For all industries with extreme temperatures and working conditions, Calderys is there for you. Combining a global network with local expertise, we offer customised solutions wherever you are: from monolithic refractory to bricks and precast shapes to a full range of engineering and installation services.

**KEY POINTS**

- Over 100 years of refractory experience
- Over 2,300 employees across 33 countries
- 19 plants in 16 countries totaling 600,000 tons capacity
- Annual revenue of over €500 million
- 1 Global Technology Centre and 15 Customisation Labs
- 150 major projects implemented every year
- Wholly-owned subsidiary of Imerys Group
As a world leader in refractory solutions, Calderys has a complete product portfolio to satisfy all your refractory requirements. With our monolithic products and a full range of bricks, we are ideally positioned to offer individual as well as full package solutions including:

- Bricks for full relines, partial relines and patching
- Gunning Maintenance materials and castables
- A full range of remotely operated application equipment
- On site labour and supervision for efficient material installation

In addition to our product offerings, Calderys provides a complete range of services:

- Design
- Product selection
- Thermal calculations
- CFD analysis
- Installation
- Labour & machinery
- Supervision
- Repair service support
- Full refractory project management

Calderys is considered a reference supplier in the steel industry, offering value-added solutions based on tailor-made designs and engineering to provide refractory linings for optimal performance.

Our comprehensive technology and services are a result of a world-class R&D network, local expertise from over 30 locations around the globe, and over 100 years of experience in the refractory business.
The world leader in monolithic refractory solutions, Calderys has a full product and service portfolio to adapt to the refractory needs of steelmakers. We ensure that we propose products most suitable for your process requirements and deliver to you superior refractory performance and reliable services. We are able to do so by combining our innovative product range and modern installation techniques with end-to-end project management.

Value Optimisation
Offering tailor-made solutions that meet the commercial and technical requirements for optimal performance.

Complete Refractory Solutions
We offer a full range of refractory products to meet the process needs of modern Steelmaking.

Technology Expertise
Ensuring the best possible equipment availability and productivity at the lowest total refractory cost per ton of steel produced, whilst adhering to strict environmental and safety regulations in operations.
Calderys holds two basic principles as the highest priorities when designing tailor-made solutions for converters:

**Reduced refractory consumption**
Selecting the correct refractory products for each zone is the key to reducing the cost per ton of steel produced.

**High Grade, Long Life gunning maintenance materials**
Reduced gunning maintenance time means increased Converter productivity and efficiency. This results in higher production rates, more efficient production planning and increased production stability.

Calderys Lining Design In-depth: Principle Of Expansion Allowance

Calderys design expertise ensures that the magnesia bricks that make up the core of any converter refractory lining solution are installed in such a way that normal expansion stresses are taken into account.

The reversible thermal expansion of magnesia bricks at steelmaking temperatures is ~1.5 - 2.0%, which in bigger vessels can add more than 200 mm expansion per ring in the lining.

This can be partially compensated by inserting expansion allowance, typically in the form of cardboard sheets, in the ring. On site experience must be considered and our design personnel will make a recommendation taking all aspects into account.
CALDERYS SOLUTIONS FOR BOF CONVERTER

- Mouth
- Upper Cone
- Scrap Charge / Impact Pad
- Trunnion
- Backfill
- Bottom Joint
- Bottom
- Permanent Lining
- Tap Hole Annular Gap
- Tap Hole
- Slag Line
- Bottom Cone
# Wear Lining - Bricks

<table>
<thead>
<tr>
<th>Zone</th>
<th>Product Recommendations</th>
<th>Chemical Analysis (Averages)</th>
<th>Residual Carbon %</th>
<th>Bulk Density g/cm²</th>
<th>Apparent Porosity %</th>
<th>CCS MPa</th>
<th>Anti Oxidants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouth</td>
<td>CALDE® MAG BRICK FM 97 PI</td>
<td>MgO 96, CaO 2.0, Fe₂O₃ 1.5, SiO₂ 1.5</td>
<td>3</td>
<td>3.08</td>
<td>8</td>
<td>50</td>
<td>No</td>
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<tr>
<td></td>
<td>CALDE® BRICK MC R 212-B</td>
<td>MgO 97, CaO 0.9, Fe₂O₃ 0.7, SiO₂ 0.9</td>
<td>6</td>
<td>3.03</td>
<td>6</td>
<td>60</td>
<td>Yes</td>
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<tr>
<td></td>
<td>CALDE® BRICK MC R 502-B</td>
<td>MgO 96.5, - Fe₂O₃ 0.8, SiO₂ 0.8</td>
<td>6</td>
<td>3.08</td>
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<td>60</td>
<td>Yes</td>
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<tr>
<td>Upper Cone</td>
<td>CALDE® BRICK MC R 604-G</td>
<td>MgO 97, CaO 1.1, Fe₂O₃ 0.65, SiO₂ 0.55</td>
<td>12</td>
<td>3.04</td>
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<tr>
<td>Scrap charge / Impact pad</td>
<td>CALDE® BRICK MC R 804-G</td>
<td>MgO 97.5, CaO 1.0, Fe₂O₃ 0.5, SiO₂ 0.5</td>
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<td>3.02</td>
<td>3.4</td>
<td>45</td>
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<tr>
<td>Slag line, Trunnion, Bottom</td>
<td>CALDE® BRICK MC R 704-G</td>
<td>MgO 97.5, CaO 1.0, Fe₂O₃ 0.6, SiO₂ 0.5</td>
<td>12</td>
<td>3.03</td>
<td>2.5</td>
<td>45</td>
<td>Yes</td>
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<tr>
<td>Tunnion</td>
<td>CALDE® BRICK MC R 808-G</td>
<td>MgO 97.5, CaO 1.0, Fe₂O₃ 0.5, SiO₂ 0.5</td>
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<td>2.95</td>
<td>3</td>
<td>35</td>
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<td></td>
<td>CALDE® BRICK MC R 706-G</td>
<td>MgO 97.5, CaO 1.0, Fe₂O₃ 0.6, SiO₂ 0.5</td>
<td>15</td>
<td>3.00</td>
<td>3.1</td>
<td>35</td>
<td>Yes</td>
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<tr>
<td>Bottom / Bottom Cone</td>
<td>CALDE® BRICK MC R 606-G</td>
<td>MgO 97, CaO 1.1, Fe₂O₃ 0.65, SiO₂ 0.55</td>
<td>15</td>
<td>2.98</td>
<td>3.1</td>
<td>35</td>
<td>Yes</td>
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<td>CALDE® BRICK MC R 502-N</td>
<td>MgO 96.5, - Fe₂O₃ 0.8, SiO₂ 0.8</td>
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<td>4.7</td>
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<td>CALDE® BRICK MC R 212-N</td>
<td>MgO 97, CaO 0.9, Fe₂O₃ 0.7, SiO₂ 0.9</td>
<td>6</td>
<td>2.99</td>
<td>6</td>
<td>60</td>
<td>No</td>
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</table>

# Permanent Lining - Bricks

<table>
<thead>
<tr>
<th>Zone</th>
<th>Product Recommendations</th>
<th>Chemical Analysis (Averages)</th>
<th>Residual Carbon %</th>
<th>Bulk Density g/cm²</th>
<th>Apparent Porosity %</th>
<th>CCS MPa</th>
<th>Anti Oxidants</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Zones</td>
<td>CALDE® MAG BRICK FM 95</td>
<td>MgO 95.0, CaO 2.0, Fe₂O₃ 1.5, SiO₂ 2.5</td>
<td>-</td>
<td>2.95</td>
<td>18</td>
<td>50</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>CALDE® BRICK MC R 112-N</td>
<td>MgO 94.5, CaO 2.3, Fe₂O₃ 0.8, SiO₂ 2.3</td>
<td>6</td>
<td>2.94</td>
<td>8.3</td>
<td>60</td>
<td>No</td>
</tr>
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</table>

# Bricks For Special Zones And Components

<table>
<thead>
<tr>
<th>Zone</th>
<th>Product Recommendations</th>
<th>Chemical Analysis (Averages)</th>
<th>Residual Carbon %</th>
<th>Bulk Density g/cm²</th>
<th>Apparent Porosity %</th>
<th>CCS MPa</th>
<th>Anti Oxidants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap Hole</td>
<td>CALDE® BRICK MC R 806-E</td>
<td>MgO 97.5, CaO 1.0, Fe₂O₃ 0.5, SiO₂ 0.5</td>
<td>15</td>
<td>2.95</td>
<td>3.2</td>
<td>35</td>
<td>Yes</td>
</tr>
<tr>
<td>Tap Hole, Tap Hole surround</td>
<td>CALDE® BRICK MC R 706-E</td>
<td>MgO 97.5, CaO 1.0, Fe₂O₃ 0.6, SiO₂ 0.5</td>
<td>15</td>
<td>2.98</td>
<td>2.3</td>
<td>35</td>
<td>Yes</td>
</tr>
<tr>
<td>Purging Plugs</td>
<td>CALDE® BRICK MC R 806-G</td>
<td>MgO 97.5, CaO 1.0, Fe₂O₃ 0.5, SiO₂ 0.5</td>
<td>15</td>
<td>2.95</td>
<td>3.0</td>
<td>35</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Monolithics For Maintenance, Repair And Special Zones

**Gunning**
- **High grade**
  - CALDE® MAG GUN BRG
  - CALDE® MAG GUN HD
  - CALDE® MAG GUN P 83
- **Standard grade**
  - CALDE® MAG GUN G 89
  - CALDE® MAG GUN S 89

**Tap Hole Repair**
- CALDE® MAG FLOW K 94
- CALDE® MAG CAST G 95
- CALDE® MAG GUN P 83 T

**Gunning**
- **Deskulling Gunning Aids**
  - CALDE® MAG GUN PSC 60 C2
  - CALDE® MAG GUN S 80
- **Hot Repair**
  - CALDE® MAG DRY S 75
  - CALDE® MAG FLOW K 94 HOT
  - CALDE® MAG BDTF 7001

**Gunning**
- **Ready Shaped / Vibrating**
  - CALDE® MAG GUN BRG
  - CALDE® MAG GUN HD
  - CALDE® MAG GUN P 83
- **Self-Flow**
  - CALDE® MAG BRG
  - CALDE® MAG HD
  - CALDE® MAG P 83

**Backfill**
- CALDE® MAG DRY K 78 G2

**Bottom Joint**
- CALDE® MAG DRY K 95
- CALDE® MAG RAM R 96 G

### Extending BOF Life In a Cost-Efficient Manner

Based on our global experience, we think that one particular gunning method cannot suit the needs of all steel plants.

The Calderys gunning and repair philosophy is dictated to a large extent by the balance between converter availability requirements and refractory life requirements.

Our converter refractory maintenance aim is to increase overall furnace availability, extend vessel life and reduce the total refractory cost per ton of steel produced.

**Focus: Composition Of BOF Maintenance Products**

Our family of BOF maintenance products optimise the use of MgO and CaO bearing aggregates and use specialised and sophisticated phosphate bonding systems which interact with the converter slag to increase sticking, durability and reduce material consumption and maintenance time.
**CALDE® MACHINE DRY GUN**

A full range of Automated Remote controlled Pressure vessel gunning machines operated with compressed air. Available in 2 models: permanent or mobile.

**BOF SHOOTER**

A Remote controlled gunning robot or 'Shooter' is available to ensure operator safety and fast, efficient, and accurate placement of material.

---

**Monolithic Refractory for BOF Converters**

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Main Component</th>
<th>Binding System</th>
<th>Max. Recomm. Temp (°C)</th>
<th>Max. Grain Size (mm)</th>
<th>Chemical Analysis (Averages %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALDE® MAG BDTF 7001</td>
<td>Magnesia</td>
<td>Carbon bonded</td>
<td>1700</td>
<td>8</td>
<td>MgO: 76.5, CaO: 2.5, SiO₂: -</td>
</tr>
<tr>
<td>CALDE® MAG CAST G 95</td>
<td>Magnesia</td>
<td>Chemical</td>
<td>1750</td>
<td>3.15</td>
<td>MgO: 94.4, CaO: 2.2, SiO₂: 2.2</td>
</tr>
<tr>
<td>CALDE® MAG DRY K 78 G2</td>
<td>Magnesia</td>
<td>Ceramic</td>
<td>1750</td>
<td>2</td>
<td>MgO: 78, CaO: 12.5, SiO₂: 1.2</td>
</tr>
<tr>
<td>CALDE® MAG DRY K 95</td>
<td>Magnesia</td>
<td>Ceramic</td>
<td>1700</td>
<td>5</td>
<td>MgO: 94.5, CaO: 2, SiO₂: 1.5</td>
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<tr>
<td>CALDE® MAG DRY S 75</td>
<td>Magnesia</td>
<td>Chemical</td>
<td>1700</td>
<td>3</td>
<td>MgO: 79, CaO: - , SiO₂: 10.5</td>
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<tr>
<td>CALDE® MAG FLOW K 94 HOT</td>
<td>Magnesia</td>
<td>Mineral Reaction</td>
<td>1850</td>
<td>6</td>
<td>MgO: 94, CaO: - , SiO₂: 4.6</td>
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<tr>
<td>CALDE® MAG GUN BRG</td>
<td>Magnesia</td>
<td>Chemical</td>
<td>1700</td>
<td>4</td>
<td>MgO: 76, CaO: 17, SiO₂: 0.5</td>
</tr>
<tr>
<td>CALDE® MAG GUN G 89</td>
<td>Magnesia</td>
<td>Chemical</td>
<td>1750</td>
<td>3.5</td>
<td>MgO: 86, CaO: 3.1, SiO₂: 9.3</td>
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<tr>
<td>CALDE® MAG GUN HD</td>
<td>Magnesia</td>
<td>Chemical</td>
<td>1750</td>
<td>4</td>
<td>MgO: 73.5, CaO: 17.5, SiO₂: 2.2</td>
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<tr>
<td>CALDE® MAG GUN P 83</td>
<td>Magnesia</td>
<td>Chemical</td>
<td>1750</td>
<td>3.5</td>
<td>MgO: 83, CaO: 3.9, SiO₂: 8.8</td>
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<tr>
<td>CALDE® MAG GUN PSC 60 C2</td>
<td>Magnesia, Olivine</td>
<td>Chemical</td>
<td>1650</td>
<td>3.5</td>
<td>MgO: 60.5, CaO: 2.4, SiO₂: 28</td>
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<tr>
<td>CALDE® MAG GUN S 65</td>
<td>Magnesia</td>
<td>Chemical</td>
<td>1700</td>
<td>3.15</td>
<td>MgO: 65, CaO: 20.0, SiO₂: 12</td>
</tr>
<tr>
<td>CALDE® MAG GUN S 89</td>
<td>Magnesia</td>
<td>Chemical</td>
<td>1750</td>
<td>3.5</td>
<td>MgO: 87.1, CaO: 2.5, SiO₂: 6.9</td>
</tr>
<tr>
<td>CALDE® MAG RAM R 96 G</td>
<td>Magnesia, Carbon</td>
<td>Chemical</td>
<td>1700</td>
<td>5</td>
<td>MgO: 96, CaO: 2.5, SiO₂: 1.5</td>
</tr>
</tbody>
</table>

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