



AP-2.2

AutoPASS Suitability for Use – Test Strategy

Version: 3.0

Date: 23 February 2024

DOCUMENT STATUS

Document nr.	AP-2.2 AutoPASS Suitability for Use – Test Strategy
---------------------	--

Status	Version	Description
Approved	3.0	

REVISION HISTORY

Version	Date	Author	Main changes
1.0	4 September 2019	NPRA	Doc. "5.6 AutoPASS TSP Suitability for use, Test strategy"
2.01	14 April 2021	NPRA	Version for publishing
3.0	23 February 2024	NPRA	Updated and restructured

TABLE OF CONTENTS

1.	PREFACE	4
1.1	Objectives	4
1.2	Reference documents	4
1.3	Concepts, Definitions, Standards, and Directives	5
1.4	AutoPASS Samvirke	5
1.5	Types of events where equipment must be tested	6
2.	MAIN TYPES OF EVENT	7
2.1	Inclusion of a new AutoPASS actor	7
2.1.1	General	7
2.1.2	Interfaces to be tested	8
2.1.3	Overall technical approval and test process for a new TSP	9
2.1.4	Overall technical approval and test process for a new TC	11
2.1.5	Processes to be tested for a new TSP or TC	11
2.2	Introduction of new or modified version of OBE by an established AutoPASS TSP	12
2.3	Introduction of new toll stations (RSE) by established AutoPASS TC	13
2.4	Other changes made by TCs, TSPs or AutoPASS HUB/IP	14
2.5	An actor terminates its AutoPASS operation, or no longer uses the AutoPASS HUB.....	14
3.	GENERAL TEST PRINCIPLES	15
3.1	Scope	15
3.2	Types of tests to be carried out	15
3.2.1	General	15
3.2.2	Integration tests in a test environment	16
3.2.3	E2E test in production environment	16
3.3	Start of operation - Pilot operation	17
4.	TEST PLANNING, MANAGEMENT AND REPORTING	18
4.1	Scope	18
4.2	Test planning	18
4.3	Test plan	19
4.4	Test organisation	19
4.5	Responsibilities	20
4.5.1	Test Manager	20
4.5.2	Test Coordinator	21
4.5.3	Toll Charger	21
4.5.4	Toll Service Provider	21
4.5.5	NPRA / Appointed Party / AutoPASS HUB/IP	22
4.6	Test preparation and execution	22
4.7	Test tracking tool	22
4.8	Test approach	23
4.9	Test entry criteria	23
4.10	Test exit criteria	23
4.11	Test report	24
4.12	Deviations	25

1. PREFACE

1.1 Objectives

This document outlines the procedures for testing when technical changes in AutoPASS Samvirke occur. Testing is necessary when a new actor (TC or TSP) is introduced and/or actors introduce new or modified equipment. This document gives a general overview of when testing is required, which tests to perform, and how the tests shall be carried out. The goal of the testing described in this document is to verify AutoPASS compliance, including correct functionality in equipment, as well as in interfaces between an actor and the AutoPASS HUB, and/or between actors. The required test steps and the extent of the testing may vary depending on the actual situation.

Detailed test procedures and specifications are not described in this document. The document does not provide details regarding file exchange between the actors' back office solutions and the AutoPASS HUB. The AutoPASS system architecture and data flow is described in ref. [2].

Before a suitability for use test as described in this document can commence, the initial acceptance tests for the basic AutoPASS infrastructure described in the test methodology in ref. [13] must be performed successfully, and the basic systems shall be in stable production.

The tests described in this document do not include internal FAT or SAT testing performed by an actor (TC/TSP) on its new or modified equipment prior to the common testing between AutoPASS HUB and TCs/TSPs equipment. Such equipment may be Roadside Equipment (RSE), back office solutions, or On Board Equipment (OBE). It is a precondition prior to start of tests with AutoPASS that an actor (TC/TSP) has shown a stable implementation of the required functionality on its production system.

1.2 Reference documents

The following table lists the documents that are referenced in this document. Other documents of relevance to the topic of this document may also be listed:

Table 1 - Reference documents

Ref.	Document Title	Description
1.	AP-1.0 AutoPASS Definisjoner, Standarder og Direktiver	Lists and describes all concepts, definitions, standards, and directives that are relevant for the specifications of AutoPASS Samvirke.
2.	AP-1.2 AutoPASS Data formats a. Overview b. Appendixes AP-3 document series	Defines the data flow and data exchange formats used in AutoPASS. The legacy descriptions in AP-1.2 are gradually being replaced by documents in the AP-3 series.
3.	AP-1.3 AutoPASS EFC Security architecture	Outlines the principles for security and encryption in AutoPASS.
4.	AP-1.5A Overordnet Krav-spesifikasjon for AutoPASS vegkantutstyr	General requirements for roadside equipment.
5.	AP-1.5B Detaljerte krav til AutoPASS vegkantutstyr	Detailed requirements for roadside equipment.
6.	AP-1.6 Requirements for On-board Equipment (OBE) for use in AutoPASS Samvirke	Minimum requirements for OBE to be approved and used in AutoPASS Samvirke.
7.	AP-1.6A AutoPASS OBE Statement of Compliance	A statement of compliance to all requirements in AP-1.6 to be filled out by TSP

8.	AP-1.7 Tilkobling til AutoPASS Samvirke	Describes how to connect to the AutoPASS system infrastructure and the principles for file exchange.
9.	AP-2.1 AutoPASS Godkjenning og drift av vegkantutstyr	Description of the acceptance process for new or modified RSE to be used in AutoPASS Samvirke
10.	AP-2.1C Egenerklæring på driftsklart vegkantsystem	A template self-declaration to be filled in by a TC, when accepting and commissioning a new or modified toll station (RSE) in AutoPASS Samvirke
11.	AP-2.3 OBE Test description - AutoPASS TSP Suitability for use	Description of tests of new or modified OBE to be used in AutoPASS Samvirke
12.	AP-2.3B Template AutoPASS TSP Suitability for use OBE Test Plan	A template for the test plan to be developed by a TSP applying for a new OBE to be accepted, or for other modifications in equipment in AutoPASS Samvirke
13.	AP-2.4 Test description of interface with AutoPASS HUB	Description of how to connect and test systems of AutoPASS actors to AutoPASS Infrastructure.
14.	AP-2.5 Søknadsskjema for godkjenning av brikke	A template application form to be filled in by a TSP for acceptance of a new or modified OBE in AutoPASS Samvirke

1.3 Concepts, Definitions, Standards, and Directives

For concepts, definitions, standards, and directives, please see ref. [1].

1.4 AutoPASS Samvirke

AutoPASS Samvirke is the network for electronic payment of tolls on public roads, as well as for tickets on a number of public ferry services in Norway. This network ensures interoperability between the parties in AutoPASS Samvirke. The Norwegian Public Roads Administration (NPRA) is responsible for the direction and management of the network.

AutoPASS Samvirke consists of the following parties:

- Interoperability management (NPRA)
- Toll Chargers (TC)
- AutoPASS Toll Service Providers (TSP)
- Service Users (SU)

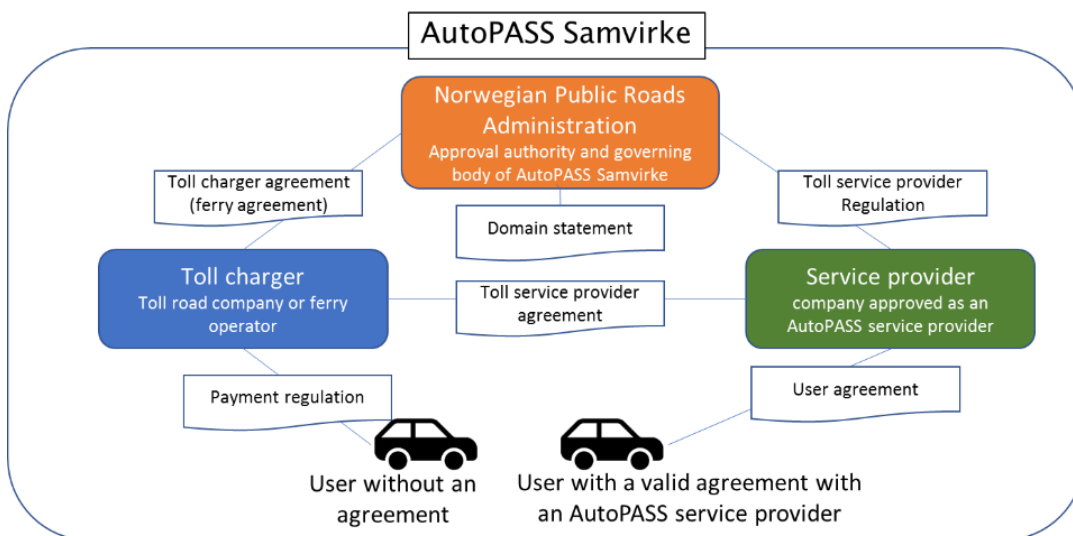


Figure 1: Model showing the parties in AutoPASS Samvirke and their contractual and legal relations.

The NPRA has the authority to specify technical and operational requirements for equipment used by any actor in AutoPASS Samvirke. They also conduct audits of established actors and their equipment.

1.5 Types of events where equipment must be tested

The following main events require testing:

1. Inclusion of a new AutoPASS actor
 - a. New TSP
 - b. New TC
2. Introduction of a new or modified type of OBE by an AutoPASS TSP
3. Introduction of a new or modified toll station (RSE) by an AutoPASS TC
4. Other changes made by TCs, TSPs or AutoPASS HUB/IP
5. A TSP (or TC) terminates operation, withdraws from AutoPASS Samvirke, or no longer uses the AutoPASS HUB

The next chapter in this document describes each of these main events.

Event 1a above is the most important objective of this document. Unless otherwise stated, the descriptions in chapter 3 and 4 apply for this event, but elements of this test strategy may be used in other tests depending on the actual situation. Event No. 2 and 3 are described in detail in ref. [11] and ref. [9], and only brief summaries are included in this document.

Based on the above, there are five main types of events where equipment must be tested:

Table 2 - Main test scenarios

Test scenarios		Test procedures	Approval criteria
1	Inclusion of new AutoPASS TC	Predefined	Predefined
2	Inclusion of new AutoPASS TSP	Predefined	Predefined
3	Introduction of a new or modified type of OBE by AutoPASS TSP	Predefined	Predefined
4	Introduction of a new or modified toll station (RSE) by AutoPASS TC	Predefined	Predefined
5	Other changes made by an AutoPASS TC, TSP or AutoPASS HUB/IP	Partly predefined and partly case by case	Partly predefined and partly case by case

2. MAIN TYPES OF EVENT

2.1 Inclusion of a new AutoPASS actor

2.1.1 General

Technically there are many similarities between a new TSP and a new toll road TC in the acceptance test requirements of equipment to be connected to AutoPASS Samvirke. For both types of actors, the following apply:

- Both TSPs and toll road TCs have their back office solutions to be connected to the AutoPASS core systems (AutoPASS HUB and IP). The NPRA division Transport and Society, department Transport Development, will have to be involved in testing as they administrate the AutoPASS core systems. The interfaces and data flow follow the same basic principles for both TC and TSP and must be compliant with the AutoPASS specifications.
- Both TSP and TC also have other system parts which have interfaces to each other. The TSP provides OBE, and the TC provides RSE. AutoPASS OBE and RSE must be compatible with each other in a many-to-many relation (many types/vendors of OBE and many types/vendors of RSE). Ideally, introduction of a new type of OBE or a new type of RSE needs to be tested for all combinations.
- When introducing a new TSP or a new TC, the test plan must define two “paths” in the initial phase of testing, - one test for the back office solution and one for the OBE test (for TSP) or RSE test (for TC). The final testing phase is when both system parts are integrated in a complete setup and are ready to be tested in an end-to-end (E2E) test. Both TSP and TC are part of any E2E test regardless of whether it is a new TSP or a new TC to be connected. See [Figure 3](#) for an overview of the full approval process for a new AutoPASS TSP.
- Testing must also include operational processes like monetary claims and settlements between TC and TSP. Such processes may include all types of actors.

A ferry operator is also a TC but is not connected to the AutoPASS HUB in the same way as a toll road TC (see chapter [2.1.4](#) for a description). The acceptance test requirements are therefore different for ferry TCs.

All new actors must be assigned an actor ID by the NPRA.

2.1.2 Interfaces to be tested

A main part of the testing for all events listed in chapter 1.5 is related to test of interfaces. *Figure 2* below shows the AutoPASS actors and the data exchange interfaces subject to testing.

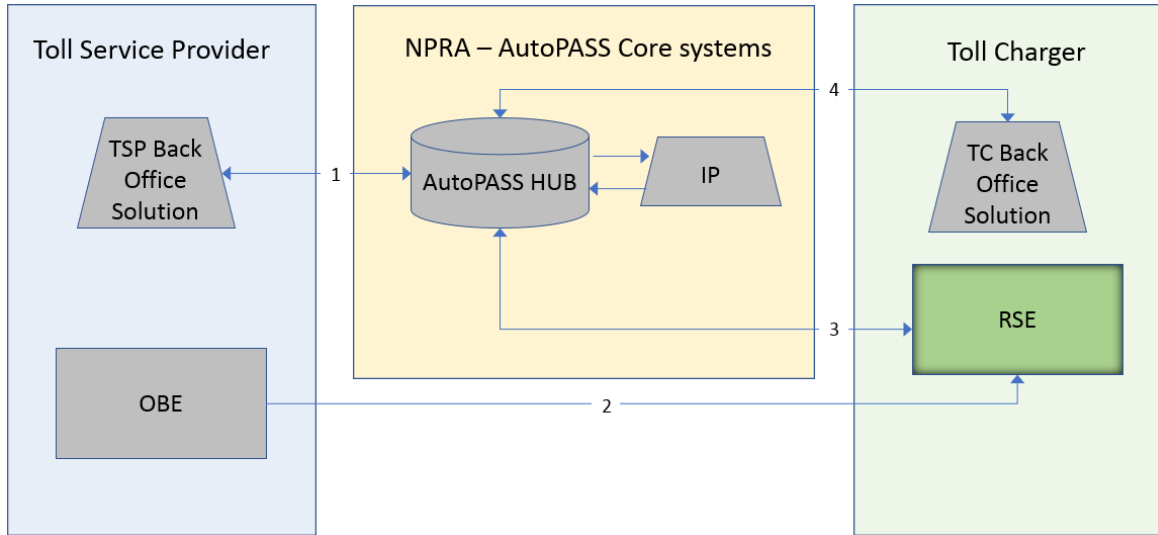


Figure 2: AutoPASS actors/systems and data exchange interfaces subject to testing

Documents describing technical and test requirements for the interfaces are:

- Interface (1) and (4) between AutoPASS IP and the back office solutions of TSP and TC, via the AutoPASS HUB (also including internal interface as e.g. between AutoPASS IP and AutoPASS HUB):
 - ref. [2]
 - ref. [8]
 - ref. [13]

- Interface (2) between TSP OBE and TC RSE:
 - ref. [5]
 - ref. [6]
 - ref. [9]
 - ref. [11]

- Interface (3) between TC RSE to AutoPASS IP via the AutoPASS HUB:
 - ref. [2]
 - ref. [5]
 - ref. [8]
 - ref. [11]
 - ref. [13]

2.1.3 Overall technical approval and test process for a new TSP

A complete technical verification process for a new operational TSP, including the test activities in the commissioning phase, comprises the following steps:

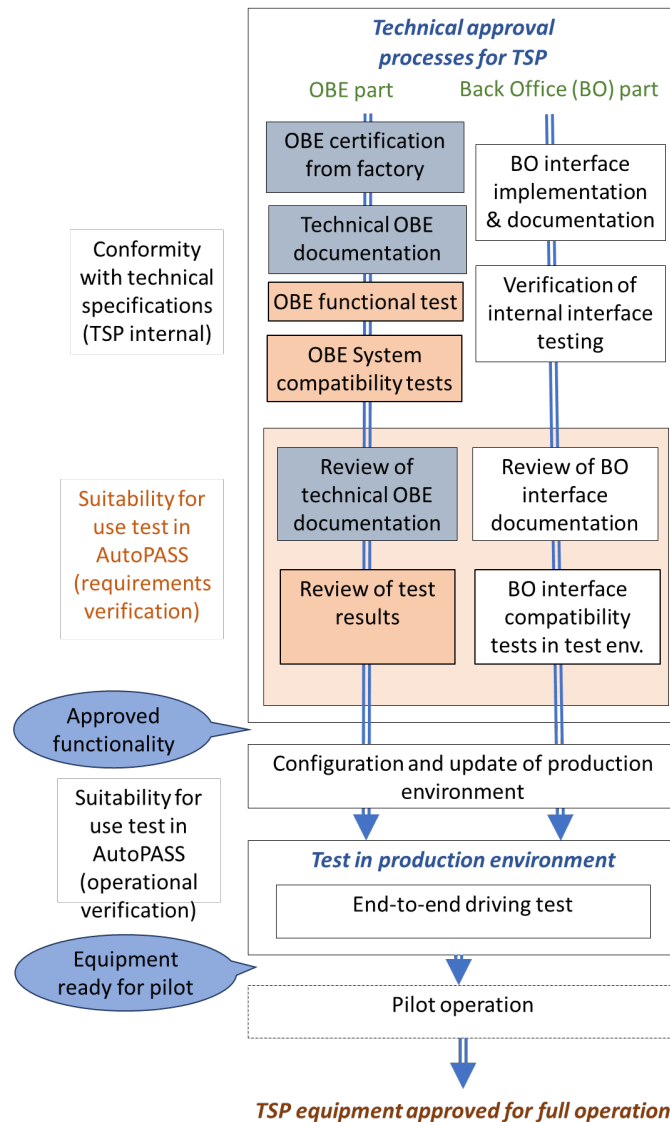


Figure 3: The full approval process for a new AutoPASS TSP

The main purposes of the various approval/test stages are as follows:

1. Conformity with technical specifications:

For the OBE: The TSP must document compliance with AutoPASS specifications for the OBE. The applicant must provide declarations of conformity for all relevant requirements of OBE standards and European directives and a complete product description for OBE. Several tests must be performed in test environment and/or laboratory for verification of functional and system compatibility features and interoperability. The NPRA may ask to receive compliance reports/certifications.

For back office: Back office interfaces to AutoPASS HUB must be documented and internally tested (TSP responsibility) to be consistent with the AutoPASS interface description.

AutoPASS is not involved in these tests but may request to review test reports.

2. Suitability for use test – requirements verification
 - For the OBE: The NPRA receives a self-declaration from the TSP which confirms conformity with technical specifications. The NPRA also reviews the required documentation from the TSP, which are statements of conformity to standards, OBE documentation and statement of compliance to all AutoPASS requirements (ref. [7]). The NPRA may also request to review test reports. If a test environment with AutoPASS RSE is available, a driving test will also be performed.
For back office: The NPRA reviews the interface documentation and tests the interfaces between TSP and AutoPASS HUB in a test back office environment.
3. Suitability for use test – operational verification: E2E driving test:
When the AutoPASS production environment for the new TSP (with both back office and OBE) is fully configured, comprehensive E2E driving tests in a representative range of RSE is performed. Transactions are followed in an E2E perspective.
4. Suitability for use test – pilot operation:
Pilot operation is also part of the suitability for use operational verification. The intention of a pilot is to verify technical, administrative, and commercial processes in small-scale operation before the TSP enters full operation.

An overview of the suitability for use (SfU) tests (test stage no. 2, 3 and 4) is presented below. The overview is intended to show how the different test phases together form an overall test approach regarding different test scopes and environments.

Table 3 – Main test phases and approaches

	2. SfU – requirements verification	3. SfU – Operational verification - End-to-end driving test	4. SfU – Operational verification - Pilot operation
Main purpose	To be approved as an AutoPASS TSP, it is necessary to verify that the TSPs equipment satisfy given requirements	To verify that the TSPs systems operate as intended when fully integrated in the production environment	To verify that all technical, administrative, and commercial processes are well-functioning in small-scale operation, and thus are ready to be commissioned full-scale
OBE test environment	If the NPRA requires such a test, this may be done in the laboratory of RSE suppliers	In operational AutoPASS RSE. Driving tests are required to be performed in representative RSE from all RSE suppliers. If relevant, also in different versions of RSE from the same supplier.	In any operational AutoPASS RSE. There are no requirements to the selection of AutoPASS RSEs used for this pilot operation, but a certain volume of Service Users and number of transactions is required.
Interface test environment	In test environment	In production environment	In production environment

Generally about the test scope	This is a document review performed by the NPRA, aiming to show that the equipment has the required functionality.	The OBE shall demonstrate good readability in AutoPASS RSE. The TSP shall also confirm that transactions are transferred correctly through AutoPASS HUB/IP and cleared correctly towards customer accounts.	In addition to the scope in stage 3, the TSP must confirm that transactions are invoiced correctly to the customer. Other technical, administrative, and commercial processes, must work according to requirements.
---------------------------------------	--	---	--

Figure 3 shows two process “paths” before the E2E driving tests can start. The left path is for the OBE approval. This path follows an almost identical approach to the highest level of test described for approval of a new or modified OBE from an already established TSP in AutoPASS Samvirke. This is described in chapter 2.2 of this document and is further detailed in ref. [11].

The right-hand path is the back office part, which is aimed at testing the interface between the TSPs back office solution and the AutoPASS infrastructure. This is described in ref. [13].

The interfaces subject to be tested are between TSP OBE and TC RSE – marked (2) in Figure 2 and between AutoPASS IP and TSP Solution via the AutoPASS HUB – marked (1). To test interface (1), a special test package/tool (described in ref. [13]) is provided. The NPRA division Transport and Society, department Transport Development, has a major role in this test.

2.1.4 Overall technical approval and test process for a new TC

There are five TCs in AutoPASS Samvirke operating toll collection on the public road network. In addition, there are ferry operators approved as TCs in AutoPASS Samvirke. A ferry operator is technically somewhat different from a toll road TC, as all ferry operators (except one: Bastø Fosen) are connected to AutoPASS HUB through a common national central system for ferry fee collection. The operator of the common central system for ferry fee collection (called “Central Service Provider” – Norwegian abbreviation STL) is responsible for interoperability with AutoPASS Samvirke on behalf of all connected ferry operators. A new ferry operator therefore only needs to be configured in AutoPASS HUB with an assigned actor ID.

It is outside the scope of this document to describe the procedure for technical approval of a new toll road TC. However, the same basic principles as for a new TSP will apply.

2.1.5 Processes to be tested for a new TSP or TC

The table below shows the main operational processes where multiple actors in AutoPASS are involved. The column “Actors involved” shows who is involved in each process and therefore needs to take part in the tests. The entity which normally initiates the process is marked with capital bold “X”.

Table 4 – Main operational processes where multiple actors in AutoPASS are involved

	AutoPASS processes	Actors involved			
		SU (Service User)	TC	TSP	NPRA (AutoPASS HUB/IP)
Setup	Configure a new TSP in AutoPASS HUB/IP			x	X
	Configure a new TC in AutoPASS HUB/IP		x		X
	Configure a new RSE in AutoPASS HUB/IP		X		
	Originate EFC context data for new OBE type		x	X	x
	Exchange of trust objects for new OBE type **		x	X	x
	Open a contract ***	X		x	
	Distribute validation data (data exchange TSP – AutoPASS HUB/IP - RSE)		x	X	x
Operation	Data exchange RSE – OBE	X	x	x	
	TC (RSE) generates transactions to AutoPASS HUB/IP		X		x
	AutoPASS IP determines the correct price for the transaction and reports it to the TSP and TC		x	x	X
	AutoPASS IP (on behalf of TC) reports billing details to the TSP		x	x	X
	TC claims payment from TSP for service usage *		X	x	
	TSP claims payment from SU for service usage	x		X	
	TSP claims issuer fee from TC *		x	X	
	Change contract data ***	X		x	
	SU replace OBE ***	x		X	
	Close contract ***	X		X	

*Includes mostly administrative processes which do not require technical testing other than appropriate reports that serve as a basis for claims. The financial figures must agree in the reports from TC and TSP.

**Exchange of security keys in AutoPASS Samvirke may involve a Trusted Third Party (TTP), see ref. [3]. Testing of functionality of security keys is done as part of process “Data exchange RSE – OBE”.

*** Testing of any change of contract data must be verified through the process “Distribute validation data”.

2.2 Introduction of new or modified version of OBE by an established AutoPASS TSP

Ref. [11] describes in detail the principles for approval of a new OBE or a new version of an OBE from an already approved and established TSP in AutoPASS. Since the TSP already is approved, it is not necessary to reassess all affected business processes of the TSP for the transactions with the new OBE. The NPRA has defined overall requirements for OBE in ref. [6] that must be fulfilled. In addition to that, it is sufficient to assess the readability and performance of the new or updated OBE in AutoPASS RSE. The tests in AutoPASS related to new OBE may differ if the OBE is a new model or an already known OBE model used by another TSP.

When an already approved TSP in AutoPASS introduces new or updated OBE, the TSP must submit an application for the OBE, see ref. [14]. The scenarios can be categorized as follows:

- a) New type of OBE that is not already in use in AutoPASS.
- b) New OBE type for this TSP, but the OBE type is already in use by another TSP in AutoPASS.
- c) A modification of an OBE that has already been approved by the same TSP. The new version contains changes in hardware (by supplier), new personalization procedures (by TSP) or other types of modifications which may or may not have consequences for its operational performance (degree of change must be assessed).

AutoPASS Samvirke has a test regime with different levels of the test to cover the different scenarios because there is a wide range in performance uncertainty. Alternative a) requires the most comprehensive testing while test procedures for b), and c) will usually be less extensive. In particular for scenario c), the TSP (with input from their OBE supplier) must describe how they assess whether the change may affect the performance of the OBE.

The NPRA will decide which of the following test levels that the OBE must undergo:

Table 5 – Test levels

Test level	Test name	Description
1	Full test	In order to prove conformity with technical specifications, the TSP must submit full documentation, results of all required internal OBE tests. These tests must be passed before the E2E Driving Test is carried out.
2	E2E Driving test	The TSP must perform a number of test passages in a limited number of designated and representative production AutoPASS RSE facilities. The test must document good OBE readability.
3	Pilot	The TSP must issue the OBE to a few “friendly” pilot users who use AutoPASS facilities. Good readability must be documented in a limited pilot period before it can be issued on a large scale.

Test level 1, Full test, corresponds to the OBE part of the test for a new TSP, see chapter 2.1.3.

In the E2E Driving test in the production environment, the TSP shall perform the tests with the new OBE in cooperation with chosen AutoPASS TCs. The OBE shall be tested in a few AutoPASS RSEs in operation, at least one from each RSE provider. There are a number of RSE suppliers in AutoPASS, and some of them have different main versions of RSE equipment in use in AutoPASS Samvirke. As differences in behaviour of this equipment can be expected, a test is required to be conducted in all main versions of RSE.

2.3 Introduction of new toll stations (RSE) by established AutoPASS TC

The NPRA has specified overall functional requirements for the roadside equipment in order to ensure interoperability in AutoPASS Samvirke (ref. [4] and ref. [5]). It is the TCs responsibility to detail the technical and functional requirements for its RSE acquisitions based on, and not in conflict with NPRA’s requirements.

The TC can seek guidance from the NPRA to clarify how the requirements are to be interpreted. This also applies if there is a need for clarification of findings that the TC uncovers in the implementation or test phase. Such inquiries to the NPRA must describe specific issues.

It is the responsibility of the TC to acquire, implement, install, test, accept and commission the RSE installation. After acceptance of the RSE, but before startup of operation, the TC shall submit a self-declaration to the NPRA, see ref. [10]. NPRA’s role in relation to this process is to verify through the TC’s self-declaration that the requirements in ref. [5] are fulfilled, and that the

roadside equipment is otherwise of the required quality for commencing operation. The NPRA shall receive information about the conclusion of the test results and that the TC has accepted the delivery from the RSE supplier. Any deviations that are detected but not considered to prevent the start of toll collection must be described. If so, a plan for rectification must be provided.

The NPRA is an approval authority and governing body of AutoPASS Samvirke. One of the main tasks is to monitor that the systems meet the AutoPASS requirements. The NPRA continuously collects statistics on operating data. Supplementary information will be requested when deemed necessary. The purpose is to be able to verify whether the TCs assessments and conclusions have given a correct picture of the quality of the system. If the processing of the self-declaration shows deviations that NPRA considers to be significant, the supervisory function in NPRA can choose to follow up on these deviations. In the event of serious deviations, the NPRA has the right to demand a suspension of toll collection. If there are significant deviations in the TC's handling of acquisition and commissioning, an inspection or audit may be conducted.

The acceptance procedure of new or modified RSE is detailed described in ref. [9].

2.4 Other changes made by TCs, TSPs or AutoPASS HUB/IP

This can be any other type of technical change by an established TC or TSP. Typically this may be a new or modified back office solution for the actor. There can also be modifications in the AutoPASS core systems (e.g. AutoPASS HUB/IP), infrastructure or interfaces in AutoPASS. Such changes may affect several parts of the AutoPASS infrastructure and therefore need to be tested in cooperation with the affected actors. The operator of AutoPASS core systems (the NPRA division Transport and Society, department Transport Development) will have a supervisory role in this matter.

For testing of modifications in AutoPASS IP/HUB, the test description in ref. [13] applies, and is therefore not covered by this test strategy.

The test requirements will include some general procedures/checklists, but also some procedures that need to be defined on a case-by-case basis. Depending on the actual situation/change, the processes described in chapter 2.1.5 have to be reassessed and modified as required by the actual circumstances.

2.5 An actor terminates its AutoPASS operation, or no longer uses the AutoPASS HUB

Technically this means a disconnection from AutoPASS HUB/IP. The operator of AutoPASS core systems (the NPRA division Transport and Society, department Transport Development) will have a supervisory role in this matter. As AutoPASS HUB/IP has a highly parameterized/configurable system setup, this is solved technically mainly by configuration parameter settings. However, a checklist must be established in each individual case to ensure that all activities related to the termination of operation are finalized.

A plan for testing of changed configuration must be worked out depending on the nature of the change. This is not described further in this document.

3. GENERAL TEST PRINCIPLES

3.1 Scope

The following descriptions give some general instructions and recommendations of how full tests should be carried out and organized. The descriptions are mainly aimed at the case of technical approval of a new TSP in AutoPASS Samvirke. Unless otherwise stated, the descriptions address this event. However, the test strategy may in many cases be simplified when the scope of the change is reduced.

The tests of any new or modified equipment shall verify its conformance to technical specifications, agreed operational procedures and the suitability for use within the context of AutoPASS. Equipment is suitable for use if it works according to the defined AutoPASS requirements and quality levels. Depending on the actual new or modified equipment that is subject to testing, the NPRA will decide which test steps shall be performed and to what extent.

3.2 Types of tests to be carried out

3.2.1 General

Figure 4 below shows the test sequence to be specified and performed when a new system is to be connected to AutoPASS HUB, typically TC or TSP back office solutions. To some extent, the steps should also be performed when a back office system has been modified, when a TC has introduced a new RSE or when an established TSP has introduced a new OBE.

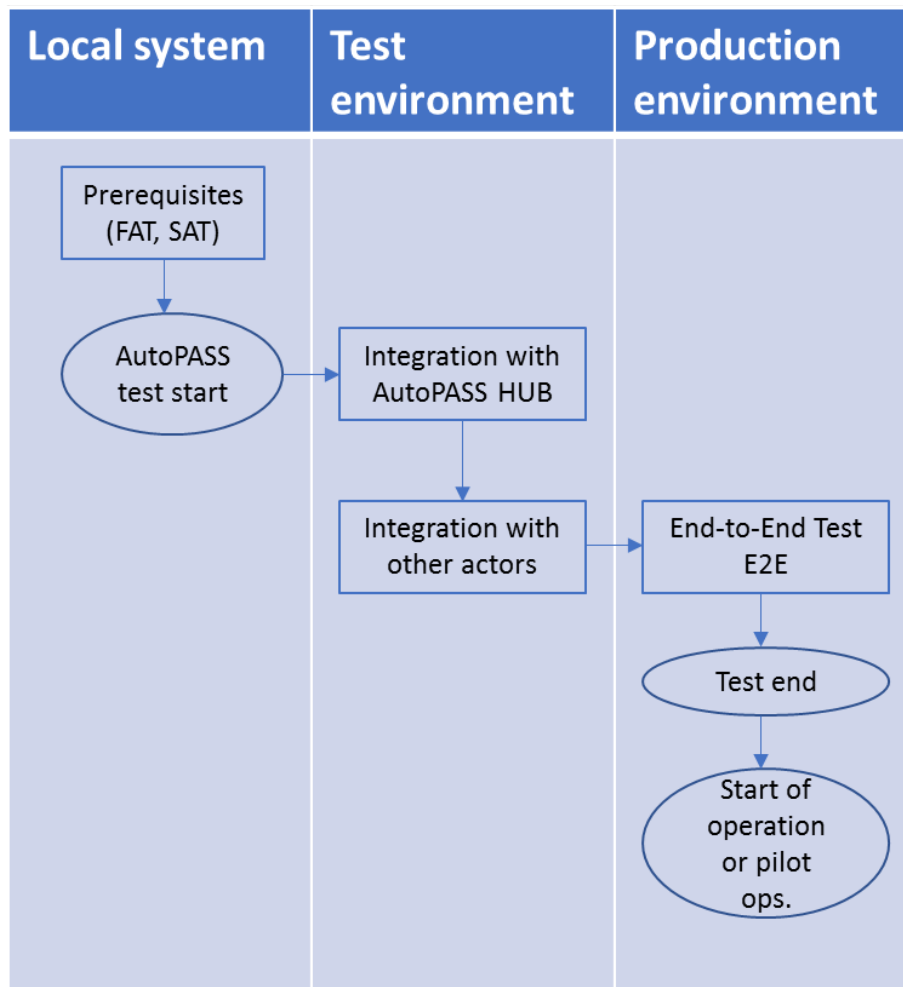


Figure 4: AutoPASS test steps

A prerequisite for starting the integration test is that the new equipment is tested and accepted by the actor in local tests in a simulated/"local" environment. This verification, which must prove fulfilment of AutoPASS requirements, is entirely the responsibility of the actor. The NPRA is not part of this test but will ask to receive a self-declaration from the actor that a successful test has taken place. In some cases, the NPRA may also ask to review the test report.

Approval criteria for each of the test steps shall be defined in the test specifications by the test manager.

3.2.2 Integration tests in a test environment

According to [Figure 4](#), the back office interface compatibility test is divided into two parts; Integration with AutoPASS HUB and Integration with other actors.

If there is a new OBE to be tested, this test is omitted physically since there are no test environment available to verify that any type of AutoPASS OBE is readable in any type of AutoPASS RSE. Such a test is instead performed as an E2E test in the production environment.

Integration with AutoPASS HUB

This test shall verify the data exchange between the new equipment and AutoPASS HUB. This might be the TC's/TSP's back office system or a new RSE to be connected. All exchanged file types involved in the new equipment must be tested. Simulated transactions must be produced. Ref. [2] describes file types, formats, and technical principles in this file exchange.

To test these interfaces with respect to correct format, a special test package/tool (described in ref. [13]) is provided.

The "Integration with AutoPASS HUB" test must be carried out with a satisfactory result before the "Integration with other actors" test can commence.

Integration with other actors

The scope of this test is to verify that the tested equipment works as expected in an integrated environment with equipment from other actors. Test cases depend on the actual situation.

If there is a new TSP or a new back office system to be introduced, it is necessary to verify that the technical and operational principles in the file exchange are followed with respect to timing of file transfer, file acknowledgement, clearing, statistics, and other relevant business processes that involve other actors.

The "Integration with other actors" test must be carried out with a satisfactory result before E2E tests can commence.

3.2.3 E2E test in production environment

E2E test for a new TSP has the following scope: A test agreement is established for each OBE to be tested. During test driving, each tested OBE is detected by a TC's RSE, and a transaction is generated and transferred to AutoPASS HUB/IP. The correct charge is determined by AutoPASS IP and a priced transaction is transferred through the AutoPASS HUB to the TSP's back office and is then cleared. The TSPs back office acknowledges this transaction.

Processes internal to the TSPs back office, like the generation of invoices, are not part of this E2E test.

Other processes in the interface between the actors, e.g. that the TC is paid accordingly, and that the TSP is generating a corresponding issuer fee invoice for the TC, are also outside the scope of

this test. It must however be verified that the correct financial amount for these settlements is communicated.

The E2E test will cover a number of scenarios where a user agreement is established for the test OBE. Based on the type of agreement, transactions are made within various RSE. If relevant, the status of the agreement may be changed as well as various types of enforcement situations are set up according to the test procedures. Such tests must be performed in cooperation with the actual TCs operating the RSE used in the test.

E2E test of a new or modified OBE for an established TSP has focus on readability of the OBE for various RSE (see chapter 2.2 for this scenario). Such tests will be carried out by test personnel. Actual service users are not involved.

3.3 Start of operation - Pilot operation

When the E2E tests have been completed and approved for a new TSP in AutoPASS Samvirke, and all other activities listed under Test exit criteria in chapter 4.10 are accomplished, the system is ready for production. Before full-scale operation, there is first a need for a pilot (trial) operation with limited volume. This is to verify that the TSP's equipment, as well as other technical, administrative, and commercial processes, are well-functioning in small-scale operation and thus proven to be ready to be commissioned full-scale. As pilot operation is part of ordinary production, a complete update must be done to the configuration in all relevant systems in AutoPASS to accept the new TSP and the OBE.

During the pilot operation, a limited number of real ("friendly") service users are free to use all AutoPASS toll stations. The pilot period has a pre-determined duration and/or must contain a pre-determined number of transactions.

When the pilot period is ended, it must be evaluated in a pilot report. The report must be accepted by the NPRA before the TSP is technically fully approved, and full-scale production can commence.

Also, in some cases when an established TSP makes minor modifications to an already accepted OBE and releases a new version of the OBE, the NPRA may decide that the new version of OBE should undergo a pilot period. The purpose of this pilot is to prove that a limited number of the OBE demonstrates acceptable readability in various RSE before the OBE can be issued full-scale.

4. TEST PLANNING, MANAGEMENT AND REPORTING

4.1 Scope

As with the test principles in the previous chapter, the descriptions in this chapter are also mainly intended for the event of a new TSP to be approved in AutoPASS Samvirke. However, many elements apply also for the other events.

4.2 Test planning

The general process steps for planning and executing a conformance test is shown in *Figure 5* below:

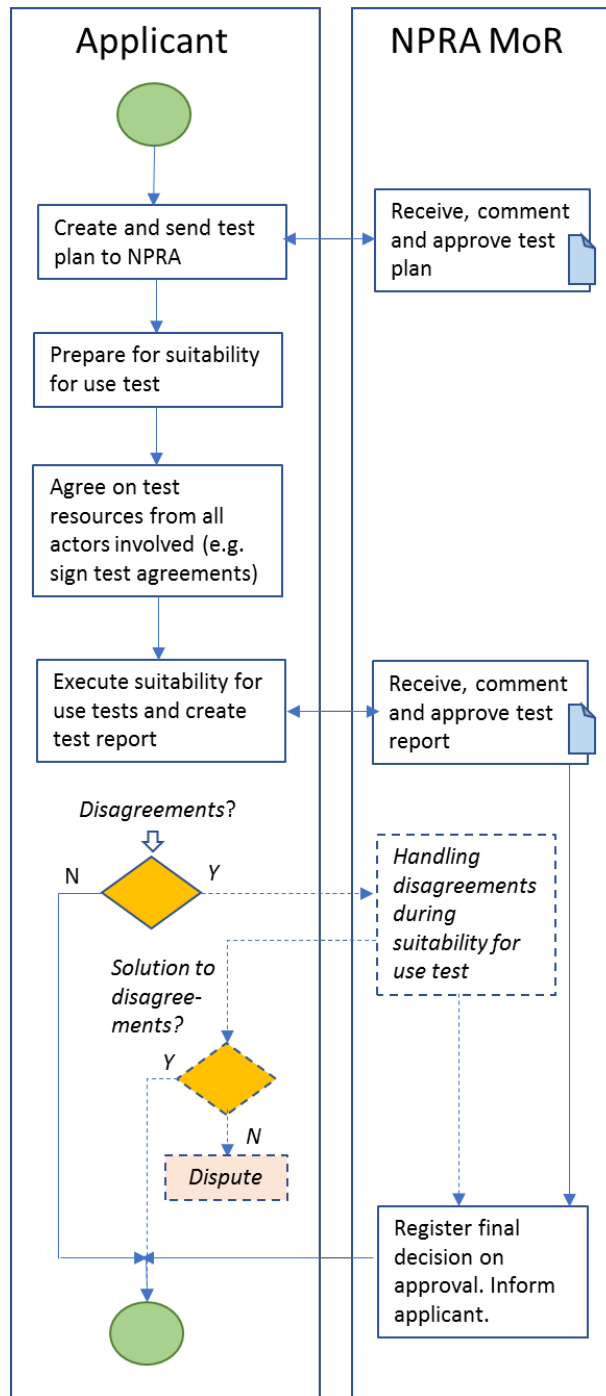


Figure 5: AutoPASS test process

4.3 Test plan

The test plan must give an overall description of how the test shall be carried out, and the resources that are needed. It must have sufficient information for all participating actors to know their responsibilities and must provide a common management tool for the test. It must contain:

- Test description
 - Objectives
 - Test entry criteria
 - Test exit criteria
 - Test acceptance criteria
- Test methods and tools
- Test data
- Test resources
- Test scenarios
- Participants and roles
- Schedule
- Plan for the compilation of test results and reporting

The test plan shall define, for each test step, which parts of the systems that are involved. It also defines the sequence of the test steps.

The NPRA provides a template (ref. [12]) for the test plan with contents as indicated above. The actual actor/applicant (e.g. a TSP) prepares a draft test plan based on this template or similar, where the other parties may be consulted if necessary.

The Test Plan must be approved by the NPRA before testing can commence.

4.4 Test organisation

There are 4 leadership roles in a such a test:

Table 6 – Test leadership roles

(Applicants) Test Manager	“Applicant” in this context means the main actor that has initiated the event (according to Table 3) to be tested. It is usually a TSP, but may also be a TC. This actor is responsible for the planning and progress of the test. See further description in chapter 4.5.1 .
NPRA Approval Authority Contact Person	The NPRA Directorate of Public Roads, Legislation and Regulatory Authority, Road User Charging, will appoint a contact person responsible for the management of the approval process on behalf of AutoPASS Samvirke. The (Applicants) Test Manager reports to the NPRA Approval Authority Contact Person. The NPRA Approval Authority Contact Person does not take active part in the testing but will set requirements for the application process and receive/review all required documentation (including test report) for approval.
Internal test leaders	“Internal” in this context means all the other actors that are affected by the change, and therefore must have a role in the testing.
Test Coordinator	This is a role that may be appointed (possibly an “independent” person) who has the responsibility of coordinating the affected actors and the activities in the test. See further description in chapter 4.5.2 .

For each new test case, test persons at all relevant organizations are appointed prior to the start of the project.

The implementation and testing of new or modified functionality will as a minimum be performed by affected actors (TC/TSP) in addition to the AutoPASS HUB/IP operational organisation. Other AutoPASS TCs, TSPs and/or external actors are involved in tests to the extent necessary to secure that the new/modified functionality works throughout the entire AutoPASS Samvirke.

The actor that introduces new or modified equipment/systems that necessitates testing, will be the party responsible for the test and will therefore be assigned the role as Test Manager. The NPRA will supervise and approve the test.

4.5 Responsibilities

4.5.1 Test Manager

The test manager is responsible for the overall test progression and is also responsible for creating the test report to be issued to the NPRA after testing is complete.

- An applicant seeking approval as an AutoPASS Toll Service Provider, shall appoint a Test Manager. This also applies for an established AutoPASS Toll Service Provider seeking approval of a new or modified OBE.
- For modifications to existing, or introduction of new roadside equipment, the Toll Charger responsible for the equipment shall appoint a Test Manager

During test preparation and execution, the Test Manager is responsible for:

- Definition of a detailed test schedule for all involved actors
- Production of detailed test procedures including approval criteria
 - The test procedures shall include step-by-step descriptions.
 - Test data should be in place before the test procedures are complete.
- Supervision of the test progress and reporting as described in the test plan
- Checking the quality of the test documentation
- Verification of the test results of each test and reporting as described in the test plan
- Handling of deviations (bugs, change proposals etc.) and decisions on further actions. This includes monitoring of deviations in the test tool and classifying these according to an agreed categorisation. Deviations shall be classified according to type of deviation and criticality, se chapter [4.12](#).
- Monitoring that bugs are fixed and that the corrected software is made available. The tester will then test the bug-fix. Regression testing of other functionality will be performed as necessary.
- Notifying the NPRA in the event of lacking cooperation or commitment from one of the parties, when this issue cannot be solved bilaterally
- Reporting of any topics it cannot solve to the NPRA

4.5.2 Test Coordinator

The Test Coordinator is appointed if there is a need for a person to assist the Test Manager in coordinating test activities between the involved parties. The Test Manager in cooperation with the NPRA will decide if such a role is to be established for the test and possibly from which actor this person is appointed. It is also possible that this can be an “independent” person. The Test Coordinator may also perform practical work in the test like gathering and documenting test results in the test report. If appointed, the Test Coordinator may typically be responsible for:

- Assisting the Test Manager in coordinating test activities between the parties. In the event of lacking cooperation from one of the parties, this must be reported to Test Manger.
- Observe the tests and assess the results and comments reported to the Test Manager
- Assisting the Test Manager in preparing the test report, along with a written statement summarizing the Test Coordinator’s observations after tests are completed

4.5.3 Toll Charger

The TC is responsible for:

- Nomination of a test team, including an internal test leader/manager to participate in testing (if TC is the applicant the internal test leader is usually the Test Manager)
- Nomination of a system responsible with sufficient knowledge of the system under test
- Performing or assisting in any tests involving the actors own equipment
- Documenting their parts of the test results including, test protocols and proof documents
- Reporting the results to the Test Manager (if TC is not the applicant)
- Provision of sufficient test resources to meet the test schedule agreed in the test plan

4.5.4 Toll Service Provider

The TSP is responsible for:

- Nomination of a test team, including an internal test leader/manager to participate in testing (if TSP is the applicant the internal test leader is usually the Test Manager)
- Nomination of a system responsible with sufficient knowledge of the system under test
- Provision of sufficient test resources to meet the test schedule agreed in the test plan
- Performing or assisting in any test involving the actors own equipment
- Documenting test results, including test protocols and proof documents
- Reporting of the results to the Test Manager (if TSP is not the applicant)
- Recruiting of test users. During the test period, the recruited test users will be responsible for following the instructions received from their TSP regarding the test period, including giving feedback to the TSP as requested.

4.5.5 NPRA / Appointed Party / AutoPASS HUB/IP

The AutoPASS HUB is the central cluster equipment of the TCs and is therefore considered a part of the TC role. AutoPASS IP is also a vital common system for all actors as all transaction data is processed in this system. The AutoPASS HUB, AutoPASS IP and other national systems are operated in a common infrastructure (operating platform) by an “Appointed Party” which reports to the test team during testing. The NPRA division Transport and Society, department Transport Development, administrates the contract with the Appointed Party, and will also be responsible for their tasks in the tests.

The NPRA division Transport and Society, department Transport Development, will be in charge of performing any tests (possibly by using an Appointed Party) regarding:

- Communication interfaces of the data exchange (e.g. VPN connection) to and from AutoPASS HUB and AutoPASS IP
- Data formats of the back office data exchange interfaces to/from the actors (TC/TSP)
- Security for the interfaces or equipment employed by the TC/TSP
- AutoPASS HUB and AutoPASS IP (including operating system, database, and application)
- All other operational issues for the systems included in the common operational technical platform

The NPRA division Transport and Society, department Transport Development, (possibly by using an Appointed Party) is responsible for the:

- Nomination of a test team to participate in testing
- Nomination of a system responsible with sufficient knowledge of the system under test
- Provision of sufficient test resources to meet the test schedule agreed in the test plan
- Documenting their parts of the test results (if any), including test protocols and proof documents
- Reporting of the results to the Test Manager

The NPRA Directorate of Public Roads, Legislation and Regulatory Authority, Road User Charging is responsible for conducting approval activities of new actors and new equipment in AutoPASS Samvirke.

4.6 Test preparation and execution

When a test plan is approved, it is necessary to commit the parties involved to the approved test plan. The applicant must enter into test agreements with all involved actors where there is a need for such an agreement. The test agreement shall regulate the provision of test resources and access to such resources.

4.7 Test tracking tool

For major modifications, it is recommended that a test tracking and bug tracking tool is used, either Jira or Confluence. Minor modifications can be tested/documentated without the use of such a tool.

4.8 Test approach

- No development / test objects should be without a reference number in the test tool
- There should only be one task per task number, with or without sub-task(s)
- All documentation must exist in the test tool case, either as an attachment or link
- Conclusions of relevant discussions are reflected in the case
- E-mail discussions about issues will generally not occur - use the comments in the case within the test tool
- Statuses and resolutions in the test tool must always be updated
- All bug reports should include step-by-step instructions on how to reproduce the issue, preferably with screenshots

4.9 Test entry criteria

Before the test may commence, the following general entry criteria shall be met:

1. The applicant has confirmed and documented conformity to AutoPASS requirement specifications
2. Previous test phases (“local” tests internal for the actor) have been successfully passed
3. The Test Plan has been approved
4. The test platforms have been prepared according to specifications
5. Test resources, accesses and artifacts must be prepared and ready
6. If needed, required training activities have been successfully completed
7. All test procedures have been approved
8. All software and hardware version numbers for the test system have been recorded as baseline
9. Necessary test data has been prepared and uploaded to the appropriate environments
10. Required test resources from all involved actors are agreed, if necessary, with written and signed test agreements

4.10 Test exit criteria

Before a test can be signed off, the following general exit criteria shall be met:

1. The testing is finalized, and the agreed acceptance criteria have been met
2. The hardware and software version numbers of the test system are unchanged from the baseline, unless changes have been approved by the NPRAs Test Manager
3. The Error Correction Plan for reported class C deviations has been approved
4. The Test Report has been approved

4.11 Test report

The Test Manager is responsible for documenting the test results in a test report. Sufficiently detailed test documentation shall be included in order to enable the NPRA to approve the report. The test report shall have this content:

- Purpose of the test
- Reference to the test script/procedure
- Documentation of test results
- Compliance to the Requirement specification (are the test results in accordance with requirements?)
- Analysis
- Conclusions
- Appendices: Detailed data and statistics

When providing a test report, each test shall be identified by a name and a number.

The following (or equivalent) table identifying the test and the reported results shall be applied.

Table 7 – Test reporting

Test name	Each test shall be identified by a name and a test number
Description	Describe the purpose and the system(s) to be tested. The system(s)/equipment must be identified by a version number.
Precondition	Describe the preparations, test data, test setup and the preconditions to be met prior to the test. If relevant, both positive and negative testing must be performed. Each test shall also have references to functionality/requirements to be verified.
Expected result	Describe the expected result of test, and (if applicable) how this should be expressed. Acceptance criteria cannot be defined on a general level and shall be defined for each test setup.
Actual result	Write the actual result of the test
Test status	State the status of the test. Test status levels are typically: Not started In progress Local test failed. Correction and a retest are necessary. Local retest in progress Local test passed NPRA rejection of test report NPRA approval of test report
Deviations	State the deviation if a test failed
Comment	Give a comment when appropriate for a passed test and always when a test has failed. The comment must give a recommendation for NPRA approval. If the test is approved with minor deviation, the plan for corrective actions must be described.

4.12 Deviations

During execution of the tests, deviations (i.e. errors or failure to meet the requirements) may be encountered. Deviations will be classified into a severity class and dealt with as follows:

Table 8 – Categorisation of errors and deviations

Severity class	Definition	Action
A	The deviation needs to be corrected before tests can continue	After correction, the concerned tests are repeated
B	The deviation may be corrected by changing: a) The requirement, and/ or b) The test procedure	ad a) The assessment of the consequences of the change in requirement is done by the actor, and is documented in the test report. ad b) The test procedure is changed, the test is executed in accordance with the new procedure, and the change is logged in the test report
C	Deviation with minor consequences which can be: a) Accepted, or b) Corrected at a later stage	The deviation is documented in the test report along with the possible corrective actions.

Categorization of the deviations is done by the Test Manger/Coordinator in cooperation with the system responsible. The test report shall not be approved by the Test Manager if there are deviations of severity class "A" or "B". All class A deviations shall be corrected and the test repeated.

The requirements or the test procedure shall be corrected for all class B deviations, and the relevant tests shall be repeated.

Remaining class C deviations shall be included in an action plan (including responsible part for corrections, retesting and a time schedule) prior to AutoPASS approval of the test report.