



Prep and Finishing Laser-Processed Materials*

Although many items exit the laser engraver/cutter bed ready-to-use, most require some form of finishing or prior preparation. These steps will be in addition to those covered in the Pre/Post Surface Treatments chapter. Using a variety of relatively low-cost equipment the user can establish a successful production workflow that addresses most of the likely problems and concerns.

Measuring

The first step in dealing with a new material is to learn as much as possible about its physical properties. In the case of laser engraving and cutting a critical factor is the material thickness. An ordinary ruler, with 1/32" increments, may be accurate enough to determine thickness, however, an easier and more precise method is with a digital caliper (FIG. 1). A precision caliper is typically accurate to within 0.01 mm, or +/-0.0005 inches. Digital calipers can usually convert between inches, millimeters, and fractions, and measure both inside and outside dimensions.

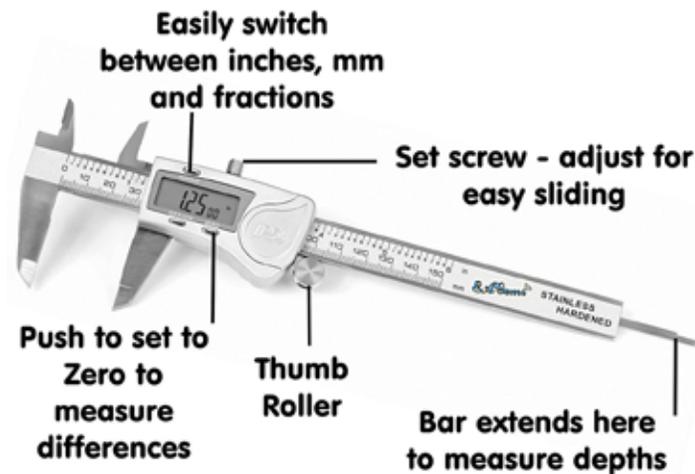


FIG. 1. Digital Vernier Caliper Measuring Tool. Credit: Amazon.

The outside jaws of the caliper are used to measure the thickness of a material; an indicator of whether or not a particular laser cutter can penetrate its depth and produce a clean cut. The inside jaws can be used to measure the inside width of a circular or rectangular cut, in order to replicate its size. Care must be taken to insure that the caliper is clean and free of dust and dirt to confidently make accurate readings. The same is true for the material being measured.

To begin a measurement the outside jaws must be closed, and the digital display set to zero. The jaws should be closed on the material so that there is a bit of a drag, but not closed to the extent that it bites into the surface.

Cutting and Trimming

Materials destined for laser engraving are seldom available in the pre-cut sizes that a user may need for specific jobs. Although materials are generally sold in convenient sizes, they are often too big for a specific purpose, and therefore must be cut or trimmed. In certain circumstances the laser itself can be used to cut oversize material, but this is often at the expense of time, and comes with the inevitable resultant singed cut edges.

Materials can be purchased from local or on-line sources, cut-to-size. While this may be convenient, it is most likely more expensive and certainly more time-consuming. The obvious answer is to do the cutting in-house.

Depending on the thickness of the material, whether paper, cardboard, or wood, it may be cut by using a self-healing cutting mat (FIG. 2), a steel ruler with an edge guard (FIG. 3), or a t-square (FIG. 4), and a utility knife (FIG. 5). The cutting mat protects the surface that it sits on and offers a surface that the user can cut into, to insure that the piece they are cutting is completely cut through. The mat also serves to keep the blade sharp by offering little resistance.

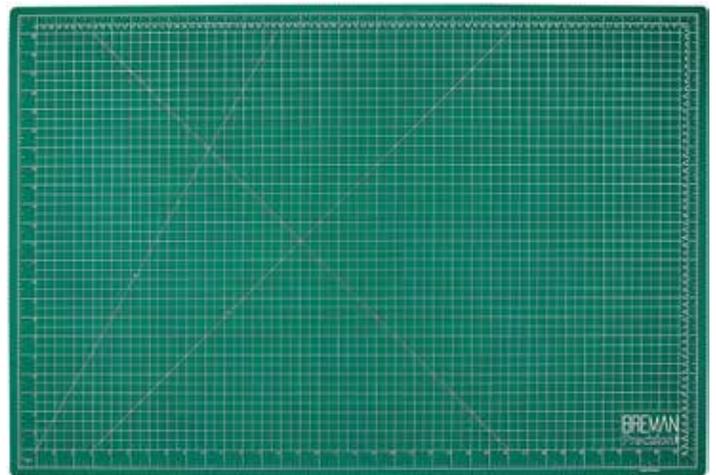


FIG. 2. Breman Precision Self-Healing Cutting Mat 24x36 Inches. Credit: Amazon.

To begin, the user should lightly draw a line representing the cut. This serves as a guide, should the ruler or t-square move, even slightly. The material is aligned to guidelines on the mat, and if a t-square is used, the head of the t-square should be flush against a side of the mat.

*Items listed in this chapter can be purchased on Amazon.com. The links are provided here: <https://tinyurl.com/3s8sxbkm> and may generate a small referral fee.



FIG. 3. Shinwa 24" Extruded Aluminum Cutting Rule Ruler Gauge with Non slip rubber Backing. Credit: Amazon.

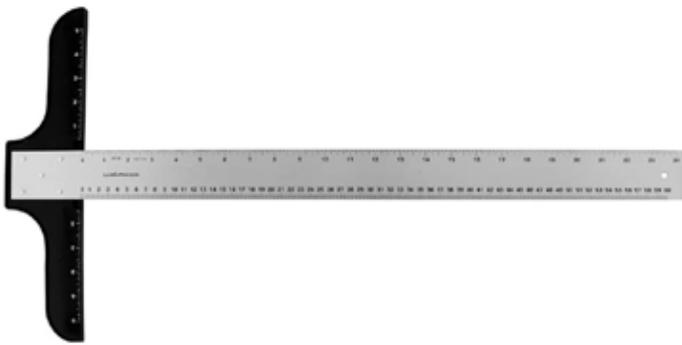


FIG. 4. Ludwig Precision Heavy-Duty Aluminum T-Square,, 24-inch. Credit: Amazon.



FIG. 5. WorkPro Folding Utility Knife Quick-change Box Cutter. Credit: Amazon.

Safety is very important, and the user should be sure that the piece being cut is secure on the mat, that the ruler is securely pressed against the material in the proper place, and that the knife blade is sharp. The knife is sharp enough to cause a bad finger cut, so exercise every precaution. The blade should protrude no more than about 2cm. Extending the blade too far makes it wobble, makes the cut uneven, as well as makes the cutter less controllable and therefore more dangerous.

The user moves the blade from the top of the piece in several firm

movements downward toward the body, until the cut is complete. If the piece being cut is longer than the ruler, the user should complete the cut almost to the end of the ruler, keeping the blade against the cut edge, then slide the ruler downward carefully so that it is aligned with the first cut.

The thicker the material, the more scores that the knife will have to make, and possibly, the less precise and clean the cut. The objective is to always let the knife do the work. Although thicker materials can be cut using this method, there is a practical limit.

Thinner materials, such as paper and card stock can be cut with a rotary or guillotine trimmer (FIG. 6), or with a scissor, provided that a straight line has been drawn as a guide.



FIG. 6. Swingline Paper Cutter, Guillotine Trimmer, 15" Cut Length, 10 Sheet Capacity, ClassicCut Lite (9315). Credit: Amazon.

Manually Cutting Acrylic. Acrylic is not easy to cut by hand since it is highly prone to scratching and cracking. New sheets come with a protective adhesive cover, which provides surface protection. Off-cuts should be covered with masking tape, or painter's tape, to protect edges that could be damaged. Larger surface areas can be covered with paper and held in position with tape. The acrylic should be placed on a self-healing mat and held in place with a rigid steel ruler incorporating an edge guard to protect the hand holding it in place. A line should be drawn indicating the location of the cut. If the acrylic is particularly thick, the piece should be clamped to a worksurface, holding the straight edge, with the piece to be cut off extending off of the work surface. The line is gently but firmly scored using an acrylic scoring tool (FIG. 7), holding the tool tightly against the ruler edge. This motion is repeated until the material has been cut.



FIG. 7. Red Devil 1170 Plexiglass cutting tool. Credit: Amazon.

Inexperienced users should avoid trying to cut thick acrylic since doing so can result in stress fractures in the material and rough edges. Scoring and snapping the material is also not advisable for the same reasons.

Small Cuts. Occasionally the laser cutter only partially cuts through a given piece of material, leaving a portion still connected to the workpiece. It is usually difficult to determine if a laser cut has been completed while the material is on the laser bed, and once removed it is nearly impossible to reposition it, and attempt another pass. A solution is to use a hobby knife (FIG. 8) to carefully follow the outline of the partial cut with successive scores, until it is cut through.



FIG. 8. 15 Packs Hobby Knife Precision Knife Set, Stainless Steel Precision Cutter. Credit: Amazon.

Tile/Glass Cutting. While many kinds of ceramic, porcelain, and glass are available in convenient pre-cut sizes, there are circumstances where a piece will need to be cut smaller. There are many specialized bench saws that can do the job, however a convenient and inexpensive solution for straight cuts is the use of a manual two-rod rail system tile cutter (FIG. 9). In use, the target piece is marked with the cut position, and placed on the bed of the cutter against the front guide. The cut mark is positioned below where the tungsten carbide scoring wheel, guided by the handle, will run up the length of the tile, while exerting slight pressure. The piece is scored bottom-to-top, just once. The pressure toggle plate, also attached to the handle, is positioned on the tile, and the handle is pressed downward exerting pressure on the tile and causing it to break cleanly on the scored line.

Tabletop Machine Cutting. The best, fastest, and most accurate way to cut materials for laser engraving/cutting is with a tabletop power saw. The performance of the saw, the accuracy of the cut, and the smoothness of the cut edges is dependent on the power of the saw motor and the proper selection of the blade. Many table saws are overpowered for this purpose, however, we have found the Rockwell Bladerunner X2 to be a good fit (FIG. 10).

The Rockwell Bladerunner X2 has a small footprint, about the size of the Ortur Laser Master Pro 2. Despite its small size it is capable of cutting a wide variety of materials, with rip, cross, and scroll cuts, rivaling much larger table saws. Its versatility is due to its quick set-up rip fence, with two easy lock screws, scribed increment saw



FIG. 9. Marshalltown 17" Tile Cutter, Perfect for Porcelain, Ceramic, Glass, and Mosaic Tile. Credit: Amazon.



FIG. 10. Rockwell RK7323 BladeRunner X2 Portable Tabletop Saw with Steel Rip Fence, Miter Gauge and 7 Accessories. Credit: Amazon.

bed markers, and a fast blade change mechanism. The selection of available blades, for wood, ceramic, plastic, aluminum, and metal, ensures that it will be able to cut virtually any material that is suitable for laser processing, and do so with professional results.

No less important than performance are the machine's safety features. The large on/off safety switch is easy to access for an immediate stop. Blades can be changed without the need for tools. The blade shield supports the attachment of a vacuum hose to connect to a shop vac, to remove saw dust and material shavings immediately, and leave a clear view of the blade cutting area.

Burnishing, Scrapping, Picking and Weeding

There are circumstances when blue painter's tape or craft transfer tape, both with adhesive backing, are used to protect the surface of a wood workpiece. These materials are secured to the wood using a plastic scraper that eliminates air pockets and wrinkles, and insures a tight adhesion. The tape, being very thin, and easily burned, yields to

the heat of the laser, while protecting the surface area that is not exposed to the laser. The tape barrier can help to prevent the formation of charring and discoloration, and can also serve as a mask for adding color or post-laser treating.

A problem arises after imaging, when the tape needs to be removed. Depending on the intricacies of image, there may be extremely small pieces of tape remaining that cannot easily be peeled off by hand. In such cases a sharply pointed instrument called a weeding tool (FIG. 11) can be quite effective.

Another method involves adhering a piece of tape with greater tack, burnishing it over the remaining stray bits of tape, and lifting them off.



FIG. 11. 17 Pack Weeding Craft Tool with Scraper, Hook, Spatula, and Tweezers. Credit: Amazon.

Drilling

Making holes for keychains, luggage tags, ornaments and other items needing to be hung or attached, can usually be accomplished using the cutting function of the laser. For whatever reason, that function might not have been performed, and needs to be done after the item has been engraved.

The most convenient way to drill holes in a wide variety of materials is with a small rotary tool, such as the Dremel (FIG. 12). The rotary tool can accommodate a variety of drill sizes, and using a compatible drill stand (FIG. 13), can make precision holes quickly.



FIG. 12. Dremel Lite 7760 N/10 4V Li-Ion Cordless Rotary Tool, Variable Rotary Tool Kit, USB Charging. Credit: Amazon.



FIG. 13. Milescraft 1097 ToolStand - Drill Press Stand (compatible with Dremel). Credit: Amazon.

Sanding

Material surface imperfections, usually in wood, appear as rough or irregular areas that can be seen visually, or felt by touch. Soft woods are particularly susceptible to nicks and scratches that may even be accentuated by laser engraving. Regardless of their source, imperfections on the surface and edges of workpieces must be eliminated prior to engraving or cutting. Also, keep in mind that sanding may be necessary after laser engraving and cutting, to address various finishing operations (see Pre/Post Surface Treatments).

The choice of a sander should include features such as variable speed, in order to maintain control over the precise amount of abrasion being applied (FIG. 14). A dust collection attachment is a requirement, both to keep the dust off of the workpiece and to keep it out of the air, and protect the user. A sandpaper system that uses hook-and-loop makes changing the sandpaper quick, and ensures that it stays in position while in use.



FIG. 14. DEWALT Random Orbit Sander, Variable Speed, 5-Inch (DWE6423). Credit: Amazon.

The choice of sandpaper grit will depend on the characteristics of the workpiece. In general, a 220 grit sandpaper is a good starting point.

The size of a workpiece, either as a pre-processed or completed laser cut piece, may be relatively small, and may have intricate cut edges, curves, slots, recesses, and cut-outs, all of which may be too small for a normal-size sander. In such cases a precision pen-size sander (FIG. 15), with a linear rather than rotary motion, may be useful. The sander comes with a variety of small changeable straight and angled shanks that can fit in tight spaces. Each shank can accommodate a like-sized adhesive piece of sandpaper available in a variety of grits.



FIG. 15. Proxxon 28594 Pen Sander PS 13, 12 Volt. Credit: Amazon.

The Dremel rotary tool has a reputation for accommodating a wide variety of attachments, including many sanding attachments. Although it is not as narrow nor as light as a pen sander, the Dremel can sand many hard-to-reach spaces. An advantage of the Dremel is the fact that it can be used while it is mounted in its drill press stand wherein the workpiece can be moved while the rotary tool remains in a fixed position.

The sanding operation may require more serious attention if the workpiece is large, and/or the surface is particularly rough. The WEN 6502T with a 4.3 amp, ½ HP motor, contains two sanding surfaces: one a 4" x 36" adjustable belt sander that can tilt from 0 to 90 degrees; and the second, a 6" disc sander with an adjustable support table and miter gauge (FIG. 15). The machine accommodates a wide variety of sanding grits, each of which can be changed quickly and easily. Both sanding options are mounted in a solid cast iron base, providing a stable and secure sanding surface with a minimum of vibration. The unit includes a 2.25" dust collection port for attaching an optional vacuum system.



FIG. 15 The WEN 6502T belt disc sander brings considerable power to the sanding operation, eliminating jagged edges and splinters, and producing exceptionally smooth and uniform surfaces. Credit: Amazon

Vacuuming

Any operation that involves sanding or cutting will produce dust. A clean work environment is a major protection against fire, with the added benefit of removing pollutants from the air, and therefore protecting the health of the people working there.

A hand-held cordless vacuum cleaner (FIG. 17) is a handy tool to clean up loose debris and remove it from the environment. It can be used not only to clean work surfaces, including the laser bed, but to remove surface dirt and dust directly from workpieces prior to, and after, sanding.



FIG. 17 BLACK+DECKER dustbuster Handheld Vacuum, Cordless, 16V (CHV1410L). Credit: Amazon.

Painting

Airbrushing. An airbrush (FIG. 18) can work in concert with a laser engraver/cutter in a number of ways. The first, and perhaps the most obvious, is that it can replace the need for spray cans for applying a number of surface treatments to materials, before and/or after engraving or cutting. One such treatment is the application of white spray paint for the creation of engraved photos on ceramic tile, commonly known as the Norton Method, or the Norton White Tile Method (NWT). The method works due to the reaction of the laser with the Titanium Dioxide (TiO₂) in the paint (FIG. 19). Titanium dioxide is a synthetic white pigment that provides maximum whiteness and opacity in paint. When the laser hits the coating it turns the paint black, and adheres permanently to the surface. Users can buy Titanium Dioxide, mix it with alcohol (1ml TiO₂ to 10ml alcohol), and apply it using an airbrush. (See Pre/Post Surface Treatments).



FIG. 18. Master Airbrush Cool Runner II Dual Fan Air Compressor Airbrushing System Kit with 3 Professional Airbrushes, Credit: Amazon.

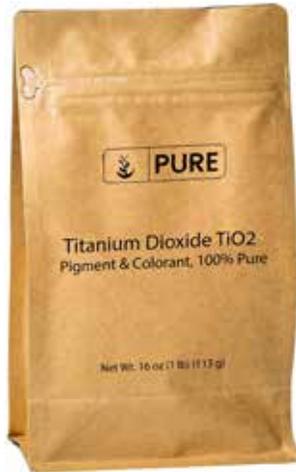


FIG. 19. Titanium Dioxide TiO₂ (1 lb.), Eco-Friendly Packaging, Naturally Occurring Mineral, pH Neutral. Credit: Amazon.

Another use of an airbrush is for painting the surface of a workpiece, either before lasering, or after. Applying a surface treatment prior to lasering is appropriate in a number of circumstances, because pre-coating, as in the case of the Norton Method, provides the laser with a surface that it can react to. For example, laser engraving on acrylic or glass, without some pretreatment, has virtually no imaging affect at all. The laser light goes right through the material. With the application of a dark, usually black, coating, the laser can react and form an image.

After a workpiece has been imaged it can be quickly and uniformly painted with an airbrush. Some of the advantages are that there will be no brush marks; multiple thin coats can be applied, including coats of primer; smooth color transitions and shading can be produced; custom colors can be mixed; and it can be more economical than the spray-can method.

As another example, the laser cutter can make a stencil, which can be used with an airbrush to quickly apply a design or marking on any number of flat or curved items. The stencil, made of paper, cardboard, or oil board, can be retained for repeated use.

Like any process that is airborne, airbrushing presents some health and safety concerns. First, the user should wear personal protection, including a respirator or mask, to avoid inhalation of fumes, and safety glasses. Appropriate clothing should also be considered. Second, the user needs to protect items in the immediate environment from being covered with unwanted paint spray. Both concerns can be addressed with the use of a spray booth (FIG. 20) that can both limit the range of spray and expel any fumes out of the immediate area.

Eye Safety

Any process using a laser presents a real safety concern. It should be obvious that the operator should not look directly at the laser when it is in use. Doing so can penetrate the pupil and focus directly on the retina. Permanent eye damage can occur quickly. The severity of eye damage is a function of the class of laser in use, and how it was viewed (direct, diffuse, reflected, scattered, etc. radiation). Even if the possibility of exposure is remote, adequate eye protection should always be worn.



FIG. 20. TUFFIOM Airbrush Spray Booth w/LED Lights Fan Filter & 6 ft Exhaust Hose. Credit: Amazon.

Most laser engravers/cutters have an optional enclosure (FIG. 21) to minimize the operator's exposure to the intense light emitted by the laser. Even with the proper use of an enclosure, the operator should wear adequate eye protection whenever the laser is on.



FIG. 21. Ortur enclosure. Credit: Ortur.

Selection of eyewear is based on the wavelength of the laser and the recommended Optical Density (OD). The proper glasses filter the light, only allowing light of a certain wavelength to pass through.

The eyeglass frame (FIG. 22) should fit comfortably, even if it is worn over prescription glasses, and be of a wrap-around design to keep unwanted light from passing through from the sides.



FIG. 22. FreeMascot Professional OD 6+ 190nm-490nm Wavelength Violet / Blue Laser Safety Glasses for 405nm, 445nm, 450nm, 473nm Laser (Frame Style 5). Credit: Amazon.

Fire Suppression

A laser beam outputs an extremely high temperature, and in the course of engraving or cutting it can generate smoke, or ignite a workpiece, some of which are known to be flammable, into an open flame. The flame can set the machine on fire and quickly spread to the building that houses it, and endanger those inside.

The first rule in fire safety is to be vigilant, and never operate a laser system unattended. The area surrounding the laser engraver/cutter should be clean, free of debris, clutter, combustible materials, and volatile solvents. Cut-outs that fall through a table tray or honeycomb base should be swept up routinely, and not be allowed to build up. An air assist system should always be used when doing vector cutting.

The laser enclosure cabinet exhaust system should be examined routinely, and any build-up in the exhaust blower and duct system should be removed. Any obstructions in the air flow through the device need to be eliminated, and a safety checklist should be established and used before starting any operation.

Fire abatement equipment, such as a fire extinguisher (FIG. 23), is an essential piece of equipment, although a spray bottle with water may be sufficient to put out nascent flames.



FIG. 23. Amerex B402, 5lb ABC Dry Chemical Class A B C Fire Extinguisher, with Wall Bracket. Credit: Amazon.