

POWERFLOW FOR CABIN COMFORT



3DEXPERIENCE®

Applicable Industries: Automotive, Motorsports, Commercial Vehicles, Off-Highway Equipment, Trains, & Aerospace

Providing drivers and passengers with an adequate comfort level is a critical design objective. This is true across all modes of transport including automobiles, trucks, off-road vehicles, trains, and aircraft. HVAC climate control is a critical element in the highly influential and respected J.D. Power and Associates APEAL study. Cabin cool-down and warm-up times are not only key design requirements, but are often regulated. Increasing globalization of brands means vehicles must be designed to operate in an ever wider range of environmental conditions with very high or very low ambient temperatures and strong solar radiation, and sometimes under extreme conditions with heavy loads on the engine. Vehicle electrification is adding additional efficiency requirements to the design of HVAC systems.

Although it is very important for cabin design to meet passenger comfort requirements, an active HVAC system can cut fuel economy by as much as ten percent, so efficiency of the entire climate-control system is essential for overall fuel economy.

Addressing cabin thermal performance early in the design cycle is critical to the key business objectives of occupant comfort and good fuel economy.

Technical Challenges

Traditionally, cabin comfort assessment depends heavily on testing physical prototypes. Physical testing is very expensive, time-consuming, and inflexible. Solar radiation is a critical component that can be reproduced only to a limited degree in climatic wind tunnels, and measuring surface and fluid temperatures is not sufficient. Passenger comfort is a complex physiological function of temperature, heat transfer rates, air velocity, clothing, body type, body mass, and other factors. With physical testing, such evaluations are very subjective.

SIMULIA Solution

The PowerFLOW suite is ideally suited to address cabin comfort 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. The resolution of large-scale turbulence provides an accurate prediction of the heat transfer coefficients. PowerTHERM is a fully coupled, highly accurate, transient, conduction and radiation solver that has sophisticated capabilities for modeling solar radiation and a best-in-class, proprietary, human comfort physiological model. The combination of PowerFLOW and PowerTHERM enables you to accurately predict cabin air temperature over long time periods, calculate heat-up and cool-down times, and visualize the flow and temperature fields for the entire cabin. This enables you to not only identify problem areas, but provide design recommendations that eliminate problems early in the design cycle. Rapid turnaround times for model setup, simulation, visualization, and design modification enable you to quickly make design changes to the baseline and evaluate the improvements in cabin comfort.

Using the SIMULIA solution for cabin comfort analysis, you can:

- Evaluate the temperature distribution in the cabin interior.
- Evaluate the passenger comfort level.
- Optimize the cabin HVAC flow.
- Control cool-down/warm-up time.
- Optimally size the HVAC system capacity.
- Predict system performance long before prototype builds.