# UN TEST REPORT

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|---|---|
| Report Number. ..... : | SDI-UN-190516-02 |
| Date of issue..... : | 2019.05.16 |
| Test period ..... : | 2019.05.01 ~ 2019.05.15 |
| Testing Laboratory..... | Samsung SDI Co., Ltd |
| Address ..... | 467, Beonyeong-ro, Seobuk-gu, Cheonan-si, Chungcheongnam-do, Korea |
| Contact..... | +82-41-560-3114 / http://samsungsdi.co.kr/ |
| Manufacturer's name ..... | Samsung SDI Co., Ltd |
| Address ..... | 467, Beonyeong-ro, Seobuk-gu, Cheonan-si, Chungcheongnam-do, Korea |
| Contact..... | +82-41-560-3114 / http://samsungsdi.co.kr/ |
| Test Standard ..... . | Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria, section 38.3 Sixth revised edition Amendment 1 |
| Description..... | Lithium ion battery ( 1S - 1P ) |
| Model Name ..... | EB-BN970ABU |
| Ratings ..... | 3.85V 3400mAh ( 13.09Wh) |
| Mass ..... | 46.60g |

SAMSUNG SAMSUNG SDI

**Test Result**

| No. | Test item | Result | Remark |
|---|---|---|---|
| T-1 | Altitude | PASS | |
| T-2 | Thermal Cycling | PASS | |
| T-3 | Vibration | PASS | |
| T-4 | Shock | PASS | |
| T-5 | External Short Circuit | PASS | |
| T-6 | Impact / Crush | PASS | |
| T-7 | Overcharge | PASS | |
| T-8 | Forced Discharge | PASS | |

| | Name | Signature | Date |
|---|---|---|---|
| Reported by | Hamhyunglwoo | | 2019. 5. 16 |
| Approved by | Hong Jong Pil | | 2019. 5. 16 |

| T1 | ALTITUDE SIMULATION TEST | Results |
|---|---|---|
| Requirements | No mass loss, no leakage, no venting,<br>no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. | ☒No leakage,<br>☒No venting,<br>☒No disassembly,<br>☒No rupture,<br>☒No fire,<br>☒No mass loss,<br>(Less than 0.2%)<br>☒No voltage drop<br>(Residual OCV not less than 90%)<br><br>See below table |

| Sample No. | Sample Condition | Voltage Before Test(V) | Weight Before Test(g) | Voltage After Test(V) | Weight After Test(g) | Residual OCV(%) | Percent of Weight Loss(%) |
|---|---|---|---|---|---|---|---|
| 1 | A | 4.333 | 46.639 | 4.332 | 46.637 | 99.98 | 0.00 |
| 2 | A | 4.334 | 46.606 | 4.334 | 46.606 | 100.00 | 0.00 |
| 3 | A | 4.333 | 46.706 | 4.332 | 46.704 | 99.98 | 0.00 |
| 4 | A | 4.332 | 46.679 | 4.330 | 46.679 | 99.95 | 0.00 |
| 5 | A | 4.335 | 46.558 | 4.334 | 46.558 | 99.98 | 0.00 |
| 6 | B | 4.334 | 46.663 | 4.334 | 46.663 | 100.00 | 0.00 |
| 7 | B | 4.334 | 46.671 | 4.333 | 46.670 | 99.98 | 0.00 |
| 8 | B | 4.333 | 46.554 | 4.333 | 46.554 | 100.00 | 0.00 |
| 9 | B | 4.334 | 46.724 | 4.333 | 46.721 | 99.98 | 0.01 |
| 10 | B | 4.334 | 46.623 | 4.334 | 46.623 | 100.00 | 0.00 |

□ Supplementary Information:

Sample Condition A : at first cycle, in fully charged states(5 pcs)

Sample Condition B : after 25th cycles ending in fully charged states(5 pcs)

| T2 | THERMAL TEST | Results |
|---|---|---|
| Requirements | No mass loss, no leakage, no venting,<br>no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. | ☒No leakage,<br>☒No venting,<br>☒No disassembly,<br>☒No rupture,<br>☒No fire,<br>☒No mass loss,<br>(Less than 0.2%)<br>☒No voltage drop<br>(Residual OCV not less than 90%)<br><br>See below table |

| Sample No. | Sample Condition | Voltage Before Test(V) | Weight Before Test(g) | Voltage After Test(V) | Weight After Test(g) | Residual OCV(%) | Percent of Weight Loss(%) |
|---|---|---|---|---|---|---|---|
| 1 | A | 4.332 | 46.637 | 4.286 | 46.632 | 98.94 | 0.01 |
| 2 | A | 4.334 | 46.606 | 4.290 | 46.600 | 98.98 | 0.01 |
| 3 | A | 4.332 | 46.704 | 4.292 | 46.700 | 99.08 | 0.01 |
| 4 | A | 4.330 | 46.679 | 4.299 | 46.675 | 99.28 | 0.01 |
| 5 | A | 4.334 | 46.558 | 4.284 | 46.551 | 98.85 | 0.02 |
| 6 | B | 4.334 | 46.663 | 4.289 | 46.658 | 98.96 | 0.01 |
| 7 | B | 4.333 | 46.670 | 4.293 | 46.666 | 99.08 | 0.01 |
| 8 | B | 4.333 | 46.554 | 4.296 | 46.554 | 99.15 | 0.00 |
| 9 | B | 4.333 | 46.721 | 4.301 | 46.720 | 99.26 | 0.00 |
| 10 | B | 4.334 | 46.623 | 4.293 | 46.619 | 99.05 | 0.01 |

□ Supplementary Information:

Sample Condition A : at first cycle, in fully charged states(5 pcs)

Sample Condition B : after 25th cycles ending in fully charged states(5 pcs)

| T3 | VIBRATION TEST | Results |
|---|---|---|
| Requirements | No mass loss, no leakage, no venting,<br>no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. | ☒No leakage,<br>☒No venting,<br>☒No disassembly,<br>☒No rupture,<br>☒No mass loss,<br>(Less than 0.2%)<br>☒No voltage drop<br>(Residual OCV not less than 90%)<br><br>See below table |

| Sample No. | Sample Condition | Voltage Before Test(V) | Weight Before Test(g) | Voltage After Test(V) | Weight After Test(g) | Residual OCV(%) | Percent of Weight Loss(%) |
|---|---|---|---|---|---|---|---|
| 1 | A | 4.286 | 46.632 | 4.284 | 46.630 | 99.95 | 0.00 |
| 2 | A | 4.290 | 46.600 | 4.290 | 46.600 | 100.00 | 0.00 |
| 3 | A | 4.292 | 46.700 | 4.292 | 46.700 | 100.00 | 0.00 |
| 4 | A | 4.299 | 46.675 | 4.297 | 46.672 | 99.95 | 0.01 |
| 5 | A | 4.284 | 46.551 | 4.283 | 46.551 | 99.98 | 0.00 |
| 6 | B | 4.289 | 46.658 | 4.289 | 46.656 | 100.00 | 0.00 |
| 7 | B | 4.293 | 46.666 | 4.292 | 46.666 | 99.98 | 0.00 |
| 8 | B | 4.296 | 46.554 | 4.295 | 46.554 | 99.98 | 0.00 |
| 9 | B | 4.301 | 46.720 | 4.301 | 46.721 | 100.00 | 0.00 |
| 10 | B | 4.293 | 46.619 | 4.293 | 46.617 | 100.00 | 0.00 |

□ Supplementary Information:

Sample Condition A : at first cycle, in fully charged states(5 pcs)

Sample Condition B : after 25th cycles ending in fully charged states(5 pcs)

| T4 | SHOCK | Results |
|---|---|---|
| Requirements | No mass loss, no leakage, no venting,<br>no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. | ☒No leakage,<br>☒No venting,<br>☒No disassembly,<br>☒No rupture,<br>☒No fire,<br>☒No mass loss,<br>(Less than 0.2%)<br>☒No voltage drop<br>(Residual OCV not less than 90%)<br><br>See below table |

| Sample No. | Sample Condition | Voltage Before Test(V) | Weight Before Test(g) | Voltage After Test(V) | Weight After Test(g) | Residual OCV(%) | Percent of Weight Loss(%) |
|---|---|---|---|---|---|---|---|
| 1 | A | 4.284 | 46.630 | 4.281 | 46.632 | 99.93 | 0.00 |
| 2 | A | 4.290 | 46.600 | 4.287 | 46.598 | 99.93 | 0.00 |
| 3 | A | 4.292 | 46.700 | 4.290 | 46.701 | 99.95 | 0.00 |
| 4 | A | 4.297 | 46.672 | 4.294 | 46.672 | 99.93 | 0.00 |
| 5 | A | 4.283 | 46.551 | 4.281 | 46.550 | 99.95 | 0.00 |
| 6 | B | 4.289 | 46.656 | 4.286 | 46.654 | 99.93 | 0.00 |
| 7 | B | 4.292 | 46.666 | 4.290 | 46.663 | 99.95 | 0.01 |
| 8 | B | 4.295 | 46.554 | 4.294 | 46.552 | 99.98 | 0.00 |
| 9 | B | 4.301 | 46.721 | 4.301 | 46.721 | 100.00 | 0.00 |
| 10 | B | 4.293 | 46.617 | 4.290 | 46.618 | 99.93 | 0.00 |

□ Supplementary Information:

Sample Condition A : at first cycle, in fully charged states(5 pcs)

Sample Condition B : after 25th cycles ending in fully charged states(5 pcs)

| T5 | EXTERNAL SHORT-CIRCUIT | Results |
|---|---|---|
| Requirements | External temperature does not exceed 170 °C and there is no disassembly, no rupture and no fire within six hours of this test. | ☒No disassembly,<br>☒No rupture<br>☒No fire.<br>☒External Temperature did not exceed 170 °C.<br><br>see below table |

| Sample No. | Sample Condition | Maximum Temperature(°C) | Test result |
|---|---|---|---|
| 1 | A | 57 | O |
| 2 | A | 57 | O |
| 3 | A | 57 | O |
| 4 | A | 57 | O |
| 5 | A | 57 | O |
| 6 | B | 57 | O |
| 7 | B | 57 | O |
| 8 | B | 57 | O |
| 9 | B | 57 | O |
| 10 | B | 57 | O |

□ Supplementary Information:

Sample Condition A : at first cycle, in fully charged states(5 pcs)

Sample Condition B : after 25th cycles ending in fully charged states(5 pcs)

Test result : O-No Disassembly, No Rupture, No Fire / D-Disassembly / R-Rupture / F-Fire

| T6 | ☐ Impact / ☒ Crush | Results |
|---|---|---|
| Requirements | Cells and component cells meet this requirement if their external temperature does not exceed 170℃ and there is no disassembly and no fire during the test and within six hours after this test. | ☒External temperature did not exceed 170℃,<br>☒no disassembly,<br>☒no fire during test and within 6 hours after test<br><br>See below table |

| Sample No. | Sample Condition | Voltage Before Test(V) | Maximum Temperature(°C) | Test result |
|---|---|---|---|---|
| T6-1 | C | 3.772 | 23 | O |
| T6-2 | C | 3.772 | 23 | O |
| T6-3 | C | 3.772 | 23 | O |
| T6-4 | C | 3.772 | 23 | O |
| T6-5 | C | 3.772 | 23 | O |
| T6-6 | D | 3.772 | 23 | O |
| T6-7 | D | 3.772 | 23 | O |
| T6-8 | D | 3.772 | 23 | O |
| T6-9 | D | 3.772 | 23 | O |
| T6-10 | D | 3.772 | 23 | O |

□ Supplementary Information:

Sample Condition C : at first cycle, in 50% charged states(5 pcs)

Sample Condition D : at 25th cycle, in 50% charged states(5 pcs)

Test result : O-No Disassembly, No Fire / D-Disassembly / F-Fire

| T7 | OVERCHARGE | Results |
|---|---|---|
| Requirements | Rechargeable batteries meet this requirement if there is no disassembly and no fire during the test and within seven days after the test. | ☒No disassembly,<br>☒no rupture,<br>☒no fire during the test and within seven days after the test.<br><br>See below table |

| Sample No. | Sample Condition | Voltage Before Test(V) | Test result |
|---|---|---|---|
| T7-1 | A | 4.333 | O |
| T7-2 | A | 4.334 | O |
| T7-3 | A | 4.333 | O |
| T7-4 | A | 4.332 | O |
| T7-5 | B | 4.333 | O |
| T7-6 | B | 4.332 | O |
| T7-7 | B | 4.334 | O |
| T7-8 | B | 4.334 | O |

□ Supplementary Information:

Sample Condition A : at first cycle, in fully charged states(4 pcs)

Sample Condition B : after 25th cycles ending in fully charged states(4 pcs)

Test result : O-No Disassembly, No Fire / D-Disassembly / F-Fire

□ Test Conditions

Charge voltage : 8.8V, Charge current : 8.84A, Test time : 24Hr

| T8 | FORCED DISCHARGE | Results |
|---|---|---|
| Requirements | Rechargeable cells meet this requirement if there is no disassembly and no fire during the test and within seven days after the test. | ☒No disassembly,<br>☒no rupture,<br>☒no fire during the test and within seven days after the test.<br><br>See below table |

| Sample No. | Sample Condition | Test result | Sample No. | Sample Condition | Test result |
|---|---|---|---|---|---|
| T8-1 | E | O | T8-11 | F | O |
| T8-2 | E | O | T8-12 | F | O |
| T8-3 | E | O | T8-13 | F | O |
| T8-4 | E | O | T8-14 | F | O |
| T8-5 | E | O | T8-15 | F | O |
| T8-6 | E | O | T8-16 | F | O |
| T8-7 | E | O | T8-17 | F | O |
| T8-8 | E | O | T8-18 | F | O |
| T8-9 | E | O | T8-19 | F | O |
| T8-10 | E | O | T8-20 | F | O |

□ Supplementary Information:

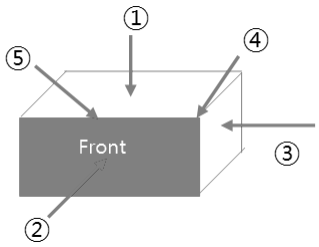
Sample Condition E : at first cycle, in fully discharged states (10 pcs)

Sample Condition F : after 25th cycles ending in fully discharged states(10 pcs)

Test result : O-No Disassembly, No Fire / D-Disassembly / F-Fire

□ Test Conditions

Initial test current : 3.4A, Test duration : 1Hr

| P1 | Package Drop Test | Results |
|---|---|---|
| Procedure | IATA Dangerous Goods Regulations<br>Each package must be capable of withstanding a 1.2m drop test in any orientation<br>  | ☒ Without damage to cells or batteries contained therein,<br>☒ Without shifting of the contents so as to allow battery to battery(or Cell to cell) contact.<br>☒ Without release of contents<br><br>See below photo |

| Battery Qty per box | Battery weight (kg) | Net weight per box (kg) |
|---|---|---|
| 160 | 0.046 | 7.36 |

| | Before Test | After Test |
|---|---|---|
| Weight (kg) | 8.95 | 8.95 |
| Test result | | |

Sample Photo

| front | back |
| --- | --- |
| | |

- End of Report -