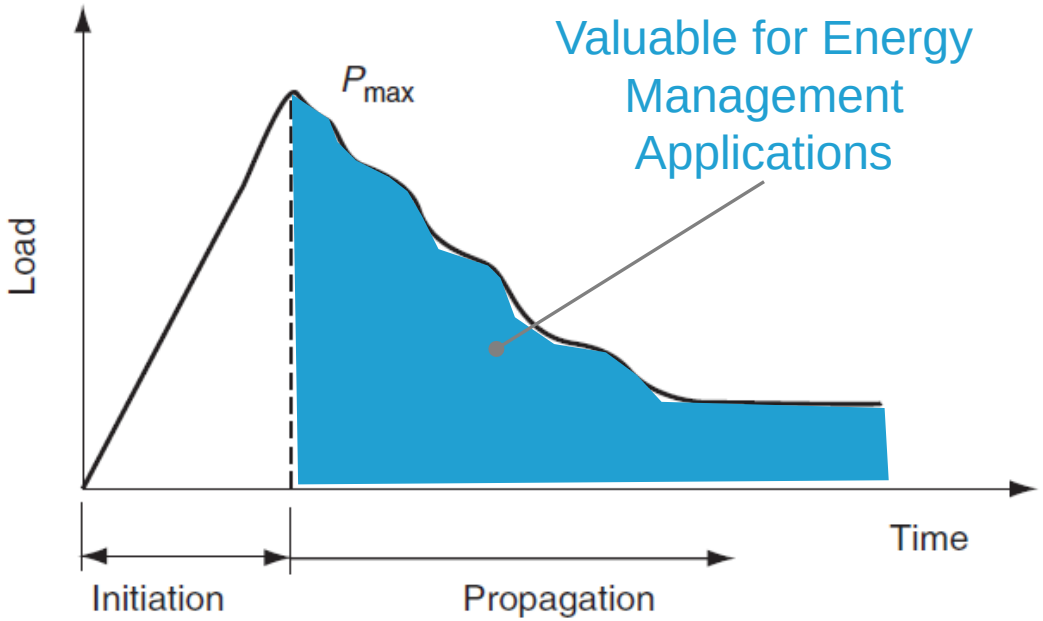
# Pultrusion Overmolding

## For Energy management

BASF Composite Technology Solutions

# CFR Energy Management
## For The Transportation Industry




- Specimen continues to carry the load on post-initial fracture region.
- *Owing to progressive delamination, the material exhibits a "ductile" behavior and absorbs significant amount of impact energy (Mallick, 2008)*[1]

**CONTINOUS FIBER REINFORCEMENT MATERIALS FOR ENERGY MANAGEMENT**

**Potential for significant cost and weight savings**



[1] *Fiber-reinforced composites: Materials, Manufacturing andDesign, Mallick, P.K. 3rd Ed. Boca Raton, FL. CRC Press 2008*

# PULTRUSION

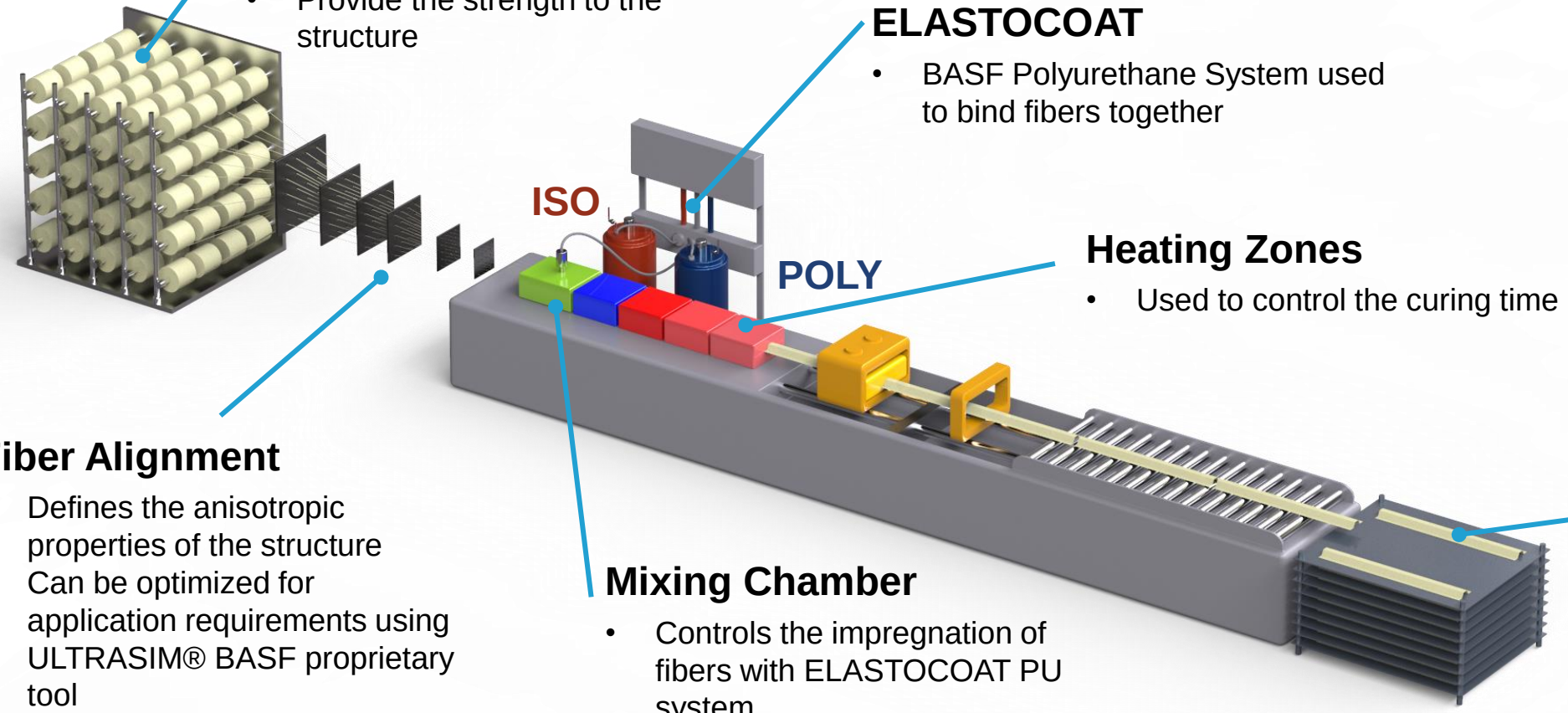
## Process Description - BASF Elastocoat® PU System

### Roving and Fiber Matts

- Provide the strength to the structure

### ELASTOCOAT

- BASF Polyurethane System used to bind fibers together




### Heating Zones

- Used to control the curing time

### Fiber Alignment

- Defines the anisotropic properties of the structure
- Can be optimized for application requirements using ULTRASIM® BASF proprietary tool

### Mixing Chamber

- Controls the impregnation of fibers with ELASTOCOAT PU system

### Customized Length Profiles



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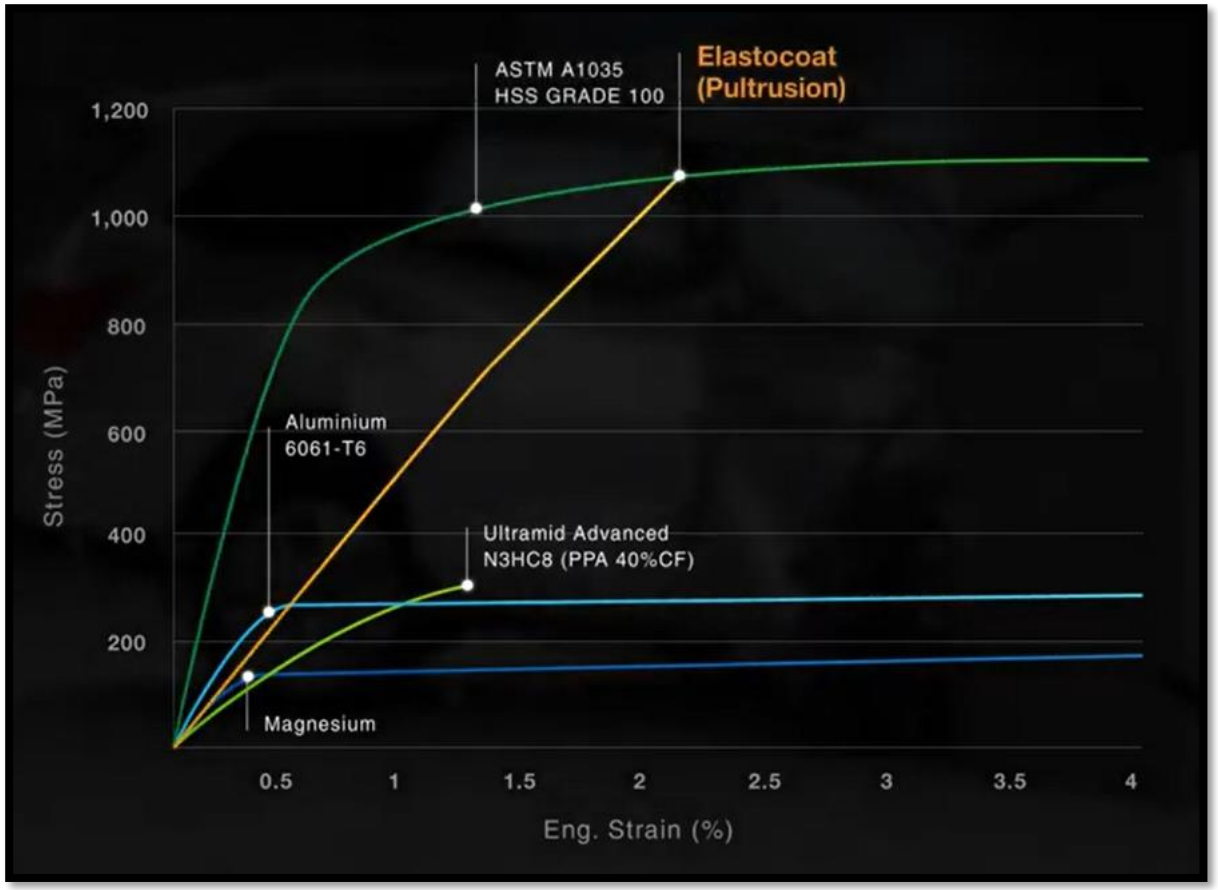
# PULTRUSION
## Performance on Tensile Test




- Pultrusion strength is comparable to Steel grades (fiber direction)
- Pultrusion elastic modulus is comparable to Magnesium
- Pultrusion density is only 1/3 compared with steel

**All Roving Architecture**

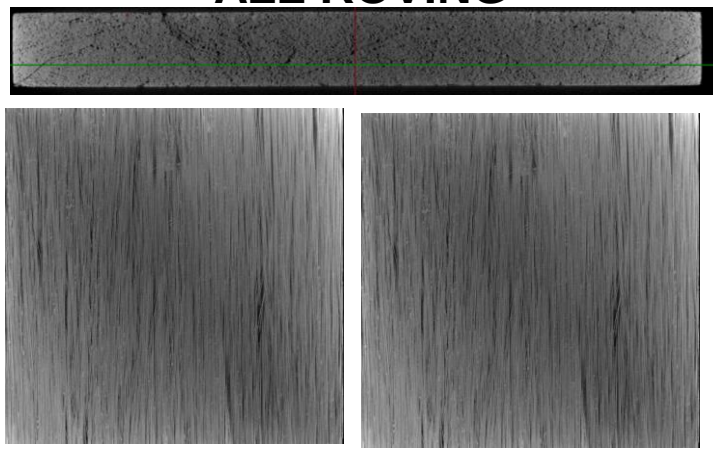
**Tensile Test**

# PULTRUSION
## Fiber Architecture (CT Scan Pictures)

Transversal

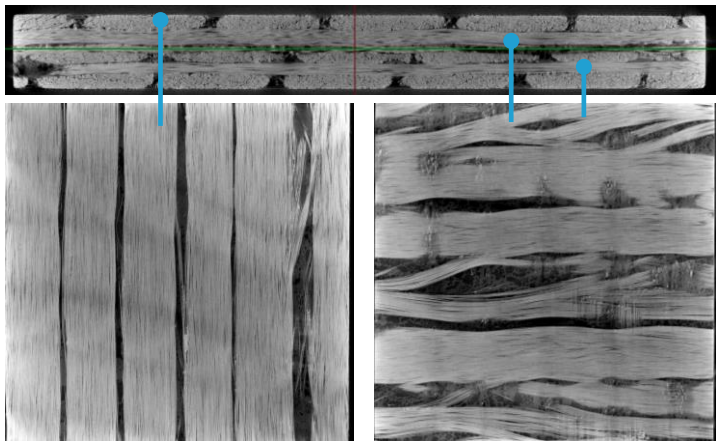
Layer to Layer

### ALL ROVING



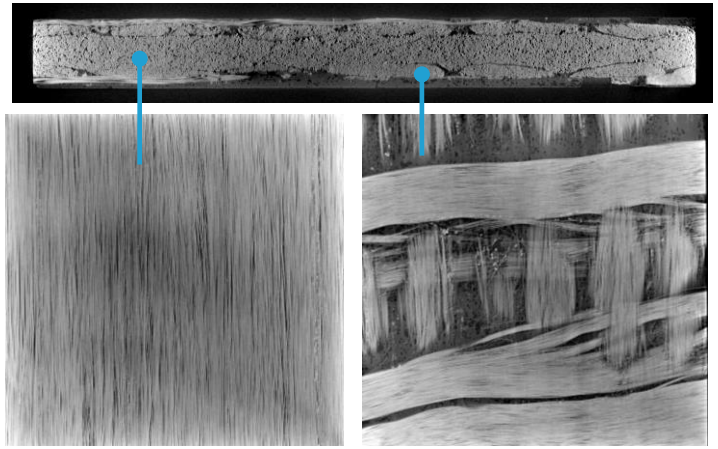
- Loose glass rovings bonded by resin

### BIAXIAL



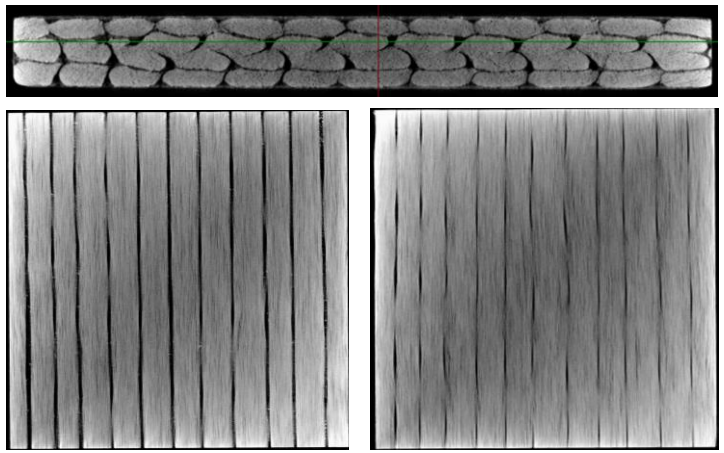
- Alternating layers of 0° and 90° oriented glass roving

### HYBRID



- Top and bottom layer: biaxial
- Middle layer: all roving

### UNI-AXIAL



- Bundled glass rovings bonded by veil



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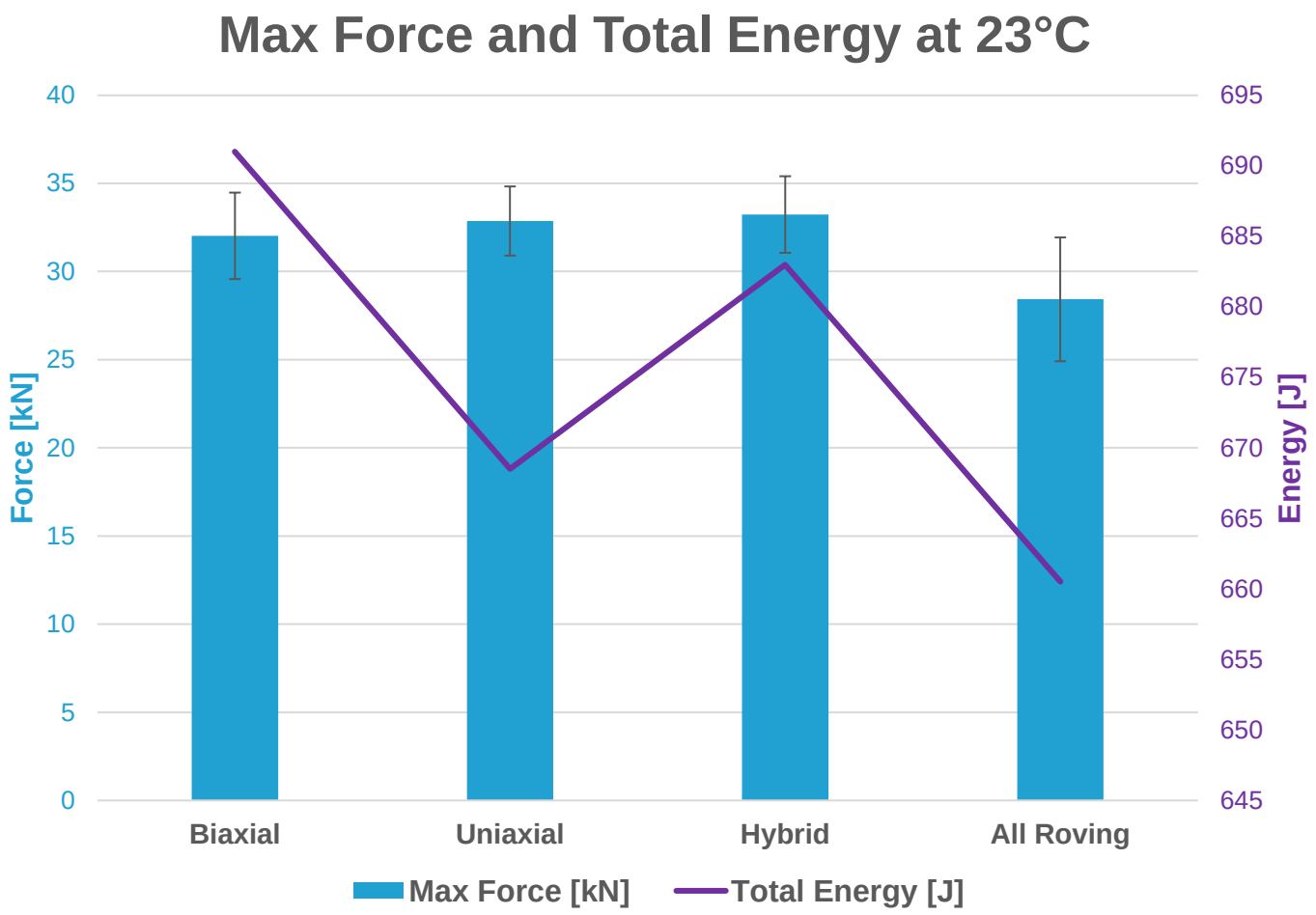
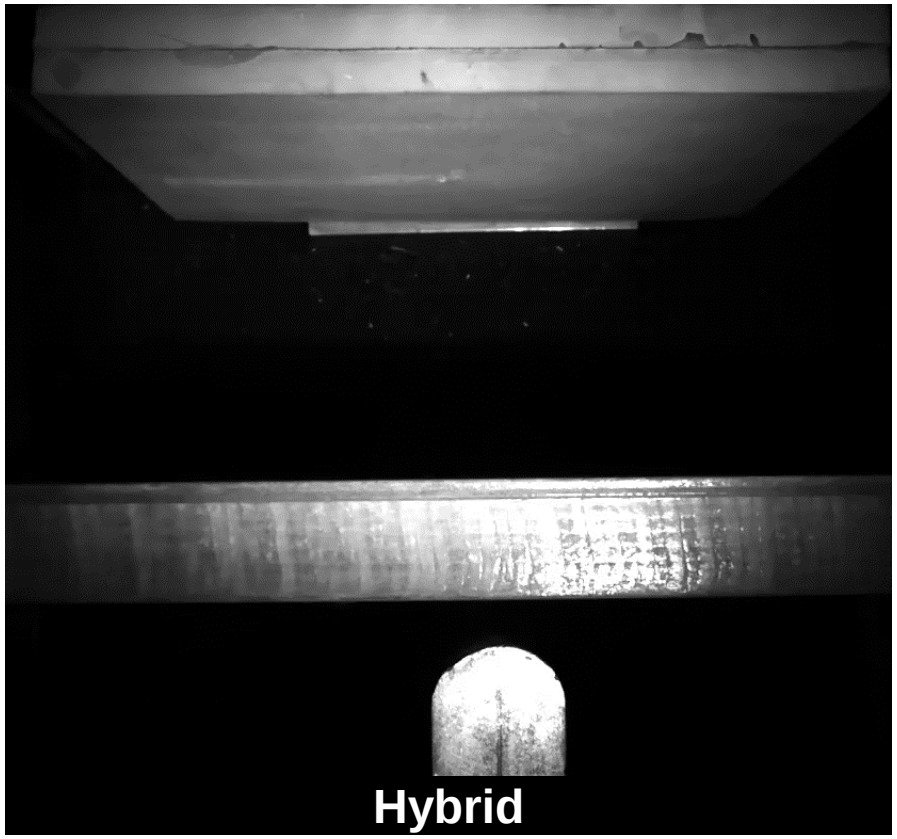
# PULTRUSION

## 3Pt Bending Impact Performance



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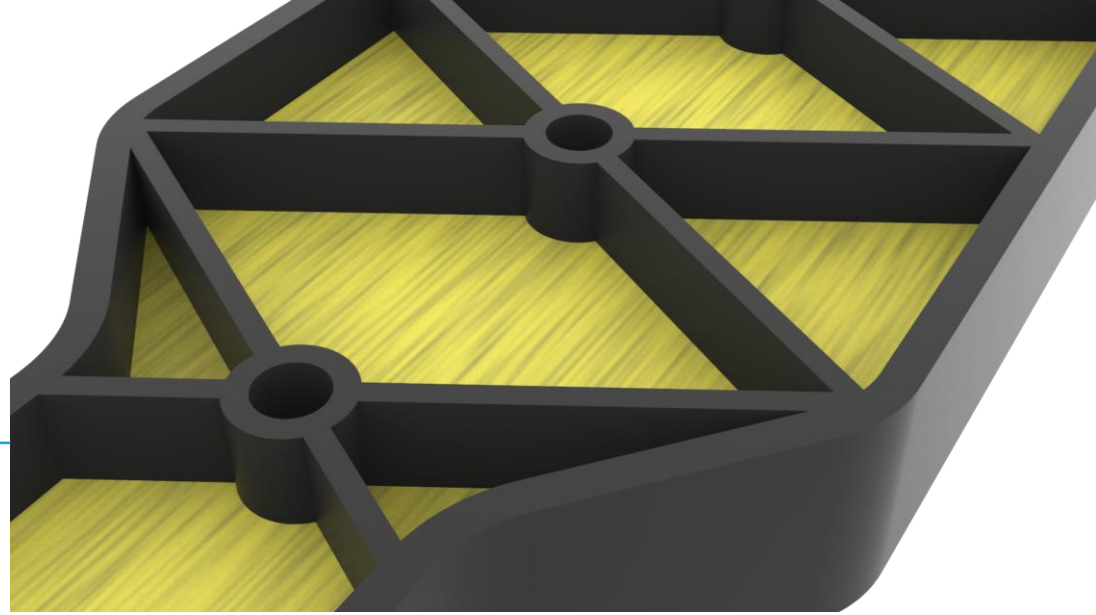
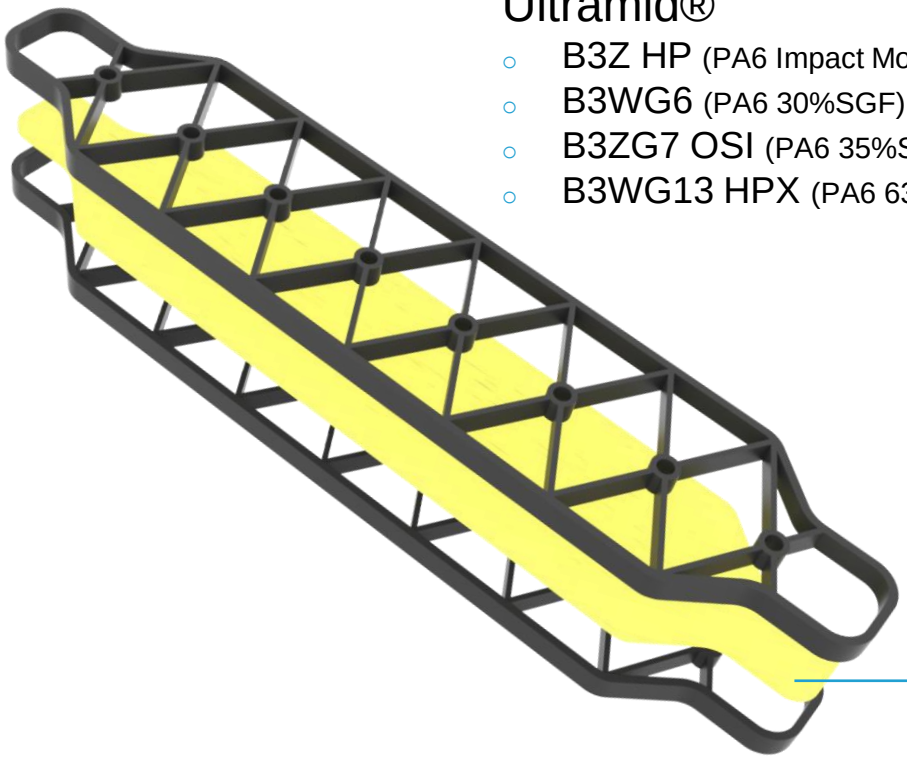
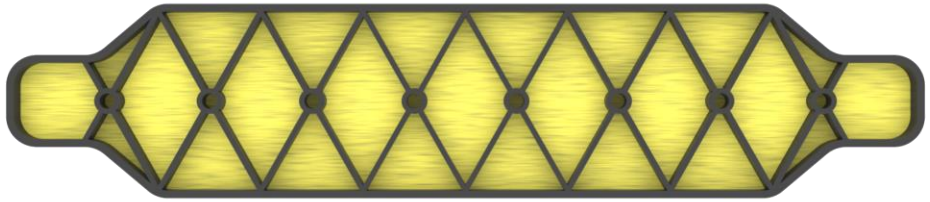
# PULTRUSION
## Overmolding BASF Multi-Test Part



Thermoplastic Overmolding
Ultramid®

- B3Z HP (PA6 Impact Modified)
- B3WG6 (PA6 30%SGF)
- B3ZG7 OSI (PA6 35%SGF Impact Modified)
- B3WG13 HPX (PA6 63%SGF)





Pultrusion Insert
Elastocoat® 74850
“All Roving” Architecture



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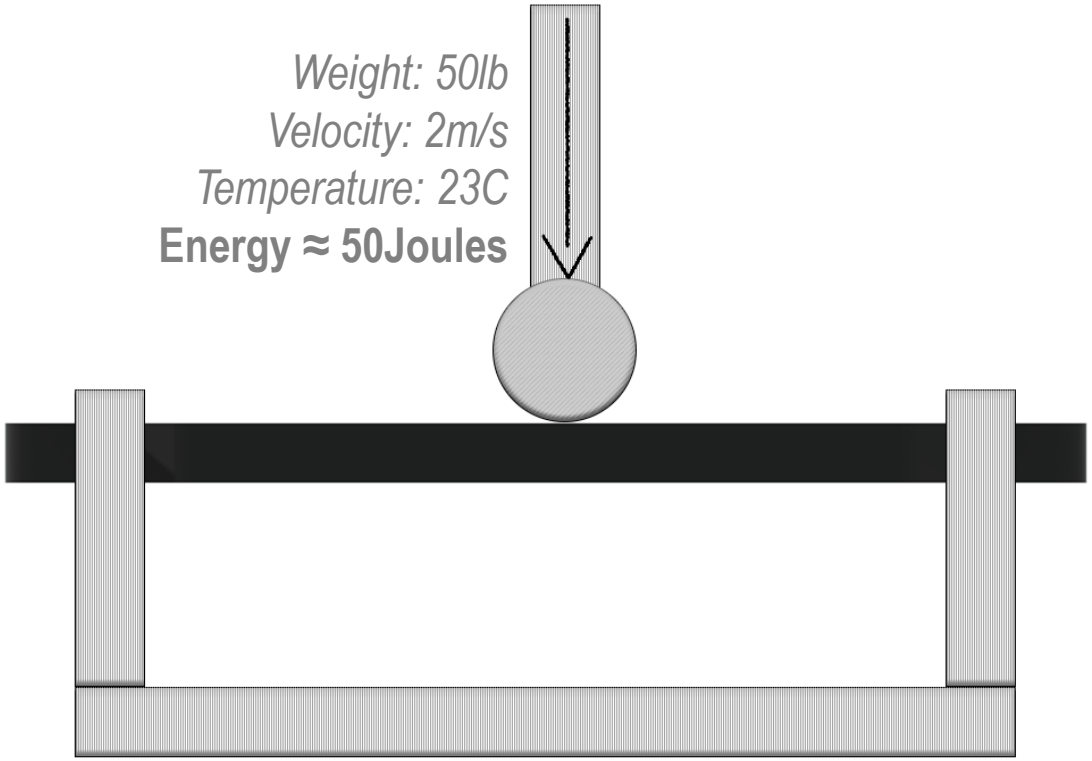
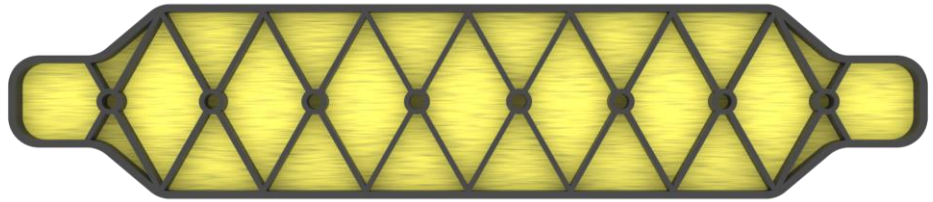
# PULTRUSION Overmolding
## Dynamic Test




Test Conditions

Testing Fixture

Overmolded Component





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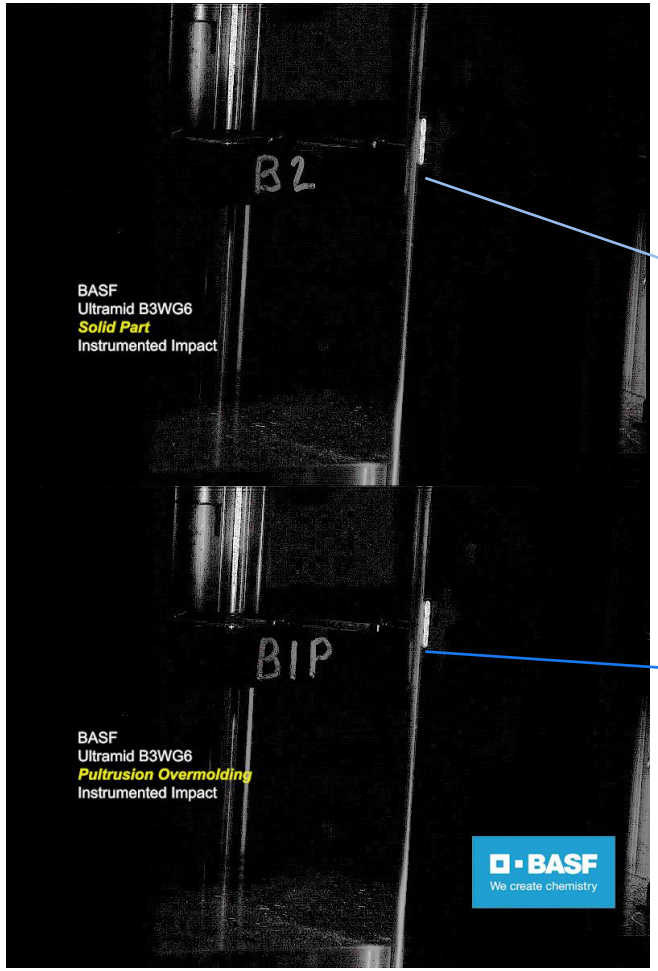
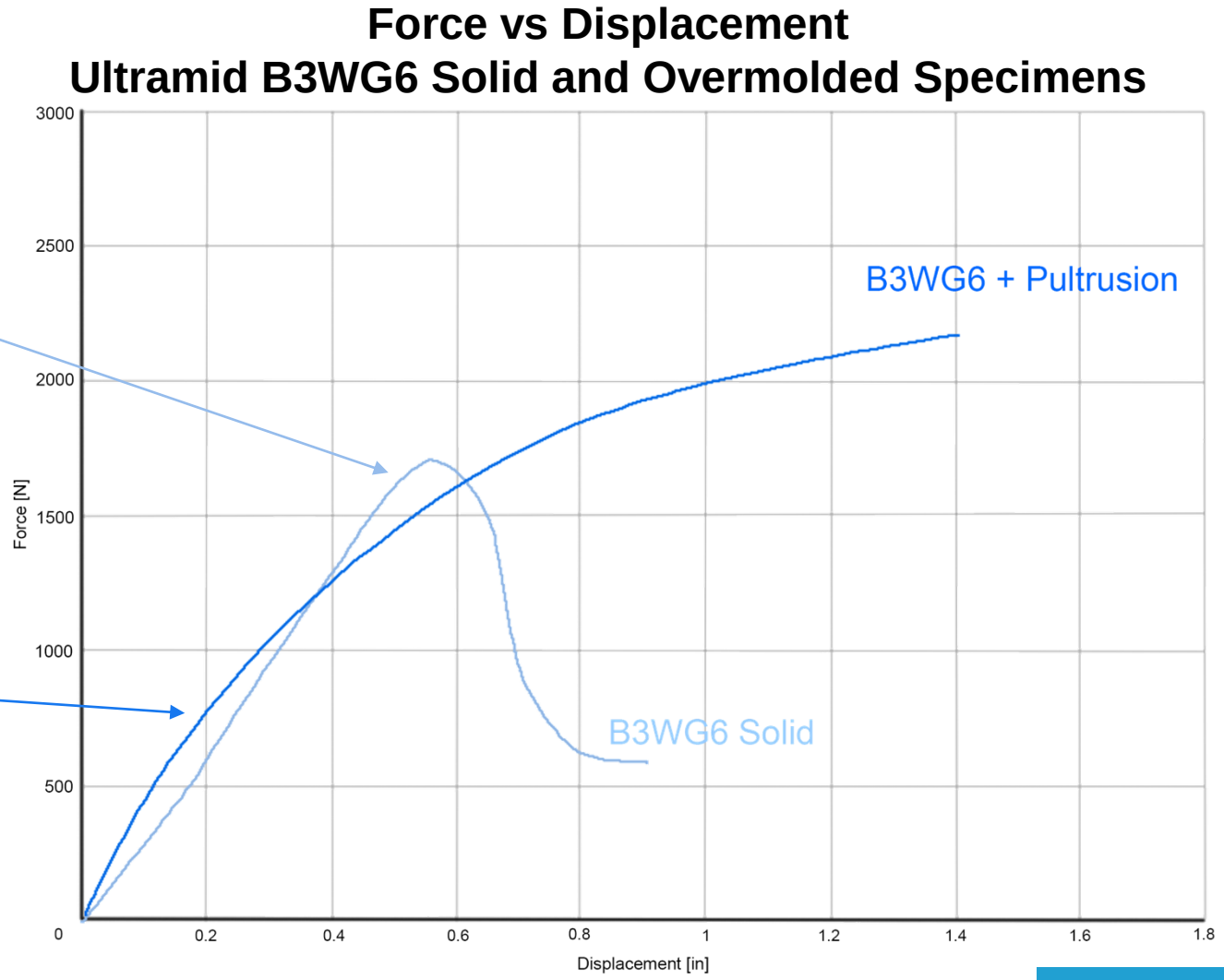
# PULTRUSION Overmolding

## Dynamic Test



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# PULTRUSION Overmolding
## Dynamic Test

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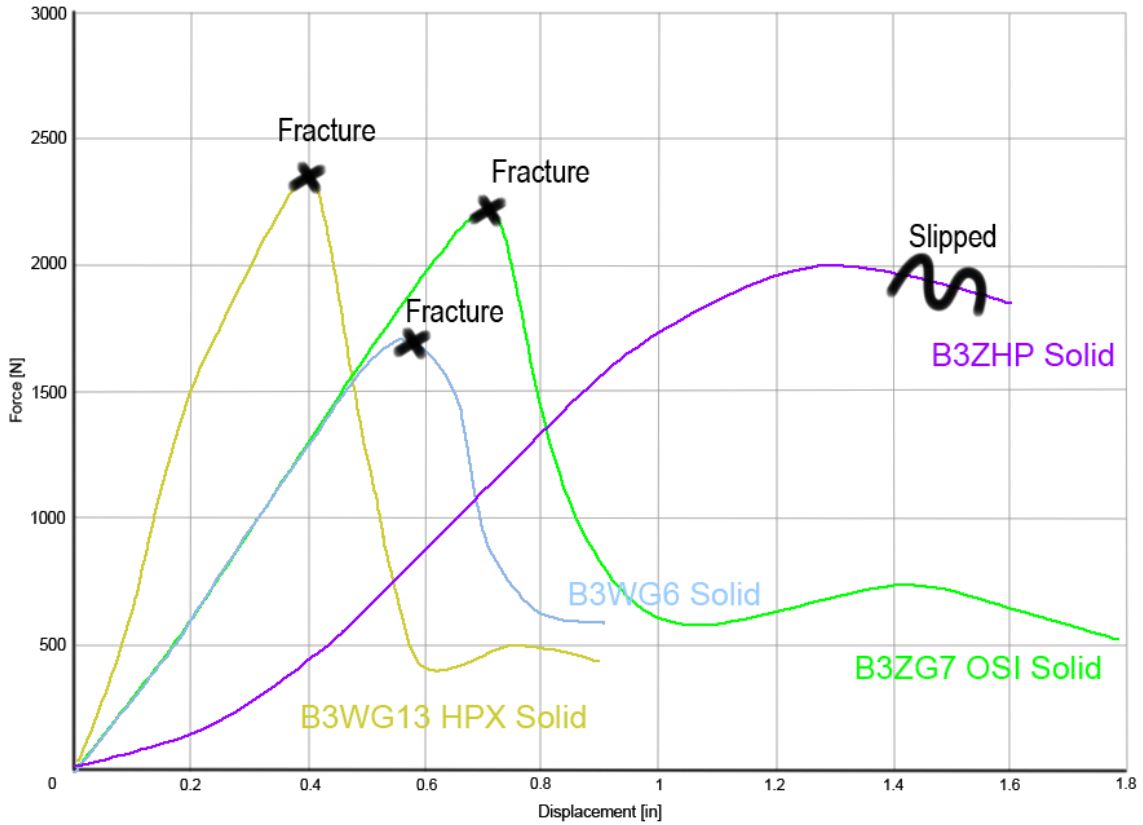
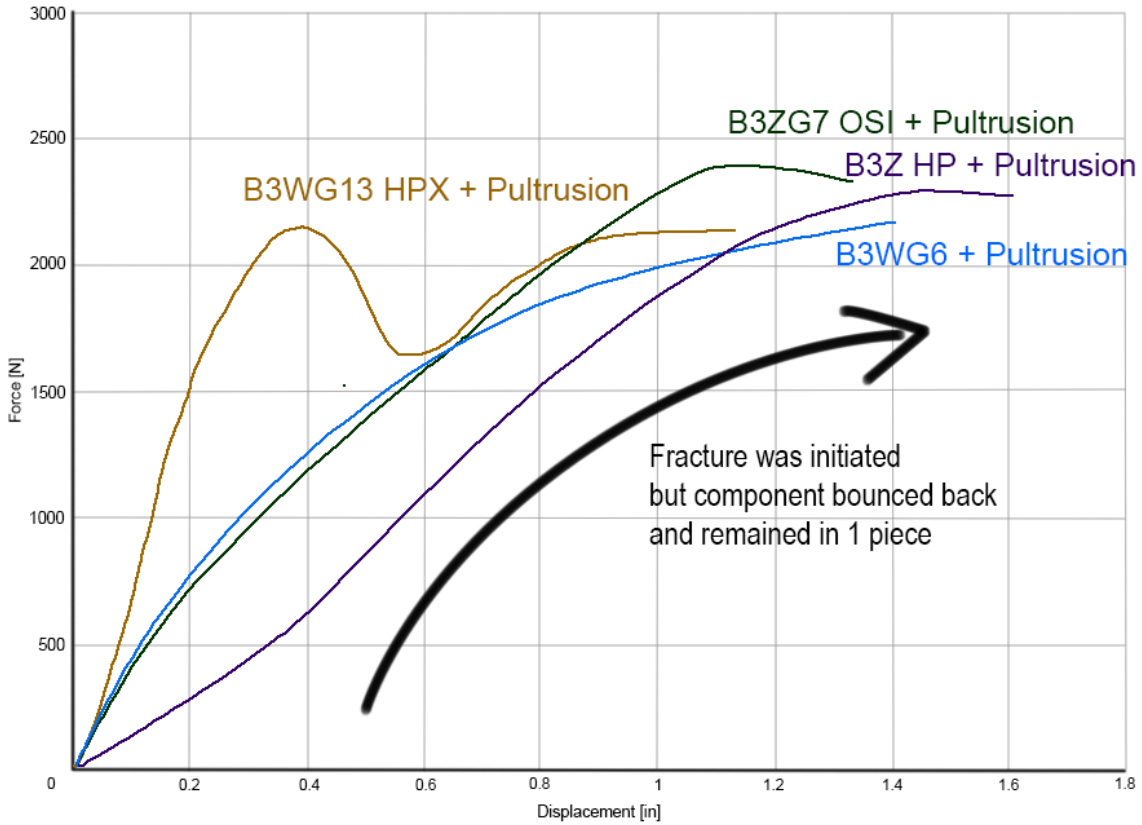
# PULTRUSION Overmolding

## Dynamic Test – Force vs Displacement

### Solid




### Pultrusion



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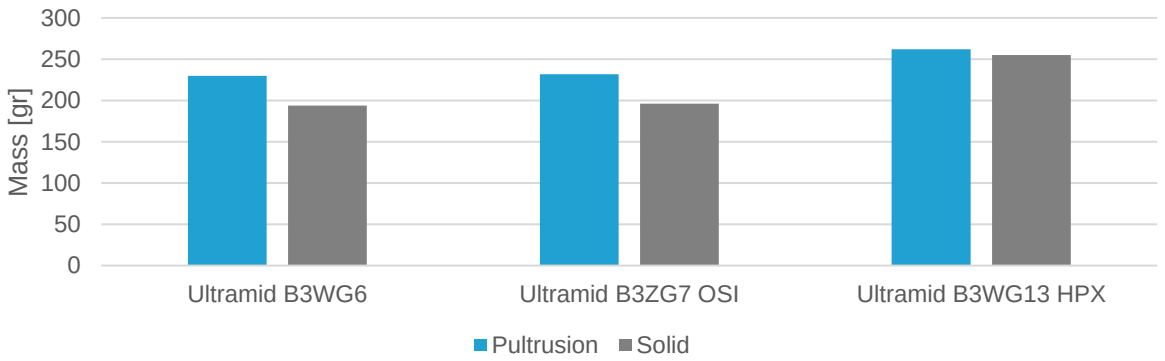
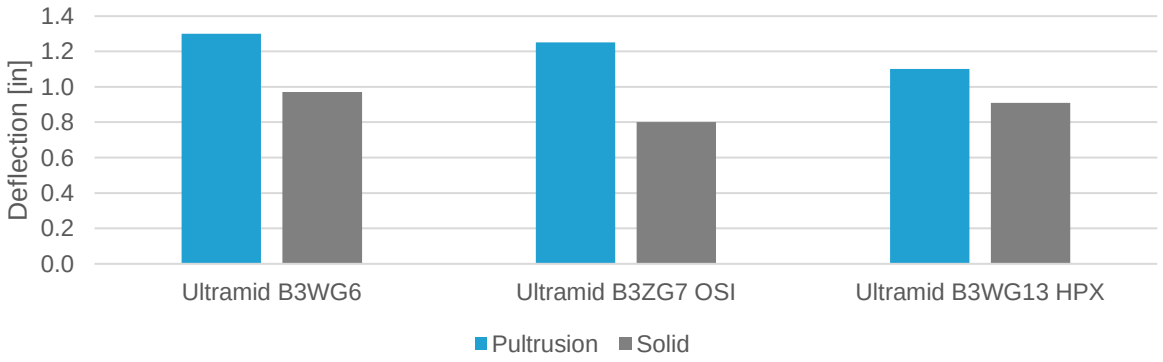
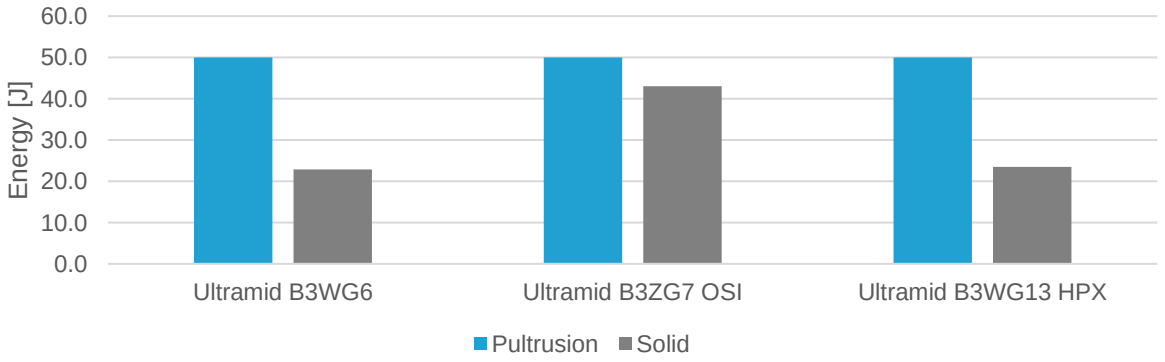
# PULTRUSION Overmolding

## Dynamic Test – Displacement and Energy Absorption

- More fiber, less difference on weight (solid vs overmolded)
- More fiber, less deflection.
- Pultrusion reinforced components absorbed energy due progressive delamination.



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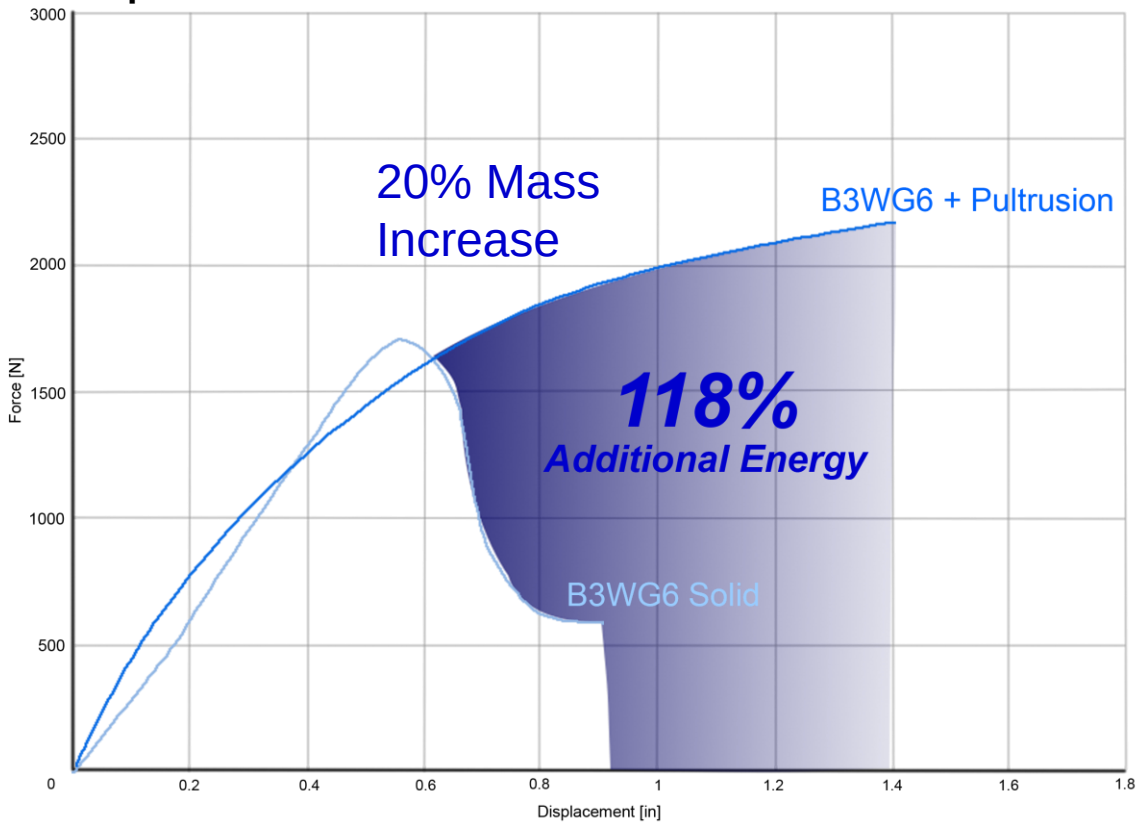
# PULTRUSION Overmolding

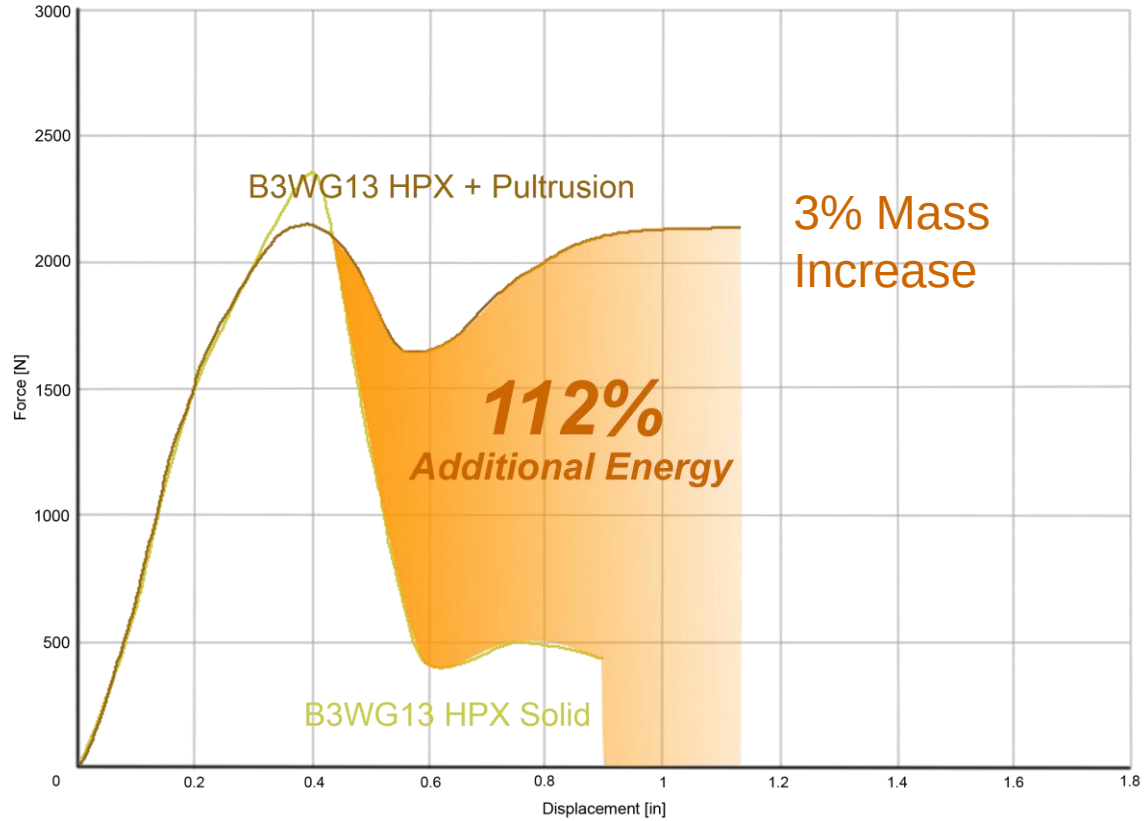
## Dynamic Test – Energy Absorption

**Ultramid B3WG6 Comparison Impact Test**




13% Mass Difference

**Ultramid B3WG13 HPX Comparison Impact Test**




Improvement on energy management capabilities using Elastocoat® pultrusion inserts



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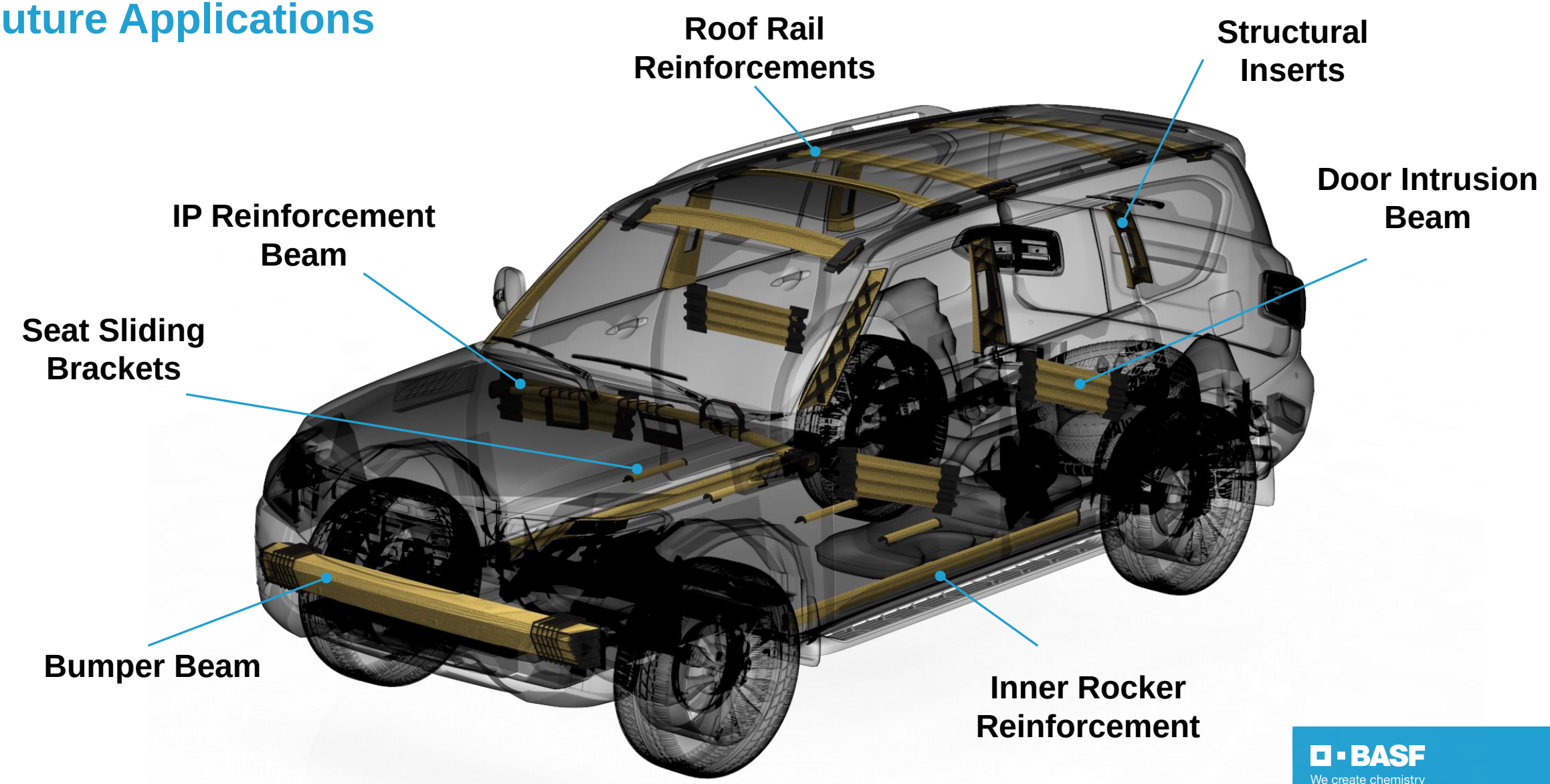
# PULTRUSION
## Future Applications



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# Conclusions

- The experiment confirmed the effect of CFR pultrusion inserts: ductile behavior and increase of impact energy absorption due progressive delamination
- Thermoplastic overmolding opens an opportunity for joining methods and features incorporation to pultrusion structural members
- Pultrusion offers a high-performance weight ratio that is traduced on weight and cost savings opportunities
- Several components have been identified for the implementation of pultrusion components with overmolded thermoplastics



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# Connect with a Composites Expert

Dr. Elias Shakour

Kipp Grumm

Ricardo Mercardo

Dr. Matt Parkinson

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