3M Advanced Materials Division

3M™ Enriched Boric Acid

Introduction
3M Technical Ceramics, Inc. a 3M company, specializes in isotopic boron products for specific applications. Our manufacturing systems give us the flexibility to customize isotopic composition to meet customer requirements. 3M™ Enriched Boric Acid is one of the basics of our product line, and is a precursor for most of our other boron containing chemicals. Enriched in either isotope to very high levels, our boric acid exceeds accepted standards of the nuclear industry throughout the world. In chemical reactions, our enriched products behave the same as their natural counterparts.

In a thermal neutron environment, Boron isotopes have opposing neutron capture cross sections. Whereas $^{10}$Boron is an extremely good neutron absorber, $^{11}$Boron is considered to be neutron transparent.

3M Technical Ceramics, Inc. manufactures a standard grade of $^{10}$B enriched boric acid to satisfy many nuclear applications. For those applications where standard product characteristics are not suitable or where alternative purity is acceptable, custom materials are also available. Product data is available for standard products as well as customized products.

Typical Physical Properties
(Not for specification purposes)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>$^{10}$B Enriched Boric Acid</th>
<th>$^{11}$B Enriched Boric Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrichment</td>
<td>To 96+% Atomic</td>
<td>To 99+% Atomic</td>
</tr>
<tr>
<td>Molecular Weight</td>
<td>61.045 @ 99% $^{10}$B</td>
<td>62.021 @ 99% $^{11}$B</td>
</tr>
<tr>
<td>Thermal Neutron Cross Section (Barns)</td>
<td>3837</td>
<td>0.005</td>
</tr>
</tbody>
</table>

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<tbody>
<tr>
<td>Enrichment</td>
<td>96 wt% $^{10}$B</td>
<td>98 wt% $^{11}$B</td>
</tr>
<tr>
<td>Equivalent Boric Acid</td>
<td>99.95 wt% min. $^{10}$B</td>
<td>99.95 wt% min. $^{11}$B</td>
</tr>
</tbody>
</table>

Impurities:
- Aluminum: 1 ppm max. —
- Arsenic: 0.2 ppm max. —
- Calcium: 1 ppm max. 2 ppm max.
- Chlorine: 0.26 ppm max. 2 ppm max.
- Fluorine: 0.2 ppm max. 1 ppm max.
- Heavy Metals (as Pb): 0.5 ppm max. —
- Iron: 2 ppm max. 2 ppm max.
- Magnesium: 1 ppm max. —
- Phosphates: 0.1 ppm max. 0.5 ppm max.
- Silicon Dioxide: 2 ppm max. —
- Sodium: 2 ppm max. 3 ppm max.
- Sulfates: 0.12 ppm max. 1.5 ppm max.
- Water Insolubles: 10 ppm max. 40 ppm max.

Boron Enrichment Capabilities
3M Technical Ceramics, Inc. is a leading global commercial processor of enriched boron, and is one of the largest boron isotope enrichment facilities in the world today. We focus on manufacturing optimized materials with an emphasis on stable boron isotopes. Our proprietary manufacturing processes allow $^{10}$B and $^{11}$B enrichment from natural occurring ratios up to levels exceeding 99% isotopic purity. We offer secure supply, consistent product quality and the ability to custom engineer products for your unique applications. Our specialists are experts at solving materials-related problems in the demanding nuclear and semiconductor industries. For more information, contact us at boron@mmm.com.

Analytical Services
As a manufacturer of specialty, high purity chemical and isotopic products, 3M Technical Ceramics, Inc. maintains sophisticated analytical and testing capabilities at its manufacturing facility in Quapaw, OK. Our analytical laboratories support on-site production activities and provide our customers with data and evidence that the products they receive meet or exceed their requirements. Our laboratories are fully equipped with current-generation instruments to perform a full range of testing.
Product is manufactured and sold by 3M Technical Ceramics Inc.

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Regulatory Summary

"B Enriched Boric Acid is approved for specific commercial use under a U.S. EPA Low Volume Exemption.

Approved commercial use:
Precurser for other chemicals
Refer to SDS for additional information.

Product Storage, Handling and Safety

Storage: Keep container tightly closed. Store away from heat. See product Safety Data Sheet (SDS) for additional information.

Handling: Do not handle until all safety precautions have been read and understood. Do not breathe dust/fume/gas/mist/vapors/spray. Do not get in eyes, on skin, or on clothing. Do not eat, drink or smoke when using this product. Wash thoroughly after handling. Avoid release to the environment. Use personal protective equipment (gloves, respirators, etc.) as required. See product SDS for additional information.

Safety: Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. See product SDS for additional information.

Packaging

Poly bottle or fiber drum, protected by vapor barrier bag. Certificate of Analysis provided with each shipment. Specific enrichments, purities and particle sizes are available to meet special requirements.