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oSIST prEN 17397-1:2019

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Železniške naprave - Napake na progi - 1. del: Upravljanje železniških napak

Railway applications - Rail defects - Part 1: Rail defect management

Bahnanwendungen - Schienenfehler - Teil 1: Handhabung von Schienenfehlern

Applications ferroviaires - Défauts de rails - Partie 1 : Gestion des défauts de rails

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ICS:

93.100	Gradnja železnic	Construction of railways

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English Version

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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.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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European foreword

This document (prEN 17397-1:2019) 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.

1 Scope

This document specifies the defect management system the infrastructure manager uses to control the risk of severe accidents due to degradation of internal or surface defects on rails complying with EN 13674-1, EN 13674-2, EN 13674-4 and EN 15689:2009 (excluding grooved rails EN 14811 — which need alternative systems).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 16729-3:2018, *Railway applications - Infrastructure - Non-destructive testing on rails in track - Part 3: Requirements for identifying internal and surface rail defects*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
plain rail
zone comprising all part of the rail located away from the rail ends and the welding zones

3.2
rail end
part of the rail located within the length of the fishplates

3.3
welding zone
weld material itself plus 20 mm from each end of the weld collar (for aluminothermic welding) or upset (flash-butt welding). Any defect occurring in this zone shall be classified as a welding defect

3.4
defective rail
rail that, for reasons of profile (including wear) or integrity, requires management (examples in Annex A)

3.5
damaged rail
rail which is neither cracked nor broken, but which has other defects

3.6
cracked area
part of the rail with a localized discontinuity of material

3.7
broken rail
rail which has separated into two or more pieces (see Figure 1 and Figure 2) or any rail from which a piece of metal becomes detached from the rail head, with a gap of more than 50 mm in length and more than 10 mm in depth resulting in a running band less than 30 mm in width (see Figure 3)

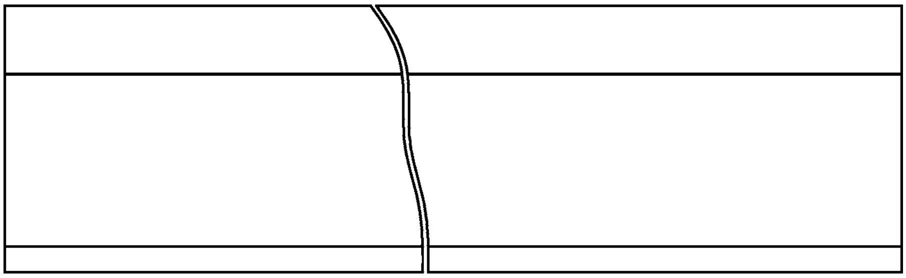
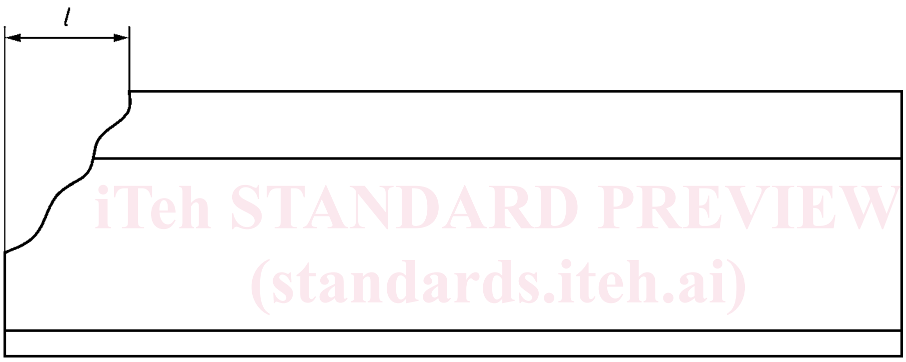


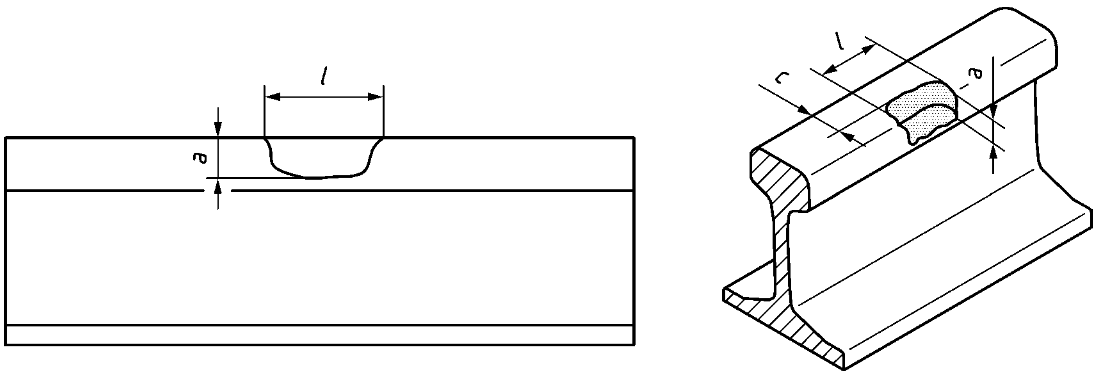
Figure 1 — Broken rail



Key

l horizontal length

Figure 2 — Example of a broken rail with a gap at the rail end



Key

a vertical depth

l horizontal length

c non-cracked area

Figure 3 — Example of a broken rail with a gap

3.8
rail surface defect
defect which initiates on any of the surfaces of the rail

3.9
rail head surface defect
defect that initiates on or close (within 5 mm) to the running surface of the rail

3.10
rail internal defect
defect which initiates from within the rail section but may grow to become visible on the rail surface

3.11
NDT Method
discipline applying a physical principle in Non-Destructive Testing

[SOURCE: EN 13938-5:2004, 08, definition 3.2]

EXAMPLE: Ultrasonic testing.

3.12
wheel/rail interaction
effect of rolling and sliding contact and direct forces from the vehicle wheels which can cause damage to the rail

3.13
environmental degradation
damage to the rail caused by external environmental factors

3.14
geometrical planes of the rail
see EN 16729-3:2018, 3.10, Figure 4

3.15
rail defect management [RDM]
process for the management of defective rails, including defects in switches and crossings, found as a result of inspections or reports

3.16
rail defect management framework
principles outlining and specifying methods to use when assessing and managing defective rails

3.17
rail defect management strategy
railway organisations approach to the management of defective rails

3.18
infrastructure manager [IM]
public body or undertaking responsible in particular for establishing and maintaining railway infrastructure, as well as for operating the control and safety systems

3.19
track maintenance engineer [TME]
engineer with "safety of line" responsibility for a defined track area

4 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

Symbol	Definition
RDM	Rail defect management
S&C	Switches and Crossings
TME	Track maintenance engineer
IM	Infrastructure manager
NDT	Non-destructive testing
CWR	Continuously welded rail
RAMS	Reliability, Availability, Maintainability, Safety
LCC	Life Cycle Costs

5 Defect management system

5.1 General

An infrastructure manager shall put a framework in place to monitor the condition of its assets. If the infrastructure becomes deteriorated, it needs to be renewed or repaired. This can be for economic reasons or, typically at a later state, due to safety reasons.

5.2 Defect types

There are a wide variety of rail defects that lead to damaged or defective rail. These defects can be grouped and categorized by a system.

The classification of the defect types along with the internationally widely used numbering scheme can be found in the annex of this standard.

5.3 NDT inspection of rails

The IM shall implement a testing framework (appropriate NDT methods and inspection frequencies) to inspect rail to detect the defects considered relevant by the IM. The testing frequency should be designed to mitigate the risk that a detectable defect propagates to a critical size leading to failure.

The standard EN 16729-3:2018 describes how several of the most relevant defects can be detected using various methods of NDT.

5.4 Management of NDT inspection results

Actions shall be taken depending on the results of the inspection. Several limits can exist that lead to different actions. Immediate action has to be taken, if the defect has reached a safety critical size.

Smaller detected defects shall be managed (by repair or removal) to prevent them from reaching a safety critical size.

The infrastructure manager shall record the lifecycle of each defect from detection, monitoring, to removal.

6 Limits of rail condition

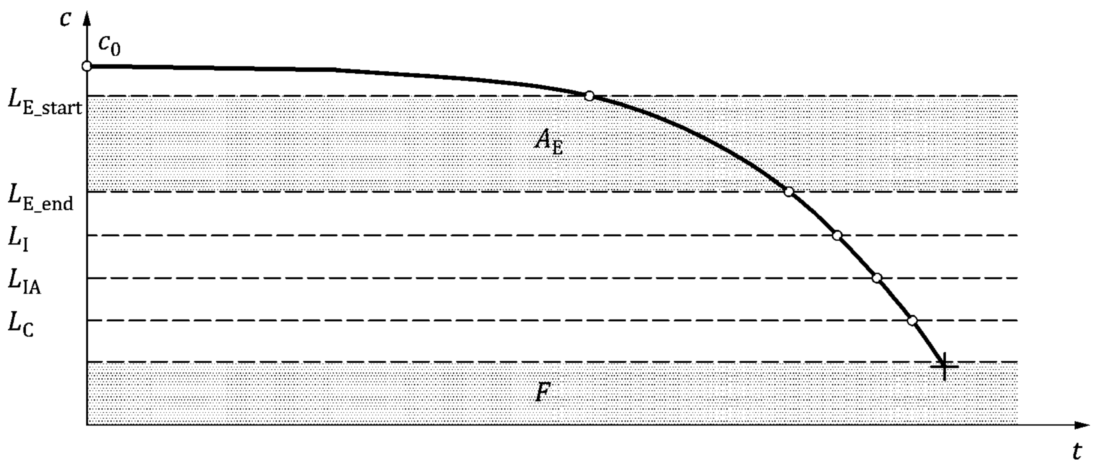
6.1 General

A methodology to analyse rail condition should take into account the economic optimum of Reliability, Availability, Maintainability, Safety (RAMS) and Life Cycle Costs (LCC). Different infrastructure managers have different limits for these economic factors, based on various boundary conditions.

The larger a defect grows, the greater becomes the safety risks and this has to be balanced against the economic limits. The urgent removal of a safety critical defect is usually not the most cost-effective action with regards to LCC.

6.2 Definition of limits

A typical degradation curve is shown in Figure 4, together with an example of various limits for intervention.



Key

C	Current condition of the rail
C_0	Basic condition, this is the condition at which new rail is accepted after the installation in track. Due to the constant usage of the rail, the condition starts to deteriorate.
L_{E_start}	Start of economic maintenance limit, when reaching or exceeding the limit L_{E_start} interventions such as rail reprofiling or repair welding can be considered to improve the condition of the rail and extend its service live.
L_{E_end}	End of economic maintenance limit, at this condition the economic maintenance of the rail has been expended. Actions to improve the condition of the rail are no longer feasible. Further use of the rail is possible. Planning of rail replacement is advised to avoid that the rail reaches a critical condition.
L_I	Intervention limit, intervention limit refers to the value which, if exceeded, requires corrective maintenance in order that the immediate action limit shall not be reached before the next inspection.
L_{IA}	Immediate action limit, the condition of the rail has reached the limit of concern with regard to the structural integrity of the rail. The condition considers an operational risk and the rail does no longer allow for safe and unlimited traffic. Corrective maintenance actions shall be executed as soon as practical, normally within a fixed time limit set by the IM. In the meantime, temporary measures shall be considered to mitigate the risks until the rail can be replaced.
L_C	Critical limit, rail of this condition is a high risk and rail traffic shall be suspended immediately until a full risk assessment has been undertaken by the track maintenance engineer or the rail has been repaired or replaced.
F	Failure of the rail (e.g. rupture)
A_E	Area of economic maintenance
t	Time

Figure 4 — Degradation curve of the rail over the service life

6.3 Rail defect immediate action limits L_{IA}

Informative immediate action limits L_{IA} for the most common types of rail defects can be found in Annex B. The IM may define more stringent limits based upon performance and overall risk management of the infrastructure.

Some defect types do not directly lead to cracks growing in the rail, but will affect the performance of the track system and need to be removed. For these defect types, end of economic maintenance limits L_{E_end} is typically used. One example is corrugation, where the values presented in EN 13231-5:2018 represent end of economic maintenance limits L_{E_end}.

7 Risk mitigation

Risk management starts with the implementation of the track-testing framework, develops on the detection of a defect and ends with the actual removal of the defect. Upon detecting a rail defect and based on the actual circumstances in the track, a variety of measures should be considered in order to mitigate the risk of failure before the rail can be changed:

— reducing line speed;

— mounting fishplates, if feasible for that type of defect;

— increase the frequency of inspection, up to constant surveillance;

— closing the track;

— restriction of the use of certain types of rolling stock.

Several factors other than defect type and size shall be taken into account when assessing the risks that defects have on the structural integrity of the rail:

— line speed, category and type of traffic;

— multiple isolated defects within a short distance or cluster density of defects over longer length;

— expected crack growth until removal;

— location of the defect site in the track;

— track condition including geometry;

— rail profile and current condition such as wear and corrosion;

— steel grade;

— manufacturing process;

— accumulated tonnage;

— site history;

— low rail temperatures causing tensile stress in the rail of continuously welded track.

Annex A
(informative)

Description of rail defects

A.1 Definition and description of rail defects

The general coding system for rail defects and the classification of the different types of defect are shown in Table A.1.

The codes in Table A.1 apply to Vignole rail only.

Table A.1 — Rail defect coding system

1st digit	**2nd digit**	**3rd digit**	**4th digit**
Situation	**Location**	**Pattern, nature**	**Additional characteristics and differentiations**
1. Rail ends 2. Plain rails	0. Full section 1. Rail head 3. Web 5. Foot	0. Unknown origin 1. Transverse 2. Horizontal 3. Longitudinal vertical 4. Corrosion 5. Passing through a hole 6. Not passing through a hole 9. Lap	
	2. Surface of rail head	0. Wear 1. Rolling Surface defects 2. Gauge corner defects 3. Crushing 4. Local batter 5. Wheel burns 7. Cracking and local subsidence of the running surface	
Situation	**Location**	**Origin, cause**	**(No 4th digit)**
3. Defects caused by damage to rail	0. Full section	1. Bruising 2. Faulty machining 3. Permanent deformation	

1st digit	**2nd digit**	**3rd digit**	**4th digit**
Situation	**Welding method**	**Pattern, nature**	**Additional characteristics and differentiations**
4. Welding and resurfacing defects	1. Electric flash-butt welding 2. Thermit welding 3. Electric arc welding 4. Oxyacetylene (autogenous) welding 5. Pressurized gas welding 6. Induction welding 7. Resurfacing 8. Other welding methods	1. Transverse 2. Horizontal or shelling 5. Wheel burns 7. Cracking and local subsidence of the running surface	

Numbering of rail defects.

Each rail defect is assigned a number shown in Table A.2.

Table A.2 — Numbering of rail defects

1	**Defects in rail ends**			
	11/12	Head		
		111	Transverse cracking	
		112	Horizontal cracking	
		113	Longitudinal vertical cracking	
		114	Corrosion	
		121	Surface defects	
			1211	Spalling
			1212	Long groove
			1213	Rolling lap
		122	Shelling of running surface	
			1221	Flaking
			1222	Shelling
			1223	Head Checking
		123	Crushing	
		124	Local batter of running surface	
		125	Isolated wheel burn	
		127	Squat. Cracking and local depression of the running surface	
	13	Web		