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Development of Transient Simulation Methodologies for Underhood Hot Spot Analysis of a Truck

This paper presents the efforts done by Volvo 3P, through a partnership with ThermoAnalytics Inc, to develop transient thermal simulation methodologies of the under hood of a truck.

The verification process for the hot spots analysis currently in use at Volvo 3P is described and the key transient situations for the hot spots analysis are identified: hot shutdown, DPF regeneration and long drive cycle, are currently only covered by physical testing late in the project, contrary to steady-state operating conditions that are already managed through simulations in the early stage of the development phase. The goal of this work is to develop simulation methodologies for these transient situations which are likely to increase the efficiency of the verification process.

The key issues to be satisfied are to minimize the model development and the simulation times while achieving an acceptable accuracy level. A constraint for this project is therefore to use the available steady-state thermal and CFD models as bases. Because the identified transient scenarios have different time scales, different methodologies are developed which imply different CFD coupling strategies : one methodology is dedicated to simulating both the hot shutdown and DPF regeneration scenarios, which are relatively short transient (typically 15 to 30 minutes) and a second methodology is dedicated to simulate a long drive cycle (typically more than 6 hours).

The two modeling processes are described and applied to an existing commercial truck: the results are compared to the available data recorded during a previous hot spots verification test campaign.

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