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**Airport hydrogen fuelling facility
operations**

Exploitation d'installation aéroportuaire d'avitaillement en hydrogène



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/PAS 15594 was prepared by Technical Committee ISO/TC 197, *Hydrogen technologies*.

Introduction

When this document was introduced in the ISO/TC 197 programme of work, all aircraft- and airport-relevant procedures, systems and components concerning hydrogen technologies were in an early development state, and the technical solutions that would enable the future use of hydrogen as a fuel for aviation were not fully developed.

The development of this document within ISO/TC 197 depended on the progress achieved within the European Aeronautic Defence and Space Company (EADS)-Airbus Cryoplane project. However, this project is no longer planned to start in the near future, and there are no other relevant practical projects underway.

ISO/TC 197 experts are convinced that the subject of using liquid hydrogen in commercial aviation is of great importance and will gain new momentum in the next decade. As a result, the latest results are presented in this Publicly Available Specification to make the information available to all interested parties.

This document is not to be regarded as an International Standard. It records the latest results of ISO/TC 197 experts until the subject of using liquid hydrogen in commercial aviation gains interest.

It is understood that this document is far from complete and that it represents the knowledge available at the time of publication. Should work on this subject resume in the next years, the primary objective of the standardization work will be to ensure safety at all phases of handling while taking into account the conditions prevailing at civil airports and the results of risk assessment studies.

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Airport hydrogen fuelling facility operations

1 Scope

This Publicly Available Specification specifies the fuelling procedures, hydrogen boil-off management procedures, storage requirements of hydrogen, and characteristics of the ground support equipment required to operate an airport hydrogen fuelling facility.

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.

ISO 14687, *Hydrogen fuel — Product specification*

ISO 20421-1, *Cryogenic vessels — Large transportable vacuum insulated vessels — Part 1: Design, fabrication, inspection and testing*

ASME 1998, *Boiler and Pressure Vessel Code*

KSC¹⁾-STD-Z-0009C, *Cryogenic Ground Support Equipment, Design of, Standard for*

KSC-STD-Z-0005B, *Pneumatic Ground Support Equipment, Design of, Standard for*

3 Terms and definitions

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

3.1

block fuel

quantity of fuel to be used for refuelling prior to each flight

3.2

refuelling block time

time needed to refuel the aircraft, measured between connection and disconnection of the couplings

3.3

inert gas

nonflammable and nonreactive gas

EXAMPLES Helium, nitrogen, carbon dioxide.

1) Kennedy Space Center.

4 Symbols and abbreviated terms

AP	auxiliary power unit
CO	carbon monoxide
CO ₂	carbon dioxide
C _n H _m	hydrocarbon containing <i>n</i> carbon atoms and <i>m</i> hydrogen atoms
EADS-Airbus	European Aeronautic Defence and Space Company
GH ₂	gaseous hydrogen
LH ₂	liquid hydrogen
N ₂	nitrogen
O ₂	oxygen

5 Fuelling procedures

5.1 General requirements

At the airport, the following situations shall be considered:

- normal refuelling during ground turnaround, with an onboard system in cold condition up to the refuelling/boil-off coupling;
- defuelling of the system on the ground due to planned maintenance activities and applicable troubleshooting cases;
- refuelling of a warm, air-floated onboard system before putting into service and after planned maintenance activities and applicable troubleshooting cases.

The airport infrastructure shall provide the ground support equipment required for performing the above-mentioned refuelling and defuelling operations, including the aircraft tank warm-up and precooling, the necessary purification and purging processes, and the evacuation and GH₂/LH₂ recovery that is required for defuelling operations and refuelling of a warm onboard system. Purge, precooling and warm-up procedures for the onboard fuel system shall be required only for putting into service, maintenance and troubleshooting activities.

The connection point between the aircraft and the ground support equipment shall consist of two couplings (similar but mistake-proof), a refuelling coupling for providing the tanks with LH₂, and a boil-off coupling for the discharge of GH₂. In Annex A, Figure A.1 provides an example of an aircraft refuelling and defuelling interface point and Figure A.2 an example of a hydrogen aircraft-fuel system layout.

5.2 Bonding and grounding procedures

Airport personnel shall apply appropriate bonding and grounding procedures prior to performing any refuelling or defuelling operations on an aircraft.