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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 23300-2

Railway infrastructure — Rail welding —

Part 2: Aluminothermic welding

*Infrastructure ferroviaire — Soudage des rails —
Partie 2: Soudage des rails par aluminothermie*

ICS: 45.080

ISO/TC 269/SC 1

Secretariat: **SAC**

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Voting terminates on:
2024-10-31

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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).

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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 269, *Railway applications*, Subcommittee SC 1, *Infrastructure*.

A list of all parts in the ISO 23300 series can be found on the ISO website.

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.

Introduction

Rail welding is an essential technology in the railway track domain for reducing noise and vibration on rail joints, improving ride comfort and reducing maintenance costs.

Since environments (e.g. geography, deployable resources and energy affairs) differ by region and railway line, rail welding processes have been developed to meet the requirements and conditions of each environment. As a result, various rail welding processes exist, e.g. flash butt welding (FBW), gas pressure welding (GPW), aluminothermic welding (ATW) and enclosed arc welding (EAW).

For this reason, a general rail welding standard on an international level covering conventional rail welding processes was deemed necessary. This document contributes to the development of railways by ensuring the quality of welded joints in terms of enhancing the reliability of train operation, improving the welding work efficiency and facilitating the introduction of new procedures.

This document covers the ATW requirements for rail welding, which specifies the approval of ATW processes, laboratory tests, requirements for welder/contractor, acceptance of aluminothermic welds in track.

This document is part 2 of the rail welding series standard and is used in conjunction with part 1 "General requirements and test methods for rail welding" (ISO 23300-1:2021) which covers the general requirements for each welding process (such as FBW, GPW, ATW and EAW).

Railway infrastructure — Rail welding —

Part 2: Aluminothermic welding

1 Scope

This ISO Standard specifies the requirements on rail aluminothermic welding, including the requirements for approval process, laboratory tests, approval of welder/contractor, as well as the acceptance criteria of aluminothermic welds in track.

In this document, 43 kg/m – 75 kg/m new vignole rails of the same profiles and same steel grades are the subject of welding.

This document is restricted to butt welding for connecting rail ends. This document does not cover safety regulation of welding operation.

Compliance with the requirements of this standard does not of itself ensure the suitability of a welding process for specific conditions of track and traffic.

The standard does not cover welds made between different rail sections, differently worn rails and different rail grades.

In addition to the definitive requirements, this standard also requires the items detailed in [Clause 4](#) to be documented. For compliance with this standard, it is important that both the definitive requirements and the documented items be satisfied.

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 3834-2, *Quality requirements for fusion welding of metallic materials — Part 2: Comprehensive quality requirements*

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 6506-1:2014)*

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

ISO 14731, *Welding coordination — Tasks and responsibilities*

ISO 23300-1:2021, *Railway infrastructure — Rail welding — Part 1: General requirements and test methods for rail welding*

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

flashing

flat fin of weld metal located on the rail surface adjacent to the weld collar caused by gaps between the mould and the rail

3.2

fusion zone

area of the weld which has been in a liquid state and which is revealed by etching sections cut through the weld

3.3

heat softened zone

part of the Heat Affected Zone (HAZ) characterised by a lower hardness

3.4

process manual

manual produced by the process supplier, it identifies the consumables, equipment and operating method to be followed for all steps of the critical welding parameters

3.5

visible heat-affected zone

areas on either side of the fusion zone within which rail steel microstructure has been visibly modified by the heat of the welding process as revealed by macro-etching

3.6

weld collar

external profile of the as-cast weld metal that remains after removal of the moulds

3.7

employer

a company that employs approved aluminothermic welders

3.8

trainer

qualified and certified trainer approved by the process supplier and/or authorised by the railway authority

3.9

responsible welding coordinator

person responsible and competent to perform welding coordination

3.10

examiner

person assigned by the process supplier and/or the railway authority to examine knowledge and skills of a welder

4 Information to be supplied by the railway authority

The following information shall be documented by the railway authority. For compliance with the standard document both the definitive requirements specified throughout the standard document and the following documented items shall be satisfied:

- a) Pre-heating limitations of the railway authority;
- b) The width levels of heat-softened zone required ([6.2.2](#));
- c) The fatigue test, if required by the railway authority, shall be carried out in accordance to either Annex C or Annex D of ISO23300-1:2021 and to the requirements as specified in [6.4](#);

- d) Other information if needed.

5 Approval process

5.1 General

An example of approval stages required for compliance to this standard is given in informative [Annex A](#).

5.2 Process identification

The approval shall involve a single process identified by:

- a) The process name;
- b) Drawing of the sand mould and crucible pouring system;
- c) The characteristic geometry of the weld collar and riser configuration as given in [5.4.2](#) and [Figure 1](#);
- d) The process manual in accordance with [5.4.1](#).

5.3 General requirements

The following requirements shall be met:

- The process shall be capable of being carried out on track where the maximum cant can be 180 mm. It shall be capable of being carried out in track, at or near trackside or in a workshop;
- The aluminothermic welding portion shall be packed to avoid the risk of moisture contamination in prescribed storage conditions. The portion shall be identified by markings on the package;
- The mould shall be pre-fabricated for the rail profiles to be welded and be identified by markings on the package;
- The crucible shall be tapped automatically (automatic tapping) and shall have a device to limit spattering.

5.4 Documents to be submitted with the request for approval

When applying for approval, the following documents shall be submitted:

5.4.1 The process manual

The supplier shall produce a manual identifying all the consumable materials and equipment used, as well as the operating method to be followed for all steps of welding. The approval procedure for laboratory tests shall not include means of alignment or finishing operations. The manual shall specify the critical parameters of the welding process and their safe bounds, and shall include the following:

- a) number of people required to carry out the operations;
- b) diagram of equipment;
- c) portion for each rail grade and profile;
- d) rail end preparation requirements;
- e) nominal gap and acceptable range;
- f) pre-heating details;
- g) range of ignition to tap times for the portion;
- h) critical process timings;

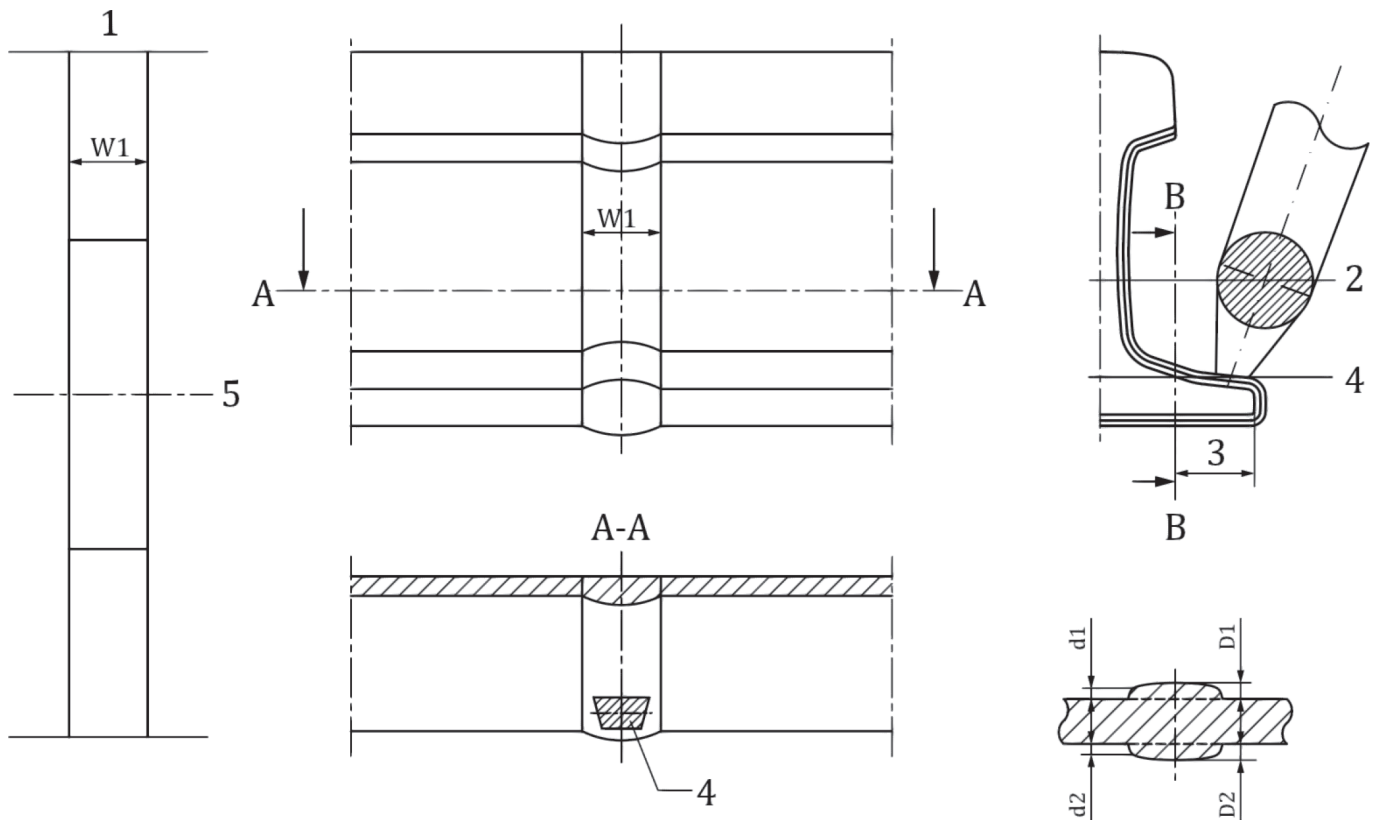
- i) time (or temperature) before trains can pass;
- j) safety information.

5.4.2 Drawing with the required measurements

A drawing, as illustrated in [Figure 1](#), which provides the measurements listed below:

- a) weld collar width (W1). The development of the weld collar shall be fully dimensioned around the weld;
- b) maximum depth of collar at section B-B (D1 and D2);
- c) minimum depth of collar at section B-B (d1 and d2);
- d) riser cross section at foot;
- e) riser cross section at neutral axis;
- f) number of risers;
- g) position of risers.

The dimensions W1, D1, and d1 and the cross-sectional areas of the risers shall be the nominal dimensions taken from the drawing of the pattern used to produce the moulds.



Key

- 1 figure showing the width of the weld collar (W1) around the weld
- 2 riser cross section on the neutral axis (mm²)
- 3 25 % of the foot width
- 4 riser cross section at the foot (mm²)
- 5 longitudinal axis under the rail foot

Figure 1 — Dimensions taken from mould pattern

5.4.3 Chemical analysis ranges and tolerances

The chemical analysis ranges and tolerances shall be in accordance with [6.7](#).

5.5 Initial compliance testing

a) For the purposes of approval the rail profiles shall be grouped as follows:

Table 1 — Rail profile groups by name of profiles

Group	Rail profile ^a
0	Up to 75 kg/m
1	60 kg/m
2	50 kg/m and above
3	43 kg/m and above

^a The name of the profile is indicating the relevant profile group. The actual weight of the profile per meter might not be the accurate weight indicated by the profile's name.

b) For the purposes of approval the rail grades (ISO 5003:2016) shall be grouped as follows:

Table 2 — Rail grade groups other than HR260A/B

Group	Rail grades
1	HR200, HR220, HR235
2	HR280, HR310A, HR310B, HR320, HR325
3	HT320, HT330, HT340
4	HT350A, HT350B, HT370A, HT370B, HT370C
5	HT400 and higher

c) Initial compliance with this standard shall be achieved by undertaking the tests specified in category 1 of [Table 3](#) using grade HR260A rail of one profile in group 1 of [Table 1](#). Compliance with all the criteria specified and with the railway authority's documented requirements specified in [Clause 4](#) shall be demonstrated. A test sequence is outlined in informative [Annex B](#). A test specimen can be used for several different tests.

Table 3 — Testing scheme

Test	Section reference	Number of specimens		
		Category 1 ^a HR260A only	Category 2 ^b HR260A only	Category 3 ^c Grades in Groups not HR260A/B 1. HR200, HR220, HR235 2. HR280, HR310A/B, HR320, HR325 3. HT320, HT330, HT340 , HT350A/B 4. HT370A/B/C, HT400 and higher
A Hardness Test	6.2.1	6	Nil	6
B Surface Examination Visual	6.1.1 6.1.2	All	All	All
C Visible Heat Affected Zone	6.1.3	2	2	2
D Slow-bending Test (Tensile stress is applied to rail bottom)	6.3	6	2	4
E Ultrasonic Testing Annex D	6.5.1	5	2	Nil
F Fatigue Test (Optional, ISO 23300-1 Annex C&D)	6.4	3	Nil	Nil
G Fusion Zone – Weld Soundness	6.3	(6)	(2)	(4)
	6.5.1	5	2	Nil
	6.4	(3)	Nil	Nil
H Fusion Zone – Shape and Dimensions	6.5.2	5	2	2
I Chemical Analysis	6.7	3	Nil	2
J Heat Softened Zone – Hardness Distribution	6.2.2	2	2	2
K Structure – Visible Heat Affected Zone and Fusion Zone	6.6	1	Nil	1
	6.2.2	1	Nil	1
Minimum number of welds		11+3	4	6
Note 1: () indicates weld soundness evaluation of the fracture face of the slow-bending test or fatigue specimens. ^a Category 1 Initial tests to be conducted using HR260A grade rail and one profile from rail profile Group 1 (Table 1). Tests carried out on one profile, approves the other profiles of that group. ^b Category 2 tests to be carried out using HR260A rail on one profile from each of the remaining rail profile groups in order to extend approval to that group. ^c Category 3 tests to be carried out on one profile from Group 1 (Table 1) for each group of grades in order to extend approval to all profile groups tested in Categories 1 and 2. Tests carried out on one grade, approves the other grades of that group. If a profile of Group 1 is not available in the relevant rail grade a profile of Group 2 can be chosen.				

5.6 Extension of initial compliance testing

Initial compliance can be extended as follows

- to other groups of rail profiles of [Table 1](#) [[subclause 5.5 a](#)] by the tests in category 2 of [Table 3](#) [[subclause 5.5 b](#)] to be conducted on one profile from each of the appropriate groups. Failure of any test shall cause non-compliance for the group of rail profiles being tested.
- to other rail grades by the tests in category 3 of [Table 3](#) [[subclause 5.5 b](#)] to be conducted on one grade from each of the appropriate group. Failure of any test shall cause non-compliance for that rail grade. Tests on one rail profile cover all profiles in categories 1 and 2.

5.7 Preparation and allocation of test welds

- a) Welding gap shall be measured after weld alignment (peaking) on both sides of the rail head (or on the running surface), web mid point and both foot tips. The maximum gap is the maximum at any of the above points and minimum the minimum of any of the above points.
- b) The weld gap for all welds made for [Table 3](#) tests shall be within the specified range. In the case of the welds required for test H in category 1 of [Table 3](#), three welds shall be produced at the minimum gap and two at the maximum, and for category 2 of [Table 3](#), one weld at the maximum gap and one weld at the minimum gap.
- c) The number of each test shall be in accordance with the appropriate parts of [Tables 3](#) and [4](#). The process supplier shall determine the order of testing.
- d) Where tests fail to meet the required test criteria as a result of a defect (or defects) in the rail, re-tests shall be made on a one-to-one basis.
- e) Initial compliance testing and extension testing shall be executed by the process supplier and approved by the railway authority.

5.8 Re-approval following process changes

5.8.1 Changes requiring approval

5.8.1.1 Geometric parameters

— Any geometric parameters given in [5.4.2](#):

- a) weld collar width (W);
- b) collar depth (D);
- c) collar depth (d);
- d) riser cross-section – in foot;
- e) riser cross-section – in neutral axis;
- f) riser configuration – position;
- g) riser configuration – numbers.

A revised drawing shall be submitted.

5.8.1.2 Crucible system

— Any changes in the chemical nature of the main component of the refractory.

5.8.1.3 Tapping system

- Any changes in the chemical nature of the main component of the refractory of the tapping system body;
- Any changes in the geometry of the tapping system body as specified in the original drawing of the supplier.

5.8.1.4 Pre-heating system

- Any change in the equipment or critical parameters;
- Any change of pre-heating fuels (oxidising or reducing);