

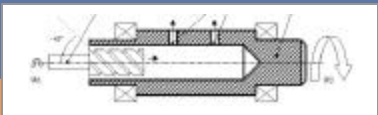


AMESim

APPLICATIONS - LUBRICATION

KEY POINTS

- Steady-state and transient simulation.
- State-of-the art for lubrication modeling.
- Fluid properties database with local pressure and temperature dependences.
- Static, dynamic and total pressures.
- Fluid cavitation with void content, air release and entrained air everywhere in the system.
- Laminar / turbulent regime transition in orifices.
- Bends, expansions, contractions and T-junctions with Idel'cik formulae.
- Plain and journal bearings for camshaft, crankshaft, connecting rods, piston cooling jets and groove brushing with steady-state and dynamic characteristics.
- Advanced line models for pipes and hoses (Nikuradse harp, wall compliance...).
- Vehicle environment with engine rotary speed, shaft power, gear ratio or road inclination. Full integration in vehicle thermal management.
- Prediction of the filling sequence from gas to liquid.
- Easy integrated comparison with experiments.



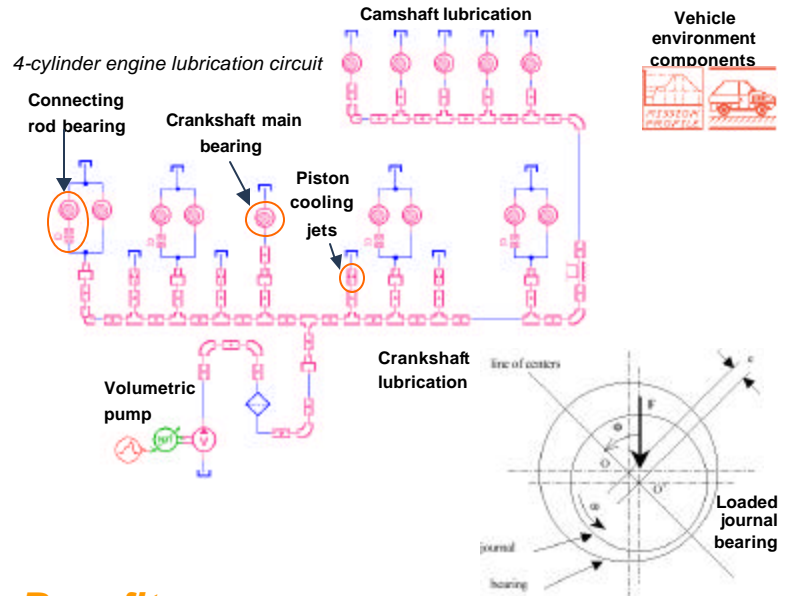
Grooved bushing

Overview

AMESim® allows you to design and optimize lubrication systems early in the process. It offers an open architecture for different approaches:

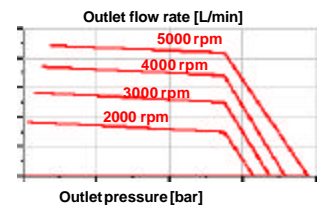
- With or without thermal considerations.
- Gas/liquid filling of the circuit.

A new step in designing lubrication systems has been made using AMESim, the most efficient tool to answer typical concerns such as sizing of your system components, optimization of your network architecture, reduction of friction, wear and heating of the operating parts, increase of component performance, prediction of flow rates in the different branches, estimation of pressures everywhere in the circuit, reduction of energy consumption, increase of efficiency, study of air release or behavior at cold start, filling sequence of gas/liquid mixture during the few first seconds, characterization of specific components such as bearings...

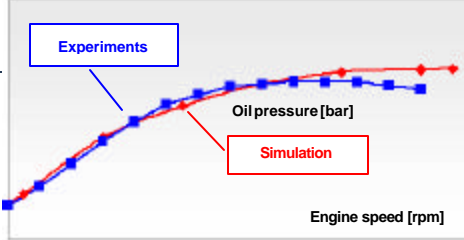
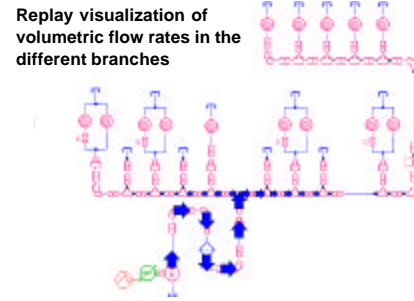
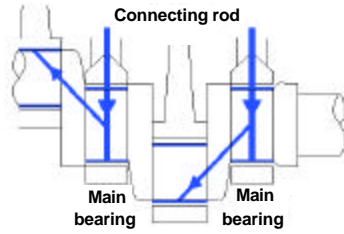
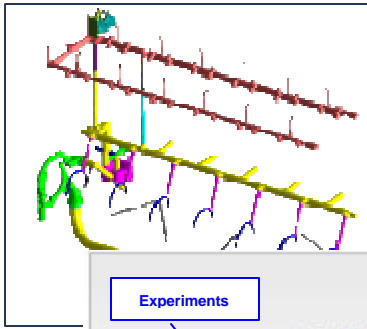


Benefits

AMESim facilitates the development of new concepts and finding answers to challenges such as minimal lubrication circuit for maximal efficiency or short-time designed and optimized lubrication systems.



The development time of your lubrication system is reduced in staggering proportions (from months to weeks). The maintainability of models is greatly facilitated thus increasing life-length while reducing costs of your system. The constant evolution of application libraries ensures applicable models in an ever changing industrial world .



6-cylinder engine lubrication results – General Motors

Unrivalled capabilities

Performing 3D surface plot within AMESim highlights your system sensitivity to particular parameters. The Replay module allows you to have a fast and global overview of the evolution of variables in the different parts of the circuit.

Evaluation of the time needed to push the air out and fill the whole circuit is possible. The filling sequence in the different branches is predicted. This allows you to reduce friction at the engine start with lubricant reaching each operating part as soon as possible.

AMESim's multi-domain environment enables the study of the natural dynamic couplings with the lubrication system boundary conditions. This is particularly crucial when thermal effects are considered.

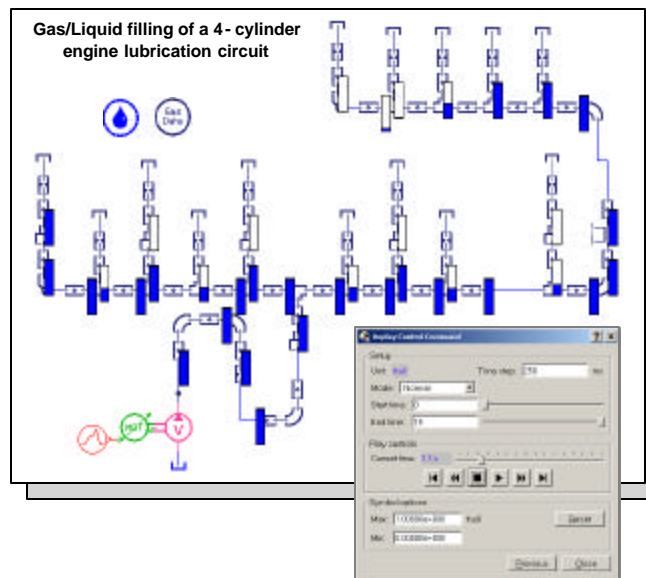
Performance

Models reliability and accuracy are demonstrated through permanent comparison with experimental data for various operating modes, different shaft speeds and load considerations.

Simulation results are so predictive that AMESim may be used in the earliest stages of the systems design. Model sensitivity analysis gives the right responses about your system's dynamic behavior. AMESim also organizes the work with 3D CFD & FE analysis exchanging variables for bearing dynamics and stress calculations.

Applicable libraries

- Standard **AMESim Mechanical & AMESim Signal, Control and Observers** libraries.
- **AMESim Hydraulic & AMESim Hydraulic Resistance** libraries for lubrication systems without thermal consideration.
- **AMESim Thermal-hydraulic & AMESim Thermal** libraries for lubrication systems with thermal consideration.
- **AMESim Cooling Systems** library for complete vehicle thermal management.
- **AMESim Filling** library for prediction of the network filling from gas to liquid.



References

AMESim is successfully used for the design of lubrication systems by a large number of manufacturers and OEMs such as Bosch Rexroth, DAF Trucks, Dassault, Delphi, Ferrari, Fiat CRF, GM, Hispano Suiza, INA, Renault Nissan, Ricardo, Robert Bosch, Snecma, Toyota Motorsport, Turbomeca...in the Motorcycle, Automotive, Heavy-duty, Aeronautic and Marine industries.

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