Cutting Material Grade Selection

Kennametal Metalcutting Grades

Kennametal provides a wide variety of top quality inserts to satisfy any machining need with reliable and consistent service backing our product. Kennametal grades include uncoated, CVD coated and PVD coated carbides as well as ceramic, cermet and polycrystalline superhard materials. For most machining operations, coated grades are the best choice because coatings reduce frictional forces at the tool tip, add chemical stability and have hot hardness at the elevated temperatures encountered in metalcutting.

The technical features of each grade group are explained in this section. When making a grade choice, base your decision upon the workpiece material and configuration, speeds, feeds, the machine tool capabilities, surface finish requirements and most importantly, your productivity objectives.

PVD Coated Carbide Grades

PVD (physical vapor deposition) coatings have technical ad vantages that make them well suited for a variety of metalcutting applications in a wide range of workpiece materials. In particular, PVD grades offer outstanding performance in milling, threading, grooving, cutoff and finish turning. They operate well at low to medium cutting speeds and have a stable, relatively sharp cutting edge. These coatings are applied to the carbide substrate at lower temperatures, which preserves edge strength and enables coating of sharp edges. Tailored carbide substrates meet the needs of different machining conditions.

PVD coatings have a relatively smooth surface that generates less frictional heat, lower cutting forces and resists edge build-up that can lead to insert chipping. PVD coatings are fine grained and very hard, so they resist abrasive wear mechanisms. The cutting edges are sharp, or only slightly honed, resulting in less chatter, fewer burrs, finer surface finishes and better dimensional control on the insert itself. Chip loads can be as low as .001 ipt.

CVD Coated Carbide Grades

CVD (chemical vapor deposition) coated carbide grades are the grades of choice for most metalcutting applications involving ferrous workpiece materials. These coatings are applied to the carbide substrate at a high temperature which causes interdiffusion of the coating with the substrate to assure a strong bond. The CVD process also permits deposition of multi-layer coatings that combine different coating compounds. This enables Kennametal to provide coatings that can suppress both crater wear and flank wear, thereby expanding the range of tool application.

CVD grades also offer cobalt-enriched substrates, an advancement Kennametal pioneered. Cobalt-enrichment produces a cutting edge with excellent edge strength and fracture resistance while maintaining deformation resistance in the bulk of the insert.

CVD is currently the only coating process that can efficiently apply alumina (Al_2O_3) to carbide substrates. Alumina coatings permit higher cutting speeds and are the best coatings to combat both abrasive and crater wear.

CVD coated carbide inserts require heavier hones on the cutting edge and chip loads over .003 ipt are recommended.

Ceramic Grades

Ceramic cutting tool materials can be divided into two basic families: **alumina based (Al_2O_3)** and **silicon nitride based (Si_3N_4)**. These cutting tools can be extremely effective and productive when higher speeds can be used in the machining process. They machine cast irons, ductile irons, high-temperature alloys (nickel and iron based) and hardened steels, stainless steels, and irons.

Cermet Grades

Cermet grades are comprised of mostly titanium carbonitride (TiCN) with nickel binder. They are chemically and thermally stable which leads to high wear resistance. Cermets are most successfully used for higher speed semi-finish and finish machining of most types of steels and stainless steels.

Cermets are able to hold a sharp cutting edge at high speeds and temperatures which enables them to produce exceptionally good surface finishes. Cermets are less suitable than carbides for heavy roughing.

Uncoated Carbide Grades

Uncoated carbides still have a place in machining applications. They work well when surface speeds are very low, when diffusion of the coating material into the workpiece is a concern, or when machining short run jobs. The cutting edges are usually sharp.

Uncoated carbides are generally classified into two groups: unalloyed and alloyed. The main application for unalloyed grades is for non-ferrous materials, where abrasive wear is the primary tool failure mechanism. Alloyed grades are applied mainly on ferrous materials where crater wear is the primary tool failure mechanism. The higher the binder content, the tougher the grade. The finer the grain size, the better the wear resistance.

Polycrystalline Grades

The **polycrystalline family** of cutting tool materials is divided into two basic groups: **diamond** and **cubic boron nitride**. Both types of materials are relatively expensive on a per unit basis, but can pay off handsomely by providing extraordinarily high productivity and tool life. This benefits the user with very low per unit manufacturing cost. Rigid machine tools and workholding fixtures are a must and as always, follow good machining practices.

Diamonds are the hardest cutting tool material available and are applied mostly on non-ferrous materials at very high speeds. They possess extremely good abrasion resistance and strength. Diamonds have high thermal conductivity to aid heat dissipation when used at high speeds.

Polycrystalline Cubic Boron Nitride (PCBN) grades can be further divided into two groups: **low CBN content** and **high CBN content** grades.

Of the two groups, **low CBN content grades** have lower thermal conductivity and comparatively higher compressive strength. These features enable low CBN content grades to promote self-induced hot cutting by combining high cutting speeds and negative rake tool geometries to soften the workpiece material and efficiently remove it from the part. These characteristics make low CBN content grades ideal for finish machining of hardened steels.

High CBN content grades possess extremely high thermal conductivity and toughness and can operate at high speeds and in severely interrupted cuts. High CBN content grades are tool materials of choice for rough cutting of hardened steel, where severe mechanical edge loading is likely to occur. The very high hardness of these cutting tools translates into excellent abrasion resistance. High PCBN content grades are very good cutting tool materials for fully pearlitic gray cast iron.