Schedule 5(o)

Signaling Engineering Rules (SER)

California High-Speed Rail Authority

Standard Specifications

TSCC Specifications

SPEC-0019 – Signaling Engineering Rules (SER)

Rev. 1.0

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First Edition

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0.0	September 2025	First edition

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1 INTRODUCTION

1.1 Scope of the document

1.1.1 This document specifies basic interlocking and ETCS engineering rules for the placement of the following signaling objects on a track layout:

- Marker Boards;
- Axle counters;
- Balises;
- Shunting signals;
- Derailers;
- Switch motors.

1.2 Application of the document

1.2.1 This document shall be used as an input for the TSCC Contractor Train Control Systems design of the California High-Speed Rail.

1.2.2 Engineering guidelines could also be used as input and high-level rules for the TSCC Contractor's detailed engineering rules. However, the TSCC Contractor will have to substantiate any changes related to rules specified in this document. The TSCC Contractor will have to develop its own engineering rules related to systems not scoped in this document in the frame of his design.

1.3 Relevant input data

1.3.1 The design shall consider ETCS system requirements which can be found in STS_ETCS [R21] (further ETCS technical specification).

1.3.2 The length of the passenger trainset according to HSR Design Criteria Manual (further HSR DCM) [R18] shall be considered – 205m (672.6 feet) for single-traction train and 410m (1,345.2 feet) for the double-traction train.

1.3.3 The useful length for the maintenance trains according to HSR Maintenance Facilities Specification [R19] shall be considered – 91,4m (300 ft).

1.3.4 Other relevant data shall also be considered by the TSCC Contractor in its design such as track geometry (gradient, fouling point location, track profile) and Trainset characteristics (deceleration rate, distances between axles, etc.).

2 REFERENCE STANDARDS AND DOCUMENTS

2.1 Reference Standards

Standard No.	Standard Title	ID
EN 50126-1	Railway applications - The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 1: Generic RAMS Process	[R1]
EN 50126-2	Railway applications - The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 2: Systems Approach to Safety	[R2]
EN 50129	Railway applications – Communication, signalling and processing systems – Safety related electronic systems for signalling.	[R3]
EN 50159	Railway applications – Communication, signalling and processing systems.	[R4]
EN 50716	Railway Applications – Requirements for software development	[R5]
TSI CCS	Commission Implementing Regulation (EU) 2023/1695 of 10 August 2023 on the technical specification for interoperability relating to the control-command and signalling subsystems of the rail system in the European Union	[R6]
TSI CCS	List of ERTMS mandatory specifications as per Appendix/Annex A – Table A2 of CCS TSI 2022 which refer to: ETCS Baseline 4; RMR: GSM-R Baseline 1 Maintenance Release 1 + FRMCS Baseline 0; ATO Baseline 1	[R7]
TSI CCS	List of supporting informative specifications as per CCS TSI Application Guide	[R8]

TABLE 55 - REFERENCE STANDARDS

2.2 Reference Documents

Doc Code	Document Title	Reference	Author
SUBSET-036	FFFIS for Eurobalise	[R9]	Unisig
SUBSET-040	Dimensioning and Engineering rules	[R10]	Unisig
SUBSET-091	Safety Requirements for the Technical Interoperability of ETCS in Levels 1 & 2	[R11]	Unisig
ERA/ERTMS/033281	Interface between CCS trackside and other subsystems	[R12]	ERA
ERA_ERTMS_OPE_AppA_5 / V 5.0	ERTMS Operational Principles and Rules	[R13]	ERA
EEIG 06E068	ETCS Marker Board definition	[R14]	EUG
EEIG 21E089	Engineering rules for harmonized marker boards	[R15]	EUG
011REC1053 V1.04	Harmonised ERTMS Marker Boards	[R16]	ERA
HSR DCM – Chapter 8	Design Criteria Manual Chapter 8: HSR Trainsets	[R17]	HSR

Doc Code	Document Title	Reference	Author
HSR MFS	HSR Maintenance Facilities Specification	[R18]	HSR
TCS Glossary	TCS Glossary of Terms, Abbreviations and Definitions	[R19]	TCS Engineer
10_STS_ETCS	TSCC Contract Requirements Partc C - System Technical Specification of ETCS	[R20]	TCS Engineer
12_STS_IXL	TSCC Contract Requirements Partc C - Interlocking	[R21]	TCS Engineer

TABLE 5 - REFERENCE DOCUMENTS

3 TERMS, DEFINITION AND ABBREVIATION

3.1.1 All the terms, definitions, and abbreviations are provided in the Glossary of Terms, Abbreviations and Definitions.

4 MARKER BOARDS

4.1 General

4.1.1 ETCS Marker Boards shall be designed according to the following documents:

- European standard EN 16494:2025: Railway applications – Requirements for ERTMS Trackside Boards;
- EEIG 06E068: ETCS Marker Board definition documents;
- EEIG 21E089: EEIG Engineering rules for harmonized marker boards;
- Harmonized ERTMS Marker Boards, European Union Agency for Railways, version 1.04;
- ERTMS Operational Principles and Rules, European Union Agency for Railways, version 5.

4.1.2 Marker Boards are located to give trains start and stop locations, which can have a significant impact on operational capacity. Several important aspects of marker board locations can be:

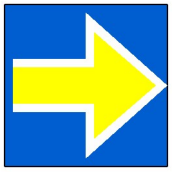
- Operational stopping points for trains;
- Needed safety distance to fouling point or conflicting routes / movement areas;
- Level transition, corresponding to transitions between ETCS levels;
- Operational needs for turning movements.

4.1.3 Marker Boards shall be installed in such a way that they clearly indicate the track to which it refers, and it may be mounted on a dedicated mast or, when possible (e.g., for line block sections), on existing structure (e.g., the catenary pole). There is not a reference standard that establishes the height from the ground/rail for Marker Boards installation. It will be defined according to infrastructure constraints, to optimize visibility and readability.

4.1.4 When locating Marker Boards, the right side of the track to which they refer shall be considered firstly as an area for installation.

4.2 Marker Boards definition

4.2.1 Below is a list (TABLE 6) of Marker Boards to be implemented for the HSR, according to European Standards.

Marker Board representation	Marker Board's name	Marker Board's location
	Stop Marker	In station: incoming and outgoing

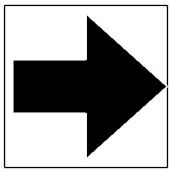
	Location Marker	In station (optionally): at the start/end of a shunting movement in OS mode
	Level Transition board	At each Level Transition border

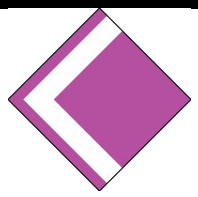
TABLE 6. STANDARD MARKER BOARDS

4.2.2 The following additional Marker Boards are provided (TABLE 7).

Marker Board representation	Marker Board's name	Marker Board's location
	Start of Mission	In station: at 30m/50m before the exit Stop Marker, only at places where trains will restart with a loss of valid position, departing from track accessible from depot/maintenance facility
	Mileage board	Located at every 660ft (1/8 mi for both directions). The blue arrow indicates increase or decrease of the MP, the black arrow indicates the track to which it refers

TABLE 7. ADDITIONAL MARKER BOARDS

4.2.3 For Shunting movements there is no standard equipment, so according to the ETCS Technical Specification [R21], the following Marker Boards could be used (TABLE 8).

Marker Board representation	Marker Board's name	Marker Board's location
	Start of Shunting area	In station: at the start of shunting movements

	End of Shunting area	In station: at the end of shunting areas

TABLE 8. SHUNTING MARKER BOARDS

4.2.4 Based on the definition from the "Harmonised ERTMS Marker Boards" [R17]:

4.2.4.1 ETCS stop markers and ETCS location markers may be used to unambiguously identify the end of a block section as an EOA where the driver requires supplementary information to identify the exact stopping location in addition to the display on the DMI;

4.2.4.2 ETCS stop markers and ETCS location markers serve to mark the location to where the driver has to drive under his responsibility (in SH/SR mode) before a possible MA in FS/OS is received.

4.2.4.3 The ETCS stop marker shall be used to unambiguously identify an EOA which protects one or a group of safety-critical points such as a switch, a conflicting route as entrance of a station, junctions, etc. where the driver requires supplementary information to identify the exact stopping location in addition to the display on the DMI (for instance where a release speed is provided);

4.2.4.4 The ETCS stop marker may be used to identify other points of the track the driver shall not overpass when an MA is not available, unless he has received a specific authorization by the Dispatcher;

4.2.4.5 The ETCS location marker may be used to unambiguously identify the end of a block section/OS section as an EOA where the driver requires supplementary information to identify the exact stopping location in addition to the display on the DMI (for instance where a release speed is provided);

4.2.4.6 The ETCS location marker may be used to identify other points of the track the driver can overpass when a MA in OS mode is not available;

4.3 Visibility of Marker boards

4.3.1 As instructed in the ETCS technical specification [R21], the visibility of the marker boards shall be the following:

- Main and block Marker boards ≥ 400m (200m on rough terrain);
- Shunting boards ≥ 100 m.

4.4 Protection of Supervised Location

4.4.1 The following Supervised Locations shall be considered:

- The entry point of an occupied block section (i.e. axle counter located ahead of the occupied section);
- The fouling point of a switch, positioned for a route, conflicting with the current direction of movement of the train;
- The derailer;
- The end of shunting area;
- End of platform or other planned stopping location of train rear end;
- The head of a switch which is uncontrolled (heel joint of turnout).

4.5 Overlap

4.5.1 Overlap distance corresponds to the distance between the marker board (marking the end of EoA) and the Supervised Location. For details refer to ETCS technical specification [R21].

4.5.2 Note: If the overlap is timed, it will be configured as an ETCS Overlap in the MA packet definition. If the overlap is not (i.e. permanent) it will be associated to an ETCS Danger Point in the MA packet definition.

4.6 Marker board placement

4.6.1 Marker boards shall refer to the track to which it belongs as indicated in the following figure (FIGURE 1):

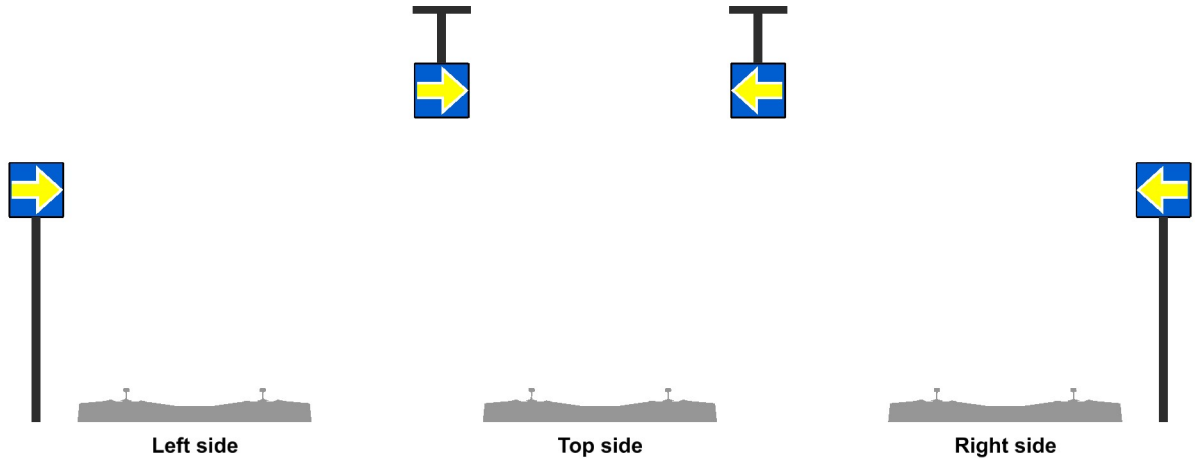


FIGURE 1. MARKER BOARD PLACEMENT

4.6.2 **Marker boards at double track lines in the main line**

4.6.2.1 In the main line, at double track lines, corresponding marker boards (FIGURE 2) should be aligned:

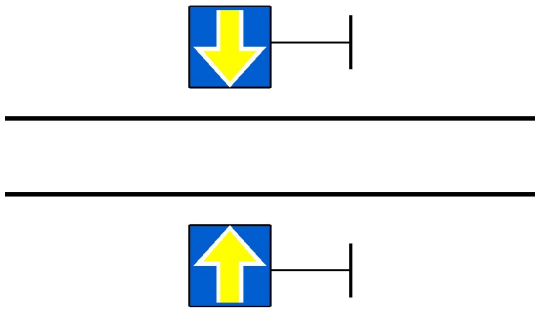


FIGURE 2. MARKER BOARDS AT DOUBLE TRACK LINES

4.6.3 **Distance of the Marker board from the fouling point**

4.6.3.1 The distance between the marker board and the fouling point (FIGURE 3) is given by the overlap distance indicated in ETCS technical specification [R21] and illustrated below:

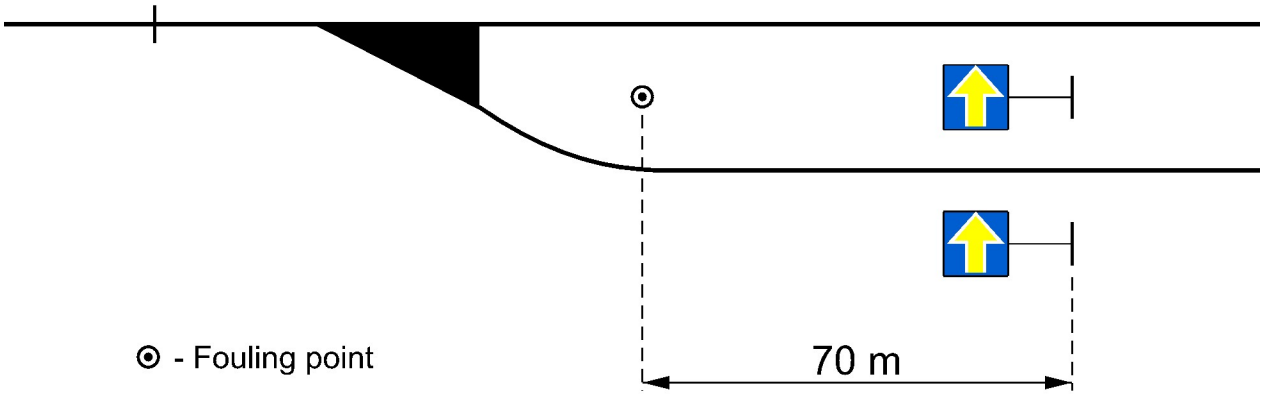


FIGURE 3. MARKER BOARD BEFORE FOULING POINT

4.6.4 **Distance of the Marker board from the tip of the switch**

4.6.4.1 The standard distance between the marker board (FIGURE 4) and the tip of a switch is given by the overlap distance from the ETCS specification [R21] and illustrated below:

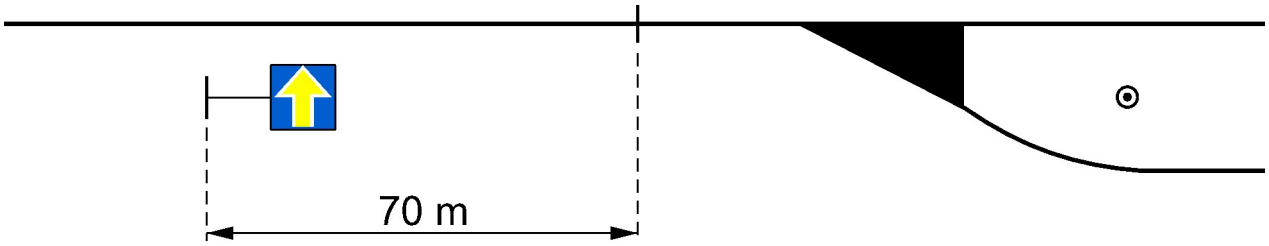


FIGURE 4. MARKER BOARD FROM THE TIP OF THE SWITCH

4.6.4.2 This distance can be adapted depending on the track layout and the operational needs but should not be less than 20m (refer to chapter 0).

4.6.5 **Station with passing loop configuration**

4.6.5.1 Based on the above principles, the following configuration for a station with passing loop configuration will be as following (**FIGURE 10**~~**FIGURE 10**~~):

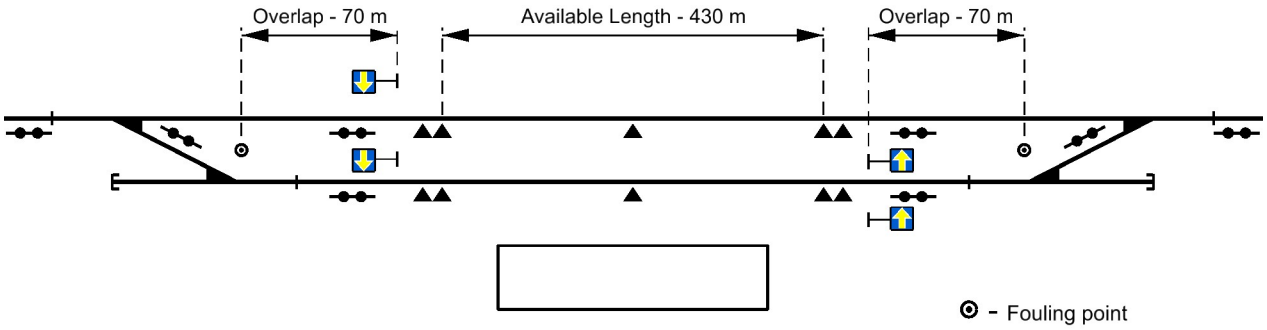


FIGURE 10. MAIN TRACK IN A STATION WITH PASSING LOOP CONFIGURATION

4.6.5.2 The available track length is defined as a distance between the first balise in “Stop if in SR” BG related to ETCS stop marker board for the specific direction and the first balise in “Stop if in SR” BG related to ETCS stop marker for the opposite direction.

4.6.5.3 The available track length shall be at least 430m for passenger trains, considering the following reserves:

- The reserve for braking inaccuracy shall consider possible inaccuracy of the end position of the train after braking - the distance of 5 m represents the regular value according to the European practice;
- The reserve for indicator view is required in front of the ETCS marker board. It allows the train driver to see the respective indication and identification marking. The distance of 10-15 m represents the value recommended by ERTMS Users Group (Engineering rules for harmonised marker boards [R16]) and shall be considered by designer.

4.6.6 **Marker board on fixed bridges/viaducts**

4.6.6.1 Marker boards shall preferably be placed at the start of a bridge, and not on the bridge due to limited availability for maintenance of marker board and axle counters.

4.6.6.2 Also, as instructed in the ETCS technical specification [R21], from an interlocking perspective it is important not to place any ETCS stop markers on the bridge / viaduct, or at a nominal train length beyond the viaduct, so that trains will not be forced to stop on the viaduct when the preceding train stops or there is a fault in the signaling system.

4.6.7 **Marker boards in non-stopping**

4.6.7.1 The marker board shall not be placed inside a non-stopping area. Non-stopping areas are defined in ETCS technical specifications.

5 AXLE COUNTER

5.1 General

5.1.1 Occupancy of main-siding tracks, turnout and other station sections, as well as block sections, will be controlled by an axle counter system.

***Note to reader**: In this section, a TVP corresponds to a portion of track between 2 axle counters.*

5.2 Axle counter placement

5.2.1 All requirements in TSI CCS [R7] regarding axle counter placement shall apply.

5.2.2 **Section minimum distance**

5.2.2.1 The minimum length of a signaling section is 20 000 mm for a 1435 mm track gauge. Indeed, as required in chapter 3.1.2.1 of ERA/ERTMS/033281 [R13], the maximum axle distance (for 1435 mm gauge) for a trainset shall not exceed 20 000 mm.

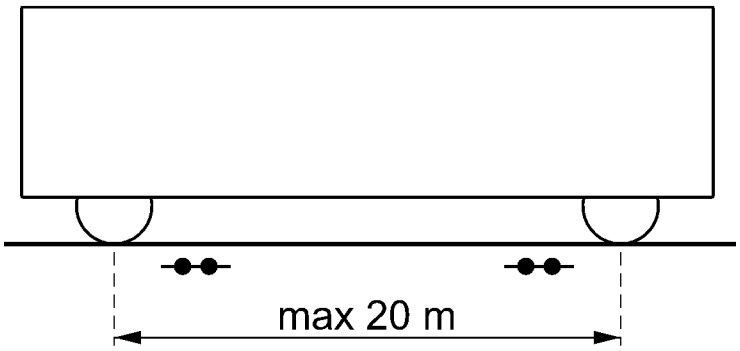


FIGURE 11. EXAMPLE OF INSUFFICIENT SECTION LENGTH - A VEHICLE OR CONSIST SHALL NOT BRIDGE A SIGNALING SECTION, MAKING THE TRAIN DETECTION SYSTEM REPORT ITS AS "UNOCCUPIED

5.2.2.2 In addition, axle counter systems shall be able to distinguish the detection of an axle by 2 subsequent counters with sufficient resolution (to avoid any count-error). As per chapter 3.1.2.2 of ERA/ERTMS/033281 [R13], the minimum trainset axle distance could be as per the table below:

Maximum Speed v [km/h]	Minimum axle distancies ai [mm]
v ≤ 100	720
100 ≤ 300	v*7,2
300 < v ≤ 400	2160

TABLE 9 - MINIMUM AXLES COUNTER DISTANCE

5.2.3 **Axle counter at a signaling point**

5.2.3.1 All marker boards, start / end of shunting areas and shunting signals shall have an associated axle counter.

5.2.3.2 The axle counter shall be placed a minimum of 15 meters beyond the EoA marker board, as shown in the following figure (FIGURE 12):

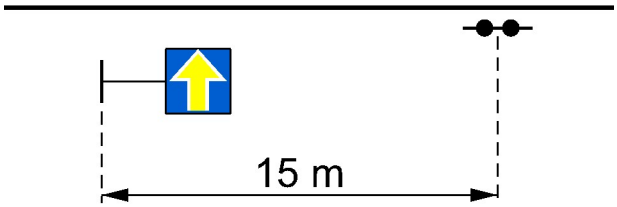


FIGURE 12. AXLE COUNTER AT A MARKER BOARD LOCATION

***Note to reader**: The rationale is the following:*

When the actual train front passes the Stop / Location MB, the cumulative odometry error affecting the distance of the minimum safe front end from the actual front end is assumed to be about 15 m. Then the train drives the first axle on the axle counter, which triggers a Conditional Emergency Stop (further CES) message to the train to confirm correct occupation of the section beyond the MB.

The adopted distance will allow the on-board equipment to reject the new EoA included in the CES command (the minimum safe front end of the train will be behind the MB) which will influence the continuation of the train movement, without tripping (change mode into TR). The distance shall be sufficient to ensure that the train will not occupy the TVP, before its minimum safe front end pass Stop / Location MB. The following situation shall be avoided (Figure 8)

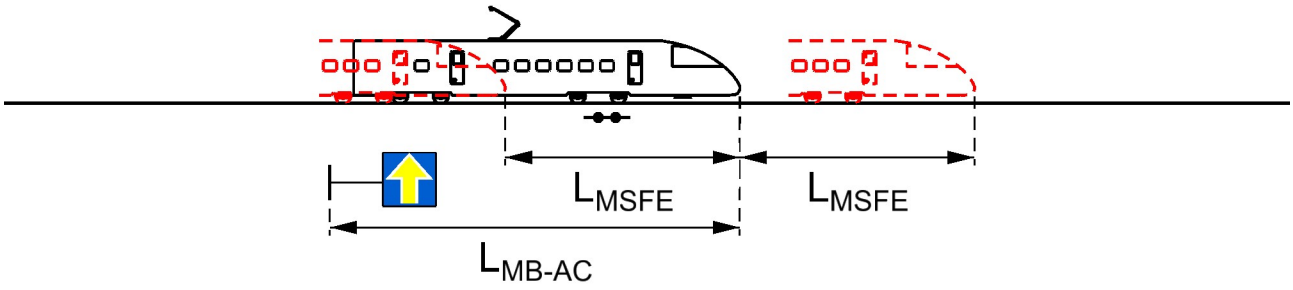


FIGURE 8. RATIONALE FOR MINIMUM DISTANCE BETWEEN MB AND AXLE COUNTER
LMSFE – DISTANCE BETWEEN ACTUAL FRONT END AND MAXIMUM/MINIMUM SAFE FRONT END BASED ON CONFIDENCE INTERVAL (SUBSET-041 POINT 5.3.1.1)
LMB-AC – DISTANCE BETWEEN STOP MARKER AND ACTUAL FRONT END
LMB-AC > LMSFE WHILE FIRST AXLE IS PASSING AXLE COUNTER

5.2.3.3 The distance between EoA and axle counter shall not be too large to avoid having a non-detected vehicle between the marker board and the axle counter such as illustrated below (FIGURE 9). Indeed, in this case, the driver will see its movement authority ends at the previous marker board whereas he will see no train before the next marker.

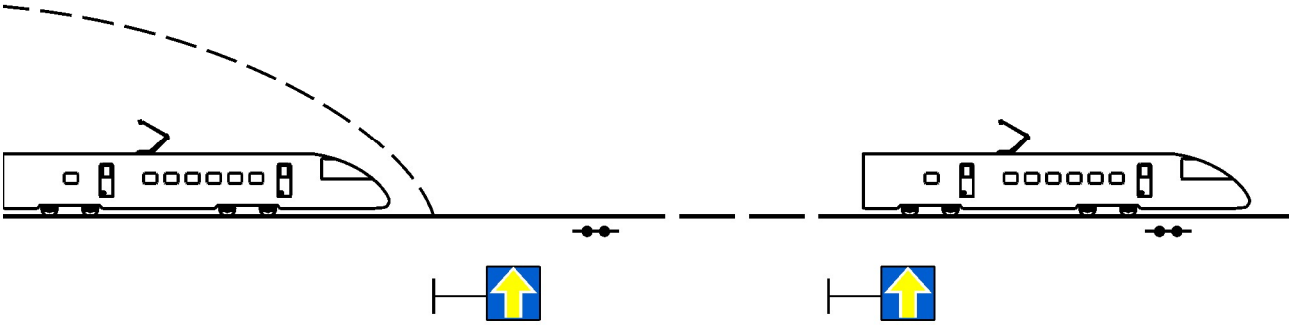


FIGURE 9. EXAMPLE OF TOO LONG DISTANCE

5.2.4 **Distance from fouling point to axle counter**

5.2.4.1 As described in TSI CCS [R7], a train detection system shall be able to detect:

- The first axle before the front of the train reaches the danger point ahead;
- The last axle until the end of the train has passed the danger point.

5.2.5 As required in chapter 3.1.2.4 of ERA/ERTMS/033281 [R13], the distance between the end of train and first axle on high-speed line will not exceed 5m.

5.2.6 **Distance from switch blade toe to axle counter**

5.2.6.1 The distance between the switch blade toe and the axle counter shall be sufficient to guarantee that the point is free to move after clearing the point's TVP section.

5.2.6.2 In addition, a 5 meters values will ensure that if a train is moving from the neighboring TVP section (that has not yet occupied the point's TVP section) simultaneously as the point receives a "switch point to opposite position" command, the train will not reach the switch blade before the point's switch blade moves.

5.2.6.3 The following figure is illustrating a typical axle counter location considering switch head

- when a 70m overlap is provisioned (as per section 4.6.4);
- for an intermediate switch of a route.

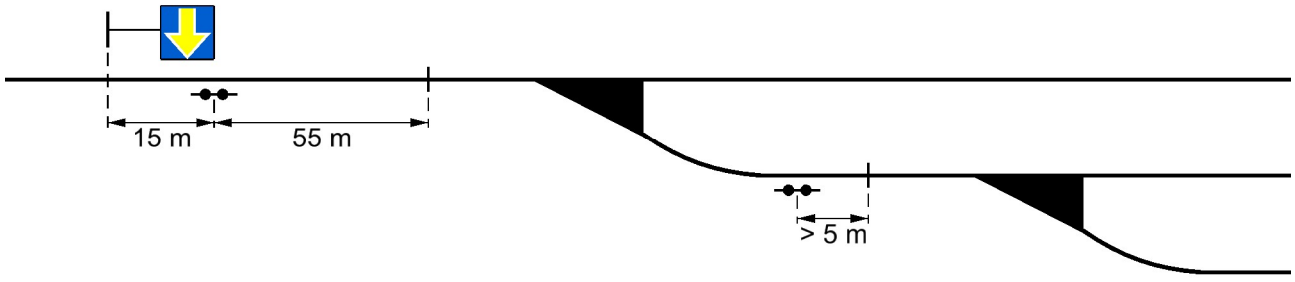


FIGURE 10. AXLE COUNTER FROM SWITCH BLADE TOE / TYPICAL LAYOUT

5.2.7 Cross over

5.2.7.1 Based on the principles exposed before in this document, a typical Axle Counter implementation for a cross over will be as following (FIGURE 11):

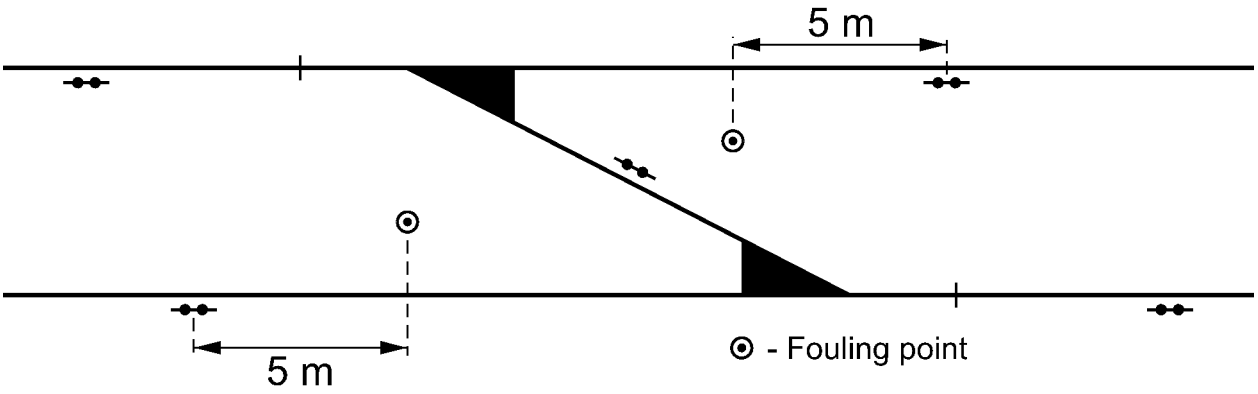


FIGURE 11. AXLE COUNTER ON CROSS OVER

5.2.8 Distance axle counter – derailer – fouling point

5.2.8.1 The axle counter shall be placed approximately 1 meter on approach to the derailer, or as close to the derailer as possible (FIGURE 17).

***Note to reader**: Rationale: To avoid that shunting movements up to the derailer are detected as occupied section over the switch.*

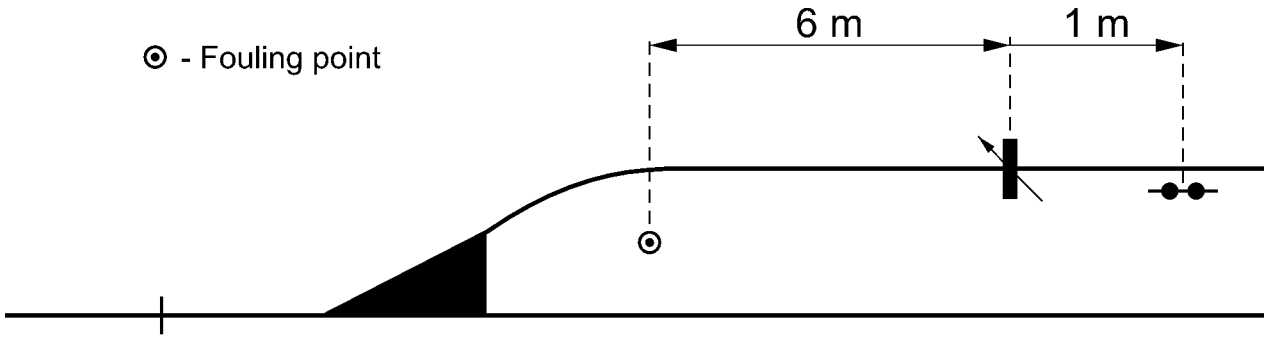


FIGURE 17. AXLE COUNTER FROM DERAILER AND FOULING POINT

5.2.9 Axle counter location additional requirements

5.2.9.1 Axle counters shall be installed:

- At all boundaries with tracks not equipped with track clearance detection or equipped with other means of train detection or equipped with different type of axle counter system;
- At the start of each train and shunting route, at the end of each train route (except for dead end track) and to locate the end of the train (in case this is not done at the exit signal (marker board) for opposite direction route;
- At all boundaries of a route section node (two or more adjacent turnouts) to ensure simultaneous train routes over it;

- At danger points to provide track clearance detection section between EoA and danger point. With regard to the principle of operation of the ETCS and the interlocking system, this principle may be changed at the next stage of design;
- At all boundaries of a flank protection area.

6 BALISE

6.1 General

6.1.1 All requirements in TSI CCS [R7] regarding balise engineering shall apply.

6.1.2 Eurobalise layout shall enable ETCS functionalities described in ETCS Technical Specification [R21].

6.1.3 For HSR CA project each Balises Group will be composed of one or more fixed eurobalises, distance between each one of them will be 3 m (according to SUBSET-036 chapter 5.6.3 [R10]).

6.1.4 The minimum distance between two balise groups, defined as the distance between closest balises of the two groups (i.e. between the Balise Reference Mark of the last one of the first group and the Balise Reference Mark of the first one of the second group) shall be calculated according to SUBSET-036 chapter 4.2.9. [R10].

6.2 Balise placement

6.2.1 In accordance with the assumptions made for the functionality of the system on the basis of ETCS technical specification [R21], a concept for the location of balises has been defined taking into account the TSI CCS specifications [R7], operational considerations and other guidelines necessary for the purpose of conducting traffic based on the indications of the ETCS L2 system.

6.2.2 This does not necessarily imply that dedicated BGs will be expected for each function described. The Telegrams length and the Balise size have to be considered in order to define if the same BG can have one or more functions, considering each BG has location related information to recalibrate the position of the train. Balise engineering will be in the scope of the future TCS contractor, which will be responsible for optimizing the number and location of BGs considering the BGs proximity.

6.2.3 **Start of Mission Balise Groups**

6.2.3.1 Assuming that Cold Movement Detection equipment will be installed on the HSR fleet, but may be unavailable, additional BGs are considered to obtain an unambiguous train position for Start of Mission, in locations where SoM can take place e.g. main station tracks.

6.2.3.2 Nominally, the train position information will be provided by the CMD devices.

6.2.3.3 In the case of CMD failure obtaining an unambiguous train position will be provided by “Start of Mission” Balise Groups located near the probable front end of parked train.

6.2.4 "Stop if in SR" Balise Groups

6.2.4.1 A group of two balises shall be located in front of each Stop Marker. This Balise Group shall be able to send a "Stop if in SR" packet to the OBU equipment in case of Staff Responsible movement.

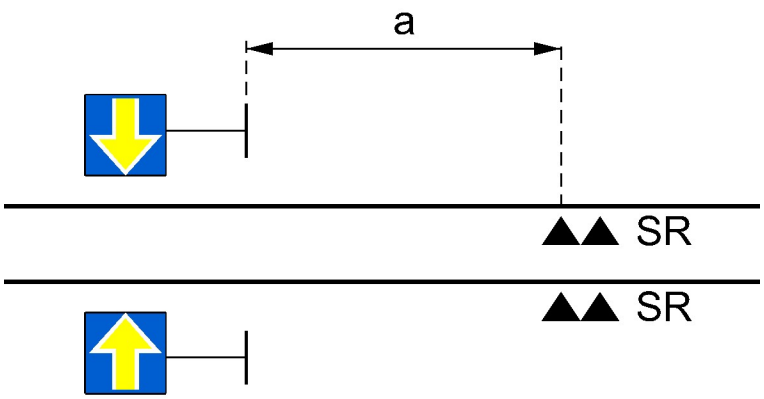


FIGURE 18. LOCATIONS OF "STOP IF IN SR" BALISE GROUPS

a – DISTANCE BETWEEN THE LRBG AND STOP MARKER, BASED ON SUBSET-040 P. 4.1.1.4, 5m IS ASSUMED

6.2.5 Relocation Balise Groups

6.2.5.1 Based on the ETCS L2 functionality assumptions from ETCS specification [R21] and TSI CCS specifications [R7], the non-switchable balises for recalibrating odometry shall be placed in the following locations:

6.2.5.2 According to the safety requirements of SUBSET-091 [R12], the maximum distance between two consecutive balise groups shall not exceed 2500 m;

6.2.5.3 Balise Groups made up of a single fixed balise placed to optimize braking curves during the braking to target:

- 200m before Marker Boards located in the main tracks;
- Note: Considering optimalization of number of balises in case of two Stop Markers placed in station for opposite movement's directions two BGs can be replaced by one located in the middle of distance between these MBs;
- 200m before speed change points (changing from higher to lower speeds).

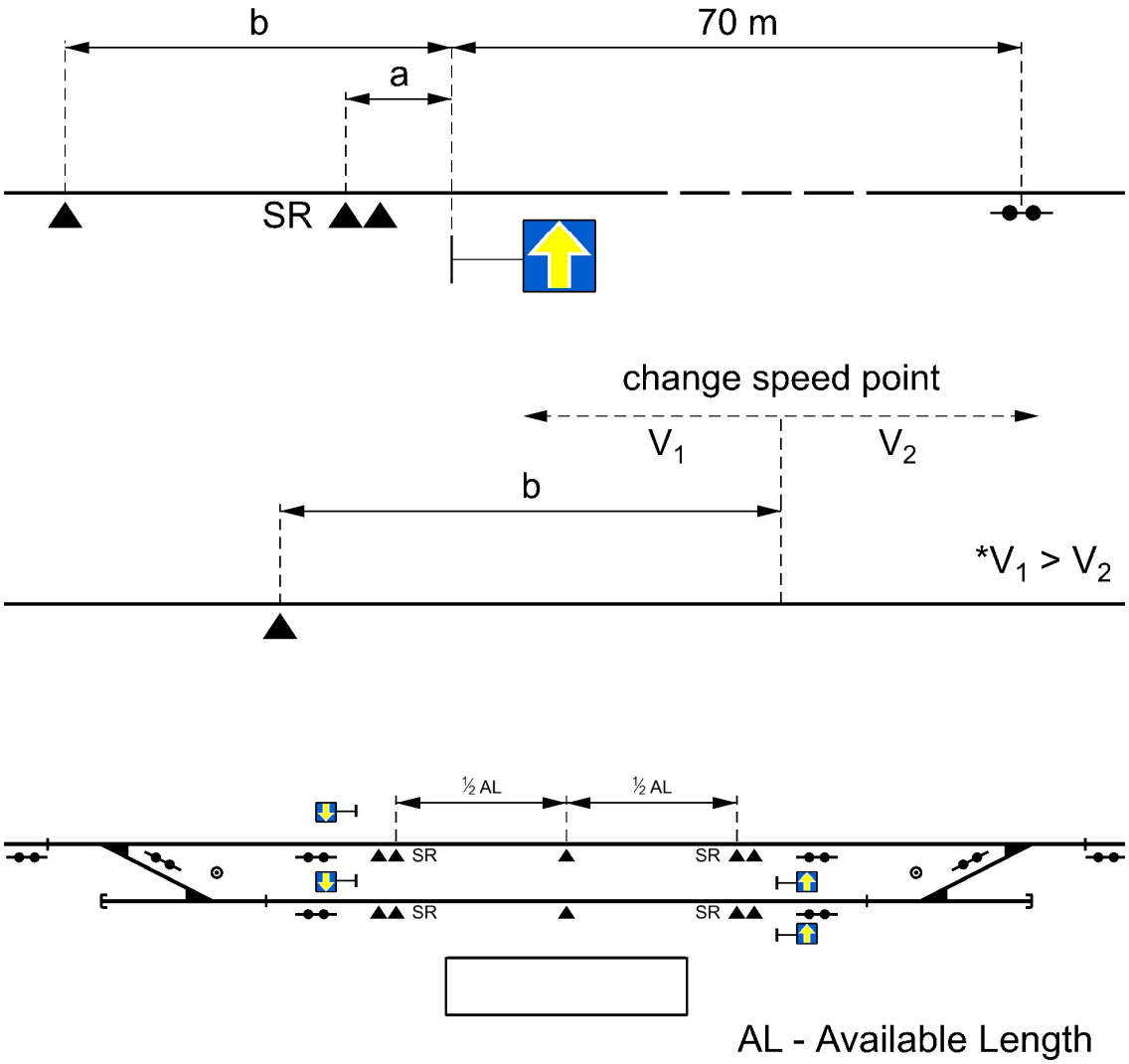


FIGURE 14 - LOCATIONS OF RELOCATION BALISE GROUPS IN FRONT OF EOA / SPEED CHANGES

a – distance of the "Stop if in SR" BGs from the EoA (in accordance with chap. 6.2.4);
*b – the distance between the LRBG and the EoA / maximum speed change is assumed to be 200m for the purpose of calibrate odometry (odometry error x calculated on basis of SUBSET-041 point 5.3.1.1: x = 0.05 * b + 5 = 0.05 * 200 + 5 = 15 [m]);*
V1, V2 – maximum permitted speed.

6.2.5.4 Balise Groups made up of a single fixed balise placed to minimize odometry error in front of points of change of track conditions located at a distance of 200 m from the beginning of the section with the given condition, e.g. regenerative braking, non-stopping area;

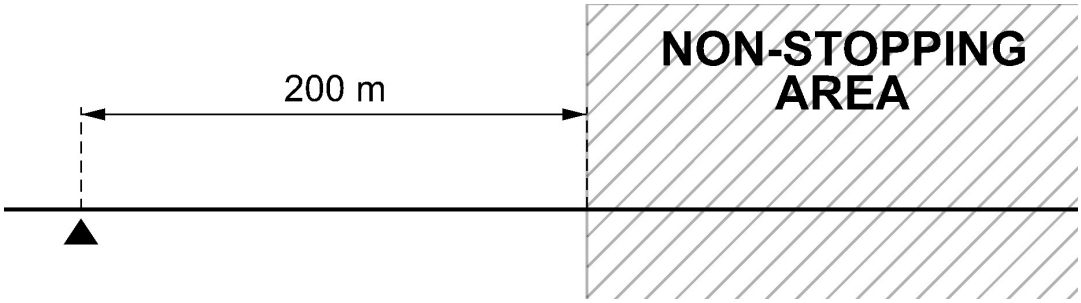


FIGURE 20. LOCATIONS OF RELOCATION BALISE GROUPS IN FRONT OF TRACK CONDITIONS

*b – the distance between the LRBG and the EoA / maximum speed change is assumed to be 200m for the purpose of calibrate odometry (odometry error x calculated on basis of SUBSET-041 point 5.3.1.1: x = 0.05 * b + 5 = 0.05 * 200 + 5 = 15 [m]);*

6.2.5.5 Balise Groups made up of a single fixed balise placed to determine the position of a train when passing a turnout located at a distance:

- min. 1 m from tip of the turnout;
- min. 1 m from the fouling point;
- min. 1,4 m between the balises placed in adjacent tracks due to ensure protection against cross-talk - SUBSET-036 pt. 4.2.5.

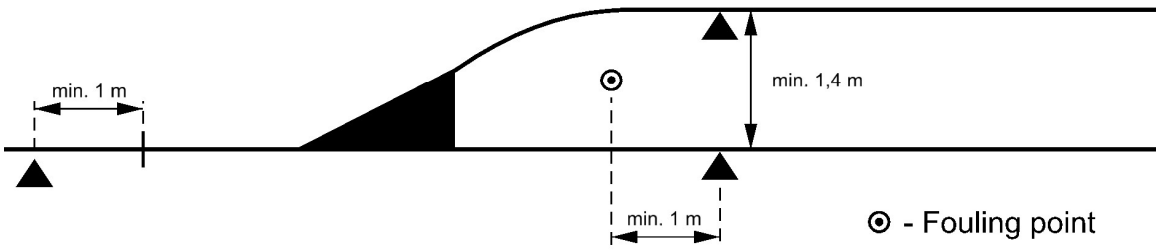


FIGURE 21. LOCATIONS OF RELOCATION BALISE GROUPS NEAR TURNOUT

d - the distance between the BG and the tip / fouling point of the turnout, assumed ~1m

6.2.6 **Shunting areas borders**

6.2.6.1 Within shunting areas, BGs shall be located to transmit package 132 "Danger for Shunting information" on the end of the shunting area.

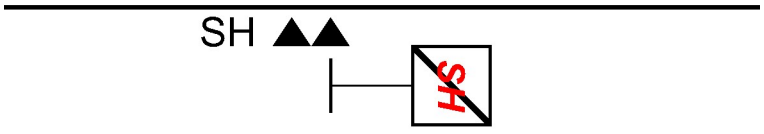


FIGURE 22. LOCATIONS OF "DANGER FOR SHUNTING INFORMATION" BALISE GROUPS

6.2.7 **National Values**

6.2.7.1 Balise Groups which transmit information about the National Values shall be placed at the boundaries between shunting yards / siding tracks and the RBC area;

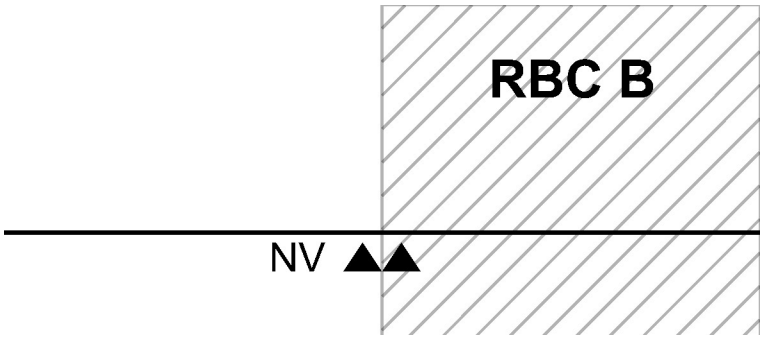


FIGURE 18. LOCATIONS OF BALISE GROUPS WITH NATIONAL VALUES

7 SHUNTING SIGNALS

7.1 General

7.1.1 Shunting signals are used to provide information about permission to move in SH mode with use of defined shunting routes when shunting movement is protected by interlocking as defined in [R22].

7.1.2 Shunting signals shall be used in the following cases:

- When shunting routes cross the main tracks;
- At the point where a shunting route starts, e.g. from a rib or stabling track, from a depot, from a siding, etc;

7.1.3 Shunting signals shall be located to the right of the track to which they relate. In exceptional cases, it is allowed to set a shunting signal on the left side of the track.

7.2 Shunting signals placement

7.2.1 **Distance to axle counter**

7.2.1.1 Shunting signals shall be placed as close as possible to the axle counter, with a tolerance of -1 meter to +30 meters.

7.2.2 **Distance to danger point**

7.2.2.1 If the shunting signal is placed at the border of shunting area or in front of fouling point of turnout included in train routes, it shall be placed at a minimum distance of 15 meters from the danger point (FIGURE 19).

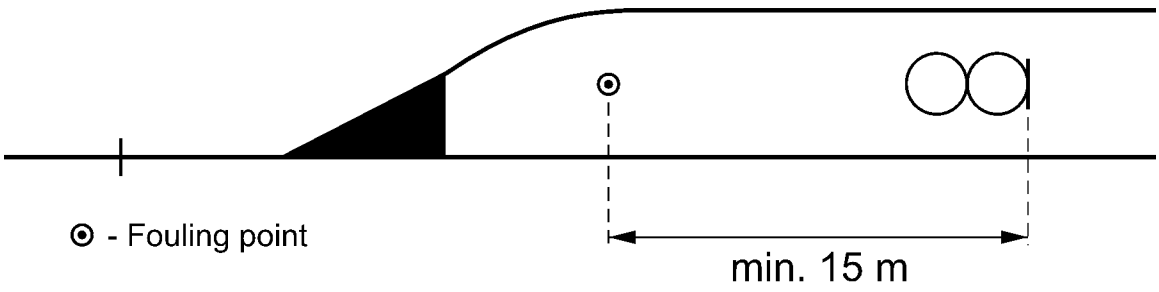


FIGURE 19. SHUNTING SIGNALS BEFORE FOULING POINT

8 DERAILERS

8.1 General

8.1.1 According to IXL technical specification [R22] derailers are used to protect the train route from trainset running away from a sidetrack.

8.1.2 Derailers should not be used on main tracks.

8.1.3 The installation location and direction of derailment shall be such that the derailed trainset causes the least possible risk to safety and damage to trackside equipment and facilities.

8.1.4 Beacons with signals indicating their position may be used for derailers. Derailer's signals shall be illuminated at night.

8.2 Distance from fouling point

8.2.1 Derailers shall be installed at a distance of 6 m in front of the fouling point of the protected turnout. This distance can be exceeded under condition of including derailer in turnout's TVP (FIGURE 25).

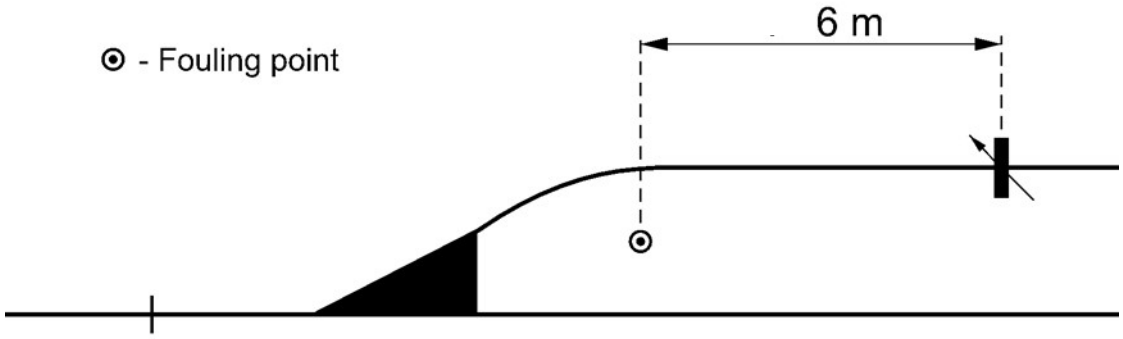


FIGURE 25. DERAILERS BEFORE FOULING POINT

8.3 Distance from catenary supports

8.3.1 Derailers shall not be located up to 5 m behind and 30 m in front of the catenary support looking in the direction of derailment.

9 SWITCH MACHINES

9.1 General

9.1.1 According to IXL technical specification [R22] switch and derailer machines are used to move and keep switch blades, derailers and moveable switch frogs in their final position.

9.1.2 The switch machine shall be installed in a location that ensures its proper operation. As far as possible, the aim shall be that:

- Convenient and safe access to the switch motor is provided;
- There is a convenient cable connection.

9.2 Switch machines configuration

9.2.1 According to Technical Specification for IXL technical specification [R22] on straight track where speed is > 200 km/h, turnouts shall be equipped with swing nose crossings.

9.2.2 In the case of turnouts with more than one inside locking for the switch blades or the switch frogs, multi-drive systems are assumed to be implemented. The use of bar / hydraulic transmission is possible and is in scope of switch machines engineering by future contractors.

9.2.3 When multi-drive systems are used, the first drive (looking from the beginning of the switch) shall be of the non-trailable type, while the subsequent drives may be trailable.

10 WORK AREAS

10.1 General

10.1.1 The work areas relate to the ‘engineering ownership’ of railway tracks. To ensure the safety of people involved in railway maintenance, access to work areas shall be adequately protected against unauthorized vehicles via the Staff Protection System.

10.1.2 According to IXL technical specification [R22] the CHSR railway network shall be divided into work areas consisting of one or few track clearance detection sections (subject of review and approval by the Authority).

10.2 Track layout segmentation

10.2.1 Division of work areas shall enable maximum functionality of movement during maintenance activities.

10.2.2 Catenary sectioning shall be considered in work areas segmentation process.

10.2.3 Crossovers shall be divided into work areas in a way to allow bidirectional movement on the maximum number of tracks.

10.2.4 In stations every track shall be included in a different work area. Grouping several tracks in one work area shall be agreed by the TSCC Contractor during the design stage.

11 NAMING

11.1 General

11.1.1 Generally signaling devices can be named using description:

- Alphabetic;
- Numerical;
- Alphanumeric.

11.1.2 Each device shall be uniquely labelled to enable easy location and referencing.

11.2 Marker boards naming

11.2.1 Stop Markers shall be named using number pool reserved for particular OCC.

11.2.2 Stop Markers shall be numbered according to increasing kilometrage/milage starting from left side to right side looking in the direction of movement, the first letter of the label specifies the OCC from which MA is provided to pass the MB.

11.2.3 Number shall be unique and considering number reserve for each indicator group.

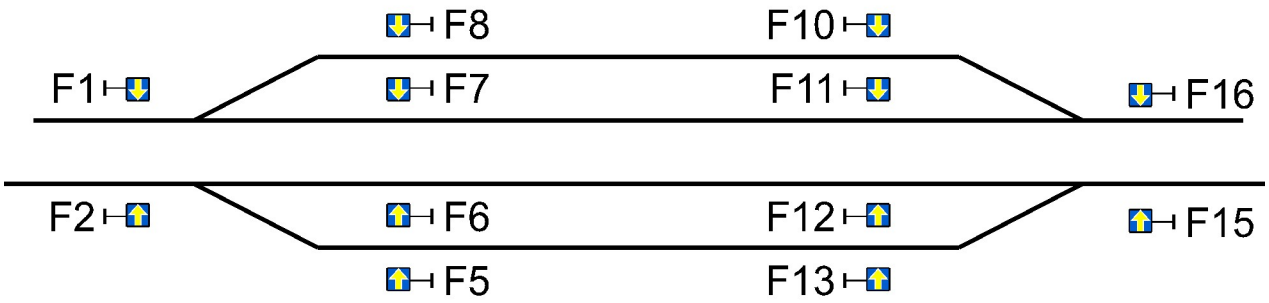


FIGURE 26. MARKER BOARDS NAMING

11.3 Axle counters naming

11.3.1 Axle counters shall be named using names of tangential TVPs e.g. s2-t2.

11.3.2 Turnout's TVP shall have alphanumeric description starting with the letter s (switch) and number of turnouts e.g. s2. If turnout's TVP includes several turnouts, then all switch numbers shall be considered with slash between them e.g. TVP for switches no. 4 and 6 shall be named s4/6. Axle counters at the ends of such a TVP may be numbered using a simplified TVP name – including only the nearest switch.

11.3.3 Station track's TVP shall have alphanumeric description starting with letter t (track) and number of tracks. Note: If on one track a few TVPs are designed a lowercase letter according to increasing kilometrage/milage shall be added to each TVP's name e.g. t4a, t4b, t4c etc.

11.3.4 Open line's TVP shall have alphanumeric description starting with letter t (track), number of track and acronym of tangential station / control point according to increasing kilometrage/milage e.g. for track no. 1 between Fresno (smaller kilometrage) and Fresno MOWF it may be t1FFM.

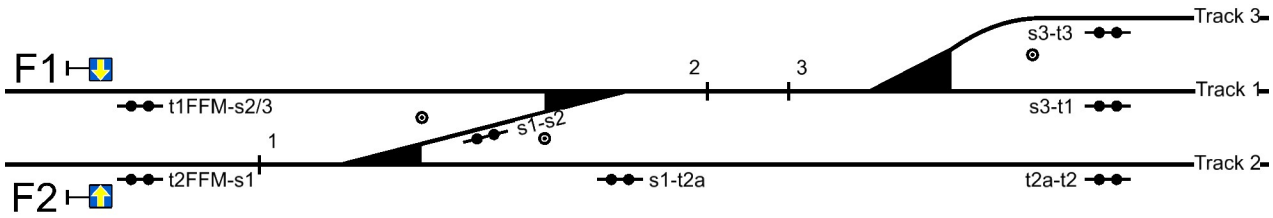


FIGURE 27. AXLE COUNTERS NAMING

11.4 Balise naming

11.4.1 Each balise group shall have its unique identification number. Identity numbers (NID_BG variable) will be engineered by the future TCS Contractor.

11.4.2 Balise groups which can send a "Stop if in SR" packet shall be numbered as follows: SR-MB number to which BG is associated-letter suffix (A/B/…) e.g. SR-F101-A. Letter suffix may be used in case there are few Balise Groups associated with the same Marker Board.

11.4.3 Balise Groups that are designated to SoM procedure (for obtaining an unambiguous train position) shall be named as follows: SM-MB number to which BG is associated-letter suffix (A/B/…) e.g. SM-F101-A. Letter suffix shall be used in the same way as described in requirement 10.4.2. Associated Marker Board means start location of the first route being set when Start of Mission occurs.

11.4.4 Relocation Balise Groups shall be numbered in accordance with the main engineering rule that was applied to locate them.

11.4.4.1 Balise groups used for relocation on open lines, before track conditions, speed changes shall be numbered as follows: RL-number of first reference mile in the nominal direction of movement-letter suffix (A/B/…) e.g. RL-23-A. Letter suffix shall be used in a similar way to that described in requirement 10.4.2. e.g. there are several relocation BGs before the same mile.

11.4.4.2 Balise groups used for relocation before Marker Boards shall be numbered as follows: RL-MB number-letter suffix (A/B/…) e.g. RL-F101-A. Letter suffix shall be used in a similar way to that described in requirement 10.4.2. If one BG is used for relocation before two MBs then for numbering purpose priority is given to the MB associated with nominal direction of movement.

11.4.4.3 Balise groups used for relocation near switches shall be numbered as follows: RL-switch number-letter suffix (A/B/…) e.g. RL-40-A. Letter suffix shall be used in a similar way to that described in requirement 10.4.2. e.g. there are several relocation BGs near the same switch.

11.4.5 Balise groups which can send a “Danger if in Shunting” packet shall be numbered as follows: SH-the nearest switch number-letter suffix (A/B/…) e.g. SH-40-A. Letter suffix shall be used in a similar way to that described in requirement 10.4.2. e.g. there are several BGs which can send a “Danger if in Shunting” packet near the same switch.

11.4.6 Balise groups which transmit information about the National Values shall be numbered as follows: NV-the nearest switch number-letter suffix (A/B/…) e.g. NV-40-A. Letter suffix shall be used in a similar way to that described in requirement 10.4.2. e.g. there are several BGs transmitting National Values near the same switch.

11.5 Shunting signals naming

11.5.1 Each shunting signal shall have numeric description from number pool reserved for particular e.g. 2.

11.5.2 Shunting signals shall be numbered according to increasing kilometrage/milage starting left side to right side looking in the direction of movement.

11.5.3 Number shall be unique and considering number reserve for each shunting signals group.

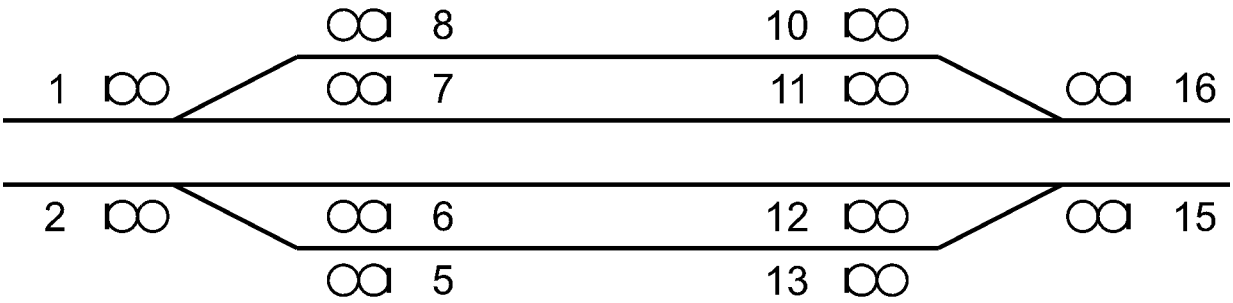


FIGURE 28. SHUNTING SIGNALS NAMING

11.6 Derailers naming

11.6.1 Each derailer shall have alphanumeric description starting with letters D (derailer) and number from number pool reserved for particular OCC e.g. D2.

11.6.2 Derailers shall be numbered according to increasing kilometrage/milage starting from track no. 1.

11.6.3 The number shall be unique and considering number reserve for each derailers group. Note: In purpose of better consistency derailers number group would be the same as switch machines number group.

11.7 Switch machines and switch detectors naming

11.7.1 Each turnout shall have a numeric description from the number pool reserved for a particular OCC. Each switch machine shall have a numeric or alphanumeric (multi-drive systems) description with the same number as turnout.

11.7.2 The alphanumeric description of the switch machine shall be composed of the number of the turnout on which the machine is mounted and the following Roman numerals.

11.7.3 Switch detectors shall be named in the same way as the switch machines, with the additional requirement that the letter d shall be added before the Roman numeral.

11.7.4 Turnouts numbers shall be unique and considering number reserve for each turnout's signals group.

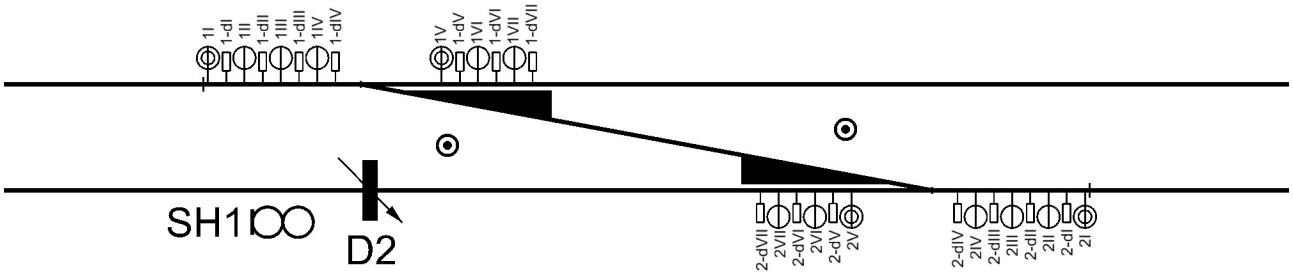


FIGURE 29. SWITCH MACHINES, SWITCH DETECTORS AND DERAILERS NAMING