



SURFACE VEHICLE/AEROSPACE TECHNICAL INFORMATION REPORT

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Dimensional and Performance Testing Specifications for Secondary Pouch Cells
for Group 1 Small Uncrewed Aerial Vehicle(s) (sUAV)

RATIONALE

Standardization of Group 1 small uncrewed aerial vehicle(s) (sUAV) pouch-cell geometry and test protocols will reduce qualification cost, strengthen supply-chain resilience, and support dual-use adoption across commercial and defense platforms. The resulting harmonization will promote innovation, safety, and economic scalability for advanced energy systems for sUAV applications. The starting point for investigating secondary pouch cell geometries was various configurations of 21700 cylindrical secondary cells in battery packs.

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1. SCOPE

This document establishes standardized dimensional cell geometry, performance-test procedures, and reporting requirements for secondary (i.e., rechargeable) pouch cells used in Group 1 sUAV. It defines reference geometries, test conditions, and uniform data formats to allow direct comparison of pouch-cell performance across manufacturers and to improve interoperability within the sUAV ecosystem.

1.1 Field of Application

1.1.1 Group 1 Small Uncrewed Aerial Vehicles (sUAV)

1.2 Product Classification

1.2.1 Electrochemical Energy Storage Device

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 1-877-606-7323 (U.S. and Canada only) or 1-724-776-4970 (outside U.S. and Canada), www.sae.org.

2.1.1.1 SAE J1715/2_202108, Battery Terminology

2.1.2 Other Publications

2.1.2.1 IEC 61960-3:2017, Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for portable applications - Part 3: Prismatic and cylindrical lithium secondary cells and batteries made from them (also known as “**IEC 61960**”)

2.1.2.2 IEC 62133-2:2017+AMD1:2021 CSV, Secondary cells and batteries containing alkaline or other non-acid electrolytes, Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications - Part 2: Lithium systems (also known as “**IEC 62133-2**”)

2.1.2.2.1 UL 62133 has been harmonized with IEC 62133-2.

2.1.2.3 IEC 62619:2022, Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications (also known as “**IEC 62619**”)

2.1.2.4 UN Manual of Tests and Criteria Rev. 8 (2023) and Amendment 1 to Rev. 8 (2025), Section 38.3: “Lithium metal, lithium ion and sodium ion batteries” (also known as “**UN 38.3**”)

2.1.2.5 NAVSEA S9310-AQ-SAF-010, Navy Lithium Battery Safety Program, Responsibilities and Procedures (also known as “**NAVSEA S9310**”)

2.1.2.6 U.S. Department of Defense Joint Publication 3-30 (DOD JP 3-30), Joint Air Operations (also known as “**DOD JP 3-30**”)

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Information Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 1-877-606-7323 (U.S. and Canada only) or 1-724-776-4970 (outside U.S. and Canada), www.sae.org.

2.2.1.1 SAE TSB 001, SAE Technical Standards Board Rules and Regulations

2.2.1.2 SAE TSB 002, SAE Preparation of SAE Technical Reports

2.2.1.3 SAE J1115, Guidelines for Developing and Revising SAE Nomenclature and Definitions

2.2.1.4 SAE Report Format Guidelines for Electronic Capture of SAE Documents

2.2.1.5 SAE Committee Guidelines Manuals

3. DEFINITIONS

3.1 GROUP 1 UNCREWED AERIAL VEHICLE(s) (sUAV)

3.1.1 DOD JP 3-30 defines a Group 1 UAV as a UAV with a maximum gross takeoff weight of 20 pounds, a maximum operating altitude of 1200 feet above ground level, and a maximum speed of 100 knots.

3.1.2 Throughout this document, the term small UAV (sUAV) may be used interchangeably with Group 1 UAV.

3.2 Terms defined in 3.3 supersede terms defined in SAE J1715/2.

3.3 Term definitions table

Term	Description
Standard Charge	Constant current charge to the Maximum Cell Voltage, hold Maximum Cell Voltage (CC-CV) until charge current tapers to C/50. Unless otherwise specified, Nominal Charge Current is used.
Standard Discharge	Constant current discharge to the Minimum Cell Voltage. Unless otherwise specified, Nominal Discharge Current is used.
Rest	No load, open circuit, until cell temperature reaches Room Temperature ($20^{\circ}\text{C} \pm 5^{\circ}\text{C}$) after a half-cycle charge/discharge, or during a temperature change.
C-rate	Current, which is equal to Nominal Capacity (Ah) divided by discharge time (h). For example, C/5 equals a current value to fully discharge a cell's capacity in 5 hours.
SOC (State of Charge)	Ratio (expressed as percent) of the cell's expected remaining capacity (Ah) available for discharging, to its Nominal Capacity (Ah).
DOD (Depth of Discharge)	Ratio (expressed as percent) of the cell's extracted capacity (Ah) from fully charged, to its Nominal Capacity (Ah); also nominally defined as 100% minus % SOC.
Capacity Retention	Ratio of the cell's extracted capacity (Ah) after an irreversible permanent loss due to aging or use, to its Nominal Capacity (Ah), also known as SOH.
SOH (State of Health)	Ratio (expressed as percent) of the cell's extracted capacity (Ah) after an irreversible permanent loss due to aging or use, to its Nominal Capacity (Ah).
EOL (End of Life)	Defined as 80% SOH for this standard.

Nominal Capacity – Ah and Wh	Determined by Standard Discharge at Nominal Discharge Current per 6.3 Discharge Rate Capability at Room Temperature test.
Nominal Cell Voltage	Determined by dividing Nominal Capacity Wh by Nominal Capacity Ah.
Maximum Cell Voltage	Determined by cell manufacturer, maximum charge voltage limit.
Minimum Cell Voltage	Determined by cell manufacturer, minimum discharge voltage cutoff.
Nominal Charge Current	Determined by cell manufacturer.
Maximum Charge Current	Determined by cell manufacturer, the maximum charge current during Standard Charge without exceeding Maximum Charge Temperature.
Nominal Discharge Current	Determined by cell manufacturer.
Maximum Continuous Discharge Current	Determined by cell manufacturer, the maximum discharge current to fully discharge cell to Minimum Cell Voltage without exceeding Maximum Discharge Temperature.
Maximum Charge Temperature	Determined by cell manufacturer, maximum cell surface temperature during charging.
Minimum Charge Temperature	Determined by cell manufacturer, minimum cell surface temperature during charging.
Maximum Ambient Charge Temperature	Determined by cell manufacturer, maximum ambient temperature during charging.
Minimum Ambient Charge Temperature	Determined by cell manufacturer, minimum ambient temperature during charging.
Maximum Discharge Temperature	Determined by cell manufacturer, maximum cell surface temperature during discharging.
Minimum Discharge Temperature	Determined by cell manufacturer, minimum cell surface temperature during discharging.
Maximum Ambient Discharge Temperature	Determined by cell manufacturer, maximum ambient temperature during discharging.
Minimum Ambient Discharge Temperature	Determined by cell manufacturer, minimum ambient temperature during discharging.
Storage Temperature Range	Determined by cell manufacturer, cell surface temperature.
Clamping Pressure	If required by cell manufacturer.
DCIR (Direct Current Internal Resistance)	The effective resistance of DC current within a cell, which can also be expressed as the sum of ionic and electronic resistances of cell components.
DCIR at 30% SOC	Per 6.5 test protocol (defined in standard).
Maximum Pulse Discharge Current at 20% SOC	Per 6.6 test protocol (defined in standard).
Cycle Life	Per 6.8 test protocol (defined in standard) providing charge and discharge rates used during test to 80% SOH cycled at 100% DOD.
Calendar Life	Per 6.9 test protocol (defined in standard) performed at combinations of temperature and SOC: 38 °C and 60 °C, 100% SOC and 30% SOC.
Retained Capacity	Used in 6.9 test protocol, determined as the capacity (Ah) remaining in a cell after storage by discharging immediately after storage.
Recovered Capacity	Used in 6.9 test protocol, determined as the cell's available capacity (Ah) after an irreversible permanent loss due to calendar aging.
Cell Weight	Average cell weight at the beginning of test 6.9.

4. CELL GEOMETRIES

4.1 21700 Battery Pack as Basis

4.1.1 For addressing interoperability between battery packs comprised of 21700 cylindrical cells and packs comprised of pouch cells defined by this standard, the dimensions of the assembled pack after welding of terminal connections (and before any associated electronics and outer wrapping) were considered negligible.

4.1.2 The maximum footprint dimensions of the 21700 battery pack are:

- a. An integer multiple of the 21700 diameter (viz. 21 mm) and
- b. An integer multiple of the 21700 length (viz. 70.0 mm).

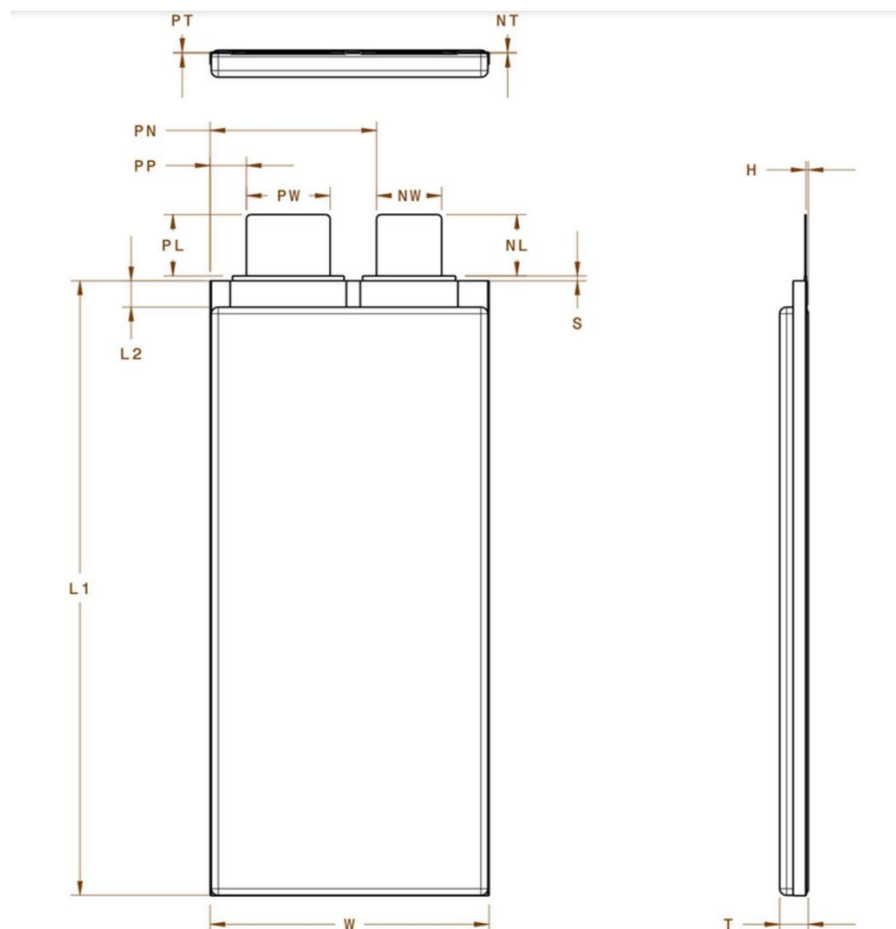
4.1.3 The dimension normal to this footprint (a “height” of the pack) is an integer multiple of the 21700 diameter, assuming square packing, and proportionally less if close packing – the nesting of cylinders – is employed.

4.1.4 Certain footprint dimensions of assembled 21700 cells were selected to provide a small pool of pouch cell sizes to serve as building blocks for interchangeability or interoperability.

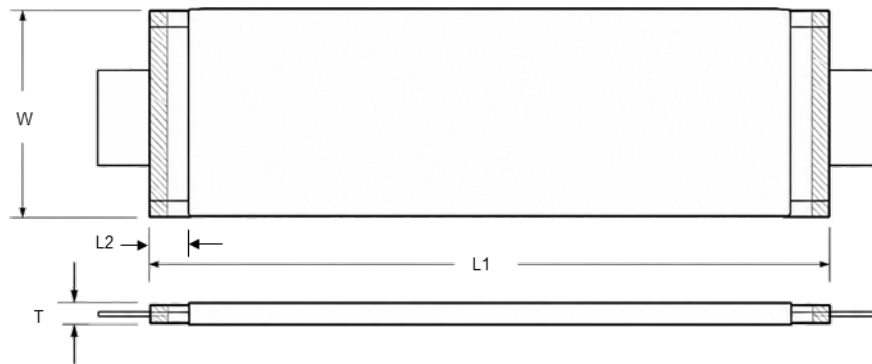
4.2 Pouch Cell Dimensions

4.2.1 The figures in 4.2.2 and 4.2.3 list the typical geometric dimensions requested by a battery pack manufacturer to aid in assembly and packaging. Not all dimensions shown are required for every cell; however, it is best practice for a cell manufacturer to provide them.

4.2.2 Pouch cell drawing showing terminals on the same side:



- 4.2.3 Pouch cell drawing showing terminals on opposite sides (can be on either the short or wide sides, where the L1 and W values would change for the case of terminals on the wide sides):



- 4.2.4 In this document, the standard dimensions specified are the following:

- T = thickness – The manufacturer will design and specify the T BOL (Beginning of Life) thickness such that the thickness during the life of the cell, including at End of Life (EOL), does not exceed the maximum specified in this standard,
- W = full width of the rectangular cell footprint with side heat seals folded
- L1 = full length of the rectangular cell footprint including heat seal length(s) L2 for sealing the terminal tab feedthroughs, but not including extruded tab sealant S or tabs

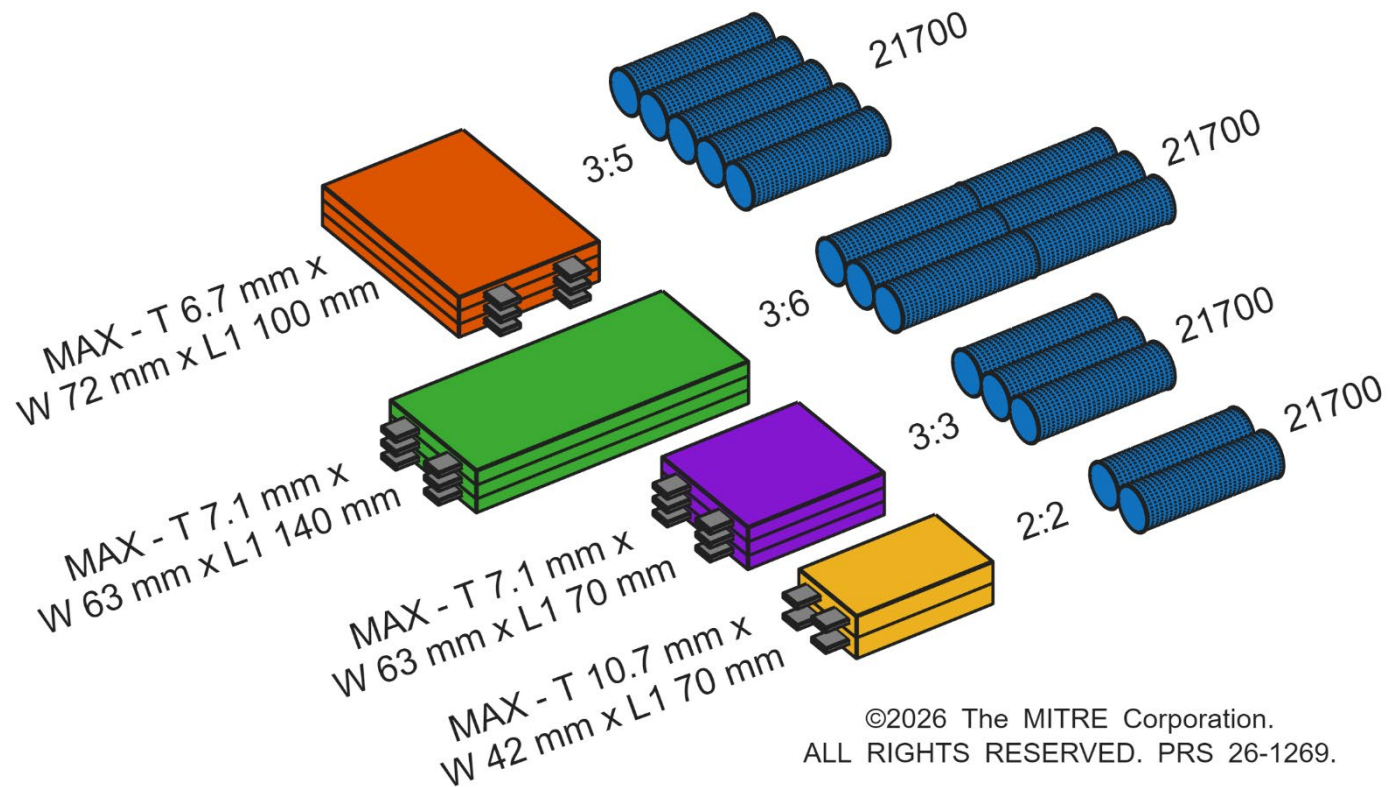
- 4.2.5 Table 4.2.6 provides the specified dimensions for four different pouch cells that are illustrated in Figure 4.2.7.1. Since the cell chemistry and other design elements are left to the cell manufacturer, the Beginning of Life (BOL) thickness is left unspecified so that the Maximum Life thickness (T) may not be exceeded. The cell thickness shall be measured during the 6.8 Cycle Life at Room Temperature test protocol.

- 4.2.6 Table of standard cell sizes and tolerances as specified by Maximum during-life Thickness (Max T life) and footprint (W x L1). The BOL thickness is dependent on the particular cell chemistry employed and its behavior in thickness growth during the life of the cell.

BOL Thickness, T BOL (mm)	Maximum Life Thickness, Max T life (mm)	Maximum Life Width, Max W life (mm)	Maximum Life Length, Max L1 life (mm)
XX ± 0.3	10.7	42	70
XX ± 0.3	7.1	63	70
XX ± 0.3	7.1	63	140
XX ± 0.3	6.7	72	100

4.2.7 Maximum during-life pouch cell geometries compatibility against cylindrical 21700 cells.

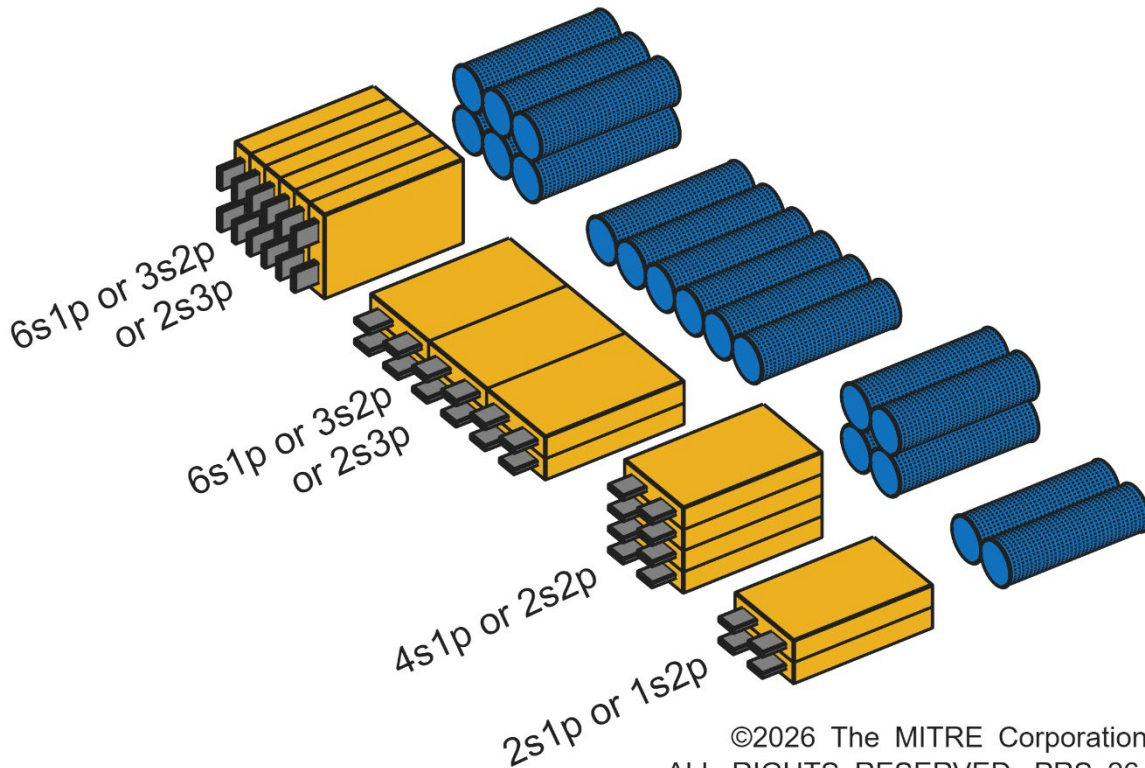
4.2.7.1 Pouch cell dimensions (Max T life x Max W life x Max L1 life) compatibility to 21700 cylindrical cells.



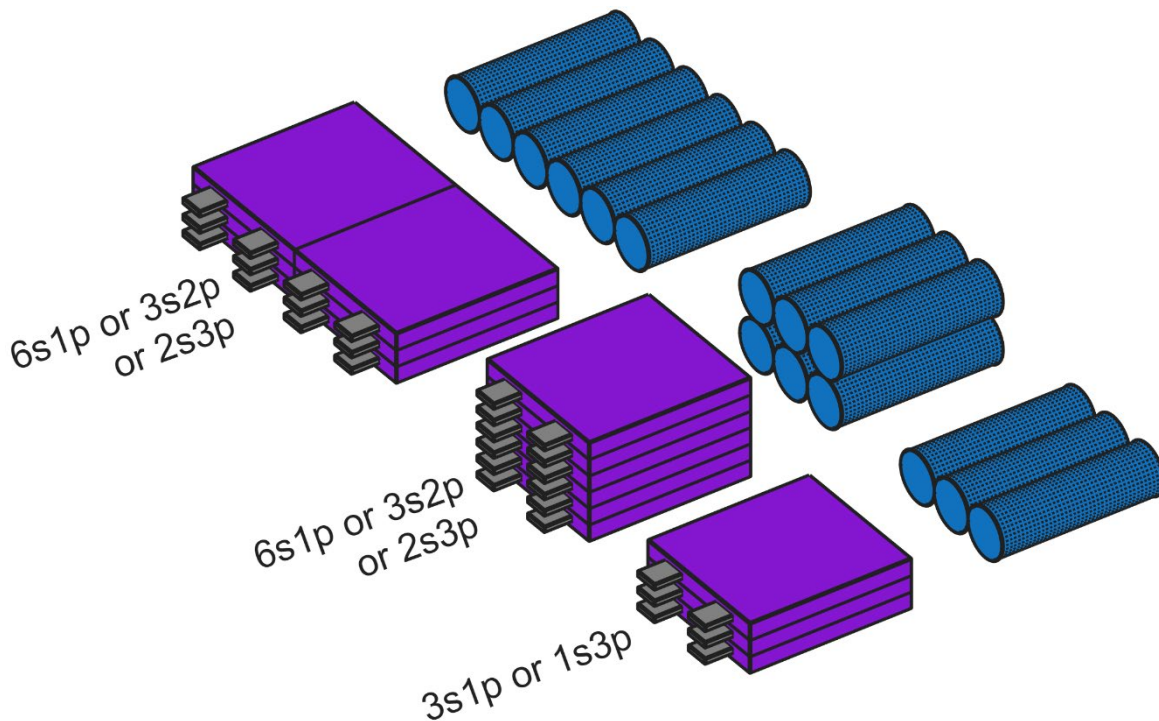
4.2.7.2 The ratio of the quantity of pouch cells to quantity of 21700 cells is listed between the illustrated pouch cells and 21700 cells in the figure above (4.2.7.1).

4.3 Geometric Compatibility

4.3.1 Example configurations: MAX During Life 10.7 mm x 42 mm x 70 mm pouch cells versus 21700 cylindrical cells.



4.3.2 Example configurations: MAX During Life 7.1 mm x 63 mm x 70 mm pouch cells versus 21700 cylindrical cells.



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4.3.3 Example configurations: MAX During Life 7.1 mm x 63 mm x 140 mm pouch cells versus 21700 cylindrical cells.

