Train Control
ETCSsys

ESC TST PLN

Test plan
Compatibility Trackside – OnBoard

Document management

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History

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Thomas Destrée	1.1	30/04/2020		Official version
Tom De Backer	1.1	12/052020		Translation into English
Yves Werner	1.2 draft 1	09/06/2020	§3	Add-ons in tests ESC_ALL_1 and ESC_ALL_2
			§2, §10, §11	Add-ons tests at Belgian borders
Yves Werner	1.2 draft 2	24/06/2020	§1, §3.2, §6.14	Minor modifications after remarks from reviewers
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Thomas Destrée	1.3 draft 1	16/11/2020	§8.3, §11	New testcase “ESC_L1LS_3” for packet 44 received by Baseline 3 train in an ETCS1LS area.
Thomas Destrée	1.3	7/12/2020		Major version
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1. Introduction

1.1 Purpose of the document

This document describes the high-level ETCS system compatibility tests (ETCS System Compatibility) as required in [1].

This tests list is compiled and based on current knowledge. New tests could be added or existing tests removed in function of any return of experience.

The detailed ETCS System Compatibility test scenarios are defined in specific documents available for all trackside sub-system types, per trackside sub-system type and per border.

1.2 Base documents

None

1.3 Reference documents

Ref.	Title	Owner
[1]	REGLEMENT D'EXECUTION (UE) 2018/545	European Commission
[2]	PSI (TC,ETCSdata,z) national values 3.2 F	Infrabel
[3]	Exigences nationales d'Infrabel pour les courbes de freinage ETCS Full Supervision du conventional network 1.2 F.pdf	Infrabel
[4]	Exigences nationales d'Infrabel pour les courbes de freinage ETCS Full Supervision Baseline 2 des LGV 1.1 F	Infrabel

1.4 Annexes

None

1.5 Applicable domain

Infrabel network equipped with ETCS.

1.6 Definitions, symbols and abbreviations

B2	Baseline 2
B3	Baseline 3
BG	Balise Group
EoA	End of Authority
FG	Freight G: Freight train braked in regime G.
FP	Freight P: Freight train braked in regime P.
IREPOS	Function of a BG sending, in one message, an MA Infill and a packet 16.
MR	Maintenance Release
LGV	Ligne Grande Vitesse (High Speed Line)
PASS	Passenger: passenger train.
SoM	Start of Mission

1.7 Known imperfections

The national requirements of Infrabel for braking curves in ETCS Limited Supervision have not been defined.

The transitions at the borders of the Infrabel network must be tested specifically.

The detailed ESC scenarios will be described step by step. The focus is set firstly on the last trackside sub-systems deployed in Belgium: ETCS2 on conventional network and ETCS1 Limited Supervision.

2. Attribution of tests to different trackside sub-systems

The tests described in this document have as objective to verify that the on-boards circulating on the Infrabel network are compatible with the design choices made when defining the different types of trackside sub-systems.

The basic functions are considered covered by the on-board's conformity certificate, only the critical functions and functions relying on using ETCS packets considered non-trivial are covered by these tests.

Some tests are present to make sure the hypotheses made when defining the trackside sub-systems are justified. These tests are identified using letter "I" in the table of chapter 11.

The compatibility tests are defined by type of trackside equipment present on the Infrabel network. The different types of trackside equipment are listed in chapter 2.1.

In addition to the tests described in the chapters 5, 6, 7 and 8 specific to the trackside types on which the train is intended to circulate, each train must also complete the tests of :

chapter 0 -

- Tests to be performed on each trackside sub-system
- chapter 4 - Common Tests shared by all trackside sub-systems
- chapter 9 - Internal Internal transitions on Infrabel Network, depending on the transitions the train might encounter
- chapter 0 – External Transitions on the Infrabel Network borders, depending on the transitions the train might encounter

2.1 Types of trackside sub-systems

2.1.1 ETCS1 FS conventional network and ETCS1 FS on LGV (L2)

This trackside sub-system is based on specification set 1 (B2).

To circulate for this trackside sub-system, the train must complete the specific tests described in chapter 5 (ETCS1FS).

No specific tests for L2 are necessary.

2.1.2 ETCS2 FS conventional network

This trackside sub-system is based on specifications set 2 (B3 MR1).

To circulate for this trackside sub-system, the train must complete the specific tests described in chapter 6 (ETCS2FS).

2.1.3 ETCS1 LS conventional network

This trackside sub-system is based on specifications set 3 (B3 MR2).

To circulate for this trackside sub-system, the train must complete the specific tests described in chapter 8 (ETCS1LS).

2.1.4 ETCS2/1 FS HSL network (L3/L4)

This trackside sub-system is based on specifications Baseline Corridor 2007 v2, SRS v2.2.2 (+ CR748, CR770 for level 2).

To circulate for this trackside sub-system, the train must complete the specific tests described in chapter 6 (ETCS2FS) and 7 (ETCS2 FS on HSL).

3. Tests to be performed on each trackside sub-system

3.1 ESC_ALL_1: Driving ergonomics and nominal conditions

Driving ergonomics in all pertinent levels and modes.

Expected result: no ergonomic issues or unexpected braking invitations detected during the ESC campaign.

Note: no specific scenarios are defined for these tests. Train runs done during the ESC test campaign are used, especially in the transfer between scenario locations.

3.2 ESC_ALL_2: Braking curves

Braking curves conform to the requirements.

Expected results:

1. no unexpected braking interventions detected during the ESC campaign.
2. Braking curves analyzed and conform to the requirements defined in [3], [4]

4. Tests shared by all trackside sub-systems

4.1 ESC_COM_1: Receiving a P203 by an OBU B3

A train equipped with OBU B3 receives a packet 203.

Expected result: the train registers the national values received.

4.2 ESC_COM_2: National values of OBU B3 in absence of P203 (default values)

A train equipped with OBU B3 does not receive P203 and no values for the Belgian NID_C are available on board.

Expected result: the train uses the default national values.

4.3 ESC_COM_3: National values of OBU B3 in absence of P203 (national values defined on board)

A train equipped with OBU B3 does not receive P203 and values for the Belgian NID_C are available on board.

Expected result: the train uses the correct national values [2].

4.4 ESC_COM_4: Receiving a P203 by an OBU B2

A train equipped with an OBU B2 receives a packet 203.

Expected result: the board rejects the P203 and does not take into account the other packets of the telegram if they are defined for a system version 1.0.

4.5 ESC_COM_5: Odometer precision

An error is introduced while encoding the wheel diameter. The train circulates with this incorrect value.

Analysis: verification of the odometer error by using the values L_DOUBTUNDER and L_DOUBTOVER.

4.6 ESC_COM_6: Resetting the confidence interval

Checking the resetting of the confidence interval when passing a BG when there is linking information on board and when there is no linking on board.

4.7 ESC_COM_7: Technical functions of electrical traction in zone FS (voltage change)

The train enters a zone with changing catenary voltage in mode FS.

Analysis: verify the correct execution when entering the zone where the voltage changes.

4.8 ESC_COM_8: Technical functions of electrical traction in zone STM

After having received a packet 39 (case of a train originating from another country), the train enters the zone STM and approaches a zone with changing catenary voltage where the packet 39 did not contain the tension information.

Expected result: the track condition is reset at the transition to STM and the voltage change can be performed. The train can continue its run.

4.9 ESC_COM_9: Technical functions of electrical traction in zone FS (phase change)

The train enters a zone with a phase change in mode FS on a line powered with 25kV.

Analysis: verify the correct execution when crossing the zone with the phase change.

5. ETCS1FS

5.1 ESC_L1FS_1: Train categories

Verification of the maximum speed in function of the *train categories*:

Expected result: the train is supervised at the speed corresponding to its train category.

Note: if a train category other than FP, FG and PASS is used, the speed profile will correspond to the lowest speed (FG).

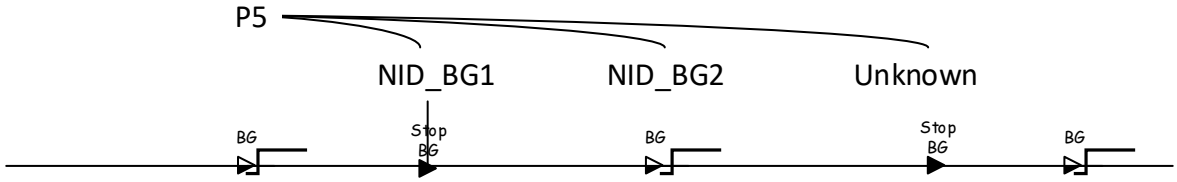
5.2 ESC_L1FS_2: IREPOS

The train in ETCS 1 mode FS crosses a BG sending the function IREPOS while this is chained with the NID_BG corresponding to the value “Unknown”.

Expected result: taking into account the resting information as well as the infill MA transmitted.

5.3 ESC_L1FS_3: REPOS on two consecutive sections

At a portion of track where the routes are unified in 2 consecutive sections, BG sending the P16 are chained with the known NID_BG on the first section and with the unknown NID_BG on the second section.



Expected result: verify that the train does not have a reaction when it crosses the first BG containing a P16 chained with its true NID_BG when it expects another BG containing a P16 further in its MA.

This test is currently not possible anymore onsite: no stations anymore with this specific configuration but this implementation stays possible (with a low probability). To be tested in lab if possible or to be tested onsite later if this specific configuration would be implemented again.

5.4 ESC_L1FS_4: Crossing closed non-permissive signal without override

Crossing a closed non-permissive signal in FS or OS without previous *override* and with an initial speed lower than the *release speed*.

Expected result: emergency break after going into TRIP mode.

5.5 ESC_L1FS_5: Crossing closed non-permissive signal with override

Crossing a closed non-permissive signal in FS or OS with previous *override* and with an initial speed lower than the *release speed*.

Expected result: transition to mode SR and absence of Trip upon crossing the signal.

5.6 ESC_L1FS_6: Crossing a closed permissive signal

Crossing a closed permissive signal in mode FS with initial speed lower than the release speed.

Expected result: transition to mode OS.

5.7 ESC_L1FS_7: CR819

A train in mode FS or OS crosses a duplicated BG (BG composed of 2 duplicated balises) of which one balise is covered.

Expected result: the train receives no more than one telegram and treats the information from the duplicated BG.

5.8 ESC_L1FS_8: CR1120

In a transition from level STM TBL1+ to ETCS 1 FS, the train receives a transition announcement applicable to the next signal. This signal is equipped with an IBG. The train crosses the IBG.

Expected result: packets 5, 12, 21, 27 received at the IBG are not accepted without packet 136.

6. ETCS2FS

6.1 ESC_L2FS_1: Joining and Splitting

Two trains in an ETCS2 zone are coupled. The resulting train moves in ETCS 2FS.

The trains are then separated and each depart in ETCS 2 FS.

Expected result: the scenario plays out correctly.

6.2 ESC_L2FS_2: CES accepted

The train receives a CES for a signal located downstream.

Expected result: the train's EoA is updated for the signal in question, the release speed allows the approach of the signal.

6.3 ESC_L2FS_3: UES

The train receives a UES.

Expected result: the train undergoes a mode transition to Trip.

6.4 ESC_L2FS_4: Reset of the confidence interval

The train crosses a BG that is already used as LRBG by the OBU, for example in case of turning back.

Expected result: the confidence interval is reset.

6.5 ESC_L2FS_5: T_NVCONTACT

Disconnecting the modem when the train is connected to RBC and waiting the appropriate time of T_NVCONTACT (40 seconds).

Expected result: the train undergoes a service brake.

6.6 ESC_L2FS_6: Replacement at the head

A train equipped with a single locomotive changes direction. The locomotive is uncoupled from the carriages and moves to the other end of the train. The locomotive is again coupled to the carriages and leaves in the other direction.

Expected result: the scenario plays out correctly.

6.7 ESC_L2FS_7: Change of front

A train equipped with a control post at each end performs a change of front.

Expected result: the scenario plays out correctly.

6.8 ESC_L2FS_8: Multiple message 18

After a trip and reception by the RBC of message 6 (acknowledgment of exit out of trip mode), the RBC sends message 18 (revocation of emergency brake) for all possible NID_EM (0 to 15), even if the NID_EM are not sent to the train.

Expected result: the board does not have any reaction to receiving multiple messages 18.

6.9 ESC_L2FS_9: National values with unknown position in position report

The train performs an SoM when the position stored on-board is unknown. The RBC sends the national values with D_NVVALID=0.

Expected result: the train accepts the national values even with an unknown position (see CR459).

6.10 ESC_L2FS_10: SoM with MaxSFE downstream of a signal

A train whose MaxSFE is located downstream of a signal located in front of it performs an SoM. The signal is open.

Expected result: upon receiving the MA by the RBC, the train must switch to mode OS and not switch to FS until it passes the signal.

Note: an odometre error facilitates this test as it allows to increase the distance travelled in mode OS.

6.11 ESC_L2FS_11: Restart in STM after loss of ETCS 2 FS

The train loses the connection to the RBC. After expiration of T_NVCONTACT, the driver performs a transition to level STM and the train continues its course.

Expected result: The scenario plays out correctly.

6.12 ESC_L2FS_12: RBC-RBC Handover with a single modem

The train crosses an RBC-RBC handover with a single operational modem.

Expected result: the handover is correctly carried out.

6.13 ESC_L2FS_13: Train categories

Verification of the maximum speed in function of the *train categories*:

Expected result: the train is supervised at the speed corresponding to its train category.

Note: if a train category is used other than FP, FG and PASS, the speed profile will correspond to the lowest speed (FG).

6.14 ESC_L2FS_14: OS extension

The driver performs a SoM at a long distance from the first operated signal downstream. This main stop signal is open in large movement.

Expected result: the train receives a MA in mode OS up to the large stop signal and does not perform the transition to FS until after having crossed the signal.

Note: this test is preferably executed with a big odometry error, though not obligatory.

7. ETCS2 FS on HSL

7.1 ESC_L2LGV_1: CR843

Multiple non-revocable TSR are sent in a single message.

Expected result: the train accepts the message and considers all TSR (CR843).

7.2 ESC_L2LGV_2: Message 33 linking a BG located under the train

The front of the train crosses a BG. This is read by the on-board and used as LRBG but the end of the train does not cross the BG. The driver then performs a change of front, and performs a SoM. The train receives a message 33 (MA with shifted location) and moves on accordingly. In packet 5, the LRBG is chained with the reaction “Service brake” although it is located behind the antenna.

Expected result: the train departs without undergoing a linking reaction.

8. ETCS1LS

8.1 ESC_L1LS_1: Crossing a closed non-permissive signal in LS without prior override

Crossing a closed non-permissive signal in LS without prior *override* and with initial speed lower than the *release speed*.

Expected result: emergency brake upon switching to Trip mode.

8.2 ESC_L1LS_2: Crossing a closed non-permissive signal in LS with prior override

Crossing a closed non-permissive signal in LS with prior *override* and with initial speed lower than the *release speed*.

Expected result: transition to mode SR and absence of Trip when crossing the signal.

8.3 ESC_L1LS_3: Reception of a packet 44 by a Baseline 3 train in level NTC (CR1338 non implemented)

A baseline 3 train in level NTC passes a signal showing yellow aspect.

This test case intends to validate the behaviour of a B3 train receiving a P44 formatted like a Baseline 2 P44 but with M_VERSION = 2.

Expected result: TBL1+ yellow lamp is lit on board.

9. Internal transitions on Infrabel network

9.1 ESC_TR_1: ETCS 1 FS >> ETCS 1 LS

Transition from zone ETCS1FS to zone ETCS1LS

- with OBU B3: Transition from level 1 FS to level 1 LS
- with OBU B2: transition to STM TBL1+

9.2 ESC_TR_2: ETCS 2 FS >> ETCS 1 LS

Transition from zone ETCS2FS to zone ETCS1LS:

- with OBU B3: Transition from level 2 FS to level 1 LS
- with OBU B2: transition to STM TBL1+

9.3 ESC_TR_3: ETCS 1 LS >> ETCS 1 FS

Transition from zone ETCS1LS to zone ETCS1FS:

- with OBU B3: Transition from level 1 LS to level 1 FS
- with OBU B2: transition from level STM TBL1+ to level 1 FS

9.4 ESC_TR_4: ETCS 1 LS >> ETCS 2 FS

Transition from zone ETCS1LS to zone ETCS2FS:

- with OBU B3: Transition from level 1 LS to level 2 FS
- with OBU B2: transition from level STM TBL1+ to level 2 FS

9.5 ESC_TR_5: ETCS 1FS >> TVM430

Transition from zone ETCS1FS to zone TVM430.

9.6 ESC_TR_6: ETCS 2FS >> TVM430

Transition from zone ETCS2FS to zone TVM430.

9.7 ESC_TR_7: TVM430 >> ETCS 1FS

Transition from zone TVM430 to zone ETCS1FS.

9.8 ESC_TR_8: TVM430 >> ETCS 2FS

Transition from zone TVM430 to zone ETCS2FS.

9.9 ESC_TR_9: ETCS1 FS >> ETCS 2 FS

Transition from zone ETCS1FS to zone ETCS 2 FS.

9.10 ESC_TR_10: ETCS 2 FS >> ETCS 1 FS

Transition from zone ETCS2FS to zone ETCS 1 FS.

9.11 ESC_TR_11: ETCS 1 LS >> STM TBL1+

Transition from zone ETCS1LS to zone STM TBL1+:

- with OBU B3: Transition from level 1 LS to level STM TBL1+.
- with OBU B2: No transition, the board stays in STM TBL1+.

9.12 ESC_TR_12: ETCS 1 FS >> STM TBL1+

Transition from zone ETCS1FS to zone STM TBL1+.

9.13 ESC_TR_13: ETCS 2 FS >> STM TBL1+

Transition from zone ETCS2FS to zone STM TBL1+.

9.14 ESC_TR_14: STM TBL1+ >> ETCS 1 LS

Transition from zone STM TBL1+ to zone ETCS 1 LS:

- with OBU B3: Transition from level STM TBL1+ to level 1 LS.
- with OBU B2: No transition, the board stays in STM TBL1+.

9.15 ESC_TR_15: STM TBL1+ >> ETCS 1 FS

Transition from zone STM TBL1+ to zone ETCS 1 FS.

9.16 ESC_TR_16: STM TBL1+ >> ETCS 2 FS

Transition from zone STM TBL1+ to zone ETCS 2 FS.

9.17 ESC_TR_17: Board reaction in absence of transition acknowledgment

Test the reaction of the train in case of lack of acknowledgment of the transition by the driver one one of the transitions.

9.18 Summary of different transitions tested

From ↓ / To →	ETCS 1 FS	ETCS 2 FS	ETCS 1 LS	STM TBL1+	TVM 430
ETCS 1 FS		9.9	9.1	9.12	9.5
ETCS 2 FS	9.10		9.2	9.13	9.6
ETCS 1 LS	9.3	9.4		9.11	No subject
STM TBL1+	9.15	9.16	9.14		Out of scope
TVM 430	9.7	9.8	No subject	Out of scope	

10. External transitions on Infrabel network borders

The Infrabel network has borders with Germany, Netherland, Luxemburg and France. A specific design is done on each border taking into account ETCS and NTC systems on both sides. Specific ESC tests will be defined at each countries border and by line, if each line has some specificities.

10.1 ESC_TR_BE-D

Transition zone ETCS Belgium ←→ zone ETCS/STM Germany

- with OBU B3
- with OBU B2

Specific to each line if needed.

10.2 ESC_TR_BE-NL

Transition zone ETCS Belgium ←→ zone ETCS/STM Netherlands

- with OBU B3
- with OBU B2

Specific to each line if needed.

10.3 ESC_TR_BE-L

Transition zone ETCS Belgium ←→ zone ETCS Luxemburg

- with OBU B3
- with OBU B2

Specific to each line if needed/

10.4 ESC_TR_BE-FR

Transition zone ETCS Belgium ←→ zone ETCS/STM France

- with OBU B3
- with OBU B2

Specific to each line if needed.

11. Applicability matrix

Scenario	ETCS 1 FS	ETCS 2 FS	LGV3, LGV4	LGV2	ETCS 1 LS
ESC_ALL_1	S	S	S	S	S
ESC_ALL_2	S	S	S	S	S
ESC_COM_1	S				
ESC_COM_2	S				
ESC_COM_3	S				
ESC_COM_4	S				
ESC_COM_5	I				
ESC_COM_6	S				
ESC_COM_7	S				
ESC_COM_8	S				
ESC_COM_9	S				
ESC_L1FS_1	S				
ESC_L1FS_2	S				
ESC_L1FS_3	I				
ESC_L1FS_4	S				
ESC_L1FS_5	S				
ESC_L1FS_6	S				
ESC_L1FS_7	S				
ESC_L1FS_8	I				
ESC_L2FS_1		S			
ESC_L2FS_2		S			
ESC_L2FS_3		S			
ESC_L2FS_4		S			
ESC_L2FS_5		S			
ESC_L2FS_6		S			
ESC_L2FS_7		S			
ESC_L2FS_8		S			
ESC_L2FS_9		S			
ESC_L2FS_10		S			
ESC_L2FS_11		S			
ESC_L2FS_12		S			
ESC_L2FS_13		S			
ESC_L2FS_14		S			
ESC_L2LGV_1			S		
ESC_L2LGV_2			S		
ESC_L1LS_1					S

ESC_L1LS_2					S
ESC_L1LS_3					S
ESC_TR_1	In function of the trackside sub-systems used.				
ESC_TR_2					
ESC_TR_3					
ESC_TR_4					
ESC_TR_5					
ESC_TR_6					
ESC_TR_7					
ESC_TR_8					
ESC_TR_9					
ESC_TR_10					
ESC_TR_11					
ESC_TR_12					
ESC_TR_13					
ESC_TR_14					
ESC_TR_15					
ESC_TR_17					
ESC_TR_18					
ESC_TR_BE-D					
ESC_TR_BE-NL					
ESC_TR_BE-L					
ESC_TR_BE-FR					

S: The success of the scenario is imperative to assure the system's compatibility.

I: The scenario is performed to verify if the behaviour of the onboard is compliant to the hypotheses made when conceiving the trackside sub-system.