



RHI MAGNESITA

STEEL / STAINLESS STEELMAKING

Refractory Solutions for Stainless Steelmaking



There for you, wherever you need us



The more closely we work with our customers, the greater the impact we can make for them. So a global network of offices, research centers, and production sites is important to us, and to them. We are continuously extending our global reach to be closer to even more customers.

Being closer to customers doesn't just mean we can be more responsive to their needs. It also helps us to listen better — to understand their concerns, cultures and ways of working. It makes us alert to new ways of thinking and ideas that enable us to deliver even better advice, services, and solutions.

Our exceptional resources and expertise extend far beyond making and selling products. We provide solutions to customers worldwide for cover projects, material specifications, thermal studies, numerical simulations, follow-ups and technical support in application of minerals, and maintenance and electromechanical services for refractory equipment.

**North
America**

3 COUNTRIES
1 R&D CENTER

35
Main production and
raw material sites

70
Sales offices

180
Countries shipped
to worldwide

6 COUNTRIES
1 R&D HUB

**South
America**

Europe

17 COUNTRIES
1 R&D HUB
1 R&D CENTER

**Middle East/
Africa**

2 COUNTRIES

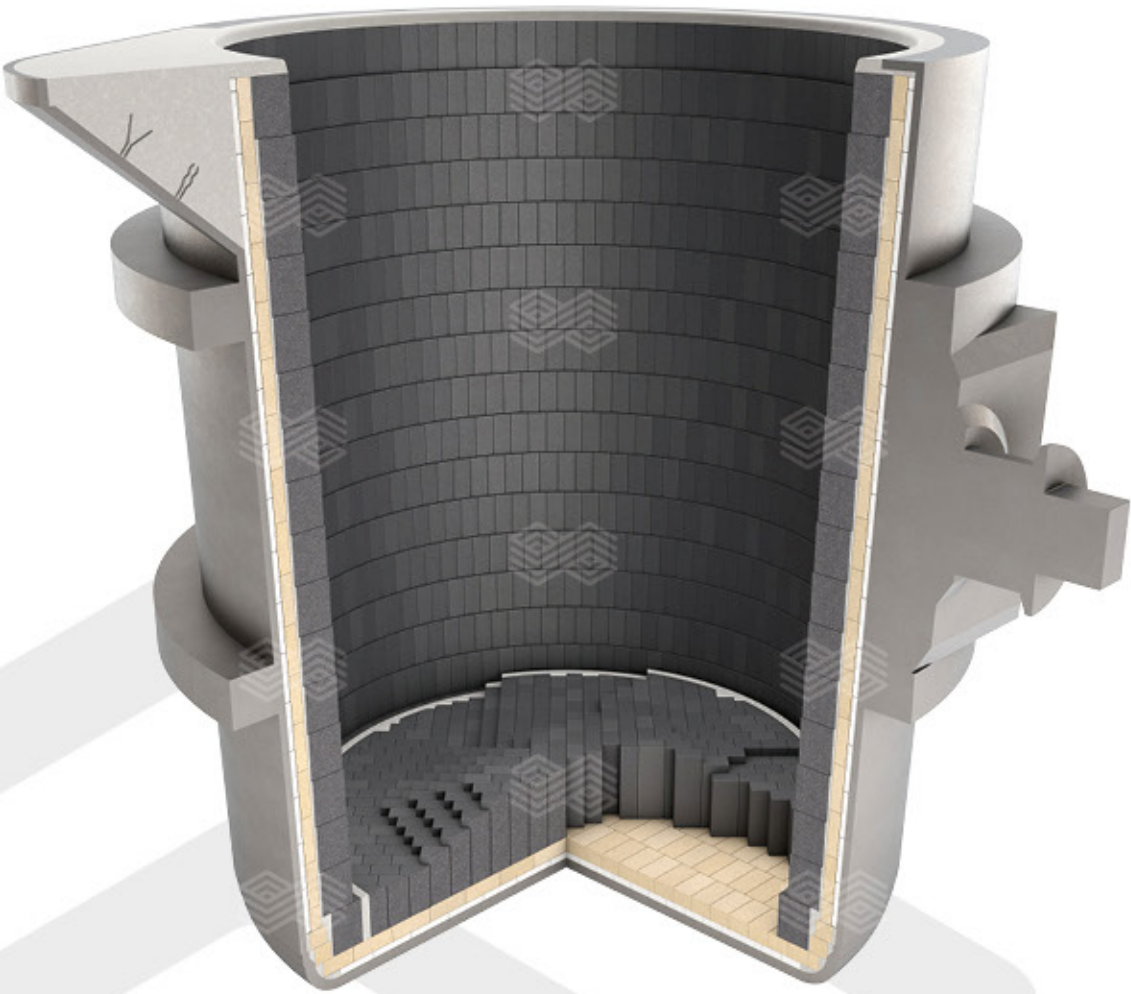
9 COUNTRIES
3 R&D CENTERS

**Asia
Pacific**

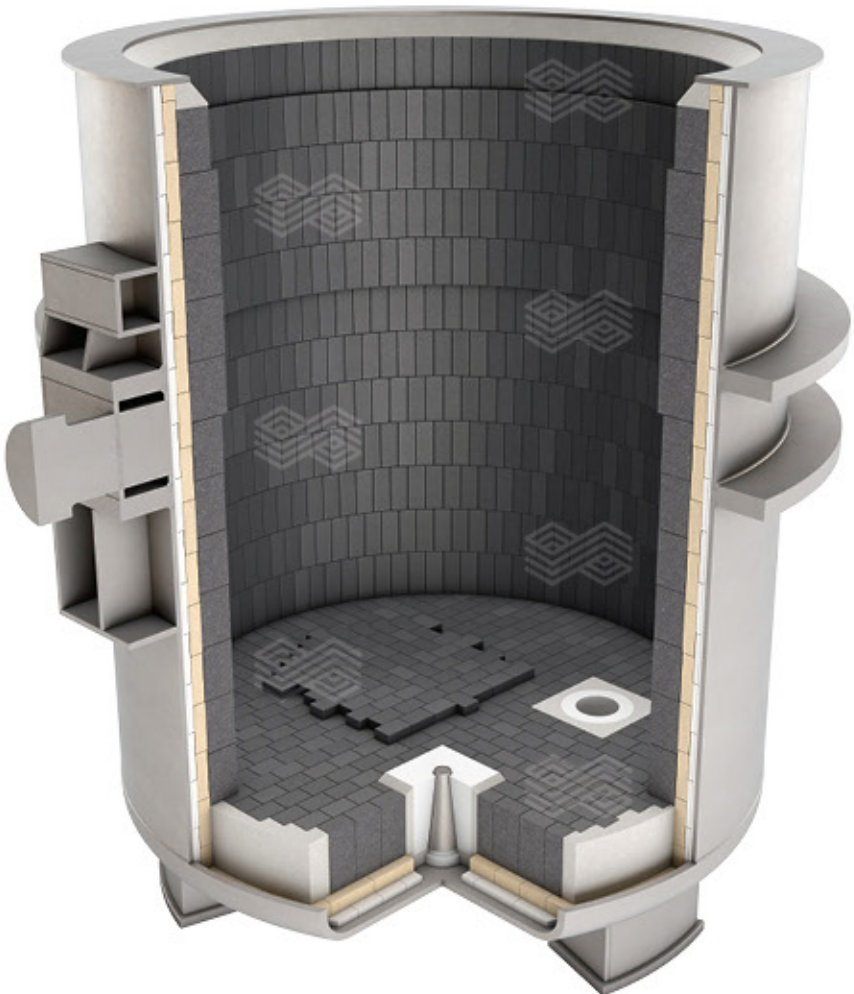
Stainless Steel Vessels



AOD Converter



Transfer Ladle



Teeming Ladle

Content	AOD	Transfer Ladle	Teeming Ladle	Maintenance
				

The AOD Converter

Top Sealing

Upper Cone, Upper Barrel

Slagline, Trunnions

Pouring Side

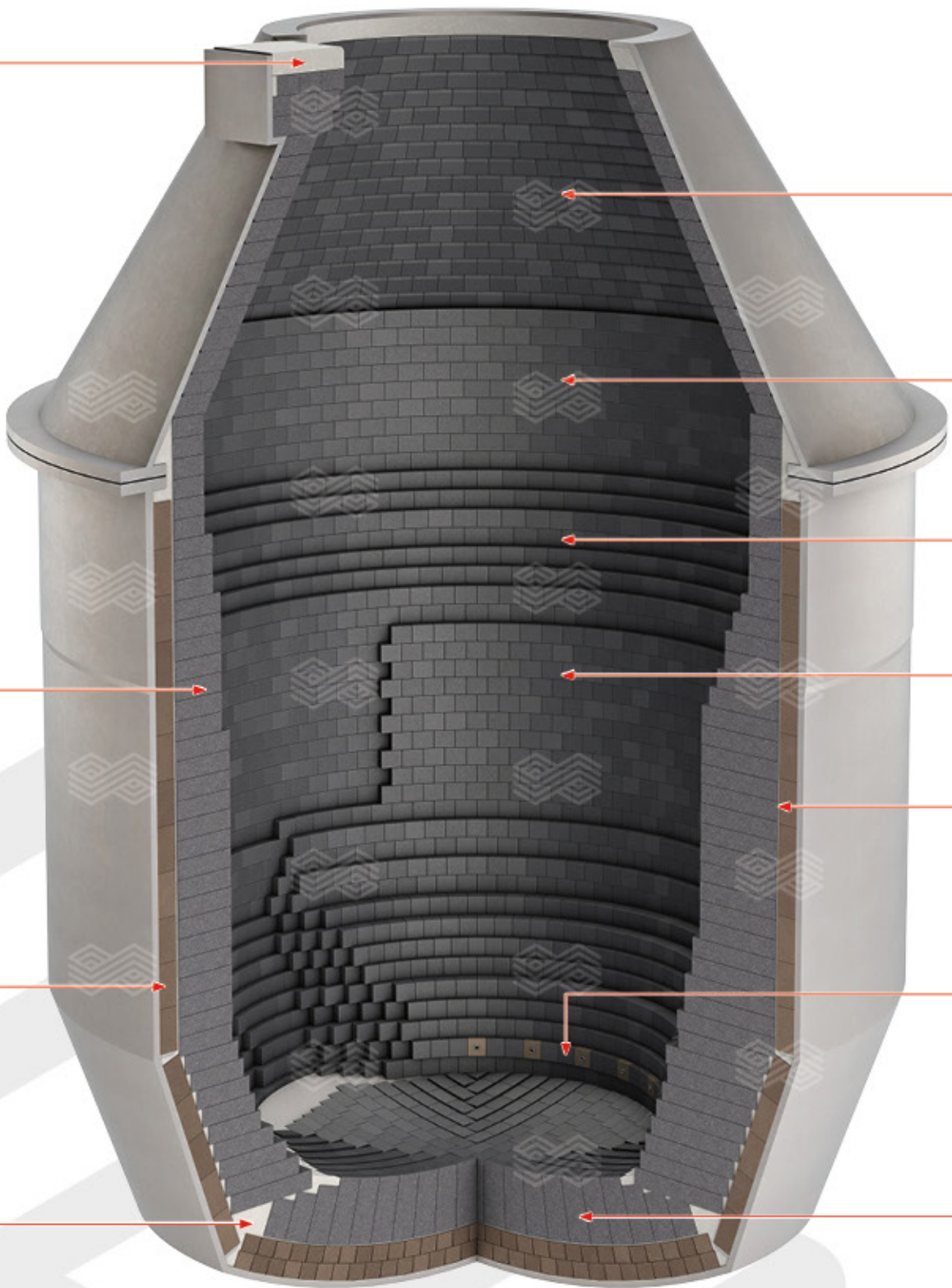
Back Fill

Safety Lining

Tuyere Zone

Bottom Ramming

Bottom



Content

AOD

Transfer Ladle

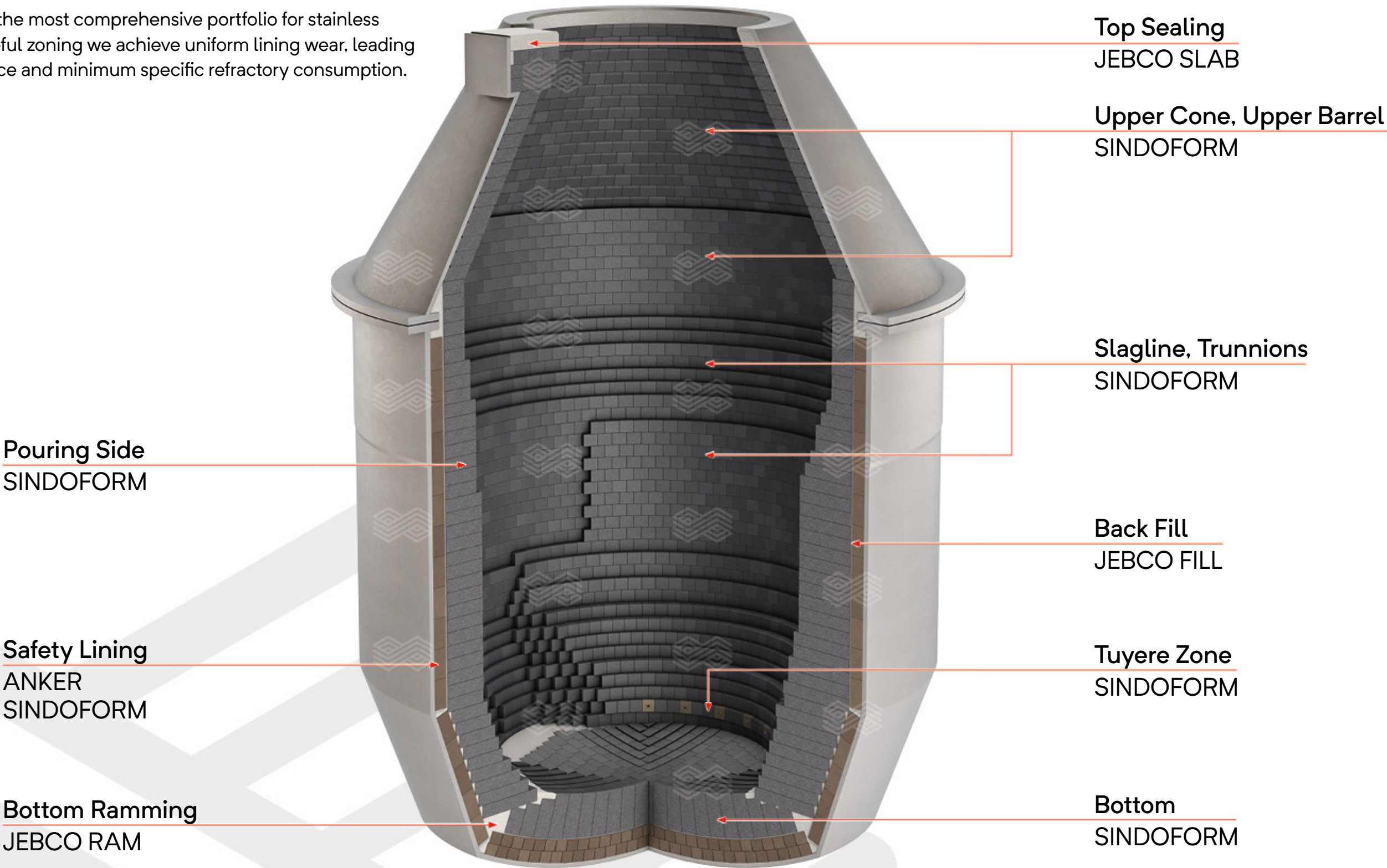
Teeming Ladle

Maintenance



Optimized Lining for AOD Converter

RHI Magnesita offers the most comprehensive portfolio for stainless converters. With careful zoning we achieve uniform lining wear, leading to highest performance and minimum specific refractory consumption.



Product Variety of Bricks & Mixes for AOD

SINDOFORM

Fired Doloma Bricks

- Carbon-free bricks for production of low carbon containing steels
- Minimal oxygen resupply to the steel
- Good coating behavior
- Excellent price-performance ratio

SINDOFORM

Doloma Carbon Bricks

- Carbon or resin bonded bricks available
- Excellent price-performance ratio
- Commonly used in transfer ladles as well as the barrel and bottom of teeming ladles

ANKER

Fired Magnesite Bricks

- Compatible with basic slags
- Niche products restricted to special applications – commonly used in converter safety linings

ANKROM

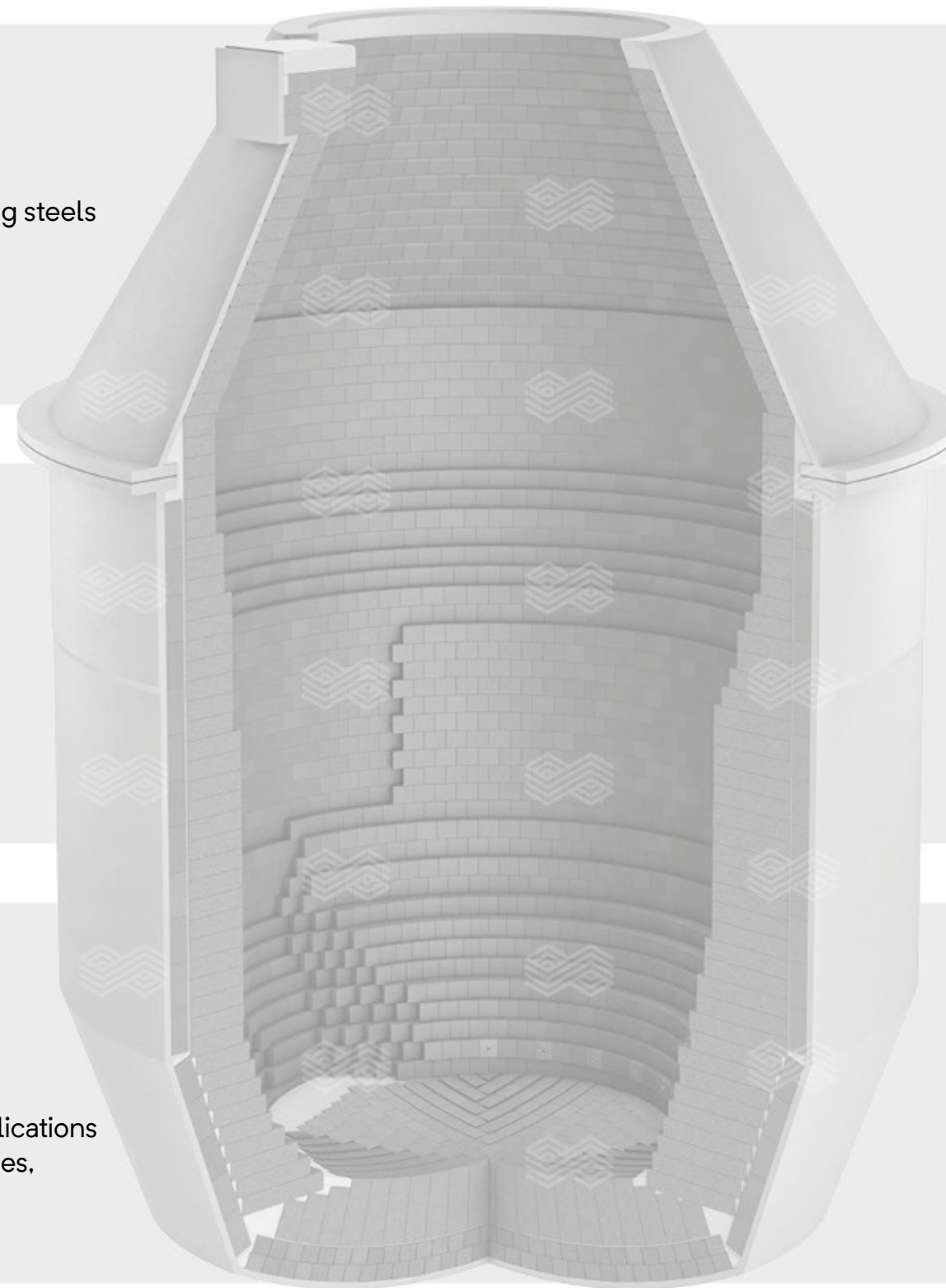
Fired Mag-Chrome Bricks

- Very high refractoriness and low thermal conductivity
- Can be used in converter safety linings or working linings (in very specialized applications)
- Direct bonded & semi rebounded

JEBCO

Doloma Mixes

- Excellent price-performance ratio
- Wide range of characteristics available for all stainless applications
- Preferred choice for stainless converter and ladle accessories, e.g. back fill or ramming mix



Content



AOD



Transfer Ladle



Teeming Ladle



Maintenance



Tuyere Solutions for Optimum Operational Efficiency

Numerical Simulations

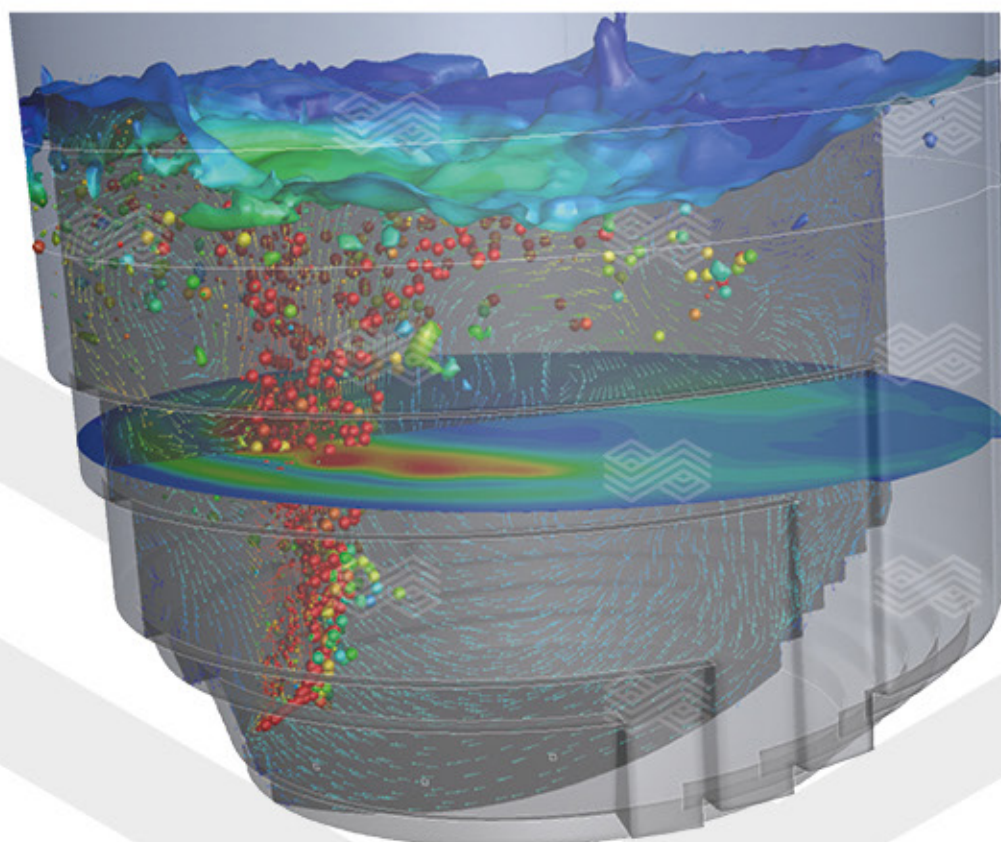
RHI Magnesita provides CFD simulations for converters and ladles.

The main focus is on:

- Optimizing mixing efficiency and total flow rates
- Enhancing inclusion removal for highest steel cleanliness
- Minimizing refractory wear
- Preventing excessive splashing and open eye formation

Typical design and process parameters addressed for optimization include:

- Design, number, sizing and positioning of tuyeres, plugs and top lance
- Total gas flow rate and allocation per tuyere / plug
- Tilt angle and tapping sequence



Tuyere Brick Grade

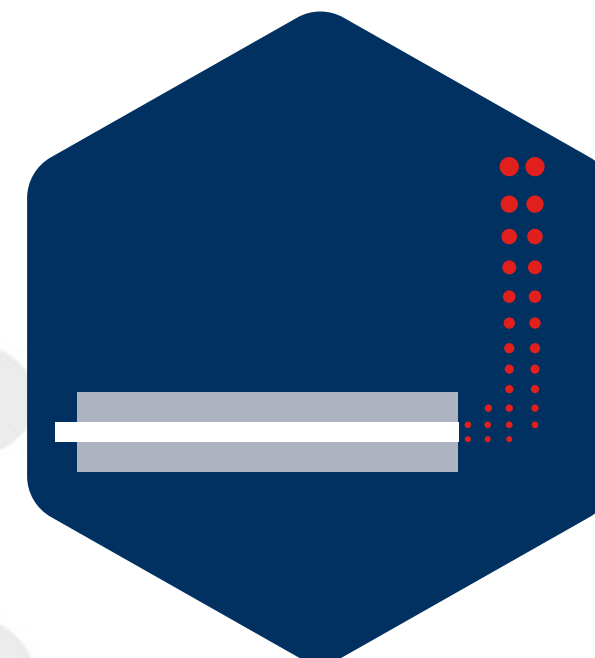
Tuyere bricks suffer from the highest wear rates stainless converter. Increased wear rates are caused by a combination of several different wear mechanisms:

- Back attack from collapsing gas plumes which erodes the hot face of the brick
- Erosion by the fast moving circular flow pattern on the tuyere side
- Chemical wear by unsaturated slags which are submerged in the steel bath
- Highest operating temperatures in the vicinity of the tuyeres due to the reaction of injected oxygen with the metal bath
- Thermal cycling due to continued cooling when the converter is horizontal

RHI Magnesita offers superior tuyere grades for optimum overall refractory lifetime and specific cost.

Top grades involve the following features:

- Fused doloma and fused magnesia for highest erosion and corrosion resistance at elevated operating temperatures
- High firing for optimum volume stability at high temperatures
- Zirconia additions which impede crack propagation in the brick matrix and thus increase resistance to thermal cycling



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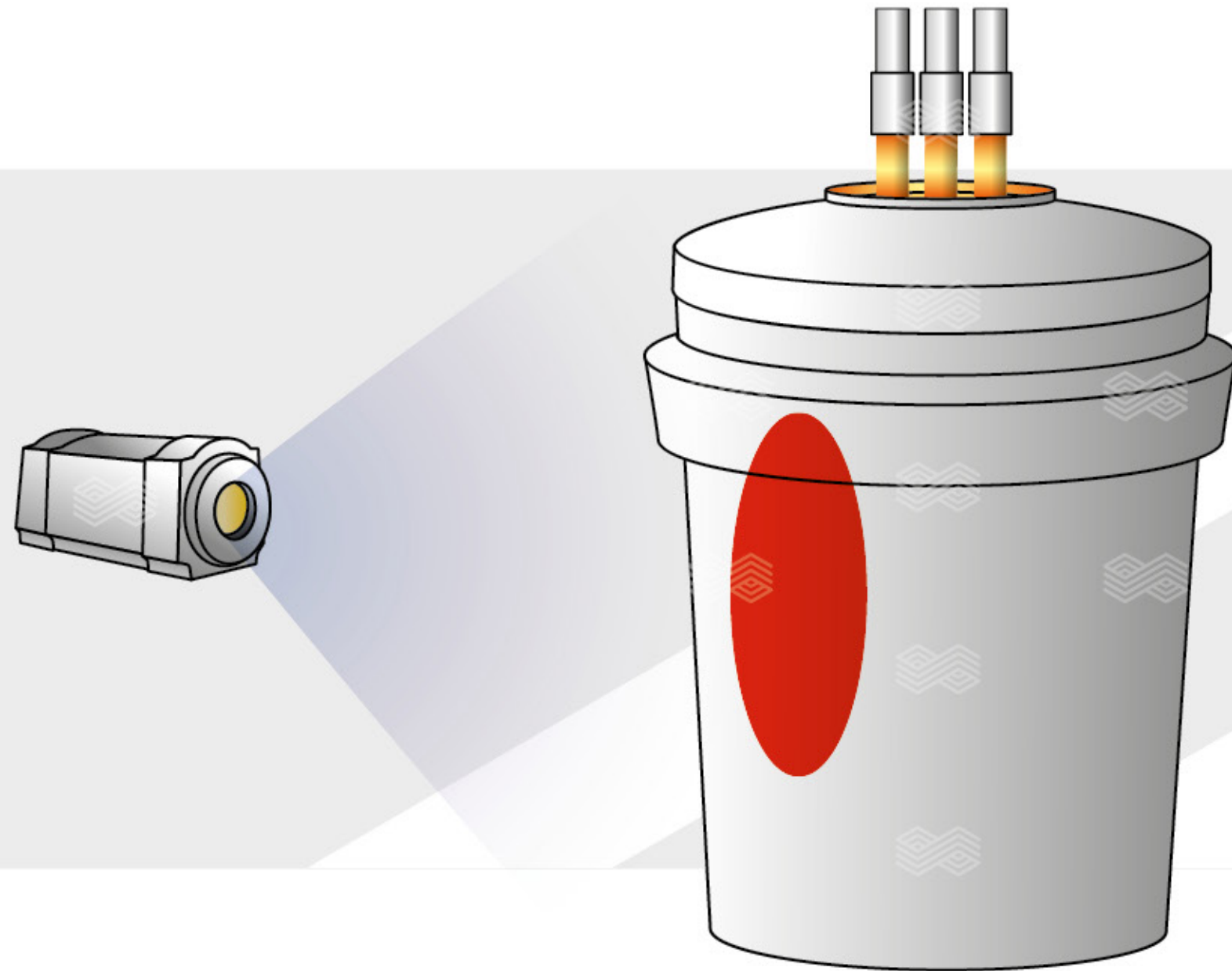
VISIR-FurnaceSafe

Furnace breakout prevention

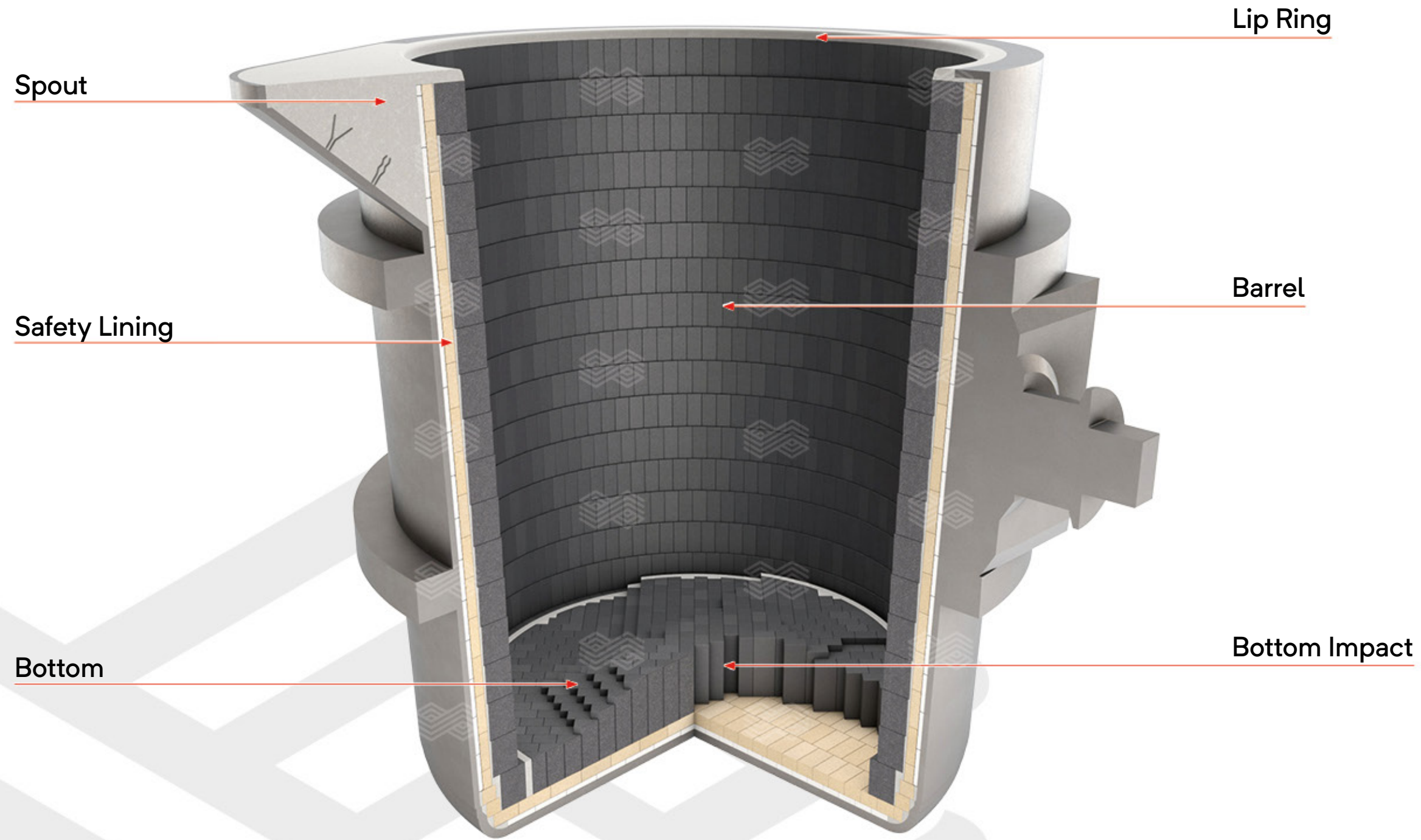
User Benefits & Advantages

- Early “hot spot” detection and warning
- Used with LF, RH, EAF, AOD, LD/BOF
- Historical database open to process metallurgist

More Information

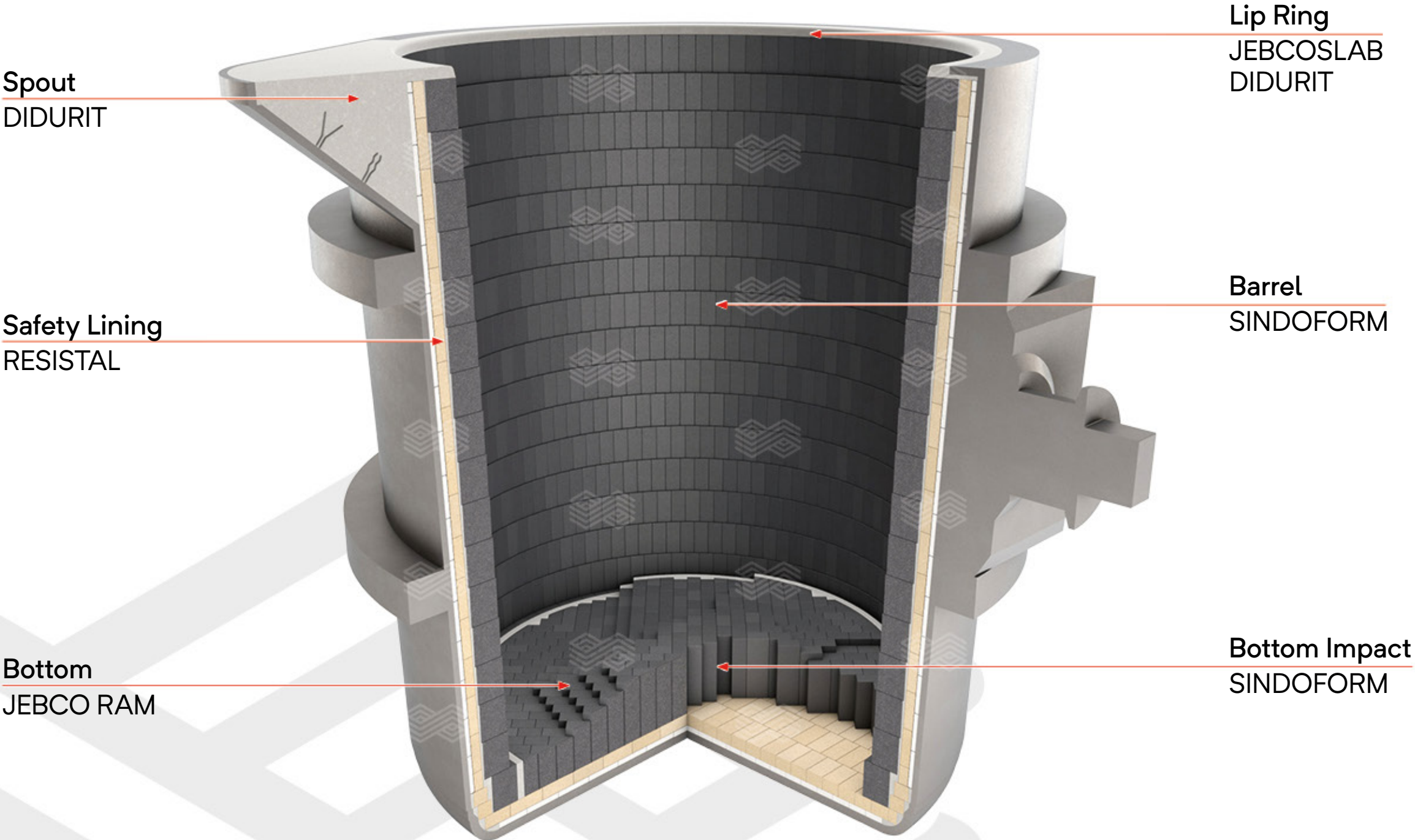


The Stainless Steel Transfer Ladle



Optimized Lining for Stainless Steel Transfer Ladle

RHI Magnesita offers a complete portfolio for stainless ladles. We develop tailormade solutions for lining design and grade selection based on wear mechanism and profile.



Product Variety of Bricks & Mixes for Stainless Steel Transfer Ladle

SINDOFORM

Fired Doloma Bricks

- Carbon-free bricks for production of low carbon containing steels
- Minimal oxygen resupply to the steel
- Good coating behavior
- Excellent price-performance ratio

RESISTAL

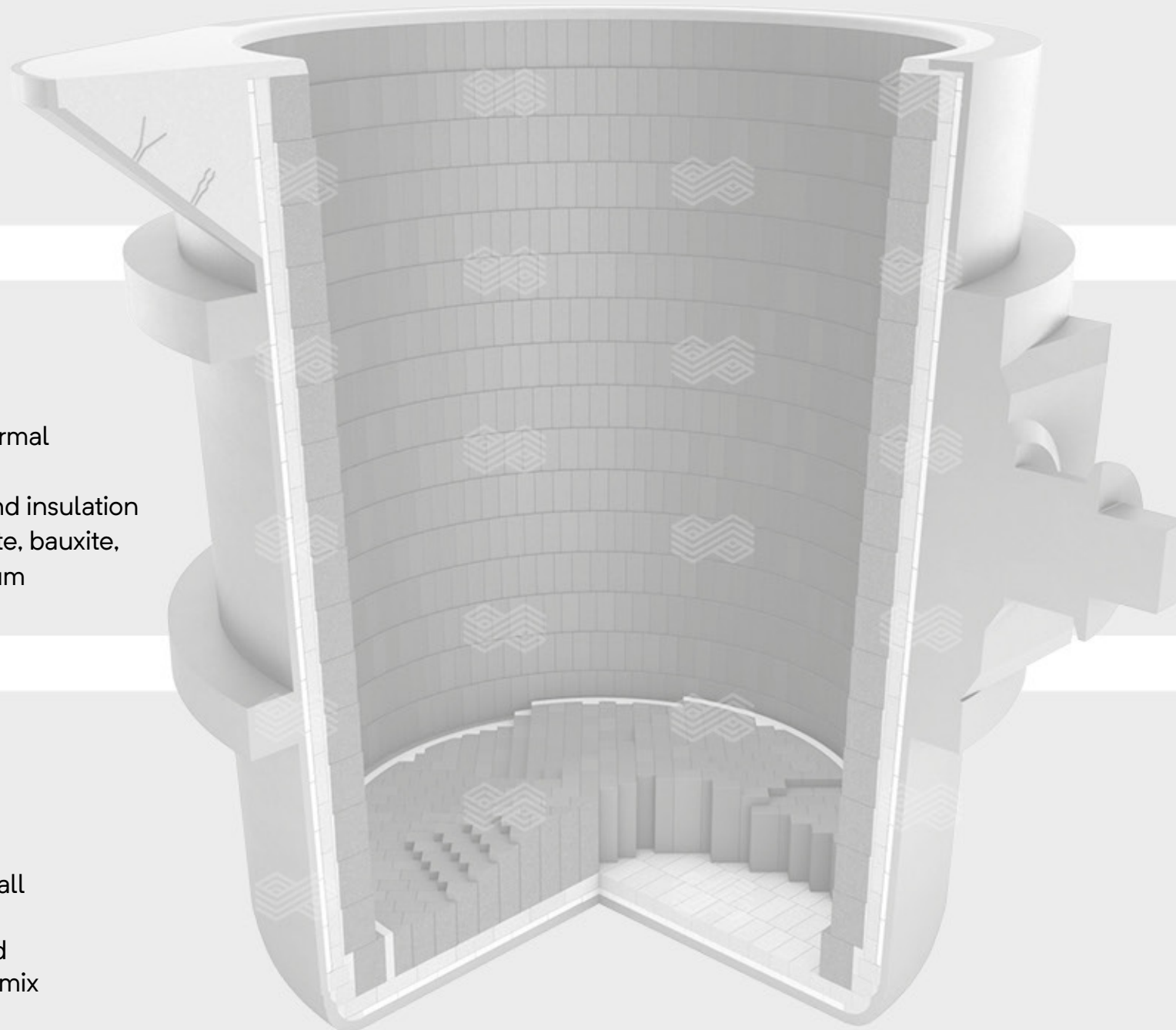
Fired Alumina Bricks

- High thermal shock resistance and low thermal conductivity
- Preferred solution for ladle safety linings and insulation
- Available as combinations of fireclay, mullite, bauxite, corundum-spinel and chromium-corundum

JEBCO

Doloma Mixes

- Excellent price-performance ratio
- Wide range of characteristics available for all stainless applications
- Preferred choice for stainless converter and ladle accessories, e.g. back fill or ramming mix



SINDOFORM

Doloma Carbon Bricks

- Carbon or resin bonded bricks available
- Excellent price-performance ratio
- Commonly used in transfer ladles as well as the barrel and bottom of teeming ladles

Content



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Transfer Ladle



Teeming Ladle



Maintenance



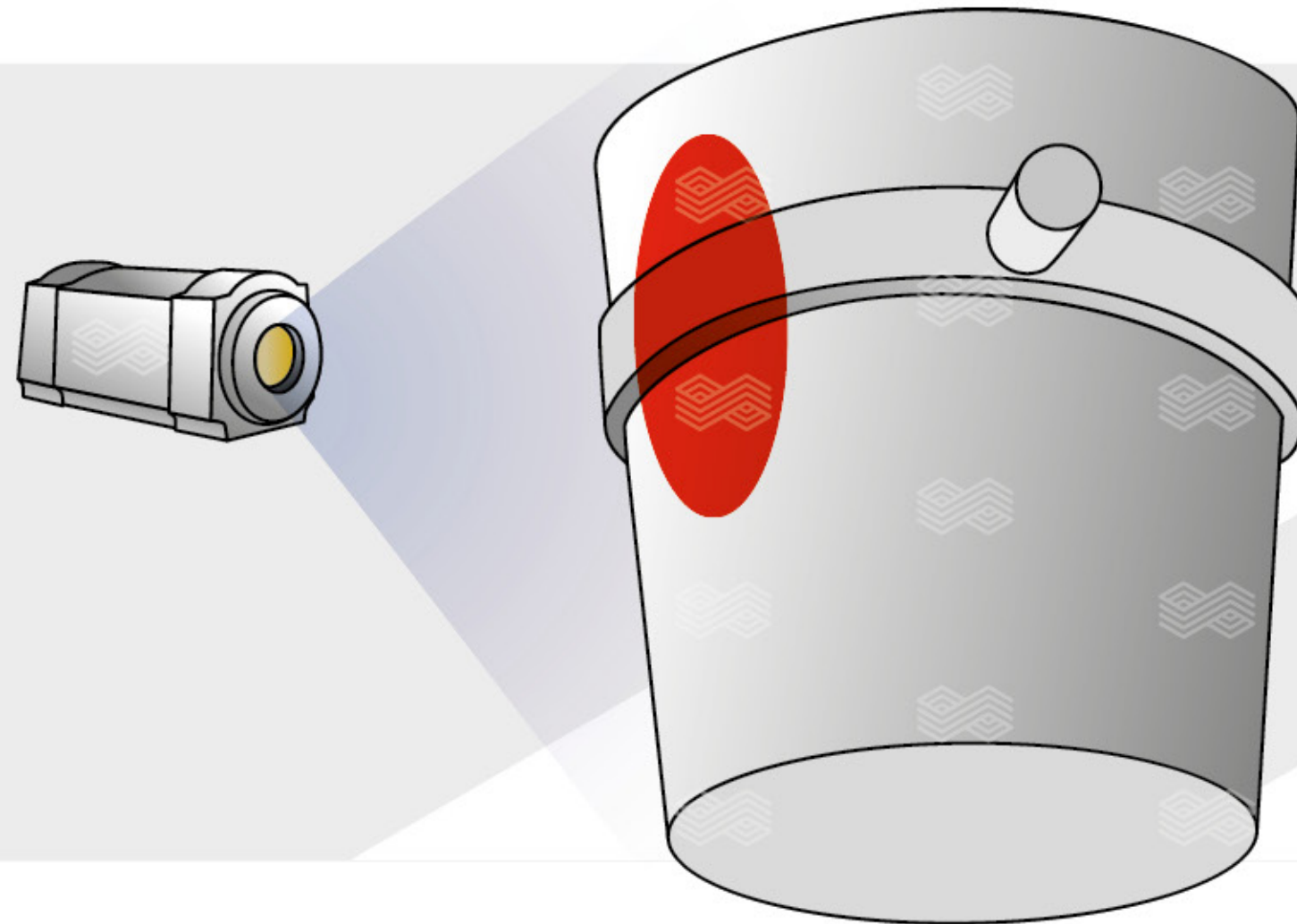
VISIR-LadleSafe

Ladle hot spot detection system

User Benefits & Advantages

- Hot spot detection and warning
- Maximize ladle refractory lifetime
- Integrated with plant PLC and network
- Maximizing safety in ladle handling areas
- Historical database open to process metallurgist

More Information



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AOD



Transfer Ladle



Teeming Ladle



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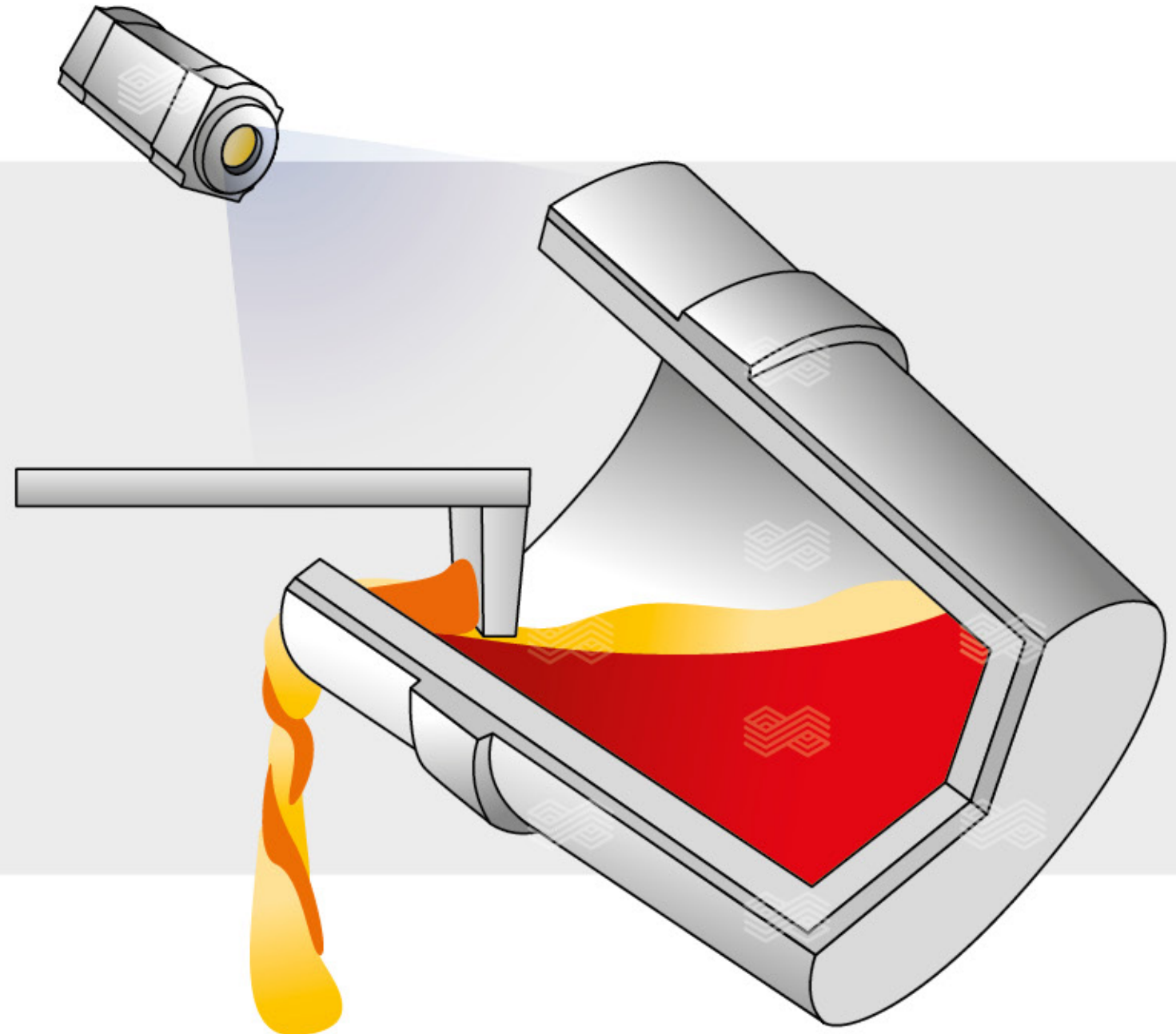
VISIR-LadleDeslag

Ladle skimming monitoring

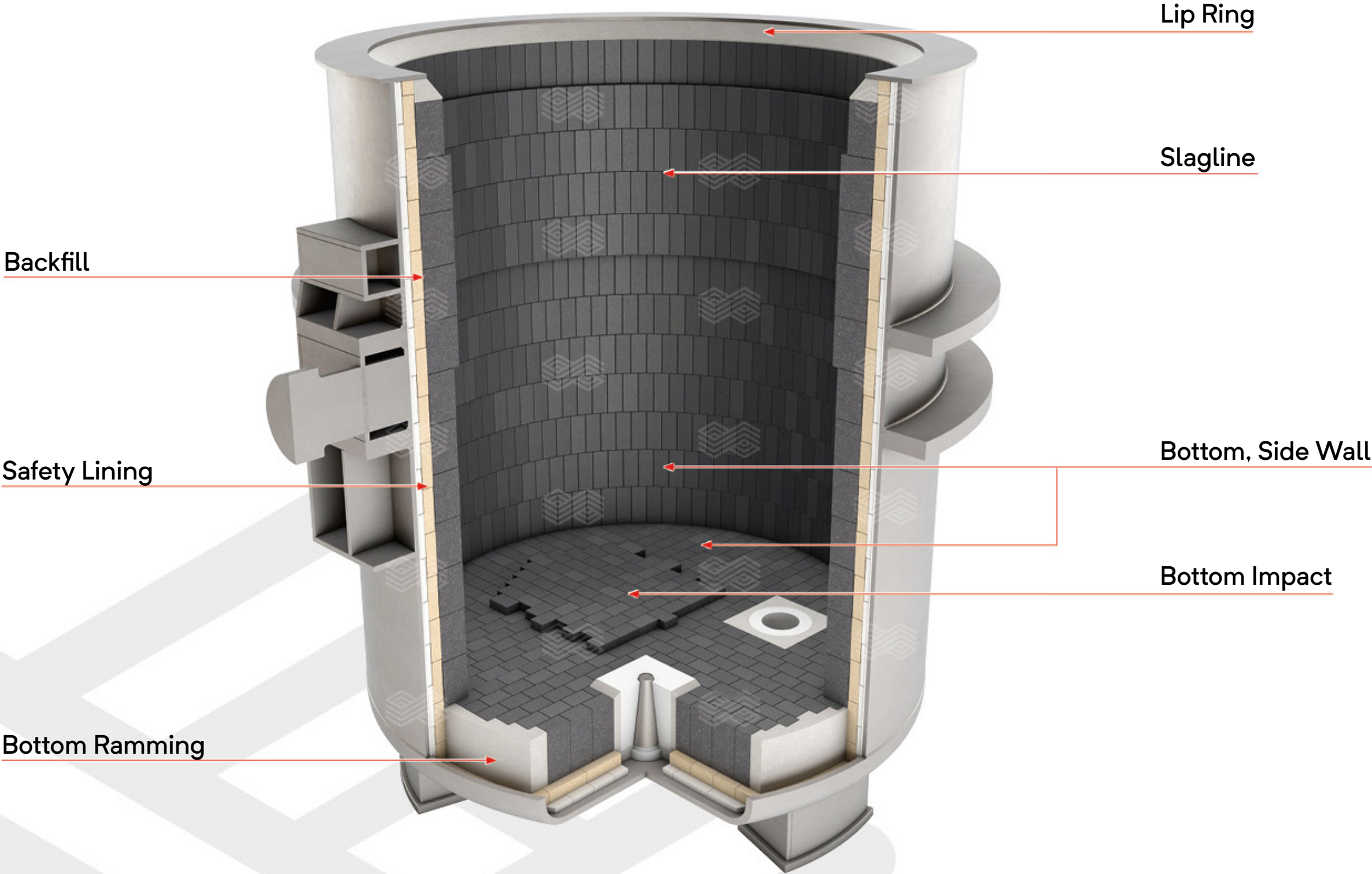
User Benefits & Advantages

- Consistent and objective monitoring of deslagging process
- Historical data stored in open and searchable database
- Metal loss warning
- Yield increase

More Information

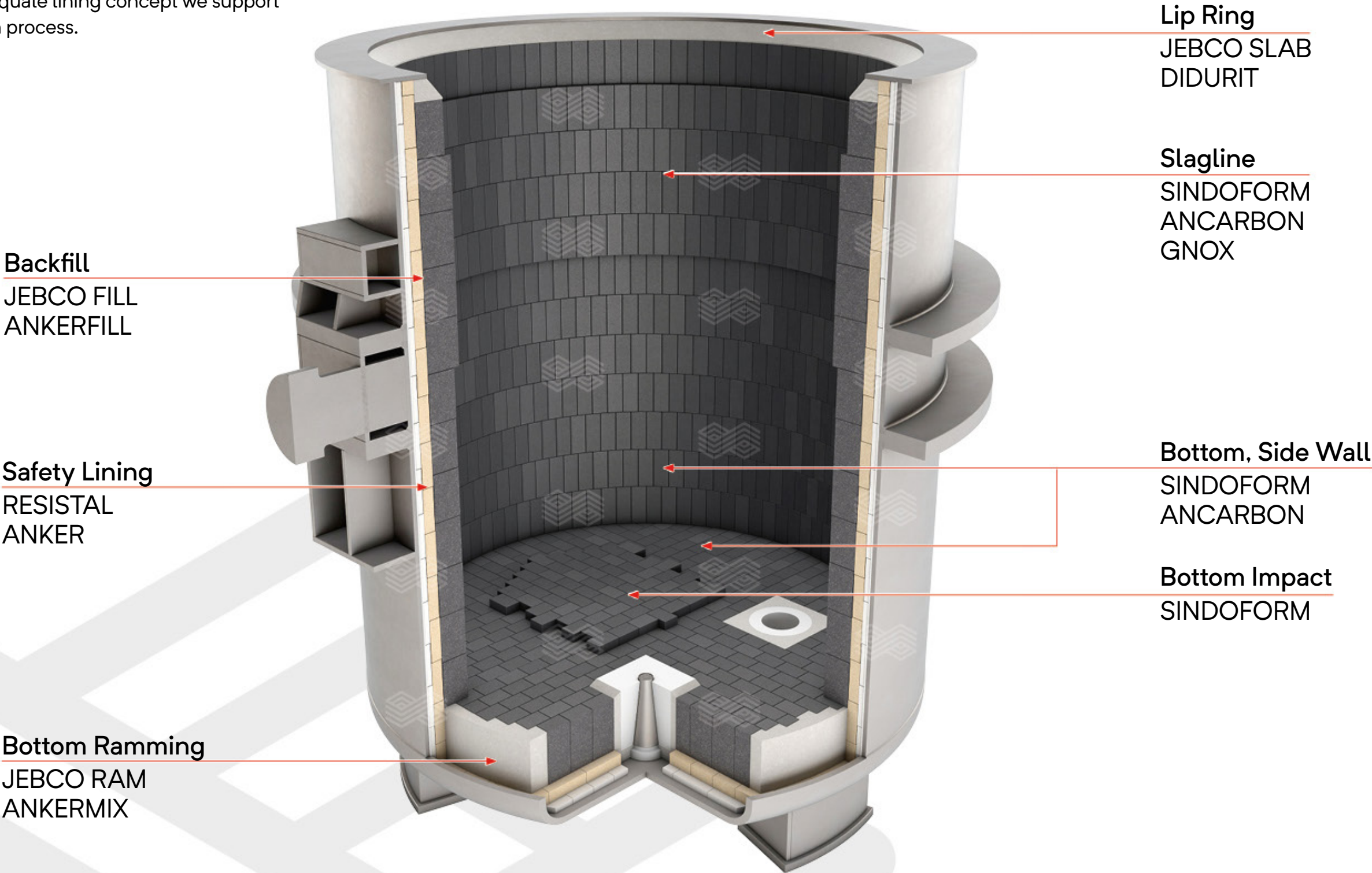


The Stainless Steel Teeming Ladle



Optimized Lining for Stainless Steel Teeming Ladle

RHI Magnesita offers a complete portfolio for teeming ladles. By selecting the most adequate lining concept we support the clean steel production process.



Product Variety of Bricks & Mixes for Stainless Steel Teeming Ladles

SINDOFORM

Fired Doloma Bricks

- Carbon-free bricks for production of low carbon containing steels
- Minimal oxygen resupply to the steel
- Preferred brick in stainless converters, commonly used in teeming ladle slaglines
- Good coating behavior
- Excellent price-performance ratio

RESISTAL

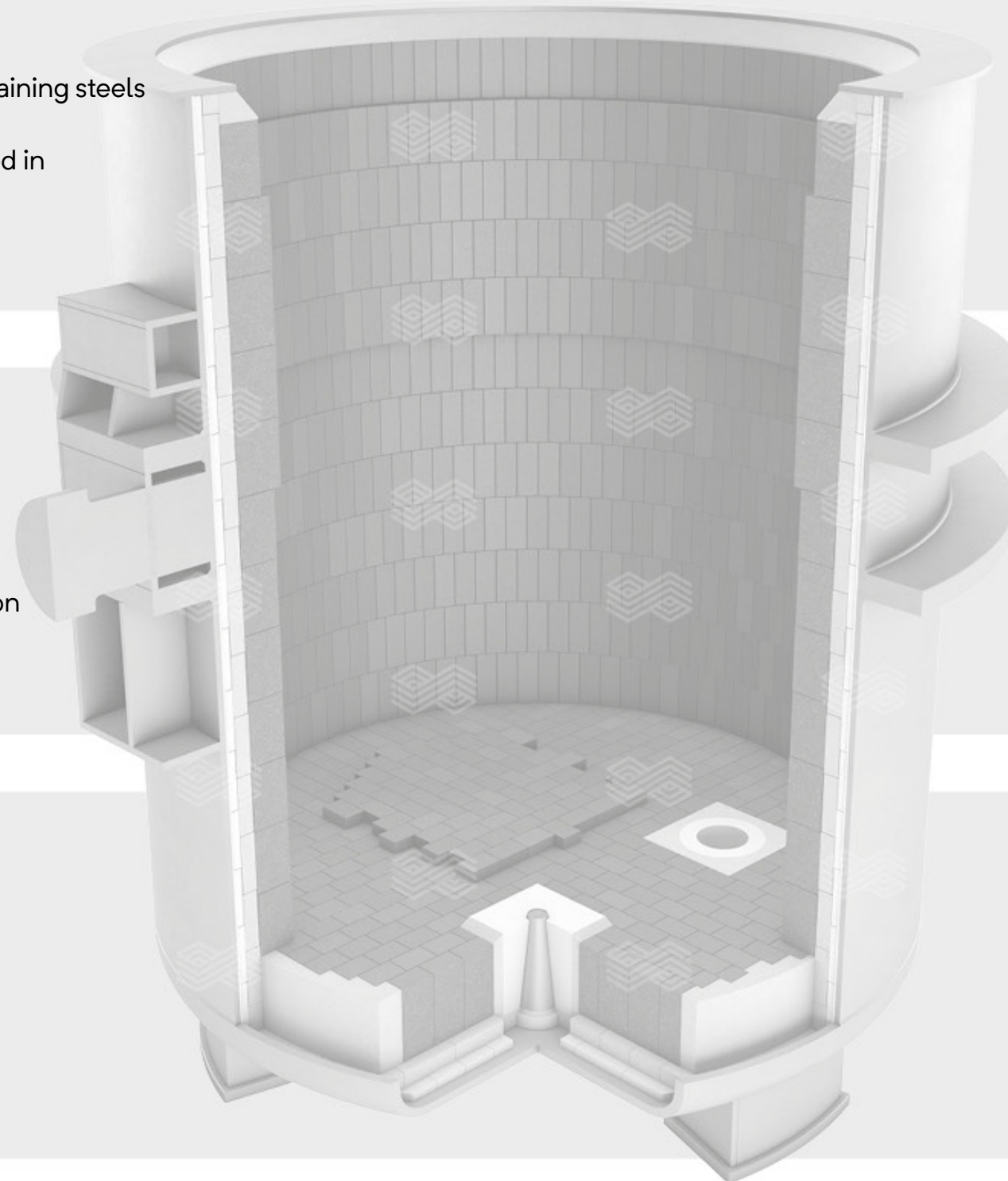
Fired Alumina Bricks

- High thermal shock resistance and low thermal conductivity
- Preferred solution for ladle safety linings and insulation
- Available as combinations of fireclay, mullite, bauxite, corundum-spinel and chromium-corundum

ANKER

Fired Magnesia Bricks

- Compatible with basic slags
- Niche products restricted to special applications – commonly used in converter safety linings



ANCARBON

Magnesia Carbon Bricks

- Very high refractoriness
- Unparalleled versatility for various and even changing process conditions
- Commonly used in teeming ladle slaglines when heats are partially Al killed

SINDOFORM

Doloma Carbon Bricks

- Carbon or resin bonded bricks available
- Excellent price-performance ratio
- Commonly used in transfer ladles as well as the side wall and bottom of teeming ladles

JEBCO

Doloma Mixes

- Excellent price-performance ratio
- Wide range of characteristics available for all stainless applications
- Preferred choice for stainless converter and ladle accessories, e.g. backfill or ramming mix

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Reduced Emission Bricks

Reduce or fully avoid smoke and emissions during preheating of ladles



Reduced Emission Technology

- Patent-protected binder technology
- Reduction of resin emission by about 30 wt.-%
- Same performance level as bricks with standard binder
- Excellent cost-benefit ratio
- Available for most MgO-C and AMC qualities



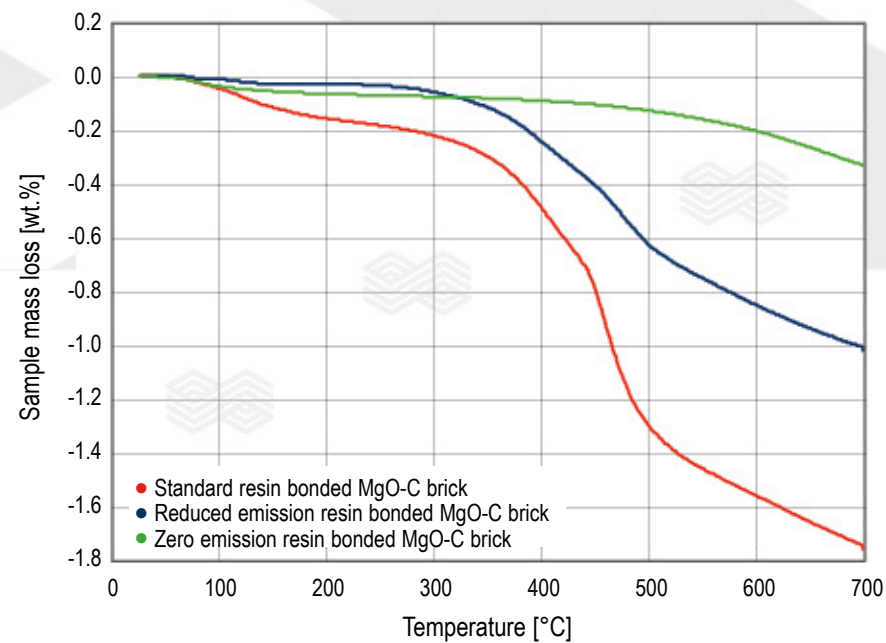
Zero Emission

- Newly developed high-temperature tempering technology
- No organic emissions
- Same performance level as standard tempered bricks
- Limited amounts available



Eco-pitch Impregnation with Reduced Emissions

- Redesigned process for new impregnation media
- BaP content < 0,1 ppm
- Same performance level as standard pitch
- Solution for highly stressed areas



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Preventing Brick Decarburization During Preheating

Challenge

Burnout of bonding matrix, graphite and carbon black

- Loss of strength
- Increased infiltration and corrosion
- Standard antioxidants may lead to excessive spalling

Solutions

Special antioxidant concepts with reduced carbide formation

- Applicable for MgO-C, AMC

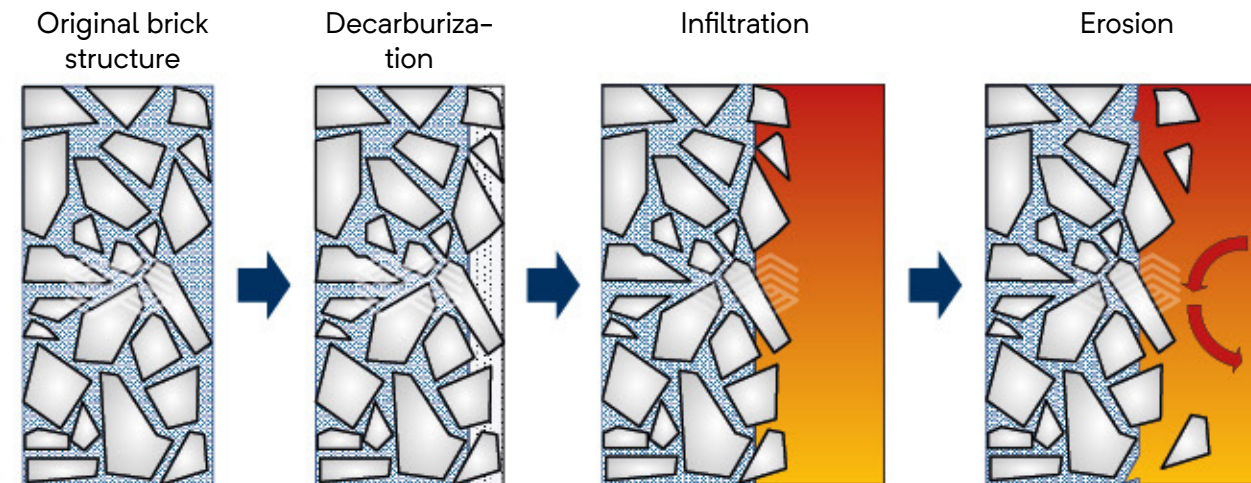
Glaze coating to prevent decarburization during preheating

- Applicable for MgO-C, AMC and Doloma

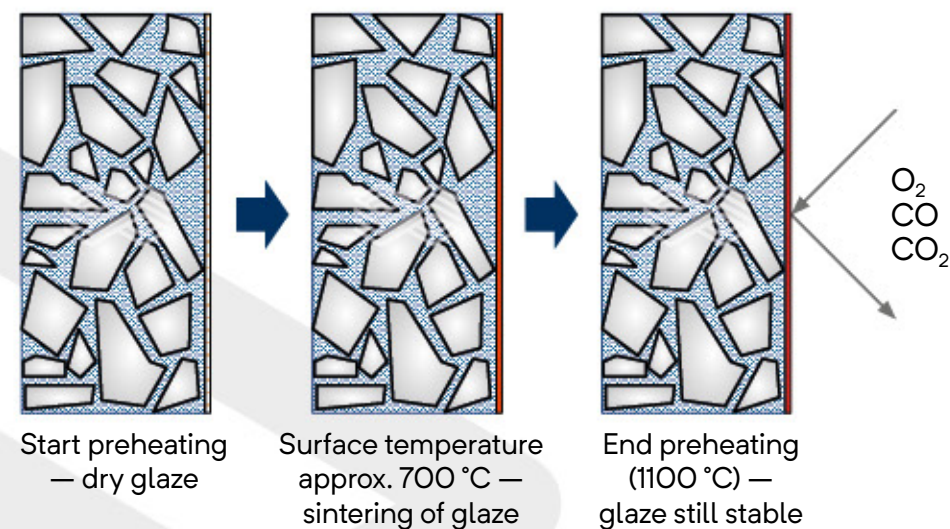
Advantages

- No loss of refractories prior to steel contact
- Higher ladle lifetime
- More reliable ladle performance
- Increased productivity

Unprotected



Bricks Protected by Glaze During Preheating



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Transfer Ladle



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Lining Solutions for Ultra Low Carbon Steels

Challenge

- Carbon pickup to steel from refractories during ladle treatment
- Monolithic lining, burnt doloma and MgCr in some cases not suitable due to metallurgy

Solution

Ultra-low carbon MgO-C

- Special carbon source
- Retained carbon < 2%
- Suitable for steel grades with 30 to 70 ppm maximum carbon content
- High thermal shock resistance



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Transfer Ladle



Teeming Ladle

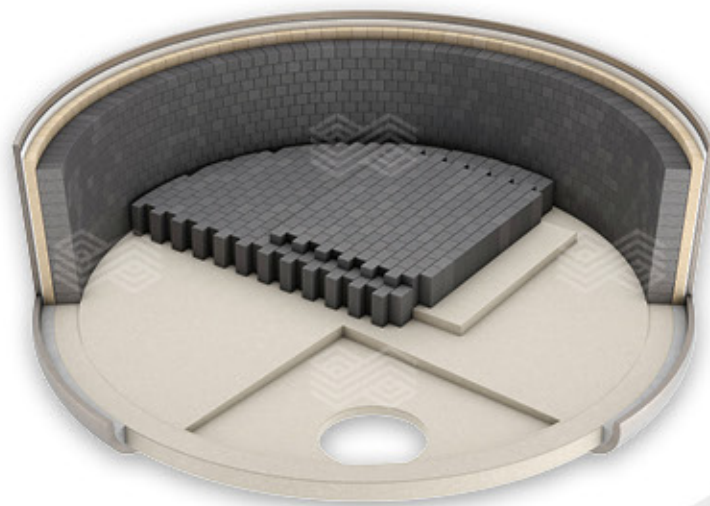


Maintenance



IBOS Ladle Solution for Maximum Yield

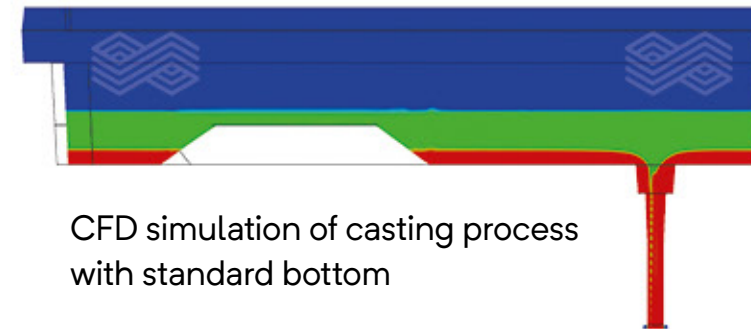
- Increased steel yield by taylor made prefabricated working or safety lining
- Patented shape for:
 - avoiding / delaying vortex formation
 - optimizing steel yield by reducing residual steel at end of casting process
- A starter ramp for bricked wall can be included
- Combination of cast and bricked areas (e.g. reinforced impact) possible
- Simple and fast installation



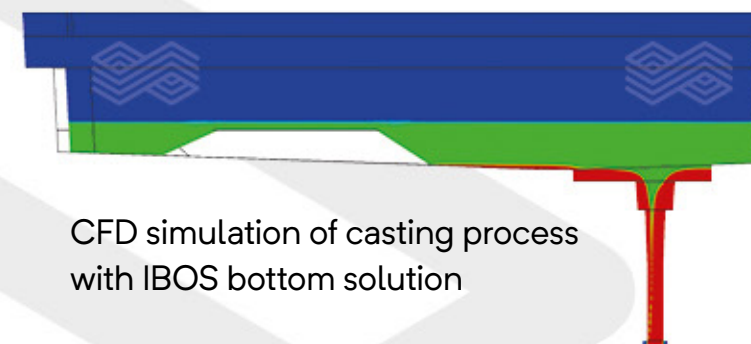
IBOS precast safety lining



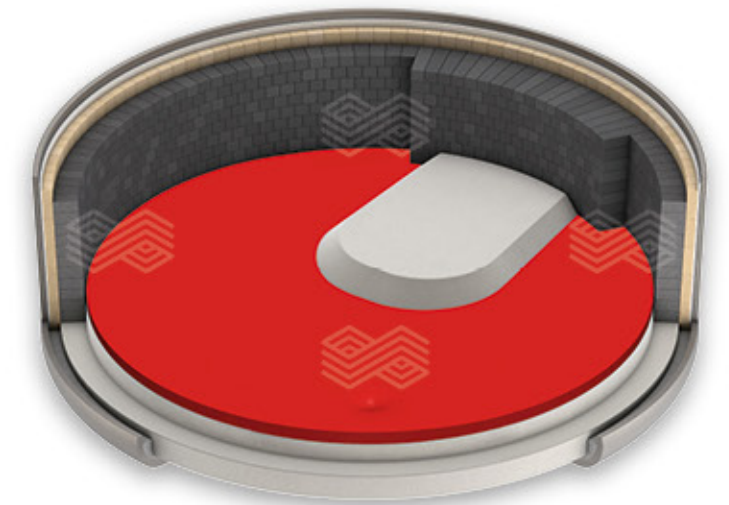
IBOS precast working lining



CFD simulation of casting process with standard bottom



CFD simulation of casting process with IBOS bottom solution



IBOS solution reduces the residual steel up to 70% for every heat

Content



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Transfer Ladle



Teeming Ladle



Maintenance



Sol-gel and Oxycarbide Solutions for Ladles

OXYCARBIDE

A new type of alumina-based no-cement refractory material

- Alumina based, no-cement, carbon containing castable with colloidal silica (SOL) binder system
- Significantly increased refractoriness under load compared to cement bonded products
- Reduced brittleness and superior thermal shock resistance
- Improved corrosion resistance (infiltration and slag resistance)
- Easy and quick drying on site due to sol bonding
- Available as prefab and cast-on-site solution

Applications in Steel Ladles:

- Ladle Furnace Roofs
- Lances
- Well Blocks



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Transfer Ladle



Teeming Ladle



Maintenance

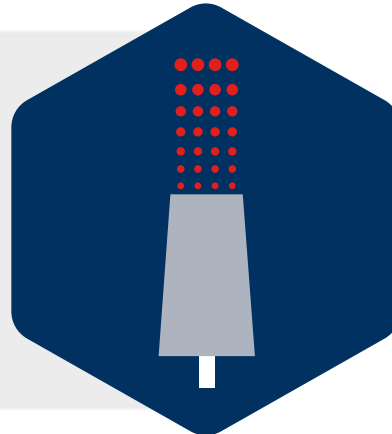


Gas Purging Systems for Steel Casting and Treatment Ladles

More than 800 customers from the steel and foundry industries in over 60 countries worldwide rely on RHI Magnesita as a trustful partner for ladle purging ceramics. As a system and solution provider we closely cooperate with you as our customer supporting you with expertise and experience in the fields of application technology, R&D, simulations, quality management and production.

Purging Ceramics

- Purging plugs with customized shapes in different designs
- Customized blocks and sleeves
- Prefabricated sets with easy exchange technology



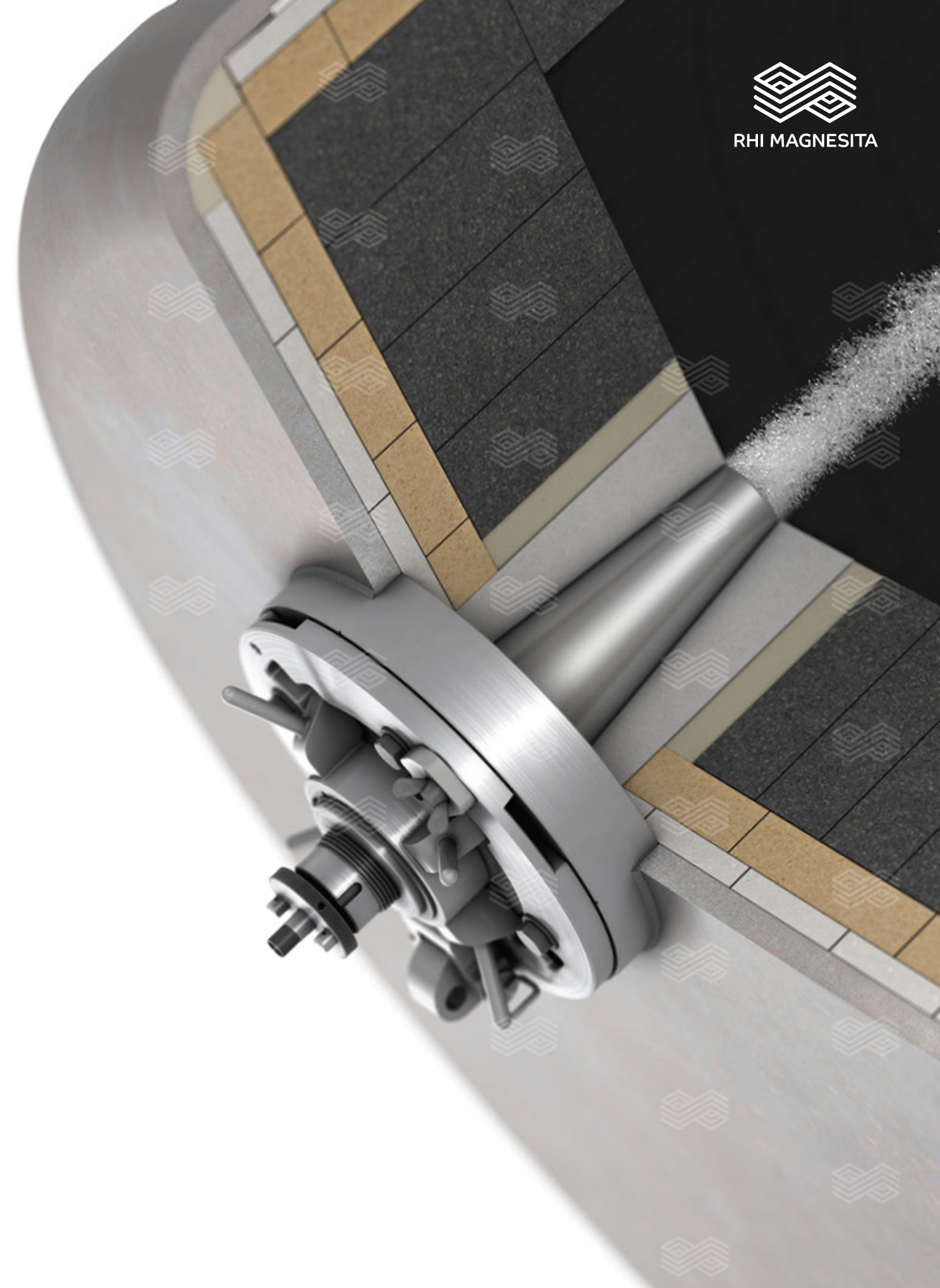
Equipment

- Safety closing systems for ladle purging plugs
- Gas control systems
- Check valves
- Testing facility for purging plug functionality tests



Technology — Service

- Customized fact-finding
- CFD analysis for optimization of plug positioning and recommended gas volume
- Commissioning of purging facility
- After sales service



Content



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Transfer Ladle



Teeming Ladle



Maintenance

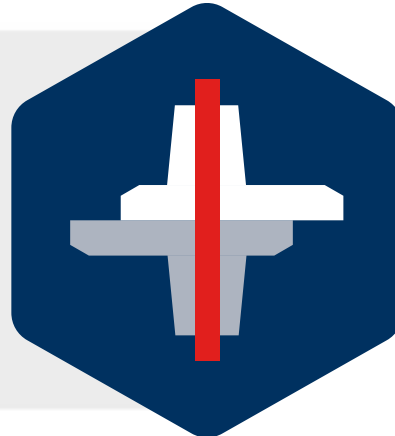


Slide Gate Systems for Steel Casting Ladles

More than 600 customers from the steel and foundry industries in over 70 countries worldwide rely on RHI Magnesita as a trustful partner for INTERSTOP® flow control systems. The latest generation of the INTERSTOP® S gate series offers extra features in terms of safety, ease of operation and low operational costs. As a system and solution provider we support our customers with expertise and experience in the fields of application technology, R&D, simulations, quality management and production.

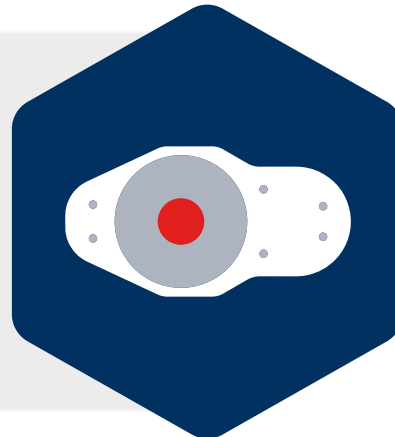
Ladle Gate Systems

- Size selection according to specific customer requirement — 2-plate or 3-plate systems available
- User-friendly design for safe, fast and simple operation
- Minimal maintenance work required
- Support of clean steel production and automation



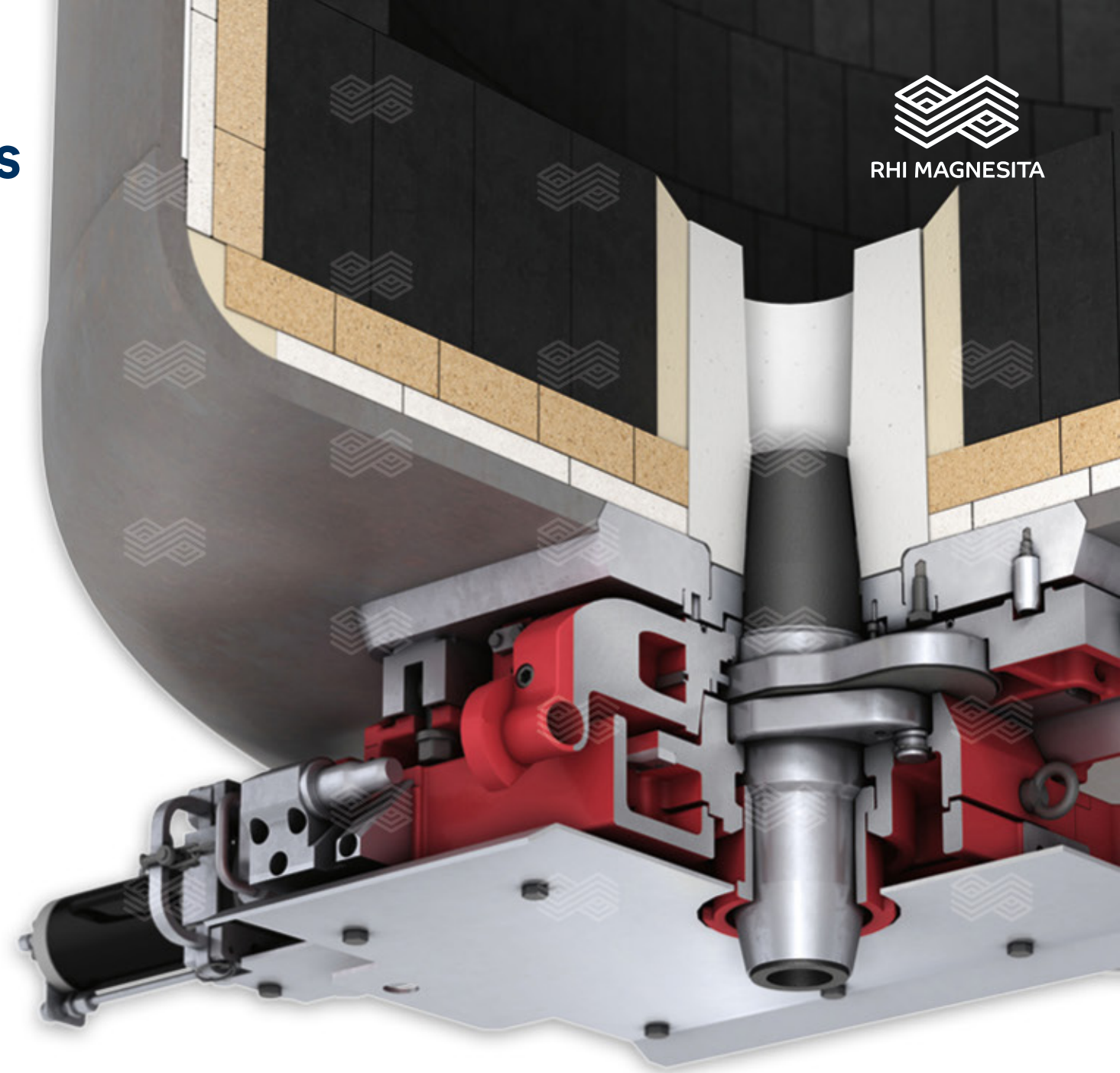
Ladle Gates Refractories

- Flexible plate sizes
- Clamping and self-centering of plates
- Positive effect to plate wear zone
- Controlled crack pattern of plates
- Wide refractory portfolio



Technology — Service

- Customized fact-finding
- Proactive optimization of engineering solution
- Commissioning support and application training on site
- INTERSTOP® after sales service



More Information



Content



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Transfer Ladle



Teeming Ladle



Maintenance



Customized Thermal Optimization

Minimizing Heat Losses Crucial for

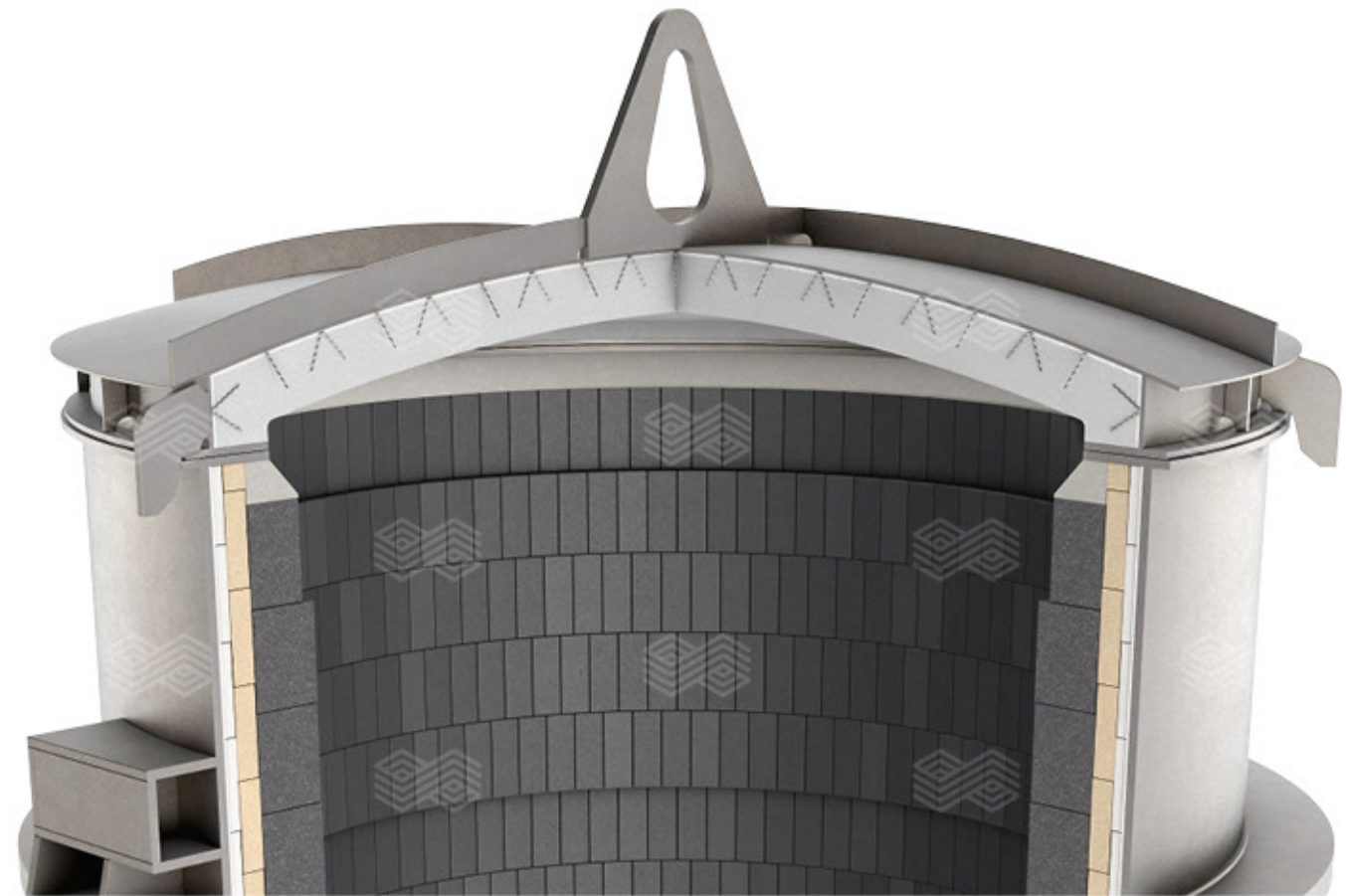
- Optimal and stable liquid steel temperature at casting for clean steel
- Energy cost reduction
- Preventing overheating and damaging steel shell

Holistic Approach and Advanced Products for

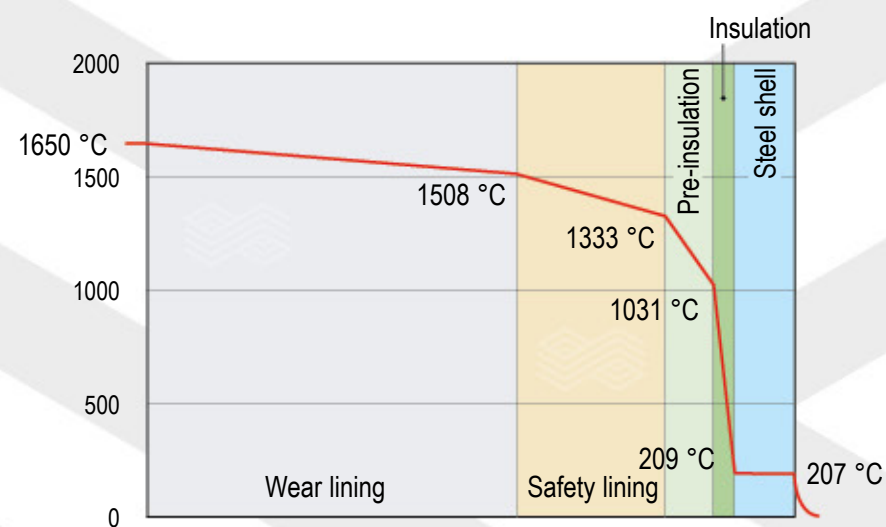
- Well insulating permanent lining
- Well insulating ladle lid
- Covering powder

Thermal Simulations to Find Optimal Lining Composition

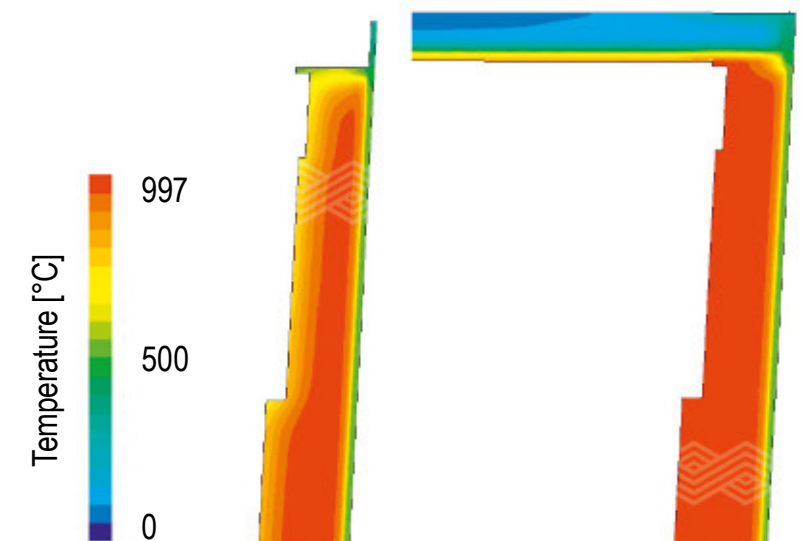
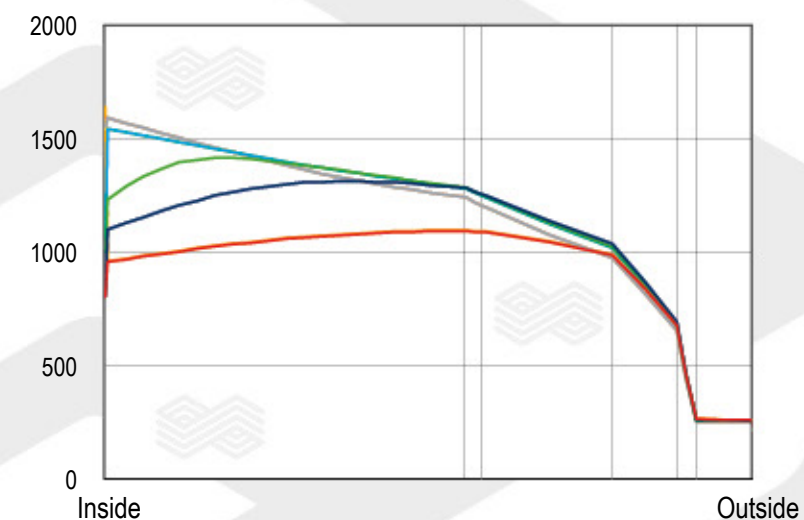
- Different levels of calculation details



Steady-state calculation



Dynamic transition calculation



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Transfer Ladle



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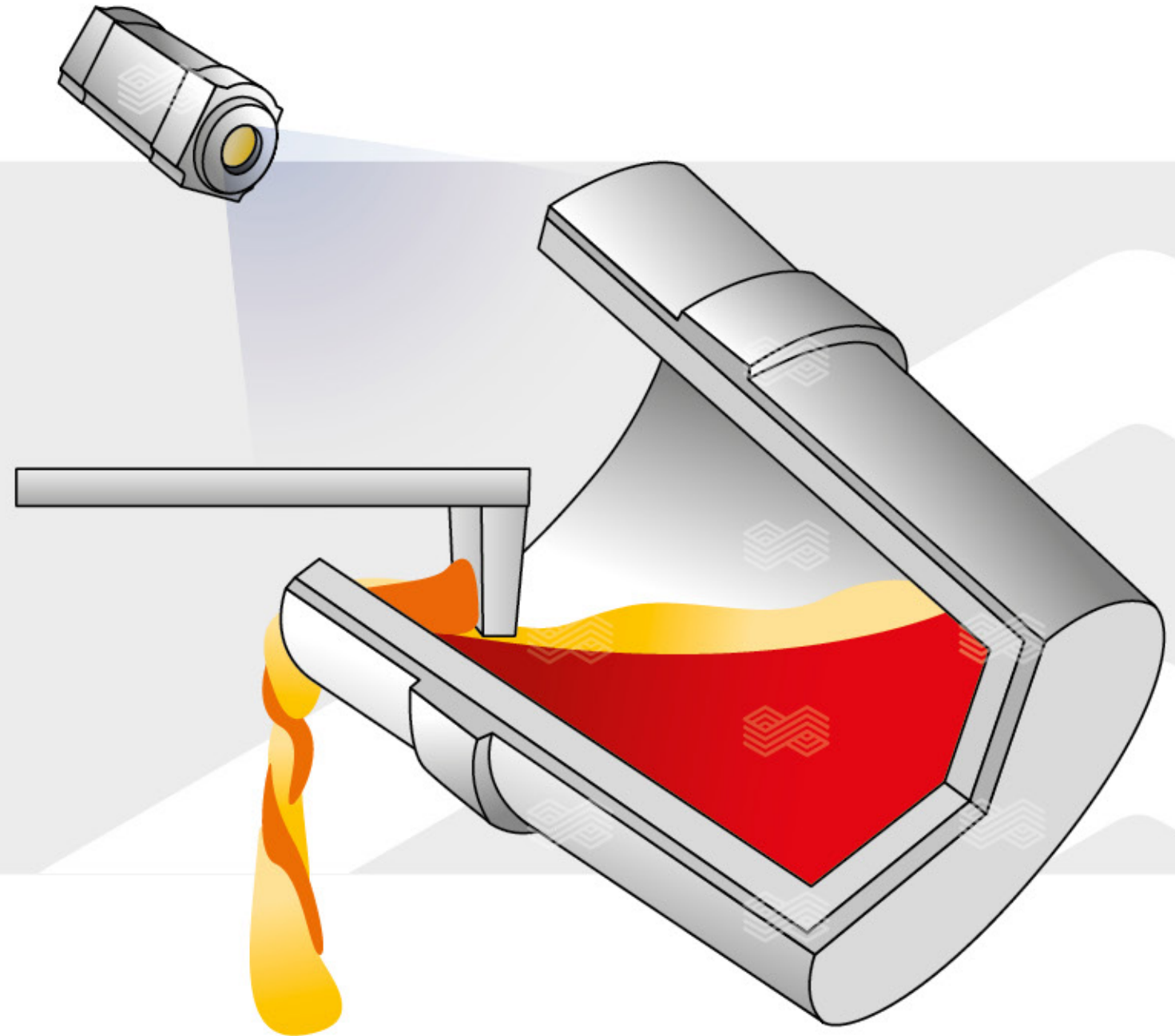
VISIR-LadleDeslag

Ladle skimming monitoring

User Benefits & Advantages

- Consistent and objective monitoring of deslagging process
- Historical data stored in open and searchable database
- Metal loss warning
- Yield increase

More Information



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Transfer Ladle



Teeming Ladle



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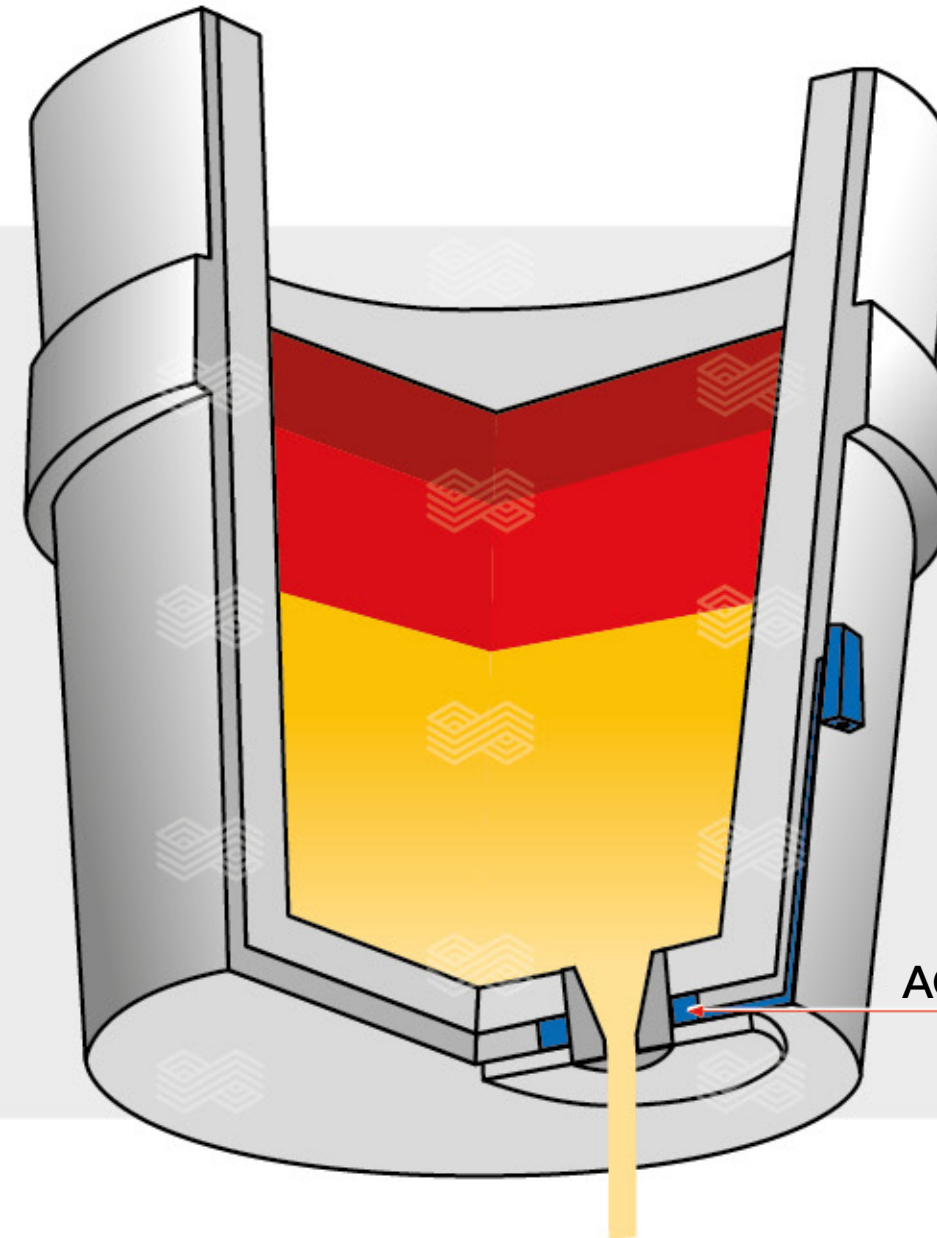
EMLI-LadleSlag

Electromagnetic slag detection for ladles

User Benefits & Advantages

- Control slag carryover precisely with a fast response time
- Increase yield by leaving minimal amounts of steel in the ladle
- Can handle any steel grade. No additional calibration necessary

More Information



AGELLIS® EMLI Sensors

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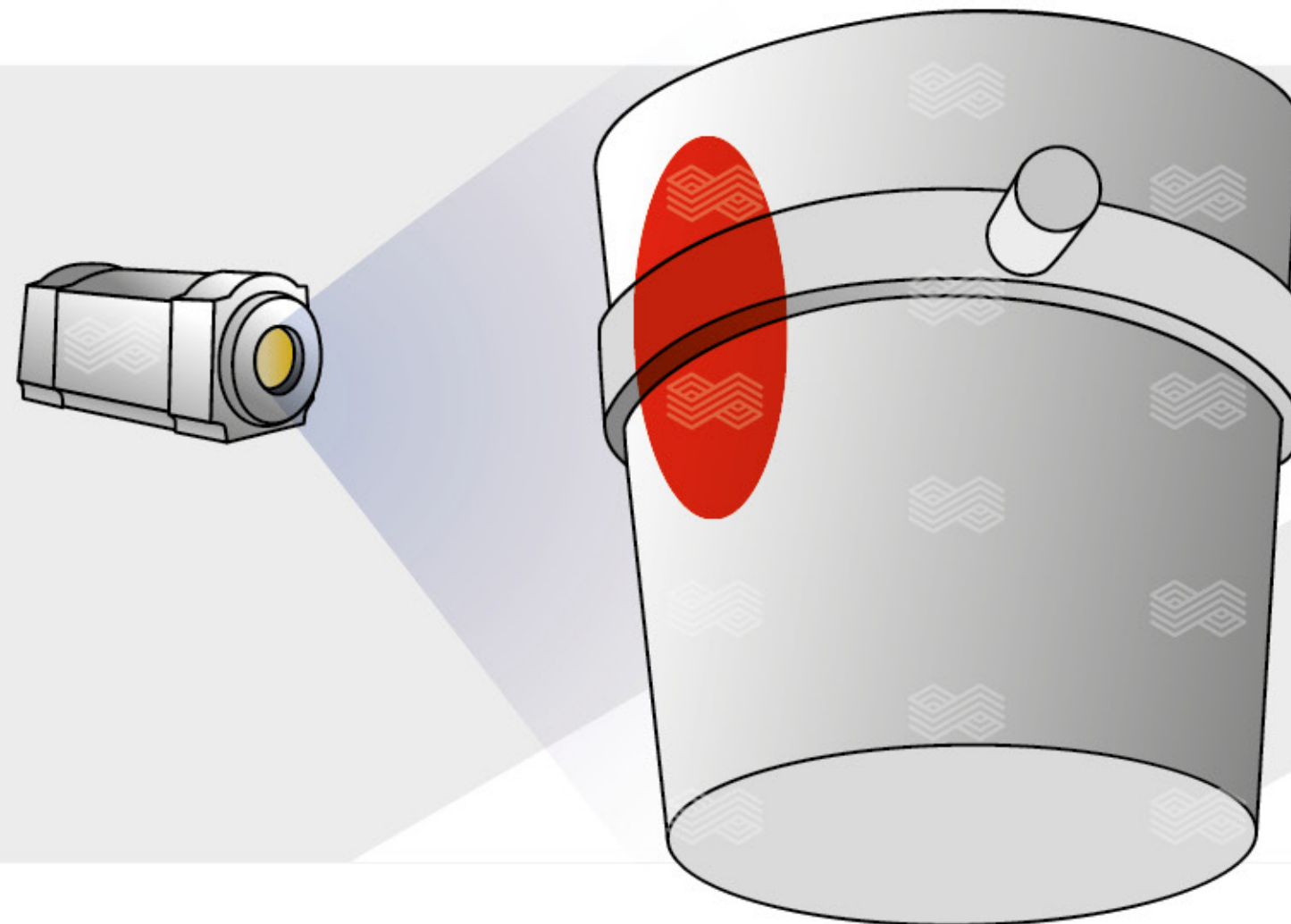
VISIR-LadleSafe

Ladle hot spot detection system

User Benefits & Advantages

- Hot spot detection and warning
- Maximize ladle refractory lifetime
- Integrated with plant PLC and network
- Maximizing safety in ladle handling areas
- Historical database open to process metallurgist

More Information



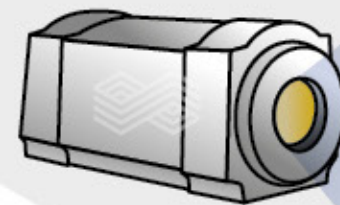
VISIR-FurnaceSafe

Furnace breakout prevention

User Benefits & Advantages

- Early “hot spot” detection and warning
- Used with LF, RH, EAF, AOD, LD/BOF
- Historical database open to process metallurgist

More Information



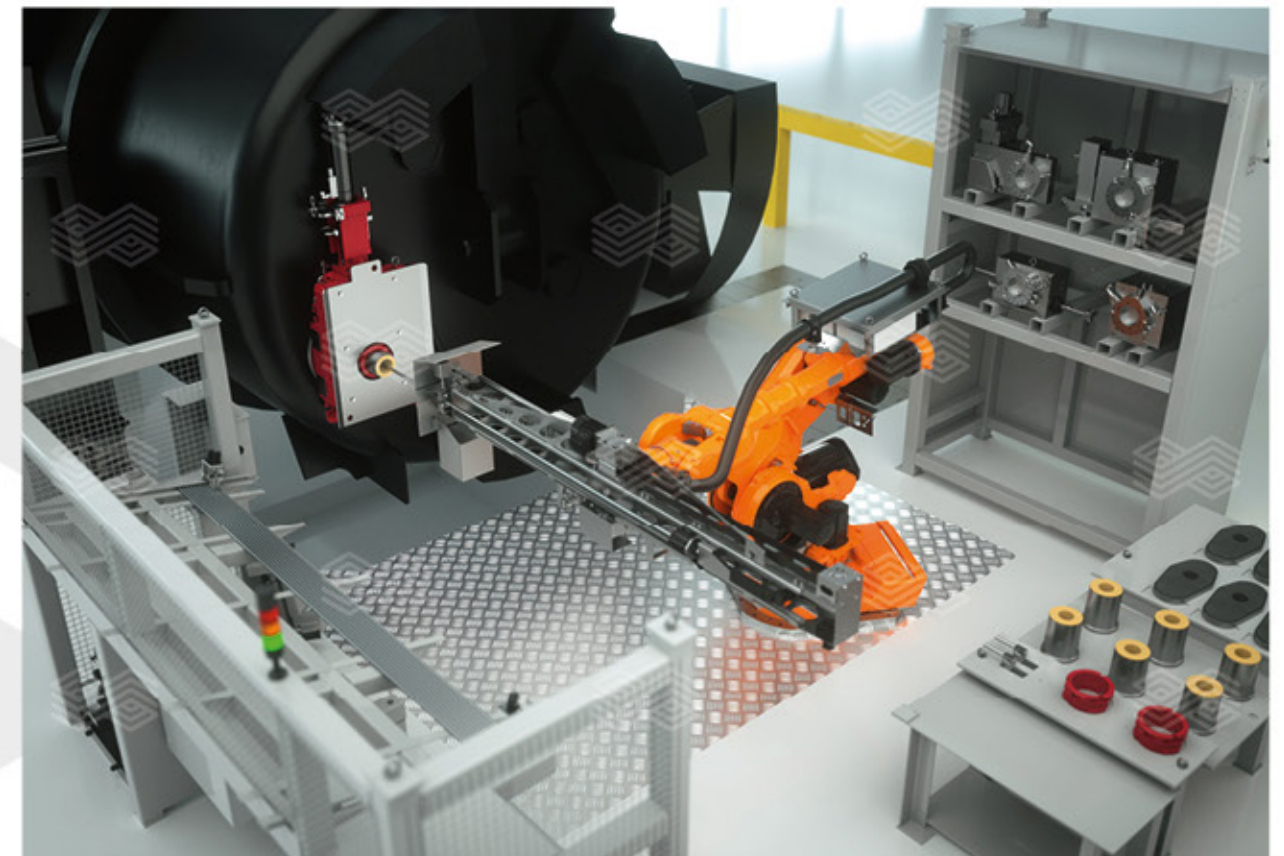
INTERSTOP® Automation & Robotic Solutions

Robotic Application Ladle to Mold (L2M)

- Automated cylinder handling
- Automated ladle shroud handling including O₂ cleaning & lancing
- Coupling of media (Ar, Air, Electric / slag detection)
- Sample taking and temperature measurement
- Mono tube handling
- Casting powder feeding

Robotic Application for Ladle Preparation

- Oxygen lancing
- Ready-to-use mortar joints
- Inner nozzle repair
- Inner nozzle surface cleaning
- Optical measuring system
- Cylinder handling
- Handling of slide gate refractory parts



Content



AOD



Transfer Ladle



Teeming Ladle



Maintenance



ANKERJET A

Application:

Multi-purpose pressure vessel machine for basic and non-basic mixes

Advantages:

- Useable in a variety of aggregates
- Consumption data recording
- Different equipment variants available (e.g. load cells, detachable silo, ...)
- Charging by crane or forklift
- Low maintenance and wear costs
- Easy-to-use automatic and manual operation
- Transportable by crane and forklift



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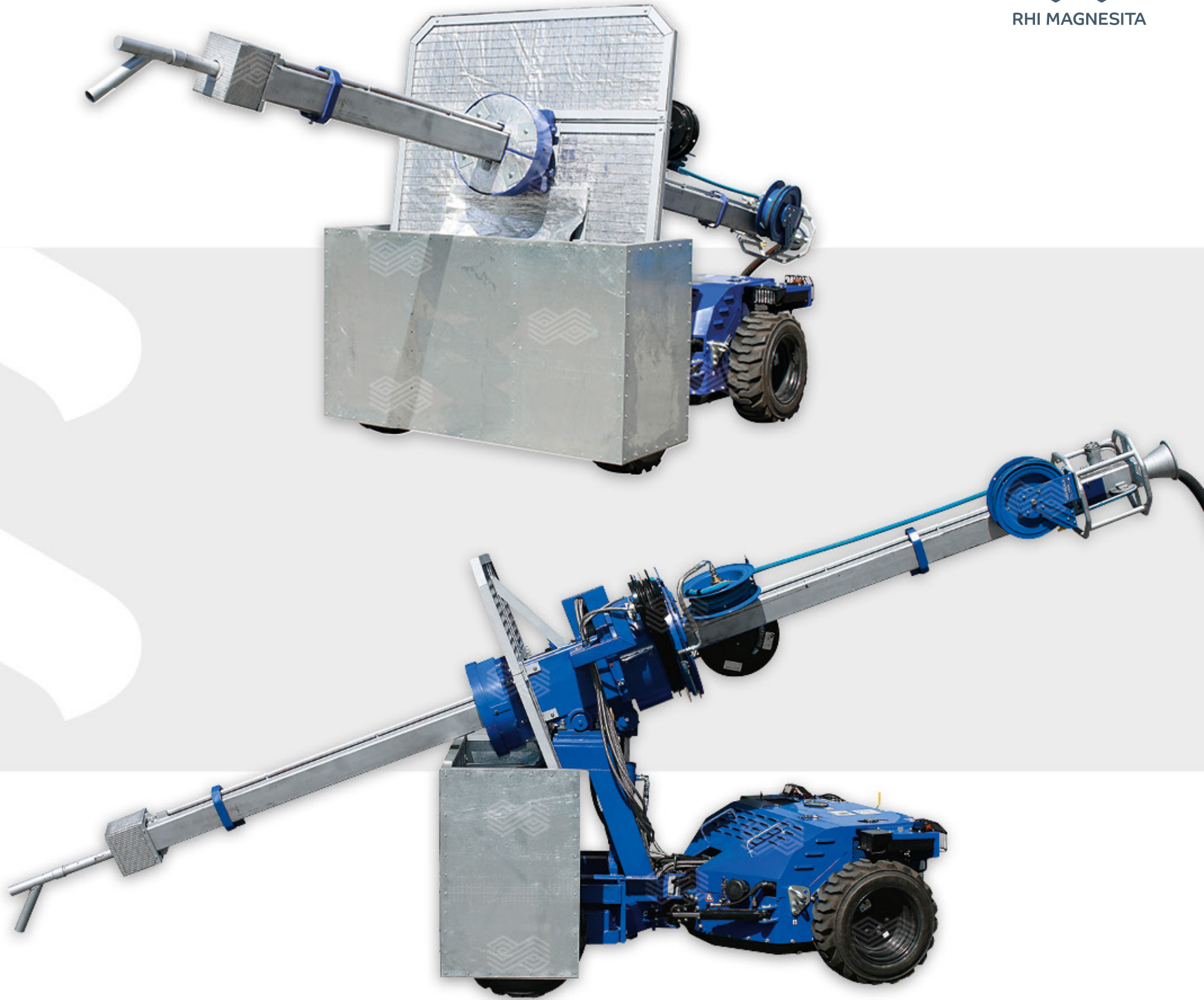
GEKKO AOD

Application:

For rapid gunning repairs in the AOD

Advantages:

- Precise gunning repair
- Less physical strain on operating personnel
- Increased AOD availability
- Battery powered undercarriage
- Four-wheel drive
- GEKKO can be operated by cable and radio remote control



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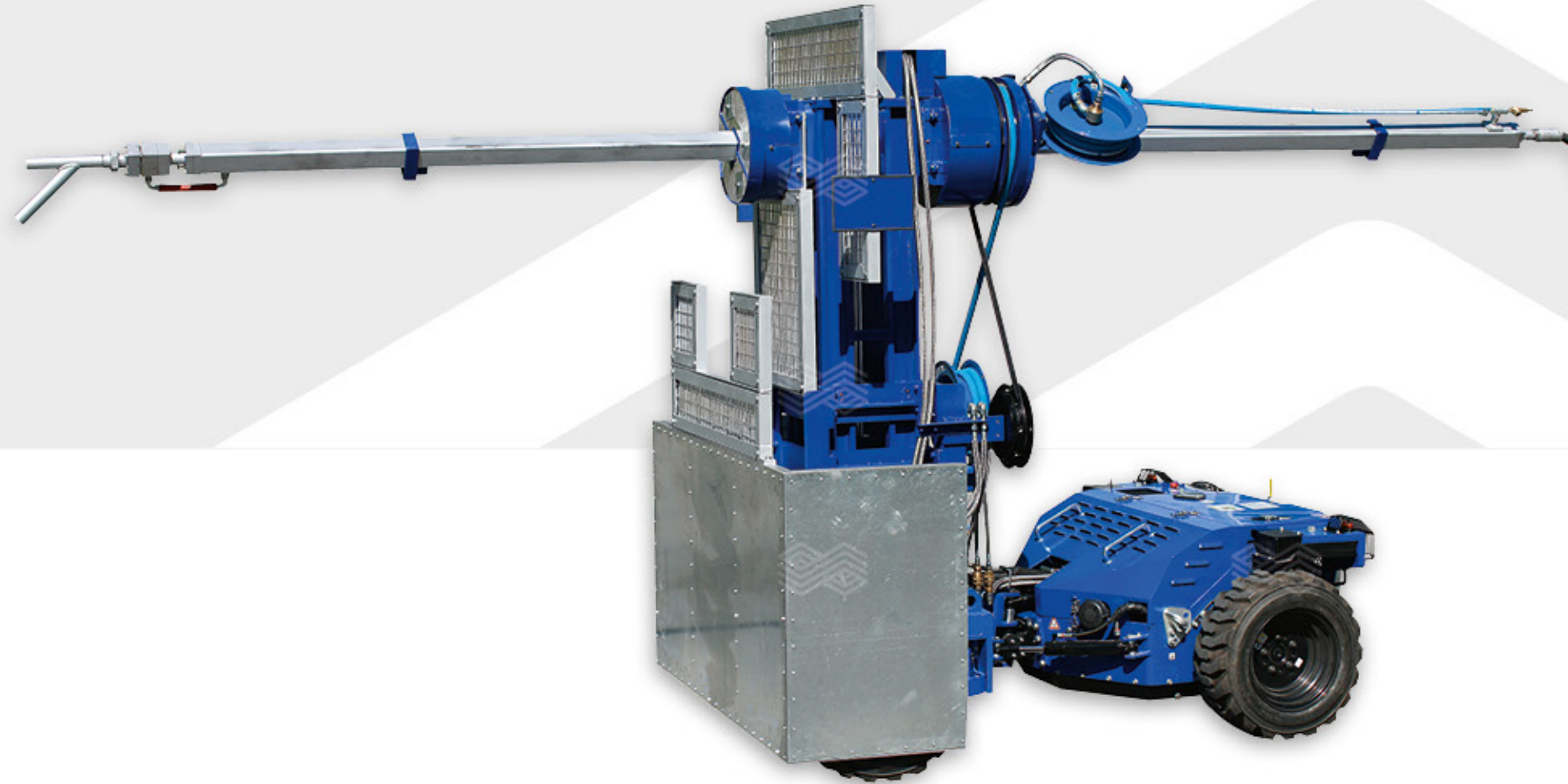
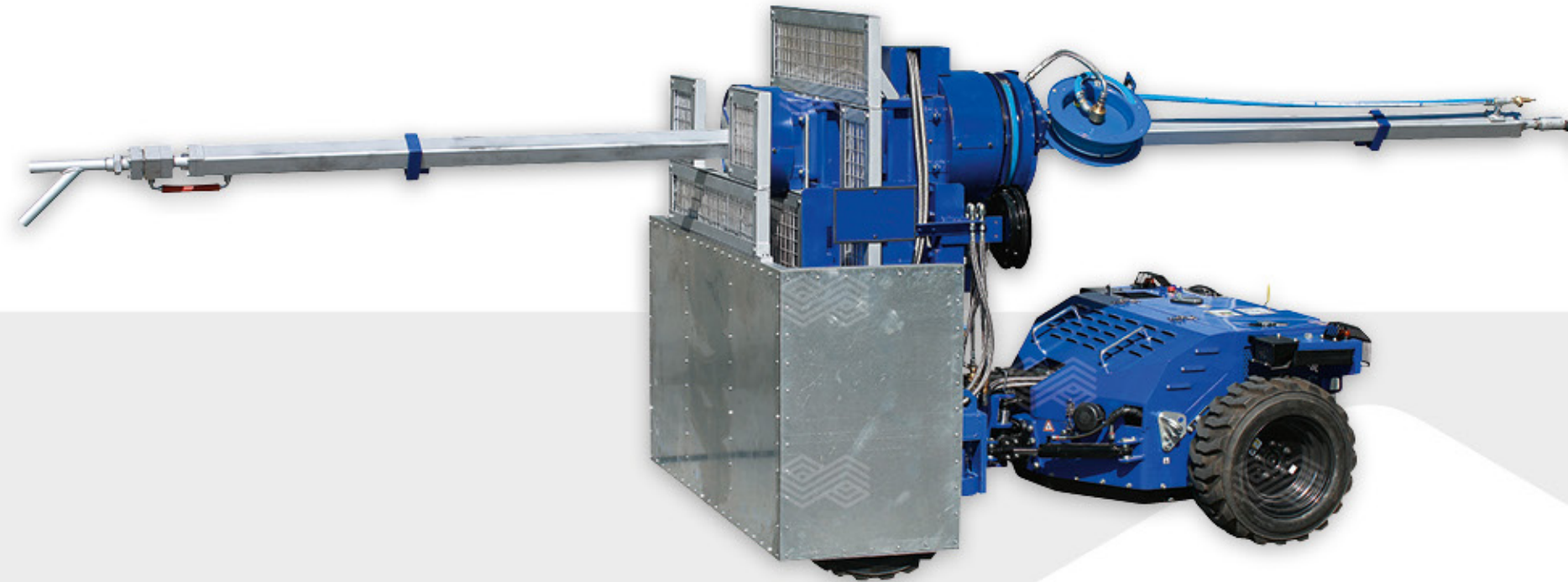
GEKKO Ladle

Application:

For rapid gunning repairs in the ladle

Advantages:

- Precise gunning repair
- Less physical strain on operating personnel
- Increased ladle durability
- Battery powered undercarriage
- Four-wheel drive
- GEKKO can be operated by cable and radio remote control



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Refractory Innovations

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