

Model name : ICR18650-30A

| | | | |
|----------------|-------------------------|---|------------|
| Executive Div. | CSG | Confidential | |
| | Name / Title | Signature | Date |
| Reported by | Jay Chung / Safety Eng. |  | 2011.04.14 |
| Approved by | John Jeon / Director |  | 2011.04.14 |

Test report; UN Manual of Tests and Criteria,
Part II, Subsection 38.3

2003, 4th Revision

Document No : MT0004587

SAMSUNG SDI
Energy Business Division



Product Information

1. Model name: **ICR18650-30A**
2. Product classification: **Li-ion cylindrical cell**
2. Nominal voltage: **3.78V**
3. Rated capacity: **2950mAh**
4. Wh Capacity: **11.15Wh**
5. Weight of product: **Maximum 48.0g**
6. Test Date: **2007.11.12**
7. Test Location: **SAMSUNG SDI Safety Center, 508 Sungsungdong, Cheonan
Chungcheongnamdo, Korea**

Test summary

| Test Item | Test Method | Criteria | Fresh | | | 50 cycled |
|----------------------------|--|---|-------|-----|----|-----------|
| | | | 100% | 50% | 0% | 0% |
| T-1 Altitude Simulation | 11.6kPa for 6Hr at 20± 5°C | No mass loss (not exceed 0.1%) No leakage No venting No disassembly No rupture No fire OCV > 90% of the initial voltage | 10 | - | 10 | - |
| T-2 Thermal test | 75± 2°C for 6Hr ↔ -40± 2°C for 6Hrs (Transfer time : 30min), 10cycle | | | | | |
| T-3 Vibration | 7Hz → 200Hz → 7Hz in 15min, 12cycle for 3Hr, 3 direction | | | | | |
| T-4 Shock | Half-sine shock of peak acceleration 150g, duration 6ms 3(pos.)shocks → 3(neg.)shocks, 3direction, Total 18shocks | | | | | |
| T-5 External short circuit | Wire: Less 0.1ohm, Case temp. : 55± 2°C for 1Hr or temp. return | | | | | |
| T-6 Impact | Flat surface, 15.8mm bar, weight:9.1Kg, Height : 61±2.5cm | No disassembly No rupture | - | 5 | - | 5 |
| T-8 Forced discharge | Maximum current(1C) specified by the manufacturer, 12V DC power supply for 1 hr(T=Capacity/test current) | No disassembly No fire within 7days | - | | 10 | 10 |

- Tests T-1 through T-5 shall be conducted in sequence with the same call
- For test 6, test should be conducted for cells in a pack
- T7 shall be performed only for Li-rechargeable battery not Li-ion cell.
- T8 shall be performed only for Li-ion cell not Li-rechargeable battery.

T-1~T-5) Transportation Test: Pass

| Fresh cell (100% SOC) | | | After T-1 | | | | After T-2 | | | | After T-3 | | | | After T-4 | | | | After T-5 | Result |
|-----------------------|----------------|-------------|----------------|---------------|---------------|-------------|----------------|---------------|---------------|-------------|----------------|---------------|---------------|-------------|----------------|----------------|----------------|-------------|--------------|--------|
| No | Weight(g) | OCV(V) | Weight(g) | Mass Loss | Loss(%) | OCV(V) | Weight(g) | Mass Loss | Loss(%) | OCV(V) | Weight(g) | Mass Loss | Loss(%) | OCV(V) | Weight(g) | Mass Loss | Loss(%) | OCV(V) | Max Temp(°C) | |
| 1 | 46.7050 | 4.32 | 46.7046 | 0.0004 | 0.00 | 4.31 | 46.7006 | 0.0040 | 0.01 | 4.21 | 46.7012 | -0.0006 | 0.00 | 4.20 | 46.7008 | 0.0004 | 0.00 | 4.20 | 63.6 | OK |
| 2 | 46.5953 | 4.32 | 46.5945 | 0.0008 | 0.00 | 4.31 | 46.5895 | 0.0050 | 0.01 | 4.21 | 46.5855 | 0.0040 | 0.01 | 4.20 | 46.5852 | 0.0003 | 0.00 | 4.20 | 62.8 | OK |
| 3 | 46.6106 | 4.32 | 46.6100 | 0.0006 | 0.00 | 4.31 | 46.6050 | 0.0050 | 0.01 | 4.21 | 46.6035 | 0.0015 | 0.00 | 4.20 | 46.6033 | 0.0002 | 0.00 | 4.20 | 57.2 | OK |
| 4 | 46.6848 | 4.31 | 46.6846 | 0.0002 | 0.00 | 4.31 | 46.6786 | 0.0060 | 0.01 | 4.21 | 46.6770 | 0.0016 | 0.00 | 4.20 | 46.6770 | 0.0000 | 0.00 | 4.20 | 61.0 | OK |
| 5 | 46.6329 | 4.31 | 46.6313 | 0.0016 | 0.00 | 4.31 | 46.6287 | 0.0026 | 0.01 | 4.21 | 46.6295 | -0.0008 | 0.00 | 4.20 | 46.6294 | 0.0001 | 0.00 | 4.20 | 59.1 | OK |
| 6 | 46.6441 | 4.31 | 46.6430 | 0.0011 | 0.00 | 4.31 | 46.6409 | 0.0021 | 0.00 | 4.21 | 46.6385 | 0.0024 | 0.01 | 4.20 | 46.6399 | -0.0014 | 0.00 | 4.20 | 60.1 | OK |
| 7 | 46.6700 | 4.31 | 46.6696 | 0.0004 | 0.00 | 4.31 | 46.6666 | 0.0030 | 0.01 | 4.21 | 46.6660 | 0.0006 | 0.00 | 4.20 | 46.6654 | 0.0006 | 0.00 | 4.20 | 68.7 | OK |
| 8 | 46.6125 | 4.31 | 46.6110 | 0.0015 | 0.00 | 4.31 | 46.6068 | 0.0042 | 0.01 | 4.21 | 46.6041 | 0.0027 | 0.01 | 4.20 | 46.6120 | -0.0079 | -0.02 | 4.20 | 61.8 | OK |
| 9 | 46.6288 | 4.31 | 46.6283 | 0.0005 | 0.00 | 4.31 | 46.6260 | 0.0023 | 0.00 | 4.21 | 46.6217 | 0.0043 | 0.01 | 4.20 | 46.6223 | -0.0006 | 0.00 | 4.20 | 63.9 | OK |
| 10 | 46.6517 | 4.31 | 46.6516 | 0.0001 | 0.00 | 4.31 | 46.6472 | 0.0044 | 0.01 | 4.21 | 46.6476 | -0.0004 | 0.00 | 4.20 | 46.6469 | 0.0007 | 0.00 | 4.20 | 60.3 | OK |
| AVE | 46.6436 | 4.31 | 46.6429 | 0.0007 | 0.0015 | 4.31 | 46.6390 | 0.0039 | 0.0083 | 4.21 | 46.6375 | 0.0015 | 0.0033 | 4.20 | 46.6382 | -0.0008 | -0.0016 | 4.20 | 61.85 | |
| MAX | 46.7050 | 4.32 | 46.7046 | 0.0016 | 0.0034 | 4.31 | 46.7006 | 0.0050 | 0.0129 | 4.21 | 46.7012 | 0.0043 | 0.0092 | 4.20 | 46.7008 | 0.0007 | 0.0015 | 4.20 | 68.70 | |
| MIN | 46.5953 | 4.31 | 46.5945 | 0.0001 | 0.0002 | 4.31 | 46.5895 | 0.0021 | 0.0045 | 4.21 | 46.5855 | -0.0008 | -0.0017 | 4.20 | 46.5852 | -0.0079 | -0.0169 | 4.20 | 57.20 | |

| Fresh cell (0% SOC) | | | After T-1 | | | | After T-2 | | | | After T-3 | | | | After T-4 | | | | After T-5 | Result |
|---------------------|----------------|-------------|----------------|---------------|---------------|-------------|----------------|---------------|---------------|-------------|----------------|---------------|---------------|-------------|----------------|---------------|---------------|-------------|--------------|--------|
| No | Weight(g) | OCV(V) | Weight(g) | Mass Loss | Loss(%) | OCV(V) | Weight(g) | Mass Loss | Loss(%) | OCV(V) | Weight(g) | Mass Loss | Loss(%) | OCV(V) | Weight(g) | Mass Loss | Loss(%) | OCV(V) | Max Temp(°C) | |
| 1 | 46.5880 | 3.25 | 46.5870 | 0.0010 | 0.00 | 3.24 | 46.5852 | 0.0018 | 0.00 | 3.05 | 46.5838 | 0.0014 | 0.00 | 3.00 | 46.5832 | 0.0006 | 0.00 | 2.99 | 58.4 | OK |
| 2 | 46.7193 | 3.24 | 46.7170 | 0.0023 | 0.00 | 3.24 | 46.7132 | 0.0038 | 0.01 | 3.03 | 46.7110 | 0.0022 | 0.00 | 2.99 | 46.7131 | -0.0021 | 0.00 | 2.98 | 56.5 | OK |
| 3 | 46.6894 | 3.25 | 46.6889 | 0.0005 | 0.00 | 3.24 | 46.6853 | 0.0036 | 0.01 | 3.02 | 46.6844 | 0.0009 | 0.00 | 2.98 | 46.6844 | 0.0000 | 0.00 | 2.97 | 57.8 | OK |
| 4 | 46.7005 | 3.25 | 46.6993 | 0.0012 | 0.00 | 3.24 | 46.6955 | 0.0038 | 0.01 | 3.02 | 46.6939 | 0.0016 | 0.00 | 2.98 | 46.6946 | -0.0007 | 0.00 | 2.97 | 58.3 | OK |
| 5 | 46.6866 | 3.24 | 46.6855 | 0.0011 | 0.00 | 3.24 | 46.6807 | 0.0048 | 0.01 | 3.03 | 46.6796 | 0.0011 | 0.00 | 2.98 | 46.6800 | -0.0004 | 0.00 | 2.98 | 58.8 | OK |
| 6 | 46.6212 | 3.25 | 46.6183 | 0.0029 | 0.01 | 3.24 | 46.6182 | 0.0001 | 0.00 | 3.04 | 46.6182 | 0.0000 | 0.00 | 2.99 | 46.6176 | 0.0006 | 0.00 | 2.99 | 58.3 | OK |
| 7 | 46.6115 | 3.25 | 46.6103 | 0.0012 | 0.00 | 3.24 | 46.6068 | 0.0035 | 0.01 | 3.03 | 46.6056 | 0.0012 | 0.00 | 2.99 | 46.6058 | -0.0002 | 0.00 | 2.98 | 56.9 | OK |
| 8 | 46.6530 | 3.25 | 46.6525 | 0.0005 | 0.00 | 3.24 | 46.6481 | 0.0044 | 0.01 | 3.02 | 46.6475 | 0.0006 | 0.00 | 2.98 | 46.6471 | 0.0004 | 0.00 | 2.97 | 58.1 | OK |
| 9 | 46.6098 | 3.25 | 46.6089 | 0.0009 | 0.00 | 3.24 | 46.6068 | 0.0021 | 0.00 | 3.04 | 46.6066 | 0.0002 | 0.00 | 3.00 | 46.6021 | 0.0045 | 0.01 | 3.00 | 58.2 | OK |
| 10 | 46.7185 | 3.24 | 46.7168 | 0.0017 | 0.00 | 3.24 | 46.7153 | 0.0015 | 0.00 | 3.03 | 46.7144 | 0.0009 | 0.00 | 2.99 | 46.7142 | 0.0002 | 0.00 | 2.99 | 58.5 | OK |
| AVE | 46.6598 | 3.25 | 46.6585 | 0.0013 | 0.0029 | 3.24 | 46.6555 | 0.0029 | 0.0063 | 3.03 | 46.6545 | 0.0010 | 0.0022 | 2.99 | 46.6542 | 0.0003 | 0.0006 | 2.98 | 57.98 | |
| MAX | 46.7193 | 3.25 | 46.7170 | 0.0029 | 0.0062 | 3.24 | 46.7153 | 0.0048 | 0.0103 | 3.05 | 46.7144 | 0.0022 | 0.0047 | 3.00 | 46.7142 | 0.0045 | 0.0097 | 3.00 | 58.80 | |
| MIN | 46.5880 | 3.24 | 46.5870 | 0.0005 | 0.0011 | 3.24 | 46.5852 | 0.0001 | 0.0002 | 3.02 | 46.5838 | 0.0000 | 0.0000 | 2.98 | 46.5832 | -0.0021 | -0.0045 | 2.97 | 56.50 | |

● Sample : 100% Charged – 10 Ea, 0% Charged – 10Ea

(weight after n-1_th test) - (weight after n_th test)

$$* \text{ Weight Loss} = \frac{\text{ (weight after n-1_th test) - (weight after n_th test) }}{\text{ (weight after n-1_th test) }} * 100$$

T-6) Impact Test: Pass

| Fresh cell (50% SOC) | | After T-6 | | Result |
|----------------------|--------------|---------------|--------------|-----------|
| No | OCV(V) | Max Temp.(°C) | Test Result | |
| 1 | 3.855 | 102.6 | Leakage Only | OK |
| 2 | 3.855 | 82.7 | Leakage Only | OK |
| 3 | 3.855 | 102.7 | Leakage Only | OK |
| 4 | 3.857 | 88.4 | Leakage Only | OK |
| 5 | 3.854 | 83.6 | Leakage Only | OK |
| AVE | 3.855 | 92.0 | | OK |
| MAX | 3.857 | 102.7 | | OK |
| MIN | 3.854 | 82.7 | | OK |

| 50cycled cell (0% SOC) | | After T-6 | | Result |
|------------------------|--------------|---------------|-------------|-----------|
| No | OCV(V) | Max Temp.(°C) | Test Result | |
| 1 | 3.372 | 41.0 | No Leakage | OK |
| 2 | 3.386 | 41.9 | No Leakage | OK |
| 3 | 3.392 | 42.0 | No Leakage | OK |
| 4 | 3.387 | 42.5 | No Leakage | OK |
| 5 | 3.392 | 41.6 | No Leakage | OK |
| AVE | 3.386 | 41.8 | | OK |
| MAX | 3.392 | 42.5 | | OK |
| MIN | 3.372 | 41.0 | | OK |

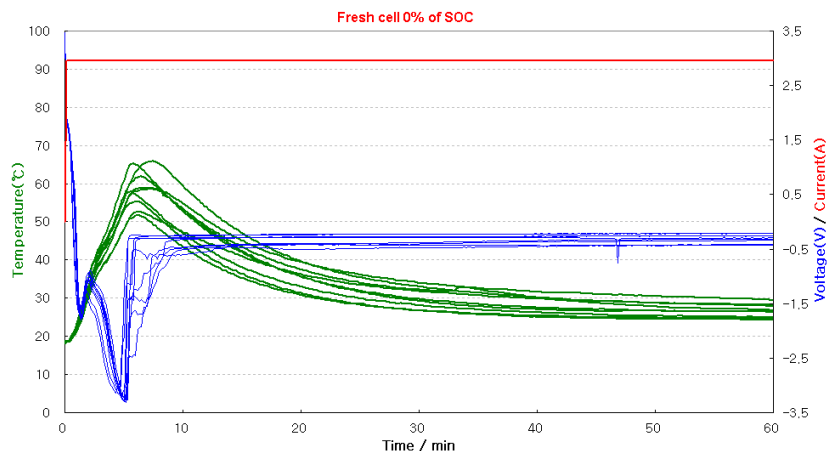
- Test method: Drop 9.1kg mass from 61cm height with 15.8mm diameter bar.
- Sample : Fresh Cell – 5 Ea / 50 cycled Cell – 5 Ea
- Test results: 5 Leakage only, 5 No Leakage.

T-8) Forced discharge Test: Pass

- Test condition: 1C / 1Hr

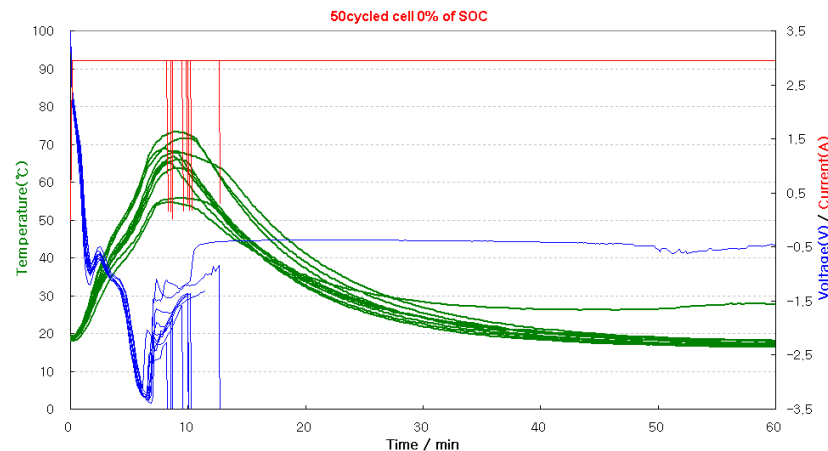
Fresh cell 0% of SOC

ICR18650-30A 12V 1C Forced Discharge



50Cycled cell 0% of SOC

ICR18650-30A 12V 1C Forced Discharge



※ curves shows representative cells

● Test method : 1C, -12V, 1.0Hrs discharge
with 0% charged cell (Fresh cell) & 0% charged cell (50 cycled cell) → 7days
storage

※ Max discharge current : 1C

● Sample : Fresh Cell – 10Ea / 50 cycled Cell – 10Ea
● Test results : All no Leakage