# Effective Gauge Face/Wheel Flange Lubrication: A Solutions Based Approach

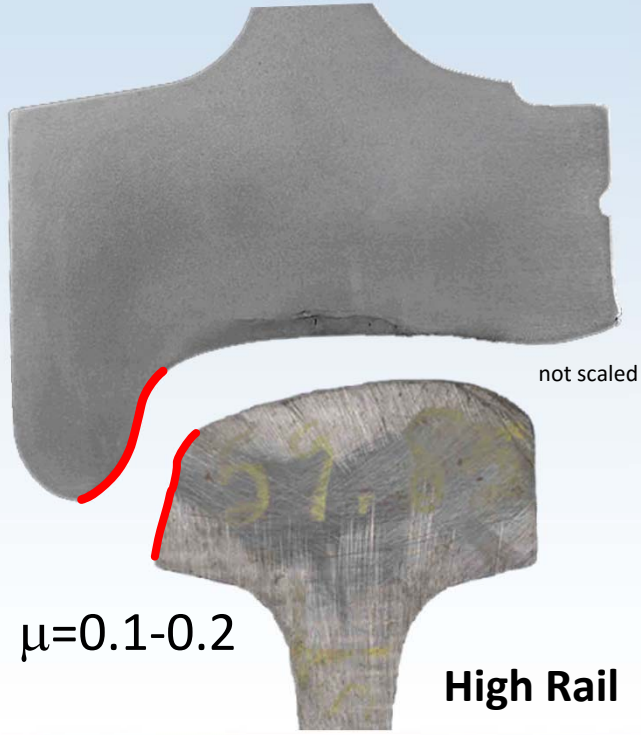
Marco Santoro
L.B. Foster Company

# Overview

- Benefits of Lubrication
- Application Systems
  - Mobile (solid sticks and onboard oil spray)
  - Trackside (wayside, drilled rail and spray)
- Implementation
- Case Studies
- Conclusions

# Flange/Gauge Face Lubrication

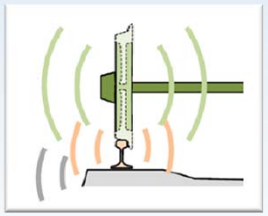
- Friction to a minimum level
- Gauge face lubrication widely implemented in the world
- Rail/Wheel Wear is the primary issue
- Impacts:
  - Rail Wear (gauge face/corner/restraining)
  - Wheel Wear (flange/back of flange)



# Additional Benefits

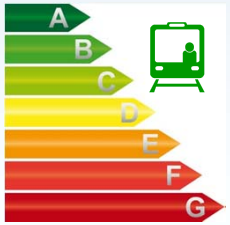
Rail / Wheel Wear

Flange Noise



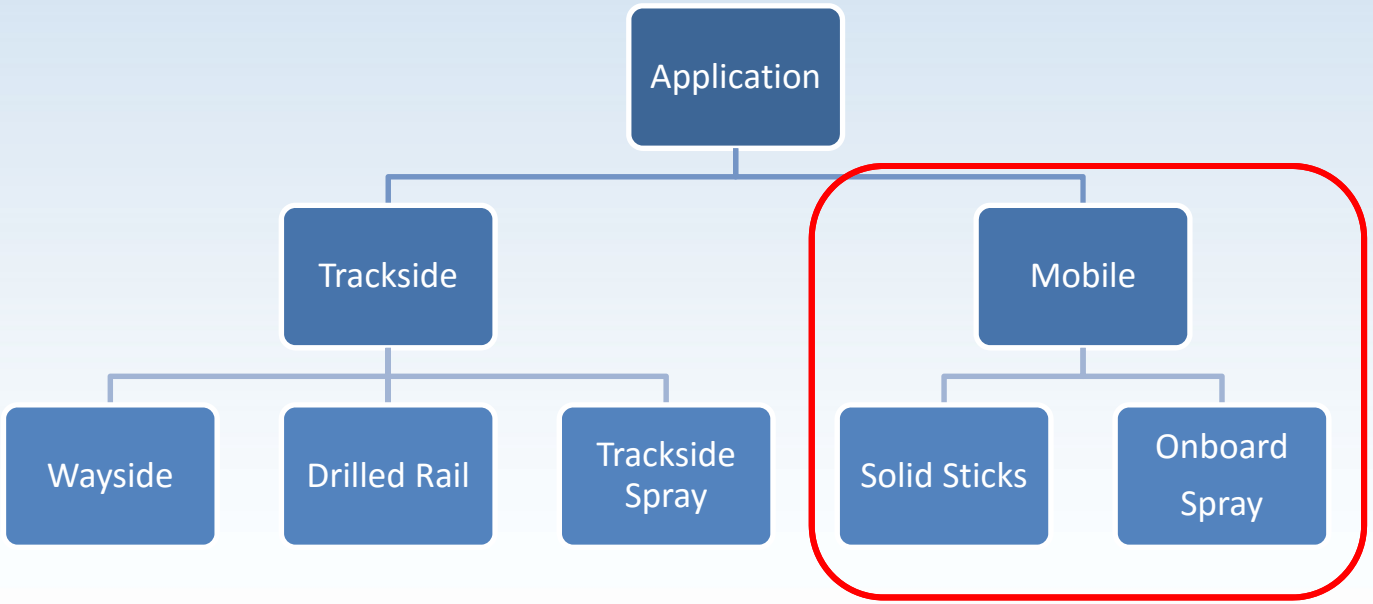
RCF Development

Derailment Potential




Energy Efficiency

# Lubrication Approaches



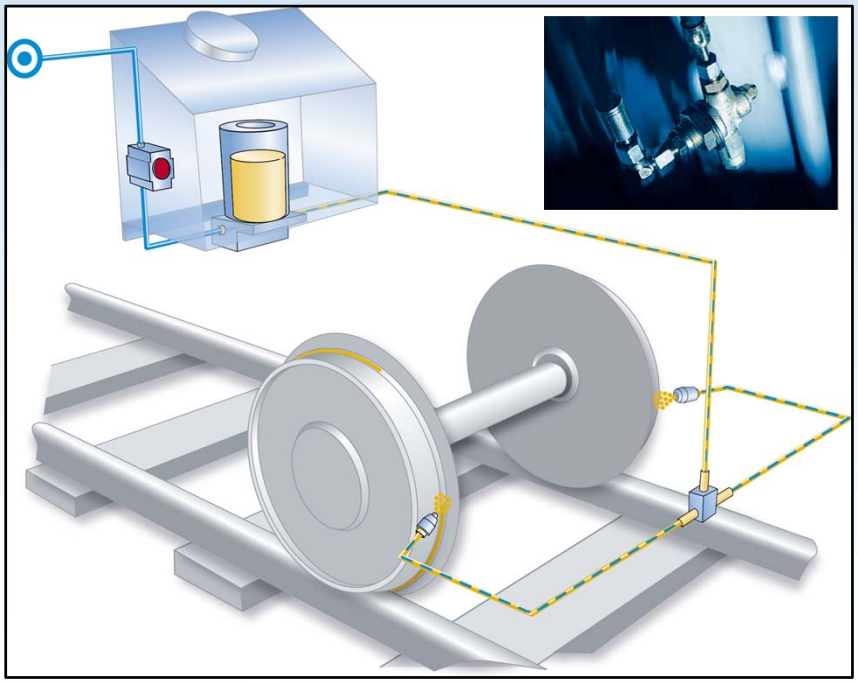
# Onboard Spray Systems

**Oil Spray Components:**

- Controls
- Reservoir
- Pump [usually piston]
- Spray nozzles

**Key Features:**

- Air or airless versions
- Curve sensors
- Multiple vehicle types



Obtained from www.skf.com

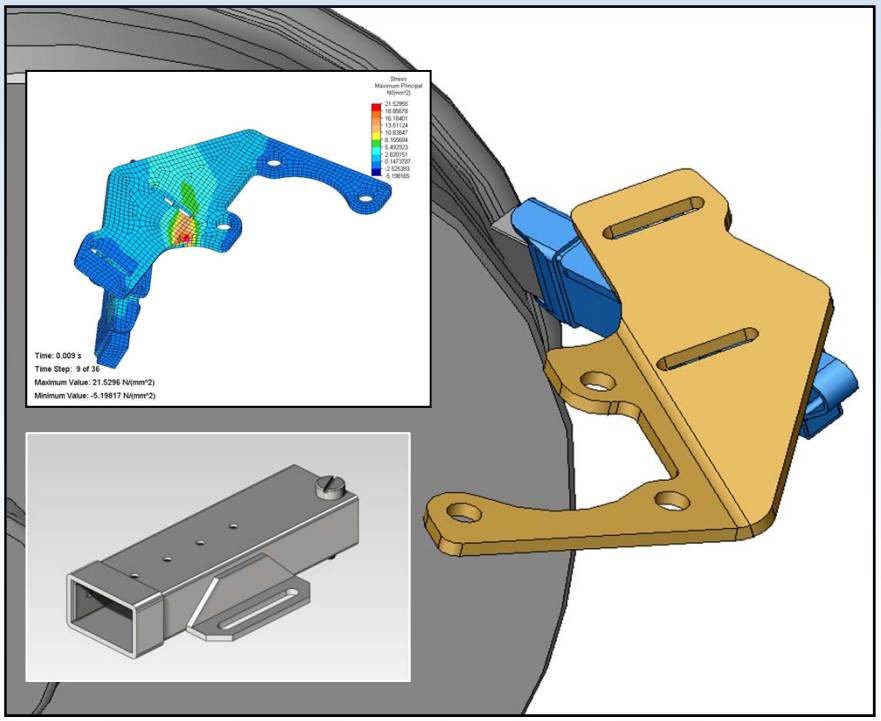
# Onboard Solid Sticks

**Primary Components:**

- Interface Bracket
  - Connects frame and applicator
- Applicator
  - Houses sticks

**Key Features:**

- Safety: design validation
- Optimized for installation and adjustment



# Mobile: Considerations

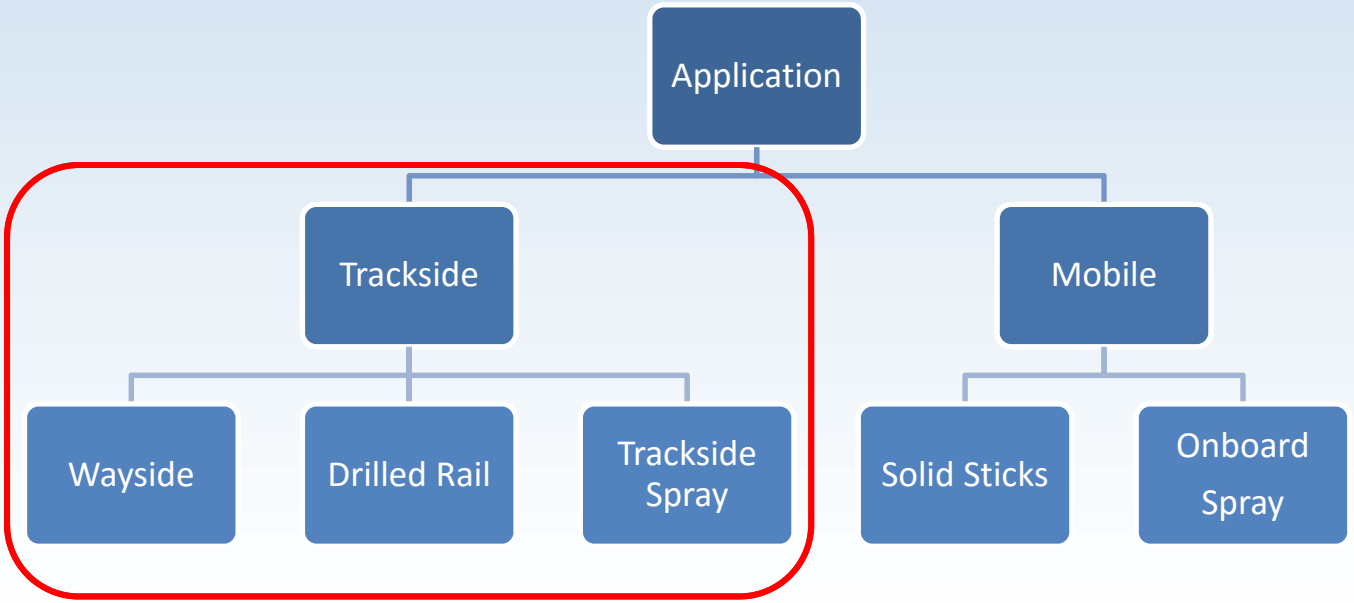
**Spray Systems:**

- Large install base, commonly used in Europe
- Single application system per train
- Fine tuned controls often with curve sensing capability

**Solid Sticks:**

- Large install base generating large volumes of engineering and performance data
- High quality lubrication, consistent application/performance with no tread/TOR migration
- Simple, clean system, easy to maintain

# Lubrication Approaches



# Trackside Lubrication

**History:**

- Historical approach to stationary track lubrication
- Many advances in technology over the years [output control, bars]
- Multiple suppliers of equipment

**Application Strategies:**

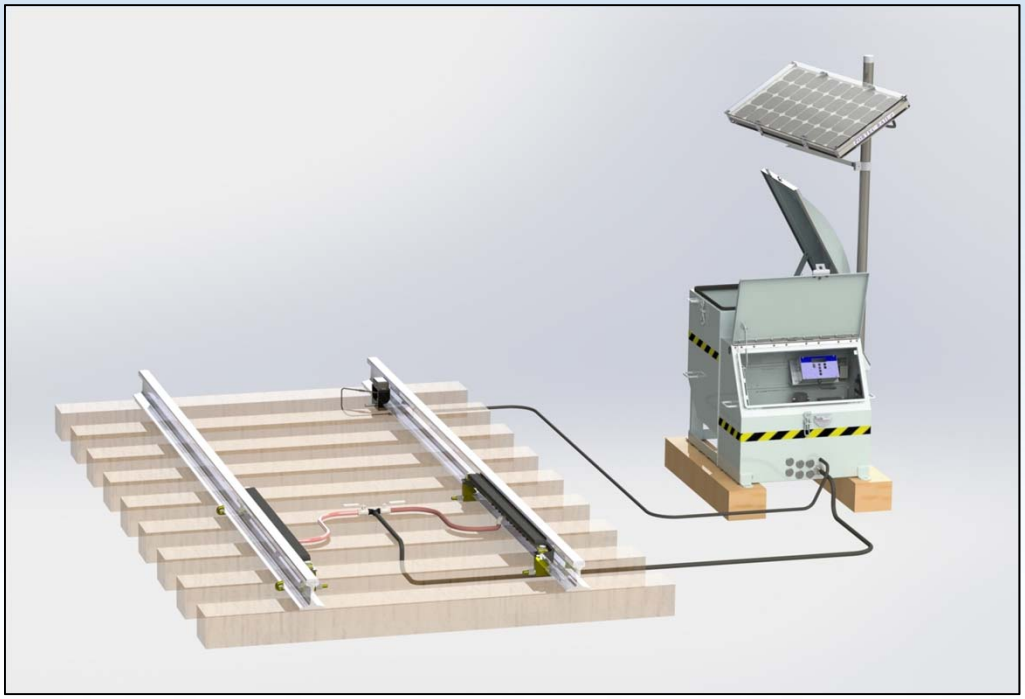
- Wayside lubricators
- Drilled rail
- Trackside spray


# Wayside Lubricator

**Accepted industry standard**

**Primary Components:**

- Tank [reservoir/electrical]
- Control System
- Pump/motor
- Wheel/train sensor
- Distribution hoses
- Application bars
- DC or AC power



# Application Bars

**Interface with Rail/Wheel:**

- Key component of a trackside lubricator for lubricant pickup and distribution

**Key Features:**

- Multiple distribution ports
- Trough or guide
- Application to running or restraining rails
- Easy to install/maintain

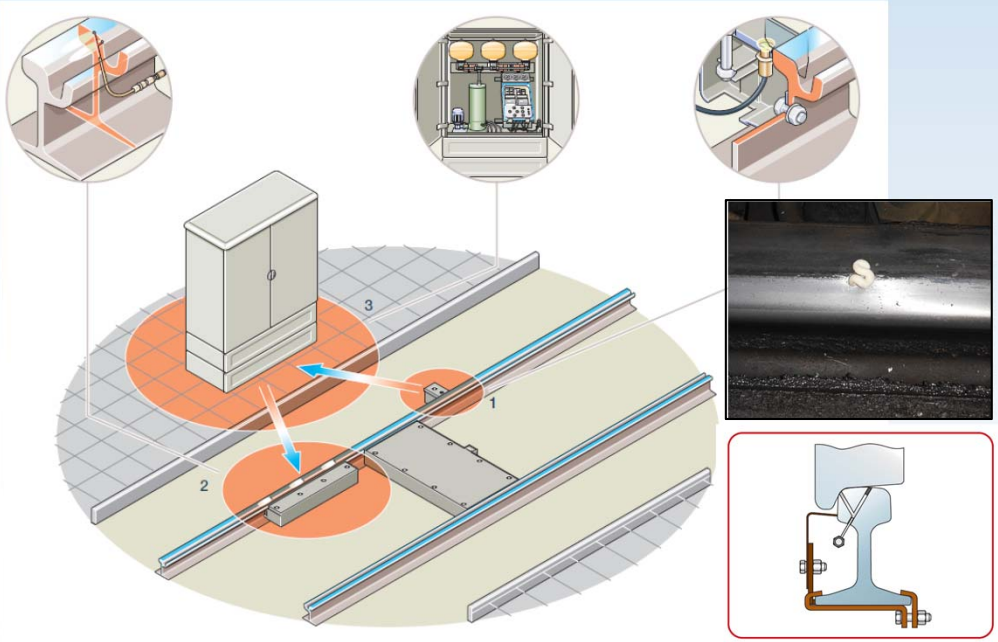
# Trackside: Drilled Rail

**Drilled Rail Lubricator:**

- Wall or pole mounted
- Controls, pump, reservoir

**Key Features:**

- Application via holes drilled in the head of the rail
- Suitable for embedded track sections
- Gauge, restraining rail, U-rail



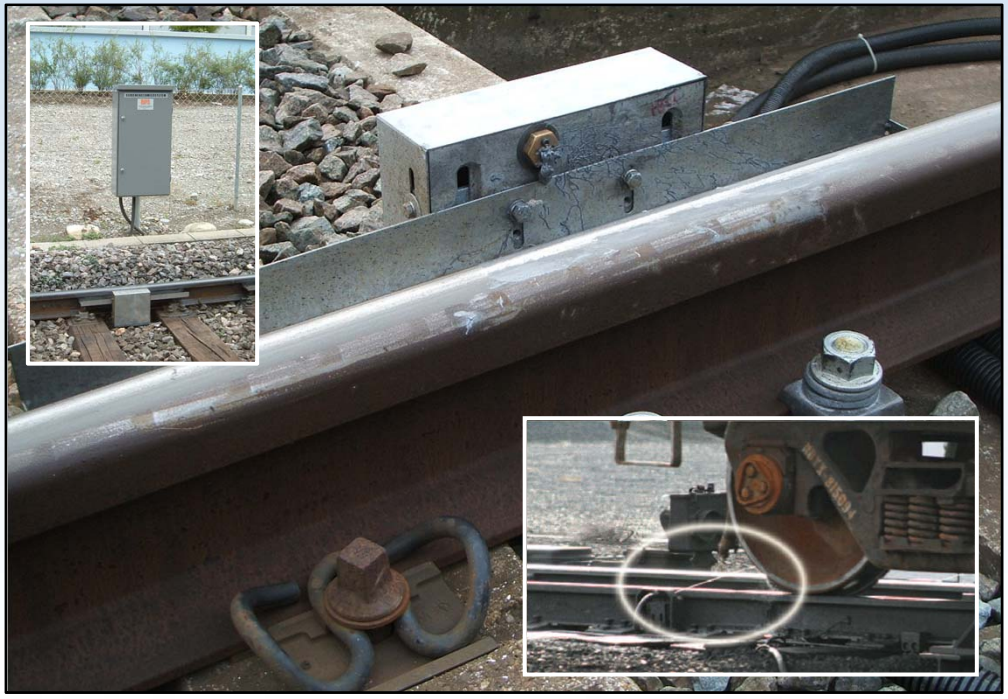
# Trackside: Spray

**Spray System Features:**

- Wall or pole mounted
- Controls, pump and reservoir
- Application by nozzles

**Key Features:**

- Application via nozzles aimed at the wheel or the head of the rail
- Multiple manufacturers



# Trackside: Considerations

**Wayside:**

- Effectively coats entire circumference of the wheel providing longer carrydown distance
- Broad range of application rates

**Drilled Rail:**

- Can be installed on embedded track, including U-rail guideway

**Spray Systems:**

- Ability to apply grease or oil

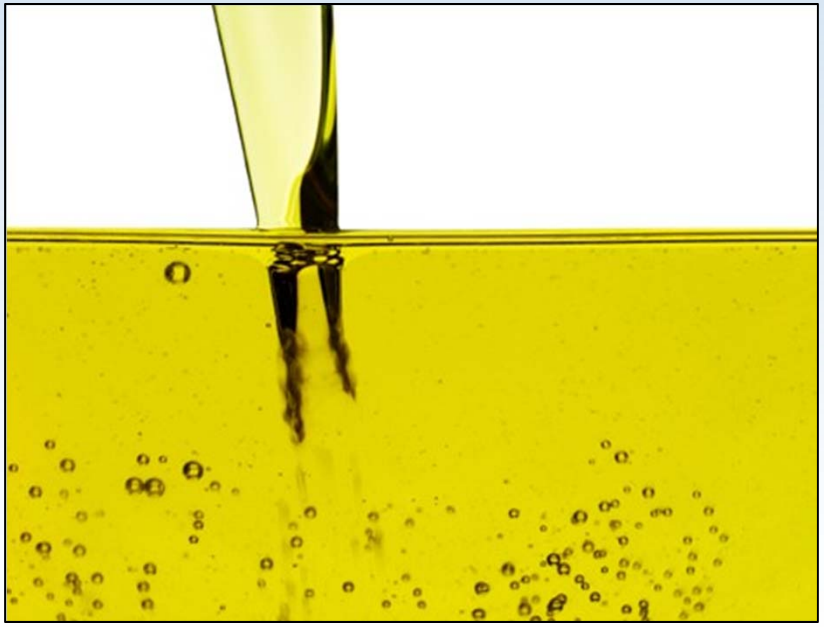
# What is the Right Consumable?

- Mobile
  - Solid Sticks
  - Oils
- Trackside
  - Grease
  - Oils

# Onboard Spray

**Onboard Spray System consumable characteristics:**

- Oils or low viscosity greases [NLGI 000]
  - May contain oil soluble additives or solid lubricants
- Generally single grade
- Multiple suppliers
- Biodegradable varieties available



# Solid Lubricant Sticks

**Solid Stick features:**

- Solid lubricant in thermosetting resin or other carrier
- Contains no oil or liquid components
- Consistent performance without migration to tread/TOR
- No contamination of the track structure, ballast or vehicle equipment
- Sticks are self extinguishing and non-toxic

# Trackside Grease

**Characteristics:**

- Compositional components
- Stability and consistency
- Retentivity/carrydown is a key feature for performance
- Functional temperature range
- Manufacturing consistency

**Three Main Families:**

- Ultra High Performance – synthetic or highly refined base oils
- Petroleum Based – industry standard
- Bio Based – readily biodegradable for environmentally sensitive areas

# Trackside Grease: Considerations

**Ultra High Performance:**

- **Advantage**: excellent carrydown at low application rates, wide temperature range
- **Limitations:** high cost per pound/kg

**Petroleum Based:**

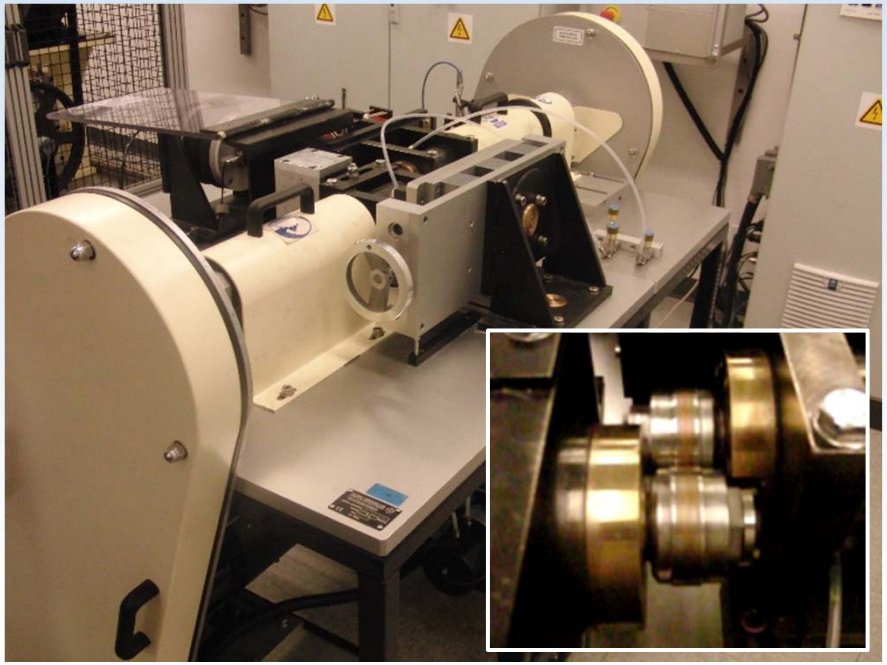
- **Advantage**: good performance at intermediate price
- **Limitations:** wide range of qualities, seasonal temperature range

**Bio Based:**

- **Advantage**: ranges of biodegradability
- **Limitations:** carrydown performance, seasonal temperature range

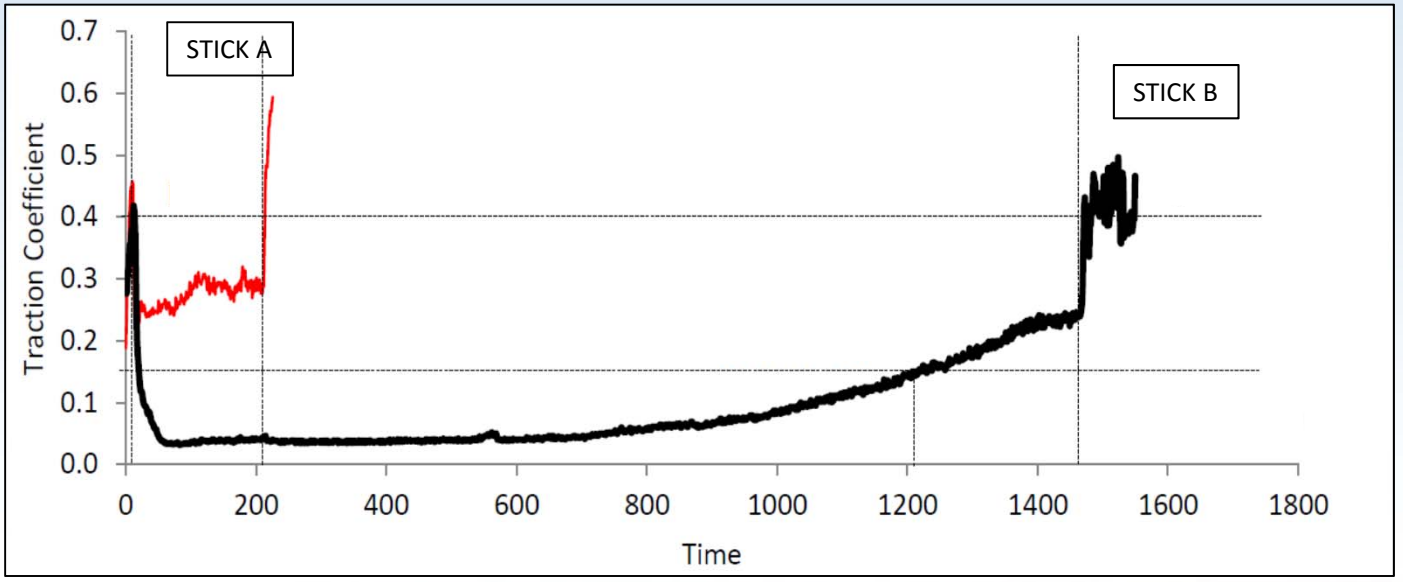
# Consumable Selection

- Multiple suppliers of consumables
- Different components/formulations
- How to understand the differences?
- Field data and published literature
- Twin Disk - Laboratory testing designed to simulate rail wheel interface
  - Friction levels
  - Retentivity

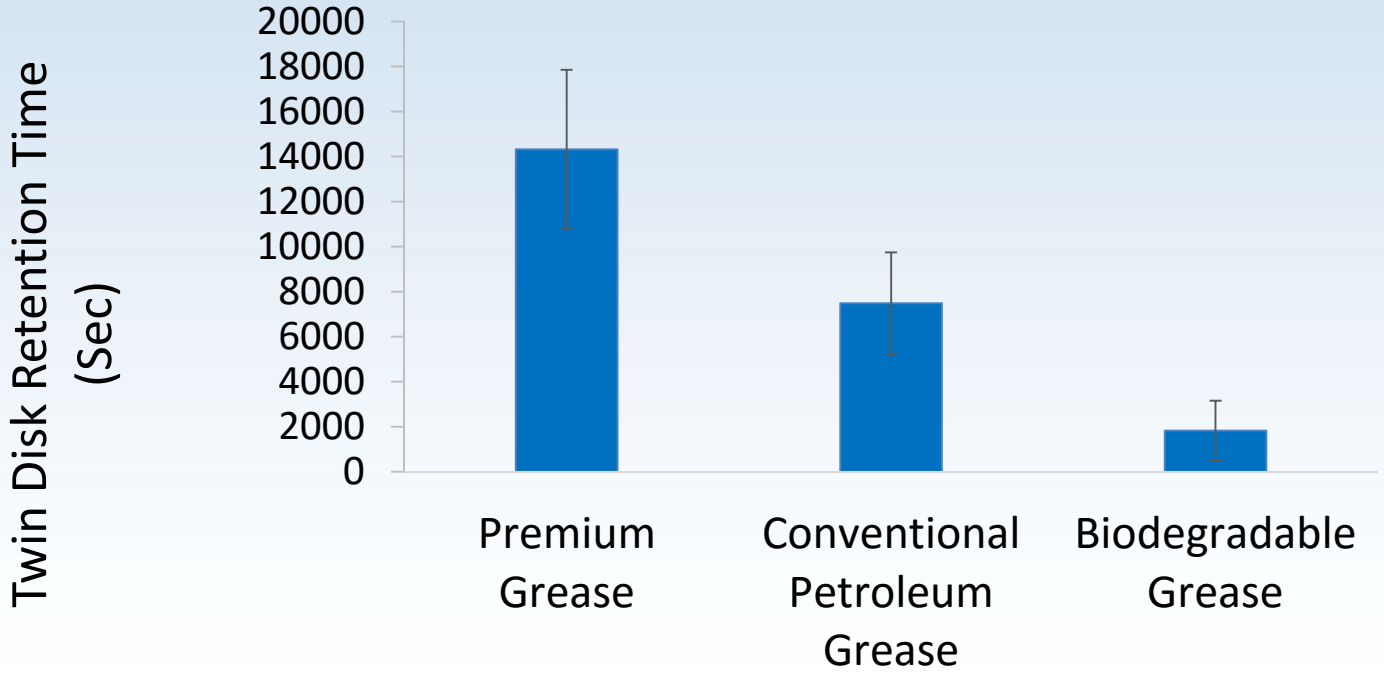


# Solid Stick Lubricant Composition

Twin disk testing of retentivity of various stick compositions



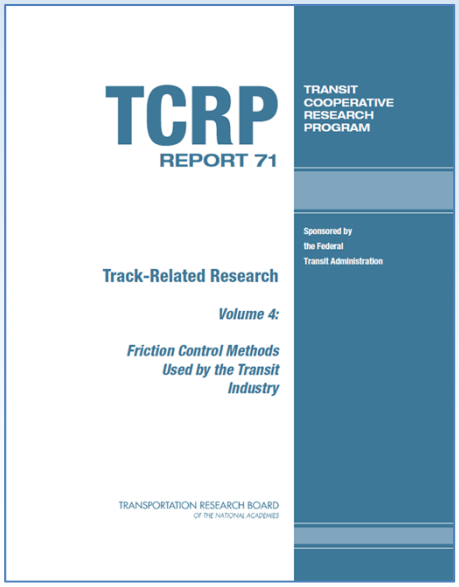
# Grease Retentivity



# Implementation

## Standards: Application/Equipment

- Standards for lubricant application and equipment are in place in Europe, UK, AUS and North America
- Mainly focused on equipment positioning/usage but beginning to look at consumables
- Rigid process for approval and focused on risk mitigation to fleet operation



# Implementation

## Standards: Consumables

- Standards for lubricants such as the NLGI specifications
- Tests developed from industrial application but they may not directly correlate to effectiveness in a rail environment
- Do not allow for alternative or new materials
- Improved standards is an area of opportunity for the rail industry

# Implementation

## Railroad/Infrastructure

- Technical Considerations
- System Details
- Organizational Characteristics

# Technical Considerations

**"Raw" Engineering Issues:**

- What is the issue to be addressed?
  - Wheel wear, rail wear, noise.
- Is it an isolated issue or multiple locations or system wide?
- How severe is the issue?
- Is the track or vehicles accessible?
- What is practical for the application?

# System Details

**Characteristics:**

- Is the system old or new?
  - Were the changes to track or vehicles?
- Who owns/operates the track and vehicles?
  - Outside party contracts?
- Is the track shared by multiple users?
- Vehicle type(s) and configuration?
- Track considerations?

# Organizational Features

**Culture/Personnel:**

- Who has the key decision making power?
- Vehicle and track departments working relationship?
- Where do the concerns come from?
- Who has the budget?
- Who realizes the benefits?
- Commitment to maintenance?

# Case Study 1

## Solid Sticks – Wheel Flange Wear

## Metro System [Suburban]

# Wheel Flange Wear: Solid Sticks

- Kuala Lumpur Airport Express with moderate curvature
- Commissioning tests indicated excessive flange wear on all vehicles
- Projected wheel life of 170,000 km (4.5 months operation)

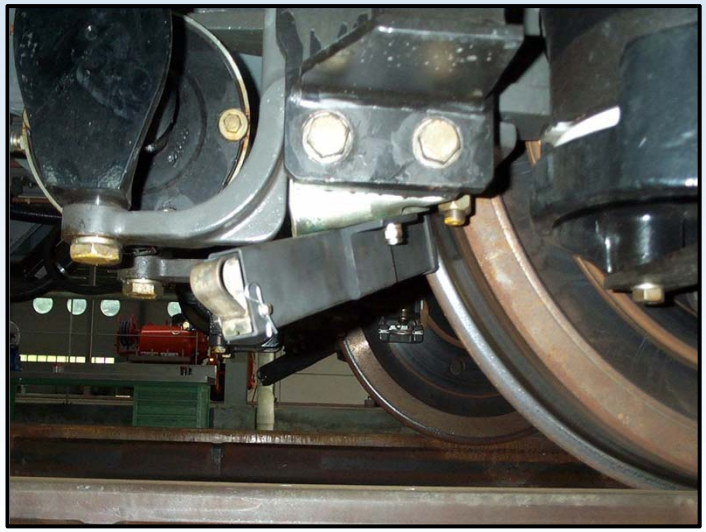
# Wheel Flange Wear: Solid Sticks

**Short term action**:

- Manual greasing increased projected wheel life to 290,000 km
- Manual application had a high labor costs.
- Misapplication of grease to railhead caused skid flats.
- Concerns about contamination from wayside lubricators

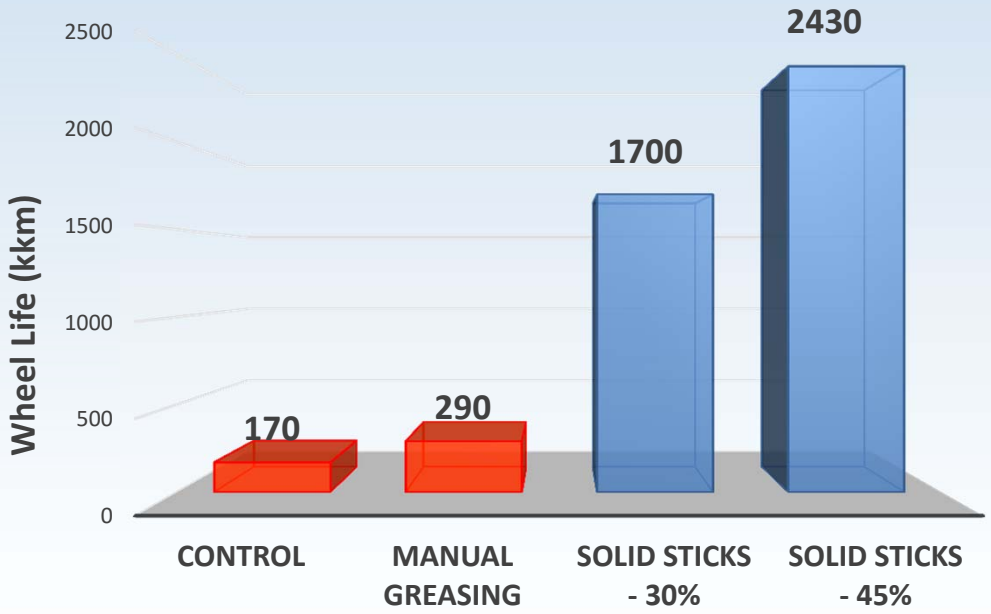
# Wheel Flange Wear: Solid Sticks

- Decision to implement train mounted solid sticks on fleet as a permanent solution.
- Fleet was initially outfitted at 30% coverage.
- Manual lubricant application stopped
- Wheel flange life extended by 10x at 30% coverage.
- Wheel flange life extended by 14x at 45% coverage.



# Wheel Flange Wear: Solid Sticks

- Reduction in rail wear – extending life of track.
- Increased train availability.
- Environmental cleanliness, both track and train.
- Net savings >US$ 2,000,000 in wheel-related costs.



# Case Study 2

## Solid Sticks – Gauge Face Wear

## Metro System

# Rail Wear: Solid Sticks

**Ankara Turkey**

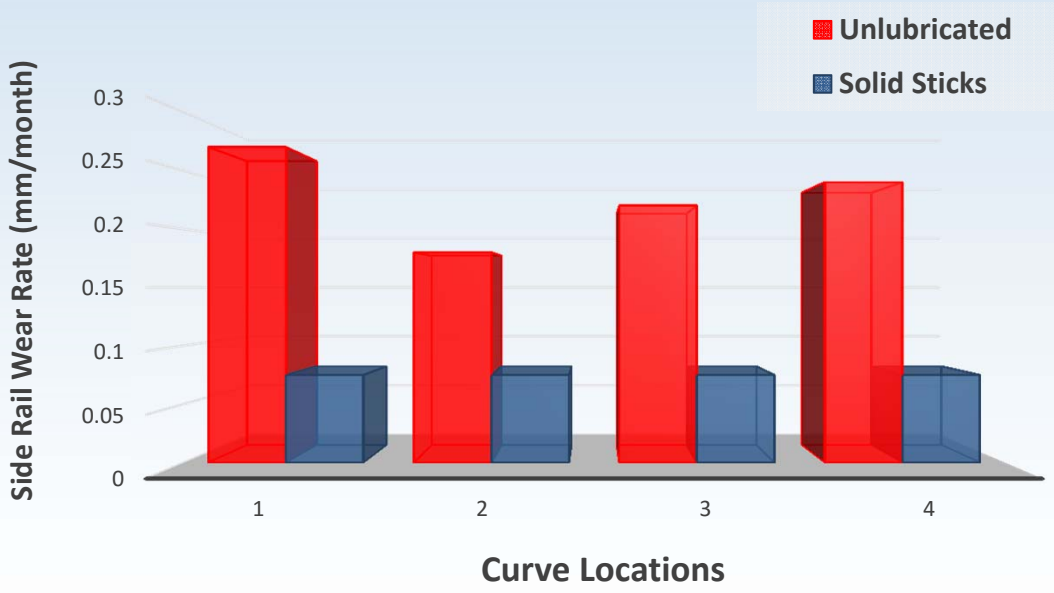
- Excessive rail gauge corner wear 9 months after commissioning.
- No lubrication planned in the design stages
- Temporary hand application of dry-film lubricant was introduced to mainline switches and some yard check rails.
- Initial reduction of wear rates with hand application of liquid lubricant.
- Concerns over top of rail contamination from onboard or trackside oil/grease application affecting acceleration/braking.

# Rail Wear: Solid Sticks

- Train mounted solid sticks were introduced due to the following advantages:
  - Continuous application
  - Precise application - no lubricant migration to TOR
  - Simple, reliable, low maintenance requirements
  - Clean, non-toxic, non-flammable
  - Proven track record

# Rail Wear: Solid Sticks

- 25% wheel coverage
- 200-500% reduction in wear achieved
- Extended mainline R300m curve rail life to 20 years
- Also saw reductions in wear on yard curves and switches



# Case Study 3

## Trackside Grease – Noise Control

## Light Rail System

# Noise Control: Trackside

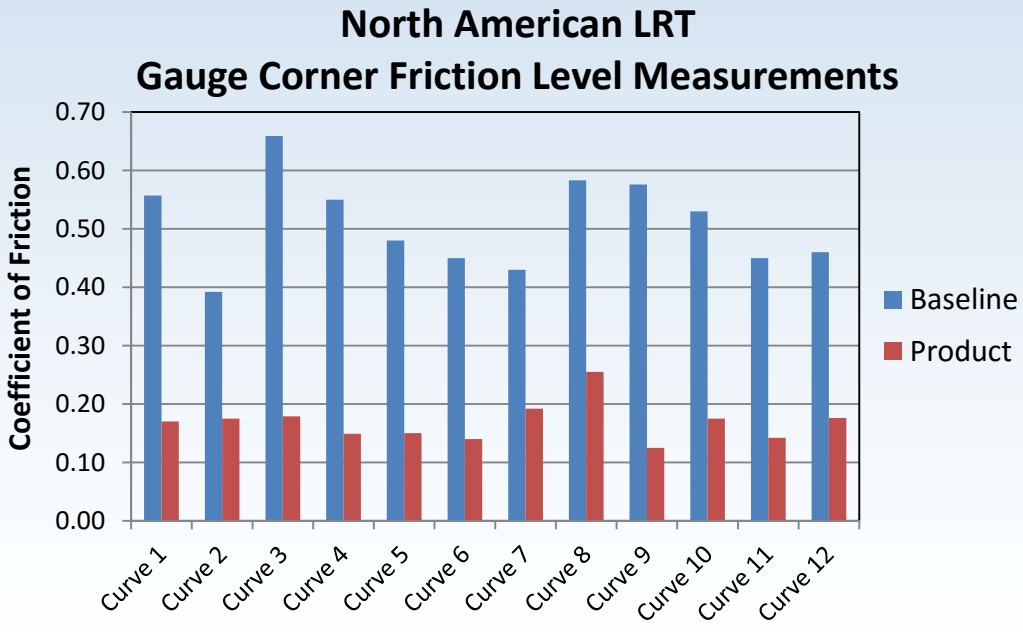
**North American Transit:**

Concern over high noise levels in a new line being constructed.

- Concern in curves with a radius less than 400 meters.
- Trackside application of grease to mainline rails on existing lines had been successful for controlling noise.
- Required carrydown of 0.5 miles to cover multiple curves

# Noise Control: Trackside

- Tribometer measurements used to verify application
- Sounds level measurements taking in revenue service
- Successfully controlled noise levels



# Conclusions

- Effective gauge face/wheel flange lubrication can successfully:
  - Mitigate high wear rates of both wheel flanges and rail gauge face/corner
  - Provide additional benefits
- Variety of application strategies and consumable options.
- Selection needs to include review of system details, technical aspects and the railroads culture.
- Ideally looked at with a systems approach as the benefits are realized by both the vehicles and track.

# Thank You for Your Attention

LBFoster
Rail Technologies