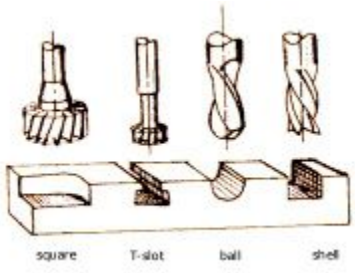
Cutter Types (Mill)

Mill in the Shop

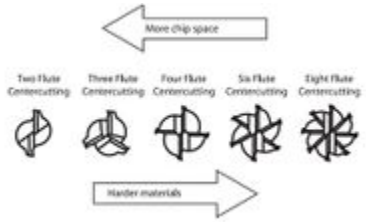
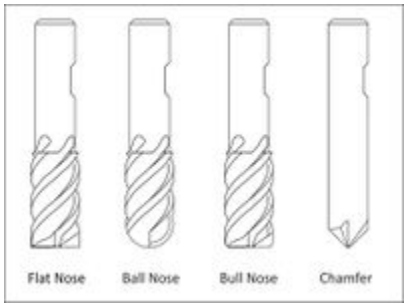
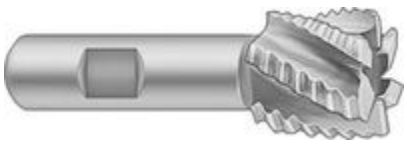
used in milling machines to perform milling operations and occasionally in other machine tools. They remove material by their movement within the machine or directly from the cutter's shape.

Milling Machine Tooling Overview

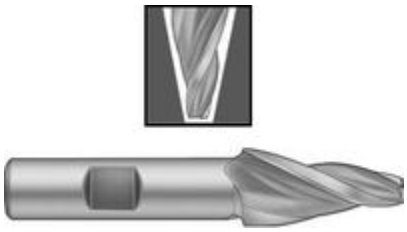
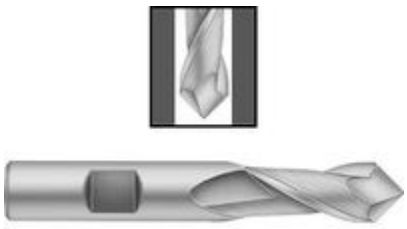
 *Milling Cutters*	Milling Cutters (excluding end mills): Used for a variety of operations from facing styles (squaring and smoothing faces), as well as cutting angles and shapes, as well as grooves and slots.[1]	
 *Slitting Cutter*	Slitting Cutters: Used for cutting a narrow slit into material, not used for removing lots of material.	
	Gear Cutters: Used for cutting teeth into stock to make a gear.[2]	

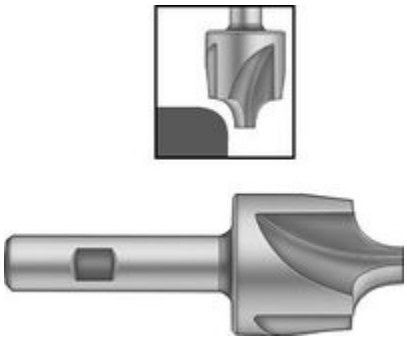
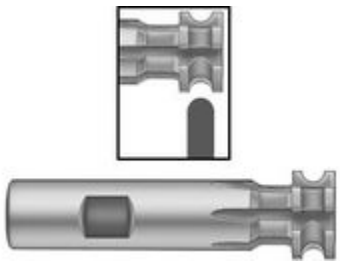
 *Gear Cutter*		
 *End Mills*	End Mills: End mills are tools which have cutting teeth at one end, as well as on the sides, they are used for a variety of things including facing an edge, and cutting slots or channels.[3]	

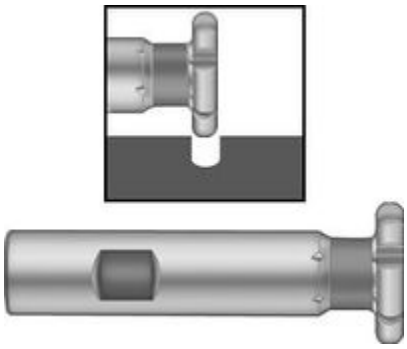
An endmill is a type of milling cutter, a cutting tool used in industrial milling applications. It is distinguished from the drill bit in its application, geometry, and manufacture. While a drill bit can only cut in the axial direction, a milling bit can generally cut in all directions, though some cannot cut axially. End mills are used in milling applications such as profile milling, tracer milling, face milling, and plunging.

 *Flute Diagram*	This is a flute diagram. It shows what a two flute, three flute, four flute, six flute, and eight flute mill end looks like from the bottom. Then, the arrows show that you want to go to the right when cutting a harder material and cut to the left to take off more chips.
 *End Mill Type*	There are many types of End Mills to choose from, and with each style there are a variety of materials including High-Speed Steel, Cobalt Steel, and Carbide. There are also many options for how many flutes there are ranging from 2 to 8 normally. Lastly, for each style there are roughing and finishing end mills.[4]
	Roughing End Mills: Leave a rough finish but cut much faster than the finishing end mill. It is recommended to use one of these to start with, and then move to a finishing one.

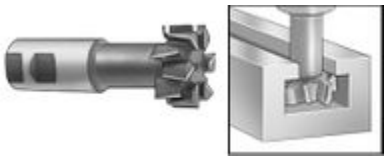
 *Finishing End Mill*	Finishing End Mills: Leave a nice finish on the stock you are working with..
 *Square End Mill*	Square End Mills: Used for milling a perfectly square corner at the bottom of your channel.[5]
 *Ball End Mill*	Ball End Mills: Machine rounded details into your stock.[6]
	Rounded Edge End Mills: Rounded edges on the tips of the flutes reduce chipping and lengthen the life of the

 *Rounded Edge (Bull Nose) End Mill*	heat-treated steel. Sometimes called Bull Nose End Mills.[7]
 *Tapered End Mill*	Tapered End Mills: Machine angled slots in dies and molds. Also known as taper degree end mills.[8]
 *Drillin End Mill*	Drilling End Mill: A 90° point angle turns these end mills into drills for slotting, side milling, beveling, and profiling.[9]

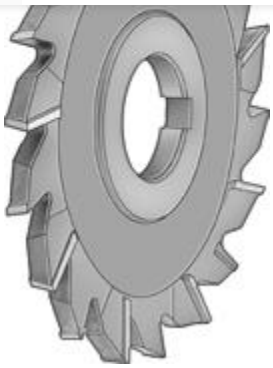
 *Chamfer End Mill*	chip clearance, while four flutes produce a finer finish.
 *Corner Ronding End Mill*	Corner Rounding End Mill: Round off sharp corners on the edge of your stock[11]
	Concave Radius End Mill: Machine rounded, outward-curved edges into your stock[12]

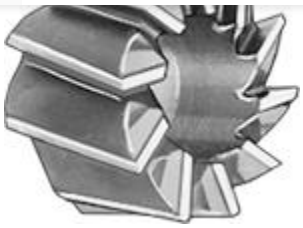
 *Convex Raduis End Mill*	Convex Radius End Mill: Machine hollow, inward-curved edges into your stock.[13]	

Cutters:

 *keyseat cutter*	Used for cutting Woodruff keyseats and other precise notches in shafts, as well as slots. Straight-tooth cutters work well on high-carbon steel and cast iron. Carbide cutters are made of premium sub-micrograin carbide for fast, smooth cuts. Staggered-tooth cutters have an alternating right- and left-hand helix for efficient cuts in mild steel, aluminum, and brass. [14]
 *Narrow width keyseat*	Narrow-Width Keyseat Cutters: Used for cutting narrow Woodruff keyseats. [15]
 *T-Slot Cutter*	T-Slot Cutters: Used for milling T-slots in machine tool tables, indexing tables, and other work holding surfaces and products. Note: Before using the cutter, mill a slot in the work surface so the neck of the cutter can enter the cut. [16]

 *Dovetail Cutter*	
 *Bevel Cutter*	Bevel Cutters: Make uniform bevel cuts in your stock.[18]
 *V-slot Cutter*	V-Slot Cutters: A single pass cuts a V-shaped slot. Also known as double-angle milling cutters, they can also mill notches, serrations, angles, and chamfers.[19]
	Staggered-Tooth milling Cutters: With peripheral and side teeth, cutters remove chips for consistent cutting width. Cutters are for deep slots and other applications

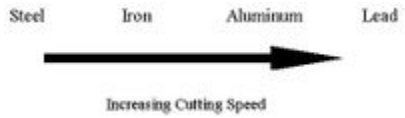
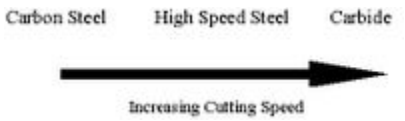
 *Staggered-Toother Milling Cutter*	helical teeth to remove more metal at higher feeds/speeds than straight-tooth cutters. The keyway lets you interlock two or more cutters of the same diameter so you can customize the thickness of the cutter to match the slot width you require.[20]
 *Straight-Tooth Milling Cutter*	Straight-Tooth Milling Cutters: Cutters are thinner, have more teeth, and leave a finer finish than staggered-tooth cutters. Use for thin slots and plunge cuts.

 *Large-Diameter High-Speed Steel Face Milling Cutters*	shell cutters, these tools have a large diameter for face and side milling.[21]
 *Large-Diameter Replaceable Carbide-Insert Face Milling Cutter*	Large-Diameter Replaceable Carbide-Insert Face Milling Cutters: These cutters remove metal 2-5 times faster than comparable high-speed steel face mills as shown above. All cutter bodies accept octagon, round, and square carbide inserts.[22]
	Square Tool Bit Flat-Surface Cutters:These are used with square tool bits for machining flat surfaces. Compared to standard end mills, they make wider cuts, produce less vibration, cut thin materials easily, and can be run at faster speeds. [23]

 *Fly Cutter*	This is a Fly Cutter; Works well to take of material in one pass on a larger surface, this tool can be hard on the machine when working with hard metals because of how far away the cutter is from the center of the tool.
 *Carbide Face Mill*	This is a Carbide Face Mill; it does not make as large of cuts as most fly cutters, but leaves a very nice finish, and is faster to cut with.
	Slitting Cutters: These cutters do not have side teeth which make them a good choice for thin slitting and

 *Slitting Cutter*	To determine how many teeth your cutter should have, follow these guidelines: 1. Always have at least three teeth in the cut. 2. Use more teeth for thin and hard materials. 3. Use fewer teeth for soft materials and larger sections. [24]
 *Gear Cutter*	Gear Cutters: Used to create a gear. Determine the cutter number you need based on the number of teeth in your gear. The cutter number has to do with the pitch of the cut, and there are many options.[25]

Mill Speeds:

Tool/Step	Description
 *shows speed for materials*	As shown, the speed increase as the material becomes softer.[26]
 *speeds for materials*	As shown, the speed increases as the tooling material becomes stronger.[27]

Cutter Material Identification / Selection:

color, and relatively light in weight. Carbide tooling is dull in color and relatively heavy compared to high speed steel. HSS is used for general purpose milling of both ferrous and non-ferrous materials. Carbide provides the user with the ability to run faster with less tool wear

 *Carbide*	for hard materials but Carbide plated tooling can chip easy, whereas the more expensive solid Carbide tooling is more durable.[28]
 *Colbalt Steel*	Cobalt steel is more resistant to heat and abrasion than high-speed steel. Uncoated end mills are for general milling of alloy steel, carbon steel, and cast iron. [29]
	Coated end mills last longer and can be run at higher feeds/speeds.[30]

 *Titanium Ntiride*	Long-life TiN (titanium nitride) coating is good for use on alloy steel, aluminum, and plastic. Max. working temperature is 1100° F. Color is gold.
 *Titanium Carbonitride*	Extra-life TiCN (titanium carbonitride) coating has better wear resistance than TiN coating, making it a good choice for tough-to-machine materials such as ductile cast iron, stainless steel, aluminum, and plastic. Max. working temperature is 750° F. Color is blue-gray.

 *titanium aluminum nitride*	the best for very high feeds/speeds and high-temperature applications. Use to mill cast iron, stainless steel, nickel-based alloys, and titanium. Not for use on aluminum. Max. working temperature is 1470° F. Color is purple-gray.	

Centercutting and Non-Centercutting Endmills

Milling tools are either center cutting or non-center cutting. Center cutting mills can plunge straight down into material, while

that the cutting edges of the center cutting end mill continues to the center of the tool. The center of the other has a small hole at the center. Non-center cutting end mills require a pilot hole, ramping or helical motion to plunge into material. the way you can tell the difference is the teeth of some cutters do not go all the way to the center of the end face.

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