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## *Operations and traffic management system TSI*

### *Acceptable means of compliance on checks and tests before departure, including brakes and checks during operation*

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The present document is a non-legally binding opinion of the European Union Agency for Railways. The purpose of this document is to define ways of establishing compliance with the essential requirements of the relevant EU legislation. It is without prejudice to the decision-making processes foreseen by the applicable EU legislation. Furthermore, a binding interpretation of EU law is the sole competence of the Court of Justice of the European Union.

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#### *Document History*

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# Part 1

## 1.1. Introduction

RUs and IMs shall manage their operations and the traffic among others in accordance with the TSI OPE.

According to Article 2(33) of the Directive on the interoperability of the rail system within the European Union (Directive (EU) 2016/797, as amended), Acceptable Means of Compliance (AMOCs) are “*non-binding opinions issued by the Agency to define ways of establishing compliance with the essential requirements*”. Therefore, AMOCs define good practices also by referring to available standards, which the actors of the railway sector can use in their safety management system as evidence that their operational procedures comply with high-level requirements set out in EU legislation (in this case the TSI OPE and the Common Safety Method on requirements for safety management systems – CSM on SMS (Commission delegated Regulation (EU) 2018/762).

## 1.2. Legal basis

The basis for the development of AMOCs is the TSI OPE, and more precisely section 4.4.3 which requires the Agency to define AMOCs by means of technical opinions<sup>1</sup> on a number of topics. These are:

1. Safety of load
2. Checks and tests before departure, including brakes and checks during operation
3. Safety of Passengers
4. Train departure
5. Degraded operation.

This AMOC covers the topic “checks and tests before train departure, including brakes and checks during operation”.

The AMOC itself constitutes a non-legally binding opinion and its use is strictly voluntary.

## 1.3. Concept

As a general concept, the RUs/IMs are responsible to manage their specific operational and traffic management requirements in their SMS.

Article 4(1) (d) of the Railway Safety Directive (Directive (EU) 2016/798) states as follows:

*“With the aim of developing and improving railway safety, Member States, within the limits of their competences shall:*

*d) ensure that the responsibility for the safe operation of the Union rail system and the control of risks associated with it is laid upon the infrastructure managers and railway undertakings, each for its part of the system, obliging them to:*

*(i) implement necessary risk control measures as referred to in point (a) of Article 6(1), where appropriate in cooperation with each other;*

*(ii) apply Union and national rules;*

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<sup>1</sup> In accordance with Article 10 of Regulation (EU) 2016/796.

*(iii) establish safety management systems in accordance with this Directive”.*

Article 4(3) (a) and (b) of the Railway Safety Directive states as follows:

*“Railway undertakings and infrastructure managers shall:*

- a) implement the necessary risk control measures referred to in point (a) of Article 6(1), where appropriate in cooperation with each other and with other actors;*
- b) take account in their safety management systems of the risks associated with the activities of other actors and third parties;”*

The same concept has been detailed in the CSM on SMS, ANNEX I Point 3.1.1.1 (for RUs) and ANNEX II point 3.1.1.1 (for IMs):

According to these provisions, the organisation shall:

- a) identify and analyse all operational, organisational and technical risks relevant to the type, extent and area of operations carried out by the organisation. Such risks shall include those arising from human and organisational factors such as workload, job design, fatigue or suitability of procedures, and the activities of other interested parties (see Annex I, Section 1. Context of the organisation);
- b) evaluate the risks referred to in point (a) by applying appropriate risk assessment methods;
- c) develop and put in place safety measures, with identification of associated responsibilities (see Annex I, Section 2.3. Organisational roles, responsibilities, accountabilities and authorities);
- d) develop a system to monitor the effectiveness of safety measures (see Annex I, Section 6.1. Monitoring);
- e) recognise the need to collaborate with other interested parties (such as railway undertakings, infrastructure managers, manufacturer, maintenance supplier, entity in charge of maintenance, railway vehicle keeper, service provider and procurement entity), where appropriate, on shared risks and the putting in place of adequate safety measures;
- f) communicate risks to staff and involved external parties (see Annex I, Section 4.4. Information and communication).

Therefore, it is the responsibility of RUs and the IMs to identify, assess, eventually mitigate, monitor and review continually their own operational risks.

Based on that, the AMOC is a proposed way addressed to the RUs to demonstrate compliance with the TSI OPE as a mean to manage operational risks, taking into account that the provisions of the TSI OPE cover the entire operational and traffic management subsystem, whilst every single RU or IM manages only part(s) of the subsystem.

The RUs should in compliance with the EU and national legal requirements define their operational context and consequently they should identify the risks occurring in their activities. Then, on a voluntary basis, they are free to assess and decide for themselves whether an AMOC is applicable to the part of the subsystem they are supposed to manage. An AMOC could be entirely or partially applicable to the RUs operational context, for example an RU could be involved in the freight transport, but without the transport of dangerous goods, whilst an AMOC could deal with both.

If an RU evaluates this AMOC as applicable to the operational context and decides to use this AMOC, the RU should assess the risks the AMOC could cover within the operational activities to be performed. For example, initially and according to the applicable legislation, risks relating to inadequate tests and checks should be identified and mitigated – then the relevant part of the good practice in the AMOCs should be crossed

referenced with the risk in the RUs' risk assessment processes. This should regularly be kept up to date as part of the monitoring activities for their operations.

As AMOCs are non-binding opinions issued by the Agency to define ways of establishing compliance with the essential requirements, the RUs are free to decide whether to apply the AMOC/part of the AMOC, or not. Nevertheless, the RUs are responsible for managing their operational risks.

AMOCs should be accepted throughout the EU by Member States and National Safety Authorities as examples of good practice.

According to TSI OPE point 4.4.2 and Appendix I, national rules<sup>2</sup> on the defined AMOC topics are generally not permitted. Therefore, if a Member State (MS) and/or a NSA/ or any other entity requires a RU or IM to comply with additional national requirements, then that MS or NSA or the other entity will have to provide, in line with Article 8 of Railway Safety Directive, evidence as to why their national requirements provide a higher degree of risk control than that set out in the AMOC. However, AMOCs are not national rules and if a RU decides not to apply the AMOC and develop their own processes, it may do this and does not have to prove that its processes are as good or better than the good practice set out in the AMOC and it should ensure that its processes are adequate in controlling/mitigating the risks that it has identified.

As a result, the substantiated use of this AMOC can be taken into consideration by the Agency or the NSAs when a RU applies for a safety certificate or authorisation, when the certification body assesses compliance of the applicant with the requirements of the CSM on SMS and the TSI OPE.

The certification body will check the sufficiency of the RUs' processes in controlling the risks and will check how the AMOC is used, if it is the case, by reviewing the risk assessment process of the RU to ensure that the AMOC good practice has been identified as a relevant control measure for the identified risk.

#### 1.4. Responsibility

Each RU remain responsible for how the AMOC is used in their SMS. They should ensure that they can identify which risks the AMOC provides controls against. The AMOC should not just be included in the SMS without the RU and justifying its use through their risk management procedures and their document management system.

Each RU should perform analysis to understand which part of the AMOC is applicable to their operational context and, by the mean of a risk analysis, they are responsible for defining how to integrate the AMOC or part of that within their own SMS.

The Agency is not responsible for how the AMOC is used. It is particularly important that when the RU or the IM use this AMOC, that they provide return of experience and/or information from accidents and incidents to ensure that the content of the AMOC remains relevant and up to date.

The Agency should be informed of any return of experience which should be used to update the AMOC.

This AMOC is specifically for RUs and how they ensure that the train, including all its vehicles and their load, is technically fit for the journey to be undertaken and remains so throughout the journey, including braking.

There are other areas of responsibility in relation to the design of the vehicles, the maintenance of the vehicles and exchange of information (Entities in Charge of maintenance – ECMs) and the planning of the route (communication between the RU and IM) which are not included but need to be managed by those with the relevant responsibilities.

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<sup>2</sup> With the meaning of Article 8 of Directive (EU) 2016/798.

## 1.5. List of acronyms used in this text

- AMOC: Acceptable Means of Compliance
- ATTI: Agreement on freight Train Transfer Inspection
- CSM: Common safety method
- ECM: Entity in Charge of Maintenance
- ERA: European Union Agency for Railways or the Agency
- EU: European Union
- FOP: Fundamental Operational Principles
- GCU: General Contract of Use for Wagons
- IM: Infrastructure Manager
- NSA: National Safety Authority
- RU: Railway Undertaking
- SMS: safety Management System
- TSI: Technical Specification for Interoperability
- TSI OPE: Technical Specification for interoperability relating to the operation and traffic management subsystem (Commission Implementing Regulation (EU) 2019/773)
- UIC: Union Internationale des Chemins de fer
- VDV: Verband Deutscher Verkehrsunternehmen

## Part 2

### 2.1. Introduction to the relevant part of the TSI OPE

The relevant TSI OPE requirement to this AMOC is:

- 4.2.3.3.1. *Checks and tests before departure*

This AMOC also relates with other topics as defined in the scope (ref. to paragraph 2.2) therefore there are interfaces with other TSI OPE requirements, mainly:

- 4.2.2.5.2. Train composition
- 4.2.2.6.1. Minimum requirements of the braking system
- 4.2.2.6.2. Braking performance and maximum speed allowed
- 4.2.2.7.1. General requirement on ensuring that the train is in running order
- 4.2.3.4.3. Dangerous goods
- 4.2.1.2. Documentation for drivers
- 4.2.1.3. Documentation for railway undertaking staff other than drivers

### 2.2. Information on the scope of the AMOC

Vehicles are exposed to influences during railway operations, freight wagons are also exposed to influences during loading and unloading; those can lead to wear and tear and damage that cannot be detected exclusively by the maintenance measures carried out by the ECM within the scope of its obligations.

Within its own role and responsibilities, the RU should identify which inspections, checks and tests are necessary in order to run their trains safely.

To the end of this AMOC, the following definitions apply:

- An inspection is a critical examination to formally determine if a device or system is fit for purpose (or fit to perform in accordance with its intended function). An example is “verify for handbrake release”.
- A check is a visual observation to ensure the device or system is in place and is not obviously damaged or obstructed. An example is “visual verification of a manometer”.
- A test is a deliberate action or experiment to find out how well something works in accordance with its intended operation or function. An example is “test of the fire detection system”.

The RU, within its role and responsibilities, defines inspections, checks and tests of freely visible parts of vehicles including its load. These should ensure that damages are detected and the operations are carried out safely. The RU defines the content and the frequency and/or places of these inspections, checks and test.

This includes the risk of a train starts moving while transported goods or the vehicles themselves may pose an intolerable risk to personnel, passengers, third parties or environment. Although not all scenarios are covered, as this depends strongly on the specific context where the RU intends to operate. The RU needs to consider all the risks of their operational context, if necessary together with all relevant stakeholders. The RU should draw up rules for the application cases occurring in the company and the types of vehicles; in case of freight wagons, including loads and loading units used.

It is essential that RUs consider the train brake performance before the train departure. In case of a change in the train composition during the journey (technical problem, etc.) the RU should be able to make the recalculation of train brake performance done before continuation of its journey.

The safety of load is a key part of the checking process however, this is covered by the AMOC on Safety of Load. The particular aspects in relation to checking safe boarding and leaving of passengers are covered by the AMOC on safety of passengers. It is for the RU to decide whether they wish to apply any of the AMOCs.

This AMOC provides guidance for RUs on:

- 1) the check of all the freely visible parts of freight wagons (also loaded with dangerous goods), including their freely visible loads and loading units during railway operations, in order to detect damage, assess it and decide whether and under what conditions safe transport can be carried out.
- 2) the inspection of the integrity of the train in order to assure that all the vehicles are properly coupled and connected to the brake pipe.
- 3) the definition of train braking sheet & wagon list and brake position rules for freight trains.
- 4) performing air brake tests.
- 5) the use of composite brake blocks.

This AMOC does not cover items such as

- 1) Competences and who is responsible for undertaking the tasks, they should be covered as part of the RU's SMS.
- 2) health & safety of passengers and personnel, cross over with other TSI's (INF, PRM, Loc&Pas).
- 3) how the train brake performance calculation is done.
- 4) the route compatibility check process.
- 5) inspections, checks and tests of the active locomotives/traction units, non-active locomotives are to be considered as wagons.
- 6) shunting.
- 7) degraded and emergency operations.

This AMOC refers to the following good practices:

1. Freight Trains
  - a. ATTI refers to GCU
    - i. Inspections, tests and checks before train movement;
    - ii. Quality assurance procedure;
    - iii. Managing defects and irregularities.
  - b. VDV 758 refers to GCU
    - i. Test before shunting (not relevant for this AMOC)
    - ii. Test after stabling/parking;
    - iii. Test before train movement;
    - iv. Inspection before train movement with specific freight wagons or loads.



2. Freight trains with dangerous goods
  - a. RID refers to UIC IRS 40471-3
    - i. Inspections and checks before train movement.
3. Train “braking sheet & wagon list” and brake position rules for Freight trains
  - a. Braking sheet and wagons list
  - b. Brake settings for different freight train types
4. Air brakes test
  - a. UIC IRS 40453
5. Use of composite brake blocks
6. Tests during the train journey:
  - a. Brake test while driving

### 2.3. Links to existing legislation on risk assessment

#### Fundamental operational principle (FOP)

The fundamental operational principle most relevant to the activity of safety of passengers is FOP 3:

**FOP 3: Before a train begins or continues its journey, it shall be ensured that passengers, staff and goods are carried safely.**

This principle concerns the train and its readiness for movement. It includes, as examples: the braking capacity of the train, the speed that the train is permitted to travel, the formation and coupling of the train, identification, loading and securing of freight, the provision of adequate information to train preparation and operational staff. The aim is to prevent collisions, derailments due to a number of risks.

#### Risk assessment

The Safety management system operational process shall cover how, when and where inspections, tests and checks before train departure including braking and checks during normal operations will be ensured.

**Requirement 5.1.3 of Regulation 2018/762 states:**

*To control risks where relevant for the safety of operational activities (see 3.1.1. Risk assessment), at least the following shall be taken into account:*

- (c) preparation of trains or vehicles before movement, including pre-departure checks and train composition;*
- (d) running trains or movement of vehicles in the different operating conditions (normal, degraded and emergency);*

Information from the output of the risk assessment should set out how the risk that a running train can create intolerable consequences on people, infrastructure and environment is managed. It should include information for staff performing inspections, checks and tests, for staff performing train preparation activities and other staff including the driver. This information should form the basis of SMS processes, procedures and instructions for staff.

The RU is responsible for integrating this AMOC into its own SMS by the means of its risk management procedures.

## 2.4. Safety Requirements

1. The departure of a train needs confirmation that the checks and/or tests and/or inspections of the train has demonstrated the existence of conditions ensuring safe movement.
2. The checks and/or tests and/or inspections of a train should cover the safety devices of the vehicles, as well as the loads, the markings on the vehicles and compliance with the allowed mass and gauge.
3. The checks and/or tests and/or inspections should also include checking the train's composition and braking characteristics, the train's head and tail signals and that the brake test has been performed.
4. Each train may only run after the presence and proper functioning of the devices and parts associated with traffic safety have been checked.
5. The train should run within the constraints imposed by its composition and, in particular:
  - a. the number of traction units and their distribution in the train,
  - b. the characteristics of the vehicles in the train and of their load,
  - c. the mass and length of the train,
  - d. the way loaded and empty vehicles are distributed in the train,
  - e. the characteristics of the coupling and buffering devices on the vehicles in the train,

taking into account the parameters and characteristics of the lines to be travelled, in order to prevent the train from dividing, derailing or otherwise being subjected to transverse and longitudinal forces on the train that would compromise its safe operation.

6. All vehicles in a train should be connected to the continuous automatic braking system as defined in the LOC&PAS and WAG TSIs.
7. The railway undertaking should ensure that during operations each train achieves at least the necessary braking performance.
8. By means of the braking system, the train, running at its maximum permitted speed, should be able to stop within the residual space of the section granted in exclusive use.
9. The train must be able to stop also in specific conditions. Therefore, the RU can also do inspections, checks and tests during the journey (E.g. bad weather conditions – heavy snow, icing; exceptional infrastructures – steep slopes, etc.)
10. The first and last vehicles (including any traction units) in any train should have the automatic brake operative.
11. In the case of a train becoming accidentally divided into two parts, both sets of detached vehicles should come automatically to a standstill as a result of a maximum application of the brake. The RU should define and put into practice all necessary actions in order to prevent uncontrolled movements of vehicles.

## 2.5. Freight trains

### 2.5.1. ATTI

The Agreement on freight Train Transfer Inspection (ATTI) sets the rules governing the transfer of wagons between RUs based on the GCU (General Contract of Use for Wagons). The objective of the ATTI is to enhance cooperation between RUs, harmonising and developing the relevant rules accordingly. It aims to allow better forward planning as well as to increase the quality and safety of trains subject to the agreement.

The GCU is a multilateral contract based on the international convention COTIF 1999 and Annex CUV. The GCU specifies the mutual rights and obligations of Wagon Keepers and Railway Undertakings with regard to the use of rail freight wagons as a means of transport throughout Europe and beyond.

This contract, including its appendices, sets out the conditions for the provision of wagons for use as a means of transport by RUs in national and international traffic.

It sets out provisions governing the technical condition of wagons exchanged between two or more RUs, as established during a transfer inspection. It describes also a quality assurance procedure to be applied by RUs and the way to manage defects and irregularities.

[<https://uic.org/special-groups/atti>]

### 2.5.2. VDV 758

VDV Recommendation 758 describes a cross-company standard for the tests of freight wagons in railway operations. It requires the application of the GCU.

The VDV Recommendation 758 is addressed to the Railway Undertaking. It provides framework conditions and uniform methods but does not make any organisational arrangements for the implementation of this VDV Recommendation. The Railway Undertakings should define operational procedures according to their own safety management system.

VDV Recommendation 758 is a basis for the creation of internal company rules for the testing of freight wagons in railway operations. It describes the minimum requirements for these tests and thus reinforces the responsibilities of the Railway Undertakings.

VDV Recommendation 758 does not deal with the obligation to provide information on safety-relevant vehicle damage and defects in accordance with the Commission Delegated Regulation (EU) 2018/762. These should be identified and implemented by the Railway Undertaking.

VDV Recommendation 758 describes four stages of tests of freight wagons in railway operations:

- Level 1 - Test before shunting; (not relevant for this AMOC)
- Level 2 - Test after stabling/parking;
- Level 3 - Test before train movement;
- Level 4 - Inspection before train movement with specific freight wagons or loads.

It is important to note that the VDV recommendations are developed and produced by the German rail sector for their use. However, many of the principles may be of use to RUs who operate throughout Europe. If the RU decides to apply them, it has to be done by using the RU's operational risk assessment (ref back to paragraph 2.3) and SMS procedures. The recommendations are voluntary and it is up to the RU to decide if they are relevant to them. If they are used, it is important to note that any reference to German law is not applicable unless the RU operates in Germany.

## 2.6. Freight trains with dangerous goods

### 2.6.1. IRS 40471-3

UIC IRS 40471-3 (Inspections of dangerous goods consignments) published by UIC is applied as a means of conformity to the Regulation concerning the International carriage of Dangerous goods (RID)<sup>3</sup> requirements for Safety obligations of the carrier.

The purpose of RID point 1.4.2.2 is to ensure that the carrier (the RU in the scope of this AMOC) who takes over the dangerous goods at the point of departure should perform inspections, **tests and checks** before train departure that mainly relates with:

- Goods' authorization for carriage,
- Provision of relevant information and instructions,
- Absence of defects, leakages or cracks, missing equipment, etc.,
- Respect of deadlines for inspections of tank-wagons, battery-wagons, wagons with demountable tanks, portable tanks, tank-containers and MEGCs,
- Respect of loading limits,
- Presence of relevant placarding & marking.

The purpose of IRS40471-3 is to:

- Set out the safety obligations required of carriers in accordance with RID 1.4.2.2.1,
- Control the risks arising from violations of the carrier obligations according to RID 1.4.2.2.1,
- Maintain consistently high-quality inspections.

## 2.7. Train “braking sheet & wagon list” and brake position rules for Freight trains

Annex I sets out example of good practice that can be applied by the RU.

Annex I defines specific practices for freight train brake settings as well as the content and format of the brake sheet and wagon list for use in freight traffic

## 2.8. Air brakes test

### 2.8.1. UIC IRS 40453

UIC IRS 40453 defines procedures for air brake tests effected with a powered unit.

The text specifies the type of tests to be carried out in the event of various changes being made to the train composition.

It indicates four different types of air brake tests:

- Type A test: Complete test,
- Type B test: Partial test,

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<sup>3</sup> Implemented by Annex II to Directive 2008/68/EC of the European Parliament and of the Council of 24 September 2008 on the inland transport of dangerous goods.

- Type C test: Attachment test,
- Type D test: continuity test.

The text also describes cases when a brake test must be carried out and type of brake test to be effected. It describes as well the way to carry out them and the cases where there is no need to effect a brake test.

## 2.9. Use of composite brake blocks

The use of UIC-homologated composite brake blocks is described in part II of UIC leaflet 541-4 on “Composite brake blocks – General conditions for certification and use” and in the relevant guidance “usage guidelines for composite (LL) brake blocks” (pending results from the Joint network Secretariat (JNS) procedures).

Part II describes the general conditions for the use (integration and maintenance) of composite brake blocks, including conditions and recommendations for actual in-operation situations.

It details the use of composite brake blocks in wagons and in coaches.

For non-UIC homologated composite brake blocks, the manufacturer and the Entity in Charge of Maintenance should define equivalent conditions, taking into account the conditions and area of use of the block and the conditions, area of use and mission profile of the freight wagon.

The Swedish Transport Agency carried out extensive tests during winters of 2018-2019, 2019-2020 and 2020-2021 in order to examine the braking performance of the composite brake blocks **during severe winter conditions** in the north of Sweden, following reported cases of loss of braking performance under such conditions. The link below provides:

- Safety Analysis from Swedish Transport Agency
- Results of the tests carried out
- Recommendations in operation and maintenance from one Swedish freight RU.

[\[Riskbedömning avseende bromsblock av komposit under svenska vinterförhållanden - Transportstyrelsen\]](#)

## 2.10. Tests during train journey

The RU should define its own operational context and should identify, assess and eventually mitigate all risks relating with the defined context. By assessing those risks, the RU should define which type of inspections, checks and tests are needed and when they have to be performed in order to ensure that trains run safely.

The scope of the inspections, tests and checks, together with “when” these are to be performed, should be determined by the risk assessment and the operational characteristics (weight/length of the train and compatibility with the routes over which it will travel). It also needs to take into account specific requirements on dangerous goods and how these risks are managed particularly in relation to train composition.

### 2.10.1. Brake tests while driving

Brake tests while driving do not replace inspections, tests and checks that are to be performed before train departure.

The RU should define procedures to be applied whenever train composition operations are carried out or operating conditions arise that may compromise the proper functioning of the braking system:

- for checking the effectiveness of the brake system;
  - This may be performed:
    - after train departure,
    - at the first favourable opportunity,
    - before reaching maximum speed,
    - before engaging in downhill sections,
    - before approaching a buffer stop,
  - by undertaking a test of the normal braking of the train;
- for reacting when the driver detects insufficient braking;
- for checking whether that the braking system is not providing any unwanted resistance to the free running of the train;
  - This may be performed by cutting the traction and observing the running behaviour of the train;
- for reacting when the driver detects unwanted resistance.

# ANNEX I

## Train brake settings, content and format of the brake sheet and wagon list for use in freight traffic

### 1. Introduction

This annex defines rules for freight train brake settings as well as the content and format of the brake sheet and wagon list for use in freight traffic. For freight train brake settings a harmonized rule-set defines which rail vehicle brake positions are to be applied dependent on train parameters. In addition, the allowance of deviating brake settings is described. The rules are based on existing UIC standards, current operational best practice as well as on dedicated research done by the TrainDY consortia by considering varying infrastructure conditions in different countries, wherever relevant.

### 2. Scope and objective

The objective is to implement an approach how brake settings of different freight train types are applied in order to fulfil the TSI OPE requirements. The currently used G- and P-braked trains have varying rules in different European countries for brake positions of individual vehicles. This AMOC defines a common rule-set for vehicle brake positions and related requirements depending on train weight, vehicle sequence in train consist and train brake setting.

In addition, specific changes to the commonly used approach have been proposed, in order to develop rules that more closely meet the practical requirements of railway operations in Europe. In some cases, research was required because the current practice in Europe varies greatly and thus does not enable adoption of a single rule-set without studying their comparable safety. Therefore, the UIC TrainDY study group has performed scientific analysis to provide proof of evidence that the new rules are not introducing any additional risks for vehicle derailment in operations.

This document also defines a common brake sheet and wagon list format and content description. The format has been developed in order to facilitate international freight train traffic without the need to use individual formats for each country or region. Therefore, it is possible to run a train through several countries by only using one document.

### 3. Train brake settings

The rules defined are intended to mitigate derailment but also specific train integrity loss risks that are related to the brake positions used in G- and P-braked trains. The evaluation criteria are the longitudinal compressive forces (LCF) occurring in a train consist during braking. Under unfavourable conditions, too high forces can cause a wagon to derail. For train integrity loss also the risks of excessive longitudinal tractive forces (LTF) have been considered for scenarios where a train accelerates immediately after brake release. This may result in coupling breakage.

#### 3.1. General rules for all freight trains

The following rules have been defined on the basis of currently common operational practices on European railways (according to IRS 40421, Politecnico di Milano study CR 42 /20, or selected best practices assuring the highest level of safety).

- The first and last vehicle of the wagon rake (all wagons composing a train – excluding the active locomotives) in any train must have operational brakes. This is to ensure that even in case of train integrity loss there will always be wagons with fully operational brakes in both parts of the train, thus avoiding uncontrolled movements.
- Active locomotives must be located at the head of the train. Any usage of banking locomotives or distributed traction must be additionally assessed as part of an RU own SMS according to the local circumstances.

**3.2. G-braked trains**

The following rules have been defined on the basis of currently common operational practices on European railways (according to UIC 421 or selected best practices assuring the highest level of safety).

- G-braked trains must have all vehicles in the consist in brake position G
- Trains may also run in position P even if the path used was foreseen for a G-train (to avoid change of brake position on the border) – no additional risks are introduced by allowing a train with a shorter braking distance to use a path of a train that may have a longer braking distance.
- The brake sheet should reflect the actual brake settings of the train. In ERTMS the actual brake settings of the train is to be entered in the on-board system.

The following rules have been defined based TrainDY study CAB2/2020-1536:

- G-braked trains may have up to 12 axles in brake position P
- G-trains may contain up to 3 consecutive unbraked vehicles

In summary, the full ruleset is shown in the following table.

Train weight without locomotive	Timetabled train type: G		
	Brake position of all vehicles (incl. locomotive)	Maximum allowance of brake position P	Maximum allowance of non-braking vehicles
0...800 t	G	12 axles, for the rest turn brakes off	3 consecutive wagons ; but first and last vehicle of the wagon rake (excl. leading working locomotives) must be able to brake
801...1200 t	G		
1201...1600 t	G		
1601...2500 t	G		
2501... 4000 t	G		
Reason for the proposal	• No differences between existing rulesets	• Harmonization to the most easily usable and universal entity (currently also rules based on no. of wagons or proportion of tonnage used)	• First and last vehicle must brake to ensure safety in case of train integrity loss, even if train direction is changed en route



### 3.3. P-braked trains

The following rules have been defined on the basis of currently common operational practices on European railways (according to UIC 421 or selected best practices assuring the highest level of safety).

- P-braked trains in the wagon rake (excl. leading active locomotives of the train) weight range of 0...800 t must have all vehicles in brake position P. This is to ensure highest possible brake performance.
- P-braked trains in the wagon rake weight range of 801...1200 t must have the leading active locomotives in brake position G and all other vehicles in brake position P. This is to alleviate longitudinal compressive forces in such trains.
- P-braked trains in the wagon rake weight range of 1201 or higher must have the leading active locomotives and the first five vehicles thereafter in brake position G and all other vehicles in brake position P (the “Long Locomotive” concept)<sup>4</sup>. This is to alleviate longitudinal compressive forces in such trains.
- P-braked trains in the wagon rake weight range of 1601...2500 t may not contain wagons with a gross weight lower than 32 tons. In addition, articulated wagons or other permanently coupled wagons are forbidden from such trains.
- P-braked trains in the wagon rake weight range of 2501...4000 t may not contain wagons with a gross weight lower than 40 tons. In addition, articulated wagons or other permanently coupled wagons are forbidden from such trains.
- Trains may also run in position P even if the path used was foreseen for a G-train (to avoid change of brake position on the border) – no additional risks are introduced by allowing a train with a shorter braking distance to use a path of a train that may have a longer braking distance.
- The brake sheet should reflect the actual brake settings of the train. In ERTMS the actual brake settings of the train is to be entered in the on-board system.
- In case a wagon in a P-braked train cannot be set to brake position P, its brakes are to be turned off. The usage of G-brakes is not allowed due to the longer release time of these brakes, which could cause excessive longitudinal tractive forces (LTF) in a train in scenarios where a train is accelerating shortly after releasing the brakes.
- In case among the first 5 wagons in a P-braked train “Long Locomotive” the brake position of a wagon cannot be set to G, its brakes are to be turned off. This is to ensure that the effect of “Long Locomotive” in alleviating longitudinal compressive forces in heavy P-trains is not reduced.

The following rule has been defined based TrainDY study CAB2/2020-1536:

- P-trains may contain up to 3 consecutive unbraked vehicles

In summary, the full ruleset is shown in the following table.

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<sup>4</sup> Counting of vehicles is to be done according to UIC leaflet 421: “Even if one of the first five vehicles does not have a functioning braking system it should nevertheless be considered as Long Locomotive. If articulated wagons or wagon units which cannot be separated in service are part of the LL and if they have bogies or more than 3 individual wheel sets, the parts of the wagons are counted individually as vehicles. Moreover, all vehicles of any single wagon unit (or all parts of any articulated wagon) must come under the same braking regime.”

Train weight without locomotive	Timetabled train type: P				
	Brake position of leading working locomotives	Brake position of the first 5 vehicles thereafter	Brake position of all following vehicles	What if required brake position is not possible?	Maximum allowance of non-braking vehicles
0...800 t	P	P	P	Turn brakes off	n/a – to be covered by the required brake ratio, but first and last vehicle of the wagon rake (excl. leading working locomotives) must be able to brake
801...1200 t	G	P	P		
1201...1600 t	G	G	P		
1601...2500 t	G	G (only wagons ≥32 t*)	P (only wagons ≥32 t*)		
2501... 4000 t	G	G (only wagons ≥40 t*)	P (only wagons ≥40 t*)		
<b>Reason for the proposal</b>	<ul style="list-style-type: none"> <li>No differences between existing rulesets</li> </ul>	<ul style="list-style-type: none"> <li>“Long loco” used widely to limit longitudinal forces</li> <li>Light wagons banned from heavy trains due to risk of derailment when braking / negotiating S-curves</li> </ul>	<ul style="list-style-type: none"> <li>Light wagons banned from heavy trains due to risk of derailment when braking or negotiating S-curves</li> </ul>	<ul style="list-style-type: none"> <li>P instead of G (in “long loco”) not proposed due to critical longitudinal forces in train</li> <li>G instead of P not proposed due to long release time of G brakes</li> </ul>	<ul style="list-style-type: none"> <li>First and last vehicle must brake to ensure safety in case of train integrity loss, even if train direction is changed</li> </ul>

\*Articulated and permanently coupled wagons forbidden.

#### 4. AMOC content – international brake sheet and wagon list

The international brake sheet and wagon list defines a standard format and content for the document that is to be provided to a locomotive driver before train departure. It can be used for international as well as domestic freight trains. The language of the document can vary but the format and fields (numbers and description) must remain the same. The specification can be found in the Appendix B.

#### 5. Area of application

The defined rules are to be applied when composing and preparing international (and possibly domestic) freight trains for departure at its origin and intermediate stations. Therefore, railway operations personnel must be trained accordingly to ensure the requirements defined in the rules are fulfilled. The personnel should be able to prepare trains in a manner that a train complies with the requirements before starting its journey, ideally for the whole journey of the train.

## **ANNEX I – *Appendix A***

### **International brake sheet and wagon list**