

Thermoforming Trouble Shooting Guide

Thermoforming Troubleshooting Guide*

Contents

1. Blister or bubbles
2. Incomplete forming, poor detail
3. Sheet scorched
4. Blushing or change in color intensity
5. Whitening of sheet
6. Webbing, bridging or wrinkling
7. Nipples on mold side of formed part
8. Too much sag
9. Sag variation between sheet blanks
10. Chill marks or "Mark-Off" lines on part
11. Bad surface markings
12. Shiny streaks on part
13. Excessive post shrinkage or distortion of part after removing from mold
14. Part warpage
15. Poor wall thickness distribution and excessive thinning in some areas
16. Non-uniform pre-stretch bubble
17. Shrink marks on part, especially in corner areas (inside radius of molds)
18. Too thin corners in deep draws
19. Part sticking to mold
20. Sheet sticking to plug assist
21. Tearing of part when forming
22. Cracking in corners during service

*Adapted from "Plastics Engineering Handbook" of the Society of the Plastics Industry, Inc.

Thermoforming Trouble Shooting Guide

1. Blisters or Bubbles

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| A. Excess Moisture | <ol style="list-style-type: none">1. Predry2. Preheat3. Heat from both sides4. Do not remove material from moisture-proof wrap until ready to use |
| B. Heating too rapidly | <ol style="list-style-type: none">1. Lower heat temperature2. Use slower heating3. Increase distance between heater(s) and sheet |
| C. Uneven heating | <ol style="list-style-type: none">1. Screen by attaching baffles, masks or screen2. Check for heaters or screens out |

2. Incomplete Forming, Poor Detail

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| A. Sheet too cold | <ol style="list-style-type: none">1. Heat sheet longer2. Raise temperature of heaters3. Use more heaters4. If problem occurs repeatedly in same area check for lack of uniformity of heat |
| B. Clamping frame not hot before inserting sheet | <ol style="list-style-type: none">1. Preheat clamping frame before inserting sheet. |
| C. Insufficient vacuum | <ol style="list-style-type: none">1. Check vacuum holes for clogging2. Increase number of vacuum holes3. Increase size of vacuum holes |
| D. Vacuum not drawn fast enough | <ol style="list-style-type: none">1. Use vacuum slots instead of holes where possible2. Add vacuum surge and/or pump capacity3. Enlarge vacuum line and valves avoiding sharp bends at tee and elbow connections4. Check for vacuum leaks5. Check vacuum system |
| E. Additional pressure needed | <ol style="list-style-type: none">1. Use 20-30 psi air pressure on part opposite mold surface if mold will withstand this pressure2. Use frame assist3. Use plug, silicone slab rubber, or other pressure assist |

Thermoforming Trouble Shooting Guide

3. Sheet Scorched

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| A. Outer surface of sheet too hot | 1. Shorten heat cycle
2. Use slower, soaking heat |
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4. Blushing or Change in Color Intensity

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|--------------------------------------|---|
| A. Insufficient heating | 1. Lengthen heating cycle
2. Raise temperature of heaters |
| B. Excess heating | 1. Reduce heater temperature
2. Shorten heater cycle
3. If in same spot on sheet, check heaters |
| C. Mold is too cold | 1. Warm mold |
| D. Assist too cold | 1. Warm plug assist |
| E. Sheet being stretched too far | 1. Use heavier gauge sheet |
| F. Sheet cools before part is formed | 1. Move mold into sheet faster
2. Increase rate of vacuum withdrawal
3. Be sure molds and plugs are hot |
| G. Poor mold design | 1. Reduce depth of draw
2. Increase draft (taper) of mold
3. Enlarge radii |

5. Whitening of Sheet

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| A. Cold sheet stretching beyond its temperature yield point | 1. Increase heat of sheets; increase speed of vacuum and drape |
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6. Webbing, Bridging or Wrinkling

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| A. Sheet too hot causing too much materials in forming area | 1. Shorten heating forming area
2. Increase heater distance
3. Lower heater temperature |
| B. Melt strength of resin too low (sheet sag too great) | 1. Use minimum sheet temperature possible |
| C. Too much or too little sheet | 1. Have sheet supplier reduce or increase |

Thermoforming Trouble Shooting Guide

orientation	orientation
D. Insufficient vacuum	<ol style="list-style-type: none">1. Check vacuum system2. Add more vacuum holes or slots
E. Extrusion direction of sheet parallel to space between molds	<ol style="list-style-type: none">1. Move sheet 90° in relation to space between molds.
F. Draw ratio too great in area of mold or poor mold design or layout	<ol style="list-style-type: none">1. Redesign mold2. Use plug or ring mechanical assist3. Use female mold instead of male4. Add take-up blocks to pull out wrinkles5. Increase draft and radii where possible6. If more than one article being formed, move them farther apart7. Speed assist and or mold travel8. Redesign grid, plug or ring assists

7. Nipples on Mold Side of Formed Part

A. Sheet too hot	<ol style="list-style-type: none">1. Reduce heating cycle2. Reduce heater temperature
B. Vacuum holes too large	<ol style="list-style-type: none">1. Plug holes and redrill with smaller bit

8. Too Much Sag

A. Sheet too hot	<ol style="list-style-type: none">1. Reduce heating cycle2. Reduce heater temperature
B. Sheet area too large giving	<ol style="list-style-type: none">1. Use screening or other means of shading or preferential heat to sheet, thus reducing relative temperature of center of sheet

9. Sag Variation Between Sheet Blanks

A. Variation in sheet temperature screens	<ol style="list-style-type: none">1. Check for air drafts through oven using solid around heater section to eliminate
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Thermoforming Trouble Shooting Guide

10. Chill Marks or “Marks-Off” Lines

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| A. Plug assist temperature too low | <ol style="list-style-type: none">1. Increase plug assist temperature2. Use wood plug assist3. Cover plug with cotton flannel or felt |
| B. Mold temperature too low | <ol style="list-style-type: none">1. Increase mold temperature, not exceeding “set temperature”2. Relieve molds in critical areas. |
| - stretching stops when sheet meets | |
| - cold mold (or plug) | |
| D. Inadequate mold temperature control | <ol style="list-style-type: none">1. Increase number of water cooling tubes or channels2. Checked for plugged water flow |
| D. Sheet too hot | <ol style="list-style-type: none">1. Reduce heat2. Heat more slowly3. Slightly chill surface of hot sheet with forced air before forming |

11. Bad Surface Markings

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| A. Pock marks due to air entrapment over smooth mold surface | <ol style="list-style-type: none">1. Grit blast mold surface |
| B. Poor vacuum | <ol style="list-style-type: none">1. Add vacuum holes2. If pock marks are in isolated area, add vacuum holes to this area or check from plugged vacuum holes |
| C. Mold is too hot | <ol style="list-style-type: none">1. Reduce mold temperature |
| D. Mold is too cold | <ol style="list-style-type: none">1. Increase mold temperature |
| E. Improper mold composition | <ol style="list-style-type: none">1. Avoid phenolic molds with clear transparent sheet2. Use aluminum molds where possible |
| F. Mold surface too rough | <ol style="list-style-type: none">1. Smooth surface2. Change mold material |
| G. Dirt on sheet | <ol style="list-style-type: none">1. Clean sheet |
| H. Dirt on mold | <ol style="list-style-type: none">1. Clean mold |

Thermoforming Trouble Shooting Guide

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| I. Dust in atmosphere necessary | 1. Clean thermoforming area; isolate area if and supply filtered air |
| J. Contaminated sheet materials | 1. If regrind is used to be sure to keep clean and different materials stored separately
2. Check supplier of sheet |
| K. Scratched sheet | 1. Separate sheets with paper in storage
2. Polish sheet |

12. Shiny Streaks on Part

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| A. Sheet overheated in this area | 1. Lower heater temperature in scorched area
2. Shield heater with screen wire to reduce overheating
3. Slow heating cycle
4. Increase heater to sheet distance |
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13. Excessive Shrinkage of Distortion of Part after Removing from Mold

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| A. Removed part from mold too soon | 1. Increase cooling cycle
2. Use cooling fixture
3. Use fan or vapor spray mist to cool part faster on mold |
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14. Part Warpage

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|-----------------------------------|--|
| A. Uneven part cooling | 1. Add more water channels or tubing to mold
2. Check for plugged water flow |
| B. Poor wall distribution in part | 1. Improve pre-stretching or plugging techniques
2. Use plug assist
3. Check for non-uniformity of sheet heating
4. Check sheet gauge |
| C. Poor mold design | 1. Add vacuum holes
2. Add moat to mold at trim line
3. Check for plugged vacuum holes |
| D. Poor part design practical | 1. Break up large flat surfaces with ribs where |

Thermoforming Trouble Shooting Guide

E. Mold temperature too low

1. Raise mold temperature to just below "set-temperature" of sheet material

15. Poor Wall Thickness Distribution and Excessive Thinning in Some Areas

A. Improper sheet sag

1. Use different forming technique such as mounting mold on top platen
2. Use vacuum snap-back technique
3. Use reverse vacuum snap-back technique
4. Use reverse vacuum snap back
5. Use billow-up plus assist or vacuum snap-back
6. Try more orientation in sheet

B. Variations in sheet gauge

1. Consult supplier regarding his commercial Tolerances and improve quality of sheet

C. Hot or cold spots in sheet

1. Improve heating technique to achieve uniform Heat distribution; screen or shade if necessary
2. Check to see if all heating elements are functioning

E. Stray drafts and air current around machine

1. Enclose heating and forming areas

E. Too much sag center

1. Use screening or other temperature control of areas of heater banks
2. Use more orientation in sheet

F. Mold too cold

1. Provide uniform heating of mold to bring to proper temperature
2. Check temperature control system for scale or plugging

G. Sheet slipping out of frame pressure

1. Adjust clamping frame to provide uniform
2. Check for variation in sheet gauge
3. Heat frames to proper temperature before inserting sheet
4. Check for non-uniformity of heat giving cold areas around clamp frame.

Thermoforming Trouble Shooting Guide

16. Non-Uniform Pre-Stretched Bubble

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| A. Uneven sheet gauge | 1. Consult sheet supplier
2. Heat sheet slowly in a "soak" type heat |
| B. Uneven heating of sheet | 1. Check heater section for heaters out
2. Check heater section for missing screens
3. Screen heater section as necessary |
| C. Stray air drafts | 1. Enclose or otherwise shield or screen machine |
| D. Non-uniform air blow | 1. Baffle air inlet in pre-stretch box |

17. Shrink Marks on Part, Especially in Corner Areas (inside radius of molds)

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|----------------------------|--|
| A. Inadequate vacuum | 1. Check for vacuum leaks
2. Add vacuum surge and/or pump capacity
3. Check for plugged vacuum holes
4. Add vacuum holes |
| B. Mold surface too smooth | 1. Grit blast mold surface |
| C. Part shrinking away | 1. May be impossible to eliminate on thick sheet with vacuum only; use 20-30 psi pressure on part opposite mold surface if mold will withstand this pressure |

18. Too Thin Corners in Deep Draws

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| A. Improper forming technique | 1. Check other techniques such as billow up plug assist etc. |
| B. Sheet too thin | 1. Use heavier gauge |
| C. Variation in sheet temperature | 1. Adjust heating as needed by adding screens to portion of sheet going into corners
2. Cross hatch sheet with marking prior to forming so movement of material can be accurately checked |
| D. Variation in mold temperature | 1. Adjust temperature control system for uniformity |

Thermoforming Trouble Shooting Guide

19. Part Sticking to Mold

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| A. Part temperature too high | <ol style="list-style-type: none">1. Increase cooling cycle2. Slightly lower mold temperature, not much less than recommended by resin manufacturer |
| B. Not enough draft in mold | <ol style="list-style-type: none">1. Increase taper2. Use female mold3. Remove part from mold as early as possible if above "set temperature," use cooling jigs |
| C. Mold Undercuts | <ol style="list-style-type: none">1. Use stripping frame.2. Increase air-eject air pressure3. Remove part from mold as early as possible if above "set temperature," use cooling jigs |
| D. Wooden mold | <ol style="list-style-type: none">1. Grease with vasoline2. Use Teflon spray |
| E. Rough mold surface | <ol style="list-style-type: none">1. Polish corners or all of mold2. Use mold release3. Use Teflon spray |

20. Sheet Sticking to Plug Assist

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| A. Improper metal plug assist temperature | <ol style="list-style-type: none">1. Reduce plug temperature2. Use mold release3. Teflon coat4. Cover plug with felt cloth or cotton flannel |
| B. Wooden plug assist | <ol style="list-style-type: none">1. Cover plug with felt cloth or cotton flannel2. Grease with vasoline3. Use mold release compound4. Use Teflon spray |

21. Tearing from Sheet When Forming

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| A. Mold design | <ol style="list-style-type: none">1. Increase radius of corner |
| B. Sheet too hot | <ol style="list-style-type: none">1. Decrease heating time or temperature2. Check for uniform heat3. Preheat sheet |

Thermoforming Trouble Shooting Guide

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| B. Sheet too cold (usually thinner gauge) | <ol style="list-style-type: none">1. Increase heating time or temperature2. Check for uniform heat3. Preheat sheet |
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22. Cracking in Corners During Service

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| A. Stress concentration | <ol style="list-style-type: none">1. Increase fillets2. In transparencies check with polarized light3. Increase temperature of sheet4. Be sure part is completely formed before some sections are too cool for proper forming thus setting up undue stresses in these areas |
| B. "Under-designed" | <ol style="list-style-type: none">1. Re-evaluate design. |