This is an ARISO Australian Standard® development draft

Content in this document is for ARISO product development purposes only and should not be relied upon or considered as final published content.

Any questions in relation to this document or ARISO's accredited development process should be referred to ARISO.

ARISO Contact details:

Head office:

Phone:	Email:	Web:
(07) 3724 0000 +61 7 3724 0000	info@ariso.org.au	www.ariso.org.au

Standard Development Manager:

Name:	Phone:	Email:
Jodie Matheson	0447 454 501	jmatheson@ariso.org.au

Copyright

Data entry – draft starts next page

Standard number	AS 7641
Version year	2026
Standard name	Rail Friction Management
Development group member organisations	Airlube, ARC Infrastructure, Aurizon, Bradken, Centre for Railway Engineering, Department of Transport and Planning Victoria, Jacobs, KiwiRail, Metro Trains Melbourne, Public Transport Authority, Queensland Rail, Sydney Trains, Transport for NSW
Standing Committee	Infrastructure
Review type	Targetted Review
First published	AS 7641:2018
ISBN	TBD
SDM name	Jodie Matheson
SDM phone	0447 454 501
SDM email	jmatheson@ariso.org.au

Development draft history

Draft version	Draft date	Notes
0	8/01/2026	Initial version generated from the most recently published version.
1	10/02/2026	SG006 and ARISO styles update and minor updates for initial DG review.
2	27/03/2026	Update post DG review and comment
3	05/05/2026	Update post DG review and comment

Preface

This standard was prepared by the Rail Friction Management Development Group, overseen by the ARISO Infrastructure Standing Committee.

The major changes in this edition are as follows:

(a) Re-write of Objective and Scope sections to further improve clarity;

(b) Content not a requirement moved to appendix; and

(c) Inclusion of top of rail (TOR) friction management.

Objective

This document establishes the functional and performance requirements, approved configuration for the design and installation of rail friction management systems, comprising of gauge face rail lubricators and top-of-rail friction modifiers

Compliance

There are four types of provisions contained within Australian Standards developed by ARISO:

(a) Requirements.

(b) Recommendations.

(c) Permissions.

(d) Constraints.

Requirements – it is mandatory to follow all requirements to claim full compliance with the Standard. Requirements are identified within the text by the term 'shall'.

Recommendations – do not mention or exclude other possibilities but do offer the one that is preferred. Recommendations are identified within the text by the term 'should'.

Recommendations recognize that there could be limitations to the universal application of the control, i.e. the identified control is not able to be applied or other controls are more appropriate or better.

For compliance purposes, where a recommended control is not applied as written in the standard it could be incumbent on the adopter of the standard to demonstrate their actual method of controlling the risk as part of their WHS or Rail Safety National Law obligations. Similarly, it could also be incumbent on an adopter of the standard to demonstrate their method of controlling the risk to contracting entities or interfacing organisations where the risk may be shared.

Permissions – conveys consent by providing an allowable option. Permissions are identified within the text by the term 'may'.

Constraints – provided by an external source such as legislation. Constraints are identified within the text by the term 'must'.

ARISO Standards address known hazards within the railway industry. Hazards, and clauses within this Standard that address those hazards, are listed in Appendix A.

Appendices in ARISO Standards may be designated either "normative" or "informative". A "normative" appendix is an integral part of a Standard and compliance with it is a requirement, whereas an "informative" appendix is only for information and guidance.

Commentary

Commentary *C Preface*

This Standard includes a commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by 'C' preceding the clause number and is printed in italics in a box. The commentary is for information and guidance and does not form part of the Standard.

Table of Contents

Figures

Equations

Tables

Section 1 Scope and general

1.1 Scope

This document specifies rail friction levels for lubricated rail curves and provides guidance on wayside lubrication systems design to achieve these friction levels.

Friction management using solid or fluid (oil, grease, etc.) substances at the wheel-rail interface includes the following aspects:

(a) Lubrication of the wheel flange/rail gauge corner (active interface), commonly referred to as 'flange or rail lubrication'.

(b) Friction modification of the top-of-rail/wheel tread interface, commonly referred to as 'top of rail friction management'.

This document does not specifically cover light rail, and high-speed rail, isolated heritage rolling stock and tourist railways but items from this document may be applied to such systems and/or rolling stock as deemed appropriate by the relevant rail transport operator.

1.2 Normative references

There are no normative references in this document.

NOTE:
Documents for informative purposes are listed in a Bibliography at the back of the Standard.

1.3 Defined terms and abbreviations

For the purposes of this document, the following terms and definitions apply:

1.3.1
CoF
coefficient of friction

1.3.2
rail friction modification
friction control at the wheel-rail interface within designed range by applying friction modifier on the top of rail

1.3.3
friction modifier
substance that is designed to be used for top-of-rail applications to control friction on the rail surface

1.3.4
high rail
rail on the outside of a circular or transition curve

1.3.5
low rail
inside rail of a circular or transition curve

1.3.6
lubricator placement number (LPN)
single number metric used to model the carry distance of a lubricator and lubricant combination

1.3.7
lubricant
substance that is designed to lower friction and wear for rail lubrication

1.3.8
safety data sheet (SDS)
document that provides information on the identification, hazards, precautions for use and safe handling of a specific product

1.3.9
rail head
region of the rail above the top-of-rail web

1.3.10
rail lubrication
reduction of friction at the wheel-rail interface by applying an intermediate substance with low friction characteristics

1.3.11
friction management systems
number of lubricant dispensing equipment within a given railway network segment that, by their placement, comprised of location, spacing, and lubricant factors, is designed and maintained to meet defined performance criteria

> Note 1 to entry: Measurement of track and wheel flange movement factors is designed to reduce occurrence of wheel and rail wear and wheel/rail interaction noise.

1.3.12
rail infrastructure manager (RIM)
As defined in Rail Safety National Law.

1.3.13
rolling contact fatigue (RCF)
fatigue of the surface and near surface material due to cyclic high wheel-rail contact stresses leading to surface and subsurface crack development

> Note 1 to entry: Caused by repeat wheel-rail contact stresses, RCF develops under cyclic high-pressure loading, leading to surface or subsurface cracks, spalling, or rail breaks.

1.3.14
tight radius curve
curve with a small radius in which the wheel steers through the curve with the flange contacting the high rail

1.3.15

shallow radius curve
large-radius curve in which the wheel steers through without the wheel flange contacting the rail

> Note 1 to entry: Shallow curves are gauge dependent and will vary between narrow, standard and broad gauge. For example, narrow gauge will have a tighter curve in comparison to standard or broad-gauge track.

1.3.16
moderate radius curve
curve with a moderate to small radius in which the wheels steer through and with some flange contacting the high rail

> Note 1 to entry: There is an intermediate position in curves where some bogies will steer through but other bogies have some or all flanges can contact the high rail.

1.3.17
top of rail (TOR)
the top running surface of the rail which makes contact with the wheel tread

1.3.18
train operating condition (TOC)
set of operational requirements, restrictions, and parameters that apply to a specific train, route, or operating scenario

1.3.19
tribometer
tool for measuring the coefficient for friction (CoF) on rail surfaces

General rail industry terms and definitions are maintained in the ARISO Glossary. Refer to: https://www.ariso.org.au/glossary/

Section 2 Rail friction levels

2.1 General

Rail friction management is primarily aimed at extending the life of rail and wheels.

Rail friction management involves introducing substances between the wheel and rail surfaces which have specific friction characteristics.

Rail friction management can be employed at specific locations on rail networks to reduce:

(a) wheel wear;

(b) rail wear;

(c) the likelihood of flange climb of high rails;

(d) RCF development;

(e) rail corrugation development; and

(f) curving noise generated at the wheel-rail interface.

Commentary *C2.1*

Lubrication can sometimes adversely affect the growth of RCF on high-rail switches and wheels—both head-check cracks and rail squats are affected by lubricants and water. The positive effects of lubrication preventing initiation can be undone by a wheel slide event that leaves a white etch layer (heat damaged steel) on the gauge corner. The white etching layer initiates cracks as it breaks down which then have accelerated growth with lubricant entering the cracks.

2.2 Rail friction management

Rail friction management comprises one or both of two key system types: gauge-face lubrication and top-of-rail friction modification.

Gauge-face lubrication involves applying lubricant to the wheel flange and rail-gauge corner to substantially reduce the coefficient of friction at that interface. It is also commonly referred to as flange lubrication or rail lubrication.

Top of rail friction modification (TORFM) involves applying a friction modifier to the top-of-rail and wheel-tread interface to control and stabilize the coefficient of friction at the interface, rather than just reducing it.

Friction management systems may be delivered through wayside equipment or onboard (rolling stock-mounted) systems, depending on operational requirements and network conditions.

2.3 Rail friction management system performance requirements

Rail friction management systems shall be designed and maintained to meet the performance requirements detailed in Table 1.

Table 1 Rail Friction Levels

Rail friction management system type	Rail head regions	Coefficient of Friction (CoF)
Lubrication	Rail-gauge corner	≤0.25
Friction modification	Top-of-rail contact band	>0.3*
NOTE: *Optimal target range is >0.35 to 0.40.		

2.4 Noise Management

Where friction management systems are used to mitigate curving noise, the resulting noise levels shall comply with the limits specified in the relevant state-based planning and environmental policies.

Measurement of rail friction should be undertaken with the methodology outlined in Section 3.

Section 3 Rail friction measurement

Rail friction measurement should be taken using a suitable tool which has been approved by the RIM.

The tool used shall be in good working order and calibrated in accordance with the manufacturer's instructions.

The measurement wheel, where fitted, shall be free from grease residue and contaminants at the commencement of each measurement.

Friction measurements shall be taken on dry track that is free of precipitation and represents normal operating conditions which can include the presence of dust, sand or other visually detectable contaminants.

Top-of-rail surface lubricant contamination can exist in the immediate vicinity of the lubricator and should not extend more than 50 m or where it has the potential to impact operational activities.

When measuring top-of-rail friction, measurements shall be taken on the top of the rail in the centre of the running surface region (nominally zero degrees).

When measuring gauge-corner friction, measurements shall be taken as close as practicable to 45 degrees from vertical while avoiding any rail-grinding facets.

Measurements should not be taken on large grinding facets.

A three-to-four-finger wipe or sticky tape measurement should be sufficient within the main body of the curve to establish whether rail lubricant is present on the gauge corner of the high leg of the curve. Figure 1 shows the gauge corner and running surface on a typical rail, including the respective rail friction measurement regions.

Measurement of both rails at measurement sites can be informative depending on the reason for measurement.

NOTE:
Rail head profiles specified in AS 1085.1 contain similar regions.

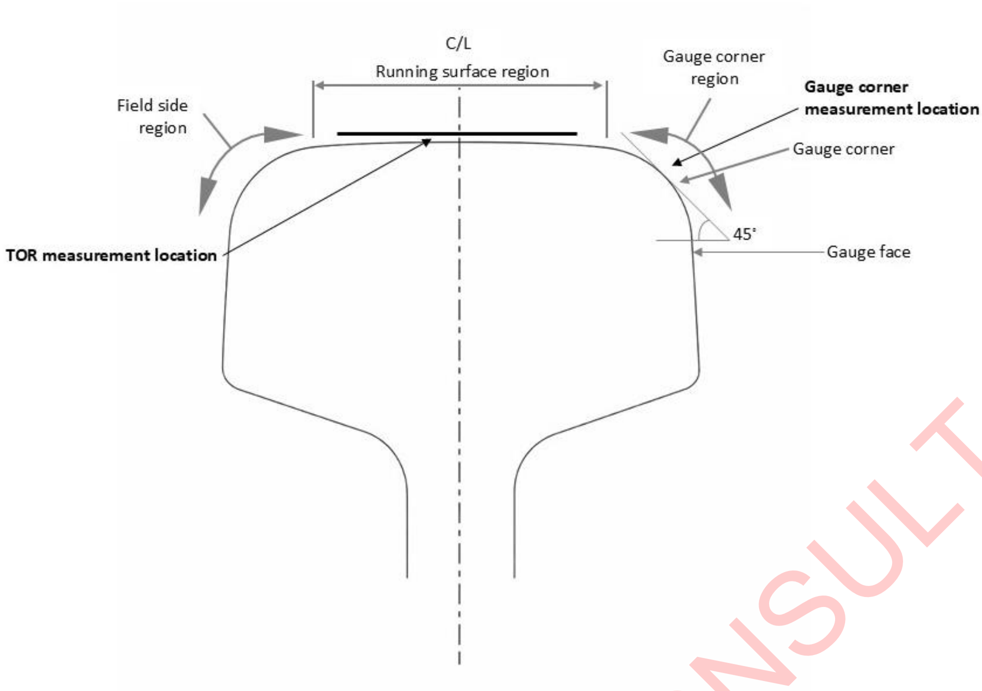

Figure 1 Rail head friction measurement regions

Section 4 Typical rail friction measurement method

At least ten (10) measurements should be taken in the body of the curve at the location of the highest curvature or wear point at intervals in the area of interest to account for variability in measurements and variability from geometry irregularities.

The friction measurements should be recorded as required by the RIM. See Appendix B for a sample friction measurement record sheet.

An average friction level for the top of each rail and the high rail gauge corner should be calculated and recorded using at least five readings after anomalous friction readings and the highest and lowest 10% of friction readings have been excluded.

Additional information that should be recorded at the time of testing includes:

(a) location and track;

(b) date;

(c) time of day;

(d) environmental conditions:

  (i) ambient temperature; and

  (ii) humidity.

(e) tribometer serial number; and

(f) tribometer settings.

These records should also include a site sketch showing the lubricator locations, the curves and friction measurement locations and photographs of both rails.

Prior to capturing rail photographs within tribometer measurement limits, the location, rail, running direction, gauge face and date should be clearly written on the rail surface.

Section 5 Wayside rail friction management system placement

5.1 General

A wayside rail friction management system consists of the following components:

(a) Unit: The off-track component that houses the consumable product, control equipment, and associated hardware (excluding hoses and on-track components).

(b) System: The complete installation, including the unit plus all on-track components such as hoses and application bars that deliver product to the rail.

5.2 Wayside rail friction management systems

Where wayside rail friction management systems are implemented, the RIM shall develop and maintain a rail friction management plan (RFMP) in accordance with the requirements and principles of this document.

The design type approval process should be done in accordance with AS 7702 and be approved by the RIM.

The RIM shall develop and maintain an asset register for all wayside rail friction management system components.

The top-of-rail friction modification systems should be placed in advance of curves that have the potential to exhibit or have a documented history of the following:

(a) Low rail RCF and plastic flow.

(b) Severe rail corrugations.

(c) Wheel/rail noise levels generated by tread contact that have been assessed as severe enough to require correction.

> Commentary *C5.2-1*
>
> For curves of a tight curve radii, an assessment of the curve, associated noise, RCF risks and profile management can demonstrate that top-of-rail friction management is not required.
>
> Commentary *C5.2-2*
>
> For curves of moderate radii, an assessment of the curve would determine the percentage of passing wheelsets in high rail gauge contact and the risks of RCF damage and can determine lubrication is not required.

A single unit may service multiple curves.

Top-of-rail friction modification system placement should be approved by the RIM.

When new track is installed or existing track is modified, the impacts to adjacent existing friction management systems shall be assessed. Any identified impacts shall be addressed to ensure alignment with the RFMP and compliance with this document.

Where new wayside friction management systems are required for new or modified track, the impacts to adjacent existing track sections shall be assessed. Any identified impacts shall be addressed to maintain consistency with the RFMP and ensure compliance with this document.

Wayside rail friction management systems shall have tank capacities appropriately sized to maintain adequate product levels for the intended maintenance intervals.

5.3 Placement requirements

Wayside rail friction management systems shall be designed and manufactured to minimize the need for routine access for monitoring, inspection and maintenance.

Units shall be located outside the rail danger zone so that inspection, maintenance and adjustment tasks can be carried out safely.

Wayside gauge face lubrication systems shall not be installed on curves with existing severe rolling contact fatigue (RCF), as lubrication can accelerate RCF propagation. Such curves shall be ground or re-railed before installation.

Lubrication can sometimes adversely affect the growth of RCF on high rails switches and wheels—both head check cracks and rail squats are affected by lubricants and water.

Systems shall be placed so that braking and traction performance near signals, stations and level crossings is not adversely affected.

Placement should also factor in the position and use of level crossing pads or flangeway fillers to minimize excess grease deposits at level crossings and stations.

The positive effects of lubrications preventing initiation can be undone by a wheel slide event that leaves a white etch layer (heat damaged steel) on the gauge corner. The white etching layer initiates cracks as it breaks down which then have accelerated growth allowing lubricant to enter the cracks.

The location of wayside rail friction management system placement shall be risk assessed to factor in the location and impacts to watercourses or other environmentally sensitive areas.

Units shall be positioned on stable, level ground or securely mounted to an appropriate fixed structure. Where this is not feasible, a structural pad shall be constructed in accordance with the manufacturer's requirements.

Units shall be secured such that there is no risk of fouling the rolling stock kinematic envelope.

Units shall be located away from existing infrastructure where their operation has the potential to interfere with the safe and correct functioning of that infrastructure.

Top-of-rail friction modifiers and gauge-face lubricant products should not be applied to the same rail within the same tangent-track segment to prevent the consumables mixing and adversely impacting the performance effectiveness of one or both friction control agents.

If both top-of-rail and gauge-face systems are required within the same tangent-track segment, the top-of-rail system should precede the gauge face system by at least 30 m or be placed after the gauge-face system by at least 75 m for the intended direction of coverage.

Application bars shall be installed at least 30 m from signalling equipment, wheel-condition monitoring systems, axle counters and any other track-mounted devices that have the potential to be negatively affected by the applied substance.

Application bars should be installed at least 30 m from insulated rail joints or as otherwise identified to manage risk.

A risk assessment should be conducted to support system placement near other infrastructure and assess the following as a minimum:

(a) The type of lubrication in use (some are more likely to affect electrical circuits than others);

(b) The location of the lubrication device — is it near a stopping location, plain track or tangent track;

(c) OEM advice for lubrication, lubrication device, track device; and

(d) Any known historical events where lubrication has caused loss of detection or wrong / right side failures.

Solar powered units shall have battery backup capacity to ensure uninterrupted operation.

Methods should be established to continually review and refine lubrication systems to optimize the performance.

Appendix A Hazard Register (Informative)

A.1 ARISO hazard register

The following hazards have been sourced from the ARISO hazard register.

Hazard number	Hazard
6.1.1.3	Excessive noise
6.2.1.1	Wheel squeal
6.4.1.3	Lubricants, service fluids and consumables
6.6.1.4	Derailment
6.6.1.7	Excessive rail wear and/or a damaged rail
6.6.1.12	Wheels climbing rail heads
6.6.1.21	Wheel skidding
6.6.1.38	Poor traction control

A.2 Other hazards

The following additional hazards can be managed through the use of this document.

Hazard
Excess lubrication
Contamination of lubricant (rail surface, tank, reservoir)
Spillage environmental impact
Contamination of ballast from friction management substances

Appendix B Example – Lubrication Using Wayside Application Equipment (Informative)

B.1 Introduction

The following information is derived from T HR TR 00111 ST (2015), © State of New South Wales (Transport for NSW), and is based on the LPN design approach.

B.2 Wayside lubricator placement design approach

The process outlined in this section for the optimal placement of lubricators is based on the concept of a lubricator number replacement (LPN) and is retained in this Appendix for information purposes for organizations that choose to use the LPN system

B.2.1 General

The system design is established during the lubricator and lubricant type test procedure.

New combinations of lubricators and lubricants may be type approved according to the organization, prior to their operational installation on the network. Guidance on the type-approval process can be obtained from the organization's lead track engineer/qualified and competent person. A concession process may be in place which outlines the process for requesting a concession to any localized procedural requirements.

B.2.2 Lubricant standards approval

All lubricants to be type tested should comply with the requirements of BS EN 15427-2-1 and AS 7702.

B.2.3 Field trials

Lubricator and lubricant combinations should be tested on a working track to establish that they operate effectively, efficiently and safely.

The test site should be a section of track that includes both left- and right-handed curves of a radius 400 m or less, and that carries both freight and passenger traffic.

Field trials should be repeated at the same site periodically to evaluate lubrication performance and inform any required adjustments.

All tests should be approved by the RIM. Refer to the lead track engineer or qualified and competent person as appointed by the RIM for the application procedure for approval to undertake field trials.

B.2.4 Requirements for a field test report

Type test reports should be submitted in accordance with the relevant type test procedure. Test reports from field trials should include the following:

(a) A description of the product(s) under test, including product specifications and safety data sheets (SDS).

(b) A detailed description of the test, including a map of the test site showing the lubricator and measurement locations, the settings used throughout the testing, calibration details for the tribometer and any other instruments used, photos of the test site, lubricator and anything else relevant to the report.

(c) Friction measurement test records and any other raw results, included in an Appendix.

(d) The lubricant carry distance, the individual curve LPNs and the final cumulative LPN value.

B.2.5 Lubricant and LPN calculation process

The following process should be followed to calculate the LPN during type testing:

(a) The lubrication configuration to be tested should be set up on a section of track that includes both left- and right-handed curves of varying radii in a position free from contamination from neighbouring lubricators, and from previous lubricator operation.

(b) The track should not be lubricated for at least 20,000 axle passes before the test starts, after which the gauge corner friction levels shall be measured to confirm that no contamination from previous lubrication operation persists.

(c) The lubricator should be operated for 40,000 axle passes under typical traffic conditions before rail friction is measured.

(d) Unidirectional rail traffic running:

  (i) On one single track of a dual-track operation with all rail traffic travelling in the same direction.

  (ii) On one single track with more than one rail traffic travelling in the same direction followed by more than one rail traffic travelling in the opposite direction. For example, in a heavy haul railway operation on a single track, the loaded trains travel from mine to port and the empty trains travel from port to mine.

(e) Bi-directional rail traffic running:

  (i) On one single track with one rail traffic travelling in one direction followed by the next rail traffic travelling in the opposite direction.

(f) Lubrication performance is established using the friction measurement procedure as detailed in Section 3.

  (i) Bi-directional rail traffic running on one single track with more than one travelling in the same direction followed by more than one rail traffic travelling in the opposite direction. Measurements should be taken after the passage of the heavier rail traffic travelling in the same direction.

  (ii) Bi-directional rail traffic running on one single track with one rail traffic travelling in one direction followed by the next rail traffic travelling in the opposite direction. Measurements should be taken after the passage of the heavier rail traffic.

(g) Friction measurements should be taken on each curve, starting from the lubricator, until the average CoF on the gauge corner of the high rail exceeds or meets the required value contained in Appendix Equation B.2.6.

(h) The in total LPN is then calculated using Appendix Equation B.2.6 for the length of track between the lubricator and the point at which the CoF limit was exceeded.

An LPN is calculated separately for each curve between the lubricator and the point where friction exceeds the limit. The total of these numbers is the LPN for that lubricator and lubricant combination. For lubricators serving both rails, the LPN shall be the greater of the individual LPNs calculated for each rail.

Following successful completion of the type-approval process for a particular lubricator and lubricant combination, the LPN may be recorded by the RIM organization.

If the initial LPN is based on a type approval process at only one or two locations, the LPN will change when the whole system has rail that is better lubricated. RIMs should have a process to update the LPN as the system conditions.

B.2.6 Example lubricator placement number formula

Appendix Equation B.2.6

$$LPN = \frac{(C + S) x G x D}{T x M x BR x BG}$$

Where:

(Track factors)

C = the length (metres) of curves in the section, including the transitions
S = 5% of the length (metres) of tangent sections between the lubricator and first curve or between curves
G = the relative performance of different lubricants
D = the degree of curvature

(Rolling stock factors)

T = the direction of traffic
M = factor to account for misaligned bogies on tight curves
BR = factor to account for train braking, that only applies to negative grades
BG = bogie factor

Commentary *CB.2.6*

Appendix Equation B.2.6 is based on the LPN process sourced from © State of New South Wales (Transport for NSW) T HR TR 00111 ST (2015) and is based on that rail network.

Track factors

C—the curve length C for the calculation is the distance between the tangents or the end of transitions before and after the curves. The longer the curve, the more that wheel flanges are in contact with the gauge face of the high rail.

S—this takes into account of the loss of lubricant on straight track due to hunting.

G—the relative performance of different lubricants. This will always be 1 if the lubricator and lubricant combination has been type tested, as any differences in lubrication performance will have been accounted for in the LPN.

D—is related to the curve radius R by: $D = \frac{1746}{R}$

Rolling stock factors

T—use values 1 for unidirectional traffic and 2 for bi-directional traffic.

True bi-directional traffic refers to one rail traffic in one direction and the next rail traffic in the opposite direction. If traffic patterns are several rail traffic in one direction, then several rail traffic in the opposite direction, the track should be assessed as unidirectional.

M—On shallow curves and tangents: M = 1

M—On moderate curves: $M = \frac{1}{1+x}$ (where x is a value between 0 and 1 and is the proportion of poorly steering bogies. 1 stands for 100% poorly steering bogies)

Heat is generated by rail traffic due to braking forces when descending graded track which displaces lubricant from the gauge corner. Tread braked vehicles will transfer more heat to the rail than disc braked

BR—(100 -10* |grade|)/100 for negative gradient, where grade is expressed as a percentage and the |…| operator stands for the absolute value and 1 elsewhere.

For example, if the gradient is -1:50, that is 2% descending, then BR = (100 – 10 * 2) / 100 = 0.8, whereas if the grade was 1:50, that is 2% ascending, then BR = 1.

BG—accounts for the greater impact of poorly steering bogies on tight curves compared to shallow curves. Where the wheel to rail contacts and bogie steering is being assessed, collaboration with experts from track and rolling stock fields will provide greater inputs into the discussion.

BG = 2 for tangent and shallow curves

BG = 1 for moderate curves

In this method, each contributing parameter is assessed individually and the resulting values are accumulated at the end of the calculation to produce the final LPN score.

Appendix Equation B.2.6 is empirical and requires an expert panel to recalibrate the parameters to the specific system. Recalibration can require replacing some terms with different terms, as an example: a super elevation balance term.

Definitions for tight moderate and shallow curves have been added to this document though it is noted that good practice for assessing curves factors the rolling stock bogies, the gauge of the track and the radius of the curve.

B.3 Stage 2 – Lubrication system configuration concept design

The lubricator system configuration concept design establishes the ideal placement of lubricators along a track. The actual placement of the lubricators is then finalized in the Stage 3, the detail design phase following site inspections.

The following calculation process establishes the ideal placement of lubricators along a track:

(a) Select a point for the placement of the first lubricator in a system to ensure that the first curve is well lubricated.

(b) Select a point on the tangent or transition past the first curve after the first lubricator. Calculate the LPN for the high rail on curve 1 (see Appendix Equation B.2.6).

(c) Repeat this process for the high rail on curve 2.

(d) Continue to repeat the process and calculate the cumulative LPN for each rail after the lubricator until the point where this total for either rail matches the type approval LPN.

(e) Establish a suitable site for a second lubricator near this point and repeat the process to position following lubricators.

B.4 Stage 3 – Lubrication system configuration detail design

The lubricator system configuration detail design will establish the final position of lubricators after a site inspection and assess a range of factors including the following:

(a) Rail traffic operations

  (i) Lubricators should be located so as to ensure that braking and traction around signals, stations and level crossings are not compromised.

(ii) Systems should be located where the rail traffic is expected to traverse the position at a consistent and steady rate or speed.

(b) Maintenance access

(i) Place lubricators as close as possible to maintenance access roads to enable positioning of maintenance vehicle beside the reservoir to minimize manual handling of lubricants.

(ii) The requirement to carry lubricants across live track should be avoided. Where the track being treated is on the opposite side of the corridor to the access road, the reservoir should be positioned adjacent to the access road and hoses should run beneath the intervening rails. The hoses should be run so that they are clearly visible, do not present a trip hazard and cannot move under rail traffic (for example, hoses may be secured to the rail clips or sleeper). Any conducting cables, such as those for wheel sensors, should be enclosed in a protective conduit where it passes under live tracks.

(c) Wheel and rail contact conditions at the site, that is, rail-mounted distribution units, should be located where the wheel/rail contact conditions at the site will support the optimum pick-up, as evidenced by rail wear and contact band checks.

Where both wheels/rails are to be treated the systems should be positioned on tangent track with zero cant to ensure central position of the rolling stock on the track, 30 m preceding the entry to the target curve.

The following conditions should be met:

(i) The static gauge at the site is within ±3 mm of the design gauge;

(ii) There is no plastic flow of rail steel on the gauge side to ensure that the distribution units can be properly fitted to the rail and grease will carry onto the gauge corner.

(iii) The rail profile is within permitted tolerances of the RIM's standard.

(iv) There are no poor rail geometry, rail surface defects (i.e. head checks, shelling, engine burns, etc.) or welds in the immediate vicinity of the lubricator bars.

NOTE:

Some track lubricators are designed to have the grease transfer to the flange by direct contact whereas, others apply the grease in tangent track when the flange is not in contact with the rail.

(d) Environmental factors

(i) Where possible, lubricators should be located more than 20 m from water courses and other environmentally sensitive sites.

(ii) Where it is not possible to be greater than 20 m from an environmentally sensitive site, the use of biodegradable lubricants should be used.

(e) Power

(i) Where solar power panels are used, the position should be verified to ensure they have sufficient sun throughout the year, in accordance with manufacturer's guidelines.

(f) Existing infrastructure

(ii) Lubricators should be located away from existing infrastructure where the operation of the lubricator will interfere with the safe and correct operation of that infrastructure.

Following the site visit and assessment of the above factors, adjust the placement of lubricators on the configuration concept design to reflect on-site realities. Identify all necessary requirements for power and the location of cables.

This adjusted design is the configuration detail design and should be subject to appropriate configuration change approval before it is implemented.

B.5 Stages 4 and 5 – Implementation and commissioning

B.5.1 General

Changes to a lubrication system, including the type, location, interfaces, settings (including the addition of, or removal of rail lubricators and associated equipment), can be deemed a configuration change and require management through the RIM's approved configuration change processes.

A lubrication performance verification process should be completed prior to commissioning. A suggested verification process for rail lubricator performance is provided in B.5.3 of this document.

B.5.2 Lubrication asset register

Fields which may be included in a lubrication asset register fields are provided below.

Corridor	This is used as a header to collate and identify entries installed within a specified corridor.
Reference Number	Is the unique number given to an installation, which may consist of more than a single lubricator installation that are in series to meet a required LPN total.
Location	Local place name, commonly used and identifiable on a specified corridor.
Track	Standard train operating conditions (TOC) reference, Up or Down plus, Main, Local Suburban.
Rail (Down or Up)	Down or Up, as identified with back to state capital central business district (CBD) as normal, down will be the rail on the left and up will be the rail on the right. NOTE: Rail directional identification can be termed differently by RIMs relevant to their specific location or uses, such as, up/down track, left/right track, left hand/right handrail.
Start KM	The start track kilometrage that is the centre of the installed lubricator equipment.
Finish KM	The completion track kilometrage that is the furthest effective range of grease dispersal.
Actuator Type	This should be verified as electric, mechanical or hydraulic.
Manufacturer	Name of the manufacturer of the equipment. Product reference name and number should also be included.
Grease Type	Name of the manufacturer of the lubrication grease. Product reference name and number should also be included.
LPN	Lubricator placement number. This is specific to the individual lubricator installation and may be cumulative to establish full coverage over a series of curves.

Date Installed	The date of installation and effective working.
Date Last Maintained	The date the equipment was last attended for a maintenance service. Not applicable at initial installation.
Remarks	Relevant commentary for condition or performance of the installation. This may also comment on adjacent infrastructure if applicable.

B.5.3 Rail lubricator performance verification process

Verification is an iterative process and can require at least three site visits.

The initial lubricator settings should be those established during the type test. The lubrication performance is checked using tribometer measurements and the lubricator settings adjusted to optimize performance.

Shortly after commencing lubricator operation, and after the passage of a small number of rail traffic, the extent of head contamination from the lubricator should be checked using tribometer measurements on each rail starting 75 m from the unit and measuring towards the unit.

The point at which the rail head CoF falls below 0.3 should be no more than 50 m from the nearest distribution unit on that rail. If head contamination exists beyond that point, the lubricator should be adjusted until contamination is at a reasonable level.

The performance of the lubricator should be checked again after a representative number of rail traffic configurations (speed, length and type) have passed. If necessary, the lubricator should be adjusted to minimize head contamination while maximizing carry.

Grease exceeding the amount required to achieve adequate lubrication of the wheel rail interface should not be allowed to accumulate on the bogies, brake rigging and underbody of rolling stock

After the required performance is obtained, a commissioning report should be prepared which should contain, as a minimum, the following:

(a) Lubricator type, including serial number and bar type.

(b) Grease type.

(c) Exact location of the unit, including the kilometrage and the track, for example, 27.365 km Main North up.

(d) Type, number and placement of grease distribution units,

(e) Photos of the lubricator control unit or reservoir and the distribution units, as installed.

(f) Final friction measurements for all curves in the track section to be serviced by the unit, including:

    (i) CoF recorded for the high rail gauge corner;

    (ii) the TOR surface for both rails; and

    (iii) the distance at which the required rail head surface CoF was achieved from the unit for both rails.

NOTE 1:

An exception exists for B.5.3(f) in high curvature density areas where track access can be limited and where effective lubrication is visually indicated to be in place.

NOTE 2:

The extent of friction measurements can be reduced to the final three curves furthest from the lubricator/closest to the next lubricator site, plus any additional curves demonstrating poor lubrication quality.

NOTE 3:

Final lubricator settings from which the required performance was achieved, including the position of the distribution units, their height relative to top of rail, the application rate.

(g) Application frequency, the amount of grease (in grams) dispensed per application, and any other settings that will allow the unit performance to be monitored.

Appendix C Sample Friction Measurement Record Sheet (Informative)

An example of a rail friction measurement record sheet is provided below. See Section 3 for rail friction measurement recording requirements.

Friction Measurement Record Sheet			
Operator name:		Temperature:	
Run number:		Relative humidity:	
Date:		Product:	
Time:		Tribometer serial #:	
Location km from:		Location km to:	
Traffic direction:		Curve direction:	
Radius (m):			
Maximum friction coefficient:		Friction to slip curves:	
Low rail (markers)	Low rail top of rail	High rail top of rail	High rail gauge corner(degrees)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Average			
Comments:			

Appendix D Remote Monitoring and Control (Informative)

D.1 Remote Monitoring

Remote monitoring of wayside rail friction management systems should be assessed when installing or upgrading systems due to the potential for such monitoring to reduce the need for in-field inspections as well as providing earlier warning of system faults.

Where remote monitoring is used, it should facilitate real time or near real time checking of the health, operational status and function of the system by users from remote locations.

These systems should also be configurable to provide automatic alerts for certain conditions of interest to the RIM, such as:

(a) access door open or closed;

(b) power source disconnected or connected;

(c) battery low status or low level of charge (for solar powered units); and

(d) consumable percentage remaining.

D.2 Remote Control

Remote control of wayside rail friction management systems should be assessed when installing or upgrading systems due to potential safety benefits related to reacting to system faults as well as operational benefits.

For example, the capability to switch the system on or off remotely can enable immediate and remote response to incidents and weather conditions and facilitate system deactivation ahead of ultrasonic or other rail testing.

Appendix E Influence of Sub-optimal Wheel and Rail Profiles (Informative)

Effective friction management is closely influenced by both wheel and rail profiles. When these profiles are not optimized, friction management performance can be reduced due to poor product pickup, carry, and coverage. This could make the system appear ineffective or performing below expectations.

Non-optimized profiles can also create undesirable conditions such as:

(a) rail side wear;

(b) wheel squeal;

(c) flanging noise; and

(d) rail corrugation.

These undesirable conditions often resolve when wheel and rail profiles are restored to an optimized state. In such cases, it may be possible to remove rail friction management systems that were installed to mitigate issues arising from non-optimized profiles.

> Commentary *CE*
>
> Top-of-rail lubrication can only influence squeal on wheelsets where the Angle of Attack (AoA) is low (for squeal) between 15–35 mRad. Low AoA squeal is more effectively treated by profile control of field side of the rail or wheel.

Wayside rail friction management systems can help compensate for the effects of non-optimized profiles. However, where wayside gauge face lubricators are used, caution is required when setting output levels due to the risk of lubricant migrating onto the rail head.

This migration can occur in two-point contact conditions, where voids in the wheel throat and/or rail gauge corner allow lubricant to be forced upward onto the top of rail.

Appendix F Rail Safety Incident Friction Measurements (Informative)

When measuring rail friction to support a rail safety incident investigation, the type of measurements required will be influenced by the type of incident which occurred.

In a suspected flange climb derailment, friction measurements should include the gauge face at 16 mm below the top of the rail profile or at 70 degrees (whichever is lower), or to a precise flange contact angle of the first derailed wheels flange if already determined.

A single gauge corner and centre line friction measurements should be taken preceding and within 20 m of the point of derailment.

The derailing wheel profile can cause an extreme head contact, and friction measurements should be taken 15 mm either side of the rail centre line or at a point as determined by the combined wheel and rail contacts for a high angle of attack.

For braking or run-away safety incident friction measurement direction on measurement of top of rail.

Bibliography (Informative)

- AS 1085.1, *Railway track material – Steel rails*
- AS 7702, *Rail Equipment Type Approval*
- EN 15427-1-1 *Railway Applications - Wheel/Rail Friction Management Part 1-1: Equipment and Application - Flange Lubricants*