BRITISH STANDARD

BS EN 15594:2009

Railway applications — Track — Restoration of rails by electric arc welding

ICS 25.160.10; 93.100

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 15594:2009.

The UK participation in its preparation was entrusted to Technical Committee RAE/2, Railway track components.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 April 2009

ISBN 978 0 580 57760 4

Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15594

April 2009

ICS 25.160.10; 93.100

English Version

Railway applications - Track - Restoration of rails by electric arc welding

Applications ferroviaires - Voie - Réparation des rails par soudure à l'arc électrique

Bahnanwendungen - Oberbau - Aufarbeiten von Schienen durch elektrisches Lichtbogenauftragschweißen

This European Standard was approved by CEN on 5 March 2009.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 15594:2009: E

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Foreword

This document (EN 15594:2009) 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of an identical text or by endorsement, at the latest by October 2009, and conflicting national standards shall be withdrawn at the latest by October 2009.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

The purpose of this standard is to unify the restoration of rail electric arc welding across Europe. The standard provides control systems for the approval and qualification of welding processes, welding procedures, welding consumables, contractors and welders for the successful delivery of welds into track.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of the EU Directive 2008/57/EC.

For relationship with the EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Restoration of rails 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. Controls must be in place from the design phase through to inspection. 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 will 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 will be clearly defined.

1 Scope

This European Standard specifies restoration by electric arc welding and is limited to the head of the rails only.

This European Standard describes the approval systems for consumables and procedures used in manual metal arc and flux cored metal deposit rail repair welding. The standard includes the quality-related tasks and responsibilities of personnel involved in the electric arc repair welding of rails. The standard applies to plain rail and switches and crossings manufactured from new vignole railway rails R200, R220, R260, R260Mn, R260Cr and R350HT grade rails of 46 kg/m and above as contained in EN 13674-1 and EN 13674-2.

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

This European Standard may be applied in situ, at line side or at out of track locations. The flash welded leg ends of austenitic manganese steel crossings are included in this standard, except when located within 500 mm of manganese crossings.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 287-1, *Qualification test of welders – Fusion welding – Part 1: Steels*

EN 571-1, *Non destructive testing – Penetrant testing – Part 1: General principles*

EN 1290, *Non-destructive examination of welds – Magnetic particle examination of welds*

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

EN 13674-2, *Railway applications - Track - Rail - Part 2: Switch and crossing rails used in conjunction with Vignole railway rails 46 kg/m and above*

EN ISO 544, *Welding consumables – Technical delivery conditions for welding filler materials – Type of product, dimensions, tolerances and markings (ISO 544:2003)*

EN ISO 3580, *Welding consumables – Covered electrodes for manual metal arc welding of creep-resisting steels – Classification (ISO 3580:2004)*

EN ISO 4063, *Welding and allied processes – Nomenclature of processes and reference numbers (ISO 4063:1998)*

EN ISO 6506-1, *Metallic materials – Brinell hardness test – Part 1: Test method (ISO 6506-1:2005)*

EN ISO 6507-1, *Metallic materials – Vickers hardness test – Part 1: Test method (ISO 6507-1:2005)*

EN ISO 14341, *Welding consumables – Wire electrodes and deposits for gas shielded metal arc welding of non alloy and fine grain steels – Classification (ISO 14341:2002)*

EN ISO 15613, *Specification and qualification of welding procedures for metallic materials – Qualification based on pre-production welding test (ISO 15613:2004)*

UIC 714, *Classification of lines for the purpose of track maintenance*

3 Terms and definitions

For the purposes of this European Standard, 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 rails by electric arc welding on that particular infrastructure

NOTE 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 manufacturer, but which has not been approved. 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
weld 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

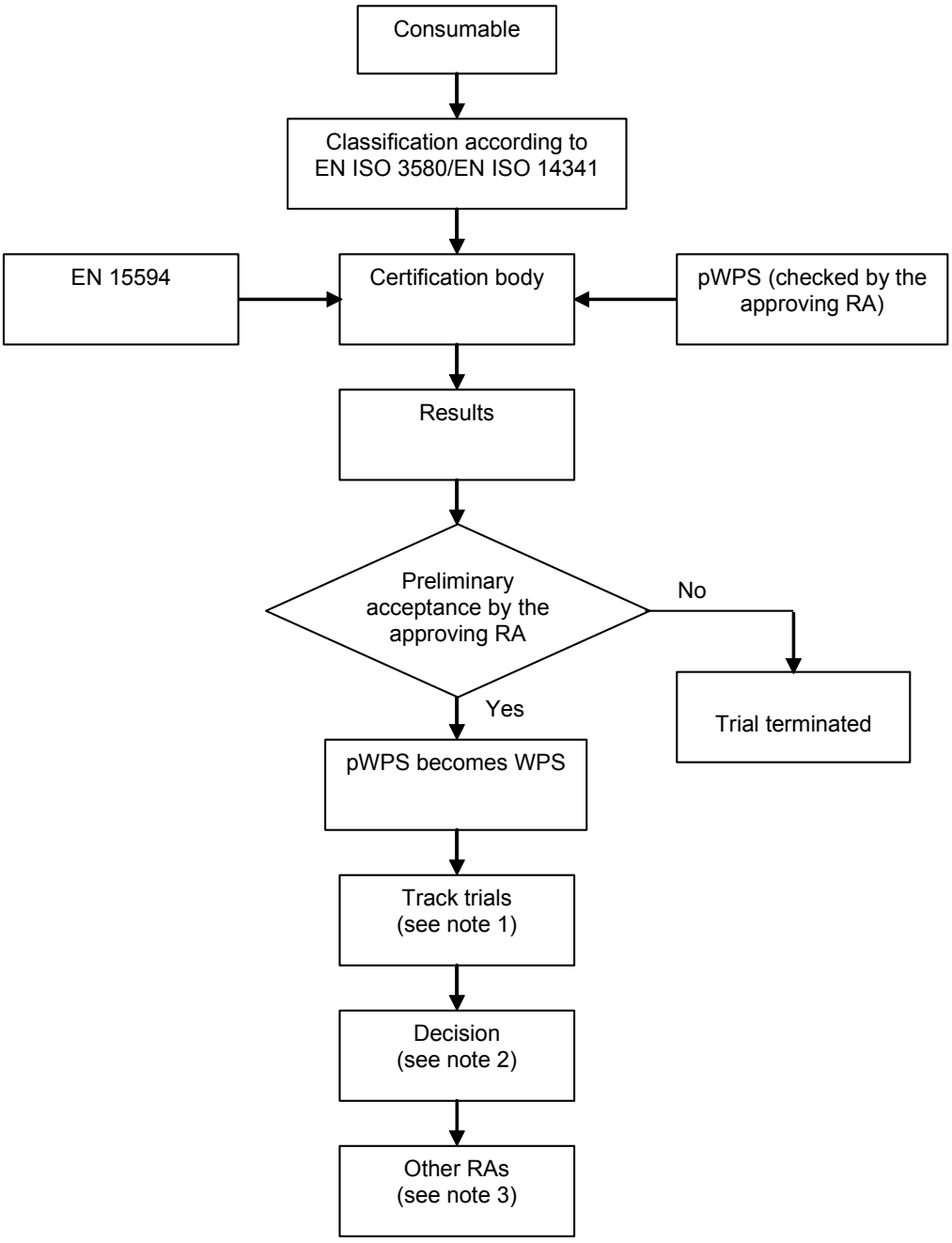
4 Consumable and WPS approval tests for MMA electrodes and FCAW wires

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 rail steel grade and use, e.g. rolling contact fatigue, the approval process shall follow this standard.

4.2 Consumable and WPS approval model

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 These track trials are undertaken by the approving RA.

NOTE 2 The approving RA shall issue an approval certificate upon successful outcome of track trial.

NOTE 3 Other RAs may require further tests to verify suitability for special service/operational conditions or deposition techniques.

4.3 Information supplied by the manufacturer to the certifying body

— Toxicity threshold levels;

— Rail steel grades in accordance with EN 13674-1;

— MMA electrode classification in accordance with EN ISO 3580;

— Wire electrodes classification in accordance with EN ISO 14341;

— Chemical analysis and batch analysis;

— Storage requirements with manufacturers recommendations;

— Current range/voltage range/polarity;

— Availability of vacuum sealed MMA electrodes;

— Dimensions, length and diameter;

— FCAW spool size/weight availability;

— Drying requirements;

— Description of marking system;

— Optimum deposition technique.

4.4 Batch testing by the manufacturer

The batch testing criteria are:

— concentricity and dimensions;

— chemical composition;

— consumable performance e.g. wire behaviour.

4.5 Test requirements of this standard under the supervision of certifying body

4.5.1 List of tests

The following tests shall be supervised by the certifying body:

— Mechanical tests;

— Chemical analysis of undiluted weld metal with batch verification;

— Hardness;

— Weld integrity (lab conditions);

— Crack free;

— Defect level;

— Porosity;

— Craters;

— Open Circuit Voltage (OCV) requirements;

— Welding parameters.

4.5.2 Information to be confirmed by the certifying body

The certifying body shall confirm the following:

— marking/branding before and after drying;

— compliance with this standard;

— complete results of laboratory tests.

4.5.3 Statement on the general weldability

The certifying body shall issue a statement on the general weldability as follows:

— bead shape;

— cratering;

— spatter;

— slag characteristics;

— strike and re-strike capability;

— other relevant information.

These checks are carried out on one bead, one layer and five layers.

The one bead test checks for cracking after grinding.

The single layer test checks the behaviour of weld deposit on rail steel.

The five-layer test checks the behaviour of weld metal on weld metal.

In single and five-layer deposits macro, micro and hardness HV tests are employed.

The five-layer test is finish ground and ultrasonic testing applied.

4.6 Laboratory tests

4.6.1 Purpose

The purpose of the laboratory tests is to prove the suitability of the consumable to successfully repair appropriate grades of rail steel.

4.6.2 General requirements for laboratory tests

The following deposits are required for laboratory tests.

— single bead on rail: one sample required;

— single layer on rail: one sample required;

— multi-layers on rail: one sample required

Deposits shall be subjected to magnetic particle inspection (MT) in accordance with EN 1290 or dye penetrant inspection (PT) in accordance with EN 571-1.

4.6.3 Description of the sample for laboratory test

Figures 1 and 2 describe the requirements of sample size, excavation details and preheat measurement positions.

Pre-heat point A shall be 75 mm from the end of the excavation on the running surface.

Pre-heat point B shall be at the full railhead flange height.

Length of the sample C shall be 600 mm minimum.

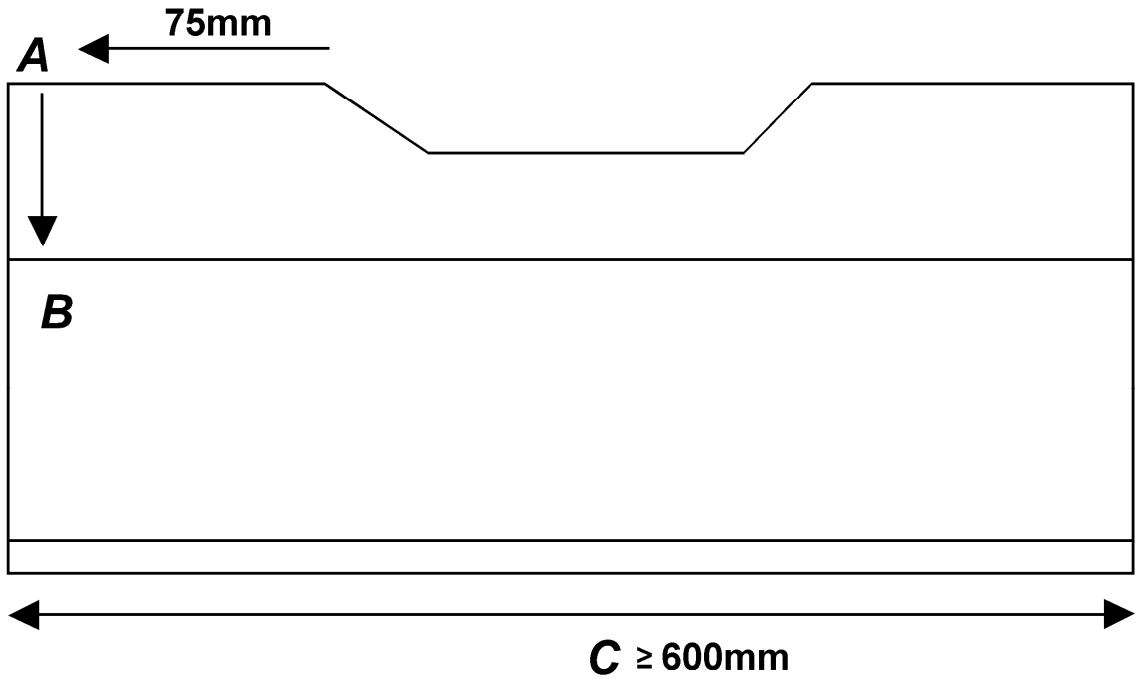
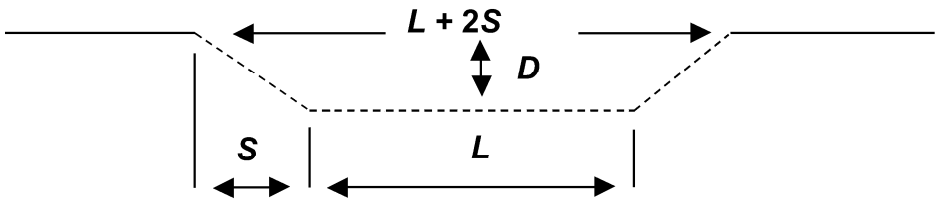


Figure 1 — Position of preheat measurement and sample size

The transverse excavation for trials shall be 100 % of the railhead width.



Key

D depth of excavation

$S \geq 5D$

$L + 2S \geq 200$ mm

Figure 2 — Excavation

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

4.6.4 Single bead on rail tests

4.6.4.1 Purpose

This test is used to demonstrate the consumable's compatibility with welding of rail steel before carrying out further detailed tests. This deposition is without any excavation.

4.6.4.2 Description

The sample shall be a minimum length of 600 mm in an appropriate grade of rail steel. The sample shall be lightly ground on the running surface to give a clean oxide-free finish. The sample shall be preheated in accordance with the pWPS and the position of pre-heat measurement in accordance with 4.6.3. For MMA only the deposit shall be made to maximum electrode recovery using the manufacturer's parameters.

4.6.4.3 Deposit examination and assessment

The deposit shall be cleaned removing all slag and spatter. Initially, the deposit 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 rail surface. Following grinding the deposit shall be examined using visual and MT or PT methods. The deposit shall be assessed in accordance with 4.6.9.

If the weld deposit fails MT or PT examination the test shall be terminated. The approval of this consumable for welding this grade shall be declined.

4.6.5 Single layer deposit on rail tests

4.6.5.1 Purpose

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

4.6.5.2 Description

The sample shall be a minimum length of 600 mm long in an appropriate grade of steel. The rail shall be prepared in accordance with 4.6.3.

For MMA only the length of the preparation shall be designed to use the full length of the electrode minus 80 mm. This length can be derived from the single bead deposit on rail.

4.6.5.3 Deposit examination and assessment

The deposit shall be cleaned removing all slag and spatter and the surface checked using MT or PT methods. The deposit shall be sectioned, prepared and subjected to hardness testing and metallography in accordance with 4.6.8. All results shall be assessed in accordance with 4.6.9.

If the weld deposit fails MT or PT examination the test shall be terminated. On completion, the rail shall be ground to rail head profile.

4.6.6 Multi-layer deposit on rail tests

4.6.6.1 Purpose

The purpose of this test is to determine the integrity of the multi-layer weld metal on rail.

4.6.6.2 Description

The sample shall be a minimum length of 600 mm long in an appropriate grade of steel. The rail shall be prepared in accordance with 4.6.3.

For MMA the length of the preparation shall be designed to use the full length of the electrode minus 80 mm. This length can be derived from the single bead deposit on rail. On completion, the rail shall be ground to rail head profile and shall contain a minimum of five layers.

4.6.6.3 Deposit examination and assessment

The deposit shall be cleaned removing all slag and spatter and the surface checked using MT or PT methods. The deposit shall be sectioned, prepared and subjected to hardness testing and metallography. All results shall be assessed in accordance with 4.6.9.

In the event of MT or PT rejection the test shall be terminated.

4.6.7 Welder’s report from trials

The following shall be recorded by the welder:

— electrode running characteristics;

— strike and re-strike capabilities;

— fume levels;

— slag and spatter detachability;

— craters.

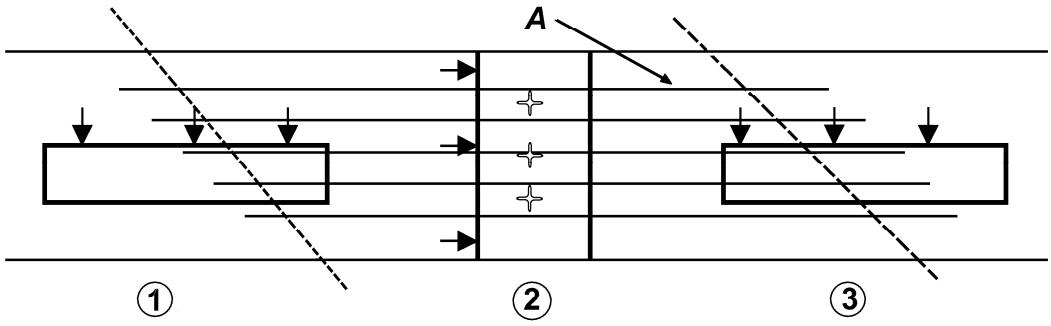
4.6.8 Preparation, examination and testing of samples

4.6.8.1 Number of cut specimens for examination

There shall be one group of samples for single layer and one group for multi-layer weld deposits.

Figure 3 shows the position of sections (thick lines) and location of hardness tests (stars).

Arrows denote examination faces for macro/micro examinations.



Key

① Length 100 mm minimum (there shall be 10 mm minimum of unwelded rail before bead start point). Depth shall be depth of excavation + 10 mm

② Width shall be 20mm minimum. Depth shall be depth of excavation + 20 mm

③ Length 100 mm minimum (there shall be 10 mm minimum of unwelded rail after bead finish point). Depth shall be depth of excavation + 10 mm

A Example of deposition technique

Figure 3 — Positions of sections and location of hardness tests

4.6.8.2 Hardness testing of weld deposit and parent rail

This applies to single layer and multi-layer deposits.

— **Surface hardness testing**

Test shall employ 3 x HBW 2,5/187,5 in weld deposit in accordance with EN ISO 6506-1. Sample 2 of Figure 3 denotes the position of HBW testing. The spacing of hardness impressions shall be 10 mm centres. Hardness shall be taken as an average of the three indentations.

— **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 taken along a line commencing 3 mm below the running surface on the central vertical axis of the rail and 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 it is permitted to use sample 2.

Figure 4 shows position of sub-surface hardness testing.

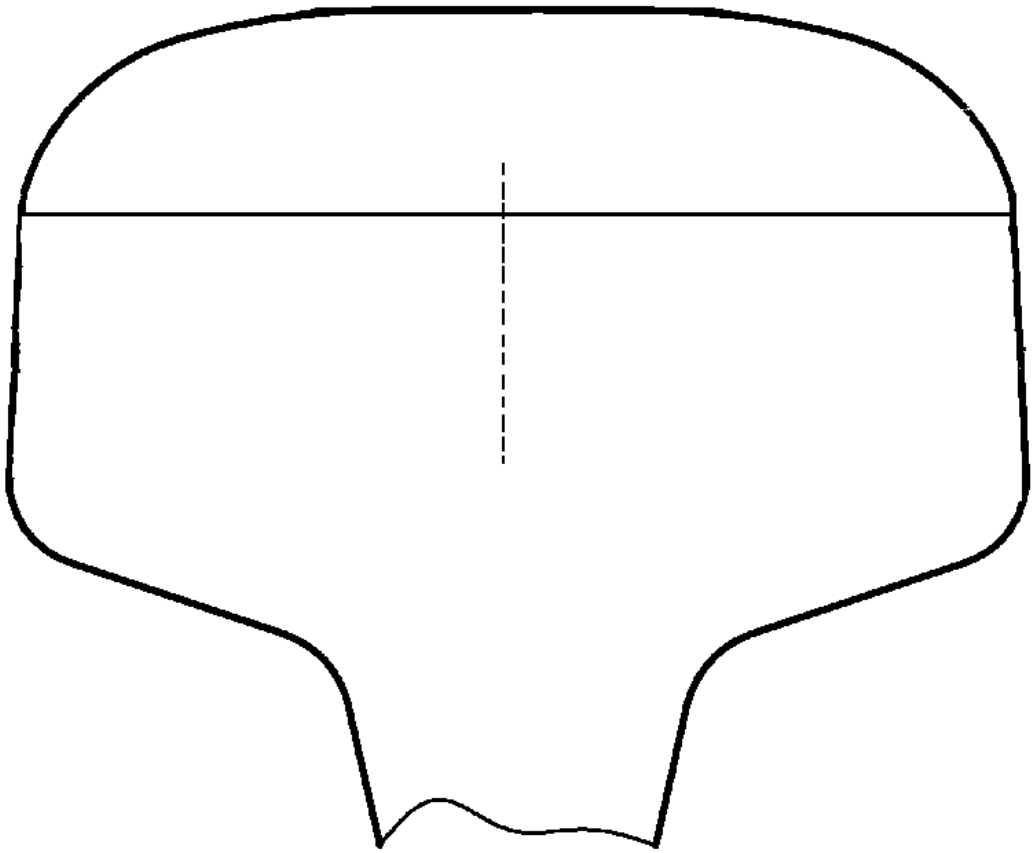


Figure 4 — Position of sub-surface hardness testing

4.6.8.3 Macro and Micro examination

In preparation for examination, the sample shall be polished and then etched with a Nital-type solution, (2 % or 4 % nitric acid in alcohol). Other etching methods shall not be employed.

4.6.9 Acceptance criteria

4.6.9.1 Hardness

Acceptance criteria for hardness are shown in Table 1.

Table 1 — Hardness requirements for surface and sub-surface hardness testing

Grade	Position	Single layer	Multi-layer
R200, R220, R260, R260Mn, R320Cr	surface	380 max. HBW	290 HBW – 340 HBW
	sub-surface	not applicable	400 HV10 max.
R350HT	surface	400 max. HBW	340 HBW – 390 HBW
	sub-surface	not applicable	400 HV10 max.

The same consumable shall produce acceptable hardness values for both single and multi-layer deposits.

4.6.9.2 Macro and micro examination

The porosity limit requirements for rail welding are much more stringent than those for general fabrication. This is due to the material chemical composition and the cyclic loading experienced in service. The assessment for defects shall be carried out on the transverse section (sample 2) and over the entire length on the longitudinal section (samples 1 and 3).

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	0 mm – 0,12 mm not limited
	0,12 mm – 0,3 mm, 3 per sample max.
	0,3 mm – 1 mm, 1 per sample max.
	> 1 mm not permitted
Clustered porosity [a]	0,4 mm max, 3 clusters per sample max.
Linear porosity [b]	Not permitted
Elongated cavities/ wormholes	Not permitted
Solid inclusions	None on polished sample to naked eye
Lack of fusion	Not permitted
Undercut	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 plane	

When measured at magnification x100, the sample shall exhibit no evidence of untempered martensite.

When measured at magnification more than 100, the untempered martensite shall not be taken into account.

4.7 Track trial tests

4.7.1 General

The track trials of the restoration of rails shall be in one or more of the following track categories: 1, 2, 3 or 4 in accordance with UIC 714.

The weld deposits shall be made in accordance with the requirements of the WPS. Details of minimum requirements for track trials are given in informative Annex A.

4.7.2 Excavation detail for track trials

Excavation details shall be in accordance with 4.6.3.

The transverse excavation for track trials shall be the full railhead width.

4.7.3 Track trial test categories

Tests shall include:

— **a**: Tests for surface cracking

— **b**: Flatness of deposit and parent rail over 1,0 m for detection of local deformation (wear or plastic metal flow)

— **c**: Weld integrity

4.7.4 Test methods

— For test **a***:* visual and MT or PT

— For test **b**: straightedge and feeler gauge or electronic straightedge

— For test **c**: ultrasonic testing (UT) in accordance with the RA requirements

4.7.5 Requirements for in-track test samples

Two types of restoration are required to examine their behaviour:

— 4 samples x single layer

— 4 samples x multi-layer (minimum of 5 layers)

4.7.6 Acceptance criteria for track trial restoration

4.7.6.1 Rail flatness geometry

If after one day the rail flatness exceeds 0,2 mm when measured over 1 m the weld test sample is rejected.

4.7.6.2 Surface defects

No visible defects are permitted when the surface of the rail is examined by the use of PT or MT techniques.

4.7.6.3 Preferential wear or deformation of the restoration

No running surface deviation more than 0,2 mm measured over 1 m shall be permitted when compared with the records of the test carried out after one day.

Any defect occurring after the test deposits are made that are not associated with the process of welding shall be excluded from measurements taken to assess the restoration.

4.7.7 Inspection frequency

The duration of in-track testing shall be 12 months with inspection occurring after 1 day, 1 month, 6 months and 12 months as a minimum requirement. Records of track inspections shall be kept for assessment purposes.

4.8 Evaluation, reporting and decision following track trials

4.8.1 General

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

— list of general information;

— track trial tests inspection records;

— decision by approving RA on consumable and WPS.

4.8.2 List of general information

— Approving RA

— Track category

— Track description

— Condition of rail before welding (ultrasonic test with RA report)

— Rail identification

— Location

— WPS (consumable manufacturer/identification/dimensions/classification)

— Name of the Engineer responsible for the track trial.

4.8.3 Track trial tests inspection records

The inspection records after each inspection visit shall include:

— presence of any cracks;

— geometry longitudinal/lateral deviation any deformation;

— weld integrity checked by ultrasonic testing.

4.8.4 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 4.7.6.

4.9 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. The labels of the production consumables shall identify their conformity with consumables proven in trials.

5 Approval of contractors

5.1 Quality management systems

The restoration contractor shall operate a quality management system which addresses this European Standard to ensure that restoration of railhead 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 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 liaisons 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 the care of the infrastructure with particular regards to:

— 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 welding procedures are included in this standard. An example for the production of a WPS can be found in Annex B.

NOTE 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

Rails shall be pre-heated prior to welding. 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 Restore, as defined in Clause 6, whether they are direct employees or contracted in.

5.11 Welder records

The contractor or sub-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;

— number of weld repairs by type produced in a given period;

— number of welds rejected;

— number of welds failed in service.

5.12 Supervision

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

5.13 Traceability

The weld shall be marked at the time of production by such a means that it can be identified in track. 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 approval of track welders for restoration of rails shall follow EN 287-1 as much as is reasonably practicable.

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 welding procedures that are approved by the RA. Training content and duration shall be in accordance with the requirements of the RA approving welding procedures.

In addition to the welding procedures 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;

— rail 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 the electric arc welding of rails in accordance with the requirements of the welding procedures.

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

6.2 Diploma in electric arc welding of rails

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

— name of welder;

— date of birth;

— diploma date and number;

— processes trained;

— skill modules passed;

— extra skills passed;

— training establishment;

— name and signature of trainer;

— name of training provider.

A specimen Diploma in Electric Arc Welding of Rails is shown in informative Annex C.

The Diploma in Electric Arc Welding of Rails shall be and remain the property of the welder.

6.3 Permit to restore rails by electric arc welding

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

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 restore rails by electric arc welding as well as the extension of the welder's skills. The maximum permitted validity of the permit to restore rails by electric arc welding is 4 years.

Upon successful completion of the requirements and demonstration of the necessary competencies, which shall include RA tests if required, the welder shall be issued with a Permit to restore rails by electric arc welding by the relevant RA upon receipt of the relevant qualifying information from the employer. The issue of the Permit to restore rails by electric arc welding shall be via the welder's employer who shall maintain up to date records.

The welder's employer shall ensure that the welder is employed on electric arc restoration of rails with reasonable continuity.

The Permit to restore rails by electric arc welding shall be and remain the property of the RA.

The Permit to restore rails by electric arc welding shall include a unique welder identification and a unique employer identification relating to that particular welder and his/her employer. Both identifications shall be marked on each and every weld made by that welder on completion of the welding.

The mandatory information that shall be recorded on the Permit to restore rails by electric arc welding is:

— employer;

— certificate number;

— name of welder;

— welder identification number;

— employer identification;

— photo of welder;

— issue date and expiry date;

— processes approved;

— which line categories approved;

— approved track components;

— issuing Railway Authority;

— authorising Body;

— signature;

— surrender conditions.

In any instance of a welder changing employment to another welding contractor or employer, the RA shall issue a new permit to restore rails by electric arc welding on the request, and receipt of relevant qualifying proof, from the new welding contractor or employer.

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 rails 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 rails 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.

The permit to restore rails by electric arc welding shall contain a statement defining the surrender conditions. (A specimen permit to restore rails by electric arc welding is shown in normative Annex D).

7 Repair applications

This standard shall be applied to restoration welding of rails as permitted by the national RA. The applications, that are not obligatory or limited by the standard, include:

— wheel burns;

— squats;

— headwear;

— sidewear;

— defects in welding zones;

— rail damage.

These types of repairs can be undertaken on plain rail and switch and crossing components.

The types of repairs permitted and the limits of those repairs shall be specified by the RA. This specification shall include the following list as a minimum for each type of repair, grade of rail steel and component description:

— competency requirements;

— maximum/minimum excavation dimensions;

— maximum/minimum repair dimensions;

— railway operational conditions;

— environmental conditions;

— specific requirements regarding the care of the infrastructure as detailed in 5.7;

— special requirements and any exceptions.

The component names are shown in informative Annex E.

The contractor shall provide evidence of owning suitable approved WPS at the time of tendering. The format of the WPS is given in Annex B.

Annex A
(informative)

Track trials supplementary information

The trials described in 4.7 are the minimum requirements; approving RA may request further site testing.

The trial welds should be placed in mid-rail positions in track, the rail being within the normal operational conditions of the approving RA. The trials should be undertaken on simulated defects using full head width of the rail. Rail where trial deposits are to be placed should be tested visually and ultrasonically. The findings should be recorded 14 days prior to welding. The test site must be free of visual and internal defects. A written description of the site should be produced e.g. presence of welds, insulated joints, rail conditions, this should describe the conditions 4,5 m either side of the trial weld. This written description should include a flatness measurement about the proposed centreline of the restoration; this should extend to 500 mm either side of the weld. In any case the deviation from flat should not exceed 0,2 mm.

Track trial tests should record welding conditions, number of deposits, line categories, sizes of deposits, period of testing time/accumulative tonnage.

Annex B
(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: Date: Signature:	Additional Information: Post Weld Treatment: Non – Destructive Examination: Other Information: Manufacturer: Issued by: Date: Signature:

Annex C
(informative)

Diploma in electric arc restoration welding of rails

Diploma in Electric Arc Restoration Welding of Rails		
is hereby awarded to		
Name----------		**Date of Birth ----------**
DATE ---------- Diploma No --------		
Processes	**Skill Modules Passed**	**Extra Skills Passed**
Training Establishment ----------		Signed ---------- Name ----------

Annex D
(normative)

Permit to restore rail by electric arc welding

PERMIT TO RESTORE RAIL BY ELECTRIC ARC WELDING

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

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

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

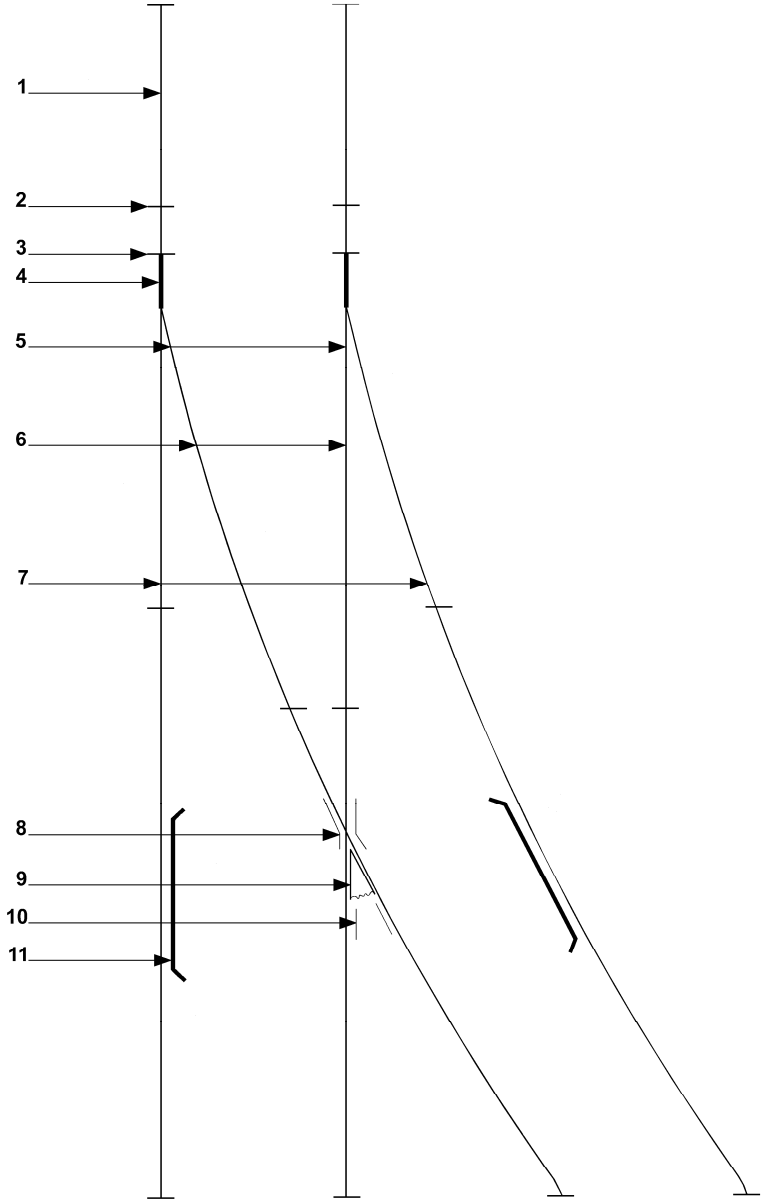
Is permitted access to the Railways Infrastructure
For The Purposes of Electric Arc Welding on line categories : ----------
Approved for processes:

Approved for components

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

Annex E
(informative)

Track components



Key

1	Plain rail	4	Stock rail front	7	Stock rail	10	Leg end
2	Rail end	5	Switch blade	8	Crossing wings	11	Check rail
3	Stock rail end	6	Switch rail	9	Crossing nose		

Figure E.1 — Track components

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC

This European Standard has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the Directive 2008/57/EC

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 for High Speed Rail Infrastructure and Table ZA.2 for Conventional Rail confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard, the Infrastructure TSI for the trans-European high speed rail system dated 20 December 2007 (published in the Official Journal L77, 19.03.2008, p.1), and Directive 2008/57/EC

Clause(s)/ sub-clause(s) of this European Standard	Chapter/ § of the TSI	Essential Requirements of Directive 2008/57/EC	Comments
Clause 4 Consumable and WPS approval tests for MMA electrodes and FCAW wires Sub-clause 4.7 Track trial tests	4.2.9 Description of the infrastructure domain – Functional and technical specifications of the domain – equivalent conicity 4.2.10 Description of the infrastructure domain – Functional and technical specifications of the domain – track geometrical quality and limits on isolated defects	Annex III, Essential Requirements, General Requirements – Clauses 1.1.1, 1.1.2, 1.1.3 - Safety Annex III, Essential Requirements, General Requirements – Clause 1.2 – Reliability and safety Annex III, Essential Requirements, General Requirements – Clause 1.4.4, 1.4.5 – Environmental protection	EN 15594 has to be read together with the technical specifications for rail restoration operations of the concerned Railway Authority

Table ZA.1 *(continued)*

Clause(s)/ sub-clause(s) of this European Standard	Chapter/ § of the TSI	Essential Requirements of Directive 2008/57/EC	Comments
§ 4.7.6. Acceptance criteria for track trial restoration 4.7.6.1 Rail flatness geometry 4.7.6.2 Surface defects 4.7.6.3. Preferential wear or deformation of the restoration 4.7.7 Inspection frequency 6. Personnel and qualification requirements 7. Repair applications Annex E Track components.	4.2.12.3 Description of the infrastructure domain – Functional and technical specifications of the domain – Switches and crossings – Geometrical characteristics. 4.5.1. Description of the infrastructure domain – Maintenance rules – Maintenance plan. 4.5.2. Description of the infrastructure domain – Maintenance rules – Maintenance requirements 4.6. Description of the infrastructure domain – Professional competences. 4.7. Health and safety conditions. 5.3.1.1. Interoperability constituents – Constituents performances and specifications – The rail – Railhead profile. 6.4. Assessment of maintenance plan.		EN 15594 does not identify any approval of power generators, welding sources or robots and rail preheating equipment in terms of electromagnetic compatibility, vehicle braking systems or any requirements regarding load gauge, environment and its attendant issues or infrastructure access pertaining to any Railway Authority.

Table ZA.2 — Correspondence between this European Standard, the ERA draft of Conventional Rail System TSI Infrastructure (version 2.6 dated 28/07/2008) and Directive 2008/57/EC

Clause(s)/ sub-clause(s) of this European Standard	Chapter/ § of the TSI	Essential Requirements of Directive 2008/57/EC	Comments
Clause 4 Consumable and WPS approval tests for MMA electrodes and FCAW wires Sub-clause 4.7 Track trial tests § 4.7.6. Acceptance criteria for track trial restoration 4.7.6.1 Rail flatness geometry 4.7.6.2 Surface defects 4.7.6.3. Preferential wear or deformation of the restoration 4.7.7 Inspection frequency 6. Personnel and qualification requirements 7. Repair applications Annex E Track components.	4.2.5.5. Description of the infrastructure subsystem – Functional and technical specifications of the subsystem – equivalent conicity 4.2.5.6. Description of the infrastructure subsystem – Functional and technical specifications of the subsystem – Track parameters – Railhead profile for plain line 4.2.6.2. Description of the infrastructure subsystem – Functional and technical specifications of the subsystem – Switches and crossings – In service geometry of switches and crossings 4.2.9. Description of the infrastructure subsystem – Functional and technical specifications of the subsystem – Track geometrical quality and limits on isolated defects 4.5. Description of the infrastructure subsystem – Maintenance plan. 4.6. Description of the infrastructure subsystem – Professional competences. 4.7. Health and safety conditions. 5.3.1. Interoperability constituents – Constituents performances and specifications – The rail. 6.4. Assessment of maintenance plan.	Annex III, Essential Requirements, General Requirements – Clauses 1.1.1, 1.1.2, 1.1.3 - Safety Annex III, Essential Requirements, General Requirements – Clause 1.2 – Reliability and safety Annex III, Essential Requirements, General Requirements – Clause 1.4.4, 1.4.5 – Environmental protection	EN 15594 has to be read together with the technical specifications for rail restoration operations of the concerned Railway Authority EN 15594 does not identify any approval of power generators, welding sources or robots and rail preheating equipment in terms of electromagnetic compatibility, vehicle braking systems or any requirements regarding load gauge, environment and its attendant issues or infrastructure access pertaining to any Railway Authority.

WARNING — Other requirements and other EC Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN ISO 15607, *Specification and qualification of welding procedures for metallic materials – General rules (ISO 15607:2003)*

[2] EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials – Welding procedure specification – Part 1: Arc welding (ISO 15609-1:2004)*

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BSI Group
Headquarters 389
Chiswick High Road,
London, W4 4AL, UK
Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
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