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Chemical Industry Standard of the People's Republic  
of China

HG/T 5225-2017

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**Modified material of antistatic and  
halogen-free flame retardant  
ultra-high molecular weight  
polyethylene for pipe lining**

**抗静电无卤阻燃超高分子量聚乙烯管材  
衬里专用料**

*(English Translation)*

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## Foreword

SAC/TC 162 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

This standard was drafted in accordance with GB/T 1.1-2009.

This standard was proposed by China Petroleum and Chemical Industry Federation.

This standard is under the jurisdiction of Technical Committee 162 on Non-Metal Chemical Equipment of Standardization Administration of China.

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# Modified material of antistatic and halogen-free flame retardant ultra-high molecular weight polyethylene for pipe lining

## 1 Scope

This standard specifies the classification and marking, requirements, test methods, inspection rules, sign, packaging, transport and storage of modified material of antistatic and halogen-free flame retardant ultra-high molecular weight polyethylene (PE-UHMW) for pipe lining.

This standard is applicable to areas such as the chemical industry, mines or other industrial and mining environment in water supply and drainage, pressure air, spray, gas emissions and wear resistant roller where the modified material of antistatic and halogen-free flame retardant ultra-high molecular weight polyethylene (PE-UHMW) for pipe lining is used.

## 2 Normative References

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

GB/T 1033.1, *Plastics -- Methods for determining density of non-cellular plastics*

— Part 1: Immersion method, liquid pycnometer method and titration method

GB/T 1632.3, *Plastics -- Determination of the viscosity of polymers in dilute solution using capillary viscometer -- Part 3: Polyethylenes and polypropylenes*

GB/T 2547, *Plastic resins -- Sampling*

GB/T 2918, *Plastics -- Standard atmospheres for conditioning and testing*

GB/T 6283, *Chemical products -- Determination of water Karl. fischer method (general method)*

GB/T 8170, *Rules of rounding off for numerical values & expression and judgement of limiting values*

GB/T 8804.3, *Thermoplastic pipes -- Determination of tensile properties -- Part 3: Polyolefin pipes*

GB/T 21461.2, *Plastics -- Ultra-high-molecular-weight polyethylene (PE-UHMW) moulding and extrusion materials -- Part 2: Preparation of test specimens and determination of properties*

GB/T 32679, *Ultra-high-molecular-weight polyethylene (PE-UHMW) resin*

MT 181, *Code for inspection of safety performance of plastic pipes used in underground coal mines*

ISO 2818, *Plastics — Preparation of test specimens by machining*

EN 14582:2016, *Characterization of waste - Halogen and sulfur content - Oxygen combustion in closed systems and determination methods*

### 3 Classification and marking

#### 3.1 Classification

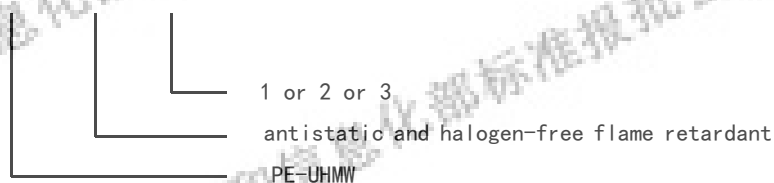
The modified material can be classified as type 1, type 2 and type 3 by its viscosity average molecular weight, given in Table 1.

Table 1 The classification of the products

Items	Type		
	1	2	3
viscosity average molecular weight / $(\times 10^4 \text{ g/mol})$	$\geq 100$ , and $< 150$	$\geq 150$ , and $< 250$	$\geq 250$

#### 3.2 Marking

PE-UHMW - MT - □



For example, PE-UHMW-MT-1 represents the modified material of antistatic and halogen-free flame retardant ultra-high molecular weight polyethylene (PE-UHMW) for pipe lining, whose viscosity average molecular weight is greater than or equal to  $100 \times 10^4 \text{ g/mol}$ , and less than  $150 \times 10^4 \text{ g/mol}$ .

### 4 Requirements

#### 4.1 Appearance

The modified material is black powder with no visible mechanical impurities or foreign matter.

#### 4.2 Technical specification

The technique specification are shown in Table 2.

Table 2 Technical specification

No.	Items		Type		
			1	2	3
1	Index of abrasion		≤ 220	≤ 190	≤ 150
2	Yield strength /MPa		≥ 16	≥ 17	≥ 19
3	Tensile strength /MPa		≥ 20	≥ 22	≥ 24
4	Elongation at break /%		≥ 300		
5	Charpy double-notched impact strength / (kJ/m <sup>2</sup> )		≥ 50		
6	Density / (g/cm <sup>3</sup> )		1.02 ~ 1.06		
7	The surface resistance (10 <sup>6</sup> )/Ω		≤ 1.0		
8	Fire-resistant performance by alcohol blowtorch	Average flame-burning time /s	≤ 3.0		
		Maximum flame-burning time /s	≤ 6.0		
		Average flameless burning time /s	≤ 3.0		
		Maximum flameless burning time /s	≤ 6.0		
9	Water content /%		≤ 0.5		
10	Halogen content /mass fraction (×10 <sup>-4</sup> )	Fluorine (F)	< 50		
		Chlorine (Cl)	< 50		
		Bromine (Br)	< 50		
		Iodine (I)	< 50		

## 5 Test methods

### 5.1 Preparation of test specimens

The test specimens for performance determination except the viscosity average molecular weight test shall be machined from extruded pipes, in accordance with ISO 2818. The diameter of the pipe shall be no less than 50 mm, and the wall thickness of the sample pipe used for type inspection shall be no less than 10 mm.

### 5.2 Condition and testing environment

Test specimens shall be conditioned in accordance with GB/T 2918 for at least 40 h at 23 °C ± 2 °C and 50 % ± 10 % relative humidity.

Testing shall be carried out in a standard atmosphere of 23 °C ± 2 °C and 50 % ± 10 % relative humidity in accordance with GB/T 2918.

### 5.3 Appearance

Appearance shall be checked by visual inspection.

### 5.4 Viscosity average molecular weight

The viscosity average molecular weight shall be determined using 0.000 2 g/mL concentration in accordance with GB/T 1632.3. When dissolving, it shall be shaken in one direction (clockwise or counterclockwise) every 4 to 5 minutes with hands until the sample is completely dissolved.

Adding a mass fraction of  $2 \times 10^{-3}$  antioxidant 4 [methylene 3-(3', 5' -di-tert-butyl-4'

-hydroxyphenyl) n-propyl] methane can prevent the oxidation of polymer solution during the test.

Calculate the viscosity average molecular weight using Formula (1);

$$\overline{M}_\eta = 5.37 \times 10^4 \times [\eta]^{1.49} \dots\dots\dots (1)$$

where

$\overline{M}_\eta$  —The viscosity average molecular weight, in gram per mole (g/mol);

$[\eta]$  —The characteristic viscosity, in litres per gram (dL/g), and it shall be calculated using Formula (2) ~ (4).

$$[\eta] = \frac{(2\eta_{sp} - 2 \ln \eta_{rel})^{1/2}}{c} \dots\dots\dots (2)$$

$$\eta_{sp} = \eta_{rel} - 1 \dots\dots\dots (3)$$

$$\eta_{rel} = \frac{t}{t_0} \dots\dots\dots (4)$$

where

$\eta_{rel}$  —Relative viscosity, dimensionless, whose value shall between 1.2 and 2.0;

$\eta_{sp}$  —Relative viscosity increment, dimensionless;

$c$  —Solution concentration at 135 °C, in gram per deciliter (g/dL).

$t$  —The outflow time of the solution at 135 °C, in second (s);

$t_0$  —The outflow time of the solvent at 135 °C, in second (s).

## 5.5 Index of abrasion

The index of abrasion shall be determined in accordance with GB/T 32679.

## 5.6 Yield strength, tensile strength and elongation at break

The yield strength, tensile strength and elongation at break shall be determined in accordance with GB/T 8804.3. And the condition and testing environment shall be carried out according to 5.2.

## 5.7 Charpy double-notched impact strength

A double-notching device shall be used to prepare the test specimens in accordance with GB/T 21461.2. And the condition and testing environment shall be carried out according to 5.2.

## 5.8 Density

The density shall be determined using impregnation method in accordance with GB/T 1033.1. And the condition and testing environment shall be carried out according to 5.2.

## 5.9 Surface resistance

The surface resistance shall be determined in accordance with MT 181.

## 5.10 Fire-resistant performance by alcohol blowtorch

The fire-resistant performance by alcohol blowtorch shall be determined in accordance with MT 181.

#### 5.11 Moisture content

The moisture content shall be determined in accordance with GB/T 6283.

#### 5.12 Halogen content

The halogen content shall be determined in accordance with EN 14582:2016.

### 6 Inspection rules

#### 6.1 Inspection type and the items

There are two types of inspection: type inspection and ex-factory inspection.

Type inspection including all items in Chapter 4.

Ex-factory inspection including appearance, yield strength, tensile strength, elongation at break, surface resistance, and fire-resistant performance by alcohol blowtorch.

Type inspection shall be conducted under one of the following circumstances:

- A) When the new product is trial-produced and finalized for identification;
- B) When raw materials or processes has been changed in production, which may affect the product performance;
- C) When the production unit has been repaired and resumed;
- D) When there is a big difference between the ex-factory inspection result and the last type inspection result.

#### 6.2 Batch rules and sampling plan

##### 6.2.1 Batch rules

The products produced from the same production line, made of the same model and brand, the same raw materials and the same process could be grouped as a batch. Accordance to this principle, the manufacturer may also grouped the products produced within a certain production period or the products stored in the same storage bin unit as a batch. So as the packaged products. The quality of products from the same group batch shall not be greater than 10 t.

The same batch of products received by the user shall be grouped as a batch, whose quality shall not be greater than 10 t, and the products shall be inspected and accepted within 14 days after receipt.

Products shall be inspected and accepted in batches.

##### 6.2.2 Sampling plan

Samples can be taken from the sampling mouth of the mixing bin or from the packaged product according to the actual situation such as the production cycle. Samples of the packaged products shall be taken in accordance with GB/T 2547.

The sampling inspection scheme for items 5.5 to 5.10 shall be done as follows: 2 packages shall be randomly selected from each batch or each 1 t product, and products shall be taken from each package 3 kg at least, (which would float according to actual pipe production equipment), the 6 kg products shall be fully mixed and made into pipes, and samples are prepared according to requirements of 5.1 for testing.

5.11 and 5.12 sampling inspection schemes are as follows: 50 g is randomly selected from each batch or 1 t product for inspection.

### 6.3 Judge and recheck

#### 6.3.1 Judge

The ex-factory products shall be inspected by the quality inspection department of the factory according to the test methods stipulated in Chapter 5.

Items in 5.5 to 5.10 shall be based on the test results specified in the respective test methods, the items in 5.11 shall be based on the arithmetic mean value of the two test results, and the items in 5.12 shall be based on the single test result.

According to the test results and technical targets (shown in Table 2), modification and determination shall be made according to GB/T 8170.

Each batch of ex-factory products shall be accompanied with the product quality certificate, indicating the product name, brand number, batch number, implementation standard, quality targets and inspection conclusion, and affixed with a special quality inspection seal and a inspector seal.

#### 6.3.2 Recheck

If the test results of an indicator do not meet the qualifications in Table 2, the item shall be rechecked by taking double sampling units from the same batch, and the recheck results shall be taken as the quality judgment of the products for the batch.

For other batches of products in the same batch, each batch shall be independently inspected, and the inspection result is only for this production batch.

## 7 Sign, packaging, transport and storage

### 7.1 Sign

There shall be a clear and firm sign on the outer packing bag of the product. The sign shall include: trademark, enterprise name and address, the standard number, product name, model, production date, batch number and net content.

### 7.2 Packing



The products shall be packaged by polypropylene woven bags lined with polyethylene film bags or other packaging materials. Packing products shall not contaminate and leak in transportation, storage and stacking. The packing specification of the product is  $25\text{ kg}\pm 0.25\text{ kg}$ , and the average net content of each batch shall not be less than 25.0 kg per bag.

### 7.3 Transport

This product is a non-hazardous chemical. Sharp tools such as iron hooks shall not be used and the product shall not be thrown during transport and handling.

The means of transport shall keep clean, dry and equipped with van or tarpaulin.

The transportation shall neither be mixed with articles with angular or easy to cause damage nor sand, coal or other articles easy to cause pollution, nor articles toxic and corrosive or inflammable.

Exposure to sunlight or rain shall be avoid during the transportation of products.

### 7.4 Storage

The products shall be stored in a ventilated, dry and clean warehouse with fine fire protection facilities. It shall be prevented from heat sources and direct sunlight, and it is strictly forbidden to pile up in the air when in storage when it is kept in storage.