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Railway applications — Track — Restoration and repair of manganese crossings

bsi.

National foreword

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European foreword

This document (EN 16725:2016) 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of an identical text or by endorsement, at the latest by May 2017, and conflicting national standards shall be withdrawn at the latest by May 2017.

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Introduction

Restoration of cast manganese crossings by electric arc welding is a special process requiring the co-ordination of welding and grinding activities to establish confidence and reliability of the weld deposit and safety of the line. Incorrect selection of materials, consumables or procedure may result in serious track welding failure. The correct application of the approved processes and the types of repairs permitted to be carried out on various rail components need to be strictly adhered to. Only consumables approved by the method described in this standard are to be used. The tasks and responsibilities of personnel involved in restoration e.g. planning, executing, supervising and inspection need to be clearly defined.

1 Scope

This European Standard specifies restoration of cast austenitic manganese steel for fixed crossings and cradles for crossings with movable parts, designed to be flash butt welded or bolted to adjoining rails manufactured according to EN 15689. The standard also applies to flash welded leg ends of austenitic manganese steel crossings and the associated tri-metal zone.

The standard specifies the approval systems for consumables and procedures used in manual metal arc and flux cored metal deposit repair welding. The standard includes the quality-related tasks and responsibilities and qualifications of personnel involved in the electric arc repair welding of cast crossings.

The permitted welding processes are limited to Electric Arc (EA) in accordance with EN ISO 4063, specifically Process No 111: MMA (Manual Metal Arc) and Process No 114: FCAW (Flux Cored Arc Welding). Their applications are described.

This standard may be applied for procedures *in situ*, at line side or at out of track locations.

The purpose of this standard is to unify restoration of cast manganese crossings by electric arc welding across Europe. The standard provides control systems for the approval and qualification of welding processes, WPS, welding consumables, contractors and welders for the successful delivery of welds on crossings in service.

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 1371-1, *Founding - Liquid penetrant testing- Part 1: Sand, gravity die and low pressure die castings*

EN 13674-1, *Railway applications - Track - Rail - Part 1: Vignole railway rails 46 kg/m and above*

EN 15689, *Railway applications - Track - Switches and crossings - Crossing components made of cast austenitic manganese steel*

EN ISO 544, *Welding consumables - Technical delivery conditions for filler materials and fluxes - Type of product, dimensions, tolerances and markings (ISO 544)*

EN ISO 2560, *Welding consumables — Covered electrodes for manual metal arc welding of non-alloy and fine grain steels — Classification (ISO 2560)*

EN ISO 3452-1, *Non-destructive testing - Penetrant testing - Part 1: General principles (ISO 3452-1)*

EN ISO 4063, *Welding and allied processes - Nomenclature of processes and reference numbers (ISO 4063)*

EN ISO 5817, *Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections (ISO 5817)*

EN ISO 6507-1, *Metallic materials - Vickers hardness test - Part 1: Test method (ISO 6507-1)*

EN ISO 15607, *Specification and qualification of welding procedures for metallic materials - General rules (ISO 15607)*

EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 1: Arc welding (ISO 15609-1)*

EN ISO 15613, *Specification and qualification of welding procedures for metallic materials - Qualification based on pre-production welding test (ISO 15613)*

EN ISO 17632, *Welding consumables - Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine grain steels - Classification (ISO 17632)*

3 Terms and definitions

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

3.1
Railway Authority
RA
either the railway regulator or the owner of a railway infrastructure or the custodian with a delegated responsibility for a railway infrastructure

3.2
contractor and sub-contractor
company approved by a railway authority to carry out the restoration of cast manganese track components by electric arc welding on that particular infrastructure

Note 1 to entry: This may include staff from within the RA

3.3
preliminary welding procedure specification
pWPS
tentative welding procedure specification, which is assumed to be adequate by the consumable manufacturer, but which has not been approved by the RA

Note 1 to entry: Welding of test pieces needed for approval of a welding procedure specification has to be carried out on the basis of a preliminary welding procedure specification.

3.4
welding procedure specification
WPS
procedure approved to European standards and agreed by the RA for use on the railway infrastructure

3.5
training establishment
welder training organisation or centre approved by the railway authority or alternatively a welder training organisation or centre approved by and belonging to a railway authority

3.6
manual metal-arc welding
MMA
manually operated metal-arc welding using a covered electrode

3.7
flux-cored arc welding
FCAW
semi-automatic or automatic arc welding process

Note 1 to entry: FCAW requires a continuously fed consumable tubular electrode containing a flux and a constant-voltage or a constant-current welding power supply.

3.8
certification body
body for the purpose of witnessing and reporting the welding and testing of test pieces

3.9
AMS
austenitic manganese steel, in accordance with EN 15689

3.10
penetrant testing
PT
method of crack detection employing capillary action. A low surface tension liquid is applied to a test area, after a given soak time a powder developer is applied, the developer draws the liquid from any cracks present giving a clear indication of any surface breaking defect

3.11
tri-metal zone
flash butt welded area of the casting containing AMS, rail steel and the stainless steel insert

3.12
million gross tonnes (MGT)
Equivalent Million Gross Tonnes Per Annum (EMGTPA)
annual traffic load (metric for assigning track category)

4 Consumable and WPS approval tests for MMA electrodes and FCAW wires

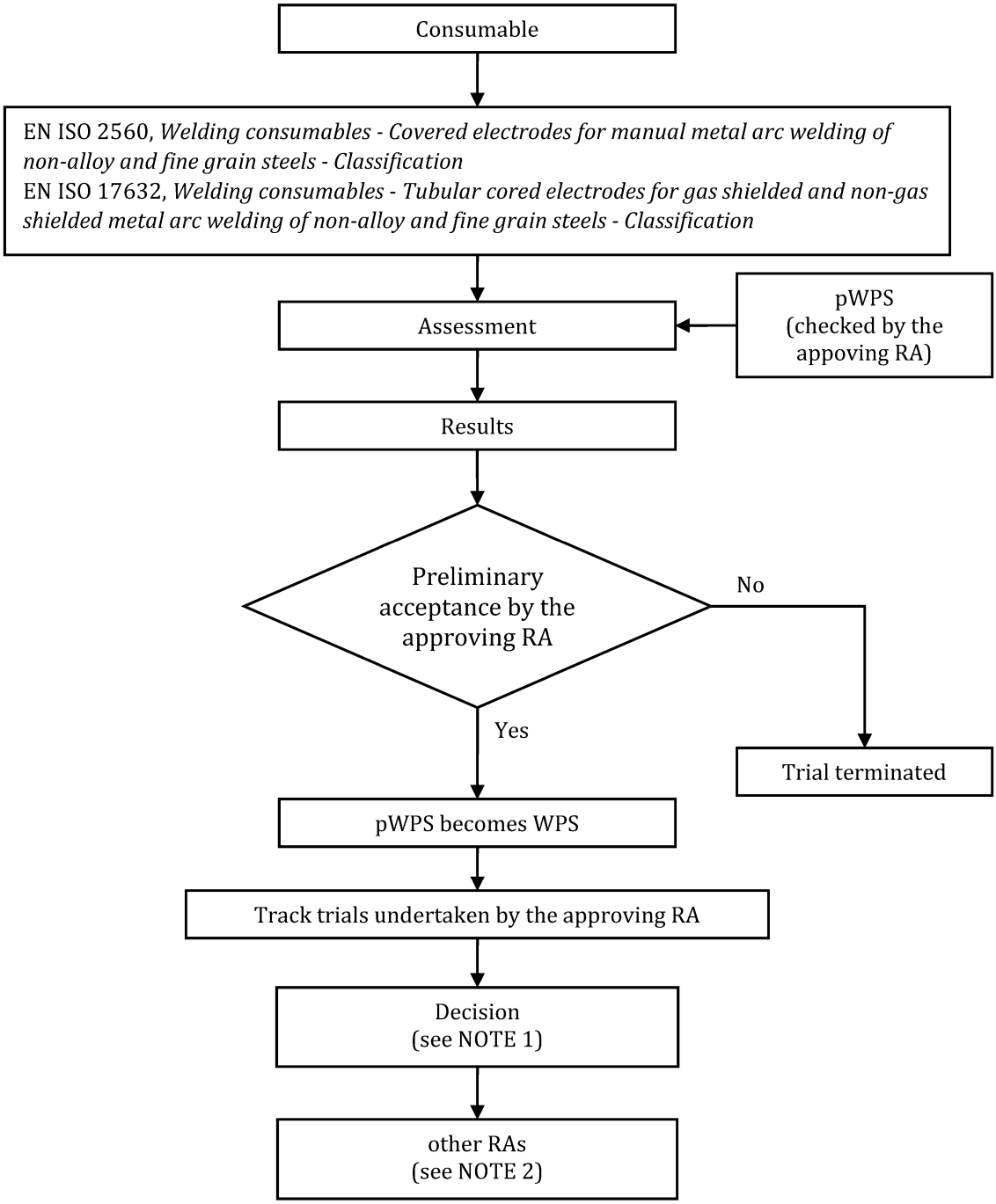
4.1 General

The approval of consumables and the related WPS is broadly in line with the requirements of EN ISO 15613, but owing to the special nature of the repair weld in terms of steel grades, the approval process shall follow this standard.

4.2 Consumable and WPS approval model

4.2.1 Flow chart

The following flow chart describes how a consumable and its related WPS shall be approved. WPS approval shall follow the principle of EN ISO 15613 approval by a pre-production test.



NOTE 1 The approving RA has to issue an approval certificate upon successful outcome of track trial.

NOTE 2 Other RAs may require further tests to verify suitability for special service/operational conditions or deposition techniques.

Figure 1 — WPS approval

4.2.2 Minimum information to be included in the pWPS

The pWPS shall contain as a minimum the following:

— Parent material;

— Consumable classification type and size;

— Welding process;

— Methods of preparation and cleaning;

— Current (A);

— Arc Voltage (V);

— Type of Current (AC/DC);

— Polarity;

— Travel Speed (mm/min);

— Deposition sequence – direction of welding;

— Heat input (kJ/mm);

— Welding position;

— Excavation details (sketch);

— Temperature measurement points (sketch);

— Maximum or minimum temperature values at measurement points;

— Interpass temperature at measurement points;

— Peening details.

4.3 Information supplied by the manufacturer of the welding consumable to the certifying body

— Toxicity threshold levels;

— Applicable steel grades in accordance with EN 15689 and/or EN 13674-1;

— Electrode classification in accordance with EN ISO 2560 for MMA and EN ISO 17632 for FCAW;

— Chemical analysis and batch analysis;

— Storage requirements with manufacturer's recommendations;

— Current range/voltage range/polarity;

— Open Circuit Voltage (OCV) requirements;

— Availability of vacuum sealed MMA electrodes;

— Dimensions, length and diameter;

— FCAW spool size/weight/winding pattern availability;

— Drying requirements;

— Description of marking system;

— Deposition technique;

— Hardness in the as welded condition and after work hardening.

4.4 Laboratory examinations of weld samples

The certifying body shall confirm compliance with this standard and record results of laboratory tests:

— Visual inspection (VT) accordance with EN ISO 5817;

— Penetrant test (PT) in accordance with EN ISO 3452-1;

— Hardness;

— Macro and micro examination.

4.5 Description of the samples for laboratory test for resurfacing work

4.5.1 General requirements for laboratory tests

The excavation shall be inspected by PT according to EN 1371-1 acceptance level SP1.

The following requirements are valid for laboratory tests:

— single bead on AMS: one sample required;

— single bead on tri-metal zone: one sample required;

— single layer on tri-metal zone: one sample required;

— multi-layers on AMS: one sample required;

— multi-layers on tri-metal zone: one sample required;

— deposits to be made in the flat (PA) position.

The samples shall be from used crossings including the tri-metal zone with materials cast, welded, heat treated, machined and inspected by the same method used for production pieces, or samples from new materials as agreed by the RA.

Single bead and multi-layer deposits can be made on the same sample.

4.5.2 Single bead on AMS

4.5.2.1 Purpose

This test is used to demonstrate the consumable's compatibility with welding of AMS before carrying out further detailed tests and allows assessment of continuous deposition of electrodes used.

4.5.2.2 Description

The sample shall normally be taken from an AMS crossing. In certain cases the sample may be purpose made in agreement with the RA. The welded bead for MMA shall be done for a maximum electrode recovery using the manufacturer's parameters.

In the case of FCAW a minimum length of 400 mm shall be welded. The AMS sample shall have a minimum length of weld bead +200 mm (100 mm on each end of the weld bead), and shall be deposited on the wheel-rail contact area of a sample from a used crossing with a surface cleaned by grinding.

4.5.2.3 Examination and assessment

The deposit shall be cleaned removing all slag and spatter and then it shall be examined visually in the as-welded condition.

Following visual examination the bead shall be ground until 0,5 mm – 0,8 mm remains above the sample surface. Following grinding the deposit shall be examined using visual and PT method. PT shall be carried out in accordance with EN ISO 3452-1. The deposit shall be assessed in accordance with 4.7.1 and 4.7.2.

If the weld deposit fails visual or PT examination, the test shall be terminated. The approval of this pWPS for welding AMS shall be declined.

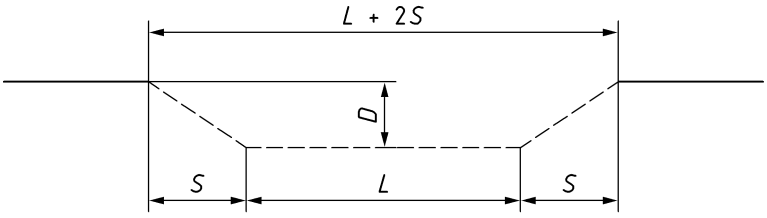
4.5.3 Multi-layer on AMS

4.5.3.1 Purpose

The purpose of this test is to determine the integrity of the multi-layer weld metal and the parent material.

4.5.3.2 Description

The sample shall normally be taken from an AMS crossing "leg end". In certain cases, the sample may be purpose made in agreement with the RA. The AMS crossing sample shall be a minimum length of 600 mm and prepared in accordance with Figure 2. The minimum depth of the excavation shall be 8 mm from the running surface, the minimum number of layers shall be 3.



Key

D depth of excavation ≥ 8 mm

S in accordance with the pWPS

L ≥ 50 mm

Figure 2 — Excavation details leg-ends

The dimension *D* shall be such that the surface of the final layer is level with the surface of the parent rail.

The transverse excavation for trials shall be minimum 50 % of the railhead width.

The layers shall be deposited on the wheel-rail contact area of a sample from a used crossing with a surface cleaned by grinding.

4.5.3.3 Examination and assessment

The deposit shall be cleaned removing all slag and spatter and then it shall be examined visually in the as-welded condition.

Following visual examination, the deposit shall be ground to head profile. Afterwards the deposit shall be examined using visual and PT methods. PT shall be carried out in accordance with EN ISO 3452-1. The deposit shall be assessed in accordance with 4.7.1 and 4.7.2.

If the weld deposit fails visual or PT examination, the test shall be terminated. The approval of this pWPS shall be declined.

If visual inspection and PT examination is successful, the deposit shall be sectioned, prepared and subjected to macro and micro examination in accordance with 4.7.4.

4.5.4 Single bead on tri-metal zone

4.5.4.1 Purpose

This test is used to demonstrate the consumable's compatibility with welding of the tri-metal zone before carrying out further detailed tests. This test also allows assessment of continuous deposition of electrodes used.

4.5.4.2 Description

The sample shall be a minimum of 150 mm long at the AMS side and a minimum of 600 mm long at the rail steel side. This is to facilitate heat input management.

The welded bead shall be deposited such that 70 mm minimum is on the rail steel side and 30 mm minimum is on the AMS side. The bead shall be deposited on the wheel-rail contact area of a sample from a used crossing with a surface cleaned by grinding.

4.5.4.3 Examination and assessment

The deposit shall be cleaned removing all slag and spatter and then it shall be examined visually in the as-welded condition.

Following visual examination the bead shall be ground until 0,5 mm – 0,8 mm remains above the sample surface. Following grinding the deposit shall be examined using visual and PT method. PT shall be carried out in accordance with EN ISO 3452-1. The deposit shall be assessed in accordance with 4.7.1 and 4.7.2.

If the weld deposit fails visual or PT examination, the test shall be terminated. The approval of this pWPS for welding tri-metal zone shall be declined.

4.5.5 Single layer on tri-metal zone

4.5.5.1 Purpose

The purpose of this test is to establish the effects of dilution on a single layer and to check the integrity of the deposit and the parent material.

4.5.5.2 Description

The sample shall be a minimum of 150 mm long at the AMS side and a minimum of 600 mm long at the rail steel side. This is to facilitate heat input management and to permit examination of the parent materials.

The welded layer shall be deposited such that 70 mm minimum is on the rail steel side and 30 mm minimum is on the AMS side. The layer shall be deposited on the wheel-rail contact area of a sample from a used crossing with a surface cleaned by grinding.

4.5.5.3 Examination and assessment

The deposit shall be cleaned removing all slag and spatter and then it shall be examined visually in the as-welded condition.

Following visual examination the layer shall be ground until smooth leaving 0,5 mm to 0,8 mm above the sample surface. Following grinding the deposit shall be examined using visual and PT method. PT shall be carried out in accordance with EN ISO 3452-1. The deposit shall be assessed in accordance with 4.7.1 and 4.7.2.

If the weld deposit fails visual or PT examination, the test shall be terminated. The approval of this pWPS shall be declined.

If visual inspection and PT examination is successful, the deposit shall be sectioned, prepared and subjected to metallography in accordance with 4.7.1. All results shall be assessed in accordance with 4.7.4.

4.5.6 Multi-layer on tri-metal zone

4.5.6.1 Purpose

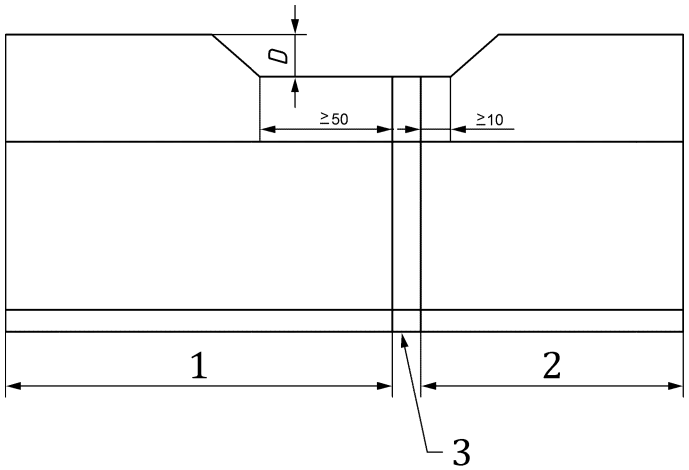
The purpose of this test is to establish the effects of dilution on a multi-layer deposit and to check the integrity of the deposit and the parent materials.

4.5.6.2 Description

The sample shall be a minimum of 150 mm long at the AMS side and a minimum of 600 mm long at the rail steel side. This is to facilitate heat input management and to permit examination of the parent material.

The welded layers shall be deposited such that 50 mm minimum is on the rail steel side and 10 mm minimum is on the AMS side at the base of the excavation. The layer shall be deposited on the wheel-rail contact area of a sample from a used crossing with a surface cleaned by grinding. The minimum depth of the excavation shall be 8 mm from the running surface, the minimum number of layers shall be 3.

Dimensions in millimetres



Key

D	depth of excavation ≥ 8 mm
1	Rail steel ≥ 600 mm.
2	AMS ≥ 150 mm
3	stainless steel insert

Figure 3 — Excavation details tri-metal zone

4.5.6.3 Examination and assessment

The deposit shall be cleaned removing all slag and spatter and then it shall be examined visually in the as-welded condition.

Following visual examination the final layer shall be ground until smooth. Following grinding the deposit shall be examined using visual and PT methods. PT shall be carried out in accordance with EN ISO 3452-1. The deposit shall be assessed in accordance with 4.7.1 and 4.7.2.

If the weld deposit fails visual or PT examination, the test shall be terminated. The approval of this pWPS shall be declined.

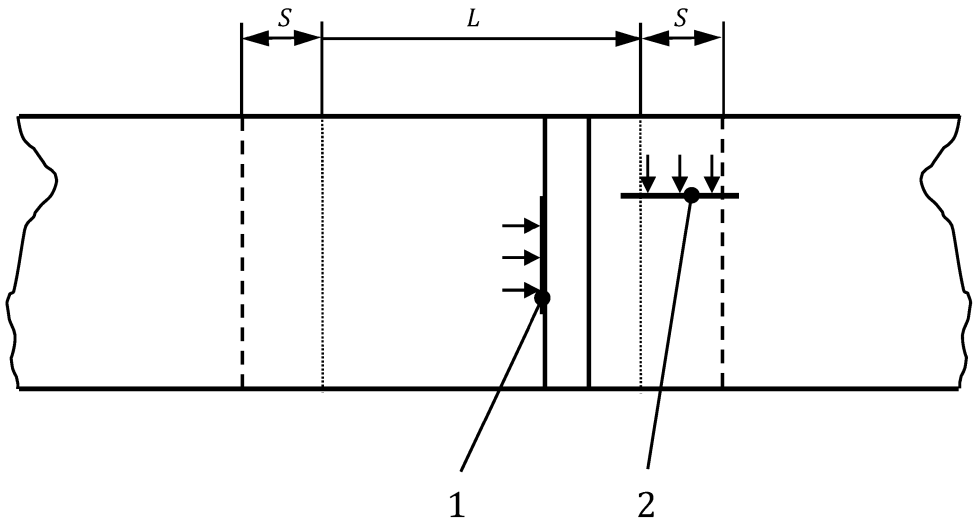
If the visual inspection and PT examination is successful, the deposit shall be sectioned, prepared and subjected to surface and subsurface hardness testing and metallography in accordance with 4.5.8. All results shall be assessed in accordance with 4.7.3 and 4.7.4.

4.5.7 Preparation and examination of AMS samples

4.5.7.1 Preparation of the AMS samples

Figure 4 is in plan view and shows the position of sections (thick lines). The dashed lines denote the limits of the deposit. The dotted lines denote the bottom of the slope.

Arrows denote examination faces for macro/micro examinations.



Key

1, 2 sections to be used for macro and micro examination

S slope of excavation

L length of the base of the repair

Figure 4 — Positions of sections

4.5.7.2 Micro and macro examination of the AMS samples

In preparation for examination, the samples shall be polished and then etched to reveal the metallographic structure.

The transverse section 1 shall be minimum 50 % of rail head width. The minimum depth shall be the depth of excavation +10 mm.

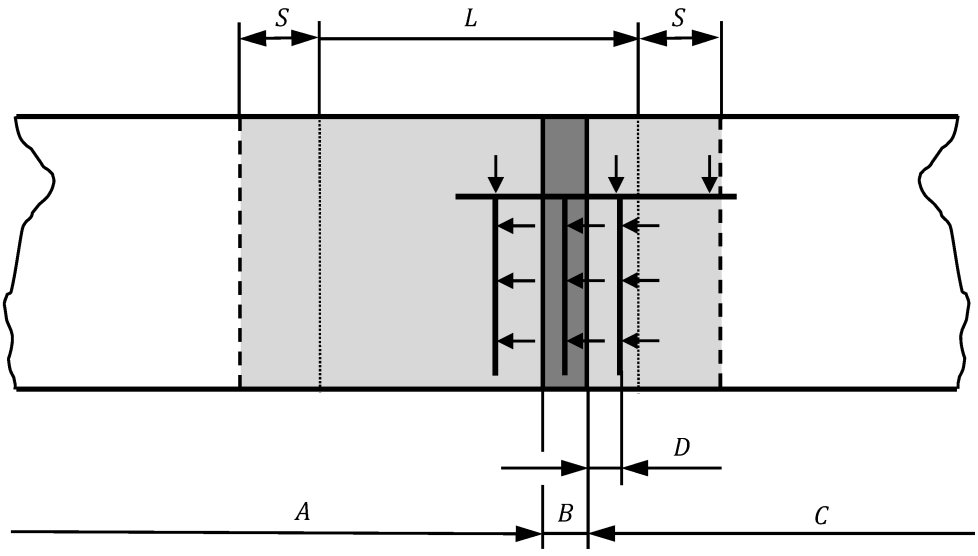
Length of section 2 shall extend minimum 10 mm beyond the bottom of the excavation slope (S) and minimum 10 mm beyond the top of the excavation slope into the un-welded parent material. The minimum depth shall be the depth of excavation +10 mm.

All results shall be assessed in accordance with 4.7.4.

4.5.8 Preparation and examination of the tri-metal zone samples

4.5.8.1 Preparation of the tri-metal zone samples

Figure 5 shows in plan view the position of sections (thick lines). The light grey area is the weld deposit, and the dark grey area is the stainless steel insert. Arrows denote examination faces for macro/micro examinations.



Key

A AMS side

B stainless steel insert

C rail steel

D minimum distance between insert and transverse section in rail steel ≥ 25 mm

S slope of excavation

L length of the base of the repair

Figure 5 — Positions of sections

4.5.8.2 Micro and macro examination of the tri-metal zone samples

In preparation for examination, the sample shall be polished and then etched to reveal the metallographic structure.

The longitudinal section shall extend 10 mm beyond start and end points of the weld beads. See Figure 5.

The transverse sections shall be minimum 50 % of rail head width. The transverse section on the rail steel side shall be at least 25 mm from the insert to be out of the HAZ of the insert welding.

The minimum depth of all sections shall be the depth of excavation +10 mm.

All results shall be assessed in accordance with 4.7.4.

4.5.8.3 Hardness testing of weld deposit on multi-layers on the tri-metal zone

This applies to the rail steel side of the tri-metal zone only.

Sub-surface hardness testing

Sub-surface hardness testing shall be carried out on multi-layer deposits only, using the Vickers hardness testing method and HV10 load in accordance with EN ISO 6507-1. Impressions are to be made along a line commencing 3 mm below the running surface of the central vertical axis of the rail, to ensure they are not affected by the surface hardness testing. The hardness traverse shall continue into the unaffected parent rail. Spacing shall be 1,5 mm centres. The measurements obtained shall be recorded in graphical and numerical form. For this test the transverse section from the carbon side shall be used.

Figure 6 shows position of sub-surface hardness testing.

Dimensions in millimetres

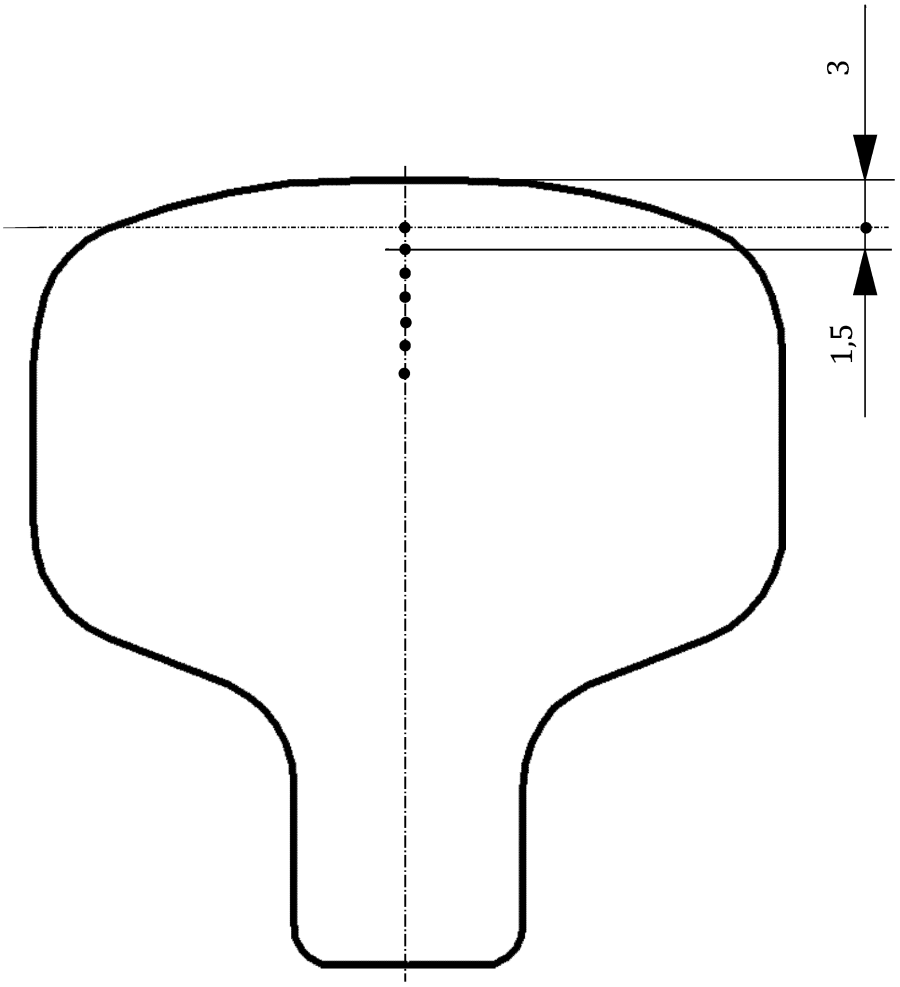


Figure 6 — Position of sub-surface hardness testing

All results shall be assessed in accordance with 4.7.3.

4.6 Assessment of general weldability

The weld deposit shall be assessed in accordance with the parameters described in the pWPS. Welding of these samples shall be witnessed and evidence of the weldability should be stated defined at least by the following criteria, including marking/branding of the consumable:

— arc stability;

— bead shape;

— cratering;

— spatter;

— slag characteristics;

— strike and re-strike capability;

— fume level;

— other relevant information.

4.7 Acceptance criteria

4.7.1 Visual inspection

The acceptance requirements of the weld deposit shall comply with level C of EN ISO 5817:2014, Table 1.

Table 1 — Acceptance criteria for visual inspection

Criteria	Acceptance level
Cracks	Not permitted
Visual porosities	Not permitted
Bead profile	Level C: $\alpha \geq 100°$
Undercut	Level C: max. 0,5 mm
Craters	Level C: max. 1 mm

4.7.2 PT examination

Acceptance shall be in accordance with EN 1371-1 quality level SP1. No linear indications shall be allowed.

4.7.3 Hardness

Purpose: the laboratory hardness test applies to the rail steel side of the tri-metal zone and is undertaken to ensure there is no presence of undesirable microstructures.

When using grades R200, R220, R260, R260Mn, R350HT, the sub-surface hardness of the carbon rail side of the tri-metal zone shall be not higher than 400 HV10.

Other or emerging rail grades employed in crossing constructions shall require agreement from the RA.

4.7.4 Macro and micro examination of single and multi-layer sections

There shall be no evidence of embrittlement e.g. acicular carbide, continuous network of intergranular carbides at X 100 magnification (note: this list is not exhaustive). Isolated martensite in the micro samples is permitted.

Macro and micro acceptance criteria are shown in Table 2.

Table 2 — Acceptance criteria for macro and micro examination

Defect type	Acceptance criteria
Cracks	Not permitted
Crater cracks	Not permitted
Isolated porosity per 400 mm² of deposited material	0 mm – 0,3 mm, not limited
	0,3 mm – 1 mm, 3 max.
	> 1 mm not permitted
Clustered porosity[a] per 400 mm² of deposited material	0,4 mm max., 3 clusters max.
Linear porosity[b]	Not permitted
Elongated cavities/wormholes	Not permitted
Solid inclusions	None to naked eye
Lack of fusion	Not permitted

[a] Porosity is considered to be clustered when the distance between two pores is less than the diameter of the smallest pore.

[b] Linear porosity is defined as three or more pores aligned in the same direction with a distance less than the diameter of the smallest pore between two pores.

4.8 Track trial tests

4.8.1 General

After submission of the results from the laboratory tests from the pWPS to the RA and their acceptance, the pWPS becomes a WPS and track trials shall be initiated.

The track trials of the restoration of cast manganese crossings and the tri-metal zone shall be in a track with an annual traffic load of minimum 8 MGT.

The weld deposits shall be made in accordance with the requirements of the WPS and shall be multi-layer.

The sample shall be welded in accordance with the geometrical requirements of the RA.

The track trials samples shall be installed in optimum track support conditions.

4.8.2 Excavation detail for track trials

The excavation shall be made on a sample that has not been previously welded.

Excavation details shall be in accordance with WPS.

For the tri-metal zone the transverse excavation for track trials shall be the full railhead width.

4.8.3 Track trial test categories

Tests shall include:

— **a**: Weld integrity

— **b**: Verification of the geometry of the crossing or the tri-metal zone. (wear, plastic metal flow)

4.8.4 Test methods

— For test **a***:* visual and PT

— For test **b**: (electronic) straight edge, profile gauges and feeler gauge

4.8.5 Number of in-track test samples

— 4 samples for validating a WPS on AMS:

  — 2 samples on a nose of a facing crossing in the wheel transfer area to evaluate the integrity

  — 2 samples on the wing-rails of a trailing crossing in the wheel transfer area to evaluate the geometry and the integrity

— 2 samples for validating a WPS on tri-metal zone

4.8.6 Welder's report from track trials

The following shall be recorded by the welder:

— electrode running characteristics;

— strike and re-strike capabilities;

— fume levels;

— slag and spatter detachability;

— craters.

4.8.7 Acceptance criteria for track trial tests

4.8.7.1 General

Immediately upon completion of welding, finishing and cooling of the track trial weld deposits, the geometry shall be recorded in accordance to the requirements of the RA.

The weld deposits shall remain in track until work hardening is complete. On completion of work hardening initial deformation shall be ground to profile and re-measured. Following this full geometry and integrity evaluation can begin.

The deposits shall be monitored over a further 7 MGT at periodicities decided by the RA.

4.8.7.2 Weld integrity

No visible defects, such as cracks, spalling, under bead cracking, corrosion cracking, are permitted when the surface of the deposit is examined by the use of visual techniques.

After visual inspection, PT examination shall be carried out. Acceptance level SP1 according to EN 1371-1 is imposed.

4.8.7.3 Weld geometry

The geometry shall be evaluated on the wing rail samples. After work hardening and grinding an initial flatness measurement over the weld deposit and the parent material at each side of the deposit shall be recorded (M1). After minimum 7 MGT, flatness shall be recorded again (M2). The difference between M1 and M2 shall not exceed 0,2 mm.

4.9 Evaluation, reporting and decision following track trials

4.9.1 General

At the completion of the track trials the approving RA shall produce a report containing:

4.9.2 List of general information

— Approving RA

— Track category

— Track description

— Condition of crossing before welding

— Crossing identification

— Location

— WPS

— Name of the Engineer responsible for the track trial

4.9.3 Track trial tests inspection records

The inspection records after each inspection visit shall include but not be limited to:

— Weld integrity;

— Weld geometry.

4.9.4 Decision by approving RA on consumable and WPS

The approving RA shall state in this report whether the consumable and associated WPS conform to the acceptance criteria defined in 4.8.6.

4.10 Validation of consumables

All consumables used following completion of track trials shall be qualified as giving the same performance and characteristics as those proven in the trials, and shall be delivered in accordance with EN ISO 544.

5 Approval of contractors

5.1 Quality management systems

The contractor who will restore the crossing shall operate a quality management system which addresses this European Standard to ensure that restoration of cast manganese track components consistently complies with the specified requirements.

5.2 Inspection and testing

The contractor shall employ a system of inspection and testing that shall qualify the integrity and the geometry of the weld deposit in accordance with this standard. The RA shall approve this system.

5.3 Subcontracting

The subcontractor shall fulfil the same requirements as the contractor or work under the auspices of the contractor.

5.4 Equipment

The plant and equipment used for all welding work shall be compatible with the process being applied. All plant and equipment shall comply with the rules of the RA and the legal requirements of the country in which it is to be used. This will apply equally to equipment to be used in workshop and off-track environments.

5.5 Welding activities

The contractor shall maintain a fully-documented system that describes all welding restoration activities from planning, execution through to inspection. The system shall describe and record arrangements with other departments.

5.6 Storage and handling of welding consumables

The contractor shall store and handle consumables in accordance with the recommendations of the manufacturer (EN ISO 544) and the rules of the RA.

5.7 Care of the infrastructure

The contractor carrying out the welding restoration work shall be responsible for undertaking a risk assessment and the care of the infrastructure:

— signalling systems;

— insulated joints;

— rail to sleeper fastening systems;

— sleepers;

— stray arcing;

— fire prevention;

— all related environmental issues.

5.8 Welding procedure specifications

Welders shall work to the appropriate WPS and work instructions approved by the RA. The requirements of WPS are included in this standard. An example for the production of a WPS can be found in Annex A. A full description on the production of a WPS can be found in EN ISO 15607 and in EN ISO 15609-1.

5.9 Pre-heating of rails when welding in tri-metal zone

The pre-heating requirement shall be selected in accordance with the grade of rail being welded, the process being used and the WPS being applied. The contractor shall use a preheating system that is approved by the RA.

5.10 Welders

The contractor shall employ welders who are in possession of a valid Permit to Weld, as defined in Clause 6, whether they are direct employees or contracted in.

5.11 Welder records

The contractor shall maintain welder records, which shall form part of a quality management system and which shall include:

— welder qualifications, dates of training tests/re-tests;

— weld records.

5.12 Supervision

The contractor shall maintain a system of management and supervision of welding that complies with the regulations of the RA.

5.13 Traceability

The contractor shall maintain a traceability system that shall include for each weld as a minimum:

— date of installation;

— location, route, mileage/kilometric point, line, rail;

— rail profile and grade;

— consumable identification;

— contractor and welder identification;

— applied WPS number;

— any non-conformances during weld production;

— welder’s daily record.

5.14 Audits

Audits shall be undertaken in accordance with the quality requirements of the RA.

5.15 Training

The contractor shall maintain a system that ensures the competence of their welding personnel by appropriate training and assessment. This shall be in accordance with the rules of the RA.

5.16 Documentation

The RA, or the contractor under instruction from the RA shall be responsible for maintaining a system of documentation fulfilling the requirements of this standard.

6 Personnel and qualification requirements

6.1 Training and qualification requirements

The training and testing shall be conducted in a training establishment approved by the RA. For the purpose of the training the contractor shall provide WPS that are approved by the RA. Training content and duration shall be in accordance with the requirements of the RA approving the WPS.

In addition to the WPS the training shall include:

— care and control of consumables;

— basic safety items relating to the process;

— cause and effect of operating outside of the correct procedures;

— steel grade identification;

— basic grinding and final profile grinding;

— basic visual weld inspection;

— geometrical measurements of restored components.

The training shall conclude with a test or tests designed to confirm the trainee's ability to carry out electric arc welding in accordance with the requirements of the WPS.

Upon the successful completion of training and testing, the welder shall be issued with a Diploma in Electric Arc Welding of cast manganese track components by the training establishment.

6.2 Diploma in electric arc welding of cast manganese track components

The mandatory information that shall be recorded on the diploma is:

— name of welder;

— date of birth;

— diploma date and number;

— processes trained;

— steel grades;

— training provider;

— name and signature of the assessor.

The Diploma in Electric Arc Welding of manganese track components shall be and remain the property of the welder.

6.3 Permit to weld cast manganese components in track

The possession of the Diploma in Electric Arc Welding of manganese track components shall be a prerequisite to apply for the Permit to restore manganese track components by electric arc welding.

Upon receipt of the Diploma in Electric Arc Welding of manganese track components the RA will be in a position to issue a permit to weld. The RA may require further evidence of competence. The issue of the Permit to restore manganese track components by electric arc welding shall be via the welder's employer who shall maintain up to date records.

The RA shall define any relevant conditions relating to the training, testing, re-training, re-testing and the validity and renewal of the Permit to weld manganese track components by electric arc welding. The maximum permitted validity of the permit to weld manganese track components by electric arc welding is four years.

To maintain the permit to weld the welder's employer shall confirm that the welder executes the minimum number of welds per annum required by the RA.

The Permit to weld manganese track components by electric arc welding shall be and remain the property of the RA.

The Permit to weld manganese track components by electric arc welding shall include a unique welder identification.

The mandatory information that shall be recorded on the Permit to weld manganese track components by electric arc welding is:

— permit number;

— name of welder;

— welder identification number;

— photo of welder;

— issue date and expiry date;

— WPS approved;

— issuing RA or RA approved authorized body;

— signature of RA or RA approved authorized body.

In any instance of a welder changing employment to another welding contractor or employer, the old employer shall notify the RA.

The RA shall, at any time, withdraw the permit to restore rails by electric arc welding upon evidence of proven poor performance by the welder.

The RA shall also withdraw the permit to restore manganese track components by electric arc welding upon documented notification from the employer. The employer shall return it to the RA.

The RA shall renew the permit to restore manganese track components by electric arc welding, as may be necessary, to record the maintenance and/or extension of the welder's skills. Such renewal shall require receipt of the relevant qualifying information from the employer.

For an example of a permit to weld, see Annex B.

7 Repair applications

This standard shall be applied to restoration welding of cast manganese track components as permitted by the national RA using WPS approved by the RA.

Annex A
(informative)

Welding Procedure Specification (WPS)

Contractor's name:

Location:

Examiner or test body:

Contractor's Welding Procedure

Reference No:

Method of Preparation and Cleaning:

Rail Grade:

Track component:

Name of welder who performed approval test:

Welding Position:

Welding Process:

Weld preparation details:

Excavation detail (sketch)	Welding sequences (sketch)

Welding details

Run number	Process number	Dimensions of electrode (mm)	Current (A)	Arc Voltage (V)	Type of Current / Polarity	Wire Speed Feed (mm/min)	Travel Speed (mm/min)	Heat input (kJ/mm)
1								
2+								

Filler Metal Classification and trade name: Shielding Gas Type; Gas: Shielding: Backing: Gas Flow Rate: Shielding: Backing: Electrode Type / Size Any Special Baking or Drying: Details of Back Gouging: Preheat Temperature: Interpass Temperature: Post – Weld Heat Treatment: Time, Temperature, Method: Heating and Cooling Rates: Approved by RA: Date: Signature:	Additional Information: Post Weld Treatment: Non – Destructive Examination: Other Information: Manufacturer: Issued by: Date: Signature:

Annex B
(informative)

Permit to weld cast manganese track components by electric arc welding

PERMIT TO RESTORE CAST MANGANESE BY ELECTRIC ARC

Employer ---------- **Certificate No ---------**

Welder's Full Name ---------- Stamp No ----------Photo 

ISSUE DATE ---------- EXPIRY DATE ----------

Is permitted access to the Railways Infrastructure
For The Purposes of Electric Arc Welding on line categories : ----------
Approved for WPS :

Approved for components

Issuing Railway Authorising Body ---------- Signed ----------
Printed Name

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