



Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

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Electric storage systems:

Testing of lithium batteries

Procedures for test T.8: Forced discharge

Transmitted by the expert from China*

I. Introduction

1. According to chapter 38.3.4.8 of the *Manual of Tests and Criteria* (ST/SG/AC.10/11/Rev.8), the test procedure for “Test T.8: Forced discharge” is as follows:

“Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12 V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer.

The specified discharge currents to be obtained by connecting a resistive load of the appropriate size and rating in series with the test cell. Each cell shall be forced discharged for a time interval (in hours) equal to its rated capacity divided by the initial test current (in ampere).”

2. The energy density of battery products has witnessed a significant rise with their development, leading to an increase in battery capacity. Consequently, the current required for testing has also escalated, posing challenges to achieving this through conventional test methods.

3. Test methods for primary batteries and rechargeable batteries need to be distinguished according to the product's development trend.

II. Justification

4. The existing test procedure is similar to that in standard IEC 60086-4 *Primary batteries – Part 4: Safety of lithium batteries*, chapter 6.5.4, Test H: Forced discharge. As the title of the standard indicates, this procedure was originally designed for primary batteries only. More suitable procedures should be selected for rechargeable batteries. The experts

* A/78/6 (Sect. 20), table 20.5.



from China propose to introduce the procedure from standards IEC 62133-2¹ and IEC 62660-2².

5. Although both standards apply to lithium batteries only, sodium-ion batteries work similarly to lithium-ion batteries, and also follow the deluging working principle, that is, during charging, sodium ions are removed from the positive electrode and embedded in the negative electrode (the more sodium ions embedded in the negative electrode, the higher the charging capacity) and during discharge, the process is reversed (the more sodium ions return to the positive electrode, the higher the discharge capacity). Thus, the forced discharge test in both standards should also be applicable to sodium-ion batteries.

III. Proposal

6. The experts from China propose to split the current 38.3.4.8.2 into two sections for primary and rechargeable cells respectively and to renumber the current 38.3.4.8.3 as 38.3.4.8.4 in the *Manual of Tests and Criteria* (deleted text appears in strikethrough and new text in **bold underlined**):

“38.3.4.8.2 Test procedure **for primary cells**

Each **primary** cell shall be forced discharged at ambient temperature by connecting it in series with a 12 V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer.

The specified discharge current is to be obtained by connecting a resistive load of the appropriate size and rating in series with the test cell. Each cell shall be forced discharged for a time interval (in hours) equal to its rated capacity divided by the initial test current (in ampere).

38.3.4.8.3 Test procedure for rechargeable cells

Each rechargeable cell shall be forced discharged at ambient temperature. The discharged cell is then subjected to a forced discharge with a current equal to the reference test current and with a voltage not exceeding the negative value of the upper limit charging voltage. The reference test current (in amperes) is equal to the rated capacity (in ampere-hours) divided by 1 hour. The total duration of the forced discharge testing is 90 minutes.

If the discharge voltage reaches the negative value of upper limit charging voltage within the testing duration, the voltage shall be maintained at the negative value of the upper limit charging voltage by reducing the current for the remainder of the testing duration. If the discharge voltage does not reach the negative value of the upper limit charging voltage within the testing duration, the test shall be terminated at the end of the testing duration.

38.3.4.8.~~3~~4 Requirement

Primary or rechargeable cells meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.”

¹ IEC 62133-2 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 – Part 2: Lithium systems 7.3.7 Forced discharge (cells).

² IEC 62660-2 Secondary lithium-ion cells for the propulsion of electric road vehicles –Part 2: Reliability and abuse testing 6.4.3 Forced Discharge.