TECHNICAL - SOLID CARBIDE END MILLS

HOW TO USE SOLID CARBIDE END MILLS

How To Mill Effectively

Solid carbide end mills are rapidly replacing high speed steel end mills because production costs can be reduced as a result of the extreme metal removal rates which can be achieved with solid carbide end mills. When combined with the appropriate coating and the correct set up, optimal performance may be achieved.

It is important to comply with the following for best performance results:

Machine Capability

The machine must have the necessary rigidity to minimize spindle deflection and sufficient horsepower to perform at recommended speeds and feeds.

Holders

Tool holders and collets must provide good concentricity between tool and machine spindle.

Workpiece

A secure and rigid workpiece to minimize deflection is needed. This is most important in climb milling operations. Because of the rigidity factor required in climb milling, speeds and feeds may be reduced by up to 25%.

Type Of Cuts

Climb Milling: The end mill revolves in the same direction as the table feed. The tooth meets the workpiece at the top of the cut, producing the thickest part of the chip first.

Conventional Milling: The end mill revolves opposite to the direction of the table feed. The width of the chip starts at zero and increases to a maximum at the end of the cut. This type of milling can lead to accelerated wear.

Peripheral Milling: The milling of a surface which is parallel to the end mill axis.

Plunge Milling: The direct movement between the workpiece and the center line of the end mill when the end mill sinks directly into the workpiece.

Slotting: All slotting applications are a combination of conventional milling and climb milling.

End Mill Selection

Utilize the shortest possible tool available for the application with the largest diameter permissible and the shortest flute length as depth of cut allows. (See chart on pp. 158-161) Extra length end mills have excessive overhang, thus a reduction in feed up to 25% may be required. Stub length end mills, due to their short overall and flute length, have more rigidity, thus an increase in feed rates of up to 25% may be required.

2-Flute: 2-flute end mills allow for maximum chip volume and are used for plunge milling, roughing of slots, or peripheral milling. These multipurpose tools allow for high feed rates where part finish and dimensional accuracy are not critical. When plunge cutting, it is recommended to use approximately 25 - 50% of the feed per tooth.

3-Flute: 3-flute end mills are more rigid, with less cut interruption than 2-flutes. They have more chip volume area than a 4-flute, allowing higher metal removal rates. The 3-flute end mill has all the machining capabilities of a 2-flute end mill, and is ideal for slotting applications. Improved part finish and dimensional accuracy can be achieved in a wider range of materials over a 2-flute end mill.

4-Flute: 4-flute end mills are stronger than either the 2 or 3-flute designs. The added rigidity allows higher metal removal rates with minimum deflection. Improved workpiece finishes and dimensional accuracy can be achieved. Limited chip volume area restricts stock removal rates and deep plunge cutting is not recommended. The 4-flute design is commonly used for finishing operations.

Speeds

Solid carbide end mills must be run at higher speeds than high speed steel end mills. Many times, lighter cuts at higher speeds can improve the finish of the workpiece.

When the application is a slotting cut, the speed should be reduced by approximately 20%. Speeds should be decreased when milling hard or tough materials or when taking heavy cuts. Speeds should be increased when milling softer materials or when taking lighter cuts. Speeds should also be increased for finishing cuts.

Feeds

The feed per tooth (Ft) value is one of the most important factors selected in the milling operation because it will determine the amount of material removed by each tooth, the tooth load on the milling cutter, the finish on the workpiece, and cutter life.

When peripheral milling, the highest feed rates can be achieved when the width of cut is less than the radius of the end mill. When machining softer materials, the feed per tooth can be increased by as much as 25%. When using extra length end mills, the feed should be reduced by 25%. When using stub end mills, the feed may be increased by up to 25%.

Coolants

Coolants are recommended when milling mild steel and high temperature alloys. The purpose of the coolant media is to direct the chips away from the cutting tool and workpiece. This prevents damage to the cutting edges due to recutting the chips. When machining titanium, coolant flow must be heavy and directed at the area of cut to prevent overheating and assist in chip removal.

Milling Tolerances

Cutting Diameter (")				Shank Diameter (")
.0312	to	.2500	+.0000-.0020	.0001-.0004
.2501	to	1.000	+.0000-.0030	