SimHydraulics® Release Notes

Contents

Summary by Version

This table provides quick access to what's new in each version. For clarification, see "Using Release Notes" on page 1.

Version (Release)	New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Latest Version V1.3 (R2008a)	Yes Details	No	Bug Reports Includes fixes	Printable Release Notes: PDF Current product documentation
V1.2.1 (R2007b)	Yes Details	No	Bug Reports Includes fixes	No
V1.2 (R2007a)	Yes Details	Yes Summary	Bug Reports Includes fixes	No
V1.1 (R2006b)	Yes Details	No	Bug Reports Includes fixes	No
V1.0 (R2006a+)	Yes Details	Not applicable	Bug Reports	No

Using Release Notes

Use release notes when upgrading to a newer version to learn about:

- New features

- Changes

- Potential impact on your existing files and practices

Review the release notes for other MathWorks™ products required for this product (for example, MATLAB® or Simulink®) for enhancements, bugs, and compatibility considerations that also might impact you.

If you are upgrading from a software version other than the most recent one, review the release notes for all interim versions, not just for the version you are installing. For example, when upgrading from V1.0 to V1.2, review the release notes for V1.1 and V1.2.

What's in the Release Notes

New Features and Changes

- New functionality

- Changes to existing functionality

Version Compatibility Considerations

When a new feature or change introduces a reported incompatibility between versions, the **Compatibility Considerations** subsection explains the impact.

Compatibility issues reported after the product is released appear under Bug Reports at the MathWorks Web site. Bug fixes can sometimes result in incompatibilities, so you should also review the fixed bugs in Bug Reports for any compatibility impact.

Fixed Bugs and Known Problems

The MathWorks offers a user-searchable Bug Reports database so you can view Bug Reports. The development team updates this database at release time and as more information becomes available. This includes provisions for any known workarounds or file replacements. Information is available for bugs existing in or fixed in Release 14SP2 or later. Information is not available for all bugs in earlier releases.

Access Bug Reports using your MathWorks Account.

Version 1.3 (R2008a) SimHydraulics® Software

This table summarizes what's new in Version 1.3 (R2008a):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	No	Bug Reports Includes fixes	Printable Release Notes: PDF Current product documentation

New features and changes introduced in this version are

- "Trimming Now Available for SimHydraulics® Models" on page 3
- "New Cartridge Valve Insert and Hydraulic Cartridge Valve Actuator Blocks" on page 3
- "Additional Configurations for the Centrifugal Pump Block" on page 4
- "Additional Fluids Available in the Hydraulic Fluid Block" on page 4

Trimming Now Available for SimHydraulics® Models

Finding and managing operating points by trimming has been implemented for models that include Simscape™ and SimHydraulics® blocks. Simulink® Control Design™ product is required for using this functionality. For more information, see Trimming Simscape Models in the Simscape documentation.

New Cartridge Valve Insert and Hydraulic Cartridge Valve Actuator Blocks

Two new blocks facilitate modeling cartridge valves:

- Cartridge Valve Insert block in the Directional Valves library represents an insert of a hydraulic cartridge valve consisting of a poppet interacting with the sleeve seat. The poppet position is determined by pressures at ports A, B, and X and force of the spring. This is a structural model based on a

3

Variable Orifice block and a Hydraulic Cartridge Valve Actuator block, described below.

- Hydraulic Cartridge Valve Actuator block in the Valve Actuators library represents a double-acting hydraulic valve actuator driven by three pressures. Use this block as a pilot actuator for cartridge valves, as well as pilot-operated pressure and control valves in applications where all the forces, except spring and pressure forces, and flow consumption can be neglected.

Additional Configurations for the Centrifugal Pump Block

The Centrifugal Pump block represents a centrifugal pump of any type as a data-sheet-based model. Depending on data listed in the manufacturer's catalogs or data sheets for your particular pump, you can now choose one of the following model parameterization options:

- `By approximating polynomial` — Provide values for the polynomial coefficients. These values can be determined analytically or experimentally, depending on the data available. This is the default method, equivalent to the implementation available in the previous release.

- `By two 1D characteristics: P-Q and N-Q` — Provide tabulated data of pressure differential and brake power versus pump delivery characteristics. The pressure differential and brake power are determined by one-dimensional table lookup. You have a choice of three interpolation methods and two extrapolation methods.

- `By two 2D characteristics: P-Q-W and N-Q-W` — Provide tabulated data of pressure differential and brake power versus pump delivery characteristics at different angular velocities. The pressure differential and brake power are determined by two-dimensional table lookup. You have a choice of three interpolation methods and two extrapolation methods.

Additional Fluids Available in the Hydraulic Fluid Block

The following predefined fluids have been added to the Hydraulic Fluid block:

- `ISO VG 22 (ESSO UNIVIS N 22)`

- ISO VG 46 (ESSO UNIVIS N 46)

- Brake fluid DOT3

- Brake fluid DOT4

- Brake fluid DOT5

- Water

See the block reference page for more information. The "Examples" section shows how you can get information on the fluids and their properties.

Version 1.2.1 (R2007b) SimHydraulics® Software

This table summarizes what's new in Version 1.2.1 (R2007b):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	No	Bug Reports Includes fixes	Printable Release Notes: PDF Current product documentation

New features and changes introduced in this version are described here:

Code Generation Now Available for SimHydraulics® Models

Code generation has been implemented for models that include Simscape™ and SimHydraulics® blocks. For more information, see "Generating Code" in the Simscape documentation.

Version 1.2 (R2007a) SimHydraulics® Software

This table summarizes what's new in Version 1.2 (R2007a):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	Yes—Details labeled as **Compatibility Considerations**, below. See also Summary.	Bug Reports Includes fixes	No

New features and changes introduced in this version are

- "SimHydraulics® Now Requires Simscape™" on page 7
- "Block Libraries Moved from SimHydraulics® to Simscape™" on page 7
- "Sharing Models Using the Simscape™ Editing Modes" on page 8
- "New SimHydraulics® Blocks" on page 8
- "Initial Conditions Added for Certain Blocks" on page 8
- "Block Library Links Must Be Resolved" on page 9
- "Changes to SimHydraulics® Demos" on page 10

SimHydraulics® Now Requires Simscape™

SimHydraulics® now depends on and requires Simscape™, the platform for all Physical Modeling products, which includes common Physical Modeling utilities and block libraries.

Block Libraries Moved from SimHydraulics® to Simscape™

The Foundation and Utilities block libraries that used to be included in SimHydraulics (V1.0 and V1.1) are now part of Simscape product.

Sharing Models Using the Simscape™ Editing Modes

When working with SimHydraulics models, you now have a selection of two Simscape editing modes that allow full or restricted editing of models.

- The Restricted mode requires SimHydraulics software to be installed, but does not require a license. It allows you change a limited set of model parameters, but not the blocks or connections, in a SimHydraulics model.

- The Full mode requires SimHydraulics software to be installed with a license. It allows you to change anything in a SimHydraulics model.

New SimHydraulics® Blocks

The new blocks introduced in Version 1.2 are listed below:

- Centrifugal Pump

- Single-Acting Rotary Actuator

- Double-Acting Rotary Actuator

- Hydraulic Single-Acting Valve Actuator

- Hydraulic Double-Acting Valve Actuator

- Valve Hydraulic Force

- Spool Orifice Hydraulic Force

Initial Conditions Added for Certain Blocks

Several blocks now have a parameter that specifies the initial condition for use in computing the block's initial state at the beginning of a simulation run. Note that some of these blocks, which used to be included in SimHydraulics (V1.0 and V1.1), are now part of Simscape product. The following is a complete list of blocks where you can specify an initial condition through the block dialog box:

- Gas-Charged Accumulator

- Spring-Loaded Accumulator

- Constant Volume Chamber

- Variable Volume Chamber

- Fluid Inertia

- Inertia

- Mass

- PS Integrator

- Rotational Spring

- Translational Spring

For details, see the block reference pages.

Compatibility Considerations
In this version, there is a difference in the way the initial conditions are computed, and as a result, the blocks that have an initial condition parameter work differently than they used to in the previous version.

Block Library Links Must Be Resolved
All SimHydraulics blocks in your models must now have resolved block library links. You can neither disable nor break these library links. This is a global requirement of Simscape modeling environment. Consult the Simscape documentation for further details.

Compatibility Considerations
If you have an existing SimHydraulics model with disabled or broken links from SimHydraulics blocks to the SimHydraulics block library, you must restore all the broken block library links for your model to be valid.

If you have disabled or broken the SimHydraulics library link for blocks that you have customized and want to keep these modified blocks in your model, you must move these modified blocks to your own custom library or libraries, then copy the block instances that you need to your model.

You must still restore the block link to its parent library, whether that parent library is SimHydraulics or your own.

Changes to SimHydraulics® Demos

The following demos have been added in Version 1.2:

Demo Name	Description
Hydraulic Actuator with Two-Chamber Snubbers (sh_actuator_with_2_chamber_snubbers)	The reciprocal actuator demonstrated in this model is equipped with snubbers (cushions) on both sides of the cylinder.
Digital Hydraulic Actuator (sh_digital_hydraulic_actuator)	The digital hydraulic actuator consists of three double-acting cylinders mounted in the same shell and interconnected through the hard stops.
Hydraulic Actuator with Load-Sensing Variable-Displacement Pump (sh_hydraulic_actuator_load_sensing_pump)	The circuit demonstrates usage of a load-sensing and pressure-limiting unit in a conventional reciprocal system with variable load on the forward stroke.
Hydraulic Actuator with Telescopic Cylinder (sh_hydraulic_actuator_telescopic_cylinder)	The actuator is built around a telescopic hydraulic cylinder, which is equipped with three rods interacting with each other through hard stops.
Closed-Circuit Reciprocal Actuator (sh_hydraulic_closed_circuit_reciprocal_actuator)	The demo illustrates a closed-circuit electrohydraulic actuator driven by a variable-velocity electrical motor.
Power-Assisted Steering Mechanism (sh_hydraulic_power_assisted_steering)	The model represents a simplified version of a power-assisted steering mechanism showing all its major parts.
Hydraulic System with Servo-Valve (sh_hydraulic_system_with_servo_valve)	The demo represents the model of a two-stage servo-valve with a 4-way, 3-position spool valve in the power stage and a flapper-nozzle amplifier in the pilot stage.
Hydraulic Transmission with Secondary Control (sh_hydraulic_transmission_secondary_control)	The system demonstrates usage of the so-called *secondary control* in hydrostatic transmissions with a variable-displacement motor.
Hydrostatic Transmission with Shuttle Valve (sh_hydrostatic_transmission_shuttle_valve)	The circuit demonstrates a hydrostatic transmission with a shuttle valve in the control unit.

Hydraulic Circuit with Load-Sensing Velocity Control (`sh_load_sensing_velocity_control`)	The circuit is equipped with the load-sensing velocity regulator installed between the pump and directional valve.
Oscillating Hydraulic Mechanism (`sh_oscillating_hydraulic_mechanism`)	The oscillating hydraulic mechanism consists of a single-acting hydraulic rotary actuator, winch, flow control valve, two-position electrohydraulic valve, and power and control units.
Reciprocal Actuator with Counterbalance Valves (`sh_reciprocal_actuator_cntrb_valves`)	The actuator is built of a double-acting cylinder, directional valve, flow control, block of counterbalance valves, power unit, replenishment arrangement, and a control unit.
Sequencing Circuit with Rotary Actuators (`sh_sequencing_circuit_rotary_actuators`)	The sequence circuit is based on four check valves installed in both pressure and return lines of the second rotary actuator.

The following demos that used to be in SimHydraulics 1.1 are now part of Simscape product:

Demo Name	Description
Simple Mechanical System (`ssc_simple_mechanical_system`)	This model is built of both rotational and translational mechanical blocks to illustrate their use in a system.
Mechanical System with Translational Friction (`ssc_mechanical_system_translational_friction`)	The demo illustrates a mass loaded with a spring and viscous damper.
Mechanical System with Translational Hard Stop (`ssc_mechanical_system_translational_hardstop`)	The demo illustrates two masses interacting through a hard stop.

Mechanical Rotational System with Stick-Slip Motion (ssc_rot_system_stick_slip)	This model demonstrates a mechanical rotational system, where a load is driven by a velocity source with a friction element between them, and stick-slip motion is developed in the regions of constant velocities.
Linkage Mechanism (ssc_linkage_mechanism)	The model demonstrates the use of the Lever block in a linkage mechanism.

Version 1.1 (R2006b) SimHydraulics® Software

This table summarizes what's new in Version 1.1 (R2006b):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	No	Bug Reports Includes fixes	No

New features introduced in this version are described here.

Linearization Support

The Simulink® `linmod` and `dlinmod` commands create continuous- or discrete-time linear time-invariant (LTI) state-space models from Simulink models. You can now use these commands to generate an LTI state-space model from a model containing SimHydraulics® components.

There are two basic ways `linmod` and `dlinmod` can be used, and the behavior of linearization differs depending on which method is chosen. If `linmod(mdl)` is called (that is, the arguments for time, state, and input are not provided), then consistent initial conditions are solved for in the same way as on the first step of a simulation. If you call `linmod(mdl, t, x, u)`, it is particularly important to provide it with a consistent state to linearize about. For more information, see "Linearizing Simscape™ Models" in the Simscape User's Guide.

New Solver Option Allows Starting Transient Analysis from a Steady State

A new solver option allows you to specify that simulation starts from a steady state. Steady state means that the system variables are no longer changing with time.

If you select the **Start simulation from steady state** check box in the Solver block dialog, the solver attempts to find the steady state that would

result if the inputs to the system were held constant for a sufficiently large time, starting from the initial state obtained from the initial conditions computation. Although the solver tries to find the particular steady state resulting from the given initial conditions, it is not guaranteed to do so. All that is guaranteed is that if the steady-state solve succeeds, the state found is a steady state (within tolerance). Simulation then starts from this steady state.

Note If the simulation fails at or near the start time when you use the **Start simulation from steady state** option, consider clearing the check box and simulating with the plain initial conditions computation only.

Extended Functionality for Working with Physical Units

Version 1.1 provides the following commands that help you specify the physical units for your system:

- pm_adddimension

- pm_addunit

- pm_getunits

Unit names are defined in the pm_units.m file, which is shipped with the product. You can open this file to see how the physical units are defined, and also as an example when adding your own units. This file is located in the directory *matlabroot*\toolbox\physmod\pm_util\pm_util.

Use the pm_getunits command to get an up-to-date list of units currently defined in your unit registry. Use the pm_adddimension and pm_addunit commands to define additional units.

New SimHydraulics® Blocks

The new blocks introduced in Version 1.1 are listed below:

- Annular Orifice

- Cylinder Friction

- Reservoir
- Elbow
- Pipe Bend
- T-junction
- Gradual Area Change
- Sudden Area Change
- Variable-Displacement Motor
- Variable-Displacement Pump
- Shuttle Valve
- PS Product
- PS Divide

Version 1.0 (R2006a+) SimHydraulics® Software

This table summarizes what's new in Version 1.0 (R2006a+):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	Not applicable	Bug Reports	No

New features introduced in this version are described here.

Product Introduction

SimHydraulics® software is a modeling environment for the engineering design and simulation of hydraulic power and control systems within Simulink® and MATLAB®. It is based on the Physical Network approach and contains a comprehensive library of hydraulic blocks, as well as one-dimensional translational and rotational mechanical elements and utility blocks.

SimHydraulics software key features are:

- Enables modeling and simulation of hydraulic power and control systems in Simulink

- Provides intuitive and convenient description of multidomain models based on physical networks

- Includes a library of hydraulic components, such as pumps, valves, accumulators, and pipelines, that account for effects such as fluid compressibility, turbulence transition, and fluid inertia

- Provides foundation library of hydraulic building blocks, as well as fundamental mechanical and mathematical elements, to enable efficient extension and customization of models

- Provides customizable library of hydraulic fluids

SimHydraulics software employs a network approach to model building. Components in the network correspond to physical elements, such as pumps, motors, valves, etc. The lines that join the components correspond to physical connections that transmit power between components. Unlike traditional Simulink block diagrams, these connections are non-directional and do not require the user to resolve the causality of the system while building the model. SimHydraulics libraries contain more than 75 models of hydraulic and mechanical components. All the models were developed to be easily characterized by data normally available in manufacturer's catalogs or data sheets. Building a model of a system is analogous to assembling the actual physical system with off-the-shelf components. The end result is a hydraulic circuit schematic in concurrence with ISO 1219 Fluid Power Standard.

SimHydraulics limitations are:

- Explicit solvers are not currently supported. Only the following solvers are supported: `ode15s`, `ode23t`, and `ode14x`.

- A SimHydraulics physical network should not exist within a Simulink algebraic loop. This means that you should not directly connect an output of a PS-Simulink Converter block to an input of a Simulink-PS Converter block of the same physical network.

- Code generation is not currently supported.

17

Compatibility Summary for SimHydraulics® Software

This table summarizes new features and changes that might cause incompatibilities when you upgrade from an earlier version, or when you use files on multiple versions. Details are provided in the description of the new feature or change.

Version (Release)	New Features and Changes with Version Compatibility Impact
Latest Version V1.3 (R2008a)	None
V1.2.1 (R2007b)	None
V1.2 (R2007a)	See the **Compatibility Considerations** subheading for these new features or changes: • "Initial Conditions Added for Certain Blocks" on page 8 • "Block Library Links Must Be Resolved" on page 9
V1.1 (R2006b)	None
V1.0 (R2006a+)	Not applicable