

# Understanding coverage and the calculation of Test and requirement statuses

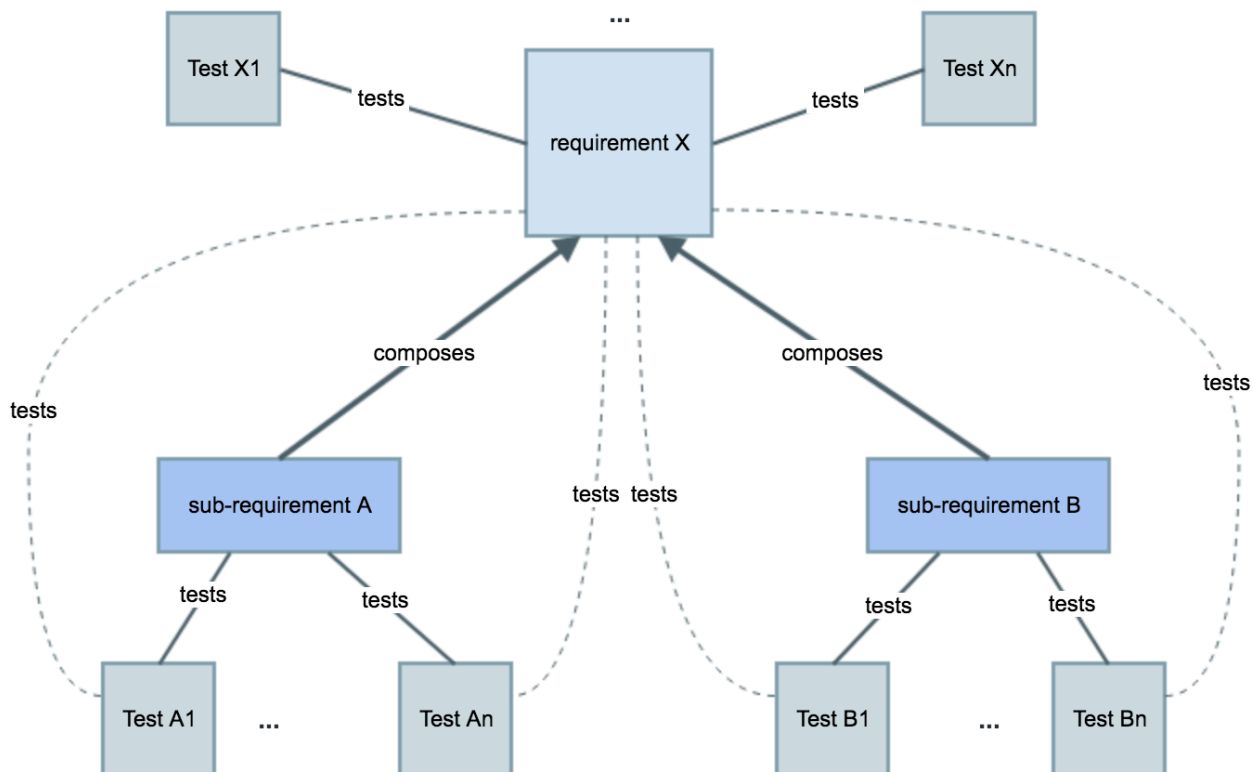
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A requirement may be either covered by one or multiple Tests. In fact, the status of a given requirement goes way further than the basic covered/not covered information: it will take into account your test results.

As soon as you start running your Tests, the individual test result may be one of many and be very specific to your use case.

To make your analysis even more complex, you may be using sub-requirements and executing related Tests.

Requirements may be validated directly or indirectly, through the related sub-requirements and associated Test cases.



Thus, how do all these factors contribute to the calculation of a requirement status? How is evaluated the status of some Test?

Let's start by detailing the different possible values Test, Test Step and requirement statuses. In the end, we'll see how they'll impact on the calculation of the coverage status of a requirement in some specific version or Test Plan.

## Overview of statuses

Whenever talking about statuses, we may be talking about statuses of requirements, Tests, Test Runs and Test Steps.

The status of a requirement depends on the status of the "related" Tests.

The status of a Test depends on the status of the "related" Test Runs, which in turn depend on the recorded Test Step statuses for each one of them.



### Please note

Whenever we're speaking about the status associated with a requirement or with a Test (and even with a Test Set), we may be talking about different things:

- (coverage) **status** for some version, taking into account executions made for that version of the Tests that validate the requirement
- workflow status associated to the requirement issue (e.g., "New", "In Progress", "Closed")
- specific custom fields for those issue types (e.g. "Requirement Status", "TestRunStatus" and "Test Set Status")

The current page details the first one, i.e. the status of the entities based on the executions made in some context.

The "Requirement Status", "TestRunStatus" and "Test Set Status" custom fields are **calculated** fields, usable in the context of requirement, Test and Test Set issues, respectively, that calculate the "status" (not the workflow status) of the requirement/Test/Test Set for a specific version, considering the executions (i.e., test runs) for that version. The version for which it calculates the status depends on the behavior defined in a global configuration ([see configuration details here](#)).

These fields will show the calculated status for the respective entity, for some specific version; they're just used to have a quick glimpse of the status of each entity, for example right in the view issue screen; therefore their usage is limited.

More information on these and other custom fields can be found [here](#).

## Test status

The status of a Test tells you information about its current consolidated state (e.g. latest record result, if existent). *Was it is executed? Successfully? In which version?*

Thus, whenever speaking about the "status of a Test" we need to give it some additional context (e.g. "In which version?") since it depends on "where" and how you want to analyze it.



The status of a Test indicates its "latest state" in some given context (e.g. for some version, some Test Plan and/or in some Test Environment).

Xray provides some built-in Test statuses (which can't be modified nor deleted):

- **TODO** – Test is pending execution; this is a non-final status;
- **EXECUTING** – Test is being executed; this is a non-final status; at least one step is mapped to a non-final Test Run status
- **FAIL** – Test failed
- **ABORTED** – Test was aborted
- **PASS** – Test passed successfully

Each of this status maps to a requirement status, accordingly with the following table.

Test status	Final status?	Requirement status mapped to
PASS	yes	OK
FAIL	yes	NOK
TODO	no	NOTRUN

ABORTED	yes	NOTRUN
EXECUTING	no	NOTRUN
custom	custom	OK, NOK, NOTRUN or UNKNOWN

The status (i.e. result) of a Test Run is an attribute of the Test Run (a “Test Run” is an instance of a Test and is not a Jira issue) and is the one taken into account to assess the status of the requirement.



#### Please note

Do not mix up the status of a given test with the "TestRunStatus" custom field, which shows the status of a given Tests for a specific version, depending on the configuration under [Custom Fields](#). More info on this custom field [here](#).

The "TestRunStatus" custom field is a calculated field that belongs to the Test issue and that takes into account several Test Runs; the "TestRunStatus" does not affect the calculation of the status of requirements.

## Managing Test Statuses

Creating new Test (Run) statuses may be done in the [Manage Test Statuses](#) configuration section of Xray.

Whenever creating/editing a Test status, we have to identify the Requirement status we want this Test status to map to.

### Test Statuses

Manage custom Test Run statuses for Xray

Name	Description	Final	Color	Requirement Status
PASS	The test run has passed	<input checked="" type="checkbox"/>	<div></div>	OK
TODO	The test run has not started	<input type="checkbox"/>	<div></div>	NOTRUN
EXECUTING	The test run is currently being executed	<input type="checkbox"/>	<div></div>	NOTRUN
FAIL	The test run has failed	<input checked="" type="checkbox"/>	<div></div>	NOK
ABORTED	The test run was aborted	<input checked="" type="checkbox"/>	<div></div>	NOTRUN
BLOCKED		<input type="checkbox"/>	<div></div>	NOTRUN
PENDING		<input checked="" type="checkbox"/>	<div></div>	UNKNOWN
FAIL_DISCARDABLE	FAIL_DISCARDABLE	<input type="checkbox"/>	<div></div>	UNKNOWN
MYFAIL	MYFAIL	<input checked="" type="checkbox"/>	<div></div>	NOK
MYPASS2	MYPASS2	<input checked="" type="checkbox"/>	<div></div>	OK

Create

### Preferences

- ☒ Final statuses have precedence over non-final statuses

When this option is enabled, the latest Test Issue Status is calculated based on the latest Test Run with a **final** status. Otherwise, this calculation will always consider the latest Test Run status is non-final.

One important attribute of a Test status is the “final” attribute. If “Final Statuses have precedence over non-final” flag is enabled, then Xray will give priority to final statuses whenever calculating the status of a Test. In other words, if you have a Test currently in some final status (e.g. PASS, FAIL) and you schedule a new Test Run for it, then this Test Run won't affect the calculation of the status of the Test.

This may be used, when users prefer to take into account only the last final/complete recorded result and want to discard Test Runs that are in an intermediate status (e.g. EXECUTING, TODO).

## Test Step statuses

The status of a Test Step indicates the result obtained for that step for some Test Run.



Statuses reported at Test Step level will contribute to the overall calculation of the status of the related Test Run.

Xray provides some built-in Test Step statuses (which can't be modified nor deleted).

Test Step status	Test status
PASS	PASS
TODO	TODO
EXECUTING	EXECUTING
FAIL	FAIL
custom	custom

## Managing Test Step Statuses

Creating new Test Step statuses may be done in the [Manage Test Step Statuses](#) configuration section of Xray.

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Whenever creating/editing a Test Step status, we have to identify the Test status we want this step status to map to.

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*Note that native Test Step statuses can't be modified nor deleted.*

## Requirement statuses

The status of a requirement tells you information about its current state, from a quality perspective. Is it covered with test cases? If so, has it been validated successfully? In which version?

Thus, whenever speaking about the "status of a requirement" we need to give it some additional context (e.g. "In which version?") since it depends on "where" and how you want to analyze it.



The status of a requirement indicates its coverage information along with its "state", depending on the results recorded for the Tests that do validate it.

The status of a requirement is evaluated in some given context (e.g. for some version, some Test Plan and/or in some Test Environment).

In Xray, for a given requirement, considering the default settings, its coverage status may be:

- **OK** – requirement has been successfully and fully validated; all the Tests associated with the Requirement are **PASSED**
- **NOK** – requirement is unsuccessfully validated; at least one Test associated with the Requirement is **FAILED**
- **NOTRUN** – requirement has not been validated completely; at least one Test associated with the Requirement is **TODO** or **ABORTED** and there are no Tests with status **FAILED**
- **UNKNOWN** – requirement is in unknown state; at least one Test associated with the Requirement is **UNKNOWN** and there are no Tests with status **FAILED**

- **UNCOVERED** – requirement is not covered with tests; the Requirement has no Tests associated to it

It's not possible to create custom requirement statuses.

You can see that in order to calculate a requirement coverage status, for some specific system version, we "just" need to take into account the status of the related Tests for that same version. We'll come back to this later on.



#### Please note

Do not mix up the status of a given requirement with the "Requirement Status" custom field, which shows the status of a given requirement for a specific version, depending on the configuration under [Custom Fields](#). More info on this custom field [here](#).

## Calculation of the status for a given Test Run

The status of a given Test Run is an attribute that most of the times is calculated automatically on the respective recorded step statuses. User can also enforce a specific status for a Test Run, which in turn may implicitly enforce specific step statuses (e.g. setting a Test Run as "FAIL" can set all steps as "FAIL").

This calculation is made by comparing steps together, following these rules:

1. if a step status is mapped to a non-final then Test Run status will be "EXECUTING"
2. compare all the step statuses, by their order (steps at the bottom of the list will have higher ranking)
  - a. the step status "PASS" has lowest ranking

The order of the steps is indifferent for the purpose of the overall Test Run status value.

### Test Step Statuses

Manage custom Test Step statuses for Xray

Name	Description	Color	Test Status	Operations
PASS	The test step has passed		<span>PASS</span>	
TODO	The test step has not started		<span>TODO</span>	
EXECUTING	The test step is currently being executed		<span>EXECUTING</span>	
FAIL	The test step has failed		<span>FAIL</span>	
SKIP	The test step has been skipped.		<span>PASS</span>	<a href="#">Edit</a> <a href="#">Delete</a>
MYFAIL	FAIL but continue		<span>FAIL_DISCARDABLE</span>	<a href="#">Edit</a> <a href="#">Delete</a>
XTODO	XTODO		<span>TODO</span>	<a href="#">Edit</a> <a href="#">Delete</a>
XPASS2	XPASS2		<span>MYFAIL</span>	<a href="#">Edit</a> <a href="#">Delete</a>
XFAIL	XFAIL		<span>MYFAIL</span>	<a href="#">Edit</a> <a href="#">Delete</a>
XPASS	XPASS		<span>FAIL</span>	<a href="#">Edit</a> <a href="#">Delete</a>

## Examples

The following table provides some examples given the Test Step Statuses configuration shown above.

Example #	Statuses of the steps/contexts (the order of the steps /contexts is irrelevant)	Calculated value for the status of the Test Run	Why?
1	<ul style="list-style-type: none"> <li>• PASS</li> <li>• PASS</li> <li>• PASS</li> </ul>	PASS	All steps are PASS, thus the joint value is PASS
2	<ul style="list-style-type: none"> <li>• PASS</li> <li>• TODO</li> <li>• PASS</li> </ul>	EXECUTING	At least one step status (i.e. TODO) is mapped to a non-final Test status

3	<ul style="list-style-type: none"> <li>PASS</li> <li>FAIL</li> <li>PASS</li> </ul>	FAIL	One of the step statuses (i.e. FAIL) has higher ranking than the other ones
4	<ul style="list-style-type: none"> <li>XPASS</li> <li>FAIL</li> <li>PASS</li> </ul>	FAIL	XPASS has higher ranking than the other ones, thus the overall calculated value is based on the mapping for that Test Step status.
5	<ul style="list-style-type: none"> <li>FAIL</li> <li>XPASS</li> <li>FAIL</li> </ul>	FAIL	XPASS has higher ranking than the other ones, thus the overall calculated value is based on the mapping for that Test Step status.

## Calculation of the status for a given Test

It is possible to calculate the status of a Test either by Version or Test Plan, in a specific Test Environment or globally, taking into account the results obtained for all Test Environments.

### Analysis:

- **By Version:** For a given Test X, in order to calculate the coverage status for version V, we need to evaluate the related Tests Runs that were executed on that same version V. A special case is whenever you don't have versions or simply don't want to calculate the status based on a version (i.e. "None (latest execution)")
- **By Test Plan:** For a given Test X, in order to calculate the coverage status for Test Plan TP, we need to evaluate the related Tests Runs that were executed on Test Executions associated with Test Plan TP.
- **On a specific Test Environment:** For a given Test X, if a specific Environment is also chosen, then only Test Runs from Test Executions with this Environment will be considered. In case no Environment is specified then all Test Executions are considered (more info [here](#)).

### What affects the calculation:

- the setting "Final statuses have precedence over non-final statuses" in Xray administration settings, in the tab "Test Statuses" (enabled by default)
- the existence of Test Runs for different Test Environments, in case the analysis is made for "All Environments"

## Calculate the status of some Test, in version V or Test Plan TP, for Test Environment TE

1. This takes into account Test Runs in version V (as a result of Test Executions in version V) or Test Runs in Test Plan TP (within Test Executions associated with Test Plan TP)
2. If Test Environment is chosen, then only Tests Runs on that Environment (e.g. TE) will be considered
3. If "Final statuses have precedence over non-final statuses" is true, then:
  - final Test Run statuses will have higher ranking than non-final ones
  - only the latest Test Run is taken into account based on its "finished on" date
4. If "Final statuses have precedence over non-final statuses" is false, then:
  - only the latest Test Run is taken into account based on its "created" date (i.e. the creation date of the related Test Execution)

## Calculate the status of some Test, in version V or Test Plan TP, for "All Environments"

1. calculate the Test status for each Test Environment, based on all the implicit Test Environments from the relevant Test Executions (i.e. Test Executions in version V or Test Executions associated with Test Plan TP)
2. calculate the joint value for the Test status
  - a. PASS has lowest ranking (i.e. for the calculated to be PASS, all calculated statuses must be PASS in the different Test Environments)
  - b. if one is FAIL, then the calculated value will be FAIL
  - c. otherwise, use the ranking of Test statuses

## Examples

The following table provides some examples given the Test Statuses configuration shown above in the [Managing Test Statuses](#) section.

Example #	Statuses of the Test Runs (ordered by time of execution/creation, ascending)	Final statuses have precedence over non-final statuses	Calculated value for the status of the Test	Why?
1a	1. PASS 2. <b>PASS</b> 3. TODO	true	PASS	Latest <b>executed</b> Test Run (2) having a final status was PASS.
1b	1. PASS 2. PASS 3. <b>TODO</b>	false	TODO	Latest <b>created</b> Test Run (3) was TODO.
2a	1. <b>PASS</b> (env1) 2. <b>MYPASS2</b> (env2) 3. TODO (env3) 4. <b>PASS</b> (env3)	true	XPASS	Latest <b>executed</b> final Test Runs on each environment were PASS, MYPASS2 and PASS respectively.  Since MYPASS2 (3) has higher ranking then the calculated status will be MYPASS2.
2b	1. <b>PASS</b> (env1) 2. MYPASS2 (env2) 3. <b>TODO</b> (env2) 4. <b>PASS</b> (env3)	false	XPASS	Latest <b>created</b> Test Runs on each environment were PASS, TODO and PASS respectively.  Since PASS has the lowest ranking, then TODO (3) will "win" and then the calculated status will be TODO
3	1. <b>PASS</b> (env1) 2. <b>TODO</b> (env2) 3. <b>PASS</b> (env3)	true	TODO	Latest <b>created</b> Test Runs on each environment were PASS, TODO and PASS respectively.  Although Test Environment "env2" has only a non-final Test Run, since there is no other Run for that environment, then it will be considered as the calculated status for that environment.  Since PASS has the lowest ranking, then TODO (3) will "win" and then the calculated status will be TODO.
4	1. PASS (env1) 2. FAIL (env2) 3. PASS (env3)	true (or false)	FAIL	Latest <b>executed (or created)</b> final Test Runs on each environment were PASS, FAIL and PASS respectively.  Since the calculated status for one of the environments is FAIL, then the calculated status will be FAIL.
5	1. <b>PASS</b> (env1) 2. <b>MYPASS2</b> (env2) 3. TODO (env2) 4. <b>MYFAIL</b> (env3)	true	MYPASS2	Latest <b>executed</b> final Test Runs on each environment were PASS, MYPASS2 and MYFAIL respectively.  MYPASS2 has higher ranking than the other ones, thus the overall calculated value will be MYPASS2.
6	1. <b>PASS</b> (env1) 2. MYPASS2 (env2) 3. <b>TODO</b> (env2) 4. <b>MYFAIL</b> (env3)	false	MYFAIL	Latest <b>created</b> Test Runs on each environment were PASS, TODO and MYFAIL respectively.  MYFAIL has higher ranking than the other ones, thus the overall calculated value will be MYFAIL.

## Calculation of the status for a given requirement

It is possible to calculate the status of a Requirement either by Version or Test Plan, in a specific Test Environment or globally, taking into account the results obtained for all Test Environments.

### Analysis :

- **By Version:** For a given requirement X, in order to calculate the coverage status for version V, we need to evaluate the related Tests statuses that were executed on that same version V.
- **By Test Plan:** For a given requirement X, in order to calculate the coverage status for Test Plan TP, we need to evaluate the related Tests statuses that were executed on Test Executions associated with Test Plan TP.
- **On a specific Test Environment:** For a given Test X, if a specific Environment is also chosen, then only Test Runs from Test Executions with this Environment will be considered. In case no Environment is specified then all Test Executions are considered (more info [here](#)).

The algorithm is similar to the overall calculation of the Test status taking into account the results obtained for different Test Environments.

In other words, the status for each linked and "relevant" Test case is calculated and in the end a joint calculation is done for a virtual Test case. The requirement status will correspond to the mapped value for the status that was calculated for this virtual Test.

The Tests that will be considered as covering the requirement are not just the ones directly linked to the requirement. In fact, they may either be direct ones or ones linked to sub-requirements. This list can be further restricted if Test Sets are being used for defining the scope of coverage (i.e. the list of Tests relevant for the coverage calculation for some version).

#### Algorithm :

1. Obtain the list of Tests that directly or indirectly through Sub-Requirements (info [here](#)) cover the requirement
  - This depends on the [Requirement Coverage configuration](#)
2. Calculate the Test status for all the Tests individually, in version V or Test Plan TP
  - This takes into account Test Runs in version V (as a result of Test Executions in version V) or Test Runs in Test Plan TP (within Test Executions associated with Test Plan TP)
  - If a specific Environment is also chosen, then only Test Runs from Test Executions with this Environment will be considered. In case no Environment is specified then all Test Executions are considered (more info [here](#)).
3. Calculate the "joint" status of all the previous Test statuses (i.e. by comparing together each Test status)
4. Calculate the requirement status mapped to the previous calculated Test status

#### What affects the calculation:

- the requirement coverage strategy defined in the respective setting, in Xray administration settings, in the tab "Requirement Coverage" (more info [here](#))
  - the strategy is used to find out the relevant Tests considered for the calculation
- the separation of concerns setting, in Xray administration settings, in the tab "Requirement Coverage" (more info [here](#))
  - this affects how the status of a Test Run contributes to the status of each linked requirement; if disabled, users can enforce a specific mapping for each requirement, otherwise the Test Run status will contribute in the same way to all the linked requirements
- indirectly, the setting "Final statuses have precedence over non-final statuses" in Xray administration settings, in the tab "Test Statuses" (enabled by default)
- the existence of Test Runs for different Test Environments, in case the analysis is made for "All Environments"

## Requirements and sub-requirements conjunction

When a requirement has some sub-requirements, then the calculated status for the parent requirement depends not only on its status calculated per-si but also on the status of each individual sub-requirement.

The calculation follows the rules described in the following table.

REQ \ SUB-REQ	OK	NOK	NOT RUN	UNKNOWN	UNCOVERED
OK	OK	NOK	NOT RUN	UNKNOWN	OK
NOK	NOK	NOK	NOK	NOK	NOK
NOT RUN	NOT RUN	NOK	NOT RUN	UNKNOWN	NOT RUN
UNKNOWN	UNKNOWN	NOK	UNKNOWN	UNKNOWN	UNKNOWN
UNCOVERED	OK	NOK	NOT RUN	UNKNOWN	UNCOVERED

From another perspective, you would obtain the same value for the calculation of the status of the parent requirement if you consider that it is being covered by all the explicitly linked Tests and also the ones linked to sub-requirements.

#### Consequences :

- the parent requirement is OK if it is NOK per-si and the sub-requirements are either UNCOVERED or also OK
- the parent requirement is NOK if it is NOK per-si or if any of the sub-requirements is NOK
- the parent requirement is only UNCOVERED if neither the parent requirement is covered per-si nor the sub-requirements are covered



#### Rationale

Even if you have sub-requirements, when you have tests that are directly linked to the parent requirement, Xray assumes that you are validating the requirement directly. Thus, it's irrelevant if the sub-requirements are uncovered by tests.

## Examples

The following table provides some examples given the Test Statuses configuration shown above in the [Managing Test Statuses](#) section.

Example #	Statuses of the related Tests (sub-requirements, whenever are present using the notation subReqX)	Calculated value for the status of the requirement	Why?
1	1. PASS 2. PASS 3. PASS	OK	All Tests are passed (it is similar to having just one virtual test that would be considered PASS and thus mapped to the OK status of the requirement)
2	1. PASS 2. PASS 3. <b>TODO</b>	NOT RUN	One of the Tests (3) is TODO, which has higher ranking than PASS.
3	1. PASS 2. PASS 3. <b>FAIL</b>	NOK	One of the Tests (3) is FAIL, which has higher ranking than PASS.
4	1. PASS 2. subReq1 => OK a. PASS 3. subReq2 => NOK a. PASS b. <b>FAIL</b>	NOK	One of the Tests (3b) is FAIL, thus subReq2 will be considered as NOK. Since it is NOK, then the parent requirement status will be NOK.
5	1. PASS 2. subReq1 => NOTRUN a. TODO 3. subReq2 => OK a. PASS b. PASS	NOT RUN	One of the subRequirements (subReq1) is NOT RUN, thus the calculated status, whenever doing the conjunction with the parent requirement status, will be NOT RUN.
6	1. PASS 2. subReq1 => UNCOVERED a. (no Tests associated) 3. subReq2 => UNCOVERED a. (no Tests associated)	OK	Since all sub-requirements are uncovered and the parent requirement is covered directly by one Test (1), which is currently PASS, then the calculated "OK" status will be based on that Test.

## Setup information for some possible use cases

- I want to skip some steps and proceed as they didn't exist
  - create a "Test Step Status" (e.g. "SKIP"), mapped to the Test Status "PASS"
- I want to fail a Test Run but I don't want to mark the requirement as being NOT OK because this failure can be discarded
  - create a "Test Status" (e.g. "FAIL\_DISCARD") , non-final and mapped to the requirement status "UNKNOWN"; setting the status as non-final will give priority to other Test Runs you may have for that Test, if "Final Statuses have precedence over non-final" flag is enabled
  - create a "Test Step Status" (e.g. "IRRELEVANT\_FAIL") and map it to the Test Status created in the previous step
- I want to always see, for a given Test, the status of Test based on the last run scheduled for it, no matter if it was completed (i.e. in a final status) or not
  - just uncheck the setting "Final Statuses have precedence over non-final"
- I want to execute some steps, set them as failed or passed, but I don't want them to reflect immediately in the status of the Test Run
  - create custom, non-final, Test statuses for passing and failure (e.g. "MYPASS", "MYFAIL"), mapped to the OK and NOK requirement statuses, respectively
  - create your own custom Test Step statuses for passed and failure (e.g. "PASS\_CONTINUE" and "FAIL\_CONTINUE"), mapped to the previously created Test statuses