



Specification for a standard EMU-DMU wheel with brake discs



SBB CFF FFS

Specification for a standard EMU-DMU wheel with brake discs

2nd edition

Original language: English

© SNCF-VOYAGEURS, Rail Safety and Standards Board (RSSB), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB), Schweizerische Bundesbahnen (SBB)

Paris, London, Munich (München), Utrecht, Vienna (Wien), Bern

January 2023

© Photo Cover Page: SNCF

Table of Contents

1	Foreword	4
2	Introduction	5
3	Scope	7
3.1	<i>Technical Scope</i>	7
3.2	<i>Objective</i>	8
4	Normative References	8
5	Terms, definitions and abbreviations	8
6	Specifications	9
6.1	<i>Aim</i>	9
6.2	<i>Field of application</i>	9
6.3	<i>General concept</i>	9
6.4	<i>Geometrical requirements</i>	10
6.4.1	Wheel dimensions.....	10
6.4.2	Disc overall dimensions	10
6.4.3	Interface to axle.....	11
6.4.4	Interface to disc.....	11
6.4.5	Finished state	11
6.5	<i>Mechanical requirements</i>	11
6.6	<i>Thermomechanical requirements</i>	11
6.7	<i>Material requirements</i>	12
6.8	<i>Product requirements</i>	12
6.9	<i>Interface requirement</i>	12
6.9.1	Interface to the axle.....	12
6.9.2	Interface to the disc and fastening requirement.....	12
6.9.3	Further requirements	12
6.10	<i>Drawing</i>	12
7	Bibliography	13

Issue Record

Version	Date	Change
1	February 2016	First draft of the specification
2	January 2023	Modification of the design of the wheel web to accept common brake disc designs

1 FOREWORD

EuroSpec is a group of European train operating companies providing harmonised product specifications for use in train procurement and refurbishment.

The main target is to align train operator's needs in order to reduce the whole life cycle cost of the train, shorten the delivery time and speed up the innovation cycle and the deployment of innovations.

The benefits of EuroSpec:

- Increase of reliability by sharing good practice and experience;
- Simplification of the tender process in time and cost as a result of fewer variations in requirements between tenders;
- Standardised products and cost reduction due to harmonisation of train operators' requirements;
- Reduction of diversity in request to the industry for more competitive and mature products;
- To provide to the industry free "Customer needs" for their future R&D program, through requirements that are not yet fulfilled by existing product nor solution.
- To promote through our common requirements to the industry the availability of information required for improving operation performance and ensuring long term sustainability of our assets, supporting open interfaces.

The EuroSpec specifications comprise merged functional and product basic requirements. All EuroSpec specifications focus on technical aspects based on lessons learned and on foreseen developments

A EuroSpec specification is a voluntary specification designed to be used within the European region. The primary field of application is the European rolling stock domain and all associated interfaces.

Regarding the hierarchy this common specification can be positioned as follows, in order of prevalence:

- European Standards (ENs)
- UIC Leaflets & International Railway Solutions (IRS)
- EuroSpec Specifications
- Company Specifications

2 INTRODUCTION

This document is a voluntary specification, produced by SNCF-VOYAGEURS, Rail Safety and Standards Board (RSSB), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB).

Individual companies may choose to mandate it through internal instructions/procedures or contract conditions.

Purpose of this document

This document provides a voluntary specification for “wheel with brake discs” for use by companies in the rail sector if they so choose.

The purpose of this document is to provide a common specification for “wheel with brake discs” in rolling stock between train operators. This document is to replace individual company specific functional requirements and constitutes a common reference being used for tendering and verification.

Application of this document

- This specification is voluntary. Individual companies may however elect to mandate all or part of its use through company procedures or contract conditions. Where this is the case, the company concerned must specify the nature and extent of application.
- Specific compliance requirements and dates of application have therefore not been identified since these will be the subject of the internal procedures or contract conditions of those companies that choose to adopt this standard.

Safety responsibilities

- Users of documents published by SNCF-VOYAGEURS, Rail Safety and Standards Board (RSSB), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB) are reminded of the need to consider their own responsibilities under the relevant European or national safety legislation.
- SNCF-VOYAGEURS, Rail Safety and Standards Board (RSSB), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB) make no warranty that application of all or any part of documents published by SNCF-VOYAGEURS, Rail Safety and Standards Board (RSSB), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB) is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duty of care.

Copyright

- Copyright to these documents is owned jointly by SNCF-VOYAGEURS, Rail Safety and Standards Board (RSSB), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB). All rights are hereby reserved. No EuroSpec specification (in whole or in part) may be used for any purpose other than the design, manufacture, purchase and operation of railway equipment.
- Any commercial use of this EuroSpec Specification or use for any other purpose other than the design, manufacture, purchase and operation of railway equipment shall be subject to explicit authorisation by SNCF-VOYAGEURS, Rail Safety and Standards Board (RSSB), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB).
- SNCF-VOYAGEURS, Rail Safety and Standards Board (RSSB), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB).

Schweizerische Bundesbahnen (SBB) accept no responsibility for, and exclude all liability in connection with the use of this EuroSpec Specification or extracts there from. This disclaimer applies to all forms of media in which extracts from this EuroSpec Specification may be reproduced.

Approval and authorisation of this document

- The content of this document was approved for publication by the technical bodies of SNCF-VOYAGEURS, Rail Safety and Standards Board (RSSB), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB).

3 SCOPE

3.1 Technical Scope

European train operating companies are faced with a plethora of different wheels regardless the similarity in application, size and functions. These components are subjected to wear and must be replaced regularly. Due to the large number of different types, cost-effective management of these wheels is difficult.

Application

Firstly, the need for standardisation of running gear components in the freight field has been covered since the eighties.

In the last decades, it is a known fact that urbanisation has concentrated on big towns and their suburbs rather than in the countryside. In this context, the need for urban, suburban, and short distance train has grown significantly and greater than for high speed and long-distance trains. This need has been answered by rolling stock with EMU-DMU architecture.

Therefore, this project has concentrated on standardisation of wheels for EMU and DMU applications. Considering the variety of existing discs and bogie designs, fitting to existing designs is almost impossible. Thus, this specification is mainly dedicated to new rolling stock, but may work for an existing one.

Dimensions

In order to fulfil the European and national regulations on passenger accessibility, many “low-floor” rolling stock have been designed within the last years. Thus, the Ø840 mm wheel satisfies this floor height and medium axle load and has been accepted as a popular size.

Axle load

A standard axle load for Ø840 mm wheels was chosen based on existing designs and constraints. It was fixed at 20 tons.

Note: Axle load used in EN 13103-1 (axle design standards) is defined as follows:

Axle load = Design mass in working order + 1,2 x Normal design payload.

with:

Design mass in working order is defined in EN 15663.

Normal design payload is defined in EN 15663 on which the standing passengers shall be: 160 kg/m² (2 passengers per m²) in standing and catering areas.

Braking system

With the “low-floor” rolling stock design, the use of brake discs on the axle was no longer possible. That is why, on these types of design, the brake discs are normally fixed to the web of the wheels. Moreover, since the beginning of the project, there was a general understanding that the wheel specification had to be opened to different technologies of brake discs that all the leading manufacturers on the market could comply with.

Technical scope summary	
Application	(new) EMU / DMUs
Axle load (EN 13103-1 definition)	20 tons
Braking system	Discs fixed through the web No tread braking
Wheel diameter dimensions	Ø840 mm
Disc Suppliers	All

3.2 Objective

The objective of this specification is a clear definition of the LOC and PAS TSI and European Standard (EN) compliant yet also standardized wheels and their interfaces to the brake disc and axle. This means that once standardised wheel properties have been firmly established in this specification, future developments of brake discs and axles are to respect a standardised interface to ensure the interchangeability of standardised wheels of different market participants. In this way, an increasing number of different discs will become available compatible with standardised wheels.

This EuroSpec specification is a first attempt to standardise wheels and in the further course will be coordinated with the stakeholders in the sector. The aim is to establish a coordinated specification for wheels that will be used by European railway operators in the same way and that form the basis for future developments of wheelsets.

4 NORMATIVE REFERENCES

The following referenced documents are indispensable for the application of this document. ENs are developed by CEN¹ or CENELEC², UIC Leaflets and IRS are developed by UIC³, ISOs are developed by ISO⁴, IEC are developed by IEC⁵ and are made available from their members.

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13979-1 Railway applications — Wheelsets and bogies - Monobloc wheels - Technical approval procedure — Part 1: Forged and rolled wheels

EN 13261 Railway applications — Wheelsets and bogies — Axles – Product requirement

EN 13262 Railway applications — Wheelsets and bogies — Wheels – Product requirement

EN 13103-1 Railway applications - Wheelsets and bogies — Axles - Design method

EN 13260 Railway applications — Wheelsets and bogies — Wheelsets – Product requirements

EN 15663 Railway applications - Definition of vehicle reference masses

5 TERMS, DEFINITIONS AND ABBREVIATIONS

Terms and definitions can be found in

EN 17343	Railway applications - General terms and definitions; Trilingual version
IEC 60050-811	International electrotechnical vocabulary - Part 811: Electric traction
IEC 60050-821	International electrotechnical vocabulary - Part 821: Signalling and security apparatus for railways

and in the

- IEC Electropedia available at: <http://www.electropedia.org/>
- ISO Online browsing platform available at: <https://www.iso.org/obp>

Abbreviations:

¹ Comité Européen de Normalisation / European Committee for Standardization - www.cen.eu

² Comité Européen de Normalisation Électrotechnique / European Committee for Electrotechnical Standardization - www.cenelec.eu

³ Union internationale des chemins de fer / International Union of Railways - www.uic.org

⁴ International Organization for Standardization - www.iso.org/home.html

⁵ International Electrotechnical Commission - www.iec.ch/homepage

TSI	Technical specification for interoperability
EN	European Standard
TEN	Tran European Network

6 SPECIFICATIONS

6.1 Aim

The aim of this specification is to describe a standardised wheel to which brake discs for different applications and from different manufacturers can be attached and that is fully compliant with Technical Specifications for Interoperability (TSI) and referred European Standards (EN).

6.2 Field of application

This wheel can be used on all rolling stock covered by the LOC and PAS TSI.

6.3 General concept

This wheel has been designed in order to interface and accept discs (either monobloc or segmented) of two different design types or technologies:

- With centring and braking functions decoupled in two different types of holes (Figure 1: Disc design type “K”).
- With centring and braking functions coupled in one unique type of hole (Figure 2: Disc design type “F”),

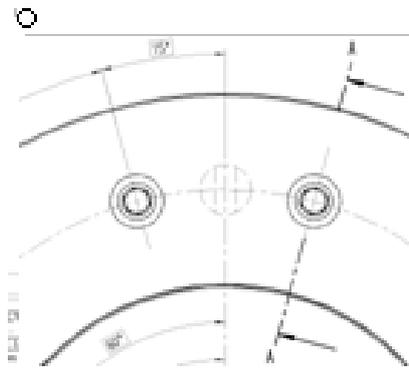


Figure 1: Disc design type “K”

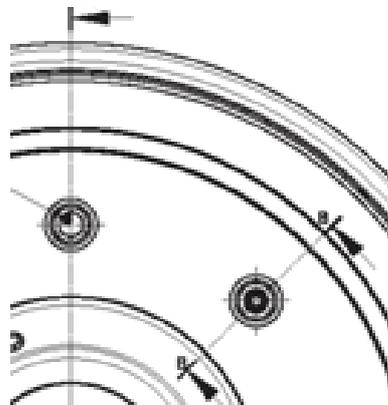


Figure 2: Disc design type “F”

Therefore, considering the braking forces to be transmitted from the disc to the wheel, the design of the wheel shall meet the following requirements:

18 holes (6x Ø34 mm and 12x Ø22 mm) leaving the possibility to:

- Use only the 6x Ø34 mm for centring and braking functions,
- Use the 6x Ø34 mm holes for centring functions and the 12x Ø22 mm holes for braking functions
- Use only the Ø22 mm holes for centring and braking functions (in the case of segmented brake discs)

6.4 Geometrical requirements

6.4.1 Wheel dimensions

The following dimensions were chosen based on European practices (see references in table), consensus and validated by calculation (see § 6.5).

DIMENSION	VALUE (mm)	REFERENCE
Nominal wheel diameter	Ø 840	
Worn wheel diameter	Ø 770	
Diameter of holes in the wheel	34H8 and 22 +/- 0,2	Remark: the tolerances of the Ø22 mm holes can be reduced to H8 in the case of segmented brake discs
Diametric position of the holes in the web	525	
Web minimum thickness	32	
Internal rim diameter (IRD)	720	
Internal hub diameter (IHD) = wheel seat diameter	205	
External hub diameter (EHD)	266,5	Chosen in order to comply with ORE B136 RP11 recommendation ($EHD/1,5 < IHD < EHD/1,3$) and to have the lightest wheel
Hub length (h)	185	Chosen in order to comply with SNCF specification and state of the art rules ($0,9IHD < h < 1IHD$) and to have the lightest wheel
Position of the web (from the internal face)	67,5	Aligned with the middle of the rim
Hub to rim overhang (internal face)	24	

The rest of the wheel detailed dimensions (rim/web radius, hub/web radius etc...) are integrated in the wheel drawing (§6.10).

6.4.2 Disc overall dimensions

DIMENSION	VALUE (mm)	REFERENCE
Disc external diameter (DED)	680 maximum	20 mm minimum clearance between disc and wheel
Disc internal diameter (DID)	375 minimum	
Diametric positions of the holes in the disc	523	Chosen in order to keep a 2 mm gap between axes of holes in web and in disc to absorb thermal expansion. In the case of segmented disc, this value may remain 525 mm

6.4.3 Interface to axle

DIMENSION	VALUE (mm)	REFERENCE
Wheel seat diameter	205	
Wheel seat length	-	Shall be defined in accordance with requirements on overhang in EN 13103-1
Interference between axle wheel seat and wheel hub bore	-	Shall be defined in accordance with EN 13260 requirements

6.4.4 Interface to disc

DIMENSION	VALUE (mm)	REFERENCE
Diameter of holes in the wheel	34H8 and 22 +/- 0,2	Remark: the tolerances of the Ø22 mm holes can be reduced to H8 in the case of segmented brake discs
Web thickness	32 +/-0,2	
Disc overhang to wheel interface (details X and Z of drawing)	> 0	In order to reduce fretting fatigue issues
Interface to disc external diameter (dimension IDEED of drawing)	660 maximum	In order to have a disc overhang of 20 mm minimum
Interface to disc internal diameter (dimension IDID of drawing)	390 minimum	In order to have a disc overhang of 15 mm minimum

6.4.5 Finished state

The wheel has been designed with fatigue criteria corresponding to a machined web according to EN 13979-1. Therefore, the roughness of the web shall be less or equal to Ra 6,3, except where the disc is in contact with the wheel web where the roughness shall be less or equal to Ra 1,6.

Roughness of the holes:

- Ra 3,2 for Ø22 mm,
- Ra 1,6 for Ø34 mm.

A particular attention shall be accorded to the finished state of the holes as follows. They shall be chamfered and without any sharp edges in order to avoid stress concentration.

6.5 Mechanical requirements

The design of the wheel, whose dimensions are detailed in §6.10, has been calculated with the conventional loads of EN 13979-1 against exceptional and service strength assessment.

Design assumptions:

- Web yield strength: 355 N/mm² minimum
- Permissible fatigue stresses: $\Delta\sigma = 360$ N/mm²

The wheel is totally compliant with the requirement of the EN 13979-1 standard.

Note: The wheel was designed for European conventional loading. Tilting trains and special applications may need additional mechanical calculations performed.

6.6 Thermomechanical requirements

The wheel was designed without any additional requirement regarding thermomechanical behaviour, for the following reasons:

- wheel is not tread-braked,
- the temperatures reached around the holes, even in case of emergency braking, are considered as non-significant.

6.7 Material requirements

The wheel shall be made of a material compliant with EN 13262, providing that their mechanical characteristics meet the design assumption above (§6.5).

6.8 Product requirements

The wheel shall meet the requirements of EN 13262.

6.9 Interface requirement

6.9.1 Interface to the axle

No requirement other than compliance with EN 13261 and EN 13103-1 standards.

6.9.2 Interface to the disc and fastening requirement

There is no requirement on the shape of the disc surface that interfaces with the wheel web, but it is recognised that shapes other than linear contact (spherical for example) tend to increase fretting fatigue issues.

Disc attachment fastenings shall be made using all or some of the 18 holes in the wheel.

Unless there is a technical justification, the type of fastening should be standardised according to ISO, EN or DIN requirements.

The tightening torque should be achieved without an angle-controlled system.

6.9.3 Further requirements

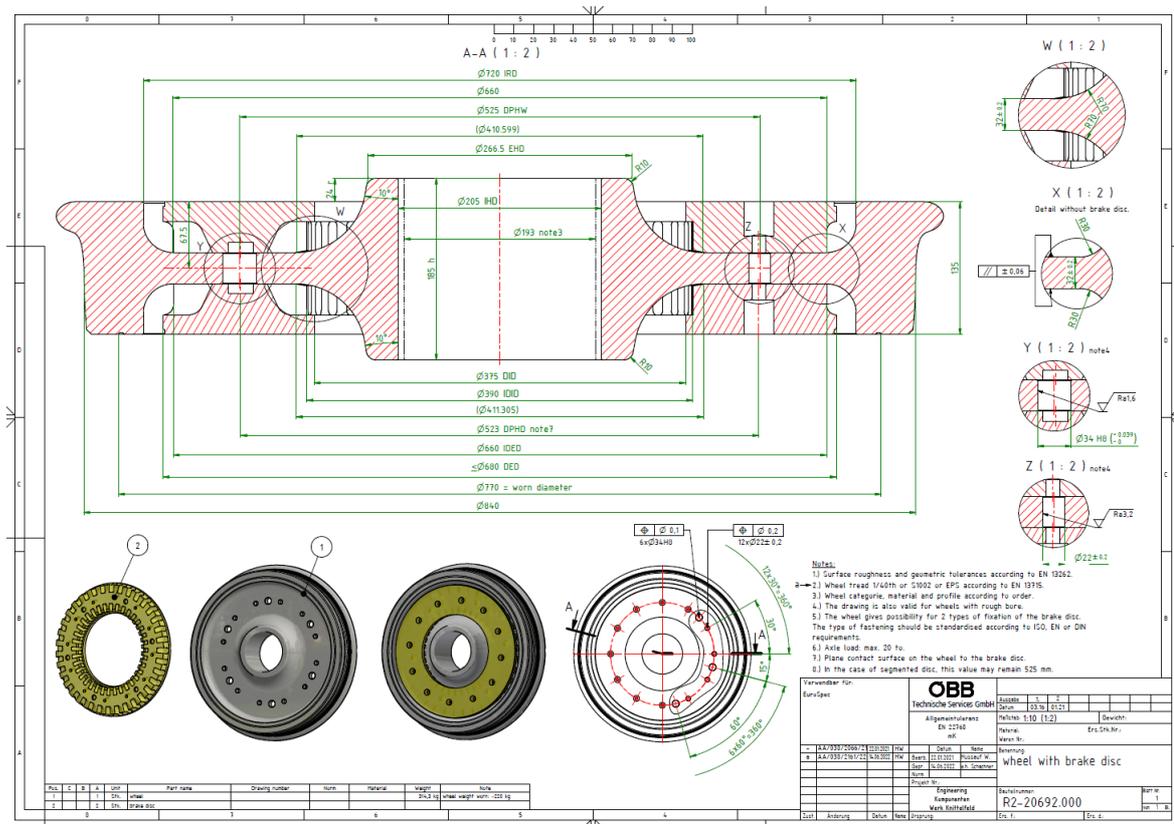
Mandatory requirements defined in the LOC and PAS TSI have to be fulfilled, especially regarding manufacturing of the wheel. The requirements regarding the design of the wheel (EC-type examination, application of TSI modulus CB) have been fulfilled and are provided in the appendix (§7).

In conformity with EU regulation 2019-250, to put the wheel on the market, the manufacturer of the wheel shall edit an EC declaration of conformity including the EC-type examination along with another certificate based on “conformity to type based on quality management system of the production process “(modulus CD) or “conformity to type based on product verification” (modulus CF).

Additional requirements from customers shall be respected within the limits given by this specification for a standardised wheel with brake disc.

6.10 Drawing

The full-size drawing of the wheel can be downloaded at <https://eurospec.eu/wheel-brake-disc/>



Note:

In some specific areas (transitions between hub and web and transition between rim and web), the design can be adapted under two conditions:

- Verification of the design through mechanical calculation compliant with EN 13979-1 requirements,
- Verification that the geometric requirements set in chapter 6 are still valid to ensure the wheel/disc assembly

7 APPENDIX

EC-type examination, application of the TSI LOC & PAS modulus CB (available on ERADIS database at https://eradis.era.europa.eu/interop_docs/NoBoCert/view.aspx?id=22324):



D3_26067_EN_1

Certificat CE d'examen de Type

Numéro 2593/1/CB/2022/RST/FR/6037/0005/V01

En conformité avec la directive (UE) 2016/797 du 11 Mai 2016 (et ses modifications ultérieures) et selon le Document Technique de l'ERA, 000MRA1044 version 1.1 de juin 2017.

Object de l'évaluation :	Le constituant d'interopérabilité suivant : « Roues » Plan sous référence : R2-20692.000 version a du 14/06/2022
Demandeur :	SNCF VOYAGEURS - SNCF MATÉRIEL - CENTRE D'INGENIERIE MATERIEL 4 Allée des Gêmeaux 72100 Le Mans
Exigences relatives à l'évaluation :	- RÈGLEMENT (UE) No 1302/2014 concernant une spécification technique d'interopérabilité relative au sous-système « matériel roulant » – « Locomotives et matériel roulant destiné au transport de passagers » du système ferroviaire dans l'Union européenne, Modifié par : <ul style="list-style-type: none"> o Règlement (UE) 2016/919 de la Commission du 27 mai 2016, o Règlement d'exécution (UE) 2018/868 de la Commission du 13 juin 2018, o Règlement d'exécution (UE) 2019/776 de la Commission du 16 mai 2019, o Règlement d'exécution (UE) 2020/387 de la commission du 9 mars 2020. en combinaison avec les normes harmonisées, les normes volontaires (ou parties de celles-ci), d'autres règles européennes ou nationales autorisées par des STI et des solutions alternatives comme indiqué dans le rapport d'audit / dossier NoBo (section 4.2).
Module Appliqué :	Le présent certificat CE d'examen de type a été effectuée par application du module CB de la décision pertinente adoptée en vertu de la directive.
Résultat de l'évaluation :	L'objet de l'évaluation comme identifié ci-dessus a été démontré conforme aux exigences d'évaluation sous réserve des conditions et limites d'utilisation énumérées ci-dessous. Les résultats d'évaluation sont fournis en détail dans le rapport d'évaluation / dossier NoBo. Les exigences essentielles ont été évaluées comme étant satisfaites par la conformité avec les exigences de la STI pertinente seulement.
Conditions et limites d'utilisation :	Voir section 3 du dossier NoBo « EC_6037_0006_1 »
Rapport d'évaluation :	Le rapport d'évaluation EC_6037_0004_1 fait partie intégrante de ce certificat CE d'examen de type.
Dossier NoBo :	Dossier NoBo « EC_6037_0006_1 »
Documentation accompagnant ce certificat :	Voir section 5 du Dossier NoBo « EC_6037_0006_1 »
Validité :	Date de certification : 05/09/2022 Fin de Validité : 04/09/2027 Ce certificat d'examen de la conception est valable pour l'objet d'évaluation mentionné ci-dessus et aussi longtemps que l'objet de l'évaluation et la documentation technique pertinente ne sont pas modifiés.



Fait à Valenciennes le 05/09/2022 par
Le Directeur Général


Pierre KADZIOLA



CERTIFER SA - Siège social : 18 rue Edmond Membreée - CS 40141 - 59308 Valenciennes Cedex
Tél. +33 (0)3 27 28 35 00 - Fax : +33 (0)3 27 28 35 09 - www.certifer.eu
Société Anonyme au capital de 9 000 180.00 € - TVA/SIRET : FR28 802 053 397 00039 - NAF : 71206 - RCS Valenciennes 802 053 397

8 BIBLIOGRAPHY

Technical specification for interoperability	Technical specification for interoperability relating to the rolling stock subsystem referred to in Annex II (1) of Directive (EU) 2016/797
ORE B136 RP11	B 136 WHEELSETS WITH ASSEMBLED AXLEBOXES: DESIGN, MAINTENANCE AND STANDARDISATION – RP 11 : Calculation of wagon and coach axles

EuroSpec

“EuroSpec” stands for European Specifications for railway rolling stock. The activity is an initiative of several European train operating companies (TOC). The main focus is on trains consisting of self-propelled carriages, using electricity as the motive power (EMU).

© SNCF-VOYAGEURS, Rail Safety and Standards Board (RSSB), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB), Schweizerische Bundesbahnen (SBB)

Paris, London, Munich (München), Utrecht, Vienna (Wien), Bern

January 2023