stiles education virtual university

Learning On-Line

Tech Tip # 3

August 2002

Written by:
Kevin Bonz
Stiles Education's
Router Specialist

CNC Tooling: Increase Profits with Proper Utilization

Did you know that using CNC tooling correctly would lead to increased profits? When properly used, it can reduce tooling costs, minimize rejected parts and lower machine maintenance costs. How is this done? Is there a special formula? Not really. In the majority of cases it is common sense pared with knowledge. Let's explore how costs savings can be accomplished.

Safety:

First, safety must always be considered. Always follow the tooling and machining manufacture's guidelines when using tooling. There are several elements that need to be taken into account. These include specific types of tooling, the colleting system, spindle motor type, fixturing, the material being routed and programming.

Panel Material & Tooling:

There are many types of material that can be routed on the CNC machine. Some of the common wood based materials include, plywood, particleboard, MDF and all types of solid wood. Just like one size of clothing does not fit all nor does one tool fit all solutions. Each of these materials plus many others requires different styles of tooling. Each material has different machining

Training Your Knowledge Workers For Tomorrow

STILES EDUCATION
3965 44th Street S.E.
Grand Rapids, MI 49512
(616) 698-7500
fax (616) 698-0196
e-mail classes@stilesmachinery.com

properties. Some of these characteristics are density, consistency, laminated faces and grain orientation. When routing these materials tooling must be chosen very carefully. A tool designed for finish cutting MDF would have a very decreased life cutting hardwood plywood. Selecting diamond tooling may be the best solution when machining plastics, MDF and HDF. Since diamond is so hard, it may not have a service life for materials that vary in consistency. The density of the material also determines the optimal chip load. The harder the material is the lower the chip load should be. The softer the material is the higher the chip load should be.

Not all materials (MDF, particle board, hardwood plywood, all types of solid wood) are created equal. Materials supplied from one company may be different than the same type of material supplied from a different supplier. Some of the problems that may occur when changing material suppliers are quality of cut and tool life. What once worked successfully now becomes a challenge.

Since the chip acts as a heat sink (pulling heat away from the tool) the size of the chip is very important to tool life. Along with the chip size, chip removal is very important. Dust collection can make a huge difference in tool life. Since the chip contains heat it needs to be evacuated away from the tooling. Work with the machine builder or distributor to determine the proper amount of CFM's of dust collection for your machine. Dust collection systems should be checked at the machine and on an annual basis.

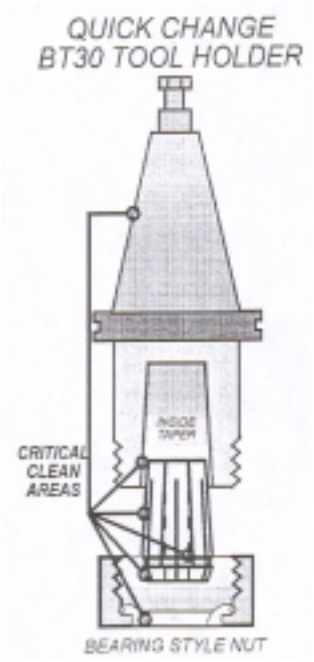
Fixturing:

The purpose of a correctly engineered and fabricated fixture is to hold the part during the routing operation and minimizing the possibility of the part from moving. The fixture can use vacuum, mechanical clamps, pneumatic clamps or any combination of these holding devices. Does this mean the fixture must cost a lot to build? Does it need to be made out of expensive material? Usually neither must be the case. The recommended cost and the material it is made

CNC Tooling: Increase Profits With Proper Utilization

from will be dependent upon on how many parts are going to be routed or the complexity of the part. In most cases some type of vacuum fixture will suffice. The most common types of these fixtures include spoil boards, bleeder boards and pods. Each of these systems has their advantages and disadvantages. Regardless of the type of fixture, if the part moves there will be several problems. When this happens the tool could break, the quality of the part could suffer (be rejected) and the tool life will shorten.

Spindle Motors:



Source: Onsrud Cutter

The machines spindle motor plays a significant role in what type of tooling can be used to machine the material. Most of today's spindle motors have sufficient RPMs and horsepower to run off-the-shelf CNC tooling. Most motors are capable of making two different types of cutting: climb cutting and conventional cutting. When climb cutting is being performed the requirement in horsepower will increase by as much as 25 percent over conventional cutting. The condition of the spindle motor will also determine what type tooling can be used. If there is vibration being generated by the spindle motor due to worn bearings or other defective internal parts, premature tooling failure will occur. Diamond tooling demands the spindle motor must be kept in tiptop condition to receive full benefit. Not only does the vibration need to be at a minimum, the runout of the spindle shaft must not be greater that 0.002 inches. The runout on most new spindle motors are 0.001 inches and less. The tool holder or shaft of the spindle must be kept clean! The mating surfaces must have a minimum of 95 percent contact. Regardless of the type of spindle, NT taper or HSK both must be clean and in excellent conditions. If there are contaminates or wear, the tool will not be in line with the center of the spindle motor shaft. This will cause the tool concentricity to be larger than the diameter of the tool. This increases vibration and causes quality issues with the parts.

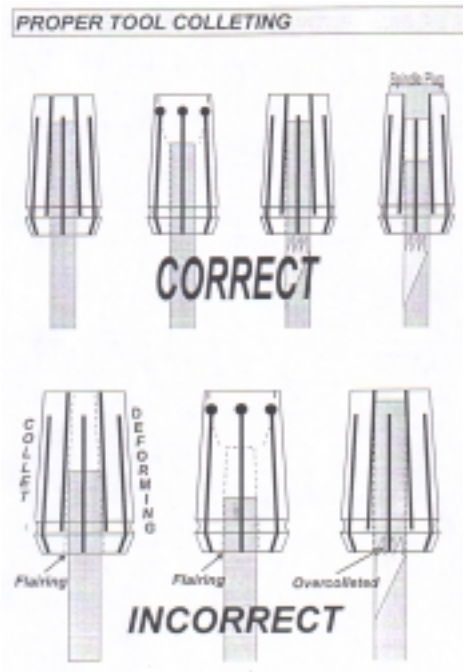
CNC Tooling: Increase Profits With Proper Utilization

When considering larger diameter tooling the spindle motor maximum RPM's may be to high for this tool. All tools have maximum RPM ratings. Never exceed these ratings! The tool could break (often damaging the spindle motor) causing safety issues. When using CCW (left hand) rotation of the spindle motor the tool being applied must be designed for this rotation. Always remember when using this type of tooling the tool holder or spindle motor shaft must have left hand threads. Otherwise the tool and the colleting system could come apart during operation. Keep in mind if the spindle motor is damaged and is being repaired production capacity will suffer. Down time is often more expensive that the actual cost of the spindle motor or tool replacement.

Collets:

The collet that holds the tool inside the tool holder or spindle shaft is one of the most overlooked items on the machine. The collet is a very high precision device. It must hold the tool firmly during extreme lateral and radial loads. There are several different choices on what type of collet to use. Trying to save money here may not always be the best policy.

When the collet becomes worn several problems start occurring. The tool will start to slip, vibrate or jump rope. When the tool slips the depth of the route will change. If the tool has a down spiral this could also be a safety issue. The tool could break off or come out of the collet completely during operation. In addition when the tool vibrates this vibration is transmitted to the surface of the material



Source: Onsrud Cutter

being machined. This is commonly known as chatter. This causes poor cut quality as shown on the material. When diamond tooling is used, this vibration will shorten the life of the tool. It may even damage the diamond where it may not be economical to repair. When the collet becomes enlarged at the opening, the tool will no longer turn in a concentric circle. This is often called bell mouthing.

How long should a collet be in service? Is it one month? Six months? A year? Several years? Most tool manufactures suggest that a collet should be replaced between 600 to 1000 hours of use. This is about 5 to 7 months based on six hours of operation per day, five days a week.

What other factors can also affect collet life? Heat will cause a short collet life. It will lose its spring tension properties. Dropping the collet will also cause it to be damaged. If this happens, do not put it back into production; replace it. The tool life and spindle bearings will suffer.

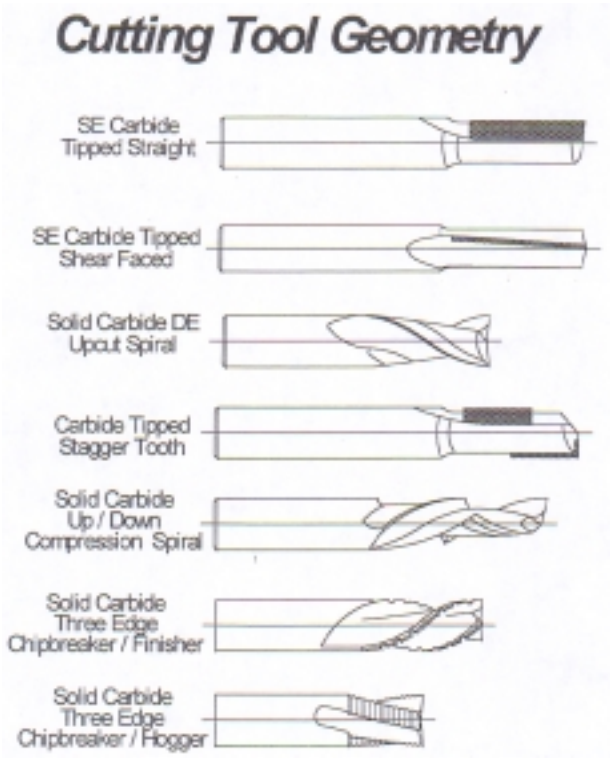
To use the phrase “Cleanliness is next to Godliness” is very true here. Collets must be kept very clean of all types of contaminates. Never apply any types of oil to the collet. Use soft brass brushes and clean lint free cloths to wipe off and clean the collet.

Tooling:

Choosing the right tooling can be a challenge. There are so many types available to choose from. This is where working with knowledgeable tooling suppliers becomes very important! By working with these companies they will be able to help make the best choices of what type of tooling best suits your needs. Some of these choices should include: safety, optimal production cycles, quality of the parts and tool life. Frequently tool suppliers specialize in a narrow range of cutters. Most specialize in one or more tools for woods, plastics and non-ferrous metals along with a general mix of the more universal tooling used. Determine which supplier is right for you.

CNC Tooling: Increase Profits With Proper Utilization

Tooling is most often made from different type of materials: they include: HSS (high speed steel), CT (carbide tipped), solid carbide, carbide insert, ceramic and PCD (polycrystalline diamond). Along with the material there are different styles of cutter. They included spiral, straight without shear angle, straight with shear angle and profiled. This is just the beginning on how tools are defined! No wonder choosing the right tool can be very time consuming. Where do you start? Start by contacting several tooling suppliers. Contact the machine manufacture or distributors. They usually have applications engineers that can assist with your tooling selection. Tooling like everything else must have a balance. The balance is between quality of cut verses tool life. The majority of tooling is balanced some where between the two extremes. This is part of the process on choosing the right tool for your application.



Source: Onsrud Cutter

In making your selection consider the following:

1. HSS can be sharpened to a much sharper edge that other cutting material. Use where quality of cut is a primary consideration. This type of tool may be ideal for use in natural woods and plastics. Tooling costs however can be deceivingly high. Their purchase costs are inexpensive. Since steel is softer than most of the other cutter tool, their life is shorter.
2. Carbide is the primary tooling material used in the wood working industry. It's much harder than steel yet still withstands impact fairly well. Carbide can machine in a large variety of material with great success. They are able to cut at higher feed speeds than steel.
3. PCD is very hard and under the right circumstances it will have the longest life. The initial cost is very high and they are not the best tools for all applications.

Work with several different tooling suppliers. Have them visit your place of business. Encourage them to look at your machines, fixtures and materials. Explain to them what you want to accomplish. Consider this a good start. Once you have a tool chosen then work more closely with the tooling supplier. They can help refine the tools geometry to improve tool life and performance.

Programming:

As with collets, programming is often over looked. Programming is just as important to tool life as all of the other areas discussed in this article. Some examples are excessive feed speeds, RPMs set too high, tool path movement (rapid traverse), excessive dwelling of the tool in the material and the type of entry into the material. Today's CAM software makes programming very easy and quick. However, this software is not a panacea. Even with software,

CNC Tooling: Increase Profits With Proper Utilization

the programmer must understand how the program works. The G and M code program that is generated by software may not be 100 percent correct. There are times when portions of the program must be manually rewritten to make it perform optimally. An experienced programmer who pays attention to details can reduce costs. These reduced costs include tooling purchases kept to a minimum, an increase of the number of times tooling can be re-sharpened, part rejects drop, general maintenance of the machine is less and production is improved. Investigate if your personnel require training. Keeping them informed and up to date often returns many dividends.

Is this everything you need to know about CNC routers? Consider this only a foundation to build on for the future. Take this beginning and continue to build upon your knowledge. Work with the machine manufacture or distributor. Training sessions from tool manufacturers and Stiles Education are highly recommended. Locate any references that may help you understand the technology better. Always ask questions and take detailed notes. Consider keeping other detailed notes on how different tools work in different materials and machines. The more complete your tracking of this information is the more informed you would become. This approach works very well for reducing machine down time and assuring quality. When everything is done properly you will have higher production rates with reduced part rejects. This all adds to the bottom line!

Want to learn more?

Stiles Education offers CNC router courses in programming, operation and maintenance. Tooling is just one of the topics covered in these classes.

Call us at 616/698-7500 for further information or to register!

stiles education virtual university