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Maintenance of Points and Crossings

ETP-03-02

Applicability

Network Wide

Publication Requirement

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1.0	01 Apr 24		Document renumbered from ETM-03-03 Add Switch and Stock Rails

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1 Introduction

1.1 Purpose

This procedure sets out the requirements for the maintenance of points and crossings by controlling lipping, metal flow & pitting. This is required to prevent early replacement of turnout steel components.

Wire feed welding of rails and turnout steel components is covered in RTS 3733.

1.2 Document Owner

The Head of Engineering Standards is the Document Owner. Queries should be directed to standards@artc.com.au in the first instance.

1.3 Definitions

The following terms and acronyms are used within this document:

Term or acronym	Description
ARTC	Australian Rail Track Corporation Ltd.
Lipping	Plastic deformed metal flow that appears as a lip.

2 Manual Grinding of Points and Crossings

2.1 Aim of Manual Grinding

Manual grinding of turnout steel components should be undertaken to prevent short term failure and enable the components to reach their expected service life.

The primary objective is to remove any metal flow, lipping & pitting which develops on the nose of the crossing, the wingrails, the switches and stock rails. The aim is not to introduce a special profile to the head of the rail but rather to correct an anomaly which if left untreated can damage the turnout steel components. The metal flow, lipping and pitting is caused by the higher stresses due to more concentrated wheel rail contact (which occurs until the profile has worn) and on some types of turnout steel components because the hardness is low prior to work hardening in service.

2.2 Planning Manual Grinding

Manual grinding should be undertaken when the lip on a turnout steel component reaches 1mm however grinding may be undertaken whenever flow is evident. Grinding is also required:

- during the wearing in period of new turnout steel components when more than one grinding cycle may be required;
- in the wearing in period after build up or repair of turnout steel components;
- as part of the normal wear of turnout steel components in some cases although normally over a longer time scale;
- should damage occur due to high impact or to restore unusual wear or badly worn profiles. This would normally be carried out in association with building up.

2.3 Inspection Strategies

The recommended inspection strategies are shown in Table 1. Where special problems are evident inspection frequencies should be increased. Local Engineering Instruction may be issued for locations that require increased inspection frequencies.

Table 1

Traffic Density	**Inspection**		
	After Installation	**From Repair**	**In Service**
Recommendation, for lines up to 15 MGT	Inspect each month until first grind thence each three months for 6 months.	Inspect each two months until first grind	Inspect each 12 months as part of turnout inspection
Recommendation, for lines over 15 MGT	Inspect each two weeks until first grind thence each two months for 12 months	Inspect each month until first grind	Inspect each six months

2.4 Grinding Requirements

The anticipated grinding requirements for various crossing types are shown in Table 2.

Table 2

Crossing Type	Period in MGT		
	After Installation	**From Repair**	**In Service**
Fabricated	2	2	20
Welded	2	2	20
Built Up (special alloy)	2	2	20
Manganese	2	2	20
Swing Nose	2	2	20
Compound	2	2	20

2.5 Allowable Extent of Wear - Crossings

The extent of wear is to be measured by placing a 2000mm straight edge across the worn area as shown in Figure 1 and measuring from the underside of the straight edge.

On the nose, building up should be undertaken when the wear has reached 3 - 4mm as this will increase the crossing life, as the weld metal has a wear resisting quality superior to the parent rail. Building up however can be undertaken with up to 6mm of wear.

On the wing rail, building up should be undertaken when the wear has reached 5 – 10mm.

2.6 Switch Blade and Stock Rail Repair Constraints

It is critical to remove any lipping or metal flow by hand grinding on switches and stock rails once they are evident. It is important to look for metal flow over the gauge corner as well as the undercut of the stock rail (where applicable). Lipping or metal flow from the stock rail has potential to chip the top of the switch if not removed.

These conditions usually occur after installation as the steel work hardens then can appear later on while in service.

The ability to repair switches by wire feed welding is reduced in the un-restrained section of the switch while in track. Only smaller repairs can be made on the unrestrained section of the switch compared to restrained rails/crossings. In the sections that are unrestrained ie not held down with e-clips, fast clips, there is potential for switches to bow out of shape if too much heat is put into the component during the wire feed weld/build up process.

2.7 Photos of conditions

Please see Appendix A for examples of lipping/metal flow on turnout steel components.

3 Fabricated Crossings and Wing Rails

3.1 Preparation for Weld Repairs

The following preparation is required prior to commencement of resurfacing

- Tightening of all bolts in crossing;

- Lifting and packing of supporting bearers;
- Test for the presence of cracks, with dye penetrant or magnetic particle tests;
- Remove any defects found by oxy-propane gouging and grinding;
- Preheating to a minimum of 350°, or for head hardened rail in the range 350° to 450°C, with soaking time a minimum of 15 minutes, covering the weld repair plus 100 - 150mm on either side of the repair;

3.2 Oxy-Acetylene Resurfacing of Fabricated Crossings and Wing Rails

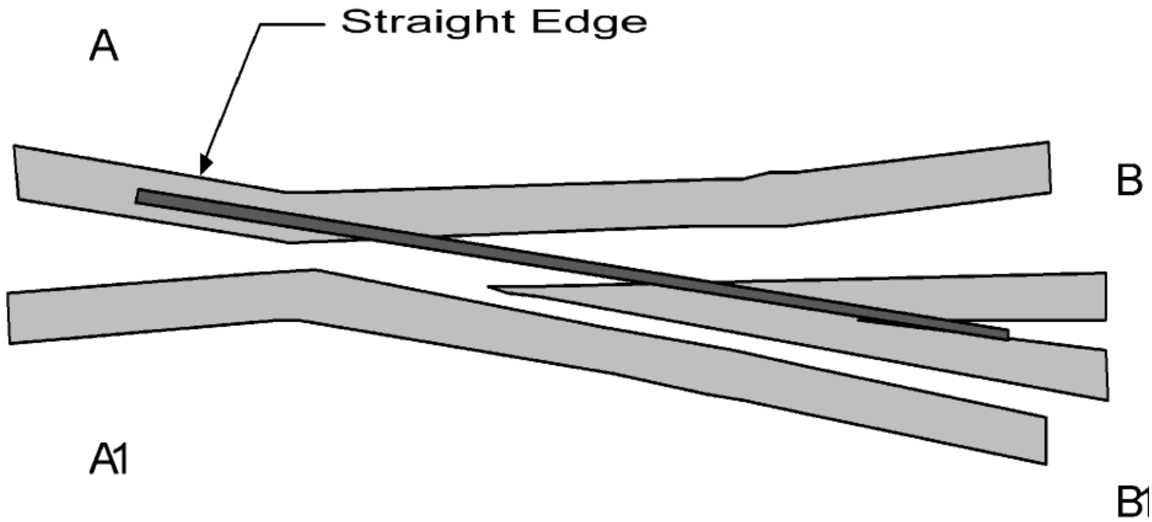


Figure 1

3.2.1 Welding Rods

Only wear resistant alloy steel welding rods 5mm and 6mm diameter are to be used for building up. These are colour coded "signal red" on the tip of each rod.

3.2.2 Copper Bonds

Weld metal must not be deposited within 25mm of the copper bond position (See Figure 7) on rails to which copper bonds are, or have been, attached, This restriction is necessary to eliminate the possibility of copper penetrating into the rail whilst welding is in progress.

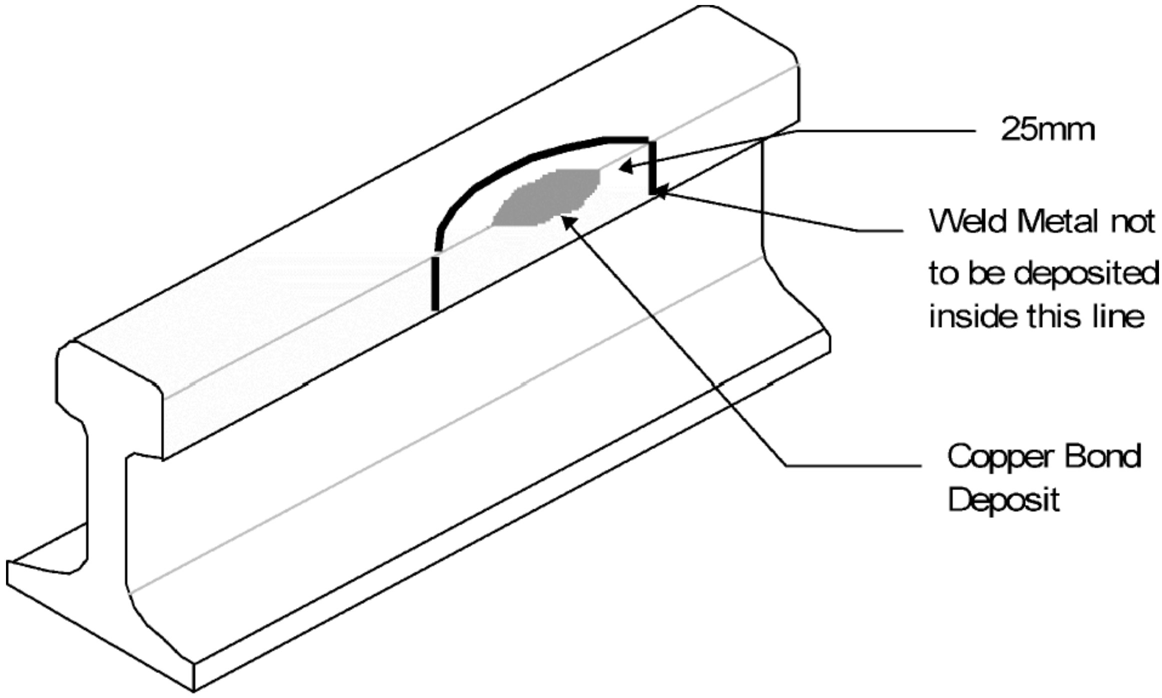


Figure 7 - Welding near Bonds

3.2.3 Hardness

The weld metal deposited will give a Brinell hardness of approx. 300 as compared to normal rail with a hardness of approx. 250. Similarly to the running surface of the existing rail there will be an increase in hardness in the built up area of 20-30 points in service due to work hardening.

The weld metal is dense, with good ductility and toughness and will react favourably under hot hammering and forging thus ensuring a sound, dense, close grained deposit. This also enables the correct contour to be obtained without the need for excessive grinding.

3.2.4 Speed of Traffic over the Worksite

The maximum speed of traffic passing over crossings in the process of being built up is 15 kph.

3.3 Electric Arc Welding of Fabricated Crossings and Wing Rails

Prequalified welding consumables shall be those given in the table below as specified in AS/NZS 2576:

Shielded metal arc welding	Self-shielded flux-cored metal arc welding	Gas shielded metal arc welding
1130-A1	1130-B7	1130-B5, B6
1430-A1	1430-B7	1430-B5, B6

Weld beads should be made primarily in the longitudinal direction;

Arc strike shall not be permitted outside the preheated weld area;

4 Inspection and Repair of Manganese Crossings

4.1 Inspection

Ultrasonic inspection is not applicable to cast manganese steel due to its internal grain structure;

Magnetic particle inspection is not applicable as the material is not magnetic.

The inspection of cast crossings is normally by visual observation. This may be supplemented by dye penetrant inspection to provide additional information on the extent of cracks.

4.2 Limits of Defects

Crossings or cast manganese components are to be replaced when cracking exceeds the following limits:

Length	100mm
Depth of transverse crack in rail head	Half the depth of the head thickness
Depth of transverse crack in wing	Half the depth of the wing profile height
Bolt hole crack	Crack extending from bolt hole into the head or flange of the crossing

4.3 Preparation

Before any repair welding, preparation must include:

- Grinding of defect to sound metal;
- Grinding of adjacent work hardened metal to a depth of 0.5mm;
- Grinding of adjacent metal outside the work hardened area to 0.2mm to 0.3mm deep;
- Avoid raising of metal temperature during the grinding process too high (the metal should not turn bluish);
- Limit grinding depth to a maximum of 15mm;
- After grinding undertake dye penetrant testing for 20mm on adjoining areas (only use to a maximum of 45°C).

4.4 Weld Repair Procedures

- The material must be kept below 204°C at all times - regularly check temperatures, fill flangeways with water to within 6mm of the weld area;
- Welding beads are to be made in narrow longitudinal passes, with no weaving;
- Each bead should overlap the previous one by about 1/3rd of its length;
- Rutile covered electrodes are to be used;
- Welding consumables are to conform to the requirements of AS/NZS 2576 for austenitic manganese steel;
- After the welding of each bead it shall be cleaned of all slag by use of pneumatic or electric needle gun prior to commencing the weld repair of the next zone.

5 Inspection and Testing of Finished Weld

Inspection and testing of finished welds following grinding shall be carried out to ensure the weld satisfies the following criteria:

- Visual Inspection - the weld shall show no regions of underfill, cracking, inclusions, lack of fusion, gas porosity, slag inclusions, grinding burn, electric contact burns;
- Undertake dye penetrant or magnetic particle testing, and remove any defects found;
- Confirm that levels and alignment are to standard;
- Arrange ultrasonic testing of the weld as specified in Technical Maintenance Plans.

6 Field Marking of Crossings

6.1 Process

This section sets out the requirements necessary to identify the life of a crossing by indicating either the date it was installed or repaired.

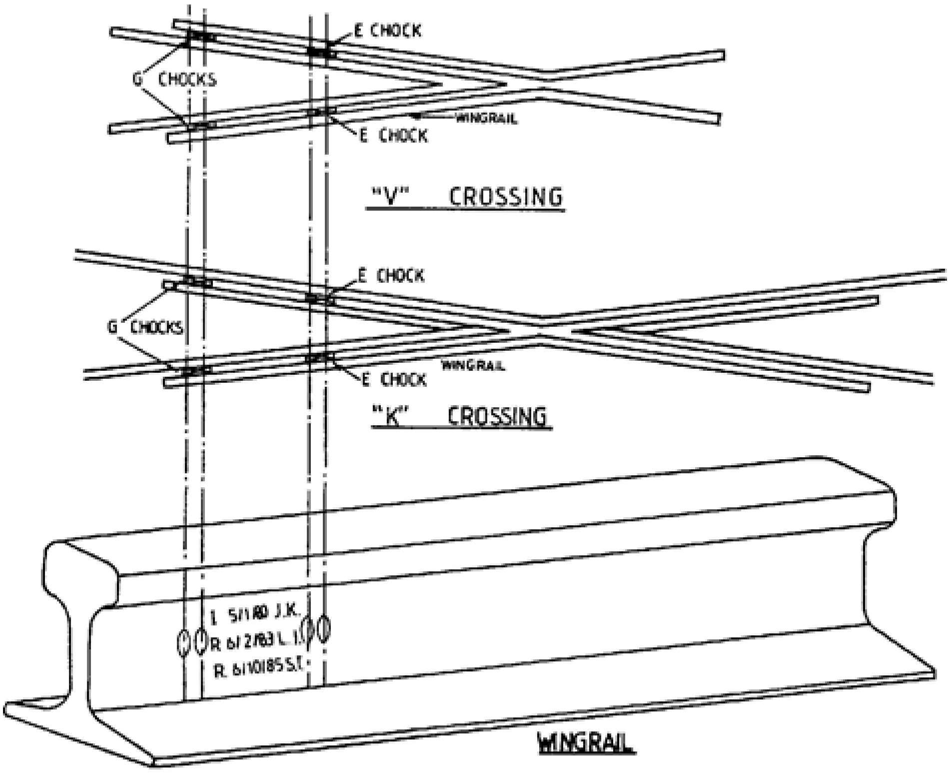
Welders are required to indicate on ‘V’ and ‘K’ Crossings when the crossings have been installed or repaired. The markings are to be placed on the wing rails (see sketch) and are to include the following information:

- Whether installed or repaired;
- Date of installation or repair;
- Welder's initials.

6.2 Marking Details

I for installation plus installation date and initials; or

R for repair plus repair date and initials.



7 Appendix A – examples of lipping/metal flow on Points and Crossings

Image 1 – metal flow on stock rail causing switch to chip.

Image 2 – metal flow from stock rail causing switch to chip

Image 3 - metal flow from stock rail causing switch to chip

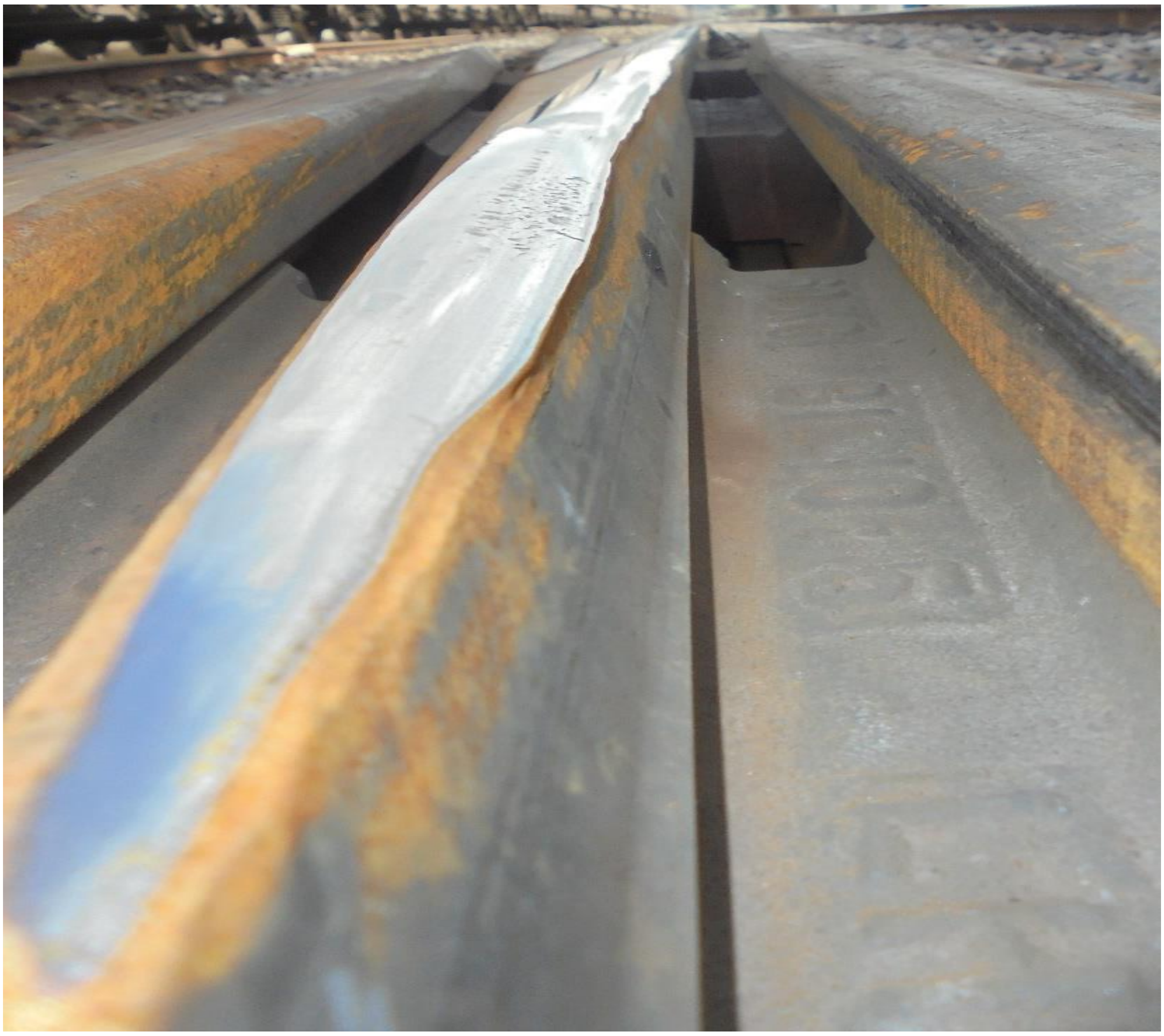


Image 4 – metal flow & rolling contact fatigue on crossing nose

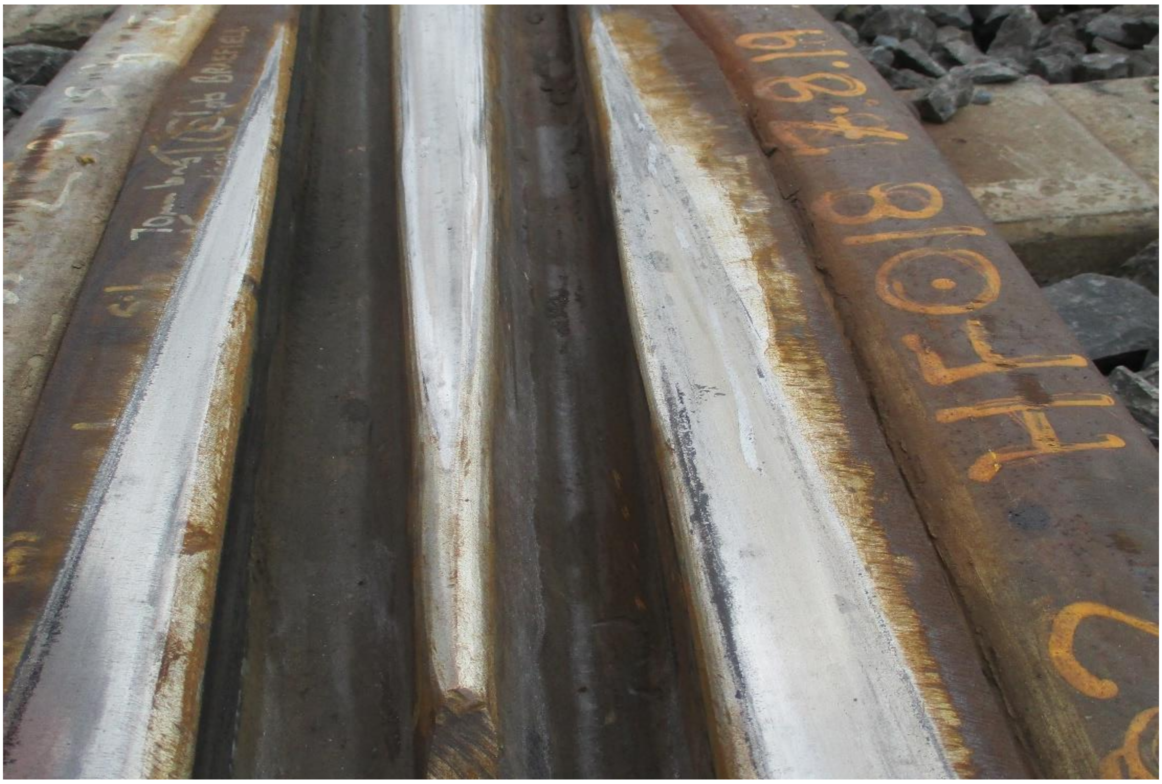


Image 4 – metal flow on a crossing nose and wing rail

Image 5 – metal flow on crossing nose and wing rail circled in black