

9.6 G9821 Derailed Wagon Inspection Record

DERAILED WAGON INSPECTED AND
CERTIFIED FIT TO TRAVEL AT
REDUCED SPEED 40 KPH INTO YASS
TO BE DETACHED FOR REPAIRS TO
BE CARRIED OUT
INSPECTED BY COSTA MUNDRA
F.R.L.

9.7 WTSA Results for Location 305.650km

prior to misalignment & following surfacing works

| Date of Analysis 17/10/2002 | | 10044 Main South Dow. | | | | | | | | | | Date of P2 | | Date of P3 | | Major Factor | | Work done / Signature / Date | |
|-----------------------------|--------|-----------------------|--------------|----------|------------------|--------|-----|--------|--------|------|------|-----------------|------|------------|-------|--------------|-------------|------------------------------|--|
| Km | Joint | Stability Loss % | Ballast Crib | Shoulder | Disturbance Time | Tonnes | Tci | Anchor | % Loss | Up | Dn | Rail Temp Error | Up | Dn | Align | Other | LF | | |
| Priority 3 | | | | | | | | | | | | | | | | | | | |
| 321.00 | CWR | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 15.1 | 12.1 | -6.3 | -5.1 | 0.3 | 0 | 1.04 | Up Rail | | |
| 288.00 | CWR | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 8.2 | 14.6 | -1.7 | -4.3 | -1.5 | 0 | 1.11 | Dn Rail | | |
| 300.00 | CWR | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 8.1 | 14.5 | -2.6 | -5.1 | -0.6 | 0 | 1.14 | Dn Rail | | |
| 302.00 | CWR | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 15.2 | 6.6 | -3.4 | 0 | -2.6 | 0 | 1.19 | Up Rail | | |
| 290.50 | CWR | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 10.9 | 10.1 | -3.1 | -2.7 | -1.2 | 0 | 1.19 | Up Rail | | |
| 308.00 | CWR | 26 | 0 | 20 | 0 | 0 | 0 | 0 | 2 | 0 | 0.2 | 3.4 | -0.9 | 0.8 | 0 | 1.16 | Shoulder | | |
| 258.50 | CWR | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 8 | 10.1 | 0.9 | 0 | -4.0 | 0 | 1.24 | Dn Align | | |
| 312.50 | CWR | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4.4 | 17.3 | -1.7 | -6.8 | 0 | 0 | 1.04 | Dn Rail | | |
| 326.00 | CWR | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4.4 | 13 | 0 | -3.4 | -1.7 | 0 | 1.27 | Dn Rail | | |
| 262.50 | CWR(c) | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14.5 | 14.5 | 0 | 0 | -5.7 | 0 | 1.24 | Up Align | | |
| 270.00 | CWR | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 8.9 | 8.9 | -1.7 | -1.7 | -1.8 | 0 | 1.24 | Up Align | | |
| 281.00 | JWR | 24 | 0 | 0 | FOUL | 10 | 10 | 8 | 2 | 0 | 0 | 7.7 | 2.2 | 0 | 0 | 1.19 | Disturbance | | |
| 315.50 | JWR | 24 | 0 | 0 | FOUL | 10 | 10 | 0 | 2 | 8.2 | 0 | -2.5 | 3.8 | 0 | 0 | 1.16 | Disturbance | | |
| 316.00 | JWR | 24 | 0 | 0 | FOUL | 10 | 10 | 0 | 2 | 5.4 | 3.1 | -1.6 | -0.9 | 0 | 0 | 1.16 | Disturbance | | |
| 325.00 | CWR | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 14.6 | 1.8 | -4.3 | 0.9 | -1.5 | 0 | 1.27 | Up Rail | | |
| 325.50 | CWR | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 8.2 | 8.2 | 1.7 | 1.7 | -4.9 | 0 | 1.27 | Up Align | | |
| 264.00 | CWR(c) | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13.4 | 13.4 | 0 | 0 | -5.3 | 0 | 1.24 | Up Align | | |
| 290.00 | CWR | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 11.1 | 5.5 | -2.2 | 0 | -2.2 | 0 | 1.19 | Up Rail | | |
| 304.50 | CWR | 22 | 0 | 0 | 0 | 0 | 1 | 2 | 6.7 | 8.9 | 4.3 | 3.4 | -6.9 | 0 | 0 | 1.16 | Dn Align | | |
| 271.00 | CWR | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 12.5 | 3.5 | -2.6 | 1.0 | -2.4 | 0 | 1.19 | Up Rail | | |
| 276.50 | JWR | 21 | 0 | 0 | FOUL | 10 | 10 | 0 | 2 | 7.3 | 0 | -2.2 | 1.6 | 0 | 0 | 1.11 | Disturbance | | |
| 249.50 | CWR | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 10.8 | 6.5 | -4.3 | -2.6 | 0 | 0 | 1.04 | Up Rail | | |
| 257.00 | CWR | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2.2 | 13 | -0.9 | -5.1 | 0 | 0 | 1.16 | Dn Rail | | |
| 283.00 | JWR | 20 | 0 | 0 | FOUL | 10 | 10 | 4 | 2 | 0 | 0 | 2.4 | 4.3 | 0 | 0 | 1.24 | Disturbance | | |
| 291.50 | CWR | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2.8 | 12.2 | 1.7 | -2.1 | -2.8 | 0 | 1.16 | Dn Align | | |
| 252.50 | CWR | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 11.9 | 3.3 | -2.6 | 0.9 | -2.1 | 0 | 1.09 | Up Rail | | |
| 265.50 | JWR | 19 | 0 | 0 | FOUL | 10 | 10 | 0 | 2 | 0 | 3.5 | 1.7 | -1.1 | 0 | 0 | 1.24 | Disturbance | | |
| 280.50 | JWR | 19 | 0 | 0 | FOUL | 10 | 10 | 4 | 2 | 0 | 0 | 7.8 | 8.2 | 0 | 0 | 1.19 | Disturbance | | |
| 281.50 | JWR | 19 | 0 | 0 | FOUL | 10 | 10 | 3 | 2 | 1 | 0 | -0.3 | 2.2 | 0 | 0 | 1.19 | Disturbance | | |
| 300.50 | CWR | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 11 | 4.5 | -4.3 | -1.7 | -0.1 | 0 | 1.07 | Up Rail | | |
| 309.50 | CWR | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 10.3 | 6 | -3.4 | -1.7 | -0.6 | 0 | 1.04 | Up Rail | | |
| 282.50 | JWR | 18 | 0 | 0 | FOUL | 10 | 10 | 2 | 2 | 0 | 5.3 | 2.2 | 0 | 0 | 0 | 1.27 | Disturbance | | |
| 296.50 | CWR | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 13.1 | 0 | -5.1 | 0.9 | -0.1 | 0 | 1.19 | Up Rail | | |
| 289.00 | CWR | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 12.9 | 7.0 | -3.4 | -1.7 | 0 | 0 | 1.16 | Dn Rail | | |
| 289.50 | CWR | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 12.4 | 0 | -2.6 | 3.1 | -2.3 | 0 | 1.16 | Up Rail | | |
| 305.50 | CWR | 17 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 11 | 6.0 | 0.9 | -5.2 | 0 | 1.24 | Dn Align | | |
| 248.50 | CWR | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 6.5 | 6.5 | -2.6 | -2.6 | 0 | 0 | 1.04 | Up Rail | | |

9.8 Yass Junction Misalignment Reports (Form 1 & 2) – 305.650km

Yass Team.

Misalignment Report (Form 1)

Rail Infrastructure Corporation.

| | | | | | |
|--|---------|---|---|-----------------|-----------|
| 1. Bundle: | | 2. Sector Code: | 611 | 3. Date: | 19-Nov-02 |
| 4. Main Southern Line Between : | Jerrawa | And: | Yass Junction. | | |
| 5. Kilometrage: | 305.650 | 7. Method of Detection: | Infrastructure Worker (1), Train Crew (2), Team Manager/Leader (3), Other (4). | | 2 |
| 6. Track: Single (1), Up Main (2), Dn Main(3), Up Sub(4), Dn Sub(5), Crossing Loop (6), Up Local/Relief (7), Dn Local/Relief (8), Siding or Refuge (9). | 3 | 10. Misalignment Description: | | | |
| 8. Time Detected (24 hour clock): | 1510 | Length. | 0-5m (1), 5-10m (2), 10-20m (3), Over 20m (4). | | 4 |
| 9. Reported To: | 3 | Displacement. | 0-20mm(1), 20-50mm (2), 50-100mm (3), Over 100mm (4). | | 4 |
| 11. Radius: 0-400m (1), 401-800m (2), 801-1600m (3), Over 1600m (4), Straight (5). | 1 | 12. Rail Section (kg. Per metre): | | | 53 |
| 13. Rail Length: Less than 13.7m (1), 13.7-55m (2), 55-110m (3), 110-220m (4), 220-550m (5), Over 500m-CWR (6). | 6 | 14. Sleeper Type: | Timber (1), Steel (2), Concrete (3), Timber & Steel (4). | | 4 |
| 15. Fastenings: Dogspikes, Sleeper Plates, Lockspikes (1), Dogs, no Plates (3), Pandrol Clips (4), Other Resilient Fastenings (inc. steel clips) (5). | 1,2 | 16. Sleeper Condition: | Good for 5 years or more (1), Split (2), Broken or Rotten (3), Other (4). | | 2 |
| 17. Anchor Pattern: | 2,4 | 18. Ambient Temperature: | Actual (1), Estimated (2). | | 1 |
| 19. Rail Temperature (degrees Centigrade): | 51 | | Temperature, (degrees Centigrade). | | 35 |
| 20. Track Disturbance: | 3 | 27. Welded Track Stability Analysis: | | | |
| Fettling (1), Manual Resleepering (2), Surfacing (3), Tie and Surfacing (4), Ballast Cleaning (5). Last Occasion: 16th October 2002. | 2 | | | | |
| 0-1 Mth (1), 1-2 Mths (2), 2-3 Mths (3), Over 3 Mths (4). | | | | | |
| 21. Ballast: | N | | | | |
| Shoulder Deficiency (Y/N). | N | | | | |
| Crib Deficiency (Y/N). | N | | | | |
| 22. Rail Adjustment: Is rail out of adjustment? (Y/N). | N | | | | |
| 23. Rail Creep: Have rails crept? (Y/N) | N | | | | |
| 24. Anchors: Were any anchors ineffective? (Y/N). | N | | | | |
| 25. Fastenings: Were any fastenings ineffective? (Y/N). | N | | | | |
| 26. Alignment: Was track off its correct alignment? (Y/N) | N | | | | |

Apparent Causes: Weak track structure, poor sleeper condition, foul ballast (typical), some round holed sleeper plates without lockspikes.

Corrective Action Taken (to restore traffic): Track lined by Tractor, opened at 10kph speed restriction.
3 joints cut into each rail (steel removed), track now SHORT of steel.

Steel Removed, Up Rail (mm): 70mm (plus 65mm total at 3 gaps)

Down Rail (mm): 65mm (plus 50mm total at 3 gaps)

Speed Restriction Imposed (km/hour): 20/20kph.

Rail Temperature (oC): 44

Train Delays: Numerous: see telegram.

Further Corrective Action Proposed: Track to be tied 1 in 4 with low profile concrete sleepers next financial year.

Comments: Pacific National Train #9821 derailed on this site. It was travelling at 72kph at the time (under the Normal 75/80 Speed for the location).
Other Trains are known to travel OVER the track speeds, and I consider this to be a factor in reducing stability at this (and other) locations.

Team Manager / Team Leader: **Date:** 25-Nov-02

Maintenance Manager: **Date:**

Yass Junction Misalignment Report (Form 2) – 305.650km

RAIL INFRASTRUCTURE
CORPORATION

Misalignment Investigation Report

Report date: 25/11/02
 Misalignment date: 19/11/02
 Bundle: South West
 Location: 305.650km, Down Main, between Jerrawa and Yass.
 Cause of misalignment as per Misalignment Report: Poor Track Structure.

| Investigation of systems & processes: | Yes/No/Not Applicable |
|--|-----------------------|
| Undetected instability site | |
| Inspection | |
| Have all Welded Track Stability inspections been completed? | Yes |
| In the case of non-welded track, have inspections been undertaken in conjunction with track patrol (as per C.2532)? | N/A |
| Are there errors in the basic information supplied in the inspection reports compared to the field information gathered at the time of the misalignment? | No |
| Has the inspecting officer performed satisfactorily when carrying out his inspection duties with respect to welded track stability? | Yes |
| Do the Standards and Procedures adequately provide for inspection in the case of this misalignment? | Yes |
| Has routine track patrol been effective? | Yes |
| Has the controlling officer provided adequate supervision to the welded track inspection program as specified in the standards? | Yes |
| Analysis | |
| Was there a Welded Track Stability Analysis completed for this section of track prior to the summer? | Yes |
| Was there any alternative analysis or assessment completed? | Yes, after Tamping |
| Has the welded track stability analysis been properly computed? | Yes |
| Does the analysis as per the Standards properly provide for the situation in this case? | Yes |
| Have the analysis results been properly interpreted by field staff for this location? | Yes |
| Was Secondary Analysis required at this location? | No |
| If so, what was the action proposed appropriate? | |
| In the case of non-welded track, were high risk locations identified prior to summer? | |
| Assurance | |
| Has this location been subject to previous misalignment in the past three years? | No |
| If so, was there special attention given to the inspection and analysis of the site prior to the summer period? | N/A |

| Investigation of systems & processes: | Yes/No/Not Applicable |
|---|---|
| Uncorrected Instability Location | |
| Elimination | |
| Did this location appear on a list of priority instability location for attention? | No (only 17% WTSA) |
| Had this location received any attention for the purpose of reducing the level of instability? | N/A |
| If not, was there a plan or program on hand to address the problem at this location? | N/A |
| Was the program as competently drawn, addressing priorities in sensible order? | Yes |
| If on the case of ballast deficiencies, was there a ballasting program and a programmed date of delivery? | N/A |
| If programs of elimination were late, are the reasons acceptable? | N/A |
| Site Protection | |
| If the site was an identified priority location, were standard precautions enforced to restrict the speed of services across the site at the time of the misalignment? | N/A |
| Was a WOLO condition applied at the time of the misalignment? | Not to this Train |
| If so, was a train speed still a factor? | No |
| Was the staff response to the identified misalignment satisfactory? | Yes |
| Was track patrol adequate for the location at the time of the misalignment? | Yes (doing Heat Patrol at time of misalignment) |
| Poor Work Performance | |
| Procedures | |
| Was the misalignment related to work at the site prior to or on the day of the misalignment? | No |
| Were there adequate written instructions to staff outlining the procedures to be adopted for hot weather maintenance? | Yes |
| Was there a variation to normal hot weather procedures applied in this case? | No |
| Was any such variation properly issued in writing? | N/A |
| Were the standard procedures as they were applied in this situation adequate for the purpose? | Yes |
| Training | |
| Can the incident be directly related to the sub-standard performance by member of staff operating within the maintenance system? | No |
| <ul style="list-style-type: none"> Were the staff involved in inspection work and routine track patrol at this site adequately briefed in their duties? | Yes |
| <ul style="list-style-type: none"> Has there been adequate opportunity for staff to be trained in the skills for inspection or maintenance prior to the current summer period? | Yes |
| Supervision | |
| Has there been a breakdown in supervision at any level in the maintenance process? | No |
| Production Work | |
| Has all production work in the area been completed according to standard? | Yes |
| Has there been adequate communication between production and maintenance staff? | Yes |

| <i>Investigation of systems & processes:</i> | <i>Yes/No/Not Applicable</i> |
|--|------------------------------|
| Incorrect Rail Adjustment | |
| Have tests shown that the rail was out of adjustment? | No |
| Was the degree of adjustment forecast by the Welded Track Stability Analysis? | Yes |
| Has the adjustment of rails in this section been properly executed and managed? | Yes |
| Are creep marks for CWR track properly maintained? | Yes |
| Has there been any recent rail welding work at or near the misalignment site? | No |
| Has this work been properly carried out with respect to rail adjustment? | N/A |
| Nomination of Responsibilities: | |
| Have all reasonable steps or precautions been taken in a responsible manner in accordance with the standard practices applicable at the time to control the heat buckling hazard? If not, the nominated responsibilities are: | Yes |
| Recommendation | |
| <p>With a view to preventing future misalignments of the type which has occurred in this case: Track has misaligned in 1998 and 1994, both times at 34o ambient. This is a known "Hot Spot"</p> <hr/> <p>Wolo was applied, however Train 9821 had departed Goulburn a few minutes prior to the WOLO Being applied. The misalignment was due to generally weak track structure (poor sleepers, Poor ballast condition, weak fastenings (some round holed plates). Adjustment and alignment Were correct at time of misalignment, and ballast profile was good. Long term, concrete sleepers And new ballast will prevent this type of misalignment. In the short to medium term, "Hot Spot"</p> <hr/> <p>Speed Restrictions are needed at an appropriate forecast ambient temperature. In this case, a Speed Restriction would need to be applied on days forecast for 30oC or more. Train speed is a Factor also (not the train which derailed), but many other trains over a long period. Operators Must ensure trains comply with posted speeds, in order to control lateral force on tracks, which Have a destabilising effect on Track Structure.</p> | |

9.9 Post Misalignment Track Structure and Adjustment Records

309.704 → 7. TP
100 metres post
limit weld

| ACTION REQUIRED |
|--|
| Measure Gaps/Temps + Analyse Adjustment |

305.500 DOWN : LF = 1.24

- WISA Lining 24.11.02.
- Ballast OK (profile)
- Foul Ballast ✓ Line O.K ✓
- Now has joints cut in. I have
emailed [redacted] to change
INTERDATA from CWR → JWR.
- However, until changed,
Use : Zero Creep (track is now start of
steel).
Line : O.K.

no steel.

UP

| Station | Gap | Temp |
|---------|-----|------|
| 305.625 | 37° | 31mm |
| 305.760 | 38° | 23mm |
| 305.920 | 38° | 28mm |
| 305.620 | 37° | 46mm |
| 305.740 | 38° | 26mm |
| 305.900 | 38° | 29mm |

- Add : sharp elbow / alignment
(C.T.P. at 305.658
Radius changes from 322 → 805 metres).

Measured
24.11.02

WISA ⇒ 46% Priority #2

Will reduce → 01.12.02 → 34%
→ 22.12.02 → 27%.

[redacted]

9.10 Bureau of Meteorology -Yass Forecast temperatures at on 19 November 2002

IDN10061

SOUTH EAST DISTRICTS FORECAST

BUREAU OF METEOROLOGY

NEW SOUTH WALES REGIONAL OFFICE

Issued at 5:41am on Tuesday the 19 of November 2002

SOUTHERN TABLELANDS

Tuesday

High to Very High Fire Danger.

Isolated afternoon showers and the chance of thunderstorms. Very warm to hot.

North to northwest winds.

Goulburn for Tuesday

Chance of an afternoon shower/thunderstorm. Hot. Light to moderate north to northwest winds.

UV Index 12 [Extreme].

Max: 32

UPDATED

SOUTHERN TABLELANDS

Tuesday

High to Very High Fire Danger.

Isolated afternoon showers and the chance of thunderstorms. Very warm to hot.

North to northwest winds.

Goulburn for Tuesday

Chance of an afternoon shower/thunderstorm. Hot. Light to moderate north to northwest winds.

UV Index 12 [Extreme].

Max: 32

Precis and temperatures for Tuesday

Goulburn : Chance late shower/thunderstorm.

Max: 32

Cooma : Chance late shower/thunderstorm.

Max: 32

Forecast issued daily at 0515, 1135 and 1625

9.11 Applicable WOLO Rail Infrastructure Corporation Safeworking Units as at 19 November 2002

9.11.1 SFM 118 Warning to driver – Condition affecting the line SWF.W.5300

Administrative details [b]

The warning to driver - Condition affecting the line form is compiled by Signallers, Train Controllers, or safeworking employees and is issued to Drivers of trains or Observers or traffic officers in charge of track vehicles operating as a train which requires to travel over the affected running line.

9.11.2 SWU 720 Warning Drivers on an SWF.W5.300 “Warning to driver – condition affecting line” form

Introduction [a]

- When drivers of trains have to be informed of a condition affecting or likely to affecting or likely to affect the safety of the line or their train, they must be warned of the potential dangers by the issue of an SWF.W5.300 “Warning to driver – condition affecting line” form (“SWF.W5.300 form”).

An “SWF.W5.300 form” can be issued:

either by hand directly to the driver

or by transmitting by telephone or two-way radio to the Observer/observer or passenger services supervisor for issue to the driver

or, if the train is stationary, by transmitting by telephone or two-way radio directly to the driver.

9.11.3 SWU 721 Precautions to be taken during extreme weather conditions: heat, flood and snow

Heat [c]

- When temperature forecast by the Bureau of Meteorology or the surrounding temperature warrants any speed restrictions in each area with Class 2 or superior lines, the civil engineering manager for each is responsible for imposing WOLO speed restrictions on the affected section of line(s) as shown in SWU 722.

9.11.4 SWU 722 Introducing WOLO speed restrictions

Introduction [c]

This unit advises the instructions to be carried out during very hot weather when there is a risk that the track will buckle.

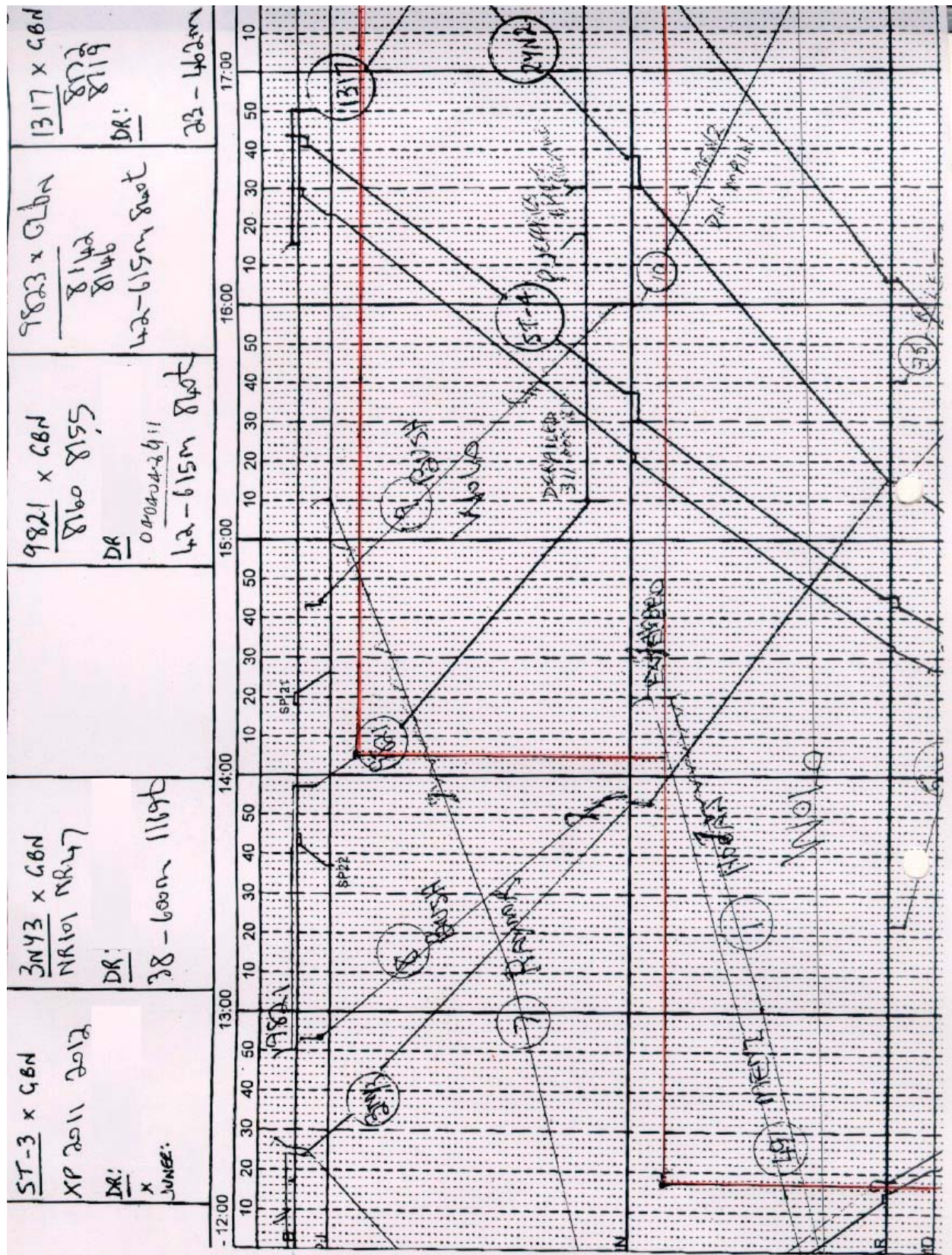
WOLO advice

[c]

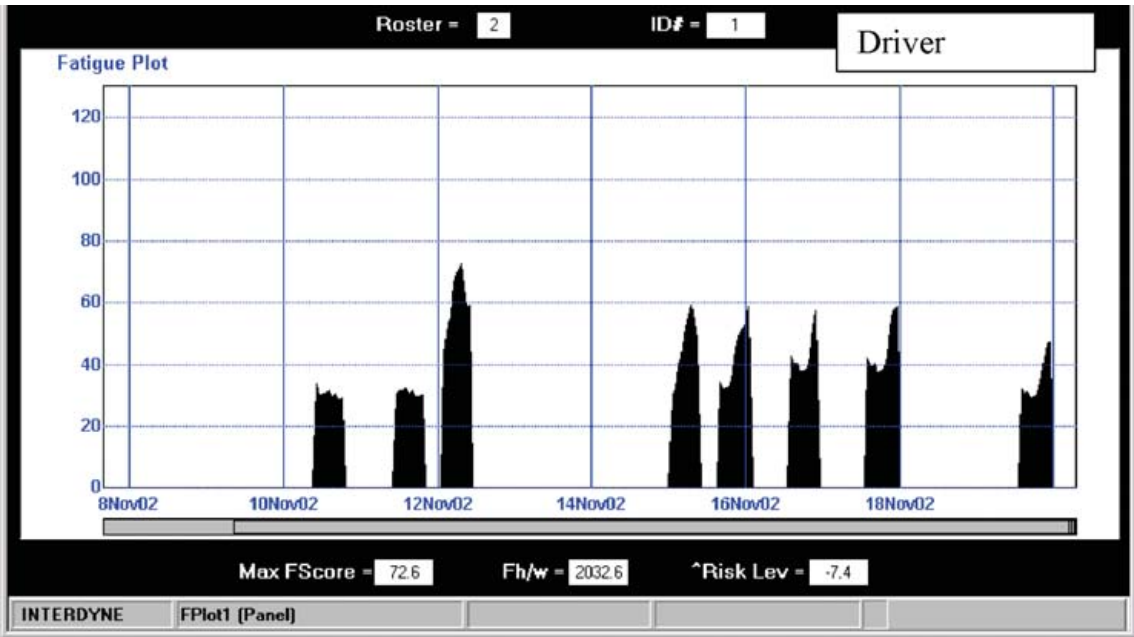
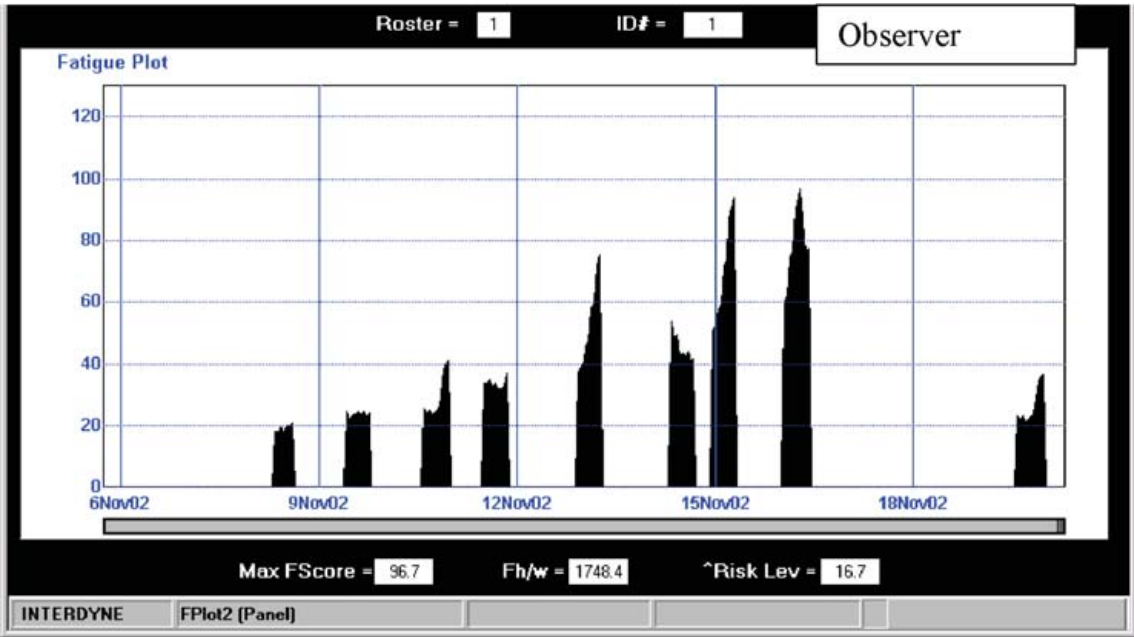
WOLO conditions are implemented, either manually by RIC or by means of automated monitoring equipment, when the air temperature reaches a pre-determined level.

- When an infrastructure maintainer determines that WOLO conditions are required in their area of control, a WOLO telegram must be sent to train controllers, signallers and operator representatives for the area concerned. Where possible, this should be by **1000hrs** and give full details of the lines affected.
- RIC must ensure that the train controller for the affected lines is in possession of the WOLO telegram by contacting the train controller via a recorded train radio or recorded telephone system.
- When WOLO conditions are implemented, the train controller for the affected area must ensure that signallers have received a copy of the WOLO telegram.
- Generally, employees receive advice of WOLO restrictions by:
 - WOLO telegrams
 - the display of WOLO warning boards
 - an SWF.W.5300 form
- Drivers who commence duty during WOLO restrictions are to receive written advice at sign-on locations before commencing their journey.
- When drivers cannot be advised by any one of the above methods, train controllers and signallers must arrange for all drivers travelling over the affected lines to be individually advised via a recorded train radio or recorded telephone system that WOLO restrictions are in force.

9.12 Train Graph Depicting G9821 and WOLO Entries



9.13 Driver and Observer FAID Fatigue Plots for two weeks prior to Derailment



9.14 Rail Painting Product Information

| |
|--|
| Residential Insulation |
| Commercial Insulation |
| Rail Line Insulation |
| Solacoat Data Sheet |
| Applying Solacoat |
| Asbestos Roofing Prep. |
| Company Profile |
| Customer Testimonials |
| Contact Us |

Testimonial

Mr. Robert Insch - Coca-Cola Bottlers.

The Alice Springs Branch warehouse was painted with Solacoat in 1989. It has made a great deal of difference in temperature within the working area. Also no stock losses due to cans blowing tops or bottles bursting has been experienced since Solacoat was used (Stock loss cost around \$10,000.00 a year).

Reducing Temperature of Rail Tracks

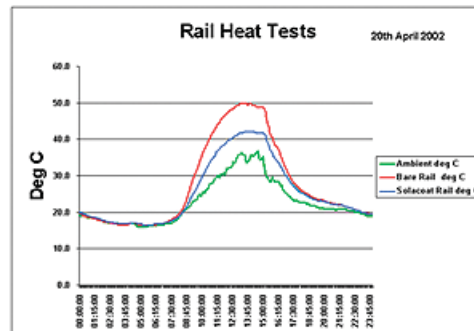
Heat Reduction in Railway Lines INNOVATION PATENT No.2001100356



Our involvement with the Rail Infrastructure Corporation of N.S.W. (RIC) began in October 2001 when we received an order for the supply and application of Solacoat to 10 Kilometres of rail track between Grafton and Kyogle.

Prior testing was initiated after we had painted the roof of the RIC Depot at Lismore and we suggested that Solacoat could reduce the temperature of the rail so as to prevent rail track misalignment.

Early testing showed that on a clear day and with the ambient temperature peaking at over 30°C, a railway track coated with Solacoat is more resistant to extreme temperatures than a bare rail.



In some cases reducing temperature by more than 16°C has been recorded.

Reduction of Rail Track Misalignment from Heat

In December 2000 the manager of the RIC (Rail Infrastructure Corporation of NSW) depot in Lismore asked us to give a quote to Solacoat the RIC depot in Lismore. They had a huge problem with heat from the roof, making working in the demountables and lunch area unbearable. Consequently we got an order and people could not believe how cool it was under the roof. Because of the extreme heat all the tools and tool boxes on the back of the RIC service vehicles would burn the user's hand and it was impossible to handle the tools or tool boxes without gloves. These were painted with Solacoat and the problem solved.



We suggested that Solacoat may help reduce the temperature of the rail track. We obtained some short off cuts of rail and started a series of tests using Unidata logging equipment. To prevent rust affecting the Solacoat we use a zinc primer base which has a specially developed rust inhibitor.

Early testing showed that on a clear day and with the ambient temperature peaking at 28°C the Solacoat had reduced temperature in the rail track by 7°C. Later tests show as much as 12°C difference. So impressed was the engineer in charge of the Rail Infrastructure Corporation of NSW (RIC) for the North Coast area that we received an order to spray around 10 kilometres of rail track between Grafton and Kyogle in October 2001.

Further trials have been sprayed with Solacoat. 20 kilometres in the Dungog area was completed in mid January 2003 and a further 20 kilometres in the Yass area in February 2003.

Please contact Solacoat for information on reducing internal temperatures.

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9.15 Aluminothermic Welds – Identification, recording and reporting RAP 5391 Standard Appendix 1

RAP 5391

RIC Engineering Practices Manual – Civil Engineering

Weekly Return - Aluminothermic Welding / Adjustment

APPENDIX 1

Note: Preprinted forms should be printed in "Foolscap"

| | |
|---------------|------------------------|
| Welder's Name | Welder's Signature |
| Licence No. | Welder's Home Station |
| Week Ending | Supervisor's Signature |

| |
|------|
| Date |
| Date |

| WELDER TO COMPLETE | | | | | | | | | | | | | | PERSON IN CHARGE OF ADJUSTMENT TO COMPLETE | | | | RAIL FLAW DETECTION OFFICER TO COMPLETE | | | | | | | | | |
|--------------------|------|-------------|-------|-------------|------------|-----------|--------------------|-----------|----------|------------------|------------------------|---------|-------|--|-------|--------------|----|---|-----------------|----------------------|--|---------------------|------|--------|--------------------------------------|--|--|
| Weld Location | | | | Weld Detail | | | | | | | | | | Adjustment Details | | | | Ultrasonic and Alignment Test | | | | | | | | | |
| Line No. | Date | Sector Code | Track | Km | Rail (U/D) | Rail Size | Weld Reason (Code) | Batch No. | Weld No. | Weld Type (Code) | Site Conditions /Codes | | | Steel in-Steel out | | Rail Temp °C | Km | Rail | | | | Team Leader to sign | Date | OK Y/N | Rail Fail No. OR Align't Failure No. | | |
| | | | | | | | | | | | Weld | Weather | Track | Before | After | | | Actual Gap mm | Required Gap mm | Add(A) or Remove (R) | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NOTES | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | Associated Work | | | | Signature | | Ultrasonic Operator | | | | | | | |
| | | | | | | | | | | | | | | Have welds been packed? | | | | YES NO | | Name | | | | | | | |
| | | | | | | | | | | | | | | Are rail ends & closures crowded to correct curvature? | | | | YES NO | | Signature | | | | | | | |
| | | | | | | | | | | | | | | Was track on design alignment when adjusted? If NO, attach Detailed alignment measurements | | | | YES NO | | | | | | | | | |

9.16 Rail Alignment Measurements at 305.650km on 20 November 2002

| Welded Track Stability Analysis Field Input Form : J.W.R. | | | Date: 20/11/02 | |
|---|----------------|----------------------|-----------------------|-----------------------|
| Track & Base Codes: Down/10044, Up/10047. | | | Name: [REDACTED] | |
| Km. | Alignment (mm) | Alignment Error (mm) | Track: Up <u>Down</u> | Signature: [REDACTED] |
| .000 | | | | |
| .020 | | | | |
| .040 | | | | |
| .060 | | | | |
| .080 | | | | |
| .100 | | | | |
| .120 | | | | |
| .140 | | | | |
| .160 | | | | |
| .180 | | | | |
| .200 | | | | |
| .220 | | | | |
| .240 | | | | |
| .260 | | | | |
| .280 | | | | |
| .300 | | | | |
| .320 | | | | |
| .340 | | | | |
| .360 | | | | |
| .380 | | | | |
| .400 | | | | |
| .420 | | | | |
| .440 | | | | |
| .460 | | | | |
| .480 | | | | |

| Ballast Deficiency (Tonnes per 20 metres) | | Tangent Creep (mm) (Show direction with "arrow") | |
|---|--|--|--|
| Crib: | | Up Rail: | |
| Shoulder: | | Dn Rail: | |

| | | |
|------------------------------|-----------------|-----------------------------|
| Effective Anchors: | Yes / No | Worst Alignment Error (mm): |
| Foul Ballast: | Yes / No | |
| Poor Formation: | Yes / No | |
| Pumping Joints: | Yes / No | |
| Steel Bridge > 39 mtrs: | Yes / No | |
| Sharp Alignment/Elbows: | Yes / No | |
| Rail Bunching Points: | Yes / <u>No</u> | |
| Bi-Directional Working: | No | |
| Braking Action: | Non | |
| Alignment Details Not Known: | Yes / No | |
| Creep Marks Missing? | Yes / No | |

| Resultant Tangent Creep: | | Tangent Creep (Show direction with "arrow") | |
|--------------------------|--------------|---|--|
| Up Rail: | Dn Rail: | Up Rail: | |
| _____ mm | _____ mm | Dn Rail: | |
| Plus/Minus ? | Plus/Minus ? | | |

| Km. | Alignment (mm) | Alignment Error (mm) | Ballast Deficiency (Tonnes per 20 metres) | Tangent Creep (mm) (Show direction with "arrow") |
|---------|----------------|----------------------|---|--|
| 305.500 | | | | |
| 520 | 1125 | -14 | | |
| 540 | 1120 | -9 | | |
| 560 | 1125 | -4 | | |
| 580 | 1120 | -9 | | |
| 600 | 1105 | +6 | | |
| 620 | 1111 | 0 | | |
| 640 | 1085 | -76 | | |
| 660 | 1190 | -79 | | |
| 680 | 1115 | -4 | | |
| 700 | 1100 | +11 | | |
| 720 | 1085 | +26 | | |
| 740 | 1111 | 0 | | |
| 760 | 1111 | 0 | | |
| 780 | | | | |
| 800 | 1111 | 0 | | |
| 820 | | | | |
| 840 | 1085 | +26 | | |
| 860 | | | | |
| 880 | 1100 | +11 | | |
| 900 | | | | |
| 920 | 1111 | 0 | | |
| 940 | | | | |
| 960 | 1100 | | | |
| 980 | 1120 | -9 | | |

| Ballast Deficiency (Tonnes per 20 metres) | | Tangent Creep (mm) (Show direction with "arrow") | |
|---|---|--|------|
| Crib: | 0 | Up Rail: | 38 ↓ |
| Shoulder: | 0 | Dn Rail: | 29 ↓ |

| | | |
|------------------------------|-----------------|-----------------------------|
| Effective Anchors: | Yes / <u>No</u> | Worst Alignment Error (mm): |
| Foul Ballast: | Yes / <u>No</u> | |
| Poor Formation: | Yes / <u>No</u> | |
| Pumping Joints: | Yes / <u>No</u> | |
| Steel Bridge > 39 mtrs: | Yes / <u>No</u> | |
| Sharp Alignment/Elbows: | Yes / <u>No</u> | |
| Rail Bunching Points: | Yes / <u>No</u> | |
| Bi-Directional Working: | No | |
| Braking Action: | Non | |
| Alignment Details Not Known: | Yes / No | |
| Creep Marks Missing? | Yes / No | |

| Resultant Tangent Creep: | | Tangent Creep (Show direction with "arrow") | |
|--------------------------|--------------|---|------|
| Up Rail: | Dn Rail: | Up Rail: | 16 ↓ |
| _____ mm | _____ mm | Dn Rail: | 24 ↓ |
| Plus/Minus ? | Plus/Minus ? | | |

Field Insp. & Secondary Analysis Sheets, Yass Team C.W.R..

Page 1 of 1.

ANCHORS MISSING IN SECA SECTION

9.17 Post Misalignment Rail Adjustment Calculations – December 2003

Adjustment Calculation Method 2 - check against rail gap measurements taken in Dec 03 which determined rail removed against gap measurements taken on 24/11

Assumptions / Provided Information

| | | | | | | | | | | | |
|--------------------------------------|------------|-----------|------------------|------------------|-----------------|--------------------------------|------------|-----------|------------------|------------------|-----------------|
| 1 Track measurements taken in Dec 03 | | | | | | Reference Rail temperature 48C | | | | | |
| Up Rail | Temp oC | Gap mm | Punch Marks B | Punch Marks A | Rail Removed | Down Rail | Temp oC | Gap mm | Punch Marks B | Punch Marks A | Rail Removed |
| | 48 | 10 | 8 | 7.975 | 35 | | 48 | 6 | 2 | 1.965 | 41 |
| | 48 | 10 | 2 | 1.975 | 35 | | 48 | 3 | 2 | 1.962 | 41 |
| | 48 | 3 | 2 | 1.959 | 44 | | 48 | 5 | 2 | 1.97 | 35 |
| Summary | 48.0 | 23 | | | 114 | Summary | 48.0 | 14 | | | 117 |

| | | | | | | | | | |
|---|------------|-----------|----------------|-------------------|--------------------------------|------------|-----------|----------------|-------------------|
| 2 Rail Adjustment Gap Measurements dated 24/11/02 | | | | | Reference Rail temperature 38C | | | | |
| Up Rail | Temp oC | Gap mm | Average Gap | Average Length | Down Rail | Temp oC | Gap mm | Average Gap | Average Length |
| | 37 | 46 | | | | 37 | 31 | | |
| | 38 | 26 | | | | 38 | 23 | | |
| | 38 | 29 | | | | 38 | 28 | | |
| Summary | 37.7 | 101 | 34 | 167 | Summary | 37.7 | 82 | 27 | 167 |

3 Rail at 35C on the correct alignment will be 500m in length.

Thermal expansion rate of steel = 1.15E-05

4 Up and Down rails were brought back into alignment following rectification works with rail being in correct alignment as measured on 24/11/02.

5 If the rail was in correct adjustment on 24/11, as stated by field staff, the total gap measurement at 38C should equate to the difference between the 114mm gap referenced at 35C and the increase in 500m rail length measured at the new gap rail temperature of 38C. The following calculation attempts to represent this correlation.

6 Thoretical calculation of change in total gap measurement with increase in temperature change from 35C to 38C

35 C

Up Rail

114mm

(total rail removed)

Down Rail

117

500m

38 C

Up Rail

97mm

{{114-17.25} = total rail removed - change in rail length with 3C increase in temperature}

Down Rail

99.75

500m

Length of rail expanded following 3C change in temperature = 500*1000*1.15x10-5*3C

17.25 mm

Remaining total gap between lengths of rail following change in temperature

Up Rail 97 mm

Down Rail 99.75 mm

7 Up Rail Actual gaps in rail at 38C with total gap measurement of 101mm

38 C

46mm

26mm

29mm

500m

8 Up Rail Adjustment error: Difference in theoretical gap and actual gap at 38C translates to an Up Rail adjustment error = 97 - 101mm = - 4 mm (up Rail). This difference approximates to an appeximate 1 C adjustment error where the rail neutral temperature would then be approximately 36C.

Down Rail Adjustment error: = 99.75 - 82mm = 17.75mm (Down Rail). This difference approximates to a 3C adjustment error where the rail neutral temperature would then be approximately 32C.