VUULCAN.

SELECTION GUIDE 12 min read Updated January 2024

High Alumina Brick Grade Selection: Matching Al_2O_3 to Your Furnace Zone

A systematic guide to selecting the correct alumina content — 48%, 55%, 65%, 75%, or 85% — based on service temperature, slag exposure, and thermal cycling requirements.

High alumina brick (HAB) grade selection requires matching the alumina (Al_2O_3) content to three critical s
chemical environment (particularly slag and alkali exposure), and thermal cycling intensity. HAB is classifi
ranging from 48% (the minimum threshold to qualify as "high alumina") to 90% (corundum brick). Each 1
50–80°C higher refractoriness under load (RUL), improved resistance to acidic slag attack, but also incre
shock resistance, and raises material cost by 15–25% per tier. The most common specification error in in
using 75% brick where 55% would perform adequately — resulting in 30–50% cost premium with no perf
leading to premature failure at 40–60% of design campaign life.

Proper grade selection follows a three-step process: (1) determine actual service temperature (not desig
modeling, (2) identify chemical attack vectors including slag composition, alkali vapor presence, and clink
balance refractoriness against thermal shock resistance. This guide provides decision matrices, RUL mat
cement kilns, steel furnaces, glass tanks, and general industrial heating equipment.

Al_2O_3 Grade Classification & Performance Characteristics

AL_2O_3 GRADE	AL_2O_3 %	BULK DENSITY (G/CM³)	RUL (°C)	MAX SERVICE TEMP (
48% Grade	48–52	2.20–2.35	1350–1380	1200–1300
55% Grade	55–60	2.30–2.45	1420–1450	1300–1400
65% Grade	65–70	2.40–2.55	1480–1520	1400–1500
75% Grade	75–80	2.55–2.70	1520–1560	1500–1600
85% Grade	85–90	2.70–2.90	1560–1600	1600–1700

RUL Definition: Refractoriness Under Load (RUL) is the temperature at which a brick deforms 0.6% under a
This is the critical specification for high-temperature structural applications — not to be confused with pyro
deformation without load.

Why Al_2O_3 Content Matters

Alumina (Al_2O_3) is the refractory phase that provides high-temperature stability. As Al_2O_3 percentage incre

- **Refractoriness increases:** Higher melting point of corundum (Al_2O_3 melts at 2054°C) vs mullite ($3Al_2O$
- **Slag resistance improves:** Better resistance to acidic slags; Al_2O_3 is amphoteric and resists most indu
- **Thermal expansion increases:** Corundum has higher thermal expansion (8.0×10^{-6}/°C) vs mullite (5.3×
- **Porosity decreases:** Denser microstructure improves hot strength but reduces ability to accommodat

RULE 1

RUL-to-Service Temperature Matching Rule

The foundational selection rule: **RUL must exceed maximum service temperature by 100–200°C**, with t

SERVICE ENVIRONMENT	REQUIRED RUL MARGIN	EXAMPLE
Clean atmosphere, no slag	+100–120°C	1300°C service → RUL ≥1400°C (55%
Moderate slag/dust	+120–150°C	1350°C service → RUL ≥1480°C (65%

SERVICE ENVIRONMENT	REQUIRED RUL MARGIN	EXAMPLE
Heavy alkali/slag exposure	+150–200°C	1350°C service → RUL ≥1520°C (75% .
Direct slag contact (e.g., ladle)	+200–250°C	1500°C service → RUL ≥1700°C (Requi

Warning: Using design temperature instead of actual measured service temperature is the #1 cause of und operate 80–150°C hotter than nameplate design due to process variations. Always verify with IR pyrometer brick grade.

RULE 2

Thermal Shock vs Refractoriness Trade-Off

Higher Al_2O_3 content improves refractoriness but **degrades thermal shock resistance**. For cyclically ope shock resistance often governs material selection over pure refractoriness.

Thermal Shock Resistance Ranking (Best to Worst)

1. **48% Al_2O_3:** Excellent — can withstand 300–400°C/hour cooling rates in many applications
2. **55% Al_2O_3:** Good — suitable for weekly thermal cycling with controlled cooling (<200°C/hour)
3. **65% Al_2O_3:** Moderate — requires controlled heat-up/cool-down (<100°C/hour) for cyclic service
4. **75% Al_2O_3:** Moderate-Poor — best suited for continuous operation; cyclic use requires very slow ram
5. **85% Al_2O_3:** Poor — not recommended for thermal cycling; use only in continuous operation (<2 shutc

Application Example: An industrial boiler arch operating at 1280°C with daily shutdowns should use **55% A** margin), NOT 75% Al_2O_3 — despite the higher refractoriness, the 75% grade will develop horizontal thermal cycling tolerance.

Application-Specific Selection Matrix

Cement Rotary Kiln Zones

The following grade recommendations focus on high alumina brick. For a complete cement rotary kiln zor selections for the burning zone, see the dedicated lining guide.

KILN ZONE	SERVICE TEMP (°C)	PRIMARY CHALLENGE	RECOMM
Preheater / Inlet	800–1200	Thermal shock, dust abrasion	48–55%
Transition Zone	1200–1400	Alkali attack, coating buildup	65–70%
Burning Zone (if brick used)	1350–1450	Direct flame, clinker abrasion	75–85%
Discharge / Cooler Inlet	1100–1350	Clinker impact, abrasion	55–65%

Steel Industry Applications

APPLICATION	SERVICE TEMP (°C)	RECOMMENDED AL_2O_3	NOTES
Ladle Safety Lining	1200–1400	75–85%	Backup laye
Reheating Furnace Hearth	1200–1350	55–65%	Abrasion frc
Reheating Furnace Roof	1300–1450	65–75%	Requires go
Soaking Pit	1250–1350	65%	Long hold ti

Common Specification Errors & Cost Impact

ERROR 01

Over-Specification: Using 75% Where 55% Is Adequate

Scenario: Industrial kiln car deck, service temperature 1180°C, no slag exposure, specified with 75% zero performance benefit. **Correct specification:** 55% Al_2O_3 (RUL 1420°C) provides 240°C safety ma

ERROR 02

Under-Specification in Alkali Environments

Scenario: Cement kiln transition zone (1320°C measured, heavy alkali) lined with 55% Al_2O_3 brick. **R** (design life: 24 months). Post-failure analysis showed 15mm alkali penetration depth. **Correct specif** margin).

ERROR 03

Ignoring Thermal Cycling in High-Alumina Selection

Scenario: Glass annealing lehr roof, 1150°C service, daily shutdowns, specified with 85% Al_2O_3 coru hot face after 4 months due to thermal shock. **Correct specification:** 55–65% Al_2O_3 with controlled

ERROR 04

Using Design Temperature Instead of Measured Temperature

Scenario: Rotary calciner "designed" for 1250°C, actual measured temperature 1380°C during upse Brick slumped during process excursion. **Prevention:** Always add 80–120°C to design temperature f with IR pyrometer.

Cost-Performance Optimization

Each alumina grade tier increase (e.g., 55% → 65%) typically adds **15–25% to material cost**. For a typica 100mm thick, ~27,000 bricks), grade selection impacts total brick cost as follows:

AL_2O_3 GRADE	RELATIVE MATERIAL COST	CAMPAIGN LIFE (TRANSITION ZONE)
55% (Under-spec)	1.0× (baseline)	10–14 months (premature failure)

AL_2O_3 GRADE	RELATIVE MATERIAL COST	CAMPAIGN LIFE (TRANSITION ZONE)
65% (Correct spec)	1.5×	18–24 months (target)
75% (Over-spec)	1.8×	20–26 months (marginal gain)

Optimization Verdict

For the cement kiln transition zone example, **65% Al_2O_3** delivers the lowest cost per month of servic failure and frequent relining downtime. Over-specifying (75%) provides only 10–15% campaign life e investment. **The optimal specification maximizes campaign life per dollar spent, not absolute car**

Pre-Specification Checklist

01 **Measure actual service temperature** — Use IR pyrometer or install thermocouples; do not rely solely on

02 **Document thermal cycling frequency** — Shutdowns per month, typical heat-up/cool-down rates, emerge

03 **Identify chemical attack vectors** — Slag composition (acidic/basic), alkali content (K_2O, Na_2O), dust abra

04 **Calculate required RUL margin** — Service temp + 100–200°C depending on slag/alkali exposure (use tab

05 **Match RUL to Al_2O_3 grade** — Use grade classification table; select lowest Al_2O_3 grade that meets RUL req

06 **Verify thermal shock compatibility** — If cycling ≥1/week, confirm grade has adequate thermal shock resi

07 **Request batch COA from supplier** — Verify Al_2O_3 content (±2% tolerance acceptable), bulk density, RUL

08 **Calculate total cost of ownership** — Material cost ÷ expected campaign life (months) = cost per month;

Vuulcan High Alumina Brick: Available in 55%, 65%, 75%, and 85% Al_2O_3 grades. All batches include RUL
series production lines with batch traceability and English-lan

View Technical Specifications →

Content produced from Zibo's refractory manufacturing cluster — China's largest concentration of high a continuous export history to cement, steel, and glass industries worldwide.

IN THIS ARTICLE

FREQUENTLY ASKED QUESTIONS

High Alumina Brick Grade Selection FAQ

What does the Al_2O_3 percentage in high alumina brick actually mean? +

Can I use 85% Al_2O_3 brick everywhere to 'be safe'? +

How do I match RUL (refractoriness under load) to my service temperature? +

What's the difference between 65% and 70% Al_2O_3 brick? +

RELATED PRODUCTS

Explore Our High Alumina Brick Range

RELATED ARTICLES

Continue Reading

VUULCAN.

The Castable-First Refractory Brand from Zibo — China's largest refractory manufacturing region. Engineered castable, firebrick, and insulation solutions for cement, steel, and glass industries worldwide.

PRODUCTS

LCC Castable

High Alumina Brick

Insulating Firebrick

Ceramic Fiber Blanket

TECHNICAL CENTER

All Articles

HAB Grade Selection

Cement Kiln Guide

COMPANY

Contact & RFQ

Main Site

inquiry@vuulcan.com

Privacy Policy Sitemap Main Site