Flow Modeling Analysis of Heat Exchanger Cuts Two Weeks and $100,000+ From Design Cycle

Case Study

CLIENT PROFILE

Modine Manufacturing Company specializes in thermal management systems and components, bringing highly engineered heating and cooling technology and solutions to the market. The company designs, engineers, tests and manufactures heat transfer products for a wide range of applications. Modine products are used in light, medium and heavy-duty vehicles, HVAC (heating, ventilating, air conditioning) equipment, industrial equipment, refrigeration systems, fuel cells, and electronics. Based in Racine, Wisconsin, the company has approximately 9,000 employees at 34 facilities in 15 countries worldwide with $1.5 billion in revenue.

BUSINESS CHALLENGE

A plate style cooler is a type of heat exchanger used in engine systems. The plate cooler contains dimples which provide structural support but may impede the coolant flow. The engineering goal was to come up with an optimal shape for the dimples as well as their placement to even the flow distribution through the cooler. For durability, the flow needed to be directed to the corners to prevent hot spots from developing. Additionally, the pressure drop across the part had to be minimized to improve the fuel economy of the engine. Using a traditional approach to meet these goals, placement of dimples in the cooler would be based on an engineer's experience and judgment then verified by flow visualization testing using prototype hardware. This approach is costly and time-consuming. The challenge for Modine is to lower both the product development time, as well as the associated costs, without sacrificing product quality by:

- Reducing traditional process cycle time (concept-build-test) for examining local flow patterns
- Eliminating the use of test facilities to select the best design pattern
- Understanding design changes on the flow field beyond only pressure drop measurements

ENGINEERING SOLUTION

By using FloWizard software, Modine engineers were able to:

- Create a virtual prototype of the cooler to carry out the engineering analyses
- Perform in-depth analyses of local flow patterns and the overall cooler performance
- Analyze multiple design patterns and chose the one which met or exceeded all performance requirements

RESULTS ACHIEVED

- Successfully analyzed multiple design patterns within several days rather than several weeks for hardware-based prototype verification
- Reduced design cycle time from three days to four hours per design change
- Eliminated testing of conceptual hardware, resulting in cycle-time and cost savings of two weeks and hundreds of thousands of dollars for tooling
- Resolved local flow features at a level of detail not possible through traditional testing methods
- Improved part durability by providing the best flow distribution to eliminate low flow areas and hot spots
- Improved engine fuel economy by minimizing pressure drop, i.e. parasitic losses

MODINE
APPLIED THERMAL INNOVATION™

COMPANY

Modine Manufacturing Company

Racine, Wisconsin USA

www.modine.com

INDUSTRY

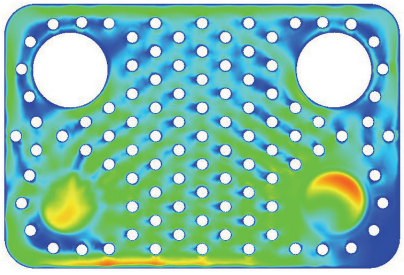
Thermal management systems and components

SOLUTION

FloWizard Software

KEY IMPACTS

- Significant design time reduction
- Engineering cost savings
- Knowledge of how to steer the design changes in the right direction, gained through detailed qualitative and quantitative understanding of the actual coolant flow



Velocity magnitude contours showing the actual flow distribution in a cross-section plane of a cooler; plots such as this help engineers assess flow uniformity and possible locations of hot spots during the design phase

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