

# *Laser Processing Guide*



*working with  
acrylic*



Acrylic is becoming an increasingly popular manufacturing material used across many industries for a wide range of products such as signs, displays and trophies, to name a few. It is highly versatile, durable, aesthetically pleasing, and processes well with a laser. For many, acrylic is a convenient and affordable alternative to glass because it's largely impact-resistant and weighs about half as much, but still offers a high level of clarity. A laser is a highly effective and efficient way to cut, mark or engrave acrylic. Including general processing instructions and pointers, time-saving tricks and troubleshooting advice, the following guide was designed to help new laser users as well as intermediate users improve their acrylic processing technique and results. With a little practice and a few pointers, you will be able to use your laser to create perfectly polished acrylic edges, engrave intricate details, and produce precise cuts and contours.

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# Getting Started

Acrylic materials come in a wide range of color, texture, and finish combinations. There are three main types of acrylic:

## **Cell Cast**

Acrylic that is cast into shapes

- Laser engraving appears frosted
- Laser cutting easy

## **Continuous Cast**

Acrylic that is continuously casted into sheets using a sheet shape molded on an assembly line

- Laser engraving appears frosted
- Laser cutting easy

## **Extruded**

- Laser engraving is translucent, making it difficult to see
- Can be easily cut with a laser using lower power settings. Results will depend on product quality



Acrylic sheets with laserable plastic backing offer a number of advantages

You can find acrylic products on the market that come with a laserable plastic backing that can be left on the material during processing, (whether you're cutting or engraving). A plastic laserable mask protects the material from scratching, improving your results and reducing scrap and rework. If you are not using a product with this feature, you are likely using an acrylic product that is shipped with an adhesive paper or plastic backing intended to protect the material during the handling process. Depending on your specific application, you should remove the backing while engraving the material and otherwise leave it intact if laser cutting less than 1/2". Engraving acrylic while the this type of protective backing is still intact can cause several issues. For one, it requires the laser to use more power and it can cause a significant loss of detail with the design being engraved. Another problem is that if the protective backing is a plastic film material, it can melt to the acrylic during the engraving process which will compromise the final product being created. If the design you are engraving is very detailed or highly intricate, we recommend still removing the layer prior to processing to avoid having to peel the backing off in many small segments.

# Processing Techniques and Recommended Settings

## **Engraving**

Engraving cell and continuous cast acrylic is an easy process that requires little material preparation. You can use a number of lenses and laser wattage combinations to effortlessly produce a frosted effect with little depth into the surface. Trotec's JobControl® laser workflow software includes a number of pre-tested parameters to help you achieve your desired effect.

You can achieve a variety of depths when laser processing acrylic, however applying high power and low speed to achieve depth can also produce an unappealing white "snow-like" residue. To achieve quality depth, we recommended utilizing multiple laser passes to eliminate the snow-like residue and produce a crisper engraving.

Depth engraving with a clear finish can be achieved with cell and continuous cast acrylic by taking a final pass with the laser, as well as by manually changing the focus to 1/2" away from the normal focus point. This process will cause the beam to create a slight melting effect and will turn the white depth into a glazed "molded" look. This is also a parameter in JobControl.

The process of engraving extruded acrylic produces a clear translucent engraving with little to no contrast. If you want to create some contrast into extruded acrylic, you can convert the digital design file being used to a grayscale around 60-70%, and engrave the acrylic with the modified file.

By using this technique, a halftone will be created similar to dithering, which will produce a prism effect with some contrast.



Cast acrylic can be engraved with little or no material preparation



Engraving extruded acrylic will result in little to no contrast



Converting your file to 60 -70% grayscale will improve contrast

# Processing Techniques and Recommended Settings

## Cutting

Acrylic is a highly flammable material that should be watched very closely during the laser cutting process. Thin acrylic can be laser cut fairly effortlessly. We recommend using an acrylic grid table, good exhaust, and vacuum under the material. An acrylic grid table is the best choice for working on acrylic with a thickness of less than 3/8 in. (10 mm) because it prevents back reflections during cutting, and each processed piece remains flat in position after cutting. The acrylic slat cutting table is the best choice for cutting acrylic sheets with a thickness of 5/16 in. (8 mm) or more, and for parts that are thicker than 3/8 in. (10 mm) when cut. The slats can be positioned individually, so the table can be adapted to any application. Acrylic cutting in one pass is ideal for best results. Multiple passes will drastically diminish the quality of the cut edge because the melting effect remains and each pass is visible.

A large part of achieving a flame-polished edge depends up the quality and type of acrylic being cut. If you're using an acrylic product that comes with a laserable plastic mask, you should leave it on to protect the material. Otherwise, if you leave the film on the top side of an acrylic sheet to protect it during cutting, there is a risk that the material will stick to the acrylic, and if you are engraving or using small or thin parts, you should take the film off to reduce the risk of flare ups. When processing acrylics with paper backing, at a minimum, always remove the paper from the top side.



## Focus

**Here are some best practices on focus:**

- Defocusing results in better beam usage
- Do not defocus when material is less than 0.25" (6mm)
- Above 0.25" (6mm) defocus 1/3" into the material (for example, cutting 0.5" Z-Offset should be -0.17")
- Defocus if the cut edge is not straight or wavy lines appear at bottom of cut edge

For materials with a thickness of less than 0.25" use a 2.0 or 2.5" lens. For materials with a thickness of 0.25" to .0.75", use the 2.5" lens. For materials above 0.75" it is optimal to use a 5" lens with 200 or 400 watt laser system.

## Power

A good rule of thumb for achieving a polished cut and good production speed is 10 watts per 0.04 inches (1mm). Sometimes reducing the power will produce the best results. Your method may also depend on your preferences.





### **Frequency**

The ideal frequency setting will depend on the material you are using. You should start at a higher level for cast acrylic (10,000 to 20,000 hz); and start lower on extruded (2,000 to 5,000 hz). Decreasing the frequency means there will be less pulses, which results in high “pulsed” energy, or no constant energy in the material. This causes:

- Less flaming
- Less boiling (too much heat in the material)
- Slower cutting speed

### **Speed**

Ideal speed will depend on the material thickness. A good starting point for acrylic sheets with a thickness less than 15 mm is 0.4 in/sec. or slower.

### **Exhaust**

Exhaust plays a huge role in achieving flame polished edges. It is important to have downdraft suction beneath the acrylic to evacuate the gases so they do not become “trapped” in the cut kerf. Without adequate exhaust, a quality cut is not possible. Negative pressure and air flow are very important. The exhaust serves a few purposes:

- Avoids flaming - a good acrylic cut is hot and produces gases. Gases are highly flammable
- Transports gases away and thus removes the possibility of the gases igniting
- Controls frosting of liquid acrylic

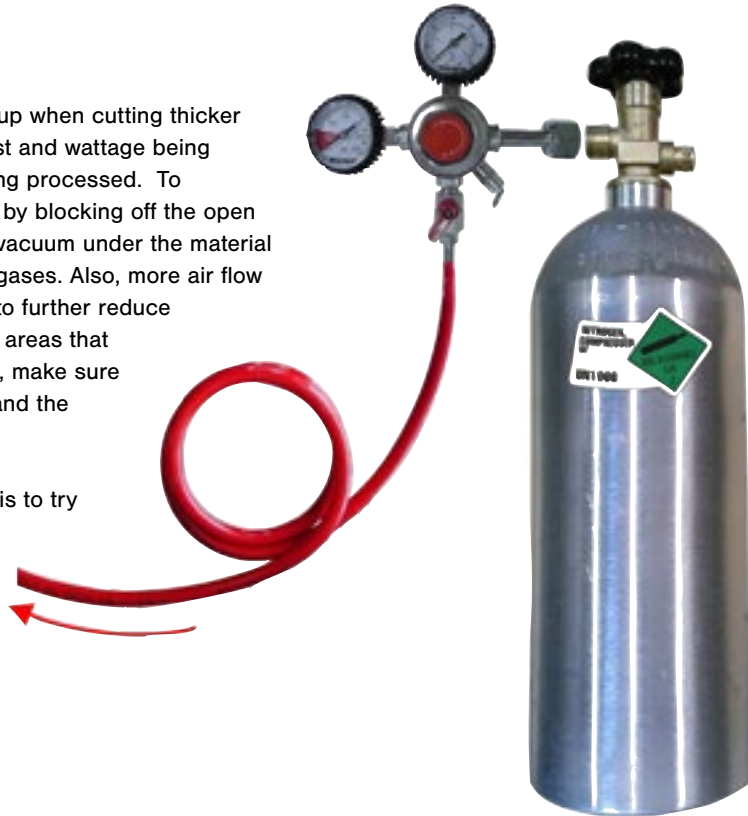
Use compressed air with a maximum of 1.5 PSI (0.1 bar) and the large diameter nose cone. Airflow through cut kerf lets acrylic melt from top to bottom. This gives flame polished cut. Otherwise you may produce wavy horizontal lines.

# Common Acrylic Processing Mistakes

## **Flare-ups**

On occasion it is possible to get a flare-up when cutting thicker acrylic, depending on the type of exhaust and wattage being used vs. the thickness of the acrylic being processed. To avoid this, more vacuum can be created by blocking off the open areas of the cutting grid creating better vacuum under the material resulting in more efficient evacuation of gases. Also, more air flow can be created around the cutting area to further reduce this issue by blocking the exhaust in the areas that are not being used. In addition to airflow, make sure that you're using a clean table or slats, and the backside of the acrylic is clean.

Another way to avoid excessive flaming, is to try laser cutting acrylic with nitrogen assist (nitrogen tank connected in place of the air assist). This is a great option for cutting very thick acrylic because it displaces the oxygen at low PSI.



## **Know what you're using**

One of the most common mistakes that consumers make when processing acrylic with a laser system is not being aware of the type of acrylic that they are using. It is important to be aware of the types of acrylic on the market as well as educated on each types capabilities and limitations. There is a wide range of acrylic manufacturers on the market, and each one has their own unique formula that will produced drastically different results when laser processed.





# Troubleshooting

## ***You cannot achieve contrast when surface engraving acrylic***

This often happens when the acrylic being used is not a cast acrylic (though it is possible to produce some contrast on extruded acrylic).

**Try this:** Convert the digital design file to around 60-70% grayscale first and then engrave the acrylic with the modified file. This will create a halftone similar to dithering, and produce a prism effect with contrast. (See page 3.)



Increase contrast by converting your design to a grayscale

## ***The cast acrylic you're engraving is not producing any contrast (engraving is clear)***

This is often caused from the laser beam being out of focus.

**Try this:** Check the laser beam to make sure it's in correct focus, and make sure you're using enough laser power. If necessary, adjust the power settings to produce your desired level of contrast.

## ***While cutting acrylic you experience flames and burning***

There are several variables that can cause flames and burning while cutting acrylic, so you may need to evaluate several factors to try and eliminate this issue.

**Try this:** Make sure that the laser is properly focused. Use air assist or increase the air pressure. Remove protective backing from the acrylic (this can cause the fumes from the cutting process to ignite). The thickness of acrylic may be too much for the wattage being used (test your settings and adjust accordingly). Cover the parts that are open to create more vacuum below the material.

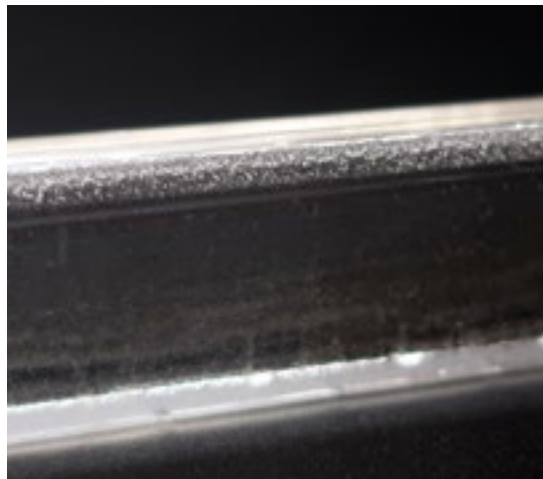
## ***You experience visible tic (reflection) marks on the acrylic edge***

**Try this:** First make sure you're using the recommended cutting table. Then try elevating the acrylic over the cutting table surface by using pins or blocks, and speed up the laser system to reduce the excess power from reflecting.

### ***A frosted edge appears when cutting thick acrylic***

This can occur when the air assist mixes air into the acrylic during the cutting process, or may be due to the material composition.

**Try this:** Reduce the air flow slightly or replace the air line with a nitrogen gas tank (in place of the air compressor), and run nitrogen at a very low 2-3 PSI (vs. air at 20+ PSI). The nitrogen will displace any oxygen present, which will keep the laser from producing flames and eliminate the possibility of bubbles being injected into the laser processed edge. This process should result in a clear edge.



Reduce air flow or use nitrogen to eliminate air bubbles at edges

### ***Residue forms on the surface of the acrylic when you deep engrave or cut***

**Try this:** If residue forms during cutting, place a paper mask over the surface to protect the material, or leave the protective backing that comes with the acrylic in place. If residue forms during engraving and cutting, apply a light layer of liquid dish soap to the surface of the acrylic. The soap will act as a non-flammable barrier which will partially shield the surface from heat residue, and can easily be rinsed off after the processing is completed.



A laserable plastic backing prevents residue build-up

### ***Cracks form on the acrylic after it is finished and cleaned***

This is most likely caused because the cleaner or paint used on the acrylic contains alcohol. Alcohol causes micro-fractures to form in the areas that have been cut or engraved.

**Try this:** Purchase a cleanser specifically made for acrylic such as Hexanes.

### ***You experience excessive odor while laser processing acrylic***

Not all acrylics are the same. Some will produce more odor than others, and any acrylic that has been laser processed can still be fragrant up to 48 hours after processing.

**Try this:** We recommend keeping all laser parts including the cut scraps in a well ventilated area during the 48 hour outgas timeframe. This will not eliminate acrylic odor all together; however it will eliminate and reduce the overpowering odor that is present.

# Popular Uses for Acrylic



## **Architecture**

- Skylights
- Sunrooms
- Security
- Noise Abatement Barriers
- Shower Doors
- Windows
- Room Partitions
- Novelty Items
- Children's Toys
- Cosmetic Mirrors
- Architectural Glazing



## **Art and Design**

- Sculptures
- Furniture
- Novelty Items
- Picture Framing

## **Transportation**

- Automotive
- Marine
- Aviation
- Instrumental Cluster Panels



## **Exhibit & Tradeshow**

- Displays
- Furniture
- Room Partitions
- Back-lit Graphics

## **Picture Framing**

- Glazing
- Engraving
- Cutting

## **POP Display/Store Fixture**

- Cosmetic Displays
- Retail Displays

## **Signage**

- Corporate Imaging
- Way Finding
- LED CAN Lights
- Backlit Graphics
- Push Through Letters
- Thermoforming

## **Technology**

- Cell Phone View Screens
- Multimedia Displays
- Security
- PDA Computer Screens
- Handheld Electronic Viewing Screens

## **Housewares**

- Tableware
- Faucet Handles
- Stationary

## **Medical**

- Blood Cuvettes
- Connectors
- Meters
- Medical Instruments

## **Optical**

- Eyewear
- Optical fibers
- Glazing

## **Furniture & Accessories**

- Tabletops
- Fixtures
- Cabinet Fronts
- Furniture
- Room Partitions

## **Lighting**

- Lighting – Residential & Specialty
- Drop Ceiling Lighting Panels



Laser Systems



Materials




Expertise


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44747 Helm Ct  
Plymouth, MI 48170  
**Tel:** 866-226-8505  
**Fax:** 734-927-6323

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