

## Troubleshooting Thermoforming Problems

For information applicable to KYDEX® FST please refer to 300 series technical briefs.

### TB - 140-E

#### Introduction

The most common problem in thermoforming KYDEX® thermoplastic sheet is one of trying to heat KYDEX® sheet too quickly. See the chart below for recommended heating times when sandwich heaters are used. If a problem still exists, review the troubleshooting section of this brief.

#### Approximate Heating Times

Sheet Thickness	Time (Seconds)
1.00mm (0.040")	15-35
1.50mm (0.060")	50-70
2.00mm (0.080")	65-85
2.40mm (0.093")	80-100
3.20mm (0.125")	100-130
4.70mm (0.187")	180-200
6.40mm (0.250")	240-285

#### Troubleshooting

Problems	Causes	Remedies
<b>Blister or Bubbles</b>	<b>Heating too Quickly</b>	<ol style="list-style-type: none"> <li>1) Lower heater(s) temperatures</li> <li>2) Use slower heating</li> <li>3) Increase distance between heaters and sheet.</li> </ol>
	<b>Excessive Moisture</b>	<ol style="list-style-type: none"> <li>1) Pre-dry material.</li> <li>2) Heat material from both sides.</li> <li>3) Lower heater temperatures (more soak time).</li> </ol>
	<b>Uneven Heating</b>	<ol style="list-style-type: none"> <li>1) Hot spots (install screening to deflect heat from overheated areas).</li> <li>2) Check heaters for proper operation.</li> <li>3) Adjust heater zones to balance sheet surface temperature.</li> </ol>
<b>Poor Detail in Formed Part</b>	<b>Sheet too Cold</b>	<ol style="list-style-type: none"> <li>1) Increase dwell time to heat sheet longer.</li> <li>2) Increase temperature of heaters.</li> <li>3) Check heaters for proper operation.</li> <li>4) Pre-heat clamping frame (cold frame can draw heat from sheet).</li> <li>5) Check for air drafts across sheet ( open doors, fans, etc.).</li> </ol>
	<b>Insufficient Vacuum</b>	<ol style="list-style-type: none"> <li>1) Check vacuum holes for blockages.</li> <li>2) Increase the number of vacuum holes.</li> <li>3) Increase size of vacuum holes.</li> <li>4) Check for vacuum leaks.</li> </ol>

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Poor Detail in Formed Part	Vacuum not drawing Fast Enough	<ol style="list-style-type: none"> <li>1) Check the vacuum gauge for minimum of in. /Hg pressure.</li> <li>2) Check for vacuum leaks.</li> <li>3) Use slots instead of vacuum holes.</li> <li>4) Increase the size of the vacuum surge tank or vacuum capacity.</li> <li>5) Check vacuum hose for leaks or collapse.</li> </ol>
Poor Detail in Formed Part (when pressure forming)	Improper pressure	<ol style="list-style-type: none"> <li>1) Use 20 - 50 psi (.137 - .345 Mpa) air pressure.</li> </ol>
Sheet Scorched	Surface of the Sheet too Hot	<ol style="list-style-type: none"> <li>1) Reduce heating cycle (dwell time).</li> <li>2) Lower heater temperature (more soak time).</li> </ol>
Blushing or Discoloration	Excessive Heat	<ol style="list-style-type: none"> <li>1) Reduce cycle time (poor detail may occur due to material being too cold).</li> <li>2) Reduce heater temperatures (increasing dwell time may be required).</li> <li>3) If problems exist in one area only, check heaters.</li> </ol>
Whitening of Part in Corners	Sheet too Cold	<ol style="list-style-type: none"> <li>1) Increase the dwell time.</li> <li>2) Reduce platen time delay.</li> <li>3) reduce vacuum delay.</li> </ol>
Webbing, Bridging or Wrinkling	Sheet too Hot	<ol style="list-style-type: none"> <li>1) Reduce heating time.</li> <li>2) Lower heater temperatures.</li> </ol>
	Insufficient Vacuum	<ol style="list-style-type: none"> <li>1) Check mold for proper vacuum.</li> <li>2) Check vacuum lines for restrictions.</li> </ol>
	Excessive Draw Ratio or Poor Mold Design	<ol style="list-style-type: none"> <li>1) Redesign mold.</li> <li>2) Increase the draft and radii of the mold design.</li> <li>3) Use a plug assist.</li> <li>4) Add take-up blocks (web catchers) to pull material away from the corners.</li> <li>5) Use recessed pockets (web moats) in web areas.</li> <li>6) If tooling is multiple mold design, increase the distance between molds.</li> </ol>

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Problems	Causes	Remedies
Nipples on Mold Side of Formed Part	Sheet too Hot	<ol style="list-style-type: none"> <li>1) Reduce dwell time.</li> <li>2) Reduce heater temperatures.</li> </ol>
	Vacuum Holes	<ol style="list-style-type: none"> <li>1) Plug vacuum holes and re-drill with smaller bit.</li> </ol>
Excessive Sag After Heating	Sheet too Hot	<ol style="list-style-type: none"> <li>1) Reduce dwell time.</li> <li>2) Reduce heater temperatures.</li> <li>3) Balance sheet surface temperature (increase the perimeter heat and lower center heat).</li> </ol>
Chill Marks or "Mark-Off Lines"	Mold Temperature too Cold	<ol style="list-style-type: none"> <li>1) Increase the mold temperature (do not exceed 165°C) if the mold is water cooled. If the mold is not temperature controlled, pre-heat the mold with a torch.</li> <li>2) Increase the pre-stretch to allow the mold to come in contact with the material later.</li> </ol>
	Plug Assist Cold	<ol style="list-style-type: none"> <li>1) Use a syntactic foam plug assist.</li> <li>2) Cover plug assist with flannel or felt.</li> </ol>
	Sheet too Hot	<ol style="list-style-type: none"> <li>1) Reduce dwell time.</li> <li>2) Reduce heater temperatures.</li> </ol>
Surface imperfections	Pock Marks on Smooth Mold Surface	<ol style="list-style-type: none"> <li>1) Air entrapment (sand blast mold texture with #30 shot grit).</li> </ol>
	Dirt on Sheet or Mold	<ol style="list-style-type: none"> <li>1) Clean sheet and/or mold surface prior to forming.</li> </ol>
Shiny Streaks or Spots	Sheet Overheated in Areas	<ol style="list-style-type: none"> <li>1) Adjust heaters in affected areas.</li> <li>2) Hot spots (screen areas to deflect heat, if unable to do with zoning).</li> </ol>
Distortion in Part after Removing Part from the Mold	Removing Part From Mold too Soon	<ol style="list-style-type: none"> <li>1) Increasing the cooling cycle.</li> <li>2) Use temperature controlled mold.</li> <li>3) Use fans or water mist.</li> </ol>
	Uneven Cooling	<ol style="list-style-type: none"> <li>1) Cool part evenly by adding additional water coolings to mold and/or add fans.</li> <li>2) Poor Material distribution (improve pre-stretch or plug assist).</li> </ol>
	Mold Temperature	<ol style="list-style-type: none"> <li>1) Lower mold temperature 10° below HDT of material.</li> </ol>

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Poor Wall Thickness Distribution	Improper Sag	<ol style="list-style-type: none"> <li>1) Heat sheet uniformly to allow material to flow properly.</li> <li>2) Mount mold on top platen.</li> <li>3) Use Billow Vacuum Snap-Back method.</li> <li>4) Use plug assist.</li> </ol>
	Hot or Cold Spots in Sheet	<ol style="list-style-type: none"> <li>1) Balance sheet heating.</li> <li>2) Check heaters for proper operation.</li> <li>3) Avoid air flow and drafts across sheet.</li> </ol>
	Mold Too Cold	<ol style="list-style-type: none"> <li>1) Increase mold temperature 10° below HDT of material.</li> </ol>
Shrink Marks in Corners	Poor Vacuum	<ol style="list-style-type: none"> <li>1) Check for vacuum leaks.</li> <li>2) Check vacuum holes for blockages.</li> <li>3) Add vacuum holes.</li> <li>4) Increase the vacuum time to hold material tight to mold until material is cooled below HDT.</li> </ol>
Thin Corners when Forming over a Female Tool	Improper Forming Techniques	<ol style="list-style-type: none"> <li>1) Use a Billow Forming technique. This will help by pre-stretching the sheet before forming.</li> <li>2) Use a plug assist.</li> </ol>
	Variation in Sheet Temperature	<ol style="list-style-type: none"> <li>1) Adjust the heating temperatures so the sheet is heated evenly.</li> <li>2) Increase the perimeter (outer) heaters approximately 10% higher than the center.</li> </ol>
Part Sticking to Mold	Mold Design	<ol style="list-style-type: none"> <li>1) Increase the draft angle of the mold.</li> <li>2) Sand blast the mold with #30 grit to roughen the surface of the mold.</li> <li>3) Use breakaway mold for undercuts.</li> <li>4) Increase the air ejection pressure.</li> <li>5) Use a mold release agent (silicone, talc, etc.)</li> </ol>
Tearing of the Sheet When Forming	Mold Design	<ol style="list-style-type: none"> <li>1) Increase the radius in the corners.</li> </ol>
	Sheet too Cold	<ol style="list-style-type: none"> <li>1) Increase heating cycle and temperatures.</li> <li>2) Balance temperature across sheet.</li> </ol>
	Vacuum Too Rapid	<ol style="list-style-type: none"> <li>1) Reduce the rate (speed) of the vacuum being pulled.</li> </ol>

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