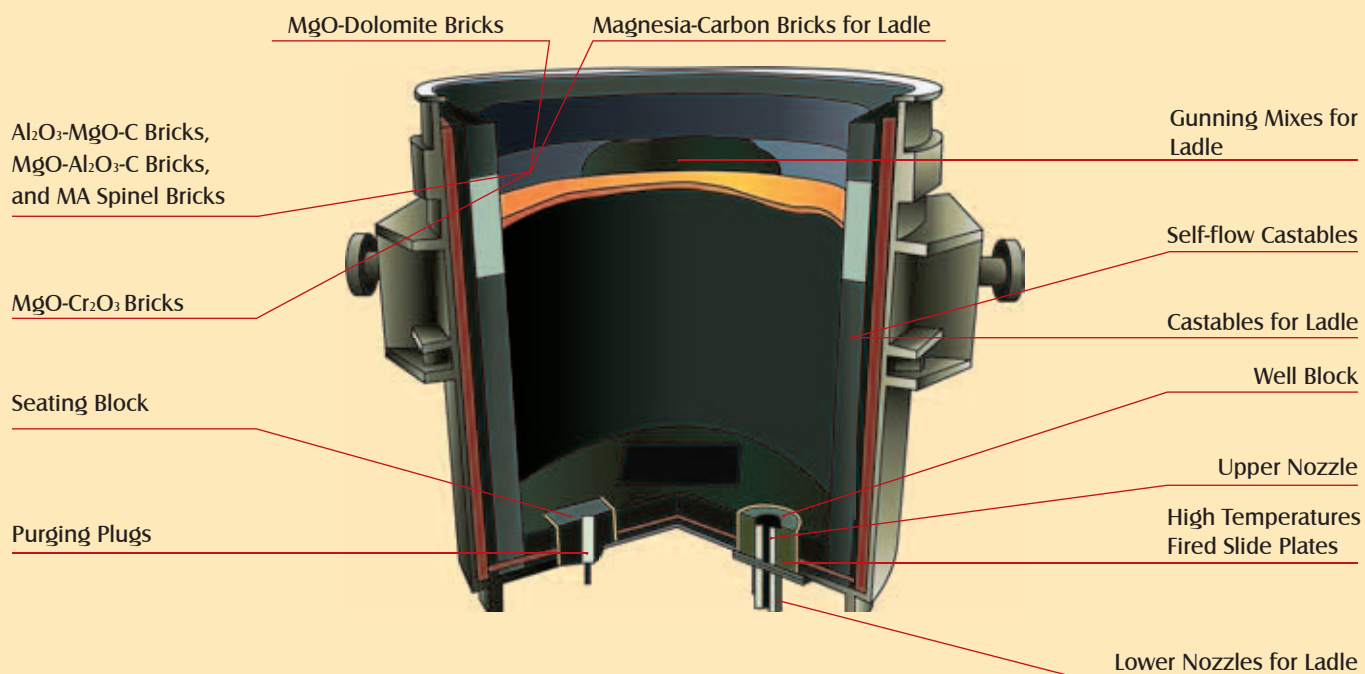


# Refractory Products for Ladle



## Upper Nozzle

Horton developed series of corundum based ladle upper nozzles with new technique. The nozzles have the features of superior resistance to thermal shock, erosion, oxidation and long service life etc. The products have been widely used in steelworks worldwide.

Al <sub>2</sub> O <sub>3</sub> % Min.	85	75		72	68
MgO % Min.			70		
C % Max.	3	4	4	8	8
Bulk Density g/cm <sup>3</sup> Min.	2.90	2.85	2.75	2.80	2.75
Apparent Porosity % Max.	14	14	14	14	14
Cold Crushing Strength MPa Min.	75	65	45	40	40
Hot Modulus of Rupture MPa Min.	12	12	10	10	10
Application area (Ladle)	≥60MT	≥40MT	High erosion steel	40-80MT	≤50MT



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Tel:+86-411-82506195 82506197 Fax:+86-411-82336278

Website: [www.chinahorton.com](http://www.chinahorton.com)

# Refractory Products for Ladle

## High Performance Slide Plates

The high performance slide plates supplied by Horton show the feature of lower percentage of carbon content, which will avoid the working surface of slide plates from being greatly roughened. So they are more suitable to both low-carbon and super-low-carbon steel grades. And also it provides much higher fired strength which will reduce the bore-enlarging while sliding repeatedly.

Al <sub>2</sub> O <sub>3</sub> % Min.	80	85	60
SiO <sub>2</sub> % Max.	5	4	8
ZrO <sub>2</sub> % Min.			5
C %	5 Max.	4 Max.	4 Min.
Bulk Density g/cm <sup>3</sup> Min.	3.00	3.05	3.00
Apparent Porosity % Max.	10	10	11
Cold Crushing Strength MPa Min.	120	120	95
Hot Modulus of Rupture MPa 1400 °C ×0.5h Min.	15	15	10
Service life (heats) Min.	1~2	2 Min.	
Application	Ladles under 70T	Ladles above 50T	Tundish



## High Temperatures Fired Slide Plates

Horton series of slide plates fired at high temperatures show the features of high strength, good erosion resistance and excellent thermal shock resistance. The products are the best choice for large and medium sized ladles and con-casting tundishes. Horton series of slide plates fired at high temperatures cover Al<sub>2</sub>O<sub>3</sub>-C based, Al<sub>2</sub>O<sub>3</sub>-ZrO<sub>2</sub>-C based and MgO-spinel based, which can meet various needs of different steel grades.

Al <sub>2</sub> O <sub>3</sub> % Min.	70	76	85	70	75	10
C % Min.	7	7	5	5	6	
ZrO <sub>2</sub> % Min.				5	5	
MgO % Min.						80
Bulk Density g/cm <sup>3</sup> Min.	2.85	2.90	3.00	3.15	3.10	2.95
Apparent Porosity % Max.	6	6	6	6	6	10
Cold Crushing Strength MPa Min.	90	100	100	100	100	70
Hot Modulus of Rupture MPa 1400 °C ×0.5h Min.	10	12	13	18	13	7
Application	Large and medium sized ladles					Calcium-treated steel, killed steel and rimming steel

# Refractory Products for Ladle

## Unburned Compounded Slide Plates

For further reduction of steelmaking cost in medium and small steel plants, Horton developed series of fine-quality unfired compounded slide plates, yielding optimum performances on medium and small sized ladles.

	Al <sub>2</sub> O <sub>3</sub> -C Slide Plates	
Brand	HTN-70	HTN-80
Al <sub>2</sub> O <sub>3</sub> % Min.	68	76
C % Min.	7	7
Apparent Porosity % Max. (with tar impregnation)	4(10)	4(10)
Cold crushing strength MPa Min.	70	80
Hot Modulus of rupture MPa Min. 1400 °C ×0.5h	6	8



## MgO-C Bricks

Horton supply a complete range of MgO-C bricks with the features of high strength, excellent resistance against slag, high refractoriness, and good thermal shock resistance. The products are widely applied to ladles and refining furnaces working lining, especially to slag zone. Optimum designs are offered to fit individual applications and actual smelting conditions, reliable performances and long service sequences have been proven.

	Magnesite-Carbon Brick.								
Brand	HMC-10A	HMC-10B	HMC-10C	HMC-14A	HMC-14B	HMC-14C	HMC-18A	HMC-18B	HMC-18C
MgO % Min.	80	78	76	76	74	74	72	70	70
C % Min.	10	10	10	14	14	14	18	18	18
Bulk Density g/cm <sup>3</sup> Min.	2.90	2.85	2.80	2.90	2.82	2.77	2.90	2.82	2.77
Apparent Porosity % Max.	4	5	6	4	5	6	3	4	5
Cold Crushing Strength MPa Max.	40	35	30	40	35	25	40	35	25

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# Refractory Products for Ladle

## Lower Nozzles for Ladle

Horton series of lower nozzles for ladle are made from corundum, bauxite, flake graphite, antioxidant and phenolic resin. They show the features of excellent thermal shock resistance, stable performance, good excellent corrosion and erosion resistance, strong cracking resistance etc.

Al <sub>2</sub> O <sub>3</sub> % Min.	75	70	72	68
C % Max.	4	4	8	8
Bulk Density g/cm <sup>3</sup> Min.	2.85	2.75	2.80	2.75
Apparent Porosity % Max.	14	14	14	14
Cold Crushing Strength MPa Min.	65	55	40	40
Hot Modulus of Rupture MPa Min.	12	10	10	10
Application	All kinds of ladles	Ladles bigger than 80T	Ladles smaller than 80T	
Service life (heats)	4 Min.	1~2	3 Min.	2~4



## Castables

Based on low-cement castable and superfine powder technologies, Horton developed HT series of castables for ladles to meet the operation conditions of various ladles. The castables are made by setting up scientific optimization of ingredients and accurate distributing of grain size as well as adding of high-quality binding agents and high-efficiency external reactants.

HT series of castables for ladle show the features of high strength, excellent thermal shock resistance, corrosion resistance and stable volume etc. The products can be applied for ordinary ladles, refining ladles and ladles of EAF.

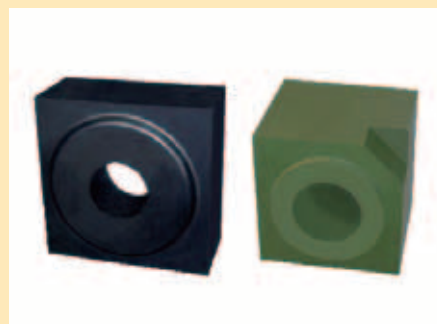
Al <sub>2</sub> O <sub>3</sub> + MgO % Min.	90	90	80	83
Bulk Density g/cm <sup>3</sup> Min.	3.20	3.25	2.85	2.80
Modulus of Rupture Mpa 110 °C x16h Min.	3	5	4	5
PLC % 110 °C x16h Min.	±0.1	±0.1	±0.1	±0.1
Water addition %	4.2±0.3	4.8±0.3		5.0±0.2
Applications	Refining ladles and ladles of EAF	Lining of medium and small sized ladles	Slag line of medium and small sized ladle	

# Refractory Products for Ladle

## Well Block

Horton series of well blocks for nozzles are made from high-purity, high-density, high-strength materials. They show the features of stable structure, excellent thermal shock resistance, good corrosion/erosion resistance and long service life.

Al <sub>2</sub> O <sub>3</sub> % Min.	84	83	84
MgO % Min.	5	4	4
Cr <sub>2</sub> O <sub>3</sub> % Min.	-	3	3
Bulk Density g/cm <sup>3</sup> 1500 °C x3h Min.	3.00	3.05	3.05
Cold Crushing Strength MPa 1500 °C x3h Min.	12	12	15
Modulus of rupture MPa 1500 °C x3h Min.	80	80	60



## MgO-Al<sub>2</sub>O<sub>3</sub>-C Series Refractories

Using top quality bauxite or corundum as aggregates, phenolic resin as binding agent and emphasizing matrix, Horton series of Al<sub>2</sub>O<sub>3</sub>-MgO-C bricks are offered in a range of MgO contents. They can be applied for ladle wall, bottom and other parts, showing the features of good corrosion resistance and spalling resistance as well as high strength etc.

Using high purity spinel and corundum as main raw materials, with the help of special additive, Horton developed series of MgO spinel bricks for carbon-free ladles, which can reduce the contamination of molten steel during smelting of clean steel grades. So far they have been proven reliable performances in decades of operations in large or middle-sized ladles worldwide.

Brand	MgO-Al <sub>2</sub> O <sub>3</sub> -C			Al <sub>2</sub> O <sub>3</sub> -MgO-C		Al <sub>2</sub> O <sub>3</sub> -MgO
	HMAC-60	HMAC-70	HMAC-74	HAMC-65	HAMC-70	HSM
MgO % Min.	55	68	71	10	10	5
Al <sub>2</sub> O <sub>3</sub> % Min.	23	8	6	65	68	88
C % Min.	8	10	10	7	7	1.5
Bulk Density g/cm <sup>3</sup> Min.	3.00	2.90	3.00	3.00	3.05	3.20
Apparent Porosity % Max.	6	5	5	8	8	6
Cold Crushing Strength MPa Min.	30	35	40	40	45	75

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# Refractory Products for Ladle

## Purging Plugs

Made from high-purity, high-density, high-strength corundum based materials and matrix-adjusted system(MAS), HT series of purging plugs, with the unique radiated through-slots structure, show the features of stable structure, high and adjustable gas-flow, high purging rate, good corrosion/erosion resistance and long service life etc.

Made from high-technology ceramic and high-performance castables and with the traditional through-slots as gas channel, HC series of purging plugs, as new generation of ceramic-clad purging plugs, not only succeed the advantages of HT series of purging plugs, but also show higher purging rate as result of adopting high-temperature ceramic as gas channel.

	HT series of purging plugs			
Al <sub>2</sub> O <sub>3</sub> + Cr <sub>2</sub> O <sub>3</sub> % Min.	94	93	92	
Al <sub>2</sub> O <sub>3</sub> + Cr <sub>2</sub> O <sub>3</sub> % Min.				92
Bulk Density g/cm <sup>3</sup> 1500 °C x3h Min.	3.00	3.10	3.20	3.10
Cold Crushing Strength MPa 1500 °C x3h Min.	80	80	100	80
Modulus of rupture MPa 1500 °C x3h Min.	12	15	20	18

	HC series of purging plugs		
Al <sub>2</sub> O <sub>3</sub> + MgO + ZrO <sub>2</sub> % Min.	99	98	98
Bulk Density g/cm <sup>3</sup> 1750 °C x3h Min.	3.30	3.00	3.40
Apparent Porosity % 1750 °C x3h Max.	10	15	10



## Magnesite-Dolomite Brick

High purity sintered dolomite that is sized, blended with fused magnesite, pressed into a brick shape, then fired in a high temperature tunnel kiln to create a strong ceramically bonded brick. Horton dolomite brick is a low porosity, low permeability working lining material for AOD's and VOD's.

Specification	MD-20	MD-30
CaO %	18-22	28-32
MgO %	75-79	65-69
$\sum(\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3 + \text{SiO}_2)$ % $\leq$	3	3
Apparent Porosity %	8	8
Cold Crushing Strength MPa $\geq$	50	55
Refractoriness Under Load °C $\geq$	1700	1700

# Refractory Products for Ladle

## Gunning Mixes

According to the gunning characteristics of gunning mixes and considering the destructibility of slag lines and easily worn parts of ladles, Horton specially developed HT series of gunning mixes with the unique binding agent and additives. The series of products show the features of strong adhesion, low rebounding rate, easy-sintering, excellent erosion and corrosion resistance. So they are ideal choices for cold/hot repair to slag lines and other part of ladles.

MgO % Min.		8
Al <sub>2</sub> O <sub>3</sub> % Min.		70
Bulk Density g/cm <sup>3</sup> Min.	110°C x16h	2.50
	1500°C x3h	2.40
Modulus of Rupture Mpa Min.	110°C x16h	5.0
	1500°C x3h	7.0
Cold crushing strength MPa Min.	110°C x16h	8
	1500°C x3h	50
Water addition %		11±1
Max. service temperature °C		1700

## Resin Bonded Magnesite Dolomite Bricks

High purity sintered dolomite that is sized, blended with magnesite, a resin and carbon system, pressed and heated to remove volatiles and create good ambient temperature strength. Horton Resin dolomite brick is a premium quality refractory for ladles.

	Magnesite Dolomite Carbon Bricks				Magnesite Dolomite Carbon Bricks		
	70	75	70		2.90	2.85	3.00
MgO % Min.	70	75	70	Bulk Density g/cm <sup>3</sup> Min.	2.90	2.85	3.00
C % Min.	5	2	8	Apparent Porosity % Max.	6	7	5
CaO % Min.	12	8	12	Cold Crushing Strength MPa Min	30	30	35

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# Refractory Products for Ladle

## Magnesite-Chrome Refractories

Horton series of magnesia-chrome bricks are composite basic refractory products, made from magnesite and chromite burned at high temperature or ultra-high temperatures. The products show the features of excellent resistance against slag, high fired strength, good erosion resistance and thermal shock resistance. They can be applied in AOD/VOD refining furnace, DH/RH degassing device, and lining of nonferrous metal converter and cement kilns.

	Magnesia-Chrome Brick								
Brand	HG-8A	HG-8B	HG-12A	HG-12B	HG-16A	HG-16B	HG-20A	HG-20B	HG-22
MgO % Min.	65	60	60	55	50	45	45	40	46
Cr <sub>2</sub> O <sub>3</sub> % Min.	8	8	12	12	16	16	20	20	22
Apparent Porosity % Max.	20	20	20	20	20	23	20	23	20
Cold Crushing Strength MPa Min.	35	30	35	30	35	30	35	30	35
Refractoriness under Load °C Min.	1620	1550	1620	1580	1620	1580	1640	1580	1600

	Direct-Bonded Magnesite-Chrome Bricks									
Brand	HDB-4	HDB-6	HDB-8A	HDB-8B	HDB-12A	HDB-12B	HDB-16A	HDB-16B	HDB-18A	HDB-18B
MgO % Min.	80	75	74	74	66	66	60	60	58	58
Cr <sub>2</sub> O <sub>3</sub> % Min.	4	6	8	8	12	12	16	16	18	18
SiO <sub>2</sub> % Max.	2.0	2.0	1.5	2.0	1.5	2.0	1.5	2.0	1.5	2.0
Apparent Porosity % Max.	18	18	18	18	18	18	18	18	18	18
Cold Crushing Strength MPa Min.	40	40	40	35	40	35	40	35	40	35
Refractoriness under Load °C Min.	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600

	Semi-Rebonded MgO-Cr <sub>2</sub> O <sub>3</sub> brick				Rebonded MgO-Cr <sub>2</sub> O <sub>3</sub> brick					
Brand	HSR-16A	HSR-16B	HSR-20A	HSR-20B	HR-16A	HR-16B	HR-20A	HR-20B	HR-24	HR-26
MgO % Min.	60	60	55	55	65	60	60	60	52	50
Cr <sub>2</sub> O <sub>3</sub> % Min.	16	16	20	20	16	16	20	20	22	24
SiO <sub>2</sub> % Max.	1.5	1.8	1.5	1.8	1.2	1.6	1.2	1.2	1.2	1.2
Apparent Porosity % Max.	17	17	17	17	16	16	16	16	16	16
Cold Crushing Strength MPa Min.	40	35	40	35	45	40	45	40	45	45
Refractoriness under Load °C Min.	1750	1700	1750	1700	1750	1700	1750	1700	1750	1750

# Refractory Products for Ladle

## Self-flow Castables

According to the solid rheology theory and the actual service condition of refractory, Horton has developed the high-tech self-flow castables (SFC) in China. Without vibration, SFC will be degassed and leveled by gravity and thereby become compact. The products show the features of good flowability, suitable setting time, labor-saving, high-strength, long service life, good insulation, high temperature, resistance, superior resistant to thermal shock.

The products have been renowned as the fourth generation castables, which can be applied in all applications where low cement, ultra-low cement and no cement castables are applied. Corundum based SFC is suitable for the ladle bottom, around the seating block, gap fitting of EAF roof. Both mullite-based SFC and alumina-based ones can be applied for the permanent lining of ladle and tundish. SFC can also be installed by machine.

Al <sub>2</sub> O <sub>3</sub> + MgO % Min.		90	-
Al <sub>2</sub> O <sub>3</sub> + MgO + Cr <sub>2</sub> O <sub>3</sub> % Min.		-	90
Bulk Density g/cm <sup>3</sup> Min.	110°C x16h	2.85	2.85
	1500°C x3h	2.85	2.85
Modulus of Rupture Mpa Min.	110°C x16h	30	20
	1500°C x3h	90	70
Cold crushing strength MPa Min.	110°C x16h	4	5
	1500°C x3h	12	12
Water addition %		4.8±0.5	4.8±0.5
Applications		Ladle bottom, around seating block, gap filling	

Al <sub>2</sub> O <sub>3</sub> % Min.		50	60
Bulk Density g/cm <sup>3</sup> Min.	110°C x16h	2.20	2.30
	1350°C x3h	2.15	2.25
Modulus of Rupture Mpa Min.	110°C x16h	5	6
	1350°C x3h	8	8
Cold crushing strength MPa Min.	110°C x16h	30	30
	1350°C x3h	50	60
Service temperature °C		1600	1600
Water addition %		7~9	7~9
Applications		Permanent lining of ladle and tundish	

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# Refractory Products for Ladle

## Seating Block

Made from high-purity, high-density, high-strength materials and matrix-optimized system, Horton series of seating blocks for purging plugs are high-tech product developed simultaneously with purging plug. The series of ladle blocks show the features of stable structure, excellent thermal shock resistance, good corrosion/erosion resistance and long service life. They suit specially for large-sized refining ladles.

	Seating Block-1		
Al <sub>2</sub> O <sub>3</sub> % Min.	92	91	93
MgO % Min.	0.5	2.5	1.0
Cr <sub>2</sub> O <sub>3</sub> % Min.	0.5	-	-
Bulk Density g/cm <sup>3</sup> 1500 °C x3h Min.	3.0	3.0	2.8
Cold Crushing Strength MPa 1500 °C x3h Min.	70	60	60
Modulus of rupture MPa 1500 °C x3h Min.	12	15	12

	Seating Block-2	
Al <sub>2</sub> O <sub>3</sub> % Min.	42	40
MgO % Min.	39	36
SiO <sub>2</sub> % Min.	3	3
Bulk Density g/cm <sup>3</sup> 110 °C x16h Min.	2.9	2.9
Cold Crushing Strength MPa 110 °C x16h Min.	70	40
Modulus of rupture MPa 110 °C x16h Min.	10	6