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Železniške naprave - Tehnično poročilo o reviziji EN 14363

Railway applications - Technical Report about the revision of EN 14363

Bahnanwendungen - Fachbericht zur Überarbeitung der EN 14363

Applications ferroviaires - Rapport technique de la révision de la norme EN 14363

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45.060.01	Železniška vozila na splošno	Railway rolling stock in general

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RAPPORT TECHNIQUE

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ICS 45.060.01

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Railway applications - Technical Report about the revision of EN 14363

Applications ferroviaires - Rapport technique de la révision de la norme EN 14363

Bahnanwendungen - Fachbericht zur Überarbeitung der EN 14363

This Technical Report was approved by CEN on 12 January 2017. It has been drawn up by the Technical Committee CEN/TC 256.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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European foreword

This document (CEN/TR 17039:2017) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

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1 Scope

EN 14363 contains a lot of requirements which were modified during the last revision. The scope was also extended. It was found in the working group, that many decisions that were taken to formulate these modifications need to be documented to improve understanding and to allow a later further development if practice of applications shows the necessity. The work for the revision was organised in 8 subgroups. Many of these subgroups recorded the way to the proposals in reporting templates, which were used for the editing work. Afterwards discussion was ongoing in WG 10 and in the enquiry process. This available information needs to be summarised and presented in a common format in order to allow people not involved in the discussions to understand the background of the modifications.

2 Members of the different drafting groups for the revision of EN 14363

Bold **X** means group leader Normal X means group member	8.1 Editing	8.2 Test Conditions	8.3 Track Quality, Contact Conditions	8.4 Special vehicles	8.5 Stationary Tests	8.6 Simulation, Extension of acceptance	8.7 Track Loading	8.8 Ride Characteristics
HS (DE)	X	X		X	X		X	**X**
SZ (DE)	**X**	X				**X**		
MW (SE)		**X**	X	X		X		
BE (UK)			**X**			X		
PD (FR)		X	X	**X**			X	
AC (UK)	X	X			**X**	X		X
JS (AT)		X	X		X	X	**X**	
VB (FR)		X				X		
AB (FR)					X			
VB (DE)		X				X		
JC (FR)		X						
OC (FR)							X	
RD (FR)								X
HG (NO)		X	X				X	
AH (AT)		X	X				X	
TH (CZ)					X			X
M J (UK)				X				
AK (AT)						X		
TK (DE)		X	X		X			X
RK (DE)					X	X		X
NK (IT)			X			X		
DL (FR)		X			X		X	

Bold **X** means group leader Normal X means group member	8.1 Editing	8.2 Test Conditions	8.3 Track Quality, Contact Conditions	8.4 Special vehicles	8.5 Stationary Tests	8.6 Simulation, Extension of acceptance	8.7 Track Loading	8.8 Ride Characteristics
JÖ (SE)							X	
MO (UK)					X			X
OP (CH)		X	X		X	X		
UR (CH)		X					X	
AS (CH)		X						
RW (UK)		X		X				
MZ (DE)			X		X		X	

3 Changes to the scope

3.1 Scope extension

The standard was further developed from a pure collection of test specifications to a description of the process for assessment of running characteristics. In addition, it also contains specifications on an informative basis not necessarily to be used for the acceptance process.

The new process also includes the use of simulations. The requirements were further developed starting from the requirements specified in UIC 518:2009 and EN 15827 and refined in discussions inside WG 10 and its relating subgroups and in a second step by the DynoTRAIN research project.

The scope was extended to freight vehicles with nominal static vertical wheelset forces up to 250 kN (previously handled in EN 15687). Also the inclusion of vehicles intended for operation with cant deficiencies above 165 mm (previously handled in EN 15686) was covered by the new requirement to specify the combination of admissible speed and admissible cant deficiency. Additionally the loading conditions for the assessment have been defined more precisely.

Further a hint to a set of recommended values for admissible cant deficiencies to be chosen for broad international approval was included. It replaces the fixed requirements made for conventional vehicles in the previous version of the standard.

In order to close the open points in the Rolling Stock TSIs about track geometric quality and the achievability of the combination of the specified test conditions during on-track tests, the concept of defined target test conditions and the assessment of achieved test results against target test conditions was developed.

Further, it needed to be stated that the standard also contains quantities and dependencies that are not directly used for acceptance purposes, but for example for purposes of validation of simulation models or determination of operating conditions outside the reference conditions.

3.2 Limitation

In order to prevent misuse of the standard for non-railway and non-standard gauge vehicles, it was better described what needs to be considered when using it “by analogy” for such vehicles.

To clarify the limits of the scope, it was stated that the strength of the vehicle and mounted parts, passengers and train crew vibration exposure, comfort, load security and effects of cross wind are out of the scope of this standard – as well as the quantification of track deterioration or track fatigue.

3.3 Clarification

It was found that the old wording needed clarification: "Testing for acceptance of vehicles is based on some reference conditions of track. If these are not respected on certain lines, appropriate measures will be taken (speed modifications, additional tests, etc.)."

The discussion in WG 10 showed that it was not possible to specify the underlying reference conditions by exact boundaries. The only way for clarification was to:

— state that all vehicles which were successfully assessed are able to be operated on tracks complying with EN 13803;

— describe the current state of the art in order to allow the EIM (European Infrastructure Managers) to continue to use their implemented process for operation under demanding track conditions in the future (for example on lines with curve radii below 250 m).

This includes two notes explaining why vehicles can also be operated safely outside the target test conditions. A third note clarifies that the methods of this standard may also be applied to determine operating rules under infrastructure conditions that are more severe than the target test conditions.

In this context, it was also stated that the document contains target test conditions for the geometric track quality, as they have been adjusted compared to the previous version of the standard.

As the target test conditions for stability testing were changed with respect of the target conditions of the TEN (Trans European Network), it was necessary to clarify, that the equivalent conicity to be included in the stability assessment might be higher in some national systems for the time being before the infrastructure target conditions are met. In this context, it was found necessary to state in a note that such national requirements do not necessarily have to include the maximum occurring values of equivalent conicity. This makes it possible to find practical test conditions and it reflects also testing at overspeed and that vehicles assessed as stable are in most cases far below the limit values.

3.4 Shifted to other sections

The allowances

— to deviate from the rules laid down if evidence can be furnished that safety is at least the equivalent to that ensured by complying with these rules and

— of variations from the defined conditions as specified by the article 7.1 of Directive 91/440 of EC which were stated in the scope of the 2005 version are now described more detailed in a separate clause (4). It is now stated that in case of deviations, these shall be reported, explained and taken into account when assessing the safety.

4 Fault modes

4.1 What was changed?

The explicit requirement on testing with deflated air springs was removed.

A new subclause 5.2.2 "Fault modes" and a new subclause in Annex T (Simulation of on-track tests), T.2.5 (Investigation of dynamic behaviour in case of fault modes) was introduced.

4.2 Why was it changed?

When testing with deflated air springs was introduced in UIC 518, air springs were a relative novelty in railway vehicles. Since then much experience has been gained and they are now very common and it was felt inappropriate to specify a test for the specific fault mode of deflated air springs, while many other possible fault modes were overlooked, such as faulty yaw dampers or failing active components.

In EN 14363:2005 faulty yaw dampers were also specifically mentioned in parallel to deflated air springs. A more open approach was also indicated in EN 14363:2005, this idea is further developed in the present revision of EN 14363.

It was therefore appropriate to further develop the writing in EN 14363:2005 and require a similar – more open – methodology for dynamics assessment. It is impossible in a standard like EN 14363 to foresee every possible relevant fault mode to assess since these will differ from vehicle to vehicle. Also, the technical development makes it necessary to adopt a methodology that can be used for future systems not known today.

It was not clear in EN 14363:2005 at what speed fault modes were to be tested, also not what test extent to apply. Therefore, a large variation of testing practice has evolved from country to country making it more difficult to follow a principle of testing in one country for acceptance in many.

With the introduction of simulations, it was also necessary to define under what conditions simulations can be used to assess fault modes.

Some important principles were clarified:

— Due to probability reasons, assessment of a fault mode is limited to running safety parameters, speed up to V_{adm} and cant deficiency up to I_{adm}.

— Independent fault modes shall be tested/ simulated independently, unless the analysis points out the combined fault is necessary to be assessed.

— The safety factor λ does not need to be derived for fault modes, see U.2.

4.3 Comments raised in the CRM process and how they were addressed

In the comment phase there were discussions, not on the principles but on the writing to make it clear yet open enough for its purpose.

The comments revealed concerns that the new approach would lead to requirements for additional testing which was not the intention. The intention was only to provide a framework to assess the relevant fault modes which may not be the same for each and every vehicle type.

To handle these concerns, modifications were made, where one of the most important changes was to clarify that potentially catastrophic failures of conventional mechanical parts are managed by the design and maintenance regime of the vehicle, and hence do not need to be additionally assessed.

5 Load conditions for testing

There were a number of different references to loading condition which were not consistent and clearly enough specified in the 2005 edition. It was concluded that for clarity, loading definitions used in EN 15663 would be the reference load cases, but where the loading conditions specified in EN 15663 are inappropriate then details for specific loading cases will be given where these apply. This is particularly the case with extreme loads. Testing in the context of EN 14363 does not relate to extreme cases, nor has it been used in the corresponding tests prior to the introduction of EN 14363 in European rail administrations. As a result, the test loading conditions to be used apply the relevant normal loading for the operation of the tested vehicle.

Another aspect was that extreme conditions could lead to outliers in the statistical sample that cannot be handled by the statistical approach of EN 14363.

Further it was agreed that the load cases to be used for stationary and on-track testing should be as consistent as possible and that for some tests not all of the load conditions need to be investigated.

For long distance and high speed trains without obligatory seat reservation it was found inadequate to test them only with occupied seats. Therefore, the load case “Design mass in working order” was adjusted by taking into account 2 P/m² in standing areas. It was found that this was already state of the art.

SNCF members of WG 10 explained, that vehicles for RER in Paris were always tested in a loaded condition taking into account up to 700 kg/m² in standing areas, referring to EN 15663:2009, 6.2. WG 10 decided that in future and if necessary, such a case should be handled as a notified national technical rule (NNTR). This will remove the possibility of uncertainty about when extreme loads are required to be considered and under which circumstances they are to be applied.

For handling the necessary fuel consumption during testing, some practical rules were specified, assuming that they will not be used to influence test results systematically. For locomotives, that normally have big fuel tanks, it was taken into account that measured values of track loading might vary too much if the full range of fuel consumption is used during testing. Therefore, the acceptable range was restricted to the upper third.

Another practical rule was created to specify the handling of loads that can be collected and/or distributed or spread along the railway track during operation.

The definitions of the load cases “empty” and “loaded” were concentrated in subclause 5.3.2 giving common rules for all tests described in EN 14363.

6 First stage assessment

6.1 General

In the 2005 edition, this topic was covered by Clause 4 'Stationary tests'. Concern was expressed that since some of the tests specified in the chapter were not in fact stationary but included movement of the test vehicle the title could therefore cause some confusion. As a result the title became the subject of much discussion, a suggestion to change the name to 'quasi-static tests' was rejected because this could also cause confusion since the term 'quasi-static' does not translate from English directly into other languages. As a result, the title of the clause was changed to 'first stage assessment' to reflect that generally the assessments that are identified in this chapter are carried out on a vehicle before the on-track testing is carried out.

The term assessment has been adopted to recognise that it is not always necessary to carry out physical tests to demonstrate the performance of a vehicle. In certain circumstances that are defined in the text of the clause, other means of demonstration of the performance is possible.

6.2 Safety against derailment on twisted track

Before the introduction of internationally accepted approval, the various approvals were carried out by each national authority. This process was generally carried out by the national railway. There was concern that a proper definition of the testing conditions did not exist, e.g. details such as tolerances on track gauge, track curvature etc. This was particularly so with the inclusion of additional institutions, who had not previously carried out these tests but were now permitted to perform the testing. A definition of the test conditions was therefore required. After inquiries with the railway test bodies, where they still existed, it became clear that there was no definitive definition of the test conditions that had historically been carried out, either arising from the UIC tests or for national requirements. In addition, the tests carried out in the past did not include records of the actual test conditions of the track, such as track gauge, deviations from the 'nominal' values of track curvature or installed cant. As a result the current text does not define limits to be applied, but does require the track conditions to be recorded in the future. When sufficient data are available, it is the intention to specify limits that shall be applied that are both practical and relevant.

There was some confusion about the compatibility of the test conditions for each of the three test methods in the 2005 edition, the coefficient of friction was not consistent between the methods. The reason for the difference could not be determined although the three methods all derive from the original work carried out within the ERRI B55 project. As a result of the possible misinterpretation, it has been made clear that each method shall be considered separately.

As with the definition of track condition, investigations were carried out to determine the signal processing that had been applied to data recordings in the past. No information could be found about what processing was applied and so nothing could be specified with any confidence, again the processing that is applied in future test is required to be recorded with the intention that when sufficient data is available requirements will be formulated.

Method 1 as defined in the 2005 edition has caused some confusion. The requirements included a double requirement, with both the Y/Q limit and the flange climb wheel lift limit Δz, specified as acceptance criteria. This has been changed by removing the Y/Q limit with the Δz remaining as the acceptance requirement. However, the requirement is to record the Y/Q value during the tests, although this is not an acceptance criterion.

With current techniques it is not credible to analyse the interface conditions that influence the Δz value with certainty and so it is not permitted to carry out analysis of any changes to a vehicle that could affect Δz value. As a result any vehicle that differs from the tested vehicle shall be retested.

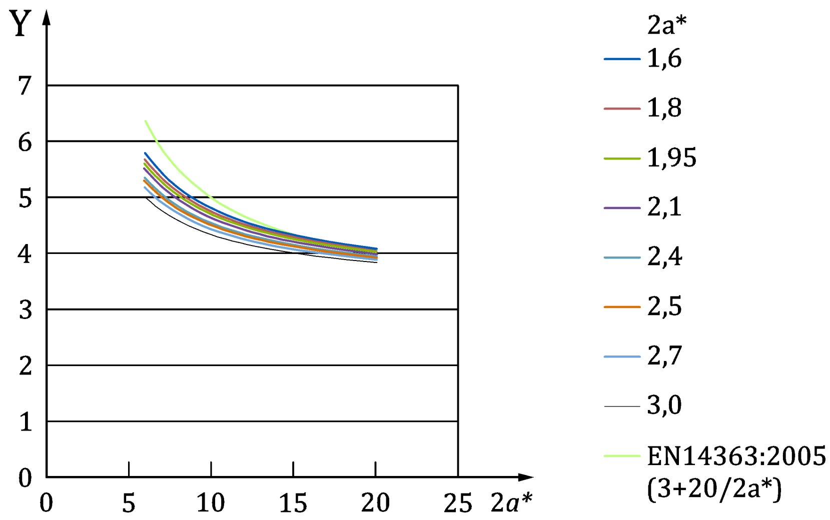
However, it is possible by using the recorded Y/Q values to analyse both the originally tested vehicle's performance and the performance of a vehicle that has undergone a change to the significant parameters of a vehicle using the method 2 criteria.

Method 2 now recognises that in the event of a change to a significant parameter of a vehicle (such as change in vertical stiffness) a vehicle type that has been previously accepted using method 2 can now be analysed to assess the effect of the change. The analysis can be made by comparing the performance of the original vehicle with that of the changed vehicle.

Method 3 In the 2005 edition, the twist criteria for the test was intended to be identical to that used in method 1, to maintain a consistent test condition. This resulted in a different test condition compared to the original criteria for method 3 which is defined in the GB RSSB document GM RT 2141.

A comment (GB 792) proposed to relax the bogie test twist of method 3 from 7 ‰ to 6,67 ‰ in order to be consistent with the origin of the requirement (GM/RT 2141, issue 3). A detailed analysis showed, that the original application of GM/RT 2141, issue 3, leads to a vehicle twist depending also on the bogie wheel base $2a^+$:

$$g^*_{GMRT} = 3{,}33‰ + \frac{3{,}33‰ \cdot \left(6m - 2a^+\right)}{2a^*}$$



Key

Y vehicle test twist in mm/m

2a* running gear distance in m

Figure 1 — Vehicle test twist as a function of vehicle dimensions

As this is lower than or roughly equal as the vehicle test twist specified in EN 14363:2005 (see Diagram) $g^*_{EN} = 3‰ + 20\,mm / 2a^*$, it was decided, to keep the vehicle test twist specification from EN 14363:2005 in combination with the slightly relaxed bogie test twist from GM/RT 2141 as it was proposed by the comment. Compared to the twist conditions of method 1 and method 2 this test condition remains roughly equal or more demanding, depending on the geometry of the vehicle to be tested.

To fit the two curves for bogie twist and vehicle twist, the limitation for the application of 6,67 ‰ needed to be increased from 5 m to 5,45 m.

6.3 Safety against derailment under longitudinal compressive forces in S-shaped curves

The tests referenced in this chapter, and detailed in EN 15839, reflect the requirements developed in the UIC leaflet 530-2. The reference has been changed from UIC 530-2 to EN 15839 and EN 14033-1 for special vehicles.

6.4 Evaluation of the torsional coefficient of a car body

This evaluation has been included since it is relevant to the tests for safety against derailment under longitudinal compressive forces in S-shaped curves and some of the tests for safety against derailment on twisted track. It was derived from ERRI B12/DT 135, Annex E and was refined in order to remove the influence of the roll moment from the results.

6.5 Determination of displacement characteristics

This chapter replaced the subclause 4.3 “Sway characteristics” in EN 14363:2005. This replacement and the inclusion of this evaluation has been made in conjunction with CEN/TC 256 WG 32, at their request. This evaluation is included because the tests described are generally performed when the other tests described in the First Stage Assessment are carried out. Only the tests are described, the data obtained is used in the processes of EN 15273. Details have been removed from the main text and placed in Annex D of the revised EN.

The term “flexibility coefficient” has replaced “roll coefficient” to relate directly to the EN 15273 series.

6.6 Loading of the diverging branch of a switch

For some railways the determination of a vehicle's performance is required when negotiating a diverging branch. The characteristics of the track at a diverging branch differ between countries and as a result it is not possible to define testing or acceptance criteria. Nevertheless, a methodology has been agreed for the process to be followed when there is a need to determine the performance when negotiating this track feature. Much of the work in developing the technique was carried out by DB but the limit values that were established during this work relates only to the DB situation. For other situations where the features of a diverging branch differ from the DB case, it would be necessary to carry out specific studies to determine specific limits for that case.

The following provides background about the work carried out by DB in determining the assessment of vehicles negotiating DB switches.

Switch Test (6.5 and Annex F)

A test which determines the loading on the turnout branch in switches was not specified in EN°14363:2005. However, it was mentioned in the scope that this is an open point and a future inclusion of turnout runs in switches with $R \leq 190$ m in the normal and simplified measurement method is possible if test conditions will be fixed after further investigations.

In UIC 518:2009 test conditions have been specified in chapter 6.1.6 and Appendix N. These test conditions are adopted and incorporated in this revision, chapter 6.5 and Annex F. It has to be mentioned that no requirements for the assessment of the vehicle behaviour in switches and crossings are specified in this revision of EN 14363. Annex F is informative and presents a methodology for a consistent approach.

After an increase of rail failures in switch blades, see Figure 2, Deutsche Bahn carried out fatigue tests of switch blades in order to determine the fatigue limit at the most critical section (fixed end of the switch blade). With the help of Finite Element calculations the maximum permissible Y and Q forces were determined in order to respect the fatigue stress limit.

Key

1 broken switch blade causes a high risk of derailment

Figure 2 — Broken switch blade in a switch (diamond crossing) with R = 190 m