

RAILDEC-SF Information

General Description

RAILDEC-SF is a decorated Polyvinylchloride (PVC) based thermoplastic sheet laminate that can be thermoformed into a variety of transit vehicle interior parts. RAILDEC-SF is graffiti and stain resistant, and meets the U. S. Department of Transportation requirements for flammability and smoke emission. RAILDEC-SF has been formulated for use on standard thermoforming equipment.

Thermoforming

Thermoforming, one of the oldest methods of processing plastic materials, produces a complex, three-dimensional part from a flat sheet. The process requires heating the sheet to its softening temperature, stretching it against a solid form and cooling the part until rigid.

Formability

RAILDEC-SF can be used under conditions common to PVC sheet for forming and secondary operations such as cutting, routing and drilling. Draw depths of 3-8 inches have been demonstrated with no cracking on vacuum forming equipment with male and female molds. Replication of textured mold surfaces is excellent. "Washout" of textured sheet is minimal even at deep draws.

Forming Temperatures

Recommended forming temperatures for decorated RAILDEC-SF sheet range between 335°F (168°C) and 365°F (185°C).

Mold Temperatures

Molds should be internally heated between 190°F (88°C) and 230°F (110°C). In addition, plug assists should also be heated between 190°F (88°C) and 230°F (110°C).

Drying

RAILDEC-SF can absorb moisture from the surrounding air. This moisture must be removed to prevent bubble formation during thermoforming. These bubbles are the result of absorbed moisture rapidly turning to steam at the forming temperature. When the bubbles flatten upon cooling, they sometimes appear as craters in the finished part. The presence of bubbles or craters indicates the need to dry the material.

Drying Recommendations

Before drying RAILDEC-SF, remove any protective masking or labels. Dry in a hot air circulating oven at 200°F (93°C) or higher. The sheets should be positioned with a minimum separation of one inch. Use the prescribed time shown in Table 1 for each gauge to insure proper drying. Once dried the sheet should be formed within four hours. In extreme humidity this time will be less. When automatic forming equipment is used, the sheets should be cooled to room temperature in order to maintain uniform cycles.

Thickness	Temperature	
	200°F	250°F
0.020"	1 hour	0.5 hour
0.040"	2 hours	1 hour
0.060"	3 hours	1.5 hours
0.080"	4 hours	2 hours
0.100"	5 hours	2.5 hours
0.120"	6 hours	3 hours
0.140"	7 hours	3.5 hours
0.160"	8 hours	4 hours

Table 1. Recommended Drying Time for RAILDEC-SF

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TECHNICAL INFORMATION

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Mold Design

Materials

Internally heated steel or aluminum molds have been used to thermoform RAILDEC-SF thermo-plastic sheet parts in production. Prototype parts can be processed using wood, epoxy, silicone, etc., molds allowing for inexpensive modifications if part changes are necessary.

Shrinkage

Formed parts will contract in size as they cool from the forming temperature to the set temperature. This mold shrinkage is predictable and must be considered in the mold design. RAILDEC-SF sheets will shrink 0.005 to 0.007 inch per inch (0.005 to 0.007 mm per mm).

Mold Shrinkage Calculation

$$\text{Shrinkage} = (M - P) / M$$

Where: M = Mold dimension at mold temperature
P = Part dimension after 24 hours cooling

Draft

Draft angles of 3 to 5 degrees are recommended on all sides to facilitate part removal from male molds. Female molds require less draft (1 to 3 degrees). However, deep textures may require additional draft in female tools. For tools greater than 24 inches (610 mm) long, use a 1-degree draft angle plus 1 degree per mil of texture depth. For tools less than 24 inches (610 mm) long, use a 2-degree draft angle plus 1 degree per mil (0.025 mm) of texture depth.

Corners / Radii

To maximize part strength and durability, sharp corners that concentrate molded-in stresses should be avoided. All corners, edges, etceteras, should be smooth and round. As a general rule, the minimum radius on mold corners should be equal to or greater than the sheet thickness.

Surface Finish

Appearance of the finished part is best controlled on the surface in contact with the mold. Therefore, female molds are used when exterior details are required and male molds when interior details are required. Vent holes should be located in non-appearance areas (e.g., corners). Holes with diameters less than 0.030 inch (0.76 mm) will minimize dimple formation. A 1/4-inch (6.35 mm) hole counter-bored from the reverse side of the mold will produce more rapid air evacuation.