Technology

What Are the Right Abrasives for Your Metal Removal and Finishing Work?

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What You Need to Know:

Abrasives can first be understood and organized by type: bonded, coated, nonwoven and loose media.
Abrasives also fall into a number of categories such as aluminum oxide, silicon carbide, zirconia alumina and other lesser-known options including garnet, ceramic and superabrasives that use diamond and CBN.
Abrasives tend to "clog up" with use, and the individual grains will wear down and grow dull. Unless steps are taken to expose fresh material, they soon become ineffective.
Always use the finest grit grade that will get the job done. Too coarse a grit creates rougher surface finishes than desirable, while too fine a grit increases cycle time, cutting into job profitability.

How do you select the right abrasive for the job at hand? More than likely, it's by trial and error. Learn how to select an appropriate abrasive for your application in this primer.

Abrasives are an often overlooked yet critically important tool for any machine shop. Improper weld preparation, time-consuming ***deburring operations***, surface finishes that fail to meet drawing specifications—these are only a few of the troublesome results of using the wrong abrasive.

Yet with thousands of product options, selecting the best belt, pad, cloth or wheel for this most fundamental metal removal operation can be just as challenging as picking the right end mill or turning tool for that titanium job you did last week. And since polishing and deburring are often the last operation for many workpieces, using the wrong abrasive can be a very expensive mistake.

Use the Right Abrasive Grain for the Job

Despite the wide variety of shapes, grits, bonding agents and abrasive media types available, each can be grouped as either **bonded abrasives** (wheels, typically), **coated abrasives** (***sandpaper, belts and discs***) or **nonwoven abrasives** (***hand pads, flap wheels***, etc.). In addition, ***loose media*** is used in blasting cabinets and hand-held sprayers. All of these abrasives work in the same manner, using what are

essentially sharp, pointy rocks to remove metal from a workpiece.

Workpiece material and geometry are key factors in deciding the type of abrasive to use. As a rule, aluminum requires a different abrasive than iron—and iron needs a different one from Inconel. How do you know if you have the right one for the job? The amount of material removal plays a role. For example, weld preparation and snagging require coarser grades, but finishing operations need finer ones. Each may call for a different bond or type of abrasive, regardless of the workpiece material.

Know the Right Speeds for Your Abrasive Material

As with any cutting tool, abrasives must be used at the correct cutting speed for them to be effective and safe. This is just as true for the abrasive pad used to shine up a turned part as it is for the wheel on the tool room's surface grinder. In the case of the abrasive discs and wheels used for weld preparation and cleanup, surface polishing, abrasive cutoff and edge deburring, be sure to apply the manufacturer's recommended rpm.

This may mean swapping out air-powered hand grinders in favor of shaft-driven or electric units with adjustable speed controls. Whatever the case, never over-rev an abrasive disc or wheel. It may shatter, sending shrapnel everywhere and possibly injuring you or a co-worker.

For most parts, these "rocks" fall into one of the following categories: aluminum oxide, silicon carbide and zirconia alumina.

Aluminum Oxide

Used in everything from toothpaste to knee implants, aluminum oxide is a hard, chemically inert material that forms when aluminum interacts with oxygen. Think of it as "aluminum rust." For abrasive use, aluminum oxide crystals, also known as corundum, are commonly available in white, pink and brown, differing primarily in hardness and purity. Aluminum oxide is one of the most commonly used abrasives, offering a cost-effective, predictable solution across a wide range of applications.

Silicon Carbide

Silicon carbide crystals are hard, thin and very sharp—in fact, the only materials harder than silicon carbide are diamond and cubic boron nitride. Unfortunately, silicon carbide's hardness and shape make it brittle, so even though it cuts quickly, it also tends to break down a bit faster than other abrasives, especially under extreme forces. So silicon carbide abrasives are best suited for finishing operations such as graining of stainless steel or where light cutting pressures are applied.

Zirconia Alumina

Zirconia alumina is basically aluminum oxide that's been toughened up with zirconia. This makes it among the most wear-resistant abrasives, ideal for heavy grinding operations, snagging (removing sprues and parting lines on castings) and general grinding of difficult materials. Some manufacturers have taken zirconia even further, blending it with alumina and titania (titanium dioxide) to make abrasives with the best characteristics of each.

Other Abrasives: Hybrid, Garnet, Ceramic, Superabrasives

Aluminum silicate is a mix of aluminum oxide and silicon dioxide, and it is a favorite for sandblasting. So is **garnet**, a naturally occurring mineral that is also the most commonly used abrasive for waterjet cutting. And **ceramics** are often added to these and other abrasives, enhancing their cutting properties and extending product life.

In the realm of high-performance machining, **superabrasives** are intended to work when grinding hardened steels or superalloys—and are used with finishing materials such as glass, ceramics and other composites. They often use diamond or CBN as the abrasive, so they are able to machine a broad spectrum of materials including ferrous and nonferrous materials.

Take Note: Abrasives Will Wear

Abrasives tend to "clog up" with use. In addition, the individual grains will wear down and grow dull. Unless steps are taken to expose fresh material, they soon become ineffective. On grinding machines, this is usually accomplished by dressing the wheel, but for virtually all other abrasives this is not an option.

Abrasive manufacturers have made great efforts to make their products "friable" or semi-friable, which means the abrasive breaks away when dull, bringing fresh material to bear. By adding ceramic to aluminum oxide, for example, a hybrid is created that is both hard and strong yet friable, making it suitable for steels and alloys that would otherwise be difficult to grind.

> **Workpiece material and geometry are key factors in deciding the type of abrasive to use.**

6 Nuanced Tips for Working with Abrasives

Abrasive selection is complex and should not be taken lightly. Here are some key considerations when choosing one.

1. Always use the finest grit grade that will get the job done. If the grit is too coarse, it will create rougher-than-desirable surface finishes; if the grit is too fine, it will increase cycle time and cut into job profitability.
2. Watch out for "bargain" abrasives. They are rarely a bargain and will only lead to higher labor costs and possibly scrapped parts.
3. Be consistent in the application of any abrasive. Develop a process plan that balances throughput and part quality—then stick to it.
4. If you are using abrasive pads or paper, use an appropriate block or holder for more consistent results.
5. Set aside time for testing any new abrasive to determine how long it should last and how much material it can remove in a given period. Document these values as part of your work instructions. Don't be afraid to try something new.
6. Pushing an abrasive too long leads to unpredictable part quality. But not pushing one long enough can lead to higher expenses when abrasives are disposed of prematurely.

So the next time you need to shine up some parts, don't just grab whatever 80-grit paper the tool crib has handy. Instead, consult with your supplier to discuss what's best for your application.

What kind of challenges have you faced with abrasives in your shop? Share your experience here.