# Cutting tools for Efficient Cutting

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***Abstract*- Cutting tool has one or more sharp cutting edges and is made of a material that is harder than the work material. The cutting edge serves to separate chip from the parent work material. Connected to the cutting edge are the two surfaces of the tool:**

- **The rake face; and**
- **The flank.**

**The rake face which directs the flow of newly formed chip, is oriented at a certain angle is called the rake angle "α". It is measured relative to the plane perpendicular to the work surface. The rake angle can be positive or negative. The flank of the tool provides a clearance between the tool and the newly formed work surface, thus protecting the surface from abrasion, which would degrade the finish. This angle between the work surface and the flank surface is called the relief angle. There are two basic types of cutting tools:**

- **Single point tool; and**
- **Multiple-cutting-edge tool**

**A single point tool has one cutting edge and is used for turning, boreing and planing. During machining, the point of the tool penetrates below the original work surface of the workpart. The point is sometimes rounded to a certain radius, called the nose radius. Multiple-cutting-edge tools have more than one cutting edge and usually achieve their motion relative to the work part by rotating. Drilling and milling uses rotating multiple-cutting-edge tools. Although the shapes of these tools are different from a single-point tool, many elements of tool geometry are similar.**

## I. INTRODUCTION

Relative motion is required between the tool and work to perform a machining operation. The primary motion is accomplished at a certain cutting speed. In addition, the tool must be moved laterally across the work. This is a much slower motion, called the feed. The remaining dimension of the cut is the penetration of the cutting tool below the original work surface, called the depth of cut. Collectively, speed, feed, and depth of cut are called the cutting conditions. They form the three dimensions of the machining process, and for certain operations, their product can be used to obtain the material removal rate for the process.

$$R_{MR} = vfd$$

Where,

- $R_{MR}$ – the material removal rate in $mm^3/s$, ($in^3/s$),
- $v$ – the cutting speed in m/s, (in/min),
- $f$ – the feed in mm, (in),
- $d$ – the depth of cut in mm, (in).

Note: All units must be converted to the corresponding decimal (or USCU) units.

Stages in metal cutting

Machining operations usually divide into two categories, distinguished by purpose and cutting conditions:

- Roughing cuts, and
- Finishing cuts

Roughing cuts are used to remove large amount of material from the starting work part as rapidly as possible, i.e. with a large Material Removal Rate (MRR), in order to produce a shape close to the desired form, but leaving some material on the piece for a subsequent finishing operation. Finishing cuts are used to complete the part and achieve the final dimension, tolerances, and surface finish. In production machining jobs, one or more roughing cuts are usually performed on the work, followed by one or two finishing cuts. Roughing operations are done at high feeds and depths – feeds of 0.4–1.25 mm/rev (0.015–0.050 in/rev) and depths of 2.5–20 mm (0.100–0.750 in) are typical, but actual values depend on the work piece materials. Finishing operations are carried out at low feeds and depths – feeds of 0.0125–0.04 mm/rev (0.0005–0.0015 in/rev) and depths of 0.75–2.0 mm (0.030–0.075 in) are typical. Cutting speeds are lower in roughing than in finishing.

A cutting fluid is often applied to the machining operation to cool and lubricate the cutting tool. Determining whether a cutting fluid should be used, and, if so, choosing the proper cutting fluid, is usually included within the scope of cutting condition.

Today other forms of metal cutting are becoming increasingly popular. An example of this is water jet cutting. Water jet cutting involves pressurized water in excess of 620 MPa (90 000 psi) and is able to cut metal and have a finished product. This process is called cold cutting, and it increases efficiency as opposed to laser and plasma cutting.

## II. RELATIONSHIP OF SUBTRACTIVE AND ADDITIVE TECHNIQUES

With the recent proliferation of additive manufacturing technologies, conventional machining has been classified, in thought and language, as a subtractive manufacturing method. In narrow contexts, additive and subtractive methods may compete with each other. In the broad context of entire industries, their relationship is complementary. Each method has its own advantages over the other. While additive manufacturing methods can produce very intricate prototype designs impossible to replicate by machining, strength and material selection may be limited.

## REFERENCES


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