



AP-2.3

OBE Test Description

AutoPASS TSP Suitability for use

Version: 2.01

Date: 13 April 2021

DOCUMENT STATUS

Document no	AP-2.3 OBE Test Description - AutoPASS TSP Suitability for use
--------------------	--

Status	Version	Description
Final	2.01	

Document Version log

The purpose of the document version log is to describe the development of the document including the changes.

Version	Date	Author	Comments/amendments
1.0	04.09.19	NPRA	Doc. "5.5 OBE Test Description - AutoPASS TSP Suitability for use"
2.0	15.06.20	NPRA	Renamed doc. no. from 5.5. Other referenced doc. also renamed, otherwise unchanged from ver. 1.0
2.01	13.04.21	NPRA	Version for publishing

Table of Contents

Document status	2
1 Introduction.....	4
1.1 Scope.....	4
1.2 Process overview	4
1.3 Prerequisites	6
1.4 Reference documents.....	6
1.5 Standards related to testing.....	6
2 Conformity to specification declaration for OBE.....	8
2.1 General.....	8
2.2 OBE Conformity declaration constituents	8
2.2.1 CE marking and declaration	8
2.2.3 Test reports	9
3 Suitability for Use test of OBE	10
3.1 General.....	10
3.2 Functional tests.....	10
3.3 System compatibility tests and integration tests	11
3.4 End-to-End (e2e) Tests.....	12
4 Start of operation - Pilot operation	13
5 APPENDIX A: Functional OBE test cases	14
5.1 Objectives	14
5.2 Laboratory test cases.....	14
6 Appendix B: System compatibility test cases.....	16
6.1 Objectives and overview	16
6.2 Test cases performed at the on-road test site.....	16
7 Appendix C: End-to-end tests	17
7.1 Objectives and overview	17
7.2 Test cases.....	17
7.3 E2E test cases in test environment.....	17
7.4 E2E test cases in production environment	18

1 INTRODUCTION

1.1 SCOPE

This document specifies the test cases for On-Board Equipment (OBE) to be used within AutoPASS Samvirke. Toll Service Providers, abbreviated as TSP within this document, provide OBE to be used by their Service Users (SU). To be accepted as AutoPASS TSPs they have to undergo certain technical verification processes. Certification of the type of OBE they provide is an important part of that. The acceptance procedures define the “Suitability for Use” test processes for OBE with DSRC transactions according to EN 15509.

The term TC represents all affected toll chargers within AutoPASS for the TSP’s services in AutoPASS.

This document is the base for the final acceptance of OBE provided by a TSP. A successful passing of the acceptance procedures will result in the “Suitability for Use” certification of the tested OBE. The successful approval is only valid for the tested OBE with the tested software version.

The test description in this document applies for all scenarios involving a new or modified OBE in AutoPASS, i.e. both for a TSP applying for being a new AutoPASS TSP and for an existing AutoPASS TSP introducing a new or modified OBE. In the case of a new AutoPASS TSP there is also an additional acceptance procedure for the TSP’s back office interface to the AutoPASS HUB and further to other systems in the AutoPASS infrastructure. The overall acceptance procedures define the assessment methodology for the “Suitability for Use” tests of an OBE in connection with the TSP’s back office interface to the TC’s back-office via the AutoPASS HUB. Back-office interface tests are not described in this document. The overall “Suitability for Use” test strategy is described in the document in ref.[1].

When introducing new OBE, the TSP shall perform internal testing (FAT and SAT) and prove conformity with AutoPASS technical specifications before joint tests with AutoPASS in a suitability for use test can be initiated.

When a TSP introduces new OBE, the requirement for testing depends on if the new OBE is a:

- A. New type of OBE not currently used in AutoPASS
- B. New batch of OBE already used by the same TSP, but with changes in firmware (by supplier), new personalization procedures (by TSP) or other changes
- C. New batch of OBE already used by another TSP
- D. New batch of OBE already used by the same TSP

Alternative A requires the most comprehensive testing while test procedures for B, C and D will be less extensive.

For alternative B, a report must be submitted by the TSP. The report must detail all software and/or hardware modification that have been made to the OBE, and will be the base for the decision concerning which phases and steps of the approval process that shall be repeated for the recertification of the OBE. It is expected that the manufacturer performs a set of basic DSRC tests after each OBE software change, also in case of only a small software change without the necessity of a recertification.

1.2 PROCESS OVERVIEW

According to ref.[1], a complete technical verification process for a new operational TSP with a new OBE, including the test activities in the commissioning phase, comprises the following steps:

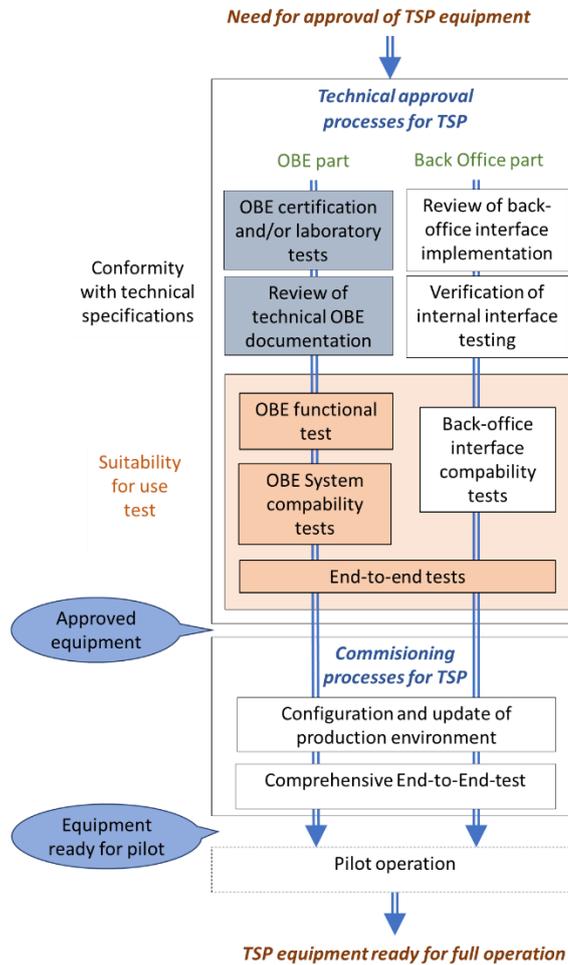


Figure 1: Full technical approval process for new AutoPASS TSP equipment

An existing AutoPASS TSP does not have to apply to AutoPASS to introduce a new type of OBE. However, the TSP must provide certification of the new type of OBE, ref. chapter 2. New OBE for an existing AutoPASS TSP follows the processes shown in the left path (OBE part) of Figure 1 while a new TSP follows both the OBE and the back-office part.

The TSP should inform NPRA and TC about the new or changed OBE as early as possible and at least six months prior to introduction to users. The OBE software or hardware change report is the base for the decision concerning which phases and steps of the approval process shall be repeated for the recertification of the OBE. A major change of the OBE could result in a full certification process defined for a new OBE type.

It is expected that the AutoPASS TSP (possibly through his OBE manufacturer) performs a basic set of DSRC tests with prototypes after any OBE change, providing a protocol of the performed tests to the NPRA. These basic tests are part of the information required for the decision which tests are necessary for a recertification.

According to Figure 1, the acceptance procedures are divided in four main test and/or verification phases:

the Conformity to Specification Declaration
 the Suitability for Use tests
 the comprehensive E2E test in the commissioning phase
 the monitoring during the pilot operation phase

This test specification deals with the OBE test part and has focus on test phase 2: Suitability for use test, but also the other test phases are briefly described.

1.3 PREREQUISITES

This test specification requires that the OBE is designed and manufactured according to the following specification:

ref.[3]

In order to verify that the OBE functions as intended in an AutoPASS environment, the OBE shall be tested in road side equipment designed and manufactured according to the following specification:

ref.[4]

1.4 REFERENCE DOCUMENTS

The most important reference documents related to testing are:

Ref. no.	Doc no.	Document title	Reference
[1]	AP-2.2	Test Strategy- AutoPASS TSP Suitability for use	An overall test strategy for Suitability for use tests for TSP that applies for being part of AutoPASS Samvirke
[2]	(not published)	Template AutoPASS TSP Suitability for use Test Plan	A template for the test plan that must be developed by the actor requesting the change and/or that applies for being part of AutoPASS Samvirke
[3]	AP-2.3	Requirements for On-board Equipment (OBE) for use in AutoPASS Samvirke	Minimum requirements to the OBE to be fulfilled by the TSP that applies for being part of AutoPASS Samvirke
[4]	AP-1.5B	AutoPASS Requirements for Charging Points	Minimum requirements to the RSE to be fulfilled by the TC when acquiring RSE to be integrated in AutoPASS Samvirke
[5]	-	Prosessbeskrivelser i test til kvalitetssystemet	Description of processes for suitability of use tests
[6]	AP-1.3	AutoPASS EFC Security Architecture	Requirements specification for handling of security keys in AutoPASS

Table 1 - Reference documents relevant for testing

1.5 STANDARDS RELATED TO TESTING

Document Ref	Document title
TS 14907	EFC - Test procedures for user and fixed equipment Part 1 Description of test procedures Part 2 Conformance test for the onboard unit application interface

Document Ref	Document title
EN15876	EFC - Evaluation of on-board and roadside equipment for conformity to EN 15509 Part 1: Test suite structure and test purposes Part 2: Abstract test suite
CEN/ISO TS 17444-1	EFC - Charging performance Part 1: Metrics Part 2: Examination framework

Table 2 – Standards relevant for testing

2 CONFORMITY TO SPECIFICATION DECLARATION FOR OBE

2.1 GENERAL

The conformity to specification declaration for an OBE contains the CE certification of the OBE to all relevant standards with the conformity statements, the certificate(s) including the evaluation report(s) and the detailed test reports. It also contains the conformity declaration to the relevant AutoPASS OBE Requirement Specification. The declaration may be delivered by the TSP or the OBE manufacturer on behalf of the TSP.

The conformity declaration shall in particular consider conformity of the OBE to

- the DSRC transaction according to EN 15509 and related DSRC standards
and
- other requirements defined in [ref.3] and the related documents.

Conformity to specifications shall be reassessed in case of a significant modification of the OBE or when the Notified Body's certificate is expired. The following list (not exhaustive) defines the most relevant modification cases of the OBE for the concerned toll context:

- Change of the DSRC hardware (e.g. change the OBE manufacturer, use of a different OBE from the same manufacturer)
- Modification of the DSRC software stack
- Modification of the OBE hardware or software architecture (e.g. change the main OBE processor, introduce a new task in the software, modification of the inter task communication)
- Modification of the OBE operating system
- Additional (new) OBE functionality
- Etc.

As described in chapter 1.1, a change report must be submitted by the TSP describing in detail all software and/or hardware modification that have been made to the OBE. This will be the base for the decision concerning a required reassessment of the OBE conformity declaration and hence also which phases and steps of the approval process that shall be repeated for the recertification of the OBE.

2.2 OBE CONFORMITY DECLARATION CONSTITUENTS

2.2.1 CE marking and declaration

The Manufacturer shall affix CE markings to the packaging where feasible. In compliance with Annex IV of Decision 2009/750/EC, a CE marking relative to EETS is accompanied by a Declaration, which will clearly specify that it concerns conformity to specifications. This "EC" Declaration should contain all relevant information to identify

- the OBE which is declared to be conform
- the European legislation according to which it is issued
- the manufacturer or its authorized representative
- the Notified Body if applicable
- reference to relevant standards
- other normative or required documents as appropriate

2.2.3 Test reports

For new OBE in AutoPASS or major changes in an OBE type, the manufacturer and/or the Notified Body shall produce test reports from all performed DSRC relevant OBE tests. If required, these test reports should be submitted. The following shows the expectation of the performed DSRC interoperability tests:

OBE tests defined in EN 15876-1 for all layers.

The results of the OBE test defined by EN 15876-1 shall be reported by the Proforma Conformance Test Report (PCTR) as defined in Annex C of this test standard. The PCTR shall include conformance log and detailed test results whenever possible. In particular it is important to verify correct OBE timing according to EN12253 and EN12795 in interaction with the beacon.

Testing of OBE transaction reliability and stability (rotor test or comparable).

A test report documenting the transaction reliability and stability of OBE software is also required. Such a test may be obtained in a test setup where OBE samples are moved repeatedly through the communication zone in order to test adequate OBE read performance. Other test procedures may be acceptable. Each OBE in this set-up shall perform several tens of thousands transactions to generate a statistically significant result. The target for this test is no more than 5 failed transactions out of 100,000. A correct transaction is defined as a transaction delivering enough data for correct tolling to the RSE data base.

Test reports about additional tests shall contain a description of the test and the constituents.

3 SUITABILITY FOR USE TEST OF OBE

3.1 GENERAL

The total scope of a Suitability for Use test, according to the test strategy in [ref.1], is to cover all aspects of the DSRC communication and back office data exchange, regarding performance as well as security and privacy issues. This document covers only the part of Suitability for Use tests for OBE (ref. Figure 1) which is divided in the following sequence of test steps:

1. Functional tests in laboratory
2. OBE system compatibility tests at test sites and/or portable RSE
3. End to end tests with the OBE both in test and in the operational EFC environment to check all required business processes

If the scenario is the introduction of a new TSP in AutoPASS, there is also a part of the Suitability for Use test for back office interface to AutoPASS HUB and against TCs road side equipment in a test environment. Generally, back office interface tests may partially be omitted if it is a new OBE for an existing TSP. However, with regard to these tests it must be verified that transactions with the new OBE do not contain data which is in conflict with the E2E processes.

The test steps shall be performed in cooperation between TC, NPRA and the TSP, possibly also their subcontractors. However, the responsibility for the test phase remains with the TSP.

The TSP shall work out a test plan according to the template in [ref.2].

The TC is entitled to appoint and authorize a company / organization (e.g. the supplier of the RSE) to carry out some or all tests.

All test results shall be fully documented in a test report, containing identification of the tested OBE, test set-up, test equipment and test results – ensuring traceability and allowing reproducibility.

The list below defines the information that shall be included in the report for each test case:

- test name
- test number
- run number and total number of test runs
- hardware version of tested OBE
- software version of tested OBE
- test location, versions and/or identification of used RSE test equipment
- description of test run (if applicable including special observations)
- test result description (including test passed/not passed)
- test date and test duration (e.g. start and end time)
- name of the responsible tester
- reference to test log files or supplementary test documentation if available

Generally, test security keys should be used when testing takes place in test environment.

3.2 FUNCTIONAL TESTS

For OBE models which were already tested successfully with identical hard- / software version and a similar / identical configuration in the past e.g. for another TSP, it can be agreed to omit selected functional OBE tests.

A precondition for starting the functional OBE tests is the accepted conformity declaration for this OBE.

Test-OBE for the (new) TSP must be distributed to actors specified in the test plan, which might be RSE suppliers of the TC.

It is important that OBE are tested in RSE provided by all suppliers having operational installations in AutoPASS. A test should be conducted on all major versions of RSE, as differences in behaviour of the equipment cannot be ruled out.

OBE shall be tested in a laboratory environment and/or in test RSE, being either portable/temporary or operational RSE. Testing must be done on equipment related to the RSE specifications given by NPRA (ref.[4]), but may not necessarily contain all required logic.

For the functional OBE tests, the used security keys should if possible differ from the ones used later on (E2E test in production environment, pilot and operational phase). This in order to reduce the exposure of the live master keys. If live OBE security keys are used they shall be handled as described in the AutoPASS security specification ([ref.6]).

The functions of the OBE to be tested are:

1. Tests of correct behaviour of security key computations for access control, as well as for authentication for both TC and TSP
2. Readability of OBE
3. Data content in OBE transaction in OBE-RSE interface
4. Signalling to Service User (sound in OBE)

All tests shall be performed at least with a batch of OBE from a pilot-run series, which are manufactured in mass production conditions. The sample size shall be large enough to proof the corresponding requirement and acceptance criteria. At least five samples of OBE shall be subject to testing.

Test cases for functional tests are presented in Appendix A.

3.3 SYSTEM COMPATIBILITY TESTS AND INTEGRATION TESTS

According to the overall test strategy (ref.[1]) for technical approval of a TSP, the integration test involves a verification of correct OBE reading in addition to processing of the transaction from RSE to a connected back office system via AutoPASS HUB/IP on the specified format.

The tests related to new OBE may differ if the OBE is a new model introduced by an existing TSP or if a new TSP seeks to join AutoPASS using an already known OBE model. As mentioned in chapter 3.1, back office interface tests may be partially omitted if the test concerns a new OBE for an existing TSP.

The main objective of the system compatibility test is to verify the functionality of the OBE in interaction with the road side equipment. System compatibility tests take place in a test environment, preferably on test RSE installed on roads or in a mock-up as close to realistic environment as possible. If test RSE installed on roads are not available, live operational RSE may be used. NPRA will in cooperation with the TCs decide the most suitable test locations.

All TCs must verify that they can read OBE issued by an AutoPASS TSP on the equipment provided by all RSE suppliers having delivered equipment for the TCs. Testing must be done on equipment according to the RSE specifications given by the NPRA, configured with validation tables etc. Validation tables and other downloaded interface files may be simplified and could contain only test data.

Test cases for system compatibility tests are presented in Appendix B.

The system compatibility tests must be carried out with a satisfactory result before E2E tests can commence.

3.4 END-TO-END (E2E) TESTS

When new OBE are introduced, the TSP shall perform end-to-end (E2E) tests with the new OBE in cooperation with chosen AutoPASS TCs.

According to the test strategy (ref.[1]), the following E2E tests will be executed in the Suitability for use test:

- i. End-to-end test in test environment (called E2E^{test})
- ii. End-to-end test in production environment (called E2E^{production})

If a test environment with test RSE installed on roads is not available, the E2E^{test} may be omitted. NPRA will in cooperation with the TCs decide the most suitable test locations.

A E2E test related to OBE for a new TSP has the following scope:

An AutoPASS contract/OBE is established by the TSP. This valid OBE is read by a TC's RSE and a transaction is generated and transferred to AutoPASS IP. The correct price is set by AutoPASS IP and a priced transaction is transferred through the AutoPASS HUB to the TSP's CS and cleared. TSP's CS acknowledges this transaction.

When the E2E test has been executed and approved in a test environment (if executed) the same test shall be executed in the production environment. Tests of transactions may only be done using physical OBE and RSE transactions.

The E2E tests in the production environment will be carried out by test personnel. Test contracts must be established. No real customers are involved. In the E2E test in the production environment, the OBE shall also be tested in a few AutoPASS RSEs in operation, at least one from each RSE supplier. If an RSE supplier has several major versions of RSE, all versions should be tested.

The E2E test will cover scenarios where an interoperable contract is established for the test personnel. Based on the type of contract, transactions are made within the various TC's equipment. The status of the contract may be changed.

Test cases for E2E tests are presented in Appendix C.

4 START OF OPERATION - PILOT OPERATION

When the Suitability for use tests have been completed and approved, the preparation for the commissioning phase may start. For a new TSP this has to await a full approval and a separate plan worked out by NPRA for commissioning.

It is outside the scope of this document to describe the tests in the commissioning phase in detail. However, in brief there is a need for the following steps before full commercial operation can start:

- If applicable (i.e. new/changed EFC_ContextMark), there must be conducted a complete configuration of all relevant systems in AutoPASS, also in all RSE in AutoPASS, to accept the new TSP and/or OBE.
- When this is done, an E2E test must be conducted in order to confirm the test results in an operative production environment.
- Normally (depending on the nature of the change) there will be a need for a pilot operation with a limited number of OBE and a limited time frame. This is to verify that TSPs equipment, as well as other technical, administrative and commercial processes, are well-functioning in small-scale operation and thus are ready to be commissioned full-scale.

The preparation for the pilot operation should start at a much earlier stage to acquire and prepare the SUs (drivers and organizations) involved in the pilot operation. Transaction handling, customer service or other processes (e.g. claim handling) during the pilot operation shall be part of the normal service even if special attention and handling is necessary to some extent. It is important that the customer service and operations personnel are informed and receive adequate training in advance.

During the pilot operation, real (“friendly”) service users will use all the AutoPASS functions for paying their tolls.

Pilot operation is described in more detail in separate documents.

5 APPENDIX A: FUNCTIONAL OBE TEST CASES

5.1 OBJECTIVES

The main objectives of the functional OBE tests are:

- Verification of the OBE security keys and corresponding security calculations when the OBE is in interaction with road side equipment. (FT.1)
- Verification of the OBE personalization and functionality in interaction with road side equipment (FT.2)
- Verification of the OBE functionality when being in the communication zone of road side equipment for a long time (FT.3)
- Verification of the OBE functionality in interaction with the beacon in case of slow entry into the communication zone (FT.3)

Implicit in all tests is verification of the transaction reliability and stability of the OBE.

In all tests, test keys should be used if possible.

5.2 LABORATORY TEST CASES

All test cases in this chapter are performed under laboratory conditions.

<i>Test name:</i>	Basic transaction security issues – stand-alone beacon	<i>No.:</i> FT.1
-------------------	---	-------------------------

Purpose: Verification of the OBE security keys and corresponding security calculations when the OBE is in interaction with road side equipment.

Equipment: Stand-alone beacon application in laboratory.

Description: As security level 1 is used in AutoPASS, all OBE are provided with Access keys in addition to Authentication keys. The structure of authentication keys in the OBE supports both TC and TSP verification of genuine OBE transactions. Master Access keys and Authentication keys are transferred to the test road side equipment. The test shall verify that the OBE and RSE between them are able to perform correct security calculations.

Intention: Verification of valid transactions:
 Check that the correct AC_CR is calculated by the RSE in order to have access to protected data in the OBE.
 Check that the MAC_TSP is read correctly by RSE.
 Check that the MAC_TC is read and processed correctly by RSE.

<i>Test name:</i>	Basic transaction data content – stand alone beacon	<i>No.:</i> FT.2
-------------------	--	-------------------------

Purpose: Verification of the OBE personalization and functionality in interaction with road side equipment

Equipment: Stand-alone beacon application

Description: Several transactions shall be performed, if applicable with OBE with different personalization data (detailed test data specification in ref.[3]). The supported vehicle-related attributes are:

- VehicleLicencePlateNumber
- VehicleClass
- VehicleDimensions
- VehicleAxles
- VehicleWeightLimits
- VehicleSpecificCharacteristics

The TSP must specify which of the RSE-supported attributes that are used by the TSP. Attributes that are supported by the OBE but are not in use, must contain specified null data. The attributes which are supported by the OBE and in use by the TSP (not null data) must contain correct data on the specified format.

To evaluate the OBE under test, a second transaction is performed with each OBE to read-out the attribute ReceiptData1 written in the previous transaction. A third transaction is performed with the OBE to read-out the attribute ReceiptData2 written in the penultimate transaction.

Checking of the acoustic signal of the OBE; checking of the toll transaction record.

Intention: Perform valid transactions: Depending on the values presented by the OBE, a transaction which contains correct data on the specified format is transferred to the RSE and further to target systems.

The received data shall be according to the defined personalization data of the OBE.

The values of ReceiptData1 and ReceiptData2 written by the RSE are correctly stored and can be correctly read out.

Verify correct function of the MMI beep signalling for "transaction OK".

<i>Test name:</i>	Transaction – static conditions	<i>No.:</i> FT.3
-------------------	--	-------------------------

Purpose: Verification of the OBE functionality in interaction with road side equipment.

Equipment: Stand-alone Beacon with EFC Application

Description: Keep an OBE in the communication area of an RSE with fixed BeaconID for more than 5 minutes.

Checking of the acoustic signal of the OBE; checking of the toll transaction record.

Intention: Correct behaviour of the OBE being in the communication zone for at least 5 minutes: Only one transaction is performed.

Correct OBE data presented by the OBE and collected in the toll transaction record.

6 APPENDIX B: SYSTEM COMPATIBILITY TEST CASES

6.1 OBJECTIVES AND OVERVIEW

The main objective of the system compatibility test is to verify the functionality of the OBE in interaction with the road side equipment and to verify the correct processing within the tolling system under as realistic operating conditions as possible. After performing the transactions, the further processing of the transaction data will be checked in all the systems receiving the data.

6.2 TEST CASES PERFORMED AT THE ON-ROAD TEST SITE

The test site offers realistic testing conditions: Preferably this is a test station/portal on closed road without traffic, but if this is not available live operating RSE may be used.

<i>Test name:</i>	OBE in dynamic conditions	<i>No.:</i> SC.1
-------------------	----------------------------------	-------------------------

Purpose: Verification of the OBE functionality in interaction with road side equipment with dynamic conditions.

Equipment: On-road (test) stations according to AutoPASS RSE specification and vehicle. If possible, tests are executed in all different types of equipment which are in operative use in AutoPASS. A test environment for AutoPASS HUB/IP must be connected on-line or off-line (for “off-line” communication it may preferably be possible to manually download interface/transaction files). As an alternative, a tool for inspecting and validating a transaction file must be provided. Validation tables and other downloaded interface files to RSE can be simplified and contain only test data.

Description: OBE with valid contract (on whitelist).
 Passages are performed with the OBE at 50-80 km/h.
 Several passages with different OBE (with different statuses and personalization data) and in different equipment.
 Check of the toll transaction sent from the RSE to AutoPASS HUB.

Intention: Correct matching of the toll transaction record with the data content in RSE.
 Correct data content in the record sent from the RSE, according to the content personalized in the OBE.
 High readability, i.e. few/none unsuccessful OBE readings.
 Correct MMI.

7 APPENDIX C: END-TO-END TESTS

7.1 OBJECTIVES AND OVERVIEW

Generally, the End-to-End tests verify the full compatibility of the OBE and the TSP’s back office interface within the whole tolling system. It shall also test the TSP’s business processes. After performing several test scenarios, the further processing of the transaction data will be checked in all the systems receiving the data.

This document only specifies test cases that apply for OBE reading. Other comprehensive E2E tests that cover functionality in the back office systems are covered by other documents.

The successful completion of functional OBE and (if relevant) back office interface compatibility tests is a precondition for starting the End-to-End tests. A successful completion of the End-to-End tests is a precondition for the start of the pilot operation phase.

The test is divided into two phases. The first test is performed at the test site. This test is somewhat similar to the system compatibility test but has a higher E2E focus with more real data. A more complete test environment is required. If such conditions can be obtained under the system compatibility test, the tests may be executed jointly.

After passing the tests on the test site, a quite similar test is conducted on operational equipment under real operating conditions.

7.2 TEST CASES

The following E2E-scenarios are performed in the testing environment during test stage E2E^{test} and in the operational EFC environment during test stage E2E^{production}. The following table gives an overview of which of the E2E-scenarios are tested in which of the test stages. Please note that for those E2E-scenarios for which actual payment is involved, the payment relevant test cases are executed in E2E^{production} test stage only.

7.3 E2E TEST CASES IN TEST ENVIRONMENT

The test site offers realistic testing conditions without real traffic. If possible, real interface files from an operational environment are used. If a test environment with test RSE installed on roads is not available, the E2E^{test} may be omitted.

<i>Test name:</i>	E2E - OBE in on-road test RSE and test system environment	<i>No.:</i> E2E.1
-------------------	--	--------------------------

Purpose: Verification of the OBE functionality in interaction with test road side equipment connected to a test environment with AutoPASS HUB, AutoPASS IP and other back office systems.

Equipment: On-road test station according to AutoPASS RSE specification, and vehicle. If possible, in all different types of equipment in operative use from all RSE suppliers. A test environment for AutoPASS HUB/IP must be connected on-line

Description: OBE with valid contract (on whitelist).
OBE without valid contract (not on whitelist).

Passages are performed with the OBE at 50 km/h and 80 km/h.
 Check of the toll transaction sent from the RSE.

Intention: Correct matching of the toll transaction record with the data content in the RSE.
 For the valid OBE, one valid transaction is created, and no enforcement transaction is created.
 For the invalid OBE, one transaction with invalid passage signal code is created, and an enforcement transaction is created.
 Correct data records sent from RSE to connected system (test AutoPASS HUB).

7.4 E2E TEST CASES IN PRODUCTION ENVIRONMENT

There must be selected suitable RSE in operative use to be configured to accept the new OBE. The test is basically the same as above, but in a real operative environment, where the transactions are followed to the CS of the TSP.

<i>Test name:</i>	E2E - OBE in an on-road production RSE and production system environment	<i>No.:</i> E2E.2
-------------------	---	--------------------------

Purpose: Verification of the OBE functionality in interaction with road side equipment connected to the AutoPASS production environment with AutoPASS HUB, AutoPASS IP and other back office systems.

Equipment: Selected on-road operative AutoPASS toll stations, and vehicles. If possible, in all different types of equipment in operative use from all RSE suppliers.

Description: OBE with valid test contract (on whitelist).
 OBE without valid contract (not on whitelist).
 Passages are performed with the OBE at 50 km/h and 80 km/h.
 Check of the toll transaction sent from the RSE.

Intention: Correct matching of the toll transaction record with the data content in the RSE.
 For the valid OBE, one valid transaction is created, and no enforcement transaction is created.
 For the invalid OBE, one transaction with invalid passage signal code is created, and an enforcement transaction is created.
 Correct data records sent to AutoPASS HUB and further to AutoPASS IP. From AutoPASS IP the correct transaction with the correct price is sent (via AutoPASS HUB) to CS-TC and CS-TSP (to CS-TSP only if valid contract). CS-TSP acknowledges the transaction.