



DANGEROUS GOODS PANEL (DGP) WORKING GROUP ON LITHIUM BATTERIES

SECOND MEETING

Montréal, 7 to 11 April 2014

Agenda Item 1: Mitigating risks associated with the carriage of lithium metal batteries

TESTING OF LITHIUM COIN CELLS

(Presented by the National Electrical Manufacturers Association (NEMA) and
The Rechargeable Battery Association (PRBA))

SUMMARY

This paper provides information for the Panel about testing done by industry
on lithium coin cells as packaged for air transport.

1. INTRODUCTION

1.1 At the International Multidisciplinary Lithium Battery Transport Coordination Meeting (Atlantic City, United States, 4 to 6 February 2014), representatives of the Battery Association of Japan (BAJ) made a brief presentation on testing BAJ performed in 2011 on lithium metal coin cells as packaged for air transport. To date, this is the only testing of which NEMA and PRBA are aware that has been performed on coin cells as packaged for air transport. As the DGP considers proposals related to Section II of Packing Instruction 968 of the Technical Instructions, it is important that any discussion factor in the *de minimis* risk that lithium metal coin cells present in air transportation.

2. LITHIUM METAL COIN CELLS

2.1 Images of the various sizes of lithium metal coin cells, accompanied by approximate lithium metal content totals for each, are provided in Appendix A.

3. **EXTERNAL SHORT CIRCUIT: SUMMARY OF TEST DESIGN AND RESULTS**

3.1 The test subject was a 300-piece package of CR2450 lithium coin cells. Net quantity of the cells was less than 2.5 kg. The 300 cells were arrayed in plastic trays that prevent cells from coming in contact with each other. A microheater was inserted into the shipping package and heat was applied to one cell to externally produce a short circuit. When the cell attached to the heater reached a temperature of 200 °C, the top and the bottom of the cell separated, as designed. No fire event occurred. None of the nearby cells displayed any abnormality. Temperatures of adjacent cells were below 50 °C.

3.2 In a separate short-circuit test, all trays in the carton were removed and CR2450 cells were returned to the carton with no separation. External short-circuits were induced on all 300 batteries at one time. The cells were observed for six hours. No separation of the cells or other events were observed.

3.3 Identical tests were performed on coin cells of different sizes in quantities of 2.5 kg: CR1025 (2,400 pieces), CR1220 (2,000 pieces), CR2032 (400 pieces), and CR 2450 (300 pieces). Identical results were observed. Images of the test set-up and results are provided in Appendix B.

4. **TEMPERATURE DIFFERENTIAL TEST**

4.1 To simulate the introduction of a heat source from outside the package, a test was performed to measure the difference in temperature of inside and outside of a package containing lithium coin batteries when heat was applied to the battery package as prepared for air transport. The test displayed that although the heat outside the package may increase quickly, the temperature inside the package increased slowly and evenly,

4.2 Images of the results are provided in Appendix C.

5. **EXTINGUISH TEST**

5.1 Three packages containing 400 CR2032 lithium coin cells each and prepared for air transport were ignited separately by an external flame. In the first case, the package was allowed to burn for 2 minutes; in the second case, four minutes; and in the third case, six minutes. In each case, the package was then extinguished by application of Halon 1301. In each case, all of the cells were encased in plastic liner trays and none of the cells had been ignited by the external flame.

5.2 Images of the results are provided in Appendix D.

APPENDIX A
LITHIUM METAL COIN CELLS

FIGURE 1: SCHEMATIC OF A LITHIUM METAL COIN CELL

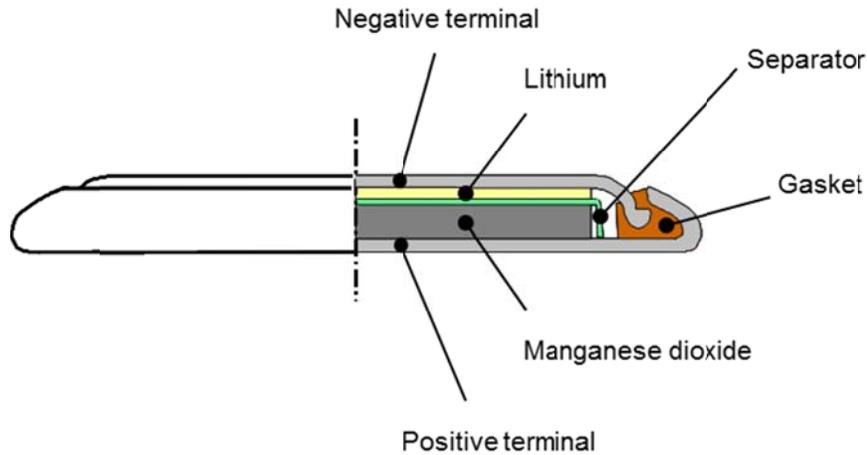


FIGURE 2: IMAGES OF THREE EXAMPLE SIZES¹, NOTATIONS OF LITHIUM METAL CONTENT



CR1220
Gross weight: 1.2 grams
Approx. 0.01 g lithium metal



CR 2025
Gross weight: 2.3 grams
Approx. 0.047 g lithium metal



CR2330
Gross weight: 3.8 grams
Approx. 0.076 g lithium metal

¹ The alphanumeric identifier for a coin cell indicates the physical size. Specifically, the first two numbers indicate the diameter of the cell in millimeters; the second two number indicate the height of the cell in tenths of millimeters. For example, a CR2320 is 23 millimeters in diameter and 2.0 millimeters in height.

APPENDIX B

EXTERNAL SHORT-CIRCUIT: TEST SET-UP AND RESULTS

FIGURE 1: PACKAGE OF 300 CR2450 COIN CELLS

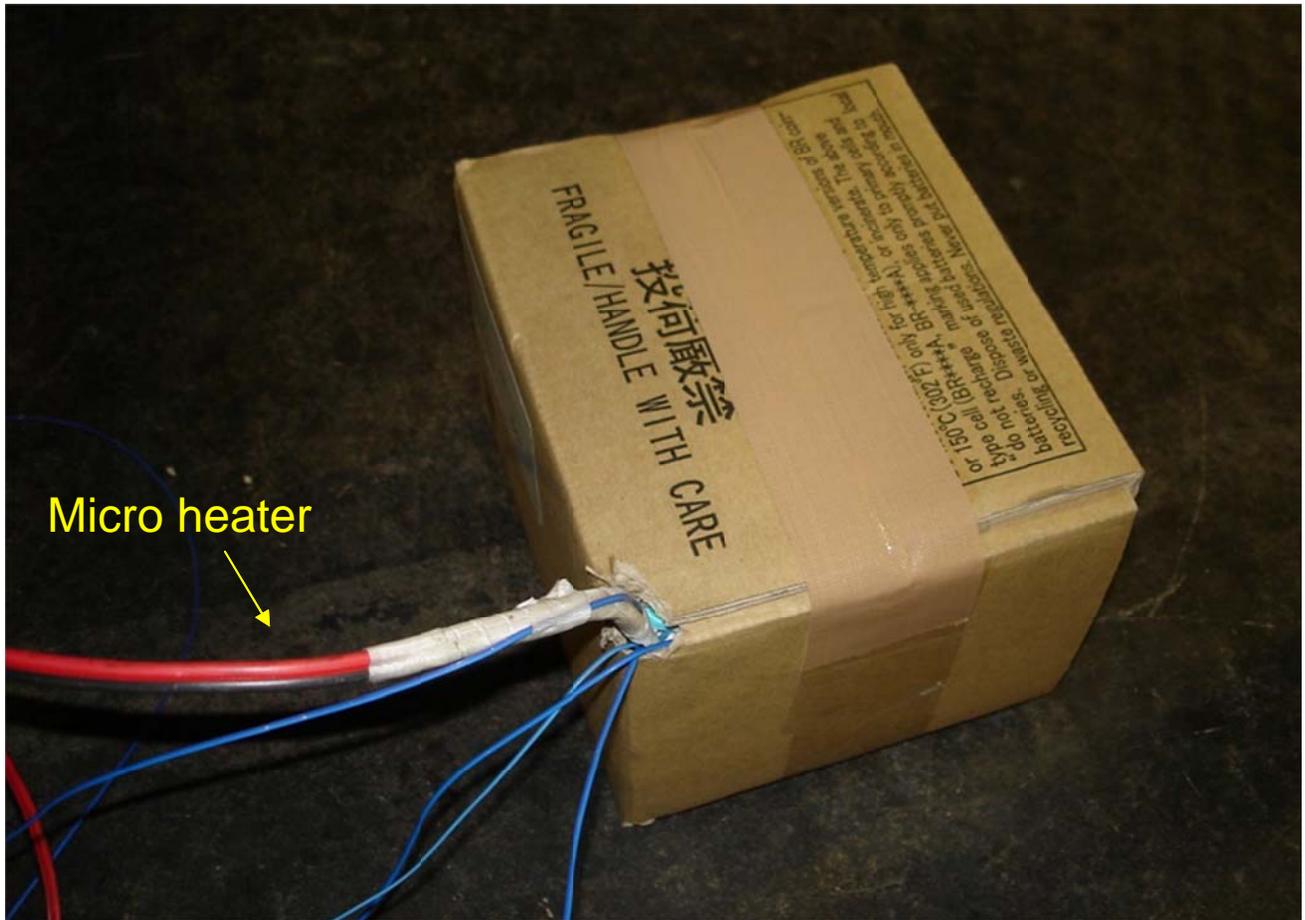


FIGURE 2: RUPTURED BATTERY



FIGURE 3: CELLS REMOVED FROM TRAYS, SHORT-CIRCUITED, AND OBSERVED



APPENDIX C

TEMPERATURE DIFFERENTIAL TEST

FIGURES 1 AND 2: DIAGRAM AND PHOTO OF TEST SET-UP

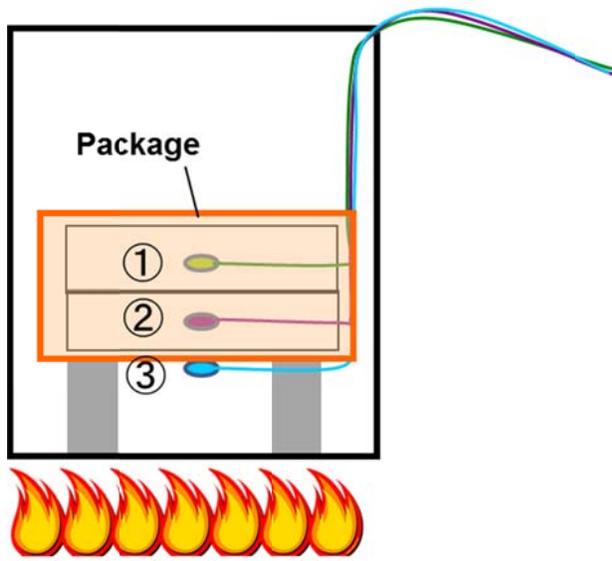
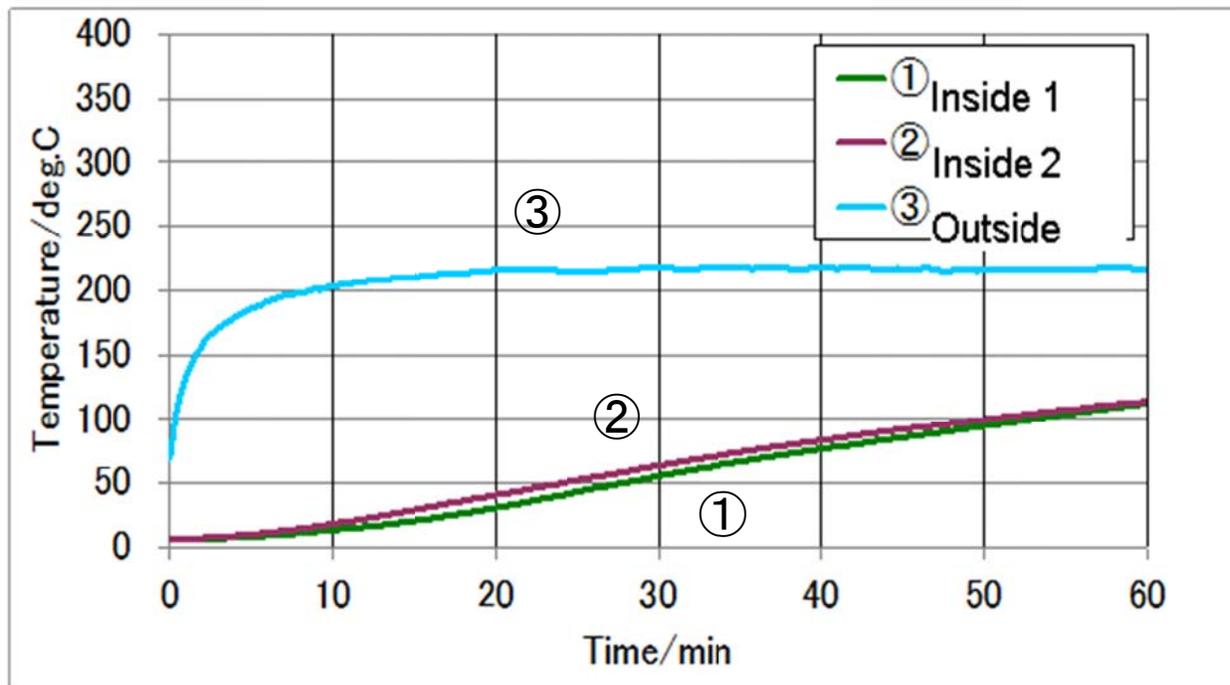


FIGURE 3: GRAPH OF RESULTS



APPENDIX D

EXTINGUISH TEST

FIGURE 1: IGNITION OF PACKAGE CONTAINING 400 CR2032 LITHIUM COIN CELLS



FIGURE 2: RESULTS

Result of extinction test

【Result】

<p>① Combustion time : 2 minutes</p>   <p>Halon 1301 extinguished fire.</p>	<p>② Combustion time : 4 minutes</p>   <p>Halon 1301 extinguished fire.</p>	<p>③ Combustion time : 6 minutes</p>   <p>Halon 1301 extinguished fire. Batteries had not ignited.</p>
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Package and plastic tray can prevent coin battery ignition, so even 6 minutes after igniting package, fire can be extinguished by Halon 1301.

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