SLOVENSKI STANDARD
oSIST prEN 15654-1:2015

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Železniške naprave - Meritve vertikalnih kolesnih in osnih obremenitev - 1. del: Meritve na interoperabilnih železniških vozilih med vožnjo

Railway applications - Measurement of vertical forces on wheels and wheelsets - Part 1: Interoperable on-track measurement sites for vehicles in service

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Bahnanwendungen - Messung von vertikalen Rad- und Radsatzkräften - Teil 1: Interoperable gleisseitige Messeinrichtungen für fahrende Fahrzeuge

Applications ferroviaires - Mesurage des forces verticales à la roue et à l'essieu - Partie 1 : Sites de mesure en voie interopérables des véhicules en service

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ICS:

45.060.01	Železniška vozila na splošno	Railway rolling stock in general

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Railway applications - Measurement of vertical forces on wheels and wheelsets - Part 1: Interoperable on-track measurement sites for vehicles in service

Applications ferroviaires - Mesurage des forces verticales à la roue et à l'essieu - Partie 1 : Sites de mesure en voie interopérables des véhicules en service

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 256.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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European foreword

This document (prEN 15654-1:2015) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2008/57/EC.

For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

This document is the first part of the standard series EN 15654 “*Railway applications — Measurement of vertical forces on wheels and wheelsets*” consisting of the following three parts:

— Part 1: Interoperable on track measurement sites for vehicles in service;

— Part 2: Test in workshop for new, modified and maintained vehicles;

— Part 3: Approval and verification of interoperable on track measurement sites for vehicles in service.

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Quantities such as vehicle weight and train weight do not depend on the attitude of the suspension (springs) and therefore they are the same when the train is standing as they are when running.

The vertical wheel force [1)] varies with time when the vehicle is in motion and may also be different from one day to another, depending on the state of the suspension.

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However, as long as the loading of the vehicle does not change, the mean value of the sum of the wheel forces will equal the vehicle weight and is also equal to the sum of the mean wheel forces [2)].

This also applies to axle loads. When the measuring system is installed in a straight track, this also applies to side loads and load differences.

1) The vertical force applied by a wheel on the rail (kN).

2) The mean value is the integration of the instantaneous load values with respect to time.

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Introduction

This standard has been developed to provide a common procedure for determining the axle load, wheel force and the weight of rail vehicles operating (in-service) in Europe. Furthermore, the measuring of assessment quantities according to EN 14363 is possible.

There are two factors that have an effect on the integrity of the infrastructure and on rail safety. These are overloaded axles and asymmetric wheel force distributions. This standard also details the evaluation of derived quantities such as asymmetric loading, overloading, vehicle weight and train weight. These quantities are obtained while the train is in motion in order not to delay its passage.

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1 Scope

The scope of this European Standard is restricted to the measurement of quasi-static vertical wheel forces and therefrom derived quantities on vehicles in service operation.

Derived quantities can be:

— axle loads;

— side to side load differences of a wheel set, bogie, vehicle or train set;

— overall weight of vehicle or train set;

— mean axle load of a vehicle or train set.

This standard is not concerned with the evaluation of:

— dynamic wheel force or derived quantities;

— wheel condition (i.e. shape, profile, flats);

— lateral wheel force;

— combination of lateral and vertical wheel forces.

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The standard defines accuracy classes for measurements to be made at any speed greater than 5 km/h within the calibrated range, which may be up to line speed.

The aim of this standard is to obtain measurement results that give representative values for the load distribution of a running vehicle, which under ideal conditions will be similar to what can be obtained from a standing vehicle.

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This standard does not impose any restrictions on the types of vehicles that can be monitored, or on which networks or lines the measuring system can be installed.

The standard lays down minimum technical requirements and the metrological characteristics of a system for measuring and evaluating a range of vehicle loading parameters. Also defined are accuracy classes for the parameters measured and the procedure for verifying the calibration.

The measuring system proposed in this standard should not be considered as being safety critical. If the measuring system is connected to track signalling, a train monitoring or a train control system then requirements that are not part of this standard may apply.

Measuring systems complying with this standard have the potential to enhance rail safety. However, the current operating and maintenance procedures rather than this standard are mandatory for ensuring safety levels in European rail networks.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 60529, *Degrees of protection provided by enclosures (IP Code) (IEC 60529)*

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3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
quasi-static wheel force
$Q_{0,j,k}$
representation of the static wheel force obtained from the dynamic measurement process of a vehicle in motion

Note 1 to entry: Where the symbol Q_{0jk} is used, j is the axle number and k is the vehicle side k = R denotes the right hand side in the direction of travel and k = L denotes the left hand side in the direction of travel.

3.1.2
quantity
property of a phenomenon, body, or substance, where the property has a magnitude that can be expressed as a number and a reference

[SOURCE: ISO/CEI GUIDE 99]

3.1.3
derived quantity
quantity, in a system of quantities, defined in terms of the measured quantities of that system

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3.1.4
measuring system
aggregation of parts that serve to determine the wheel force and which may also be used to derive other quantities

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3.1.5
load sensor
that part(s) of the instrument that receives the load and which realises a change in the balance (of the instrument) when a load is placed upon it

3.1.6
maximum permissible error
extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given measurement, measuring instrument, or measuring system

[SOURCE: ISO/CEI GUIDE 99]

3.1.7
accuracy class
class of measuring instruments or measuring systems that meet stated metrological requirements that are intended to keep measurement errors or instrumental measurement uncertainties within specified limits under specified operation conditions

[SOURCE: ISO/CEI GUIDE 99]

Note 1 to entry: A measuring system can have different accuracy classes for different quantities.

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3.1.8
running gear
bogie or on non-bogied vehicles the axle

3.1.9
in service
running and not at a maintenance or manufacturing site

3.1.10
line speed
maximum speed at which vehicles are allowed to run on a line or branch, or on sections of a line or branch

3.1.11
speed band
range of speeds pertaining to a particular accuracy class

3.1.12
instrumented track
section of track where the wheel forces are measured

3.1.13
lead-on track
section of track that precedes the instrumented track

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3.1.14
lead-off track
section of track that follows the instrumented track

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3.1.15
approach track
section of track that precedes the lead-on track

3.1.16
leaving track
section of track that follows the lead-off track

3.1.17
measurement site
section of track that contains the instrumented track, the lead-on/lead-off tracks and the approach/leaving tracks

Note 1 to entry: A measurement site is shown in Figure B.1.

3.1.18
cross level
difference in height of the adjacent running surfaces computed from the angle between the running surface and a horizontal reference plane

Note 1 to entry: It is expressed as the height of the vertical leg of the right-angled triangle having a hypotenuse that relates to the nominal track gauge plus the width of the rail head rounded to the nearest 10 mm.

Note 2 to entry: For nominal gauge of 1 435 mm the hypotenuse is 1 500 mm in length. For nominal gauge of 1 524 mm the hypotenuse is 1 600 mm in length.

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3.1.19
gradient
ratio of the difference in height, of the running surface, at two successive points, to the distance between the points

3.1.20
vertical track deflection
amount by which the track deflects under a defined axle load

3.1.21
track twist
algebraic difference between two cross levels taken at a defined distance apart, usually expressed as a gradient between the two points of measurement

Note 1 to entry: Refer to EN 13848–1:2003+A1:2008, 4.6.

Note 2 to entry: Twist may be expressed as a ratio (‰ or mm/m).

3.1.22
weighbridge
legal for trade instrument that measures the mass of rail vehicles

Note 1 to entry: The results of measurement are made in units of kilogram (kg) or tonnes (t).

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3.2 Abbreviations

For the purposes of this document the following abbreviations apply:

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CEN	European Committee for Standardization
EMC	Electromagnetic compatibility
EN	European Standard
ERA	European Railway Agency
ISO	International Standards Organization
NF	Norme Française
OIML	Organization Internationale de Métrologie Légale
TSI	Technical Specification for Interoperability

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3.3 Symbols

For the purposes of this document the following symbols apply:

j	wheelset index	(1, 2, 3, ...)
i	running gear index	(1, 2, 3, ...)
k	vehicle side R for the right hand side in the direction of travel L for the left hand side in the direction of travel	
n	total number of vehicles in the train	
n_{trn}	total number of wheelsets of the train	
n_{veh}	total number of wheelsets of individual vehicle	
n_{rg}	total number of running gear of individual vehicle	
z	number of wheelsets per running gear i	
x	number of first wheelset in running gear i	
l_{trn}	length of the train, distance between first and last axle	(m)
g	acceleration due to gravity	(m/s^2)

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NOTE Mass can be converted to force or load by the formula:

$F = m \times g$

where

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g is the local acceleration due to gravity.

4 Measured and derived quantities

4.1 Measured quantities

The quasi-static wheel force Q_{0jk} is the basic value for all derived quantities

where

j is the axle number

k is the vehicle side (R for the right hand side in the direction of travel, L for the left hand side in the direction of travel)

Quasi-static wheel force is evaluated in kN.

4.2 Mandatory derived quantities

The following Table 1 defines mandatory derived quantities.

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Table 1 — Mandatory derived quantities

Quantity	Dimension	Formula	Comment
individual wheelset force	kN	$P_{\mathrm{F0},j} = Q_{0,j,\mathrm{L}} + Q_{0,j,\mathrm{R}}$	EN 14363:2005 $2Q_{0j}$ P_{F0}
individual axle load	t	$P_{0,j} = \frac{Q_{0,j,\mathrm{L}} + Q_{0,j,\mathrm{R}}}{g}$	
train mass	t	$m_{\mathrm{trn}} = \sum_{j=1}^{n_{\mathrm{trn}}} P_{0,j}$	

4.3 Optional derived quantities

The following Table 2 defines optional derived quantities.

Table 2 — Optional derived quantities

Quantity	Dimension	Formula	Comment
vehicle mass	t	$m_{\mathrm{veh}} = \sum_{j=1}^{n_{\mathrm{veh}}} P_{0,j}$ NOTE Optional quantity, because there is no exact definition for a vehicle (e.g. articulated train/vehicle).	EN 14363:2005 m_{veh}
Sum of wheel forces per running gear side	kN	$Q_{\mathrm{rg},i,k} = \sum_{j=1}^{z} Q_{0,j,k}$	
Sum of axle loads per running gear	t	$P_{\mathrm{rg},i} = \sum_{j=x}^{x+z-1} P_{0,j}$	
Maximum axle load of the vehicle	t	$P_{\mathrm{max,veh}} = \max(P_{0,j})$	EN 14363:2005 $2Q_{0,\mathrm{max}}$ (in kN)
Mean axle load of train	t	$\overline{P}_{\mathrm{trn}} = \frac{\sum_{j=1}^{n_{\mathrm{trn}}} P_{0,j}}{n_{\mathrm{trn}}}$	
Mean axle load of vehicle	t	$\overline{P}_{\mathrm{veh}} = \frac{\sum_{j=1}^{n_{\mathrm{veh}}} P_{0,j}}{n_{\mathrm{veh}}}$	EN 14363:2005 $2Q_{0,mean}$ (in kN)

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