Aluminium Boron

The electrical conductivity of aluminium can be dramatically improved by the addition of tightly controlled amounts of boron to eliminate the undesirable effects of chromium, titanium, vanadium, and zirconium. Aluminium-boron master alloys in the form of waffle, bar, or continuous feeding rod provide a convenient mechanism for making the desired boron addition. Boron has also been acknowledged as an effective grain refiner for aluminium-silicon alloys.

AMG Aluminum produces master alloys of AlB₁₂ and AlB₂ phase morphology dependent on boron concentration. AlB₁₂ particles are large and settle quicker while AlB₂ particles are smaller and are less likely to produce sludge buildup in the furnace. Both types of particles react immediately when introduced into molten aluminium, and form borides of Cr, Ti, V, and Zr.

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Designation</th>
<th>Color Code</th>
<th>B</th>
<th>Si</th>
<th>Fe</th>
<th>Ti</th>
<th>K</th>
<th>Na</th>
<th>Others Each</th>
<th>Total</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>3% Boron</td>
<td>AA-H2203</td>
<td>![ ]</td>
<td>2.5 - 3.5%</td>
<td>0.20%</td>
<td>0.30%</td>
<td>1.0%</td>
<td>0.50%</td>
<td>0.03%</td>
<td>0.10%</td>
<td>Waffle Ingot</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CEN-90500</td>
<td>![ ]</td>
<td>2.5 - 3.5%</td>
<td>0.30%</td>
<td>0.30%</td>
<td></td>
<td></td>
<td>0.04%</td>
<td>0.10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4% Boron</td>
<td>AA-H2204</td>
<td>![ ] ![ ]</td>
<td>3.5 - 4.5%</td>
<td>0.20%</td>
<td>0.30%</td>
<td>1.0%</td>
<td>0.50%</td>
<td>0.03%</td>
<td>0.10%</td>
<td>Waffle Ingot</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CEN-90502</td>
<td>![ ] ![ ]</td>
<td>3.5 - 4.5%</td>
<td>0.30%</td>
<td>0.30%</td>
<td></td>
<td></td>
<td>0.04%</td>
<td>0.10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5% Boron</td>
<td>AA-H2217</td>
<td>![ ] ![ ] ![ ]</td>
<td>4.5 - 5.5%</td>
<td>0.20%</td>
<td>0.30%</td>
<td>0.05%</td>
<td>1.0%</td>
<td>0.50%</td>
<td>0.03%</td>
<td>0.10%</td>
<td>Waffle Ingot, Rod</td>
</tr>
<tr>
<td></td>
<td>CEN-90504</td>
<td>![ ] ![ ] ![ ]</td>
<td>4.5 - 5.5%</td>
<td>0.30%</td>
<td>0.30%</td>
<td></td>
<td></td>
<td>0.04%</td>
<td>0.10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8% Boron</td>
<td>AA-H2222</td>
<td>![ ] ![ ]</td>
<td>7.5 - 9.0%</td>
<td>0.25%</td>
<td>0.30%</td>
<td>0.05%</td>
<td>1.0%</td>
<td>0.50%</td>
<td>0.03%</td>
<td>0.10%</td>
<td>Waffle Ingot, nugget</td>
</tr>
<tr>
<td>10% Boron</td>
<td></td>
<td>![ ] ![ ]</td>
<td>9.0 - 11.0%</td>
<td>0.30%</td>
<td>0.35%</td>
<td>0.08%</td>
<td>1.0%</td>
<td>0.50%</td>
<td>0.03%</td>
<td>0.10%</td>
<td>Waffle Ingot</td>
</tr>
</tbody>
</table>

Composition is a maximum unless shown as a range.
Aluminium Boron

Determination of addition quantity
The amount of aluminium boron required to remove unwanted chromium, titanium, vanadium, and zirconium as insoluble borides is easily calculated. The following “rule of thumb” equations, which are simplified versions of the stoichiometric equations, may be used for determining the amount of aluminium boron required.

_mass addition calculation: waffle and bar

\[ B = \left( \frac{M}{P} \right) \times \frac{Cr+Ti+V+Zr}{2} \]

Where:
- \( B \) = Total weight of aluminium boron required, pounds (kilograms)
- \( M \) = Weight of aluminium to be treated, pounds (kilograms)
- \( P \) = Concentration of boron in AlB master alloy, weight percent, i.e., 10, 8, 5, 4 or 3 percent
- \( Cr, Ti, V, Zr \) = Concentration of impurity element, weight percent

Addition Calculation: Continuous Rod

\[ F = \left( \frac{R}{PW} \right) \times \frac{Cr+Ti+V+Zr}{2} \]

Where:
- \( F \) = Feed rate, inches (meters) per minute
- \( R \) = Aluminium flow rate, pounds (kilograms) per minute
- \( P \) = Concentration of boron in aluminium boron, weight percent, i.e., 5, 4 or 3 percent
- \( W \) = Weight per unit length of rod, 0.011 lbs. per inch (0.192 kilograms per meter)
- \( Cr, Ti, V, Zr \) = Concentration of impurity element, weight percent

**AlB\(_{12}\)**
- Quick settling
- Available in 3% - 8%, 10%
- Available in waffle, sheared cast bar, and rod 3% - 5%

**AlB\(_{12}\)**
- Rapid reaction, minimal sludging
- Available in 3% - 5%
- Continuous feeding rod available for trough addition