Gunning Refractory vs Casting: When Gunning Beats Conventional Installation

Four scenarios where gunning wins — emergency repair, inaccessible geometry, hot application, and partial-thickness relining — plus the trade-offs that make casting the right call everywhere else.

Gunning refractory (also called gunite or shotcrete refractory) is a castable mix applied pneumatically through a hose and nozzle rather than poured into formwork. The method eliminates formwork construction and allows placement in positions inaccessible to conventional casting — overhead surfaces, irregular cavities, and existing hot linings without full shutdown. The trade-off is density: gunned material typically achieves 85–92% of the bulk density of the equivalent cast grade due to rebound loss (5–30% of material bouncing off the substrate) and the absence of vibration consolidation. For structural primary linings in new construction, this density gap matters. For the four scenarios described in this article — emergency repair, complex geometry, hot-surface application, and partial-thickness face relining — the installation advantages outweigh the density disadvantage and gunning is the correct method. This guide defines when each scenario applies, which mix properties enable hot-face performance, and how to calculate real in-place cost including rebound to compare accurately against casting.

Gunning is used across cement kilns (inlet and outlet zone patches), EAF and ladle repairs, glass furnace crown repairs, and industrial boiler hot-face maintenance. The Zibo refractory manufacturing cluster produces both standard and specialty gunning mixes covering the full temperature range from 1,200℃ to 1,650℃ service, including alkali-resistant and abrasion-resistant formulations for the most demanding repair environments.

The Four Scenarios Where Gunning Wins

Scenario 1: Emergency Hot Repair Without Full Shutdown

When a kiln or furnace develops a localised hot spot — shell temperature above 350℃ on a cement kiln, or visible lining erosion on an EAF — the economic cost of a full shutdown for conventional casting (cool-down, formwork installation, cast, cure, dry-out, heat-up: typically 7–14 days) is often larger than the cost of several months of gunning-maintained operation. Gunning mixes formulated for hot application (substrate temperature 200–600℃) allow repair of the affected zone with a 4–8 hour shutdown window rather than a full relining campaign. The

repaired patch operates at reduced thickness (50—100 mm vs 150—200 mm full lining) and will need replacement at the next planned shutdown, but the furnace returns to production within hours.

Operational rule: Hot-repair gunning buys time — it does not replace full relining. Schedule the full repair at the next planned shutdown. Operating a hot-gunned patch beyond 3—4 months without inspection risks accelerated failure because the reduced thickness has lower thermal buffering capacity.

Scenario 2: Geometrically Inaccessible Areas

Formwork casting requires a closed void to fill. Where the geometry prevents formwork construction — curved overhead surfaces, taphole surrounds, tuyere zones, irregularly eroded cavities in existing linings — gunning is the only practical placement method. The material bonds to the substrate under pneumatic force and does not require gravity to fill a mould. Typical applications: EAF roof patches between water-cooled panels, blast furnace taphole surround maintenance, rotary kiln riding ring zones where the kiln support geometry prevents formwork access.

Scenario 3: Partial-Thickness Face Relining (Encapsulation)

When a lining has eroded to 60—70% of original thickness but remains structurally sound (no cracking through the cold face, no shell deformation), gunning a 50—80 mm working face onto the existing lining extends campaign life without full demolition. This is standard practice in glass furnace side walls and steel ladle safety linings. The existing lining provides structural support, which compensates for the lower density of the gunned layer. Adhesion between old and new refractory is critical — the substrate must be cleaned of loose material, slag, and dust before gunning.

Scenario 4: Areas With Interrupted Installation Cycles

Casting requires continuous pouring to avoid cold joints — if a pour is interrupted for more than 45—60 minutes, the partially set material creates a weak plane. In large kilns and furnaces where installation proceeds in sections over multiple shifts, gunning eliminates the cold-joint risk because each pass is a discrete layer that bonds mechanically and thermally to the previous one without requiring wet-to-wet continuity.

When Casting Remains the Better Choice

Factor	Gunning Advantage	Casting Advantage
New full-thickness lining, accessible area	—	Higher density, better mechanical properties, lower in-place cost
Structural load-bearing zones	—	Full vibration consolidation achieves design density

Factor	Gunning Advantage	Casting Advantage
Large monolithic pours (>5 m^3)	—	No rebound loss; consistent density throughout
Emergency repair, hot substrate	No shutdown required; fast turnaround	—
Overhead or inaccessible geometry	No formwork needed; pneumatic placement	—
Partial-thickness face repair	Bonds to existing lining; no demolition	—
Interrupted installation (multi-shift)	No cold-joint risk between passes	—

Common mistake: Using gunning as a cost-saving measure on new accessible linings because it avoids formwork labour. The rebound loss (15—30% for dry-process) means the in-place material cost per cubic metre often exceeds casting once rebound is included. Gunning saves installation time and enables hot-surface placement; it does not consistently reduce material cost.

Mix Design: How Gunning Mixes Differ From Castables

A gunning mix is formulated to remain cohesive during pneumatic transport, adhere to the substrate on impact, and set rapidly enough to build thickness without slumping. These requirements differ from castable mix design in three ways:

- **Water content:** Gunning mixes use 10—14% water vs 6—9% for LCC castables. Higher water enables pumping but reduces final density and strength.
- **Accelerator:** Rapid-setting accelerators (sodium silicate, calcium aluminate cement additions) are used to achieve 2—4 hour handling strength and prevent sag on overhead applications.
- **Aggregate grading:** Finer aggregate distribution (top size 6—8 mm vs 10—12 mm for castables) reduces rebound by improving adhesion energy at the substrate surface.

Property	Gunning Mix (Wet Process)	Gunning Mix (Dry Process)	LCC Castable
Al_2O_3 %	60—75	60—75	65—80
Water addition %	10—14	Added at nozzle (8—12)	6—9
Bulk density (installed) kg/m^3	2,100—2,350	1,950—2,250	2,400—2,600
Rebound loss %	5—15	15—30	N/A
Min substrate temp ℃	−5 to +600	−5 to +800	5—40 (ambient cure)

Property	Gunning Mix (Wet Process)	Gunning Mix (Dry Process)	LCC Castable
Max single-pass thickness mm	50—80	40—70	No limit (vibrated)
Cold crushing strength (110℃) MPa	25—45	20—40	50—90

In-Place Cost Calculation: Including Rebound

The most common mistake when budgeting gunning vs casting is comparing quoted price per tonne. Rebound loss means the in-place material volume requires more tonnes than the installed volume suggests. Use this calculation:

Parameter	Dry-Process Gunning	Wet-Process Gunning	LCC Casting
Material price per tonne (index 100)	85	90	100
Rebound loss %	25	10	0
Tonnes needed per m^3 installed (bulk density 2,100 kg/m^3)	2.8	2.3	2.1
In-place material cost per m^3 (index)	238	207	210
Labour & formwork per m^3 (index)	60	65	120
Total installed cost per m^3 (index)	298	272	330

Key insight: Wet-process gunning has the lowest total installed cost per cubic metre in this comparison because formwork savings offset the material premium. Dry-process gunning looks cheap per tonne but rebound loss erases the advantage. When casting is structurally acceptable, it remains competitive on material cost alone; the saving from gunning comes from labour and access, not material price.

Dry-Out Requirements After Gunning

Gunned refractory requires the same staged dry-out as cast refractory — the higher water content in gunning mixes makes dry-out *more* critical, not less. Rapid heating of a freshly gunned patch causes steam explosion spalling (explosive dehydration) if the temperature ramp exceeds the moisture diffusion rate. Standard dry-out protocol after gunning:

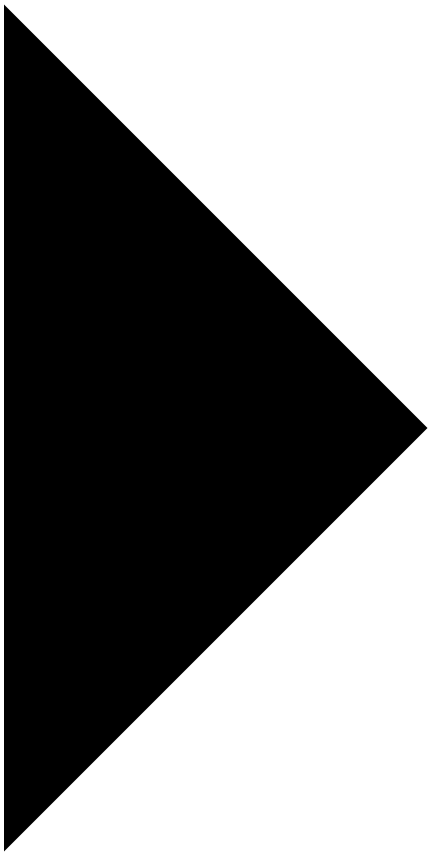
01 **Ambient cure: minimum 24 hours** before any heat exposure. 48 hours preferred for patches >80 mm thick. Do not use accelerated curing (steam or forced hot air) — it creates a hard surface crust while the interior remains wet.
02 **Ramp 1 (ambient to 150℃):** 25℃/hour maximum. Hold at 150℃ for 2 hours per 25 mm of thickness to drive free water.

03 **Ramp 2 (150℃ to 350℃):** 20℃/hour maximum. Hold at 300℃ for 2 hours to complete chemically bound water removal from calcium aluminate cement phases.
04 **Ramp 3 (350℃ to operating temperature):** 30℃/hour to service temperature. No hold required above 350℃ unless the mix contains hydraulic bonding phases requiring sintering hold.
05 **Hot-repair exception:** Gunning mixes designed for hot-substrate application (substrate >200℃) contain accelerated dewatering additives. Follow the specific datasheet ramp — it will differ from the above cold-start schedule.

Emergency Repair or Planned Relining?

Share your furnace type, zone dimensions, and substrate temperature. We recommend the right mix and calculate in-place cost with rebound included.

Request Mix Recommendation



Application Quality: Nozzle Distance and Rebound Control

Rebound loss and in-place density are directly controlled by nozzle technique. Poor technique can double rebound loss and create lamination defects (weak planes between passes where wet material was sprayed onto partially dried previous passes).

- **Nozzle distance:** 0.6—1.0 m from substrate is optimal. Closer than 0.5 m creates impact-driven delamination; farther than 1.2 m increases rebound and reduces density.

- **Nozzle angle:** 85—95° perpendicular to surface. Oblique angles increase rebound significantly — a 30° angle can increase rebound by 8—12 percentage points.
- **Pass thickness:** Apply in 20—30 mm passes. Let each pass stiffen (15—30 minutes) before the next pass to prevent the new material weight causing the previous layer to sag.
- **Rebound removal:** Sweep fallen rebound material away before it can be buried under subsequent passes. Buried rebound creates weak porous inclusions.
- **Cold-substrate pre-wetting:** For dry-process gunning on cold substrates (<50℃), light pre-wetting of the substrate surface improves first-layer adhesion and reduces initial rebound.

Contents

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We supply gunning mixes for hot-surface application up to 800℃ substrate. Response in 6 hours.

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Gunning Refractory — FAQ

Can gunning refractory achieve the same density as cast refractory?

No. Gunned refractory typically achieves 85—92% of the bulk density of the equivalent cast material due to rebound losses and the absence of vibration consolidation. For repair patches and complex-geometry fills where the parent lining provides structural support, this difference is acceptable. For new primary structural linings in accessible areas, casting remains preferable.

What is the maximum single-pass thickness for gunning refractory?

Single-pass gunning is limited to 50—80 mm depending on mix design and substrate temperature. Beyond this the material sags or delaminates before setting. Full lining thickness of 150—200 mm requires multiple passes with minimum 4—6 hours between passes.

How does rebound loss affect gunning refractory cost?

Rebound loss is 5—15% for wet-process and 15—30% for dry-process gunning. The material is unrecoverable. Effective in-place cost is 10—40% higher than the quoted price per tonne. Always calculate in-place cost including rebound when comparing gunning vs casting.

At what substrate temperature can gunning refractory be applied?

Most gunning mixes allow application to substrates up to 400–600℃ for emergency hot repairs without full shutdown. Specialist hot-gunning formulations allow up to 800℃. Standard casting mixes cannot be used for hot application because formwork placement is impractical at elevated temperatures.

Related Products

Explore Our Castable Range

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Low Cement Castable

Al_2O_3 70–80%, CaO <2.5%, service temp to 1,550℃. Standard grade for casting; also available in gunning formulation.

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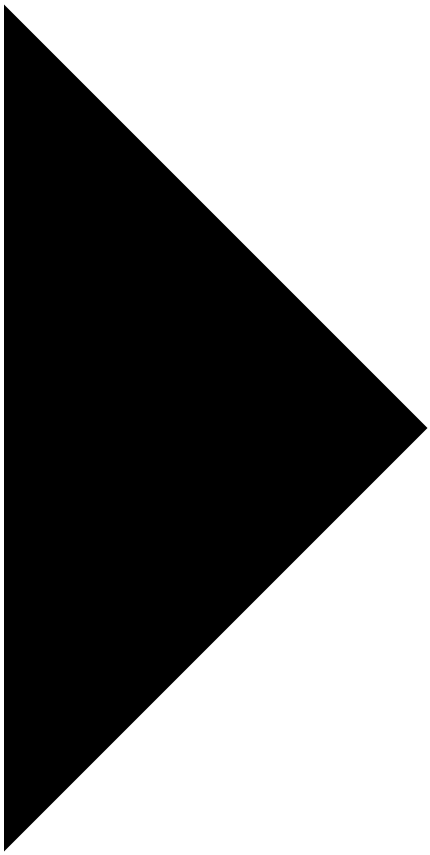

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High Alumina Castable

Al_2O_3 80–90%, suitable for EAF roof and ladle repair applications. Available in gunning mix specification.

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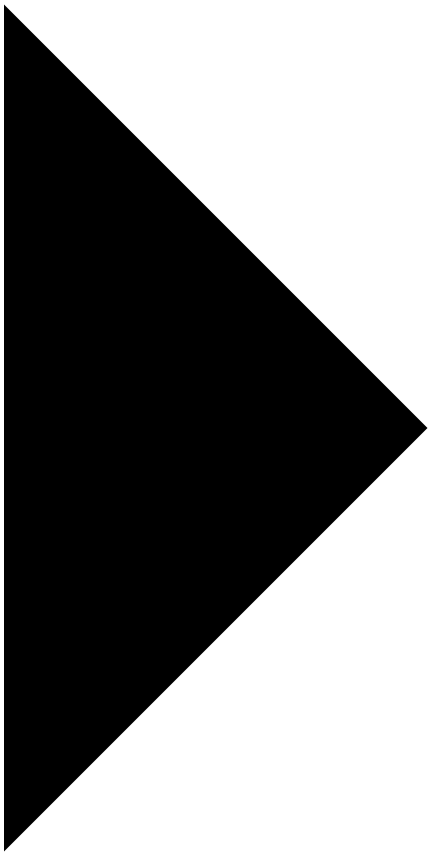

Gunning

Hot-Repair Gunning Mix

Formulated for substrate temperatures to 600℃. Accelerated set, low rebound. Suitable for cement kiln emergency patches and ladle hot repair.

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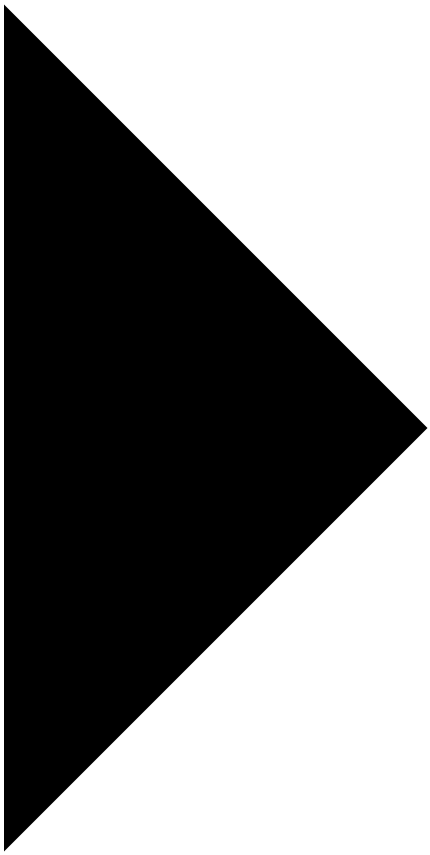

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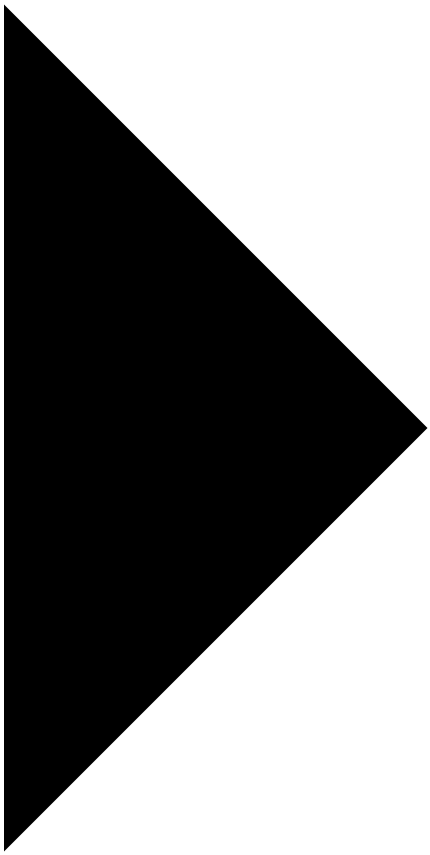

L2

Refractory Dry-Out Schedule

How to heat up a new castable lining without cracking — applies equally to gunned repairs.

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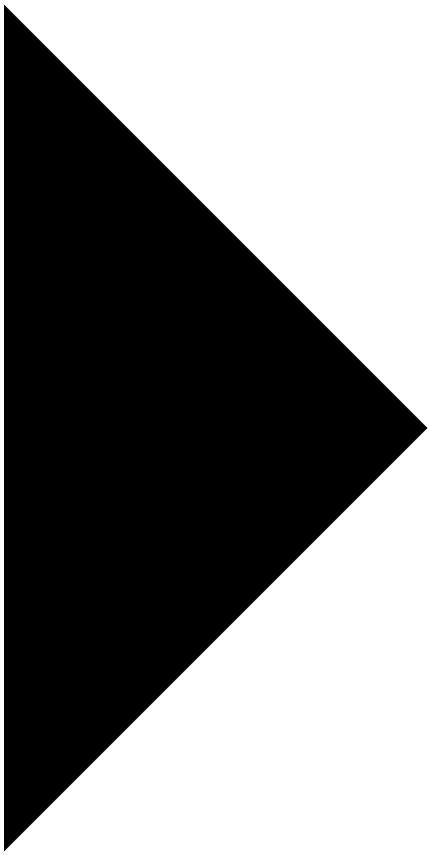

L1

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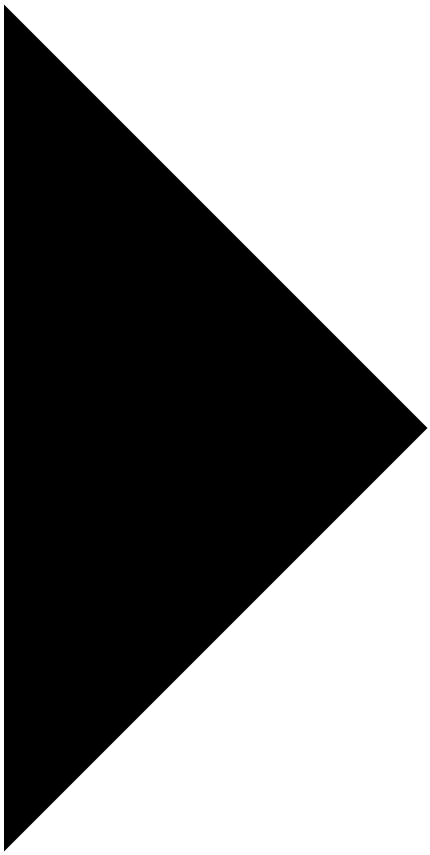

Gunning Mix Selection

Emergency Repair or Planned Relining?

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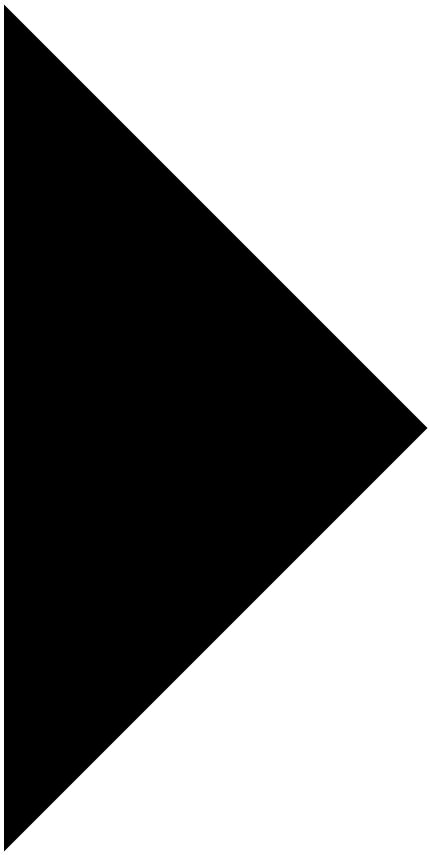

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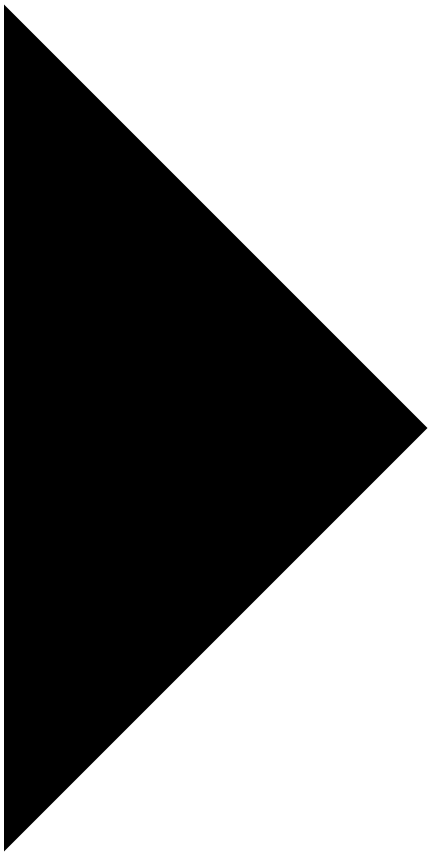

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