

Business unit I-AT-SAZ

System management ETCS CH

Master test concept to obtain ETCS authorisation of placing in service (On-board and trackside equipment)

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Name	M. Kehrli		
Position / function	I-AT-SAZ SM ETCS CH Safetymanager		

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Proof of changes

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X1.4	13.11.2013	Christina Ambrus	Incorporating review comments: Titles used in version X1.3 have been adapted as follows (adjustments also in [2]): Test Area XI is now called Test Area V Certificate XI is now called Certificate V Titles no longer used: Test Area XI, Certificate XI and Safety Case XI. Section 3.2 of version X1.3 has been deleted (it is part of [2]). Assessment by QA.
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Abbreviations

CH	Switzerland
DMI	Driver-machine interface (driver's operating and display unit)
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
FAT	Factory acceptance tests (in the lab)
GBL	Gotthard base line
GSM-R	Global System for Mobile Communication – Railways
I-AT-ZBF	Train control systems (SBB organisational unit)
IOP	Interoperability
L1	ETCS Level 1
L2	ETCS Level 2
LBL	Lötschberg base line
LS	Limited supervision
MA	Movement authority
MATA	Mattstetten branch line
MMI	Man-machine interface (operating and display unit)
NL	Non-leading (operating mode)
OBU	On-board unit
OR	Operational Rule
QA	Quality assurance
RBC	Radio block centre
RIU	Railway infrastructure undertaking
RTR	Rothrist
RU	Railway undertaking
RV	Reversing (operating mode)
SAT	Site acceptance tests (on the line)
SBB	Swiss Federal Railways
SC	Safety case
SIOP	Safety-related testing (phase A, phase B)
SL	Sleeping (operating mode)
SM	System management
SO	Solothurn
SPOC	Single point of contact, contact person
TBD	To be defined
TET	Test evaluation team (from the railway infrastructure undertaking)
TRK	Trackside
UNISIG	Union Industry of Signalling
V&T	Verification and tests
Veh.	Vehicle(s)

Terms used

Applicant	Natural person or legal entity requesting an APS or type approval for a vehicle (more details concerning the type approval procedure can be found in [9]). For vehicles, the APS is issued to the vehicle keeper (VK). For lines, the APS is issued to the licensed railway infrastructure undertaking (RIU).
Authorisation of placing in service (APS)	Decree with which the FOT confirms that the vehicle or the components have been adequately checked from both a technical and operational standpoint so that its deployment for a particular purpose under specific conditions of use is possible and that the vehicle is compliant with ETCS TSI requirements – if necessary. If type approval exists, the authorisation of placing in service also declares conformity with the type.
Homologation/ type approval	<p>Decree with which the FOT confirms that the object of homologation has been adequately checked from both a technical and operational standpoint so that its deployment for a particular purpose under specific conditions of use is possible and that the vehicle is compliant with ETCS TSI requirements – if necessary. For vehicles, the type approval is generally issued at the same time as the APS for the first vehicle in a series.</p> <p>Type approval is intended for vehicles and components thereof that are used multiply in exactly the same way and in the same function (series). Type approval is intended to simplify and accelerate the FOT's testing for the authorisation of placing in service procedure (Art. 7 Railways Ordinance, reference [9]).</p>
Operational IOP tests	Tests based on the integrated technical system consisting of a line and vehicle and the corresponding operating rules (OR). All of these must be verified in order for a railway vehicle to be given ETCS Authorisation for Placing in Service in Switzerland (APS ETCS CH).
Overall system	Technical and operational interaction between railway vehicles and railway line using ETCS.
Railway infrastructure undertaking (RIU)	Licensed railway infrastructure undertaking: a registered undertaking to which infrastructure equipment is assigned. In particular, a RIU is responsible for the life cycle of trackside systems.
Test scope	A test scope includes the test cases, test subjects and objectives that are required for the corresponding safety case. Generally, each test scope belongs to a safety case - using the same Roman numeral in brackets.
Vehicle keeper (VK)	Natural or legal person who is responsible for the homologation, authorisation of placing in service and operating capability of a vehicle. The Vehicle Keeper (VK) may be an RU, a rolling stock leasing company or a vehicle supplier.
Vehicle operator (VO)	The railway undertaking (RU) operating a vehicle, or the operator of infrastructure vehicles.

References

- [1] SBB (PUBL.): SM ETCS CH: Safety case concept to obtain ETCS homologation in Switzerland (On-board and trackside equipment), Version V2.0, 22.11.14.
- [2] SBB (PUBL.): SM ETCS CH: Test scope/cases for SIOP B of ETCS on-board equipment – Version V1.9; 16.11.2016.
- [3] SBB (PUBL.): SM ETCS CH: Requirements for the use of vehicles on ETCS lines - the currently valid version according to FOT homepage
- [4] SBB (PUBL.): Network access: operational IOP tests – the latest version including a test list in the appendix can be found on the FOT homepage.
- [5] Alstom (PUBL.): Technical IOP test set RTR-MATA/SO: – Technical interoperability statement of the vehicles and the SA-NBS trackside equipment – the valid version must be requested from the supplier.
- [6] Thales (PUBL.): Technical IOP test set: valid for Thales equipped lines.
Thales determines the test set to be performed based on the OBU configuration. The most recent document must be obtained from RBC supplier Thales.
- [7] Siemens (PUBL.): Technical IOP test set: - for the Sion-Sierre line, the valid version must be requested from the supplier.
Siemens determines the test set to be performed based on the OBU configuration.
- [8] ERA (PUBL.): Current Legal References for ERTMS: TSI CCS Annex A for Baseline 2 and Baseline 3 – the latest valid documents can be found on the ERA homepage.
- [9] FOT (PUBL.): Guideline: Type approval for elements of railway equipment – Version V2.0 dated 01.09.2014.
- [10] SBB (PUBL.): SM ETCS CH: Specification document regarding IOP testing (for ETCS-equipped vehicles and lines) Version V 1.1, 29.01.2018.

Explanatory notes on references

Reference [3]:

The currently valid notified national technical rules (NNTR), notified by the European Union Agency for Railways (ERA) – to be addressed in safety cases X and VI – are to be obtained from FOT or SM ETCS CH.

Reference [4]:

The SM ETCS CH requirements 'Network Access Tests ETCS Switzerland' need to be considered: these network access tests are a prerequisite for obtaining an APS for on-board equipment and hence for the network access to be agreed upon in the arrangement for network access signed by the RU and the IM.

References [5] – [7]:

Here the situation depends on the OBU configuration and the RBC supplier. The supplier of on-board equipment must obtain an IOP Statement (safety case VII) for the vehicle in question from the corresponding supplier of trackside equipment. In addition, the test cases described in the latest IOP test sets drafted by the supplier of trackside equipment must be verified.

Reference [8]:

Lists of reference documents valid for ETCS systems have been provided for Baseline 2 and Baseline 3. These lists include the subsets 074, 076, 085 and 103 from test specifications for ETCS products. Suppliers of ETCS products are to refer to the corresponding specifications provided in the reference documents.

FOT homepage: <https://www.bav.admin.ch/bav/de/home.html>

ERA homepage: http://www.era.europa.eu/activities/technical-specifications-interoperability_en

1 Aim, purpose and scope

- 1.1.1.1 This master test concept is based on the safety concept [1]. It describes the test areas needed to achieve a complete, fully functioning, interoperable and integrated ETCS system in Switzerland.
- 1.1.1.2 The test concept indicates which parties are responsible for individual test areas.
- 1.1.1.3 The test concept identifies the test specifications and references to be used in the individual test areas.
- 1.1.1.4 The test concept excludes estimates of the resources needed to conduct individual tests with vehicles on ETCS Level 2 lines. This is because the specific range of tests still needs to be decided by TET vehicles.

2 Procedure

- 2.1.1.1 In [10], we find a description of the typical procedures followed when carrying out IOP tests to verify technical Interoperability along with clarification of the roles and responsibilities of the parties involved.

3 Context

- 3.1.1.1 The dependencies of the present master test concept are shown in the chart below (Fig. 1).

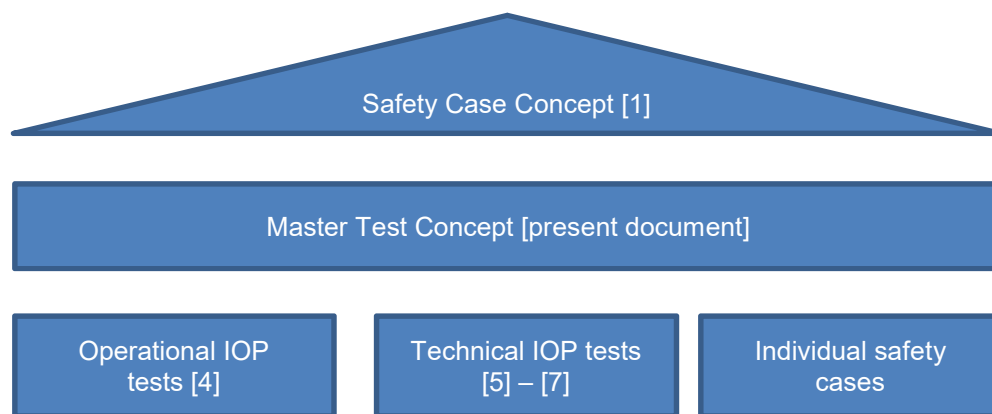


Figure 1: Positioning of master test concept

4 Limitations in scope

- 4.1.1.1 The present Master Test Concept is limited to the use of ETCS in Switzerland, i.e. ETCS L2, ETCS L1 LS and ETCS L0 P44 (ETM: EuroZUB, EuroSIGNUM).
- 4.1.1.2 The present Master Test Concept makes no statements about the ETCS operating mode L1 FS or L3, since these ETCS applications are not used in Switzerland.
- 4.1.1.3 The present Master Test Concept does not describe applications at transitions between different national train control systems or between ETCS and national train control systems. These are described in the relevant documents concerning border transitions.

- 4.1.1.4 This master test concept is not a replacement for the detailed test concepts provided by the relevant bodies responsible for carrying out tests in the individual test areas.
- 4.1.1.5 The specific tests for the generic products and applications from the suppliers do not form part of this test concept. European specifications for such ETCS product tests can be found in [8].
- 4.1.1.6 The ETCS data channel tests of the GSM-R which are part of the OBU type approval process are not covered by this master test concept.
- 4.1.1.7 GSM-R devices needed to run data channel tests of this kind must be approved by SBB Telecom before being activated for the first time as part of the Swiss GSM-R network.

5 Structure of test areas

- 5.1.1.1 The content of safety cases is comprised of test findings, test measures and test results. Therefore, the structure of test areas matches the structure of safety cases in keeping with [1].
- 5.1.1.2 The table below shows the structure, the test subjects and the objectives of the test areas and includes some examples.
- 5.1.1.3 The Roman numerals (I) to (XII) assigned to the test areas correspond to the numbers in the safety case structure in [1].
- 5.1.1.4 In Figure 2, the blue boxes refer to tests for which the RIU or VK is responsible. The green boxes refer to tests for which suppliers are responsible.

<p>(I) Overall system</p> <p>Objective:</p> <ul style="list-style-type: none"> - To convey an overall picture of the application, including, for example, the accumulated line and vehicle risks - Summary of safety cases II, V and IV (incl. associated test results) - No tests – successful test results must be shown in subordinate safety cases 	<p>(II) Operational vehicle tests</p> <p>Objective:</p> <ul style="list-style-type: none"> - Proof of compliance with the application conditions - Proof of behaviour in specific operational situations - Ability to apply the periodic maintenance and testing regulations from an operational perspective - Proof that the operating regulations are fit for purpose 	<p>(V) Network access tests</p> <p>Objective:</p> <p>Ideally no tests are needed except for the following:</p> <ul style="list-style-type: none"> - Tests to be carried out at the discretion of the RIU in the case of doubt - Tests that may be ordered by the RIU for reasons of due diligence to demonstrate safe and reliable network access in connection with ETCS - Proof of the assumptions made in connection with the processing of the SRACs between the line and the vehicle, if necessary - Proof of the suitability of any new/special ORs generated for 	<p>(IV) Operational line tests/ SIOP B line</p> <p>Objective:</p> <ul style="list-style-type: none"> - Proof of the fitness for service of the trackside operating processes and regulations - Fulfilment of the infrastructure operator's duty of care
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<p>Examples:</p> <ul style="list-style-type: none"> - Correct braking in RV mode - Vehicle data displayed and evaluated on the appropriate level - Journey with the relevant ORs for the lines - Correct functioning of the control car with the possible vehicle types, multiple unit control of different vehicle types - Correct operational use of the neutral section - Processing the train data set - Managing the failure of the tilt system 	<p>safety case V.</p> <p>Examples:</p> <ul style="list-style-type: none"> - Operating tests with the implemented brake curve parameterisation - Capacity/safety requirements with flat braking curves 	<p>Examples:</p> <ul style="list-style-type: none"> - Test of the operating processes - Repeat of the technical tests for safety case (VIII) as part of the duty of care - Integration into the existing rail infrastructure - SIOP B line
<p>(III) IOP OBU and RBC</p> <p>Objective:</p> <ul style="list-style-type: none"> - No tests, only a summary of the IOP Statement (VII) and IOP Notes (IX) 		
<p>(VI) Vehicle integration tests/ SIOP B vehicle</p> <p>Objective:</p> <ul style="list-style-type: none"> - Proof of the correct integration of the OBU into a specific vehicle type (class) by the vehicle integrator (including braking curve validation) - Proof of the correct activation of the brakes, including in the event of faults - Testing specific vehicle functions - Proof of the correct activation of ETCS modes SL and NL - Proof of the correct integration of SIL 0 ETCS peripheral systems <p>Examples:</p> <ul style="list-style-type: none"> - Brake control when the vehicle power supply fails - Traction switched off when the train control and command system (TCCS) fails - OBU odometry in collaboration with the TCCS - Activating the SL/NL modes, depending on the vehicle configuration - Processing the direction of travel, depending on the driver's control panel - Correct technical use of the neutral section - Correct function of the control car with the possible vehicle types - Multiple-unit control of different vehicle types - Special vehicle functions: look-out, radio remote control - DMI-OBU integration 	<p>(VII) IOP tests</p> <p>Objective:</p> <ul style="list-style-type: none"> - The RBC supplier demonstrates the technical IOP of the OBU with the trackside ETCS components within the specific design of a line or the generic engineering rules <p>Examples:</p> <ul style="list-style-type: none"> - All relevant technical scenarios in accordance with UNISIG requirements within the configurable range - Correct reception of an MA - Correct behaviour in the event of an incomplete MA 	<p>(VIII) Supplier (factory test)</p> <p>Objective:</p> <ul style="list-style-type: none"> - Proof of the correct integration of the RBC into the specific line by the line integrator - Interaction, correct functionality, correct data preparation and correct line construction - Proof of the correct integration of SIL 0 ETCS peripheral systems <p>Examples:</p> <ul style="list-style-type: none"> - TRK FAT/SAT (terms used by SBB for factory tests in the lab and on the track), using the vehicle as a measuring instrument - MMI-RBC integration
<p>(X) OBU tests</p> <p>Objective:</p> <ul style="list-style-type: none"> - Proof of the correct function of the manufacturer's OBU in 	<p>(IX) IOP-CH statement</p> <p>Objective:</p> <ul style="list-style-type: none"> - The OBU supplier demonstrates that the ETCS status, the 	<p>(XII) RBC tests</p> <p>Objective:</p> <ul style="list-style-type: none"> - Proof of the correct function of the manufacturer's RBC in

accordance with UNISIG requirements	implementation of the subsets and versions and the data configuration correspond with the specified values of the ETCS CH system manager and the trackside operators	accordance with the UNISIG requirements
Examples: <ul style="list-style-type: none">- Reaction of the OBU to balises with implausible content- Reaction of the OBU to failure of an internal computer	Examples: <ul style="list-style-type: none">- None	Examples: <ul style="list-style-type: none">- Factory test of the RBC in the lab (TRK V&T, TRK data V&T)- Testing on installation

Figure 2: Structure, themes and objectives of ETCS Level 2 tests

6 Overview of master test concept

Test area no.	Reference to [2]	Title	Responsible for running tests and reporting	Responsible for commissioning	Responsible for test specifications	Test specifications filed, reference from	Results evaluated by	Test location	Test resources	Comments
(I)	SC (I) APS	Overall system	----	----	----	----	----	----	----	No tests required, only certificate in accordance with [1].
(II)	SC (II) APS	Operational vehicle tests (vehicle type)	Applicant	Applicant	Applicant	Applicant	Applicant	Vehicle or possibly vehicle on line	Vehicle: dependent on type Vehicle on line: See Section 0	None
(III)	IOP Certificate Overview (III)	IOP OBU-RBC	----	----	----	----	----	----	----	No tests required, only proof in accordance with [1]. Only applies to specific OBUs with specific RBCs.
(IV)	SC (IV) APS	Operational line tests / SIOP B	Infrastructure operator SIOP B	Infrastructure operator	Infrastructure operator SIOP B	Infrastructure operator SIOP B	Infrastructure operator's TET SIOP B	Line	Dependent on line, change/modification and OP	Using the vehicle as a measuring instrument. Test specifications as required (new operating processes). SIOP B: Test specifications defined for specific lines.
(VI)	SC (VI)	OBU - Vehicle integration tests	Vehicle integrator	Vehicle integrator	Vehicle integrator	Vehicle integrator	Vehicle integrator	Vehicle type	Dependent on vehicle type	None
(VII)	IOP Statement (VII)	IOP-Statement (VII)	RBC supplier	OBU supplier	RBC supplier	Alstom: [5] Thales: [6] Siemens:[7]	RBC supplier	OBU in lab (vehicle on line)	Lab: dependent on supplier Vehicle on line: See Section 0	Currently the labs are specific to the lines and RBC suppliers.

Test area no.	Reference to [2]	Title	Responsible for running tests and reporting	Responsible for commissioning	Responsible for test specifications	Test specifications filed, reference from	Results evaluated by	Test location	Test resources	Comments
(VIII)	SC (VIII)	Factory test (supplier)	RBC supplier	RBC supplier	RBC supplier	RBC supplier	RBC supplier	Lab/line	Dependent on line	TRK FAT/SAT (terms used by SBB for factory tests in the lab and on the track). If necessary, using the vehicle as a measuring instrument.
(IX)	IOP Notes (IX)	IOP CH statement OBU	----	----	----	----	----	----	----	No tests required, only proof in accordance with [1].
(X)	SC (X)	OBUEVC tests	OBUSupplier	OBUSupplier	OBUSupplier	OBUSupplier	OBUSupplier	OBU in lab	Dependent on OBU supplier	Dependent on vehicle, OBU type approval
(V)	SC (V) APS vehicle type	Operational IOP tests	Infrastructure operator	Railway undertaking	Infrastructure operator	Infrastructure operator	TET vehicles	Vehicle on line or [4]	See Section 0	Operational IOP tests are listed in [4].
(XII)	SC (XII)	RBC tests	RBC supplier	RBC supplier	RBC supplier	RBC supplier	RBC supplier	Lab, installation	Dependent on line (data preparation)	Factory test of the RBC in the lab (TRK V&T, TRK data V&T). Testing on installation.

Table 1: Overview of master test concept

7 Resource requirements for vehicle tests on an ETCS Level 2 line

- 7.1.1.1 The resource requirements for tests with vehicles on an ETCS Level 2 line depend on the extent of testing required by TET vehicles.
- 7.1.1.2 It is not possible to estimate exactly the extent of testing nor the amount of resources required.
- 7.1.1.3 Contact SPOC RIU (etcs.fahrzeuge@sbb.ch) to find out the extent of testing required.

8 Contact details

Infrastructure operators	RBC suppliers	Other
SBB lines SBB Infrastructure I-AT-SAZ Hilfikerstrasse 3 CH-3000 Bern 65 E-mail: etcs.fahrzeuge@sbb.ch	Alstom (RTR-MATA/SO) Alstom Transport Belgium Train Life Service ANTOINE Cedric Rue Cambier Dupret 50-52 B-6001 Charleroi E-mail: cedric.antoine@transport.alstom.com and tis-rw-sbb-ertms.be.transport@alstom.com	System management ETCS CH SBB Infrastructure I-AT-SAZ-SNG-SF Hilfikerstrasse 3 CH-3000 Bern 65 E-mail: sf.etcs@sbb.ch
Lötschberg Base Line (LBL) BLS Netz AG Christoph Munter Genfergasse 11 CH-3001 Bern Tel: +41 (0) 58 327 30 27 E-mail: christoph.munter@bls.ch	Thales (LBL, GBL, PU-VIL) Thales Rail Signalling Solutions AG Friesenbergstrasse 75 CH-8036 Zurich Tel. +41 (0) 44 465 48 00 E-mail: cs.rss-ch@thalesgroup.com	SBB Telecom Tel.: +41 (0)51 220 11 82 E-mail: tc@sbb.ch
	Siemens Siemens Schweiz AG - Infrastructure & Cities Sector Mobility and Logistics, MOL PH 5 1 Gildo Paganini Belpstrasse 26, 3007 Bern, Switzerland Tel.: +41 (0)58 558 07 40 E-mail: gildo.paganini@siemens.com	

Table 2: Contact addresses