SLOVENSKI STANDARD
SIST EN 16729-5:2023

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Železniške naprave - Infrastruktura - Neporušitveno preskušanje na progi - 5. del: Neporušitveno preskušanje zvarnih spojev na progi

Railway applications - Infrastructure - Non-destructive testing on rails in track - Part 5: Non-destructive testing on welds in track

Bahnanwendungen - Oberbau - Zerstörungsfreie Prüfung an Schienen im Gleis - Teil 5: Zerstörungsfreie Prüfung an Schweißungen im Gleis

Applications ferroviaires - Infrastructure - Essais non destructifs sur les rails en voie - Partie 5 : Essais non destructifs sur les soudures en voie

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ICS:

19.100	Neporušitveno preskušanje	Non-destructive testing
25.160.40	Varjeni spoji in vari	Welded joints and welds
93.100	Gradnja železnic	Construction of railways

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EUROPEAN STANDARD

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Railway applications - Infrastructure - Non-destructive testing on rails in track - Part 5: Non-destructive testing on welds in track

Applications ferroviaires - Infrastructure - Essais non destructifs sur les rails en voie - Partie 5 : Essais non destructifs sur les soudures en voie

Bahnanwendungen - Oberbau - Zerstörungsfreie Prüfung an Schienen im Gleis - Teil 5: Zerstörungsfreie Prüfung an Schweißungen im Gleis

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Contents

Page

European foreword

This document (EN 16729-5:2023) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2023, and conflicting national standards shall be withdrawn at the latest by October 2023.

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Introduction

The procedures are intended for new welds but are applicable to all welds on demand of the responsible IM. If welds are to be tested, they should be tested by the procedures defined in this document.

1 Scope

This document specifies the procedures of visual testing and ultrasonic testing of rail welds in track for rail profiles meeting the requirements of EN 13674-1.

This document specifies the principles for testing procedures for manufactured welds. This document defines the procedure for repair welds and joint welds. This document does not define the number of welds to be tested.

This document is not concerned with the approval of the welding procedure.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

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

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

3.1
collar
excess of weld material outside the rail profile

3.2
registration level
ultrasonic signal amplitude where indications shall be recorded, not to be confused with acceptance criteria

3.3
tandem rig
rig that ensures a correct distance between two ultrasonic probes

3.4
testing zone
location where probes or devices are placed/moved on the rail surface

3.5
inspection zone
area or volume which is checked for indications

4 Symbols and abbreviations

For the purposes of this document, the abbreviations in Table 1 apply.

Table 1 — Abbreviations

Abbreviation	Abbreviated term
DAC	Distance Amplitude Correction
FBH	Flat Bottom Hole, see EN 16729-1
FSH	Full Screen Height
H	Phase H for testing with hand-held single probes
T	Phase T for testing with tandem 45° on the running surface
TS	Phase TS for testing with tandem 70° on the side of the rail head, web and foot
UT	Ultrasonic testing
VT	Visual testing
W	Phase W for testing with a walking stick
IG	Inspection gain
G_{DAC}	Gain distance amplitude correction
ΔG	Transfer gain compensation
G_{weld}	Gain needed for 80 % FSH in the weld
G_{plain_rail}	Gain needed for 80 % FSH in the plain rail
IM	Infrastructure manager

5 NDT methods to detect defects in rail welds

5.1 General

This part of this document specifies non-destructive testing methods for the detection of internal and surface defects in rail welds and the suitability of the test methods for the detection and assessment of weld defects in rails in track. The description of the defects can be found in Table 3 to Table 17, including the respective Figure 1 to Figure 19. The procedures for detecting indications in rail welds are presented in the Annex A and Annex B. The procedures according to defect and inspection number are presented in Table 2.

The requirements to inspect welds are determined by the IM. If the inspection of a selection or all the welds is required by the IM, the IM should define which procedure and which inspection number shall be performed.

The informative annexes do not give acceptance criteria. The acceptance criteria can be defined on the basis of the reference blocks and the level of sensitivity, including the number of indications which exceed the sensitivity and the registration level. These parameters should be defined in the inspection instruction approved by the IM.

Table 2 — Testing procedures of the weld defects according to the inspection number in Annex A and Annex B

Procedures in Annex			VT	UT										
Inspection phase [a]				W.1	W.2	W.3	H.1	H.2	H.3	H.4	T.1	TS.1	TS.2	TS.3
Electric arc repair welds	Volumetric defects	Porosity	X	X	X	X	X	X	X		X	X		
	Planar defects	Surface cracking	X	X	X	X	X	X	X		X	X		
		Transverse cracking	X	X	X	X	X	X	X		X	X		
		Lack of fusion	X	X	X	X	X	X	X		X	X		
Flash butt welds	Volumetric defects	Lack of fusion			X	X		X	X	X	X			X
Alumino-thermic welds	Volumetric defects	Porosity	X	X	X	X	X	X	X	X	X	X	X	X
		Inclusions		X	X	X	X	X	X	X	X	X	X	X
		Shrinkage											X	
		Lack of fusion		X	X	X	X	X	X	X	X	X	X	X
	Planar defects	Sand burn	X	X	X	X	X	X	X		X	X		
		Surface defects in the weld collar	X										X	
		Thermal contraction (hot tear)	X	X	X	X	X	X	X	X	X		X	X
		Fatigue cracks	X	X	X	X	X	X	X	X	X	X	X	X
		Transversal tearing of the surface weld material	X	X	X	X	X	X	X		X			
		Weld collar damage at vent riser	X							X			X	X

[a] Overview of inspection numbers in Table B.1.

5.2 Visual testing – VT

5.2.1 General

Visual testing of welds in rails is an examination of the surface, to detect the presence of a defect and to define and measure it.

5.2.2 VT inspection zone

Visual testing can inspect all surface areas of welds.

5.2.3 Example of defects

Examples of defects identified by visual testing are:

— broken welds;

— gas holes;

— surface porosity;

— surface breaking cracks;

— sand inclusions;

— geometrical errors.

5.3 Ultrasonic Testing — UT

5.3.1 General

Ultrasonic testing of welds in rails is an examination of the internal volume, to detect the presence of a defect and to define and measure it.

5.3.2 UT inspection zone

Ultrasonic testing can inspect the internal volume of the weld, fusion zone and heat affected zone. The inspection zone depends on welding type and expected indications.

5.3.3 Example of defects

Examples of defects identified by ultrasonic testing are:

— lack of fusion;

— cracks;

— inclusions;

— porosity;

— hot tear.

6 Description of weld defects

6.1 Defects in electric arc repair welds

6.1.1 Volumetric defects - Porosity

Table 3 — Porosity

Weld type:	Electric arc repair welds
Defect type:	Porosity
Appearance, causes and location: — Porosity in electric arc repair welds is characterized by small inclusions on the welding material. — It is presented on the surface or inside the welding material itself, more common on the longitudinal limits of the repair weld. — It can derive from poor execution on the part of the welder, unfavourable environmental conditions and the quality/suitability of the electrodes used. — It can develop cracks under impact loads.	

Figure 1 — Porosity on electric arc repair welds (a)

Figure 2 — Porosity on electric arc repair welds (b)

6.1.2 Planar defects

6.1.2.1 Surface cracking

Table 4 — Surface cracking

Weld type:	Electric arc repair welds
Defect type:	Surface cracking
Appearance, causes and location: — Surface cracking on electric arc repair welds is characterized by superficial cracks on the welding surface material. — It originates either isolated or associated with superficial porosities. — It is presented on the surface of the repair weld, more common on the longitudinal limits of the repair weld. — It can derive from poor execution on the part of the welder, unfavourable environmental conditions and the quality/suitability of the electrodes used. — It has accelerated propagation due to impact loads, especially at joints in poor conditions. — It may progress into spalling and at a later stage pieces of welding material may break away.	

Figure 3 — Surface cracking

6.1.2.2 Transverse cracking

Table 5 — Transverse cracking

Weld type:	Electric arc repair welds
Defect type:	Transverse cracking
Appearance, causes and location: — Transverse cracking on electric arc repair welds has its point of origin in the head of the rail in or under the repair weld. — It can derive from either not sufficient removal of rail material to eliminate pre-existing cracks in the rail head or by slag intrusion at the fusion face of the weld. — It may occur due to residual stresses caused by incorrect welding procedure such as incorrect pre-heat or wrong consumables. — It can rapidly develop in size and severity, mainly associated with the heating produced during the weld repair procedure.	

Figure 4 — Transverse cracking

6.1.2.3 Lack of fusion

Table 6 — Lack of fusion

Weld type:	Electric arc repair welds
Defect type:	Lack of fusion
Appearance, causes and location: — Lack of fusion between the welding and the rail material is characterized by poor contact between the two materials. — It can develop in to a breakaway of a significant piece of welding material, down to the rail material under the repair weld. — It derives mainly from insufficient preheating of the rail under repair, but it can also be associated with poor execution on the part of the welder, unfavourable environmental conditions and the quality/suitability of the electrodes used. — It has accelerated propagation due to impact loads, especially at joints in poor conditions. — It shall not to be confused with a severe stage of spalling on the weld material.	