Modelling ISA88/IEC61512 Batch systems

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Who am i:

- Jan de Liefde
- Systems engineer in the infrastructure and industry domain
- Focus on Model Based (Systems) Engineering
- Jan.de.liefde@thecollective.si

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Batch industry

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- ANSI/ISA-88, is a standard addressing batch process control. It is a design philosophy for describing equipment, and procedures. It is not a standard for software, it is equally applicable to manual processes. It was approved by the ISA in 1995 and updated in 2010.
- Its original version was adopted by the IEC in 1997 as IEC 61512-1.

IEC61512 Batch control

EUROPEAN STANDARD **EN 61512-1**
NORME EUROPÉENNE
EUROPÄISCHE NORM June 1999

ICS 25.040.40; 01.040.25

English version

Batch control
Part 1: Models and terminology
(IEC 61512-1:1997)

Contrôle-commande des processus de fabrication par lots
Partie 1: Modèles et terminologie
(CEI 61512-1:1997)

Chargenorientierte Fahrweise
Teil 1: Modelle und Terminologie
(IEC 61512-1:1997)

This European Standard was approved by CENELEC on 1999-05-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: *rue de Stassart 35, B - 1050 Brussels*

Ref. No. EN 61512-1:1999 E

EUROPEAN STANDARD **EN 61512-2**
NORME EUROPÉENNE
EUROPÄISCHE NORM October 2002

ICS 35.240.50

English version

Batch control
Part 2: Data structures and guidelines for languages
(IEC 61512-2:2001)

Contrôle-commande des processus de fabrication par lots (batch)
Partie 2: Structures de données et règles générales relatives aux langages
(CEI 61512-2:2001)

Chargenorientierte Fahrweise
Teil 2: Datenstrukturen und Leitfaden für Sprachen
(IEC 61512-2:2001)

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 61512-2:2002 E

EUROPEAN STANDARD **EN 61512-3**
NORME EUROPÉENNE
EUROPÄISCHE NORM September 2008

ICS 25.040.40; 35.240.50

English version

Batch control -
Part 3: General and site recipe models and representation
(IEC 61512-3:2008)

Contrôle-commande des processus de fabrication par lots -
Partie 3: Modèles et représentation des recettes générales et des recettes de site
(CEI 61512-3:2008)

Chargenorientierte Fahrweise -
Teil 3: Modelle und Darstellungen von Verfahrens- und Werksrezepten
(IEC 61512-3:2008)

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 61512-3:2008 E

EUROPEAN STANDARD **EN 61512-4**
NORME EUROPÉENNE
EUROPÄISCHE NORM September 2010

ICS 25.040.40

English version

Batch control -
Part 4: Batch production records
(IEC 61512-4:2009)

Contrôle-commande des processus de fabrication par lots -
Partie 4: Enregistrements de production par lots
(CEI 61512-4:2009)

Chargenorientierte Fahrweise -
Teil 4: Aufzeichnungen zur Chargenproduktion
(IEC 61512-4:2009)

This European Standard was approved by CENELEC on 2010-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 61512-4:2010 E

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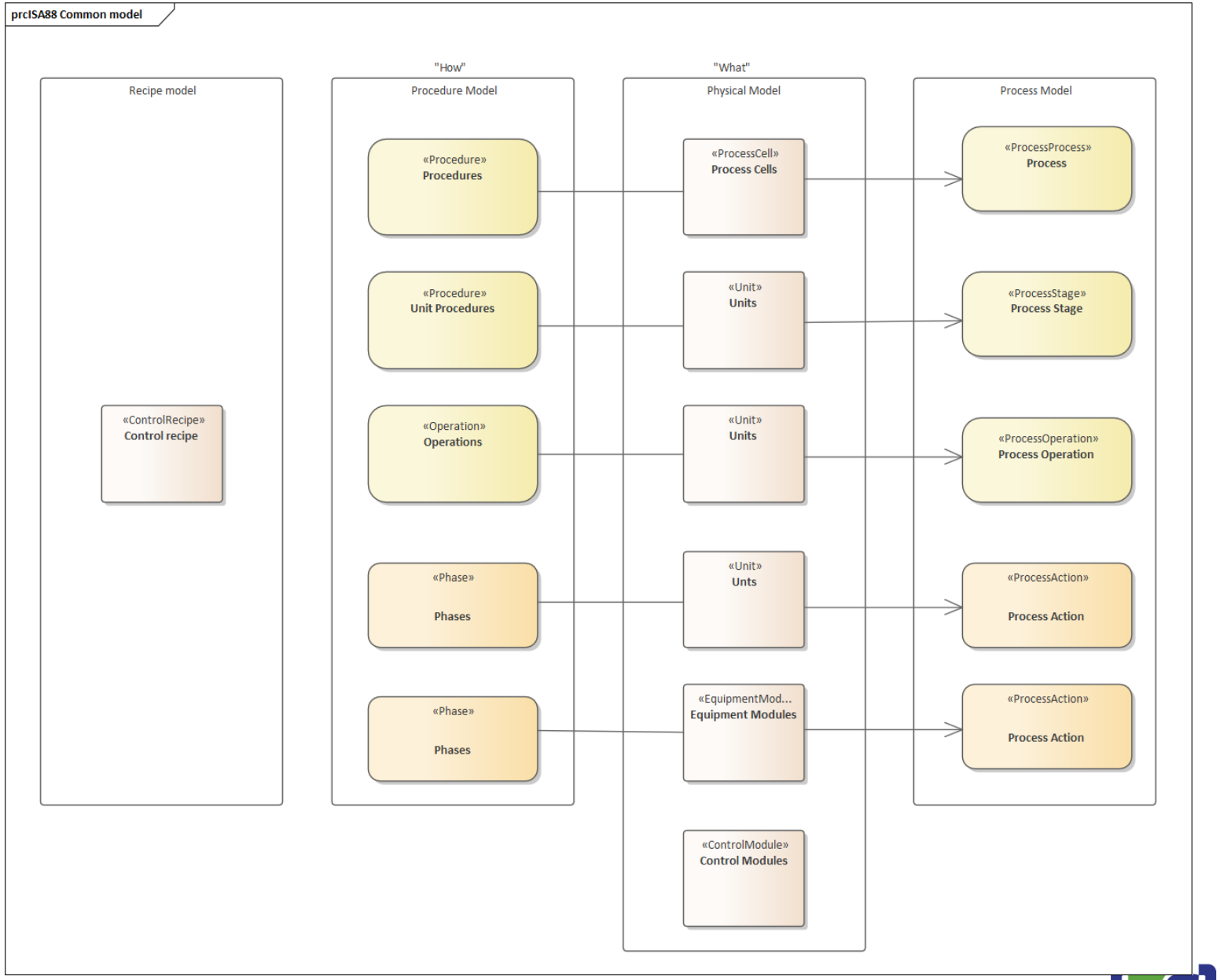
Overview



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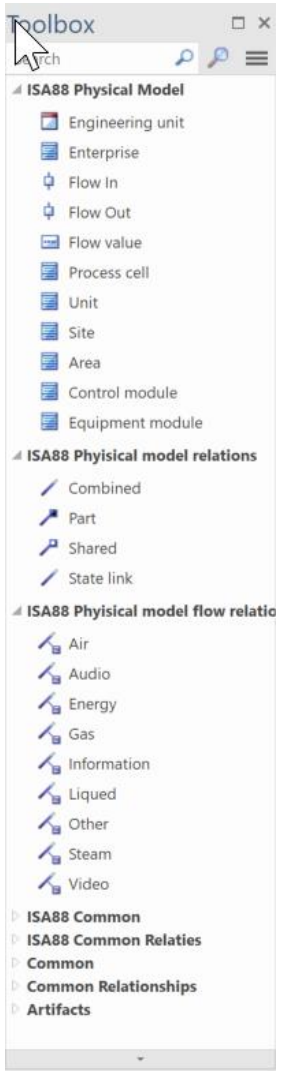
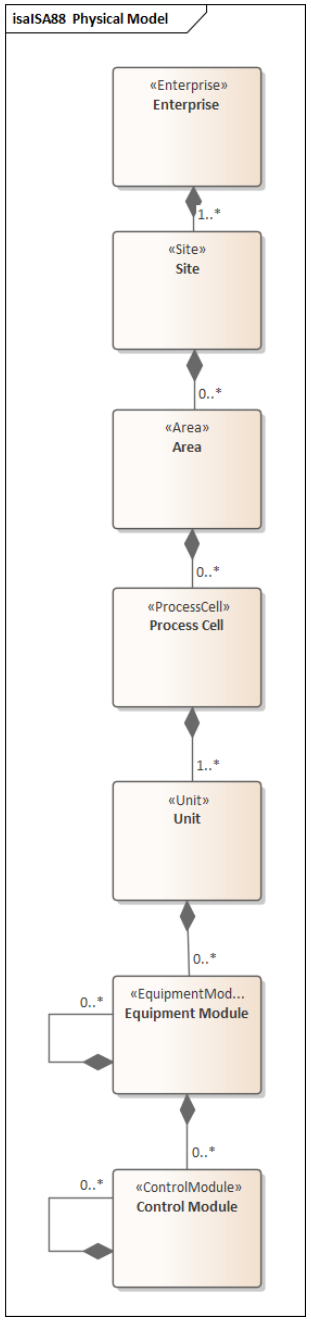
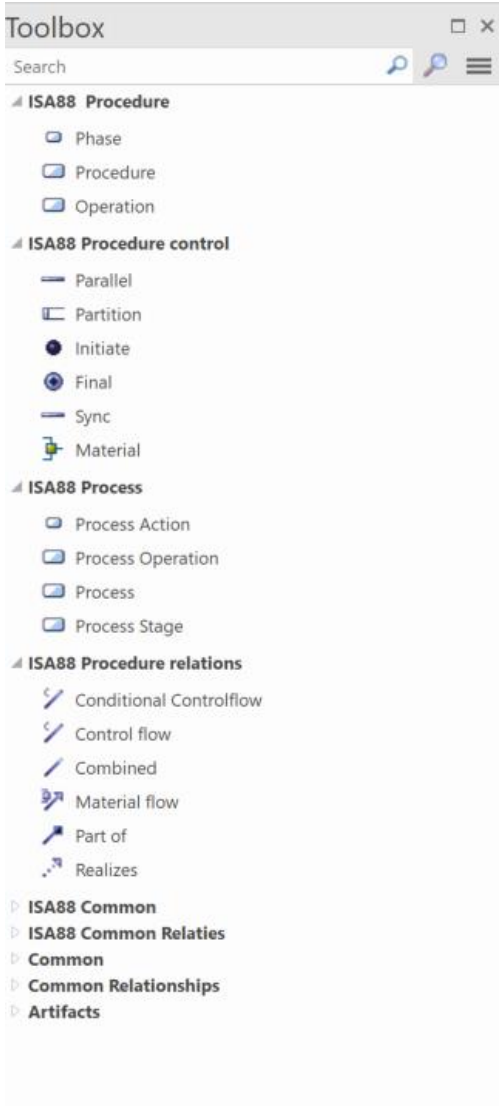
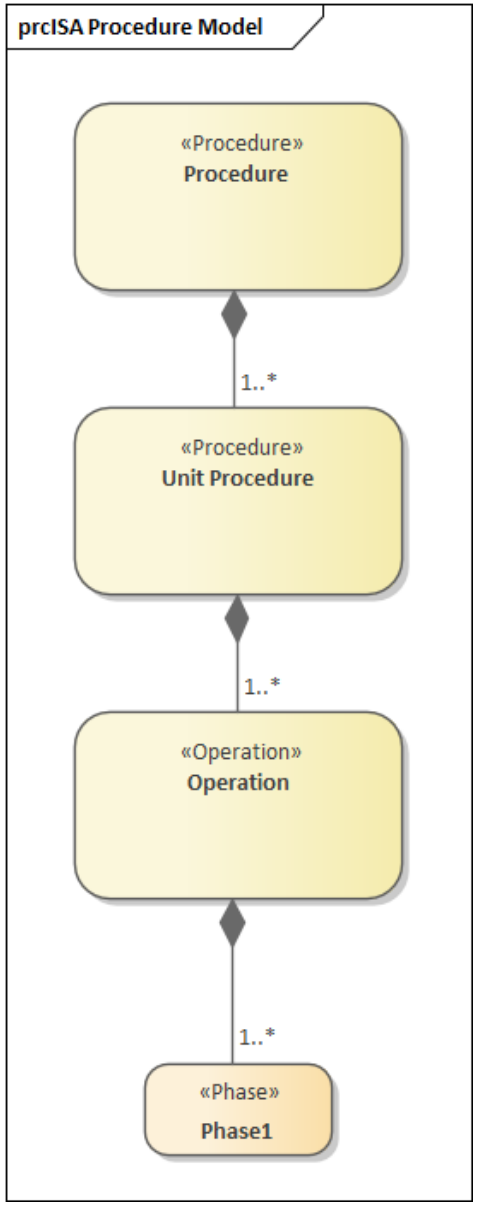
Physical model



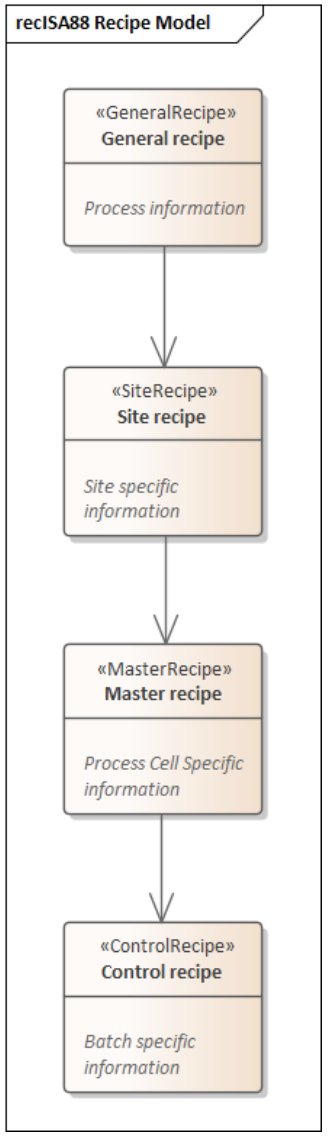


Procedural model





Recipe Model



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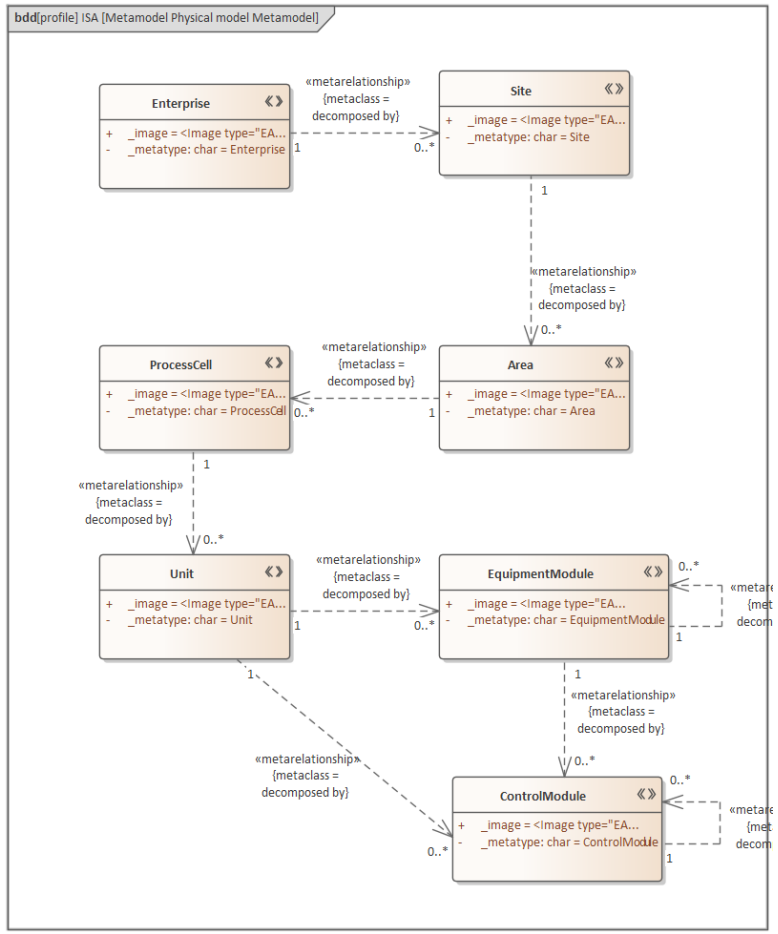
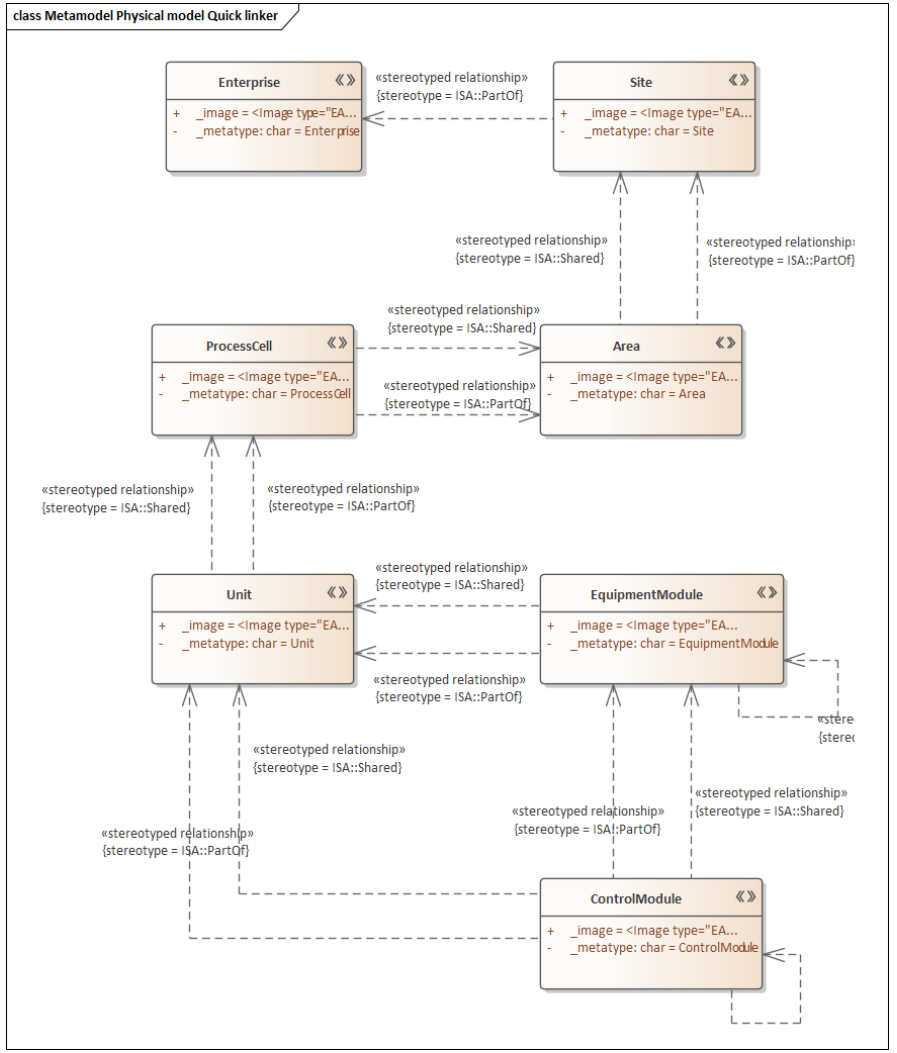
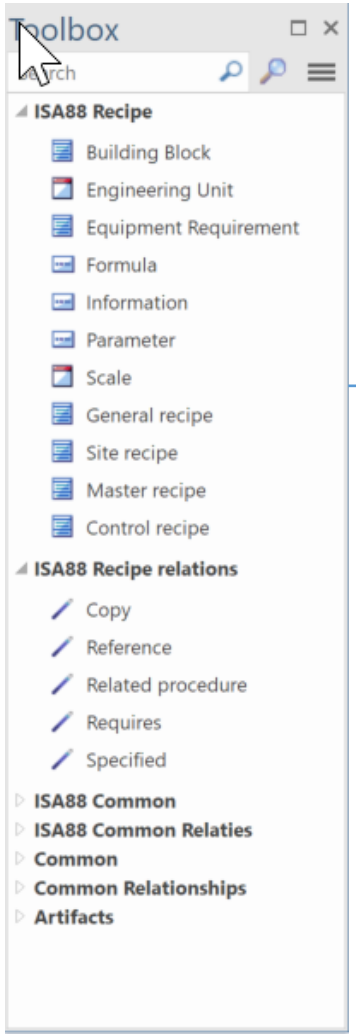
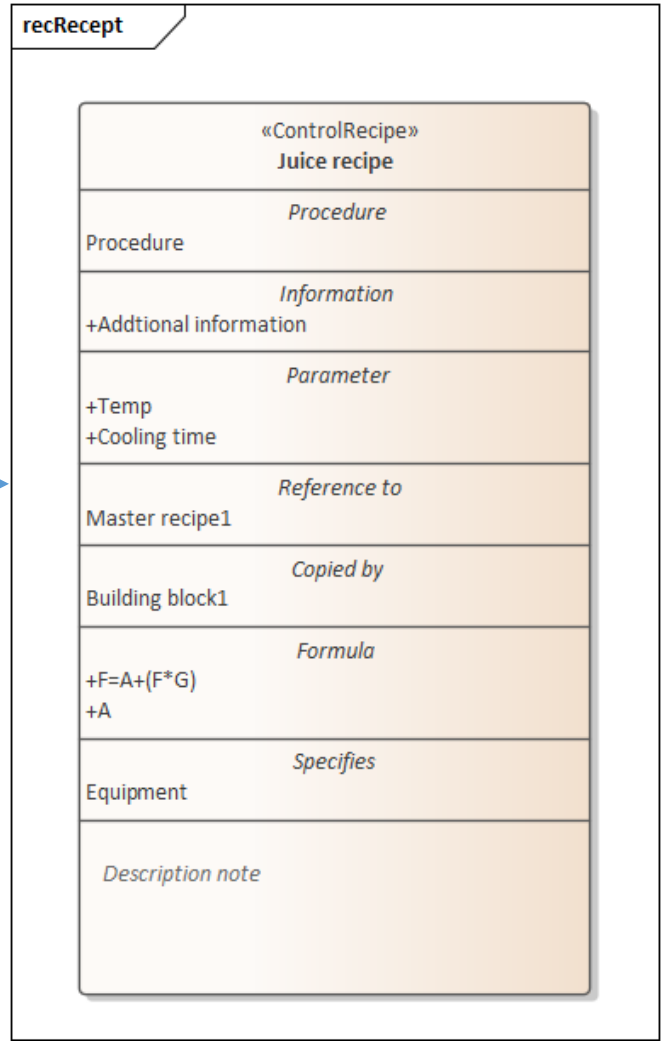
Metamodel & quicklinker

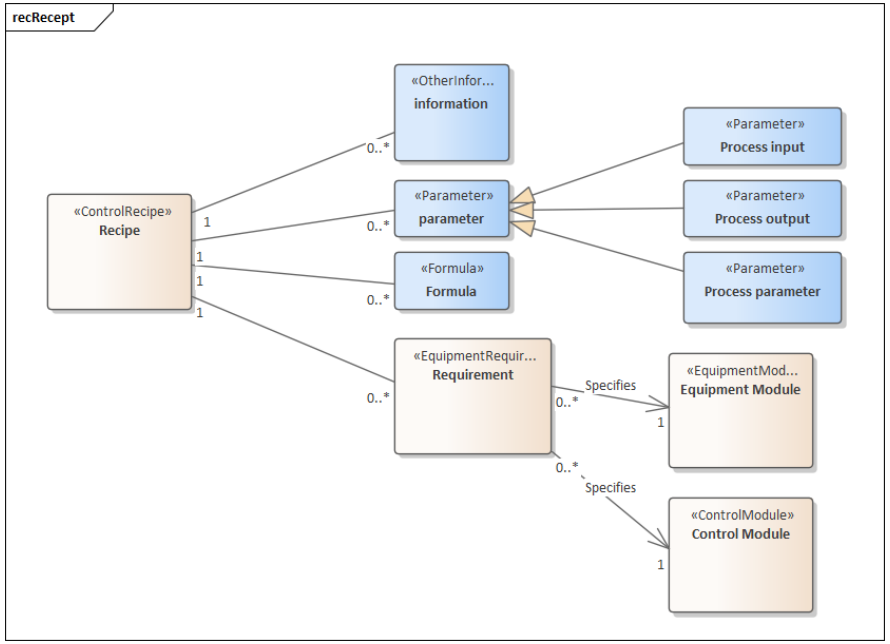




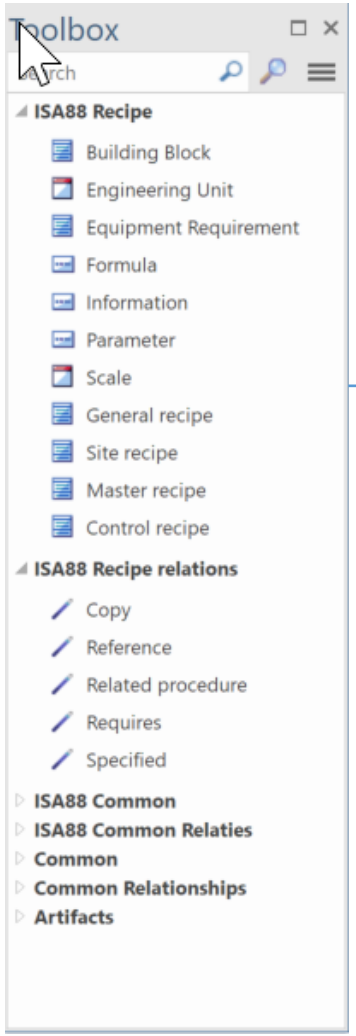
Recipes

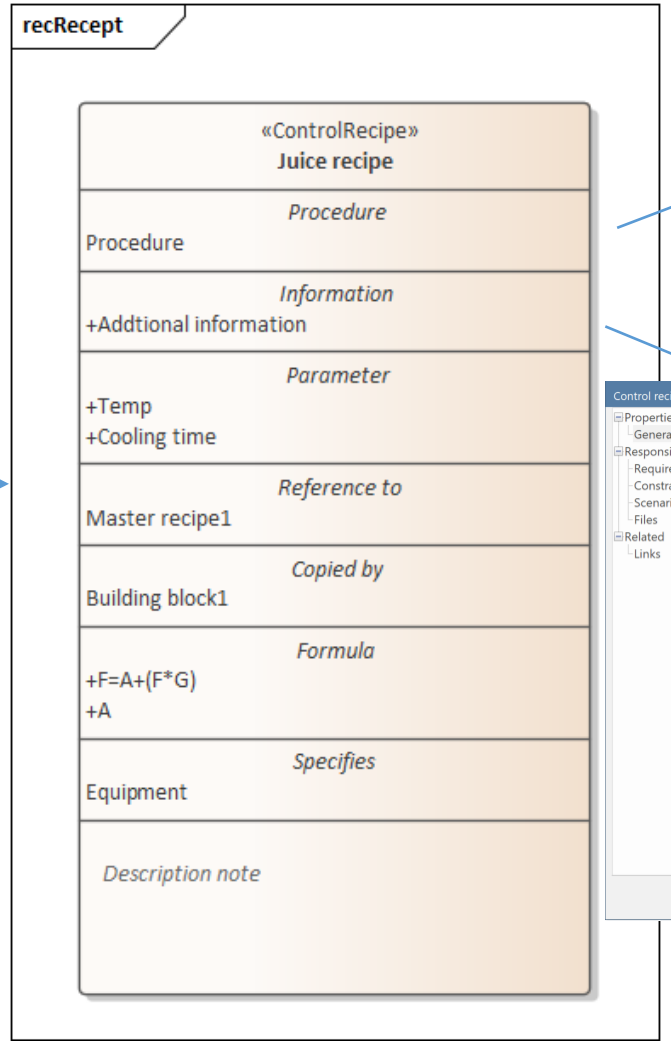

Toolbox
ISA88 Recipe
Building Block
Engineering Unit
Equipment Requirement
Formula
Information
Parameter
Scale
General recipe
Site recipe
Master recipe
Control recipe
ISA88 Recipe relations
Copy
Reference
Related procedure
Requires
Specified
ISA88 Common
ISA88 Common Relaties
Common
Common Relationships
Artifacts

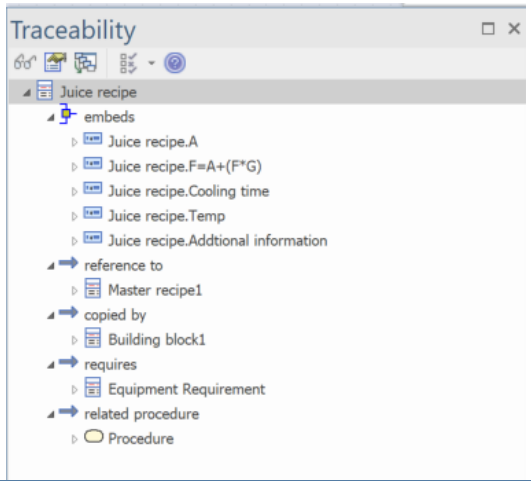

recRecept
«ControlRecipe»
Juice recipe
Procedure
Procedure
Information
+Addtional information
Parameter
+Temp
+Cooling time
Reference to
Master recipe1
Copied by
Building block1
Formula
+F=A+(F*G)
+A
Specifies
Equipment
Description note

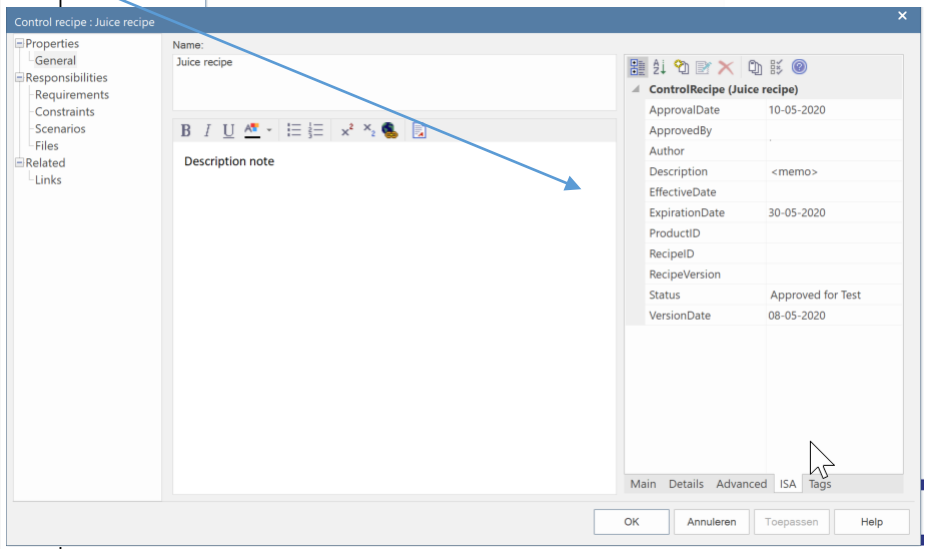

recRecept
«ControlRecipe»
Recipe
«OtherInfor...
information
«Parameter»
parameter
«Formula»
Formula
«EquipmentRequir...
Requirement
«Parameter»
Process input
«Parameter»
Process output
«Parameter»
Process parameter
«EquipmentMod...
Equipment Module
«ControlModule»
Control Module
Specifies
Specifies
0..*
1

Recipes









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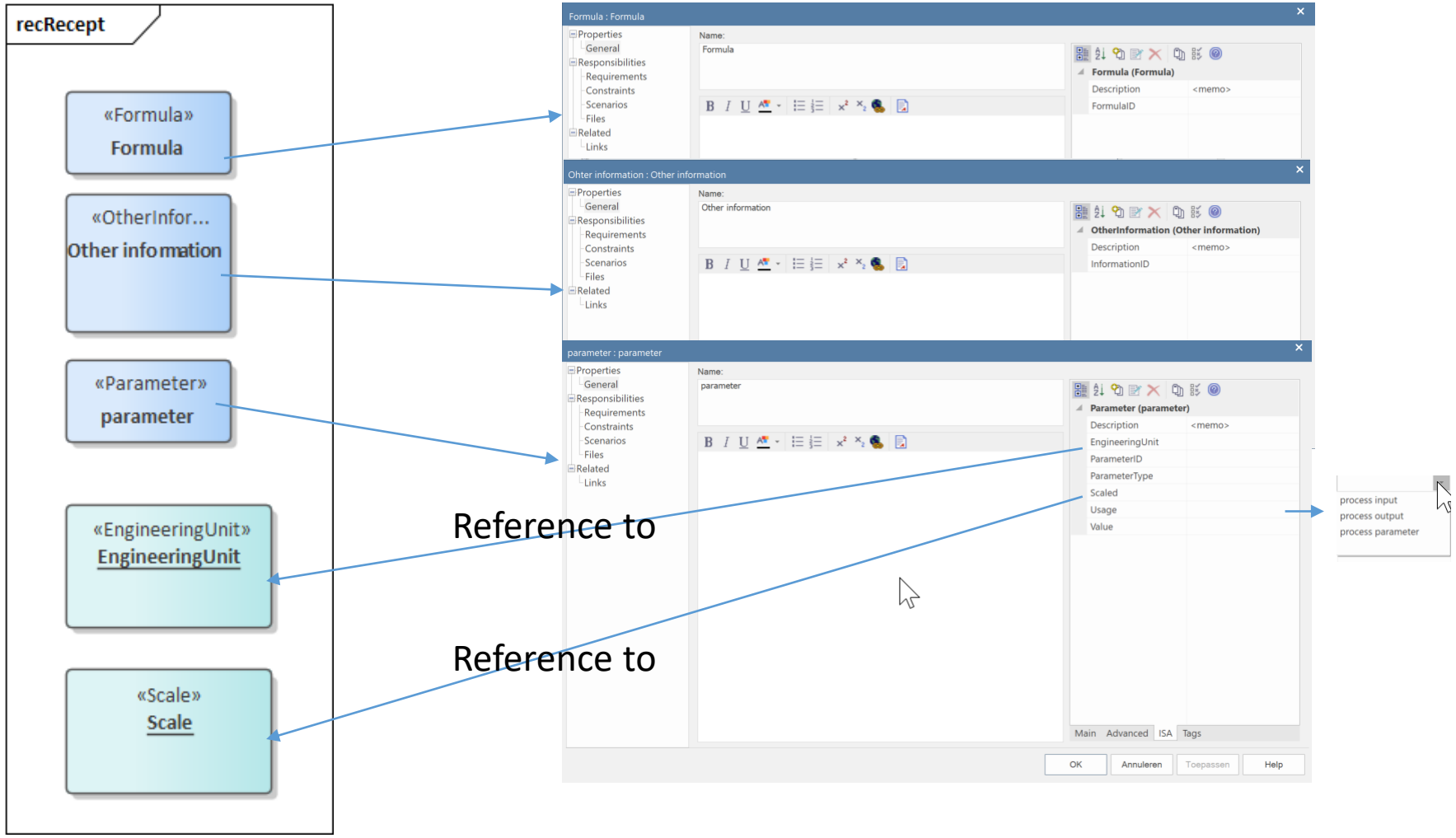
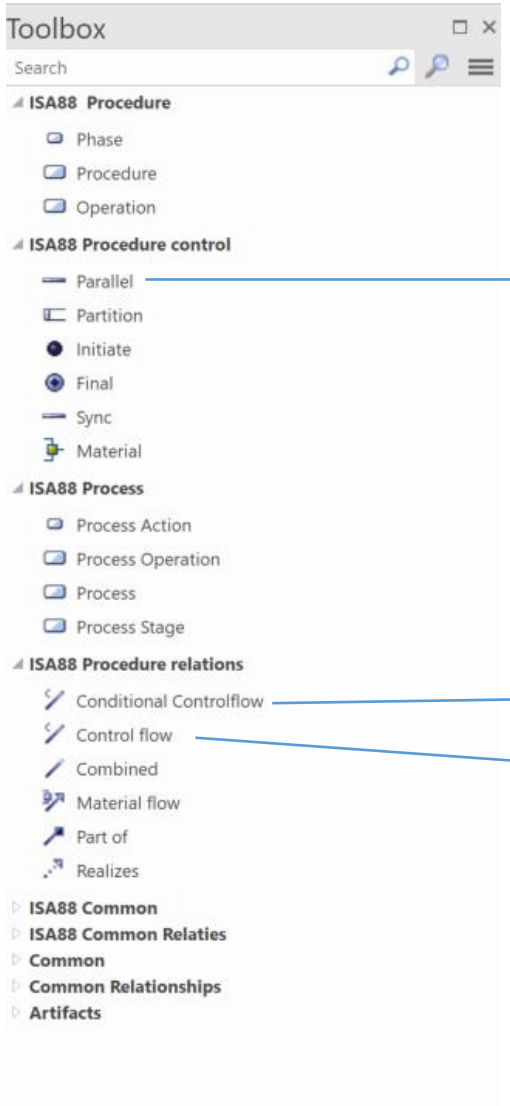
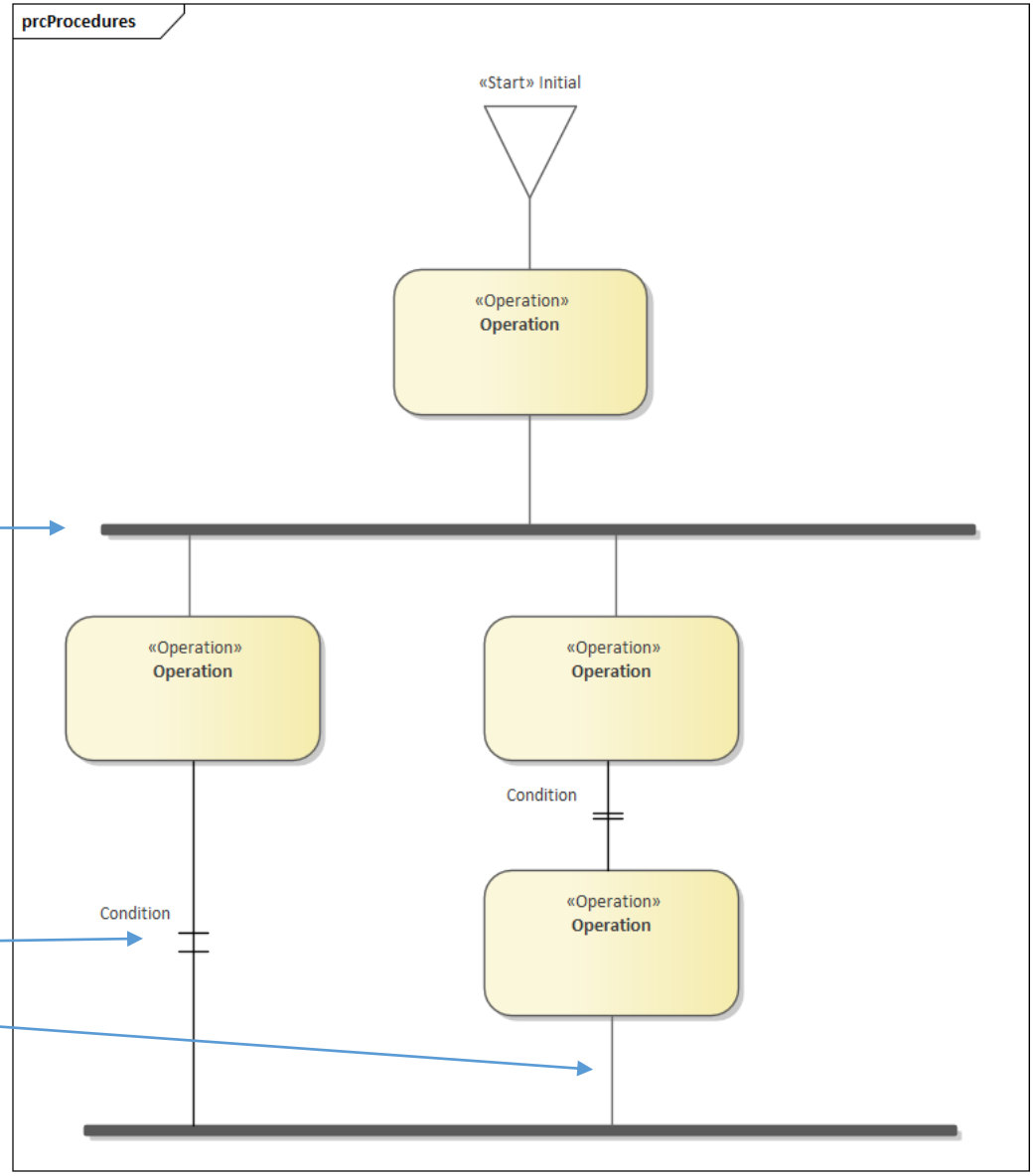
Recipe information

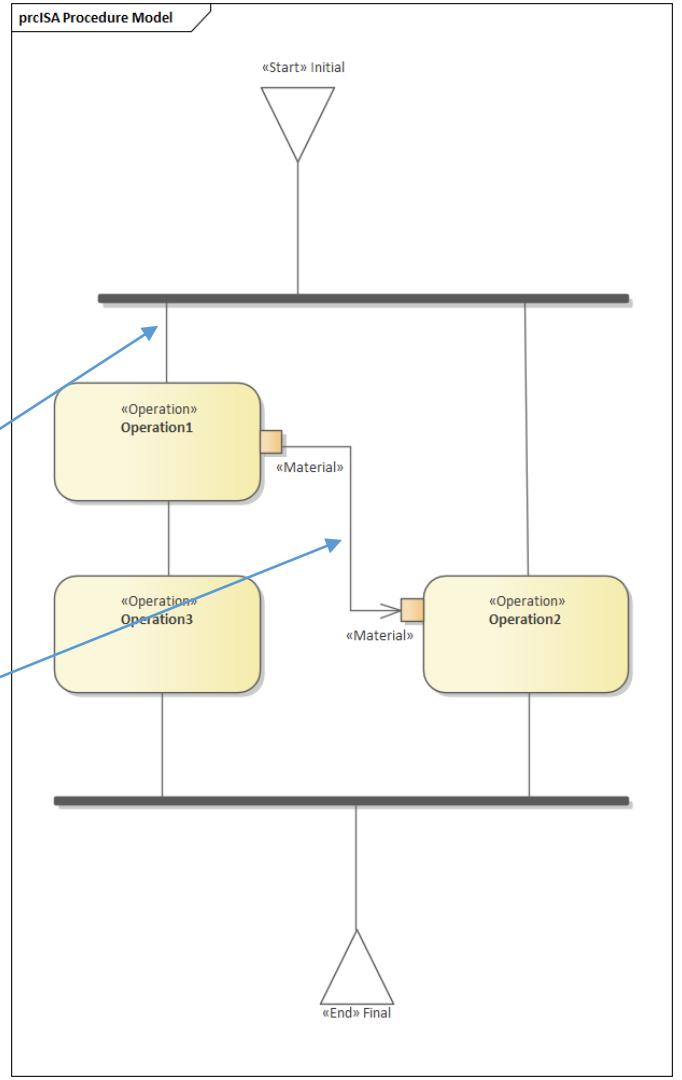


Procedures: control flow

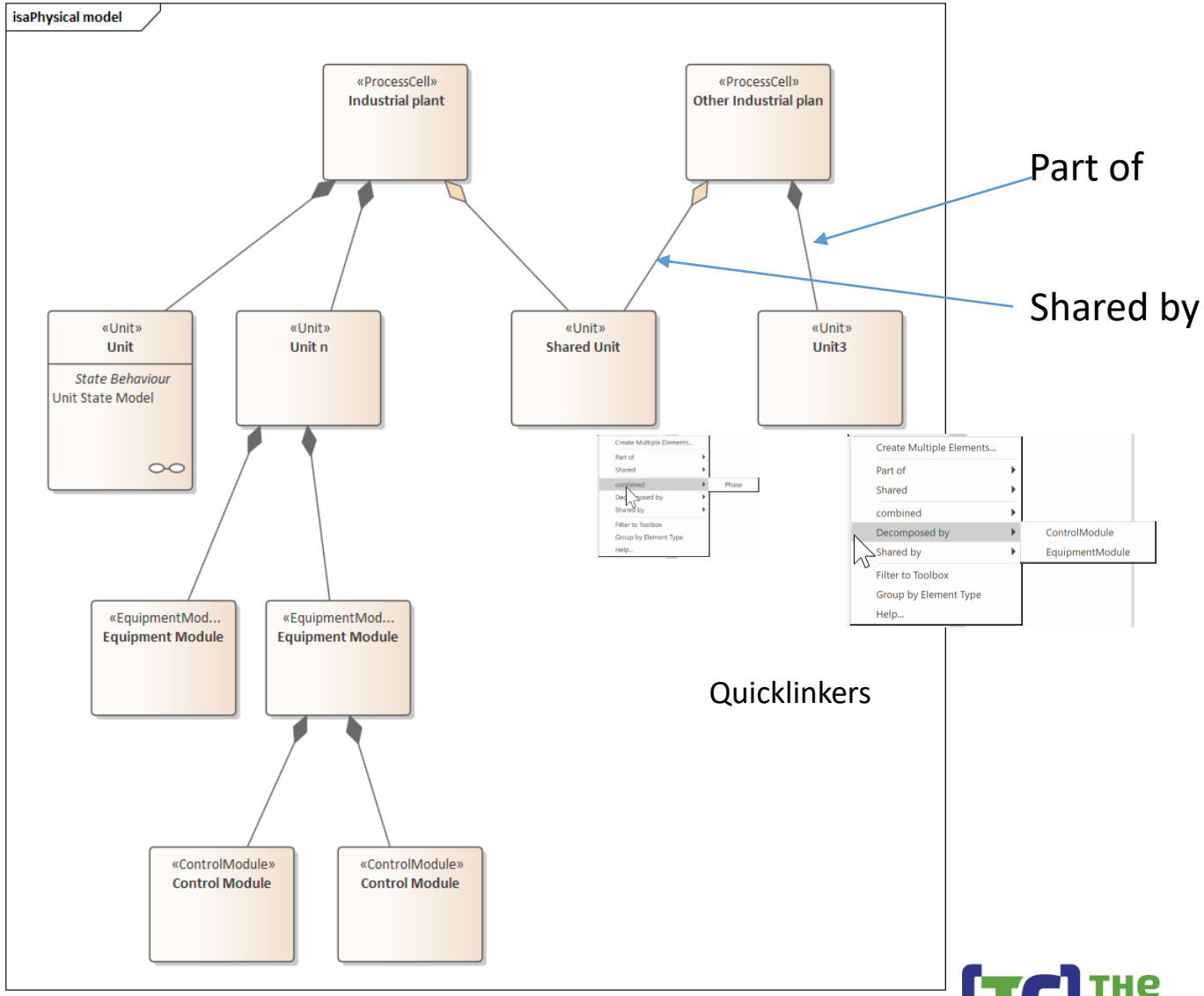




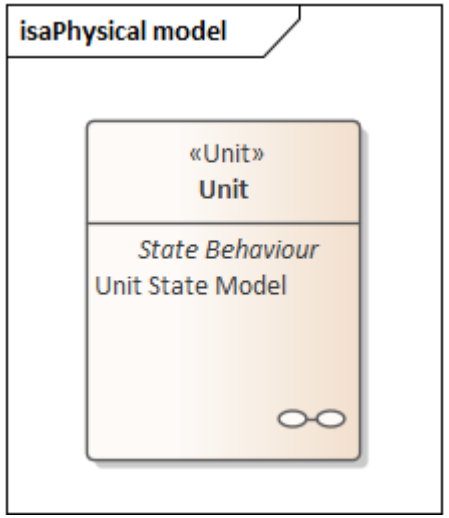
Procedures: Material flow

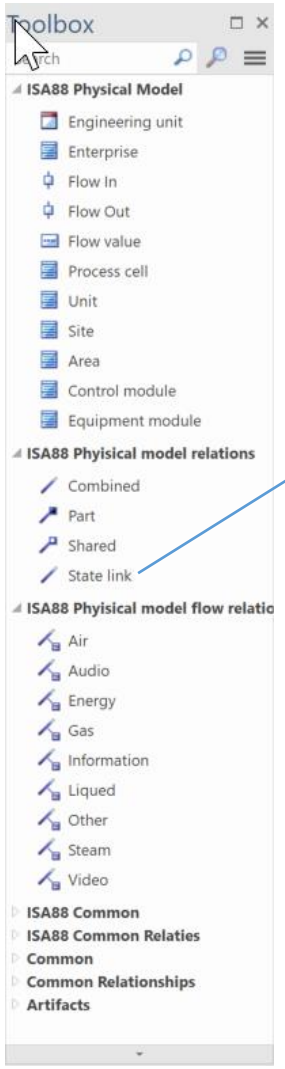


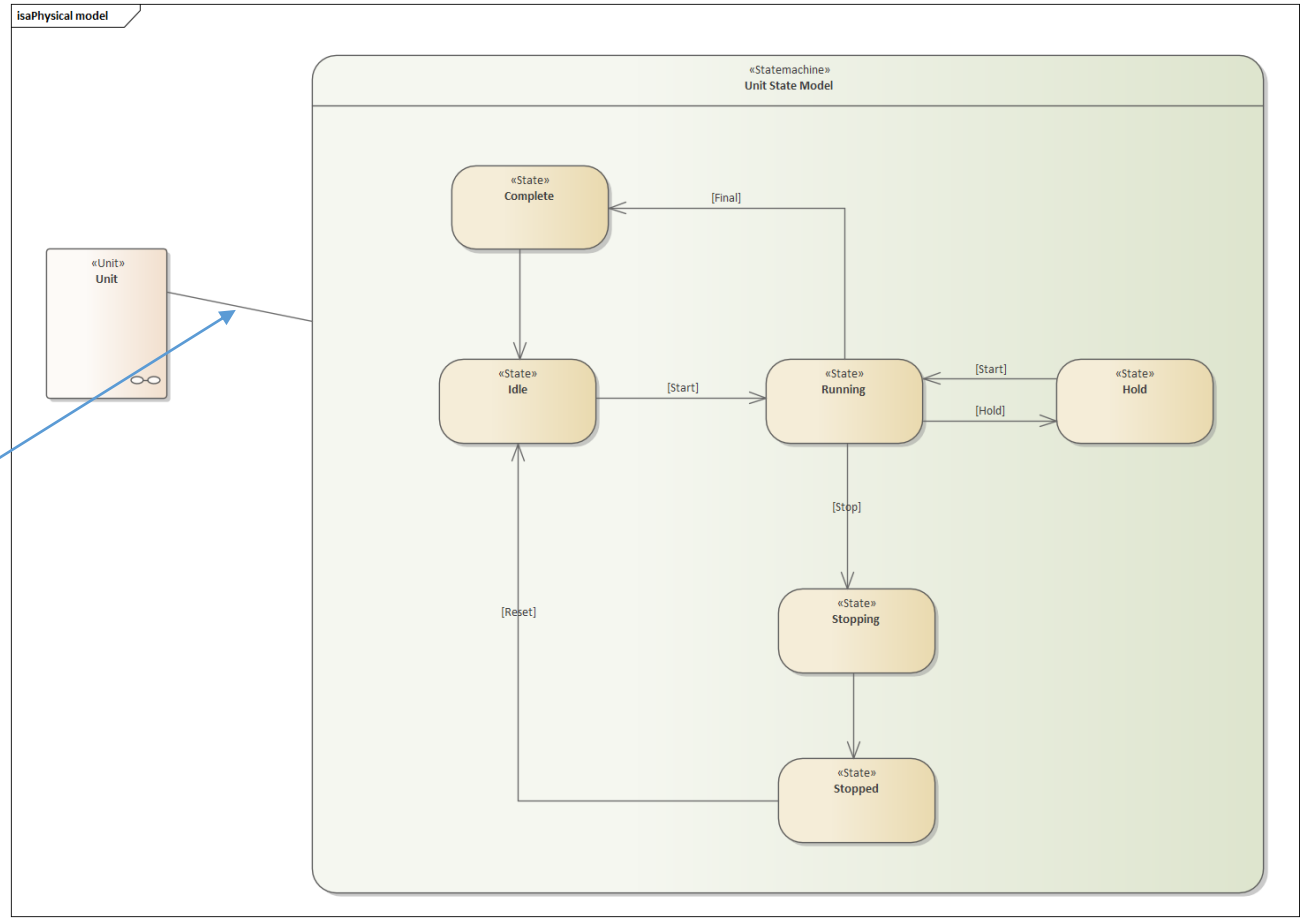
Physical model



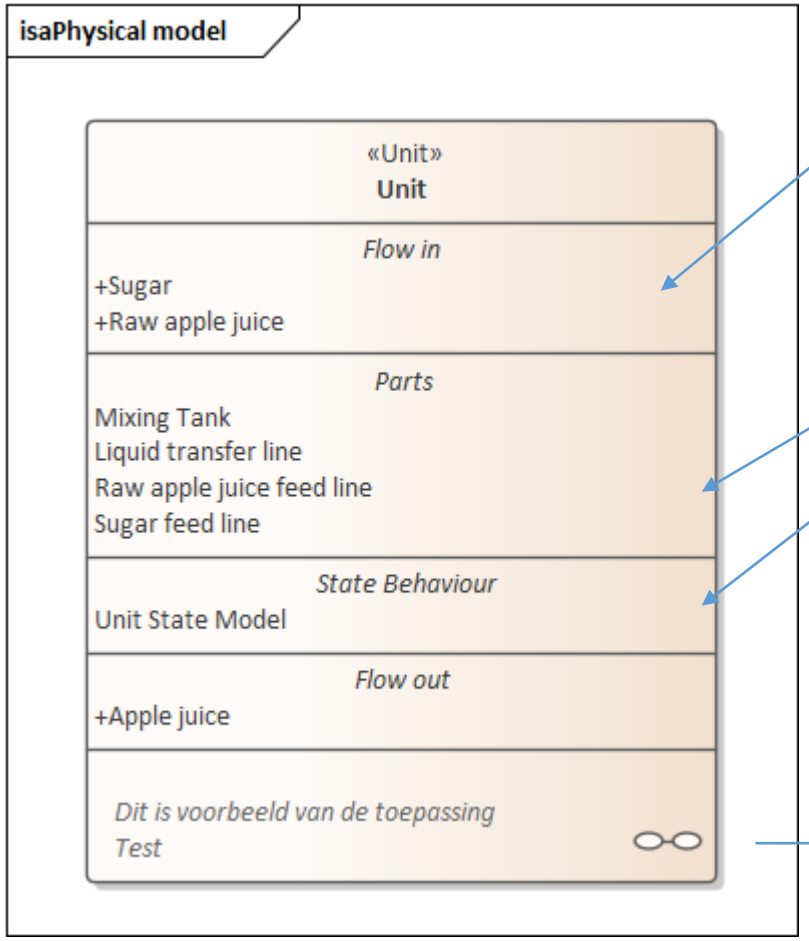
State Model

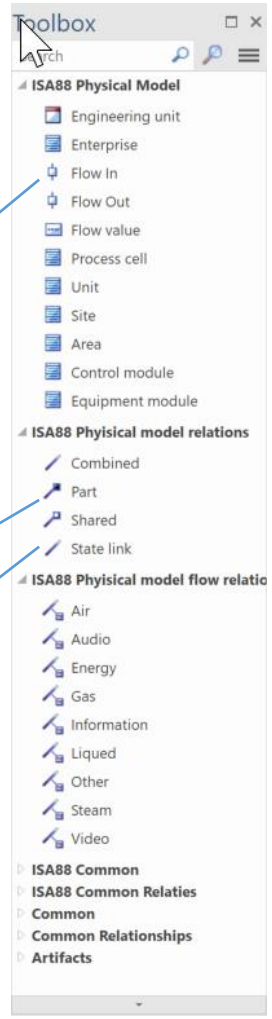

isaPhysical model
«Unit»
Unit
State Behaviour
Unit State Model

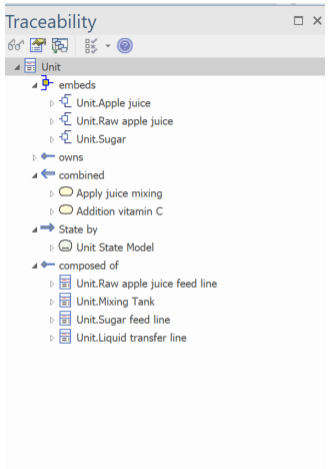

Toolbox
ISA88 Physical Model
Engineering unit
Enterprise
Flow In
Flow Out
Flow value
Process cell
Unit
Site
Area
Control module
Equipment module
ISA88 Phyisical model relations
Combined
Part
Shared
State link
ISA88 Phyisical model flow relatio
Air
Audio
Energy
Gas
Information
Liqued
Other
Steam
Video
ISA88 Common
ISA88 Common Relaties
Common
Common Relationships
Artifacts


isaPhysical model
«Statemachine»
Unit State Model
«Unit»
Unit
«State»
Complete
[Final]
«State»
Idle
[Start]
«State»
Running
[Start]
[Hold]
«State»
Hold
[Stop]
[Reset]
«State»
Stopping
«State»
Stopped

Example







Source:

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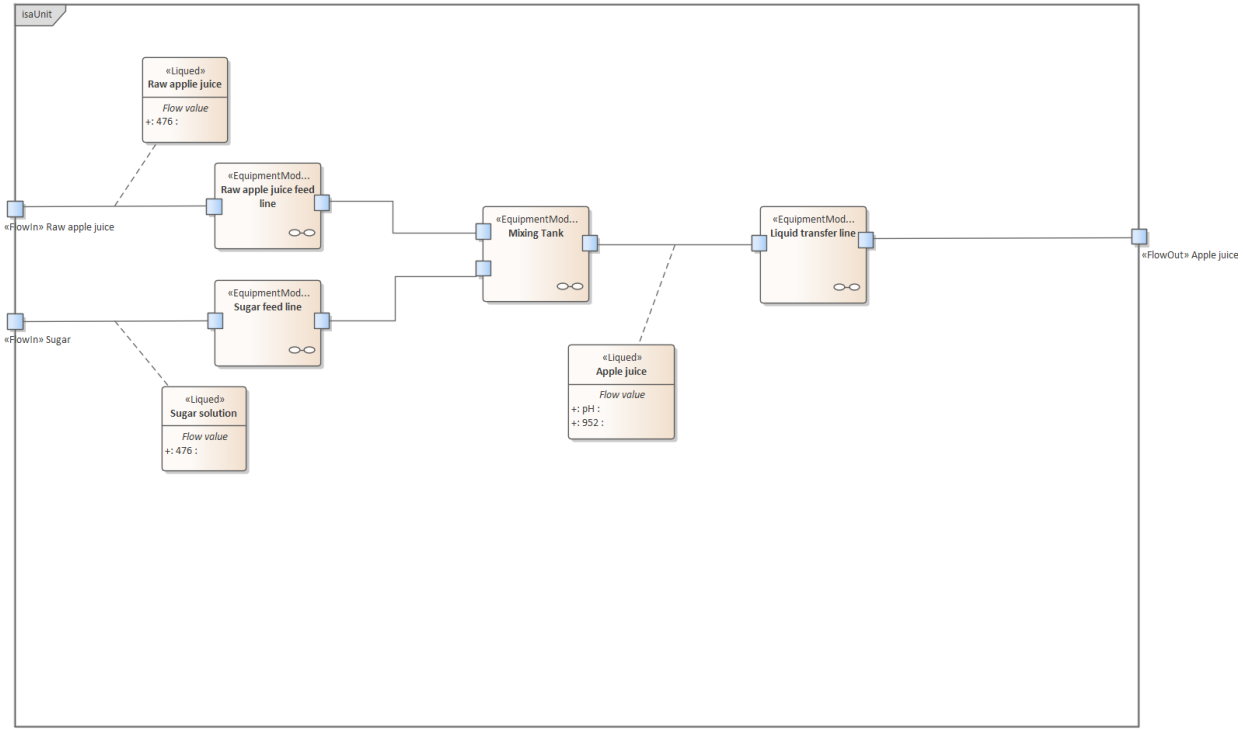
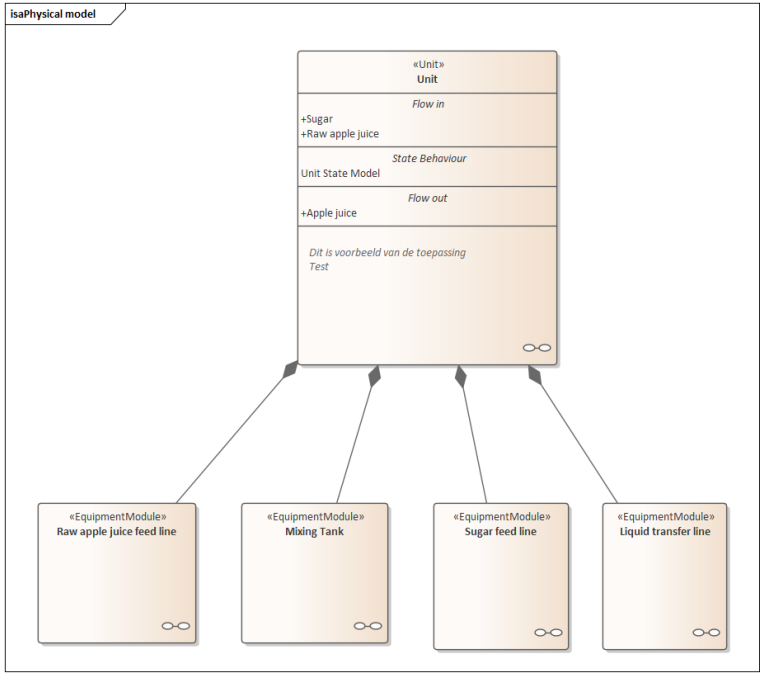
Physical model





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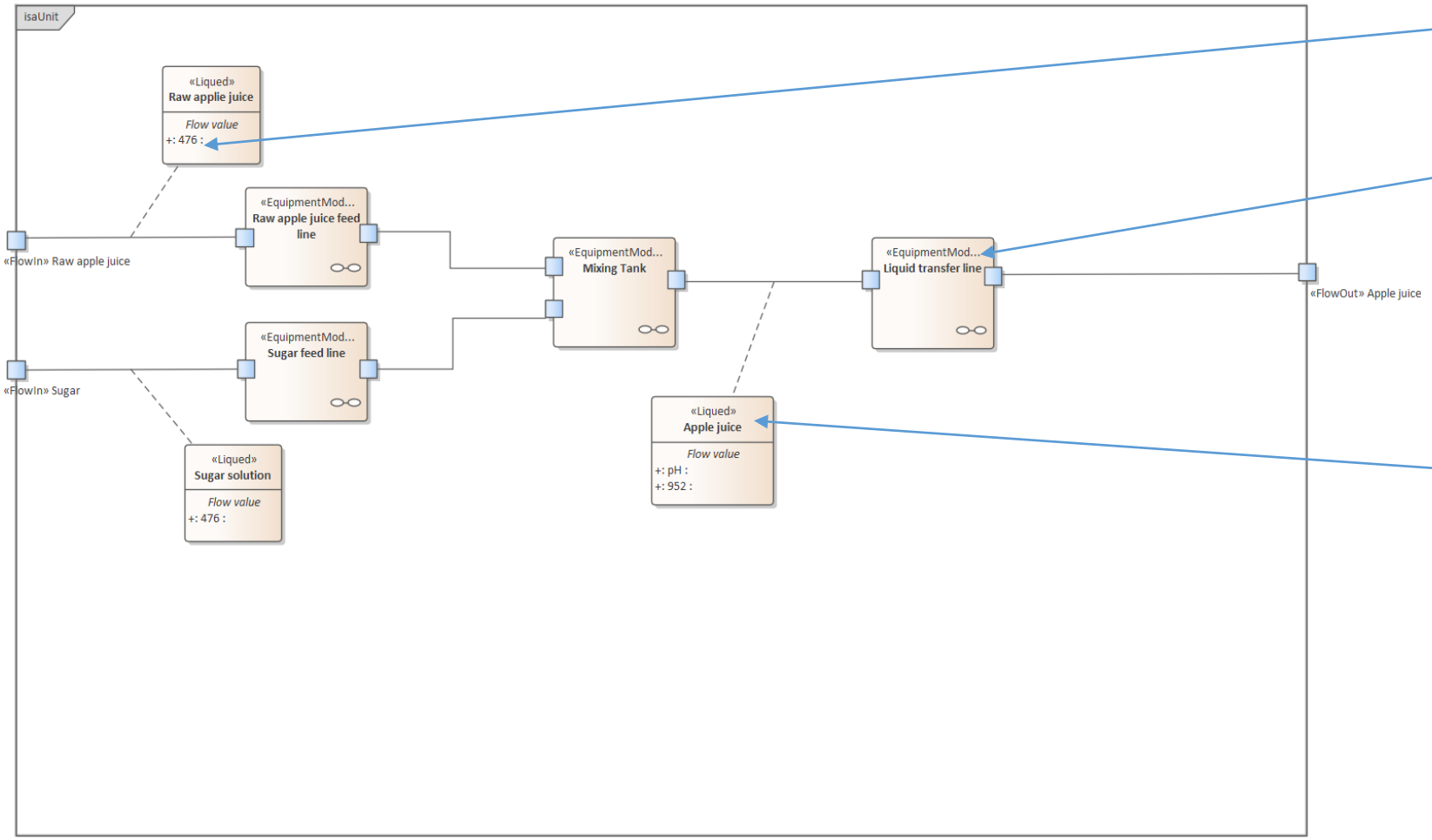
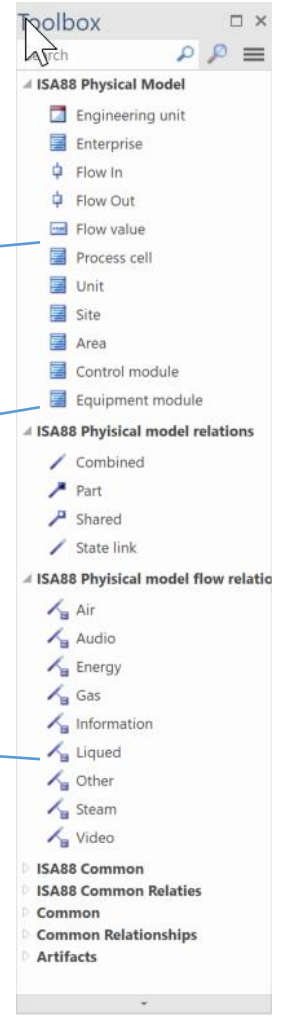
Physical model





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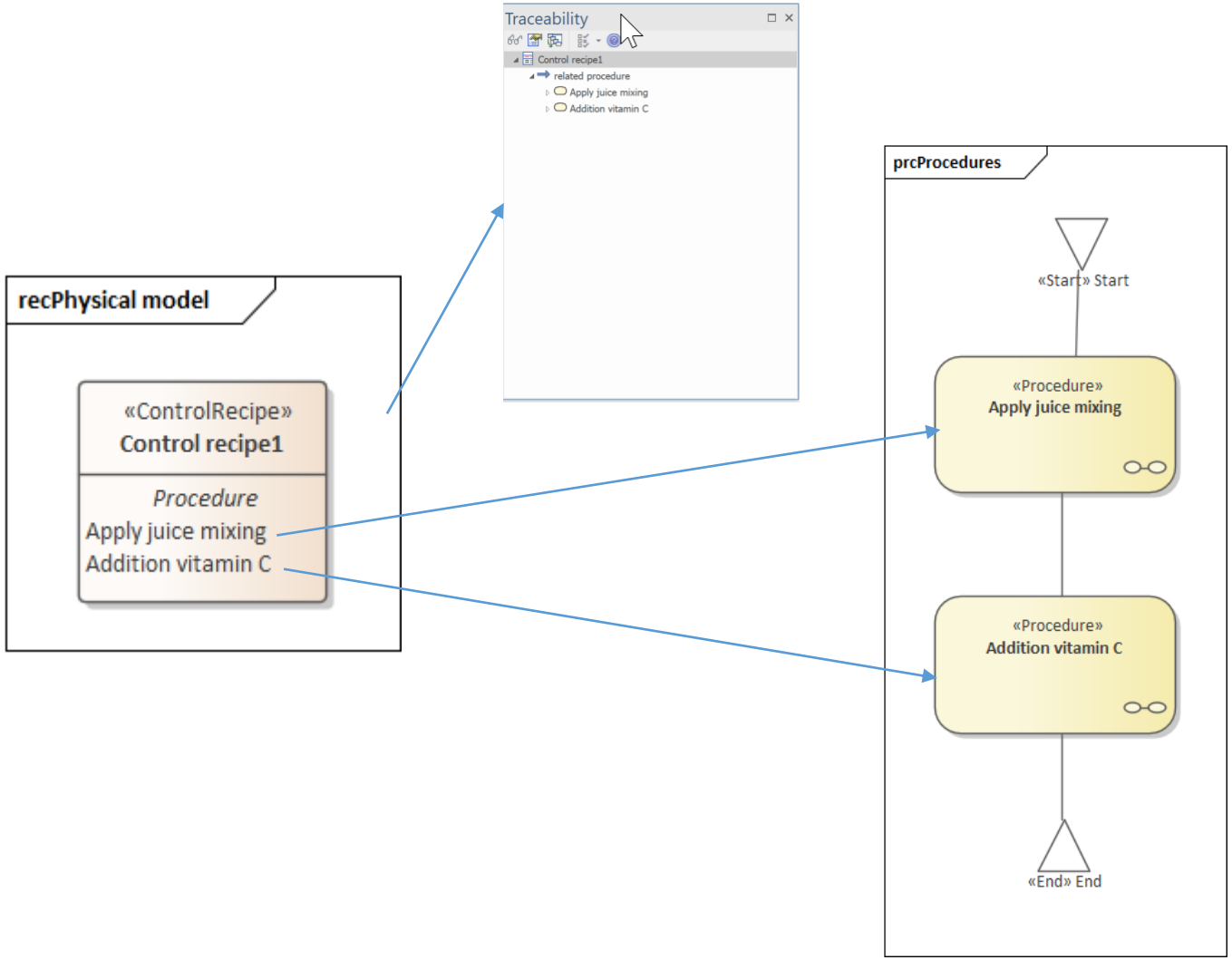
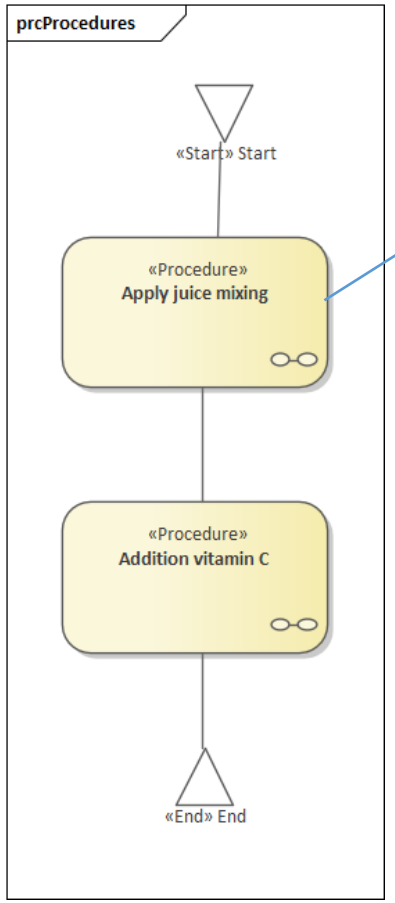
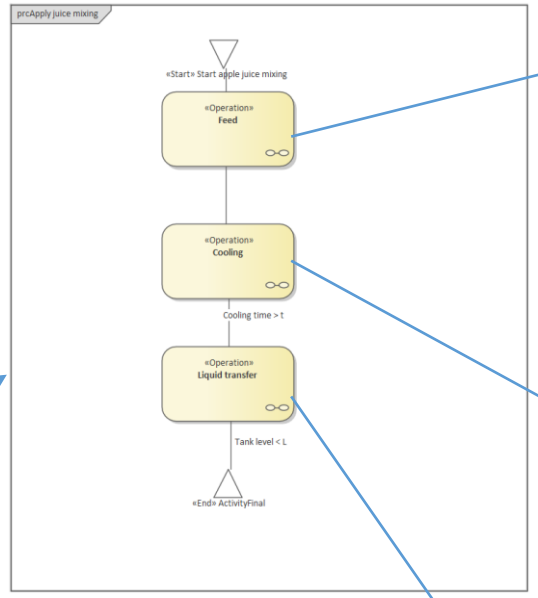
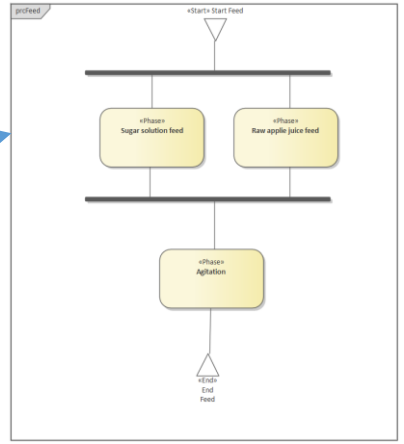
Recipes

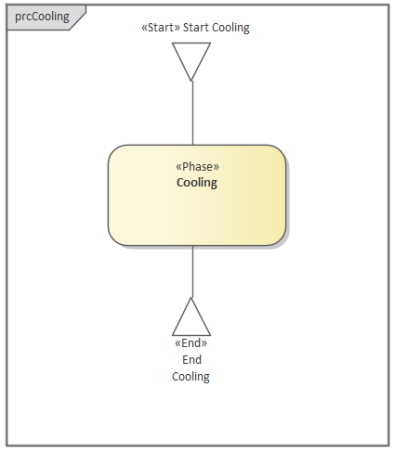

Traceability
Control recipe1
related procedure
Apply juice mixing
Addition vitamin C
recPhysical model
«ControlRecipe»
Control recipe1
Procedure
Apply juice mixing
Addition vitamin C
prcProcedures
«Start» Start
«Procedure»
Apply juice mixing
«Procedure»
Addition vitamin C
«End» End

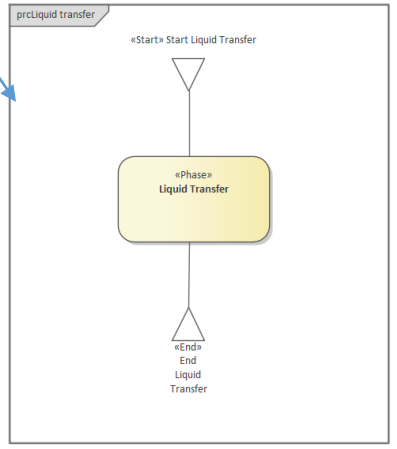
Procedures











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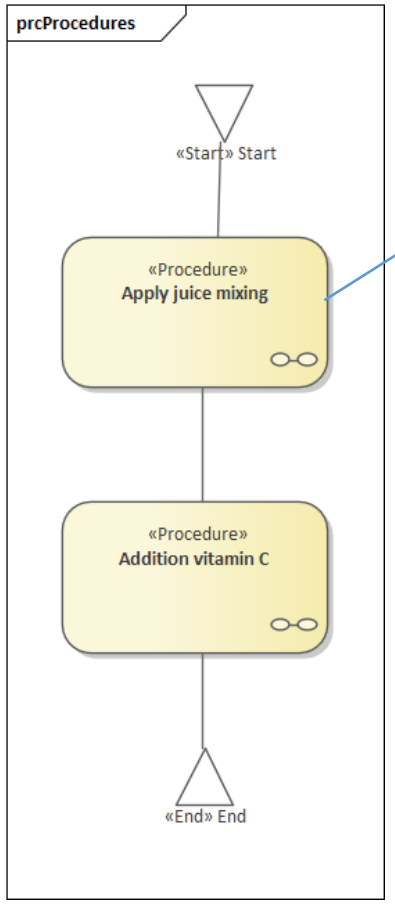
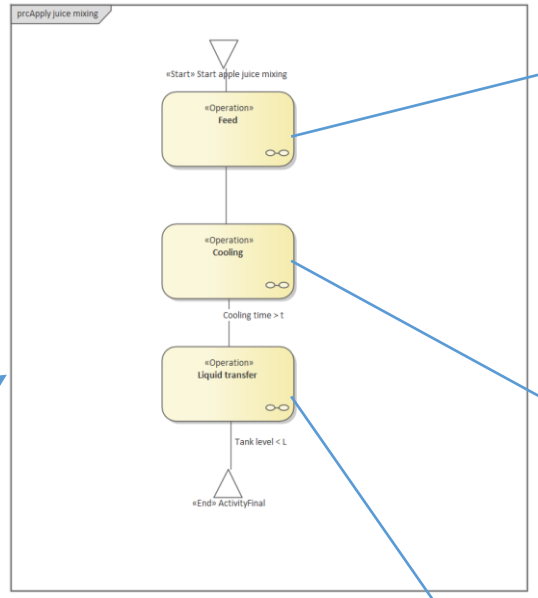
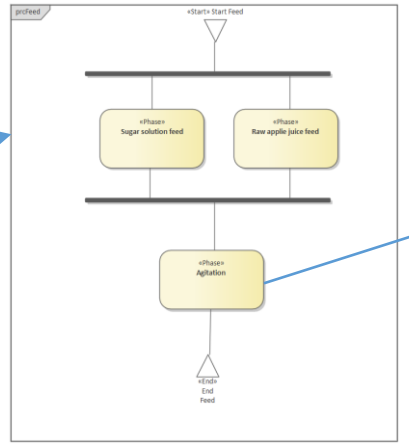
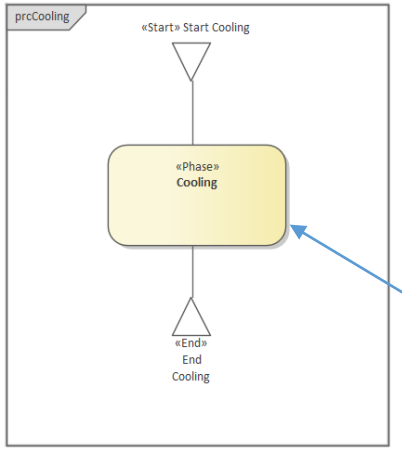
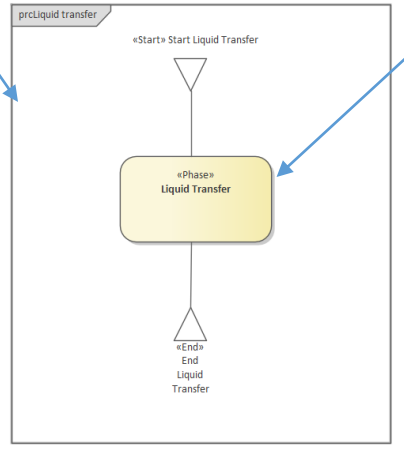
Procedures

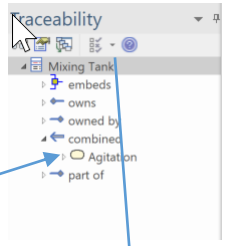

prcProcedures
«Start» Start
«Procedure»
Apply juice mixing
«Procedure»
Addition vitamin C
«End» End

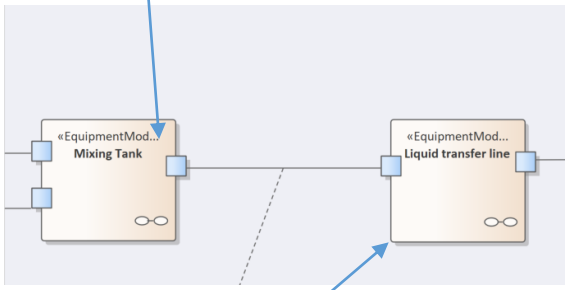

prcApply juice mixing
«Start» Start apple juice mixing
«Operation»
Feed
«Operation»
Cooling
Cooling time > t
«Operation»
Liquid transfer
Tank level < L
«End» ActivityFinal

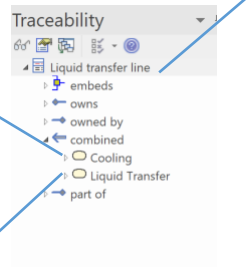

prcFeed
«Start» Start Feed
«Phase»
Sugar solution feed
«Phase»
Raw apple juice feed
«Phase»
Agitation
«End»
End
Feed


prcCooling
«Start» Start Cooling
«Phase»
Cooling
«End»
End
Cooling

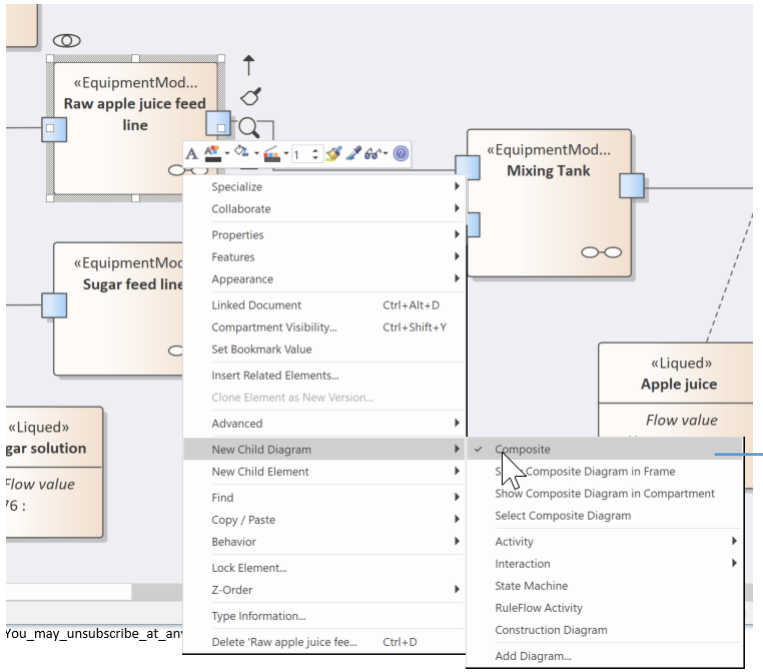

prcLiquid transfer
«Start» Start Liquid Transfer
«Phase»
Liquid Transfer
«End»
End
Liquid
Transfer

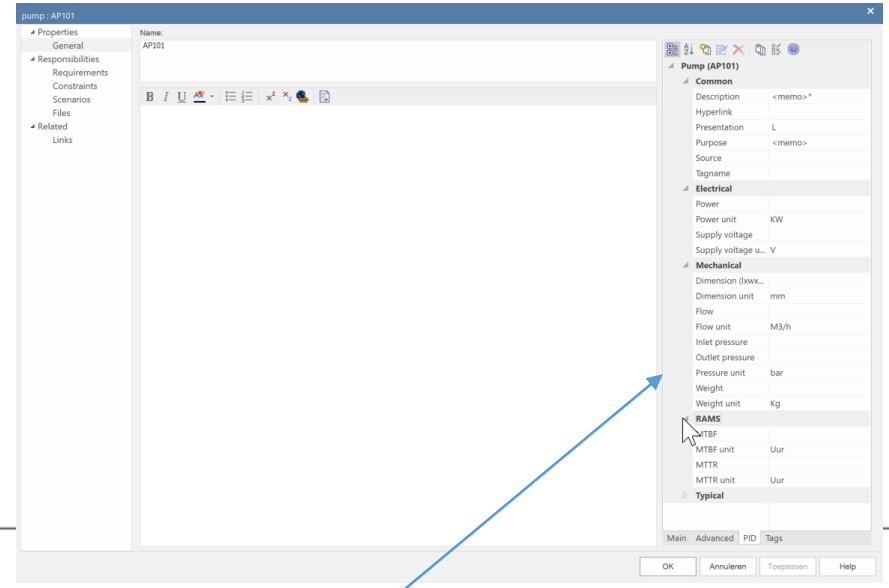

Traceability
Mixing Tank
embeds
owns
owned by
combined
Agitation
part of

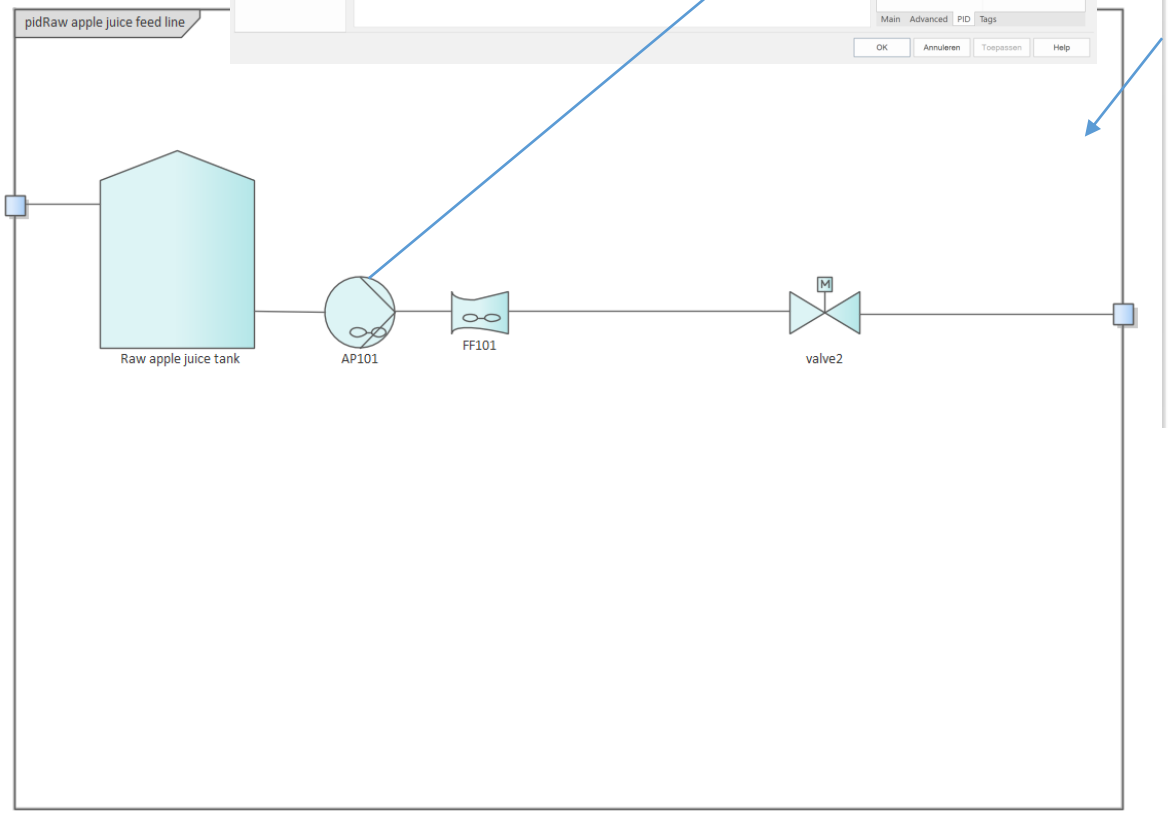

«EquipmentMod...
Mixing Tank
«EquipmentMod...
Liquid transfer line

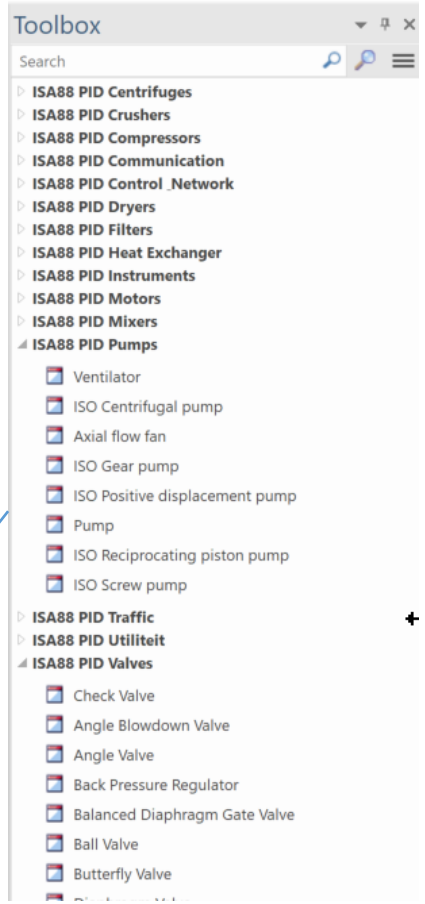

Traceability
Liquid transfer line
embeds
owns
owned by
combined
Cooling
Liquid Transfer
part of

Composite diagram









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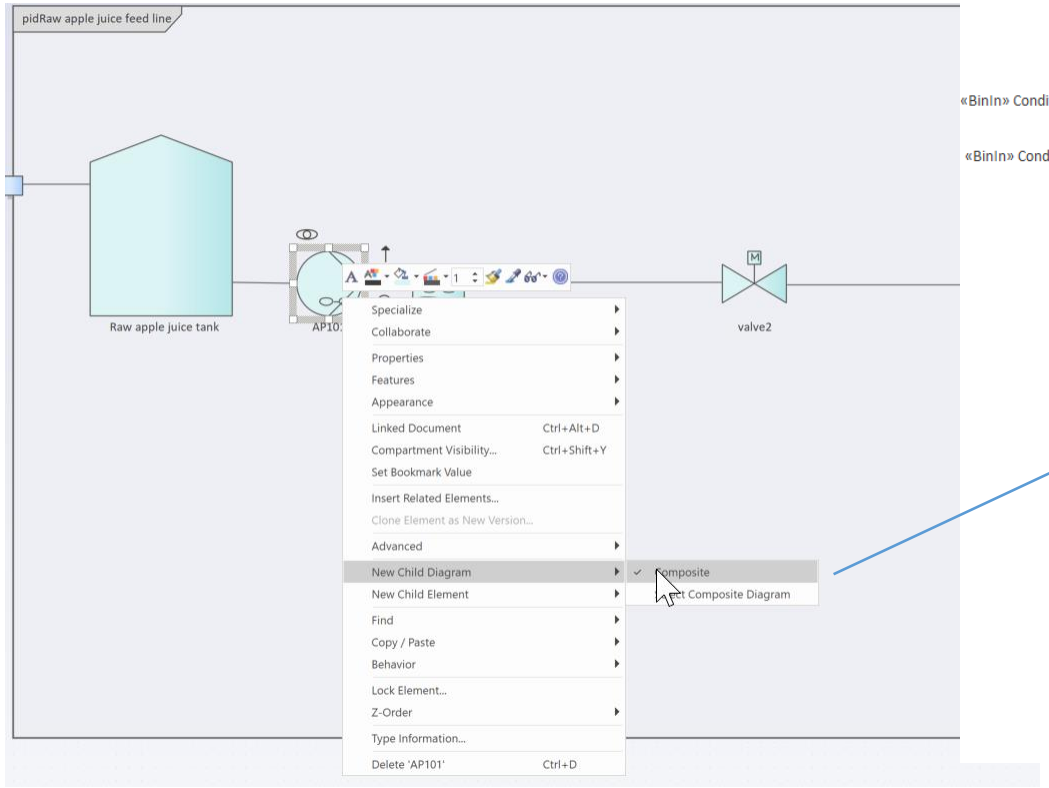
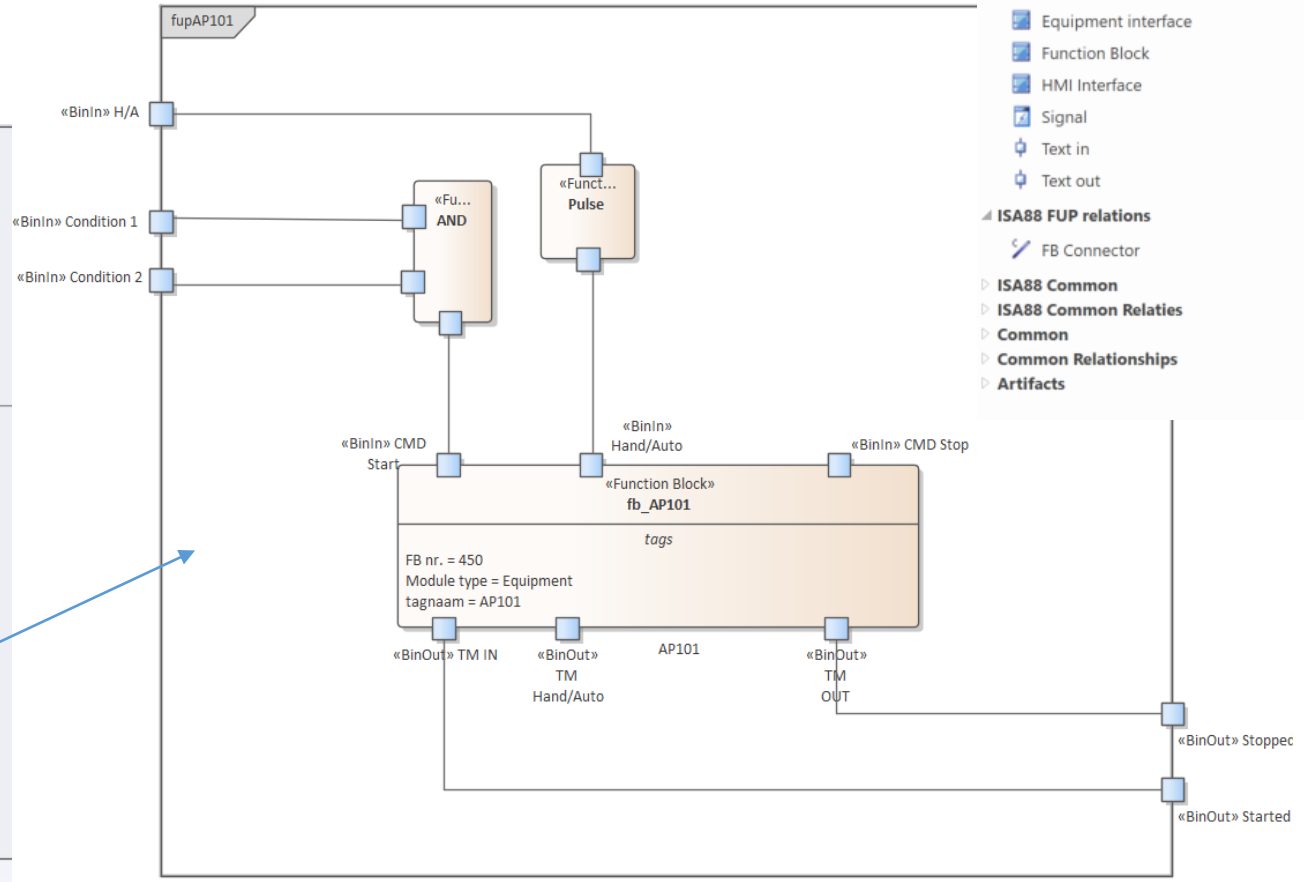
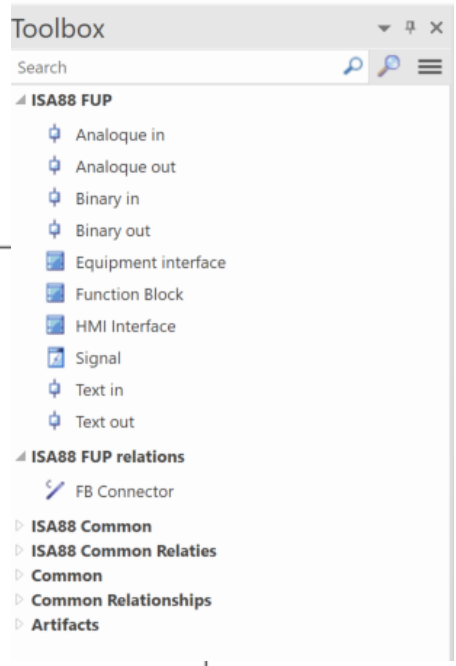
Process automation







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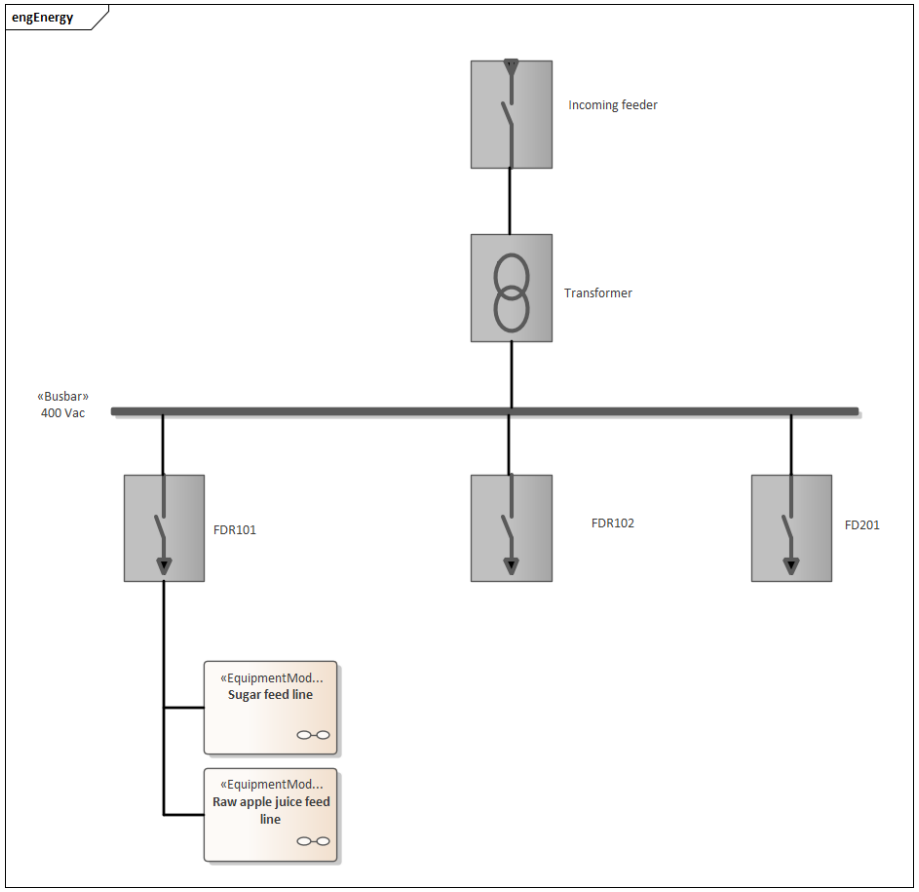
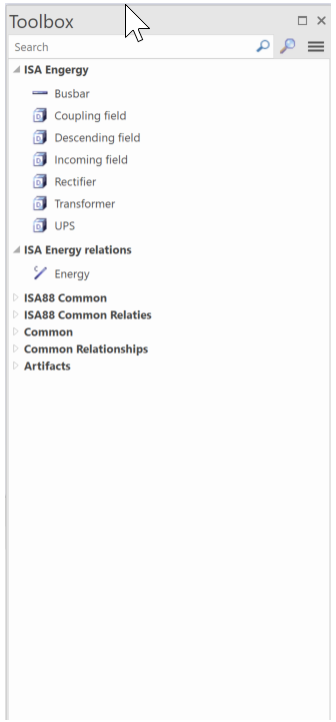
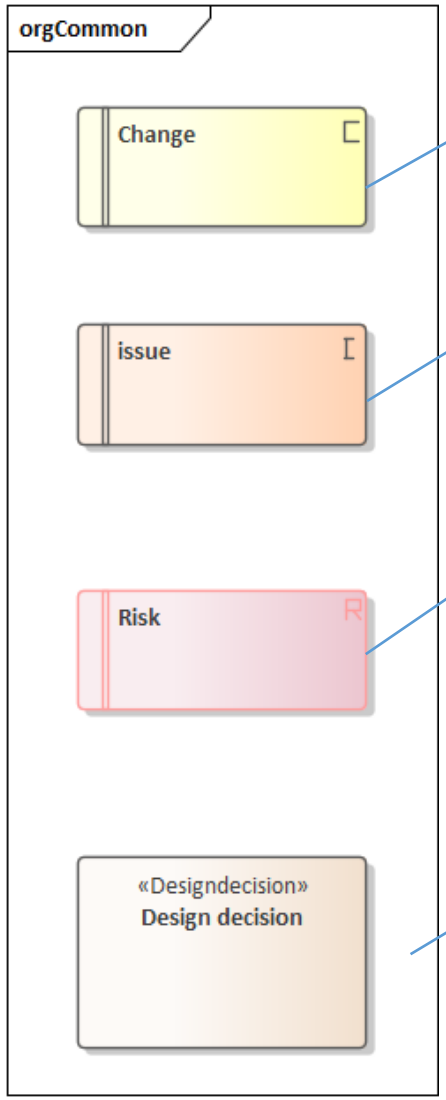
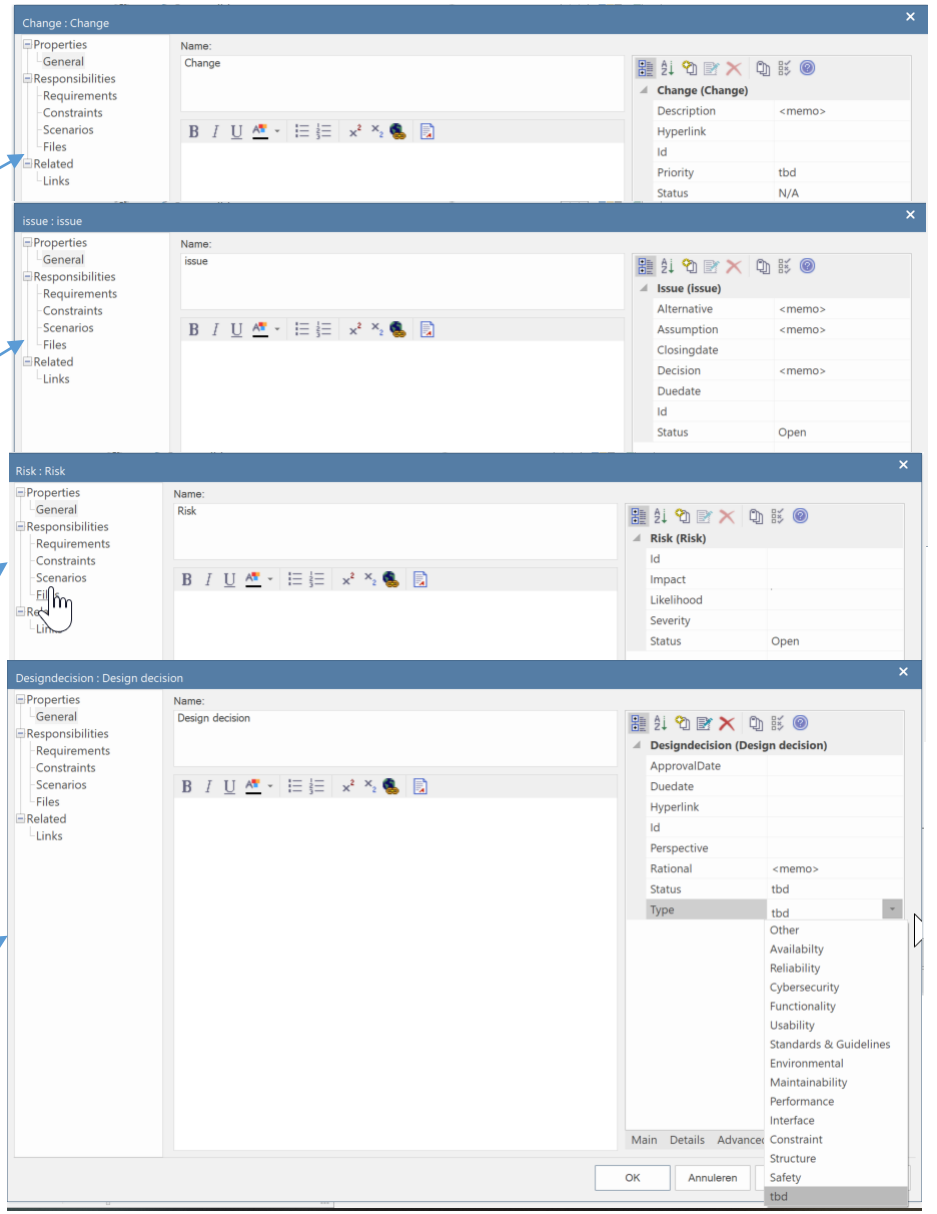
Energy


engEnergy
Incoming feeder
Transformer
«Busbar»
400 Vac
FDR101
FDR102
FD201
«EquipmentMod...
Sugar feed line
«EquipmentMod...
Raw apple juice feed line


Toolbox
Search
ISA Engergy
Busbar
Coupling field
Descending field
Incoming field
Rectifier
Transformer
UPS
ISA Energy relations
Energy
ISA88 Common
ISA88 Common Relaties
Common
Common Relationships
Artifacts

Management





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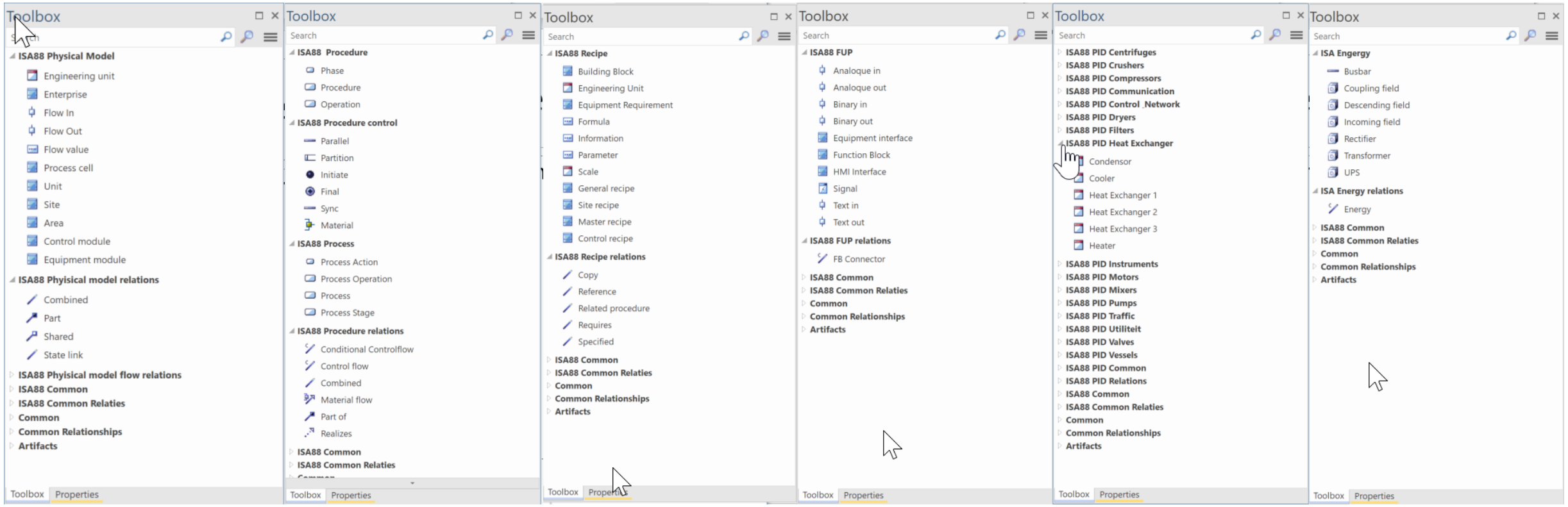
Toolbox
Search
ISA88 Physical Model
Engineering unit
Enterprise
Flow In
Flow Out
Flow value
Process cell
Unit
Site
Area
Control module
Equipment module
ISA88 Phyisical model relations
Combined
Part
Shared
State link
ISA88 Phyisical model flow relations
ISA88 Common
ISA88 Common Relaties
Common
Common Relationships
Artifacts
Toolbox
Properties
Toolbox
Search
ISA88 Procedure
Phase
Procedure
Operation
ISA88 Procedure control
Parallel
Partition
Initiate
Final
Sync
Material
ISA88 Process
Process Action
Process Operation
Process
Process Stage
ISA88 Procedure relations
Conditional Controlflow
Control flow
Combined
Material flow
Part of
Realizes
ISA88 Common
ISA88 Common Relaties
Toolbox
Properties
Toolbox
Search
ISA88 Recipe
Building Block
Engineering Unit
Equipment Requirement
Formula
Information
Parameter
Scale
General recipe
Site recipe
Master recipe
Control recipe
ISA88 Recipe relations
Copy
Reference
Related procedure
Requires
Specified
ISA88 Common
ISA88 Common Relaties
Common
Common Relationships
Artifacts
Toolbox
Properties
Toolbox
Search
ISA88 FUP
Analoque in
Analoque out
Binary in
Binary out
Equipment interface
Function Block
HMI Interface
Signal
Text in
Text out
ISA88 FUP relations
FB Connector
ISA88 Common
ISA88 Common Relaties
Common
Common Relationships
Artifacts
Toolbox
Properties
Toolbox
Search
ISA88 PID Centrifuges
ISA88 PID Crushers
ISA88 PID Compressors
ISA88 PID Communication
ISA88 PID Control _Network
ISA88 PID Dryers
ISA88 PID Filters
ISA88 PID Heat Exchanger
Condensor
Cooler
Heat Exchanger 1
Heat Exchanger 2
Heat Exchanger 3
Heater
ISA88 PID Instruments
ISA88 PID Motors
ISA88 PID Mixers
ISA88 PID Pumps
ISA88 PID Traffic
ISA88 PID Utiliteit
ISA88 PID Valves
ISA88 PID Vessels
ISA88 PID Common
ISA88 PID Relations
ISA88 Common
ISA88 Common Relaties
Common
Common Relationships
Artifacts
Toolbox
Properties
Toolbox
Search
ISA Engergy
Busbar
Coupling field
Descending field
Incoming field
Rectifier
Transformer
UPS
ISA Energy relations
Energy
ISA88 Common
ISA88 Common Relaties
Common
Common Relationships
Artifacts
Toolbox
Properties

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