

Extrusion Deposition/Compression Molding of Hybrid Carbon/Glass Fiber Thermoplastic Oil Pans

By

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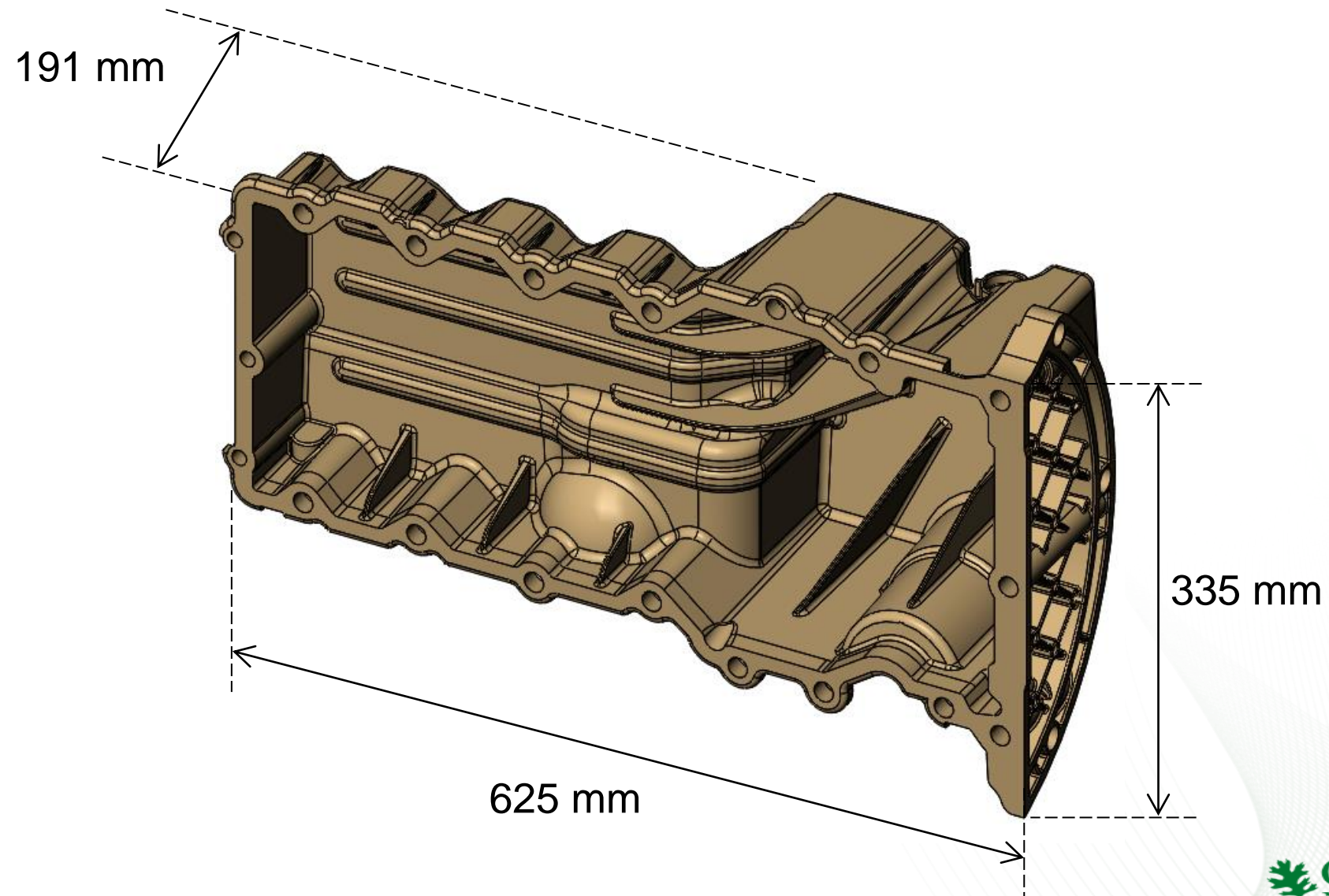
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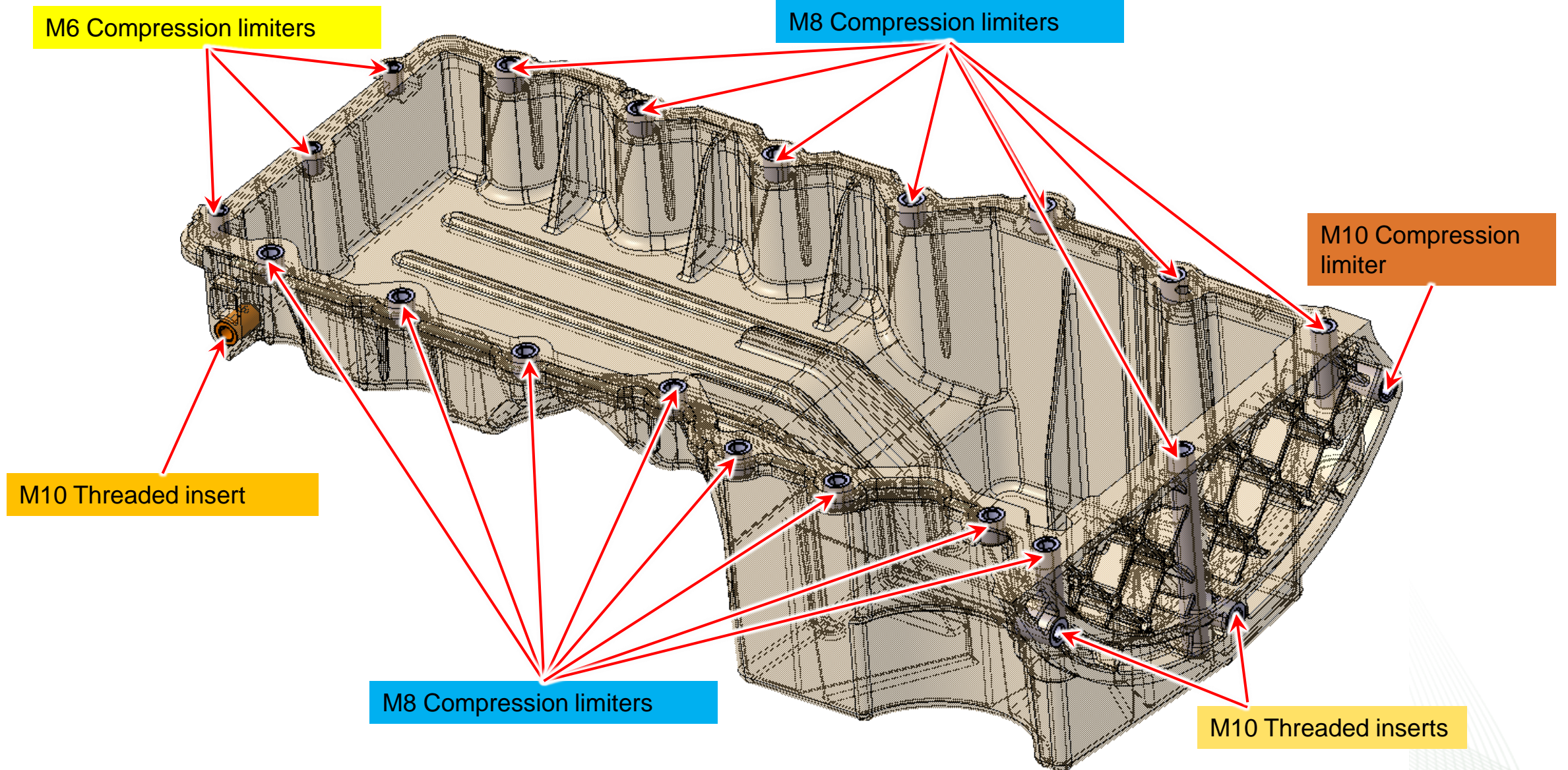
Background

- Ford received Project Award Number DE-EE0008878 to develop a light weight 3.7L ICE Engine
- ORNL partnered with Ford to fabricate polymer composite oil pans
 - Ford provided the original designs.
 - ORNL ran the Finite Element Analysis to determine composite design.
 - ORNL modified the designs for composite processing.
 - AES (Additive Engineering Solutions in Akron, OH) was contracted to make the tool and perform the final machining of the oil pans as well as the metal inserts.
 - Solvay provided the material.
 - ORNL fabricated the oil pans.

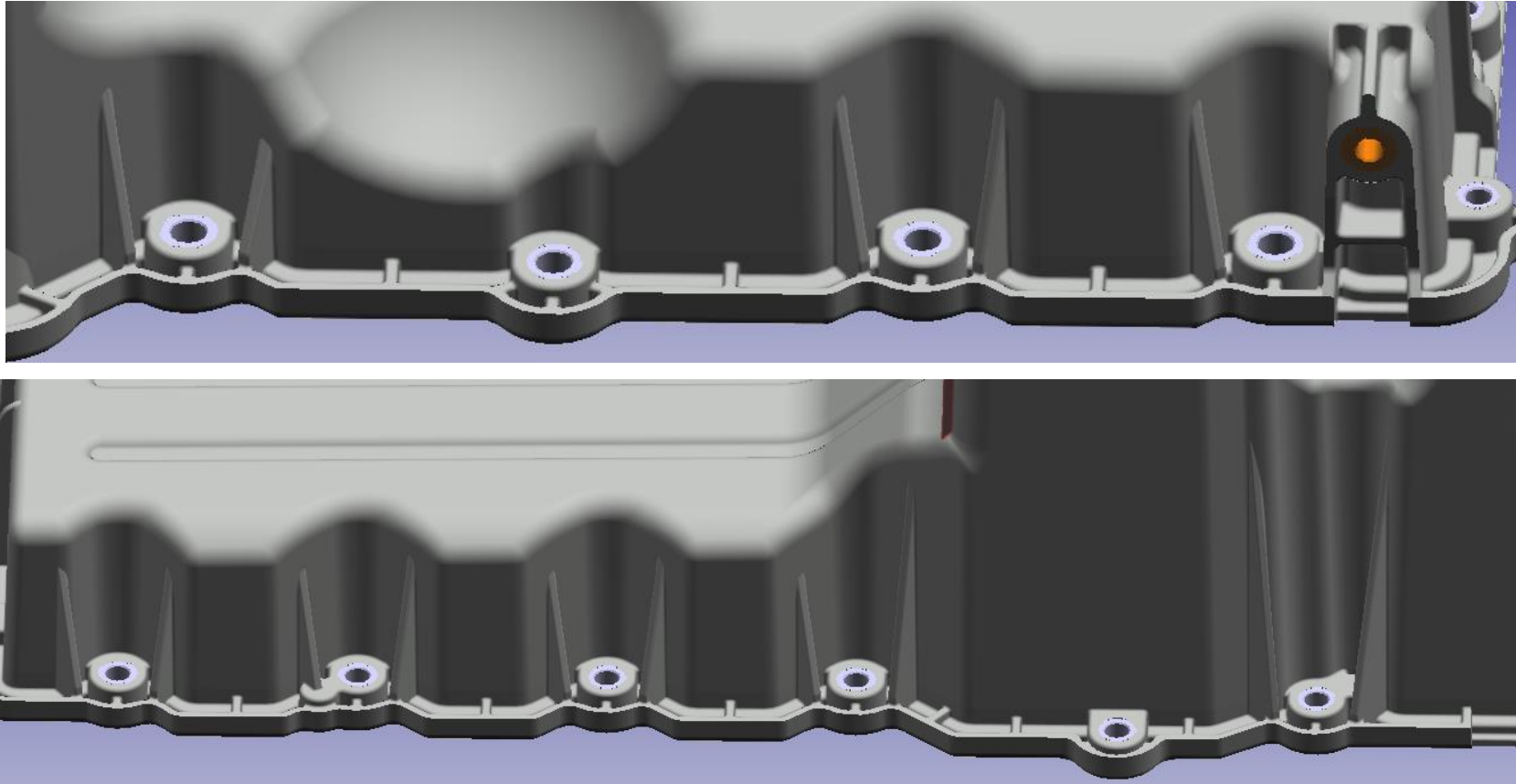
Overall Dimensions of Oil Pan



Ford Aluminum Design with Inserts

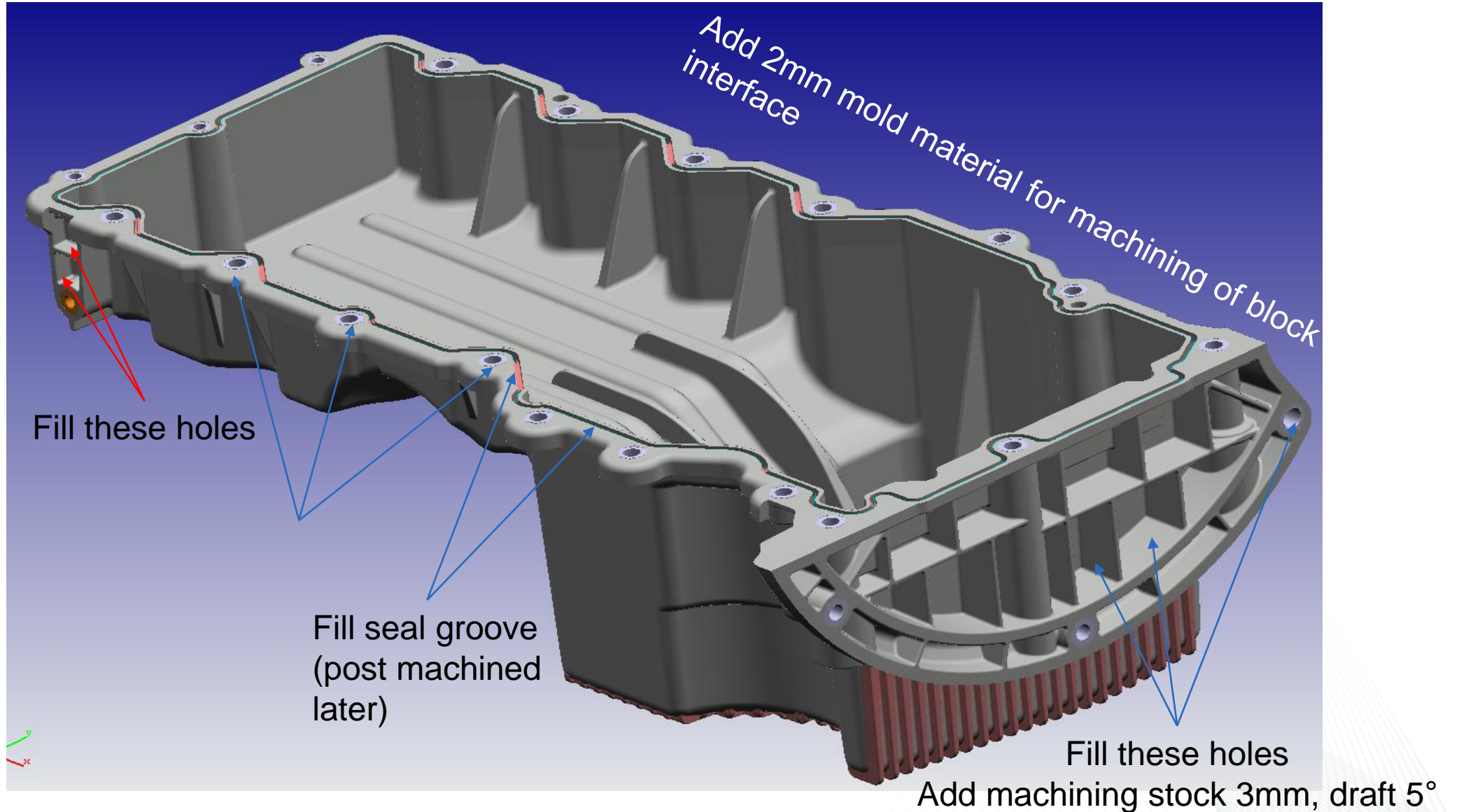


CAD Model Modifications

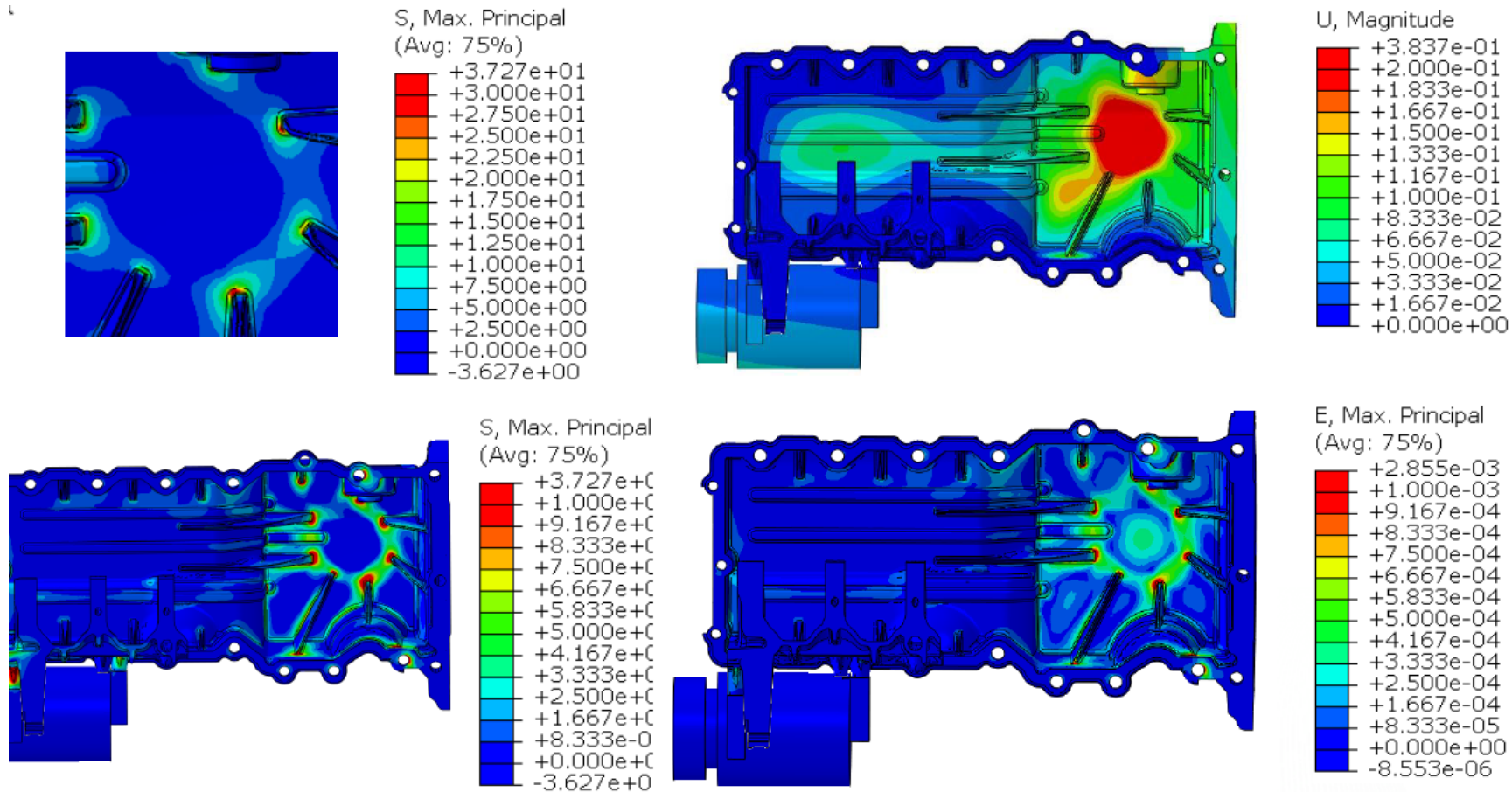


Many changes were made to CAD models to make these designs compression moldable. For example, 5° draft angles were added to the ribs while not changing the height of the ribs. Clearance for sockets also had to be added to allow the oil pan installation and removal.

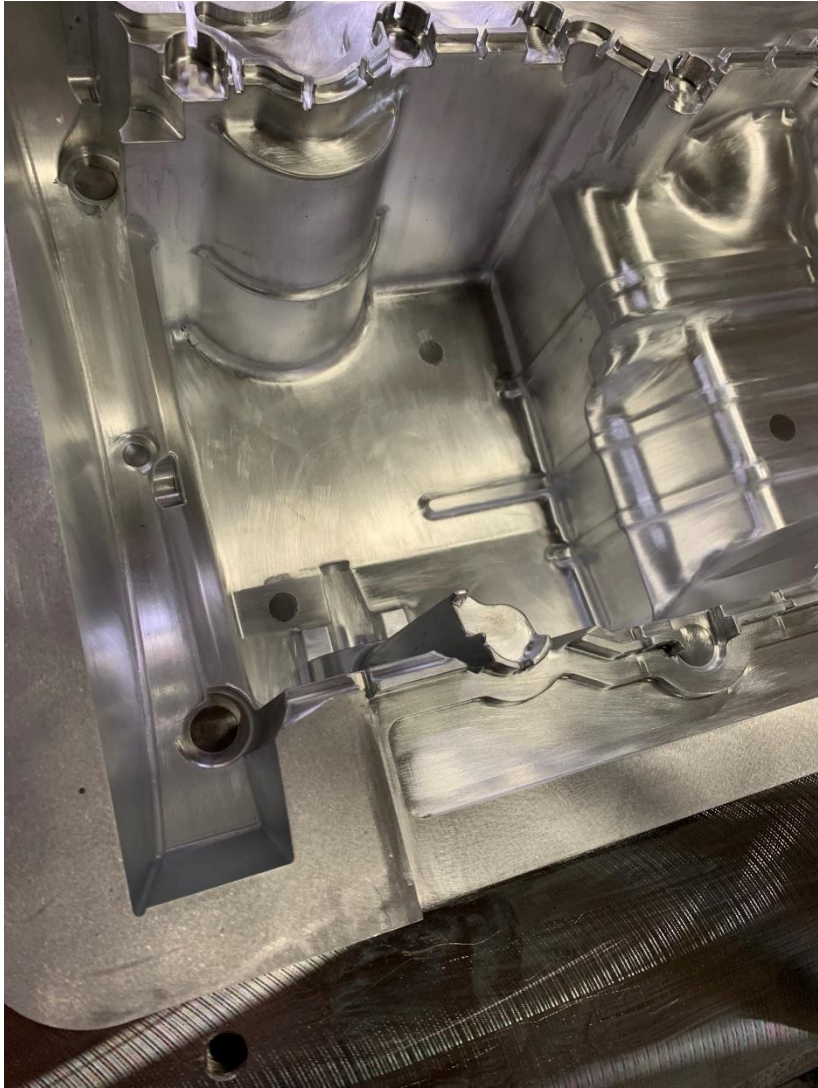
CAD Model Modifications



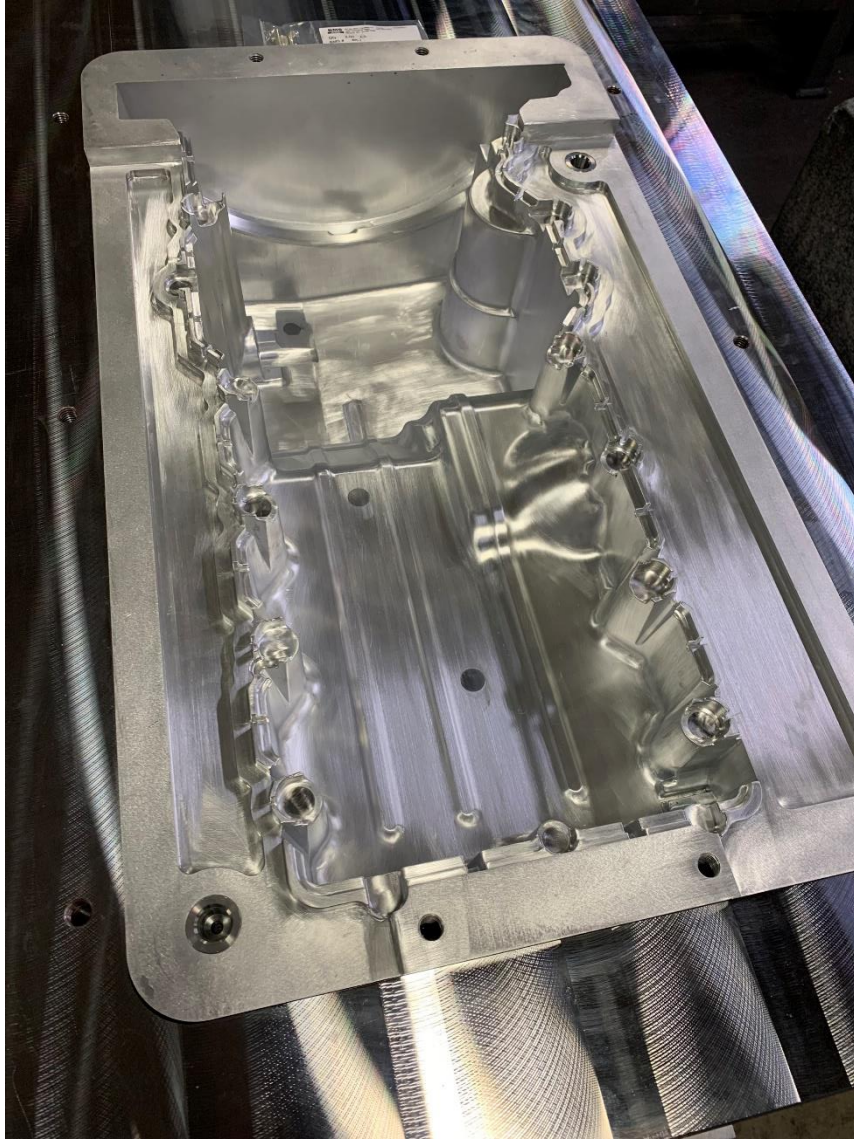
FEA using Provided Load Cases (Body and oil weight). Stress is in MPa.



Aluminum Tooling Supplied by AES



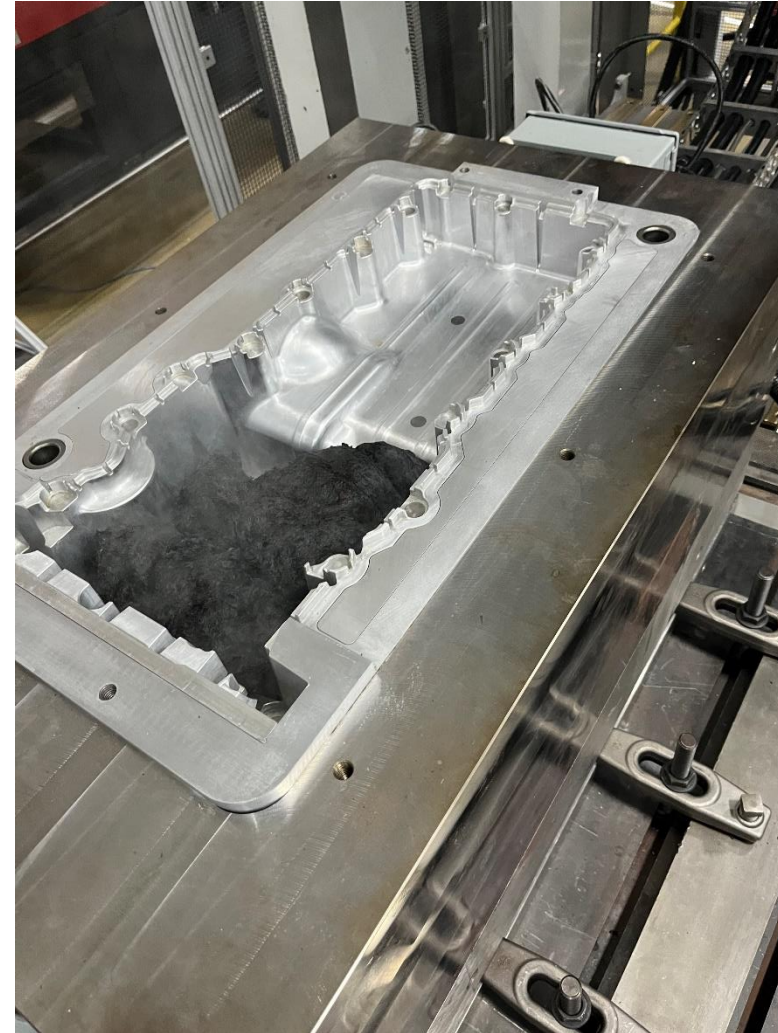
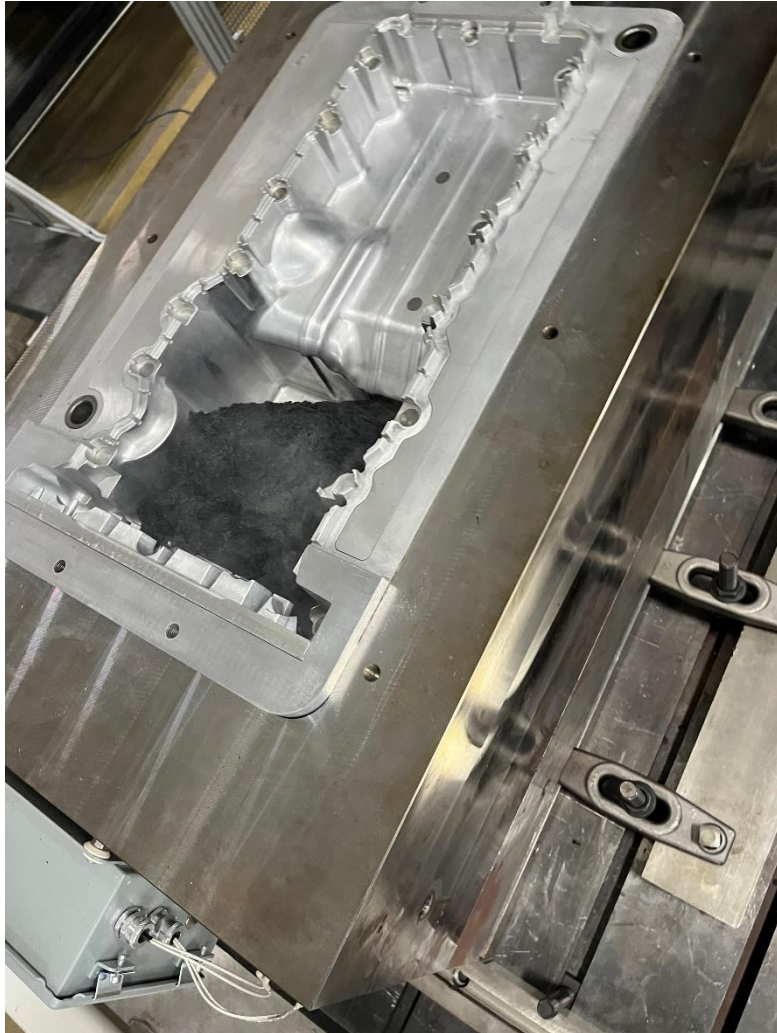
Aluminum Tooling Supplied by AES



Material: Solvay Amodel AXS-1655 (aka PXM=18179)

- Amodel® XAS-1655 is a highly-filled glass fiber and recycled carbon fiber polyphthalamide (PPA) designed to work in the modern automotive environment. This grade features high heat deflection temperature, high flexural modulus and high tensile strength, as well as excellent creep resistance and low moisture absorption.
- Charge ~ 13 lbs
- Mold Temp ~ 150 C
- Tonnage ~ 375 t
- Time ~ 120-180 seconds
- Tensile Strength ~ 275 MPa at 23C, 125 MPA at 120C
- Thank you Sandra!!!

Processing at MDF: Charge from Extruder Placed into Mold



Short Shot Parts



Backing Plate used to Create Ribs on Front Face



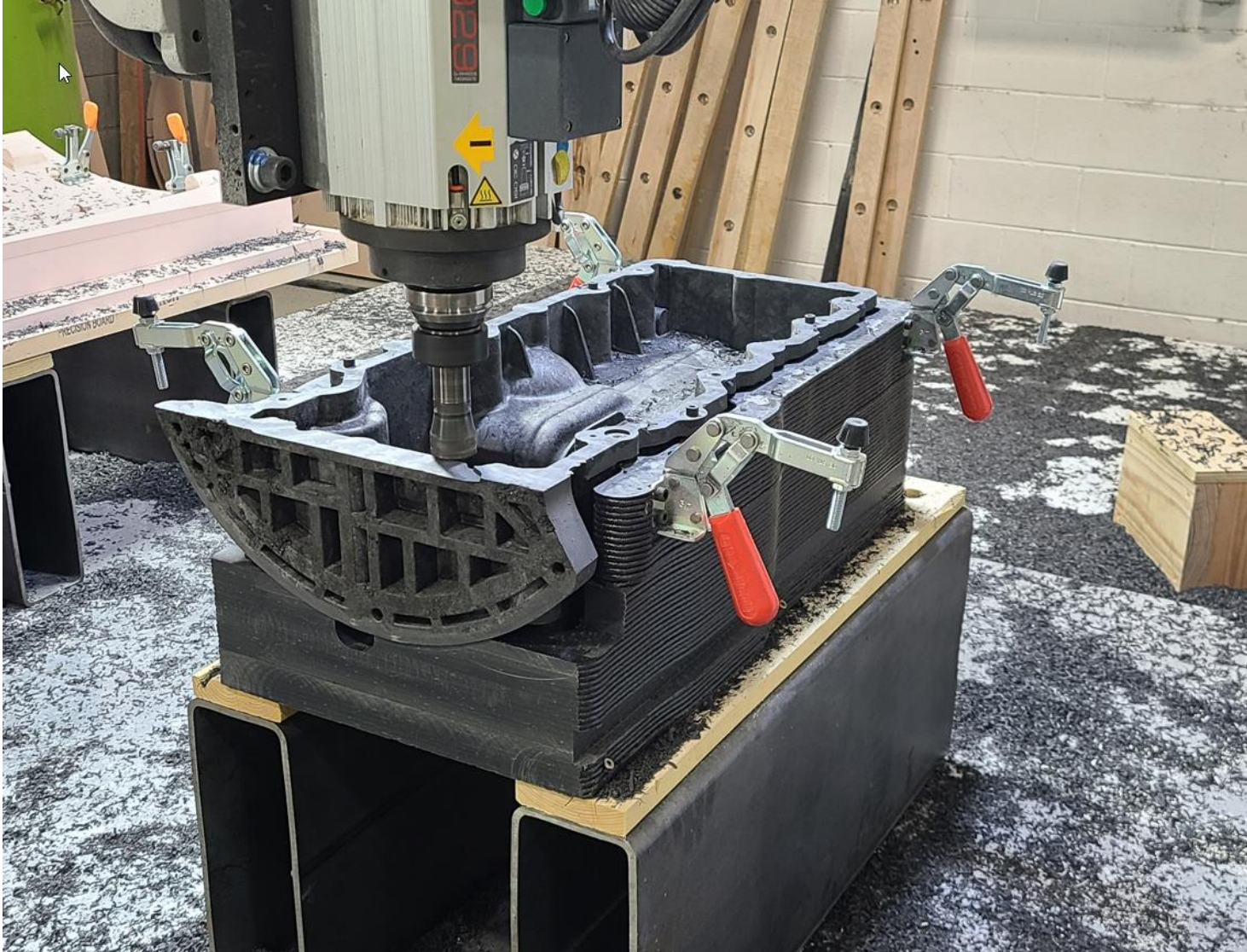
Full Part Deflashed for Shipment to AES



Machining at AES to obtain Exact Dimensions



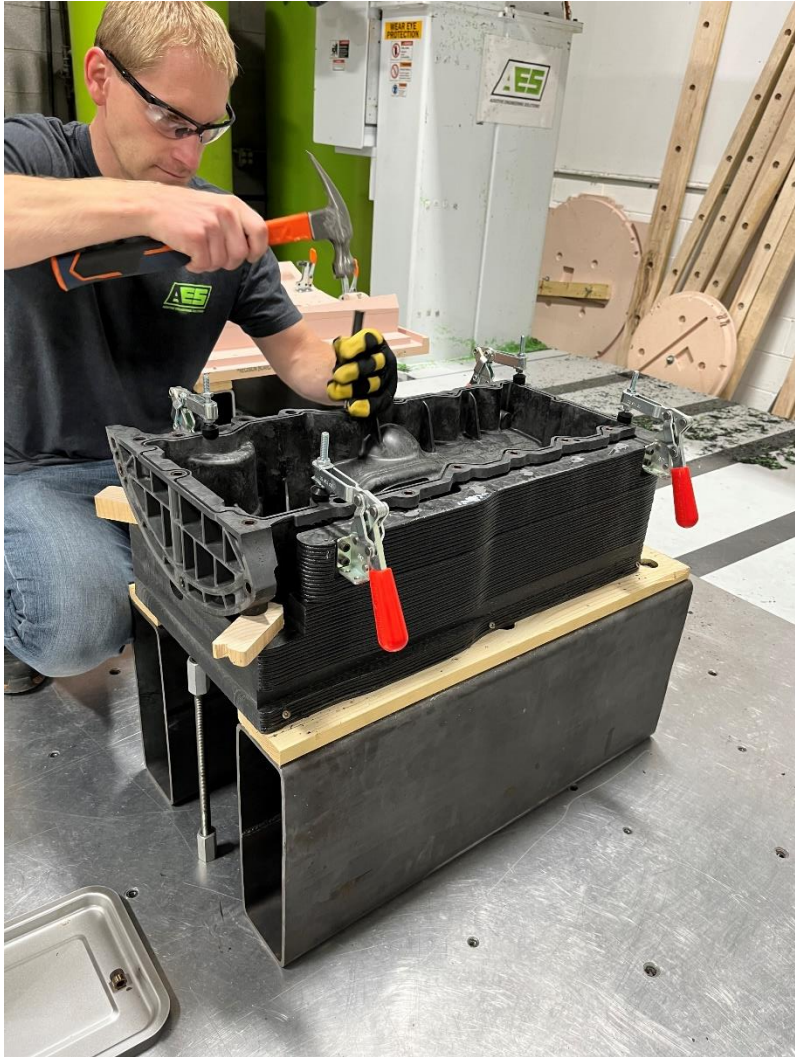
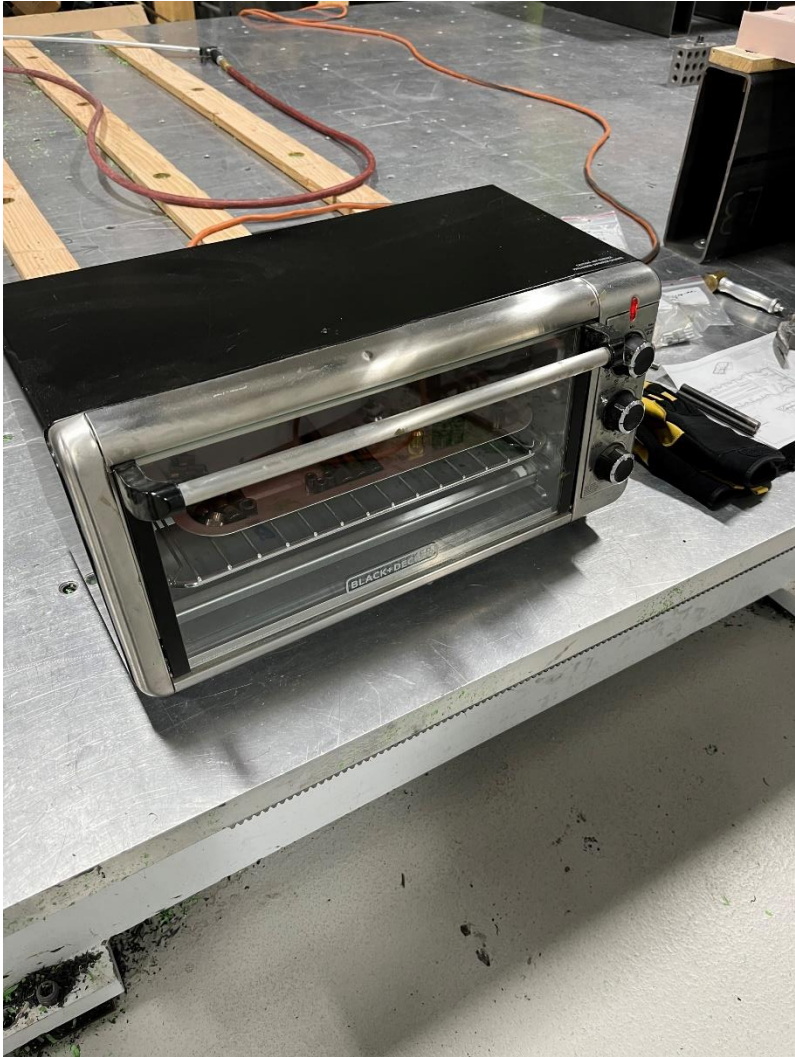
Machining at AES



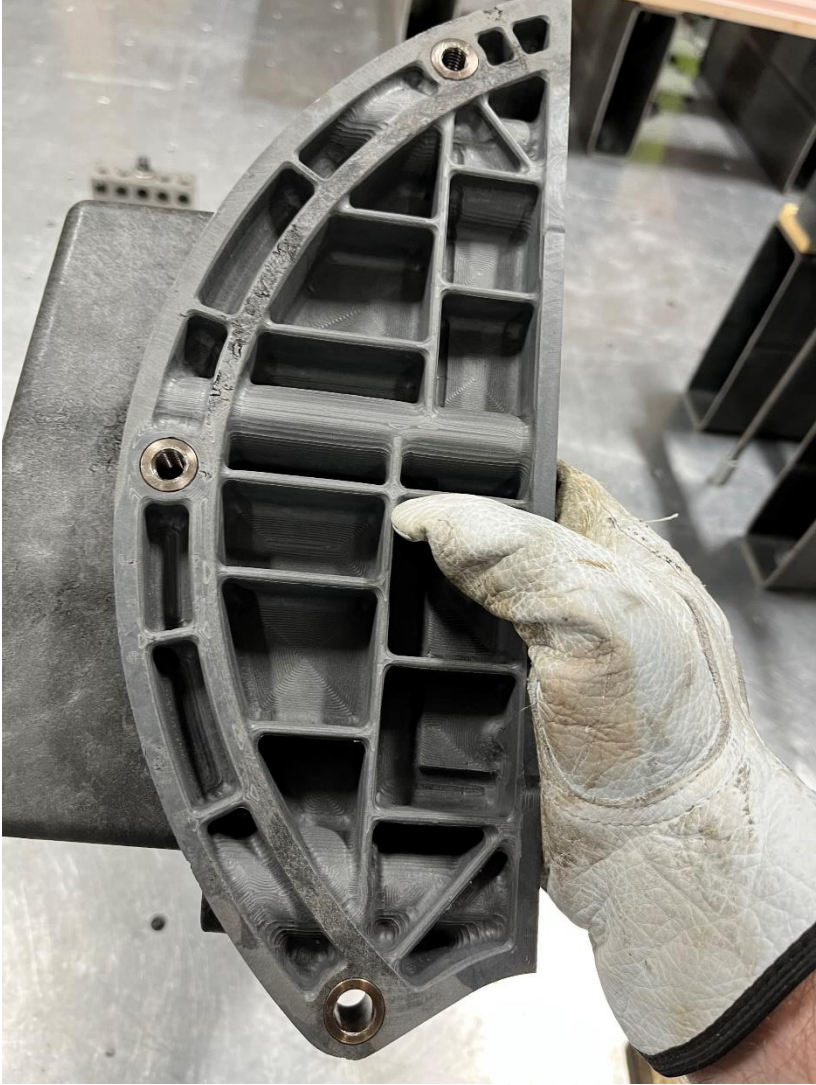
Machining at AES



Bushing Insertion at AES



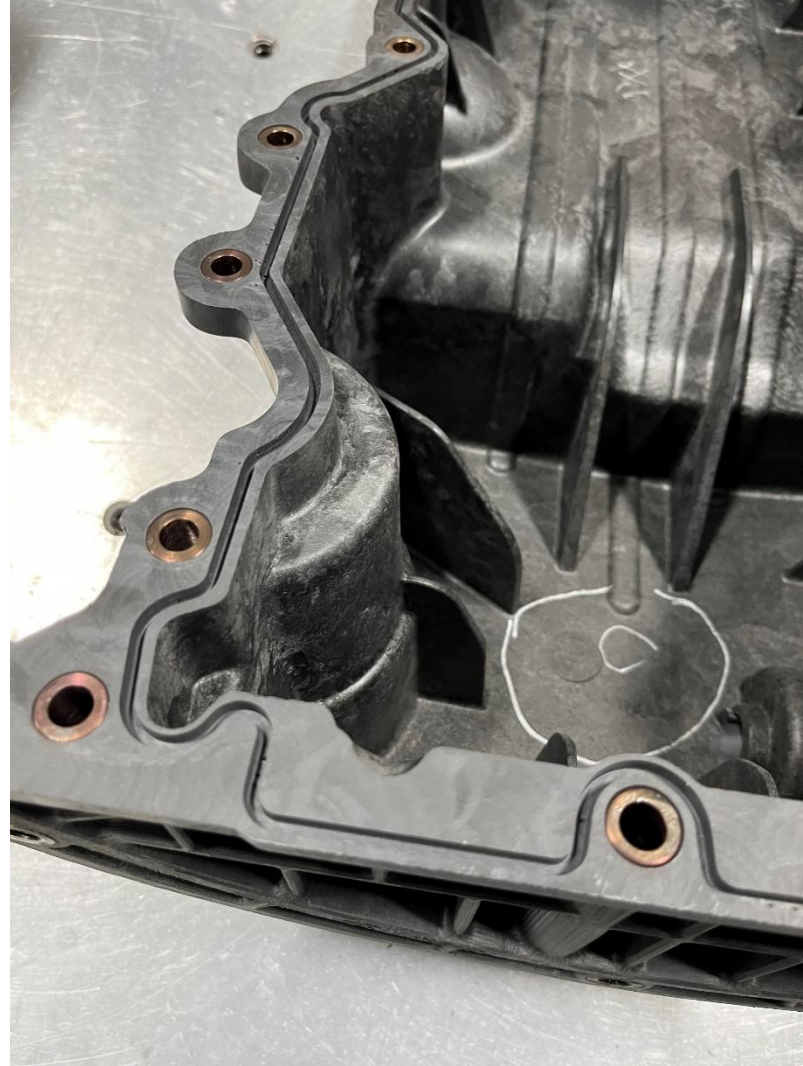
Bushing Insertion at AES



Bushing Insertion at AES



Bushing Insertion at AES



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- ORNL (Vipin Kumar and Nikolaos Tsiamis)