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Weight is Great

Generally, the heavier the cnc router, the better it is. Heavier machines tend to be more rigid and therefore more precise. Lighter weight cnc routers tend to be more prone to undesirable vibrations and inaccuracy.

The Frame Game

As mentioned, the heavier your frame is, the better it will perform. Aluminum and even wood frames might be appropriate for hobby shops or small projects. They are low-cost, but short-lived, less rigid and therefore far less accurate. Extruded aluminum framing can work for small-footprint systems that are 2x3' cnc router or less. Anything larger, or requiring considerable accuracy, should use steel.

Bent and stamped sheet metal is inadequate for table frames or gantry components because it will flex, causing undesirable vibrations that affect the final cut.

One-piece welded steel frames are stronger, more rigid, and more accurate. These frames will give you better cuts and they will last much longer than other frames. One-piece welded steel frames are the foundation of a high-quality CNC router. Anything less will compromise every other component's performance.

Working Envelope

The working envelope is the space your router has available to operate within. An adequate working envelope should be at least slightly larger than the largest job you expect the machine to perform. Include all three axes: X, Y, and Z. Consider the available footprint and access to the machine. How will work be loaded/unloaded? Give the machine enough space to do what you expect it to do.

Table Type

Cutting applies large forces to the material you are cutting. The setup must apply adequate counter forces to prevent the material from shifting out of place. There are different methods for holding material in place, depending on the material itself and the application involved.

Vacuum Tables

Vacuum tables create suction zones that hold the material in place. There can be numerous zones, which you activate as needed. These systems are

powerful, easy to use, and often employed in the sign and wood industries. However, if used continuously, vacuums may consume a lot of power.

Other Options

A vice offers effective hold without consuming power. Likewise, special fixtures hold jobs that might not fit well into a vice.

For plastics, two-sided tape is often the best choice.

Whatever method you use to hold your work, always make sure you secure it firmly. Don't operate on loose material, and NEVER hold material with your hand!!!

Servo/Stepper Motors

Servo or Stepper motors move the spindle across each axis to complete the toolpath defined by your program code. Motors should be powerful enough to provide the feed rates that will give you clean, efficient cuts. Router tables that are 4' x 4' or larger and cut sheet goods such as plywood should have stepper motors in the 4-6 Amp and 400-600 oz range. Servo motors might also be a good option, depending on your needs. Check out our article on stepper vs. servo motors.

Positional Accuracy

Positional accuracy refers to the resolution of the motors that position the cutter. The smaller the resolution, the more granular the cutter movements, the more precise the cut is. Typically, the more precise the machine, the more costly it will be.

Examples of common resolutions:

- 0.005" (less precise)
- 0.001"
- 0.0001"(more precise)

- 0.1mm
- 0.002mm

Spindle Speed & Power

Speed

The spindle is what rotates the cutting tool on a CNC router. The rate at which it rotates depends on the material you are cutting and the tool doing the work. When engraving products with fine detail, you need to use pointed conical tools at very high rpm (18,000-24,000 rpm, depending on the material).

Power

The higher the material removal rate, the more power the spindle must have. In other words, the more power your spindle has, the faster it can remove material.

Generally, speed relates to the specific material being worked, whereas power relates to the rate material is removed.

Examples of speed rates:

- 10,000 rpm
- 15,000 rpm
- 24,000 rpm

Examples of spindle power:

- 1 Kw
- 15 Kw

Tooling

The market offers a wide variety of tools for various applications. Some tools have general applications and others are highly specialized. Research what's available on the market and select tools that address your specific needs.

If your work requires numerous tools, an automatic tool changer (ATC) is likely a worthwhile investment. ATCs swap out tools in a matter of seconds, decreasing cycle times and increasing productivity.

Control System

The control system (or controller) tells the motors and spindle what to do. The operator loads the program code into the controller and gives commands through its interface. The controller also notifies the operator of the system's status, including current position and any alarms that occur.

Industrial or PC-based

Control systems generally fall into two categories: industrial (non-PC) controllers and PC-based controllers. PC-based controllers give the operator a familiar interface, which functions and feels like any other desktop computer. Non-PC controllers offer custom-made instrumentation designed exclusively for operating industrial equipment. PC-based controllers will encounter certain limitations because they function as both a PC and controller; however, many operators prefer the familiar keyboard and mouse setup.

Processing Speed

The data processing speed determines how fast the controller can handle the information it sends to the rest of the system. Work that is complex, high speed or high volume with large toolpath files requires faster processing speed than smaller, simpler work.

Connections

Of course, the controller is only as good as its connection. A parallel port provides the most reliable connection for CNC controllers. The technology is well established, widely implemented, and not considered a bottleneck. USB, meanwhile, suffers from high latency connection times and limited availability. Alternatively, serial connections are simply too slow.

You should also consider how the controller connects to your design computer. When direct connection is impractical, some controllers offer networking capabilities, through either Bluetooth or Wi-Fi technology. Otherwise, operators can transfer files from a USB flash drive if there is an available port.

Software

G-code

Gcode is a set of instructions that tells your machine to perform specific operations. There are two types of CNC software languages—industry standard and proprietary languages. The industry standard CNC language is G-code. G-code is well established, widely used, and offers many powerful features that can tackle nearly any need you might have. Some CNC routers come with proprietary languages that are not G-code, and likely offer fewer features. As you would expect from anything non-standard, proprietary languages vary widely.

G-code is standard for a reason. It works, and it works well. There are many G-code resources and a vast community to support users of the language. Moreover, G-code programmers are easier to find than someone who happens to know any given proprietary language. You will have a lot of difficulty finding resources, including program examples, for a proprietary language. Also, proprietary controlled systems will have significantly less resale value. Eventually, you will encounter G-code, so you might as well learn the one language and stick with it.

Post Processor

The post processor is the software that modifies generic G-code for use on a particular CNC router. Your post processor should be industrial quality and compatible with your design software.

Technical Support

Although often overlooked, technical support is the most important factor when choosing your CNC router. Anything with moving parts will eventually require servicing. No matter how productive your machine is when operating properly, downtime is costly. Therefore, choose a CNC system with reliable service technicians and readily available parts to avoid future headaches.

Conclusion

With the right information and research, you will choose a CNC router that fits your needs and markedly increases productivity. Start with a good understanding of your particular needs and look for a quality cnc router that addresses them.

Good luck!