EASTMAN

Tips for **thermoforming**

Eastar™ copolyester 6763
Eastman Tritan™ copolyester MP100
Eastman Eastalite™ copolyester MP007F

Extruded sheet

Sheet extruded from Eastar™ copolyester 6763, Eastman Tritan™ copolyester MP100, and Eastman Eastalite™ copolyester MP007F is easy to thermoform. This brochure lists some helpful tips in processing Eastar, Tritan, and Eastalite.

Mold design

Eastar 6763, Tritan MP100, and Eastalite MP007F can be used successfully with male molds, but female molds are recommended. Thermoformed parts made with female molds will have more consistent flange thicknesses, easier part removal, and reduced bridging (i.e., webbing) issues.

- Generous draft angles of 5–7 degrees in a tapered mold design will better facilitate part release.
- All contours should have a minimum radius of 5⁄64 in. (1.98 mm) throughout the mold design to reduce tray fracture issues.
- To achieve acceptable finished part detail, vacuum channels should lead directly from the vacuum mold inlet to the vacuum holes on the corners of the mold. Vacuum channels should always be kept clean. Minimize the use of right angles in the vacuum system and piping to maximize vacuum speed. This will enable good contact between the plastic and the mold.
- To prevent excess bridging and flange thinning, use proper cavity spacing, especially on male molds. For every 1 in. (25 mm) of depth into the mold cavity, there should be 1 in. of space between cavities.

Note: Mold shrinkage will vary depending on the thermoforming process equipment. Typical shrinkage percentages are shown in Table 1.

Table 1–Typical mold shrinkage

Product	Typical mold shrinkage, %
Eastar™ copolyester 6763	0.40–0.45
Eastman Tritan™ copolyester MP100	0.50–0.75
Eastman Eastalite™ copolyester MP007F	0.04–0.40

Thermoforming process

- Eastman recommends starting with quality Eastar 6763, Tritan MP100, and Eastalite MP007F sheet. Quality sheet is characterized as having consistent gauge, little to no contamination, low cosmetic defects, and good inherent viscosity (i.e., molecular weight).
- Coatings or internal additives are often used to separate packages within a stack (i.e., denesting).
  - These coatings are not typically used or needed to aid in denesting of Eastalite articles.
- Silicone-coated sheet is often used to optimize denesting of packages. Eastman suggests using Dow Corning® 365 Dimethicone NF Emulsion.
  - When silicone coating is not permitted, an internal antiblock or denest concentrate can be added to the Eastar, Tritan, or Eastalite copolyester resin during extrusion.
    - These are typically blended with the Eastar resin at a ratio of 50:1 to 100:1. Eastar additives cannot be used in products made of Tritan, and Tritan additives cannot be used in products made of Eastar.
    - With Tritan, the antiblock and denest concentrates must be specifically formulated for Tritan. These are typically blended with Eastar at a ratio of at least 50:1 but more preferably 20:1 to 10:1.
- The mold surface should maintain a consistent temperature of 100°F (40°C) to 140°F (60°C) to prevent chill line formation or sticking.
- Heat settings on thermoforming equipment should be adjusted to produce the highest possible sheet temperature without sticking or bridging. For Eastar 6763, the optimum sheet temperature range for thermoforming is 300°F (149°C) to 350°F (177°C). For Tritan MP100, the optimum sheet temperature range for thermoforming is 350°F (177°C) to 370°F (189°C). For Eastalite MP007F, the optimum sheet temperature range for thermoforming is 230°F (110°C) to 285°F (140°C).

  Higher sheet temperatures during thermoforming promote lower internal stress in the final packages. However, overheating film and sheet can cause the sheet to sag, resulting in bridging (webbing) in the final thermoformed package.

Table 2–Copolyester thermoforming conditions

Product	Forming range (sheet temp)	Optimum forming range
Eastar™ copolyester 6763	225°F (107°C)–350°F (176°C)	300°F (148°C)–350°F (176°C)
Eastman Tritan™ copolyester MP100	300°F (148°C)–380°F (193°C)	350°F (176°C)–370°F (187°C)
Eastman Eastalite™ copolyester MP007F	200°F (93°C)–290°F (143°C)	230°F (110°C)–285°F (140°C)

- As sheet temperatures increase, the plastic starts to sag which will eventually cause bridging. Sag is the result of temperature and time in the oven. Higher sheet temperatures without additional sag can be obtained by:
  - Decreasing cycle time and increasing oven temperature
  - Heating the sheet without using the full oven length and increasing temperature on the area closest to the mold. Note: Chain rails must be parallel for this setup.
- Two-sided heating may be required.
- For blank-fed male mold thermoforming machines, forming can be improved and bridging can be eliminated by using wire-helper grids.
- Internal stresses should be monitored using a polarized light table.

Cutting sheet

Sharp, properly guarded, and well-maintained steel cutters are required for proper trimming of formed packages. A typical trimming press uses steel-rule or matched metal dies.

Steel-rule die design

- Double bevel measuring 3 point, 0.042 in. (1.1 mm) with a Rockwell C hardness of 45 to 55 is suggested.
- Blisters should be cut through completely when using steel-rule cutting. The cutting stroke on the trim press should stop (i.e., fixed stroke) just after cutting through the blister. This is known as a “kiss” cut.
- Stainless steel striker plates 0.125 in. (3.2 mm) thick with an equivalent (or slightly softer) hardness than the die material are recommended.
- Heated steel-rule knives can often improve the quality of the cut.
- Dies should have steel backup plates with a thickness of 0.030 in. (0.80 mm).
- Backup plates should be made of metal with a Rockwell C hardness of 30 to 35.

Matched metal punches and dies should be properly maintained and have as close to zero tolerance as possible.

Eastman recommends following these tips to fully experience the benefits of easy thermoforming with Eastar™ copolyester 6763, Eastman Tritan™ copolyester MP100, and Eastman Eastalite™ copolyester MP007F on a consistent basis.

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