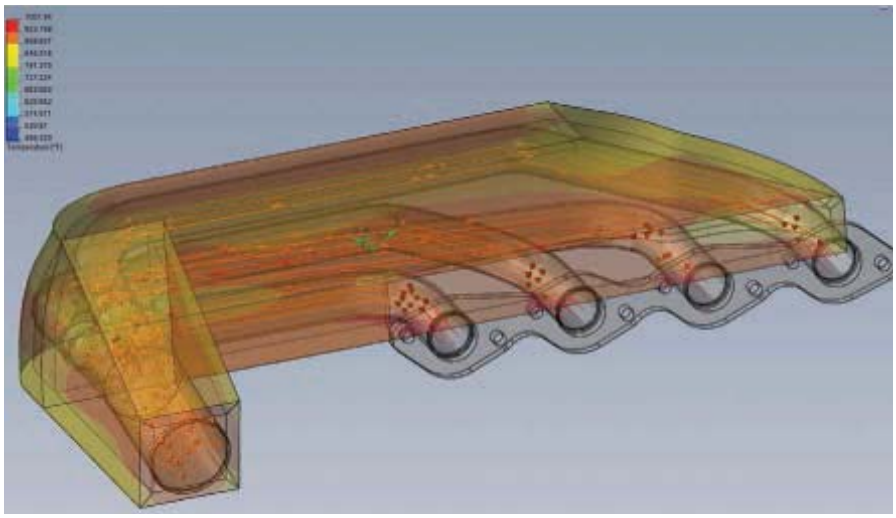


To understand how heat moves through an exhaust system, Firwin Corp. has developed its capabilities in heat flow analysis. This allows the company, a supplier of blanket-type and hard-coat insulation products, to more effectively engineer application-specific insulation systems for stationary and mobile engine systems.

GOING MORE WITH THE FLOW

Firwin finds heat flow analysis capability key to meeting growing engine insulation challenges

Insulating engine components such as manifolds, turbochargers, exhaust and aftertreatment systems with blanket-type or hard-coat insulation can be a fairly straightforward process for experienced insulation manufacturers. Provided with the dimensions of a particular manufacturer's engine and the specific exhaust components, exhaust temperatures and a desired heat reduction level, the appropriate insulation solution can often be found without the need for sophisticated analysis.

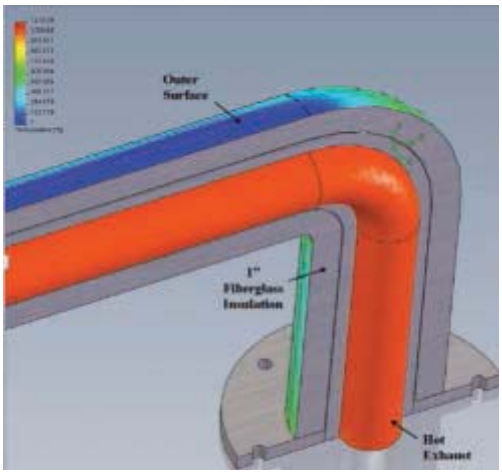
This is especially the case as many insulation suppliers maintain extensive libraries of engine and component patterns and are already familiar with a particular engine's characteristics. They are also able to deal with constraints such as clearance, nonstandard modifications and customized changes compared to specifications.

Yet as engine exhaust temperatures trend upward, and exhaust systems become more complex due to increasingly stringent emissions control requirements, some insulation companies are turning toward sophisticated heat flow modeling when validating an insulation solution. That's been the experience for Firwin Corp., which specializes in insulation systems for engines in stationary and mobile applications.

"When a company is designing a new exhaust system, with space and cost constraints, they often would like to see the effects of different variables on the temperature of the exhaust along the various parts of the exhaust system," said Joash Katsivo, a design engineer at Firwin. "This is where our ability to perform computational fluid dynamics (CFD) using flow simulation software can be extremely useful, especially to companies requiring this type of analysis, but who do not have the ability to do it themselves in-house."

Firwin has been developing its heat flow modeling and analysis capabilities over several years. During that time, it has extended its 3-D modeling capability by integrating with finite element analysis (FEA) software that provides meshing capability on top of existing 3-D models. This can provide a detailed analysis of heat flow under a variety of conditions relative to a specific application.

"The analyses are meaningful where the customer is dealing with boundary constraints close to critical, taking into account their level of comfort and the demands of the application," said Jon Miles, Firwin's senior design engineer. "These demands often are the need to effectively insulate to achieve a specific cold surface temperature in a confined space. Other factors are protection of electronic sensors, ensuring a level of fire prevention safety and maintaining acceptable ambient temperature conditions in the engine compartment and adjacent areas."



The configuration of exhaust piping, bends, elbows, etc., can significantly impact how heat flows through exhaust systems. Through the use of heat flow analysis systems, a more accurate assessment of real-world conditions can be made, which can affect the type and configuration of thermal insulation selected.

Thermal flow analysis can also be used to compare different insulation products under similar conditions to find the product offering the best solution and meet the customer's expectations, Miles added.

Previously, suppliers were limited to performing relatively simple analyses on straight pipe systems due to the complexity and number of variables involved in computing heat flows. Computing power is now commonly available that allows CFD to account for the number of variables required for a more accurate analysis of the heat and flow characteristics of a given exhaust system.

"We are getting closer to being able to simulate the actual operating behaviors," Miles said. "Whereas in the past we were restricted to linear heat flow analysis, we can now more accurately analyze the changes in temperature anywhere along a given exhaust system.

"Furthermore, the system can take into account the configuration of the exhaust system (engine exhaust temperatures, silencers, catalysts, elbows, bends, external heat and cooling sources). This type of analysis can give you the heat changes through a complete cycle over a period of time from engine start through operation time to cooldown time of the engine/vehicle/equipment."

Beyond providing insight into the exhaust, the ability to simulate heat flow analysis can also have significant economic impacts. For original equipment manufacturers, it allows for comparison of different exhaust configurations and helps them make the appropriate insulation decision before even building a prototype.

Miles also cited a recent instance where a company was considering insulating a large silencer in its in-house testing area, as the company was concerned about the heat it would generate in the relatively close environs. "Instead of having to insulate the entire silencer," Miles noted, "a heat flow analysis showed that insulating the top of the silencer only, would suffice for them to achieve the heat containment they were looking for."

A typical heat flow analysis can take two to three weeks, Miles said, depending on the complexity of the model and whether the customer can provide a suitable model for analysis. "Due to the need to get extensive meaningful data from the customer, we find that a number of conversations/communications have to take place to get the required information in order to actually do the analysis," Miles said. "These relate to environment, exhaust gas flow temperature and rate, fuel type, ambient temperature, proximity to adjacent parts and structure and ambient air movement, to list a few relevant factors.

"The latest flow simulation software allows for much more sophisticated analysis than in the past. This, along with our experience with insulation products, gives Firwin the ability to assist companies who have somewhat complex heat flow situations, and who would like data validation for their insulation decisions." **dp**

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