EUROPEAN UNION AGENCY FOR RAILWAYS

Making the railway system
work better for society.

OPINION

OPI 2021-2

OF THE EUROPEAN UNION AGENCY FOR RAILWAYS

For

THE EUROPEAN COMMISSION

Regarding

Potential deficiency/discrepancy in the clause 3.1.3.5 Metal and inductive components-free space between wheels of the document ERA/ERTMS/033281 rev 4.0

1. General Context

In the note referenced as ARES (2021) 1323722 dated 17/02/2021 (see Annex 1 to this opinion), addressed to the Executive Director of European Union Agency for Railways ("the Agency"), the European Commission asked the Agency to provide an opinion related to a potential deficiency/discrepancy in the clause 3.1.3.5 Metal and inductive components-free space between wheels of the document ERA/ERTMS/033281 rev 4.0. This document is referenced in the list of mandatory specifications in the Annex A (index 77) of the Control-command and Signalling TSI ("CCS TSI" - set out as Annex to the Commission Regulation (EU) 2016/919) and in Appendix J-2, index 1 of the LOC&PAS TSI (set out as Annex to Commission Regulation (EU) 1302/2014) .

The possible deficiency was described in a letter from UNIFE, dated on 17 December 2020, addressed to the Executive Director of the Agency and to the Head of Unit C.4, Rail Safety & Interoperability, Directorate-General Mobility and Transport of the European Commission (see Annex 2 to this Opinion).

In their letter, UNIFE explained their concerns regarding a potential deficiency/discrepancy in the recently included requirements of "dynamic stimulation" and "maximum width of 130 mm for magnetic track brakes" within the document ERA/ERTMS/033281 rev 4.0 20/09/2018.

The Agency was asked to provide an Opinion in accordance with Article 19 of Regulation (EU) 2016/796 on the European Union Agency for Railways. The Agency prepared and sent the European Commission its Opinion ERA/OPI/2021-2 on this issue.

2. Legal Background

According to Article 10 (2) of Regulation (EU) 2016/796[1], the Agency shall issue opinions at the request of the Commission on amendments to any act adopted on the basis of Directive (EU) 2016/797[2], especially where any alleged deficiency is signalled. This is the legal background under which this opinion is prepared.

According to Article 19(1) of Regulation (EU) 2016/796, the Agency shall issue opinions which constitute acceptable means of compliance concerning deficiencies in TSIs and provide those opinions to the Commission.

The request of the Commission relates to the following clause: § 3.1.3.5 Metal and inductive components-free space between wheels of the document ERA/ERTMS/033281rev 4.0.

[1] *Regulation (EU) 2016/796 of the European Parliament and of the Council of 11 May 2016 on the European Union Agency for Railways and repealing Regulation (EC) No 881/2004, OJ L 138, 26.5.2016, p. 1.*
[2] *Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union, OJ L 138, 26.5.2016, p. 44.*

3. Analysis

3.1. Analysis of the requirements and their evolution:

§ 3.1.3.5. “Metal inductive components free-space between wheels” in the Version 3.0 of document ERA/ERTMS/033281 gave only requirements for freight wagons while for other vehicles it remained an open point. The Version 4.0 made no difference anymore between these kind of vehicles and introduced requirements related to the installation of sanding pipes and other metal parts in the sensitive area of axle counters, taking into account all operational conditions, wear of the wheel and spring compression.

UNIFE remarked that the dynamic stimulation and that the presence of a metal part with the maximum width lateral dimension of 130mm inside the shaded area in §3.1.3.5 can be relaxed as specified in their solution proposal (see Annex 2 of the letter of UNIFE), so that they still meet the essential requirements concerning technical compatibility between vehicles and network (train detection systems).

According to UNIFE, previously authorized vehicles (according to TSI LOC PAS 2014 & ERA/ERTMS/033281 rev. 2.0) with magnetic track brakes or eddy current brakes have been designed for the same minimum vertical distance with fulfilling the conditions as defined in EN 16207:2014 with the static deflection only. A re-design of these well-proven bogie/brake combinations with respect to the required axle counter compatibility is technically not feasible. This non-compliance to the ERA/ERTMS/033281 rev. 4.0 (as referenced in TSI LOC PAS 2019) has not led to any miscounts with the axle counters in operation and also this is neither the case for previously authorized vehicles (according to TSI LOC PAS 2019 & ERA/ERTMS/033281 rev. 4.0).

EN 16207:2014 as stated above requires taking only into account the condition static deflection at maximum load and fully worn wheels for the evaluation of the lowest position of magnetic track brakes.

The more stringent requirements in ERA/ERTMS/033281 rev. 4.0 related to § 3.1.3.5.versus EN 16207 were proposed by the experts of the TDC working group in the past, based on the requirements within the former EN 50238 series. These requirements seemed to be too strict, so based on practical experiences and EN 16207 a more relaxed approach is proposed by UNIFE.

According to UNIFE, extensive laboratory and field measurement results concerning the passive effect between magnetic track brakes/eddy current brakes exist today in many different companies/organisations, mainly related to FM (Frequency Management) compliant axle counters, which have been taken into account for the calculation/verification (e.g. for the lateral displacement, lamination effect of eddy current brakes) of the cumulative likelihood for vertical displacements below 40mm to top of the rail.

In order to justify the relaxation of the dynamic stimulation and the presence of a metal part with the maximum width lateral dimension of 130mm inside the shaded area in §3.1.3.5, UNIFE refers in its letter to a performed stochastic analysis, where all relevant effects, which influence the vertical displacement have been taken into account. The effects have been categorized in adverse normal, increased and extreme range of magnitude and probabilities of each respective range have been determined/analysed. All the possible combinations of events and their added displacements have been determined by cumulation as well as the related likelihood. From all this, and as a result, a relation between displacement and likelihood has been derived.

Extreme lowering resulting from simultaneous extreme occurrence of a multitude of influences is extremely unlikely.

The letter of UNIFE refers to a specific stochastic analysis for a design following the “EN 16207:2014 setup”. This analysis shows for magnetic track brakes that a limit value of 40 mm with respect to top of the rail will only be reached by a probability of 6E-10 per magnetic track brake and per axle counter passing for a multitude of representative vehicles with an adverse parameter configuration. In a similar stochastic analysis

for eddy current brakes, the displacement down to an equivalent of 40 mm was determined with a probability of 4E-9 per eddy current brake and per axle counter passing.

According to UNIFE the above in-depth analysis demonstrates that it is suffienct enough to be compliant with the disturbance requirement of the axle counters by only taking into account the condition static deflection at maximum load and fully worn wheels (EN 16207:2014 setup). The actual setup in the document ERA/ERTMS/033281 rev. 4.0, however, refers (in its combination of effects) to a theoretic and extreme event, being extremely unlikely to occur over the range of operation conditions.

The addressed problem by UNIFE including the proposed solution to lower the requirements related to dynamic stimulation and the presence of a metal part with the maximum width lateral dimension of 130mm inside the shaded area in §3.1.3.5 (in line with EN 16207:2014 setup and the solution proposal in Annex 2 of the UNIFE letter) was discussed during the ERA TDC Workgroup 56 at 26.02.2021. All experts agreed on this proposal.

3.2. Economic impact assessment

The proposed solution in the Technical Opinion will provide less restrictive requirements for vehicles related to the parameter § 3.1.3.5 “Metal and inductive components-free space between wheels”.

For this reason there is no additional cost impact for the railway sector. The solution generates additional benefits for the railway sector by offering more flexibility concerning the design of the metal and inductive components-free space between wheels

4. The opinion

Taking into account the technical analysis in the UNIFE letter, the results of the discussions in the Working Group on Train Detection Compatibility as well as the additional benefits for the railway sector, the Agency proposes to modify chapter 3.1.3.5. of document ERA/ERTMS/033281 Version 4.0 in the following way:

3.1.3.5. Metal and inductive components-free space between wheels

Harmonised parameter:

Only wheels and their parts (gearboxes, brake parts) or non-metallic and non-inductive components are permitted to be mounted in the sensitive area of Figure 5.

Sanding pipes of sanding devices and rail guards are allowed to be mounted in a vertical (z-) distance ≥30 mm above the top of the rail. For sanding pipes below 40 mm to the top of the rail a maximum diameter of 60 mm is allowed.

Other metal parts (e.g. sanding pipe support, heating elements, magnetic brakes or eddy current brakes in rest position) are allowed to be mounted in a vertical distance ≥40 mm above the top of the rail. Inside of the shaded area in Figure 5, a metal part with the lateral dimension of maximum 130 mm and maximum 140 mm for magnetic track brakes, based on the dimensions of magnetic track brakes defined in EN 16207:2014, is allowed.

Magnets and wear pads for magnetic track brakes shall respect the dimensions as set out in EN 16207:2014, excerpt of chapter 5.5.2.

For magnetic track brakes or eddy current brakes in rest position, the vertical distance requirement (≥40

mm above the top of the rail) shall be met:

- Taking into account static vertical deflection of the running gear at maximum load
- With fully allowed wear of the wheel or the maximum wear of the wheel between two re-adjustments

For metal parts excluding magnetic track and eddy current brakes the vertical distance requirement shall be met:

- under all operational conditions (running in a curve, over switch, ..)
- for the maximum allowed wear of the wheel or the maximum wear of the wheel between two re-adjustments
- for the maximum spring compression of the primary and the secondary vehicle suspensions, considering:

a. static load

b. additional dynamic stimulation

c. tolerances of the stiffness

- for air springs the totally evacuation of the air-suspension bellow („emergency suspension“)

Requirements on steel springs and rubber springs:

Locomotive:

Spring compression for an overload of 30% of the suspended mass

Freight wagon:

Complete spring compression (till touchdown)

Passenger wagon, baggage wagon, specific freight wagon and train set:

Spring compression for an overload of 30% of the suspended mass (maximum load)

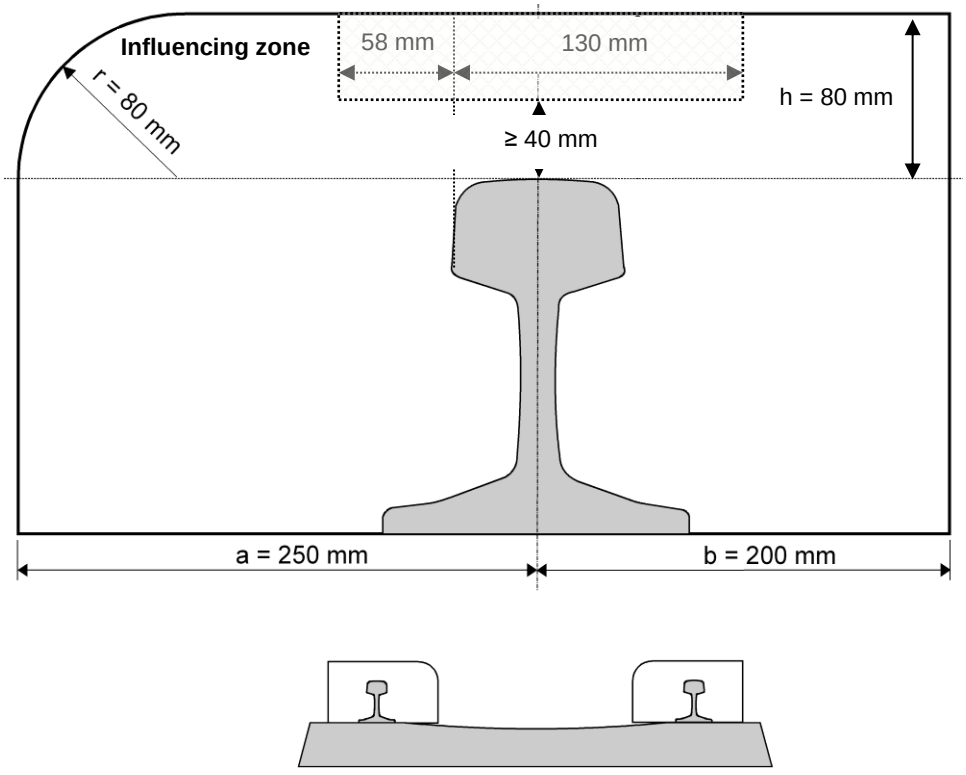

Figure 5: Sensitive area

These corrections should be applicable to the next revision of the document ERA/ERTMS/033281 .

This Opinion should constitute acceptable means of compliance, pending the revision of the relevant TSIs.

Valenciennes, 06/05/2021

Josef DOPPELBAUER
Executive Director

ANNEX 1

ANNEX 2

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REF.: Technical Opinion request for reviewing 'dynamic stimulation' and 'maximum width of 130 mm for magnetic track brakes' requirements from the ERA ERTMS interface document 2018 V4

Mr. Keir Fitch
Head of Unit C.4, Rail Safety & Interoperability - Directorate-General Mobility and Transport
European Commission, Rue De Mot 24-28, 1040 Brussels

Mr. Josef Doppelbauer
Executive Director - European Union Agency for Railways
Rue Marc Lefrancq 120, Valenciennes

Brussels, 17 December 2020

Dear Keir,
Dear Josef,

With this letter we would like to raise to your attention UNIFE's concerns regarding a potential deficiency/discrepancy in the recently included requirements of "dynamic stimulation" and "maximum width of 130 mm for magnetic track brakes" within the ERA ERTMS Interface document (ERA/ERTMS/033281 rev 4.0 20/09/2018).

UNIFE would like to outline that the recently included requirements in §3.1.3.5 could lead to non-compliances concerning the minimum vertical distance of 40 mm above the top of the rail for brakes in rest position and concerning the reduced maximum width of 130 mm for magnetic track brakes in contrary to EN16207:2014 which allows a maximum width of 140 mm), although the essential requirements concerning technical compatibility between vehicles and train detection systems are met.

Previously authorized vehicles (according to TSI LOC PAS 2014/ ERTMS Interface V2 Version) with magnetic track brakes or eddy current brakes have been designed for the same minimum vertical distance with fulfilling the conditions as defined in EN 16207:2014 with the static deflection only. A re-design of these well-proven bogie/brake combinations with respect to the required axle counter compatibility is technically not feasible.

It needs to be stressed however, that this non-compliance to the ERA ERTMS V4 (as referenced in TSI LOC PAS 2019) has not led to any miscounts with the axle counters in operation and also this is neither the case for previously authorized vehicles (according to TSI LOC PAS 2019 & ERA ERTMS V4 2018).

After being discussed and agreed with the Chairman and members of ERA Train Detection Compatibility (TDC) working group during the conference calls on 29th September and 3rd December, UNIFE would like to request a Technical Opinion be produced to review the **ERA/ERTMS/033281 rev 4.0 - Interface between control- command signalling trackside and other subsystems** and its next revision given the analysis and the resulting new elements from it.

As agreed in the ERA TDC working group, UNIFE has proposed the content for such a Technical Opinion which can be found in the annexes to this letter (Annexes contain: technical analysis, proposed changes to §3.1.3.5, Annex C of EN 16207:2014+A1:2019 and excerpt of § 5.5.2 of EN 16207: 2014+A1:2019)

We welcome your feedback on this matter and remain available for any further dialogue to close the identified deficiency.

Yours sincerely,

Philippe Citroën
UNIFE Director-General

Christian Rausch
Chairman of UNIFE Standards and Regulation Group (SRG)

Annex-1 Technical Analysis

The EN 16207:2014 as stated above requires taking into account the condition *static deflection at maximum load* and *fully worn wheels* for the evaluation of the lowest position of magnetic track brakes. This is also referred to as *"EN 16207 setup"*.

This is the starting point of the stochastic analysis which investigates probabilities of given influences on low heights. In other words, how deep can a brake part generally go which has been designed according to the EN 16207 setup and fulfilling the geometrical requirements (e.g. 140mm max. width for the magnetic track brake) and the vertical distance ≥40 mm above the top of the rail.

Extensive laboratory and field measurement results to the passive effect between magnetic track brakes / eddy current brakes exist today in many different companies/organisations, mainly related to FM (Frequency Management) compliant axle counters, which have been taken into account for the calculation/verification (e.g. for the lateral displacement, lamination effect of eddy current brakes) of the cumulative likelihood for vertical displacements below 40mm to top of the rail.

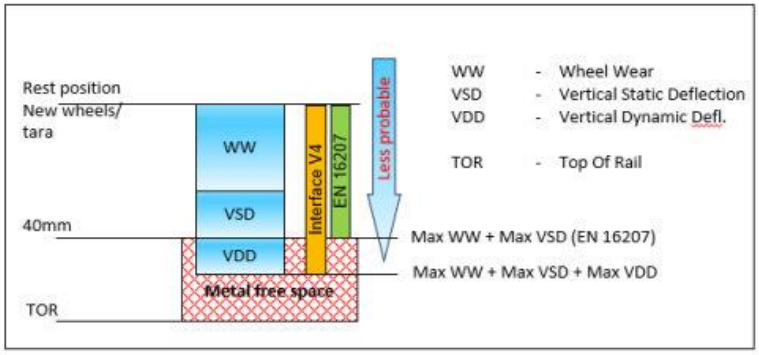
Stochastic influences on vertical displacement of track brakes (magnetic and eddy current brake)

It is commonly agreed that a possible disturbance of axle counters resulting from a low vertical displacement of a track brake is related to probabilities due to the stochastic nature of the vertical displacement. In particular, the vertical lowering in the context of a track brake is a stochastic variable resulting from various, mostly additive individual influences.

Influencing variables and stochastic process variables are:

Wheel-wear, static compression by load, dynamic compression at the very location of the axle counter, lateral movement at the very location of the axle counter, friction material built-up, pad wear, effect of laminated coils, geometric tolerances, electrical variance. Some variables are only relevant for magnetic track brakes like friction material built-up, pad wear whereas the laminated coils exist only for eddy current brakes.

In the following diagram, the typical order of magnitude of some relevant influence effects is shown. The current technical rule in the actual ERA/ERMTS interface V4 setup leads to a very low displacement by considering maximum wheel wear and maximum vertical static deflection as well as a high value of vertical dynamic deflection (Max WW + Max VSD + Max VDD). In general, various individual influence effects add to a possible low displacement of the brake component. Apart from the lowering by wheel wear and spring deflection, there are even additional relevant influence effects, which raise the distance e.g. brake pad wear of magnetic track brakes or the influence of laminated coils for the eddy current brake.



Stochastic analysis of magnetic track brake and eddy current brake

In the performed stochastic analysis, all relevant effects, which influence the vertical displacement have been taken into account. The effects have been categorized in *adverse normal*, *increased* and *extreme* range of magnitude and probabilities of each respective range have been determined/analysed. All the possible combinations of events and their added displacements have been determined by cumulation as well as the related likelihood. From all this, and as a result, a relation between displacement and likelihood has been derived.

Extreme lowering resulting from simultaneous extreme occurrence of a multitude of influences is extremely unlikely.

Given a design following the *"EN 16207:2014 setup"*, a performed stochastic analysis shows in case of magnetic track brakes, that even for a multitude of representative vehicles and with an adverse parameter configuration considered, a low value of 40 mm with respect to top of the rail will only be reached by a probability of 6E-10 per magnetic track brake.

The result of the stochastic analysis for the eddy current brakes, the low displacement down to an equivalent of 40 mm was determined with a probability of 4E-9 per eddy current brake.

The above in-depth analysis shows that taking into account the condition *static deflection at maximum load and fully worn wheels* (*EN 16207:2014 setup*) is enough to be compliant with the disturbance requirement of the axle counters. The actual setup in the ERA/ERMTS interface V4 document, however, refers (in its combination of effects) to a theoretic and extreme event, being extremely unlikely to occur over the range of operation conditions.

Annex-2 Proposal for revised text for §3.1.3.5 of ERA/ERTMS/033281 rev 4.0

(new/changed text underlined)

3.1.3.5. Metal and inductive components-free space between wheels

Harmonised parameter:

Only wheels and their parts (gearboxes, brake parts) or non-metallic and non-inductive components are permitted to be mounted in the sensitive area of Figure 5.

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Other metal parts (e.g. sanding pipe support, heating elements, magnetic brakes or eddy current brakes in rest position) are allowed to be mounted in a vertical distance ≥40 mm above the top of the rail. Inside of the shaded area in Figure 5, a metal part with the lateral dimension of maximum 130 mm and maximum 140 mm for magnetic track brakes, based on the dimensions of magnetic track brakes defined in EN 16207:2014, is allowed.

End pieces for magnetic track brakes shall respect the dimensions as set out in Annex C of EN16207:2014 (see annex of this letter).

Magnets and wear pads for magnetic track brakes shall respect the dimensions as set out in EN 16207:2014, excerpt of chapter 5.5.2 (see annex of this letter).

For magnetic track brakes or eddy current brakes in rest position, the vertical distance requirement (≥40 mm above the top of the rail) shall be met:

- *Taking into account static vertical deflection of the running gear at maximum load*
- *With fully allowed wear of the wheel or the maximum wear of the wheel between two re-adjustments*

For metal parts excluding magnetic track and eddy current brakes the vertical distance requirement shall be met:

- *under all operational conditions (running in a curve, over switch, ..)*
- *for the maximum allowed wear of the wheel or the maximum wear of the wheel between two re-adjustments*
- *for the maximum spring compression of the primary and the secondary vehicle suspensions, considering:*
    a. *static load*
    b. *additional dynamic stimulation*
    c. *tolerances of the stiffness*
- *for air springs the totally evacuation of the air-suspension bellow („emergency suspension")*

Requirements on steel springs and rubber springs:

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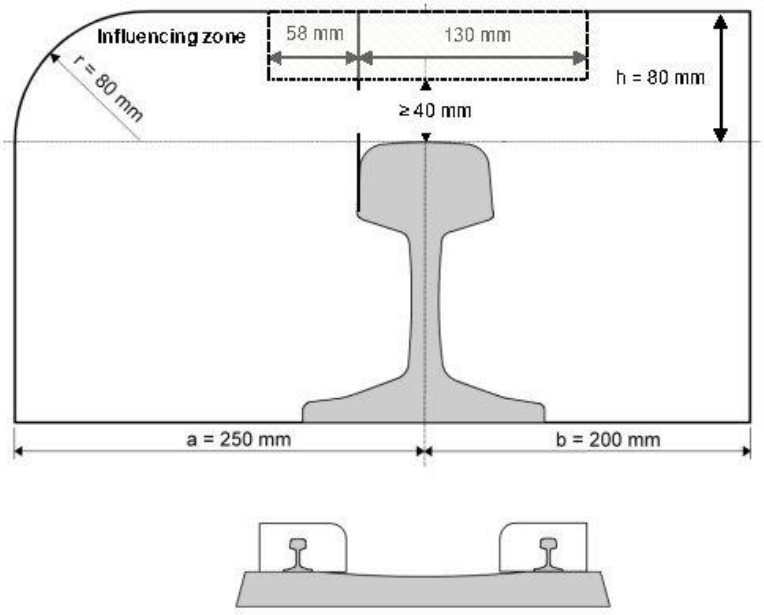


Figure 5: Sensitive area

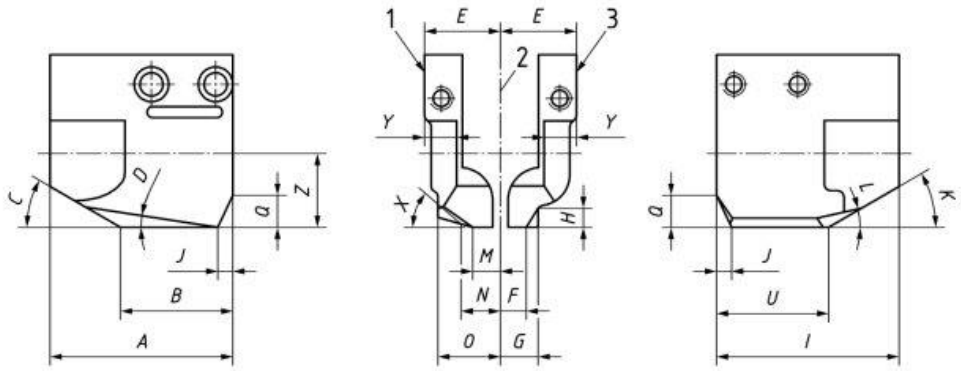
Annex-3 Copy of Annex C of EN 16207:2014+A1:2019

Annex C
(normative)

End pieces of MTB

Figure C.1 to C.4 contain schematic diagrams of different forms of end pieces with main dimensions.

Table C.1 contains different forms of end pieces which are currently being used and which comply with the requirements of 5.5.1.

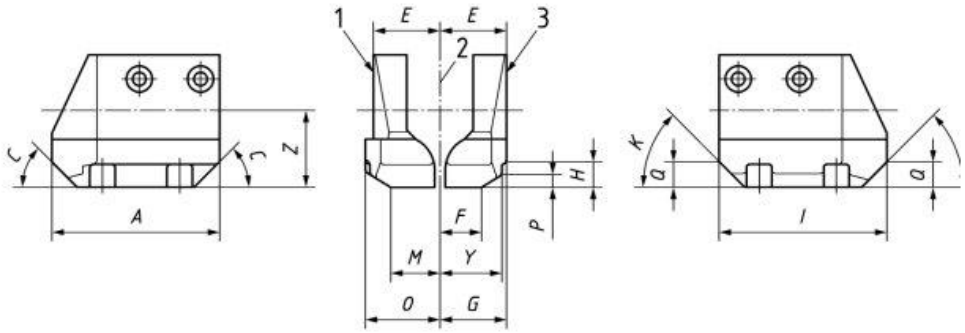


Key

1 outer side
2 centerline
3 inner side

NOTE Source: UIC 541–06; Appendix 3, Type 1 (SNCF).

Figure C.1 — End piece – Form 1

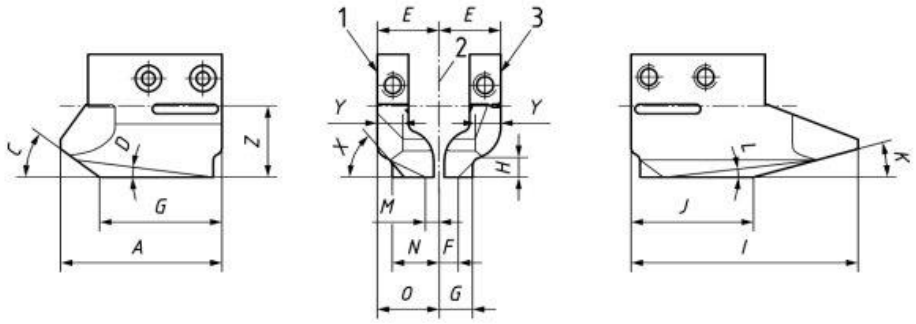


Key

1 outer side
2 centerline
3 inner side

NOTE Source: UIC 541-06; Appendix 3, Type 2 (SNCF, Origin: SAM F 102).

Figure C.2 — End piece – Form 2

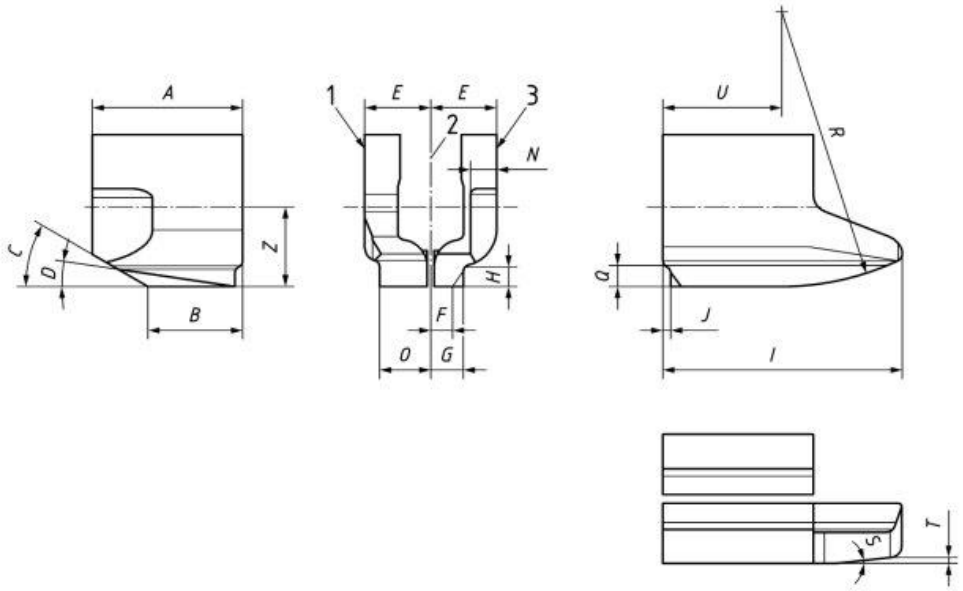


Key

1 outer side
2 centerline
3 inner side

NOTE Source: UIC 541-06; Appendix 3, Type 3 and 6 (DB; Origin: KB).

Figure C.3 — End piece – Form 3

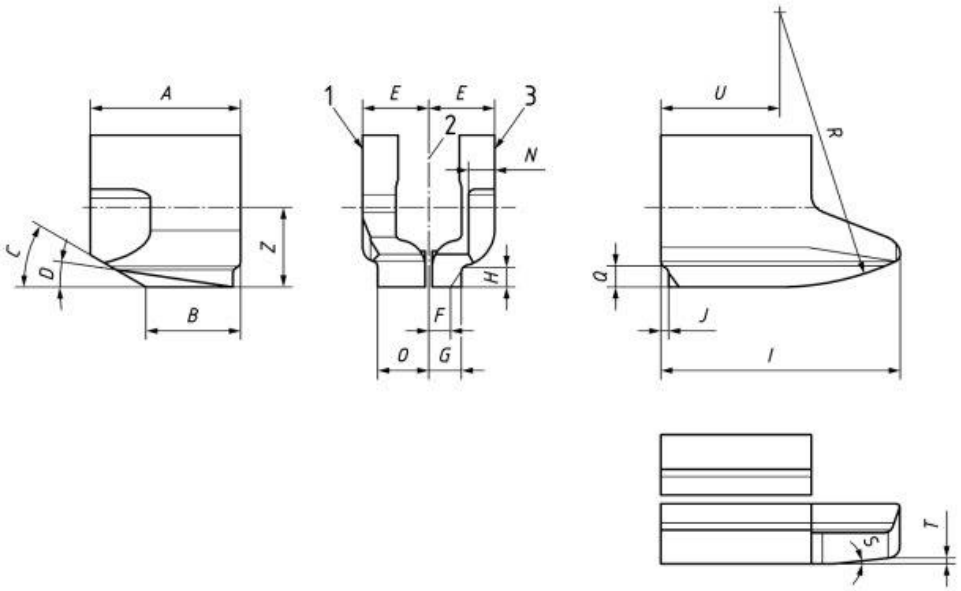


Key

1 outer side
2 centerline
3 inner side

NOTE Source: UIC 541-06; Appendix 3, Type 4 and 5 (DB; Origin: FT).

Figure C.4 — End piece - Form 4



Key

1 outer side
2 centerline
3 inner side

NOTE Source: UIC 541-06; Appendix 3, Type 4 and 5 (DB; Origin: FT).

Figure C.4 — End piece - Form 4

	UIC 541-06 Appendix 3, Type 1	UIC 541-06 Appendix 3, Type 2	UIC 541-06 Appendix 3, Type 3	UIC 541-06 Appendix 3, Type 4	UIC 541-06 Appendix 3, Type 5	UIC 541-06 Appendix 3, Type 6
	SNCF (Origin KB)	SNCF (SAM F 102)	DB AG (Origin KB)	DB AG (Origin FT)	DB AG (Origin FT)	DB AG (Origin KB)
	End piece					
	Form 1	Form 2	Form 3	Form 4	Form 4	Form 3

[b] (+) Bevel edge.
[c] Wear height.

Annex-4 Excerpt of § 5.5.2 of EN 16207: 2014+A1:2019

5.5.2 Pole shoes

The magnet can have a single rigid pole shoe which is generally used in low speed applications. For Mainline operation the state of the art is a magnet body with several pole shoes, which are free to move within the support frame.

The width of the pole shoe that is in contact with the rail head shall be 65 mm to 72 mm and the maximum width of the magnet shall not exceed 140 mm. It is permitted for the magnets to be fitted with renewable friction plates to enable easy replacement while on the vehicle. The limit of wear of the pole shoe and/or the friction plates shall be clearly identifiable.