

TECHNICAL REPORT



Secondary cells and batteries containing alkaline or other non-acid electrolytes – Experimental procedure for the forced internal short-circuit test of IEC 62133:2012



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE
OR OTHER NON-ACID ELECTROLYTES – EXPERIMENTAL
PROCEDURE FOR THE FORCED INTERNAL
SHORT-CIRCUIT TEST OF IEC 62133:2012**

FOREWORD

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IEC/TR 62914, which is a technical report, has been prepared by subcommittee 21A: Secondary cells and batteries containing alkaline or other non-acid electrolytes, of IEC technical committee 21: Secondary cells and batteries.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
21A/537/DTR	21A/549/RVC

Full information on the voting for the approval of this technical report 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.

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- withdrawn,
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INTRODUCTION

The second edition of IEC 62133 was published on December, 2012. This technical report provides supplemental information to perform the forced internal short-circuit test of IEC 62133:2012.

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SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES – EXPERIMENTAL PROCEDURE FOR THE FORCED INTERNAL SHORT-CIRCUIT TEST OF IEC 62133:2012

1 Scope

This Technical Report identifies experimental procedures for the forced internal short-circuit tests in terms of designation, dimensions, tests and requirements. It supplements 8.3.9 of IEC 62133:2012.

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 62133:2012, *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*

3 Experimental procedure of the forced internal short-circuit test

3.1 Example of preparation of nickel particle

3.1.1 Material and tools

The necessary material and tools required for this preparation are listed below.

- a) a nickel piece: Prepare nickel plate (soft temper; ISO 6208, NW2200 (Ni 99.0) or NW2201 (Ni 99.0 -LC) $0,10 \pm 0,01$ mm thick made into a piece $0,20^{+0,05}_{-0,03}$ mm wide and $2,00 \pm 0,30$ mm long by slit processing or using a punching press;
- b) a stereomicroscope;
- c) a cutter knife;
- d) glass slides (2 slides: 1 mm or thicker with square corners);
- e) a graph paper (1 mm square);
- f) a storage container for nickel particles.

3.1.2 Example of a nickel particle preparation procedure

The following steps are to be undertaken:

- a) place graph paper on the stage of the stereomicroscope and focus the microscope on the lines of the graph paper;
- b) while looking through the microscope, place the nickel piece parallel to a line of the graph paper. The nickel piece should be placed horizontally, with its $0,20$ mm sides extending downward perpendicularly from and its $2,0$ mm sides running parallel to the line on the graph paper;
- c) place a glass slide vertically over the left half ($1,0$ mm) of the nickel piece. Use a line of the graph paper as a guide to position the edge of the glass slide;

- d) while holding the glass slide in place with your fingers, fold and raise the right half (1,0 mm) of the nickel piece using a cutter;
- e) place the other glass slide to the right of the nickel piece to sandwich the raised part. Slightly press the right slide against the raised part so that the nickel piece is bent to an angle of 90° ;
- f) Store the completed nickel particles in a storage container to prevent it from being deformed before the test.

NOTE The completed nickel particles can also be obtained in using a press machine.

Figure 1 shows the nickel material after folding to a nickel particle.

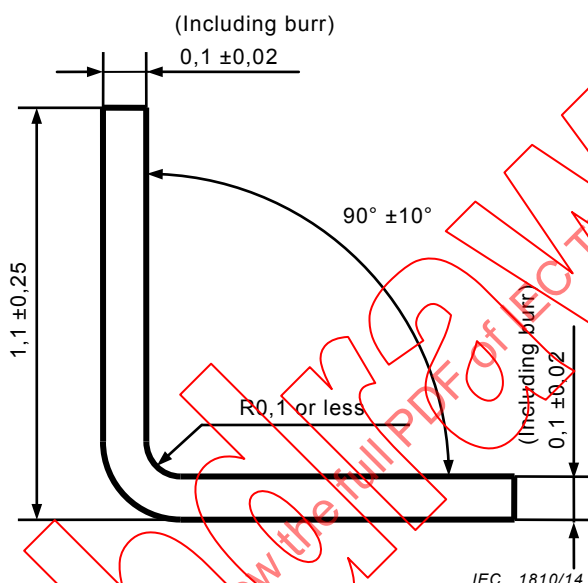


Figure 1 – Dimensions of a completed nickel particle

3.2 Positioning (or placement) of a nickel particle

The following represents some recommendations on the way to place nickel particle:

- a) In the case that nickel particle cannot be placed in the position as described in draft IEC 62133, the position can be changed.
- b) For a prismatic cell, you may place a nickel particle in a flat area. However, it shall be positioned in the center of the pressurized surface. If it is difficult to place a nickel particle under the most outside layer, it may be placed under an inside layer as shown in Figure 2.
- c) A nickel particle shall not be placed in an area where the positive active material has come off from the aluminum foil. If the material has come off in the specified area, place the nickel particle in another area where the positive active material exists, where the position can be pressed with the centre of the pressuring jig.
- d) The position of nickel particle may be determined by the cell manufacturer and the test agent.

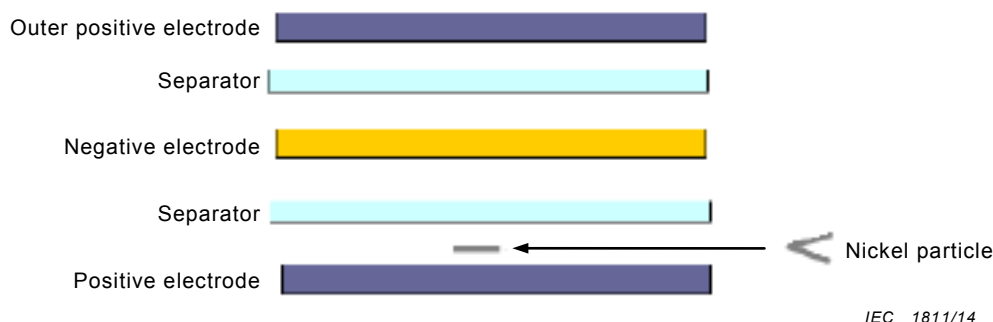


Figure 2 – Positioning of nickel particle when it cannot be placed in the specified area

3.3 Damaged separator precaution

The sample for evaluation shall not be used when a separator is damaged during preparation e.g., separator is torn.

(When a separator is damaged, e.g., the membrane is ruptured, the cell shall not be used as a sample for evaluation)

3.4 Caution for rewind separator and electrode

During rewinding the core to original position by pulling the positive, negative and separator, pay attention to avoid loosening the wound core.

Figure 3 below shows an example of cylindrical cell.

1. Unwind the wound core to the edge of coated area of positive electrode. Draw a line from outer separator to center.
2. Rewind the core after insertion of nickel particle.
3. When rewind the cor, return the marked area to the original position.

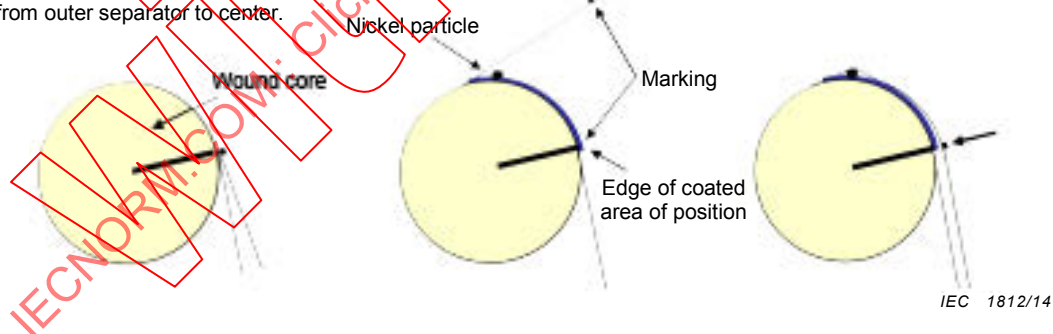


Figure 3 – Cylindrical cell

3.5 Insulation film for preventing short circuit

To prevent short circuit before the test, it is recommended to insert an insulation film of a thickness of 25 μm or less.

3.6 Cautions on disassembling cell

The following represents some recommendations on the way to disassemble the cell:

- a) Cells should be disassembled in an open-type dry chamber or a dry room, where the temperature is $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and the dew point temperature is below $-25\text{ }^{\circ}\text{C}$.

- b) Be careful not to short-circuit cells during disassembling. For example, use tools whose edges are made of ceramics or insulated. Take great care to disassemble sealing area of cells in particular.
- c) There are many different cell structures, so it is recommended to check with the manufacturer for the most appropriate structure and part where a short-circuit may easily happen.
- d) Cells short-circuited during disassembling should not be used for the following test.

3.7 Protective goods for safety

It is recommended that long sleeved protective clothing, protective glasses, a mask and gloves should be worn.

3.8 Cautions in case of fire during disassembling

The following represents some recommendations on the way to manage a fire:

- a) To prevent fire spreading, unnecessary flammable materials should not be placed in the work area.
- b) Take countermeasures to prevent the cell contents scattering when cells catch fire. For example, a fire protection cloth or sand should be available in the work area, and the gas should be exhausted effectively.

3.9 Cautions for disassembling process and pressurizing electrode core

The following represents some recommendations on the way to handle the wound core:

- a) Place one wound core in one zip-lock polyethylene bag, and then place them in one aluminum laminated bag. To minimize vaporization of the electrolyte, use bags as small as possible. For example, use a polyethylene bag of 100 mm (W) × 140 mm (H) × 0,04 mm (T) and an aluminum laminated bag of 120 mm (W) × 180 mm (H) × 0,11 mm (T).
- b) Carry out the work from cell disassembling to placing in the aluminum laminated bag within 30 min.
- c) The storage period in the aluminum laminated bag should be within 12 h.
 - 1) The wound core should be placed on the testing machine within 2 min after taking out the wound core from the bags.
 - 2) When the temperature of the wound core reaches the testing temperature, start pressurizing.
 - 3) When the test is conducted at a high temperature, to minimize vaporization of the electrolyte, it is desirable to start pressurizing within 3 min after placing the wound core on the testing machine. When the test is conducted at a low temperature, it is desirable to start the test within 10 min.

3.10 Recommended specifications of a pressurizing device

The locus of the servo-motor press moves linearly, however the one of the hydraulic press does not. When the internal short-circuit occurs, the pressurizing device shall stop immediately by detecting the cell voltage drop. The servo-motor press can stop immediately. However, the hydraulic press cannot. Therefore, the servo-motor press is recommended for the pressurizing device.

The recommended specifications of the servo-motor press are shown in Table 1.

Table 1 – Recommended specifications of a pressurizing device

Item	Specifications in IEC 62133:2012	Recommendation
Pressurizing method	—	Servo-motor press
Press speed	0,1 mm/s	0,1 ± 0,01 mm/s
Position stability after pressurizing	—	±0,02 mm
Maximum pressurizing capability	Cylindrical:	1 000 N or more (recommended press capability to achieve the specification in left column)
	800 N MAX	
	Prismatic:	
	400 N MAX	
Pressure measuring method	—	Directly measured with a load cell
Pressure measuring period	—	5 m s or less
Time to stop pressure head after 50 mV delta is detected	—	100 m s or less

Figure 4 shows the plots of the distance from the start point of the pressurizing devices.

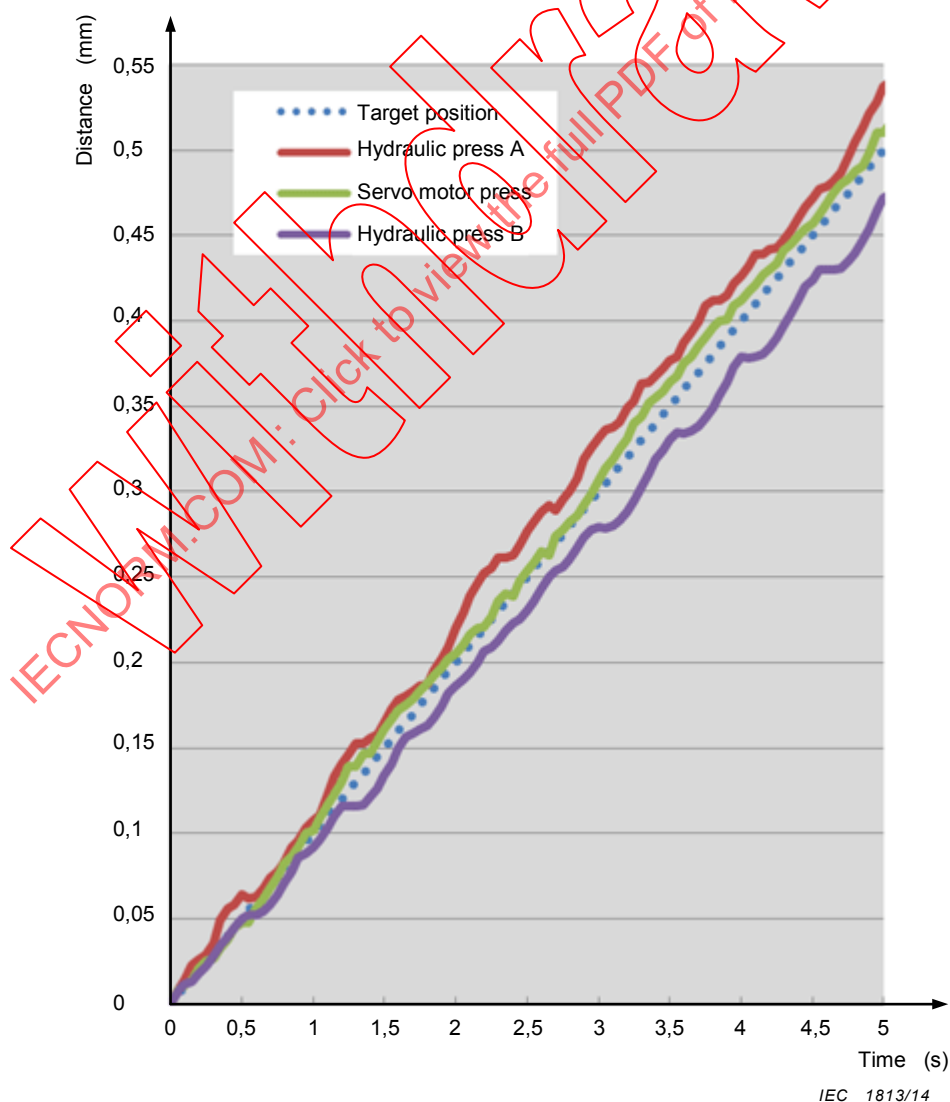


Figure 4 – Distance / time ratio of several types of pressurizing devices