SPECIALITY GRAPHITE MATERIALS
FOR CONTINUOUS CASTING

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A WORLD EXPERT in materials and solutions for high temperature processes
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Global expert in materials and solutions for extreme environments as well as in the safety and reliability of electrical equipment Mersen designs innovative solutions to address its clients specific needs to enable them to optimize their manufacturing processes in sectors such as energy, transportation, electronics, chemical, pharmaceutical and process industries.
Continuous casting

is a metallurgical process which allows continuous control of the transformation from a liquid metal to a solid state in order to directly obtain semi-finished products like:

- wires,
- rods,
- tubes,
- strips,
- custom sections.

The graphite “die” used in this transformation, permits:

- the shaping of the metal,
- the heat extraction necessary to transform the metal from liquid to solid state.
The selection of the best graphite grade for your application...

... depends mainly on the composition of the alloy to be cast: grey iron requires a graphite resistant to wear abrasion; brass, a graphite relatively dense but with enough open porosity to allow zinc to evaporate in the area of the solidification front; non-ferrous alloys containing elements like nickel or cobalt need high density graphite to reduce chemical attack of the graphite die...

The other parameters which determine the choice of the grade are:

- the size and shape of the cast section,
- the speed of casting,
- the total amount of alloy to cast,
- casting orientation (i.e., vertical or horizontal).

In addition to the graphite grade chosen, the casting results are also a function of die design, quality of machining, and the specific characteristics of the casting installation. Our grades have been developed in conjunction with foundrymen to obtain the proper blend of physical characteristics for continuous casting. We can provide technical services to assist you in finding a suitable graphite for your application. However, in many cases optimal grade selection can be made only through actual trials. The following application chart should be used only as an indicative guide for grade selection.

**Recommended Grades**

<table>
<thead>
<tr>
<th>Cast alloy</th>
<th>Wire casting</th>
<th>Billet casting</th>
<th>Strip casting</th>
<th>Tube casting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey and ductile iron</td>
<td>-</td>
<td>1940</td>
<td>1940</td>
<td>1940</td>
</tr>
<tr>
<td>Brass (Cu-Zn)</td>
<td>2236 - 2554</td>
<td>2236 - 2554</td>
<td>2236 - 2554</td>
<td>2236 - 2554</td>
</tr>
<tr>
<td>Bronze</td>
<td>2236 - 2554</td>
<td>2236 - 2554</td>
<td>2236 - 2554</td>
<td>2236 - 2554</td>
</tr>
<tr>
<td>Phosphorus bronze</td>
<td>2220 - 2236</td>
<td>2220 - 2236</td>
<td>2220 - 2236</td>
<td>2220 - 2236</td>
</tr>
<tr>
<td>Maillechort (Cu-Zn-Ni) Nickel-silver</td>
<td>2230 - 2554</td>
<td>2230 - 2554</td>
<td>2554</td>
<td>2220 - 2236</td>
</tr>
<tr>
<td>Nickel-copper</td>
<td>2230 - 2554</td>
<td>2230 - 2554</td>
<td>2230 - 2554</td>
<td>2554</td>
</tr>
<tr>
<td>Red copper, Phosphorus deoxidized copper</td>
<td>1940</td>
<td>1940 - 2220</td>
<td>2230</td>
<td>-</td>
</tr>
<tr>
<td>Aluminium</td>
<td>1940</td>
<td>1940 - 2220</td>
<td>1940 - 2220</td>
<td>-</td>
</tr>
<tr>
<td>Silver, Gold</td>
<td>2236 - 2554</td>
<td>-</td>
<td>2236 - 2554</td>
<td>-</td>
</tr>
<tr>
<td>Precious metal alloys</td>
<td>2236 - 2554</td>
<td>-</td>
<td>2236 - 2554</td>
<td>2236 - 2554</td>
</tr>
</tbody>
</table>
## Typical characteristics

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>2020</th>
<th>1940</th>
<th>2220</th>
<th>2236</th>
<th>2230</th>
<th>2554</th>
</tr>
</thead>
<tbody>
<tr>
<td>THERMAL CONDUCTIVITY</td>
<td>W/m^°C</td>
<td>85</td>
<td>95</td>
<td>112</td>
<td>140</td>
<td>112</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>Btu-Ft/°F/HzF</td>
<td>49</td>
<td>55</td>
<td>65</td>
<td>81</td>
<td>65</td>
<td>81</td>
</tr>
<tr>
<td>Density</td>
<td>g/cm³</td>
<td>1.77</td>
<td>1.79</td>
<td>1.84</td>
<td>1.78</td>
<td>1.9</td>
<td>1.88</td>
</tr>
<tr>
<td>Porosity</td>
<td>lbs/ft³</td>
<td>110.5</td>
<td>112</td>
<td>114</td>
<td>111</td>
<td>118</td>
<td>117</td>
</tr>
<tr>
<td>Hardness</td>
<td>Rockwell</td>
<td>95H</td>
<td>98L</td>
<td>80H</td>
<td>80L</td>
<td>85H</td>
<td>90H</td>
</tr>
<tr>
<td>(Young’s Modulus)</td>
<td>Shore</td>
<td>52</td>
<td>63</td>
<td>65</td>
<td>55</td>
<td>76</td>
<td>64</td>
</tr>
<tr>
<td>Modulus of elasticity</td>
<td>GPa</td>
<td>10.7</td>
<td>9.2</td>
<td>11.4</td>
<td>9.8</td>
<td>11.4</td>
<td>11.2</td>
</tr>
<tr>
<td>(Young’s Modulus)</td>
<td>psi/100</td>
<td>1.6</td>
<td>1.3</td>
<td>1.6</td>
<td>1.4</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Flexural strength</td>
<td>MPa</td>
<td>45</td>
<td>43</td>
<td>58</td>
<td>52</td>
<td>59</td>
<td>52</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>psi</td>
<td>6,500</td>
<td>10,300</td>
<td>8,400</td>
<td>7,500</td>
<td>8,500</td>
<td>7,500</td>
</tr>
<tr>
<td>Coefficient of Thermal Expansion (CTE)</td>
<td>x10^-6 / °C</td>
<td>4.3</td>
<td>5.2</td>
<td>5.5</td>
<td>4.0</td>
<td>5.4</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>x10^-6 / °F</td>
<td>2.4</td>
<td>2.9</td>
<td>3.1</td>
<td>2.1</td>
<td>3.0</td>
<td>2.3</td>
</tr>
<tr>
<td>Electrical resistivity</td>
<td>µohm.cm</td>
<td>1,550</td>
<td>1,320</td>
<td>1,140</td>
<td>965</td>
<td>1,140</td>
<td>965</td>
</tr>
<tr>
<td></td>
<td>ohm-in</td>
<td>0.00061</td>
<td>0.00052</td>
<td>0.00045</td>
<td>0.00038</td>
<td>0.00045</td>
<td>0.00038</td>
</tr>
<tr>
<td>Average grain size</td>
<td>µm</td>
<td>15</td>
<td>13</td>
<td>13</td>
<td>10</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>inch</td>
<td>0.0006</td>
<td>0.0005</td>
<td>0.0005</td>
<td>0.0004</td>
<td>0.0005</td>
<td>0.0004</td>
</tr>
<tr>
<td>Max Standard block size</td>
<td>mm</td>
<td>1500x1500x300</td>
<td>530x435x1830</td>
<td>308x620x2030</td>
<td>308x620x915</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>inch</td>
<td>60x60x12&quot;</td>
<td>21.4x21.4x72</td>
<td>12x24x80</td>
<td>12x24x36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ash</td>
<td>ppm</td>
<td>750</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>1000</td>
<td>1000</td>
</tr>
</tbody>
</table>

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Graphite is well adapted for use as continuous casting dies because of its unique physical characteristics:

- Capable of withstanding molten metal temperatures. Graphite sublimates at 3,650°C and atmospheric pressure.
- High thermal conductivity.

### Typical values of thermal conductivity

<table>
<thead>
<tr>
<th>Material</th>
<th>W/m.°K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>385</td>
</tr>
<tr>
<td>Tungsten</td>
<td>163</td>
</tr>
<tr>
<td>Graphite for Continuous Casting</td>
<td>100</td>
</tr>
<tr>
<td>Nickel</td>
<td>90</td>
</tr>
<tr>
<td>Iron</td>
<td>75</td>
</tr>
<tr>
<td>Carbon</td>
<td>42</td>
</tr>
<tr>
<td>Brick</td>
<td>0.7</td>
</tr>
<tr>
<td>Rigid carbon insulation CALCARB®</td>
<td>0.1</td>
</tr>
</tbody>
</table>

### Graphite manufacturing

- RAW MATERIALS (natural graphite, coke, recycled graphite)
- SIEVING
- BAKING 1,000°C
- GRAPHITIZATION 3,000°C
- MACHINING
- COATING 1,500°C
- ISOSTATIC or UNIAXIAL COMPRESSION
- SEMI-FINISHED PRODUCTS
- FINAL TESTS

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- CARBON BRUSHES AND COMPONENTS
- GRAPHITE COMPONENTS FOR HIGH TEMPERATURES

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