Material Handling Guidelines

Forming parts from Parts-In-Minutes polyurethanes - particularly when building large pieces weighing five pounds or more — requires careful material selection to ensure adequate gel time to shoot the part. If the polyurethane starts to set up in the mold and the dispensing equipment continues to pump, catastrophic tool failure can occur. Before starting a project, therefore, the time required to completely fill the mold should be determined and compared with the gel time of the polyurethane to be used.

Shoot Time

Calculate shoot time using the following formula:

$$\frac{\text{Part Weight (lbs.)}}{\text{Pumping Capacity (lbs./min.)}} = \text{Part Shoot Time (min.)}^*$$

Determine part weight by taking part dimensions from a drawing and calculating the weight based on a Parts-In-Minutes polyurethane density of 70 lb./ft^3. If a master model exists, it can be weighed and the prototype part weight estimated by comparing the densities of the Parts-In-Minutes polyurethane vs. the material used in the master.

Determine pumping capacity of the meter mixing equipment by shooting polyurethane into an empty cup for a specified time period. Then, calculate the pounds dispensed per minute.

***NOTE: Actual pumping time may take up to 10 to 20% longer than the calculated time because the equipment injection rate may slow down as the tool fills with polyurethane.**

Part Injection

Material Selection. Choose a polyurethane with a gel time long enough to provide for complete mold filling, keeping in mind that Parts-In-Minutes polyurethanes can be dispensed into the mold for a period approximately 50% longer than the gel time stated on the product specification sheet. Calculated part shoot time should not exceed the estimated maximum shoot time indicated on page 8 for each Parts-In-Minutes polyurethane. If the estimated maximum shoot time is exceeded, the pumping capacity of the dispensing equipment **must be** increased or a different material selected.

Polyurethane Injection. Injecting a part for longer than the estimated maximum shoot time may damage the tool or result in a poor quality part. If the polyurethane gels in the mold and shooting continues, the resulting "hydraulic effect" can cause internal tool pressure to build up. If the pressure becomes too great, it can cause tool failure.

If possible, feed the polyurethane into the mold from several different locations using an exterior runner or manifold. This manifold can be easily built using standard shop materials: vinyl tubing, plastic or brass T's with barbed fittings, and hose clamps. NOTE: It is especially important to run tubing into tool areas that will be difficult to fill.

Other Considerations

Part Shrinkage. A variety of factors can affect the shrinkage obtained with Parts-In-Minutes polyurethanes including: casting thickness, gel time, temperature, mold type, and length of time the part is left in the mold. Shrinkage of Parts-In-Minutes polyurethanes generally ranges from less than 0.001 in./in. for small parts to 0.004 to 0.006 in./in. for large parts or parts with a wall thickness of 3 mm or more. Please contact your Ren Shape Tooling Systems representative for more details.

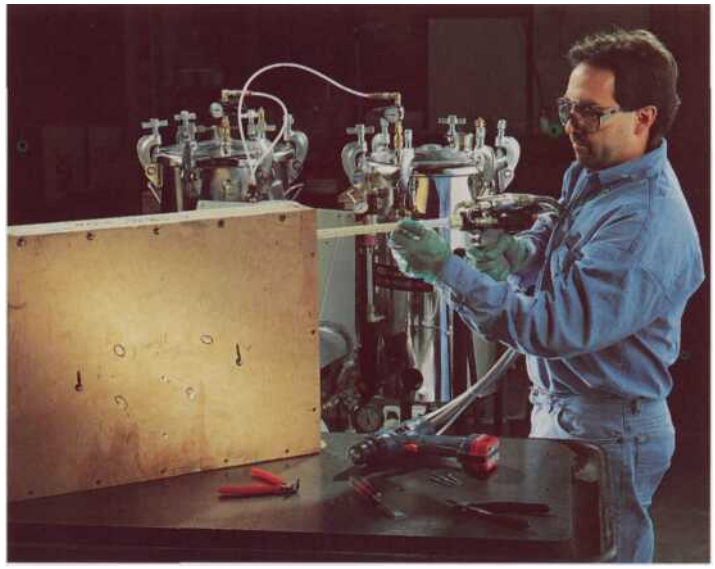
Tooling. Molds for large parts can be built using room-temperature laminating materials, silicone rubbers, casting epoxies or polyurethanes, or a combination of these products.

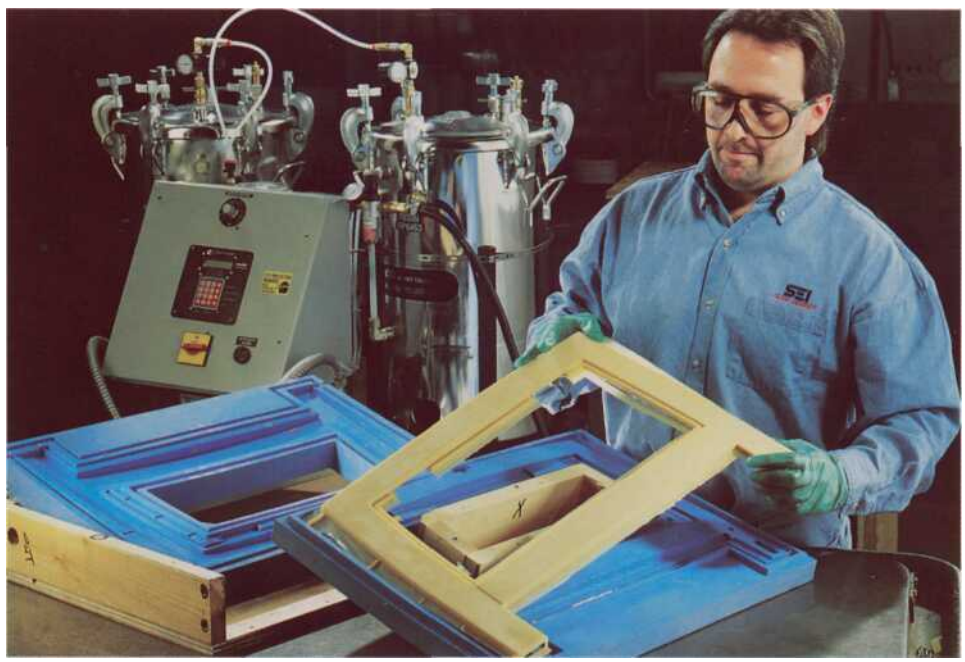
Internal Pressure. The mold's internal pressure is affected by dispensing equipment pumping rate, tool venting, part size and thickness, and polyurethane viscosity. In general, the pressure inside the tool will be low, unless the polyurethane gels and pumping continues and creates a hydraulic effect as described above.

Pigmenting/Coloring. Parts-In-Minutes (PIM) polyurethanes can be colored to most end-user specifications using PIM coloring pastes. Pastes are available in: Jet Black, White, Yellow, Red, Green, Blue and Brown. The pastes may also be blended to produce custom colors. PIM color pastes are concentrated to provide for good color intensity at low proportions; colors may be added to the hardener component of Parts-In-Minutes polyurethanes at a level up to 3% by weight. Each of the new pastes is supplied in a 400-gram, wide-mouth jar along with two empty syringes to facilitate precise dispensing.

Painting. Polyurethane prototypes can be readily painted using the proper materials and procedures. Before beginning, allow the part to cure for at least 24 hours after molding. NOTE: If the cured surface is oily, the typical cause is an improper resin to hardener mix ratio. Correct the mix ratio to produce prototypes with a smooth, dry surface before attempting to apply paint. Then, wash surfaces with an automotive grease and wax remover such as PPG Acryli-Clean DX 330. This type of product is formulated to take off silicone wax and is, therefore, ideal for removing silicone release agents remaining on parts after demolding. NOTE: RP 76 release can be removed by washing surfaces with a commercial-grade automatic dishwashing detergent and hot (150°F) water.

Next, etch surfaces by sanding, bead blasting, or sand blasting. NOTE: This is necessary because polyurethanes, unlike





thermoplastics, do not soften when exposed to solvent. Polyurethane surfaces must be etched to produce a good bond between the prototype and the paint. After etching, clean the part once again using grease and wax remover to remove any contaminants that may have been redeposited on the surface during sanding.

To begin the painting process, apply a surface primer, such Du Pont Fill' N Sand #131S. Allow the primer to dry according to package instructions and etch again. Then, apply the topcoat color. Lacquer finishes, such as Du Pont Clear Coat 380S, are easy to use and produce good results. However, when coating a flexible polyurethane part, a flexible paint that can be obtained from an auto body repair shop supplier must be used.

Whether a lacquer or flexible paint is selected, it is critical to follow the manufacturer's recommendations for that particular product. (One company supplies six different thinners and each has its own handling properties, including dry times ranging from 30 seconds to more than one hour.)

During painting, minimize the amount of paint applied. When excessive paint is used, drying time will be increased and may cause the part to warp until the paint is completely cured. (Complete cure of a part coated with excessive amounts of paint can take several weeks.)

Bonding and Repair. RP 6465 R/H Part-In-Minutes polyurethane is specially formulated for fast patching, bonding or modifying of rigid polyurethane prototype parts. The system is supplied in amber or black and is packaged in convenient 50 ml dual-cartridges for neat, easy mixing and dispensing. It gels in 45 to 75 seconds and can be sanded after 15 minutes.

To patch or bond a part with RP 6465 R/H polyurethane, install a static mixing nozzle on the cartridge and then pull the trigger on the dispensing gun to apply material directly onto the repair area. For void filling, the dispensing gun trigger can be pulled quickly to utilize the dual-viscosity characteristics of the paste. The dispensed material will flow easily with fast trigger pulls. If slow, even trigger pulls are used, the paste will be more viscous and sag-resistant for application to vertical surfaces.

Packaging. Parts-In-Minutes polyurethanes are supplied in one-gallon and five-gallon containers and drums. For packaging information on specific products, call customer service or contact your distributor.

Storage. Store at temperatures between 70°F and 90°F. Parts-In-Minutes polyurethanes are moisture-sensitive and are packaged under a blanket of dry nitrogen. This factory seal should be maintained. After use, reblanket any material remaining in the container with dry nitrogen and tightly reseal.