IEC 62282-4-202

Edition 1.0 2023-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fuel cell technologies –
Part 4-202: Fuel cell power systems for propulsion and auxiliary power units – Unmanned aircrafts – Performance test methods

Technologies des piles à combustibles –
Partie 4-202: Systèmes à piles à combustible pour les groupes auxiliaires de puissance et de propulsion – Aéronefs sans pilote – Méthodes d'essai des performances

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IEC 62282-4-202:2023-10(en-fr)

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FUEL CELL TECHNOLOGIES –

Part 4-202: Fuel cell power systems for propulsion and auxiliary power units – Unmanned aircrafts – Performance test methods

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IEC 62282-4-202 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
105/998/FDIS	105/1009/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

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INTRODUCTION

This part of IEC 62282-4 provides consistent and repeatable test methods for the electrical, thermal and environmental performance of fuel cell power systems for unmanned aircrafts.

The IEC 62282-4 series deals with the safety, performance, and interchangeability of fuel cell power systems for propulsion for categories of vehicles other than road vehicles and for auxiliary power units (APUs). Among the categories covered by the IEC 62282-4 series, this document focuses on fuel cell power systems for unmanned aircrafts because there is an urgent demand for such an application in the world.

This part of IEC 62282-4 describes type tests and their test methods only. No routine tests are required or identified, and no performance targets are set in this document.

The purpose of this document is to evaluate the fuel cell system in the various combinations of fuel cell and unmanned aircrafts. This document provides a framework for designing and evaluating a fuel cell system for use specifically in an unmanned aircraft.

This part of IEC 62282-4 can be used by manufacturers of fuel cell power systems used for unmanned aircrafts or those who evaluate the performance of their systems for certification purposes.

Users of this document selectively execute test items that are suitable for their purposes from those described in this document. This document is not intended to exclude any other methods.

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FUEL CELL TECHNOLOGIES –

Part 4-202: Fuel cell power systems for propulsion and auxiliary power units – Unmanned aircrafts – Performance test methods

1 Scope

This part of IEC 62282 covers performance test methods of fuel cell power systems intended to be used to power unmanned aircrafts, including general requirements, start-up, shutdown, power output, continuous running time, electric efficiency, data transmission, warning and monitoring, environmental compatibility, etc.

The scope of this document is limited to electrically powered unmanned aircrafts with a maximum take-off mass not exceeding 150 kg (i.e. level 5 or lower unmanned aircrafts (UAs)).

This document applies to fuel cell power systems with a rated output voltage not exceeding 220 V DC for outdoor use.

This document applies only to compressed gaseous hydrogen-fuelled fuel cell power systems.

This document does not apply to reformer-equipped fuel cell power systems.

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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.

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IEC 60050-485, *International Electrotechnical Vocabulary (IEV) – Part 485: Fuel cell technologies,* available at http://www.electropedia.org

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-485 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
unmanned aircraft
unmanned aerial vehicle
remotely-piloted aircraft
UA
UAV
RPA
aircraft without a human pilot aboard with its flight being controlled either autonomously by onboard control systems or by the remote control of a pilot on the ground

[SOURCE: ISO 21384-4:2020, 3.67 and 3.79, modified – The terms are listed under a single entry as equivalent terms and the definition has been adapted for the purposes of this document and to add clarity.]

3.2
fuel cell power system for UA
fuel cell power system onboard a UA that provides electric power for propulsion and non-propulsion needs of the UA during its flight

3.3
start-up time
time duration from the moment a signal is sent out or an action is taken to start up the fuel cell power system to the moment the fuel cell power system is able to provide net electric power output

[SOURCE: IEC 60050-485:2020, 485-20-05, modified – The definition has been adapted for the purposes of this document and to add clarity.]

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3.4
shutdown time
time duration from the moment a signal is sent out or an action is taken to shut down the fuel cell power system to the moment the fuel cell power system shuts down completely

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[SOURCE: IEC 60050-485:2020, 485-20-04, modified – The definition has been adapted for the purposes of this document and to add clarity.]

3.5
rated power output
maximum continuous DC power output of the fuel cell power system when operated under normal conditions specified by the fuel cell power system manufacturer

Note 1 to entry: A continuous running duration of the fuel cell power system at rated power output can be agreed upon by the related parties.

3.6
peak power output
maximum DC power output of the fuel cell power system that can last for a short time

Note 1 to entry: It is recommended that the time duration be more than 2 min.

Note 2 to entry: The time duration can also be agreed upon by the related parties based on actual situations.

3.7
output voltage range
under the normal operational conditions specified by the fuel cell power system manufacturer, range from the lowest output voltage to the highest output voltage of the fuel cell power system in the entire process from start-up, to operation, to shutdown

Note 1 to entry: It is important that the DC output voltage of the fuel cell power system is always within the input voltage range of the DC/DC or DC/AC converter or the electronic speed controller (ESC) used on the UA by the UA manufacturer.

3.8
continuous running duration
under the normal operational conditions specified by the fuel cell power system manufacturer, time duration the fuel cell power system can last at the rated power output with its output voltage within the output voltage range described in 3.7

Note 1 to entry: The DC/DC or DC/AC converter or the electronic speed controller used on the UA can either be damaged or not function effectively when the output DC voltage from the fuel cell power system is out of the input voltage range of the DC/DC or DC/AC converter or the electronic speed controller.

3.9
H_2 management subsystem
combination of all the parts, apparatus, devices, pipes, connectors and controls that is responsible for sending hydrogen from the H_2 storage vessel to the fuel cell module

Note 1 to entry: The fuel management subsystem can include all or part of the following: stop valve, filter, electromagnetic valve, pressure regulator, fusible valve, excess flow valve, pressure release valve, unidirectional valve, ejector, recirculation pump, pressure sensor, temperature sensor, pressure gauge, flowmeter, controls.

Note 2 to entry: The hydrogen storage vessel is not included in the H_2 management subsystem. Parts that accompany the hydrogen storage vessel to be supplied to the fuel cell power system manufacturer can be considered not the responsibility of the fuel cell power system manufacturer.

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3.10
H_2 leakage rate
ratio of the amount of hydrogen leaking out of the fuel cell power system to the amount of hydrogen theoretically required by the fuel cell power system at the rated power output

3.11
power management subsystem
device or system that manages the DC power from both the fuel cell module and the energy storage subsystem, sends unregulated main DC power to the UA's propulsion system, and sends either regulated or unregulated minor DC or AC power to the power consuming devices within the fuel cell power system for the internal power needs

4 Fuel cell power system requirements for UAs

4.1 System configuration

Figure 1 illustrates the general fuel cell power system configuration pertaining to this document, and shows the system boundary and physical items entering and leaving the system.

The fuel cell power system can contain part or all of the subsystems.

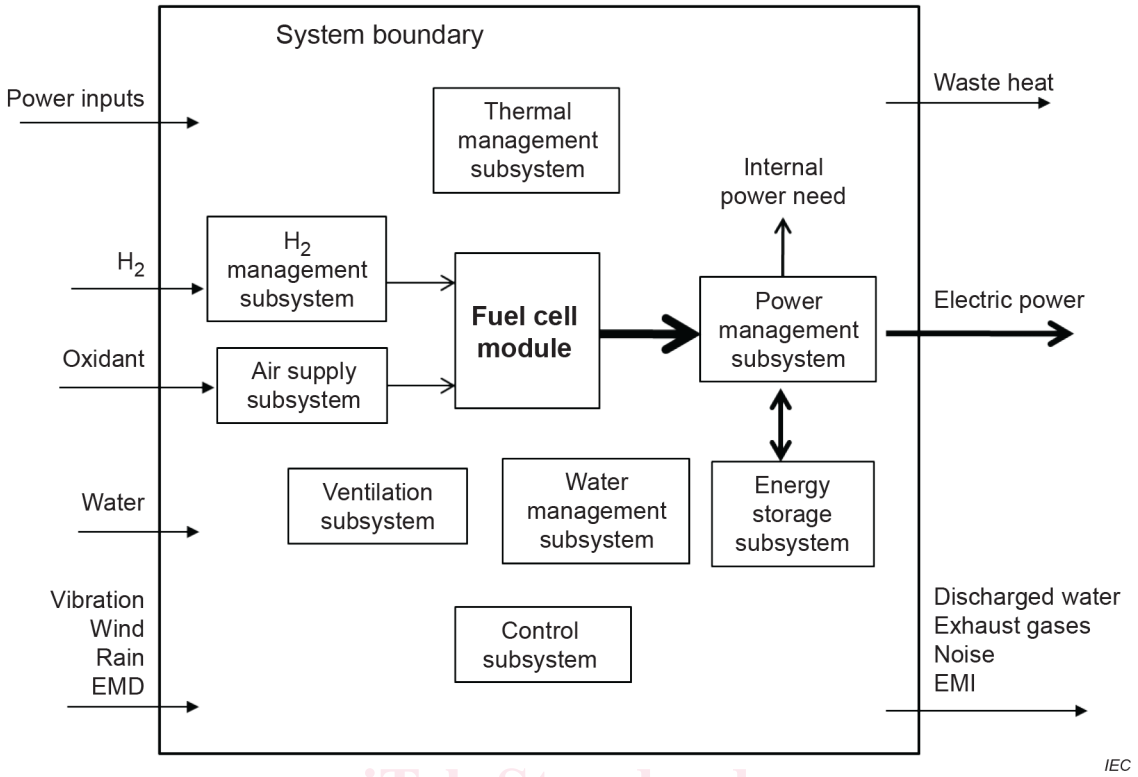

Figure 1 – General configuration of a fuel cell power system for UAs

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The power management subsystem provides unregulated DC power to the DC/DC or DC/AC converter or the electronic speed controller provided by the UA manufacturer. In other words, any device that is required to regulate the main DC power from the fuel cell power system to propel the UA is not part of the fuel cell power system in this document. However, the power management subsystem provides unregulated or regulated DC or AC power for the internal power need of the fuel cell power system.

4.2 Appearance and structure

1) The appearance of the fuel cell power system shall show no signs of mechanical damage, cracks, dents, rust, and obvious deformation.
2) There shall be no sharp edges and corners that can cause injury to human beings.
3) During the normal operation of the fuel cell power system, parts, modules, subsystems, and connections within the system shall be sturdy and reliable, without loss of stability, deformation, breaking and abrasion.
4) The communications connection ports, the power connection ports, the user interfaces, and the hydrogen inlet and outlet ports of the fuel cell power system shall be labelled clearly.
5) The positive voltage terminal and the negative voltage terminal of the fuel cell power system shall be labelled clearly.

4.3 General technical requirements

1) The fuel cell power system shall be operational under the following environment conditions: temperature: −5 °C to 40 °C; pressure: 86 kPa to 106 kPa, relative humidity: ≥ 60 %.
2) The fuel cell power system shall be able to provide enough electric power to the propulsion system, ancillaries, payload, etc. of the UA from take-off to landing during normal flights.
3) The fuel cell power system itself or the communications system of the UA shall be able to communicate with the ground control system, and provide information on the fuel cell system's state-of-health, remaining fuel, battery's voltage, alarm conditions, etc., provided the tele-message transmission is under normal conditions.