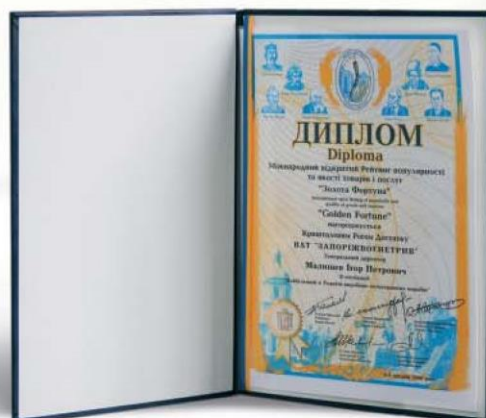




ΠΑΟ ΖΑΠΟΡΟΖΟΓΗΕΥΡ
ZAPOROZHOGNEUR PJSC



PJSC "ZAPOROZHOGNEUPOR" ("ZAPORIZHZHIA REFRACTORIES") is Ukraine's largest producer of high-quality refractory products and materials.

The company produces chamotte, mullite silica, mullite, mullite-corundum, quartzite non-fired, periclase, periclase-chromite, chromite-periclase, periclase-carbon, alumina-periclase-carbon, corundum-carbon, concrete vibrocast shaped products, unshaped refractories and various types of chamottes, including fractionated, high-tech castables and mixes for steel, glass, cement, machine-building, chemical, sugar, and other industries.

The products are supplied throughout Ukraine and to various European countries.

The company has developed and operates a Quality Management System and is compliant with the requirements of the international standard ISO 9001:2015 in the TUV AUSTRIA certification system. ZAPORIZHZHIA REFRACTORIES applies the quality management system in the development, design, production, sales and after-sales service of refractories for steel and other industries.

By continuously implementing timely upgrades and improving its technical and economic resources, ZAPORIZHZHIA REFRACTORIES strives to dramatically improve product quality and maintain lasting competitiveness in the refractory market. ZAPORIZHZHIA REFRACTORIES prioritises technical re-equipment and revamping of its production, development of new products, including high-tech ones, continuous work to enhance product quality, engineering support, warranty service, and technical assistance for our customers.

International and national awards recognising the company's competitive and high-quality products serve as a testament to its strong reputation in the business world.

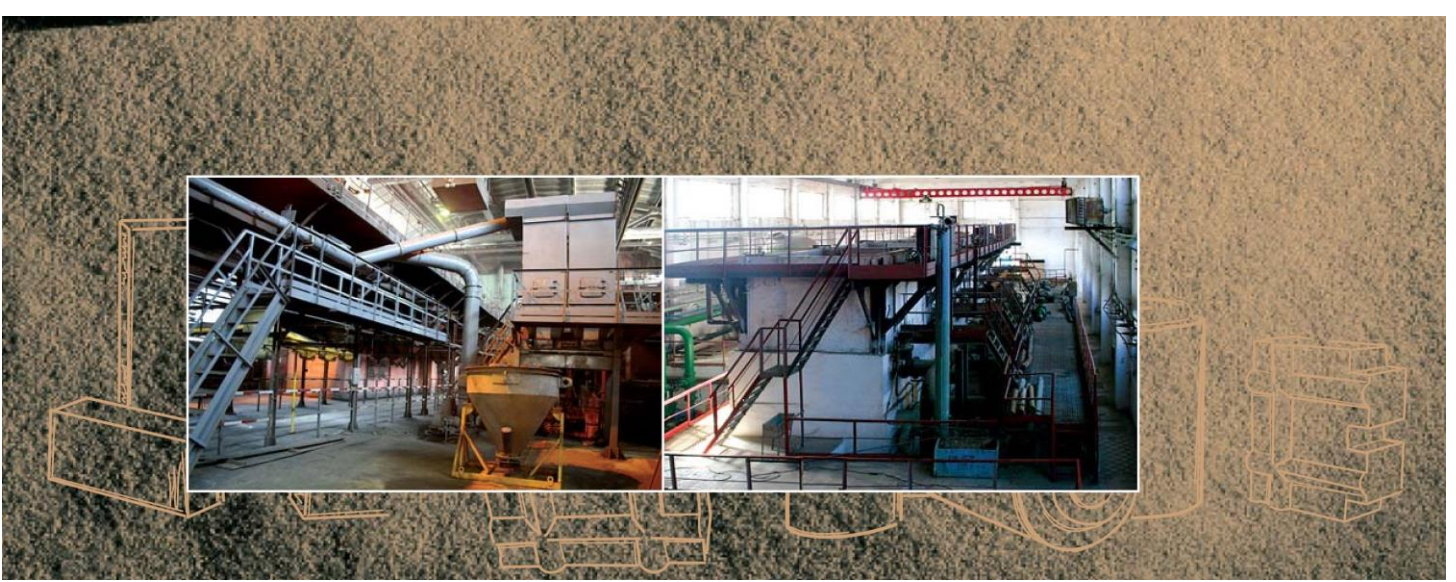
We look forward to establishing long-term, mutually beneficial cooperation with you!



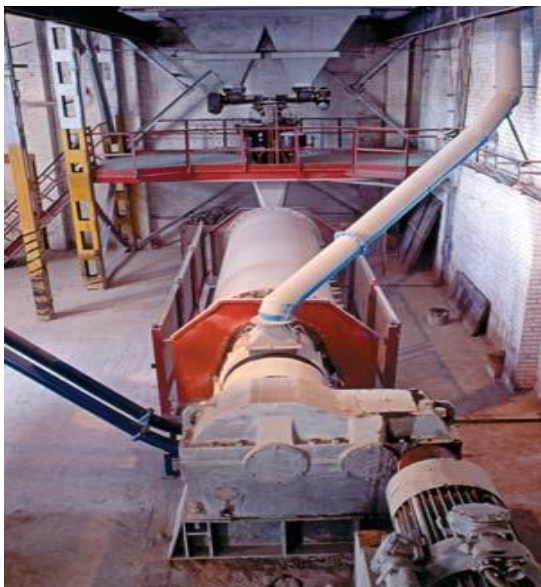
The construction of the Zaporizhzhia Refractory Plant commenced in August 1929. The plant was intended to supply refractories to steel, machine-building, and chemical industries in the Dnieper region and southern Ukraine. The first products were made in 1933.

To meet the needs of the developing industry, the company expanded its range of chamotte products.





In parallel, production facilities for magnesia, high-alumina, and silicon carbide products were established. By government decision, the plant was designated as a pilot facility among refractory producers for automation, mechanisation, and the development of new products and technologies. The ring kilns were replaced by tunnel kilns with automatic control of the firing process, rotary kilns were installed, press equipment with mechanised removal and refractory product loading onto kiln cars were installed.





In 1995, the Zaporizhzhia Refractory Plant was reorganised into Open Joint Stock Company "ZAPOROZHOGNEUPOR".

The next modernisation of equipment was carried out in 1997: presses made by the German company Laeis-Bucher with a force of 1,250, 1,600, 2,000, and 2,500 tf were installed. The grinding areas of the shops were reconstructed, packaging equipment was purchased and put into operation, and the mechanical repair shop was re-equipped to manufacture high-precision and high-strength press tools from a range of high-alloy steels. All of this enabled the plant to achieve a new level of product quality.





In 2011, the company was reorganised into Public Joint Stock Company "ZAPORozHOGNEUPOR".

In 2013, PJSC "ZAPORozHOGNEUPOR" became part of Metinvest Group, marking a new milestone in the company's development. PJSC "ZAPORozHOGNEUPOR" was now faced with the task of meeting the essential needs of the Metinvest Group companies in high-quality refractory products. One of the areas of focus for PJSC "ZAPORozHOGNEUPOR" became the development of advanced technologies and the establishment of industrial production for high-tech refractory products and unshaped materials, which had until then been imported to meet the demand in the Ukrainian market.

So, in May 2013, PJSC "ZAPORozHOGNEUPOR" put into commercial operation a new shop for producing high-tech refractory castables, designed and equipped with automated, high-precision equipment from EIRICH.

In 2015, the company set up a service department to improve the efficiency of technical solutions for maintaining the lining of metallurgical facilities and reduce repair costs for metallurgical enterprises. An unshaped refractories shop was set up on the premises of the silicon carbide refractories shop and the refractory castables and bodies shop.

In 2016, the company was reorganised into Private Joint Stock Company "ZAPOROZHOGNEUPOR".

In 2017, PJSC "ZAPOROZHOGNEUPOR" set a record for lining durability in Ukrainian steelmaking. Azovstal's first basic oxygen furnace lasted 6,842 heats before undergoing a major overhaul shutdown.

In 2018, following the expansion of the service function, the Service Department was reorganised, and two service centres were established: the Zaporizhzhia Service Centre and the Mariupol Service Centre.

The production of periclase-carbon refractories, one of the highest-margin products, increased by 52.8%.

To date, PJSC "ZAPOROZHOGNEUPOR" is Ukraine's largest producer of refractories, offering an unmatched variety of high-quality products, including more than 1,200 main grades of refractories, unshaped materials, and castables.





ALUMINOSILICATE PRODUCTION

Fire clay (chamotte) products

The plant's production activities began in 1933 with a workshop for the production of fire clay products. Due to its early development, production is characterized by the widest range of refractory products produced. The range of the workshop includes ladle, composite and particularly composite shapes, general-purpose products, stopper, center tubes, hoppers, siphons, stars, nozzles, etc. The grinding section is equipped with drying drums, clay crushing equipment, ball mills, general grinding tube mills, vibrating screens, which allows for high-quality preparation of powders of the required grain size. The pressing section is equipped with hydraulic presses (Laeis-Bucher) with a force of 1600 tf and DRP-350), mechanical presses CM 1085 with a system of cradle conveyors transporting semi-finished products to charging areas, ensuring a wide range of products. The workshop is equipped with 168 m and 87 m long tunnel furnaces with an automatic firing processes. The workshop includes a plastic pressing section dedicated to producing composite-shaped

products and steel casting blanks. Finished products are stacked and loaded using electric forklifts and overhead cranes. The products are packed in bags, wrapped in paper and secured with metal straps. Upon agreement with the consumer, other types of packaging are provided to improve the appearance of packages and ensure safety of products during transportation.

GENERAL-PURPOSE CHAMOTTE REFRACTORY PRODUCTS GOST 390-96 Shape and dimensions TECHNICAL SPECIFICATION TU U 23.2-00191885-031:2021	
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Parameter	Norm for the grade	
	ShA (III A)	ShB (III B)
1 Mass fraction, %: Al ₂ O ₃ , min	30	28
2 Refractoriness, °C, min	1690	1650
3 Apparent porosity, %, max, for products of the subgroup I II	24 30	24 30
4 Cold crushing strength, MPa, min, for products of the subgroup I II	20 15	- -
5. Refractoriness under load, °C, min	1300	-

**REFRACTORY PRODUCTS FOR BOTTOM
(UPHILL) TEEING OF STEEL
DSTU GOST 11586:2006
(GOST 11586-2005, IDT)**



Parameter	Norm for the grade	
	ShS-32 (IIC-32)	ShS-28 (IIC-28)
1 Mass fraction, %: Al_2O_3 , min	32	28
2 Refractoriness, °C, min	1690	1670
3 Permanent change in dimensions on heating, at 1350°C, %, max	0.4	0.5
4 Apparent porosity, %,	15-24	15-26
5 Thermal shock resistance, number of thermal cycles, min, for risers, runners, and end runners; thermal cycles (heating to 800 °C and air cooling).	1	1

Note:

1. For the products of grade ShS-28 made by the plastic method, an apparent porosity slightly above 28% is permissible.
2. For the products of grade ShS-28, subject to agreement between the parties, the following specifications are permissible: refractoriness: not lower than 1650 °C; permanent change in dimensions on heating: not more than 1.0%.

**REFRACTORY PRODUCTS FOR BOTTOM
(UPHILL) TEEING OF STEEL
TECHNICAL REQUIREMENTS
TV 00191885-084:2022**



Parameter	Norm for the grade
	ShST-32 (ИСТ-32)
1 Mass fraction, %: Al_2O_3 , min	32
2 Refractoriness, $^{\circ}\text{C}$, min	1690
3 Permanent change in dimensions on heating, at 1350°C , %, max	0.4
4 Apparent porosity, %,	17.0 – 27.0
5 Thermal shock resistance, number of thermal cycles, min, for risers, runners, and end runners, thermal cycles (heating to 800°C and air cooling).	1

**CHAMOTTE REFRACTORY PRODUCTS
FOR
OPEN-HEARTH FURNACE BRICKWORK
TECHNICAL SPECIFICATION
TU U 23.2-00191885-033:2023**



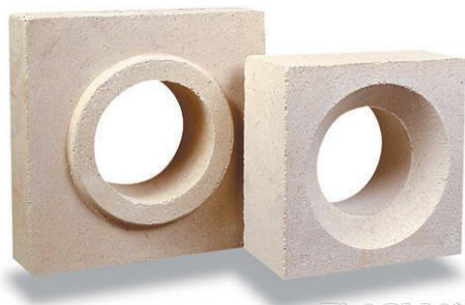
Parameter	Norm for the grade	
	ShAM (ШАМ)	ShBM (ШБМ)
1. Mass fraction, %: Al ₂ O ₃ , min	30.0	28.0
2 Refractoriness, °C, min	1690	1650
3. Permanent change in dimensions on heating, at 1400°C, %, max	-	-
4. Apparent porosity, %, max, for products of the subgroup I II	24.0 30.0	24.0 30.0
5. Cold crushing strength, MPa, min, for products of the subgroup I II	20.0 15.0	- -
6.Refractoriness under load, °C, min	1300	-
Note 1. For the products of grade ShBM, refractoriness not lower than 1630 °C is permissible. Note 2. For shaped products of grades ShAM, subject to agreement with the customer, a cold crushing strength of not less than 10 MPa is permissible.		

**REFRACTORY STOPPER PRODUCTS FOR STEEL
CASTING FROM LADLES
DSTU GOST 5500:2006 (GOST 5500 -2001, IDT)**



Parameter	Norm for the grade	
	ShSP-32 (ШСП-32)	ShSP-35 (ШСП-35)
1. Mass fraction on ignition basis, %: Al_2O_3 , %, min	32	35
2. Refractoriness, °C, min	1690	1710
3. Apparent porosity, %,	15-26	15-26
4. Permanent linear shrinkage, %, max, at: 1350 °C	1690 0.3	1710 0.3
5. Thermal shock resistance, number of thermal cycles, min	1	

**REFRACTORY PRODUCTS FOR SLIDE GATES
OF STEEL LADLES
SPECIFICATION
TUU 23.2 – 00190503--460:2021**



Parameter	Norms for well blocks of grade ShG - 32 (ШГ - 32)
1. Mass fraction on ignition basis, %: Al_2O_3 , %, min	32
2. Apparent porosity, %, max	23
3. Cold crushing strength, MPa, min,	15

**PRODUCTS FOR THE STEEL LADLE
LINING**

GOST 5341-98



Parameter	norm for grades						
	ShKU-37 (ШКУ-37)	ShKP-37 (ШКП-37)	ShKU-39 (ШКУ-39)	ShKP-39 (ШКП-39)	ShKU-41 (ШКУ-41)	ShKP-41 (ШКП-41)	ShKU-42 (ШКУ-42)
Mass fraction, %: Al_2O_3 , min	37	37	39	39	41	41	42
Fe_2O_3 , max							3.5
Refractoriness, $^{\circ}C$, min	1730	1730	1750	1750	1750	1750	1750
Apparent porosity, %, max	18	16	18	16	18	16	18
Cold crushing strength, N/mm^2 , min	30	40	30	40	30	40	40
Softening starting temperature, $^{\circ}C$, min	1400	1410	1430	1450	1430	1450	1400
Permanent linear shrinkage at 1400 $^{\circ}C$, %, max	0.3	0.2	0.3	0.2	0.3	0.2	0.3
Thermal shock resistance, number of thermal cycles, min	4	3	4	3	4	3	4

Note: The specifications for the products of grades ShKU-41 and ShKP-41 are subject to agreement with the customer.



**REFRACTORY PRODUCTS
FOR BLAST FURNACE BRICKWORK
DSTU 2345-94 (GOST 1598-96)**

Parameter	Value for the products of grades		
	ShPD-43 (ШПД-43)	ShPD-41 (ШПД-41)	ShPD-39 (ШПД-39)
Mass fraction, %:			
Al ₂ O ₃ , min	43	41	39
Fe ₂ O ₃ , max	1.5	1.5	1.5
Refractoriness, °C, min	1750	1750	1750
Softening starting temperature, °C, min	1530	1500	1440
Permanent linear shrinkage at 1450 °C, %, max	0.2	0.2	0.2
Apparent porosity, %, max	12	12	16
Cold crushing strength, N/mm ² , min for the products Nos.: 5,6,7,8 the rest	40 70	40 70	- 50

	REFRACTORY PRODUCTS FOR ROTARY KILN LINING DSTU GOST 21436:2006
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Parameter	Norm for grades		
	MLTs (МЛН)	MKRTs (МКРН)	ShTsU (ШТУ)
Mass fraction, %: Al_2O_3 , min	62	45 (50)	32
Refractoriness, °C, min	1800	1750	1710
Softening starting temperature, °C, min	1450	1400	1370
Apparent porosity, %, max	24	22	20
Cold crushing strength, N/mm ² , min	25	30	25
Thermal shock resistance, thermal cycles, min	4	3	4
Permanent change in dimensions, %, max, at a temperature of (°C): 1500 1400	0.4	0.5	0.3

	CHAMOTTE REFRACTORY PRODUCTS FOR OPEN-HEARTH FURNACE REGENERATOR CHECKERS TECHNICAL SPECIFICATION TUU 23.2-00190503-458:2021
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Parameter	Norm for the products of grade		
	ShKN-41 (IIIKH-41)	ShN-38 (IIIH-38)	ShN-37 (IIIH-37)
Mass fraction, %: Al_2O_3 , min	41	38	37
Apparent porosity, %, max	21	21	21
Cold crushing strength, N/mm^2 , min	26	22	22
Refractoriness under the load of $0.2 N/mm^2$, $(T_{0.5})$, $^{\circ}C$, min	1450	1400	1400
Permanent change in dimensions on heating at $1400^{\circ}C$ with 2 hours exposure, %, max	0.4	0.4	0.4
Refractoriness, $^{\circ}C$, min	-	1730	1730

	REFRACTORY PRODUCTS FOR BRICKWORK OF HOT BLAST STOVES AND HOT BLAST AIR DUCTS OF BLAST FURNACES TECHNICAL SPECIFICATION TUU 23.2-00191885-038:2020
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Parameter	Parameter value for grade		
	ShV-28 (IIIB-28)	ShV-37 (IIIB-37)	ShV-42 (IIIB-42)
1. Mass fraction, %: Al ₂ O ₃ , min Fe ₂ O ₃ , max	28.0 -	37.0 -	42.0 1.7
2. Refractoriness, °C, min	1670	1730	1750
3. Apparent porosity, %, max, of products for: - checkers - walls, domes, and air ducts	25.0	23.0	20.0
	27.0	25.0	20.0
4. Cold crushing strength, N/mm², min, of products for: - checkers - walls, domes, and air ducts	15.0	20.0	40.0
	15.0	20.0	30.0
5. Deformation temperature under load (softening point), °C, min	1270	1330	1500

ZAPORIZHZHIA REFRACTORIES manufactures checker products of grade ShV 37 No. 80a and ShV 42 No. 80 a - 19-hole

**CHAMOTTE REFRACTORY PRODUCTS FOR
LIME KILN LINING
TECHNICAL SPECIFICATION
TUU 23.2-00191885-045:2022**



Parameter	Norm for the products of grade
	ShY (III)
Mass fraction of Al_2O_3 , %, min	32
Refractoriness, $^{\circ}C$, min	1690
Apparent porosity, %, max	20
Cold crushing strength, N/mm^2 , min	30
Refractoriness under load, $^{\circ}C$, min	1300

**CHAMOTTE REFRACTORY PRODUCTS FOR
HOT METAL LADLE LINING
TECHNICAL SPECIFICATION
TUU 23.2-00191885-034:2024**



Physical and chemical parameters

Parameter	Norm for grades	
	ShChU-37 (IIIЧУ-37)	ShChU-41 (IIIЧУ-41)
Mass fraction of Al_2O_3 , %, min	37	41
Refractoriness, $^{\circ}C$, min	1730	1730
Apparent porosity, %, max	20	20
Cold crushing strength, MPa, min	25	25
Permanent change in dimensions on heating at 1400 $^{\circ}C$, %, max	0.4	0.4

**CHAMOTTE REFRACTORY
PRODUCTS
FOR COKEMAKING
FACILITIES
TECHNICAL SPECIFICATION
TU U 23.2-00191885-041:2022**



Parameter	Norm for the products of grade		
	ShK-37 (IIIK-37)	ShK-35 (IIIK-35)	ShK-28 (IIIK-28)
	Typical brickwork areas		
	sole, doors, and chambers of dry quenching plants, gas burners	roof, doors, ports, walls of regenerators, gas burners,	checkerwork, other locations, chambers of dry quenching plants, grate bars
1	2	3	4
1. Mass fraction, %:			
Al ₂ O ₃ , min	37	35	28
Fe ₂ O ₃ , max	2.5	Not specified	
2 Refractoriness, °C, min	1730	1710	1670
3. Apparent porosity, %, max	-	26	26
within the range of	12-24	-	-
4. Cold crushing strength, MPa, min	Norms in accordance with the note to the table		
5. Permanent change in dimensions on heating, %, max, at a temperature of:			
1350° C	+ 0.4	+ 0.4	+ 0.6
1450° C	Not specified		
6. Thermal shock resistance, thermal cycles, min	Not specified	2	Not specified
Note 2. For grade ShK-37, the norm for the cold crushing strength is: - for linings of chambers of dry quenching plants with a thickness up to and including 65 mm and for sole products - not less than 40 MPa; for thicknesses over 65 mm - not less than 30 MPa; - for end roof bricks, corbel area bricks, inspection door bricks, and inspection ports — not less than 35 MPa; - door lining - no less than 20 MPa. The permanent change in dimensions on heating is not specified for chambers of dry quenching plants.			

1	2	3	4
Note 3. For grade ShK-35, the norm for the cold crushing strength is: - for end roof bricks, corbel area bricks, inspection door bricks, and inspection ports — not less than 25 MPa; - for products for other brickwork areas – no less than 20 MPa. For gas burners, the norm for the following parameters is: - the cold crushing strength and the permanent change in dimensions on heating - not specified; - the apparent porosity - within the range of (12 - 20)%; - the thermal shock resistance (at least 2 thermal cycles without cracking) is specified only for gas burners Note 4. For grade Shk-28, the norm for the permanent change in dimensions on heating is specified only for products for other brickwork areas; The norm for the cold crushing strength is: - checkerwork – no less than 12 MPa; - for linings of chambers of dry quenching plants – no less than 15 MPa. Note 5. For grades ShK-28, ShK-35, and ShK-37 produced from non-fired raw materials (kaolin) using plastic molding or vibrocasting methods, an increase in apparent porosity up to 28% is permissible.			

HIGH-ALUMINA PRODUCTS

The shop was commissioned in 1961 for the production of high-alumina refractories characterised by high strength and refractoriness, with Al_2O_3 content ranging from 62% to 85%. The shop's products are used for lining blast furnace stoves, hot blast ducts, secondary metallurgy pipelines, and other thermal equipment in non-ferrous metallurgy. The shop is equipped with high-efficiency grinding equipment, domestically produced mechanical presses, and hydraulic presses manufactured by Laeis-Bucher. The products are fired in a high-temperature tunnel kiln with a length of 156 metres and a drying section of 45 metres. The tunnel kiln has been modernised and has computerised process control.

All products are packed into packages at the finished product warehouse. The high-alumina products shop at ZAPORIZHZHIA REFRACTORIES is the only one of its kind in Ukraine. The shop's products are in demand in many countries around the world, as well as on the domestic market.

	REFRACTORY PRODUCTS FOR BRICKWORK OF HOT BLAST STOVES AND HOT BLAST AIR DUCTS OF BLAST FURNACES TECHNICAL SPECIFICATION TUU 23.2-00191885-038:2020		
Parameter	Parameter value for grade		
	MKRV-50 (MKPB-50)	MKV-72 (MKPB-50)	MKVN-72 (MKBH-72)
1. Mass fraction, %: Al_2O_3 , min Fe_2O_3 , max	50.0 1.5	72.0 1.5	72.0 1.5
2. Apparent porosity, %, max, of products for: - checkers - walls, domes, and air ducts	21.0 23.0	21.0 24.0	23.0 -
3. Cold crushing strength, - checkers - walls, domes, and air ducts	40.0 30.0	50.0 30.0	40.0 -
4. Deformation temperature under load (softening point), °C, min	1540	1550	1580
Note: Subject to agreement with the customer, the mass fraction of Fe_2O_3 shall not exceed 2.0%.			

	CORUNDUM AND HIGH-ALUMINA REFRACTORY PRODUCTS TECHNICAL SPECIFICATION TU U 23.2-00191885-040:2020
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Parameter	Parameter value for grade			
	MKS-72 (MKC-72)	MKSK-72 (MKCK-72)	MLS-62 (MJIC-62)	MKRS-50 (MKPC-50)
Mass fraction, %				
Al ₂ O ₃ , min	72	72	62	50
Fe ₂ O ₃ , max	2.0	2.0	2.0	1.8
Apparent porosity, %, max	24	24	24	24
Cold crushing strength, N/mm ² , min	30	30	25	20
Deformation temperature under load (softening point), °C, min	1500	1500	1450	1400
Permanent linear change (permanent linear shrinkage), %, max, at a temperature, °C:				
1400	-	-	-	0.5
1500	-	-	0.4	-
1600	1.0	1.0	-	-

	MULLITE-SILICA REFRACTORY PRODUCTS FOR STEEL LADLE LINING TECHNICAL SPECIFICATION TU U 26.2-00191885-017:2011
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Parameter	Norm for the products of grade		
	MKRK-45 (MKPK-45)	MKRK-48 (MKPK-48)	MKRK-50 (MKPK-50)
1 Mass fraction, %:			
Al ₂ O ₃ , min	45	48	50
Fe ₂ O ₃ , max	1.8	1.8	1.8
2 Apparent porosity, %, max	23	22	22
3 Cold crushing strength, N/mm ² , min	30	40	50
4 Refractoriness under load, °C, min	1400	1450	1480
5 Permanent change in dimensions on heating, at 1400°C, %, max	0.5	0.4	0.4
6 Thermal shock resistance (heating up to 1300°C, water cooling), thermal changes, min	3	3	3
7 Refractoriness, °C, min	1750	1750	1750

REFRACTORY PRODUCTS FOR SLIDE GATES OF STEEL LADLES TU U 23.2–00190503–460:2021		
Parameter	Norm for well blocks of grade	
	MKG-72 No. 1 (МКГ-72 № 1), MKG 72 No. 2 (МКГ 72 № 2)	MKG-80 No. 1 (МКГ-80 № 1), MKG -80 No. 2 (МКГ -80 № 2)
1. Mass fraction, %: Al ₂ O ₃ , min Fe ₂ O ₃ , max	72.0 1.4	80.0 1.4
2. Apparent porosity, %, max	24	23
Note: Subject to agreement with the customer, the mass fraction of Fe₂O₃ shall not exceed 2.0%.		



MULLITE-CORUNDUM REFRACTORY PRODUCTS OF GRADE MKS-85 (MKC-85)

Parameter	Parameter value for grade MKS-85
Mass fraction, %	
Al ₂ O ₃ , min	85
Fe ₂ O ₃ , max	2.0
Apparent porosity, %, max.	23
Cold crushing strength, N/mm ² , min	70
Softening starting temperature, °C, min	1580
5 Permanent change in dimensions on heating (at 1600°C), %, max	0.5

Physical and chemical parameters, drawings, overall dimensions of products, deviations from overall dimensions, and appearance characteristics - in accordance with the customer's contract (specification).



**HIGH-DUTY REFRACTORY PRODUCTS FOR
BRICKWORK OF HOT BLAST DUCTS OF BLAST
FURNACES OF GRADE MKT-80 (MKT-80)**

Parameter	Parameter value for grade MKT-80
Mass fraction, %	
Al ₂ O ₃ , min	80
Fe ₂ O ₃ , max	2.0
Refractoriness, °C, min	1750
Apparent porosity, %, max	23
Cold crushing strength, N/mm ² , min	40
Softening starting temperature, °C, min	1600

Products are manufactured as agreed with the customer.

Physical and chemical parameters, drawings, overall dimensions of products, deviations from overall dimensions, and appearance characteristics - in accordance with the customer's contract (specification).

The shape and dimensions shall meet the requirements of TUU 23.2-00191885-038:2020.

LIGHTWEIGHT INSULATING REFRACTORY PRODUCTS**DSTU 2342-94 (GOST 5040-96)**

Parameter	Value for the products of grades		
	ShKL-1,3 (ШКЛ-1,3)	ShL-1,3 (ШЛ-1,3)	ShL-1,0 (ШЛ-1,0)
Apparent density, g/cm ³ , max	1.3	1.3	1.0
Permanent linear shrinkage (growth) with 2 hours exposure, %, max at a temperature, °C	1.0 1400	1.0 1300	1.0 1300
Cold crushing strength, N/mm ² , min	3.5	3.5	3.0
Thermal conductivity, W/(m·K), max, at mean temperature, °C: 350±25 650±25*	0.5 0.6	0.6 0.7	0.5 0.6
*Measured upon customer request			

**QUARTZITE NON-FIRED REFRACTORY PRODUCTS
FOR LADLES
TECHNICAL REQUIREMENTS
TV 00191885-087:2022**



Parameter	Norm for products KBKZhS (КБКЖС)
Mass fraction of SiO ₂ , %, min	95
Mass fraction of Na ₂ O + K ₂ O*, %, max	1.2
Moisture, %, max	0.8
Refractoriness, °C, min	1690
Apparent porosity after drying, %, max	18
Cold crushing strength, MPa, min	17
Apparent density, g/cm ³ , min	2.14

Note*. The mass fraction of Na₂O + K₂O* is measured subject to agreement between the manufacturer and the customer. It is measured optionally and reflected in the quality certificate.

**ALUMINOSILICATE REFRACTORY AND HIGH-DUTY
REFRACTORY TUBES FOR STEEL PURGING IN
LADLES WITH
INERT GASES AND FOR TUNDISH STOPPERS**



Parameter	Parameter value for grade MKF-72 (MKΦ-72)
1. Mass fraction, %: Al ₂ O ₃ , min Fe ₂ O ₃ , max	74 2
2. Apparent porosity, %, within the range	18-23
3. Permanent change in dimensions on heating at 1600 °C, max	0.2
4. Thermal shock resistance (heating up to 800 °C, cooling - by air)	After seven thermal cycles, there shall be no through cracks, dividing the tube into parts

Note. Physical and chemical parameters, drawings, overall dimensions of products, deviations from overall dimensions, and appearance characteristics - in accordance with the customer's contract (specification).



PRODUCTION OF MAGNESIA REFRACTORIES

Magnesia refractories

The magnesia refractories shop produces a wide range of periclase, periclase-chromite, chromite-periclase, periclase-carbon, alumina-periclase-carbon, corundum-carbon products and unshaped refractory materials used for the lining of open-hearth, electric arc, basic oxygen, rotary furnaces and other thermal facilities. Magnesia refractories are and will continue to be the primary structural material for lining steelmaking and other metallurgical facilities in the near future. Carbon-containing refractories, used in advanced metallurgical processes, continue to be the most promising materials. Among carbon-containing refractories, periclase-carbon refractories play a key role in modern steelmaking, being used for

lining basic oxygen furnaces, electric arc furnaces, steel teeming ladles, and more. The production facility is equipped with hydraulic presses from Laeis-Bucher with a force of 1,250, 1,600, 2,000, and 2,500 tf. To improve product quality, the pressing area is equipped with automated systems that load the pressed products onto a furnace car based on a pre-set program, alongside computerised monitoring of production parameters. The products are fired in a 156-meter-long tunnel furnace in

an automatic firing mode. The tunnel kiln has been modernised and has computerised process control.

At the finished goods warehouse, after sorting and acceptance by the company's technological control department, the products are packed in packages, placed in corrugated cardboard boxes, with the top edges of the packages protected by corner protectors. They are then tied with polyester straps and wrapped in elastic polyethylene film, providing a good appearance and guaranteeing the safety of the products.

**HIGH-DUTY PERICLASE-CARBON REFRACTORY
PRODUCTS FOR BASIC OXYGEN FURNACES
TECHNICAL SPECIFICATION
TUU 23.2-00191885-023:2025**



Parameter	Parameter value for grade									
	PUKK-1 (ПУКК-1)	PUKK-2 (ПУКК-2)	PUKK-3 (ПУКК-3)	PUKK-4 (ПУКК-4)	PUKK-5 (ПУКК-5)	PUKK-6 (ПУКК-6)	PUKK-7 (ПУКК-7)	PUKK-8 (ПУКК-8)	PUKK-9 (ПУКК-9)	PUKK-10 (ПУКК-10)
Mass fraction, %										
MgO, min	93.0	93.0	93.0	93.0	93.0	93.0	91.0	91.0	91.0	91.0
Al ₂ O ₃ , within the range of	-	-	-	-	-	-	3.0-5.0	3.0-5.0	3.0-5.0	3.0-5.0
SiO ₂ , max	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Fe ₂ O ₃ , max	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Mass fraction of total carbon (C), %, within the range of	5.0-10.0	10.0-14.0	10.0-14.0	5.0-10.0	5.0-10.0	10.0-14.0	5.0-10.0	10.0-14.0	5.0-10.0	10.0-14.0
Cold crushing strength, N/mm ² , min	35.0	35.0	32.0	35.0	35.0	35.0	35.0	35.0	40.0	40.0
Apparent porosity, %, max	6.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0
Apparent density, g/cm ³ , min	2.88	2.88	2.88	2.88	2.90	2.90	2.90	2.90	2.95	2.95

Grades PUKK-1, PUKK-2 – for the lining of the basic oxygen furnace bottom (based on sintered periclase);

Grades PUKK-3, PUKK-4 – for the lining of the lower cone of a basic oxygen furnace (based on sintered and fused periclase);

Grade PUKK-5 – for the lining of the upper cone of a basic oxygen furnace (based on fused periclase);

Grade PUKK-6 – for the lining of the cylindrical zone of a basic oxygen furnace (based on fused periclase);

Grades PUKK-7, PUKK-8 – for the lining of the upper cone of a basic oxygen furnace (based on fused and sintered periclase with an antioxidant);

Grades PUKK-9, PUKK-10 – for the lining of the cylindrical zone of a basic oxygen furnace (based on fused periclase with an antioxidant).

The shape and dimensions of the products are in accordance with TUU 23.2-00191885-023:2025 "High-duty periclase-carbon refractory products for basic oxygen furnaces" and the customer's drawings.

Dimensional tolerances:

For sizes up to 400 mm $\pm$ 1.0 mm

For sizes greater than 400 mm $\pm$ 2.0 mm

	PERICLASE-CARBON REFRACTORY PRODUCTS FOR THE LINING OF STEEL TEEMING LADLES TUU 23.2-00191885-024:2025	
Parameter	Norm for grades	
	PU-9 (IIY-9)	PU-10 (IIY-10)
Mass fraction, %		
MgO, min.	93.0	91.0
Al ₂ O ₃ , within the range	-	3.0-5.0
CaO, max.	1.5	1.5
SiO ₂ , max.	1.5	1.5
Fe ₂ O ₃ , max.	1.0	1.0
Mass fraction of total carbon (C), %, within the range	10-15	10-15
Ultimate compression strength, N/mm ² , min.	35.0	35.0
Open porosity, %, max.	6.0	6.0
Apparent density, g/cm ³ , min.	2.90	2.90

Products intended for the lining of steel teeming ladles:

- grades PU-10 – for the slag zone lining (with the addition of an antioxidant);
- grades PU-9 – for the wall and bottom lining.

The shape and dimensions of the products are according to TUU 23.2-00191885-024:2025 "Periclase-carbon refractory products for the steel teeming ladle lining" and the customer's drawings.

Tolerances for the lining layer and the brickwork thickness ± 0.5 mm



**HIGHLY REFRACTORY MAGNESIA PRODUCTS
FOR STEEL TAPHOLES OF
BASIC OXYGEN AND OPEN-HEARTH FURNACES
TU U 23.2-00191885-042:2022**

Parameter	Norm for products of grade PLK-94
1 Mass fraction, %:	
MgO, min.	94.5
Fe ₂ O ₃ , max.	1.5
2 Ultimate compression strength, N/mm ² , min.	30
3 Open porosity, %, max.	17



**PERICLASE-CARBON REFRACTORY PRODUCTS
FOR STEEL TAPHOLES OF BASIC OXYGEN AND
OPEN-HEARTH FURNACES.
TU U 23.2-00191885-025:2025**

Parameter	Norm for products of PUL grade
1. Mass fraction (on ignition basis), %	
MgO, min.	92.0
Al ₂ O ₃ , within the range	3.0-5.0
CaO, max.	1.5
SiO ₂ , max.	1.5
Fe ₂ O ₃ , max.	1.0
C, within the range	8.0-15.0
2. Apparent density, g/cm ³ , min.	2.95
3. Ultimate compression strength, N/mm ² , min.	37.0
4. Open porosity, %, max.	5.0
Note. Fused periclase with an MgO content of no less than 97% is used	

PERICLASE REFRACTORY PRODUCTS GOST 4689-94	
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Parameter	Norm for grades		
	P-91 (II-91)	P-90 (II-90)	P-89 (II-89)
1	2	3	4
1.Mass fraction, %			
magnesium oxide MgO, min	91.0	90.0	89.0
calcium oxide CaO, max	3.0	4.0	4.5
iron oxide Fe ₂ O ₃ , max	2.5	2.5	-
silicon dioxide SiO ₂ , max	3.0	3.0	-
2.Apparent porosity, % max	22.0	23.0	26.0
3.Cold crushing strength, N/mm ² , min	60.0	50.0	40.0
4. Refractoriness under load, °C, min	1550	1550	1500

PERICLASE REFRACTORY PRODUCTS
TECHNICAL SPECIFICATION
TU U 26.2-00191885-019:2011 with
amendments 1-4



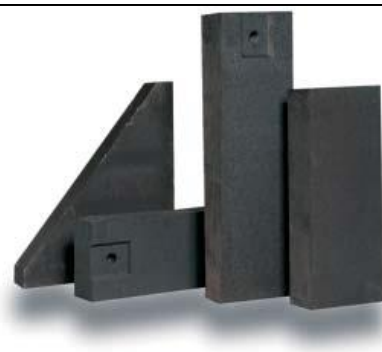
Parameter	Norm for grades							
	P-96 (II-96)	P-94 (II-94)	P-93 (II-93)	P-92Si (II-92Si)	P-91Si (II-91Si)	P-91-1 (II-91-1)	P-90-1 (II-90-1)	P-89-1 (II-89-1)
1	2	3	4	5	6	7	8	9
1. Mass fraction on ignition basis, %								
MgO, min	96.0	94.0	93.0	92.0	91.0	91.0	90.0	89.0
CaO, max	1.5	2.0	2.5	3.0	3.0	3.0	4.0	4.0
Fe ₂ O ₃ , max	1.0	1.5	1.5	2.0	2.0	-	-	-
Fe ₂ O ₃ , within the range of	-	-	-	-	-	2.5-6.0	-	2.5-8.5
SiO ₂ , max	1.4	2.5	3.0	4.0	5.0	1.8	-	2.0
2. Apparent porosity, % max	18.0	19.0	20.0	20.0	20.0	20.0	20.0	20.0
3. Cold crushing strength, N/mm ² , min	70.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
4. Refractoriness under load, °C, min	1600	1550	1530	1530	1530	1530	1500	1500

**HIGH-DUTY PERICLASE-CHROMITE
REFRACTORY PRODUCTS FOR BRICKWORK
OF STEELMAKING FURNACE ROOFS
DSTU 2573-94**



Parameter	Norm for the products of grade		
	PKhSP (ПХСП)	PKhSUT (ПХСУТ)	PKhSU (ПХСУ)
1. Mass fraction (on ignition basis), %			
MgO, min	70	70	65
Cr ₂ O ₃ , within the range of	7-15	7-15	7-15
2. Apparent porosity, %, max	16	18	20
3. Cold crushing strength, N/mm ² , min	37.5	35.0	32.5
4. Refractoriness under load, °C, min	1560	1540	1540
5. Permanent change in dimensions at 1650 °C, with 3 hours exposure %, max	0.7	0.7	0.8
6. Thermal shock resistance (heating up to 1300°C, water cooling), thermal cycles, min	4	6	5

**HIGH-DUTY PERICLASE-CHROMITE DIRECT-
BONDED OPTIMISED AND MAGNESIA-SPINEL
REFRACTORY PRODUCTS FOR BRICKWORK OF
OPEN-HEARTH FURNACE ROOFS
TECHNICAL SPECIFICATION
TU U 23.2-00191885-004:2022**



Parameter	Norm for the products of grade		
	PKhSOSP** (ПХСОП**)	PKhSOS (ПХСОС)	PKhShS (ПХШС)
1. Mass fraction (on ignition basis), %:			
MgO, min	65.0	65.0	60
Cr ₂ O ₃ , within the range of	12.0-17.0	12.0-17.0	11.0-17.0
SiO ₂ , max	2.0	2.0	-
Fe ₂ O ₃ , within the range of	7.0-13.0	7.0-13.0	7.0-11.0
Al ₂ O ₃ , within the range of*	3.0-6.0	3.0-6.0	max 8.0
CaO, max*	3.0	3.0	3.0
2. Apparent porosity, %, max	17.0	17.0	18.0
3. Apparent density (fired products), g/cm ³ , min	3.12	3.12	3.12
4. Cold crushing strength, N/mm ² , min	35.0	35.0	30.0
5. Refractoriness under load, °C, min	1630	1630	1600
6. Permanent change in dimensions on heating, %, max	0.5	0.5	0.5
7. Thermal shock resistance (heating up to 1300°C, water cooling), thermal cycles, min	8.0	8.0	8.0

Note*. The mass fractions of Al₂O₃ and CaO are measured subject to agreement between the manufacturer and the customer.

Note.** For the products of grade PKhSOSP – using fused periclase with an MgO mass fraction of not less than 97 %.

	HIGH-DUTY REFRACTORY PRODUCTS OF OPTIMISED COMPOSITION FOR ROTARY KILN LINING PKhTsOS (IIХІІОС)	
Parameter	Norm for the products of grade PKhTsOS (IIХІІОС)	
1. Mass fraction (on ignition basis), %		
MgO, min	68.0	
Cr ₂ O ₃ , within the range of	9.0-15.0	
CaO, max	2.0	
2. Apparent porosity, %, max	16.0	
3. Cold crushing strength, N/mm ² , min	35.0	
4. Refractoriness under load, °C, min	1640	
5. Thermal shock resistance (heating up to 1300 ⁰ C, water cooling), thermal cycles, min	8.0	

	HIGH-DUTY REFRACTORY PRODUCTS FOR ROTARY KILN LINING DSTU GOST 21436:2006		
Parameter	PKhTs (IIХІІ)	KhPTs (XIIIІ)	
1. Mass fraction (on ignition basis), %			
MgO, min	65.0	42.0	
Cr ₂ O ₃ , within the range of	8.0-18.0	20.0-30.0	
2. Apparent porosity, %, max	24.0	25.0	
3. Cold crushing strength, N/mm ² , min	25.0	20.0	
4. Refractoriness under load, °C, min	1500	1450	
5. Thermal shock resistance (heating up to 1300 ⁰ C, water cooling), thermal cycles, min	8.0	2.0	

	HEAT-RESISTANT CHROMITE-PERICLASE PRODUCTS FOR THE LINING OF THERMAL EQUIPMENT IN METALLURGY TECHNICAL SPECIFICATION TU U 23.2-00191885-055:2025		
	Parameter	KhPTU (XIITY)	KhPTS (XIITC)
1. Mass fraction (on ignition basis), %			
MgO, min		55.0	55.0
Cr ₂ O ₃ , within the range		15-22	14-22
2. Apparent porosity, %, max		20	23
3. Cold crushing strength, N/mm ² , min		25	20
4. Refractoriness under load, °C, min		1510	1510
5. Thermal shock resistance (heating up to 1300 ⁰ C, water cooling), thermal cycles, min		6	6

	OPTIMISED HEAT-RESISTANT CHROMITE-PERICLASE PRODUCTS FOR THE LINING OF THERMAL EQUIPMENT IN METALLURGY KhPTUOS (XIITYOC)		
	Parameter	KhPTUOS (XIITYOC)	
1. Mass fraction (on ignition basis), %			
MgO, min		58.0	
Cr ₂ O ₃ , within the range		15-17	
2. Apparent porosity, %, max.		17	
3. Cold crushing strength, N/mm ² , min		35	
4. Refractoriness under load, °C, min		1640	
5. Thermal shock resistance (heating up to 1300 ⁰ C, water cooling), thermal cycles, min		8	

	HIGH-DUTY MAGNESIA-CHROMITE PRODUCTS FOR BASIC OXYGEN FURNACES TECHNICAL SPECIFICATION TUU 23.2-00190503-464:2021	
Parameter	Norm for the products of grade KhPKK (XIHKK)	
1 Mass fraction, %: MgO, min Cr ₂ O ₃ , within the range of	55 15-22	
2 Cold crushing strength, N/mm ² , min	35	
3 Apparent porosity, %, max	18	
4 Refractoriness under the load of 0.2 N/mm ² , (T _{0.5}), °C, min	1580	
5 Thermal shock resistance, thermal cycles (R _{tr} , water, 1300), min	5	

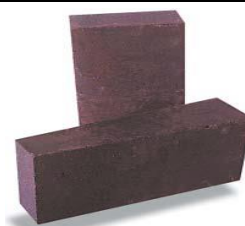
	HIGH-DUTY CHROMITE-PERICLASE PRODUCTS OPTIMISED FOR BASIC OXYGEN FURNACES TUU 26.2-00191885-007:2009 with amendments 1-3	
Parameter	Norm for the KhPKKOS products	
1. Mass fraction, %		
MgO, min	65.0	
Cr ₂ O ₃ , within the range of	12.0 - 17.0	
SiO ₂ , max	2.0	
CaO, max	3.0	
Fe ₂ O ₃ , within the range of	7.0-13.0	
Al ₂ O ₃ , within the range of	3.0-6.0	
2. Apparent porosity, %, max	16.0	
3. Cold crushing strength, MPa, min	50	
4. Refractoriness under load, °C, min	1630	
5. Thermal shock resistance, thermal cycles, min	9	

**MAGNESIA UNFIRED NOZZLES AND COLLECTING
NOZZLES
TECHNICAL SPECIFICATION
TUU 23.2-00190503-460:2021**



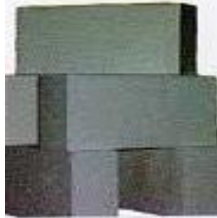
Parameter	PBS-88 (ПБС-88)
Mass fraction on ignition basis, %:	
MgO, min	88.0
Al ₂ O ₃ , min	-
SiO ₂ , max	-
Fe ₂ O ₃ , max	-
Cr ₂ O ₃ , within the range of	-
2 Loss on ignition, %, within the range of	-
3 Apparent porosity, %, max	-
4 Refractoriness, °C, min	-
5 Apparent density, g/cm ³ , min	2.55
6 Cold crushing strength, N/mm ² , min	25
7 Moisture content, %, max	0.5
Note. Unfired magnesia nozzles may be wax-coated subject to agreement between the manufacturer and the customer.	

**HIGH-DUTY CHROMITE-PERICLASE REFRACTORY
PRODUCTS
DSTU 2509-94(GOST 5381-93)**



Parameter	Norm for the products of grade				
	KhP -1 (XII -1)	KhP -2 (XII -2)	KhP -3 (XII -3)	KhP -4 (XII -4)	KhP -5 (XII -5)
1. Mass fraction (on ignition basis), %					
MgO, min	46	46	42	42	42
Cr ₂ O ₃ , within the range of	22	22	20	15	15
SiO ₂ , max	6	7	8	8	8
2. Apparent porosity, %, max	20	22	23	24	25
3. Apparent density, g/cm ³ , min	2.95	2.95	2.95	-	-
4. Cold crushing strength, N/mm ² , min	30	27.5	25	25	20
5. Refractoriness under load, °C, min	1550	1520	1500	1500	1450
6. Thermal shock resistance (heating up to 1300°C, water cooling), thermal cycles, min	2	2	2	-	-

PERICLASE-CHROMITE REFRACTORY PRODUCTS FOR OPEN-HEARTH FURNACE REGENERATOR CHECKERS TECHNICAL SPECIFICATION TU U 23.2-00191885-014:2022		
Parameter	Norm for the PKhN (ПХН) products	
1. Mass fraction, %:		
MgO, min	65.0	
Cr ₂ O ₃ , within the range of	10.0-15.0	
Fe ₂ O ₃ , max	12.0	
Al ₂ O ₃ , max	5.0	
2. Apparent porosity, %, max	18.0	
3. Cold crushing strength, N/mm ² , min	30.0	
4. Refractoriness under load, °C, min	1540	
5. Thermal shock resistance (heating up to 1300°C, water cooling), thermal cycles, min	6.0	

ALUMINA-PERICLASE-CARBON REFRACTORY PRODUCTS FOR STEEL LADLE BOTTOM LINING BRICKWORK TECHNICAL SPECIFICATION TU U 23.2-00191885-051:2023		
Parameter	APU-65 (АПУ-65)	APU-70 (АПУ-70)
1. Mass fraction, %		
Al ₂ O ₃ , min	65.0	70.0
MgO, min	9.0	9.0
CaO, max	-	-
Fe ₂ O ₃ , max	-	-
2. Mass fraction of total carbon (C), %, min	within the range of 8-12	min 6
3. Cold crushing strength, MPa, min	35.0	45.0
4. Apparent porosity, %, max	10.0	6.0
5. Apparent density, g/cm ³ , min	2.95	3.20

**CORUNDUM-CARBON REFRACTORY PRODUCTS
FOR HOT METAL LADLE LINING BRICKWORK
TECHNICAL SPECIFICATION
TU U 23.2-00191885-051:2023**



Parameter	Parameter value for grade	
	ZOZ brick KS-60 (KC-60)	ZOZ brick KS-85 (KC-85)
1. Mass fraction, %		
Al ₂ O ₃ , min	60	85
MgO, min	-	-
CaO, max	1.0	1.0
Fe ₂ O ₃ , max	2.0	2.0
2. Mass fraction of total carbon (C), %	min 8	min 8
3. Cold crushing strength, MPa, min	35.0	35.0
4. Apparent porosity, %, max	10.0	8.0
5. Apparent density, g/cm ³ , min	2.80	3.0



PRODUCTION OF UNMOULDED REFRACTORIES

The use of unmoulded refractories instead of artificial refractories creates conditions for mechanizing the lining process. In some cases, the use of unmoulded refractories allows increasing the service life of the lining in thermal units and reduce the costs of performing refractory work.



GROUND CHAMOTTE AND REFRACTORY CLAY POWDERS AND CHAMOTTE-CLAY POWDERS TECHNICAL SPECIFICATION TU U 23.2-00191885-052:2024	
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Powder grade	Parameter		
	Refractoriness, °C, min	Mass fraction on ignition basis, %, Al_2O_3 , min	Moisture content, %, max
PShKA (ПШКА)	1730	35	4
PShKB (ПШКБ)	1670	30	4
PShTA (ПШТА)	1730	35	4
PShTB (ПШТБ)	1670	30	4
PShTV (ПШТВ)	1580	28	4
PShGT-2 (ПШГТ-2)	1730	36	5

The grain size composition of ground refractory clay powders shall comply with the requirements specified in the table.

Parameter	Norm for the powders of grade		
	PShTA, PShTB, PShTV	PShKA, PShKB	PShGT-2
Passage through sieve No. 3.2 mm, %, min	-	100	-
Passage through sieve No. 2, %, min	-	90	95
Passage through sieve No. 1, %, min	100	-	-
Passage through sieve No. 05, %, min	90	40	within the range of 40-65
Passage through sieve No. 009, %, within the range of	-	-	20-30

Note. Subject to agreement between the manufacturer and the customer, ground chamotte, refractory clay powders, and chamotte-clay powders may be supplied with a different grain size distribution.

GROUND CHAMOTTE AND REFRACTORY CLAY POWDERS AND CHAMOTTE-CLAY POWDERS TECHNICAL SPECIFICATION TU U 23.2-00191885-052:2024	
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Powder grade	Parameter		
	Refractoriness, °C, min	Mass fraction on ignition basis, %, Al_2O_3 , min	Moisture content, %, max
PGOSA (ПГОСА)	1730	35	12
PGOSB (ПГОСБ)	1670	30	12
PGPKV (ПГПКВ)	1580	18	12
PGOSV (ПГОСВ)	1580	28	12
PGPKB (ПГПКБ)	1670	23	12

Note. Subject to agreement between the manufacturer and the customer, clay powders of grades PGOSA, PGOSB, and PGOSV may be supplied with a moisture content not exceeding 18%.

The grain size composition of ground refractory clay powders shall comply with the requirements specified in the table.

Parameter	Norm for the powders of grade
	PGOSA, PGOSB, PGOSV, PGPKB, PGPKV
Passage through sieve No. 3.2 mm, %, min	100
Passage through sieve No. 2, %, min	98
Passage through sieve No. 1, %, min	-
Passage through sieve No. 05, %, min	40

Note. Subject to agreement between the manufacturer and the customer, chamotte and refractory clay powders may be supplied with a different grain size distribution.

**ALUMINOSILICATE REFRACTORY
MORTARS
TECHNICAL SPECIFICATION
TU U 23.2-00191885-037:2025**



Parameter	Norm for grades				
	MSh 36 (MIII 36)	MSh 39 (MIII 39)	MShA 36 (MIIIA 36)	MShA 39 (MIIIA 39)	MSh 42 (MIII 42)
Mass fraction, %:					
Al ₂ O ₃ , min	36	39	36	39	42
Fe ₂ O ₃ , max	2.0	2.0	2.0	2.0	2.0
sodium carbonate (Na ₂ CO ₃), within the range of	0.12–0.18	0.12–0.18	-	-	-
lignosulfonates (LST), within the range of	0.07-0.13	0.07-0.13	-	-	-
Loss on ignition, %, within the range of	1.3-3.2	1.3-3.2	1.3-3.2	1.3-3.2	1.3-3.2
max	-	-	-	-	-
Refractoriness, °C, min	1730	1730	1730	1730	1730
Moisture content, %, max	5	5	5	5	5
Grain size distribution, %, passage through sieve No.:					
1, min	100	100	100	100	100
0.5, min	95	95	95	95	95
0.09, within the range of	60-90	60-90	60-90	60-90	60-90

**PLASTICIZED REFRACTORY
MORTARS
TECHNICAL SPECIFICATION
TU U 23.2-00191885-037:2025**



Parameter	Norm for grades			
	MMKR 45 (MMKP 45)	MMKR 50 (MMKP 50)	MMLA 62 (MMJA 62)	MMK 72-1 (MMK 72-1)
Mass fraction, %:				
Al ₂ O ₃ , min	45	50	62	72
Fe ₂ O ₃ , max	3.0	2.8	2.0	2.0
sodium carbonate (Na ₂ CO ₃), within the range of	-	-	-	-
lignosulfonates (LST), within the range of	-	-	-	-
Loss on ignition, %, within the range of	1.5-3.3	1.5-3.3	1.5-3.3	-
max	-	-	-	3.0
Refractoriness, °C, min	1750	1770	1790	-
Moisture content, %, max	5	5	5	5
Grain size distribution, %, passage through sieve No.:				
1, min	-	-	-	-
0.5, min	100	100	100	100
0.09, within the range of	60-90	60-90	60-90	60-90

CHAMOTTE REFRACTORY MORTARS

DSTU 3475–96 (GOST 6137–97)



Parameter	Norm for the grade	
	MP-18 (MII-18)	MSh-28 (MIII-28)
1. Mass fraction, %: Al ₂ O ₃ , min Fe ₂ O ₃ , max	18 -	28 -
sodium carbonate (Na ₂ CO ₃), within the range of	0.12–0.18	0.12–0.18
lignosulfonates (LST), within the range of	0.07-0.13	0.07-0.13
2 Loss on ignition, within the range of, %	1.3-3.0	1.3-3.0
3. Refractoriness, °C, min	1610	1650
4. Moisture content, %, max	6	5
5. Grain size distribution, %, passage through sieve No.: 2, min 0.5, within the range of	100 60-94	100 60-94

MULLITE BUFFER MIX OF GRADE MLBS-62 (МЛБС- 62)
TECHNICAL SPECIFICATION
TU U 23.2-00191885-036:2024



Parameter	Norm for MLBS-62
1. Mass fraction (on ignition basis), %:	
Al ₂ O ₃ , min	62.0
Fe ₂ O ₃ , max	3.0
P ₂ O ₅ , within the range of	0.3-1.0
2. Moisture content, %, within the range of	1.0-2.0
3. Grain size distribution, %:	
residue on sieve No. 5, max	5.0
residue on sieve No. 3, max	15.0
passage through sieve No. 0.5, within the range of	37.0-47.0
passage through sieve No. 009, within the range of	28.0-37.0

**PERICLASE-CHROMITE REFRACTORY
MORTARS**
TECHNICAL SPECIFICATION
TU U 26.2-00191885-016:2011



Parameter	Norm for the grade	
	MPKh (МІХ)	MPKhG-10 (МІХГ-10)
1 Mass fraction, %:		
MgO, min	65	50
Cr ₂ O ₃ , within the range of	13-17	12-17
Al ₂ O ₃ , min	optional	5
2 Grain size distribution, %:		
passage through sieve No. 05, min	-	90
passage through sieve No. 0063, min	93	75

Note. Subject to agreement between the manufacturer and the customer, refractory mortar may be supplied with a different grain size distribution.

	REFRACTORY AGGREGATES GOST 23037-99		
Parameter	Norm for the grade		
	ZShA (ЗША)	ZMK (ЗМК)	ZShB (ЗШБ)
Mass fraction, %: Al ₂ O ₃ , min Fe ₂ O ₃ , max	35 -	72-95 1.5	28 -
Refractoriness, °C, min	1690	-	1630
Moisture content, %, max	5	5	5
Water absorption, %, max	6	3	8
Note. 1 For aggregates made from rejects and scrap, water absorption shall not exceed 15%; the mass fraction of Fe₂O₃ is not regulated. 2 For aggregates of classes 5–8, water absorption is not regulated.			

	PERICLASE-CHROMITE AND CHROMITE- PERICLASE POWDERS FOR GUNNING OF WALLS AND SLOPES OF STEELMAKING FURNACES TECHNICAL SPECIFICATION TU U 23.2-00191885-044:2022		
Parameter	Norm for the products of grade		
	PPKhT (ППХТ)	PPKhT-1 (ППХТ-1)	PPKhPT (ППХПТ)
1 Mass fraction, %			
Cr ₂ O ₃ , within the range of	15-25	10-25	30-40
MgO, min	55	55	-
max	-	-	55
SiO ₂ , max	5	5	7
CaO, max	3	3	2.5
2 Moisture content, %, max	1.5	2	2
3. Grain size distribution, %			
residue on sieve No. 3	Not permitted		
residue on sieve No. 1, max	5	10	10
passage through sieve No. 05, within the range of	65-85	-	70-80
including passage through sieve No. 009, within the range of	20-30	20-40	20-30

	CHROMITE POWDER TECHNICAL SPECIFICATION TU U 23.2-00191885-050:2023		
Parameter	Norm for the products of grade		
	PKh-45 (IIX-45)	PKh-40 (IIX-40)	
1 Mass fraction, %			
Cr ₂ O ₃ , within the range of	45	40	
2. Grain size distribution, %			
residue on sieve No. 3.2, min	Not permitted		
residue on sieve No. 2, max	5	8	
passage through sieve No. 0.5, max	90	90	

	MULLITE-CORUNDUM REFRACTORY MIXES FOR LINING IN BASIC OXYGEN FURNACE AND BLAST FURNACE OPERATIONS TECHNICAL SPECIFICATION TU U 23.2-00191885-053:2024	
Parameter	Norm for the mix of grade MMK-72 (MMK-72)	
1. Mass fraction (on ignition basis), %:		
Al ₂ O ₃ , min	72.0	
Fe ₂ O ₃ , max	1.3	
P ₂ O ₅ , within the range of	2.4-3.2	
2. Loss on ignition, %, within the range of	1.5-2.2	
3. Moisture content, %, within the range of	6-7	
4. Grain size distribution, %:		
passage through sieve No. 5, min	100	
passage through sieve No. 3.2, within the range of	90-100	
passage through sieve No. 2, within the range of	80-90	
passage through sieve No. 05, max	70	
passage through sieve No. 009, within the range of	39-46	

**CERAMIC MIX FOR HARDFACING
TECHNICAL SPECIFICATION
TU U 23.2-00191885-028:2016**



Parameter	Norm for grade SNK-1 (CHK-1)
1 Mass fraction of SiO ₂ (on ignition basis), % min	85.0
2 Moisture content, %, max	1.0
3 Refractoriness, °C, min	1580
4 Grain size distribution, %, 0-1 mm	100

Note. The production of the mixture with other physico-chemical properties and a different grain size distribution is permitted subject to agreement between the manufacturer and the customer.

**REFRACTORY AGGREGATES FOR CONCRETE
PRODUCTS, MIXES, COMPOUNDS, COATINGS,
AND MORTARS
GOST 23037-99**



Parameter	Norm for the aggregates of grade				
	ZPKh (3HX)	ZKhP (3XII)	ZKh-30 (3X-30)	SPSp-85 (3HCn-85)	SPSp-90 (3HCn-90)
1 Mass fraction, %					
Cr ₂ O ₃ , within the range of	5-20	15-35	Minimum 30	-	-
MgO, min	60	Less than 55	-	85	90
SiO ₂ , max	5.0	7.0	8.5	5.0	4.0
CaO, max	-	-	2.0	10.0	8.0
2 Moisture content, %, max	2	3	3	1	1
3. Loss on ignition, % max	-	-	-	1	0.6
4 Grain size distribution, %, Norm for class					
	4	5	6	7	
residue on sieve No. 10, max	Not permitted	-	-	-	
residue on sieve No. 5, max	5	Not permitted	-	-	
residue on sieve No. 2, max	40	50	Not permitted	-	
residue on sieve No. 1, max	-	-	5	Not permitted	
passage through sieve No. 0.5, min	20	40	60	95	
including No. 009, min	-	15	30	80	

**PLASTICIZED REFRACTORY
SILICA MORTARS
TECHNICAL SPECIFICATION**

TU U 23.2-00191885-046: 2022



Parameter	Norm for the products of grade MD 94 (МД 94)
1. Mass fraction %, SiO_2 , min	94
Al_2O_3 , within the range of	2.0-3.5
Na_2CO_3 , within the range of	0.10-0.15
LST, within the range of	0.07-0.12
2. Loss on ignition, %, max	1.1
within the range of	
3. Moisture content, %, max	5
4. Grain size distribution, %	
passage through sieve No. 2, min	100
passage through sieve No. 1, min	97
passage through sieve No. 02, within the range of	65-85
passage through sieve No. 009, within the range of	45-65

Note. The production of mortar with other physico-chemical properties and a different grain size distribution is permitted subject to agreement between the manufacturer and the customer.

**REFRACTORY SILICA MORTAR
FOR COKE OVEN
BRICKWORK
TECHNICAL SPECIFICATION
TU U 23.2-00191885-047: 2022**



Parameter	Norm for the mortar of grade	
	MDK-1 (МДК -1)	MDK-2 (МДК -2)
1. Mass fraction, %		
SiO ₂ , min	90	90
Al ₂ O ₃ , within the range of	3.5-5.0	3.5-5.0
Na ₂ CO ₃ , within the range of	0.10-0.15	0.10-0.15
2. Loss on ignition, %:		
within the range of	0.9-1.7	-
max	-	2.0
3. Moisture content, %, max	5	5
4. Refractoriness, °C, min	1610	1610
5. Grain size distribution, %:		
passage through sieve No. 2, min	100	100
passage through sieve No. 1, min	97	97
passage through sieve No. 02, within the range of	65-80	65-80
passage through sieve No. 009, within the range of	45-60	45-65
6. Brickwork properties – joint thickness during the mortar spread (105–110) mm, within the range of	3-5*	3-5*
7. Aluminium sulphate, %	0.1**	-
Note.* – the parameter is recommended and not subject to control. **Aluminium sulphate is added in the amount of 0.1% (over 100%) by the customer and is not subject to control.		



CASTING POWDERS

ZAPORIZHZHIA REFRACTORIES develops and produces slag-forming powders, heat-insulating and starting mixtures, which are used for continuous casting of steel, as well as for casting steel in casting moulds during bottom pouring for a long time.

At present, casting powders produced by ZAPORIZHZHIA REFRACTORIES are successfully used at steelmaking enterprises of Ukraine, etc.

With the use of the developed mixtures, more than 15 mln tonnes of various steel grades, including those with a carbon content of 0.03% to 0.8%, as well as alloyed with silicon, manganese, chromium, niobium, vanadium, aluminum, etc., were cast at slab and bloom CCMs.

Slag-forming mixtures are used in continuous casting of steel and bottom casting into moulds to protect the liquid steel surface from secondary oxidation, assimilation of non-metallic inclusions and improve the surface quality of cast

steel.

Heat-insulating mixtures are used to insulate the steel surface in tundishes and steel ladles. Having low aggressiveness towards the tundish lining, the heat-insulating mixture allows you to increase the heat sequences and, as a result, reduce the consumption of gunning mix for lining the working layer of tundish. The use of heat-insulating mixtures in steel ladles allows you to ensure the fluidity of slag and its easy removal at the end of pouring. After the end of steel casting and slag removal, the lining

of steel ladle is kept clean – without slag build-ups and steel scraps. The use of heat-insulating mixtures in bottom casting of steel into moulds allows you to reduce the shrinkage cavities in ingots.

Starting mixtures are used to fill the ladle tap hole for easy opening of the slide gate for steel tapping, with guaranteed openness without the use of oxygen at least 99%.

**REFRACTORY MIXTURES FOR PROCESS
NEEDS
TECHNICAL SPECIFICATION
TU U 23.2–00191885–029:2024**



Parameter	Norm for the products of grade				
	ZOZ MIX ht 15–20/3	ZOZ MIX rms 25-03	ZOZ MIX hm 25-02	ZOZ MIX hm 45-01	ZOZ MIX hs 30-01/2
1. Mass fraction of SiO_2 , %	max 60.0	max 28.0	within the range of 30.0-70.0	within the range of 30.0-50.0	within the range of 30.0-70.0
2. Mass fraction of Al_2O_3 , %, within the range of	15.0-40.0	-	-	-	10.0 – 30.0
3. Mass fraction of CaO , %	max 10.0	-	-	-	-
4. Mass fraction of C , %	within the range of 10.0-20.0	min 0.6	within the range of 20.0-35.0	within the range of 35.0 -45.0	max 25
5. Mass fraction of Cr_2O_3 , %, min	-	34.0	-	-	-
6. Moisture content, % max	2.0	0.5	2.0	4.0	2.0
7. Bulk density	-	min 1.8 g/cm ³	within the range of 150-300 kg/m ³	max 210.0 kg/m ³	max 800.0 kg/m ³
8. Grain size distribution, %	Residue on sieve No. 5- max 5.0	Passage through screen No. 1- min 95	-	-	-

REFRACTORY MIXTURES FOR PROCESS NEEDS
TECHNICAL SPECIFICATION
TU U 23.2-00191885-029:2024

Parameter	Norm for the products of grade					
	ZOZ MIX sfc 7-12	ZOZ MIX sfm 14-06	ZOZ MIX sfc 15-20 (M)	ZOZ MIX sfc 14-17	ZOZ MIX sfc 20-28	ZOZ MIX sfc 17-20
1. Mass fraction of SiO_2 , %, within the range of	27.0 - 34.0	26.0 - 35.0	20.0 - 30.0	22.0 - 30.0	20.0 - 30.0	20.0 - 30.0
2. Mass fraction of Al_2O_3 , %, max	6.0					
3. Mass fraction of CaO , %, within the range of	25.0 – 32.0	28.0 – 35.0	22.0 - 30.0	23.0 - 32.0	20.0 - 30.0	22.0 - 32.0
4. Mass fraction of $\text{Na}_2\text{O} + \text{K}_2\text{O}$, %, within the range of	3.0 – 6.0	-	2.0 – 6.0	-	2.0 – 6.0	-
5. Mass fraction of C , %, within the range of	7.0 – 12.0	3.0 – 6.0	15.0 – 20.0	14.0 – 17.0	20.0–28.0	17.0 – 20.0
6. Free carbon, %, within the range of	5.0 – 10.0	1.0 – 3.0	-	11.0 – 15.0	-	-
7. Mass fraction of F_2 , %, within the range of	5.0 – 8.0	5.0 – 8.0	5.0 – 10.0	5.0 – 10.0	5.0 – 8.0	5.0 – 10.0
8. Mass fraction of S , %, max	0.8	1.0	1.0	1.0	1.0	1.0
9. Moisture content, %, max	0.5	0.5	0.5	1.0	1.0	1.0
10. Basicity, within the range of CaO/SiO_2	0.8 – 1.2	0.8 – 1.2	0.8 – 1.0	0.8 – 1.2	0.8 – 1.2	0.8 – 1.2
11. Grain size distribution, %	Residue on sieve No. 3 - not permitted Residue on sieve No. 1 - maximum 3.0 Residue on sieve No. 063 - maximum 10.0 Passage through sieve No. 0063 - minimum 50.0					

The data presented in the tables are for informational purposes only, as they are based on average actual values obtained from laboratory testing of serial production.



PRODUCTION OF REFRACTORY CONCRETES AND MIXTURES

The shop for the production of high-tech refractory concrete mixtures was put into operation in May 2013. The new production site, designed and equipped by EIRICH, is highly productive continuous automated plant, equipped with high-precision weighing, dosing and mixing equipment.

Production facilities allow the production of a wide range of high-tech refractory concrete mixtures of various compositions for lining thermal units of enterprises of metallurgical, cement, glass, chemical, heat and power industries, etc.

The use of modern refractory concretes is a key tool for reducing the specific consumption and costs of refractories, the development of new structural high-efficiency schemes for lining thermal units, improving the conditions of their operation and repair, improving the production culture of enterprises.



**DRY REFRACTORY
CONCRETE MIX
of grade SSB-90V (CCБ-90B)**



Parameter	Norm for grade SSB-90V
1. Mass fraction, %	
Al ₂ O ₃ , min	90.0
Fe ₂ O ₃ , max	0.5
CaO, max	1.5
2. Moisture content, %, max	0.2
3. Grain size distribution, size 0-10 mm	
residue on sieve No. 10, %, max	10
4. Cold crushing strength, MPa, min	
after firing at 1000°C (T _{firing1})	50.0
after firing at 1500°C (T _{firing2})	80.0
5. Apparent density, g/cm ³ , min	
after firing at 1000°C (T _{firing1})	2.8
after firing at 1500°C (T _{firing2})	2.8
Note. 1 Type of binding: hydraulic 2. Method of application: vibration 3. Mixing water quantity, l/100 kg, within the range of 4.5–5.5 — for monolithic lining at the customer's site.	

**DRY REFRACTORY
CONCRETE MIX
of grade SSB-80V (CCБ-80B)**



Parameter	Norm for grade SSB-80V
1. Mass fraction, %	
Al ₂ O ₃ , min	90.0
Fe ₂ O ₃ , max	0.5
CaO, max	1.5
2. Moisture content, %, max	0.2
3. Grain size distribution, size 0-10 mm	
residue on sieve No. 10, %, max	10
4. Cold crushing strength, MPa, min	
after firing at 1000°C (T _{firing1})	50.0
after firing at 1500°C (T _{firing2})	80.0
5. Apparent density, g/cm ³ , min	
after firing at 1000°C (T _{firing1})	2.8
after firing at 1500°C (T _{firing2})	2.8
Note. 1 Type of binding: hydraulic 2. Method of application: vibration 3. Mixing water quantity, l/100 kg, within the range of 4.5–5.5 — for monolithic lining at the customer's site.	

Physical and chemical parameters - in accordance with the customer's contract (specification)

**DRY REFRACTORY
CONCRETE MIX
of grade SSB-80S (CCB-80C)**



Parameter	Norm for grade SSB-80S
1. Mass fraction, %	
Al ₂ O ₃ , min	90.0
Fe ₂ O ₃ , max	0.5
CaO, max	1.5
2. Moisture content, %, max	0.2
3. Grain size distribution, size 0-10 mm	
residue on sieve No. 10, %, max	10
4. Cold crushing strength, MPa, min	
after firing at 1000°C (T _{firing1})	50.0
after firing at 1500°C (T _{firing2})	80.0
5. Apparent density, g/cm ³ , min	
after firing at 1000°C (T _{firing1})	2.8
after firing at 1500°C (T _{firing2})	2.8
Note. 1 Type of binding: hydraulic 2. Method of application: vibration 3. Mixing water quantity, l/100 kg, within the range of 4.5–5.5 — for monolithic lining at the customer's site.	

Physical and chemical parameters - in accordance with the customer's contract (specification)

DRY REFRACTORY CONCRETE MIXES TECHNICAL SPECIFICATION TU U 23.2-00191885-030:2023 (for lining various thermal equipment)						
Parameter	ZOZ CAST FC40 MCC	ZOZ CAST HA 60 VL	ZOZ CAST HA 65 LCC	ZOZ CAST HA 75 LCC	ZOZ CAST FC 55 MCC	ZOZ CAST HA 55-01 LCC
Mass fraction on ignition, %						
Al ₂ O ₃ , min	45	60	65	80	62	55
Fe ₂ O ₃ , max	-	-	1.5	1.2	2.0	-
CaO, max	3.5	2	1.5	1.5	4.0	1.8
SiO ₂ , max	-	-	-	-	-	-
SiC, max	-	-	-	-	-	-
Moisture content, %, max	0.2	0.2	0.2	0.2	0.2	0.2
Amount of mixing water, l/100kg	7.5-8.0	6.0-7.0	6.0-6.5	6.0-6.5	7.0-7.5	5.0-6.0
Cold crushing strength, MPa, min						
After drying at 110 ⁰ C	25		30	25	40	50
After firing at 1000 ⁰ C (T _{firing2})	-	30	40	-	55	-
After firing at 1500 ⁰ C (T _{firing2})			70	50	70	95
After firing at 1400 ⁰ C	30	-	-	-	-	-
Apparent density, g/cm ³ , min						
After drying at 110 ⁰ C	2.15	-	2.45	2.65	2.4	2.4
After firing at 1000 ⁰ C (T _{firing2})	-	-	2.5	-	2.4	-
After firing at 1500 ⁰ C (T _{firing2})	-		2.52	2.65	2.35	2.3
After firing at 1400 ⁰ C	2.1	-	-	-	-	-

DRY REFRACTORY CONCRETE MIXES TECHNICAL SPECIFICATION TU U 23.2-00191885-030:2023 (for linings of various thermal equipment)						
Parameter	ZOZ CAST bot 16 VD	ZOZ CAST bot 17 VD	ZOZ CAST HA 85 LCC	ZOZ CAST wos 17 VD	ZOZ CAST bod 50 VD	ZOZ CAST bod 60 VD
Mass fraction on ignition, %						
Al ₂ O ₃ , min	80	72	85	90	50	66
Fe ₂ O ₃ , max	1.2	1.5	1.0	0.5	1.8	1.0
CaO, max	1.5	1.5	1.5	1.5	2.4	2.3
SiO ₂ , max	-	-	-	-	-	27
SiC, max	-	-	-	-	19	-
Moisture content, %, max	0.2	0.2	0.2	0.2	0.2	0.2
Amount of mixing water, l/100kg	5.5-6.0	5.5-6.5	5.5-6.0	4.5-5.5	4.0-6.0	4.6-5.2
Cold crushing strength, MPa, min						
After drying at 110 ⁰ C	35	-	50	-	50	50
After firing at 1000 ⁰ C (T _{firing2})	50	35	40	50	70	70
After firing at 1500 ⁰ C (T _{firing2})	70	70	80	80	50	50
After firing at 1400 ⁰ C	-	-	-	-	-	-
Apparent density, g/cm ³ , min						
After drying at 110 ⁰ C	2.65	-	2.8	-	-	-
After firing at 1000 ⁰ C (T _{firing2})	2.6	2.5	2.8	2.8	2.65	2.65
After firing at 1500 ⁰ C (T _{firing2})	2.65	2.5	2.85	2.8	-	-
After firing at 1400 ⁰ C	-	-	-	-	-	-

**DRY REFRACTORY
CONCRETE MIXES
TECHNICAL SPECIFICATION
TU U 23.2-00191885-030:2023
(for linings of various thermal equipment)**



Parameter	ZOZ CAST wad 57 VD	ZOZ CAST wad 48 VD	ZOZ CAST wod 65 VD	ZOZ CAST wod 70 VD	ZOZ CAST wod 71 VD	ZOZ CAST bod 74 VD
Mass fraction on ignition, %						
Al ₂ O ₃ , min	57	48	65	70	71	74
Fe ₂ O ₃ , max	1.5	2.0	1.0	0.5	2	0.8
CaO, max	2.7	2.9	1.0	1.0	1.0	1.0
SiO ₂ , max	38	43	6.0	4,3	5.0	16.0
SiC, max	-	-	18.0	18.6	21	6.0
Moisture content, %, max	0.2	-	-	-	0.2	-
Amount of mixing water, l/100kg	4.5-5.8	4.5-5.8	4.2-5.0	3.5-4.8	3.0-4.2	4.1-5.1
Cold crushing strength, MPa, min						
After drying at 110 ⁰ C	50	52	45	40	40	80
After firing at 1000 ⁰ C (T _{firing2})	50	40	55	40	40	-
After firing at 1500 ⁰ C (T _{firing2})	-	-	-	-	-	100
After firing at 1400 ⁰ C	-	-	-	-	-	-
Apparent density, g/cm ³ , min						
After drying at 110 ⁰ C	-	-	-	-	-	-
After firing at 1000 ⁰ C (T _{firing2})	2.48	2.65	2.93	3.0	2.85	2.86
After firing at 1500 ⁰ C (T _{firing2})	-	-	-	-	-	-
After firing at 1400 ⁰ C	-	-	-	-	-	-

**DRY REFRACTORY
CONCRETE MIXES
TECHNICAL SPECIFICATION
TU U 23.2-00191885-030:2023
(for linings of various thermal equipment)**



Parameter	ZOZ CAST wod 85 VD	ZOZ CAST wod 77 VD	ZOZ CAST wod 75 VD	ZOZ CAST wod 74 VD
Mass fraction on ignition, %				
Al ₂ O ₃ , min	85	77	75	74
Fe ₂ O ₃ , max	0.2	0.5	0.1	0.9
CaO, max	0.5	0.6	0.9	0.7
SiO ₂ , max	1,6	6	4.2	9.0
SiC, max	10	13	18	12
Moisture content, %, max	-	-	-	-
Amount of mixing water, l/100kg	3.4-4.4	4.4-5.4	3.8-4.8	3.4-4.4
Cold crushing strength, MPa, min				
After drying at 110 ⁰ C	40	50	65	100
After firing at 1000 ⁰ C (T _{firing2})	-			
After firing at 1500 ⁰ C (T _{firing2})	60	140	80	100
After firing at 1400 ⁰ C	-	-	-	-
Apparent density, g/cm ³ , min				
After drying at 110 ⁰ C	-	-	-	-
After firing at 1000 ⁰ C (T _{firing2})	3.27	2.98	3.08	3.0
After firing at 1500 ⁰ C (T _{firing2})	-	-	-	-
After firing at 1400 ⁰ C	-	-	-	-

Note 1. The mass fraction of SiC is ensured by the manufacturing process.

Note. The cold crushing strength and apparent density at firing temperatures of 1400⁰C and 1500⁰C are ensured by the manufacturing process

PRODUCTS UNDER TESTING AND DEVELOPMENT

HARDENING AGENT OF GRADE ZOZ MIH QH-2 <i>FOR INSULATING INSERTS OF MOULDS</i>																			
<table><tr><th>Parameter</th><th>Norm for grade ZOZ MIH QH-2</th></tr><tr><td>1. Mass fraction, %</td><td></td></tr><tr><td>Al₂O₃, min</td><td>7.0</td></tr><tr><td>SiO₂, min</td><td>30</td></tr><tr><td>CaO, min</td><td>35</td></tr><tr><td>2. Moisture content, %, max</td><td>1.0</td></tr><tr><td>3. Grain size distribution, %:</td><td></td></tr><tr><td>residue on sieve No. 1, max</td><td>3</td></tr><tr><td>passage through sieve No. 0.09mm, min</td><td>75</td></tr></table>		Parameter	Norm for grade ZOZ MIH QH-2	1. Mass fraction, %		Al ₂ O ₃ , min	7.0	SiO ₂ , min	30	CaO, min	35	2. Moisture content, %, max	1.0	3. Grain size distribution, %:		residue on sieve No. 1, max	3	passage through sieve No. 0.09mm, min	75
Parameter	Norm for grade ZOZ MIH QH-2																		
1. Mass fraction, %																			
Al ₂ O ₃ , min	7.0																		
SiO ₂ , min	30																		
CaO, min	35																		
2. Moisture content, %, max	1.0																		
3. Grain size distribution, %:																			
residue on sieve No. 1, max	3																		
passage through sieve No. 0.09mm, min	75																		
Physical and chemical parameters - in accordance with the customer's contract (specification)																			

GUNNING MIX ZOZ AL55 SIC9	
Parameter	Norm for grade ZOZ AL55 SIC9
1. Mass fraction, %	
Al ₂ O ₃ , min	55
SiC, within the range of	8 - 12
2. Moisture content, %, max	0.5
3. Cold crushing strength, N/mm ² :	
- after drying at 110°C (24 hours)	minimum 10
- after firing at 1500°C (5 hours)	minimum 20
5. Apparent density, g/cm ³ , min	
- after drying at 110°C (24 hours)	minimum 2.15
- after firing at 1500°C (5 hours)	minimum 2.25
Physical and chemical parameters - in accordance with the customer's contract (specification)	

**SHOTCRETE
ZOZ GUN 60-01 TD**



Parameter	Norm for grade ZOZ AL55 SIC9
1. Mass fraction, %	
Al ₂ O ₃ , min	60
Fe ₂ O ₃ , max	1.0
2. Moisture content, %, max	0.5
3. Cold crushing strength, N/mm ² :	
- after drying at 110°C (24 hours)	minimum 15
- after firing at 1500°C (5 hours)	minimum 20
4. Apparent density, g/cm ³ , min	
- after drying at 110°C (24 hours)	minimum 2.10
- after firing at 1500°C (5 hours)	minimum 2.15

Physical and chemical parameters - in accordance with the customer's contract (specification)

VIBROCAST PRODUCTS

The shop includes a section for the production of refractory concrete products, where complex vibrocast products are manufactured.

VIBROCAST CONCRETE PRODUCTS FOR CONTINUOUS STEEL CASTING TUNDISHES



Parameter	Norm for products	
	Crucible	Well block
1. Mass fraction, %		
Al ₂ O ₃ , min	90.0	90.0
Fe ₂ O ₃ , max	0.5	0.5
CaO, max	1.5	1.5
2.Cold crushing strength, MPa, min: -after firing, in the cold state	50.0	40.0
3.Apparent density, g/cm ³ , min: -after firing, in the cold state	2.8	2.8
Note. Physical and chemical parameters, drawings, overall dimensions of the product, dimensional tolerances, and appearance parameters - in accordance with the customer's contract (specification).		

**VIBROCAST CONCRETE PRODUCTS
FOR CONTINUOUS STEEL CASTING
TUNDISHES**



Parameter	Norm for products	
	Impact plates	Block for the installation of thermocouples
1. Mass fraction, %		
Al ₂ O ₃ , min	90.0	90.0
Fe ₂ O ₃ , max	0.5	0.5
CaO, max	1.5	1.5
2. Cold crushing strength, MPa, min: -after firing, in the cold state	50.0	40.0
3. Apparent density, g/cm ³ , min: -after firing, in the cold state	2.8	2.8
Note. Physical and chemical parameters, drawings, overall dimensions of the product, dimensional tolerances, and appearance parameters - in accordance with the customer's contract (specification).		

VIBROCAST CONCRETE PRODUCTS FOR STEEL LADLES



Parameter	Norm for products	
	Well block for slide gates	Tuyere block for bottom argon purging
1. Mass fraction, %		
Al ₂ O ₃ , min	90.0	90.0
Fe ₂ O ₃ , max	0.5	0.5
CaO, max	1.5	1.5
2. Cold crushing strength, MPa, min: -after firing, in the cold state	50.0	50.0
3. Apparent density, g/cm ³ , min: -after firing, in the cold state	2.8	2.8
Note. Physical and chemical parameters, drawings, overall dimensions of the product, dimensional tolerances, and appearance parameters - in accordance with the customer's contract (specification).		

VIBROCAST CONCRETE PRODUCTS FOR STEEL LADLES



Physical and chemical parameters

Parameter	Norm for products	
	Ladle nozzle	Impact plate
1. Mass fraction, %		
Al ₂ O ₃ , min	90.0	90.0
Fe ₂ O ₃ , max	0.5	0.5
CaO, max	1.5	1.5
2. Cold crushing strength, MPa, min: -after firing, in the cold state	50.0	50.0
3. Apparent density, g/cm ³ , min: -after firing, in the cold state	2.8	2.8
Note. Physical and chemical parameters, drawings, overall dimensions of the product, dimensional tolerances, and appearance parameters - in accordance with the customer's contract (specification).		

**VIBROCAST CONCRETE PRODUCTS
FOR PELLET INDURATION MACHINES**



Physical and chemical parameters

Parameter	Norm for products
	Burner block
1. Mass fraction, %	
Al ₂ O ₃ , min	58.0
2. Cold crushing strength, MPa, min: -after firing, in the cold state	20.0
3. Apparent density, g/cm ³ , min: -after firing, in the cold state	2.6
4. Apparent porosity, %, max -after firing, in the cold state	25
Note. Physical and chemical parameters, drawings, overall dimensions of the product, dimensional tolerances, and appearance parameters - in accordance with the customer's contract (specification).	



REFRACTORY SERVICE OF ZAPORIZHZHIA REFRACTORIES

One of the new and prioritised areas of activity for ZAPORIZHZHIA REFRACTORIES is the performance of refractory works. Many years of experience in the refractory business have demonstrated that while high-quality refractory products are important, they are not the sole factor in the efficient use of refractories. Our customers often cite "low-quality" refractories as the reason for not achieving the planned economic benefits. However, failure to follow the methodology for performing and preparing the lining for operation, as well as lining maintenance recommendations or intermediate repair schedules, leads to premature lining wear, which increases specific costs and reduces the efficiency of use of refractories.

Only through strict control and adherence to the supplier's technical requirements for the

preparation and operation of linings can the customer achieve the main goal – reliable production, desired properties of finished products, reduced labour costs for refractory installation works, higher lining durability, and lower specific consumption and refractory expenses.

To date, ZAPORIZHZHIA REFRACTORIES offers a wide range of services for the organisation and performance of refractory work:

- inspection of facilities;
- development of lining designs;
- selection of required materials;
- manufacture and supply of refractories and related materials;
- performance of refractory installation works, including on a turnkey basis;
- putting into operation;
- after-sales warranty service.

This allows customers to focus on managing and improving core business efficiency; reducing refractory inventories and freeing up working capital; reducing specific costs for refractories and their use; as well as lowering personnel costs related to sourcing, installation, maintenance, and repair of linings.





PACKAGING

Effective packaging is the key to ensuring the safe delivery of refractory products to customers, preserving their appearance and protecting them from moisture.

The company has done a lot in this area. Refractory products are packed in packages placed on metal or wooden pallets.

Palletised packages are covered with corrugated cardboard boxes and stretch polyethylene film. All packages are secured with polyester straps.

Special packing machines, purchased in Canada and the USA, automatically wrap the packages in self-adhesive film, protecting the products from mechanical damage and moisture.

Particularly complex refractories are packed in wooden boxes weighing up to 1 ton. Bulk materials are packed in Big Bags.

While improving packaging, we completed the mechanisation of warehouse operations and the loading of refractories onto rail and road transport.

Reliable packaging ensures that refractory products reach customers with all their physical and chemical properties fully preserved in accordance with technical regulations.



All raw materials supplied to the company are subject to incoming inspection: ore, magnesites, clays, kaolins, etc.

All raw materials delivered to the enterprise – including ore magnesite, clays, kaolins, and others – are subject to incoming inspection.

Samples are taken and sent to the Central Laboratory of the Quality Control Department to determine quality parameters such as chemical composition, moisture, grain size distribution, and others. Chemical composition is analysed by

the Quality Control Department using the chemical method and X-ray spectrometry on a Simultix 14 unit. The raw materials are qualified based on the results of laboratory tests.

Finished products are certified by the Quality Control Department for compliance with regulatory documents (GOST, DSTU, TUU, etc.) and attested according to ISO 17025, as well as other regulatory documents in force at the manufacturing facility and in Ukraine.

Based on external inspection (dimensions, completeness, packaging, etc.), as well as results of physical and mechanical testing and chemical composition control performed by the QCD, a certificate of conformity is issued. All shipped products have quality certificates.





RESEARCH WORK

The technical divisions of ZAPORIZHZHIA REFRACTORIES are supported by the central integrated laboratory (CIL) that includes a research department (RD).

The department was established to develop new types of refractories and improve existing products, conduct product testing at customers' sites, and gather analytical data on refractory performance. The establishment of the RD has enabled the company to introduce new technologies and launch

the production of modern refractories with minimal cost, such as periclase-carbon refractories for the lining of ladles, basic oxygen furnaces, and steel tapholes, periclase fired refractories for steel tapholes, and periclase-chromite direct-bonded refractories for the lining of open-hearth furnace roofs. This has resulted in extended service life of thermal equipment and reduced specific refractory consumption for customers.

The RD provides engineering services and consulting on the sustainable use of refractories. They develop technical proposals for refractory linings of thermal equipment based on customers' requests.

Even after new products have been developed and introduced into serial production, the RD continues to monitor their performance at customers' sites and adjusts their properties according to specific service conditions.

Systematic research and development activities contribute to the improvement of aluminosilicate and magnesia refractory manufacturing processes, reduction of production defects, and enhancement of process equipment.



ENVIRONMENTAL PROTECTION

ZAPORIZHZHIA REFRACTORIES pursues a consistent policy aimed at reducing emissions of harmful substances to the atmosphere and discharges into water bodies. By-products, raw materials generated during processing, and non-conforming products are recycled. The company currently operates 135 dedusting plants of various types, covering all process equipment. Between 1995 and

2005, the company invested over UAH 12 million in the reconstruction, replacement, and construction of modern electrostatic precipitators. In parallel, funds are allocated to improve production equipment and implement additional measures, which also contribute to reducing harmful emissions. Each year, the company spends UAH 1-2 million from its production development fund for these purposes.

In 1998, to eliminate discharges into the Dnieper River and to switch shops to full water recirculation, the company introduced new wastewater treatment facilities that integrate industrial and stormwater effluents into one recirculation system, reusing the treated water for production.

The construction of the wastewater treatment facilities brought the concentration of harmful substances in discharges in line with the regulatory values and decreased the discharge volume tenfold.

Work is currently underway to further modernise and improve dedusting equipment.

