

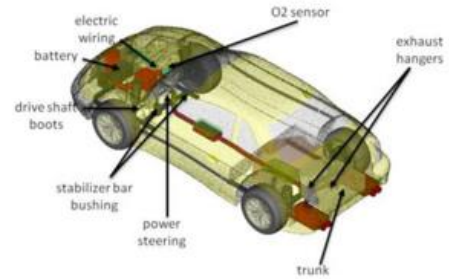
POWERFLOW FOR THERMAL PROTECTION



3DEXPERIENCE®

Safe, Reliable Thermal Management

Many components in a vehicle can become so hot that they can potentially fail or degrade nearby components, leading to serious safety, durability, and warranty issues. Plastic components are being used increasingly to save on cost and weight, but are more sensitive to temperature. Globalization is leading to vehicles or vehicle platforms that must operate in extremely wide temperature ranges. Careful and detailed analysis of component placement and thermal shielding is required to avoid costly late-stage design fixes or, worse, failures when in production.



1.1. Technical Challenges

Vehicle thermal design traditionally depends heavily on prototype testing in thermal wind tunnels or on-road testing with hundreds of thermocouples. The testing process is very expensive, time consuming, and inflexible. Testing involves thermocouple instrumentation that requires test engineers to estimate a priori where thermal problems might occur — but the highly turbulent nature of underbody flows makes this very difficult or impossible to predict. Relying on redesign and retesting is an expensive hit-or-miss process that often ultimately fails to identify the highest temperature locations. The inherently transient nature of turbulent flow is almost impossible to visualize in a wind tunnel, yet these complex structures must be understood in order to optimally locate and protect components. In addition, temperature is a function of the complex interaction between conduction, radiation, and convection in the surrounding fluid, especially for very hot components. Accurately predicting this is extremely challenging.

Given that there is increasing pressure from the marketplace to speed up and improve the vehicle development process, it is clear that a more effective method is required to address thermal protection early in the vehicle design process. A high-fidelity simulation is necessary to capture the relevant physics in order to solve thermal protection problems.

1.2. SIMULIA Solution

The PowerFLOW suite is ideally suited to address vehicle thermal protection issues. PowerFLOW's unique, inherently transient Lattice Boltzmann-based physics enables it to perform simulations that accurately predict real-world transient conditions on the most complex geometry. PowerTHERM is a fully coupled, highly accurate, conduction and radiation solver. The combination of PowerFLOW and PowerTHERM enables you to accurately predict temperatures and visualize the flow and temperature fields for the entire vehicle. This enables you to identify problem areas and provide recommendations to improve the design and eliminate problems. Rapid turnaround time for simulation and model setup enables you to quickly make design changes to the baseline and evaluate the improvements in thermal performance.

Measurements in thermal wind tunnels can evaluate vehicle thermal performance and locate potential hot spots. PowerFLOW can be used to not only predict the location of these hot spots,

but explain the physical causes behind them. These insights in turn provide much quicker design and better thermal solutions. Typically, using PowerFLOW significantly reduces the number of thermal failures observed in the first prototypes (or completely eliminates them), at a significantly lower design cost.

Using the SIMULIA solution for thermal protection, you can:

- Identify hot spots.
- Improve component lifetime and reliability.
- Optimally place, or eliminate, heat shields.
- Optimize component layout.
- Reduce development costs by eliminating prototype testing.