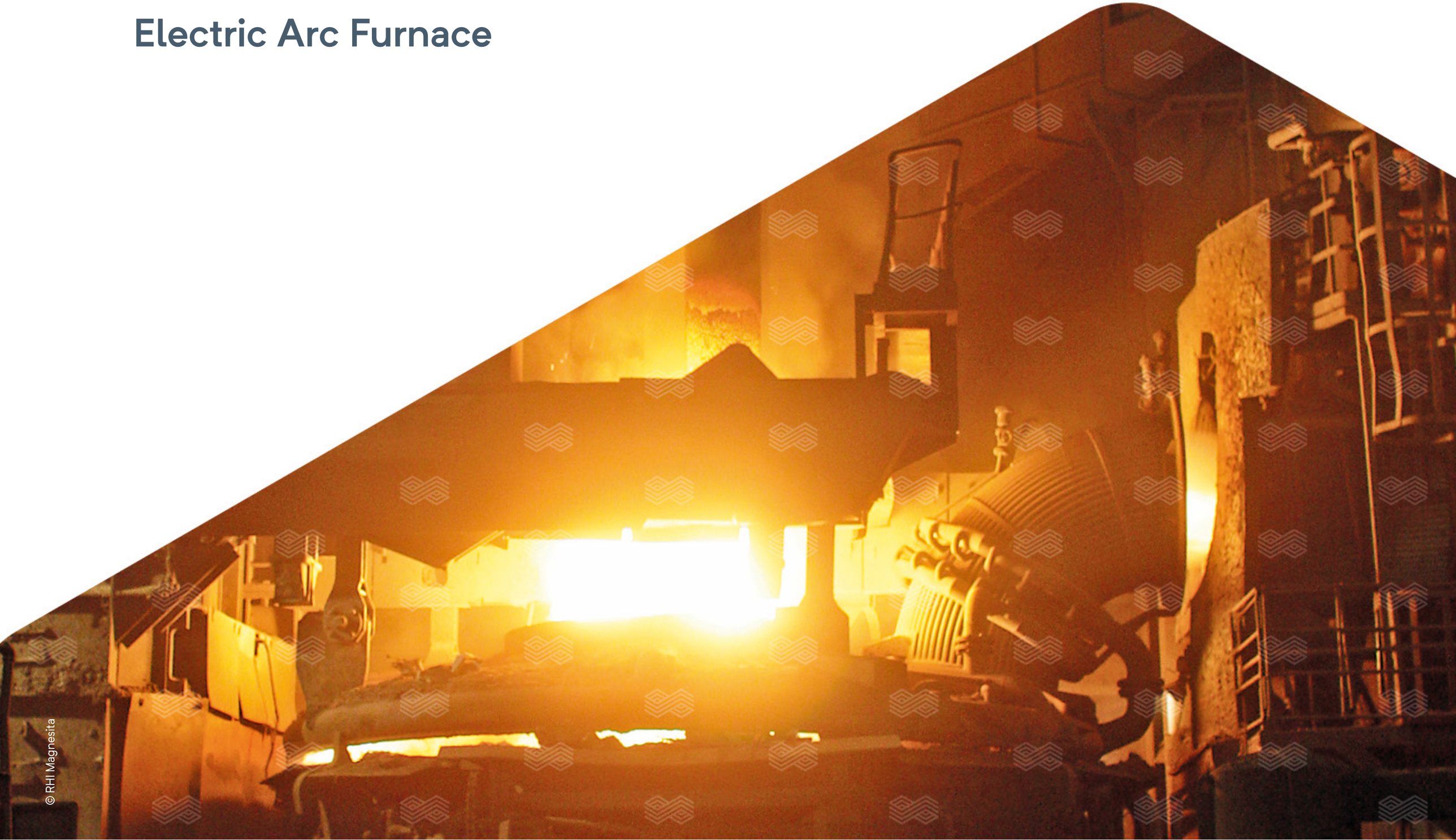
RHI MAGNESITA

STEEL

Electric Arc Furnace



© RHI Magnesita

There for you, wherever you need us

RHI MAGNESITA

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.



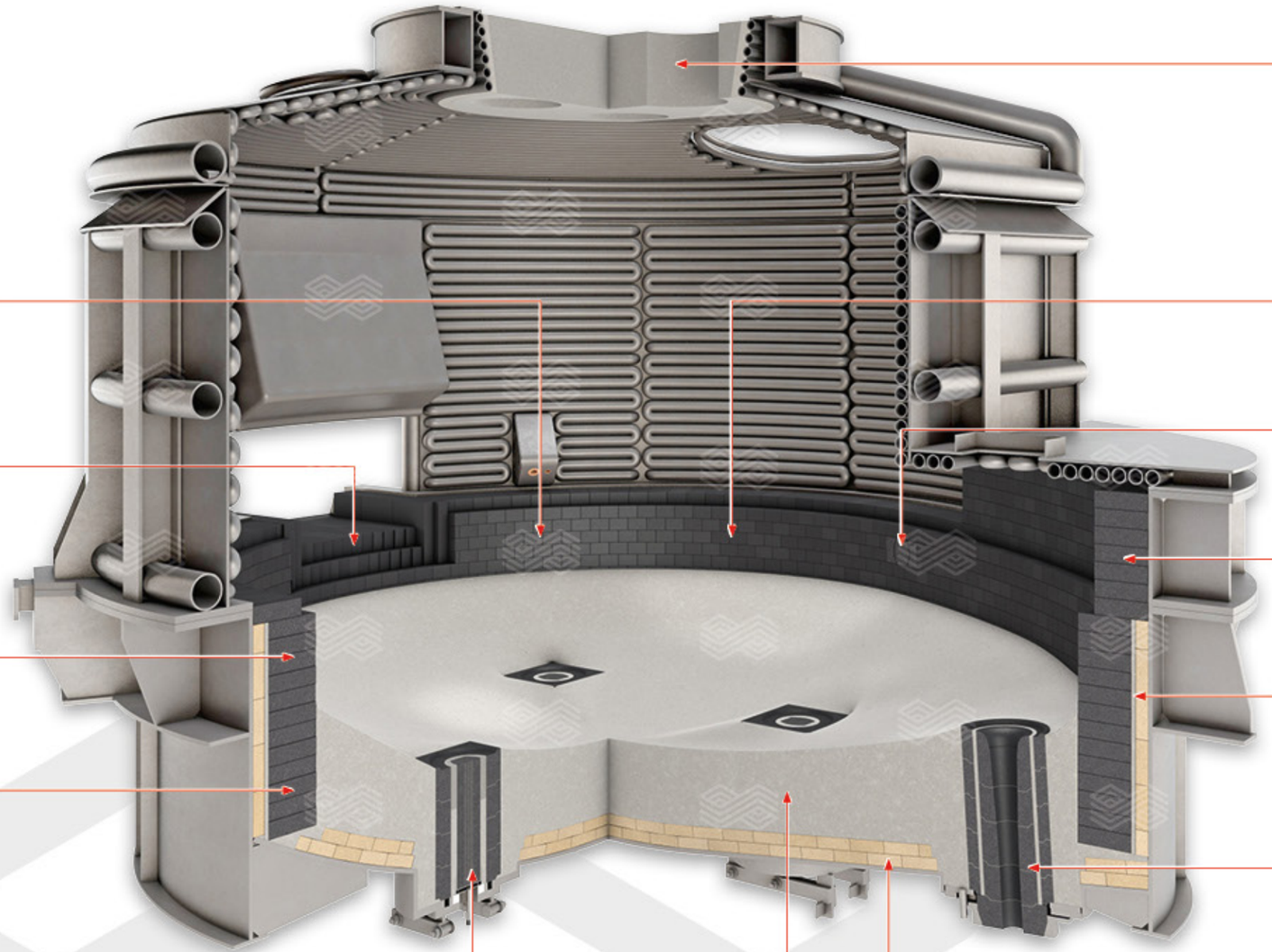
35
Main production and raw material sites

70
Sales offices

180
Countries shipped to worldwide

The Electric Arc Furnace

RHI MAGNESITA



Roof Center Piece

Injector Area

Hot Spot

Slag Door Area

Pre Wear Area

Wall Upper Part

Slag Zone

Backfilling

Wall Lower Part

Taphole Systems (bottom/lateral)

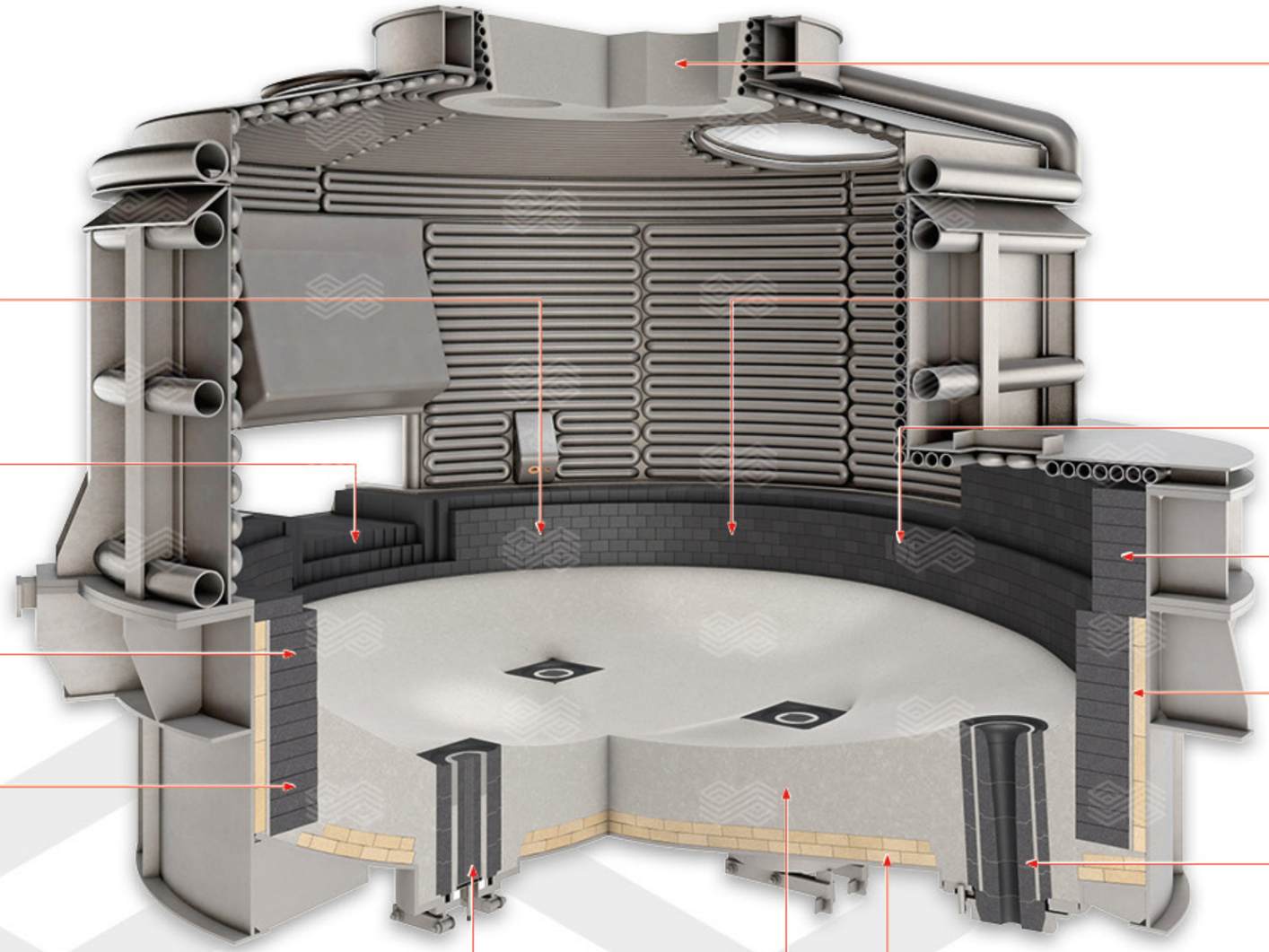
Inert Gas Purging/Stirring Plug

Hearth

Permanent Lining

Electric Arc Furnace — Our Refractory Solutions and Innovations

RHI MAGNESITA



Roof Center Piece
ANKOFORM
COMPAC SOL

Injector Area
ANCARBON

Hot Spot
ANCARBON

Slag Door Area
ANKER DOOR

Pre Wear Area
ANKER ROCS

Wall Upper Part
ANCARBON

Slag Zone
ANCARBON

Backfilling
ANKERFILL

Wall Lower Part
ANCARBON

Taphole Systems (bottom/lateral)
ANKERTAP
ANKERBLOCK

Inert Gas Purging/Stirring Plug
RADEX DPP

Hearth
ANKERHARTH
PERRAMIT
DOLA

Permanent Lining
ANKER

Bricks Overview Electric Arc Furnace

RHI MAGNESITA

ANCARBON

Magnesia Carbon Bricks

- Universal usability in all areas of the working lining
- Highest refractoriness
- Carbores or resin bonded
- Dense or ULTRA dense pressed
- Adapted special additions

ANKROM

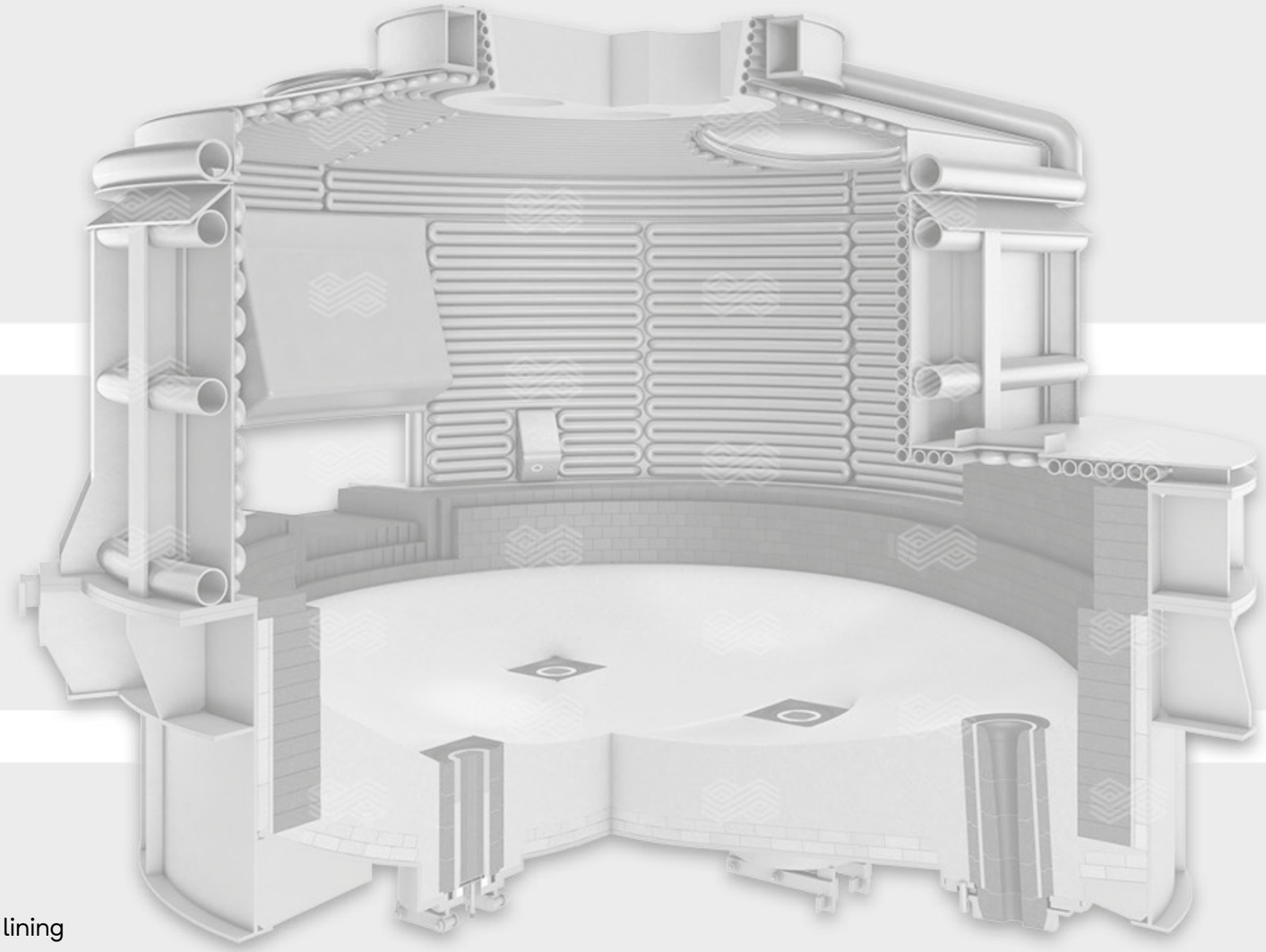
Fired Magnesia Chromite Bricks

- Standard solution for foundries
- Available with chromium oxide or pre-reacted oxicrom
- High hot errosion resistance
- High slag resistance

ANKER

Fired Magnesia Bricks

- Standard solution for the permanent lining
- Ceramic bonded — no decarburization
- Low thermal conductivity
- High cold crushing strength



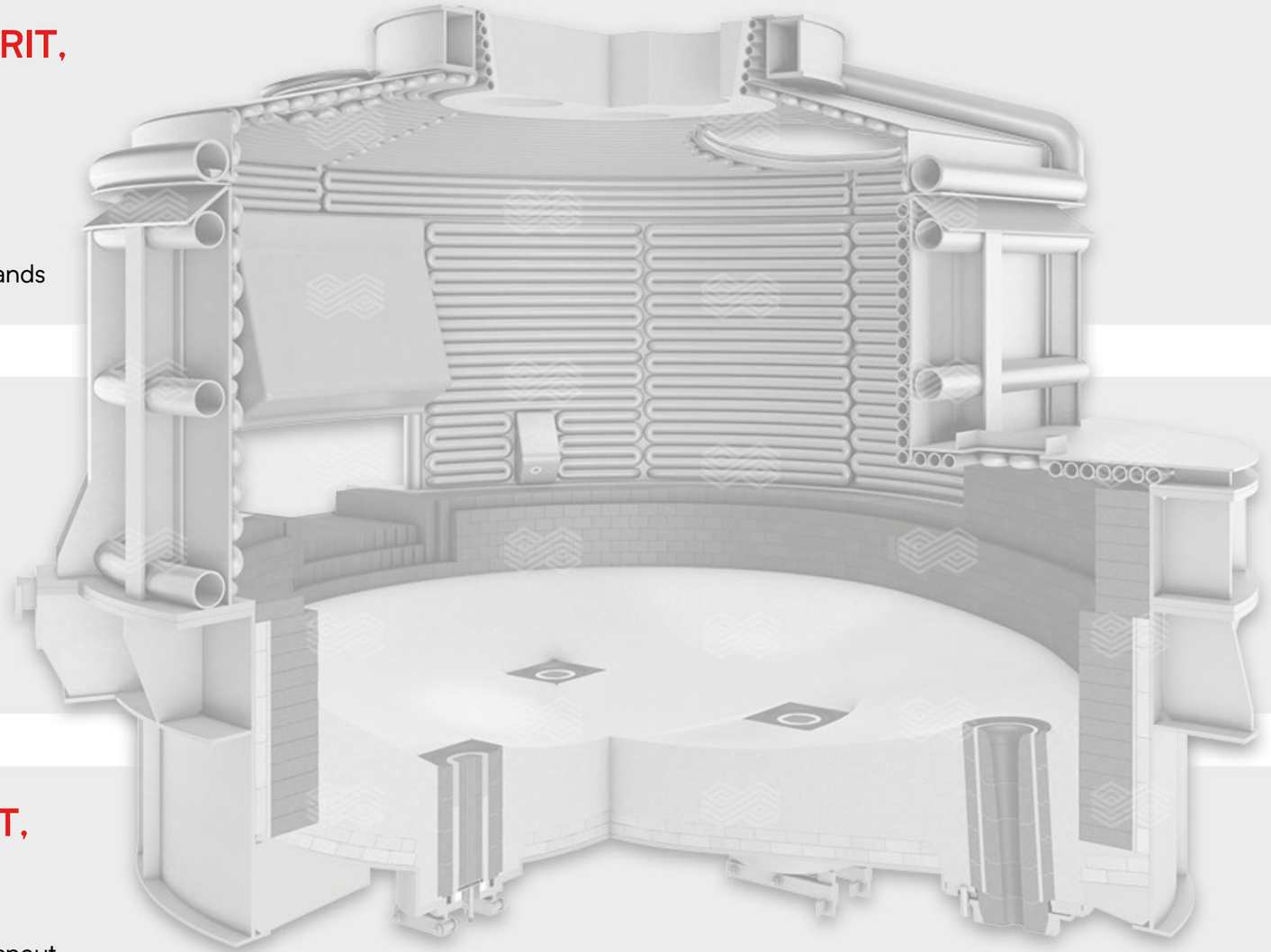
Mixes Overview Electric Arc Furnace

RHI MAGNESITA

ANKERHARTH, ANKERFRIT, ANKERJET

Magnesia Mixes

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



DOLA

Magnesia-Doloma Mixes

- Usable as an alternative hearth ramming mix

COMPAC SOL, COMPRIT, DIDURIT

Alumina Mixes

- Usable for the roof center piece and spout
- Monolithic prefab — ANKOFORM
- Cast-on-site mix — e.g. COMPAC SOL
- High thermal shock resistance

STEEL / ELECTRIC ARC FURNACE

ANKER DOOR — The Slag Door Solution!

Pre-assembled Block for the Highly Demanding Slag Door Area

RHI MAGNESITA



Functionality

- Usage of wedged bricks at the sill level, eliminates the loosening of bricks due to cleaning
- Increased mechanical stability at this highly stressed area due to big rectangular bricks as door jambs

Benefits

- Simple and quick slag door installation
- Reduced specific reractory consumption (maintenance effort)
- Reduced downtime of the EAF



Lateral Taphole System

RHI MAGNESITA

Nowadays modern lateral taphole systems are composed of a prefabricated taphole block and a prefabricated spout.

Prefabricated Spout

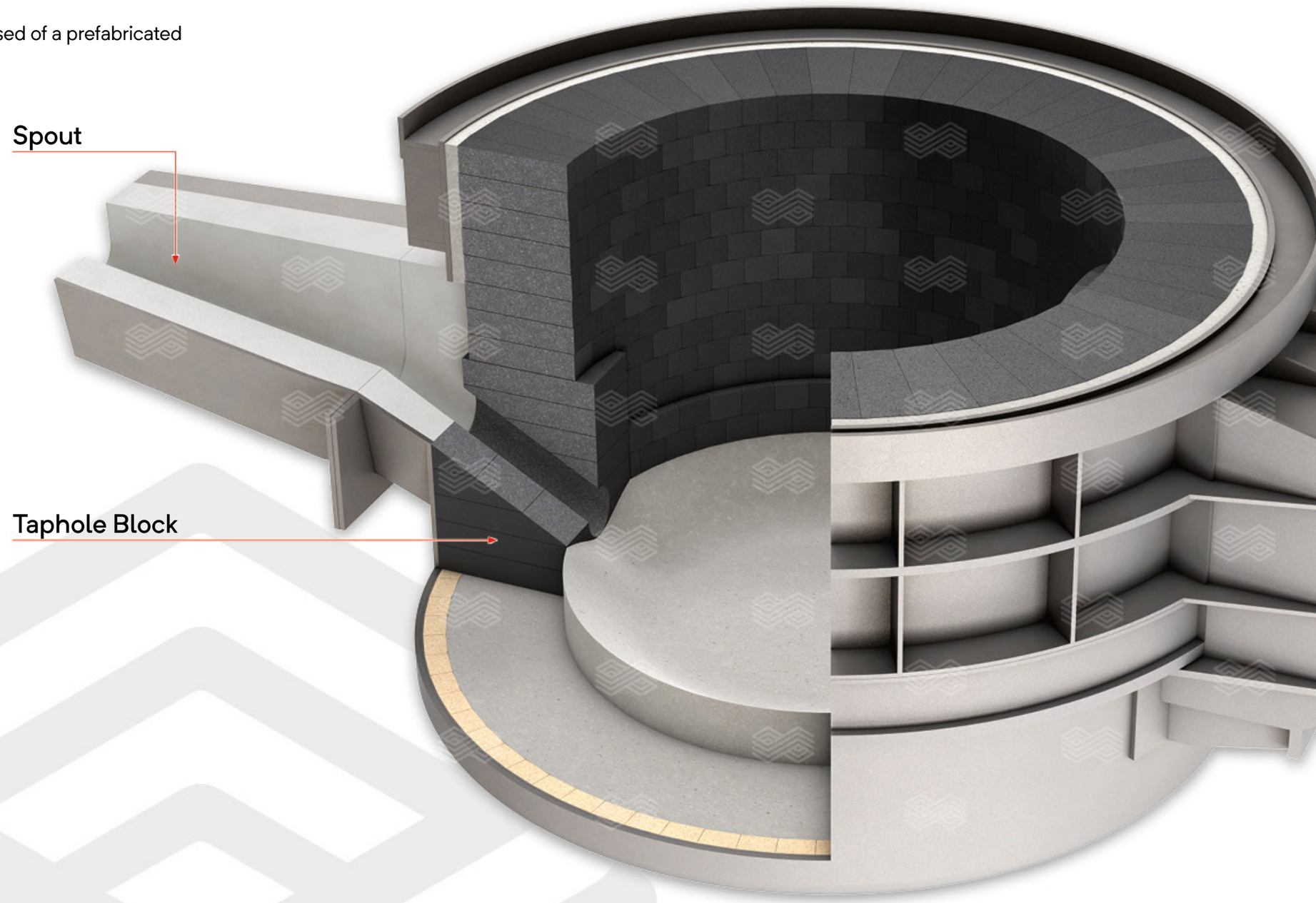
Benefits

- High end sol gel-bonded prefabs
- Simple and fast installation
- Excellent hot properties
- Excellent corrosion resistance
- Increased service life/productivity

Prefabricated Taphole Block

Benefits

- Higher mechanical stability
- Simple and fast installation
- Fewer joints along the taphole channel
- Increased service life/productivity

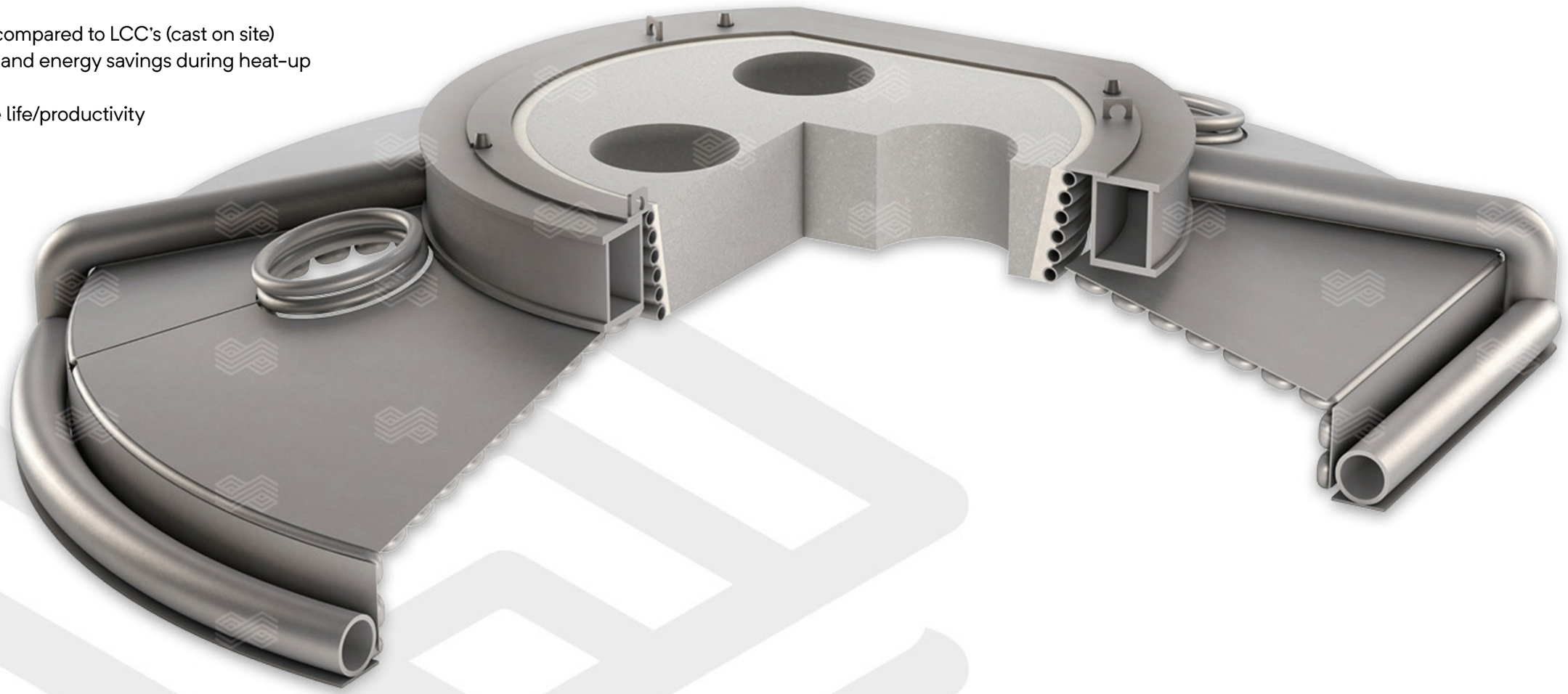


Monolithic Roof Center Piece

The new generation of sol-bonded products has shown impressive results both as cast-on-site solution as well as in prefabricated deltas.

Benefits

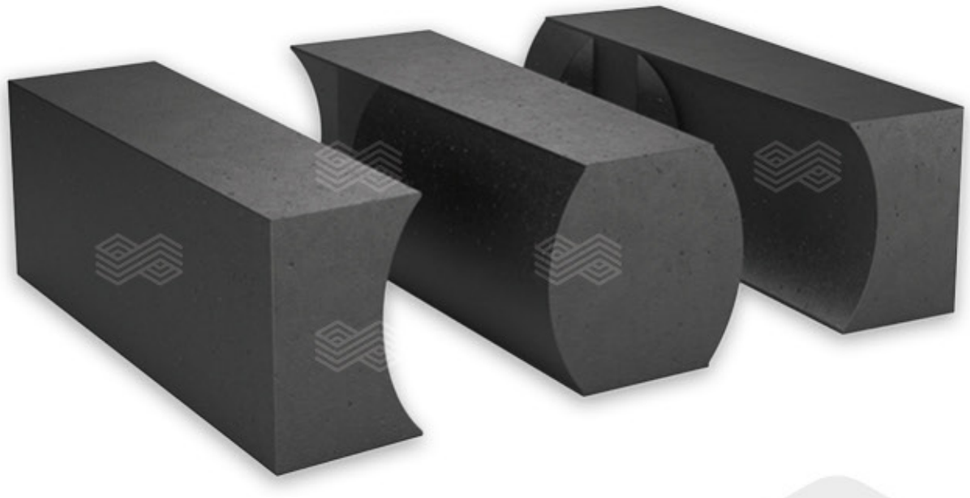
- Excellent hot properties
- Excellent corrosion resistance
- No special requirements regarding mixing equipment (cast on site)
- Longer shelf life compared to LCC's (cast on site)
- Remarkable time and energy savings during heat-up (cast on site)
- Increased service life/productivity



ANKER ROCS — The Smart Brick

RHI MAGNESITA

ANKER ROCS — The **R**efractory **O**bserving **C**ontrol **S**ystem — is a brick that tells you the remaining sidewall thickness at any time during the operation.



Functionality

- Refractory wear is indicated by changing the surface joint patterns on the hot face as the brick wear increases
- For best visibility of “glowing joints“ the contact surfaces are coated with a special mortar

Benefits

- Enhanced operational safety
- Enhanced process control
- Identification of pre wear areas
- Improved utilization of the refractory material– decreased wastage (Gunning indicator)
- Reduced overall costs

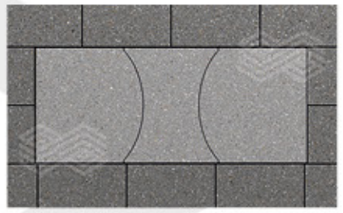
ANKER ROCS — Indication of Wear



Minor wear
Residual thickness: > 20 cm
Operational safety:



Medium wear
Residual thickness: 20–8 cm
Operational safety:



Heavy wear
Residual thickness: < 8 cm
Operational safety:

ANKERHARTH — The Worldwide Benchmark for Hearth Mixes

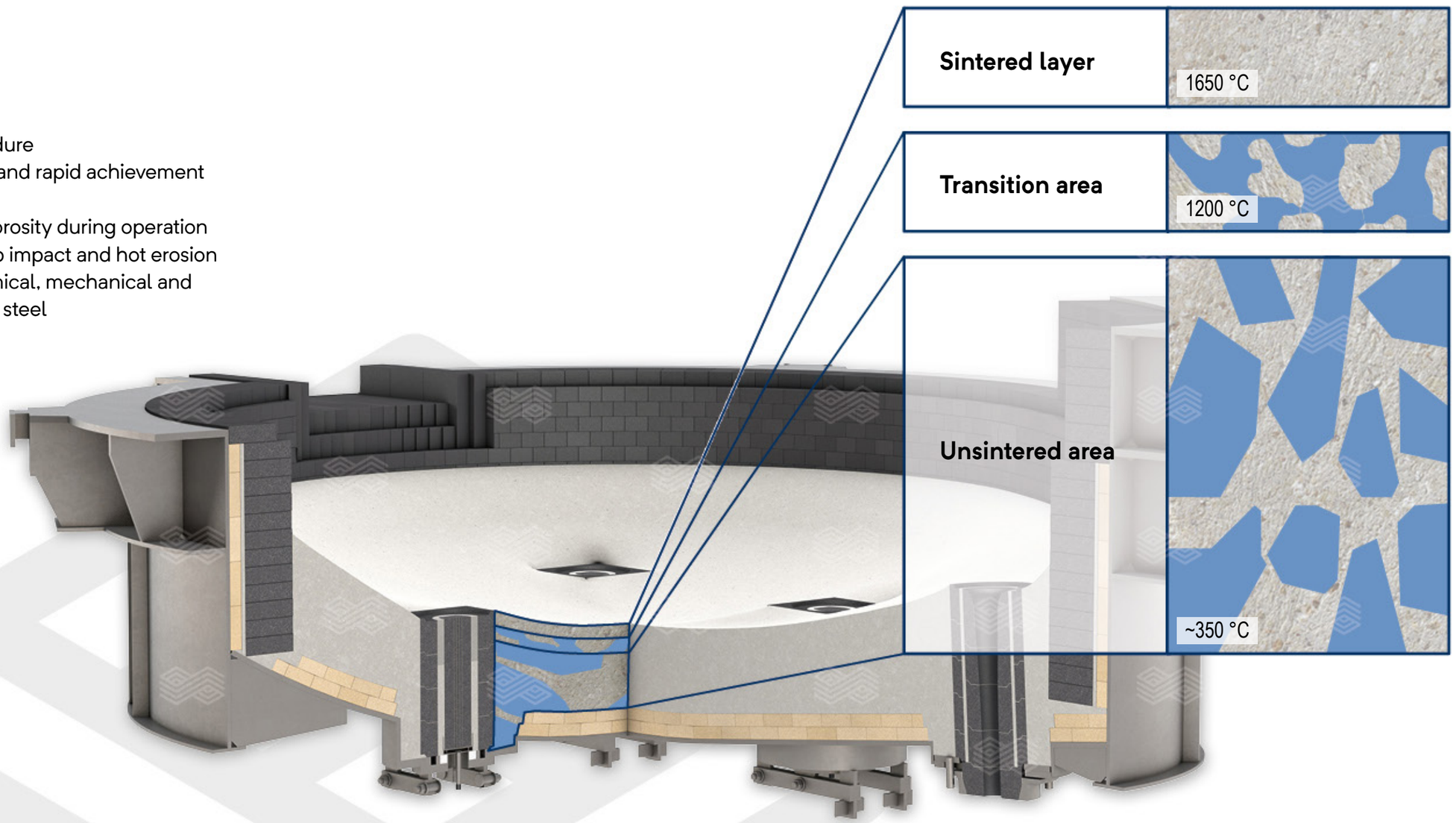
RHI MAGNESITA

RHI Magnesita offers a comprehensive portfolio of hearth mixes combining the best of two companies to provide the right solution for every customer:

- ANKERHARTH
- DOLA
- PERRAMIT

Benefits

- Quick and easy lining procedure
- Excellent sintering behavior and rapid achievement of ceramic bond
- High bulk density and low porosity during operation
- High resistance against scrap impact and hot erosion
- Best resistance against chemical, mechanical and thermal attack from slag and steel



ANKERHARTH — Special Solutions

RHI MAGNESITA

ANKERHARTH Only — No Permanent Brick Lining!

- Several customers worldwide confidently rely on ANKERHARTH only — without installing a bricked permanent lining in their bottom lining!

Benefits

- Equally safe operation
- Longer EAF campaigns possible
- Lower shell temperature
- Easier initial installation of hearth lining



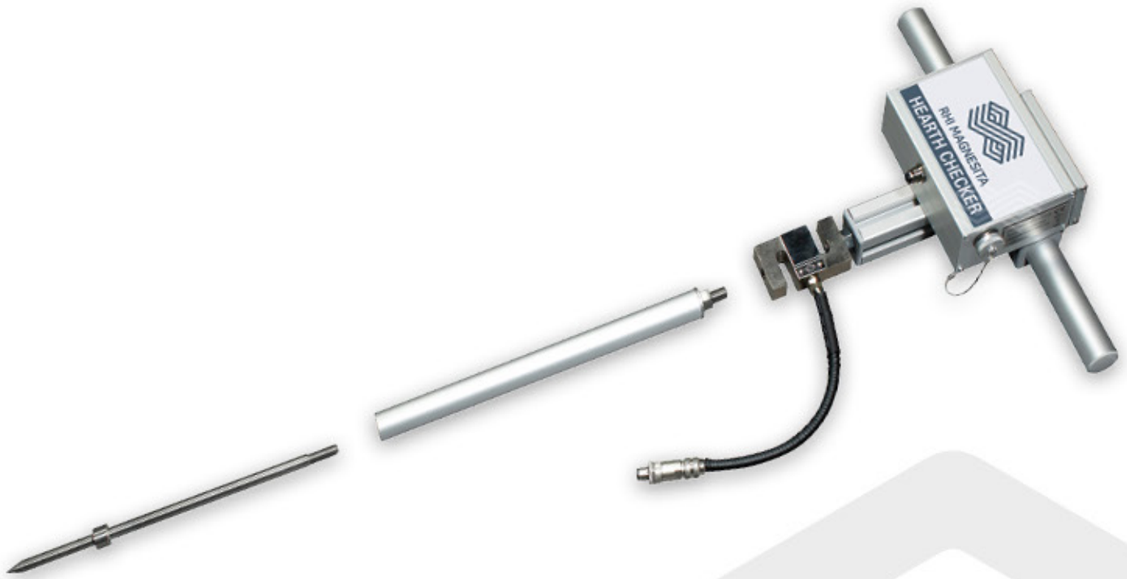
ANKERHARTH SB — The “Steep Bank” Mixes

Benefits

- ANKERHARTH SB contains a special component to make the mix more plastic and sticky! This allows shaping steep banks up to an angle of 80° — without using templates!
- Quick & easy installation

The Hearth Checker — For Maximum Hearth Performance

The **HEARTH CHECKER©** is a simple measuring device to check the right degree of densification of our ANKERHARTH mix during installation in order to achieve the maximum performance.



Benefits

- Quick and easy monitoring of densification of ANKERHARTH mixes during installation
- Ensure maximum hearth performance
- Enhanced installation procedure

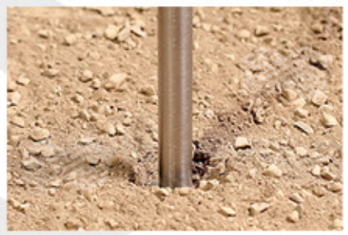
Measurement Process



Case 1
Optimal densification
Densification: ■ ■ ■ ■ ■



Case 2
Densification sufficient, but rework recommended
Densification: ■ ■ ■ ■ ■



Case 3
Densification insufficient,
rework is necessary
Densification: ■ ■ ■ ■ ■

Anode Mixes — Our Solutions for DC Electric Arc Furnaces

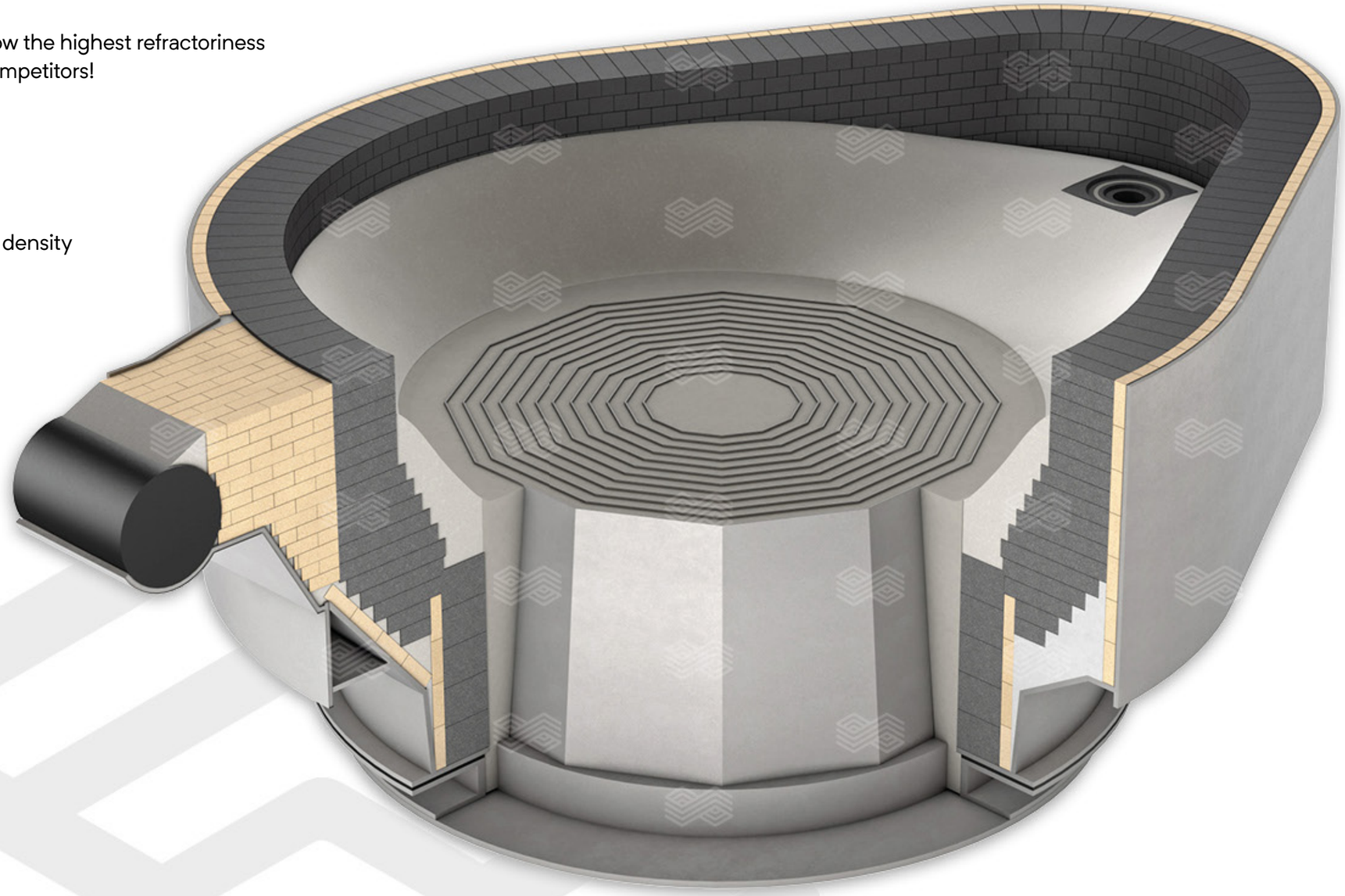
RHI MAGNESITA

Hearth mixes in the anode area of DC electric arc furnaces (fin, pin, billet & conductive bottom) are exposed to extreme conditions.

RHI Magnesita DC bottom anode mixes show the highest refractoriness in the market that cannot be reached by competitors!

Benefits

- Unique raw material bases
- Adapted mineralogical composition
- Special grain size distribution for highest density



Inert Gas Purging / Stirring — RADEX DPP System

RHI MAGNESITA

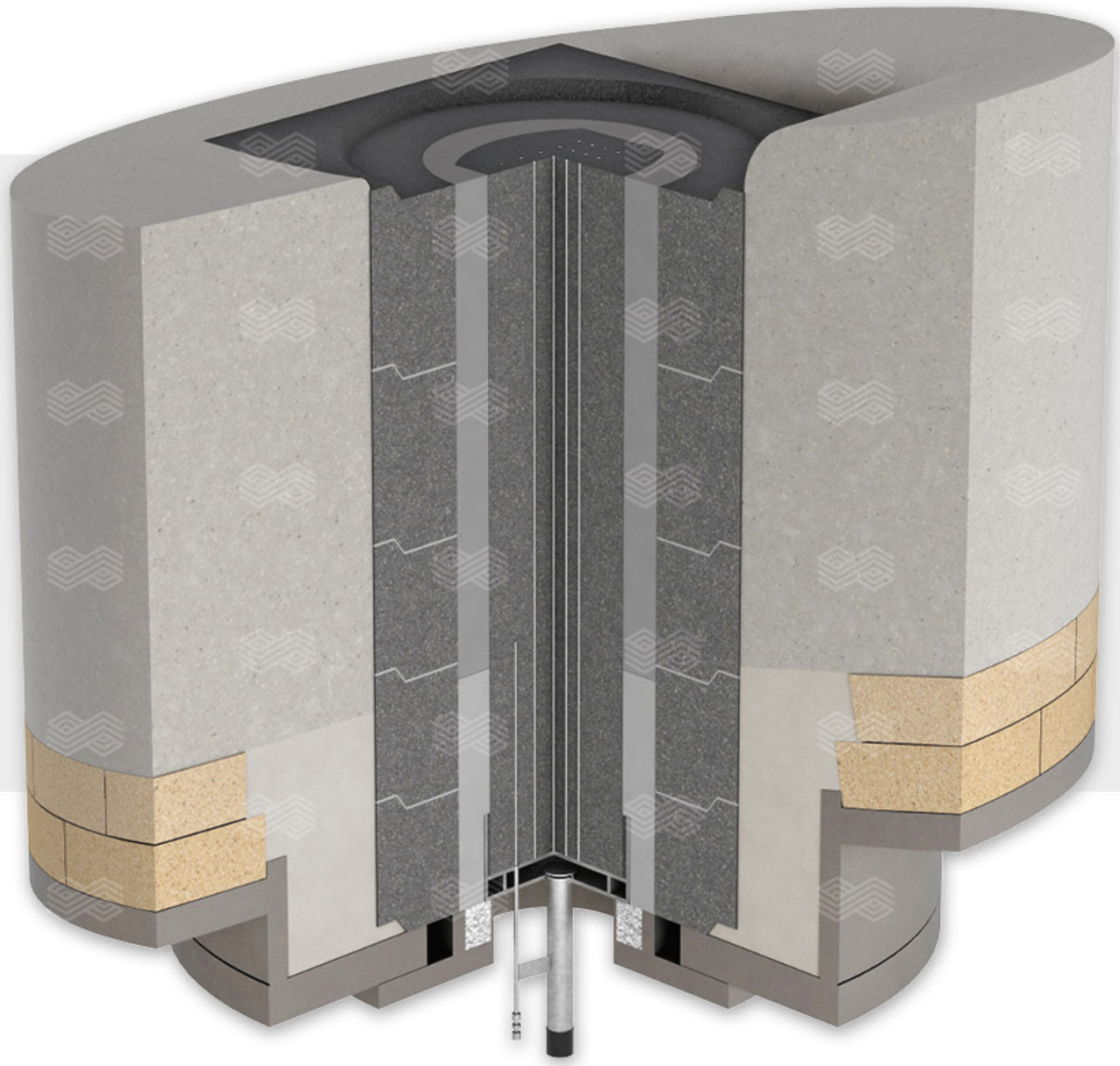
Optimization of EAF process operation by introducing an inert gas flow to the steel melt with a gas purging plug.

Significant process improvements in the steel melt:

- Increased mixing behavior, mass and energy transfer
- Increased thermal homogeneity
- Increased chemical homogeneity
- Provision of continuous degassing

Benefits

- Decreased melting time of scrap, DRI, HBI, etc.
- Decreased specific electrical energy demand
- Increased metal yield
- Increased oxygen efficiency
- Avoidance of delayed CO boiling and slopping
- Improved control on and higher reliability of temperature and metal composition probe

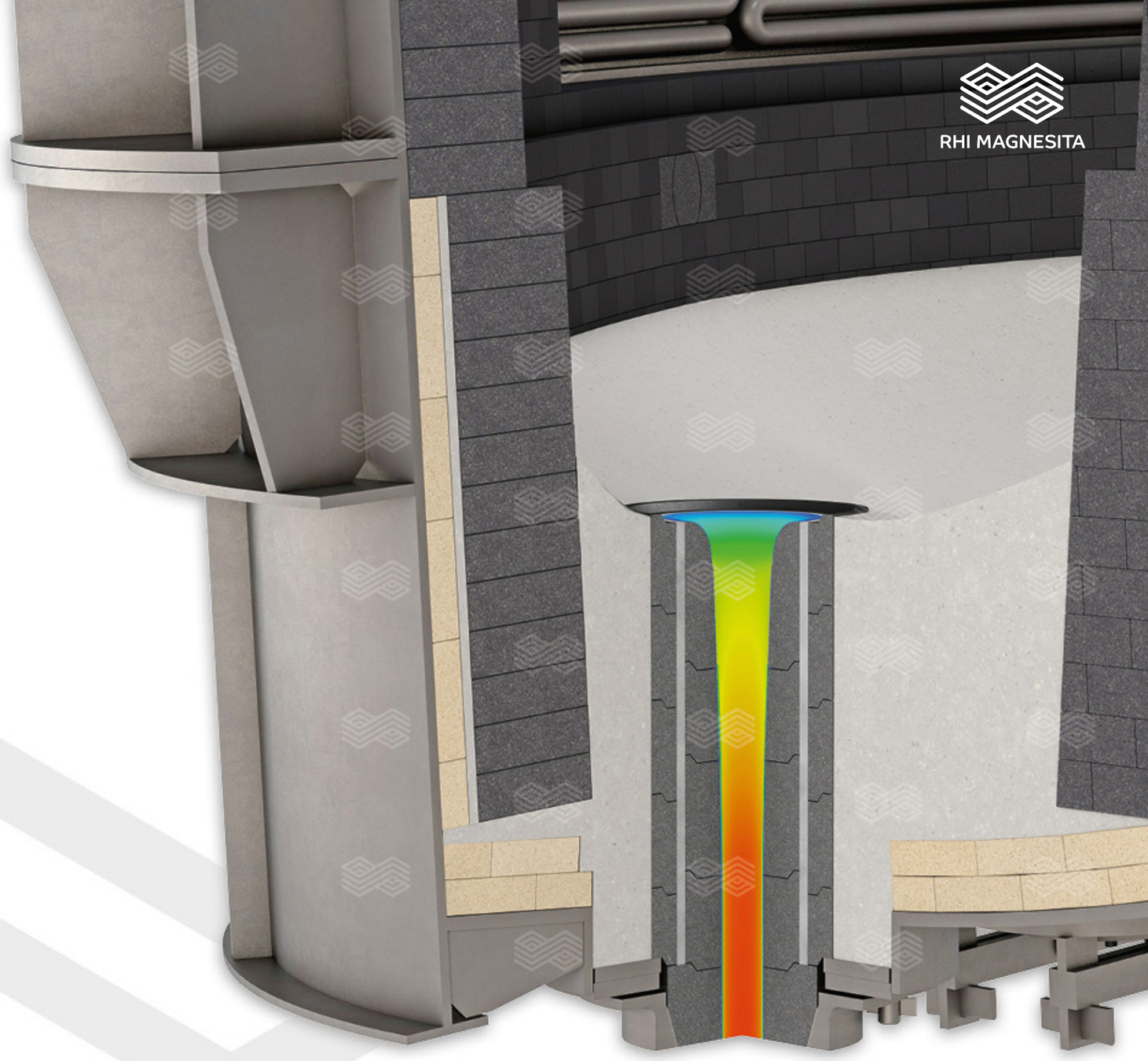


STEEL / ELECTRIC ARC FURNACE

Eccentric Bottom Taphole (EBT)

Eccentric bottom tapping technology has occupied an established place in steel making throughout the world and is an important element to ensure an optimized furnace performance.

As a technology partner RHI Magnesita is the only refractory producer who can supply unique customized taphole solutions , which are designed to fit your needs.



CFD Taphole:
The Perfect Tapping Solution!

Benefits

- Revolutionary patent-protected technology
- Outstanding performance, due to flow optimized design
- Increases your productivity
- Next step towards cleaner steel
- Designed to fit your needs

STEEL / ELECTRIC ARC FURNACE

APO Automated Process Optimization

Fostering a greater understanding of the correlation between steel production parameters, maintenance and refractory by analyzing data on a central master computer, using artificial intelligence methods.



Easily accessible via mobile devices



Example of APO lifetime prediction

Customer Challenges

- Unforeseen downtimes / excessive maintenance — casting interruption and delayed delivery
- Inefficient processes — increased energy costs
- Unsafe operations

APO Value Proposition

- Digital refractory wear model
- Identification of wear influencing parameters
- Refractory benchmarking
- Automated maintenance

Customer Benefits

- Matching refractory cycles with plant cycles enables better use of refractory and reduces refractory waste
- Optimized plant scheduling and saves energy costs
- Increased operational safety

AGELLIS® Solutions

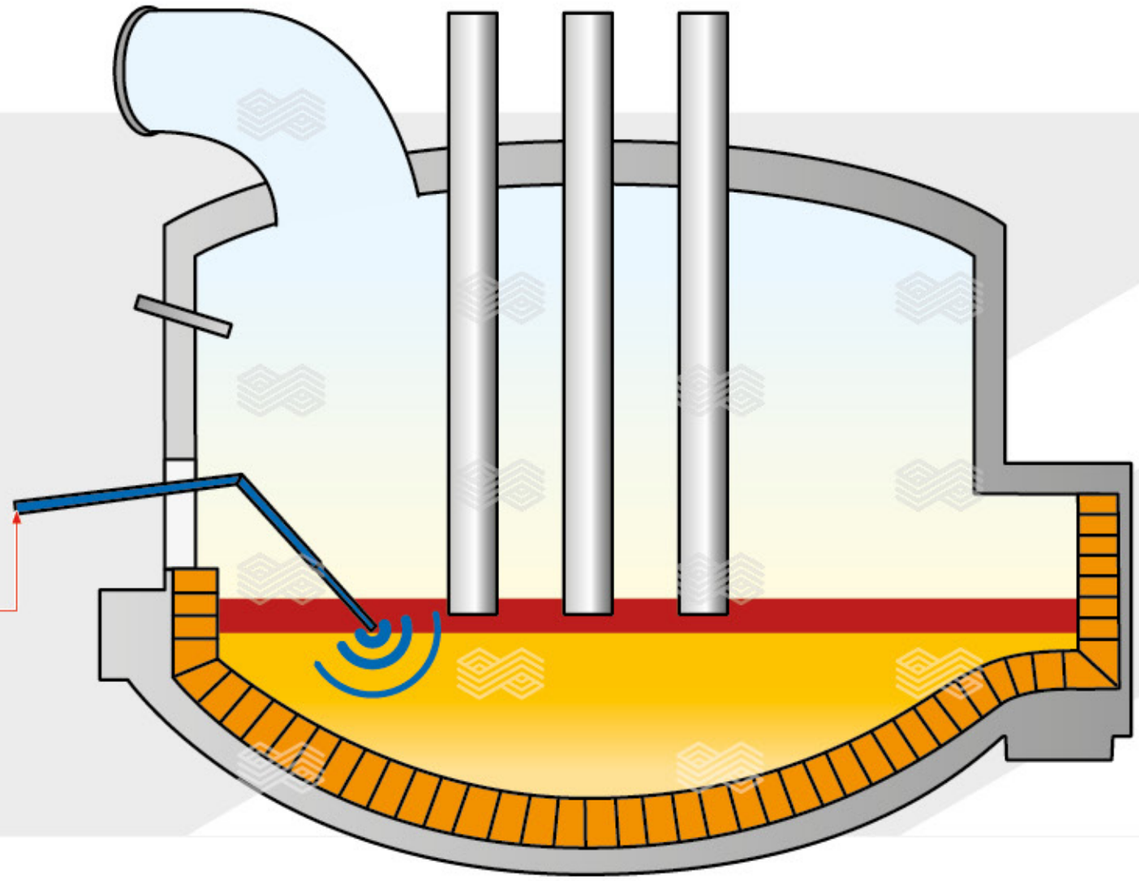
RHI MAGNESITA

EMLI-EAFLevel

Electromagnetic steel level tracking in EAF

User Benefits & Advantages

- Measure steel level accurately, when taking sampling
- No time loss for an additional measurement
- No additional comsumables
- Optimize side wall injection efficiency, by knowing and managing the steel level
- Provide tracking of the steel level assisting the hot-heel management



More Information



STEEL / ELECTRIC ARC FURNACE

AGELLIS® Solutions

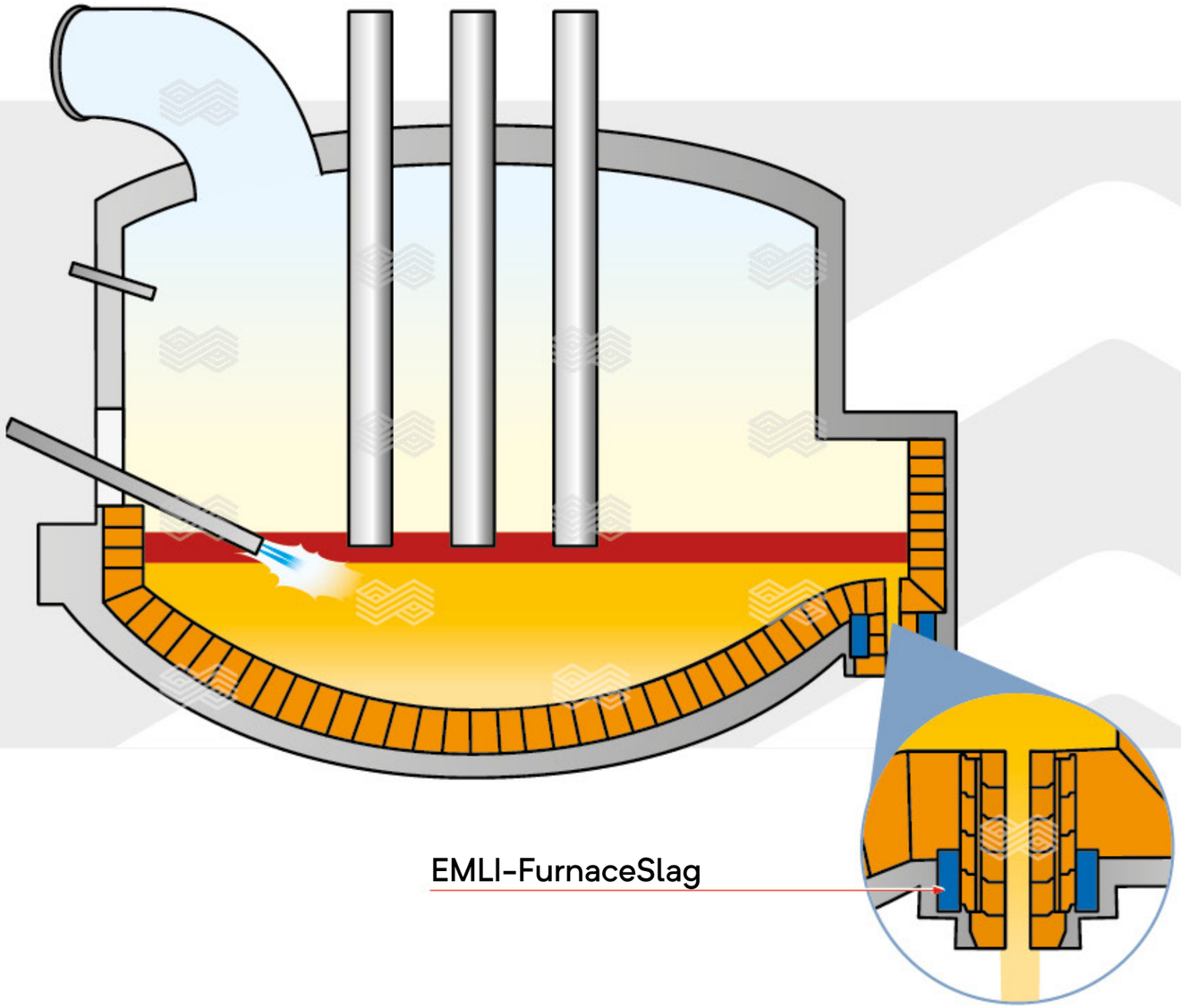
RHI MAGNESITA

EMLI-FurnaceSlag

Electromagnetic slag detection for furnaces

User Benefits & Advantages

- Control slag carryover with a fast response time
- Calculation of slag transfer amount
- Detect and avoid vortex formation during tapping
- Flames and smoke do not affect the system
- Ensure consistent secondary metallurgy process



More Information



STEEL / ELECTRIC ARC FURNACE

EAF Maintenance

Three main application areas of EAF repair mixes:

- Cold repair of hearth and banks:
  Hearth mixes — ANKERHARTH
- Hot repair of hearth and banks:
  Fettling mixes with advanced sintering properties — ANKERFRIT
- Repair of sidewalls, door area and slag zone:
  Gunning mixes containing different binders — ANKERJET

Benefits

- Easy application
- Self-compaction and quick sintering
- Individual customer solutions can be developed on request
- Prolonging sidewall lifetime and achieving a balanced lining
- RHI Magnesita offers a broad range of standard gunning mixes
- Individual customer solutions can be developed on request
- Excellent results in combination with RHI Magnesita gunning robots



STEEL / ELECTRIC ARC FURNACE

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



Content | Lining | Purging | Tapping | Solutions | Maintenance

STEEL / ELECTRIC ARC FURNACE

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



STEEL / ELECTRIC ARC FURNACE

ANKERGUN

RHI MAGNESITA

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



STEEL / ELECTRIC ARC FURNACE

Vibra Spike

RHI MAGNESITA

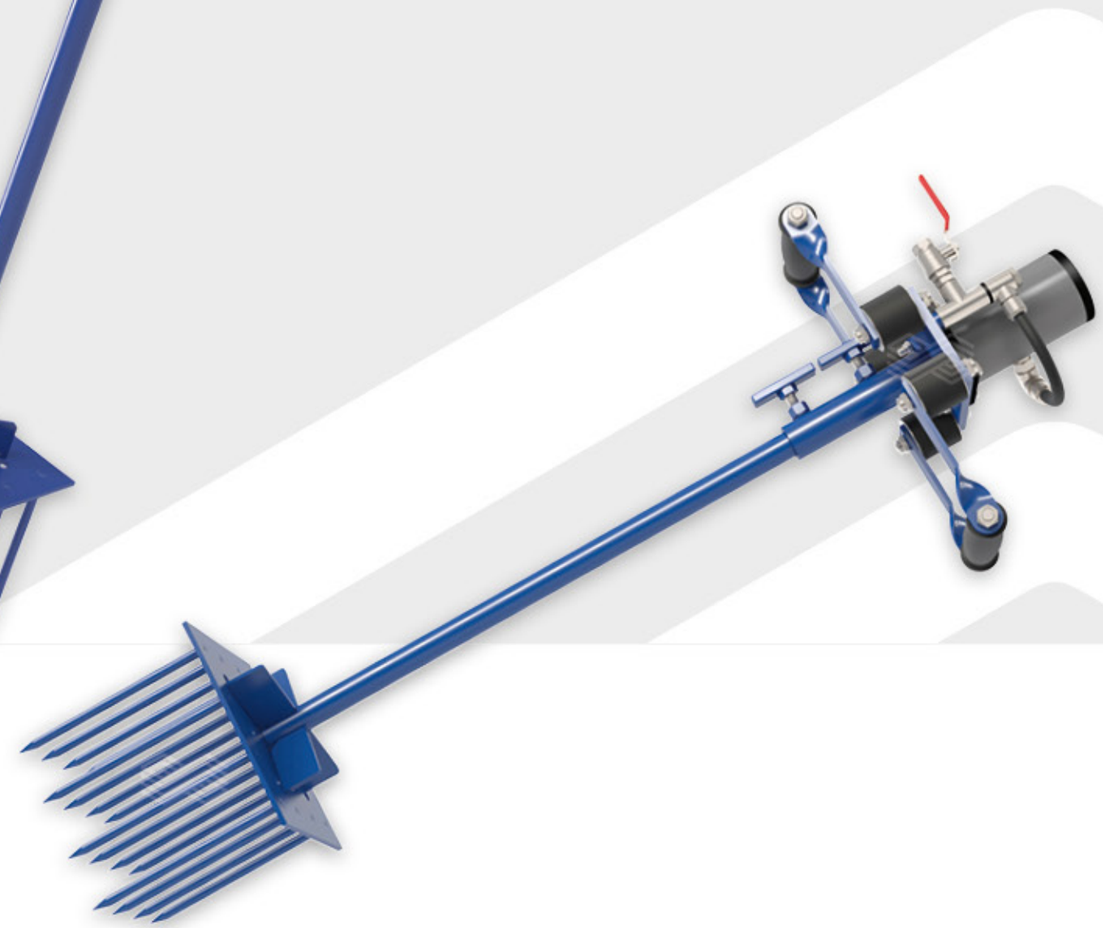
Application:

De-airing of hearth mixes for the installation

Advantages:

- Improved de-airing of banks
- Improved service life of hearths and banks due to higher lining density
- Less physical strain on operating personnel
- Substantially shorter lining times





ANKERHARTH

RHI MAGNESITA

Application:

Compacting of hearth mixes for the installation

Advantages:

- Optimal compaction of the surface



STEEL / ELECTRIC ARC FURNACE

ANKERFRIT

Application:

Repair of the bank and hearth area in EAF

Advantages:

- Precise application of the fettling mix to the bank and hearth area
- Dust free processing of the fettling mix
- Minimizes segregation of the fettling mix during application
- Improves lifetime and reduces mix consumption
- Time saving through high flow rate and precise mix application
- Pneumatically powered machine



STEEL / ELECTRIC ARC FURNACE

ANKERFRIT RC

Application:

Repair of the bank and hearth area in EAF

Advantages:

- Improved visibility and work safety for operators by means of a radio remote control
- Battery powered machine
- Precise application of the fettling mix to the bank and hearth area
- Dust free processing of the fettling mix
- Minimizes segregation of the fettling mix during application
- Improves lifetime and reduces mix consumption
- Time saving through high flow rate and precise mix application



Content | Lining | Purging | Tapping | Solutions | Maintenance

STEEL / ELECTRIC ARC FURNACE

ANKERROTO DRY

RHI MAGNESITA

Application:

Repair of the bank area in EAF

Advantages:

- Improved de-airing of banks
- Improved service life of hearths and banks due to higher lining density
- Less physical strain on operating personnel
- Substantially shorter lining times



STEEL / ELECTRIC ARC FURNACE

ANKERROTO WET

Application:

Repair of the slag zone and hot spots in EAF

Advantages:

- Short repair times
- Sector selection enables precise mix application
- Mix shut-off device reduces mix consumption
- Big bag charging
- Pneumatically powered machine
- Easy to use



RHI MAGNESITA

Content | Lining | Purging | Tapping | Solutions | Maintenance

STEEL / ELECTRIC ARC FURNACE

TERMINATOR S

Application:

State-of-the-art gunning manipulator for highly efficient gunning repair of any part of the EAF

Advantages:

- Highly accurate gunning repair
- Reduces rebound
- Less physical strain on operating personnel
- Minimum preparations
- High flow rate ensures short repair times
- Application of two different mixes
- Increased EAF availability
- Reduction of refractory and maintenance costs



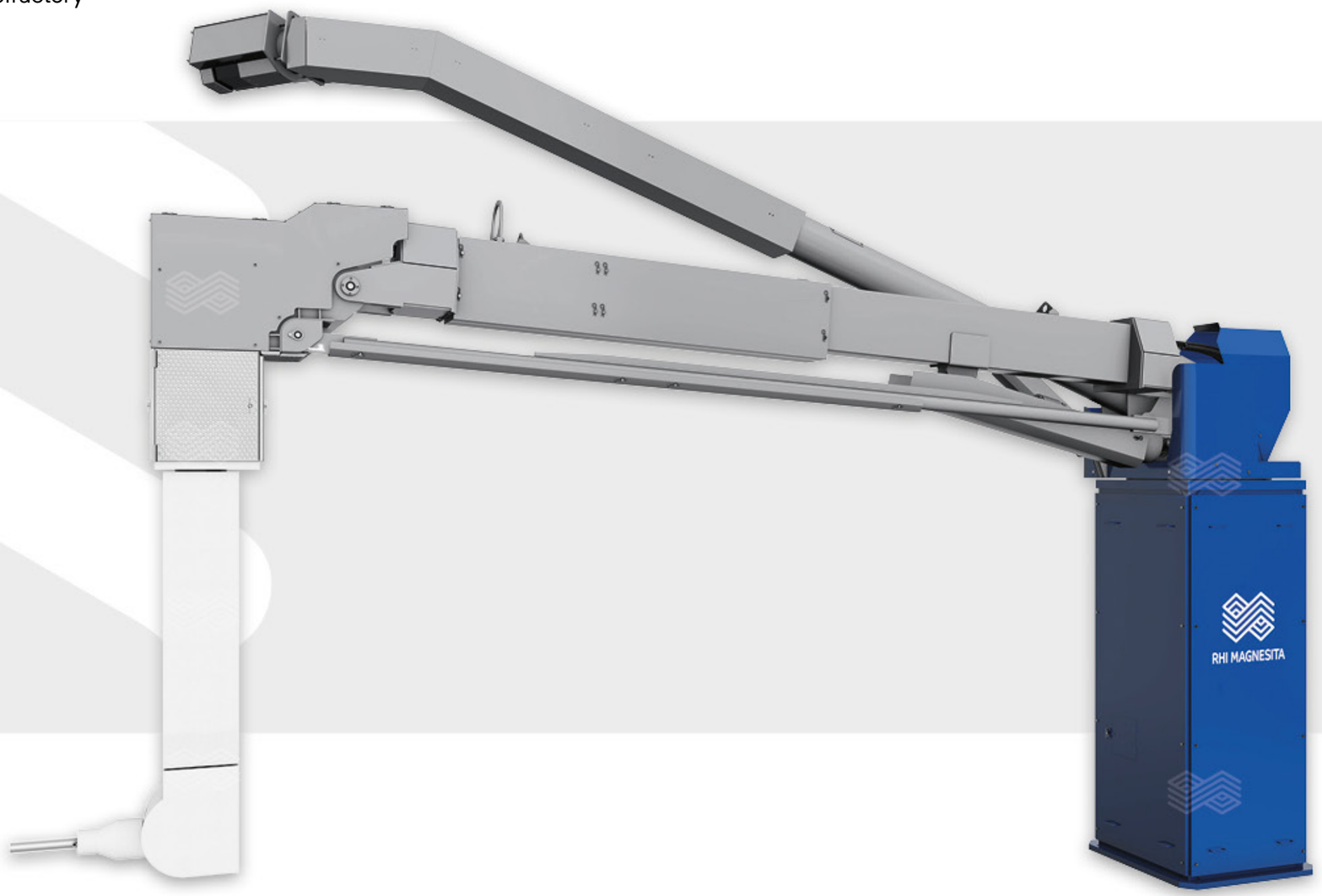
STEEL / ELECTRIC ARC FURNACE

TERMINATOR XL

RHI MAGNESITA

Application:

EAF gunning manipulator with laser scanner for residual refractory lining measurement



Advantages:

- Fast scanning of the EAF lining thickness
- Fully automatic gunning repair
- Reduces rebound
- Less physical strain on operating personnel
- Minimum preparations
- High flow rate ensures short repair times
- Application of two different mixes
- Increased EAF availability
- Reduction of refractory and maintenance costs

STEEL / ELECTRIC ARC FURNACE

ANKERTWIN

Application:

Gunning and fettling machine for EAF

Advantages:

- Useable for multiple furnaces on the same floor
- Gunning and fettling with one single machine reduces repair time
- Reduces rebound
- Increased EAF availability
- Improved visibility and work safety for operators by means of a radio remote control
- Less physical strain on operating personnel
- Low maintenance and wear costs



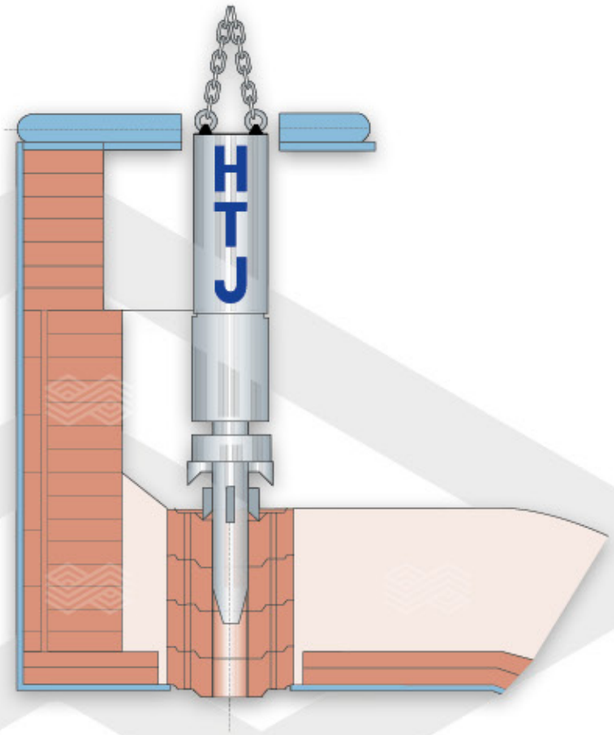
HTJ

Application:

For quick break out of the worn EAF taphole

Advantages:

- Rapid breakout of the hot taphole elements from above
- Higher availability of the furnace
- Less physical strain on operating personnel
- Low maintenance costs
- Pneumatically powered (no electricity required)
- Quick return on investment
- Clean inner surface of the surrounding blocks





STEEL / ELECTRIC ARC FURNACE

ETP

Application:

For fast EAF taphole exchange in hot condition

Advantages:

- Rapid change of the taphole from below
- Higher availability of the furnace
- Less physical strain on operating personnel
- Safe working conditions
- Complete solution
  - > Removal of end brick
  - > Breakout of the channel bricks
  - > Installation of new taphole bricks
  - > Pumping of refractory mix into the annular gap



PTX

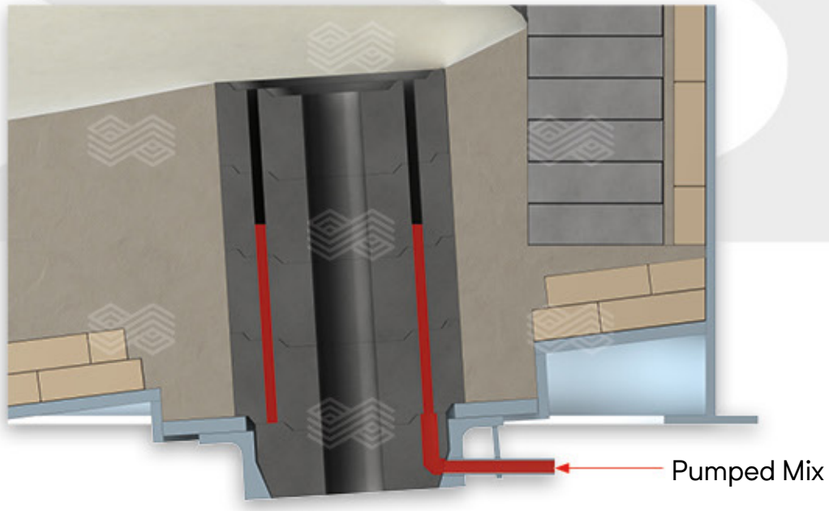
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Application:

For filling the annular gap between taphole surrounding elements and taphole sleeves

Advantages:

- Optimal filling of the annular gap
- Less steel infiltration
- Longer life time of the taphole
- Easy handling
- Increased EAF availability





STEEL / ELECTRIC ARC FURNACE

GEKKO EAF

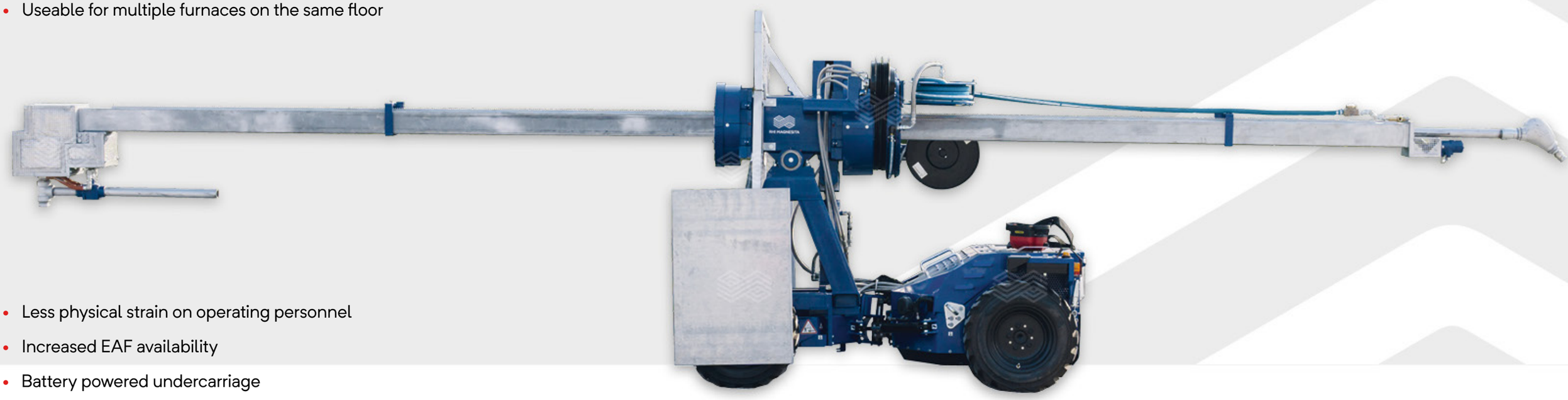
RHI MAGNESITA

Application:

For rapid gunning repairs in the EAF

Advantages:

- Precise gunning repair
- Useable for multiple furnaces on the same floor



- Less physical strain on operating personnel
- Increased EAF availability
- 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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