



Dubai Future Solutions – Extreme Weather-Proof Batteries Competition Terms and Conditions

In 2021, Dubai Future Foundation launched the Dubai Future Solutions Initiative (the “**Initiative**”). Through the Initiative, Dubai Future Foundation, hereafter referred to as “**DFF**”, “**us**” and “**we**”, calls on innovators, creators, technologists, scientists and futurists to push the boundaries of what is possible to create breakthrough solutions that benefit all humanity.

The first challenge of the Initiative is the Extreme Weather-Proof Batteries Challenge (the “**Competition**”). These terms and conditions (“**T&Cs**”), together with following specific competition rules set out in Annex A (together the “**Competition Rules**”).

If there is any conflict or inconsistency between these T&Cs, the Competition Rules, and the Guidelines, the Competition Rules shall prevail. By entering the Competition, you agree to be fully and unconditionally bound by these T&Cs and the Competition Rules, including any amendments and the decisions of DFF, which are final and binding in all respects.

A. Eligibility

The criteria for eligible individuals to enrol and participate in the Competition are as per the requirements set out in the applicable Competition Rules (“**Eligible Individuals**”). We reserve the right to ask for proof of age and evidence to verify the identity of all Participants at any time.

The Competition is not open to the employees of DFF or the Competition Organisers, or any of their affiliates, subsidiaries or licensees.

Eligible Individuals may join together to form a team (“**Team**”). An Eligible Individual may not join more than one Team and an Eligible Individual who is part of a Team may not enter the Competition on an individual basis. If a Team is entering the Competition, they must appoint and authorize one individual (the “**Team Leader**”) to represent, act, and enter the submission, on their behalf. The Team Leader and each Team member who participates in the Competition must meet the eligibility requirements set out in these T&Cs and the applicable Competition Rules. By entering a submission for the Competition on behalf of a Team, you represent and warrant that you are the Team Leader authorized to act on behalf of your Team.

Eligible Individuals and Teams that enrol to the Competition by the end of deadline stated in the applicable Competition Rules are hereafter referred to as “**Participant(s)**”.

We reserve the right to disqualify any Participant(s) from the Competition if, in DFF’s sole judgement, the Participant has not complied with these T&Cs and/or the applicable Competition Rules, has tampered with the operation of the Competition, or has engaged in any conduct that is detrimental or unfair to us, the Competition, or any other Participant(s).

We reserve the right, in our sole discretion, to maintain the integrity of the Competition, to void votes (as applicable) for any reason. Any attempt by a Participant to deliberately damage any website or undermine the legitimate operation of the Competition may be a violation of criminal and civil laws. Should such an attempt be made, we fully reserve the right to seek damages to the fullest extent permitted by law and report to authorities as appropriate.

We accept no responsibility for any late, lost or misdirected entries due to technical disruptions, network congestion or for any other reason.



B. Submission Requirements

Participants must enter their submissions in accordance with the entry requirements set out in the applicable Competition Rules. We fully reserve the right to reject submissions without any explanation or prior notice.

Each Participant agrees that no aspect of their entry, including but not limited to their proposal, blueprint and/or prototype, will infringe the Intellectual Property Rights (as defined below) of us or any third party.

For the purposes of these T&Cs and the Competition Rules, “**Intellectual Property Rights**” means all intellectual property rights, including but not limited to, patents, registered designs, trademarks and service marks, rights in the nature of unfair competition rights, copyright, database rights, design rights, and all similar property rights including those subsisting (in any jurisdiction) in inventions, designs, drawings, performances, computer programs, semi-conductor topographies, processes, including but not limited to, automated processes, manufacturing processes and fabrication processes, research results, test results, research tools, algorithms, solutions, sales and marketing plans, business and contractual relationships, techniques, protocols, software code, control systems, prototypes, sensors, materials, machines, electronics, installations, robotics, robotic infrastructure, robotic systems, robotic manipulators, metrology equipment, mobile operating systems and all other forms of technology, and the right to apply for protection of any of the above rights, in each case whether registered or unregistered and including all applications and rights to apply for and be granted, renewals or extension of, and rights to claim priority from, such rights and all similar or equivalent rights or forms of protection which subsist or will subsist now or in the future in any part of the world.

C. Submission Rights

Subject to the licenses described below, any applicable Intellectual Property Rights to a submission will remain with the relevant Participants.

By entering the Competition, you hereby grant us and each of our affiliates, and any other third parties acting on behalf of any of the foregoing, Competition partners (including judges and technical advisory partners), prize providers and the successors, licensees and assigns of each of the foregoing (collectively, the “**Competition Organisers**”), a fully paid up, non-exclusive, assignable, sublicensable, worldwide, perpetual license to display publicly and use for promotional purposes all information included in the submissions, including but not limited to the blueprints, proposals and/or prototypes. This license includes, but not limited to, posting or linking to the submission on our and partners' websites and applications, including our website, and display and promotion of the submission on any other media, worldwide.

Without limitation of any of the Competition Organisers' rights pursuant to these T&Cs, the following submission components may be displayed to the public: name, description, images, video URL, website URL, team members, the submission category and platform, and submitter type. Other submission materials may be viewed by us and judges for screening and evaluation.

Participants represent and warrant that the Competition Organisers are free to use Participant's submissions in the manner described above, as provided or as modified by us, without obtaining permission or license from any third party and without any compensation to Participants.



D. Selection of winners

All submissions for the Competition will be evaluated in collaboration with us by a selected judging panel, to be appointed in our sole discretion. The specific judging requirements and process for the Competition are set out in the applicable Competition Rules.

E. Prizes

The winner of the Competition will receive the prize as specified in the relevant Competition Rules. All prize details will be specified in the Competition Rules and will be determined by us, in our sole discretion. The prize will be awarded if properly claimed. Unless the prize is specifically stated as being a cash amount, no cash redemption or transfer/assignment of the right to receive the prize is permitted, except in our sole discretion. We may, at our sole discretion, substitute any prize won with a prize of equal or greater value.

The prize consists only of the items expressly specified in the relevant Competition Rules and, unless stated otherwise in the Competition Rules, does not include any travel arrangements or expenses. All expenses or costs associated with the acceptance or use of the prize or any component of the prize are the responsibility of each winner. All prizes are awarded “as is” and without any warranty, except as required by law. In no event will more than the number of prizes stated in the relevant Competition Rules be awarded. In the event that a prize is not claimed, that prize shall remain our property. To the extent that any prize providers or Competition partners provide any additional benefits or prizes to any winner(s) which are not expressly provided for in the Competition Rules, we will have no liability in respect of such additional benefits and/or prizes. Any liability in respect of any such additional benefits or prizes shall be solely with the prize provider or specific Competition partner (as applicable).

F. Entry Conditions and Release

By entering the Competition, you (and, if you are entering on behalf of a Team, each participating member) agree(s) to the following:

- (i) The relationship between you, the other Participant(s), and us, is not a confidential, fiduciary, or other special relationship.
- (ii) You will be bound by and comply with these T&Cs and the Competition Rules and our decisions are binding and final in all matters relating to the Competition.
- (iii) You release, indemnify, defend and hold harmless each of DFF, the Competition Organisers, the prize suppliers and any other organizations responsible for sponsoring, fulfilling, administering, advertising or promoting the Competition, and all of their respective past and present officers, directors, employees, agents and representatives (hereafter the “**Indemnified Parties**”) from and against any and all claims, expenses, and liabilities (including reasonable attorneys’ fees), including but not limited to negligence and damages of any kind to persons and property, defamation, slander, libel, violation of right of publicity, infringement of any third parties Intellectual Property Rights, property damage, or death or personal injury, arising out of or relating to the Competition, any Participant’s entry, creation of submission or entry of a submission, participation in the Competition, acceptance or use or misuse of the prizes (including any travel or activity related thereto) and/or the broadcast, transmission, performance, exploitation or use of the submission as authorized or licensed by these T&Cs and/or the applicable Competition Rules.



Without limiting the foregoing, the Indemnified Parties shall have no liability in connection with:

- (i) any incorrect or inaccurate information, whether caused by our electronic or printing error, or by any of the equipment or programming associated with or utilized in the Competition;
- (ii) technical failures of any kind, including, but not limited to malfunctions, interruptions, or disconnections in phone lines, internet connectivity or electronic transmission errors, or network hardware or software or failure of the Competition website (as applicable);
- (iii) unauthorized human intervention in any part of the entry process or the Competition;
- (iv) technical or human error which may occur in the administration of the Competition; or
- (v) any injury or damage to persons or property which may be caused, directly or indirectly, in whole or in part, from the Participant's participation in the Competition or receipt or use or misuse of any prize.

The Indemnified Parties are not responsible for incomplete, late, misdirected, damaged, lost, illegible, or incomprehensible submissions or for address or email address changes of the Participants. Proof of sending or submitting will not be deemed to be proof of receipt by us.

If for any reason any Participant's submission is determined to have not been received or been erroneously deleted, lost, or otherwise destroyed or corrupted, the Participant's sole remedy is to request the opportunity to resubmit its submission. Such request must be made promptly after the Participant knows or should have known there was a problem, and will be determined by us, at our sole discretion.

Each Participant acknowledges that each of the Competition Organisers engages, has engaged and will in the future engage in the development, preparation, production, acquisition and dissemination of software, technology and other material (collectively, "**Materials**"), including without limitation Materials that may be similar or identical to a Participant's submission, and that other people may previously have submitted to one or more of the Competition Organisers Materials that are similar or identical to a submission. Each Participant agrees that it will not be entitled to any compensation or credit in connection with, and will not have any other legal, equitable or other rights of any nature with respect to, the use by any of the Competition Organisers of any Material that is similar or identical to any submission or any component thereof. As an inducement to us to accept the Participant's entry, each Participant hereby waives any claim or right of action against any of the Competition Organisers in connection with the Competition Organisers' use of any Materials (or any portions thereof), whether or not such Materials are similar or identical to an Participant's submission or contain any features, ideas, material and/or elements that are similar or identical to those contained in an Participant's submission. Without limitation of the foregoing, the Competition Organisers will have the right to use, without any payment or other obligation whatsoever to any Participant, any part of any submission, and any idea or concept contained therein, that (a) is similar or identical to, or contains elements encompassed in, any material or concept that has been developed, produced or disseminated or is under consideration or in development by or for any of the Competition Organisers before or at the time of the Participant's submission, (b) is not unique, novel, original and concrete so as to be entitled to protection under applicable laws, (c) has been made public by anyone at the time of its submission in the Competition or otherwise is in the public domain, (d) would be freely usable by a third party if it had not been submitted as a submission or the subject of any agreement, or (e) is



similar or identical to, or contains elements encompassed in, an idea, concept or material that is independently created by any Competition Organisers or any third party. Acceptance of a submission is not an admission by any Competition Organisers of the novelty or originality of the submission.

G. Winner Selection

If a selected winner is ineligible, cannot be reached, or fails to claim their prize within the period of time stipulated in the applicable Competition Rules, or as otherwise communicated such as via email, that winner will forfeit the prize and it will be awarded to a substitute winner. If, having attempted to contact a winner and a substitute winner, we are unable to award a prize, we reserve the right to consider the prize unclaimed.

This process is final, and no correspondence will be entered into. Non-winners will not be notified.

By entering the Competition, you also consent to us announcing your first name, location and age when the prize is to be offered should we opt to do so, acting in our sole discretion.

By accepting a prize, Participants consent to the use of their name, county of residence, age and/or prize information for promotional and other reasonable purposes without further payment, except where prohibited by law. A winner may be requested to participate in our reasonable marketing and promotional activities. By entering the Competition, you expressly consent to any photos or videos of events connected with the prize that may be posted on our social media accounts or website and agree to sign all necessary releases to document this express consent.

If you are a winner and you submit and expressly consent to any material, including but not limited to photographs, videos or testimonials, to us for use or publication in connection with our reasonable marketing and promotional activities, including but not limited to our official social media activities, you waive any right you may have to inspect or approve such activities and you release and discharge us from any claims or liability relating to our reasonable use of your material.

H. Events outside DFF's control

We will not be liable or responsible for any failure to perform, or delay in performance of, any of our obligations under the Competition, the T&Cs and/or the Competition Rules that is caused by events outside our reasonable control ("**Force Majeure Event**"). A Force Majeure Event includes any act, event, non-happening, omission or accident beyond our reasonable control and includes in particular (without limitation) the following:

- a) Strikes, lock-outs or other industrial action;
- b) Civil commotion, riot, invasion, terrorist attack or threat of terrorist attack, war (whether declared or not) or threat or preparation for war;
- c) Fire, explosion, storm, flood, earthquake, subsidence, epidemic or other natural disaster;
- d) Impossibility of the use of railways, shipping, aircraft, motor transport or other means of public or private transport;
- e) The postponement or cancellation of any Competition;
- f) Impossibility of the use of public or private telecommunications networks;
- g) Delays, losses, errors or omissions in or made by the postal or other delivery service or by the banking system;
- h) The acts, decrees, legislation, regulations or restrictions of any government or regulator;
- i) Failure of any telecommunications system.



Our performance of the Competition is deemed to be suspended for the period that the Force Majeure Event continues, and we will have an extension of time for performance for the duration of that period. We will use our reasonable endeavours to bring the Force Majeure Event to a close or to find a solution by which our obligations under the Competition, the T&Cs and Competition Rules may be performed despite the Force Majeure Event.

I. General Conditions

- (i) We reserve the right, in our sole discretion, to change these T&Cs and/or the Competition Rules or to cancel, suspend and/or modify the Competition, these T&Cs and/or Competition Rules at any time.
- (ii) We reserve the right, in our sole discretion, to disqualify any individual or Participant we find to be actually or presenting the appearance of tampering with the entry process or the operation of the Competition or to be acting in violation of these T&Cs and/or the Competition Rules or in a manner that is inappropriate, unsportsmanlike, not in the best interests of the Competition, or a violation of any applicable law or regulation.
- (iii) Any attempt by any person to undermine the proper conduct of the Competition may be a violation of criminal and civil law. Should we suspect that such an attempt has been made or is threatened, we reserve the right to take appropriate action including but not limited to requiring an Participant(s) to cooperate with an investigation and referral to criminal and civil law enforcement authorities.
- (iv) These T&Cs and/or the Competition Rules are subject to change at any time, including our or the Participant(s) rights or obligations.
- (v) If at any time during the Competition, a Participant or prospective Participant believes that any of these T&Cs and/or the Competition Rules may be unclear or ambiguous, they must submit a written request by email to solutions@dubaifuture.ae for clarification.
- (vi) Our failure to enforce any terms of these T&Cs and/or the Competition Rules shall not constitute a waiver of that provision. Should any provision of these T&Cs or the Competition Rules be or become illegal or unenforceable in the United Arab Emirates, such illegality or unenforceability shall leave the remainder of these T&Cs or the Competition Rules including the term or condition affected, to the fullest extent permitted by law, unaffected and valid. The illegal or unenforceable provision shall be replaced by a valid and enforceable provision that comes closest and best reflects our intention in a legal and enforceable manner with respect to the invalid or unenforceable provision.
- (vii) Excluding submissions, all Intellectual Property Rights related to this Competition, including these Terms and Conditions and Competition Rules (“**DFF Materials**”) are owned or used under license by us and our affiliates. All rights are reserved. Unauthorized copying or use of any copyrighted material or our Intellectual Property Rights without the express written consent of its owners is strictly prohibited.
- (viii) All DFF Materials are strictly confidential. You must not use or disseminate any DFF Materials other than for the purpose of fulfilling your obligations under this Agreement. You have no rights to use DFF Materials except as expressly provided herein.



- (ix) By entering this Competition, you represent and warrant that your submission is an original work of authorship and does not violate any third party's proprietary or Intellectual Property Rights. If your submission infringes upon the Intellectual Property Rights or other right of a third party, you will be disqualified at our sole discretion. If the content of your submission is claimed to constitute infringement of any proprietary or Intellectual Property Rights of any third party, you shall at your sole expense, defend or settle against such claims. You shall indemnify, defend and hold us harmless from and against any suit, proceeding, claims, liability, loss, damage, costs or expense, which we may incur, suffer or be required to pay arising out of such infringement or suspected infringement of any third party rights.

J. Limitations of Liability

By entering this Competition, all Participants (including, in the case of a Team, all participating members) agree to be bound by these T&Cs and the applicable Competition Rules and hereby release the Indemnified Parties from any and all liability in connection with the prizes or Participant's participation in the Competition. Provided, however, that any liability limitation regarding gross negligence or intentional acts, or events of death or body injury shall not be applicable in jurisdictions where such limitation is not legal.

K. Miscellaneous

- a) Amendment: To the maximum extent permitted by applicable law, we reserve the right to change these Competition T&Cs and/or the Competition Rules at any time, in our sole discretion.
- b) Privacy Notice: All information submitted in connection with the Competition will be treated in accordance with our Privacy Policy found here: <https://www.dubaifuture.ae/privacy-policy/>.
- c) Entire Agreement: Participation in the Competition constitute Participants full and unconditional agreement to these T&Cs and the Competition Rules. By entering this Competition, all Participants agrees that all decisions related to the Competition are final and binding, and that all such decisions are at our sole discretion.
- D) WAIVER OF LIABILITY: NEITHER DFF NOR THE COMPETITION ORGANISERS OR PRIZE PROVIDERS (AS APPLICABLE) WILL BE RESPONSIBLE OR LIABLE FOR: (I) ANY FAILURE TO RECEIVE ENTRIES DUE TO TRANSMISSION FAILURES OR OTHER CONDITIONS BEYOND THEIR REASONABLE CONTROL; (II) ANY LATE, LOST, MISROUTED, GARBLED OR DISTORTED OR DAMAGED TRANSMISSIONS OR ENTRIES; (III) ANY DISRUPTIONS, INJURIES, LOSSES OR DAMAGES CAUSED BY EVENTS BEYOND THEIR REASONABLE CONTROL; (IV) ANY POSTPONEMENT, DELAY OR CHANGES THAT MAY IMPACT ON THE PRIZE CAUSED BY EVENTS BEYOND THEIR REASONABLE CONTROL; OR (V) ANY PRINTING OR TYPOGRAPHICAL ERRORS IN ANY MATERIALS ASSOCIATED WITH THE COMPETITION.



Annex A - Dubai Future Solutions – Extreme Weather-Proof Batteries Competition Rules

Competition Rules

Set out below are the official rules that apply to Participants of the Competition. This Annex A, the proposal concept design guidelines at Attachment 1 (the “**Concept Guidelines**”), and the Challenge technical guidelines at Attachment 2 (the “**Technical Guidelines**”) together comprise the **Competition Rules**.

The Competition Rules and the T&Cs apply to the Competition.

1. Entry Requirements

Each Participant (“**You**”) is eligible to participate in the Competition provided that You comply with the following entry requirements by the Submission Deadline (defined in section 3 below).

Your submission must:

- have a detailed proposal and design for a prototype for a weather-proof battery technology that can operate for a challenging range of flight, under varying temperatures, with an ability to fly and to serve several key applications (such as delivery and transportation of goods, infrastructure, surveillance, etc.) which satisfies all requirements set out in the Guidelines (“**Solution**”);
- the Solution must be uploaded to the designated platform through the website dubaifuture.ae/dubai-future-solutions/

In addition to submitting the Solution, You will be required to submit the following information as part of your enrolment in the Competition:

- First name
- Last name
- Age
- Nationality
- Country of residence
- Short brief of the proposal to be developed as part of the Solution
- Passport copy

All Team Leaders must be over the age of 21. DFF reserves the right to request any individuals and Team members under the age of 21 to provide a written consent to participate from their respective parent or legal guardian.

2. Deadline for submissions

The Competition opens for submissions on 1 March 2022. **Submission deadline is 31 December 2022 at 23:59 (GST)**. Submissions which do not meet the deadline will be excluded from the Competition.

3. Submission confirmation

An e-mail confirming the receipt of the submitted nomination is normally sent out within a couple of months of the submission deadline.

4. Verification Procedure

DFF WILL ONLY BE RESPONSIBLE FOR VERIFYING EACH PARTICIPANT'S ELIGIBILITY TO MAKE A SUBMISSION. THE JUDGES WILL BE SOLELY RESPONSIBLE FOR DETERMINING THE WINNER.

5. Judges

The Winner of this Competition will be determined by a judging committee. The judges are experienced in the fields of technology, innovation and entrepreneurship. We reserve the right to nominate the judges and determine the number of judges in our sole discretion.

The judges are responsible for the selection of the Winners.

6. Timeline

Phase 1: 1 March 2022 until 31 December 2022:

- Call for application submission in accordance with the requirements set out in the T&C's, these Competition Rules and the Guidelines

Phase 2: 1 January 2023 until 31 January 2023:

- Evaluation and selection of the Solution proposals

Phase 3: 1 February 2023 until 31 December 2023

- Prototype development

Phase 4: 1 January 2024 – 31 May 2024

- Testing at selected test center

Phase 5: From 1 July 2024

- Evaluation of tests and announcement of winners

7. Prizes

There will be **one** winner who will receive a grand prize of US\$ 1,000,000 (subject to additional terms and conditions to be issued in due course).

The prize will be awarded to the winner in USD. Neither DFF nor the Competition Organisers will have any liability in relation to any currency fluctuations or conversion rates relating to the transfer of the prize fund to the winner. The winner shall also bear sole responsibility for any taxes related in any way to the receipt of the prize by the winner.

8. Announcements

The winner of the Competition will be announced at an award ceremony, expected in late 2024. Such date will be confirmed at a later stage, and may be subject to change subject to public health conditions and the ability to hold the event in person.

Attachment 1 - Dubai Future Solutions

“Extreme Weather-Proof Batteries” Proposal Concept Design Guidelines

REQUIREMENTS FOR PHASE I OF THE CHALLENGE

In Phase I of the Extreme Weather-Proof Batteries Challenge, participants are required to submit a concept paper that describes, in a conceptual manner, the methodology and concept that the participant/team will follow to achieve the objectives of the challenge towards developing a prototype for a weather-proof battery technology that can operate under challenging flight environments, under cold temperatures or above certain hot temperatures within the range of -10°C to 60°C.

FORMAT OF THE APPLICATION SUBMISSION/CONCEPT PAPER

Participants are required to follow the following format and sections in their submissions for Phase I of the challenge.

The concept paper must be in PDF or MS Word file format, with a maximum of 15 pages.

1) Cover Page, Team Information & Executive Summary

This section is limited to two (2) pages, and consists of the following:

a) Team Information:

- Names of Team members
- Name of Team Leader/representative
- Organization Name (where applicable)
- Team/Organization Address
- Contact information of the team members (Email, and phone numbers)

b) Executive Summary:

A brief description of the proposed design approach, highlighting the objectives of the proposal and the methodology to achieve the state-of-the-art technical objectives of the challenge. This should also highlight the current state-of-the-art available solutions, and how the proposed solution differentiates itself from the current solutions.

2) Solution Description

This section is limited to ten (10) pages, and consists of the following:

A detailed description of the proposed solution, and how it tackles and achieves each performance attribute of the technical criteria (See the Technical Guidelines at Annex 2).

It is recommended to include the following sections:

- Background, Literature review and analysis of existing solutions
- Technical/physical limitations of the challenge
- Specific technical objectives and goals of the proposed solution



- How the solution will exceed the current technology limitations and achieve the objectives while scoring highly on aspects of efficacy, efficiency, feasibility, scalability, and technical effectiveness.
- Compatibility of the proposed solution with existing applications (Drones, or other similar battery-operated devices).
- Proposed measurements and performance tests that the team will conduct internally before shipping the prototype for external testing
- A detailed project timeline for developing the required number of sample battery cells

3) Data Sheets and Technical diagrams

This section is limited to two (2) pages, and consists of the following:

Concept and technical schematics or visual materials supporting the concept design. This may also include any computer simulation of the proposed solutions both in terms of composition and performance.

4) References

This section is limited to one (1) page and consists of all the literature references cited in the paper.



Attachment 2 - Dubai Future Solutions “Extreme Weather-Proof Batteries” Challenge Guidelines

Introduction

This guidebook discusses the target specifications for the “Extreme Weather-Proof Batteries” Challenge focused on advanced batteries for drones. Only the flight battery will be considered, not the battery used in the remote controller.

Targets have been defined for 12 specifications an advanced battery should be capable to do and a weight is given to each of these specifications.

1 Battery Target Performance Attributes

To compare different approaches to meet the target requirements, weighting factors have been introduced. Specific energy is the primary target. Other important factors are fast charge, swelling and cycle life, listed in table 1 below.

Table 1: Targets for cell development:

Test #	Performance Attribute	Target	Weighting Factor	Comment
1	Cell size (energy content)	20 to 40 Wh	NA	Cells tested must fall in this range
2	Specific energy	400 Wh/kg	30	
3	Energy density	1000 Wh/L	5	Determined in the charged state in case of pouch cells
4	Max. discharge rate	90% energy delivered at 2 C	5	
5	Temperature range discharge	-10°C to 60°C 70% energy delivered at -10°C Better than 98% Coulomb efficiency at 60°C	5	Temperatures lower than -10 °C by battery heating.
6	Charge time to 90% SOC	10 minutes	10	Charge protocol can be selected
7	Charge time to 100 % SOC	15 minutes	5	
8	Temperature range charge	10°C to 60°C	5	Lower temperatures by battery heating
9	Cell swelling during operation	<5%	10	Difference between charged and discharged state (no external pressure)
10	Cycle life	100 cycles	10	Cycles at 100% DOD
11	Calendar life	3 years at 25°C	10	
12	Cell swelling during lifetime	<5%	5	

2 Test Protocol for Cell Prototypes

Table 2 defines the test protocol for the 12 performance attributes in Table 1.

A total of nine identical cells must be tested. Cells 1 to 3 will undergo tests #1 and #4 to #9 in the order given by the table. Each test should be repeated twice. The test result will be the average of the 9 measurements.

Cells 4 to 6 will be tested according to # 10. The swelling (#12) will be determined after 100 cycles or when 80% capacity is reached before this. The test result will be the average of the performance of the three cells.

Cells 7 to 9 will be tested according to # 11. The test result will be the average of the performance of the three cells.

The currents in the test protocol are stated as C-rates. These refer to the capacity determined in test #1.

Unless stated otherwise, the cells are charged at a constant current equal to C/2 at 23°C ambient temperature. For tests at different temperatures, the cells will be soaked at that temperature for at least 24 hours.

Cycle life is determined at 1C charge and discharge and 100% DOD. Between each charge and discharge, a 15-minute rest is inserted.

To shorten the test period, calendar life is determined by an accelerated test at 50°C. The capacity remaining is determined at room temperature. The storage can be interrupted periodically to determine the remaining capacity at the time.

Swelling is a concern with pouch cells. Cylindrical cells do not significantly change their dimensions. However, if the expansion of the jelly roll becomes too large, the cell case can split open. This is considered a failure.

Table 2: Test for the performance attributes:

Test #	Performance Attribute	Unit	Test Protocol
1	Cell size (energy content)	Wh	Charge and discharge at 0.5C rate at 23°C. Energy= Ah*average discharge voltage
2	Specific energy	Wh/kg	Energy divided by cell weight
3	Energy density	Wh/L	Energy divided by cell volume, excluding tabs or terminals
4	Max. discharge rate	C-rate	Discharge fully charged cell at 2 C rate and determine delivered energy. 100% is given by test #1.
5	Temperature range discharge	°C	Determine delivered energy of a cell fully charged at 23°C with a 2C discharge at -10°C. Repeat at 60°C for both charge and discharge temperature. Calculate Coulomb efficiency of the 60°C test by using the ratio of discharge to charge capacity.



6	Charge time to 90% SOC	minutes	10-minute charge followed by 0.5C discharge at 23°C to determine % capacity relative to charge/discharge rate of 0.5C/0.5C
7	Charge time to 100 % SOC	minutes	15-minute total charge time at 23°C to achieve 98% of energy content at a discharge rate of 0.5 C
8	Temperature range charge	°C	15-minute total charge time at 10°C to achieve 90% of energy content at a discharge rate of 0.5 C at 23°C
9	Cell swelling during operation	%	Pouch cells: Difference in thickness between 0% SOC and 100% SOC. Cylindrical cells: No splitting of cell case
10	Cycle life	# full cycles	Charge and discharge at 1C, 100% DOD at 23°C for 90 cycles. Increase temperature for the next 10 cycles to 50°C. Afterwards, continue cycling at 23°C. EOL at 80% of initial energy content.
11	Calendar life	years	Accelerated test: 0.5 years stored at 50°C, 50% SOC. Remaining energy 80% of initial content at 1C/1C at 23°C.
12	Cell swelling during lifetime	%	Pouch cells: Difference in thickness at 100% SOC between fresh cells and cycled cells less than 5% Cylindrical cells: No splitting of cell case