INTERNATIONAL STANDARD

ISO 22055

First edition
2019-11

Switch and crossing rails

Rails pour appareils de voie

Reference number
ISO 22055:2019(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 15, *Railway rails, rails fasteners, wheels and wheelsets*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Switch and crossing rails

1 Scope

This document specifies switch and crossing rails that carry railway wheels as specified in ISO 5003. These are used in conjunction with flat bottom (vignole) railway rails. After switch and crossing rails are produced, in order to be ready for railway track use, secondary processing (forging, grinding and heat treatment etc.) is carried out. This document does not include secondary processing. Secondary processing is specified in other standards or through agreements between manufacturer and purchaser.

Sixteen pearlitic steel grades are specified, covering a hardness range of 200 HBW to 440 HBW, and include non-heat-treated carbon manganese steels, non-heat-treated alloy steels, heat-treated carbon manganese and heat-treated low alloy steels.

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.

ISO 3887, *Steels — Determination of the depth of decarburization*

ISO 4967, *Steel — Determination of content of non-metallic inclusions — Micrographic method using standard diagrams*

ISO 4968, *Steel — Macrographic examination by sulfur print (Baumann method)*

ISO 4969, *Steel — Etching method for macroscopic examination*

ISO 5003:2016, *Flat bottom (Vignole) railway rails 43 kg/m and above*

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

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:

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

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

3.1
heat
<liquid steel> melt tapped out of a converter or electric arc furnace which includes after continuous casting a given number of blooms relating to the weight of the heat and the extension of the mixing zone

Note 1 to entry: In the case of sequence casting the blooms belonging to the mixing zone should be clearly defined.

3.2
sequence
any number of *heats* (3.1), of the same steel grade, which undergo continuous casting in tundishes

Note 1 to entry: Tundishes can be used in parallel if the caster has many strands.

3.3
heat-treated rail
rail that has undergone accelerated cooling from austenitizing temperature during the metallurgical transformation period

3.4
rolling process
process between the blooms leaving the heating furnace and exiting the finishing pass

3.5
isothermal treatment process
process whereby blooms are held for a period of time at an elevated temperature for reducing the hydrogen content

Note 1 to entry: For maximum efficiency this is as near to (but below) the pearlite to austenite transformation temperature as is practically possible.

Note 2 to entry: This process is sometimes referred to as sub-critical diffusion annealing.

3.6
rail running surface
curved surface of the rail head

Note 1 to entry: It may also refer to any area between both gauge corners (transition points of the head inclination and the first head radius).

4 Information to be supplied by the purchaser

The purchaser shall provide the supplier with the following information at the time of enquiry or order:

a) the rail profile (by submitting a drawing);

b) the steel grade (see 7.2);

c) the non-metallic inclusion determination method and if applicable: the class “1” or “2” of rail (see Table 12);

d) the determination of the macrostructure (see 5.10);

e) the lengths of rail (see 6.1 and Table 3);

f) undrilled or drilled rail ends to take fish bolts, and location and dimensions of holes when required (see 6.1 and Table 3);

g) paint code requirements (see 9.4.4).

5 Test methods

5.1 Test items, testing frequency and test methods

Test items, sampling position, sampling numbers and test methods shall be as given in Table 1.

Table 1 — Testing frequency for acceptance testing

Test items	As-rolled rails	Heat-treated rails	Relevant subclause
Chemical composition	One per heat	One per heat	5.2
Hydrogen	One per heat (2 tests from first heat in sequence)	One per heat (2 tests from first heat in sequence)	5.3
Total oxygen	One per sequence[a]	One per sequence[a]	5.4
Tensile	One per heat[a,b,d]	One per heat[a,c]	5.5
Hardness	One per heat[a,b]	One per heat[a,c]	5.6
Microstructure	Not required for grades HR200, HR220, HR235 and HR260A One per 1 000 tonnes or part thereof for grades HR260B, HR310C and HR320[a,b]	One per 100 tonnes of heat-treated rail[a,c]	5.7
Decarburization	One per 1 000 tonnes or part thereof[a,b]	One per 500 tonnes or part thereof[a,c]	5.8
Nonmetallic inclusions	One per sequence[b]	One per sequence[b or c]	5.9
Macrostructure	One per 500 tonnes or part thereof[a,b]	One per 500 tonnes or part thereof[a,b or c]	5.10
Dimension	Whole length	Whole length	6.1
Straightness	Whole length	Whole length	6.2
Surface quality	Whole length	Whole length	7.9
Ultrasonic test	Whole length	Whole length	5.11

[a] Samples shall be taken at random. When different rail grades are cast in the same sequence, the samples shall be taken outside the mixing zone.

[b] Samples shall be cut after rolling.

[c] Samples shall be cut after heat-treating for heat-treated rails.

[d] One calculation per heat and one testing per 2 000 tonnes if agreed between purchaser and manufacturer.

5.2 Chemical composition

The chemical composition shall be determined on the liquid.

When the solid chemical composition is to be checked as a requirement of the purchaser, this shall be carried out at the position of the tensile test piece shown in Figure 1.

5.3 Hydrogen content

The hydrogen content of the liquid steel shall be measured by determining the pressure of hydrogen in the steel using an on-line immersion probe system or a method agreed between the purchaser and manufacturer.

At least two liquid samples shall be taken from the first heat of any sequence using a new tundish and one from each of the remaining heats and analysed for hydrogen content (see Table 1). The first sample from the first heat in a sequence shall be taken from the tundish at the time of the maximum hydrogen concentration.

When testing of rails is required rail samples shall be taken at the hot saw at a frequency of one per heat at random. However, on the first heat in a sequence, the rail sample shall be from the last part of a first bloom teemed on any strand. Hydrogen determination shall be carried out on samples taken from the centre of the rail head and determined by automatic machine.

5.4 Total oxygen content

The total oxygen content can be determined in the liquid or solid.

If the total oxygen content is determined from the solid rail head, the testing positions are shown in Figure 2.

5.5 Tensile test

Test samples shall be taken from the rail head as shown in Figure 1.

The tensile properties shall be determined in accordance with ISO 6892-1 by using a round tensile test piece with the dimensions as follows:

— diameter 10 mm;

— gauge length 50 mm.

In the case of dispute, the tensile test pieces shall be maintained at a temperature of 200 °C for 6 h before testing.

For as-rolled rails, the tensile strength and elongation may be determined as agreed between purchaser and manufacturer by a correlation to the chemical composition based on the statistical data analysis. The method to be applied is shown in ISO 5003:2016, Annex B.

5.6 Hardness

5.6.1 General requirements

Brinell hardness tests (HBW) shall be carried out in accordance with ISO 6506-1. The method used is at the discretion of the manufacturer.

In case of dispute, the test shall be done using HBW 2,5/187,5.

5.6.2 Surface hardness

The surface hardness shall be tested at position RS as shown in Figure 3.

The surface hardness shall be tested on the centre line of the rail head crown. 0,5 mm shall be removed from the running surface before a hardness impression is made. Surface quality shall be in accordance with ISO 6506-1.

5.6.3 Internal hardness

For heat-treated rails the internal hardness shall be tested in accordance with ISO 6506-1 at the testing positions shown in Figure 3.

The internal hardness of heat-treated rails of any steel grade shall be determined on a transverse specimen cut from the end of the rail. The specimen shall be ground or milled so that the transverse surfaces are parallel.

5.7 Microstructure

The microstructure testing position in the rail head shall be as shown in Figure 1 and shall be determined at a magnification of ×500.

5.8 Decarburization

Decarburisation depth shall be assessed by means of a hardness test using HBW 2,5/187,5 indentation. The test shall be performed at three points in the centre of the rail crown after minimal preparation of the rail head surface (less than 0,2 mm material removed). None of the hardness test results shall be more than 7 points lower than the minimum hardness of the specified grade (e.g. 253 HBW for 260 grade rail). If the test fails to meet the requirements, decarburization shall be measured at the same sample location metallographically.

As an alternative or in the case of dispute decarburisation depth shall be measured metallographically. The testing position in the surface of the rail head shall be as shown in Figure 4. The test shall measure the depth of closed ferrite network in accordance with ISO 3887. Photomicrographs showing examples of how to determine the depth of decarburization are shown in Figure 5.

5.9 Non-metallic inclusions

5.9.1 General requirements

Samples shall be taken from one of the last blooms of the last heat of the sequence. From each sample 2 specimens shall be tested.

The non-metallic inclusions testing position in the rail head is shown in Figure 6.

5.9.2 Testing methods

The test shall conform with the method shown in ISO 5003:2016, Annex C.

If agreed between purchaser and manufacturer [see Clause 4 c)], alternative methods may be used:

— ISO 4967:2013, Method A.

— ASTM E45, Method A.

5.10 Macrostructure

Macrostructure of transverse rail sections shall be tested in accordance with ISO 4969 or ISO 4968, as agreed between purchaser and manufacturer [information given by the purchaser in Clause 4 d)].

5.11 Ultrasonic test

5.11.1 Testing area

The minimum cross-sectional area examined by the ultrasonic technique shall be:

— at least 70 % of the head;

— at least 60 % of the web;

— and the area of the foot to be tested shall be as shown in Figure 7.

In the case of a web width exceeding 16,5 mm or an asymmetrical rail geometry, the area on the foot to be tested can be determined by agreement between the purchaser and the manufacturer.

By convention these areas are based on projecting the nominal crystal size of the probe. The head shall be tested from both sides and from the running surface.

5.11.2 Sensitivity requirements

The sensitivity levels of the automated equipment used shall be a minimum of 4 dB greater than the level required to detect the reference reflectors described in 5.11.3. A rail giving an echo referring to a possible defect shall be separated by means of an automatic trigger/alarm level combined with a marking and/or sorting system. For possible retesting, the test sensitivity shall be increased to 6 dB instead of 4 dB.

The system shall incorporate continuous monitoring of interface signals and, if present, backwall echo signals.

5.11.3 Calibration rails

There shall be a calibration rail for each profile to be tested ultrasonically. The positions of the artificial defects are given for the rail head, web and foot of the 60E1 profile (see Annex D in ISO 5003:2016) in Figures 8, 9 and 10 respectively. Calibration rails for other profiles with calibration defects similar to those in accordance with Figures 8, 9 and 10 for 60E1 shall be available.

Other methods of calibration may be used but these methods shall be equivalent to that described above.

6 Tolerances for dimension, length and weight

6.1 Dimension and length tolerance

The dimensions of the profile [see Clause 4 a)] which shall have certain tolerances are given in Table 2.

The cut length and shortened length of rails shall be agreed by the purchaser and manufacturer [see Clause 4 e)]. The tolerances for cutting, drilling and length shall be as given in Table 3. The chamfer angle of drilled holes shall be 45° and 0,8 mm to 2,0 mm in depth.

6.2 Straightness, surface flatness and twist

Flatness testing of the body shall be performed automatically.

Tolerances for straightness, surface flatness and twist shall meet the requirements given in Table 4.

If the rail shows evidence of twist, this shall be checked in accordance with Figure 11 by inserting feeler gauges between the base of the rail and the rail skid nearest the rail end with the rail being laid head up on an inspection bed. If the gap exceeds 2,5 mm the rail shall be rejected. For twist measurement the rail may not overhang the end skid by more than 2 000 mm.

Rotational twist in the end metre of the rail as measured by the gauge illustrated in Figure 12 shall not exceed 0,2°.

Rejected rails may be subject to only one roller re-straightening.

In cases of dispute on the results of the automatic technique, rail flatness shall be verified using a straight edge as shown in Table 4.

6.3 Weight

Rails shall be delivered in theoretical weight. The density of 7,85 g/cm^3 shall be applied to calculate the rail theoretical weight.