

100 percent™ | fabrication manual

guidelines for working with and fabricating 3form 100 percent

3form 100 Percent is an engineered thermoplastic panel product produced from 100% post-consumer high density polyethylene (HDPE). The completion and installation of applications may involve secondary fabrication operations including cutting, drilling or bonding. This publication covers the properties and characteristics of 100 Percent that should be taken into account if secondary operations are to be performed successfully.

Storage Instructions

100 Percent should be stored at room temperature in a dry environment that is not exposed to direct sunlight or heat. 100 Percent panels should be stored horizontally (flat), as delivered, to prevent warpage. The protective masking must be removed within 30 days of receipt to prevent adhesive from sticking to the panel. Due to possibilities for expansion or contraction, allow material to come to room temperature prior to fabricating.

Cutting and Drilling Techniques

100 Percent can be fabricated with most tools used for machining plastics, wood or metal. Tool speeds should be such that the 100 Percent panels do not melt from frictional heat. In general, the highest speed at which overheating of the tool or sheet does not occur will give the best results.

It is important to keep cutting tools sharp at all times. Hard, wear-resistant tools with greater cutting clearances than those used for cutting metal are suggested. High-speed or carbide-tipped tools are efficient for long runs and provide accuracy and uniformity of finish. Bring the blade to full speed before starting the cut. Secure the sheet to minimize vibration. Since engineered resins are poor heat conductors, the heat generated by machining operations must be absorbed by the tool or carried away by a coolant. (A jet of air directed on the cutting edge will aid in cooling the tool and removing chips.) Another method of reducing heat is by making several passes while cutting or trimming the part rather than trimming "deep" through the part.

DO

- Leave the original masking on the sheet during cutting operations.
- Practice on pieces of scrap before cutting parts.
- Use recommended saw blades.
- Use sharp, clean blades and bits.
- Use slow, consistent feed rate.
- Hold sheet firmly while cutting to minimize vibration; use just enough clamp pressure to prevent vibration.
- Use compressed air to minimize heat buildup.
- Feed against the rotation of the blade or tool.
- Wear proper safety equipment.

DO NOT

- Cut or drill with a dull blade, cutter or bit.
- Apply excessive clamping pressure.
- Use a blade with side-set teeth.
- Scribe-break product sheet.

SAW CUTTING

Any of the following saw types, commonly used for wood or metal, should be satisfactory for cutting 100 Percent sheets: circular saws, band saws, saber saws, jigsaws, hacksaws, or handsaws. However, some saw designs are better suited than others for sawing 100 Percent because they produce smoother or faster cuts. Table saws and band saws usually produce the best surfaces, and they can be used in most sawing operations.

Blade design plays an important part in successful sawing of 100 Percent sheets. A skip tooth band saw blade is preferred because the wide gullet provides ample space for the plastic chips to be carried out of the kerf (the cut made by the saw). For best results, the teeth should have zero rake and some set. For a curved cut, the blade should be narrower and have more set than for a straight cut. The blade must be kept sharp to prevent melting or chipping of the sheet, and the blade guide should be placed very near the cut to minimize vibration.

A circular saw is preferred to a band saw for straight cuts even though it tends to generate more heat. A circular saw should be operated at approximately 8,000 to 10,000 RPM and 10-20 feet per minute with carbide-tipped saw blades having 40 teeth and should have plenty of set or be hollow ground. A perforated saw blade will run cooler than a solid blade. It is essential that the spindle bearing be tight so that the saw will run true.

Remember: Be sure to hold or clamp the panel securely while sawing.

DRILLING

Drills designed especially for plastics are widely available. It is suggested that the fabricator utilize such drills when drilling 100 Percent. Standard twist drills for wood or metal can be used however they require slower speeds and feed rates to produce a clean, non-gummed hole. Optimum bit speed, feed rate, and applied pressure will depend on hole size and sheet thickness. Use drill speeds up to 1,750 RPM for smaller holes and use speeds as low as 350 RPM for larger holes.

Twist drills used for plastics are suited to working 100 Percent —they should have two flutes, a point with an included angle of 60 to 90 degrees, and a lip clearance of 12 to 18 degrees.

Wide, highly polished flutes are desirable since they expel the chips with low friction and thus tend to avoid overheating and consequent gumming. Drills with substantial clearance on the cutting edge of the flutes make smoother holes than those with less clearance. Drills should be backed out often to free chips, especially when drilling deep holes. Peripheral speeds of twist drills for plastics ordinarily range from 100 to 200 ft. (30.5 to 61 m) per minute. The rate of drill feed into the plastic sheet generally varies from 0.010 to 0.025 in (0.254 to 0.635 mm) per revolution.

Remember: When drilling be sure to hold or clamp the part securely to prevent it from cracking or slipping and presenting a safety hazard to the operator.

ROUTING

Routing with sharp two-flute 1 1/8" diameter straight cutters produces very smooth edges. Routers are useful for trimming the edges of flat or formed parts, particularly when the part is too large or irregular in shape for a band saw. Portable, overarm, and under-the-table routers work equally well. 100 Percent should be fed to the router slowly to avoid excessive frictional heating and shattering. The router or sheet, whichever is moving, must be guided with a suitable template. It is good practice to employ compressed air during the routing operation to cool the bit and aid in chip removal.

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EDGE FINISHING

The edges of 100 Percent may be mechanically polished to achieve a smooth edge. To prepare for edge polishing, sand away all machine or saw marks using 150 grit sandpaper using a dual action orbital sander. Once the machine marks are removed, sand with 400 grit sandpaper. Be careful not to concentrate the sander in one area for too long, as heat build-up may damage the 100 Percent panel. Apply even pressure so that the edges of the sander do not dig into the panel.

To mechanically polish, use a dual action orbital sander with a foam application pad. 3form recommends the use of 3M™ Perfect-It™ 3000 Extra Cut Rubbing Compound (06060) with a 3M Superbuff™ III Buffing pad (05703). Apply a small amount of compound to the surface of panel before using the wool pad. Apply medium pressure to remove the scratches from the sanding process. When the scratches have been removed, use light pressure and work the residual compound back into the pad. Use a clean soft cloth to remove any remaining compound.

Inspect the surface for sanding scratches, and repeat above process if necessary. Next use 3M Perfect-It 3000 Swirl Mark Remover (06064) with the 3M Perfect-It Foam Polishing Pad. (05725) Apply a small amount of compound to the edge of panel before using the foam pad. Apply medium pressure to remove the swirl marks. Once the swirl marks have been removed, apply light pressure and a head speed of 1800 rpm to polish. Use a clean soft cloth to remove any remaining polish or residue. The surface of the panels should be polished and swirl marks should be nearly eliminated. To achieve an even glossier finish use 3M Perfect-It 3000 Ultrafina SE compound (06068).

EDGE FINISHING SUMMARY:

- 1. Sand away machine or saw blade marks from edge using coarse sandpaper
- 2. Sand edge using 400 grit or higher sand paper
- 3. Polish using rubbing compound
- 4. Final polish using polishing compound

Fastening and Adhesion Techniques

MECHANICAL FASTENING

100 Percent can be fabricated attractively with mechanical fasteners. Mechanical fastening using through-holes is recommended. Self-threading screws should not be used with 100 Percent panels. Mechanical fastening is recommended for assembly of larger articles.

MECHANICAL FASTENING GUIDELINES

DO

- Use 3form Hardware for best results
- Use screws designed specifically for plastics.
- Drill holes slightly oversized to allow for thermal expansion and contraction.
- Insure drilled holes have smooth edges.
- Use washers for better load distribution.
- Use light to moderate clamping pressure

DO NOT

- Over-tighten fasteners. Hand tightened fasteners are sufficient.
- Use self-tapping screws to hang large panels.
- Use Cyanoacrylate or solvent type thread locking materials.

BONDING (WITH ADHESIVES & CEMENTS)

100 Percent also can be fabricated with adhesive bonds. We do not recommend using solvents for bonding or seaming 100 Percent panels.

Two-part adhesives are recommended when bonding 100 Percent to dissimilar plastics and to bond 100 Percent to itself. 3form specifies the use of 3M adhesives. 3M DP8005 is to be used when bonding 100 Percent panels to other substrates. Review the 3form 3form Adhesives Matrix for a list of substrates that have been tested. DO NOT use 3M DP8005 for bonding large surface areas. 3M DP8005 should only be used for seaming or bonding surface areas LESS than 5 in (12.7cm) wide.

When bonding the edges of 100 Percent, first mask the the face of the panel with masking tape closest to the edge to be bonded. Next apply the adhesive to the edge of the panel with an adhesive gun. Use a finger-tip to spread the adhesive evenly along the joint. Apply the adhesive to the second surface to be bonded. Use light to moderate clamping pressure during curing process. Finally, use a clean rag with isopropyl alcohol to clean up any adhesive that dripped out of the joint.

When larger articles are to be joined or fastened, mechanical fastening is recommended.

BONDING TECHNIQUES: VHB TAPE

Clear 3M™ VHB™ tape 4910 or 4905 can be used to adhere 100 Percent to a variety of substrates while still achieving desirable aesthetics. 3M VHB tape can be used to attach 100 Percent to sealed wood, sealed ceramics, metal, glass and some other plastics. VHB tape is UV stable and can be used in interior and exterior conditions as well as in the toughest environmental conditions. 3M VHB tape provides an excellent seal against moisture, however splices or seams in the tape may require additional sealing. The tape can tolerate some shear extension due to substrate movement from thermal expansion and contraction. Special surface preparation is needed before applying 3M VHB tape to a 100 Percent panel. First both surfaces are to be cleaned with a 50:50 mixture of isopropyl alcohol and water. Next the 100 Percent surface to be used should be flame treated. (Only the area to which the tape is to be applied requires flame treatment). To flame treat use a butane torch. Turn flame to lowest setting. Keep flame 1-3" (25.4-76 mm) away from the material. Use a quick sweeping motion. Always keep the flame in motion. If you keep the flame concentrated on one spot for a prolonged period of time burning, melting or bubbling may occur. Continue to sweep the flame across the surface until the material is polished. Practice on a scrap piece of material before working on finished panels. After the area has been flame treated and is dry, the tape can be applied to the first surface. Only handle the tape by the edges and apply firm pressure to the tape using a roller. Attach the second bonding substrate and apply pressure on the finished joint with a roller. Apply firm application pressure to the entire length of the taped area (at least 15 psi is necessary) to develop good adhesive contact and to improve the bond strength. Bond strength will increase over time, 90% of the ultimate strength will develop after 24 hours and full strength after 3 days. Ultimate bond strength can be achieved more quickly by exposure to higher temperatures (e.g. 150°F for 1 hour). If the entire weight of the 100 Percent panel is supported by the 3M VHB Tape, a minimum of 4 in2 (25.8 cm2) of tape should be used for every pound of panel weight to be supported. 3M support is available for questions related to the use of 3M VHB Tape. Call 877-649-2670 and ask for technical service support especially when bonding 100 Percent to other nonmetal substrates. Other support materials and data are also available online at www.3m.com/vhb.

DO

- Seal porous materials like cement and wood before bonding.
- Keep tape away from debris and handle tape by the edges.
- Make sure both surfaces are clean and dry.
- Use a 50/50 isopropyl/water solution for metal and plastic surfaces.
- Apply flame treatment on 100 Percent surface to be bonded.
- Apply Tape to first surface, apply firm pressure (more than 15psi) with a roller.
- Remove liner from second side and apply to second surface.
- Apply very firm pressure to entire bond line.
- Wait 72 hours until tape has reached full adhesion strength (1 day = 90% strength).

ADHESIVES AND SEALANTS FOR PRODUCT FABRICATION

PRODUCT NAME	DESCRIPTION	APPLICATION
3M DP8010	2-Part Acrylic Adhesive	100 Percent to plastics, wood, metal
3M VHB 4910 Clear Tape	2-Sided Tape	100 Percent to sealed wood, metal, glass or other plastics

Cleaning Instructions

3form 100 Percent, like all thermoplastic resin materials, should be cleaned periodically. A regular, seasonal cleaning program will help to maintain the aesthetics and life of the material.

Rinse the sheets with lukewarm water. Remove dust and dirt from 100 Percent with a soft cloth or sponge and a solution of mild soap and/or liquid detergent in water. A 50:50 solution of isopropyl alcohol and water also works well. Rinse thoroughly with lukewarm water.

Always use a soft, damp cloth to blot dry. Rubbing with a dry cloth can scratch the material and create a static charge. Never use scrapers or squeegees on 100 Percent. Also avoid scouring compounds, gasoline, benzene, acetone, carbon tetrachloride, certain deicing fluids, gasoline, lacquer thinner or other strong solvents.

3FORM RECOMMENDED PRODUCTS

Windex, Formula 409, Simple Green, Fantastik, 10:1 Water/Bleach Solution

DO:

- Use warm water, mild detergent and a soft cloth or chamois.
- Blot dry with a slightly damp soft cloth or chamois.

Keep cleaner one inch away from stand-offs or other mounting hardware.

DO NOT:

- Use squeegees or scrapers as they may scratch the sheet.
- Use scouring compounds or solvents such as: acetone, gasoline, benzene, carbon tetrachloride, or lacquer thinner to clean sheet.
- Clean in hot sun or elevated temperatures.
- Use a dry cloth or a cloth of synthetic fiber such as rayon or polyester as they may scratch the sheet.
- Use cleaners around edges or holes where the cleaner can wick into the interlayer.

Note: If a cleaning material is found to be incompatible in a short-term test, it will usually be found to be incompatible in the field. The converse, however, is not always true. Favorable performance is no guarantee that actual end-use conditions have been duplicated. Therefore, these results should be used as a guide only and it is recommended that the user test the products under actual end-use conditions.

For more information, please visit 3-form.com or call 877-649-2670.