Requirements verification

On this page

Systems Modeling Language (SysML) is used to capture systems design as descriptive and analytical system models, which relate text requirements to the design and provide a baseline to support analysis and verification. With the system parameter calculated, you can verify the system requirement and decide whether it is satisfied or not. The modeling tool enables you to perform this verification automatically.

Getting ready for automated Requirements verification

Before performing the automatic Requirements verification, you need to get ready.

To get ready for automated Requirements verification

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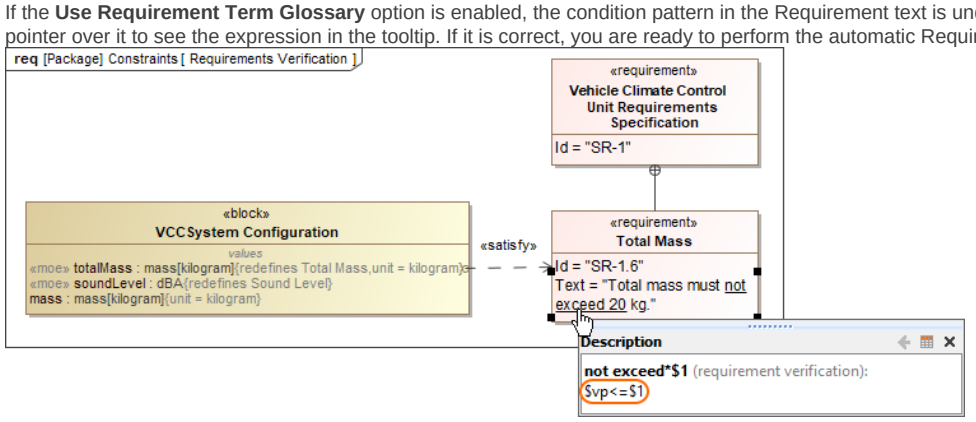
1. Define the constraint in the Requirement text.
2. Create a Satisfy relationship from the Value Property to the Requirement.

   The Value Property captures the system parameter whose value determines whether the system requirement is satisfied or not.

3. Do one of the following:

   - If the **Use Requirement Term Glossary** option is enabled, the condition pattern in the Requirement text is underlined. Move the mouse pointer over it to see the expression in the tooltip. If it is correct, you are ready to perform the automatic Requirement verification.

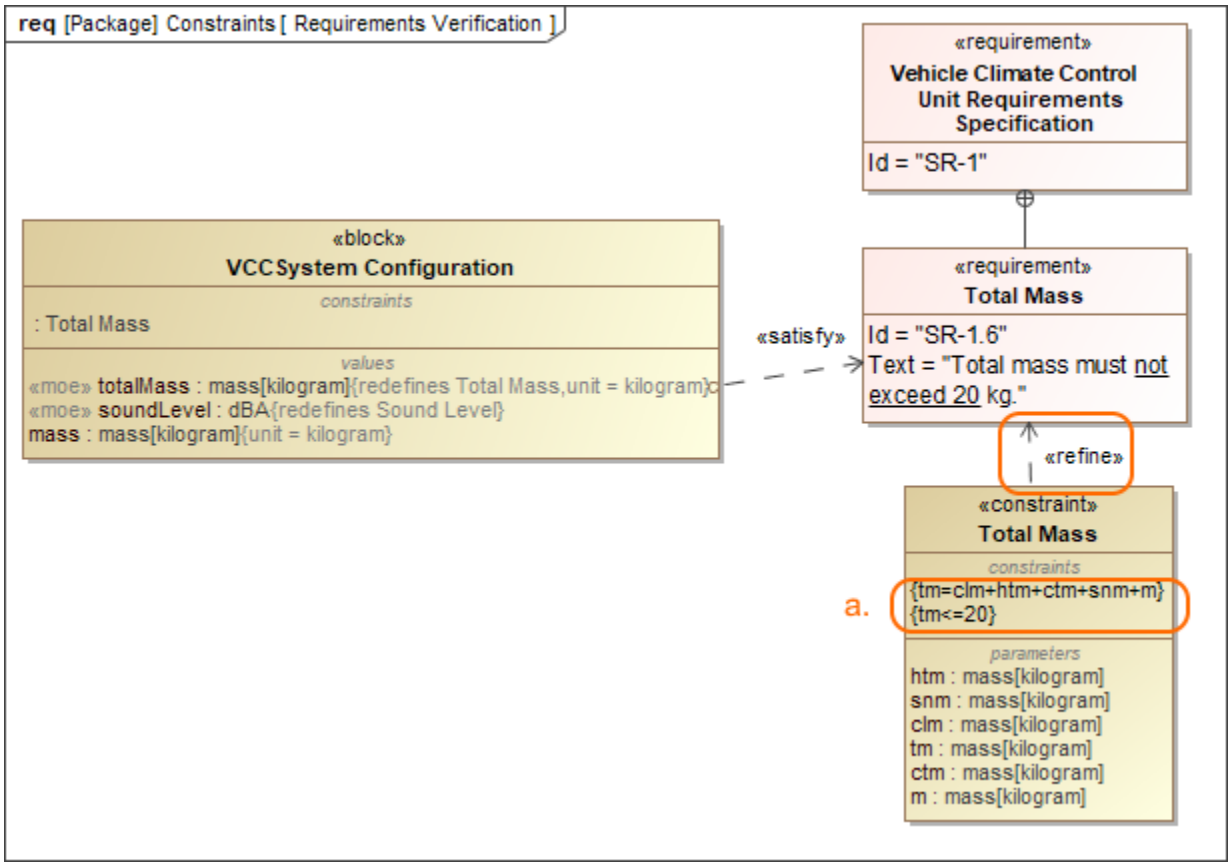


   Learn more:

   - How enable/disable the **Use Requirement Term Glossary** option.
   - How to define custom condition patterns.
   - How to check predefined condition patterns.
   - How to extract the Constraint from Requirement text.

   - If the expression in the tooltip is not correct, do the following:
     a. Perform either of the two options:
        - Right-click a value property in the compartment area of the element shape.
        - Right-click the Requirement.
     b. Select **Tools > Extract Constraint Block From Requirement** to automatically create a Constraint Block.
     c. You can modify the constraint expression and the parameters as needed (see Figure A below).

You are now ready to perform the automatic Requirement verification.



In the example above, a Constraint Block with the constraint *{totalMass <= 20}* and the constraint parameters is automatically created. The constraint expression is then modified to *{tm=clm+html+ctm+snm+m}{tm<=20}*.

Performing automated Requirements verification in Requirement Table

The automated Requirements verification analysis can be carried out directly in the Requirement Table. The analysis is performed by evaluating whether the value of the property that satisfies the Requirement falls within a range of upper and lower bounds that are extracted from the Requirement text. Additionally, the automatically calculated margin value helps to determine how close the system model is to fulfilling Requirements.

To perform automated Requirements verification

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1. Create a Requirement Table. You can also use an existing Requirement Table.
2. Specify the scope for the table.
3. Set the context element (i.e., a Block as the table context) to perform the context-specific analysis.

> **Note**
> If the **Context** field is left unspecified, properties satisfying Requirements are collected from the entire model.

4. Select the columns (**Columns** > **Select Columns**) to show in the table:
   - **Property** - the Value Property that satisfies the Requirement.
   - **Bounds** - lower and upper bounds of the required value extracted from the Requirement text.
   - **Value** - the calculated value (default value or initial value) of the property that satisfies the Requirement.
   - **Margin** - the difference between the calculated value and the required value.
5. Display the Requirement Verification legend to highlight passing and failing Requirements.
   The Requirement Table with the *Property*, *Bounds*, *Value*, and *Margin* columns is created and passing/failing Requirements are marked (see an image below).

Criteria

Scope (optional): REGULAR Requirements,COMMON_Requirements ... Filter: Context (optional): SUV_REGULAR ...

Requirement Verification: Pass Fail

#	Name	Text	Property	Bounds	Value	Margin
1	1 SUV_REGULAR Requirements					
2	1.1 Spring Coils	Spring shall have less than 8 coils.	suspension.spring.coils : Real	<8	7	1
3	1.2 Spring Deflection Distance	Spring shall have not more than 108-mm deflection distance.	suspension.spring.deflectionDistance : diameter[metre]	<=108	132	-24
4	1.3 Spring Free Length	The spring shall have a free length of 200 mm.	suspension.spring.freeLength : distance[millimetre]	=200	160	-40
5	1.4 Spring Outer Diameter	The diameter shall be less than 105 mm and more than 95 mm.	suspension.spring.outerDiameter : diameter[millimetre]	(95;105)	85	-10
6	1.5 Shock Absorber Length	Overall shock absorber length shall be at maximum of 600.	suspension.shockAbsorber.length : distance[millimetre]	<=600	450	150
7	1.6 Shock Absorber Weight	Shock absorber shall weight not more than 4 kg.	suspension.shockAbsorber.weight : mass[kilogram]	<=4	3	1
8	1.7 Tire Diameter	The tires shall have 18-inch rolling diameter.	suspension.wheel.tire.diameter : Integer	=18	17	-1
9	1.8 Tire Height	The tire height shall be not less than 45 and not more than 60.	suspension.wheel.tire.height : distance[millimetre]	[45;60]	50	5
10	1.9 Tire Width	The tire width shall be between 205 and 270 millimeters.	suspension.wheel.tire.width : distance[millimetre]	[205;270]	185	-20
11	1.10 Rotor Diameter	The brake rotors shall not exceed 0.28 meter diameter.	brake.rotor.rotorOuterDiameter : diameter[millimetre]	<=0.28	0.29	-0.01
12	1.11 Pad Center Length	The Pad Center Length shall be between 0.075 and 0.14 meters.	brake.pad.padLength : length[metre]	[0.075;0.14]	0.15	-0.01
13	1.12 Brake Pad Life	Brake pads shall have a projected life of at least 57500 km.	brake.pad.padLifeSpan : distance[kilometre]	>=57500	90000	32500
14	1.13 Pad Width	The Pad width shall be more than or equals 45e-3 and less than 65e-3 meters.	brake.pad.padWidth : diameter[metre]	(0.045;0.065)	0.042	-0.003

Using the Requirement patterns mechanism, the constraint extracted from the Requirement text is shown in the **Bounds** column. The **Value** column shows the initial value (if it exists) or the default value of the Value Property. Finally, the **Margin** column displays the difference between the calculated and required values.

Requirements refined by Constraint Blocks

The Requirements Verification analysis in the Requirement Table considers constraints extracted directly from the Requirement text only, meaning that the analysis cannot be performed for Requirements refined by Constraint Blocks.

Simulation configuration option

If an Instance is defined as the Requirement Table context, the Requirements verification analysis does not consider the Simulation configuration option Remember Failure Status.

Performing automated requirements verification using Simulation

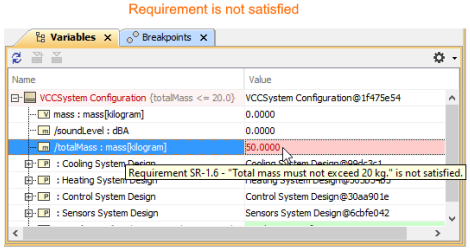
With the help of simulation, you can perform automatic Requirements verification.

To perform automatic Requirements verification you must have the Cameo Simulation Toolkit installed. How to install >>

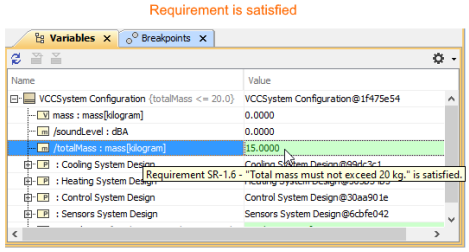
To perform automatic Requirements verification

1. Right-click the Block which contains the Value Property.
2. From the shortcut menu, select **Simulation** > **Run**.
3. In the **Question** dialog, click **Yes** to load the validation rules and validate the model before the simulation or **No** to simulate the model without validating it.
4. In the Simulation window, click or press F8 to start simulation.
   The result indicating whether or not the value is satisfied is shown in the Variables pane. In the following figure, you can see when the Requirement is not satisfied (highlighted in red) and satisfied (highlighted in green). You can change the value directly in the Value cell and the Requirement constraint is checked automatically.

Requirement is not satisfied



Requirement is satisfied



Additional features of Cameo Simulation Toolkit

Learn more about how to perform verification for a single element >>

Webinar: Automated Requirements Verification

Learn more about how to validate the model against a set of validation rules before executing it >>