Process Manual

Railtech PLA
Including HWR, STARTWEL® & GASBOX

One-Shot Crucible Processes

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This manual provides detailed instructions for successfully carrying out the PLA - One Shot Crucible welding process.

This manual shall be used with the relevant Track authority specification documents concerning the installation of Aluminothermic welds.

Only skilled operators who have attended an appropriate training course and hold a valid Certificate of Competence issued either by Railtech UK Limited, or an approved body, shall attempt this operation.

Operators required to work on Network Rail Infrastructure shall hold a current Sentinel card with the appropriate competence.

When working on Network Rail Infrastructure this manual shall be used in conjunction with the latest version of Network Rail Company Specification NR/L2/TRK/0032 'Joining of Rails by Aluminothermic welding'.
INTRODUCTION

The manual is made up from the following sections:

**Section 1** Safety Awareness

Hazard and risk assessment on process application and material storage.

**Section 2** General Instructions - Part 1

The general instructions provide detailed information regarding site assessment and rail preparation.

**Section 3** Process Application - PLA Standard Gap Weld

The process application provides the step by step performance of the standard gap welding operation with felt moulds and sand moulds.

**Section 4** Process Application - PLA 68mm Wide Gap Weld

The process application provides the step by step performance of the wide gap welding operation.

**Section 5** General Instructions - Part 2

The general instructions provide detailed information on weld finishing and inspection.

**APPENDICES**

- **Appendix 1** Rail and Welding Kit Identification
- **Appendix 2** Alignment Devices
- **Appendix 3** Illustrated Parts List
- **Appendix 4** Weld Inspection
- **Appendix 5** Operating Procedures
- **Appendix 6** Preheating Equipment
- **Appendix 7** Luting method for standard and wide gap with Pate a Lute
- **Appendix 8** HWR Process (Head Wash Repair)
- **Appendix 9** STARTWEL® (Electrical Ignition System)
SECTION 1

SAFETY AWARENESS

1.1 - HAZARDS

1.1.1 Burns

Burns may be sustained during the welding operation from a number of sources:

- Rail end preparation
- Hot rails, tools and materials used throughout the welding operation
- Preheating.
- Ignition and reaction of the portion
- Weld cleaning
- Airborne hot sparks and particles

1.1.2 Fire

Fire may occur through accident or negligence due to the following:

- Sparks from cutting and grinding.
- Molten metal spillage and splashes.
- Flammable material too close to the welding operation.
- Incorrect disposal of hot slag.

1.1.3 Explosion

Explosion may occur through accident or negligence due to the following:

- Use of compressed gases.
- Molten metal in contact with water.
- Molten metal in contact with wet or frozen ballast.
- Hot slag or hot slag bowls coming into contact with wet or frozen ballast.

1.1.4 Flying Objects

There may be a risk from flying objects in the following circumstances:

- When removing and replacing rail fittings.
- When removing vent risers and mould debris.
- Splinters from broken tools and grind stones.
- Splinters and sparks from hot materials.
1.2 - HAZARD PREVENTION

1.2.1 Safety Equipment

It is essential that personal protective equipment (PPE) is provided for the welders and worn correctly at all times. The PPE required for welding includes:

- Flame retardant overalls
- Welders gloves
- Clear goggles
- Dark welding goggles GW 5/6
- Ear defenders
- Welding boots
- Hard hat

1.2.2 Welder Training & Assessment

Welders shall have attended training courses in welding and all associated skills before performing track welding. The skill courses required are as follows:

- Railtech PLA Process Welding Certificate
- Oxy-fuel gas safety
- Abrasive wheels
- The safe operation and use of small plant required for welding including weld shear, profile grinder, disc cutter and angle grinder
- The safe operation and use of approved welding tents and umbrellas

1.2.3 Check of Substances Hazardous to Health

Material safety data sheets, on which to base COSHH assessments, are available for all Railtech UK products from Railtech UK Ltd.

1.3 - MATERIAL STORAGE AND TRANSPORTATION

1.3.1 Material Storage Area

Storage buildings shall be dry and well ventilated.

Building construction shall be in accordance with the fire regulations applicable to the substance being stored.

Welding kits shall be stored no more than 4 boxes high

One-shot crucibles shall be stored no more than 3 boxes high for CJ2 crucibles

Crucibles shall always be stored in an upright position
1.3.2 Material Transportation

Transportation of materials shall be in accordance with the fire regulations applicable to the substance being transported.

Crucibles shall always be transported in an upright position.

1.3.3 Spillage of Welding Charge

Spillage shall be mixed with 40% sand to prevent combustion and disposed of as industrial waste.

1.3.4 Disposal of Spoiled Portions

Spoiled portions shall be returned to Railtech UK Ltd for safe disposal.

Note: For further detailed advice on all safety issues, please refer to the site specific method statement and risk assessments available from the site contractor in charge.
2.1 – THE WELDING TEAM AND THEIR RESPONSIBILITIES

- The procedures contained within this Process Manual are designed for use by a welding team.

- Usually, a welding team is made up of a welder and a welder’s assistant.

- A welding team could also be comprised of two welders or one welder and a welder undertaking a mentoring programme prior to full qualification.

- The welder and the welder’s assistant shall hold valid certificates of competence, issued by Railtech UK Ltd, or other approved training organisation, for the process being used.

- The welder will assume full responsibility for the production of the weld and adhere to the welding procedure.

- The welder will mark the weld with his unique identification stamp.

- The assistant will work to the instructions of the welder.

2.2 - SITE ASSESSMENT

- The welder will be responsible for checking that the track conditions meet with the requirements of the relevant track authority.

- Site assessment will include track stability, sleeper type and spacing, proximity of features such as other welds, bolt holes, bond attachments and rail defects such as chair gall, wheel burns and rolling contact fatigue (RCF).

- The welder shall take into account the position of the weld with respect to bridge decks and longitudinal timbers.

- Rails to be welded shall be identified in respect of rail section, wear and steel grade to establish the correct welding kit and procedures.
2.3 - WEATHER CONDITIONS

2.3.1 Wet weather

- Welding may be undertaken in wet weather providing adequate protection is used; i.e. approved welding tent or large umbrella.
- All consumables shall be kept dry, and wet rails dried prior to welding. In severe weather conditions the welder following consultation with their Line Manager may decide to suspend welding for personal safety reasons.

2.3.2 Cold weather

- Welding may be undertaken in sub zero temperatures on normal grade and grade A rails, providing preheating pressures can be maintained. If preheating pressures cannot be maintained welding shall be suspended.
- It is permissible to weld grade R220 and R260 rails at rail temperatures down to -14°C.
- The temperature of luting paste shall not be allowed to fall below -5°C. Welding may be undertaken at ambient temperatures lower than -5°C only if the pastes are protected from the cold.

2.4 - WELDING GAP PREPARATION

- The preferred method for preparing the welding gap is by disc or saw cutting, alternatively the oxy-fuel gas technique using Propane or Acetylene may be adopted. The correct gap and tolerances are laid down in the operating parameters.
- Where oxy-fuel gas cutting of rails is carried out, Railtech UK advise that the following points shall be taken into account:
  1. When preparing to cut into C.W.R., it is unsafe to cut into stressed rail using abrasive disc cutting equipment. In these circumstances, the rail may be separated by using flame cutting, providing the cut ends are then inspected and re-cut if necessary, and using the appropriate method for the grade of rail steel. All grades of steel other than BS11 Normal, Grade R260 or equivalent shall be re-cut using mechanical means, and then the rail is welded immediately. Full instructions as to the permitted methods of cutting rails shall be provided by the Track Authority.
  2. Only normal grade group of rails shall be prepared by oxy-fuel gas cutting, i.e. EN R200, EN R220, EN R260.
  3. The operator shall be fully trained with possession of the appropriate certificate of competency for this technique. Check that the rail is of a grade for which flame cutting is permitted (see details above) and the method is approved by the appropriate Track Authority.
  4. Only cutting torches equipped with a roller guide shall be used for the purpose.
5. The prepared rail ends shall be thoroughly cleaned after oxy-fuel gas cutting, to remove all mill scale, oxide and slag.

6. The rails are to be welded immediately after the cutting and cleaning processes have been completed.

7. Always make sure that traffic (Trains running) does not pass over flame cut rail ends.

8. The squareness laterally and vertically of each rail end shall be within a tolerance of ± 2mm.

9. Rails ends shall be free of oil, grease and dirt.

2.5 - JOINT ALIGNMENT

Prior to joint alignment, each rail shall be checked for straightness and that it is free of damage that could affect the correct joint alignment.

Using a 1-metre nibbed calibrated straight edge, the vertical alignment of the two rails is adjusted to 1.5 mm high over the 1 metre span. Four points of contact with the straight edge will occur when this is achieved.

The alignment of the running edge shall be adjusted until continuous contact along the bevelled edge of the straight edge for the full 1 metre is achieved.

Where the webs or feet are of different widths, the difference shall be halved on both sides of the rail.

Twist in the rail alignment may prevent the bottom briquette fitting correctly and may cause weld metal run-outs.

For alignment devices, see Appendix 2

2.6 - DATUM MARKS

On completion of alignment and to detect any longitudinal movement, 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.

These marks shall be checked at the prescribed times.

If rail movement is observed, welding shall be suspended and corrections made before welding is resumed.
3.1 THE WELDING GAP

Rails shall be positively identified before welding commences. Rail identification will determine the procedure and consumables to be used.

For the PLA standard weld, the welding gap shall be 25mm+/- 2mm (23 to 27mm). The method of gap preparation is given in Section 2.4.

Note: Every effort shall be made to achieve the 25mm gap for PLA standard weld.

3.2 THE WELDING KIT

The welding kit shall be checked and identified as the correct type (See Appendix1). The moulds, portion and One-shot crucible shall be in good condition.

3.3 SETTING THE PRE-HEATER

The pre-heater is positioned square and central to the welding gap at a minimum distance of 110mm from the rail end. 110mm of running surface is required to position an engineer’s square to check the burner alignment. (See Photo 1)

The pre-heater shall be set in accordance with the process parameters in Appendix 5.

The preferred position of the preheater is on the most worn rail where practicable.
3.4 POSITION CLAMP ASSEMBLY

- The clamp assembly shall be positioned so that the arms are central to the welding gap, using the bottom of the rail head as a central mark, to apply even pressure on the moulds. (See Photo 2)

- Incorrect positioning of the clamp may result in uneven contact between the mould and the rail, which could lead to excessive flashing.

3.5 MOULD SELECTION AND MODIFICATION

- A key area of making a satisfactory weld is the choice and modification of the moulds. Incorrect choice or modification will result in poor mould fitment and a weld collar that may not fulfil the required acceptance criteria. Particular areas of concern would be weld collar verticality, flashing and weld metal run-out.

3.5.1 Mould Selection

- Mould choice is determined by the amount of wear on the rails to be joined. Each rail shall be measured within 25mm of the rail end with a rail wear gauge. The amount of wear shall be used with the matrix in Section 3.5.3 to determine the correct type of mould to be used.

- Type A moulds are used for welding new and nearly new rail where the amount of wear on both rails is 3mm or less (see Photo 3).
HY. Type B moulds are used for welding new, and nearly new rails to worn rails, where the amount of wear does not exceed 15mm on the most worn rail, and the differential in wear (step) on the rails is in the range 4 to 7mm (see Photo 4).

HY. Type C moulds are used for welding worn rail, where the amount of wear does not exceed 15mm on both rails and the differential in wear (step) on the rails is in the range 0 to 3mm (see Photo 5).

These moulds can also be used for welding new rails also.

3.5.2 Mould Adjustment

3.5.2.1 Type A moulds

Type A moulds use a 6mm thick strip of felt on both sides of the weld collar to produce a weld with no flashing. The felt will also accommodate some difference in rail height, as well as imperfections in the rail surface.

In situations where the difference in rail height is 2mm or more, it will be necessary to remove part of the thickness of the felt to allow the moulds to fit vertically to the rail with a snug fit. Part of the thickness of the felt shall be removed at the following positions on both mould halves:

a. On the underside of the head on the least worn side
b. On the top of the foot on the most worn side

The method of felt removal is given in Section 3.6.1. It is not necessary to remove any felt from the bottom briquette.
3.5.2.2 HY Type B moulds

HY Type B moulds are manufactured to fit worn rails with up to 15mm of headwear and 4mm minimum of dissimilar wear. They can be adjusted to fit worn rail combinations with up to 7mm dissimilar wear.

**Mould adjustment**

The first mould shall be adjusted and fitted to the least worn rail; this will be achieved by removing material from the 3 x 5mm segments on both sides of the mould by filing away sand to achieve a secure fit-up against the rail profile, as shown in (Photo 6).

The second mould shall be adjusted as per the first mould (least worn rail); this also will be achieved by removing material from the 3 x 5mm segments on the mould by filing away sand to achieve a secure fit-up against the rail profile.

**Bottom briquette**

When using the HY. Type B moulds, the bottom briquette is manufactured with a 4mm step/slope on the worn side that can accommodate dissimilar wear in the range of 4 to 7mm. No adjustment is necessary.

The HY. Type B moulds and briquette have rail identification on the side, i.e. 110A – 113A PLA. This will indicate the correct way the bottom briquette and mould are to be located; the markings are on the same side.

3.5.2.3 HY Type C moulds

HY. Type C moulds are manufactured to fit new to new rail and worn to worn rail, where the amount of wear does not exceed 15mm on both rails and the difference in wear (step) is in the range of 0 to 3mm.

**Mould adjustment**

The first mould shall be adjusted and fitted to the least worn rail; this will be achieved by removing material from the 3 x 5mm adjustable segments on both sides of the mould by filing away sand to achieve a secure fit-up against the rail profile, as shown in (photo 6).
The second mould shall be adjusted as per the first moulds (least worn rail); this also will be achieved by removing material from the 3 x 5mm adjustable segments on the mould by filing away sand to achieve a secure fit-up against the rail profile.

**NB:** When welding new to new rail with HY. Type C moulds; this is achieved by removing the 3 x 5mm segments on the mould, then placing felt from the blue kit packets to seal the luting gap. This is placed within the preformed luting strip of the moulds as shown in (section 3.7.3 photo 14).

**Bottom briquette**

The bottom briquette is manufactured exactly the same as with type A moulds and no adjustment is required.

Good practice is to check the fitment of the bottom briquette prior to luting to ensure the correct fitment can be achieved.
### 3.5.3 Mould Selection Matrix

**RAILTECH PLA MOULD SELECTION MATRIX**

**HYBRID FELT MOULDS FOR MAINTENANCE**

<table>
<thead>
<tr>
<th>WEAR ON THE FIRST RAIL</th>
<th>WEAR ON THE SECOND RAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>HYB HYB A</td>
</tr>
<tr>
<td>1</td>
<td>HYC HYB A</td>
</tr>
<tr>
<td>2</td>
<td>HYC HYC HYB</td>
</tr>
<tr>
<td>3</td>
<td>HYC HYC HYC</td>
</tr>
<tr>
<td>4</td>
<td>HYB HYC HYC</td>
</tr>
<tr>
<td>5</td>
<td>HYB HYB HYC</td>
</tr>
<tr>
<td>6</td>
<td>HYB HYB HYB</td>
</tr>
<tr>
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<td>HYB HYB HYB</td>
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<td>HYB HYB HYB</td>
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<tr>
<td>14</td>
<td>HYB HYB HYB</td>
</tr>
<tr>
<td>15</td>
<td>HYB HYB HYB</td>
</tr>
</tbody>
</table>

**Example 1**
- First rail worn 8mm
- Second rail worn 11mm
- Step = 3 mm = Mould type HYC

**Example 2**
- First rail worn 7mm
- Second rail worn 12mm
- Step = 5 mm = Mould type HYB

**Note:** Either Type A moulds or HYC moulds can be used for welding together rails that both have 3mm wear or less.
3.6 FITTING TYPE A MOULDS

- Each mould shall be placed into a mould shoe, making sure the recess in the side of the mould locates fully with the locating block inside the shoe. (See photo 7).

- Incorrect fitting of the mould into the shoe can result in the poor fitting of the bottom briquette.

- The first mould shall be fitted central to the welding gap and supported by the mould clamp. The central aperture and vent risers shall be checked for correct positioning. Verticality shall be checked with a Railtech mould square (See photo 8). The polystyrene insert will assist with centralisation and verticality of the moulds.

- If the position of the mould needs to be adjusted, make sure that the mould shoe locking clamp is released before moving the mould.

- When the first mould is fitted correctly, the second mould is then fitted. Both moulds shall be checked for squareness and verticality using appropriate tools (See photo 9).
3.6.1 Mould Modification

3.6.1.1 Felt mould modification for 2 or 3mm dissimilar wear

Type A moulds can be modified by removing part of the felt from the underside of the head on the new rail and above the foot on the worn rail. This will relieve the pressure exerted at these points and allow the mould to fit vertically.

A thin layer of felt may be removed by cutting into it with a sharp edge and peeling away the top layers but leaving the foot tip intact (See Photo 10).

Caution shall be exercised as removing too much felt may lead to excessive flashing.

After modification, the moulds are fitted to the rail joint and checked for verticality, squareness and a snug fit.

3.6.1.2 Bottom Briquette Modification

The felt on the bottom briquette requires no modification as it is designed for new rail with similar or dissimilar wear up to 3mm.

3.6.2 Fitting the Bottom Plate and Bottom Briquette

Before fitting the bottom briquette in the bottom plate, make sure the plate is clean and free from paste.

The bottom briquette shall be placed into the bottom plate. When fitted, the bottom briquette shall fit flat in the bottom plate and not rock.

Cartridge luting paste shall be applied around the edges of the bottom briquette and bottom plate. The paste shall be built up until it is 1-2mm higher than the surface of the felt along the sides (See Photo 11). It is not necessary to build up the paste level with felt at the ends, 2 runs of luting paste is sufficient.
The bottom plate shall be placed carefully onto the mould clamp, checking that the locating lugs on the bottom briquette fit square and central to the two mould halves. (See Photo 12)

Care shall be taken to guarantee that luting paste is not wiped from the bottom briquette during fitting.

Both locking handles shall be operated at the same time whilst the bottom briquette is held in position.

The bottom plate shall be tapped firmly with a small hammer to guarantee a tight fit with the underside of the rail.

After the plate has been fitted, the mould alignment shall be re-checked.

3.6.3 Luting

Cartridge luting paste shall be applied into all the recesses around the perimeter of the rail and mould joints (see photo 13). Additional paste shall be applied to the vertical mould joint above the rail head.

Luting paste shall not be allowed to enter the mould cavity, as this will result in inclusions in the finished weld.

Poor luting can result in weld metal run-outs.

Excessive paste must not be used, too much paste applied and it will not dry enough during pre-heat and not form a strong seal. One bead is enough.

Note: Pate A Lute may be used to seal felted moulds also; however it is important that you apply the paste by hand only and do not apply too much pressure as this could dislodge the felt from the moulds and push the felt into the weld collar.
3.7 FITTING HY TYPE B & C MOULDS

Where a difference of wear is determined between the two rails to be welded, the correct type of mould shall be identified using the table in Section 3.5.3.

3.7.1 Mould Modification

Before any modification is carried out, make sure that the moulds are orientated with the slag overflow (Pouring gate) to the least worn side were possible.

HY. Type B and C moulds can be modified by filing as previously explained in Section 3.5.2.2 & Section 3.5.2.3.

Example 1: If the first rail has 8mm wear, and the second rail has 11mm wear, step = 3mm = HY Type C mould would be used. This would require both moulds to be modified by removing 7mm material from the 3 x 5mm adjustable segments by filing away sand to achieve a secure fit. Remember; always modify both moulds to suit the least worn rail.

Example 2: If the first rail has 7mm wear, and the second rail has 12mm wear, step = 5mm = HY Type B mould would be used. This would require both moulds to be modified by removing 8mm material from the 3 x 5mm adjustable segments by filing away sand to achieve a secure fit-up. Remember; always modify both moulds to suit the least worn rail.

After modification, the moulds are fitted to the rail joint and checked for verticality and a snug fit.

When the first mould is fitted correctly (See photo 14), the second mould is then fitted. Both moulds shall be checked for squareness and verticality using appropriate tools.
3.7.2 Fitting the Bottom Plate and Bottom Briquette

- When fitting the bottom plate & bottom briquette, follow the same sequence as in section 3.6.2.

- NB: When fitting the bottom briquette for the HY Type B moulds, make sure the 4mm step/slope designed to accommodate dissimilar wear is fitted correctly; this can be done by checking that the rail type markings written on the side of the briquette are fitted to the same side as the rail type markings on the moulds.

3.7.3 Fully Luting

- Where moulds have been modified (Both HY, Type B & C) there will be an absence of felt and crevices will be present around the head of the rail. Therefore It will be necessary to fit felt (from the blue kit boxes) to fill the crevices prior to using luting paste (See photo 15).

- The remaining luting procedure will be as per Section 3.6.3.

- Mould fully luted (See photo 16).
3.8 THE ONE SHOT CRUCIBLE

3.8.1 Types of One-Shot Crucible

One type of One-Shot crucible is available in the UK for PLA:

- CJ2 + Eco-filter - Used for standard (25mm), wide-gap (68mm) welds and HWR welds.

3.8.2 One-shot crucible procedure

- The one shot crucible is made from bonded refractory sand and does not require any preparation.

- When the crucible is removed from the box, check the crucible for damage and make sure the automatic tapping mechanism is not damaged, and clear any loose sand from inside the crucible.

- The crucible shall be placed on a dry / grease free surface. There is cardboard supplied in the bottom of the box to stand the crucible on if needed.

- The contents of the weld portion bag shall be emptied into the crucible, checking that the portion is free of dirt and moisture.

- One igniter only shall be placed in the centre of the portion approx 20 – 30mm depth ready for use, and the crucible lid replaced. The crucible is then ready for use (See Photo 17).

- Wet or damaged crucibles shall not be used. To reduce the risk of moisture contamination, the crucible box can be placed over the prepared crucible.

3.9 PREHEATING

- All gas equipment shall be assembled and checked for leaks prior to use. A complete list of pre-heating equipment and its assembly is given in Appendix 6.
The position of the pre-heater on its support shall be re-checked to make sure that no movement has occurred and the correct height has been set.

Gas cylinders shall be checked to make sure that there are sufficient contents for the full duration of the pre-heat procedure.

The valves on the pre-heater shank shall be fully opened.

The pre-heater shall be lit and the pressures set by adjusting the pressure adjustment screws on the regulator and reading the pressures on in-line pressure check gauges.

### 3.9.1 Preheating Parameters

The parameters for oxy-propane and oxy-acetylene preheating are shown below.

<table>
<thead>
<tr>
<th></th>
<th>Oxy-propane</th>
<th>Oxy-acetylene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preheating burner</td>
<td>RT22</td>
<td>RT8</td>
</tr>
<tr>
<td>Fuel gas pressure</td>
<td>0.6 bar</td>
<td>0.6 bar</td>
</tr>
<tr>
<td>Oxygen pressure</td>
<td>1.2 bar</td>
<td>0.6 bar</td>
</tr>
<tr>
<td>Cone length</td>
<td>25mm</td>
<td>8mm</td>
</tr>
<tr>
<td>Burner height</td>
<td>50mm</td>
<td>60mm</td>
</tr>
<tr>
<td>Preheat time</td>
<td>4 minutes</td>
<td>6 minutes</td>
</tr>
</tbody>
</table>

If the correct cone length cannot be achieved, a tolerance +/- 10% can be applied to the fuel gas pressure to facilitate flame adjustment. The flat of the slag bowl handle can be used as a guide to achieve a 25mm cone length.

Incorrect flame cone length may indicate problems with pressure check gauges. If the correct cone length cannot be maintained the gas equipment shall be repaired or replaced.

### 3.9.2 Preheating

After setting the pre-heating flame condition, the slag bowl shall be dried to remove any moisture by holding the preheating flame to the outside of the bowl.

The pre-heater shall be placed into the support and held with the locking nut.

At this point the stopwatch shall be started.

During the preheat the following shall be checked:
- Pressures shall be maintained throughout the duration of the pre-heat.
- The luting paste condition remains undamaged. Additional paste can be applied during the preheat (See photo 18).
- Datum marks shall be checked for any rail movement.

If any problems occur, the welding operation shall be suspended and the problem rectified before continuing.

3.9.3 Attaching the slag bowl

The slag bowl shall be placed along the pouring gate side of the mould (See Photo 19).

Luting paste or pate-a-lute shall be applied between the side of the mould and the slag bowl to prevent molten slag running between the bowl and the mould (See Photo 20).

Attaching the slag bowl one minute before the end of the preheat will allow the condition of the luting above the rail to be monitored and reinforced if necessary.

3.10 COMPLETION OF PRE-HEATING

The pre-heater shall be removed and the rail ends observed. The rail ends shall appear cherry red without melting or oxidisation.

The sand core shall be fitted in to the aperture of the moulds using the tongs (see Photo 21).
The one shot crucible shall be positioned centrally on the moulds taking care not to block the slag pouring gate (See Photo 22).

The crucible lid is removed and the igniter lit with the pre-heating torch. The igniter is then inserted into the portion and the lid is replaced. (See Photo 23) Take care to light the tip of the igniter only.

This action shall not take more than 30 seconds from removal of the pre-heater to the insertion of the igniter. If a delay of more than 30 seconds occurs welding shall be suspended, moulds removed and welding recommenced only when rail reaches ambient temperature.
3.11 REACTION AND POUR

When the reaction has started, the gas supply shall be turned off at the regulators, the hoses purged and the pressure adjustment screws slackened off.

The reaction shall be timed from the insertion of the igniter until the crucible taps.

Tapping may be observed from the small gap between the moulds and the one shot crucible. (See Photo 24)

The reaction time shall be in the range 17 to 32 seconds.

Note that the range was extended from 17 to 32 seconds for the use of the Electrical Ignition System named STARTWEL®.

On completion of the pour (as soon as slag starts to pour into the slag bowl) the stopwatch shall be started for stripping down.

The weld shall then be left undisturbed for 3 minutes.

3.12.1 Tapping Mechanism

The tapping mechanism is the F1 type thimble and is characterised by an inverted aluminium cap, containing a small amount of portion, covering and protecting the tapping mechanism, and a 16mm diameter pouring aperture beneath.

The benefit of the F1 thimble is that it cannot be contaminated with crucible debris and is therefore more reliable.

3.12.2 Secondary Tapping

The one shot crucible has been designed with a secondary release hole if the main tapping mechanism fails to work. The molten steel will be released safely into the mould via the vent riser approximately 2 minutes after the ignition of the portion.

If the crucible taps through the secondary release hole, the weld shall be rejected by the welder, who shall arrange for the weld to be clamped and report the circumstances to the person in charge.

If the secondary release hole fails, the one shot crucible shall be left undisturbed for 30 minutes until the molten steel has solidified and cooled down.

The crucible can then be removed to a safe position.
3.13 STRIPPING DOWN TIMES ON COMPLETION OF POUR

After 3 minutes has elapsed, the one shot crucible may be removed with the crucible fork. The crucible shall be placed on a steel tray clear from flammable material.

The slag bowl shall be removed and placed on the hot waste/sand tray containing at least 25mm of sand after first breaking the solidified slag between the moulds and the slag bowl with a small hammer. Breaking the solidified slag will prevent breaking into the moulds too early.

The clamp and mould shoes may be removed after 4 minutes.

3.14 SHEARING AND RISER REMOVAL

Prior to weld shearing, luting paste shall be cleaned from the rail head each side of the weld, to prevent impregnation into the hot weld metal. This can be done by wire brushing.

The weld shear blades shall be adjusted to leave 2mm of weld metal above the running surface for profile grinding.

After 5 minutes has elapsed from completion of the pour, the excess weld material can be sheared.

On completion of shearing, if alignment device needs to be moved, wood or nylon wedges can be inserted 10 minutes after completion of pour to permit removal of the device.

If it is not possible to trim the weld using the hydraulic weld trimming machine the head riser shall be removed, when cold, 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 profile grinding.

The vent riser shall be removed after 30 minutes from the pour and once the weld has cooled down.

To remove the vent riser, notch the vent riser 50% of its depth, and not more than 5mm from the weld collar surface using an angle grinder and a metal cutting disc. On completion of notching, knock the riser along the rail for complete removal.

**Important:** If the vent riser is greater than 5mm high above the weld collar, it shall be ground down to 5mm or less.

### 3.15 BS 95RBH BULL HEAD RAIL

When welding 95RBH section rail, Type A mould welding procedures shall be followed with the following exceptions,

The as-cast weld incorporates a vent riser support that protrudes approximately 30mm from each foot tip. The vent riser and its support shall be removed separately after 30 minutes from the pour and once the weld has cooled down.

To remove the vent riser, notch the vent riser 50% of its depth, and not more than 5mm from the weld collar surface using an angle grinder and a metal cutting disc. On completion of notching, knock the riser along the rail for complete removal.

**Important:** If the vent riser is greater than 5mm high above the weld collar, it shall be ground down to 5mm or less.

After the vent riser has been removed, if no damage is evident, the vent riser support may be left on. However, if damage to the vent riser support has occurred, cut off the vent riser support using an angle grinder and metal disc, and grind back to within 3mm of the foot of the rail. All sharp edges shall be removed by grinding.

**Note:** Care shall be taken at all times to protect the rail and weld collar from damage during the grinding and cutting operations.

For mould selection and modification when using HY Type B & C Moulds on BS 95RBH Bull Head rail, follow the same procedure as shown in section 3.5 MOULD SELECTION AND MODIFICATION.

When fitting HY Type B & C Moulds on BS 95RBH Bull Head rail, follow the same procedure as shown in section 3.7 FITTING HY Type B & C MOULDS.
SECTION 4

PROCESS APPLICATION – 68mm WIDE GAP WELD

4.1 REMOVING A DEFECT OR DEFECTIVE WELD FROM STRESSED TRACK

Before cutting into stressed track, datum marks shall be marked on the rail 100mm either side of the centre-line of the defective weld. These marks will identify how much rail movement takes place when the rail is cut.

Tensors shall be assembled around the defect and a load applied to prevent excessive movement of the rail through adjacent fastenings after it has been cut.

The defective weld or rail defect shall be flame cut through its centre.

*Disc cutting into stressed track is highly dangerous and is prohibited*

When the rail has been cut, the tensor pressure can be released and the amount of rail movement measured.

The required gap can be calculated as:

\[ \text{Required gap} = \text{Welding gap} + \text{Rail Movement} \]

It is essential that the rail is pulled back to give 200 mm spacing between the original datum marks. Failure to pull the rail to this dimension will lead to over or under-stressed track.

Equal amounts of material shall be cut from each rail to produce the required gap.

Various defects require NDT prior to welding, reference shall be made to NR/L2/TRK/0032.

4.2 THE WELDING GAP

The PLA 68mm wide gap weld can be used on BS110A, BS113A and CEN 60 rails with up to 3mm of wear. Oxy-propane and oxy-acetylene versions are available for all rail sections.

Rails shall be positively identified before welding commences.

The welding gap shall be 68mm +/- 3mm (65 to 71mm). The method of gap preparation is given in Section 2.4.

*Note:* Every effort shall be made to achieve the 68mm gap for the wide gap PLA process weld.
4.3 THE WELDING KIT

The welding kit shall be checked and identified as the correct type (see Appendix 1). The moulds, portion and One-shot crucible shall be in good condition.

4.4 SETTING THE PRE-HEATER

The pre-heater is positioned square and central to the welding gap. (See photo 24).

The pre-heater stem shall be set to guarantee the correct burner height and set in accordance with the process parameters in Appendix 5.

The preheater shall be positioned on the most worn rail.

4.5 POSITION CLAMP ASSEMBLY

The clamp assembly shall be positioned so that the arms are central to the welding gap using the bottom of the rail head as a central mark to apply even pressure on the moulds (See Photo 25).

Incorrect positioning of the clamp may result in uneven contact between the mould and the rail, which could lead to excessive flashing.
4.6 MOULD SELECTION AND MODIFICATION

4.6.1 Mould Selection

68mm wide gap welds can only be used for welding new and nearly new rail where the amount of wear on both rails is 3mm or less. Mould choice is, therefore, only determined by rail section.

4.6.2 Mould Adjustment

68mm wide gap moulds use a 6mm thick strip of felt on both sides of the weld collar to produce a weld with no flashing. The felt will also accommodate a 3mm difference in rail height as well as imperfections in the rail surface.

In situations where the difference in rail height is 2mm or more, it may be necessary to remove part of the thickness of the felt to allow the moulds fit vertically to the rail with a snug fit. Part of the thickness of the felt shall be removed at the following positions on both mould halves:

- on the underside of the head on the least worn side
- on the top of the foot on the most worn side

The method of felt removal is given in Section 3.6.1.1. It is not necessary to remove any felt from the sand briquette.

4.7 FITTING 68mm WIDE GAP MOULDS

Each mould shall be placed into a mould shoe, making sure the recess in the side of the mould locates fully with the locating block inside the shoe.

Incorrect fitting of the mould can result in a poor fitting of the sand briquette.

The first mould shall be fitted central to the welding gap and supported by the mould clamp. The central apertures and weld collar shall be checked for correct positioning.

Verticality can be checked using an engineer’s square positioned across the gap and against the outside face of the mould (See Photo 26).

If the position of the mould needs to be adjusted, make sure that the mould clamp is released before moving the mould.
When the first mould is fitted correctly, the second mould is then fitted. Both moulds shall be checked for squareness and verticality using appropriate tools. The sand core shall be checked for a good fit in the head riser. (See photo 27).

4.8 FITTING THE BOTTOM PLATE & BOTTOM BRIQUETTE

Before luting and fitting the bottom briquette, check the fit of the briquette with the mould halves (See Photo 28).

The bottom briquette shall be a snug fit with the moulds and the underside of the rail.

If the bottom briquette feels tight in the moulds, file both ends of the briquette equally until a good fit is achieved.

Before fitting the bottom briquette in the bottom plate, check that the plate is clean and free from paste.

The bottom briquette shall be placed into the bottom plate. When fitted, the briquette shall fit flat in the bottom plate and shall not rock.

Cartridge luting paste shall be applied around the edges of the bottom briquette and bottom plate. The paste shall be built up until it is level, or just above, the surface of the felt (See Photo 29)

The bottom plate shall be placed carefully onto the mould clamp to guarantee it fits square and central to the two mould halves.
Both locking handles shall be operated at the same time whilst the bottom briquette is held in position.

Care shall be taken to make sure that luting paste is not wiped from the bottom briquette during fitting.

The bottom plate shall be tapped firmly with a small hammer to guarantee a tight fit with the underside of the rail.

After the plate has been fitted, the mould alignment shall be re-checked.

4.9 LUTING

Luting is carried out in the same manner as standard gap Type A moulds (Section 3.6.3). Cartridge luting paste shall be applied into all recesses around the perimeter of the rail and mould joints. Additional paste shall be applied to the vertical mould joint above the rail head.

Luting paste shall not be allowed to enter the mould cavity, as this will result in inclusions in the finished weld.

Note: Pate A Lute may be used to seal felted moulds; however it is important that you apply the paste by hand only and do not apply too much pressure as this could dislodge the felt from the moulds and push the felt into the weld collar.

4.10 THE ONE SHOT CRUCIBLE

4.10.1 Types of One Shot Crucible

A CJ2 crucible is used for 68mm wide gap welds. This type of crucible is large enough to accommodate the bigger portion.

The CJ2 crucible incorporates an Eco-filter lid.

4.10.2 One-shot crucible procedure

The one shot crucible procedure for 68mm wide gap welds is the same as that used for 25mm standard welds (Section 3.8.2)

4.11 PREHEATING

The same general conditions for 25mm standard welds apply to 68mm wide gap welds. Details can be found in Section 3.9 also Appendix 5
4.11.1 Preheating Parameters

The parameters for oxy-propane and oxy-acetylene preheating are shown below.

<table>
<thead>
<tr>
<th></th>
<th>Oxy-propane</th>
<th>Oxy-acetylene</th>
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<tbody>
<tr>
<td>Preheating burner</td>
<td>RT22</td>
<td>RT8</td>
</tr>
<tr>
<td>Fuel gas pressure</td>
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<td>0.6 bar</td>
</tr>
<tr>
<td>Oxygen Pressure</td>
<td>1.2 bar</td>
<td>0.6 bar</td>
</tr>
<tr>
<td>Cone length</td>
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</tr>
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<td>Burner height</td>
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</tr>
<tr>
<td>Preheat time</td>
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</tbody>
</table>

If the correct cone length cannot be achieved, a tolerance +/- 10% can be applied to the fuel gas pressure to facilitate flame adjustment.

4.11.2 ATTACHING THE SLAG BOWL

The same conditions for 25mm standard welds apply to 68mm wide gap welds. Details can be found in Section 3.9.3.

4.12 COMPLETION OF PRE-HEATING

The same conditions for 25mm standard welds apply to 68mm wide gap welds. Details can be found in Section 3.10.

4.13 REACTION AND POUR

The same conditions for 25mm standard welds apply to 68mm wide gap welds. Details can be found in Section 3.11.

The weld shall be left undisturbed for 3 minutes.

4.14.1 TAPPING MECHANISM

The same general conditions for 25mm standard welds apply to 68mm wide gap welds. Details can be found in Section 3.12.1.

4.14.2 Secondary Tapping

The same general conditions for 25mm standard welds apply to 68mm wide gap welds. Details can be found in Section 3.12.2.
4.15 STRIPPING DOWN TIMES ON COMPLETION OF POUR

- After 3 minutes has elapsed, the one shot crucible may be removed with the crucible fork. The crucible shall be placed on a steel tray clear from flammable material.

- After 6 minutes has elapsed, the slag bowl shall be removed and placed on the hot waste/sand tray containing at least 25mm of sand after first breaking the solidified slag between the moulds and the slag bowl with a small hammer. Breaking the solidified slag will prevent breaking into the moulds too early.

- The clamp and mould shoes may be removed after 10 minutes.

4.16 SHEARING AND RISER REMOVAL

- Prior to weld shearing, mould sand and loose paste shall be cleaned from the rail head each side of the weld, to prevent impregnation into the hot weld metal. This can be done by wire brushing.

- The weld shear blades shall be adjusted to leave 2mm of weld metal above the running surface for profile grinding.

- After 13 minutes has elapsed from completion of the pour, the excess weld material can be sheared.

- If it is not possible to trim the weld using the hydraulic weld trimming machine the head riser shall be removed, when cold, 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 profile grinding.

- The vent risers shall be removed after 50 minutes from the pour and once the weld has cooled down.

- To remove the vent riser, notch the vent riser 50% of its depth, and not more than 5mm from the weld collar surface using an angle grinder and a metal cutting disc. On completion of notching, knock the riser along the rail for complete removal.

Important: If the vent riser is greater than 5mm high above the weld collar, it shall be ground down to 5mm or less.
4.17 CEN 60 / 56E1(113A) COMPOSITE JOINTS

4.17.1 Mould Fitting

Where 56E1 section rail needs to be welded to CEN60 section rail, moulds for composite welds shall be used.

These moulds do not have felt, however no adjustment is necessary. If a gap exists between the moulds and underneath the head of the rail, it is advisable to place a small amount of felt.

These moulds are purposely designed to accommodate the two rail sections (See photo 30).

4.17.2 Bottom Briquette

4.17.2.1 Luting Bottom Briquette

Prior to fitting the bottom briquette, there is a requirement to apply luting paste from the tubes, as can be seen there are no felted strips along the bottom briquette (See photo 31).

The luting paste is only applied along the side, not along the edges.

4.17.2.2 Fitting the Bottom Briquette

The bottom plate shall be placed carefully onto the mould clamp, checking that the bottom briquette fits squarely and centrally to the two mould halves.

Both locking handles shall be operated at the same time whilst the bottom briquette is held in position.

The bottom plate shall be tapped firmly with a small hammer to guarantee a tight fit with the underside of the rail.

After the plate has been fitted, the mould alignment shall be re checked.
4.17.3 Luting

- Pate a Lute shall be applied into all the recesses around the perimeter of the rail and mould joints, including the underside of the rail and the joint behind the bottom plate hangers.

- Pate a Lute is applied from the bucket, by hand. Initially, small quantities of paste shall be pushed firmly into the luting recesses to guarantee correct sealing. Larger quantities can then be applied to reinforce the seal (See Photos 32 and 33).

- Luting paste shall not be allowed to enter the mould cavity, as this will result in inclusions in the final weld.

4.18 POST LUTING PROCEDURE

- Following mould fitting and luting, the procedure for CEN 60/113A composite welds is the same as that for conventional PLA 68mm welds. Please refer to sections 4.10 to 4.16 for details.
5.1 RAIL STRESSING EQUIPMENT

- To prevent hot tears when welds are made between rail stressors, the equipment shall remain in position for a minimum time from the completion of the pour.

- These times, also specified in the process data sheets in Appendix 5, are as follows.
  - 25mm standard gap welds – 30 minutes from completion of the pour
  - 68mm wide gap welds – 50 minutes from completion of the pour

- In addition, newly made welds shall not be subjected to stressing operations or the use of rail stressors in close proximity for the same minimum times given above.

5.2 REMOVAL OF RISERS ON ALL RAIL TYPES

- To minimise the risk of weld collar damage, the following procedure shall be used for the removal of vent risers.

  Method for removal

  - For standard welds (25mm gap) the vent riser shall be allowed to cool for 30 minutes after completion of the pour (50 minutes for PLA 68mm wide gap and 113A/UIC60 Composite welds).

  - At least 30 minutes from completion of the pour (50 minutes for 68mm welds and 113A/UIC60 Composite welds.), and after the removal of all sand from the base of the risers, notch the risers 5mm above the weld collar using an angle grinder and metal cutting disc. The notch shall be approximately 50% deep and not more than 5mm from the weld collar surface. On completion of notching, knock the risers towards and along the rail for complete removal.

  - Vent riser stubs on any rail profile shall not project vertically more than 5mm once removal has been completed. Vent risers that are more than 5mm high can be ground back accordingly.

  - Extreme care shall be exercised during vent riser removal to avoid damage to the collar or surrounding rail.

- Times for riser removal are specified in the process data sheets in Appendix 5.

Important: If the vent riser is greater than 5mm high above the weld collar it shall be ground down to 5mm or less.
5.3 REMOVAL OF MOULD AND CLEANING WELD

The mould material may be removed more easily when cold, using a wire brush and the round end of a ball pein hammer. The use of a needle gun is also allowed.

5.4 PROFILE GRINDING

Before grinding can commence, all insulators, pads and fastenings shall be replaced.

The times for reinstating the track are 30 minutes after pour for standard PLA gaps (25mm) and 50 minutes after pour for PLA wide gaps (68mm) and 113A/UIC60 Composite welds. If alignment device needs to be moved, wood or nylon wedges can be inserted 10 minutes after completion of pour to permit removal of the device.

A minimum time shall have elapsed since the weld was sheared in order to prevent grinding hot material, this will affect the finished profile when cold. Times for grinding are specified in the process data sheets in Appendix 5.

Final profile grinding shall be within the tolerance laid down by the track authority. For Network Rail infrastructure, these tolerances are specified in Network Rail Company Specification NR/L2/TRK/0032.

5.5 PASSING OF TRAFFIC OVER NEWLY MADE WELD

It is recommended that traffic does not pass over a newly made weld until it has been ground; however, local track authority procedures shall be consulted for emergency action.

5.6 WELD IDENTIFICATION

Welds shall be identified in accordance with local track authority regulations.

5.7 WELD INSPECTION

The welder shall inspect all welds before leaving the site.

The weld shall be checked for any visual defects and geometry misalignment.

Defects shall be reported and action taken before leaving the site.

The welding inspector will carry out a further, more detailed, inspection, to local Track Authority requirements.

For full weld inspection guidelines, see Appendix 4.
APPENDIX 1  RAIL AND WELDING KIT IDENTIFICATION

A.1.1 RAIL IDENTIFICATION

Prior to welding, both rails shall be identified in respect to the following:

- Rail section
- Rail steel grade
- Rail wear

The amount of rail wear shall be measured, but rail section and grade information can usually be obtained from the rail itself.

All rails manufactured have the basic details of steel type and rail section imprinted on one side of the rail. These are known as rolled markings; other information such as year of manufacture, supplier and process are also imprinted.

Before 1978

Before 1978, rolled markings were not standardized but were usually in the form

<table>
<thead>
<tr>
<th>Rail Section</th>
<th>Process</th>
<th>Manufacturer</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>OB BSC CARGO FLEET 1965</td>
<td>Rail section</td>
<td>(from British Standard 11)</td>
<td></td>
</tr>
<tr>
<td>OB</td>
<td>Process</td>
<td>(basic open hearth)</td>
<td></td>
</tr>
<tr>
<td>1965</td>
<td>Manufacturer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110 A</td>
<td>Year of manufacture</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

An example of these rolled marks would be as follows:

Rolled markings were imprinted in letters 18mm high, repeated every 2.5 metres along the rail web

From 1978

In 1978, roll markings were standardized in the form

<table>
<thead>
<tr>
<th>Rail Section</th>
<th>Rail Grade</th>
<th>Manufacturer</th>
<th>Year</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>OB BSC CARGO FLEET 1965</td>
<td>Rail section</td>
<td>(from British Standard 11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OB</td>
<td>Process</td>
<td>(basic open hearth)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1965</td>
<td>Manufacturer</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Rolled markings were imprinted in letters 30mm high, repeated every 2.5 metres along the rail web.

An example of these rolled marks would be as follows:

**BS113AA WORKINGTON 98 O**

This translates as:

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS113 A</td>
<td>Rail section (from British Standard 11)</td>
</tr>
<tr>
<td>A</td>
<td>Rail grade (wear resisting grade A)</td>
</tr>
<tr>
<td>WORKINGTON</td>
<td>Manufacturer (Corus Workington)</td>
</tr>
<tr>
<td>98</td>
<td>Year of manufacture</td>
</tr>
<tr>
<td>O</td>
<td>Process (basic oxygen)</td>
</tr>
</tbody>
</table>

Where the grade of rail is omitted, this means the rail is normal grade.

Full details of roll markings, including the latest European markings, can be found in Network Rail Company Specification NR/L2/TRK/0032 Table 2. Appendix C.

### A.1.2 RAIL WEAR

Along with the rail section and grade, rail wear shall be determined to establish the correct moulds to be used.

A validated rail wear gauges shall be used on both rails to be welded.

### A.1.3 KIT IDENTIFICATION

Following the positive identification of rail section, grade and wear, the correct welding kit can be chosen using the selection matrix in Section 3.5.3.

Each kit is printed with information including its suitability for rail steel type, rail section and wear.

Other information includes the batch number and process details.

An explanation of kit markings is given in the following section.
A.1.3.1 Kit Markings

Using the above as an example, the kit markings have the following meanings:

<table>
<thead>
<tr>
<th>Box Marking</th>
<th>Information Given</th>
<th>Other Possible Markings</th>
<th>Information Given</th>
</tr>
</thead>
<tbody>
<tr>
<td>110A-113A</td>
<td>For use with 109-110A-113A rails</td>
<td>95RBH</td>
<td>For use with 95RBH Bull Head rails</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UIC60</td>
<td>For use with UIC60/CEN 60 rails</td>
</tr>
<tr>
<td>HY TYPE C</td>
<td>For rails with up to 15mm wear and 0 to 3mm step</td>
<td>TYPE A</td>
<td>For rails with up to 3mm wear and 0 to 3mm step</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HY TYPE B</td>
<td>For rails with up to 15mm wear and 4 to 7mm step</td>
</tr>
<tr>
<td></td>
<td></td>
<td>68MM</td>
<td>For 68mm wide gap welds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UIC60/113A</td>
<td>Composite welds for CEN 60/113A</td>
</tr>
<tr>
<td>JS</td>
<td>Joint Sec (Felt mould)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLA</td>
<td>Process description – Prechauffage Limite A (short preheat type A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CJ</td>
<td>Creuset Jetable (for use with one-shot crucible)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D42</td>
<td>Relates to size of portion for 113A</td>
<td>D38</td>
<td>For BS 80A rails</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D44</td>
<td>For UIC60/CEN 60 rails</td>
</tr>
<tr>
<td>PLA</td>
<td>As above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CJ</td>
<td>As above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Nominal gap size 25mm</td>
<td>68</td>
<td>Nominal gap size 68mm</td>
</tr>
<tr>
<td>D</td>
<td>For use with normal and grade A rails &amp; when welding 350 HT rail to normal and grade A rails.</td>
<td>HH or 350HT</td>
<td>For use with heat treated rails</td>
</tr>
<tr>
<td>5V3771</td>
<td>Batch number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow label</td>
<td>Indicates Type C kit</td>
<td>Green</td>
<td>Indicates Type A kit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blue</td>
<td>Indicates Type B kit</td>
</tr>
</tbody>
</table>
### A1.4 Suitable Portion When Welding Different Rail Grades

#### Oxy Propane or Oxy Acetylene Preheating

<table>
<thead>
<tr>
<th>2nd Rail</th>
<th>R200</th>
<th>R260</th>
<th>R260 Mn</th>
<th>R320 Cr</th>
<th>R350 LHT</th>
<th>R350 HT</th>
<th>R400 MHH</th>
<th>HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>R200</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>+ cool. cap</td>
<td>D</td>
<td>+ cool. cap</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>R260</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>+ cool. cap</td>
<td>D</td>
<td>+ cool. cap</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>R260 Mn</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>+ cool. cap</td>
<td>D</td>
<td>+ cool. cap</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>R320 Cr</td>
<td>320Cr</td>
<td>+ cool. cap</td>
<td>320Cr</td>
<td>+ cool. cap</td>
<td>320Cr</td>
<td>+ cool. cap</td>
<td>320Cr</td>
<td>+ cool. cap</td>
</tr>
<tr>
<td>R350 LHT</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
</tr>
<tr>
<td>R350 HT</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
</tr>
<tr>
<td>R400 MHH</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
</tr>
<tr>
<td>HP</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
<td>HH</td>
<td>+ cool. cap</td>
</tr>
</tbody>
</table>

More comments:

- Note that grade 320Cr to 320Cr requires the use of 320Cr portion +cooling cap.
- D = Normal/Regular Grade
- HH = 350HT
- Cool Cap = Cooling Cap
WELDING 400MHH GRADE

TECHNICAL PARAMETERS

1.1. WELDING PARAMETERS

The welding parameters are the same as those for R260 grade rail which are specified in the process manual issue 5.3 June 2011. For preheating, the pressures are set at 1.2 bar for oxygen and 0.6 bar for propane at the pressure check gauges positioned after the flashback arrestors. The burner height is 50 mm and the preheating time is 4 minutes.

1.2. THE WELDING KIT

The portion for welding R400 MHH grade rail is the same as that used for the welding of R350HT grade rails (HH).

1.3. THE COOLING RETARDER CAP

The only difference in welding this grade is the use a cooling retarder cap, also known as a “muffle” and is used for controlling the cooling of the weld. The cooling retarder cap is placed on top of the rail head immediately after weld shearing and moving of the risers has been completed.

Cooling retarder Ref: 82620500
PADS No: 0046/014151
PROCEDURE

1.1. WELD TRIMMING

After 5 minutes has elapsed from the completion of pour, the excess metal can be sheared. This operation is carried out following the instructions given in process manual issue 5.3

1.2. DISPLACEMENT OF THE RISER

Space shall be made between the head of the rail and the vent risers for placing the cap which is wider than the normal space between the head and vent risers.

Immediately following shearing, remove the head riser with a sledgehammer.

Separate the risers from the rail far enough to accommodate the cooling retarder cap. Risers shall be moved laterally by using a bar or sledgehammer. The riser should not be moved too far, a maximum of 45 degrees from the vertical is sufficient.
1.1. POSITIONING THE CAP

When the risers have been moved sufficiently as described in 2.2, position the cap on top of the weld. This operation shall be carried out as quickly as possible.

The cap shall remain in place for a minimum period of 8 minutes from completion of shearing.
A.2 ALIGNMENT DEVICES

Two types of alignment device are available

The Alignment Beam is designed to provide vertical, lateral and twist adjustment of rails with minimal support (see Photo A.2.1).

A-frame aligners also provide vertical, lateral and twist adjustment of rails, but sleepered support is required for effective adjustment.

A.2.1 Alignment Beam

Alignment beams are especially suited to lineside welding where sleepered support is not available.

Screw jacks are used to achieve vertical alignment.

The Alignment Beam grips the rail head at two points and effects lateral adjustment through the adjustment of two further clamping positions.

Twist adjustment is made by bracing an adjustable screw between the beam and the rail foot.

Photo A.2.1
Type BA240 Alignment Beam
Railtech Part No 11131009
PADS: 0046/014175
A.2.2 A-Frame Aligner

There are two types of A-frame alignment device

- CR57 – Basic design giving vertical, lateral and twist adjustment of rails
- CR61 – Same design as CR57 but with the addition of anti-shifting screws to prevent slippage of the A-frame on concrete and steel sleepers

A-Frames are especially suited for use on wooden sleepers where driven wedges are not permitted. They can also be used more generally in place of wedges.

Integral screw adjusters facilitate alignment in all axes.

When using the A-frame aligner, it shall remain in position supporting the rail while the weld metal cools down. The removal times are 30 minutes after pour for standard PLA gaps (25mm) and 50 minutes after pour for PLA wide gaps (68mm).

A-frames cannot be used with Permaquip rail stressors or in some tight areas of S&C layouts

Photo A.2.2
(Illustrated)
Type CR57 A-Frame
Railtech Part No 11111001
PADS: 0046/014175

(Not Illustrated)
Type CR61 A-Frame
Railtech Part No 11111003
PADS: 0046/014885
# APPENDIX 3

## ILLUSTRATED PARTS LIST

### A.3.1 CONSUMABLES

- **Welding kit 113A/110A Type A 350HT**
  - Part No. 76200014 / PADS No: 0046/035053
- **Welding kit 113A/110A Type A**
  - Part No. 78800032 / PADS No: 0057/050991
- **Welding kit 113A/110A HY Type B**
  - Part No. 78800024 / PADS No: 0046/014198
- **Welding kit 113A/110A HY Type C**
  - Part No. 78800025 / PADS No: 0046/014197
- **Welding kit BS80A Type A**
  - Part No. 78800037 / PADS No: 0046/014952
- **Welding kit BS80A Type A 350HT**
  - Part No. 78800038
- **Welding kit BS95 Bull Head Type A**
  - Part No. 78800030 / PADS No: 0046/014950
- **Welding kit BS95 Bull Head HY Type B**
  - Part No. 78800033 / PADS No: 0046/014956
- **Welding kit BS95 Bull Head HY Type C**
  - Part No. 78800034 / PADS No: 0046/014957
- **Welding kit S49 Type A**
  - Part No. 78800020
- **Welding kit CEN60 Type A**
  - Part No. 78800023 / PADS No: 0046/014180
- **Welding kit CEN60 HY Type B**
  - Part No. 78800046 / PADS No: 0046/035058
- **Welding kit CEN60 HY Type C**
  - Part No. 78800047 / PADS No: 0046/035059
- **Welding kit CEN60 HY Type A 350HT**
  - Part No. 78800016 / PADS No: 0046/035052
- **Welding kit composite 113A/CEN60 CJ 68mm**
  - Part No. 76807002 / PADS No: 0046/014199
- **Welding kit 68mm 113A/110A Type A**
  - Part No. 76600001N / PADS No: 0046/014184
- **Welding kit 68mm CEN60 Type A**
  - Part No. 76600002N / PADS No: 0046/014187
- **Welding kit 68mm BS80A**
  - Part No. 76800016
- **Welding kit 68mm S49 Type A**
  - Part No. 78800013
- **Welding kit for 110/113A HWR - CJ - 260**
  - Part No. 79900002 / PADS No: 0046/035060
- **Welding kit for 60CEN(60E1) HWR - CJ - 260**
  - Part No. 79900005 / PADS No: 0046/035066
CJ2 Crucible with Eco-filter
Part No. 83450123 / PADS No: 0046/014181
Supplier: RAILTECH International

Igniters
Part No. 82632450 / PADS No: 0046/014145
Supplier: RAILTECH International

Tube of Luting Paste
Part No. 83661112 / PADS No: 0046/014182
Supplier: RAILTECH International

Bucket of Luting Paste
Part No. 83661130 / PADS No: 0046/014188
Supplier: RAILTECH International

Wooden Wedges - Box of 100
PADS No: 0046/0035063

Box of Felt Strips
Part No. 83661115 / PADS No: 0046/014178
Supplier: RAILTECH International
A.3.2 HARDWARE

3 – Level Pre-Heater Burner Support
Part No. S0000253 / PADS No: 0046/014140
Supplier: RAILTECH International

Mould Clamp Complete (Mk.II)
Part No. S0000136 / PADS No: 0046/014139
Supplier: RAILTECH International

Mould Clamp for Tight Areas
Part No. 81250902 / PADS No: 0046/014141
Supplier: RAILTECH International

Cooling Cap
Part No. 82620500 / PADS No: 0046/014151
Supplier: RAILTECH International

PLA 25 Mould Shoes – Pair
Part No. 83200001 / PADS No: 0046/014142
Supplier: RAILTECH International

PLA 25 Base Plate
Part No. 83100002 / PADS No: 0046/014143
Supplier: Railtech International

PLA 68 Mould Shoes – Pair
Part No. 83200002 / PADS No: 0046/014133
Supplier: RAILTECH International
PLA 68 Base Plate
Part No. 83100003 / PADS No: 0046/014830
Supplier: Railtech International

PLA HWR Mould Shoes – Pair
Part No. S0000361 / PADS No: 0046/035065
Supplier: Railtech International

Crucible Fork
Part No. 82631411 / PADS No: 0046/014828
Supplier: Railtech International

Plug Holders
Part No. S0000137 / PADS No: 0046/014146
Supplier: Railtech International

Metal Tray for Hot Waste
Part No. 11319003 / PADS No: 0046/014148
Supplier: Railtech International

A.3.3 Oxy-fuel GAS EQUIPMENT

Pre-heater RT 22 hole Propane
Part No. 35910229 / PADS No: 0046/014152
Pre-heater RT 8 hole Acetylene
Part No. 35910247 / PADS No: 0046/014838
Supplier: Railtech International

Mixer Harris F43 Propane
Part No. 48302003 / PADS No: 0046/014153
Supplier: Railtech or Harris distributor only

Mixer Harris E243 Acetylene
Part No. H2087 / PADS No: 0046/014843
Supplier: Railtech or Harris distributor only
Shank Harris 43-2 (UNF)
Part No. H2125 / PADS No: 0046/014847
Supplier: Railtech or Harris distributor only

Flashguard 883-FGR 9/16 (UNF)
Part No. H4018 / PADS No: 0046/014155

Flashguard 883-FGL 9/16 (UNF)
Part No. H4017 / PADS No: 0046/014156
Supplier: Harris Gas Equipment or Similar

Hose Oxygen 10mm bore x 20m long 3/8 BSP to 9/16 UNF Nut R/H
PADS No: 0046/014157
Supplier: Harris Gas Equipment or Similar

Hose Propane 8mm bore x 20m long 3/8 BSP to 9/16 UNF Nut L/H
PADS No: 0046/014158
Supplier: Harris Gas Equipment or Similar

Hose Oxygen 8mm bore x 18m long 3/8 BSP to 9/16 UNF Nut R/H
PADS No: 0046/014859
Supplier: Harris Gas Equipment or Similar

Hose Acetylene 8mm bore x 18m long 3/8 BSP to 9/16 UNF Nut L/H
PADS No: 0046/014860
Supplier: Harris Gas Equipment or Similar
T-piece in line 3/8 BSP R/H
Part No. H2221 / PADS No: 0046/014159
Gauge 8E661 0-6.0 bar oxygen
Part No. H5200 / PADS No: 0046/014850

T-piece in line 3/8 BSP L/H
Part No. H2222 / PADS No: 0046/014160
Gauge 8E686 0-2.5 bar propane
Part No. H2223 / PADS No: 0046/014162

Rubber cover for gauge
Part No. H5232 / PADS No:
Supplier: Harris Gas Equipment or Similar

T-piece in line 9/16 UNF R/H
Part No. H2226 / PADS No: 0046/014848
Gauge 8E661 0-6.0 bar oxygen
Part No. H5200 / PADS No: 0046/014850

T-piece in line 9/16 UNF L/H
Part No. H2227 / PADS No: 0046/014849
Gauge 8E686 0-2.5 bar acetylene
Part No. H5199 / PADS No: 0046/014862
Supplier: Harris Gas Equipment or Similar

Flashback Arrestor Oxygen 188-2TRGB
Part No. H1307 / PADS No: 0046/014840

Flashback Arrestor Fuel Gas 188-2TLGB
Part No. H1308 / PADS No: 0046/014841
Supplier: Harris Gas Equipment or Similar

Regulator Oxygen model 996 10.0 bar
Part No. H1043 / PADS No: 0046/014167

Regulator Propane model 829 4.0 bar
Part No. H1029 / PADS No: 0046/014168

Regulator Acetylene model 896 4.0 bar
Part No. H1041 / PADS No: 0046/014839
Supplier: Harris Gas Equipment or Similar
Cutting Attachment 49-2 Propane
Part No. H2124 / PADS No: 0046/014169
Supplier: Harris Gas Equipment or Similar

Propane Nozzle 4NFF
Part No. H3084 / PADS No: 0046/035064
Supplier: Harris Gas Equipment or Similar

Nozzles Acetylene (spare)
Supplier: Harris Gas Equipment or Similar

HWR cutting tool
Part No. S0000344 / PADS No: 0046/035062
Supplier: Railtech International

HWR preheater holder for RT22
Part No. S0000347 / PADS No: 0046/035061
Supplier: Railtech International
Gas Box

Gas Box Complete
(Equipped with standard connection or quick release couplers in option)

Part No. S0000297 / PADS No: 0046/035055
Supplier: Railtech International

Self Centreing Burner

Part No. S0000339 / PADS No: 0046/035055
Supplier: Railtech International

Gas Box Only
(Equipped with standard connection or quick release couplers in option)

Part No. S0000338 / PADS No: 0046/035056
Supplier: Railtech International
A.4 WELD INSPECTION

The weld acceptance criteria detailed in Table 1 of Network Rail Company Specification NR/L2/TRK/0032 form the basis for the inspection of PLA welds.

Where there appears to be a conflict between the requirements of NR/L2/TRK/0032 and this Process Manual, this is likely to be due to differences between two and three-piece mould configurations.

Because Railtech PLA welds are produced with three-piece moulds and felt luting strips, the following, additional, acceptance criteria need to be observed.

A4.1 Misalignment of bottom briquette

A4.1.1 Lateral

The maximum lateral misalignment of the collar formed by the bottom briquette is +/- 2mm (see diagram A.4.1.1).

![Diagram A.4.1.1](image)

The extremity of the weld collar formed by the bottom briquette shall not be confused with flashing at the foot tip described in A.4.3.

A4.1.2 Longitudinal

The maximum longitudinal misalignment of the collar formed by the bottom briquette with respect to the collar on the upper foot surface is +/- 2mm (see diagram A.4.1.2).
A.4.2 Undercutting of the collar edge

The maximum amount of undercutting of the collar edge by intrusion of felt sealing strips is 2mm (see Diagram A.4.2).
A.4.3 Flashing at the foot tip

Flashing at the foot tip (see Diagram A.4.3) is indicative of the bottom briquette not being fitted properly or the springs weakening in the shoes and is usually an extension of flashing on the underside of the rail foot.

Flashing at the foot tip is not detrimental to the integrity of the weld. However, if the thickness of the flashing becomes excessive, the corresponding flashing on the underside of the foot could compromise the strength of the weld. To overcome this problem, if flashing protrudes more than 3mm, it shall be ground back to the edge of the weld collar at the foot tip.

The maximum thickness of flashing is 2mm.

A.4.4 Verticality

When using felt moulds, the collar edge is defined by the position of the felt and not the collar formation on the mould.

The attachment of the felt to the moulds is a manual operation and precise positioning cannot be achieved in every case.

This can occasionally result in three sides of the weld collar being within the verticality tolerance, while the fourth side is not.

One side of the weld collar out of four exceeding the verticality tolerance is permissible for PLA welds made with felt moulds.
## APPENDIX 5

### PROCESS REQUIREMENTS

#### A.5.1 PLA 25 - Standard gap 113A Section with oxy-propane preheating

<table>
<thead>
<tr>
<th>Rail Grades</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>BS110A and BS113A</td>
</tr>
<tr>
<td>Heat Treated (R350HT)</td>
<td>Up to 15mm worn</td>
</tr>
<tr>
<td>HP and 400MHH (Disc Cut Only)</td>
<td></td>
</tr>
</tbody>
</table>

### Rail Preparation

- **Rail cutting method**: Disc cutter/rail saw or flame
- **Welding gap**: 25 +/- 2mm

### Preheating

- **Burner type**: RT 22 holes
- **Mixer type**: F43
- **Burner height**: 50mm
- **Oxygen pressure**: 1.2 bar
- **Propane pressure**: 0.6 bar +/- 10%
- **Cone length**: 25mm
- **Preheating time**: 4 minutes

### Welding portion details

- **Crucible type**: CJ2
- **Portion type**: 113A PLA JS CJ
- **Welding charge and gap**: D42 CJ 25 D (350HT for heat treated)
- **Date and batch details**: 14.05.11 1V2580 (example)
- **Maximum time between end of preheat and igniter insertion**: 30 seconds
- **Tapping time**: 17 – 32 seconds

### Strip down procedure from completion of pour

**Leave undisturbed for 3 minutes**
- Removal spillage tray: 3 minutes
- Remove crucible: 3 minutes
- Removal slag bowl: 3 minutes
- Removal of mould shoes: 4 minutes
- Shear weld: 5 minutes
- Post weld treatment: Not required
- Remove tensors: 30 minutes
- Remove Alignment Device: 30 minutes
- Remove vent risers: 30 minutes
- Replace fastenings: 30 minutes
- Commence grinding: 30 minutes
- Welder’s examination of weld: Immediately after grinding

---

**Minimum times**
A.5.2 PLA 25 - Standard gap 113A Section with oxy-acetylene preheating

<table>
<thead>
<tr>
<th>Rail Grades</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>BS110A and BS113A</td>
</tr>
<tr>
<td>Heat Treated (R350HT)</td>
<td>Up to 15mm worn</td>
</tr>
<tr>
<td>HP and 400MHH (Disc Cut Only)</td>
<td></td>
</tr>
</tbody>
</table>

**Rail Preparation**
- Rail cutting method
- Welding gap
- Disc cutter/rail saw or flame
- 25 +/- 2mm

**Preheating**
- Burner type
- RT 8 holes
- Mixer type
- E2-43
- Burner height
- 60mm
- Oxygen pressure
- 0.6 bar
- Acetylene pressure
- 0.6 bar +/- 10%
- Cone length
- 8mm
- Preheating time
- 6 minutes

**Welding portion details**
- Crucible type
- CJ1 or CJ2
- Portion type
- 113A PLA JS CJ
- Welding charge and gap
- D42 CJ 25 D (350HT for heat treated)
- Date and batch details
- 14.05.11 1V2580 (example)
- Maximum time between end of preheat and igniter insertion
- 30 seconds
- Tapping time
- 17 – 32 seconds

**Strip down procedure from completion of pour**

<table>
<thead>
<tr>
<th>Task</th>
<th>Minimum Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal spillage tray</td>
<td>3 minutes</td>
</tr>
<tr>
<td>Remove crucible</td>
<td>3 minutes</td>
</tr>
<tr>
<td>Removal slag bowl</td>
<td>3 minutes</td>
</tr>
<tr>
<td>Removal of mould shoes</td>
<td>4 minutes</td>
</tr>
<tr>
<td>Shear weld</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Post weld treatment</td>
<td>Not required</td>
</tr>
<tr>
<td>Remove tensors</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Remove Alignment Device</td>
<td>Minimum times</td>
</tr>
<tr>
<td>Remove vent risers</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Replace fastenings</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Commence grinding</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Welder’s examination of weld</td>
<td>Immediately after grinding</td>
</tr>
</tbody>
</table>
A.5.3 PLA 25 - Standard gap CEN60 Section with oxy-propane preheating

<table>
<thead>
<tr>
<th>Rail Grades</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>CEN 60 E1 and E2</td>
</tr>
<tr>
<td>Heat Treated (R350HT)</td>
<td>Up to 15mm worn</td>
</tr>
<tr>
<td>HP and 400MHH (Disc Cut Only)</td>
<td></td>
</tr>
</tbody>
</table>

**Rail Preparation**

- Rail cutting method
- Welding gap

**Preheating**

- Burner type
- Mixer type
- Burner height
- Oxygen pressure
- Propane pressure
- Cone length
- Preheating time

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burner type</td>
<td>RT 22 holes</td>
</tr>
<tr>
<td>Mixer type</td>
<td>F43</td>
</tr>
<tr>
<td>Burner height</td>
<td>50mm</td>
</tr>
<tr>
<td>Oxygen pressure</td>
<td>1.2 bar</td>
</tr>
<tr>
<td>Propane pressure</td>
<td>0.6 bar +/- 10%</td>
</tr>
<tr>
<td>Cone length</td>
<td>25mm</td>
</tr>
<tr>
<td>Preheating time</td>
<td>4 minutes</td>
</tr>
</tbody>
</table>

**Welding portion details**

- Crucible type
- Portion type
- Welding charge and gap
- Date and batch details
- Maximum time between end of preheat and igniter insertion
- Tapping time

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crucible type</td>
<td>CJ2</td>
</tr>
<tr>
<td>Portion type</td>
<td>UIC60 PLA JS CJ</td>
</tr>
<tr>
<td>Welding charge and gap</td>
<td>D44 CJ 25 D (350HT for heat treated)</td>
</tr>
<tr>
<td>Date and batch details</td>
<td>14.05.11 1H3456 (example)</td>
</tr>
<tr>
<td>Maximum time between end of preheat and igniter insertion</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Tapping time</td>
<td>17 – 32 seconds</td>
</tr>
</tbody>
</table>

**Strip down procedure from completion of pour**

Leave undisturbed for 3 minutes

- Removal spillage tray
- Remove crucible
- Removal slag bowl
- Removal of mould shoes
- Shear weld
- Post weld treatment
- Remove tensors
- Remove Alignment Device
- Remove vent risers
- Replace fastenings
- Commence grinding
- Welder’s examination of weld

<table>
<thead>
<tr>
<th>Task</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal spillage tray</td>
<td>3 minutes</td>
</tr>
<tr>
<td>Remove crucible</td>
<td>3 minutes</td>
</tr>
<tr>
<td>Removal slag bowl</td>
<td>3 minutes</td>
</tr>
<tr>
<td>Removal of mould shoes</td>
<td>4 minutes</td>
</tr>
<tr>
<td>Shear weld</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Post weld treatment</td>
<td>Not required</td>
</tr>
<tr>
<td>Remove tensors</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Remove Alignment Device</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Remove vent risers</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Replace fastenings</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Commence grinding</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Welder’s examination of weld</td>
<td>Immediately after grinding</td>
</tr>
</tbody>
</table>

Minimum times:
## A.5.4 PLA 25 - Standard gap CEN60 Section with oxy-acetylene preheating

### Rail Grades
- Normal and Grade A (220 and 260)
- Heat Treated (R350HT)
- HP and 400MHH (Disc Cut Only)

### Rail Section and Wear
- CEN 60 E1 and E2
- Up to 15mm worn

### Rail Preparation
- Rail cutting method
- Welding gap
- Disc cutter/rail saw or flame
- 25 +/- 2mm

### Preheating
- Burner type
- RT 8 holes
- Mixer type
- E2-43
- Burner height
- 60mm
- Oxygen pressure
- 0.6 bar
- Acetylene pressure
- 0.6 bar +/- 10%
- Cone length
- 8mm
- Preheating time
- 6 minutes

### Welding portion details
- Crucible type
- CJ2
- Portion type
- UIC60 PLA JS CJ
- Welding charge and gap
- D44 CJ 25 D (350HT for heat treated)
- Date and batch details
- 14.05.11 1H3456 (example)
- Maximum time between end of preheat and igniter insertion
- 30 seconds
- Tapping time
- 17 – 32 seconds

### Strip down procedure from completion of pour

#### Leave undisturbed for 3 minutes
- Removal spillage tray
- Remove crucible
- Removal slag bowl
- Removal of mould shoes
- Shear weld
- Post weld treatment
- Remove tensors
- Remove Alignment Device
- Remove vent risers
- Replace fastenings
- Commence grinding
- Welder’s examination of weld

- 3 minutes
- 3 minutes
- 3 minutes
- 4 minutes
- 5 minutes
- Not required
- 30 minutes
- 30 minutes
- 30 minutes
- 30 minutes
- 30 minutes

#### Minimum times
- Remove Alignment Device
- Remove vent risers
- Replace fastenings
- Commence grinding
- Welder’s examination of weld

- 30 minutes
- 30 minutes
- 30 minutes
- 30 minutes
- Immediately after grinding
### A.5.5 PLA 25 - Standard gap S49 Section with oxy-propane preheating

<table>
<thead>
<tr>
<th>Rail Grades</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>S49</td>
</tr>
<tr>
<td>Heat Treated (R350HT)</td>
<td>Up to 3mm worn</td>
</tr>
</tbody>
</table>

### Rail Preparation

- **Rail cutting method**: Disc cutter/rail saw or flame
- **Welding gap**: 25 +/- 2mm

### Preheating

- **Burner type**: RT 22 holes
- **Mixer type**: F43
- **Burner height**: 50mm
- **Oxygen pressure**: 1.2 bar
- **Propane pressure**: 0.6 bar +/- 10%
- **Cone length**: 25mm
- **Preheating time**: 3.5 minutes

### Welding portion details

- **Crucible type**: CJ2
- **Portion type**: UIC60 PLA JS CJ
- **Welding charge and gap**: D40 CJ 25 D (350HT = heat treated)
- **Date and batch details**: 14.05.11 1H3456 (example)
- **Maximum time between end of preheat and igniter insertion**: 30 seconds
- **Tapping time**: 17 – 32 seconds

### Strip down procedure from completion of pour

- **Leave undisturbed for 3 minutes**
- **Remove spillage tray**: 3 minutes
- **Remove crucible**: 3 minutes
- **Remove slag bowl**: 3 minutes
- **Remove mould shoes**: 4 minutes
- **Shear weld**: 5 minutes
- **Post weld treatment**: Not required
- **Remove tensors**: 30 minutes
- **Remove Alignment Device**: 30 minutes
- **Remove vent risers**: 30 minutes
- **Replace fastenings**: 30 minutes
- **Commence grinding**: Minimum times
- **Welder’s examination of weld**: Immediately after grinding
### A.5.6 PLA 25 - Standard gap S49 Section with oxy-acetylene preheating

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>S49</td>
</tr>
<tr>
<td></td>
<td>Up to 3mm worn</td>
</tr>
</tbody>
</table>

#### Rail Preparation

- **Rail cutting method**
  - Disc cutter/rail saw or flame
- **Welding gap**
  - 25 +/- 2mm

#### Preheating

- **Burner type**
  - RT 8 holes
- **Mixter type**
  - E2-43
- **Burner height**
  - 60mm
- **Oxygen pressure**
  - 0.6 bar
- **Acetylene pressure**
  - 0.6 bar +/- 10%
- **Cone length**
  - 8mm
- **Preheating time**
  - 5.5 minutes

#### Welding portion details

- **Crucible type**
  - CJ2
- **Portion type**
  - D40 PLA JS CJ
- **Welding charge and gap**
  - CJ 25 D
- **Date and batch details**
  - Jan 09 9V2580 (example)
- **Maximum time between end of preheat and igniter insertion**
  - 30 seconds
- **Tapping time**
  - 17 – 32 seconds

#### Strip down procedure from completion of pour

- **Leave undisturbed for 3 minutes**
- **Remove spillage tray**
  - 3 minutes
- **Remove crucible**
  - 3 minutes
- **Remove slag bowl**
  - 3 minutes
- **Remove of mould shoes**
  - 4 minutes
- **Shear weld**
  - 5 minutes
- **Post weld treatment**
  - Not required
- **Remove tensors**
  - 30 minutes
- **Remove Alignment Device**
  - 30 minutes
- **Remove vent risers**
  - 30 minutes
- **Replace fastenings**
  - 30 minutes
- **Commence grinding**
  - 30 minutes
- **Welder’s examination of weld**
  - Immediately after grinding
## A.5.7 PLA 25 - Standard gap BS80A Section with oxy-propane preheating

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Normal and Grade A (220 and 260)</td>
<td>- BS 80A</td>
</tr>
<tr>
<td>- Up to 3mm worn</td>
<td></td>
</tr>
</tbody>
</table>

### Rail Preparation
- Rail cutting method: Disc cutter/rail saw or flame
- Welding gap: 25 +/- 2mm

### Preheating
- Burner type: RT 22 holes
- Mixer type: F43
- Burner height: 50mm
- Oxygen pressure: 1.2 bar
- Propane pressure: 0.6 bar +/- 10%
- Cone length: 25mm
- Preheating time: 3.5 minutes

### Welding portion details
- Crucible type: CJ2
- Portion type: 80A PLA JS CJ
- Date and batch details: Jan 09 9V2580 (example)
- Maximum time between end of preheat and igniter insertion: 30 seconds
- Tapping time: 17 – 32 seconds

### Strip down procedure from completion of pour

**Leave undisturbed for 3 minutes**

- Removal spillage tray: 3 minutes
- Remove crucible: 3 minutes
- Removal slag bowl: 3 minutes
- Removal of mould shoes: 4 minutes
- Shear weld: 5 minutes
- Post weld treatment: Not required
- Remove tensors: 30 minutes
- Remove Alignment Device: 30 minutes
- Remove vent risers: 30 minutes
- Replace fastenings: Minimum times
- Commence grinding: 30 minutes
- Welder’s examination of weld: Immediately after grinding
A.5.8 PLA 25 - Standard gap BS80A Section with oxy-acetylene preheating

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>BS 80A</td>
</tr>
<tr>
<td></td>
<td>Up to 3mm worn</td>
</tr>
</tbody>
</table>

### Rail Preparation

- **Rail cutting method**: Disc cutter/rail saw or flame
- **Welding gap**: 25 +/- 2mm

### Preheating

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burner type</td>
<td>RT 8 holes</td>
</tr>
<tr>
<td>Mixer type</td>
<td>E2-43</td>
</tr>
<tr>
<td>Bumer height</td>
<td>60mm</td>
</tr>
<tr>
<td>Oxygen pressure</td>
<td>0.6 bar</td>
</tr>
<tr>
<td>Acetylene pressure</td>
<td>0.6 bar +/- 10%</td>
</tr>
<tr>
<td>Cone length</td>
<td>8mm</td>
</tr>
<tr>
<td>Preheating time</td>
<td>5.5 minutes</td>
</tr>
</tbody>
</table>

### Welding portion details

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crucible type</td>
<td>CJ2</td>
</tr>
<tr>
<td>Portion type</td>
<td>D40 PLA JS CJ</td>
</tr>
<tr>
<td>Welding charge and gap</td>
<td>CJ 25 D</td>
</tr>
<tr>
<td>Date and batch details</td>
<td>Jan 09 9V2580 (example)</td>
</tr>
<tr>
<td>Maximum time between end of preheat and igniter insertion</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Tapping time</td>
<td>17 – 32 seconds</td>
</tr>
</tbody>
</table>

### Strip down procedure from completion of pour

Leave undisturbed for 3 minutes

- Removal spillage tray: 3 minutes
- Remove crucible: 3 minutes
- Remove slag bowl: 3 minutes
- Removal of mould shoes: 4 minutes
- Shear weld: 5 minutes
- Post weld treatment: Not required
- Remove tensors: 30 minutes
- Remove Alignment Device: 30 minutes
- Remove vent risers: Minimum times
- Replace fastenings: 30 minutes
- Commence grinding: 30 minutes
- Welder’s examination of weld: Immediately after grinding
A.5.9 PLA 25 - Standard gap BS 95RBH Section with oxy-propane preheating

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Normal and Grade A (220 and 260)</td>
<td>▪ BS 95</td>
</tr>
<tr>
<td></td>
<td>▪ Up to 15mm worn</td>
</tr>
</tbody>
</table>

**Rail Preparation**

<table>
<thead>
<tr>
<th>Rail cutting method</th>
<th>Welding gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Disc cutter/rail saw or flame</td>
<td>▪ 25 +/- 2mm</td>
</tr>
</tbody>
</table>

**Preheating**

<table>
<thead>
<tr>
<th>Burner type</th>
<th>Mixer type</th>
<th>Burner height</th>
<th>Oxygen pressure</th>
<th>Propane pressure</th>
<th>Cone length</th>
<th>Preheating time</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ RT 22 holes</td>
<td>▪ F43</td>
<td>▪ 50mm</td>
<td>▪ 1.2 bar</td>
<td>▪ 0.6 bar +/- 10%</td>
<td>▪ 25mm</td>
<td>▪ 4 minutes</td>
</tr>
</tbody>
</table>

**Welding portion details**

<table>
<thead>
<tr>
<th>Crucible type</th>
<th>Portion type</th>
<th>Welding charge and gap</th>
<th>Date and batch details</th>
<th>Maximum time between end of preheat and igniter insertion</th>
<th>Tapping time</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ CJ2</td>
<td>▪ BS 95 PLA JS CJ</td>
<td>▪ D40 CJ 25 D</td>
<td>▪ April 08 8V2580 (example)</td>
<td>▪ 30 seconds</td>
<td>▪ 17 – 32 seconds</td>
</tr>
</tbody>
</table>

**Strip down procedure from completion of pour**

Leave undisturbed for 3 minutes

- Removal spillage tray: 3 minutes
- Remove crucible: 3 minutes
- Removal slag bowl: 3 minutes
- Removal of mould shoes: 4 minutes
- Shear weld: 5 minutes
- Post weld treatment: Not required
- Remove tensors: 30 minutes
- Remove Alignment Device: 30 minutes
- Remove vent risers: 30 minutes
- Replace fastenings: 30 minutes
- Commence grinding: Minimum times
- Welder’s examination of weld: Immediately after grinding
A.5.10 PLA 25 - Standard gap BS 95RBH Section with oxy-acetylene preheating

<table>
<thead>
<tr>
<th>Rail Grades</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>BS95</td>
</tr>
<tr>
<td>Heat Treated (R350HT)</td>
<td>Up to 15mm worn</td>
</tr>
</tbody>
</table>

**Rail Preparation**

- Rail cutting method
- Welding gap
  - Disc cutter/rail saw or flame
  - 25 +/- 2mm

**Preheating**

- Burner type
- Mixer type
- Burner height
- Oxygen pressure
- Acetylene pressure
- Cone length
- Preheating time
  - RT 8 holes
  - E2-43
  - 60mm
  - 0.6 bar
  - 0.6 bar +/- 10%
  - 8mm
  - 6 minutes

**Welding portion details**

- Crucible type
- Portion type
- Welding charge and gap
- Date and batch details
- Maximum time between end of preheat and igniter insertion
- Tapping time
  - CJ2
  - BS95 PLA JS CJ
  - D40 CJ 25 D
  - April 08 8V2980 (example)
  - 30 seconds
  - 17 – 32 seconds

**Strip down procedure from completion of pour**

**Leave undisturbed for 3 minutes**

- Removal spillage tray
- Remove crucible
- Removal slag bowl
- Removal of mould shoes
- Shear weld
- Post weld treatment
- Remove tensors
- Remove Alignment Device
- Remove vent risers
- Replace fastenings
- Commence grinding
- Welder’s examination of weld
  - 3 minutes
  - 3 minutes
  - 3 minutes
  - 4 minutes
  - 5 minutes
  - Not required
  - 30 minutes
  - 30 minutes
  - 30 minutes
  - Minimum times
  - 30 minutes
  - 30 minutes
  - Immediately after grinding
### A.5.11 PLA 68 - Wide Gap BS113A Section with oxy-propane preheating

#### Rail Grade
- Normal and Grade A (220 and 260)
- HP and 400MHH (Disc Cut Only)

#### Rail Section
- BS110A and 113A
- Up to 3 mm worn

#### Rail Preparation
- Rail cutting method
- Disc cutter or rail saw
- Welding gap
- 68 +/- 3mm

#### Preheating
- Burner type
- RT 22 holes
- Mixer type
- F43
- Burner height
- 70mm
- Oxygen pressure
- 1.2 bar
- Propane pressure
- 0.6 bar +/- 10%
- Cone length
- 25mm
- Preheating time
- 7 minutes

#### Welding portion details
- Crucible type
- CJ2
- Portion type
- 113A PLA CJ 68 D
- Welding charge and gap
- PLA CJ 68 D (17kg)
- Date and batch details
- Sept 2010 0U0929 (example)
- Maximum time between end of preheat and igniter insertion
- 30 seconds
- Tapping time
- 17 – 32 seconds

#### Strip down procedure from completion of pour

**Leave undisturbed for 3 minutes**

- Remove crucible
- 3 minutes
- Remove spillage tray
- 6 minutes
- Remove slag bowl
- 6 minutes
- Remove mould shoes
- 10 minutes
- Shear weld (manual)
- 13 minutes
- Shear weld (powered)
- 13 minutes
- Post weld treatment
- Not required
- Remove tensors
- 50 minutes
- Remove Alignment Device
- 50 minutes
- Remove vent risers
- 50 minutes
- Replace fastenings
- 50 minutes
- Commence grinding
- 50 minutes
- Welder’s examination of weld
- Immediately after grinding

**Minimum times**

- Remove Alignment Device
- 50 minutes
- Remove vent risers
- 50 minutes
- Replace fastenings
- 50 minutes
- Commence grinding
- 50 minutes
- Welder’s examination of weld
- Immediately after grinding
## A.5.12 PLA 68 - Wide Gap BS113A Section with oxy-acetylene preheating

### Rail Grade
- Normal and Grade A (220 and 260)
- HP and 400MHH (Disc Cut Only)
- BS110A and 113A
- Up to 3 mm worn

### Rail Section

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>BS110A and 113A</td>
</tr>
<tr>
<td>HP and 400MHH (Disc Cut Only)</td>
<td>Up to 3 mm worn</td>
</tr>
</tbody>
</table>

### Rail Preparation
- Rail cutting method: Disc cutter or rail saw
- Welding gap: 68 +/- 3mm

### Preheating
- Burner type: RT 8 holes
- Mixer type: E2-43
- Burner height: 60mm
- Oxygen pressure: 0.6 bar
- Acetylene pressure: 0.6 bar +/- 10%
- Cone length: 8mm
- Preheating time: 7 minutes

### Welding portion details
- Crucible type: CJ2
- Portion type: 113A PLA CJ 68 D
- Welding charge and gap: PLA CJ 68 D (17kg)
- Date and batch details: Sept 2010 0U0929 (example)
- Maximum time between end of preheat and igniter insertion: 30 seconds
- Tapping time: 17 – 32 seconds

### Strip down procedure from completion of pour

**Leave undisturbed for 3 minutes**
- Remove crucible: 3 minutes
- Remove spillage tray: 6 minutes
- Remove slag bowl: 6 minutes
- Remove mould shoes: 10 minutes
- Shear weld (manual): 13 minutes
- Shear weld (powered): 13 minutes
- Post weld treatment: Not required
- Remove tensors: 50 minutes
- Remove Alignment Device: 50 minutes
- Remove vent risers: 50 minutes
- Replace fastenings: 50 minutes
- Commence grinding: 50 minutes
- Welder’s examination of weld: Immediately after grinding
A.5.13 PLA 68 - Wide Gap CEN60 Section with oxy-propane preheating

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>CEN60 E1 and E2</td>
</tr>
<tr>
<td>HP and 400MHH (Disc Cut Only)</td>
<td>Up to 3 mm worn</td>
</tr>
</tbody>
</table>

Rail Preparation

- Rail cutting method
- Welding gap
  - Disc cutter or rail saw
  - 68 +/- 3mm

Preheating

- Burner type
- RT 22 holes
- Mixer type
- F43
- Burner height
- 70mm
- Oxygen pressure
- 1.2 bar
- Propane pressure
- 0.6 bar +/- 10%
- Cone length
- 25mm
- Preheating time
- 7 minutes

Welding portion details

- Crucible type
- CJ2
- Portion type
- UIC60 PLA CJ 68 D
- Welding charge and gap
- PLA CJ 68 D (17kg)
- Date and batch details
- Sept 2010 0U0929 (example)
- Maximum time between end of preheat and igniter insertion
- 30 seconds
- Tapping time
- 17 – 32 seconds

Strip down procedure from completion of pour

Leave undisturbed for 3 minutes

- Remove crucible
  - 3 minutes
- Remove spillage tray
  - 6 minutes
- Remove slag bowl
  - 6 minutes
- Remove mould shoes
  - 10 minutes
- Shear weld (manual)
  - 13 minutes
- Shear weld (powered)
  - 13 minutes
- Post weld treatment
  - Not required
- Remove tensors
  - 50 minutes
- Remove Alignment Device
  - 50 minutes
- Remove vent risers
  - 50 minutes
- Replace fastenings
  - 50 minutes
- Commence grinding
  - Minimum times
  - 50 minutes
- Welder’s examination of weld
  - Immediately after grinding
### A.5.14 PLA 68 - Wide Gap CEN60 Section with oxy-acetylene preheating

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>CEN60 E1 and E2</td>
</tr>
<tr>
<td>HP and 400MHH (Disc Cut Only)</td>
<td>Up to 3 mm worn</td>
</tr>
</tbody>
</table>

### Rail Preparation
- Rail cutting method: Disc cutter or rail saw
- Welding gap: 68 +/- 3mm

### Preheating
- Burner type: RT 8 holes
- Mixer type: E2-43
- Burner height: 60mm
- Oxygen pressure: 0.6 bar
- Acetylene pressure: 0.6 bar +/- 10%
- Cone length: 8mm
- Preheating time: 7 minutes

### Welding portion details
- Crucible type: CJ2
- Portion type: UIC60 PLA CJ 68 D
- Welding charge and gap: PLA CJ 68 D (17kg)
- Date and batch details: Sept 2010 0U0929 (example)
- Maximum time between end of preheat and igniter insertion: 30 seconds
- Tapping time: 17 – 32 seconds

### Strip down procedure from completion of pour

<table>
<thead>
<tr>
<th>Step</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove crucible</td>
<td>3 minutes</td>
</tr>
<tr>
<td>Remove spillage tray</td>
<td>6 minutes</td>
</tr>
<tr>
<td>Remove slag bowl</td>
<td>6 minutes</td>
</tr>
<tr>
<td>Remove mould shoes</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Shear weld (manual)</td>
<td>13 minutes</td>
</tr>
<tr>
<td>Shear weld (powered)</td>
<td>13 minutes</td>
</tr>
<tr>
<td>Post weld treatment</td>
<td>Not required</td>
</tr>
<tr>
<td>Remove tensors</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Remove Alignment Device</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Remove vent risers</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Replace fastenings</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Commence grinding</td>
<td>Minimum times</td>
</tr>
<tr>
<td>Welder’s examination of weld</td>
<td>Immediately after grinding</td>
</tr>
</tbody>
</table>
# A.5.15 PLA 68 - Wide Gap CEN60 / BS113A Section Composite with oxy-acetylene preheating

## Rail Grade & Rail Section

- Normal and Grade A (220 and 260)
- CEN60 E1 and E2 & BS113A
- Up to 3 mm worn

## Rail Preparation

- Rail cutting method
  - Disc cutter or rail saw
- Welding gap
  - 68 +/- 3mm

## Preheating

- Burner type
  - RT 8 holes
- Mixer type
  - E2-43
- Burner height
  - 60mm
- Oxygen pressure
  - 0.6 bar
- Acetylene pressure
  - 0.6 bar +/- 10%
- Cone length
  - 8mm
- Preheating time
  - 7 minutes

## Welding portion details

- Crucible type
  - CJ2
- Portion type
  - UIC60/113A PLA CJ 68 D
- Welding charge and gap
  - PLA CJ 68 D (17kg)
- Date and batch details
  - April 2009 9B7312 (example)
- Maximum time between end of preheat and igniter insertion
- Tapping time
  - 17 – 32 seconds

## Strip down procedure from completion of pour

**Leave undisturbed for 3 minutes**

- Remove crucible
  - 3 minutes
- Remove spillage tray
  - 6 minutes
- Remove slag bowl
  - 6 minutes
- Remove mould shoes
  - 10 minutes
- Shear weld (manual)
  - 13 minutes
- Shear weld (powered)
  - 13 minutes
- Post weld treatment
  - Not required
- Remove tensors
  - 50 minutes
- Remove Alignment Device
  - 50 minutes
- Remove vent risers
  - 50 minutes
- Replace fastenings
  - 50 minutes
- Commence grinding
  - 50 minutes
- Welder’s examination of weld
  - Immediately after grinding

## Minimum times

- Remove Alignment Device
  - 50 minutes
- Remove Alignment Device
  - 50 minutes
- Replace fastenings
  - 50 minutes
- Commence grinding
  - 50 minutes
- Welder’s examination of weld
  - Immediately after grinding
A.5.16 PLA 68 - Wide Gap CEN60 / BS113A Section Composite with oxy-propane preheating

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>CEN60 E1 and E2 &amp; BS113A</td>
</tr>
<tr>
<td>Up to 3 mm worn</td>
<td></td>
</tr>
</tbody>
</table>

**Rail Preparation**
- Rail cutting method
- Welding gap
- Disc cutter or rail saw
- 68 +/- 3mm

**Preheating**
- Burner type: RT 22 holes
- Mixer type: F43
- Burner height: 70mm
- Oxygen pressure: 1.2 bar
- Propane pressure: 0.6 bar +/- 10%
- Cone length: 25mm
- Preheating time: 7 minutes

**Welding portion details**
- Crucible type: CJ2
- Portion type: UIC60/113A PLA CJ 68 D
- Welding charge and gap: D44 PLA CJ 68 D (17kg)
- Date and batch details: April 2009 9B7312 (example)
- Maximum time between end of preheat and igniter insertion: 30 seconds
- Tapping time: 17 – 32 seconds

**Strip down procedure from completion of pour**

Leave undisturbed for 3 minutes

- Remove crucible
- Remove spillage tray
- Remove slag bowl
- Remove mould shoes
- Shear weld (manual)
- Shear weld (powered)
- Post weld treatment
- Remove tensors
- Remove Alignment Device
- Remove vent risers
- Replace fastenings
- Commence grinding
- Welder’s examination of weld

<table>
<thead>
<tr>
<th>Strip down procedure from completion of pour</th>
<th>Minimum times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove tensors</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Remove Alignment Device</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Remove vent risers</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Replace fastenings</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Commence grinding</td>
<td>Immediately after grinding</td>
</tr>
</tbody>
</table>
### A.5.17 PLA 68 - Wide gap BS80A Section with oxy-propane preheating

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>BS 80A Up to 3mm worn</td>
</tr>
</tbody>
</table>

#### Rail Preparation

- Rail cutting method: Disc cutter/rail saw
- Welding gap: 68 +/- 3mm

#### Preheating

- Burner type: RT 22 holes
- Mixer type: E2 43
- Burner height: 50mm
- Oxygen pressure: 1.2 bar
- Acetylene pressure: 0.6 bar +/- 10%
- Cone length: 25mm
- Preheating time: 6 minutes

#### Welding portion details

- Crucible type: CJ2
- Portion type: PLA JS CJ
- Welding charge and gap: CJ 68 D
- Date and batch details: Jan 09 9V2580 (example)
- Maximum time between end of preheat and igniter insertion: 30 seconds
- Tapping time: 17 – 32 seconds

#### Strip down procedure from completion of pour

**Leave undisturbed for 3 minutes**

- Removal spillage tray: 3 minutes
- Remove crucible: 6 minutes
- Removal slag bowl: 6 minutes
- Removal of mould shoes: 10 minutes
- Shear weld (manual): 13 minutes
- Shear weld (powered): 13 minutes
- Post weld treatment: Not required
- Remove tensors: 50 minutes
- Remove Alignment Device: 50 minutes
- Remove vent risers: Minimum times
- Replace fastenings: 50 minutes
- Commence grinding: 50 minutes
- Welder’s examination of weld: Immediately after grinding
# A.5.18 PLA 68 – Wide Gap BS80A Section with oxy-acetylene preheating

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Normal and Grade A (220 and 260)</td>
<td>- BS 80A</td>
</tr>
<tr>
<td></td>
<td>- Up to 3mm worn</td>
</tr>
</tbody>
</table>

## Rail Preparation

| Rail cutting method               | Disc cutter/rail saw                        |
|                                  |                                           |
| Welding gap                      | 68 +/- 3mm                                 |

## Preheating

| Burner type                      | RT 8 holes                                 |
|                                  |                                            |
| Mixer type                       | E2-43                                      |
| Burner height                    | 60mm                                       |
| Oxygen pressure                  | 0.6 bar                                    |
| Acetylene pressure               | 0.6 bar +/- 10%                            |
| Cone length                      | 8mm                                        |
| Preheating time                  | 6 minutes                                  |

## Welding portion details

| Crucible type                    | CJ2                                        |
|                                  |                                            |
| Portion type                     | D38 PLA JS CJ                              |
| Welding charge and gap           | CJ 68 D                                    |
| Date and batch details           | Jan 09 9V2580 (example)                   |
| Maximum time between end of preheat and igniter insertion | 30 seconds |
| Tapping time                     | 17 – 32 seconds                            |

## Strip down procedure from completion of pour

Leave undisturbed for 3 minutes

- Removal spillage tray          - 3 minutes
- Remove crucible                - 6 minutes
- Removal slag bowl              - 6 minutes
- Removal of mould shoes         - 10 minutes
- Shear weld (manual)            - 13 minutes
- Shear weld (powered)           - 13 minutes
- Post weld treatment            - Not required
- Remove tensors                 - 50 minutes
- Remove Alignment Device        - 50 minutes
- Remove vent risers             - 50 minutes
- Replace fastenings             - 50 minutes
- Commence grinding              - Immediately after grinding
- Welder’s examination of weld   - Minimum times
A.5.19 PLA 68 - Wide gap S49 Section with oxy-propane preheating

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>S49</td>
</tr>
<tr>
<td></td>
<td>Up to 3mm worn</td>
</tr>
</tbody>
</table>

**Rail Preparation**

- Rail cutting method
- Welding gap
  - Disc cutter/rail saw
  - 68 +/- 3mm

**Preheating**

- Burner type: RT 22 holes
- Mixer type: E2-43
- Burner height: 70mm
- Oxygen pressure: 1.2 bar
- Acetylene pressure: 0.6 bar +/- 10%
- Cone length: 25mm
- Preheating time: 6 minutes

**Welding portion details**

- Crucible type: CJ2
- Portion type: PLA JS CJ
- Welding charge and gap: CJ 68 D
- Date and batch details: Jan 09 9V2580 (example)
- Maximum time between end of preheat and igniter insertion: 30 seconds
- Tapping time: 17 – 32 seconds

**Strip down procedure from completion of pour**

**Leave undisturbed for 3 minutes**

- Removal spillage tray: 3 minutes
- Remove crucible: 6 minutes
- Removal slag bowl: 6 minutes
- Removal of mould shoes: 10 minutes
- Shear weld (manual): 13 minutes
- Shear weld (powered): 13 minutes
- Post weld treatment: Not required
- Remove tensors: 50 minutes
- Remove Alignment Device: Minimum times
- Remove vent risers: 50 minutes
- Replace fastenings: Minimum times
- Commence grinding: 50 minutes
- Welder’s examination of weld: Immediately after grinding
### Rail Grade
- Normal and Grade A (220 and 260)
- BS 80A
- Up to 3mm worn

### Rail Section and Wear

### Rail Preparation
- Rail cutting method
- Welding gap
- Disc cutter/rail saw
- 68 +/- 3mm

### Preheating
- Burner type
- Mixer type
- Burner height
- Oxygen pressure
- Acetylene pressure
- Cone length
- Preheating time
- RT 8 holes
- E2 43
- 60mm
- 0.6 bar
- 0.6 bar +/- 10%
- 8mm
- 6 minutes

### Welding portion details
- Crucible type
- Portion type
- Welding charge and gap
- Date and batch details
- Maximum time between end of preheat and igniter insertion
- Tapping time
- CJ2
- PLA JS CJ
- CJ 68 D
- Jan 09 9V2580 (example)
- 30 seconds
- 17 – 32 seconds

### Strip down procedure from completion of pour

#### Leave undisturbed for 3 minutes
- Removal spillage tray
- Removal crucible
- Removal slag bowl
- Removal of mould shoes
- Shear weld (manual)
- Shear weld (powered)
- Post weld treatment
- Remove tensors
- Remove Alignment Device
- Remove vent risers
- Replace fastenings
- Commence grinding
- Welder’s examination of weld
- 3 minutes
- 6 minutes
- 6 minutes
- 10 minutes
- 13 minutes
- 13 minutes
- Not required
- 50 minutes
- 50 minutes
- 50 minutes
- Minimum times
- Immediately after grinding
A.5.21 70 - HWR - BS113A/110A/60E1 Section with oxy-propane preheating

<table>
<thead>
<tr>
<th>Rail Grade</th>
<th>Rail Section and Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and Grade A (220 and 260)</td>
<td>BS110A and BS113A</td>
</tr>
<tr>
<td>60E1</td>
<td>Up to 15mm worn</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rail Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail cutting method</td>
</tr>
<tr>
<td>Welding Excavation</td>
</tr>
<tr>
<td>MPI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preheating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burner type</td>
</tr>
<tr>
<td>Mixer type</td>
</tr>
<tr>
<td>Burner height</td>
</tr>
<tr>
<td>Oxygen pressure</td>
</tr>
<tr>
<td>Propane pressure</td>
</tr>
<tr>
<td>Cone length</td>
</tr>
<tr>
<td>Preheating time</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Welding portion details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crucible type</td>
</tr>
<tr>
<td>Portion type</td>
</tr>
<tr>
<td>Welding charge and gap</td>
</tr>
<tr>
<td>Date and batch details</td>
</tr>
<tr>
<td>Maximum time between end of preheat and igniter insertion</td>
</tr>
<tr>
<td>Tapping time</td>
</tr>
</tbody>
</table>

Strip down procedure from completion of pour

Leave undisturbed for 6 minutes

<table>
<thead>
<tr>
<th>Step</th>
<th>Minimum Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove spillage tray</td>
<td>6 minutes</td>
</tr>
<tr>
<td>Remove crucible</td>
<td>6 minutes</td>
</tr>
<tr>
<td>Remove slag bowl</td>
<td>6 minutes</td>
</tr>
<tr>
<td>Removal of mould shoes</td>
<td>7 minutes</td>
</tr>
<tr>
<td>Shear weld</td>
<td>8 minutes</td>
</tr>
<tr>
<td>Post weld treatment</td>
<td>Not required</td>
</tr>
<tr>
<td>Remove Lifting Device</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Replace fastenings</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Commence grinding</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Welder’s examination of weld</td>
<td>Immediately after grinding</td>
</tr>
</tbody>
</table>

Minimum times

Remove Lifting Device: 50 minutes
Replace fastenings: 50 minutes
Commence grinding: 50 minutes
Welder’s examination of weld: Immediately after grinding
### A.5.21 70 - HWR - BS113A/110A/60E1 Section with oxy-acetylene preheating

**Rail Grade**

- Normal and Grade A (220 and 260)
- BS110A and BS113A
- 60E1
- Up to 15mm worn

**Rail Section and Wear**

- BS110A and BS113A
- 60E1
- Up to 15mm worn

**Rail Preparation**

- Rail cutting method
- Welding Excavation
- MPI
- HWR Cutting Device Only
- 80mm/90mm – 10mm/8mm

**Preheating**

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burner type</td>
<td>RT 8 holes</td>
</tr>
<tr>
<td>Mixer type</td>
<td>E2-43</td>
</tr>
<tr>
<td>Burner height</td>
<td>110mm</td>
</tr>
<tr>
<td>Oxygen pressure</td>
<td>0.6 bar</td>
</tr>
<tr>
<td>Acetylene pressure</td>
<td>0.6 bar +/- 10%</td>
</tr>
<tr>
<td>Cone length</td>
<td>8mm</td>
</tr>
<tr>
<td>Preheating time</td>
<td>6 minutes</td>
</tr>
</tbody>
</table>

**Welding portion details**

- Crucible type
- CJ2
- HWR CJ
- Portion type
- HWR CJ
- Welding charge and gap
- R1 HWR CJ 260
- Date and batch details
- Jan 13 3V2580 (example)
- Maximum time between end of preheat and igniter insertion
- 30 seconds
- Tapping time
- 17 – 32 seconds

**Strip down procedure from completion of pour**

**Leave undisturbed for 6 minutes**

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal spillage tray</td>
<td>6 minutes</td>
</tr>
<tr>
<td>Remove crucible</td>
<td>6 minutes</td>
</tr>
<tr>
<td>Removal slag bowl</td>
<td>6 minutes</td>
</tr>
<tr>
<td>Removal of mould shoes</td>
<td>7 minutes</td>
</tr>
<tr>
<td>Shear weld</td>
<td>8 minutes</td>
</tr>
<tr>
<td>Post weld treatment</td>
<td>Not required</td>
</tr>
<tr>
<td>Remove Lifting Device</td>
<td>50 minutes</td>
</tr>
</tbody>
</table>

**Minimum times**

- Replace fastenings
- 50 minutes
- Commence grinding
- 50 minutes
- Welder's examination of weld
- Immediately after grinding
A.6 PREHEATING EQUIPMENT

Oxy fuel gas equipment shall be checked that it is good working order and suitable for use, each time it is used.

Oxy fuel gas equipment shall be tested every 6 months in accordance with British Compressed Gas Association Code of Practice CP7 or Rail Authority requirements.

CP7 recommends that gas equipment is renewed 5 years after the date of manufacture. Harris equipment is stamped with a two-letter code denoting year and month of manufacture.

<table>
<thead>
<tr>
<th>Year of manufacture</th>
<th>Letter code</th>
<th>Year of manufacture</th>
<th>Letter code</th>
<th>Month of manufacture</th>
<th>Letter code</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>A</td>
<td>1996</td>
<td>N</td>
<td>January</td>
<td>A</td>
</tr>
<tr>
<td>2009</td>
<td>B</td>
<td>1997</td>
<td>P</td>
<td>February</td>
<td>B</td>
</tr>
<tr>
<td>2010</td>
<td>C</td>
<td>1998</td>
<td>Q</td>
<td>March</td>
<td>C</td>
</tr>
<tr>
<td>2011</td>
<td>D</td>
<td>1999</td>
<td>R</td>
<td>April</td>
<td>D</td>
</tr>
<tr>
<td>2012</td>
<td>E</td>
<td>2000</td>
<td>S</td>
<td>May</td>
<td>E</td>
</tr>
<tr>
<td>2013</td>
<td>F</td>
<td>2001</td>
<td>T</td>
<td>June</td>
<td>F</td>
</tr>
<tr>
<td>2014</td>
<td>G</td>
<td>2002</td>
<td>U</td>
<td>July</td>
<td>G</td>
</tr>
<tr>
<td>2015</td>
<td>H</td>
<td>2003</td>
<td>V</td>
<td>August</td>
<td>H</td>
</tr>
<tr>
<td>2016</td>
<td>J</td>
<td>2004</td>
<td>W</td>
<td>September</td>
<td>J</td>
</tr>
<tr>
<td>2017</td>
<td>K</td>
<td>2005</td>
<td>X</td>
<td>October</td>
<td>K</td>
</tr>
<tr>
<td>2018</td>
<td>L</td>
<td>2006</td>
<td>Y</td>
<td>November</td>
<td>L</td>
</tr>
<tr>
<td>2019</td>
<td>M</td>
<td>2007</td>
<td>Z</td>
<td>December</td>
<td>M</td>
</tr>
</tbody>
</table>

For example, SE would represent May 2000, UB would represent February 2002.

NB: The letter code indicating the year of manufacture returns to A for 2008.
A.6.1 Oxy-Propane Preheating

The oxy-propane preheating system for both standard and wide gap welds is shown in Figure A.6.1.

Whilst Figure A.6.1 shows Harris equipment used throughout the system, this is the recommended set up for PLA welding although any make of regulator, flash back arrestor and in-line check gauge can be used provided they conform to appropriate standard and system requirements.

- Propane regulators can be single stage and shall conform to BS EN ISO 2503
- Oxygen regulators shall be multi-stage and conform to BS EN ISO 2503
- Flash Back Arrestors shall conform to BS EN 730
- In line check gauges shall conform to the requirements of BS EN ISO 5171 and shall be capable of displaying and measuring 0.6bar propane or 1.2bar oxygen clearly and with an accuracy of +/- 5%

Hoses shall be 20metres long, with 8mm bore propane and 10mm bore oxygen. Failure to use hoses of this length and diameter will result in a preheating flame that could cause over or under heating of the rails.

Hose tail internal diameters must be greater than 5.5mm

Hoses shall conform to BS EN ISO 3821

Hoses shall be fitted to a hose check valve (flashguard) at the preheater end.

The RT 22 hole preheater burner can only be obtained from Railtech UK Ltd

The minimum sizes of cylinder for use with oxy-propane preheating are

- Propane – 23kg
- Oxygen – size ‘Y’
Figure A.6.1 Oxy propane preheating arrangement
A.6.2 Oxy-Acetylene Preheating

The oxy-acetylene preheating system for both standard and wide gap welds is shown in Figure A.6.2.

Whilst Figure A.6.2 shows Harris equipment used throughout the system, this is the recommended set up for PLA welding although any make of regulator, flash back arrestor and in-line check gauge can be used provided they conform to appropriate standard and system requirements.

- Regulators shall be multi-stage and conform to BS EN ISO 2503
- Flash Back Arrestors shall conform to BS EN 730 and be both pressure and temperature sensitive
- In line check gauges shall conform to the requirements of BS EN ISO 5171 and shall be capable of displaying and measuring 0.6bar propane or 1.2bar oxygen clearly and with an accuracy of +/- 5%

Hoses shall be a maximum of 18metres long, with 8mm bore acetylene and 8mm bore oxygen.

Hose tail internal diameters must be greater than 5.5mm

Hoses shall conform to BS EN ISO 3821

Hoses shall be fitted to a hose check valve (flashguard) at the preheater end.

The RT 8 hole preheater burner can only be obtained from Railtech UK Ltd

The minimum sizes of cylinder for use with oxy-acetylene preheating are

- Acetylene – size ‘D’
- Oxygen – size ‘Y’
A.6.3 Gas Box Digital Pre-heating

The box is fitted with 2 digital gauges and offered 2 options: quick release couplers or standard connection (nut connection). The gas box can be clipped safely on the rail head in line with the preheating by a clip underneath.

Quick release couplers or standard connection are used to connect the gas cylinder to the digital box. They allow a quick release from the gas box to fit the oxy flame cutting torch.

Digital gauges provide the accurate pressures required with a high tolerance of one thousandth of a bar. They work with a lithium battery that could be changed easily on the top of the box. Gauges can be set for switching off automatically after use.

The hoses

There are 2 hoses, one for the propane and one for the oxygen. On the one end, they are connected to the gas box and on the other end to the torch mixer. They are 1.50 metres long and they have a 10 mm diameter. It is absolutely essential that neither of these be altered.

Self-centring burner

The burner head has a frame that is adjustable in height and widths, to fit all the mould range supplied by Railtech UK Ltd. Moulds have a notch where the torch clamps seats. They are then tightened to the mould. It is not necessary to over tighten it as it may crack the mould.

Recommendations when using the Gas Box digital device

- The two taps of the GASBOX must be closed
- Turn on the cylinders and the regulators – propane 1.5 bars / oxygen 2.5 bars
- Start the GASBOX flow gauges and verify that the pressure unit is on “bar” position on the gauge screen.
- Remove the preheater from the moulds.
- Light the preheater
- Progressively increase the gas and oxygen flows for adjusting the propane pressure between 0.28 bar and 0.29 bar and the oxygen pressure around 0.50 bar (between 0.50bar and 0.51bar) on the GASBOX’s gauges.
- Check that the cone length measure 20mm. If it is not the case, adjust the propane (with propane tap located at the GASBOX) to obtain right value (20mm). The propane pressure must be between 0.25 and 0.30 bar. In either case, never modify the oxygen pressure.
- Place the device onto and center the preheater into the moulds, adjust again the pressures.
Check the pressures during the preheating.

During the preheating, the flame which comes out of the risers must be symmetrical and measured approximately 300 - 400mm.

Place the plug close to a riser with the upper side close to the flame. (Take care not to block the exhaust of the flame).

Preheating Parameters

<table>
<thead>
<tr>
<th></th>
<th>Propane</th>
<th>Oxygen</th>
<th>Burner Height</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLA 25</td>
<td>0.25 – 0.30</td>
<td>0.50 – 0.51</td>
<td>50mm</td>
<td>4 minutes</td>
</tr>
<tr>
<td>PLA 68</td>
<td>0.25 – 0.30</td>
<td>0.50 – 0.51</td>
<td>70mm</td>
<td>7 minutes</td>
</tr>
</tbody>
</table>

Setting the gauges

The device can be operated menu driven via three pushbuttons in the touchpad. Besides showing information about the nominal pressure range as well as minimal and maximal pressure of the process, several pressure units (bar, mbar, PSI, mWs, inHg, cmHg, mmHg, kPa, MPa) and the position of decimal point can be set. Upper and lower range of the measured range can be recalibrated by the customer. Defaults can be loaded again via menu.

Structure of the menu system

It is possible to select different parameters in the menu which structure is:
Structure of the menu system

**▲/on button:** with this button you turn the device on; in the operating menu system or increased the displayed value.

**▼/off button:** with this button you turn the device off; in the operating menu you move backwards in the menu system or decrease the displayed value.

**OK button:** with this button you enter the operating mode; besides, it is used to activate the different menu items and to confirm the set value.

To configure the different menu items, set the desired value by pushing "▲" or "▼" buttons. Confirm the setting with the “OK” button and the menu item will start blinking to indicate that you can start the configuration.

To save the configured values or to leave a menu item, you also have to push the “OK” button.

Changes of the adjustable parameters become only effective after pushing the OK button and leaving the menu item. After leaving the menu system, all parameters will be checked against each other and in reference to the characteristics of the device. If the message “OK” appears in the display for some seconds, the configuration was successfully. If the message “ERROR” appears, at least one of the set values is out of the permissible range.

**Automatic switch off**

It is possible to configure the gauge for switching it off automatically:

Press “OK”
Press ON (▲) 5 times
Press “OK”
Press ON (▲) and select the time required between 1 and 5 minutes
Press OK
Zero offset

It is possible to reset the gauge for having the zero. It is advised to do this procedure before calibrating the digital box for example:

Press „OK“
Press „ON (▲)“ 7 Times
Press „OK“ (CAL ZP starts flashing)
Press „ON (▲)“ button ONCE
Press „OK“ -

For additional information about the different possibilities, please refer to the manufacturer instruction manual.

Changing the batteries

The digital pressure gauge is supplied by two 3.6 V-lithium batteries (Type 1/2 AA). Stored values/parameters are also kept after changing the batteries. If the symbol for low batteries is indicated in the display, it is necessary to replace them as soon as possible with two new ones of the same type in order to ensure a good readability of the values. This has only to be done in switched-off condition. The battery case is located under the black, circular plastic cap on the top of the housing.

To change the batteries:

Turn the plastic cap 45° anti clockwise by a coin (e.g. £2 coin) as far as possible
Hold tight and lever the plastic cap out of the housing
Take the cap off and change the batteries
Lock the device after properly
APPENDIX 7

ALTERNATIVE LUTING METHOD

The previous method of luting moulds using pate a lute did not give satisfactory results. An alternative luting method using pate a lute has been developed which overcomes the previous issues and gives improved final quality avoiding the possibility of porosity or weld metal run-outs.

This method is suggested as an alternative to the standard method that uses paste as described in the process manual for both standard and wide gap welds. Therefore, this method could be used with all felted moulds throughout the Railtech range.

The picture below shows examples of provided by the previous luting method with "pate a lute" [as described in this process manual] and the alternative method.

PHOTO 1: Examples of luting using both methods
A.7 PROCEDURE FOR THE ALTERNATIVE METHOD

A.7.1 Preparation of the Pate a Lute

1. Take some Pate A Lute from the bucket (836 611 30) and shape it into a 100mm cylindrical shape by rolling it between the hands.

2. Tear 35mm of paste from the roll and flatten it to obtain a flat piece of paste as shown on the picture.

A.7.2 Application of Pate a Lute

1. Apply the flattened paste along the web and into the luting strip using fingers only. Be careful – LUTING TOOLS SHALL NOT BE USED.

Picture A.7.1: Flattened piece of 35 mm paste

Picture A.7.2: Paste applied in the luting strip
Compress the paste with the finger making sure it comes into contact with the felt

Continue the process until the whole luting strip is filled

Following the first application of paste to the luting strip, a further layer is applied to complete the luting process
A.7.3 Luting the bottom briquette

For luting the briquette prepare the paste by rolling it into a cylindrical shape as described previously.

Using the thumb, apply the whole roll along the full length of the briquette making sure that the paste is in contact with the briquette and the bottom plate. The paste shall be higher than the felt.

To obtain a flat surface between the felt and the paste, use a sharp edge to remove the excess paste.

Figure A.7.3: Paste before cutting and levelling

Figure A.7.3: Paste after cutting
A.7.4 Fitting the bottom briquette

Fitting of the bottom briquette is carried out by following the standard procedure as described in the process manual.

When the briquette has been fitted correctly, use the thumb and run it along the paste to compress it against the rail and briquette. If required, additional paste can be applied.

A further layer is applied along the back of the bottom plate and above the rail head to the top of the mould to complete the luting process as described earlier in the process manual.
Guidance on the type, size and location of defects that can be removed by the HWR method.

This guidance provides additional information to that given in form TEF/3003, on the type, size and location of defects that may be removed by the HWR method;

**Squat type defects**: 
- maximum excavation size (finish ground) - 90mm long, full railhead width, 8mm above the lower edge of the head

**Wheelburns**: 
- maximum number of 1 overlapping repair
- minimum overlap measured from edge of fusion zone - 30mm
- maximum length of visibly damaged area - 160mm
- depth - as for squat type defects (standard depth excavation)

**Defect location:**
- In plain line (not currently permitted above fishbolt holes)
- Where repairs are to be carried out near a fishbolt hole, the edge of the excavation shall be a minimum distance of 125mm from the edge of the nearest bolt hole measured vertically through the railhead
- Repairs are not permitted where heavy or severe RCF is present, however, repairs may be installed into light or moderate RCF provided that there is a minimum of 100mm of clean rail either side of the proposed repair
- Above flash butt welds (mould adjustment will be required to accommodate the trimmed upset)
- Above defective arc weld repairs
- Where multiple defects are to be removed, a minimum distance of 100mm shall be observed between repairs, however, a minimum time of 2 hours shall be observed between finish profile grinding and commencement of the next repair

**Notes:**
1. defects repaired using the HWR method subsequently found to be defective following NDT, may be re-repaired using the same method
2. subject to weld straightness check before repair (no dipped joints)
Excavation Procedure

According to Network Rail standard, the excavation is made by flame cutting. The geometrical parameters are:

- The size of the excavation to be full head width 80mm – 90mm long maximum excavation after grinding.
- A minimum of 10mm of rail running edge must remain after flame cutting. After grinding the minimum of rail running edge which must remain is 8mm.
- Rail lifting criteria – <100mph = 0.5mm over 1m, >100mph lift = 1.0mm over 1m

To achieve the excavation, Railtech have developed a special jig for excavating, you can use different tools available on the market, but if you are using the tools developed by Railtech, place it on the top of the rail, the defect to be removed in the centre.

The jig uses the underside of the head as a datum and will always leave 10mm of rail head after cutting.
Pressures are set:
- Propane 0.4 bar
- Oxygen 3.5 bar

2 arcs of the gun to warm the rail up. Excavation process should be made smoothly in one fluid movement. *(10 seconds from start to finish)*

![Image of arc welding]

**A smooth excavation is achieved. The excavation will leave 10mm of rail head.**

The excavation is then ground with an angle grinder to remove any ridges and slag.

When the defect has been ground, Non Destructive Tests are made following Network Rail procedure for NDT.
Welding Procedure

In case of welding on worn rail, the wear is measured by using the gauges as described in the instruction manual page 15 or 3.5.1

Secondly, a peak of 1 mm is made by using a jack.

HWR Moulds incorporate the Hybrid Wear System. The moulds are filed in accordance with the wear measured previously. For new rail, moulds are fully filed for example.

110/113 moulds fit straight onto 110 rail, for 113 about 2mm of mould will need to be filed from the web area.
Moulds are then put on the rail and bedded in to the profile of the rail by rubbing.

Moulds are put face to face, each welder having one mould. They are rubbed together and a correct fitting around the rail head is checked.

It is very important not to rub too much for avoiding any gap underneath the rail which could result in flashing.

Moulds are clamped together by following the standard procedure and by using the standard clamp. One mould is firstly clamped, alignment is checked, and then the second one.
The gap around the rail head is filled with felt, the same method for Hybrid moulds.

Both moulds are luted by using pâte a lute and following the luting procedure described in the instruction manual.

**A.7 PROCEDURE FOR THE ALTERNATIVE METHOD**

Preheater holder is then placed on the top of the rail.
Check the vertically of the burner and its alignment with the holder.
The height is 110 mm.

Or use the Gas Box set to the highest setting.
Pressures are the standard pressures used for welding with PLA:
- Oxygen: 1.2 bar
- Propane: 0.6 bar +/- 10% to achieve a 25mm cone length.

The rail is pre-heated for 4 minutes.

At completion of the preheating, the pre-charged one shot crucible is set on the top of the moulds and the portion is ignited using one igniter only.
Weld is trimmed after 8 minutes. Depending on the weather condition and the type of trimmer used, trimming time could be adjusted more or less one minute.

Finally, the weld is ground to the required standard for the speed of track as set out in the Network Rail standards.
APPENDIX 9  STARTWEL® – Electrical Ignition System

STARTWEL® is the electrical ignition system for rail aluminothermic welding charges, developed and patented by RAILTECH INTERNATIONAL.

It has been designed to guarantee constant and reliable ignition.

In addition to the quality STARTWEL® brings to welding, it also makes work safer for track technicians.

On ignition, a drop of molten metal falls inside the crucible and causes combustion of the aluminothermic charge.

The ignition point is always in the same place, thus obtaining reliability and constancy in weld repetition.

Caution: the charge must always be horizontal in the crucible

Conditions for use and storage

STORAGE

Store in the original packaging, in a dry and adequately ventilated room. Keep away from heat, sparks, flames and any source of ignition. Do not expose thermic starters to electric current.

SAFETY & USE

The safety pin must imperatively remain “clipped in” and be removed only during use. Use only the STARTWEL® electric handle to power up the starter. The thermic starter can only be powered up when it is in a housing appropriate for its use. Use only for ignition of an aluminothermic charge, to the express exclusion of any other use. Risk of burning in the event of improper use.

FIRE

The molten steel produced by the aluminothermic reaction may cause violent projections on contact with snow, ice, water, damp floors or frost.

In the event of a fire, use dry sand to the exclusion of any other product.

Warning: It is strictly forbidden to use water to put out a fire caused by the aluminothermic portion.
Check the battery charge status by pressing the button (LED indicator)

<table>
<thead>
<tr>
<th>LED</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>🟢🟢🟢 LED</td>
<td>&gt; 2/3</td>
</tr>
<tr>
<td>🟢🟢🟢 LED</td>
<td>&gt; 1/3</td>
</tr>
<tr>
<td>🟢🟢🟢 LED</td>
<td>&lt; 1/3</td>
</tr>
<tr>
<td>⚪️ LED</td>
<td>Reserve</td>
</tr>
</tbody>
</table>

1 Flashing green LED = recharge the battery

If the cap is a filter cap, use a tool to clear the position provided for the starter.

This operation must be carried out away from the crucible.

Remove the pin from the starter
Insert the starter in the hole in the cap

Position the ignition indicator so that it is visible

Place the electrodes of the electric handle on the terminals of the STARTWEL® starter

Press and hold the trigger until ignition
Charge has started when the red light becomes visible.

Warning

Do not use the electric handle on the STARTWEL® starter with the pin in place or on any conductive surfaces: copper, aluminium, steel, etc.
Components of the STARTWEL® kit

StartWel® (Ignition System Complete case)
Part No. 82632507 / PADS No: 0046/14969

1-StartWel® Handle (only)
Part No. 82632509 / PADS No: 0046/14962

2-Rechargeable battery
Part No. 82632504 / PADS No: 0046/14964

Complete Handle (Starter+battery)
Part No. 82632503 / PADS No: 0046/14963

3-StartWel® Thermic Starter x100
Part No. 82632502 / PADS No: 0046/14966

3bis-StartWel® Thermic Starter x10
Part No. 82632501 / PADS No: 0046/14965

4-Li-Ion Battery Charger
Part No.: / PADS No: 0046/14967

5-StartWel® empty metal case
Part No. 82632506 -/ PADS No: 0046/14968