FOLLOW-UP SERVICE PROCEDURE
(TYPE R)

LITHIUM BATTERIES - COMPONENT
(BBCV2)

Manufacturer:	SEE ADDENDUM FOR MANUFACTURER LOCATIONS
Applicant:	2467591 (Party Site) Zhongbei Runliang New Energy (jining) Co Ltd In the South Automobile Industrial Park at the intersection of Chengxiang Avenue and Jiamei Road, Jining Economic Development Zone Jining Shandong 272400 CN
Recognized Company:	2467591 (Party Site) SAME AS APPLICANT

Use of the Mark

This Follow-Up Service Procedure authorizes the above Manufacturer(s) to use the marking specified by UL LLC, or any authorized licensee of UL LLC, including the UL Contracting Party, only on products when constructed, tested and found to be in compliance with the requirements of this Follow-Up Service Procedure and in accordance with the terms of the applicable service agreement with UL Contracting Party. The UL Contracting Party for Follow-Up Services is listed in the addendum to this Follow-Up Service Procedure ("UL Contracting Party"). UL Contracting Party and UL LLC are referred to jointly herein as "UL."

It is the responsibility of the Applicant, Manufacturer(s), and Recognized Company to make sure that only the products meeting the aforementioned requirements bear the authorized Marks of UL LLC, or any authorized licensee of UL LLC.

Additional Responsibilities

Additional responsibilities, duties and requirements for the Applicant and Manufacturers are defined under Additional Resources at the following web-site: http://www.ul.com/fus. Manufacturers without Internet access may obtain the current version of these documents from their local UL customer service representative or UL field representative. For assistance, or to obtain a paper copy of these documents or the Follow-Up Service Terms referenced below, please contact UL's Customer Service at http://www.ul.com/aboutul/locations/, select a location and enter your request, or call the number listed for that location.

Acceptance of Follow-Up Services

The Applicant and the specified Manufacturer(s) and any Recognized Company in this Follow-Up Service Procedure must agree to receive Follow-Up Services from UL Contracting Party. If your applicable service agreement is a Global Services Agreement ("GSA"), the Applicant, the specified Manufacturer(s), and any Recognized Company will be bound to a Service Agreement for Follow-Up Services upon the earliest by any Subscriber of a) use of the prescribed UL Mark, b) acceptance of the factory inspection, or c) payment of the Follow-Up Service fees. The Service Agreement incorporates such GSA, this Follow-Up Service Procedure and the Follow-Up Service Terms which can be accessed by clicking the following link: http://services.ul.com/fus-service-terms. In all other events, Follow-Up Services will be governed by and incorporate the terms of your applicable service agreement and this Follow-Up Service Procedure.

Use and Ownership of the Follow-Up Service Procedure

This Follow-Up Service Procedure, and any subsequent revisions, is the property of UL and is not transferable. This Follow-Up Service Procedure contains confidential information for use only by the Applicant, the specified Manufacturer(s), and representatives of UL and is not to be used for any other purpose. It is provided to the Subscribers with the understanding

that it is not to be copied, either wholly or in part unless specifically allowed, and that it will be returned to UL, upon request.

Definition of Terms

Capitalized terms used but not defined herein have the meanings set forth in the GSA and the applicable Service Terms or any other applicable UL service agreement.

No Third Party Liability

UL shall not incur any obligation or liability for any loss, expense or damages, including incidental, consequential or punitive damages arising out of or in connection with the use or reliance upon this Follow-Up Service Procedure to anyone other than the above Manufacturer(s) as provided in the agreement between UL LLC or an authorized licensee of UL LLC, including UL Contracting Party, and the Manufacturer(s).

Certification Body

UL LLC has signed below solely in its capacity as the certification body to indicate that this Follow-Up Service Procedure fulfills the requirements for certification documentation issued by the certification body.

Bruce A. Mahrenholz
Director
Conformity Assessment Programs (CPO)
UL LLC

LOCATION

2467591 (Party Site)
Zhongbei Runliang New Energy (jining) Co Ltd
In the South Automotive Industry Park at the intersection of Chengxiang Avenue and Jiamei Road
Jining Economic Development Zone
Jining Shandong 272400 CN
Factory ID: none
UL Contracting Party for above site is: UL GmbH

ISSUED: 2012-03-19

STANDARDIZED APPENDIX PAGES
Subject 1642

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

STANDARDIZED APPENDIX PAGES

TABLE OF CONTENT

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

STANDARDIZED APPENDIX PAGES

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COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

APPENDIX A - FIELD REPRESENTATIVE'S RESPONSIBILITIES AND INSTRUCTIONS FOR EXAMINATION OF THE PRODUCT

GENERAL

The Field Representative's general responsibilities, as part of the Follow-Up Services Procedure, are as noted in the published document titled, "UL Mark Surveillance Requirements", and is available through UL's secure customer portal MyHome@UL.com and/or through UL's internet site www.UL.com. Manufacturers that do not have Internet access may obtain the current version of these requirements from their local UL Customer Service Representative or UL Field Representative.

PROCEDURE IN THE EVENT OF NONCONFORMANCE

When a product does not comply with the Follow-Up Service Procedure, require that the manufacturer implement appropriate action as outlined in the "UL Variation Notice and Corrective Action Requirements" document, which can be found at www.ul.com/fus.

INSTRUCTIONS FOR INSPECTION OF THE PRODUCT

General -

The following are applicable only to secondary cells.

There are two types of factory Follow-Up Programs that apply to the BBCV2 Product Category for secondary lithium battery cells. One type relies on the verification of critical dimensions and/or specifications contained in detailed drawings, specification sheets, and/or the FUS Procedure (in lieu of required factory testing). The other relies on required factory testing (in lieu of verification of critical dimensions and/or specifications contained in detailed drawings/specification sheets, and/or the FUS Procedure). Follow-Up Testing at UL is applicable to both Follow-Up Programs.

Cell Models Relying Upon Required Factory Testing –

They are models that are specified in Table D of Sp. App. D.

No special instructions beyond those already contained in the Appendix Pages, Special Appendix Pages, or the body of the FUS Procedure.

Cell Models Relying Upon Verification of Critical Dimensions and/or Specifications –

They are models that are <u>not</u> specified in Table D of Sp. App. D.

The Field Representative shall examine the construction from the information provided in the construction details outlined in the FUS Procedure. If the FUS Procedure referenced drawings and/or specification sheets are not physically

contained in the FUS Procedure, they will be referenced by drawing/specification sheet number and last revision date. The Field Representative shall use the manufacturer's copies of the drawings and/or specification sheets to conduct the inspection. If requested by the UL Office, the Field Representative shall provide information from the FUS Procedure referenced drawing or specification sheet in use at the time of the visit.

In addition to the information outlined in the electrode and electrolyte items of the product description section of the FUS Procedure, the following information shall be checked on each visit for each product inspected.

1. Positive (Cathode) and Negative (Anode) Electrode(s): A generic description of the active materials, a description of the substrate materials, the overall dimensions of the electrode and the ratio of the negative to positive electrode capacity per area. See Ill 1 for an example of the critical information required for inspection.

Changes to the active material or substrate materials, a change in the dimensions of the electrode or a change in the manufacturer's specifications for the ratio of the negative to positive electrode capacity per area would necessitate a re-evaluation by UL. For changes in other areas contained in the FUS Procedure referenced drawing or specification sheet, it is not necessary for the manufacturer to have the FUS Procedure changed to incorporate the latest revision level/date. However, you shall work with the manufacturer to preserve the critical information contained on the document referenced in the FUS Procedure so that it could be used during subsequent inspections to determine that critical information contained on documents with newer revision levels/dates has not changed.

2. Electrolyte(s): The lithium salts and their percentage of the total electrolyte composition, the solvents and their percentage of the total electrolyte composition, a description of allowed contaminants and maximum levels allowed. See Ill 2 for an example of the critical information required for inspection.

Changes to the lithium salt composition or in its percentage of the total electrolyte composition, in the solvent(s) used or in each solvent's percentage of the total electrolyte composition, an increase of the current maximum allowed contaminant levels or the addition of new allowed contaminants would necessitate a re-evaluation by UL. For changes in other areas contained in the FUS Procedure referenced drawing or specification sheet, it is not necessary for the manufacturer to have the FUS Procedure changed to incorporate the latest revision level/date. However, you shall work with the manufacturer to preserve the critical information contained on the document referenced in the FUS Procedure so that it could be used during subsequent inspections to determine that critical information contained on documents with newer revision levels/dates has not changed.

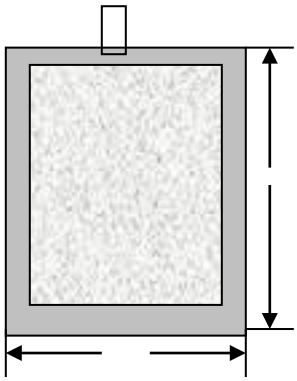
COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

ILLUSTRATION 1: ELECTRODE INFORMATION
(Example)

1. Drawing Number and Revision date

2. The capacity ratio of the negative (anode) to positive (cathode) electrodes: i.e. ≥ 1.008

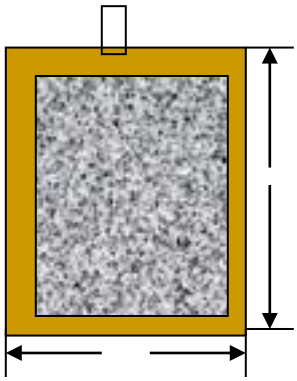
3. Positive Electrode Information:



Overall Dimensions of Positive Electrode

Positive Electrode Active Materials: i.e. $LiCoO_2$, $LiCoMnNiO_2$, etc.
Positive Electrode Substrate Material: i.e. aluminum foil

4. Negative Electrode Information:



Overall Dimensions of Negative Electrode

Negative Electrode Active Materials: i.e. graphite, carbon, etc.
Negative Electrode Substrate Material: i.e. copper foil

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

ILLUSTRATION 2: ELECTROLYTE INFORMATION
(Example)

1. Drawing number and revision date

2. Lithium Salts: *i.e. $LiPF_6$, $LiBF_4$, $LiClO_4$, etc.*
   Lithium salt - weight % of composition: *i.e.13.2 ± 0.3 %*

3. Solvent(s) (typically more than one): *i.e. EC, PC, DMC, EMC, EA, MA*
   For each solvent – weight % of composition: *i.e. 10.0 ± 1.0 %*

4. Allowed Impurities: i.e. H_20, HF, Fe, Na, K, Ca, etc.
   Maximum impurity levels: *i.e. 4 ppm*,

Electrolyte Drawing # ABC *Revision Date: 12/1/07*	
Lithium Salt	Weight percentage
$LiPF_6$	13.2 ± 0.3 %
Solvent(s)	Weight Percentage
EC	30.2 ± 1.0 %
DC	28.1 ± 1.0 %
DMC	27.3 ± 1.0 %
Allowed Impurities	Maximum Allowed Levels, ppm
H_20	18
HF	35
FE	4
Na	4
K	4

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

APPENDIX B - INSTRUCTIONS FOR FIELD REPRESENTATIVE'S SAMPLE SELECTION

GENERAL

Certain products covered by this Procedure employ constructions or materials requiring Follow-Up Tests to be conducted at UL.

Referring to Sp. App. B, Table B. Within each calendar year and for each sample group, select either the number of cells or separator materials indicated in the No. Per Group Per Year (#/Group/Year) column, or the number in that group which are available during inspection visits, whichever is lesser.

Unless specifically requested, a cell or separator material, shall only be selected once each year.

If it is not possible to select the required number of cells or separator materials for a given calendar year due to production schedules, continue with the sample selection per Sp. App. B, Table B when inspection visits resume the following year. Do not select multiple samples of the same cell or separator material to fulfill the #/Group/Year requirement.

SAMPLES FOR THE TESTING OFFICE

The Field Representative is responsible for selecting the appropriate cells and/or separator materials for Follow-Up testing as indicated above. For each cell or separator material selected, the sample requirements and FUS Test Program are indicated in code, in the Test Program Code column in Sp. App. B, Table B. Specific details regarding the Test Program Codes are contained in Table A below, including quantity of samples, size, thickness, and the required test program.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

TABLE A – SAMPLES AND TEST PROGRAMS

Test Program Code	Samples Required	Required FUS Sample Tests
A	1 cell sample	Open Circuit Voltage Measurement
B	11 cell samples	Open Circuit Voltage Measurement
		Projectile Test
C	5 cell samples	Abnormal Charging Test
D	15 cell samples	Abnormal Charging Test
		Projectile Test
E	A piece of 60 x 200 mm separator material	Separator ID Test: IR
		Separator ID Test: TGA
		Separator ID Test: DSC
F	A length of 100 cm separator material in the machine direction, i.e. along the length of the material as it is unrolled	Separator Thickness Test
G	3 cell samples employing the separator material	Disassembly of Separator
		Separator ID Test: IR
		Separator ID Test: TGA
		Separator ID Test: DSC
		Separator Thickness Test

Samples shall be identified and tagged with the applicable information using a Sample Tag (Form 3000-217). Unless otherwise stated, the Field Representative shall inform the manufacturer that the samples are to be forwarded to the Test Office(s) as designated on the specific Procedure Volume subscriber card.

Cells Samples –
The following additional information of the cells shall be included on the Sample Tag:

Primary and Secondary cells:

- Manufacturer’s Name and Model Number
- Rated Voltage in Vdc (include tolerances if applicable)
- Rated Capacity in Ah

Secondary cells only:

- Manufacturer’s specified discharge end point voltage in Vdc
- Manufacturer’s maximum specified charge current, Ic, in mA
- Manufacturer’s maximum specified charge voltage, Vc, in Vdc
- Manufacturer’s specified charging parameters for “topping off” samples including the cut off current

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

Separator Material Samples:
The following additional information of the separator material shall be included on the Sample Tag:

- Separator ID/Part number
- The cell model number in which the material is used

In the special circumstance that individual separator samples cannot be shipped for testing, complete cells as indicated in Table B may be selected and sent instead. The Sample Tag of the cells samples shall be marked with:

- the cell manufacturer’s name
- the cell model number
- the cell capacity

Note: Because of the way lithium ion polymer cells are constructed, the option of sending whole cell samples for separator testing is not offered, and actual separator samples as noted above must be sent.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

APPENDIX C - INSTRUCTIONS FOR FOLLOW-UP TESTS AT UL

GENERAL

The samples selected in accordance with Appendix B shall be subjected to the tests indicated in Table B of Sp. App. B for the specific product. Tests are to be conducted in accordance with the current Standard for Lithium Batteries, UL 1642.

CELL TESTS

The following cell tests shall be conducted as specified in Table B of Sp. App. B on samples received.

OPEN CIRCUIT VOLTAGE MEASUREMENT (PRIMARY CELLS ONLY):

METHOD

The open circuit voltage for one sample of each primary model cell and battery was measured using a direct-current (dc) voltmeter and compared to its specified opened circuit voltage as indicated in Table C of Sp. App. C.

BASIS FOR ACCEPTABILITY

The measured voltage of the battery was within the tolerances of the manufacturer’s specified open circuit voltage.

ABNORMAL CHARGING (SECONDARY CELLS ONLY):

METHOD

Five samples of each model shall be tested in an ambient temperature of 20 ± 5°C. Temperatures are monitored, for information purposes only, on cell casings using thermocouples.

Samples subjected to this test shall be charged to the top off parameters outlined in Table C of Sp. App. C.

Each fully charged sample is discharged at a constant current of 0.2C/1 h to the manufacturer’s maximum specified discharge endpoint voltage per Table C of Sp. App. C.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

ABNORMAL CHARGING (SECONDARY CELLS ONLY): (CONT'D)

The sample is then charged with a constant current (CC) charging method with a maximum target charging current limit which is 3 times the manufacturer's maximum specified charging current, I_c, until the manufacturer's specified maximum charging voltage, as noted in the Table C of Sp. App. C is reached. At that point the charging method is changed to a constant voltage (CV) charging method at the manufacturer's specified maximum charging voltage, as noted in Table C of Sp. App. C.

Testing is conducted on at least two samples at a charge current equal to 1.5 times the manufacturer's maximum specified charging current, I_c.

The charge duration is 7 hours.

BASIS FOR ACCEPTABILITY

The samples shall not explode or catch fire as a result of the abnormal charge test.

PROJECTILE: (PRIMARY AND SECONDARY CELLS)

METHOD

Five of the 10 fully charged samples of each model selected are subjected to this test. Secondary cells are charged in accordance with the top off parameters of Table C of Sp. App. C under abnormal charging before being subjected to the projectile test.

As shown in Fig. 1, each test sample cell is placed on a screen that covers a 102 mm (4 inch) diameter hole in the center of a platform table. The screen is constructed of steel wire mesh having 20 openings per inch (25.4mm) and a wire diameter of 0.017 in. (0.43mm). The screen is mounted 38mm (1-1/2 inch) above a burner. The fuel and airflow ratios are set to provide a bright blue flame that causes the supporting screen to glow a bright red.

An eight-sided covered wire cage, 610 mm (2 feet) across and 305 mm (1 foot) high, made from metal screening is placed over the test sample as shown in Figure 1. The metal screening is constructed from 0.25mm (0.010 inch) diameter aluminum wire with 16-18 wires per inch (25.4mm) in each direction. The aluminum screening should be free from holes and secured tautly around the frame.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

PROJECTILE: (PRIMARY AND SECONDARY CELLS) (CONT'D)

Each sample is heated and shall remain on the screen until it explodes or the cell has ignited and burned out. It is not required to secure the sample in place unless it is at risk of falling of the screen before the test is completed. When required, the sample shall be secured to the screen with a single wire tied around the sample.

Note: The securement wire is only utilized if the sample will not remain above the flame during the test to achieve ultimate results. In this case the single wire utilized should be the minimal thickness necessary to hold the cell in place.

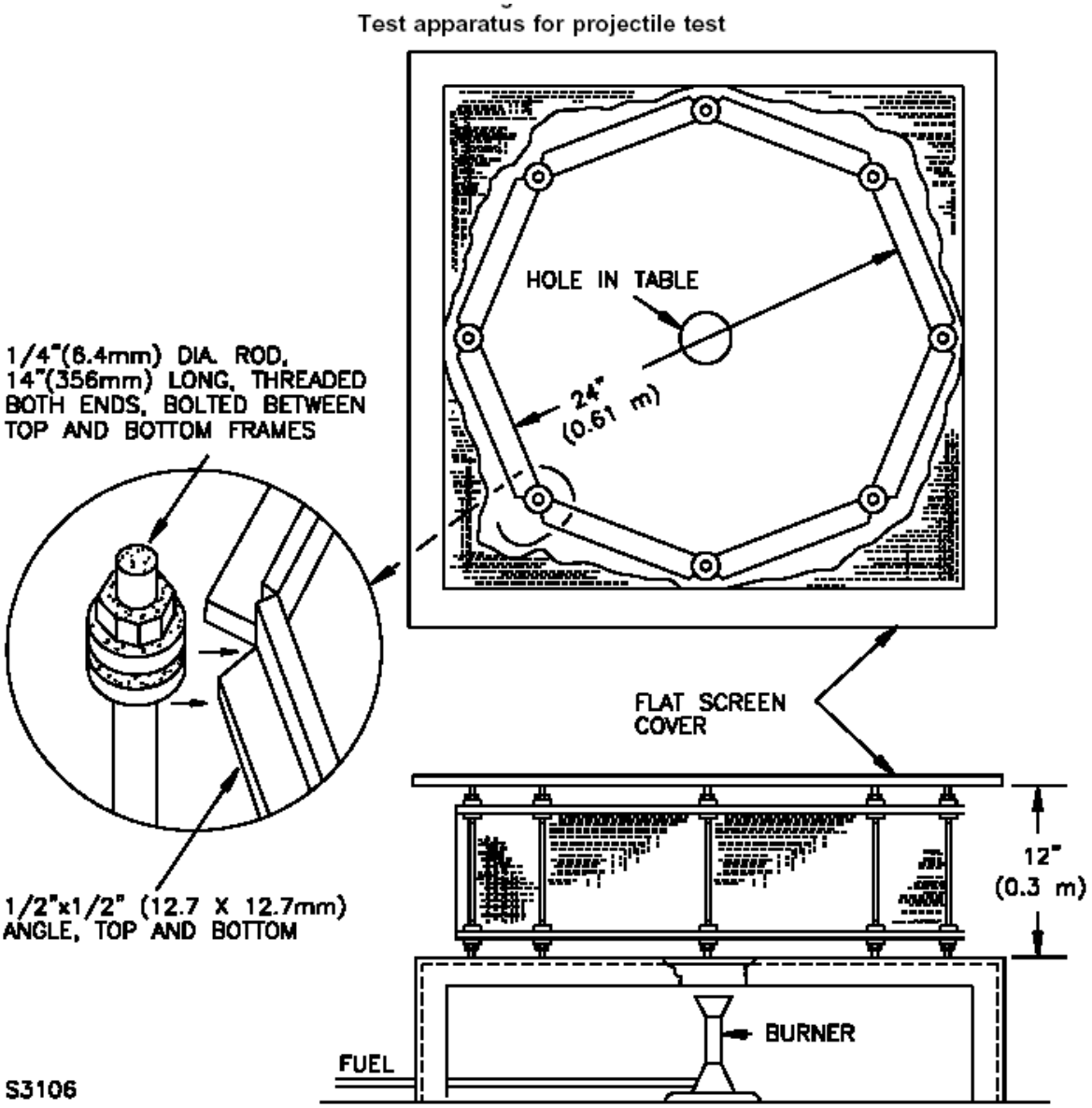
BASIS FOR ACCEPTABILITY

No part of an exploding cell shall penetrate the aluminum wire screen.

Note: A hole in the screen created by a piece of the cell sitting on the screen and burning a hole through the screen is not considered a failing result. Only those holes created by exploding parts puncturing the screen due to the force of the explosion are considered failing results.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

FIG. 1



COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

SEPARATOR MATERIAL TESTS:

The following tests shall be conducted on samples of separator selected in accordance with Table B of Sp. App. B.

For special circumstances, when cells must be shipped in lieu of separator samples, special additional sample preparation must be followed as outlined under Preparation of Samples Obtained From Cells.

PREPARATION OF SAMPLES OBTAINED FROM CELLS

Cells provided for separator tests, shall be fully discharged at a 1C rate until they are completely discharged (@ 0.2Vdc open circuit voltage). The cells shall be carefully disassembled in a sample preparation area taking care to prevent damage to the electrode assembly. The electrode assembly shall be unwound, or disassembled and a sufficient quantity of separator material as outlined in Table B of Sp. App. B under Test Program Codes G, is to be removed from the electrodes for testing.

The separator sample(s) shall then be soaked in a suitable cleaning solvent (i.e. acetone) to remove active material and/or electrolyte residue for 24 hours, and allowed to air dry in a clean chamber prior to conducting the separator material ID and thickness measurement as noted below.

SEPARATOR MATERIAL ID TESTS

GENERAL

The Qualitative Infrared Analysis (IR), Differential Scanning Calorimetry (DSC), and Thermogravimetric Analysis (TGA) Tests are to be conducted in accordance with the current Standard for Polymeric Materials Short Term Property Evaluations (UL 746A).

CONDITIONING

Prior to material ID testing, the samples shall be conditioned in an atmosphere of 50.0 ±2.0% RH and 23.0 ±1.0°C for a minimum of 40 hours.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

A. QUALITATIVE INFRARED ANALYSIS

METHOD

The separator sample(s) shall be subjected to the Qualitative Infrared Analysis (IR) test and comply with the Basis for Acceptability.

An infrared spectrum of the material shall be obtained using an infrared spectrophotometer.

BASIS FOR ACCEPTABILITY

The test spectrum shall correlate with the spectrum referenced on Special Table C of Sp. App. C.

B. DIFFERENTIAL SCANNING CALORIMETRY

METHOD

The separator sample(s) shall be subjected to the Differential Scanning Calorimetry (DSC) Test and shall comply with the Basis for Acceptability below.

BASIS FOR ACCEPTABILITY

The test thermogram shall indicate the same thermal response over the programmed temperature range as that referenced in Table C of Sp. App. C.

C. THERMOGRAVIMETRY

METHOD

The separator sample(s) shall be subjected to the Thermogravimetry (TGA) Test and shall comply with the Basis for Acceptability.

BASIS OF ACCEPTABILITY

The thermogram obtained shall indicate the same characteristic weight loss over the programmed temperature range as referenced in Table C of Sp. App. C.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

D. THICKNESS MEASUREMENT

METHOD

The separator thickness is determined by utilizing an instrument designed for measuring easily deformed work pieces at thicknesses in the 10 – 30 μm range. The measuring instrument shall be adjusted so that a force of 0.01N (1 gram-force) is placed on the sample when measuring the thickness.

The thickness of the sample is measured every 20 cm in the machine direction of the sample for a total of 5 measurements. The thickness of the sample is calculated as the average of the 5 measurements. The thickness value obtained shall be compared with the value noted in Table B of Sp. App. B.

BASIS OF ACCEPTABILITY

The separator thickness shall be within the thickness measurement tolerances as noted in Table B of Sp. App. B.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

APPENDIX D - MANUFACTURER' S RESPONSIBILITIES, CONSTRUCTION CONSIDERATIONS, AND REQUIREMENTS FOR FACTORY TESTS

The Follow-Up Service Procedure covering the product is loaned to the manufacturer and constitutes the basis on which the product is judged for compliance with the applicable requirements.

GENERAL

The Manufacturer’s general responsibilities, as part of the Follow-Up Services Procedure, are as noted in the published document titled, “UL Mark Surveillance Requirements”, and is available through UL’s secure customer portal MyHome@UL.com and/or through UL’s internet site www.UL.com. Manufacturers that do not have Internet access may obtain the current version of these requirements from their local UL Customer Service Representative or UL Field Representative.

MANUFACTURER' S RESPONSIBILITIES

Specific manufacturer's responsibilities include, but are not limited to:

Production Tests – For those models indicating in Table D of Sp. App. D, conduct the Factory Tests detailed in Appendix D.

Required Records - Maintain records of test performance. Unless indicated otherwise in the Procedure, the information to be recorded should include the model or catalog number, identification of the product, the test conducted, the test date, and the results. Records are to be retained for at least 6 months and shall be readily available for review by the Field Representative.

Note: It is not necessary to keep complete test records when 100% of production is tested, if the manufacturer has an auditable system in place to confirm that production is always subjected to the required tests. Instead, exception reports indicating noncompliance and corrective action should be retained.

Markings – The cells shall be marked with the manufacturer’s name, trademark or other identifier; cell part number; date of manufacturer; and as outlined in the Section General and individual procedures.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

CONSTRUCTION CONSIDERATIONS

For those cases where the Follow-Up Service is based upon verification of critical dimensions and/or specifications, it is recognized that the manufacturer may change dimensions and/or specifications (therefore changing revision levels) for parameters not specified in the FUS Procedure. It is acceptable for the manufacturer to do so without seeking a change to the FUS Procedure as long as he still retains a copy of the FUS Procedure referenced drawing, so the Field Representative during subsequent visits can continue to confirm that the latter revision levels do not include any changes to the dimensions and/or specifications for parameters referenced by the FUS Procedure. Any changes to dimensions and/or specifications for parameters covered in the FUS Procedure must first by authorized by UL and the latest version (revision level) of the drawing must be incorporated in the FUS Procedure.

MANUFACTURER'S PERIODIC PRODUCTION TEST PROGRAM FOR SECONDARY CELLS

For cell models subjected to periodic production testing, refer to Table D of Sp. App. D.

The applicable tests and examinations described below shall be performed by the manufacturer on random samples chosen in accordance with Table E below.

TABLE E – FREQUENCY OF PERIODIC PRODUCTION TESTS

Test or Examination	Type of Product	Frequency
Weight Measurement	Lithium ion and lithium ion polymer cells	Daily
Upper Discharge Profiles	Lithium ion and lithium ion polymer cells	Monthly
Lower Discharge Profile	Lithium ion and lithium ion polymer cells	Monthly
Leakage	Lithium ion and lithium ion polymer cells	Monthly
X-Ray Construction Examination	Lithium ion and lithium ion polymer cells	Monthly

A. Weight Test

Test Method

Using a calibrated scale, a representative sample of production cells from each model as outlined in Table 1 of Sp. App. D shall be weighed and compared with the manufacturer's specified weight.

Basis for Acceptability

The weight of samples shall be within the tolerances per Table 1 of Sp. App. D.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

B. Upper Discharge Profile

Test Method

A representative sample of production cells as outlined in Table 2 of Sp. App. D from each model shall be subjected to a 1.0C Discharge Profile Production Test. Cells intended for high rate discharge applications greater than 1.0C, shall be subjected to a higher discharge profile as outlined in Table 2.

Samples shall be fully charged in accordance with the manufacturer's specifications for charging. The samples shall than be discharged at a 1.0C A discharge rate, or higher rate as applicable, at an ambient of 20 ± 5°C to the manufacturers specified end point voltage. The voltage over current discharge profiles shall be recorded during discharging of the cell. The curves obtained shall be compared with the manufacturers specified discharge profile for the cell.

Basis of Acceptability

The discharge voltage over current profile shall be within the manufacturer's specification tolerances per Table 2 of Sp. App. D.

C. Lower Discharge Profile

Test Method

A representative sample of production cells as outlined in Table 2 of Sp. App. D from each model shall be subjected to a 0.2C Discharge Profile Production Test. Cells intended for high rate discharge applications greater than 1.0C, shall be subjected to a low discharge profile at higher rates than 0.2C, as outlined in Table 2.

Samples shall be fully charged in accordance with the manufacturer's specifications for charging. The samples shall than be discharged at a 0.2C A discharge rate, or higher rate as applicable, at an ambient of 20 ± 5°C to the manufacturers specified end point voltage. The voltage over current discharge profiles shall be recorded during discharging of the cell. The curves obtained shall be compared with the manufacturers specified discharge profile for the cell.

Basis of Acceptability

The discharge voltage over current profile shall match the manufacturer's specification tolerances per Table 2 of Sp. App. D.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

D. Leakage

Test Method

A representative sample of production cells as outlined in Table 3 of Sp. App. D from each model shall be subjected to a Leakage Test.

Samples fully charged in accordance with the manufacturer's specifications, shall be subjected to conditioning at 60 ± 2°C for 20 days.

At the conclusion of the conditioning, the cells shall be allowed to return to room ambient (20 ± 5°C) and examined for visual signs of leakage of electrolyte.

Basis of Acceptability

There shall be no signs of leakage.

E. X-Ray Construction Review

Test Method

A representative sample of production cells as outlined in Table 4 of Sp. App. D from each model shall be subjected to an X-Ray Construction Review as outlined below.

Samples shall be X-rayed utilizing equipment as outlined in Table F in Sp. App. D. The X-rays of the chosen production test samples shall be compared with the manufacturer's comparison X-Ray of the cell model to determine that construction features such the placement and size of the electrodes, length of center tube, tab placement and design, etc. have not changed from the manufacturer's X-ray Construction Review.

Basis of Acceptability

The X-rays of the examined production samples shall be comparable with the manufacturer's X-Ray Construction Review. There shall be no signs of change.

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

Procedure In Case of Nonconforming Results

When nonconformance is encountered during the manufacturer's test and inspection program, the manufacturer shall follow the procedure detailed below:

a. Reject the lot and hold production since last acceptable sample.

b. Perform analysis to determine cause of nonconformance, corrective action to be taken, and portion of segregated production or lots affected.

c. Implement corrective action.

d. Randomly select a minimum of verification samples in accordance with parameters tables in Sp. App. D for retest of nonconforming parameters.

e. If all verification samples pass, the lot may be accepted.

f. If any verification sample does not conform, all reference to UL may be removed from the affected production, the production may be scrapped entirely or, the manufacturer may notify the Field Representative of the nonconformance and a Special Investigation shall be initiated by the manufacturer. The Special Investigation shall be concluded and the segregated production may bear the UL Listing Mark only when, in the judgment of UL, the conditions responsible for the Special Investigation have been corrected.

Recognized Component Marking Data Page (RCMDP)

(FILE IMMEDIATELY AFTER AUTHORIZATION PAGE)

RECOGNIZED COMPONENT MARKING

Products Recognized under UL's Component Recognition Service are identified by marking elements consisting of:

1. The Recognized Company's identification specified in this document.
2. A catalog, model or other applicable product designation specified in the descriptive sections of this document.
3. The UL Recognized Component Mark shown below.

Only those components, which actually bear the Marking, should be considered as being covered under the Recognition Program. The UL Listing or Classification Mark is not authorized for use on or in connection with Recognized Components.

Recognized Component Mark

Minimum size of the Recognized Component Mark is not specified as long as it is legible. Minimum height of the registered symbol ® shall be 3/64 inch but may be omitted if it is out of proportion to the Recognized Component Mark or not legible to the naked eye.

The manufacturer may reproduce the Mark electronically. Any decision regarding the acceptability of the manufacturer's Mark reproduction will be made at the Reviewing Office.

Recognized Component Marking Data Page (RCMDP)

(FILE IMMEDIATELY AFTER AUTHORIZATION PAGE)

RECOGNIZED COMPONENT MARKING

Products Recognized under UL's Component Recognition Service are identified by marking elements consisting of:

1. The Recognized Company's identification specified in this document.
2. A catalog, model or other applicable product designation specified in the descriptive sections of this document.
3. The UL Recognized Component Mark shown below.

Only those components, which actually bear the Marking, should be considered as being covered under the Recognition Program. The UL Listing or Classification Mark is not authorized for use on or in connection with Recognized Components.

Recognized Component Mark

Minimum size of the Recognized Component Mark is not specified as long as it is legible. Minimum height of the registered symbol ® shall be 3/64 inch but may be omitted if it is out of proportion to the Recognized Component Mark or not legible to the naked eye.

The manufacturer may reproduce the Mark electronically. Any decision regarding the acceptability of the manufacturer's Mark reproduction will be made at the Reviewing Office.

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COMPONENT - LITHIUM BATTERIES (BBCV2, BBCV3)

TABLE B - SAMPLE SELECTION GUIDE

Sample Group	#/Group	Model #	Report Date	Category	Type of Cells	Cell capacity (C) mAh	Thickness(µm)	Additional Info	Test Program Code
1	**1**	**NCM18650P-2000**	**2022-04-20**	**Secondary**	**Cylindrical**	**2000**	**NA**	**-**	**D**

COMPONENT - LITHIUM BATTERIES (BBCV2, BBCV3)

INDEX TO FOOTNOTES:

COMPONENT - LITHIUM BATTERIES (BBCV2, BBCV3)

TABLE C - TEST CRITERIA

Refer to Sp. App. B for Footnotes and TABLE B for Additional Information

Model #	Cell capacity (C) mAh	Open Circuit Voltage, Vdc	Top-off Charge voltage(V_C), Vdc	Top-off Charge current (I_C), mA	End Point/ Cut Off Voltage, Vdc	External Protector Left in Circuit, Y/N?	IR Reference	TGA Reference	DSC Reference
NCM18650P-2000	**2000**	**-**	**4.2**	**1000**	**2.75**	**-**	**-**	**-**	**-**

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

TABLE D – CELL MODELS SUBJECT TO PERIODIC PRODUCTION TESTING (WITH SIMPLIFIED CONSTRUCTION DESCRIPTIVE DETAILS)(FOR SECONDARY CELLS)

Cell Model	Section No./ Report Date*

** - Note to CAS: Cells from the same family (i.e. same chemistry and construction except different ratings) must all be subjected to or all not subjected to Periodic Production Testing, but not both, within a procedure section/report date. Cells from different families may choose either option within each volume, but the two options shall not be mixed within a single section/report date.*

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

TABLE F - TEST EQUIPMENT

The following equipment has been evaluated with respect to the requirements expressed in Appendix D and has been found suitable:

Test	Type of Equipment	Equipment Manufacturer's Name	Equipment Model No.
Weight			
Upper Discharge			
Lower Discharge			
Leakage			
X-Ray Construction Review			

TABLE 1
PRODUCTION WEIGHT TEST PARAMETERS

Cell Models	Section No.	No. of Production Samples Tested per Day (≥ 3 samples)	Manufacturer's Specified Weight ± tolerances, g

TABLE 2
PRODUCTION UPPER and LOWER DISCHARGE TEST PARAMETERS

Cell Models	Section No.	No. of Production Samples Tested per Month (≥ 3 Samples for each discharge)	Upper Discharge Test		Lower Discharge Test	
			Discharge Rate, mA	Mfg. Specified Tolerances for V/C Discharge Profile	Discharge Rate, mA	Mfg. Specified Tolerances for V/C Discharge Profile

COMPONENT – LITHIUM BATTERIES (BBCV2, BBCV3)

TABLE 3
PRODUCTION LEAKAGE TEST PARAMETERS

Cell Models	Section No.	No. of Production Samples Tested per Month, (≥ 5 Samples)

TABLE 4
PRODUCTION X-RAY CONSTRUCTION REVIEW PARAMETERS

Cell Models	Section No.	No. of Production Samples Tested per Month, (≥ 10 Samples)

SECTION GENERAL

PRODUCT COVERED:

Component - Lithium Batteries (BBCV2).

FACTORY LOCATION AND IDENTIFICATION:

REFER TO ADDENDUM TO AUTHORIZATION PAGE FOR FACTORY ID'S

MARKING:

The Recognized manufacturer’s name, trade name or trademark or other descriptive markings or traceable ID code; Catalog number or model designation or equivalent; and date of manufacturer on the cell.

Additional marking requirements are outlined in the individual sections describing the batteries.

DATE OF MANUFACTURE MARKING

The batteries shall be marked with the manufacturer’s date of manufacture, which may be abbreviated; or may be in a nationally accepted conventional code; or in a code that does not repeat in less than 10 years.

The date code consists of the following: Detail refer to description.

File MH65554
Project 4790312667

April 20, 2022

REPORT

on

COMPONENT - Lithium Batteries
(BBCV2)

Zhongbei Runliang New Energy(Jining) Co.,Ltd.

Jining, Shandong, China

DESCRIPTION

PRODUCT COVERED:

USR Component – Secondary, lithium-ion cells as noted below.

Model Number	Chemistry	Shape/Type
NCM18650P-2000	Cathode: $LiNi_xMn_yCo_{(1-x-y)}O_2 \rightleftharpoons Li_{(1-a)}Ni_xMn_yCo_{(1-x-y)}O_2 + aLi^+ + (1-a)e^-$ Anode: $6C + aLi^+ + (1-a)e^- \rightleftharpoons Li_aC_6$	Cylindrical/Lithium-ion

ELECTRICAL RATING:

See also Conditions of Acceptability for charge limit specifications.

Model Number	Voltage (Nominal), Vdc	Capacity, (Nominal), mAh
NCM18650P-2000	3.6	2000

TECHNICAL CONSIDERATIONS (NOT FOR FIELD REPRESENTATIVE'S USE):

USR indicates compliance with the requirements outlined in UL 1642, Standard for Lithium Batteries, Edition 6, Issue Date 09/29/2020.

Use - For use only in products where the acceptability of the combination is determined by UL LLC.

Conditions of Acceptability - The use of these cells may be considered generally acceptable under the conditions given below:

1. The cells should be used within their manufacturer's specified temperature ranges as noted in Table below:

Models	Manufacturer Specified Temperature ranges	
NCM18650P-2000	Charging Temperature Range	0°C~45°C
	Discharging Temperature Range	-20°C~60°C
	Upper Limit Charging Voltage	4.2Vdc
	Upper charging Temp limit(T3)	45°C
	Lower charging Temp limit(T2)	0°C

The end product shall be designed to prevent the high temperature excursions on cell surface from exceeding 100°C (212°F).

2. These cells are to be used only in devices where servicing of the cell circuit and installation and replacement of the lithium-ion cells will be done by a trained technician. These cells are intended to be installed in a protective enclosure in the end use application that prevents access to the cells and associated cell circuitry by the user during charging and discharging of the cells.

3. These cells shall be installed within an enclosure that provides mechanical protection in the end use application, so that they protected from physical abuse that could result in damage to the cells including internal short circuits or shorting of terminals. Enclosures provided in the end use application shall prevent access to the cells through the use of simple tools or through openings.

4. The suitability of these cells for multi cell applications including series or parallel connections shall be determined in the end use. Cells used in multi-cell applications shall be of the same type, ratings and age to prevent the potential for explosions and fire due to cell imbalance.

5. For cells intended for series applications, protection shall be provided in the end use application to prevent cell reversal due to a forced discharge condition. A forced discharge test shall be conducted in the end use application for series connected cell applications.

6. These cells have been subjected to an abnormal charge test which subjects the cells to a constant current (CC) charge method followed by a constant voltage (CV) charge method. The test limit parameters for the abnormal charge test are outlined in the table below. The charging circuit in the end use application shall limit the charging current and charging voltage to the levels noted in the table under both normal and single fault condition. If the charging current and voltage in the end use application cannot be maintained at or below the levels noted in the table or if the charging method is different from the CC/CV method noted above, additional evaluation and testing may be necessary.

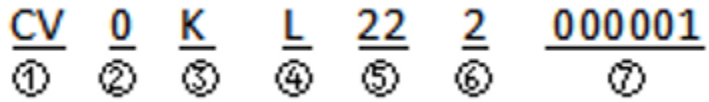
Model	Maximum Charging Current (Ic), mA	Maximum Charging Voltage (Vc), V dc
NCM18650P-2000	2000	4.2

MARKINGS/INSTRUCTIONS:

The Recognized manufacturer's name, file No. (MH65554), trade name or trademark or other descriptive markings or traceable ID code; Catalog number or model designation or equivalent; and date of manufacturer on the cell.

The cell or smallest package containing the cell shall be marked with the UL Recognition Mark.

The manufacturer's date code is as follows by scan the QR code:



③ One letter represents the year, K for 2021, L for 2022, ... Z for 2036, A for 2037.....;

④ One letter represents the month, A~L, A for January, B for February..... L for December;

⑤ Two digitals represent the day, 01, 02, 03.....30, 31;

Example: CV0LB252000001 represents that the cell is manufactured on February 25, 2022.

Lithium-Ion Cylindrical Cells - Fig(s).1-3
General – See Ill(s).1 for additional details of construction.

1. Cell Case – Consists of material, overall dimensions, and thickness of plating as noted below.

Model	Case Material	Case Dimensions, mm		Case Thickness, mm	Plating Thickness
		Length	OD		
NCM18650P-2000	Steel: BDCK	68.30	18.5	0.30	3~6μm

2. Cell Lid - Consists of: Cap-up/vent plate/PP gasket/Al welding plate/CID/
top insulator, Secured to case by crimping.

3. Electrode Assemblies – Consists of positive and negative electrodes rolled in a “jelly roll” assembly within the case and constructed as noted below.

Model No.	Positive Electrode		Negative Electrode		Negative Electrode/ Positive Electrode Capacity ratio
	Drawing No.	Dimensions, mm	Drawing No.	Dimensions, mm	(Ah_{NE}/Ah_{PE})
NCM18650P -2000	ILL.2	905mm*57.0mm*92μm	ILL.2	977mm*58.5mm*108μm	≥1.1

4. Separator – UnListed component battery separator Located between the electrodes and constructed as noted below. The separator is sized to extend beyond the electrodes as noted below for reliable insulation.

Cell Model	Separator Mfg.	Type Designation	Report Reference (UnListed Component)		Dimensions, mm		Minimum Extension beyond electrodes, mm
			File Number	Report Date	Length	Width	
NCM18650P-2000	lanketu	16	MH65555	2022-04-20	Separator 1: 1087 Separator 2: 1087	60.5	0.5

5. Electrolyte – Constructed as noted below.

Cell Model	Generic Composition	Drawing No.
NCM18650P-2000	LiPF6, EC/EMC/DMC/DEC	TR1, ILL.1(P1-RD-010)

6. Protection Mechanism – Located within cell. Consist of either one or a combination of the methods outlined below.

a. Circuit Interrupt Device (CID) – (Pressure activated protection mechanism that opens cell circuit when pressure within the cell reaches a certain limit.) Constructed as noted below. The circuit interrupt device is located within the cell cover as shown in the illustration(s).

Cell Model	CID Ills. No.
NCM18650P-2000	ILL.3

7. Insulators – Consists of the following parts within the cell: Information on the materials employed, location and construction information are as noted in the illustrations below.

Cell Model	Insulation Parts	Ill. Nos.
NCM18650P-2000	Top/Bottom Insulators: PET	ILL.4

8. Electrode Tabs – (Provided for the electrical connection of the electrodes to the cell terminals). Tabs constructed as noted below:

Model	Tab Construction Ill. Nos.
	Tab dimension:（thickness* width* length）(mm)
NCM18650P-2000	ILL.5 positive tab: Al 0.1mm*4.0mm*68mm Negative tab: Ni(1) 0.1mm*4.0mm*55mm Ni(2) 0.1mm*4.0mm*61mm

9. Vent Mechanism – The vent mechanism is constructed as noted below.

Model	Vent Ill. No.
NCM18650P-2000	ILL.3

Figure-1 Page-1

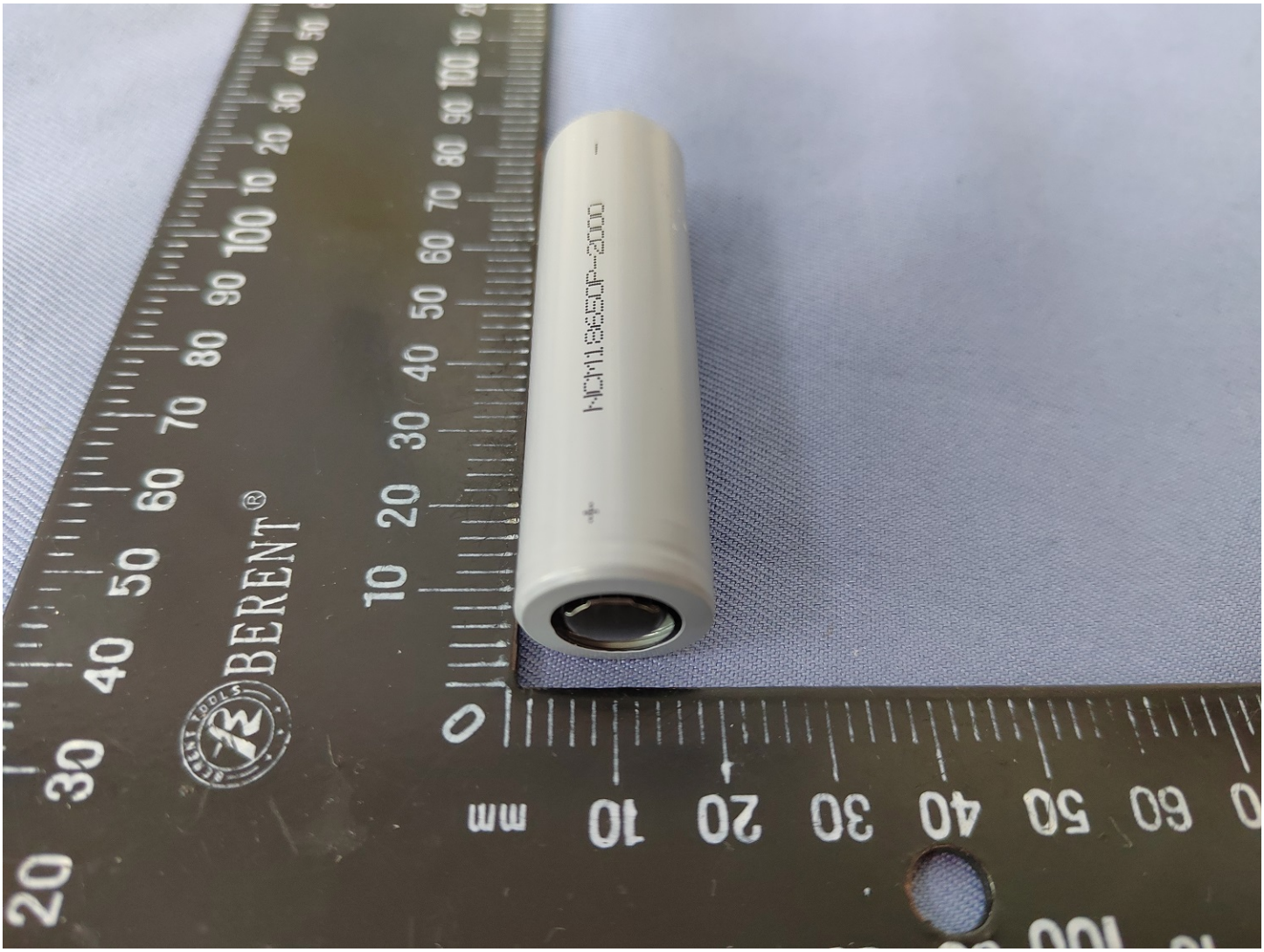


Figure-2 Page-1

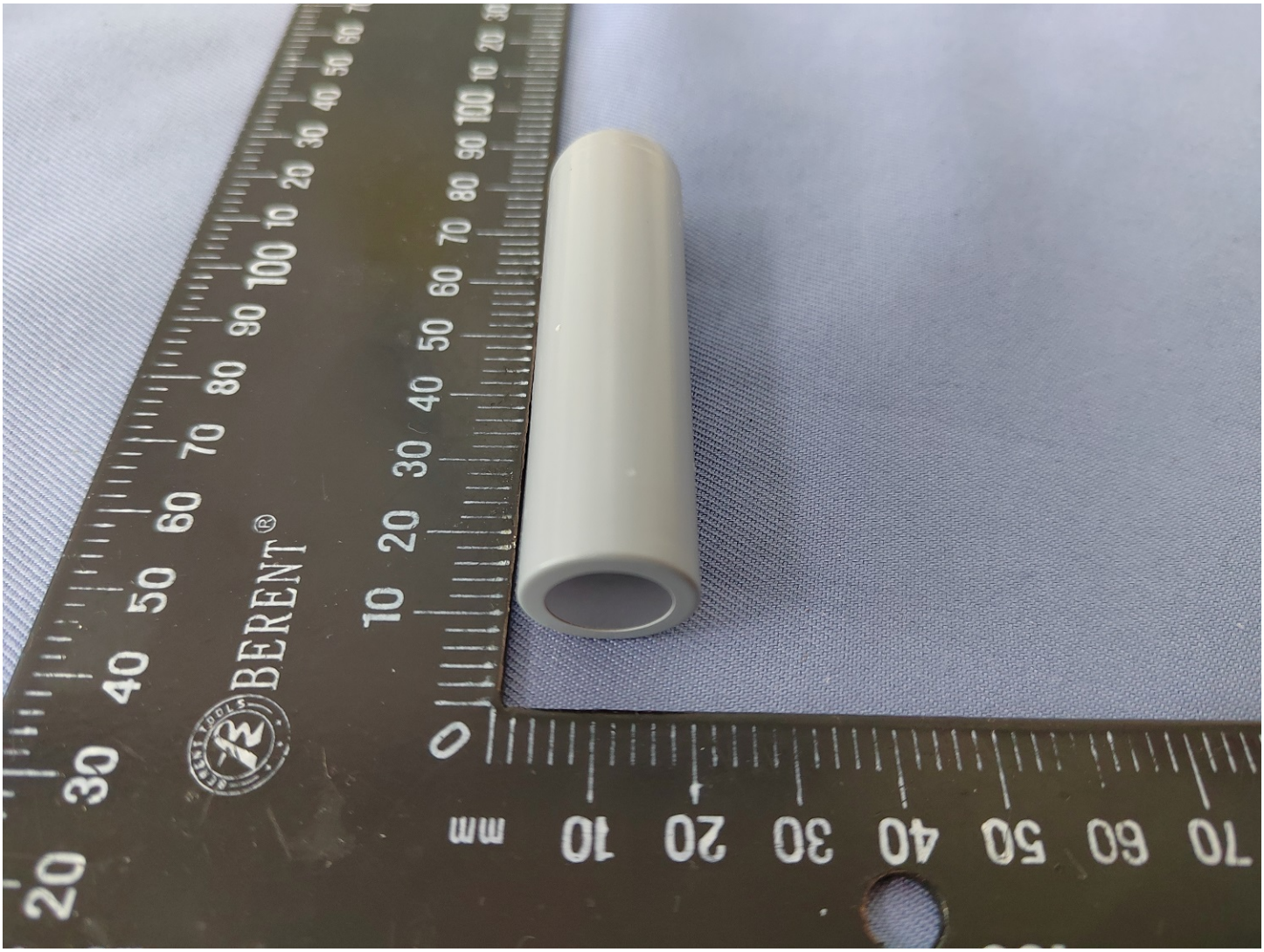
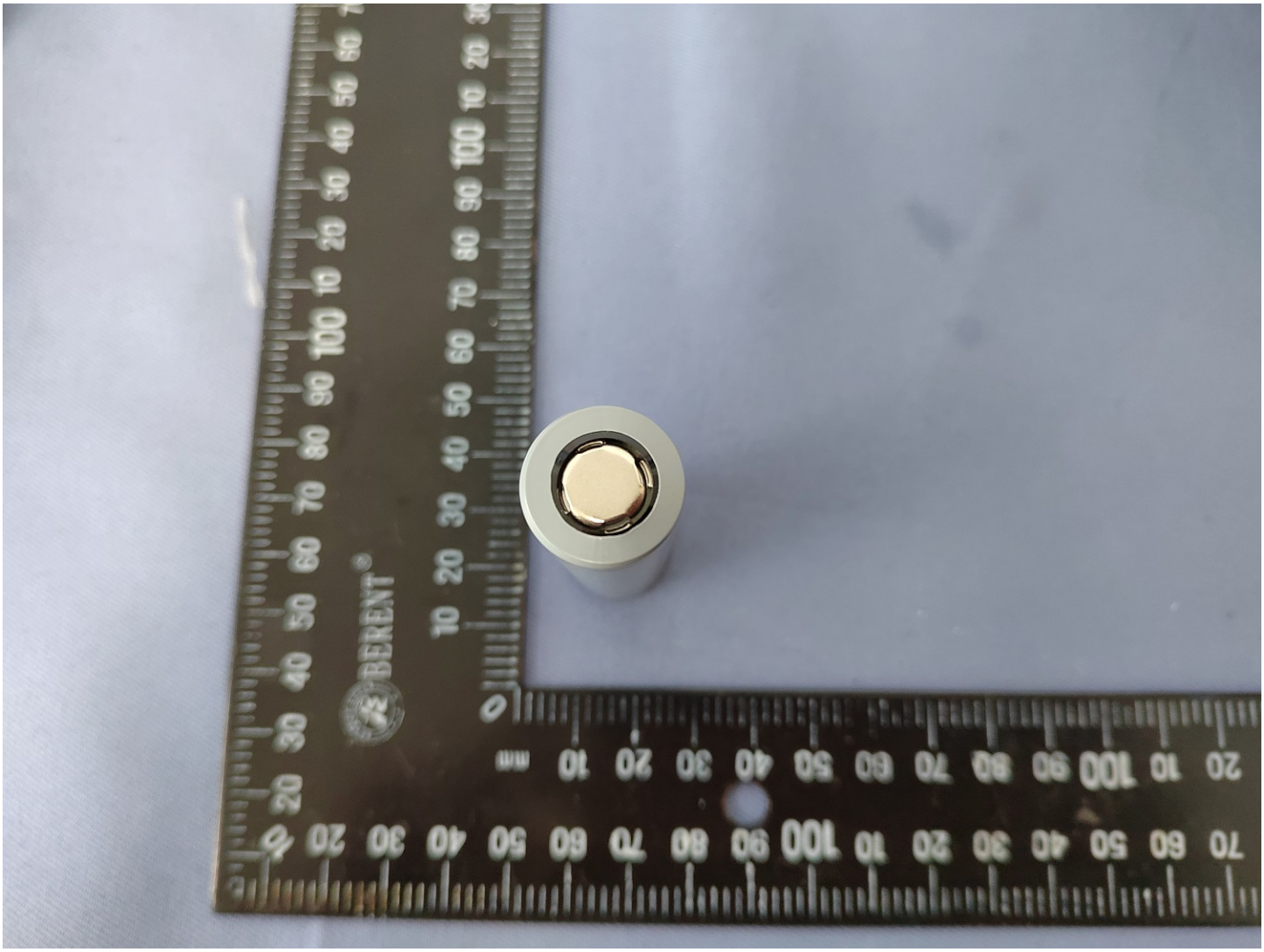
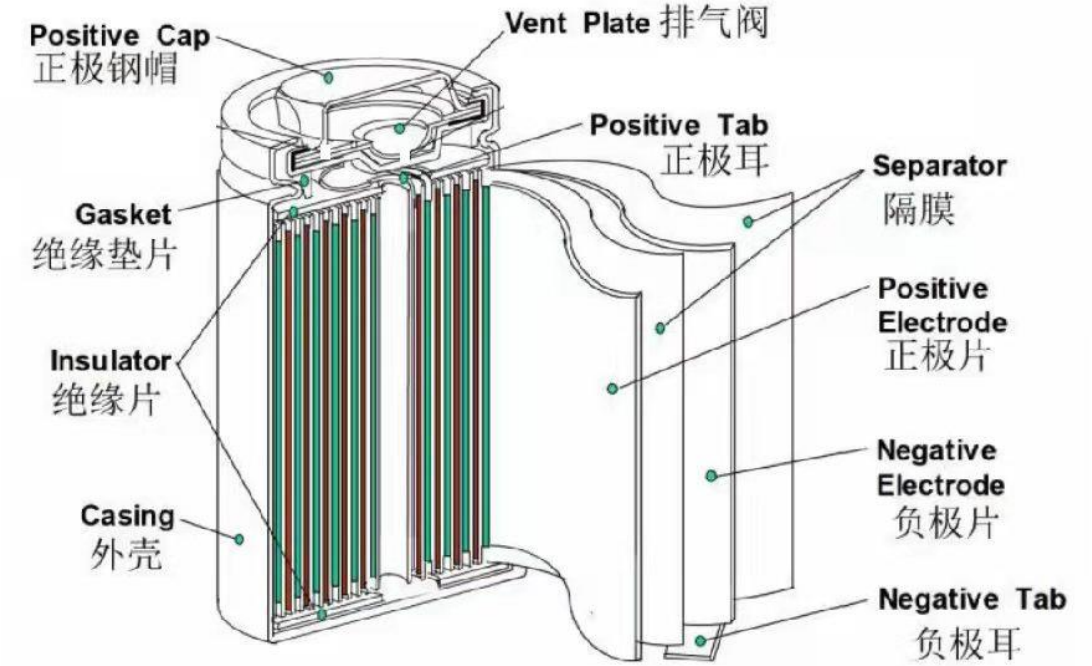
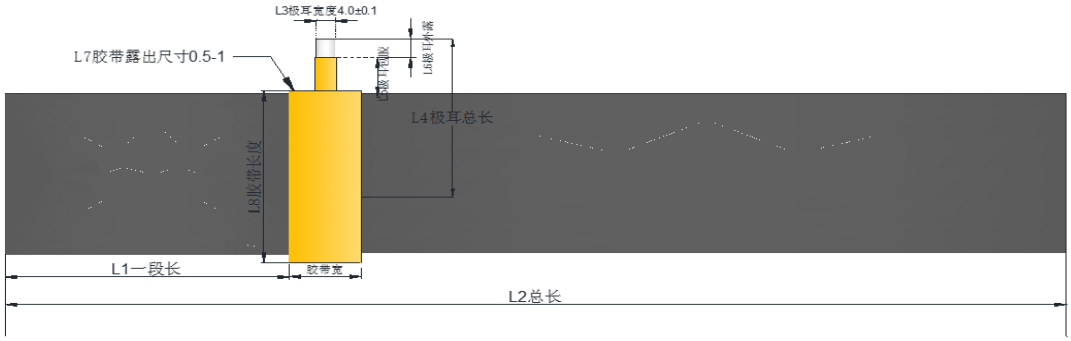


Figure-3 Page-1



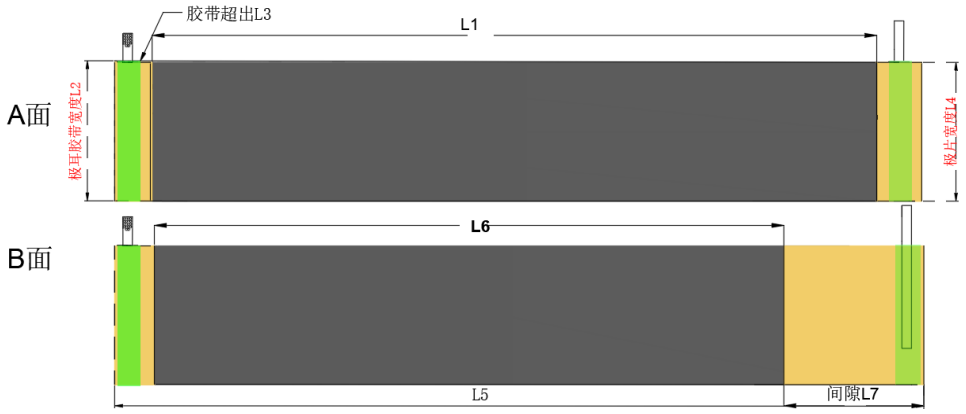

Positive Cap
正极钢帽
Vent Plate 排气阀
Positive Tab
正极耳
Separator
隔膜
Gasket
绝缘垫片
Positive
Electrode
正极片
Insulator
绝缘片
Negative
Electrode
负极片
Casing
外壳
Negative Tab
负极耳

正极片结构图:

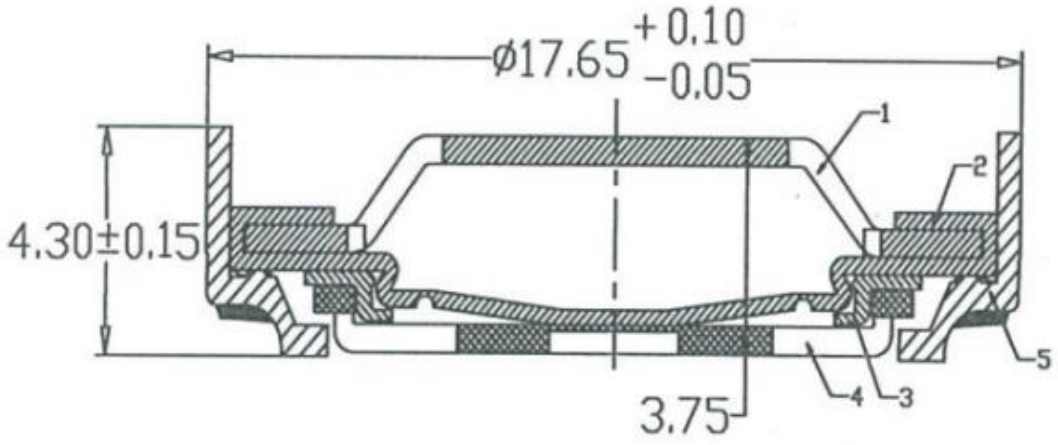


项目	尺寸/mm	公差	项目	尺寸/mm	公差
L1一段长	268	±5	L6极耳外露	5.5	±0.5
L2总长	905	±1	L7胶带外露	0.5-1	
L3极耳宽度	4	±0.1	L8胶带长度	59	±0.5
L4极耳总长	68	±1	L9间隙	8	±1
L5极耳包胶宽度	11	±0.2	极片宽度	57.0	±0.1
极耳对贴胶宽度	10		极耳宽度	4	±0.1

负极片结构图:

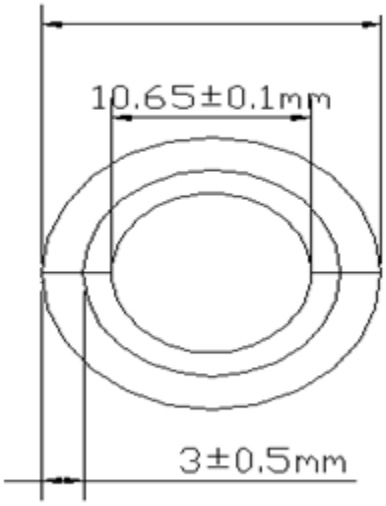


项目	尺寸/mm	公差	项目	尺寸/mm	公差	项目	尺寸/mm	公差
L1A面长度	955	±1	L7间隙	66	±1	L13距离	2	±0.5
L2极耳胶宽度	60	±0.5	L8内极耳间隙	11	±2	L14外极耳外露	14	±1
L3胶带外露	0.5	±0.5	L9外极耳间隙	11	±2	L15外极耳总长	61	±1
L4极片宽度	58.5	±0.1	L10内极耳总长	55	±1	内极耳压花深度	0.16	**±0.01**
L5极片总长	977	±2	L11内极耳外露	8	±0.5			
L6B面长度	900	±1	L12距离	2	±0.5			



编号	零件名称	尺寸（直径*高度*材料厚度）	材料
1	钢帽	15.9 mm *1.9 mm *0.4 mm	镀镍碳钢
2	防爆片	16.65 mm *1.36 mm *0.3 mm	铝 1060
3	密封圈	17.65 mm *4.3 mm *0.5 mm	PP（白色）
4	连接片	12.85 mm *1.23 mm *0.5 mm	铝 1060
5	隔离圈	13.2mm*0.9 mm	高温材料
6	CID 焊接断点压力	1.0～1.3 MPa	--
7	CID 开启力	2.8～3.5 MPa	--

绝缘片结构图



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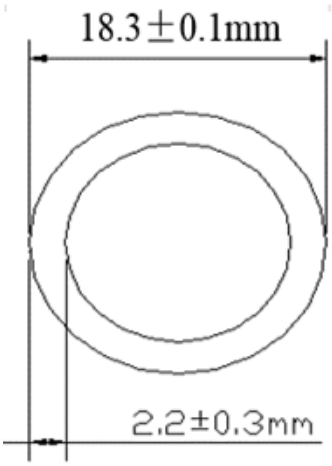

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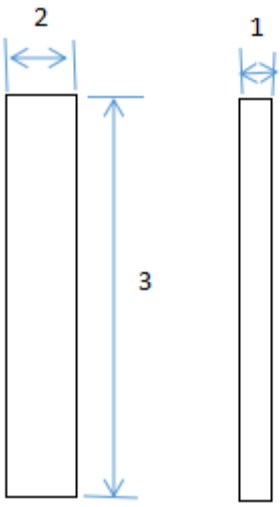

名称	尺寸1（mm）	尺寸2（mm）	尺寸3（mm）
铝带	0.1	4.0	68
镍带1	0.1	4.0	55
镍带2	0.1	4.0	61