

About Machine Tools

Machine tools are machines used to process the parts that make up various products and support our daily lives as "manufacturing" machines that make people's lives more comfortable and convenient. For example, metal parts that compose products made of metal, from everyday items such as cameras and watches to products essential for transportation such as automobiles, airplanes, and ships, all have a process of cutting and drilling the material to create them. The machines that perform these processes are "Machine Tools," which process not only metals, but also non-metals such as ceramics, glass, wood, and plastics.

Machine tools can make precise and complex parts accurately, efficiently, and inexpensively. And since all machines and parts are made by machine tools, they are also called "machine making machines" or "mother machines. In a broad sense, machine tools are defined as "machines for bringing metal, wood, or other materials into a useful shape by cutting, grinding, shearing, forging, and rolling, etc." The Japanese Industrial Standard (JIS) defines machine tools as "machines that, usually interpreted in a narrow sense, remove unwanted parts from metal workpieces by cutting, and grinding, etc., or by using electricity, or other energy to give them the required shape. However, it excludes machines that are held by hand, or fixed with a magnetic stand during use. On the other hand, internationally, machine tools are often interpreted in a broader sense to include presses and woodworking machines.

Machine tools are broadly divided into "General-purpose Machine Tools", which are operated by the operator by turning a handle, and "NC Machine Tools", which are automatically operated by numerical control using a computer or other means. The emergence of NC machine tools, which can produce the same machining results regardless of who uses them and enables the automation of production, has had a major impact on the entire manufacturing industry, with NC machine tools now accounting for over 90% of Japan's machine tool production. The main types of machine tools and their machining methods are listed below.

A lathe	A lathe is one of the most common types of machine tools, and is generally used to rotate cylindrical, or disk-shaped workpieces for machining. Machining performed by this machine includes external rounding, face grinding, taper cutting, boring, drilling, punching, and thread cutting.
Drilling Machines	Drilling machines perform drilling by rotating a drill tool and can also perform reaming, threading, and other processes.
Boring Machine	A machine for boring the inner surface of a hole drilled by a drill tool to a specified size with high accuracy.

Milling Machines	Milling Machines are used to process flat, curved surfaces and grooves by rotating a tool called a milling tool. There are many types of milling tools, such as face milling machines, end mills, and groove milling machines.
Grinding machines	Machines that use grinding wheels instead of cutting tools, such as bites and milling tools, have the features of better machining accuracy and better surface finish than machining.
Gear Cutting Machine	This machine performs gear cutting using tools called hob cutters, pinion cutters, and rack cutters.
Machining Centers	NC machine tools that can perform a variety of machining operations in succession, such as boring, milling, drilling, threading, and reaming, and are equipped with a function that automatically changes the tools required for each operation. Various types of machining centers are used, such as horizontal, vertical, and gantry machining centers, depending on the axis configuration of the machine. In recent years, 5-axis machining centers, which control 3 orthogonal axes and 2 swivel axes simultaneously to enable the machining of even more complex shapes, have become increasingly popular.
Turning Centers	Turning Centers are NC machine tools that combine the functions of a lathe with those of an NC lathe, and are equipped with many tools and a rotary tool spindle that can automatically change tools in addition to turning. Machines equipped with a rotary tool spindle that can perform machining while turning (indexing) are called "lathe-type multitasking machines" and have been rapidly gaining popularity in recent years.
Electrical Discharge Machines (EDM)	Electrical Discharge Machines (EDM) are machines that process using electrical discharge energy, and are classified into two types according to the shape of the electrode that conducts the discharge: engraving EDMs and wire EDMs. Other types of machines include "laser cutting machines," which use laser energy to cut, drill, or harden workpieces; "ultrasonic processing machines," which insert grains or processing fluid between a workpiece and a tool that vibrates with ultrasonic waves, and removes the workpiece while pressing the tool against it; and "wire EDMs," which slices three-dimensional CAD data into contour lines and forms two-dimensional shapes, then stacks the layers to create a three-dimensional shape. Special machining tools are also collectively referred to as special machining tools, including stacked molding equipment that realizes three-dimensional shapes by slicing three-dimensional CAD data into contour lines and stacking the layers.

In addition, machining methods of machine tools are broadly classified into three categories: "cutting," "grinding," and "special machining"

Machine Tools Machining Method	Cutting Machining	Cutting by rotation of workpiece	Biting
		Cutting by tool rotation	Milling (milling tools), boring (bites), drilling, threading, reaming (drills), and gear cutting (hob cutters)
		Cutting by direct motion of workpiece or tool	Flat grinding (milling tools), profile grinding and vertical grinding (bites), broaching (broaching tools), and gear shape grinding (pinion cutters, and rack cutters)
	Grinding Machining	Grinding with fixed abrasives	Grinding, honing, super-finishing, and lapping (dry type)
		Grinding with loose abrasives	Lapping (wet), barrel finishing, and liquid honing
	Special Machining	Electrical discharge machining, electrolytic machining, ultrasonic machining, electron beam machining, laser machining, additive manufacturing (additive manufacturing)	

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