



AUSTRALIAN RAIL TRACK CORPORATION LTD

Discipline  
Engineering Specification

Category  
Track & Civil

# General Appendix to ARTC Track & Civil Code of Practice

## Specification Clauses

### Rail

### ETG-01-01

#### Applicability

|                      |   |
|----------------------|---|
| ARTC Network wide    |   |
| New South Wales      |   |
| Western Jurisdiction | ✓ |
| Victoria             | ✓ |

#### Primary Source

(ARTC A1 Specification Rail - Design & Rating, Inspection & Assessment and Work on Asset/TCS-17)

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#### List of Amendments

| Issue | Date      | Clause  | Description                 |
|-------|-----------|---------|-----------------------------|
| 1.0   | 01 May06  |         | First issue                 |
| 1.1   | 23 Oct 06 | 1.7.6   | Replace Figure 1.2          |
| 1.2   | 22 Dec 11 | 1.7.5.5 | Removed rail wear reporting |
|       |           |         |                             |

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## 1.7. Rail

### 1.7.1 Rail Lubrication and Friction Modifiers

#### 1.7.1.1. Requirements

- (a) On curves where rail lubrication is required by ARTC, sufficient rail lubricant shall be applied on the gauge face of the outer rail of curves so that:
- Rail wear is optimised
  - Wheel squeal from flanging is minimised
  - Lubricant on the rail head is avoided
- (b) Rail lubrication equipment and assembly details shall be of an ARTC agreed design and shall be installed, adjusted, cleaned, maintained and used in accordance with the manufacturer's specifications.
- (c) The Contractor may use alternative methods for rail lubrication and for the application of friction modifiers, subject to ARTC approval. In such cases the Contractor shall specify the:
- Type of lubricant and friction modifiers to be used
  - Method of application and the controls to be used
  - Extent of application
- (d) The Contractor shall comply with the relevant environmental Statutory requirements for the control of spillage of excess lubricant and friction modifiers.

#### 1.7.1.2. Fixed Rail Mounted Lubricators and Lubricants

A register shall be established and maintained by the Contractor, which clearly specifies where rail lubrication or friction modification is to be used and the method of application.

When rail lubrication is used practices shall be established to ensure that the application of the lubricant/friction modifier is regulated to avoid contamination of the wheel rail contact band.

Changes to the use of lubricants or friction modifiers shall:

- Only occur following rigorous analytical or empirical analysis or investigation and
- be agreed with ARTC on the basis of appropriate evidence from the Contractor.

### **1.7.2 Rail Handling and Stockpiling**

Rails shall be handled and stockpiled with care to minimise the potential for damage from the rail being crippled or notched.

During unloading from rail or road vehicles, rail shall be placed or stockpiled in such a manner to prevent it from moving and to eliminate any potential damage to traffic.

### **1.7.3 Welding of Rail Into Track**

During rerailing work, rail when being inserted into track shall be laid using the following principles:

- Minimise the total number of welds
- Flashbutt welding is preferred, with Alumino Thermic Welds only to be used for Junction welds, Stress Welds and joining Long Welded Strings where Flashbutt Welds cannot be used.
- The target is to maximise the use of Flashbutt Welds.

### **1.7.4 Rerailing**

#### **1.7.4.1. Placing Rail for Rerailing**

Rail that is being placed for rerailing shall be located so that there is no risk of it fouling the rolling stock outline.

#### **1.7.4.2. Rail Insertion into Track**

When the rail to be replaced has been removed from the rail seat (on concrete or steel sleepers):

- Ineffective pads shall be replaced when rerailing is carried out.
- The rail seat shall be cleared of all ballast
- Ineffective spacers shall be replaced
- Ineffective clips shall be replaced

When the rail to be replaced has been removed from sleeper plates on timber sleepers:

- The rail seat shall be cleared of all ballast
- Ineffective fastenings shall be replaced

### **1.7.5 Inspection and Assessment**

#### **1.7.5.1. Corrugation Test Measurement of Rail Surface Roughness**

- (a) This inspection is used to provide data for rail profile rectification work planning purposes and providing notification of defects that require action to be taken, and shall be carried out at yearly intervals.

The Track and Rail Condition Monitoring Contractor shall be responsible

for:

- Ensuring that the specified calibration checks have been carried out in accordance with the procedures developed by the Track and Rail Condition Monitoring Contractor and as agreed with ARTC and that the equipment has passed such calibration checks
- Undertaking the specified calibration of the Corrugation Test Equipment
- To monitor system output that may indicate a failure or requirement for maintenance or re-calibration of the Corrugation Test Equipment and carry out such maintenance or recalibration as required
- Input and report the following data measurements where applicable:
  - Management area
  - Line (eg. TAR, northbound Junee - Macarthur)
  - Start and finish locations of the measuring run or line section
  - Direction of measurement
  - Which end of the vehicle is leading
  - Date of run
  - Kilometre post locations
  - Special events or comments including calibrations, any incidents or features which can assist with the interpretation of the data and reports.

The Contractor shall deliver results to ARTC in accordance with Clause 1.7.5.8.

(b) Record of Recording Runs

The Track and Rail Condition Monitoring Contractor shall maintain records of runs carried out, which shall include as applicable any of the following:

- Date
- Start and finish location and times for the day
- Recording or not recording (traveling)
- Summary of service details
- Summary of any mechanical or measuring system faults or problems
- Odometer reading at finish of day

- Amount of fuel taken on3
- Any other comments

#### **1.7.5.2. Measurement Rail Weld Longitudinal Profiles**

Refer to Table 1.10 and notes, Clause 1.2.4 for the measurement of rail and rail weld longitudinal profiles.

#### **1.7.5.3. Measurement of Rail Wear**

The Track and Rail Condition Monitoring Contractor shall carry out the measurement of rail wear at intervals not exceeding 7 months (twice yearly).

The criteria for measuring rail wear specified in Clause 1.1.1(b) shall apply.

The following outputs are required:

- (a) Top Wear
  - Determining the height of the rail in mm in the centre of the head to an accuracy of 0.5 mm
- (b) Side Wear
  - Determining the width of the rail 16mm below the running surface to an accuracy of 0.5 mm.
- (c) Head Loss
  - Determining the loss of head area as a percentage of the original head area to an accuracy of 2%
- (d) Rail Gauge Face Angle

The gauge face angle is measured as the angle between a line perpendicular to the sleeper plane (ie. the plane of the track) and the line tangent to the rail gauge face where wheel flange contact occurs to an accuracy of 2 degrees.

#### **1.7.5.4. Rail Head Profile Inspection and Measurement**

- (a) This inspection is used to provide data for track maintenance planning purposes and providing notification of defects that require action to be taken.

The Track and Rail Condition Monitoring Contractor shall be responsible for:

- Ensuring that the specified calibration checks have been carried out in accordance with the procedures developed by the Track and Rail Condition Monitoring Contractor and as agreed with ARTC and that the equipment has passed such calibration checks
- Undertaking the required calibration of the rail head measuring equipment

- To monitor system output that may indicate a failure or requirement for maintenance or re-calibration of the rail head measuring equipment and carry out such maintenance or recalibration as required
- Input and report the following data measurements where applicable:
  - Management area
  - Line (eg. TAR, northbound Junee - Macarthur)
  - Locations of the measurement
  - Date of run
  - Special events or comments including calibrations, location names, resetting of zero alignment base, any incidents or features which can assist with the interpretation of the track charts and reports.

The Contractor shall deliver within 21 days or otherwise agreed with ARTC, following each measurement the following outputs:

- Raw data files
- Rail Profile Plots (as locations specified by the Superintendent for non continuous system or agreed intervals if continuous system)
- Line Section Data Summary Sheets and plotted data (Locations, rails and measurement results for each measurement location as defined in clause 1.7.5.5.

All plotted data in spreadsheet form.

- (b) Backup of raw data and computer files.

The data files created during the measuring run shall be saved and stored electronically for permanent storage and any later or offboard analysis. A copy shall be held by the Contractor and an electronic copy forwarded to ARTC. A hardcopy list of all file names with dates and data storage references shall be forwarded to ARTC.

#### **1.7.5.5. Rail Surface Roughness and Impact Exceedence Analysis**

- (a) The Contractor shall deliver the following hard copy outputs:

- Line Section Summary (Impacts on a per km basis)
- Comparison with previous year of roughness 10 km summary (both rails combined)
- Roughness 10 km summary (Left and Right comparison)
- Roughness 1 km summary (Left rail only)

- Roughness 1 km summary (Right rail only)
- Roughness 50 m summary (Left rail only)
- Roughness 50 m summary (Right rail only)
- Impact 1 km comparison with previous year (Both rails)
- Roughness comparison of all previous runs 10km summary (both rails combined) for previous runs as agreed with ARTC.

(b) Electronic Format

The plotted data spreadsheets shall be supplied in electronic format as Excel spreadsheets or similar.

(c) Backup of raw data and computer files

The data files created during the measuring run shall be saved and stored electronically for permanent storage and any later or offboard analysis. A copy shall be held by the Contractor and an electronic copy forwarded to ARTC. A hardcopy list of all file names with dates and data storage references shall be forwarded to ARTC.

**1.7.5.6. Ultrasonic Test Car**

(a) Output

The Nominated Contractor if required by ARTC shall:

1. Transmit during the test run to the Chase vehicle via Contractor supplied Modem and Laptop PC.
2. Deliver at the completion of the test run electronic data files the following information:
  - Raw data files (All reflections as detected by vehicle)
  - System detection level parameters (Pulse Count, Sensitivity levels and Calibration settings)
  - B Scan, or digital data processed into visual plots of all reflections
  - Summary of all reflections (Non Significant Defect, suspected flaw as determined by ARTC, Other reasons such as loss of signal)
  - All plotted data in electronic format as Excel spreadsheets or similar.

(b) Backup of raw data and computer files.

The data files created during the flaw detection run shall be saved and stored electronically for permanent storage and any later or offboard analysis. A copy shall be held by the Contractor and an electronic copy

forwarded to ARTC. A hardcopy list of all file names with dates and data storage references shall be forwarded to ARTC.

- (c) The Area Maintenance Management Contractor shall provide an on board representative during all Ultrasonic Test Car runs.

**1.7.5.7. New Welds**

All new welds shall be ultrasonically tested within 90 days of production. Refer to Clause 1.4.8 for assessments and responses for defects.

New weld geometry shall comply with ARTC Standard ETM-01-01 Rail Weld Geometry Standard.

**1.7.5.8. Standard following rail rectification**

- (a) Following Rail Rectification the following finished work standards shall be achieved:

| PARAMETER  | COMPLETION STANDARD FOLLOWING GRINDING  | COMPLETION STANDARD FOLLOWING BENDING AND STRAIGHTENING  |
|--|---|--|
| Longitudinal Roughness in Wavelength of 150 to 1500mm  | No 5 metre track section to have a Standard Deviation of greater than 0.1mm RMS<br><br>95 % of all 5 metre sections over 200 metres to achieve a Standard Deviation better than 0.08mm RMS.<br><br>65 % of all 5 metre sections over 200 metres to achieve a Standard Deviation better than 0.06mm RMS. | No 5 metre track section to have a Standard Deviation of greater than 0.15mm RMS<br><br>95 % of all 5 metre sections over 200 metres to achieve a Standard Deviation better than 0.12mm.<br><br>65 % of all 5 metre sections over 200 metres to achieve a Standard Deviation better than 0.08mm. |
| No uncorrected dipped or peaked welds are to be left in track that exceed                        | 0.5 mm peak over a 1 metre reference length.<br><br>All welds where ballast disturbance is evident are to be treated  | 0.2 mm dip over a 1 metre reference length.<br><br>All welds where ballast disturbance is evident are to be treated  |
| Treated Dipped, Peaked and laterally misaligned welds  | All dipped and peaked welds that are treated are to have finished profiles as specified in Clause 1.2.4, table 1.10 and notes   | All dipped and peaked welds that are treated are to have finished profiles as specified in Clause 1.2.4, table 1.10 and notes  |
| The Contractor shall achieve the following impact exceedence count as assessed in Clause 1.7.5.6 | No more that 5 impacts per track km of 30 ms <sup>-2</sup> .  | No more that 10 impacts per track km of 45 ms <sup>-2</sup> .  |

- (b) Cross sectional rail profile



The specified cross section rail profile shall be achieved on all track that is either fully or partially correctively treated, or is maintenance ground. The finished profile shall be within 0.2mm of the specified design profile.

(c) Visual appearance: acceptance criteria

The maximum facet widths shall be:-

- 4mm on the gauge corner
- 7mm on the shoulder
- 10mm within 10mm of the crown.

The maximum variation in facet width over a 100mm length of rail shall be 25% of the maximum width of the facet. The reprofiling shall blend smoothly into the parent rail.

There shall not be continuous blueing of the reprofiling zone.

**1.7.5.9. Measurements Following Mechanised Grinding**

The following measurements to be taken of the Rail Head:

- Cross sectional profiles of the rail head to an accuracy of 0.1mm
- Longitudinal profile of wavelengths between 150 and 1500mm or other wavelengths as specified and as agreed with ARTC
- Grind stone Facet Widths - by direct measurement
- Tracking band Location - by direct measurement
- Tracking band Width - by direct measurement

**1.7.5.10. Rail Discontinuities Assessment**

Table 1.15B below gives limits and responses below which unnecessary damage may be caused to track and rolling stock.

**Table 1.15B  
WELDED RAIL DISCONTINUITIES (BASE OPERATING STANDARD)**

| Factor   | In track discontinuities greater than | Response  |
|--|---------------------------------------|---|
| Peak in running surface                                  | 4 mm over 1 m                         | Remove or speed restrict prior to passage of next train |
| Dip in running surface                                   | 4 mm over 1 m                         |   |
| Gauge widening due to change in rail                     | 4 mm over 1 m                         |   |
| Gauge narrowing due to change in rail                    | 4 mm over 1 m                         |   |
| Vertical deviations in rail running surface (Ramp angle) | 20 milliradians [Note 2]              |   |

**NOTES:**

- [1] *Imposition of site specific speed restrictions should be considered when defects are detected at or near the above limits.*
- [2] *Measured with a dipped weld gauge over 100mm, over the full extent of grinding of the weld.*

**1.7.5.11. Visual Inspection of Temporary Joints**

Visual inspection of temporary joints shall be carried out by a close visual and physical examination of the temporary joint(s).

The inspection shall look for suspected defects including:

- Broken Bolts
- Loose Clamps
- Cracked or Broken Plates
- Excessive vertical deformation
- Excessive Rail End Batter
- Track Circuit Bond Failure
- Other obvious defects or missing components

**1.7.5.12. Guard Rail Assessment**

Repairs or reinstatement works of defects in guard rails shall only be carried out by agreement with ARTC following a site specific risk assessment looking at the necessity for retaining guard rails at the site.

If the risk assessment (carried out jointly between ARTC and the Contractor) indicates that the guard rails are unnecessary, they shall be removed.

Note that all guard rails on bridges in Victoria have been removed.

**1.7.5.13. Assessment of Insulated Joint Defects**

In addition to the requirements of Clause 1.4.8, Tables 1.14 and 1.16, insulated joints will be assessed as follows:

**Table 1.21 METAL FLOW ACROSS JOINT**

| <b>DEFECT SIZE</b>     | <b>RESPONSE TIME</b>                   | <b>ACTION</b>                                  |
|------------------------|--|--|
| Gap greater than 4 mm  | <b>None</b>                            | No action                                      |
| Gap between 2 and 4 mm | 90 days                                | Reassess, repair by grinding or replace joint. |
| Gap less than 2 mm     | 14 days                                |  |
| No Gap                 | Prior to the passage of the next train |  |

Insulated joints should be replaced when the insulation has broken down to a level that prevents track circuits from functioning reliably.

### 1.7.6 Insulated Joint Assemblies

Only insulated joint assemblies in accordance with AS1085.12 shall be used and shall incorporate swage lock fastenings. Rail ends shall be angle cut at 15 degrees from normal. See below.

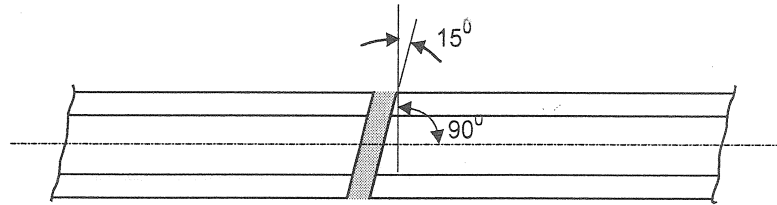


Figure 1.2 – Rail End angle

The centre of the insulated joint is to be located within 700 mm of design location.

### 1.7.7 Rail - Other Specification Clauses

#### 1.7.7.1. Replacement of defective rails and welds

The Contractor shall select the site for closure rail insertion, ensuring conservation of rail. One end of the closure rail shall be located centrally between sleepers at a point one sleeper spacing away from defect.

#### 1.7.7.2. Mechanical Joints

##### (a) Installation

Where the installation of mechanical joints is required the joints shall:

- Be no closer than 9 metres to any other mechanical or insulated joint
- Include electrical bonding across the mechanical joint in electrically circuited track.

New mechanical joints or joints that have been repaired should have all bolts fully tightened, and a maximum dip of 1mm over 1 metre, measured with a straight edge.

##### (b) Servicing

Where mechanical rail joints are not functioning or they are frozen, lubrication of fishing surfaces shall be carried out, depending on local conditions, by loosening off the fishbolts and spraying grease into the gap between the fishplate and rail.

#### 1.7.7.3. Temporary Joints and Fishplates

Temporary joints are those intended for the temporary joining of rails to permit the short term passage of trains at reduced speed and requiring special inspections when in use. Temporary joints shall have a speed restriction of 30km/h or less imposed.

Temporary joints consist of clamped fishplates (for example "G" clamps) and are used to join broken or cut rails. This type of assembly may be secured additionally by fishbolt(s) if suitable hole(s) are present in the rail. They shall only

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to be used under the following circumstances:

- (i) To permit the passage of trains during work possessions.
- (ii) To plate broken rails or welds including those from rail profile rectification work.

The following temporary joint elements may be used as appropriate:

- (i) Clamped straight for vertical breaks
- (ii) 100 mm long machine cut rail inserts are to be used for breaks caused by vertical crowing and defects such as bolt hole cracks.

Where electrical bonding is provided for temporary joints in electrically circuited areas it shall be installed such that it fails if the temporary joint fails.

Temporary fishplates (for example bow plates) shall only be used to plate defective rails or welds or as required as a precautionary action.

*NOTES:*

[1] *Short rail sections (e.g. inserts and cobs) may be used within temporary joints during relaying.*

[2] *Temporary fishplates should not remain in place once the weld has broken.*

#### **1.7.7.4. Rail and Rail Weld Defect Marking**

Rail and rail weld defects (Existing and New) shall be marked on the rail web in paint based marker the defect number, classification and sizing.