

Why Diamond Tools in Woodworking?

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INDUSTRIAL DIAMOND ASSOCIATION OF AMERICA, INC.

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It all began several thousand years ago in ancient Egypt. An overworked craftsman, trying to meet a production deadline

discovered that some of the crystalline stones used for decorative jewelry would cut the granite blocks much faster than his conventional tools. His associates probably scoffed at the waste of such expensive material until they realized that this brilliant unnamed individual was able to produce more and better quality products and still be able to go home when the sun went down while they toiled long into the night. This discovery probably resulted in a flurry of activity to find the best crystalline cutting tool among all the jewelry in the area and launched us into the age of "Industrial Diamond".

From the very beginning, the cost of diamond was a factor, but in general, diamond was the only logical choice when cutting the hardest, most difficult materials. But a second major evolution in the use of industrial diamond occurred within the last 20 years that has dramatically changed the way diamond tooling is perceived in industry. Previously diamond was the "Tool of Choice" for materials that really could not be cut with any other cutting edge. Generally, processing the hardest materials—glass, stone, carbides—represented the major areas for industrial diamond use. However, with the coming of the computer age, CNC production equipment and the need for high production speeds with minimum machine downtime, technology gave way to the accountants' calculator. Diamond, one of the most expensive materials per pound, was looked on as the most economical choice for cutting tools. Not because it was the only cutting edge strong enough to do the job, but because it was able to maintain a cutting edge long enough to save significant costs in other production related areas.

There is no other manufacturing area today that exemplifies this more than the current surge in the use of diamond tooling for woodworking. When you think about using diamond, the hardest material on earth, to cut wood, you have to scratch your head to figure out the logic. Wood has always been a favored construction material because it was so easy to cut. From the hollowed out canoes of the ancients to furniture, wood was chosen as the base material because you could cut it with virtually anything, from soft bronze knives to sharp stones. All would easily cut the wood material.

So it is evident that you don't need diamond to cut wood. But why then is diamond becoming the favored cutting tool for so many of the companies involved in the wood processing industry around the world? The answer is simply "economics". The advent of Polycrystalline Diamond has made it possible to produce diamond tools relatively inexpensively; the increased usage of higher cost computer controlled production equipment makes production speed essential. Somewhere in the last 10 years, increasing production cost and decreasing diamond cost intersected. At this point, it became cost effective to use one of the most expensive cutting tools available to process one of the easiest to cut materials.

To give a rough idea of the economics involved, a diamond tool will cost approximately 40 times the equivalent carbide tool. But the life of the diamond tool will be approximately 150 times longer. It does not take much mathematics to realize that over the life of the diamond tool, there will be a considerable cost savings. But, as welcome as direct cost savings are, that is not even the major benefit of using diamond tooling to process wood. The most significant benefit diamond provides is the enormous reduction in machine downtime. Generally in high volume production woodworking operations, the carbide tooling has to be changed at least once and usually twice per 8 hour shift. This is a loss of production that can represent several hours per day. In an automated CNC production line, an hour's worth of production represents several thousand dollars in costs. Instead of hav-

ing to change the tooling every shift, diamond tools can run several months without any attention. When a diamond tool is put into production, 150 tool changes have just been eliminated. The removal of this machine downtime from the daily schedule actually saves enough in production costs to more than pay for the original tooling. And it is not only the large companies which benefit from this type of savings. Any company, large or small, that loses a significant amount of production time due to tool changes, is addressing this problem through the use of diamond tooling.

It is becoming common knowledge in the woodworking industry that if you invest \$250,000 on an automated CNC controlled router and you put a \$25 carbide tool on it, you will get a \$25 result. But when you use diamond, even though the tool may cost \$1000, you will get much more effective utilization of the equipment investment and hence a lower overall production cost.

In addition to the relative cost of diamond tooling going down and the upsurge in automated equipment, there are some other factors which spurred the increased shift to diamond in the woodworking industry. The shortage of solid wood has caused a major shift to manufactured wood for furniture. This manufactured wood is made of wood chips and glue or resins. This makes a very strong, inexpensive substitute for the natural solid woods but it also raises havoc on the tooling used to process it. The high resin content is very abrasive. It destroys the cutting edge on carbide tool-



Figure 1 - One diamond tipped cutter will cut as much material as 150 carbide tipped tools.

ing in a matter of minutes. Since these manufactured woods generally have a chip board or particle board core and a nice looking veneer of plastic laminate to "disguise" what is inside, the cutting edge has to be able to effectively handle several types of materials at once and cut them all cleanly. Carbide will not hold up long enough to produce an adequate production run. Only diamond has the proper abrasion resistance characteristics to handle these various materials all at once to produce a quality product.

Another significant factor in stimulating the use of diamond in woodworking is that suppliers of the Polycrystalline Diamond have been able to make the diamond blanks in larger sizes (above 50mm diameter). For woodworking this is critical since we are not making a cutting tip, we are making a cutting edge. The entire edge has to be a continuous, non-interrupted cut. Any lines or rough spots cannot be accepted since virtually all the products made will be openly displayed by the consumer. Whether it is a dining room table, a desk or a bookcase, any defect in the cut will reduce the value of the final product.

As with other industries, there was an initial "sticker shock" with diamond tooling. But the woodworking industry has begun to embrace the use of diamond tooling for the factors discussed above and for additional factors that are less obvious but also very important. Because diamond stays sharper longer, overall quality of the cut is better, thus reducing scrap. Additionally, sharper edges and smoother cut will result in a reduced load on the motors and bearings in the machinery. It has been shown that diamond actually reduces the maintenance cost of operating the production machinery.

In some manufacturing operations, noise on the machines is a serious problem. Diamond tooling with its sharper edges will run much quieter and thus reduce noise pollution. This becomes a more important consideration as the environmental protection agency adds more stringent regulations in the area of noise reduction.

Also, diamond tools are known to maintain their dimensions much more accurately over the working life of the tool. In some woodworking applications, this does not provide any benefit. But in a few areas, such as tongue and groove cutting for interfacing wood sections, the complex profiles have to be maintained

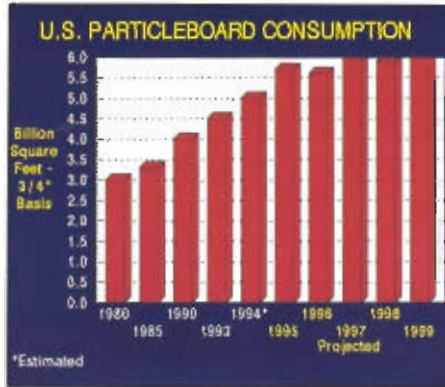
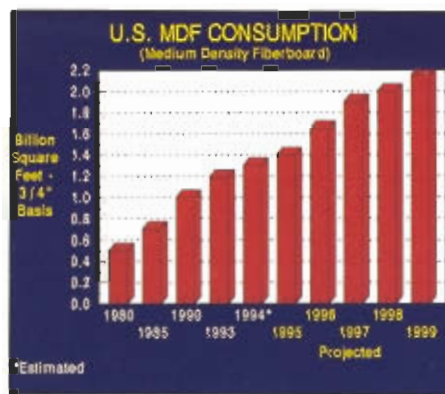


Figure 3
Various types of manufactured wood are being used.

Figure 2
The use of manufactured wood products has increased significantly.



Figure 4
Diamond tipped tools are used to cut a variety of wood and plastic products.



Figure 5
Diamond tooling for woodworking is generally comprised of complex profiles and intricate body styles.

to within a few thousands of an inch. Carbide has a problem in these types of tools because the cutting edge will round over as it wears. This causes changes in the profile which are enough to result in a poor fit between adjoining surfaces. Diamond will not wear in this manner and the accuracy of diamond cutting edge has led to further upgrades in the quality level that can be achieved in this type of woodworking application.

As seen above, there are many factors which have stimulated the use of diamond tooling in the woodworking industry. But this success has not come without a lot of technical development work among the diamond producers, machine builders and tool manufacturers. Some of the early technical problems

involved the size and type of diamond that was available. Some wood profiles are 2 inches long. Most times this cut is not straight and involves the combination of many radii or curves as in the case of a stairway railing or dining room table top. Still the cut has to be made with no lines or defects. In addition the tool may be running at as high as 22,000 RPM and a feed rate that can exceed 150 feet per minute - with no cooling fluid able to be used on the tool. The impact, chip load, surface finish, complex profile, heat generation, chemical effect of the resin on the polycrystalline diamond and resin build-up on the tool all present problems. As usual, the solution to one of these problems may compound another of the problem areas. Much development work is being done to further expand the areas

where diamond can be used in the wood producing and wood fabrication markets.

The use of diamond tooling in the woodworking industry will continue to expand due to the industry's realization that it **must** continue to invest for the future. As with many other industries in the United States, the woodworking industry has begun to adopt the attitude that they cannot continue to work on short term measurements. Most companies understand if they don't invest in equipment that will generate benefits over the long haul, they will not be in a competitive position for the future. Any woodworking company not investing in the latest CNC machinery and in cutting tools such as diamond has already made the decision to go out of business. They just haven't set the date. ♦



Saber Diamond Tools, Inc. specializes in polycrystalline diamond for the woodworking, plastics and electronics industries. For more information, please contact one of the following production and sales locations...

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