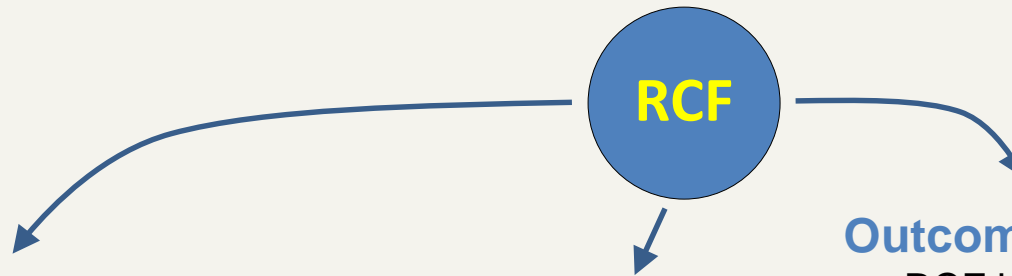


RCF – Current Approach



Inspection Methods

- Visual surface assessment
- Non-destructive:
 - Dye penetrant
 - Magnetic particle
 - Walking stick (Rohmann, MRX, Sperry)
- Destructive:
 - Cutting
 - Milling
 - Metallography
 - LOM, SEM

Factors to Consider

- Rail type
- Position in curve
- Track curvature
- Lubrication
- Traffic:
 - Axle load
 - MGT accumulation
 - Frequency
- Maintenance practices
 - Grinding/Milling
 - Frequency
 - Amount

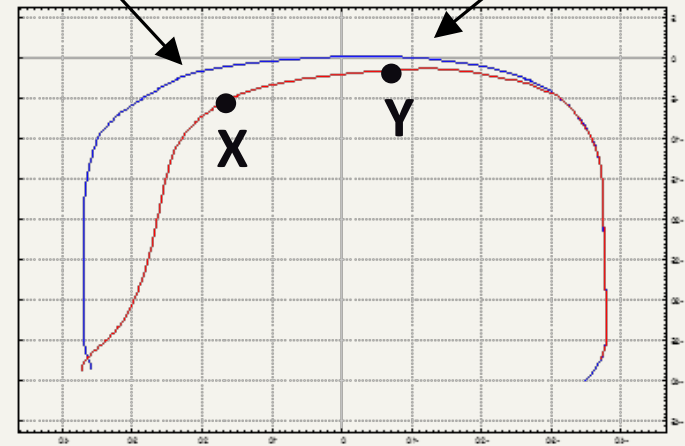
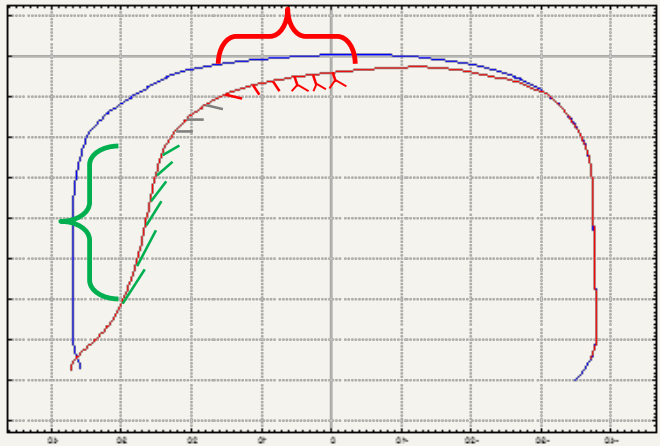
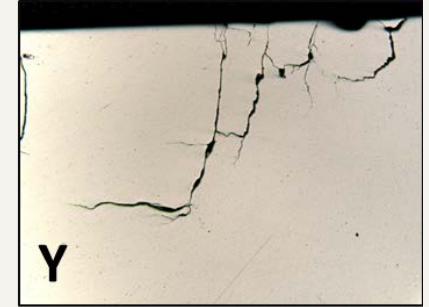
Outcomes to Evaluate

- RCF location:
 - TOR vs. GF
- RCF severity:
 - Mild vs. Severe
 - Depth of spalling
- RCF crack morphology:
 - Length, depth, angle to rail surface, density & distribution, amount of branching
 - Propagation in rail microstructure
 - Trans-granular vs. inter-granular fracture
 - Assisted by inclusions (rail cleanliness)

Quantifying Rail Surface Damage Metallography of Crack Morphology

Steep
Angle

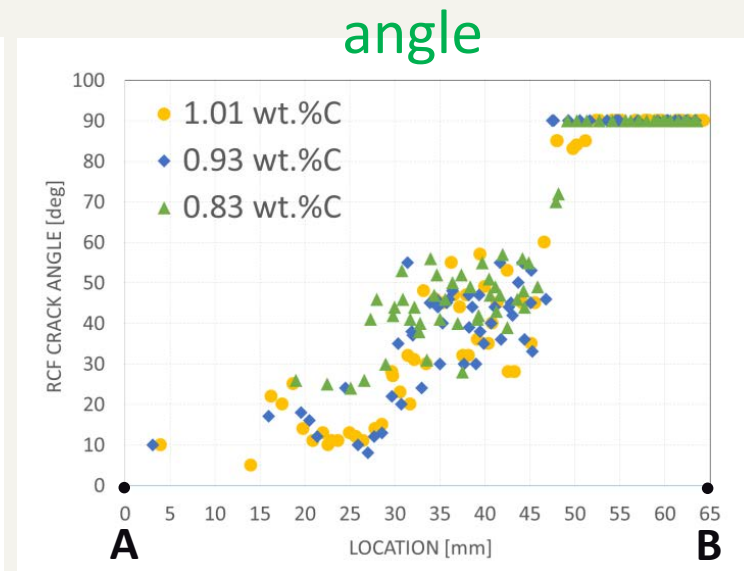
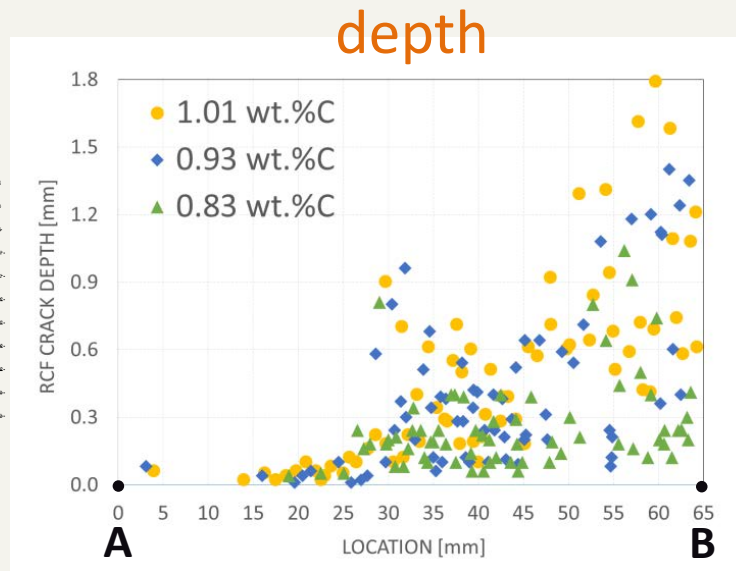
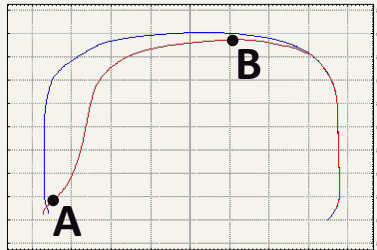
Shallow
Angle



Quantifying Rail Surface Damage

Metallography of Crack Morphology

- High rail quantitative RCF assessment on a **5 degree curve**
- RCF crack **depth** & **angle** analyzed in three rail types with varying Carbon content



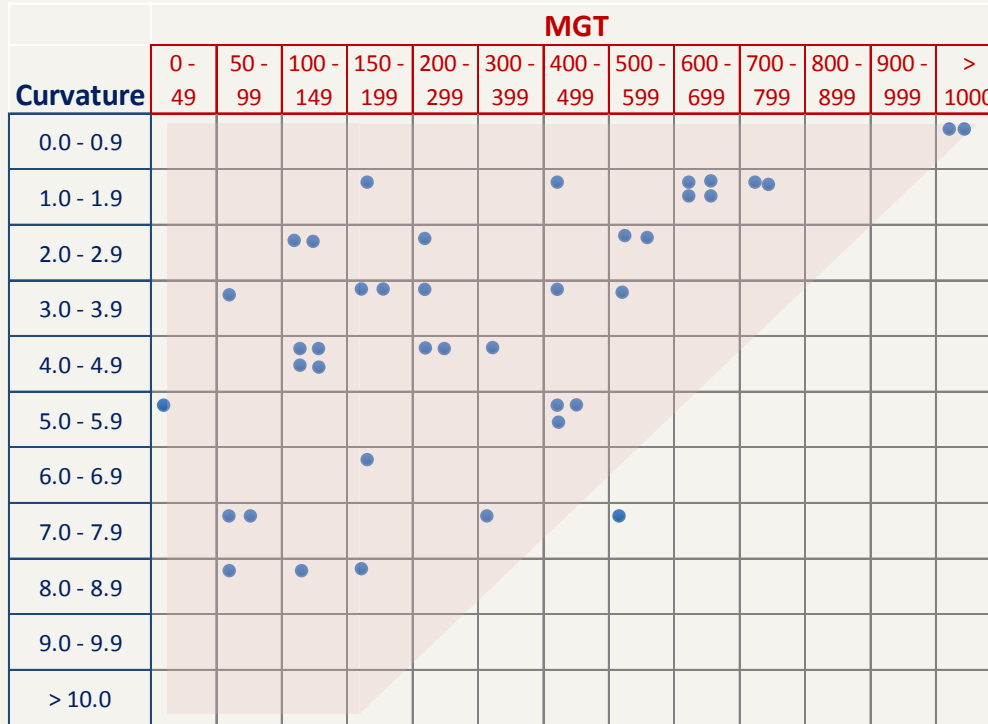
Quantifying Rail Surface Damage – RCF Matrix

Example:

- 40 rails placed in the matrix

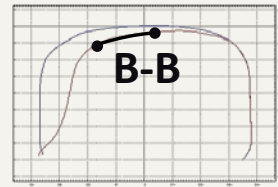
Layers to Consider:

- **High & Low Rails**
- **Rail Grade** (i.e. standard, intermediate, premium)
- **Track Curvature** (i.e. variable radius)
- **Tonnage Accumulation** (i.e. variable MGT in rail life-cycle)
- **Running Surface Condition** (i.e. dry, lubricated, TOR friction modified)
- **Traffic Type** (i.e. axle load, train speed)
- **Maintenance Grinding** (frequency and amount)



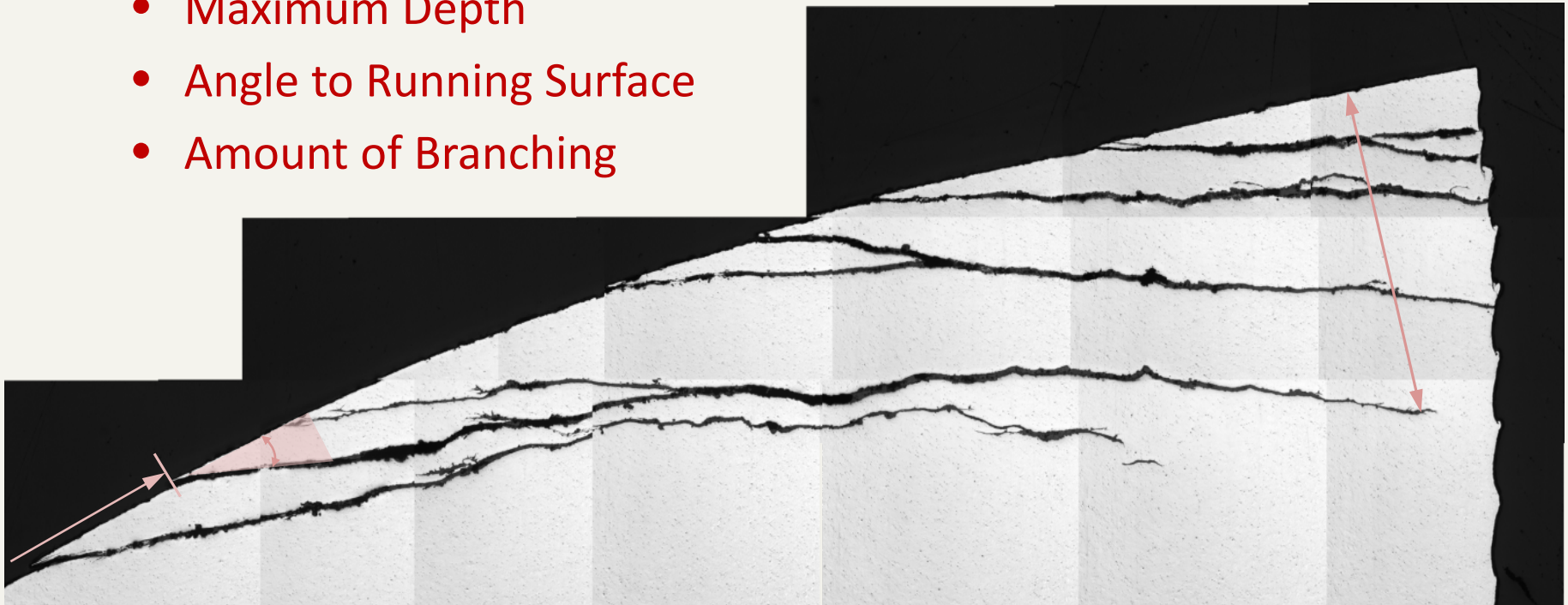
Quantifying Rail Surface Damage

Metallography of Crack Morphology



RCF Morphology:

- Position on Rail Surface
- Length
- Maximum Depth
- Angle to Running Surface
- Amount of Branching



BNSF-7 rail:
2-Deg curve, high rail
1994 (most likely premium rail)

Rails for RCF Matrix

Rail Request:

- 40 rails (1-3 foot sections, 1m max)
- Preference is on premium rails, but intermediate and/or standard rails considered as well
- Mixed or heavy axle load environment
- High rail location (1-10 degree)
- Visible RCF on TOR and/or GF locations (>100MGT tonnage accumulation)
- All friction environments (dry, lubricated, TOR FM)
- All grinding environments (with or without maintenance grinding)

Send rails to NRC of Canada:

Attn: Daniel Szablewski

National Research Council (NRC) of Canada

2320 Lester Rd., Building U-89, Ottawa, ON, Canada, K1V 1S2

Email: Daniel.Szablewski@nrc-cnrc.gc.ca

Cell: (613) 462-9396