

# JNS Normal Procedure

## “Accident Gotthard base tunnel - broken wheels”

Final report | version 2.0 | 11.07.2024

**Outcome of the Joint Network Secretariat Normal Procedure**  
**“Accident Gotthard base tunnel - broken wheels”**

**Part 1 : Introduction**

**Part 2 : Outcome**

### *Version history:*

Version	Date	Comments
0.9	19.06.2024	Outcome meeting speaker subgroup, NSA CH, ERA
1.0	24.06.2024	Outcome Task Force meeting #7
1.1	01.07.2024	Additions by speaker of subgroup (see green text slide 38&39 and new slides 58 & 59)
2.0	11.07.2024	Comments from TF meeting #7 and #8 included. ERA final review

## **Part I. Introduction**

Chapter 1: explanation JNS

Chapter 2: background and risk to be tackled

Chapter 3: organization of work

## **Part II. Outcome**

Chapter 0: summary and orientation

Chapter 1: risk control measures

1a: identification of comparable wheel types

1b: risk control measures 2024

Chapter 2: changes to legislation and standards

Chapter 3: research needs and related ongoing projects

Chapter 4: impact assessment

# Part I

## Chapter 1: explanation JNS

### Content

Chapter 1 : explanation JNS

Chapter 2: background and risk to be tackled

Chapter 3: organization of work

### Joint Network Secretariat (JNS)

- Triggered by accident Viareggio 2009 → Joint Sector Group at ERA
- National Safety Authorities (**NSA network**) + Representative Bodies (**NRB network**)
- Creation of **Task Forces of experts** to solve technical issues  
(usually after accidents and dangerous events)
- Urgent (2 months) - and Normal Procedures (max. 2 years)
- **Every actor** can notify a JNS procedure  
Form can be found at [https://www.era.europa.eu/activities/joint-network-secretariat\\_en](https://www.era.europa.eu/activities/joint-network-secretariat_en) to be sent to [jns@era.europa.eu](mailto:jns@era.europa.eu)
- **Neutral moderation and chairing** by ERA
- **From 2024<sup>1)</sup>**: Legal basis in **CSM ASLP** (Assessment of Safety level and Safety Performance)

1) Depends on the adoption of the Regulation on these Common Safety Methods

# Part I, Chapter 1. : Explanation JNS JNS in the EU safety framework

## Roles of actors

### Role of JNS procedures in the EU safety framework<sup>\*)</sup>

- Railway Undertaking (RU) and Infrastructure Manager (IM) are together responsible for safe operation.
- In case of incidents and accidents, RUs and IMs shall evaluate, where appropriate with entities in charge of maintenance (ECM) and all other actors having a potential impact on the safe operation of the Union rail system, including manufacturers, maintenance suppliers, keepers, service providers, contracting entities, carriers, consignors, consignees, loaders, unloaders, fillers and unfillers if the risk requires measures immediately preventing any related danger and if yes, define and implement them.
- RUs, IMs and any other actor involved have to share relevant information (currently in Safety Alert IT (SAIT)) to allow other actors to react appropriately to ensure safety.

<sup>\*)</sup> DIRECTIVE (EU) 2016/798 (Railway Safety Directive), Article 4

## Part I, Chapter 1. : Explanation JNS JNS in the EU safety framework

### Roles of actors

Role of JNS procedures in the EU safety framework\*)

- After incidents and accidents the National Safety Authority (NSA) supervises stakeholder's immediate actions aiming at assessing whether the measures taken by the companies involved sufficiently prevent any related danger (at European level).
- If not, the NSA shall intervene respecting the responsibility of all actors. These immediate measures might increase costs for the sector and may harm interoperability
- NSAs have to share relevant information within the SIS system to allow other NSAs to react appropriately in order to ensure safety. This is usually done in the form of a **Safety Alert**

\*) DIRECTIVE (EU) 2016/798 (Railway Safety Directive), Article 4

# Part I, Chapter 1. : Explanation JNS JNS in the EU safety framework

## Roles of actors

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- In parallel the National Investigation Body (NIB) may run an independent investigation of the incident or accident with the objective to find the causes and to give recommendations to the different actors involved within one year<sup>\*)</sup>.
- In case of an incident or accident any entity (preferably the competent NSA) might notify a Joint Network Secretariat (JNS) urgent (fast track) or normal procedure by submitting a filled notification form [https://www.era.europa.eu/activities/joint-network-secretariat\\_en](https://www.era.europa.eu/activities/joint-network-secretariat_en) to ERA ([jns@era.europa.eu](mailto:jns@era.europa.eu)).

<sup>\*)</sup> DIRECTIVE (EU) 2016/798 (Railway Safety Directive), Articles 20 to 24

## JNS urgent (fast track) procedure

- **Objective:** recommendation of appropriate European-wide harmonised short-term risk control measures in order to :
  - ensure safety,
  - maintain or restore interoperability, and
  - reduce costs for the sector (as far as possible at this stage).
- **Result:**
  - replacement of the often costly and restrictive immediate measures of the actors and/or NSAs
- **Timeline:** maximum 2 months



## JNS normal procedure

- **Objective:** development of mid- and long term measures, to sustainably
  - restore / increase the safety level,
  - ensure interoperability, and
  - return to the previous cost base or lower.
- **Result:**
  - identification of research needs,
  - improvement of regulation, standardisation and other rules,
  - update of the measures from the Urgent Procedure
- **Timeline:** maximum 2 years

## Part I, Chapter 1. : Explanation JNS JNS in the EU safety framework

### JNS Panel and Task Force

- After submission of **the notification form** to ERA, the JNS Panel needs to endorse the proposed JNS procedure.
- The **JNS panel** consists of two NSA and two RB representatives
  - Michael SCHMITZ (NSA DE)
  - Benjamin STEINBACHER-PUSNJAK (NSA SI)
  - Enno WIEBE (CER)\*
  - Gilles PETERHANS (UIP)
- The networks of National Safety Authorities and Representative Bodies nominate **competent experts** for the respective **JNS Task Force**
- The **Agency is moderator/facilitator and secretariat**
- ERA strives for **consensus**.

\*) During the course of this Normal Procedure, Enno Wiebe changed to UNIFE

## Part I, Chapter 1. : Explanation JNS JNS in the EU safety framework

### Sharing of information

- Only nominated **Task Force members** should participate in the meetings.
- **Information shared** within the task force **remain within its members**
- **Documents are shared** on dedicated space on the Agency's Extranet.  
(only accessible to nominated experts)
- The **results** (e.g. action plan, conclusions, final report) will be published in an appropriate way agreed among the task force members and have the character of a recommendation

# Part I

## Chapter 2: background and risk to be tackled

### Content

Chapter 1 : explanation JNS

Chapter 2: background and risk to be tackled

Chapter 3: organization of work

## Part I, Chapter 2. : Background and risk to be tackled

### Background

May  
2017

July  
2017

August  
2017

December  
2019

November  
2023

July  
2024

JNS Urgent Procedure “Broken  
Wheels”

JNS Normal Procedure  
“Broken Wheels” <sup>1)</sup>

Continuation  
of  
analysis  
of cases

JNS Normal Procedure  
“Gotthard – Broken  
Wheels”

Collection of cases of broken wheels

Several cases of broken and cracked wheels **BA 314 / ZDB29** (with a slope under the wheel flange) and BA004 in some applications in the European rail freight business occurred



- Notification JNS UP by NSA IT

#### Outcome:

- Short term risk control measures

#### Risk to be treated:

Broken wheels

#### Outcomes<sup>1)</sup>:

- Long term risk control measures for wheel types BA 004 and BA 314/ZDB 29
- Proposal for amendments in standards and regulation
- Complementary investigation and activities

Accident in  
Gotthard tunnel  
on 10.08.2023



Notification of JNS NP by NSA CH.

#### Initial objective:

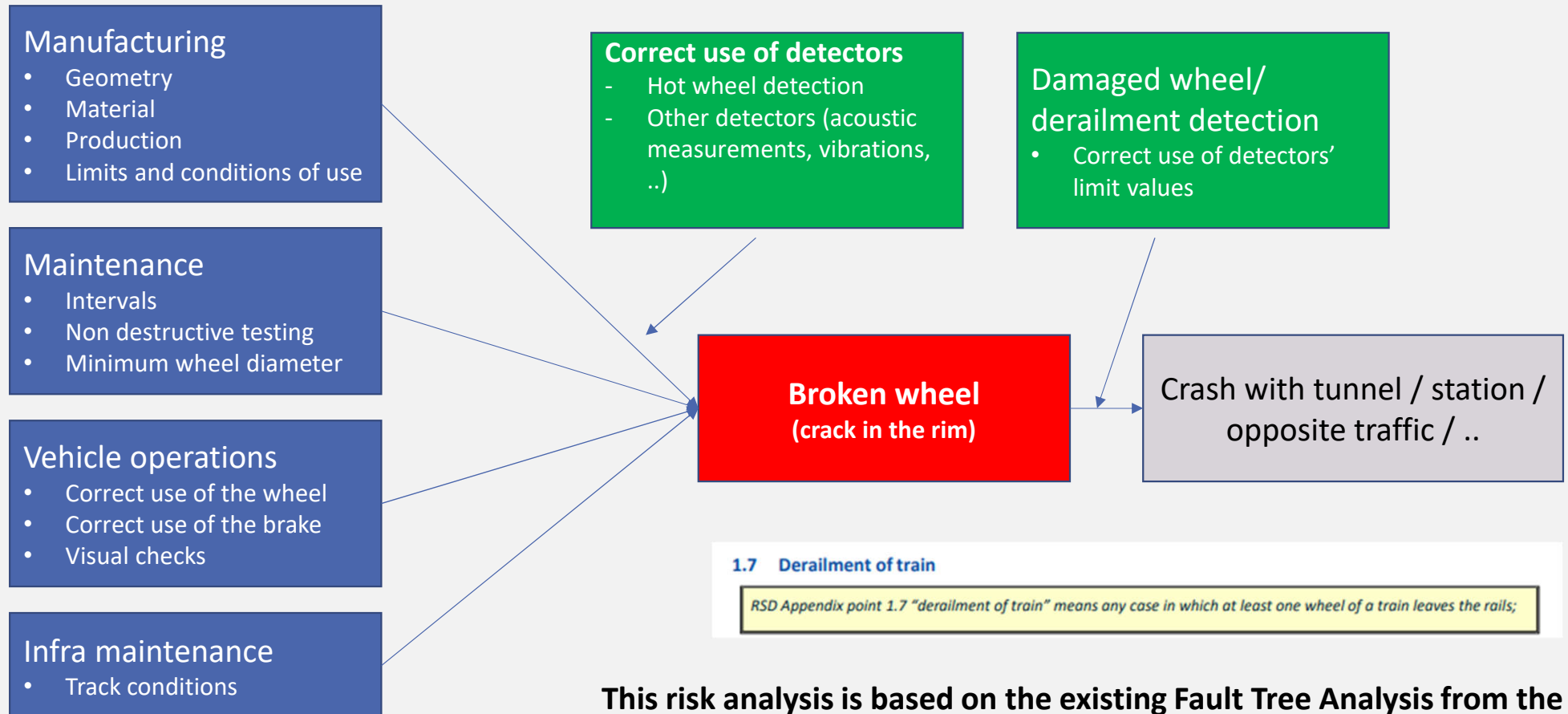
- Analyse whether the long-term mitigation measures identified for wheelsets of type BA 004 would be effective for wheels of wheelset BA 390 and **if they could be extended to other similar wheel types.**

In case these measures would not be sufficient, improvements of these measures will need to be identified

1) See report of JNS Urgent Procedure: [Short Term measures agreed und proposed by UIC, ERFA, UIP dated 13/07/2017 \(europa.eu\)](#)

## Part I, Chapter 2. : Background and risk to be tackled

### Risk to be tackled in the Normal Procedure



**This risk analysis is based on the existing Fault Tree Analysis from the JNS NP Broken Wheels 2017-2019 (for "crack in the rim" cases)**

# Part I

## Chapter 3: organization of work

### Content

Chapter 1 : explanation JNS

Chapter 2: background and risk to be tackled

Chapter 3: organization of work

# Part I, Chapter 3 : Organization of work Background

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- On 10 August 2023, a freight train derailed in the Gotthard base tunnel, caused by a broken wheel of type BA 390. The accident led to a damage of infrastructure and rolling stock amounting to around 150 Mio. CHF (ca. 160 Mio. €). For the repair works, one tube of the Gotthard base tunnel had to be closed for more than one year and subsequently the cross alpine traffic was tremendously disturbed;
- On 15 August 2023, the Swiss National Investigation Body (NIB CH)<sup>1)</sup>, announced to launch an investigation. The final report is expected by the end of 2024. In its intermediate report of 28 September 2023, the NIB CH provided details of the accident and made two safety recommendations:
  - 183. Extension of risk control measures identified in the JNS procedure on broken wheels of 2019 to the wheel type used in wheelsets BA 390.*
  - 184. Notification of a new JNS procedure.*
- Accordingly, NSA CH submitted a notification for a JNS Normal Procedure on 17 October 2023, which was subsequently approved by the JNS Panel on 24 October 2023;
- The NSA CH described the expected outcomes in its notification :
  - “Analyse whether the long-term mitigation measures identified by the JNS NP on broken wheels for wheelsets of type BA 004 would be effective for the wheel type of wheelset type BA 390 and if they could be extended to other similar wheel types.*
  - In case these measures would not be sufficient, improvements of these measures will need to be identified.”*

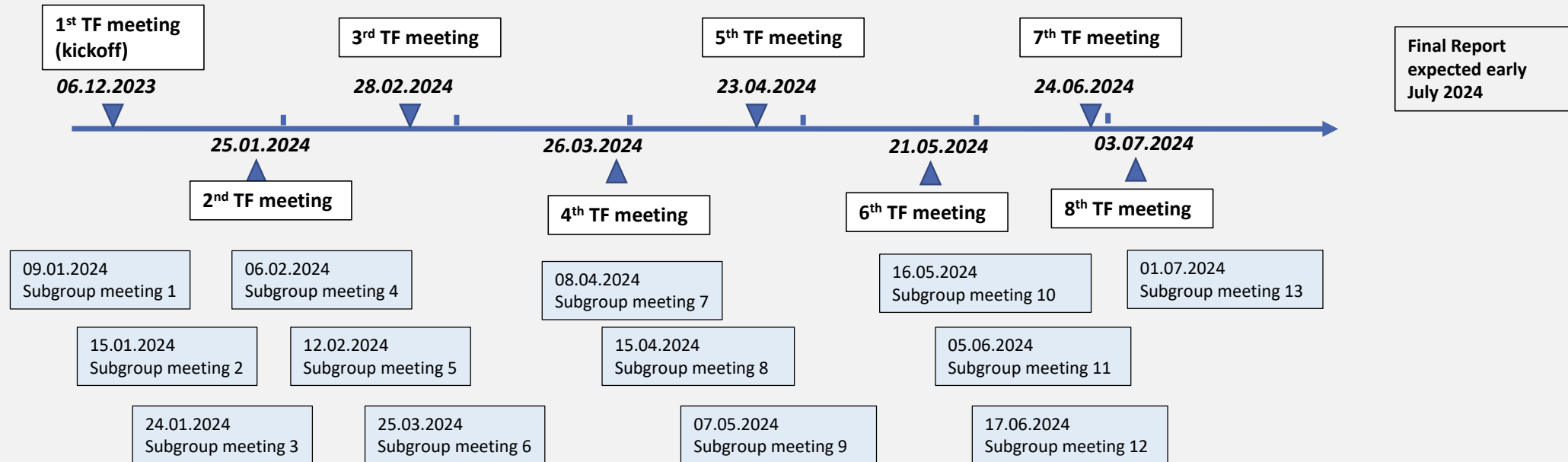
1) the Transport Safety Investigation Board (STSB)



## Part I, Chapter 3. : Organization of work Background

- A Task Force of experts nominated by the NSAs and the European Representative Bodies was assembled;
- In its kickoff meeting on 6 December 2023, the experts discussed the scope and objective of the new Normal Procedure and decided to regard it as a continuation of the previous JNS Normal Procedure on Broken Wheels which concluded its works in 2019 and which was focused among others on wheels of type BA 004 where cracks have been initiated in the rim;
- Similar to the “Joint Sector Group” that was created in the previous JNS Broken Wheels procedures, the Task Force members decided to create a Subgroup of experts that worked on the different tasks and reported in the meetings of the plenary Task Force. Contrary to the former Joint Sector Group, the new Subgroup included also representatives from the NSAs and the European Union Agency for Railways;
- Next slide shows an overview of the Task Force and Subgroup meetings held.

## Part I, Chapter 3. : Organization of work Overview of meetings



- 8 plenary Task Force meetings held
- 13 Subgroup meetings held
- + Further meetings on specific topics

# Part II

## Chapter 0: Summary and orientation

Chapter 0: summary and orientation

Chapter 1: risk control measures

1a: identification of comparable wheel types

1b: risk control measures 2024

Chapter 2: changes to legislation, standards and company rules

Chapter 3: related non-JNS analyses

Chapter 4: impact assessment

## Part II, chapter 0 : Summary and orientation

(1/4)

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- In the past years, events of broken tread braked wheels have occurred all over Europe. As a response, the experts of the JNS Urgent (2017) and Normal Procedure (2017 - 2019) on Broken Wheels identified risk control measures for the wheel type BA 004 (crack in the rim) and BA 314 old/ZDB29 (crack in the web);  
(see [https://www.era.europa.eu/domains/accident-incident/joint-network-secretariat-jns\\_en](https://www.era.europa.eu/domains/accident-incident/joint-network-secretariat-jns_en))
- After the conclusion of the Normal Procedure in 2019, the Task Force experts continued to analyse cases of broken wheels which occurred after 2019 and followed-up the implementation of the identified risk control measures and recommended changes to legislation, standardization and company rules;
- The experts of the new JNS Task Force analysed the accident in the Gotthard base tunnel based on
  - the intermediate report of the NIB CH of 28 September 2023;
  - the recurrent updates of the NIB CH's representative in the Task Force and Subgroup meetings;
  - The metallurgical investigation by QualiTech, initiated by NIB CH.
- Based on this, the experts confirmed that the risk to be treated is covered by the fault tree analysis of broken wheels with crack initiation in the rim, as undertaken during the previous JNS Normal Procedure (see **slide 14**).
- As in the Gotthard base tunnel accident, for the first time a wheel type other than BA 004 experienced crack initiation in the rim, questions arise if the risk control measures of 2019
  - shall be, next to the BA 390 (accident Gotthard), also extended to further wheel types comparable to BA 004, and
  - if these measures of 2019 control the risk sufficiently or need to improved;

## Part II, chapter 0 : Summary and orientation

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- The Task Force members developed an assessment scheme to identify wheel types comparable to BA 004 (see **slides 25-34**);
- In respect of the urgency, the Task Force applied this scheme to wheel types covering the vast majority of wheels currently in operation. In April 2024, the Task Force informed via SAIT and SIS about the intermediate results of this assessments. The three wheel types comparable to BA 004<sup>1)</sup> were :
  - BA 390 (involved in the accident in the Gotthard tunnel);
  - Db-004sa;
  - RI 025.

The Task Force also stressed to immediately apply the risk control measures from 2019 to these wheel types.

- Afterwards, the Task Force further developed the assessment scheme (see **slides 27 to 31**) and further analysed the effectiveness of the measures from 2019.
- At the end of the JNS normal procedure, the following five wheel types have been identified as comparable to BA 004<sup>1)</sup> (see **slides 32 to 34**):
  - BA 390 (involved in the accident in the Gotthard tunnel);
  - Db-004sa;
  - RI 025;
  - R 32;
  - BA 304.

1) Note: The wheel type BA 004 could also be used in some versions of wheelset type VRY.

- For all wheel types not covered by the assessment by the JNS Task Force (see **slide 33**), actors shall use the final assessment scheme to clarify if these wheel types are also comparable to BA 004.;
- The Task Force analysed the list of new cases that occurred after 2019 to evaluate whether the measures of 2019 control the risk sufficiently or need to be improved. As a result, it must be stated that in most of the cases, the risk control measures of 2019 have not been (fully) applied. Nevertheless, the Task Force identified improvements of these measures (see **slides 36-51**). Changes compared to the original measures are highlighted in yellow;
- **For all wheel types identified as comparable to BA 004, all actors involved shall either implement fully the improved JNS risk control measures (see slides 36-51) or, implement measures justified by a risk assessment that guarantee at least the same level of safety;**
- The improved risk control measures from the JNS NP 2024 replace entirely the risk control measures from the JNS NP 2017-2019 for BA 004 (“crack in the rim”). The measures for “crack in the web” (wheel types BA 314 old/ZDB29) remain valid;
- The Task Force members identified several changes to company rules and developed concrete proposals for the General Contract of Use for wagons (GCU) (see **slides 53-59**). Actors who are not members of the GCU shall translate this in their respective company rules;

1) Note: The wheel type BA004 could also be used in some versions of wheelset type VRV.

- The Task Force members agreed to summarize in the final report the outcome of a discussion on responsibilities in accordance with Article 4 of the Railway Safety Directive and the related liabilities after accidents and incidents (see **slide 60**). The Task Force members concerned are encouraged to follow up the outcome;
- The crack in the wheel involved in the accident in the Gotthard base tunnel was probably initiated by a thermal overload that occurred a long time before the accident. Therefore, the Task Force members ...
  - remind all actors concerned to consider the risk control measures aiming at reducing the number of fixed brakes and subsequently cases of thermal overload, as identified in the JNS Normal Procedure “Consequences of unintended brake applications with LL blocks” of March 2024 (see **slide 62**) ([https://www.era.europa.eu/system/files/202403/JNS%20NP%20LL%20brake%20blocks\\_Final%20report\\_v2.0.pdf](https://www.era.europa.eu/system/files/202403/JNS%20NP%20LL%20brake%20blocks_Final%20report_v2.0.pdf))
  - recommend to follow-up development in Project “Brake Blocks/Wheel Interaction” and the “UIC Project ‘NETWORK MONITOR’ that aims at harmonizing requirements for trackside detection systems (see **slide 62**);
- All actors are reminded to report new cases of broken wheels, independently of the wheel type involved, using the template available on the website of the European Union Agency for Railways ([www.era.europa.eu/jns](http://www.era.europa.eu/jns)).
- Finally, ERA, together with the Task Force members, developed a Light Impact Assessment. The outcomes of this JNS Normal Procedure will further reduce the probability of potentially tremendously costly accidents caused by broken wheels and therefore justify the additional costs (see **slide 64** and the full document on the ERA website [www.era.europa.eu/jns](http://www.era.europa.eu/jns)).

# Part II

## Chapter 1: Risk control measures

Chapter 0: summary and orientation

Chapter 1: risk control measures

1a: identification of comparable wheel types

1b: risk control measures 2024

Chapter 2: changes to legislation, standards and company rules

Chapter 3: related non-JNS analyses

Chapter 4: impact assessment





## Part II, chapter 1a : identification of comparable wheel types

### Reflections on identification of wheel types comparable to BA 004

A scientific justification on why crack initiation and propagation on BA 004 wheels is more frequent is not possible with the available knowledge and methods. There is no calculation model to predict the initiation and propagation of cracks in the wheel rim.

For this reason, the identification of wheel types comparable to BA 004 is carried out in a phenomenological way;

Due to the copyrights the wheel designs for tread braked wheels between the different designers vary widely;

The criteria selected to identify comparability are listed in the following slides. A distinction is made between the operational conditions of the specific application cases and the geometry of BA 004. Detailed weighting of the different criteria is not feasible;

The identification of wheel types comparable to BA 004 takes into account the findings from the JNS Broken Wheels normal procedure 2017 - 2019.

The wheel type BA 314 old / ZDB29, which had been subject to the JNS procedure 2017 - 2019 as well, does not need to be considered, as the cracks in these wheel types were initiated in the web (and not in the rim).

## Part II, chapter 1a : identification of comparable wheel types

### General criteria to identify wheel types comparable to BA 004

The thermally initiated cracks in the wheel rims occurred mainly on wheels of wheel type BA 004 in freight operation.

The following general criteria need to be fulfilled in order for a wheel type to be considered for the assessment scheme if it is comparable to BA 004:

- **100 % tread braked freight application with cast iron or composite brake blocks;**

Reason:

- Cracked rim was thermally initiated and happened with all types of brake blocks.

- **Nominal wheel diameter 920 mm;**

Reasons:

- BA 004 has only this nominal wheel diameter.
- The vast majority of the other wheel types used in tread braked freight application also have this nominal wheel diameter.
- In wheels with lower nominal wheel diameter, the reduced distance between hub and rim results in different radii of the web contour.
- In wheel types with a smaller nominal wheel diameter than 920 mm, there is no negative service experience

- **Wheel material R7 or ER7:**

Reason:

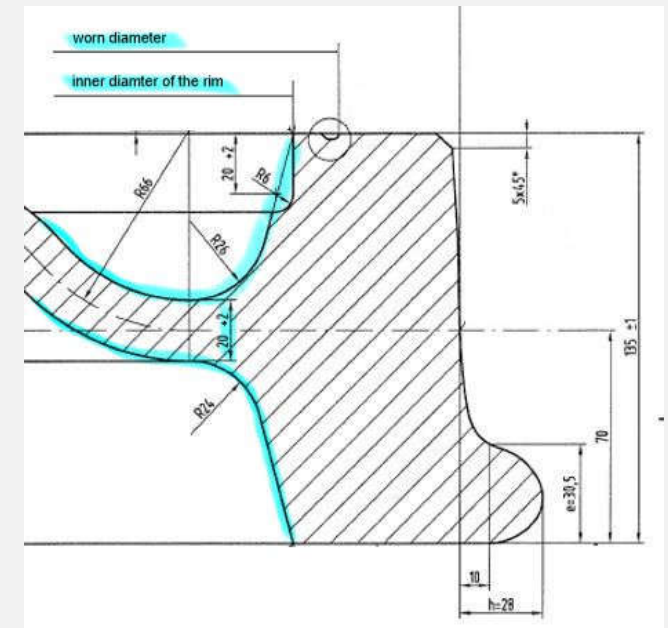
- These wheel materials are most common in freight operation. The cases occurred with wheels made of these two materials.
- Remark: In case of the application of other wheel materials (e.g. with higher carbon content compared to R7 or ER7) this has to be taken into account in a general risk assessment by the actors (e.g., ECM with support by designers and manufacturers).

In the next slides, the specific criteria to assess whether a wheel type is comparable to wheel type BA 004 are explained.

## Part II, chapter 1a : identification of comparable wheel types

### Specific criteria to identify wheel types comparable to BA 004 (1/3)

Criteria	Reason and justification
design of the contour of the wheel web in the transition from rim to web	cracks in the wheel rims occurred on BA 004 , Special design features of wheel BA 004 (combination of this features)
1. Radii in the transition between rim and web	<ul style="list-style-type: none"> <li>• Slim radii like BA 004, no fixed threshold</li> </ul>
2. Position of the web in the middle of rim	<ul style="list-style-type: none"> <li>• Design feature of BA 004</li> </ul>
3. Nominal thickness of the web near the rim = 20 mm	<ul style="list-style-type: none"> <li>• Larger thickness can improve the mechanical and thermomechanical behavior</li> <li>• Other wheel designs with slim thickness show not bad service experience</li> </ul>



## Part II, chapter 1a : identification of comparable wheel types

### Specific criteria to identify wheel types comparable to BA 004 (2/3)

Criteria	Reason and justification
4. Relevant in combination with geometry comparable to BA 004: wheels with geometry of the rim with residual rim thickness in worn conditions acc. EN13979-1 Criteria: 0,23 dm <sup>2</sup>	Low values identified as relevant for wheels BA 004 for application with higher probability for the development of thermally initiated defects  Other wheel designs with low residual rim thickness show not bad service experience.

## Part II, chapter 1a : identification of comparable wheel types

### Specific criteria to identify wheel types comparable to BA 004 (3/3)

Criteria	Reason and justification
5. Axle load $\geq 22,5t$	See below

#### Criteria axle load: Lower axleload $\rightarrow$ lower thermal input:

In EN 13 979-1, the braking power is specified as a function of the wheel diameter for reasons of simplification. The maximum value is specified for each diameter step.

Technically, it differs depending on the axle load, as shown in the original UIC 510-5:2003:

Diameter range in mm	1000 - 920 and 920 - 840	840 - 760	760 - 680
<b>Axleload</b> (indicative)	22,5 t	20 t	18 t
<b>Power<sup>a</sup></b> (equivalent to $1,2 P_a$ )	50 kW	42,5 kW	38 kW
<b>Application time</b>	45 min	45 min	45 min
<b>Running speed</b>	60 km/h	60 km/h	60 km/h

The reduced input of braking energy/ brake power occurs not only during long drag braking, but also in the service braking range.

## Part II, chapter 1a : identification of comparable wheel types

### Assessment scheme

Criteria and value		Value/ evaluation	result
design of the contour of the wheel web in the transition rim – web like BA 004	Position of the web in the middle of rim	yes	relevant
	Radii in the transition between rim and web	yes	relevant
	Nominal thickness of the web near the rim = 20 mm	20 mm	relevant
residual rim thickness in acc. prEN13979-1: < 0,23 dm <sup>2</sup>		0,2025 dm <sup>2</sup>	relevant
Axle load ≥ 22,5t		22,5 t	relevant

### Example for the individual assessment of wheel designs:

- If all the results are “relevant”, the wheel type is comparable to BA 004.
- If one result is “not relevant”, the wheel type is not comparable to BA 004 but included in a similar family.

Based on the result of the comparison the introduction of the JNS measures is not necessary for these wheel types.

## Part II, chapter 1a : identification of comparable wheel types

### Identification of wheel types comparable to BA 004 (1/3)

- In the European freight sector, many wheel designs are used. The European maintenance guideline (EMG) from the Verband der Privatwagen Interessenten (VPI) provides a good overview;
- The table in the next slide includes the analysis based on the assessment scheme (see slide 31) of the wheel types known to the Task Force experts:
  - Wheel types from the VPI EMG 04 – 04.02
  - Additional wheel types with information from the original designer and the JNS TF members
- The table contains also wheel types with a low residual rim thickness. These wheel types have a different rim and web design compared to BA 004 without negative service experience. Therefore, they are not considered as comparable.

**The assessment in accordance with the assessment scheme (see slide 31) of wheel types not included in this table shall be done by actors (e.g. ECM with support by designers and manufacturers).**



# Part II, chapter 1a : identification of comparable wheel types

## Identification of wheel types comparable to BA 004 (2/3)

Wheel types already assessed by the JNS Task Force

Nr. from VPI EMG	additional wheel type from JNS analysis	wheel type	2	nominal wheel diameter [mm]	outer diameter of the wear groove [mm]	inner diameter of the rim - outer side of the wheel [mm]	inner diameter of the rim - inner side of the wheel [mm]	axle load in the wheelset [t]	web thickness near the rim [mm]	residual rim area (like definition in prEN13979-1:2022) [dm <sup>2</sup> ]	residual rim area (like definition in prEN13979-1:2022, but considering clamping side inner rim diameter only) [dm <sup>2</sup> ]	web geometric comparable to BA 004 (yes/no)	Decision JNS - relevant (yes/no)	Detailed analysis in JNS backup presentati	Remark
1		002	Fwg 665.0.02.001007	920	854	820	N/A	22,5	20	N/A	0,23	no	no	-	
2		004	2Fwg 302.0.02.001007	920	840	810	810	22,5	20	0,20	0,20	Reference	Reference	-	
9		102	Fw 0600.02.00105.67	920	840	810	N/A	22,5	19	N/A	0,20	no	no	-	
14		302	Fwg 665.0.02.003.302	920	880	820	N/A	22,5	22	N/A	0,41	no	no	-	
15		303	2Fwg 302.0.02.003.303	920	840	796	800	25	20	0,28	0,30	yes	no	yes	
16		304	3Fwg 302.0.02.003.304	920	854	810	810	25	20	0,30	0,30	yes	yes	yes	taken in account because similar to BA 390
17		306	2Fwg 000.0.02.003.013	920	840	775	775	22,5	22	0,44	0,44	no	no	-	
18		307	2Fwg 000.0.02.003.014	920	840	775	775	25	22	0,44	0,44	no	no	-	
	x	309	21724.01	920	840	780	775	25	25	0,42	0,41	yes	no	yes	
	x	310	21724.00	920	840	780	775	25	25	0,42	0,41	yes	no	yes	
	x	313		920	840	800	800	25	17	0,27	0,27	yes	no	yes	DB Number, manufacturer CAF
19		313	455.0.2.5.000.36	920	840	800	800	25	20	0,27	0,27	partially	no	yes	VPI Number, manufacturer Bonatrans, Bona 313
20		314	2Fwg 000.0.02.003.002	920	840	805	810,5	25	20	0,22	0,24	no	no	-	Crack in the web case - old JNS: evolution of ZDB 29, underestimated rim thickness by special connection between rim and web
21		315	2Fwg 000.0.02.003.001	920	840	800	N/A	25	22	N/A	0,27	no	no	-	
22		318	455.0.2.5.000.07	920	840	800	800	22,5	22	0,27	0,27	no	no	-	
	x	319		920	840	800	800	25	22	0,27	0,27	no	no	-	
23		324	2Fwg 000.0.02.003.003	920	840	805	810,5	22,5	20	0,22	0,24	no	no	-	Crack in the web case - old JNS: evolution of ZDB 29, underestimated rim thickness by special connection between rim and web
24		325	2Fwg 000.0.02.003.004	920	854	820	820	22,5	17	0,23	0,23	no	no	-	
29		428	455.0.2.5.000.07	920	854	820	N/A	22,5	22	N/A	0,23	no	no	-	
30		706	X.03.00706	920	840	800	800	25	17	0,27	0,27	partially	no	yes	
32		ESFA	455.0.2.5.000.41	920	840	800	800	25	20	0,27	0,27	partially	no	yes	same like ZDB 34
34		RI 027	21738.00	920	840	780	775	25	25	0,42	0,41	partially	no	yes	
35		VRY	038-0.022/00020445-02.11	920	854	820	N/A	22,5	22	N/A	0,23	no	no	-	
36		VRY	-0.023/00022325-02.11	920	840	810	N/A	22,5	20	N/A	0,20	yes	yes	see BA 004	
39		RI 025	2106156	920	840	810	N/A	25	20	N/A	0,20	yes	yes	yes	
41		803	X094400-1+01	920	854	820	N/A	22,5	22	N/A	0,23	no	no	-	ORE Standard wheel
46		9054	0.4005.784 Rep. 1	920	850	N/A	N/A	22,5	N/A	N/A	N/A	overview drawing	depends from wheel	yes	4 wheel designs
47		9054B	0.40 R.802	920	850	820	820	22,5	17	0,20	0,20	overview drawing	no	yes	4 wheel designs
	x	9054B CAF		920	850	820	820	22,5	17	0,20	0,20	partially	no	yes	
50		9071	70761	920	830	800	800	25	17	0,20	0,20	overview drawing	depends from wheel	yes	3 wheel types
	x	9071 CAF		920	830	800	800	25	17	0,20	0,20	no	no	yes	Wheel from CAF
51		9074B	0.40 P.647	920	830	800	800	22,5	17	0,20	0,20	overview drawing	depends from wheel	yes	3 wheel types
	x	9074B CAF		920	830	800	800	22,5	17	0,20	0,20	no	no	yes	Wheel from CAF
59		B46UR/m	03.023	920	854	820	820	22,5	22	0,23	0,23	no	no	-	
61		SURA25	100000179	920	840	775	775	25	22	0,44	0,44	no	no	-	
62		LF26	1000001E.0	920	840	785	785	25	19	0,37	0,37	no	no	-	
63		ZDB29	455.0.2.5.000.03	920	840	810	845	25	20	0,08	0,20	no	no	-	not relevant, old JNS Crack in the web case
64		ZB34	455.0.2.5.000.41	920	840	800	800	25	20	0,27	0,27	partially	no	yes	same like ZDB 34
	x	390	2106128	920	840	810	N/A	22,5	20	N/A	0,20	yes	yes	yes	
	x	VALD25+	VD0277	920	830	782	784	25	16	0,32	0,32	no	no	-	
	x	ULT25	KP-0050-16 /CV	920	840	790	790	25	31,6 (20)	0,34	0,34	partially	no	yes	
	x	ULT23	KP-0050-16 /CV	920	840	790	790	22,5	31,6 (20)	0,34	0,34	partially	no	yes	
	x	LITheS CAF		920	840	783	783	25	16	0,38	0,38	no	no	yes	
	x	RI 028	21740.00	920	840	796	808	25	21	0,26	0,30	partially	no	yes	
	x	Db-004sa	2106143	920	840	810	810	22,5	20	0,20	0,20	Reference	Reference	yes	
	x	Db-10sa		920	854	open	open	22,5	open	N/A	N/A	overview drawing	depends from wheel	yes	
	x	Db-10sa	RM 41100.5512	920	854	800	800	22,5	25	0,36	0,36	partially	no	yes	Wheel from RAFIL/ BVV
	x	Db-10sa		920	852	820	825	22,5	22	0,20	0,22	no	no	yes	Wheel from Bonatrans
	x	Db-10	ZFW 41100.525.2	920	854	820	820	22,5	22	0,23	0,23	no	no	-	ORE Standard wheel
	x	RI 101		920	840	796	800	22,5	20	0,28	0,30	yes	no	yes	same like BA 303
	x	R32	A68.0A.Z0.07.02b	920	840	810	810	22,50	20	0,2025	0,2025	yes	yes	yes	

## Part II, chapter 1a : identification of comparable wheel types

### Identification of wheel types comparable to BA 004 (3/3)

The following wheel types were identified by the JNS Task Force as comparable to BA 004<sup>1)</sup>:

- Db-004sa
- BA 390
- RI 025
- R32<sup>2)</sup>
- BA 304<sup>2)</sup>

The risk control measures of this JNS Normal Procedure (see Part II, Chapter 1b) are valid for these wheel types.

1) Note: The wheel type BA 004 could also be used in some versions of wheelset type VRV.

2) These wheel types were identified as comparable to BA 004 after the SAIT / SIS information of April 2024 has been published.

# Part II

## Chapter 1: Risk control measures

Chapter 0: summary and orientation

Chapter 1: risk control measures

1a: identification of comparable wheel types

1b: risk control measures 2024

Chapter 2: changes to legislation, standards and company rules

Chapter 3: related non-JNS analyses

Chapter 4: impact assessment

## Part II, chapter 1b : Risk control measures 2024

Applicable to wheel types BA 004 and comparable (1/

### Measures for ECM, RUs, NSAs and ECM-Certification Bodies

The measures replace entirely the measures from the JNS NP “Broken wheels” from 2019 ‘ for BA 004 (crack in the rim). Amendments are highlighted in yellow.

Result	<ul style="list-style-type: none"> <li>Apply the risk control measures of the JNS Normal procedure “Accident Gotthard base tunnel – broken wheels” for the following wheel types:             <ul style="list-style-type: none"> <li>BA 004 (also used in some versions of wheelset type VRV)</li> <li>Db-004sa</li> <li>BA 390</li> <li>RI 025</li> <li>R32</li> <li>BA 304</li> <li>Other comparable wheel types, which were not part of the JNS NP assessment (see slide 32)</li> </ul> </li> <li>These wheel types are in the context of the JNS results not longer considered as a thermostable wheel.</li> </ul>
Motivation/ reason	<ul style="list-style-type: none"> <li>reduce thermal overload of the wheels</li> </ul>
Proposed place/ way for implementation	<ul style="list-style-type: none"> <li>Application of the JNS results</li> </ul>
To be applied by	<ul style="list-style-type: none"> <li>ECM, RUs, NSAs and ECM-Certification Bodies</li> </ul>

Amendments to the JNS measures from 2019 highlighted in yellow

# Part II, chapter 1b : Risk control measures 2024

Applicable to wheel types BA 004 and comparable

## New measure: general requirements – ECM

Measure	Analysis affected ECM and affected application
To be applied by	ECM
Scope	<ul style="list-style-type: none"> <li>BA 004 and comparable (assessed by JNS TF: Db-004sa, BA 304, BA 390, RI 025, R32) and possible other wheel types comparable to BA 004</li> </ul>
Measure	<ul style="list-style-type: none"> <li>Check if the wheel types BA 004 and comparable (assessed by JNS TF: Db-004sa, BA 304, BA 390, RI 025, R32) are used. If yes, apply the JNS NP risk control measures 2024 or alternative measures which achieve at least the same level of safety.</li> <li>Check if other wheel types not yet assessed by the JNS TF (see slide 33) are used. If yes, apply the assessment scheme (see Part II, chapter 1a) to them. If other wheel types are identified as comparable to BA 004, apply the JNS NP risk control measures 2024 or alternative measures which achieve at least the same level of safety.</li> <li>Check if the identified wheel types are used within an affected application. If yes, apply the JNS NP recommendation on the minimum wheel diameter of slide 40.</li> </ul> <p>In case</p> <ul style="list-style-type: none"> <li>alternative measures which achieve at least the same level of safety are applied</li> <li>and for the assessment “affected application” (see slide 44)</li> </ul> <p>undertake a risk assessment in accordance with the process described in Annex I of (EU) 402/2013 CSM REA (Risk Evaluation and Assessment).</p>
Status 06/2024	<ul style="list-style-type: none"> <li>new</li> </ul>

# Part II, chapter 1b : Risk control measures 2024

## Applicable to wheel types BA 004 and comparable

### Operation and wagon maintenance

Measure	Visual inspection of the wheels before departure	Inspection of the wheels during change of brake blocks (in and outside of workshops)	
<b>To be applied by</b>	All RUs	All affected ECMs in case of order repairs	In case of GCU repairs: RUs
<b>Scope</b>	<ul style="list-style-type: none"> <li>Tread braked wagons</li> <li>all wheel types (even wheels with white stripe)</li> <li>limited to visible parts of the wheel</li> </ul>	<ul style="list-style-type: none"> <li>Tread braked wagons</li> <li>wheel type BA 004 and comparable</li> <li>limited to visible parts of the wheel</li> </ul>	<ul style="list-style-type: none"> <li>Tread braked wagons</li> <li>Wheels without white stripes</li> <li>limited to visible parts of the wheel</li> </ul>
<b>Criteria</b>	Visual inspection: <ul style="list-style-type: none"> <li>single cracks on the wheel tread*</li> <li>Cracks in rim and web (Annex GCU Appendix 9 and slide 48, 49)</li> <li>any indication of thermal overload of the wheel (Annex Appendix 9 GCU)**</li> <li>Check release of the handbrake</li> <li>Adapted requirements for thermal overload due to braking (size of paint burns and measuring or diagnostic devices – see slide 57)</li> </ul>	Visual inspection: <ul style="list-style-type: none"> <li>single cracks on the wheel tread*</li> <li>Cracks in rim and web (Annex GCU Appendix 9 and slide 48, 49)</li> <li>any indication of thermal overload of the wheel**</li> <li>Sound checks of the wheel in case of no full visibility of the wheel tread and rim***</li> <li>Optional: White stripe suppression (depending on environmental conditions)</li> </ul>	Visual inspection: <ul style="list-style-type: none"> <li>single cracks on the wheel tread*</li> <li>Cracks in rim and web (Annex GCU Appendix 9 and slide 48, 49)</li> <li>any indication of thermal overload of the wheel**</li> <li>Adapted requirements for thermal overload due to braking (size of paint burns and measuring or diagnostic devices)</li> </ul>
<b>Measures on findings:</b>	<ul style="list-style-type: none"> <li>dispatch wagon to workshop</li> <li>Off vehicle wheelset maintenance (ECM)</li> </ul>	<ul style="list-style-type: none"> <li>dispatch wagon to workshop</li> <li>Off vehicle wheelset maintenance (ECM)</li> </ul>	<ul style="list-style-type: none"> <li>dispatch wagon to workshop</li> <li>Off vehicle wheelset maintenance (ECM)</li> </ul>
<b>Status 06/24</b>	<ul style="list-style-type: none"> <li>Already implemented in GCU for all brake block types - only reminder</li> <li>New: see proposal amendment GCU (see slides 53 to 59)</li> </ul>	<ul style="list-style-type: none"> <li>Individual implemented for BA 004</li> <li>Open for comparable wheel types</li> <li>New: see proposal amendment GCU (see slides 53 to 59)</li> </ul>	<ul style="list-style-type: none"> <li>Amendment from 2019 implemented in GCU</li> <li>New: see proposal amendment GCU (see slides 53 to 59)</li> </ul>

Amendments to the JNS measures from 2019 highlighted in yellow

\* single cracks on the wheel tread ("isolated transverse cracking" cf. EN 15313 §C.2.6 and 6.2.3.4) – Criteria: see slide 45 to 47 and GCU Appendix 9, 1.3.6.4

\*\* any indication of thermal overload of the wheel (burnt paint, excessive wheel deformation, cf. EN 15313 §C.3.2.2 and 6.2.4.3) – Criteria: see slides 57

\*\*\* sound test (hammer test): see slides 50, 51

# Part II, chapter 1b : Risk control measures 2024

Applicable to wheel types BA 004 and comparable

## Operation and wagon maintenance

Measure	Information to the Workshops	Visual inspection of the wheels in workshops (complementary to <b>European Visual Inspection Catalogue</b> – EVIC, <b>see GCU Appendix 10, Annex 3</b> )	
<b>To be applied by</b>	All affected ECM	In case of GCU repairs: All ECM and RU	In case of ordered repairs: All affected ECM
<b>Scope</b>	<ul style="list-style-type: none"> <li>Information to the Workshops on ECM's instructions</li> <li>wheel design BA 314 / ZDB29 (with a slope under the wheel flange) and BA004 and comparable</li> </ul>	<ul style="list-style-type: none"> <li>wheel BA 314 / ZDB29 (with a slope under the wheel flange) and BA004 and comparable</li> <li>In case the concerned wheel types cannot be clearly identified - Systematic for all wheel types</li> <li>If wheel design clearly identified is not BA 004 and comparable, BA 314/ZDB 29 (with a slope under the wheel flange); no specific measures are needed</li> </ul>	<ul style="list-style-type: none"> <li>wheel BA 314 / ZDB29 (with a slope under the wheel flange) and BA004 and comparable</li> </ul>
<b>Criteria</b>	<ul style="list-style-type: none"> <li>Order visual inspection during change of brake blocks</li> <li>White stripe suppression</li> <li>Implement measures in "off vehicle Wheelset maintenance"</li> <li>Individual relevant measures (e.g. maintenance plan, equipment, mileage)</li> </ul>	Visual inspection: <ul style="list-style-type: none"> <li>single cracks on the wheel tread*</li> <li>Cracks in rim and web (GCU Appendix 10, 1.14 and slide 48, 49)</li> <li>any indication of thermal overload of the wheel**</li> </ul>	Visual inspection: <ul style="list-style-type: none"> <li>single cracks on the wheel tread*</li> <li>Cracks in rim and web (GCU Appendix 10, 1.14 and slide 48, 49)</li> <li>any indication of thermal overload of the wheel**</li> <li><b>White stripe suppression</b></li> </ul>
<b>Measures on findings:</b>	<ul style="list-style-type: none"> <li>E.g. Maintenance plan review, braking equipment adaptation <b>(ECM)</b></li> </ul>	<ul style="list-style-type: none"> <li>Off vehicle wheelset maintenance <b>(ECM)</b></li> </ul>	<ul style="list-style-type: none"> <li>Off vehicle wheelset maintenance <b>(ECM)</b></li> </ul>
<b>Status 06/2024</b>	<ul style="list-style-type: none"> <li>Individual implemented for BA 004</li> <li>Open for comparable wheel types</li> </ul>	<ul style="list-style-type: none"> <li>Individual implemented for BA 004</li> <li>Open for comparable wheel types</li> </ul>	<ul style="list-style-type: none"> <li>Individual implemented for BA 004</li> <li>Open for comparable wheel types</li> </ul>

Amendments to the JNS measures from 2019 highlighted in yellow)

\* single cracks on the wheel tread ("isolated transverse cracking" cf. EN 15313 §C.2.6 and 6.2.3.4) – Criteria: see slide 45 to 47 and GCU Appendix 10, 1.6.1

\*\* any indication of thermal overload of the wheel (burnt paint, excessive wheel deformation, cf. EN 15313 §C.3.2.2 and 6.2.4.3) – Criteria: see slides 57

## Part II, chapter 1b : Risk control measures 2024

Applicable to wheel types BA 004 and comparable

### Off vehicle maintenance

Measure	Elimination of the identification for thermostable wheels	Intensified measures after findings in operation and wagon maintenance	Stronger criteria for residual stress measurements	Wheel diameter recommendation
<b>To be applied by</b>	All affected ECM	All affected ECM	All affected ECM	All affected ECM
<b>Scope</b>	<ul style="list-style-type: none"> <li>BA 004 and comparable</li> </ul>	<ul style="list-style-type: none"> <li>BA 004 and comparable</li> </ul>	<ul style="list-style-type: none"> <li>BA 004 and comparable</li> </ul>	<ul style="list-style-type: none"> <li>BA 004 and comparable</li> <li>in affected application (see slide 44)</li> </ul>
<b>Measure (see also boundary conditions)</b>	<ul style="list-style-type: none"> <li>remove white stripe marking on bearing box cover</li> </ul>	<ul style="list-style-type: none"> <li>Measures after thermal overload:               <ul style="list-style-type: none"> <li>Residual stress measurement*</li> <li>Measurement back to back distance between the wheels</li> <li>Reprofiling</li> <li>NDT of the tread*</li> </ul> </li> </ul> <p>*alternative: systematic reprofiling of large depth in diameter and visual inspection of the tread according to service experience</p>	<ul style="list-style-type: none"> <li>First check and after signs of thermal overload</li> <li>Generally reduced limit 300 MPa instead of 400 MPa</li> </ul>	<p>Wheel Diameter recommendation:</p> <ul style="list-style-type: none"> <li>In service limit <math>\geq 860-864</math> mm</li> </ul> <p>Tasks of the ECMs:</p> <ul style="list-style-type: none"> <li>Decide on a suitable minimum wheel diameter for last reprofiling. (The JNS TF considers a minimum wheel diameter after the last reprofiling of 880 mm sufficient **).</li> <li>Inform the workshop about the chosen minimum wheel diameter for the last reprofiling and the wagons concerned.</li> </ul>
<b>Status 06/2024</b>	<ul style="list-style-type: none"> <li>Already applicable BA 004 and complemented 2024</li> <li>Extended to wheel types comparable to BA 004</li> </ul>			

\*\* In case a lower minimum wheel diameter than 880mm should be used for the last reprofiling, the (EU) 402/2013 CSM REA shall be applied, considering this a significant change.



## Part II, chapter 1b : Risk control measures 2024

Applicable to wheel types BA 004 and comparable

### New measure : general requirements in operation, wagon and wheelset maintenance

Measure	Application of general wheelset maintenance requirements
To be applied by	All affected RUs and ECMs
Scope	<ul style="list-style-type: none"> <li>BA 004 and comparable</li> </ul>
Measure	<ul style="list-style-type: none"> <li>The general wagon and wheelset maintenance requirements in accordance with GCU Appendix 9 and 10 must be applied, e.g.               <ul style="list-style-type: none"> <li>Handling of Brake block protruding (Appendix 9, 3.2.3)</li> <li>Wheel profile (Appendix 9, 1.4.x)</li> </ul> </li> </ul>
Status 06/2024	<ul style="list-style-type: none"> <li>reminder</li> </ul>

## Part II, chapter 1b : Risk control measures 2024

Applicable to wheel types BA 004 and comparable

### New measure : general requirements – ECM-Certification Bodies or NSA

Measure	Supervision
To be applied by	ECM-Certification Bodies or NSA
Scope	<ul style="list-style-type: none"> <li>BA 004 and comparable (assessed by the JNS TF: Db-004sa, BA 304, BA 390, RI 025, R32) and possible other wheel types comparable to BA 004</li> </ul>
Measure	<ul style="list-style-type: none"> <li>The correct application of the JNS NP risk control measures 2024 respectively the achievement of at least the same level of safety in case of alternative measures by the railway undertakings and ECMs must be supervised by the ECM-certification bodies or the National Safety Authorities (NSA).</li> <li>During supervision special attention must be drawn to:             <ul style="list-style-type: none"> <li>correct implementation of the JNS NP risk control measures 2024,</li> <li>the risk assessment in accordance with the process described in Annex I of (EU) 402/2013 CSM REA (Risk Evaluation and Assessment), if required, and</li> <li>the monitoring of the risk control measures in accordance with (EU) 1078/2012 CSM MON (Monitoring).</li> </ul> </li> </ul>
Status 06/2024	<ul style="list-style-type: none"> <li>new</li> </ul>

## Part II, chapter 1b : Risk control measures 2024

Applicable to wheel types BA 004 and comparable

### Definition of affected ECM

#### Affected ECM – BA 004 and comparable

~~ECMs which use the defined wheel types and may be faced with similar defects (broken wheels and cracks in rim and web) which have to be checked by every ECM under its own responsibility based on a documented risk analysis.~~

ECMs which use the wheel types BA 004 and wheel types identified as comparable to BA004 shall apply either the JNS NP risk control measures 2024 or alternative measures achieving at least the same level of safety.  
In case of alternative measures, at least the same level of safety shall be demonstrated by undertaking a risk assessment in accordance with the process described in Annex I of (EU) 402/2013 CSM REA (Risk Evaluation and Assessment).

## Part II, chapter 1b : Risk control measures 2024

### Definition of affected application

#### Affected application for BA 004 and comparable

The analyse has demonstrated, that in some applications the probability for the development of thermally initiated defects is higher. These includes several of the following conditions

The analysis by the JNS TF has shown, that the following conditions are particularly relevant for the probability of the occurrence of thermally initiated defects :

#### Wagon type / configuration

- Type of traffic (combined traffic ~~or not~~)
- brake input (high ~~or not~~).

High: brake regime "ss" or with brake weight per axle calculated > 15,25t (according to UIC 544-1 6<sup>th</sup> Edition)

- Brake blocks (composite ~~or not~~)
- wheel diameter (below 864 mm ~~or not~~)

#### Operational conditions – predominant use in

- Alp crossing ~~or not~~
- Northern countries ~~or not~~

#### Special waggon design

- articulated waggon – middle bogie ~~or not~~

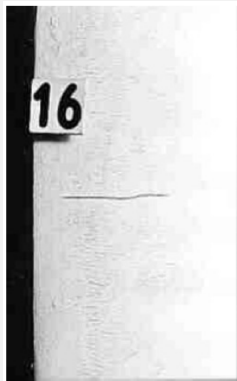
**By combination** of these conditions and with an increase of the number of conditions the probability of defects increase. ~~This has to be checked by every ECM under its own responsibility integrated in the documented risk analysis.~~ The analysis of the affected application shall be demonstrated by undertaking a risk assessment in accordance with the process described in Annex I of (EU) 402/2013 CSM REA (Risk Evaluation and Assessment).

## Part II, chapter 1b : Risk control measures 2024

Reference “single cracks on the wheel tread” (1/3)

### Reference “single cracks on the wheel tread”

**Description:** The tread exhibits cracks at an angle of approximately 90° to the circumference of the wheel and have a typical length of 30mm or more. Transverse cracks generally develop at the surface in either straight or slightly crooked lines and can penetrate radially (usually of thermal origin in these cases) or branch out in a circumferential direction (usually of mechanical origin in this case). They occur individually and can be distributed at several points around the circumference. [EN 15313, §C.2.6 ]



Transverse crack revealed by magnetic particle testing [EN 15313, §C.2.6 ]



Example for single cracks on the wheel tread by visual inspection

# Part II, chapter 1b : Risk control measures 2024

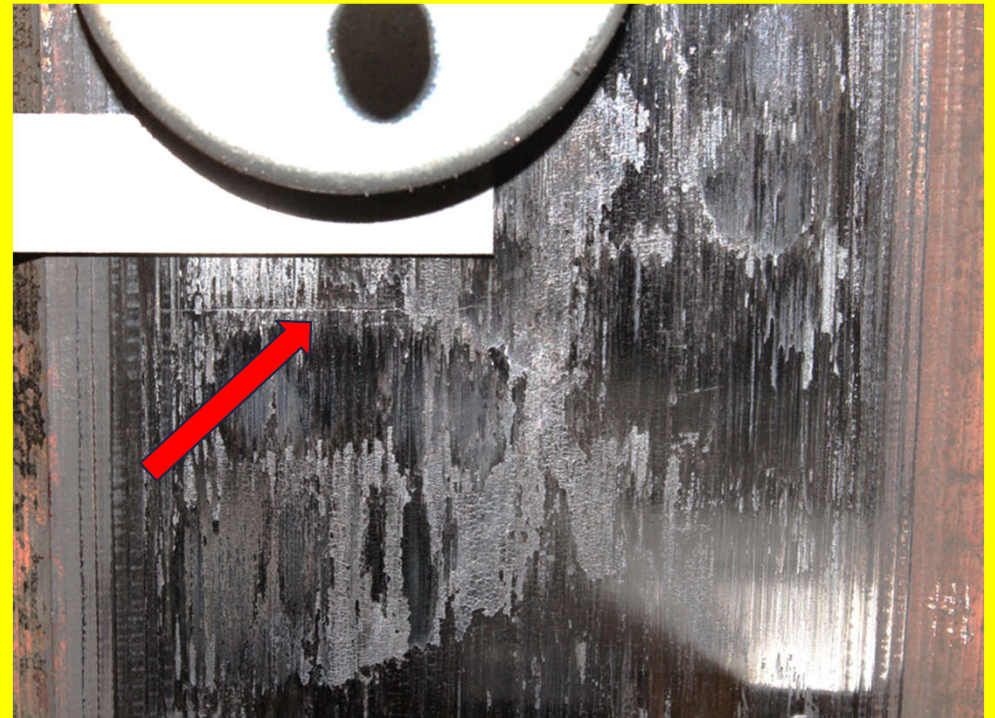
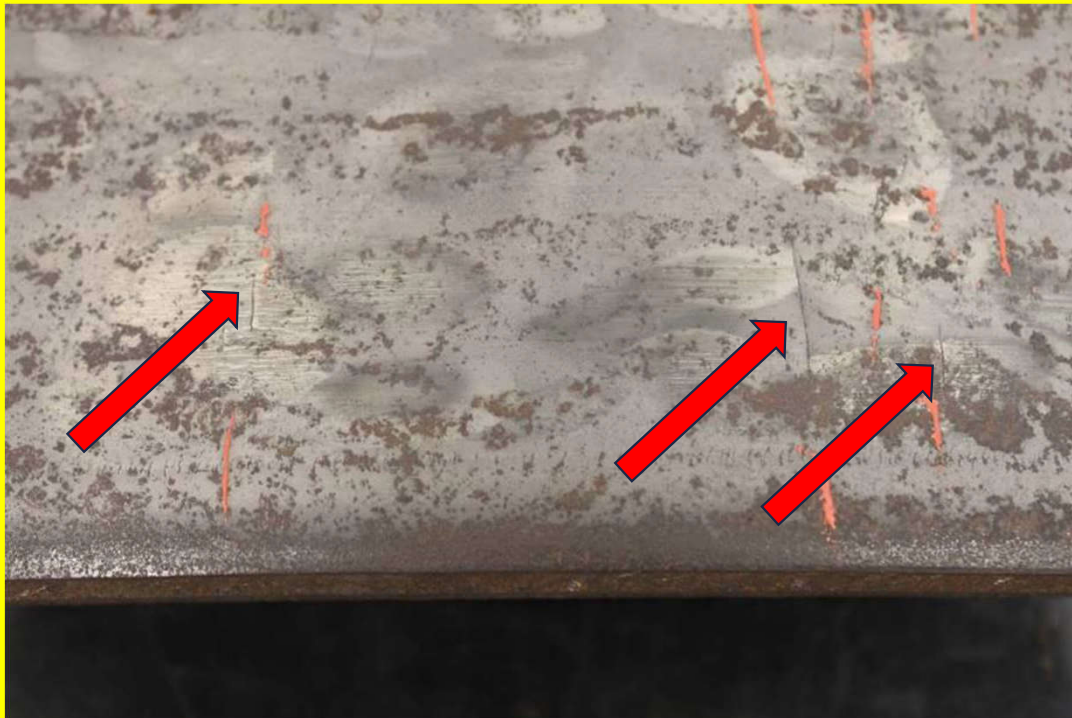
Reference "single cracks on the wheel tread" (2/3)



Amendments to the JNS measures from 2019 highlighted in yellow

## Part II, chapter 1b : Risk control measures 2024

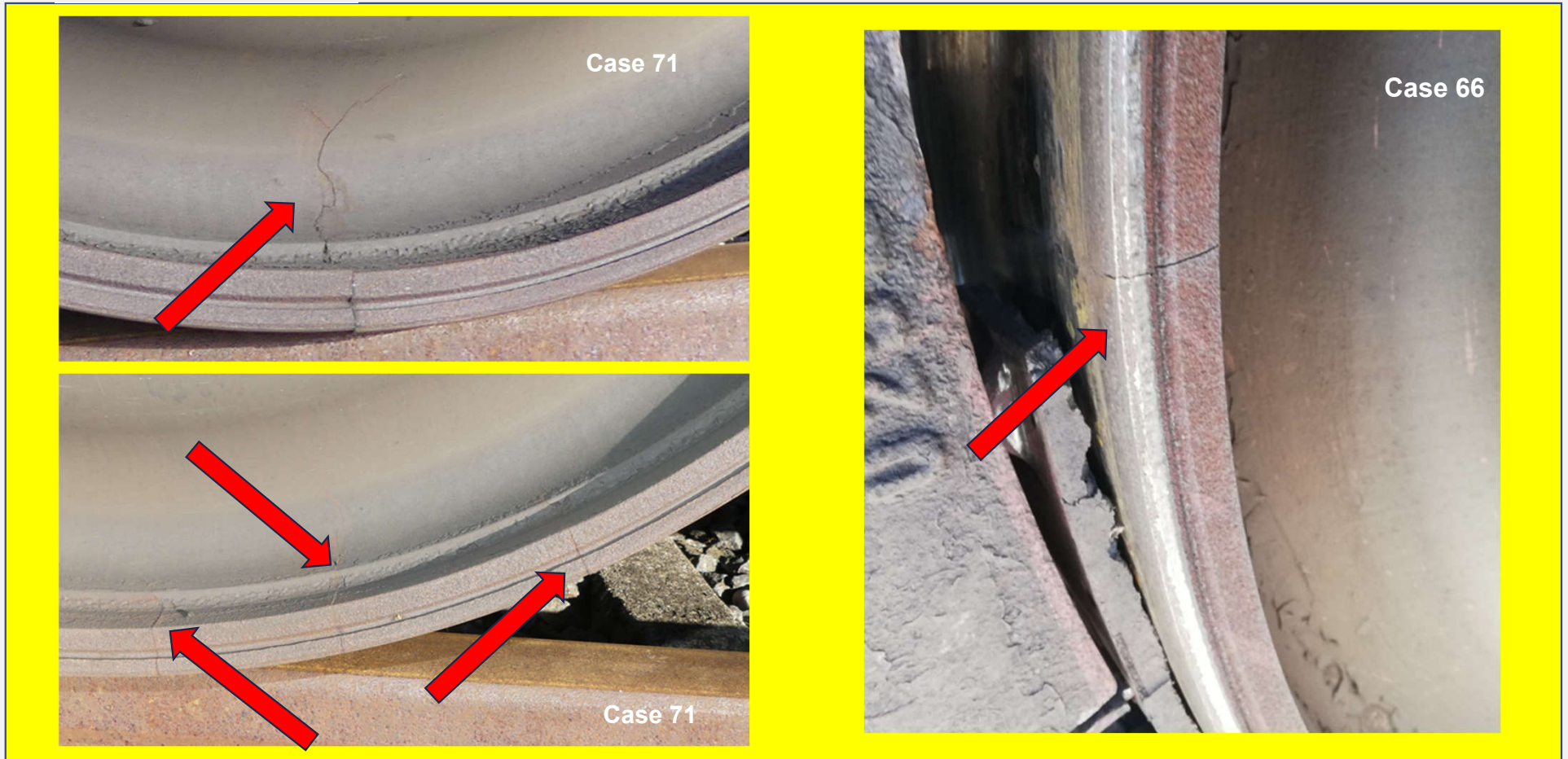
Reference “single cracks on the wheel tread” (3/3)



Amendments to the JNS measures from 2019 highlighted in yellow

# Part II, chapter 1b : Risk control measures 2024

Reference "cracked rim/web" (1/2)

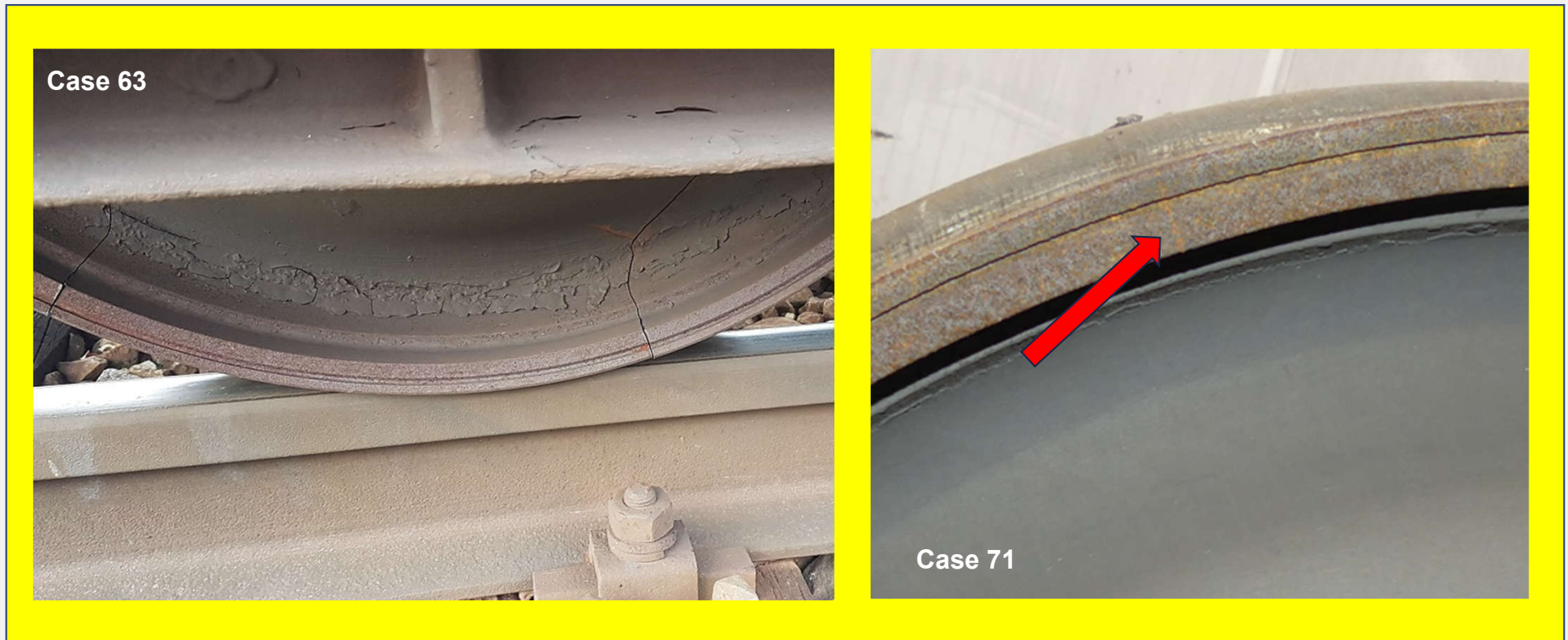


Amendments to the JNS measures from 2019 highlighted in yellow



## Part II, chapter 1b : Risk control measures 2024

Reference "cracked rim/web" (2/2)



## Part II, chapter 1b : Risk control measures 2024

### Sound-test (hammer test) of the wheels (1/2)

#### Wheels with cracks from the rim to the web

- A wheel with cracks from the rim to the web can be detected by sound-test independently from the position of the cracks over the circumference. The wheel responds with a thud-like sound.
- Defects on the tread (without cracks propagated to the web) can't be detected.
- Uncracked wheels respond with a ringing sound independently from the wheel type (web shape) and wheel diameter.

#### Preconditions for the sound test

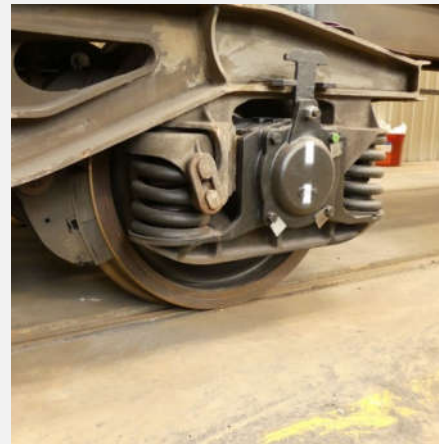
- The test should be done between 2 and 5 or 7 and 11o' clock around the circumference.
- The test can be done on the tread or the outer sides of the rim.
- **Brake shall be released.**
- The test can be done with a regular hammer with short handle or with a special hammer with long handle by the waggon inspector. For ergonomically reasons a long handle is recommended.

## Part II, chapter 1b : Risk control measures 2024

### Sound-test (hammer test) of the wheels (2/2)

#### Misleading test results

- The test on the 12 o'clock position (upper position of the wheel) sounds always thud/ damped.
- Wheelsets with applied brake blocks or not fully released brake blocks sound also thud/ damped. In this case the full release of the brake blocks has to be checked.
- In case of a thud / damped sounding wheel it is necessary to inspect the whole wheel more carefully.



#### Conclusion

The sound-test can be adapted in special cases as additional method to detect a cracked rim and broken wheels.

# Part II

## Chapter 2: Changes to legislation, standards and company rules

Chapter 0: summary and orientation

Chapter 1: risk control measures

1a: identification of comparable wheel types

1b: risk control measures 2024

Chapter 2: changes to legislation, standards and company rules

Chapter 3: related non-JNS analyses

Chapter 4: impact assessment

## Part II, chapter 2 : Changes to legislation, standards, company rules

### Proposal for GCU amendments - Introduction

- The following slides aim at incorporating the improved JNS risk control measures in the General Contract of Use (GCU);
- The proposed changes refer to GCU 2024. The proposed amendments are highlight in yellow (see slides 57 to 59);
- These proposed changes are addressed to the GCU Joint Committee, to be taken into account as soon as possible;
- Actors who are not members of the GCU shall also incorporate the improved JNS risk control measures or alternative measures, justified by a risk assessment, that guarantee at least the same level of safety, in their respective company rules;

## Part II, chapter 2 : Changes to legislation, standards, company rules

### Proposal for GCU amendments – explanation (1/3)

#### GCU: Signs of thermal overload

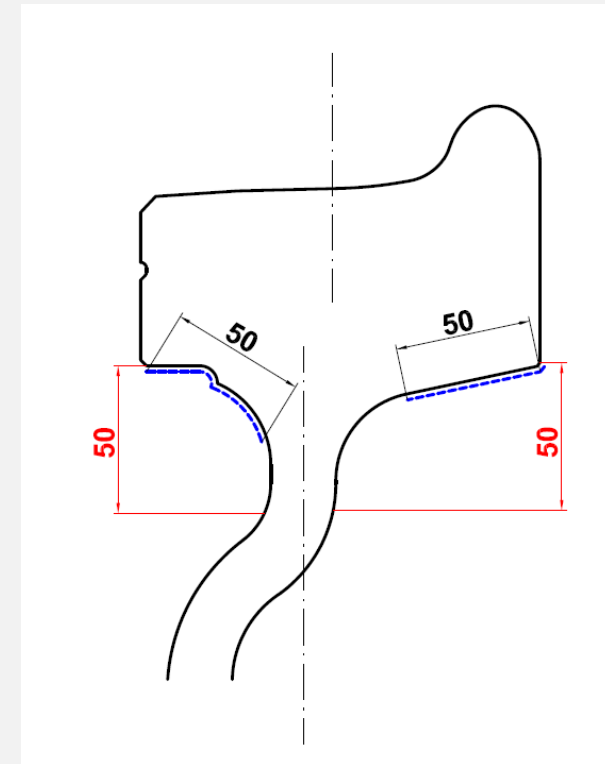
In the GCU, Appendix 9, Annex 1 the size of burned paint is defined with “50 mm or more”. Different interpretations are possible.

- **Definition 1:** Measurement along the contour of the wheel web, starting from the outer/inner lower edge of the wheel rim into the wheel web (see blue marking, greater than or equal to 50 mm) = close to the contour
- **Definition 2:** Vertical distance from the outer/inner lower edge of the wheel rim (see dimensioning greater than or equal to 50 mm) = vertical distance

**Recommendation:** Apply definition 1 or adapted proposal and prepare proposal for GCU amendment

Possible solutions and content of the analysis:

- reduce the red length from 50 to e.g. 25 mm => *comparison of the radial length for existing wheels*
- Better radial direction as near the contour, because different wheel designs
- Or use only “marked bunt paint” like JNS proposal 2019



## Part II, chapter 2 : Changes to legislation, standards, company rules

### Proposal for GCU amendments – explanation (2/3)

#### GCU: Signs of thermal overload

##### Reason for the need of an amendment:

- Clear definition necessary
- For traces of rust exists no length definition
- In line with the findings in the list of cases (e.g. case 67 - Denmark)
- No reliable relationship between size of the paint burn and the level of residual stress in the rim. However, solid wheels exhibiting marked paint burn also exhibit high residual stresses in the rim [ORE B169 RP 5]
- Temperature in the intersection rim – wheel web depends on the wheel type, diameter and thickness of the rim, brake application => different definitions of the size of burnt paint not practical applicable

Thermally overloaded wheelsets with burnt paint shall receive the appropriate maintenance measures when removed, regardless of the size of the burnt paint.

##### 1.3 Observations regarding the method

The stress measurements taken in the rim of solid wheels and the classification of the size of the paint burn have shown, however, that there is **no reliable relationship between the size of the paint burn and the level of residual stresses in the rim**. However, **solid wheels exhibiting marked paint burn, also exhibit high residual tensile stresses<sup>1)</sup> in the rim** (see Appendix A, Figs 1, 2, and 3 in this connection). It is possible that thin rims or rims which have been worn down to the limit will exhibit clearly visibly paint burn<sup>1)</sup> on account of their greater flexibility and deflection and because of the more rapid heat transmission and lower heat-absorption capacity in the rim; but all the same the residual tensile stresses are relatively low.

In order to enable a reliable conclusion to be drawn in all cases concerning the stress condition, it is advisable to check the stresses using a non-destructive method.

[ORE B169 RP 5, Standardization of wheelsets, Methods of monitoring solid wheelsets]

## Part II, chapter 2 : Changes to legislation, standards, company rules

### Proposal for GCU amendments – explanation (3/3)

#### GCU: Actions after detection of thermal overload by track side detection systems

- Actions after detection of thermal overload by track side detection systems are not integrated in the GCU 2024
- Proposal: Add in GCU a similar requirement like for axle box in 1.8.3.2

GENERAL CONTRACT OF USE FOR WAGONS APPENDIX 9, ANNEX 1

Component	Code no.	Irregularities/Criteria/Notes	Action to be taken	Irregularity class
Solid wheel	1.2			
	1.2.1	Groove marking the minimum thickness is no longer fully visible in cross-section <sup>2</sup>	Detach wagon	4
	1.2.2	<b>Thermal</b> overload due to braking <ul style="list-style-type: none"> <li>• obviously recent paint burns of 50 mm or more at connection between rim and wheel plate (cracks or shelling on paint)</li> <li>• traces of rust on rim (plate not painted)</li> <li>• fusion of brake blocks</li> <li>• deterioration of wheel tread with build-up of metal (see also no. 1.3.4)</li> <li>• Uneven blueish appearance on rim due to the effect of <b>thermal</b> overload</li> </ul>	Proceed in accordance with Annex 8, point 4	
	1.2.2.1	–without gauge widening of the inner faces	K + R1 (isolate brake)	4

Hard manganese wear plate on axle box of Y bogie or derivative designs		• traces of rust		
	1.8.3.2 <sup>4</sup>	Confirmation by the RU of box overheating during transport	Detach wagon	5
	1.8.4	Displaced or missing	Detach wagon	4

<sup>4</sup> Hot box: Observation by automatic detection – Observation outside the scope of TI by special inspection.



## Part II, chapter 2 : Changes to legislation, standards, company rules

### Proposal for GCU amendments – changes (1/3)

Proposal for Appendix 9, Annex 1: Technical Conditions for Wagon Transfers between Railway Undertakings

In the GCU the possibilities to detect thermal overloaded wheels with Hot Wheel Detection Systems are not mentioned and the definition of signs of thermal overload needs to be improved.

#### GCU 2024

1.2.2	<p>Thermal overload due to braking</p> <ul style="list-style-type: none"> <li>• obviously recent paint burns of 50 mm or more at connection between rim and wheel plate (cracks or shelling on paint)</li> <li>• traces of rust on rim (plate not painted)</li> <li>• fusion of brake blocks</li> <li>• deterioration of wheel tread with build-up of metal (see also no. 1.3.4)</li> <li>• Uneven blueish appearance on rim due to the effect of thermal overload</li> </ul>	Proceed in accordance with Annex 8, point 4	
1.2.2.1	– without gauge widening of the inner faces	K + R1 (isolate brake)	4
1.2.2.2	– with gauge widening of the inner faces	Detach wagon	5

Amendments to the GCU 2024 highlighted in yellow

#### Proposal for GCU amendments

1.2.2:

Thermal overload due to braking

- ~~obviously recent~~ burned paint (cracks or shelling on paint) or no paint or corrosion (trace of rust) ~~burns~~ of more than approximately 25 mm, radial from the rim at the edge between rim and wheel web plate ~~(cracks or shelling on paint)~~
- ~~traces of rust at connection between rim and wheel web (plate not painted)~~
- fusion of brake blocks
- deterioration of wheel tread with build-up of metal (see also no. 1.3.4)
- Uneven blueish appearance on rim due to the effect of thermal overload
- measuring or diagnostic devices (e.g Hot Wheel Detection System)

## Part II, chapter 2 : Changes to legislation, standards, company rules

### Proposal for GCU amendments – changes (2/3)

#### Proposal for Appendix 9, Annex 1: Technical Conditions for Wagon Transfers between Railway Undertakings

Cracked or broken wheel rims are not explicitly listed in the GCU. We therefore propose the inclusion of a separate damage code comparable to Appendix 9, Annex 1, 1.1.6 for tyred wheels.

#### GCU 2024

Component	Code no.	Irregularities/Criteria/Notes	Action to be taken	Irregularity class
Solid wheel	1.2			
	1.2.1	Groove marking the minimum thickness is no longer fully visible in cross-section <sup>2</sup>	Detach wagon	4
	1.2.2	Thermal overload due to braking <ul style="list-style-type: none"> <li>obviously recent paint burns of 50 mm or more at connection between rim and wheel plate (cracks or shelling on paint)</li> <li>traces of rust on rim (plate not painted)</li> <li>fusion of brake blocks</li> <li>deterioration of wheel tread with build-up of metal (see also no. 1.3.4)</li> <li>Uneven blueish appearance on rim due to the effect of thermal overload</li> </ul>	Proceed in accordance with Annex 8, point 4	
	1.2.2.1	– without gauge widening of the inner faces	K + R1 (isolate brake)	4
	1.2.2.2	– with gauge widening of the inner faces	Detach wagon	5

Amendments to the GCU 2024 highlighted in yellow

#### Proposal for amendment GCU

Add new after 1.2.2:  
Damage to the rim

Component	Code No.	Irregularities/Criteria/Notes	Action to be taken	Irregularity class
Solid wheel	1.2.3	Damage to the rim or web: <ul style="list-style-type: none"> <li>cracked</li> <li>broken</li> </ul>	Detach wagon	5

The JNS slides 48 and 49 contains representative examples and can be included in the GCU.

## Part II, chapter 2 : Changes to legislation, standards, company rules

### Proposal for GCU amendments – changes (3/3)

#### Proposal for Appendix 10, Annex 1: MINIMUM CONDITION AND MEASURES TO RESTORE FITNESS TO RUN OF WAGONS

Cracked or broken wheel rims are not explicitly listed in the GCU. We therefore propose the inclusion of a separate damage code comparable to Appendix 9, Annex 1, 1.1.6 for tyred wheels.

#### GCU 2024

#### Proposal for amendment GCU

GENERAL CONTRACT OF USE FOR WAGONS

APPENDIX 10

- 1.10.2 The tyre must show no signs of sideways movement (a tyre can only move sideways if the tyre clip is missing or has become loose, broken or clearly deformed),
- 1.10.3 The tyre clip must not be cracked. When the tyre clip is held in place with a wedge, the wedge must not be missing,
- 1.10.4 Tyres must not be cracked or fissured in the transverse or longitudinal directions.
- 1.11 The wheel hub must not be cracked.
- 1.12 The rim of a spoked wheel must not be broken across.
- 1.13 None of the spokes of a wheel may be broken or cracked.
- 1.14 A solid or monobloc wheel must not show:
- any defects repaired by welding and
  - any cracks.
- Minor defects in the wheel body resulting from the casting process are acceptable.

#### Add in 1.14

A solid or monobloc wheel must not show:

- any defects repaired by welding and
- any cracks (e.g. cracked rim or web).

*The JNS slides 48 and 49 contains representative examples and can be included in the GCU.*

Amendments to the GCU 2024 highlighted in yellow

## Part II, chapter 2 : Changes to legislation, standards, company rules Responsibilities and related liability of the actors

### Outcome of a discussion in the JNS Task Force

#### Current situation:

The accident in the Gotthard tunnel in August 2023 resulted in an enormous damage to infrastructure and rolling stock and has caused severe operating restrictions on the important transit line between North and South Europe over a period of more than one year. The accident was caused by a broken wheel which was probably triggered by a thermal overload several months before the accident.

In the current claims settlement, the responsibility lies probably with the Railway Undertaking of the accident journey, despite the fact that the defined JNS risk control measures are supposed to be applied by many other actors:

- Other Railway Undertakings;
- ECMs;
- NSAs and ECM Certification Bodies;
- Infrastructure Managers.

#### Recommendations:

- Representative Bodies or EU member states resp. EFTA member states should initiate a discussion to clarify responsibilities and liability of the different actors, in particular the Entity in Charge of Maintenance, with the European commission;
- Representative Bodies should consider to notify a JNS procedure to give guidance to railway undertakings regarding the correct involvement of third parties, in particular Entities in Charge of Maintenance, in their operational activities. Subsequently, the need for modifications to the legal framework shall be analysed and proposals for improvement shall be formulated, if any.

# Part II

## Chapter 3: Related non-JNS analyses

### Content

Chapter 0: summary and orientation

Chapter 1: risk control measures

Chapter 2: changes to legislation and company rules

Chapter 3: related non-JNS analyses

Chapter 4: impact assessment

## Part II, chapter 3 : Related non-JNS analyses

### JNS Normal Procedure “Consequences of unintended brake ...”, Sector projects

The crack(s) in the wheel involved in the accident in the Gotthard base tunnel was probably initiated by a thermal overload that occurred a long time before the accident. Therefore, the Task Force members recommend..

- The concerned actors to implement the risk control measures aiming at reducing the number of fixed brakes and subsequently cases of thermal overload, as identified in the already concluded JNS Normal Procedure “Consequences of unintended brake applications with LL blocks” of March 2024 ([https://www.era.europa.eu/system/files/2024-03/JNS%20NP%20LL%20brake%20blocks\\_Final%20report\\_v2.0.pdf](https://www.era.europa.eu/system/files/2024-03/JNS%20NP%20LL%20brake%20blocks_Final%20report_v2.0.pdf));
- That the Task Force members closely follow the Sector Project “Brake Blocks/Wheel Interaction” and in case the outcome has an impact on the risk control measures, a new JNS procedure shall be notified;
- That the Task Force members closely follow the UIC Project ‘NETWORK MONITOR’ that addresses track side Hot Axle Box Detection Systems and Hot Wheel Detection Systems and in case the outcome has an impact on the risk control measures, a new JNS procedure shall be notified.

# Part II

## Chapter 4: Impact assessment

### Content

Chapter 0: summary and orientation

Chapter 1: risk control measures

Chapter 2: changes to legislation and company rules

Chapter 3: related non-JNS analyses

Chapter 4: impact assessment

## Part II, chapter 4 : Impact Assessment

### Light Impact Assessment

- Agency has 3 types of IA outputs:
  - for this procedure, a LIA was selected (similar to the 2024 JNS “Consequences of unintended brake applications with LL blocks”)
- Options:
  - Option 0: outcome of the JNS NP “Broken Wheels” of 2019
  - Option 1: outcome of the current JNS NP procedure “Accident Gotthard base tunnel - broken wheels” of 2024
- Main findings:
  - Option 1 is preferred to Option 0.
  - Questionnaire with 10 answers from TF members confirmed to some extent cost figures from 2019 JNS NP although some cost increases could materialize.
  - Follow-up monitoring (similar to the consideration of 2024 JNS NP “Consequences of unintended brake applications with LL blocks”) could be relevant to analyse the implementation and JNS risk control measures and their effectiveness.



**END OF REPORT**