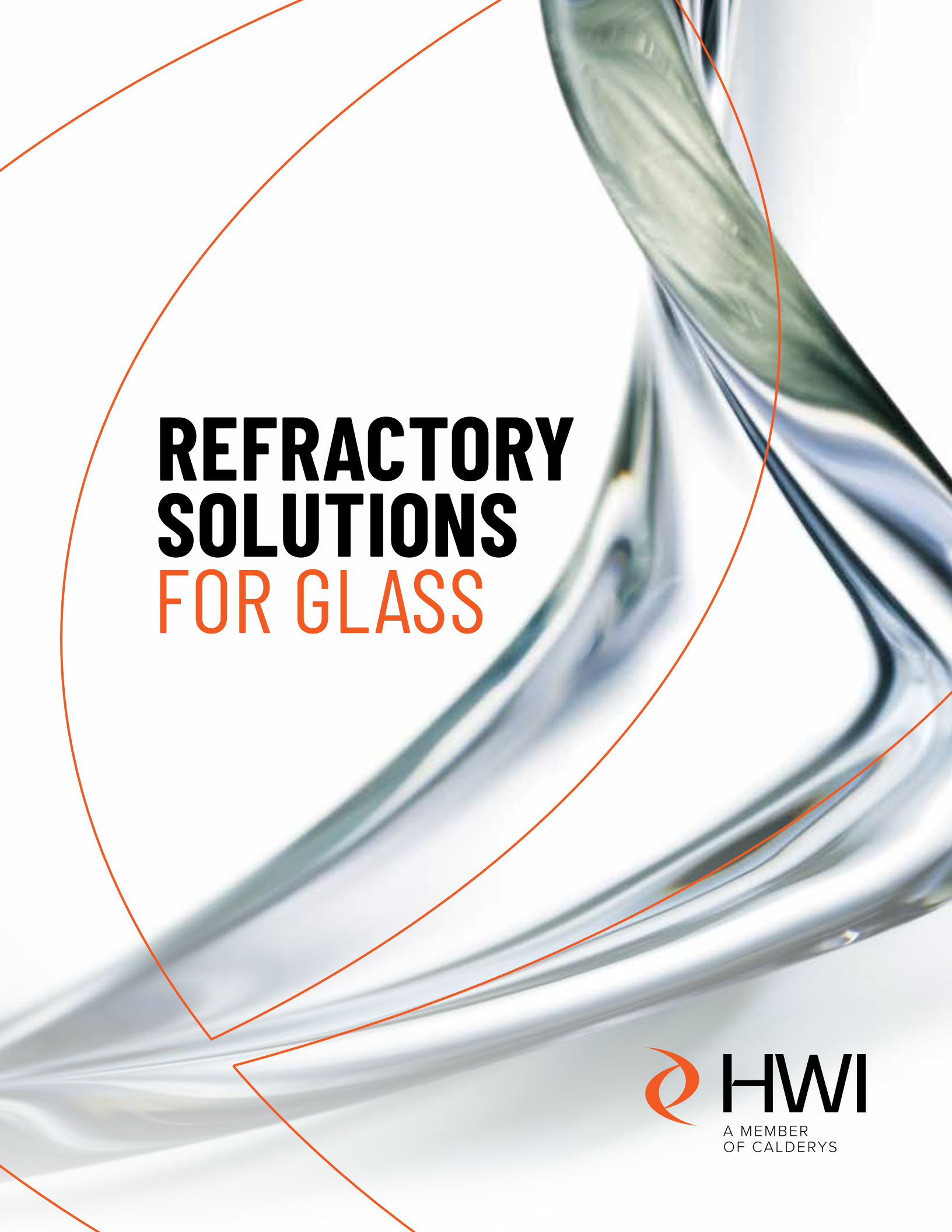


REFRACTORY SOLUTIONS FOR GLASS

HWI
A MEMBER OF CALDERYS

HWI

Every day around the world, HWI's people and products stand up to the challenges and pressures of every job. And for over 160 years, we've served virtually every industry that needs refractory products to do its job. As HWI, a member of the Calderys Group, we deliver one of the industry's widest, deepest lines of refractory solutions. We have been forged by legacy. We are fueled by excellence. Our world-class refractory products perform to the highest degree. And by bringing long-lasting reliability, and our passion and excellence to work every day, we're able to provide superior value to our customers and their businesses.

NO ONE DELIVERS LIKE HWI

HWI provides the largest refractory manufacturing capacity to the glass industry in North America. Over 90 years of research and development in the glass market have enabled us to pioneer innovative glass solutions.

Our refractory products provide a competitive edge. We are the only manufacturer to offer CENTAUR technology, a combo-cast block that provides the highest-performing protection while remaining economical. We also introduced JADE®, the first high-thermal shock resistant brand for hot repairs. JADE® continues to help customers save energy in electric furnaces.

Our dedicated glass application specialists build custom solutions, troubleshoot issues, develop technical papers, conduct refractories training, and offer a variety of consultation services.

Our Value-Added Service (VAS) team can provide a wide range of support, from simple consultation to on-site installation services. We have equipment-rental services and a full range of inventory solutions. We can also provide priority access to our Advanced Technology and Research Center (ATRC) testing services. Our role can be customized to your needs. We can step in as simply a product supplier, or we can take the job all the way through installation. You decide.

PRODUCTS THAT PASS THE TEST. EVERY DAY.

Have high expectations for your refractory products? We do too. Our products set benchmarks for the industry, including TZB®, VISION®, SERV®, ZIRMUL®, and JADE®.

The competitive edge you're looking for starts with us—and with your dedicated HWI application specialist. They're experts who will understand every inch of your process and who will work intensely to optimize your refractory performance.

With the right products identified, we deliver with lightning speed—the products you need, when you need them. We ship around the world at a moment's notice. And we stock our most popular products so that you can have them the same day or the next day. Let us work with you to reduce your potential for downtime.

Want to save time and money? Want to improve your productivity? Talk to your HWI sales representative today. Don't have one? **Call 1-800-492-8349.**

MADE FROM A DIFFERENT MOLD.

Meet our problem-solving, fly-into-action, whatever-it-takes people who are driven to minimize your downtime. We're beyond responsive. We're beyond reliable. Here's how:

Dedicated personnel ready to respond 24/7/365

Manufacturing sites and strategically placed distribution centers throughout North America

HWI associates and partners strategically located around the world—and ready to take your call

Our dedicated glass application specialists leverage the global network of the Calderys Group to offer custom solutions, trouble-shoot issues, develop technical papers, conduct refractories training, and offer a range of services.

APPLICATIONS

ART GLASS

CONTAINER GLASS

FIBERGLASS

FLOAT GLASS

TECHNICAL GLASS

GENERAL REFRACTORY RECOMMENDATIONS

Who else but HWI for your most intense and challenging applications? From art glass and container glass to fiber, float, and technical glass, we provide solutions that keep your business moving. Whether it's our people or our products, we're intensely focused on meeting today's demands for strength, wear resistance, and insulating properties. So name your refractory requirements. And then count on HWI to deliver superior performance.

WOOL "C" FIBERGLASS

CROWN
SERV® 30
RESERV® 50
TIGER® 33 RC
AZTECH-S®
NIKE S75

SUPER-STRUCTURE BACKUP
NIKE S65W
KX-99®
CLIPPER® DP

SUB-LAYER (MONOLITHIC)
TZ® 748 RAM
SHAMROCK® 296

CARRIER COURSE
CLIPPER® DP
CRYLA® XXL
KX-99®

SIDEWALLS
JADE® 50 DCX
SERV® 50 DCX
JADE® 95 DC
SERV® 95 DC
CENTAUR

STACK
SERV® 52 XL
JADE® 95 DC
SERV® 95 DC
RESERV® 50
JADE® 52 XL

SUPER-STRUCTURE
RESERV® 30
RESERV® 50
SERV® 30
AZTECH-S®
TIGER® 33 RC
TZB®
TAYLOR ZIRCON®

TOP PAVING
RESERV® 30
SERV® 30
RESERV® 50
SERV® 52 XL

SUB-PAVING
TZB®
VISION®
ZIRMUL
SERV® 30
RESERV® 30

BOTTOM INSULATION
GREENLITE® DC
GREENTHERM
LOTHERM® DC

SIDEWALL BACKUP
JADE® 52 XL
SERV® 52XL
RESERV® 50

"E" FIBERGLASS

CROWN
NIKE S75 HF
NIKE S75
GEM®
NIKE S65W

SUPER-STRUCTURE
SERV® 30
AZTECH-S®
GEM®
TZB®
NIKE S65W

SUPER-STRUCTURE BACKUP
KX-99®
CLIPPER® DP

SUB-LAYER (MONOLITHIC)
TZ® 748 RAM

SUB-PAVING
TZB®

CARRIER COURSE
CLIPPER® DP
KX-99®
CRYLA® XXL

BOTTOM INSULATION
LOTHERM® DC
GREENTHERM
GREENLITE® DC

SIDEWALLS
TIGER® Z95

SIDEWALL BACKUP
SERV® 95
JADE® 95
JADE® 52 XL
SERV® 52XL
RESERV® 50

STACK
RESERV® 50
SERV® 30
TZB®

SODA-LIME

CROWN
VEGA

SUPER-STRUCTURE
AZTECH DC
TIGER® 33 RC
AZTECH-S®
TZB®-S
GEM®
NIKE S65W
HORIZON DC

SUPER-STRUCTURE BACKUP
CLIPPER® DP
KX-99®
KALA®

TOP PAVING
VISION®
VISION® TILE

SUB-LAYER (MONOLITHIC)
TZ® 748 RAM
TZ® 717-W RAM
ZIRMUL® 160 PATCH

SUB-PAVING
VISION®
TZB®
ZIRMUL®

CARRIER COURSE
CLIPPER® DP
KX-99®
CRYLA® XXL
NIKE S65W XXL

BOTTOM INSULATION
LOTHERM® DC
GREENTHERM
GREENLITE® DC

SIDEWALLS/ THROAT
TIGER® AZS 41 VF
TIGER® AZS 33 VF

SIDEWALL BACKUP
VISION® TILE

HOT OVERCOATS
HORIZON®
JADE® 52 XL
VISION® TILE
ZIRMUL®

BOROSILICATE SPECIALTY

CROWN
NIKE S75 HF
NIKE S75
GEM®
NIKE S65W

SUPER-STRUCTURE
AZTECH DC
TIGER® 33 RC
AZTECH-S®
TZB®
NIKE S65W

SUPER-STRUCTURE BACKUP
NIKE S65W
KX-99®
CLIPPER® DP

TOP PAVING
VISION®

SUB-LAYER (MONOLITHIC)
TZ® 748 RAM

SUB-PAVING
TZB®

CARRIER COURSE
CLIPPER® DP
KX-99®
CRYLA® XXL

BOTTOM INSULATION
LOTHERM® DC
GREENTHERM

SIDEWALLS/ THROAT
TIGER® AZS 41 VF
TIGER® AZS 33 VF

SIDEWALL BACKUP
VISION® TILE
ZIRMUL®

SODIUM-SILICATE

CROWN
NIKE S65W
NIKE S75

SUPER-STRUCTURE
NIKE S65W
ZRX®
AZTECH-S®
AZTECH DC

SUPER-STRUCTURE BACKUP
KX-99®
CLIPPER® DP
GREENTHERM

PAVING
ZIRMUL® (High Ratios)
KORUNDAL XD® (Low Ratios)

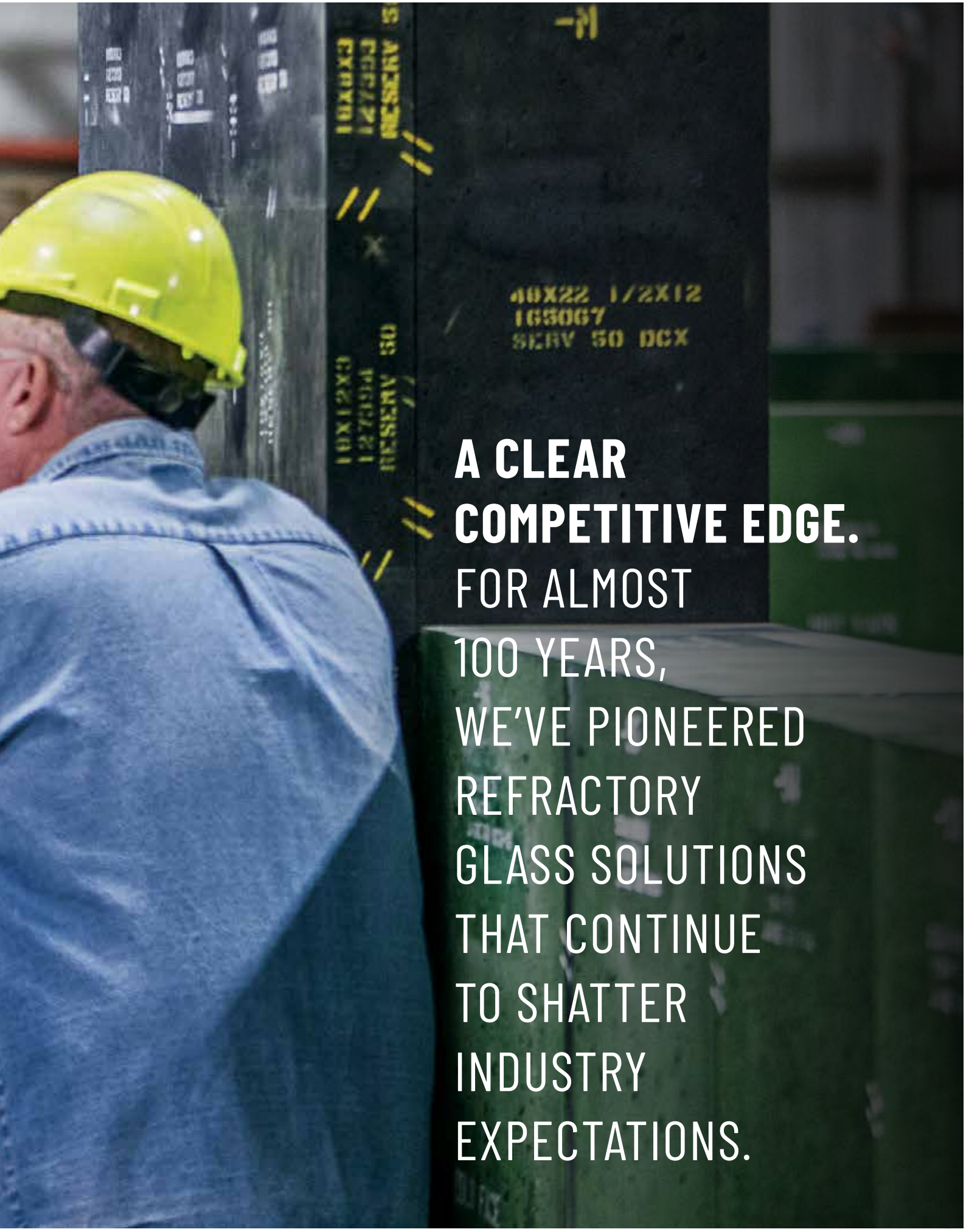
SUB-LAYER (MONOLITHIC)
TZ® 717-W RAM
ZIRMUL® 160 PATCH

CARRIER COURSE
CLIPPER® DP
KX-99®

BOTTOM INSULATION
LOTHERM® DC
GREENTHERM
GREENLITE® DC

SIDEWALLS
TIGER® AZS 33 VF
ZIRMULCAST (High Ratios)
GREFCON® 98T (Low Ratios)

SIDEWALL BACKUP
KX-99®
ZIRMUL®



A CLEAR COMPETITIVE EDGE.

FOR ALMOST 100 YEARS, WE'VE PIONEERED REFRACTORY GLASS SOLUTIONS THAT CONTINUE TO SHATTER INDUSTRY EXPECTATIONS.

REGENERATOR CHECKER PACKS

Fuel-fired furnaces in the glass industry typically utilize checker brick to improve efficiencies by taking advantage of the excellent heat exchange properties inherent in ceramic materials. As the furnace exhausts through the checker pack, the bricks are preheated by the waste gases, providing a source of energy to preheat the combustion air when the cycle is reversed. Regenerator efficiencies can be affected by a variety of factors, from pack design to regenerator size. The materials utilized in regenerators must be able to withstand many different forms of attack, including corrosion by alkalis, silica, and sulfates, as well as thermal shock and creep. The selection of refractory materials is critical to the operation and life cycle of the regenerator.

TOP CHECKERS

This zone has an atmosphere laden with alkali vapors and solid batch carryover (CaO, SiO2). High temperature cycling and oxidizing/reducing effects are also considered

TUFLINE® 98 DM
High alumina (corundum) with excellent thermal shock resistance

NARMAG® 98B
Burned 98% MgO with a forsterite bond

NARMAG® VZ
Mag-zircon composition with a forsterite bond

MIDDLE CHECKERS

This zone has temperature fluctuations that are considered relatively mild. Solid carryover is low and less reactive because of the lower temperature. The atmosphere is rich in alkali vapors and some deposition can occur.

SUPER NARMAG® B
Burned 98% MgO with improved creep resistance

NARMAG HRB
Hydration resistant burned magnesia option to SUPER NARMAG B.

Various checker designs are available to suit your needs, including conventional settings, HPC (chimney type), and the HYDE Checker. All modular checker settings available from HWI can be designed with horizontal clean-outs where appropriate. In addition, all modular checker settings are color coded to height groupings to provide excellent stability.

CONDENSATE ZONE CHECKERS

This zone has lower temperatures, but ranges may be wide where cold incoming air enters the checker setting. A large amount of condensation of volatile constituents is present from the exhaust gas. Plugging may occur from the entrapment of solid dust and fragments from higher up in the setting. Reducing conditions can also affect refractory selection.

SUPER NARMAG® B (gas fired)
Burned 98% MgO with improved creep resistance

NARMAG® VZ (oil fired)
Mag-zircon composition with a forsterite bond

NARMAG® 50 DBRG
50% MgO direct-bonded magnesite chrome

LOWER CHECKERS, RIDER TILE AND ARCHES

This zone has temperature cycling and sulphate condensate that can be an issue. In addition, creep resistance is critical in this application due to the increased load on the refractory.

NIKE S65W
65% Al2O3 for increased resistance to condensate

UFALA® XCR
60% Al2O3 with increased creep resistance

KALA®
Unique 50% Al2O3 that has superior resistance to thermal cycling and creep

KX-99®
Conventional high-fired superduty fireclay

REGENERATOR WALLS & CROWNS

CROWNS, UPPER WALLS, AND UPPER DIVISION WALLS

This section of the regenerator must resist solid carryover attack and is typically subjected to higher temperatures. Careful consideration of insulation being used on crowns must be taken regarding hot-face temperature and expected mean temperature of the hot-face refractory.

NIKE S75 HF
High alumina with superior creep resistance

SUPER NARMAG® B
Burned 98% MgO with improved creep resistance

NIKE S65W
High alumina with excellent alkali resistance

NARMAG® 50 DBRG
50% MgO direct-bonded magnesite chrome

UFALA® XCR
60% Al2O3 with increased creep resistance

TARGET WALLS

Regenerator target walls experience extreme conditions from batch carryover. Issues are most severe in end-port furnaces and the first two or three ports in side-port furnaces.

GEM®
A high-alumina, fused mullite brick with excellent refractoriness and creep resistance

AZTECH-S®
Sintered AZS with high resistance to alkali attack

NIKE S75
High alumina with high strength and good creep resistance

NIKE S65W®
High alumina with excellent alkali resistance

NARMAG® VZ
Mag-zircon composition with a forsterite bond

SUPER NARMAG® B
Burned 98% MgO with improved creep resistance

TZ® 150 PATCH

A multipurpose high-strength patch for hot and cold repairs. For regenerator and port applications, this product is ideal for patching rat holes, thin spots, and open holes in the crown, as well as providing a monolithic seal layer.

MIDDLE WALLS

This section of the regenerator is exposed to lower temperatures, with relatively minor thermal cycling. It's position is roughly 2-10 feet (1-3 meters) below the top checkers. The most important requirement for the refractory selection is resistance to creep.

SUPER NARMAG® B
Burned 98% MgO with improved creep resistance

UFALA® XCR
60% Al2O3 with increased creep resistance

NIKE 60 AR
60% Al2O3 for increased resistance to condensate

KALA®
Unique 50% alumina brick with outstanding alkali and creep resistance

LOWER WALLS

Like the lower checkers, this section is exposed to temperature cycling and sulphate condensate that can be an issue. In addition, creep resistance is critical in this application due to the increased load on the refractory.

UFALA® XCR
60% Al2O3 with increased creep resistance

KX-99®
Conventional high-fired superduty fireclay

CLIPPER® DP
Conventional superduty fireclay

KALA®
Unique 50% alumina brick with outstanding alkali and creep resistance

HWI BOTTOM CONCEPTS

The HWI BOTTOM CONCEPT, which has been used in thousands of furnaces, was first introduced in the early 1970s. Today's design utilizes the same core products: VISION®, TZB®, and TZ® 748 RAM, with a Clay Flux and Insulating Package.

VISION®

A sintered AZS material is chosen over Fused Cast AZS due to its engineering properties, including linear thermal expansion, higher electrical resistivity, no glassy phase, uniform density, and a lower k-factor. VISION® and the HWI bottom concept offer glassmakers the best of both worlds: good corrosion resistance, less heat lost out of the bottom, and added protection from metal drilling.

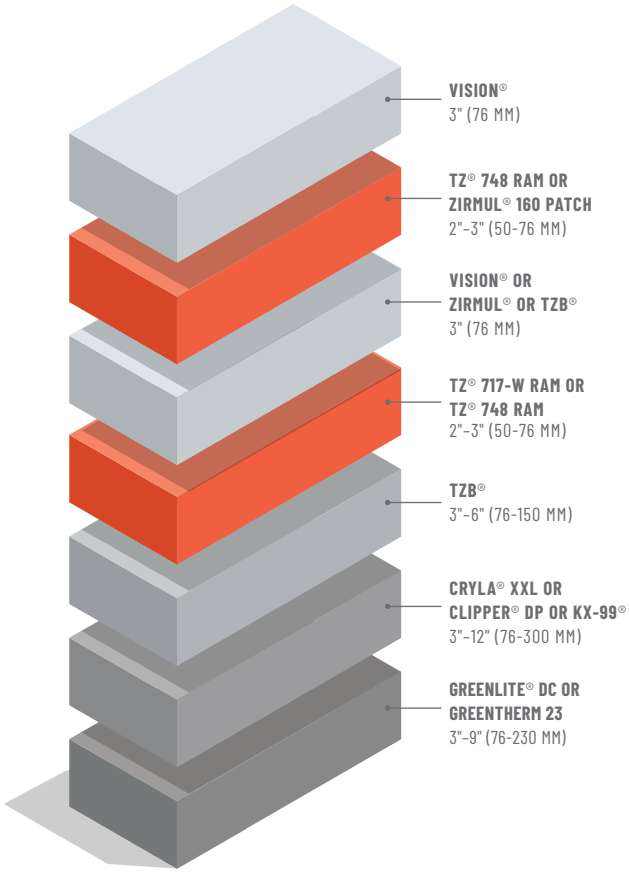
TZ® 748 RAM

A leader in the marketplace for its glass-corrosion resistance and its ability to encapsulate metal. A zircon seal layer protects the furnace from glass following the metal as it drills.

INSULATION PACKAGE

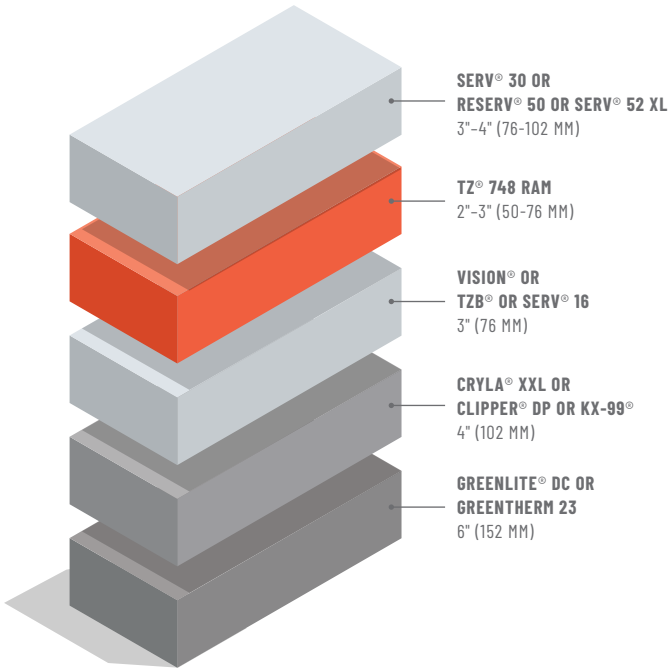
Clay Flux and Insulating Packages are available in two design options: standard brick series and large blocks. Clipper® DP and KX-99® are the options for standard series superduty fireclay and high fired super duty, respectively. CRYLA® XXL and CRYLA® DC provide a solution when large or specialty shapes are preferred. GREENTHERM 23 is available in standard brick series, while GREENLITE® DC is the option for large or specialty shapes.

SODA-LIME GLASS



HWI's bottom design always features VISION® for the top paving, laid with ZIRMUL® 362 mortar, and multiple monolithic layers for corrosion resistance or metal encapsulation. TZ® 717-W RAM is used for its excellent metal encapsulation properties, which protect the bottom from metal drilling at a lower temperature. TZ® 748 also encapsulates metal while providing superior glass-corrosion resistance. With little or no cullet and glass corrosion as the failure mechanism, customers choose ZIRMUL® 160 Patch as the upper monolithic layer.

WOOL GLASS (C-GLASS)



Top paving in wool furnaces is typically 30–50% chrome-alumina materials in order to provide optimum corrosion resistance. Staying true to the HWI design, backup courses include zircon ram and additional sub-paving layers of AZS, zircon, or chrome-alumina.

FOREHEARTHS

HWI has a long history of supplying quality specialty shapes to the glass industry for forehearths. In fiberglass furnaces, the SERV® products are the industry leader for glass-contact materials. In all soda-lime superstructure applications, the NIKE S65W products are world renowned for their excellent alkali resistance. HWI is proud to promote the newest addition to solutions for forehearths in the soda-lime furnace: TAYCOR® M dc. This product is a 99% alumina shape that rivals the performance of fused cast refractories while permitting novel design solutions for the forehearth.

WOOL "C" GLASS FOREHEARTH

BAFFLE BLOCKS
TAYLOR ZIRCON® GC
AZTECH DC
ZIRMUL® DC

SUPER-STRUCTURE
TAYLOR ZIRCON® GC
AZTECH DC
ZIRMUL® DC
TZB®
TIGER® 33 RC

BURNER BLOCKS
KX-99®
CLIPPER® DP

PAVING
SERV® 30
SERV® 16
VISION®

SIDE RAILS
SERV® 52 XL
SERV® 30

TEXTILE "E" FIBERGLASS FOREHEARTH

SUPER-STRUCTURE
NIKE S65W
GEM® GC
NIKE S75

BURNER BLOCKS
GEM® GC
NIKE S65W GC

BAFFLE BLOCKS
GEM® GC
NIKE S65W GC

SODA-LIME GLASS FOREHEARTH & DISTRIBUTOR

COVER BLOCKS
NIKE S65W GC

SKIMMERS & MANTLES
TAMAX® GC

BURNER BLOCKS
NIKE S65W GC
TAMAX® GC

GLASS CONTACT
H/W CORUNDUM/C
TIGER® AZS 33 VF

SODA-LIME GLASS (COLORANT) FOREHEARTH

COVER BLOCKS
AZTECH DC
ZIRMUL® DC

SKIMMERS & MANTLES
AZTECH DC
ZIRMUL® DC

BURNER BLOCKS
AZTECH DC
ZIRMUL® DC

GLASS CONTACT
TIGER® AZS 41 VF
TIGER® AZS 33 VF

INSULATION

HWI has a variety of insulating products to lower thermal conductivity and improve your operation. Our INSWOOL® ceramic fiber blanket products provide excellent handling strength and low heat storage, are easy to install, and are resistant to thermal shock. The Inswool® ceramic fiber blankets are offered in temperature classifications up to 2600ºF. Our insulating firebricks (IFBs) are manufactured with a porous structure that also produces low thermal conductivity and good thermal shock characteristics, resulting in excellent insulating properties. The IFBs have excellent strength at operating temperatures and resistance to corrosive alkali environments. The IFBs are offered in a variety of temperature grades and densities.

BRICK

IFB
GREENTHERM 23
GREENTHERM 25
GREENTHERM 26
GREENTHERM 28
GREENTHERM 30

ALUMINA-SILICA
LOTHERM® RK
GREENLITE® HS

ALUMINA
NA-33 HF
KORUNDAL® LW

BOARD

2300°F (1260°C)
INSBOARD 2300 HD
INSBOARD 2300 LD
INSBOARD 2300-45
INSBOARD S 2300

2600°F (1426°C)
INSBOARD 2600 HA
INSBOARD 2600 HD
INSBOARD 2600 HT

3000°F (1649°C)
INSBOARD 3000

PAPER

2300°F (1260°C)
INSWOOL® 2300
INSWOOL® UG
INSWOOL® S

2600°F (1426°C)
INSWOOL® 880

3000°F (1649°C)
INSWOOL® 3000

BLANKET

2300°F (1260°C)
INSWOOL® HP
INSWOOL® S

2600°F (1426°C)
INSWOOL® HTZ

3000°F (1649°C)
INSWOOL® 3000

PRE-CAST BLOCKS

ALUMINA-SILICA
LOTHERM® DC
GREENLITE® DC

ROPES

CERAMIC FIBER
INSWOOL® 3-PLY TWISTED
INSWOOL® HIGH DENSITY
INSWOOL® ROUNDED BRAID
INSWOOL® SQUARE BRAID

MOLDABLE & PUMPABLE

CERAMIC FIBER
INSWOOL® MOLDABLE
INSWOOL® PUMPABLE
INSWOOL® 2600 PUMPABLE

Material	PRODUCT	Chemical Composition, wt. %									Bulk Density lb/ft³ (g/cm³)	Apparent Porosity (%)	k @ Mean Temp BTU-in/ft²-hr-°F (W/m-K)		Thermal Expansion % @ 2552°F (1400°C)	CMOR lb/in², (N/mm²)	Recommended Mortars
		Al_2O_3	ZrO_2	SiO_2	MgO	Fe_2O_3	TiO_2	Cr_2O_3	CaO	Other			2000°F (1093°C)	2500° F (1371° C)			
ALUMINA-CHROME	SERV® 95	2.2	-	0.8	Trace	0.2	2.7	92.5	0.1	1.5	247 (3.96)	18.7	27.0 (3.9)	25.0 (3.6)	1.10	3800 (26.2)	SHAMROCK® 394
	SERV® 95 DC	5.1	-	-	-	-	1.1	92.2	-	1.6	233 (3.73)	25.0	27.0 (3.9)	25.0 (3.6)	0.65	3100 (21.4)	SHAMROCK® 394
	JADE® 95 DC	7.3	-	-	-	-	-	92.0	-	0.7	230 (3.68)	25.0	23.0 (3.4)	22.2 (3.3)	-	1300 (9.0)	SHAMROCK® 394
	JADE® 52 XL	42.6	-	2.1	0.4	0.1	-	52.5	0.3	3.8	221 (3.54)	18.4	13.6 (2.0)	13.8 (2.0)	-	1500 (10.3)	SHAMROCK® 394
	SERV® 52 XL	39.4	-	3.0	0.7	0.6	-	54.2	0.5	-	222 (3.56)	17.0	18.0 (2.6)	17.0 (2.4)	1.17	4000 (27.6)	SHAMROCK® 394
	RESERV® 30	72.9	-	1.6	-	-	-	24.5	-	1.0	211 (3.38)	15.5	-	-	-	4200 (29.0)	SHAMROCK® 391, 392
	RESERV® 50	38.2	0.4	4.0	0.9	0.6	-	53.7	0.5	-	218 (3.49)	20.1	18.0 (2.6)	17.0 (2.4)	1.18	3700 (25.5)	SHAMROCK® 394
	JADE® 75	19.5	-	1.2	0.1	0.2	-	74.5	0.1	4.4	246 (3.94)	14.0	18.4 (2.7)	19.1 (2.8)	0.62	2200 (15.2)	SHAMROCK® 394
	JADE® 75 DC	20.5	-	3.5	0.1	0.1	-	74.0	0.5	1.3	231 (3.70)	20.0	-	-	0.54	900 (6.2)	SHAMROCK® 394
	JADE® 50 DCX	36.3	-	5.3	0.4	0.2	-	54.9	-	1.6	208 (3.33)	20.0	13.6 (2.0)	13.8 (2.0)	-	800 (5.5)	SHAMROCK® 394
	SERV® 50 DCX	41.6	-	2.2	0.1	1.0	-	52.5	0.6	1.8	214 (3.43)	20.5	18.5 (2.7)	20.0 (2.9)	1.06	3500 (24.1)	SHAMROCK® 394
	SERV® 30 DC	62.7	-	3.1	-	-	-	29.6	-	1.6	202 (3.24)	18.1	17.6 (2.5)	19.0 (2.7)	1.16	3100 (21.4)	SHAMROCK® 391, 392
	JADE® 30 DC	65.5	-	3.1	-	<0.1	-	29.6	-	1.6	202 (3.24)	17.7	13.4 (1.9)	13.6 (2.0)	-	1600 (11.0)	SHAMROCK® 394
	SERV® 30	66.8	-	1.3	-	0.2	-	29.3	-	-	201 (3.22)	18.8	22.0 (3.2)	21.5 (3.5)	1.16	2400 (16.6)	SHAMROCK® 391, 392
	JADE® 30	66.8	-	1.3	-	0.2	-	29.3	-	-	203 (3.25)	17.9	13.4 (1.9)	13.6 (2.0)	-	1700 (11.7)	SHAMROCK® 394
	SERV® 16	80.4	-	2.0	-	0.1	-	16.0	-	-	204 (3.27)	16.0	26.0 (2.7)	26.0 (2.7)	1.10	3000 (20.7)	SHAMROCK® 391, 392
	CENTAUR 50	Zoned glass sidewall blocks consisting of JADE® 50 DCX over JADE® 30 DC															
	CENTAUR 95	Zoned glass sidewall blocks consisting of JADE® 95 DC over JADE® 30 DC															
SILICA	VISIL®	0.6	-	98.8	0.1	0.1	-	-	0.2	-	118 (1.89)	14.0	9.0 (1.3)	10.1 (1.5)	0.16	800 (5.5)	VEGABOND®
	VISIL® GC	0.4	-	97.4	-	-	0.1	-	0.2	1.9	109 (1.74)	-			-	-	VEGABOND®
	VEGA	0.14	-	95.7	0.33	0.52	0.01	-	3.06	-	116 (1.86)	19.5	13.2 (1.9)	15.9 (2.3)	1.35	1100 (7.6)	VEGABOND®
	VEGALITE	1.3	-	94.4	0.2	0.5	0.03	-	2.7	-	69 (1.10)	52.3	5.8 (0.8)	6.2 (0.9)	-	650 (7.0)	VEGABOND®

Material	PRODUCT	Chemical Composition, wt. %									Bulk Density lb/ft³ (g/cm³)	k @ Mean Temp BTU-in/ft²-hr-°F (W/m-K)			
		Al_2O_3	ZrO_2	SiO_2	MgO	Fe_2O_3	TiO_2	Cr_2O_3	CaO	Other		1000°F (538°C)	1400°F (760° C)	1600°F (871°C)	2000°F (1093°C)
INSULATING BRICK AND PRECAST SHAPES	KORUNDAL® LW	92.2	-	7.5	<0.1	<0.1	<0.1	-	<0.1	0.2	101 (1.62)	-	-	-	-
	NA-33 HF	83.6	-	14.6	0.3	0.4	0.4	-	0.3	0.4	96 (1.54)	5.62 (0.81)	5.78 (0.83)	5.92 (0.85)	6.25 (0.90)
	GREENTHERM 30	73.1	-	24.9	0.2	0.5	0.4	-	0.2	0.7	63 (1.00)	2.90 (0.42)	3.06 (0.44)	3.16 (0.46)	3.39 (0.49)
	GREENTHERM 28	67.3	-	29.9	0.2	0.6	0.8	-	0.4	0.1	54 (0.86)	2.81 (0.41)	2.98 (0.43)	3.08 (0.44)	3.30 (0.48)
	GREENTHERM 26	56.5	-	39.7	0.4	0.8	1.1	-	0.5	1.0	55 (0.80)	2.22 (0.32)	2.58 (0.37)	2.77 (0.40)	3.18 (0.46)
	GREENTHERM 25	46.0	-	36.0	0.5	0.7	0.6	-	14.0	1.4	38 (0.61)	0.91 (0.13)	1.12 (0.16)	1.26 (0.18)	1.62 (0.23)
	GREENTHERM 23	51.0	-	44.8	0.4	0.9	1.5	-	0.4	1.0	39 (0.62)	1.87 (0.27)	2.22 (0.32)	2.43 (0.35)	2.88 (0.42)
	LOTHERM® RK	41.4	-	53.4	0.4	1.5	1.9	-	0.3	1.1	101 (1.62)	5.70 (0.82)	5.90 (0.85)	5.98 (0.86)	6.12 (0.88)
	LOTHERM® DC	39.0	-	48.8	0.5	1.8	1.0	-	7.6	1.3	111 (1.77)	6.40 (0.92)	6.70 (0.97)	7.00 (1.01)	7.70 (1.11)
	GREENLITE®-HS	36.4	-	57.0	0.6	1.8	2.1	-	0.4	1.7	73 (1.17)	4.09 (0.59)	4.35 (0.63)	4.51 (0.65)	4.88 (0.70)
	GREENLITE® DC	46.2	-	44.1	0.3	1.0	1.6	-	5.8	1.0	96 (1.54)	4.04 (0.58)	4.19 (0.60)	4.30 (0.62)	4.60 (0.66)
CERAMIC FIBER BOARD	INSBOARD 2300 HD	43.0	-	55.0	-	-	-	-	-	2.0	26 (0.42)	0.68 (0.10)	0.88 (0.13)	0.99 (0.14)	1.23 (0.18)
	INSBOARD 2300 LD	43.0	-	55.0	-	-	-	-	-	2.0	16 (0.25)	0.68 (0.10)	0.88 (0.13)	0.99 (0.14)	1.23 (0.18)
	INSBOARD 2300-45	25.0	-	70.0	-	-	-	-	-	5.0	43 (0.69)	0.95 (0.14)	1.10 (0.16)	1.25 (0.18)	1.72 (0.25)
	INSBOARD S 2300	50.6	-	48.6	0.1	0.9	0.8	-	26.0	0.3	16 (0.25)	0.79 (0.11)	1.18 (0.17)	1.34 (0.19)	2.00 (0.29)
	INSBOARD 2600 HA	35.0	15.0	76.0	15	-	-	-	-	9.0	20 (0.40)	0.72 (0.10)	1.02 (0.15)	1.20 (0.17)	1.60 (0.23)
	INSBOARD 2600 HD	33.0	17.0	50.0	-	-	-	-	-	-	16 (0.40)	0.69 (0.10)	0.90 (0.15)	1.00 (0.14)	1.20 (0.17)
	INSBOARD 2600 HT	33.0	15.0	52.0	-	-	-	-	-	-	14 (0.19)	0.69 (0.10)	0.90 (0.15)	1.00 (0.14)	1.20 (0.17)
	INSBOARD 3000	51.0	-	49.0	-	-	-	-	-	-	16 (0.19)	0.78 (0.11)	1.18 (0.17)	1.40 (0.20)	1.88 (0.27)
CERAMIC FIBER PAPER	INSWOOL® 2300 PAPER	47.0	-	52.6	-	<0.1	-	-	-	0.3	12 (0.19)	0.70 (0.10)	0.92 (0.13)	1.05 (0.15)	1.31 (0.20)
	INSWOOL® UG PAPER	47.0	-	52.6	-	<0.1	-	-	-	0.3	12 (0.19)	0.94 (0.14)	1.36 (0.20)	1.58 (0.23)	2.10 (0.29)
	INSWOOL® S PAPER	-	-	75.0	22.5	-	-	-	-	2.5	8 (0.13)	0.68 (0.10)	0.93 (0.13)	1.05 (0.15)	1.32 (0.19)
	INSWOOL® 880 PAPER	55.0	-	43.7	-	<0.1	-	-	-	1.2	9 (0.14)	0.68 (0.10)	0.92 (0.13)	1.05 (0.15)	1.32 (0.19)
	INSWOOL® 3000 PAPER	97.0	-	2.8	-	-	-	-	-	0.2	8 (0.13)	0.54 (0.08)	1.38 (0.20)	1.87 (0.27)	2.63 (0.38)
CERAMIC FIBER BLANKET	INSWOOL® HP BLANKET	45.0	-	54.0	0.1	<0.1	0.1	-	0.1	0.2	8 (0.13)1	0.81 (0.11)	1.20 (0.17)	1.40 (0.20)	1.80 (0.26)
	INSWOOL® S BLANKET	0.7	-	61.5	4.0	0.4	-	-	31.5	1.9	8 (0.13)1	0.82 (0.12)	1.20 (0.17)	1.43 (0.21)	1.92 (0.28)
	INSWOOL® HTZ BLANKET	35.0	16.0	48.4	0.1	0.1	0.1	-	0.1	0.2	8 (0.13)1	0.80 (0.11)	1.20 (0.17)	1.40 (0.20)	1.80 (0.26)
	INSWOOL® 3000 BLANKET	72.0	-	28.0	-	-	-	-	-	-	8 (0.13)1	0.90 (0.13)	1.38 (0.20)	1.87 (0.27)	2.68 (0.39)
MOLDABLE & PUMPABLE	INSWOOL® MOLDABLE	31.6	-	60.0	-	0.2	-	-	7.3	0.9	27 (0.43)2	-	-	-	-
	INSWOOL® PUMPABLE	31.6	-	60.0	-	0.2	-	-	7.3	0.9	26. (0.42)2	-	-	-	-
	INSWOOL® 2600 PUMPABLE	42.9	9.1	46.9	-	0.1	0.1	-	0.1	0.8	23 (0.37)2	-	-	-	-

(2)Other densities are available.Dried density after 1500°F (815°C)

SHAPED PRODUCTS

Material	PRODUCT	Chemical Composition, wt. %									Bulk Density lb/ft³ (g/cm³)	Apparent Porosity (%)	k @ Mean Temp BTU-in/ft²-hr-°F, (W/m-K)		Thermal Expansion % @ 2552°F (1400°C)	CMOR lb/in² (N/mm²)	Recommended Mortars
		Al_2O_3	ZrO_2	SiO_2	MgO	Fe_2O_3	TiO_2	Cr_2O_3	CaO	Other			2000°F (1093°C)	2500°F (1371°C)			
ALUMINA-SILICA	TAMAX® GC	75.2	–	23.2	–	–	0.5	–	–	1.1	146 (2.34)	25.1	11.8 (1.7)	12.0 (1.7)	0.90	1500 (10.3)	ZIRMUL® 362 / TASIL® 302
	NIKE S75	75.0	–	24.0	–	0.5	0.1	–	–	0.5	167 (2.68)	16.0	12.1 (1.7)	13.4 (1.9)	0.66	1800 (12.4)	ZIRMUL® 362 / TAYCOR® 342
	GEM®	74.6	–	24.2	–	0.1	0.1	–	–	0.6	165 (2.65)	15.0	12.9 (1.9)	13.7 (2.0)	0.75	2500 (17.2)	ZIRMUL® 362 / TAYCOR® 342
	NIKE S75 HF	74.0	–	24.4	0.3	0.6	0.2	–	–	0.3	165 (2.64)	16.9	12.0 (1.7)	13.3 (1.9)	0.68	1700 (11.7)	ZIRMUL® 362 / TAYCOR® 342
	GEM® GC	73.0	–	26.0	–	0.1	0.2	–	–	0.3	155 (2.48)	18.4	12.9 (1.9)	13.7 (2.0)	0.75	3000 (20.7)	ZIRMUL® 362 / TAYCOR® 342
	TAMAX®	70.3	–	28.0	0.1	0.4	0.7	–	–	0.5	154 (2.47)	17.5	11.8 (1.7)	12.0 (1.7)	0.90	2500 (17.2)	ZIRMUL® 362 / MEXI-KOMO®
	TAMUL®	68.0	–	28.0	–	0.9	2.6	–	–	0.5	153 (2.45)	19.1	11.1 (1.6)	11.8 (1.7)	0.90	1700 (11.7)	ZIRMUL® 362 / MEXI-KOMO®
	TAMUL® F	68.0	–	28.0	–	0.9	2.6	–	–	0.5	151 (2.42)	20.1	10.9 (1.6)	11.7 (1.7)	0.90	2100 (14.5)	ZIRMUL® 362 / MEXI-KOMO®
	NIKE S65W GC	66.0	–	32.0	–	0.5	–	–	–	–	150 (2.40)	22.0	13.5 (1.9)	16.4 (2.4)	0.81	1500 (10.3)	ZIRMUL® 362 / MEXI-KOMO®
	NIKE S65W	64.8	–	33.5	–	0.9	0.2	–	–	0.6	159 (2.53)	15.7	13.5 (1.9)	16.4 (2.4)	0.81	1600 (11.0)	ZIRMUL® 362 / MEXI-KOMO®
	NIKE 60 AR	63.0	–	35.0	0.07	0.9	1.0	–	–	0.3	158 (2.53)	14.0	13.2 (1.9)	14.3 (2.1)	0.81	2100 (14.5)	ZIRMUL® 362 / MEXI-KOMO®
	UFALA® XCR	60.3	–	36.8	0.1	1.1	1.3	–	–	0.4	158 (2.53)	15.0	12.5 (1.8)	13.4 (1.9)	0.74	2200 (15.2)	ZIRMUL® 362 / MEXI-KOMO®
	UFALA®	59.0	–	36.7	0.1	1.3	2.6	–	–	0.3	155 (2.48)	15.0	12.5 (1.8)	13.4 (1.9)	0.80	2300 (16.6)	ZIRMUL® 362 / MEXI-KOMO®
	KALA®	49.6	–	46.5	0.1	1.3	2.3	–	–	0.2	151 (2.42)	14.1	14.6 (2.1)	14.6 (2.1)	0.80	2000 (13.8)	TASIL® 301, 317
	CRYLA® DC	50.6	–	43.6	0.2	1.2	1.2	–	1.0	1.2	144 (2.31)	15.0	10.5 (1.5)	10.9 (1.6)	0.70	1600 (11.0)	TASIL® 301, 317
	CLIPPER® DP	43.0	–	52.0	0.3	1.3	2.3	–	–	1.3	142 (2.27)	14.5	9.7 (1.4)	10.2 (1.5)	0.70	1300 (9.0)	TASIL® 301, 317
	KX-99®	42.1	–	53.0	0.2	1.3	2.2	–	–	1.2	142 (2.27)	13.5	10.7 (1.5)	11.1 (1.6)	0.70	1700 (11.7)	TASIL® 301, 317
	EMPIRE® S	37.6	–	56.3x	0.4	1.7	2.0	–	0.3	1.7	134 (2.13)	19.0	9.5 (1.4)	9.9 (1.5)	-0.30	1100 (7.6)	TASIL® 301, 317
ALUMINA-ZIRCONIA-SILICA (AZS)	AZTECH DC	42.7	34.9	21.2	–	0.1	0.1	–	–	1.0	194 (3.14)	16.9	11.9 (1.7)	15.4 (2.2)	–	3000 (20.7)	ZIRMUL® 362
	HORIZON DC	42.3	34.8	21.1	–	0.1	0.1	–	0.8	0.8	196 (3.14)	14.7	13.8 (2.0)	16.4 (2.4)	1.80	1900 (13.1)	ZIRMUL® 362
	VISION® DC	42.3	34.8	21.1	–	0.1	0.1	–	–	1.5	198 (3.17)	14.1	15.2 (2.2)	16.2 (2.3)	1.81	3000 (20.7)	ZIRMUL® 362
	VISION®	59.4	25.9	13.9	–	–	–	–	–	0.8	202 (3.23)	11.0	10.9 (1.6)	12.0 (1.7)	0.82	4800 (33.1)	ZIRMUL® 362
	VISION® TILE	55.6	26.0	14.3	–	–	–	–	–	3.1	190 (3.04)	15.5	15.2 (2.2)	16.2 (2.3)	0.82	4000 (27.6)	ZIRMUL® 362
	AZTECH-S®	55.0	24.0	19.5	–	–	–	–	–	1.5	197 (3.16)	16.5	–	–	–	4000 (27.6)	ZIRMUL® 362
	ZIRMUL®	70.0	19.3	10.4	–	–	–	–	–	0.3	197 (3.16)	17.0	13.5 (1.9)	14.3 (2.1)	0.94	2000 (16.0)	ZIRMUL® 362
	ZIRMUL® DC	66.1	19.9	13.4	–	–	–	–	–	0.1	192 (3.12)	17.2	13.5 (1.9)	14.3 (2.1)	0.94	2200 (16.0)	ZIRMUL® 362
	ZIRMUL® SC	70.0	19.5	10.2	–	–	0.1	–	–	0.2	193 (3.09)	18.0	13.5 (1.9)	14.3 (2.1)	0.94	2600 (17.9)	-
	ZRX®- F	50.9	19.5	28.4	0.2	0.4	0.3	–	–	0.3	172 (2.76)	16.7	11.7 (1.7)	12.2 (1.8)	0.82	3400 (23.4)	ZIRMUL® 362
HIGH-PURITY ALUMINA	TUFLINE® 98 DM	97.6	–	0.12	0.16	0.09	0.05	–	–	1.98	204 (3.27)	14.6	24.8 (3.6)	24.2 (3.5)	1.05	2000 (13.8)	TAYCOR® 342
	PRISM® DC	96.3	–	0.1	0.8	0.1	0.6	–	2.5	0.2	181 (2.90)	23.0	19.5 (2.8)	19.7 (2.8)	1.10	4100 (28.3)	ZIRMUL® 362 / TAYCOR® 342
	KORUNDAL 95	95.0	–	4.5	–	0.1	–	–	–	0.4	204 (3.27)	13.0	–	–	–	3600 (24.8)	ZIRMUL® 362 / TAYCOR® 342
	KORUNDAL XD®	90.0	–	9.7	0.1	–	–	–	–	0.3	191 (3.06)	15.4	19.6 (2.8)	19.7 (2.8)	0.93	2200 (15.2)	ZIRMUL® 362 / TAYCOR® 342
ZIRCONIUM - SILICATE	TZB®	–	66.0	32.0	–	–	0.6	–	–	2.0	235 (3.77)	17.8	16.3 (2.3)	17.5 (2.5)	0.65	3000 (20.7)	TZ® 702, 352
	TZB®-S	–	66.0	32.0	–	–	–	–	–	2.0	228 (3.74)	19.9	16.3 (2.3)	17.5 (2.5)	0.65	1200 (16.6)	TZ® 352
	TAYLOR ZIRCON® GC	–	64.7	34.0	–	–	–	–	–	1.3	223 (3.57)	21.1	16.3 (2.3)	17.5 (2.5)	0.65	2700 (18.6)	TZ® 352
BASIC	SUPER NARMAG® B	0.2	–	0.4	98.0	0.5	–	–	0.9	–	186 (2.98)	14.6	33.0 (4.7)	32.9 (4.7)	1.90	2300 (15.9)	NARMAG® HS
	NARMAG® 98B	0.2	–	0.2	98.1	0.6	–	–	0.9	–	183 (2.93)	15.8	30.6 (4.4)	28.4 (4.1)	1.92	2100 (14.5)	NARMAG® HS
	NARMAG® VZ	0.3	12.0	6.5	80.0	0.4	–	–	0.7	–	194 (3.11)	13.5	24.7 (3.5)	25.0 (3.6)	1.70	1800 (12.4)	NARMAG® HS
	NARMAG® 50 DBRG	9.0	–	1.6	50.6	13.1	–	24.9	0.8	–	200 (3.20)	17.5	21.0 (3.0)	21.0 (3.0)	1.40	900 (6.2)	NARMAG® HS

Material	PATCHES	Chemical Composition, wt. %										Material Required pcf (g/cm³)	Storage Life (months)	Shipping Conditions	MOR after Temp. lb/in² (N/mm²)	
		Al_2O_3	ZrO_2	SiO_2	MgO	Cr_2O_3	P_2O_5	Fe_2O_3	TiO_2	CaO	Other				2000°F (1093°C)	2500°F (1371°C)
AZS	ZIRMUL® 160 PATCH	56.8	25.9	12.6	-	-	4.4	0.1	0.1	-	0.1	200 (3.2)	12.0	wet	2600 (17.9)	3100 (21.4)
HIGH-PURITY ALUMINA	SHOTKAST® TAB	96.5	-	0.05	-	-	3.2	0.05	-	0.05	-	170 (2.7)	3.0	wet	-	-
	KORUNDAL® HOT GUN MIX ADTECH®	88.8	-	8.4	0.1	-	-	0.4	0.5	1.6	0.2	141 (2.3)	12.0	dry	500 (3.4)	-
ZIRCONIUM-SILICATE	TZ® 150 PATCH	0.2	63.6	31.3	-	-	4.4	0.1	0.3	0.1	-	230 (3.7)	12.0	wet	3700 (25.5)	3900 (26.9)
SILICA	VISIL® PATCH	0.4	-	99.4	-	-	-	0.1	-	-	0.1	80 (1.3)	12.0	dry	-	-
	CROWNSEAL	0.4	-	98.6	-	-	-	-	-	0.3	0.7	108 (1.7)	6.0	dry	-	-
	SHOTKAST® FS	0.2	-	99.4	-	-	-	0.1	-	0.08	0.22	109 (1.7)	12.0	2-component	1100 (7.6)	-
ALUMINA-CHROME	SHAMROCK 192 PATCH	73.4	-	0.2	-	22.4	3.7	0.1	-	-	0.2	200 (3.2)	8.0	wet	-	5600 (38.6)

Material	RAMS	Chemical Composition, wt. %										Material Required pcf (g/cm³)	Storage Life (months)	Shipping Conditions	MOR after Temp. lb/in² (N/mm²)	
		Al_2O_3	ZrO_2	SiO_2	MgO	Cr_2O_3	P_2O_5	Fe_2O_3	TiO_2	CaO	Other				2000°F (1093°C)	2500°F (1371°C)
ALUMINA-SILICA	BRIKRAM 57 RB	57.6	-	36.1	0.3	-	3.9	0.9	0.7	0.3	0.2	160 (2.6)	6.0	wet	-	1300 (9.0)
AZS	ZIRMUL® 260 RAM MIX	67.8	19.3	9.6	-	-	3.0	0.1	0.1	-	0.1	200 (3.2)	12.0	wet	1600 (11.3)	2360 (16.3)
HIGH-PURITY ALUMINA	TAYCOR® 248 RAM	98.2	-	1.0	0.1	-	-	0.1	-	-	0.6	175 (2.8)	3.0	wet	800 (5.5)	-
ZIRCONIUM-SILICATE	TZ® 717-W RAM MIX	1.0	64.5	33.9	-	-	-	0.1	-	0.1	0.4	220 (3.5)	12.0	wet	1900 (13.1)	3400 (23.4)
	TZ® 748 RAM MIX	1.0	63.4	32.7	-	-	2.4	0.1	0.3	-	-	225 (3.6)	12.0	wet	2300 (15.9)	2900 (20.0)
ALUMINA-CHROME	SHAMROCK® 296 RAM	80.1	-	0.1	-	15.1	4.4	0.1	-	-	0.2	200 (3.2)	4.0	wet	3300 (22.8)	4200 (29.0)
	SHAMROCK® 30 RAM	65.1	-	0.1	-	28.2	5.3	0.1	-	-	0.2	200 (3.2)	4.0	wet	-	6000 (41.4)

Material	PLASTICS	Chemical Composition, wt. %										Material Required pcf (g/cm³)	Storage Life (months)	Shipping Conditions	MOR after Temp. lb/in² (N/mm²) 2500°F (1371°C)
		Al_2O_3	ZrO_2	SiO_2	MgO	Cr_2O_3	P_2O_5	Fe_2O_3	TiO_2	CaO	Other				
ALUMINA-SILICA	SUPER HYBOND® 60 PLUS	58.9	-	36.9	0.2	-	-	1.2	2.2	0.1	-	158 (2.53)	4.0	wet	700 (4.8)
	SUPER HYBOND® PLUS	44.0	-	49.9	0.3	-	-	1.4	2.7	0.5	-	146 (2.3)	4.0	wet	600 (4.1)
ZIRCONIUM-SILICATE	TZ® 951 PLASTIC	2.4	63.0	31.2	-	-	2.1	0.2	0.6	0.4	-	215 (3.4)	25 days	wet	2900 (20.0)
AZS	ZIRMUL® 960 PLASTIC	58.4	25.0	14.0	-	-	2.2	0.1	0.1	0.1	-	190 (3.0)	1.5	wet	2300 (16.0)
HIGH-PURITY ALUMINA	PLASTECH® 90P	90.0	-	4.9	0.1	-	4.3	0.1	0.1	0.2	-	197 (3.2)	6.0	wet	1800 (12.4)
ALUMINA-CHROME	SHAMROCK® 885 PLASTIC	67.5	-	0.2	-	29.7	2.4	0.1	-	-	-	220 (3.5)	4.0	wet	-

* C=Conventional, V=Vibration, P=Pumping, S=Shotcreting, G=Gunning

UNSHAPED PRODUCTS

Material	CASTABLES	Chemical Composition, wt. %									Material Required pcf (g/cm³)	Storage Life (months)	Water to Cast (wt. %)	Installation Methods*	MOR after 220°F (105°C)	CCS after 220°F (105°C)
		Al_2O_3	ZrO_2	SiO_2	MgO	Cr_2O_3	Fe_2O_3	TiO_2	CaO	Other					lb/in² (N/mm²)	lb/in² (N/mm²)
ALUMINA -SILICA	VERSAFLOW® 57A PLUS	60.9	-	35.6	0.1	-	0.7	0.6	1.8	0.3	156 (2.5)	12	6.5	V, P, S	2200 (15.2)	11,500 (79.3)
	VERSAFLOW® 60 PLUS	60.2	-	34.2	0.2	-	1.1	2.4	1.6	0.3	148 (2.4)	12	6.6	C, V, P	1600 (11.0)	15,000 (103.4)
	VERSAFLOW® 45 PLUS	44.6	-	49.4	0.2	-	0.7	2.2	2.4	0.5	132 (2.1)	12	7.5	C, V, P	1050 (7.2)	8500 (58.6)
	KS-4® PLUS	44.9	-	42.6	0.3	-	2.3	2.3	6.7	0.9	122 (2.0)	12	13.5	C, V	900 (6.3)	4150 (28.5)
	SENTINEL® RC	37.6	-	42.5	0.9	-	1.5	2.0	14.4	0.8	128 (2.1)	12	11.0	C, V, P	2000 (13.8)	8300 (57.2)
AZS	NARCON® MZA CASTABLE	42.3	34.8	21.1	-	-	0.1	0.1	0.8	0.2	198 (3.2)	12	3.8	V	2000 (13.8)	9400 (64.8)
	ZIRMULCAST	66.1	19.9	13.4	-	-	-	-	-	0.6	190 (3.0)	9	5.5	V, P	700 (4.8)	2700 (18.6)
ZIRCONIUM -SILICATE	TZ® 452 CASTABLE	5.1	58.6	34.1	-	-	-	0.6	1.4	0.8	214 (3.4)	6	4.7	V	2600 (17.7)	14,000 (96.6)
HIGH-PURITY ALUMINA	GREENCAST®-94 F PLUS	96.4	-	0.1	-	-	0.1	-	3.1	0.3	176 (2.82)	6	6.2	P	2500 (17.2)	10,000 (69.0)
	TAYCOR® 414-FH HYDROCAST	94.8	-	-	0.1	-	0.1	-	4.3	0.1	175 (2.8)	12	10	V	1500 (10.3)	9100 (62.7)
	GREFCON® 98T	98.1	-	0.1	-	-	-	0.1	1.4	0.1	185 (3.0)	12	5.7	V	1400 (9.7)	12,000 (82.7)
	MIZZOU® CASTABLE PLUS	59.2	-	34.9	0.1	-	1.0	2.1	2.3	0.4	141 (2.26)	12	9	C, V	1300 (9.0)	8600 (59.3)
ALUMINA -CHROME	JADECAST® 95	9.8	-	-	-	86.5	-	-	-	3.7	223 (3.6)	4	5.2	V, P	1100 (9.7)	-
	JADECAST® 50	36.3	-	5.3	0.4	54.9	0.2	0.2	0.7	2.2	212 (3.4)	6	4.7	V, P	1200 (8.3)	3200 (22.1)
	JADESHOT 50	39.8	-	4.4	0.5	-	52.5	0.3	0.8	1.3	209 (3.35)	6	5.5	S	720 (5.8)	-
	JADECAST® 30	65.7	-	3.1	-	29.6	-	-	-	1.6	200 (3.2)	4	4.7	V, P	800 (5.5)	3000 (20.7)
INSULATING	KAST-O-LITE® 23 LI PLUS	30.6	-	55.2	0.2	-	0.9	0.9	10.1	2.1	50 (0.8)	12	54	C, G	120 (0.8)	300 (2.1)
	KAST-O-LITE® 26 LI PLUS	43.2	-	41.4	0.5	-	1.6	2.2	9.9	1.2	86 (1.4)	12	20	C	700 (4.8)	3500 (24.1)
	KAST-O-LITE® 30 LI PLUS	55.5	-	36.1	0.2	-	0.9	1.3	4.9	1.1	92 (1.47)	12	17	C	500 (3.4)	2200 (15.2)

Material	MORTARS	Chemical Composition, wt. %										Setting Characteristics	Storage Life (months)	Shipping Conditions	% Water Required (troweling)	Cement Required per 1000 9 in. equivalent (troweled) lbs (kg)
		Al_2O_3	ZrO_2	SiO_2	MgO	Cr_2O_3	P_2O_5	Fe_2O_3	TiO_2	CaO	Other					
ALUMINA - SILICA	SAIRBOND	40.2	-	52.8	0.2	-	-	1.1	2.1	0.2	3.4	air	12.0	dry	21	400 (181)
	SAIRSET®	35.0	-	60.0	0.0	-	-	1.0	1.7	0.2	2.1	air	6.0	wet	-	350 to 400 (159 to 181)
	TASIL® 301 TR MORTAR	50.0	-	45.0	0.1	-	-	1.0	1.1	0.1	2.8	air	3.0	wet	-	450 to 500 (205 to 225)
	MEXI-KOMO®	50.1	-	45.4	0.2	-	-	1.4	2.1	0.2	2.4	heat	12.0	dry	27	350 to 400 (159 to 181)
	SATANITE	59.4	-	35.7	0.3	-	-	1.2	2.3	0.1	1.0	heat	12.0	dry	29.1	275 (125)
	TASIL® 317 MORTAR	51.0	-	44.0	0.1	-	-	1.0	1.0	0.1	2.6	air	12.0	dry	27	350 to 400 (160 to 180)
AZS	ZIRMUL® 362 MORTAR	50.0	31.0	15.0	-	-	2.5	0.1	0.1	-	1.1	heat	12.0	dry	19	525 (238)
HIGH-PURITY ALUMINA	TAYCOR® 342 DRY MORTAR	96.0	-	3.0	-	-	-	0.1	0.1	-	0.4	heat	12.0	dry	23	475 (218)
	GREENSET® 94-P	92.0	-	1.2	0.1	-	6.2	0.1	0.1	0.1	0.2	heat	6.0	wet	-	600 (270)
	KORUNDAL® BOND	82.8	-	14.5	-	-	-	0.2	0.3	0.1	2.1	air	12.0	dry	24	425 (193)
ZIRCONIUM - SILICATE	TZ® 352 DRY MORTAR	1.0	60.0	32.0	-	-	4.7	-	-	-	1.0	heat	12.0	dry	14	600 to 650 (270-295)
	TZ® 702 DRY MORTAR	0.6	66.0	33.0	-	-	-	0.1	0.2	-	0.3	heat	12.0	dry	13	625 (284)
	TZ® 716 DRY MORTAR	0.7	62.0	35.0	-	-	-	0.1	0.2	-	2.1	air	12.0	dry	19	625 (284)
BASIC	NARMAG® MORTAR HEAT SET	0.3	-	1.1	95.3	-	-	0.4	-	0.8	1.6	heat	6.0	dry	25	550 (249)
ALUMINA - CHROME	SHAMROCK® 391-TR MORTAR	67.5	-	2.5	-	28.9	-	-	-	-	1.1	air	3.0	wet	-	625 to 675 (284 to 306)
	SHAMROCK® 392 DRY MORTAR	67.1	-	-	-	29.8	2.9	-	-	-	0.2	heat	12.0	dry	17	550 (249)
	SHAMROCK® 394 DRY MORTAR	23.8	-	1.2	-	74.9	-	-	-	-	0.1	heat	12.0	dry	20	625 (283)
SILICA	SILSET	0.3	-	96.8	0.1	-	-	0.2	0.1	-	2.5	air	12.0	dry	23	350 (159)
	VEGABOND®	0.6	-	99.0	-	-	-	0.1	0.1	0.1	0.2	heat	12.0	dry	38	350 (159)

FUSED CAST AZS

HWI and DY have had a joint collaboration to produce the TIGER® product line since 2005. Since the foundation, DY has adopted the special equipment and advanced oxidizing technology on producing high quality fused cast blocks which are used in glass furnaces. The annual production capacity has reached 30,000 tons already.

Products have been exported to more than 50 countries all over the world, including the major glass producers in United States and European Union. The manufacturing facility is ISO 14001:2004, ISO 9001:2008, and OHSAS 18001:2007 Certified.

PRODUCTS		TIGER® AZS 33	TIGER® AZS 36	TIGER® AZS 41
Chemical wt. %	Al_2O_3	50.5	47.4	45.8
	ZrO_2	33.0	36.0	41.0
	SiO_2	15.0	14.0	12.0
Bulk Density lb/ft³ (g/cm³)		237 (3.80)	242 (3.88)	248 (3.97)
Apparent Porosity (%)		1.0	1.0	1.0
k @ Mean Temp Btu/ft²/hr (W/mK)	1472°F (800°C) 2°F(800°C)	23.1 (3.35)	23.1 (3.35)	23.5 (3.40)
	2192°F (1200°C)	26.6 (3.85)	26.6 (3.85)	26.5 (3.85)
Thermal Expansion % @2552°F (1400°C)		0.72	0.72	0.71
CCS lb/in² (MPa)		37,700 (260)	37,700 (260)	40,600 (280)
Recommended Mortar		ZIRMUL® 362	ZIRMUL® 362	ZIRMUL® 362

EMISSHIELD®

Emisshield® is a high-emissivity ceramic coating that is offered exclusively by HWI for application in glass furnaces. Now in over 100 furnaces worldwide, Emisshield® works hard to minimize heat loss and increase efficiency. HWI also provides in-house installation services for all Emisshield® coatings. This technology has revolutionized the glass industry by providing:

- **Lower operating costs**
- **More even heating**
- **Increased productivity**
- **Longer refractory life**
- **Increased fuel savings**
- **Decreased NOx**
- **Reduced carbon footprint**

The Emisshield® product was originally developed by NASA to protect space vehicles. In these applications, the coating is designed to modify the surface of the substrate on which it is placed to increase the emissivity and therefore the amount of energy radiated from it. In space applications, temperatures can range from subzero to over 3000°F in a matter of seconds. The Emisshield® coating was designed to maintain adhesion and not lose its emissivity under these conditions. Emisshield® comes in a variety of formulas designed to adhere to various substrates, whether they be refractory or metal alloys. Most versions are applied just 2–3 mils thick—the thickness of a garbage bag—and are capable of operating at temperatures up to 3500°F.

SERVICE LIKE YOU'VE NEVER SEEN

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Enjoy the utmost in service. HWI's dedicated VAS team provides on-site management, installation, equipment, inventory management, and supervisory services. Benefits include:

- Single-source responsibility that delivers cost savings
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- Quick response times, minimizing outages and downtime
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To learn more, contact us at: **VAS@thinkHWI.com**

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The Global Projects and Engineering Team specializes in greenfield construction, manufacturing and plant modernization, and also services the advanced engineering needs of existing facilities. These services include the following benefits:

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- Expertise in all applications, including rapidly advancing technologies such as coal gasification units
- Strong conceptual drawing capabilities with meticulous attention to detail

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ADVANCED TECHNOLOGY AND RESEARCH CENTER (ATRC)

HWI has an ATRC center for learning, testing, exploration, and innovation. Here in the United States, ATRC houses some of the brightest minds in the refractory industry. Our team of research and development experts works directly with our customers to design, test, and trial new products and applications. Services include:

- Research and development of new applications and products
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- Quality-assurance testing
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- Slag analysis
- Postmortem analysis
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We're the thought leaders. The researchers. The innovators. The tech geeks. We're the refractory partners who won't melt when the heat is on, who live to solve your greatest challenges. Every day at HWI, we design solutions that help improve efficiencies, make installations easier, extend campaign lives, and save customers millions of dollars. And it all begins with our intensely driven service teams.

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Every day, our people and products stand up to the challenges of every job. Being a member of the Calderys Group, we have the capability to operate in proximity to our customers to meet the specific challenges of our local markets anywhere in the world.

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