

RTSA SA CHAPTER NEWSLETTER

August 2010



NEXT MEETING: Rail Revitalisation – Signalling Outcomes for TransAdelaide

Joint meeting with the PWI and the IRSE.

Hosted by the IRSE at **Adelaide Oval**.

Koos Rohlandt, Signals and Communications Manager for TransAdelaide will be presenting on some of the Rail Revitalisation projects including the new Dry Creek Depot and new Computer Based Interlocking, the Seaford Rail Extension and immunisation of the Adelaide rail network for electrification.



Concept Image of Seaford Rail Extension (for illustrative purposes only)
http://www.dtei.sa.gov.au/infrastructure/seaford/seaford_rail_extension

TECHNICAL PRESENTATION

VENUE:

Gil Langley Room
Adelaide Oval Function
Centre
Memorial Drive
North Adelaide
SA 5006

DATE:

Thursday 2nd September
2010

TIME:

5.45pm (for 6pm start)

Cocktail Meal and
Refreshments to be
provided at 7pm, after the
presentation.

RSVP by 27 August to
Malcolm Menadue:

mmenadue@internode.on.net

See flyer for more
information.

The Railway Technical Society of Australasia (RTSA)

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CHAPTER MEETINGS 2010

Monday 27 September

Andrew McNaughton, Eminent Speaker CORE 2010
Creating the 21st Century Transport System of
Choice
Eminent Speaker Tour

Tuesday 5 October (lunchtime meeting)

Joint IRSE, RTSA and PWI Meeting
Paul Radmann, Thermit Australia

Thursday 4 November

Port Adelaide Viaduct
Ms Guillermina Perelmuter, DTEI

Tuesday 30 November

RTSA Annual Dinner and AGM
The Lion Hotel, North Adelaide

Publisher

This newsletter is a publication of the South Australian Chapter of the Railway Technical Society of Australasia. Opinions expressed within are not necessarily those of the Chapter, Society or Editor.

Contributions

Contributions, including news, opinions, or letters to the editor, are always welcome. Send material by e-mail to saeditor@rtsa.com.au

Continuing Professional Development

Engineers Australia members are reminded that attendance at RTSA technical meetings contributes towards CPD requirements. Each RTSA technical meeting generally has a value of 1 CPD point.

RTSA Website

The RTSA website www.rtsa.com.au has details of RTSA activities, including future meetings and reports from past meetings, for all Chapters. Membership information for potential new members and an application form may be found at www.rtsa.com.au.

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Newsletter Dispatch

Despatch of the newsletter is undertaken by Steve Torok. Contact Steve on storok@tge.com.au if you have any problems receiving this newsletter electronically or in hard copy, or to change your e-mail address.

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NEWS

Dr Ron Fitch Presentation

It was an absolute pleasure to welcome Ron Fitch to our August meeting where he was presented with a framed photo montage commemorating his long service to the Australian rail industry. Photos of this event can be seen at the end of this newsletter. Our thanks go to John Adams for arranging this wonderful gift for Ron. A fitting tribute to mark Ron's outstanding contribution to the rail industry.

Wheel / Rail Profiles on the Defined Interstate Rail Network

Our thanks to Carlyne Southern and Nick Petticrew for their very informative presentation at the August meeting on the lessons learnt from amending wheel and rail profiles on the Defined Interstate Rail Network. The slides from the presentation can be seen at the end of this newsletter.

COMING EVENTS

Core 2010 – Wellington, NZ

Core 2010 is almost upon us! A full conference program, together with the social and partners' program, are available for viewing on the website. Take a look at the website now <http://www.core2010.org.nz/> for more information and get booking!

AusRAIL 2010 – 23-25th November, Perth

This year AusRAIL will focus upon taking the industry forward through innovation,

modernisation and technology leadership. To find out more see the website www.ausrail.com

Another Date for the Diary!

In case you missed it on Page 2, the date for this year's AGM and Annual Dinner is **Tuesday 30th November** at a new venue, **The Lion Hotel, North Adelaide**. Please put the date in your diaries now for what will be a great social event!

LETTERS TO THE EDITOR

We were very pleased to receive a letter of thanks from **Dr Ron Fitch** following our presentation to him at last month's meeting. The full letter is published later in the newsletter along with some photos of the event. A lovely occasion I am sure you will agree! No other new correspondence to

raise this month, but if you have a comment or observation you would like to raise, the SA Editor would be pleased to hear from you at saeditor@rtsa.com.au

Get writing or typing now!

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CHAIRMAN'S CHATTER

NO 'thought for the month' this edition! I think many people, and certainly yours truly, have used up much of their deliberative energies following the events unfolding near Lake Burley Griffin...

Nevertheless this month I can reflect on last month's meeting and Dr Ron Fitch. This is illustrated elsewhere in the newsletter, but I think it deserves to be reiterated how fortunate we were to experience this unique engineer – addressing us with the enthusiasm and coherence of someone a fraction of his age.

My thanks again go to John Adams for his thoughtful words in presenting the Chapter's gift, which he also arranged – and I am pleased to say that Ron certainly seemed to appreciate our efforts (refer his letter of thanks).

IN other news, the RTSA Executive met in Sydney on 23rd July, where some interesting results to the Member Survey were discussed at length.

One key subject garnering a strong response was the apparent feeling that the RTSA should take a greater leadership role in the industry. I understand that a decision was made previously to focus on Professional Development, leaving lobbying to the ARA – but it was interesting to note that members nevertheless seemed a little unfulfilled in this regard.

THE Infrastructure Report Card has also recently been released by Engineers Australia. Railways in South Australia were categorised as C ('adequate').

It was considered that the "intrastate rail network has improved marginally in some areas, but the remainder of this network continues to wither. The interstate network has improved due to selective upgrades by the ARTC, but bottlenecks remain, particularly in the Adelaide Hills and metropolitan areas."

The bottlenecks identified on the ARTC network include Goodwood and Torrens Junctions - priority projects that have been assessed by Infrastructure Australia as 'Ready to Go'. ARTC is also investing in Crossing Loop extensions and has recently received a further equity injection from the Australian Government to re-rail the rail line from Whyalla to Broken Hill, allowing axle loads to increase from 23 to 25 tonnes.

It was also thought that "the metropolitan rail network has experienced a continual decline in service quality over the last five years", but that "the planned investments in metropolitan rail will arrest the trend of deterioration."

It is interesting to speculate that full concrete resleepering, electrification, a line extension to Seaford and expansion, renewal and refurbishment of the fleet ought do a bit more than just this.

Daniel Martucci – Chair, RTSA SA Chapter

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Presentation to **Dr Ron Fitch** in honour of his dedication and long service to the Australian rail industry and to mark the occasion of his recent **100th birthday!**

Mr Daniel Martucci

Chair RTSA

SA Chapter

Dear Daniel

I can not let the opportunity pass without formally expressing my appreciation to your Society's and especially your Chapter's action in honouring my recent birthday.

To this day I remain proud of the fact that virtually my whole life has been railway oriented. Consequently I deem the gesture a highlight, and would ask you to convey my deep appreciation to all of your members.

Kind regards

Sincerely

R.J.Fitch



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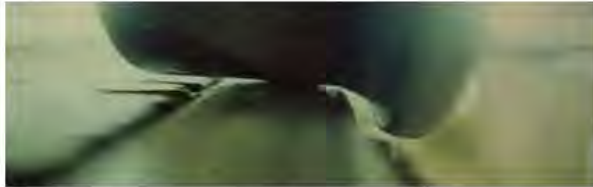
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Lessons Learnt from Amending Wheel and Rail Profiles on the Defined Interstate Rail Network

By Nick Petticrew and John Furness
And Carolyne Southern



Managing the Interface



"Above rail" meets "below rail" at the wheel to rail interface.

The key things we must get right are:

- Wheel stability - no excessive hunting
- Contact stresses
- Wheel and rail wear characteristics



Background



The shapes of wheel and rail profiles, in the new and worn conditions, have a major influence on:

- Wheel and rail wear (flange and gauge face).
- Wheel and rail contact fatigue defect development (spalling, shelling, etc).
- Wheel and rail plastic deformation (tread hollowing, corrugations, etc).
- Wheel/rail interaction and dynamic characteristics (hunting).
- Wheel/rail interaction noise.



Wheel Rail Interface Committee



Wheel Rail Interface Committee Began forming in 1998

Main study initiated in 1999, with the primary aim of developing generic wheel and rail profiles that can be used by:

- All the major network operators (State Rail, National Rail and FreightCorp)
- Rail Infrastructure Corporation (RIC) and Australian Rail Track Corporation (ARTC), WestNet Rail
- Aim was to improve wheel and rail life.



Wheel Rail Interface Committee



- Phase 1 - Development of project proposals by potential consultants and awarding of contract to BHP Institute of Railway Technology (2 months)
- Phase 2 - Review of current wheel and rail profiles (3 months)
- Phase 3 - Development of generic modified wheel and rail profiles (12 months)
- Phase 4 - Field assessment of modified wheel and rail profiles (9-12 months)
- Phase 5 - Full scale implementation of modified wheel and rail profiles (2-3 years)
- Phase 6 - Review of performance and possible refinement of modified wheel and rail profiles

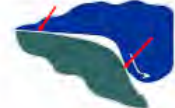


Wheel Rail Interface



2 Point Contact

- Produces excess creep (high wear rates and material flow)
- Undercuts any lubrication



Single Point Contact

- High contact stress
- Very damaging (RCF, Head Checks)



Conformal Contact

- Preferred option
- Lubrication film is maintained
- Harder to achieve



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Background

The main infrastructure and operating systems have used a range of wheel profiles running over a range of rail profiles, which lead to a range of wheel/rail contact conditions and interaction characteristics.

ANZR Wheel (General Freight) 2 point Improved Stability but Higher Wear

MQD 2 Wheel (Hunter Coal) Narrow conformal Lower Wear but Reduced Stability and Higher RCF Defects

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Project Outcomes

- One wheel profile to suit all traffic (Mod XX or WPR 2000). The profile features a “worn” wheel shape, good steering capability on curves to reduce wear, conformal contact to reduce RCF defects, and increased run-off to reduce tread hollowing.
- Two sets of rail profiles for curved track (< 1000 m radius):
 - One set applicable for mainly passenger or light axle load lines (<20 tonnes), with increased steering capability on sharp curves (H1 high rail and L1 low rail).
 - One set for mainly heavy duty traffic, with less steering capability, greater resistance to rolling contact fatigue damage (H2 high rail and L2 low rail), and greater allowance for hollow wheels.
- One rail profile for application to tangent track (TGT).

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ANZR1 vs WPR2000 shapes

The high conicity is designed to pull the high outer wheel from the high rail and reduce wear of both wheel and rail

The thickening of 6mm (3mm each wheel profile) in the gauge corner gives the wheel more conformal contact, with a side benefit of more wheel metal to wear away

The 1 in 10 conicity allows this profile to go around tighter curves than the ANZR1 profile without wheel creep

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Predicted Outcomes

Predicted wear improvements from modeling analysis:

For passenger traffic, in lines with high proportion of sharp curves

Current TP2 Vs ANZR -	20% reduction
WPR2000 Vs TP2 -	13% reduction
WPR2000/Mod rails Vs TP2 -	30% reduction

For heavy duty traffic

Mod 3 profiles	wheel flanging in curves with radii up to 1500m
Mod 2 profiles	wheel flanging in curves with radii up to 800m
WPR2000 profiles	wheel flanging in curves with radii up to 400m

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Some Assumptions Made By the Committee

New wheel and rail profiles have been designed for application for the standard gauge interstate network.

The new profiles will not only lead to clear and significant technical/ economic benefits, but for the first time will also lead to consistent profiles throughout the Systems.

Furthermore, the cost associated with the implementation of the new profiles should be negligible, involving only the cost of new templates.

The optimisation of wheel and rail performance can be obtained only when there is a coming together of the various organisations with the common aim of achieving what is best for the rail industry.

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What happened when the WPR2000 was introduced in 2001

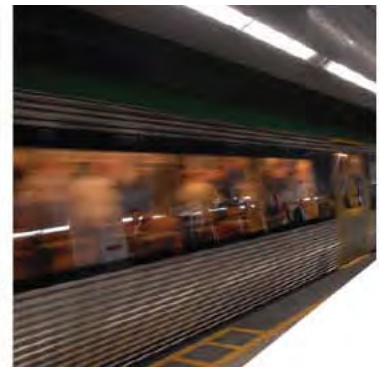
When the WPR2000 was introduced in year 2001

- Limited modelling of the wheel or rail profiles
- Testing and modelling was predominantly done on City Rail and the Hunter Valley in NSW on low speed and curved track operations.
- Limited testing of the new wheel profile on existing interstate track
 - Tight gauge, various rail profiles ground and unground.
- Limited testing of existing wheels (ANZR1) on the proposed new rail profile.
- No testing for ride performance
 - at interstate train speed - 110kph
 - over track irregularities

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Evaluation of new profiles

WPR2000 wheels were not introduced in large quantities on the network immediately, it took 1-2 years for the population to build.

The rate of wheels being machined to the new wheel profile was much faster than the rate at which rail profiles were ground to the new rail profile. This introduced a strong time lag between the wheel and rail reaching anywhere close to being matched perfectly.

At this stage very little of the ARTC network tangent track was ground to the new profile.

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Things were not going to plan....

After several years problems began to arise and people began to question some strange reports of train behaviour.

Reports of hunting increased in many locations. Typically on high speed tangents.

- Locomotive driver complaints (Loco's never actually adopted the WPR2000 from very early on due to drivers complaints)
- Passenger vehicle ride complaints (seasick)
- Load shifts
- Damaged freight
- Track damage (unquantified)
- VIDEO

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Why does hunting occur

Hunting is influenced by:

- Tight gauge
 - Bogie Condition and side bearer set-ups
 - Rail seats tight
 - Dogged tight (timber)
 - Concrete sleepers manufactured tight
 - Rails wear to lipped shape
- Complex action with wheelsets in bogies
- Amplitude increases with increased train speed
- Modern experimental wheel profiles (eg WPR2000)
 - Wheel profiles with steeper coning
 - Wheel profiles with flatter coning
 - Thicker wheel throat radius

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The motion of a conical wheel set Called the Klingen movement : 1883

Interconnecting two wheelsets in the lateral plane increases the kinematic wavelength

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Motion of conical wheelsets

The motion of a conical wheelset describes a sinusoidal path as the wheel set moves along the track

$t_{wc} = \text{hangeway clearance}$

Tight gauge promotes high conicity contact with the wheel throat. This promotes bogie hunting and high flange wear

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Conicity of the WPR2000 Profile

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How can tight gauge be made worse

New 53 kg rail with new ANZR1 wheels

12mm clearance, 5mm below rail head

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Normal Rail Lipping

Rail grinding to get correct profile only

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Significant Rail Lipping

Railmate at 556.578km Up rail showing a lip of 6.3mm

Rail grinding to

- get correct rail profile
- And to remove rail lip

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Add a lip and a square gauge corner

3mm lip each side to gauge corner, as can occur on Parkes to Broken Hill line

6mm clearance now left, 5mm below rail head

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Add WPR2000 Wheel profile

Thicker throat radius, approx. 3mm thicker than ANZR1 at 5mm below the rail head

0mm clearance (12mm less 6mm lipping, less 6mm WPR2000 throat, at 5mm below rail head

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Add 5mm tight gauge Rail seat gauge

Track gauge at sleepers 2-5mm tight gauge.

LESS than 0mm clearance ! , at 5mm below rail head, continuous flanging in throat region where high concavity exists.

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Combined effects inhibit smooth Klingel motion.

WPR 2000 wheel profile

Effective gauge = 17 mm tight

Metal flow on rail head

Track gauge tight

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Position of Rail Gauge

Track gauge

The AK car measures gauge electronically 16mm from rail surface. This is the track ARTC inherited in Sept 2004

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Some practical issues

- Limited grinding of tangent tracks on interstate routes. Very little on tangents on interstate lines in NSW.
- Grinding Standard focussed on:
 - Longitudinal rail smoothness (removing corrugations)
 - Rolling Contact Fatigue & defects (removing cracks/burns etc)
 - Rail cross section - rail profile conformance
- Concrete sleepers tight to gauge, particularly in 1970's and 1980's
- Conventional Railway standards for tight gauge do not consider lipping or wheel interface requirements.

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WPR-2000 on Uground Rail All NSW in 2001 except the metro

Note All Loading is in the gauge corner leading to rapid formation of Rolling contact fatigue and other surface defects

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High contact stress if wheels do not match rails

Very high stresses in gauge corner, 4000 MPA plastic flow occurs quickly. Rail behaves like plasticine stresses are 4 times failure stress

1120 MPa

WPR2000 Wheel on unground 53 kg rail ; Broken Hill to Parkes and most of MacArthur to Albury in year 2000 and at ARTC take up of NSW

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Gauge corner plastic failure creating untestable rail, Shelling, Flaking, Squats,

Existing rail profile is overstressed by WPR

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Other problems

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In summary

- All of these facts tell us that the WPR2000 wheel design is very sensitive to the rail network conditions where it is planned to operate.
- The design is sensitive to tight gauge and existing rail profile's.
- It was designed to be used with a specific modified range of rail profiles and conditions (definitely no tight gauge conditions)
- At the time of introduction many of these conditions above were unknown, and not surveyed extensively on ARTC track.
- Detailed plans/budgets were not in place nationally for the upgrades and full introduction of the new rail profiles.
- Field testing by PN and modelling by ARTC's consultants has shown the WPR2000 profile both new and worn to be less stable than ANZR1, particularly when it meets;
 - Slightest variation in gauge
 - A weld not properly ground off
 - Slightly crippled rail
- Once instability is initiated it stays in an unstable condition for considerably longer than a ANZR1 profile

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New National Guideline for Future Profiles

Through the Wheel Rail Interface Committee, the members are developing a new guideline for all future profile implementation.

It has been agreed that one single wheel or rail profile WILL NOT SUIT ALL CONDITIONS, variations will need to be developed for

- slower speed and higher axle loads
- lighter axle load at higher speeds on majority straight track

Improvement in the wheel rail interface will be possible with a systematic approach from all key stakeholders - above and below rail.

Increased demands on the rail system, through increasing axle loads and longer trains is going to result in more affective rail and wheel management.

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New National Guideline for Future Profiles

The committee is developing

- new guidelines for wheel and rail assessment.
- New standards for wheel and rail interface
 - Rail lipping
 - Sleeper design for correct gauge
 - Datum at which to measure rail gauge
- A new hollowing gauge, that will measure at the correct datum
- Ride Interface Requirements
- And particularly ensuring that all rail standards both above and below rail interface correctly

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Future Aim of Wheel / Rail profiles

In the future it would be deemed successful if:

- The cost of maintaining wheels and rails decreased
- The contact zone between wheel and rail occurred where the engineers wanted it to
- The axle loads could be increased without detrimental affects
- Refurbishment of worn wheel and rail profiles was minimal
- New profiles were stable at varying speeds

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Get the interface right

"In the vehicle/track system, which is married at the wheel/rail interface, anything less than a good condition of both the vehicle and the track, causes a vicious spiral downwards to a bad condition of both". Roderick Smith

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