International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Cutting Tools and its Types

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A B S T R A C T

The best tool for the job isn't always the cheapest or the most expensive, and it's not always the same instrument that was used previously. Cutting tools are built of various materials to attain these qualities. This isn't to say that the most costly tool is necessarily the best. The material selected for a given application is determined by the material to be machined, the type of machining, the quantity, and the quality of the finished product. Users of cutting tools can't afford to disregard the ongoing developments and advancements in the field of tool material technology. They require some particular features under such circumstances, in addition to the normal requirements of the cutting instrument. Before selecting the tool for the project, a performance comparison should be done when a tool change is required or predicted. The best tool is one that has been carefully selected to complete the task swiftly, efficiently, and cost-effectively. There are numerous distinct sorts of cutting processes that are used in various situations.

Keywords:Belts, Belt drives, Conveyor, Slip, Creep, Materials.

1. INTRODUCTION

1.1. A saw can be operated by hand, or it can be powered by steam, water, electricity, or another source of energy. Continuous pedaling at 14 HP is only possible for limited periods of time, about 10 minutes. Mechanical energy can be used to power a variety of gadgets right instantly. A saw is a tool that cuts through softer materials with a hard blade or wire with an abrasive edge. When compared to hand-cranking, pedaling generates four times the power (1/4 HP). A saw's cutting edge is either a serrated or abrasive blade. Some third-world development programs are currently converting used bicycles into pedal-powered development instruments. Pedal power is the use of a foot pedal and crank device to transfer energy from a human source. Pedal power is used less frequently to power agricultural and hand tools, as well as to generate electricity. This technology has been used to drive bicycles for over a century and is most typically employed for transportation. Pedal-powered laptops, grinders, and water wells are just a few examples of applications. Instead of a serrated blade, an abrasive saw cuts with an abrasive disc or band. However, pedaling at half the power (1/8 HP) can be maintained for over 60 minutes, however power capacity varies with age. As a result of the brainstorming session, it became clear that the principal role of pedal power was best served by one single product: the bicycle. This project focuses on hacksaw machining with a pedal. The same carbide was first produced in the United States in 1928, and in Canada in 1930. In 1926, Germany was the first country to develop and market commercial tungsten carbide using a 6% cobalt binder. The majority of later developments in hard carbides have been adaptations of the original patents, primarily including the replacement of tungsten carbide with other carbides, particularly titanium carbide and/or tantalum carbide, for part or all of the tungsten carbide. When it came to machining cast iron, nonferrous, and nonmetallic materials, these carbides performed admirably, but when it came to steel, they fell short. It weighed more than 16 times the weight of water. Previous cutting tool materials, which were molten metallurgy products, relied heavily on heat treatment for their qualities, which might be degraded by additional heat treatment. Henri Moissan developed tungsten carbide in 1893 while looking for a way to make artificial diamonds. Hard carbides at the time were made out of the basic tungsten carbide system with cobalt binders. With the introduction of cemented carbides, a new phenomenon emerged, allowing for higher speeds once more. In an arc furnace, he melted tungsten sub-carbide by charging it with sugar and tungsten oxide. The hardness of carbide is higher at room temperature than that of most other tool materials, and it has a stronger ability to hold its hardness at higher temperatures, allowing for higher speeds to be supported. As a result, new multi-carbide cutting tool materials were developed, allowing for high-speed steel machining. The tungsten was carburized and the oxide was reduced by the carbonized sugar. The material proved to be exceedingly fragile, limiting its industrial application. Moissan discovered that tungsten carbide was exceedingly hard, approaching diamond hardness and surpassing sapphire hardness. Cemented carbides are subjected to a distinct set of circumstances. These molten metallurgical products failed at fast speeds and, as a result, at high temperatures.

1.2. Types of Cutting Tools

There are only two types of tool:

- Single point cutting tool
- Multi-Point cutting tool

1. Single Point cutting tool: One cutting point or tip is available Example: Lathe Machine, Planning Machine tool.
2. Multi-Point cutting tool: More than One cutting point or tip is available Example: Milling cutter, Grinding wheel, drill tool, extra.

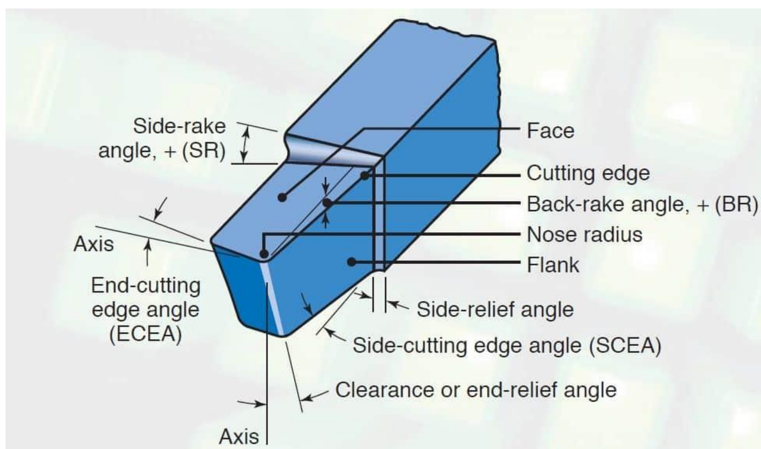

Fig.1.1: Single Point Cutting tool

1.2 Raw materials used in cutting tools:

Cast iron is a low-cost, high-strength iron-carbon alloy that can be used to create complicated constructions. Cast iron has a carbon concentration of 3% to 4.5 percent by weight. It also contains silicon, as well as trace levels of manganese, sulphur, and phosphorus. Cast iron goods have a reasonable level of corrosion resistance. It can't be hardened like steel because it's neither malleable nor ductile. It has a crystalline or granular fracture and melts at around 2100 oF. The shape of cast iron's carbon content has a significant impact on its mechanical properties. In gray cast iron, carbon is present in the form of plates, whereas in white cast iron, it is integrated into the complex Fe3C (cementite). Carbon is carried in the form of sphere-shaped graphite particles in nodular cast iron, which has higher tensile strength and strain than gray cast iron.

1.3 Properties of Castiron:

Tensile Strength: Cast iron is utilized in the construction of equipment and constructions in many forms. Cast iron with a tensile strength of less than 5 tons per square inch is useless for applications requiring strength. This type, on the other hand, can be utilized for balance weights, foundation blocks, or other applications where weight alone is important. Cast iron has tensile strengths as high as 19 tons per square inch in some kinds, although on average, the strength is 7 tons per square inch. The addition of vanadium to cast iron can improve its strength.

High Compressive Strength: Compressive strength refers to a material's ability to withstand pressures that try to squeeze or compress it. Cast iron has a high compressive strength, making it ideal for use in building columns and posts. Gray cast iron has a compressive strength that is nearly equal to that of some mild steels.

Low Melting Point: It melts at temperatures ranging from 1140 to 1200 degrees Celsius. Many improved melting, alloying, and casting technologies are now being used, which can put newly created irons in direct rivalry with steel.

Deformation Resistance: Cast iron constructions are deformation resistant and provide a solid frame. However, if one portion of the casting is very thin and another is quite thick after the iron is put into the molds, the structure will be compromised. Breakdown becomes more noticeable. The reason for this is that when the thin section cools first and contracts, the thick component cools later, causing stress in the thin part and allowing it to shatter.

1.4Characteristics of cutting tools:

A cutting tool must have the following characteristics in order to produce good quality and economical parts:

Hardness: The cutting tool's hardness and strength must be maintained at high temperatures, also known as Hot Hardness.
Toughness: Cutting tools must be tough in order to avoid chipping or fracture, especially during interrupted cutting operations.
Wear Resistance: Wear resistance refers to a tool's ability to last a long time before it needs to be replaced. Cutting tools are created from a variety of materials that are all robust and sturdy. For machining processes, a large range of tool materials are available, and the basic classification and use of these materials are of importance here.

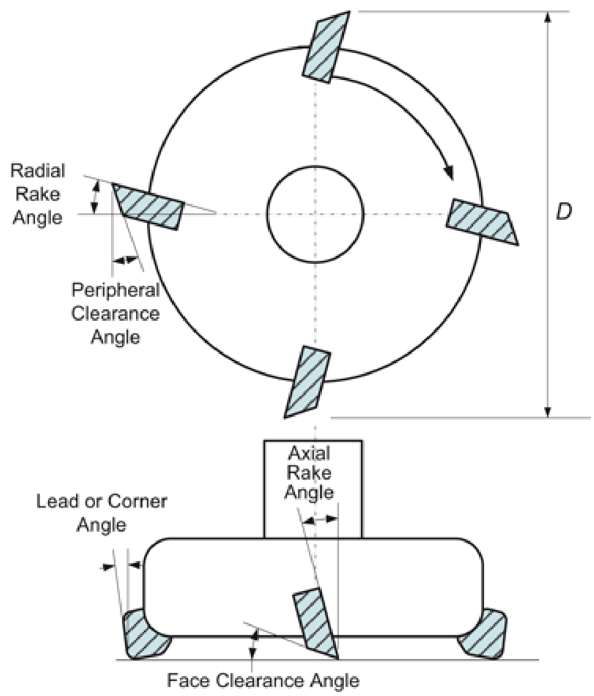

Fig.1.2: Multi-Point Cutting tool

1.5Tool Steels and Cast Alloys:

Plain carbon tool steel is the oldest of the tool materials dating back hundreds of years. In simple terms it is a high carbon steel (steel which contains about 1.05% carbon). This high carbon content allows the steel to be hardened, offering greater resistance to abrasive wear. Plain high carbon steel served its purpose well for many years. However, because it is quickly over tempered (softened) at relatively low cutting temperatures, (300 to 500 degrees F), it is now rarely used as cutting tool material except in files, saw blades, chisels, etc. The use of plain high carbon steel is limited to low heat applications.

2. HSS Surface Treatment:

3. Many surface treatments have been created in the hopes of extending tool life, lowering power usage, and controlling other aspects that affect operating conditions and costs. Some of these treatments have been around for a long time and have shown to be effective. The black oxide coatings that are typically seen on drills and taps, for example, are useful as a build-up deterrent. The black oxide creates a 'dirty' surface that prevents work material from adhering to it. Titanium nitride deposited by physical vapor deposition (PVD) is one of the most recent advancements in high-speed steel coatings. Titanium nitride is formed on the tool surface at a low temperature in one of several distinct types of furnaces, which has no effect on the heat treatment (hardness) of the tool being coated. This coating is known to considerably extend the life of a cutting tool or allow it to be utilized at higher speeds. Tool life can be increased by up to thrice, and operating rates can be raised by up to 50%.

4. Cutting Tools Force

The alloying elements in high-speed steel, primarily cobalt, chromium, and tungsten, improve cutting characteristics to the point where metallurgical researchers developed cast alloys, a family of these materials that do not contain iron. 45 percent cobalt, 32 percent chromium, 21 percent tungsten, and 2% carbon was an unusual composition for this type of tool material. The goal of this alloying was to create a cutting tool with a hot hardness that was higher than that of high-speed steel. Cast alloy tools' brittleness should be considered when using them, and adequate support should be supplied at all times. Cast alloys have a strong abrasion resistance, making them ideal for cutting scaly or hard-to-cut materials.

When a work material deforms, it signifies the tool has applied enough force to permanently alter or fracture the material. A material is considered to have exceeded its plastic limit if it is reshaped. A chip is the result of fracture and reshaping. Fracture separates the distorted chip from the parent material. When the tool's edge is oriented perpendicular to the relative motion of the material, it's easier to analyze the cutting action and chip production. The thickness of the undeformed chip before leaving the workpiece is t1, and the thickness of the deformed chip after leaving the workpiece is t2. The shear zone is where the greatest deformation occurs, and the angle of shear is determined by the diameter. Using the example of a normal turning operation, a broad description of the forces involved in metal cutting is offered. When a solid bar is turned, the cutting tool is subjected to three forces (Fig. 4.1):

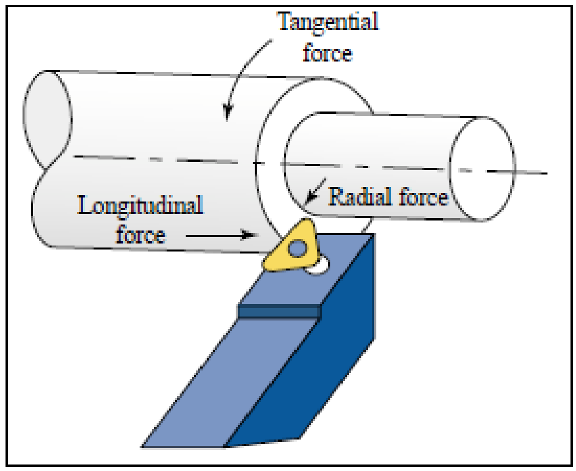

Fig. 3.1: Typical Turing Operation

Tangential Force: This indicates the resistance to the rotation of the workpiece and acts in a direction tangential to the revolving workpiece. Tangential force is the most powerful of the three forces in a normal operation, accounting for over 98 percent of the total power required.

Longitudinal Force: Longitudinal force is the resistance to the tool's longitudinal feed when it acts in a direction parallel to the work axis. Longitudinal force is typically half as strong as tangential force. Because feed velocity is often low in comparison to the rotating workpiece's velocity, longitudinal force accounts for just approximately 1% of the total power required.

Radial Force: Radial force is applied in a radial direction from the workpiece's center line. The radial force is usually the weakest of the three, accounting for about half of the longitudinal force. Because velocity in the radial direction is minimal, it has a negligible influence on power consumption.

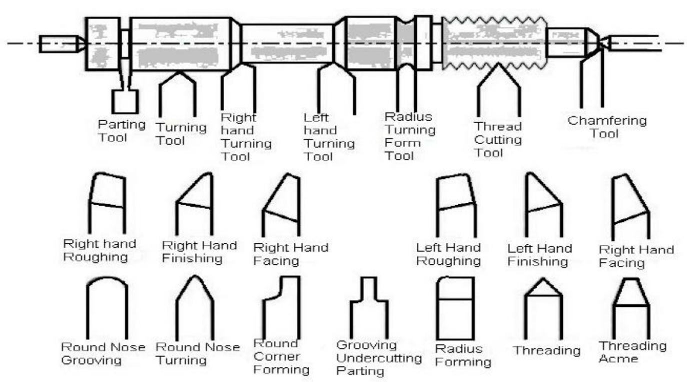

Fig.3.2: Lathe Machine Cutting Tool

5. Conclusion

We looked at many sorts of cutting tools that have a sharpened cutting element called the point and a shank. One of the most significant issues in machining is the cutting tool and its quality. The conclusion is that generating individual tables for optimum cutting settings for each tool material saves time and money while improving tool life and surface roughness. It is also stated that developing new cutting tools or selecting cutting tool materials for a certain cutting process is mostly dependent on a number of elements that interact with one another and are difficult to isolate.

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