

HOW TO MACHINE MACHINABLE CERAMICS

Machinable ceramics can be machined with ordinary machine and tool. Nevertheless it is ceramic material. Advisable points are as follows:

Basic points

1. Treat it carefully. Don't hit it or wrench it by tool.
2. Clamp or chuck it with evenly distributed force.
Consider to adhere it on other materials which can be chucked safely.
3. In case of low-speed machining coolant is not needed. In order to remove powder, use a vacuum system or cooling water.
4. As for cooling water solution type (which contains solely anti-corrosion agent) is advisable.
5. Chipping can be occurred when tool gives it a shock or tool thrust through it. In order to prevent chipping, use attaching material made of graphite, plastic or metal. The attaching material shall be laid under machinable ceramics or adhered with it temporarily.
6. "Proof-Wax" (temporary adhesive for machining process) is advisable.
7. Machinable ceramic can be machined with high-speed-working tool, but carbide tool C-3 is more advisable. In any case carbide tool is indispensable to T. Ceramic-, cermet- and coated-tips are not recommended.
8. Soap water, solvent or weak abrasive cleaner are advisable to clean machined products.

Drilling

1. Keep the spindle speed slow. Cutting speed of 300 rev./min or less is recommended in case of high-speed-steel drill.
2. Sharp point-angle (about 80 degrees) is advisable.
3. Step-feeding is recommended to remove powder.
4. In order to prevent chipping when drill get through, bore it together with attaching material or drill at small rete when the drill get through.
5. Bore the large hole after drilling smaller center hole.
6. Strange shaped hole can be bored by ultrasonic method.
7. CO₂ laser cutting can be done.

Tapping & Thread-cutting

1. The clearance hole should be made with a drill the next size larger than that recommended for metals. If possible chamfer both ends of the hole to reduce chipping.
2. From time to time blow powder off by blowing compressed air while tapping.
3. Before pulling off the tap, blow powder off by compressed air.
4. Make male screw by turning. Don't use thread cutting die.

Cutting

1. Water cooled continuous cutting wheel is advisable.
2. Machinable ceramic can be sawn.

Grinding

1. Cool by water to prevent the powder clogging on tool and to cool it.
2. Wide variety of abrasive materials is used.

Polishing

1. Polishing with abrasive paper is possible in both of dry and wet process.
2. Final polishing is done by cerium-oxide powder.

Turning

1. Slow cutting speed is recommended. At the beginning cut it at the rate of 10m/min in case of high-speed-steel tool and 30m/min in case of carbide tool. When turning T, more slow speed is advisable.
2. In order to get smooth finish feed shall be small Start from 0.05mm/rev. and gradually increase it. Depth of cut can be set deep for instance to the extent of 6 mm.
3. Relief angle of tool shall be positive, for instance 5 – 10 degrees.
4. Side cutting-edge angle shall be 15 – 45 degrees to increase efficiency.
5. Use sharp cutoff tool to cut it off.
6. Inside-turning shall be done at the first step while it is thick.
7. Thread cutting also should be done at low spindle speed for instance 60 rev/min. Depth of cut will be 0.03mm per path.

Milling

1. Use carbide working tool.
2. Recommended conditions are 5m/min in cutting speed, 0.05mm/t in chip load and 0.5mm in depth of cut at the beginning.
3. Cooling is recommended.
4. Down cutting is recommended rather than up-cutting.
5. In order to prevent chipping fix attaching material to it on the place where tool cut in and out and cut them together.