

Machining

Overcoming Common Challenges in Cutting and Grinding Aluminum

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Aluminum is a versatile material that is widely used across many applications and industries — from cell phones and household items, such as ladders and utensils, to automotive, manufacturing and construction projects. Most people use or touch aluminum every day.

The benefits of using aluminum in fabrication and manufacturing applications include lightweight, strength, malleability and corrosion resistance.

However, cutting and grinding aluminum effectively and efficiently can be challenging for several reasons. Aluminum is a softer metal with a lower melting point than other materials, such as steel. These characteristics can lead to loading, gouging or heat discoloration when cutting and grinding the material.

While many factors can impact the results — including operator experience and work environment — choosing the right products for the job is key to achieving success.

Pairing the right products with some common best practices can also help get the job done faster, reduce costs and time spent on rework, and produce the best possible finish.

The Challenges of Aluminum

The three most common types of aluminum are 3000 series, a general-purpose material used in many manufacturing applications; 5000 series, a marine-grade aluminum for shipbuilding; and 6000 series, used in structural applications.

To improve results, be aware of these common challenges when working with aluminum:

- Because aluminum is a softer material with a low melting point, it can gum up or load on the abrasive or wire brush during cutting, grinding and finishing. The heat and friction that build up during these processes can quickly melt the aluminum, causing it to stick and accumulate on the tool's surface (aka loading) — making it less effective. To avoid this issue, be deliberate when grinding. For example, always begin with a back stroke to avoid unwanted gouging.
- Aluminum that is exposed to the atmosphere contains an oxide layer. If this oxide isn't removed before welding aluminum, it can cause imperfections such as inclusions or porosity. It can also result in material burn-through since the heat required to remove the oxide layer is higher than needed for the base material below. Remove this layer with a dedicated stainless-steel brush before welding aluminum.
- The possibility of contamination is more prevalent with aluminum than it is with common metals like steel. As when working with stainless steel, aluminum can be contaminated if there is product crossover with steel or the consumable being used has steel wire or the abrasive contains iron. Be sure to use abrasives marked as contaminant-free that are designed for aluminum.
- Aluminum is more expensive than other materials, so replacement and repair costs can be much

higher should it become damaged. Mistakes or rework are costly — both in labor time and scrap material loss. It's very easy to gouge aluminum due to its softness, so it's important to be careful when cutting or grinding. In addition, most aluminum products are not painted or coated, which means the surface finish is often exposed. This makes it even more critical to take care of the material's appearance and finish when cutting and grinding it.

Choosing the Right Product for Aluminum

There are many tools and products available for cutting, grinding and finishing aluminum, each with advantages and disadvantages. Making the right choice for the application can help companies gain better quality, safety, and productivity, while also minimizing downtime and labor costs.

Consider these four common categories when choosing a product for aluminum:

- **Coated Abrasives:** This category, which includes flap discs and resin fiber discs, is popular when working with all categories of aluminum. Coated abrasives are well-suited to removing the oxide layer and are more aggressive than non-woven abrasive products. The best discs are pre-treated or coated with a top coat that helps reduce heat buildup while grinding. This feature prevents the disc from loading and offers higher cut rates, along with a longer product life.
- **Non-Woven Abrasives:** Products in this category include surface conditioning and coarse stripping discs, and they tend to be used for light to medium finishing work or when a fine surface finish is required. The natural makeup of the non-woven abrasives helps reduce loading on aluminum. Coarse, non-woven abrasives can also be a good choice for removing the oxide layer prior to welding.
- **Power Brushes:** Wire brushes are good for prepping and for cleaning the black discoloration around aluminum welds, so they are often used in welding applications. Welding aluminum results in a black oxide layer around the weld. Power brushes can be used to clean without removing any base material or changing the dimension of the part. For aluminum applications, choose a brush with the smallest diameter wire that will still do the job. This helps prevent loading or aluminum buildup. Also, use a stainless-steel wire brush to avoid contaminating the aluminum workpiece.
- **Cutting and Grinding Wheels:** Grinding wheels are commonly used in structural aluminum applications and when there is a need to remove a lot of base material. Cutting wheels are used everywhere, often for dimensional reasons or openings. Grinding wheels tend to be less popular than coated abrasives for grinding general purpose aluminum due to several factors — a key one being that the operator typically has less control with a grinding wheel, increasing the risk of gouging the base material.

Follow Best Practices

Once it's determined which type of product is best for the specific aluminum application, following a few key best practices can improve quality and efficiency and reduce costs.

With coated abrasives and cutting and grinding wheels specifically, always look for a product that is designed for use with aluminum to avoid the possibility of contamination. This designation is typically marked on the product label. Non-woven abrasives and wire brushes aren't usually labeled as designed specifically for aluminum, but they can be used with the material with great results. Look for a wire brush that is stainless steel.

Coated abrasives and cutting and grinding wheels are also available with added inhibitors that help reduce the chance for loading while grinding aluminum. This extra layer of coating lessens loading

between the grains on the wheels. With an inhibitor additive on a resin fiber disc, for example, the aluminum that loads on the product is more of a fine dust that sits below the cutting grain, so the grains are still allowed to work effectively.

Taking a focused approach when working with aluminum is also helpful in preventing gouging. When cutting, use only the depth that is necessary for the outside edge of the wheel to cut the material, which reduces the amount of heat friction buildup and possible distortion. Using a slight rocking motion will speed up the cut and extend wheel life.

Always start with a pull-back motion and maintain a constant, fluid motion while grinding (especially with hard wheels); don't linger too long in one spot, which can damage the workpiece and cause heat discoloration. When using a wire brush to clean aluminum, focus on using the tips of the wires and not applying too much pressure.

A common reaction when a wheel or wire brush is not performing as desired is to push harder. But pushing harder exacerbates the problem by creating even more heat and friction with abrasives and causes premature breakage with wire. Take care to maintain a moderate and consistent amount of pressure.

Finally, it's important to always use the proper personal protection and respiratory equipment when grinding or cutting aluminum because the process generates fine dust and flakes.

Final Thoughts

Because aluminum is much more malleable and less forgiving than steel — and more expensive — it's important to pay close attention when cutting, grinding or finishing the material. Remember that aluminum can be easily damaged with overly aggressive practices.

People often measure how much work is being done by the sparks they see. Remember, cutting and grinding aluminum does not produce sparks, so it can be harder to tell when a product is not performing as it should. Check the product after cutting and grinding and look for large aluminum deposits, paying close attention to the amount of material being removed.

Applying the proper pressure and reducing the heat generated in the process helps address the challenges presented when working with aluminum.

It's also important to choose the right product for the application. Look for high-quality, contaminate-free products that are designed for use with aluminum. The right product coupled with key best practices can help produce quality results, while also reducing the time and money spent on rework and scrap material.

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