

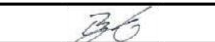


|          |                            |   |
|----------|----------------------------|---|
| 문서번호     | QAE EF02 150325 CY18650HG2 |   |
| Prepared | 남익현                        |  |
|          | 장승현                        |   |
| Reviewed | 남대호                        |  |
|          | 박해나                        |   |
| Approved | 김병수                        |  |

**SolutionPartner**

# UN Test Report

## - INR18650HG2 (Nom. 3000 mAh)-

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2019. 12. 27



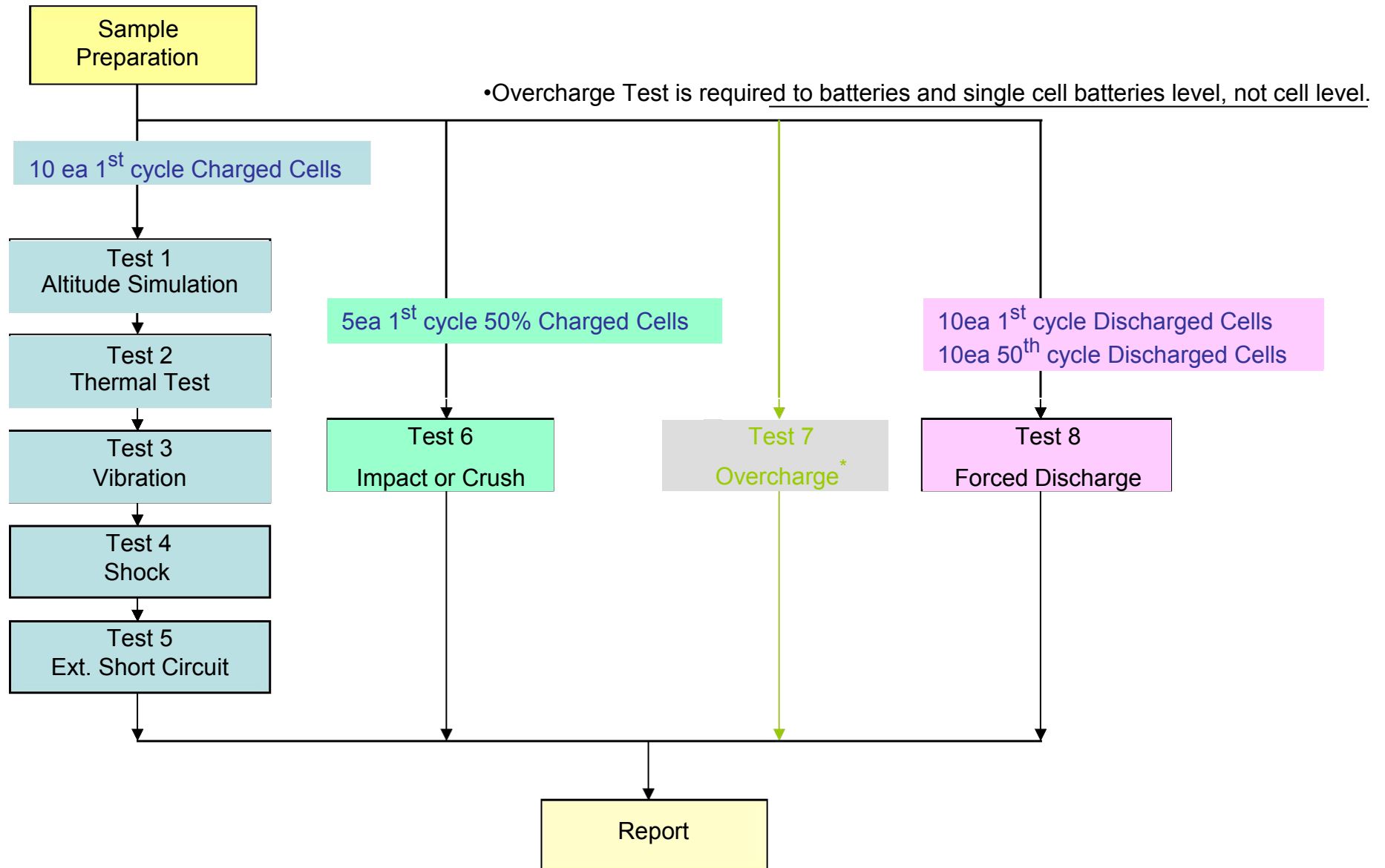
# 1. UN Transportation Regulation Test

| Test  | Condition  | Requirements   |
|---|--|--|
| Test 1. Altitude Simulation   | Storing at (low pressure) 11.6kPa for 6hr at 20+/- 5°C   | Measuring mass before/ after each test<br>(If M<1g, less than 0.5%, If 1g≤M≤75g, less than 0.2%, If M>75g, less than 0.1%)<br>Measuring voltage before/ after each test (more than 90%)<br>No leakage, no venting, no disassembly, no rupture, no fire |
| Test 2. Thermal Test  | [72±2°C, 6hr ↔ 40±2°C, 6hr, interval max. 30min] x 10 cycle<br>Storing at 20±5°C for 24h   |  |
| Test 3. Vibration   | [7Hz↔200Hz↔7Hz, in 15min] x 12 times x 3 direction<br>1) sinusoidal waveform with a logarithmic sweep<br>2) 7Hz 18Hz (maintaining 1gn) app. 50Hz (until 8gn)<br>200Hz (maintaining 8gn), 1.6mm total excursion | No disassembly, no rupture, no fire within 6 hours after the test<br>Temp. monitoring (max. 170°C)   |
| Test 4. Shock   | Half sine shock<br>(peak acceleration : 150gn, pulse duration : 6msec) x 6 (±x, y, z), direction x 3 cycle   |  |
| Test 5. External Short Circuit  | 100m ext. short circuit at 55±2°C<br>1hr continue after returning at 55±2°C  | No disassembly,<br>no fire within 6 hours after the test<br>Temp. monitoring (max. 170°C)  |
| Test 6. Impact<br>for cylindrical cells (> 18mm diameter)   | Φ=15.8mm bar, 9.1kg mass, 61±2.5cm height  |  |
| Test 6. Crush<br>for cylindrical cells (≤ 18mm diameter)<br>for prismatic, pouch, coin/button cells | Crushing rate : 1.5cm/s, until 13kN±0.78kN or 100mV drop or 50% deformation  | Overcharge Test is required to pack battery level, not cell level.   |
| Test 7. Overcharge  | Only for battery, not cell.  |  |
| Test 8. Forced Discharge  | Discharge at max. discharge current (with 12V DC power supply),<br>Duration time = rated capacity/initial test current   | No disassembly,<br>no fire within 7 days after the test  |

5. Tests through T1 T5 shall be conducted in sequence with the same samples.

6. We declare that the above mentioned test is the result of being checked according to UN Test ( Manual of Test and Criteria ST/SG/AC.10/11/Rev.5/Amd.2)

## 2. Test Procedure



# 3-1. T1-T4 Test Result

| Before                           |       |        | Altitude (T1) |        |                 |              |        | Thermal (T2) |        |                 |              |        | Vibration (T3) |        |                 |              |        | Shock (T4) |        |                 |              |        |
|----------------------------------|-------|--------|---------------|--------|-----------------|--------------|--------|--------------|--------|-----------------|--------------|--------|----------------|--------|-----------------|--------------|--------|------------|--------|-----------------|--------------|--------|
| NO.                              | OCV   | Mass   | OCV           | Mass   | Residual OCV(%) | Mass Loss(%) | Result | OCV          | Mass   | Residual OCV(%) | Mass Loss(%) | Result | OCV            | Mass   | Residual OCV(%) | Mass Loss(%) | Result | OCV        | Mass   | Residual OCV(%) | Mass Loss(%) | Result |
| A. 1st cycle fully charged state |       |        |               |        |                 |              |        |              |        |                 |              |        |                |        |                 |              |        |            |        |                 |              |        |
| 1                                | 4.180 | 44.878 | 4.180         | 44.878 | 100.00          | 0.000        | Pass   | 4.129        | 44.877 | 98.78           | 0.002        | Pass   | 4.129          | 44.875 | 100.00          | 0.004        | Pass   | 4.129      | 44.875 | 100.00          | 0.000        | Pass   |
| 2                                | 4.180 | 44.866 | 4.180         | 44.865 | 100.00          | 0.002        | Pass   | 4.129        | 44.864 | 98.78           | 0.002        | Pass   | 4.129          | 44.863 | 100.00          | 0.002        | Pass   | 4.129      | 44.863 | 100.00          | 0.000        | Pass   |
| 3                                | 4.180 | 44.938 | 4.180         | 44.937 | 100.00          | 0.002        | Pass   | 4.130        | 44.935 | 98.80           | 0.004        | Pass   | 4.130          | 44.934 | 100.00          | 0.002        | Pass   | 4.130      | 44.934 | 100.00          | 0.000        | Pass   |
| 4                                | 4.180 | 44.795 | 4.180         | 44.794 | 100.00          | 0.002        | Pass   | 4.130        | 44.792 | 98.80           | 0.004        | Pass   | 4.130          | 44.792 | 100.00          | 0.000        | Pass   | 4.130      | 44.792 | 100.00          | 0.000        | Pass   |
| 5                                | 4.180 | 44.945 | 4.180         | 44.944 | 100.00          | 0.002        | Pass   | 4.129        | 44.942 | 98.78           | 0.004        | Pass   | 4.129          | 44.942 | 100.00          | 0.000        | Pass   | 4.129      | 44.942 | 100.00          | 0.000        | Pass   |
| 6                                | 4.180 | 44.816 | 4.180         | 44.815 | 100.00          | 0.002        | Pass   | 4.131        | 44.813 | 98.83           | 0.004        | Pass   | 4.131          | 44.813 | 100.00          | 0.000        | Pass   | 4.130      | 44.812 | 99.98           | 0.002        | Pass   |
| 7                                | 4.180 | 44.993 | 4.180         | 44.992 | 100.00          | 0.002        | Pass   | 4.130        | 44.992 | 98.80           | 0.000        | Pass   | 4.130          | 44.992 | 100.00          | 0.000        | Pass   | 4.130      | 44.990 | 100.00          | 0.004        | Pass   |
| 8                                | 4.180 | 44.926 | 4.180         | 44.925 | 100.00          | 0.002        | Pass   | 4.131        | 44.924 | 98.83           | 0.002        | Pass   | 4.131          | 44.924 | 100.00          | 0.000        | Pass   | 4.131      | 44.923 | 100.00          | 0.002        | Pass   |
| 9                                | 4.180 | 44.929 | 4.180         | 44.928 | 100.00          | 0.002        | Pass   | 4.130        | 44.927 | 98.80           | 0.002        | Pass   | 4.130          | 44.926 | 100.00          | 0.002        | Pass   | 4.130      | 44.926 | 100.00          | 0.000        | Pass   |
| 10                               | 4.180 | 44.869 | 4.180         | 44.868 | 100.00          | 0.002        | Pass   | 4.131        | 44.867 | 98.83           | 0.002        | Pass   | 4.130          | 44.867 | 99.98           | 0.000        | Pass   | 4.130      | 44.867 | 100.00          | 0.000        | Pass   |
| Ave.                             | 4.180 | 44.896 | 4.180         | 44.895 | 100.00          | 0.002        |        | 4.130        | 44.893 | 98.80           | 0.003        |        | 4.130          | 44.893 | 100.00          | 0.001        |        | 4.130      | 44.892 | 100.00          | 0.001        |        |

|             |  |
|-------------|--|
| Requirement | Measuring mass before/after each test (If M>75g, less than 0.1%, 1g≤M≤75, less than 0.2%, M<1g, less than 0.5%)<br>Measuring voltage before/after each test (more than 90%, only charged samples)<br>No leakage, no venting, no disassembly, no rupture, no fire |
|-------------|--|

# 3-2. T5/T6/T8 Test Result

| EXT.Short Circuit (T5)           |                |                |        |
|----------------------------------|----------------|----------------|--------|
| NO.                              | Initial OCV(V) | Max. Temp (°C) | Result |
| A. 1st cycle fully charged state |                |                |        |
| 1                                | 4.129          | 88.39          | Pass   |
| 2                                | 4.129          | 95.36          | Pass   |
| 3                                | 4.130          | 79.10          | Pass   |
| 4                                | 4.130          | 87.97          | Pass   |
| 5                                | 4.129          | 86.86          | Pass   |
| 6                                | 4.130          | 96.57          | Pass   |
| 7                                | 4.130          | 92.04          | Pass   |
| 8                                | 4.131          | 89.95          | Pass   |
| 9                                | 4.130          | 95.19          | Pass   |
| 10                               | 4.130          | 93.19          | Pass   |
| MAX.                             | 4.131          | 96.57          |        |

| Test Condition                    |
|-----------------------------------|
| 100m ext. short circuit at 55±2°C |

| Requirement   |
|---|
| Temperature < 170 (°C)<br>No disassembly, no rupture, no fire within 6 hours after the test |

| Impact (T6)                    |       |                |                |        |
|--------------------------------|-------|----------------|----------------|--------|
| Direction                      | NO.   | Initial OCV(V) | Max. Temp (°C) | Result |
| A. 1st cycle 50% charged state |       |                |                |        |
| Flat                           | 11    | 3.643          | 23.29          | Pass   |
|                                | 12    | 3.646          | 23.24          | Pass   |
|                                | 13    | 3.643          | 32.05          | Pass   |
|                                | 14    | 3.645          | 35.23          | Pass   |
| 15                             | 3.642 | 23.89          | Pass           |        |
| MAX.                           | 3.646 | 35.23          |                |        |

| Test Condition                            |
|---|
| Φ=15.8mm bar, 9.1kg mass, 61±2.5cm height |

| Requirement   |
|---|
| Temperature ≤ 170 (°C)<br>No disassembly, no fire within 6 hours after the test |

| Forced Discharge (T8)               |                |                |        |
|-------------------------------------|----------------|----------------|--------|
| NO.                                 | Initial OCV(V) | Max. Temp (°C) | Result |
| A. 1st cycle fully discharged state |                |                |        |
| 16                                  | 2.848          | 87.99          | Pass   |
| 17                                  | 2.847          | 86.58          | Pass   |
| 18                                  | 2.866          | 92.50          | Pass   |
| 19                                  | 2.853          | 91.33          | Pass   |
| 20                                  | 2.848          | 87.78          | Pass   |
| 21                                  | 2.851          | 90.97          | Pass   |
| 22                                  | 2.839          | 91.64          | Pass   |
| 23                                  | 2.826          | 84.84          | Pass   |
| 24                                  | 2.832          | 87.53          | Pass   |
| 25                                  | 2.880          | 94.42          | Pass   |
| MAX.                                | 2.880          | 94.42          |        |

|                                      |       |        |      |
|--------------------------------------|-------|--------|------|
| B. 50th cycle fully discharged state |       |        |      |
| 26                                   | 3.120 | 119.24 | Pass |
| 27                                   | 3.120 | 114.17 | Pass |
| 28                                   | 3.124 | 118.38 | Pass |
| 29                                   | 3.121 | 113.94 | Pass |
| 30                                   | 3.120 | 107.10 | Pass |
| 31                                   | 3.122 | 112.09 | Pass |
| 32                                   | 3.123 | 118.47 | Pass |
| 33                                   | 3.121 | 111.64 | Pass |
| 34                                   | 3.123 | 116.38 | Pass |
| 35                                   | 3.123 | 108.95 | Pass |
| MAX.                                 | 3.124 | 119.24 |      |

| Test Condition  |
|---|
| Discharge at max. discharge current (with 12V DC power supply) : 20000mA<br>Duration time: rated capacity (9min ) |

| Requirement  |
|--|
| No disassembly, no fire within 7 days after the test |