



National Standard of the People's Republic of China

GB/T 33143—2023
Replace GB/T 33143—2016

Aluminium and aluminium alloy foils for
lithium-ion batteries

锂离子电池用铝及铝合金箔

(English Translation)

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Implementation

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FOREWORD

SAC/TC 243 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

This document is drafted in accordance with the rules given in GB/T 1.1–2020 Guidelines for standardization – Part 1: Structure and drafting rules for standardization documents.

This document replaces the GB/T 33143–2016 Aluminium and Aluminium Alloy foils for lithium-ion batteries. In addition to a number of editorial changes, the following technical deviations have been made with respect to the GB/T 33143–2016.

——Added the categories and purpose codes in a classification (see Subclause 4.1, Subclause 3.1.1 of 2016 edition), modified the example (see Subclause 4.2, Subclause 3.1.2 of 2016 edition);

增加了分类中的类别与用途代号（见 4.1，2016 年版的 3.1.1），更改了示例（见 4.2，2016 年版 3.1.2）；

——Modified the requirements for chemical composition (see Subclause 5.2.1, Subclause 3.3.1.1 of 2016 edition);

更改了化学成分要求（见 5.1，2016 年版的 3.2）；

——Modified the thicknesses tolerances of uncoated foils (see Subclause 5.2.1, Subclause 3.3.1.1 of 2016 edition); Modified the surface densities tolerances of uncoated foils (see Subclause 5.2.2, Subclause 3.3.1.2 of 2016 edition); Modified width tolerances (see Subclause 5.2.3, Subclause 3.3.2 of 2016 edition); Added the requirements for length (see Subclause 5.2.4); Added the requirements for burrs and cracks (see Subclause 5.2.5); Added the requirements for shapes (see Subclause 5.2.6); Modified the requirements for oscillations (see Subclause 5.2.7, Subclause 3.3.3 of 2016 edition);

更改了厚度允许偏差（见 5.2.1，2016 年版的 3.3.1.1），更改了基材的面密度允许偏差（见 5.2.2，2016 年版的 3.3.1.2），增加了涂层的面密度（见 5.2.2.2），更改了宽度允许偏差（见 5.2.3，2016 年版的 3.3.2），增加了长度的要求（见 5.2.4），增加了毛刺、裂边的要求（见 5.2.5），增加了板形的要求（见 5.2.6），更改了错层的要求（见 5.2.7，2016 年版的 3.3.3）；

——Modified the requirements for tensile properties at room temperature (see Subclause 5.3, Subclause 3.7 of 2016 edition);

更改了室温拉伸力学性能（见 5.3，2016 年版的 3.7）；

——Modified the requirements for porosities (see Subclause 5.4, Subclause 3.8 of 2016 edition);

更改了针孔的要求（见 5.4，2016 年版的 3.8）；

——Modified the requirements for surface wetting tension (see Subclause 5.5, Subclause 3.4 of 2016 edition);

更改了表面润湿张力的要求（见 5.5，2016 年版的 3.4）；

——Modified the requirements for cores (see Subclause 5.5, Subclause 3.4 of 2016 edition);

更改了管芯的要求（见 5.7，2016 年版的 3.6）；

——Modified the requirements for appearances (see Subclause 5.8, Subclause 3.9 of 2016 edition);

更改了外观质量的要求（见 5.8，2016 年版的 3.9）；

——Added the test methods for chemical composition of the coating (see Subclause 6.1.3); Modified the test methods for thicknesses and surface densities of foils, added the test methods for surface densities of coated foils (see Subclause 6.2.3.2, Subclause 4.2.2 of 2016 edition); Modified the test methods for width (see Subclause 6.2.4, Subclause 4.2.3 of 2016 edition); Added the test methods for length (see Subclause 6.2.5); Added the test methods for burrs and cracks (see Subclause 6.2.6); Added the test methods for shapes (see Subclause 6.2.7);

增加了涂层箔涂层化学元素试验方法的规定（见 6.1.3），更改了厚度及面密度的试验方法，增加了涂层箔涂层面密度的试验方法（见 6.2.3.2，2016 年版的 4.2.2），更改了宽度的试验方法（见 6.2.4，2016 年版的 4.2.3），增加了长度的试验方法（见 6.2.5），增加了毛刺、裂边的试验方法（见 6.2.6），增加了板形的试验方法（见 6.2.7）；

——Modified the test methods for tensile properties at room temperature (see Subclause 6.3, Subclause 4.6 of 2016 edition);

更改了室温拉伸力学性能的试验方法（见 6.3，2016 年版的 4.6）；

——Modified the test methods for porosities (see Subclause 6.4, Subclause 4.7 of 2016 edition); Added the inspection methods for on-line pinholes and holes (see Annex A); 更改了针孔的检验方法（见 6.4，2016 年版的 4.7），增加了针孔及孔洞的在线检测方法（见附录 A）；

——Modified the test methods for surface wetting tension (see Subclause 6.5, Subclause 4.3 of 2016 edition);

更改了表面润湿张力的试验方法（见 6.5，2016 年版的 4.3）；

——Modified the inspection methods for appearances (see Subclause 6.8, Subclause 4.8 of 2016 edition); Added the on-line inspection methods for surface defects (see Annex B);

更改了外观质量的检验方法（见 6.8，2016 年版的 4.8），增加了表面缺陷在线检测方法（见附录 B）；

——Added the qualification appraisal of product (see Clause 7 and Annex C);

增加了产品合格鉴定（见第 7 章、附录 C）；

——Added the quality control (see Clause 8 and Annex D);

增加了过程控制（见第 8 章、附录 D）。

——Modified the inspection item (see Subclause 9.4, Subclause 5.4 of 2016 edition)

更改了检验项目（见 9.4，2016 年版的 5.4）。

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This document was first published in 2016 and this is the first revision.

This second edition cancels and replaces the first edition (GB/T 33143-2016), which has been technically revised.

本文件于 2016 年首次发布，本次为第一次修订。

Aluminium and Aluminium Alloy foils for Lithium-ion batteries

锂离子电池用铝及铝合金箔

1 Scope 范围

This document specifies product classifications, technical requirements, test methods, qualification appraisal of products, quality control, marking, packaging, transportation, storage and contract (or order) information of aluminium and aluminium alloy foils for lithium-ion batteries.

本文件规定了锂离子电池用铝及铝合金箔的分类、技术要求、试验方法、产品合格鉴定、过程控制、检验规则和标志、包装、运输、贮存及质量证明书与订货单（或合同）等内容。

This document is applicable to aluminium and aluminium alloy foils for lithium-ion batteries current collector (hereinafter referred to as foils).

本文件适用于锂离子电池集流体用铝及铝合金箔（以下简称“铝箔”）。

2 Normative references 规范性引用文件

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

下列文件中的内容通过文中的规范性引用而构成本文件必不可少的条款。其中，注日期的引用文件，仅该日期对应的版本适用于本文件；不注日期的引用文件，其最新版本（包括所有的修改单）适用于本文件。

GB/T 3190 *Chemical composition of wrought aluminium and aluminium alloys*

GB/T 3190 变形铝及铝合金化学成分

GB/T 3199 *Wrought aluminium and aluminium alloy products - Packing, marking, transporting and storing*

GB/T 3199 铝及铝合金加工产品包装、标志、运输、贮存

GB/T 7999 *Optical emission spectrometric analysis methods of aluminium and aluminium alloys*

GB/T 7999 铝及铝合金光电直读发射光谱分析方法

GB/T 8005.1 *Aluminium and aluminium alloys - Terminology - Part 1: Products and processing processes*

GB/T 8005.1 铝及铝合金术语 第1部分：产品及加工处理工艺

GB/T 8170 *Rules of rounding off for numerical values & expression and judgment of limiting values*

GB/T 8170 数值修约规则与极限数值的表示和判定

GB/T 16865 *Test pieces and methods for tensile test for wrought aluminium and magnesium alloys products*

GB/T 16865 变形铝、镁及其合金加工制品拉伸试验用试样及方法

GB/T 17432 *Methods for sampling for analyzing the chemical composition of wrought aluminium and aluminium alloys*

GB/T 17432 变形铝及铝合金化学成分分析取样方法

GB/T 20975 (All parts) *Methods for chemical analysis of aluminium and aluminium alloys*

GB/T 20975 (所有部分) 铝及铝合金化学分析方法

GB/T 22638.1 *Test methods for Aluminium and Aluminium Alloy foils - Part 1: Determination of thickness*

GB/T 22638.1 铝箔试验方法 第1部分：厚度的测定

GB/T 22638.2 *Test methods for Aluminium and Aluminium Alloy foils - Part 2: Determination of pinhole*

GB/T 22638.2 铝箔试验方法 第2部分：针孔的检测

GB/T 22638.4 *Test methods for Aluminium and Aluminium Alloy foils - Part 4: Determination of pinhole*

GB/T 22638.4 铝箔试验方法 第4部分：表面润湿张力的测定

GB/T 22638.10 *Test methods for Aluminium and Aluminium Alloy foils - Part 10: Determination of surface densities of foilss*

GB/T 22638.10 铝箔试验方法 第10部分：涂层表面密度的测定

GB/T 24533-2019 *Lithium ion battery graphite anode material*

GB/T 24533-2019 锂离子电池石墨类负极材料

GB/T 26492.4 *Defects in moulded aluminium and aluminium alloy ingots and processed products - Part 4: foils*

GB/T 26492.4 变形铝及铝合金铸锭及加工产品缺陷 第4部分：铝箔缺陷

3 Terms and definitions 术语和定义

The terms and definitions defined in GB/T 8005.1 and GB/T 26492.4 apply to this documents.
GB/T 8005.1、GB/T 26492.4 界定的术语和定义适用于本文件。

4 Product classifications 分类

4.1 Categories, purpose codes, Designations, Temper and dimensions 类别、用途代号、牌号、状态、尺寸规格

The categories, purpose codes, Designations, Temper and dimensions of foils shall be as specified in Table 1. Requirements for other categories, purpose codes, Designations, Temper and dimensions shall be agreed between purchaser and supplier, and stated in order (or contract)。

铝箔的类别、用途代号、牌号、状态、尺寸规格见表1。需方需要其他类别、牌号、状态、尺寸规格时，由供需双方协商确定后在订货单（或合同）中具体注明。

Table 1 categories, purpose codes, Designations, Temper and dimensions

表1 类别、用途代号、牌号、状态、尺寸规格

Categories	Purpose codes 用途代号	Designations	Temper 状态	Dimensions 尺寸规格 mm
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类别	For power storage 动力储能类	For digital products 数码类	牌号		Thickness 厚度	Width 宽度	Typical core diameter 典型管芯内径	Coil outside diameter 卷外径
Uncoated foil 光箔 ^a	BP	BC	1070、 1060、 1050、 1235、 1C30、	H18	0.008 ~0.020	≤1600.0	75.0、76.2、 150.0、152.4	agreed between purchaser and supplier 供需双方协商
Coated foil 涂层箔 ^b	RP	RC	1100、 8011、 8A21					
^a Uncoated foils is a general term for single-sided foils and double-sided foils.光箔为单面光铝箔和双面光铝箔的统称。 ^b Foils with coated surface.表面有涂覆层的铝箔。								

4.2 Marking of products 标记

The marking of products shall be expressed in the order of categories, purpose codes, this document number, designations, temper, dimensions. The examples of marking are listed as follows:

Example 1:

Uncoated foils for power storage with the designations 1235, temper H18, 0.015mm in thickness and 476.0mm in width should be marked as:

Uncoated foil BP GB/T 33143-1235H18-0.015×476.0

Example 2:

Coated foils for digital products with the designations 1060, temper H18, 0.013mm in thickness and 522.0mm in width should be marked as:

Coated foil RC GB/T 33143-1060H18-0.013×522.0

标记按产品类别、用途代号、本文件编号、牌号、状态、尺寸规格的顺序表示。

示例 1:

1235 牌号、H18 状态、厚度为 0.015mm、宽度为 476.0mm 的动力储能类光箔，标记为：

光箔 BP GB/T 33143-1235H18-0.015×476.0

示例 2:

1060 牌号、H18 状态、厚度为 0.013 mm、宽度为 522.0 mm 的数码类涂层箔，标记为：

涂层箔 RC GB/T 33143-1060H18-0.013×522.0

5 Technical requirements 技术要求

5.1 Chemical composition 化学成分

5.1.1 The chemical composition of uncoated foils with designations 1C30 and 8A21 shall be in conformity with Table 2, the chemical composition of other uncoated foils shall be in conformity with the requirements specified in GB/T 3190.

1C30及8A21牌号的光箔化学成分应符合表2的规定，其他光箔及涂层箔基材的化学成分应符合GB/T 3190的规定。

Table 2 Chemical composition

%

表2 化学成分

%

Designations 牌号	mass fraction (percent) 质量分数%中文没有%									
	Si	Fe	Cu	Mn	Mg	Zn	Ti	Others		Al
								Single 单个	Total 合计	
1C30	0.05~0.15	0.3~0.5	0.05~0.15	≤ 0.01	≤ 0.01	≤ 0.01	≤0.04	≤0.05	≤ 0.15	≥99.3
8A21	≤0.15	1.0~1.6	≤0.05	—	—	—	0.01~0.03	≤0.05	≤ 0.15	Remainder 余量

5.1.2 The iron content of the coating is not more than 0.005%, other elements of the coating shall be in conformity with 6.12 in GB/T 24533-2019.

涂层箔涂层部分 w_{Fe} 不大于0.005%，其他化学成分应符合GB/T 24533—2019中6.12的规定。

5.2 Tolerances on dimensions 尺寸偏差

5.2.1 Tolerances on thicknesses of foils 铝箔的厚度

Thicknesses of uncoated foils shall be in conformity with the Table 3, when special class or super special class of tolerances on thicknesses are required by purchaser, the class shall be stated in order (or contract), otherwise uncoated foils with ordinary class will be delivered. when the difference between the maximum and minimum (hereinafter referred to as maximum difference) of thicknesses of uncoated foils is required by purchaser, maximum differences shall be agreed between purchaser and supplier, and stated in order (or contract).
光箔及涂层箔基材的厚度偏差应符合表3的规定，需方需要高精级或超高精级时，应在订货单（或合同）中注明，未注明时按普通级供货。需方对光箔及涂层箔基材的厚度最大值与最小值的差值（以下简称极差）有要求时，由供需双方协商确定后在订货单（或合同）中具体注明。

Table 3 Tolerances on thicknesses

Unit in millimeter

表3 厚度偏差

单位为毫米

tolerances on thicknesses (T) 厚度 (T) 允许偏差		
Super special class 超高精级	Special class 高精级	Ordinary class 普通级
±3%T	±4%T	±5%T

5.2.2 Tolerances on Surface densities of foils 铝箔的面密度

5.2.2.1 Tolerances on surface densities of uncoated foils 光箔及涂层箔基材的面密度

Tolerances on surface densities of uncoated foils shall be in conformity with the Table 4, when special class or super special class of tolerances on surface densities is required by purchaser, the class shall be stated in order (or contract), otherwise uncoated foils with ordinary class will be delivered. When maximum differences of tolerances on surface densities

of uncoated foils is required by purchaser, maximum differences shall be agreed between purchaser and supplier, and stated in order (or contract).

光箔及涂层箔基材的面密度偏差应符合表4的规定,需方需要高精级或超高精级时,应在订货单(或合同)中注明,未注明时按普通级供货。需方对光箔及涂层箔基材面密度的极差有要求时,由供需双方协商确定后在订货单(或合同)中具体注明。

Table 4 Tolerances on surface densities of uncoated foils

The unit in grams per square meter

表4 光箔及涂层箔基材面密度偏差

单位为克每平方米

Tolerances on surface densities 面密度 (A) 允许偏差		
Super special class 超高精级	Special class 高精级	Ordinary class 普通级
$\pm 3\%A$	$\pm 4\%A$	$\pm 5\%A$

5.2.2.2 Tolerances on surface densities of coated foils 涂层的面密度

Tolerances on surface densities of coated foils with single surface densities not less than 2.00 g/m^2 shall be in conformity with the Table 5. When special class of tolerances on surface densities of coated foils is required by purchaser, the class shall be stated in order (or contract), otherwise coated foils with ordinary class will be delivered.

单面面密度不小于 2.00 g/m^2 的涂层面密度偏差应符合表5规定。需方需要高精级时,应在订货单(或合同)中注明,未注明时按普通级供货。

Table 5 Tolerances on surface densities of coated foils

The unit in grams per square meter

表5 涂层面密度偏差

单位为克每平方米

Purpose codes 用途代号	surface densities 涂层面密度	Tolerances on surface densities 涂层面密度允许偏差	
		Special class 高精级	Ordinary class 普通级
RP、RC	0.30~2.00	0.05	0.10

5.2.3 Tolerances on width 宽度

Tolerances on width of foils (include coating) shall be in conformity with the Table 6, when special class of tolerances on width of foils is required by purchaser, the class shall be stated in order (or contract), otherwise foils with ordinary class will be delivered. If unidirectional tolerances on width of foils be required by purchaser, the values of tolerances on width in Table 6 would be doubled. 铝箔(包含涂覆层)宽度偏差应符合表6的规定,需方需要高精级时,应在订货单(或合同)中注明,未注明时按普通级供货。当需方要求单向偏差时,其允许偏差值应为表6中对应数值的两倍。

Table 6 Tolerances on width

Unit in millimeter

表 6 宽度偏差

单位为毫米

Purpose codes 类别	Tolerances on width 宽度允许偏差	
	Special class 高精级	Ordinary class 普通级
BC、BP	±0.5	±1.0
RC、RP	±0.5	—

5.2.4 Tolerances on length 长度

Tolerances on length of foils with a specific length shall be agreed between purchaser and supplier, and stated in order (or contract). 定尺供货的铝箔长度偏差由供需双方协商确定, 并在订货单 (或合同) 中具体注明。

5.2.5 Burr and cracks 毛刺、裂边

5.2.5.1 The length of the burr (distance from the head point to the tail point of the burr, see Figure 1) at the edge of the foil shall be in conformity with the Table 7. When special class or super special class of length of the burr is required by purchaser, the class shall be stated in order (or contract), otherwise foils with ordinary class will be delivered. 铝箔边缘毛刺尺寸 (沿其底部至毛刺尾端两点间直线距离, 如图1所示) 应符合表7的规定。需方需要高精级或超高精级时, 应在订货单 (或合同) 中注明, 未注明时按普通级供货。

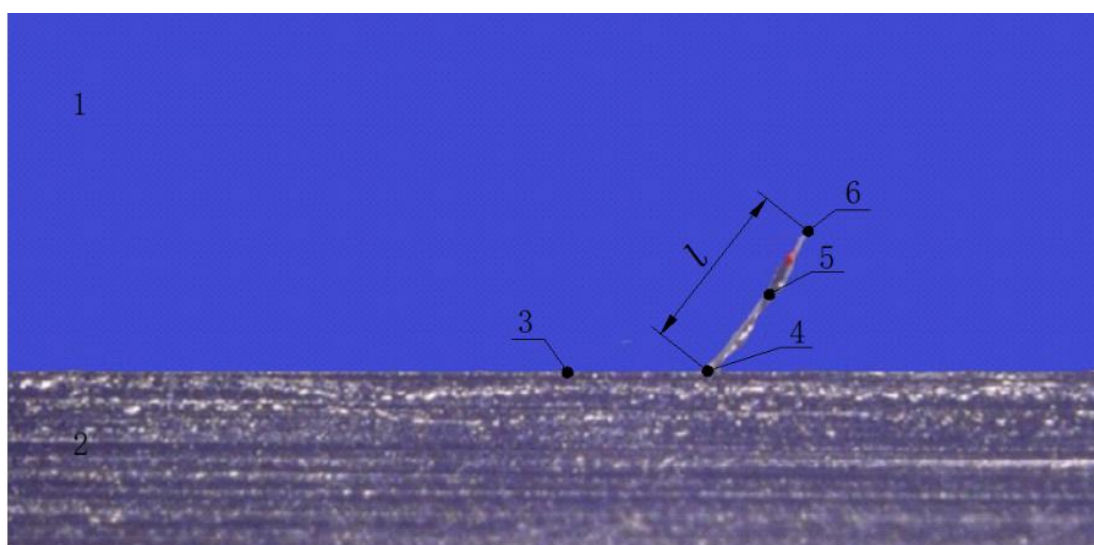
Table 7 Burr

Unit in millimeter

表7 毛刺

单位为微米

length of the burr (l), not more than 边缘毛刺尺寸 (l), 不大于		
Super special class 超高精级	Special class 高精级	Ordinary class 普通级
50	100	150



Key 标引序号说明:

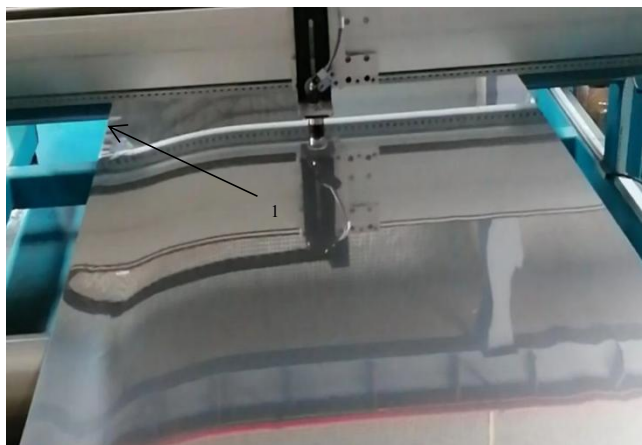
- 1 Background;背景色
- 2 Foil;铝箔
- 3 Edge of foil;铝箔边缘
- 4 Head point of burr;毛刺底部
- 5 Burr;毛刺
- 6 Tail point of burr;毛刺尾端
- l Length of burr. 边缘毛刺尺寸

Figure 1 Illustration of the burr图1毛刺示意图

5.2.5.2 The requirements of crack at edge of foil shall be agreed between purchaser and supplier, and stated in order (or contract). 铝箔边缘裂边要求由供需双方协商，并在订货单（或合同）中具体注明。

5.2.6 Shapes板形

5.2.6.1 Waves at the edge (see figure 2), the middle-width (see Figure 3), the quarter-width (see Figure 4) positions and their mixture are not allowed on foils. 铝箔不允许有边部波浪（见图2）、中间波浪（见图3）、二肋波浪（见图4）及复合波浪等板形缺陷。



Key 标引序号说明:

- 1 Waves波浪.

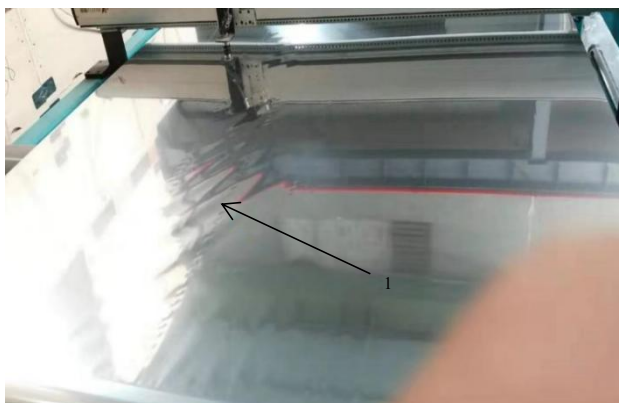
Figure 2 Illustration of waves at the edge position图2 边部波浪示意图



Key 标引序号说明:

- 1 Waves波浪.

Figure 3 Illustration of waves at the middle position图3 中间波浪示意图

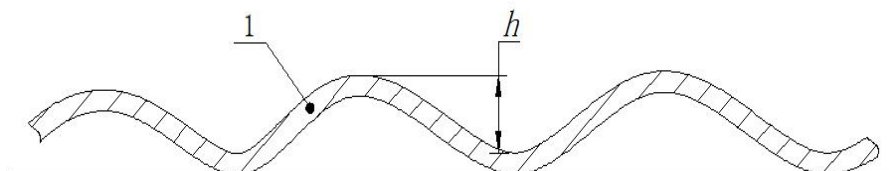


Key 标引序号说明:

1 Waves波浪.

Figure 4 Illustration of waves at the quarter position图4 二肋波浪示意图

5.2.6.2 When the width of the foil is not less than 400mm, the height of the waves (see Figure 5) shall be in conformity with the Table 8, when special class or super special class of size of burrs is required by purchaser, the class shall be stated in order (or contract), otherwise foils with ordinary class will be delivered. 铝箔宽度大于等于400mm时，波浪的波高（见图5）应符合表8的规定，需方需要高精级或超高精级时，应在订货单（或合同）中注明，未注明时按普通级供货。



key标引序号说明:

1 Foil; 铝箔

h Height. 波高

Figure 5 Height of waves diagram图5 波高示意图

Table 8 Height of waves 表8 波高

Purpose codes 用途代号	Distance between guiding coilers 辊间距 ^a m	Height of waves, not more than 波高 (h), 不大于 mm		
		超高精级	高精级	普通级
BC、BP	1.0	2.0	3.0	5.0
BC、BP、RC、RP	1.5 或 2.0	4.0	8.0	10.0

^aDistance between guiding coilers shall be stated in order (or contract) by purchaser and supplier. 辊间距由供需双方在订货单（或合同）中注明。

5.2.7 Oscillations 错层

Each oscillations on the end face of the coils shall be no greater than 1mm. 铝箔端面错层不应大于1mm。

5.3 The tensile properties at room temperature 室温拉伸力学性能

The longitudinal tensile properties at room temperature shall be in conformity with the Table 9. When purchaser needs the tensile properties of other alloy foils at room temperature or has other requirements for tensile properties at room temperature, the requirements shall be agreed between purchaser and supplier, and stated in order (or contract). 铝箔的室温纵向拉伸力学性能应符合表9的规定。需方需要其他合金牌号铝箔的室温拉伸力学性能或对室温拉伸力学性能有其他要求时, 由供需双方协商确定并在订货单 (或合同) 中具体注明。

Table 9 the tensile properties at room temperature 表9 室温拉伸力学性能

牌号 Designations	Temper 状态	Thicknesses 厚度 mm	The tensile testing results at room temperature 室温拉伸试验结果						
			Tensile strength 抗拉强度 (R_m) MPa	Elongation (A_{100}) 断后伸长率 (A_{100}) %		Elongation (A_{50}) 断后伸长率 (A_{50}) %			
				bright one-side foil 单面光铝箔	bright two-side foil 双面光铝箔	bright one-side foil 单面光铝箔	bright two-side foil 双面光铝箔		
1070	H18	≤ 0.010	≥ 185	—	≥ 2.0	—	—		
		$> 0.010 \sim 0.013$							
		$> 0.013 \sim 0.015$	≥ 180						
		$> 0.015 \sim 0.020$	≥ 175						
1060、 1050	H18	≤ 0.010	—	—	≥ 2.5	—	—		
		$> 0.010 \sim 0.013$	≥ 190						
$> 0.013 \sim 0.015$		—		≥ 2.0		≥ 3.0			
$> 0.015 \sim 0.020$		≥ 185							
1235	H18	≤ 0.010	—	—	—	≥ 2.0	—		
		$> 0.010 \sim 0.013$	≥ 180						
		$> 0.013 \sim 0.015$	≥ 185						
		$> 0.015 \sim 0.020$	≥ 175						
1C30	H18	≤ 0.010	≥ 220	≥ 2.0	—	≥ 2.0	≥ 2.5		
		$> 0.010 \sim 0.013$	≥ 230	—					
		$> 0.013 \sim 0.015$	≥ 225	≥ 2.0				≥ 2.5	—
		$> 0.015 \sim 0.020$	≥ 220	≥ 2.5				—	≥ 3.0
1100	H18	≤ 0.010	≥ 230	≥ 1.0	≥ 2.0	—	≥ 3.0		

		>0.010~0.013					
		>0.013~0.015	≥220	—	—	—	—
		>0.015~0.020			≥2.0		
8011		≤0.010			≥1.0		
		>0.010~0.013	—	≥2.0	—		
		>0.013~0.015		≥180			
		>0.015~0.020		—			
8A21		≤0.010	—	—	—		
		>0.010~0.013	—	—			
		>0.013~0.015				≥165	≥4.0
8A21		>0.015~0.020	—	—	—	—	

5.4 Porosities针孔

The off-line pinholes test results of uncoated foil shall be in conformity with the Table 10, when special class or super special class of porosities is required by purchaser, the class shall be stated in order (or contract), otherwise foils with ordinary class will be delivered. The on-line pinhole test results shall be agreed between purchaser and supplier, and stated in order (or contract). 光箔及涂层箔基材针孔离线测试结果应符合表10的规定, 需方需要高精级或超高精级时, 应在订货单(或合同)中注明, 未注明时按普通级供货。针孔在线测试结果要求应由供需双方协商确定, 并在订货单(或合同)中具体注明。

Table 10 The off-line pinholes test results 表 10 针孔离线测试结果

厚度 mm	Number of pinholes in any area of 1m ² 任意1m ² 内针孔个数 不大于		
	Super precision grade 超高精级	Precision grade 高精级	Ordinary grade 普通级
≤0.010	15	20	30
>0.010~0.013	6	10	15
>0.013~0.015	3	5	10
>0.015~0.020	0		3

5.5 Surface wetting tension表面润湿张力

Surface wetting tension of uncoated foil should not be less than $30 \times 10^{-3} \text{N/m}$, surface wetting tension of coating shall be agreed between purchaser and supplier, and stated in order (or contract). 光箔的表面润湿张力宜不小于 $30 \times 10^{-3} \text{N/m}$, 涂层箔的涂层表面润湿张力由供需双方协商确定。

5.6 Joints接头

Foils are not allowed to have joints. 铝箔不允许有接头。

5.7 Cores管芯

The material, length and length tolerances of cores shall be agreed between purchaser and supplier, and stated in order (or contract). The inner and outer walls of cores shall be clean, smooth and free of dirtiness, neither end of cores shall be allowed to be concaved into the coil. 管芯材质、长度、长度允许偏差由供需双方协商确定，并在订货单（或合同）中具体注明。管芯的内、外壁应洁净、光滑、无污物，其任一端不允许凹入铝箔卷。

5.8 Appearances外观质量

5.8.1 Surfaces表面

5.8.1.1 Visible oil spots and oil stains shall not be allowed on the surface of uncoated foils, and visible oil spots are not allowed on the uncoated part of coated foils, but visible volatile oil spots are allowed. 光箔表面不允许有可见油斑、油污，涂层箔未涂覆部分不允许有可见油斑，但允许存在目视可见的挥发性油斑。

5.8.1.2 The surface of uncoated foils are not allowed to have ~~rub marks~~ (scratches), coil bruise kinks, crepes, wrinkles, holes, corrosions, voids, coil-in metals and coil-in dirt, slitting and other defects. 光箔表面不允许有擦伤、压折、皱纹、起皱、孔洞、腐蚀、气道、金属及非金属压入、开缝等缺陷。

5.8.1.3 The surface of the uncoated foil is not allowed to have severe impression dents, coiler holes, bright dots, and the diameter of the circumference circle of such point defects should not exceed 1mm. Uncoated foil is not allowed to have severe defects, such as crosswise streaks, blisters, impression dents, bright lines, scratches, colour difference on matt side, streak on matt side, white streaks, herringbone streaks, arbor marks, protuberances, coil-in defects or damages. Purchaser and supplier should determine the reference samples with limits on acceptable defect and unacceptable defect. 光箔表面不允许有严重的印痕、辊眼、亮点，且此类点状缺陷的外接圆直径宜不大于1mm。光箔不允许有严重的横纹、表面起泡、印痕、亮线、划伤、暗面色差、暗面条纹、白条、人字纹、起棱、起鼓、压陷或碰伤等缺陷。供需双方宜确定可接受缺陷上限和不可接受缺陷下限参比样品。

5.8.1.4 Coating should be uniform, uncoated foil shall not be visible on coated area. 涂层箔涂层应均匀，涂覆区域不允许漏出基材。

5.8.2 End face of the coil端面

Foils are not allowed to have arrows on the end face of foils, neither stains, bruises, and mass aluminium powders with visible reflected light shall not be allowed. 铝箔端面不允许有箭头，不允许有污渍、碰伤等缺陷，不允许有目视可见反射光的密集铝粉。

6 Test methods 试验方法

6.1 Chemical composition 化学成分

6.1.1 Chemical composition analysis of uncoated foil shall be carried out in accordance with GB/T 20975 or GB/T 7999. Referee analysis shall be carried out in accordance with GB/T 20975. The "Al" content is calculated according to the methods specified in GB/T 3190. When calculating the "Al" content, the sum of the analytical values of the conventional analytical elements and the excessive non-conventional analytical elements suspected is taken as the

"element content sum". 光箔及涂层箔基材的化学成分分析方法应符合GB/T 20975或GB/T 7999的规定, 仲裁分析应采用GB/T 20975规定的方法。“Al”含量按GB/T 3190规定的方法计算, 计算“Al”含量时, 取常规的分析元素与怀疑超量的非常规分析元素分析数值的和作为“元素含量总和”。

6.1.2 The rounding comparison methods is used for the determination of analyzed values. The rules of rounding off for numerical values shall be in accordance with GB/T 8170. The rounded off decimal places shall be the same number of limiting places as specified in GB/T 3190. 分析数值的判定采用修约比较法, 数值修约规则按GB/T 8170的有关规定进行, 修约数位与表2或GB/T 3190规定的极限数位一致。

6.1.3 Chemical composition analysis of the coating shall be agreed between purchaser and supplier. 涂层箔涂层的化学成分分析方法由供需双方协商确定。

6.2 Tolerances on dimensions 尺寸偏差

6.2.1 Rounding for dimensions 尺寸修约

Values of measured dimensions shall not be rounded off. The methods used to determine the limiting values shall be in accordance with GB/T 8170. 尺寸测量值不准许修约, 极限数值的判定方法应符合GB/T 8170的规定。

6.2.2 Thicknesses 厚度

Thicknesses of uncoated foil shall be measured in accordance with GB/T 22638.1. When purchaser requires the use of nonstandard area samples to measure the thicknesses, the requirements shall be stated in order (or contract). Methods for determination of the maximum differences in thicknesses shall be agreed between purchaser and supplier. 光箔及涂层箔基材的厚度按 GB/T 22638.1 规定的方法测定。当需方要求选取非标面积试样测定厚度时, 应在订货单 (或合同) 中注明。厚度极差的测定方法由供需双方协商确定。

6.2.3 Surface densities 面密度

6.2.3.1 Tolerances on surface densities of uncoated foils shall be measured in conformity with GB/T 22638.10. When purchaser requires nonstandard area samples to determine the surface densities, the requirements shall be stated in order (or contract). Methods for determination of the maximum differences in surface densities shall be agreed between purchaser and supplier. 光箔及涂层箔基材的面密度按 GB/T 22638.10 规定的方法测定。当需方要求选取非标面积试样测定面密度时, 应在订货单 (或合同) 中注明。面密度极差的测定方法由供需双方协商确定。

6.2.3.2 Tolerances on surface densities of uncoating shall be measured in conformity with GB/T 22638.10 or with the methods agreed between purchaser and supplier. 涂层箔的涂层面密度按 GB/T 22638.10 规定的方法测定, 或由供需双方协商确定。

6.2.4 Width 宽度

Width shall be measured with Film ruler or other measuring tools. 用相应精度的菲林尺或其他工具进行测量。

6.2.5 Length 长度

Length shall be measured with measuring tools capable of measuring to the accuracy required. 用相应精度的工具测量。

6.2.6 Burr and cracks毛刺、裂边

Select the cutting position on both sides of the coil, and cut the samples along the edge, containing the edge of the coil. The length of the samples should be greater than 30cm. Under the microscope (optical magnification should not be less than 100 times, digital magnification should not be less than 500 times), visually inspect the smooth edge of the samples, crack defects and measure the burr size. It is advisable to observe the edge of the foil from different directions. 选取铝箔卷两侧切边位置,沿切边裁取包含铝箔切边边缘的试样,试样长度应大于30cm。于显微镜(光学放大倍数宜不低于100倍、数显放大倍数宜不低于500倍)下目视检查试样边缘平整光滑情况、裂口缺陷及测量毛刺尺寸。宜多角度观察铝箔边缘情况。

6.2.7 Shapes板形

6.2.7.1 Waves shall be visually inspected under unit tension of $8\text{N}/\text{mm}^2$. 在 $8\text{N}/\text{mm}^2$ 的单位张力下目视检查铝箔板形不良缺陷。

6.2.7.2 Height of waves shall be measured with off-line shape test device under unit tension of $8\text{N}/\text{mm}^2$. 在 $8\text{N}/\text{mm}^2$ 的单位张力下,采用离线板形测试装置测出铝箔波浪的波高。

6.2.8 Oscillation错层

Oscillation shall be measured by instruments with sufficient accuracy. 采用相应精度的工具测量。

6.3 The tensile properties at room temperature室温拉伸力学性能

The tensile test at room temperature shall be carried out in accordance with GB/T 16865. The gauge length of test pieces should be 50mm or 100mm, the test speed should be in the range 5mm/min or 10mm/min, which shall be agreed between purchaser and supplier. 室温拉伸力学性能按 GB/T 16865 规定的方法进行检测。试验标距选用 50mm 或 100mm,测试速率为 5mm/min 或 10mm/min,由供需双方协商确定。

6.4 Porosities 针孔

The off-line pinhole test methods shall be carried out in accordance with GB/T 22638.2. The on-line pinhole test methods should be in accordance with Annex A. 针孔离线测试按 GB/T 22638.2 规定的方法进行,针孔在线测试方法见附录 A。

6.5 The surface wetting tension表面润湿张力

The surface wetting tension test shall be carried out in accordance with GB/T 22638.4. 按 GB/T 22638.4 规定的方法进行检测。

6.6 Joint接头

Visual inspection. 目视检查。

6.7 Cores管芯

Tolerances of core dimensions shall be measured by tools with sufficient accuracy. The material of the core shall be guaranteed by supplier. Other items shall be inspected visually. 管芯尺寸偏差用能保证精度的量具测量,管芯材质由供方保证,其他项目目视检查。

6.8 Appearance外观质量

6.8.1 Surface表面

6.8.1.1 During arbitration inspection, examination of appearances shall be inspected visually under natural light. 仲裁检验时, 在自然散射光下目视检查外观质量。

6.8.1.2 The diameter of the circle tangent to the surface defects could be measured by tools with sufficient accuracy. 铝箔表面点状缺陷的外接圆直径可使用相应精度的量具测量。

6.8.1.3 The on-line pinhole test methods should be in accordance with Annex A. Other on-line surface quality inspection should be carried out in accordance with Annex B. 铝箔表面孔洞在线检测方法见附录A。其他表面缺陷的在线检测方法见附录B。

6.8.2 End face of the coil端面

Examination of end face of the coil shall be inspected visually under bright light. 在明亮的环境下目视检查端面质量。

7 the qualification appraisal of product 产品合格鉴定

When required by purchaser, the qualification appraisal of products of uncoated foils should be carried out in accordance with Annex C. 需方有要求时, 可参照附录 C 的规定对铝箔进行产品合格鉴定。

8 Quality control 过程控制

supplier shall control the production process, quality control should be carried out in accordance with Annex D. 供方应对产品生产过程进行控制, 过程控制宜参照附录 D 的规定。

9 Conformity with standards 检验规则

9.1 Inspection and acceptance 检查与验收

9.1.1 The coil shall be inspected by supplier to ensure the products are in conformity with this document and with the stipulations of order (or contract). A quality certificate shall be filled out accordingly. 铝箔应由供方技术监督部门进行检验, 保证产品质量符合本文件及订货单(或合同)的规定, 并填写质量证明书。

9.1.2 Inspection of the received products shall be carried out by purchaser in accordance with the requirements of this document. In case of non-conformity with the requirements of this document or with the stipulations of order (or contract), purchaser shall make complaints in writing to supplier for a solution which shall be discussed and agreed between the two parties. Complaints of non-conformity concerning deviations of appearance quality or dimensions shall be made within one month after the date of receiving the products; complaints of non-conformity concerning other properties shall be made within three months after the date of receiving the products. In case of arbitration, testing and examination shall be carried out by an arbitrator chosen by mutual agreement between purchaser and supplier, and sampling shall be carried out by both parties. 需方应对收到的产品按本文件的规定进行复验。复验结果与本文件及订货单(或合同)的规定不符时, 应以书面形式向供方提出, 由供需双方协商解

决。属于表面质量及尺寸偏差的异议，应在收到产品之日起一个月提出，属于其他性能的异议，应在收到产品之日起三个月内提出。如需仲裁，供需双方共同进行仲裁取样。

9.2 Lots组批

Inspection and acceptance shall be carried out in lots. Each lot shall consist of coils with same categories, designations, temper and dimensions. 铝箔应成批提交验收，每批应由同一类别、牌号、状态、尺寸规格的产品组成。

9.3 Weight calculation计重

Foils shall be calculated by net weight. 产品应检斤计重。

9.4 Inspection items检验项目

Process assured items and factory inspection items shall be as specified in Table 11. 铝箔工艺保证项目和出厂检验项目应符合表11的规定。

Table 11 Process assured items and factory inspection items 表 11 工艺保证项目及出厂检验项目

Inspection items检验项目		Process assured items工艺保证项目	Factory inspection items出厂检验项目	
Chemical composition 化学成分	Pb, Cd, Hg, Cr ⁶⁺	√	—	
	Other elements其他元素	—	√	
尺寸偏差	Thicknesses 厚度	—	√	
	surface densities 面密度	—	√	
	Width 宽度	—	√	
	Length 长度	—	√	
	Burrs and cracks 毛刺、裂边	—	√	
	板形 Shapes	光箔 Foils	—	√
		涂层箔基 材 Uncoated foils	√	—
Oscillation 错层	—	√		
The tensile properties at room temperature 室温拉伸力学性能		—	√	
Porosities 针孔	Off-line 离线	—	√	
	On-line 在线	√	—	
Surface wetting tension 表面润湿 张力		—	√	
Joints 接头		√	—	
Cores管芯	Materials 材质	√	—	

	Other requirement 其他要求	—	√
Appearances 外观质量	Off-line 离线	—	√
	On-line 在线	√	—
Note: “√” in the Table means “choose”; “—” means “not choose”. 注: “√”表示检验项目或工艺保证项目; “—”表示非检验项目。			

9.5 Sampling 取样

Sampling for the inspection items shall be as specified in Table 12. 产品取样应符合表12规定。

Table 12 Sampling 表12 取样

Inspection items 检验项目		Sampling rules 取样规定	Clause and subclause of the requirement 要求的章条号	Clause and subclause of the test methods 试验方法的章条号
Chemical composition 化学成分		Sampling shall be carried out according to GB/T 17432. 按GB/T 17432的规定进行	5.1	6.1
尺寸偏差	Thicknesses 厚度	Shall be measured for each coil. 逐卷检查	5.2.1	6.2.2
	Surface densities 面密度	Shall be measured for each coil. 逐卷检查	5.2.2	6.2.3
	Width 宽度	Shall be measured for each coil. 逐卷检查	5.2.3	6.2.4
	Length 长度	Shall be measured for each coil. 逐卷检查	5.2.4	6.2.5
	Bursr and cracks 毛刺、裂边	Shall be measured for each coil. 逐卷检查	5.2.5	6.2.6
	Shapes 板形	Shall be measured for each coil. 逐卷检查	5.2.6	6.2.7
	Oscillations 错层	Shall be measured for each coil. 逐卷检查	5.2.7	6.2.8
The tensile properties at room temperature 室温拉伸力学性能		Randomly select 2% of the coils (not less than 2 coils) in each lot, take three test pieces along the longitudinal direction at each coil in 1/6, 1/2, 5/6 width. 每批抽取2%的卷(不少于2卷), 每卷在 1/6、1/2、5/6 宽度处, 沿轧制方向取3个试样	5.3	6.3
Porosities 针孔	Off-line 离线	Inspects not less than 2 coils in each lot 每批不少于2卷	5.4	6.4
	On-line 在线	Shall be inspected for each coil 逐卷检查		

表12 取样 (续)

Inspection items 检验项目	Sampling rules 取样规定	Clause and subclause of the requirement 要求的章条号	Clause and subclause of the test methods 试验方法的章条号
Surface wetting tension 表面润湿张力	Randomly select 2% of the coils (not less than 2 coils) in each lot 随机抽取2%的卷(不少于2卷)	5.5	6.5
Joint 接头	Shall be inspected for each coil 逐卷检查	5.6	6.6
Core 管芯	Shall be inspected for each coil 逐根检查	5.7	6.7
Appearance 外观质量	Shall be inspected for each coil 逐卷检查	5.8	6.8

9.6 Determination of test results 检验结果的判定

9.6.1 If any specimen of uncoated foil fails in terms of chemical composition and the casting batches can be distinguished, the casting batch represented by the specimen shall be deemed not to comply with the requirements of this document, then the other casting batches shall be checked one by one, and only the qualified coils shall be delivered. If the casting batches cannot be distinguished, the whole lot shall be deemed not to comply with the requirements of this document. The determination of the chemical composition of coating shall be agreed between supplier and purchaser. 任一光箔及涂层箔基材试样的化学成分不合格时，产品能区分熔次时，则判该试样代表的熔次不合格，其他熔次依次检验，合格者交货。不能区分熔次时，则判该批产品不合格。涂层箔的化学成分结果判定由供需双方协商确定。

9.6.2 If any product does not meet the requirements for tolerances on dimensions, the product shall be deemed unqualified. 任一产品的尺寸偏差不合格时，判该产品不合格。

9.6.3 If any test piece does not meet the requirements for tensile properties at room temperature, test pieces in double quantity shall be taken from the coils (including the coil represented by the test piece) of the same lot (heat treatment furnace) for retesting. If all these test pieces for retesting meet the requirements for tensile properties, the corresponding lot shall be deemed to qualified. If any of these test pieces fail to meet the requirements for tensile properties, the lot shall be deemed unqualified. The coils of this lot can be tested one by one by supplier after agreement between purchaser and supplier, with qualified coils delivered to purchaser. 任一试样的室温拉伸力学性能不合格时，应从该批产品（包括该不合格试样代表的产品）中（或该不合格试样代表的产品上）另取双倍数量的试样进行重复试验。重复试验结果全部合格，则判该批产品合格。若重复试验结果中仍有试样性能不合格，则判该批产品不合格。经供需双方商定允许供方逐件检验，合格者交货。

9.6.4 If any coil does not meet the requirements for porosities, the inspection lot which they represent shall be deemed not to comply with the requirements of this document. However, supplier shall be allowed to check coil by coil, with qualified coils delivered to purchaser. 任一产品的针孔不合格时，判该产品不合格，其余产品逐卷检验，合格者交货。

9.6.5 If any coil does not meet the requirement for the surface wetting tension, twofold further specimens shall be taken from the coils (including the coil represented by the specimen) of the same lot (heat treatment furnace) for retesting. If all these specimens for retesting meet the requirements, the lot which they represent shall be deemed to comply with the requirements of this document. If any of these specimens fail to meet the requirements, the

lot shall be deemed not to comply with the requirements of this document. The coils of this lot can be inspected one by one by supplier after agreement between purchaser and supplier, with qualified coils delivered to purchaser.任一产品的表面润湿张力不合格时,判该产品不合格,在其余产品中另取双倍数量的铝箔进行重复试验。重复试验结果全部合格,则判该批产品合格。若重复试验结果中仍有不合格,则判该批产品不合格。经供需双方商定允许供方逐件检验,合格者交货。

9.6.6 If any coil does not meet the requirement for joints, the coil shall be deemed not to comply with the requirements of this document.任一产品的接头不合格时,判该产品不合格。

9.6.7 If any coil does not meet the requirement for cores, the inspection lot which they represent shall be deemed not to comply with the requirements of this document.任一产品的管芯不合格时,判该产品不合格。

9.6.8 If any coil does not meet the requirement for appearance, the coil shall be deemed not to comply with the requirements of this document.任一产品的外观质量不合格时,判该产品不合格。

10 Marking, packing, transporting and storing 标志、包装、运输、贮存和质量证明书

10.1 Marking 标志

10.1.1 Product marking 产品标志

The qualified coils shall be marked (or labeled) accordingly, with the following information:应在检验合格的每卷产品上做标记(或贴标签),标记内容如下:

- a) Product name 产品名称;
- b) Purpose codes 用途代号;
- c) Designations 牌号;
- d) Temper 状态;
- e) Dimensions 尺寸规格;
- f) Batch or coil number 批号或卷号 (In order to realize the traceability of coil number, it is advisable to adopt the bar code 为实现卷号可追溯性,宜采用条形码形式);
- g) Net weight 净重;
- h) Inspection stamp of supplier's Quality Control Department (or signature or seal of quality inspection personnel) 供方技术监督部门的检印或质检员签字(或印章)。

10.1.2 包装箱标志

The marking of the packaging box shall be in conformity with GB/T 3199. In order to realize the traceability of box number, it is advisable to adopt the bar code 产品的包装箱标志应符合GB/T 3199的规定,为实现箱号可追溯性,宜采用条形码形式。

10.2 Packing, transporting and storing 包装、运输、贮存

The packing, transporting and storing of the products shall be in conformity with GB/T 3199. 产品的包装、运输、贮存应符合 GB/T 3199 的规定。

10.3 Quality certificate 质量证明书

Each lot shall be delivered with a product quality certificate with the following information stated: 每批铝箔应附有产品质量证明书, 其上注明:

- a) Supplier 供方名称;
- b) Product name 产品名称;
- c) Purpose codes 用途代号;
- d) Designations and temper 牌号、状态;
- e) Dimensions 尺寸规格;
- f) Net weight 净重;
- g) Batch or coil number 批号(或卷号);
- h) Inspection results of various analysis items 各项分析项目的检验结果;
- i) This document number 本文件编号;
- j) Inspection stamp of supplier's Quality Control Department 供方技术监督部门的印记;
- k) Date of packaging (or date of manufacture) 包装日期(或出厂日期)。

11 订货单(或合同)内容

Order (or contract) for the products listed in this document shall contain the following information: 订购本文件所列产品的订货单(或合同)内应包括下列内容:

- a) Product name 产品名称;
- b) Categories 类别 (uncoated foil, coated foil, or single-sided, double-sided 光箔、涂层箔或单面光铝箔、双面光铝箔);
- c) Designations 牌号、状态;
- d) Dimensions 尺寸规格;
- e) Net weight 重量;
- f) Material and dimensions of core 管芯材质及规格;
- g) Items "to be stated in the contract or order" as required in this document (Grade of thicknesses, density thicknesses, width, length, burr, requirement of cracks, Grade of wave height, special requirements of the tensile properties at room temperature and grade of porosities); 本文件要求的“应在订货单(或合同)中注明”的事项(厚度/面密度/宽度/长度偏差级别、边缘毛刺级别、边缘裂口要求、波高级别、特殊的室温拉伸力学性能要求、针孔级别等);
- h) Other information in addition to this document as agreed between purchaser and supplier. 增加本文件以外内容时的协商结果;
- i) This document number. 本文件编号。

Annex A 附录 A
(Informative 资料性)

The inspection methods for on-line pinholes and holes 针孔、孔洞在线检测方法

A.1 Principles 方法原理

Utilizing the nature of light transmission through pinholes and holes, the size, quantity and distribution of pinholes and holes in foils are detected by on-line pinhole detector.

利用针孔、孔洞透光的性质,采用针孔在线检测仪检测铝箔针孔、孔洞的大小、数量和分布情况。

A.2 Apparatus 设备

The on-line pinhole detector meets the following conditions: 针孔在线检测仪符合以下条件:

- Detection accuracy 0.02mm; 检测精度 0.02mm;
- The light source is laser or LED; 光源为激光或 LED;
- Equipped with automatic correction and automatic statistical functions; 具备自动校正和自动统计功能。

A.3 Samples 试样

Light foils and coated foils substrate to be cut.

待分切的光箔及涂层箔基材。

A.4 Tests 测定

A.4.1 Input volume number, purpose codes, grade, temper, width and other information in the on-line pinhole detector system.

在针孔在线检测仪系统中输入卷号、用途代号、牌号、状态、宽度等信息。

A.4.2 Refer to Table A.1 to set the aperture statistical range.

参照表A.1设定孔径统计范围。

Table A.1 Division of aperture ranges

Unit in millimeter

表A.1 孔径范围划分

单位为微米

Aperture grade 孔径等级	Aperture 孔径
A	≤100
B	>100~300
C	>300~800
D	>800

A.4.3 When the aluminium foil coil slitting starts, initiate the on-line pinhole detector, and the on-line detection is starting. The monitor can display the number, size, density and position of pinholes and holes in real time online.

在铝箔卷分切开始时,启动针孔在线检测仪,开始在线检测,显示器可实时显示在线针孔及孔洞的数量、大小、密度和位置。

A. 4. 4 After the slitting is complete, turn off the on-line pinhole detector.

分切结束后，关闭针孔在线检测仪。

A. 5 Result display 结果显示

The system automatically counts the pinholes or holes, and automatically summarizes the number, density and position of each grade of pinholes and holes. The typical pinhole and hole distribution diagram is shown in Figure A. 1.

系统自动对针孔或孔洞进行计数，自动汇总各等级针孔及孔洞数量、密度和位置。典型的针孔及孔洞分布示意图见图 A. 1。

QUALITY CONTROL REPORT COIL

料卷质量控制报告

COIL卷号	: 2L19X275BT														
ALLOY TYPE合金牌号	: 1100														
THICKNESS (um)厚度	: 12.00														
LENGTH (m)长度	: 13745														
WIDTH (mm)宽度	: 594														
DATE日期时间	: 01-12-2019 05:00:38														
NOTE备注	:														
Threshold [um]临界值	A= 20-100 B=100-300 C=300-800 D>800 RD= 5														
Inspection Table检测分类	12电池箔														
Cpk (Usl Lsl)过程能力指数	-6.28 (550 100)														
S	Int.[m]	Cls A	Cls B	Cls C	Cls D	Cls RD	Cls Big	CL	CH	Cls ABCD	Dens. A [h/m2]	Dens. B [h/m2]	Dens. C [h/m2]	Dens. D [h/m2]	Dens. ABCD [h/m2]
1	0 - 687	10	0	0	0	0	0	0	0	10	0.02	0.00	0.00	0.00	0.02
2	687 : 1375	17	0	0	0	0	0	0	0	17	0.04	0.00	0.00	0.00	0.04
3	1375 : 2062	7	0	0	0	0	0	0	0	7	0.02	0.00	0.00	0.00	0.02
4	2062 : 2749	19	0	0	0	0	0	0	0	19	0.05	0.00	0.00	0.00	0.05
5	2749 : 3436	9	0	0	0	0	0	0	0	9	0.02	0.00	0.00	0.00	0.02
6	3436 : 4124	15	0	0	0	0	0	0	0	15	0.04	0.00	0.00	0.00	0.04
7	4124 : 4811	26	0	0	0	0	0	0	0	26	0.06	0.00	0.00	0.00	0.06
8	4811 : 5498	12	0	0	0	0	0	0	0	12	0.03	0.00	0.00	0.00	0.03
9	5498 : 6185	10	0	0	0	0	0	0	0	10	0.02	0.00	0.00	0.00	0.02
10	6185 : 6873	13	0	0	0	0	0	0	0	13	0.03	0.00	0.00	0.00	0.03
11	6873 : 7560	9	0	0	0	0	0	0	0	9	0.02	0.00	0.00	0.00	0.02
12	7560 : 8247	16	0	0	0	0	0	0	0	16	0.04	0.00	0.00	0.00	0.04
13	8247 : 8934	9	0	0	0	0	0	0	0	9	0.02	0.00	0.00	0.00	0.02
14	8934 : 9622	11	0	0	0	0	0	0	0	11	0.03	0.00	0.00	0.00	0.03
15	9622 : 10309	10	0	0	0	0	0	0	0	10	0.02	0.00	0.00	0.00	0.02
16	10309 : 10996	8	0	0	0	0	0	0	0	8	0.02	0.00	0.00	0.00	0.02
17	10996 : 11683	7	0	0	0	0	0	0	0	7	0.02	0.00	0.00	0.00	0.02
18	11683 : 12371	13	0	0	0	0	0	0	0	13	0.03	0.00	0.00	0.00	0.03
19	12371 : 13058	9	0	0	0	0	0	0	0	9	0.02	0.00	0.00	0.00	0.02
20	13058 : 13745	13	0	0	0	0	0	0	0	13	0.03	0.00	0.00	0.00	0.03
	0 : 13745	243	0	0	0	0	0	0	0	243	0.03	0.00	0.00	0.00	0.03

Figure A.1 Schematic diagram of typical pinhole and hole distribution

图 A.1 典型的针孔及孔洞分布示意图

Annex B 附录 B
(Informative) (资料性)
(On-line detection of surface defects) 表面缺陷的在线检测

B.1 Methods and principles 方法原理

A camera is used to take pictures of the aluminium foil surface for inspection. The pictures are compared with the surface defect database stored in the system, so as to detect in real-time the type, area and distribution of surface defects that could affect the usage or pose a risk of customer complaints.

采用相机对检测铝箔表面进行拍照，并与系统储存的表面缺陷库进行比对分析，从而实时检测出影响使用或有被投诉风险的表面缺陷类型、面积与分布情况。

B.2 Test conditions 试验条件

B.2.1 Room temperature: 0°C~50°C. 环境温度：0°C~50°C。

B.2.2 Slitting speed: ≤600m/min. 分切速度：≤600m/min。

B.3 Apparatus 设备

The surface defect online detector mainly includes a mainframe, a camera and a light source, and the camera configuration can cover the entire width of the aluminium foils. Horizontal accuracy is 0.09mm, Vertical accuracy is 0.15mm.

表面缺陷在线检测仪主要由主机、相机、光源组成，相机配置能覆盖整个铝箔幅宽。横向精度 0.09mm、纵向精度 0.15mm。

B.4 Samples 试样

foil coils.
铝箔卷。

B.5 Tests 测定

B.5.1 Arrange the detection apparatus according to operational procedures.

按操作规程安置检测设备。

B.5.2 Enter volume number, purpose codes, grade, temper, width and other information in the on-line surface defect detector.

在表面缺陷在线检测仪中输入卷号、用途代号、牌号、状态、宽度等信息。

B.5.3 After the slitting starts, initiate the on-line surface defect detector, and the on-line detection is starting. During the detection, ensure that each camera board is properly connected to the serial port.

分切开始后，启动表面缺陷在线检测仪，开始在线检测，检测过程中确认各个相机板和串口连接正常。

B.5.4 After the slitting is complete, close the on-line surface defect detector.

分切结束后，关闭表面缺陷在线检测仪。

B.6 Result representation 结果表示

B.6.1 Classification of defects according to Table B.1.

按表 B.1 评定缺陷等级。

Table B.1 Defect area of corresponding grade The unit is square millimeter

表 B.1 相应等级的缺陷面积

单位为平方毫米

Detect 缺陷	Defect area of each grade 各等级缺陷面积				
	Grade A A 级	Grade B B 级	Grade C C 级	Grade D D 级	Grade E E 级
Oil contamination 油污	<25.00	25.00~50.00	>50.00~100.00	>100.00~200.00	>200.00
Coil marks 印痕	<0.60	0.60~1.20	>1.20~2.40	>2.40~4.80	>2.40~4.80
Others 其他	<0.04	0.04~0.16	>0.16~0.36	>0.36~0.64	>0.64

B.6.2 Provide the test report (see Figure B.1 for a typical schematic diagram), which can contain information such as defect type and grade, as well as defect distribution and density.

给出检测报告（典型示意图见图 B.1），可包含缺陷类型与等级及缺陷分布与密度等信息。

电池箔表面质量检测报告一分布图 机架 上机架

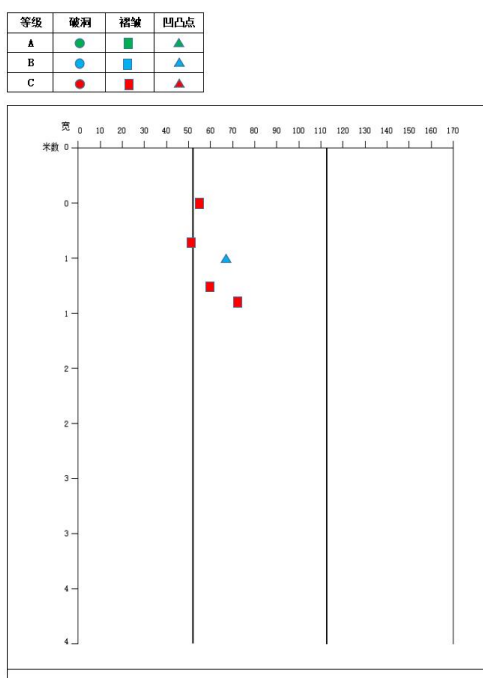


Figure B.1 Typical schematic diagram of the test report

图B.1 检测报告的典型示意图

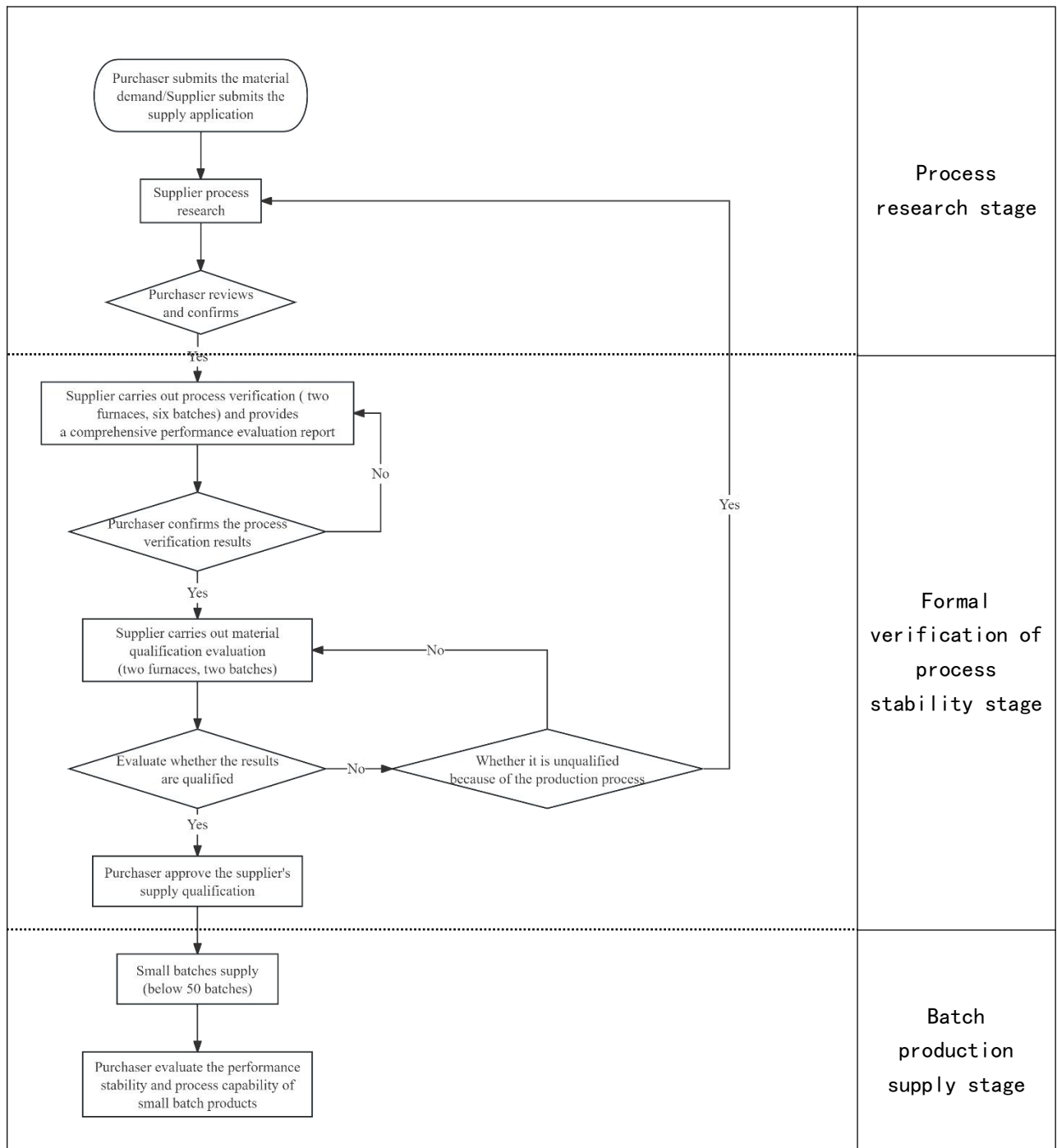
Annex C附录C
(Informative资料性)

The qualification appraisal of product产品合格鉴定

C.1 Product qualification process 产品合格鉴定流程

The qualification appraisal of product is divided into three stages: process research stage, formal verification of process stability stage, batch production supply stage, product qualification process is shown in Figure C.1.

产品合格鉴定分为三个阶段：工艺研究阶段、工艺稳定性正式验证阶段、批产供货阶段，产品合格鉴定流程见图 C.1。



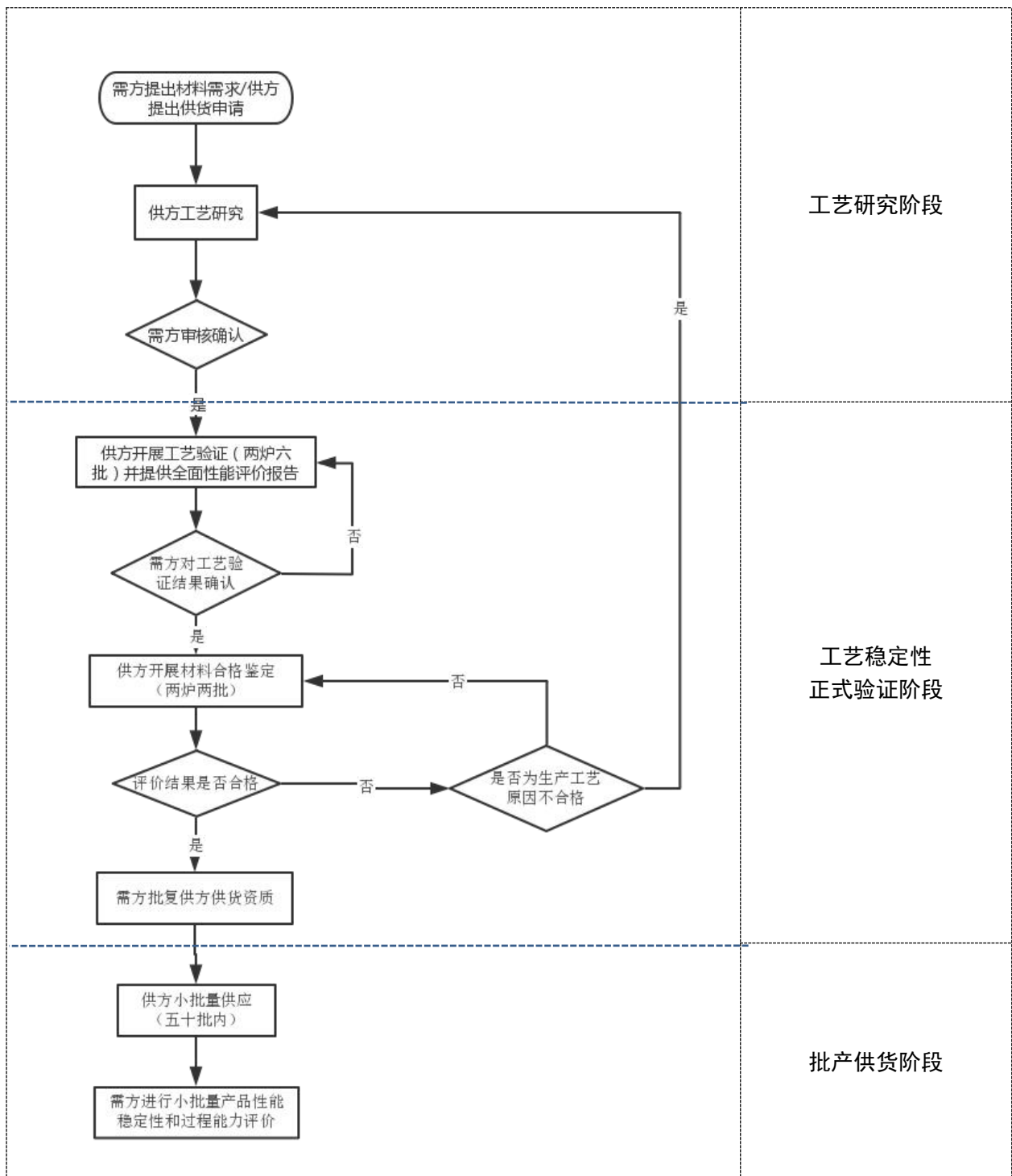


Figure C.1 Flow chart of the qualification appraisal of product

图C.1 产品合格鉴定流程图

C.2 Requirements 产品合格鉴定要求

C.2.1 Process research stage 工艺研究阶段

Before officially carrying out the verification of all specifications of the product and

the supply ability of the entire project, select some thicknesses specifications for process development, and verify the rationality of the process according to this document or purchaser requirements. To verify whether supplier has the ability to carry out all specifications of product production; When supplier has the production and supply experience of aluminium and foils for lithium batteries, it could be negotiated by supplier and purchaser and directly enter the next stage.

正式开展产品的全规格范围、全项目的供货能力验证前, 选取部分厚度规格, 进行工艺研制, 并按照标准或客户要求验证工艺的合理性。从而验证供应商是否有能力开展产品的全规格范围生产; 当供应商有锂电池用铝及铝合金箔的生产及供货经验时, 可由供需双方协商, 直接进入下一阶段。

C.2.2 Formal verification of process stability stage 工艺稳定性正式验证阶段

C.2.2.1 Process stability evaluation 工艺稳定性评价

C.2.2.1.1 According to purchaser's requirements, supplier produces no less than 2 melting furnaces and 6 production batches (hereinafter referred to as two furnaces and six batches) in accordance with the defined process, and supplier submit the test report (purchaser's approved laboratory or testing capability) until all the test results meet the requirements.

供方根据需方要求, 按照确定的工艺生产不少于2个熔炼炉、6个生产批次(以下简称两炉、六批)的产品, 并由供方提交检测报告(客户认证过的实验室或测试能力), 直至检测结果全部满足要求。

C.2.2.1.2 If any batch fails during continuous production, the previously qualified batches shall be checked. At the same time, supplier analyzes and finds out the causes of nonconformity, re-determine the production trial process, and organize another two furnaces, six batches of production verification and performance evaluation.

若连续生产中出現任一批次不合格, 则之前生产合格批次均需排查。同时供方分析查找不合格原因, 重新确定生产试制工艺, 并组织重新两炉、六批生产验证及性能评价。

C.2.2.1.3 After the completion of foils test, supplier forms a full set of process documents, original production records, original test reports, stability analysis reports, development stage summary reports, and process rationality explanations and keep them on file. Supplier provides them if required by purchaser.

铝箔生产检测完成后, 供方形成全套工艺文件、生产原始记录、原始检测报告、稳定性分析报告、研制阶段总结报告、工艺合理性说明并进行存档, 需方有要求时, 由供方提供。

C.2.2.2 Materials qualification stage 材料合格鉴定阶段

C.2.2.2.1 After supplier establishes the process, carry out 2 melting furnaces and 2 production batches according to the established production process. Carry out the material qualification, and submit them to the laboratory approved by purchaser for testing until all the test results meet the requirements.

供方确定工艺后, 按照确定的生产工艺进行2个熔炼炉、2个生产批次的生产, 开展材料合格鉴定, 并提交需方认可的实验室进行检测, 直至检测结果全部满足要求。

C.2.2.2.2 If any batch fails during continuous production, this stage will not pass. Supplier analyzes and finds out the cause of the failure and report to purchaser in written report. In case of production process problems, supplier shall re-starts the process development work; in case of non-process problems, supplier shall re-organizes the qualification.

若连续生产中出现任一批次不合格，则本阶段不通过，供方分析查找不合格原因，并向需方进行书面汇报，如因生产工艺问题，则供方重新开展工艺研制工作，如因非工艺原因问题，则供方重新组织合格鉴定。

C.2.2.2.3 Under the premise of relevant confidentiality clauses, representatives of relevant departments of purchaser have the rights to investigate each processes of supply ability verification.

在相应保密条款的前提下，需方相关部门代表有权目击、调研供货能力验证的各个过程。

C.2.2.2.4 Form a qualification report by the material qualification stage, which contains the following information: project name, manufacturer's name and address, relevant product production and supply experience, document number, alloy, temper, product size, casting batch, heat treatment batch, inspection items and results, original test report, process route description, tooling apparatus description, quality certificate, etc.

通过材料合格鉴定阶段的材料形成材料合格鉴定报告，报告包含以下的信息：项目名称、生产商的名字和地址、相关的产品生产供货经验、标准号、合金、状态、产品尺寸、熔铸批次、热处理批次、检验项目及检验结果、原始检测报告、工艺路线描述、工装设备描述、质量证明书等内容。

C.2.3 Batch production supply stage 批产供货阶段

C.2.3.1 Products in small batches could be delivered after obtaining the supply qualification approved by purchaser.

供方获得需方批复的供货资质后，进行小批量供货。

C.2.3.2 After small batches delivery, purchaser analyzes and evaluates the data. Make sure that the performance and its stability all meet the requirements before mass production.

小批量供货后，需方对小批量供货数据进行分析和评价。确定性能及性能稳定性全部满足需方要求后方可进行大批量生产。

C.2.3.3 During the batch production, supplier monitors the process and apparatus according to the process control documents, carry out relevant tests on the apparatus regularly, carry out stability analysis on the process parameters to ensure the stability of product performance.

C.2.3.4 供方在产品批产过程中按照工艺控制文件要求对生产过程、设备等进行监控，并定期对设备进行相关测试，生产过程参数进行稳定性分析，以保证产品性能的稳定。

Annex D附录D
(Informative资料性)
Process control过程控制

D.1 Development procedures 过程控制文件制定程序

After supplier has the ability to produce qualified product according to the requirements specified in this document, it shall conduct necessary material certification. Before certification, supplier shall prepare process control documents according to this document. In order to ensure the stability of material quality, the requirements related to the production shall be specified in the process control documents. Process control documentation procedures are as follows:

- a) supplier produces the specified batches of products in accordance with the requirements of the purchaser according to this document;
- b) supplier has a quality system certified by a third party;
- c) supplier formulates process control documents in accordance with the provisions of this document;
- d) supplier and purchaser confirm the process control documents, which shall be executed after the confirmation takes effect.

供方在有能力按照本文件规定的要求生产合格产品后, 进行必要的材料认证, 材料认证前, 供方按照本文件规定的生产控制要求编制过程控制文件, 为保证材料质量的稳定性, 与本产品生产或生产相关的要求均在过程控制文件中规定。过程控制文件制定程序如下:

- a) 供方按用户需求生产规定批次的符合本文件要求的产品;
- b) 供方具有第三方认证的质量体系;
- c) 供方按本文件规定内容制定过程控制文件;
- d) 供需双方对过程控制文件确认, 确认生效后方可执行。

D.2 Scope and requirements 过程控制范围及要求

D.2.1 Scope 过程控制范围

In order to ensure the effectiveness of process control, it shall include following contents:

- a) raw materials requirements;
- b) processes requirements;
- c) apparatus requirement.

为保证材料过程控制有效性, 过程控制文件包括以下内容:

- a) 原材料要求;
- b) 工艺要求;
- c) 设备要求。

D.2.2 Raw materials requirements 原材料要求

D.2.2.1 Raw materials process control includes supplier qualification confirmation and raw material quality control.

原材料过程控制包括供应商资格确认和原材料质量控制。

D.2.2.2 Foils process are controlled from the production of ingots or roll-casting strips. Ingots or roll-casting strips used for foils production shall meet the requirements of the specific material standards. Supplier and the designation of raw materials shall not be

replaced after the stabilization of process. If the raw material supplier needs to be changed for special reasons, notify the purchaser, conduct a comprehensive test on the material performance and deliver the product after the purchaser's approval.

铝箔从铸锭坯料或铸轧带材生产进行控制，用于铝箔生产的铸锭或铸轧带材原料符合具体材料标准的规定。供方生产工艺稳定后，不更换原材料的供货厂家、原料牌号。如因特殊原因需更换原材料供应商，通知客户，并对材料性能进行全面测试，客户认可后方可交货。

D.2.3 Apparatus requirement 设备要求

D.2.3.1 In order to ensure the performance stability of foils, special apparatus is designated for the production of foils in each process. The uses and accuracy of some apparatus are shown in Table D.1. And check the apparatus regularly to ensure the stability of product performance.

为了保证铝箔性能稳定性，各个工序指定专门的设备用于铝箔的生产，部分设备用途及精度见表D.1。并对设备进行定期校验，保证产品性能稳定性。

D.2.3.2 The accuracy and inspection period of the main apparatus shall not be lower than the requirements of Table D.1.

主要设备的精度和检验周期不低于表D.1的要求。

Table D.1 Precision requirements for the main product apparatus

表 D.1 锂离子电池用铝箔主要生产设备精度要求

Main apparatus 主要设备		Process purpose 工艺用途	Precision requirements 精度要求	Inspection cycle requirements 检验周期要求	Whether certification is required 是否需要相关认证
Hot rolling process 热轧工艺	Melter 熔炼炉	Aluminium alloy melting 熔炼铝合金	±15°C	6 months 6 个月	No 否
	Homogenization furnace 均火炉	Ingot homogenization annealing 铸锭均匀化退火	±15°C	6 months 6 个月	No 否
	Ingot heating furnace 铸锭加热炉	Ingot heating 铸锭加热	±10°C	6 months 6 个月	No 否
	Rolling mill 轧机	Rolling 轧制	—	6 months 6 个月	No 否
Cast-rolling process 铸轧工艺	Melter 熔炼炉	Aluminium alloy melting 熔炼铝合金	±15°C	6 months 6 个月	No 否
	Holding furnace 静置炉	Temperature holding 保温	±15°C	6 months 6 个月	No 否

	Cast-rolling mill 铸轧机	Cast-rolled strips 铸轧带材	—	6 months 6 个月	No 否
	Cold-rolling mill 冷轧机	Strip rolling 板带轧制	—	6 months 6 个月	No 否

表 D.1 (续)

Main apparatus 主要设备	Process purpose 工艺用途	Precision requirements 精度要求	Inspection cycle requirement 检验周期要求	Whether certification is required 是否需要相关认证
Plate and strip annealing furnace 板带退火炉	High temperature annealing 高温退火	$\pm 10^{\circ}\text{C}$	6 months 6 个月	No 否
Foil roughing mill 铝箔粗轧机	Foil rolling 铝箔轧制	—	6 months 6 个月	No 否

D.2.4 Processes requirements 工艺要求

D.2.4.1 Foil production process is divided into research stage, formal verification of process stability stage, batch production supply stage of the process. The process of the above three stages must be completely consistent.

铝箔生产工艺分为研究阶段、工艺稳定性正式验证阶段、批量生产供货阶段的工艺，以上三个阶段的工艺需保证完全一致。

D.2.4.2 If the process needs to be changed, it shall be re-determined by supplier and purchaser, otherwise it shall not be changed.

不变更稳定供货后的工艺，需更改时，由供需双方研究重新确定。

D.2.4.3 Develop special process guidance documents, process control documents and operation instructions for foil production.

铝箔生产制定专项的工艺指导文件，过程控制文件及作业指导书。

D.2.4.4 The main processing parameters control requirements of foils are shown in Table D.2.

铝箔主要工艺参数控制要求见表D.2。

Table D.2 The main control process

表 D.2 锂离子电池用铝箔主要受控工艺

Main stages 主要工序	Main parameters 主要工艺	Monitoring frequency 监控频次	Monitoring record 监控记录
Hot rolling process 热轧工艺	Casting metal temperature 铸造金属温度	real time 实时	Computer data or log book 电脑数据或记录纸
	Casting water temperature	per furnace	Computer data or log book 电脑数据或记录纸

		铸造水温度	每炉	
		Casting speed 铸造速度	per furnace 每炉	Computer data or log book 电脑数据或记录纸
	Homogenization annealing 均匀化退火	Homogenization temperature 均火温度	per furnace 每炉	Computer data or log book 电脑数据或记录纸
		Homogenization time 均火时间	per furnace 每炉	Computer data or log book 电脑数据或记录纸
	Rolling 轧制	Rolling temperature 轧制温度	per piece 逐块	log book 记录纸
		Thicknesses of hot-rolled sheet 板材热轧厚度	per batch 逐批	log book 记录纸
Cast-rolling process 铸轧工艺	Melter 熔炼炉	Metal temperature 金属温度	real time 实时	Computer data or log book 电脑数据或记录纸
	Holding furnace 静置炉	Metal temperature 金属温度	real time 实时	Computer data or log book 电脑数据或记录纸
	Cast-rolling mill 铸轧机	rolling force, water flow, speed 轧制力、水流量、速度	per furnace 每炉	Computer data or log book 电脑数据或记录纸
Cold rolling process 冷轧工序	Cold-rolling mill 冷轧机	Thicknesses, plate type 厚度、板型	per coil 每卷	Computer data or log book 电脑数据或记录纸
	Annealing furnace 退火炉	Metal temperature, furnace temperature 金属温度、炉气温度	per furnace 每炉	Computer data or log book 电脑数据或记录纸
Foil process 铝箔工序	Roughing mill 粗轧机	Thicknesses, plate type 厚度、板型	per coil 每卷	Computer data or log book 电脑数据或记录纸
	Middle finishing mill 中精轧机	Thicknesses, plate type 厚度、板型	per coil 每卷	Computer data or log book 电脑数据或记录纸
	Slitting machine 分切机	Porosities, surfaces 针孔、表面	per coil 每卷	Computer data or log book 电脑数据或记录纸
	Fine cut area 精切区域	Ambient particulate matter 环境颗粒物	per shift 每班	Computer data or log book 电脑数据或记录纸

D.3 Process control documents 过程控制文件

D.3.1 Approval page 批准页

The approval page shall contain at least the following information:

- a) process control document name, document number and version number, material grade and referenced material standard;
- b) name of supplier and purchaser;
- c) supplier and approval date, including at least the signature of supplier's personnel responsible for quality, production and technology;
- d) purchaser and approval date, including signature from materials engineer and quality personnel of materials department.

批准页至少包含以下信息：

- a) 工艺控制文件名称、文件号及版本号，材料牌号及引用的材料标准文件；
- b) 供方及需方名称；
- c) 供方批准和日期，至少包括供应商负责质量、生产和技术的人员的签字；
- d) 需方和批准日期，包括来自材料部门材料工程师和质量人员的签字。

D.3.2 Contents of the process control file 过程控制文件内容

The process control file contains the following information:

- a) apparatus and apparatus number required for product production process;
- b) identify production process control variables, monitoring frequency, and list reference process documents;
- c) identify key process parameters, key characteristics and control methods;
- d) recording methods of process control variables;
- e) process deviation from the action taken and referenced process deviation from the documents;
- f) the changed record page.

过程控制文件包含下列内容：

- a) 产品生产工序需要的设备及设备编号；
- b) 识别生产工序过程控制变量、监测频率，并列参考工艺文件；
- c) 识别关键工艺参数、关键特性及控制方法；
- d) 过程控制变量记录方式；
- e) 过程偏离采取措施及引用的过程偏离文件；
- f) 更改记录页。

D.3.3 Save and change process control files 过程控制文件保存及更改

D.3.3.1 Each version of the process control documents and the technical corrigendum shall be kept for at least 10 years.

过程控制文件各版本文件及更改单至少保存10年以上。

D.3.3.2 It needs to be replaced if the process control file accumulates more than 3 changes.

过程控制文件累计超过3处更改时，需进行换版处理。

Reference 参考文献

- [1] GB/T 3198 Aluminium and foils 铝及铝合金箔
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