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Service Ingénierie Infrastructure		

**TECHNICAL DOCUMENTATION FOR NON TSI COMPLIANT
TRAIN DETECTION
ERA-TDC-MS-LU**

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Version	Date	Explications	Application date
V0.1	25/07/2023	First draft version.	-
V0.2	10/11/2023	<p>Clause 2: Clarification added that the Tertiary Network is not intended for Unique Authorisation or passenger coaches.</p> <p>Clause 3.1.3.4: Editorial correction in the explanation.</p> <p>Clause 3.1.5: Admissible lubricated zone and guidance on approvals testing and verification added.</p> <p>Clauses 3.2.1, 3.2.1.1, 3.2.1.2, 3.2.1.3 and 3.2.1.4: Relaxed EMC requirements added for AZSB 300, Zp30H, Zp30C-NT, Zp30 and Zp30K axle counter detectors.</p> <p>Clause 3.2.1.5: Clause deleted because EMC requirements defined by the EN 50121 series are covered by the Directive 2014/30/EU (see “Summary of references of harmonised standards published in the Official Journal – Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (generated by the European Commission on 19/09/2022)”).</p> <p>Clause 3.2.2.1: Note added.</p> <p>Clauses 3.2.2.4.1 and 3.2.2.8.1.1: Clarification on the weighted band pass filter for the 83.3 Hz track circuit added.</p> <p>Clauses 3.2.2.4.1, 3.2.2.4.2 and 3.2.2.7: Clarifications on IU added and editorial adaptation.</p>	-
V1.0	13/12/2023	<p>Clauses 3.1.5, 3.2.1, 3.2.1.1, 3.2.1.2, 3.2.1.4: Editorial changes after review from ACF (11.12.2023) and ERA (12.12.2023).</p> <p>Clause 3.2.2.4.1: NOTE 6 added to provide clarification about the 50 Hz traction current evaluation in relation to the 83.3 Hz track circuits.</p>	-

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1 INTRODUCTION

This document specifies the requirements for non TSI compliant train detection systems in a harmonised format as for TSI compliant train detection systems.

2 SCOPE

It applies for non TSI compliant train detection systems installed in Member State **Luxembourg (LU)**.

The requirements in this document ensure compatibility with the following non TSI compliant train detection systems:

- **83.3 Hz track circuits**
- **125 Hz track circuits**

installed on lines in the area of use of the **National Rail Network** (“Réseau Ferré National (RFN)”), and:

- **50 Hz track circuits**
- **DC track circuits**
- **DSS200-45 axle counter detectors**

installed on tracks in the area of use of the **Tertiary Network** (“Réseau Tertiaire (RT)”).

The Tertiary Network is not intended for Unique Authorisation or passenger coaches.

NOTE: The **Luxembourg Rail Network** (“Réseau Ferré Luxembourgeois (RFL)”) is constituted by the **National Rail Network** (“Réseau Ferré National (RFN)”) and the **Tertiary Network** (“Réseau Tertiaire (RT)”).

3 PARAMETERS

3.1 Vehicle design and operation

3.1.1 Definitions

For the definition of the longitudinal vehicle dimensions, Figure 1 (which shows an example for a three-axle twin-bogie vehicle) applies, where:

- a_i = distance between following axles, where $i = 1, 2, 3, \dots, n - 1$, where n is total number of axles of the vehicle
- b_x = distance from first axle (b_1) or last axle (b_2) to the nearest end of the vehicle, i.e., nearest buffer/nose
- L = total length of the vehicle

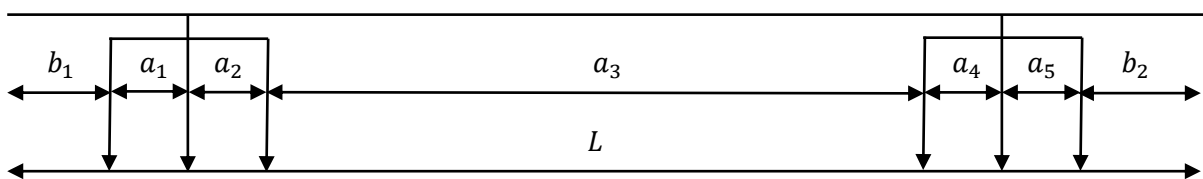


Figure 1: Longitudinal vehicle dimensions

If more vehicles are connected in a consist, the characteristics stated in the following part of this section 3.1 and related to a_i apply to the relevant distance of the axles belonging to each vehicle individually, while the characteristics related to b_i only apply to the two ends of the complete consist.

For definition of wheel dimensions, Figure 2 applies, where:

- D = wheel diameter
- $B_R + Burr$ = width of the rim
- S_d = thickness of the flange measured at the line 10 mm above the running tread as given in Figure 2
- S_h = height of the flange

Other dimensions in Figure 2 are not relevant in this document.

The values quoted in the following paragraphs are absolute limit values including any measurement tolerances.

The term wheelset applies to any pair of opposite wheels, even those not connected by a common axle. Except where stated, wheelset assemblies are assumed to have continuous wheel centres and not have spoke wheels. Any references to wheel sets concern centre of wheels.

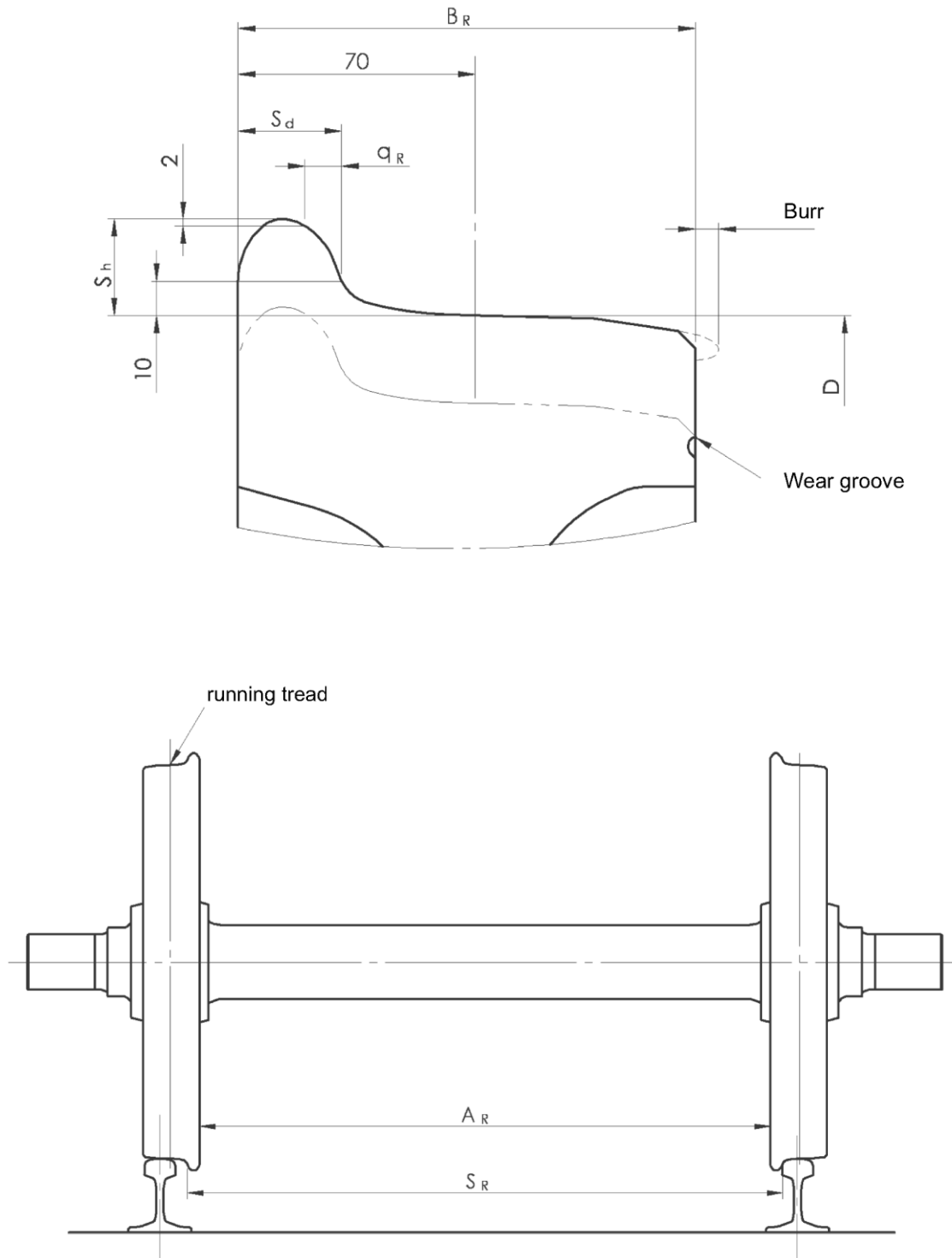


Figure 2: Wheel and wheelset dimensions

3.1.2 Axle distances

3.1.2.1 Maximum distance between following axles

Compliance with ERA/ERTMS/033281 version 5.0 (1435 mm track gauge).

3.1.2.2 Minimum distance between following axles

Compliance with ERA/ERTMS/033281 version 5.0 (applying $v \leq 175$ km/h), **except for DSS200-45 axle counter detectors** where the minimum axle distances (a_i) is dependent to the wheel diameter (D) as follows:

Wheel diameter (D)	Minimum axle distances (a_i)
$330 \text{ mm} \leq D < 600 \text{ mm}$	$a_i \geq 0,72 \text{ m}$
$600 \text{ mm} \leq D < 1000 \text{ mm}$	$a_i \geq 1,40 \text{ m}$
$D \geq 1000 \text{ mm}$	$a_i \geq 2,10 \text{ m}$

NOTE: The requirement related to the DSS200-45 axle counter detectors is needed as long as these detectors do operate on the Tertiary Network.

Explanation:

- The applicable speed of $v \leq 175$ km/h has been established considering the maximum allowed speed on the Luxembourg Rail Network, $v_{RT} < v_{RFN} \leq 160$ km/h, and $dV_{ebi_max} = 15$ km/h according to SUBSET-026-3.
- The defined distances between following axles are necessary to assure safe and reliable wheel detection and subsequent axle count for DSS200-45 axle counter detectors currently existing on the Tertiary Network.

3.1.2.3 Minimum distance between first and last axle

Compliance with ERA/ERTMS/033281 version 5.0.

NOTE: Not applicable for the Luxembourg Rail Network.

Explanation: There are no track circuits with electrical joints on the Luxembourg Rail Network.

3.1.2.4 Maximum distance between front/ rear end of train and first/last axle for trains running exclusively on High Speed lines

Compliance with ERA/ERTMS/033281 version 5.0.

NOTE: Not applicable for the Luxembourg Rail Network.

Explanation: There are no High Speed lines on the Luxembourg Rail Network.

3.1.2.5 Maximum distance between front/ rear end of train and first/last axle for trains running on other lines

Compliance with ERA/ERTMS/033281 version 5.0 (1435 mm track gauge).

3.1.3 Wheel geometry

3.1.3.1 Geometric dimension of the wheel rim width

Compliance with ERA/ERTMS/033281 version 5.0 (1435 mm track gauge).

3.1.3.2 Minimum wheel diameter

Compliance with ERA/ERTMS/033281 version 5.0 (applying $v \leq 175$ km/h).

Explanation: The applicable speed of $v \leq 175$ km/h has been established considering the maximum allowed speed on the Luxembourg Rail Network, $v_{RT} < v_{RFN} \leq 160$ km/h, and $dV_{ebi_max} = 15$ km/h according to SUBSET-026-3.

3.1.3.3 Geometric dimension of flange thickness

Compliance with ERA/ERTMS/033281 version 5.0 (1435 mm track gauge).

3.1.3.4 Geometric dimension of the flange height

Compliance with ERA/ERTMS/033281 version 5.0 (1435 mm track gauge), **except for DSS200-45 axle counter detectors** where the dimension of the flange height (S_h) is dependent to the wheel diameter as follows:

Wheel diameter (D)	Flange height (S_h)
$330 \text{ mm} \leq D \leq 760 \text{ mm}$	$32 \text{ mm} \leq S_h \leq 36 \text{ mm}$
$D > 760 \text{ mm}$	$27,5 \text{ mm} \leq S_h \leq 36 \text{ mm}$

NOTE: The requirement related to the DSS200-45 axle counter detectors is needed as long as these detectors do operate on the Tertiary Network.

Explanation: The defined flange heights are necessary to assure safe and reliable wheel detection and subsequent axle count for DSS200-45 axle counter detectors currently existing on the Tertiary Network.

3.1.3.5 Metal and inductive-components-free space between wheels

Compliance with ERA/ERTMS/033281 version 5.0.

3.1.3.6 Wheel material

Compliance with ERA/ERTMS/033281 version 5.0.

3.1.4 Use of sanding equipment

The use of sanding equipment is restricted as follows:

- (1) The output of the sanding devices fitted to the vehicle shall not exceed 0,3 liter per minute per rail.

NOTE 1: This requirement is needed as long as:

- 83.3 Hz and 125 Hz track circuits do operate on the National Rail Network,
- 50 Hz and DC track circuits do operate on the Tertiary Network.

Explanation: As a result of sanding, thick layers of sand can remain on the surface of the rail head, thus reducing the quality of contact between wheel and rail with the risk of not detecting vehicles on tracks equipped with track circuits.

- (2) The sanding in the stations identified in the RINF is prohibited.

NOTE 2: This requirement is needed as long as 125 Hz double rail track circuits do operate on the National Rail Network.

Explanation: Double rail track circuits with inductive connections to assure a return path for the traction current require in general a smaller shunting impedance to assure vehicle detection, which in combination with even small layers of sand on the surface of the rail head can lead to no vehicle detection on tracks equipped with such track circuits.

- (3) The sanding in the area of switches is prohibited.

Explanation: Sand can jam the moving parts of switches and/or restrict their movement, thus leading to disturbances in railway traffic and increased wear of mechanical parts.

- (4) For emergency braking, no restrictions shall apply.

Explanation: In case of an emergency braking, sand on the surface of the rail head increases friction and thereby helps to reduce the braking distance.

3.1.5 On-board flange lubrication

After passage of a vehicle equipped with flange lubricators, the rail head shall not be contaminated by the lubricant in an area delimited by the outside of the running rail (field side) up to a minimum value of 53 mm. The admissible lubricated area is located inside of the running rail (gauge face) as indicated in Figure 3. Approvals testing and verification shall be done according to the guidance set out in Annex B in EN 15427-1-1:2022.

If that requirement cannot be met, the on-board flange lubricators must be deactivated (according to ERA/ERTMS/033281 version 5.0). These requirements apply to all wheels equipped with flange lubricators.

NOTE: This requirement is needed as long as:

- 83.3 Hz and 125 Hz track circuits do operate on the National Rail Network,
- 50 Hz and DC track circuits do operate on the Tertiary Network.

Explanation: Lubricants create an isolating film between wheels and rails that increase the contact electrical resistance, with risk of not detecting vehicles on tracks equipped with track circuits. As no specific type of lubricant has been defined for the Luxembourg Rail Network with the assurance of safe and reliable vehicle detection by track circuits, the contact zone between the wheel tread and rail head shall not be contaminated by any type of lubricant.

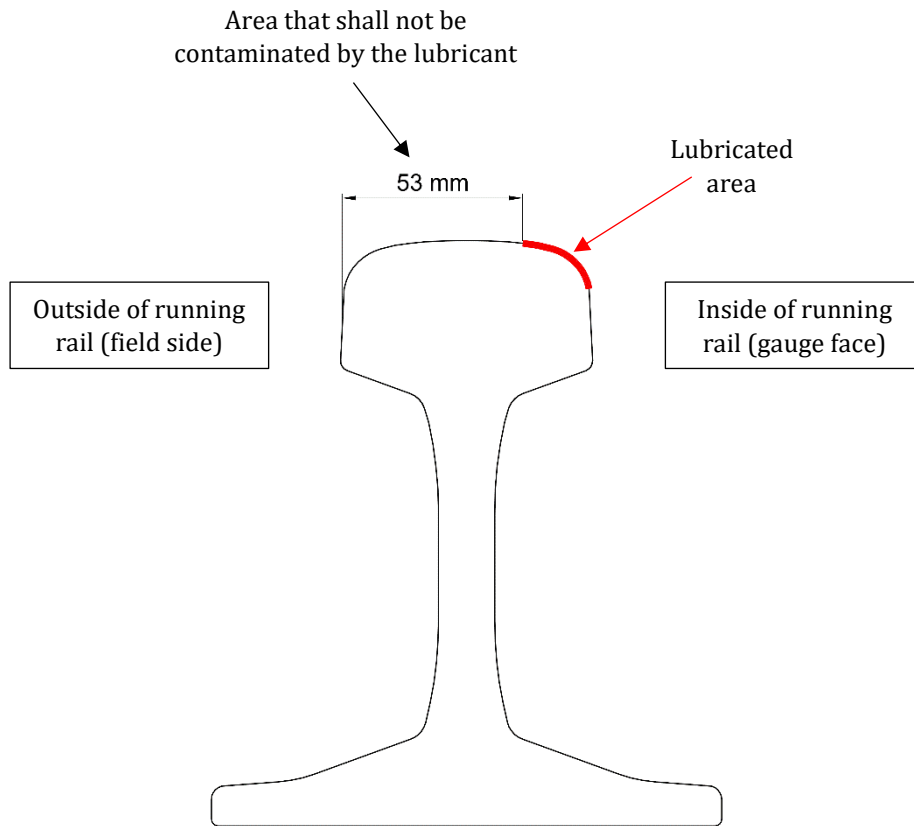


Figure 3: Admissible lubricated area of a rail head

3.1.6 Use of composite brake blocks

Compliance with ERA/ERTMS/033281 version 5.0.

3.1.7 Vehicle axle load and metal construction

3.1.7.1 Vehicle axle load

Compliance with ERA/ERTMS/033281 version 5.0 (1435 mm track gauge).

3.1.7.2 Vehicle metal construction

Compliance with ERA/ERTMS/033281 version 5.0 (1435 mm track gauge).

3.1.8 Shunting behaviour and shunting assisting devices

The use of shunting assisting devices is prohibited (compliance with ERA/ERTMS/033281 version 5.0 (1435 mm track gauge) **if shunting assisting devices are not used**).

NOTE: The use of shunting assisting devices is not required on the Luxembourg Rail Network if vehicles are compliant with the requirements defined in this document.

Explanation: Shunting assisting devices can have a negative impact on the proper functioning of inductive loops.

3.1.9 Impedance between wheels

Compliance with ERA/ERTMS/033281 version 5.0.

3.2 Electromagnetic compatibility

3.2.1 Electromagnetic fields

For the frequency management (**clause 3.2.1.1**), vehicle emission limits and evaluation parameters (**clause 3.2.1.2**), evaluation of exceedances of limits (**clause 3.2.1.3**) as well as measurement, test and evaluation specification (**clause 3.2.1.4**) the method based on the frequency management and defined in ERA/ERTMS/033281 version 5.0 is applicable, **except for DSS200-45 axle counter detectors** where the method for rolling stock compatibility with the axle counter detectors DSS200-45 SYS1 and DSS200-45 SYS2 listed in CLC/TS 50238-3:2022 is applicable.

3.2.1.1 Frequency management

Compliance with ERA/ERTMS/033281 version 5.0, **except for DSS200-45 axle counter detectors** where the frequency ranges defined in Table A.1 (DSS200-45 SYS1 and DSS200-45 SYS2) in CLC/TS 50238-3:2022 are applicable.

See clause 3.2.1.3 for evaluation of exceedances.

3.2.1.2 Vehicle emission limits and evaluation parameters

Compliance with ERA/ERTMS/033281 version 5.0, **except for DSS200-45 axle counter detectors** where the narrow band emission limits and evaluation parameters defined in Table A.1 (DSS200-45 SYS1 and DSS200-45 SYS2) in CLC/TS 50238-3:2022 shall be applied.

See clause 3.2.1.3 for evaluation of exceedances.

3.2.1.3 Evaluation of exceedances of limits

Compliance with ERA/ERTMS/033281 version 5.0, **except for DSS200-45 axle counter detectors** where the weighting of short duration interference according to Table A.2 (DSS200-45 SYS1 and DSS200-45 SYS2) in CLC/TS 50238-3:2022 shall be applied.

In case there are exceedances of the vehicle emission limits in the:

- band 1 (except the frequency range of 41.2 kHz to 44.8 kHz) specified in ERA/ERTMS/033281 version 5.0, the weighting of short duration interference according to Table A.2 in CLC/TS 50238-3:2022 can be applied for the Zp30H, Zp30C-NT, Zp30 and Zp30K,
- band 2 specified in ERA/ERTMS/033281 version 5.0, the weighting of short duration interference according to Table A.2 in CLC/TS 50238-3:2022 can be applied for the AZSB 300,

axle counter detectors.

NOTE: For the band 1 with the frequency range of 41.2 kHz to 44.8 kHz, the evaluation of exceedances of limits as specified in ERA/ERTMS/033281 version 5.0 remains applicable.

3.2.1.4 Measurement, test and evaluation specification

Compliance with ERA/ERTMS/033281 version 5.0, **except for DSS200-45 axle counter detectors** where EN 50592:2016 in combination with Annex A (DSS200-45 SYS1 and DSS200-45 SYS2) in CLC/TS 50238-3:2022 shall be applied.

See clause 3.2.1.3 for evaluation of exceedances.

NOTE 1: Test runs shall not be performed on the Luxembourg Rail Network (because of the low availability of test tracks).

NOTE 2: Tests of vehicles shall be performed under the electrification system(s) for which the vehicle is to be authorized, which implies for the Luxembourg Rail Network a 25 kV AC 50 Hz electrification system.

3.2.2 Conducted interference

3.2.2.1 Vehicle impedance

No values for the vehicle impedance have been defined for the Luxembourg Rail Network.

Note 1: The impact of the impedance of the electric traction power supply system is assessed during test runs on lines of the National Rail Network (see clause 3.2.2.7).

NOTE 2: Resonance phenomena between the electric traction power supply system and rolling stock (defined i.a. by the vehicle input impedance) may lead to overvoltages according to EN 50388, thus requiring test runs on the Luxembourg Rail Network to assure compatibility between its electric traction power supply system and the rolling stock.

3.2.2.2 Intentionally deleted

3.2.2.3 Traction current at fundamental power supply frequency

83.3 Hz track circuits may be disturbed in case of an excessive value of the 50 Hz traction current. In case of disturbances:

- during test runs (see **clause 3.2.2.7**), a disturbance of existing 83.3 Hz track circuits is not tolerated,
- after the vehicle has been authorised for being placed on the market, the Infrastructure Manager will take appropriate measures (adding comb filters to the affected track circuits or replacing them by TSI compliant axle counters).

The rolling stock emissions (traction current) occurring during test runs (see **clause 3.2.2.7**) shall be evaluated according to the parameters defined the following table in relation with 50 Hz traction current:

Frequency range	Interference current limit	Evaluation method	Evaluation parameters
47 – 53 Hz	Not defined	FFT with weighted rectangular filter	– FFT characteristics: - Time window ≈ 1 s . - HANNING window.

			<ul style="list-style-type: none"> - Overlap: 80 %. - Characteristics of the rectangular filter: <ul style="list-style-type: none"> - Gain for $f < 47$ Hz: 0. - Gain for $47 \text{ Hz} \leq f \leq 53$ Hz: 1 - Gain for $f > 53$ Hz: 0.
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NOTE: This requirement is needed as long as 83.3 Hz track circuits do operate on the National Rail Network.

Explanation: The 83.3 Hz track circuits currently existing on the National Rail Network are not TSI compliant and are not listed in CLC/TS 50238-2:2022 Annex A. As the critical interference levels depend on the length of the track circuit in combination with the number of traction return rails and the RMS value of the total traction return current, a reliable and unique interference current limit cannot be defined.

3.2.2.4 25 kV AC, 50 Hz Electromagnetic interference limits for traction current

3.2.2.4.1 83.3 Hz track circuits

The limits and associated parameters for the evaluation of rolling stock emissions (traction current) are provided in the following table to assure compatibility with 83.3 Hz track circuits on the National Rail Network:

Frequency range	Interference current limit	Evaluation method	Evaluation parameters
80 – 86.7 Hz	$8 A_{RMS}$ for one IU $8 A_{RMS}/N$ for each TU in one IU comprising $N \times TU$	FFT with weighted band-pass filter	<ul style="list-style-type: none"> - FFT characteristics: <ul style="list-style-type: none"> - Time window ≈ 1 s. - HANNING window. - Overlap: 80 %. - Characteristics of the band-pass filter: <ul style="list-style-type: none"> - Gain for $f < 52$ Hz: 0. - Gain for $52 \text{ Hz} \leq f < 80$ Hz: see Figure 4. - Gain for $80 \text{ Hz} \leq f \leq 86.7$ Hz: 1. - Gain for $86.7 \text{ Hz} < f \leq 148$ Hz: see Figure 4. - Gain for $f > 148$ Hz: 0. - Maximum time of exceedance: 1 s.

NOTE 1: IU (influencing unit) and TU (traction unit) fed from the overhead line by a pantograph according to clauses 3.1.2 and 3.1.11 in CLC/TS 50238-2:2020 and without passenger coaches.

NOTE 2: **Clause 3.2.2.8.1** is applicable for passenger coaches.

NOTE 3: **Clause 3.2.2.8.1** is applicable for TUs that are not fed from the overhead line by a pantograph.

NOTE 4: Transients shall be ignored if their duration in the time domain does not exceed 1 s.

NOTE 5: This requirement is needed as long as 83.3 Hz track circuits do operate on the National Rail Network.

NOTE 6: In case of a disturbance of the 83.3 Hz track circuit, an analysis of the 50 Hz traction current shall be done using the evaluation parameters defined in clause 3.2.2.3 to identify the possible influence of the 50 Hz signal amplitude.

Explanation: The 83.3 Hz track circuits currently existing on the National Rail Network are not TSI compliant and are not listed in CLC/TS 50238-2:2022 Annex A.

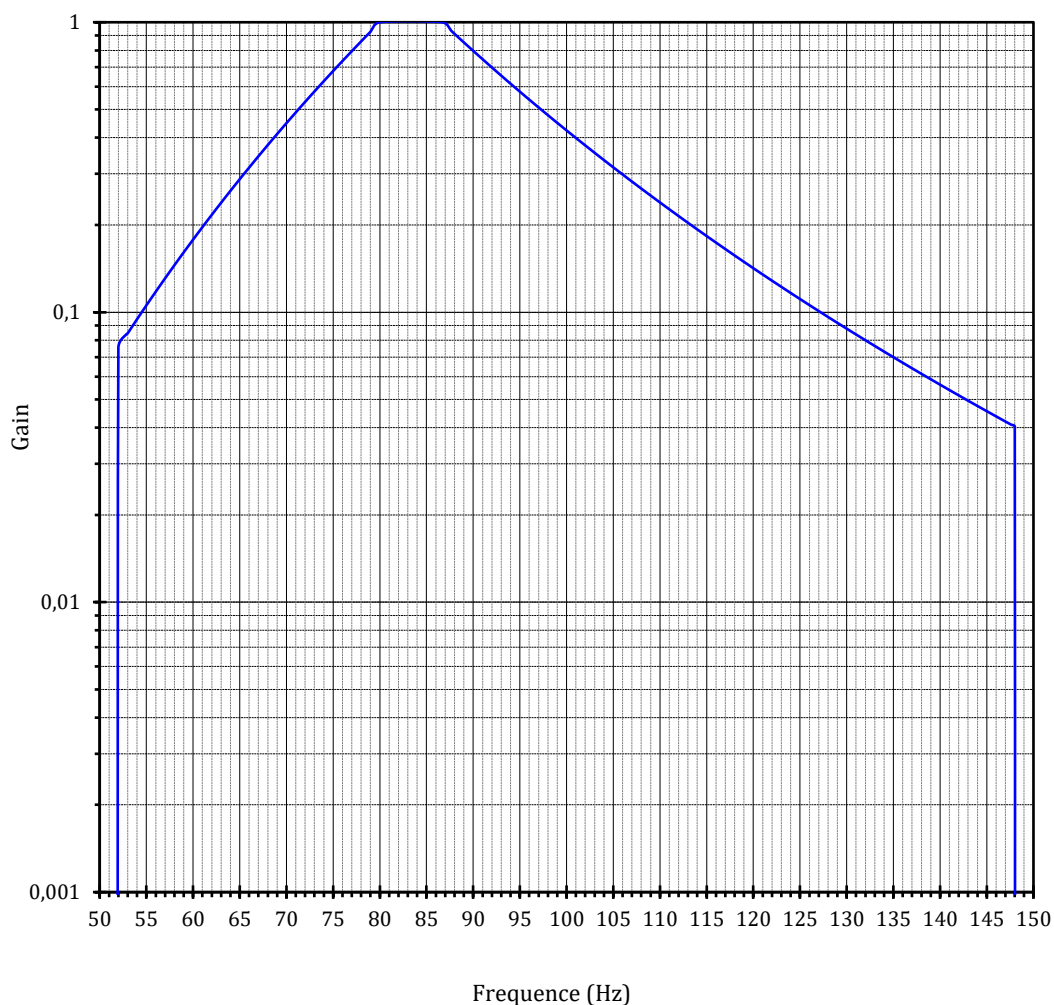


Figure 4: Weighted band pass filter for 83.3 Hz track circuits

3.2.2.4.2 125 Hz track circuits

The limits and associated parameters for the evaluation of rolling stock emissions (traction current) are provided in the following table to assure compatibility with 125 Hz track circuits on the National Rail Network:

Frequency range	Interference current limit	Evaluation method	Evaluation parameters
120 – 130 Hz	0.7 A _{RMS} for one IU 0.7 A _{RMS} /N for each TU in one IU comprising N × TU	FFT with weighted rectangular filter	<ul style="list-style-type: none"> – FFT characteristics: <ul style="list-style-type: none"> - Time window ≈ 1 s. - HANNING window. - Overlap: 80 %. – Characteristics of the rectangular filter: <ul style="list-style-type: none"> - Gain for $f < 120$ Hz: 0. - Gain for $120 \text{ Hz} \leq f \leq 130$ Hz: 1. - Gain for $f > 130$ Hz: 0. – Evaluation criteria: Maximum time of exceedance: 1 s.

NOTE 1: IU (influencing unit) and TU (traction unit) fed from the overhead line by a pantograph according to clauses 3.1.2 and 3.1.11 in CLC/TS 50238-2:2020 and without passenger coaches.

NOTE 2: **Clause 3.2.2.8.1** is applicable for passenger coaches.

NOTE 3: **Clause 3.2.2.8.1** is applicable for TUs that are not fed from the overhead line by a pantograph.

NOTE 4: Transients shall be ignored if their duration in the time domain does not exceed 1 s.

NOTE 5: This requirement is needed as long as 125 Hz track circuits do operate on the National Rail Network.

Explanation: The 125 Hz track circuits currently existing on the National Rail Network are not TSI compliant and are not listed in CLC/TS 50238-2:2022 Annex A.

3.2.2.5 15 kV AC, 16,7Hz Electromagnetic interference limits for traction current

Not applicable for the Luxembourg Rail Network.

Explanation: There is no 15 kV AC 16,7 Hz electrification system on the Luxembourg Rail Network.

3.2.2.6 DC (3kV, 1.5kV) Electromagnetic interference limits for traction current

Not applicable for the Luxembourg Rail Network.

Explanation: There is no DC electrification system on the Luxembourg Rail Network.

3.2.2.7 Measurement, test and evaluation specification

The interference current limit value defined in **clause 3.2.2.4.1 / 3.2.2.4.2** shall not be exceeded for more than one second. The interference limit value applies to one IU.

Summation rule: Let N be the maximum number of TUs allowed to enter the composition of one IU, then no TU shall exceed the interference limit value of:

- 8 A_{RMS}/N for 83.3 Hz track circuits (see **clause 3.2.2.4.1**)

- $0,7 A_{RMS}/N$ for 125 Hz track circuits (see **clause 3.2.2.4.2**)

for more than one second.

NOTE 1: Transients shall be ignored if their duration in the time domain does not exceed 1 s.

NOTE 2: IU (influencing unit) and TU (traction unit) fed from the overhead line by a pantograph according to clauses 3.1.2 and 3.1.11 in CLC/TS 50238-2:2020 and without passenger coaches.

NOTE 3: **Clause 3.2.2.8.1** is applicable for passenger coaches.

NOTE 4: **Clause 3.2.2.8.1** is applicable for TUs that are not fed from the overhead line by a pantograph.

The RMS value of the 50 Hz / 83.3 Hz / 125 Hz component of the line current is determined by (see **clause 3.2.2.3 / 3.2.2.4.1 / 3.2.2.4.2**):

- measurement using test runs on lines of the National Rail Network supplied with 25 kV AC 50 Hz and conducted according to clause B.4.4 in EN 50388-1:2019, in particular:
 - with IUs consisting of all possible number of TUs as foreseen in future operation (example: a maximum of 3 TUs is foreseen in future operation, thus the following IUs must be tested: $IU = 1 \times TU$, $IU = 2 \times TU$ and $IU = 3 \times TU$),
 - with IUs in standstill (in parking mode, such as auxiliaries only),
 - with IUs in acceleration with 100 % traction effort (less traction effort shall be tested if relevant for the generation of (inter)harmonic currents) and with speeds up to 140 km/h,
 - with IUs in speed hold / with and without traction effort,
 - with IUs in breaking mode (such as regenerative and rheostatic breaking),
 - with TUs in all functional modes (normal and degraded configurations that are foreseen in future operation),
 - with the electric traction power supply system in functional configurations (normal and degraded operational configurations),
 - with typical variations of the electric power supply voltage (such as in the presence of other electric trains),
 - with typical weather conditions that may affect the generated (inter)harmonic currents (such as wheel slide protection, ice on the overhead line),
 - with transient events (such as closure of the main circuit breaker on-board the TUs, pantograph bouncing, abrupt break of the traction and breaking effort),
- spectral analysis of the line current according to the FFT characteristics defined in **clause 3.2.2.3 / 3.2.2.4.1 / 3.2.2.4.2**, followed by the application of the weighted filter defined in **clause 3.2.2.3 / 3.2.2.4.1 / 3.2.2.4.2**, followed by the calculation of the RMS value.

NOTE 5: The configurations of the electric traction power supply system that need to be tested as well as the transition from test runs in isolated traffic into mixed traffic are defined by the Infrastructure Manager of the Luxembourg Rail Network.

Explanation: The applicability of EN 50728 must be assessed before its publication by the Infrastructure Manager of the Luxembourg Rail Network.

3.2.2.8 Further requirements

3.2.2.8.1 Harmonic rail currents generated by the power supply installations in vehicles

3.2.2.8.1.1 83.3 Hz track circuits

Passenger coaches shall be compliant with UIC 550 (11th edition, April 2005) and UIC 550-3 (1st edition, April 2005) Annex C.

For other vehicles, the limits and associated parameters for the evaluation of rolling stock emissions (rail currents not issued from traction) are provided in the following table to assure compatibility with 83.3 Hz track circuits on the National Rail Network:

Frequency range	Interference current limit	Evaluation method	Evaluation parameters
80 – 86.7 Hz	8 A _{RMS} for one IU	FFT with weighted band-pass filter	– FFT characteristics: <ul style="list-style-type: none"> - Time window \approx 1 s . - HANNING window. - Overlap: 80 %. – Characteristics of the band-pass filter: <ul style="list-style-type: none"> - Gain for $f < 52$ Hz: 0. - Gain for $52 \text{ Hz} \leq f < 80$ Hz: see Figure 4. - Gain for $80 \text{ Hz} \leq f \leq 86.7$ Hz: 1. - Gain for $86.7 \text{ Hz} < f \leq 148$ Hz: see Figure 4. - Gain for $f > 148$ Hz: 0. – Maximum time of exceedance: 1 s.

NOTE 1: IU (influencing unit) according to clause 3.1.2 in CLC/TS 50238-2:2020.

NOTE 2: Transients shall be ignored if their duration in the time domain does not exceed 1 s.

NOTE 3: This requirement is needed as long as 83.3 Hz track circuits do operate on the National Rail Network.

Explanation: Electrical installations in vehicles, and in particular energy supply systems supplied by the train line, shall not interfere with 83.3 Hz track circuits currently existing on the National Rail Network.

3.2.2.8.1.2 125 Hz track circuits

Passenger coaches shall be compliant with UIC 550 (11th edition, April 2005) and UIC 550-3 (1st edition, April 2005) Annex C.

For other vehicles, the limits and associated parameters for the evaluation of rolling stock emissions (rail currents not issued from traction) are provided in the following table to assure compatibility with 125 Hz track circuits on the National Rail Network:

Frequency range	Interference current limit	Evaluation method	Evaluation parameters
120 – 130 Hz	0.7 A _{RMS} for one IU	FFT with weighted rectangular filter	– FFT characteristics: <ul style="list-style-type: none"> - Time window ≈ 1 s. - HANNING window. - Overlap: 80 %. – Characteristics of the rectangular filter: <ul style="list-style-type: none"> - Gain for $f < 120$ Hz: 0. - Gain for $120 \text{ Hz} \leq f \leq 130$ Hz: 1. - Gain for $f > 130$ Hz: 0. – Evaluation criteria: Maximum time of exceedance: 1 s.

NOTE 1: IU (influencing unit) according to clause 3.1.2 in CLC/TS 50238-2:2020.

NOTE 2: Transients shall be ignored if their duration in the time domain does not exceed 1 s.

NOTE 3: This requirement is needed as long as 125 Hz track circuits do operate on the National Rail Network.

Explanation: Electrical installations in vehicles, and in particular energy supply systems supplied by the train line, shall not interfere with 125 Hz track circuits currently existing on the National Rail Network.

3.2.2.8.1.3 50 Hz and DC track circuits

Only:

- locomotives without feeding a train line, and
- wagons without a supplied train line

shall run on the Tertiary Network.

Locomotives / Wagons running on the Tertiary Network with a feeding / supplied train line are an exception and require a specific compatibility assessment with the 50 Hz and DC track circuits currently existing on the Tertiary Network.

NOTE: This requirement is needed as long as 50 Hz and/or DC track circuits do operate on the Tertiary Network.

Explanation: The Tertiary Network is an industrial network and reserved solely for freight traffic. Therefore, only locomotives and wagons are to be expected on that network. Considering the characteristics of the track circuits as well as their location on the Tertiary Network, no interference current limits have been defined for the traction current.

3.2.2.8.1.4 Measurement, test and evaluation specification

Passenger coaches shall be compliant with UIC 550 (11th edition, April 2005) and UIC 550-3 (1st edition, April 2005) Annex C.

For other vehicles (according to **clause 3.2.2.8.1.1 / 3.2.2.8.1.2**):

- The interference limit value defined in **clause 3.2.2.8.1.1 / 3.2.2.8.1.2** shall not be exceeded for more than one second. The interference limit value applies to one IU.
- Proof of compliance with the limit value must be provided by measurements carried out for all functional modes (normal and degraded configurations that are foreseen in future operation) of the interference sources on board the IU.
- The RMS value of the 83.3 Hz / 125 Hz component of the injected rail current is determined by spectral analysis of the current according to the FFT characteristics defined in **clause 3.2.2.8.1.1 / 3.2.2.8.1.2**, followed by the application of the weighted band-pass / rectangular filter defined in **clause 3.2.2.8.1.1 / 3.2.2.8.1.2**, followed by the calculation of the RMS value.

For locomotives and wagons running on the Tertiary Network, see **clause 3.2.2.8.1.3**.

NOTE 1: Test runs shall not be performed on the National Rail Network (because of the low availability of test tracks).

NOTE 2: Transients shall be ignored if their duration in the time domain does not exceed 1 s.

NOTE 3: IU (influencing unit) according to clause 3.1.2 in CLC/TS 50238-2:2020, but TUs are not fed from the overhead line by a pantograph.

Explanation: The applicability of EN 50728 must be assessed before its publication by the Infrastructure Manager of the Luxembourg Rail Network.

3.2.3 Use of magnetic / eddy current brakes

3.2.3.1 Use of magnetic brakes

The use of magnetic brakes is allowed only for emergency brake (as indicated in the RINF).

In case of an emergency brake, the activation of the magnetic brakes shall take place by:

- a simple one-hand command from the driver in normal driving position, and
- a command from the on-board ETCS equipment according to TSI CCS.

Explanation: Activated magnetic brakes can interfere with axle counter detectors as well as inductive loops and lead to their disturbance which is acceptable in case of an emergency brake.

3.2.3.2 Use of eddy current brakes

The use of eddy current brakes is not allowed (as indicated in the RINF).

NOTE: Eddy current brakes must be deactivated.

Explanation: The use of eddy current brakes is prohibited on the Luxembourg Rail Network (because they can affect the EMC with train detection systems and rise the temperature in the rail and/or cause its distortion or buckling).