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General Rules for Flame Retardant and Fire Resistant Electric Wires and Cables or Optical Fiber Cables

阻燃和耐火电线电缆或光缆通则

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General Rules for Flame Retardant and Fire Resistant Electric Wires and Cables or Optical Fiber Cables

1 Scope

This Standard specifies the code, technical requirements, test methods and acceptance rules for the combustion characteristics of flame-retardant and fire-resistant wires, cables or optical fiber cables, including halogen-free, low-smoke, low-toxicity, flame-retardant and fire-resistant combustion characteristics.

This Standard applies to halogen-containing, halogen-free, low-smoke, low-toxic flame-retardant and fire-resistant wire and cable or optical fiber cable products.

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 document.

GB/T 4208-2017 Degrees of Protection Provided by Enclosure (IP Code)

GB/T 17650.1 Test on Gases Evolved During Combustion of Materials from Cables or Optical Fiber Cables-Part 1: Determination of the Halogen Acid Gas Content

GB/T 17650.2 Test on Gases Evolved During Combustion of Materials from Cables or Optical Fiber Cables - Part 2: Determination of Acidity (by pH Measurement) and Conductivity

GB/T 17651.2 Measurement of Smoke Density of Cables or Optical Fiber Cables Burning under Defined Conditions - Part 2: Test Procedure and Requirements

GB/T 18380.12 Test on Electric and Optical Fiber Cables under Fire Conditions - Part 12: Test for Vertical Flame Propagation for a Single Insulated Wire or Cable - Procedure for 1kW Pre-Mixed Flame

GB/T 18380.13 Tests on Electric and Optical Fiber Cables under Fire Conditions - Part 13: Test for Vertical Flame Propagation for a Single Insulated Wire or Cable - Procedure for Determination of Flaming Droplets/Particles

GB/T 18380.22 Tests on Electric and Optical Fiber Cables under Fire Conditions - Part 22:

Test for Vertical Flame Propagation for a Single Small Insulated Wire or Cable - Procedure for Diffusion Flame

GB/T 18380.33 Tests on Electric and Optical Fiber Cables under Fire Conditions - Part 33: Test for Vertical Flame Spread of Vertically-Mounted Bunched Wires or Cables - Category A

GB/T 18380.34 Tests on Electric and Optical Fiber Cables under Fire Conditions - Part 34: Test for Vertical Flame Spread of Vertically-Mounted Bunched Wires or Cables - Category B

GB/T 18380.35 Tests on Electric and Optical Fiber Cables under Fire Conditions - Part 35: Test for Vertical Flame Spread of Vertically-Mounted Bunched Wires or Cables - Category C

GB/T 18380.36 Tests on Electric and Optical Fibre Cables under Fire Conditions - Part 36: Test for Vertical Flame Spread of Vertically-Mounted Bunched Wires or Cables - Category D

GB/T 19216.21 Tests for Electric Cables under Fire Conditions - Circuit Integrity - Part 21: Procedures and Requirements - Cables of Rated Voltage up to and including 0.6/1.0kv

GB/T 19216.23 Tests for Electric Cables under Fire Conditions - Circuit Integrity - Part 23: Procedures and Requirements - Electric Data Cables

GB/T 19216.25 Tests for Electric Cables under Fire Conditions - Circuit Integrity - Part 25: Procedures and Requirements - Optical Fiber Cables

IEC 60331-1 Tests for Electric Cables under Fire Conditions – Circuit Integrity – Part 1: Test Method for Fire with Shock at a Temperature of at least 830°C for Cables of Rated Voltage up to and including 0.6/1.0kV and with an Overall Diameter Exceeding 20mm

IEC 60331-2 Tests for Electric Cables under Fire Conditions – Circuit Integrity – Part 2: Test Method for Fire with Shock at a Temperature of at least 830°C for Cables of Rated Voltage up to and including 0.6/1.0kV and with an Overall Diameter not Exceeding 20mm

IEC 60684-2:2011 Flexible Insulting Sleeving – Part 2: Methods of Test

IEC 60754-3 Test on Gases Evolved during Combustion of Materials from Cables – Part 3: Measurement of Low Level of Halogen Content by Ion Chromatography

3 Terms and Definitions

For the purposes of this Document, the following terms and definitions apply.

3.1 Flame retardance

The characteristics that, when the sample is burned under specified conditions, the spread of flame on the sample is only within a limited range after the ignition source is removed, and it has the capability of preventing or delaying the occurrence or spread of flame.

3.2 Fire resistance

The characteristic that a specimen can continue to operate under specified conditions when it is burned under specified ignition source and time.

3.3 Halogen free

The characteristic that the halogen (fluorine, chlorine, bromine, iodine) content of the gas released during combustion is all less than or equal to 1.0 mg/g.

3.4 Low smoke

The characteristic that the concentration of smoke produced by burning does not reduce visibility (light transmittance) to the extent that it affects escape.

3.5 Low toxicity

The characteristic that the toxic effect and concentration of the toxic fumes produced during combustion shall not cause the living organisms to die within 30min.

4 General

The combustion characteristics of flame-retardant and fire-resistant wire and cable or optical fiber cable products shall comply with the requirements of this Standard; and other properties other than combustion characteristics shall comply with the requirements of the corresponding product standards.

Wire and cable or optical fiber cable products may reduce their original basic characteristics while achieving their flame retardance and/or fire resistance purposes, or cause some original test methods to be inapplicable. All parties using this Standard shall discuss or negotiate a suitable solution to ensure that the wire and cable or optical fiber cable products achieve the purpose of flame retardance and/or fire resistance while ensuring safety and reliability during use. On the premise of without reducing the safety and reliability during use, the corresponding technical indicators or test methods can be adjusted appropriately.

5 Product Model

5.1 Code and combination of combustion characteristics

5.1.1 Code of combustion characteristics

Halogen-free, low-smoke, flame-retardant wire and cable or optical fiber cable sheathing and / or insulation can select halogen-free, low-smoke, flame-retardant materials; and the performance shall be in line with the requirements of relevant product standards. Filling, wrapping or flame-retardant reinforcement layer and other auxiliary materials shall be selected appropriately, so that the product meets the requirements of the corresponding flame retardant category.

The non-metallic materials used by the halogen-free, low-smoke, flame-retardant wire and cable or optical fiber cable shall meet the requirements of halogen-free performance. The acidity and electrical conductivity of the released gas, halogen acid gas release or the halogen content during the combustion of the non-metallic materials shall meet the requirements of 6.3; the smoke density (minimum transmittance) of the finished products shall meet the requirements of 6.4.

7.1.3 Halogen-free, low-smoke, low-toxicity flame-retardant wire and cable or optical fiber cable

The non-metallic materials used by the halogen-free, low smoke and low toxicity flame-retardant wire and cable or optical fiber cable shall have very little halogen content; the combustion products are of lower corrosion and toxicity; the combustion products have lower smoke (higher transmittance). It can be divided into the following categories according to the flame-retardant characteristics:

--- halogen-free, low smoke, low toxicity, single-piece flame-retardant WDUZ, the single-piece flame retardance shall meet the requirements of 6.1.1;

--- Halogen-free, low smoke, low toxicity, bunched flame-retardant WDUZA, WDUZB, WDUZC, WDUZD, the bunched flame-retardance shall meet the requirements of 6.1.2.

Halogen-free, low smoke, low toxicity flame-retardant wire and cable or optical fiber cable sheathing and / or insulation can select halogen-free, low smoke, low toxicity flame-retardant materials; the performance shall meet the requirements of the relevant product standards. Filling, wrapping or flame-retardant reinforcement layer and other auxiliary materials shall be properly selected to make the product meet the requirements of the corresponding flame-retardant category.

The non-metallic materials used by the halogen-free, low smoke, low toxicity flame-retardant wire and cable or optical fiber cable shall meet the requirements of halogen-free and low toxicity; the acidity and electrical conductivity of the released gas, halogen acid gas release or halogen content during the combustion of the non-metallic materials shall meet the requirements of 6.3; the toxicity indicator shall meet the requirements of 6.5; the smoke density (minimum transmittance) of the finished products shall meet the requirements of 6.4.

7.2 Fire-resistant wire and cable or optical fiber cable series

The cable at the rated voltage of 0.6/1kV and below shall use the copper conductors; the

insulation shall have fire-resistant characteristics; otherwise, the conductor and / or cable core shall be set with fire-resistant layer. Data cables shall be set up on the cable core of the fire-resistant layer. The commonly-used refractory layer shall be wrapped by the refractory mica tape; its thickness, the number of layers, and erect rate of winding, and other parameters shall be determined by the manufacturer according to the manufacturing process, product rated voltage and mica tape characteristics and other factors. The refractory layer is allowed to be set on the enhancement layer. The fire resistance of finished wire and cable shall meet the requirements of 6.2.

Fire-resistant optical fiber cable shall meet the requirements of fire resistance of the optical fiber cable in 6.2.

Fire-resistant wire and cable or optical fiber cable products shall be flame retardant; and the flame retardance shall meet the corresponding requirements of 6.1. Halogen-free, low smoke products shall also meet the requirements of 6.3 and 6.4. Halogen-free, low smoke, low toxicity products shall also meet the requirements of 6.3, 6.4 and 6.5.

The refractory layer of fire-resistant wire and cable or optical fiber cable shall lead to an increase in external dimensions; the assessment indicators of external size shall be corrected in accordance with the requirements of Clause 4.

8 Acceptance Rules

8.1 The basic performance of the flame-retardant and fire-resistant wire and cable or optical fiber cable products shall meet the requirements of the relevant product standards. When the product standard does not specify the flame resistance, fire resistance, halogen-free performance, low smoke performance and low toxicity performance indicators, then the provisions of this standard shall be met.

8.2 The combustion performance requirements specified in this Standard include flame retardance (see 6.1), fire resistance (see 6.2), halogen-free performance (see 6.3), low smoke performance (see 6.4) and low toxicity performance (see 6.5), which are the type test items.

8.3 The security requirements of flame-retardant and fire-resistant wire and cable or optical fiber cable are higher. Given the actual situation of wire and cable or optical fiber cable materials often changes, the manufacturers shall conduct strict quality control; establish the appropriate intermediate quality control means; develop the appropriate combustion performance sampling test cycle; so as to ensure product quality. When the supplier and the purchaser accept the products, they shall determine a reasonable sampling program, if necessary, the corresponding combustion performance sampling test shall be carried out.

Appendix C

(Normative)

Toxicity Indicator Test Method

C.1 General

Toxicity indicator test is applicable to non-metallic materials taken from halogen-free, low smoke, low toxicity wire and cable or optical fiber cable. When appropriate, the non-metallic raw materials of halogen-free, low smoke, and low toxicity wire and cable or optical fiber cable are applicable.

Low toxicity materials shall meet the requirements of halogen-free performance. Preliminary qualitative analysis can be performed to determine if nitrogen and sulfur are present. If confirmed the presence of nitrogen and sulfur, then take the subsequent quantitative analysis on SO_2, NO_x and HCN. If confirmed that there is no nitrogen and sulfur, then do not take the subsequent quantitative analysis on SO_2, NO_x and HCN.

C.2 Take the qualitative analysis on nitrogen and sulfur by using molten sodium

C.2.1 Preparation of test solutions

Warnings -- The operator shall take precautions to avoid jetting and bursting, shattering of the test tube, and dissolution of soluble material.

Put about 0.1g of the test sample cut into fine particles together with a grain of sodium metal into a test tube; heat until red; and then put the test tube into a beaker with 10 mL of water for cooling. The formed product shall be filtered to obtain a clean solution and divided into two equal portions.

C.2.2 Determination

C.2.2.1 Determination of nitrogen

In one of the above original solutions, add a small amount of 10% concentration of ferrous sulfide solution. If the sulfur is present, then form the black iron sulfide. If there is no sulfur, then form the dark green ferrous hydroxide. Boil the formed product; add a small amount of ferric chloride solution; drop the hydrochloric acid to make it acidification; if there is the blue ferrous cyanide mixture formed, which indicates the presence of nitrogen.

C.2.2.2 Determination of sulfur

Add a few drops of sodium nitrate solution with a concentration of about 1% to another above original solution, if it appears a dark purple color, which indicates the presence of sulfur.

NOTE: The detection limit of this method is 0.1%.

C.3 Quantitative analysis (discontinuity analysis method)

C.3.1 Principle of the method

Put the material specimen into a test tube; and a stream of air is passed the test tube over the specimen to maintain its combustion; and then analyze the released material.

NOTE: Because the continuity analysis method cannot analyze the nitrogen oxides, only the discontinuity analysis method is specified here.

C.3.2 Test apparatus

The test apparatus (see Figure C.1), including the air bag with volume of 40 dm^3.

C.3.3 Specimen and pretreatment

Take approximately 1g of specimen from the relevant wire and cable or optical fiber cable insulation or sheathing (or other non-metallic materials need to be tested). The specimen shall be placed for at least 48h at (23±2) °C and a relative humidity of (50±5) %.

C.3.4 Combustion process

Warnings – The operators shall take precautions, such as wearing goggles and appropriate protective clothing; because some materials burn rapidly and can cause "backflow" of hot gases. Care shall also be taken to avoid over-pressurization of the system and to use appropriate measures to vent exhaust gases.

Place the specimen in a pre-weighed combustion boat, accurate sample mass to 0.001 g. The tube furnace is operated at (800±10) °C. When starting the test, start the compressed air blower; immediately put the combustion boat and the specimen into the central part of the combustion tube; and use the temperature detector to monitor the temperature during the whole test.

The air flow was adjusted by a needle valve to ensure a flowrate of approximately 33 cm^3/s; and continuous bubble generation was observed in the gas wash bottle.

The high temperature pyrolysis or combustion lasts for 20 min and the gases emitted from the combustion tube are purified by a filter. Then then the categories of gas produced by the combustion of the material is analyzed by using a specific method.

Even if the combustion or high temperature pyrolysis is not finished, the combustion boat shall be taken out of the combustion tube. Use 40 dm^3 of air to drive out the released gases. At the end of the test, use 80 dm^3 of air to remove the released gases from the combustion tube.

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