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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 33143-2022

Aluminium and aluminium alloy foils for lithium-ion batteries

锂离子电池用铝及铝合金箔

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1 Scope

China's national standard for the aluminium and aluminium alloy foil used as the current collector in lithium-ion batteries. It specifies the classification, the technical requirements, the test methods, the product qualification, the process control, the inspection rules, the marking, packaging, transport, storage and quality certificate, and the contents of the order form or contract, with informative annexes on the online detection of pinholes and holes, the online detection of surface defects, product qualification and process control. It replaces GB/T 33143-2016. Aluminium foil is the cathode current collector: the cathode coating is applied to both faces of it, and every electron that leaves the cathode during discharge travels through it. That makes it one of the few genuinely critical components of a cell that is bought as a commodity by the tonne, and it has to satisfy requirements that pull against each other. It must be thin, because it is inert mass in a battery whose value is measured in

energy per kilogram, and thinner foil has taken over the market accordingly. It must be strong, because it is unwound, coated, dried, calendered and wound at speed, and a foil that breaks stops a coating line. It must be free of pinholes, because a hole in the collector is a discontinuity in the current path and a site where coating adhesion fails. And its surface must accept the coating uniformly, since the interface between coating and foil carries the whole cell's current. The scale of the annexes on online defect detection reflects where the industry is: at line speed, defects have to be found by machine or not at all. Issued on 9 March 2022 and in force since 1 October 2022.

This Document specifies the classification, technical requirements, test methods, product qualification, process control, inspection rules and marking, packaging, transportation, storage and quality certificates, as well as purchase orders (or contracts) of aluminum and aluminum alloy foils for lithium-ion batteries. This Document applies to aluminum and aluminum alloy foils (hereinafter referred to as "aluminum foils") for lithium-ion battery current collectors.

2 Normative References

The provisions in following documents become the essential provisions of this Document through reference in this Document. For the dated documents, only the versions with the dates indicated are applicable to this Document; for the undated documents, only the latest version (including all the amendments) is applicable to this Document.

GB/T 3190 Wrought Aluminum and Aluminum Alloys - Chemical Composition Limits

GB/T 3199 Wrought Aluminum and Aluminum Alloy Products - Packing, Marking, Transporting and Storing

GB/T 7999 Optical Emission Spectrometric Analysis Method of Aluminum And Aluminum Alloys

GB/T 8005.1 Aluminum and Aluminum Alloys - Terms and Definitions - Part 1: Product and Method of Processing and Treatment

GB/T 8170 Rules of Rounding off for Numerical Values & Expression and Judgement of Limiting Values

GB/T 16865 Test Pieces for Tensile Test for Wrought Aluminum and Magnesium Alloy Products

GB/T 17432 Methods of Sampling for Analyzing the Chemical Composition of Wrought Aluminum and Aluminum Alloy

GB/T 20975 (all parts) Methods for Chemical Analysis of Aluminum and Aluminum Alloys

5.8.1.4 The coating of the coating foil shall be uniform, and the coating area shall not be allowed to expose the substrate.

5.8.2 End face The end face of the aluminum foil is not allowed to have arrows, stains, bumps and other defects, and dense aluminum powder with visible reflected light is not allowed.

6.1 Chemical composition

6.1.1 The chemical composition analysis method of the light foil and coating foil substrate shall comply with the provisions of GB/T 20975 or GB/T 7999; and the arbitration analysis shall adopt the method stipulated in GB/T 20975. The "Al" content is calculated according to the method specified in GB/T 3190. When calculating the "Al" content, the sum of the analytical values of the conventional analytical elements and the unconventional analytical elements suspected to be excessive is taken as the "sum of element content".

6.1.2 The determination of the analysis value shall adopt the rounding-off comparison method; the rounding-off rules of the numerical value shall be carried out according to the relevant provisions of GB/T 8170; and the rounding-off digits shall be consistent with the limit digits specified in Table 2 or GB/T 3190.

6.1.3 The chemical composition analysis method for the coating of the coating foil shall be determined through negotiation between the supplier and the purchaser.

6.2 Dimensional deviation

6.2.1 Dimension rounding-off Dimensional measurements are not allowed to be rounded-off; and the method for determining the limit value shall comply with the provisions of GB/T 8170.

6.2.2 Thickness The thickness of the light foil and the coating foil substrate shall be determined according to the method specified in GB/T 22638.1. When the purchaser requires the selection of non- standard area samples to measure the thickness, it shall be indicated in the order form (or contract). The measurement method of the thickness extreme difference shall be determined through negotiation between the supplier and the purchaser.

6.2.3 Areal Density

6.2.3.1 The areal density of the light foil and the coating foil substrate shall be determined according to the method specified in GB/T 22638.10. When the purchaser requires the selection of non-standard area samples to measure the surface density, it shall be indicated in the order form (or contract). The measurement method of areal density extreme difference shall be determined through negotiation between the supplier and the purchaser.

6.2.3.2 The areal density for the coating of the coating foil shall be determined according to the method specified in GB/T 22638.10, or determined through negotiation between the supplier and the purchaser.

6.2.4 Width Measure with a film ruler or other tool of corresponding accuracy.

6.2.5 Length Measure with tools of corresponding accuracy.

6.2.6 Burrs, cracked edges Select the trimming positions on both sides of the aluminum foil roll, and cut the sample including the trimming edge of the aluminum foil along the trimming edge, and the length of the sample shall be greater than 30cm. Under a microscope (optical magnification should be no less than 100x, digital magnification should be no less than 500x), visually check the smoothness of the edge of the sample, crack defects and measure the burr size. It should observe the edge of the aluminum foil from multiple angles.

6.2.7 Plate shape

6.2.7.1 Under the unit tension of 8N/mm², visually inspect the aluminum foil for poor plate shape defects.

6.2.7.2 Under the unit tension of 8N/mm², the wave height of the aluminum foil wave is measured by the off-line plate shape testing device.

6.2.8 Staggered layer Measure by tools of corresponding precision.

6.3 Tensile mechanical properties at room temperature The tensile mechanical properties at room temperature shall be tested according to the method specified in GB/T 16865. The test gauge length is 50mm or 100mm; and the test rate is 5mm/min or 10mm/min, which is determined by the negotiation between the supplier and the purchaser.

6.4 Pinhole The pinhole offline test is carried out according to the method specified in GB/T 22638.2; and the pinhole online test method is shown in Appendix A.

6.5 Surface wetting tension It shall be tested according to the method specified in GB/T 22638.4.

6.6 Joints Visual inspection.

6.7 Tube core The dimension deviation of the tube core is measured by a measuring tool that can guarantee the accuracy; the material of the tube core is guaranteed by the supplier; and other items are checked visually.

6.8.1 Surface

6.8.1.1 During the arbitration inspection, visually inspect the appearance quality under natural scattered light.

6.8.1.2 The diameter of the circumscribed circle of point defects on the surface of the aluminum foil can be measured by a measuring tool with corresponding accuracy.

6.8.1.3 See Appendix A for the online detection method of holes on the surface of aluminum foil. See Appendix B for on-line detection methods for other surface defects.