# 2021 ARM Workshop
# Determining Processing Envelope for New Products or Resins

**Henry Hay and Carmine D'Agostino**

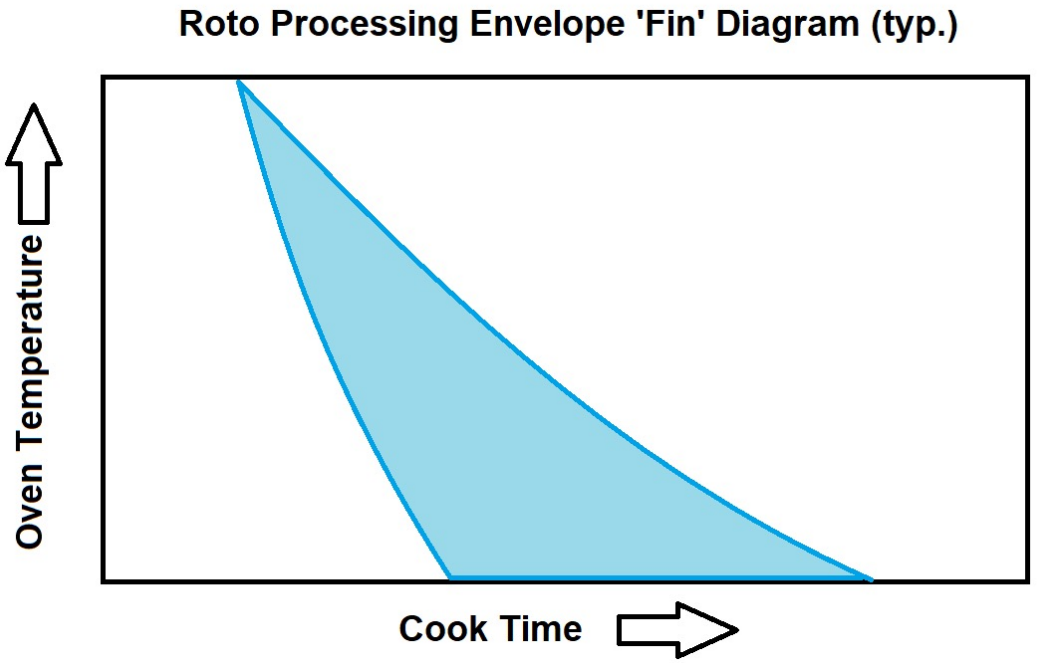
Sept 2021, Chicago IL

NOVA Chemicals®

# Outline

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

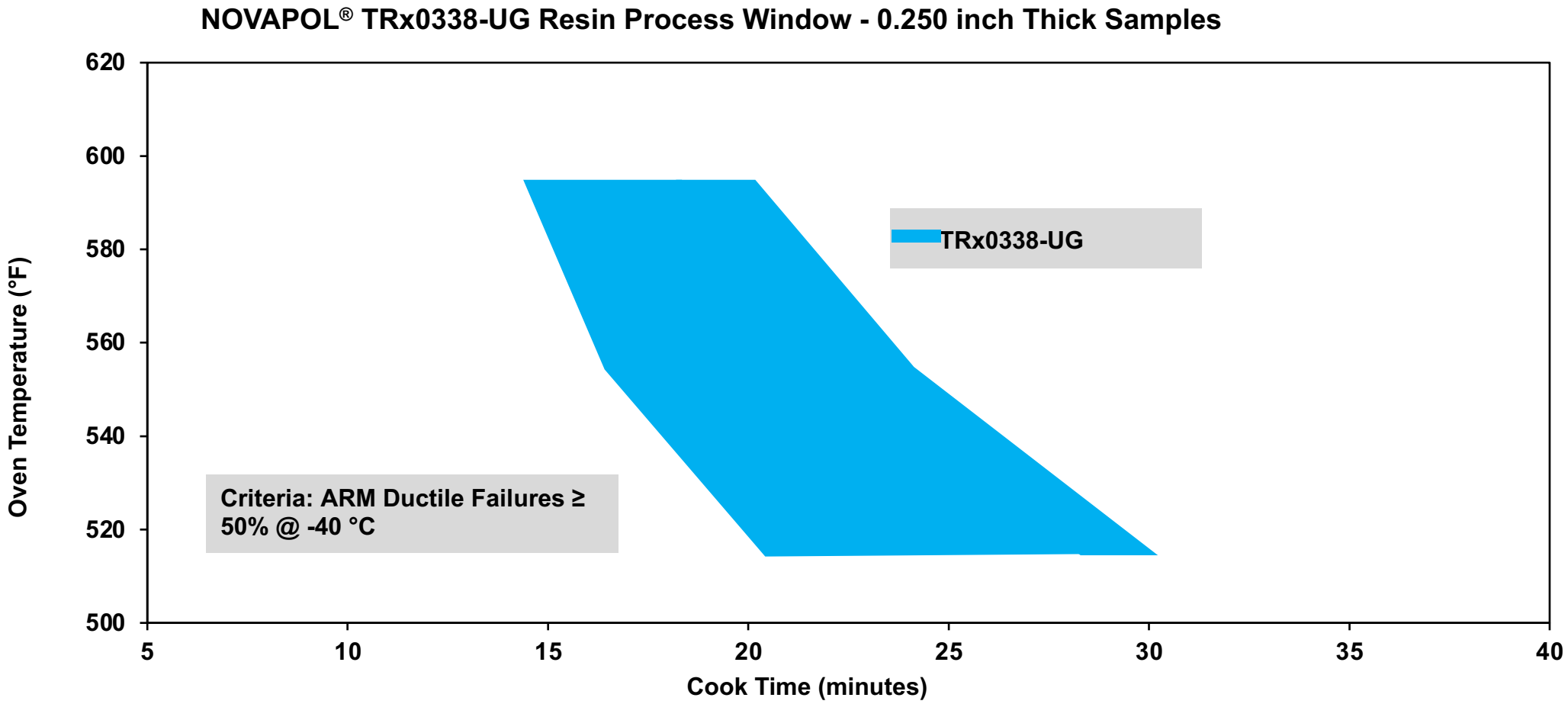
# 1. Determining Processing Temperatures




**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 ≥ 60% of max
- Cold ductility ≥ 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:**

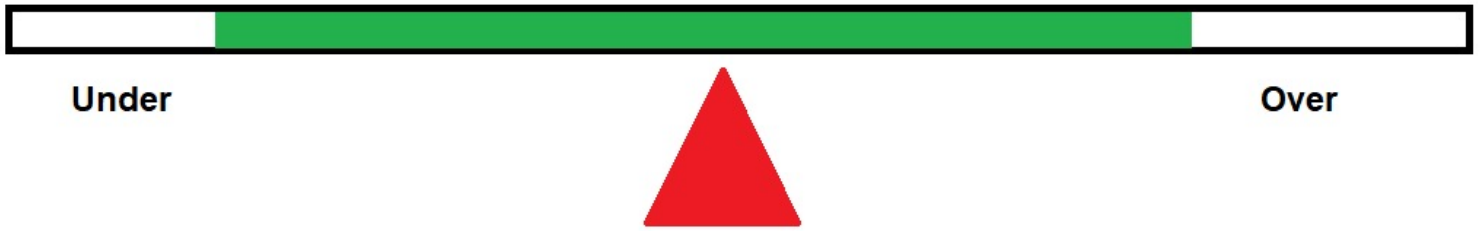
**Machine: _____**
**Arm 1 part: _____**

| Part Label | Color | Part Weight (lbs) | Resin | Oven Temperature (ºC) | 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 ???

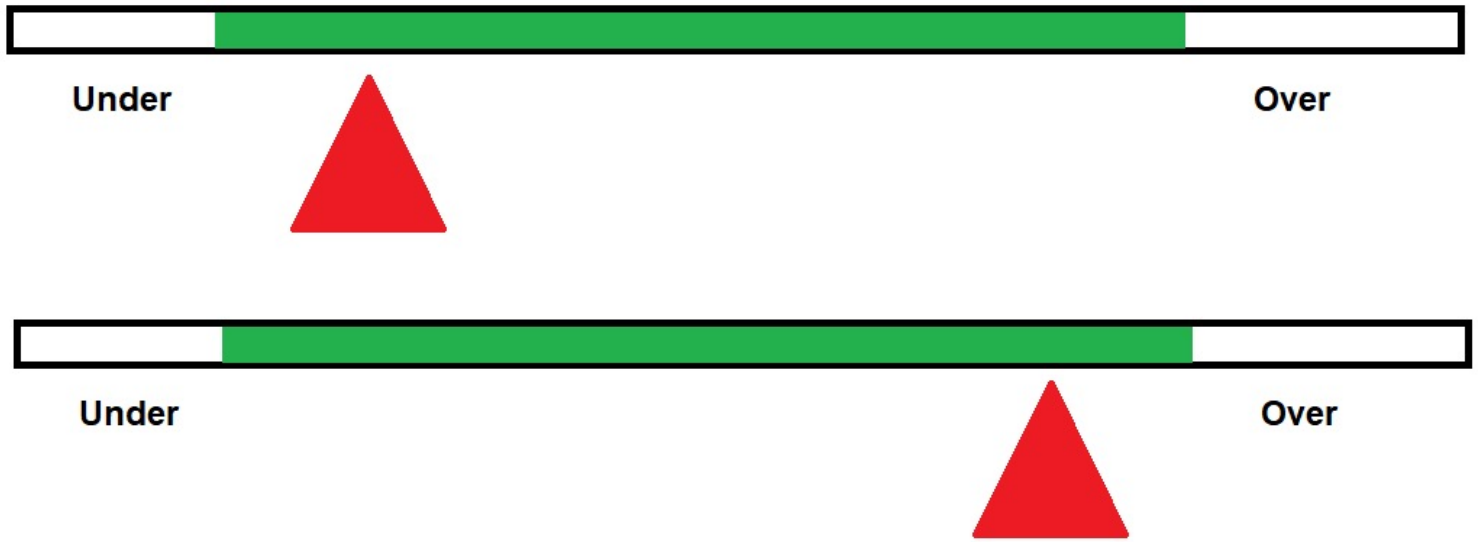
# 5. Setting SOP's




## 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.

NOVA Chemicals®

**novachemicals.com**

Responsible Care®
Our commitment to sustainability.