Critical manufacturing
an ASM PT company

Quantity Variation

11.2

February 2026

DOCUMENT ACCESS

Public

Quantity Variation

This tutorial provides an overview of the different ways the quantity of a BOM Item can be defined and configured in Critical Manufacturing MES. It covers quantities dependent on the main **Material**, fixed quantities, negative quantities for by-products, as well as specific configurations such as quantity tolerances and reference items.

Overview

This tutorial will explain the key concepts related to how BOM Item quantities can be defined and managed, including:

- BOM Item consumption dependent on main **Material** quantity - where the required quantity scales with the quantity of the main **Material**.
- BOM Item consumption with fixed quantity - where the required quantity remains constant, regardless of the main **Material** quantity.
- BOM Item consumption tolerances - allowing flexibility in meeting exact quantity requirements.
- Negative quantity (by-products) - where the **BOM** defines **Materials** produced as a result of the process.
- BOM reference Items - used for reference or informational purposes without consumption in MES.
- Option to capture - enabling the recording of specific values or details during assembly.

The tutorial concludes with a practical use case that brings these concepts together, demonstrating their application and the necessary configurations to support them.

Dependent Quantity

The dependent quantity configuration is the most common approach for BOM Items. In this scenario, the required quantity of a BOM Item is directly proportional to the quantity of the main **Material** being assembled.

This behavior covers situations where, for example, assembling 1 unit of a main **Material** of a given **Product** requires X units of a specific consumable **Product**.

Main configuration requirements:

- Units of the **Product** to be assembled
- BOM Item **Products** and their substitutes
- Amount of BOM Item units to be consumed

Fixed Quantity

The fixed quantity configuration applies when the required amount of a BOM Item is constant, regardless of the main **Material** quantity being processed.

For example, a quality test kit might be included with the **Product**. Whether 1 or 100 units are assembled or tested, only a single kit is added for the final customer. This applies for Assemble, Disassemble and Replace & Disassemble operations, and is also considered for Material Transfer Requirements and BOM Explosion.

Main configuration requirements:

- Units of the **Product** to be assembled
- BOM Item **Products** and their substitutes
- Amount of BOM Item units to be consumed
- Assembly Type must be Explicit Long Running, Automatic at Track-In or Automatic at Track-Out

Tolerances

Tolerances allow for flexibility in BOM Item consumption, enabling the recorded consumed quantity to differ from the theoretical quantity. This is available for **BOMs** with the Materials scope with manual assembly types, and is in use by default in BOM Weigh and Dispense.

This supports use cases, as for example: an industrial air conditioning unit BOM specifies 1.2 m^2 of insulation foam based on CAD measurements. In practice, operators may use 1.6-1.8 m^2 due to manual cutting inaccuracies or overlapping pieces to ensure coverage.

Main configuration requirements:

- Units of the **Product** to be assembled
- `Use Tolerances` property set to true
- BOM Item products and quantities
  - Lower and upper tolerance values (percentage-based set from 0 to 100) for all BOM Items
  - If the **Product** is discrete, tolerances are not supported or required
- Substitute BOM **Products**, where applicable

Regarding the Disassemble operation, the calculated quantities are the theoretical ones, and tolerances are applied in order to allow the user to disassemble the same quantity that was assembled before. Regarding the Replace, BOM Item tolerances are applied to the quantity available for replacement.

Negative Quantity

Negative quantities support scenarios where the production process also produces by-products that need to be tracked in the system. This applies to **BOMs** with the Materials scope only. Also, Transfer Requirement for material ignore the negative BOM Item and it is not possible to add negative BOM Item for Material deviation in a **Checklist**.

The key difference from normal BOM Items is that consumption happens in reverse: the by-product quantity increases during assembly and decreases during disassembly.

To illustrate an example, consider a juice production, where processing fruit yields peel by-products. These peels may be collected for essential oil extraction or biofuel production.

Main configuration requirements:

- Units of the **Product** to be assembled
- BOM Item **Products**, no substitutes are not allowed for negative BOM Items
- Negative quantity value representing the by-product yield

Reference Items

A reference item is a BOM Item which consumption is not recorded in MES. It is included purely for informational or display purposes within the **BOM**, ensuring that relevant, non-consumable items are visible in the assembly context.

Main configuration requirements:

- Units of the **Product** to be assembled
- BOM Item **Products** and their substitutes
- Flag option `IsReference` set to True for the Reference Items
- Any informational quantity (optional, since it will not be tracked in the system)

Option to Capture

The Option to Capture setting is independent of whether the BOM Item is to be consumed or is just a reference. It enables the collection of specific data during assembly, which is associated with the BOM Item.

This feature is available for **BOMs** with Materials and Parts scope. It does not apply to substitutes, which inherit the capture settings from the main BOM Item.

There are some use cases where this feature might be relevant:

- Capturing lot, batch, or serial numbers for traceability, with or without actual consumption.
- Recording details for external components not tracked as materials in MES, such as cable ties used in machine assembly.
- Enforcing manual entry of specific data during the assembly of certain components.

Main configuration requirements:

- Units of the **Product** to be assembled
- BOM Item **Products** and their substitutes
- Enable the `Information Capture Required` field for the item, and set the `Information Capture` data

Use Case

For this use case, a more specific manufacturing context will be presented, as these concepts are easier to assimilate with a actual production process.

Consider a manufacturing company that assembles Industrial Coffee Machines (**Product**: CMC-5000). Each unit requires a set of components, some of which are consumed proportionally to the quantity of machines, while others are fixed.

The process may also produce by-products, allow tolerances for certain components, include items for reference only, or require optional data capture for traceability.

At the final stages of the production processes, the following steps and requirements must be considered:

Step	BOM Item Functionality	Product	Quantity	Extra Settings	Description
Grinder Assemble	Option to Capture	Coffee Grinder Module	1 per unit	Capture Serial Number	Serial number recorded for warranty and traceability.
Thermal Insulation	Tolerances	Thermal Insulation Foam	1.2 m^2 per unit	Lower: 0% ; Upper: 50%	Allows extra usage due to manual cutting imprecision.

Step	BOM Item Functionality	Product	Quantity	Extra Settings	Description
Machine Testing	Negative Quantity	Coffee Grounds Waste	-0.5 kg per unit	—	Produced during testing, collected and sold to composting partner.
Boxing	Reference Item	User Manual	1 per unit	Display only	Included in packaging; not tracked for consumption.
Boxing	Fixed Quantity	Water Quality Test Kit	1 kit (fixed per order)	—	Used once per production order for water flow testing.

For simplicity, the overlaying structure includes a general **Service** provided by a shared **Resource**, which is required by all **Steps**.

In addition, there is a storage **Flow** and a **Step** dedicated to gathering all component Materials.

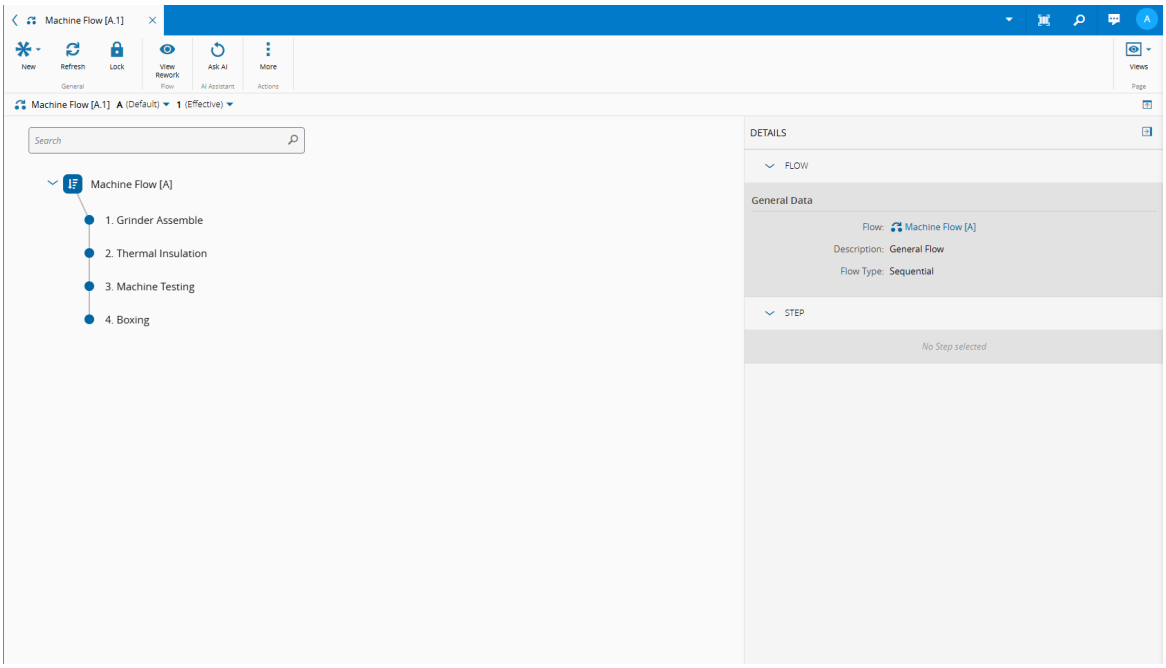
Configuration

Basic configurations like **Calendar**, **Facility**, **Area**, **Resource**, and **Service** are assumed to be pre-defined and are not detailed here.

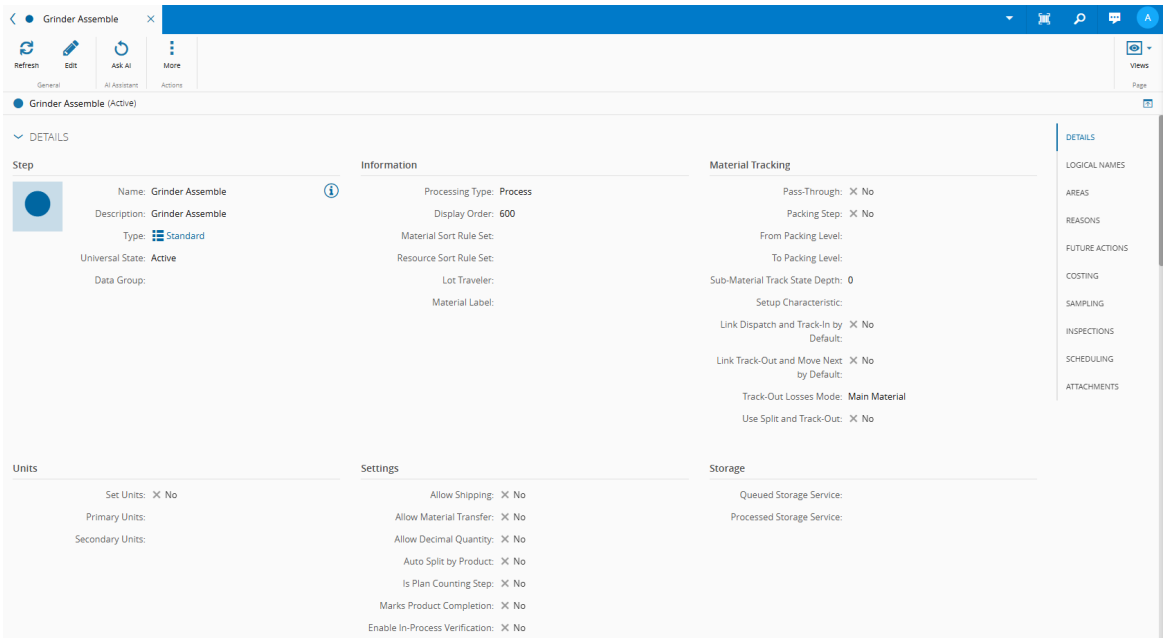
Useful Documentation

Steps and Flows

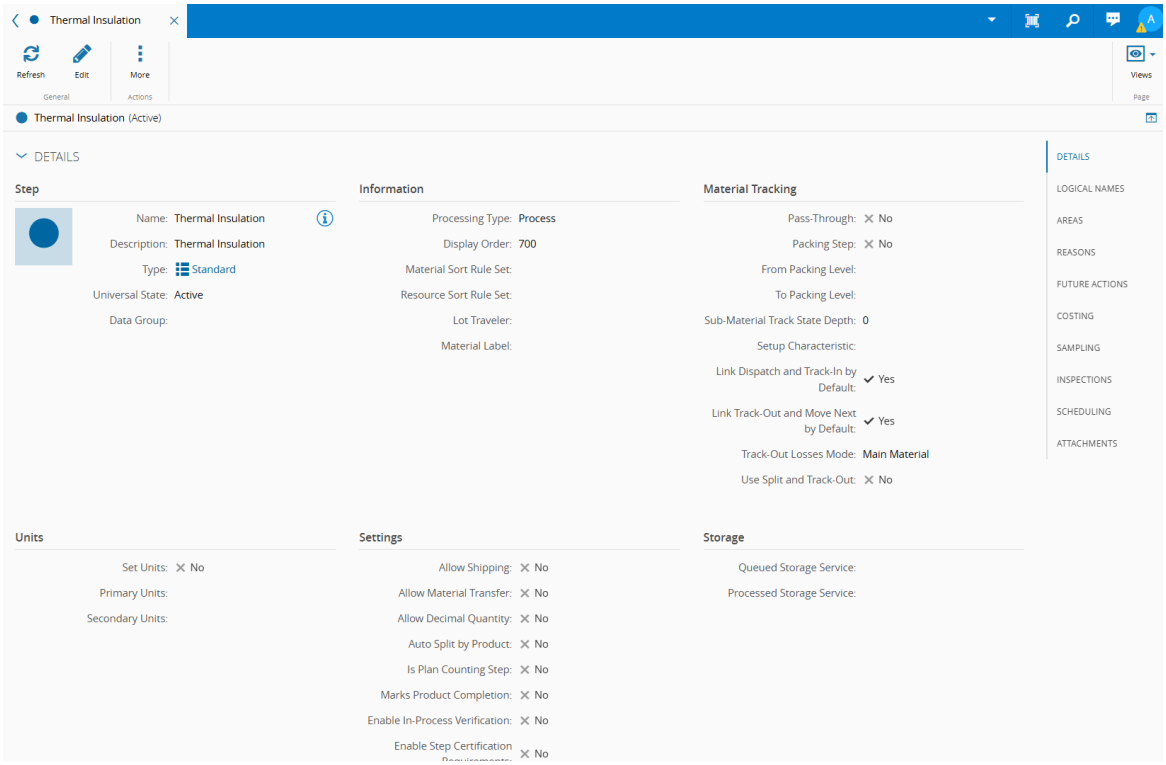
The general configuration of the sequential main production **Flow** and **Step** is detailed in the images below.



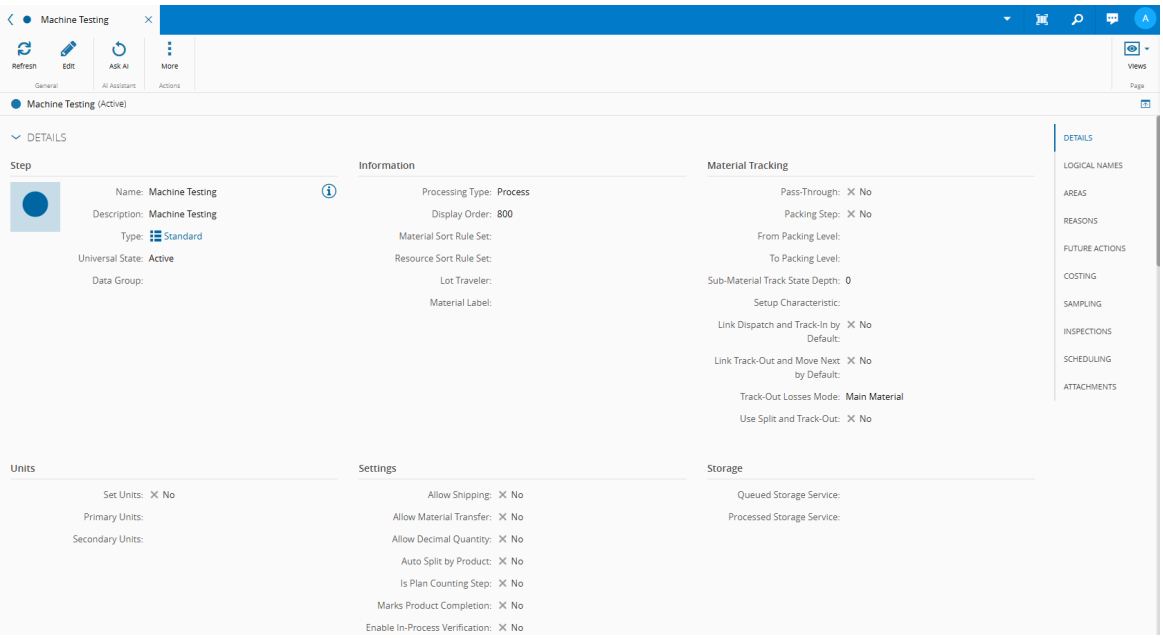
Grinder Assemble Step



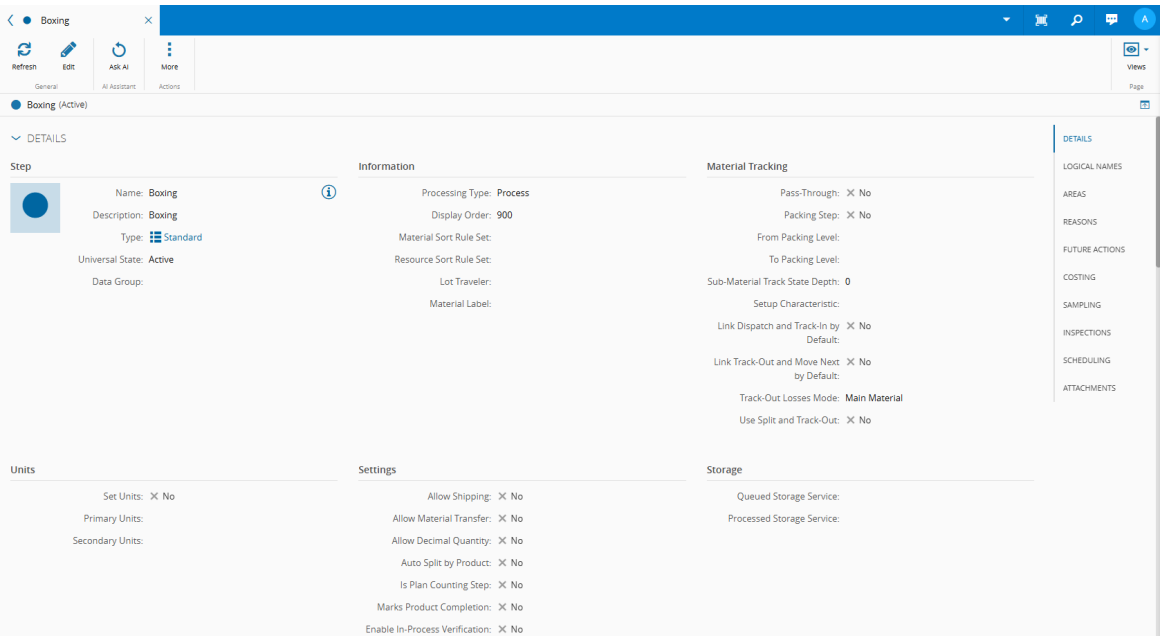
Thermal Insulation Step



Machine Testing Step

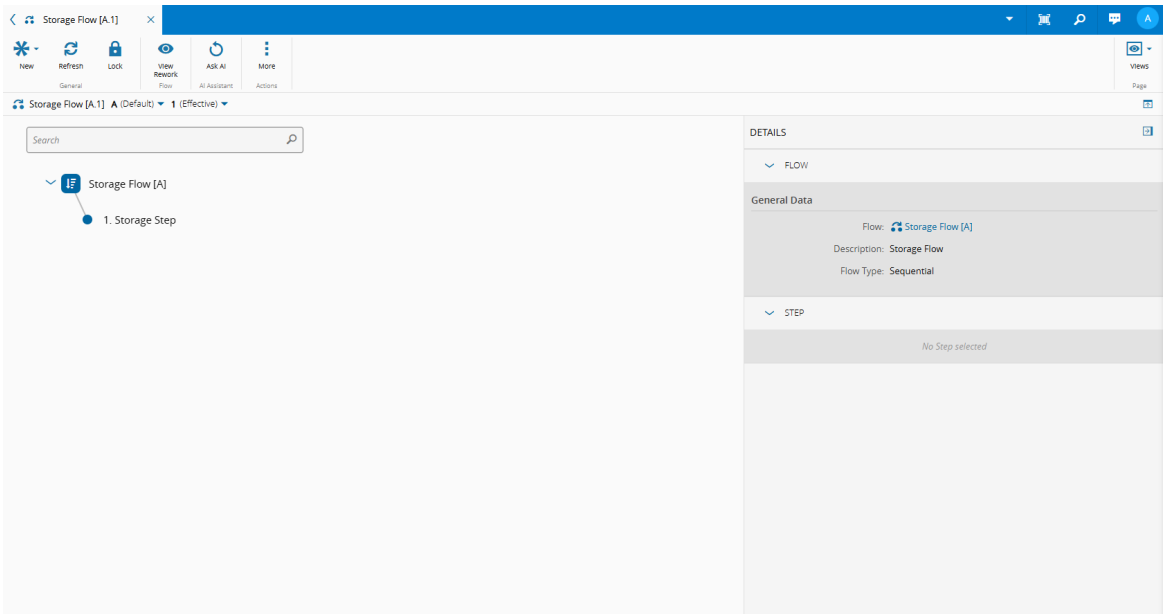


Boxing Step

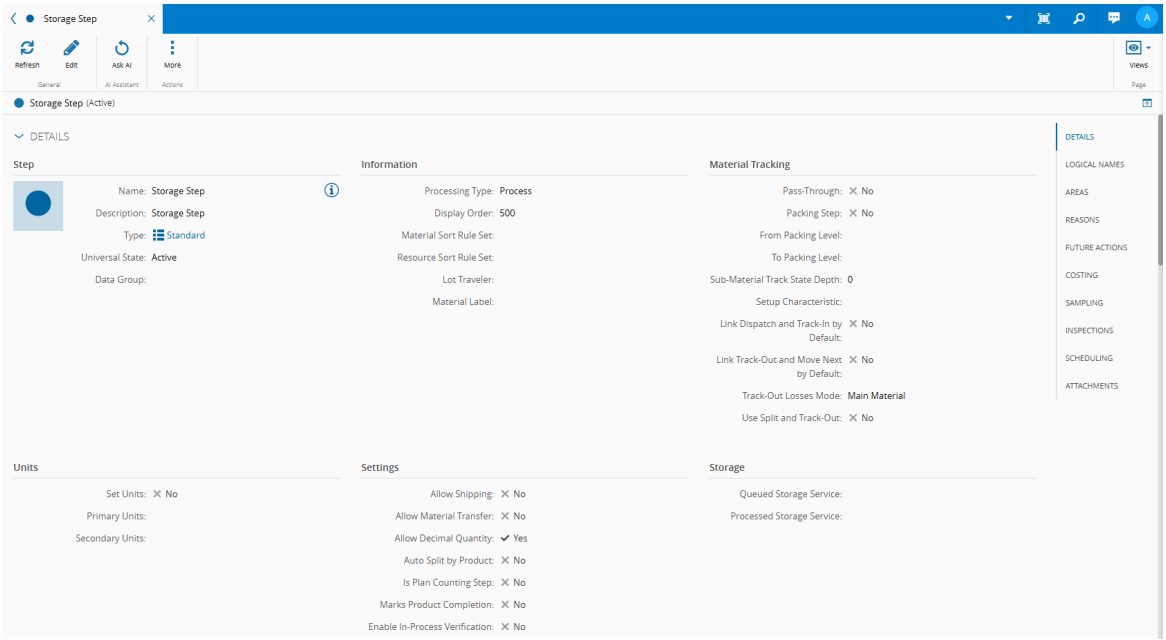


The general configuration of the sequential storage **Flow** and **Step** is detailed in the images below.

Storage Flow



Storage Step



A few details worth mentioning are the following:

- The property `IsDecimalQuantityAllowed` is set to true for the Storage Step as this **Step** will deal with decimal quantities for **Materials** of the **Product** Thermal Insulation Foam and Coffee Grounds Waste.
- Both Storage and Machine Flows are sequential.

Useful Documentation

- Create Step
- How to: Create a Step
- Create Flow
- How to: Create a Flow

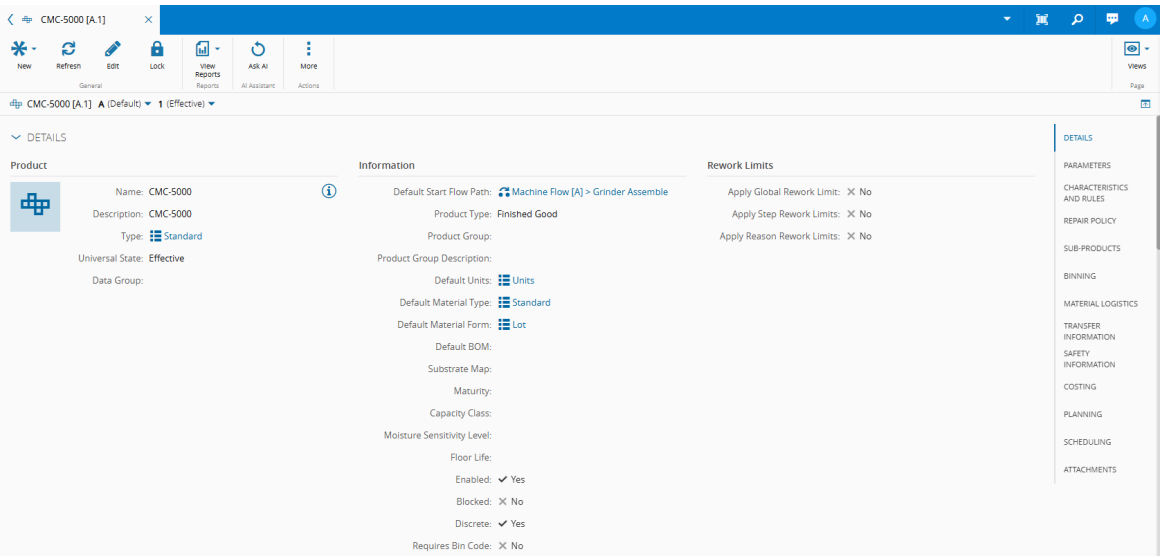
Product

For this scenario, six **Products** are considered:

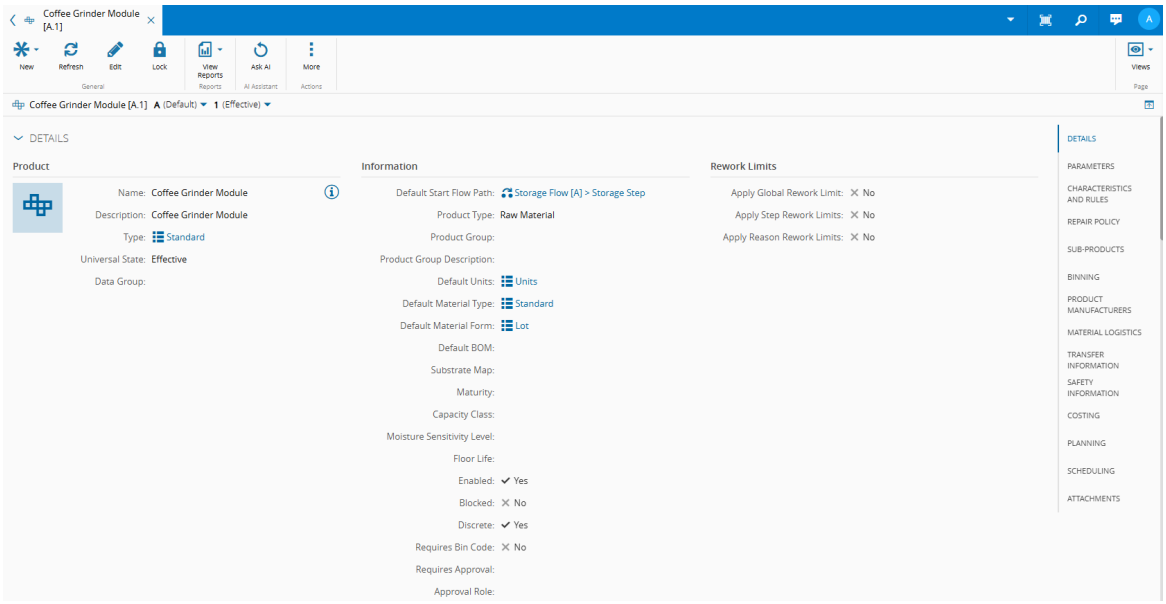
Product	Product Type	Default Units	Is Discrete
CMC-5000	Finished Good	Units	Yes
Coffee Grinder Module	Raw Material	Units	Yes
Thermal Insulation Foam	Raw Material	m^2	No
Coffee Grounds Waste	Raw Material	Kg	No
User Manual	Raw Material	Units	Yes
Water Quality Test Kit	Raw Material	Units	Yes

The general configuration of the **Products** is detailed in the images below.

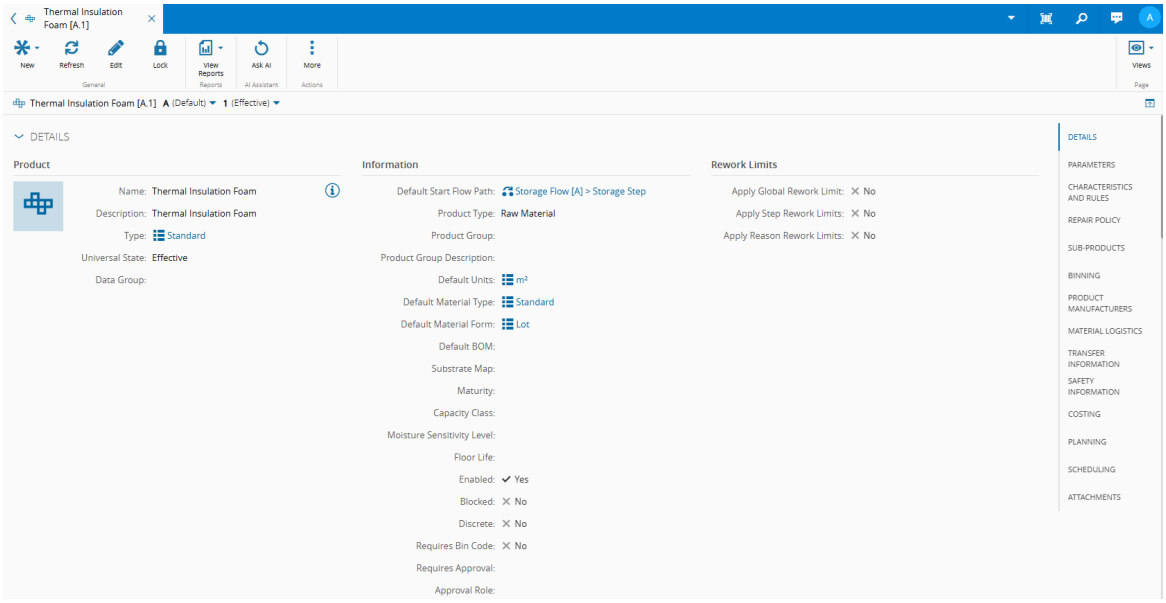
CMC-5000



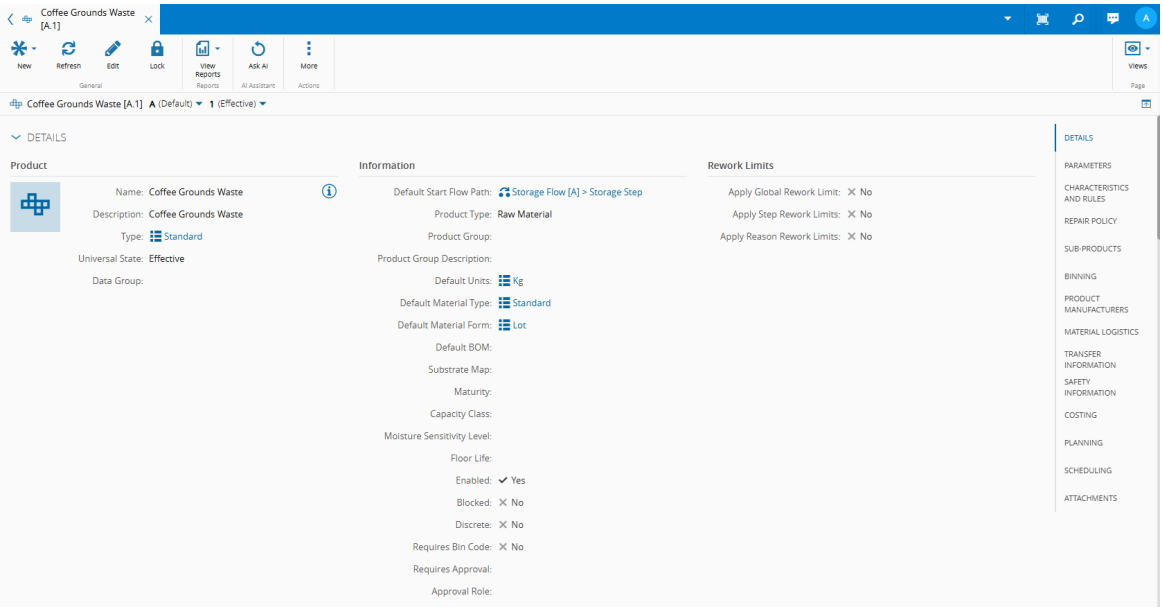
Coffee Grinder Module



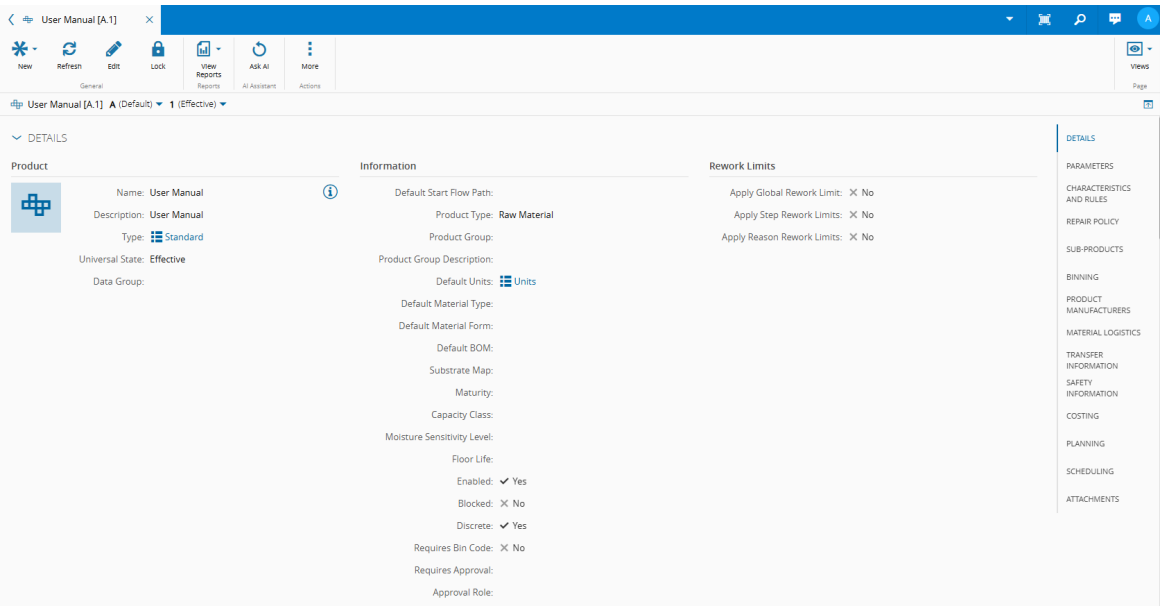
Thermal Insulation Foam



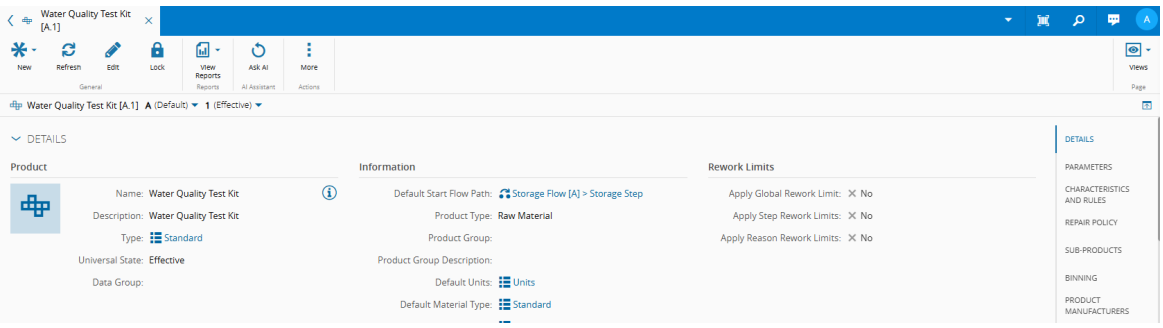
Coffee Grounds Waste

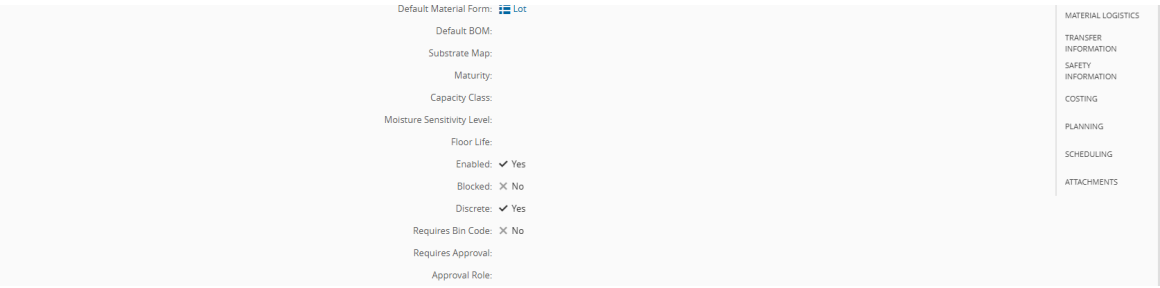


User Manual



Water Quality Test Kit





Useful Documentation

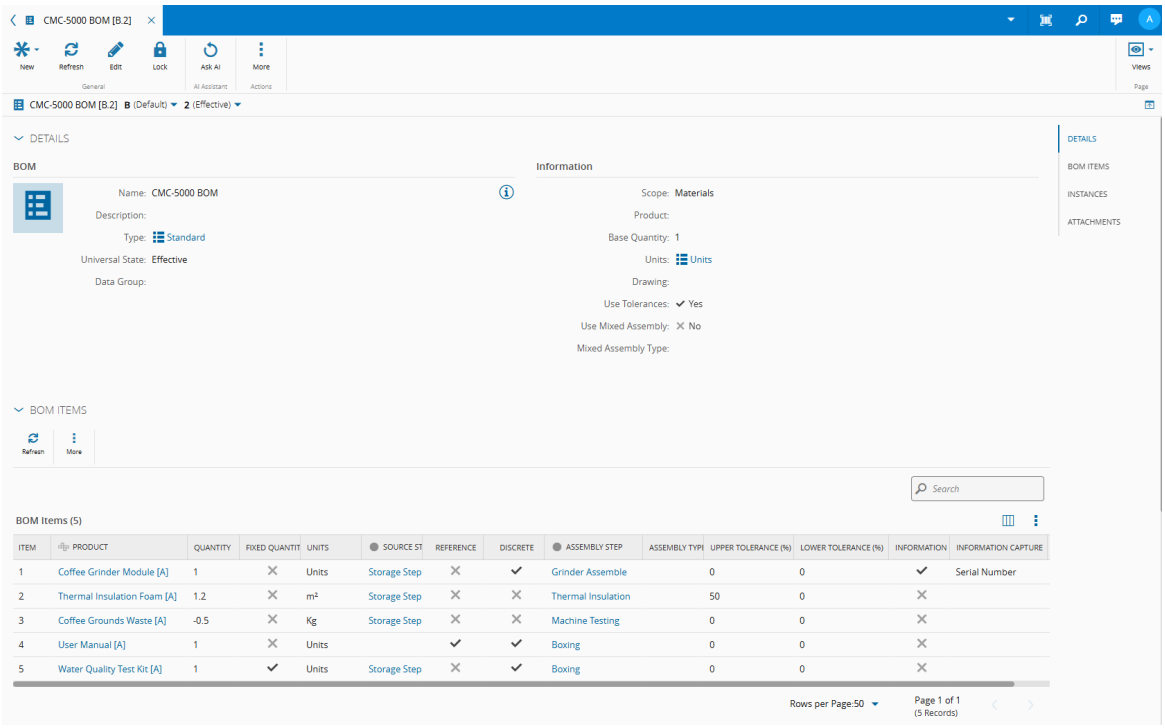
- Create Product
- How to: Create a Product

BOM

The **BOM** is configured to be of scope Materials, and to use tolerances. The details to consider for each BOM Item are the following:

Source Product	Quantity	Is Fixed Quantity	Lower Tolerance	Upper Tolerance	Source Step	Assembly Step	Is Ref
Coffee Grinder Module	1 Units	No	0	0	Storage Step	Grinder Assemble	No
Thermal Insulation Foam	1.2 m^2	No	0	50%	Storage Step	Thermal Insulation	No
Coffee Grounds Waste	-0.5 Kg	No	0	0	Storage Step	Machine Testing	No
User Manual	1 Units	No	0	0	Storage Step	Boxing	Yes
Water Quality Test Kit	1 Units	Yes	0	0	Storage Step	Boxing	No

The configuration of the **BOM** and BOM Items can be found in the image below.



- The `Use Mixed Assembly` property is set to false.
- The **BOM** is configured with the Materials scope.
- The `Base Quantity` property is set to 1.

BOM Context

For each **Step**, when a **Material** of CMC-5000 Product is tracked in, the CMC-5000 BOM will be triggered, and each **Step** has its own assembly type.

The configuration of the BOMContext Smart table is presented in the table below.

Step	Product	BOM	Assembly Type
Grinder Assemble	CMC-5000	CMC-5000 BOM	Explicit
Thermal Insulation	CMC-5000	CMC-5000 BOM	Explicit
Machine Testing	CMC-5000	CMC-5000 BOM	Explicit
Boxing	CMC-5000	CMC-5000 BOM	Explicit Long Running

Useful Documentation

- How to: Add Value to Smart Table

The master data file supporting this use case is available here: XML File.

Execution

To begin this scenario, a **Material** must exist for each BOM Item that is not marked as a reference (for example, all BOM Items except the User Manual **Product**). These Materials must be available at the Storage Step of the Storage Flow, with sufficient quantity to fulfill the demand of the main **Material**.

In addition, a **Material** with a quantity greater than 0 must exist to simulate the production of a CMC-5000 **Product**. This **Material** should be placed at the Grinder Assemble **Step** of the Machine Flow.

Grinder Assemble **Step**:

1. Dispatch and Track-In the CMC-5000 **Material**.
    - The **BOM** information for the BOM Item Coffee Grinder Module and its required quantity is displayed.
2. Perform Assemble.
    - Select the component **Material**.
    - The system prompts for the Serial Number, as defined in the configuration.
    - Once assembled, it is possible to perform Disassemble or Replace.
3. After the full **Material** quantity is assembled, Track-Out and Move Next.

Thermal Insulation **Step**:

1. Dispatch and Track-In the CMC-5000 Material.
    - The **BOM** information for the BOM Item Thermal Insulation Foam and its required quantity is displayed.
2. Perform Assemble.
    - Select the component **Material**.
    - Since this BOM Item has tolerances, the user may assemble a quantity within the allowed range (up to 50% above the theoretical requirement).
    - Because this step uses the Explicit Assembly type, it is also possible to disassemble quantities within the defined tolerances, as explained above.
3. After the full **Material** quantity is assembled, Track-Out and Move Next.

Machine Testing **Step**:

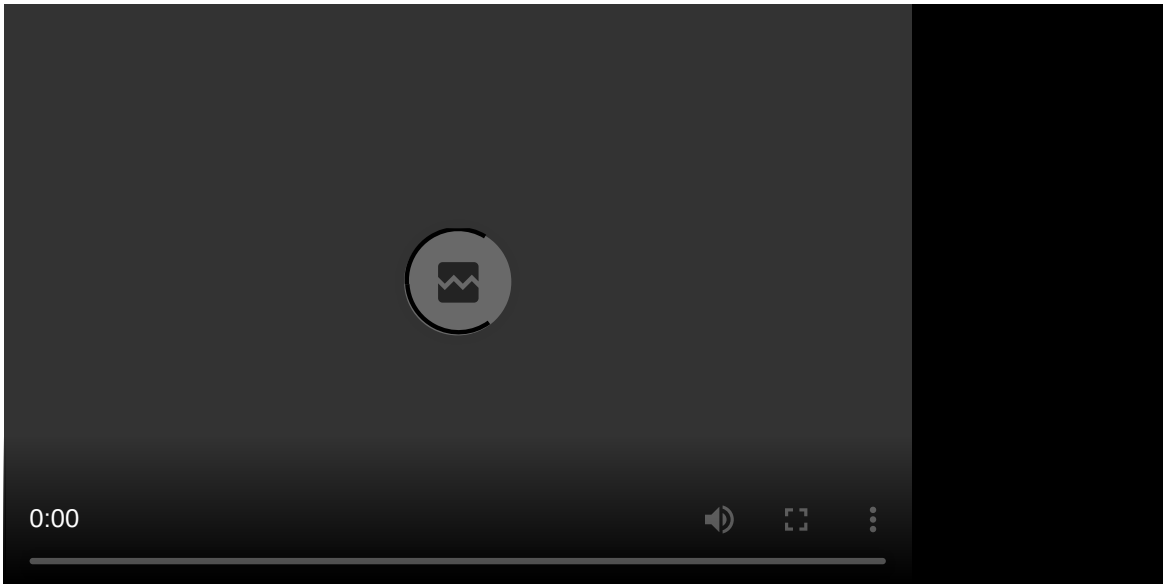
1. Dispatch and Track-In the CMC-5000 **Material**.
    - The BOM information for the BOM Item Coffee Grounds Waste and its expected quantity is displayed.
2. Perform Assemble.
    - Select the component **Material**.
    - As this BOM Item represents a by-product, the quantity of the source **Material** increases when assembled.
    - Once assembled, it is possible to perform Disassemble or Replace.
3. After the full **Material** quantity is assembled, Track-Out and Move Next.

Boxing **Step**:

1. Dispatch and Track-In the CMC-5000 **Material**.
    - The **BOM** information for the BOM Items User Manual and Water Quality Test Kit, along with their required quantities, is displayed.
2. Perform Assemble.
    - For the User Manual, marked as a Reference BOM Item, no source **Material** is required.

- For the Water Quality Test Kit, configured with a fixed quantity of 1, only one kit is consumed/assembled regardless of the main **Material** quantity.
- Once assembled, it is possible to perform Disassemble or Replace.

3. After the full **Material** quantity is assembled, Track-Out.



Legal Information

Disclaimer

The information contained in this document represents the current view of Critical Manufacturing on the issues discussed as of the date of publication. Because Critical Manufacturing must respond to changing market conditions, it should not be interpreted to be a commitment on the part of Critical Manufacturing, and Critical Manufacturing cannot guarantee the accuracy of any information presented after the date of publication. This document is for informational purposes only.

Critical Manufacturing makes no warranties, express, implied or statutory, as to the information herein contained.

Confidentiality Notice

All materials and information included herein are being provided by Critical Manufacturing to its Customer solely for Customer internal use for its business purposes. Critical Manufacturing retains all rights, titles, interests in and copyrights to the materials and information herein. The materials and information contained herein constitute confidential information of Critical Manufacturing and the Customer must not disclose or transfer by any means any of these materials or information, whether total or partial, to any third party without the prior explicit consent by Critical Manufacturing.

Copyright Information

All title and copyrights in and to the Software (including but not limited to any source code, binaries, designs, specifications, models, documents, layouts, images, photographs, animations, video, audio, music, text incorporated into the Software), the accompanying printed materials, and any copies of the Software, and any trademarks or service marks of Critical Manufacturing are owned by Critical Manufacturing unless explicitly stated otherwise. All title and intellectual property rights in and to the content that may be accessed through use of the Software is the property of the respective content owner and is protected by applicable copyright or other intellectual property laws and treaties.

Trademark Information

Critical Manufacturing is a registered trademark of Critical Manufacturing.

All other trademarks are property of their respective owners.