

DYMOLA – Air Conditioning Library

Overview

- Modeling, simulation, and analysis of automotive air conditioning dynamics and behavior
- Component design and cycle performance

Key Features

- Transient and steady-state simulation
- Easy-to-use templates
- State-of-the-art air conditioning models with access to source code
- Extensive coverage of different coolants

Benefits

- Reduced testing time and cost
- Seamless integration of user-defined models
- Compatible with all other Modelica® libraries

The Air Conditioning Library (ACL) allows you to optimize and verify the design of your air-conditioning system from the early design phases through control design and implementation. ACL multi-engineering capabilities let you fully integrate the A/C system design with vehicle energy management for both conventional and hybrid vehicles. With the accuracy of ACL, customers have been able to reduce their testing with expensive prototypes to a fraction.

> A/C system design

The Air Conditioning Library features an open, object-oriented architecture with access to the model source code in Modelica. Template models of typical automotive A/C cycles and dialogs with detailed graphical information about the components make the library convenient and easy-to-use. Users can connect components freely and redesign or create their own templates, which makes it is easy to complete non-standard configurations such as parallel evaporators.

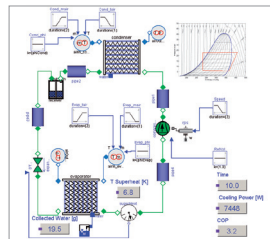
The modular, hierarchical structure of the library enables users to integrate their own correlations and component models seamlessly into their system models.

> State-of-the-art backbone

The library models are based on many years of experience and validation in advanced research applications. The library is adapted to the particular needs of automotive air-conditioning systems.

The hierarchical structure of the library and a clean separation between the underlying physics and the geometrical parameterization are key features that make the adaptation to new components and technologies easy.

Template models make it straight-forward for users to obtain results for their A/C-cycle quickly.



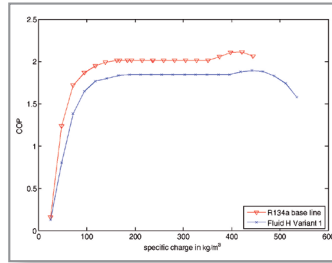
All commercial refrigerants, (R134a, CO₂, R404a, R410a, etc.) can be used as working media. New refrigerant blends that are discussed as global alternative refrigerants, R1234yf and others, are also available. The selection of correlations for friction pressure losses and heat transfer is based on up to date research and is under constant review. The airflow distribution across the face of the heat exchangers can be in-homogeneous and use CFD result data as inputs.

> Multi-engineering

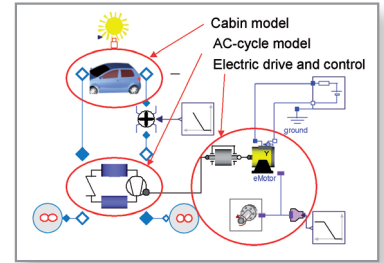
For hybrid vehicles of all types, electrically driven compressors are discussed as a possibility for improving the overall energy management and reduce the fuel impact of the A/C-system. Dymola® lets you combine the electric drive and its control from the Smart Electric Drives Library or a conventional powertrain from the PowerTrain Library with a cabin model and A/C-cycle from the Air Conditioning Library. Cooling of batteries for all types of hybrid vehicles can also be modeled and integrated with the A/C system.

> Support in all phases

The Air Conditioning Library supports the design engineer during all development phases, from early concept studies through detailed component selection to system and control design. High fidelity models enable the user to perform virtual charge optimization experiments for cycle variants. An interface to MS Excel simplifies calibration of component models with test rig measurements.



Analysis for optimizing the refrigerant charge of an A/C-cycle and comparison between R134a and a low GWP refrigerant blend.

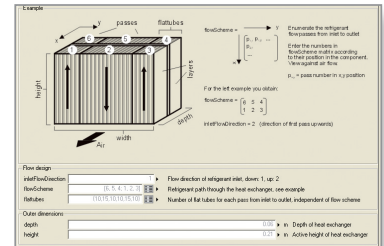


An electrically driven A/C-cycle and cabin model from the Air Conditioning library combined with a speed-controlled electric drive from Smart Electric Drives.

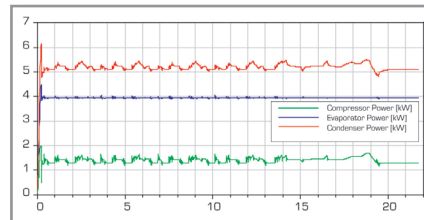
> Towards industry standard

German automotive manufacturers such as Daimler, BMW, Audi and Volkswagen have jointly decided to use Dymola and the Air Conditioning Library as a tool for model exchange and simulation of automotive air conditioning systems. Key reasons for choosing Dymola and the Air Conditioning Library were the flexibility and openness of the models and Modelica as an open modeling standard. Several Tier 1 automotive A/C equipment manufacturers are also using the Air Conditioning Library for their internal development and model exchange with the OEM.

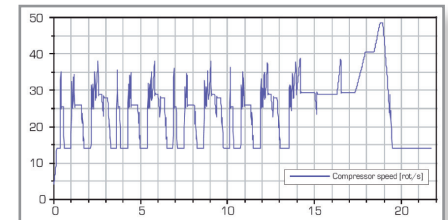
The Air Conditioning Library is developed, supported, and maintained by Modelon AB, a Dassault Systèmes technology partner.



The heat exchanger flow scheme captures the 3-dimensional connections of air and refrigerant paths. Internally, the discretization of each path is 1-dimensional in the flow direction.



Component power levels of A/C system during EUDC simulation run. Control keeps the cooling capacity (blue) constant in spite of changing compressor speed.



Dassault Systèmes (Head Office)
10, rue Marcel Dassault
CS 40501
78946 Vélizy-Villacoublay Cedex
FRANCE
Tel: +33 1 61 62 61 62

Dassault Systèmes of America
6320 Canoga Avenue
Trillium East Tower
Woodland Hills, CA91367-2526
USA
Tel: +1 818 999 2500

Dassault Systèmes Kabushiki Kaisha
Pier City Shibaura Bldg 10F
3-18-1 Kaigan, Minato-Ku
Tokyo 108-0022
JAPAN
Tel: +81 3 5442 4011

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