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# GB/T 19666-2005

# Flame retardant and fire resistant wires and cables

阻燃和耐火电线电缆通则



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# Foreword

Flame retardant and fire resistant wires and cables, including halogen, halogen-free, low smoke and other products, have been produced and used in China for more than ten years, and play an important role in fire safety. However, as there is no international standard nor national standard, therefore, there is no unified product names, models, technical requirements, test methods, etc.; and some are even inconsistent with international requirements. This Standard is developed so as to unify the domestic production and application, and meet the needs of international trade and exchange on economy and technology.

Considering that the flame retardance, fire resistance and other requirements cover almost all of wire and cable products, it generally does not need to change the structure of wire or cable but the materials used to achieve this objective. Therefore, it does not develop product standards one by one. Instead, this General Rule is made to specify the requirements on flame retardance, fire resistance and other combustion characteristics which are different from the existing ordinary product standards. It recommends the flame retardant and fire resistant materials that may be adopted. And relevant marks are added in front of the common product model, so as to distinguish it from ordinary products.

In this Standard, all test methods and performance requirements on halogen-free, low smoke, flame retardant and fire resistant characteristics use the following latest international standards:

IEC 60331:1999 Circuit integrity test of cable or optical cable under flame conditions

IEC 60332:2000 Burning test of cable or optical cable under flame conditions

IEC 60754:1997 Test methods for the release of gases in the burning of the materials from cable or optical cable

IEC 61034:1997 Measurement of burning smoke density of cable or optical cable under specified conditions

This General Rule shall be used as product standard. For the compilation of individual-series product standard, the relevant content must comply with the provisions of this General Rule.

In this Standard, Annex A, Annex B and Annex C are informative.

# Flame retardant and fire resistant wires and cables

## 1 Scope

This Standard specifies the models, technical requirements, test methods and acceptance criteria for flame retardant and fire resistant wires and cables, including halogen-containing, halogen free, low smoke and other characteristics. This Standard applies to the halogen, halogen free and low smoke flame retardant and fire resistant wires and cables.

## 2 Normative References

The following standards contain the provisions which, through reference in this Standard, constitute the provisions of this Standard. For dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard. However, the parties who enter into agreement based on this Standard are encouraged to investigate whether the latest versions of these documents are applicable. For undated reference documents, the latest versions apply to this Standard.

GB/T 17650.2-1998 Test on gases evolved during combustion of materials from cables - Part 2: Determination of degree of acidity of gases by measuring pH and conductivity (idt IEC 60754-2:1991)

GB/T 17651.2-1998 Measurement of smoke density of cables burning under defined conditions - Part 2: Test procedure and requirements (idt IEC61034-2:1997)

GB/T 18380.1-2001 Tests on electric cables under fire conditions - Part 1: Test on a single vertical insulated wire or cable (idt IEC 60332-1:1993)

GB/T 18380.2-2001 Tests on electric cables under fire conditions - Part 2: Test on a single small vertical insulated copper wire or cable (idt IEC 60332-2:1989)

GB/T 18380.3-2001 Tests on electric cables under fire conditions - Part 3: Tests on bunched wires or cables (idt IEC60332-3:1992)

GB/T 19216.21-2003 Tests for electric cables under fire conditions - Circuit integrity - Part 21: Procedures and requirements - Cable of rated voltage up to and including 0.6/1.0 kV (idt IEC 60331-21:1999)

GB/T 19216.23-2003 Tests for electric cables under fire conditions - Circuit integrity - Part 23: Procedures and requirements - Electric data cables (idt IEC 60331-23:1999)

IEC 60332-3-25:2000 Tests on electric cables under fire conditions - Part 25: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category D

# 3 Terms and definitions

## 3.1 Flame retardance

It refers to the characteristics of flame spreading above the sample only in limited range and extinguishing by itself when the sample is burned and fire source is removed under specified test conditions, i.e. the ability to prevent or delay occurrence or spreading of flame.

## 3.2 Fire resistance

The ability to continuously run under a specified condition when burning under the prescribed fire and at prescribed time, i.e. the ability to maintain the integrity of the circuit.

## 3.3 Halogen free

Not containing halogen, the corrosivity of combustion products is weak.

## 3.4 Low smoke

It produces less smoke when it is burning, namely, the light transmittance (visibility) is higher.

# 4 Type

## 4.1 Composition of types

The model of flame retardant and fire resistant wire and cable is composed of the product combustion characteristics code and the relevant wire and cable model, as shown in Figure 1.

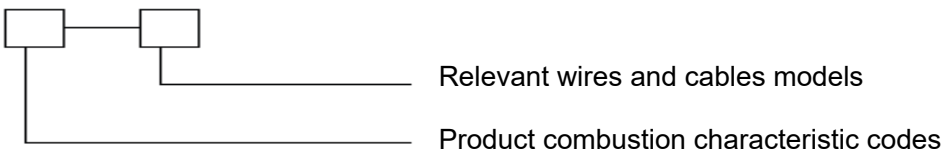


**Figure 1 Model composition of flame retardant and fire resistant wires and cables**

Y - Polyethylene or polyolefin insulation or sheath;

YJ - Cross-linked polyethylene or cross-linked polyolefin insulation or sheath;

3 - Polyethylene or polyolefin external sheath;

4 - Cross-linked polyethylene or flexible external sheath;

6 - Non-magnetic metal band armored;

7 - Non-magnetic metal wire armored;

**4.4 Product representation method**

The product is represented by "Model, specification and standard number / relevant product standard number". Refer to Annex A for the relevant product standards.

Example 1: Polyvinyl chloride insulated polyvinyl chloride sheath Category A flame retardance power cable is:

ZA-W Specification (omitted) GB/T 19666-2005/GB/T 12706.1-2002

Example 2: Cross linked polyethylene insulated polyvinyl chloride sheath Category B flame retardance power cable is:

ZB-YJV Specification (omitted) GB/T 19666-2005/GB/T 12706.1-2002

Example 3: Cross linked polyethylene insulated polyvinyl chloride sheath Category C flame retardance power cable is:

ZCN-YJV Specification (omitted) GB/T 19666-2005/GB/T 12706.1-2002

Example 4: Cross-linked polyethylene insulated polyolefin sheath halogen free low smoke Category B flame retardance power cable is:

WDZB-YJY Specification (omitted) GB/T 19666-2005/GB/T 12706.1-2002

Example 5: Polyvinyl chloride insulated Category D flame retardance wires for fixed wiring is:

ZD-BV Specification (omitted) GB/T 19666-2005/GB 5023.3-1997

**Table 4 Group flame retardance performance requirements**

| Code | Volume of non-metallic material of sample (L/m) | Fire provision time s | Qualification standard | Test methods |
|---|---|---|---|---|
| ZA | 7 | 40 | 1) Charring length on the sample shall not exceed 2.5m from the bottom of the nozzle;<br>2) After the fire is stopped, flaming time for sample shall not exceed 1h. | GB/T 18380.3<br>IEC 60332-3-25 |
| ZB | 3.5 | 40 | | |
| ZC | 1.5 | 20 | | |
| ZD[a] | 0.5 | 20 | | |
| [a] ZD applies to wires and cables of which the outside diameter of sample is not more than 12mm. | | | | |

## 5.2 Fire resistance performance requirements

Fire resistance performance must comply with the requirements in Table 5.

**Table 5 Fire resistance performance requirements**

| Code | Application scope | Fire-supplying time + cooling time /min | Test voltage /V | Qualification standard | Test methods |
|---|---|---|---|---|---|
| N | 0.6/1kV-and-below cable | 90+15 | Rated value | 1) 2A fuse does not burn;<br>2) LEDs do not turn off | GB/T 19216.21 |
| | Data cable | 90+15 | Relevant to earth: 110±10 | 1) 2A fuse does not burn;<br>2) LEDs do not turn off | GB/T 19216.23 |
| Notes: supplying temperature is $750^{+50}_{0}$ ℃. | | | | | |

## 5.3 Halogen free performance requirements

Halogen free performance must comply with the requirements in Table 6.

**Table 6 Halogen free performance requirements**

| Code | Halogen free (low corrosive) | | Test methods |
|---|---|---|---|
| | PH weighted value | The weighted value of conductivity/μs/mm | |
| W | ≥4.3 | ≤10 | GB/T 17650.2 |

## 5.4 Low smoke performance requirements

Low smoke performance must comply with the requirements in Table 7.

Single piece flame retardance Z: its flame retardance performance shall be consistent with the provisions of 5.1.1 in this Standard.

The group flame retardance ZA, ZB, ZC, ZD: its group flame retardance performance shall be consistent with the provisions of 5.1.2 in this Standard.

The product sheath and/or insulation can use halogen free and low smoke flame retardant materials, such as halogen free and low smoke flame retardant polyethylene or polyolefin WJ1, WJ2, WH1, WH2 described in Annex b. It can select the appropriate auxiliary materials for filling, wrapping, taping or preventing the flame of enhancement layer so that products can meet the appropriate fire-retardant levels. Under normal circumstances, the sheath can be the thermoplastic halogen free low smoke flame retardance sheath WH2. If oil-proof is required, the thermosetting halogen free low smoke flame retardance sheath WH2 can be adopted.

The materials used for this product shall be free of halogen, that is, the measured pH weighted value and conductivity weighted value shall be consistent with the provisions of 5.3 in the Standard. And the smoke density measured for finished products (minimum light transmittance) shall comply with the provisions in 5.4 of this Standard.

**6.4** Fire resistant wires and cables series

The wire and cable for this product must be made of copper conductor; the rated voltage shall be 0.6/1kV and below (higher voltage level is under consideration); its insulation shall have fire resistant characteristics, or on the conductors and/or cable cores, the fire resistant layer shall be set. Common fire resistant layer shall be wrapped by fire resistant mica tapes; its thickness, number of layers and wrapped cover rate shall be designed and determined by the manufacturer. Provisions in Annex C of this Standard can be used as reference for performance of fire resistance mica tape. If the fire resistant layer is between the conductor and the insulation, the thickness of the insulating layer is allowed to be thinned, but the thickness after thinning shall not be less than 80% of the original standard thickness. Setting enhancement layer on fire resistance layer is allowed. Fire resistance performance (i.e. circuit integrity) of the finished products shall comply with the provisions in 5.2 of this Standard.

Flame retardance performance of this series of product must comply with the provisions in 5.1 of this Standard. Halogen free low smoke products shall also comply with 5.3 and 5.4 of this Standard.

Note: Setting refractory layer often leads to increase in wire and cable size, the demand party can not use this reason for rejection of acceptance.

# Annex A

## (Informative)

## Example of relevant wire and cable products

GB/T 12706-2002 Rated voltage 1kV (Um=1.2kV) to 35kV (Um=40.5kV) extruded insulation power cables and accessories

GB 9330-1988 Plastic insulated control cables

GB 5023-1997 PVC insulated power cables with the rated voltage of 450/750V and below

GB/T 13849-1993 Indoor communication cable with polyolefin insulation olefin sheath

| | | | | | |
|---|---|---|---|---|---|
| 8 Physical and mechanical properties after immersion oil | | | | | GB/T 2951.5 |
| Test temperature, °C | - | - | - | 100±2 | |
| Duration time, h | - | - | - | 24 | |
| 8.1 Maximum change rate of tensile strength, % | - | - | - | ±40 | |
| 8.2 Maximum change rate of elongation at break, % | - | - | - | ±40 | |
| 9 Low temperature test | | | | | GB/T 2951.4 |
| 9.1 Cold bending (diameter is less than 12.5mm) | | | | | |
| Test temperature, °C | -15±2 | -15±2 | - | - | |
| 9.2 Low-temperature tensile test (dumbbell test piece) | | | | | |
| Test temperature, °C | -15±2 | -15±2 | - | - | |
| 9.3 Low-temperature impact | | | | | |
| Test temperature, °C | - | - | -15±2 | -15±2 | |
| 10 Corrosiveness (halogen free) | | | | | GB/T 17650.2 |
| 10.1 PH value, the minimum | 4.3 | 4.3 | 4.3 | 4.3 | |
| 10.2 Conductivity, the maximum, μS/mm | 10 | 10 | 10 | 10 | |

Note 1: Insulation use conditions: Rated voltage is not more than 0.6/1kV, the maximum operating temperature of thermoplasticity for conductor: 70°C, thermoset is 90°C; Sheath use conditions: Rated voltage is not limited; the maximum working temperature of conductor is 90°C.

Note 2: For substrate for flame-retardant materials such as non-polyethylene or polyolefin, when using ethylene propylene rubber, silicone rubber, etc., the performance of its insulation and sheath can refer to the insulation and sheathing requirements in relevant product standards.

Note 3: GB/2951-1997 Common test methods for cable insulation and sheathing materials

| | | |
|---|---|---|
| 10 Coil<br>Diameter of pipeline, mm<br>Thickness of pipe wall, mm<br>Disk diameter, mm<br>Number of joints | 50±2 or 76±2<br>≤5<br>200±5, 250±5, 300±5<br>Number of joints per coil is no more than two | Use ruler of which the precision is 0.5mm to measure. |
| 11 Storage period | Storage period is six months under room temperature from the date of delivery | |

1) Code meaning: M (Muskovit) - muscovite; P(Phlogopit) - Phlogopite; S (Synthetic mica) - Synthetic mica (such as fluorphlogopite); G (Glass cloth) - Glass fabric; F (Film) - Thin film (such as polyester film).
2) Allows using other quantitative woven glass fabric or films with other thicknesses as the reinforcing layer.
3) GB/T 5019-1985 mica products for electrical insulation methods of test (neq IEC 60317-2:1973).
4) Electrical properties at high temperatures is tested by the following test methods:
On the copper wire of which the diameter is 1.6mm, use fire-resistant mica tape of which the thickness is 0.11mm and the width is 10mm (or the thickness and width provided for test) to wrap it in two layers with 50% overlapping, then twist two pitches which are not more than 100mm together as a sample. Insert it into a tubular furnace of which the insertion length is not less than 300mm. Make it suspended and not contact with the pipe wall. Central temperature of tubular furnace shall be ±10°C of the specified temperature; till it reaches to 90min, use (500-1000)V megger to measure the insulation resistance between the two cores, and apply 1kV of frequency voltage for 1min.

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