Critical manufacturing
an ASM PT company

Inspection

10.2

April 2026

DOCUMENT ACCESS

Public

Inspection

Estimated time to read: 46 minutes

Generally, an inspection is an organized examination or formal quality evaluation exercise.

Inspection activities can involve the measurements, tests, and gauges applied to certain characteristics in regard to an object or activity. The results are usually compared to specified requirements and standards for determining whether the item or activity is in line with these targets, often with a Standard Inspection Procedure in place to ensure consistent checking.

Note

Inspections are usually non-destructive.

There are three primary types of quality inspections: pre-production, in-line, and final. There are a variety of details that must be inspected and approved during each phase in order to detect and correct quality problems.

Info

Sampling is a separately licensed module.

This document will guide you through the required configurations for the Inspection functionalities.

Overview

Inspection is a common practice in the industry to ensure the desired level of quality. It is common in the industry to implement an inspection plan based on sampling, being AQL (Acceptance Quality Limit) a very common method.

An Inspection consists in taking a sample out of every Material being processed and recording the values of Parameters to be controlled. All the processed Materials are inspected and it must be a User to select the units of the sample to be inspected, even though MES can provide some guidance on which sample units should be inspected.

An Inspection can either be performed in the production step itself or there can be separate dedicated inspection steps. Furthermore, an Inspection will have a pass or fail result depending on the number of acceptable defects.

Info

The main differences between the Inspection functionality and:

- The Sampling Plan is that Sampling Plan is used to implement counter-based and time-based sampling, to send Materials to a Sampling Step, whereas in an Inspection Plan all the Materials being processed are inspected
- The Sampling Pattern is that the Sampling Pattern is used to set a Sampling Selection that defines which Sub-Materials must be sampled at a particular Step and in which sequence. In-Step Sampling

can be used separately or in combination with Lot-based Sampling as provided by a Sampling Plan. On the other hand, the Inspection functionality only provides a hint of which/how many sample units are to be inspected

The Critical Manufacturing Inspection-related concepts and functionalities will be described in more detail over the next sections.

Setting up Inspection Related Entities

To enable the Inspection functionalities, it is necessary to set up the Critical Manufacturing MES entities.

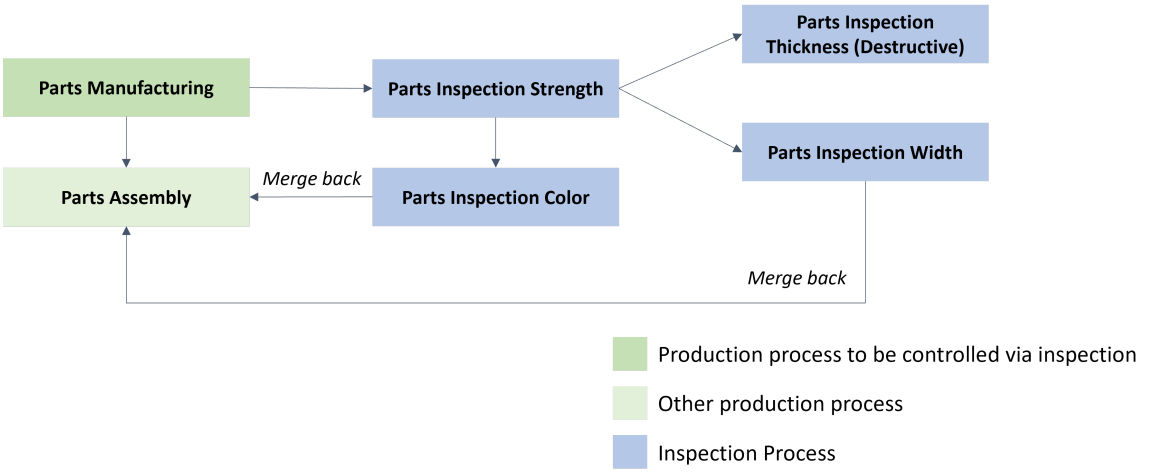
Note

An example with the production and the inspection steps is displayed in the Figure below. In this example the following structure can be observed:

- A production Flow that comprises two production Steps: *Parts Manufacturing* and *Parts Assembly*. The Step to be controlled by the inspection is the *Parts Manufacturing*.
- An Inspection Plan that comprises five inspection Steps: *Parts Inspection Strength*, *Parts Inspection Color*, *Parts Inspection Width*, and *Parts Inspection Thickness*. The goal of the Inspection Plan is to support the inspection of production Materials which are tracked-in in the *Parts Manufacturing* Step through five inspection steps. The Samples of the Inspection Steps *Parts Inspection Color* and *Parts Inspection Width* are returned to the Production Flow to the *Parts Assembly* Step. The Sample of the *Parts Inspection Thickness* Inspection Step is not returned to the Production Flow since it is a destructive test.

Info

Separate Inspection Steps were defined as those require specialized inspection equipment that is available on stations outside of the shop floor.



In order to set up the Inspection related Entities, it's necessary to follow the steps as described in the Table below.

Step Number	Step	Description

Step Number	Step	Description
1	**Create the necessary Resources**	Create the necessary production and inspection Resources of Processing Type Process or Line and, if required, the Resources of Processing Type Instrument. For each inspection Step, there must be a Resource that provides the required Service.
2	**Create the necessary Data Collections**	Create a Data Collection for each inspection Step.
3	**Create the necessary Data Collection Limit Sets**	Depending on the Data Collection Parameter Sample Data Type and Data Collection Parameter Inspection Frequency it may be required to create a Data Collection Limit Set.
4	**Create the necessary Steps**	Create the necessary production and inspection Steps.
5	**Create the necessary Flows**	Create the necessary production and inspection Flows.
6	**Create the Inspection Plan**	Create the Inspection Plan and define the Inspection Steps.
7	**Define the Inspection Plan Configurations**	Define at least one Configuration per Inspection Plan, i.e., the Data Collection and Data Collection Limit Set to be used in each Inspection Step.
8	**Define the Inspection Plan Context**	Define the Inspection Plan and Configuration context for the production Step.

Table: Steps to setup the Inspection related Entities

The next sub-sections will cover the required configuration steps in more detail.

Concepts

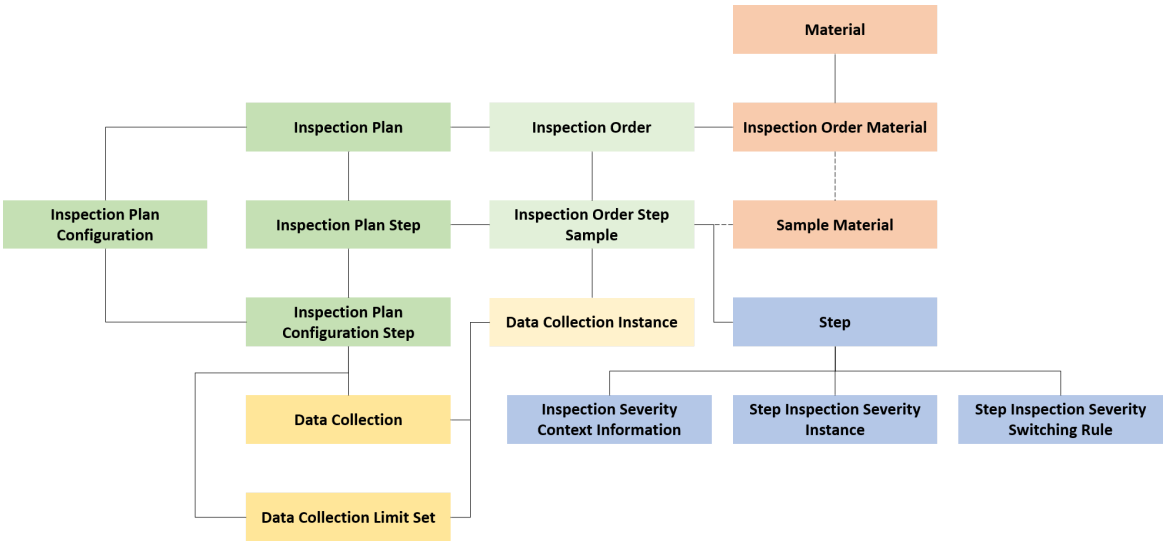
The table below describes the main concepts related to Inspection.

Concept	Description
Inspection Plan	A structured definition of the Inspection process to be implemented. An Inspection Plan must have one or more Inspection Steps.

Concept	Description
Inspection Plan Step	The Inspection Steps to follow for an Inspection Plan. The Inspection Steps may be performed in a productive step or in a separate inspection step.
Inspection Plan Configuration Step	Each Inspection Plan Step must have at least one Configuration, i.e., a definition of how data will be collected for the parameters under inspection. To do so, it must be defined a Data Collection and Data Collection Limit Set, if required.
Inspection Order	The running Inspection for a Material, based on an Inspection Plan and Step Inspection Context.
Inspection Order Step	The Inspection Steps defined for the Inspection Order's Inspection Plan.
Inspection Order Step Sample	The sample to be analyzed in an Inspection Order Step.
Instrument	A Resource with measurement capabilities used in an Inspection to collect the parameter's values.

Table: Inspection main concepts

The concepts presented above are linked to the MES object models displayed in the figure below.



1 - Create the necessary Resources

To perform an inspection it may be required not only to have the right Instruments but also to ensure that those are correctly calibrated. Furthermore, for the Inspection Steps, Resources of Processing Type Process or Line must be configured. If an Instrument is required, it must be attached to the Process Resource and calibrated when performing an inspection on a sample.

To create an Instrument, the properties listed in the table below need to be defined.

Property	Description

Property	Description
Processing Type	The selected Processing Type must be *Instrument*.
Instrument Type	Defines the Instrument type and the available values are in the *InstrumentType* Lookup Table.
Calibration Status	Defines the calibration status of the Instrument. The possible values are: - **Calibrated** - **In Calibration** - **Not Calibrated**
Last Calibration Date	The date on which the Instrument was last calibrated. If Calibration Status is set as Calibrated, a Last Calibration Date must be defined.
Exclusive Usage	If set to *True* the Instrument can only be associated to one Resource of Processing Type Process Or Line.

Table: Resource properties

Note

For the given example, you must create at least one Resource of Processing Type Process or Line per Inspection Step and, if required, Resources of Processing Type Instrument.

Manage Instrument Capabilities

After the creation of an Instrument, it is possible to characterize it by the following capabilities: Parameters, Measurement Units, Range, Resolution, Precision, and Accuracy, as detailed in the Table below. The Manage Instrument Capabilities wizard can be accessed through the Resource Details page in the Measurement Capabilities section.

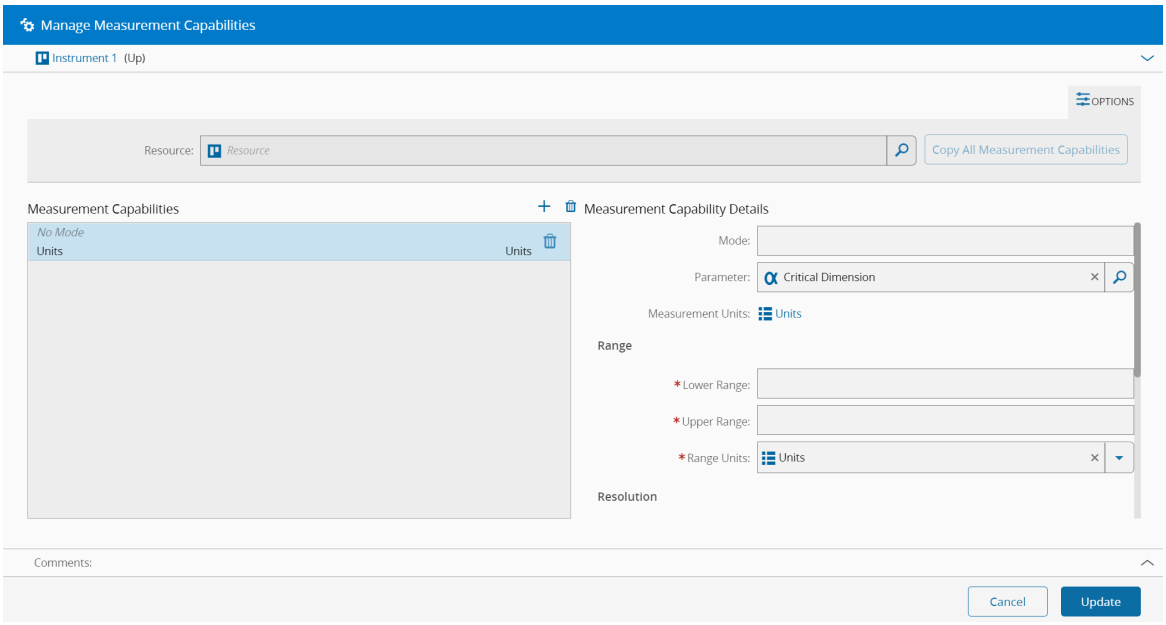
Property	Description
Mode	The Name of the Measurement Capability Mode. If the Instrument only contains one measurement capability, the mode must not be defined.
Parameter	Optionally, you can define a Parameter and it must be of data type Decimal, Long or Boolean and have Units and Minimum and Maximum values defined. This is relevant when the instrument can measure different physical properties with the same measurement units.
Measurement Units	The Units of the Measurement Capability Mode. If a Parameter is defined, the Measurement Unit is the one defined in the Parameter's Units and it cannot be changed.
Lower Range	It is the minimum value that can be measured.
Upper Range	It is the maximum value that can be measured.
Range Units	The Units of the Range.

Property	Description
Resolution	The Resolution of the Instrument represents the minimum readable value.
Resolution Units	The Units of the Resolution.
Precision	The Precision of the Instrument is the difference between repeated measurements at the same location, which can also be given as resolution divided by two. If Precision is defined, Resolution cannot be defined and vice-versa.
Precision Units	The Units of the Precision.
Accuracy (%)	The Accuracy of the Instrument is how close the measurement is to the true value being measured.

Table: Manage Instrument Capabilities properties

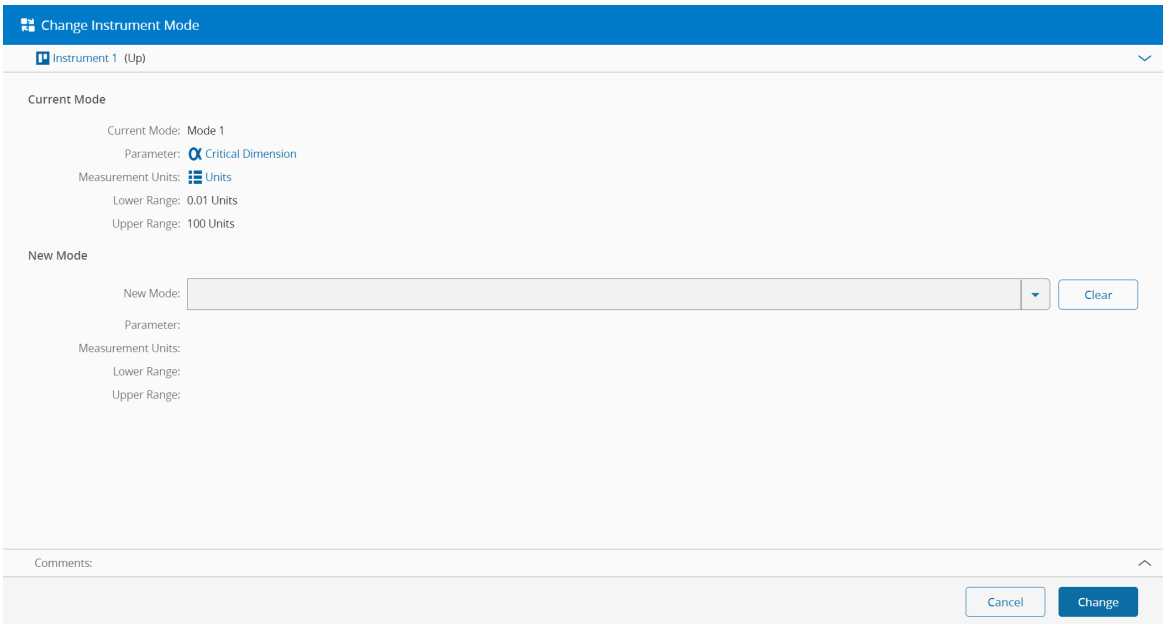
At least one of the Resolution, Precision, or Accuracy properties must be defined.

Measurement Capabilities can also be copied from other Instruments, using the 'Copy All Measurement Capabilities' Option, as displayed in the Figure below.



Change Instrument Mode

To define the Instrument Mode, you must access the Change Instrument Mode wizard available in the Resource View, as displayed in the Figure below. The Instrument Modes available are the ones defined as Measurement Capabilities.

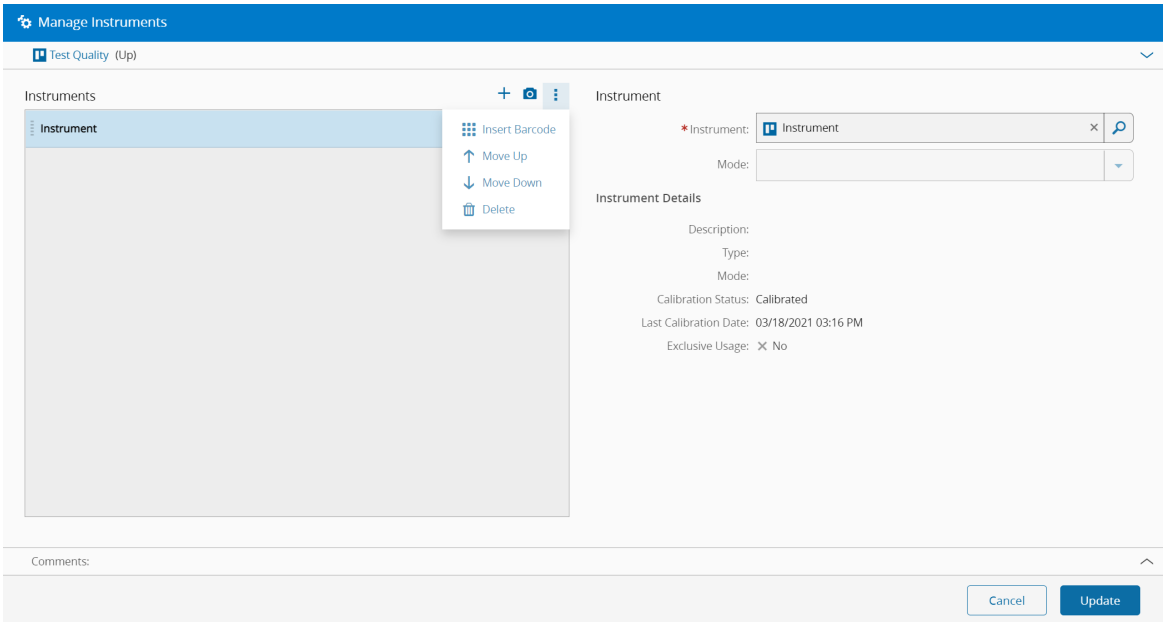


Manage Resource Instruments

To associate an Instrument to a Resource, you must access the Manage Instruments wizard through the Resource page. You can either select an Instrument through the search box or through a barcode reader, as displayed in the Figure below. You can check which Instruments are attached to a Resource in the Instruments section of the Resource page.

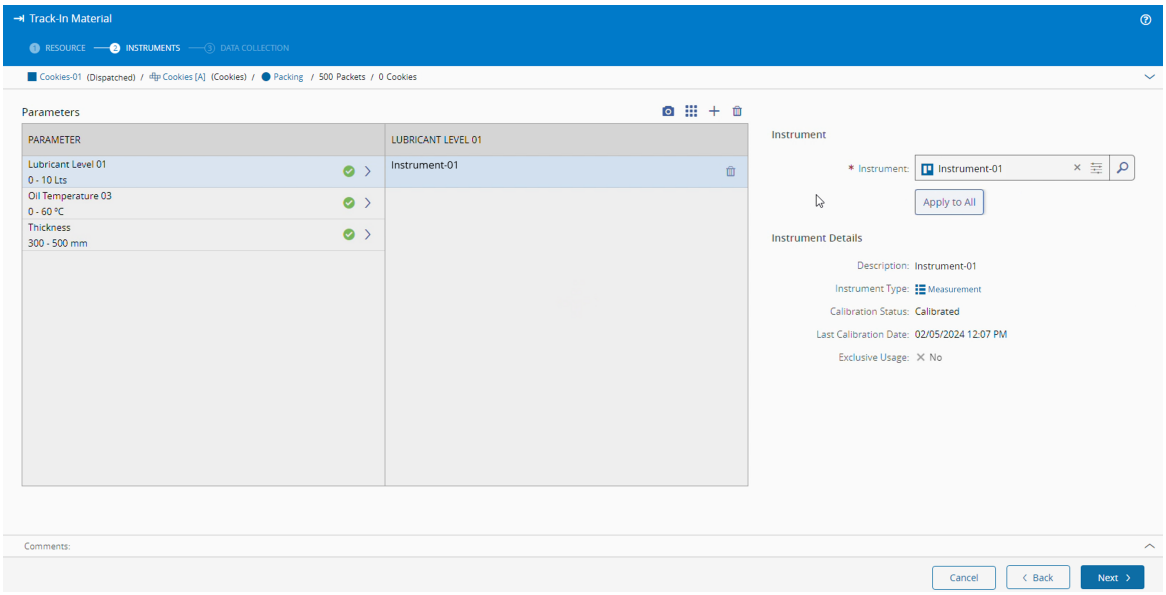
To select an Instrument the following conditions have to be met:

- The Resource must have the Processing Type defined as Process or Line
- The Resource and the Instrument must be in the same Facility
- If the Instrument property *Exclusive Usage* is set to True, then it can not already be associated with a Resource



Apply One Instrument to All Applicable Parameters

If an Instrument is used to measure multiple Parameters, you can choose the Apply to All option, as shown in the wizard below.



2 - Create the necessary Data Collections

The collection of data for a sample during an Inspection is performed through a Data Collection. The properties to be configured are detailed in the Table below.

Property	Description
Scope	The Scope must be defined as Inspection.
Parameter	The Parameter for which data will be collected. The available Parameters must have the Units defined and the Data Type must be either Decimal, Long or Boolean.
Reference	If this property is set to True, it defines whether the Parameter is only displayed, but not captured.
Capture Behavior	Specifies, for Inspection, how the Instrument is captured for the Parameter: - **Always**: the instrument must be selected for each sample - **None**: no instrument must be selected - **On Change**: the instrument must be selected for each Parameter
Instrument Type	If the Capture Behavior property is different from None, you can further narrow the available Instruments that can be used to capture this Parameter. The values are available in the *InstrumentType* Lookup Table.

Property	Description
Frequency	Defines for Inspection, how the number of Samples is calculated. The available options are: - **AQL** - **Any** - **Centering** - **Counter Based** - **First** - **First And Last** - **Fixed** - **Last** - **Percentage** The following Frequencies are size-dependent, i.e., the sample size will depend on the Material quantity: AQL, Counter Based, and Percentage. Please check the sub-section Data Collection Parameter Frequencies for further information.
Configuration Mode	Defines how some information is set: - **Manual**, if the information comes from the Data Collection - **Automatic**, if the information comes from the Step Inspection Severity Instance. The Configuration Mode can only be set to Automatic if Inspection Frequency is AQL, Fixed, Percentage, or Counter Based, otherwise it must be Manual.
Inspection Level	Defines the AQL Inspection level to be used if the selected Inspection Frequency is AQL and if the Inspection Frequency Configuration Mode is Manual.
Severity	Defines the AQL Severity to be used if the selected Inspection Frequency is AQL and if the Inspection Frequency Configuration Mode is Manual. The available values are set in the *AQLSeverity* Lookup Table. It affects the number of acceptable defects through the Generic Table AQLAcceptanceQualityLimit. The following values are available out-of-the-box: - **Normal**: Use of a sampling plan with an acceptance criterion that has been devised to secure the producer a high probability of acceptance when the process average of the lot is better than the acceptance quality limit. - **Tightened**: Use of a sampling plan with an acceptance criterion that is tighter than that for the corresponding plan for normal inspection. - **Reduced**: Use of a sampling plan with a sample size that is smaller than that for the corresponding plan for normal inspection and with an acceptance criterion that is comparable to that for the corresponding plan for normal inspection.
Acceptance Limit	Defines the AQL Acceptance Limit to be used if the selected Inspection Frequency is AQL and if the Inspection Frequency Configuration Mode is Manual.
Counter Frequency	Defines the frequency of the calculation of the number of Samples. It must be defined if the selected Inspection Frequency is Counter Based and if the Configuration Mode is defined as Manual.

Property	Description
Maximum Acceptable Defects Mode	Defines the Maximum Acceptable Defects Mode to be used: - **None**, if the selected Inspection Frequency is AQL - **Automatic Fixed**, if the selected Inspection Frequency is Any, Centering, First, First And Last, Fixed, Last, or Percentage. If this mode is defined, you must define the Step Maximum Acceptable Defects - **Automatic Percentage**, if the selected Inspection Frequency is Counter Based or Percentage. If this mode is defined, you must define the Step Maximum Acceptable Defects Percentage - **Fixed**, if the Inspection Frequency selected is Any, Centering, Counter Based, First, First And Last, Fixed, Last, or Percentage - **Percentage**, if the selected Inspection Frequency is Counter Based or Percentage
Maximum Acceptable Defects	Defines the Maximum Acceptable Defects to be used. It must be defined if the selected Maximum Acceptable Defects Mode is Fixed.
Maximum Acceptable Defects Percentage	Defines the Maximum Acceptable Defects Percentage to be used. It must be defined if the selected Maximum Acceptable Defects Mode is Percentage.
Sample Size	Defines the size of the sample. It can be defined if the Inspection Frequency is Fixed and the Configuration Mode is Manual.
Sample Percentage Value (%)	Defines the size of the sample. It can be defined if the Inspection Frequency is Percentage and the Configuration Mode is Manual.
Sample Type	Defines whether the Parameter is of type: - **Attribute** - **Result** - **Defect Count** - **Variable** If the selected Sample Type is Attribute or Defect Count, the Inspection Frequency can only be AQL, Fixed, or Percentage. If the selected Inspection Frequency is Centering, the Sample Type must be Variable. The Sample Type must be Attribute, Result, or Variable if AQL Limit Type is PercentNonconforming and must be Defect Count if AQL Limit Type is Nonconformities Per Hundred Units. If the selected Sample Type is Variable, the Parameter must be of type Decimal, Long or Integer and the Parameter must have Units defined. Please check the sub-section Data Collection Parameter Sample Type for further information.
Sample Key Type	Defines whether the Parameter Key Type is: - **Piece Number**, if the Inspection Frequency is defined as Counter Based - **Sample Number** is the default value The Sample Key Type is only defined if the Sample Type is Variable or Result.
Sample Source	Defines the Source to which the Sample Count is applied. It must be defined if the selected Inspection Frequency is AQL, Percentage, or Counter Based. The possible values are: - **Primary Quantity** - **Secondary Quantity** - **Materials Count**

Property	Description
Use First Piece Measurement Strategy	Defines whether to measure the first piece. It can only be defined if the Inspection Frequency is defined as Counter Based. **Note:** If the measurement fails, all subsequent pieces are measured until a good one is found.
Measure Last Piece	Defines whether to measure the last piece. It can only be defined if the Inspection Frequency is defined as Counter Based.
Test All Since Last Pass	Defines whether if one unit fails, new Samples need to be created since the last good sample. It can only be defined for Parameters having Sample Type defined as Variable or Result, the Sample Key Type defined as Piece Number and the Inspection Frequency defined as Counter Based.
Test All On Fail	Defines whether all units must be tested if one unit fails. It can only be set to true if Sample Type is defined as Attribute and if Inspection Frequency is defined as Percentage or Fixed.
Instruction	Provides some instruction information on how to capture the Parameter value.

Table: Data Collection properties

The Parameters' configuration can also be copied from other Data Collections, using the 'Copy Parameters' Option.

Note

For the given example, you must create a Data Collection per Inspection Step.

Data Collection Parameter Frequencies

The Data Collection Parameter Inspection Frequency defines how the size of the Samples is calculated for a Material being inspected. Each Frequency will be detailed over the next sub-sections.

ACCEPTANCE QUALITY LIMIT (AQL)

Acceptance Quality Limit (AQL) Sampling is a method used to define if a lot/production order meets the customer's requirements through random sampling. This method complies with the ISO 2859-1:1999, ANSI/ASQ z1.4 2018, and the MIL-STD 105E standards.

An AQL Strategy should be agreed upon between the buyer and the supplier and is defined by the following parameters:

- **Inspection Level** - determines the number of samples to inspect from a production lot
- **Inspection Severity** - determines the number of acceptable defects. There are three types of Severity: Normal, Tightened, and Reduced
- There are three types of **Defects Classification**. The proportion of acceptable defects vary in function of the product and its market.
- Critical Defects (Percentage) – Defects that when accepted could harm users. Such defects are unacceptable
- Major Defects (Percentage) – Defects that are usually not acceptable by the end-users, as they are likely to result in failure

- Minor Defects (Percentage) – Defects that are not likely to reduce the usability of the product for its intended purpose but differ from specified standards; some end users will still buy such products

The percentage of Defects depends on the product type and can be determined through the table below.

Classification	High Valued Products	Low-medium Valued Products
Critical Defects	0	0
Major Defects	AQL1.0/1.5	AQL2.5
Minor Defects	AQL2.5/4.0	AQL4.0

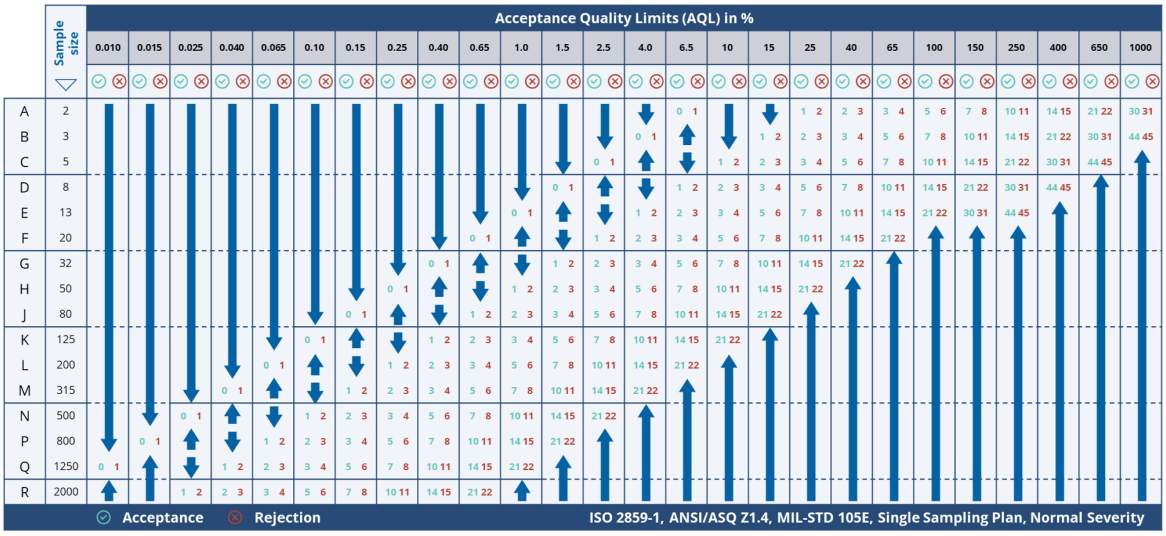
Table: Percentage of Defects per product type

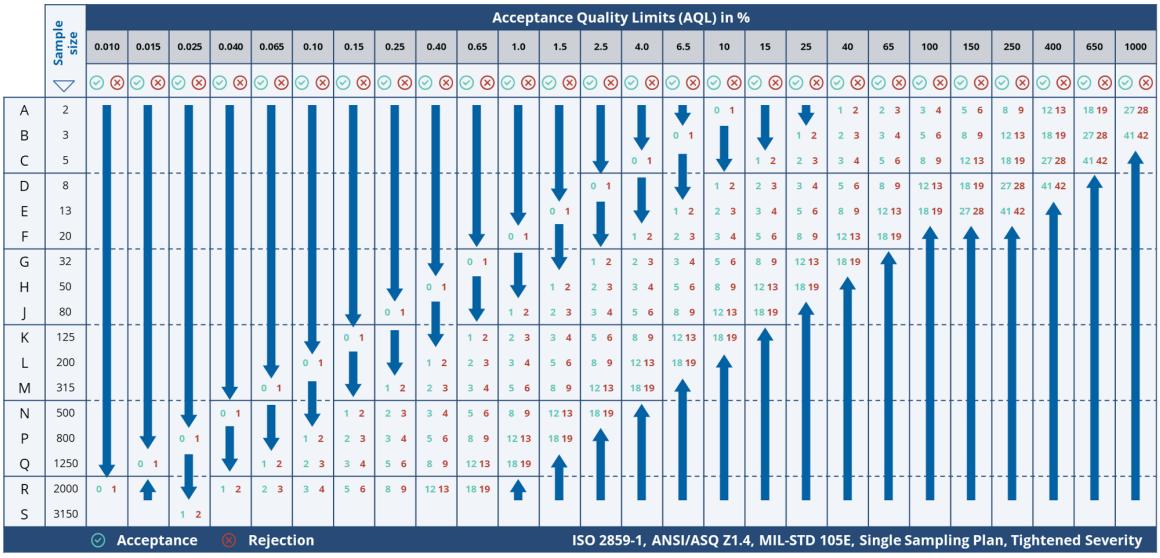
The first step to obtain the number of samples is through a code letter that can be derived from the table below, having the lot size and the desired Inspection Level.

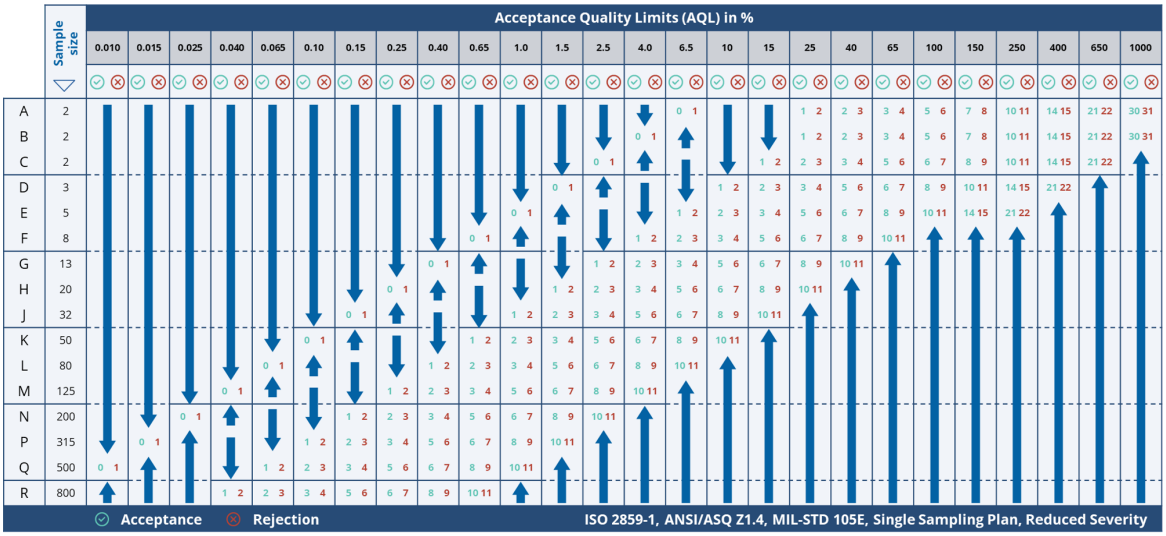
	Special Inspection Levels				General Inspection Levels		
Lot size (number of ordered products)	S-1	S-2	S-3	S-4	I	II	III
2 → 8	A	A	A	A	A	A	B
9 → 15	A	A	A	A	A	B	C
16 → 25	A	A	B	B	B	C	D
26 → 50	A	B	B	C	C	D	E
51 → 90	B	B	C	C	C	E	F
91 → 150	B	B	C	D	D	F	G
151 → 280	B	C	D	E	E	G	H
281 → 500	B	C	D	E	F	H	J
501 → 1200	C	C	E	F	G	J	K
1201 → 3200	C	D	E	G	H	K	L
3201 → 10 000	C	D	F	G	J	L	M
10001 → 35 000	C	D	F	H	K	M	N
35001 → 150 000	D	E	G	J	L	N	P
150001 → 500 000	D	E	G	J	M	P	Q
500001 and over	D	E	H	K	N	Q	R
ISO 2859-1, ANSI/ASQ Z1.4, MIL-STD 105E, Single Sampling Plan							

The code letter determines the sample size. Along with the selected Inspection Severity and Acceptance limit, it provides the maximum number of acceptable defects. Each Inspection Severity has its own table (Inspection Severity Table). Below are the tables for a Normal, Tightened, and Reduced Inspection Severity, for a Single Sampling Plan.

The arrow pointing upwards means that the first sampling plan above the arrow will be used. The arrow pointing downwards means that the first sampling plan below the arrow will be used.





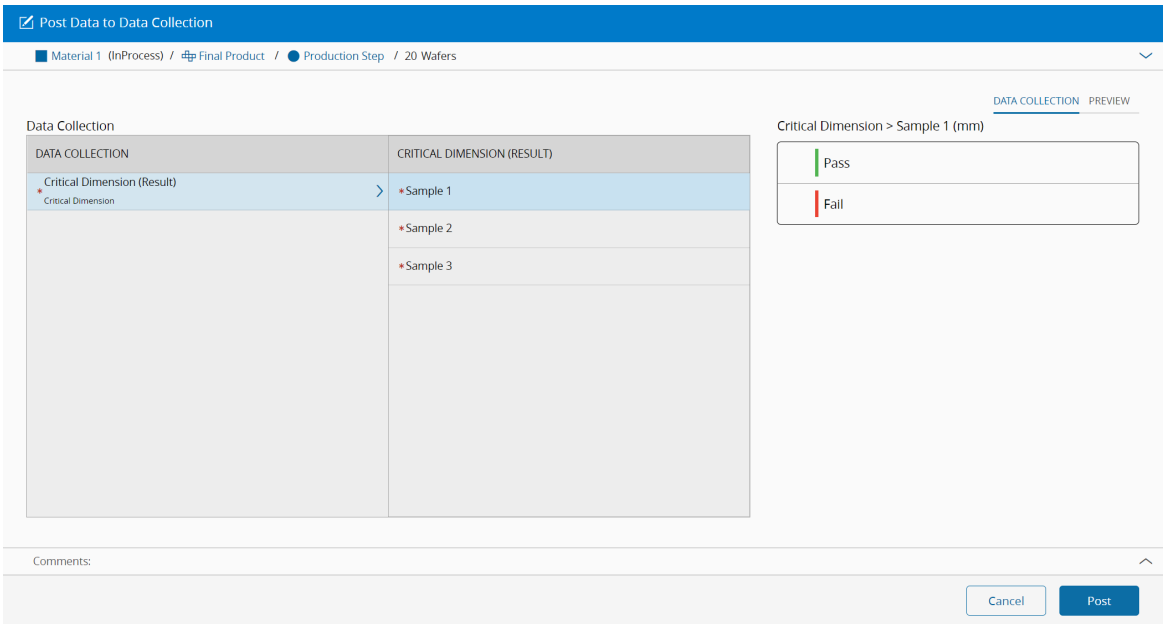


Info

If the lot quantity is less than the sample size, the lot must be inspected at 100%.

For example, having a production lot with 20 000 units and an Inspection Level II, the code letter is M. Looking at the Sampling and Acceptance Limits table for a Normal Inspection Severity, the number of samples is 315. If the AQL is set at 2.5% for major defects and 4.0% for minor defects, the lot is accepted if no more than 14 units with major defects and no more than 21 units with minor defects are found.

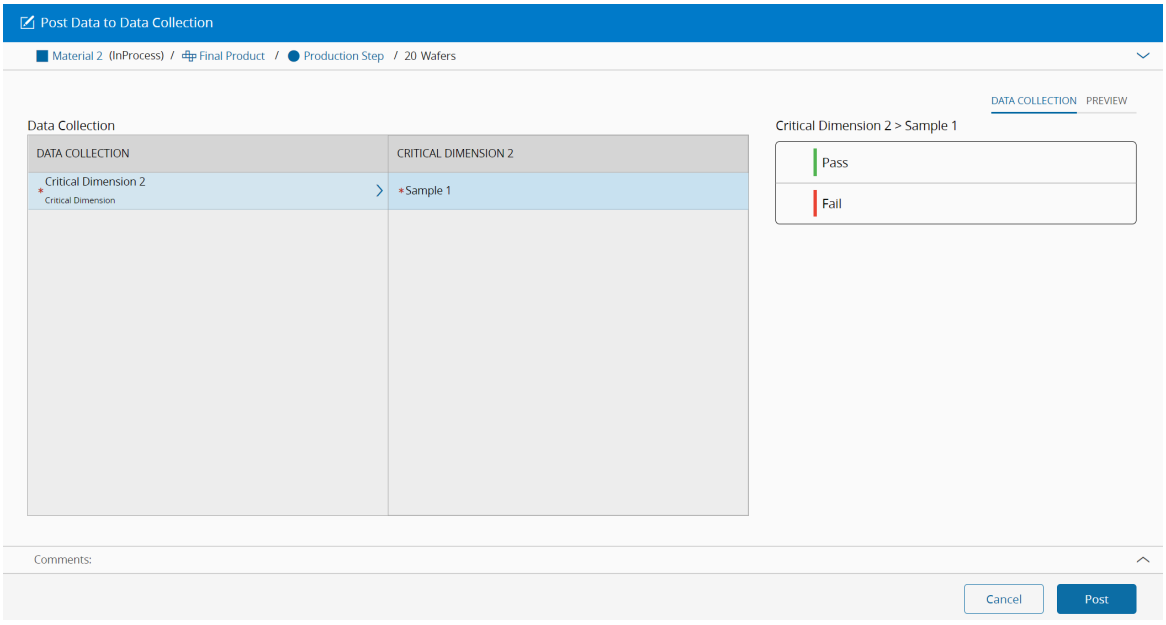
An example is displayed in the Figure below.



ANY

The Any Inspection Frequency intends to inspect any one of the units being produced.

An example is displayed in the Figure below.



CENTERING

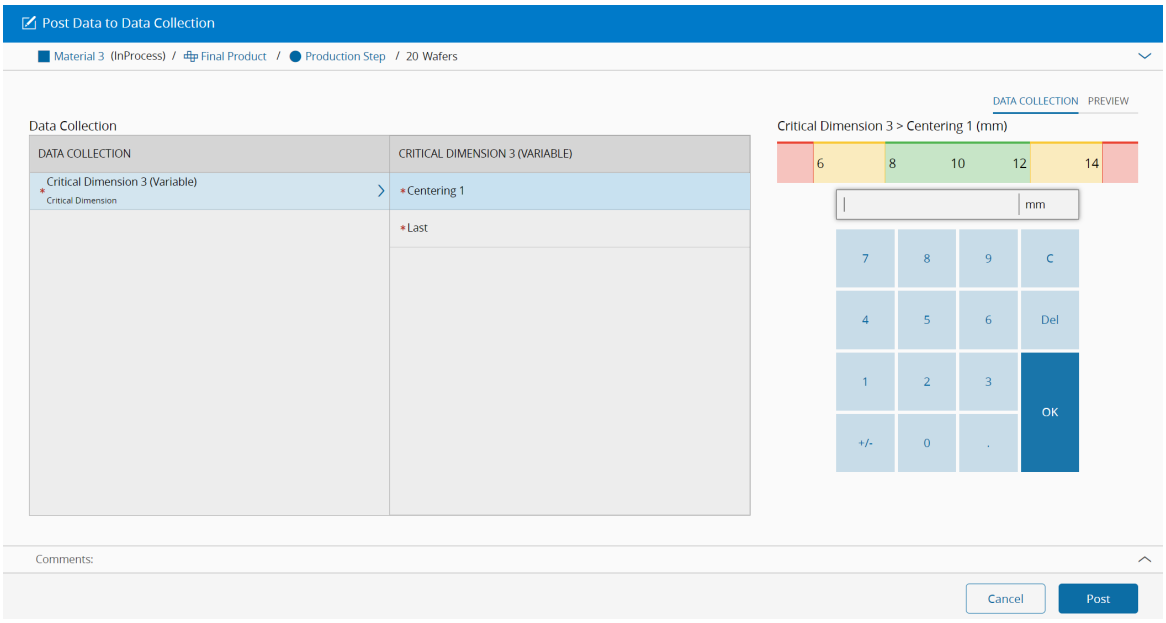
The Centering Inspection Frequency intends to calibrate the production process by measuring the produced units until those are within the expected values (Data Collection Limit Set Warning Limits). Once a unit is centered, only the last unit needs to be measured.

If a sample reading is out of the defined Data Collection Limit Set Warning Limits, a new sample is created so that a new measurement can be performed on the next unit being produced in order to ensure that the process is calibrated within the spec limits.

Info

It can only be used for Parameters having the Sample Type defined as Variable and you must provide a Data Collection Limit Set with configured Warning Limits.

An example is displayed in the Figure below.

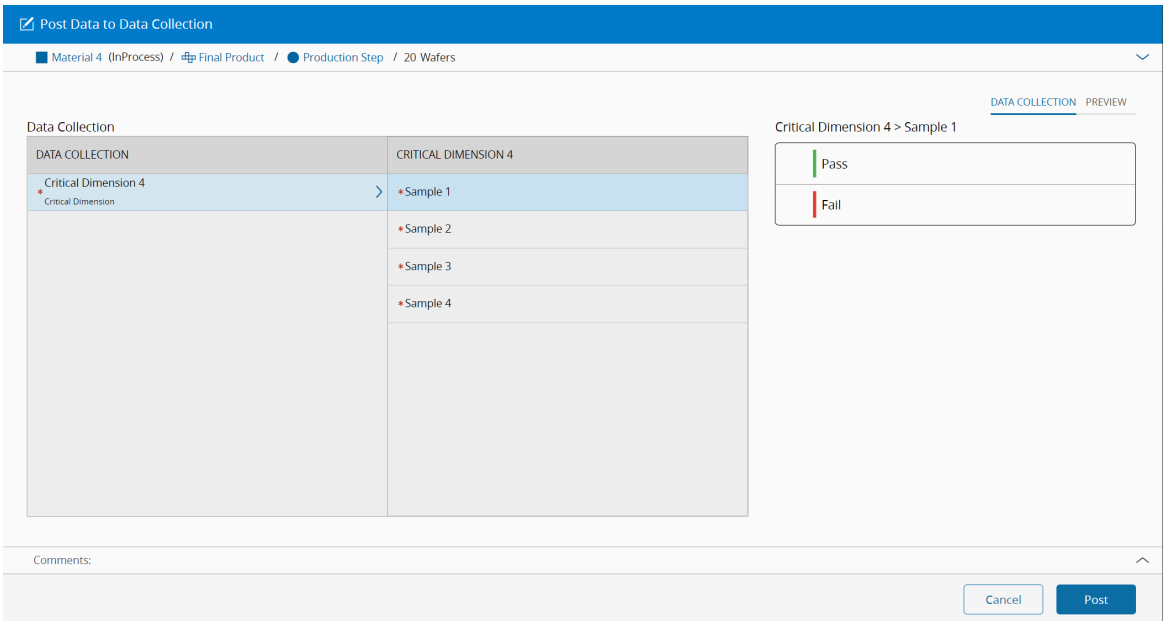


COUNTER BASED

The Counter Based Inspection Frequency intends to inspect a certain number of units of a Material depending on a defined Counter Frequency. For example, if a Material Primary Quantity is 20, the Inspection Frequency is equal to 5 and the Sample Source is:

- Sample Number: four Samples must be inspected
- Piece Number: Pieces 5, 10, 15 and 20 must be inspected

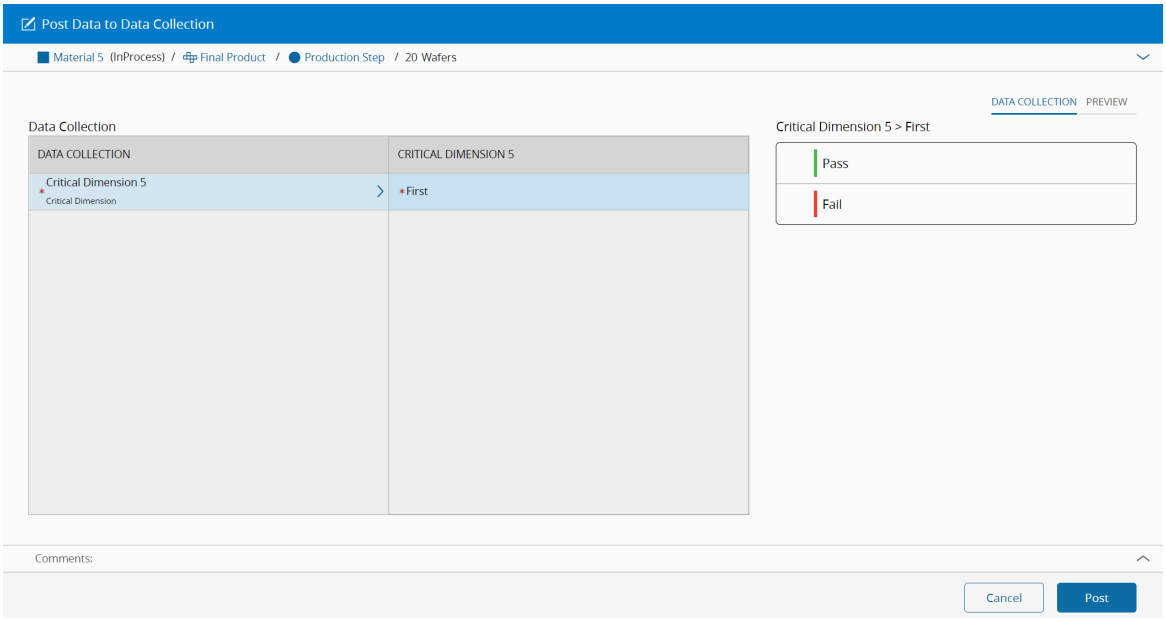
An example is displayed in the Figure below.



FIRST

The First Inspection Frequency intends to inspect only the First unit being produced.

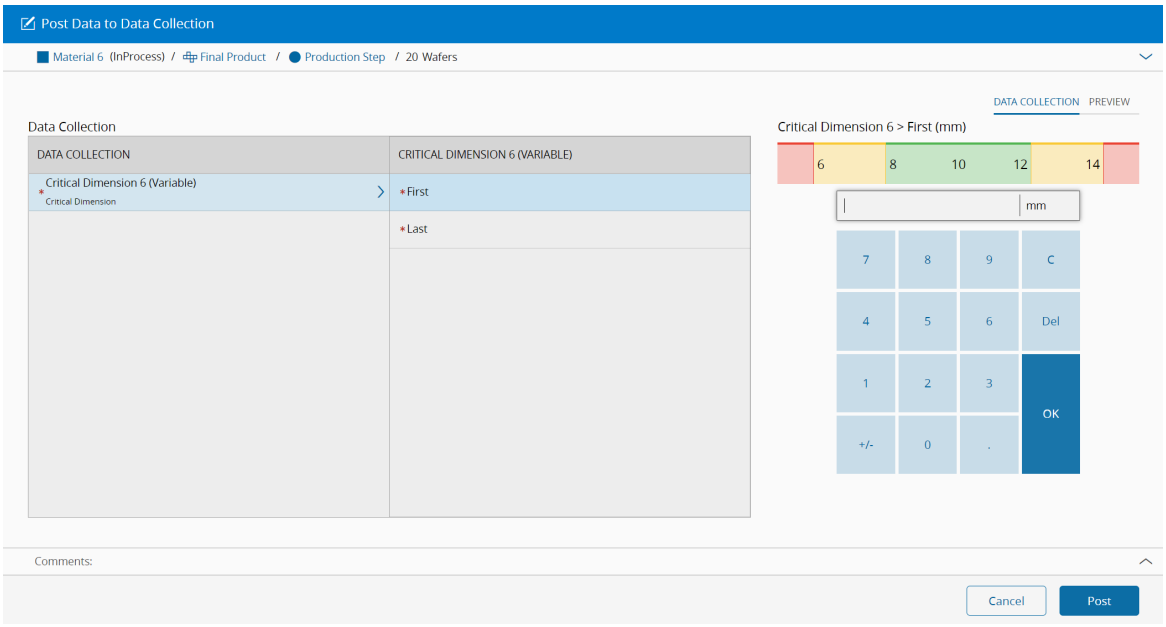
An example is displayed in the Figure below.



FIRST AND LAST

The First And Last Inspection Frequency intends to inspect the First and Last units being produced.

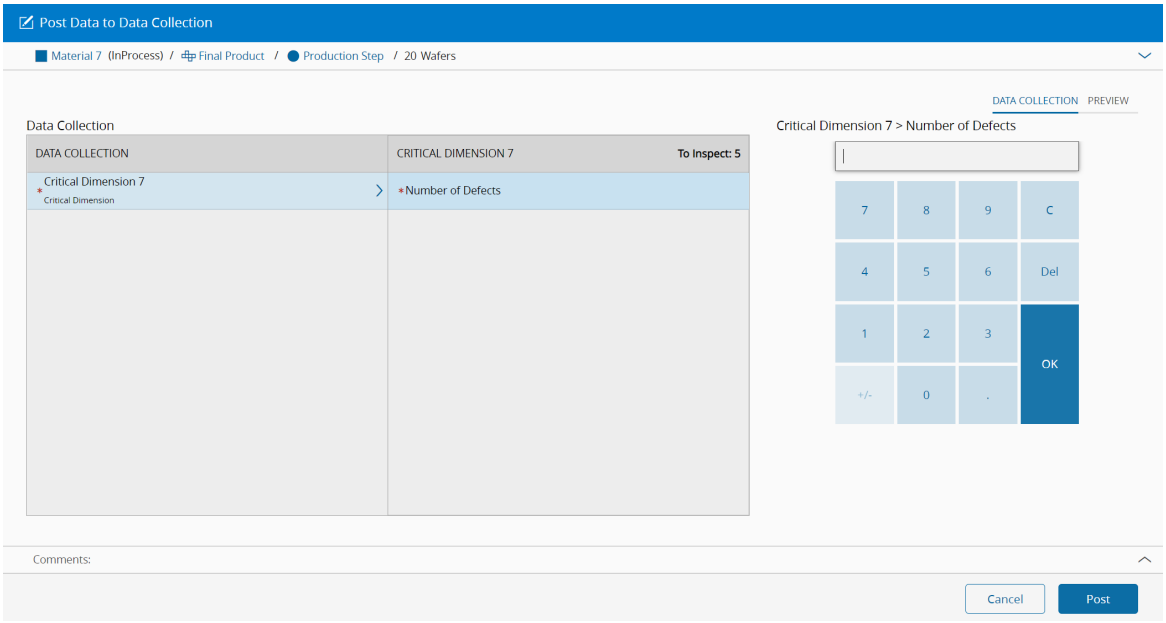
An example is displayed in the Figure below.



FIXED

The Fixed Inspection Frequency intends to inspect a fixed number of units (Sample Size) being produced.

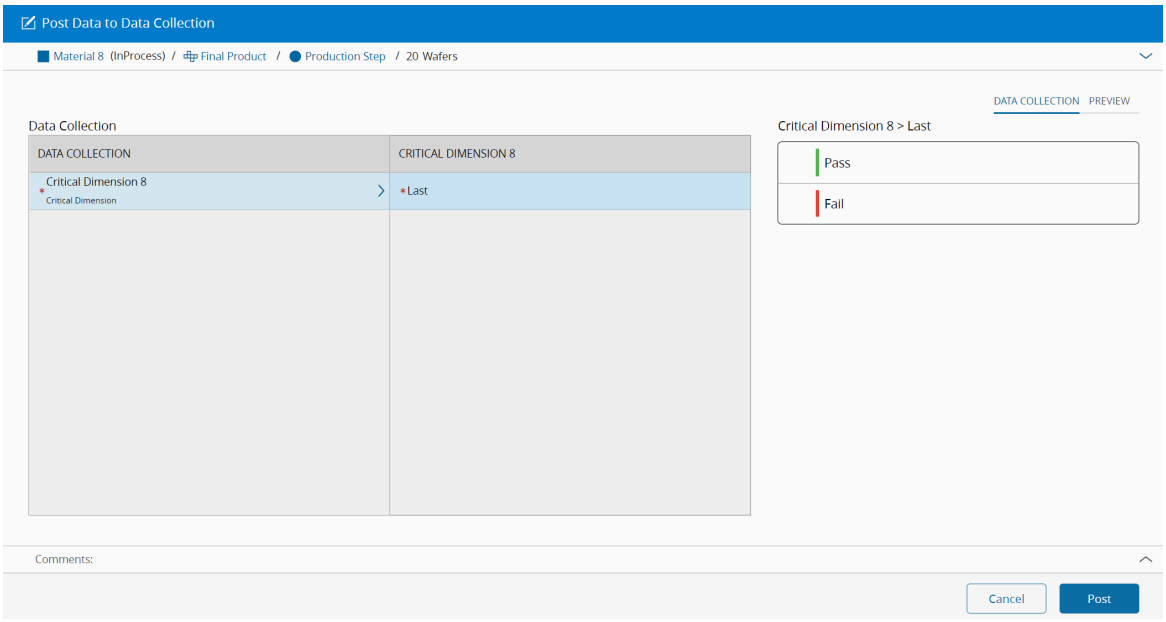
An example is displayed in the Figure below.



LAST

The Last Inspection Frequency intends to inspect only the last unit being produced.

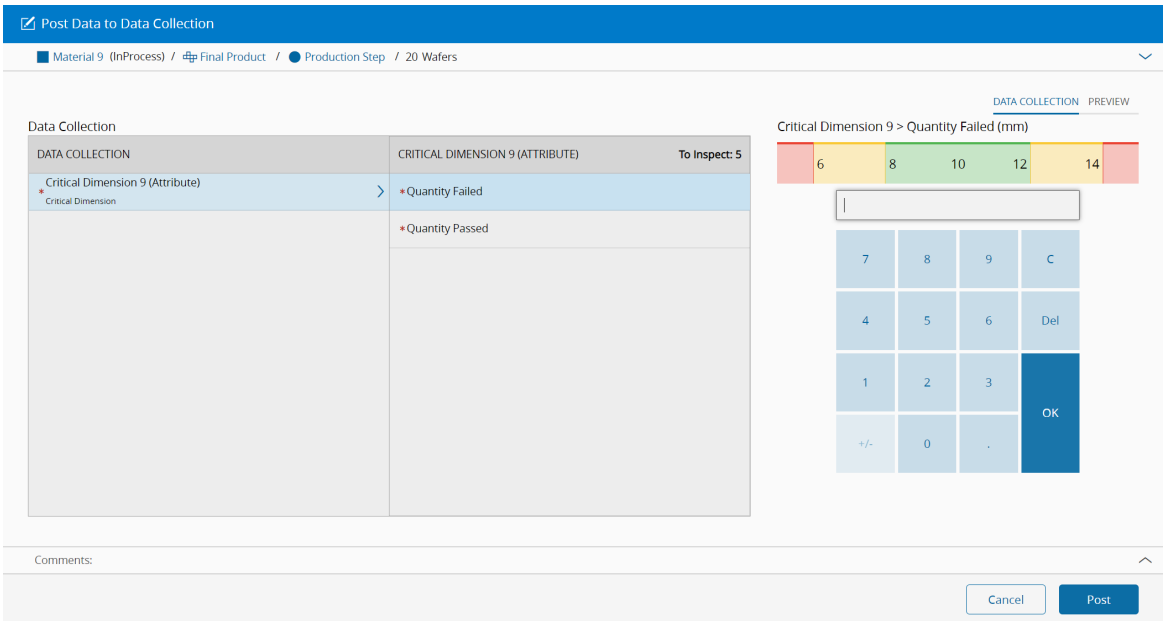
An example is displayed in the Figure below.



PERCENTAGE

The Percentage Inspection Frequency intends to inspect a percentage of the number of units (Percentage Value) being produced.

An example is displayed in the Figure below.

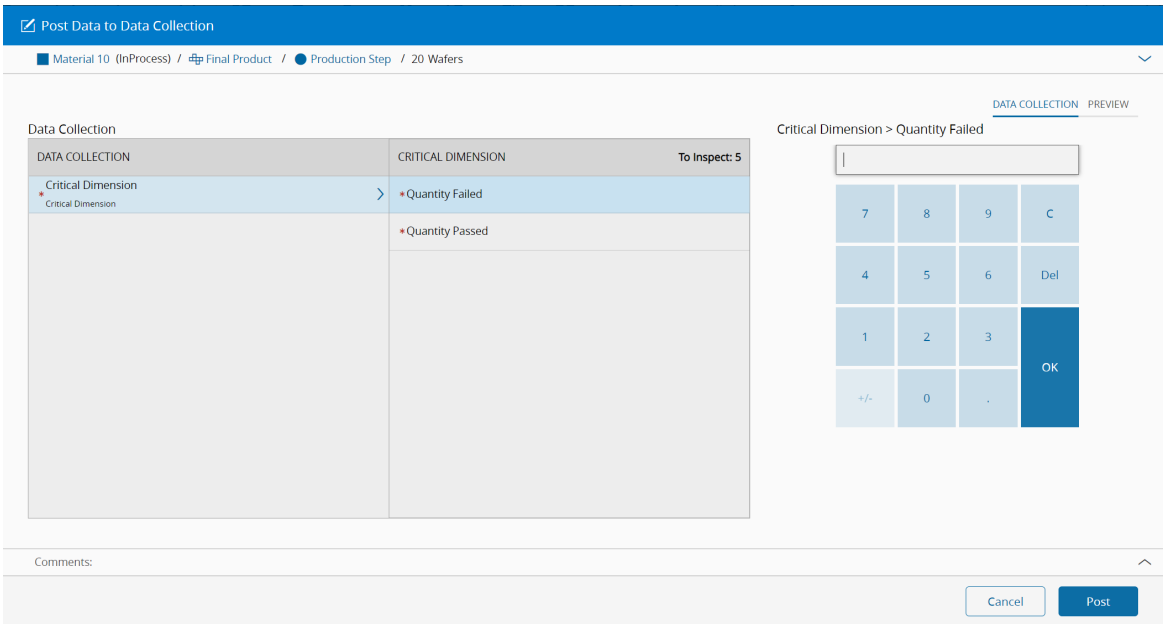


Data Collection Parameter Sample Type

The Data Collection Parameter Sample Type defines the type of the Parameter, i.e. the type of information that a User will provide about the Parameter.

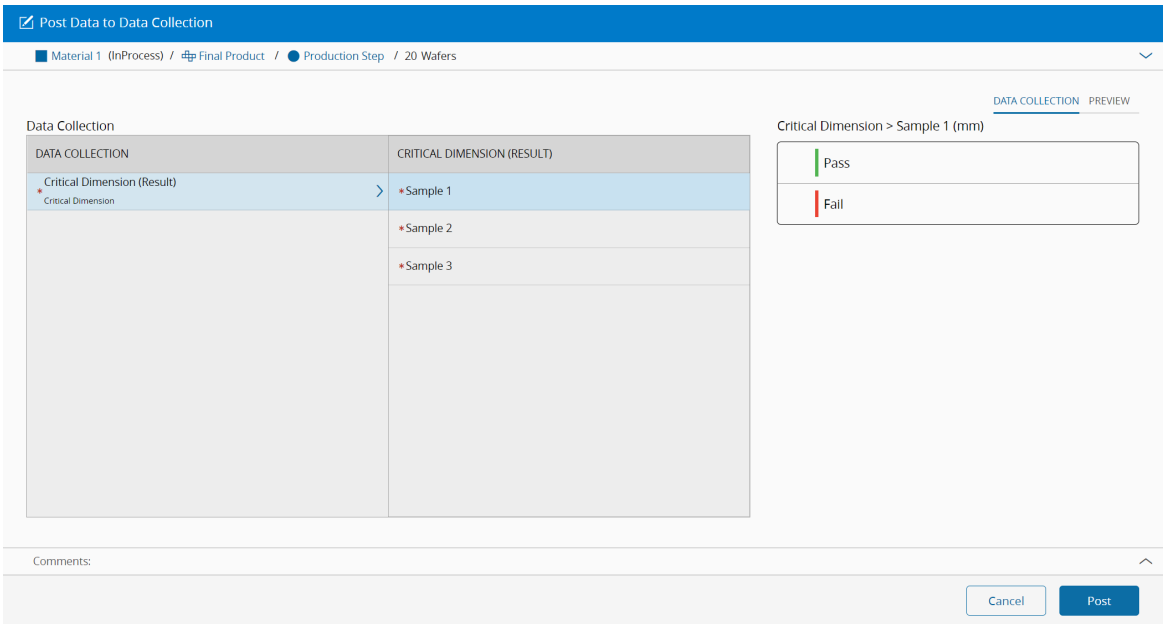
ATTRIBUTE

The User will provide for the Parameter the quantity of sample that has Passed and Failed.



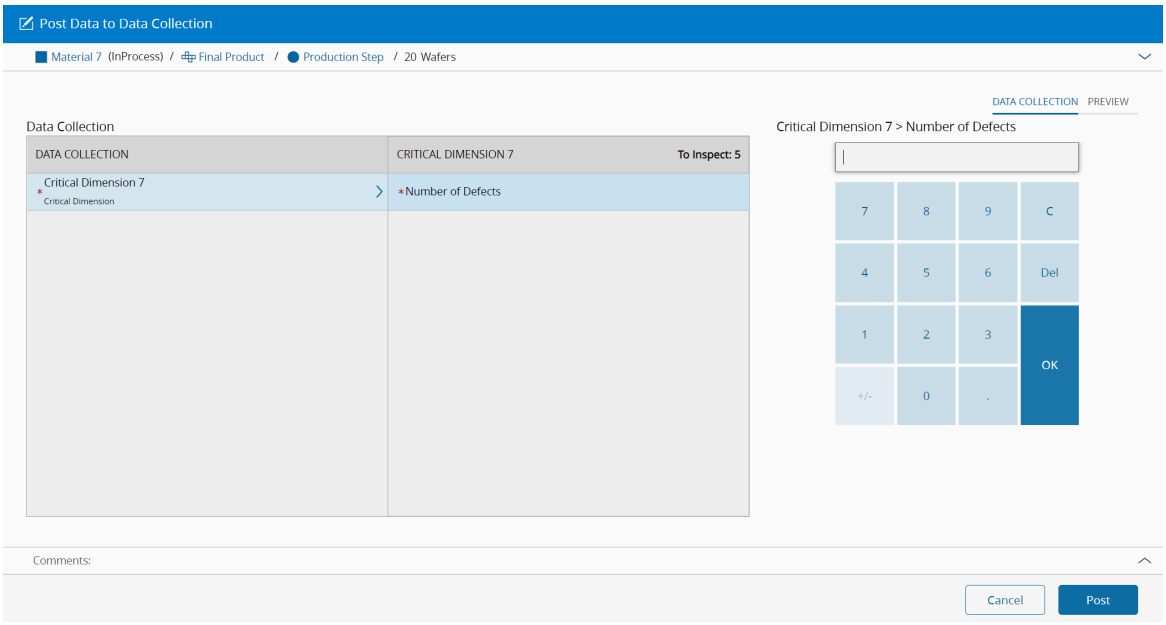
RESULT

The User will select if the sample Parameter has Passed or Failed.



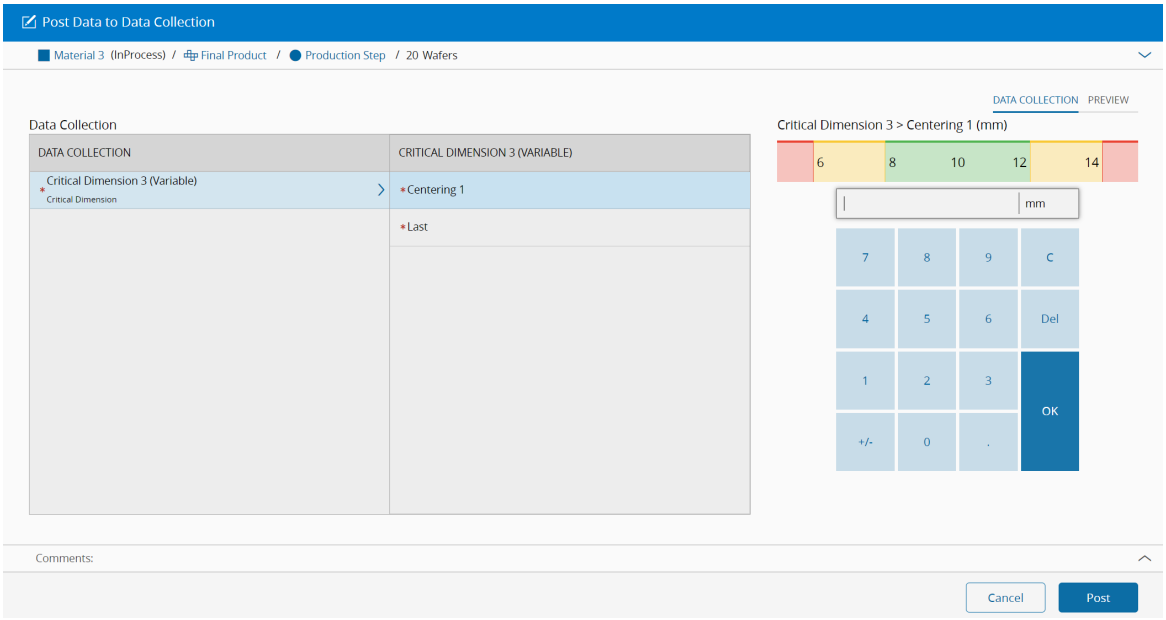
DEFECT COUNT

The User will provide for the sample and Parameter the observed number of defects.



VARIABLE

The User will provide the Parameter value for the sample.



3 - Create the necessary Data Collection Limit Sets

When collecting data for a Data Collection Parameter in an Inspection, a Data Collection Limit Set Parameter must be provided if:

- The Data Collection Parameter Sample Data Type is set to Variable, which has both the Target, Lower Error Limit, and Upper Error Limit defined
- The Data Collection Parameter Inspection Frequency is set to Centering, which has both the Target, Lower Warning Limit, and Upper Warning Limit defined

> **Info**
>
> Please note that the Data Collection Limit Set Parameter Limit Type must be set as Absolute.

4 - Create the necessary Steps

To consider a Step for inspection, the properties listed in the Tables below must be configured. Please note that an Inspection can be performed not only in a production Step but also in dedicated inspection Steps.

In the Edit Step wizard, you can configure the properties listed in the Table below.

Property	Description
Require Instruments at Track-In	If set to True, Instruments are required at track-in.
Disassociate Instruments at Track-Out	If set to True, Instruments will be disassociated from the Resource at track-out.

Table: Step properties

The Manage Inspection Information wizard can be accessed through the Step Details view, in the Inspection section.

In the Manage Inspection Information wizard, in the **General** tab, you can configure the properties listed in the Table below.

Property	Description
Enable Inspections	If set to True, the Step Inspection information can be defined. This property must only be defined for Steps that will require the resolution of an Inspection Plan. The configurations defined for the Step Inspection information will only be applied if the Data Collection Parameter Configuration Mode is set as **Automatic**.
Severity	Defines the Inspection Severity and the values are available in the *InspectionSeverity* Lookup Table. It will be used for the Switching Rules *From Inspection Severity* and *To Inspection Severity* and for the Severity Instances *Severity*.
AQL Inspection Severity	Defines the AQL Severity to be used if the selected Inspection Frequency is AQL and if the Inspection Frequency Configuration Mode is Automatic. The available values are set in the *AQLSeverity* Lookup Table. It affects the number of acceptable defects through the Generic Table AQLAcceptanceQualityLimit. The following values are available out-of-the-box: - **Normal**: Use of a sampling plan with an acceptance criterion that has been devised to secure the producer a high probability of acceptance when the process average of the lot is better than the acceptance quality limit. - **Tightened**: Use of a sampling plan with an acceptance criterion that is tighter than that for the corresponding plan for normal inspection. - **Reduced**: Use of a sampling plan with a sample size that is smaller than that for the corresponding plan for normal inspection and with an acceptance criterion that is comparable to that for the corresponding plan for normal inspection.
AQL Inspection Level	Defines the level of the AQL Inspection and the values are available in the *AQLInspectionLevel* Lookup Table. General Inspection levels I to III and Special Inspection levels 1 to 4 are available out-of-the-box.

Property	Description
AQL Acceptance Limit	Defines the value of the AQL Acceptance Limit and the values are available in the *AQLAcceptanceLimit* Lookup Table.
Counter Frequency	Defines the default Inspection Counter Frequency.
Percentage (%)	Defines the default Inspection Percentage.
Fixed Quantity	Defines the default Inspection Fixed Quantity.
Maximum Acceptable Defects Fixed	Defines the To default Inspection Maximum Acceptable Defects (fixed).
Maximum Acceptable Defects Percentage (%)	Defines the To default Inspection Maximum Acceptable Defects (percentage).

Table: Manage Inspection Information - General tab properties

You can define Contexts to apply Inspection Configurations different from the Default Configurations listed in the Table above. Those can be defined in the Manage Inspection Information wizard, in the **Context Information** tab, as listed in the Table below. For further information please check the *Manage Inspection Severity Instances* sub-section.

Property	Description
Contexts	Defines the Contexts for the Step Inspection Severity. The following Contexts are available: **Material Type**, **Product**, **Product Group**, **Resource**, **Model**, **Resource Type** and **Flow**.

Table: Manage Inspection Information - Context Information tab properties

You can define Rules which will change the Severity in use depending on the results of previous Inspection Orders, for a certain context. In the Manage Inspection Information wizard, in the **Switching Rules** tab, you can configure the properties listed in the Table below. For further information please check the *Switching Rules* sub-section.

Property	Description
From Inspection Severity	Defines the initial Inspection Severity. The selected Severity must exist in the InspectionSeverity Generic Table.

Property	Description
To Inspection Severity	Defines the final Inspection Severity. The selected Severity must exist in the InspectionSeverity Generic Table.
Direction	Defines the direction of the switching Rule and depending on the selected Direction (**Tightening** or **Reduced**), different Rules are available for selection. If the selected Direction is Tightening, the From Inspection Severity Rank must be smaller than the To Inspection Severity Rank and vice-versa.
Rule	For Direction **Tightening** the following Rules are available out-of-the box: - **NorMoreInspectionsFailed**: assesses, for the defined filter, if there are N or more Inspections failed - **NorMoreFailsFound**: assesses, for the defined filter, if there are N or more Data Collection Parameters failed - **NorMoreInspectionsWithFails**: assesses, for the defined filter, if there are N or more Inspections with Data Collection Parameters which have failed - **NorLessInspectionsPerformed**: assesses, for the defined filter, if there are N or less Inspections performed - **NorMoreInspectionsPassedWithWarning**: assesses, for the defined filter, if there are N or more Inspections that have passed with warning For Direction **Reduced** the following Rules are available out-of-the box: - **NorMoreInspectionsPassed**: assesses, for the defined filter, if there are N or more inspections passed - **NorLessFailsFound**: assesses, for the defined filter, if there are N or less Data Collection Parameters failed - **NorLessInspectionsWithFails**: assesses, for the defined filter, if there are N or less Inspections with Data Collection Parameters which have failed - **NorMoreInspectionPerformed**: assesses, for the defined filter, if there are N or more Inspections performed
Rule Parameter	The value (N) to be passed as a parameter to the Rule.
Filter Type	Defines the type of filter to be applied for the inspection, **Time** or **Last Occurrences**.
Time Interval	To be defined if the selected filter type was Time. Sets a time interval for considering the last inspections.
Last Occurrences	To be defined if the selected filter type was Last Occurrences. Sets the number of occurrences for considering the last inspections.
To Inspection AQL Inspection Severity	Defines the final AQL Severity and the values are available in the *AQLSeverity* Lookup Table. Out-of-the box are available the Normal, Tightened and Reduced Severities.
To Inspection AQL Inspection Level	Defines the final level of the AQL Inspection and the values are available in the *AQLInspectionLevel* Lookup Table. Out-of-the box are available General Inspection levels I to III and Special Inspection levels 1 to 4.
To Inspection AQL Acceptance Limit	Defines the value of the final AQL Acceptance Limit and the values are available in the *AQLAcceptanceLimit* Lookup Table.

Property	Description
To Inspection Counter Frequency	Defines the To default Inspection Counter Frequency, used for automatic configurations.
To Percentage (%)	Defines the To default Inspection Percentage, used for automatic configurations.
To Inspection Fixed Quantity	Defines the To default Inspection Fixed Quantity, used for automatic configurations.
To Inspection Maximum Acceptable Defects Fixed	Defines the To default Inspection Maximum Acceptable Defects (fixed), used for automatic configurations.
To Inspection Maximum Acceptable Defects Percentage	Defines the To default Inspection Maximum Acceptable Defects (percentage), used for automatic configurations.

Table: Manage Inspection Information - Switching Rules tab properties

Note

For the given example, the following Steps must be created:

- *Parts Manufacturing*
- *Parts Assembly*
- *Parts Inspection Strength*
- *Parts Inspection Color*
- *Parts Inspection Width*
- *Parts Inspection Thickness*

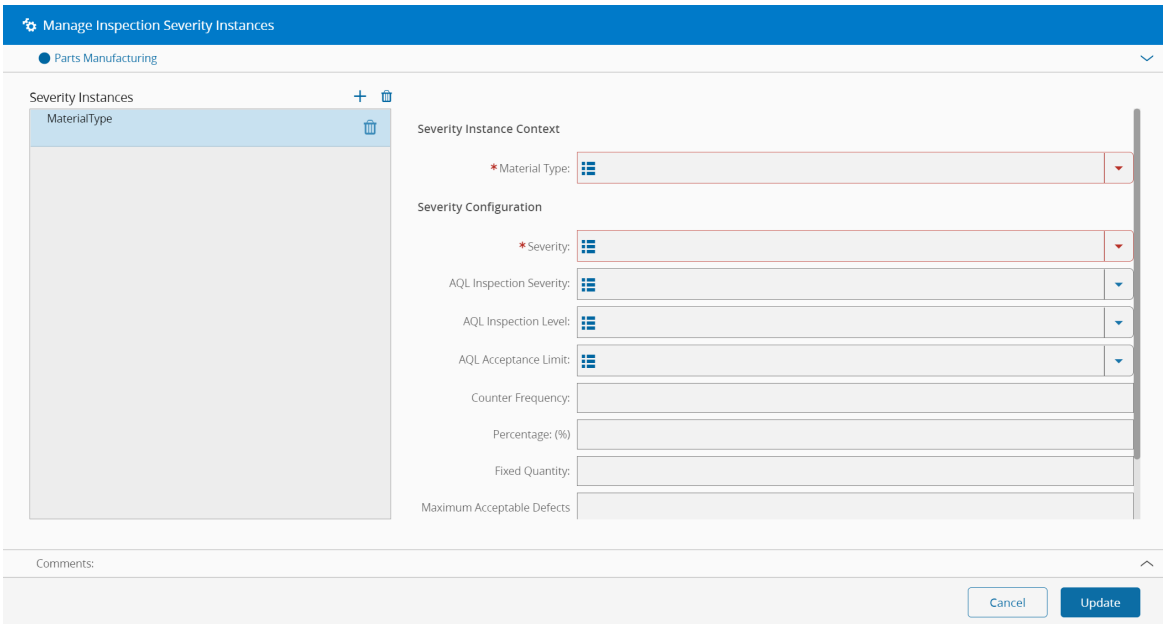
However, it is only required to access the Manage Inspection Information wizard for the **Parts Manufacturing** Step, i.e. set the Enable Inspections property to True and define the remaining required properties.

Manage Inspection Severity Instances

It is possible to define different Inspection Severity Instances per Context, besides the Step Inspection Default Configuration, if you define a Context in the Context Information tab. The Manage Inspection Severity Instances wizard can be accessed through the Step Details view, in the Inspection section and it is displayed in the Figure below.

> **Info**
>
> The Inspection Severity Instances will only be used if the Data Collection Parameter Configuration Mode is Automatic. This means that when a Material is tracked-in, instead of using the Step Inspection Information Default Configuration, MES will use the information of the corresponding Inspection Severity Instance. Otherwise, if the Configuration Mode is Manual, MES will use the Data Collection Parameter values.

The Context information can be manually added in the Inspection Severity Instances or, when a Material is tracked-in, a Severity Instance with the Material Context and Inspection Severity will be added to the Inspection Severity Instances.

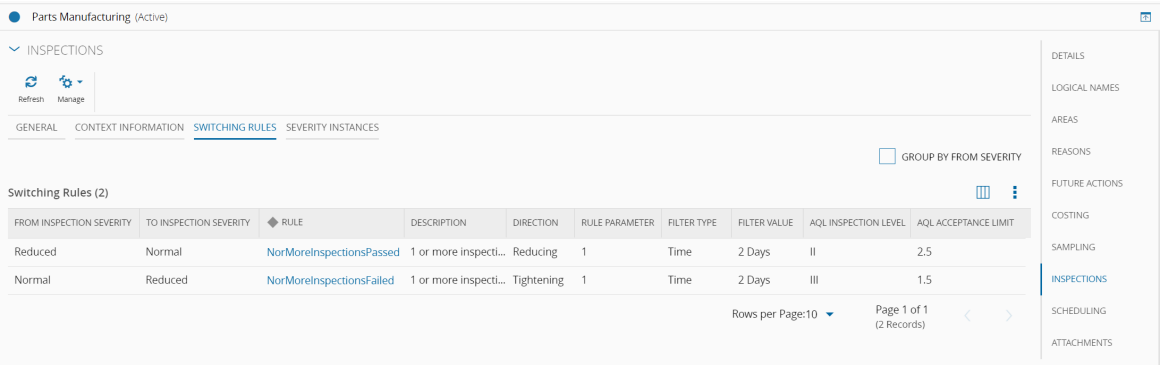


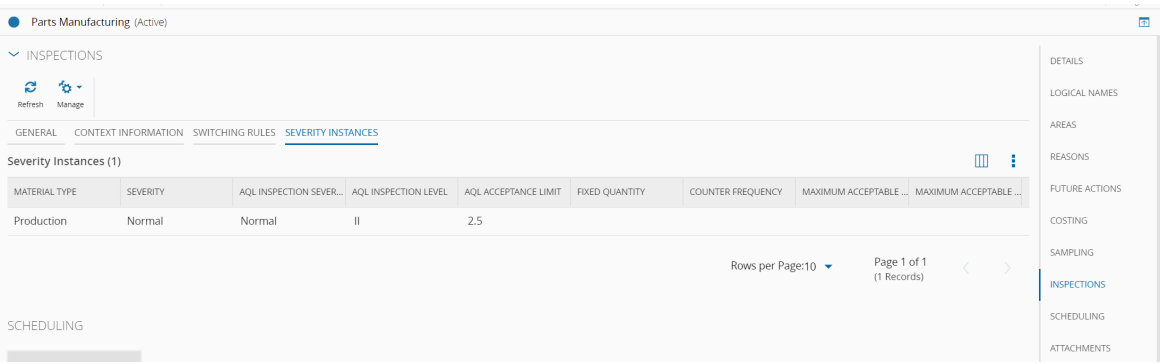
Switching Rules

A Switching Rule will be run when Closing an Inspection Order for a Material if there is a match between the Material Severity Instance Context (defined in the Severity Instances) and a Switching Rule's *From Inspection Severity* (defined in the Step Switching Rules). If the condition of the Rule is met, the *To Inspection Severity* configurations will be set for the Material Severity Instance Context.

> **Info**
>
> In order to apply a Switching Rule, the Data Collection Parameter Configuration Mode must be *Automatic* and the From Inspection Severity must be listed in the Inspection Severity Instance Contexts.

For example, having the Material Type Context defined and the Switching Rules and Severity Instances defined as displayed in the Figures below. If a Material having the Material Type Production will have its Inspection Order Closed, MES will run the NorMoreInspectionsFailed Rule. If the last Inspection Order for that Context had failed, then the Severity Instance for the Production Material Type Context will have its Severity changed to Reduced, as well as the corresponding configurations.



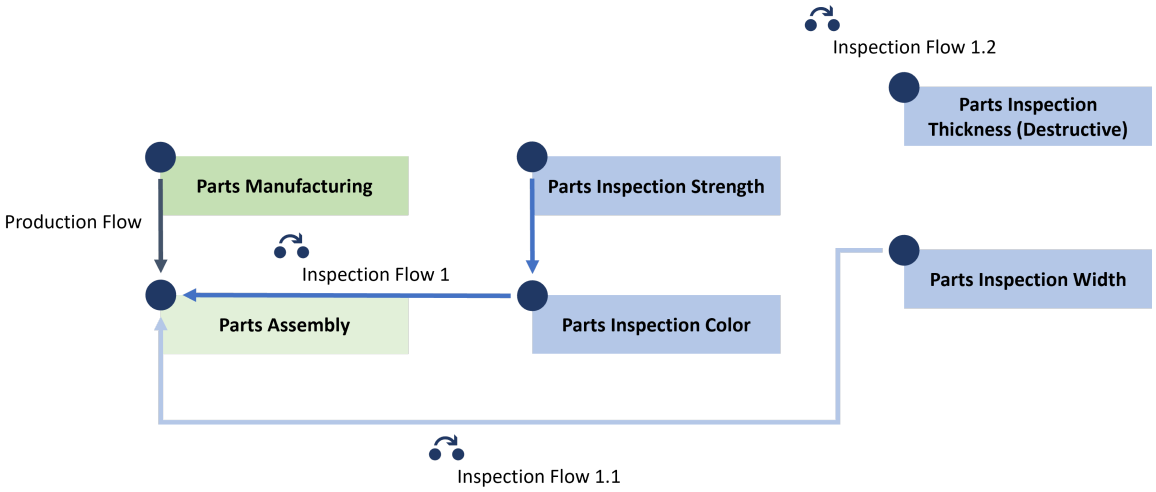


5 - Create the necessary Flows

After configuring the production and inspection Steps, the corresponding Flows must be defined.

> **Note**
>
> For the given example, the following Flows, as shown in the Figure below, must be created:

- A *Production Flow* having the Steps: *Parts Manufacturing* and *Parts Assembly*
- The following inspection Flows:
- *Inspection Flow 1* having the Steps: *Parts Inspection Strength*, *Parts Inspection Color*, and *Parts Assembly*. The *Parts Assembly* must be the last Step of this Flow since the Material will return to this Step in the *Production Flow*
    - *Inspection Flow 1.1* having the Steps: *Parts Inspection Width* and *Parts Assembly*. The *Parts Assembly* must be the last Step of this Flow since the Material will return to this Step in the *Production Flow*
    - *Inspection Flow 1.2* having the Step: *Parts Inspection Thickness*



Info

Please note that it is not possible to configure future merges of Material Samples for the Step with the property Is in Process Inspection set to True since:

- Material Samples must be created after the Material is processed in the Step
- To merge two Materials those must have the same System State

For the given example, the *Parts Inspection Color* and *Parts Inspection Width Steps* can't be merged into the *Parts Manufacturing* Step.

6 - Create the Inspection Plan

The Inspection Plan will define the Inspection Steps and the samples' flow throughout the Inspection Steps.

To create an Inspection Plan, the properties listed in the table below need to be defined.

Property	Description
Required Before Track-Out	Defines whether the Inspection results are required before the main Material can be Tracked-Out.
Enable Multiple Samples	Defines whether the system allows multiple Samples to be created for the same Inspection Plan. This property can be set to True if the process extends through time and it is not possible to create a single sample with all the necessary quantity.
Contains Separate Inspection Steps	Defines whether the Inspection Plan contains Inspection Steps outside the process Step that needs to be controlled. If the Inspection requires specific tests that need equipment that is only available, for example, in a laboratory or even in a station separate from the production area, then separate dedicated inspection steps is the suitable option.
Close Automatically on Pass	Defines whether Inspection Orders of this Inspection Plan are automatically closed on pass.

Property	Description
Close Automatically on Fail	Defines whether Inspection Orders created from this Inspection Plan are automatically closed on fail.
Open Protocol on Fail	Defines whether a Protocol will be opened if the Inspection fails.
Protocol	A Protocol to be opened in the case that the Inspection fails. Can be defined if the property Open Protocol on Fail is set to True.
Future Hold Creation Mode	Defines whether a Future Hold is to be created never (**None**), **Always** or **On Fail** for Inspection Orders of this Inspection Plan.
Set Hold on Fail	Defines whether the Material will be put on Hold if the Inspection Fails.
Future Hold Step	Defines the Future Hold Step in case it's intended to put the Material on hold at a future Step. It must be defined if the Future Hold Creation Mode is defined as Always or On Fail.
Future Hold Reason	Defines the Future Hold Reason in case it's intended to put the Material on hold at a future Step. It must be defined if the Future Hold Creation Mode is defined as Always or On Fail. The Future Hold Reason must be associated with the Future Hold Step.
Future Hold Release Role	Defines the Future Hold Release Role in case it's intended to put the Material on hold at a future Step. It can optionally be defined if the Future Hold Creation Mode is defined as Always or On Fail.
Future Hold Release Code	Defines the Future Hold Release Code in case it's intended to put the Material on hold at a future Step. It can optionally be defined if the Future Hold Creation Mode is defined as Always or On Fail.
Future Hold Comment	Defines the Future Hold Release Comment in case it's intended to put the Material on hold at a future Step. It can optionally be defined if the Future Hold Creation Mode is defined as Always or On Fail.
Future Hold Distribution List	Defines the Future Hold Distribution List in case it's intended to put the Material on hold at a future Step. It can optionally be defined if the Future Hold Creation Mode is defined as Always or On Fail.
Hold Reason	Defines the Hold Reason in case it's intended to put the Material on hold if the Inspection fails. It must be defined if the Set Hold on Fail property is set to True.
Hold Release Role	Defines the Hold Release Role in case it's intended to put the Material on hold if the Inspection fails. It can optionally be defined if the Set Hold on Fail property is set to True.
Hold Release Code	Defines the Hold Release Code in case it's intended to put the Material on hold if the Inspection fails. It can optionally be defined if the Set Hold on Fail property is set to True.
Hold Comment	Defines the Hold Comment in case it's intended to put the Material on hold if the Inspection fails. It can optionally be defined if the Set Hold on Fail property is set to True.

Property	Description
Is in Process Inspection	Defines whether the Inspection takes place at the Step where the Inspection Plan Context is defined (process Step). Only one Step can have the property Is in Process Inspection set to True.
Inspection Flow	Defines the Inspection Flow and must be defined only if the property Is in Process Inspection is set to False.
Inspection Step	Defines the Inspection Step and must be defined only if the property Is in Process Inspection is set to False. The Inspection Plan can only contain Steps other than the Step where the Inspection Plan Context is defined (process Step) if the property Has Separate Inspection Steps is set to True.
Split Type	Defines whether a split is required when sending a Sample to this Inspection Step. The Split Type can be: - **None** - **Temporary** - **Permanent**
Split Mode	Defines what is the Split Step Mode. The Split Step Mode can be: - **Inspection Step**, if the source Step, i.e. the Step which precedes the Inspection Step, is an Inspection Step - **Process Step**, if the source Step is the process Step
Split Step	Defines the source Step from which the Inspection Step will be split. The source Step must belong to an existing Inspection Plan Step of the Inspection Plan.
Scrap Material Sample	Defines whether to scrap the inspected material. This property can only be set to True if the Split Type is Permanent.
Scrap Reason	Defines the Scrap Reason for the Material.

Table: Inspection Plan creation

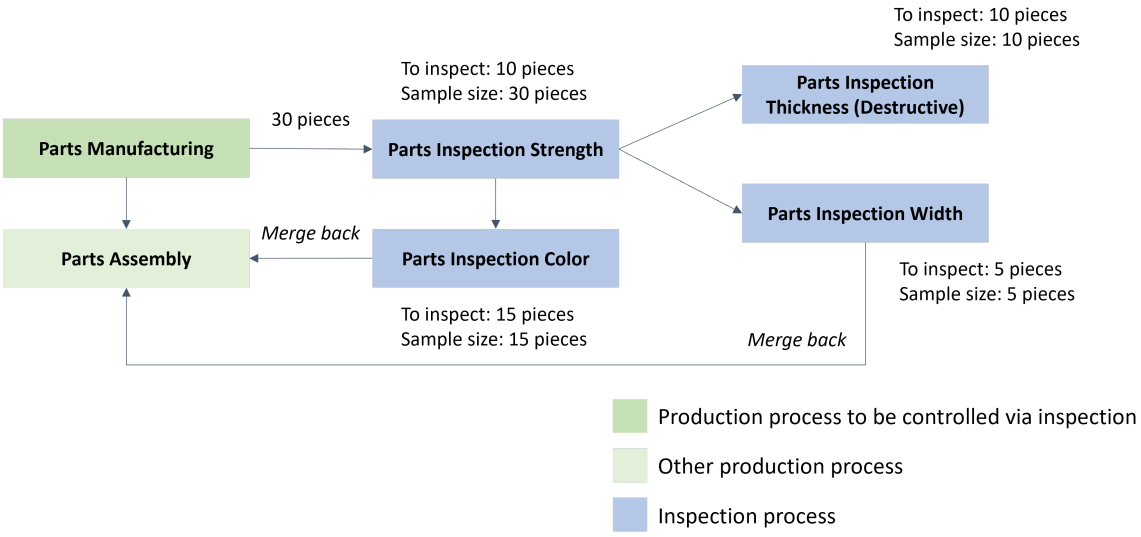
Note

For the given example, the Inspection Plan must have the property Contains Separate Inspection Steps set to True and the Inspection Steps to be configured are detailed in the Table and Figure below.

Property	Parts Inspection Strength	Parts Inspection Color	Parts Inspection Width	Parts Inspection Thickness
Is in Process Inspection	False	False	False	False
Inspection Flow	Inspection Flow 1	Inspection Flow 1	Inspection Flow 1.1	Inspection Flow 1.2

Property	Parts Inspection Strength	Parts Inspection Color	Parts Inspection Width	Parts Inspection Thickness
Inspection Step	Parts Inspection Strength	Parts Inspection Color	Parts Inspection Width	Parts Inspection Thickness
Split Type	Temporary	None	Temporary	Permanent
Split Mode	Process Step	None	Inspection Step	Inspection Step
Split Step	-	-	Parts Inspection Strength	Parts Inspection Strength
Scrap Material Sample	False	False	False	True
Scrap Reason	-	-	-	Broken

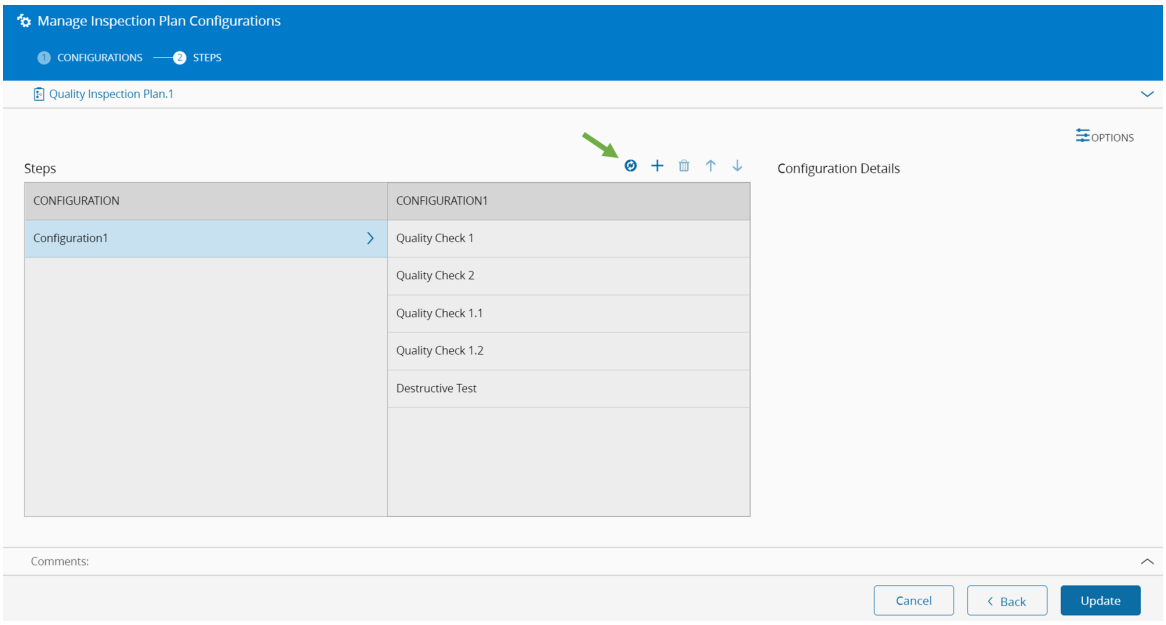
Table: Inspection Plan Steps example



7 - Define the Inspection Plan Configurations

An Inspection Plan must have defined which Data Collection and Data Collection Limit Set will be used in each Inspection Step. This can be defined as an Inspection Plan Configuration. An Inspection Plan can have several Configurations defining different Data Collections and Data Collection Limit Sets for the same Inspection Step. To create an Inspection Plan Configuration, the Manage Inspection Plan Configurations wizard can be accessed through the Inspection Plan Details page, under the Configuration section.

To display all the Inspection Steps, the button flagged in the Figure below can be selected.



The Inspection Plan Configuration Steps can also be copied from other Inspection Plan Configuration Steps that belong to an existing version of the same Inspection Plan, by using the Copy Steps option.

Info

For an Inspection Plan Step with the property Is in Process Inspection set to False, the Data Collection Parameter Inspection Frequency can only be Fixed, Percentage or AQL.

Note

For the given example, you must define the Data Collections and Data Collection Limit Sets, if required, to be used for each one of the Inspection Steps (Parts Inspection Strength, Parts Inspection Color, Parts Inspection Width, and Parts Inspection Thickness).

8 - Define the Inspection Plan Context

To define the contexts of the production Step for the Inspection Plan, you must define the Inspection Plan and Configuration in the Inspection Plan Context. This can be defined through the Add Inspection Plan Context Record(s) wizard, which can be accessed in the Step Context view, in the Inspection Plan Context section.

Note

For the given example, you must define the Inspection Plan Context for the **Parts Manufacturing** Step.

Using Inspection

After setting up the required configurations mentioned in the previous sections, the Inspection functionalities can be used, as described over the next sections.

The Inspection functionalities are described in the Table below.

Step Number	Step

Step Number	Step
1	Track-in Material
2	Create Samples
3	Post Data to Data Collection
4	Manage Inspection Order Materials
5	Recalculate Data Collection Instance Samples
6	Track-out Material
7	Close Inspection Order

Table: Inspection functionalities

1 - Track-In Material

When performing track-in of a Material in a Step of a process to be controlled via inspection (with an Inspection Plan context defined), an Inspection Order will be created. This means that, in order to ensure a desired level of quality, random samples will be collected from all the Materials tracked-in in this Step.

If the Step's property Require Instruments On Track-In is set to True, instruments that can measure the required Data Collection Parameters must be associated with the Resource. The Instrument Calibration Status must be set as Calibrated. Furthermore, if the Data Collection Parameter defines an Instrument Type, the Resource Instrument Type must match that Instrument Type.

For every Inspection Plan Step, an Inspection Order Step will be created as well. For each Inspection Order Step, the system will resolve a Data Collection and Data Collection Limit Set, if applicable. If the Data Collection Parameter Inspection Frequency Configuration Mode is Automatic, the Data Collection Parameter properties will be inherited from the Step in which the main Material is being tracked-in. If the Data Collection Parameter Inspection Frequency Configuration Mode is Manual, the Data Collection Parameter properties will be inherited from the Data Collection Parameter.

Furthermore, depending on the Inspection Frequency and, as mentioned in the previous paragraph, depending on the Inspection Frequency Configuration Mode, the Sample Sizes will be calculated as described in the Table below.

Inspection Frequency	Sample Size for Automatic Mode	Sample Size for Manual Mode
AQL	Depends on the Step's AQL properties (AQL Inspection Severity and AQL Inspection Level)	Depends on the Data Collection Parameter's AQL properties (AQL Inspection Severity and AQL Inspection Level)

Inspection Frequency	Sample Size for Automatic Mode	Sample Size for Manual Mode
Counter Based	Defined as the Reference Quantity divided by the Counter Frequency. If the Use First Piece Measurement Strategy property is set to True, another sample will be considered. Furthermore, if the Measure Last Piece property is set to True, another sample will be considered.	-
Centering	Defined as two (at least the first and the last samples)	-
First, Any or Last	Defined as one	-
First and Last	Defined as two	-
Fixed	Defined as the Fixed Quantity	Defined as the Sample Size
Percentage	Defined as the Percentage times the Reference Quantity	Defined as the Sample Percentage Value times the Reference Quantity

Table: Sample Size calculation for each Inspection Frequency

Note

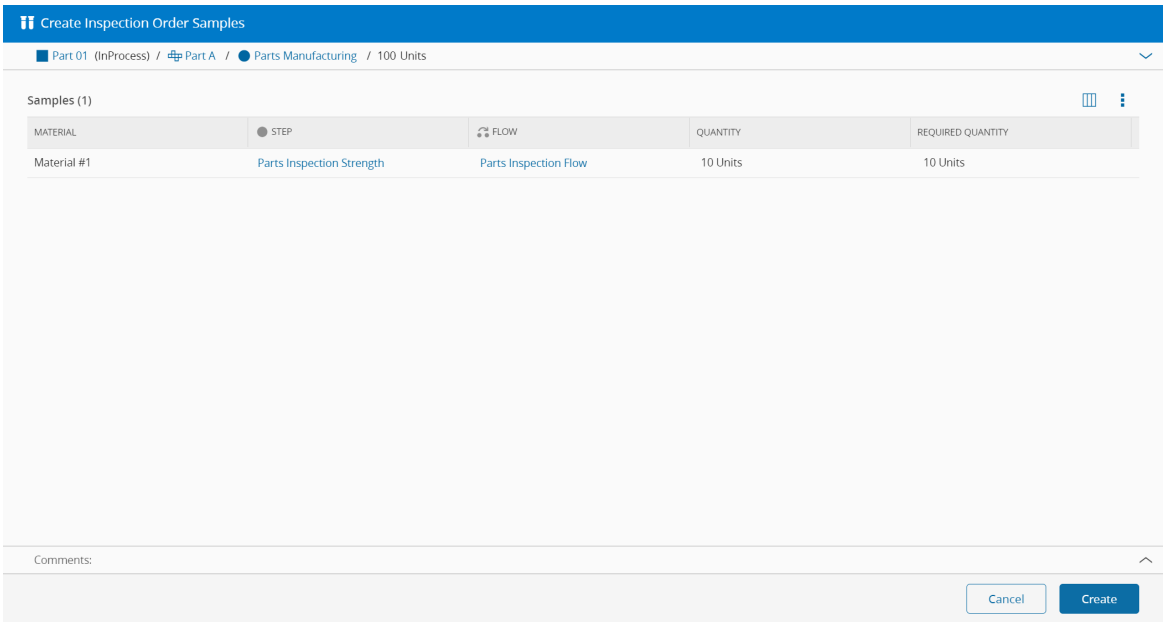
Reference Quantity is set as the Material's Primary Quantity, Secondary Quantity, or the number of Sub-Materials, depending on the defined Sample Source.

Note

For the given example, you will perform the track-in of the Materials present in the *Parts Manufacturing* Step.

2 - Create Samples

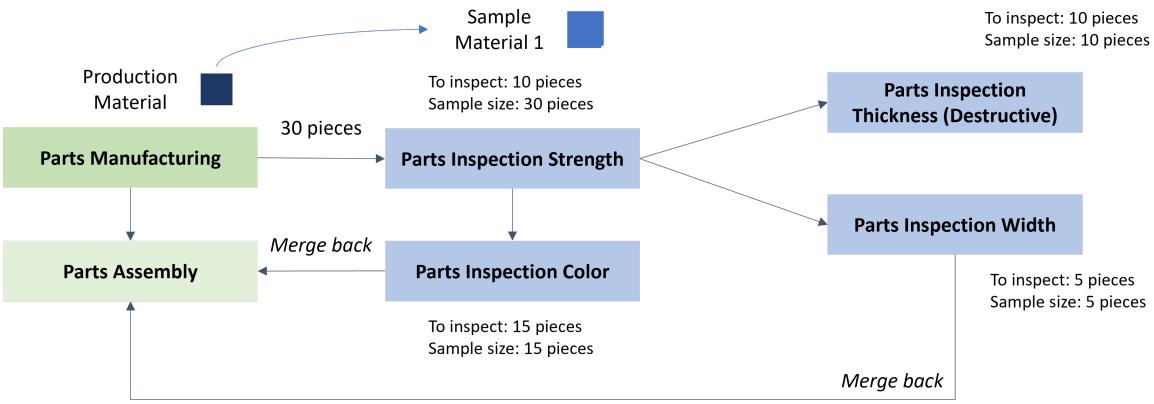
After tracking-in a Material with an associated Inspection Order and if the Inspection Order has the property Includes Separate Inspection Steps set to True, you must create the required samples. Thus, you must access the Create Samples wizard available in the Material or Step View pages, as displayed in the Figure below.



After the Inspection Order Material Sample is created, the Material is moved to the corresponding Inspection Step. Then, you will track-in the Material Sample in a Resource that provides the Service required by the Inspection Step.

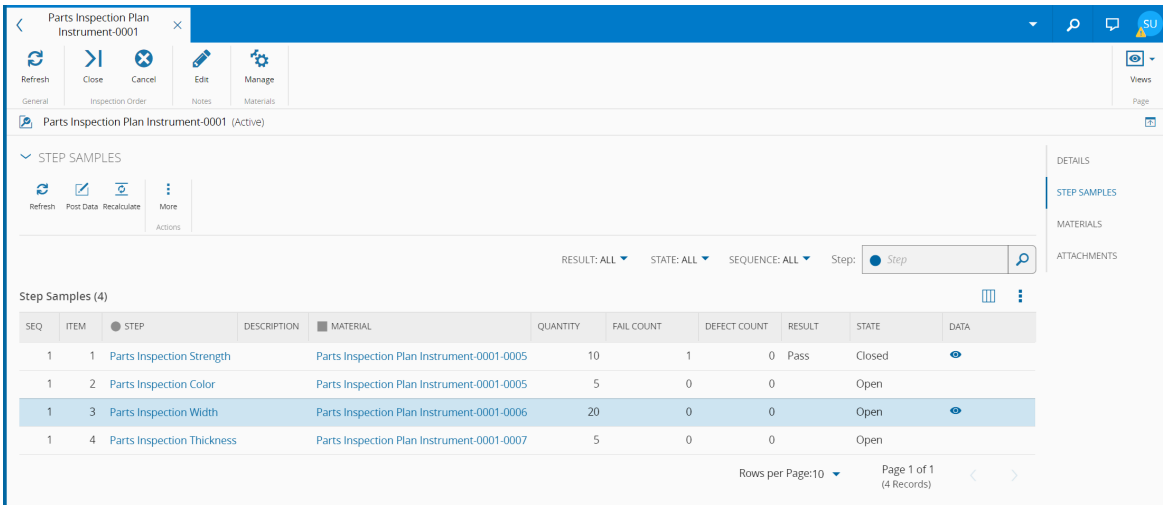
Note

For the given example, you will create samples for Materials that were tracked-in in the *Parts Manufacturing* Step. The sample will automatically be moved to the *Parts Inspection Strength* Step, as displayed in the Figure below.



3 - Post Data to Data Collection

All the Inspection Order Steps require a Data Collection. Thus, to post a value for the Data Collection of the Material in the Inspection Order Step, you must access the Post Data to Collection Collection wizard available in the Material Details, Step, Resource, or Inspection Order Views. The Inspection Order view is displayed in the Figure below.



If for the Data Collection Parameter the Capture Instrument Mode is different from None, an Instrument must be provided.

Depending on the Sample Type of the Data Collection Parameter, different options to insert information will be presented:

- **Attribute**: you must provide the quantity of the sample that has Passed and Failed
- **Defect Count**: you must provide the observed number of defects
- **Result**: you must select if the sample has Passed or Failed
- **Variable**: you must provide the Parameter value

New Data Points can be created if:

- The Data Collection Inspection Frequency is defined as Centering and it is provided a value which falls outside the Data Collection Limit Set Warning Range - the Data Collection Points will be created sequentially, by the Reading Name
- The property Test All Since Last Passed is set to True and it is provided a value that falls outside the Data Collection Limit Set Error Range (the value is less than Lower Error Limit or greater than the Upper Error Limit) - the Data Collection Points will be created by filling the complete number of pieces since the last pass and the current sample and adding an additional sample, since new pieces must be measured until one is passed

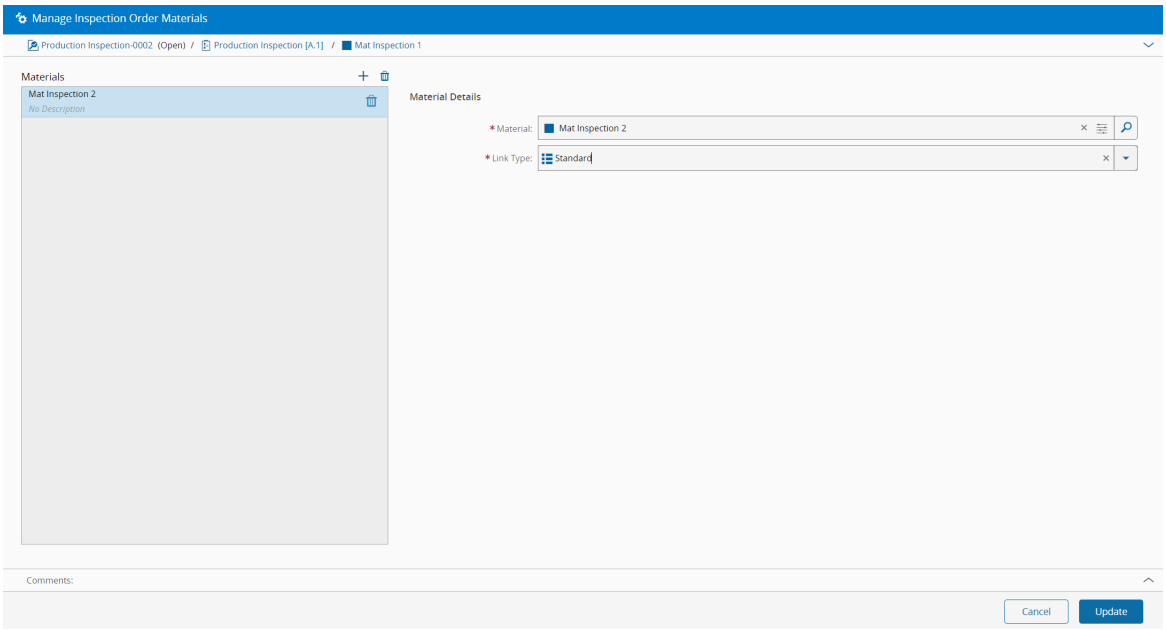
Furthermore, if the Data Collection Parameter property Test All On Fail is set to True and if a value Fails, the Sample Size is set as the Reference Quantity.

4 - Manage Inspection Order Materials

If you want to manage the Materials of an Inspection Order, you must access the Manage Inspection Order Materials wizard available in the Inspection Order details, as displayed in the Figure below. The Link Type provides information about the qualification of the relationship for the non-main Materials.

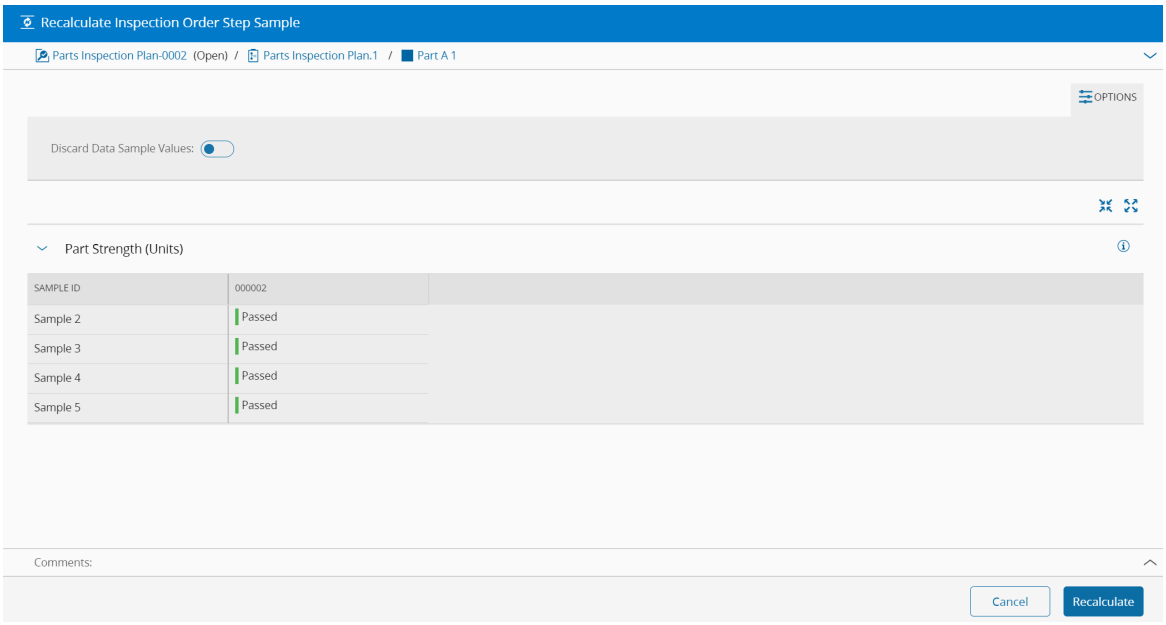
Info

Note that it is only possible to remove a Material if it isn't a main Material, a Material Sample or a Main Split.



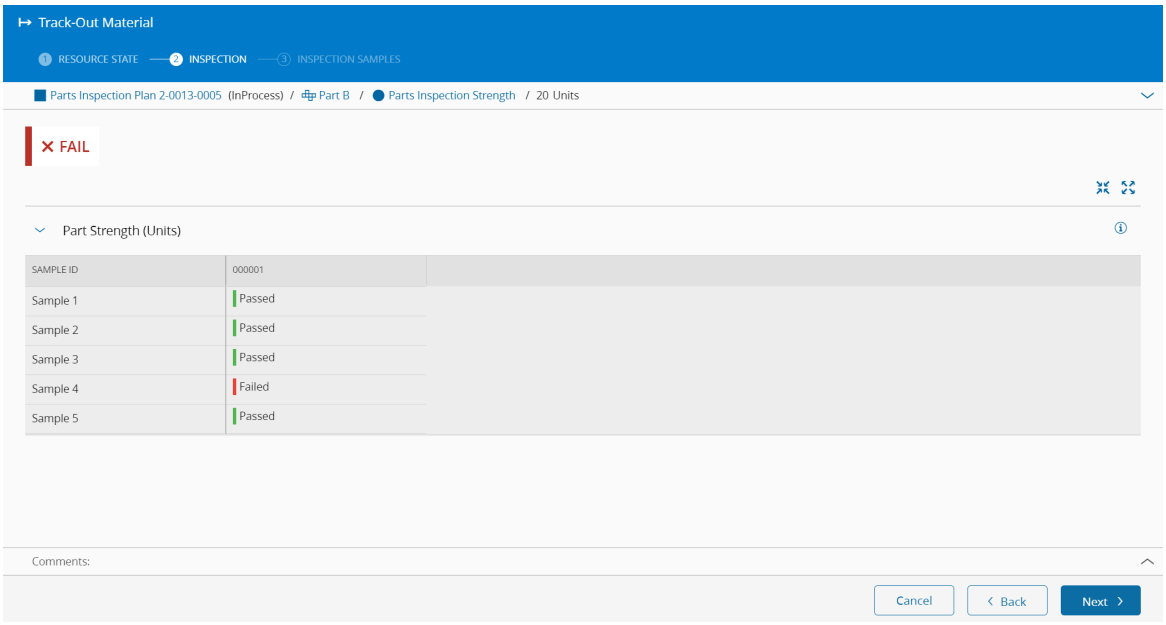
5 - Recalculate Data Collection Instance Samples

The number of samples to be collected can be recalculated if there is a significant change in the quantity of the Material. To recalculate the number of samples, you must access the Recalculate Inspection Order Step Sample wizard available in the Inspection Order details, as displayed in the Figure below.



6 - Track-Out Material

After posting all the required Sample values in the Data Collection, you can track-out the sample Material. When the track-out of the sample Material is performed, the Inspection Order Step Sample is Closed and is presented the result of the Inspection Order Step Sample Result, as displayed in the Figure below.



The Inspection Order Step Sample will have the information of the number of Fails (Fail Count) and Defects (Defect Count) identified.

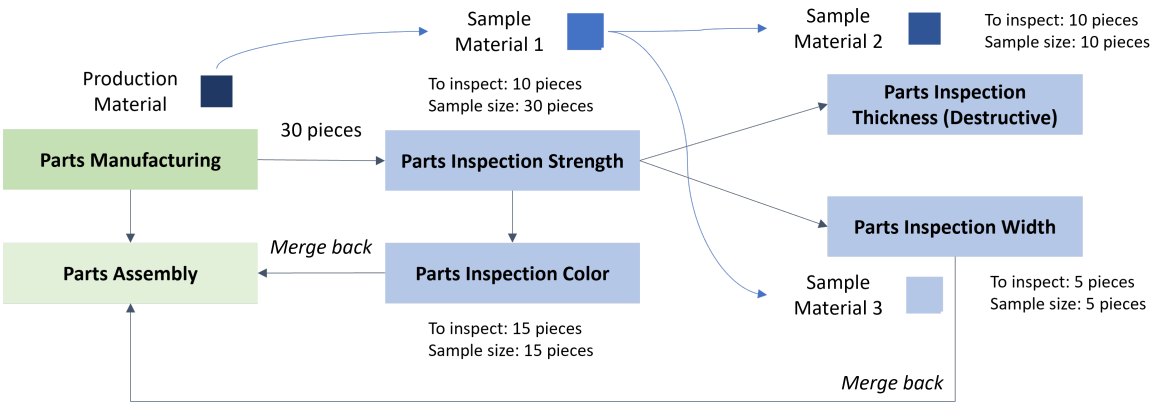
If the property Maximum Defects For Acceptance is not defined, the Inspection Order Step Sample Result will be Pass. If the property Maximum Defects For Acceptance is defined, the Result can be one of the following:

- **Pass**, if the detected Fails are lower than the Maximum Defects For Acceptance
- **Pass with Warning**, if the detected Fails are bigger than the Maximum Defects For Acceptance but lower than the Minimum Defects For Rejection, for Inspection Frequency defined as AQL
- **Fail**, otherwise

When tracking-out a sample Material, if its Step is mentioned as a Split Step in the Inspection Plan for an upcoming Inspection Order Step, the sample Material will be split in the Required Quantity for the linked upcoming Inspection Order Steps.

Note

For the given example, when tracking-out the sample Material in the *Parts Inspection Strength* Step, the system will automatically create two samples which will be moved to the *Parts Inspection Width* and *Parts Inspection Thickness* Steps, as displayed in the Figure below.



After tracking-out the sample Material and if there are further Inspection Steps or if the sample Material shall return to the production Flow, the move-next of the sample Material must be performed.

> **Note**
>
> For the given example, after tracking-out the sample Material in the *Parts Inspection Strength* Step, the sample Material will be moved to the *Parts Inspection Color* Step.

If the sample Material split was temporary, when it arrives at the destination Step and if the main Material is already available in that Step, the sample Material will be merged with the main Material.

> **Note**
>
> For the given example, after tracking-out the sample Material in the *Parts Inspection Color* Step, the sample Material will be moved to the *Parts Assembly* Step. If the main Material is already available in the *Parts Assembly* Step, it will be merged with the sample Material. The same will occur with the sample Material which was moved from the *Parts Inspection Width* Step.

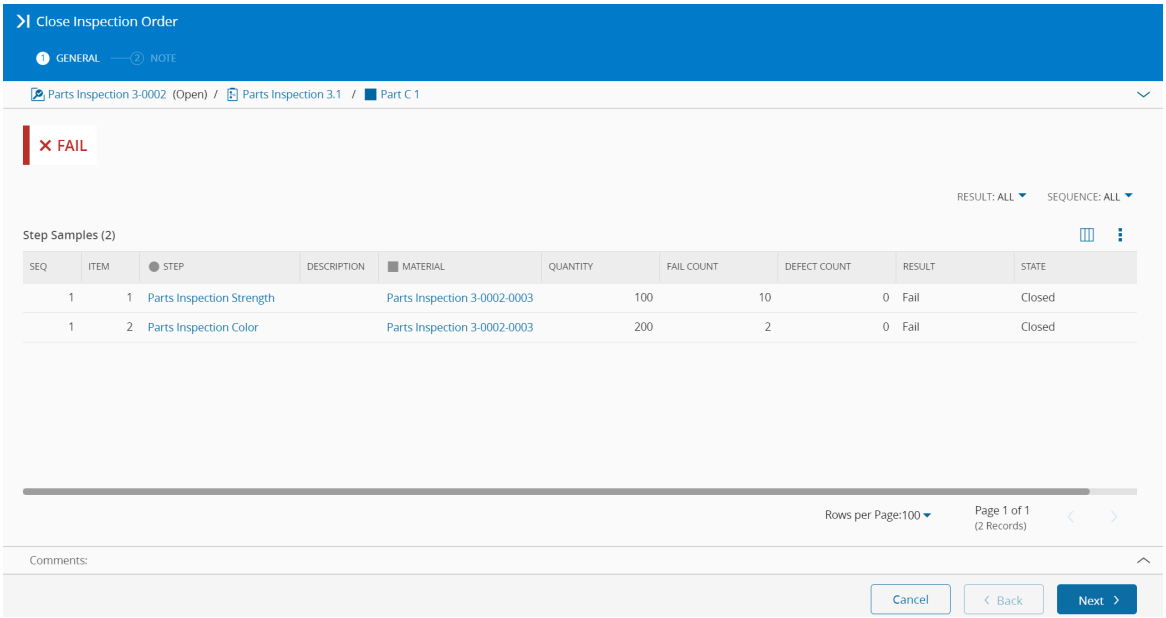
7 - Close Inspection Order

After all the Inspection Order Step Samples are Closed, the Inspection Order can be Closed.

The Result of the Inspection Order will depend on the results of the Inspection Order Steps. If all the Inspection Order Steps Pass, then the Inspection Order Result is Pass. If an Inspection Order Step Result is Pass with Warning, then the Inspection Order Result is Pass With Warning. However, if one Inspection Order Step Fails, then the Inspection Order Fails.

If the Inspection Order Fails and the property Close Automatically on Fail is set to True, the Inspection Order is automatically closed. Otherwise, you must access the Inspection Order and close it using the Close Inspection Order wizard, as displayed in the Figure below.

Furthermore, if the Inspection Order Fails and the property Set Hold on Fail is set to True, all the non-sample Materials will be put on Hold. Also, if the property Open Protocol on Fail is set to True, a Protocol Instance will be created and all the non-sample Materials will be added to that Protocol.



If the Inspection Order Passes and the property Close Automatically on Pass is set to True, the Inspection Order is automatically closed. Otherwise, you must access the Inspection Order and close it using the Close Inspection Order wizard.

The Material in the production Step can only be tracked-out if:

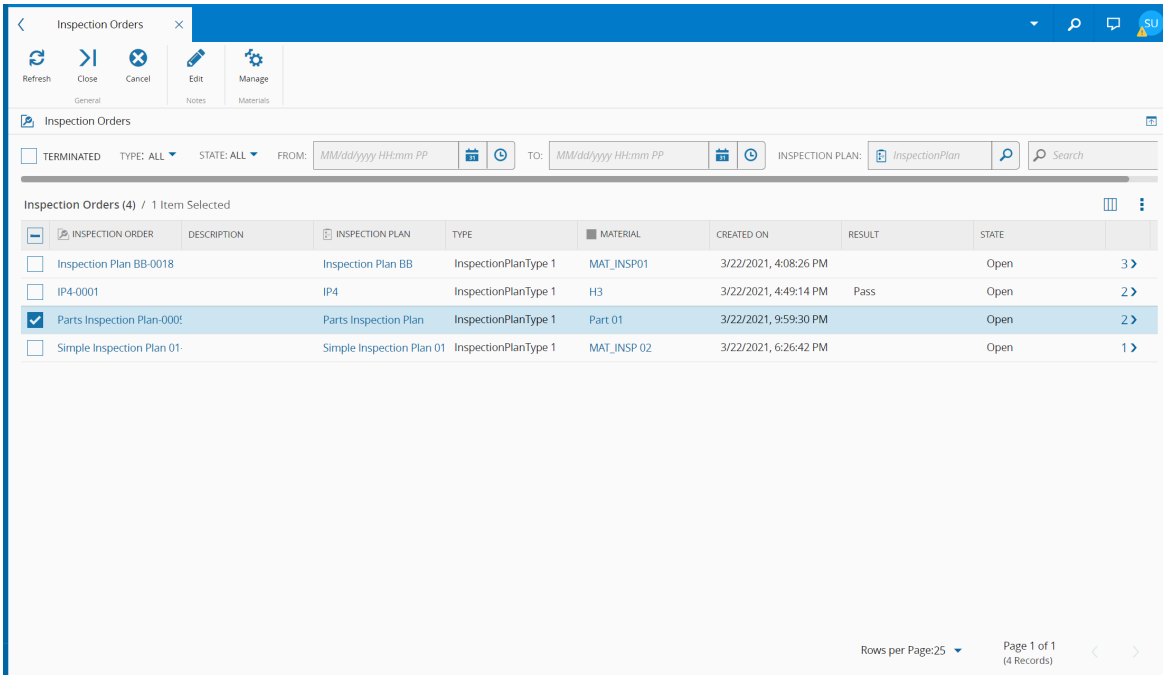
- The samples for the Inspection Steps which will occur right after the production step have already been created
- The Inspection Order is Closed if the Inspection Order property Required Before Track-Out is set to True

Quality - Inspection Orders

The existing Inspection Orders are available to be consulted on the Quality section, as displayed in the Figure below.

It is possible to perform the following operations:

- Close
- Cancel
- Manage Materials
- Edit Notes



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.