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Aluminum and aluminum alloy non-stick cookware

铝及铝合金不粘锅

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Foreword

This standard non-equivalently adopts British standard BS 7069-1988 "Specification for cookware".

Annexes A, B, C and D are all informative.

This standard was proposed by Industry Management Department of State Light Industry Bureau.

This standard shall be under the jurisdiction of National Daily Hardware Standardization Center.

The main drafting organizations of this standard: Shanghai 1st Aluminum Product Factory, Shenyang Light Industry Research and Design Institute, Shanghai Xingli Hardware Products Co., Ltd., Zhejiang Taizhou ASD Electric Appliances Co., Ltd., Shaoxing Huachang General Factory of Aluminum Products, Non-stick Cookware Branch of Fenglei Brmory Aviation Industry Corporation of Guizhou China, Guangdong Nanhai Hefeng Electrochemical Co., Ltd., Southern General Hardware Factory of Guangdong, Dupont China Holding Co., Ltd. AND Daikin Fluoro Coatings (Shanghai) Co., Ltd.

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This standard shall be interpreted by National Daily Hardware Standardization Center.

Aluminum and aluminum alloy non-stick cookware

1 Scope

This standard specifies the definition, product classification, technical requirements, test methods, inspection rules, mark, packaging, transportation and storage requirements of aluminum and aluminum alloy non-stick pan products.

This standard is applicable to household aluminum and aluminum alloy non-stick pan products which is made by using aluminum and aluminum alloy as base-body, painting its inner surface with non-stick coating and polishing its outer surface or painting its outer surface with heat resistance paint or other surface treatment such as aluminium enameling.

2 Normative references

The following normative documents contain the provisions, which through reference in this text, constitute the provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties who enter into agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

GB 191-90 Packaging - Pictorial markings for handling of goods

GB/T 2828-87 Sampling procedures and tables for lot-by-lot inspection by attributes (Apply to inspection of successive lots or batches)

GB/T 2829-87 Sampling procedures and tables for periodic inspection by attributes (Apply to inspection of stability for productive process)

GB/T 6060.4-88 Roughness comparison specimens - Polished surfaces

GB/T 6388-86 Transport package shipping mark

GBAT 6543-86 Corrugated box

GB/T 6544-86 Corrugated fiberboard

GB/T 6739-1996 Determination of film hardness by pencil test

GB 11678-89 Hygienic standard for polytetrafluorethylene used as inner coating of food containers

GB/T 11679-89 Method for analysis of hygienic standard of polytetrafluorethylene coating

Assessment of coating surface by microscope.

3.10 Crack

The non-stick coating crack which is observed with microscope.

4 Product classification

4.1 Product category

4.1.1 The products can be classified, according to usage, into boiling pan, frying pan, wok, milk pan and accessories.

4.1.2 The inner product surface is painted with non-stick coating. Non-stick coating is classified into one-layer, double-layer and three-layer system and so on.

4.1.3 The outer surface is treated with painting non-stick coating, aluminium enameling, high temperature resistance paint or polishing and other kinds of treatment methods.

4.2 Product specification

4.2.1 The product specification can be expressed in inner diameter or volume.

4.2.2 When the specification is expressed in inner diameter, the unit shall be centimetre (cm), and even number series has the priority to be used.

4.2.3 When the specification is expressed in volume, the unit shall be litre (L). The value is taken to keep a decimal places.

4.3 Product diagram

The typical product structure and components name is shown as Figure 1.

Peeling strength is tested according to clause 6.4. The striped coating shall not be greater than 6mm away from the edge of knife scratch.

5.3.6 Scratch resistance

Scratch resistance is tested according to clause 6.5. The total length of coating which is not removed shall not be less than 10%.

5.3.7 Non-stick performance

Non-stick performance is tested according to clause 6.6. The tested food can be taken out with non-metal scoop from the coating surface without any damage and the coating surface can be cleaned with soft cloth.

5.3.8 Stability after heated and shock cooling

It shall be tested according to clause 6.7 and there shall not be bubble or cracks on coating surface.

5.3.9 Alkali resistance

It shall be tested according to clause 6.8 and there shall not be peeling or cracks on coating surface.

5.3.10 Acid resistance

It shall be tested according to clause 6.9 and there shall not be peeling, cracks. or shrinkage on coating surface.

5.3.11 Saline water corrosion resistance

It shall be tested according to clause 6.10 and there shall not be additive defects on coating surface such as bubble, corrosion spot and so on.

5.3.12 Microscopic appearance

It shall be tested according to clause 6.24. There shall not be bottom exposure and cracks on the coating when observed with 10x microscope.

5.3.13 Hygienic requirements

The hygienic requirements of non-stick coating shall fulfill requirements of GB 11678.

5.4 High temperature resistant paint film

5.4.1 Appearance

The paint film surface shall be smooth and have uniform color and there is no blister or peeling. A small amount of micro particles and pores are permitted.

The coating shall be completely hot melted. Its surface shall be basically smooth and have uniform color while there is no obvious bubbles, cracks, bottom exposure and peelings.

5.6.2 Thickness

It shall be tested according to clause 6.12 and the average coating thickness shall not be less than 10 μ m.

5.6.3 Adhesion strength

It shall be tested according to clause 6.13. There shall not be whole coating stripe peeling within the gridded area.

5.6.4 Hardness

It shall be tested according to clause 6.14 and pass 2H pencil test.

5.6.5 Stability after heated and shock cooling.

It shall be tested according to clause 6.15 and the coating shall have no bubbles and cracks.

5.6.6 When the non-stick coating is used as outer coating, it shall not be in direct contact with open fire.

5.7 Polished surface

The polished surface shall be shine and have uniform color. It shall be tested according to clause 6.16 and the polishing roughness R_a shall not be less than 0.4 μ m.

5.8 Riveting

The coating on rivet surface shall have no peeling and the rivet shall be regular and fit perfectly.

5.9 Water leakage of pan body

It shall be tested according to clause 6.21 and there shall have no water leakage on riveting parts.

5.10 Appearance

The exposed parts of products and components shall be smooth and have no rags, cracks and sharp edges.

5.11 Decorative figure

The decorative figure on outer surface of products shall be clean as well as basically complete.

6.5.2 Hold the pneumatic pen with hand and press it downward to make its second guide roller contact with the coating surface. Move the pneumatic pen evenly at the condition of keeping it vertical to carve a 40mm~50mm long scratch

6.5.3 Observe the scratch visually and the total length of coating which is not removed shall not be less than 10%.

6.5.4 Check that whether the ball-point pen can rotate flexibly before each scratch test is carried out. Checking method: continuous line can be made with the ball-point. Otherwise, the ball-point pen shall be replaced with a new one.

6.6 Non-stick performance test of non-stick coating

6.6.1 Wipe the non-stick coating surface by using soft cloth with vegetable oil. Clean it with warm water which has been added with detergent. Then clean it with clean water and dry it.

6.6.2 Put the test-piece on a daily electric heater with rated voltage of 220V and output capacity of 1000W for heating. Use surface thermometer with accuracy of no less than 2.5 class for measurement. When the inner surface temperature is within 140°C~170°C, crack a fresh egg and put it in the pan without adding edible oil or other fatty oil. Wait until the protein congealed (the inner surface temperature shall not exceed 210°C).

6.6.3 Use non-metal scoop to take out the egg and clean the coating surface with soft cloth. Repeat procedures in clause 6.6.2 and 6.6.3 for 3 times.

6.7 Non-stick coating stability after heated and shock cooling

Put test-piece into a constant temperature oven and heat it to $(250\pm 5)^{\circ}\text{C}$. Keep the temperature for 5min and put it into room temperature water to cool it for 1min. Inspect the non-stick coating with 4x microscope. Repeat the above-mentioned procedures for 5 times.

6.8 Alkali resistance test of non-stick coating

Pour 2% sodium carbonate solution into test-piece until it reaches 2/3 height. Soak it for 2h and take it out. Clean the test piece with clean water and dry it with soft cloth. Then inspect the coating surface with 4x microscope.

6.13 Adhesion strength test of paint film and non-stick outer coating

It shall be carried out according to clause 6.3.2~clause 6.3.4.

6.14 Hardness measurements of paint film and non-stick outer coating

It shall be carried out according to method B in chapter 4 of GB/T 6739 and replace the sample with test panel.

6.15 Paint film and non-stick outer coating stability test after heated and shock cooling

Put the test sample into constant temperature oven and heat it to $(170\pm 5)^{\circ}\text{C}$. Keep the temperature for 5min and put it into room temperature water to cool it for 1min. Take it out and dry it with soft cloth and inspect paint film surface with 4x microscope. Repeat the above-mentioned procedures for five times.

6.16 Polishing roughness test

Inspect it with polishing roughness comparison plate which fulfills GB/T 6060.4.

6.17 Aluminum enamel thickness measurement

It shall be carried out according to Annex A.

6.18 Thermal shock resistance test of aluminum enamel

It shall be carried out according to Annex B.

6.19 Anti-stripping test of aluminum enamel

It shall be carried out according to Annex C.

6.20 Acid resistance test of aluminum enamel

It shall be carried out according to Annex D.

6.21 Water leakage test of pan body

Pour water of room temperature into the pan until it exceeds riveting parts and lay it aside for 3 min to observe the water leakage.

6.22 Boiling fastness test of phenolics

Clean the sample with neutral detergent and clean water. Put it into pan with water and put the pan on electric heater for heating. Time since the water is boiling and stop heating after 30min. Take out the sample and put it into cool water. Take out the sample after it is cooled and inspect it.

6.23 Fitting test between lid and pan body

Cover the pan body with the lid. The lid can rotate with slight force. Measure the radius displacement distance on the diameter of pan with steel ruler.

6.24 Microscopic appearance inspection of non-stick coating

Observe any different parts of the sample bottom with 10x microscope.

6.25 Visual appearance inspection

Inspect the appearance with visual observation, hand feeling and general measurement instrument.

7 Inspection regulation

7.1 Products can only be delivered after tested and qualified by manufacturers.

7.2 Product tests can be classified as delivery tests and type tests.

7.3 Delivery tests shall be carried out according to GB/T 2828 and special inspection level S-3 and single sampling of normal inspection can be used.

7.3.1 Items of delivery test, unqualified items, qualified quality level are shown in Table 5.

7.3.2 For the qualified lots of delivery test, delivery can only be permitted after the supplier replaces the unqualified products with qualified products. If the lot is unqualified, the supplier shall carry out reworking and submit the products for re-inspection after tidying. Only the unqualified items can be tested for the lot submitted for inspection.

7.4 Type tests shall be carried out according to specification of GB/T 2829 and acceptance level I as well as single sampling scheme can be used.

7.4.1 Type tests shall be carried out under any of the following conditions:

- a) When the product performance maybe affected due to significant change concerning structure, material and technology;
- b) Type tests shall be carried out annually, and the hygienic requirements type test shall be carried out biennially under condition of normal production;
- c) When the production is resumed after it is suspended for more than half year;
- d) When it is required by superior qualify supervision authority.

II	B	1	Microscopic appearance of non-stick coating	5.3.12	6.24	65	1 2	3
		2	Scratch resistance of non-stick coating	5.3.6	6.5			
		3	Acid resistance of non-stick coating	5.3.10	6.9			
		4	Handle loading strength	5.2	6.1			
III	B	1	Thickness of paint film	5.4.2	6.12	65	1 2	3
		2	Hardness of paint film	5.4.4	6.14			
		3	Adhesion strength of paint film	5.4.3	6.13			
		4	Thickness of aluminum enamel coating	5.5.2	6.17			
		5	Acid resistance of aluminum enamel coating	5.5.5	6.20			
		6	Thickness of non-stick outer coating	5.6.2	6.12			
		7	Adhesion strength of non-stick outer coating	5.6.3	6.13			
		8	Hardness of non-stick outer coating	5.6.4	6.14			
		9	Non-stick performance of non-stick coating	5.3.7	6.6			
		10	Saline water corrosion resistance of non-stick coating	5.3.11	6.10			
IV	B	1	Alkali resistance of non-stick coating	5.3.9	6.8	65	1 2	3
		2	Paint film stability after heated and shock cooling	5.4.5	6.15			
		3	Non-stick outer coating stability after heated and shock cooling	5.6.5	6.15			
		4	Thermal shock resistance of aluminum enamel coating	5.5.3	6.18			
V	B	1	Boiling fastness of phenolics	5.1.2	6.22	65	1 2	3
		2	Anti-stripping of aluminum enamel coating	5.5.4	6.19			
		3	Non-stick coating stability after heated and shock	5.3.8	6.7			

			cooling					
Note: Draw 2 samples randomly from these samples underwent the group II tests. Combine the 2 samples with these samples in group IV to form 5 samples which are used for the 4th test item of thermal shock resistance of aluminum enamel coating.								

8 Marking, label and instructions for use

8.1 Marks

8.1.1 There shall be the following marks on the products:

- a) trademark;
- b) manufacturer name.

8.1.2 Package marks

8.1.2.1 There shall be the following marks on the package box:

- a) manufacturer name;
- b) product name;
- c) trademark;
- d) specification.

8.1.2.2 There shall be the following marks on the package cases. The storing pictorial marks shall fulfill requirements of GB 191 and shipping marks shall fulfill requirements of GB/T 6388.

- a) trademark;
- b) product name and specifications;
- c) quality grade;
- d) delivery date;
- e) manufacturer name and address;
- f) quantity;
- g) net weight, gross weight, volume (length×width×height).

8.2 Label

In the package there shall be qualification certificate and the following content shall be

included in the qualification certificate:

- a) trademark;
- b) qualification certificate (text);
- c) inspector (signature or seal);
- d) manufacturing date;
- e) manufacturer name.

8.3 Using instructions

In the package there shall be using instructions and the following content shall be included in instructions for use:

- a) preparation before using;
- b) instructions for use;
- c) precautions of safety and cleaning;
- d) standard No. implemented by this product;
- e) manufacturer name, address and postal code.

9 Package, transportation and storage

9.1 Package

9.1.1 Box package

Package the pan body and lid with neutral material and then put them in corrugated paper box fulfilling the requirements of GB/T 6544.

9.1.2 Simplified package

Put pan body and lid into plastic bags respectively, and seal them or package them with plastic shrink package.

9.1.3 Casing

Put box package products and convenience package products into paper case fulfilling the requirements of GB/T 6543.

9.1.4 Seal paper cases with sellotape and bundle them with plastic packing belts.

9.1.5 In cases there shall be accompanied with packing list.

Annex A

(Informative)

Thickness measurement of aluminum enamel coating, non-stick outer coating and high temperature resistant paint film.

A1 Instruments

Use eddy current thickness meter with accuracy of 2 μm .

A2 Lathed pans

A2.1 Make two surface lines rectangle to each other through the center of outer bottom (keep them away from welded support).

A2.2 Trisect the surface lines along outer wall surface arc length. Then use the bottom center as circle center and the distance between bottom center and trisection point as radius to make circles which intersect with the outer surface lines, by which 8 intersection points are got. Measure the thickness on the 8 intersection points and get the average value.

A3 Non-lathed pans

Get measurement points on two surfaces. One group of 4 points is on the outer bottom and the other group of 4 points is on the outer wall.

A3.1 Outer bottom surface: Make two lines rectangle to each other through the outer bottom center. Use the outer bottom center as circle center and half ($R/2$) of the bottom radius R as radius to make circle which intersect with the lines and 4 measurement points are got.

A3.2 Outer wall: quarter the circumference of the circle at $1/2$ height of the outer wall and 4 measurement points are got.

A3.3 Measure thickness of the 4 measurements points on outer bottom and the 4 measurements points on outer wall respectively. Then get the average value of them.

Annex B

(Informative)

Thermal shock resistance test method of aluminum enamel coating

B1 Applicable scope

This test method is used to test thermal shock resistance of aluminum enamel coating and is applicable to any enamel utensil which can contain water of 25mm depth.

B2 Test equipment

B2.1 Heating plate: It can make the temperature of the whole plate surface identical and the maximum surface temperature different is lower than 6.7°C。

The plate surface temperature shall be capable of being adjusted within the range of (245~440)°C±5.5°C. Plate surface temperature shall be measured with proper surface thermometer and be adjusted by changing the input power of heating plate. If the temperature scale of heating plate corresponds to the input power, the required heating plate surface temperature can be obtained by determining the input power (See B6.2 and B6.3).

B2.2 Timer: clock or similar instrument.

B2.3 Container: it can hold about 18L water.

B2.4 Container: it is used to pour water into sample utensil.

B2.5 Sponge: it is used to dry sample utensil.

B3 Water for quenching

Running water or distilled water (if running is too hard, distilled water shall be used).

B4 Samples

Samples consists of 5 identical utensils. Identical utensils means the utensils which have the same dimensions, the same size and the same surface treatment.

B5 Test preparation

B5.1 Lay the heating plate flat and turn on the switch to adjust heating plate temperature to (245±5.5)°C. Keep the heating plate at this temperature for at least 1h to make all the heating surface be at the same temperature.

B5.2 Fill a big container with water and adjust water temperature to (21±1)°C. Measure the

Annex C

(Informative)

Anti-stripping test method of aluminum enamel coating

C1 In this method, 1% antimony trichloride ($SbCl_3$) test solution is distributed on enamel coating of aluminum or aluminum alloy sample to determine the weather resistance of enamel and its durability in damp condition.

C2 Samples are drawn from the products produced every 4 hours according to color and one sample shall be drawn for every 1000 pieces of products. Carve on the enamel surface with sharp pen point and the carve depth is the best when aluminum is exposed. Put 1% antimony trichloride test solution into plastic or glass container and put the sample into the container with the scratch being above solution. Carry out the immersion at room temperature for 20h.

C3 Appraisal

If any of the following situations appears, it will be judged as unqualified:

- a) The scratch extends for more than 3mm;
- b) There is peeling spot with diameter more than 3mm on the un-carved area (not defects or scratch).
- c) There are more than 6 peeling spots on an $10dm^2$ area (the pore with diameter less than 1.5mm is neglected).

Annex D

(Informative)

Acid resistance test method of aluminum enamel coating

D1 Samples

Samples can be whole product or pieces cut out from products as well as specially made samples

Note: Due to that machining parameters during spraying, drying and sintering affect the degree of acid corrosion on enamel surface, the samples used in this test shall have the same machining conditions as products.

D2 Reagents

Dissolve 10g of analytically pure (AR) crystallized citric acid into distilled water to prepare test solution. Test solution must be prepared before test.

D3 Test procedures

D3.1 Soak soft cotton towel with warm saturated trisodium phosphate solution and clean the surface of samples. Then wash the samples with warm running water and blot them with soft towel. Lay the samples aside at $(26\pm 1)^{\circ}\text{C}$ for a long enough period to make them be within this temperature range before and during test.

Note: if water drop forms on the surface during washing, wash the samples again until water distributes evenly on the surface.

D3.2 Surface on which the products in use are at horizontal or near horizontal position shall be used as test surface. Put the samples properly to make sure that there is surface with diameter of 38.1mm and above at horizontal position. Drop several citric acid drops on the sample surface with temperature of $(26\pm 1)^{\circ}\text{C}$ and cover it with monitoring glass (the solution volume shall suffuse the monitoring glass except one bubble. It usually needs 3~6 drops of solution according to dropping bottle size and curvature of monitoring glass). After 15min treatment, take the monitoring glass away and rinse out the solution and blot it with clean cotton towel (do not wipe).

Note: The test surface shall be completely dry before grading.

D4 Grading

Grade the samples according to test procedures in Figure D1 within 2h after the samples are treated with acid solution. Classify the samples into five grades as AA, A, B, C and D, as Figure D1 shows.

completely. Neglect all color variations. The test will be failed if there is a visible projection stain when the light source pass the interface between treated surface and protective surface. Otherwise, the test is passed.

D4.4 Wet clean test

Draw line on other parts of the treated surface as D4.2 described. Then use wet soft cotton towel (soak it and squeeze out the residual water) to wipe the treated surface repeatedly (without cleaning materials such as soap, abrasive paper and so on). If the line is cleaned completely, the sample passes the test. Otherwise, it fails the test.

D4.5 Bright light disappear test.

The criterion of this test is the same as bright light stain test in D4.3 except for that bright light disappears on treated surface completely. If there is visible bright light on treated surface, the sample passes the test. Otherwise, it fails the test.

_____ **END** _____