

Letter of instruction

Information for users

The following document:

NR/L2/TRK/0032 Issue 5

has had changes made to it, most recently, with effect from **23 September 2013**.

Instructions for use

It is essential that you first read and understand each letter of instruction pertaining to the standard before proceeding to use the standard. You must then apply the requirements of each letter to the standard.

NR/BS/LI/305	Issue 1	23 September 2013	Proceed to letter ►
NR/L2/TRK/0032	Issue 5	04 December 2010	Proceed to standard ►

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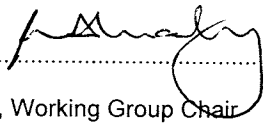
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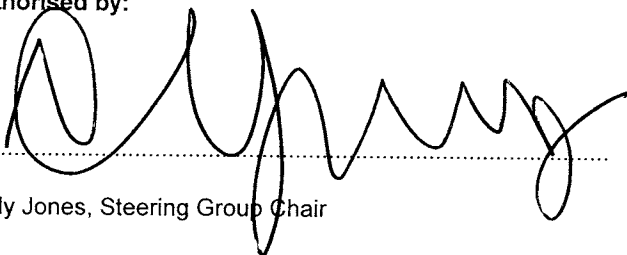
Joining of Rails by Aluminothermic Welding

Endorsement & Authorisation

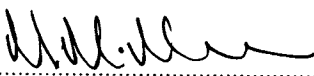
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ISSUE RECORD

Issue	Date	Comments
1	Feb 1996	Renumbering of BR Standard GC/EH0032 (Sept 1993)
2	Feb 2003	Replaces prescriptive instructions for making welds with a requirement to use process suppliers' manuals
3	Apr 2007	Incorporation of TNCs; amendment to main body of text which includes: new definitions, revision of welder training, competence and certification requirements to reflect current Sentinel requirements; change to planning of welding work; clarification and pictorial representation of joint misalignment; revision of weld inspection training, competence and certification requirements; relaxation of inspection requirements when welding at lineside; revision of Table 1; inclusion of new Table 2 for minimum actions and UIC codes; revision of matrix of approval for welding competency
4	Aug 2008	Updated to reflect Phase 2A reorganisation
5	Dec 2010	General tidying up of document; updated to reflect Engineering reorganisation (Nov 2009); requirements for Competence and Training removed and referenced to new document; incorporation of NR/BS/LI/180 for weld acceptance requirements; addition of new clause (4.8) for measuring and inspection equipment; change to maintenance and testing requirements (4.9.2) for oxy-fuel gas equipment; reference and addition of new alloyed steel grades; change of requirements for welding into RCF; removal of minimum rail distance and reference to NR/L2/TRK/2102; addition of references.

Compliance

This Network Rail Specification is mandatory and shall be complied with by Network Rail and its Contractors if applicable from 4 June 2011.

When this Standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 4 to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Stage 4 was reached and not to comply with requirements contained herein, unless the designated Standard Owner has stipulated otherwise in the accompanying Briefing Note.

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1 PURPOSE

This specification defines the standards to be achieved when aluminothermic welding is carried out, whether in or out of the track, and defines the welding procedures to be used.

2 SCOPE

This specification applies to all aluminothermic welding that may be carried out on, or for installation into, Network Rail managed infrastructure.

This specification identifies the prerequisites for process suppliers and recognises the process supplier as the leading exponent of that process in terms of training, certification and re-certification.

Network Rail's requirements are contained in this specification with a list of approved process suppliers and their respective operating manuals and procedure documents referenced in Appendix A. All appended documents shall be treated as an integral part of this specification and thus their contents shall be considered to be mandatory.

The inspection of welds is included in this specification, together with time-based remedial actions.

3 DEFINITIONS

Aluminothermic - a process by which two rails are permanently butt-welded together by the introduction of cast metal (see Appendix A for those processes approved by Network Rail).

Assistant Welder - a person who has been trained and tested and who is currently certificated to assist a Welder in carrying out defined welding processes and procedures.

Attachment - any compound brazed or welded to a rail.

Bainitic - a grade of steel used for rail production.

Contractors Welding Engineer - a person with comprehensive technical knowledge in welding and allied processes relevant to track welding, which shall be attained by a combination of theoretical knowledge, training and/or experience.

Contractors Welding Manager - a person with specific technical knowledge, where the level of technical knowledge needs to be sufficient for the planning, executing, supervising and testing of the tasks and responsibilities relevant to track welding.

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Emergency fishplates and clamps - specially forged fishplates held together with G clamps or other approved devices, which can be applied to a defective or suspect weld, rail defect, or rail break and which hold the rails to line and level.

Experienced Welder - a qualified welder who has completed his/her first two-yearly recertification cycle.

LCAMS (Low Carbon Austenitic Manganese Steel) - this is a grade of steel used for rail and cast crossings production.

Lineside welding - welding out of track

Normal Grade Group rails - rails made from the following steel types may be treated as normal grade for the purposes of the welding procedures in this Specification,

- EN R220 grade (BS11 normal grade)
- EN R260 grade (BS11 and UIC grade 'A')
- AREA 90
- Rolled Bainitic.

Trainee Welder - a person who has been trained and tested and who is currently certificated to carry out defined welding processes and procedures during a defined period of mentorship.

Tunnel - for the purposes of this specification, the term includes any structure covering more than 50 metres, measured along the track. Special precautions are required when welding in tunnels owing to the limited ventilation.

Welded Joint (Weld or Butt Weld) - a union between two pieces of rail with or without the use of a filler metal. It is a joint in the rail without fishplates, bolting or clamping, to provide a continuous, uninterrupted running surface (e.g. aluminothermic, flash-butt or gas pressure weld).

Welder - a person who has been trained and tested and who is currently certificated to carry out defined welding processes and procedures.

4 GENERAL REQUIREMENTS

4.1 Process Suppliers

Only process suppliers approved by Network Rail shall manufacture and supply those process materials and requisites for use on Network Rail managed infrastructure. The approval of a process supplier does not form part of this specification.

Network Rail reserves the right to withdraw the approval of a welding process supplier, or a particular welding process or procedure, should there be any risk from continued use in Network Rail managed infrastructure.

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The process supplier shall be responsible for producing a welding process operating manual for those welding processes and procedures for which Network Rail approval is being or is to be sought. These documents shall not be altered or changed to reflect any alteration or change to a process or procedure without Network Rail's previous approval to that alteration or change to the process and procedure.

Welding shall be carried out in accordance with this specification and the process supplier's operating manual in respect of general and process-specific applications. Information regarding process suppliers' operating manuals can be found in Appendix A.

The process supplier's operating manual shall include details of the following critical features:

- Welding rails of similar or dissimilar wear, grade or profile
- Use of moulds, including approved modifications
- Use of mould shoes
- Approved use of portions
- Rail end squareness and tolerances
- Nominal gap dimension and tolerances
- All oxy-fuel gas equipment including cylinder sizes and numbers of cylinders
- Special precautions for welding at ambient temperatures approaching or below 0°C
- Preheating conditions
- Maximum delay - preheating to portion ignition
- Reaction times
- Removal of equipment
- Minimum trimming times associated with particular trimming equipment
- Work in conjunction with tensors – application of additional pressure
- Minimum time before grinding can commence.

Welding materials, consumables and other process-specific equipment shall not be used for any welding process other than that identified by the process supplier and included in the process supplier's operating manual.

4.2 Welding Processes

Only Network Rail approved welding processes shall be used. The approval of welding processes does not form part of this specification.

4.3 Welding Procedures

Within each welding process there may be several procedures for welding different rail profiles and grades. Only Network Rail approved welding procedures shall be used. The approval of welding procedures does not form part of this specification. It shall be the delivery organisation or contractor's responsibility to acquire and retain full updated details of each process and procedure it is intended to use from the relevant process supplier.

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4.4 Welder Training, Competency and Certification

The requirements for welder training, continuing competency and certification, can be found in Network Rail Standard, NR/L2/CTM/222; Competence and Training in Track Welding, Weld Inspection and Ancillary Processes.

4.5 Responsibilities

Network Rail and/or the contractor shall manage and confirm that:

- All welding activities are subject to verification/approval by audits undertaken or approved by the Senior Maintenance Support Engineer (Welding)
- Only Network Rail approved processes and procedures are used
- Complete and up to date copies of this specification are held
- Complete and up to date copies of the process supplier's operating manuals are held for those processes and procedures it is intending to use
- Records of initial certification, testing for re-certification or updating of certification and safety critical work assessments are maintained
- Only welders and assistant/trainee welders who are certificated as currently competent, and are in possession of a Sentinel welding competency card, shall carry out welding or assistant/trainee welding duties.

Network Rail and/or the contractor shall be responsible for checking the Occupational Health of all personnel carrying out welding duties and that they are provided with a safe working environment.

Network Rail and/or the contractor shall be responsible for checking that:

- The welding materials are in good condition and suitable for use
- The welding equipment is in good condition and suitable for use
- All welds are produced in accordance with the requirements of this specification and the appropriate welding procedure within the Process Supplier's manual
- All welds are inspected in accordance with the requirements of this specification and within the specified timescale.

Network Rail and/or the contractor shall also instruct and subsequently check that any welding work contracted to a sub-contractor is not further sub-contracted by that sub-contract company.

Network Rail reserves the right to withdraw the approval of a contractor or sub-contractor, should there be any continued cause for concern regarding the quality of work.

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4.6 Responsibilities of the Welder

In the interests of safety, the welder shall be responsible for confirming that only persons involved in the making of the weld are to be allowed in the immediate work area.

The welder shall also be responsible for checking and confirming that:

- Only those processes and procedures for which current certification is held, are carried out
- Welds are produced in accordance with the requirements of this specification and the relevant process supplier's operating manual referred to in this specification
- Relevant welding certification is readily available, for production upon request, at each and every work site
- A safety critical work permit providing means of positive personal identification is readily available, for production upon request, at each and every work site
- The assistant/trainee welder has the relevant welding certification and a safety critical work permit providing means of positive personal identification readily available for production upon request
- All aluminothermic welds made by that welder are duly stamped on completion.

Network Rail reserves the right to withdraw the approval of a welder should there be any cause for concern regarding the quality of work.

4.7 Welding Requirements

4.7.1 Control of substances hazardous to health

The process supplier shall be responsible for the supply and issue of material safety data sheets required for the assessment of consumables to the Network Rail, Senior Technology Engineer (Welding) and to any contractor who is approved to use the welding process.

The delivery organisation or contractor shall be responsible for the assessment of all substances used in conjunction with the welding process and not covered by the process supplier. The contractor shall be responsible for the issue of all applicable documents to the Network Rail, Senior Technology Engineer (Welding) and to any sub-contractor.

4.7.2 Planning of welding work

All welding activities shall be subject to a work-activity risk assessment (WARA) and a site-specific method statement.

Sufficient time shall be planned in order to enable the welder to carry out the work to the standard required in accordance with this specification.

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The line on which aluminothermic welding is to be carried out, shall be blocked to the passage of traffic. In certain circumstances it will be necessary to prevent the passage of any train on an adjacent line, e.g. when welding on through timbers or bearers in S&C. During the casting of the weld, precautions shall also be taken such that the weld integrity is not adversely affected by vibration from the passage of trains on adjacent lines or by other work activities. In such circumstances, the supervisor shall consider risk mitigation as appropriate, eg, imposition of a TSR or temporary suspension of traffic.

When welding on the 6ft rail, when it is deemed necessary that a welding tent or umbrella is to be used to protect the weld from inclement weather, the WARA shall take account of their use.

The following minimum times are to be used as guidance when planning the various types of work:

Installation of a closure rail involving two welds and including grinding (tensors in use)	4 hrs 10 mins
Installation of a wide gap weld including grinding (tensors in use)	3 hrs 15 mins
Production of a single weld in a multi-weld site excluding grinding	1 hr
Production of a weld in the conversion of jointed track to LWR or CWR, excluding grinding	1 hr 10 mins

The above times assume that one team of welders is at the site of work and all equipment is available and ready for use.

4.7.3 Welding in low ambient temperatures

The process supplier shall identify, in the process supplier's operating manual, any special conditions that the welder shall apply to welding when the rail temperature is at or below 0°C.

If for any reason compliance with the special conditions cannot be met, then welding shall cease until either the circumstances can be rectified, or the low ambient temperature rises sufficiently to enable welding to recommence.

In exceptional circumstances where the correct special conditions cannot be met, or the correct preheating conditions cannot be attained or maintained and it is considered imperative that welding shall continue, then any weld made shall be considered to be defective and fitted with emergency fishplates and clamps before the possession is given up. Such welds shall be identified in accordance with the Network Rail and/or contractor's procedure for non-conforming welds made during low temperatures. If emergency fishplates and clamps are not fitted before the possession is given up, then a TSR of 5mph shall be imposed and a watchman appointed until the emergency fishplates and clamps are fitted.

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In both of the above cases, the welder shall submit a signed report within 24 hours, including all the relevant details, to the Network Rail or contractor's delegated representative for the necessary remedial action to be carried out.

A record shall be maintained of all welds produced at low ambient temperatures of 0°C and below and also when special conditions were invoked. The ambient temperature shall be identified on the record in degrees Celsius.

4.7.4 Welding in inclement weather

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

Should the weather become inclement after the welding process has commenced and a welding tent or umbrella is not available on site, the weld shall be fitted with emergency fishplates and clamps on completion of work, the supervisor informed and the minimum action specified in 11h of Table 1 applied.

Welding consumables shall be protected against inclement weather to prevent contamination and damage on site.

4.7.5 Welding in tunnels and confined spaces

Dissolved acetylene shall be used as the fuel gas when welding in tunnels or confined spaces. Dissolved acetylene cylinders shall be left to stand in the upright position for a minimum period of 60 minutes prior to use, regardless of the length of time stored or transported in the prone position.

4.7.6 Welding between hydraulic tensors

Only hydraulic tensor equipment approved by Network Rail shall be used. Welders and assistant/trainee welders who are required to assemble and operate hydraulic tensor equipment shall have been trained in their use and shall hold a current certificate of competence. Welders and assistant/trainee welders who are required to carry out welding activities in the vicinity of hydraulic tensor equipment, shall be briefed on the requirements of working adjacent to them.

When hydraulic tensors are to be used, they shall be applied to the rail and the rail extended by the required amount before the final welding gap is measured and cut.

Note: Use of an abrasive saw between tensors is prohibited. When stressing CWR consisting of mill heat-treated (MHT), wear-resisting grade 'B', 90 or 110kg/mm² Chromium, microalloyed head hardened (MHH), high performance (HP) or low-carbon austenitic manganese steel (LCAMS) rails, it should be noted that these rail grades may require three separate cuts as follows:

- i. Oxy-fuel gas flame cut the CWR before fastenings are removed

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- ii. Calculate the required extension of the rail and cut the rail ends using mechanical means, e.g. disc cut or saw, allowing for the weld gap
- iii. Pull the rail with tensors to the required extension and check all tell-tales
- iv. If movement at the tell tales is greater than 10mm, the rail shall be released from the tensors and one rail end re-cut using an abrasive saw to allow for the movement at the tell tale(s)
- v. Refit the tensors and pull the rail to the required extension
- vi. Check the welding gap and, if incorrect, note the amount of rail still to be cut, release the rail and re-cut one rail end using an abrasive saw.

Repeat (v) and (vi) until correct welding gap is achieved.

At least 40 metres of rail on either side of the tensor shall be fastened down prior to welding.

To avoid the possibility of hot tears the hydraulic tensors shall remain in position after completion of the pour, under tension, for the minimum time prescribed in the process supplier's operating manual for that particular welding process.

Tensor equipment shall be subject to three-monthly maintenance in accordance with the manufacturer's maintenance requirements. Particular attention shall be paid to the pressure gauge reading (where fitted) and the actual load achieved, checked 10 minutes after the load has been applied.

Tensor equipment that has been involved in a tensor slip on site shall be removed from service to establish the cause of slippage. The particular item of equipment shall not be returned to service until it can be demonstrated that the cause has been rectified. Tensor equipment involved in a tensor slip shall be reported on the welder's daily installation form.

4.7.7 Welding on underbridges, direct fastenings or longitudinal timbers

When welding is associated with underbridges with directly fastened track, longitudinal timbers or cross-sleepered track seated directly onto longitudinal timbers or bridge members, the position of any aluminothermic weld shall conform with the following requirements, which can also be found in Figure 1:

- Welds shall not be closer than 4.5 metres to the end of the longitudinal timber or bridge deck. The dimension shall be observed within and adjacent to the bridge and shall be measured along the centre of the 4 ft (this requirement is reduced to 2.5 metres in the case of a ballasted bridge deck)
- Welds in cross-sleepered track seated on or fastened to longitudinal timbers or bridge members, shall not be closer than 4.5 metres to the end of the longitudinal timber or bridge deck. The dimension shall be observed within and adjacent to the bridge and shall be measured along the centre of the 4 ft
- Welds shall not be closer than 2 metres to the end of any individual timber or longitudinal timber within the bridge

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- Wherever possible, welds shall be installed opposite each other in the same track.

Note: The above requirement does not apply to masonry arches with fully ballasted cross-sleepered track.

4.7.8 Welding of rails of different wear, grade or profile

Rails of different wear, grade, or profile may be welded only if the welding procedures have been approved by Network Rail and included in the process supplier's operating manual referred to in this specification.

4.7.9 Welding consumables

Moulds shall be used in accordance with the following requirements:

- Standard moulds - shall be used for similar rail sections up to the maximum dimension and dissimilar wear as identified in the process supplier's operating manual
- Stepped moulds - shall be used only for dissimilar wear for which they are designed
- The process supplier shall produce moulds such that following use the resultant weld shall display the mould wear identity on the weld collar. There shall be no identity displayed on the underside of the rail foot
- Moulds shall be used for welding those rail profiles for which they are designed, except that, in some circumstances where the face of the moulds would contact directly within the rail, the moulds may be modified in the web only, by up to 2mm maximum, to accommodate the welding of rails of different profiles but nominally the same contour and for which special moulds have not been designed or supplied.

Details of the use of moulds where modification is approved by Network Rail, shall be contained in the process supplier's operating manual.

Welding portions shall be used to weld those grades of rail steel as approved by Network Rail and contained in the process supplier's operating manual.

The process supplier shall identify in the operating manual the approved luting medium to be used in conjunction with any welding procedure. Only an approved luting medium having the correct moisture content shall be used.

4.7.10 Weld trimming

Normally, the weld shall be trimmed by a hydraulic weld trimming machine, which shall remove the head riser completely from the rail head, leaving a minimum of 2mm of trimmed material around the rail head profile. The rail and weld shall not be undercut by the trimming operations.

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Hydraulic weld trimming machines shall be approved by Network Rail and the process supplier for use in conjunction with their welding process(es). Details of approved machines shall be contained in the process supplier's operating manual.

Welds in LCAMS shall always be trimmed using a double-bladed hydraulic weld trimming machine. The resultant surplus trimmed material around the entire rail head contour shall be at least 3mm thick.

If it is not possible to trim the weld using the hydraulic weld trimming machine, the head riser shall be removed using a suitable angle grinder and abrasive cut-off wheel. The head riser shall be removed to within 5mm of the rail head, and the remaining head riser removed by final profile grinding.

Flame washing of welds is **not permitted**.

4.7.11 Weld cleaning

All welds shall be cleaned of mould, mould residue and luting material by the use of tools that will not cause damage to the rail. The use of hammers, setts and similar tools is not permitted except for the removal of the main bulk of the mould.

4.7.12 Weld profile finishing

Profile finishing shall not commence until the specified time has elapsed, all rail alignment aids have been removed, all pads and insulators have been replaced and the rail fastened down.

Profile finishing shall be applied to the complete rail head contour at the weld. In certain circumstances, e.g. third rail, access to the back edge may be difficult and consideration shall be given to locally profiling the rail head using an angle grinder.

Profile finishing shall be contained in the shortest possible length on the rails either side of the weld, but shall not exceed 450mm on either rail. Exceptions to this shall be made when profiling rails of differing head wear: any projection of a rail at the weld shall occasion that rail to be profile finished and blended to the adjacent rail extending over a minimum distance of 1.5 metres from the weld. A fully supported grinder shall be used for this purpose: manual support alone is not permitted.

Trains shall be permitted to run from a sideworn rail to a new or full contour, or lesser sideworn rail, or vice-versa, only when the difference between the two rails has been blended into the lesser sideworn rail. The blending shall extend over a minimum distance of 1.5 metres from the weld maintaining the sidewear angle throughout.

The alignment of the welded joint shall be measured using appropriate equipment. Alignment tolerances are specified in Table 1.

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Allowance shall be made for welds in rails on sharp curves and shall not exceed the average deviation from straight measured over 1 metre of rail immediately either side of the weld.

Trains shall not normally be allowed to pass over a newly made weld until profile finishing has been completed. However, should trains be required to pass over an unprofiled weld, this may be permitted at a maximum speed of 5mph, provided that the weld has been trimmed by the use of an hydraulic weld trimming machine only. In such a circumstance, the specified time for rail alignment support to remain in position shall have elapsed, pads and insulators replaced and the track fastened down.

4.8 Measuring and Inspection Equipment

All measuring and inspection equipment used for the manufacture and final inspection of aluminothermic welds shall be maintained in accordance with the requirements of NR/L2/RMVP/0172 and NR/L3/RMVP/0201. Master equipment used for calibration and validation purposes shall be calibrated against relevant UKAS requirements and certificated accordingly.

Contractors and sub-contractors may continue to use existing processes and procedures, provided that the requirements of these are no less onerous than those specified in the above documents.

4.9 Oxy-Fuel Gas Equipment

4.9.1 Type of equipment

The process supplier shall identify the specific items and types of oxy-fuel gas equipment applicable to each welding process and/or welding procedure and shall include the following:

- Type(s) of regulator and flow or pressure capacity for each gas
- Type(s) of flashback arrestor for each gas
- Length and bore diameter of gas hose for each gas
- Preheating equipment, including injector size if required
- Type(s) of pressure check gauges
- Gas cylinder sizes.

All items of oxy-fuel gas equipment specified by the process supplier shall conform in every respect to applicable European and/or International Standards.

The use of repair exchange regulators and flashback arrestors is **not permitted**.

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4.9.2 Safe assembly, care and use of equipment

The safe assembly, care and use of equipment for oxy-fuel gas welding, cutting and heating processes, shall be observed at all times. Such equipment shall be used as follows:

- Positioned safely on site to minimise any hazard to welding personnel, or other personnel working on or near to the line
- Wherever possible, positioned clear of the line and any walking routes.

Where it is essential to leave items of equipment unattended on Network Rail managed infrastructure, those items shall be left secured, chained and padlocked to prevent any possibility of being placed on the line.

Oxy-fuel gas equipment shall be checked to comply with the following:

- It is of a type approved by the process supplier
- It is registered and positively marked accordingly
- It has been tested within the previous 6 months or any lesser period specified by the process supplier in accordance with an approved written scheme of examination
- It is in good working order and suitable for use.

All examiners carrying out testing of oxy-fuel gas equipment shall have been trained and hold a vocational qualification issued by an awarding body.

Maintenance of oxy-fuel gas equipment shall be carried out in accordance with the requirements of Network Rail document, NR/L3/RMVP/0201/CAL501. Contractors and sub-contractors may continue to use existing processes and procedures, provided that the requirements of these are no less onerous than those specified in the above document.

Network Rail, Contractors and sub-contractors shall maintain a register of all oxy-fuel gas equipment and test dates.

Fuel gas cylinders shall be secured in an upright position to a suitable frame on rail mounted vehicles or trolleys. Oxygen cylinders shall be secured in either the prone or vertical position on rail mounted vehicles or trolleys.

Gas cylinders shall be positioned as close as possible to the source of welding, but shall not be less than 5 metres from all welding or sources of ignition.

Gas cylinders shall be turned off at all times when not in use.

Flashback arrestors and hose check valves shall be incorporated into every set of oxy-fuel gas equipment used in conjunction with aluminothermic welding.

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Digital or analogue check gauges shall be incorporated into every set of oxy-fuel gas equipment used in conjunction with aluminothermic welding. The process supplier shall identify the position of the check gauges, as relevant to each welding procedure, in the process supplier's operating manual.

Following site assembly of oxy-fuel gas equipment and the tightening of all connections, all joints shall be tested for gas tightness using an ammonia-free, non-aerosol type, leak detection spray or a 0.5% Teepol/water solution applied with a brush. If any leak is detected and cannot be rectified on site, the gas equipment involved shall not be used.

4.10 Preheating and Rail Movement

If for any reason it becomes necessary to make any alteration to the preheater alignment, or the preheating conditions cannot be maintained unaltered and without interruption throughout the entire preheating cycle, then preheating shall be terminated, the moulds removed from around the joint and the rails allowed to cool to a temperature below 50°C before welding of that particular joint may be recommenced. The temperature shall be checked with a suitable temperature indicating crayon.

If during production of a weld, an inspection of the datum marks (see section 4.15) reveals that rail movement has taken place, or will take place, such that the welding gap will be outside the permitted tolerance, then work on that weld shall be terminated and the necessary corrective actions made.

4.11 Track Conditions and Site Details

Network Rail and/or the contractor shall plan and install welds only where:

- The track is in good condition and suitable for welding
- The rails are suitable for welding
- The vertical and lateral alignment are suitable for welding
- Sleeper, timber or bearer spacing is correct
- Two sleepers on either side of the weld to be made (i.e. a total of four) are of the same material and depth.

Welds shall be made centrally between sleepers, which shall be at the correct sleeper spacings depending on the track category as specified in NR/L2/TRK/2102.

Welds in S&C shall be made centrally between timber or bearer supports being at a nominal spacing of 710mm for vertical S&C or 650mm for NR60 S&C.

Aluminothermic welds shall not be permitted to be in contact with, or positioned on a sleeper, timber, chair or baseplate at any time or through any circumstance.

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Aluminothermic welds made in rails on, or to be installed on, a continuous support condition, e.g. slab track, shall incorporate a collar not exceeding 4mm deep on the underside of the rail foot.

4.12 Rail Identification

Before commencing any part of the welding operation, the welder shall positively identify the profile, grade and amount of head wear for each rail to be welded.

Any rail that cannot be positively identified shall be reported to the person in charge of the worksite. If the person in charge of the worksite instructs the welder to weld into the unidentifiable rail, the welder shall establish by the use of a magnet that the rail steel is not of austenitic-manganese origin. Once this is established, the welder shall produce a non-conformance report [TEF/3007](#) which is to be endorsed by the person in charge of the worksite who shall make arrangements for the weld to be clamped prior to passage of traffic (as a further safeguard, the details may also be forwarded to fault control).

The welder shall give the report to their line manager within 72 hours and on receipt the line manager shall inform the relevant RAM (T) who will determine the course of action to be taken.

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

4.13 Rail End Preparation

Rail ends to be welded shall be prepared, whether on site or otherwise, by mechanical means, e.g. disc cut or sawn, or by oxy-fuel gas cutting. In all cases, the method of preparing the rail end for welding, shall be in accordance with the process supplier's manual.

Cutting into stressed rail by mechanical means is not permitted.

In circumstances where it has been necessary to supply a rail with a flame cut end, then that rail shall only be welded following the necessary rail end preparation shown below:

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Rail Steel	Rail End Condition	Rail End Preparation
BS11, Normal Grade group	Flame cut less than 24 hours earlier	No further preparation required provided that no traffic is allowed to pass.
BS11, Normal Grade group	Flame cut more than 24 hours earlier	The rail shall be disc cut or sawn at a minimum distance of 8mm from the flame cut end. The prepared rail end shall then be inspected by the magnetic-particle testing (MPT) method.
BS11, Grade B UIC, Grade B 110 kg/mm ² Chrome MHT MHH HP	Flame cut at any time	The rail shall be disc cut or sawn at a minimum distance of 8mm from the flame cut end. The prepared rail end shall then be inspected by the MPT method.
LCAMS	Flame cut at any time	Rail end preparation shall be the same as rail end condition/preparation for normal grade group, except that inspection by the MPT method shall be replaced by the liquid penetrant testing (LPT) method.

Notes:

- 1) MPT shall be carried out using either a permanent or electro-magnet. Either magnet shall be capable of lifting the required weight test prior to use.
- 2) Whenever an inspection by MPT or LPT reveals the presence of a crack, the rail shall be re-cut and the inspection repeated for as many occasions as becomes necessary, until the inspection confirms a rail end free from cracking.
- 3) The running of any train over rails with a flame cut end in grades R220, R260, R350 HT, MHH and HP (see Appendix B for identification purposes), shall be permitted only in an emergency. In these circumstances, the rail end shall be fitted with emergency fishplates and clamps and a TSR of 20mph imposed. The flame cut rail end shall be removed within 7 days. The passage of trains over other rail steel grades with flame cut ends is **not permitted**.

4.14 Joint Alignment

Prior to aligning the joint, the straightness of the running surface, running edge and foot tips of each rail shall be checked. Any lack of straightness that may affect the standard of alignment that can be achieved, shall cause that particular rail end to be rejected.

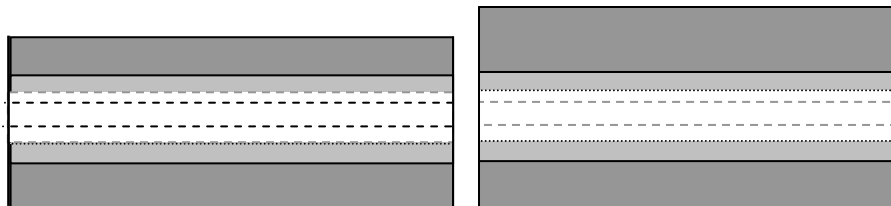
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In the case of side worn rail, a minimum depth of 5mm of gauge face, measured from the bottom of the rail head, shall be available to allow the straightedge to be positioned for alignment purposes. Where the minimum depth of gauge face is less than 5mm, the rails may be aligned on the field side. In these cases the weld shall be blended to profile in accordance with the requirements of 4.7.12 using a fully supported grinder.

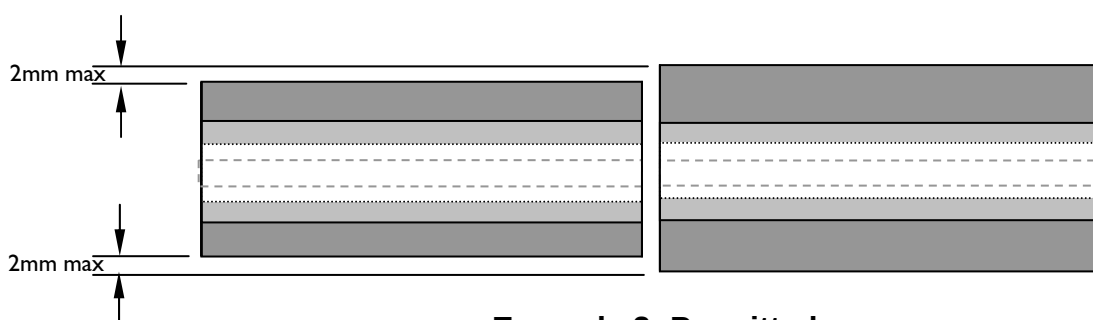
All fastenings, insulators and pads, shall be removed from at least two sleepers, timbers, bearers or fastening positions on either side of the joint to be welded. On a continuous slab support, the pad beneath the rail shall be cut and removed for a distance to at least the second fastening position.

The correct vertical and lateral alignment of the joint shall be obtained within each rail fully supported on both sides of the foot on the first sleeper, timber, bearer, or fastening position on either side of the joint.

Where rail foot misalignment occurs due to differing foot widths, the amount of misalignment shall be equalised across both rails before fitting of the moulds takes place as shown below. Any misalignment present shall be subject to a maximum measurement of 2mm on either side.



Example 1: Not permitted



Example 2: Permitted

No alignment aids shall be permitted that may contact with the rail and the second sleeper, timber, bearer, or fastening position on either side of the joint. The rail shall be clear of any baseplate, chair, or track support feature.

Note: The above requirement does not apply when A frames are to be used.

Wedges shall not be driven into wooden sleepers, nor into timbers in S&C. Only approved alignment devices designed for these applications shall be used.

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Alignment about the rail head shall be checked over a 1 metre span and that about the foot over a 300mm span.

4.15 Datum Marks

Immediately following the achievement of the correct joint alignment, the welding gap shall be checked and if still within acceptable limits, the details shall be recorded for the gap dimensions at the head, web and foot tips.

Datum marks shall be made on the foot of each rail coincident with the edge of a fastening housing, baseplate, chair, or a mark on the second sleeper, timber, bearer, or support on either side of the joint. When using A frames, the third sleeper, timber, bearer, or support shall be used.

Strippable contrast paint shall be applied to the rail foot and the datum marks applied with a scribe to give a fine outline. Datum marks shall be of sufficient length to remain visible after the refitting of fastenings following the completion of the weld, for a minimum period of 1 calendar month to facilitate examination.

Failure to apply datum marks in accordance with the above shall cause the weld to be classed as suspect and the minimum action 4a of Table 1 applied.

Datum marks shall be inspected at the prescribed times. If any longitudinal movement of the rails is detected resulting in an incorrect welding gap, the welding operation shall cease and the necessary corrections to the joint made.

4.16 Location of welds relative to other welds, joints etc.

Aluminothermic welds shall not be formed less than 4.5 metres (or 9 metres on curves with a radius of 600 metres or less) from a fishplated or glued insulated joint, another weld or adjustment switch tip.

Minimum distances and rail lengths less than 4.5m are permitted in certain circumstances provided they conform to the requirements of NR/L2/TRK/2102. The minimum distance may also be shorter than 4.5 metres in the following circumstance:

- When replacing existing welds in S&C, machined rails or IRJ's, it may be a minimum of 1.95m, subject to it being supported on at least three sound timbers/bearers and subject to the approval of the Route Asset Manager (Track)

4.17 Proximity of Holes, Attachments and Gall

4.17.1 Fish bolt holes in CWR

New CWR plain line and in the through route of S&C in Track Categories 1A, 1 and 2, shall be planned to be installed without any holes greater than 15mm diameter

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remaining in the rail except as required for permanent insulated joints, axle counters or bonds.

Where the creation of fishplate back holes is unavoidable, they may remain in track provided they conform to the requirements of NR/L2/TRK/2102. Where fishplate back holes have been created, these shall be a minimum distance of 30mm from the prepared rail end.

Redundant front bolt holes are not permitted in any Track Category.

4.17.2 Conversion of jointed track to CWR and bond holes

Prior to conversion, rails shall be visually and ultrasonically examined to confirm that they are free from defects which would require replacement within 13 weeks. Such defective rails shall be replaced prior to conversion.

In track categories 1A, 1, 2 and 3, existing bolted joints shall be removed by cutting back beyond the bolt holes. In track categories 4, 5 and 6, bolt holes may be left in position as long as any rail-end dip or batter will not prevent the weld geometry requirements specified in Table 1 from being achieved. If bolt holes are left in position they shall not be within 30mm of the prepared rail end.

Bond holes are not permitted within 30mm of the prepared rail end.

4.17.3 Attachments and gall

The nearest edge of bond attachments or bond scars shall not be closer than 30mm from the prepared end of the rail to be welded.

A reduction in the foot width due to chair gall is permitted up to a maximum dimension of 2mm. A reduction in foot depth due to gall of any kind is not permitted within 50mm from the prepared rail end to be welded.

4.18 Proximity of Rail Defects

The prepared end of the rail to be welded, shall be at least 100mm distant from the edge of any wheelburns, squats or taches-ovales.

Welding into light or moderate Rolling Contact Fatigue (RCF) is permitted. There shall be no welding into heavy or severe RCF unless there is a minimum distance of 100mm of clean rail between the nearest RCF crack and the edge of the prepared rail end. Where this requirement is achieved by grinding, this shall be blended over a distance of 1 in 600, eg, for a crack depth of 4mm, the transition shall be a minimum distance of 2.4 metres. Any grinding shall be carried out by operators trained in the technique using approved techniques/procedures and grinding machines only.

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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.

4.19 Non-compliant Welds

If the person in charge of the worksite instructs the welder to weld into a rail that does not comply with this standard in respect of track condition or proximity to other welds, bolt holes, track features, defects or heavy or severe RCF, the welder shall produce a non-conformance report [TEF/3007](#) which is to be endorsed by the person in charge of the worksite who shall make arrangements for the weld to be clamped prior to passage of traffic (as a further safeguard, the details may also be forwarded to fault control).

The welder shall give the report to their line manager within 72 hours.

4.20 Non-Destructive Testing

All operators carrying out non-destructive testing (NDT) using MPT, or LPT, shall have been trained in accordance with the requirements of RT/CE/S/056, Rail Testing - Non-ultrasonic Procedures and hold a current certificate of competency.

All operators carrying out NDT using ultrasonic testing (UT), shall have been trained in accordance with the requirements of NR/SP/TRK/1110, Qualification and Certification of NDT Personnel Written Practice - Ultrasonic Testing and hold a current certificate of competency.

4.21 Weld Inspection by the Welder

All newly installed welds shall be visually inspected by the welder for defects immediately after the weld has been completed. The welder shall complete an aluminothermic welding installation form, [TEF/3006](#) and record all relevant information whilst on site, and shall give a copy of the report to the person in charge of the worksite before leaving the site.

The following defects shall require the fitting of emergency fishplates and clamps and the weld stamping with the letter 'R' before the possession is given up:

- Porosity (group of gas pores) in the ground head and/or weld collar
- Isolated gas pores, surface cavities or inclusions in the ground/unground head or weld collar that exceed the maximum permitted dimension in Table 1
- Collar distortion
- Incomplete collar formation
- Black holes
- Porosity or cracks on the contour of the head of the weld.

When any of the above defects are found by the welder following visual inspection, the welder shall complete a welding non-conformance form, [TEF/3007](#) recording all relevant information and shall give a copy of the report to the person in charge of the worksite before leaving the site.

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Network Rail and/or the contractor carrying out the weld installation shall direct and monitor that all of the relevant details concerning defects found by the welder's inspection are included in the weld installation record system within 72 hours and that arrangements are made for the necessary minimum actions to be carried out as specified in Table 1.

4.22 Identification of Welds

All stamps used for the identification of welds shall be a minimum size of 8mm.

Every welding contract company shall have a unique weld stamp identification mark which shall comprise no more than two alpha characters.

Every welder shall be allocated a unique welder stamp identification number within that contract company, which shall comprise numeric characters.

On completion of the visual inspection following profile finishing and before leaving the site, the welder shall stamp all of the welds for which he or she was responsible. All stamp marks shall be applied to the back edge of the rail head within the weld. If access to the back edge is restricted (e.g. third rail), the stamp mark shall be applied to the centre of the web on the four-foot side of the rail.

In addition to the welder's identification stamp, welds shall be stamped with the following suffix characters as appropriate:

- T - For welds made between hydraulic tensors
- L - For welds made out of track
- R - For welds which have been rejected by the welder.

The final part of the stamp mark shall be the date by year with two numeric characters, e.g. for 2010, stamp 10.

4.23 Final Weld Inspection

The requirements for training, continuing competency and certification, can be found in Network Rail Standard, NR/L2/CTM/222; Competence and Training in Track Welding, Weld Inspection and Ancillary Processes.

Aluminothermic welds which have not already been stamped 'R' as being rejected by the welder, shall be inspected within 4 weeks of installation, by the qualified Welding Inspector, in the employ of the main contractor, contracted by Network Rail to carry out the work.

Exceptions to the time limit are not permitted.

Cognisance shall be given, in planning the work, to those locations where access requires special arrangements in order that the 4 week requirement is met.