DDA ENGINEERING

DESIGN - DEVELOPEMENT - ANALYSIS

Water Jacket CFD Modeling

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Outline

1. Purpose.
2. Waterjacket Core Model and Set Up.
3. Gasket Options Studied.
4. Results Summary.
    a. Gasket Flow.
    b. Convective Head Transfer Coefficient Contours.
    c. Wall Pressure Contours.
    d. Velocity Sections.
5. Summary.

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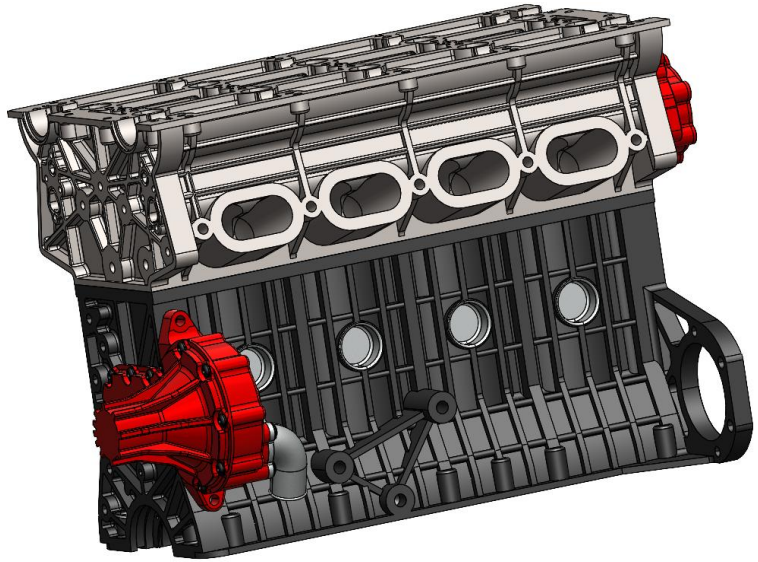
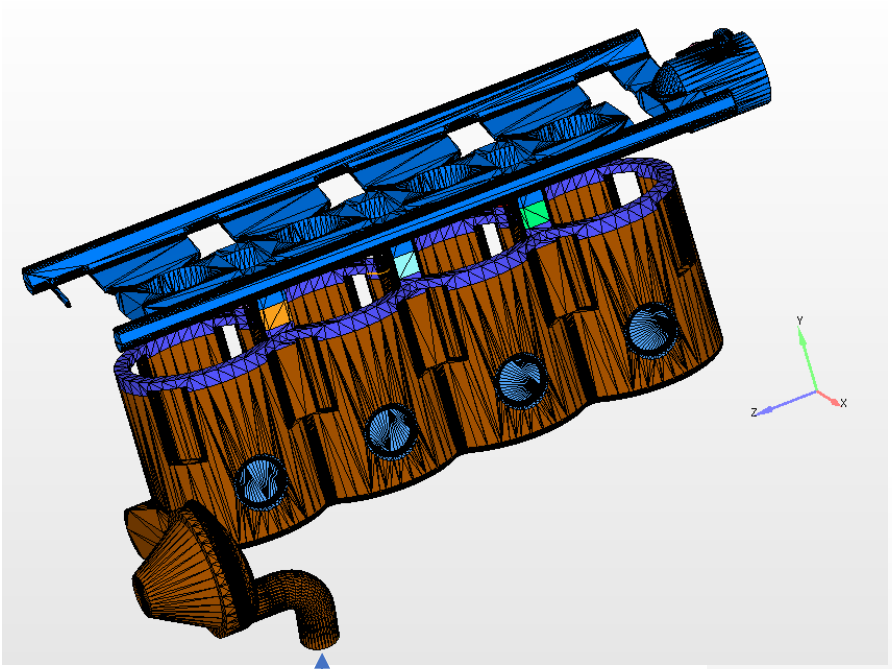
Purpose

1. Evaluate the Balance of Water Flow Throughout the Waterjacket of a Generic Four-Cylinder Engine.
   a) Mass Flow Through the Head Gasket Passages.
   b) Pressure Distribution.
   c) Convective Heat Transfer Coefficient on Wall.

CAD Model and Water Jacket Core Models

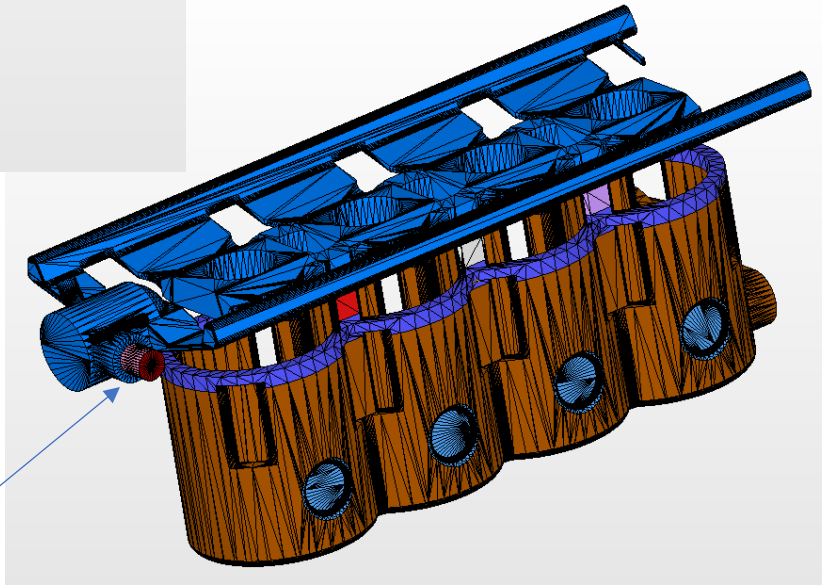
Block and Head Assembly





Water Pump Inlet, Impeller was not included as part of this model, flow rate was set to 2.29 kg/s or 36 gpm

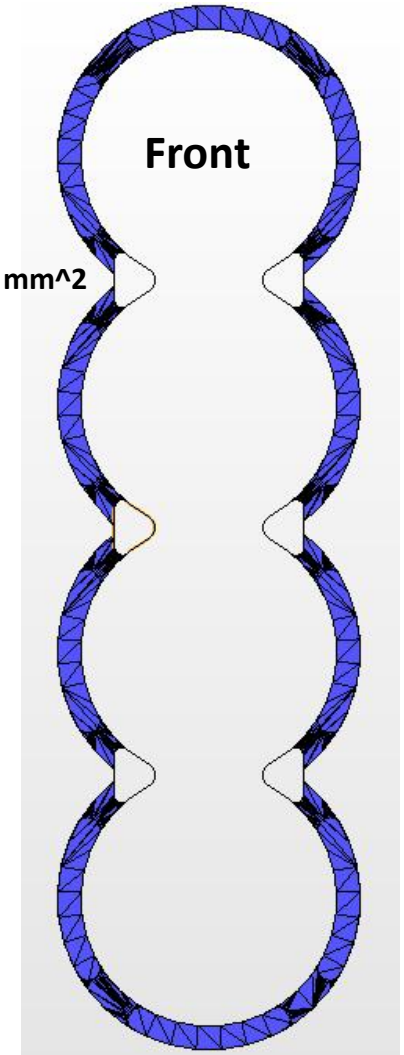
Water Jacket Core



Thermostat water outlet, area was set to obtain desired restriction of 186 kPa (abs) or 12.9 psig.

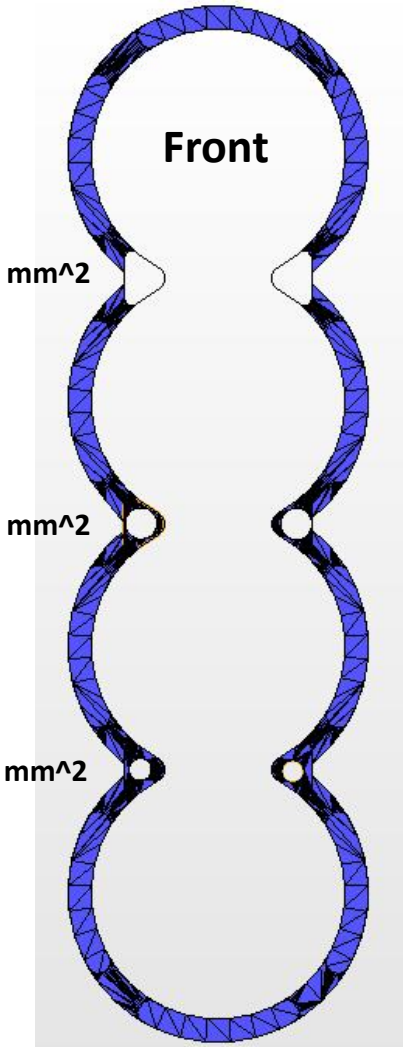
Gasket Area Options Studied

Baseline



6 X 230 mm^2

Option 1

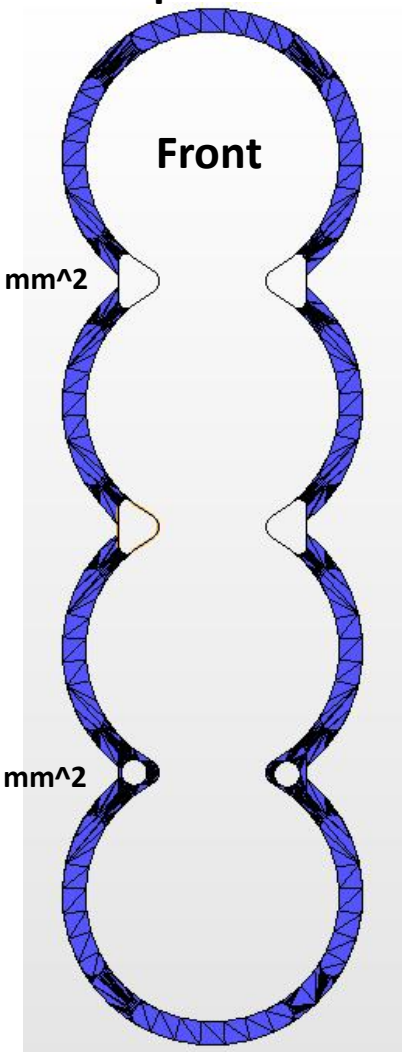


2 X 230 mm^2

2 X 115 mm^2

2 X 57.5 mm^2

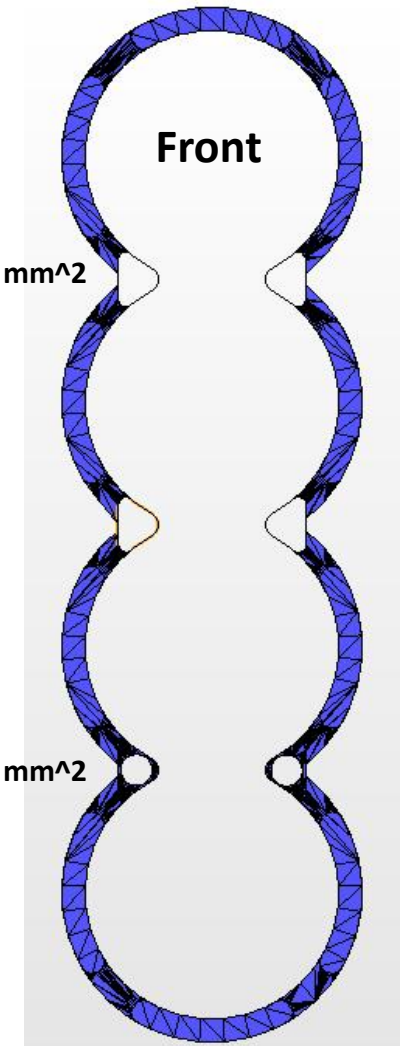
Option 2



4 X 230 mm^2

2 X 76.7 mm^2

Option 3

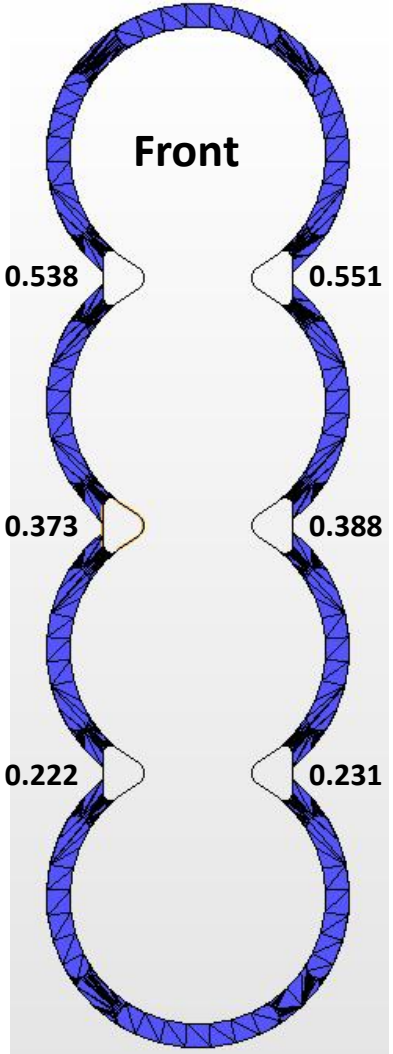


4 X 230 mm^2

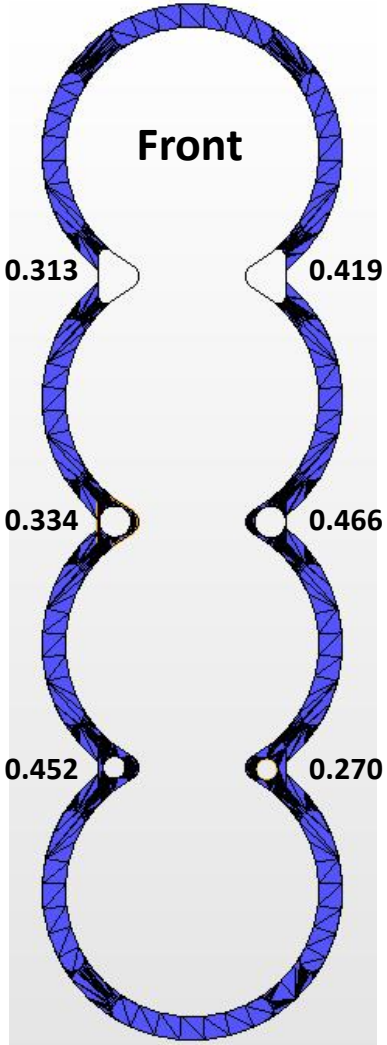
2 X 115 mm^2

Gasket Area Options Flow Rate Results, Ave = 0.381 kg/s

Baseline



Option 1



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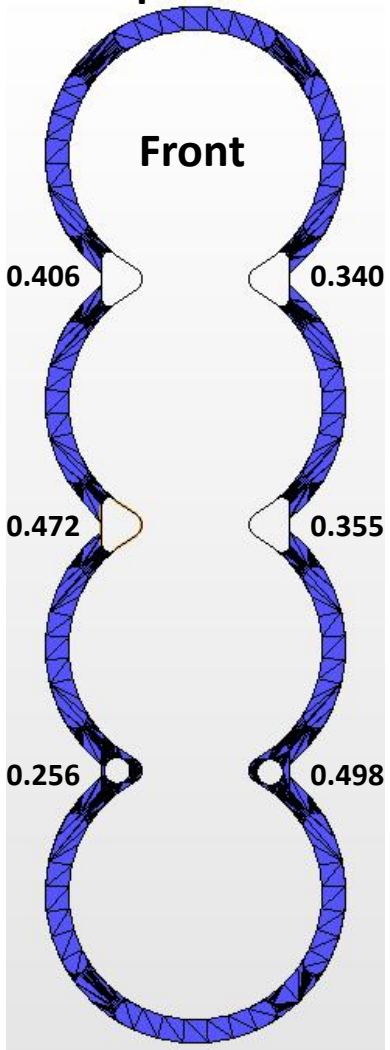

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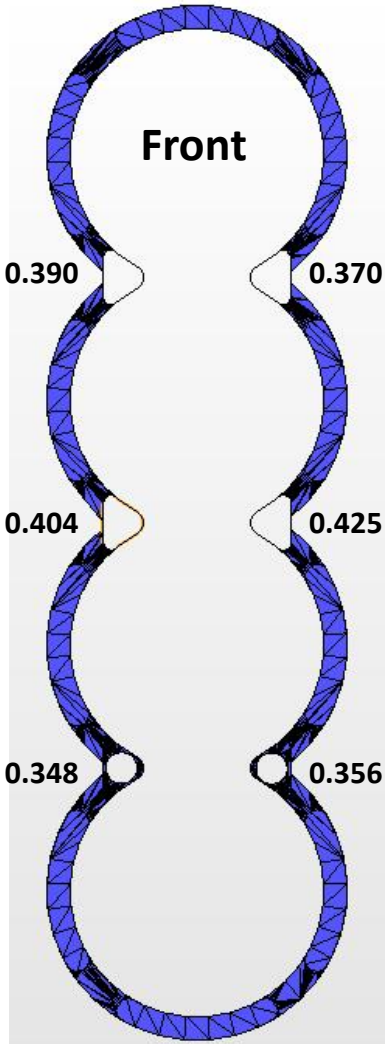
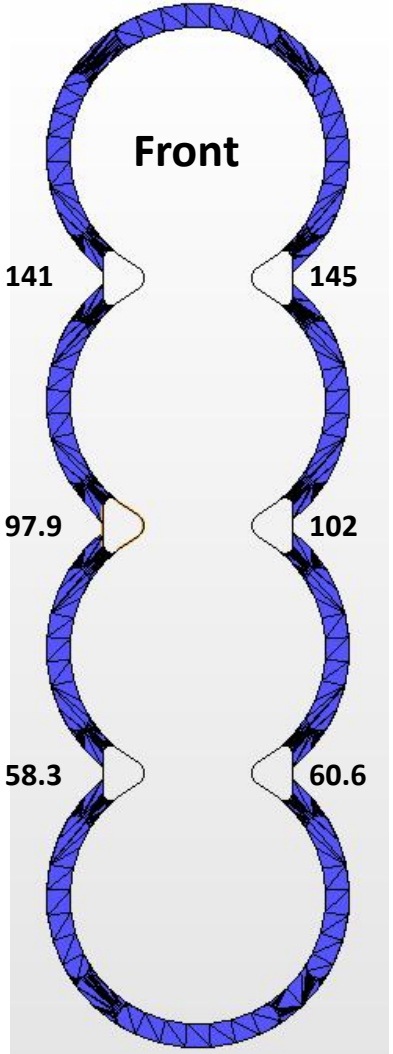
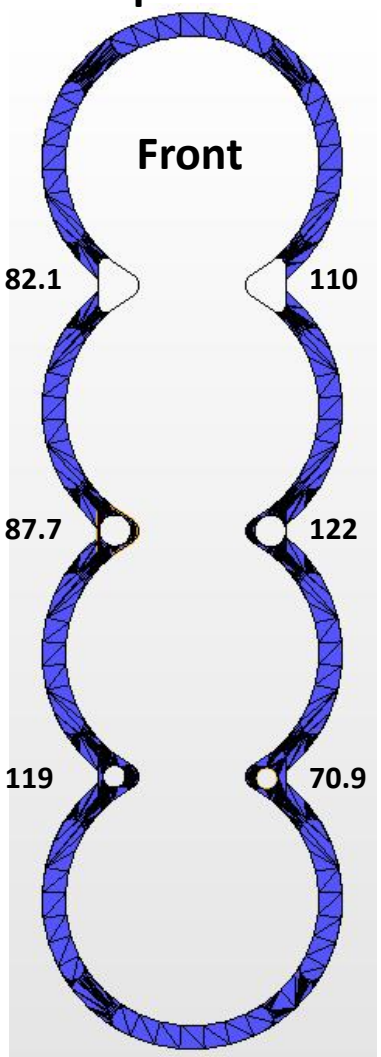
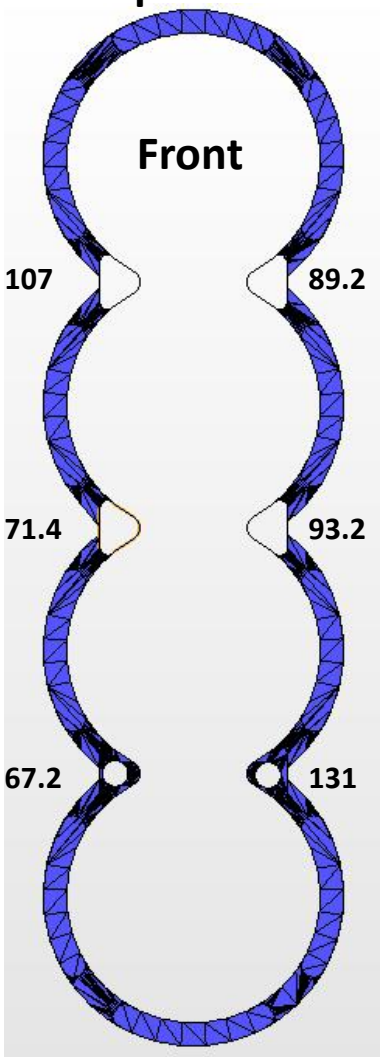
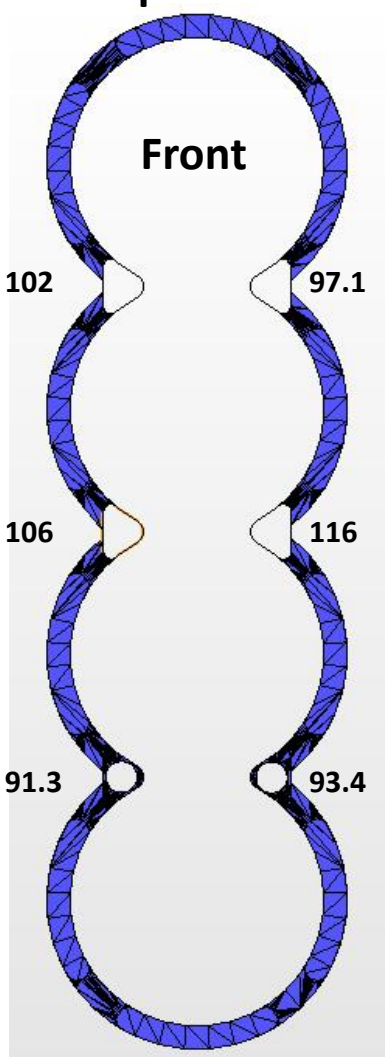


Gasket Area Options Flow Rate Results, % From Average

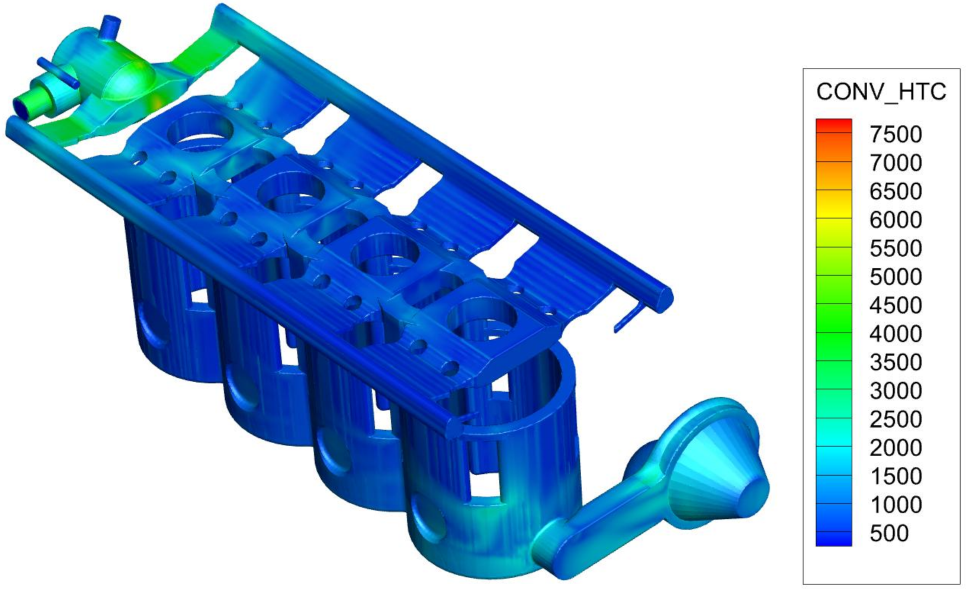


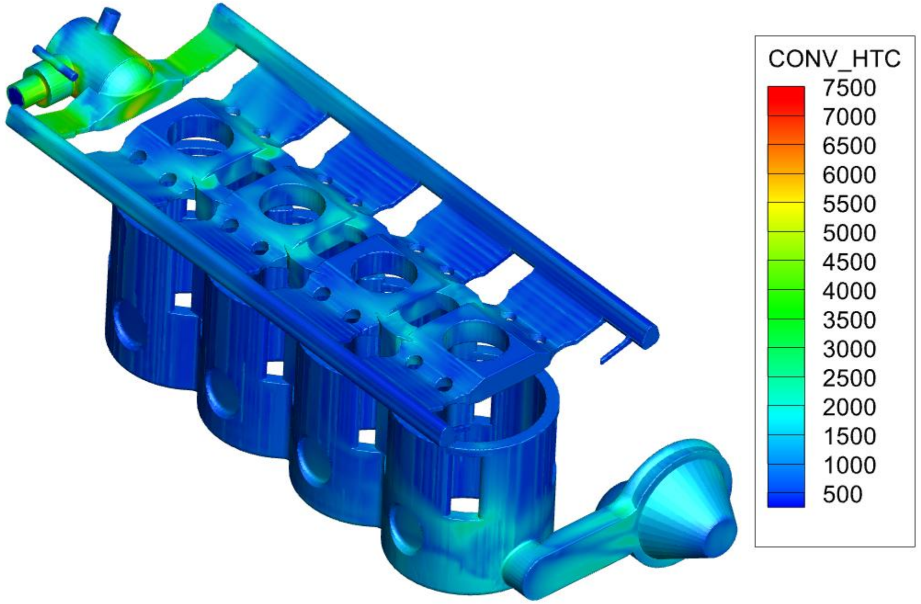


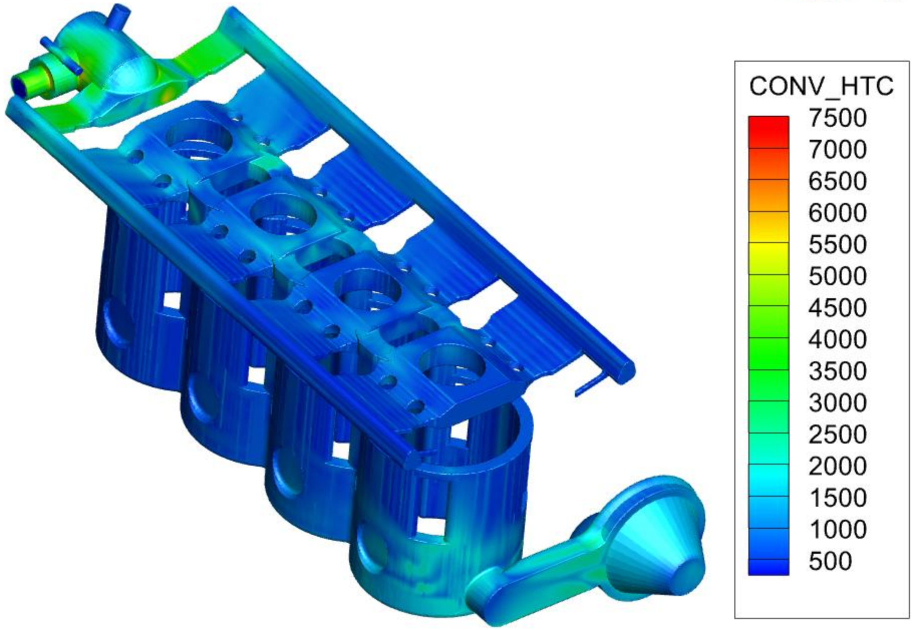


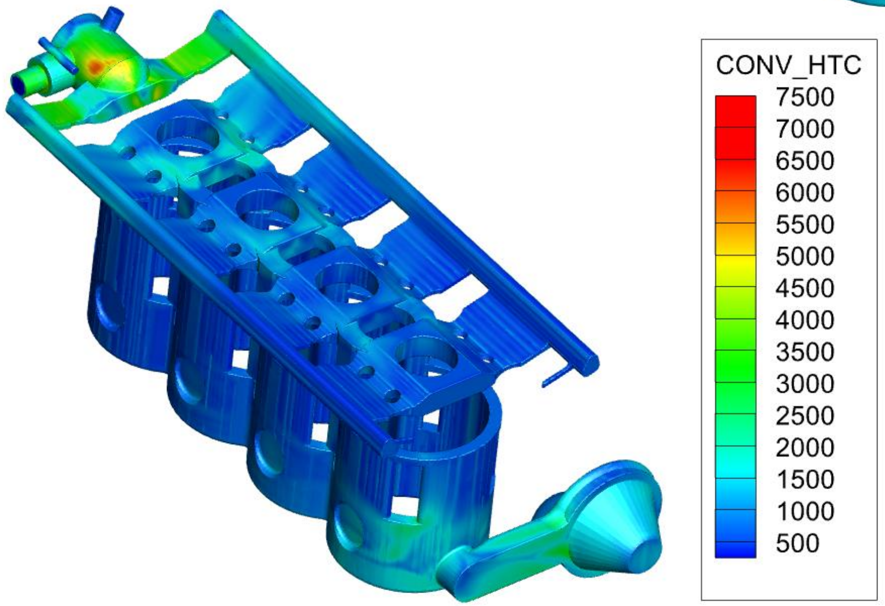


Convective Heat Transfer Coefficient

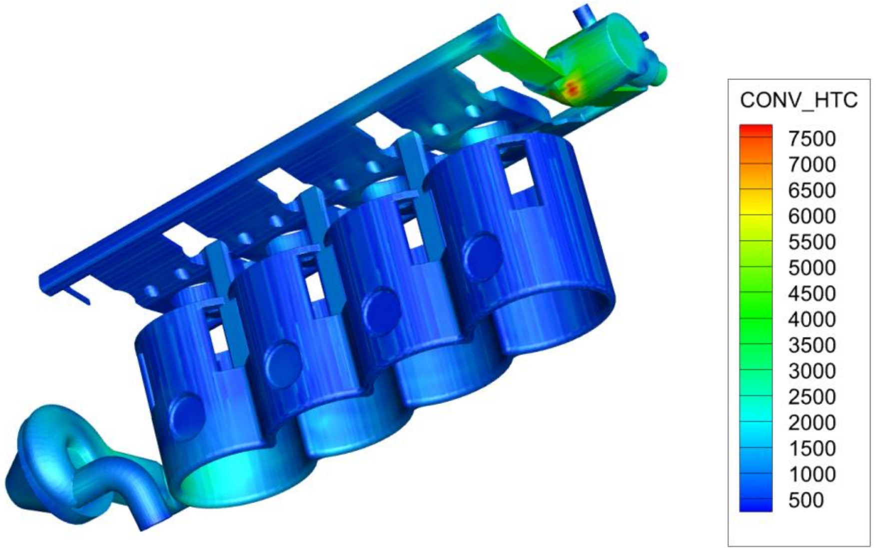


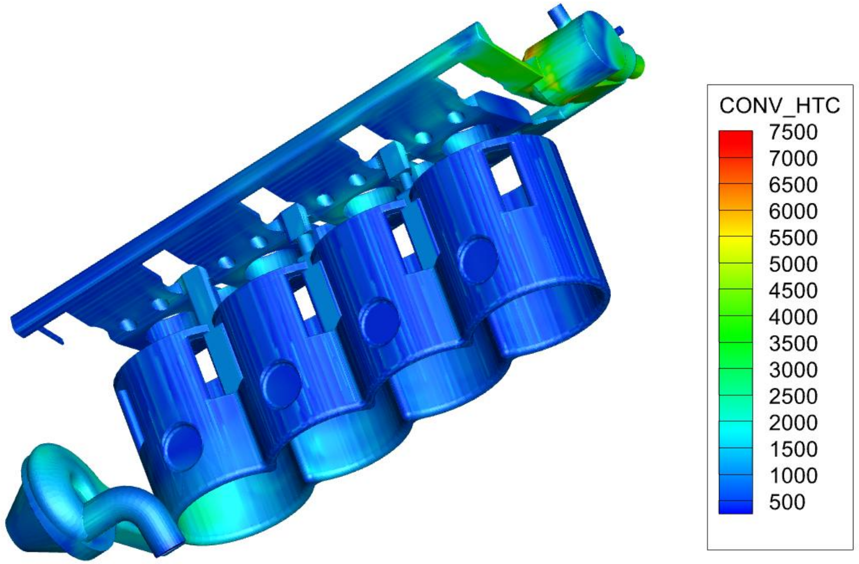


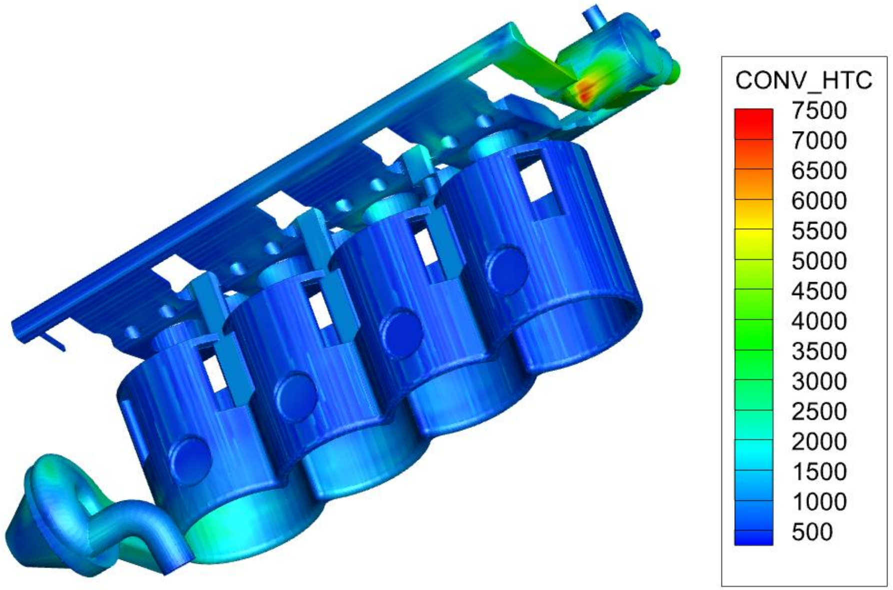


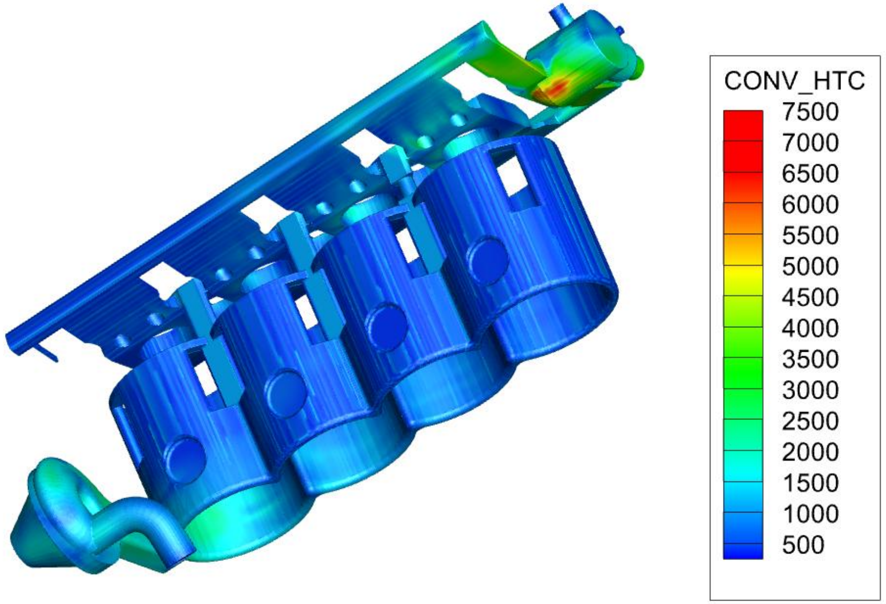


Convective Heat Transfer Coefficient

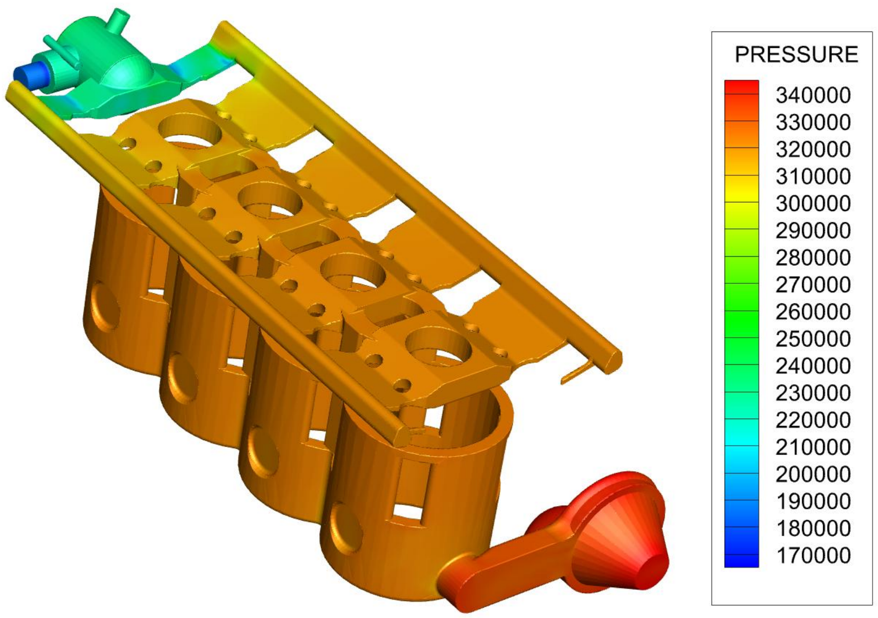


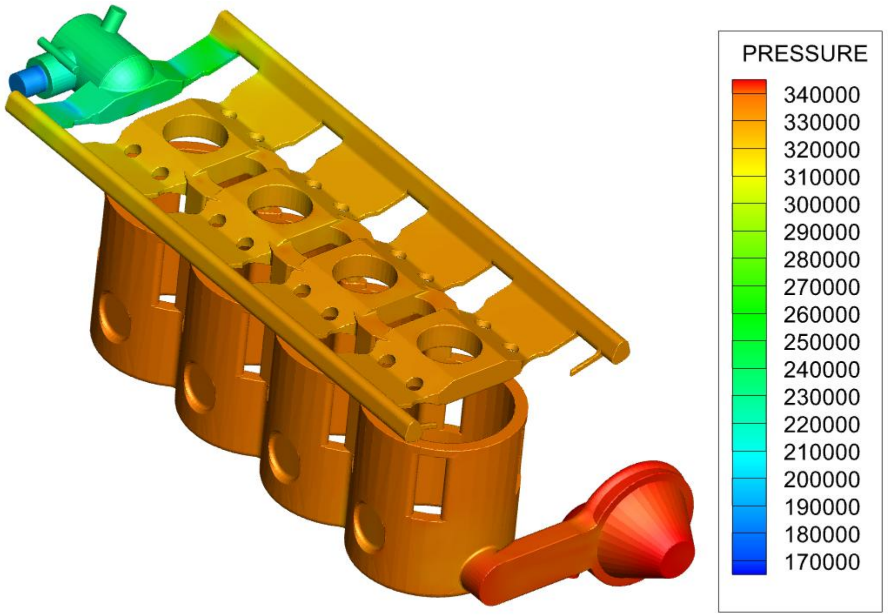


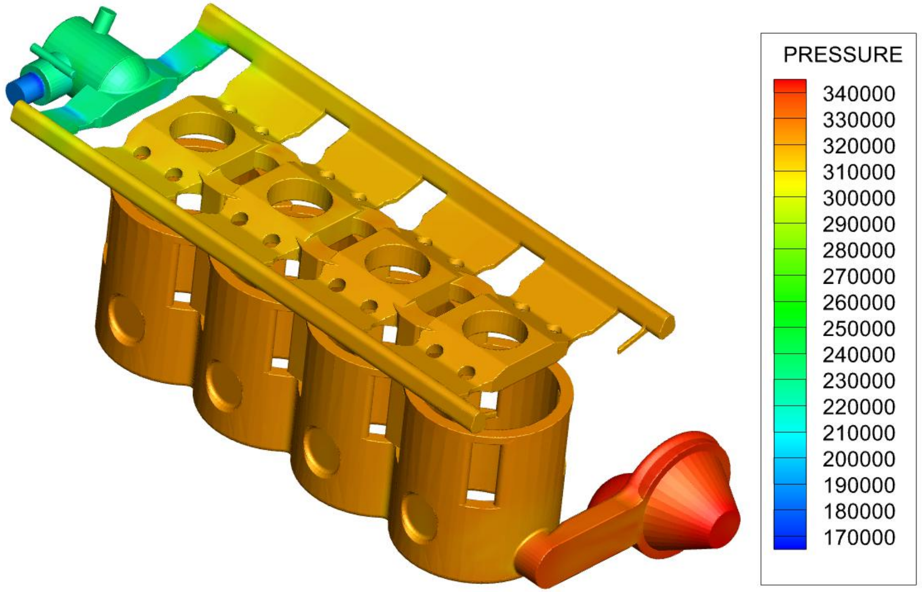


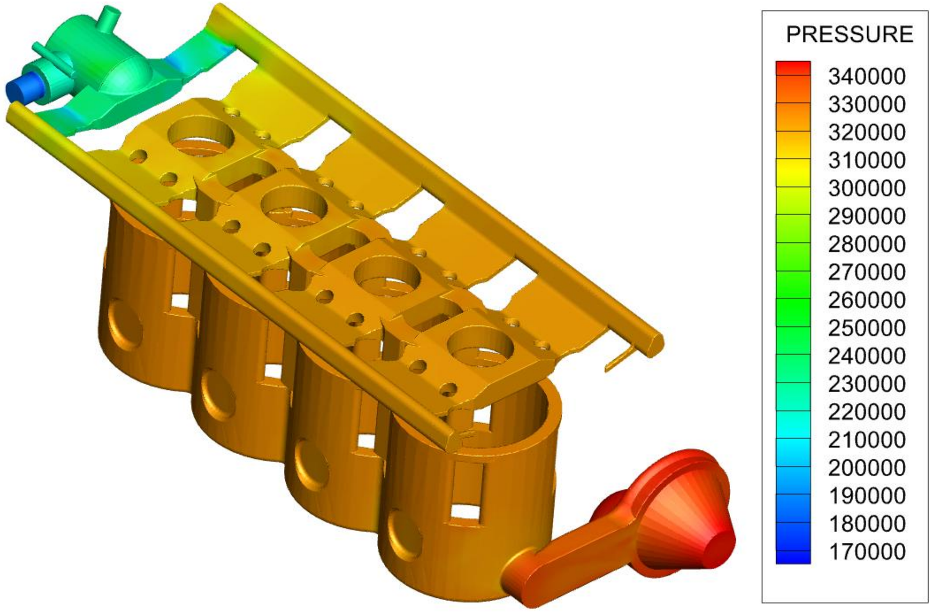


Pressure Contours









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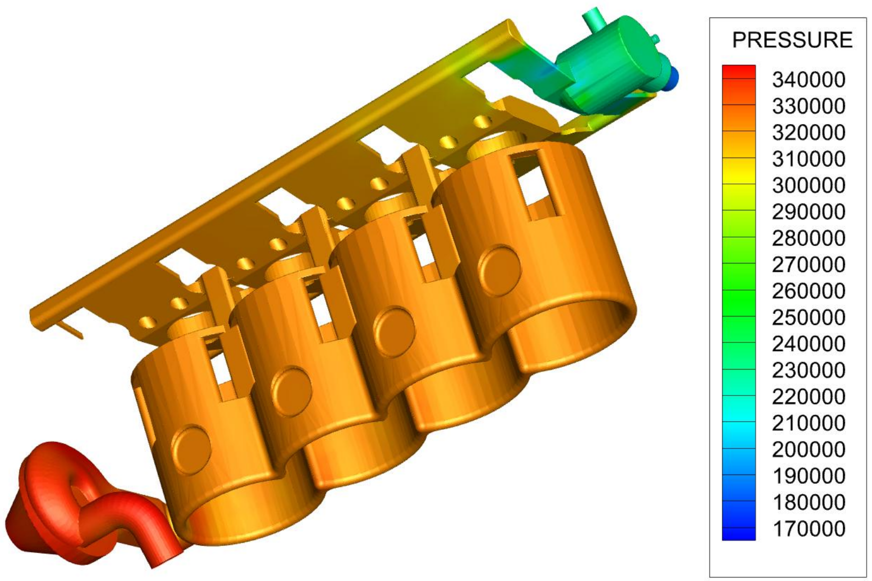
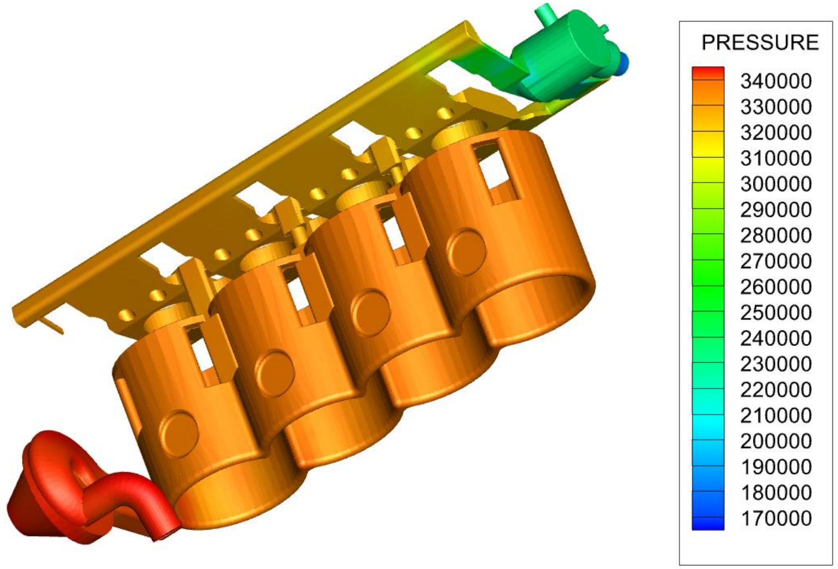
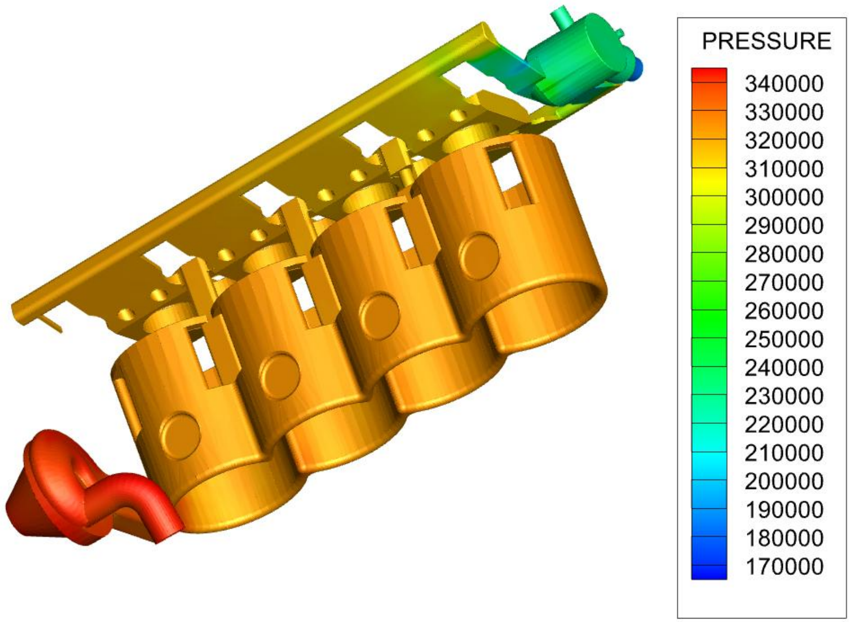
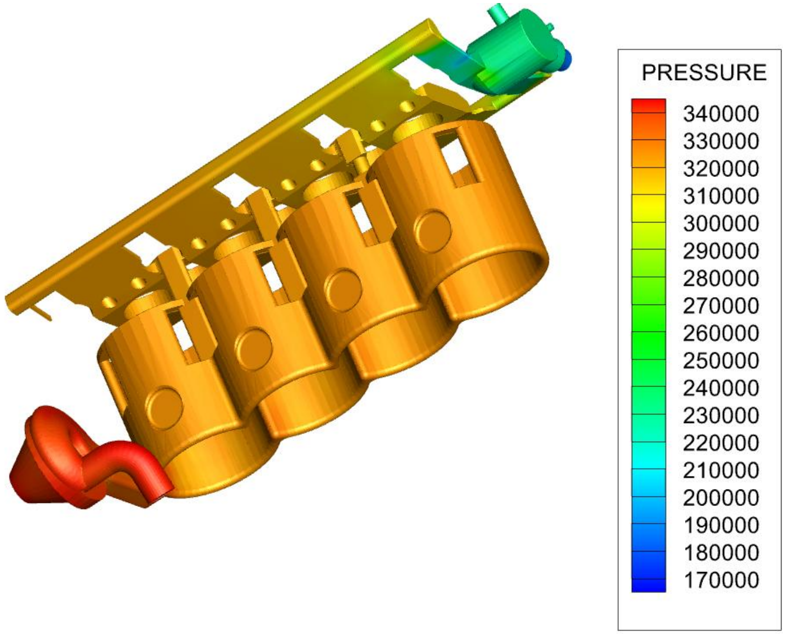
Pressure Contours









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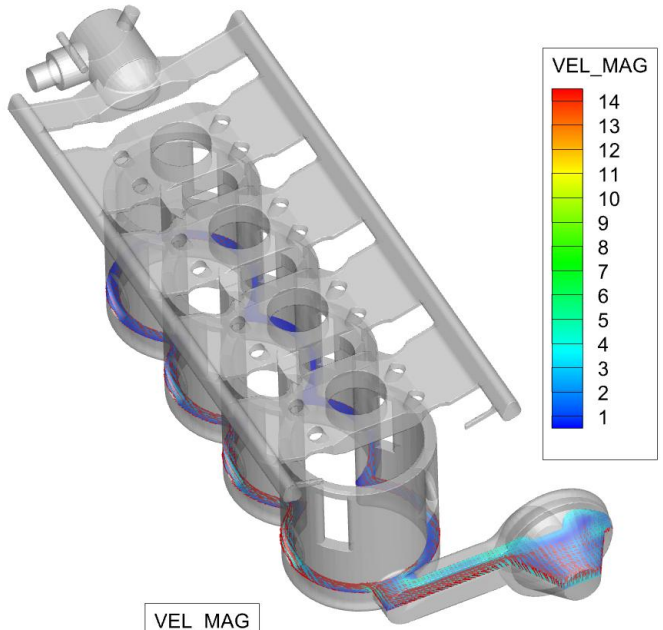
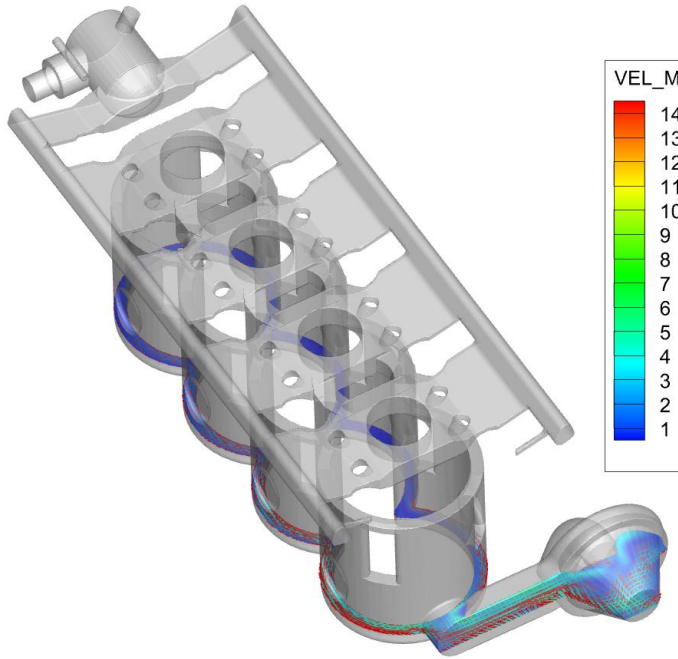
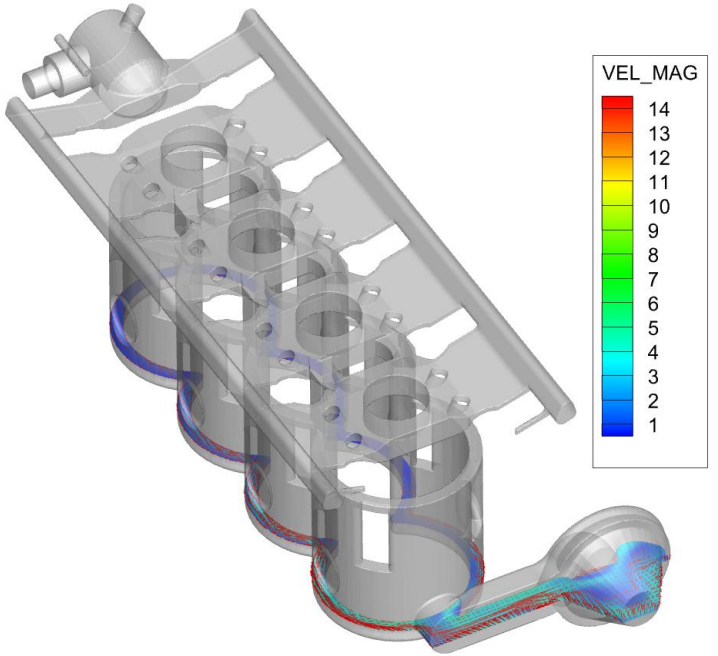
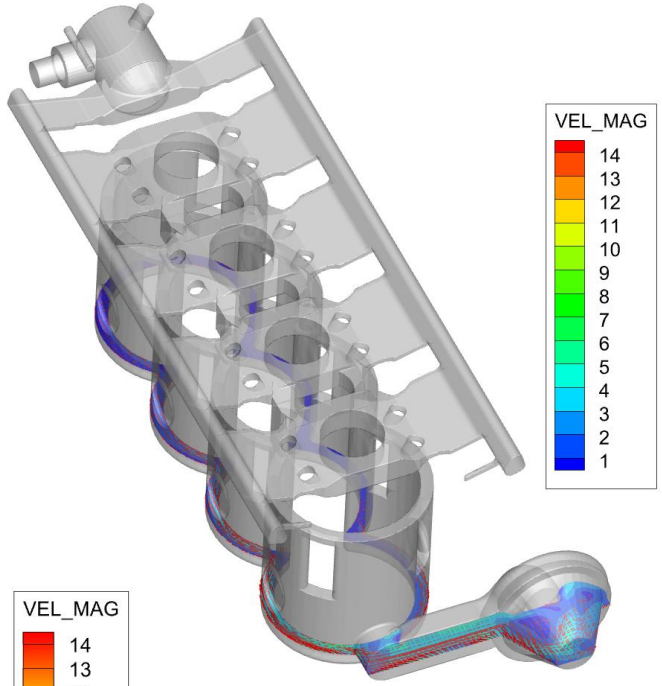
Velocity – Section Through Lower Block

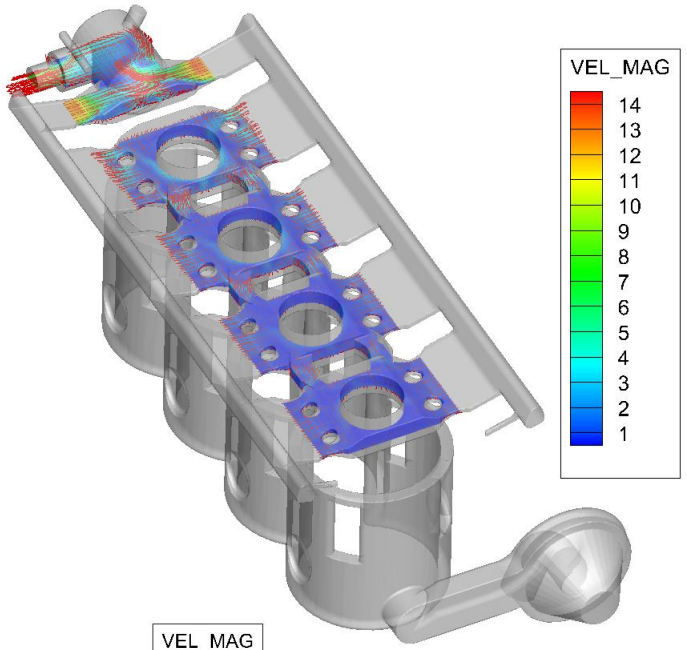


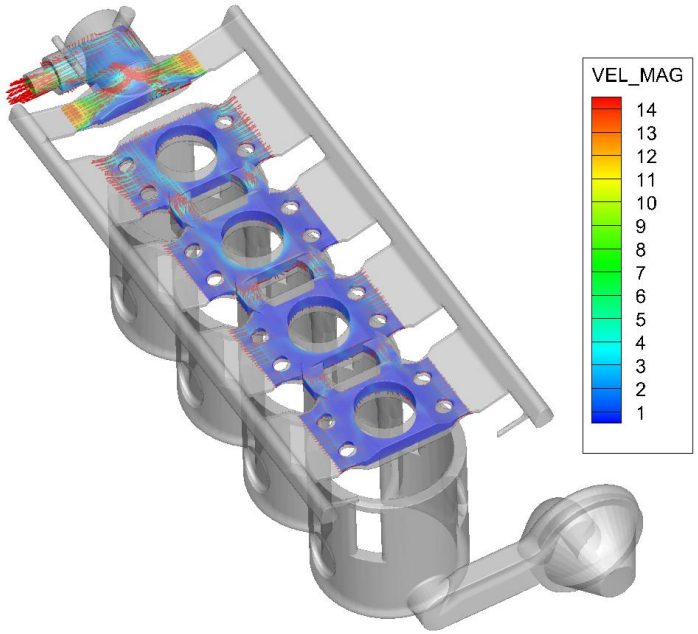


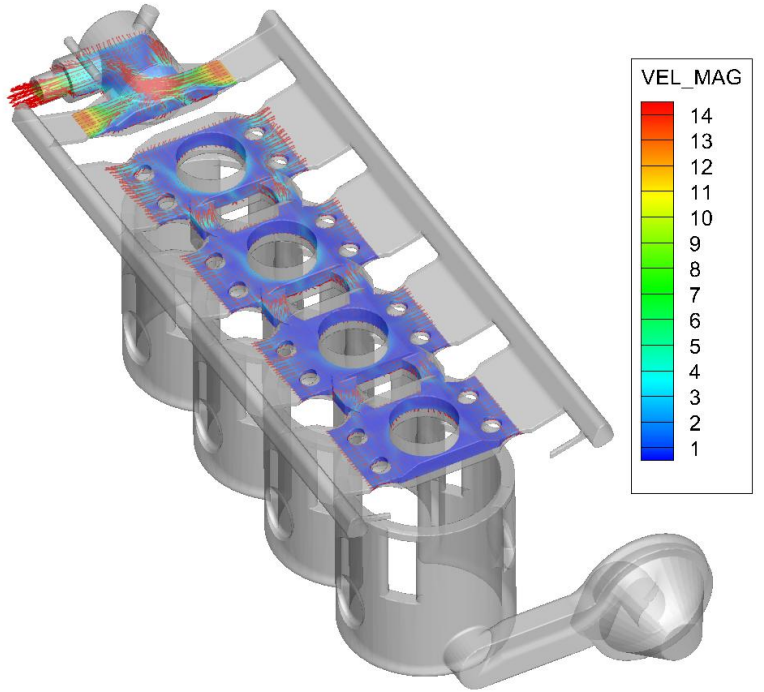


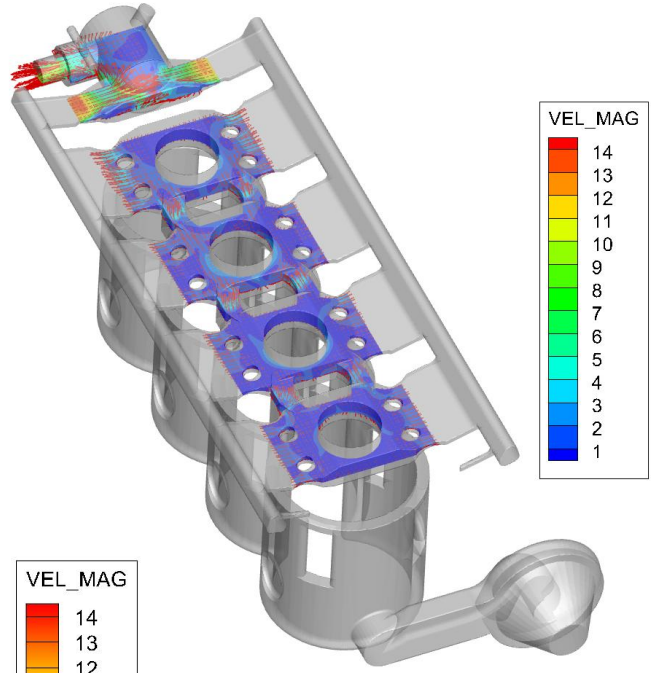


Velocity – Section Through Head









Summary

1. As shown by the models here, engine water jacket systems (or any thermal system) can be modeled effectively this way in a simple and efficient manner with little investment, and much can be learned quickly.
2. In this case, with only making area changes to the head gasket, good improvements can be made in flow uniformity.
3. If more detailed information is required, these models can then be further advanced to a more complete thermal structural analysis.