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**ENERGY INDUSTRY STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

NB/T 10328-2019

**Heat-shrinkable polyolefin tubing for high-voltage copper
bus-bar of electric vehicles
(English Translation)**

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1 Scope

This standard specifies the structure, requirements, test methods, inspection rules, marking, packaging, transportation, storage of heat-shrinkable polyolefin tubing for high-voltage copper bus-bar of electric vehicles.

This standard applies to heat-shrinkable polyolefin tubing for high-voltage copper bus- bars of electric vehicles, which have a rated voltage of DC60V-1000V or AC25V-660V.

2 Normative references

The following documents are essential to the application of 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 standard.

GB/T 1034-2008 Plastics - Determination of water absorption

GB/T 2411-2008 Plastics and ebonite - Determination of indentation hardness by means of a durometer (shore hardness)

GB/T 2828.1-2012 Sampling procedures for inspection by attributes - Part 1:

Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection (ISO 2859-1:1999, IDT)

GB/T 7113.2-2014 Flexible insulating sleeving - Part 2: Methods of test

GB/T 2423.22-2012 Environmental testing - Part 2: Tests methods - Test N: Change of temperature

3 Structure

The heat-shrinkable polyolefin tubing for high-voltage copper bus-bars of electric vehicles consists of an outer layer and an inner layer. The outer layer is made of polyolefin heat-shrinkable material, whilst the inner layer is made of silicone resin. The schematic diagram of the structure is as shown in Figure 1.

5.2 Appearance

Visual inspection shall be used.

5.3 Inner diameter, length change, concentricity

The specimen length is not less than 100 mm.

Use a cylindrical or tapered plug gauge of appropriate diameter, to measure the inner diameter of the specimen, before shrinkage and after complete shrinkage. The plug gauge shall be inserted smoothly, without causing the specimen to expand.

Use an image projector, which has a graduation value of 0.001 mm, to measure the wall thickness of the specimen before shrinkage and after complete shrinkage, to obtain the maximum wall thickness and minimum wall thickness.

Use a steel ruler, which has a graduation value of 0.1 mm, to measure the length of the specimen, before shrinkage and after complete shrinkage.

Calculate the length change, according to the formula (1). Calculate the concentricity, according to the formula (2).

Where:

LC - The value of length change;

L1 - Numerical value of the length before shrinkage, in millimeters (mm);

L2 - Numerical value of the length after shrinkage, in millimeters (mm).

Where:

Ec - The value of concentricity;

M1 - The value of the maximum wall thickness, in millimeters (mm);

M2 - The value of the minimum wall thickness, in millimeters (mm).

5.4 Tensile strength and elongation at break

Tensile strength and elongation at break shall be carried out, in accordance with the provisions in Chapter 20 of GB/T 7113.2-2014; the tensile rate shall be 500 ± 50 mm/min.

5.5 Shore hardness

The Shore hardness shall be carried out, according to the provisions of Type A Shore hardness tester, in GB/T 2411-2008.

5.6 Breakdown voltage

The breakdown voltage shall be in accordance with the provisions of Chapter 22 of GB/T 7113.2-2014, at a voltage increasing rate of 500 V/s.

5.7 Volume resistivity

Volume resistivity shall be carried out, in accordance with the provisions of Chapter 24 of GB/T 7113.2-2014.

5.8 Low temperature bendability

The low-temperature bendability shall be carried out, according to the provisions in Chapter 15 of GB/T 7113.2-2014; the test temperature shall be $-55\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. For strip specimen, the mandrel diameter shall not exceed 10 times the wall thickness; for full-section hoses, there shall be no filling, meanwhile the mandrel diameter shall not exceed 10 times its outer diameter.

5.9 Resistance to cracking after heating

The cracking resistance after heating shall be carried out, according to the provisions in Chapter 6 of GB/T 7113.2-2014; the test temperature shall be $158\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

5.10 Thermal shock

Thermal shock shall be carried out, in accordance with the provisions in Chapter 7 of GB/T 7113.2-2014; the test temperature is $180\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

5.11 Crack resistance after heating

Shrink the specimen, which has a length of not less than 500 mm, on the high-voltage copper bus-bar corresponding to Table 1 (the ratio of the perimeter of the high-voltage copper bus-bar to the perimeter of the inner surface of the specimen before shrinking is 0.75 ± 0.02); the shrinkage temperature is $155\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$; the time is (15 ± 1) min. Then make a 5 mm longitudinal incision, at one end of the specimen (as shown in Figure 3); place it in an oven at $120\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for (168 ± 2) h; take it out to measure the length of the incision of the specimen.

5.16 Water absorption

Water absorption shall be carried out, according to the provisions of method 1 in GB/T 1034-2008.

6.1 Exit-factory inspection

Products of the same model and specification, that are continuously produced using the same material and the same process, constitute one batch. Before the product leaves the factory, each batch shall be subject to exit-factory inspection. According to the provisions of GB/T 2828.1-2012, use the one-time sampling plan (integer number of acceptances), S-3 level of special inspection, acceptance quality limit (AQL) of 4.0 (%), to take sample from product and carry out exit-factory inspection, according to the test methods of 5.2 and 5.3. The exit-factory inspection shall meet the requirements of 4.1 and 4.2. If the number of unqualified products is less than the number received, the batch of products is considered qualified. However, if the number of unqualified products is greater than the number received, the batch of products is considered unqualified. If the user thinks it is necessary, the sampling quantity of each batch shall be determined, according to the agreement between the supplier and the buyer.

6.2 Type test

When any of the following situations occurs, the type test shall be carried out, according to the test methods of 5.2 ~ 5.16; the test results shall meet the requirements of 4.2.

- a) Identification of new products;
- b) Changes in product structure, raw materials, processes;
- c) After five years of stable production;
- d) Resume production after more than half a year of suspension;
- e) The user makes a request, which is agreed upon by both parties;
- f) Change of production site;
- g) The quality supervision department makes a request.

7.1 Marking

There shall be at least the following marks, on the outer packaging of the product:

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