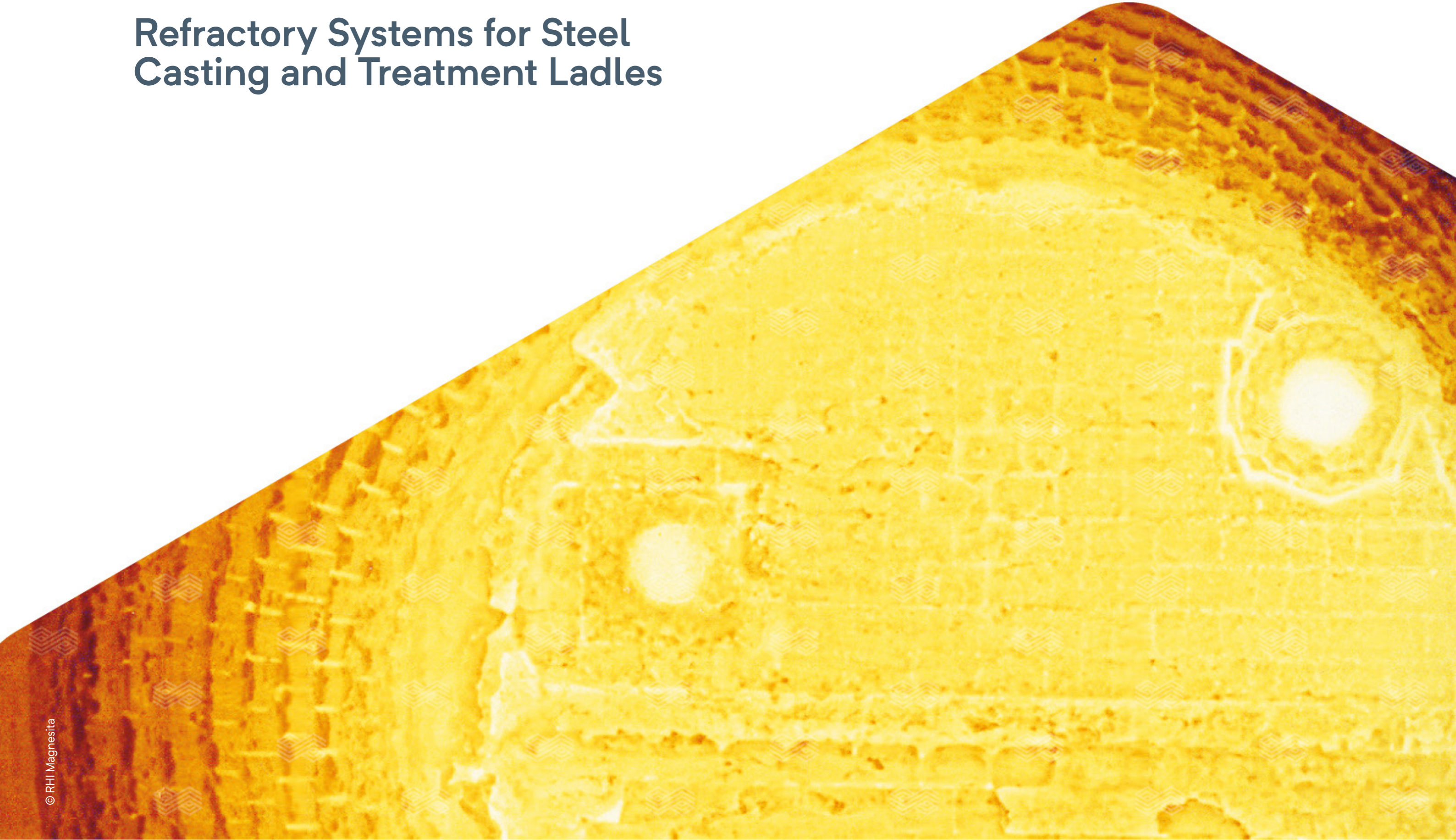




RHI MAGNESITA

STEEL / LADLES

# Refractory Systems for Steel Casting and Treatment Ladles



# 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.

**35**  
Main production and  
raw material sites

**70**  
Sales offices

**180**  
Countries shipped  
to worldwide

North  
America

3 COUNTRIES  
1 R&D CENTER

South  
America

6 COUNTRIES  
1 R&D HUB

Europe

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

Middle East/  
Africa

2 COUNTRIES

9 COUNTRIES  
3 R&D CENTERS

Asia  
Pacific



# The Ladle

Lip Ring Ramming Mix

Freeboard

Permanent Lining

Slag Zone

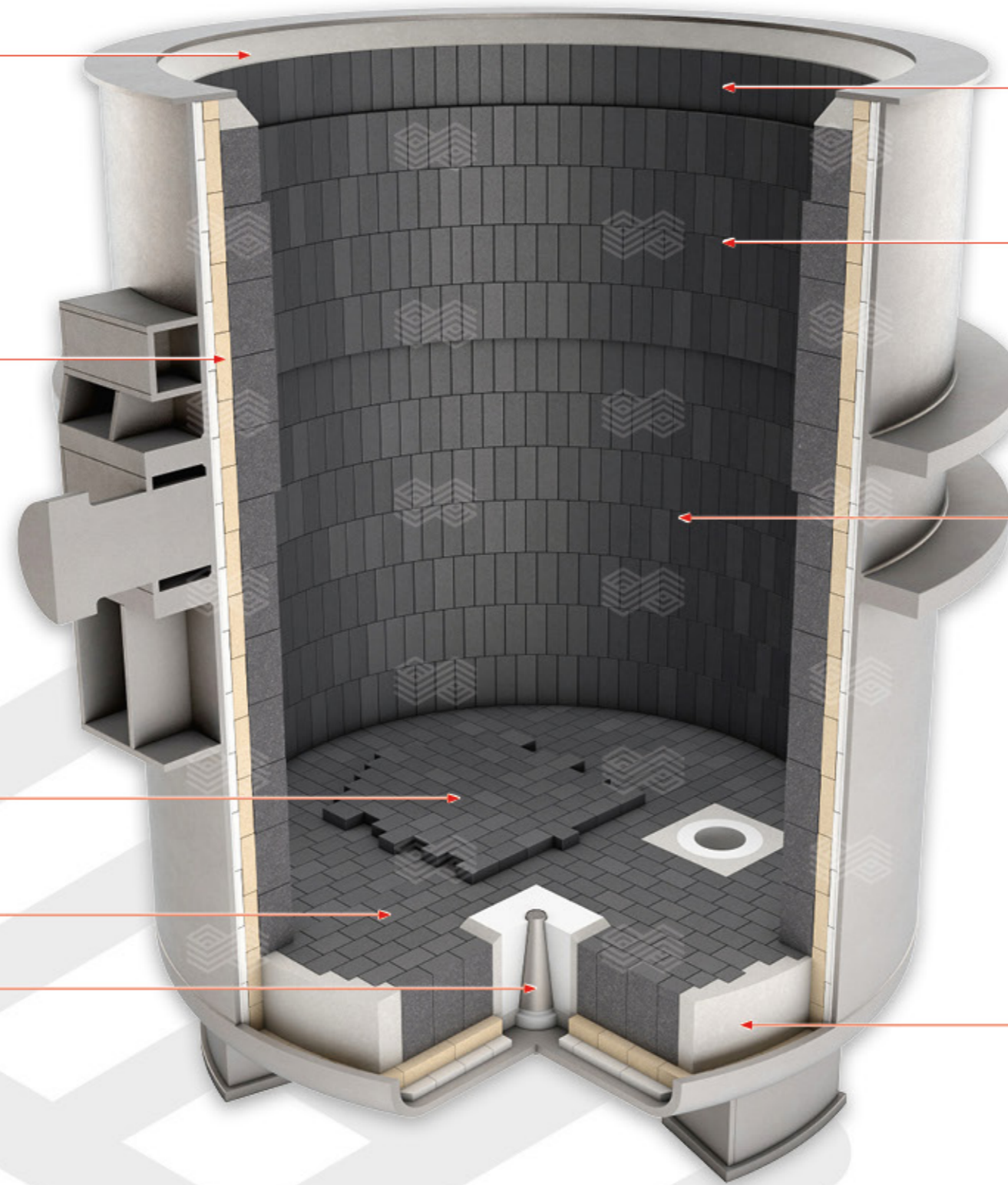
Impact Area

Side Wall

Bottom

Purging Set

Bottom Ramming Mix



# Optimized Lining for Ladle Metallurgy

The areas subjected to low wear and those to extreme wear in the ladle, such as the slag zone, purging or impact area, should have a comparable residual thickness at the end of a ladle campaign in order to utilize the lining in the best possible way. This is accomplished by a suited combination of refractory material selection, shapes and maintenance concepts.

**Permanent Lining**  
ANKERMIX  
COMPRIT  
JEBCO

**Side Wall**  
COMPRIT  
ANKOFLO

**Bottom**  
ANKOFLO  
ANCOCAST

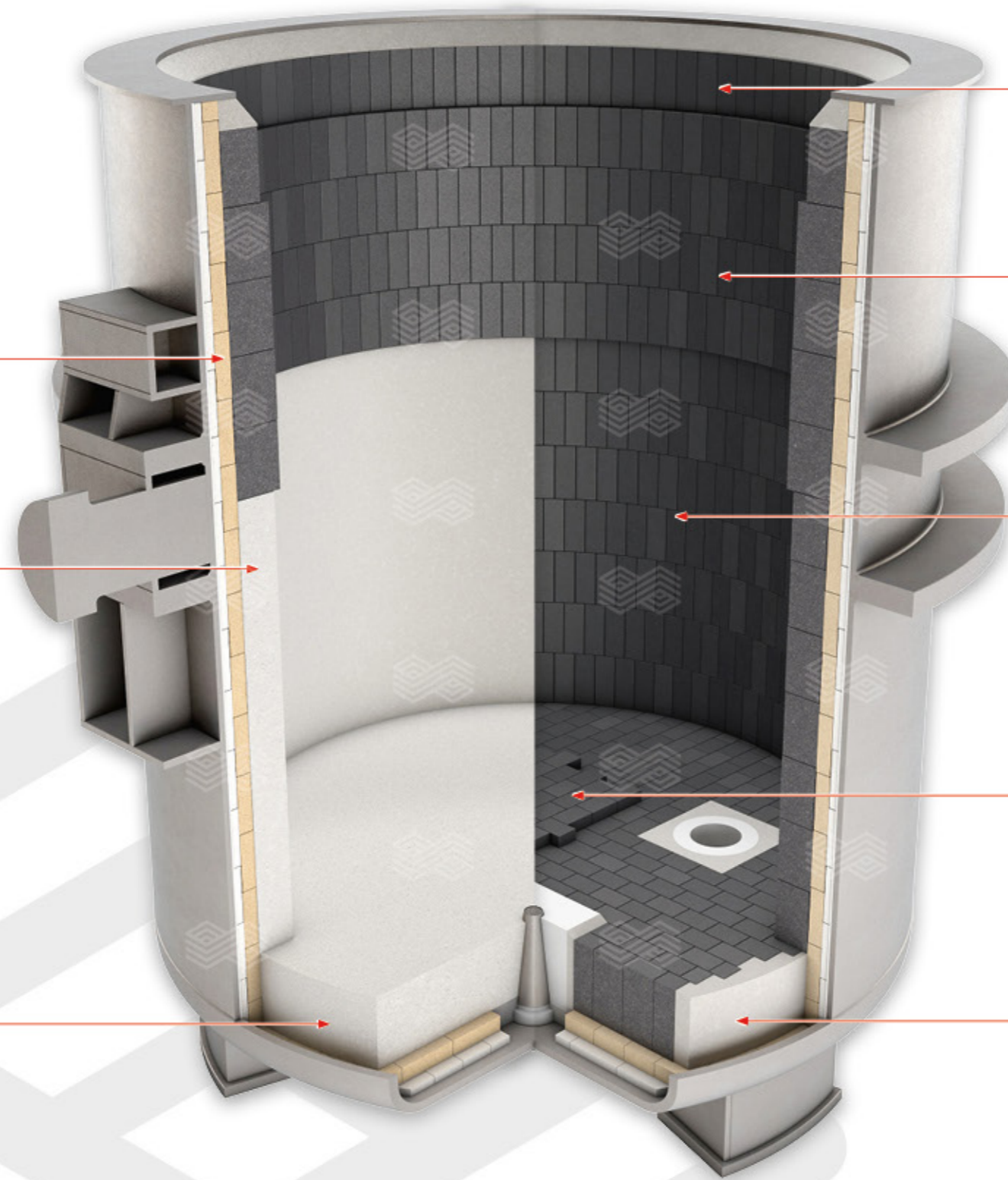
**Freeboard**  
ANKER  
RESISTAL  
ANCARBON

**Slag Zone**  
ANCARBON  
SINDOFORM

**Side Wall**  
ANCARBON  
SINDOFORM  
ANKO  
RESISTAL

**Impact Area**  
ANKO  
ANCARBON  
SINDOFORM

**Bottom Ramming Mix**  
ANKERMIX  
COMPRIT  
JEBCO



# Bricks for the Ladle

## SINDOFORM

### Fired Doloma Bricks

- Usable in ladle slaglines
- Carbon-free bricks for production of ultra low carbon containing steels
- Minimal oxygen resupply to the steel
- Excellent price-performance ratio

## RESISTAL

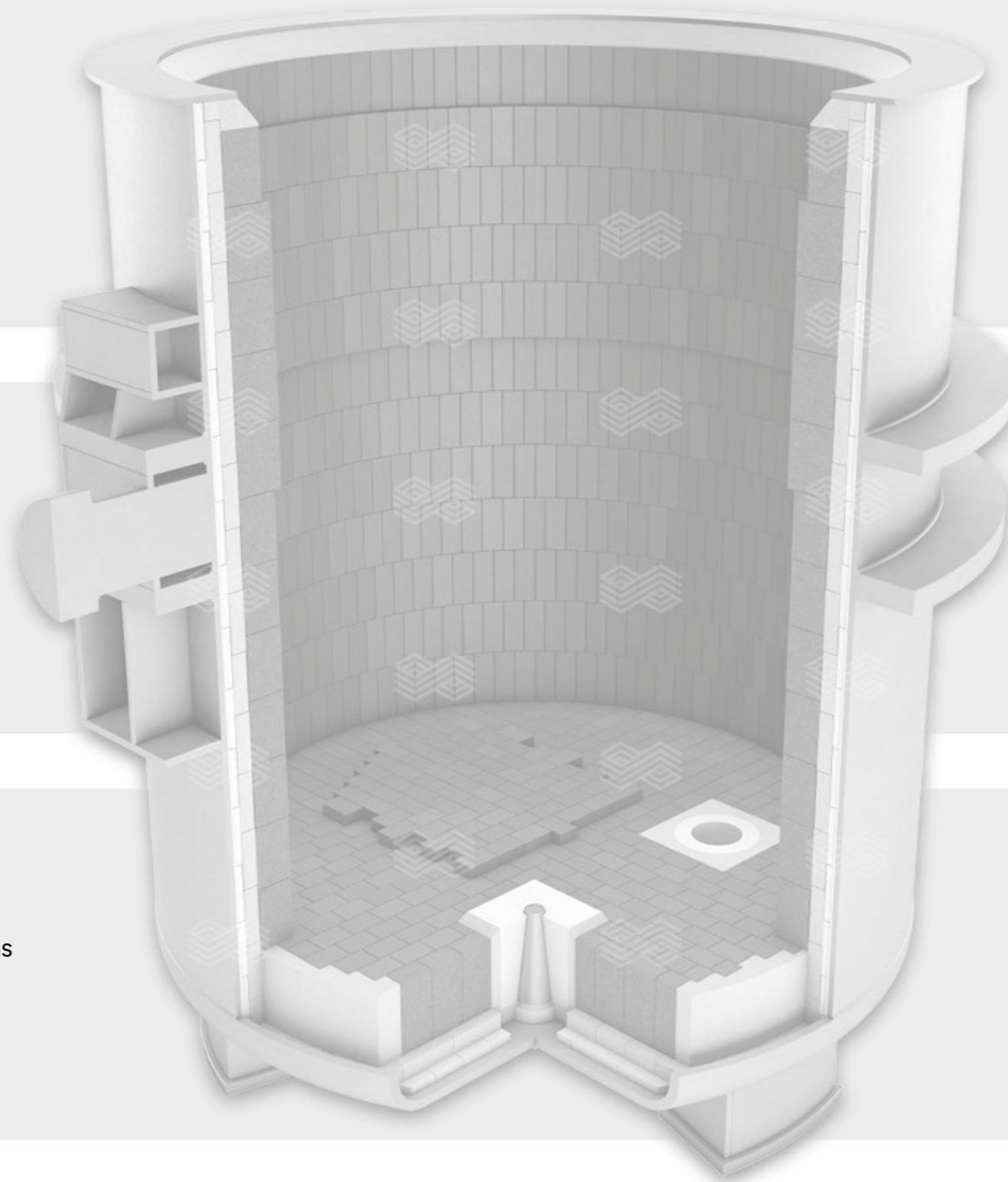
### Fired Alumina Bricks

- Products for bath area, safety lining and insulation of ladles
- High thermal shock resistance and low thermal conductivity
- Available in many different raw material combinations

## ANKER

### Fired Magnesia Bricks

- Exceptional products restricted to special applications
- Products for safety linings and special wear lining applications
- Available as pure burnt magnesia or combined with either chromium oxide or direct-bonded oxycrom



## ANCARBON

### Magnesia Carbon Bricks

- Universal usability in all areas of the wear lining
- Carbores or resin bonded
- Highest refractoriness
- Unparalleled flexibility for different and even changing process conditions

## SINDOFORM

### Tempered Doloma Bricks

- Usable in all areas of the wear lining
- Good coating behavior in silicon killed steel shops
- Carbores or resin bonded
- Excellent price-performance ratio

## ANKO

### Alumina-Magnesia-Carbon Bricks

- Optimal for impact area
- Usable for bath area especially in alumina killed steel shops
- Highest erosion resistance

Content



Lining



Purging



Flow Control



Solutions



Maintenance



# Mixes for the Ladle

## ANKERJET, ANKERMIX, ANKERFILL

### Basic Mixes

- Versatile range of mixes for ramming, casting, gunning and backfilling
- High refractoriness
- Adaptable to specific customer demands

## JEBCO

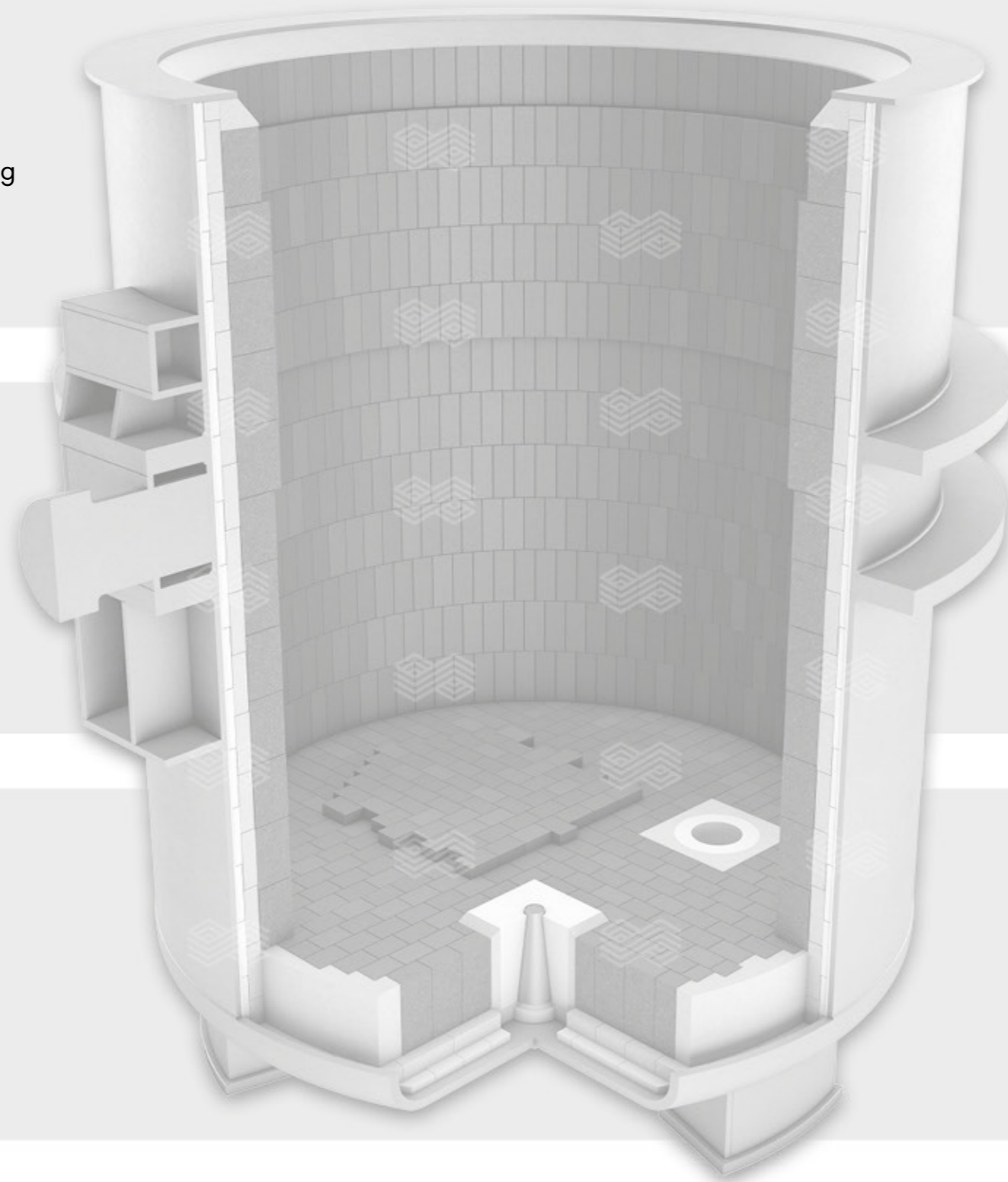
### Doloma Mix

- Preferred in combination with dolomite bricks for back fill or ramming mix
- Wide range of characteristics available
- Excellent price-performance ratio

## COMPRIT, DIDURIT, COMPAC

### Non-Basic Mixes

- Auxiliary mixes for gunning, ramming, casting and mortars
- Usable as monolithic lining for ladle bath areas
- High thermal shock resistance



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# Reduced Emission Bricks

Reduce or fully avoid smoke and emissions during preheating of Magnesia-Carbon and Alumina-Magnesia-Carbon lined 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



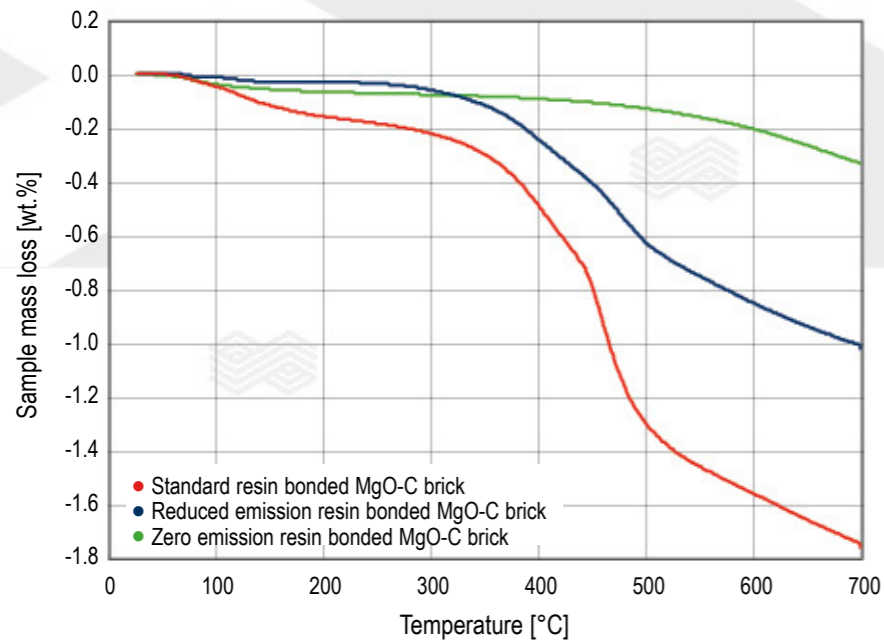
## Zero Emission

- 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



# 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

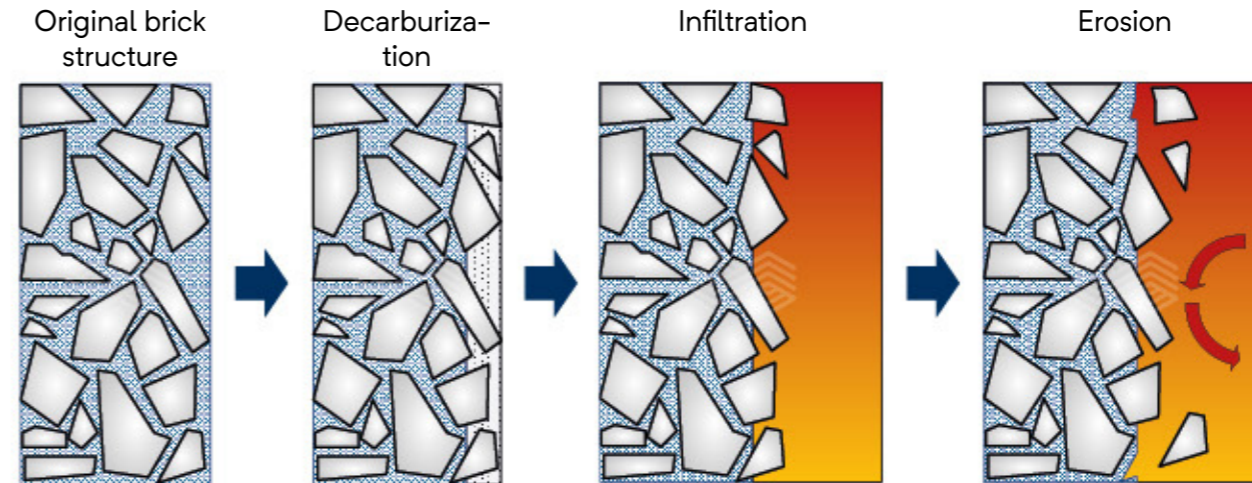
## Solutions

- 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 Dolomite-C

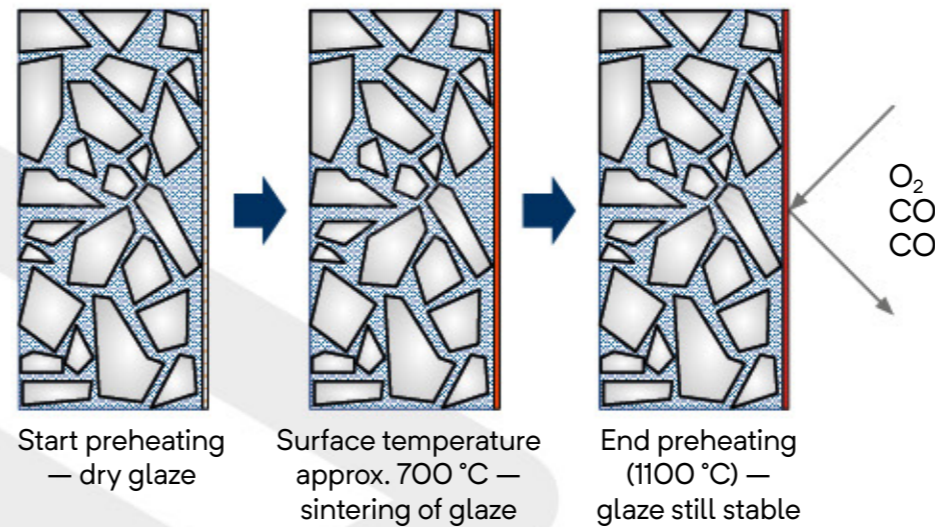
## Advantages

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

### Unprotected

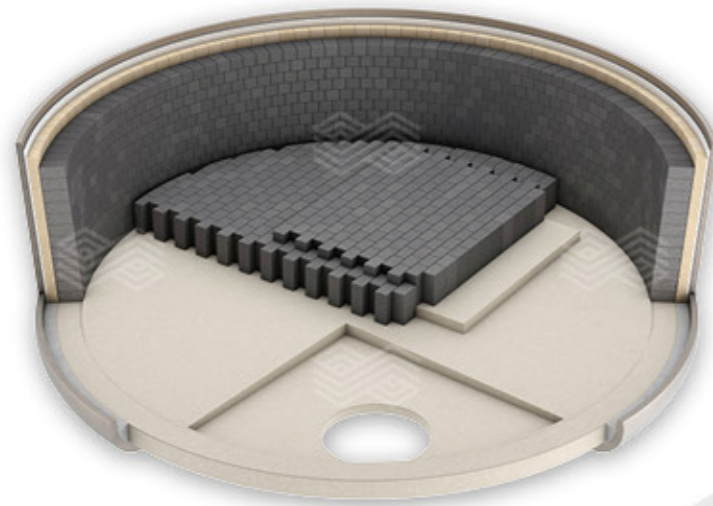


### Bricks Protected by Glaze During Preheating



# IBOS Ladle Solution for Maximum Yield

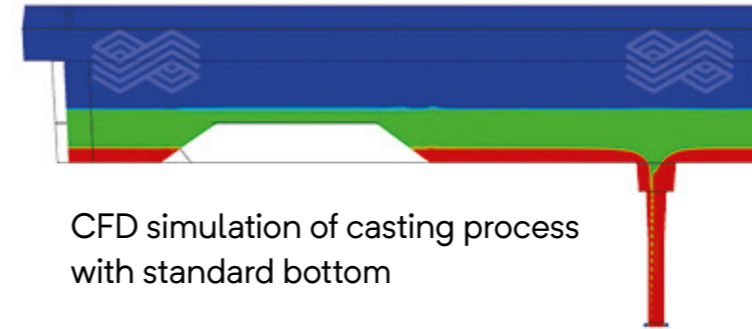
- Increased steel yield by taylor made prefabricated working or safety lining
- Patented shape for:
  - avoiding / delaying vortex formation
  - optimizing steel yield by reducing residual steel at end of casting process
- A starter ramp for bricked wall can be included
- Combination of cast and bricked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



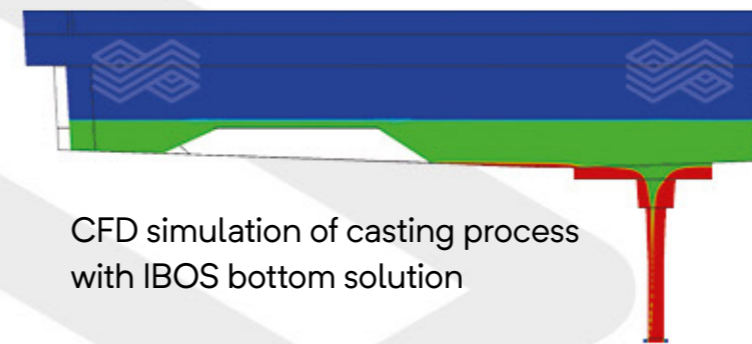
IBOS precast safety lining



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**

# 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

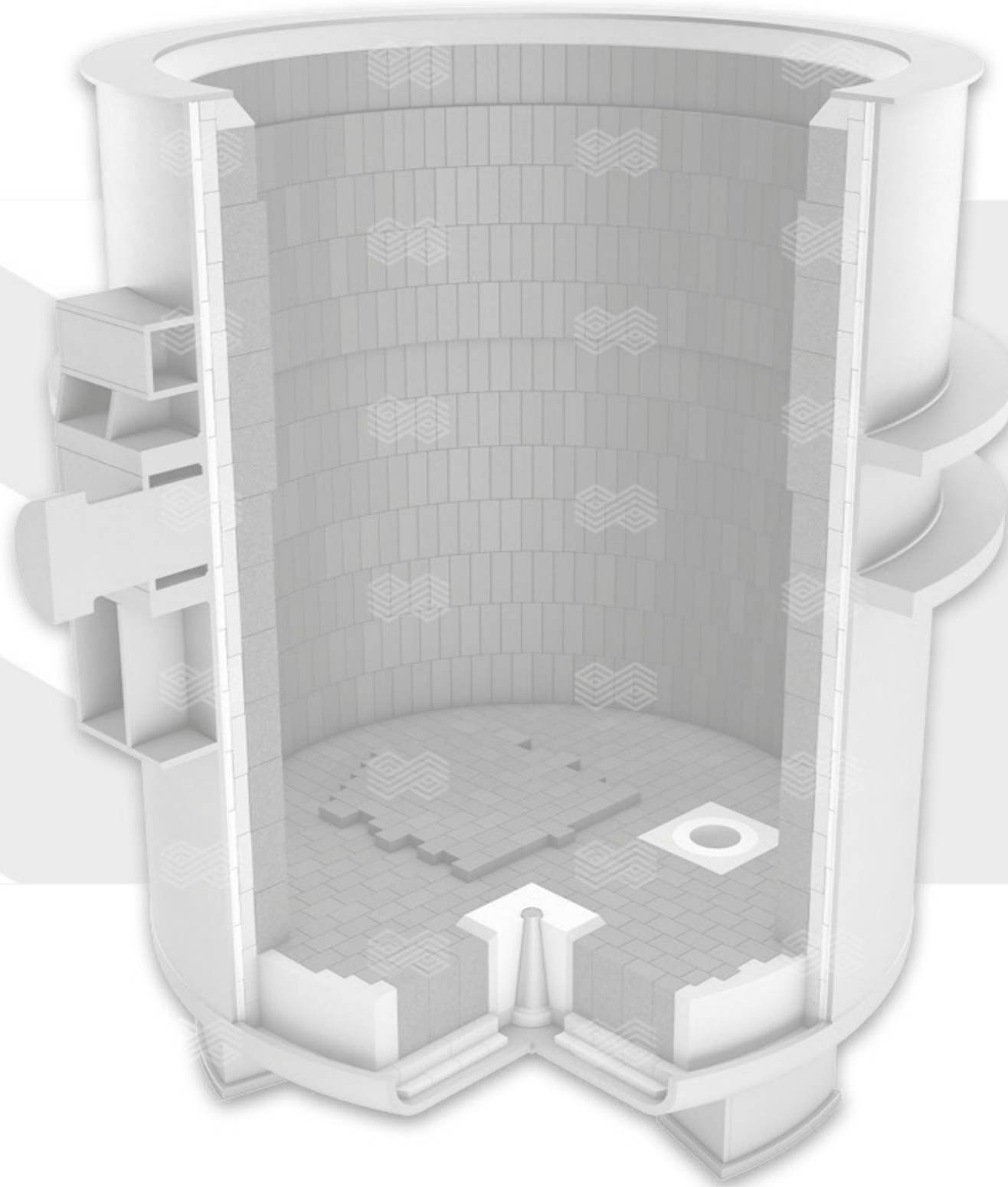
Two new generations of special bricks developed

### Alumina Spinel Bricks

- Carbon-free
- Burnt or chemical bonded
- Designed for Al-killed steel
- Suitable for steel grades with maximum carbon contents below 30ppm

### 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



Content



Lining



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# 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
- CAS-OB Bells
- Lances
- Well Blocks



Content



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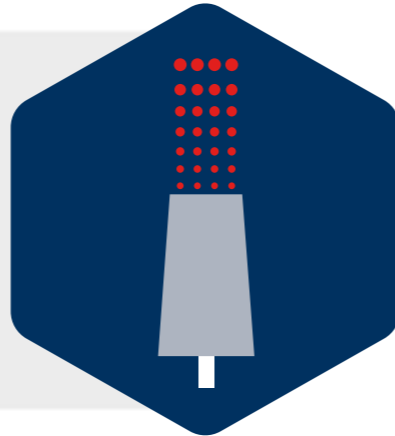


# Gas Purging Systems for Steel Casting and Treatment Ladles

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



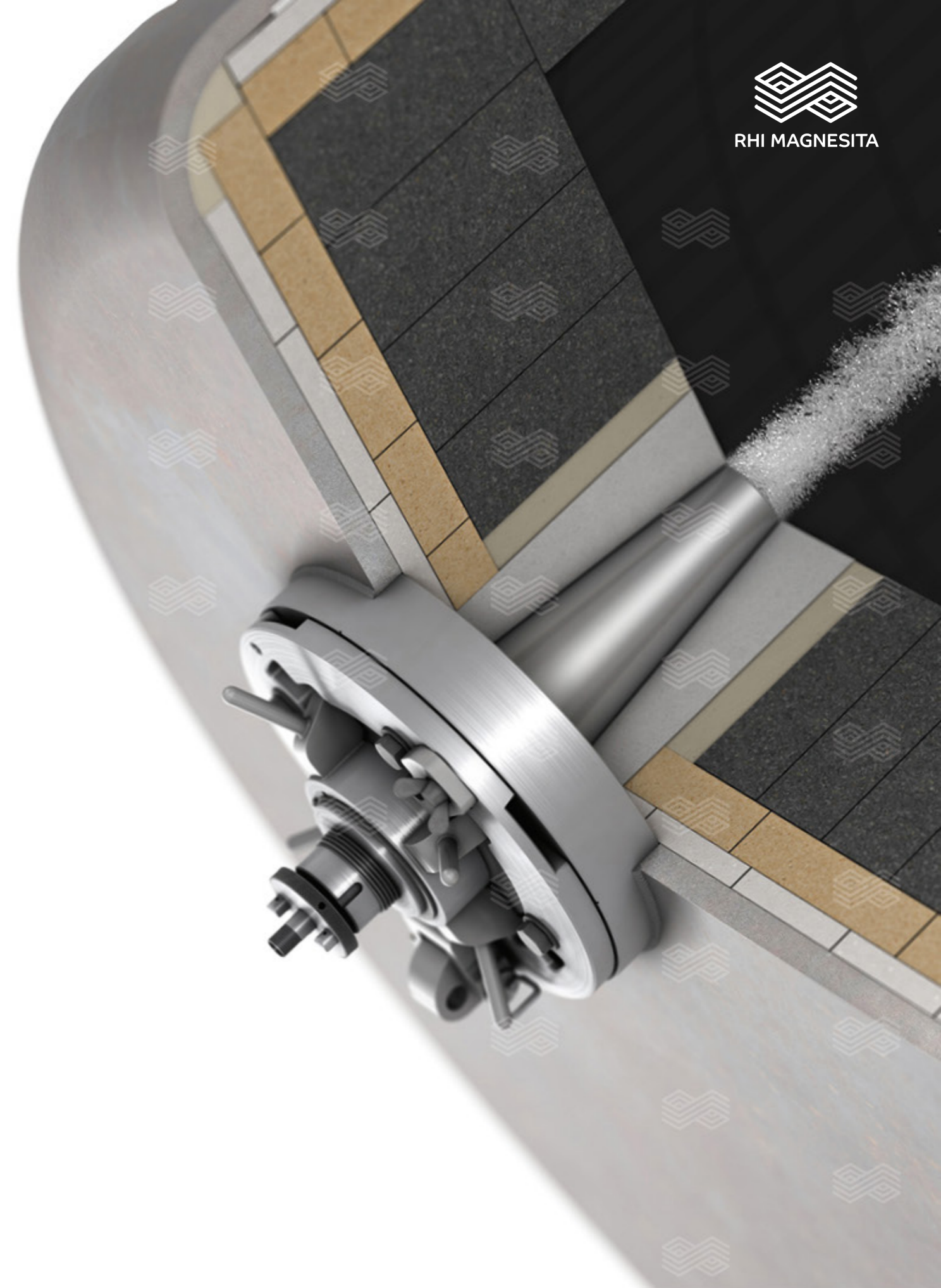
## Equipment

- 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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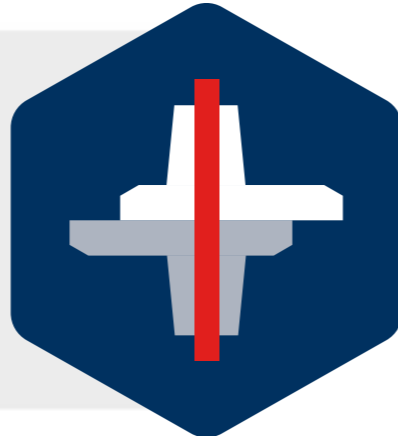


# Slide Gate Systems for Steel Casting Ladles

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.

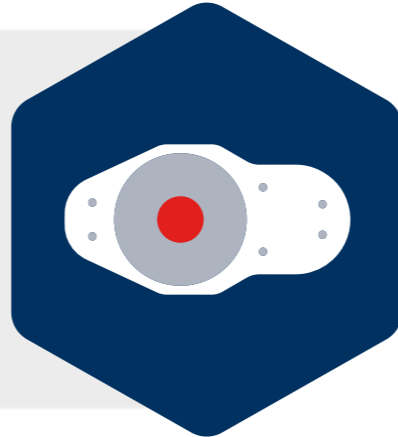
## Ladle Gate Systems

- 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



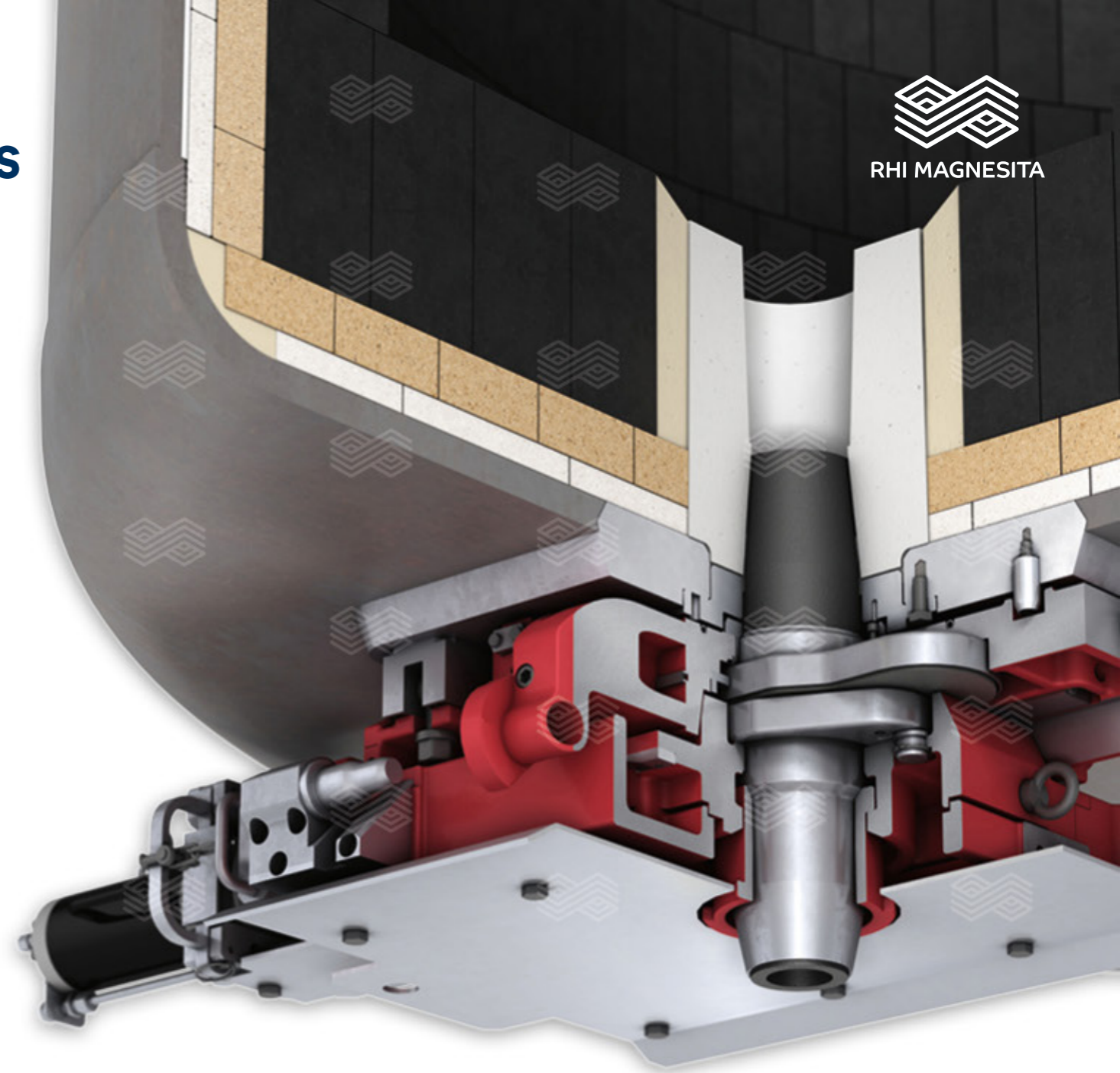
## Ladle Gates Refractories

- 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



# Customized Thermal Optimization

## Minimizing Heat Losses Crucial for

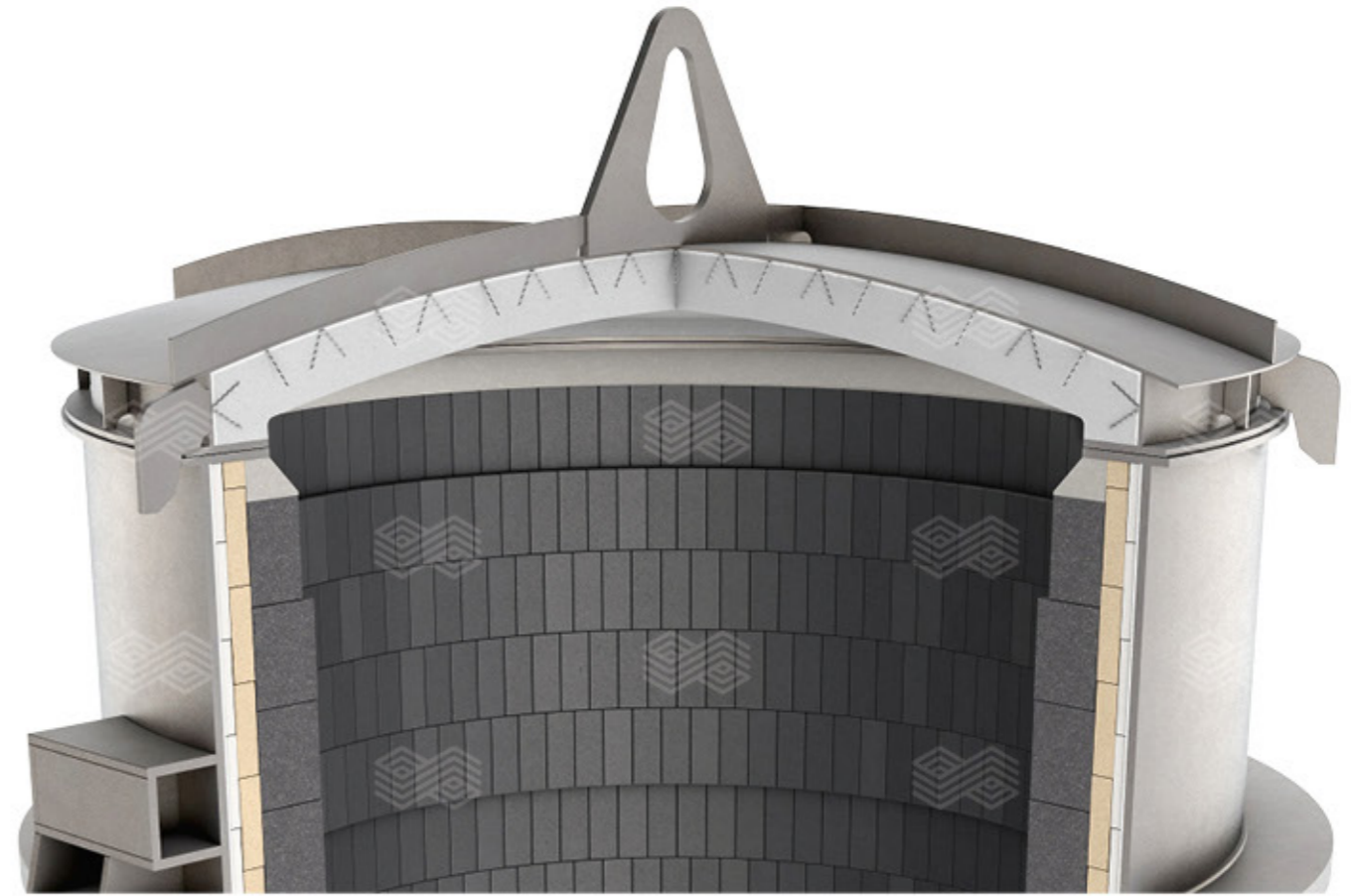
- Optimal and stable liquid steel temperature at casting for clean steel
- Energy cost reduction
- Preventing overheating and damaging steel shell

## Holistic Approach and Advanced Products for

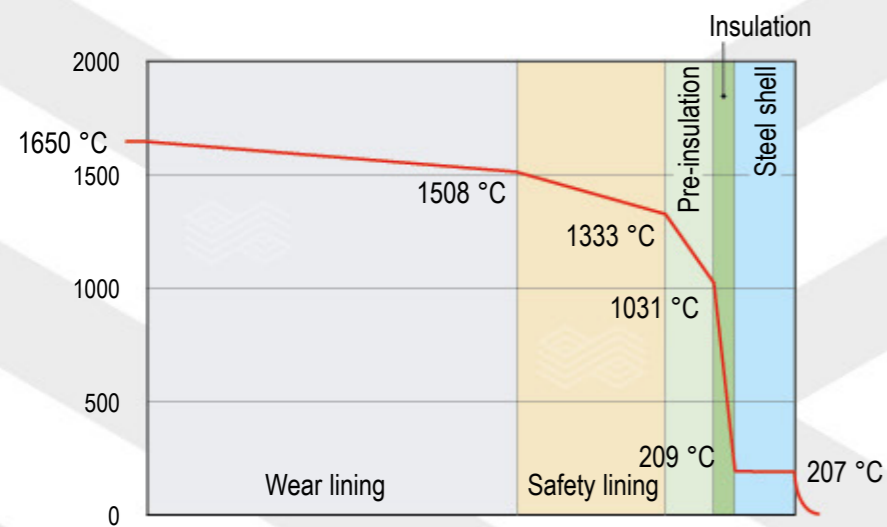
- Well insulating permanent lining
- Well insulating ladle lid
- Covering powder

## Thermal Simulations to Find Optimal Lining Composition

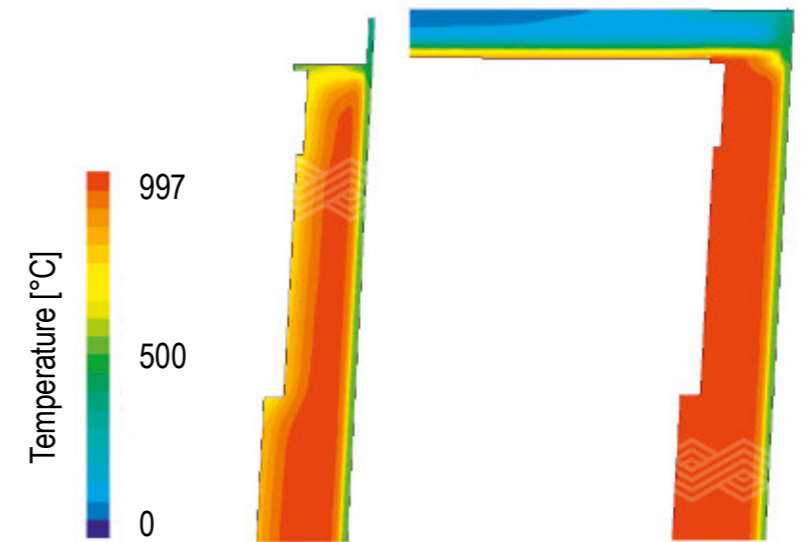
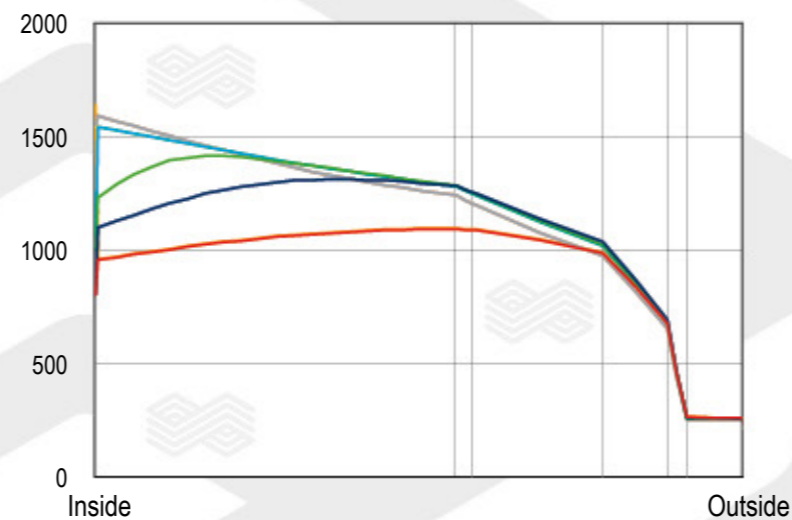
- Different levels of calculation details



Steady-state calculation



Dynamic transition calculation



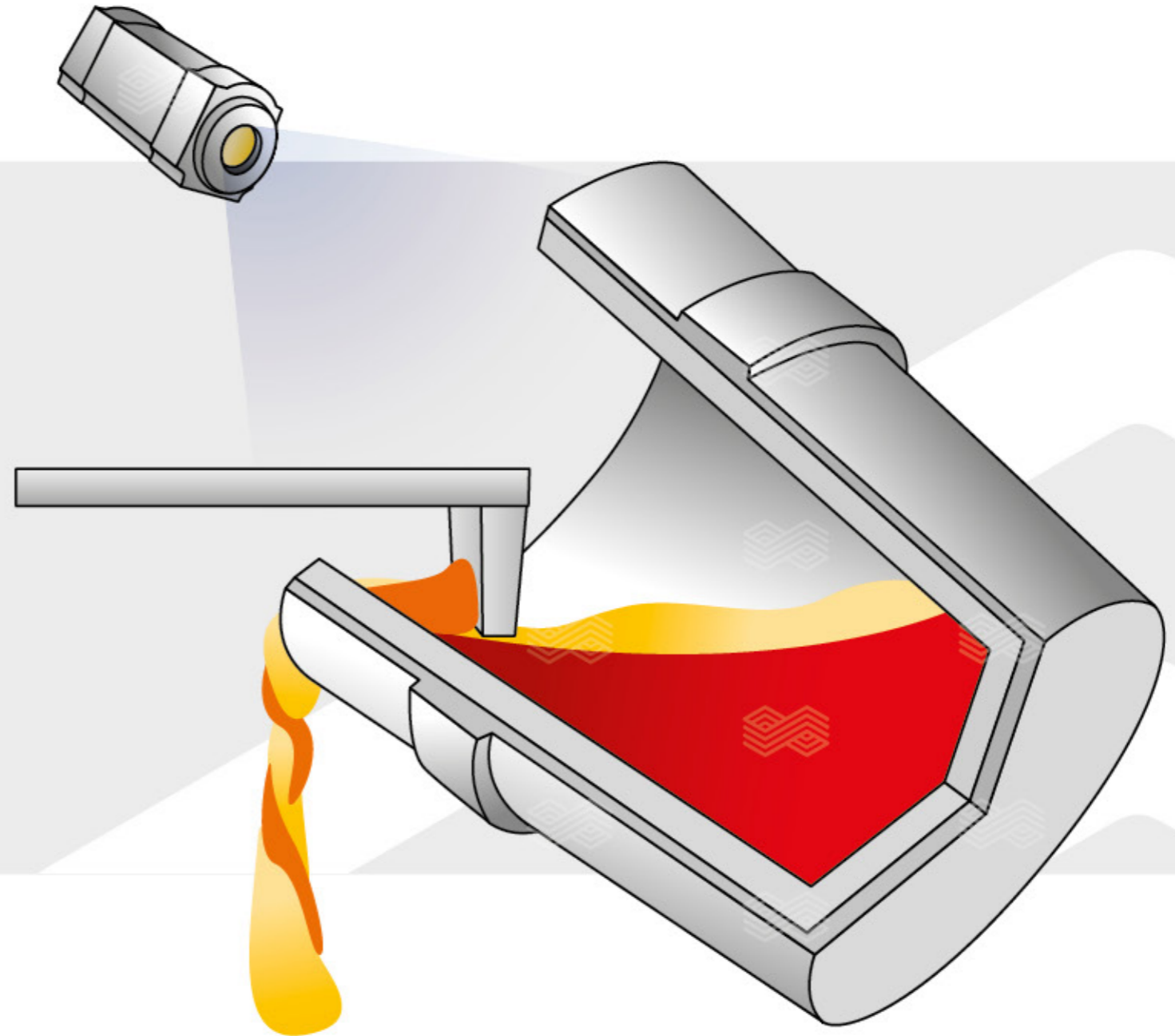
## VISIR-LadleDeslag

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



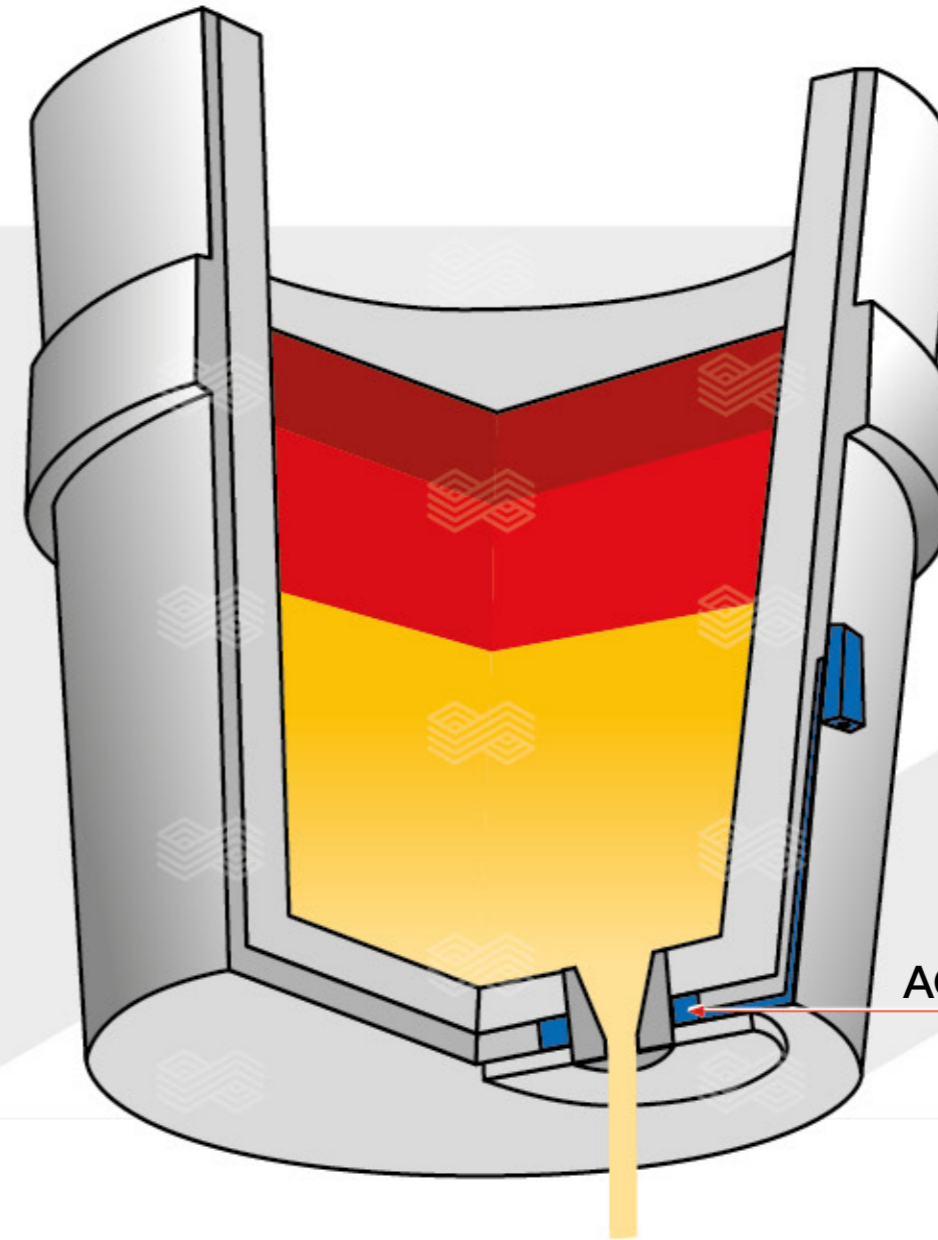
## EMLI-LadleSlag

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

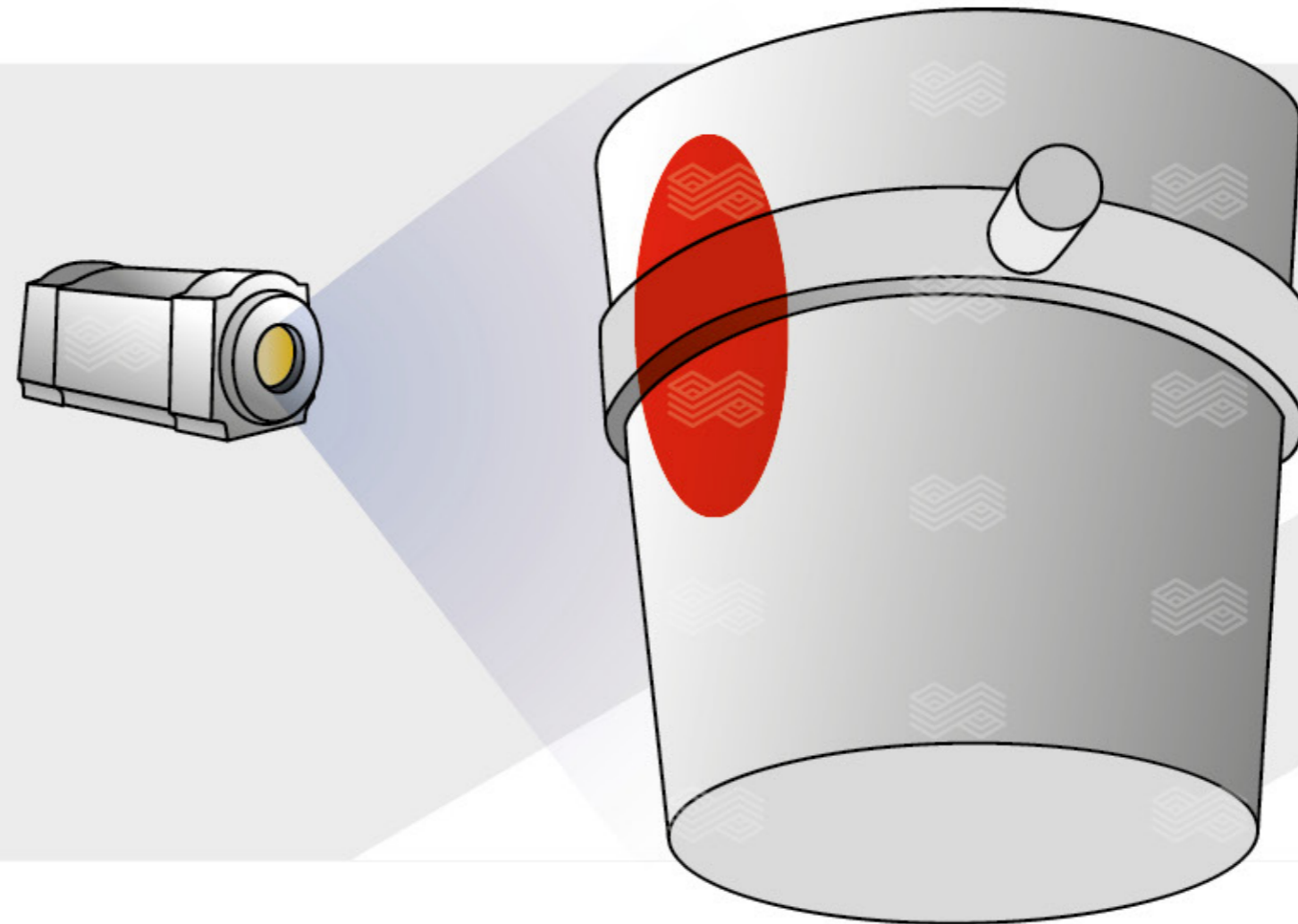
## VISIR-LadleSafe

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



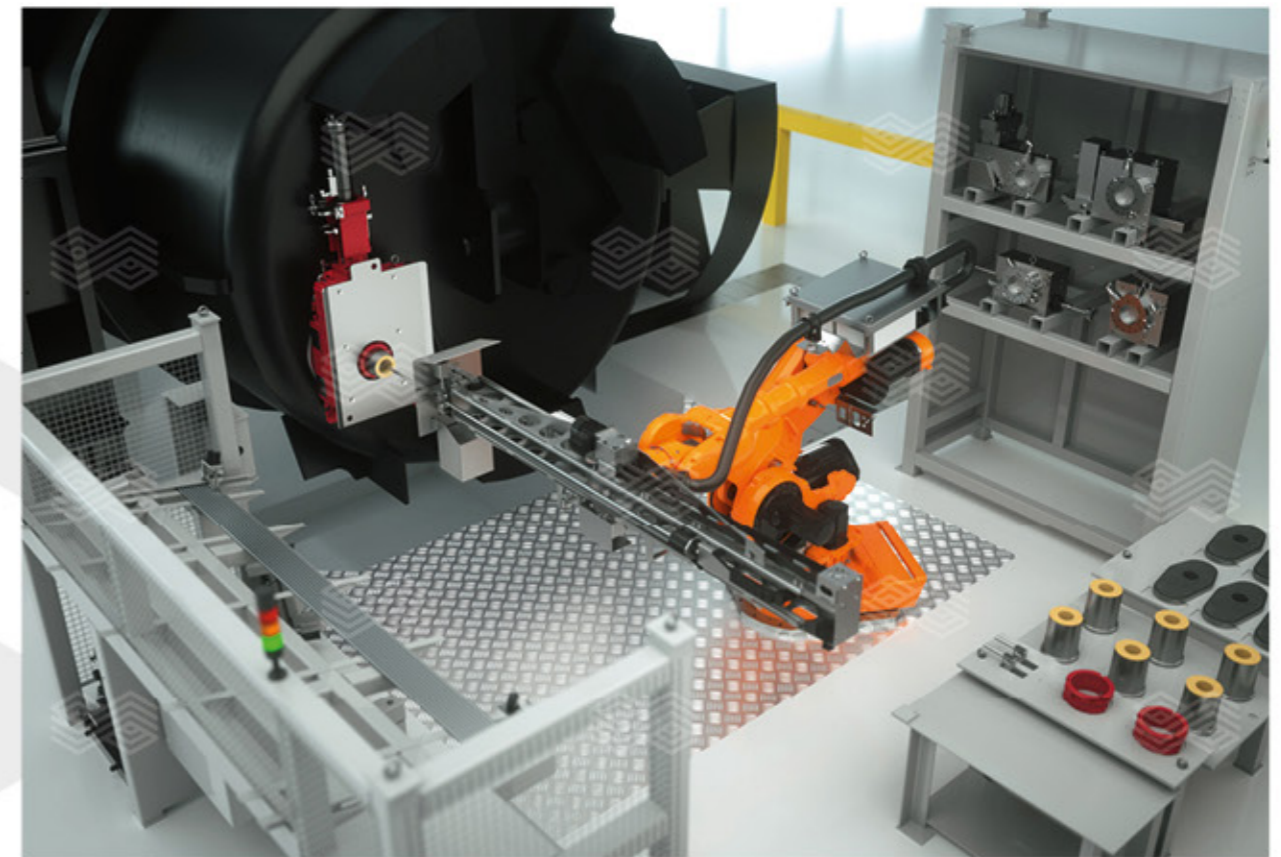
# INTERSTOP® Automation & Robotic Solutions

## Robotic Application Ladle to Mold (L2M)

- Automated cylinder handling
- Automated ladle shroud handling including O<sub>2</sub> 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



Lining



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Solutions



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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# ANKERJET M







## Application:

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

## Advantages:

- Useable in a variety of aggregates
- Small hopper with bag ripper for charging 25 kg paper bags
- Mobile design means flexibility of application
- Low maintenance and wear costs
- Pneumatic driven machine (no electricity required)
- Easy manual operation



Content	Lining	Purging	Flow Control	Solutions	Maintenance
					

# ANKERGUN

## Application:

Multipurpose rotary gunning machine for basic and non-basic mixes

## Advantages:

- Useable in a variety of aggregates
- Small hopper with bag ripper for charging 25 kg paper bags
- Mobile design allows flexibility of application
- Continuous gunning mix feeding



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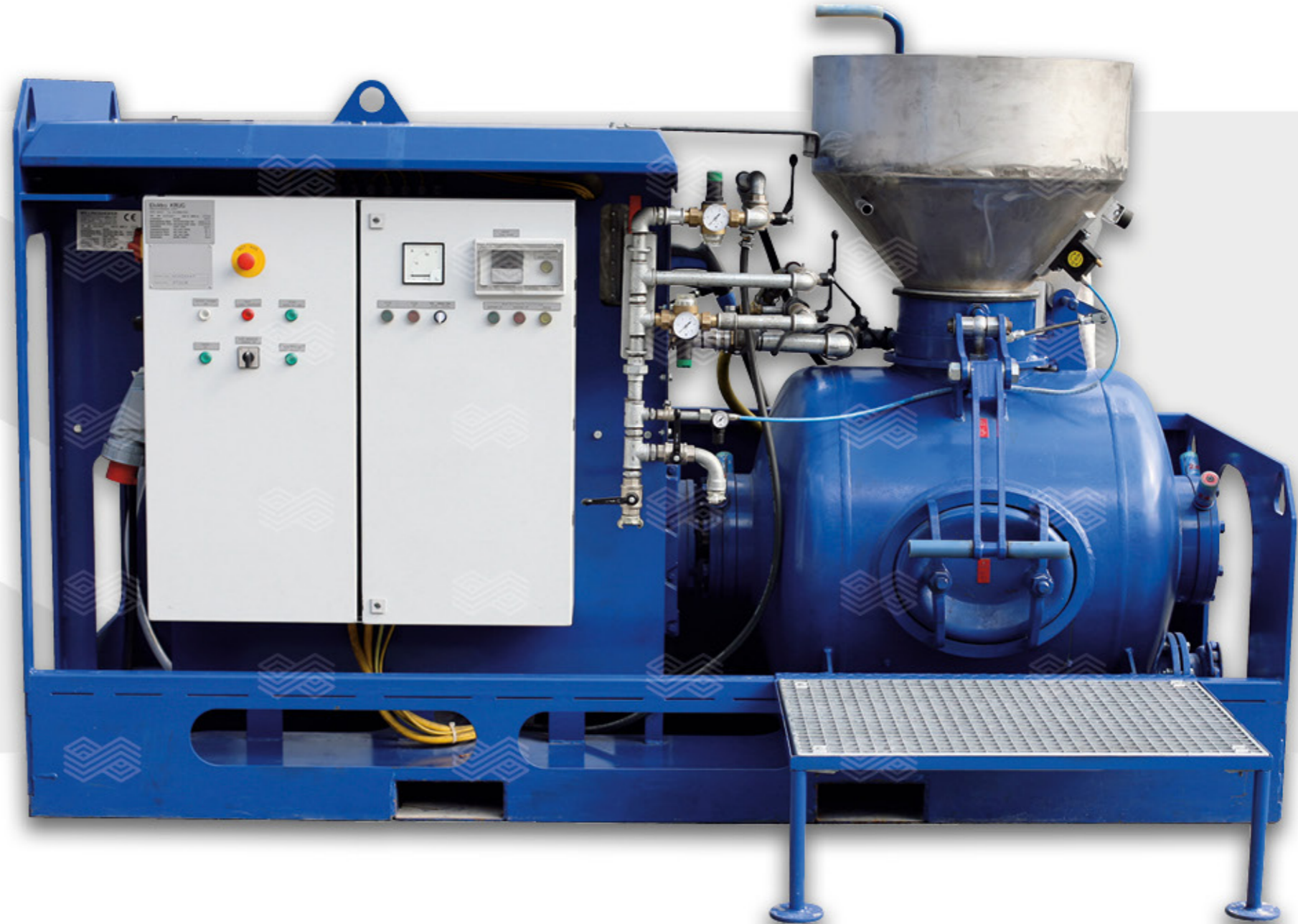
# MIXOMAT

## Application:

Mixing and pumping unit for monolithic refractory linings

## Advantages:

- Useable in a variety of aggregates
- Precise water addition
- High mixing quality
- Transportable by crane and fork lift



Content



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# E402L

## Application:

Continuous mixer for monolithic refractory linings

## Advantages:

- Useable in a variety of aggregates
- Easy to use and install
- Continuous lining



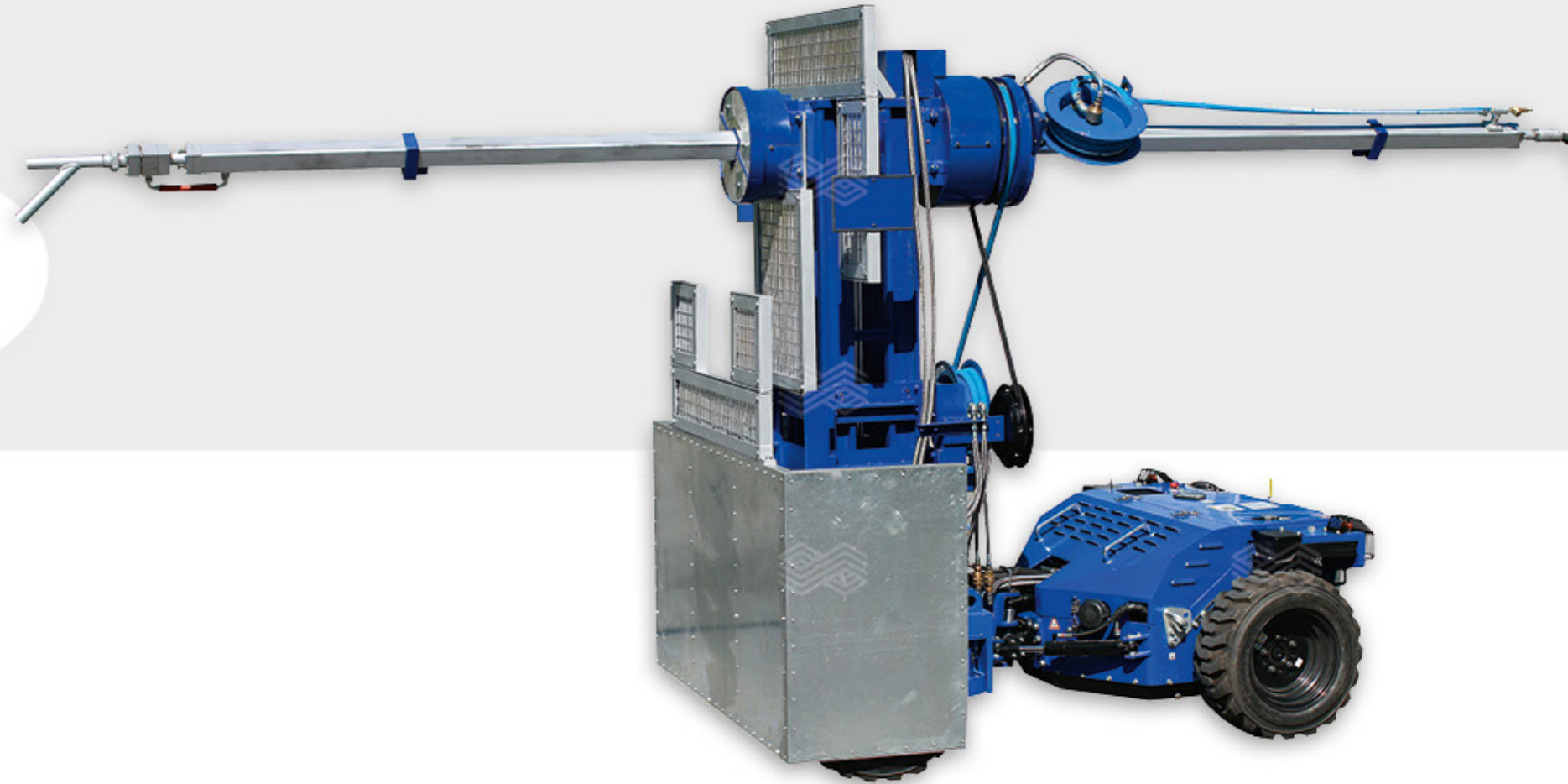
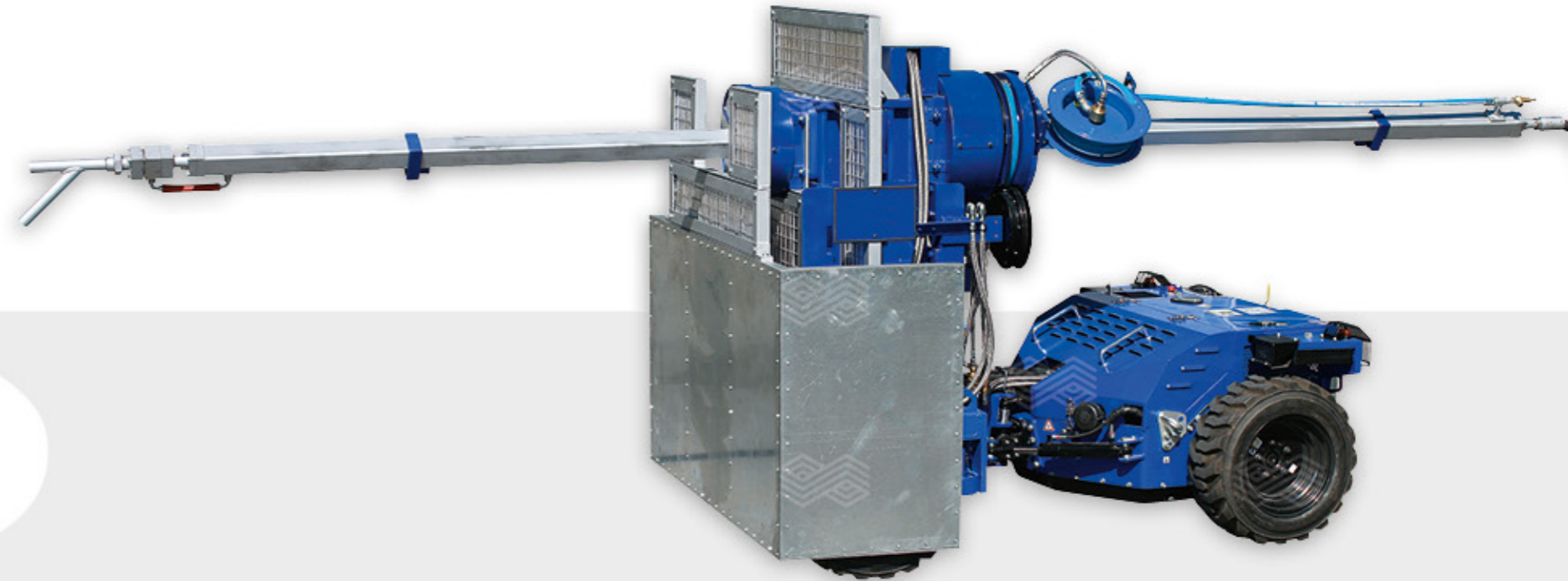
# GEKKO Ladle

## 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



# Purging Plug Manipulator

## Application:

For fast installation and extraction of purging plugs

## Advantages:

- Increased operation safety
- Less physical strain on operating personnel
- Easy installation and extraction of purging plugs
- Accurate purging plug centering into the well block
- Purging plug is pressed into the correct position by a compressed air hammer

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# SOC-H

## Safety Optimized Closing System — Hinged

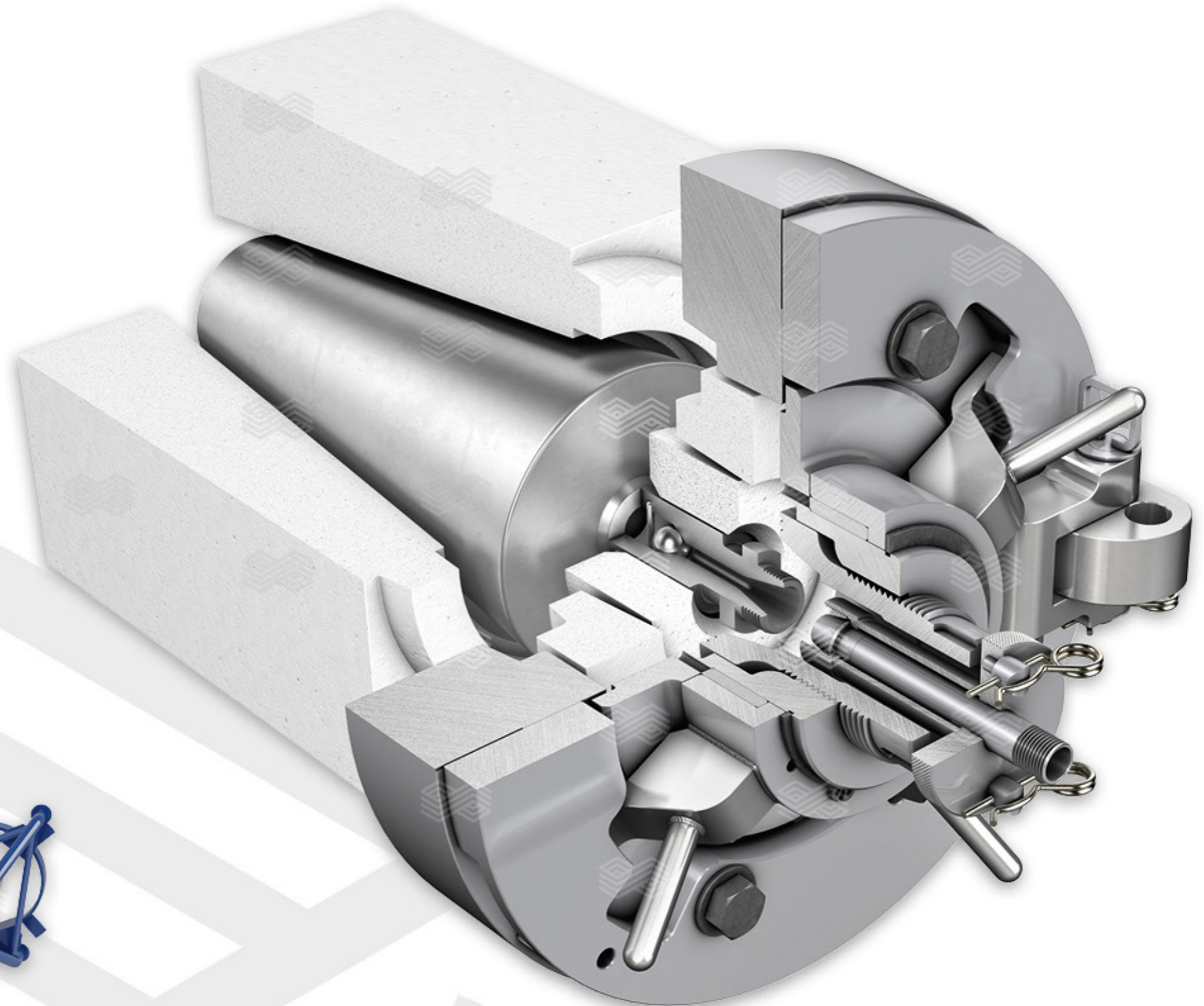
SOC-H is the latest evolution of ladle closing systems by RHI Magnesita and is a further development of the well-established SOC system.

### Advantages

- All-in-one system solution
- 100% reliable and safe
- Compact design
- No loose parts (screws, etc.)
- Easy handling
- No heavy parts (closing plate) have to be lifted
- Easy upgrade from SOC to SOC-H

The SOC-H system can be used with every RHI Magnesita purging plug type. As entire system solution it includes:

- SOC-H purging ceramics
- SOC-H closing system
- SOC-H setting device
- SOC-H extraction device
- SOC-H tools & accessories



SOC-H setting device



SOC-H extraction device

Content



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# Plug Functional Device — PFD

## Application:

High initial opening rates as well as high service life of ladle purging plugs are important prerequisites for efficient and modern steel production.

These two parameters can be optimally achieved by a correctly performed plug service.

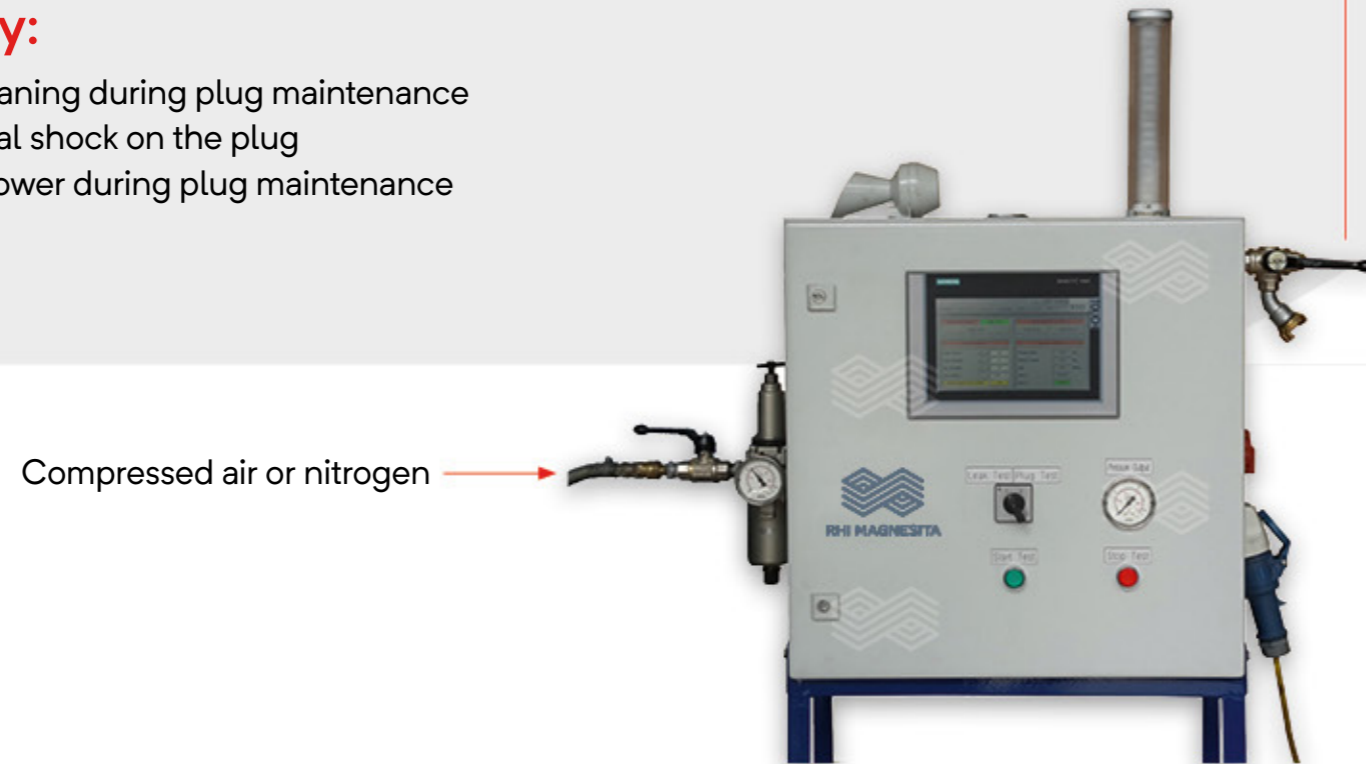
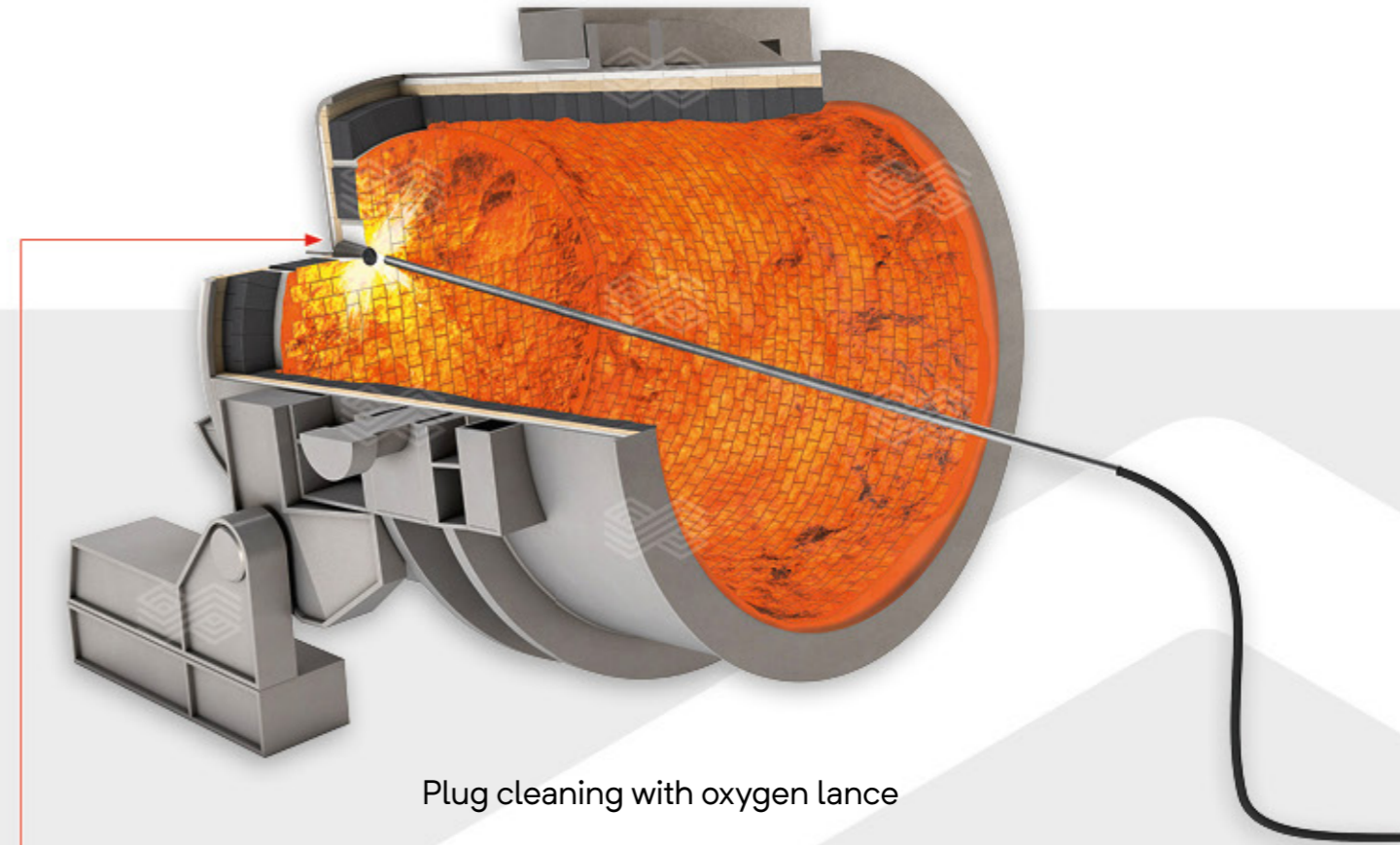
The PFD supports the ladle operators in correctly performing plug cleaning and using the oxygen lance to the required extent.

## Customer Benefits:

- Increased productivity
- Increased safety
- Increasing plug opening rate
- Increasing life time of purging ceramics

## Achieved by:

- Reduced O<sub>2</sub> cleaning during plug maintenance
- Reduced thermal shock on the plug
- Reduced manpower during plug maintenance



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**RHI MAGNESITA**

Kranichberggasse 6, 1120 Vienna, Austria

**T** +43 50213 **O** **F** +43 50213 6213

**E** [steel@rhimaginesita.com](mailto:steel@rhimaginesita.com)

[rhimaginesita.com](http://rhimaginesita.com)