

Dubai Metro WRI and Rail Grinding Review

**National Research Council Canada (NRC) with
Sroba Rail Services (SRS)**

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Outline

1. **Background**
2. **Review of wheel/rail performance**
3. **Review of RCF/GCC, grinding machine and grinding strategy**
4. **Recommendations for a preventive grinding strategy**
5. **New grinding machine**
6. **Benefits**



Dubai Metro

- Driverless fully automated metro rail, Dubai, UAE
- Longest fully automated metro network in the world at 75km (47 mi)
- Currently consists of two main lines, Red Line and Green Line



Dubai Metro

- Dubai Metro is operated by SERCO under contract to the RTA
- Systra/Parsons oversees Dubai Metro for RTA for the warranty period of 5 years
- NRC was chosen by Systra/Parsons to evaluate the grinding program implemented by SERCO



Objective

NRC was to determine whether the grinding machine provided by the Contractor was 'fit for purpose' with regards to the related requirements of Dubai Metro.

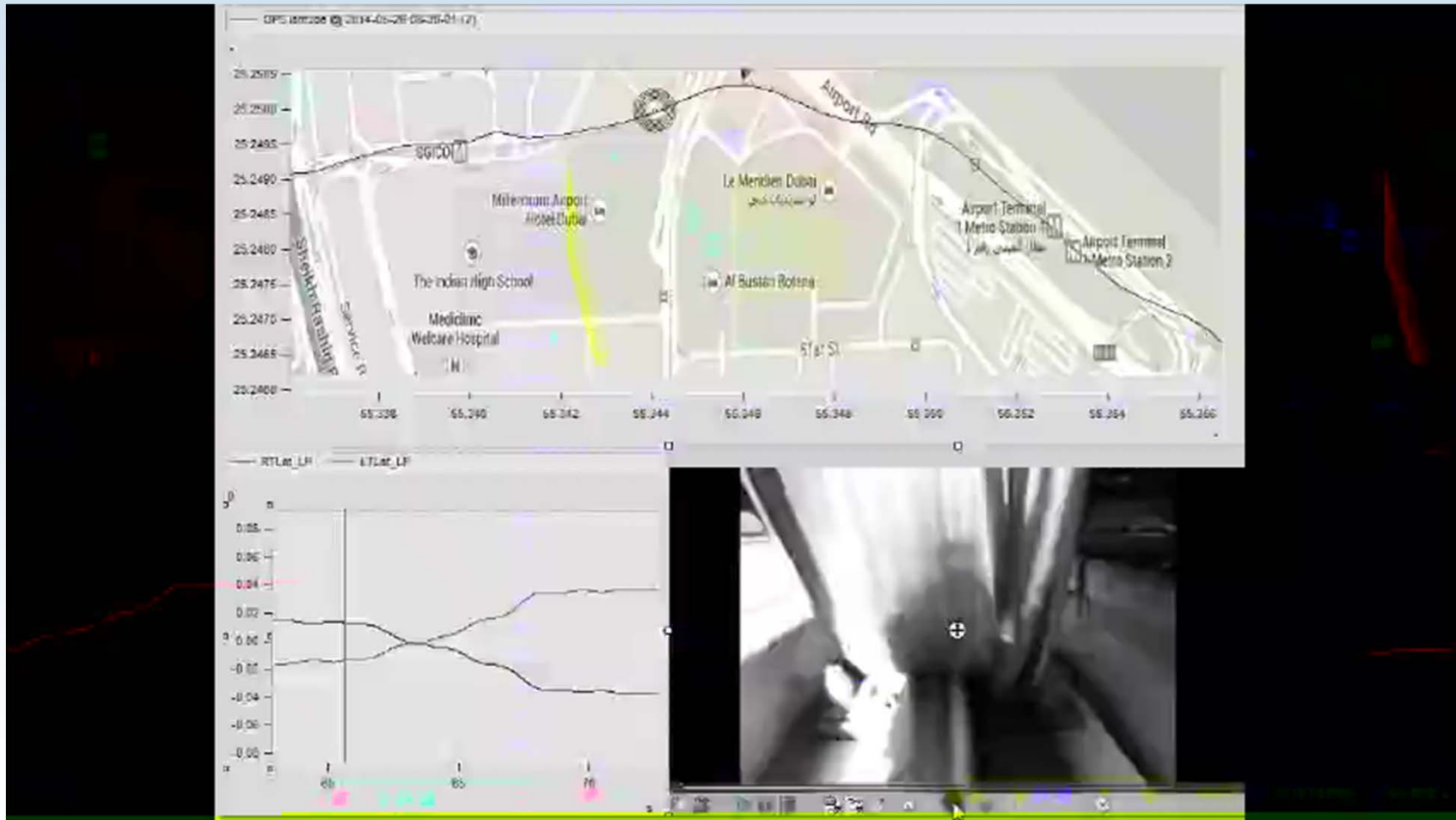


NRC Approach

1. Instrumented trainsets to gauge WRP on both lines
2. Review of inspection procedures regarding classification of rolling contact fatigue / gauge corner cracking
3. Grinding implementation using the current rail grinders
4. The quality of finished grinding results
5. Capability of using the current grinders to implement a best practice preventive grinding strategy – are they “fit for purpose?”



Review of W/R Performance



Classification of RCF and GCC

- RCF/GCC is classified based on severity
- 20mm is considered “severe” and actionable for maintenance



Classification Practice

- Some locations were prioritized for maintenance unnecessarily, this wastes resources
- The maintenance contractor should incorporate their eddy current machine into the inspection process to identify and prioritize track sections for maintenance



Grinding Machine



Inspector calls for an increase or decrease in pressure

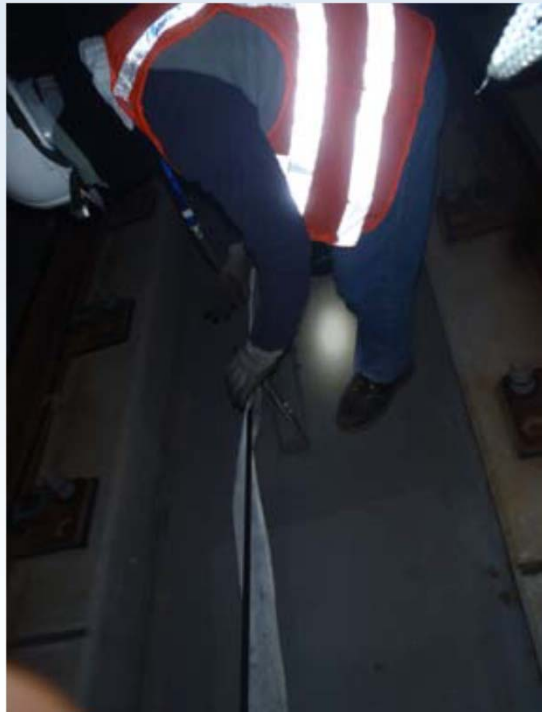
Operator with remote control panel to set grinding pressure and grinding speed

Fireproof blanket



Grinding Operation

**Fire blanket installation –
too time consuming**



**Grinding motor angle
input – poor accuracy**



Grinding Strategy

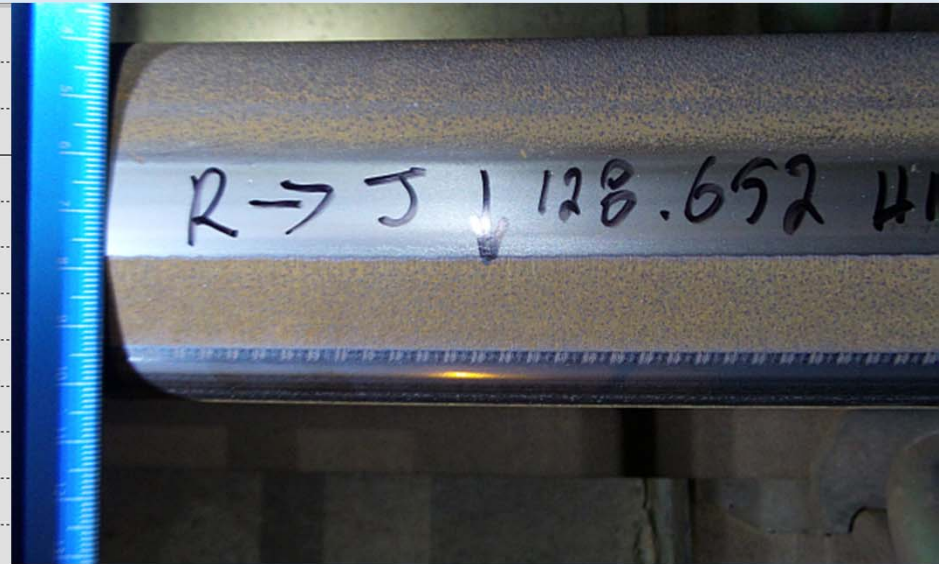
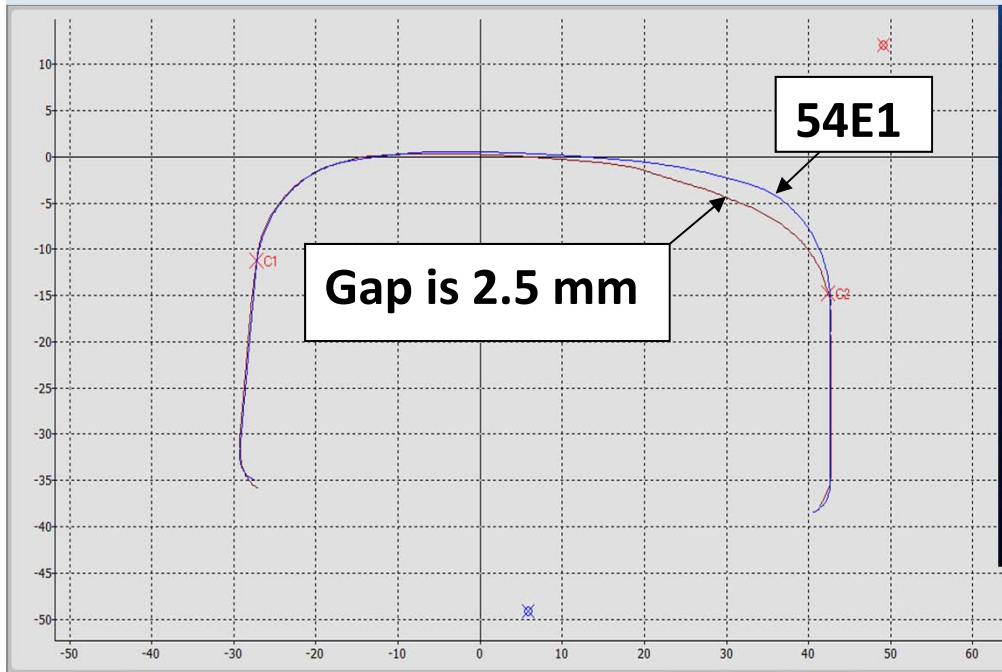
- GCC grinding and “fire fighting”
- No plan to get past this cycle
- No target profile



Finished Profile

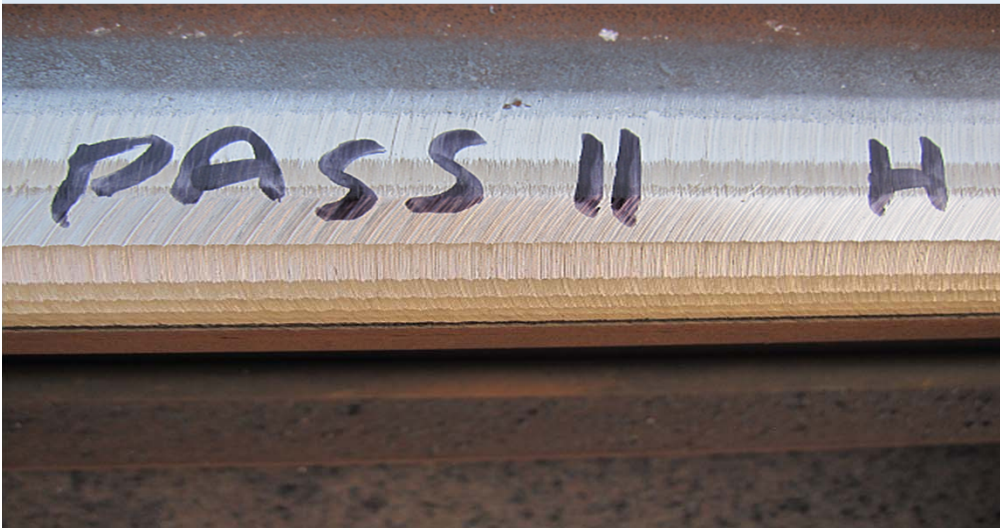
Gap too large on gauge corner of high rail

Narrow contact band on top of high rail



Finished Profile

Wide facet on high rail gauge corner



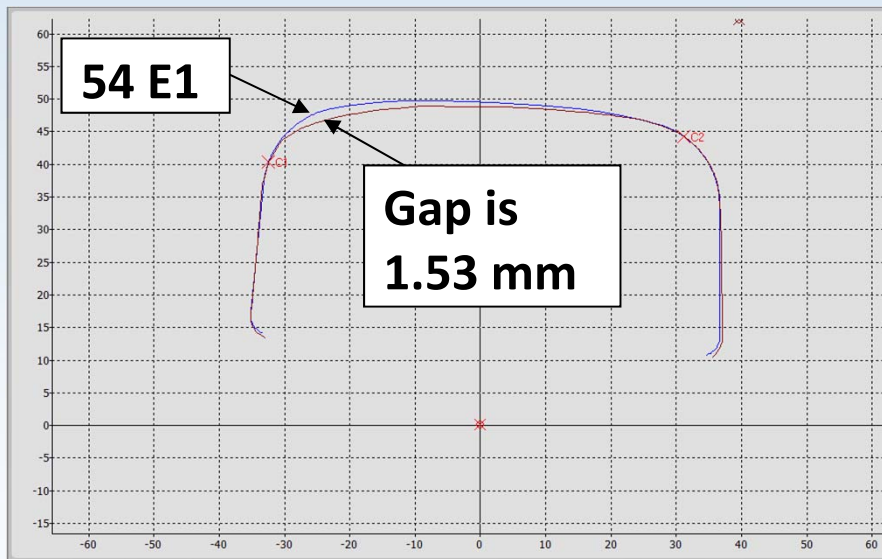
Damage from severe contact stress on ridge of wide facet



Finished Profile

Excessive field side metal removal on low rail

Poor control of grinding motor pressure and angles



Recommended Preventive Grinding Strategy

- Control RCF and corrugations
- Reduce rail surface defects
- Increase wheel and rail life
- Improve curving performance and stability on tangent track
- Reduce energy consumption



Preventive Grinding

Can it be achieved with the current grinder?

- Preventive grinding metal removal = 15mm^2 per cycle
- Average metal removal with current grinder = 1.33mm^2 per pass

→ 13 passes for preventive grinding metal removal

- Average grinding speed per shift = 0.72 km/h
- Average shift length = 2.6 hours

→ 1.872 pass-km per shift



Preventive Grinding

RED LINE

Can preventive grinding be achieved with the current grinder?

618 km to grind each year on a preventive grinding program

430 km maximum annual grinding capacity (1.872km/shift x 230 shifts)

→ 1.44 years to required with current grinder for PG program

→ Annual preventive grinding NOT POSSIBLE



Preventive Grinding

GREEN LINE

Can preventive grinding be achieved with the current grinder?

317 km to grind each year on a preventive grinding program

430 km maximum annual grinding capacity (1.872km/shift x 230 shifts)

→ 0.74 years to required with current grinder for PG program

→ Annual preventive grinding IS POSSIBLE

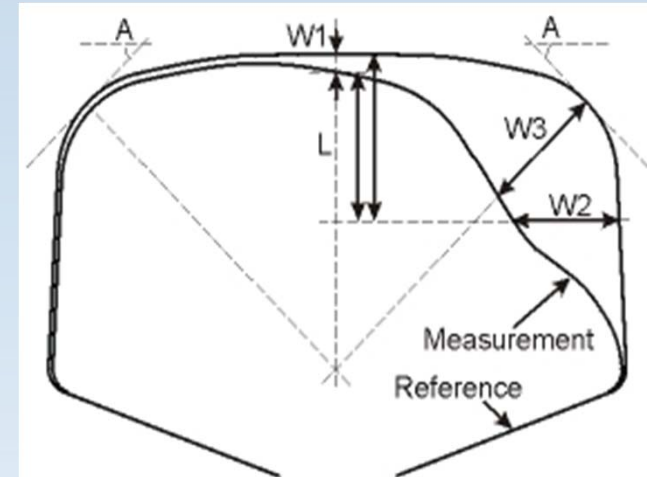


New Grinder Required for Red Line

- Lack of rail grinding capacity to maintain preventive grinding cycles on both Red and Green lines
- Recommended Dubai Metro procure a high technology grinder
- Minimum of 8 electric motors capable of grinding between 30 degrees field and 60 degrees gauge
- 30 HP motors required for the use of harder stones
- Minimum metal removal rate of 3 mm² per pass at 10 km/h



Why Preventive Grinding? Rail Wear



Rail asset life is reduced with the current grinding program

	Red Line	Green Line
Current wear rates (mm/year)		
Curve body wear data only	0.839	0.517
Including spiral wear data	0.714	0.564
Average of the two	0.777	0.541
Preventive grinding wear rate	0.348	0.348
W3 wear life based on 8 mm limit (in years)		
Current practices	9.46	14.8
Annual preventive grinding	22.4	22.4
Fraction	42%	66%



Dubai Metro Long Term Objectives

- Catch up to and control RCF/GCC
- Prolong asset life
- Increase productivity
- Improve wheel rail performance



Summary

- Red line grinder not fit for purpose
- Rail life can be extended significantly with changes to the grinding practices
- Despite being a world class system there was room for improvement in Dubai Metro's WRI
- Be proactive and not reactive with your maintenance strategy



Thank You.....

Questions

