



## Requirements for a standard EMU-DMU wheel with brake discs



Mobility  
Networks  
Logistics



## **Requirements for a standard EMU-DMU wheel with brake discs**

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## Issue Record

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No.	Chap.	Open point / non-agreed item	Finalisation
1	-	void	-

## 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 improve the reliability and quality of trains by using common and standardised functional and non-functional specification and verification methods.

The benefits of using EuroSpecs:

- 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.

The EuroSpec specifications comprise merged functional and product basic requirements. All EuroSpec specifications focus on technical aspects exclusively based on the existing national requirements.

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:

- EN standards
- UIC/ UNIFE Technical Recommendations (TecRecs)
- UIC Codes (leaflets)
- EuroSpec Specifications
- Company Specifications

## 2 INTRODUCTION

This document is a voluntary specification, produced by SNCF, the Association of Train Operating Companies (ATOC), Deutsche Bahn (DB), 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 document is set out in the same format as EN standards including, where appropriate, normative and informative annexes in order to facilitate the interface with Euro Norms.

### 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.

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## Approval and authorisation of this document

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## 3 SCOPE

### 3.1 Technical Scope

European train operating companies are faced with a plethora of different wheels regardless of the similarity in application, size and function. 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 brake discs and bogie designs, fitting to existing designs is almost impossible. Thus, this specification is intended for new rolling stock but may be used 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 recent years. Thus the 840mm diameter wheel satisfies this floor height; medium axle load and has been accepted as a popular size.

#### Axle load

A standard axle load for Ø840 diameter wheels was chosen on the basis of existing designs and constraints. It was fixed at 20 t.

Note: Axle load used in EN 13103 and EN 13104 (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/m<sup>2</sup> (2 passengers per m<sup>2</sup>) 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 / DMU 's
Axle load (EN13103/13104 definition)	20 t
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 EuroNorm compliant yet also standardised 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 must 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 CEN<sup>1</sup> or CENELEC<sup>2</sup> 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 Railway applications — Wheelsets and bogies — Non powered axles - Design method

EN 13104 Railway applications — Wheelsets and bogies — Powered axles - Design method

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

EN 15663 Railway applications — Definition of vehicle reference masses

Note: EN13103 and EN13104 are subjected to merging and are under enquiry. They should be published under EN 13103-1 numbering with no impact on the requirements of this technical specification.

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<sup>1</sup> Comité Européen de Normalisation/ European Committee for Standardisation - [www.cen.eu](http://www.cen.eu)

<sup>2</sup> Comité Européen de Normalisation Électrotechnique/ European Committee for Electrotechnical Standardisation - [www.cenelec.eu](http://www.cenelec.eu)

## 5 Terms, definitions and abbreviations

TSI	Technical specification for interoperability
EN	EuroNorm
TEN	Trans 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 EuroNorms (EN).

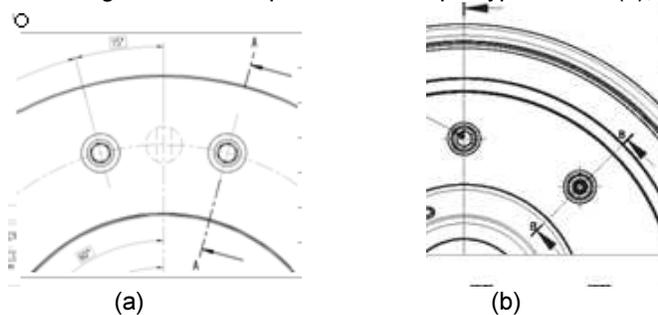
### 6.2 Field of application

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

### 6.3 General concept

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

- With centring and braking functions decoupled in two different types of holes (a).
- With centring and braking functions coupled in one unique type of hole (b).



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 (6xØ34 + 12xØ22) leaving the possibility to:

- Use only the 6xØ34 holes for centring and braking functions,
- Use the 6xØ34 holes for centring functions and the 12xØ22 holes for braking functions.

### 6.4 Geometrical requirements

#### 6.4.1 Wheel dimensions

The following dimensions were chosen on the basis of 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	
Diometric position of the holes in the web (DPHW)	525	
Web minimum thickness	26	
Internal rim diameter (IRD)	720	

DIMENSION	VALUE (MM)	REFERENCE
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) (r)	24	

The rest of the wheel detailed dimensions (rim/web radius, hub/web radius etc...) are included on the wheel drawing (§7).

#### 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 (DPHD)	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 at 525 mm.

#### 6.4.3 Interface to axle

DIMENSION	VALUE (MM)	REFERENCE
Wheel seat diameter (IHD)	205	
Wheel seat length (on axle)	-	Shall be defined in accordance with requirements on overhang in EN 13103 and EN 13104.
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	
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 IDED 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 than or equal to Ra 6,3.

Roughness of the holes:

- Ra 3,2 for Ø22,
- Ra 1,6 for Ø34.

Particular attention shall be given to the finished state of the holes. They shall be chamfered and without any sharp edges or burrs, in order to avoid any stress concentration.

## 6.5 Mechanical requirements

The design of the wheel whose dimensions are detailed in §7 has been calculated with the conventional loads of EN 13979-1 against exceptional and service strength assessment.

Design assumptions:

- Web yield strength : 355 N/mm<sup>2</sup> minimum
- Permissible fatigue stresses :  $\Delta\sigma = 360$  N/mm<sup>2</sup>

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

Note: The wheel was designed with European conventional loading. Tilting trains and special applications may require additional mechanical calculations.

## 6.6 Thermomechanical requirements

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

- the wheel is not tread braked,
- the temperatures reached around the holes, even in the 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 assumptions above (§6.5).

## 6.8 Product requirements

The wheel shall meet the requirements of EN 13262 standard.

## 6.9 Interface requirements

### 6.9.1 Interface to the axle

There is no other requirement other than compliance with EN13261 and EN13103 and 13104 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 a shape other than linear contact (spherical for example) tend to increase fretting fatigue issues.

Disc attachment fastening shall be made by all or some of the 18 holes in the wheel.



## 8 BIBLIOGRAPHY

Technical specification for interoperability	Technical specification for interoperability relating to the rolling stock subsystem of the trans-European conventional rail system referred to in Annex II (1) to Directive 2008/57/EC (2011/291/EU – published 26/05/2011)
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).

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