

THERMOFORMING KYDEX® SHEET

QUICK REFERENCE GUIDE

CHOOSING A MOLD

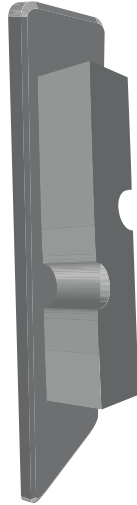
MALE MOLDS

Characteristics:

- Better detail inside the part
- Minimum Draft Angle: 2-4°
- Minimum Radius: 2.4mm (3/32")
- Mold Shrinkage: 0.4 - 0.6%
- Beware of webbing

Techniques for Thermoforming:

- Drape forming/vacuum
- Billow-snap back/vacuum
- Billow-snap back/vacuum/pressure



FEMALE MOLDS

Characteristics:

- Better detail outside the part
- Minimum Draft Angle: 1-2°
- Minimum Radius: 1.6mm (1/16")
- Mold Shrinkage: 0.5 - 0.7%
- Beware of excessive thinning in corners

Techniques for Thermoforming:

- Straight vacuum
- Drape forming/vacuum
- Plug assist/vacuum
- Billow-plug assist/vacuum



*The choice of male or female mold depends on many factors: Dimensional requirements, part finish, tooling costs, etc. Your results will vary depending on which technique is used.

PROCEDURES, TIMES & TEMPERATURES

DRYING KYDEX® SHEET (SEE CHART A)

KYDEX® sheet is not exceptionally hygroscopic and usually does not require pre-drying. However, when using old stock and/or thermoforming in high-humidity conditions, drying may be needed. Some grades are more hygroscopic than others. Contact your KYDEX® sheet sales representative for more information.

HEATING KYDEX® SHEET (SEE CHART B)

- Two-sided (sandwich heaters) are required for 2mm (0.080") and greater sheet thicknesses.
- Heating times, (dwell times,) will vary depending on the heat source, oven conditions, oven dimensions and the age of the oven.

NOTE: if the part looks shiny, the surface is being over-heated. Cut back on the percentage timers (or heat) and increase the heating time to improve definition.

- Recommended heater settings: 30-50% Top, 50-70% Bottom.
- Optimum forming temperature range is 165-204°C (330-400°F) depending on thickness. Do not exceed 204°C (400°F) surface temperature

COOLING KYDEX® SHEET

- The part must be cooled below 66°C (150°F) for the part to be dimensionally stable with no warpage upon removal.
- Fans should be used to facilitate cooling.

RECOMMENDED DRYING TIMES @ 68°C (155°F) in an air-circulating oven:	
Sheet Thickness	Minimum Time (hrs)
2.0mm (0.080")	10
3.2mm (0.125")	16
6.4mm (0.250")	24

FORMING TEMPERATURE GUIDELINES		
Sheet Thickness Range	Approx. Dwell Time (sec)	Forming Temperature Range
0.7mm (0.028")- 2mm (0.080")	15-80	165-177°C 330-350°F
2mm (0.080")- 3.2mm (0.125")	70-170	177-196°C 350-385°F
3.2mm + (0.125") +	110 +	196-204°C 385-400°F

Times and temperatures shown are approximate and should be used as guidelines only. A rough rule-of-thumb is one second per millimeter of sheet thickness.



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RELY ON SHEET APPEARANCE DURING HEATING

As KYDEX® sheet is heated, the stress inherent in the sheet will relax. This sequence is generally the same for all extruded thermoplastics; only the oven temperatures and times will vary. There are 4 "stages" to observe in the forming process.

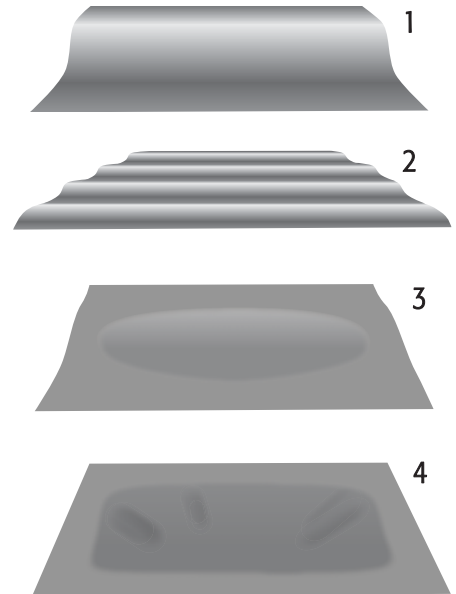
Stage 1 is marked by wide undulations as the material is beginning to soften in the oven.

Stage 2 the material will start to form ripples in the sheet - particularly along the edges where it is clamped in the tenter frame

Stage 3 the material will start to smooth out and sag. KYDEX® sheet will generally sag less than other plastics due to its higher melt strength.

Stage 4 the ripples will have disappeared and the sheet will be smooth and sagging slightly. This indicates that most stresses in the material have been removed and that the core of the sheet has reached thermoforming temperature. At this point, the sheet is ready to form.

If you cannot achieve stage 4 before the material blisters and/or becomes shiny, IT IS BEING HEATED TOO QUICKLY. Cut down the heat in the oven and increase cycle time.



TROUBLESHOOTING GUIDE

NOTE: Most often the problem is one of trying to heat KYDEX® sheet too quickly. See reverse side for heating times and see above for how the sheet should look during forming.

PROBLEM	PROBABLE CAUSE	PROBABLE SOLUTION
POOR PART DEFINITION	<ul style="list-style-type: none"> - Heating too quickly - not getting core of sheet to proper forming temp - Uneven heating of sheet - Insufficient heating - Poor or insufficient vacuum 	<ul style="list-style-type: none"> - Cut back on heat and increase heating time to compensate if needed. - Replace old or worn heaters - use screening if necessary to even-out heat distribution. - Increase heating time . - Check vacuum lines. Increase vacuum holes. Check seals.
GLOSSY OR SHINY SPOTS	<ul style="list-style-type: none"> - Heating too quickly or over-heating - Uneven heating of sheet 	<ul style="list-style-type: none"> - Cut back on heat and increase heating time to compensate if needed, - Replace old or worn heaters - use screening if necessary to even-out heat distribution.
WARPAGE IN PART	<ul style="list-style-type: none"> - Removing part too soon - Sheet core too cold during forming 	<ul style="list-style-type: none"> - Increase cooling time on mold or use cooling fixture. - Cut back on heat and increase heating time to compensate if needed.
EXCESSIVE WALL THINNING	<ul style="list-style-type: none"> - Sheet too cold during forming - Sheet gauge too thin - Improper forming method 	<ul style="list-style-type: none"> - Increase heating time. - Increase sheet gauge - Try Billow-snap back (male) or billow-plug assist (female).

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