

Manufacturing Polyurethane Picture Frames

by Bob Hamon, CPF

Plastics are being used so extensively in our lives today, it is no wonder that they have become a factor in picture frame materials. Understanding those material and their qualities is the first step to being an informed framer.

Modern plastics are said to have emerged in 1855 with the creation of nitrocellulose. Since then, the creation of new plastics has been constant. If you look at a list of important plastics, you will see the names of items you use every day. Some will be familiar to you, like cellulose acetate (Mylar) used to encapsulate paper borne art, or silicone that we use as a glue in object boxes.

Plastics come from both natural sources and man-made sources. Natural plastics are resin, rubber, amber, shellac, pitch, tar, and asphalt. The “compo” (or composition) we use is a form of plastic composed of rabbit skin glue, slacked plaster, and resins that allow it to be soft and pliable, and therefore moldable. Man-made plastics are produced from organic substances. The basic elements of these plastics are carbon, hydrogen, oxygen, and nitrogen. The addition of compounds like ammonia or formaldehyde alters the molecules to form new plastics.

One of these man-made plastics is polyurethane, which was developed in the 1930s. Polyurethanes are a family of plastics with a diverse range of characteristics. When the molecule chain in the polyurethane is altered, a new polyurethane will result. A comparison between pillow stuffing and a bowling ball illustrates this range of polyurethanes.

Most of the polyurethanes used in picture frames are a high-density, rigid cast product, which gives durable strength to a lightweight frame. The ornate or complex ready-made frame is where the casting abilities of polyurethane really shine. Some even say that cast polyurethane frames are superior to wooden ready-made frames since they will not rot, crack, split, or shrink, and are resistant to insects. However, length molding is best left to the wood/compo frames when they can be produced more efficiently with current manufacturing systems than casting in polyurethane.

Today, one major caster of polyurethane frames in the United States is Marlock, Inc., located in Maynardville, Tennessee. This modest facility has been producing cast polyurethane picture and mirror frames since 1968. I recently



Photo 1: The frame pattern is attached to plywood.



Photo 2: The frame pattern is placed within plywood forms.



Photo 3: Polyurethane castings are resting on top of silicone rubber molds and slip boxes.

visited Marlock and was given an extensive guided tour.

There is a great amount of work and care that goes into the production of a frame. The manufacturing process is well thought out, from how the frame is handled at each step, to how that step will affect subsequent procedures. I will describe what I saw at Marlock in order to help you understand the process involved in the making of quality cast polyurethane frames.

Prepping The Frame

To begin producing frames in quantity by casting, a pattern is used as the initial frame. It might be an antique frame, a classic frame copy, or a frame made from a new design. Several silicone rubber molds may eventually be made from the pattern, so it must be stable, true, and clean. The silicone rubber mold will make an accurate likeness of the original—even imperfections—so extra time in preparing the pattern is well spent.

The pattern is first attached to a thick plywood board (Photo 1). Another plywood board with two attached plywood forms will create a surround that will come to within $\frac{1}{4}$ " of the inner and outer edges of the pattern (Photo 2). When the board with the attached surround is fastened to the board with the pattern, it will create a mold box. The mold box has a cavity that will confine the liquid silicone rubber as it cures into a rubber mold. The mold box surround will prevent the silicone rubber mold from distorting when being used to cast frames. The inside edges of the surround are cut on a slight bevel to facilitate easy removal of the silicone rubber mold from the mold box after each casting. A release agent is coated on all surfaces to prevent the silicone rubber from sticking to the wood surfaces. With the preparations done, the entire mold box is taken to the rubber room for the pouring of the silicone rubber.

The Rubber Room

The mold box is now ready to be filled with RTV (room temperature vulcanizing) silicone rubber. The rubber room is set up specifically to fill the cavity around the pattern with this rubber. Silicone rubber is made by mixing a silicone liquid polymer with a catalyst. The mixing is facilitated as the two parts are pumped through a mixing machine, then dispensed into the box. The liquid silicone becomes a rubber as the mixture polymerizes in the cavity of the mold box. The silicone rubber mixture is controlled to give a firm mold, yet have enough flex to



Photo 4: The storage area for an extensive collection of molds and slip boxes.



Photo 5: A pour is in progress in the flow room.

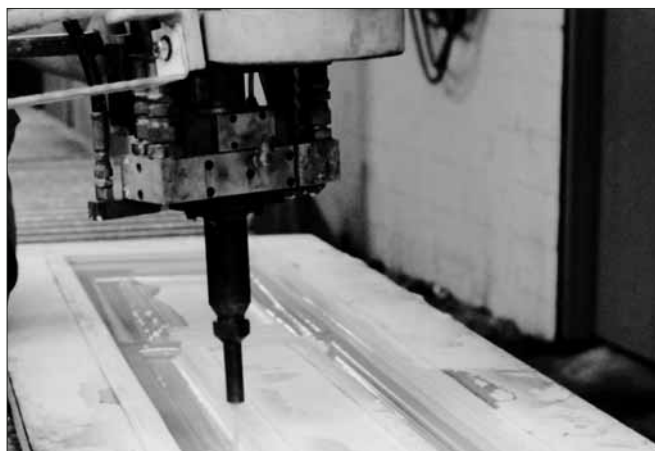


Photo 6: A mold for a door panel is being poured. The remaining space is filled as the polyurethane expands under pressure.

pull out and around deep undercuts. The silicone rubber cures in about 24 hours.

The box is then dismantled and the rubber, with the pattern still intact, is removed from the surround. The silicone rubber is then “pulled” away from the pattern

(Photo 3). With the pattern now free, the rubber mold is placed back into the surround of the mold box (Photo 4). The mold is cleaned and ready to go to the casting line.

The life expectancy of a silicone rubber mold is about 100 castings. A large production schedule may require more than one silicone rubber mold; therefore, more plywood mold boxes and rubber molds may be made from the pattern.

Go With The Flow

The mold box with the rubber mold is now open-faced. The plywood board with the pattern is not needed for casting and is sent to the storage area. The mold box is now used as a carrier to facilitate accurate casts, which now proceeds to the casting line. Traveling on a roller conveyor, the rubber mold is sprayed with a tinted in-mold barrier coat. The tinted coating gives the casting a base coat that helps to prevent the polyurethane from deteriorating the silicone rubber. With the barrier coat dry, the mold box travels the casting line to the flow room. The room is aptly named because the polyurethane is mixed here and flows into the silicone rubber mold.

Polyurethane is a plastic polymer that results when two liquid formulations, isocyanate and polyol, are mixed. Two types of polyurethanes are available, one that expands as it cures called polyurethane foam, and the other, nonrising polyurethane, which does not expand. In the nonrise method, the mold is filled to capacity with liquid polyurethane that then cures to form a solid. Smaller producers may hand mix the polyurethane formulations, which can result in variations of the “pour,” and possibly make it harder to produce a consistent product.

At large facilities, the components of polyurethane are pumped into a computer controlled machine that mixes and dispenses the fluid into the mold (Photos 5 and 6). Marlock uses the foam type of polyurethane. By using expanding polyurethane, and then containing its expansion under pressure (Photo 7), a controlled density is achieved in the product for a more stable and durable frame.

Just how dense the polyurethane will be made is determined by the size and type of the frame. Large bulky frames tend to be cast using lighter, less dense polyurethane. The mass of a large frame will give it the stability it requires. Picture frames that are complex in



Photo 7: Cast frames are stacked near press used to cure frames.



Photo 8: This is a cast frame waiting for the sander. The flashing around the edges is removed in the sander.



Photo 9: A door panel is being placed in cradle before sanding. Other cradles are in the background, with frames.

ornament and shape are generally cast in a denser polyurethane to withstand the handling when removed from the mold.

Casting times vary according to the mix, temperature, humidity, and mold depth, but castings can be

removed from the mold in as little as ten minutes or as much as several hours. Even after the frame is out of the mold, it will take 24 hours for the polyurethane to achieve total and proper curing.

C'mon Back

The newly cast frames are stacked by style, and when the total production run has been cast, they move as a group through the factory. The first step after casting is to dress the back of the frame. Manufacturing techniques vary. Some use thin strips of wood to give the appearance of an all wood frame, while some leave the raw back exposed, and others dress the back by sanding. At Marlock, the back of the frame will be exposed and therefore, back sanding is in order.

Meanwhile, while the production run to pour the castings was underway, the wood shop was making a sander jig fitted to the first production piece which they received after it was removed from the silicone rubber mold. The sanding jig is a plywood base that will cradle the newly cast frame snugly in place for the proper angle and depth for sanding. In the sanding area, the sanding jig, with a new frame tucked in, travels through a double-belt sanding machine (Photo 9). The belts sand approximately $\frac{1}{8}$ " of the extra material from the back (called flashing). The result is a clean, smooth look.

Let The Chips Fly Where They May

The stack of sanded frames now moves into the routing room. A craftsman uses a template specifically made for the frame to cut the rabbet into the back. The new rabbet will accommodate the glass or mirror.

The Putty Princess

Next, the frame is given a thorough check. Imperfections are filled with synthetic putty and sanded smooth. The time given here for touch-up allows this to be one of the several places along the production line where quality control can reject frames. This has been planned into the production run by producing more frames than is required by the order. Everything needed to ensure the best possible finish is done here. The frame might also be given a light sanding and dust "blow off."

The Pause That Refreshes

Thus far, you have an insight as to the complexities in making polyurethane frames. The care and work that are



Photo 10: These stacked frames have been sprayed with undercoat and are waiting for finishing.

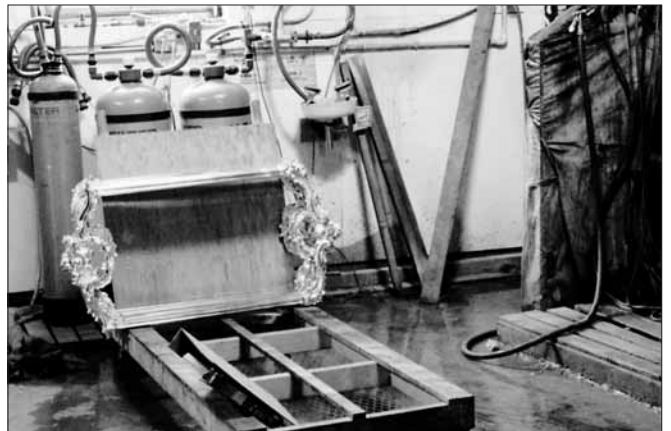


Photo 11: Shown is a spray booth for silver nitrate.



Photo 12: The silver frames are stacked to dry, and wait to be sealed and tinted.

applied to each frame is equivalent to efforts made on manufactured compo/wood frames.

Objections to polyurethane frames in the past have stemmed mostly from the chunkiness of the frame or the cheap looking gold finish. Poor quality frames did little to boost the confidence of frame buyers. Up until now, the market has been for contract orders, standard-sized ready

mades, and decorative mirrors. This has resulted in the demand for mass production. The time restraints of a production schedule mean that efficient finishing systems need to be practiced. As always, the producers of poor quality framing will fall by the wayside as manufacturers strive for quality and value. Today's manufacturers can provide frames with a quality look and finish. Polyurethane frames can be gilt, toned, and waxed like the finest museum copies. When done right, the look and feel is very similar to wood.

The Midas Touch

Throughout the production process, the frames have gone step by step, and are now stacked again, having been sprayed with an undercoat and dried (Photo 10). A worker pulls frames from a nearby stack, and standing in a spray booth, sprays and then stacks each frame. In what looks like a choreographed part in a musical, the sprayer operator performs a four-step process to apply the silver nitrate. First, the frame is sprayed with a synthetizer to allow it to accept the silver nitrate. Next, the frame is sprayed with treated water to remove excess synthetizer (Photo 11). The frame is then sprayed with a silver nitrate solution that plates it and gives it a beautiful chromed look (Photo 12). It is again sprayed with water to rinse and racked to dry.

When dry, the frames have to be sealed within 24 hours or the silvering begins to oxidize. To transform the silver frame into gold is a new twist to an old game. Just like the processes of the past, in which a silver frame was coated with orange shellac to give it the appearance of a gilt frame, the modern technique is to spray the silvered frame with a transparent gold tinted dye (Photo 13). This process produces the look of gold. Other metallic surfaces such as bronze, steel, and pewter can also be imitated using the silver nitrate plate base.

Any desired finish can be achieved in the finishing area. Frames may be given a faux finish to meet a designer's specifications. Stone, wood, grain, leather, bamboo, and rough plaster are just a few of Marlock's specialties (Photo 14). After the surface has been laid down, it is on to toning, antiquing, and the final coat of clear lacquer. The finished frames are then fitted in accordance to the work order and sent to the packing and shipping area (Photo 15).

A Fitting Close

For the picture framer, finding a product that meets the needs and expectations of the shop, while at the same



Photo 13: A silvered frame is sprayed with gold tint dye as it spins.



Photo 14: Samples of some of Marlock's finishes are shown here.



Photo 15: Finished frames are stacked, waiting to be packed.

time being affordable and profitable, is a daunting task. Keeping that in mind, we can truly appreciate a well done polyurethane frame. Viewing the operation of the nation's premier polyurethane frame producer has given me, and I hope you as well, the tools to make an informed decision when purchasing polyurethane frame products. Leaders in any industry have accepted the challenge of change. Are you ready? ■