KENNAMETAL
Engineering Your Competitive Edge

Technical Tip #126 – Types of Inserts

1.) Utilize Lead Angles

Lead angles provide three primary functions:

1) Control the direction of radial cutting forces
2) Provide effective chip thinning
3) Protect weakest part of the cutting edge

Note: In finishing operations with a shallow depth of cut, the nose radius of the insert acts as an extension of the lead angle.

2.) CVD Coatings Over Carbide Inserts (Chemical Vapor Deposition):

- The most common coatings consist of TiC, TiCN, TiN and Al_2O_3.
- Materials are multi layered and contain thermal cracking on surface.
- Coating cannot be used on sharp cutting tools.

CVD-coated cutting edges require a larger edge preparation. This larger edge preparation requires an increased feed (ipt) to obtain satisfactory tool performance. CVD process produces significant heat shield and increased speed capability.

3.) PVD Coatings Over Carbide Inserts (Physical Vapor Deposition):

PVD adds lubricity and seals porosity and keeps material from penetrating the tool surface. PVD coatings have finer grain size than CVD coatings and can be coated over sharp edges.

Primarily used as a top coat of TiN or TiAlN. It is used to coat over CVD coatings to seal surface. Also used on finish turning applications.

4.) Cermet Ceramic and Metal Combination

Grades come in coated or uncoated.

Advantages: High flank wear, good crater resistance, high chemical stability and hot hardness (resistance to heat).

- Good in stainless steels, steels, and ductile irons.
- Used at high speeds for finish turning, precision turning with low chipload, and light depth of cut.

5.) Alumina Ceramics consist of nearly 100% Alumina (Al_2O_3)

Good for machining steel and cast irons

- White ceramic tool has best wear resistance but is not too strong.
- Dark gray is stronger but has less speed capability

Advantages:

- Low thermal conductivity
- Good hot hardness
- Chemically inert with steel
- Higher speeds & Feeds

Disadvantages:

- Poor transverse rupture strength
- Low toughness
- Expensive processing
- Unreliable tool failure

6.) Ceramic Composite Materials (Al_2O_3 + TiC)

- Addition of TiC or TaC increases toughness
- Addition of Zircronium Oxide (ZrO_2) increases fracture toughness by 25%, making it possible to machine nickel-based alloys

7.) Silicon Whisker-Reinforced Alumina (SiC) 25%

- Fracture toughness and resistance to crack close to carbide grades.
- Proven successful for machining nickel-based alloys.

8.) Sialon Ceramics (Si_3N_4 and AlN + Alumina + alloying agent)

The combination creates better bend strength, high hardness and low coefficient of thermal expansion, to create good thermal shock resistance.

Sialon grades use negative rake angles with heavy hones or T-Lands. Successfully applied for roughing cuts, rough surfaces, and interrupted cuts. Also successfully machine steel and cast irons.

9.) Polycrystalline Cubic Boron Nitride (PCBN)

- Extremely hard, and second in hardness only to diamond.
- PCBN is used in hard steels and cast irons with hardness greater than 45RC. It can be used for finish turning cast iron and high-temp alloys.
- Applied using negative rake heavy hones or T-lands.
- Has excellent abrasive resistance and long predictable tool life.
- Parts can be machined without grinding.
- It can be used on interrupted cuts.

10.) Polycrystalline diamond (PCD)

- Provides significant productivity and tool life advantages. They are generally limited to machining nonferrous and nonmetallic materials such as aluminum, copper, magnesium and various nonmetals.
- Grade exhibits good abrasion resistance and high strength.
- Not recommended for nickel alloys because diamond and ferrous metals turn to graphite at high temperatures.