



# REFRACTORIES

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## FOR

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# SILICON & FERROSILICON METALS



Global **Refractory** Solutions



Allied Mineral Products is a world leader in the design and manufacture of monolithic refractories and precast shapes. With strong sales and service teams in the foundry, aluminum, steel, heat treat/forge and industrial markets, our success is based on our dedication to *Being There Worldwide with Refractory Solutions*.

Producing quality, consistent products is top priority at Allied and we have the products to meet your refractory needs. Our extensive product line includes innovative refractory technology and longstanding refractory alternatives.

Allied's focus on quality at every stage in the production process is unparalleled. A stringent raw material standard and global quality control testing before and after each batch is produced, provides customers with consistent products. We provide quick response times to any urgent request through flexible manufacturing systems at all our manufacturing facilities.

## Global **Refractory** Solutions



**13 MANUFACTURING FACILITIES**  
OVER **145** INTERNATIONAL SALES REPRESENTATIVES  
**3 RESEARCH AND TECHNOLOGY FACILITIES**  
SALES ACTIVITY IN MORE THAN **100** COUNTRIES  
**6 PRECAST SHAPES FACILITIES**



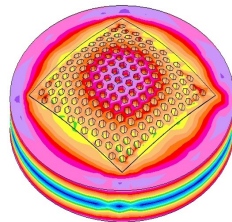
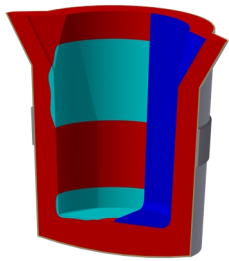
# RESEARCH & ENGINEERING

After gaining a detailed understanding of your specific needs, our team evaluates operating criteria and physical design parameters to create a detailed engineered design encompassing:

- Patented technologies
- Optimized product zoning
- Thermal models to optimize and validate designs
- Proven safety lining system designs
- Unique installation properties and techniques
- Leading edge refractory system designs

We're focused on developing new products, improving existing products and perfecting installation techniques. Our product development and testing is conducted in our state of the art research and technology center. We have an on-site gunning and shotcreting lab allowing extensive testing of installation properties.

As an innovative, technology-driven supplier we're devoted to providing customized refractory solutions for various industry operations. We offer a wide variety of high performance refractory products with superior raw material quality.



FEA Thermal Analysis



Flow Testing



Contact Tests



Strength Tests





# PRODUCTS

refractory

research

## PRODUCTS FOR FERROSILICON AND SILICON METAL APPLICATIONS

Ladle Area	Product	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	Density	Application
Spout	METAL-ROK® Precast Shapes	70.2%	25.4%	3.06 g/cm <sup>3</sup> (191 lb/ft <sup>3</sup> )	-
Bottom	METAL KAST 85 Precast Shapes	82.6%	12.4%	2.85 g/cm <sup>3</sup> (178 lb/ft <sup>3</sup> )	-
	METAL KAST 68 Precast Shapes	60.0%	27.0%	2.64 g/cm <sup>3</sup> (165 lb/ft <sup>3</sup> )	-
Lining	METAL KAST 60	57.9%	36.1%	2.48 g/cm <sup>3</sup> (155 lb/ft <sup>3</sup> )	Si metal ladles
	METAL KAST 70	70.3%	23.9%	2.68 g/cm <sup>3</sup> (167 lb/ft <sup>3</sup> )	Si and FeSi ladles
	METAL KAST 68	60.0%	27.0%	2.64 g/cm <sup>3</sup> (165 lb/ft <sup>3</sup> )	High calcium slag Si metal ladles; SiC addition
	METAL KAST 85	82.6%	12.4%	2.85 g/cm <sup>3</sup> (178 lb/ft <sup>3</sup> )	FeSi ladles
Maintenance & Additional	MELTZONA CLAY	7.60	89.0%	2.12 g/cm <sup>3</sup> (132 lb/ft <sup>3</sup> )	Parting plain for tundish or tapping ladle

Taphole Area	Product	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	Density	Application
Block	ARMORMAX® 80 SiC	76.9%	11.6%	2.76 g/cm <sup>3</sup> (172 lb/ft <sup>3</sup> )	Jambs and lintels around block
	Graphite Carbon Precast Shape	-	-	-	Taphole block
Taphole clay	RSR 1133 PLUGGING PASTE	2-5%	71.0-74.0%	2.0-2.1 g/cm <sup>3</sup> (128-132 lb/ft <sup>3</sup> )	Anhydrous plugging paste for ferrosilicon alloy furnaces
Maintenance & Additional	ARMORGUN 80 SiC	13.0%	5.0%	2.31 g/cm <sup>3</sup> (144 lb/ft <sup>3</sup> )	Taphole maintenance for continuous tapping of Si Metal; setting (fills void surrounding)
	NANO-TEK® 418A	69.5%	18.9%	2.95 g/cm <sup>3</sup> (184 lb/ft <sup>3</sup> )	taphole blocks

Furnace	Product	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	Density	Application
Spout	NANO-TEK® 418A	69.5%	18.9%	2.95 g/cm <sup>3</sup> (184 lb/ft <sup>3</sup> )	-

General Maintenance	Product	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	Density	Application
	TUFFCRETE® 47	47.1%	46.5%	2.16 g/cm <sup>3</sup> (135 lb/ft <sup>3</sup> )	-
	TUFFCRETE® 60	60.5%	34.3%	2.44 g/cm <sup>3</sup> (152 lb/ft <sup>3</sup> )	-
	TUFFCRETE® 70	69.0%	25.0%	2.55 g/cm <sup>3</sup> (169 lb/ft <sup>3</sup> )	-
	TUFFCRETE® 80	79.6%	14.0%	2.64 g/cm <sup>3</sup> (165 lb/ft <sup>3</sup> )	-

\*Additional Shotcrete products available, contact your Allied representative.





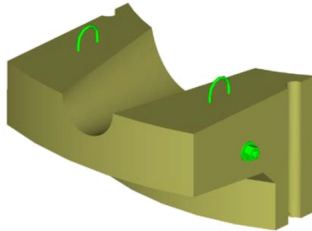
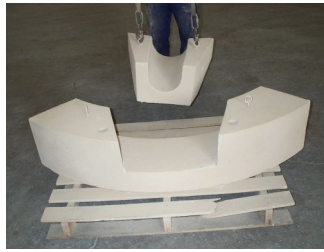
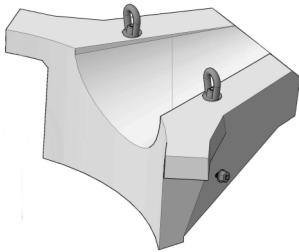
# REFRACTORY SOLUTIONS

## Precast Shapes for ladles

Allied is a leading producer of custom precast refractory shapes. We boast five precast shapes facilities around the globe and have the capability to design and manufacture shapes of virtually any size and for any application.

Faster installation | Minimized heat-up times | Easier slag or dross removal due to lower porosity | Consistent and controlled manufacturing process

## Precast Ladle Spouts



## Precast Ladle Bottoms



METAL-ROK® fiber distribution

METAL-ROK® is the ultimate ceramic-metal composite that withstands a wide range of destructive high temperature environments. Metal fibers are uniformly distributed in the refractory structure, which demonstrates excellent corrosion resistance, high abrasion resistance and strength through thermal shock.

## Taphole Solutions

### Precast Jamb and Lintel (around taphole block)

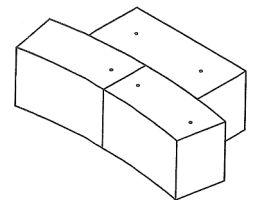
Allied engineers precast jambs and lintels using our quality, high alumina products. Precast shapes are a hassle-free, longer lasting alternative to traditional castables in the taphole block area. We also supply graphite carbon taphole blocks.



### Taphole Clay

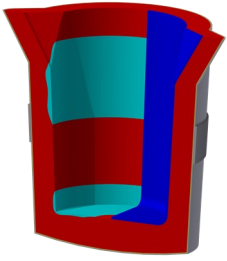
Anhydrous taphole clay designed specifically for ferrosilicon and silicon metal furnaces.

- RSR 1133





# REFRACTORY SOLUTIONS



## Ladles

Allied can help control the thermal dynamics of your ladle to extend the life of the ladle refractory. We generate customized solutions—based on existing practices—to prevent destruction and create a more efficient process.

Failure to control calcium slag is a major factor in the wearing of ladles. We can recommend the best refractory products for various ladle areas, the ideal lining thickness and a precise fines addition schedule to increase the number of taps between relines.

## Theoretical Case

**Situation:** Silicon metal in tap stream contains calcium at a level that is destructive to refractory. When silicon metal includes 1% calcium or above, a potential for corrosive slag exists.

**Problem:** Very high wear in ladle lining during refining. Refractory thickness is storing too much heat, resulting in a shell temperature less than 300°F (149°C) and inhibiting destructive slag.

**Existing process:** Ladle is taken out of service when the shell temperature measures 450°F (232°C). Refractory then added to a lining 7 in (17.78 cm) thick—typical when the shell is 450°(232°C).

**Current product:** 70% alumina castable

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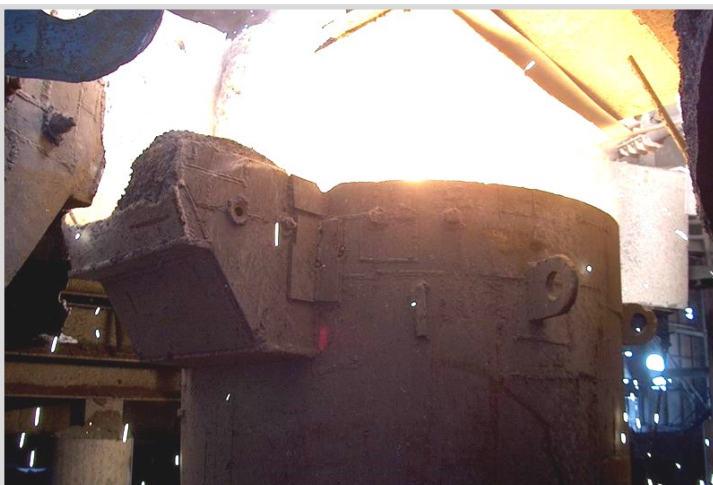
**Allied's Proposed Product Solution:** Change to 68% alumina castable with silicon carbide to help with slag.

**Allied's Proposed Process Solution:** Take ladle out of operation when the shell is 650°F (343°C), indicating the refractory thickness is 4 in (10.2 cm) or less.

**Result:** By implementing these recommendations, ladle lining life can increase by 150 taps.

**Reason:** Allied helps combat calcium slag and refractory wear in ladles by recommending the proper refractory products and controlling temperature.

With our expertise, customers can achieve the hot face life typical in the silicon metal industry—between 650 and 1100 taps between relines.





# GRAPHITE PRODUCTS

**Allied** offers a comprehensive catalog of carbon and graphite based cements, mortars, ramming materials and grouts. These dependable, industry-leading products are designed to fulfill ancillary needs in blast furnaces, cupolas and ferroalloy furnaces.

## We can fill the void.

Our product collection has expanded to include several staple products for the steel, ferroalloy and iron industries. These are the same refractory cements and pastes you know and trust, now manufactured and sold under the Allied name.

Product	Information
C34	Two part carbonaceous heat setting cement developed specifically as a mortar for use between carbon or graphite structural shapes.
C38	Two part carbonaceous heat setting cement developed specifically as a bonding agent for use between large carbon or graphite refractory shapes.
C46	Single-component carbonaceous heat setting cement developed specifically as a mortar for use between carbon or graphite structural shapes.
CP9	Carbonaceous hot ramming paste.
EZRAM RP10	Highly thermally conductive graphitic ram, primarily used in sub-hearth, cooling pipe, and annulus between steel work and refractories.
SMART RAM® RP20	Ram with specially treated graphite flake, designed to provide excellent thermal conductivity, ease of installation and a unique expanding characteristic which can "self-correct" in case refractory movement or voids due to improper installation result in loss of cooling contact.
GR37	Two-part carbonaceous grout with expanding flake graphite. It has been used to reestablish contact between carbon refractory and cooling members, as well as stop gas leaks in blast furnace applications.
EZRAM RP3	Single component carbonaceous ram.
EZRAM RP4	Single component, carbonaceous ram for filling in contained areas behind forms or between carbon structural shapes and furnace shells.

Product	Information
HC3F	One component, clean carbon mortar for bonding carbon and graphitic materials, especially block and brick in blast furnace hearths and ferroalloy furnaces. Product is air cured and has good thermal conductivity.
HC4F	One component, water-based grout designed for cold grout applications, specifically filling the gaps between steel shell and carbon bricks in cupolas and blast furnaces.
HC5F	One-component grout for hot applications to fill in the gaps between steel shell and carbon bricks in blast furnaces and cupolas.
HC6F	Two-component collector bar and cathode block bonding mix with visible metal beads.
HC8F	High conductivity, multi-purpose ramming mix used to repair carbon and graphite bricks in blast furnace hearths or as a patch for cracks in high carbon refractory linings.





# GRAPHITE CARBON BRICKS

Choosing the right graphitic carbon brick is as important as the refractory cement binding the bricks together. That's why Allied recommends graphite carbon bricks from GT Refractories. GT Refractories uses the same dependable technology as Grafftech Advance Graphite Materials, making them the standard in graphitic carbon bricks. Combining Allied's line of cement refractories with GT's bricks is the best solution to ensure optimal furnace performance.

The proprietary HotPressed™ method of manufacturing produces carbon and semigraphite refractories with low permeability, high strength, superior resistance to chemical attack and outstanding thermal conductivity. These HotPressed™ refractories have an unsurpassed track record of reliable service in metallurgical processes around the world. The automated manufacturing process ensures very high consistency in the important properties, adding to the products exceptional performance.

## NMA™ HotPressed™ Carbon Brick

NMA™ Carbon bricks offer superior refractory lining performance in the most demanding metallurgical processes. Featuring:

- high density
- easy to handle
- high thermal conductivity
- super low permeability
- high cold crushing strength
- high resistance to chemical attack
- proven HotPressed™ characteristics

NMA™ KEY PROPERTIES	Typical Average
Thermal Conductivity (W/mK) (WG)	18
Permeability (millidarcys)(WG)	10
Bulk Density (g/cm³)	1.61
Crushing Strength (kPa) (AG)	35000
Ash (%)	12

## NMD™ HotPressed™ Semigraphite Brick

NMD™ Semigraphite bricks offer superior performance in the most demanding blast furnace and submerged arc furnace refractory linings. Featuring:

- high resistance to chemical attack
- very high thermal conductivity
- exceptionally low permeability
- easy to handle
- high density
- very low ash content
- proven HotPressed™ characteristics

NMD™ KEY PROPERTIES	Typical Average
Thermal Conductivity (W/mK) (WG)	70
Permeability (millidarcys) (WG)	5
Bulk Density (g/cm³)	1.82
Crushing Strength (kPa) (AG)	28000
Ash (%)	9

## GRAPHITES

### AE-XT™ and CBY™ Graphites

Low ash and low iron graphites for blast furnace linings, hearth, stack, cooling course, bosh, and side wall blocks. Features include excellent thermal conductivity, high density, high strength and exceptional machinability.

### AE-XT30™ and CS™ Graphites

Low ash and low iron graphites for blast furnace linings, hearth stack, bosh, tuyere, tapholes and side wall blocks. Features include excellent thermal conductivity, high density, high strength and exceptional machinability. Through additional processing steps, these graphites have higher density, strength, and thermal conductivity than AE-XT™ and CBY™ Graphites.

### AE-XT30X™ and CSX™ Graphite

Low ash and low iron graphites for blast furnace linings, hearth, stack, cooling course, bosh, and side wall blocks. Features include excellent thermal conductivity, high density, high strength and exceptional machinability. As a result of additional process steps, AE-XT30X™ and CSX™ Graphites have higher density, strength, and thermal conductivity than AE-XT30™ and CS™ Graphites.

KEY PROPERTIES	Typical Average
Thermal Conductivity (W/mK) (WG)	145
Permeability (millidarcys) (WG)	130
Bulk Density (g/cm³)	1.66
Crushing Strength (kPa) (AG)	30
Ash (%)	.07

KEY PROPERTIES	Typical Average
Thermal Conductivity (W/mK) (WG)	160
Permeability (millidarcys) (WG)	50
Bulk Density (g/cm³)	1.74
Crushing Strength (kPa) (AG)	42
Ash (%)	.09

KEY PROPERTIES	Typical Average
Thermal Conductivity (W/mK) (WG)	175
Permeability (millidarcys) (WG)	25
Bulk Density (g/cm³)	1.78
Crushing Strength (kPa) (AG)	55
Ash (%)	.11

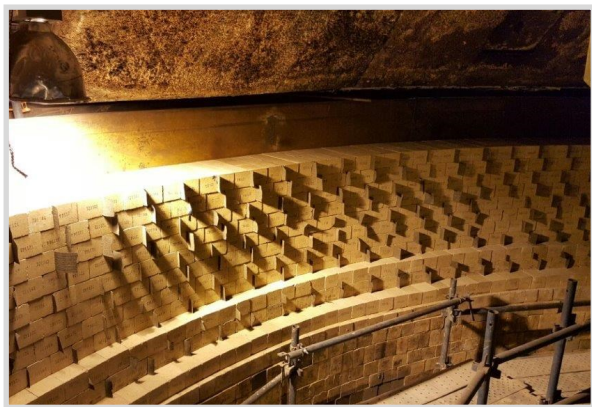


in our  
element

process  
global  
BRICK INSTALLATIONS

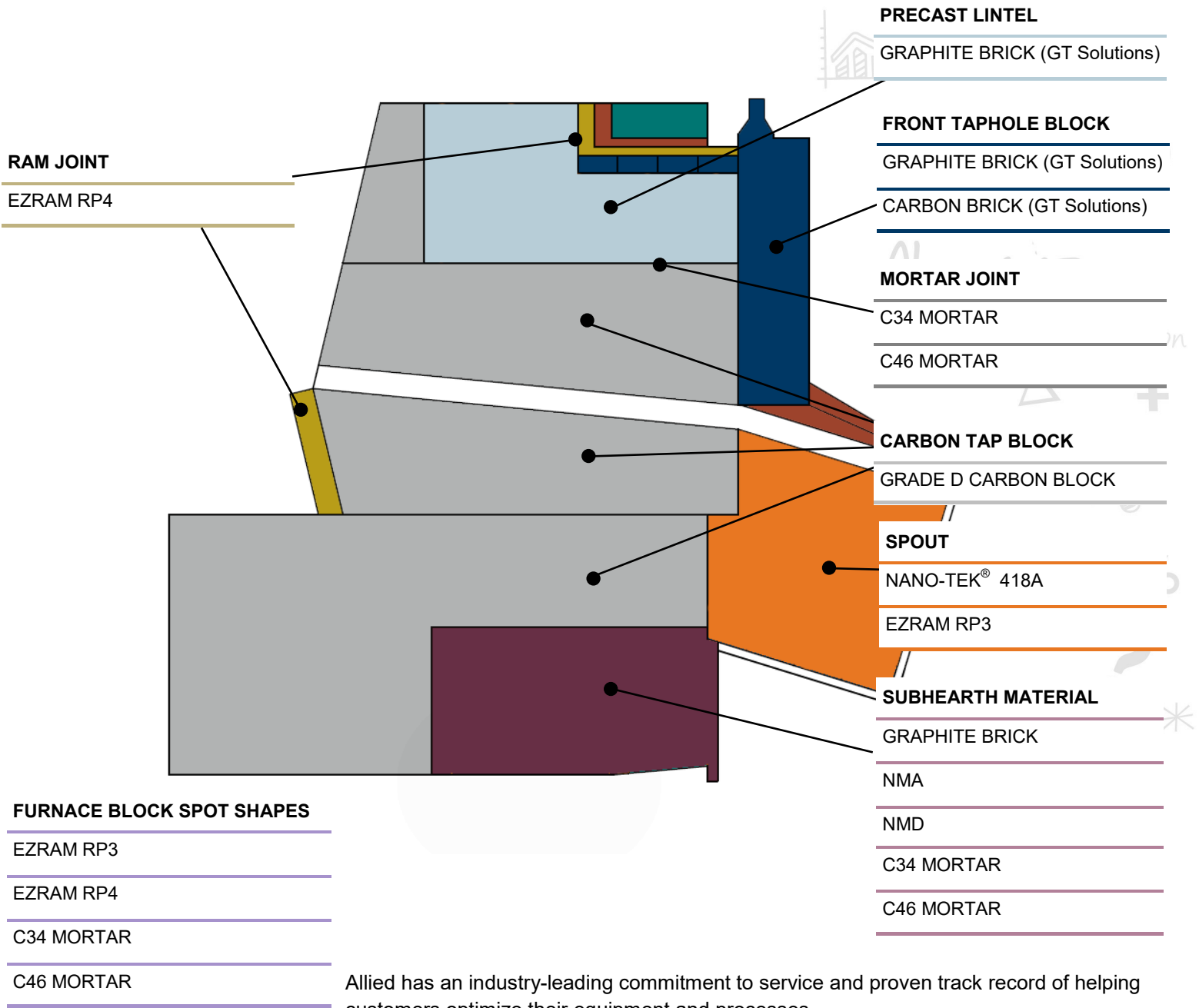
refractory

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# TAPHOLE AREA SOLUTIONS



Allied has an industry-leading commitment to service and proven track record of helping customers optimize their equipment and processes.

Our capabilities for the **ferrosilicon and silicon metal** industry fall into three categories:

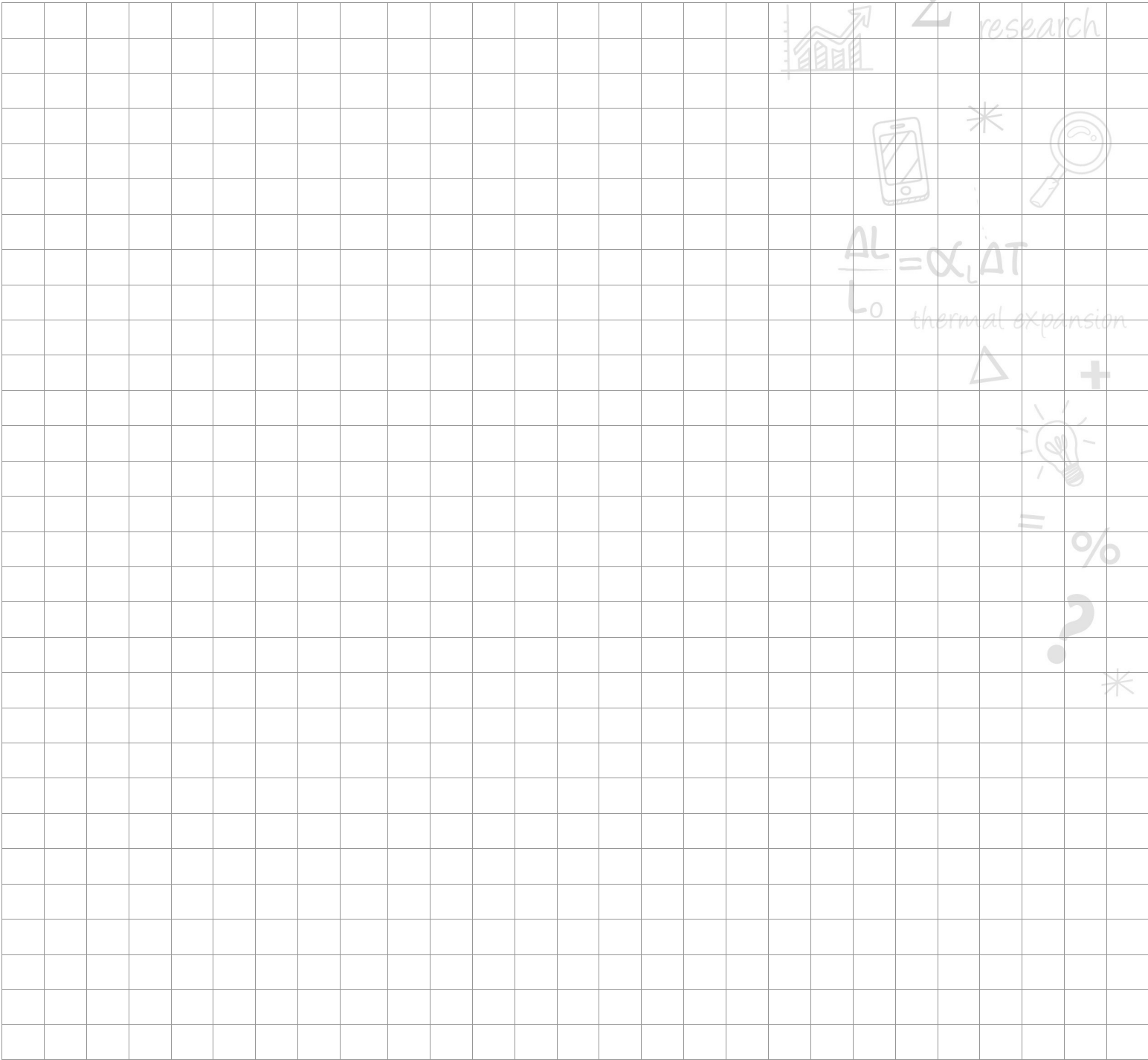
- Product suitability
- Consistency
- Advancement of customer practices

Along with high quality refractories, we offer knowledge and support to help improve your practice. For ferrosilicon and silicon metals customers, we focus our experience and technical expertise on ladles and furnace tapholes.



in our  
element

process  
global  
NOTES  
refractory  
research



The Allied Difference

Being There Worldwide with Refractory Solutions

## Headquarters:

**Allied Mineral Products, LLC**  
Columbus, Ohio, U.S.A.  
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956-831-2022 - [info@alliedmin.com](mailto:info@alliedmin.com)

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