REFRACTORY SOLUTONS FOR **LADLES**

HWI
A MEMBER OF CALDERYS

STEELY RESOLVE. IRONCLAD TRUST.

FOR MORE THAN 150 YEARS, WE HAVE BEEN A VITAL PARTNER TO ALL THE MAJOR STEEL PRODUCERS. WE PROVIDE WORLD-CLASS PRODUCTS THAT SET THE GOLD STANDARD.

Over the years, iron and steel processing technology has evolved from employing ladles as holding and transport vessels between major production areas into vessels used for the refining of molten metal for a variety of steelmaking processes

HarbisonWalker International (HWI) helps steel companies that need refractory solutions achieve maximum production capacity at the lowest cost to competitively supply steel-consuming industries such as automotive, construction, agriculture, oil and gas drilling and production, appliances, packaging and more.

HWI STEEL LADLE SOLUTIONS

HWI offers a broad portfolio of products and solutions to support our customers' technical challenges and production needs.

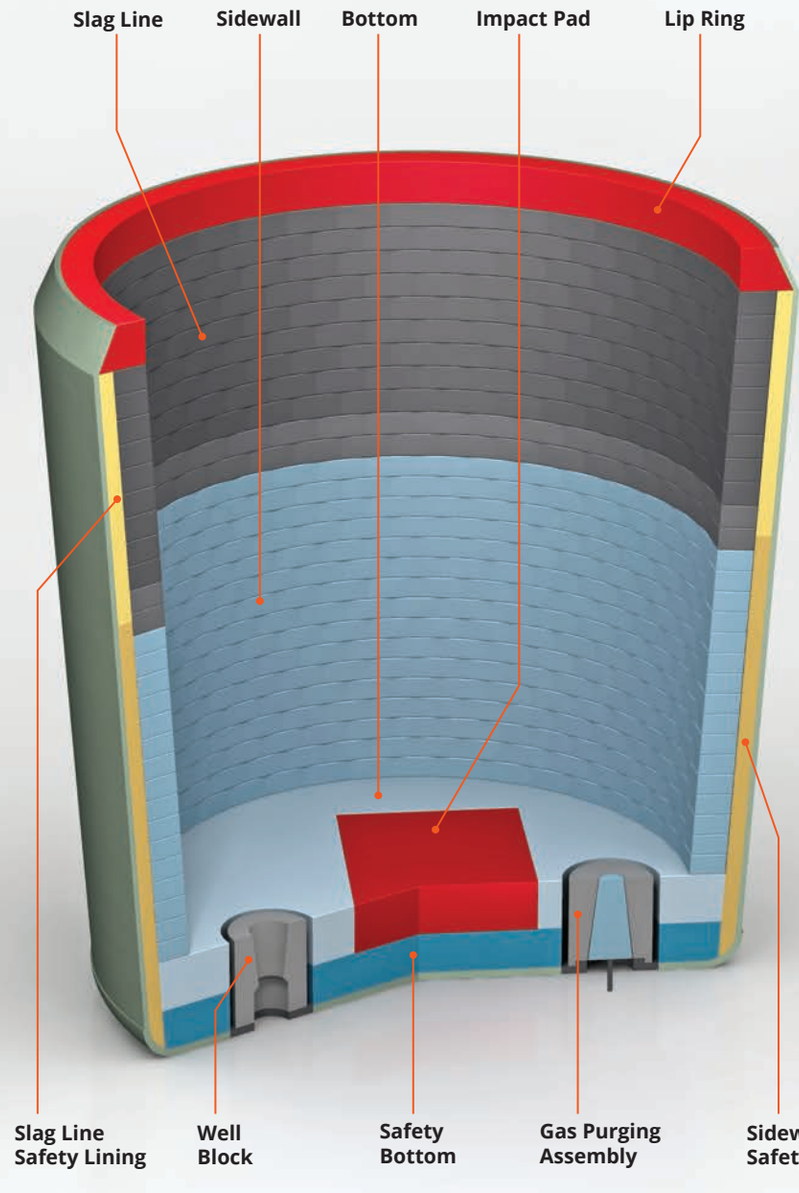
OUR PRODUCT RANGE INCLUDES:

- Safety linings
- Working linings
- Shapes, assemblies, and functional products
- Complete line of gas purging refractories and hardware systems
- Value-added services, including
  - Ladle steel fabrication services
  - Refractory installation service
  - Gunning / ladle maintenance services
  - Non-destructive testing inspection services

HWI STEEL LADLE SOLUTIONS

HWI is one of the largest domestic manufacturers of steel ladle refractories. Our steel ladle refractory solutions are customized based on shop-specific conditions to optimize refractory performance and improve safety, refractory life and yield.

We provide high-performance brick and monolithic ladle linings designed to withstand any secondary refining, heating, stirring, and alloying in the slag line, as well as the sidewall and bottom of the ladle.



HWI STEEL LADLE SOLUTIONS

HWI provides both brick and monolithic ladle safety linings

Brick safety linings provides structural integrity for the working linings, ease of installation, and the ability to zone sections of the sidewall. The three most common ladle safety lining brick designs are arch-wedge, semi-universal, and book-tile construction.

Monolithic safety linings are installed either by casting or shotcreting. They provide a joint-free lining and quick installation. Multiple product options are available to meet process requirements.

BRICK SAFETY LININGS

The three most common brick safety lining designs are:

- Arch-wedge: provides one of the tightest safety linings
- Semi-universal: is easy and quick to install for quick turn-arounds
- Book-tile: gives added protection against steel penetration

MONOLITHIC SAFETY LININGS

Monolithic safety linings are installed either by casting or by shotcreting.

- ***Casting method:*** delivers a very compact and geometrically precise safety lining, but requires a mandrel for casting. HWI can provide shop-specific, custom mandrels to fit the specific ladle geometry.
- ***Shotcreting method:*** easy-to-install due to form-free application that does not require a mandrel, but the final geometry of the lining is not exact and could create some difficulties for brick construction of the working lining. In this case, a half-inch layer of dry vibratable is recommended to separate the shotcrete safety lining from the working lining.

We provide high-performance brick and monolithic ladle linings designed to withstand any secondary refining, heating, stirring, and alloying in the slag line, as well as the sidewall and bottom of the ladle.

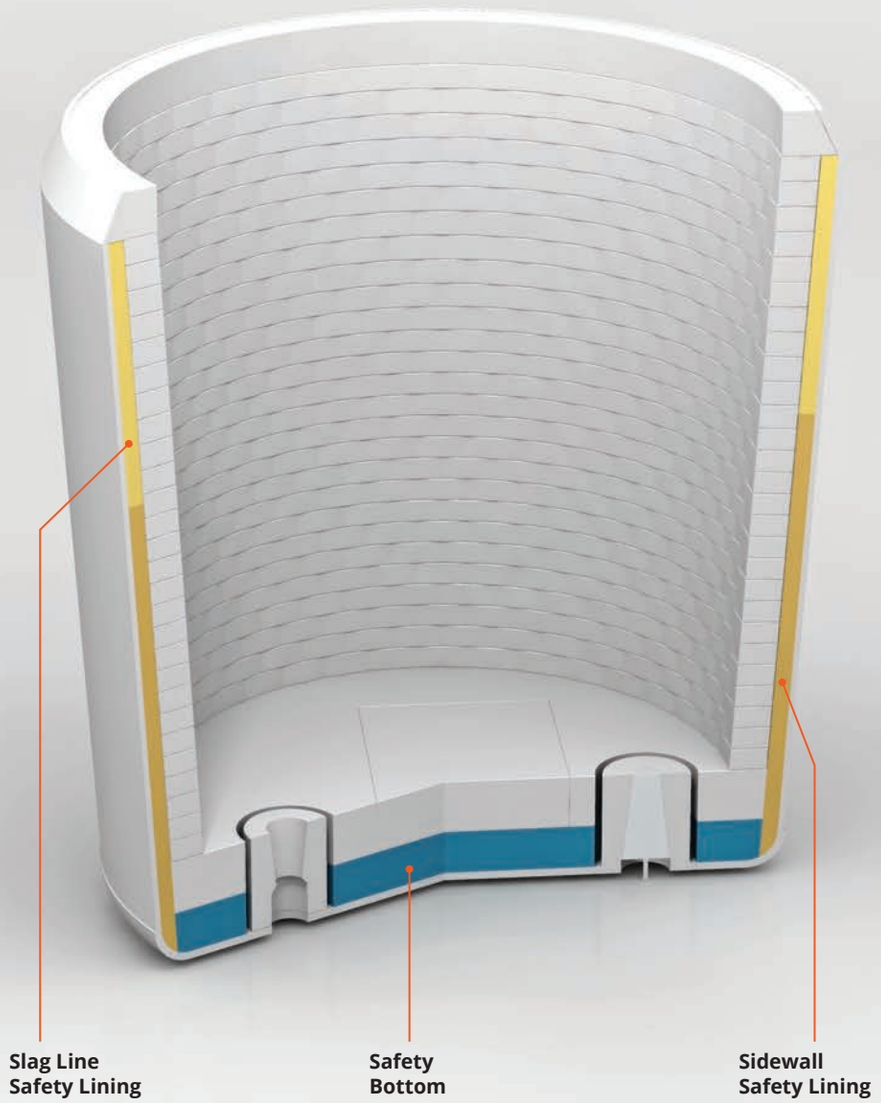
SAFETY LINING PRODUCTS

Safety Bottom
- FASTKAST®
- NARCON®
- VERSAFLOW®
- ULTRA-EXPRESS®

Sidewall
- KRUZITE®
- UFALA®
- NARCON®
- SHOT-TECH®

Slag Line
- 60DB
- 50DB
- LADLE SL TANK

Mortars
- NO. 36 REFRACTORY



RECOMMENDED SAFETY LINING PRODUCTS

LOCATION	TYPE	HWI PRODUCT	SPECIFICATION	BENEFIT
Safety Bottom	Brick	UFALA®	60% alumina	- CO-resistance - Wear resistance
	Monolithic	FASKAST® 75 PLUS	Ultra low cement, 75% alumina	- Ease of installation - Excellent hot strength
		NARCON® 70 CASTABLE	Ultra-low cement, high alumina	- Outstanding volume stability - Excellent hot strength
		VERSAFLOW® 70C PLUS	High alumina, coarse grain	- Ease of installation - Added toughness for mechanical abuse
		ULTRA-EXPRESS® 70	Ultra low cement	- Cost effective - Self leveling
Sidewall	Brick	UFALA®	60% alumina	- CO-resistance
		KRUZITE® 70	70% alumina	- Good slag resistance
		NARCON® 70 CASTABLE	Ultra-low cement, high alumina	- Outstanding volume stability - Excellent hot strength
	Monolithic	SHOTKAST® 65	Shotcrete	- Ease of installation - Formless installation
		SHOT-TECH® 70	70% alumina	- Long working time - Outstanding installation characteristics
Slag Line	Brick	60DB	Magnsia-chrome	- Good slag resistance - Good thermal shock resistance
		50DB	Magnsia-chrome	- Less brittle than 60DB - Good slag resistance
		LADLE SL TANK	Magnesia-carbon	- Excellent slag resistance - Good thermal shock resistance
Mortars	Monolithic	NO. 36 REFRACTORY	65% alumina, air-set cement	- Good strength

SAFETY LINING PRODUCTS

HWI's broad range of brick, monolithic, and precast solutions provides customers witha single source for the optimization of the ladle fleet.

This is especially important for working linings. Directly in contact with molten steel and slag in the bottom, sidewall and slag lines, ladle working linings must be able to withstand secondary refining, heating, stirring, and alloying. These operations affect the slag line, as well as the sidewall and bottom of the ladle. Working linings can be either brick or monolithic and are selected on the basis of operating conditions and slag compatibility.

BRICK WORKING LININGS

Bricks are used extensively for ladle working linings. A major advantage of brick working linings is that the ladle can be returned to service quickly after relining.

Magnesia-carbon (MgO-C) bricks are used in shops where ladle furnaces are in operation. They perform well with the basic slags needed for desulfurization. Magnesia-chrome (MgO-Cr) bricks are used with less basic slags and no ladle furnace.

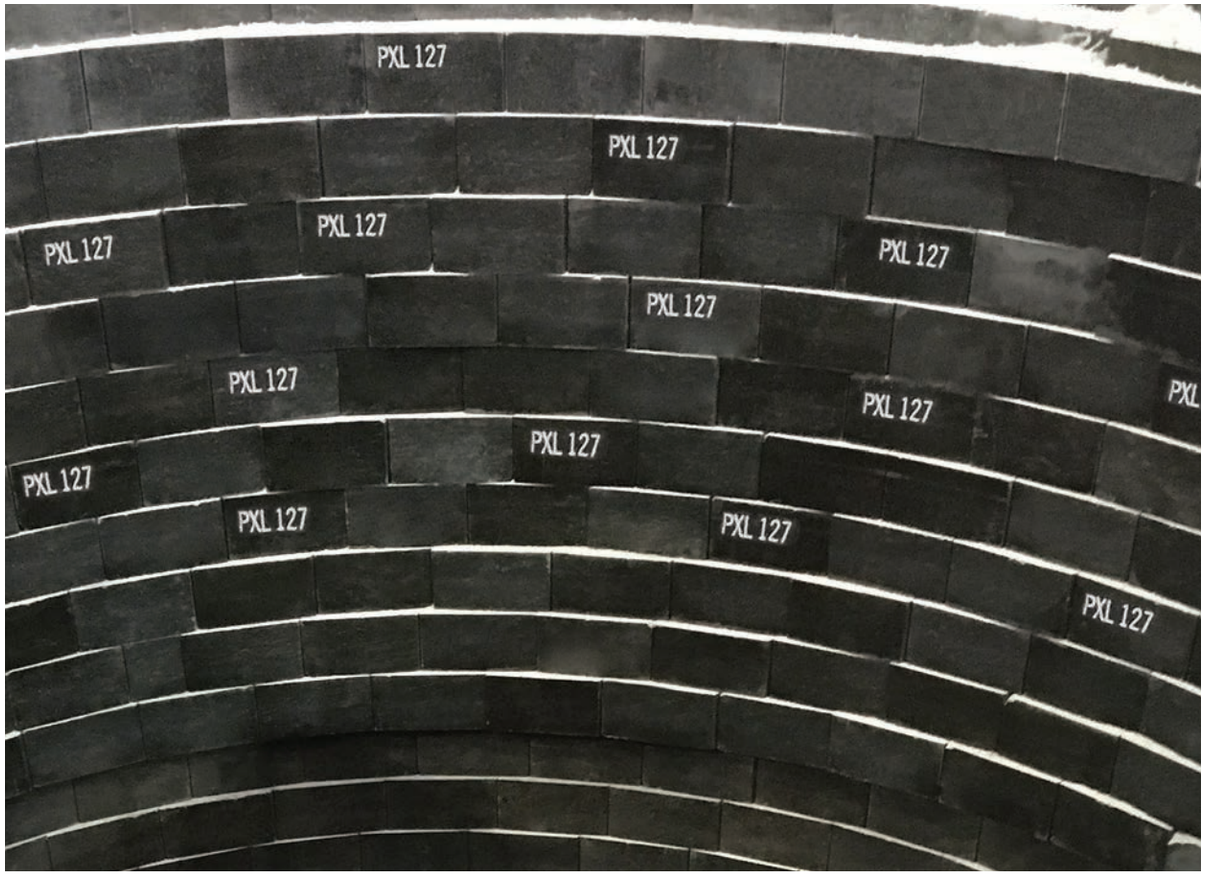
HWI offers the following materials for brick working linings:

- Magnesia-carbon (MgO-C)
- Alumina-magnesia-carbon (AMC)
- Dolomite
- Magnesia-chrome (MgO-Cr)
- Magnesia-alumina-carbon (MAC)
- High Alumina

HWI also provides custom-designed precast ladle bottoms as well as a full range of monolithic castables, ramming materials, gunning materials, and shotcrete products.

MONOLITHIC WORKING LININGS

A typical monolithic working lining is cast. Monolithic linings require a properly designed form and the time and facilities for curing and drying before the ladle can be put into service. Generally, monolithics are used in the sidewall and bottom, and bricks are used in the slag line. A major benefit of monolithics is that a worn-out lining can be resurfaced by cleaning the old surface, inserting the form, and recasting the gap between the used refractory and the form. Monolithic working linings can also be maintained with shotcrete. Although shotcrete allows for form-free installation, it requires specific pumping and mixing equipment and the labor costs could be higher.



CONSIDERATIONS FOR WORKING LININGS

HWI provides brick, monolithic and precast shapes for ladle working linings.

Some advantages of brick working linings are a wide range of products and the ability to optimize total cost of ownership through zoning to normalize wear.

WORKING LINING PRODUCTS

Impact Area:

- COMANCHE® FA
- COMANCHE® FA SUPER
- COMANCHE®
- HP-CAST® ULTRA
- NC-CAST® MAXIMA

Bottom:

- COMANCHE®
- COMANCHE® GOLD
- COMANCHE® SUPER
- COMANCHE® FA
- NC CAST® MAXIMA
- HP-CAST® ULTRA
- D-CAST® 85 GOLD

Sidewall:

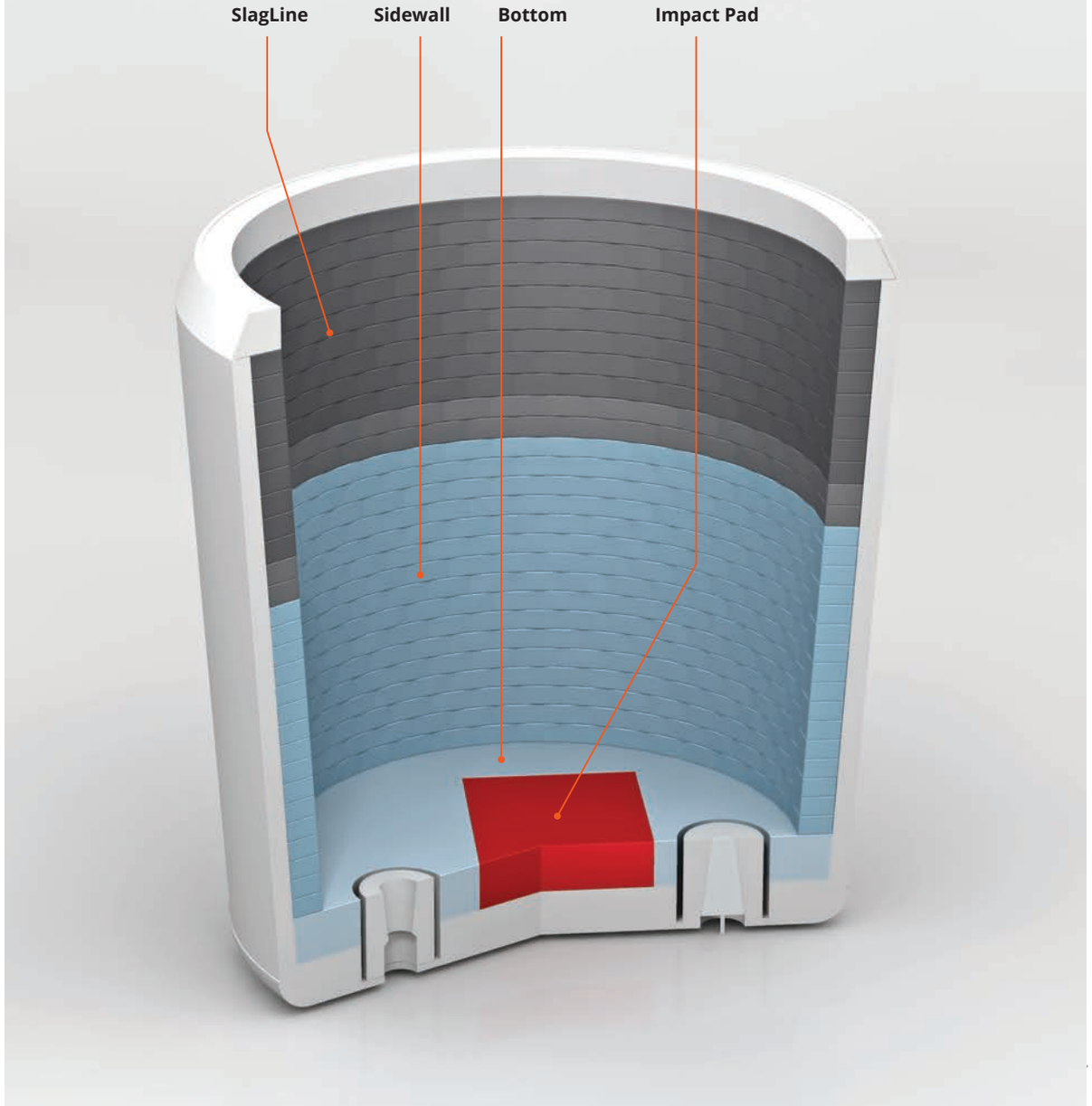
- GREENAL®
- COMANCHE® GOLD
- COMANCHE® FA
- COMANCHE® PLATINUM
- CHEROKEE® GOLD
- QUANTUM®
- PHANTUM®
- HP-CAST® ULTRA

Slag Line

- BARRICADE®
- PHANTUM®
- MAGNUM®
- RENEGADE®
- OPTIMUM®

Stir Plug and Nozzle

- ANKORBOND®
- BAYONET®
- NOZZLE SET®
- RUBY®



RECOMMENDED WORKING LINING PRODUCTS

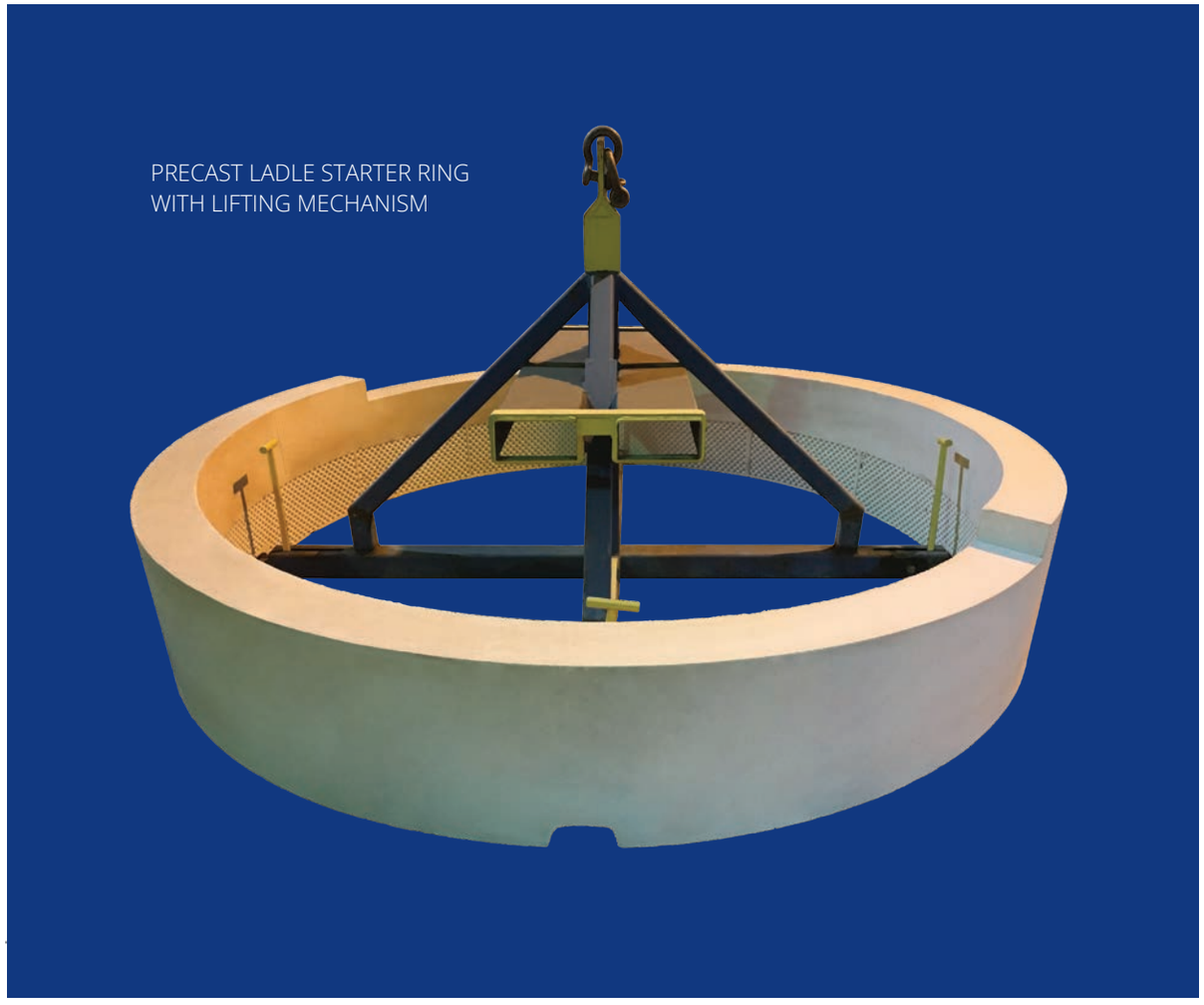
LOCATION	TYPE	HWI PRODUCT	SPECIFICATION	BENEFIT
Bottom	Brick	COMANCHE® GOLD	82% alumina	- Permanent expansion
		COMANCHE® FA	80% alumina	- Excellent wear resistance - Permanent expansion
		COMANCHE® FA SUPER	80% alumina	- Good wear resistance - Permanent expansion - Good thermal shock resistance
	Precast	NC-CAST® MAXIMA	90% alumina, cement free, spinel forming	- Outstanding wear resistance
		HP-CAST® ULTRA	96% alumina, spinel forming	- Excellent wear resistance
		D-CAST® 85 GOLD	85% alumina, coarse grain	- For non-impact areas
Impact area	Brick	COMANCHE® FA	80% alumina	- Excellent wear resistance - Permanent expansion
		COMANCHE® FA SUPER	80% alumina	- Permanent expansion - Outstanding wear resistance
		COMANCHE® PLATINUM	84% alumina	- Permanent expansion, - Good wear resistance
	Precast	HP-CAST® ULTRA	96% alumina, spinel forming	- Excellent wear resistance
		NC-CAST® MAXIMA	90% alumina, spinel forming	- Outstanding wear resistance
		HP-CAST® 94MA-C	94% alumina, spinel containing, course grain	- Excellent wear resistance - Good corrosion resistance
Bottom around perimeter and blocks	Monolithic	HP-CAST® ULTRA VC	96% alumina, spinel forming	- Permanent expansion - Quick cure
		FASKAST® 80	80% alumina, ultra-low cement	- Ease of installation
		NARPHOS® 90R RAM MIX	90% alumina, phos-bonded	- Excellent wear resistance
		RUBY® RAMMING MIX	84% alumina 10% chromic oxide	- Slag and wear resistant
Sidewall	Brick	GREENAL®-85 HP	85% alumina	- Cost effective
		COMANCHE® GOLD	82% alumina	- Permanent expansion - Good wear resistance
		COMANCHE® PLATINUM	84% alumina	- Permanent expansion - Outstanding wear resistance
		COMANCHE® FA	81% alumina	- Permanent expansion - Excellent wear resistance
		CHEROKEE® GOLD	65% magnesia	- Good wear resistance against Al-killed steels slags
		QUANTUM® BL7G	87% magnesia.	-Good wear resistance - Good for Al-Si killed steels
		PHANTUM® XL087	88% magnesia	- Excellent wear resistance
		PHANTUM® XL067	88% magnesia	- Excellent wear resistance
	Monolithic	HP-CAST® ULTRA	96% alumina, spinel forming	- Excellent wear resistance

LOCATION	TYPE	HWI PRODUCT	SPECIFICATION	BENEFIT
Transition	Brick	COMANCHE® PLATINUM	84% alumina	- Permanent expansion - Excellent wear resistance
		QUANTUM® XL 10G	87% magnesia	- Good wear resistance
Slag Line	Brick	PHANTUM® XL 127	83% magnesia	- Good slag resistance
		PHANTUM® XL 128	84% magnesia	- Very good slag resistance
		PHANTUM® XL 148 SUPER	82% magnesia	- Excellent slag resistance
		MAGNUM® XL 10F	82% magnesia	- Good slag resistance
		MAGNUM® XL 12F	78% magnesia	- Good oxidation resistance - Excellent hot strength
		RENEGADE® XL 10 F	77% magnesia	- Permanent expansion
		BARRICADE® BSZ83	86% magnesia	- Good Thermal Shock Resistance - Resists vertical cracking - Outstanding slag resistance
		BARRICADE® BSA72	78% magnesia	- Excellent thermal shock resistance - Resists vertical cracking - Good erosion resistance
		OPTIMUM® XL 127	80% magnesia	- Good slag resistance - Good erosion resistance
		OPTIMUM® MXL 12F	78% magnesia	- Good oxidation resistance - Medium slag resistance
		OPTIMUM® RXL10F	77% magnesia	- Good slag resistance - Permanent expansion
Stir Panel	Brick	MAGNUM® XL12F	78% magnesia	- Excellent erosion resistance - Good slag resistance
		PHANTUM® XL 148 SUPER	82% magnesia	- Outstanding slag resistance - Good erosion resistance
Plastics General	Monolithic	PLASTECH® 85P	85% alumina, phos-bonded	- Good strength - Soft, Standard, or Firm consistency
		PLASTECH® 90P	90% alumina, phos-bonded	- Excellent wear resistance - Soft, Standard, or Firm consistency
		PLASTECH® RUBY	Alumina-chrome, phos-bonded	- Good corrosion resistance - Soft, Standard, or Firm consistency
Stir Plug and Nozzle	Mortar	ANKORBOND C®	60% alumina, heat-set resin bonded	- Carbon containing for easy plug and nozzle removal - Cost effective
		BAYONET MORTAR®	70% alumina, heat-set	- Carbon containing for easy plug and nozzle removal - Good wear resistance
		NOZZLE SET® 90P	90% alumina, phos-bonded	- Good strength - Excellent wear resistance
		RUBY® 190 KSV MORTAR	90% alumina-chrome	- Good strength - Outstanding wear and slag resistance

FUNCTIONAL PRODUCTS

HWI is a Full-Scale Ladle Refractory Supplier

We offer all of the necessary special assemblies and accessories. These can include bottom assemblies, tilt bricks, starter sets, well blocks, pocket blocks, stir plugs, and lip retention systems. The specific designs in many cases are custom-made to fit individual steel shop ladle sizes and metallurgical conditions.



PRECAST LADLE STARTER RING
WITH LIFTING MECHANISM

TILT BRICKS AND STARTER SETS

Used at the bottom of the sidewall to position bricks above them at the proper angle to the wall, tilt bricks and starter sets can be brick, precast shapes, or integrated into precast bottoms. .

WELL BLOCKS AND POCKET BLOCKS

Erosion and corrosion resistance are key factors for material selection. The proper selection of well and pocket block depends on shop practice and life expectancy. The overall objective is to match the life or half-life of the bottom. Pocket blocks, used in conjunction with stir plugs, provide stability and protection to the plug. Material and design decisions will be a function of the plug's internal or external exchange.

HWI manufactures and supports both systems. HWI's proven ISO-STAR™ technology is designed to work together with our high-performance slag line and sidewall brick products. ISO-STAR™ products are uniquely shaped to give the best performance in pocket or well blocks. Both magnesia-carbon and alumina-magnesia-carbon versions are available.

PRECAST BOTTOMS AND ASSEMBLIES

Ladle bottoms can be zoned with different refractory qualities to match wear. High wear areas can be zoned with high purity materials for superior wear resistance. Impact pads may consist of a precast shape, a brick assembly, or a brick and castable assembly. In some cases, the refractory components are incorporated into a fully assembled bottom or cast shapes that are manufactured by HWI and sent to the customer as one piece. This allows for a quicker, more ergonomic installation process of shapes and components.

Other Fully Assembled Products

- Precast ladle bottoms
- Starter sets
- Ladle starter rings

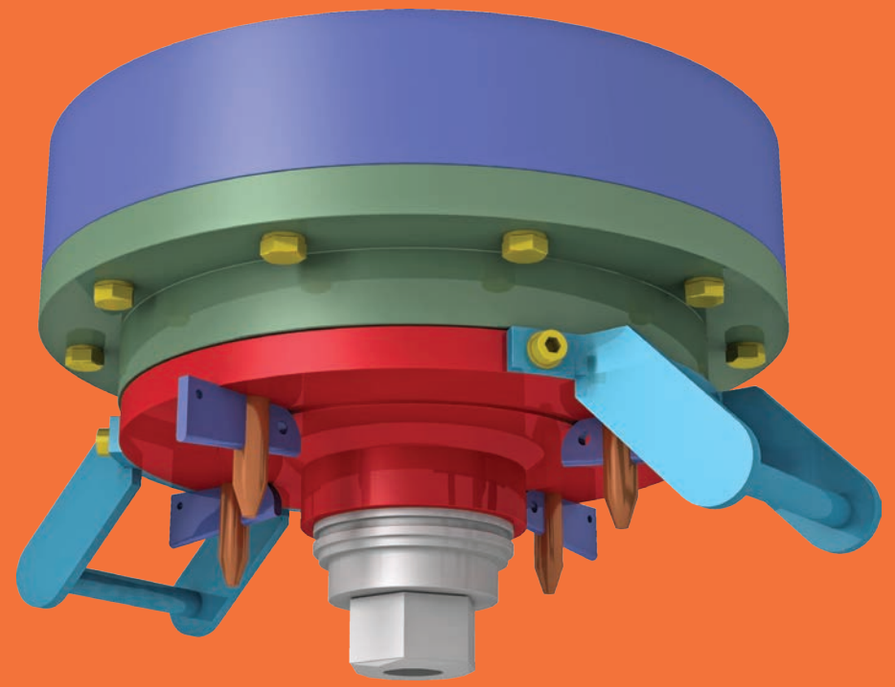
GAS PURGING

Purge plugs are used for temperature and chemistry homogenization, inclusion removal, and desulfurization. Argon and nitrogen are gases that are typically used for stirring. Purge plug technology is one way to improve the overall efficiency of metallurgical processes. a Full-Scale Ladle Refractory Supplier

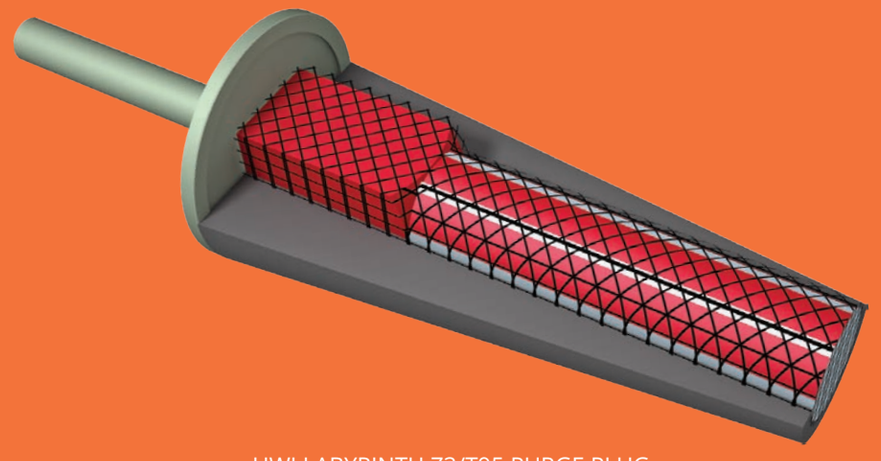
HWI supplies both porous and directional purge plugs, plug-block assemblies, and plug exchange systems. The purge plugs are available in several standard sizes and shapes. HWI offers multiple internal designs of the purge plugs to meet the required gas flows and process requirements. Similarly, HWI can provide multiple types of pocket blocks which are used to support the plug during operation. The external exchange system, which enables the plug to be replaced with ladle in-service, eliminates downtime related to plug exchanges.

HWI offers a complete line of gas purging refractories and systems:

- Stir Plugs: directional, porous, and combination porous/directional
- Pocket Blocks: conventional cast & iso-pressed
- Plug Exchange Systems:
- 1608 Exchange System
- Delta Plate System
- Hybrid Systems



HWI 1608 GAS PURGING GATE



HWI LABYRINTH Z3/T95 PURGE PLUG

RECOMMENDED SHAPES, ASSEMBLIES, AND ANCILLARY PRODUCTS

LOCATION	TYPE	HWI PRODUCT	SPECIFICATION	BENEFIT
Pocket Blocks	Iso-press	ISO-STAR® MX2	65% alumina	- Permanent expansion
		ISO-STAR® MC	89% magnesia	- Dolomite ladles
	Precast	NC-CAST® MAXIMA	90% alumina, spinel forming, cement free	- Good wear resistance
		HP-CAST® ULTRA	95% alumina, spinel forming	- Outstanding wear resistance
		GREFCON® 98 SPL	96% alumina, spinel containing	- Excellent erosion and corrosion resistance
Stir Plugs	Capillary	LABYRINTH® HPU	95% alumina	- Excellent wear resistance
	Combination slit/capillary	LABYRINTH® Z3/T95	94% alumina, with thermal shock resistance	- Excellent thermal shock resistance
	Combination Porous/slit	LABYRINTH® Z3/A94	95% alumina, with high purity alumina porous core	- Excellent stir reliability and wear resistance
Mortars-Stir Plugs	Monolithic	BAYONET™ MORTAR	68% alumina carbon containing	- Easy plug installation and removal
		NOZZLE SET™ 90P	90% alumina, phos-bonded	- Good strength and wear resistance
		ANKORBOND-C®	55% alumina, carbon containing, resin bonded	- Good strength and wear resistance
Lip Retention System	Monolithic	VERSAFLOW® 80 C	80% alumina	- Excellent strength and toughness - Ease of installation
		D-CAST® 85G	85% alumina	- Excellent wear resistance
		FASKAST® 80	Ultra low cement, high alumina	- Ease of installation - Excellent hot strength

LOCATION	TYPE	HWI PRODUCT	SPECIFICATION	BENEFIT
Tilt brick	Brick	GREENAL® 80	80% alumina	- Cost effective
		COMANCHE® GOLD	82% alumina	- Permanent expansion
Starter Sets	Brick	GREENAL® 80	80% alumina	- Cost effective
		COMANCHE® GOLD	82% alumina	- Permanent expansion
		QUANTUM® BL7G	87% magnesia	- Dolomite ladles
Coves	Monolithic	HP-CAST® ULTRA VC	95% alumina, spinel forming	- Permanent expansion
		NARPHOS® 90R RAM MIX	90% alumina	- Moderate slag resistance
		RUBY® RAMMING MIX	Chrome-containing	- Good slag resistance
		SHOT-TECH® 80	80% alumina, shotcrete	- Cost effective
Well Blocks	Iso-press	ISO-STAR® MX	76% alumina, ISO pressed AMC	- Excellent wear resistance for most demanding applications
		ISO-STAR® MX2	80% alumina, ISO pressed AMC	- Permanent expansion
	Precast	NC-CAST® MAXIMA	90% alumina, spinel forming	- Excellent corrosion and erosion resistance
		NC-CAST® OPTIMA	86% alumina, high level spinel	- Outstanding corrosion and excellent erosion resistance
		HP-CAST® ULTRA	95% alumina, spinel forming	- Outstanding hot strength and good corrosion resistance
	Ladle Sand	SCHIEBERSAND® FAMILY	Chrome silica sand	- Outstanding free open rates
		SCHIEBERSAND® Z20	Chrome silica with zircon	- For high temps and long hold times

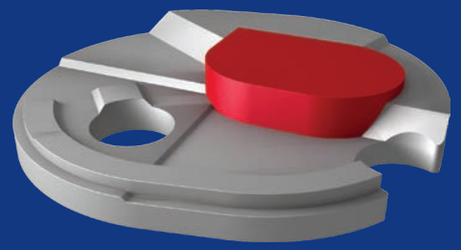
DESIGN CONSIDERATIONS

There are many options for proper lining design that utilize different shapes and installations. They usually are selected based on the size of the ladle, the availability of skilled brick layers, and the availability of installation equipment such as mixers, pumps, and shotcrete machines. The final selection is always unique and based on shop-specific conditions.

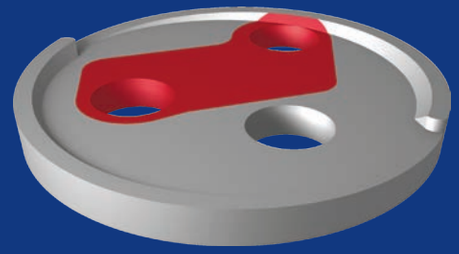
BOTTOM DESIGN

Depending on the ladle requirements, either a plug or a full bottom may be required. For a plug bottom, first the ladle walls are installed and then the bottom is lined. The joint between the two components is vertical. For full bottom installations, the bottom is installed first and then the sidewall is then built on top of it. The joint between the two components is horizontal. In both cases, the joint is protected from steel penetration with a cove. The bottom also can be built so that there is a slope toward the well block for greater steel yield. A ladle with a brick bottom will have a herringbone pattern or be bricked straight across. Pattern selection will depend on the ease of incorporating accessories (such as impact pads and well blocks) into the ladle bottom.

BOTTOM DESIGN EXAMPLES

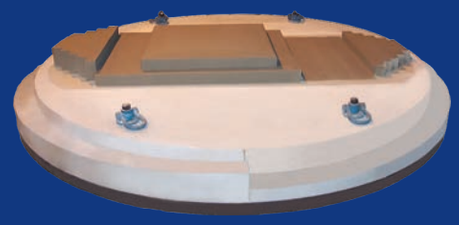


HI-YIELD LADLE BOTTOM FOR IMPROVED STEEL YIELD

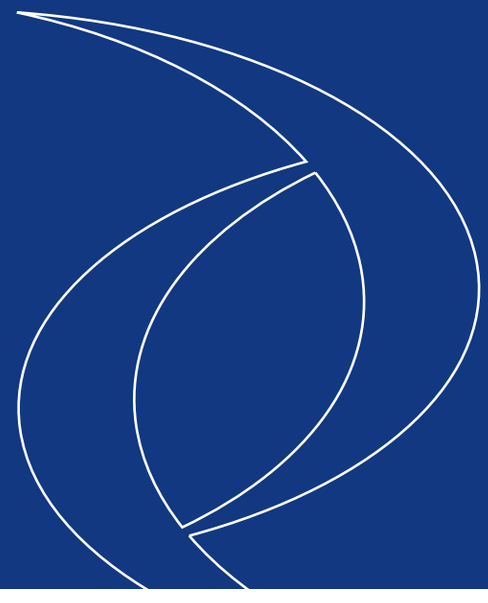


PRECAST BOTTOM WITH HIGH WEAR MATERIAL IN IMPACT AREA AND COST EFFECTIVE MATERIAL IN NON CRITICAL AREA.

PRECAST LADLE BOTTOM WITH BRICK IMPACT PAD. STARTER SET CAST IN.



PRECAST LADLE BOTTOM WITH BRICK IMPACT PAD ZONED FOR WEAR



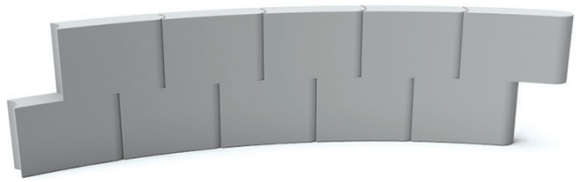
SIDEWALL AND SLAG LINE DESIGNS

Sidewalls and slag lines can be built of semi-universal, mini-keys, or arch-wedge shapes, depending on the shape of the ladle and shop preference. Ladle sidewalls generally consist of two different types of brick – those in contact with the metal and those in contact with the slag. A transition zone with a third type of brick between these two areas is sometimes desirable. HWI representatives make recommendations based on shop specifics.

SAFETY LININGS

UNIVERSAL CIRCLE BRICK

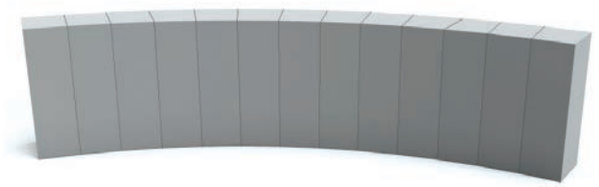
- Easy to install
- Starter sets available
- Curved design conforms well to the curved shells of round ladles
- Good for round and oval ladles



2.5-, 3-, AND 4-IN. THICKNESS AVAILABLE;
6-IN HEIGHT AVAILABLE

BEVELED EDGE ARCH BRICK

- Tight safety lining construction
- Good bricklaying skills required
- Good for round, oblong, and oval ladles



2.5-, AND 3-IN. THICKNESS AVAILABLE;
9-IN HEIGHT AVAILABLE

TONGUE AND GROOVE BRICK

- Tight safety lining construction
- Courses and brick locked together
- Good bricklaying skills required
- Good for round, oblong and oval ladles

3-IN. THICKNESS AVAILABLE
9-IN HEIGHT AVAILABLE

WORKING LININGS

SEMI-UNIVERSAL BRICK

- Easy to install
- Starter sets available
- Small brick height conforms well to tapers steel ladle shells
- Good for round, obround, and oval ladles

3-, 4-, 5-, 6-, 7-, 8-, AND 9-IN. THICKNESS AVAILABLE;
3-IN AND 100MM HEIGHT AVAILABLE

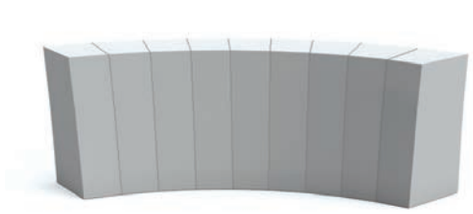
MINI-KEYS

- Keyed lining hot face to cold face
- Keyed lining can be worn thinner, therefore longer service life
- Keyed lining can be laid tighter than semi- universal without mortar
- Keyed linings remain tighter to safety linings at trunnions during service, especially in oval and obround ladles

4-, 5-, 6-, 7-, 8-, AND 9-IN. THICKNESS AVAILABLE;
3-IN AND 100MM HEIGHT AVAILABLE

SOLDIERED ARCH-WEDGE BRICK

- Tight safety lining construction
- Good bricklaying skills required
- Good for round, obround, and oval ladles



4-, 5-, 6-, AND 6.75-IN. THICKNESS AVAILABLE;
9-IN HEIGHT AVAILABLE

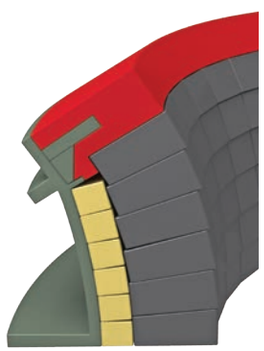
LIP RETENTION SYSTEMS

Lip Retention Systems, also referred to as lip rings, are extremely important for ladle refractory integrity.

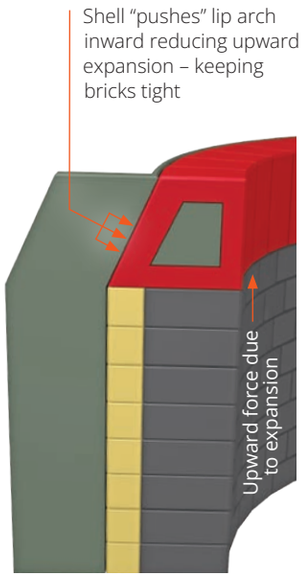
The lip ring provides a means to hold the lining under compression while the ladle is in service. If they are missing or tilt upwards, due to the refractory pushing on them, there is a likelihood of steel penetration due to joints opening-up and/or brick falling out.

HWI supplies an array of products for building various styles of lip ring. HWI provides monolithic materials as well as bricks with or without co-molded steel for customers who prefer to build their lip rings on-site. HWI also manufactures pre-cast lip ring assemblies that result in easy installation and consistent build quality.

The flexibility of HWI's lip retention systems allows easy adjustment for differences in a ladle's shape over time, or between ladles in a fleet.

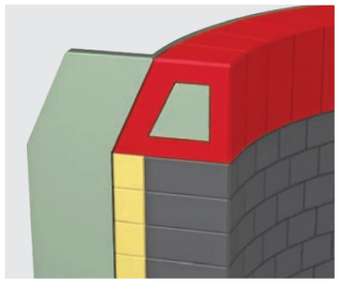


FAILED LADLE LIP DUE TO VERTICAL EXPANSION



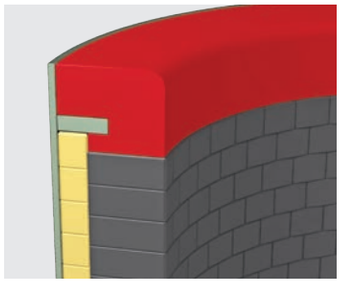
REVERSE TAPER LIP ARCH DESIGN

The vertical forces created by the thermal expansion of the sidewall brick can cause deformation of the steel lip of ladle resulting in the loss of compression of sidewall brick. Loss of compression can result in steel penetration and cracking of working lining brick. The incorporation of a reversed taper lip arch brick with co-molding creates a ladle top construction that eliminate the upward expansion of sidewall and slag line brick.



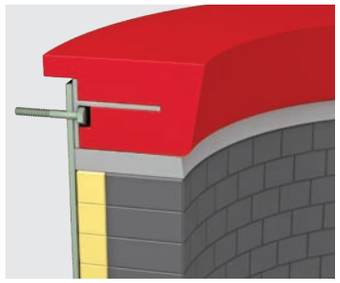
CO-MOLDED REVERSE TAPER ARCH BRICK

- Outstanding brick compression
- Excellent durability during lip deskulling (with co-molded brick)
- Can be cast or bricked
- Does require ladle shell gussets



CASTABLE WITH EMBEDDED STEEL FLANGE

- Easy on-site installation
- Good for holding brick in compression
- Does not require holes in ladle shell
- Accommodates variance in brick height
- Requires a form for casting

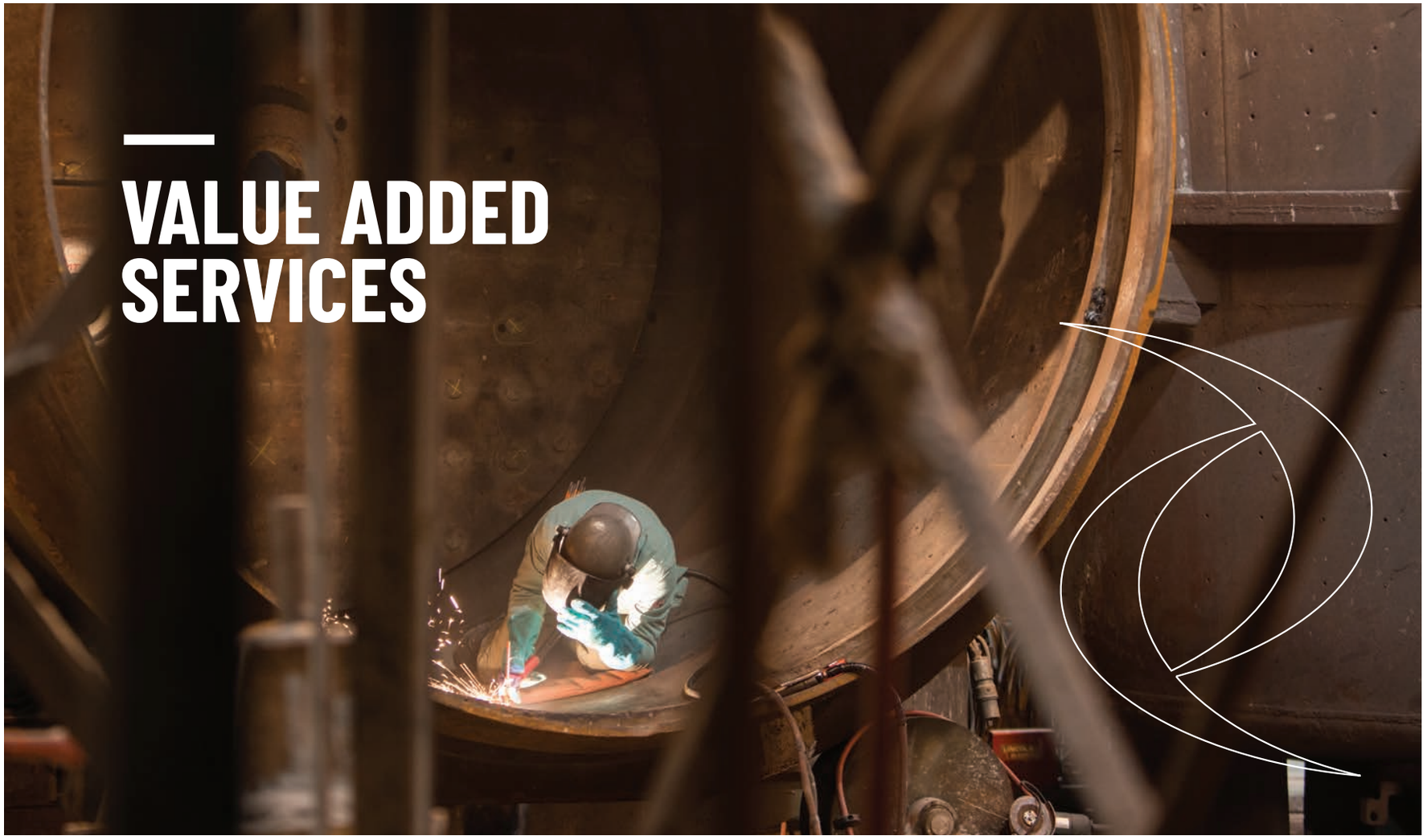


PRE-CAST BOLT-ON LIP SECTION

- Easy on-site installation
- Ability to zone lip ring sections
- Quick turnaround, shapes already dried
- Does not work well on deformed ladle shells

PRODUCTS FOR LIP RETENTION SYSTEMS

LOCATION	TYPE	HWI PRODUCT	SPECIFICATION	BENEFIT
Lip Retention System	Monolithic	VERSAFLOW® 80 C PLUS	80% alumina	- Excellent strength
		FASKAST® 80 PLUS	80% alumina, ultra-low cement	- Ease of installation high alumina - Cost effective
		D-CAST® 85 GOLD CASTABLE	85% alumina	- Excellent wear resistance
		SHOT-TECH® 80	80% alumina, shotcrete	- Cost effective - Ease of installation
	Gun Products	VERSAGUN® 80 ADTECH®	80% alumina	- Ease of installation
		NARCOGUN® 70 BG	70% alumina	- Ease of installation - Ideal for high volume batch guns
		GREENCAST®-94 GR PLUS	94% alumina, low-silica	- Excellent for high temperature
	Brick	RENEGADE® LA	88% MgO	- Excellent strength and wear resistance
		RENEGADE® LA CO-MOLDED	88% MgO	- Steel Plates in mating brick surfaces for increased mechanical strength



VALUE ADDED SERVICES

HWI has multiple service options that can deliver value for customers. While our Value Added Service (VAS) Group can provide on-site management, installation, equipment, and testing at the customer's site, our facility in Gary, Indiana offers a complete line of services including engineering, installation, inspection, and maintenance if the customer's ladles can be transported to our site.

INSTALLATION

HWI's Value Added Service (VAS) Group provides refractory installation and support services at the customer's site. While the VAS Group focuses on brick, assembly, pre-cast, and monolithic product installation in the field, HWI's Gary facility can additionally design and install custom-cast refractory linings.

FULL-SERVICE STEEL FABRICATION AND ENGINEERING

HWI's Gary facility is a complete source for iron and steel support services and refractory products. HWI-Gary offers the inspection, engineering, maintenance, repair and refractory installation services required to help customers maintain safe, efficient, and continuous operation.

MAINTENANCE WELDING AND FABRICATION SERVICES

- Iron and steel ladles
- Trunnion pin replacement
- Wear sleeve replacement
- Ladle head replacement
- Brick retainer systems
- Ladle stands
- Dry-out covers
- Tilting runners
- Tundish boxes
- Scrap boxes
- Casting mandrels
- Casting forms
- Lifting hooks and spreader beams

MACHINE SHOP SERVICES

- Trunnion pins
- Trunnion safety collars
- Wear sleeves
- Slide gate leveling plates
- Argon stirring units
- Tilt pins
- Shafts
- Flanges
- Fixtures

NDT INSPECTION SERVICES

- Full structural inspections
- Iron and steel ladles
- Hot metal transport cars
- Tundish boxes
- Scrap boxes
- Tilting runners
- Ultrasonic inspection of trunnion pins
- Thickness inspections
- Ladle shells
- Furnace vessel shells
- Leveling plates

PUT OUR INTENSITY TO WORK FOR YOU

Every day, our people and products stand up to the challenges of every job. As a global supplier, we'll save you time and money. And our experience in heat containment makes us the safest, most reliable choice for your investment. We are your one-stop shop for refractory solutions.

We are your one-stop shop for refractory solutions. And we can take your inventory or new build to the next level. To learn more, talk with a HWI representative at **800-492-8349** or visi**t thinkhwi.com.**

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