

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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Sub-Committee of Experts on the Transport of Dangerous Goods

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Item 4 (f) of the provisional agenda

Electric storage systems: miscellaneous

Introduction in China of proficiency testing for lithium batteries in accordance with UN 38.3 and relevant proposal

Transmitted by the expert from China

Background

1. China National Accreditation Service for Conformity Assessment (CNAS) organized and carried out in 2019 the nationwide proficiency testing of lithium battery in accordance with sub-section 38.3 of *Manual of Tests and Criteria* (UN 38.3), under project number CNAS Z0222. In total, 91 laboratories participated in the project. Details on implementation of the proficiency testing project are included in the annex.

2. In this proficiency testing project, tests were carried out in accordance with UN 38.3 (Sixth Edition, Amendment 1) and two models of cylindrical 18650 lithium cobalt oxide cells with different capacity were used as test samples. Comprehensive evaluation was carried out according to the test data and documents were submitted by the 91 laboratories. Afterwards, the evaluation results were analysed to find out the key problems.

3. The analysis on proficiency testing results shows that some laboratories have deviations in understanding the methods of the standard. One of the noteworthy problems is that 21.35% of the participating labs performed the tests of T.3 Vibration and T.4 Shock only in the axial and radial directions of the cylindrical lithium cells, while the standard requires T.3 and T.4 to be conducted in three mutually perpendicular mounting positions of the cells or batteries. These participants considered that two radial directions were indistinguishable.

4. 38.3.4.3.2 of Manual of Tests and Criteria reads:

“Cells and batteries are firmly secured to the platform of the vibration machine without distorting the cells in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of the three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face.”

5. 38.3.4.4.2 of Manual of Tests and Criteria reads:

“Each cell or battery shall be subjected to three shocks in the positive direction and to three shocks in the negative direction in each of the three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.”

6. China is of the opinion that it is difficult to perform the tests on cylindrical lithium cells or batteries in three perfectly mutually perpendicular directions in practice, particularly when testing in radial directions. Cylindrical lithium cells or batteries are easy to roll, and may rotate slightly during the testing process. So, after the vibration test in the first radial

direction (e.g. X-axis in Fig.1), it is difficult to make sure the perpendicular second radial direction (e.g. Y-axis) is exactly the same as the vibration direction through all the test.



Fig.1 Vibration direction diagram

(In this case, X-axis is the direction which has been tested and the perpendicular Y-axis is the direction which we intend to test now. However, as the vibration starts, the battery rotates slightly, and Y-axis is no longer in the direction of vibration. The second radial direction actually tested is not perfectly perpendicular to the first.)

7. Experts from China understand that the intention of choosing three mutually perpendicular directions is to ensure the representativeness of tested directions, but for cylindrical lithium cells or batteries, there is no evidence to prove that two mutually perpendicular radial directions are more representative than random two. The Sub-Committee is invited to consider whether testing cylindrical lithium cells or batteries in three mutually perpendicular directions, which will increase the difficulty of operation to a large degree, can truly help to improve safety in transport?

8. Experts from China consider that it is not necessary to select two strictly perpendicular radial directions for the test of cylindrical lithium cells or batteries. Therefore, it is proposed to clarify how to determine the three mutually perpendicular mounting positions of the samples during the T.3 Vibration and T.4 Shock test for cylindrical lithium cells or batteries.

Proposal

9. Amend the first paragraph of 38.3.4.3.2 as follows (new text is **underlined and bold**, deleted text in ~~strikethrough~~):

“Cells and batteries are firmly secured to the platform of the vibration machine without distorting the cells in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of the three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face.

Note: Cylindrical cells and batteries shall be subjected to vibration of 3 hours for axial direction, and 3 hours for each of any two radial directions, for a total of 9 hours.”

10. Amend the last paragraph of 38.3.4.4.2 as follows (new text is **underlined and bold**, deleted text in ~~strikethrough~~):

“Each cell or battery shall be subjected to three shocks in the positive direction and to three shocks in the negative direction in each of the three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.

Note: Cylindrical cells and batteries shall be subjected to three shocks in the positive direction and three shocks in the negative direction in axis, and to three shocks in each of any four radial directions, for a total of 18 shocks.”

Annex

Details on the CNAS Proficiency Testing Project (No. CNAS Z0222)

1. China National Accreditation Service for Conformity Assessment (CNAS) is the only organization in China that is qualified to carry out accreditation work for relevant institutions, such as certification bodies, laboratories, inspection bodies, etc. It is a full member of International Accreditation Forum (IAF), International Laboratory Accreditation Cooperation Organization (ILAC) and Asia Pacific Accreditation Cooperation Organization (APAC). To address safety and security in the transport of dangerous goods, a CNAS Professional Committee of Logistics Safety and Dangerous Goods Transport was found in 2018, consisting of experts from various backgrounds including aviation, railway, logistics, chemical industry, etc.
 2. The Professional Committee carried out the proficiency test of lithium battery (project number CNAS Z0222) in accordance with sub-section 38.3 of Manual of Tests and Criteria (UN 38.3) nationwide. The project aimed not only at evaluating the understanding to regulations and practical operating skills of different laboratories, but also at identifying texts that may cause ambiguities or misunderstandings in UN 38.3.
 3. A total of 91 laboratories nationwide participated in the project, including laboratories directly affiliated to government departments, laboratories of scientific research institutes, third-party laboratories and first-party laboratories of lithium battery factories. 87 of these laboratories took part in all accreditation items, while four took only some items.
 4. The proficiency test was in accordance with sub-section 38.3 of the *Manual of Tests and Criteria (Sixth Edition, Amendment 1)*. Furthermore, an Operation Instruction for Accreditation of the Capability to Conduct "UN 38.3 Test for Lithium Battery" was compiled as a working guidance. 18650 lithium cobalt battery with two capacity specifications (3.65V 2500mAh and 3.65V 2800mAh) were used as test samples. 50 samples with same capacity specification which had passed uniformity and stability test were distributed to each laboratory on a random base.
 5. Laboratories participating in this project were requested to submit not only detailed test data and reports, but also other relevant materials including equipment calibration certificates, personnel capability certificates, test method operation instructions, sample photos before and after the test. Based on the submitted data and documents, the Professional Committee conducted comprehensive evaluation, and systematically examined the participating laboratories' ability to understand, master and implement UN 38.3 tests from six aspects, namely "personnel allocation, equipment allocation, sample confirmation, test method, test environment and test results".
 6. 56 participating laboratories were rated as satisfactory, accounting for 61.5%. The expected purposes of evaluating the comprehensive technical ability of lithium battery testing in the participating laboratories were basically achieved. However, it was also found that some laboratories have misunderstandings on the standard test methods.
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