

2021 ARM Workshop

Determining Processing Envelope for New Products or Resins

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Outline

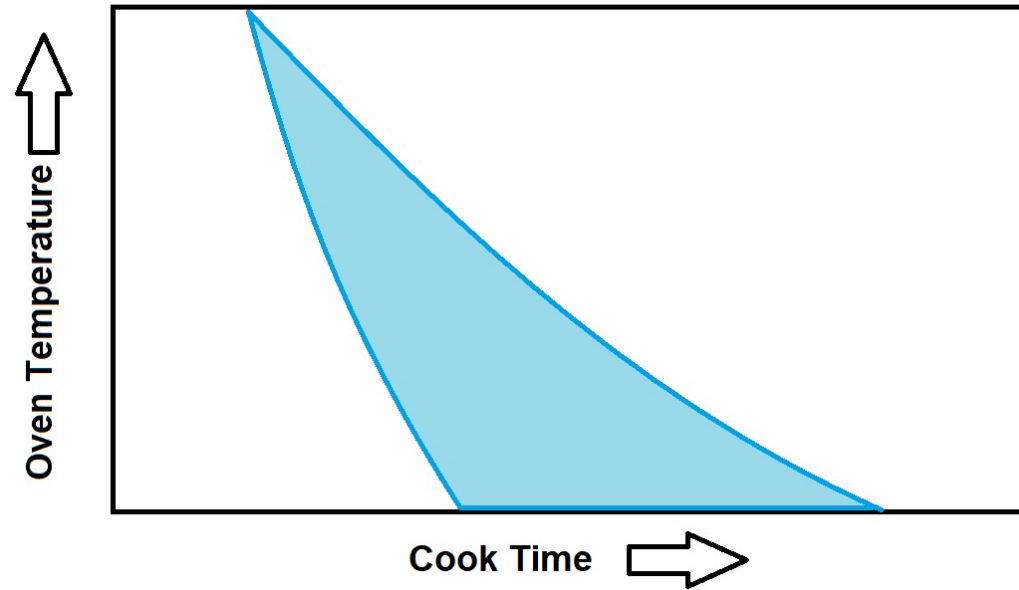
1. Determining Process Temperature
2. Evaluating the Cure
3. Determine Processing Window
4. Cooling Options
5. Setting SOPs





1. Determining Processing Temperatures

Roto Processing Envelope 'Fin' Diagram (typ.)



NEED FOR SPEED

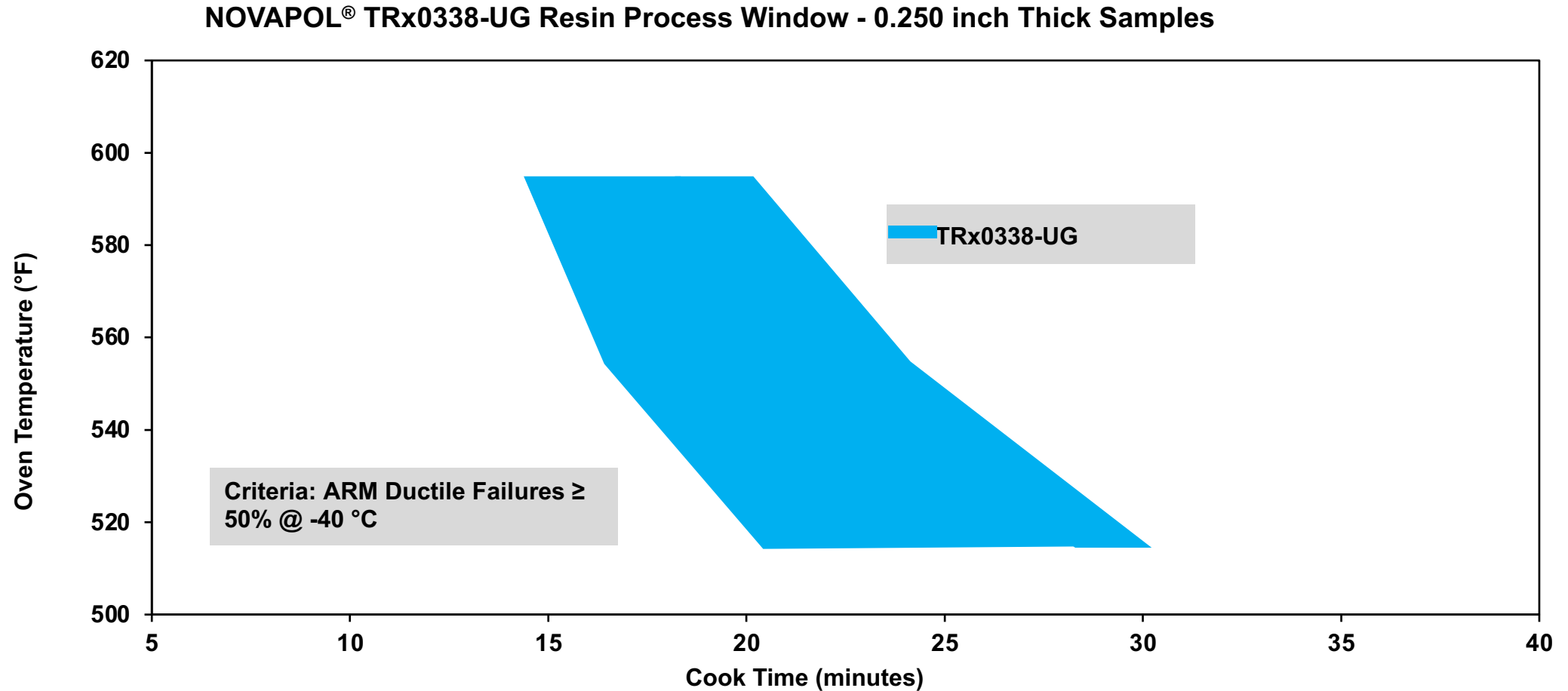
Higher Temps
Narrower Windows
Single Parts

QUEST FOR QUALITY

Lower Temps
Broader Windows
Multi Sized Parts



1a. Actual fin diagram example





2. Evaluating the Cure

- Color - yellowing (darkening) = **over cure**
- Odor (burnt wax smell) = **over cure**
- Inside surface roughness = **under cure**
- Glossiness (shiny) = **over cure** (linear resins)
- Side wall bubbles = generally (not always) **under cure**
- Cold impact $\geq 60\%$ of max
- Cold ductility $\geq 50\%$ of samples tested

Per Carmine's presentation, be aware that over/ under cure conditions can impact properties such as stiffness, ESCR, UV resistance, etc.



3. Determining the Processing Window

- I. Define an acceptable part
- II. Determine oven temp (s)
- III. Start at obvious under cure time
- IV. Run same part, increasing time in regular increments 'til obvious overcure
- V. Test per acceptable part definition
- VI. Record minimum and maximum cure times for acceptable cures
- VII. Correlate and record appearance of 'good' parts for operators



3a. Resin Trial Document (typical)

Trial Sequence:

Day 1:

Machine: _____

Arm 1 part: _____

Part Label	Color	Part Weight (lbs)	Resin	Oven Temperature (°C)	Oven Time (min)	Comments/Observations (during trial):
A	NAT	15	TR-0535-U	600 F	10	Under cure, powder on surface
B					11	Extensive bubbles
C					12	Few bubbles
D					13	Bubble free, smooth
E					14	Bubble free, smooth
F					15	Bubble free, smooth
G					16	Yellow, glossy inside
H						

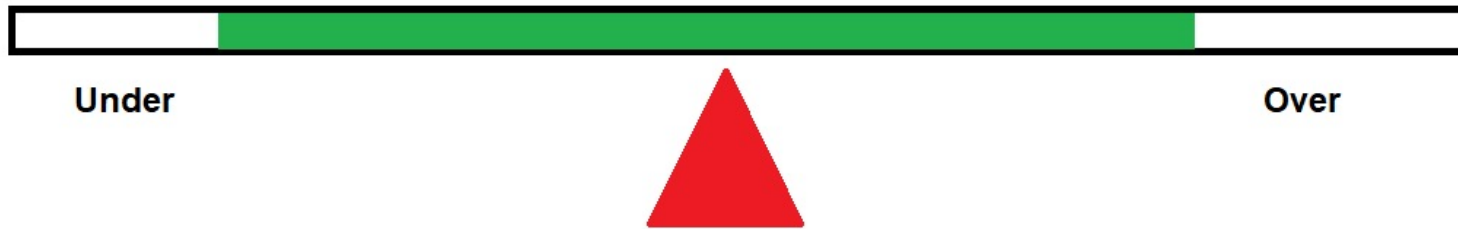


4. Cooling Options

- Fan Only:
 - Long, gentle, minimal warping
 - Oven time x 1.5
- Fan + Deluge:
 - Most aggressive, can promote warping, can be hard on molds, requires drainage
 - Oven Time x 1
- Fan + Mist:
 - Throttleable, minimal drainage, can minimize warping
 - Oven time x 1.2
- Internal Cooling:
 - Best all around, if you can do it
 - Oven Time x ???



5. Setting SOP's

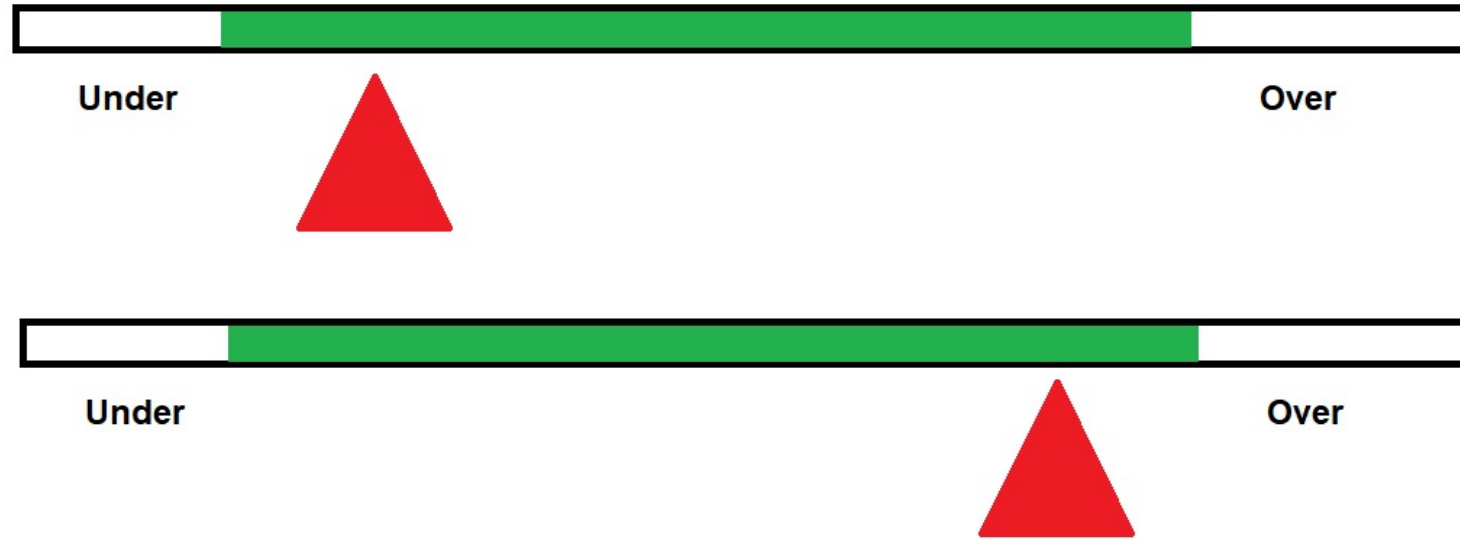


Case 1: Dead Center of Window

- Forgiving
 - i. Resin variability
 - ii. Process variability
 - iii. Operator variability
 - iv. Environmental variability
- Maximum Quality
- Minimum Scrap



5. Setting SOP's (cont.)



Case 2: Offset Window

- May be needed on a loaded arm
- Can be challenging to quality
- Maximizes production
- Set, Monitor scrap rate, Adjust



6. Summary

- Proper determination of standard processing conditions requires forethought and some experimentation.
- Selecting conditions and materials (resins) with the broadest possible operating window have significant impacts on product quality, scrap rates and your bottom line.
- In the case of multiple molds, balancing speed with quality requires careful knowledge of the material's processing window and the effects of temperature on that window.
- Your resin supplier can help with strategies to determine and optimize processing window for your particular applications.



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