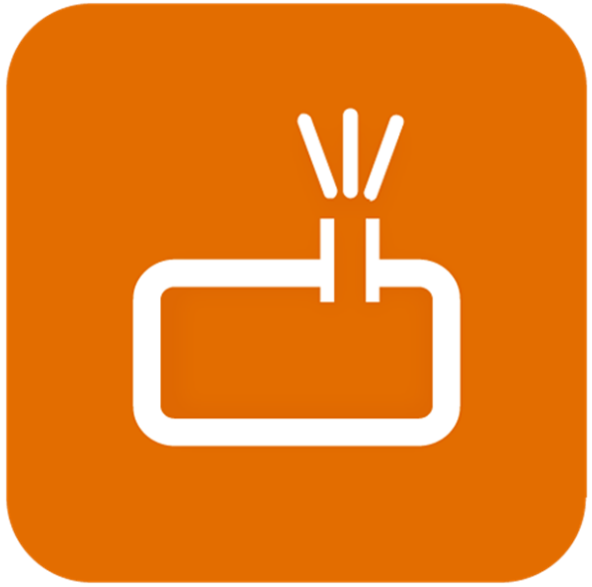
PNEUMATICS LIBRARY

Overview

Modelon

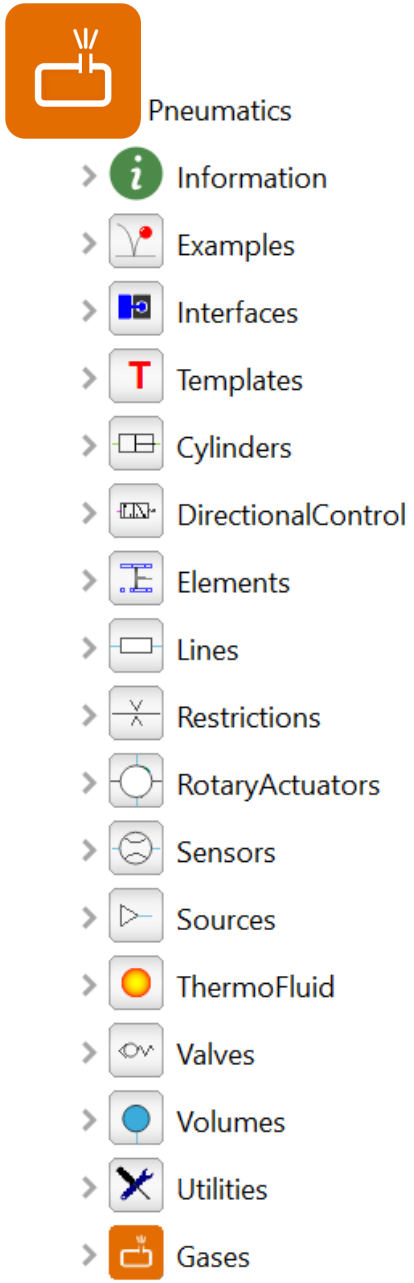
AGENDA

- ❑ About Product Name
- ❑ Key Benefits
- ❑ Key Capabilities
- ❑ Key Applications
- ❑ Library Contents
- ❑ Modelon Compatibility
- ❑ Latest Release



ABOUT PNEUMATICS LIBRARY

- Modelica library for pneumatic systems and pneumatic circuits
  - Based on the ideal gas law assumption
- Components
  - Most models needed for pneumatic applications available, both mobile and stationary
  - More can be built from basic building blocks
- Open Code means user is in control
  - View, extend, modify models
  - Ideal for model sharing (encryption)
- Simulation of pneumatic systems for
  - Overall system dynamics
  - Verification of dimensioning
  - Parameter studies



KEY BENEFITS

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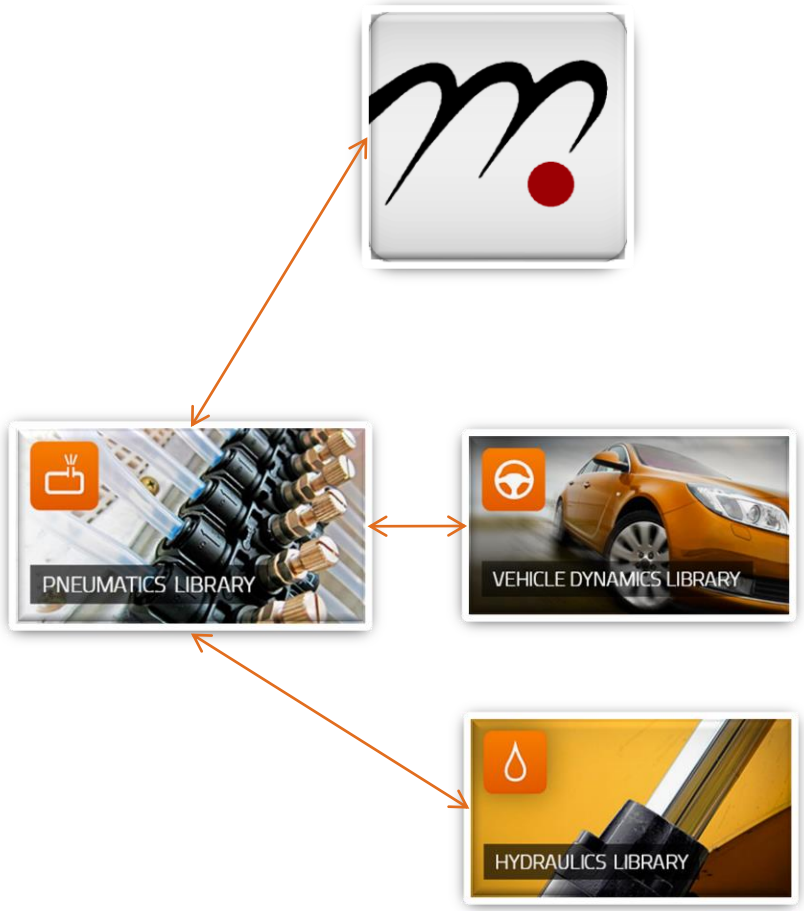
- Easy-to-Use yet powerful
  - Wide range of predefined components
- Well suited for control design and validation
- True multi-engineering tool
  - Modeling of multi-domain systems, combine with multibody mechanics, control system etc.
- Visualization
  - Easily visualize system behavior
  - Graphical workspace looks like a pneumatic schematic



KEY CAPABILITES

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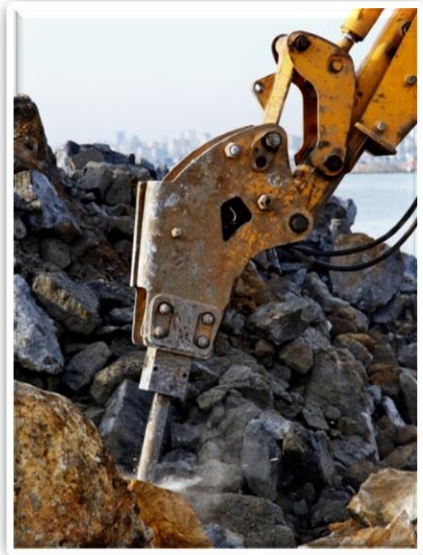
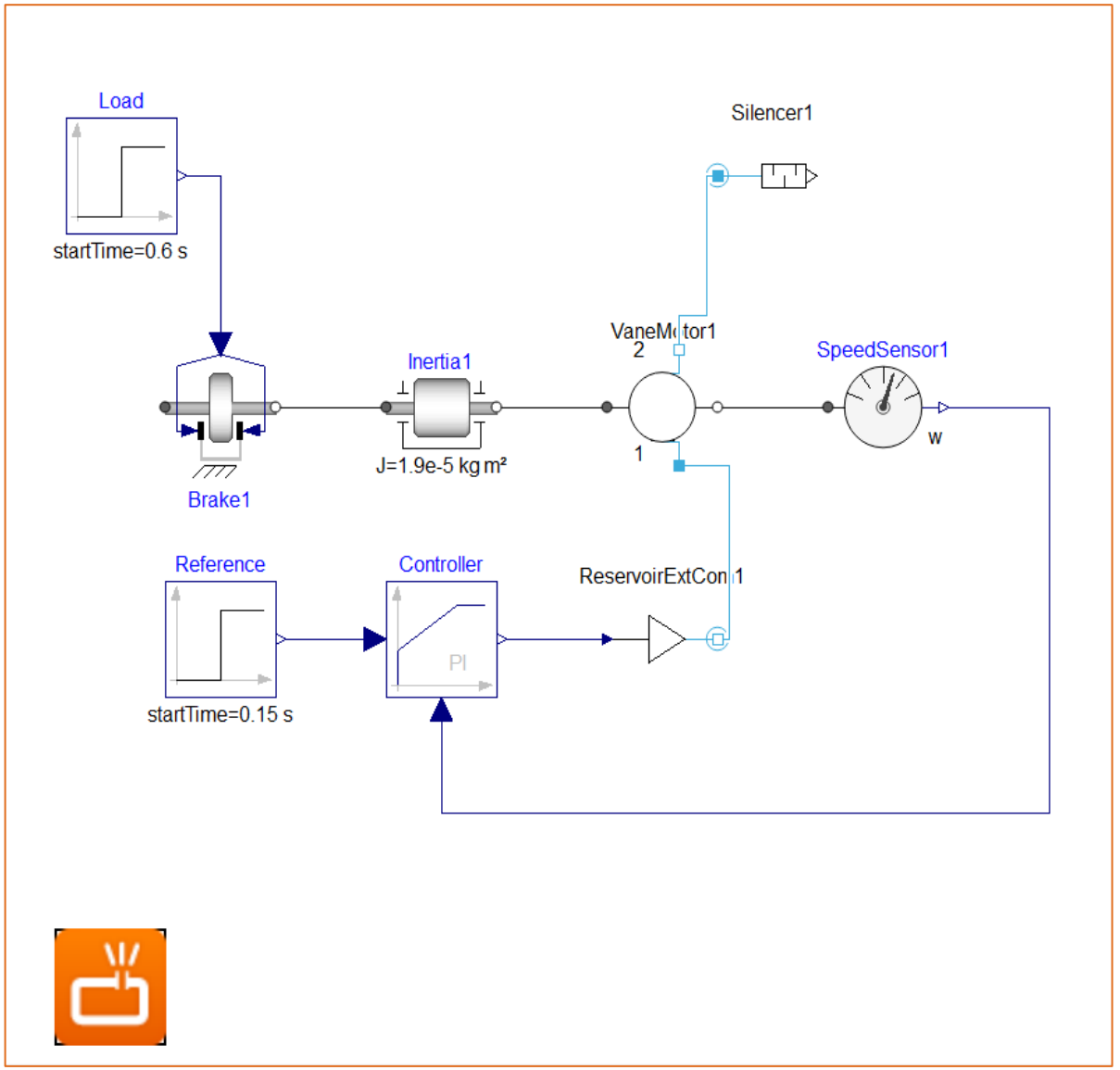
- Integration of pneumatic systems in wide range of multi-physics models
- Parametric studies of designs
- Deployment
  - Design of experiment
  - Optimization
- List of applications
  - Industrial Equipment:
    - Road construction, drills, hammers etc.
  - Vehicles
    - Brake systems, air suspension



KEY APPLICATIONS

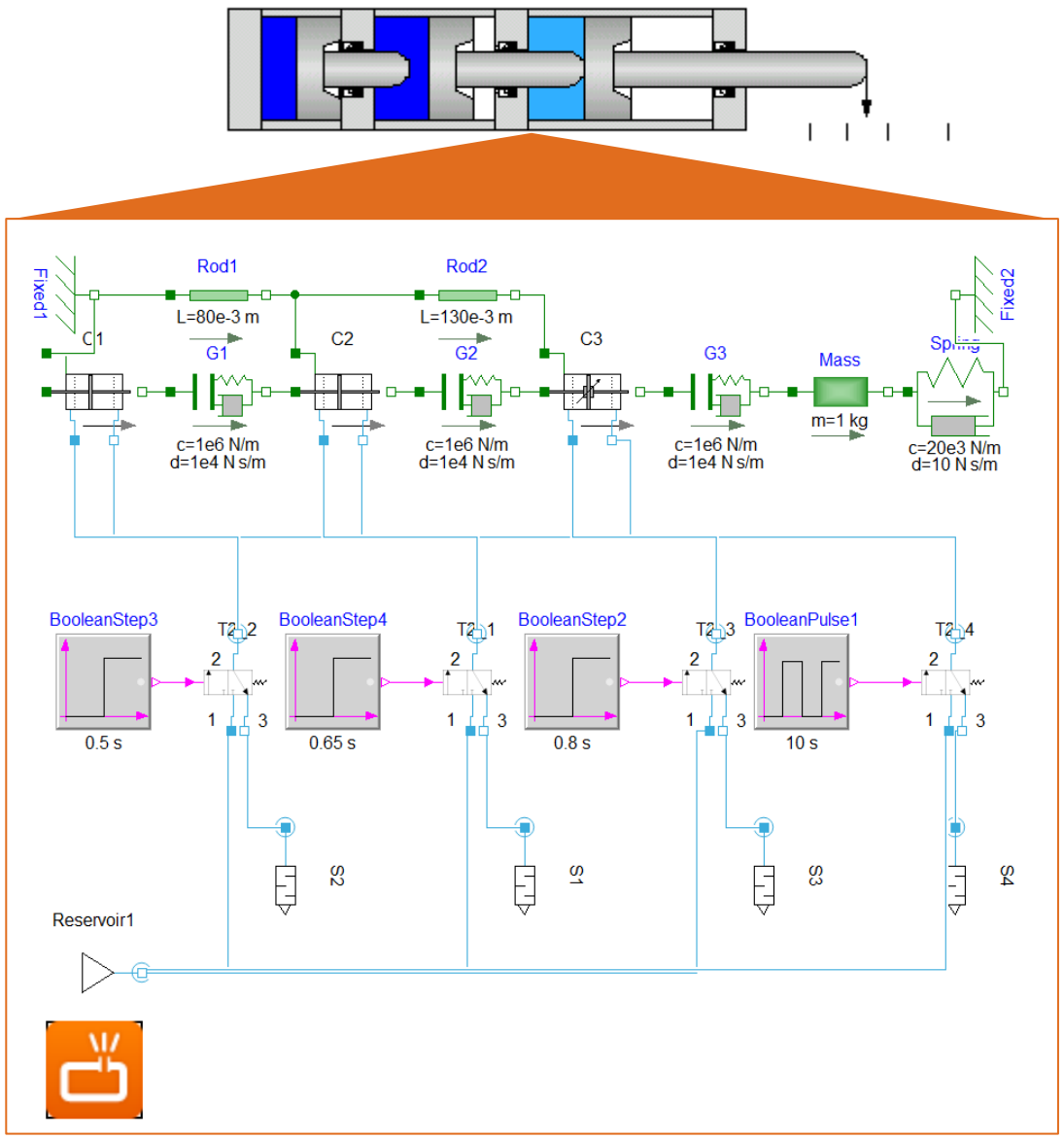
EXAMPLE: MOTOR CONTROL

This example model demonstrates a PID controller that tries to maintain the vane motor at a constant speed. By controlling the air pressure in to the motor the controller can control the speed of the vane motor. A load is model through a brake that is activated at 0.6 s. Pneumatic vane motors can be used is to start large engines e.g. industrial engines



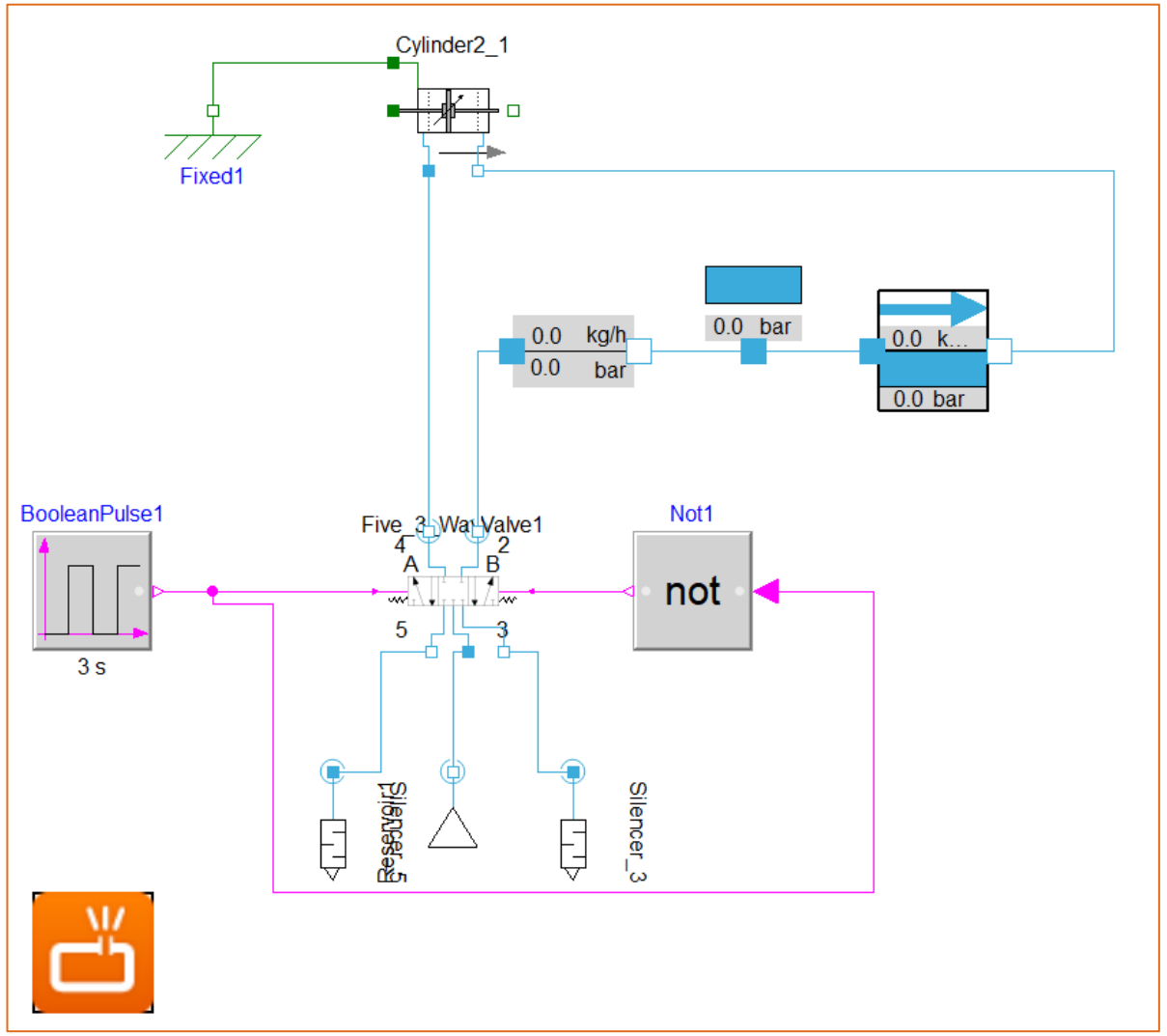
EXAMPLE: MULTI-POSITION CYLINDER

This example shows how easy even a complex systems can be modeled with Pneumatics Library. Multi position cylinders typically consist of two or three connected cylinders to reach three or four end positions. There is typically one port for every head-end chamber and one port for the connected rod-end chambers. In this example three double acting cylinders are used from the library. One of the cylinders (C3) has pneumatic stroke cushioning enabled, indicated by an arrow over the piston in the icon. The rods (Rod1 and Rod2) places the housing at the correct positions. The cylinders are connected by ElastoGaps.



EXAMPLE: LINEAR ACTUATOR

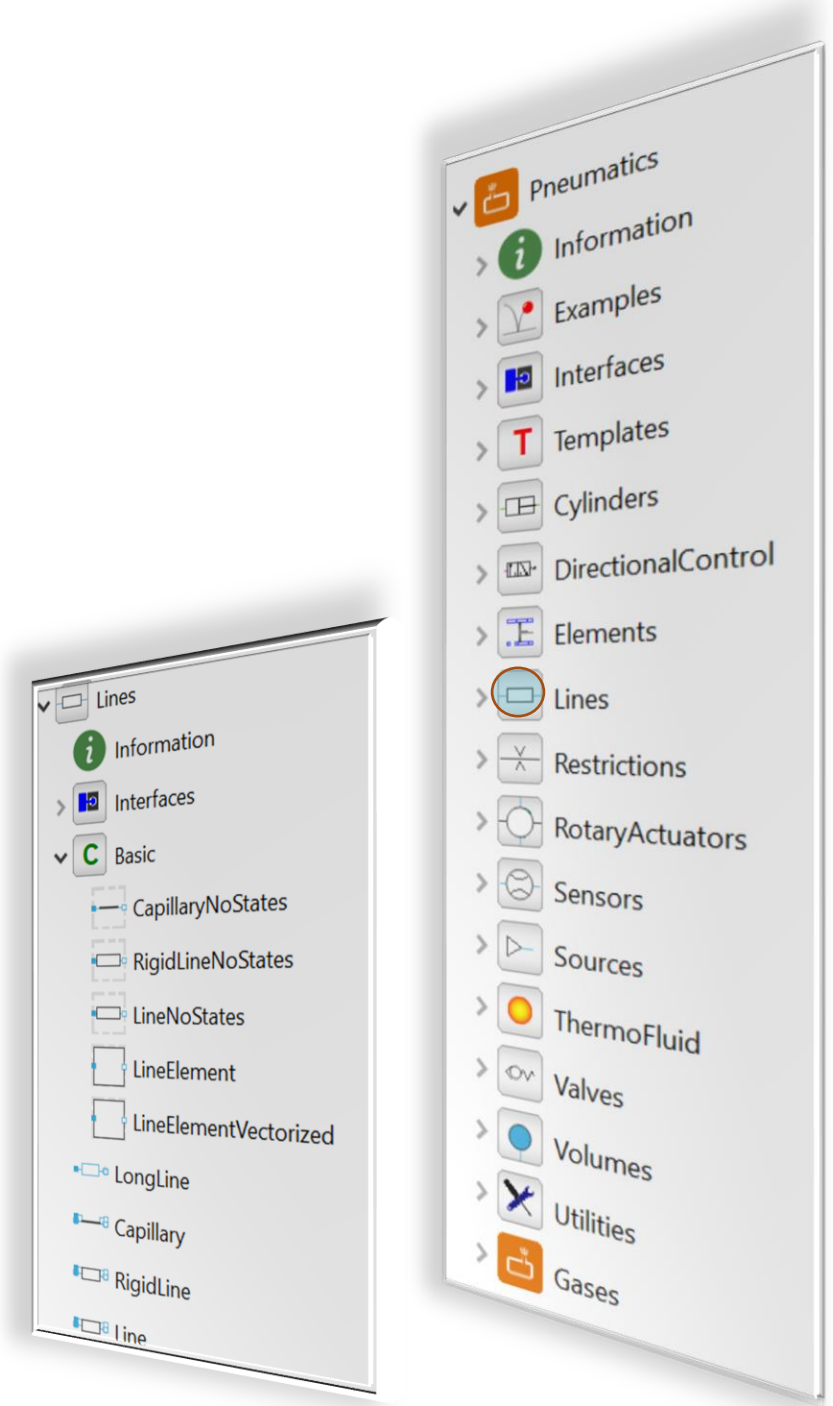
This example shows the principle of pneumatic stroke cushioning. A typical cylinder drive can very easily be modeled with the cylinder models in the library.



LIBRARY CONTENTS

LIBRARY CONTENTS

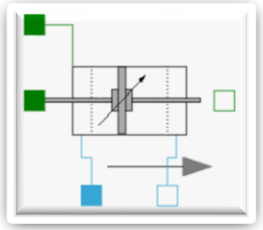
- Standard package order
  - Information
  - Examples
  - Interfaces
  - Templates
  - Components by type
- 2 Levels of components
  - Top level components for end user
  - Basic components are sub-components, building blocks for new, user-defined components



LIBRARY CONTENTS

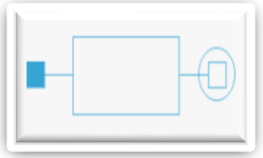
Cylinders

- With or without cushioning effect
- Bellows



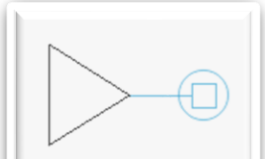
Lines

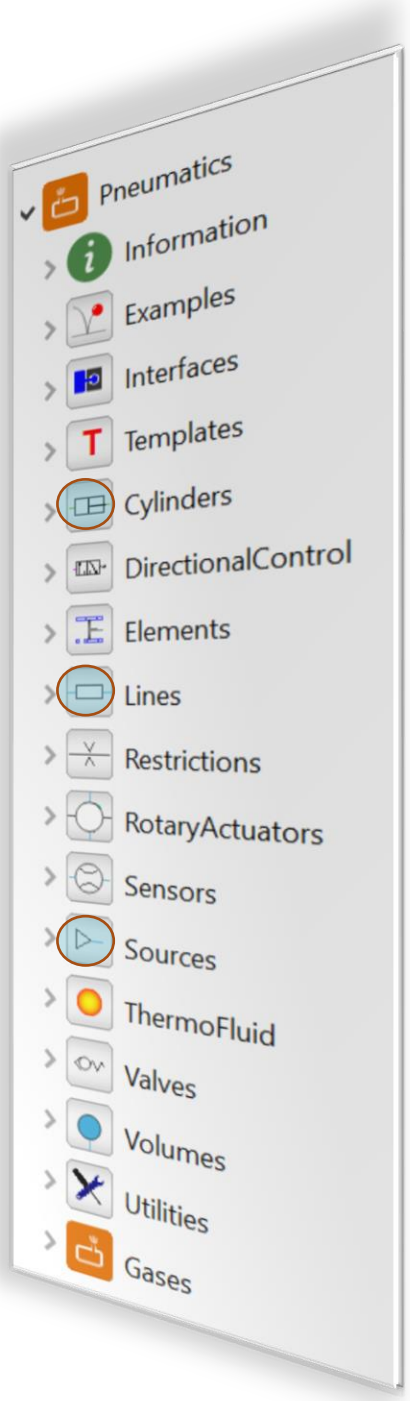
- Long line
- Capillary



Sources

- Reservoirs
- Silencers





LIBRARY CONTENTS

Constant

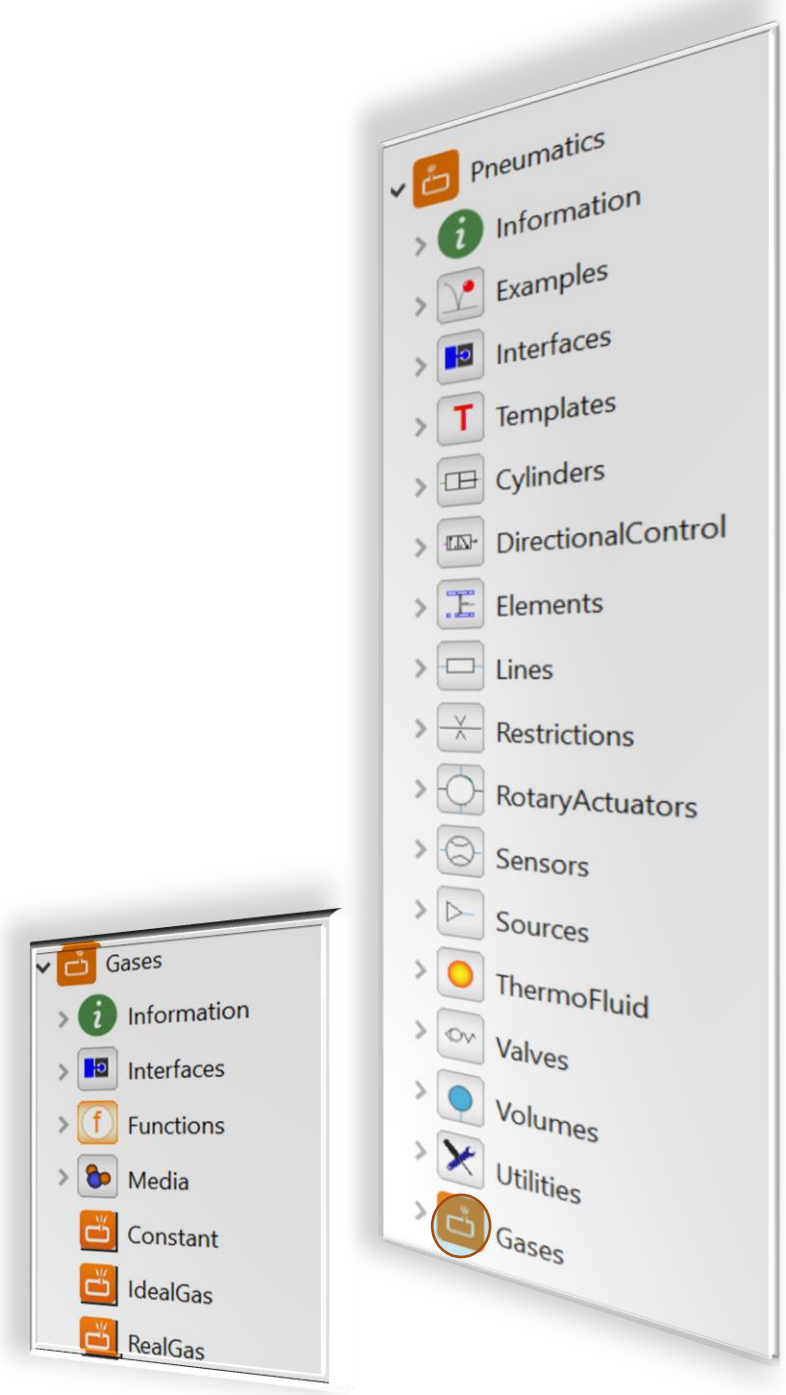
- Constant gas property model
- Backward compatible with old Environment component

IdealGas

- Ideal gas model compatible with fluids from Modelon Base Library
- 7 pre-defined fluids: Moist air, dry air, argon, nitrogen, oxygen, carbon dioxide

Real gas

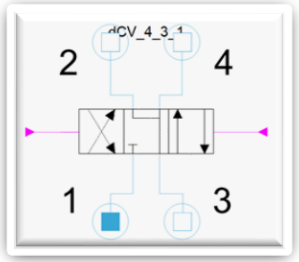
- Fast switching between real and ideal gas
- High pressure media - H2 and N2 models
- Visualize compressibility factor for gas model validity



LIBRARY CONTENTS

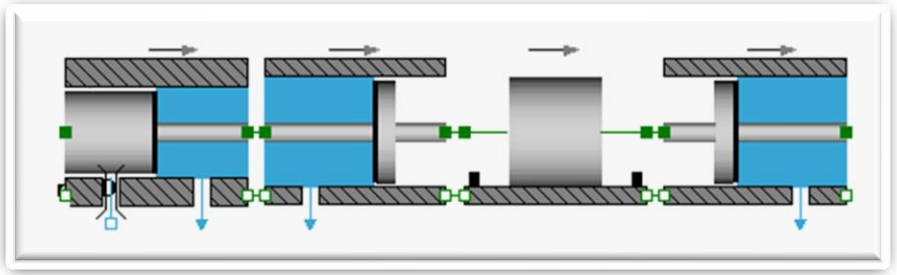
DirectionalControl

- For flow control
- First order spool dynamics



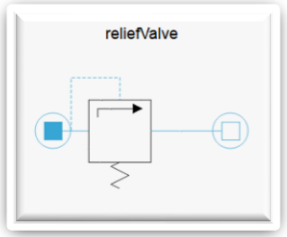
Elements

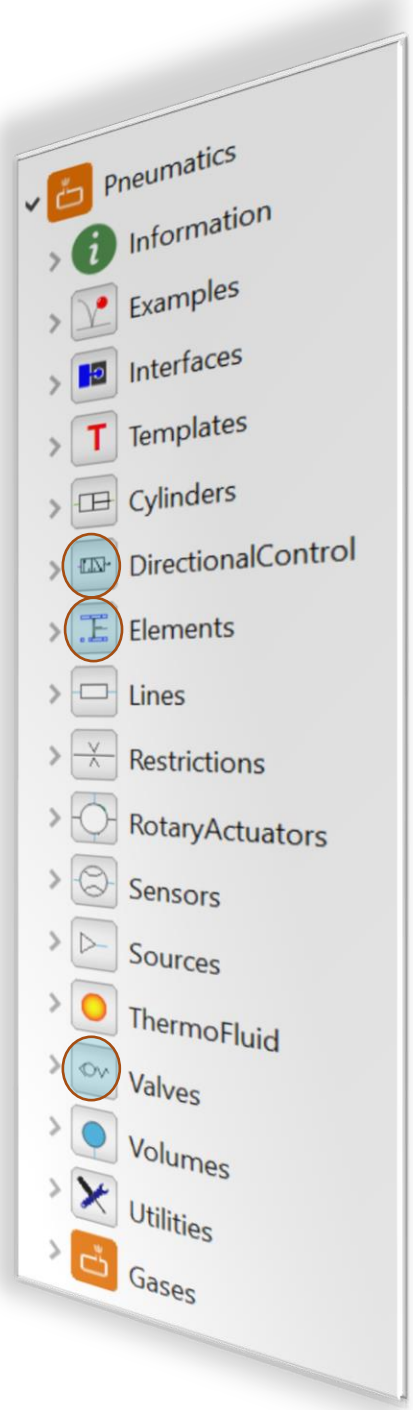
- Primitives for detailed component design



Valves

- Pressure and flow actuated

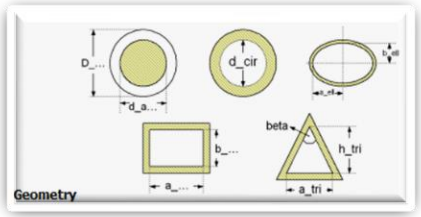




LIBRARY CONTENTS

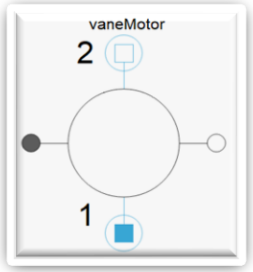
Restrictions

- Fittings
- Geometry based restrictions
- Nozzles and orifices



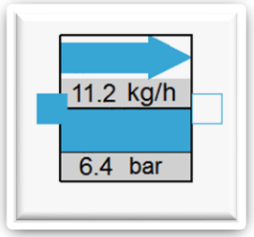
Rotary Actuator

- Vane motor
- Rotary actuator



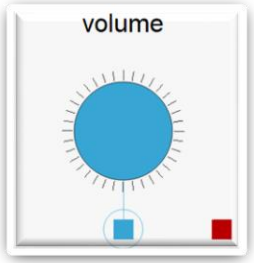
Sensors and Utilities.Visualizers

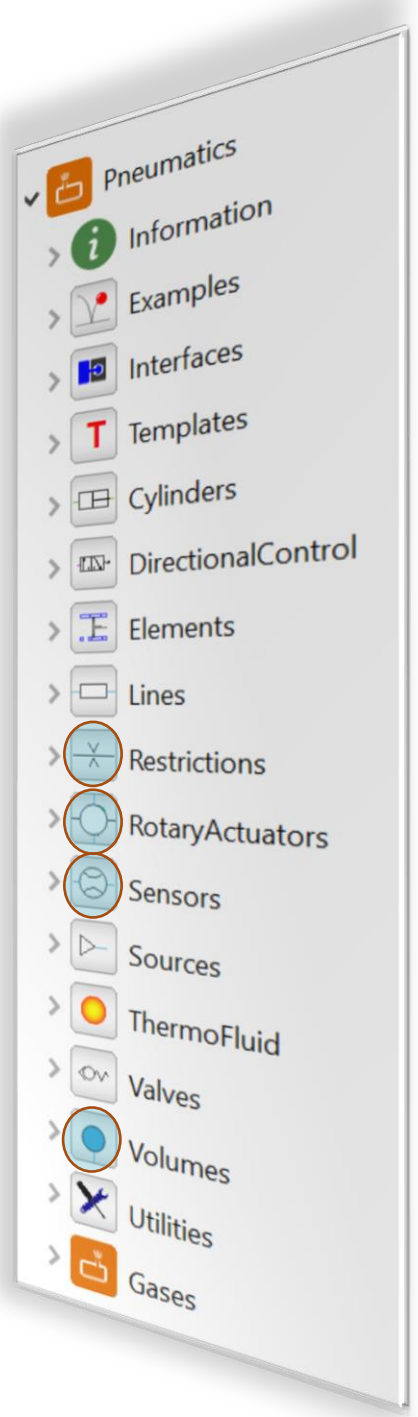
- Pressure and flow



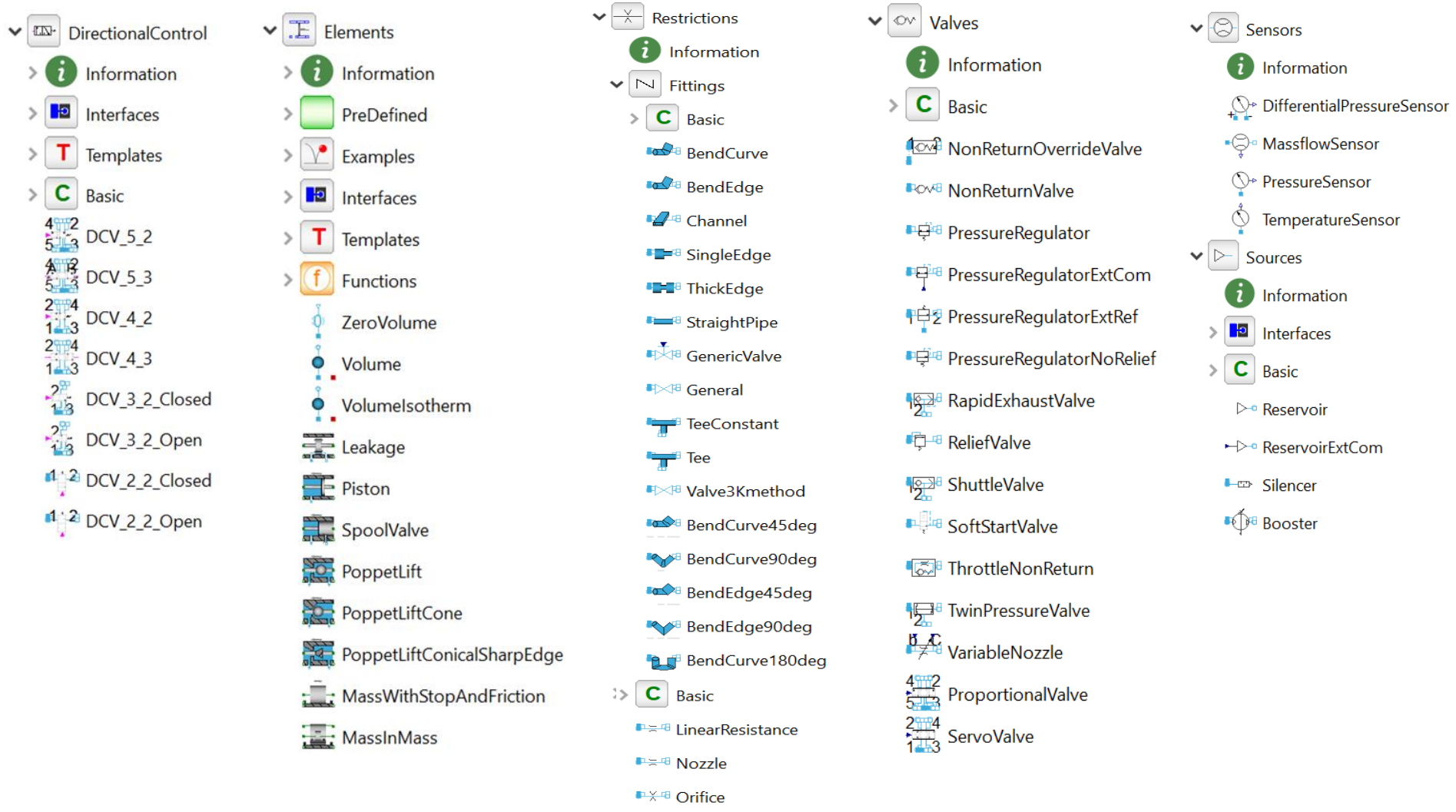
Volumes

- Chamber and volume models





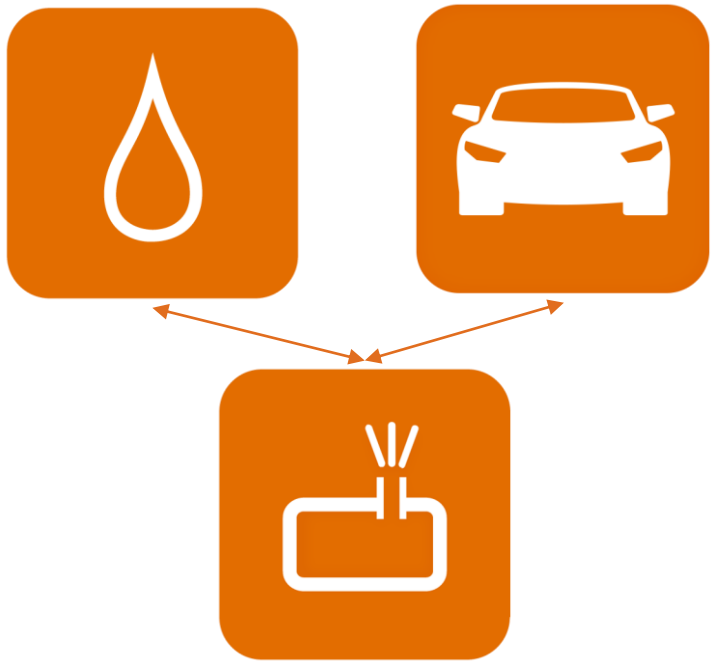
MORE LIBRARY VIEWS



MODELON COMPATIBILITY

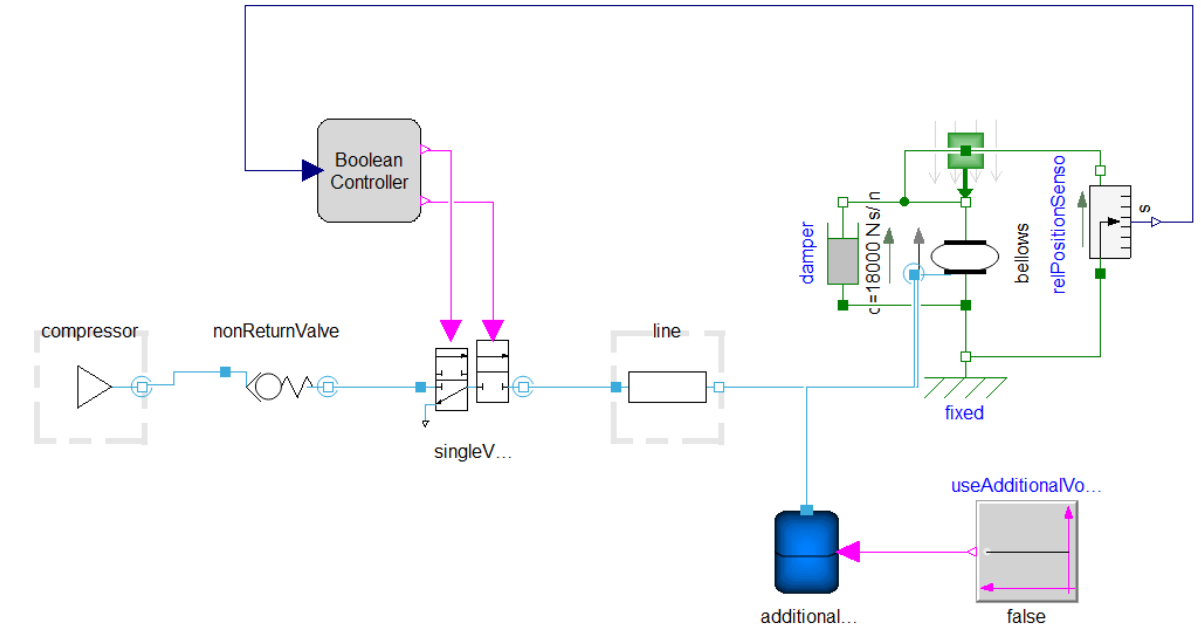
RECOMMENDED MODELON LIBRARY COMPATIBILITY

- Pneumatics Library can be combined with other Modelon libraries to solve specific engineering design tasks.
- Interesting libraries include the
  - Hydraulics Library
  - Vehicle Dynamics Library
- These libraries can also be used as a stand-alone solution.

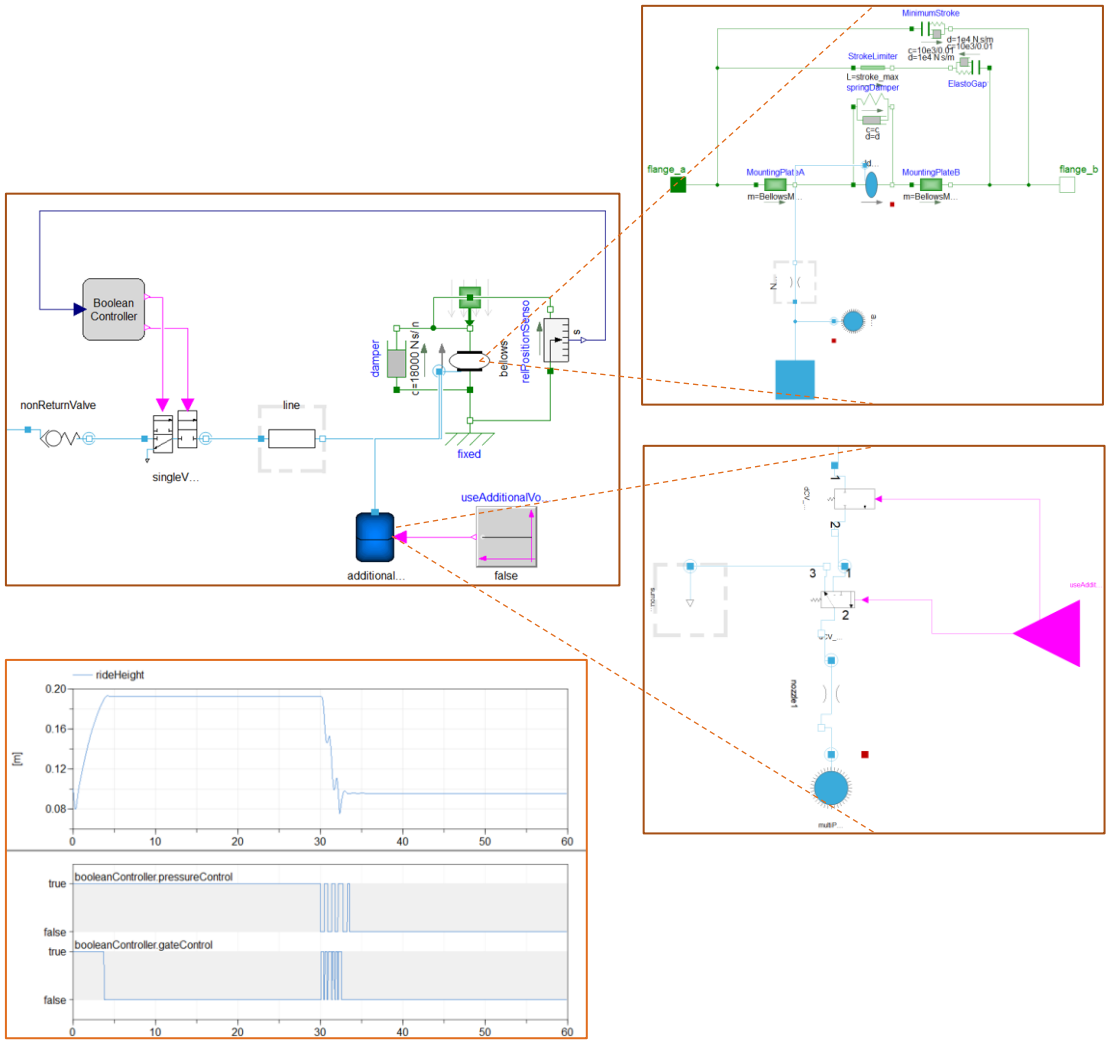


EXAMPLE: AIR SUSPENSION SYSTEM

Air suspension model demonstrating vehicle ride height change



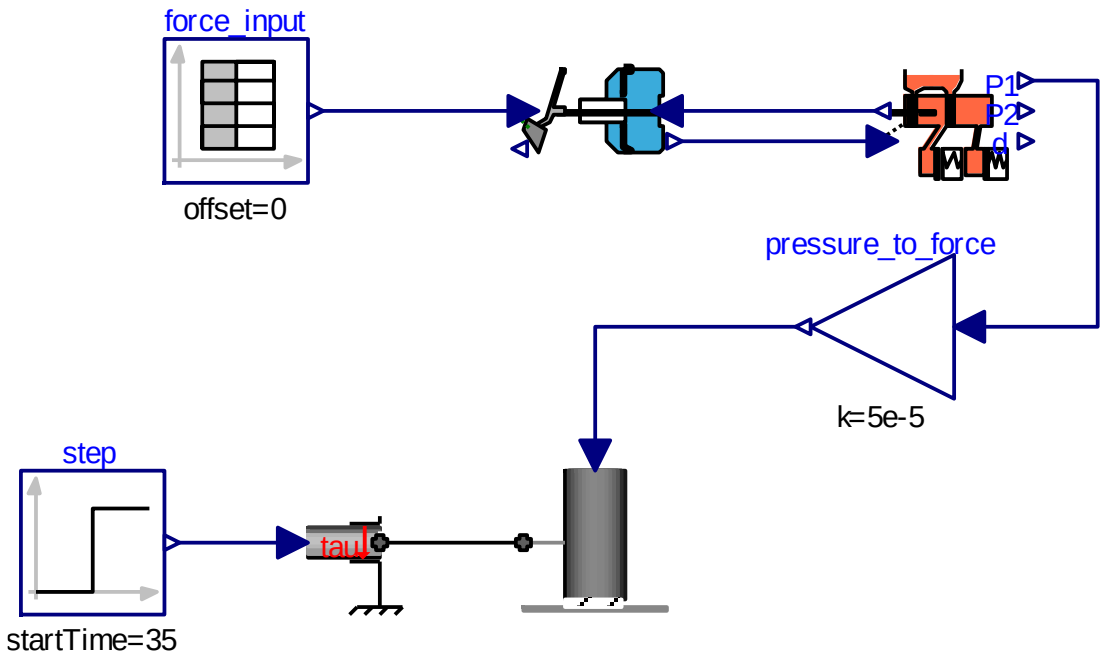
AIR SUSPENSION MODEL



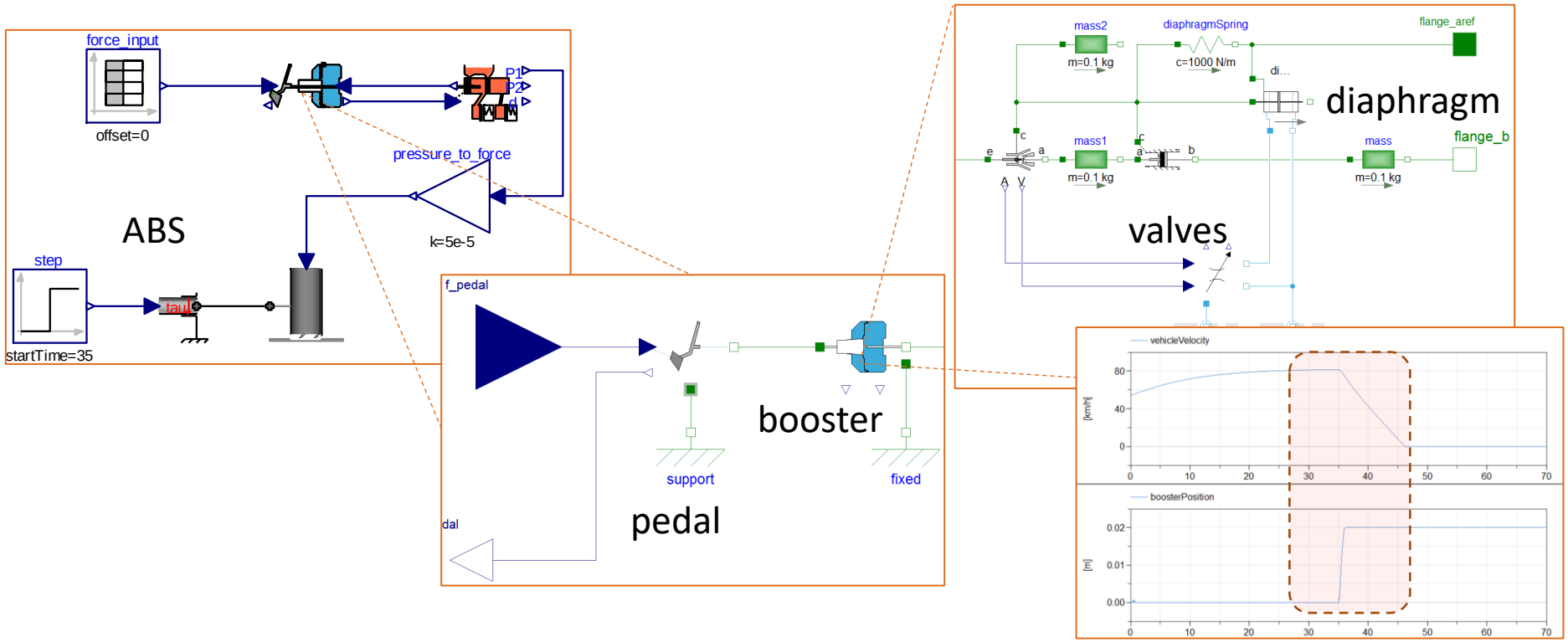
- Air suspension modeling using bellows
- Ride height changing circuit with other valves modeled

EXAMPLE: BRAKE SYSTEM

Hydraulic brake system and pneumatic brake booster example demonstrating FMI capabilities



BRAKE SYSTEM MODEL



- Anti-lock braking system involving the vacuum booster model
- Off-the-shelf component models from library used to build the booster circuit

INDUSTRIAL EQUIPMENT

- Typical usage:
  - Model Calibration and verification of existing designs
  - Analyze system behavior of a new design
    - New design plausible?
  - Analyze possible design improvements
    - Depends on Design goals
  - Robustness of design

LATEST RELEASE

RELEASE: 2021.2

Enhancements

- Improved initialization in the examples within AirSuspensionSystem
- Complete review of all experiment-annotations