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GrafTech International Ltd. ("GrafTech") is the leader in the carbon and graphite industry because we focus on maximizing our customer’s bottom line and providing unparalleled support for their business, while developing cutting edge technology that sets the standard in the steel industry. From the very beginning of the company in 1886 through today, we have worked in close partnership with our steelmaking customers by focusing on transforming their needs into products and services. Our knowledge base in the steelmaking process is unequalled in the graphite electrode industry and is the key to our unmatched technical service.

Throughout the last century and into the 21st century, GrafTech’s aggressive and impressive research and development record has led to revolutionary innovations in graphite technology which has increased productivity for our customers. GrafTech is proud of our strong commitment to our customers to provide the necessary competitive advantage to maximize productivity. Technical and service leadership is the foundation of our business.

GrafTech, through its Seadrift Coke L.P. subsidiary, produces petroleum needle coke, which is the key raw material in the manufacture of graphite electrodes, which are consumed in EAF steel production.

In August 2015, GrafTech became an indirect wholly owned subsidiary of Brookfield Asset Management Inc., which is an experienced operator of industrial, natural resource and other tangible asset businesses. This transaction has provided us a stable equity partner with experience in cyclical capital intensive industries.
GrafTech Global Quality

We consider sustained customer satisfaction the ultimate measure of product and service performance. Therefore, GrafTech’s stringent quality system focuses on customer’s needs and satisfaction. It is powered by lean and 6 sigma methodology to minimize product variation and drive continuous performance improvement.

- Our Arc Furnace Technology engineers analyze customer applications and requirements – current and future – and feed them into our technology systems. This enables us to optimize today’s electrode performance and model next generation technology.

- Technology uses material science to translate customer applications and requirements into raw material, processing and testing Best Practices. This key Know-How ensures that all of our manufacturing locations utilize the latest process technology.

- Manufacturing focuses on Best Practice procedures and targets. Process and product variation is minimized through extensive use of statistical process control.

- Customer Technical Service engineers provide electrode use Best Practices to assure optimum graphite electrode performance.

- GrafTech employs strategic management techniques to achieve optimal manufacturing capability and global quality. We utilize ISO 9000 standards and statistical process control throughout all levels of the organization to assure our success.
### Graphite Electrode Properties

#### Typical Range

<table>
<thead>
<tr>
<th>Property</th>
<th>Units</th>
<th>250-400mm</th>
<th>450-600mm</th>
<th>650-700mm</th>
<th>10”-18”</th>
<th>18”-24”</th>
<th>26”-30”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk density</td>
<td>g/cm³</td>
<td>1.55-1.66</td>
<td>1.66-1.74</td>
<td>1.56-1.66</td>
<td>1.66-1.73</td>
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<tr>
<td>Specific resistance</td>
<td>µm</td>
<td>6.0-8.0</td>
<td>4.7-6.0</td>
<td>5.5-7.0</td>
<td>4.3-5.4</td>
<td>4.1-4.8</td>
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<tr>
<td>Flexural strength</td>
<td>MPa</td>
<td>6.0-12.0</td>
<td>9.0-13.5</td>
<td>9.0-12.0</td>
<td>8.0-12.0</td>
<td>9.0-12.5</td>
<td>0-651</td>
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<td>Coefficient of thermal expansion</td>
<td>x10^-6/°C</td>
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<td>0.2-1.4</td>
<td>0.2-1.8</td>
<td>0.15-0.6</td>
<td>0.2-0.5</td>
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#### Testing Method (ASTM)

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<td>Specific resistance</td>
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<td>Coefficient of thermal expansion</td>
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</table>

#### Connecting Pin Properties

#### Main Properties

**Bulk Density**
A measurement of weight per unit volume. A higher bulk density will generally be reflected in improved mechanical properties.

**Specific Resistance**
The electrical resistance of a unit length of graphite. One of graphite’s useful properties is that electrical resistance does not increase strongly with temperature. Up to 1400°C, the electrical resistance is lower than it was at room temperature.

**Flexural Strength**
The maximum stress which the material will withstand before rupture in bending (also called Bending Strength or Modulus of Rupture). Higher flexural strength in electrodes will generally result in lower electrode breakage frequency.

**Tensile Strength**
A measurement of pure tensile force per unit area required to cause rupture by pulling apart. Higher tensile strength in pins will generally result in lower pin breakage frequency. Graphite’s strength characteristics increase significantly with temperature.

**Coefficient of Thermal Expansion (CTE)**
A measurement of the increase in length per unit length per degree rise in temperature. Lower CTE will give better resistance to thermal shock. Also, CTE compatibility between the graphite electrode and the connecting pin is important for satisfactory performance of the electrode joint.

**Ash Content**
UCAR® Graphite Electrodes typically have less than 0.1% impurities, and do not contain elements harmful to steelmaking.
The following operating considerations must be addressed before selecting the electrode size and grade for a particular application.

- Production / Productivity Goals
- Furnace Design
- Steel Type and Grade
- Charge Material
- Charging Practice
- Power Level
- Current Level
- Slag Practice
- Burner / Oxygen Practice
- Water Spray Rings
- Fume Control System
- Graphite Electrode Consumption Goal

### GRAPHITE ELECTRODE SELECTION GUIDE (Metric)

<table>
<thead>
<tr>
<th>Select Electrode Diameter</th>
<th>Electrode Length Options</th>
<th>Pin Options</th>
<th>IEC</th>
<th>Designation</th>
<th>Diameter</th>
<th>Length</th>
<th>Threads per 25.4mm</th>
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* Longer maximum length available to many 2700 mm customers

### GRAPHITE ELECTRODE SELECTION GUIDE (English)

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<th>Electrode Length Options</th>
<th>Pin Options</th>
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* Longer maximum length available to many 110 inch customers
Graphite Electrode Selection

Your GrafTech Technical Service Engineer can help you decide which type of product best suits your existing or future needs. The standard grades can be refined to meet your special needs.

**Grade AGX™:**
A premium grade recommended for high power, ultra-high power and DC furnaces operating under severe electrical, mechanical and/or thermal conditions. AGX™ can also be used for ladle furnace applications.

**Grade AGR:**
A standard grade for applications where operating conditions are not severe.

### Current Carrying Ranges for Ladle Furnace Applications

These are typical current carrying capacities as observed in present use of GrafTech electrodes around the world. More severe operating capacities and unusual applications may differ and require investigation by your GrafTech Technical Service Engineer to define a product to meet your requirements.

### Current Carrying Ranges for Electric Arc Furnace

Typical current carrying ranges for different electrode diameters are shown in the graph.