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Železniške naprave - Zgornji ustroj - Prevzem del - 5. del: Postopki za reprofiliranje tirov na odprti progi, stikal, prehodov in razširjevalnih naprav

Railway applications - Track - Acceptance of works - Part 5: Procedures for rail reprofiling in plain line, switches, crossings and expansion devices

Bahnanwendungen - Oberbau - Abnahme von Arbeiten - Teil 5: Procedere zur Reprofilierung von Schienen in Gleisen, Weichen, Kreuzungen und Schienenauszügen

Applications ferroviaires - Voie - Réception des travaux - Partie 5 : Procédure pour le reprofilage de rails en voie courante, en appareil de voie et en appareil de dilatation

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European foreword

This document (prEN 13231-5:2016) 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/CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This European Standard is one of the series EN 13231, *Railway applications — Track — Acceptance of works* as listed below:

— *Part 1: Works on ballasted track — Plain line, switches and crossings*;

— *Part 3: Acceptance of reprofiling rails in track*;

— *Part 4: Acceptance of reprofiling rails in switches and crossings*;

— *Part 5: Procedures for rail reprofiling in plain line, switches, crossings and expansion devices* (the present document).

1 Scope

This European Standard specifies the procedure for inspection, planning and execution of rail reprofiling work including description of rail surface defects. It concerns work in both plain lines and switches and crossings generally done with machines according to the EN 14033 series and EN 15746 series.

It applies to vignole railway rails of 46 kg/m and above according to EN 13674-1.

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 13231-3:2012, *Railway applications — Track - Acceptance of works — Part 3: Acceptance of reprofiling rails in track*

EN 13231-4:2013, *Railway applications — Track - Acceptance of works — Part 4: Acceptance of reprofiling rails in switches and crossings*

3 Terms and definitions

For the purposes of this document the terms and definitions given in EN 13231-3:2012 and EN 13231-4:2013 and the following apply.

3.1
anti–head check profile
AHC Profile
rail head profile with a geometry to prevent and reduce head checking

3.2
rolling contact fatigue
RCF
rail damage caused by the complex stresses that are characteristic of rail wheel contact

3.3
head checking
HC
small parallel cracks on the rail head near or on the gauge corner

3.4
Belgrospi
network of cracks developing on the rail head of track with speed greater than 160 km/h affected by short pitch corrugation

3.5
squat
rolling contact fatigue defect whose main characteristics are a blackish patch on rail head, a lateral flow of steel and a collapsed and widened rolling band

3.6
flaking
surface condition consisting of the gouging of metal on the rail head

3.7
spalling
cracking and chipping on the top of the rail

Note 1 to entry: Occurs commonly on low rails.

3.8
transverse profile deformation
plastic metal flow on the rail head

3.9
side cutting
wear occurring on high rails in small radius curves where wheel flanges contact the rail

3.10
lipping
plastic metal flow occurring on the rail head under conditions of high axle load and high gross tonnage

3.11
short pitch corrugation
quasi-periodic irregularities on the running surface

Note 1 to entry: The wavelength usually is 10 mm to 100 mm.

3.12
short wave corrugation
depressions in the running surface which are pronounced

Note 1 to entry: The wavelength usually is 30 mm to 300 mm.

3.13
long wave corrugation
irregular unevenness on the running surface

Note 1 to entry: The wavelength usually is 300 mm to 1 000 mm.

3.14
imprint
damage resulting from a small object which has been pressed into the rail by the wheel

3.15
wheel burn
abrasive, plastic and thermal damage occurring in zones where trains start to move

Note 1 to entry: Occurs e.g. at signals.

4 Basics

4.1 Technical Introduction

The complexity of vehicle-track interaction generates high stresses at the rail-wheel contact, the severity of which is governed by local track characteristics, vehicle type and other operational conditions. The repeated application of these stresses results in the development of fatigue cracks usually referred to as RCF manifested as head checks, gauge corner cracking, or squats. Although rail

metallurgy offers a key mitigation measure against such fatigue degradation, there are no rail steels currently in use that could fully withstand the repeated application of such contact stresses. Furthermore the majority of rails in track today, despite their adequate but lower fatigue resistance, have an appreciable residual life span, which makes it more economic to maintain them in an appropriate manner to extend their life rather than to change them.

Management of rail profile and condition is therefore a prerequisite for safe and cost effective operation of railways. Predictable work – at least in a medium time horizon – organized in a strategic way needs to be defined to extract the maximum benefit from existing technologies and to guide the industry for future development. However, it is essential to ensure that the chosen approach provides enough flexibility to adapt to changing situations in both senses: increased requirements for maintenance due to higher loads and dynamic forces, reduced requirements for maintenance due to lower loads (improved vehicle characteristics) and better performing rails (reduced fatigue development).

The life expectancy of a rail is influenced by its interactions with the other parts of the train-track system. The faster and more frequent train services, higher axle loads and new generations of vehicles with greater primary yaw stiffness have significantly increased the critical track forces that promote more rapid degradation of the rail (and wheel) leading to more frequent and costly maintenance interventions and even rail renewal. Significant research into rail metallurgy has resulted in the development of rail steels with much higher resistance to wear and RCF. Nevertheless rail maintenance by reprofiling is an essential requirement for efficient and safe functioning of railway track. The combination of rail grade selection and maintenance strategy considering local track and traffic characteristics assures effective control of any kind of rail surface defects.

4.2 Background of rail reprofiling

Reprofiling strategy is a planned maintenance activity usually defined by the infrastructure maintainer. In theory it is independent of available technologies, but in practice it is often influenced by the equipment that is easily accessible to or proposed by the contractors.

Work is programmed depending on damage having reached predetermined intervention thresholds such as corrugation depth, deviation from the transverse profile and depth of cracks.

Alternatively work is executed in cycles which are derived from experience and influenced by availability of machines, track possession times and similar factors such as traffic, usually expressed in mega gross tons (MGT), months, seasons, etc. Often work is combined with other maintenance activities (e.g. after rail replacement, after tamping or when the line is closed for other work, etc.).

Before the execution of rail maintenance work, specifications (i.e. the results that need to be achieved) shall be defined for:

— defect repair (metal removal);

— longitudinal profile (tolerance);

— transversal profile (target and tolerance);

— surface condition (roughness, facet widths, etc.).

Rail reprofiling as described in this document refers to rail rectification using currently available technologies such as grinding, milling, planning, etc.

4.3 Specific reprofiling strategy

In addition to the use of the appropriate rail steel grade the consecutive reprofiling cycles are also dependant on other important parameters, such as existing reprofiling capacity (e.g. maximum/minimum metal removal rates, sections lengths, etc.) and available working intervals

(possession times, route reprofiling capabilities, etc.). For the development of an optimized reprofiling strategy these parameters shall also be taken into account.

Shorter reprofiling intervals result in smaller metal removal requirements, consequently in such short periods the development of RCF and irregularities such as corrugation and resulting track deterioration is limited.

The best strategy is preventive cyclic reprofiling with small metal removal requirements applying profiles with moderate gauge corner relief. If the interval between reprofiling cycles is appropriately matched with the initiation and subsequent growth of cracks, metal removal can be adjusted for a one-pass regime which is operationally the best option.

In order to maintain RCF-sensitive sections economically, a certain damage level can be accepted (as intervention threshold or as remaining depth after treatment). However, this damage needs to be kept low enough to be removed pre-emptively and thereby avoiding safety issues. A rail reprofiling strategy requiring metal removal rates of up to 0,6 mm at the critical gauge area and a maximum of 0,2 mm in the centre of the rail head shall be programmed.

Several Infrastructure Managers (IMs) utilize these metal removal specifications to control HC in standard carbon rail (R260) based on reprofiling cycles at 15 MGT for curves and 45 MGT for tangent track. For harder heat treated rails (e.g. R350HT) the intervals may be doubled depending on track and traffic characteristics.

If squats need to be controlled in tangent track due to traffic and vehicle characteristics (stiffness, traction and braking) shorter cycles may be required.

The reprofiling interval and the related average metal removal should depend on actual HC measurements which need to be checked again during reprofiling work. Such a policy optimizes the magnitude of artificial wear by reprofiling and hence prolongs rail life.

5 Rail surface defects

5.1 General

Each irregularity causes a higher dynamic load on the surface of the rail and consequently an impact occurs at each wheel passage. Consequently the rail is subjected to high stresses and the damage often progresses at a significant rate.

Not only is the rail affected but also the whole track system. As the rail cannot always absorb the energy from the impact, the shock load continues further into the track. Local damage to fastenings, pads and sleepers may result. Ultimately the ballast becomes locally overloaded and disturbed and the stability of the track can no longer be assured.

5.2 Rolling contact fatigue

5.2.1 Head check

Head checking is characterized by small parallel cracks on the rail head near the gauge corner or on the gauge corner (see Figure 1). The exact localization of the head check depends on the contact conditions. It appears mainly on the high rail on large radius curves but can occur on small radius curves or tangent track. The orientation and periodicity of the cracks depends on rail grade and track geometry. However the cracks are generally oriented from the top of the rail to the gauge in the direction of traffic. In the vertical section through the cracks their orientation is from the top of the rail to the bottom of the rail in the direction of traffic.

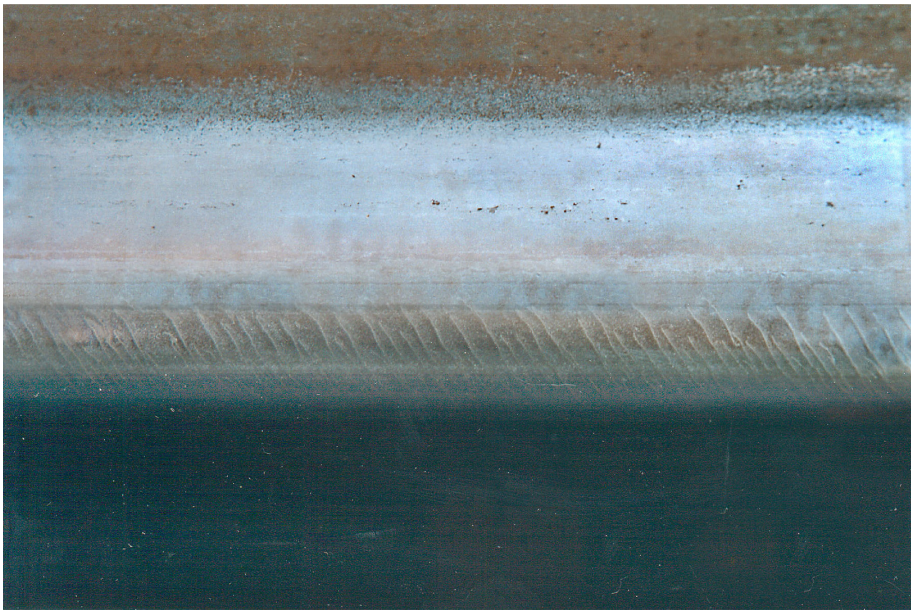

Figure 1 — Head check

5.2.2 Belgrospi

A network of cracks may develop on rail of track speed greater than 160 km/h affected by short pitch corrugation (see Figure 2). The cracks appear at short pitch corrugation with a depth of 0,03 mm. If not removed in time they may grow and develop into squats (see 5.2.3).

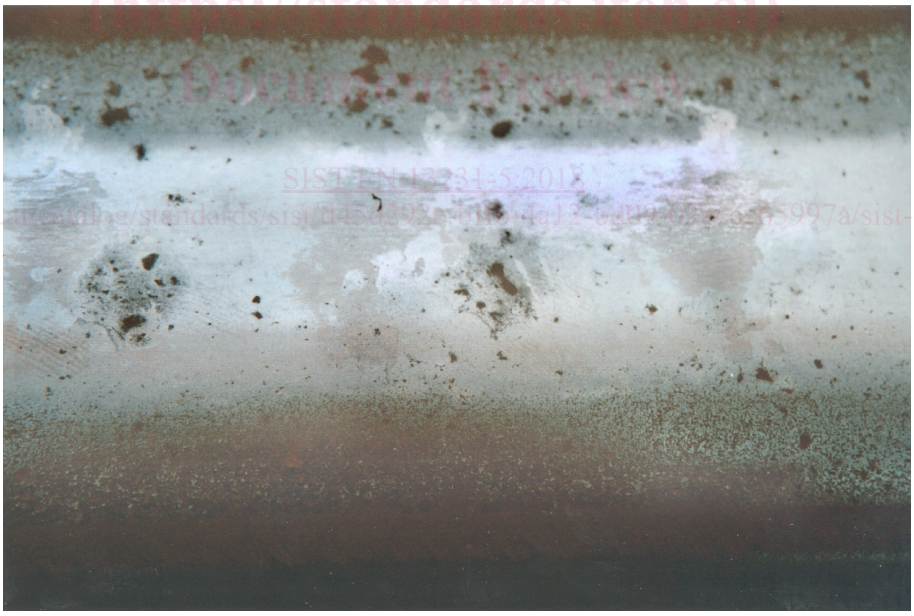

Figure 2 — Belgrospi

5.2.3 Squats

Squat defects (see Figure 3) are rolling contact fatigue defects whose main characteristics are:

— a blackish patch on rail head;

— a lateral flow of steel;

— a collapsed and widened rolling band.

Under this defect a network of cracks grows from two main horizontal cracks and may lead to a severe and unexpected rail breakdown. This network of cracks makes it difficult to analyse the defect.

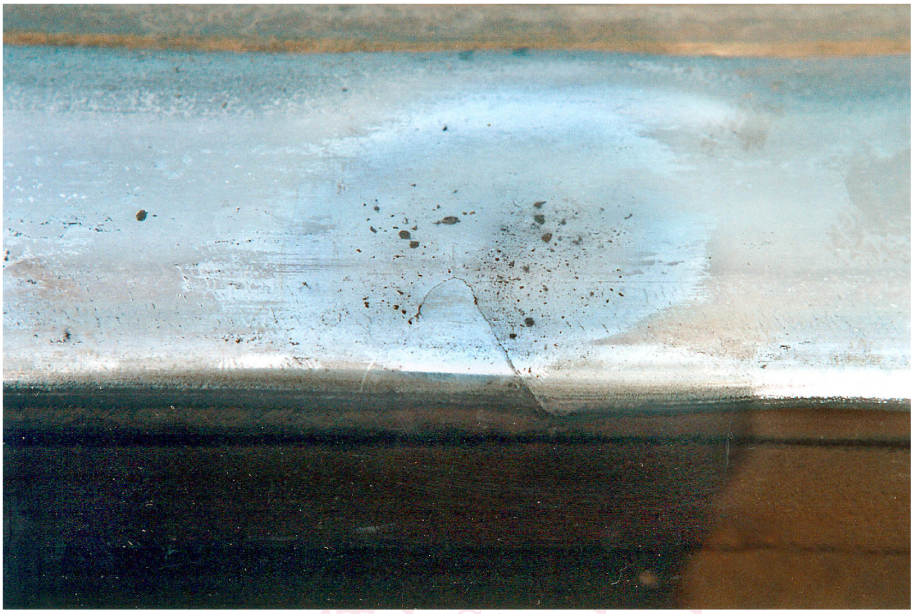

Figure 3 — Squat

5.2.4 Flaking (Gauge corner cracking)

Flaking is a surface condition consisting of the gouging of metal on the rail head. It is indicated by small chipping and cavities (see Figure 4). It is a progressive horizontal separation on the running surface of rail near the gauge corner with scaling or chipping of small slivers. Flaking should not be confused with shelling as the flaking takes place only on the running surface usually near the gauge corner of the rail and is not as deep as shelling.