

CNC router

A **computer numerical control (CNC)** router is a computer-controlled cutting machine related to the hand-held router used for cutting various hard materials, such as wood, composites, aluminum, steel, plastics, and foams. CNC routers can perform the tasks of many carpentry shop machines such as the panel saw, the spindle molder, and the boring machine. They can also cut mortises and tenons.

A CNC router is very similar in concept to a CNC milling machine. Instead of routing by hand, tool paths are controlled via computer numerical control. The CNC router is one of many kinds of tools that have CNC variants.

A CNC router typically produces consistent and high-quality work and improves factory productivity. Unlike a jig router, the CNC router can produce a one-off as effectively as repeated identical production. Automation and precision are the key benefits of CNC router tables.

A CNC router can reduce waste, frequency of errors, and the time the finished product takes to get to market.

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Applications

A CNC router can be used in the production of many different items, such as door carvings, interior and exterior decorations, wood panels, sign boards, wooden frames, moldings, musical instruments, furniture, and so on. In addition, the CNC router helps in the thermoforming of plastics by automating the trimming process. CNC routers can help ensure part repeatability and sufficient factory output.

Process

Depending on what type of machine you have, determines what process you have to take to get the CNC machine running. Typically you have to upload a picture or file into a drawing software (CAD) and then have it converted to vectors [if you don't have a file or picture, you can also use a drawing software to create your own image or drawing]. After uploading the file and tracing the file with vectors, now you are ready to select the tool and toolpath that you want the machine to make. This is where you have a lot of control over the system. First, you want to select the tool that you want to use, whether it be a .25-inch v-bit or a .75-inch core box bit. This is also where you have the option of changing the speed of the router along with the cut depth. After selecting the tool, you have to select the toolpath that you want to use. In most cases, you can either trace the vectors, cut outside the vectors, or cut inside the vectors. This is up to the discretion of the machinist depending on what they need. After selecting the toolpath, then it's time to upload the vectors into a g-code software [typically this is the control panel of the CNC router itself]. By doing this task, you will convert the vectors into a script of G-code. In this G-code, you will see coordinates for X, Y, and Z [X being horizontal to the table, Y being vertical to the table, and Z being perpendicular to the table]. After having the vectors converted to G-code, you then need to determine where the center point of the part is [doing this is very key in the next few steps]. After finding the center of the part, you then load the part onto the table and secure it with clamps [it's very important that the part doesn't move during this cutting process]. After securing the part to the table, you then need to jog the machine over until the router bit is directly above the center point that you marked. Once you have it properly aligned, you need to jog the machine down until the router bit is on the face of the part [make sure not to dig into the part with the bit]. Once this step is complete, you need to mark this point as your absolute zero. Doing this will create the start point once the machine is up and running. Once the absolute zero point is set, jog the machine up a few inches and you're ready to begin. Once you're off the part, select the run G-code function and the machine will begin to cut your design.

Overview of CAM (computer-aided manufacturing)

CAM software makes the CAD drawing/design into a code called g-code. This code the CNC machine can understand. In short, CNC technology is not very complicated. It is a tool controlled by a computer. It only becomes more sophisticated when considering how the computer controls the tool. The illustration shows what a bare bones CNC machine might look like without its controller

Sizes and configurations of router

CNC routers come in many configurations, from small home-style D.I.Y. "desktop" like k2 CNC, to large industrial CNC routers like Motion master. CNC routers are used in sign shops, cabinet making, aerospace and boat-making facilities. Originally CNC routers added computer control to consumer router power tools.

Although there are many configurations, most CNC routers have a few specific parts: a dedicated CNC controller, one or more spindle motors, servo motors or stepper motors, servo amplifiers, AC inverter frequency drives, linear guides, ball screws and a workspace bed or table.

In addition, CNC routers may have vacuum pumps, with grid table tops or t-slot hold down fixtures to hold the parts in place for cutting. CNC routers are generally available in 3-axis and 5-axis CNC formats. Many Manufacturers offer A and B Axis for full 5 Axis capabilities and rotary 4th axis. Common industrial CNC router sizes include 4' x 8' and 5' x 10.'

Controlling the machine

The CNC router is controlled by a computer. Coordinates are uploaded into the machine controller from a separate CAD program. CNC router owners often have two software applications—one program to make designs (CAD) and another to translate those designs into a 'G-Code' program of instructions for the machine (CAM). As with CNC milling machines, CNC routers can be controlled directly by manual programming, and CAD/CAM opens up wider possibilities for contouring, speeding up the programming process and in some cases creating programs whose manual programming would be, if not truly impossible, certainly commercially impractical.

Types of materials

Wood

A CNC wood router is a computer-controlled router tool that carves/etches objects or images into the face of a piece of wood. The CNC Router is ideal for hobbies, engineering prototyping, product development, art, and production works. The CNC works on the Cartesian coordinate system (X, Y, Z) for 3D motion control; however, typical CNC operated systems can only make carvings on flat planes. The machine sits on a track and is not capable of making round or spherical cuts. Parts of a project can be designed in the computer with a CAD/CAM program, and then cut automatically using a router or other cutters to produce a finished part. In some instances, the table will not come with a router included, this gives the user a certain amount of freedom. This will allow the user to change out routers for different applications. For lighter strained cuts, you could use a lower grade router but for more intensive applications you could replace the router to something more industrial.

Metal Milling

is the machining process of using rotary cutters to remove material from a workpiece advancing (or *feeding*) in a direction at an angle with the axis of the tool. It covers a wide variety of different operations and machines, on scales from small individual parts to large, heavy-duty gang milling operations. It is one of the most commonly used processes in industry and machine shops today for machining parts to precise sizes and shapes.

Stone

A stone CNC router is a type of CNC router machine designed for marble, granite, artificial stone, tombstone, ceramic tiles, glass machining, polishing for arts and crafts, etc. The biggest difference between the different types of materials is that you have to have certain "bits" or "inserts" to cut different materials. You wouldn't use the same bit to cut stone as you would to cut wood. There is bit call as diamond tools with different diameter 4mm,6mm,8mm mainly used. For wood CNC-in, you could use a softer metal bit, but for Stone CNC-in, you would have to use a much harder metal bit. The bits/inserts have to be harder than the material it's cutting.

Polyurethane foam

Polyurethane foam can also be cut using a CNC router in order to produce complex shapes which would otherwise be difficult or impossible to replicate by hand. Depending on the type of foam being converted, a CNC router would be able to cut through up to an 8lb density. By converting a CAD design file to a CAM file, the CNC Router is able to read relevant information and produce a highly accurate finished product.