

3M Advanced Materials Division

# 3M™ Antioxidants for Carbon-Bonded Refractories

## Introduction

Carbon is used in refractory materials to improve thermal shock resistance and to protect against wetting by metals and slag. Carbon bonded refractories also have the best chemical resistance against molten steel. However, they are sensitive to oxidation and require extra protection. 3M offers a family of ceramic-based powders as antioxidants for carbon-bonded refractories. While metallic additives are very common, ceramic antioxidants have proven to be more effective at prolonging the service life of carbon bonded refractory materials.

## Typical Chemical Composition

(Not for specification purposes.)

<b>B<sub>4</sub>C</b>	
B + C	>95%
C <sub>free</sub>	<4%
N	<2%

  

<b>CaB<sub>6</sub></b>	
Ca + B	>87%
C	<6%



Grains and Powders



3M™ Boron Carbide

### 3M™ Boron Carbide (B<sub>4</sub>C) Powders

When oxidized, an interaction occurs with the matrix material to form liquid and/or gaseous phases that protect the carbon from oxidation. This material has a proven track record for use with carbon-bonded aluminum oxide (Al<sub>2</sub>O<sub>3</sub>-C) slide gates and various isostatically pressed components and monolithics.

#### Grain Size Distribution

(Not for specification purposes)

Property	3M™ Antioxidants	
	B <sub>4</sub> C	CaB <sub>6</sub>
Particle Size Mesh	- 100	-400
3%-Value (minimum 97%)	<56 μm	<56 μm
50%-Value (average)	3 – 15 μm	9 – 17 μm
94%-Value (maximum 6%)	<1 μm	<5 μm

Measured with laser diffractometer, Coulter LS 13320.  
Additional coarser or finer grain sizes on request.



3M™ Calcium Hexaboride

### 3M™ Calcium Hexaboride (CaB<sub>6</sub>) Powders

This material is primarily used for carbon-bonded magnesium oxide (MgO) bricks and monolithics in steel production.

#### Typical Physical Properties

(Not for specification purposes)

Property	3M™ Antioxidants	
	B <sub>4</sub> C	CaB <sub>6</sub>
Crystal Structure	rhombohedral	cubic
Molecular Weight	55.26 g/mol	104.95 g/mol
Density	2.54 g/cm <sup>3</sup>	2.45 g/cm <sup>3</sup>
Melting Point	2,450°C 4,440°F	2,185°C 3,965°F
Hardness (Mohs scale)	9	8 – 9
Thermal Expansion (20 – 1,000°C)*	5 × 10 <sup>-6</sup> /K	6.5 × 10 <sup>-6</sup> /K

\* measured on dense shapes

**Warranty, Limited Remedy, and Disclaimer:** Many factors beyond 3M's control and uniquely within user's knowledge and control can affect the use and performance of a 3M product in a particular application. User is solely responsible for evaluating the 3M product and determining whether it is fit for a particular purpose and suitable for user's method of application. User is solely responsible for evaluating third party intellectual property rights and for ensuring that user's use of 3M product does not violate any third party intellectual property rights. Unless a different warranty is specifically stated in the applicable product literature or packaging insert, 3M warrants that each 3M product meets the applicable 3M product specification at the time 3M ships the product. 3M MAKES NO OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY IMPLIED WARRANTY OF NON-INFRINGEMENT OR ANY IMPLIED WARRANTY OR CONDITION ARISING OUT OF A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE. If the 3M product does not conform to this warranty, then the sole and exclusive remedy is, at 3M's option, replacement of the 3M product or refund of the purchase price.

**Limitation of Liability:** Except where prohibited by law, 3M will not be liable for any loss or damages arising from the 3M product, whether direct, indirect, special, incidental or consequential, regardless of the legal theory asserted, including warranty, contract, negligence or strict liability.

**Technical Information:** Technical information, recommendations, and other statements contained in this document or provided by 3M personnel are based on tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed. Such information is intended for persons with knowledge and technical skills sufficient to assess and apply their own informed judgment to the information. No license under any 3M or third party intellectual property rights is granted or implied with this information.

The management system has been certified according to DIN EN ISO 9001, DIN EN ISO 50001, DIN EN ISO 14001.



### 3M Technical Ceramics

Zweigniederlassung der 3M Deutschland GmbH  
Max-Schaidhauf-Str. 25, 87437 Kempten, Germany

Phone +49 (0)831 5618-0  
Email [info.technical-ceramics@3M.com](mailto:info.technical-ceramics@3M.com)  
Web [www.3M.de/Technical-Ceramics](http://www.3M.de/Technical-Ceramics)

### 3M Advanced Materials Division

3M Center  
St. Paul, MN 55144 USA

Phone 1-800-367-8905  
Web [www.3M.com/advancedceramics](http://www.3M.com/advancedceramics)

3M is a trademark of 3M Company.  
Used under license by 3M subsidiaries  
and affiliates.

Please recycle. Printed in USA © 3M 2017.  
All rights reserved. Issued: 3/17 11233HB  
98-0050-0334-2