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Classification of dense shaped refractory products —

Part 4: Special products

Classification des produits réfractaires façonnés denses —

Partie 4: Produits spéciaux

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 33, *Refractories*.

This second edition cancels and replaces the first edition (ISO 10081-4:2007), of which it constitutes a minor revision. Changes have been made to Tables 7 and 8 and the bibliography has been updated.

ISO 10081 consists of the following parts, under the general title *Classification of dense shaped refractory products*:

— *Part 1: Alumina-silica*

— *Part 2: Basic products containing less than 7 % residual carbon*

— *Part 3: Basic products containing from 7 % to 50 % residual carbon*

— *Part 4: Special products*

Classification of dense shaped refractory products —

Part 4:
Special products

1 Scope

This part of ISO 10081 specifies the classification and designation of dense shaped refractory products of special composition including

a) oxide products,

b) oxide and non-oxide products,

c) non-oxide silicon carbide or carbon-based products, and

d) further special products which are only designated but not classified, for example, non-oxide products, such as boride, nitride or further combinations of the series listed above.

2 Principle

Dense shaped special products shall be classified according to the following six criteria:

a) the type of product;

b) the group determined by the content of its main chemical component(s);

c) the principal raw material(s);

d) the state of the raw materials;

e) the nature of the bond;

f) any post-treatment.

3 Classification

3.1 Type of product

The following types of dense shaped refractory special products shall be classified by chemical analysis as shown in 3.2.

a) alumina-chromia (ACr);

b) chromia (Cr);

c) alumina-chromia-zirconia (ACrZ);

d) alumina-chromia-zirconia-silica (ACrZS);

e) zirconia-silica (ZS);

f) alumina-zirconia-silica (AZS);

g) alumina-carbon (AC);

h) alumina-magnesia-carbon (AMC);

i) alumina-fused silica-carbon (AFC);

j) alumina-silicon carbide-carbon (ASC);

k) zirconia-carbon (ZC);

l) silicon carbide (SiC);

m) carbon (C).

3.2 Group

The groups of dense shaped refractory special products in the above-mentioned series shall be determined by the content of their main chemical component(s) as shown in Tables 1 to 12, and in accordance with the ranges given in the tables.

Table 1 — Alumina-chromia refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)	
		Al_2O_3	Cr_2O_3
Alumina-Chromia	ACr90/5	$90 \leq Al_2O_3 < 95$	$5 \leq Cr_2O_3 < 10$
	ACr80/10	$80 \leq Al_2O_3 < 90$	$10 \leq Cr_2O_3 < 20$
	ACr70/20	$70 \leq Al_2O_3 < 80$	$20 \leq Cr_2O_3 < 30$
	ACr60/30	$60 \leq Al_2O_3 < 70$	$30 \leq Cr_2O_3 < 40$
	ACr50/40	$50 \leq Al_2O_3 < 60$	$40 \leq Cr_2O_3 < 50$
Chromia	Cr90		$90 \leq Cr_2O_3$
	Cr50		$50 \leq Cr_2O_3 < 90$
NOTE The analysis is carried out on calcined products using International Standards such as ISO 12677.			

Table 2 — Alumina-chromia-zirconia refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)		
		Al_2O_3	Cr_2O_3	ZrO_2
Alumina-Chromia-Zirconia	ACrZ15/5	$15 < Al_2O_3 \leq 70$	$5 \leq Cr_2O_3 < 25$	$25 \leq ZrO_2 < 50$
	ACrZ5/25	$5 < Al_2O_3 \leq 65$	$25 \leq Cr_2O_3 < 40$	$10 \leq ZrO_2 < 40$
	ACrZ5/40	$5 < Al_2O_3 \leq 55$	$40 \leq Cr_2O_3 < 80$	$5 \leq ZrO_2 < 30$
NOTE 1 $Al_2O_3 + Cr_2O_3 + ZrO_2 \geq 85$ % by mass, 5% by mass $< Al_2O_3 \leq 70$ % by mass, 5% by mass $\leq Cr_2O_3 < 80$ % by mass, and 5% by mass $< ZrO_2 \leq 50$ % by mass. NOTE 2 ZrO_2 content includes HfO_2. NOTE 3 The analysis is carried out on calcined products using International Standards such as ISO 12677.				

Table 3 — Alumina-chromia-zirconia-silica refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)		
		Al_2O_3	Cr_2O_3	ZrO_2+SiO_2
Alumina-Chromia-Zirconia-Silica	ACrZS20/10	$20 < Al_2O_3 \leq 55$	$10 \leq Cr_2O_3 < 25$	$25 \leq ZrO_2+SiO_2 < 50$
	ACrZS15/25	$15 < Al_2O_3 \leq 60$	$25 \leq Cr_2O_3 < 40$	$10 \leq ZrO_2+SiO_2 < 50$
	ACrZS5/40	$5 < Al_2O_3 \leq 30$	$40 \leq Cr_2O_3 < 80$	$10 \leq ZrO_2+SiO_2 < 30$
NOTE 1 ZrO_2 content includes HfO_2.				
NOTE 2 The analysis is carried out on calcined products using International Standards such as ISO 12677.				

Table 4 — Zirconia-silica refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)	
		ZrO_2	SiO_2
Zirconia	Z95	$95 \leq ZrO_2$	
	Z90	$90 \leq ZrO_2 < 95$	
	Z70	$70 \leq ZrO_2 < 90$	$10 \leq SiO_2 < 30$
Zirconia-Silica	ZS60	$60 \leq ZrO_2 < 70$	$30 \leq SiO_2 < 40$
	ZS50	$50 \leq ZrO_2 < 60$	$40 \leq SiO_2 < 50$
	ZS35	$35 \leq ZrO_2 < 50$	$50 \leq SiO_2 < 65$
NOTE 1 The analysis is carried out on calcined products using International Standards such as ISO 12677.			
NOTE 2 ZrO_2 content includes HfO_2.			
NOTE 3 If necessary, the stabilizer should be specified in “Nature of raw materials” (see 3.3).			

Table 5 — Alumina-zirconia-silica refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)		
		Al_2O_3	ZrO_2	SiO_2
Alumina-Zirconia-Silica	AZS70/2	$70 < Al_2O_3 \leq 95$	$2 \leq ZrO_2 < 15$	$SiO_2 < 28$
	AZS30/15	$30 < Al_2O_3 \leq 50$	$15 \leq ZrO_2 < 30$	$SiO_2 < 35$
	AZS30/30	$30 < Al_2O_3 \leq 55$	$30 \leq ZrO_2 < 40$	$SiO_2 < 40$
	AZS30/40	$30 < Al_2O_3 \leq 55$	$40 \leq ZrO_2 < 50$	$SiO_2 < 30$
NOTE 1 The analysis is carried out on calcined products using International Standards such as ISO 12677.				
NOTE 2 For AZS products, a group is indexed according to the zirconia content (see Table 4).				
NOTE 3 ZrO_2 content includes HfO_2.				

Table 6 — Alumina-carbon refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)	
		Al_2O_3	**C**
Alumina-Carbon	AC90/N*	$90 \leq Al_2O_3$	N
	AC80/N*	$80 \leq Al_2O_3 < 90$	N
	AC70/N*	$70 \leq Al_2O_3 < 80$	N
	AC60/N*	$60 \leq Al_2O_3 < 70$	N
	AC50/N*	$50 \leq Al_2O_3 < 60$	N
	AC40/N*	$40 \leq Al_2O_3 < 50$	N
	AC30/N*	$30 \leq Al_2O_3 < 40$	N

N*	Carbon contents % (mass fraction)
1	$1 \leq C < 5$
5	$5 \leq C < 10$
10	$10 \leq C < 15$
15	$15 \leq C < 20$
20	$20 \leq C < 25$
25	$25 \leq C < 30$
30	$30 \leq C$

NOTE 1 The asterisk indicates the antioxidant additive which is denoted by adding A to the group classification.

NOTE 2 The analysis is carried out on calcined products using International Standards such as ISO 12677.

NOTE 3 Residual carbon content after coking.

NOTE 4 N is equal to the lowest limit of the residual carbon content range.

Table 7 — Alumina-magnesia-carbon refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)		
		Al_2O_3	MgO	C
Alumina-magnesia-carbon	AMC90/N*	$90 \leq Al_2O_3$	$5 \leq MgO < 10$	N
	AMC80/N*	$80 \leq Al_2O_3 < 90$	$10 \leq MgO < 20$	N
	AMC70/N*	$70 \leq Al_2O_3 < 80$	$20 \leq MgO < 30$	N
	AMC60/N*	$60 \leq Al_2O_3 < 70$	$30 \leq MgO < 40$	N
	AMC50/N*	$50 \leq Al_2O_3 < 60$	$40 \leq MgO < 50$	N

N*	Carbon contents % (mass fraction)
1	$1 \leq C < 5$
5	$5 \leq C < 10$
10	$10 \leq C < 15$
15	$15 \leq C < 20$
20	$20 \leq C < 25$
25	$25 \leq C < 30$

NOTE 1 The asterisk indicates the antioxidant additive which is denoted by adding A to the group classification.

NOTE 2 The analysis is carried out on calcined products using International Standards such as ISO 12677.

NOTE 3 Residual carbon content after coking.

NOTE 4 N is equal to the lowest limit of residual carbon content range.

Table 8 — Alumina-fused silica-carbon refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)		
		Al_2O_3	**Fused Silica (FS)**	**C**
Alumina-fused silica-carbon	AFC80/N*	$80 \leq Al_2O_3$	$5 \leq SiO_2 < 20$	N
	AFC70/N*	$70 \leq Al_2O_3 < 80$	$15 \leq SiO_2 < 30$	N
	AFC60/N*	$60 \leq Al_2O_3 < 70$	$25 \leq SiO_2$	N

N*	**Carbon contents** % (mass fraction)
1	$1 \leq C < 5$
5	$5 \leq C < 10$
10	$10 \leq C < 15$
15	$15 \leq C < 20$
20	$20 \leq C < 25$
25	$25 \leq C < 30$
30	$30 \leq C < 35$

NOTE 1 The asterisk indicates the antioxidant additive which is denoted by adding A to the group classification.

NOTE 2 The analysis is carried out on calcined products using International Standards such as ISO 12677.

NOTE 3 Fused silica content determined in delivered state.

NOTE 4 Residual carbon content after coking.

NOTE 5 N is equal to the lowest limit of residual carbon content range.

Table 9 — Alumina-silicon carbide-carbon refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)		
		Al_2O_3	SiC	C
Alumina-SiC-carbon	ASC80/N*	$80 \leq Al_2O_3$	$1 \leq SiC < 5$	N
	ASC70/N*	$70 \leq Al_2O_3 < 80$	$5 \leq SiC < 15$	N
	ASC60/N*	$60 \leq Al_2O_3 < 70$	$10 \leq SiC$	N
	ASC50/N*	$50 \leq Al_2O_3 < 60$	$10 \leq SiC$	N

N*	Carbon contents % (mass fraction)
1	$1 \leq C < 5$
5	$5 \leq C < 10$
10	$10 \leq C < 15$
15	$15 \leq C < 20$
20	$20 \leq C < 25$

NOTE 1 The asterisk indicates the antioxidant additive which is denoted by adding A to the group classification.

NOTE 2 The analysis is carried out on calcined products using International Standards such as ISO 12677.

NOTE 3 SiC content determined on product as received.

NOTE 4 Residual carbon content after coking.

NOTE 5 N is equal to the lowest limit of residual carbon content range.

Table 10 — Zirconia-carbon refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)	
		ZrO_2	C
Zirconia-Carbon	ZC90/N*	$90 \leq ZrO_2$	N
	ZC80/N*	$80 \leq ZrO_2 < 90$	N
	ZC70/N*	$70 \leq ZrO_2 < 80$	N
	ZC50/N*	$50 \leq ZrO_2 < 70$	N

N*	Carbon contents % (mass fraction)
1	$1 \leq C < 5$
5	$5 \leq C < 10$
10	$10 \leq C < 20$
20	$20 \leq C < 30$
30	$30 \leq C < 50$

NOTE 1 The asterisk indicates the antioxidant additive which is denoted by adding A to the group classification.

NOTE 2 The analysis is carried out on calcined products using International Standards such as ISO 12677.

NOTE 3 Residual carbon content after coking.

NOTE 4 N is equal to the lowest limit of residual carbon content range.

Table 11 — Silicon carbide refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)
		SiC
Silicon carbide	SiC99	99 ≤ SiC
	SiC90	90 ≤ SiC < 99
	SiC80	80 ≤ SiC < 90
	SiC70	70 ≤ SiC < 80
	SiC50	50 ≤ SiC < 70
	SiC30	30 ≤ SiC < 50
NOTE The analysis is carried out on the product as received, using the analytical methods in International Standards such as ISO 12677.		

Table 12 — Carbon refractory special products — Classification by product type and group

Designation	Group	Contents % (mass fraction)	
		C	Ash
Carbon	C99,9	99,8 ≤ C	Ash < 0,2
	C99	99 ≤ C	Ash < 1
	C95	95 ≤ C < 99	1 ≤ Ash < 5
	C90	90 ≤ C < 95	5 ≤ Ash < 10
	C80/M	80 ≤ C < 90	10 ≤ Ash < 20
	C60/M	60 ≤ C < 80	10 ≤ Ash < 40
NOTE 1 M indicates that the higher ash content is caused by non-carbon components (e.g. alumina, silicon carbide, metals, etc.). This leads to micro-pores in the structure.			
NOTE 2 The analysis is carried out on products carbonized in accordance with ISO 10060 using the analytical methods in International Standards, and analytical results are expressed as a dry-basis percentage composition.			

3.3 Nature of raw materials

Dense shaped refractory special products shall be classified in accordance with 3.1 by the chemical component contents which have been calculated from the chemical composition of their principal raw materials.