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Železniške naprave – Združljivost voznih sredstev in tirnih tokokrogov

Railway applications Compatibility between rolling stock and track circuits

Bahnanwendungen - Störgrenzwerte von Gleiskreisen der europäischen Bahnen

Applications ferroviaires - Limites des interférences des circuits de voie existants sur les réseaux ferroviaires européens

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Railway applications – Interference limits of existing track circuits used on European railways

Applications ferroviaires -
Limites des interférences des circuits de voie existants sur les réseaux ferroviaires européens

Bahnanwendungen -
Störgrenzwerte von Gleiskreisen der europäischen Bahnen

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This Technical Report was prepared by SC 9XA, Communication, signalling and processing systems, of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The draft, which was based on information supplied by some European railway infrastructure authorities for track circuits currently in use in the individual countries, was submitted to vote and was approved by CENELEC as CLC/TR 50507 on 2007-01-16.

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1 Scope

This Technical Report has been written to define the interference limits of existing track circuits used on European railways. The purpose of this Technical Report is to provide an overview, a reference and a source of information for other specifications and specifications that are presently in preparation. As required by the CENELEC rules, it will be updated as needed and will be finally replaced by a future specification or standard.

According to CENELEC rules, the existing national specifications are not required to be replaced by this Technical Report. They will remain in use as the basis for approval of vehicles in the respective countries. Where available, the national specifications are referenced in Annex A of this Technical Report.

The two main parts of this Technical Report are:

1) the List of European track circuit equipment;
2) the National Annex.

The contents of these two parts have been provided by railway infrastructure representatives. Not all EU countries have provided information and in some cases the information may be incomplete.

In 4.5, the track circuits are classified into preferred and non-preferred types [1] with regard to their future use on interoperable lines. This definition provides an indication which types of track circuits are preferred for new signalling projects.

In Annex A the interference limits and test specifications are defined within a template prepared by CENELEC, which is intended to ensure a large degree of common content and to facilitate comparisons between national specifications. The content of Annex A is based on existing national specifications.

This Technical Report will remain informative until it is replaced by a specification. It may, however, be used as a basis for defining requirements, for example in improved national specifications. If the content is used in the TSI, the TSI document shall clearly define the consequences of the requirements. The vehicles have only to be made compatible with the track circuits used on the lines where they run, as defined in EN 50238. Normally an approval certificate will be restricted to these lines or countries.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50238, *Railway applications - Compatibility between rolling stock and train detection systems*

UIC leaflet 512 , *Rolling stock – Conditions to be fulfilled in order to avoid difficulties in the operation of track circuits and treadles*

TSI CCS AAA1; *Train detection systems characteristics necessary to be compatible with rolling stock.*

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[1] Previously Class A and Class B as defined in TSI CCS.

3 Definitions

For the purposes of this document, the following terms and definitions apply.

3.1
accepting body
body that is responsible for evaluating the compatibility case and issuing the certificate of acceptance

3.2
certificate of acceptance
written authorisation from the Accepting Body that the compatibility case is acceptable to allow the new or modified systems to enter service

NOTE This may be qualified.

3.3
compatibility case
suite of documents which records the evidence demonstrating the degree of compatibility between rolling stock, traction power supplies and train detection systems for a specific route or specific railway network

3.4
coupled vehicles (CV)
part of the influencing unit except the traction subsystem

3.5
degraded modes
modes of operation in the presence of faults which have been anticipated in the design of the rolling stock

NOTE Degraded modes will normally allow the rolling stock to complete its journey.

3.6
gabarit
maximum permissible levels of interference signal, with respect to frequencies and duration, to which a train detection system may be exposed

3.7
influencing unit (IU)
rolling stock influencing the infrastructure

NOTE This comprises all coupled/connected vehicles, e.g. complete train with single or multiple traction, single vehicle, multiple connected/coupled vehicles.

3.8
right side failure
failure of a signalling system, which results in a more restrictive condition for the movement of traffic than is appropriate

3.9
traction subsystem (TS)
subset of the traction unit which produces traction force or electric brake force

3.10
traction unit (TU)
subset of the influencing unit

NOTE Comprises all traction subsystems including auxiliary supplies and other power supplies, which can be collectively switched off by one collector/pantograph.

3.11
wrong side failure
failure of a signalling system, which results in a less restrictive condition for the movement of traffic than is appropriate

4 Summary of specifications

4.1 General

The essential characteristics of the track circuits are listed in tabular form. The annexes contain the specified interference limits (gabarits) of the track circuits and the test specifications for the vehicles.

4.2 Gabarits

The set of gabarits and their associated test specifications are grouped according to the following traction parameters:

– traction frequency;

– traction voltage.

The traction systems are:

– 25 kV, 50 Hz;

– 15 kV, 16,7 Hz;

– 3 kV, DC;

– 1 500 V, DC;

– 750 V, DC;

– non-electrified.

This differentiation is necessary to avoid unnecessarily pessimistic interference levels, and take account of harmonic content as a function of the traction frequency and voltage.

Each gabarit consists of a graph of the maximum interference current as a function of frequency. Time constraints are defined for each case or frequency range.

The gabarits define the maximum interference current permitted for the track circuit operating frequency bandwidth. Formulas for calculating the effect of multiple trains/locomotives are defined. This will enable the vehicle manufacturer or tester to establish the maximum interference current of a single locomotive, power converter on a passenger coach, or a complete train.

The gabarits take account of the requirements in the existing national specifications as they stand.

4.3 Test specifications

The test specifications are intended to ensure that the test results are consistent and may be assumed to apply in other locations. In particular the following aspects are considered:

a) how to measure on the vehicle:

   – cumulative current flowing via the current collectors to the vehicle, to be measured as close as possible to the current collectors via a suitable filter (e.g. 100 Hz in the case of a 100 Hz track circuit test);

   – frequency and bandwidth parameters/bandpass filter characteristics (see 4.4);

b) vehicle test conditions:

- velocity: full range from standstill to maximum speed;
- traction modes: variation of acceleration, stationary and coasting modes, constant velocity, brake mode, start-up against the brakes;
- normal mode and failure modes;
- auxiliary supplies – from no load to full load;
- compliance with TSI CCS AAA1 (electrical impedance between the wheels);
- configuration management of hardware and software of the unit being approval tested;

c) test location:

- description of power supply arrangement;
- definition of reference test track or route, if applicable;

d) number of measurements:

- a minimum of several measurements per vehicle mode is required to identify critical areas which require more lengthy test series;

e) analysis and evaluation of test results:

- the final analysis is usually given in the time domain. Some Rail Administrations may require an analysis in the frequency domain;
- the integration time (length of time window) or smoothing time constant takes the required maximum allowable interference duration into account to avoid misleading results.

It is to be expected that deviations in test results may occur if tests are performed on different infrastructures due to differing traction supply characteristics such as resonant frequencies of supply networks, ripple on DC supplies or harmonics of AC supplies. The difficulties of finding a worst-case test site, which is representative of different countries with the same basic traction voltage and frequency are not trivial and may require that testing takes place on specific test tracks or routes in the different countries.

4.4 Example of filter

Figure 1 shows an example of the filter characteristics for a 100 Hz track circuit compatibility test with f_K is equal to 100 Hz and B is equal to 4 Hz.

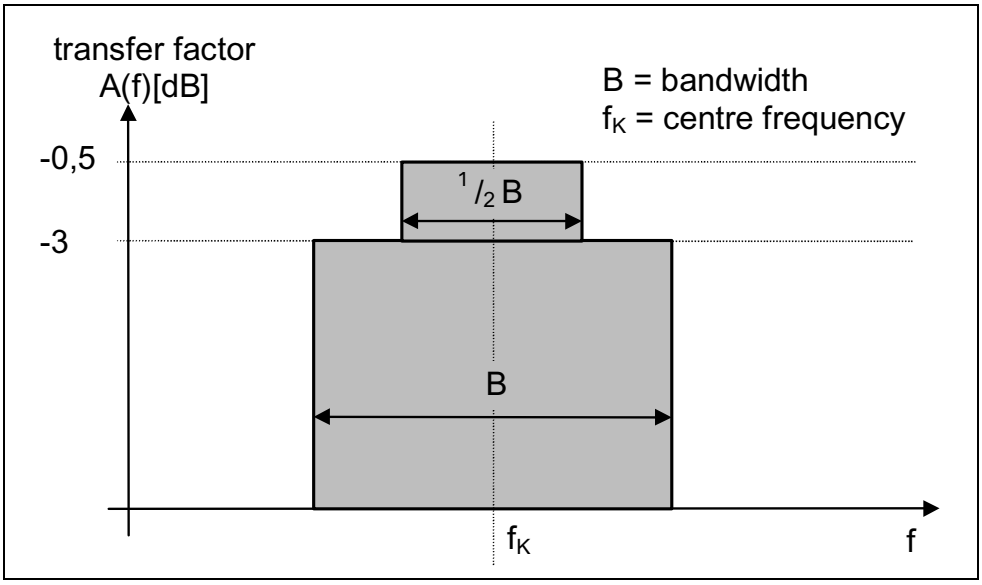

Figure 1 – Example of filter characteristics

4.5 List of European track circuit equipment

Table 1 gives a list that defines the types of track circuit equipment currently being used by European railways. Types classified as “preferred” are designated to be used on future re-signalling projects.

Table 1 – Types of track circuit equipment

Country	Information source	Type	Manufacturer	Operating frequency	Interference limits	Traction voltage	Application	Classification
AT	ÖBB GB-ST	2-Lagen Motorgleisrelais BsSk 1722/8	Siemens	100 Hz	See A.1		Interoperable	Preferred
		3-Lagen Motorgleisrelais BsSk 1722/4	Siemens					
		Transistorgleisrelais S 50108914	Alcatel	100 Hz; 106,7 Hz				Preferred
	ÖBB GB-ST	Gleichstromgleisrelais 960 90760	Alcatel / Zelisko	DC	No			
		Gleichstromgleisrelais V25427	Siemens					
		Gleichstromgleisrelais Z70	Siemens					
		Gleichstromgleisrelais 001183	SBW					
		Gleichstromgleisrelais 590040202	Zelisko					
		Tonfrequenzgleisstromkreise uncodiert	Siemens	~ 10 KHz				
BE	INFRABEL, I.I.3 Signalling DPt	Jointless Track Circuit	Alstom	f_0 = 1 600, 1 900, 2 200, 2 500 Hz	See A.2	3 kV, 25 kV	Interoperable	Preferred
	INFRABEL	HFJointless Track Circuit ER428	Acec	15 kHz	No	3 kV		
		50 Hz Track Circuit Birail	Acec, Area, Automation,..	50 Hz	See A.2			
		50 Hz Track Circuit Monorail	Acec, Area, Automation,..	50 Hz				
		High Voltage Track Circuit	Acec	4 Hz pulse rate	Not applicable	3 kV, 25 kV		Preferred
	INFRABEL	DC Track Circuits	Acec	DC	No	Diesel	No	
	INFRABEL	UM 71 C TVM 430	CSEE Transport	1 700, 2 000, 2 300, 2 600 Hz	See A.2 (Cf Gabarits)	25 kV	Interoperable (HSL 1)	
CZ	SZDC	KO-1583/KO-1599		25 Hz	See A.3		no	
		KO-2491/KO-2796		50 Hz				
	SZDC	KO-3595/KO-3599		75 Hz	See A.3	3 kV, 25 kV	Interoperable	
		KO-31/KO-32	AZD					
		KO-34/KO-35/KO-36	AZD					
		KO-3102/KO-3103	AZD					
		KO-43	AZD	275 Hz				

Table 1 – Types of track circuit equipment *(continued)*

Country	Information source	Type	Manufacturer	Operating frequency	Interference limits	Traction voltage	Application	Classification
DK	Denmark Railway Network	DC track circuit	Bombardier	DC	See A.4	25 kV	Interoperable	Preferred
		77 Hz track circuit	Bombardier	77 Hz				Preferred
		FTGS 46, FTGS 917	Siemens	4 750-6 250 Hz, 9 500-16 500 Hz				Preferred
FI	RHK	JZE 53500	Adtranz	DC	< 20 A/s (DC)			
		JZE 53100	Adtranz	DC	< 20 A/s (DC)			
		DC	VR	DC				
		DC	Ganz	DC				
		DC, diode	VR	DC				
		125 Hz Single Rail, Motor Relay	Siemens	125 Hz				
		126 Hz Double Rail, Motor Relay	Siemens	125 Hz				
		FTGS46	Siemens	4,75 - 6,25 kHz				
		FTGS917	Siemens	9,6 - 16 kHz				
		?	Russia	25 Hz				

Table 1 – Types of track circuit equipment *(continued)*

Country	Information source	Type	Manufacturer	Operating frequency	Interference limits	Traction voltage	Application	Classification
FR	SNCF/IG.SF	50 Hz	CSEE/Transport- Alstom - C.F.S.W - Mors - Saxby	50 Hz	See A.6 (Cf Gabarits)	1,5 kV DC	Interoperable (conv & detour)	
		83 Hz	CSEE/Transport- Alstom - Aster - C.F.S.W - Mors -Saxby	83 Hz		25 kV AC		
		UM71C	CSEE/Transport	1 700, 2 000, 2 300, 2 600 Hz		1,5 kV DC, 25 kV AC		
	SNCF/IG.SF	UM71 CB	CSEE/Transport	1 700, 2 000, 2 300, 2 600 Hz				Preferred
		UM 71 C TVM PSE	CSEE/Transport	1 700, 2 000, 2 300, 2 600 Hz		25 kV AC	Interoperable (HS)	
	SNCF/IG.SF	UM71 C TVM 300	CSEE/Transport	1 700, 2 000, 2 300, 2 600 Hz		1,5 kV DC, 25 kV AC		
		UM 71 C TVM 430	CSEE/Transport	1 700, 2 000, 2 300, 2 600 Hz		25 kV AC		
	SNCF/IG.SF	UM71 C TVM SEI	CSEE/Transport	1 700, 2 000, 2 300, 2 600 Hz				Preferred
		HVI Track Circuit	Alstom	3 Hz pulse rate	No	1,5 kV DC, 25 kV AC	Interoperable (conv & detour)	Preferred
		300/850 Hz	CSEE/Transport	300, 850 Hz		25 kV AC		
	SNCF/IG.SF	DC	CSEE/Transport	DC pulsed at 175 Hz	No		no	
		DC	CSEE/Transport- Silec Thomson - C.F.S.W -	DC				
FR	RATP	CVCM	Alstom	8 200, 8 600, 9 200, 10 000, 10 600, 11 000, 12 300 Hz - FSK ± 75 Hz	No		Suburban railway	