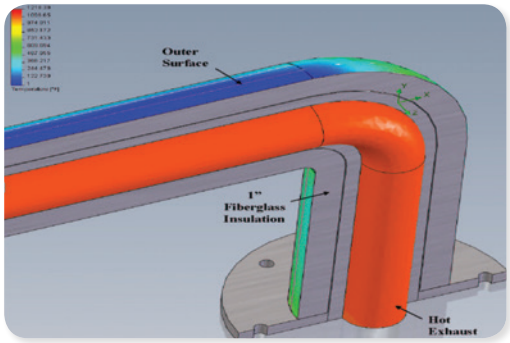
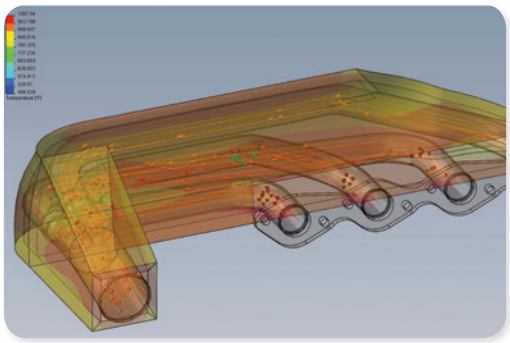
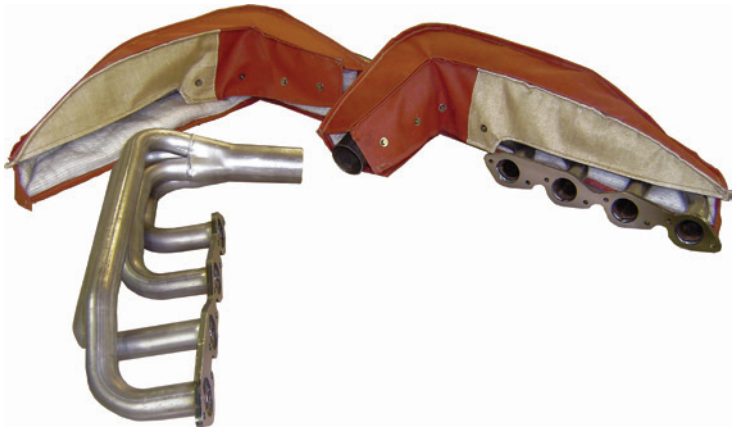
Exhaust Design, Heat Flow Analysis, and Insulation –

Using software modeling to determine the optimal insulation solution for exhaust systems & components.







White Paper

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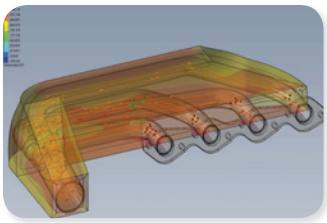


In order to develop application specific insulation solutions for stationary and mobile engine systems, designers and engineers are turning to heat flow analysis, allowing them to understand how heat moves through an exhaust system.

Exhaust Design, Heat Flow Analysis, and Insulation – Using software modeling to determine the optimal insulation solution for exhaust systems & components.

Insulating engine and exhaust components such as manifolds, turbochargers, exhaust piping and after-treatment systems with removable insulation blankets has typically been a fairly straightforward process. Armed with some basic information, such as the dimensions of the components to be insulated, the exhaust temperature, where the insulation will be located (i.e. indoors or outdoors), and the desired touch temperature, an experienced insulation professional can generally identify the correct insulation solution without the need for sophisticated analysis.

Yet with exhaust systems becoming more complex, and engine and exhaust temperatures trending upwards due to increasingly stringent emissions control requirements, engineers and designers are increasingly turning to sophisticated heat flow modeling when validating an insulation solution.

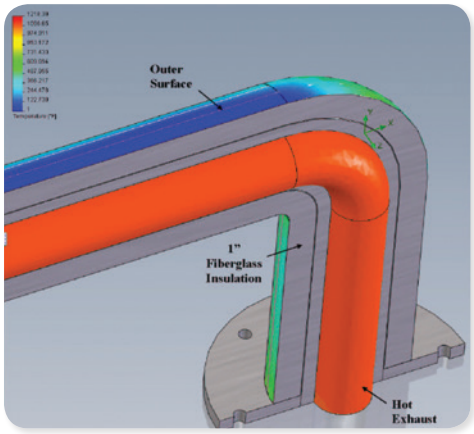
Heat Flow Simulation - Analyzing Real World Situations

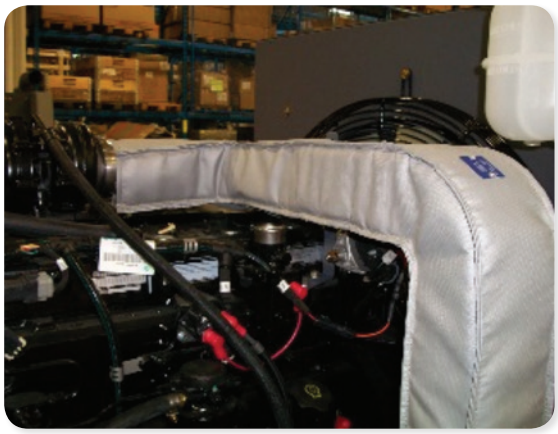
Due to the large number of variables that have to be considered when computing heat flows, modeling real world situations has until recently been somewhat limited to 'steady state analysis' – meaning that a company would be restricted to performing relatively simple analyses on straight pipe systems. However, in the real world, there are many variables that can affect the exhaust temperature, and as a result the optimal insulation solution. For example, the configuration of the exhaust piping (bends, elbows, etc.), the model of the engine, catalyst, silencer, etc., ambient temperature, humidity, air flow, sunlight, emissivity, and other environmental factors.

With robust computing power now commonly available and recent advances in flow simulation software, designers and engineers can now perform "computational fluid dynamics (CFD)" using flow simulation software that allows for multiple variables to be taken into account that might affect the exhaust temperature on even complex exhaust configurations.

The software allows heat flow temperatures to be viewed as the exhaust moves its way through the various engine components, and can account for gradations in temperature anywhere across a given exhaust system. The software can also provide a picture of the heat changes through a complete cycle over a period of time, from engine start through operation time to cool-down time. The result is a much more accurate picture of what the characteristics of a given exhaust system would be in real-life situations. This analysis is especially meaningful for applications that need to meet critical boundary constraints, such as:

- The need to effectively insulate to achieve a specific cold surface temperature in a confined space.
- The protection of electronic sensors.
- Ensuring an appropriate level of fire prevention safety.
- 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 that provides the optimal insulation solution.

Heat Flow Simulation - Savings to Customers' Bottom Line

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

For non OEM applications, there are also situations where a heat flow analysis can prove quite beneficial. For example, a company may want to insulate a large silencer in their in-house testing area because of concerns over the heat it would generate in the relatively close environs. A heat flow analysis could show that instead of insulating the entire silencer body, insulating the top of the silencer alone would suffice for them to achieve the heat containment they are looking for.

Conclusion:

The latest flow simulation software allows for a much more sophisticated analysis than in the past. For companies who have somewhat complex heat flow situations, and who would like data validation for their insulation decisions, heat flow simulation has the ability to factor in multiple variables and thus simulate actual operating behaviours.

For more information on heat flow simulation software and how it can help you arrive at correct insulation solution for your application, please contact Firwin at:

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