

# PUBLICLY AVAILABLE SPECIFICATION

## PRE-STANDARD



Fuel cell technologies – **STANDARD PREVIEW**  
Part 6-150: Micro fuel cell power systems – Safety – Water reactive (UN Division  
4.3) compounds in indirect PEM fuel cells  
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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## FUEL CELL TECHNOLOGIES –

**Part 6-150: Micro fuel cell power systems – Safety –  
Water reactive (UN Division 4.3) compounds in indirect PEM fuel cells**

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IEC-PAS 62282-6-150 has been processed by IEC technical committee 105: Fuel cell technologies.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft PAS	Report on voting
105/309/PAS	105/321/RVD

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## FUEL CELL TECHNOLOGIES –

### Part 6-150: Micro fuel cell power systems – Safety – Water reactive (UN Division 4.3) compounds in indirect PEM fuel cells

#### 1 Scope

##### 1.1 General

- a) This consumer safety PAS covers micro fuel cell power systems using hydrogen produced from the reaction of an aqueous solution with solid UN Division 4.3 (water-reactive) compounds in indirect PEM fuel cell systems that are wearable or easily carried by hand, providing d.c. outputs that do not exceed 60 V d.c. and power outputs that do not exceed 240 VA. Portable fuel cell power systems that provide output levels that exceed these electrical limits are covered by IEC 62282-5-1.
- b) Externally accessible circuitry is therefore considered to be safety extra low voltage (SELV) circuitry as defined in IEC 60950-1:2005, and as limited power circuits if further compliance with 2.5 of IEC 60950-1:2005 is demonstrated. Micro fuel cell power systems or units that have internal circuitry exceeding 60 V d.c. or 240 VA should be appropriately evaluated in accordance with the separate criteria of IEC 60950-1:2005.
- c) This consumer safety PAS establishes requirements for micro fuel cell power systems, micro fuel cell power units and fuel cartridges using hydrogen produced from the reaction of an aqueous solution with solid UN Division 4.3 (water-reactive) compounds for use in indirect PEM fuel cell systems to ensure a reasonable degree of safety for normal use, reasonably foreseeable misuse, and consumer transportation of such items. The fuel cartridges covered by this PAS are not intended to be refilled by the consumer. Fuel cartridges refilled by the manufacturer or by trained technicians shall meet all requirements of this PAS.
- d) These products are not intended for use in hazardous areas as defined by IEC 60079-10-1.

##### 1.2 Fuels and technologies covered

- a) This PAS covers micro fuel cell power systems, micro fuel cell power units and fuel cartridges using hydrogen produced from the reaction of an aqueous solution with solid UN Division 4.3 (water reactive) solid compounds as fuel. These systems and units use polymer electrolyte membrane fuel cell technologies. The designs may include fuel processing subsystems to derive hydrogen gas from the water-reactive solid fuel.
- b) Micro fuel cell power system block diagrams for covered systems are shown in Figures 1.1 and 1.2.
- c) All portions of this PAS apply to micro fuel cell power systems, micro fuel cell power units and fuel cartridges as defined in 1.1 above.

Clauses 1 through 7 of this PAS parallel the general safety requirements given in IEC 62282-6-100, considered relevant to micro fuel cell systems of all types and further includes requirements specific to water reactive solid fuels as included in Annex F of IEC 62282-6-100:2010.

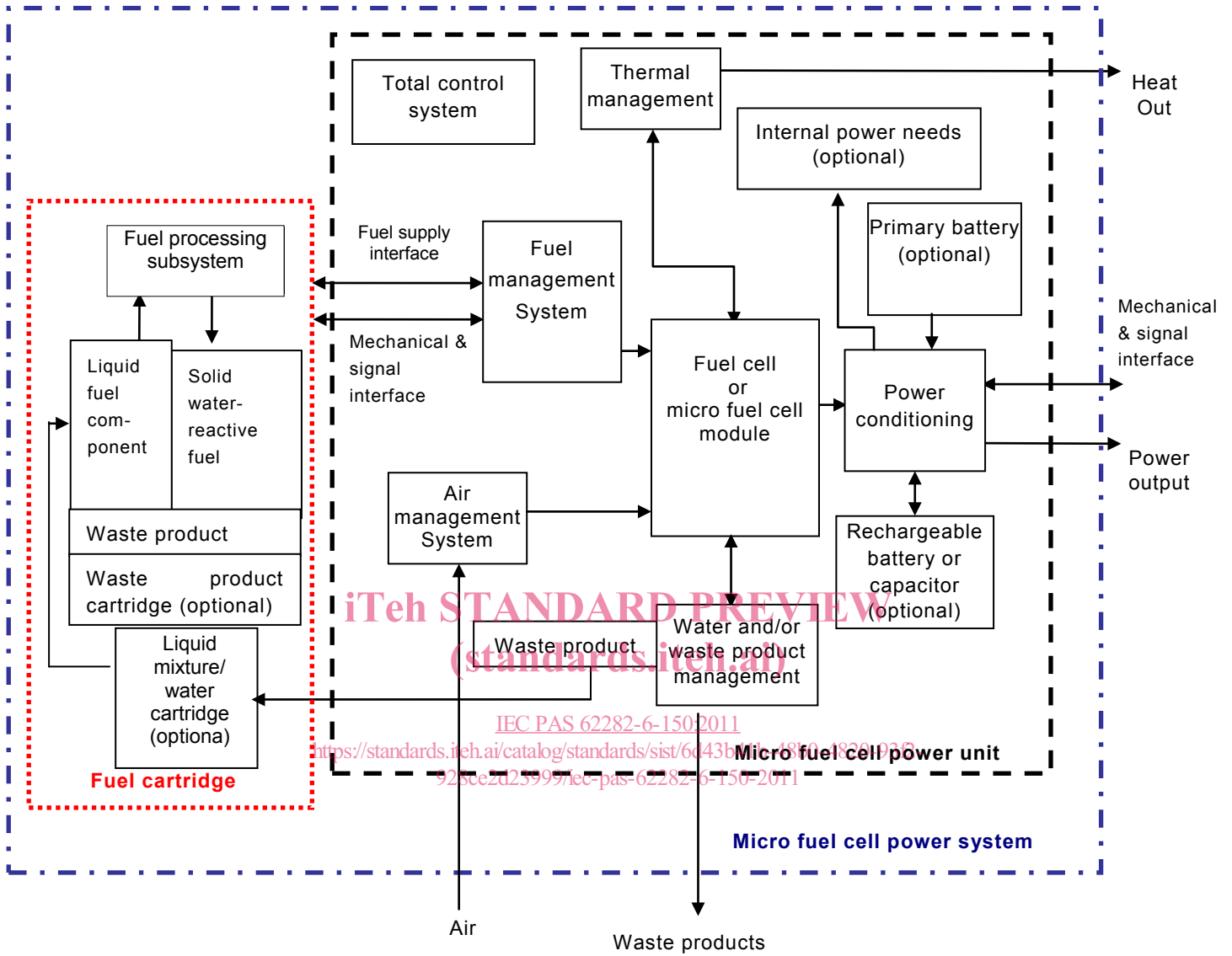
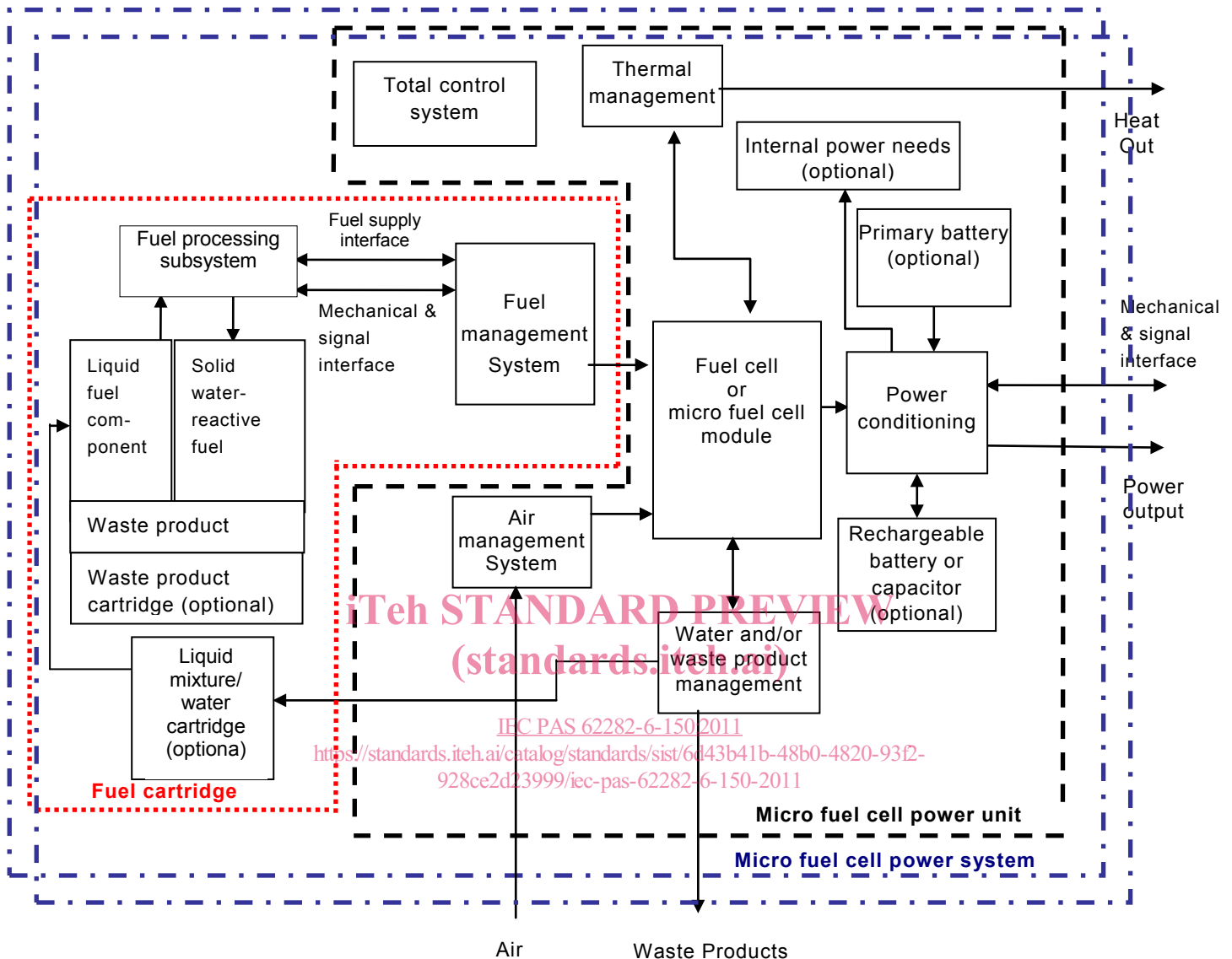


Figure 1.1 – Micro fuel cell power system block diagram for UN Division 4.3 (water reactive) compound fuel in indirect PEM fuel cell system – Fuel management system in micro fuel cell power unit



**Figure 1.2 – Micro fuel cell power system block diagram for UN Division 4.3 (water reactive) compound fuel in indirect PEM fuel cell system – Fuel management system in fuel cartridge**

### 1.3 Equivalent level of safety

- The requirements of this PAS are not intended to constrain innovation. The manufacturer may consider fuels, materials, designs or constructions not specifically dealt with in this PAS. These alternatives should be evaluated as to their ability to yield levels of safety equivalent to those prescribed by this PAS.
- It is understood that all micro fuel cell power systems, micro fuel cell power units and fuel cartridges shall comply with applicable country and local requirements including, but not limited to, those concerning transportation, child-resistance and storage, where required.

## 2 Normative references

The following referenced documents are indispensable for the application 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 60050-426:2008, *International Electrotechnical Vocabulary – Part 426: Equipment for explosive atmospheres*

IEC 60079-15, *Explosive atmospheres – Part 15: Equipment protection by type of protection "n"*

IEC 60086-4, *Primary batteries – Part 4: Safety of lithium batteries* IEC 60086-5, *Primary batteries – Part 5: Safety of batteries with aqueous electrolyte*

IEC 60695-1-10: *Fire hazard testing – Part 1-10: Guidance for assessing the fire hazard of electrotechnical products – General guidelines*

IEC 60695-1-11: *Fire hazard testing – Part 1-11: Guidance for assessing the fire hazard of electrotechnical products – Fire hazard assessment*

IEC 60695-2-11, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60730-1:2010, *Automatic electrical controls for household and similar use – Part 1: General requirements*

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61032, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 62133, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications*

IEC 62281, *Safety of primary and secondary lithium cells and batteries during transport*

ISO 175, *Plastics – Methods of test for the determination of the effects of immersion in liquid chemicals*

ISO 188, *Rubber, vulcanized or thermoplastic – Accelerated ageing and heat resistance tests*

ISO 1817, *Rubber, vulcanized – Determination of the effect of liquids*

ISO 9772, *Cellular plastics – Determination of horizontal burning characteristics of small specimens subjected to a small flame*

ISO 15649, *Petroleum and natural gas industries – Piping*

ISO 16000-3, *Indoor air – Part 3: Determination of formaldehyde and other carbonyl compounds – Active sampling method*

ISO 16000-6, *Indoor air – Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS/FID*

ISO 16017-1, *Indoor, ambient and workplace air – Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography – Part 1: Pumped sampling*

ISO 16111:2008, *Transportable gas storage devices – Hydrogen absorbed in reversible metal hydride*

*United Nations Recommendations on the Transport of Dangerous Goods – Model Regulations; Sixteenth revised edition*

*United Nations Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria; Fifth revised edition*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

#### 3.1

##### **attached cartridge**

fuel cartridge, which has its own enclosure that connects to the device powered by the micro fuel cell power system

#### 3.2

##### **electrical enclosure**

parts of the micro fuel cell power system intended to limit access to parts that may be at hazardous voltages or hazardous energy level

#### 3.3

##### **exterior cartridge**

fuel cartridge, which has its own enclosure that forms a portion of the enclosure of the device powered by the micro fuel cell power system

#### 3.4

##### **fire enclosure**

parts of the micro fuel cell power system intended to minimize the spread of fire or flames from within

#### 3.5

##### **fuel**

UN Division 4.3 (water-reactive) solid formulation of compounds comprising constituents selected from the following group used as fuel for an indirect PEM micro fuel cell power system:

(water reactive) mixtures, alloys, compounds or chemical hydrides of the following materials: sodium, magnesium, borohydride compounds, silicon, silicon dioxide, iron, nickel, cobalt.

The formulation may contain a non-hazardous activator to facilitate the production of hydrogen.

Only UN Division 4.3 (water reactive) solid compounds which solely evolve hydrogen gas upon contact with water (or non-hazardous aqueous solutions) shall be permitted. Compounds with a subsidiary hazard risk, or which are not permitted to be transported by air according to the ICAO Technical Instructions, shall not be permitted under this PAS.

**3.6****fuel cartridge**

removable article that contains fuel and supplies hydrogen to the micro fuel cell power unit or internal reservoir, not to be refilled by the user

**3.7****fuel cell power system**

generator system that uses a fuel cell module(s) electrically and thermally connected to generate usable electric energy and/or thermal energy

**3.8****hazardous liquid fuel**

liquid fuel component with a pH < 3,5 or > 10,5

**3.9****insert cartridge**

fuel cartridge, which has its own enclosure and is installed within the enclosure of the device powered by the micro fuel cell power system

**3.10****internal reservoir**

structure in a fuel management system that stores hydrogen and cannot be removed

**3.11****leakage**

accessible fuel, hazardous fuel byproducts or hazardous liquid fuel outside the micro fuel cell power system, micro fuel cell power unit, or fuel cartridge

**3.12****limited power sources**

electrical supply either isolated from a mains supply or supplied by a battery or other device (i.e. fuel cell power unit) where the voltage, current and power levels are either inherently or non-inherently limited to levels that do not result in an electric shock or fire hazard

NOTE An inherently limited power source does not rely on a current-limiting device to meet limited power requirements although it may rely on an impedance to limit its output. However, a non-inherently limited power source relies upon a current-limiting device such as a fuse, etc. to meet limited power requirements.

**3.13****toxic material**

any material having a toxic hazard rating of 2 (medium) or higher, in the Sax's dangerous properties of industrial materials – 11th edition, or related reference guide

**3.14****mechanical enclosure**

parts of the micro fuel cell power system or micro fuel cell power unit intended to be a barrier to protect, shield, and control access to the internal components or material

**3.15****micro fuel cell**

fuel cell that is wearable or easily carried by hand, providing a d.c. output that does not exceed 60 V d.c. and power outputs that do not exceed 240 VA

**3.16****micro fuel cell power system**

micro fuel cell power unit and associated fuel cartridges that is wearable or easily carried by hand

**3.17****micro fuel cell power unit**

electric generator as defined in Figure 1, providing direct current output that does not exceed 60 V d.c. and continuous power output that does not exceed 240 VA

The micro fuel cell power unit does not include a fuel cartridge or other cartridges (optional).

**3.18****no accessible liquid**

liquid fuel component that is not subject to contact by consumers

**3.19****no fuel vapour loss**

not applicable

**3.20****normal use conditions**

range of conditions such as pressure, temperature, physical, chemical and thermal conditions of use as defined by the manufacturer

**3.21****partially utilized fuel cartridge**

fuel cartridge that has been put into operation such that approximately 45 % – 55 % of the initial fuel has been utilized and that the operation of the micro fuel cell power system has been halted for at least 1 h

**3.22****rated power**

manufacturer specified maximum continuous power capability of the micro fuel cell power system

**3.23****satellite cartridge**

fuel cartridge that is intended to be connected to and removed from the micro fuel cell power unit to transfer hydrogen to the internal reservoir inside the micro fuel cell power unit

**3.24****refill valve**

component of the non-user-refillable fuel cartridge that allows refilling the fuel cartridge only by the manufacturer or by trained technicians

**3.25****shut-off valve**

component of a fuel cartridge that controls the release of fuel or hydrogen

**3.26****waste cartridge**

cartridge that stores waste and byproducts from the micro fuel cell power unit

**3.27****water cartridge/liquid mixture**

cartridge that is filled with water or liquid fuel component

**3.28****fuel management system**

optional components used to control fuel or hydrogen properties (e.g. concentration, flow rate, purity, temperature, humidity or pressure) or aspects of hydrogen generation to support micro