

## FURNACE & FOREHEARTH REFRACTORIES

Since the foundation of the company PSR has only ever been involved in manufacturing refractories for the glass industry. From isolation has developed specialisation and a range of bespoke refractory products specifically for glass.

The majority of PSR's furnace & forehearth refractories are made by the slip-casting method. This ensures total flexibility of production and a range of sizes to satisfy almost every conceivable situation. Some pressing of standard shapes and sizes is also carried out, enabling larger quantities of specific glass industry compositions to be undertaken.

The glass industry is a very demanding customer and PSR recognise the need to provide consistent products with exact dimensions and tight tolerances.

- All mixes and casting slips are sampled and checked on a batch by batch basis to ensure conformity to the standard.
- Drying is carried out in humidity controlled drying chambers where moisture content and rate of drying can be carefully monitored.
- Modern high-temperature kilns ensure repeatability and consistency from one firing to the next, and a wide variety of schedules can be accommodated ensuring complete flexibility of production.
- Computer controlled cutting machines ensure that the fired product is machined to tight tolerances, enabling machining costs to be kept low whilst maintaining a fully machined finish.
- Pre-assembly ensures accurate assembled dimensions with minimum construction time on site.

### Quality Control

The manufacture of all PSR's refractory products is covered by a quality assurance scheme accredited by CICS (Ceramic Industry Certification Scheme) to the international standard ISO 9001:2000.



*PSR Furnace bottom blocks are used in all sectors of the glass industry. Photograph (1) illustrates construction of a container furnace bottom prior to installation of paving tiles.*



(1)

## THE MATERIALS

The furnace and forehearth refractory compositions manufactured by PSR reflect the specialised nature of our customer base. None of these products are used outside the glass industry and all have been developed for their specific attributes related to the production of glass.

### SM-62 62% Al<sub>2</sub>O<sub>3</sub> Super-mullite

SM-62 is a high fired reaction bonded alumino-silicate refractory material developed specifically in response to the aggressive conditions found in many modern single-block forehearth and distributor superstructures. Its exceptionally low creep (0.1% at 1425°C) and high strength make it the ideal material for this application. In laboratory tests its resistance to thermal shock exceeded the sillimanite standard by a factor of 10.

*We manufacture refractories for many types of forehearth design in addition to our own System 500 Forehearth.*

*Recommended uses: Forehearth & distributor superstructure, spout accessory parts, burner blocks, furnace & regenerator brickwork.*

### VC-60 60% Al<sub>2</sub>O<sub>3</sub> Sillimanite

VC-60 is the natural successor to PSR's renowned vacuum cast sillimanite. With an enhanced slip-cast formulation VC-60 is a dense super-duty sillimanite developed specifically for furnace bottoms. It is the ideal material for back-up to the barrier layers in the melting end and with full glass contact qualities is also suitable for use in working ends and other less aggressive glass contact furnace applications.

*Recommended uses: Furnace bottom blocks, sidewall back-up blocks, glass contact blocks in working ends and day tanks*



# PSR Refractories Division

## VC-40 40% Al<sub>2</sub>O<sub>3</sub> Flux / Chamotte

VC-40 is a traditional slip-cast fireclay block made from high quality calcined fireclays. It is widely used in float glass furnace bottoms and in multi-course furnace bottoms. Its glass contact qualities also make it suitable for day tanks and other special glass contact applications.

*Recommended uses: Float & container furnace bottom blocks, sidewall back-up blocks, day tanks.*

## LW-40 40% Al<sub>2</sub>O<sub>3</sub> Insulating fireclay

LW-40 is a pressed semi-insulating fireclay block. It combines good insulation properties with high compressive strength and has been designed specifically for glass tank bottom and sidewall insulation.

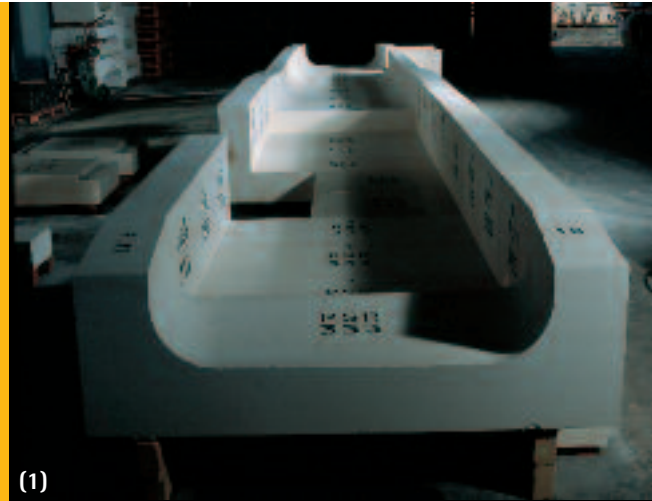
*Recommended uses: Bottom insulation tiles, sidewall insulation tiles.*

## PSR-333 11.25% ZrO<sub>2</sub> Zircon-mullite

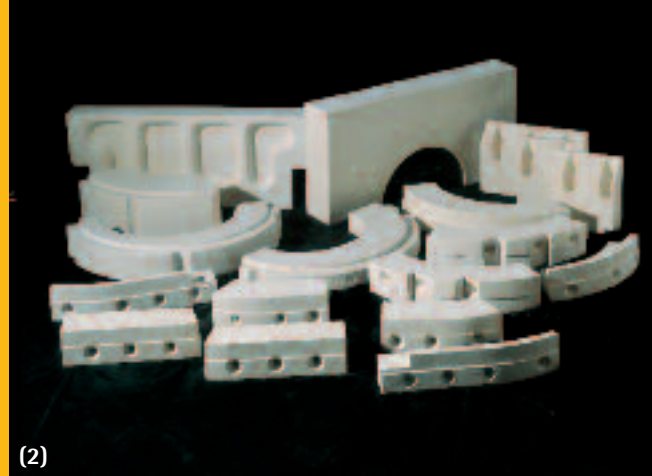
Originally developed as a feeder expendable composition PSR-333 is also used extensively in the forehearth and distributor. A direct bonded zircon-mullite material, it is widely used for forehearth channel blocks and distributor glass contact blocks and its excellent corrosion resistance combined with resistance to thermal shock provide long life in these critical glass contact areas. Its unique 'closed-pore' surface characteristics also make it suitable for use in aggressive forehearth and distributor superstructure applications.

*Recommended uses: Channel blocks, skimmer & mantle blocks, colouring forehearth superstructures, fibreglass & borosilicate forehearth superstructures.*

(1) Distributor blocks in PSR 333 are an acceptable alternative to the use of fused cast materials. (2) The complete range of spout accessory parts is available for Emhart and all feeder types. (3) Spout cover blocks can also be supplied in ceramic fibre on request.



(1)



(2)



(3)

## P56-HP 56% Al<sub>2</sub>O<sub>3</sub> Sillimanite

P56-HP is a pressed sillimanite brick of very high purity. It has been formulated specifically for use in the construction of the forehearth & distributor.

*Recommended uses: Forehearth & distributor brickwork*

## P60-HD 60% Al<sub>2</sub>O<sub>3</sub> Andalusite

P60-HD is a pressed andalusite brick. Its high density and high firing temperature make it suitable for use in the furnace and lower regenerator brickwork.

*Recommended uses: Furnace & lower regenerator brickwork*

## P66Z 66% ZrO<sub>2</sub> Zircon

A dense pressed zircon brick with excellent glass corrosion characteristics.

*Recommended uses: Furnace bottom paving and other areas subject to severe corrosion or volatile attack.*



## TYPICAL CHEMICAL & PHYSICAL PROPERTIES

		LW-40	VC-40	VC-60	SM-62	333	P56-HP	P60-HD	P66Z
SiO <sub>2</sub>	%	53.0	54.0	37.0	36.78	15.0	40.0	38.0	32.0
Al <sub>2</sub> O <sub>3</sub>	%	40.0	41.0	60.0	61.41	73.0	56.0	60.0	0.7
ZrO <sub>2</sub>	%					11.1			66.0
Fe <sub>2</sub> O <sub>3</sub>	%	1.0	1.75	1.0	0.64	0.2	0.70	0.80	0.2
TiO <sub>2</sub>	%		1.10	1.0	0.43	0.17	0.60	0.15	1.0
CaO	%		0.25	0.05	0.05	0.1	0.25	0.14	0.05
MgO	%		0.21	0.1	0.08	0.1	0.25	0.11	0.05
Na <sub>2</sub> O	%		0.30	0.5	0.03	0.3	0.20	0.20	0.05
K <sub>2</sub> O	%		0.10	0.2	0.29	0.15	0.70	0.20	0.05
Bulk Density	kg m <sup>-3</sup>	1220	2199	2490	2450	2820	2160	2500	3700
Cold compressive Strength	MN m <sup>-2</sup>	15	66.4		101	87.3	70	90	100
Apparent porosity	%	45	18	16	20	21	26	15	18
Refractoriness	°C		1717		1809	1743			1800
Reversible thermal Expansion 20-1000°C	%		0.5		0.52	0.63			0.60
Creep in compression 50hrs@1425°C (0.2MN m <sup>-2</sup> )	%				0.1	0.017			
Thermal conductivity	W mK <sup>-1</sup>								
@ 200°C		0.65							
@ 600°C		0.65	1.44		1.98	2.02			
@ 1000°C		0.72	1.57		1.90	1.87			
@ 1200°C			1.60		1.86	1.80			

All values are average and subject to change without notice

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