



Technical Report

Thermoforming Clear LEXAN® Sheet

Description

Clear LEXAN sheet is available in several grades designed for applications ranging from general purpose industrial to specialty sign grade and vending products. The products covered in this publication include: 9030; 9034; 9038; XL10; S100; SGC100; S100A; S300; SGC300; and V200.

Thermoforming

All LEXAN sheet products must be pre-dried before forming. Failure to dry the material will result in moisture bubbling, uneven expansion, loss of mold detail, and usually unattractive part surfaces.

Pre-Drying

Before loading the sheets into the drying oven, first remove the protective masking. For pre-drying, use a hot air circulating oven set to a temperature of 250°F±5°F. The oven should be vented to the outside to allow for efficient moisture removal. The sheets should be placed vertically in the oven and held suspended or placed in a vertical or horizontal rack that provide good air circulation and a minimum of 1" separation between the sheets. After the sheets have been dried for the prescribed times, they should be used within four hours to prevent the re-absorption of moisture. When automatic forming equipment is used the sheets should be allowed to cool to room temperature in order to maintain a uniform forming cycle.

Do not expose the sheet to prolonged drying times at this elevated temperature. Continuous exposure beyond 24-30 hours can reduce the physical performance of the LEXAN sheet and cause discoloration.

LEXAN Sheet Drying Times

Thickness	Time
.093	3.5 Hours
.118	4 Hours
.177	12 Hours
.236	24 Hours

Molds & Mold Design

Internally heated cast or machined aluminum molds have been successfully used and are suggested for long production runs and parts that require fine small areas of definition. Small production runs and prototype parts can be produced using wood, epoxy, silicone, etc., allowing for inexpensive tooling modifications if part changes are necessary.

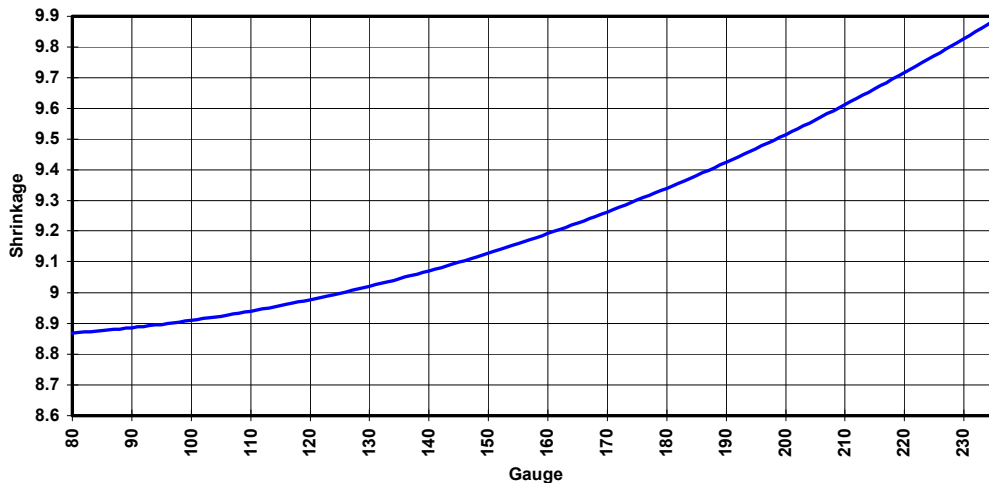
Shrinkage

Formed parts will contract in size as they cool to room temperature. This shrinkage is predictable and must be considered in the mold design. Recent studies have show that the mold shrinkage of clear LEXAN sheet will differ from gauge to gauge. You will experience larger amounts of shrinkage as the sheet thickness increases, i.e. .080" thick material will shrink less then .236" thick material. In order to provide you with the most accurate mold shrinkage numbers, select the gauge you will be using, and then select the shrinkage number that corresponds with that thickness. These mold shrinkage numbers were generated using a tightly controlled forming process and included the following conditions:

- A Both male and female molds
- B 250°F Mold Temperature
- C Removed the Parts as Soon as They Became Form Stable
- D Measured the Mold Dimension at Temperature (250°F)
- E Measured the Formed Part at Room Temperature, 24-Hours After Being Formed

LEXAN® Sheet

Mold Shrinkage Values



Mold Shrinkage Calculation

$$\text{Shrinkage} = \frac{\text{Mold Dimension @ Temperature} - \text{Part Dimension (After 24-Hours)}}{\text{Mold Dimension @ Mold Temperature}}$$

Draft

Draft angles of 5 to 7 degrees are recommended on all sides to facilitate part removal from male molds. Female molds require less draft (1 to 3 degrees). However, if you are molding in a texture, the mold will require additional draft. Approximately one degree per mil of texture depth is usually sufficient.

Corners/Radii

To maximize part strength and durability, sharp corners that concentrate molded-in stresses and inhibit production of uniform wall thickness should be avoided. All corners, edges, etc., should be smooth and round. As a general rule, the minimum radius on any mold corners should be equal or greater than the sheet starting thickness.

Surface Finish

Since the part detail is better on the side of the material that contacts the mold, female molds are used when exterior part details are required, and male molds should be used when the interior of the part requires detail. Male molds may also be preferred when the exterior surface details are minimal and the exterior polish or matte finish of the sheet needs to be preserved. Large flat mold surfaces should not be highly polished because they will restrict the flow of vacuum and can cause air entrapment. Slightly sand the mold surfaces with 600 grit paper to insure proper vacuum evacuation. Vacuum holes should be drilled in all areas that require detail. These vacuum evacuation holes should be kept as small as possible to minimize dimple formation of the finished part. Vacuum holes with diameters less than .030" should help minimize dimple mark-off. Back drilling with larger holes will produce a more rapid air evacuation and make drilling the small surface holes easier.

Forming Temperatures

The material forming temperature for LEXAN sheet ranges between 350°F and 400°F. Double or two-sided heating is recommended to maximize cycle efficiency and prevent overheating one-side of the sheet. As heat is applied to the sheet, it will begin to relax and sag. The amount of sag required to obtain good part definition depends on the depth and complexity of the mold. The optimum sag can be easily determined by forming a few parts at different sag distances.

Mold Temperatures

Thermally conductive molds should be internally heated between 250°F to 270°F. In addition, plug assist should also be heated to prevent chilling.

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