

Technical Specification

T0436 Weld repair of plain rails, switches and crossings

Issue: A1

Issue date: June 2012

Review date: June 2015

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1 Purpose

- 1.1 This specification sets out the requirements for the weld-repair of rails. It also covers the use of stainless steel deposit on rails.

2 Scope

- 2.1 This specification covers the requirements for the weld repair of the following:
- a) Plain running rails;
 - b) Switch rails;
 - c) Fabricated crossings;
 - d) Semi-welded crossings;
 - e) Cast crossings;
- 2.2 More detail of the scope of this specification is set out in the Attachment.
- 2.3 This specification supersedes TE-MTS-0804-A3 and TE-MTS-0806-A3.

3 Requirements

Weld repair of rails shall be carried out in accordance with the Attachment to this specification. The Attachment comprises a copy of Network Rail document NR/L2/TRK/0132, amended only to the extent necessary to suit the LU environment.

4 Competence

- 4.1 Any person assigned a responsibility related to this standard shall be qualified and certificated to undertake that responsibility. In particular they shall be fully conversant with the requirements of this standard.
- 4.2 Only welding inspectors and welders who have been approved by LU or Tube Lines shall carry out welding activities.
- 4.3 Training and certification of welding inspectors and welders, and training in the use of powered plant, shall be carried out at a training centre approved by LU or Tube Lines.
- 4.4 Welders undertaking weld repair work shall be certificated in LPT and MPT as part of the skills set for MMA certification.
- 4.5 Welders wishing to progress to MMA 4 (repair of crossings, all rail grades) certification shall have been trained and certificated in MMA 1, 2 and 3.
- 4.6 Recertification of welding inspectors and welders shall be carried out at a training centre approved by LU or Tube Lines, at intervals not exceeding 24 months.
- 4.7 Site assessment of welding inspectors and welders shall be carried out, in track, at the interim 12-monthly interval by an A1 occupationally competent assessor who shall record the assessment for audit purposes.
- 4.8 Prior to welders undertaking any weld-repair activity on LU infrastructure the approved training centre shall forward details of all training and testing carried out, together with a record of those weld-repair processes that the welder is approved to carry out. The training centre shall provide the following information:
- a) Name of training centre;
 - b) Name and signature of welding trainer;
 - c) Welder's name;
 - d) Welder's NI number;
 - e) Weld-repair processes approved to carry out;



- f) Date of test;
- g) Welder's unique stamp number;
- h) Details of safety certification.

4.9 Welding contractors shall supply a list of all welders and their unique stamp numbers to LU (or Tube Lines if appropriate) before any weld-repair work is undertaken.

5 References

5.1 References

5.1.1 LU standards

Document no.	Title
S1175	Track – Inspection of cast crossings and cast vees
S1176	Inspection and repair to reduce the risk of derailment at switches
TE-MTS-0804	Repair welding of crossings (withdrawn)
TE-MTS-0806	Repair welding of isolated wheelburns in running rail (withdrawn)

5.1.2 British Standards

Document no.	Title
BS 7865	Specification for steel electrical conductor rail for railway motive power supply
EN 13674-1	Railway applications – Track – Rail: Vignole railway rails 46 kg/m and above
EN ISO 15613	Specification and qualification of welding procedures for metallic materials - Qualification based on pre-production welding test

Note: European Standards (EN) are prefixed “BS” when used in the United Kingdom

5.1.3 Network Rail standards

Document no.	Title
NR/SP/TRK/055	Rail testing: Ultrasonic procedures
NR/L2/TRK/0132	Maintenance arc welding of rails, switches and crossings
NR/L2/TRK/1054	Inspection, maintenance and repair procedures for cast, welded and fabricated crossings in the track

5.1.4 Network Rail drawings

Drawing no.	Title
RE/PW/425	Switch and crossing maintenance gauge
RE/PW/429	Switch wear gauge
RE/PW/430	Switch blade radius gauge
RE/PW/436	Switch blade angle gauge

5.2 Abbreviations

The following abbreviations are created:

- a) within London Underground's Glossary of Terms (S1622) (a Category 1 Standard);
- b) from Network Rail document NR/L2/TRK/0132.



Abbreviation	Definition	Source
AMS	Austenitic manganese steel	b
FCAW	Flux-cored arc welding	b
HCAMS	High-carbon austenitic manganese steel	b
HP	High performance (a Tata proprietary rail grade)	b
LCAMS	Low-carbon austenitic manganese steel	b
LPT	Liquid penetrant testing	b
LU	London Underground	a
MHH	Microalloyed head hardened	b
MMA	Manual metal arc	a
MPT	Magnetic particle testing	b
NDT	Non-destructive testing	b
TMZ	Tri-metallic zone	b
UKAS	United Kingdom Accreditation Service	a
WPS	Welding procedure specification	b

5.3 Definitions

No topic-specific definitions are created:

5.4 Person accountable for the document

Person accountable for the document
Head of Track Engineering, LU

5.5 Document history

Issue no	Date	Changes	Author
R1	March 2012	Issued for review and comment. Replacement of Category 2 standards TE-MTS-0804-A3 and TE-MTS-0806-A3 as per DRACCT No.1146. Is a close copy of Network Rail standard NR/L2/TRK/0132	Quentin Phillips
A1	June 2012	Authorised for use	Quentin Phillips



6 Attachment – Weld repair of rails

Note: This attachment is a copy of Network Rail document NR/L2/TRK/0132 Issue 6, slightly modified for LU's purposes but retaining the original clause numbering. Unless otherwise stated, clause references relate to the attachment; clause references relating to that part of the specification preceding this attachment are qualified as such.

6.1 Part A - General Requirements

A.1 PURPOSE

This attachment defines the methods to be used when weld repairs to plain rail and switch and crossing components are carried out. It also specifies the permissible limits of defect and damage to be removed, including sidewear for specific rail steel types. Procedures for track-circuit deposits (zig-zag deposits) are also included.

A.2 RESPONSIBILITIES

LU and/or Contractors' staff shall be responsible for ensuring that:

- All welding procedures are qualified in accordance with the requirements of clause A.3.1;
- All welders carrying out weld repairs are qualified in accordance with the requirements of clause A.3.2;
- A thorough inspection of the rails and/or switches and crossings is carried out to establish those repairs required;
- All the necessary details are recorded on the relevant welders' work return forms;
- All loose debris and combustible materials are removed to provide a safe working environment
- The area of the rail to be repaired is thoroughly cleaned immediately prior to the commencement of welding using a suitable degreasing agent. It is essential that all grease and lubricants are removed to prevent fumes;
- All weld repairs are inspected within the specified timescales. Exceptions to this time limit shall be permitted where access requires special arrangements. All necessary details are to be recorded on the relevant welders' work return form;
- The relevant welders' work return form is retained for a period of 2 years for audit purposes;
- Additionally to NR/L2/TRK/0132 – in tunnel locations, a safety assessment is made prior to work.

At the initial site visit the rail shall be inspected for defects which would necessitate replacement of the rail.

This attachment contains references to persons in supervisory roles who are required to undertake certain duties. The Network Rail titles in NR/L2/TRK/0132 have been replaced with generic LU/Tube Lines titles and their duties are summarised in the table below.



Generic LU/Tube Lines title	Duty
Head of Track Engineering	D.4.6.1 Own the procedures for repairs across TMZs.
Track Maintenance Engineer	D.4.6.2 Be briefed by Track Welding Manager on TMZ repair procedures.
Track Welding Manager	D.4.6.1 Authorise repairs across TMZs.
	D.4.6.2 Review list of persons authorised by Local Track Welding Manager to carry out TMZ repairs.
	D.4.6.2 Brief the Track Maintenance Engineer and Local Track Welding Manager on procedures for repairs across TMZs.
	D.4.6.2 Review AMS crossings for suitability for TMZ repairs.
	D.4.6.2 Keep record of persons he authorises to carry out TMZ repairs.
	D.4.6.6 Receive results of post-weld inspections of TMZ repairs from the Local Track Welding Manager.
	D.4.6.6 Create and maintain record of all TMZ repairs.
Local Track Welding Manager	A.4.4, D.5.2 Receive weld-repair forms from welders.
	B.2, C.2 Assess proposed repairs exceeding stipulated lengths.
	D.2 Advise in situations where crossing cannot be repaired in-track.
	D.2, D.4.3.2 Receive notification from welders of temporary repairs, fit plates or clamps, and consult with the Track Welding Manager regarding full repair or replacement.
	D.2, D.4.3.2, D.5.2 Programme temporary or incomplete weld repairs for full repair or replacement.
	D.3.2 Advise on repair of AMS crossings with specified defect codes
	D.4.6.2 Supervise TMZ repairs.
	D.4.6.2 Be briefed by Track Welding Manager on TMZ repair procedures.
	D.4.6.3 Brief welders carrying out TMZ repairs.
	D.4.6.6 Notify Track Welding Manager of results of post-weld inspections of TMZ repairs.
	D.5.2 Notify Track Welding Manager when repair if temporary or incomplete.
	E.4 Arrange fitting of temporary fishplates where weld deposit is defective

A.3 WELDING REQUIREMENTS

A.3.1 Welding procedure requirements

Welding procedures shall be qualified and approved in accordance with the requirements of BS EN ISO 15613 for all rail grades to be welded. All welding procedures and welding procedure specifications (WPSs) shall be subject to approval by LU.

A.3.2 Welder Training, Competency and Certification

Welder training, continuing competency and certification shall be managed in accordance with section 4 of this specification.

A.3.3 Welding plant and equipment

All plant and equipment shall be subject to maintenance in accordance with the manufacturers' recommended requirements and testing schedules shall comply with those requirements, the details



of which shall be documented for audit purposes. The schedules shall include the correctness of amperage setting, engine speed, voltage output, voltage regulation, wire feed speeds and tachometer readings of associated grinder spindles as appropriate to the technique and process. Lists of welding plant and equipment required for plain rail and switch and crossing repairs are given in Appendices A, B and C.

When using the flux-cored arc welding (FCAW) process, the power source shall provide direct current (DC) or rectified alternating current (AC).

A.3.4 Measuring and inspection equipment

All measuring and inspection equipment used for the production and final inspection of arc weld repairs shall be maintained in accordance with an approved procedure. Master equipment used for calibration and validation purposes shall be calibrated against relevant UKAS requirements and certificated accordingly.

A.3.5 Rail steel identification

The welder shall check and identify the grade of rail steel or crossing component to be welded. Where a rail steel or crossing component cannot be positively identified, the rail or crossing component in question shall not be welded.

Rails are usually identified by a combination of alpha-numeric brand markings on the rail web. The various identification of brand markings according to age of rails, grade, relevant standard and manufacturer, can be found in Table 1.

Crossings manufactured from cast austenitic-manganese steel (AMS) or Bainitic (also known as Titan) steel have the type of material cast onto the side of the crossing in the form of raised lettering. Cast crossings can also be identified by the use of a magnet: AMS shows little or no attraction to a magnet.

Note: There has been little use of Bainitic steel on LU and those installations that exist are gradually being removed.

A.3.6 Manual metal-arc (MMA) electrodes

All electrodes shall be kept in a dry and heated store in accordance with the manufacturers' recommendations.

Only LU-approved electrodes of 2.5mm, 3.25mm and 4.0mm diameter shall be used for plain rail and switch and crossing weld repairs. Approved electrodes are listed in Table 2.

Electrodes shall be examined for contamination, moisture or damaged flux coatings. Electrodes found with any of these conditions shall not be used as this could result in porosity or cracking in the weld deposit.

Sufficient electrodes to complete the work shall be available at the site.

Vacuum-packed electrodes shall be used in accordance with the manufacturer's recommendations.

Non-vacuum-packed electrodes shall be dried in accordance with the manufacturer's recommendations before being taken into use, or, if this cannot be achieved with the equipment available, in accordance with the instructions specified in the relevant WPS.

A.3.7 Self-shielding FCAW wires

All flux-cored wires shall be kept in a dry and heated store in accordance with the manufacturers' recommendations.

Only LU-approved flux-cored wires of 1.2mm and 1.6 mm diameter shall be used for plain rail and switch and crossing weld repairs. Approved flux-cored wires are listed in Table 2.



Flux-cored wires shall be examined for contamination with grease, oil, rust etc, moisture, kinks or a damaged outer sheath. Flux-cored wires found with any of these conditions shall not be used.

Sufficient flux-cored wire to complete the work shall be available at the site.

A.3.8 Welding cables

Welding cables shall conform fully to the requirements of relevant European/International standards and be of a length and cross sectional area compatible with the welding power source and selected current. They shall not exceed 14m when using AC and 18.5m when using DC power supplies.

The welding cables shall not be used when tangled or coiled. The cable fitted with the electrode holder shall be permanently and clearly marked at the power source connection end. When using AC the welding and return cables shall be taped together throughout their length and shall not be used when separated.

Welding cables shall not run parallel to any rail for more than 10m to avoid inductive interference with track circuits.

The foot of the rail to be welded shall be lightly ground, as close as possible, but no more than 2m from any point of welding, such that a good electrical contact will be made when the return current clamp is fitted.

The return current clamp shall be fitted tightly to the foot of the rail at the nearest ground position to the point of welding.

A.3.9 Preheating requirements

A.3.9.1 Rail grades R220 and R260

The temperature of the rail over the area to be welded, including an additional 75mm at each end, shall be subjected to an initial preheat of 343C minimum, maintained throughout welding.

Bainitic rail steels shall be preheated to a minimum temperature of 200C with the maximum temperature not exceeding 350C. Bainitic steel shall also be subject to a maximum interpass temperature of 300C.

Care shall be taken when preheating not to subject the rail to excessive heat. Only one rail heater shall be used, at any one time, on any single rail or switch and crossing component.

All temperature checks shall be carried out by the use of a suitable temperature indicating crayon and shall be measured 75mm from each end of the excavated area and at the bottom of either side of the rail head.

A.3.9.2 AMS

Preheating is not required for AMS. However, to avoid embrittlement of the rail, the temperature during welding shall not exceed 204C. The temperature of the rail shall be measured after each weld run, adjacent to the weld deposit, allowance being made for equalisation of heat following deposition.

A.3.9.3 Other grades

The welding of R260Mn (wear-resisting grade B), alloyed rails (90 and 110kg/mm² chromium, microalloyed head hardened (MHH)) and high performance (HP) is not permitted without the prior written approval of the LU Head of Track Engineering.

A.3.10 Inclement weather

Welding shall be undertaken during inclement weather only when an approved welding tent or umbrella is used for protection.



A.3.11 Location of repair welds relative to rolling contact fatigue

Arc weld repairs of isolated defects shall not be carried out in rolling contact fatigue (RCF) of any category unless there is at least 100mm of clean rail from the nearest RCF crack and edge of the prepared excavation. Where this requirement is achieved by grinding, this shall be blended over a distance of 1 in 600, e.g. for a crack depth of 4mm, the transition shall be a minimum distance of 2.4m. Any grinding shall be carried out by the use of approved techniques/procedures and grinding machines only.

On completion of grinding, MPT or LPT shall be carried out to confirm that any RCF cracks have been completely removed prior to commencement of welding.

A.4 NON-DESTRUCTIVE TESTING (NDT) REQUIREMENTS

A.4.1 Operator certification

Welding staff carrying out NDT in conjunction with weld repairs, shall be trained in the use of magnetic-particle testing (MPT) and liquid penetrant testing (LPT) as part of the LU-approved MMA 1 training course.

A.4.2 Initial NDT

The ground area shall be inspected visually followed by examination using MPT or LPT techniques.

If there are any defects present following grinding, which exceed the maximum permitted depth specified in the relevant sections of this specification, the welder shall:

- record the details on the relevant welders' work return form;
- immediately report the details to the person in charge of the work;
- weld repair the ground area and restore the rail profile using the welding and profiling techniques prescribed for each process;
- on completion of welding, fit emergency fishplates and clamps where this is practicable, prior to the defect being removed within the timescales specified in Table 3.

A.4.3 Completed weld check

On completion of welding, the welder shall carry out a check of the completed weld repair using either MPT or LPT to confirm the absence of surface-breaking defects in accordance with the requirements of Table 3. Should any surface breaking defects be found that exceed the requirements of those permitted in Table 3, the welder shall either;

- excavate the defect and re-repair provided that there is sufficient time to do so; or
- arrange for the fitting of emergency fishplates and clamps where this is practicable and advise the Local Track Welding Manager to arrange for the weld repair to be removed within the timescales specified in Table 3.

A.4.4 Final weld inspection

Operators carrying out ultrasonic testing of weld repairs shall have been trained and hold a current certificate of competence.

Weld Inspectors carrying out weld inspection and MPT/DPT of weld repairs shall have been trained and hold a current certificate of competence.

Weld repairs shall be inspected in accordance with the timescales specified below, by the qualified Welding Inspector.

All completed weld repairs shall be examined in accordance with the following requirements:

- **Surface crack detection** - All weld repairs shall be examined by the use of MPT or LPT within one month of completion of welding;



- **Volumetric examination** - All weld repairs shall be examined by ultrasonic examination using the U5 technique and are based on the following timescales according to Track Category:
 - Track Category A: within one month of completion of welding;
 - Track Categories B and C: within 13 weeks of completion of welding;
 - Track Category D: no ultrasonic inspection required.

Exceptions to the above time limits in Track Category A may be permitted where access requires special arrangements, but shall not exceed six weeks.

Final weld inspections shall be carried out by persons other than those involved in carrying out the weld repair.

Checks to be made during the final weld inspection shall include profile finish quality.

Details of weld inspection acceptance criteria and those minimum actions required for any non-compliance are contained in Table 3.

Following completion of the final weld inspection, the person carrying out that inspection shall apply a stamp mark to the back edge of the rail head central to the repair. If access to the back edge is restricted by the proximity of a conductor rail, then the stamp mark shall be applied to the centre of the web on the four-foot side of the rail.

The inspection stamp marks shall indicate acceptance or rejection of the weld as follows:

- 'A' - shall be used to indicate acceptance
- 'R' - shall be used to indicate rejection by the welder
- 'X' - shall be used to indicate rejection by the inspector.

The final weld inspection shall also include the tidiness of the site.

A report shall be completed for each new weld inspected and shall include at least the following items:

- Line;
- Rail;
- LCS code and metreage;
- Contract company (if applicable);
- Welder's name;
- Welder's stamp number;
- Date welded;
- Weld inspector's name and signature;
- Date inspected;
- Defect number if applicable;
- Compliance with this Specification;
- Reason(s) for non-compliance (if applicable).

Contractors carrying out weld repairs shall submit the completed relevant welder's work return form to the Local Track Welding Manager within 72 hours of completion of work.

6.2 Part B - Weld Repair of Plain Line Rails

B.1 SCOPE

This part of the specification applies to weld repairs to plain rails (limits on the applicability of weld repair are specified in clause B.2).

The weld repair techniques covered are MMA and FCAW.

The inspection of weld repairs is included in this part of the specification, together with time-based remedial actions.

B.2 LIMITS OF APPLICABILITY OF PLAIN RAIL WELD REPAIR PROCEDURES

The weld repair of plain rails shall be carried out only on the rail steels and within the limits specified below (the "R" grade designations are defined in EN 13674-1):

Wheelburns and Squat-type defects	
Rail steels	R220 grade (BS11 Normal Grade), R260 grade (BS11 wear-resisting grade A), R350HT (mill heat-treated), AMS.
Rail profiles	All profiles
Max. length of repair	MMA: 200mm ^{1, 2} (R220 and R260), 125mm ^{1, 2} AMS FCAW: 200mm ^{1, 2} (R220 and R260), 250mm ^{1, 2} AMS
Max. width of repair	50mm when defect extends across full rail head (half head width) ³
Max. depth of repair	25mm from crown ^{4, 5}

Notes

1. The maximum lengths specified include the tapered ends at the stop/start positions. Longer defects may be repaired. The 250, 200 or 125mm length shall be completed and ground to profile on each occasion, prior to cutting back into the previously repaired length and continuing to completion.
2. Longer lengths can be repaired when using fully-automatic welding equipment. An assessment of each proposed repair shall be carried out, prior to welding, by the Local Track Welding Manager;
3. If defect extends to full head width, cut back into the head of the rail from the opposite side already repaired to remove fully. Repairs shall always commence on the non-running edge of the rail (see figure 3).
4. If the defect cannot be removed at the maximum specified depth, a temporary repair shall be made, the rail fitted with emergency fishplates and clamps where this is practicable and the rail replaced within 4 weeks.
5. This depth applies when trains are not running, as is normal practice for weld-repair activity on LU.

B.3 GENERAL REQUIREMENTS

B.3.1 Plain rail weld repairs - exceptions and exclusions

Repairs to wheelburns and squat type defects shall not be carried out when the following conditions apply:

- if within 100mm proximity of an aluminothermic weld;
- when welding would take place above [i.e. within fishplate limits of] an insulated joint in CWR¹;
- when welding would take place within fishplate limits².

Notes

1. Weld repairs are permitted to wheelburns or squats above dry insulated joints, provided that the joint is dis-assembled prior to welding and that there is no associated vertical defect greater than 15mm present.
2. Weld repairs are permitted to wheelburns and squats within fishplate limits provided that there is no associated vertical defect greater than 15mm deep present. Weld repairs are also permitted to rail end batter in Track Categories B and C.

In both of the above situations, NDT in the form of MPT or LPT is to be carried out on the boltholes prior to and on completion of the weld repair. If it is not possible to remove the fishplates (*Note 2*), consideration may be given to carrying out ultrasonic examination using the U1/U2 technique(s) (as described in Network Rail document NR/SP/TRK/055).



B.3.2 Tri-metallic zones on AMS crossing leg end extensions

Weld repairs carried out in the vicinity of a tri-metallic zone (TMZ) are subject to the proximity limits shown in Figure 1. However, where defects extend across a TMZ, repairs to these are permitted in accordance with the requirements of clause D.4.6.

B.3.3 Initiation of plain rail weld repairs

Before any plain rail weld repairs are carried out, the rail shall be checked for condition of fastenings and these shall be renewed as necessary. The sleeper condition shall be good with an absence of voids. Top, alignment and ballast consolidation shall also be checked, and rectified where necessary.

B.4 WELDING REQUIREMENTS

B.4.1 Requirements for plain rail weld repairs

Plain rail weld repairs shall be carried out in a possession or during engineering hours.

B.4.2 Preparation of work

The extent of the repair work required shall be checked, by referring to information provided in ultrasonic reports.

The length of defect to be repaired shall be marked on the rail by the welding supervisor and/or the ultrasonic operator as appropriate.

The area to be repaired shall be excavated by grinding (gouging electrodes shall not be used for this purpose) to produce a smooth, bright surface and shall not exceed the maximum dimensions specified in clause B.2. The ends of the repair shall be blended to a 30mm taper to the existing rail surfaces. Light pressure only shall be used when grinding, particularly with AMS, to avoid overheating of the rail.

B.4.3 Welding conditions

When using the MMA process, the welding current shall be set in accordance with the consumable manufacturers' recommendations and the suitability of the current selected, checked by trial depositions on a striking plate, or similar.

When using the FCAW process, the welding current and voltage shall be set in accordance with the consumable manufacturers' recommendations and the suitability of the current and voltage selected, checked by trial depositions on a striking plate or similar.

In both instances, the striking plate shall not be positioned on any part of the rail.

B.4.4 Deposition techniques

Weld beads shall be deposited as follows:

MMA: Only the stringer bead technique shall be used. The use of the weave technique is not permitted. Weld beads shall be deposited such that they overlap one another by approximately one third.

FCAW: Using a weave technique up to a maximum width of approximately 20mm. Weld beads shall be deposited such that they overlap one another by approximately 25%.

When carrying out welding with the MMA process, weld beads shall be deposited using a technique that will minimise the incidence of start porosity.

Care shall be taken to strike the arc at the intended position on the component to be welded. Stray arcing shall be avoided as cracking of the component may result. The starts, joins and finish position of weld runs shall be staggered across the rail head (see Figure 2).



Where the weld repair is contained within the gauge corners of the rail head, the first weld bead shall be deposited along one of the edges of the excavation. The maximum permitted bead length is specified in section B.2 although longer weld beads are permitted when using fully-automatic welding processes. The second and subsequent weld beads shall then be deposited adjacent to the previous weld bead(s).

The work shall be carried out following the above sequence until the first layer of weld is completed.

Following completion of the first layer of weld metal, subsequent weld layers shall be deposited until there is sufficient weld metal to restore the rail to original profile.

Where the weld repair extends across the full width of the rail, half of the rail head shall be excavated, with the first weld bead being deposited along the non-running edge of the rail. The second and subsequent weld beads shall then be deposited adjacent to the previous weld bead(s) moving inwards towards the centre of the rail head. Sufficient weld beads/layers shall be deposited to restore the rail to original profile. The weld repair shall then be profiled using a rail-mounted grinder, prior to the remaining part of the repair being ground back into the previously repaired half from the running edge side of the rail head (see Figure 3). The weld repair shall then be completed as previously. The maximum permitted bead length is specified in clause B.2.

Weld beads shall be thoroughly cleaned immediately following deposition. All slag must be removed by means of a chipping hammer, hammer and chisel, or needle gun, following which the weld bead shall be cleaned by means of a wire brush. If slag is trapped in the weld metal, or if any other defect occurs, it shall be removed by grinding before welding continues, followed by NDT using either the MPT or LPT technique to confirm removal and the area re-welded.

Any spatter present shall be removed by means of a hammer and chisel.

Where weld repairs extend beyond the maximum permitted dimensions specified in clause B.2 the maximum length of repair shall be completed and the rail ground to profile prior to continuing with the remainder of the defect. When continuing the repair, care shall be taken to grind back into the previous weld repair by 25mm, to remove all defective material.

B.4.5 Inspections during welding

Regular checks of the rail temperature shall be made in accordance with the requirements of section A.3.9. For normal grade rail groups, if the rail temperature should drop below the specified minimum value, further preheating of the rail shall take place prior to recommencement of welding. For AMS, if the temperature exceeds the maximum value, the rail shall be allowed to cool to the required level before welding recommences.

If only one layer of weld metal is deposited onto the surface of the rail, the weld deposition shall be inspected visually for defects. Any visible defects shall be removed by grinding, followed by NDT using either the MPT or LPT technique to confirm removal and the area re-welded.

If more than one layer of weld metal is deposited onto the surface of the rail, then each layer deposited shall provide a smooth and flat surface for deposition of the next layer. Each deposited weld layer shall be inspected visually for defects. Any visible defects shall be removed by grinding and the area re-welded and inspected by use of the MPT or LPT technique.

B.5 WELD FINISHING

B.5.1 Profile grinding

Grinding and re-profiling of the weld repair shall be carried out by the use of an approved grinder where the repair is contained within the gauge corners of the rail head.

Should the repair extend across the full width of the rail head, half of the repair shall be completed and the rail profile restored prior to completing the remaining part of the repair. In both instances, the rail shall be re-profiled using a rail mounted grinder.