

Automotive System Simulation

Cooling Systems



Technical Flyer

Features

- Model heat transfer effects for both Steady State and Transient flow conditions using a wide range of heat transfer options
- Examine system pressures, flow rates and temperatures
- Model zero coolant flow following engine start-up
- Geometric Heat Exchanger Modelling*
- Model using a wide range of standard and cooling specific components
- Co-simulate with other industry tools such as ANSYS FLUENT, STAR-CD and MATLAB®/Simulink®

Benefits

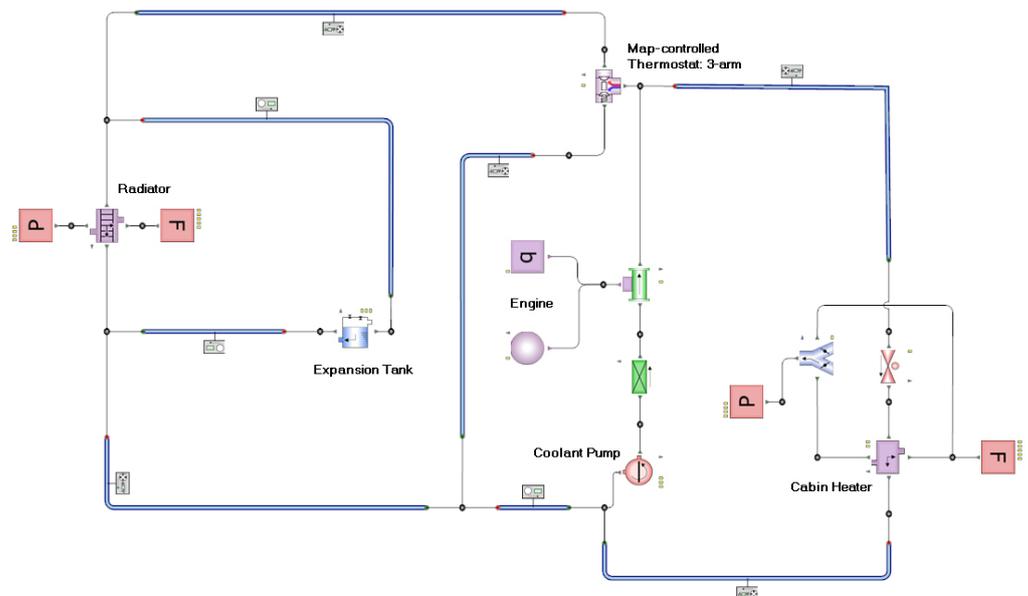
- Design and optimise cooling systems to underhood sizing and packaging constraints
- Investigate if coolant temperature oscillations occur and whether they affect passenger comfort or engine emissions
- Accelerate your validation process by simply importing test data directly into the cooling system model

Cooling Systems Modelling

In modern automotive engine design, control over the operating conditions, especially temperature is essential to achieve maximum engine efficiency and to minimise emissions. Engineers are challenged to design and optimise for packaging space restrictions, powertrain architecture variations and thermal loads.

The Cooling Systems Modelling packages from Flowmaster enable users to model and optimise cooling system designs before building the real thing. Whether varying the design parameters of the thermostat to ensure a constant temperature in the cooling system or resize key components to packaging constraints, Flowmaster allows evaluation of:

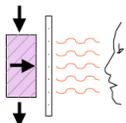
- The impact of components from different suppliers on the overall cooling system
- The effects of different operating conditions; warm-up cycles in winter
- The effect of zero coolant flow following engine start-up
- The sizing of the expansion tank or de-gas bottle and its effects on performance
- Heat rejection based on engine speed and load
- The thermal flow paths between the engines metal structure with the coolant and underhood air flow
- The rate of heat transfer



Screenshot of a Cooling System in Flowmaster V7 Automotive

*available in the Advanced Heat Exchanger Module

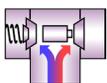
Engine Cooling System Components:



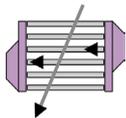
Cabin Air Heater



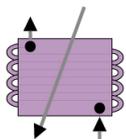
Map-Controlled Thermostat (2-Arm)



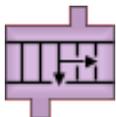
Map-Controlled Thermostat (3-Arm)



Charge Air Cooler



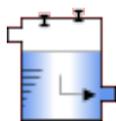
Oil Cooler



Radiator



Water Pump



Expansion Tank



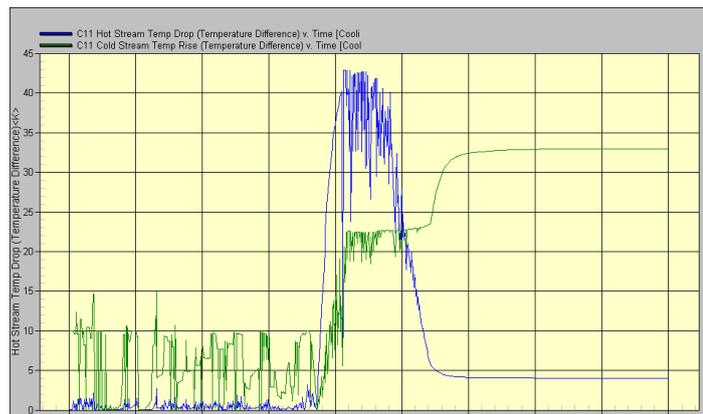
Thermostat

The Flowmaster V7 Automotive Cooling System package comes with a wide range of standard and cooling specific components including a new Map-Controlled Thermostat component. The Map-Controlled Thermostat enables engineers to simulate zero coolant flow during the first few minutes of operation following engine start-up and thereby increase the rate of engine warm up. Available in 2-arm and 3-arm variants the Map-Controlled Thermostat enables:

- Valve opening based on pressure as well as temperature
- Loss Coefficient based on Valve Opening and Re
- Facility for coolant Reference Temperature to be set via a control signal input
- Independent operation of two valves (for 3-arm variant)

Models can be run under various conditions to simulate steady or transient conditions. This allows users to accurately predict coolant pressure, flow rates, temperatures and other performance parameters as well as optimise component sizes and understand the effect of component changes on the entire system.

Globally recognised drive cycles within the performance data catalogue of Flowmaster V7 Automotive enable transient drive cycles such as the New European Drive Cycles (NEDC) to be simulated, without the need for third party tools. By linking a coolant and lubrication model, the effects of the engine cooling system on the lubrication system during scenarios such as warm-up or standard industry drive cycles, can be assessed.



Temperature of Coolant in the Radiator Versus Temperature of Air Across the Radiator Over Time

Flowmaster V7 Automotive provides an enjoyable user experience, allowing you to quickly and efficiently build networks and to communicate with non-Flowmaster users easily. Featuring validated data entry and an advanced graphical user interface, margin for error is reduced, optimising accuracy of results first time.

Unique database capabilities mean all data for components, systems and results can be stored and accessed easily. Co-simulation via COM, MpCCI and XML allows Flowmaster V7 Automotive to contribute to the entire development process. Its sophisticated Simulation Data Management Tool provides an audit trail which enables users to manage parameters and run "what-if" scenarios at the concept stage. Specific industry help and tutorials are available within the software, making integration easier and faster.