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Halogen Free Low Smoke and Flame-retardant Compounds for Wires and Cables

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Foreword

This Standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This Standard was proposed by China Electrical Equipment Industry Association.

This Standard shall be under the jurisdiction of the National Standardization Technical Committee on Wire and Cable (SAC/TC 213).

The responsible drafting organizations of this Standard: Hengtong Group Suzhou Hengtong Communication Materials Co., Ltd., Shanghai Electric Cable Research Institute.

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Halogen Free Low Smoke and Flame-retardant Compounds for Wires and Cables

1 Application Scope

This Standard specifies the classification, technical requirements, test methods, inspection rules and packaging, marking, transportation and storage of halogen free low smoke and flame-retardant compounds for wires and cables.

This Standard applies to sheath for halogen free low smoke and flame-retardant wires and cables and optical cables, and insulation for halogen free low smoke and flame-retardant wires and cables of rated voltage 3 kV and below.

This Standard applies to halogen free low smoke and flame-retardant compounds for wires and cables, which is made by adding halogen free fire retardants and other performance additives to one or multiple halogen free polymer or copolymer and by mixing, plasticification, granulation.

This Standard applies to thermoplastic and cross-linking type halogen free low smoke fire-retardant compounds for wires and cables.

NOTE For cross-linking products, the specified properties refer to the properties of material after cross linking.

2 Normative References

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

GB/T 1040.3-2006, *Plastics – Determination of Tensile Properties – Part 3: Test Conditions for Films and Sheets*

GB/T 1408.1-2006, *Electrical Strength of Insulating Materials – Test Methods – Part 1: Tests at Power Frequencies*

GB/T 1410-2006, *Methods of Test for Volume Resistivity and Surface Resistivity of Solid Electrical Insulating Materials*

GB/T 2406.2-2009, *Plastics – Determination of Burning Behaviour by Oxygen Index – Part 2: Ambient-temperature Test*

GB/T 2408-2008, *Plastics – Determination of Burning Characteristics – Horizontal*

elastomer compounds for sheath are designated as WDZ-TPU-H70.

EXAMPLE 3 125°C halogen free low smoke fire-retardant cross-linking polyolefin compounds for insulation are designated as WDZ-YJ-J125.

4 Technical Requirements

4.1 Appearance

Halogen free low smoke fire-retardant compounds for wires and cables shall have good plasticization and uniform colour, and shall be cylinder-shaped grains of diameter about 3 mm ~ 4 mm and height 3 mm or of any other shape as agreed on by the supplier and the purchaser.

4.2 Colours

The colours of halogen free low smoke fire-retardant compounds for sheath are black, white, natural colour, grey and so on.

The colours of halogen free low smoke fire-retardant compounds for insulation are black, white, natural colour, red, yellow, blue, green, orange, grey, brown and so on.

Any other colour can be as agreed on by the supplier and the purchaser.

4.3 Properties

4.3.1 The properties of halogen free low smoke fire-retardant thermoplastic polyolefin compounds for insulation and sheath shall be as specified in Table 1.

4.3.2 The properties of halogen free low smoke fire-retardant thermoplastic elastomer compounds for insulation and sheath shall be as specified in Table 2.

4.3.3 The properties of halogen free low smoke fire-retardant cross-linking polyolefin compounds for insulation shall be as specified in Table 3.

4.3.4 The properties of halogen free low smoke fire-retardant cross-linking polyolefin compounds for sheath shall be as specified in Table 4.

sheath, under natural light.

5.2 Specimen preparation

Use the mould pressing method for the preparation of test specimens. Plasticize and extrude cable compound grains; preheat without pressurizing in hydraulic machine for 10 min and then pressurize for 5 min; set the working temperature of plastic mixing mill and hydraulic machine in accordance with the plasticizing characteristics of material to ensure material is fully plasticized but not decomposed; ensure the pressurizing pressure not smaller than 15 MPa; pressurize and cool to room temperature.

When the mould pressing method is not appropriate for the preparation of test specimens for the materials including silane cross-linking or elastomer material, other appropriate methods can be used; or cable compound grains can be directly pressed into sheet, but the working conditions of preparation shall be indicated.

Compounds which can be cross linked need to be cross linked; the cross-linking conditions shall be provided by the manufacturer.

Test specimens shall be smooth and clean, uniform in thickness and free of bubbles.

The thickness of test specimens shall meet the specifications for all test items.

Before an individual test of test specimens prepared, they shall be conditioned at room temperature for 4 h at least.

5.3 Tensile strength and elongation at break

The test for tensile strength and elongation at break shall be as specified in GB/T 1040.3-2006. Test specimens are dumb-bell test pieces of type 5. The thickness is (1.0 ± 0.1) mm and the tensile speed (250 ± 50) mm/min.

Test specimens shall be conditioned for 4 h under the environmental conditions of temperature (23 ± 2)°C and relative humidity 45% ~ 55%.

5.4 Air oven thermal ageing

Use an electric ageing oven with natural ventilation. The number of replacements per hour in the ageing oven is not smaller than 8 and not greater than 20, at the specified test temperature. No fan or blower shall be used in the ageing oven; the air entering into the ageing oven shall flow past the surface of test specimens and then discharged through the top of the ageing oven.

The effective test pieces for the air oven thermal ageing test shall not be less than 5; the test specimens are dumb-bell test pieces of type 5 as specified in GB/T 1040.3-2006; the thickness of test specimens is (1.0 ± 0.1) mm. The thickness of test pieces shall be measured before thermal ageing; the parallel gauge distance for the determination of elongation at break shall be marked after thermal ageing. Test specimens are suspended in the effective working zone in at the centre of the ageing

TS_1—deformation at 100% fixed elongation;

T_2—measured gauge length of test specimens after 100% fixed elongation;

T_1—original gauge length, in mm.

5.6 Thermal deformation

The test for thermal deformation shall be carried out as specified in 6.4 of GB/T 8815-2008; test temperature shall be as specified in Table 1 and Table 2.

5.7 Volume resistivity

The test for volume resistivity shall be carried out as specified in GB/T 1410-2006. The thickness of test pieces is (1.0 ± 0.1) mm and the test voltage 1 000 V.

For the test of volume resistivity at 20°C, test specimens shall be soaked in distilled water at (20 ± 2)°C for 24 h and wiped dry immediately before the test.

For the test of volume resistivity at working temperature, the electrodes used shall be preheated in the oven to test temperature which shall be maintained for more than 1 h. Test specimens shall be kept in the oven at test temperature for 1 h immediately before the test.

5.8 Dielectric strength

The test for dielectric strength shall be carried out at the environmental temperature (20 ± 2)°C as specified in GB/T 1408.1-2006. Use symmetry electrodes: the diameter of electrodes is 25 mm; the radius of the arc on the edge of electrodes is 2.5 mm. The thickness of test pieces is (1.0 ± 0.1) mm; the dielectric constant of electric insulating oil for the test is close to 2.3, which has sufficient dielectric strength. The initial test voltage is 0; the boosting rate is 2 kV/s.

5.9 Thermal impact resistance

The test for thermal impact resistance shall be carried out as specified in Annex A. Test conditions shall be as specified in Table 1 and Table 2.

5.10 Hot set

The test for hot set shall be carried out in accordance with the procedure specified in GB/T 2951.21-2008. The test temperature is (200 ± 3)°C; test specimens are dumb-bell test pieces of type 5 as specified in 1040.3-2006; the thickness of test specimens is (1.0 ± 0.1) mm and the parallel gauge distance 25 mm.

5.11 Impact brittleness temperature

The test for impact brittleness shall be carried out as specified in GB/T 5470-2008. The impact testing machine shall meet the requirements for testing machine of type A. The thickness of test specimens is (2.0 ± 0.1) mm. Under the specified test temperature,

5.19 PH value and conductivity

The test for pH value and conductivity shall be carried out as specified in GB/T 17650.2-1198.

5.20 Toxic hazard of smoke generated by material

The test for toxic hazard of smoke generated by material shall be carried out in accordance with the places and requirements of application. The method specified in Annex A of GB/T 20285-2006 or JB/T 10707-2007 may be used as the test method, which shall be as agreed on by the interested parties. If the method specified in Annex A of JB/T 10707-2007 is used, the toxicity index shall not be greater than 5.

6 Inspection Rules

6.1 Inspection classification

Inspection is classified into ex-factory inspection and type inspection as specified by this Standard.

6.2 Ex-factory inspection

During the ex-factory inspection of each batch of products, the ex-factory inspection is sampling inspection. Each batch of products can only by delivered after they are qualified in the sampling inspection by the inspection department of the manufacturer. The inspection items include:

a) insulation material: tensile strength, elongation at break, volume resistivity at 20°C, oxygen index or vertical burning test, hot set test (only for cross-linking material), deformation at 100% fixed elongation (only for elastomer);

b) sheath material: tensile strength, elongation at break, impact brittleness temperature test, oxygen index or vertical burning test, hot set test (only for cross-linking material), deformation at 100% fixed elongation (only for elastomer).

6.3 Type inspection

Type inspection includes all items specified by the technical requirements. Under any of the following circumstances, type inspection shall be carried out:

a) during the pattern evaluation of a new product or an old product whose production is transferred to another factory;

b) when there is any major change in material or technology which may influence the performance of product, after full production;

c) generally every 6 months during normal production;

Annex A

(Normative)

Thermal Shock Resistance Test Method

A.1 Test apparatus

Metal bar: diameter (6.00 ± 0.05) mm; test bar is equipped with attaching clamp to fix test specimens.

Oven: thermal ageing air oven; the temperature range is room temperature to 200°C and the temperature deviation is ± 3°C.

A.2 Test specimens

Prepare 3 test specimens; each test piece is about 127 mm in length, (6.0 ± 0.1) mm in width and (3.0 ± 0.1) mm in thickness.

A.3 Test procedure

Store test specimens prepared, under the environmental conditions of temperature (23 ± 2)°C and relative humidity 45% ~ 55%, for 4 h at least.

Fix a metal bar of diameter (6.00 ± 0.05) mm at about 12° angle of inclination to the ground level, to make test specimens form a compact, neat arrangement during the process of winding.

Use a fixing clamp to fix one end of test specimens; use a reinforced clamp to fix the other end and hang weights. Rotate the metal bar to wind test specimens around the metal bar compactly (with 6 turns of winding); use a fixing clamp to fix the other end under load; remove weights. The test specimens winding method and winded test specimens are shown in Figure A.1.

NOTE 1 When mounting test specimens, the fixing degree of fixing clamp for test specimens shall be moderate, exactly ensuring test specimens do not loosen. If it is too tight, it may result in cracking in the clamping parts of test specimens.

NOTE 2 The recommended mass of weights is 2 kg.

Place the winded specimen strip and test coupon into a drying oven preheated to a specified temperature and maintain for 1 h; then take the specimen strip and test coupon out of the drying oven and cool to room temperature.

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