ETCS System Compatibility Process

SPOP-1442693290-

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Version 3.0

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Revised	Revised by	Approved	Approved by
26.01.2021	JHM	27.01.2021	JSMO

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1 Background for ETCS System Compatibility

1.1 Scope

ETCS System Compatibility testing is used to document the technical compatibility between a NoBo certified ETCS onboard constituent and the NoBo certified Banedanmark ETCS trackside subsystems. The testing is documented in an ESC Test Report and an ESC IC Statement. If the test is made on a specific application for a train series, then an ESC Statement for the train type (also called First of Class) can also be issued. The ESC statement can be used by the ERTMS onboard owner or supplier to document the CCS compliance with the intended Area of Use of a vehicle fitted with this version of the ERTMS onboard.

1.1.1 Definitions

General process, roles and definitions from the European guide [3] for the application of the CCS TSI [1] applies.

Following specific definitions apply:

(1) ESC Test Facility: Banedanmark owned and operated Joint Test Lab in Valby.
(2) ESC Test Manager: Banedanmark System Integration Architect. Analysis, test planning can be delegated to specialists and Test execution will normally be delegated to test specialists.
(3) ESC Test Facility manager: JTL Test tool manager.
(4) Type of Line (ToL): The integrated signalling trackside based on a NoBo certified ETCS Subsystem. It is the intention to have two ToL for the entire future Banedanmark ETCS infrastructure (ToL "East" and ToL "West").
(5) First of Class (FoC): The first train in a series equipped with ERTMS which has been used to define the ERTMS configuration of the train type. The FoC documentation is normally used as basis for a Type Authorisation and an Authorisation to place on the market.

1.1.2 Contact point regarding ESC test planning

The contact point for ESC test planning at the Banedanmark ESC test facility is

ESC- Test Facility Manager@BANE.dk

Please contact 4-6 months in advance of the time where testing is foreseen to allow proper analysis and planning.

1.1.3 Abbreviations

Acronym	Description
ATAF	Automatic Track Ahead Free
BG	Balise Group
DEG	Degraded Scenarios
DMI	Driver Machine Interface

EDL	Early Deployment Line
EoA	End of Authority
ERA	European Railway Agency
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EVC	European Vital Computer
FS	Full Supervision (driving mode)
GSM-R	Global System for Mobile Communications - Railway
IC	Interoperability Constituent
KM	Key Management
KMS	Key Management System
JRU	Juridical Recording Unit
JTL	Joint Test Laboratory
LINK	Linking Information
LoA	Limit of Authority
LRBG	Last Relevant Balise Group
LT	Level Transitions
LX	Level Crossing
MAD	Movement Authority Description
MB	Marker Board
MPV	Specific Requirements for ETCS Messages, Packets and Variables
NL	Non-Leading (driving mode)
NoBo	Notified Body
NTC	National Train Control
NV	National Values
OBU /OB	On-Board Unit
OMA	Obtaining Moving Authority
OS	On-Sight (driving mode)
OSP	On-Sight Protection
OTC	Operational Test Case
OTH	Others
OTS	Operational Test Scenario
OV	Override (either authorised or not)
RBC	Radio Block Centre
RBCH	RBC/RBC Handover
RFB	Rules for Balises
SB	Stand By (driving mode)
SH	Shunting (driving mode)
SJ	Splitting/Joining
SL	Sleeping (driving mode)
SMA	Shortening of Movement Authority
SoM	Start of Mission
SR	Staff Responsible (driving mode)
SRS	System Requirements Specification
SS	Subsystem
STM	Specific Transmission Module
SvL	Supervised Location
TC	Track Conditions
TIU	Train Interface Unit

TM	Text Messages
TSR	Temporary Speed Restriction
UES	Unconditional Emergency Stop

1.1.4 References

[1] TSI CCS: Commission regulation (EU) 2016/919 as amended by Implementing Regulation (EU) 2019/776 of 16 May 2019.

[2] Vehicle authorisation regulation: Commission implementing regulation EU 2018/545

[3] Guide for the application of the CCS TSI, GUI/CCS TSI/2019, version 6.1

[4] ERTMS L2 - Generic Operational Test Cases Data Sheets (SP-EMO-P2-002008 v3.2)

[5] Subset 026 System Requirement specification v3.4.0

[6] Denmark Fjernbane Operational Concept

[7] ORF-20-4 – Banedanmark Fjernbane Operational Rules v20-4

[8] SP-FB-ON-006631 v3.5 – F-bane Infrastructure Common Engineering Rules

[9] SP-FIW-GD-000693 v3.0 – Functional Requirements

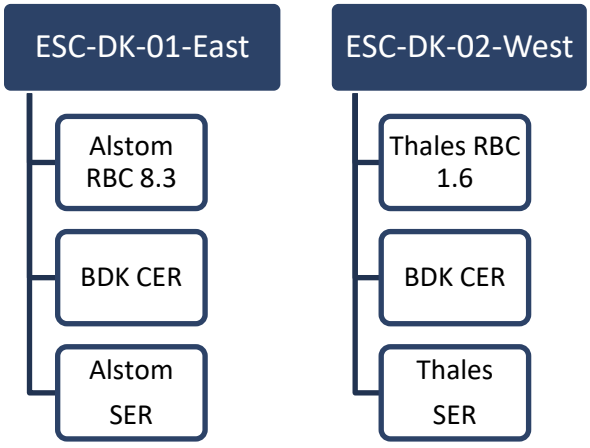
[10] SP-FIW-GD-000777 v3.0 – Non-Functional Requirements

[11] BDK National Values – SP-FB-FD-008858

[12] SP-FIW-GD-000649 v1.0 – LX

1.1.5 Type of Line concept

The infrastructure Type of Line is defined by the ETCS subsystem and its engineering principles (**C**ommon **E**ngineering **R**ules and **S**upplier **E**ngineering **R**ules). For the ERTMS Level 2 trackside the system identifier is the RBC version.



Note: The system identifiers are valid January 2021

1.2 Operational test cases

The operational test cases for the Danish ERTMS signalling system are defined in the document [4] available on BDK website https://uk.banedanmark.dk/en/Railway-Undertaking/Testing-ETCS_onboard-systems-_ESC_.

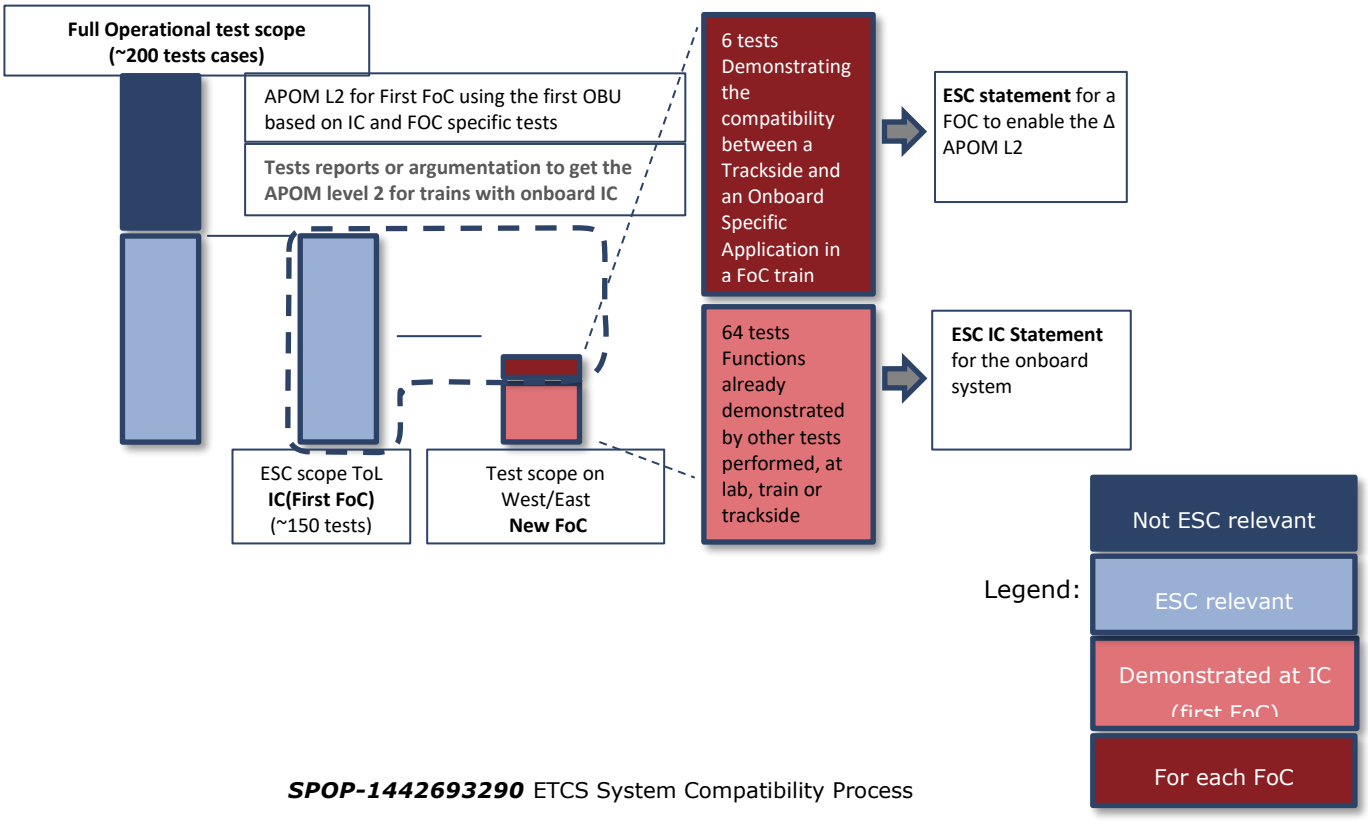
These operational test cases cover the testing scope of the complete signalling system including TMS and specific functionalities which doesn't affect the ERTMS onboard-trackside integration. A subset of approximately 150 generic operational test cases cover the compatibility between ERTMS onboard and trackside for the Danish implementation.

Generically executed tests at the IC level are tests which are independent of the Rolling Stock characteristics of the First of Classes in which the IC's will specifically be built in. The Onboard family can be seen as the group of First of Class vehicles which will be equipped with the same generic OB CCS IC's. Only tests being impacted by the vehicle characteristics will be replayed, if the other vehicle-independent tests have been executed on a FoC in the IC family. These first tests then serve the compatibility argument and are FoC-uniquely executed each time, while the latter will be reused without re-execution. No ESC tests are foreseen on series vehicles, instead the applicant's declaration of "Verification to Type" is used for the application for authorisation to place on the market (APOM).

The test cases for a specific ESC session are selected to cover the ERTMS onboard IC functional implementation and its limitations (chapter 3 of the technical file). Any limitations, which based on the analysis are deemed to potentially affect the interaction with the infrastructure, shall be covered by an operational test case, new test cases can be added for this purpose.

The following figure represents the case where the compatibility of a new onboard IC system is validated against a new trackside subsystem (ToL).

Figure 1: Overview of OTS and relation with ESC and ESC IC test cases



2 Testing and evaluation process

The testing is done remotely by connecting the onboard system in an onboard test facility with the ETCS trackside representations in the Banedanmark Joint Test Laboratory according to ETCS Subset 111. Supplementary testing on operational lines may be necessary to cover dynamic aspects which cannot be fully tested in the test lab environment, but trackside tests mainly serve the purpose of demonstrating safe integration of ERTMS in the vehicle which is outside ESC scope.

Figure 2: Connection facilities for remote JTL testing

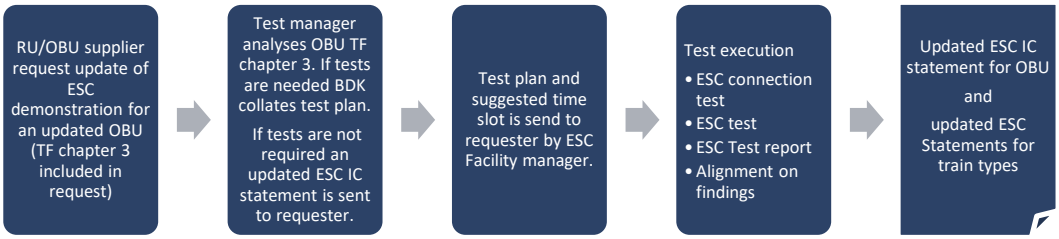
2.1 ESC application cases

The entity applying for ESC demonstration can be one of the following:

1. A Railway Undertaking or an onboard supplier with a new version of an existing ETCS onboard system requiring an update of the ESC IC statement.
    a. Based in an analysis of the changed OBU including chapter 3 of the associated technical file the need for a full or partial ESC demonstration shall be decided.
    b. If none of the changes affect the compatibility with the ToL, then the ESC Test manager can decide to update the ESC IC statement for the OBU based in the desktop analysis.
2. A Railway Undertaking or an onboard supplier with a new ETCS onboard system without a previous Danish ESC IC Statement against this ToL.
    a. Full ESC test including any additional tests associated with the specific OBU IC technical file chapter 3.
3. Banedanmark or their trackside ERTMS supplier with a new version of the existing ETCS trackside system (Type of Line) which formed basis for the valid ESC IC statements against this ToL.
    a. All OBU systems with ESC IC statements (currently including the ESC IC statement implicitly) referring to the current ToL shall be considered for the compatibility analysis.
    b. Based in an analysis of the changed trackside the need for full or partial ESC demonstrations shall be decided.
    c. If none of the changes affect the compatibility with the OBUs, then the ESC Test manager can decide to update the ESC IC statements for the OBUs based in the desktop analysis.

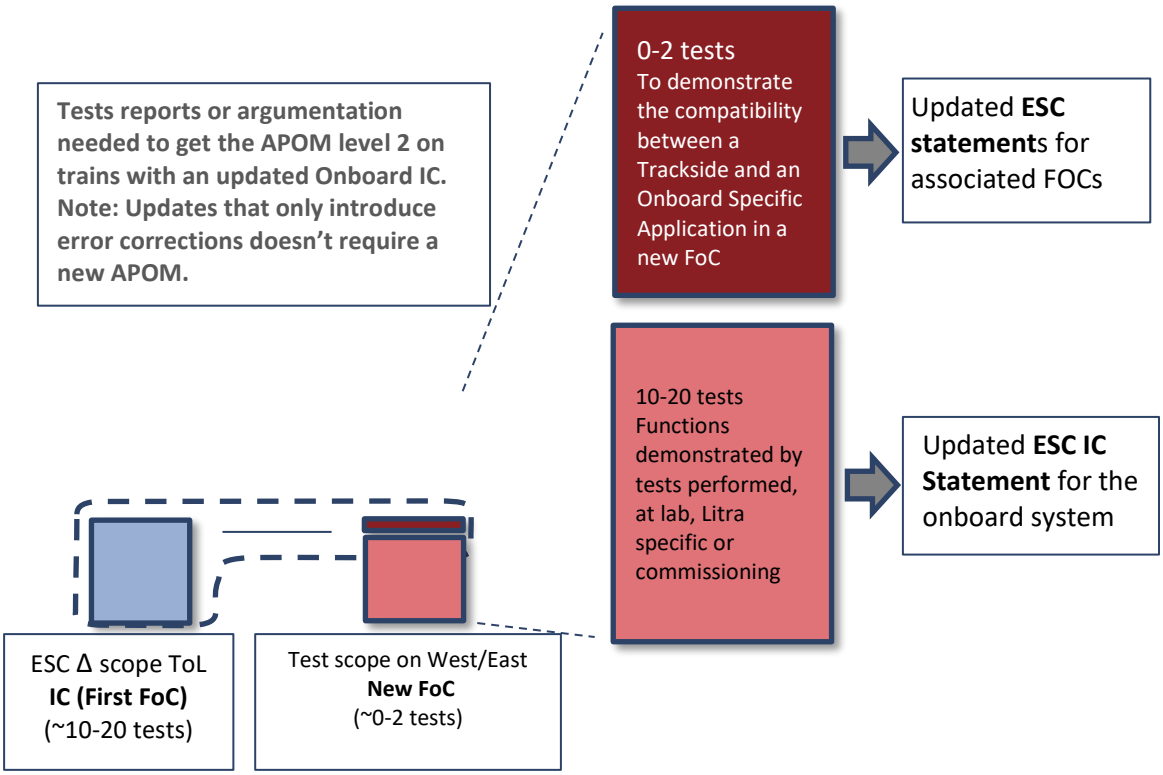
The selection of OTCs for the following ESC cases are detailed in Appendix 1.

Case 1. Updated OBU (delta of Appendix 1 §2.3).

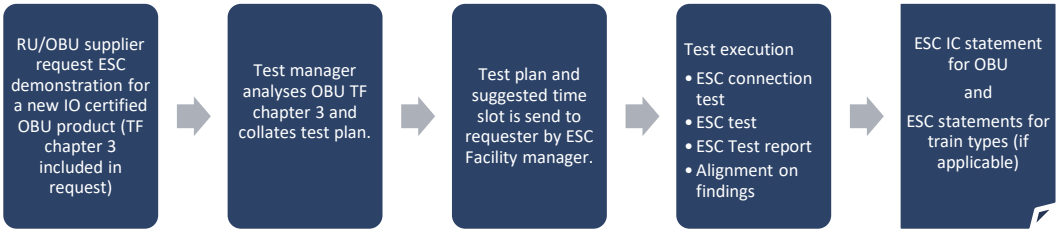


The functional changes for the onboard are analysed towards the trackside functional scope(Non-regression) and any new or changed limitations (Technical File chapter 3) are analysed for possible impact on integration with trackside.

Figure 3: Test strategy overview for case 1

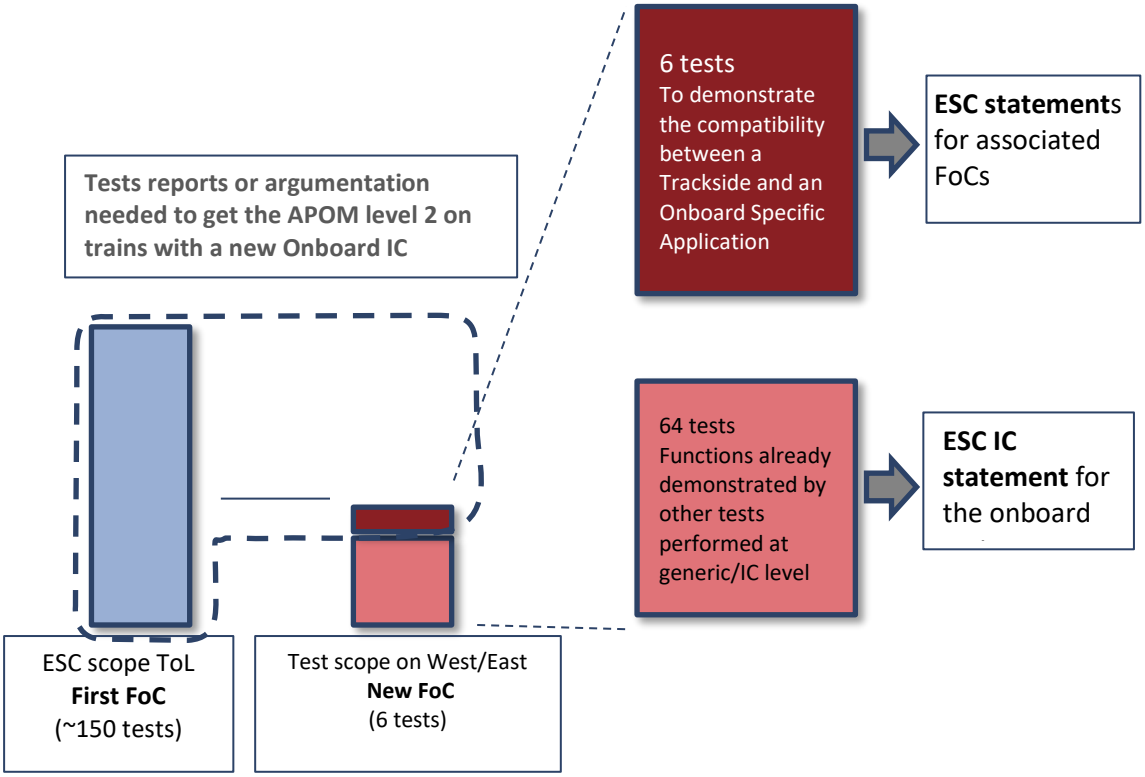


Case 2. New OBU (Appendix 1 §2.3).



The onboard limitations (TF chapter 3) are analysed for possible impact on integration with trackside. Any aspects which may impact the integration shall be addressed by tests.

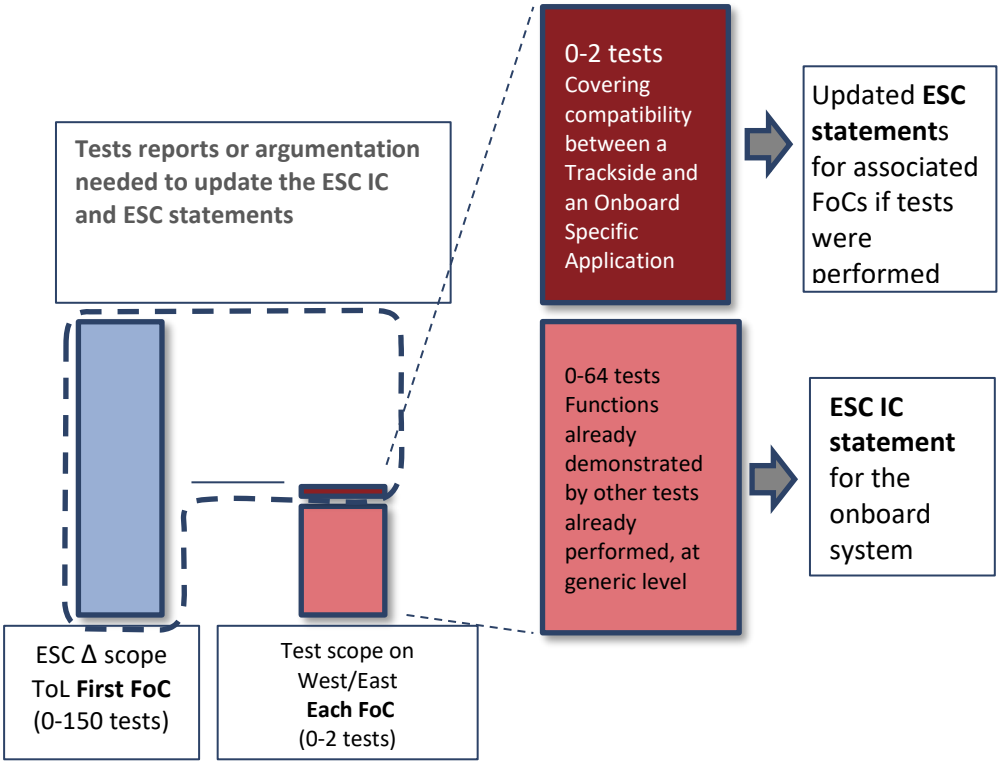
Figure 4: Test strategy overview for case 2



Case 3. Updated Type of Line(Appendix 1 §2.2 + delta).

The functional changes to the infrastructure are analysed towards all the onboard ICs (Non-regression) and any new or changed limitations (Trackside TF chapter 3) are analysed for possible impact on integration with the onboards.

Figure 5: Test strategy overview for case 3



2.2 Intention of the ESC

The ESC IC Statement and ESC statements will refer to the above-mentioned tests, and together will lead the authorising entity (NSA or ERA) to issue:

- A new/updated APOM for the Onboard EC DoV if required per TSI CCS [1] and regulation 2018/545 [2], with registration in the national vehicle register and ERATV, together with an updated registration regarding compatibility only (update of ToL).
- If no new or updated APOM is required (regulation 2018/545 [2] article 15.1c) then only the registration in National vehicle register and ERATV is needed.

Appendix 1. Selection of test scenarios

1.1. Purpose

This appendix provides a set of recommendations for the testing of the ERTMS system in the three scenarios:

- Demonstrating interoperability for a new First of Class of an already proven onboard IC on an already authorised Line
- Demonstrating interoperability of a new ERTMS line when a previous line has been already authorised with the same trackside and onboard subsystems
- Demonstrating interoperability for a new onboard IC (supplier) coming to Banedanmark network

The purpose is to describe a delta approach and to limit the number of tests that need to be re-played.
The recommendations are based on criteria established thanks to the Ineco and Banedanmark experiences (coming from the tests already performed in the two Banedanmark Early Deployment Lines and first roll-out lines) and considering the requirements of the current TSI (see Ref. [1]).

1.2. OTCs Scope

The Operational Test Cases (OTCs) correspond to the operational test scenarios as defined in the TSI CCS §6.1.2 (see Ref. [1]):

> *"For the purpose of this TSI, an 'operational test scenario' means the description of the intended railway system operation in situations relevant for ETCS and GSM-R (e.g. entry of a train into an equipped area, awakening of a train, overriding a signal at stop), by means of a sequence of trackside and on-board events related to or influencing the Control-command and Signalling subsystems (e.g. sending/receiving messages, exceeding a speed limit, actions of operators and the specified timing between them.*
> *The operational tests scenarios are based on the engineering rules adopted for the project.*
> *Check of compliance of a real implementation with an operational tests scenario shall be possible gathering information through easily accessible interfaces (preferably the standard interfaces specified in this TSI)."*

The OTCs have been created as proposed in the TSI and considering the engineering rules adopted for the Banedanmark ERTMS infrastructure (see Refs.[6]-[12].
Once these OTCs are executed, their results are part of the supporting evidence for the trackside subsystem regarding the integration with CCS on-board subsystems and with rolling stock.
More concretely, these results serve to check that all functions required by the application are implemented in accordance with specifications referenced in the CCS TSI (see table 6.3 in Ref. [1]).

In addition to be above, the TSI refers to other uses for these OTCs:

- The *operational test scenarios* of the relevant trackside subsystem are also the basis of the **verification of the compatibility** tests to support a decision on the use of an on-board/trackside

subsystems based on how it interacts with the respective trackside/on-board subsystems that are relevant for its intended use (see 6.5 in Ref. [1]).

- The TSI also foresees the use of the *operational test scenarios* in additional tests to **increase the confidence in the on-board** equipment operating correctly on different trackside subsystems (see 6.2.5 in Ref. [1]):

– *"to increase confidence that the On-board ETCS Interoperability Constituent will operate correctly when installed in On-board Control-command and Signalling Subsystems running on different Trackside Control- command and Signalling applications, it is recommended that it is tested using relevant scenarios from the ones published by the Agency; see point 6.1.2 (Principles for testing ETCS and GSM-R). The tests can be performed using real equipment or a simulated Trackside Control-command and Signalling Subsystem.*

– *These tests are not mandatory for the certification of the On-board ETCS Interoperability Constituent."*

Finally, the TSI requires evidence of test runs under full operational conditions. The tests for the onboard subsystem must also increase the confidence in the absence of systematic failures at subsystem level. For this purpose, a subset of the OTCs can be used (see tables 6.2 and 6.3 in Ref. [1]).

1.3. Laboratory vs. Site Tests

The long term Banedanmark testing strategy is to execute most of the tests (targeting as close as possible 100% of tests) in laboratory environments. This is already reflected in the OTC selections for new train series of an already known onboard with a well known and controlled relation between generic product, generic application and specifc implementation for the train series.
To reach that objective, the laboratory environment needs to provide trust about the results obtained; they must be equal to the results gathered in the field implementation. It is important to evaluate if the simulators and the facilities provided by a laboratory, provides a representative picture of the reality (e.g. can errors be simulated as they will happen on site?).
Therefore, at the beginning of the testing activities, some tests were performed twice, in the laboratory and on the site, to compare that the results obtained were equal. As more tests are executed, and evidences of equivalent results are seen, the less tests on site will be necessary.

Tests can be avoided if the arguments of correctness can be built by other means (design documentation, previous tests results, or other analysis techniques).
Considering all the above and involving the skilled and right stakeholders, the "only and really" necessary set of tests to be executed can be identified.

2. Testing Strategies

Onboard

Regarding the tests to increase confidence in the onboard (see 6.2.5 in Ref. [1]), these should be decided by the on-board supplier and as they are related to the on-board constituent and not to the on-board subsystem (i.e. on-board integrated in the train), it should be enough to test them once in East and once in West (i.e. to test it on different trackside subsystems). Note that, performing these tests at OB constituent level may reduce the number of checks at on-board subsystem level.
Ideally, the trackside line selected should provide as much functionality as possible.
Regarding the test runs under full operational conditions these are part of the subsystem EC certificate (see table 6.2 in Ref. [4]) and should be proposed by the applicant and agreed with the NoBo.
Regarding the verification of the compatibility, only tests which result could be impacted because of the integration of the on-board with a different train should be tested.
This document proposes the list of OTCs that can be used for the three above purposes, based on the criteria:

(1) Nominal and Degraded operations at the entry/exit to/from the line, SoM or Handover
(2) Tests affected by Odometry
(3) Tests affected by Braking Curves

Trackside

For obtaining the EC certificate and authorisation of each line a set of OTCs traced to the engineering rules have to be tested to provide **supporting evidence for the trackside subsystem** verification (see 6.1.2 and table 6.3 in Ref. [1]).
For an additional line, and although common engineering rules have been already tested there is a need for evidence and assurance that the specific application (data and specific engineering rules) is also correct. Therefore, the proposal for the tests to be executed for a new line when a previous line has been already authorised with the same trackside and on-board subsystems is:

(1) Main operational situations that could happen in the line: for example, sampling of all the functionalities implemented by the trackside subsystem in nominal conditions (SoM, TSR, LX, entries in SH and OS areas, track conditions, shortening and extending MA etc).
(2) Test with various trains: for example, Handover with more than one train and/or Split and Join.
(3) Test singularities of the new line: for example, Entry and Exit to/from the line including also entry/exit to/from workshops, depots, etc.
(4) Test related to Keys.

Detailed OTCs data sheets can be found in Ref. [4].
Note that the detailed steps for the execution of some test cases are different between West (Thales) and East (Alstom) trackside implementations.

2.1. New FoC (in an already Authorised line)

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
MAD1	The train is running from the beginning to the end of the line at the maximum permitted speed. Static speed profile supervision.	Y	Y	(a) and (e)Along all the line	Verify that no braking curves not related to the SSP are shown in the DMI when the train is running at a maximum permitted speed and with all the marker boards of the route in proceed aspect.In addition it shall be verified that the onboard correctly manages the SSP.
MAD6	Management of the release speed. Release speed is calculated onboard.	Y	Y	(d) and (e) Once	Verify that the release speed calculated on board allow the train to approach close enough to the marker board.
RFB1	The train is running from the beginning to the end of the line at the maximum permitted speed.	Y	Y	(a)Along all the line	Normal operation (full operational conditions).Verify that on-board reads and manages all the information received from balises when the train is running at the maximum permitted speed.
RBCH1	Handover management. FS mode.	Y	Y	(a) Once	Normal operation (full operational conditions).
LT1	Level transition from LNTC to L2. The first marker board after the transition border is in proceed aspect and the train is running at the maximum permitted speed.	Y	Y	(a) and (c) Once	It shall be checked that the transition is performed correctly and without significant changes in the permitted speed.
LT2	Level transition from L2 to LNTC. The last marker board before the level transition border is in proceed aspect and the train is running at the maximum permitted speed.	Y	Y	(a) and (c)At every possible location	It shall be checked that the transition is performed correctly and without significant changes in the permitted speed.

2.2. New Line (same On-Board and Trackside than in an already Authorised Line)

Code	Test Case	West (Thales)	East (Alstom)	Criteria and conditions
SoM1	SoM in SB mode with valid position. The train front end is outside the ATAF zone.	N	Y	(1) Once
SoM2	SoM in SB mode when the train has invalid or unknown location information. ATAF procedure.	N	Y	(1) Once
SoM5	SoM in SB mode with valid position. ATAF procedure. Train inside a trusted area.	Y	N	(1) Once
SoM6	SoM in SB mode when the train has an invalid or unknown location information. ATAF procedure.	Y	N	(1) Once
OMA7	MA Request. SoM of two trains in SB mode leaving the same track in opposite directions simultaneously.	Y	Y	(2) Once
SH1	Entering a PSA. Mode transition from FS to SH ordered by trackside.	Y	Y	(1) and (3) Once
SH4	Entering a TSA or Possession. Mode transition from FS to SH selected by the driver. The train has a valid position within a TSA/Possession.	Y	Y	(1) and (3) Once
SJ1	Joining procedure. Movement to couple to a stationary train. Mode transition from FS mode to OS mode and to SB mode. Approaching train.	Y	Y	(2) Once
SJ2	Joining procedure. Mode transition from SB mode to SL mode. Stationary train.	Y	Y	(2) Once
SJ3	Splitting procedure. New train data introduced in the train that was supervising the movement before.	Y	Y	(2) Once
SJ4	Splitting procedure. SoM performed in the "New train after splitting"	Y	Y	(2) Once
OSP1	Mode transition from FS to OS at the current location.	Y	Y	(1) Once
OSP4	Mode transition from OS to FS at a marker board	N	Y	(1) Once
OSP5	Mode transition from OS to FS at a marker board	Y	N	(1) Once
OSP6	Mode transition from OS to SH at a marker board.	Y	Y	(1) Once
TSR1	Management of TSR information sent by RBC. FS mode	Y	Y	(1) Once
TSR7	TSR revocation before reaching the TSR area.	Y	Y	(1) Once
MAD1	The train is running from the beginning to the end of the line at the maximum permitted speed. Static speed profile supervision.	Y	Y	(1) Along all the line
SMA2	Co-operative shortening of a MA due to a marker board closure. Request to shorten MA is granted.	Y	Y	(1) Once
SMA3	Shortening MA due to IXL failure: train is inside IXL area.	N	Y	(1) Once

Code	Test Case	West (Thales)	East (Alstom)	Criteria and conditions
SMA10	MA shortening in RBC/RBC Handover area.	Y	Y	(1) and (3) Once
SMA16	Shortening MA due to IXL failure. Train is outside IXL area.	N	Y	(1) Once
RFB1	The train is running from the beginning to the end of the line at the maximum permitted speed.	Y	Y	(1) Along all the line
LINK1	The train is running from the beginning to the end of the line. Verify that all the BGs are marked as "linked"	Y	Y	(1) Along all the line
LINK2	The train is running from the beginning to the end of the line. Verify that the linking reaction at every balise group is set to "No reaction".	Y	Y	(1) Along all the line
LINK3	The train is running from the beginning to the end of the line. Verify that the value of Q_LOCACC is correct.	Y	Y	(1) Along all the line
OV1	Perform a SPAD at an EoA. Mode transition from FS to TR at a level 2 marker board.	Y	Y	(1) Once
OV2	Override with authorization. FS mode.	Y	Y	(1) Once
RBCH1	Handover management. FS mode.	Y	Y	(1) and (3) Once
RBCH5	Accepting RBC is not functioning appropriately.	Y	Y	(1) and (3) Once
RBCH7	Handover management with more than one train in different tracks and same direction.	Y	Y	(2) Once
RBCH8	Handover management with more than one train in different tracks and opposite direction.	Y	Y	(2) Once
LX3	Level crossing procedure when the RBC can confirm that the status of level crossing is protected.	Y	Y	(1) Once
LX4	Level crossing procedure when the RBC cannot confirm that the status of level crossing is protected.	Y	Y	(1) Once
LX6	Management of Staff Crossing when the warning system has been verified successfully for the route.	Y	Y	(1) Once
LX8	Management of Passenger Crossing when the warning system has been verified successfully for the route.	Y	Y	(1) Once
TC4	Management of powerless sections.	Y	Y	(1) Once
TC5	Management of a radio hole.	Y	Y	(1) Once
TC6	Track condition Station Platform.	Y	Y	(1) Once
LT1	Level transition from LNTC to L2. The first marker board after the transition border is in proceed aspect and the train is running at the maximum permitted speed.	Y	Y	(1) and (3) At every possible location

Code	Test Case	West (Thales)	East (Alstom)	Criteria and conditions
LT2	Level transition from L2 to LNTC. The last marker board before the level transition border is in proceed aspect and the train is running at the maximum permitted speed.	Y	Y	(1) and (3) At every possible location
LT3	Level transition from LNTC to L2. The first marker board after the transition border is in OS aspect.	Y	Y	(1) and (3) Once
LT5	Level transition from LNTC to L2. The first marker board after the transition border is in stop aspect.	Y	Y	(1) and (3) Once
LT6	Level transition from L2 to LNTC. The first signal after the transition border is in stop aspect.	Y	Y	(1) and (3) Once
LT13	Level transition from L0 to L2. The first marker board after the transition border is in proceed aspect and the train is running at the maximum permitted speed.	Y	Y	(1) and (3) Once
LT14	Level transition from L2 to L0. The last marker board before the transition border is in proceed aspect and the train is running at the maximum permitted speed.	Y	Y	(1) and (3) At every possible location
LT15	Level transition from L0 to L2. The first marker board after the transition border is in OS aspect.	Y	Y	(1) and (3) Once
LT17	Level transition from L0 to L2. The first marker board after the transition border is in stop aspect.	Y	Y	(1) and (3) Once
LT22	Level transition from L2 to L0 when level transition order is not received.	Y	Y	(1) and (3) Once
LT38	Shorten MA in the level transition.	Y	Y	(1) and (3) Once
KM1-RBC	Key generation and installation.	Y	Y	(4) Once
KM2-RBC	Key deletion.	Y	Y	(4) Once
KM3-RBC	Key modification.	Y	Y	(4) Once
KM4-RBC	Key validity period.	Y	Y	(4) Once

2.3. New On-Board Supplier coming to Banedanmark network

When a new on-board supplier is about to enter into Banedanmark rail network, in order to **increase confidence in the on-board** (see 6.2.5 in Ref. **Fejl! Henvisningskilde ikke fundet.**) and to secure the **verification of the compatibility** (see 6.5 in Ref. [1]), a set of operational tests must be played.

This document proposes the list of OTCs that can be used for the above purpose, based on the criteria:

(1) Situations where an action in the DMI must be performed (i.e. driver performing SoM, acknowledging the transition to OS/SH, exit from SH, etc.)

(2) Situation where a reaction from the on-board must be performed (supervision of track conditions, radio hole, management of MA request parameters, establishing RBC connection, etc.)

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
SoM1	SoM in SB mode with valid position. The train front end is outside the ATAF zone.	N	Y	(a) Once	Normal operation (full operational conditions). Verify that the start of mission procedure is performed correctly.
SoM2	SoM in SB mode when the train has invalid or unknown location information. ATAF procedure.	N	Y	(a) Once	Normal operation (full operational conditions). Verify that the start of mission procedure is performed correctly.
SoM3	SoM in SB mode with valid position. The train front end is inside the ATAF zone.	N	Y	(a) Once	Normal operation (full operational conditions). Verify that the start of mission procedure is performed correctly.
SoM5	SoM in SB mode with valid position. ATAF procedure. Train inside upgrade window.	Y	N	(a) and (d) Once	Normal operation (full operational conditions). Verify that the start of mission procedure is performed correctly.
SoM6	SoM in SB mode when the train has an invalid or unknown location information. ATAF procedure.	Y	N	(a) and (d) Once	Normal operation (full operational conditions). Verify that the start of mission procedure is performed correctly.
SoM8	SoM procedure inside the upgrade window when the distance between the marker board and the axle counter is very short. Mitigation of HZ-74.	Y	N	(d) Once	Verify the mitigation of the HZ 074. This test case is directly linked to the train odometry.

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
OMA3	Mitigation for an erroneous track occupation. The train ignores the conditional emergency stop.	Y	N	(d) At different train speeds	Verify that the odometry of the train does not make the train accept the CES.
SH1	Entering a PSA. Mode transition from FS to SH ordered by trackside.	Y	Y	(d) and (e) Once	Verify that the odometry and the braking curves of the train allow the train to approach the SH area at a sufficient speed.
SH3	Entering a PSA. Mode transition from FS to OS and after to SH ordered by trackside.	Y	Y	(d) and (e) Once	Verify that the odometry and the braking curves of the train allow the train to move at a sufficient speed when it is approaching to an OS area and thereafter to an SH area.
SH4	Entering a TSA or Possession. Mode transition from FS to SH selected by the driver. The train has a valid position within a TSA/Possession.	Y	Y	(a) Once	Normal operation (full operational conditions).
SJ1	Joining procedure. Movement to couple to a stationary train. Mode transition from FS mode to OS mode and to SB mode. Approaching train.	Y	Y	(d) and (e) Once	Verify that the odometry and the braking curves of the train allow the train to move at a sufficient speed when it is approaching to another train in order to perform a joining procedure.
OSP1	Mode transition from FS to OS at the current location.	Y	Y	(d)Once	Verify that if the on-board equipment receives a mode profile giving an OS area which the train has already entered with its "max safe front end" the on-board equipment immediately switches to OS mode.

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
OSP4	Mode transition from OS to FS at a marker board	N	Y	(d) and (e) Once	Verify that the odometry and the braking curves of the train allow the train to move at a sufficient speed when it is approaching the end of the OS area.
OSP5	Mode transition from OS to FS at a marker board	Y	N	(d) and (e) Once	Verify that the odometry and the braking curves of the train allow the train to move at a sufficient speed when it is approaching the end of the OS area.
OSP6	Mode transition from OS to SH at a marker board.	Y	Y	(d) and (e) Once	Verify that the odometry and the braking curves of the train allow the train to approach the SH area at a sufficient speed.
TSR1	Management of TSR information sent by RBC. FS mode	Y	Y	(a), (d) and (e) Once	It shall be verified that the on-board equipment supervises correctly the TSR information (the on-board shall supervise the "permitted speed supervision limit" with the "max safe front end" and the end of the TSR with the "Min safe rear end")
TSR5	Management of the most restrictive speed profile when a TSR is established after a crossover. TSR more restrictive than the crossover permitted speed.	Y	Y	(d) and (e) Once	It shall be verified that the on-board equipment supervises correctly the MRSP information (TSR and SSP). The on-board shall supervise the "permitted speed supervision limit" with the "max safe front end" and the end of the MRSP with the "Min safe rear end"

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
TSR6	Management of the most restrictive speed profile when a TSR is established after a crossover. TSR less restrictive than the crossover permitted speed.	Y	Y	(d) and (e) Once	It shall be verified that the on-board equipment correctly supervises MRSP information (TSR and SSP). The on-board shall supervise the "permitted speed supervision limit" with the "max safe front end" and the end of the MRSP with the "Min safe rear end").
TSR7	TSR revocation before reaching the TSR area.	Y	Y	(b) Once	Verify that the onboard does not manage the TSR once the RBC has revoked it.
MAD1	The train is running from the beginning to the end of the line at the maximum permitted speed. Static speed profile supervision.	Y	Y	(a) and (e)Along all the line	Verify that no braking curves not related to the SSP are shown in the DMI when the train is running at a maximum permitted speed and with all the marker boards of the route in proceed aspect.In addition it shall be verified that the onboard equipment manages the SSP correctly.
MAD2	MA in shifted location after a SoM. Train position in advance of the max safe front end position.	Y	Y	(a) and (d) Once	Verify that the onboard is able to manage an MA in shifted location correctly.
MAD6	Management of the release speed. Release speed is calculated onboard.	Y	Y	(d) and (e) Once	Verify that the release speed calculated on board allow the train to approach close enough to the marker board.
MAD9	Static speed profile supervision when train data changes.	Y	N	(e) Once	Verify the correct management of the SSP in relation to the different train categories and train data.
SMA2	Co-operative shortening of a MA due to a marker board closure. Request to shorten MA is granted.	Y	Y	(e) Once	Depending on the braking curve the co-operative shortening of MA could be accepted or not.

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
SMA3	Shortening MA due to IXL failure: train is inside IXL area.	N	Y	(b) Once	Main degraded situation. Verify that once the RBC sends a shortened MA (packet 3) due to an IXL failure the movement authority stored onboard is up to date immediately.
SMA4	Co-operative shortening of a MA due to a marker board closure. Request to shorten MA is rejected.	Y	Y	(e) Once	Depending on the braking curve the co-operative shortening of MA could be accepted or not.
SMA8	Conditional emergency stop due to signal closure.	Y	N	(b) Once	Main degraded situation. Verify that the on-board accepts the Conditional Emergency Stop received from the trackside subsystem.
SMA10	MA shortening in RBC/RBC Handover area.	Y	Y	(b), (d) and (e) Once	Verify that the on-board accepts the co-operative shortening of MA.
SMA14	Co-Operative Shortening of MA due to Radio Hole.	Y	Y	(e) Once	Verify that the on-board equipment accepts the co-operative shortening of MA.
SMA16	Shortening MA due to IXL failure. Train is outside IXL area.	N	Y	(b) Once	Main degraded situation. Verify that once the RBC sends a shortened MA (packet 3) due to a IXL failure the movement authority stored onboard is up to date immediately.
RFB1	The train is running from the beginning to the end of the line at the maximum permitted speed.	Y	Y	(a)Along all the line	Normal operation (full operational conditions).Verify that on-board equipment reads and manages all the information received from balises when the train is running at the maximum permitted speed.

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
DEG4	Unconditional emergency stop is sent by the RBC in order to stop one train.	Y	Y	(b) Once	Main degraded situation. Verify that when an Unconditional emergency stop is received the on-board equipment switches to TR mode. In addition it shall be verified that the UES is revoked correctly once the RBC has sent the revocation of the UES.
OV1	Perform a SPAD at an EoA. Mode transition from FS to TR at a level 2 marker board.	Y	Y	(d) Once	Verify that when the train passes the EoA with its "min safe front end" the on-board equipment switches to TR mode.
OV2	Override with authorization. FS mode.	Y	Y	(a) Once	Normal operation (full operational conditions).
RBCH1	Handover management. FS mode.	Y	Y	(a) Once	Normal operation (full operational conditions).
RBCH5	Accepting RBC is not functioning appropriately.	Y	Y	(b) Once	Main degraded situation
RBCH6	Management of the overlapping TSRs information in handover area.	Y	Y	(e) and (d) Once	It shall be verified that the onboard correctly supervises the TSR information (the on-board shall supervise the "permitted speed supervision limit" with the "max safe front end" and the end of the TSR with the "Min safe rear end") when performing a Handover procedure.

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
LX1	Management of Private Crossing. The RBC sends a Temporary Speed Restriction with the value set to zero.	Y	Y	(a), (d) and (e)	It shall be verified that the on-board equipment correctly supervises the TSR information (the on-board shall supervise the "permitted speed supervision limit" with the "max safe front end" and the end of the TSR with the "Min safe rear end") when the train is passing through a private crossing.
LX3	Level crossing procedure when the RBC can confirm that the status of level crossing is protected.	Y	Y	(a) Once	Normal operation (full operational conditions). Verify that the information regarding level crossing (packet 88) is managed correctly by the on-board when the status of the level crossing is "Protected".
LX4	Level crossing procedure when the RBC cannot confirm that the status of level crossing is protected.	Y	Y	(b) Once	Main degraded situation. Verify that the information regarding level crossing (packet 88) is managed correctly by the on-board when the status of the level crossing is "Non protected"
LX6	Management of Staff Crossing when the warning system has been verified successfully for the route.	Y	Y	(a) Once	Normal operation (full operational conditions).
LX7	Management of Staff Crossing when the warning system has been verified unsuccessfully for the route.	Y	Y	(b), (d) and (e) Once	It shall be verified that the onboard correctly supervises the TSR information (the on-board shall supervise the "permitted speed supervision limit" with the "max safe front end" and the end of the TSR with the "Min safe rear end") when the train is passing through a staff crossing.

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
LX8	Management of Passenger Crossing when the warning system has been verified successfully for the route.	Y	Y	(a) Once	Normal operation (full operational conditions).
LX9	Management of Passenger Crossing when the warning system has been verified unsuccessfully for the route.	Y	Y	(b), (d) and (e) Once	It shall be verified that the onboard correctly supervises the TSR information (the on-board shall supervise the "permitted speed supervision limit" with the "max safe front end" and the end of the TSR with the "Min safe rear end") when the train is passing through a passenger crossing.
TC1	Change of the adhesion factor.	Y	Y	(e) Once	Verify that the indication regarding the adhesion factor is shown correctly in the DMI and the train manages the braking curves accordingly.
TC4	Management of powerless sections.	Y	Y	(a) Once	Verify that the indication regarding the powerless section is shown in the DMI and the train performs the powerless section correctly (main power switch to be switched off, pantograph to be lowered).
TC5	Management of a radio hole.	Y	Y	(a) and (d) Once	Verify that the radio hole indication is shown correctly in the DMI and once the train has entered the radio hole area the onboard unit deactivates the safe radio connection supervision.
TC6	Track condition Station Platform.	Y	Y	(a) Once	Verify that the train correctly manages the "Station platform" condition received from trackside.

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
LT1	Level transition from LNTC to L2. The first marker board after the transition border is in proceed aspect and the train is running at the maximum permitted speed.	Y	Y	(a) and (c) Once	It shall be checked that the transition is performed correctly and without significant changes in the permitted speed.
LT2	Level transition from L2 to LNTC. The last marker board before the level transition border is in proceed aspect and the train is running at the maximum permitted speed.	Y	Y	(a) and (c)At every possible location	It shall be checked that the transition is performed correctly and without significant changes in the permitted speed.
LT5	Level transition from LNTC to L2. The first marker board after the transition border is in stop aspect.	Y	Y	(a) and (c) Once	It shall be checked that the transition is performed correctly and without significant changes in the permitted speed.
LT6	Level transition from L2 to LNTC. The first signal after the transition border is in stop aspect.	Y	Y	(a) and (c) At every possible location	It shall be checked that the transition is performed correctly and without significant changes in the permitted speed.
LT7	Level transition from LNTC to L2 when level transition order is not received.	Y	Y	(b) and (c) Once	Test train behaviour in case of degraded transition
LT8	Level transition from LNTC to L2 with no communication session established between the EVC and the RBC.	Y	Y	(b) and (c) Once	Test train behaviour in case of degraded transition
LT10	Level transition from L2 to LNTC when level transition order is not received.	Y	Y	(b) and (c) Once	Test train behaviour in case of degraded transition

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
LT12	Level transition from L2 to L0/LNTC. The driver does not acknowledge the transition.	Y	Y	(b) and (c) Once	Test train behaviour in case of degraded transition
LT13	Level transition from L0 to L2. The first marker board after the transition border is in proceed aspect and the train is running at the maximum permitted speed.	Y	Y	(a) and (c) At every possible location	It shall be checked that the transition is performed correctly and without significant changes in the permitted speed.
LT14	Level transition from L2 to L0. The last marker board before the transition border is in proceed aspect and the train is running at the maximum permitted speed.	Y	Y	(a) and (c) At every possible location	It shall be checked that the transition is performed correctly and without significant changes in the permitted speed.
LT17	Level transition from L0 to L2. The first marker board after the transition border is in stop aspect.	Y	Y	(a) and (c) Once	It shall be checked that the transition is performed correctly, and the train is able to follow the braking curve and stop before the first marker board.
LT18	Level transition from L2 to L0. The first signal after the transition border is in stop aspect.	Y	Y	(a) and (c) At every possible location	It shall be checked that the transition is performed correctly and the permitted speed at the level transition border allows the train to stop before the first signal at the level 0 area.
LT19	Level transition from L0 to L2 when level transition order is not received.	Y	N	(b) and (c) Once	Test train behaviour in case of degraded transition
LT20	Level transition from L0 to L2 with no communication session established between the EVC and the RBC.	Y	Y	(b) and (c) Once	Test train behaviour in case of degraded transition

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
LT22	Level transition from L2 to L0 when level transition order is not received.	Y	Y	(b) and (c) Once	Test train behaviour in case of degraded transition
LT29	Level transition from LNTC to L2 (use of "TAF up to L2") when the information related track ahead free up to level 2/3 transition location is not received.	N	Y	(b) and (c) Once	Test train behaviour in case of degraded transition
LT35	Level transition from L0 to L2 (use of "TAF up to L2") when the information related track ahead free up to level 2/3 transition location is not received.	N	Y	(b) and (c) Once	Test train behaviour in case of degraded transition
TM1	ETCS Text Message to inform the Train that no MA can be sent by the RBC at SoM. Timetable issue.	Y	Y	(a) Once	Verify that the information regarding the text messages are shown in the DMI correctly
TM2	ETCS Text Message to inform the Train about a joining procedure.	Y	Y	(a) and (d) Once	Verify that the odometry and the braking curves of the train allow the train to move at a sufficient speed when it is approaching to another train in order to perform a joining procedure. The information regarding the text messages is shown in the DMI correctly. To be performed with SJ1
TM4	ETCS Text Message to warn the train as it enters in a platform that is too short.	Y	Y	(a) Once	Verify that the information regarding the text messages are shown correctly in the DMI according to length of train and platform

Code	Test Case	West	East	Criteria and conditions	Objective for compatibility
KM1-EVC	Key generation and installation.	Y	Y	(a) Once	Normal operation (full operational conditions). Check that once the keys are installed in the EVC the EVC is able to establish the communication session with the RBC.
OTH8	VBC-Virtual Balise Cover. Driver set as VBC the balise groups which sends the VBC order.	Y	Y	(a)Once	Normal operation (full operational conditions).Check that the driver can set a VBC
EoM1	Mode transition from FS mode to SB mode. CT_027.	Y	Y	(a) Once	Normal operation (full operational conditions). Verify that the end of mission procedure is performed correctly