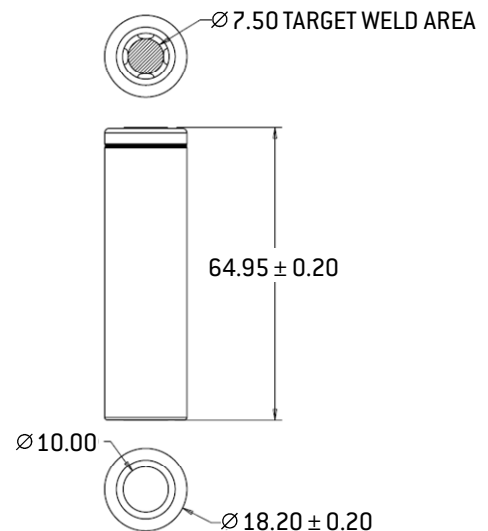


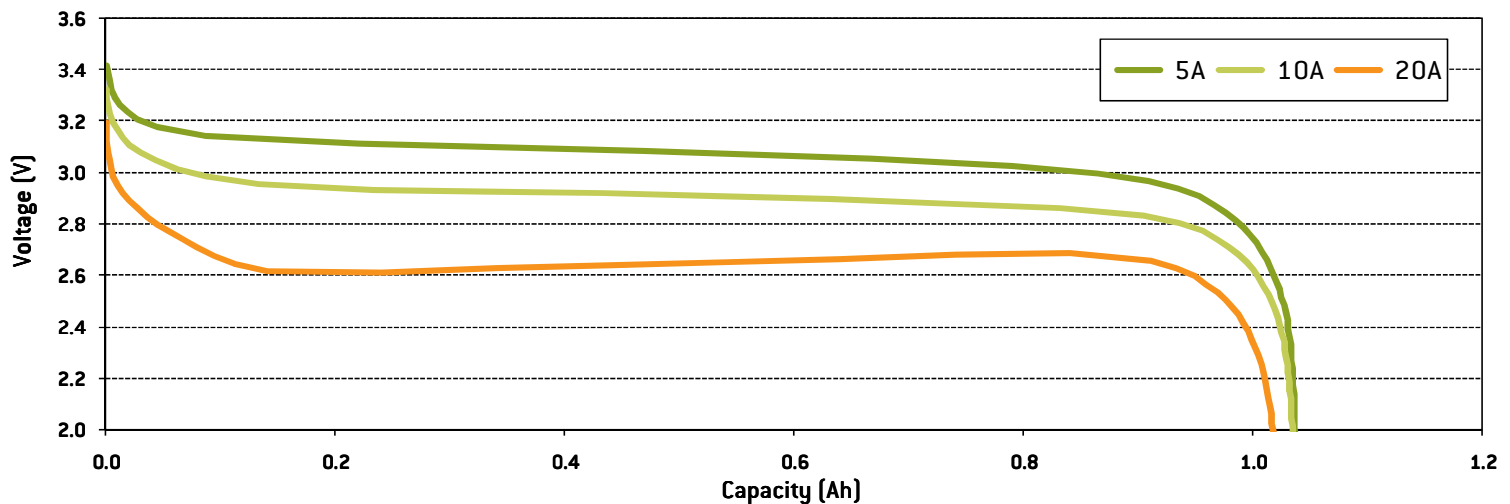
# High Power Lithium Ion APR18650<sup>m1</sup>A

A123Systems' lithium ion rechargeable APR18650<sup>m1</sup>A cell is capable of very high power, long cycle and storage life, and has superior abuse tolerance due to the use of patented Nanophosphate™ technology.

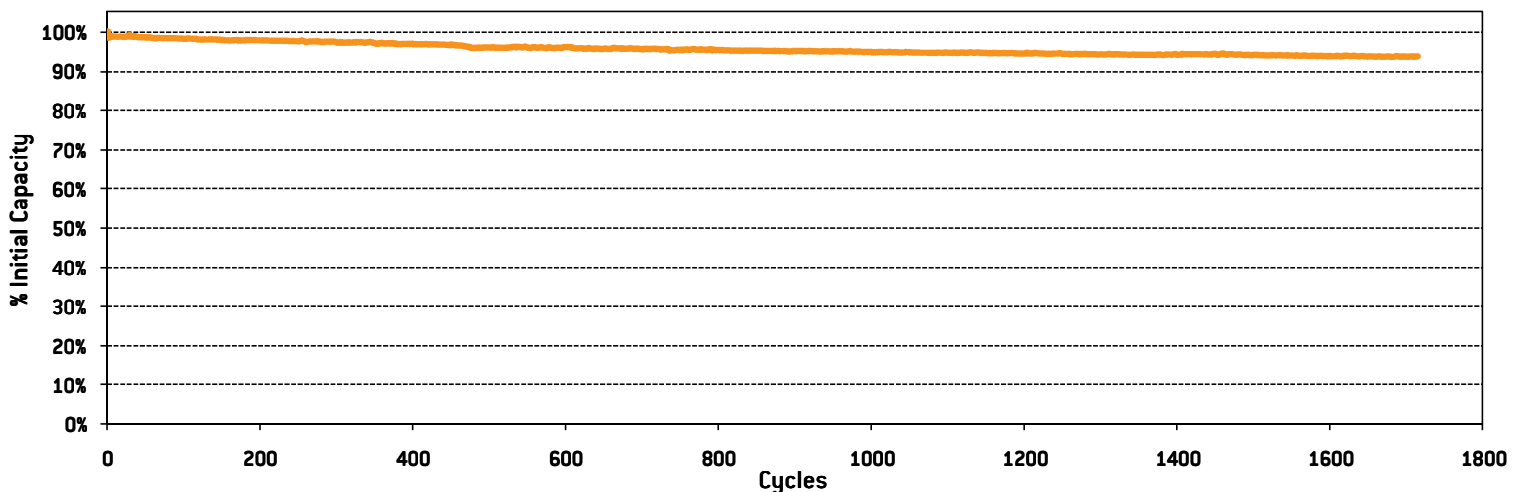
Nominal capacity and voltage	1.1Ah, 3.3 V
Recommended standard charge method	1.5A to 3.6V CCCV, 45 min
Recommended fast charge current	4A to 3.6V CCCV, 15 min
Maximum continuous discharge	30A
Cycle life at 5C discharge, 100% DOD	Over 1,000 cycles
Recommended charge and cut-off V at 25°C	3.6V to 2V
Operating temperature range	-30°C to +60°C
Storage temperature range	-50°C to +60°C
Core cell weight	39 grams



Discharge Characteristics, Room Temperature



Projected Cycle Life, 100% DOD, 1C/1C, Room Temperature



Title: Cell, Finished, Model APR18650M1A (TJL)

Location: s:\Company\Documentation\Product Specs\active\FSA300030\_04

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**2.0 PURPOSE**

This document describes the specification of the final stage of an assembled, formed, aged discharged, labeled and packaged APR18650M1A cell, assembled at TJL facilities.

**3.0 SCOPE**

This specification applies to finished APR18650M1A cells produced at TJL facilities. Unless otherwise specified, the body of this document pertains to all dash variations of the specification's main part number.

**4.0 DEFINITIONS**

Ship State: Approximately 50 % SOC, resulting from the final processing step.

**5.0 REFERENCE DOCUMENTS**

*All documents cited below represent the most recent revisions, unless otherwise stated.*

Ref. Document Number	Description
UL1642	Underwriters Laboratory specification of Lithium cells
LS003.CT748	Center Pin (TJL Internal Specification)
LS003.CT634-01	Cylindrical Cell Can (TJL Internal Specification)
LS003.CT749	Cell Cap (TJL Internal Specification)
LS003.CT637-02	Jellyroll Seal Tape (TJL Internal Specification)
LS003.CT637-01	Tab Protection Tape (TJL Internal Specification)
LS003.CT712-01	Top Insulator (TJL Internal Specification)
LS003.CT713-01	Bottom Insulator (TJL Internal Specification)
LS003.CT630-09	Separator (TJL Internal Specification)
LS003.CT711-01	Outside Insulator (TJL Internal Specification)
LS003.CT700	PET Sleeve (TJL Internal Specification)
OP000023	Lot Qualification Testing at TJL for APR18650M1
LS431.316QP	TJL Control Plan (Internal Document)

## 6.0 SPECIFICATION

### 6.1 Description

This is the final state of a 1.1Ah (nominal capacity), 18650 size lithium transition metal Nanophosphate™ ion cell.

### 6.2 Physical requirements

#### 6.2.1 Raw Material Requirements:

All raw materials not mentioned below must meet the requirements defined in TJL's internal specifications. These documents are referenced in Section 5.0.

##### 6.2.1.1 Electrolyte:

Moisture Limit:	20 ppm, Maximum	
HF content:	50 ppm, Maximum	
Density:	1.289 – 1.319 g/cc (@ 20°C)	
Color (APHA):	< 50	
Conductance:	9.3 +/- 0.3mS/cm	
Metal particle content data:	Cl: 1 ppm, max	Ca: 1 ppm, max
	Fe: 1 ppm, max	K: 1 ppm, max
	Na: 1 ppm, max	SO <sub>4</sub> : 3 ppm, max
	Pb: 1 ppm, max	

6.2.1.2 Cap to Can Sealant Material: Polyisobutylene

##### 6.2.1.3 PET Shrink Sleeve:

Dielectric Strength: > 80kV/mm

(All other Requirements defined in LS003.CT700)

#### 6.2.2 In-Process Requirements:

Refer to TJL Control Plan (LS431.316QP) for all assembly specifications not defined below.

##### 6.2.2.1 Jellyroll Winding:

Separator slit edge to Anode slit edge:	0.2mm minimum overlap, throughout jellyroll
Anode slit edge to cathode slit edge:	0.2mm minimum overlap, throughout jellyroll
Anode cut edge to cathode cut edge:	0.5mm minimum overlap, in the wound jellyroll form and at both the inside (core) and outside of the jellyroll. "CTQ"

6.2.2.2 Activation fill, weight: 7.00 ± 0.20 g

6.2.2.3 PET Shrink Sleeve Coverage: Coverage as shown in Cell Drawing (Appendix V)

6.2.3 General: The materials, processes and equipment used in the manufacture of these cells must be suitable for the intended use. Every effort must be taken to ensure contaminant levels are minimized.

### 6.3 Physical Specifications

Dash Variant	Title	Model
-001	Cell, Finished, Model APR18650M1A, Type A	APR18650M1A

*NOTE: \*CTQ\* Denotes Product Specifications that are Critical to Quality*

- 6.3.1 Weight, including PET shrink sleeve:  $39.00 \pm 1.0$  g **\*CTQ\***
- 6.3.2 Height, including PET shrink sleeve:  $64.95 \pm 0.20$  mm **\*CTQ\***  
(see Appendix V for additional detail)
- 6.3.3 Diameter, including PET shrink sleeve:  $18.20 \pm 0.20$  mm **\*CTQ\***
- 6.3.4 Markings: refer to section 10.3

### 6.4 Electrical Specifications

- 6.4.1 Self-discharge, 14 days of initial aging at 38°C:  $\geq 95.5\%$  capacity retention **\*CTQ\***
- 6.4.2 Voltage, in ship state (OCV)\*:  $3.310V < OCV < 3.330V$
- 6.4.3 AC Impedance, 1 kHz (ACR)<sup>+</sup>\*:  $ACR_{LOT\ AVERAGE} \pm 5m\Omega$  **\*CTQ\***  
(Absolute min: 12 mΩ  
Absolute max: 25 mΩ)
- 6.4.4 Voltage, within each cell lot, in ship state, prior to shipment (OCV)\*\*: Mean  $\pm 0.015$  V

\*As measured 18 – 168 hours after completion of the partial recharge process to approximately 50% SOC. If any cell sits in inventory for longer than 7 days after the partial recharge process, the OCV and ACR test must be repeated prior to packing for shipment, and the same criteria applies.

\*\* Mean Voltage is calculated from a sampling of a minimum of 30 cells within a given lot.

+ ACR Measurement to be done in Ambient Temp =  $25 \pm 3^\circ C$ . Cell must be in this environment for a minimum of 4 hours prior to measurement

### 6.5 Performance Specifications

- 6.5.1 Energy Density:

**Standard Charge: CC-CV 1.5A to 3.6 V (20 mA termination) at 25°C**

**Standard Discharge: CC-CV 10A to 2.0V at 25°C**

Items		Specification		Conditions
1)	Rated Energy Density at 25°C	5A	$> 75$ Wh/kg	Energy Density at 5A. 5A Discharge to 2.0V after standard charge
		10A <b>*CTQ*</b>	$> 70$ Wh/kg	Energy Density at 10A. Standard Discharge to 2.0V after standard charge
2)	Rated Energy Density at -10°C (Temp. Capability)	5A <b>*CTQ*</b>	$> 75\%$ of 5A Discharge Rated Energy Density at 25 °C ( $> 60$ Wh/kg)	Energy Density at 5A. 5A Discharge to 1.75V at -10°C after standard charge
		10A	TBD	Energy Density at 10A Discharge to 1.00V at -10°C after Standard charge

## 6.5.2 Cycle Life:

### Standard Cycling: CC-CV 1.5A Charge to 3.6V (20mA termination) and 10A discharge to 2.0V

Items		Specification		Conditions
1)	Cycle Life	25°C 10A <b>*CTQ*</b>	≥ 1000 Predicted Cycles (based on a minimum of 100 actual cycles)	Projected t <sup>x</sup> Cycle life to 75% of cycle 4 capacity. Standard Cycling at 25°C
		45°C 10A	≥ 750 Predicted Cycles (based on a minimum of 100 actual cycles)	Projected t <sup>x</sup> Cycle life to 75% of cycle 4 capacity. Standard Cycling at 45°C
		60°C 10A	≥ 500 Predicted Cycles (based on a minimum of 100 actual cycles).	Projected t <sup>x</sup> Cycle life to 75% of cycle 4 capacity. Standard Cycling at 60°C
2)	Long-term Cycle Life	25°C 10A <b>*CTQ*</b>	Capacity at cycle 1000 ≥ 75% of cycle 4 capacity.	Standard Cycling at 25 °C

## 6.5.3 Storage:

Items		Specification		Conditions
1)	Retained Capacity	25°C 28 Days	≥ 92%	Stored at 100% SOC Ratio of pre- and post-storage 550mA Discharge Capacity (to 2.0V)
		25°C 180 Days <b>*CTQ*</b>	≥ 85%	
2)	Recovered Capacity	25°C 28 Days	≥ 95%	Stored at 100% SOC Ratio of pre- and post-storage 550mA Discharge Capacity (to 2.0V)*
		25°C 180 Days	≥ 90%	
		60°C 14 Days	≥ 85%	
		60°C 180 Days <b>*CTQ*</b>	≥ 70%	
		70°C 14 Days <b>*CTQ*</b>	≥ 80%	Stored at 50% SOC Ratio of pre- and post-storage 550mA Discharge Capacity (to 2.0V)*
3)	ACR Increase	60°C 14 Days	< 30%	Stored at 100% SOC
		70°C 14 Days	< 30%	Stored at 100% SOC

## 6.5.4 Safety and Abuse Testing:

**All tested cells charged to 100% SOC unless otherwise noted**

Vent Codes:

Code #	Definition
0	No change
1	CID activate, ACR>40mΩ, capacity<80% initial, or OCV change>10%
2	Leak (>0.1% weight loss), or Vent opens
3	Smoke (more than a wisp)
4	Spark (more than just one spark)
5	Temperature > 150 °C
6	Sustained flame (more than one second)
7	Explosion, including Jelly roll ejection (length of JR outside of can greater than 50mm)
8	Explosion where battery parts penetrate aluminum wire screen by breaking holes in that screen (Note: powder or similar small particles that exit through the normal openings of the screen mesh is not considered 'penetrating the screen".)

Items	Criteria	Conditions
1) Temp Cycling <b>*CTQ*</b>	< 0.1 % No fire, Vent, Leak, or Explosion	Per UL1642, Test 18
2) Vibration <b>*CTQ*</b>	Change in OCV: < 2% immediately after test < 2% 24 hrs. after test ACR Change: < 15% immediately after test < 20% 24 hrs. after test < 0.1 % Weight Change after test Vent Code ≤ 0	Random vibration spec for 3 hours. Axial and Radial vibration Frequency Range 20 to 1000 Hz Random Vibration: a) @ 20 Hz acceleration 0.04997 G2/Hz b) @ 55 Hz, acceleration 0.1956 G2/Hz with a slope of 4 dB/Octave from 20 Hz c) @ 350 Hz, acceleration 0.1956 G2/Hz with a slope of 0 dB/Octave from 55 Hz d) @ 1000 Hz, acceleration 0.06998 G2/Hz with a slope of -2.951 dB/Octave from 350 Hz OCV, ACR, and Weight change immediately after and 24 hrs after Test.
3) Overcharge <b>*CTQ*</b>	Vent Code ≤ 1	Discharged to 0% SOC (1~2A discharge rate) Charge Rate: 7A Charge Voltage: 5V Charge for 3 hours at 25° C
4) Short Circuit <b>*CTQ*</b>	Vent Code < 4	Temp: 55°C. External circuit resistance: 40 – 65 mΩ
5) Hot Box <b>*CTQ*</b>	Vent Code ≤ 5	Per UL 1642, test 17 Temp: 130°C
6) Impact Test <b>*CTQ*</b>	Vent Code ≤ 5	Per UL 1642, test 14
7) Drop Test <b>*CTQ*</b>	No Leakage or Temp increase Change in ACR: < 15% immediately after test. < 20% 24 hours after test. Change in OCV: < 2 % immediately after test < 2 % 24 hours after test Cell height < 65.5 mm immediately after drop and after 24 hours	Drop cell from 1 m height onto concrete Drop 3 times on Anode and 3 times on Cathode

8)	Nail Penetration <b>*CTQ*</b>	Vent Code $\leq 6$	Nail Dimensions: Dia = 3 mm Tip Angle $< 30^\circ$ Speed = 33 mm/s Nail must penetrate completely through the cell and remain in the cell for 20 minutes minimum
9)	Flat Plate Crush Test <b>*CTQ*</b>	Vent Code $\leq 5$	Per UL 1642, test 13
10)	Projectile <b>*CTQ*</b>	Vent Code $\leq 7$	Per UL 1642, test 20

## 7.0 SAMPLE PREPARATION

Per A123Systems-approved Control Plan (LS431.316QP)

## 8.0 INSPECTION

In process and Final Inspections are per TJL Control Plan (LS431.316QP) that must be approved by A123Systems (*minimum of items of CoA*).

Performance and abuse tolerance must be demonstrated to meet criteria by completing the Lot Qualification testing (As defined in OP000023). Samples are to be taken from the regular population, in accordance with the information from OP000023 and after 3 days aging.

## 9.0 DISPOSITION

### 9.1 Meets Specification

If the supplier determines that the material satisfies the specifications laid out in this document, that material shall be shipped to A123Systems or its affiliates, as instructed on the Purchase Order.

### 9.2 Failure to Meet Specification:

If the supplier determines that the material does not satisfy the specifications laid out in this document, that material shall not be shipped to A123Systems or its affiliates unless under the following circumstances.

#### 9.2.1 Requested Waiver

If the material does not meet specification, the supplier may request a written waiver from A123Systems prior to shipping the product. This waiver request must clearly describe the characteristic(s) that are outside of specification, the actual measured values, and the affected quantities(s). Should such a waiver be granted by A123Systems it will apply only to the quantity clearly laid out within, and shall not be construed to indicate that similar excursions will be permitted in the future, nor that the product specification will be revised.

### 9.2.2 Rework

**No Rework is permitted without written approval from A123Systems. Refer to TJL Control Plan (LS431.316QP), for allowable rework situations.**

If the material does not meet specification and rework is not permitted per TJL Control Plan, the supplier may request a written approval to allow Rework of the product. The request must clearly describe the characteristic(s) that are outside of specification, the actual measured values, the affected quantities(s) and intended form of rework. Should each rework approval be granted by A123Systems it will apply to the quantity clearly laid out within the request. Such approval by A123Systems cannot be applied to future lots of material.

### 9.3 Defect Grade Sorting

Cells are to be sorted into Defect Grade designations according to the amount and severity of cosmetic and performance defects. Cells without defects will be designated as Defect Grade “A”. Cells with certain defects will be further sorted into Defect Grades “B” and “C”, as defined in the table below. See Appendix IV for Cosmetic Grade Sorting Criteria.

Characteristic	Code designation						
	If <u>ALL</u> of the indicated characteristics exist						if <u>ANY ONE</u> of the indicated characteristics exist
	A	B1	B2	B3	B4	B5	C (=scrap)
SD, original: $\leq 4.5\%$	✓			✓		✓	
SD, original: $4.5\% < X \leq 7.5\%$ ,		✓			✓		
SD, original: $7.5\% < X \leq 10\%$			✓				
SD, original: $10\% < X$ ,							✓
Capacity: $1000\text{mAh} \leq X$	✓	✓	✓			✓	
Capacity: $900\text{mAh} \leq X \leq 999 \text{mAh}$				✓	✓		
Capacity: $X < 900 \text{mAh}$							✓
Cosmetic grade I (good)	✓						
Cosmetic grade I (good), or Cosmetic grade II (medium rust, medium stains, etc)		✓	✓	✓	✓		
Cosmetic grade II (medium rust, medium stains, etc)						✓	
Cosmetic grade III (serious rust, serious stain, leak, dents, etc)							✓



## 10.0 LOT COMPOSITION

### 10.1 Master Lot Definition

The determination of the Lot Number is made according to the criteria listed below and consists of a 9 digit base lot number.

A new cell lot number is started whenever any one of the following happens:

- the cathode electrode lot number is changed
- the anode electrode lot number is changed
- the separator supplier is changed (i.e. it is OK to have more than one lot number of separator from the same supplier in the same cell lot, but not OK to have two different suppliers in the same cell lot (right now this is not so important as we only have one qualified separator, Celgard)
- the electrolyte supplier is changed (i.e. it is OK to have more than one lot number of e'lyte from the same supplier in the same cell lot, but not OK to have two different suppliers in the same cell lot (example: Ferro and Shinestar)
- a new calendar month begins

### 10.2 Lot Number Format:

Each lot of cells is designated by a unique 9-character lot number followed by one additional character, as defined below:

SLYYMMXXX

where:

S identifies the cell size and form factor

- “E” is for 18650 cylindrical

L identifies the location that the cell was made:

- “L” is for Chinese subcontractor #2 (TJL)

YY identifies the year in which the Crimped Cell lot was made; it takes the last two numbers of the Christian era. (e.g. 2007 = 07)

MM identifies the month in which the Welded Cell lot was made; it takes the two digit number representing the month by sequence starting at the new year. (e.g. January = 01, December = 12)

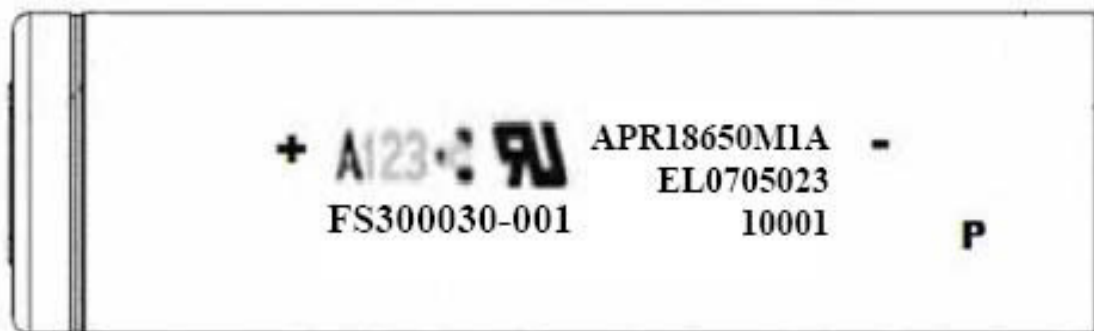
XXX identifies the sequential number of the Welded Cell lot made in that month, beginning at 001 and incrementing upwards by 1 for each new lot. This resets to 001 at the beginning of each month.

### 10.3 Shrink Sleeve Marking

The following marking must be ink-jet printed onto that PET shrink sleeve of each cell:

- A123 Logo
- Underwriters Laboratory symbol
- Model Number (APR18650M1A)
- Cell part number (FS300030-001)
- Nine-character Cell Lot Number
- One alpha-character capacity-grade designation, as defined in Section 10.4 below. \*
- Five digit Individual Cell Identification Number. ('10001' in example below)\*\*
- Cell polarity ('+' sign to be positioned at the crimped end, '-' sign to be positioned at the can bottom end)

Example:



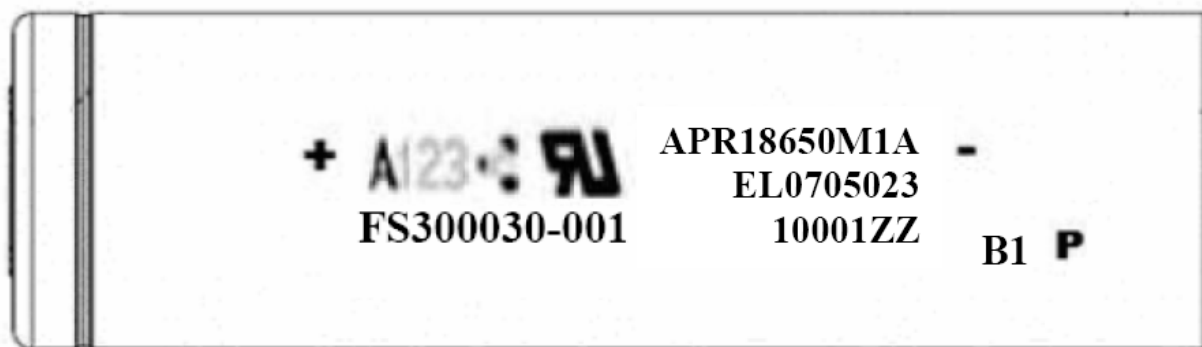
\* NOTE: The alpha-character capacity grade designation does not need to be perfectly aligned with the cell lot number.

\*\* NOTE: Cells that have undergone rework due to shrink sleeve defects will be designated with “ZZ” after the 5 digit cell identification number.

#### 10.3.1 Additional Shrink Sleeve Marking for Defect Grade Cells

In addition to the Marking requirements mentioned above, Cells classified as Defect Grade “B” (as defined in section 9.3) must have a two digit, alpha-numeric Defect Grade designation (i.e. ‘B1’, ‘B2’, ‘B3’, ‘B4’, or ‘B5’) ink-jet printed on the PET Shrink Sleeve. This Defect Grade designation does not need to be perfectly aligned with other labeling.

Example (‘B1’ denotes Defect Grade Designation):



#### 10.4 Capacity Grading

Cells are graded into Capacity ‘bins’ during the Discharge process. These groupings, as well as each cell Lot Number, must be maintained and not mixed. Cells are to be packaged into Shipping Cartons according to Cell Lot Number and Cell Grade Letter. Refer to section 11.3 for restrictions on packaging. The designation of each grade letter is given below for reference.

- Grade “P”:  $1150 \text{ mAh} \leq \text{Discharge Capacity} < 1200 \text{ mAh}$
- Grade “R”:  $1100 \text{ mAh} \leq \text{Discharge Capacity} < 1150 \text{ mAh}$
- Grade “T”:  $1050 \text{ mAh} \leq \text{Discharge Capacity} < 1100 \text{ mAh}$
- Grade “V”:  $1000 \text{ mAh} \leq \text{Discharge Capacity} < 1050 \text{ mAh}$
- Grade “X”:  $900 \text{ mAh} \leq \text{Discharge Capacity} < 1000 \text{ mAh}$
- Grade “Z”:  $0000 \text{ mAh} \leq \text{Discharge Capacity} < 900 \text{ mAh}$

## 11.0 MATERIAL HANDLING AND STORAGE

### 11.1 General

Handling of the cell should be minimized so as to avoid damage.

Any cell that is dropped from a height of more than 1200 mm is to be rejected. For drops of less than this height, carefully inspect the components for damage, retest OCV and ACR per 6.2 in this document, and reject any where damage is evident, or if either OCV or ACR are not within the specified limits.

Cells must not be shorted. Any cells that have been subjected to even a brief external short circuit must be discarded.

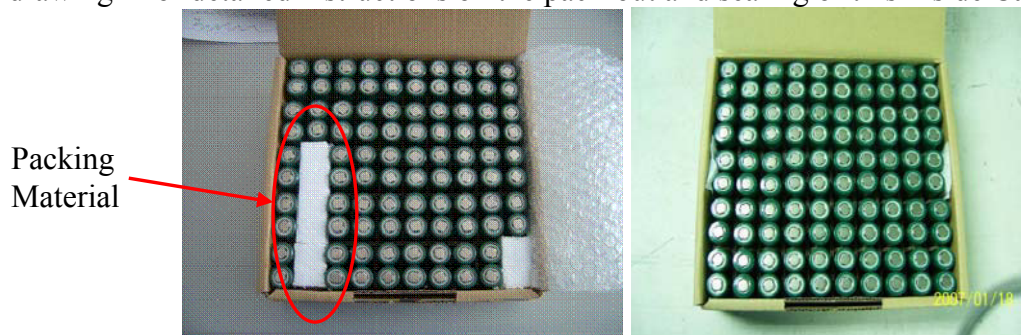
### 11.2 Ambient Conditions

Finished Cells must be stored at a maximum temperature of 35°C. In process ambient conditions are per A123Systems-approved Control Plan (LS431.316QP)

### 11.3 Packaging:

- 11.3.1 The cells are to be packaged in Inside Cartons of 100 cells each. Less than 100 cells are allowed per Inside Carton, but any empty spaces must be filled with packing material as shown in the figure below. Two desiccant packages are to be placed in each Inside Carton, as shown below.

A maximum of two cell lot numbers (assembled within  $\pm$  one month code of each other and with average voltage within  $\pm$  5mV of each other) and only one cell grade letter are permitted in the same Inside Carton. Each lot grouping within the box must have a minimum of 10 cells. Refer to Appendix VI, drawing 1 for detailed instructions on the pack-out and sealing of this Inside Carton.



*Note: Cells shown have non-standard color shrink sleeve*

Each Inside Carton is required to have a Caution message pre-printed on the side of the box as show in the pictures below. Aside from this UL required message, no other printing on the Inside Carton is permitted. Refer to Appendix I for location and exact wording of this message.



The filled and sealed Inside Cartons must have identifying stickers placed on the sides. Included in these labels is a Carton label that includes a scanable bar-code, per bar-code format code 39 (3 of 9), containing the following information for the cells contained within that Inside Carton:

- the Product Specification Number (CAT number, “FS300030-001” in the example below)
- the Lot Number (“EL0705019” in the example below)
- the Grade Letter (“T” in the example below)

A second scan-able barcode must also appear on this label, indicating:

- the quantity of cells within

Additionally, all information listed above and the date that the cells were packed is to be printed on the label in a readable format. See example below:



For Inside Cartons that contain two cell lots, two Carton Labels (one for each lot) are required.

11.3.2 Two of the 100-cell Inside Cartons are to be wrapped in a sealed plastic bag vapor barrier, then two placed in an Outer Carton, as shown below:



The same labeling information as described in 11.3.2 is to be applied to the Outer Carton. If more than one cell lot is contained in the Outer Carton then multiple labels (one for each lot) are required.

Additionally, each Outer Carton must have a Li-Ion Caution Label (See Appendix I for sample) affixed to the side, as detailed in Appendix VI, page 2.

11.3.3 For shipments of 16 Outer Cartons or greater, the completed boxes are to be palletized as shown in Appendix VI, drawings 2 and 3. Stack the Outer Cartons in layers of 4 x 4, to a maximum of 5 layers tall. It is not permitted to stack one loaded pallet on top of another.

It is permitted to combine differing cell lot numbers on the same pallet as long as their Grade Letters are all the same. NO MORE THAN TWO CAPACITY GRADES CAN BE PACKAGED WITHIN ONE PALLET.

When a pallet contains two capacity grades, a clear and visible note must be attached to indicate so. EX: "NOTE: PALLET CONTAINS TWO CAPACITY GRADES"

Each Pallet must be labeled with a Pallet Label (see Appendix I for sample). See Appendix VI, drawing 3, for details on packaging and labeling the pallet. The Outer Cartons should be arranged on the pallet with the labels facing outward.

11.3.4 For shipments of fewer than 16 Outer Cartons the use of a pallet is not necessary.

**12.0 DOCUMENTATION**

Certificates of Analysis (CoA) must be generated for each lot of cells. A sample CoA is included in the Appendix II. These certificates are NOT to be forwarded with the shipment as the formulation is not to be disclosed to the recipient. Instead, these documents are to be emailed to "SQEforms@A123Systems.com."

Packing lists must be generated for each Outer Carton or Pallet of cells. The content and format of these lists is included in Appendix III. One such list is to be placed in each box/pallet and a duplicate copy emailed to "SQEforms@A123Systems.com."

**13.0 QUALITY ASSURANCE**

**13.1 Warranty Period**

The supplier shall warrant that the material shall remain in accordance with the specifications of this document for a period of twelve months after the date of shipment to A123Sytems or its' affiliates. This is provided that the material is stored in the original packaging.

**13.2 Proposed Changes**

Notification of any proposed changes in composition, properties, manufacturing methods, inspection methods, or packaging methods must be forwarded in writing to A123Systems prior to implementation. A123Systems retains the right to deny these proposed changes, at least until the potential impact can be fully characterized and tested.

## 14.0 REVISION HISTORY

Rev	Effective Date	Rev Author	Description of Revision
01	2-Jun-2007	DD, PH	First issue
<b>Reason for Revision:</b> (n/a) Initial Release			<b>EC:</b> EC100285_01
02	1-Oct-2007		<p>6.2.3 Added</p> <p>10.1 Changed line #3 or #4 to "A" for line #3 or "B" for line #4. Removed cell lot number printed on can requirement.</p> <p>10.2 Removed "G" suffix from lot number format.</p> <p>10.3 Separated lot number and Capacity grade into two requirements. Fixed typo (referenced 10.3 should be 10.4). Removed dash from model number</p> <p>10.4 Added Grade Z. Changed Grade X from '0 mAh ≤ Discharge Capacity &lt; 1000 mAh' to '900 mAh ≤ Discharge Capacity &lt; 1000 mAh'</p> <p>11.3.2 Replaced label with new one. Added "FS" to cat number 300030-001.</p> <p>11.3.4 Changed from one capacity grade to two capacity grades per pallet and added label requirement. Removed receiving label criteria</p> <p>Appendix I: Removed customer order bar code from pallet label. Changed the pallet label per conditional approval. (SEE EC)</p> <p>Appendix II Pictorial BOM, changed separator and electrode tabs to phantom. Changed pin part number into 1703 and tape part number into R0835. Changed TJL PET sleeve part number from R1026 to R1026-01</p> <p>Appendix III Removed Receiving label from drawing. Moved position of internal carton label to side of box from top. Changed position of master carton labels to match production.</p> <p>Appendix IV: COA replaced with new "Cell OQC Report and added 3rd Lot Q Item table.</p> <p>Appendix VI: Changed Grade A dents on can wall spec from "None Permitted" to "Length of Dent ≤ 3.5mm"</p>
<b>Reason for Revision:</b> Symbols for Line designations (ex: A for #3) defined at TJL. Capacity grade removed from lot number designation (independent value). New capacity grade and change in 'X' grade due to inclusion of 'B' cells as saleable product (must separate from scrap). Shipping label updated to match current production. Two capacity grades allowed per pallet because of small quantities. Customer order number removed because order numbers and product shipment do not always coincide. BOM change and removal of receiving label at TJL request. PET sleeve changed to improved material by sleeve vendor. First cell lot to use the new PET (1026-1) was EL0709078. Cell OQC report (including different sampling plan) used because small quantities in lots made each lot inspection time consuming. Can dent spec changed due to incoming defects causing large Grade B cell quantities.			<b>EC:</b> EC100405_01
03	6-Dec-2007	DD	<p>10.1 Removed requirement to print cell ID#, JR, winder, and assembly line# on can.</p> <p>10.3 Removed requirement to print JR winder, and assembly line# of shrink sleeve</p> <p>10.4 Removed: "No two lot numbers or grade letters can be packaged in the same master carton" Replaced with: "Refer to section 11.3 for restrictions on packaging"</p> <p>Appendix VI: Removed "None Permitted" from Cosmetic Grade II column of Dents on Can Wall</p> <p>Replaced with: Must scrap if worse than Cosmetic Grade I.</p>
<b>Reason for Revision:</b> Correct inconsistency with packaging in the Capacity Grading section. JR winder and assembly line letters omitted from sleeve as, information is tracked in production records by cell ID number. Cosmetic criteria changed to add clarity - all dents >3.5mm must be scrapped.			<b>EC:</b> EC100468_01

<b>Document #:</b> FSA300030_04	<b>Title:</b> Cell, Finished, Model APR18650M1A (TJL)	<b>Page</b> 14 of 23
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04	5-Jun-2008	PH	<p>6.2.2 Added Anode cut edge to cathode cut edge specification and Cpk requirement. Additional wording to clarify between slit and cut edge overlap.</p> <p>6.5.2 Removed requirement for post storage cycles.</p> <p>Various changes to performance and safety performance specs. See redlined draft in the released EC.</p> <p>11.3.1 Added requirement for UL pre-printed caution message on Inside Carton</p> <p>Appendix I: Added Inside Carton Dimensions, Pre-printed Message Location, and Message Details</p> <p>Appendix V: Added Performance Parameters table and related notes</p>
<p><b>Reason for Revision:</b> Addition to 6.2.2 made to ensure proper anode overlap in wound jellyroll state. Electrode lengths also changed per this EC to ensure that the cut edge overlap specified in 6.2.2 can be met. Addition of Inside Carton caution message requirement because of UL requirements. Addition of performance parameters table done to define the key product specs for Cell Model APR18650M1A. Change to 6.5.2 made to harmonize finished cell spec with previous Lot Qual revision. Various changes made to Finished Spec and Lot Qualification testing based off review of historical data, test facility limitations, and revised customer requirements. See EC for further explanation.</p>			<p><b>EC:</b> EC101115</p>

<b>Appendix I</b>	<b>LABEL SAMPLES (one page)</b>
<b>Appendix II</b>	<b>Sample Certificate of Analysis (CoA)</b>
<b>Appendix III</b>	<b>Sample Packing List</b>
<b>Appendix IV</b>	<b>Cosmetic Grading Criteria</b>
<b>Appendix V</b>	<b>Individual Cell Drawing</b>
<b>Appendix VI</b>	<b>Packaging Drawings: 3 Pages</b>
	Page 1: Individual Shipping Carton Packing
	Page 2: Shipping Carton Labeling
	Page 3: Palletized Outer Cartons

## Appendix I LABEL SAMPLES

### Label, Caution, Li-Ion

   <b>IF DAMAGED</b> 如果被损坏	 <b>CAUTION</b>	 <b>警告</b>
	<p><b>Lithium ion rechargeable batteries inside.</b>  <b>(No lithium metal)</b></p> <p><b>Do not damage or mishandle this package.</b></p> <p><b>If package is damaged, batteries must be quarantined, inspected, and repacked.</b></p> <p>For chemical emergency          Spill Leak Fire Exposure or Accident          Call CHEMTREC Day or Night          Domestic North America 800-424-9300          International, Call 703-527-3887 (Collect calls accepted)</p>	<p>里面是可再充电锂离子电池。          ( 非锂金属 )</p> <p>不要损坏或者错误处理这个包裹。          如果包裹被损坏，电池必须被检疫，          检查，并重新包装。</p> <p>如有紧急情况，溢出，泄漏，火情和其它意外          请电 CHEMTREC 日夜          北美洲国内电话：800-424-9300          国际电话：703-527-3887</p>

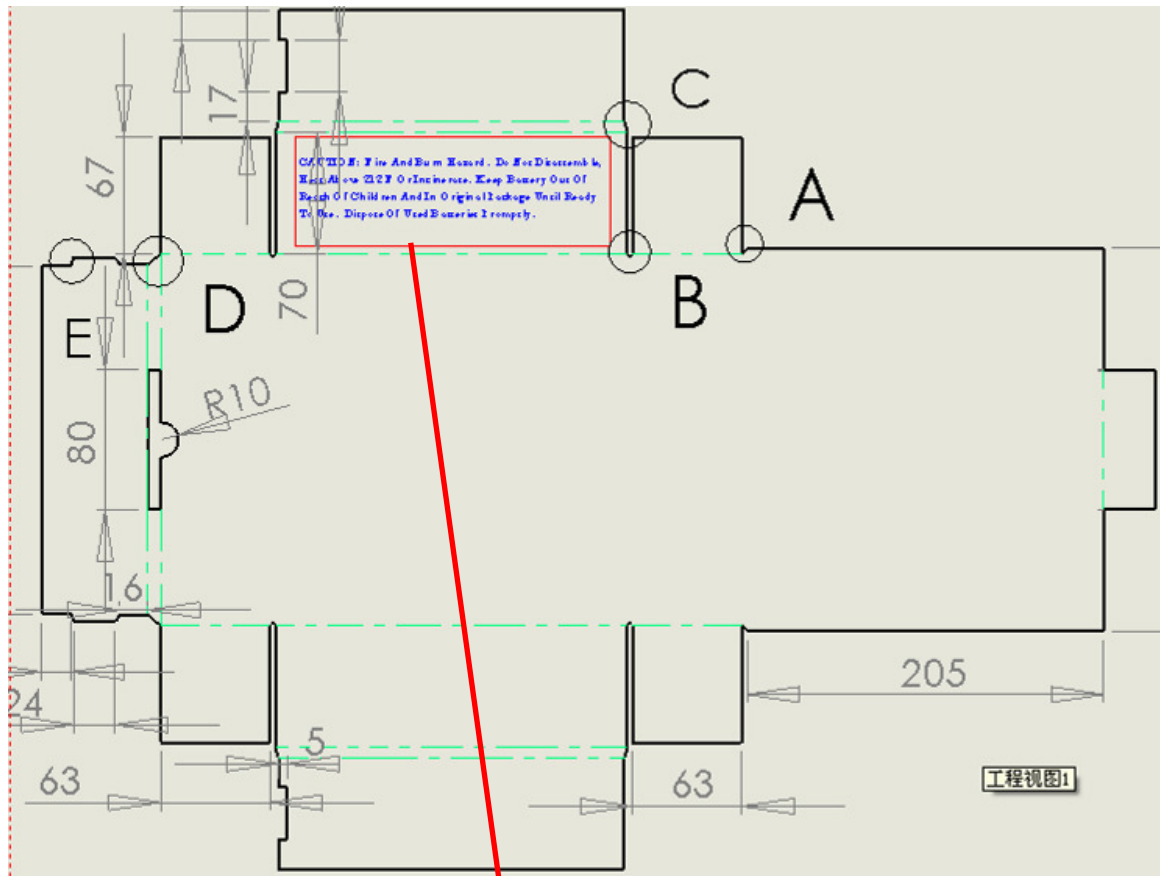
### Label, Pallet

Model	APR18650M1A
Quantity	
Pallet Number	
Customer	A123
Pin Status	
Enter the warehouse date	

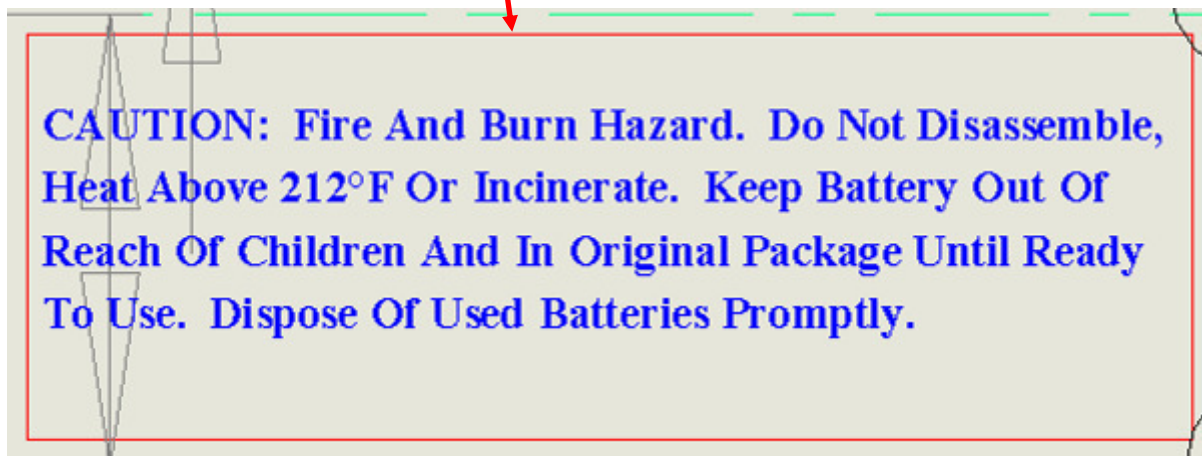


**Inside Carton Pre-printed Message**

Carton Dimensions and Message Location:



Message Details:



## Appendix II

## CERTIFICATE OF ANALYSIS

(suggested format only)

Manufacturing Company: \_\_\_\_\_ Finished Cell Specification #: \_\_\_\_\_

Cell OQC Report			
Ref.:		Date:	
Part Number:	LP1865AM	Lot Size:	
Lot Number:		Defects:	
P.O. Number		Accepted:	
Inspected By:		Description:	
Customer:			
AQL Major:			
AQL Minor:			
Acknowledged By:			
Inspection			
Test Item:	Length	Diameter	Weight
Test Equipment:	callipers	callipers	Electronic scale
Unit	mm	mm	g
USL	65.15	18.40	40
LSL	64.75	18.00	38
Max.:	0.00	0.00	0.00
Min.:	0.00	0.00	0.00
Items within spec:	-	-	-
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			

Lot Number	Capacity Grade	AC Impedance (mOhms)		OCV, at ship state		Number of Boxes	Comments	Completed by (initial)
		Average	Std Deviation	Average	Std Deviation			
Lot Q. Item							Comments	Completed by (initial)
Cell Performance Test							OK/NG	
Reliable Test							OK/NG	
Safety/Abuse Test							OK/NG	

### Appendix III

### PACKING LIST (suggested format only)

Manufacturing Company: \_\_\_\_\_ Finished Cell Specification #: \_\_\_\_\_ Pallet / Outer Box *(circle one)* Packed by: \_\_\_\_\_

Cell Carton	Qty of cells in carton	Cell Lot	Cell Grading Group
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			

Cell Carton	Qty of cells in carton	Cell Lot	Cell Grading Group
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			

Cell Carton	Qty of cells in carton	Cell Lot	Cell Grading Group
49			
50			
51			
52			
53			
54			
55			
56			
57			
58			
59			
60			
61			
62			
63			
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65			
66			
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68			
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70			
71			

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**Appendix IV: Aesthetics Criteria:**


Cells are to be classified into 3 Cosmetic Grades as defined below:





Cosmetic Grade I: Good Cells with no or minimal rust, no or minimal stains, etc.

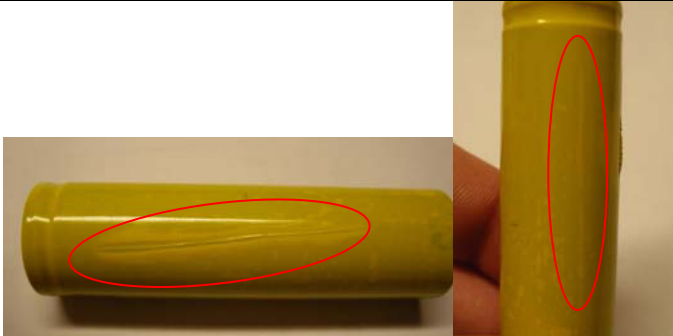
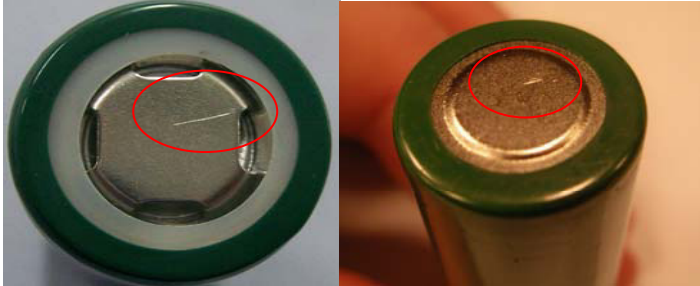

Cosmetic Grade II: Cells with medium rust, medium stains, etc.




Cosmetic Grade III: Cells with serious rust, serious stains, leaks, dents, etc.

Each cell is to be manually taken from the tray and inspected on all surfaces for the features described below. The cell is to be viewed with the naked eye at an approximate distance of 300 mm and under good lighting conditions. Any defect that is not outlined below, as well as any cell that does not meet the specifications laid out in FSA300030 regardless of Cosmetic Grading, must be treated as No Good and either scrapped or reworked in accordance with standard procedures.



Defect name/type	Example of defect <i>Pictures are shown to give examples of the defect type only. They are <u>not</u> intended to show examples of Grades I, II, or III. NOTE: Some cells shown have non-standard shrink sleeve color.</i>	Defect description	Cosmetic Grade I Criteria <i>(Cells must meet all criteria below)</i>	Cosmetic Grade II Criteria <i>(Cells must meet all criteria below)</i>	Cosmetic Grade III Criteria <i>(Cells must meet all criteria below)</i>
Ni Plating Defect on Weld Surfaces		Spots of Damaged Ni Plating Layer in target Weld Area of the cap or can bottom	1. Affected Area $\leq 25\%$ of Target Weld Area <u>AND</u> 2. # of Spots $\leq 3$ <u>AND</u> 3. Size of Spots $\leq 0.04$ mm	1. Affected Area: 25 ~ 50 % of Target Weld Area <u>AND</u> 2. # of Spots: 4 ~ 10 <u>AND</u> 3. Size of Spots $\leq 0.04$ mm	1. Affected Area: $\geq 50\%$ of Target Weld Area <u>OR</u> 2. # of Spots: $\geq 10$ <u>OR</u> 3. Size of Spots $\leq 0.04$ mm

Rust on the Can Wall			Evidence of rust on the Can Wall, under the shrink sleeve	No amount of Rust permitted	1. Smooth surface (i.e. no change in surface flatness) <u>AND</u> 2. Total Area < 10 mm <sup>2</sup>	1. Rough Surface <u>OR</u> 2. Total Area ≥ 10 mm <sup>2</sup>
Rust on Cell ends			Evidence of rust on the cap or can bottom	No amount of rust permitted	1. Smooth surface (i.e. no change in surface flatness) <u>AND</u> 2. Total Area < 4 mm <sup>2</sup>	1. Rough Surface <u>OR</u> 2. Total Area ≥ 4 mm <sup>2</sup>
Discoloration on the Can Wall			Watermark or other discoloration ( <u>no foreign material and no rust</u> ) on the Can Wall, under the shrink sleeve	Acceptable		
Discoloration on Cell ends			Watermark or other discoloration ( <u>no foreign material and no rust</u> ) on cap or can bottom surface	Total Area < 25 % of Target Weld Area	Total Area: 25~50 % of Target Weld Area	Total Area > 50% of Target Weld Area

Scratches on Can Wall		Scratches on the Can wall that can be seen through the shrink sleeve	Shrink sleeve surface does not visibly change in height. (i.e. does not create 'valley' by falling into scratch depth)	Shrink sleeve surface does change in height.	
Scratches on Cell ends		Scratches in weld area of cap or can bottom	1. Length < 5 mm <u>AND</u> 2. Width < 0.1 mm	1. Length < 5 mm <u>AND</u> 2. 0.1 < Width < 0.3 mm	1. Length > 5 mm <u>OR</u> 2. Width > 0.3 mm
Dents on Can Wall		Dents anywhere on the Can Wall	Length of Dent: ≤ 3.5 mm	Must scrap if worse than cosmetic Grade I.	Length of Dent: > 3.5 mm

Dents on Can Bottom Surface			Dents on the bottom surface	1. Depth of dent $\leq 0.3$ mm. AND 2. Deepest point of Dent must be within 2 mm diameter of cell centerline	Must scrap if worse than Cosmetic Grade I	Must scrap if worse than Cosmetic Grade I
Pits at Anode Weld Site			Pitting of Can Bottom due to Welding	Not permitted	Not permitted	Any Sized Pit
Weld points			Small Points of Discoloration at Anode Weld Site ( <u>no burn marks</u> )	No Protrusion over the cell surface.	Any weld point protrusion above cell surface.	

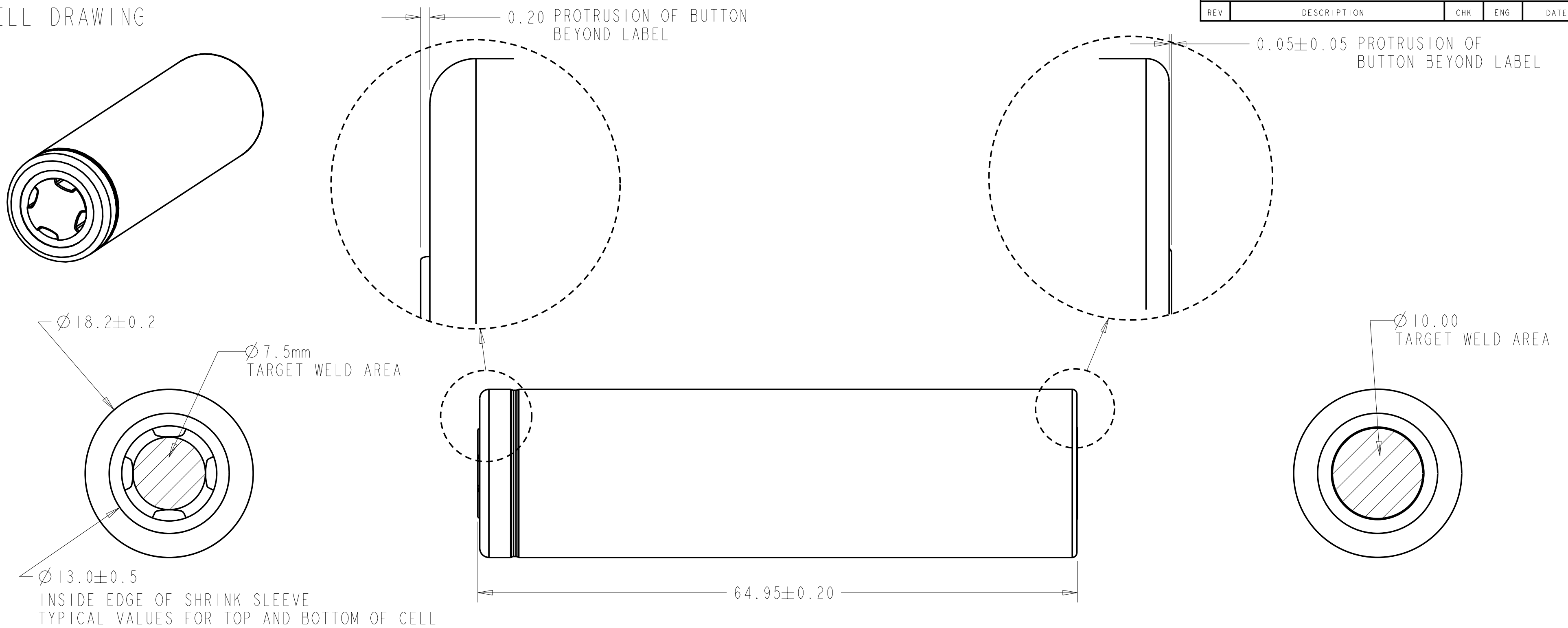


Shrink sleeve deformity at Cell Ends*		Shrink Sleeve is wrinkled or deformed on Cell's bottom or top surface	No protrusion of Deformity over the Weld area Surface	Must rework if worse than Cosmetic Grade I	Must rework if worse than Cosmetic Grade I
Scratches on Shrink Sleeve*		Scratches anywhere on the shrink sleeve	No breaks in Shrink sleeve (i.e. rips, tears, breakage or exposed metal)	Must rework if worse than Cosmetic Grade I	Must rework if worse than Cosmetic Grade I

\* All Shrink Sleeve Defects that cannot be classified as Cosmetic Grade I per this specification, as well as any Shrink Sleeve defect that is not mentioned above must be reworked. This includes Cell Label defects that render the ink-jet printing unreadable.



## CELL DRAWING



## PERFORMANCE PARAMETERS PROVIDED FOR REFERENCE ONLY AND SUBJECT TO CHANGE WITHOUT NOTICE

	MINIMUM	NOMINAL OR RECOMMENDED	MAXIMUM	UNITS	NOTES
DISCHARGE CAPACITY, LOW RATE	1.0	1.1	1.2	Ah	2
DISCHARGE CAPACITY, HIGH RATE	0.95	1.05	1.15	Ah	3
DISCHARGE ENERGY, LOW RATE	3.1	3.4	3.7	Wh	2
DISCHARGE ENERGY, HIGH RATE	2.7	2.9	3.2	Wh	3
ENERGY DENSITY, GRAVIMETRIC, HIGH RATE	70	77	-	Wh/kg	2
ENERGY DENSITY VOLUMETRIC, HIGH RATE	185	204	-	Wh/l	3
CHARGE TERMINATION VOLTAGE	-	3.6	4.2	V	4
DISCHARGE TERMINAL VOLTAGE	0.5	2.0	-	V	
CHARGE RATE	-	3.3	20	A	4
DISCHARGE RATE, CONTINUOUS	-	10	30	A	
DISCHARGE RATE, PULSE	-	-	-	A	5
INITIAL AC IMPEDANCE	12	18	25	mOhm	6
INITIAL DC RESISTANCE	18	27	40	mOhm	7
OPEN CIRCUIT VOLTAGE AT SHIP STATE	3.25	3.31	3.34	V	8
TEMPERATURE AT START OF CHARGE	0	23	60	°C	9
TEMPERATURE AT TERMINATION OF CHARGE	-	60	70	°C	9
TEMPERATURE AT TERMINATION OF DISCHARGE	-	70	80	°C	9
STORAGE TEMPERATURE, MAXIMUM RANGE	-50	-	+60	°C	
STORAGE TEMPERATURE, RECOMMENDED RANGE	15	-	35	°C	
CELL MASS	38.0	39.0	40.0	g	10

## NOTES:

- 1) UNLESS OTHERWISE NOTED, CELL PERFORMANCE PARAMETERS ARE MEASURED AFTER A CC-CV CHARGE TO 3.6V AT d1.5A TO A CURRENT CUTOFF OF 20mA AND IN A 25°C AMBIENT
- 2) MEASURED AT 0.55A, 25°C AMBIENT, 3.6V~2.0V
- 3) MEASURED AT 10A, 25°C AMBIENT, 3.6V~2.0V
- 4) MAXIMUM VALUE APPROVED UNDER UL1642
- 5) NO VALUE CITED AS MAX RATE WILL DEPEND ON PULSE DURATION AND CELL TEMPERATURE. CONTACT A123
- 6) MEASURED AT 1kHz, 25°C AMBIENT, 10~90%SOC
- 7) MEASURED AT 5A, 1 SECOND, 25°C AMBIENT, 10~90%SOC
- 8) MEASURED AT 25°C AMBIENT, NOMINAL 50% SOC
- 9) MEASURED AT CELL BODY
- 10) VARIES BY DESIGN VARIANT
- 11) CELL PERFORMANCE MAY BE DEGRADED IF STORED OR USED ABOVE OR BELOW THE NOMINAL OR RECOMMENDED VALUES DESCRIBED ABOVE

 THIRD ANGLE PROJECTION UNLESS OTHERWISE SPECIFIED INTERPRET THIS DRAWING PER ANSI Y14.5M-1982 NOTICE A123 SYSTEMS PROPRIETARY RIGHTS ARE INCLUDED HEREIN. THIS INFORMATION MAY NOT BE COPIED, TRANSFERRED OR DISCLOSED EXCEPT AS AUTHORIZED BY A123 SYSTEMS	DRAFTER P. HARRIS	 ONE KINGSBURY AVENUE WATERTOWN, MA, USA 02472		
	CHECKER			
	ENGINEER	DESCRIPTION CELL, FINISHED, APR18650M1A		
	SIZE C	SCALE C	CLASS FSA	DWG NO. 300030

NOTE: SCALE IS FOR REFERENCE ONLY

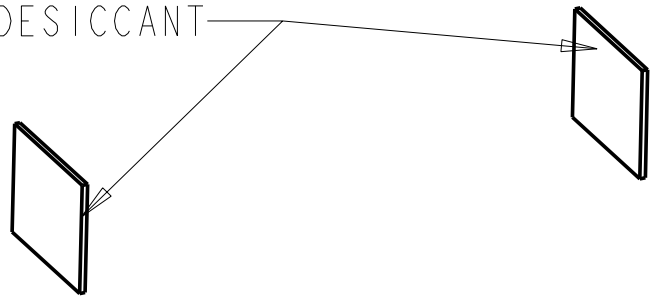
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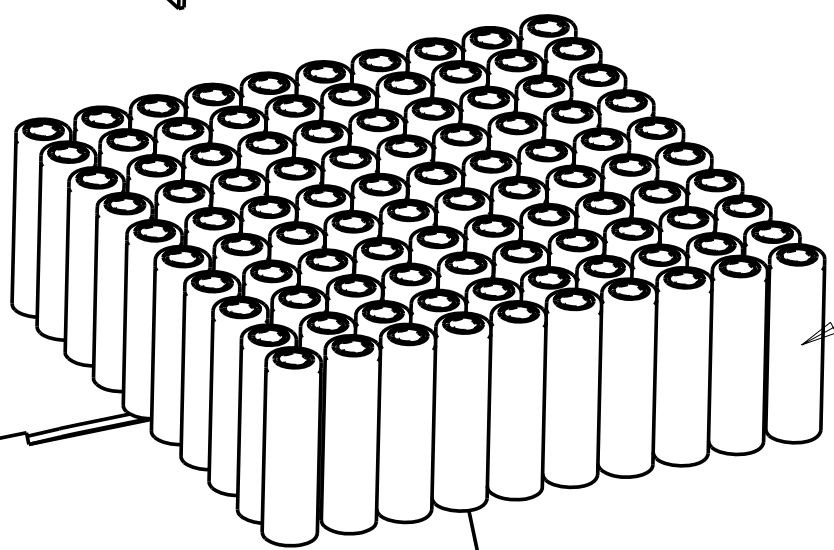
REVISIONS				
REV	DESCRIPTION	CHK	ENG	DATE

PACKAGING DRAWINGS

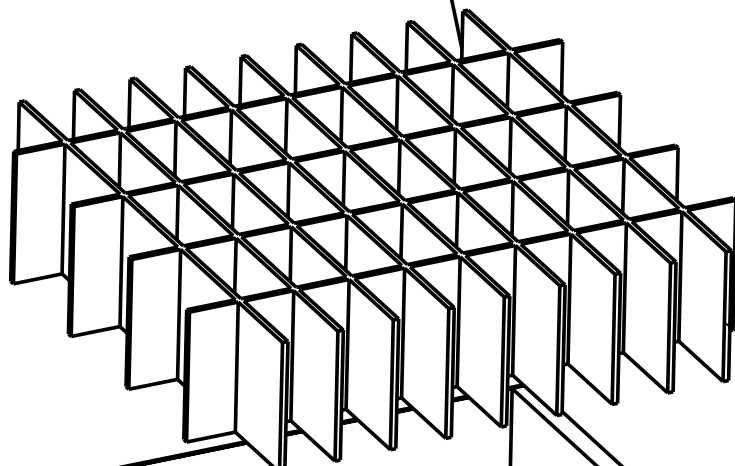
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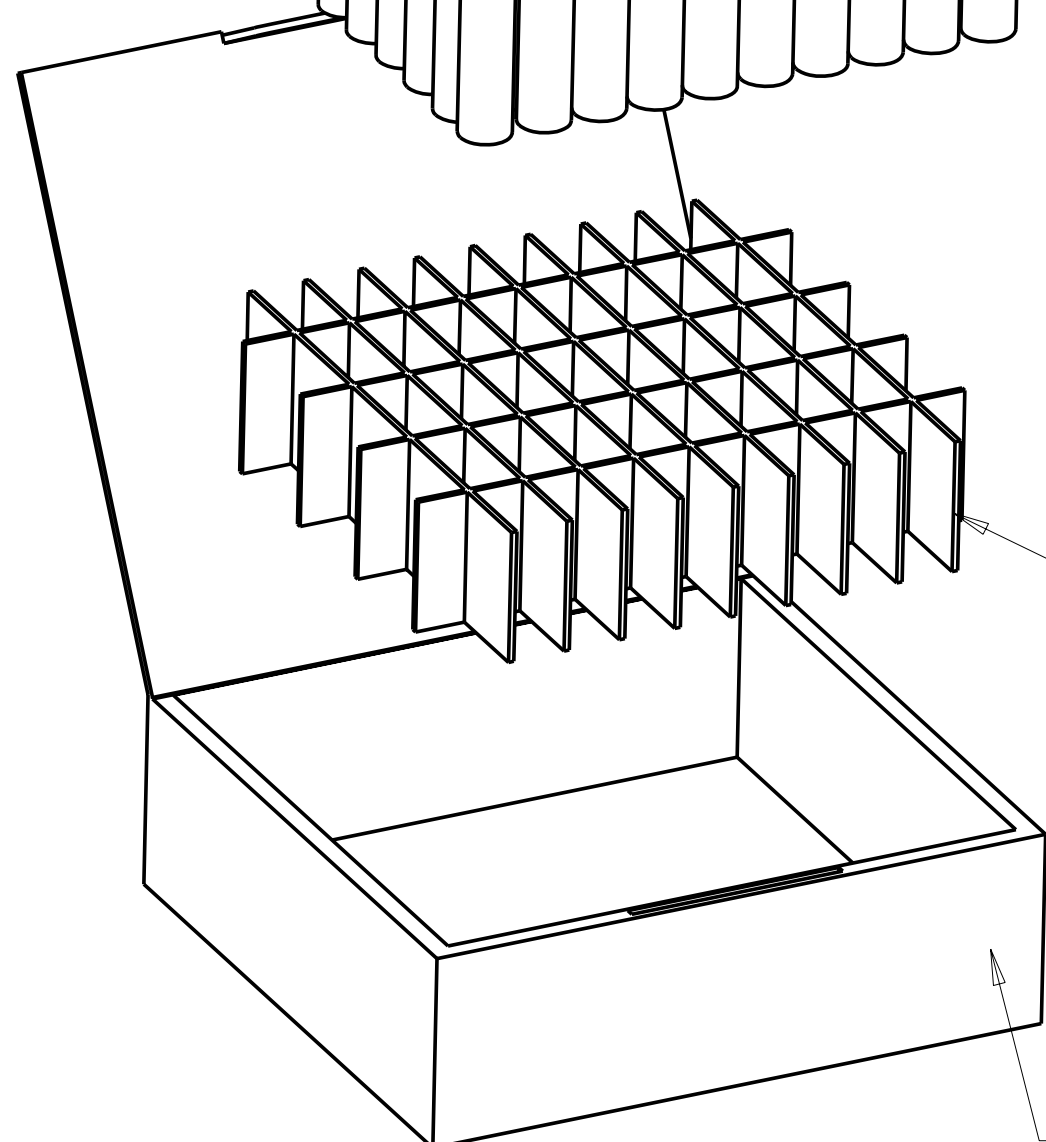
FSA300030 X 100



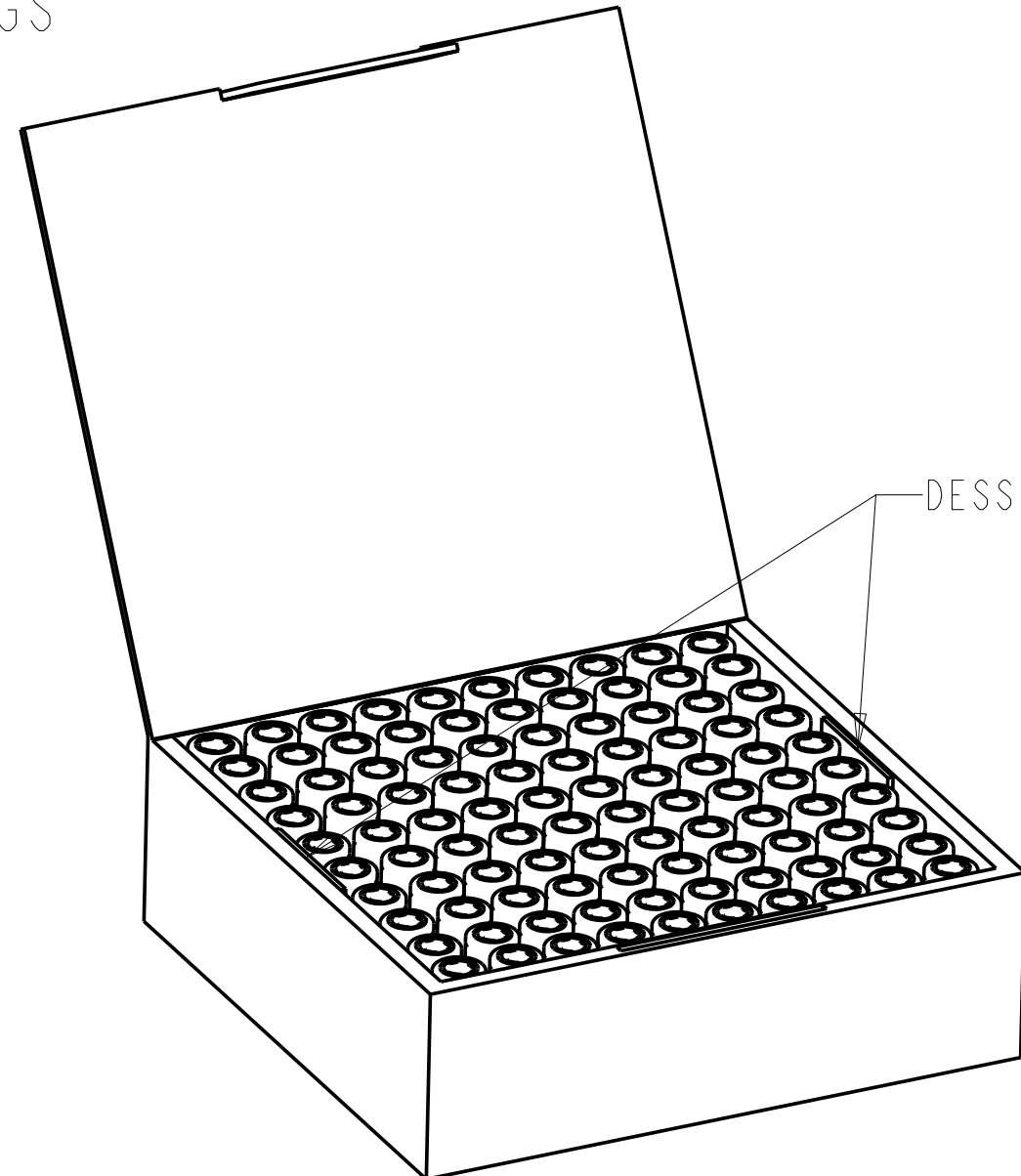
CELL DIVIDER



INSIDE CARTON

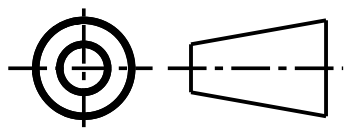



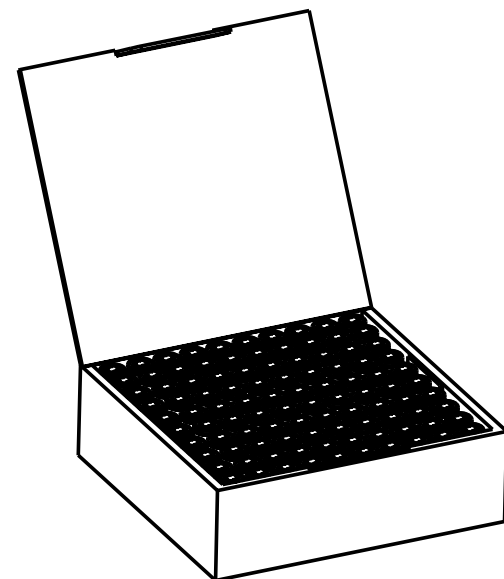
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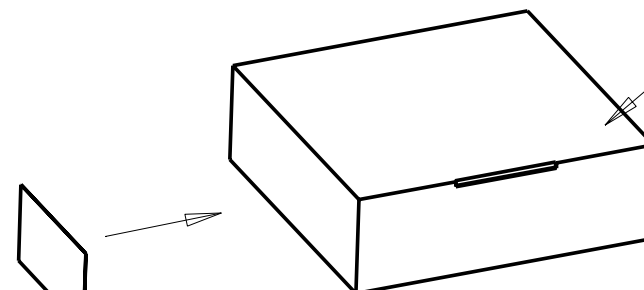
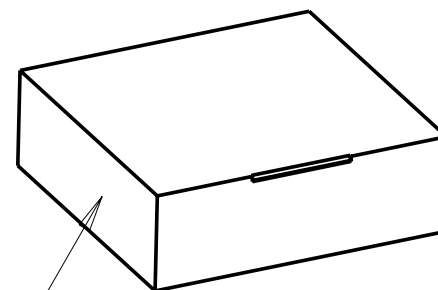
NOTES:

- 1) ALL CELLS MUST BE PLACED IN INSIDE CARTON WITH CATHODE HEADER END UP.
- 2) IF LESS THAN ONE HUNDRED CELLS ARE PACKAGED IN A INSIDE CARTON, EMPTY SPACES MUST BE FILLED WITH PACKAGING MATERIAL. SEE SECTION 11.3.1 FOR FURTHER DETAIL.

THIRD ANGLE PROJECTION  <small>UNLESS OTHERWISE SPECIFIED INTERPRET THIS DRAWING PER ANSI Y14.5M-1982</small>	DRAFTER	 ONE KINGSBURY AVENUE WATERTOWN MA, USA 02472		
NOTICE <small>A123 SYSTEMS PROPRIETARY RIGHTS ARE INCLUDED HEREIN. THIS INFORMATION MAY NOT BE COPIED, TRANSFERRED OR DISCLOSED EXCEPT AS AUTHORIZED BY A123 SYSTEMS</small>	CHECKER			
ENGINEER	DESCRIPTION CELL, FINISHED, MODEL APRI8650MIA			
SIZE B	SCALE	CLASS FSA	DWG NO. 300030	REV 04
NOTE: SCALE IS FOR REFERENCE ONLY				SHEET 1 OF 3

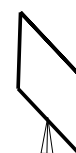
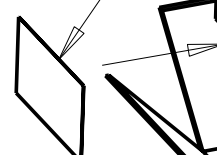
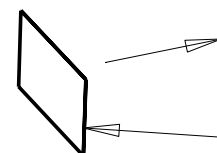


INNER CARTON

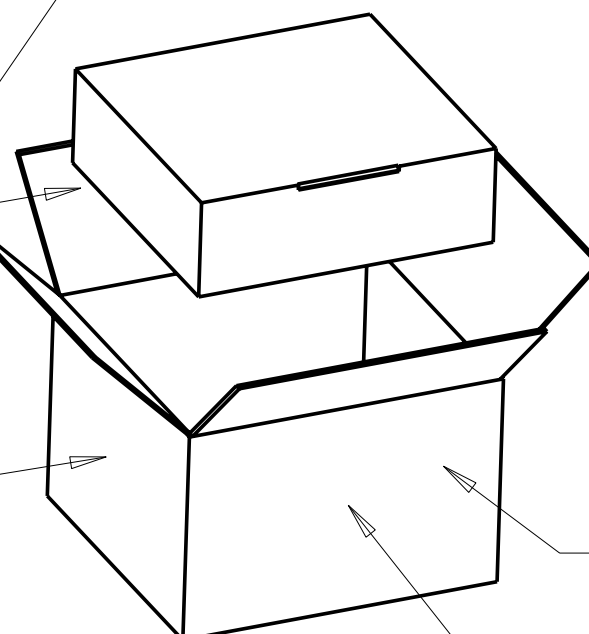


CARTON LABEL  
(SEE NOTE 3)

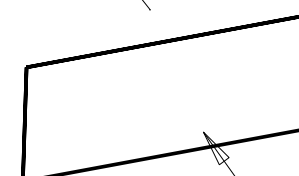
LOCATION OF PRE-PRINTED  
CAUTION MESSAGE PER SEC  
11.3.1 AND APPENDIX I



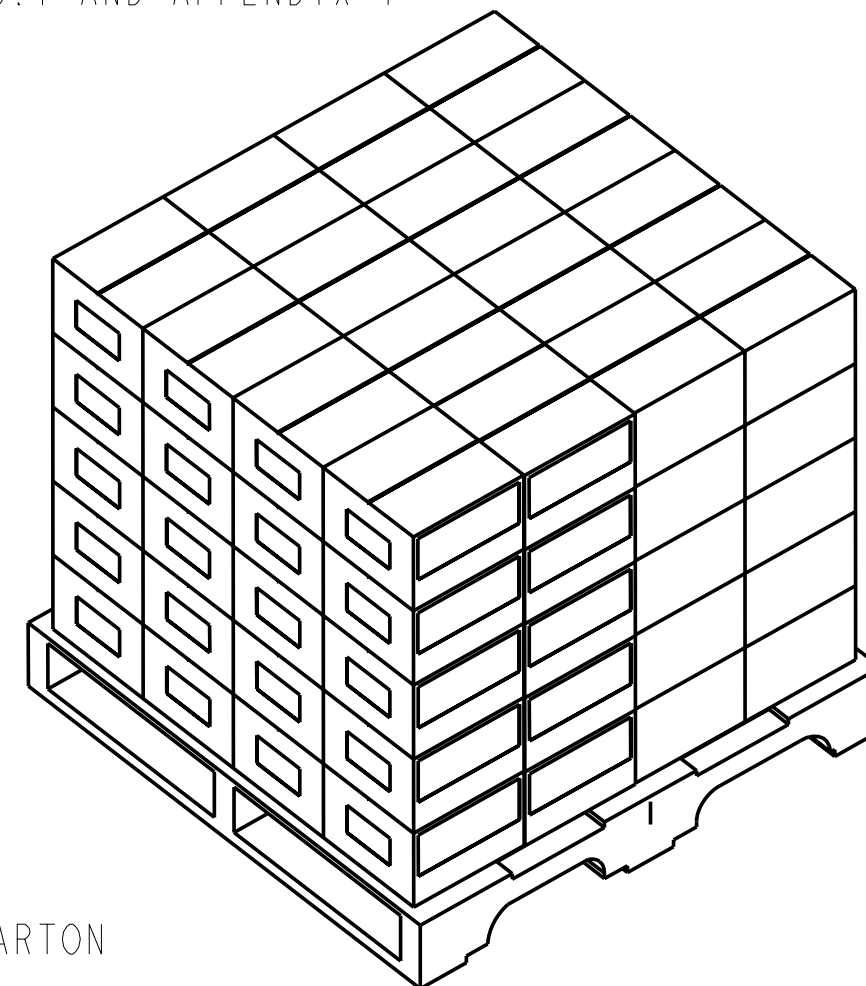
CARTON LABEL  
(SEE NOTE 5)



OUTER CARTON



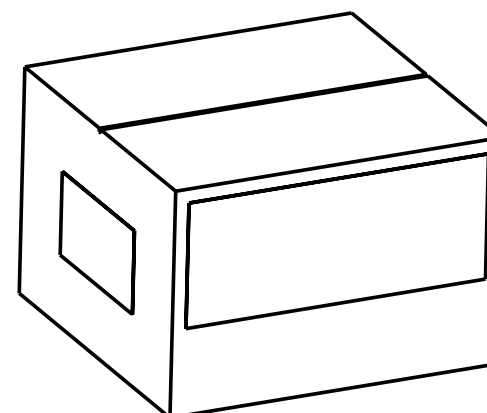
Li-ION CAUTION LABEL  
(SEE NOTE 6)



PALLET

NOTES:

3. IF AN INNER CARTON CONTAINS MORE THAN ONE CELL LOT, MULTIPLE CARTON LABELS (ONE PER CELL LOT) ARE REQUIRED.
4. TWO INSIDE CARTONS ARE TO BE WRAPPED IN A SEALED PLASTIC BAG VAPOR BARRIER (NOT SHOWN IN DRAWING) BEFORE BEING PLACED IN OUTER CARTON. SEE SECTION 11.3.3 FOR FURTHER DETAILS.
5. IF AN OUTER CARTON CONTAINS MORE THAN ONE CELL LOT, MULTIPLE CARTON LABELS (ONE PER CELL LOT) ARE REQUIRED.
6. EACH OUTER CARTON MUST BE LABELED WITH A LITHIUM ION CAUTION LABEL.
7. STACK OUTER CARTONS A MAXIMUM OF 5 LAYERS HIGH. EACH LAYER MUST HAVE 16 CARTONS



DESCRIPTION				
CELL, FINISHED, MODEL APRI8650MIA				
SIZE	SCALE	CLASS	DWG NO.	REV
B		FSA	300030	04
SHEET 2 OF				3



CORNER BOARDS, SHORT

PACKING TAPE  
(SEE NOTE 10)

PLASTIC WRAP  
(SEE NOTE 9)

CORNER BOARDS, LONG

PALLET LABEL  
(FORMAT IN APPENDIX I)

NOTES:

8. PALLETS MUST BE PACKED SO THAT LITHIUM WARNING LABELS ARE READABLE. SEE SECTION 11.3.4 FOR MORE DETAILS.
9. STACKED CARTONS ARE TO BE FULLY SHRINK WRAPPED PRIOR TO APPLYING CORNER BOARDS.
10. CORNER BOARDS ARE SECURED TO PALLET VIA PACKING TAPE (NOT SHOWN IN EXPLODED VIEW).
11. ONCE CORNER BOARDS HAVE BEEN SECURED, EACH PALLET IS TO BE WRAPPED IN A SEALED PLASTIC VAPOR BARRIER (NOT SHOWN)

DESCRIPTION

CELL, FINISHED, MODEL APRI8650M1A

SIZE	SCALE	CLASS	DWG NO.	REV
B		FSA	300030	04