

# MACHINING GRAPHITE AND CARBON

Cutting Graphite (or carbon) is different from cutting Metals. Metal exerts plastic deformation when a tool edge cuts it producing a curl or chips.

When a graphite is machined small powder-like particles separate from the workpiece as a result of brittle fracture caused by the stress produced by the cutting tool edge.

Cutting graphite operation consumes much less energy and generates much less heat than in cutting metals.

- ☐ **General guidelines for machining graphite and carbon**
- ☐ **Milling graphite and carbon**
- ☐ **Turning graphite and carbon**
- ☐ **Drilling graphite and carbon**
- ☐ **Sawing graphite and carbon**
- ☐ **Grinding graphite and carbon**
- ☐ **Surface finishing graphite and carbon**

## General guidelines for machining graphite and carbon

- ☐ Graphite is abrasive material causing fast wear of metallic uncoated cutting tools. Only diamond (preferable) or carbide tools may be used for cutting graphite.
- ☐ Graphite and carbon are generally machined dry without using Cutting fluids (coolants). If coolants are used in some machining operations (grinding, honing, polishing) the workpiece should be dried at 300-400°F (150-200°C) to remove liquids absorbed by the material.
- ☐ Graphite as compared to metals is machined at higher cutting speed, feed speed and depth of cut;
- ☐ Chipping (breakage) of the material in the exit of a cutting pass may be avoided by limiting the depth of cut to a half of the insert length;
- ☐ Lowering feed rate in the exit of a pass also prevents chipping;
- ☐ Chamfer at the end of the workpiece makes the tool entrance and exit easier and diminishes chipping;
- ☐ Machining graphite and carbon produces dust with particles size in the range 0.0004"-0.005" (10-130µm). The dust must be removed from the machining region by a dust extraction system providing a minimum air velocity of 6 ft/s (20 m/s).

## Milling graphite and carbon

<b>Milling graphite and carbon</b>		
<b>Tools:</b> with inserts of 1/64-1/32" (0.4-0.8 mm) nose radius, clearance angle at least 10°		
<b>Parameter</b>	<b>Value in metric unit</b>	<b>Value in US unit</b>

<b>General purpose</b>				
<b>Cutting speed</b>	100-300	m/min	333-1000	ft/min
<b>Feed speed</b>	0.1	mm/(tooth*revolution)	0.004	inch/(tooth*revolution)
<b>Depth of cut</b>	5-10	mm	0.2-0.4	inch
<b>Finish</b>				
<b>Cutting speed</b>	150-600	m/min	500-2000	ft/min
<b>Feed speed</b>	0.013-0.05	mm/(tooth*revolution)	0.0005-0.002	inch/(tooth*revolution)
<b>Depth of cut</b>	0.5-2	mm	0.02-0.08	inch

## Turning graphite and carbon

Square nose tools are not recommended since they increase chipping.

<b>Turning graphite and carbon</b>				
<b>Tools:</b> with inserts of 1/64-1/32" (0.4-0.8 mm) nose radius, angle 20°				
<b>Parameter</b>	<b>Value in metric unit</b>		<b>Value in US unit</b>	
<b>General purpose</b>				
<b>Cutting speed</b>	100-300	m/min	333-1000	ft/min
<b>Feed speed</b>	0.13	mm/(revolution)	0.005	inch/(revolution)
<b>Depth of cut</b>	10-20	mm	0.4-0.8	inch
<b>Finish</b>				
<b>Cutting speed</b>	200-600	m/min	666-2000	ft/min
<b>Feed speed</b>	0.025-0.076	mm/(revolution)	0.001-0.003	inch/(revolution)
<b>Depth of cut</b>	0.2-0.5	mm	0.008-0.02	inch

## Drilling graphite and carbon

<b>Drilling graphite and carbon</b>				
<b>Tools:</b> point angle 70°-100°, clearance angle 10°-15°				
<b>Parameter</b>	<b>Value in metric unit</b>		<b>Value in US unit</b>	
<b>Cutting speed</b>	60-900	m/min	200-3000	ft/min
<b>Feed speed drill diam. 1/32-3/16" (1-5 mm)</b>	0.025-0.1	mm/rev.	0.001-0.004	in/rev.
<b>Feed speed drill diam. 3/16-1/4" (5-6 mm)</b>	0.05-0.13	mm/rev.	0.002-0.005	in/rev.
<b>Feed speed drill diam. 1/4-5/16" (6-8 mm)</b>	0.05-0.15	mm/rev.	0.002-0.006	in/rev.
<b>Feed speed drill diam. 5/16-3/8" (8-10 mm)</b>	0.05-0.2	mm/rev.	0.002-0.008	in/rev.
<b>Feed speed</b>	0.05-0.25	mm/rev.	0.002-0.010	in/rev.

<b>drill diam. 3/8-1/2" (10-12 mm)</b>				
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## Sawing graphite and carbon

Graphite is cut by band saws (5 teeth/inch) at speed 1000-2000 ft/min (300-600 m/min).

Carbon is cut by diamond cutting wheels at speed 170-200 ft/s (50-60 m/s).

## Grinding graphite and carbon

<b>Milling graphite and carbon</b>				
<b>Tools:</b> grinding wheel with the structure parameter between 6 to 9				
<b>Parameter</b>	<b>Value in metric unit</b>		<b>Value in US unit</b>	
<b>General purpose (made by silicon carbide wheels of grit 20-46)</b>				
<b>Cutting speed</b>	20-30	m/s	65-100	ft/s
<b>Feed speed</b>	300-600	mm/min	12-24	inch/min
<b>Depth of cut</b>	0.5-5	mm	0.02-0.2	inch
<b>Finish (made by electro-corundum wheels of grit 120-160)</b>				
<b>Cutting speed</b>	20-30	m/s	65-100	ft/s
<b>Feed speed</b>	150-300	mm/min	6-12	inch/min
<b>Depth of cut</b>	0.05-0.3	mm	0.002-0.012	inch

## Surface finishing graphite and carbon

Lapping.

Lapping is carried out by aluminum oxide/silicon carbide powder with grain size 12-16  $\mu\text{m}$ .

Polishing.

Polishing is carried out by diamond/aluminum oxide powder with grain size 6-10  $\mu\text{m}$ .

Source : [http://www.substech.com/dokuwiki/doku.php?id=machining\\_graphite\\_and\\_carbon](http://www.substech.com/dokuwiki/doku.php?id=machining_graphite_and_carbon)