



AUCOTEC
Create Synergy – Connect Processes

Engineering Base

Rule-Based Design

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1 General Information

Using the rule-based design, you can specify rules for working in P&I diagrams and logic diagrams.

You can define rules that are to be taken into account for item combinations on editing sheets. If the defined rules are not met, you can specify the severity level with which the conflict is to be stored. On the sheet, the conflict list is displayed in which the conflicts are described in further detail. You can navigate between the conflict list and the affected objects on the opened sheet.

In case of an error, the conflict is graphically marked with a warning triangle .

In the rules, you can define the following actions:

- Consistency check
Comparison of the attribute values of
 - Pipelines and objects of an item group or
 - Items of two item groups.

With these actions, you can, for instance, check whether the attribute value of the attribute **Nominal Size** in a pipeline matches the value of the valves placed into the pipeline as inline devices. If this is not the case, a conflict is displayed in the sheet and in the conflict list.

- Passing on attribute values from one item to another if the specified conditions are met. This, for instance, enables you to pass on the **pipe class** of a pipeline to all in-line devices.



Copying attributes values cannot be linked to the conditions of another attribute.

Prerequisites

You can only use the functionality of this assistant on sheets of the following **Smart Diagram Types**:

- **P&I Diagram**
- **Logic Diagram.**

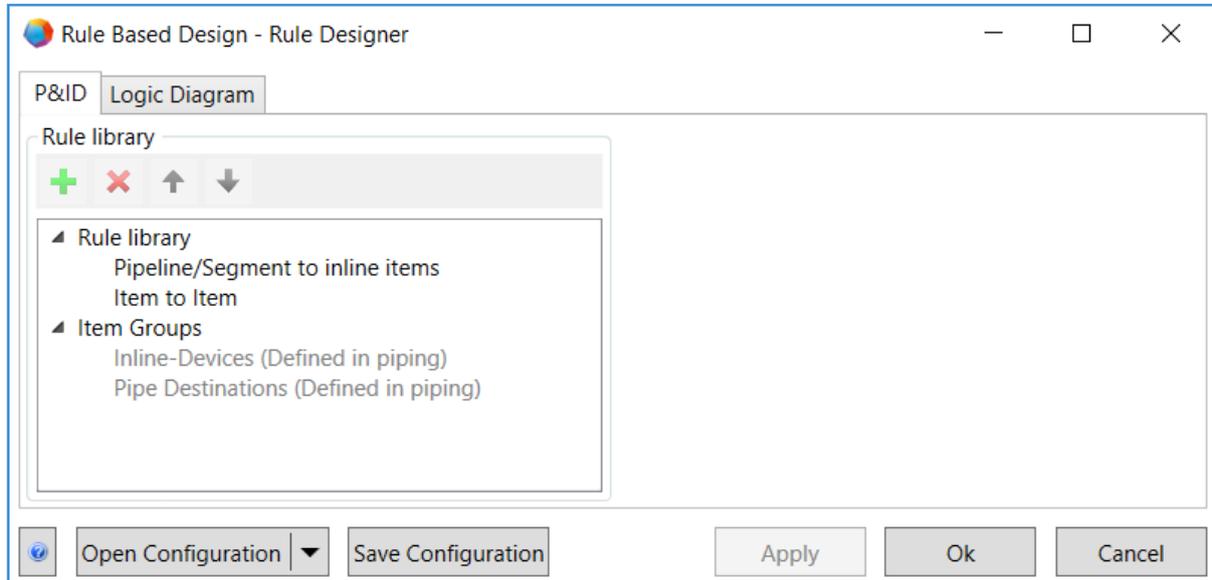
To activate the rule-based design for a project

1. In the **Engineering Base Explorer**, select the project.
2. On the shortcut menu, click **Properties**.
3. In the **Properties** dialog of the project, expand the **Engineering** folder and click **Rule Based Design**.
4. Click the option **Activate Rule Based Design**.
5. Click the **Configuration** button to edit the rule-based design specifications according to your requirements.
6. Make the changes of your choice in the configuration and click **OK** to save the settings.

2 Configuration

On activating the rule-based design in the project properties, click the **Configuration** button to open the Rule Designer.

In the **Rule Based Design - Rule Designer** dialog, you can define rules that are to be valid for specific items or item groups.



In the dialog, you can adjust the settings for P&I diagrams and logic diagrams.

Tabs in the dialog

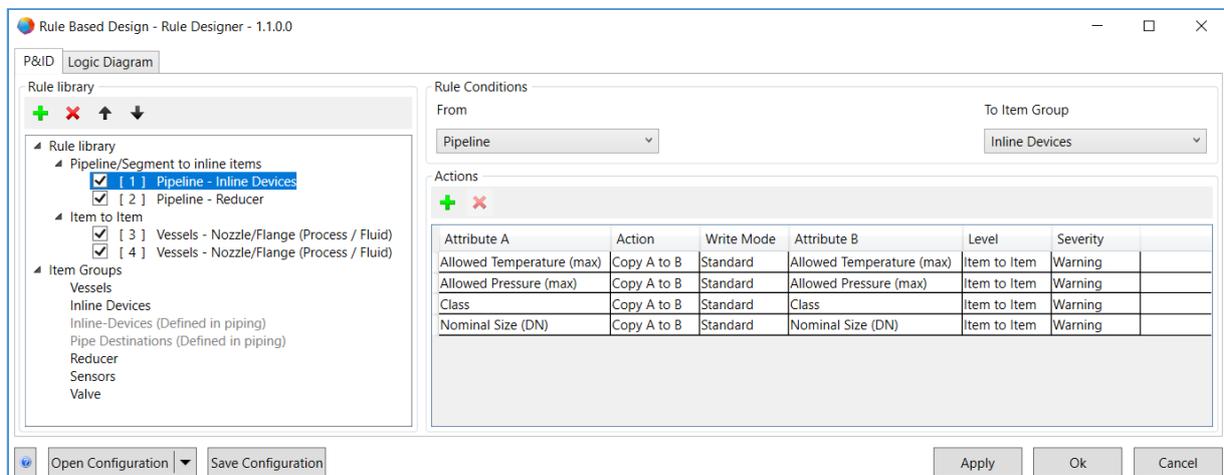
P&ID	<p>Definition of item groups and rules for planning in P&I diagrams.</p> <p>Definition of actions to be carried out if the specified conditions for two connected items are met.</p> <p>For the piping, you can define which actions are to be carried out for the different inline devices of a pipeline.</p>
Logic Diagram	<p>For logic diagrams, you can define actions to be carried out if the specified conditions for two connected items are met.</p>

Meaning of the buttons

Open Configuration	<p>Select an existing configuration.</p> <ul style="list-style-type: none"> • From File System A file selection dialog is opened in which you can select a *.rul configuration file. • Project All projects of the database are offered for selection. If there is no configuration defined in a specific project, the empty default configuration is used.
Save Configuration	<p>The current configuration is saved as *.rul. You can select the storage location in a file selection dialog. The file name "YYYYMMDD_project name" is suggested.</p>
Apply	<p>The settings are saved in the project. The dialog remains opened for further input.</p>
Ok	<p>This ends the dialog. The settings made are saved in the project.</p>
Cancel	<p>This ends the dialog; the settings are not saved.</p>

2.1 The P&ID Dialog

In the **P&ID** dialog, you can define item groups and specify rules in the rule library.



You can edit the rules, item groups or actions via the following icons:

	<p>In the Rule library section: Adds a rule line or a new item group.</p> <p>In the Actions section: Displays a new row to define a new action.</p>				
	<p>Deletes the selected rule, item group or action.</p>				
	<p>The priority of the selected rule in the rule library is moved down. The number in front of the rule illustrates the priority that is assigned to the rule.</p> <table border="0"> <tr> <td><input checked="" type="checkbox"/> [1] Rohrleitung - Inline Devices</td> <td><input checked="" type="checkbox"/> [1] Pipeline - Inline Devices</td> </tr> <tr> <td><input checked="" type="checkbox"/> [2] Rohrleitung - Reduzierung</td> <td><input checked="" type="checkbox"/> [2] Pipeline - Reducer</td> </tr> </table>	<input checked="" type="checkbox"/> [1] Rohrleitung - Inline Devices	<input checked="" type="checkbox"/> [1] Pipeline - Inline Devices	<input checked="" type="checkbox"/> [2] Rohrleitung - Reduzierung	<input checked="" type="checkbox"/> [2] Pipeline - Reducer
<input checked="" type="checkbox"/> [1] Rohrleitung - Inline Devices	<input checked="" type="checkbox"/> [1] Pipeline - Inline Devices				
<input checked="" type="checkbox"/> [2] Rohrleitung - Reduzierung	<input checked="" type="checkbox"/> [2] Pipeline - Reducer				
	<p>The priority of the selected rule in the rule library is moved up. The number in front of the rule illustrates the priority that is assigned to the rule.</p> <p>In general, the rules under Pipeline/Segment to inline items take priority over the rules under Item to Item.</p>				

2.1.1 Definition of the Item Groups

Under **Item Groups**, you can group items (devices, functions, mechanical tags etc.) into various item groups. For these item groups, you can then create rules in the rule library.

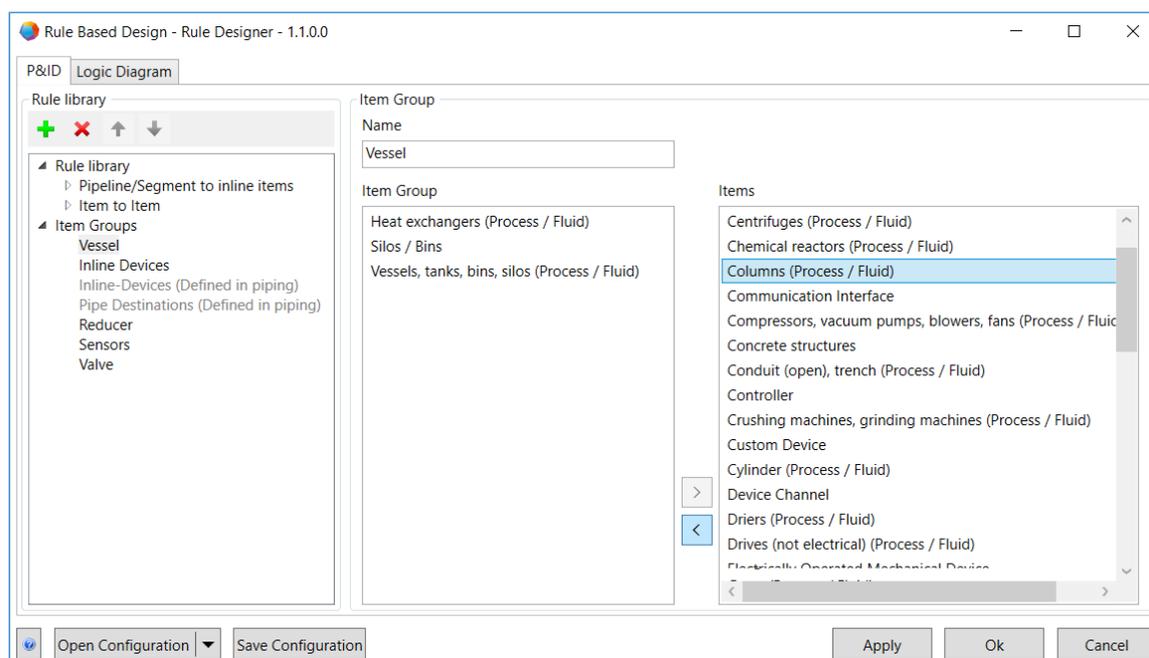
The inline devices and pipe destinations defined in the **Piping** are also displayed as item groups. In this dialog, you cannot change the composition of these two item groups.

Definition of a new item group

1. Mark **Item Groups** or an already defined item group.
2. Click  to create a new item group.
3. In section **Item Group**, enter the name of the new item group into the **Name** field.
4. In the **Items** table, mark an item and click  to allocate it to the **Item Group** table.

The items in the item group table are sorted alphanumerically.

To remove an item from the item group, mark the item and click .



Deletion of an item group

1. Mark the item group and click .



You can only delete an item group if it is not used in the rule library.

2.1.2 Rule Library

In the rule library, you can define rules that are to be valid for pipelines, pipeline segments and item groups.

A rule consists of the following aspects:

- Name of the rule
- Priority
The numbers in front of the rule names define the priority with which the rules are to be applied.
- Relation between two item groups (objects)
- Actions that are to be carried out for specified attributes of items of the item group.
For the evaluation, the pin always takes priority over the device; i.e. if an attribute does not exist at a pin, the attribute at the device is taken into account.

The rules defined for the relation between two items (item groups) are applied to every change of an object in the P&I diagram.

The following changes are taken into account:

- Changes in the pipeline network (Adding, deleting, associating objects etc.)
- Changes to an attribute of connected objects.
Changes may include aspects such as changing the nominal size of a pipeline from 4" to 6", changing the type of a connected device or pin, or reversing the flow direction at a pin.

If the same attribute is to be copied from two different source objects into the same target object by two different rules with the same priority, no attribute values are copied. Instead, a conflict is displayed.

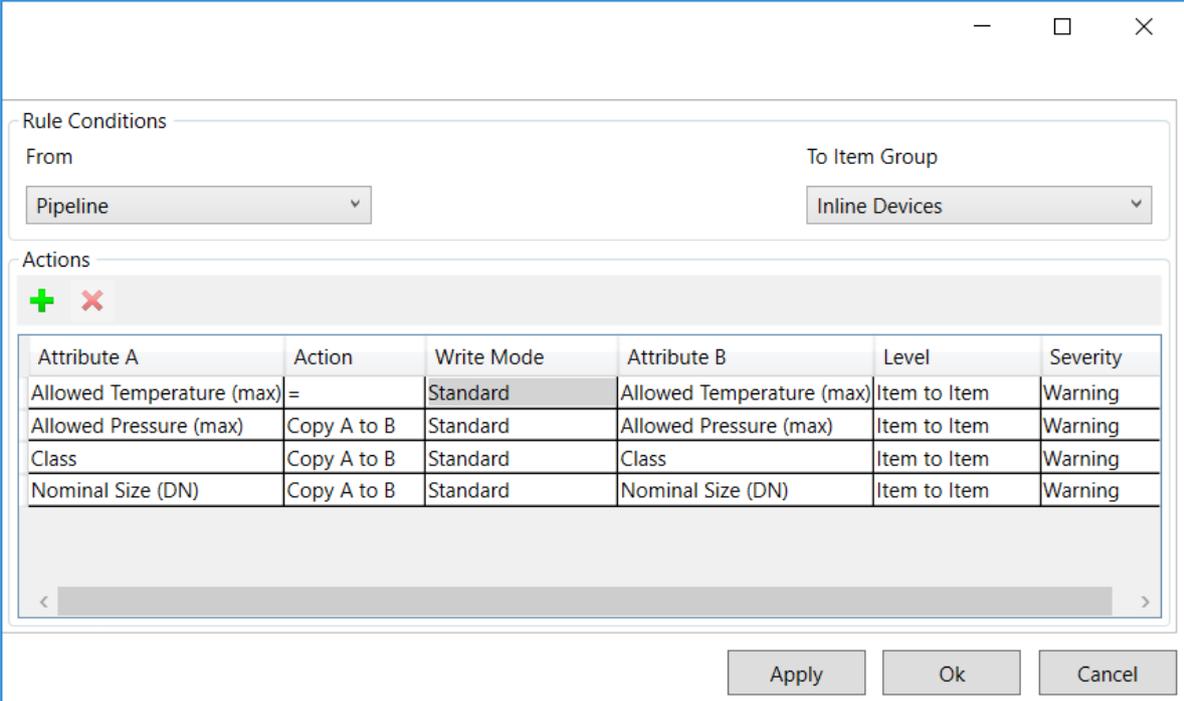
Definition of a new rule

1. Select the folder in which the new rule is to be defined. The following options are available:
 - **Pipeline/Segment to inline items**; in this section, you can define further rules for the piping.
 - **Item to Item**
2. Click  to create a new rule.
The name of the rule is automatically created; it is composed of the two objects or item groups to which the rule is to be applicable.
3. In the **Rule Conditions** section, define to which objects or item groups the rule is to be applicable.
4. Click  in the **Actions** section to create a new row for the definition of the rules.
5. Define which actions are to be carried out for specific attributes.
6. In the **Rule library** section, define the priority that is to be assigned to the rule via the arrow keys   or the shortcut menu of the rule. The priority of the rule is displayed in the squared bracket [] in front of the rule name.

2.1.2.1 Rule Library: Pipeline/Segment to Inline Items

In this section of the **Rule Based Design - Rule Designer** dialog, you can define the rules for the different connections of pipelines and pipeline segments to inline items or other objects (item groups).

The following chapters describe the respective entry fields of the rule creation dialog.



The screenshot shows a dialog box with the following sections:

- Rule Conditions:**
 - From:** Pipeline
 - To Item Group:** Inline Devices
- Actions:**
 - Buttons:  
 - Table:

Attribute A	Action	Write Mode	Attribute B	Level	Severity
Allowed Temperature (max)	=	Standard	Allowed Temperature (max)	Item to Item	Warning
Allowed Pressure (max)	Copy A to B	Standard	Allowed Pressure (max)	Item to Item	Warning
Class	Copy A to B	Standard	Class	Item to Item	Warning
Nominal Size (DN)	Copy A to B	Standard	Nominal Size (DN)	Item to Item	Warning

Buttons at the bottom: Apply, Ok, Cancel

The Rule Conditions section		
From	Select the source object via  . The possible choices are: <ul style="list-style-type: none"> • Pipeline • Pipeline Segment. 	
To Item Group	Select the target object via  . The following item groups are available: <ul style="list-style-type: none"> • individually defined item groups • inline devices as defined in the piping • pipeline segment • pipe destinations as defined in the piping. 	
The Actions section		
Attribute A	An attribute of the source object. Its attribute value is either to be copied into an attribute of the target object, or it is to be used for a comparison. Click the cell, then click the selection button  . This opens the Attribute Selection dialog. You can select the attributes of the source object (From or Item A) or a list of all available attributes.	
Action	In the Action column, you can define whether the attribute value of attribute A of the source object is to be copied into attribute B of the target object or whether the two attributes are to be compared.	
	Copy A to B	The attribute value of attribute A of the source object (item A) is copied into attribute B of the target object (item B).
	Copy B to A	The attribute value of attribute B of item B is copied into attribute A of item A. This option can only be selected for rules of the Item to Item relation.
	 Copying characteristics for attributes with units	The attribute value is copied in the following cases: <ul style="list-style-type: none"> • Unit attribute to unit attribute (with the same dimension group, e.g. length or weight) • Unit attribute to attribute without unit (text attribute). A conflict is displayed in the following case: <ul style="list-style-type: none"> • Attribute without unit to unit attribute.
	You can select the following relational operators. If the condition is not met, a conflict of the defined severity is displayed.	
=	The attribute values of the attributes A and B must be identical.	

	>	The attribute value of attribute A must be greater than the attribute value of attribute B.
	>=	The attribute value of attribute A must be greater than or equal to the attribute value of attribute B.
	<	The attribute value of attribute A must be less than the attribute value of attribute B.
	<=	The attribute value of attribute A must be less than or equal to the attribute value of attribute B.
	< >	The attribute value of attribute A must not be equal to the attribute value of attribute B.
The relational operators can be used for the following data types:		
	Strings	=, <>
	Numbers, floating point numbers	=, <, >, =<, >=, <>
	Dates	=, <, >, =<, >=, <>
	Boolean attributes	=, <>
	Unit attributes (base unit)	=, <, >, =<, >=, <>
	Formula attributes	No relational operators selectable
	 Behavior on comparing attributes with units	<p>The attribute values can be compared in the following case:</p> <ul style="list-style-type: none"> Unit attribute to unit attribute (with the same dimension group, e.g. length or weight). <p>In the following cases, a conflict is displayed:</p> <ul style="list-style-type: none"> Unit attribute to attribute without unit Attribute without unit to unit attribute.
Write Mode	Select the write mode for copy processes via  .	
		Attributes with the properties Read-Only and From Catalog are never overwritten.
	Only when empty	The attribute value is copied if the attribute in the target object is empty and does not have the property Manual Entry .
	Standard	The attribute value is copied if the attribute in the target object does not have the property Manual Entry .

	Overwrite manual entry	The attribute value is copied if the attribute in the target object does not have the property Read-Only .
Attribute B	<p>An attribute of the target object. The attribute value of the source object is to be copied into this attribute, or its attribute value it is to be used for a comparison with Attribute A.</p> <p>Click the cell, then click the selection button .</p> <p>This opens the Attribute Selection dialog.</p> <p>You can select the attributes of the target object (To Item Group or Item B) or a list of all available attributes.</p>	
Level	<p>Define the level of the source and the target object on which the action is to be carried out.</p> <p>The offered level selection is based upon the object (item) selection and the selection of the action.</p> <p>Available levels:</p> <ul style="list-style-type: none"> • Item to Item • Item to Pin • Auto (The level is selected depending on the items and the selected action) • Pin to Pin 	
Severity	<p>Define the severity level that is to be assigned to the conflict in the conflict list.</p> <p>Click  to select one of the three severity levels.</p> <ul style="list-style-type: none"> • Information • Warning • Error - Errors are additionally marked with a warning triangle in the graphics 	

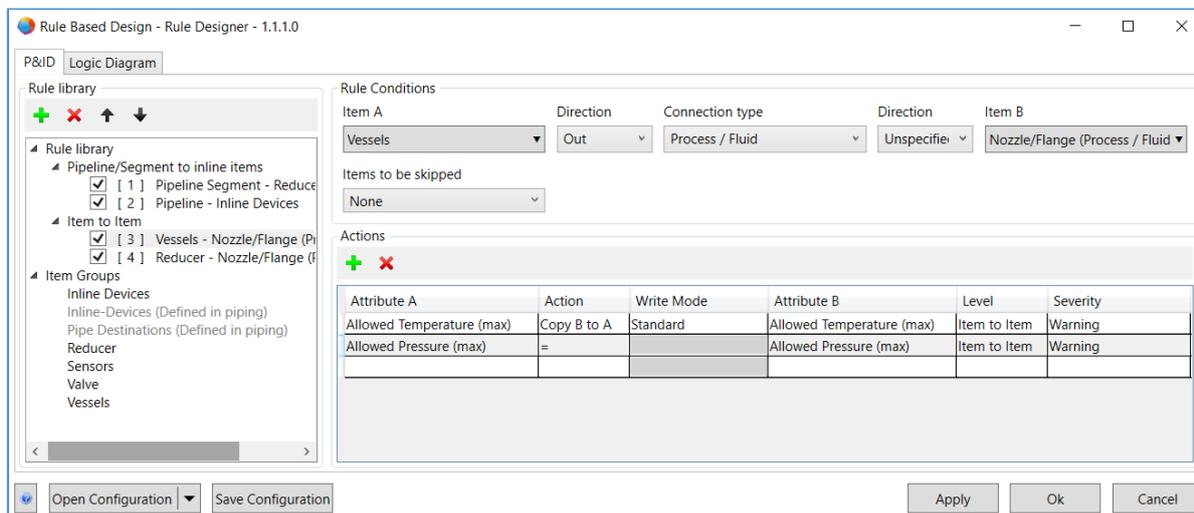
Actions for copying attribute values between item A and item B

Only when empty	The attribute value is only copied if the attribute in the target object is empty or if it does not have the properties Read-Only and Manual Entry .
Standard	The attribute value is only copied if the attribute in the target object does not have the properties Read-Only and Manual Entry .
Overwrite manual entry	The attribute value is copied if the attribute in the target object does not have the property Read-Only .

2.1.2.2 Rule Library: Item to Item

In this section of the **Rule Based Design - Rule Designer** dialog, you can define the rules that are to be applicable to two objects or item groups.

The following chapters describe the respective entry fields of the rule creation dialog.



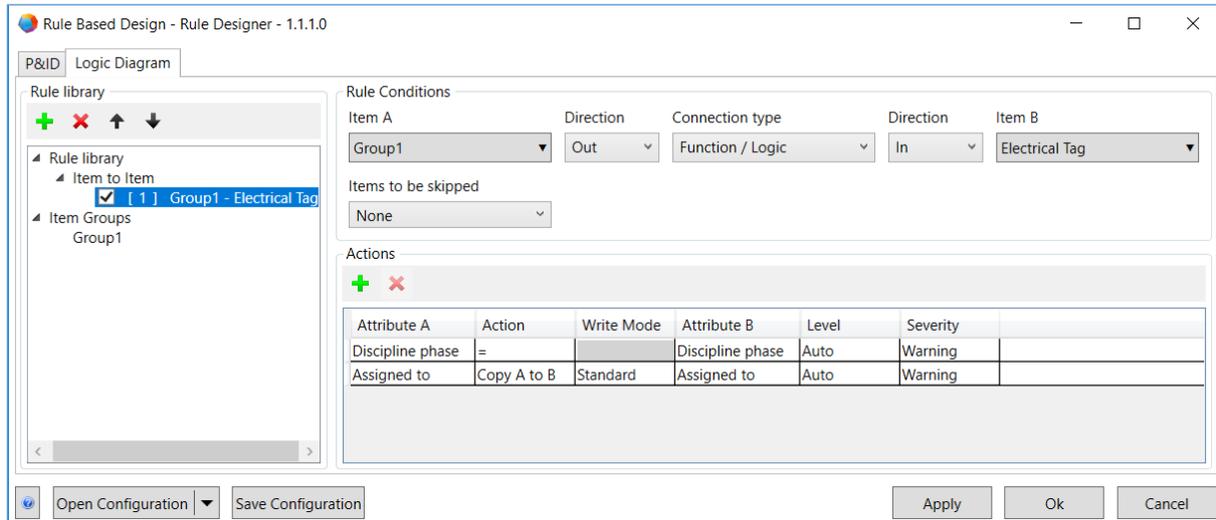
The Rule Conditions section	
Item A	Select an object type via <input type="button" value="v"/> . The possible choices are: <ul style="list-style-type: none"> • Device Types • Function Types • All individually defined item groups.
Direction	Via <input type="button" value="v"/> , you can select the following flow directions: <ul style="list-style-type: none"> • In (Inlet) • Out (Outlet) • Unspecified • Neutral (only for pin type process control).
Pin type	Via <input type="button" value="v"/> , the following pin types are available: <ul style="list-style-type: none"> • Process / Fluid • Process Control.
Item B	Select an object type via <input type="button" value="v"/> . The possible choices are: <ul style="list-style-type: none"> • Device Types • Function Types • All individually defined item groups.
Items to be skipped	Via <input type="button" value="v"/> , select the items that are not to be taken into account. The possible choices are: <ul style="list-style-type: none"> • None • All individually defined item groups.

The Actions section

The meaning of the table columns in the Actions section is described in chapter 2.1.2.1, [Rule Library: Pipeline/Segment to Inline Items](#).

2.2 The Logic Diagram Dialog

For logic diagrams, you can define item groups and specify rules in the rule library via the **Logic Diagram** dialog.



Description of the entry fields in chapter 2.1.2.2, [Rule Library: Item to Item](#)

Definition of item groups: All function types can be selected

Definition of items to be skipped: none or all individually defined item groups.

2.2.1 Definition of the Item Groups

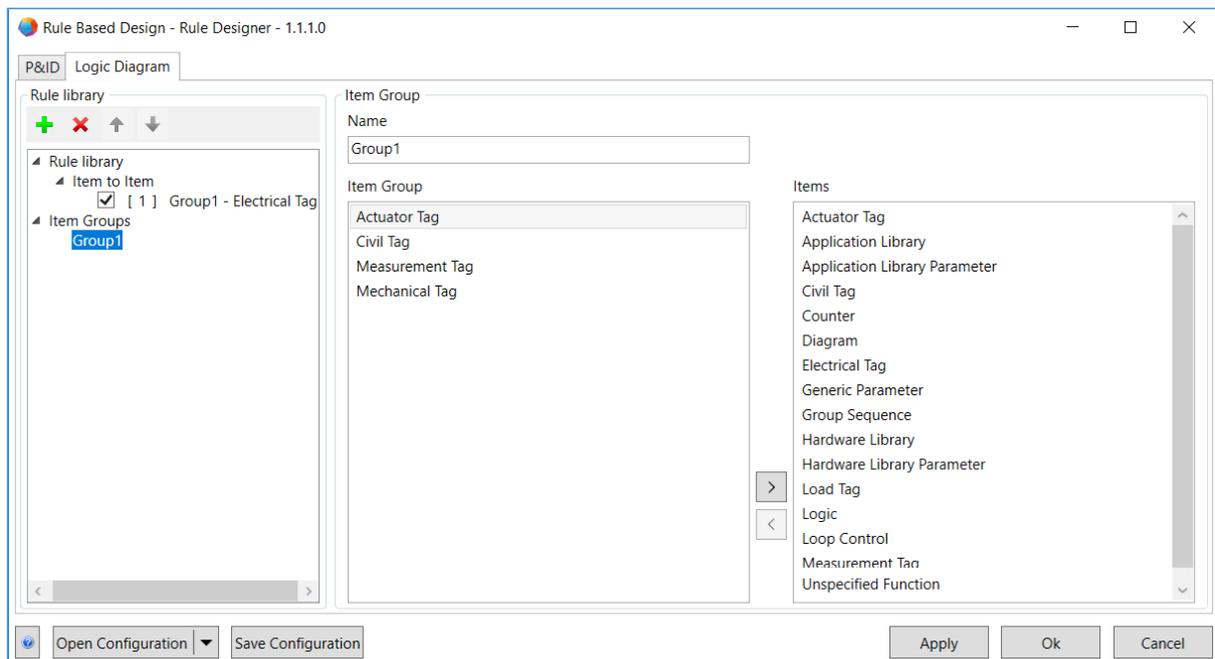
Under **Item Groups**, you can group function types into various item groups. For these item groups, you can then create rules in the rule library.

Definition of a new item group

1. Mark **Item Groups** or an already defined item group.
2. Click  to create a new item group.
3. In section **Item Group**, enter the name of the new item group into the **Name** field.
4. In the **Items** table, mark an item and click  to allocate it to the **Item Group** table.

The items in the item group table are sorted alphanumerically.

To remove an item from the item group, mark the item and click .



2.2.2 Rule Library: Item to Item

In this section of the **Rule Based Design - Rule Designer** dialog, you can define the rules that are to be applicable to two functions or item groups.

The Rule Conditions section	
Item A	Select an object type via <input type="button" value="v"/> . The possible choices are: <ul style="list-style-type: none"> Function Types All individually defined item groups.
Direction	Via <input type="button" value="v"/> , you can select the following flow directions: <ul style="list-style-type: none"> In (Inlet) Out (Outlet) Unspecified
Pin type	<ul style="list-style-type: none"> The pin type Logic is preset
Item B	Select an object type via <input type="button" value="v"/> . The possible choices are: <ul style="list-style-type: none"> Function Types All individually defined item groups.
Items to be skipped	Via <input type="button" value="v"/> , select the items that are not to be taken into account. The possible choices are: <ul style="list-style-type: none"> None All individually defined item groups.
The Actions section	
The meaning of the table columns in the Actions section is described in chapter 2.1.2.1, Rule Library: Pipeline/Segment to Inline Items .	

3 Conflict List

If any errors have occurred during the planning in the P&I diagram and the logic diagram, they are graphically marked with a warning triangle and specified in further detail by an entry in the conflict list.

You can activate the display of the conflict list on the sheet via the **EB Tools** tab.

101 Record	▲2 Priority	Description	Items	Action	▲1 Severity	Category	Diagram Type
1	1	Several Pipelines are connected without pipe separat...	+F1 1R11,+F1 1R17,+...		Error	Pipe symbol	
2	1	Several Pipelines are connected without pipe separat...	+F1 1R10,+F1 1R14,+...		Error	Pipe symbol	
3	1	Several Pipelines are connected without pipe separat...	+F1 1R3,+F1 1R6,+F1...		Error	Pipe symbol	
4	1	The flow stream is not associated with pipeline.	MeOH (Rescued)		Error	Flow stream	
5	1	The flow stream is not associated with pipeline.	6) Methyl ester crude		Error	Flow stream	
6	1	The flow stream is not associated with pipeline.	3) MeOH+N+OIL (Re...		Error	Flow stream	
7	1	The flow stream is not associated with pipeline.	Diluted Glycerol		Error	Flow stream	

In the Engineering Base Help, you will find further information about the conflict list.