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ERTMS/ETCS

Engineering rules for harmonised marker boards

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1. MODIFICATION HISTORY

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0a 27-Sep-22	All	First issue after preliminary iteration with ERA (GK)	AJ, GR
0b 31-Oct-22	All § 4, 5	Completion of all chapters of the document after second iteration with ERA (GK). Implementation of comments from EUG ESG.	AJ, GR, EUG ESG
0c 14-Nov-22	All	Implementation of comments from ERA (GK).	AJ, GR
0d 13-Dec-22	All	Merge of statement (b) of 3.3.1 into the note of statement (a) of 3.3.1 Removal of use cases and additional information Added reference to applicability conditions stated in the CCS TSI Split of operational purposes c), engineering rule c) and justification of the engineering rules (c) of ETCS Stop Marker and Location Marker into (c) and (d)	EUG ESG
0e 21-Dec-22	4.1	Restored applicability conditions in agreement with CCS TSI migration provisions	AJ, GR

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2. TABLE OF CONTENTS

1. MODIFICATION HISTORY	2
2. TABLE OF CONTENTS.....	4
3. INTRODUCTION.....	5
3.1 Scope of marker boards engineering rules.....	5
3.2 Abbreviations	5
3.3 Terms.....	6
3.4 References	6
4. APPLICABILITY AND CONDITIONS OF USE	8
4.1 Applicability	8
4.2 Applicability of the GSM-R network border marker.....	9
4.3 Marker board visibility	9
4.4 Length of train to consider.....	9
4.5 Marker board placement margins.....	10
5. ENGINEERING RULES	11
5.1 ETCS Stop Marker.....	11
5.2 ETCS Location Marker.....	12
5.3 Level transition marker board.....	13
5.4 Lower pantograph marker board	14
5.5 Pantograph lowered marker board.....	14
5.6 Raise pantograph marker board.....	14
5.7 Neutral section announcement marker board.....	15
5.8 Neutral section marker board	15
5.9 End of neutral section marker board	16
5.10 GSM-R network border marker board.....	16

3. INTRODUCTION

3.1 Scope of marker boards engineering rules

- 3.1.1 The engineering rules are system-related limitations for installation of harmonised MBs that complement the implementation of ERTMS trackside subsystems.
- 3.1.2 These engineering rules provide additional constraints to the requirements stated in the SRS and other sub-level documents in order to ensure operational interoperability and enhance safety.
- 3.1.3 The engineering rules stated here are therefore complementary to the requirements stated in the SRS and subdocuments. References herein to other documents are not exhaustive, in particular to the SRS.
- 3.1.4 The engineering rules defined herein are mandatory under conditions reported in chapter 4; engineering advice is not in the scope of this document.
- 3.1.5 This document has been created by the EUG Engineering Support Group (ESG) in cooperation with ERA ERTMS Operational Harmonisation WG.
- 3.1.6 The engineering rules are described with reference to the relevant MBs defined in EN16494:2015 (CCS App. A index 38). Operational purpose(s) and justifications for the engineering rules are provided. References to ERTMS/ETCS functions are also reported.

3.2 Abbreviations

- 3.2.1 The following table includes acronyms and abbreviations, which are used in the current document. Some of them are derived from SUBSET-023.

EOA	End of Authority
ERA	European Union Agency for Railways
IM	Infrastructure Manager
MB	Marker Board
SRS	System Requirements Specifications
TAF	Track Ahead Free
TC	Track Condition
TRK	Trackside

3.3 Terms

The following definitions are used in the current document and are not present in SUBSET-023.

3.3.1 Applicable speed: in the engineering rules for TC announcement MBs, it refers to the degraded mode speed or the nominal line speed, depending on whether TCs are transmitted from TRK or not, resp. The following statements are valid for all TC announcement MBs:

- a) In case the ERTMS/ETCS trackside system provides the TC information to the on-board, the driver makes use of the MBs only in case of SR, OS and SH. Therefore, the distance at which the announcement MBs are installed in rear of the beginning of the concerned area shall be calculated, considering the highest speed admitted when the on-board is in any of those modes.

Note: the planning area is a mitigation against the risk the TC icon is showed to the driver too late or not at all in DMI area B3/4/5 (due to the limit of 3 contemporary icons; see DMI specifications: ERA ERTMS 015560). Therefore, MB engineering rules are defined assuming the planning area is displayed to the driver.

- b) In case the ERTMS/ETCS trackside system does not provide the information to the on-board, the distance at which the announcement MBs are installed in rear of the beginning of the concerned area shall be calculated considering the nominal line speed.

3.3.2 Concerned area: area wherein the concerned TC is applicable.

3.3.3 Necessary time: in the engineering rules for TC announcement MBs, it is the maximum time required to perform the actions (i.e. the driver reaction time + the time needed by the system to perform the action once commanded by the driver) and refers to the values specified in SUBSET-040 4.2.4.7 with reference to the different TCs (10s for the inhibition of the brakes, 11s for the powerless section and 17s for the change of traction system & the pantograph to be lowered). The necessary time is sufficient for the driver and the system to perform the required actions based on the assumption that the driver perceives the MB at the latest when passing it, and it does not include the sighting time (see § 4.3).

3.4 References

3.4.1 The following documents are referenced in this document:

- Glossary of Terms and Abbreviations – SUBSET-023
- System Requirement Specification – SUBSET-026
- Dimensioning and Engineering rules – SUBSET-040



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- ETCS Driver Machine Interface – ERA ERTMS 015560
- Railway applications – Requirements for ERTMS Trackside Boards, EN 16494, dated 2015
- App. D of Layout of driver's cab in locomotives, railcars, multiple-unit trains and driving trailers, UIC Leaflet 651, dated July 2002
- Assignment of values to ETCS variables, ERA_ERTMS_040001
- App. A of Technical Specification for the Interoperability relating to Operation and traffic management
- App. F of Technical Specification for the Interoperability relating to the Rolling Stock – Locomotives and Passengers

4. APPLICABILITY AND CONDITIONS OF USE

4.1 Applicability

4.1.1 The harmonised MBs shall be used and the relevant engineering rules shall be applied only if:

- the IM has a specific operational need to use a MB that matches the operational purpose of the harmonised MB

AND

- the transition regime stated in CCS TSI for this document applies.

4.1.2 The transition regime stated in the CCS TSI for this document refers to the following possible conditions:

- a) new line being equipped with ERTMS/ETCS only (ERTMS/ETCS is the only train protection system)
- b) new line being equipped with ERTMS/ETCS and Class B system at the same time
- c) existing line renewal or upgrade of infrastructure subsystem where new MBs need to be installed
- d) existing line renewal or upgrade of CCS subsystem where new MBs need to be installed.

4.1.3 Cases c) and d) of 4.1.2 apply in any of the following subcases:

4.1.3.1 lines fitted with only ERTMS/ETCS (nor class B and neither legacy signalling system) before and after the upgrade/renewal;

4.1.3.2 lines fitted with ERTMS/ETCS and the legacy signalling system (with or without class B) before and after the upgrade/renewal;

4.1.3.3 lines fitted with ERTMS/ETCS and the legacy signalling system (with or without class B) before the upgrade/renewal and fitted with only ERTMS/ETCS after the upgrade/renewal;

4.1.3.4 lines fitted with only the legacy signalling system (with or without class B) before the upgrade/renewal and fitted with ERTMS/ETCS and the legacy signalling system (with or without class B) after the upgrade/renewal;

4.1.3.5 lines fitted with only the legacy signalling system (with or without class B) before the upgrade/renewal and fitted with only ERTMS/ETCS after the upgrade/renewal.

- 4.1.4 In case of upgrade of the infrastructure or CCS subsystem where additional MBs need to be installed, the implementation of harmonised MBs applying the relevant engineering rules can be decided by the IM according to operational considerations. For consistency, coexisting harmonised and non-harmonised MBs giving the same operational indication must be avoided on the same section of line.
- 4.1.5 Although the harmonised MBs are not mandated on lines not equipped with ERTMS, they are nevertheless recommended to ensure future operational interoperability.
- 4.1.6 The presence of luminous main signals does not have impact on the MBs' principles despite it having an impact on operational procedure. For instance:
- a) possible conflict (due to failure) between the aspect of the signal and the EOA has to be managed;
 - b) the luminous signal can replace the European instruction by the signaller in case of SoM in SR, however operational interoperability is not ensured.
- 4.1.7 Migration scenarios (Class A overlapping Class B) are not considered in this document.
- 4.1.8 Note: the use of harmonised MBs in Class B-only systems is not considered in this document either.

4.2 Applicability of the GSM-R network border marker

- 4.2.1 Since the GSM-R network border marker refers to GSM-R voice function, it can also be used in sections of line not equipped with ERTMS/ETCS.

4.3 Marker board visibility

- 4.3.1 Regarding the "engineering rules for MB location" of all MBs in chapter 5, MB visibility is a criterion to be considered, even if not explicitly mentioned. The lateral position of the MB (including height and orientation) relative to the track shall respect the visibility constraints deriving from Appendix F of LOC & PAS TSI with reference to App. D of UIC Leaflet 651:2002, subject to the constraints of the applicable clearance gauge, which always prevail over any other installation requirement of lineside equipment.
- 4.3.2 Note: other standards also deal with this consideration. For instance, EN 16494 already covers certain aspects (e.g., under § 5.6 and § 5.7 thereof) while also relating the absolute size of the MB to the line speed. The CCS TSI basic parameter "trackside CCS objects" addresses this need by linking it to the respective OPE TSI basic parameter "Signal and lineside marker sighting".

4.4 Length of train to consider

- 4.4.1 Regarding following MBs:

- a) Pantograph lowered (§ 5.5)
- b) Raise pantograph (§ 5.6)
- c) Neutral section (§ 5.8)
- d) End of neutral section (§ 5.9)

the MB location shall not consider the length of trains running on the line or the position of the pantographs on these trains. It is the responsibility of the driver to operate the pantograph or to switch on/off the main power switch at the appropriate location.

4.5 Marker board placement margins

- 4.5.1 A margin up to $\pm 10\text{m}$ on top of the engineering rules for MB location can be applied by the IM, providing safety requirements are respected.
- 4.5.2 A higher margin is admitted when properly justified for safety reasons.

5. ENGINEERING RULES

5.1 ETCS Stop Marker

5.1.1

Operational purpose	<p>(a) To be used to unambiguously identify an EOA which must not be overpassed without authorisation by the signaller and which may protect one or a group of safety-critical points such as a point switch, a conflicting route, an entrance of a station, junctions, etc.</p> <p>(b) To be used to identify specific location on the track the train shall not overpass when an MA is not available, unless the driver has received a specific authorisation by the signaller.</p> <p>(c) To be used to mark the location up to which the driver needs to confirm that the line is clear (e.g. for TAF function).</p> <p>(d) To be used to mark the location up to which the driver has to drive under his/her responsibility before a possible MA in FS/OS is received.</p>
Reference	<p>(a) SUBSET-026 § 3.8.1, 3.15.10</p> <p>(b) SUBSET-026 § 5.8</p> <p>(c) SUBSET-026 § 3.15.5</p> <p>(d) SUBSET-026 § 4.4.11</p>
Engineering rule for MB location	<p>It shall be placed according to at least one of the following:</p> <p>(a) in correspondence to the EOA</p> <p>(b) in correspondence to specific locations on the track the train shall not overpass when running without a MA</p> <p>(c) in correspondence to specific locations on the track up to which the driver needs to confirm that the line is clear</p> <p>(d) in correspondence to specific locations on the track where the driver has to drive under his responsibility before a possible MA in FS/OS is received.</p> <p>It shall be placed in such a way that it clearly indicates which track it applies to: the arrow shall point to the track the ETCS Stop Marker refers to.</p>
Justification of the engineering rules	<p>The ETCS Stop Marker serves to identify at least one of the following:</p> <p>(a) the physical location of an EOA</p> <p>(b) the physical location the train shall not overpass while an MA is not available; it can be used as reference point for movements authorised by operational procedure (instructions from signaller)</p>

	<p>(c) the physical location up to which the driver needs to confirm that the line is clear (e.g. for TAF)</p> <p>(d) the physical location up to which the driver needs to drive under his responsibility before a possible MA in FS/OS is received.</p>
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5.1.2 When operational purposes of § 5.1.1 a) and b) are applicable, the ETCS Stop Marker shall be chosen, even if one or more operational purposes of the ETCS Location Marker § 5.2.1 are applicable simultaneously.

5.1.3 Note: the operational purposes of § 5.1.1 and § 5.2.1 may coincide often.

5.2 ETCS Location Marker

5.2.1

Operational purpose	<p>(a) To be used to unambiguously identify an EOA which does not protect a safety-critical location. It is up to IM to decide whether an ETCS Location Marker can be used instead of an ETCS Stop Marker where no safety critical point needs to be protected.</p> <p>(b) To be used to identify specific locations on the track where the train shall stop when running without MA if the driver has received specific instruction from the signaller.</p> <p>(c) To be used to mark the location up to which the driver needs to confirm that the line is clear (e.g. for TAF function)</p> <p>(d) To be used to mark the location up to which the driver has to drive under his/her responsibility before a possible MA in FS/OS is received.</p>
Reference	<p>(a) SUBSET-026 § 3.8.1, 3.15.10</p> <p>(b) SUBSET-026 § 5.8</p> <p>(c) SUBSET-026 § 3.15.5</p> <p>(d) SUBSET-026 § 4.4.11</p>
Engineering rule for MB location	<p>It shall be placed according to at least one of the following:</p> <p>(a) in correspondence to the EOA</p> <p>(b) in correspondence to specific locations on the track where the train shall stop when instructed by the signaller when running without MA</p> <p>(c) in correspondence to specific locations on the track, where ETCS Stop Marker is not used, and up to which the driver needs to confirm that the line is clear</p>

	<p>(d) in correspondence to specific locations on the track where the driver has to driver under his/her responsibility before a possible MA in FS/OS is received.</p> <p>It shall be placed in such a way that it clearly indicates which track it applies to: the arrow shall point to the track the ETCS Stop Marker refers to.</p>
Justification of the engineering rules	<p>The ETCS Location Marker serves to identify at least one of the following:</p> <p>(a) the physical location of an EOA</p> <p>(b) the physical location the train shall not overpass while an MA is not available, when the driver has been instructed by the signaller</p> <p>(c) the physical location up to which the driver needs to confirm that the line is clear (e.g. for TAF function)</p> <p>(d) the physical location up to which the driver needs to drive under his/her responsibility before a possible MA in FS/OS is received.</p>

5.2.2 If the operational purpose c) or d) of § 5.1.1 and the operational purpose c) or d) of § 5.2.1 are the only ones valid simultaneously, the ETCS Location Marker shall be chosen.

5.3 Level transition marker board

5.3.1

Operational purpose	To be used to indicate to the driver the location of the transition when the train enters into or exits from lines equipped with ERTMS/ETCS (including changing level between levels 1 or 2).
Reference	SUBSET-026 § 5.10
Engineering rule for MB location	It shall be placed in correspondence to the location where the level transition takes place and in such a way that it clearly indicates which track it applies to.
Justification of the engineering rules	The level transition MB serves to identify the physical location where a level transition takes place normally (i.e. no trackside failures, no missed balise groups), in case the ERTMS/ETCS system does not support the driver to identify that point.

5.4 Lower pantograph marker board

5.4.1

Operational purpose	To be used to alert the driver that the train has to pass a section of the line with the pantograph(s) lowered at the latest at the location the pantograph lowered MB is placed.
Reference	SUBSET-026 § 3.12.1, 5.18, 5.20
Engineering rule for MB location	It shall be placed at sufficient distance in rear of the beginning of the powerless section that the train has to pass with the pantograph(s) lowered, considering the applicable speed and the necessary time (driver reaction time + time needed for the system to perform the action). See § 3.3.1 and § 3.3.3 for the definitions of the applicable speed and necessary time.
Justification of the engineering rules	The lower pantograph MB serves to notify the driver about an upcoming section that the train needs to pass with pantograph(s) lowered and for which actions need to be completed before reaching the pantograph lowered MB.

5.5 Pantograph lowered marker board

5.5.1

Operational purpose	To be used to indicate to the driver the beginning of a section of the line that the train has to pass with lowered pantograph(s).
Reference	SUBSET-026 § 3.12.1, 5.18, 5.20
Engineering rule for MB location	It shall be placed at the start location of the powerless section that the train has to pass with the pantograph(s) lowered.
Justification of the engineering rules	The pantograph lowered MB serves to help the driver to identify the physical location by which he/she has to have lowered the pantograph(s) in case the ERTMS/ETCS system does not support the driver to identify that location (e.g. in an ERTMS/ETCS degraded situation or in SR).

5.6 Raise pantograph marker board

5.6.1

Operational purpose	To be used to indicate to the driver the end of the section of the line that the train has to pass with lowered pantograph(s).
Reference	SUBSET-026 § 3.12.1, 5.18, 5.20
Engineering rule for MB location	It shall be placed at the end location of the powerless section that the train has to pass with pantograph(s) lowered.

Justification of the engineering rules	The raise pantograph MB serves to help the driver to identify the physical location where he/she is allowed, at the earliest, to raise the pantograph in case the ERTMS/ETCS system does not support the driver to identify that location (e.g. in an ERTMS/ETCS degraded situation or in SR).
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5.7 Neutral section announcement marker board

5.7.1

Operational purpose	To be used to alert the driver that the train has to pass a section of the line with the main power switch switched off at the latest at the location the neutral section MB is placed.
Reference	SUBSET-026 § 3.12.1, 5.18, 5.20
Engineering rule for MB location	It shall be placed at sufficient distance in rear of the beginning of the powerless section that the train has to pass with the main power switch switched off, considering the applicable speed and the necessary time (driver reaction time + time needed for the system to perform the action). See § 3.3.1 and § 3.3.3 for the definitions of the applicable speed and necessary time.
Justification of the engineering rules	The neutral section announcement MB serves to notify the driver about an upcoming section that the train needs to pass with the main power switch switched off and for which actions need to be completed before reaching the neutral section MB.

5.8 Neutral section marker board

5.8.1

Operational purpose	To be used to indicate to the driver the beginning of a section of the line that the train has to pass with the main power switch switched off.
Reference	SUBSET-026 § 3.12.1, 5.18, 5.20
Engineering rule for MB location	It shall be placed at the start location of the powerless section that the train has to pass with the main power switch switched off.
Justification of the engineering rules	The neutral section MB serves to help the driver to identify the physical location by which he/she has to have switched off the main power switch in case the ERTMS/ETCS system does not support the driver to identify that location (e.g. in an ERTMS/ETCS degraded situation or in SR).

5.9 End of neutral section marker board

5.9.1

Operational purpose	To be used to indicate to the driver the end of a section of the line that the train has to pass with the main power switch switched off.
Reference	SUBSET-026 § 3.12.1, 5.18, 5.20
Engineering rule for MB location	It shall be placed at the end of the powerless section that the train has to pass with the main power switch switched off.
Justification of the engineering rules	The end of neutral section MB serves to help the driver to identify the physical location where he/she is allowed, at the earliest, to switch on the main power switch in case the ERTMS/ETCS system does not support the driver to identify that location (e.g. in an ERTMS/ETCS degraded situation or in SR).

5.10 GSM-R network border marker board

5.10.1

Operational purpose	To be used to indicate to the driver the location where the GSM-R network must be changed, and which network must be selected in order to perform radio voice functions.
Reference	SUBSET-026 § 3.5.6
Engineering rule for MB location	It shall be used at all GSM-R network boundaries, in the direction the train enters the indicated GSM-R network.
Justification of the engineering rules	This MB serves to identify the physical location where the driver has to select the new GSM-R network when the ERTMS system does not support the driver with this information.