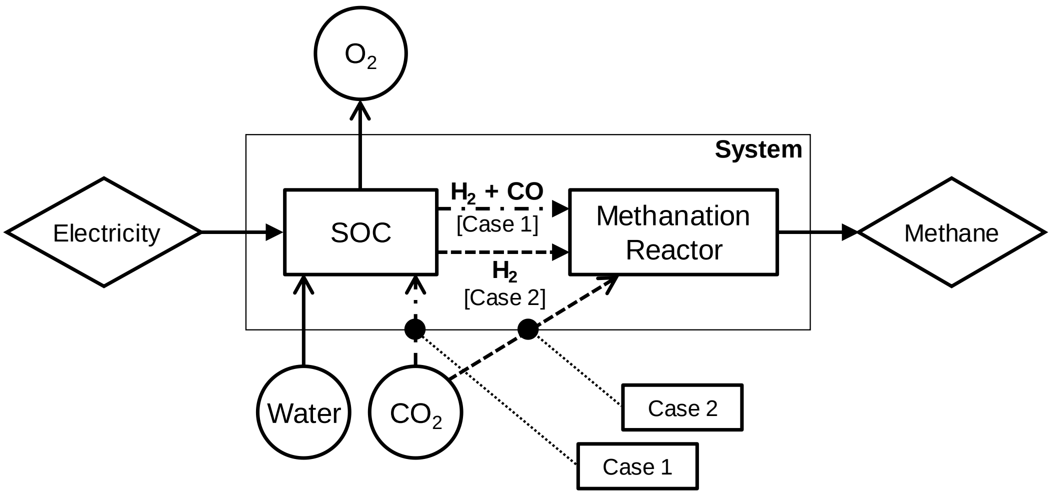

Figure 1 –Process schematic of the scope of this standard

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 60050-485, *International electrotechnical vocabulary (IEV) – Part 485: Fuel cell technologies*

IEC 60051, *Recommendations for indicating electrical measuring instruments and their accessories*

IEC 60359, *Electrical and electronic measurement equipment – Expression of performance*

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 60688, *Electrical measuring transducers for converting A.C. and D.C. electrical quantities to analogue or digital signals*

IEC 61028, *Electrical measuring instruments – X-Y recorders*

IEC 61143-1, *Electrical measuring instruments - X-t recorders - Part 1: Definitions and requirements*

IEC 61143-2, *Electrical measuring instruments - X-t recorders - Part 2: Recommended additional test methods*

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

IEC 62052-11, *Electricity metering equipment – General requirements, tests and test conditions – Part 11: Metering equipment*

IEC 62053-22, *Electricity metering equipment – Particular requirements – Part 22: Static meters for AC active energy (classes 0,1S, 0,2S and 0,5S)*

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

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

IEC 62282-8-101, *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 – Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full*

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

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

ISO 6142-1, *Gas analysis – Preparation of calibration gas mixtures –Gravimetric method for Class I mixtures*

ISO 6143, *Gas analysis – Comparison methods for determining and checking the composition of calibration gas mixtures*

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 with defined uncertainty by gas chromatography*

ISO 6975, *Natural gas – Extended analysis – Gas-chromatographic method*

ISO 6976, *Natural gas – Calculation of calorific values, density, relative density and Wobbe indices from composition*

ISO/TR 7066-1, *Assessment of uncertainty in calibration and use of flow measurement devices – Part 1: Linear calibration relationships*

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 10101-1, *Natural gas — Determination of water by the karl fischer method — Part 1: Introduction*

ISO 10101-2, *Natural gas — Determination of water by the karl fischer method — Part 2: Titration procedure*

ISO 10101-3, *Natural gas — Determination of water by the karl fischer method — Part 3: Coulometric procedure*

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

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

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

3.1.1
active electrode area
effective electrode area
geometric area of the electrode where the electrochemical reaction takes place

Note 1 to entry: Usually this corresponds to the smaller of the two areas of negative electrode or positive electrode.

Note 2 to entry: Area perpendicular to the ionic current flow, usually expressed in m^2 or cm^2.

[SOURCE: IEC 62282-8-101:2020, 3.1.1]

3.1.2
additional gas
gas added to the product gas from the negative electrode for the reaction in the methanation reactor

Note 1 to entry: For case 2 in Figure 1, the additional gas is CO_2.

Note 2 to entry: For case 1 in Figure 1 (co-electrolysis mode), CO_2 and/or H_2 can be added to convert the product gas from the negative electrode into CH_4 efficiently.

3.1.3
area-specific resistance
ASR
internal resistivity of any component of a cell or a stack, including the change of potential due to the electrochemical reaction

Note 1 to entry: It is normalized by the active electrode area and is expressed in $\Omega \cdot m^2$, $\Omega \cdot cm^2$.

[SOURCE: IEC 62282-8-101:2020, 3.1.2]

3.1.4
catalyst

substance that accelerates a reaction without being consumed itself

[SOURCE: IEC 60050-485:2020, 485-01-01, modified – “electrochemical reaction” is replaced by “reaction”, and Note 1 and Note 2 deleted.]

3.1.5
cell
single cell

basic unit of a solid oxide cell

[SOURCE: IEC 62282-8-101:2020, 3.1.6]

3.2

3.2.1
cold state

state of a power to methane system at ambient temperature with no power input or output

NOTE: The storage state may follow the cold state.

[SOURCE: IEC 60050-485:2020, 485-21-01, modified – “fuel cell power system” is replaced by “power to methane system”.]

3.2.2
compression force
axial load
compressive load applied to the single cell or the end plates of a planar SOC stack to ensure electric contact and/or gas tightness

Note 1 to entry: The compression force is in practice expressed in N

[SOURCE: IEC 62282-8-101:2020, 3.1.7]

3.2.3
conditioning
preliminary step of treatment that is required to properly operate a SOC and is usually realized by following a protocol specified by the manufacturer

[SOURCE: IEC 60050-485:2020, 485-11-08, modified – “of treatment” added and “fuel cell” replaced by “SOC” and "to achieve a desired performance" replaced by “and is usually realized”.]

3.2.4
contact layer
layer applied between the interconnect and the cell to minimize the contact resistance

[SOURCE: IEC 62282-8-101:2020, 3.1.9]

3.2.5
conversion of carbon dioxide
catalytic conversion percentage of carbon dioxide into methane in the methanation reactor

3.2.6
current collector
electronically conductive material in a cell/stack assembly unit that collects/conducts electrons from/to the electrodes

[SOURCE: IEC 60050-485:2020, 485-06-07, modified – "electronically" added, "fuel cell" replaced by "cell/stack assembly unit", and "anode/cathode" replaced by "electrodes".]

3.2.7
current density
current per unit active area of the electrode

Note 1 to entry: The current density is expressed in A/m^2 or A/cm^2.

[SOURCE: IEC 60050-485:2020, 485-12-01, modified –"of the electrode" added.]

3.2.8
derived quantities
quantities that can be derived or calculated from test input parameters, and/or test output parameters (e.g. current density, reactant utilization, electric efficiency)

[SOURCE: IEC 62282-8-101:2020, 3.1.12, modified – Note 1 deleted.]

3.2.9
electrode gas
gas present at the positive or negative electrode

Note 1 to entry: Electrode gases can be reactants, products or inert gas.

[SOURCE: IEC 62282-8-101:2020, 3.1.14]

3.2.10
interconnector
interconnect
electronically conductive and gas-tight component connecting single cells in a stack

[SOURCE: IEC 60050-485:2020, 485-06-05, modified – "electronically" added.]

3.2.11
methanation reactor
catalytic reactor which converts CO_2, CO, and H_2 into CH_4

3.2.12
minimum voltage
lowest cell/stack assembly unit voltage specified by the manufacturer

Note 1 to entry: Minimum voltage is expressed in V.

[SOURCE: IEC 62282-8-101:2020, 3.1.17]

3.2.13
maximum voltage
highest cell/stack assembly unit voltage specified by the manufacturer

Note 1 to entry: Maximum voltage is expressed in V.

[SOURCE: IEC 62282-8-101:2020, 3.1.18]

3.2.14
negative electrode
electrode at which fuel (reductant) gas is consumed or produced