# Rotomoldable Acetal With Low Fuel Permeation and High Impact

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Celanese

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# Celanese Corporation

is a global specialty materials leader in the production of differentiated chemistry solutions and specialty materials used in most major industries and consumer applications.

Based in
**Dallas, Texas USA**

Global network of
**43 Manufacturing Sites**

**~7,700 Employees**
worldwide

**VISION:**

Improving the world and everyday life through our people, chemistry and innovation.

people | safety | customers | quality | community | shareholders

# HOSTAFORM®

## Polyacetal copolymer

- ✓ Outstanding wear resistance
- ✓ High strength and rigidity over a broad temperature range
- ✓ Long-term fatigue resistance
- ✓ Toughness and creep resistance
- ✓ Excellent resistance to moisture, solvents, and strong alkalis
- ✓ Low Fuel Permeation
- ✓ Very resilient (e.g. snap fit properties)
- ✓ Easy to process via traditional techniques

### Traditional Processing Technology

| Type | Availability |
|---|---|
| Injection Molding | ✓ |
| Blow Molding | ✓ |
| Extrusion | ✓ |
| Rotational Molding | ✓ |

### End use applications in various market sectors

Automotive
Consumer Goods
Electric Appliances
E&E
Machine Construction
Medical
Precision Mechanics
Watchmaker

### Hostaform® POM has a strong history in fuel applications

# HOSTAFORM® *POM RF*

## is a single layer solution for fuel tanks

- Low Fuel permeation inherent to the base resin
  - Fuels: C10, Carb Lev. III, etc.
- Does not require secondary steps
  - Fluorination
  - Multilayer/drop molding
- Low swelling during fuel exposure
- High temperature resistance (>100°C)
- Tunable impact for protected or unprotected tanks
- Passes ANSI SORE impact and UV testing
- Passes EPA slosh and UV testing
- Passes ABYC marine flammability and shock testing
- Potential for bio-sourced content (POM ECO-B) and recyclability

**Target and Commercial Applications**

Lawn Mowers and Small Off Road
Small Construction / Ag Equipment
Recreational Fuel Tanks
Marine Fuel Tanks
OEM Tank Replacement

# HOSTAFORM® POM *RF*

Delivers new, unique properties to the rotomolding resin toolkit

| | XLPE | Multi-layer barrier | **Hostaform® POM RF** |
|---|---|---|---|
| Tank system cost | $$$ | $$$$ | $$ |
| Processing cycle time | 100% | 300% | 100% |
| Secondary Operations (fluorination) | $$ | - | - |
| Operational Access | ✓ | Limited | ✓ |
| Certifications | EPA | EPA /CARB | EPA / CARB |
| Supply Chain Complexity | Inventory, shipping, offsite fluorination | Available to sell after molding | Available to sell after molding |

# LOW FUEL PERMEATION

**EPA** Fuel Permeation: USEPA 40CFR Part 1060.520

- CE10 Fuel, Emissions Method: Gravimetric, Test Temp = 28ºC

**CARB** Fuel Permeation

- CARB Fuel, Emissions Method: FID, Test Temp = 43ºC

| | EPA (g/m²/day) | CARB (g/m²/day) |
|---|---|---|
| Hostaform® POM RF2162 (2x impact) | 0.60 (PASS<2.5) | 1.132 (PASS <1.4) |
| Hostaform® POM RF2464 [DEV] (4x impact) | 0.05 (PASS<2.5) | Testing in Progress |

**EPA & CARB Testing Pictures**

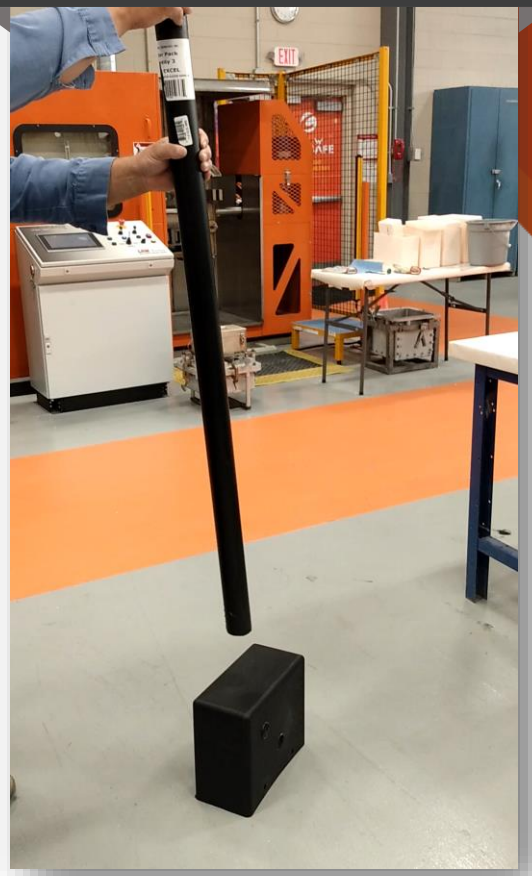
# APPLICATION FOCUSED IMPACT

ANSI/OPEI N71.10-2018

Requirement

- 2” Diameter Ball (1.18lb) dropped from 51in.  All season temp. = -4°F
- Energy Requirement: 2.574 ft-lb @ 8.9 ft/s.
- Thickness Requirement per application (typical ~0.160”)
- Multiple hits on different areas of the same part on a rigid attachment and supported.
- Go/NoGo based on functionality of the tank after multiple hits.

ANSI Tank Impact Test Simulation



# APPLICATION FOCUSED IMPACT

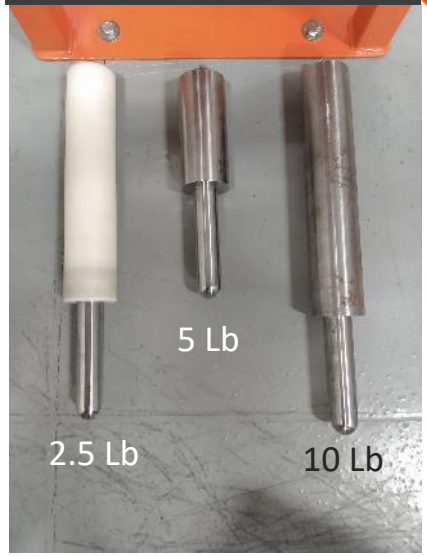
A.R.M. Low Temp. Impact Test Method

Adapted

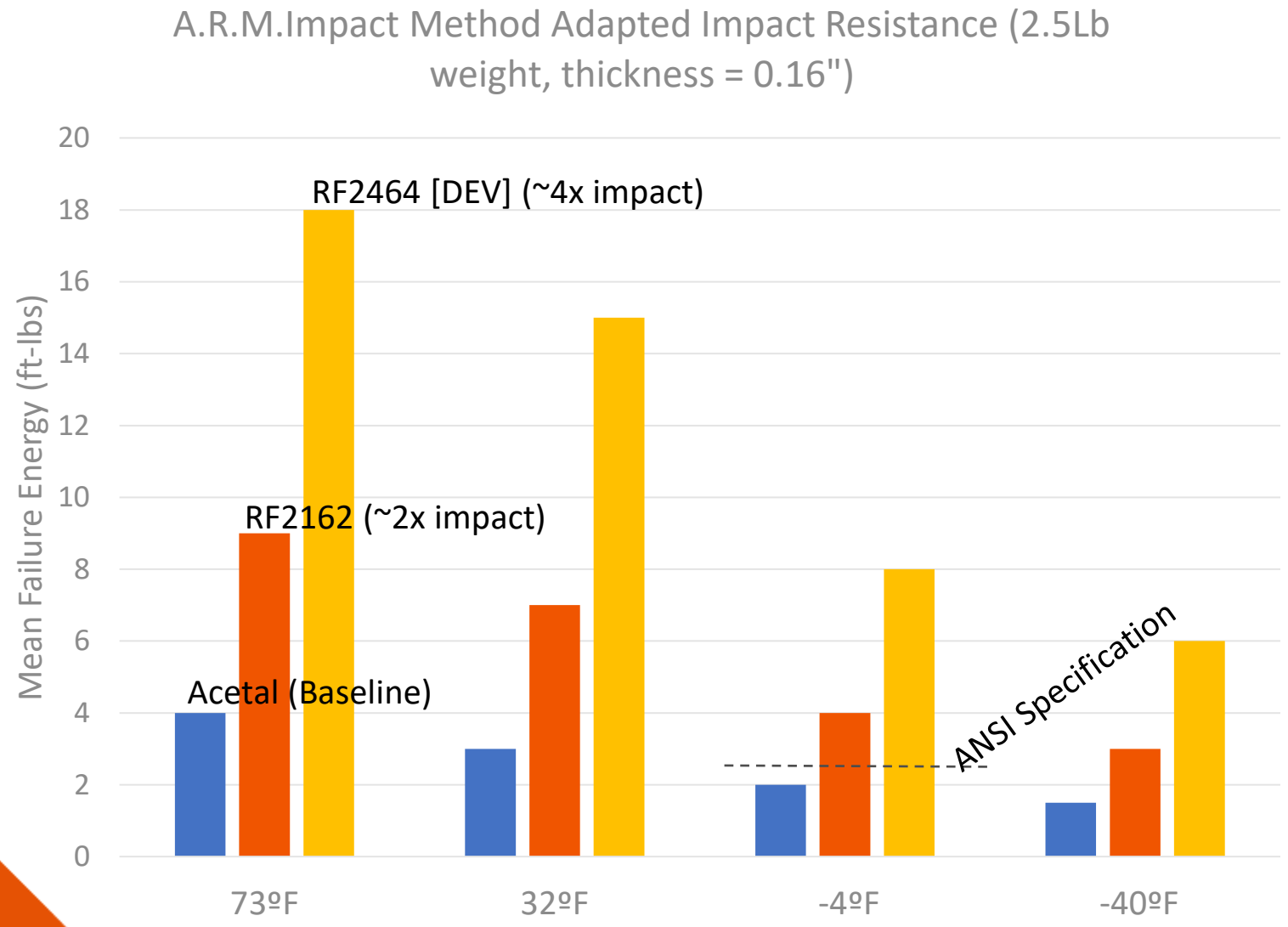
- 1” Diameter.  Tup weight: 2.5, 5.0, 10.0lb.  Temp: 73, 32, -4, -40 °F
- Energy & Speed calculated from height & weight of drop
- 2.5lb weight @ 1 foot: 2.50 ft-lb @ 9.1ft/s (a close match to ANSI).
- Typical thickness ~0.160”
- Simply supported 5”x5” plaque through 4” diameter hole.
- Bruceton Staircase Method for Calculation of Mean Failure Energy.

Typical A.R.M. Drop Tower

Adapted weights



# APPLICATION FOCUSED IMPACT



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# HOSTAFORM® POM *RF* properties

| | XLPE | **Hostaform® POM RF** | PA-IM |
|---|---|---|---|
| Stiffness | - | **0** | + |
| HDT | - | **+** | 0 |
| Fuel Perm. | - | **+** | 0 |
| Impact | + | **0** | + |
| Density | + | **-** | 0 |
| Mold Shrink | 0 | **0** | 0 |
| Oven Time | 0 | **0** | - |

# *Processing* HOSTAFORM® POM *RF*

## Basic Instruction

- Existing molds typically suitable.
- Standard pulverizers (attrition mills) are suitable.  Reduce pellets to 35 mesh powder.
  - Cryogrinding not required
- ARM 2.1 Flowability and Bulk Density Funnels are suitable to test powder.
  - 35 mesh.  Powder Flow can be 15sec to 32sec.
- Pre-Drying powder not necessary
- Nitrogen not necessary
- Mold Release or special tool coatings typically not needed.
- Typical 4:1 ratio Major/Minor axis rotational speed usually suitable (8:2, 6:1.5, etc.)
- Good Flow and Seal around inserts
- In mold labelling and other standard Secondary Operations
- Adequate ventilation at demold stations

# HOSTAFORM® *POM RF*

## Typical processing parameters

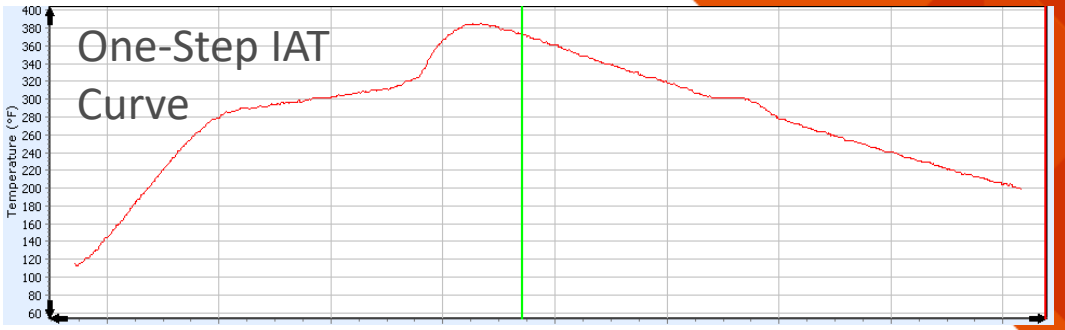
- ***Monitoring the Internal Air Temp. Is key in setting a recipe.***

### Internal Air Temp (IAT)

- Temperature 365-400ºF
- Time (Depends on Part Size, Thickness, Complexity) 5-30 min
- 1 or 2 step oven process may be needed

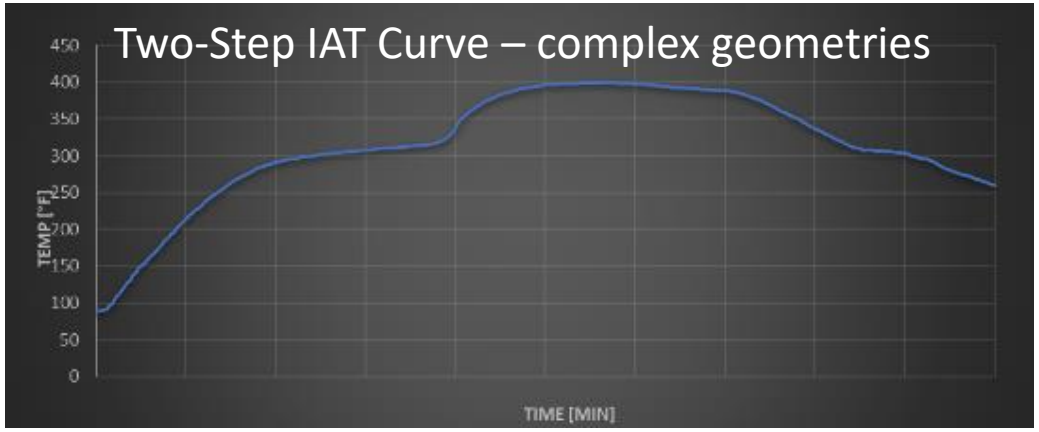
### Oven Setup

- Temperature (Actual at the mold) 440-480ºF
- Time (Depends on Part Size, Thickness, Complexity) 15-45 min




### Outer wall Temp.

- 410-450ºF (210-232ºC) Typical
- 450ºF (232ºC) do not exceed




### Typical Air Cooling

- Rotate in air 5-10minutes
- Rotate in forced air 10-30 minutes
- Acetal's recrystallization temp. 290ºF
- Demold temp. ~150ºF
  - Accelerated cooling with water acceptable



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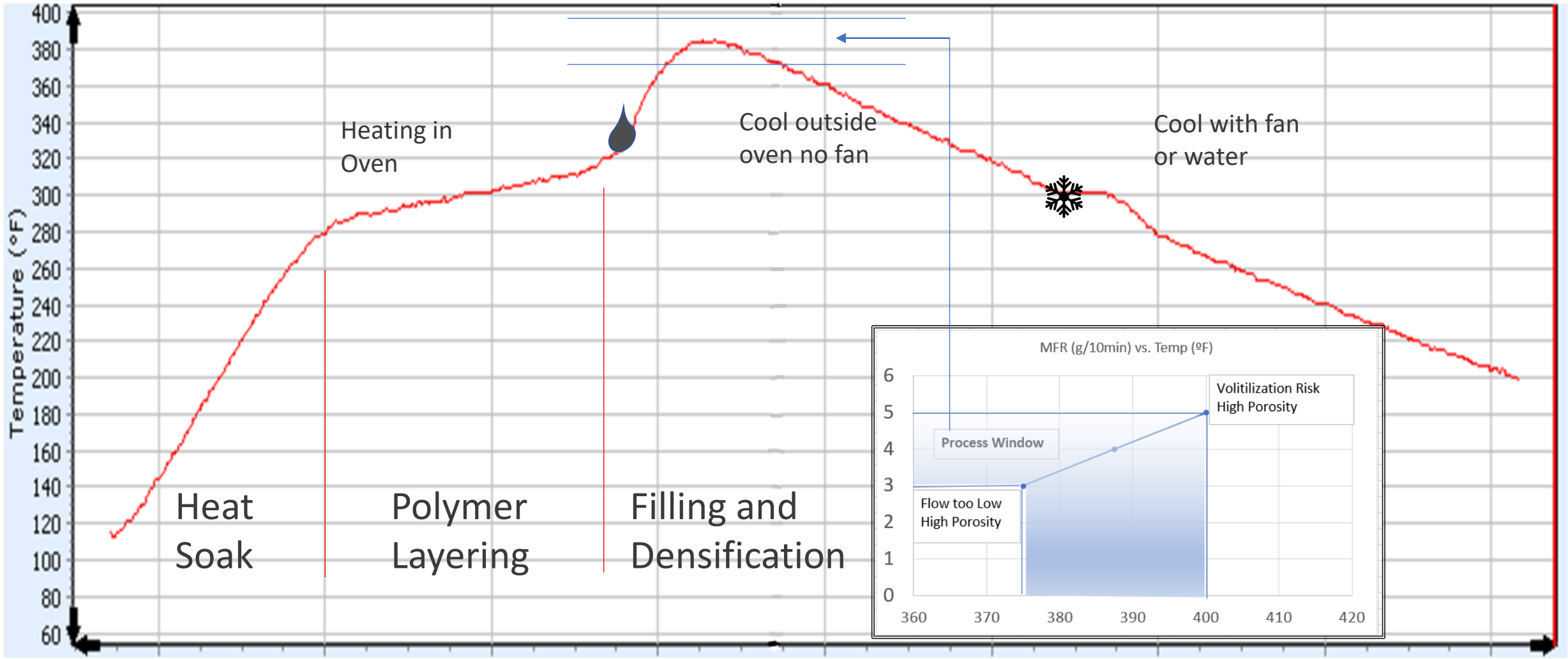
# PIAT CURVE - BASIC



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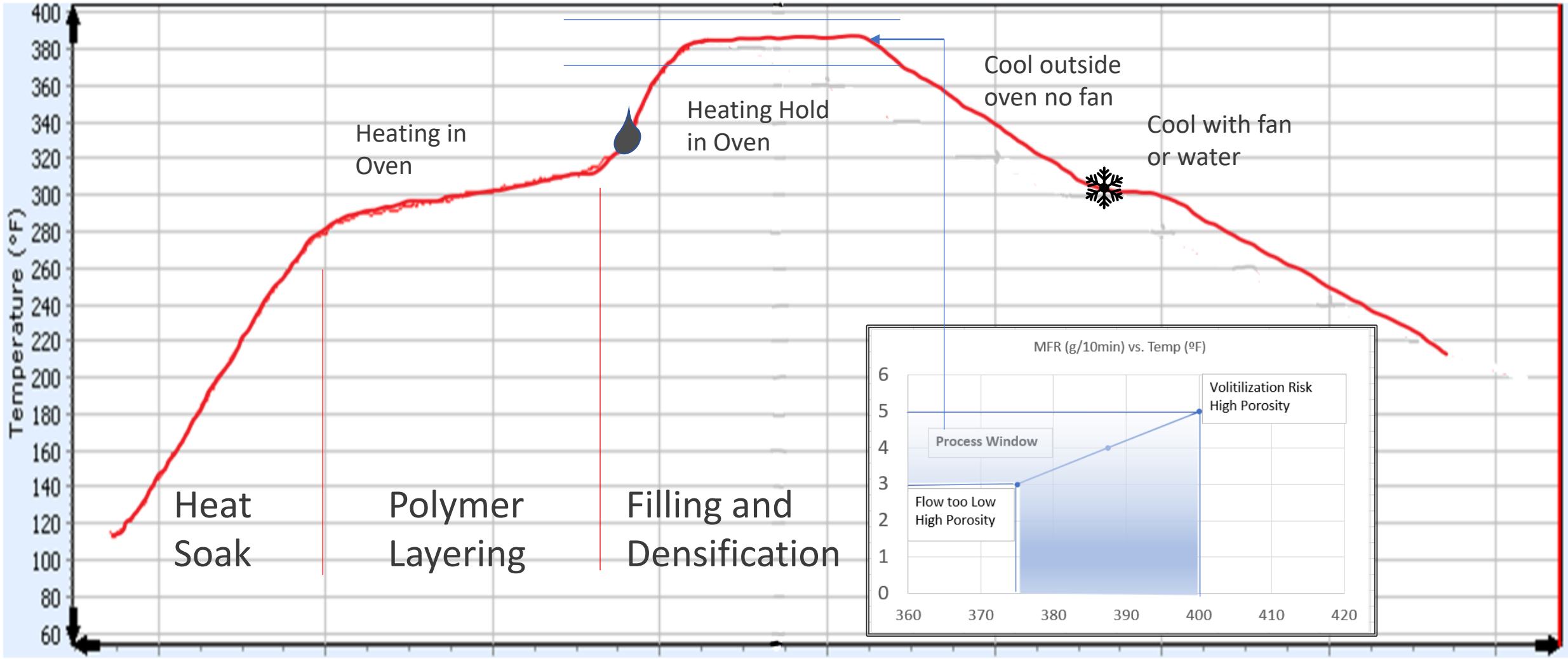
# PIAT CURVE - COMPLEX GEOMETRY



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# ROTOMOLDING RESIN MANUFACTURING AND SUPPORT SERVICES

**Global Manufacturing and Supply**

**Rotomolding Lab in Florence, KY**

- Grinding
- Rotomolding
- Application specific testing
- Drop and density testing

**Field Tech Services**

- On-site acetal rotomolding education
- Design and consulting
- Processing assistance
- Testing and evaluation of acetal tanks

# ROTOMOLDING AT CELANESE

## Look out for new markets and products!

1. Tunable Higher Impact Properties
2. Industrial and Food Processing
3. Appearance Portfolio
4. Sustainable Offerings

# CONCLUSION

Hostaform® POM RF provides a good balance of mechanical properties with low fuel permeation for a single layer tank solution

Hostaform® POM Resins have been designed to use standard Rotomolding equipment at typical cycle times

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Celanese Materials ACADEMY

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