PRINCIPLES COURSE

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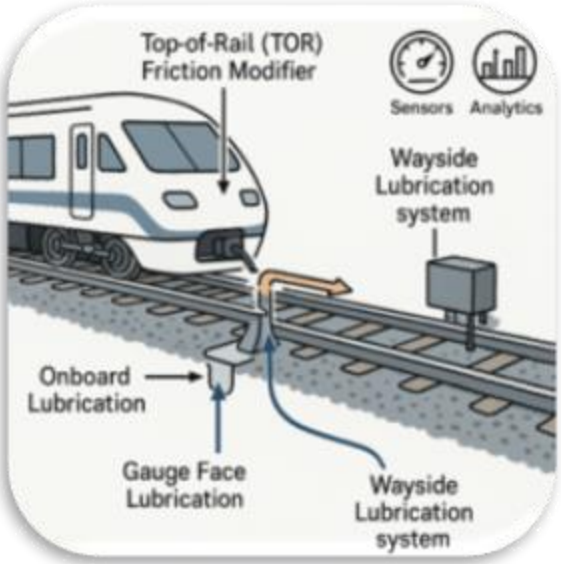
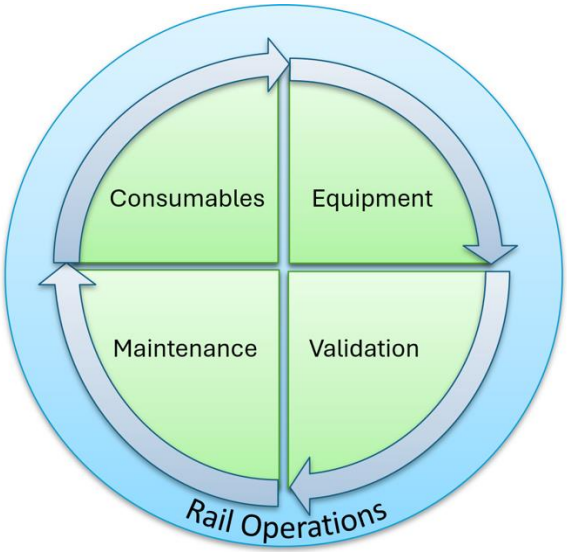
WRI2025 30th ANNIVERSARY
Plasser American
PEARL MILESTONE SPONSOR

Friction Management

LBFoster

PRINCIPLES COURSE





August 26-28, 2025

SEATTLE, WA

WRI2025RT

Outline

Case Study

- Why Friction Management (FM)
- How Friction Management Works
- Top-of-Rail / Wheel Tread Application
- Gauge Face / Restraining Rail / Wheel Flange Application
- Validation & Measurement
- Maintenance

Wheel / Rail Interface Control

Five main factors drive track reliability and maintenance requirements:

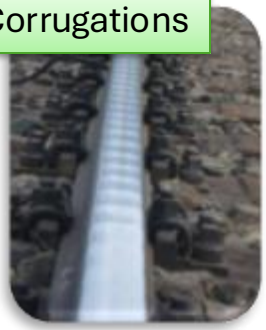
Regardless of whether the four non-FM factors have been optimized, trains will always face frictional challenges, especially in curves.

Friction Management directly improves track reliability, reduces maintenance interventions, and starts protecting your infrastructure immediately, regardless of age and condition.

Examples of Friction-Related Problems

Rolling Contact Fatigue

Corrugations

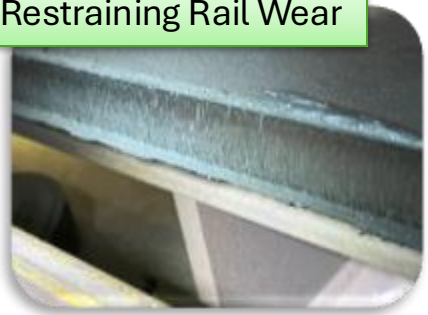


Noise

Lateral Forces

Running Rail Wear

Restraining Rail Wear



Wheel Wear

Traction

Friction Management FAQ

What are my friction targets?

What consumable product/s should I select?

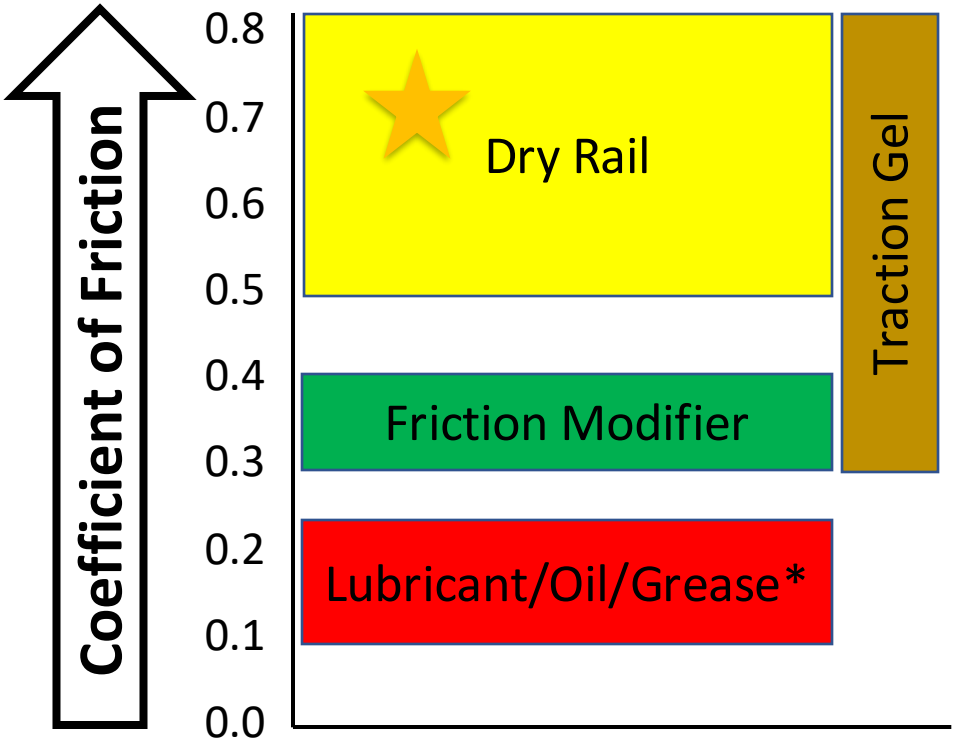
What application equipment should I use?

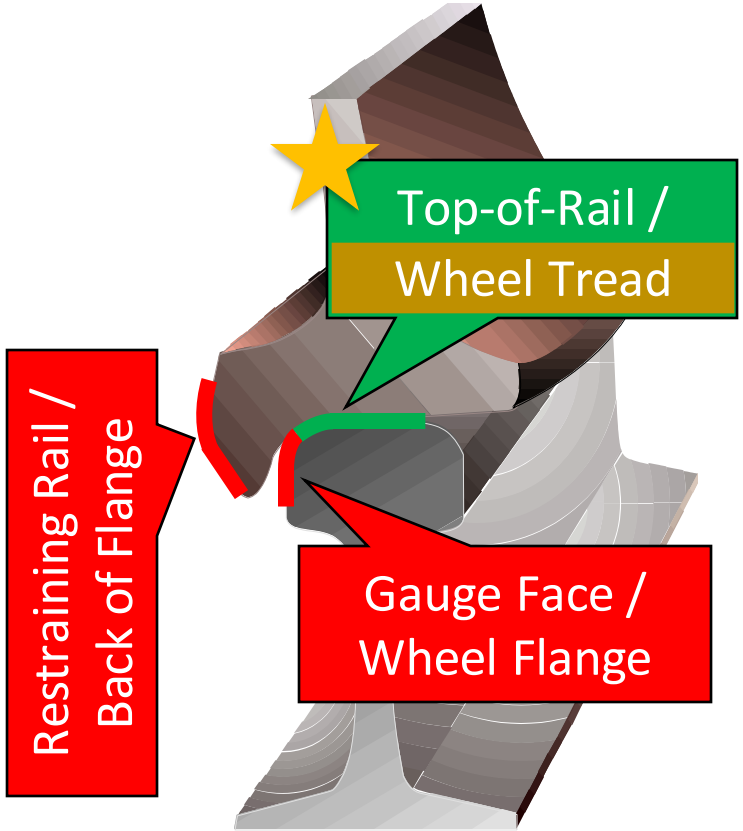
What do I specify for procurement?

How do I validate my FM program?

How do I maintain a successful FM program?

Surfaces & Target Friction Levels





* AREMA Manual for Railway Engineering - Section 4.7
Recommended Practices for Rail/Wheel Friction Control

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Consumable Selection

1. What is your biggest issue?

Issue	Friction Modifier	Lubricant	Traction Gel
Noise – Squeal (Top of Rail)	✓✓	-	-
Noise – Flanging (Gauge Face / Restraining)	✓	✓✓	-
Corrugation	✓✓	-	-
Lateral Forces – Rolling Contact Fatigue	✓✓	-	-
Lateral Forces – Track Structure Degradation	✓✓	-	-
Rail Wear – Gauge Face / Corner	✓	✓✓	-
Rail Wear – Top of Rail	✓✓	-	-
Wheel Wear – Flange (Front or Back)	✓	✓✓	-
Wheel Wear – Tread	✓✓	-	-
Derailment Potential	✓✓	✓✓	-
Fuel Efficiency	✓	✓	-
Ride Quality & Hunting	✓	-	-
Leaf Fall / Steep Grades	-	-	✓✓

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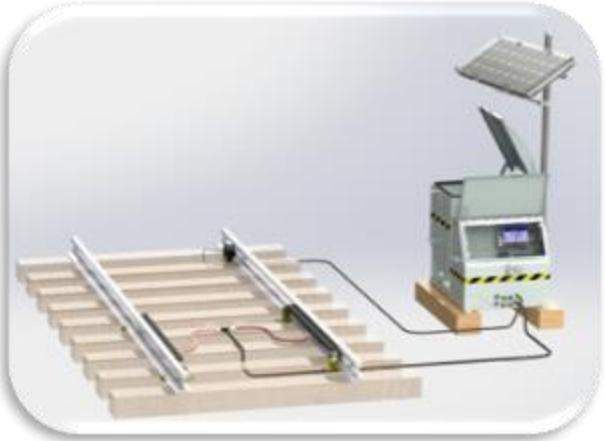
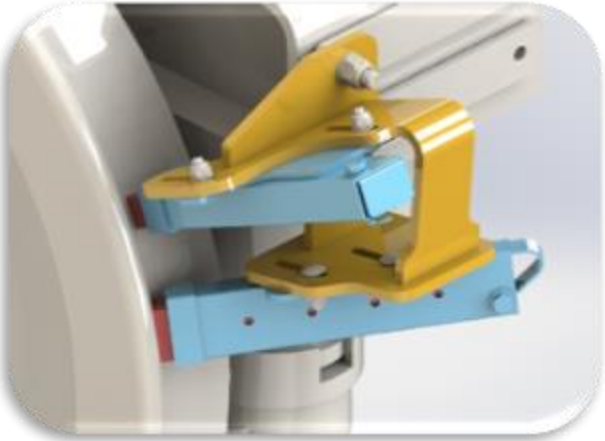
Application Selection

Three Primary Choices:



Trackside



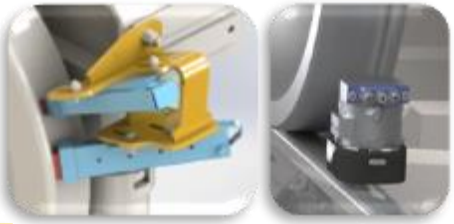
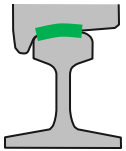
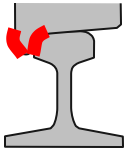
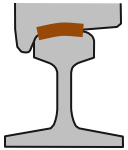
On-Board Solid Sticks

On-Board Spray

Best For:

- Localized Issues
- System-Wide Issues

FM Application Matrix

			APPLICATION	
			Trackside 	On-Board 
CONSUMABLE		Top-of-Rail / Wheel Tread Friction Modifier	- Water-based Friction Modifier - Top-of-Rail (TOR) Oil - Oil-based Hybrid	- Solid Stick Friction Modifier - Friction Modifier Spray - TOR Oil-Based Spray
		Gauge Face / RR / Wheel Flange Lubrication	- Rail Curve Grease *Gauge Face (GF) or Restraining Rail (RR)*	- Solid Stick Lubricant - Oil Spray *Front or Back of Flange*
		Traction Enhancers	- Traction Gel	- Sand - Traction Gel - Innovative Cleaning Tech

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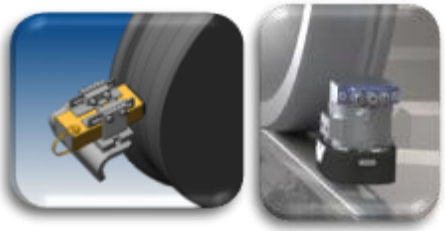
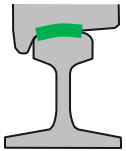
		Trackside 	On-Board 
CONSUMABLE	 **Top-of-Rail / Wheel Tread Friction Modifier**	- Water-based Friction Modifier - Top-of-Rail (TOR) Oil - Oil-based Hybrid	- Solid Stick Friction Modifier - Friction Modifier Spray - TOR Oil-Based Spray
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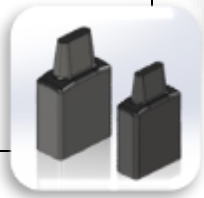
TOR Consumable - Key Specifications

ALL	• Intermediate friction • Positive friction • Good film durability & carry down • Low environmental & health impact • Safe operation
LIQUID	• Effective pumpability & pick-up at operating temperatures • Water wash-off resistance • Product stability
SOLID	• Good mechanical strength & thermal stability • Optimized consumption rate • Interlocking (continuous) design



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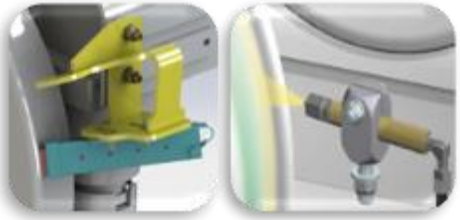
		Trackside 	On-Board 
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	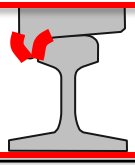 **Gauge Face / RR / Wheel Flange Lubrication**	- Rail Curve Grease *Gauge Face (GF) or Restraining Rail (RR)*	- Solid Stick Lubricant - Oil Spray *Front or Back of Flange*
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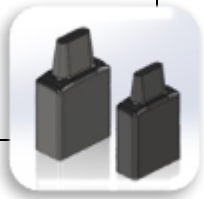
Lubricant Consumable - Key Specifications

ALL	• Low coefficient of friction • Good film durability & wear protection • Effective product carry down and transfer • Low environmental & health impact
LIQUID	• Low bar clogging propensity • Good column strength • Optimized pumpability at operating temps • Optimized oil separation • Good adhesion to rail & water wash-off resistance
SOLID	• Good mechanical strength & thermal stability • Optimized consumption rate • Interlocking (continuous) design



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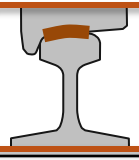
	 **Traction Enhancers**	- Traction Gel	- Sand - Traction Gel - Innovative Cleaning Tech

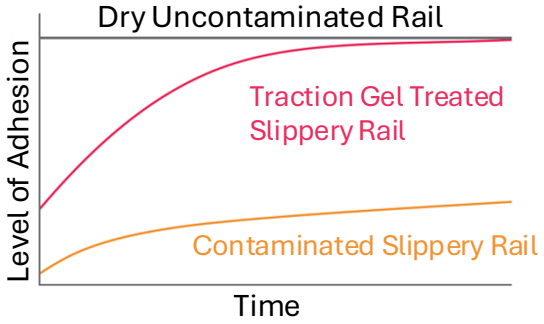
Trackside Traction Enhancer Gel

Benefits

- Reduced operational & safety issues
- Enhanced braking and traction
- Fewer station overruns
- Reduced risk of Signals Passed at Danger (SPAD)
- Fewer train delays and improved on-time reliability
- Fewer wheel flats
- Reduced consumption of train-based traction enhancement solutions (e.g. sand)

Key Specifications

- Effective traction enhancement
- Effectively breaks down leaf film
- Good film durability & carry down
- Effective pumpability & pick-up at operating temperature
- Product stability
- Low environmental & health impact



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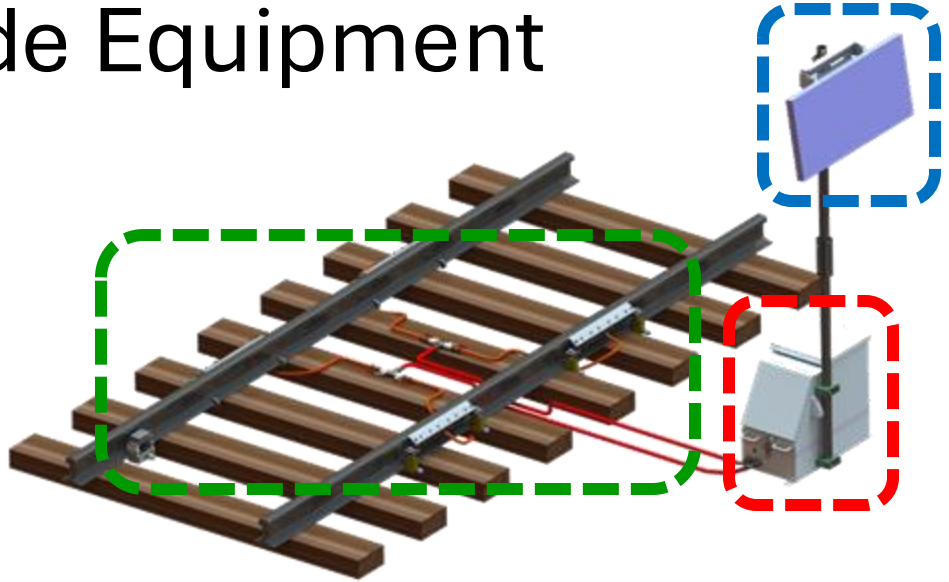
Trackside Equipment

Key Specifications

- Tank Size & Shape
- Single or Dual Track Application
- Type & No. of Applicator Bars
- AC or DC Solar Power
- Directional Application Control
- Exposed or Embedded Rail
- Remote Performance Monitoring



Top-of-Rail

Gauge Face

Restraining

Traction Gel

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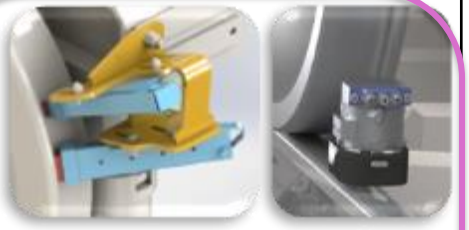
			Trackside 	On-Board 
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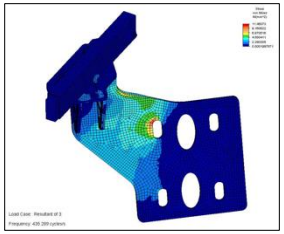
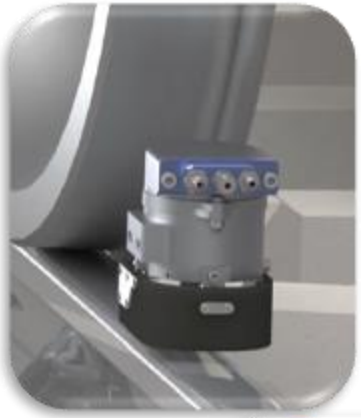
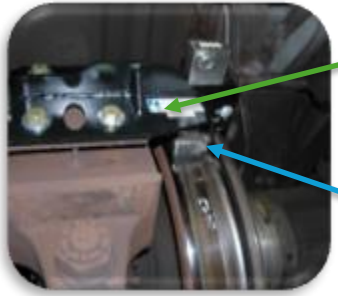
On-Board Equipment

Key Specifications

- Finite Element Analysis
- Shock & Vibration Testing
- Vehicle Integration
- Adjustability
- Compatibility with Consumable







Solid Stick

Spray

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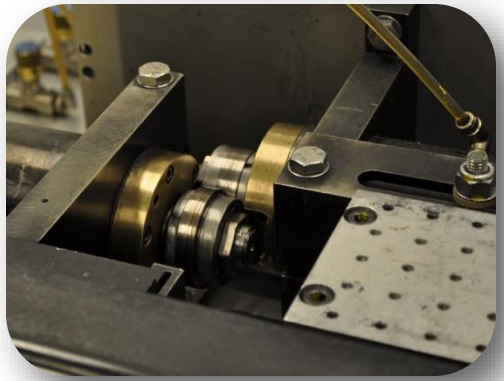
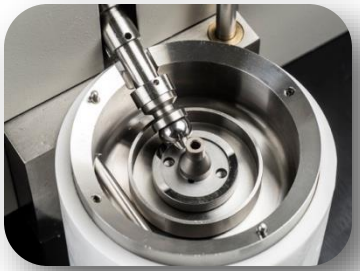
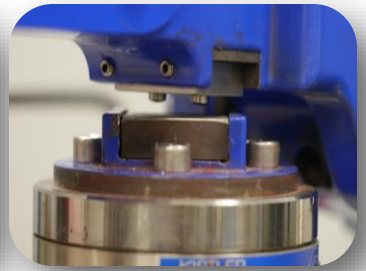
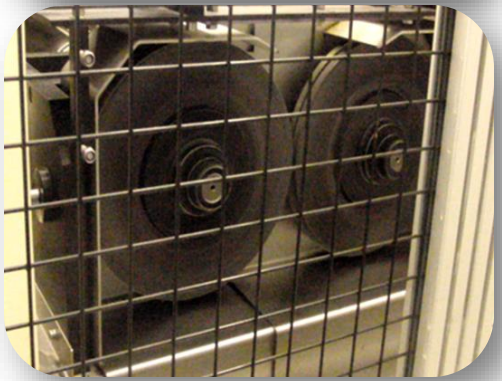
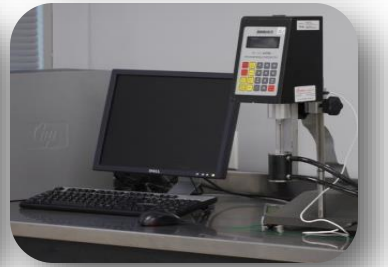
Laboratory Performance Testing

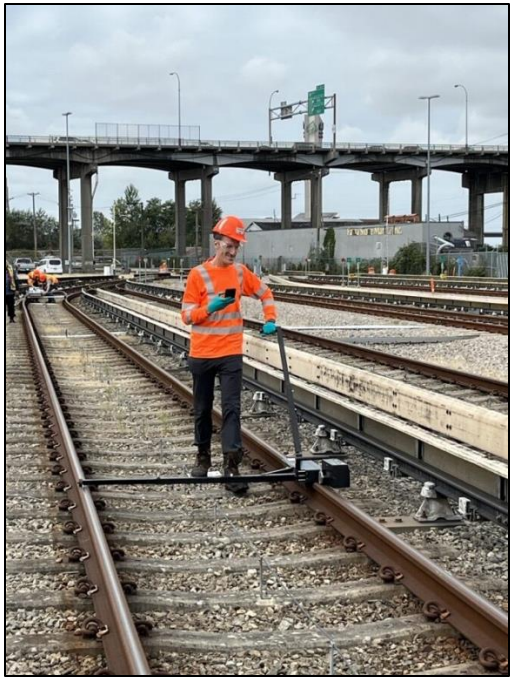






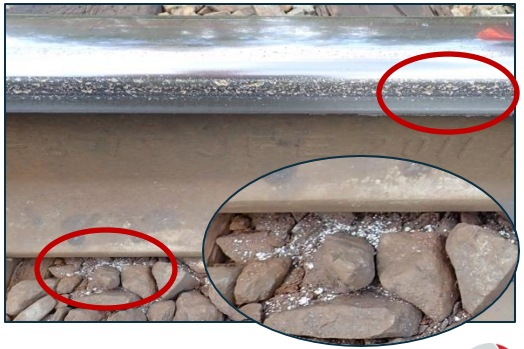
Carry Distance Measurements

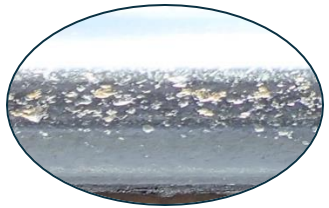
Tribometer Measurements



Visual Assessment

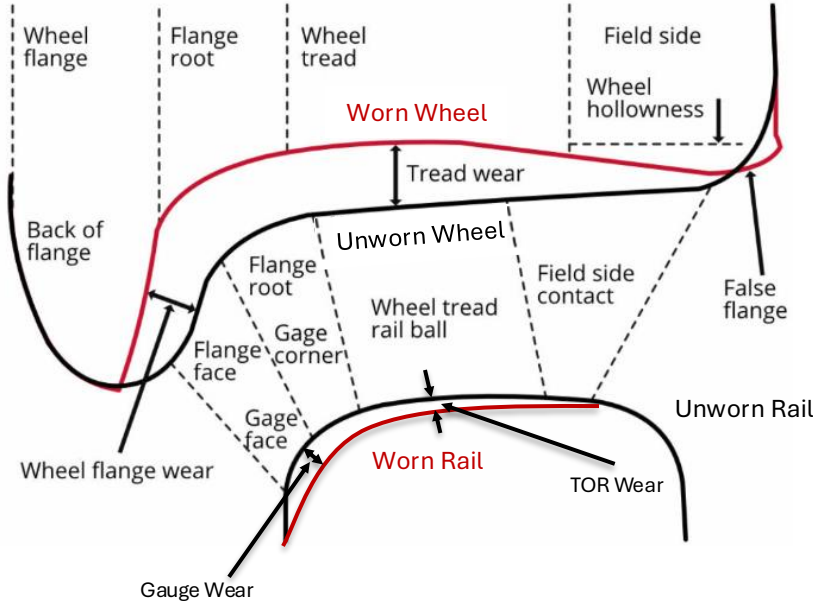
Good
Grease
Coverage





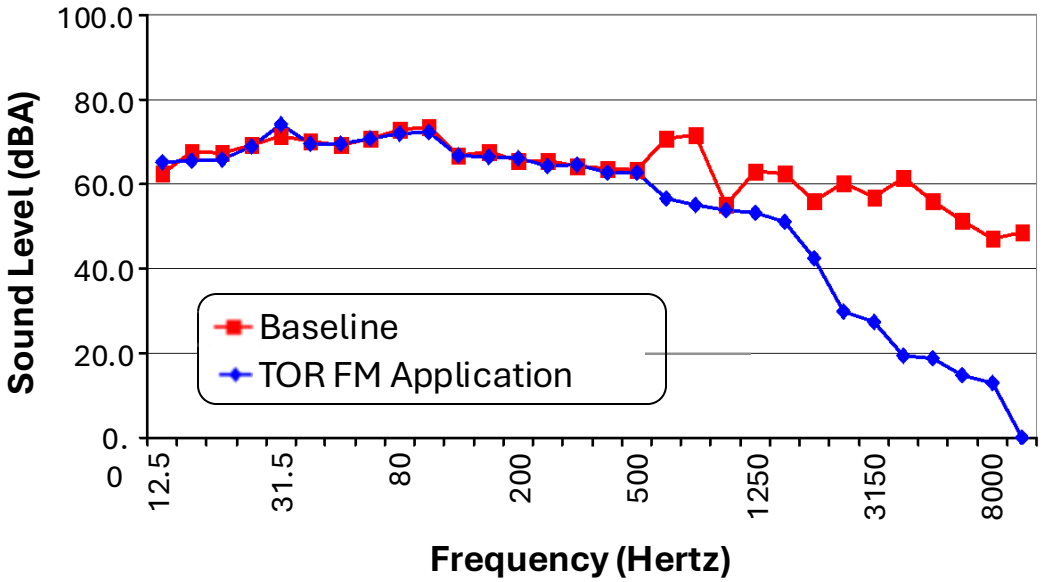
Poor
Grease
Coverage

Rail & Wheel Wear Measurements



Noise Measurements

Noise Type	Frequency range (Hz)
Rolling	30 – 2500
Rumble (including corrugations)	200 – 1000
Flat spots	50 – 250 (speed dependant)
Ground borne vibrations	30 – 200
Top of rail squeal	1000 – 5000
Flanging noise	5000 – 10000

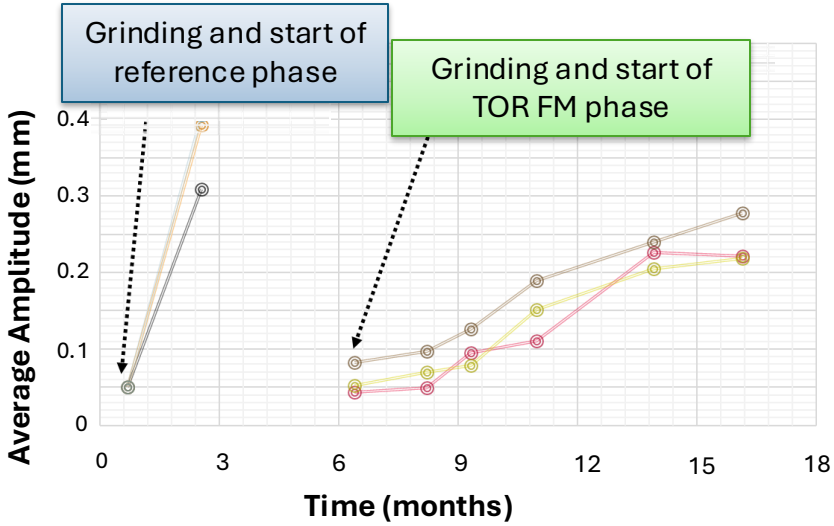


Corrugation Measurement

CAT – Corrugation Analysis Trolley

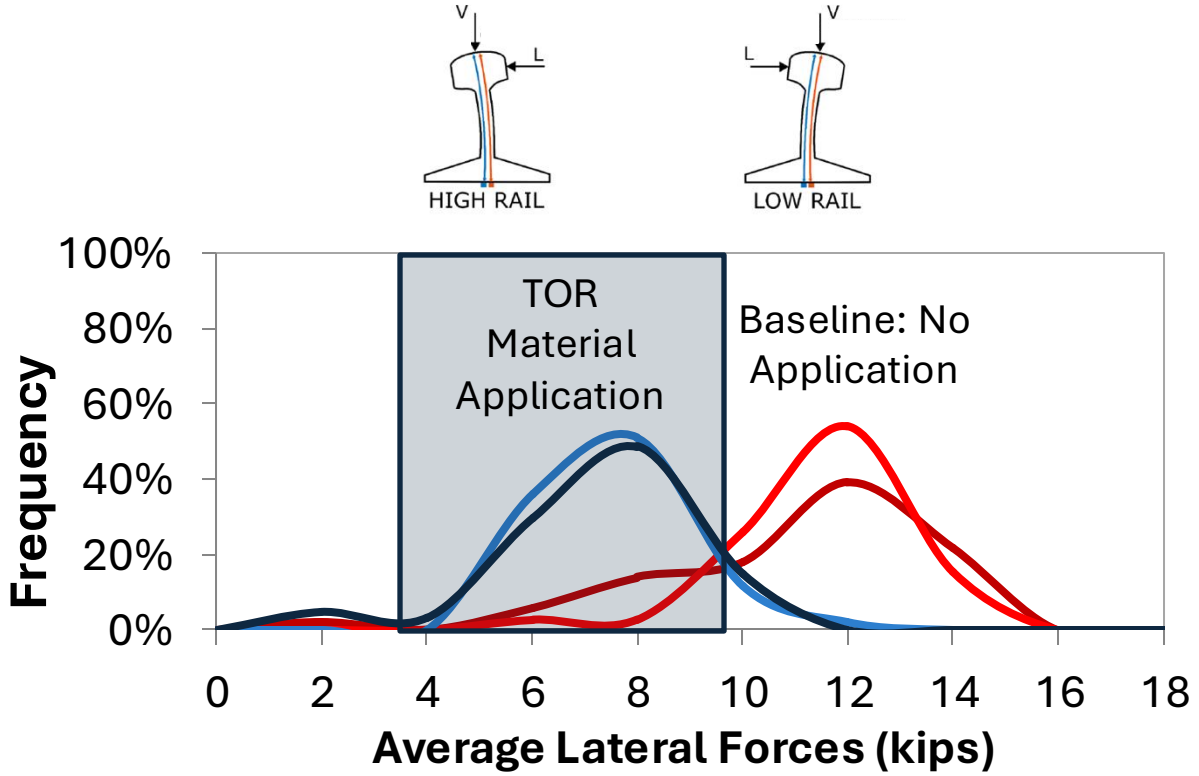
Reference Phase

TOR Phase



Lateral Force Measurement

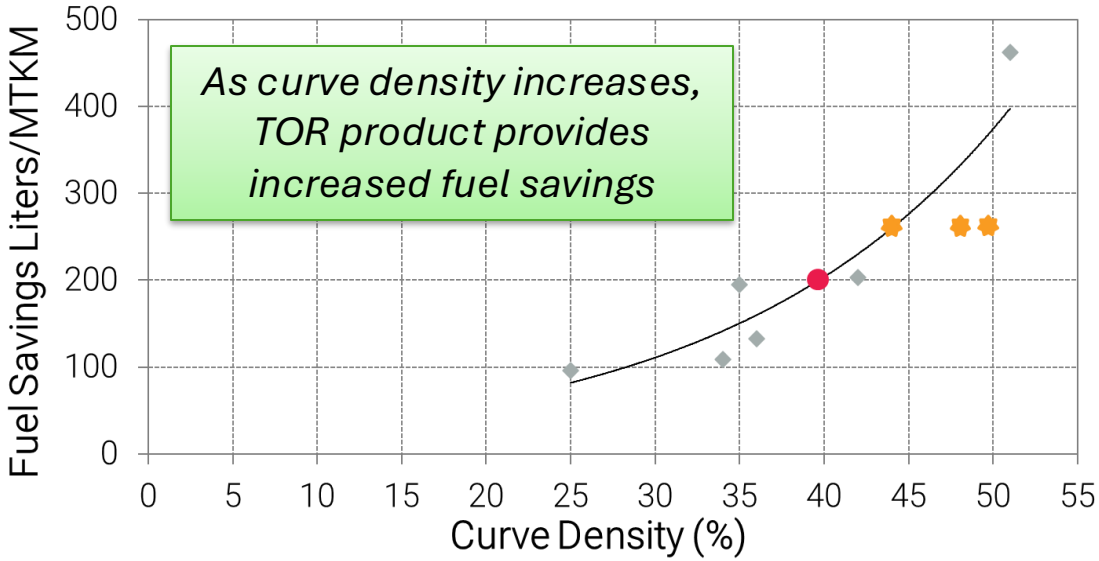
Measure effectiveness of reducing lateral forces



Energy Consumption

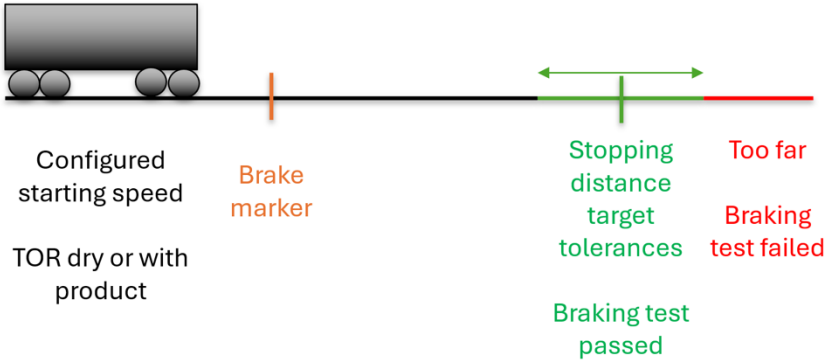
Top-of-rail product has been shown to be effective in reducing energy consumption for freight railroads

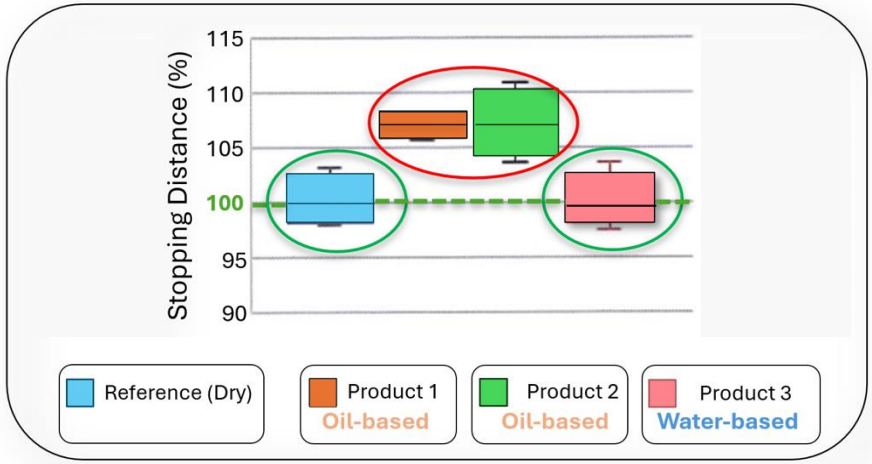
Opportunity for future work in transit agencies



Safety - Braking and Traction Tests

- Common agency approval requirement
- Braking must pass agency's safe criteria
  - Configured starting speeds
  - Stopping distances and deceleration rates measured
  - Ensure braking does not cause wheel slide issues





Reference: SBB, Rad Schiene Conference, Dresden, Feb 2020

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How do I maintain a successful FM program?

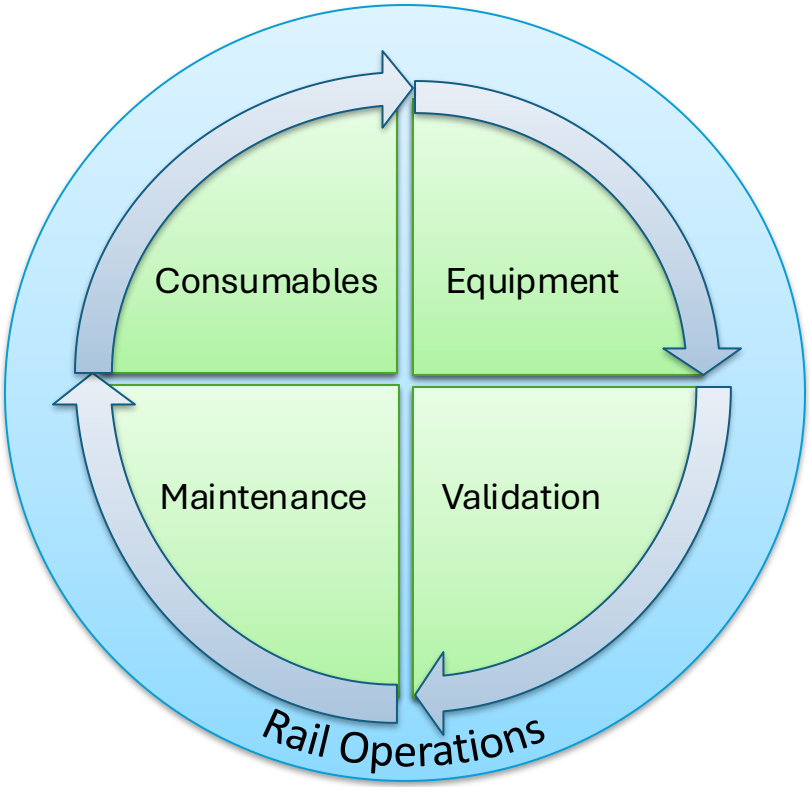
Maintenance & Upkeep

Selecting the right equipment and consumable solution is the first step, but need to sustain the FM program

Those who do Friction Management well:

- ✓ Have a purpose
  - > *They know why they are doing it*
  - > *They have someone who cares (a champion)*
- ✓ Track their inventory
  - > *They know what equipment they have and where it is*
- ✓ Keep their assets in good working condition
  - > *They dedicate trained individuals specifically to this task*
  - > *They incorporate maintenance into their processes*
- ✓ Have an Asset Investment Plan
  - > *They manage an inventory of spare parts & consumables*
  - > *They ensure friction management is specified in capital & operating programs*

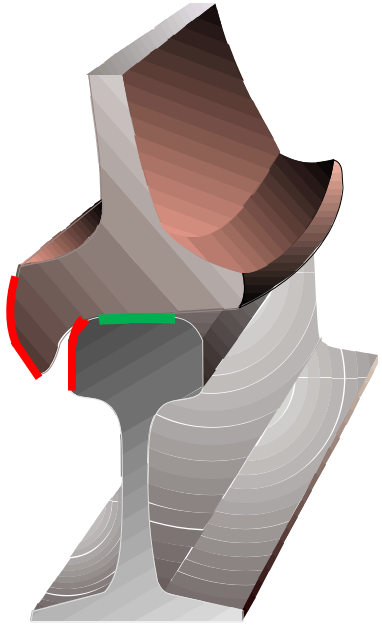
Friction Management Program Checklist



- ❑ Correct problem/s identified
- ❑ Correct type of consumable/s selected
  - ❑ *Friction Modifier; Lubricant; Traction Gel*
- ❑ Correct type of application/s selected
  - ❑ *Trackside; On-Board*
- ❑ Specific consumable/s & equipment selected
  - ❑ *Has the desired properties / specifications*
- ❑ Benefits measured and validated
- ❑ Maintenance program implemented
  - ❑ *High uptime*
  - ❑ *Ongoing validation*
- ❑ Works within Rail Operations
  - ❑ *Reliability of service is improved*
  - ❑ *Service disruptions are reduced*

Summary

- Effective Friction Management is a critical part of successful wheel / rail interface management
- Extends infrastructure life, improves safety, and reduces noise
- Select the consumable/s and equipment that meets your agency's needs and operating conditions
- Lab measurements and track testing can help identify and verify the optimal solution
- Maintenance is a necessary component of success, and industry partners are available to help



Thank You!