Industrial Ceramic Balls - Inert Ceramic Balls

HG/T 3683.1-2014

(Replacing HG/T 3683.1-2000)

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Foreword

HG/T 3683 *Industrial Ceramic Balls* is divided into 3 parts:

- Part 1: Industrial Ceramic Balls - Inert Ceramic Balls;
- Part 2: Industrial Ceramic Balls - Active Ceramic Balls;
- Part 3: Industrial Ceramic Balls - Perforated Ceramic Balls.

This part is Part 1 of HG/T 3683.

This part is drafted in accordance with the rules specified in GB/T 1.1-2009.

This part replaces HG/T 3683.1-2000 *Industrial Ceramic Balls - Inert Ceramic Balls*. Compared with HG/T 3683.1-2000, the main technical changes are as follows:

- Unified alkali resistance index for products with different Al_2O_3 contents;
- Unified thermal shock resistance index (temperature difference) for products with different Al_2O_3 contents;
- Added the index of maximum heat resistance temperature;
- Increased compressive strength indexes according to different product specifications.

This part is proposed by the China Petroleum and Chemical Industry Federation.

This part is under the jurisdiction of the National Technical Committee for Standardization of Non-Metallic Chemical Equipment (SAC/TC 162).

Drafting units of this part: Pingxiang Zhongtian Chemical Packing Co., Ltd., Pingxiang Global Chemical Packing Co., Ltd., Sinopec Engineering Construction Co., Ltd., National Testing Center for Industrial Ceramics.

Note: This standard for inert ceramic balls (industrial ceramic balls standard) is a translated document. Due to translation errors, it is only used as a reading material and requires careful verification of the content.

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Because we have many years of experience in the production of inert ceramic balls, our quality is more reliable. As it is a direct factory, our prices are more favorable. We offer wholesale, retail, neutral packaging, customized production, and sufficient inventory to meet emergency shipments.

Release history of the replaced standards of this part:

- HG/T 3683.1-2000.

1 Scope

This part specifies the product classification, requirements, test methods, inspection rules, delivery documents, packaging, transportation and storage of inert ceramic balls.

This part applies to inert ceramic balls used as cushioning materials for supporting and covering catalysts in reactors of petroleum, chemical and other related industries, as well as tower packing.

2 Normative References

The following documents are indispensable for the application of this document. For dated referenced documents, only the version with the indicated date is applicable to this document. For undated referenced documents, the latest version (including all amendments) is applicable to this document.

GB/T 4734 Test Methods for Chemical Analysis of Ceramic Materials and Products

HG/T 3210 Test Methods for Properties of Acid-Resistant Ceramic Materials

3 Terms and Definitions

The following terms and definitions are applicable to this document.

Inert Ceramic Ball

A ceramic ball made from industrial alumina and kaolin as main raw materials, through shaping and high-temperature calcination, with sufficient chemical stability and thermal stability.

4 Product Classification

4.1 Types

Inert ceramic balls are divided into 5 types according to the Al_2O_3 content in their materials, as shown in Table 1.

Table 1 Types of Inert Ceramic Balls

Material Type	Ordinary Ceramic	Low-Alumina Ceramic	Medium-Alumina Ceramic	High-Alumina Ceramic	Corundum Ceramic
Al_2O_3 Content / %	20~30	31~45	46~70	71~90	>90

4.2 Specifications

Inert ceramic balls are divided into 12 specifications according to their outer diameter: 3mm, 6mm, 8mm, 10mm, 13mm, 16mm, 20mm, 25mm, 30mm, 38mm, 50mm, 76mm.

4.3 Others

Inert ceramic balls of other specifications and types can be manufactured through negotiation between the supplier and the buyer. Except for special provisions in the contract, their quality requirements shall still comply with this part.

5 Requirements

5.1 Appearance Quality

Inert ceramic balls shall be regular spheres, and their surface quality shall comply with the provisions in Table 2.

Table 2 Surface Quality of Inert Ceramic Balls

Appearance Defect	Characteristics	Scope	Allowable Number of Defects	

		Φ ≤ 10 mm	Φ > 10 mm	
Crack	Cracking signs penetrating into the body	Length: 3 mm ≤ L ≤ 5 mm	Not allowed	≤ 2
		Length: L > 5 mm	Not allowed	
Spot	Iron spots, pits and peelings on the surface	Max size: 1 mm ≤ S ≤ 2 mm	≤ 2	≤ 3
		Max size: S > 2 mm	Not allowed	
Bubble	Hollow protrusions on the surface	Max size: 1 mm ≤ S ≤ 2 mm	≤ 2	≤ 3
		Max size: S > 2 mm	Not allowed	

5.2 Dimensional Deviation

The diameter deviation of inert ceramic balls shall comply with the provisions in Table 3.

Table 3 Diameter Deviation of Inert Ceramic Balls

Unit: mm

Diameter (Φ)	3	6	8	10	13	16	20	25	30	38	50	76
Allowable Deviation	±1.0	±1.0	±1.0	±1.0	±1.5	±1.5	±1.5	±2.0	±2.0	±2.0	±2.0	±2.0

5.3 Physicochemical Properties

The physicochemical properties of inert ceramic balls shall comply with the provisions in Table 4.

Table 4 Physicochemical Properties of Inert Ceramic Balls

Property	Material Type				
	Ordinary Ceramic	Low-Alumina Ceramic	Medium-Alumina Ceramic	High-Alumina Ceramic	Corundum Ceramic
Chemical Composition / %	Al_2O_3	20~30	31~45	46~70	71~90
	Al_2O_3 + SiO_2	≥90	≥90	≥90	≥90
	Fe_2O_3	≤1	≤1	≤1	≤1
Water Absorption / %	≤8	≤5	≤5	≤5	≤5
Acid Resistance / %	≥90	≥90	≥90	≥90	≥90
Alkali Resistance / %	≥85	≥85	≥85	≥85	≥85
Thermal Shock Resistance (ΔT) / ℃	≥300	≥300	≥300	≥300	≥300
Maximum Heat Resistance Temperature / ℃	1000	1200	1300	1400	1500
Compressive Strength / (kN/piece)	Φ 3 mm	≥0.20	≥0.25	≥0.30	≥0.35
	Φ 6 mm	≥0.50	≥0.60	≥0.65	≥0.70

	Φ 8 mm	≥0.70	≥0.80	≥0.90	≥1.00
	Φ 10 mm	≥0.85	≥1.00	≥1.20	≥1.50
	Φ 13 mm	≥1.80	≥2.30	≥3.00	≥4.00
	Φ 16 mm	≥2.30	≥3.00	≥4.50	≥6.00
	Φ 20 mm	≥4.30	≥5.00	≥6.00	≥7.50
	Φ 25 mm	≥6.20	≥7.00	≥8.00	≥10.00
	Φ 30 mm	≥7.00	≥8.00	≥10.00	≥12.00
	Φ 38 mm	≥8.80	≥10.00	≥12.00	≥16.00
	Φ 50 mm	≥12.00	≥13.00	≥15.00	≥18.00
	Φ 76 mm	≥16.00	≥18.00	≥20.00	≥22.00
Bulk Density / (kg/m³)	1300~1400	1400~1500	1500~1600	1600~1800	≥1800

Note: The bulk density data is for reference only and shall not be used as acceptance criteria.

6 Test Methods

6.1 Appearance Quality

Check the appearance quality using conventional measuring tools and visual inspection.

6.2 Dimensional Deviation

Measure the dimensional deviation with a caliper with a measuring range of 0~150 mm and a division value of not less than 0.1 mm. Measure two mutually perpendicular points, and take the arithmetic mean as the measurement result.

6.3 Chemical Analysis

Analyze the chemical composition of inert ceramic balls in accordance with the provisions of GB/T 4734.

6.4 Water Absorption, Acid Resistance, Alkali Resistance and Thermal Shock Resistance

Test the water absorption, acid resistance, alkali resistance and thermal shock resistance of inert ceramic balls in accordance with the provisions of HG/T 3210.

6.5 Compressive Strength

Use a testing machine with sufficient pressure capacity, adjustable loading speed and grade 1 force measurement accuracy. Take at least 10 ceramic balls as samples. Place each sample in the center of the pressure plate of the testing machine, apply load stably and uniformly at a speed of 5 mm/min~20 mm/min or 0.5 kN/min~2.5 kN/min, record the pressure value when the sample is broken, and calculate the arithmetic mean as the test result.

6.6 Heat Resistance Temperature

Use a heating furnace with sufficient heating temperature and capability to observe the heating status of samples. Take no less than 3 ceramic balls as samples. The samples shall have a regular and clear appearance without obvious defects. Observe and record the appearance of the samples at room temperature, place the samples in the heating furnace, make the hot end of the thermocouple close to the samples, raise the furnace temperature to 200 ℃ lower than the required temperature within 1.5 h~2 h, then raise the temperature to the required temperature at a uniform speed of 2.5 ℃/min on average, and keep it warm for 30 min. Observe or video-record the deformation of the samples. The samples are qualified if no obvious deformation occurs.

7 Inspection Rules

7.1 Inspection Classification

Product inspection is divided into type inspection and delivery inspection.

7.1.1 Type Inspection

Type inspection of products shall be conducted once a year, and the inspection items shall cover all items specified in this part.

Type inspection shall also be conducted under any of the following circumstances:

a) When the product structure, raw materials or process are significantly changed, which may affect product performance;

b) When the production is transferred or resumed after suspension;

c) When the delivery inspection results have a significant difference from the previous type inspection results;

d) When required by national laws and regulations;

e) When specified in the contract.

7.1.2 Delivery Inspection

All products must undergo delivery inspection before leaving the factory. The inspection items include 5 items specified in Chapter 5 of this part: appearance quality, dimensional deviation, chemical composition, water absorption and compressive strength.

7.2 Lot Formation Rule

Inert ceramic balls shall be accepted by lot. A lot consists of products manufactured under the same conditions (raw materials, process, equipment, etc.) with a quantity of 50 tons. Products less than 50 tons shall also be regarded as one lot.

7.3 Sampling Rule

Representative and random sampling shall be adopted for each lot of products. According to different product specifications, sample quantities shall be taken as specified in Table 5. Mix the samples uniformly, take 1/4 of them by the quartering method for appearance quality and dimension inspection, and then randomly take the corresponding quantity for physicochemical performance testing.

Table 5 Sampling Scheme for Inert Ceramic Balls of Different Specifications

Specification / mm	3	6	8	10	13	16	20	25	30	38	50	76
Sampling Quantity / piece	80	80	60	60	40	40	40	40	40	40	40	40

7.4 Judgment Rule

7.4.1 For Appearance Quality and Dimensional Inspection of Inert Ceramic Balls

- If the unqualified rate does not exceed 10%, the lot is judged as qualified;
- If the unqualified rate exceeds 10%, double the number of samples shall be taken from the same lot for re-inspection, and the re-inspection result shall be the final result. If the unqualified rate of the re-inspection result still exceeds 10%, the lot is judged as unqualified;
- If the unqualified rate in the initial inspection exceeds 20%, the lot is judged as unqualified.

7.4.2 For Physicochemical Performance Inspection of Inert Ceramic Balls

- If all items are qualified, the lot is judged as qualified;

- If one index is unqualified, samples of the same quantity shall be taken from the same lot for re-inspection of that index. The average value of the re-inspection result and the initial inspection result shall be the final result. If it is still unqualified, the lot is judged as unqualified;
- If more than two indexes are unqualified in the initial inspection, the lot is judged as unqualified.

7.4.3 For a Lot of Products Judged as Unqualified Due to Unqualified Appearance Quality or Dimensional Deviation

The supplier is allowed to remove the unqualified products and re-form a lot for submission to inspection.

8 Delivery Documents

Inert ceramic balls shall be accompanied by a quality certificate and an instruction manual when leaving the factory, indicating the following contents:

a) Product name, standard number, trademark;

b) Product specification

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