

The Value of Superabrasives – Making versus Saving Money

Improved material removal rates and lower abrasive costs per part have been touted by wheel manufacturers since the introduction of superabrasives. But these are only a few of the many exciting and rewarding advantages when superabrasives are combined with multi-axis CNC grinding systems. Although cost savings can be significant, the real money making potential for CNC superabrasive grinding is in higher productivity. Stan Huffman's patented 8-axis Tool and Cutter Grinder introduced manufacturers to the benefits of superabrasive grinding technology in toolrooms in the early seventies. Over the years and some 900 machines later, improvements in machine and grinding wheel technology have ushered Huffman Superabrasives Grinder Systems from the toolroom to the production floor. The extraordinary results of superabrasives are achieved by an accumulation of benefits, including:

- Higher Speeds, Improved Material Removal Rates, Lower Per Part Abrasive Costs
- Smaller Wheels, More Wheels On The Spindle, Multiple Operations
- Improved Total Throughput Time With Less Machines Required
- Less Total Manufacturing Floor Space Required
- Much Higher Speeds Than Conventional Wheels
- Wheel Wear Virtually Eliminated
- Consistent Surface Speed From Part To Part
- Lower Tooling & Fixturing Costs
- Less Scrap, Less Inventory
- CNC Automated/Less Labor Intensive/Less Training

Higher Productivity

Bonded or electroplated superabrasive wheels typically have a higher **rpm** rating than conventional abrasives. Higher surface speeds alone account for much of the increased productivity. Where conventional abrasives normally operate in the 3,000 - 5,000 surface feet per minute (SFM) range, bonded superabrasive wheel speeds can safely reach 10,000 SFM and electroplated wheels can exceed 30,000 SFM.

Conventional abrasive wheels are oftentimes heavy, large, and require

lengthy setup times for changeover, truing and dressing. Setup times are generally lower for superabrasive wheels since they are smaller and easier to handle, they need to be changed less often, and little, if any, truing and dressing is needed. If one agrees that a grinder only adds value when it is grinding, then it follows that it does not add value when it is being setup or when wheels are being trued and dressed. By reducing the frequency and duration of wheel changes and wheel truing, superabrasive wheels, especially electroplated wheels, "free" the machine to add value.

Lower Abrasive Costs Per Part

Although superabrasive wheels cost more than conventional abrasive wheels, case studies demonstrating reductions in abrasive cost per part are widely documented. The "G" ratio, defined as the ratio of volume of material removed to the volume of grinding wheel loss, of superabrasive wheels can be hundreds of times higher than that of conventional abrasives.

Combined Operations

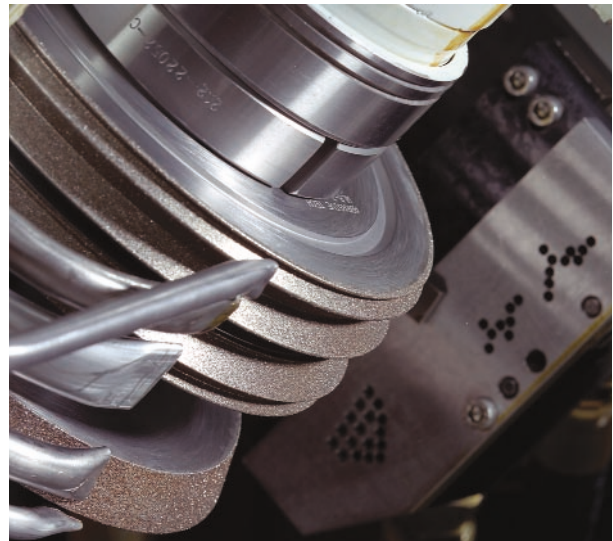


Figure 1: Multiple Wheel/Single Spindle Set-Up.

For a conventional abrasive wheel with a low **rpm** rating, the only way to safely achieve higher surface speeds is to use a larger diameter. But given the much higher RPM rating of a superabrasive wheel, the

diameter can be kept relatively small and still achieve very high surface speeds. Using smaller diameter wheels affords the opportunity to "gang" several wheels on a spindle and combine several grinding operations into a single setup.

Many conventional abrasive manufacturing processes involve tooling a machine to perform only one operation. The intent is to optimize the setup to minimize the cycle time for that particular operation. Although the conventional abrasive method is capable of very short cycle times for a given operation, it can have other offsetting costs. As an example, a large batch size is usually required to make this process economically viable.

Reduced Setup Time, Fixture Costs, Labor Costs, Work-In-Process, Throughput Time And Floor Space

By combining many grinding operations into one workpiece clamping, many of the setup operations are eliminated. For example, if a workpiece requires five grinding operations, then combining these operations can conceivably reduce machine setup, fixture costs and manual part handling by as much as five to one. This was the appeal of Stan Huffman's 8-axis superabrasive grinders when Huffman first began selling them in 1972. While the workpiece fixture for a multi-operation setup may be more expensive than a single-operation setup, total fixture costs are usually lower.

In a work cell or manufacturing line, there is typically a staging area where incoming parts "wait" to be processed. As the number of machines in the line increases, so increases the Work-In-Process (WIP) and throughput time. If parts need to be inspected between operations, then the inventory costs and throughput time increase yet again. In one case, using multiple superabrasive wheels on a two-spindle machine, a manufacturer has combined as many as 24 grinding operations into one setup. By combining operations using superabrasives, fewer machines are required, freeing floor space for better factory utilization.

Increased Quality

In any machining operation, the finished dimensional accuracy of the workpiece is largely dependent on the fixturing. The more times a workpiece moves from fixture to fixture in a multiple-machine single-operation production line, the more the final dimensions are susceptible to stack-up errors and misfixturing. Combining operations into superabrasive machines ensures that each of the operations is referenced to the same datum point or surface, making it easier to achieve quality parts.

Another factor which increases quality is that superabrasive grinding generally introduces less process variability than conventional grinding, especially in the case of electroplated wheels which require no wheel truing and exhibit negligible wheel wear. This is in sharp contrast to conventional abrasives that are either continually dressed while grinding or are intermittently dressed between parts or between grinding passes. Wheel diameter changes introduce process variability — in wheel RPM or SFM, in length of the grinding zone and in the critical area of coolant placement.

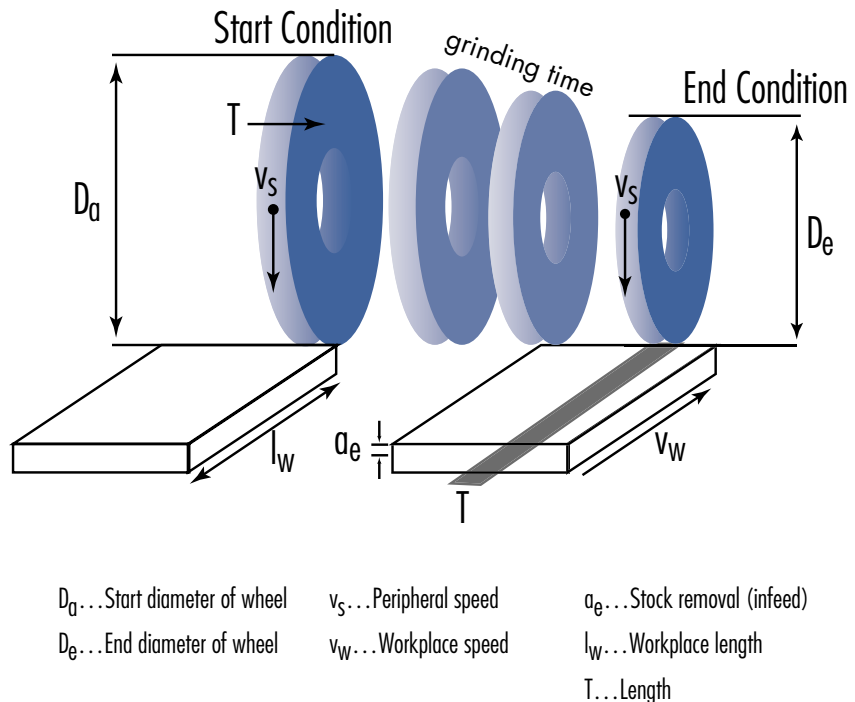


Figure 2: Wheel Diameter Changes on Conventional Abrasive Wheels

Less Scrap, Less Inventory, Less Swarf

Because of process consistency, little scrap is generated. Wheel life can be planned more readily due to the slow, predictable wheel wear. This predictability results in better managed and lower wheel inventories. Parts inventories become more predictable and controllable, and often less inventory is needed to maintain good service. Cost savings are realized even in swarf management and disposal. Given little or no wear with superabrasive wheels, almost all of the grinding swarf consists of the workpiece material. Continuous or intermittent dress processes with conventional abrasive wheels generate much more grinding swarf, the costs of which appear in the grinder's more expensive coolant filtration system and in higher disposal costs.

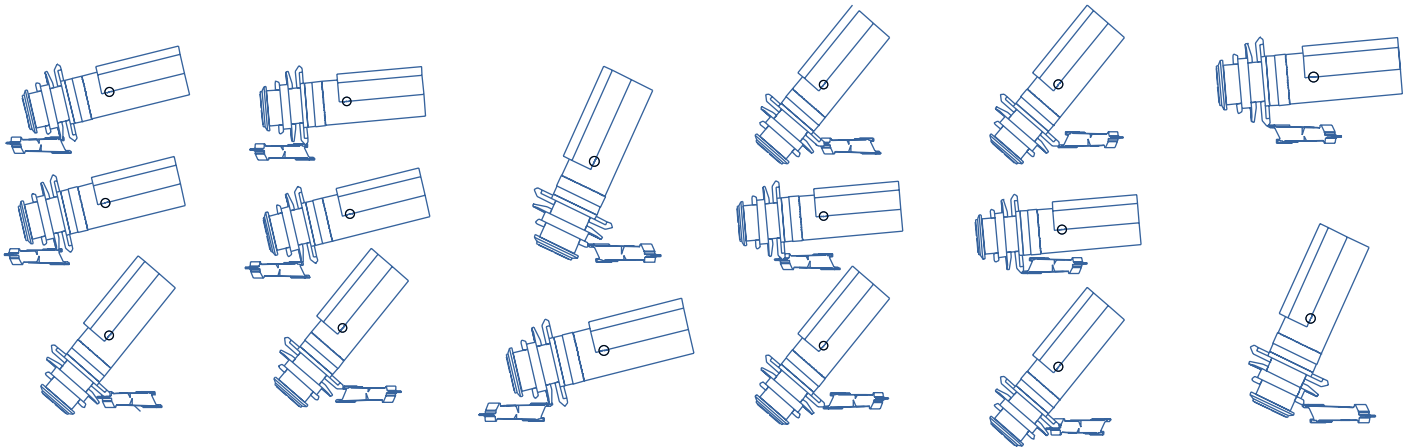


Figure 3: Superabrasive technology, in conjunction with a multi-axis grinding system, delivers several advantages over conventional grinding methods. The above example illustrates 2 clampings and 3 grinding wheels grinding 16 surfaces which completes the part.

CNC Automated, Less Labor Intensive, Less Training

CNC automated grinding systems address the scarcity of skilled labor in today's work force. With less machines required, less manpower is needed. CNC automation places heavier emphasis on defining a process and on the machine technologies and capabilities, and less on operator technique. Proper process definition coupled with automatic loaders allow for virtually unattended operation.

Return On Investment

To summarize, the benefits of multi-axis superabrasive grinding are many. Significant increases in productivity can be realized from higher material removal rates, from combining operations, and from fewer setups. Additionally, a 5-axis superabrasive grinder can cost as little as one third to one half of a large conventional abrasive creep feed grinder. Think about it...much more output from much less input. That's a better return on investment. That's making real money!



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