

# INTERNATIONAL STANDARD

Fuel cell technologies –  
Part 7-2: Test methods – Single cell and stack performance tests for solid oxide  
fuel cells (SOFCs)

## Document Preview

IEC 62282-7-2:2025

<https://standards.iteh.ai/catalog/standards/iec/df930d75-34e3-41df-b2cc-3d7e4c8fa19c/iec-62282-7-2-2025>



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2025 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

#### IEC publications search - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

#### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

#### IEC Products & Services Portal - [products.iec.ch](http://products.iec.ch)

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

International  
Standards  
Document Preview

[IEC 62282-7-2:2025](https://standards.iteh.ai/catalog/standards/iec/df930d75-34e3-41df-b2cc-3d7e4c8fa19c/iec-62282-7-2-2025)

<https://standards.iteh.ai/catalog/standards/iec/df930d75-34e3-41df-b2cc-3d7e4c8fa19c/iec-62282-7-2-2025>



IEC 62282-7-2

Edition 2.0 2025-03  
REDLINE VERSION

# INTERNATIONAL STANDARD

---

Fuel cell technologies – iTeh Standards  
Part 7-2: Test methods – Single cell and stack performance tests for solid oxide  
fuel cells (SOFCs) (<https://standards.iteh.ai>)

Document Preview

[IEC 62282-7-2:2025](https://standards.iteh.ai/catalog/standards/iec/df930d75-34e3-41df-b2cc-3d7e4c8fa19c/iec-62282-7-2-2025)

<https://standards.iteh.ai/catalog/standards/iec/df930d75-34e3-41df-b2cc-3d7e4c8fa19c/iec-62282-7-2-2025>

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

ICS 27.070

ISBN 978-2-8327-0306-9

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

|                                                                    |    |
|--------------------------------------------------------------------|----|
| FOREWORD.....                                                      | 5  |
| INTRODUCTION.....                                                  | 2  |
| 1 Scope.....                                                       | 8  |
| 2 Normative references .....                                       | 8  |
| 3 Terms, definitions and symbols.....                              | 9  |
| 3.1 Terms and definitions.....                                     | 9  |
| 3.2 Symbols.....                                                   | 11 |
| 4 General safety conditions .....                                  | 12 |
| 5 Cell/stack assembly unit .....                                   | 13 |
| 6 Testing system .....                                             | 13 |
| 6.1 Subsystems in testing system .....                             | 13 |
| 6.1.1 General .....                                                | 13 |
| 6.1.2 Anode gas control subsystem .....                            | 14 |
| 6.1.3 Cathode gas control subsystem .....                          | 14 |
| 6.1.4 Cell/stack assembly unit temperature control subsystem ..... | 14 |
| 6.1.5 Output power control subsystem.....                          | 14 |
| 6.1.6 Measurement and data acquisition subsystem .....             | 15 |
| 6.1.7 Safety subsystem.....                                        | 15 |
| 6.1.8 Mechanical load control subsystem.....                       | 15 |
| 6.1.9 Gas pressure control subsystem for anode and cathode.....    | 15 |
| 6.1.10 Test system control subsystem.....                          | 15 |
| 6.2 Maximum variation in test items of testing system .....        | 15 |
| 7 Instruments and measurement methods .....                        | 16 |
| 7.1 General.....                                                   | 16 |
| 7.2 Instrument uncertainty .....                                   | 16 |
| 7.3 Anode gas .....                                                | 16 |
| 7.3.1 Anode gas flow rate .....                                    | 16 |
| 7.3.2 Anode gas composition.....                                   | 16 |
| 7.3.3 Anode gas temperature .....                                  | 17 |
| 7.3.4 Anode gas pressure.....                                      | 18 |
| 7.3.5 Anode exhaust gas flow rate.....                             | 18 |
| 7.3.6 Anode exhaust gas component .....                            | 18 |
| 7.3.7 Anode exhaust gas temperature .....                          | 18 |
| 7.3.8 Anode exhaust gas pressure.....                              | 18 |
| 7.4 Cathode gas .....                                              | 19 |
| 7.4.1 Cathode gas flow rate.....                                   | 19 |
| 7.4.2 Cathode gas component .....                                  | 19 |
| 7.4.3 Cathode gas temperature .....                                | 19 |
| 7.4.4 Cathode gas pressure.....                                    | 19 |
| 7.4.5 Cathode exhaust gas flow rate.....                           | 19 |
| 7.4.6 Cathode exhaust gas component.....                           | 20 |
| 7.4.7 Cathode exhaust gas temperature .....                        | 20 |
| 7.4.8 Cathode exhaust gas pressure .....                           | 20 |
| 7.5 Output voltage .....                                           | 20 |
| 7.6 Output current.....                                            | 20 |
| 7.7 Cell/stack assembly unit temperature.....                      | 20 |

|        |                                                              |    |
|--------|--------------------------------------------------------------|----|
| 7.8    | Mechanical load .....                                        | 20 |
| 7.9    | Total impedance .....                                        | 21 |
| 7.10   | Ambient conditions .....                                     | 21 |
| 8      | Test preparation .....                                       | 21 |
| 8.1    | General .....                                                | 21 |
| 8.2    | Standard test conditions and test range .....                | 21 |
| 8.3    | Components and impurities of anode gas and cathode gas ..... | 22 |
| 8.4    | Basis of the test procedure .....                            | 22 |
| 8.5    | Confirmation of aging conditions of unit .....               | 22 |
| 8.6    | Confirmation of criteria of stable state .....               | 22 |
| 8.7    | Data acquisition method .....                                | 22 |
| 9      | Test procedure .....                                         | 23 |
| 9.1    | Set-up .....                                                 | 23 |
| 9.2    | Initial conditioning .....                                   | 23 |
| 9.3    | Shutdown .....                                               | 23 |
| 10     | Performance test .....                                       | 23 |
| 10.1   | Rated power test .....                                       | 23 |
| 10.1.1 | Objective .....                                              | 23 |
| 10.1.2 | Test method .....                                            | 24 |
| 10.1.3 | Presentation of results .....                                | 24 |
| 10.2   | Current-voltage characteristics test .....                   | 24 |
| 10.2.1 | Objective .....                                              | 24 |
| 10.2.2 | Test method .....                                            | 24 |
| 10.2.3 | Presentation of results .....                                | 25 |
| 10.3   | Effective fuel utilization dependency test .....             | 25 |
| 10.3.1 | Objective .....                                              | 25 |
| 10.3.2 | Test method .....                                            | 25 |
| 10.3.3 | Presentation of results .....                                | 26 |
| 10.4   | Long term durability test .....                              | 26 |
| 10.4.1 | Objective .....                                              | 26 |
| 10.4.2 | Test method .....                                            | 26 |
| 10.4.3 | Presentation of results .....                                | 27 |
| 10.5   | Thermal cycling durability test .....                        | 27 |
| 10.5.1 | Objective .....                                              | 27 |
| 10.5.2 | Test method .....                                            | 27 |
| 10.5.3 | Presentation of results .....                                | 28 |
| 10.6   | Internal reforming performance test .....                    | 28 |
| 10.6.1 | Objective .....                                              | 28 |
| 10.6.2 | Test method .....                                            | 28 |
| 10.6.3 | Presentation of results .....                                | 29 |
| 10.7   | Resistance components identification test .....              | 29 |
| 10.7.1 | Objective .....                                              | 29 |
| 10.7.2 | Test method .....                                            | 29 |
| 10.7.3 | Presentation of results .....                                | 30 |
| 11     | Test report .....                                            | 31 |
| 11.1   | General .....                                                | 31 |
| 11.2   | Report items .....                                           | 31 |
| 11.3   | Test unit data description .....                             | 32 |

|                                                                                                            |                                                                               |    |
|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----|
| 11.4                                                                                                       | Test conditions description.....                                              | 32 |
| 11.5                                                                                                       | Test data description .....                                                   | 32 |
| 11.6                                                                                                       | Uncertainty evaluation .....                                                  | 32 |
| Annex A (informative) Example of cell assembly unit .....                                                  |                                                                               | 33 |
| Annex B (informative) Calculation of effective fuel utilization .....                                      |                                                                               | 34 |
| B.1                                                                                                        | General.....                                                                  | 34 |
| B.2                                                                                                        | Calculation method .....                                                      | 34 |
| B.3                                                                                                        | Calculation examples.....                                                     | 36 |
| B.3.1                                                                                                      | Calculation from anode gas composition and flow rate.....                     | 36 |
| B.3.2                                                                                                      | Calculation from supplied H <sub>2</sub> and H <sub>2</sub> O flow rate ..... | 36 |
| Annex C (informative) Calculation of effective oxygen utilization.....                                     |                                                                               | 37 |
| C.1                                                                                                        | General.....                                                                  | 37 |
| C.2                                                                                                        | Calculation method .....                                                      | 37 |
| C.3                                                                                                        | Calculation example.....                                                      | 38 |
| Annex D (informative) Maximum width of the voltage hysteresis in <i>I-V</i> characteristics test .....     |                                                                               | 39 |
| Annex E (informative) Current-voltage characteristics test under constant effective fuel utilization ..... |                                                                               | 40 |
| Annex F (informative) Test report (template).....                                                          |                                                                               | 41 |
| F.1                                                                                                        | Overview.....                                                                 | 41 |
| F.2                                                                                                        | General information .....                                                     | 41 |
| F.3                                                                                                        | Test unit data description.....                                               | 41 |
| F.4                                                                                                        | Test conditions .....                                                         | 42 |
| F.5                                                                                                        | Rated power test.....                                                         | 42 |
| F.6                                                                                                        | Current-voltage characteristics test.....                                     | 42 |
| F.7                                                                                                        | Effective fuel utilization dependency test .....                              | 43 |
| F.8                                                                                                        | Long-term durability test .....                                               | 44 |
| F.9                                                                                                        | Thermal cycling durability test.....                                          | 45 |
| F.10                                                                                                       | Internal reforming performance test .....                                     | 46 |
| F.11                                                                                                       | Resistance components identification test.....                                | 46 |
| Annex G (informative) Method for determining instrument expanded uncertainty.....                          |                                                                               | 47 |
| Bibliography.....                                                                                          |                                                                               | 49 |

|                                |    |
|--------------------------------|----|
| Figure 1 – Testing system..... | 14 |
|--------------------------------|----|

|                                                                    |    |
|--------------------------------------------------------------------|----|
| Figure 2 – Typical diagram of complex impedance plot for SOFC..... | 31 |
|--------------------------------------------------------------------|----|

|                                                 |    |
|-------------------------------------------------|----|
| Figure A.1 – Example of cell assembly unit..... | 33 |
|-------------------------------------------------|----|

|                                                                                               |    |
|-----------------------------------------------------------------------------------------------|----|
| Figure D.1 – Voltage hysteresis at a given sweep rate in <i>I-V</i> characteristics test..... | 39 |
|-----------------------------------------------------------------------------------------------|----|

|                                                                                                                                                           |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Figure E.1 – Example of the record in current-voltage characteristics test under constant effective fuel utilization at increasing steps in current ..... | 40 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----|

|                         |    |
|-------------------------|----|
| Table 1 – Symbols ..... | 12 |
|-------------------------|----|

|                                                  |    |
|--------------------------------------------------|----|
| Table B.1 – $n_j$ for representative fuels ..... | 35 |
|--------------------------------------------------|----|

|                                                                                                 |    |
|-------------------------------------------------------------------------------------------------|----|
| Table B.2 – Anode gas composition, flow rate of each fuel component $q_j$ , and $n_j q_j$ ..... | 36 |
|-------------------------------------------------------------------------------------------------|----|

|                                                                         |    |
|-------------------------------------------------------------------------|----|
| Table C.1 – Cathode gas composition, $q_{O_2}$ , and $I_{theory}$ ..... | 38 |
|-------------------------------------------------------------------------|----|

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## FUEL CELL TECHNOLOGIES –

**Part 7-2: Test methods – Single cell and stack performance tests  
for solid oxide fuel cells (SOFCs)**

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

**This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 62282-7-2:2021. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.**