IEC 60952-1

Edition 3.0 2013-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Aircraft batteries –
Part 1: General test requirements and performance levels

Batteries d'aéronefs –
Partie 1: Exigences générales d'essais et niveaux de performances

IEC 60952-1:2013

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FOREWORD

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International Standard IEC 60952-1 has been prepared by IEC technical committee 21: Secondary cells and batteries.

This third edition cancels and replaces the second edition published in 2004. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition: additional test requirements to meet the needs of the regulatory airworthiness authorities for both product performance and qualification.

The text of this standard is based on the following documents:

FDIS	Report on voting
21/803/FDIS	21/814/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 60952 series, published under the general title *Aircraft batteries* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

The IEC 60952 series defines minimum environmental and performance requirements for establishing a qualification standard for airworthiness of lead-acid and nickel-cadmium aircraft batteries, which contain corrosive electrolytes.

The series defines test procedures for determining battery performance. The electrical test results may be used to establish airworthiness in a particular application. For all tests, the manufacturer declares the minimum performance for each battery type.

The requirements of IEC 60952 for aircraft batteries are divided into three parts:

– Part 1 defines test procedures for the evaluation, comparison and qualification of batteries and states minimum environmental performance levels for airworthiness.
– Part 2 defines the design requirements for aircraft batteries as well as their format (shape and size) and the range of aircraft interface connectors that are used.
– Part 3 defines the product specification which is used to define specific requirements for an application and a declaration of design and performance (DDP), which details the performance of a battery format when tested to Part 1.

AIRCRAFT BATTERIES –

Part 1: General test requirements and performance levels

1 Scope

This part of the IEC 60952 series defines test procedures for the evaluation, comparison and qualification of batteries and states minimum performance and environmental levels for airworthiness. Where specific tests are defined with no pass/fail requirement (to establish performance capability), the manufacturer’s declared values, from qualification testing, will be used to establish minimum requirements for ongoing maintenance of approval for that design of battery.

To provide representative examples, this standard utilises voltage and current values based upon an aircraft electrical system nominally rated at 28 V d.c. Additionally, the nominal values for cell voltage are assumed to be 1,2 V per cell for nickel-cadmium batteries and 2,0 V per cell for lead-acid batteries.

The specific topics addressed in this part of IEC 60952 serve to establish acceptable quality standards required to qualify a battery as airworthy.

In cases where the requirements for a specific application exceed those detailed in this standard, the purchaser will detail said requirements in the product specification and the method of establishing compliance.

It is recognised that additional data may be required by other organisations (national standards bodies, AECMA, SAE etc.). The present standard can be used as a framework to devise tests for generation of the required data.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60051-1, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 1: Definitions and general requirements common to all parts*

IEC 60051-2, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 2: Special requirements for ammeters and voltmeters*

IEC 60485, *Digital electronic d.c. voltmeters and d.c. electronic analogue-to-digital convertors*[1]

IEC 60952-2:2013, *Aircraft batteries – Part 2: Design and construction requirements*

IEC 60952-3:2013, *Aircraft batteries – Part 3: Product specification and declaration of design and performance (DDP)*[2]

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1 Withdrawn.

2 The first edition (1993) was published under the title *Aircraft batteries – Part 3*: *External electric connectors*

ISO 2859 (all parts), *Sampling procedures for inspection by attributes*

ISO 7137, *Aircraft – Environmental conditions and test procedures for airborne equipment*

RTCA DO-160:2010, *Environmental Conditions and Test Procedures for Airborne Equipment*

U.S. Federal Test Method, Standard No. 191A / Federal Test Method 5906: 1978, Flammability (Horizontal Test)

SAE AIR 1377A-80, *Aerospace Information Report – Fire Test Equipment for Flexible Hose and Tube Assemblies*

SAE AS 1055B:1978, *Aerospace Standard – Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings and Similar System Components*

3 Terms and definitions

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

3.1
current value
value of current in ampere (A) used to charge and discharge cells and batteries, expressed as a multiple of the capacity

EXAMPLE For example, a current of 20 A used to charge a cell with a rated capacity C (Ah) of 100 Ah would be expressed as $C/5$ or 0,2 C (A).

Note 1 to entry: IEC 61434 is equally applicable to both nickel-cadmium and lead-acid and therefore the reference current (I_t) can be expressed as

(I_t)A = C_nAh/1 h

where C_n is the rated capacity declared by the manufacturer in ampere hours and n is the timebase in hours for which the rated capacity is declared.

3.2
1 I_1 rate
current which the battery delivers to give not less than its rated C_1 capacity in 1 h

Note 1 to entry: This is the basis on which all other current ratings are defined.

3.3
rated capacity
C_1
minimum capacity, obtained from a charged battery when discharged at the 1 I_1 rate to the end point voltage (see 3.6)

Note 1 to entry: Rated capacity is expressed in Ah.

3.4
constant voltage current
I_{pr}
discharge current, which the battery delivers at the conclusion of a 15 s power discharge, controlled so as to maintain a constant terminal voltage of half the nominal voltage

3.5
charged battery
battery that has been fully charged in accordance with the battery manufacturer's instructions or as defined in the product specification

3.6
end point voltage
EPV
unless otherwise stated, during discharge the battery end point voltage (EPV) corresponding to a mean voltage per cell of 1,00 V for nickel-cadmium or 1,67 V for lead-acid batteries

Note 1 to entry: This note applies to the French language only.

3.7
serviced battery
battery that has been fully prepared and maintained in accordance with the manufacturer's instructions or as defined in the product specification

3.8
airworthiness
compliance of a battery or part thereof with all conditions and regulations required by the appropriate governmental authorities for their safe operation and performance

3.9
product specification
separate document which details the specific requirements which a battery is expected to meet for a particular aircraft application

4 Test conditions and measuring apparatus

4.1 General test conditions

If specific test conditions are not defined for a test, the test shall be carried out under the following general test condition:

– air pressure: 85 kPa to 106 kPa (850 mbar to 1 060 mbar),

– temperature: 23 °C ± 2 °C,

– relative humidity (RH): not to exceed 70 %.

If definite tolerances have not been specified, a deviation of not more than ±5 % from the given non-electrical values will be permitted.

When using this standard to evaluate products designed to operate on an aircraft electrical system other than the nominal 28 V d.c., or whose chemical properties are such that the individual cell voltage differs from that stated above, test values shall be adjusted accordingly.

4.2 Measuring apparatus

4.2.1 General

The measuring method used for the tests shall be selected to suit the magnitude of the parameters to be measured. The apparatus shall be regularly calibrated and shall have at least the degree of accuracy given below.

4.2.2 Voltage measurement

The instruments used for measuring voltage shall be voltmeters having an accuracy of class 0,5 or better, as defined in IEC 60051-1 and IEC 60051-2. Digital systems shall comply with IEC 60485. The resistance of the voltmeters shall be at least 5 000 Ω/V. To establish the battery voltage, the measurements shall be taken at the battery interface connector.

4.2.3 Current measurement

The instruments used for current measurement shall be ammeters having an accuracy of class 0,5 or better, as defined in IEC 60051-1 and IEC 60051-2. Digital systems shall comply with IEC 60485. This accuracy class shall be maintained for the assembly of ammeter, shunt and leads.

4.2.4 Temperature measurement

The instruments used for temperature measurement shall have an accuracy of ± 1 °C or better.

4.2.5 Time measurement

The instruments used for time measurement shall be to an accuracy of 0,5 % or better.

4.2.6 Additional test equipment

Equipment used shall have a measurement accuracy of 5 % unless otherwise stated.

4.2.7 Mass test equipment

Equipment used shall have a measurement accuracy of 0,5 % unless otherwise stated.

4.3 Charging method

The battery shall be serviced and charged in accordance with the manufacturer's instructions or using the dedicated charger or as required in the product specification.

4.4 Physical examination

Prior to the commencement of the electrical and environmental testing, each battery being tested shall be inspected to ensure that it complies with the relevant product specification as defined in IEC 60952-3, or to the manufacturer's drawing as follows:

a) mass and dimensions;
b) minimum marking as detailed in 15.3 of IEC 60952-2:2013;
c) correct warning labels;
d) correct interface connectors;
e) damage to case, lid and interface connectors;
f) no signs of corrosion;
g) no signs of electrolyte leakage;
h) general standards of workmanship.

5 Electrical requirements and test procedures

5.1 Capacity tests at the 1 I_1 rate

5.1.1 Rated capacity C_1

Test method – The battery shall be commissioned and charged in accordance with 4.3. After standing for not less than 20 h and not more than 24 h at an ambient temperature of 23 °C ± 2 °C, it shall be discharged at the 1 I_1 rate to its EPV, maintaining the ambient temperature at 23 °C ± 2 °C during discharge.

Requirements – The battery shall deliver a capacity of not less than 100 % C_1 (discharge time 1 h).

5.1.2 Initial capacity requirement for vented and valve regulated nickel-cadmium batteries

To meet the rated capacity requirement each cell shall produce a voltage of not less than 1,0 V at the end of 60 min of discharge at 1 I_1 at an ambient temperature of 23 °C ± 5 °C.

5.1.3 Capacity at 1 I_1 and –18 °C

Test method – The battery shall be commissioned and charged in accordance with 4.3. After standing for not less than 20 h and not more than 24 h at an ambient temperature of –18 °C ± 2 °C, it shall be discharged at the 1 I_1 rate to its EPV, maintaining the ambient temperature at –18 °C ± 2 °C during discharge.

Requirements – The capacity shall be recorded and shall not be less than the value declared by the manufacturer or stated in the product specification.

5.1.4 Capacity at 1 I_1 and –30 °C

Test method – The battery shall be commissioned and charged in accordance with 4.3. After standing for not less than 20 h and not more than 24 h at an ambient temperature of –30 °C ± 2 °C, it shall be discharged at the 1 I_1 rate to its EPV, maintaining the ambient temperature at –30 °C ± 2 °C during discharge.

Requirements – The capacity shall be recorded and shall not be less than the value declared by the manufacturer or stated in the product specification.

5.1.5 Capacity at 1 I_1 and 50 °C

Test method – The battery shall be commissioned and charged in accordance with 4.3. After standing for not less than 20 h and not more than 24 h at an ambient temperature of 50 °C ± 2 °C, it shall be discharged at the 1 I_1 rate to its EPV, maintaining the ambient temperature at 50 °C ± 2 °C during discharge.

Requirements – The capacity shall be recorded and shall not be less than the value declared by the manufacturer or stated in the product specification.

5.2 Constant voltage discharge

5.2.1 General

Either of the following test methods shall be carried out as agreed by the approving authority. The discharge current capability of the test equipment shall exceed 50 I_1.

5.2.2 Constant voltage

5.2.2.1 General

Subject the battery to a constant voltage discharge equal to the number of cells multiplied by half their nominal voltage at the following temperatures.

5.2.2.2 Constant voltage current at 23 °C

Test method – The battery shall be serviced and charged in accordance with 4.3. After standing for not less than 20 h and not more than 24 h at 23 °C ± 2 °C, it shall be discharged at a rate so as to maintain a constant terminal voltage corresponding to half the nominal voltage for not less than 15 s. The discharge load shall be automatically controlled to enable a plot of current against time to be recorded throughout the test.

Requirements – The current at 15 s shall be designated I_{PR} and the current at 0,3 s shall be designated I_{PP}. The values obtained shall be reported and shall not be less than the values declared by the manufacturer or as stated in the product specification.

5.2.2.3 Constant voltage current at –18 °C

Test method – The battery shall be serviced and charged in accordance with 4.3. After standing for not less than 20 h and not more than 24h at –18 °C ± 2 °C, it shall be discharged at a rate so as to maintain a constant terminal voltage corresponding to half the nominal voltage for not less than 15 s. The discharge load shall be automatically controlled to enable a plot of current against time to be recorded throughout the test.

Requirements – The current at 0,3 s and 15 s shall be reported and shall not be less than the value declared by the manufacturer or as stated in the product specification.

5.2.2.4 Constant voltage current at –30 °C

Test method – The battery shall be serviced and charged in accordance with 4.3. After standing for not less than 20 h and not more than 24 h at –30 °C ± 2 °C, the battery shall be discharged at a rate so as to maintain a constant terminal voltage corresponding to half the nominal voltage for not less than 15 s. The discharge load shall be automatically controlled to enable a plot of current against time to be recorded throughout the test.

Requirements – The current at 0,3 s and 15 s shall be reported and shall not be less than the value declared by the manufacturer or as stated in the product specification.

5.2.3 Constant voltage discharge (14 V)

5.2.3.1 General

Subject the battery to a constant voltage (14,0 V) discharge at the following temperatures.

The testing equipment for high rate discharge at 14 V shall be capable of recording data with a resolution of 0,1 s intervals.

5.2.3.2 Constant voltage current at 23 °C

Test method – The battery shall be serviced and charged in accordance with 4.3. After standing for not less than 20 h and not more than 24 h at 23 °C ± 2 °C, it shall be discharged at a rate so as to maintain a constant terminal voltage of 14,0 V for not less than 60 s.

Throughout the test, a plot of current against time shall be recorded.

Requirements – The current at 0,3 s, 5 s, 15 s and 30 s together with the average current for the 60 s of the test shall not be less than the value declared by the manufacturer or as stated in the product specification.

5.2.3.3 Constant voltage current at – 18 °C

Test method – The battery shall be serviced and charged in accordance with 4.3. After standing for not less than 20 h and not more than 24 h at –18 °C ± 2 °C, it shall be discharged at a rate so as to maintain a constant terminal voltage of 14,0 V for not less than 60 s.

Throughout the test, a plot of current against time shall be recorded.

Requirements – The current at 0,3 s, 5 s, 15 s and 30 s together with the average current for the 60 s shall not be less than the value declared by the manufacturer or as stated in the product specification.