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High-density Polyethylene Silicore Plastic Duct

高密度聚乙烯硅芯管

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High-density Polyethylene Silicore Plastic Duct

1 Scope

This Standard specifies the structure and classification, materials, requirements, test methods, inspection rules, marking, packaging, transportation and storage of high-density polyethylene silicore plastic ducts (hereinafter referred to as “silicore ducts”).

This Standard is applicable to silicore ducts and supporting duct fittings used for the protection of optical cables and power cables, which are laid in environments, such as: underground direct burial, pipelines and trenches, etc.

This Standard is not applicable to silicore ducts and supporting duct fittings used for the protection of optical cables and power cables, which are directly exposed outdoor to the sunlight and with an air blowing pressure greater than 1.2 MPa.

2 Normative References

Through the reference in this Standard, the clauses of the following documents become clauses of this Standard. In terms of references with a specified date, all the subsequent modification sheets (excluding the corrected content) or revised versions are not applicable to this Standard. However, the various parties that reach an agreement in accordance with this Standard are encouraged to explore the possibility of adopting the latest version of these documents. In terms of references without a specified date, the latest version is applicable to this Standard.

GB/T 191 *Packaging - Pictorial Marking for Handling of Goods* (GB/T 191-2008, ISO 780:1997, MOD)

GB/T 1842-2008 *Plastics - Test Method for Environmental Stress-cracking of Polyethylene*

GB/T 2411 *Plastics and Ebonite - Determination of Indentation Hardness by Means of A Durometer (shore hardness)*

GB/T 2828.1-2003 *Sampling Procedures for Inspection by Attribute - Part 1: Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-by-lot Inspection*

GB/T 2918-1998 *Plastics - Standard Atmospheres for Conditioning and Testing*

GB/T 3682-2000 *Determination of the Melt Mass-flow Rate (MFR) and the Melt Volume-flow Rate (MVR) of Thermoplastics*

GB/T 6111-2003 *Thermoplastics Pipes for the Conveyance of Fluids - Resistance to*

Figure 1 -- Schematic Diagram of Cross-sectional Structure of Silicore Duct

3.2 Product Classification

3.2.1 By structure, it may be classified into:

- Both the inner and outer walls are smooth solid-walled silicore ducts: represented by the Latin letter S;
- Ribbed silicore duct with smooth outer wall and longitudinal ribbed inner wall: represented by the Latin letter R1;
- Ribbed silicore duct with ribbed outer wall and smooth inner wall: represented by the Latin letter R2;
- Ribbed silicore duct with ribbed outer and inner walls: represented by the Latin letter R3.

3.2.2 By color, it may be classified into:

- Single-color silicore duct whose outer layer is a single color and without color stripes;
- Color-striped silicore duct whose outer layer is inlaid with color stripes of other colors.

3.3 Product Marking

The product marking of silicore ducts is composed of name, standard No., sequence number, material, specifications, duct wall structure and outer-layer color code, in which, the material is represented by PE-HD; the specifications are shown in Table 2, for example, 40/33; the duct wall structure is shown in 3.2.1: S---solid-walled duct, which may usually be omitted, R1, R2, R3---ribbed ducts; the outer-layer color code is shown in Table 1.

An example of product marking: 40/33 black silicore duct with smooth inner and outer walls in compliance with GB/T 24456 shall be marked as:

Silicore duct GB/T 24456 PE-HD 40/33 BK

4 Materials

The main material for the production of silicore ducts shall be high-density polyethylene extrusion grade resin that complies with the stipulations of GB/T 11116. Its melt mass-flow rate MFR (190/2.16) is 0.1 g/10 min ~ 1.0 g/10 min. Under the condition of ensuring compliance with the requirements of Chapter 5 of this Standard, no more than 10% of the company's clean recycled materials may be used.

Tightly put a silicone duct sample (length: 100 mm) on a metal rod with an appropriate outer diameter; place it directly under the Type-D Shore Hardness Tester. In accordance with the method specified in GB/T 2411, read the instantaneous hardness of the test as the measurement result. Read 5 times in total; take the arithmetic mean value as the measurement result.

6.5.2 Inner wall friction coefficient

6.5.2.1 See Appendix C for the static-state inner wall friction coefficient test method.

6.5.2.2 See Appendix D for the dynamic-state inner wall friction coefficient test method.

6.5.3 Tensile yield strength and elongation at break

The shape of the sample shall comply with the stipulations of Type-2 in GB/T 8804.3-2003. Through the method of punching, cut 3 samples from the duct. The test shall be conducted in accordance with the steps in GB/T 8804.1-2003. The test rate is (100 ± 5) mm/min. Take the arithmetic mean value of 3 valid tests as the test result.

NOTE: when there is no obvious yield point, take the maximum tensile strength as the test result.

6.5.4 Maximum traction load

Take three intact silicone duct samples with a length of (200 ± 5) mm. Both ends of the sample shall be cut straight and flat. Use a special fixture to clamp the sample on the testing machine at a tensile speed of (450 ± 10) mm/min, until the sample yields. Then, read the yield load as the test result. If the sample breaks at the edge of the fixture, then, the test is invalid, and the sample shall be replaced. Take the arithmetic mean value of three valid tests as the test result.

6.5.5 Cold bending performance

See Appendix E for the cold bending performance.

6.5.6 Ring stiffness

Take three intact silicone duct samples with a length of (200 ± 1) mm. The compression speed is (5 ± 1) mm/min; the amount of compression is 5% of the inner diameter, which shall be performed in accordance with the stipulations of GB/T 9647-2003.

6.5.7 Recovery rate

Take three intact silicone duct samples with a length of (200 ± 1) mm. Both ends of the sample shall be cut straight and flat. Mark both ends of the sample diameter; measure-take the outer diameter at the mark as the initial outer diameter. In accordance with the stipulations of GB/T 9647-2003, place the sample between two parallel pressing plates.

In accordance with the stipulations of GB/T 1842-2008, from the silicone duct, along the axis, directly cut the sample. The length direction of the notch is consistent with the axis. In terms of the depth of the notch, when the wall thickness is less than or equal to 3.5 mm, it is 0.65 mm; when the wall thickness is greater than 3.5 mm, it is 0.80 mm. See GB/T 1842-2008 for other stipulations. The reagent is 10% (volume fraction) aqueous solution of nonylphenol polyoxyethylene ether (TX-10); the test temperature is 50 °C.

6.5.12 Resistance to hydrocarbons

Under the standard test environment, take three silicone duct samples with a length of (300 ± 1) mm. Use heptane to immerse it for 720 h, then, take it out. Drain the test liquid. At room temperature, place it for 30 min. Then, apply a radial pressure of 528 N to the silicone duct and maintain for 1 min. After unloading, immediately observe the sample. If the sample has no damage, or, if the generated permanent deformation does not exceed 5%, the sample is qualified.

6.5.13 System airtightness test

Take two intact silicone duct samples with an appropriate length. Use the special joint for silicone duct, in accordance with the instruments and methods provided by the manufacturer, properly connect them. One end is sealed with a stopper, and the other end is connected to a special fixture for water injection. At the water temperature of (20 ± 2) °C and a pressure of 50 kPa, maintain it for 24 h. If the joint and duct stopper of the sample do not leak, then, the sample is qualified.

6.5.14 Connection force of duct joint

Take two intact silicone ducts with a length of (200 ± 5) mm. Use the special joint for silicone duct, in accordance with the instruments and methods provided by the manufacturer, properly connect them and compose a sample. Use a special fixture to clamp the sample to the tensile testing machine, at a tensile speed of (100 ± 5) mm/min, until the duct joint is broken or the silicone duct is pulled out, then, read the maximum tensile load of the test as the test result. In this way, perform a total of three sets of tests. Take the arithmetic mean value of the three test results as the test result.

6.5.15 Melt mass-flow rate

In accordance with the stipulations of GB/T 3682-2000, conduct the test. The test temperature is 190 °C; the test load is 2.16 kg.

7 Inspection Rules

7.1 General Rules

Production inspection is divided into type inspection and exit-factory inspection.

date of production.

8.2 Packaging

After both ends of silicone duct are sealed, fix it on the plate rack; use appropriate packing materials for protection, so as to ensure that no water or other debris would enter during normal transportation and storage. In addition, the packaging shall have the capability of resisting ultraviolet radiation for a short term. Each plate rack shall be accompanied by a rack number and packaging marking. The marking shall have characters or signs, for example, "avoid exposure to the sun" or "keep away from heat". The marking shall comply with the relevant stipulations of GB/T 191.

8.3 Transportation

During transportation, silicone duct shall not be subject to severe collision, friction and heavy pressure. When unloading, a forklift or a crane shall be used. The silicone duct shall not be directly pushed down from the means of transport.

8.4 Storage

8.4.1 The storage site for silicone ducts shall be level and tidy. The storage site shall have an obvious sign of "NO SMOKING". During storage and application, prevent the silicone ducts from being scratched by sharp objects; keep them away from high-temperature heat sources or open flames; the silicone ducts shall not be exposed to the open air in the long term.

8.4.2 The storage period is generally not greater than 18 months.

8.5 Accompanying Documents

8.5.1 Each plate of silicone ducts shall be accompanied by a manufacturing label and a certificate label. A product instruction manual shall also be provided for each batch.

8.5.2 The main content of the manufacturing label includes: product marking, length, date of production, batch No., plate No., serial No. of product standard, and the manufacturer's name and address, etc.

8.5.3 The main content of the certificate label includes: qualification certificate, inspection personnel code and date of inspection, etc.

8.5.4 The product instruction manual shall provide the limit service conditions, construction methods and precautions of the silicone ducts.

Appendix B

(normative)

Test Method for Out-of-roundness

B.1 Scope of Application

This Method is applicable to the determination of out-of-roundness of silicone duct products packaged in the form of plates / coils and silicone ducts cut from the production line.

B.2 Inspection Equipment

Vernier caliper, accurate to ± 0.02 mm.

B.3 Sample

Take a silicone duct sample with a length of 500 mm. Under the standard state, recover it for 24 h. When it is used to determine the out-of-roundness of silicone duct on the production line, the sample shall be taken before the silicone duct lead-out device.

B.4 Result Determination

The out-of-roundness shall not exceed the specified value in the Standard.

B.5 Test Procedure

B.5.1 Continuously and slowly rotate the sample. On a fixed circle in the middle of the sample, use a Vernier caliper to perform a series of outer diameter measurements; measure the maximum outer diameter and minimum outer diameter of the cross section. In this way, measure five cross sections. The interval between each measurement is about 50 mm. Calculate the arithmetic mean value of the maximum outer diameter of the five measurement results to obtain the maximum average outer diameter. Likewise, calculate the arithmetic mean value of the minimum outer diameter of the five measurement results to obtain the minimum average outer diameter.

B.5.2 In accordance with Formula (B.1), calculate the average outer diameter:

$$\text{Average outer diameter} = (\text{maximum average outer diameter} + \text{minimum average outer diameter}) / 2 \dots \dots \dots \text{(B.1)}$$

B.5.3 In accordance with Formula (B.2), calculate the out-of-roundness:

$$\text{Out-of-roundness} = 100 \times (\text{maximum average outer diameter} - \text{minimum average outer diameter}) / \text{average outer diameter} \dots \dots \dots \text{(B.2)}$$

Appendix D

(normative)

Test Method for Dynamic-state Friction Coefficient by Round Drum Method

D.1 Scope of Application

This Method is applicable to the determination of the dynamic-state friction coefficient between the optical (power) cable and the inner surface of the duct when sliding on the inner wall of the silicone duct through the round drum method.

D.2 Inspection Equipment

D.2.1 Round drum: steel round drum with an outer diameter of 760 mm.

D.2.2 Tensile testing machine: electronic universal material testing machine with a recording device.

D.2.3 Special weight: the mass of the weight is 20 kg.

D.2.4 Computer control and data recording software.

D.3 Sample

D.3.1 Test sample: silicone duct with a length of about 4 m.

D.3.2 Test cable: PE-MD sheathed optical (power) cable with a diameter of (15 ± 2) mm and a length of about 6 m.

D.3.3 The inner surface of the silicone duct and the outer surface of the optical (power) cable shall have no defects that would restrict the sliding of the optical (power) cable.

D.4 Test Conditions

Before the test, the test equipment and sample shall be placed at $(23 \pm 2) ^\circ\text{C}$; maintain for 2 h. Conduct the test under the same condition.

D.5 Test Procedures

D.5.1 In accordance with the method shown in Figure D.1, use a U-shaped clamp to fix the silicone duct on the drum. The fixation shall be stable, so as to prevent relative movement of the silicone duct and the drum during the test. The winding angle of the silicone duct along the drum is 450° .

D.5.2 Place the test cable in the silicone duct. The length of the cut cable shall satisfy the maximum stroke of the test.

Appendix E

(normative)

Test Method for Cold Bending Performance

E.1 Scope of Application

This Method is applicable to the determination of the bending resistance of silicone duct at a low temperature.

E.2 Inspection Equipment

Low-temperature device: the temperature can be controlled at $(-20 \pm 2) ^\circ\text{C}$.

Bending test device: steel round roller with radius error not more than 5 mm; the outer surface of the roller has no burrs.

E.3 Sample

Take three silicone ducts (length: 1.5 m) as the sample (when the outer diameter of silicone duct is greater than 40 mm, the length shall be 2.0 m). Before the test, the sample shall be placed at $(-20 \pm 2) ^\circ\text{C}$ and maintain for 2 h.

E.4 Test Procedures

E.4.1 From the low-temperature device, take out one sample. Promptly conduct the bending test in four different directions. For each direction, along the roller, bend 180° ; the bending state is U-shaped.

E.4.2 After the first bend, rotate 180° for the second bend. Then, rotate 90° for the third bend. Then, rotate 180° for the fourth bend. Starting from taking out the sample from the low-temperature device, the time interval for each bending test shall not exceed 20 s; the total time of the four bending tests shall not exceed 40 s.

E.4.3 Take out the other two samples from the low-temperature device. In accordance with the steps of E.4.1 and E.4.2, successively conduct the bending test.

E.5 Result Determination

After undergoing the bending test, if the sample manifests no cracking and obvious stress whitening, it is qualified. When all three samples are qualified, their cold bending performance is qualified.

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