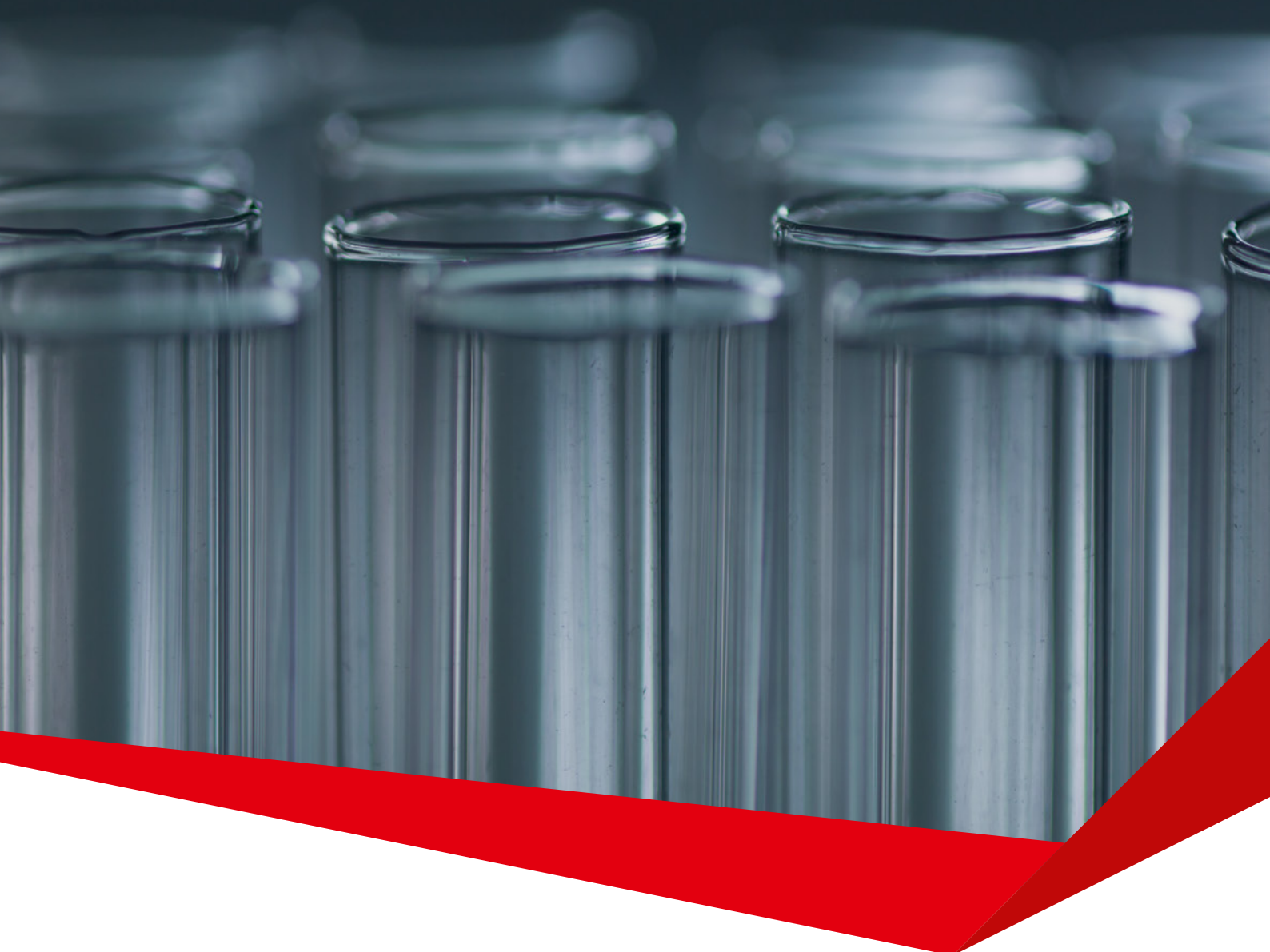


TOP QUALITY REFRACTORY MATERIALS

TAILOR-MADE SOLUTIONS FOR
THE GLASS INDUSTRY



top technology |
creates confidence

RATH



SPECIALIST IN TOP TECHNOLOGY IN HIGH TEMPERATURE

QUALITY WITH AN OPTIMUM PRICE-PERFORMANCE RATIO.

Rath perfectly combines tradition and innovation. The result: optimum refractory solutions for a wide variety of applications. Our extensive product range is manufactured in-house. By using selected materials and precise processing techniques we are able to guarantee the highest levels of quality.

The Rath sales teams are focused on the sector and familiar with its specific requirements. In addition to this, our technical departments possess the required expertise in engineering and assembly. This means we can offer our customers individual, complete refractory solutions with an optimal price-performance ratio.

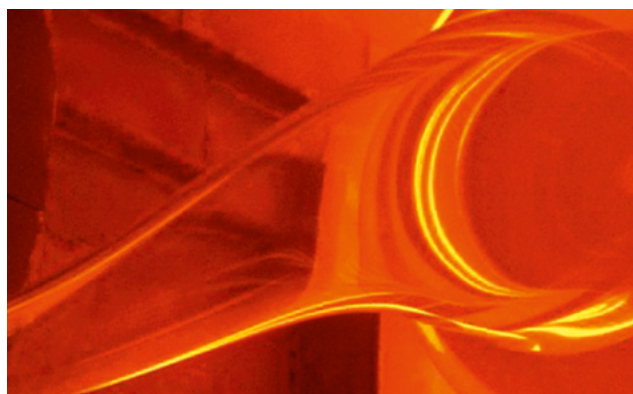


EFFICIENT PRODUCTION: A CRYSTAL-CLEAR GOAL.

The window letting in the light, the wine bottle preserving the bouquet, the mirror that "examines" us every day – glass is a key element of our daily lives. Great expertise is needed to produce it and the energy costs are high. The quality of the refractory material is a key factor, both technical and economic in this complex process.

Rath offers a wide range of refractory and insulating products for all types of glass melting furnaces, melting tanks, regenerative U-flame furnaces, cross fired furnaces, recuperative furnaces, oxy-fuel, electric furnaces, daily tanks, pot furnaces, as well as provides complete refractory solutions for different types of forehearth systems.

Tube forming with Danner-system



A KALEIDOSCOPE OF REFRACTORY PRODUCTS, INCLUDING YOURS

If you rely on Rath, you opt for products that are qualitatively and technologically up to date. Rath offers the right refractory and insulating materials for the construction and operation of all types of furnaces and associated units from the various areas of glass production:

- › flat glass/float glass
- › glass for solar technology
- › container glass
- › glass wool
- › technical glass
- › lighting glass
- › crystal glass
- › tableware
- › glass for art and decoration

Our product range extends from dense refractory bricks and cast components to refractory, insulating and gunning castables, insulating bricks and other insulation materials such as high temperature wool, vacuum-formed and micro porous products.

Feeder burner block



Feeder burner blocks



HIGH-TEMPERATURE INSULATION WOOL¹

Name		CALSITRA Mat 1100	CALSITRA Mat 1250	ALSITRA Mat 1300	ALSITRA Mat 1400	ALSITRA Mat 1400 Z	ALTRA® Mat 72
Raw material base		Calcium silicate	Calcium/Magnesium silicate	Aluminium silicate	Aluminium silicate	Alumina- zircon-silicate	Aluminium silicate
Classification temperature [°C]		1100	1250	1300	1400	1400	1650
Continuous application temperature [°C]		900	1100	<1150	<1250	<1300	1600
Average fiber diameter [µm]		2 - 4	2 - 4	1.5 - 3.5	1.5 - 3.5	2 - 3	2 - 4
Fiber density [kg/m³]		96 -128	96 -128	96 -160	96 -160	96 -128	60-120
Permanent linear change (after 24 hours at:)	1100°C	-2.0	-	-2	-	-1	-
	1200°C	-	-	-3	-2	-1.6	-
	1300°C	-	1250°C/-3.0	-4	-3	-3.2	-
	1400°C	-	-	-	-4	-4	-
	1500°C	-	-	-	-	-	-1
	1600°C	-	-	-	-	-	-2.0//1650°C/-4.0
Chemical analysis fired [%]	Al ₂ O ₃	-	-	48	54	37	72
	SiO ₂	62-68	70-80	52	46	48	28
	CaO/MgO	26-32	18-25	-	-	-	-
	ZrO ₂	-	-	-	-	15	-
Thermal conductivity [W/mK] (hot wire method)	400°C	0.11	-	0.11	0.11	0.08	0.09
	600°C	0.15	0.14	0.15	0.15	0.12	0.13
	800°C	0.23	0.23	0.21	0.21	0.18	0.19
	1000°C	0.31	0.34	0.31	0.31	0.20	0.28
	1200°C	-	0.48	0.44	0.44	0.36	0.41
	1400°C	-	-	0.64	0.64	-	0.61

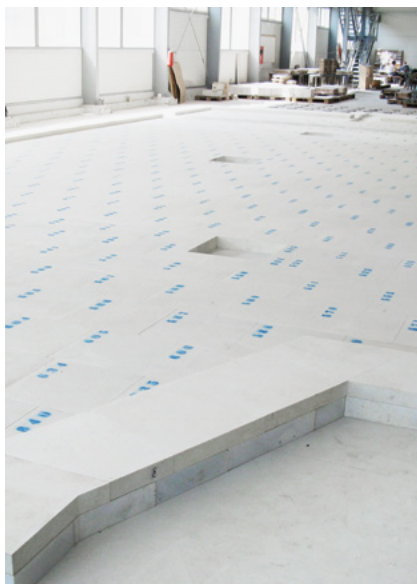
¹ this table only presents a part of the wide Rath product range

A FLEXIBLE COMPANY FOR SPECIAL REQUIREMENTS

WE IMPLEMENT YOUR IDEAS PERFECTLY.

Optimized structures and production processes enable the Rath Group to always react flexibly to customer requirements, whether in terms of production deadlines, single pieces or special applications. Our customer service departments can thus satisfy any request – and always with the focus on uncompromising quality.

Mullite bottom layer, Oxy-fuel glass melting furnace



Melting tank fireclay bottom



Melting tank bottom with
big size light-weight insulation blocks





Back-up layers of an electrical boosted distribution channel

INSULATING FIRE BRICKS¹

Name		PORRATH® 900	PORRATH® FL 24-06	PORRATH® FL 24-10	PORRATH® FL 25-08	PORRATH® FL 25-10	PORRATH® FL 25-12	PORRATH® FL 26-08	PORRATH® FL 27-12	PORRATH® FL 28-09	PORRATH® FL 30-11
Raw material base		Calcium-Alumina-Silicate	Aluminium silicate	Aluminium silicate	Aluminium silicate	Aluminium silicate	Aluminium silicate	Aluminium silicate	High alumina fireclay	Aluminium silicate	Aluminium silicate
Classification temperature [°C]		900	1350	1350	1380	1400	1400	1430	1500	1540	1650
ASTM-Group		-	-	-	-	-	-	26	-	28	30
Bulk density [g/cm³]		0.45	0.64	1	0.8	1	1.15	0.8	1.2	0.9	1.1
Cold crushing strength [MPa]		1	1.2	8	4	8	8	3.5	15	4	5
Permanent linear change [%]		875°C/24h -0.3	1320°C/12h -0.7	1320°C/12h -1	1350°C/12h -0.9	1370°C/12h -0.9	1370°C/12h -0.5	1400°C/12h -0.5	1500°C/12h -1.4	1510°C/12h -0.7	1620°C/12h -1.1
Chemical analysis [%]	Al ₂ O ₃	15	37	39	38	40	48	52	64	66	72
	SiO ₂	60	56	55	55	54	47	44	31	31	27
	Fe ₂ O ₃	4	1.9	1.9	2.2	2.3	1.8	1.1	1.3	0.8	0.3
Thermal conductivity [W/mK] (hot wire method)	200 °C	0.12	-	-	-	-	-	-	-	-	-
	400 °C	0.14	-	-	-	-	-	-	-	-	-
	600 °C	0.17	0.28	0.39	0.36	0.42	0.46	0.36	0.52	0.38	0.44
	800 °C	0.20	0.32	0.44	0.41	0.46	0.50	0.39	0.57	0.40	0.46
	1000 °C	-	0.38	0.49	0.47	0.50	0.55	0.43	0.63	0.43	0.51
	1200 °C	-	0.43	0.54	0.50	0.54	0.60	0.48	0.69	0.47	0.58
	1400 °C	-	-	-	-	-	-	0.53	0.77	0.50	0.61

¹ this table only presents a part of the wide Rath product range

REFRACTORY SOLUTIONS IN ALL SHAPES AND FORMS

ALL PRODUCTS FROM ONE SINGLE SOURCE.

Our extensive product portfolio enables us to cover virtually all product requirements for regenerative glass melting furnaces. The range extends from regenerator walls for low-, medium- or high-temperature zones through regenerator crowns to complete insulation of waste gas channel. Rath offers an optimal selection of high-quality products. Whether

- › low-iron oxide fireclay bricks, castables and pre-casted blocks
- › andalusite bricks, andalusite-mullite bricks, mullite bricks
- › insulating fire bricks
- › calcium-silicate boards
- › or finishing mixes

INSULATING FIRE BRICKS, ENDLESS VERSATILITY.

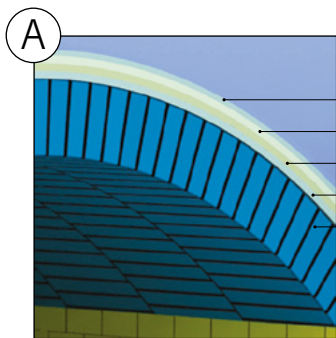
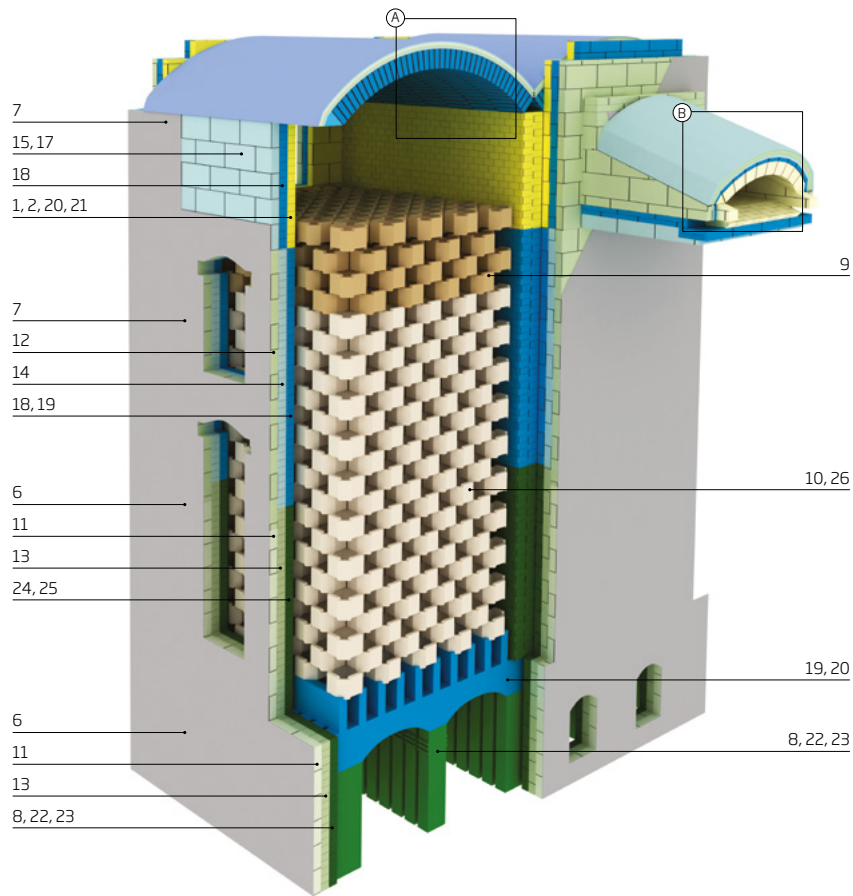
Insulating fire bricks are available at densities from 0.45 to 1.4 g/cm³ and classification temperatures from 900°C up to 1840°C. Large calibre bottom layer blocks are also available, as are tailor-made designs for special applications.

Regenerator chamber

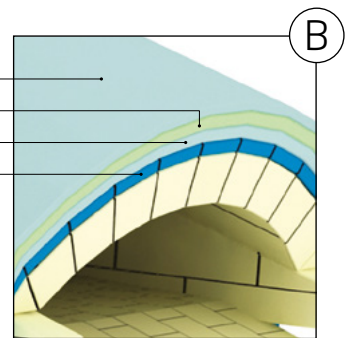


Doghouse protection arch





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4, 5
16
17
1, 2, 19, 20, 21

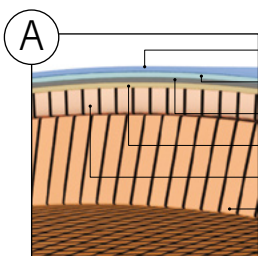
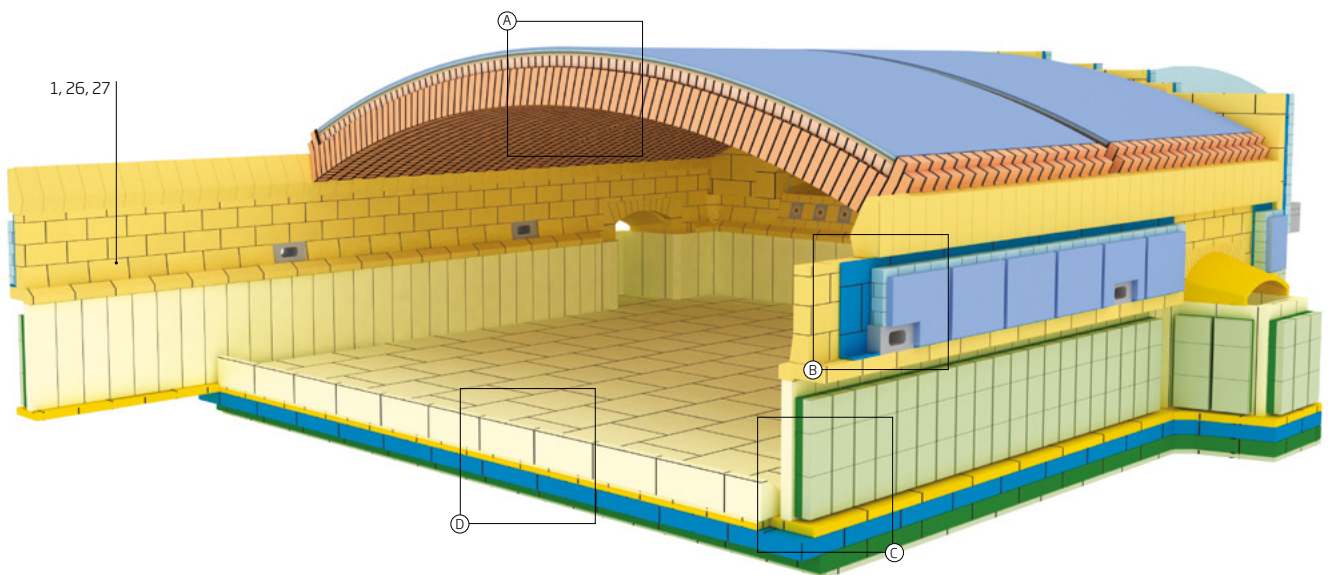


4, 5
16
17
18

KEY

Alurath E 75	1	Durrath HD 48	8	Porrath FL 25-10	15	Suprath A 40-t	22
Alurath M 704	2	Korrath K 99E	9	Porrath FL 26-08	16	Suprath A 401-t	23
Calsitra MS 1250	3	Magnesite	10	Porrath FL 28-09	17	Suprath A 403-t	24
Carath FL 1301	4	Porrath 900	11	Silrath AK 60	18	Suprath T 45	25
Carath FL 1404	5	Porrath FL 24-06	12	Silrath AK 65	19	Zircon-magnesite	26
CAS 1000	6	Porrath FL 24-10	13	Silrath AK 70	20		
CAS 1100	7	Porrath FL 25-08	14	Silrath AK 75M	21		

THE CORE OF YOUR PRODUCTION PERFECTLY LINED



6

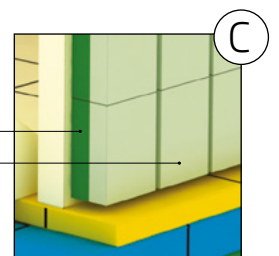
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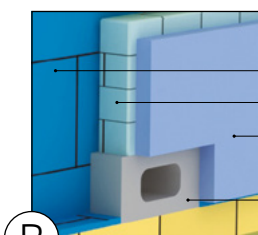
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21



22, 24

16, 18, 20



22

17, 19

14

8, 25, 30

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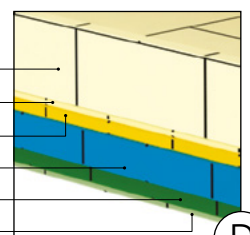
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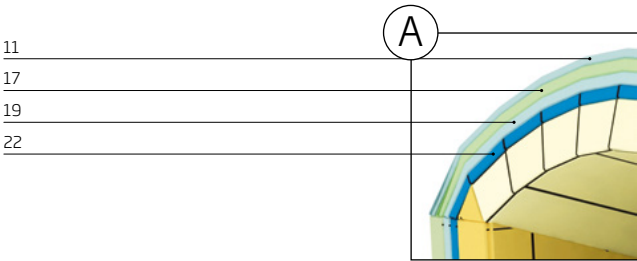
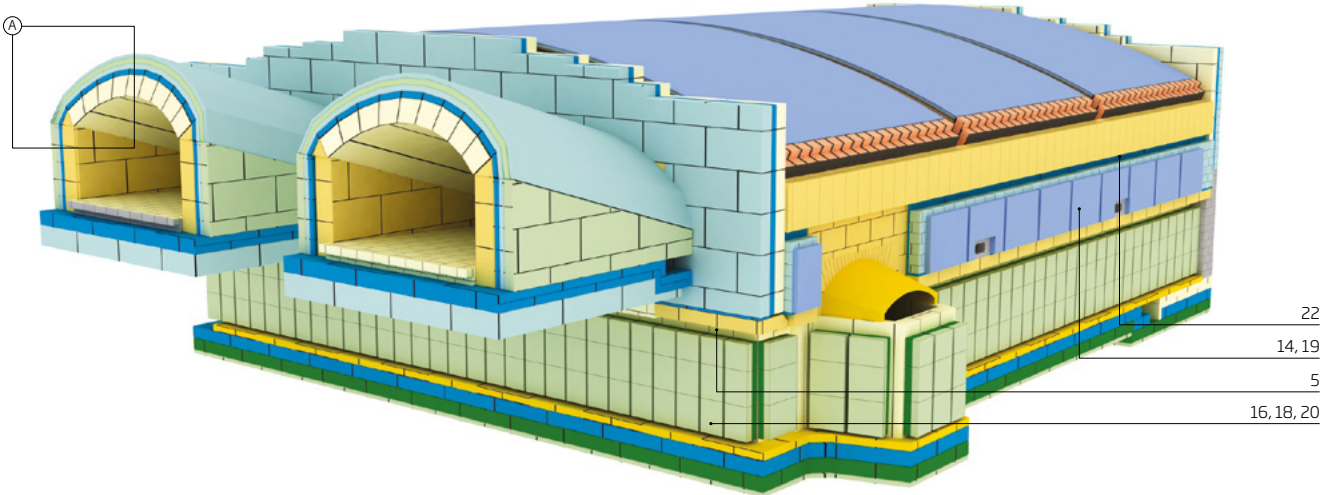
29

9, 10, 22, 23

7, 24

16, 18, 20





KEY

Alurath E 75	1	Carath FL-1301	11	Silica	21
AZS Fused-cast	2	Carath FL-1404	12	Silrath AK 60	22
AZS (33%)	3	Carathplast 1650-AZS	13	Silrath AK 601	23
AZS (33-41%)	4	Evac EVS 131	14	Suprath A 40-t	24
AZS (41%)	5	LW Silica	15	Vibrorath A 70M	25
Calsitra MS 1250	6	Porrath FL 25-12	16	Zirrath AZS 20	26
Carath 1400-LC	7	Porrath FL 26-08	17	Zirrath AZS 30	27
Carath 1650-ULC AZS	8	Porrath FL 27-12	18	Zirrath AZS 20NC-SF	28
Carath 1650 LC-SF	9	Porrath FL 28-09	19	Zirrath ZS 65	29
Carath 1655-LC	10	Porrath FL 24-16	20	Zirrath ZS 65 NCSF	30

QUALITY AND LIFETIME- THE IDEAL COMBINATION



Melting tank burner block

OUR QUALITY ENSURES A LONG "LIFETIME".

For melting tank linings we offer:

- › pressed or
- › casted

big size bottom layer blocks that have been grinded and pre-assembled according to the customer's requirements. In addition we offer special shape blocks, such as burner blocks, peephole blocks, camera blocks, bricks for doghouse protection arches, melting tank hanging roof and many other products with high fire resistance. Concerning raw material composition, for our bricks we use our wide range of fireclay, andalusite or zircon raw material. Our monolithics are mostly made of fireclay, andalusite, zircon and zircon-mullite.

Doghouse of melting tank



Melting tank superstructure/detail of peephole block



Melting tank



DENSE BRICKS¹

Name		SUPRATH A 40-t	SUPRATH T 45	DURRATH HD 48	SILRATH AK 601	SILRATH AK 60	SILRATH AK 65	KORRATH K 702 Cr	ALURATH E 75	KORRATH K 974 Zr	KORRATH K 99
Raw material base		Fireclay	Mullite contained fireclay	Low-iron mullite fireclay	Andalusite	Andalusite	Andalusite	Corundum, Escolaite	Fused mullite	Corundum	Tabular alumina
Bulk density [g/cm³]		2.25	2.30	2.50	2.55	2.58	2.65	3.56	2.69	3.40	3.15
Open porosity [%]		16	15	8	14	14	13	15	13	14	17
Cold crushing strength [MPa]		50	60	120	70	100	110	150	180	130	80
Thermal shock resistance [number of quenching]		30	30	35	50	100	120	4	40	36	10
Refractoriness under load T _{0.5} [20 MPa]		1420 °C	1400 °C	1620 °C	1560 °C	1600 °C	>1600 °C	>1600 °C	>1700 °C	>1600 °C	>1600 °C
Chemical analysis [%]	Al ₂ O ₃	40	43	49	58	60	62	69	73	97	99
	SiO ₂	50	-	48	39	37	33	-	26	0.10	0.20
	Fe ₂ O ₃	1.9	2	1.4	1.20	1	1	0.20	0.3	0.10	0.10
	Cr ₂ O ₃	-	-	-	-	-	-	28	-	-	-
	ZrO ₂	-	-	-	-	-	-	2.90	-	2.80	-
Hot modulus of rupture [MPa]	1200 °C	-	-	-	-	-	-	21.0	20	12.0	18.0
	1400 °C	1.8	1.9	-	-	2.5	2.0	23.0	6.0	8.0	12.0
	1500 °C	-	-	-	-	-	-	23.0	5.0	6.0	8.5
Thermal conductivity [W/mK] (hot wire method)	800 °C	-	1.50	-	1.64	2.02	1.75	-	-	2.40	2.90
	1000 °C	-	1.60	-	1.81	2.12	1.98	2.40	3.0	2.50	2.90
	1200 °C	-	1.80	-	1.99	2.32	2.24	2.50	3.40	2.60	3.00
	1400 °C	-	2.00	-	2.17	2.64	2.53	2.60	3.80	2.70	-

¹ this table only presents a part of the wide Rath product range

LAY THE GROUNDWORK FOR A SMOOTH PROCESS

YOUR INVESTMENT PAYS OFF IN THE LONG TERM.

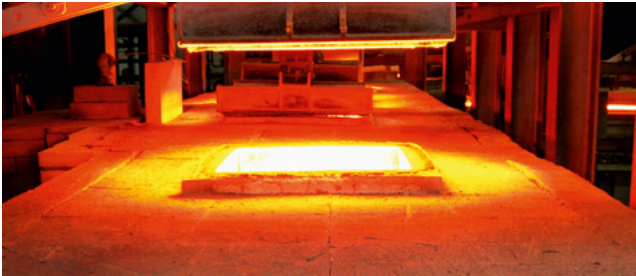
Whether we develop products, select materials or plan your system, we always focus on quality and functionality, as the basis for your long-term production to run smoothly. Economically, an investment that pays for you. We can build your furnace largely from one single source. We provide solutions for the various layers of the substructure.

The superstructure will be made of cover blocks (forehearth, working end) or with end arches (working end), as requested. Here we pre-assemble parts of the system – reducing on-site construction time and improving quality. Your investment pays off in the long term.

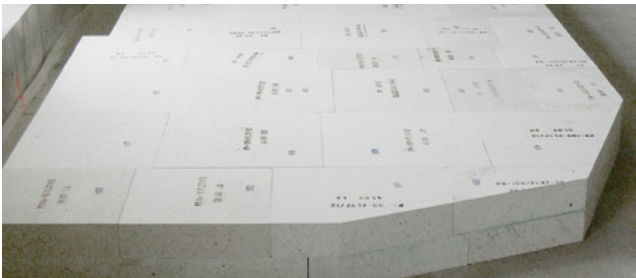
UNFORMED NO-CEMENT SHAPES

Name	Vibrorath A 70	
Raw material base	Andalusite/Corundum	
Service temperature [°C]	1700	
Bulk density [g/cm³]	2.43	
Open Porosity [Vol.-%]	≤20	
Cold crushing strength [MPa]	≥55	
Chemical analysis [%]	Al ₂ O ₃	68
	SiO ₂	30
	Fe ₂ O ₃	0.6

Distribution channel/forehearth superstructure insulation, with detail of flue openings



Working end insulating bottom layers



Forehearth channel



Pre-assembled forehearth cover blocks

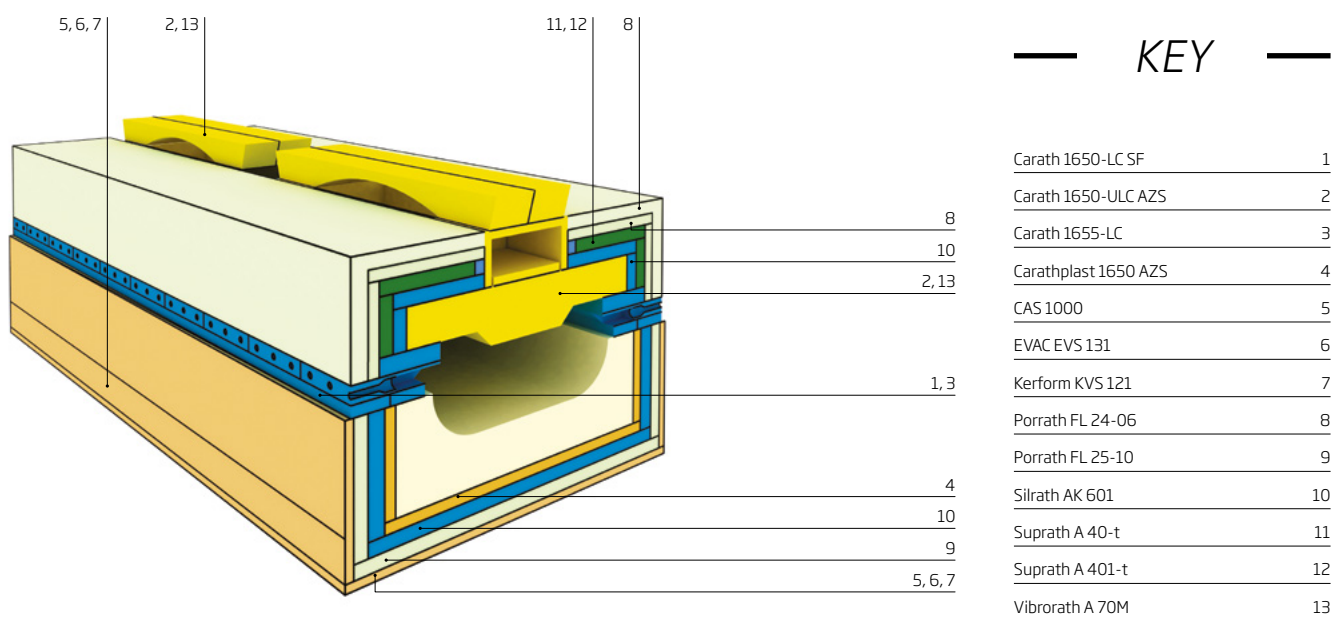




KEY

Alurath E 75	1
Carath 1400 LC	2
Carath FL-1301	3
EVAC EVS 131	4
Korrath K 901	5
Porrath FL 24-06	6
Porrath FL 25-12	7
Porrath FL 25-08	8

Porrath FL 28-09	9
Porrath FL 30-11	10
Porrath FL 24-16	11
Silrath AK 60	12
Suprath A 40-t	13
Suprath A 401-t	14
Zirrath AZS 20	15
Zirrath AZS 30	16



UNSHAPED REFRACTORIES/PRECAST SHAPES¹

		dense castable	low cement castables			ultra-low cement castables		insulating castables	
Name		CARATH 1400-D	CARATH 1400-LC	CARATH 1500-LC	CARATH 1655-LC	CARATH 1651-ULC	CARATH 1650-ULC AZS	CARATH FL-1401	CARATH FL-1405
Raw material base		fireclay	high mullite fireclay	high mullite fireclay	andalusite	spinel	Zircon mullite	light weight fireclay	light weight fireclay
Service temperature [°C]		1400	1400	1500	1650	1650	1650	1400	1400
Material requirement [kg/m³]		2250	2300	2350	2550	2850	3000	1400	1500
Cold crushing strength [MPa] (after drying at 110 °C)		40	100	100	75	100	110	25	25
Grain size [mm]		<5, <10	<10	<10	<6	<6	<6	<8	<8
Chemical analysis [%]	Al ₂ O ₃	46	50	52	63	85	56	45	55
	SiO ₂	40	41	42	34	2.4	16	35	30
	Fe ₂ O ₃	<1.5	1.3	1	0.8	-	-	3	0.8
	BaO	-	-	-	-	-	-	-	-
	CaO	-	-	-	-	-	-	11	-
	MgO	-	-	-	-	10	-	-	-
	ZrO ₂	-	-	-	-	-	26	-	-
Thermal conductivity [W/mK] (hot wire method)	200°C	1.29	1.27	-	-	2.90	2.30	-	0.53
	400°C	1.25	1.29	-	-	2.60	2.27	-	0.53
	600°C	1.22	1.34	-	-	2.30	2.23	-	0.55
	800°C	1.21	1.41	-	1.73	2.10	2.18	0.55	0.60
	1000°C	1.27	1.50	-	1.80	1.90	2.14	0.58	0.67
	1200°C	1.42	1.62	-	2.01	1.80	2.09	0.63	0.77
	1400°C	1.54	1.76	-	2.23	1.70	2.02	0.68	0.89

¹ this table only presents a part of the wide Rath product range

ENTIRELY FROM ONE SOURCE EVERYTHING FITS

Rath can supply its customers with complete forehearths thanks to its extensive product portfolio. This includes zircon-mullite or high alumina forehearth components and construction with forehearth safety and insulating layers (zircon-mullite, sillimanite or mullite).

The channel cover blocks are machined and pre-assembled. Produced in one of the newest and most modern components precast lines: partially automated with vibration technology. Adherence to the strictest possible quality criteria goes without saying.

Spout area (burner and cover blocks)



Gob forming



INSULATING MATERIALS¹

		Vacuum formed shapes				
Name		EVAC EVF 131/180	EVAC EVS 131	EVAC EVS 144/ 400	EVAC EVS 151/700	KERFORM KVF 121
Raw material base		Alkaline-earth silica wool	Alkaline-earth silicate wool with refractory fillers	Alkaline-earth silica wool	Alkaline-earth silica wool	Aluminium silicate wool
Classification temperature [°C]		1300	-	-	-	-
Maximum application [°C]		1300	1280	1450	1600	1250
Continous application [°C]		-	-	1350	1500	1150
Bulk density [kg/m³]		180	320	400	700	>160
Permanent linear change [%]	900 °C/24h	-	-	-	-	-1.0
	1000 °C/24h	-	-1.8	-	-	-2.0
	1100 °C/24h	-2.0	-3.0	-	-	-3.0
	1150 °C/24h	-	-	-	-	-
	1200 °C/24h	1250 °C/-2.6	-	-	-	-
	1300 °C/24h	-3.7	-3.9	1450 °C/-3.5	-	-
	1400 °C/24h	-	-	-	1450 °C/-2.88	-
	1500 °C/24h	-	-	-	-2.85	-
	1600 °C/24h	-	-	-	-	-
Chemical analysis [%]	SiO ₂	79	76	85	63	53
	Al ₂ O ₃	2.5	2	<1	3	46
	BaO	-	-	-	-	-
	MgO	19	-	14	6	-
	CaO/MgO	-	22	-	-	-
	CaO	-	-	-	-	-
	ZrO ₂	-	-	-	29	-
	organic components	6	5	-	-	5
Thermal conductivity [W/mK] (hot wire method)	200 °C	0.10	0.09	-	-	-
	400 °C	0.12	0.12	-	-	-
	600 °C	0.15	0.16	0.15	0.17	0.12
	800 °C	0.23	0.21	0.20	0.22	0.18
	1000 °C	0.35	0.29	0.27	0.27	0.25
	1200 °C	0.54	0.37	0.34	0.34	0.35
	1400 °C	-	-	0.42	0.42	-

¹ this table only presents a part of the wide Rath product range

Vacuum formed shapes						Insulating panel
	KERFORM KVS 121	KERFORM KVS 141	KERFORM KVS 146/301	KERFORM KVS 161	ALTRAFORM KVS 161/302	CAS 1000
	Aluminium silicate wool	Aluminium silicate wool	Aluminium silicate wool	Aluminium silicate wool/ Alumina wool	Alumina wool	Calcium silicate
	-	-	1430	1600	1600	1000
	1250	1400	1400	1600	1600	-
	1150	1300	1300	1500	1600	-
	300	300	500	300	300	245
	-	-	-	-	-	-
	-	-1.6	-1.5	-	-	-
	-2.9	-2.5	-2.0	-	-	-
	-3.1	-	-	-	-	-
	1250 °C/-3.7	1250 °C/-3.7	1250 °C/-3.1	-	-	-
	-	-	-	-	-	-
	-	-	-	-2.0	-3.0	-
	-	-	-	-2.0	+/-0	-
	-	-	-	-3.0	1.0	-
	49	44	64	34	26	45
	50	55	30	65	74	-
	-	-	-	-	-	-
	-	-	-	-	-	-
	-	-	-	-	-	-
	-	-	-	-	-	42
	-	-	6	-	-	-
	4	4	-	4	4	0.02/alkaline
	-	-	-	-	-	-
	-	-	-	0.17	0.11	0.10
	0.15	-	-	0.18	0.14	0.14
	0.19	0.19	-	0.20	0.18	0.17
	0.25	0.24	-	0.26	0.23	-
	0.34	0.31	-	0.34	0.28	-
	-	0.40	-	0.44	0.34	-

PRODUCTION IN OUR OWN FACTORIES

There is one very special feature of Rath: we can always fully guarantee the quality of our highly refractory products, as we manufacture them all ourselves. State-of-the-art production processes are used in our plants in Europe and the USA.

We constantly adapt these processes in line with technical and technological developments as we strive to provide you with top quality.

Our approach benefits our customers: high quality products ensure operational safety and reliability over a long period of time. This means less repairs, less breaks in production and lower costs.

RATH MEETS ALL ISO CRITERIA.

Quality in production can be measured with ISO 9001/9002. All companies in the Rath Group are certified according to the strict criteria for this standard. We are doing everything to build constantly on this quality standard.

Our products undergo rigorous testing in our own company laboratories. We also regularly have externally government authorized test centers which check material characteristics.

Our customers can rest assured that all our products are up to date – and provide, in practice, everything that we have promised.

Bennewitz, Germany



Meissen, Germany



Moenchengladbach, Germany



Milledgeville, GA/USA



Budapest, Hungary



Krummussbaum, Austria



Newark, DE/USA



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