BY DON STRUBLER

Second Chances

What you need to know about reconditioning carbide drills.

High-performance carbide drills. The very mention of them brings thoughts of escalating tooling costs to the minds of many plant managers.

Costs do rise significantly with the implementation of carbide drills. But the total cost-of-operation savings are usually more significant when you factor in the cycle-time reductions and increased tool life they provide.

Justifying the use of carbide drills requires the end user to invest a substantial amount of time evaluating various manufacturers' tools to determine which one offers the best combination of cost and performance. Often, though, end users fail to evaluate a carbide drill's performance after it has been reconditioned. They should.

Carbide drills are usually reconditioned four or more times, depending on the application. Therefore, the OEM is only responsible for about 20 percent of a drill's cutting-edge life. That means the reconditioning service is responsible for 80 percent.

In light of this, the end user should base his selection of a reconditioning service on solid information about the process.

Four-Step Process

Reconditioning is the process of restoring a used cutting tool, such as a solid-carbide drill, to a like-new condition. You may be more familiar with drill resharpening, or regrinding, but that is only one step in the reconditioning process.

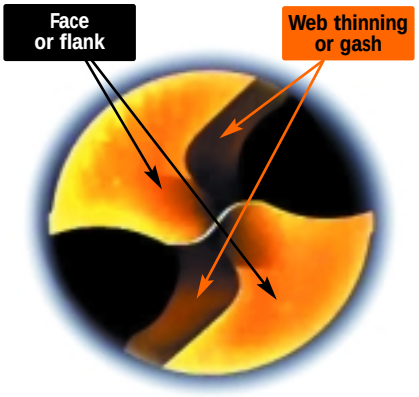
Properly reconditioning a carbide drill involves four steps:

- making the initial drill-point inspection;
- regrinding to OEM or customer specifications;
- chamfering and/or rounding the cutting edges to prevent chipping;
- and, in the case of coated tools, recoating.

Proficiency in each of these areas is required to ensure that the reconditioned drill performs like it did when new. The following is a discussion of each step, along with recommendations for choosing a tool reconditioner.

Initial Inspection. Today, there are a multitude of drill-point designs, which creates myriad opportunities to misidentify a drill point. When reconditioning, each drill must be examined to correctly identify its point geometry and, when applicable, its coating. Without proper identification, a different—and unacceptable—point may be applied.

Qualified service providers are knowledgeable about the major drill-point geometries and can identify them. These reconditioners have access to the necessary information about dimensions and tolerances to replicate the OEM's or customer's specifications.



A high-performance carbide drill with its face and web surfaces identified.

In many cases, drawings are unavailable for drills sent out for reconditioning. This requires the reconditioner to reconstruct them. Drawings, and all information about tool geometry, tolerances and routing, should accompany a drill during each step of the reconditioning process.

In addition, high-quality reconditioning services provide product traceability throughout the process. This is a fundamental part of ISO certification and helps ensure that the drills you send in are the drills you get back.

Regrinding process. When carbide drills are resharpened, a new point is

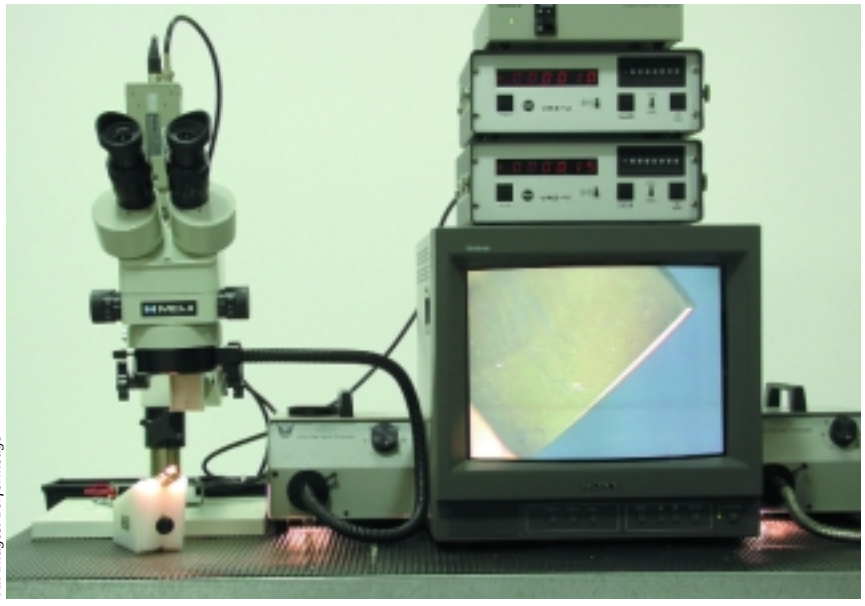
ground onto the end of the tool. This usually requires a face- or flank-grinding operation, a web-thinning or gashing operation, as well as any other procedures needed to repair corner chamfers or radii. Moreover, step drills require additional operations for grinding a new step chamfer.

Carbide tools are ground with diamond wheels, and coolant is applied to minimize heat generation, which can cause the carbide to crack. The flutes and diameters (or margins) of the drill aren't reground.

In the past, drills were manually reground. Today, however, it's important to select a reconditioner that has CNC grinders. CNC machines offer much greater repeatability than manual grinders, which means you get greater consistency from drill to drill.

Moreover, most CNC machines are loaded with programs that generate the more popular drill-point geometries, though some geometries are proprietary and require special licensing. If the service provider doesn't have the program(s) necessary to recondition your drills, find one that does.

A reconditioner's inspection equipment is important, too. It's amazing how many reconditioners make adjustments by "eye" because they have no inspection equipment!



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A reconditioning service should at least have a microscope (top, left) and optical comparator (top, right) for inspecting tools. Another important piece of inspection equipment is a stereomicroscope, which helps inspect such features as T-land edge preparations (shown on the monitor).

A CNC grinder is like any other CNC machine tool. It has a program, program variables and tooling offsets, which must be properly adjusted to produce drills to specific dimensions and within specific tolerances. For these things to happen, the reconditioning service must be capable of measuring the necessary dimensions and of making adjustments accordingly. The minimum equipment necessary is a microscope, with a micro-adjustable X-Y table, and a good optical comparator.

A valuable piece of inspection equipment for reconditioning is a stereomicroscope. It is used to visually inspect for chips, margin damage and thermal cracks that aren't detectable by the naked eye.

Edge preparation. There are two basic types of edge preparations: the T-land and the hone. Most high-performance drills have one or both applied to their cutting edge. The T-land is a negative surface along the cutting edge that strengthens the edge and assists with chip control. It is usually created by hand with a diamond file.

Applying a hone involves rounding the cutting edge to remove microscopic roughness and strengthen the edge. The hone is applied with a soft abrasive wheel or through abrasive-liquid blasting.

Make sure your reconditioning service is knowledgeable in this area and has a means of measuring and controlling the size of the edge preparation. A T-land should be filed while viewing the drill at 15× to 20× magnification. The hone should be applied as a timed operation to consistently maintain its size. Honed edges should be inspected at 25× to 30× magnification.

Coating. If the carbide drill to be reconditioned is coated, the final process step is to apply the proper PVD coating. This is done in a CNC coating furnace. Most reconditioners do not have this capability in-house, unless they are also an OEM. They have to subcontract the work. Even when the recoating must be outsourced, your reconditioner should be aware of the latest recoating technologies.

Beware of reconditioning services that blame the recoater for a tool that

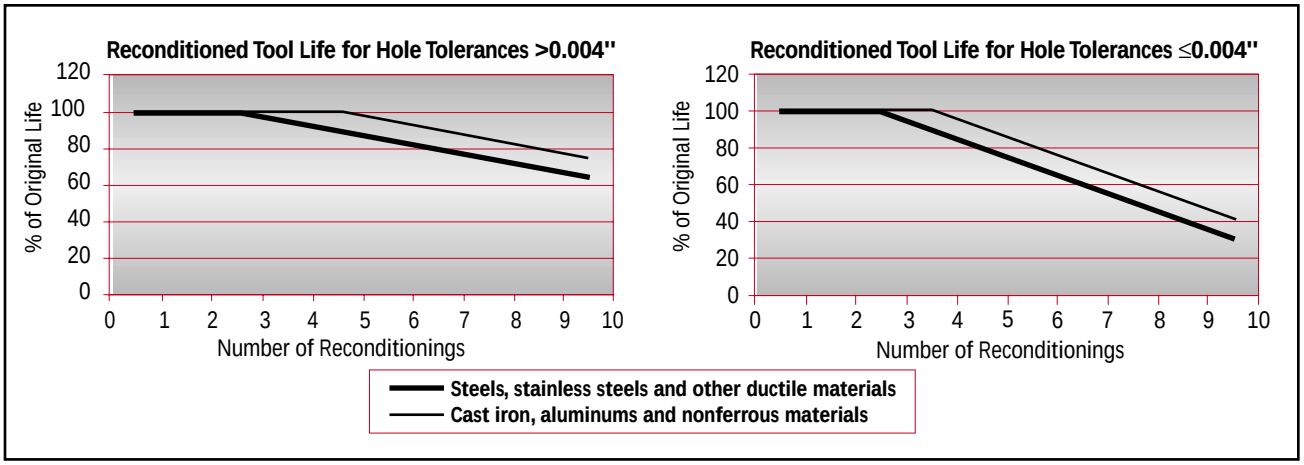


Chart 1, left: This chart shows average tool life for reconditioned carbide drills that machine holes with a tolerance greater than 0.004". Chart 2, right: This chart shows average tool life for reconditioned carbide drills that machine holes with a tolerance less than or equal to 0.004". The slope of deterioration in tool life is much steeper than in Chart 1. This is not because the drills are performing differently, but the definition of tool life has changed because of the tighter tolerance requirement.

performs poorly after it's returned. It is rare to have bad coating runs. Most tool recoaters are competent and have quality-control mechanisms in place.

Other considerations when selecting a reconditioning service are tool packaging and pricing.

After a drill is reconditioned, it should perform like new. It should be packaged like a new tool, too. A properly reconditioned drill returned in an old, greasy tube may negatively affect your workers' perception about the quality of the reconditioning process. The tubes should also come with traceable labeling.

As for pricing, some reconditioning services confuse the end user by charging for individual tasks that it performs instead of quoting one price for the entire job. This type of pricing scheme includes separate charges for regrinding, coating, and cutting off or rebuilding if there is excessive damage. As with any business transaction, know up front what you are paying for before you're invoiced.

What to Expect

Unfortunately, many in the industry have accepted less-than-original performance from their reconditioned drills. They've heard a variety of excuses and explanations, but the truth is their reconditioning service is probably lacking in one or more areas.

So what should you expect when it comes to a reconditioned drill's performance? The answer depends on the following variables:

- The material family being machined.
- The tolerance requirement for the hole being machined.
- The number of times the drill has been reconditioned.
- The coating being reapplied, if applicable.

Charts 1 and 2 depict the relationships of these variables. The material families are broken down into two groups. One is cast irons, aluminum alloys and other nonferrous materials that generally have a lower material hardness and generate small, short chips. The second is steels, stainless steels and other ductile materials that typically have a higher material hardness and generate longer, curled chips.

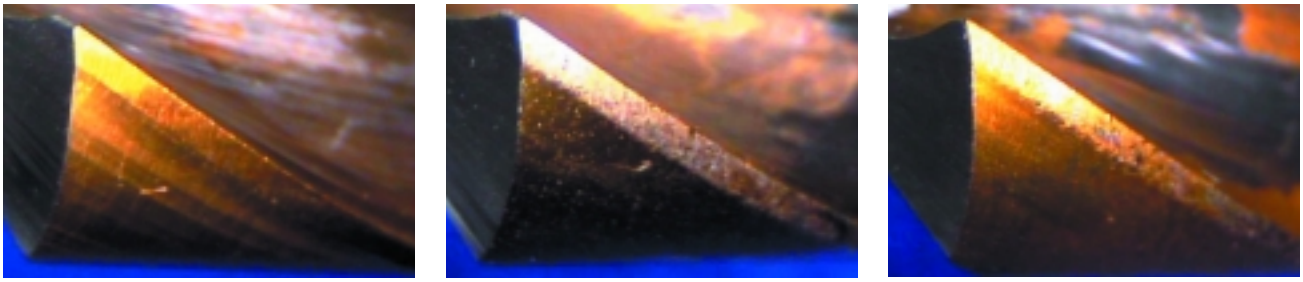
When cutting cast iron and aluminum, a reconditioned carbide drill should produce 90 to 100 percent of the holes it did when new. You should expect to maintain this tool life for six or seven reconditionings. When cutting steel and stainless steel, a carbide drill should deliver 90 to 100 percent of the original tool life for four or five reconditionings. However, be aware that after multiple reconditionings, the coating layers that build up and the surface damage that cannot be repaired on a drill's margins and flute surfaces shorten tool life.

In applications where the hole has a tolerance less than or equal to 0.004", a drill can't be reconditioned as often. When cutting cast iron and aluminum, a carbide drill for tight-tolerance holes should deliver 90 to 100 percent of the original tool life for four or five reconditionings. When cutting steel and stainless steel, a carbide drill for tight-tolerance holes should deliver 90 to 100 percent of the original tool life for three or four reconditionings.

Charts 1 and 2 assume that the reconditioned drill has the original point geometry, edge preparation and coating. But the original combination of

Material Family	New Drill Coating	Reconditioned Drill Coating	Percent of Tool Life Expectancy
Cast Irons	None	TiN, TiAlN	100 to 150
Cast Irons	TiN	None	80 to 100
Cast Irons	TiN	TiAlN	100 to 150
Steels	None	TiN, TiAlN	120 to 150
Steels	TiN	None	50 to 75
Steels	TiN	TiAlN	100 to 130

Table 1: The influence a coating has on drill performance.



A drill that's been reconditioned once (left) has a margin that can be recoated with a level of smoothness equal to the original. A drill that's been reconditioned three times (center) has a degraded margin with some roughness on the surface. The margin degrades because of both normal surface contact during drilling and the cavitation effect that occurs during the pump-like action of the rotating drill. A drill that's been reconditioned many times has a significantly degraded margin, and its coating layers are beginning to flake (right). This drill will not perform like it did when new.

tool features and coating doesn't guarantee the highest performance. High-performance carbide drills for specific applications are too expensive for OEMs to stock large inventories of, so they choose a design and coating combination that yields the best overall performance in a wide variety of applications. It's possible that a reconditioning service can generate significant productivity improvements for specific applications by altering the point geometry, edge preparation and coating.

As an example of this, Table 1 shows the influence coating has on performance. For cast iron, you may achieve adequate tool life without recoating during reconditioning. But applying a TiAlN coating improves performance and extends tool life dramatically.

In general, a solid-carbide drill can be reconditioned three to five times and achieve 90 to 100 percent of the original tool life—regardless of the application. Anything less is unacceptable.

Keep in mind, though, that there is a point of diminishing returns. As the carbide drill is reconditioned multiple times, its overall performance decreases due to damage that cannot be repaired.

Now that you know what drill reconditioning is, what to look for and what to expect, you can better appreciate the value of your tool-reconditioning service. If you invest the same amount of time when selecting a carbide drill reconditioner as you do when choosing a new-drill supplier, your efforts will be rewarded.

About the Author

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