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Railway applications — Wheel/ rail friction management — Lubricants for trainborne and trackside applications

National foreword

This British Standard is the UK implementation of EN 16028:2012.

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Contents

Page

Foreword

This document (EN 16028:2012) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2013, and conflicting national standards shall be withdrawn at the latest by January 2013.

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Introduction

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

— lubrication of the wheel flange/rail gauge corner (active interface), commonly referred to as "flange or rail lubrication";

— friction modification of the top of rail/wheel tread interface, commonly referred to as "top of rail friction management".

This European Standard sets out requirements for the lubricant for flange or rail lubrication. It specifies requirements for the lubricant, how to test it and how to approve it.

Lubricants should be tested to confirm there is:

— compatibility with lubricating systems;

— no intolerable increased risk of fire;

— no harmful environmental effects;

— no incompatibility between the different lubricants in use, particularly between solid and fluid systems;

— satisfactory and consistent product quality and performance.

The main purpose of the lubricant is to reduce friction and wear, and keep them at an acceptable level.

The content is based on current experience and should not exclude developments that can be later incorporated at reissue.

1 Scope

This European Standard specifies the requirements of lubricants intended for lubrication of the wheel-rail interface between the wheel flange and the rail gauge corner (active interface) applied either directly or indirectly to the wheel flange or to the rail to achieve an acceptable level of friction and wear.

It covers the approval procedure, the method of testing and routine control/monitoring of the lubricant.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10130, *Cold rolled low carbon steel flat products for cold forming — Technical delivery conditions*

EN 15427, *Railway appllications — Wheel/rail friction management — Flange lubrication*

EN ISO 868, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness) (ISO 868)*

EN ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer method and titration method (ISO 1183-1)*

EN ISO 2160, *Petroleum products — Corrosiveness to copper — Copper strip test (ISO 2160)*

EN ISO 2592, *Petroleum products — Determination of flash and fire points — Cleveland open cup method (ISO 2592)*

EN ISO 3104, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity (ISO 3104)*

EN ISO 3146, *Plastics — Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods (ISO 3146)*

EN ISO 3675, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method (ISO 3675)*

EN ISO 4589-1, *Plastics — Determination of burning behaviour by oxygen index — Part 1: Guidance (ISO 4589-1)*

EN ISO 4589-2, *Plastics — Determination of burning behaviour by oxygen index — Ambient temperature test (ISO 4589-2)*

EN ISO 5659-1, *Plastics — Smoke generation — Part 1: Guidance on optical-density testing (ISO 5659-1)*

EN ISO 5659-2, *Plastics — Smoke generation — Determination of optical density by a single-chamber test (ISO 5659-2)*

ISO/TR 5659-3, *Plastics — Smoke generation — Part 3: Determination of optical density by a dynamic-flow method*

EN ISO 12185, *Crude petroleum and petroleum products — Determination of density — Oscillating U-tube method (ISO 12185)*

EN ISO 20623, *Petroleum and its products — Determination of the extreme-pressure and anti-wear properties of fluids — Four ball method (European conditions) (ISO 20623)*

ISO 760, *Determination of water — Karl Fischer method (General method)*

ISO 2049, *Petroleum products — Determination of colour (ASTM scale)*

ISO 2137, *Petroleum products and lubricants — Determination of cone penetration of lubricating greases and petrolatum*

ISO 2176, *Petroleum products — Lubricating grease — Determination of dropping point*

ISO 3016, *Petroleum products — Determination of pour point*

ISO 3733, *Petroleum products and bituminous materials — Determination of water — Distillation method*

ISO 6072,*Rubber — Compatibility between hydraulic fluids and standard elastomeric materials*

ISO 6743-99, *Lubricants, industrial oils and related products (class L) — Classification — Part 99: General*

ISO 7120, *Petroleum products and lubricants — Petroleum oils and other fluids — Determination of rust-preventing characteristics in the presence of water*

ISO 9772, *Cellular plastics — Determination of horizontal burning characteristics of small specimens subjected to a small flame*

ISO 11007, *Petroleum products and lubricants — Determination of rust-prevention characteristics of lubricating greases*

DIN 51350-4, *Testing of lubricants — Testing by the Shell four-ball tester — Determination of welding load of consistent lubricants*

DIN 51350-5, *Testing of lubricants — Testing by the Shell four-ball tester — Determination of wear data for consistent lubricants*

DIN 51398, *Testing of lubricants — Procedure for measurement of low temperature apparent viscosity by means of the Brookfield viscometer (liquid bath method)*

DIN 51418-1, *X-ray spectrometry — X-ray emissions and X-ray fluorescence analysis (XRF) — Part 1: Definitions and principles*

DIN 51418-2, *X-ray spectrometry — X-ray emissions and X-ray fluorescence analysis (XRF) — Part 2: Definitions and basic principles for measurements, calibration and evaluation of results*

DIN 51451, *Testing of petroleum products and related products — Analysis by infrared spectrometry — General working principles*

DIN 51631, *Mineral spirits — Special boiling point spirits — Requirements*

DIN 51777-2, *Testing of mineral oil-hydrocarbons and solvents — Determination of the water content according to Karl Fischer (indirect method)*

DIN 51805, *Testing of lubricants — Determination of flow pressure of lubricating greases — Kesternich method*

DIN 51807-1, *Testing of lubricants — Test of the behaviour of lubricating greases in the presence of water — Static test*

DIN 51810-1, *Testing of lubricants — Determination of shear viscosity of lubricating greases by the rotational viscosimeter – Part 1: System of cone / plate*

DIN 51811, *Testing of lubricants — Testing of corrosiveness to copper of greases — Copper strip tarnish test*

DIN 51817, *Testing of lubricants — Determination of oil separation from greases under static conditions*

DIN 51820-1, *Testing of lubricants — Analysis of greases by infrared spectrometry — Taking and evaluating an infrared spectrum*

ASTM D1831, *Standard Test Method for Roll Stability of Lubricating Grease*

ASTM D4049, *Standard Test Method for Determining the Resistance of Lubricating Grease to Water Spray*

IP 396, *Determination of dropping point of lubricating grease — Automatic apparatus method*

<u>OECD 301 suite</u>

OECD Document	Equivalent Standard
301a	EN ISO 7827, *Water quality — Evaluation in an aqueous medium of the 'ultimate' aerobic biodegradability of organic compounds — Method by analysis of dissolved organic carbon (DOC) (ISO 7827)*
301b	EN ISO 9439, *Water quality — Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium — Carbon dioxide evolution test (ISO 9439)*
301c	Nil
301d	EN ISO 10707, *Water quality — Evaluation in an aqueous medium of the 'ultimate' aerobic biodegradability of organic compounds — Method by analysis of biochemical oxygen demand (closed bottle test) (ISO 10707)*
301e	EN ISO 7827, *Water quality — Evaluation in an aqueous medium of the 'ultimate' aerobic biodegradability of organic compounds — Method by analysis of dissolved organic carbon (DOC) (ISO 7827)*
301f	EN ISO 9408, *Water quality — Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium by determination of oxygen demand in a closed respirometer (ISO 9408)*

3 Terms and definitions

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

3.1
lubricant
substance that is designed to lower friction and wear

3.2
oil
liquid lubricant

Note 1 to entry: Oil can be mineral, natural or synthetic in origin and can have additives included.

3.3
grease
semi-solid lubricant

Note 1 to entry: Grease consists of a thickener and additives integrated in a lubricating oil.

3.4
stick
encapsulated solid lubricant

Note 1 to entry: Typically, the stick is comprised of a solid lubricant which is encapsulated in a polymeric binder/carrier. The product is designed for direct contact with a rotating wheel flange; the polymeric binder has a sufficiently high melting point such that it does not melt but rather wears when in contact with the wheel flange to ensure dimensional stability.

3.5
batch
entire content of a single identified production of lubricant from the same manufacturing process

3.6
active interface
contact area between the wheel flange root and the rail gauge side corner

Note 1 to entry: For more information on this definition, see EN 15427.

3.7
flange lubrication
lubrication of the active interface by applying a lubricant to the wheel flange

3.8
rail lubrication
lubrication of the active interface by applying a lubricant to the rail gauge side face

3.9
Lubricant Application Unit (LAU)
component of the lubrication system (trainborne or trackside) that delivers lubricant to the active interface

Note 1 to entry: This includes spray nozzles, trackside grease distribution units/blades, stick applicators, etc.

3.10
lubrication system
components required to apply lubricant to the active interface

Note 1 to entry: A lubrication system can include one or more Lubricant Application Units, a reservoir unit, pump and/or a control device.

3.11
trainborne
type of lubrication system installed on a train

3.12
trackside
type of lubrication system installed on or adjacent to the track

3.13
customer
railway undertaking, infrastructure owner, manufacturer or buyer of railway products or subassemblies, or their representative

3.14
supplier
supplier of lubricants

Note 1 to entry: A supplier might also be the manufacturer of the product.

3.15
product specification
document prepared by the customer that describes the conditions and requirements for the lubricant to meet

4 Legislative compliance

Where legislation and regulations (European, national or local) concerning ecological and environmental compatibility of lubricants (biodegrability, toxicity, etc.) are applicable, consideration will need to be given to the relevant requirements.

The lubricant should be non hazardous and/or non-toxic and should not contain, for example, solvents, lead or any other noxious material.

The product should preferably be bio-degradable, as defined in Tables A.1 to A.3.

5 Approval procedure

5.1 General

The approval process is undertaken in four stages.

Approval given by another customer may be applied during any or all of this approval process.

If after any stage the requirements are not met, a decision shall be made to decide whether or not to cease with the approval process.

5.2 Stage 1 – Product specification

The product specification shall be fully documented and shall include the following information:

a) relevant application data, including equipment types, operating temperatures, route information etc.;

NOTE The typical operating temperature range to take into account is from -25 °C to +80 °C.

b) type tests for approval of the lubricant (see Clause 6 and Tables A.1 to A.3);

c) additional validation tests (see Table A.4);

d) conditions for delivery, packaging and marking (see Clause 9);

e) routine tests for production batches (see Clause 8 and Tables A.1 to A.4) and their frequency.

Additional requirements may be included such as access to test records, retention of samples, witnessing of tests etc.

5.3 Stage 2 – Presentation of technical data file

A file of technical data showing compliance with the requirements in the product specification and the results of type tests and trials shall be presented.

A safety data sheet for the product in the language of the interested customer or country shall be included.

Refer to European Directive EC1907/2006 (REACH).

5.4 Stage 3 – Validation tests

If required by the product specification, the functional characteristics of the lubricant shall be verified by type tests and inspections, usually in a laboratory situation. The results shall be recorded.

If required by the product specification, specific, in-service or field trials shall be carried out to verify that the lubricant complies with the requirements in the product specification. The results shall be recorded.

For specific tests the lubricant is tested on a specified piece of equipment, usually in the laboratory.

Where in-service or field trials are carried out they should be over a time period that will determine the lubricant's performance in as close to normal service conditions as possible. This should also be over at least a hot and cold season and for a typical range of weather.

5.5 Stage 4 – Decision

The approval of the product can be granted by the customer only if all the stages of the procedure and the following are satisfied:

— technical documents have been approved;

— characteristics conform with the requirements laid down in this European Standard and in the product specification;

— functional and in-service trials have been satisfactory.

6 Control and monitoring of product

6.1 Manufacturing process

The manufacturing process of the standard production of the lubricant shall be the same as that applied for the product submitted for approval. If the manufacturing process is changed in any way, it shall be documented and the customer shall be notified.

NOTE In some cases, this leads to a new approval being required.

6.2 Type tests

The purpose of these tests is to check the parameters and to determine if the lubricant meets them for the purpose of approval testing.

The sample of lubricant submitted for type testing shall have been manufactured in a regular production batch. The entire sample of lubricant used for the approval tests shall be taken from the same production batch and delivered in a single consignment.

Lubricants shall be submitted to the required type tests shown in the 'Type' column in Tables A.1, A.2 and A.3 and, if applicable, to the optional ones as defined in the product specification. The results of the type tests shall be recorded.

6.3 Routine tests

The purpose of these tests is to verify consistent characteristics from batch to batch to assure continued conformity with the approved type test sample. The tests are made on samples taken from mass produced batches.

Lubricants shall be submitted to the required routine tests shown in the 'Routine' column in Tables A.1, A.2 and A.3 and, if applicable, to the optional ones as defined in the product specification. The results of the routine tests shall be recorded.

7 Technical datasheet

7.1 General

The technical datasheet shall include the individual identifying code or name of the lubricant, a description of the product's field of use and typical means of application. For each lubricant type, the information in the following sub-clauses shall also be included.

7.2 Grease type lubricant characteristics

The product shall be described by its consistency, its temperature range, the type of thickener and type of base oil used. Where solid lubricants are used, the type and content shall be reported. Further technical data shall be provided as listed under the 'datasheet' column in Table A.1.

7.3 Oil type lubricant characteristics

The product shall be described by its viscosity, its temperature range and by the type of oil used. Where solid lubricants are used the type and content shall be reported. Further technical data shall be provided as listed under the 'datasheet' column in Table A.2.

7.4 Solid type lubricant characteristics

The product shall be described by its melting point, hardness, dimensions and its temperature range. Further technical data shall be provided as listed under the 'datasheet' column in Table A.3.

The product shall be designed to minimize stick debris on the ballast.

It is suggested that the mass of any piece of debris should be no greater than 5 g.

8 Tests

8.1 Explanation of Annex A: Tables A.1 to A.4

For each required property of the lubricants, Tables A.1, A.2 and A.3 list the mandatory and optional tests for grease, oil and sticks respectively, and parameters for trainborne and trackside applications.

The optional tests required by the customer shall be listed in the product specification. Although used, oil based lubricants have not been included for trackside applications as the usage is low.

Table A.4 lists additional tests to check that the lubricant will operate correctly in typical equipment or specific lubrication systems used in service.

8.2 Key to Annex A table columns ‘Type’, ‘Routine’ and ‘Datasheet’

The key to the columns ‘Type’, ‘Routine’ and ‘Datasheet’ in Tables A.1 to A.4 is as follows:

‘Type’ = This indicates the type tests required for the purpose of approval testing (see 5.4 and 6.2).

‘Routine’ = This indicates the routine tests required for testing from approved mass produced batches (see 6.3).

‘Datasheet’ = This indicates the characteristics to be listed in the product documentation.

In each column, a symbol is used to indicate the required test or information:

‘■’ indicates a mandatory test or piece of information is required;

‘□’ indicates an optional test or piece of information is required;

where it is blank there is no requirement.

8.3 Key to Annex A table column ‘Use’

Tables A.1 to A.4 include a column headed ‘Use’ and the letters used mean the following:

A – Trainborne

B – Trackside

C – Trainborne using a solid lubricant

This column identifies the most common systems in current use. Most trainborne equipment sprays the lubricant in the form of a free-flowing grease or thin oil and most trackside equipment pumps it in the form of a thicker grease. However, where alternatives exist, careful consideration to the tests required is needed.

9 Packaging, labelling and storage

The packaging shall protect the contents from contamination and damage.

The labelling shall include at least the following:

— supplier’s name;

— brand name and/or code of the lubricant;

— batch number and date of manufacture, uncoded or coded;

— net mass/quantity/volume;

NOTE Local regulatory requirements might also apply.

The following additional information shall be included if specified in the product specification:

- customer stock number;
- an indication that the batch has been accepted by the customer.

The storage conditions and, if necessary, the date limit of use of the lubricant shall be provided.

Annex A
(normative)

Requirements for lubricants and testing

Table A.1 — Requirements for greases *(1 of 6)*

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.1.1	Appearance	A & B	-	Visual	Homogenous	■	■	□	Appearance is a general assessment of the product.
A.1.2	Colour	A & B	-	ISO 2049	Homogenous	■	□	□	
A.1.3	Consistency	A	-	ISO 6743-99	Typically 00-000	■	■	■	
		B	-	ISO 6743-99	Typically 1	■	■	■	
A.1.4.1	Un-worked grease penetration at:	A							
a)	25 °C		0,1 mm	ISO 2137	Typically 400 to 475	■	□		
b)	0 °C		0,1 mm	Annex J	≥ 350	■	□		
c)	-25 °C		0,1 mm	Annex J	≥ 300	■	□		
A.1.4.2	Un-worked grease penetration at:	B							
a)	25 °C		0,1 mm	ISO 2137	Informative – no criteria	■	□		
b)	0 °C		0,1 mm	Annex J	Informative – no criteria	■	□		
c)	-25 °C		0,1 mm	Annex J	Informative – no criteria	■	□		

(2 of 6)

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.1.5	Worked grease penetration 60 strokes at 25 °C	B	0,1 mm	ISO 2137	Typically 310 to 340	■	■	■	
A.1.6	Drop point	A & B	°C	ISO 2176 or IP 396	Higher than operating range upper limit	■	■	■	
A.1.7	Flash point	A & B	°C	EN ISO 2592	≥ 200	■		■	
A.1.8	Water content	A & B	% mass	ISO 760 or DIN 51777-2 or ISO 3733	≤ 1,0	■	■		
A.1.9	Water resistance at 40 °C	A & B	Level	DIN 51807-1	1	■	□	■	
A.1.10	Adhesion to sheet steel	A	Stage	Annex D	1	□	□	□	
	(0,05 mm, 24 h at 60 °C)	B	Stage	Annex D	1	□	□	□	
A.1.11	Volatile components (24 h at 60 °C)	A & B	% mass	Annex E	≤ 10	□	□	□	

(3 of 6)

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.1.12	Oil separation / "bleeding"								
A.1.12.1	(18 h at 40 °C)	A	% mass	DIN 51817	≤ 5	■	□		Without 100 g weight
A.1.12.2	(168 h [7 days] at 40 °C)	B	% mass	DIN 51817	5 % maximum by weight for NLGI No.2 grease & 7 % maximum by weight for a NLGI No.1 grease	■	□		With 100 g weight
A.1.13	Corrosion test								
a)	Steel	A	Level	Annex C	1	□	□	□	
		B	Rating	ISO 11007 using water	0; 0	□	□	□	
b)	Copper 24 h at 50 °C	A & B	Grade	DIN 51811	1	□	□	□	
A.1.14	Compatibility with elastomers (60 °C for 168 h)	A & B							Where applicable
a)	Change in volume for NBR1		%	ISO 6072	+15/-0	■			Other elastomer types may be tested as necessary
b)	Change in hardness for NBR1		IRHD	ISO 6072	± 8	■			Other elastomer types may be tested as necessary

(4 of 6)

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.1.15	Identity testing: Using Infra-red, or Xray fluorescence, or Inductively coupled plasma	A & B		Standard laboratory method. (See comments for applicable standards)	For routine tests compare with approved batch using same process	■	■		Applicable standards: DIN 51418-1 DIN 51418-2 DIN 51451 DIN 51820-1
A.1.16	Apparent viscosity *(1° cone, s = 300 s,* $D = 1\,000\ s^{-1}$) at:	A							
a)	25 °C		mPa·s	DIN 51810-1	≥ 150	□	□	□	
b)	0 °C				≥ 400	□	□	□	
c)	-25 °C				≤ 4 000	□	□	□	
A.1.17	Four ball test	A & B							
a)	Wear test rating (300 N, 1 h at 1 500 r/min)		mm	DIN 51350-5; Method D	≤ 0,8	■		■	
b)	Extreme pressure		kg	DIN 51350-4	Weld load not less than 315 kg	■			
A.1.18	Effect of water (water wash-off test)	B	visual	Annex B	No corrosion after 72 h	□			
			% loss	ASTM D4049 at 83 kPa	Informative – no criteria	□			
A.1.19	Low temperature flow pressure (pumpability)	B	mbar	DIN 51805	Less than 500 mbar at -20 °C	□	□		

(5 of 6)

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.1.20	Density at 15 °C	A	kg/m3	EN ISO 12185 EN ISO 3675	Informative – no criteria	☐	☐	☐	
A.1.21	Biodegradability	A & B	%	Dependent upon test type from OECD 301 suite or its equivalent standard	>60 after 28 days	☐		☐	As defined in Product Specification. See normative references in Clause 2.
A.1.22	Fire behaviour a) Smoke b) Spread of flame c) Toxicity	A & B		As defined in the Product Specification		☐		☐	
A.1.23	Bead size/droop/peaking	B		Example test in Annex F	Sufficient bead size that peaks and does not droop	☐			
A.1.24	Water pollution	A & B	As required	As defined in the Product Specification, see comment.	Local conditions may apply	☐			For example, in Germany: Verwaltungsvorschrift wassergefährdender Stoffe [German Administrative Regulation on Substances Hazardous to Water]
A.1.25	Low-temperature torque (rheometer measurement)								
A.1.25.1	at -30 °C	A	mNm	Annex G	Max. 10	☐	☐		
A.1.25.2	at -20 °C	B	mNm	Annex G	Indicative	☐	☐		

(6 of 6)

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.1.26	Miscibility with other flange/rail lubricants used	A & B		Follow Annex H and then carry out tests A.1.26.1 to A.1.26.3		□			
A.1.26.1	*Worked penetration (60* double strokes) at 25 °C	A & B	0,1 mm	ISO 2137	400 to 475				
A.1.26.2 a)	*Oil separation (18 h at 40* °C)	A	% mass	DIN 51817	≤ 5				Without 100 g weight
A.1.26.2 b)	*Oil separation* (168 h [7 days] at 40 °C)	B	% mass	DIN 51817	5 % maximum by weight for NLGI No.2 grease & 7 % maximum by weight for a NLGI No.1 grease				With 100 g weight
A.1.26.3	*Dropping point*	A & B	°C	ISO 2176	≥ 90				
A.1.27	Electrical resistance	A & B		As defined in the Product Specification		□			

Table A.2 — Requirements for oils *(1 of 3)*

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.2.1	Appearance	A	-	Visual	Homogenous	■	■	□	Appearance is a holistic assessment of the product
A.2.2	Colour	A	-	ISO 2049	Homogenous	■	□	□	
A.2.3	Flash point	A	°C	EN ISO 2592	≥ 200	■		■	
A.2.4	Corrosion test								
a)	Steel	A	level	ISO 7120	1	□	□	□	
b)	Copper 3 h at 50 °C	A	grade	EN ISO 2160	1b	□	□	□	
A.2.5	Compatibility with elastomers (60 °C for 168 h)	A							Where applicable
a)	Change in volume for NBR1		%	ISO 6072	+15/-0	■			Other elastomer types may be tested as necessary
b)	Change in hardness for NBR1		IRHD	ISO 6072	± 8	■			Other elastomer types may be tested as necessary
A.2.6	Identity testing: Using Infra-red, or Xray fluorescence, or ICP	A		Standard laboratory method. (See comments for applicable standards)	For routine tests compare with approved batch using same process	■	■		Applicable standards: DIN 51418-1 DIN 51418-2 DIN 51451 DIN 51820-1

(2 of 3)

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.2.7	Four ball test	A							
a)	Wear test rating (400 N, 1 h at 1 500 r/min)		mm	EN ISO 20623	0,45	■		■	
b)	Extreme pressure		kg	EN ISO 20623	Weld load not less than 315 kg	■			
A.2.8	Density at 15 °C	A	kg/m^3	EN ISO 12185 EN ISO 3675	Informative – no criteria	□	□	□	
A.2.9	Biodegradability	A	%	Dependent upon test type from OECD 301 suite or its equivalent standard	> 60 after 28 days	□		□	As defined in Product Specification. See normative references in Clause 2.
A.2.10	Fire behaviour a) Smoke b) Spread of flame c) Toxicity	A		As defined in the Product Specification		□		□	
A.2.11	Pour point	A	°C	ISO 3016	Lower than operating range lower limit	□			
A.2.12	Dynamic viscosity at 40 °C	A	mPa·s	EN ISO 3104	Informative – no criteria	□	□	□	
A.2.13	Brookfield viscosity at 40 °C	A	mPa·s	DIN 51398	Informative – no criteria	□	□	□	

(3 of 3)

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.2.14	Water pollution	A	As required	As defined in the Product Specification, see comment	Local conditions may apply	☐			For example, in Germany: Verwaltungsvorschrift wassergefährdender Stoffe [German Administrative Regulation on Substances Hazardous to Water]
A.2.15	Miscibility with other flange/rail lubricants used	A		Follow Annex I and then carry out tests 2.15.1 to 2.15.6 below		☐			
A.2.15.1	Dynamic viscosity at 40 °C		mPa·s	EN ISO 3104	Between the limits of two oils tested				
A.2.15.2	Flash point		°C	EN ISO 2592	≥ 200				
A.2.15.3	Pour point		°C	ISO 3016	Lower than operating range lower limit				
A.2.15.4	Corrosiveness to steel		level	ISO 7120	1				
A.2.15.5	Corrosiveness to copper 3 h at 50 °C		grade	EN ISO 2160	1b				
A.2.15.6	Compatibility with elastomers (60 °C for 168 h)								
a)	Change in volume for NBR1		%	ISO 6072	+15/-0				
b)	Change in hardness for NBR1		IRHD	ISO 6072	±8				

Table A.3 — Requirements for sticks *(1 of 2)*

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.3.1	Appearance	C	-	Visual	For routine tests compare with approved batch	■	■	□	Batch to batch comparison
A.3.2	Colour	C	-	ISO 2049	For routine tests compare with approved batch	■	■	■	Batch to batch comparison
A.3.3	Melting point	C	°C	EN ISO 3146	Higher than operating range	■			
A.3.4	Friction value	C	Coefficient of Friction	Twin disc test in Annex L	≤ 0,15	■	■	■	
A.3.5	Stick dimensions	C	mm	Measurement	As specified	■	■	■	Batch to batch comparison. See Note 1
A.3.6	Behaviour in fire	C							The following standards may be used:
a)	Smoke density		-	See comments		□		□	EN ISO 5659-1 EN ISO 5659-2 ISO/TR 5659-3
b)	Spread of flame		-	See comments		□		□	EN ISO 4589-1 EN ISO 4589-2 ISO 9772

NOTE 1 Consistent stick dimensions are critical to ensure that the solid sticks fit and do not jam in the applicator.

(2 of 2)

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.3.8	Identity testing Using ICP / LECO or X-ray fluorescence	C		Standard laboratory method	For routine tests compare with approved batch using same process	□			
A.3.9	Density at 23 °C	C	kg/m3	EN ISO 1183-1 Method A	For routine tests compare with approved batch	■	■		See Note 2
A.3.10	Hardness	C	Shore	EN ISO 868	For routine tests compare with approved batch	■	■		See Note 3
A.3.11	Water pollution	C	As required	As defined in the Product Specification, see comment	Local conditions might also apply	□			For example, in Germany: Verwaltungsvorschrift wassergefährdender Stoffe [German Administrative Regulation on Substances Hazardous to Water]

NOTE 2 Significant differences in density could indicate a change in composition or level of solid lubricants, or presence of voids in product.

NOTE 3 Different hardness value could lead to differing stick consumption values under similar operating conditions.

Table A.4 — Functional tests for all lubricant types

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.4.1	Fling-off test	A & B		See comments		□			This can be performed on a test rig in a laboratory or on a test train. If required, the test method shall be defined in the Product Specification.
A.4.2	Functional tests using lubricating equipment (at low, normal & high temperature)	A & B		Annex K		□			
A.4.3	Field testing including carry down & propagation	A, B & C		Annex M		□			Refer to EN 15427 for more guidance
A.4.4	Carry down/ film retention	C		Twin disc test in Annex L	Carry down/ film retention	□			

Annex B
(normative)

Water wash-off test

B.1 Purpose

This test serves to assess the ability of trackside lubricants to resist the effects of rain. This resistance to being washed-off is indicated by a lack of corrosion on the steel plate at the end of the test.

B.2 Short description

A steel plate is coated with a layer of lubricant which is then set at an angle. A steady stream of water is then allowed to flow onto the plate After a period of time the plate is inspected for signs of corrosion which will indicate whether or not the lubricant has been washed-off, exposing the plate to the water.

B.3 Conditions for testing

B.3.1 Test conditions

The temperature of the laboratory and the water shall be between 15 °C and 25 °C.

B.3.2 Required testing and measuring equipment

B.3.2.1 Steel sheet, 150 mm × 100 mm × 6 mm according to EN 10130 - DC04-B or similar, finish-ground longitudinally with a surface finish of around 0,4 µm Ra measured across the plate.

B.3.2.2 Template, for a film thickness of (0,1 ± 0,01) mm.

B.3.2.3 Scraper, for levelling lubricant.

B.3.2.4 Frame, inclined at about 70° to the horizontal.

B.3.2.5 Degreaser.

B.3.2.6 Water supply, where the flow can be varied.

B.4 Test process

B.4.1 Preparation of test piece

Degrease the steel sheet with degreaser and dry it.

Deposit a 0,1 mm thick film of the lubricant to be tested on the steel gauge plate, using a scraper and template.

B.4.2 Performance of test

Lean the steel sheet against the frame and set a water drip of ordinary tap water to deliver (15 ± 1) ml/min of water in 140 to 160 separate droplets from a height of about 300 mm above the point at which the droplets strike the plate for 24 h. See Figure B.1.

Leave the sheet for 48 h.

After this period, inspect the sheet for signs of corrosion.

B.4.3 Evaluation

The lubricant layer shall not be ruptured and no corrosion shall be visible after the test period of 72 h.

Dimensions in millimetres

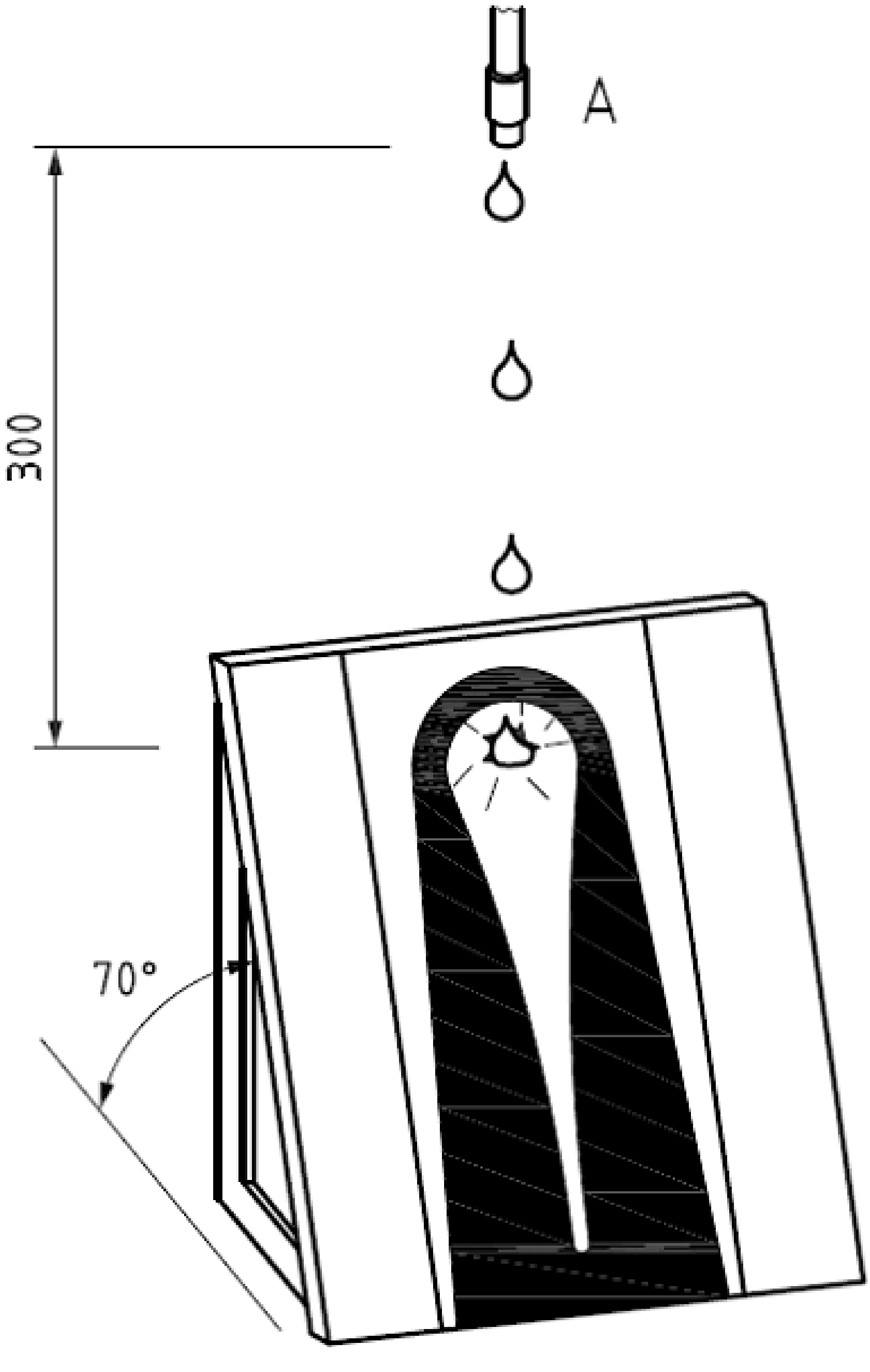


Figure B.1 — Water wash-off test

Annex C
(informative)

Corrosion test on steel

C.1 Purpose

This test serves to determine the corrosion protection ability of these lubricants at high moisture and temperature loading. This helps ensure that corrosion will not form in the lubrication system which could lead to blockage and malfunction.

C.2 Short description

The lubricant to be tested is applied to a steel sheet. The rear and edges of the steel sheet are sealed with a suitable protective wax and the steel sheet is then suspended in a tank which contains a small quantity of water inside a heating cabinet. After a period of time, the percentage of the sheet surface which is corroded is evaluated.

C.3 Conditions for testing

C.3.1 Test conditions

The test is carried out in a saturated water-vapour atmosphere at (60 ± 1) °C for 14 days.

The conditions for the tests are set in the heating cabinet.

C.3.2 Required testing and measuring equipment

C.3.2.1 Thermometer, with a measuring range of 0 °C to 100 °C and accuracy of 0,5 °C.

C.3.2.2 Heating cabinet.

C.3.2.3 Scraper, for levelling lubricant.

C.3.2.4 Spatula.

C.3.2.5 Steel sheet, (200 mm × 100 mm × 2 mm) according to EN 10130 - DC04-B or similar, finish ground longitudinally with a surface finish of around 0,4 µm Ra measured across the plate.

C.3.2.6 Glass tank, 300 mm high × 400 mm long × 240 mm wide.

C.3.2.7 Brush, for applying the protective wax.

C.3.2.8 Spray flask, for protective wax (corrosion-protection film).

C.3.2.9 Template, for a film thickness of 0,05 mm ± 0,01 mm.

C.3.3 Chemicals

C.3.3.1 Mineral spirit, (of type 2 according to DIN 51631 or equivalent, but see following).

Regardless of which mineral spirit is chosen, it is suggested that, in order to obtain consistent results, the same spirit is used each time.

C.3.3.2 Protective wax.

C.4 Test process

C.4.1 Preparation of test piece

Degrease the steel sheet with mineral spirit and dry. Coat the rear of the steel sheet with protective wax and allow to harden (approximately 2 h). Attach the template to the front of the steel sheet.

Spread the lubricant to be tested on to the front of the steel sheet with a spatula and remove any excess with a scraper to produce an even film of 0,05 mm. Remove the template. Seal the edges of the lubricant film with protective wax and allow to harden.

C.4.2 Performance of test

Fill the glass tank with water to a depth of approximately 20 mm. Suspend the prepared steel sheet in the glass tank so that the sheet is not touching the water.

Cover the glass tank and place in the heating cabinet.

Carry out the test for the duration and at the test temperature given above.

C.4.3 Evaluation and recording of test result

An assessment of the steel sheet is made after completion of testing.

Assess the corrosion spots that have occurred on the steel sheet referring to the information in Table C.1.

The result shall be recorded as a stage value.

Table C.1 — Corrosion stages

Appearance of sheet	**Indication**	**Stage**
0 % of the sheet surface corroded	no corrosion	1
< 0,5 % of the sheet surface corroded (e.g. a few, small rust spots)	slight corrosion	2
< 3 % of the sheet surface corroded	moderate corrosion	3
> 5 % of the sheet surface corroded	heavy corrosion	4

Annex D
(informative)

Behaviour at an elevated temperature – Adhesion on steel sheet

D.1 Purpose

This test is used to assess the ability of the lubricant to adhere to a vertical surface (its adhesiveness) at an elevated temperature.

D.2 Short description

The lubricant is applied as a defined film thickness onto a steel sheet which is then placed vertically into a heating cabinet set to the test temperature. Evaluation is performed after a defined period.

D.3 Conditions for test

D.3.1 Test conditions

The test is carried out at a temperature of (60 ± 1) °C for a duration of 24 h.

The conditions for the tests are set by a heating cabinet.

D.3.2 Required testing and measuring equipment

D.3.2.1 Thermometer, with a measuring range of 0 °C to 100 °C and accuracy of 0,5 °C.

D.3.2.2 Heating cabinet.

D.3.2.3 Steel sheet, (200 mm × 100 mm × 2 mm) according to EN - 10130 DC04-B or similar finish-ground longitudinally with a surface finish of around 0,4 µm Ra measured across the plate.

D.3.2.4 Template, for a film thickness of (0,05 ± 0,01) mm.

D.3.2.5 Scraper, for levelling the lubricant.

D.3.3 Chemicals

D.3.3.1 Mineral spirit, (to type 2 in DIN 51631 or equivalent, but see following).

Regardless of which mineral spirit is chosen, it is suggested that, in order to obtain consistent results, the same spirit is used each time.

D.4 Test process

D.4.1 Preparation of test

Degrease the steel sheet with mineral spirit and dry.

Attach the template firmly to the steel sheet in order to prevent lubricant intrusion.

Apply the lubricant with a spatula and spread evenly with a scraper covering the entire width of the plate surface inside the template to give a film thickness of 0,05 mm. Remove the template.

D.4.2 Performance of test

Place the lubricant-coated steel sheet vertically, [90 (0, -5)° to the horizontal] in the heating cabinet.

Carry out the test for the duration and at the test temperature given above.

D.4.3 Evaluation and recording of test result

An assessment of the steel sheet is made after the completion of testing.

Assess the adhesion ability of the lubricant on the steel sheet by referring to the information in Table D.1.

The result is to be recorded as a stage value.

Table D.1 — Lubricant adhesion

Appearance of lubricant	Indication	Stage
lubricant shows original pattern after testing	very good adhesion	1
only small change in the lubricant in the spread location, but there is not yet any oil secretion	sufficient adhesion	2
lubricant runs off	insufficient adhesion	3

Annex E
(informative)

Determination of the volatile constituents in greases

E.1 Purpose

The volatile constituent in a lubricant is the low-boiling point component of the grease used to improve low-temperature behaviour. The volatile constituents determined with the method below are predominantly solvents. It is of considerable interest in real-life practice to know the solvent content of a wheel-flange lubricant; and since no suitable standard exists to date, the method described below has been developed as a guide.

This method can help identify where solvents are used to lower the lubricant viscosity at low temperature. The use of these modified lubricants can lead to problems when the solvent content evaporates with time.

E.2 Short description

A defined amount of grease is weighed out onto an evaporating dish and placed in a heating cabinet for a period of time. It is then weighed to determine the volatile constituent content.

E.3 Conditions for testing

E.3.1 Test conditions

The test is carried out at a temperature of (60 ± 1) °C for a duration of 24 h.

The conditions for the tests are set by a heating cabinet.

E.3.2 Required testing and measuring equipment

E.3.2.1 Thermometer, with a measuring range of 0 °C to 70 °C and accuracy of 0,5 °C.

E.3.2.2 Analytical balance, with a range of 0 g to 200 g and accuracy of 0,001 g.

E.3.2.3 Heating cabinet.

E.3.2.4 Flat porcelain evaporating dish, 95 mm in diameter.

For the test described, here, the dish above is used. Where other sizes or types are used, the result might be different.

E.3.2.5 Dessicator.

E.4 Test process

E.4.1 Preparation of test

None.

E.4.2 Performance of test

Weigh the empty porcelain evaporating dish with the analytical balance. Add (10 ± 0,1) g of the grease to be examined to the dish and spread over the base.

Place the evaporating dish in the heating cabinet set at the temperature given above for the specified time duration.

Transfer the dish to the dessicator and allow it to cool to ambient temperature. Weigh the dish with the analytical balance.

Repeat the test with a fresh quantity of grease so that the average of the results can be used in the evaluation.

E.4.3 Evaluation

The content of volatile constituents is calculated in mass percentage rates according to the following numerical value formula:

$$F_{\text{A}} = \left(\frac{a - b}{m_{\text{E}}} \right) \times 100\ \%$$

where

F_{A} is the volatile constituents as mass percentage rates;

a is the mass of porcelain dish and test grease before heat treatment;

b is the mass of porcelain dish and test grease after heat treatment;

m_{E} is the mass of the test grease spread on the dish.

Therefore, the two tests can be regarded as conforming if they do not deviate from each other by more than 1 %.

Calculate the mean of the two values of F_{A}.

E.5 Recording of test results

The test report is to include the mean value of the individual measurements of the volatile constituents (F_{A}) rounded to 0,1 mass percentage rate.

Annex F
(informative)

Peak forming and droop

F.1 Purpose

This test is carried out on a specially designed test rig (see Figure F.1), which incorporates a short length of full size rail with a lubricant distribution unit clamped to it to form a fully operating lubrication system to check that the lubricant can be delivered to the rail in the required quantities. The equipment chosen will only demonstrate the abilities of the chosen lubricant to operate in that equipment; it is not necessarily applicable to all equipment.

F.2 Short description

The lubricant is pumped through the equipment. A check is made that it appears at all the ports in the lubricant distribution unit and forms peaks and does not droop.

F.3 Conditions for testing

F.3.1 Test conditions

The test is to be performed at the temperatures defined in the Product Specification. The temperatures should be recorded along with the observations.

F.3.2 Required testing and measuring equipment

See Figure F.1.

F.3.2.1 Lubricant distribution unit (LDU).

F.3.2.2 Pressure gauge, which measures at least 5 bar.

F.3.2.3 Lubricant pump.

F.3.2.4 Hose, of a specified length.

F.4 Test process

F.4.1 Preparation of test

Set the lubricant distribution unit between 22 mm and 29 mm below the level of the rail head (see Figure F.2).

F.4.2 Performance of test

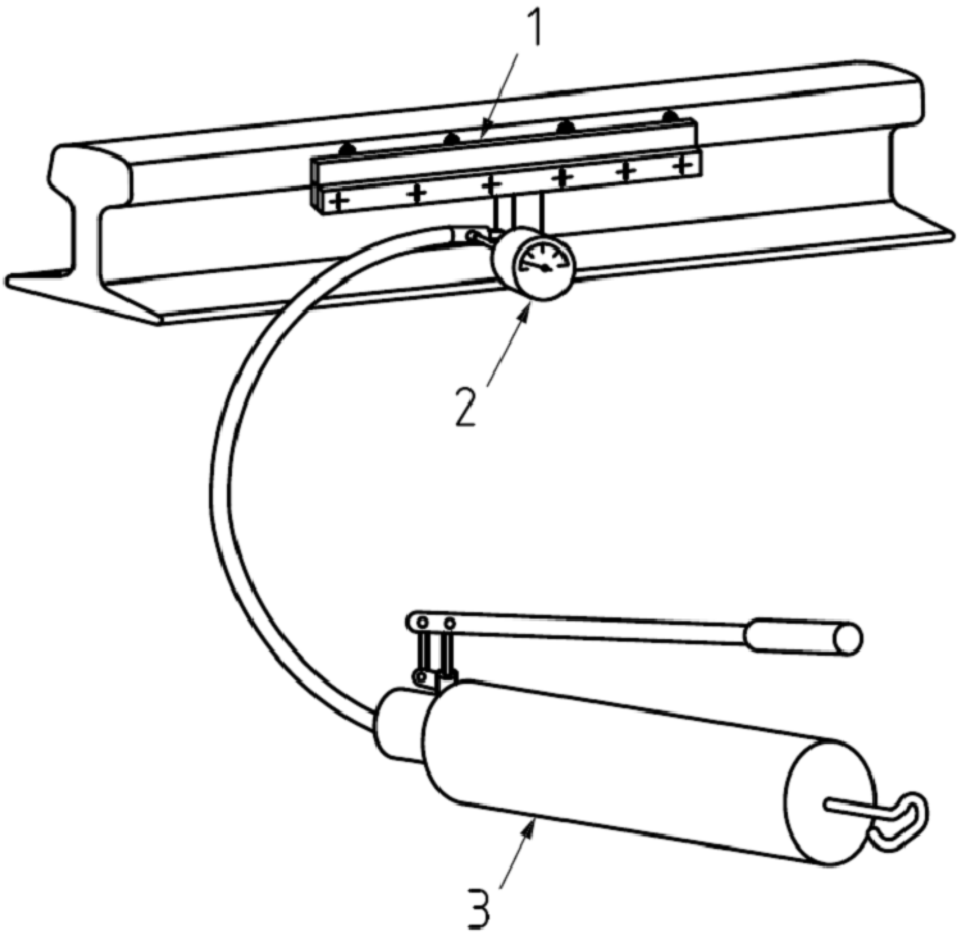
Using the pump to deliver the lubricant to the LDU until it appears at every port on the LDU.

F.4.3 Evaluation

Lubricant should exit all ports at an indicated pressure of less than 3 bar over the maximum quoted distance within the supplier's specification for the specific unit.

Lubricant should peak form/column at every port to the form shown in Figure F.3.

Lubricant should not droop within 30 min.



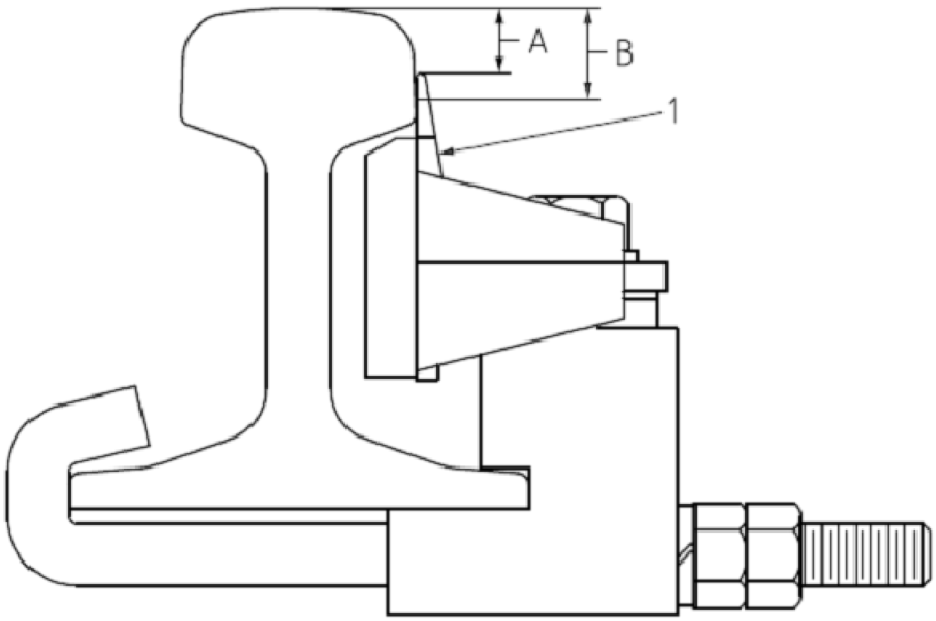
Key

1 lubricant distribution unit

2 pressure gauge

3 lubricant pump

Figure F.1 — Peak forming and droop test rig



Key

1 lubricant distribution unit blade

A 22mm

B 29mm

Figure F.2 — Setting height of LDU

Dimensions in millimetres

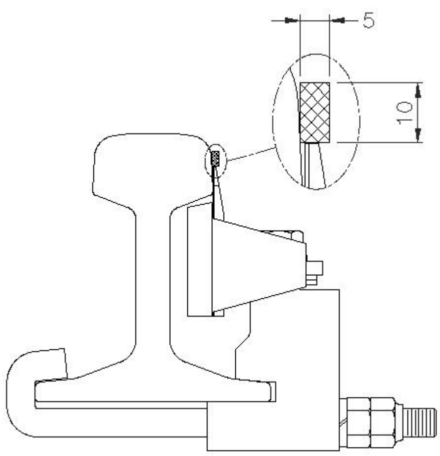


Figure F.3 — Peak forming / column dimensions

Annex G
(informative)

Low-temperature torque (rheometer measurement at -20 °C and -30 °C)

G.1 Purpose

This test measures the resistance of a grease to movement at low temperature. It indicates how elastic a grease would be after it had stood for a period of time at low temperature and was then called upon to be used.

This test procedure can be used for all consistent lubricants up to NLGI type 2 or 3 (see ISO 6743-99).

G.2 Short description

A stirrer is moved through a quantity of grease in a test vessel which has been cooled and the maximum torque required to move the stirrer for one revolution is measured. This indicates its “stirability”.

The parameters and settings in this test are for using the example equipment listed in G.3.2. These parameters and settings will need to be verified for other equipment types.

G.3 Conditions for test

G.3.1 Test conditions

The sample is brought to the test temperature by the test device. It is to be protected against ice-formation by means of a cover.

G.3.2 Required testing and measuring equipment

G.3.2.1 Rheometer.

EXAMPLE A rheometer, item MRC 301 from Anton Paar.[1)]

G.3.2.2 Stirrer adapter, (see Figure G.1).

G.3.2.3 Measuring shaft.

EXAMPLE A measuring shaft, item D-CP/PP7 from Anton Paar.[1)]

G.3.2.4 Disposable measuring cup.

EXAMPLE A disposable measuring cup, item C-CC270D/Al from Anton Paar.[1)]

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1) MRC 301, as well as D-CP/PP7, C-CC270D/Al and Physica VT 2 are the trade names of products supplied by Anton Paar. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of the products named. Equivalent products may be used if they can be shown to lead to the same results.

G.3.2.5 Template, for setting the filling height to 15 mm;

G.3.2.6 Cryostat, for cooling down the rheometer-test chamber;

EXAMPLE A typical cryostat is the Physica VT 2.

G.3.2.7 Rubber mat.

G.3.3 Chemicals

G.3.3.1 Ethanol, for cleaning.

G.4 Test process

G.4.1 Preparation of test

G.4.1.1 Preparation of equipment

Clean all the equipment with ethanol and leave to dry.

G.4.1.2 Preparation of the sample

Fill the disposable measuring cup with grease to a depth of at least 15 mm. Knock the bottom of the cup two or three times on a rubber mat to fill any voids in the lubricant and to make it as bubble-free as possible. Set the height precisely by means of the template and spread the surface smooth.

G.4.1.3 Preparation of the rheometer

Prepare the rheometer prior to measuring by positioning the stirrer in the cup as shown in Figure G.1 and ensure that it meets the following height parameters:

— cup filling height: (15 ± 1) mm;

— stirrer measuring height: about 2 mm above bottom of cup (see Figure G.1).

-20 °Table G.1 — Low-temperature torque-test parameters -30 °C

Section	Parameter	Test temperature	
		-20 °C	**-30 °C**
1	Temperature drop	linear ramp: 10 °C …-20 °C	linear ramp: 0 °C …-30 °C
	drop duration	40 min ± 0,5 min	60 min ± 0,5 min
2	holding time at test temperature	20 min ± 0,5 min	
3	rotational speed	linear ramp: 0…30 min^{-1}	
	number of measuring points	100 (minimum)	
	measuring point duration	(variable) 0,1 s…0,5 s [a]	

[a] The first revolution of the stirrer is the most important therefore the time duration between measurements at the beginning of the test is to be shorter.

G.4.2 Performance of test

Before the beginning of measuring, make sure that the cryostat has reached the relevant temperature.

Place the filled and prepared measuring cup in the cooling chamber.

Once the sample has reached the upper temperature limit in Section 1 of Table G.1, allow it to cool to the test temperature for the duration shown. Once it has attained this temperature, hold it at this temperature for the duration given in Section 2 of Table G.1.

Once the test is ready to begin, increase the rotational speed of the rheometer between the limits given in Section 3 of Table G.1 until the stirrer has made one revolution. Because it is an automatic process, the number of measuring points and their duration are recorded.

G.4.3 Evaluation

Plot the torque/time curve. An example is shown in Figure G.2.

Evaluate the absolute maximum of the curve (torque), identifying the coordinates for the measuring point which is nearest to the absolute maximum. Only the first revolution of the stirrer is to be considered.

The result for the torque is given in mN·m to one decimal place and the test temperature to zero decimal places, e.g. 43,1 mN·m (-20 °C)

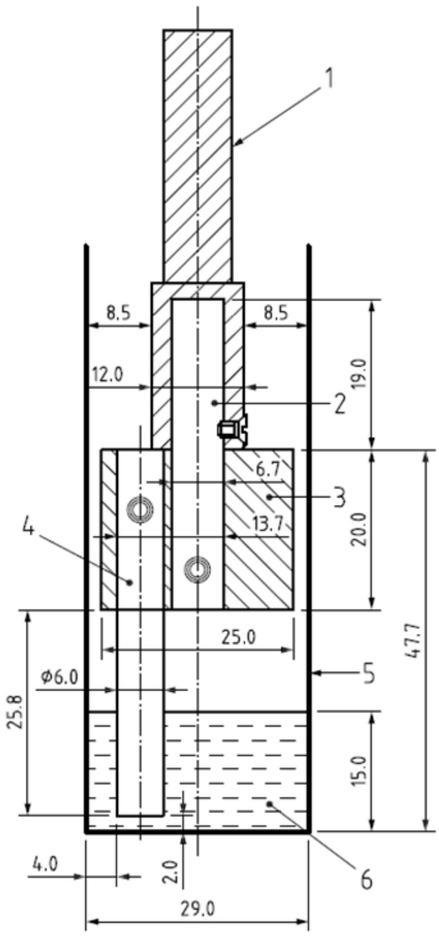
Repeat the test to verify the accuracy. With regard to reproducibility, two values are regarded as correspondent when they do not deviate from the mean value by more than 2 mN·m.

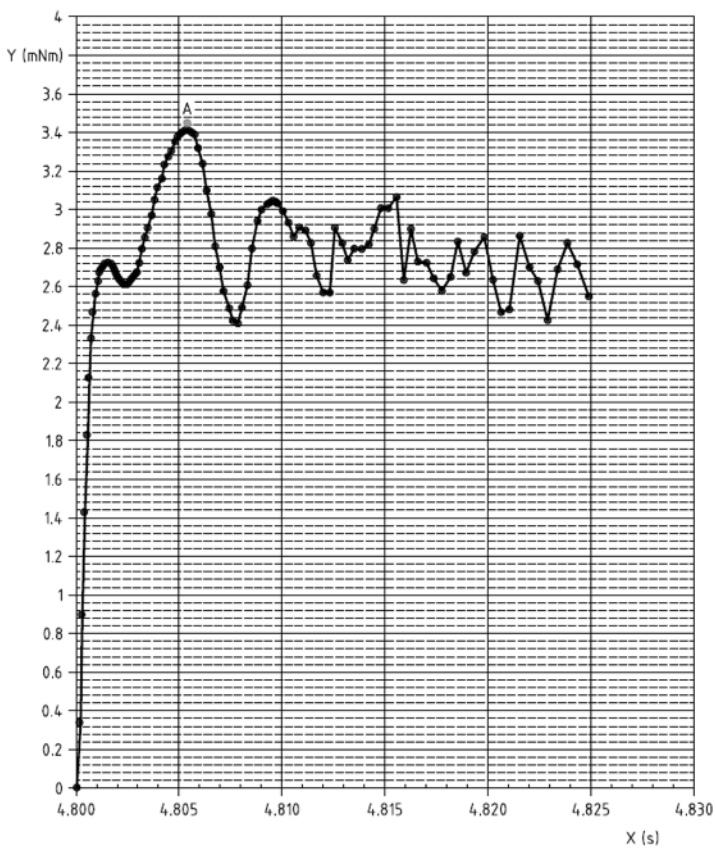
Table G.2 shows some typical values for various greases.

Table G.2 — Examples of typical results for various greases in low-temperature torque-test

NLGI type grease from ISO 6743-99	**typical results at °C [mN·m]**		**Torque [mN·m]**	**Comments**
000	3,2	-30	0…10,0	very stirrable
000	3,3	-30		
000	5,1	-30		
1,2	20,0	-20	10,1…30,0	easy to stir
1-2	24,5	-20		
0	28,4	-30		
2-3	38,5	-20	30,1…60,0	stirrable
2	39,6	-20		
2	41,0	-20		
2	49,1	-30		
2-3	67,2	-20	60,1…70,0	still stirrable
2	84,0	-20	> 70,0	difficult to stir
2	84,4	-20		

Dimensions in millimetres





Key

1 measuring shaft
2 shaft
3 insulating holder
4 stirrer
5 disposable cup
6 grease

Figure G.1 — Dimensions for stirrer and positioning arrangement for cup

Key

A maximum peak value during first revolution
Y torque
X time

Figure G.2 — Typical torque/time diagram (free flowing grease)

Annex H
(informative)

Miscibility with flange/rail lubricants in use – greases

H.1 Purpose

Miscibility is the compatibility of lubricants to combine with each other in various mixtures without any significant changes in the physical-chemical properties being seen. This test is used to check that where a new product is introduced into a lubricating system there is no adverse reaction with the previous product, which could lead to clogging or loss of operation. It is not intended to demonstrate the miscibility of products put down at the active interface.

The test method described in this annex is one way of checking miscibility and compatibility between greases used for flange/rail lubrication. This test method along with its follow-up investigations such as penetration, oil separation and drop point is, in addition, well-suited for determining the influence of mixing different greases.

Since there is no standard in place for this test, the method described below was included in this standard as a guide.

For a miscibility test for oils see Annex I.

H.2 Short description

At ambient temperature, a 100/0, 50/50 and 0/100 mix of the greases to be tested are each subjected to shear stressing in a revolving cylinder containing an iron roller with a lead core to ensure they are well mixed and worked.

Following this cone penetration, drop point and oil separation tests of the mixes are carried out.

H.3 Conditions for testing

H.3.1 Test conditions

The duration of the roll test is to be 24 h at room temperature.

H.3.2 Required testing and measuring equipment

H.3.2.1 Roll stability tester, according to ASTM D 1831.

H.3.3 Chemicals

H.3.3.1 Mineral spirit, (of type 2 according to DIN 51 631 or equivalent, but see following).

Regardless of which mineral spirit is chosen, it is suggested that in order to obtain consistent results the same spirit is used each time.

H.3.3.2 Ethanol, (technical grade).

H.4 Test process

H.4.1 Preparation for test

Clean the roller and cylinder each time before they are used, first with mineral spirit and then with ethanol. Dry with a clean, lint-free cloth.

For the 100/0 and 0/100 samples, take 50 g of the grease and place inside the hollow cylinder; then place the roller inside. Screw on the end cap.

For the 50/50 sample, take 25 g of each grease to be tested and mix them together. Distribute the mixture inside the hollow cylinder; then place the roller inside. Screw on the end cap.

In order to ensure unimpeded rolling, roll the hollow cylinder 2 to 3 times on a flat surface. If it rolls evenly, it can be assumed that the grease is distributed evenly in the hollow cylinder. If the roller sticks to the wall of the hollow cylinder, release it with a rubber hammer.

H.4.2 Performance of test

Once unimpeded and smooth rolling is ensured, place the hollow cylinder on the driving rollers of the test device.

Run the test for the duration and at the temperature given above.

After this time, remove the hollow cylinder and open it.

Allow the hollow cylinder to rest for an hour before the roller is removed.

Remove the three grease samples from the hollow cylinder and roller in the following manner and transfer them into the penetration test beakers:

— from the centre of the wall of the roller;

— from the centre of the wall of the hollow cylinder;

— a mixture in equal parts produced from the same locations above.

After a period of acclimatization, smooth the grease surface.

Carry out the penetration, oil separation and drop point tests for each of these three samples in accordance with the tests listed in Table A.1, item A.1.26.

H.4.3 Evaluation

The arithmetic mean is calculated from the three individual measurements obtained during the penetration, oil separation and drop point tests.

Annex I
(informative)

Miscibility with flange/rail lubricants in use – oils

I.1 Purpose

Miscibility is the compatibility of lubricants to combine with each other in various mixtures without any significant changes in the physical-chemical properties being seen. This test is used to check that where a new product is introduced into a lubricating system there is no adverse reaction with the previous product, which could lead to clogging or loss of operation. It is not intended to demonstrate the miscibility of products put down at the active interface.

The test method described in this annex is one way of checking miscibility and compatibility between oils used for flange/rail lubrication This test method along with its follow-up investigations such as drop point is, in addition, well-suited for determining the influence of mixing different oils.

Since there is no standard in place for this test, the method described below was included in this standard as a guide.

For a miscibility test for greases see Annex H.

I.2 Short description

Two oils are mixed together in different ratios and then tested against various standard tests to ensure that there is no loss of performance or function.

I.3 Conditions for testing

I.3.1 Test conditions

At temperatures defined in the Product Specification.

I.3.2 Required testing and measuring equipment

I.3.2.1 Filter, of 50 µm.

I.3.2.1 Mixing vessel.

I.3.3 Chemicals

I.3.3.1 Heptane.

I.4 Test process

I.4.1 Preparation of tests

Mix for 5 min minimum a quantity of about 1 l of both products, in each of the following proportions: 50/50, 90/10 and 10/90 by volume. Allow the mixes to stabilize for 7 days minimum at an ambient temperature.

I.4.2 Performance of tests

Test 1: Pass each mixture through a filter of 50 µm; after, if necessary, dilution in heptane.

Evaluate this test in accordance with I.4.3. If it passes the evaluation, carry out test 2.

Test 2: Carry out the following tests on the 50/50 mixture only. Refer to Table A.2, item A.2.15 of this standard for the applicable standards:

— dynamic viscosity;

— flash point;

— pour point;

— corrosiveness to steel;

— corrosiveness to copper;

— compatibility with elastomers.

I.4.3 Evaluation

Test 1: At the end of the period of stabilization, the products are not considered miscible if for the 10/90, 50/50 and 90/10 mixtures the following are seen:

— a permanent emulsion;

— a producing of solids or fluffy deposits on the filter.

Test 2: Additionally, carry out the following for the 50/50 mixture. Refer to Table A.2, item 2.15 for values to achieve:

— dynamic viscosity of the mixture should be in the range of viscosity of both the products;

— flash point should be in accordance with this European Standard;

— pour point should be in accordance with this European Standard;

— corrosiveness to steel should be in accordance with this European Standard;

— corrosiveness to copper should be in accordance with this European Standard;

— compatibility with elastomers should be in accordance with this European Standard.

Annex J
(informative)

Determination of low temperature cone penetration of greases

J.1 Purpose

This test is used to assess the ability of a lubricant to be available for use after it has been in a storage reservoir on a train in low temperatures for a period of time.

J.2 Short description

A sample of unworked lubricant is cooled. The cone device of the penetrometer specified in ISO 2137 is released into the sample. The depth sunk is measured during a specified time period.

The penetration is determined using the penetrometer and the full-scale cone as defined in ISO 2137. The measurement is carried out on a sample, cooled under specified conditions, to the test temperature, with the cone also being cooled to the same temperature.

J.3 Conditions for test

J.3.1 Test conditions

A re-circulated air heating cabinet sets the conditions for the tests. The values are given in Table A.1, tests A.1.4.1 and A.1.4.2.

J.3.2 Required testing and measuring equipment

J.3.2.1 Thermometer, with a measuring range of 0 °C to -30 °C and accuracy of 0,5 °C.

J.3.2.2 Forced-air refrigerator, working with a precision of ± 1 °C.

J.3.2.3 Penetrometer, according to ISO 2137.

J.3.2.4 Standard cone, according to ISO 2137.

J.3.2.5 Grease worker cup, according to ISO 2137.

J.3.2.6 Timer, capable of timing to 4 h ± 5 min.

J.4 Test process

J.4.1 Preparation of test

Overfill the grease worker cup with the lubricant to be tested. Place the cup and the cone in a forced-air refrigerator set to the test temperature and leave to cool to the test temperature for 4 h ± 5 min.

J.4.2 Performance of test

Place the penetrometer stand near the refrigerator. Make sure that the cone shaft is absolutely plumb (vertical) and free for sliding in the release mechanism.

Remove the cone from the refrigerator quickly and fit it on the vertical shaft of the penetrometer, ensuring that the release mechanism is perfectly free. Then transfer the test sample from the chamber to the penetrometer stand.

The time between the measurement and the removal from the chamber shall be less than 1 min in order to avoid too great a variation in the temperature of the grease and of the cone.

Without smoothing the grease, carry out the penetration measurement immediately, as follows:

a) Place the stem of the dial gauge and that of the cone in contact, then set the dial gauge to the “zero” position. Carefully adjust the penetrometer so that the tip of the cone is just in contact with the centre of the surface of the test portion.

b) Release the shaft of the cone quickly and allow it to take effect for (5 ± 0,1) s.

Lower the stem of the dial gauge gently until it is stopped by the shaft of the cone and read the penetration on the scale of the indicator.

J.4.3 Evaluation

Carry out at least two measurements for each sample. Establish the mean value of the individual values and round to the nearest unit (0,1 mm).

Annex K
(informative)

Functional test on specific equipment

K.1 General

The good flow behaviour of lubricants used in wheel flange and rail lubricating installations is important to ensure the lubricant can be delivered from the reservoir to the outlet. Apart from the lubricant, the flow behaviour is also dependent on the temperature, the pressure in the installation and the pipe length.

To select suitable lubricants for practical use, it is advisable to perform testing with original components.

K.2 Flowing behaviour of wheel-flange greases

K.2.1 Purpose

This annex describes a test to determine the quality of the spray of a lubricant in a sample lubrication system at ambient, low and raised temperatures.

K.2.2 Short description

The test carried out in order to see whether a wheel-flange lubricant can be fed and sprayed by an appliance under pressure at various temperatures. This appliance is modelled on a wheel-flange lubricating installation using original components and the worst conditions occurring in real-life practice are chosen for the pressure and the pipe length. Ten impulses in the form of spray patterns are recorded on paper and ten impulses are used to determine the spray volume when compared with the value at 20 °C.

K.2.3 Conditions for testing

K.2.3.1 Test conditions

The following suggested test temperatures are set consecutively: 20 °C, 0 °C, -10 °C, -25 °C.

Other temperatures above and below these can also be used, but the spray volumes for these will need to be determined.

When changing between each test temperature, a stabilization time of one hour should be allowed for each 10 °C temperature difference.

The test conditions are set by means of a climatic chamber.

K.2.3.2 Required testing and auxiliary equipment

K.2.3.2.1 Climatic test chamber, with a measuring range of -25 °C to 30 °C and accuracy of 0,5 °C.

K.2.3.2.2 Control unit for solenoid valves, with a measuring range of 0 s to 100 s and accuracy of 0,1 s.

K.2.3.2.3 Analytical balance, with a measuring range of 0 g to 200 g and accuracy of 0,01 g.

K.2.3.2.4 Appliance, to test pumpability.

K.2.3.2.5 Test nozzle.

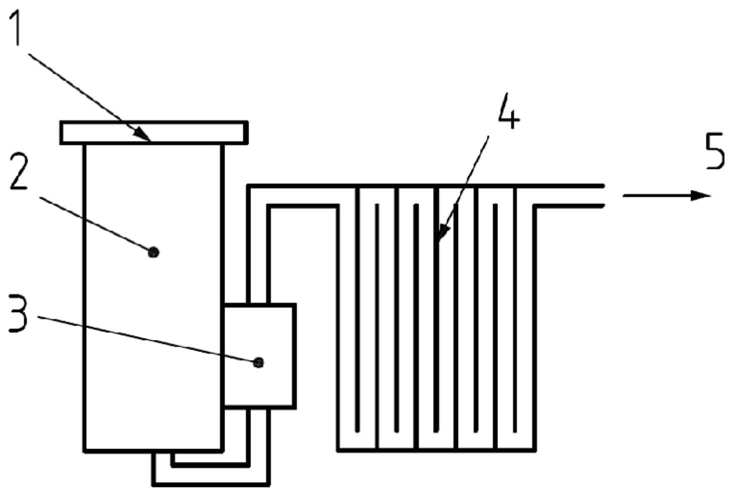
K.2.3.2.6 Pressure reduction valve.

K.2.3.2.7 Steel sheet.

K.2.3.2.8 Recording paper, (typically 80 g/m^2 white office paper).

K.2.3.3 Devices/equipment

An appliance to test the pumpability should consist of a reservoir with a pump and filter and a lubricant pipe, see Figure K.1. A test nozzle is connected to the end of the lubricant pipe.



Key

1 cover

2 reservoir

3 filter

4 lubricant pipe

5 to test nozzle

Figure K.1 — Appliance to test the pumpability of lubricant

K.2.4 Test process

K.2.4.1 Preparation of test

Set the nozzle at the required distance away from the spraying surface. This will vary dependent upon the equipment used. Check that the appliance is clean of lubricant. Add the lubricant to be tested to the reservoir.

Weigh and record the mass of the steel sheet.

K.2.4.2 Performance of test

Allow the appliance to reach its test temperature. Operate the appliance to allow it to stabilize.

Operate the appliance and capture the first ten impulses as a spray pattern on a sheet of paper. Allow the next ten impulses to be sprayed onto the metal sheet. Weigh and record the mass of the metal sheet and the lubricant.

Repeat the test at the next test temperature.

K.2.4.3 Evaluation and reporting of test

Inspect the ten spray patterns on the paper. There should be signs of lubricant on the paper from the fifth impulse onwards.

Compare the masses of each spray volume test with the quantity weighed at 20 °C and convert to a percentage. The expected limit is given in Table K.1. Record the results.

Table K.1 — Evaluation table

Temperature [°C]	**Spray volume expected** [%]
20	100
0	80
-10	60
-25	30

K.3 Test of spraying of oils at various temperatures

K.3.1 Purpose

This test indicates the quality of spray of a lubricant in a given lubrication system at ambient, low and raised temperatures.

K.3.2 Short description

The lubricant is sprayed from a nozzle on to a paper strip. The test is done when the paper strip is stationary and when it is moving. The shape of the pattern produced on the paper is used to determine the quality of the lubricant in that nozzle at different temperatures. The nozzle should be from a system in common use by the customer.

K.3.3 Conditions for test

K.3.3.1 Test conditions

At the temperatures specified below:

— t_{amb} 20 °C ± 5 °C;

— t_{min} lowest operating temperature stated in the Product Specification;

— t_{max} highest operating temperature stated in the Product Specification.

The test can be carried out at a temperature different to these but, in such cases, it will be necessary to define the following in the Product Specification:

— the ambient temperature;

— the acceptable maximum time between the end of the stabilization at t_{max} or t_{min} and the first spraying. This time is to be as short as possible in order to stay close to t_{max} or $t_{min.}$

K.3.3.2 Required testing and measuring equipment

K.3.3.2.1 Lubricating system, in common use by the customer.

K.3.3.2.2 Recording paper, (typically 80 g/m^2 white office paper).

K.3.4 Test process

K.3.4.1 Preparation of test

The parameters to set-up the lubrication system should be the ones applied in service. They should be defined in the Product Specification.

The parameters are, for example:

- the air supply pressure;
- the quantity of lubricant per ejection and per nozzle;
- the duration of spraying;
- the distance between the end of the nozzle and the surface to be lubricated.

The complete lubrication system (reservoir unit, pump, nozzle and lubricant) should be primed and then stabilized for 8 h minimum at the test temperature, ± 5 °C.

All the test parameters, including the ambient temperature at the time of the test, should be recorded and indicated in the test report.

K.3.4.2 Performance of test

Carry out the spray tests under the following conditions:

- with the nozzle positioned at 45° downward;
- in a still atmosphere (no vibrations or draughts);
- at the relevant test temperature (see K.3.3.1);
- by collecting the lubricant on a strip of paper placed at (30 ± 1) mm from the end of the nozzle;
- by having the strip of paper perpendicular to the axis of spray.

Two series of test should be carried out at each test temperature:

- with the paper strip stationary;
- with the paper strip moving at a speed of (100 ± 10) mm/s in one direction only.

Carry out three sprayings for each test temperature.

At the end of each spray test, there should not be any lubricant adhering to the end of the nozzle.

K.3.4.3 Evaluation and recording of the test

K.3.4.3.1 Test with the paper strip stationary

The lubricant should be uniformly spread with the appearance of fine droplets. The impact point should have a round shape (see example Figures K.2 and K.3).

A photograph of the splashes of the lubricant on the strips of paper is to be included in the test report.

K.3.4.3.2 Test with the paper strip moving

The lubricant should be regularly spread, without discontinuity (see example Figures K.4 and K.5).

A photograph of the splashes of the lubricant on the strips of paper is to be included in the test report.

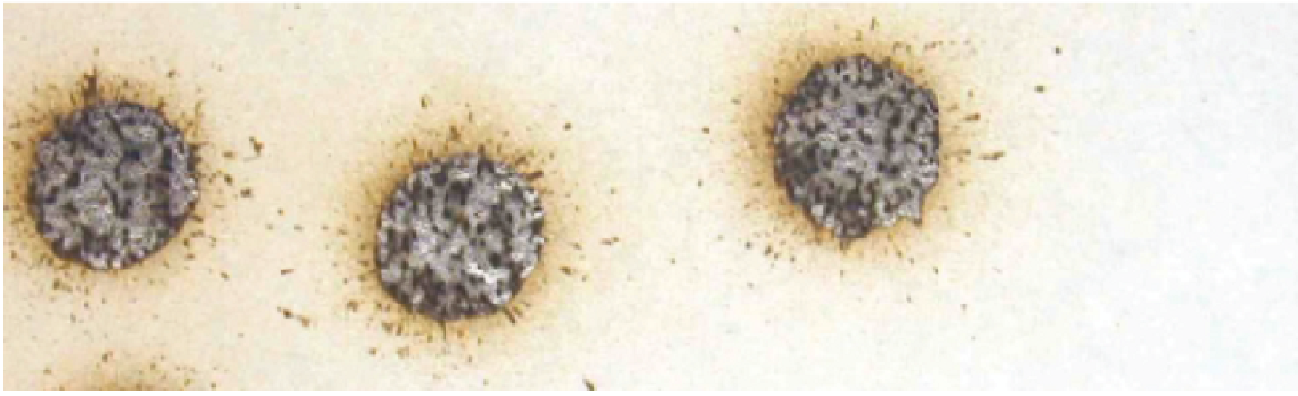


Figure K.2 — Test with the stationary strip - Satisfactory result

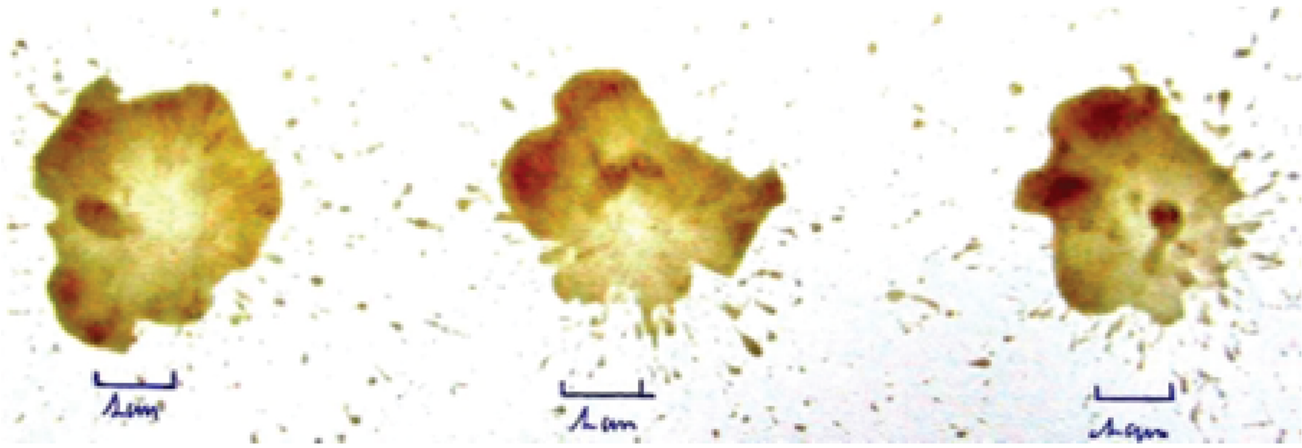


Figure K.3 — Test with the stationary strip - Unsatisfactory result

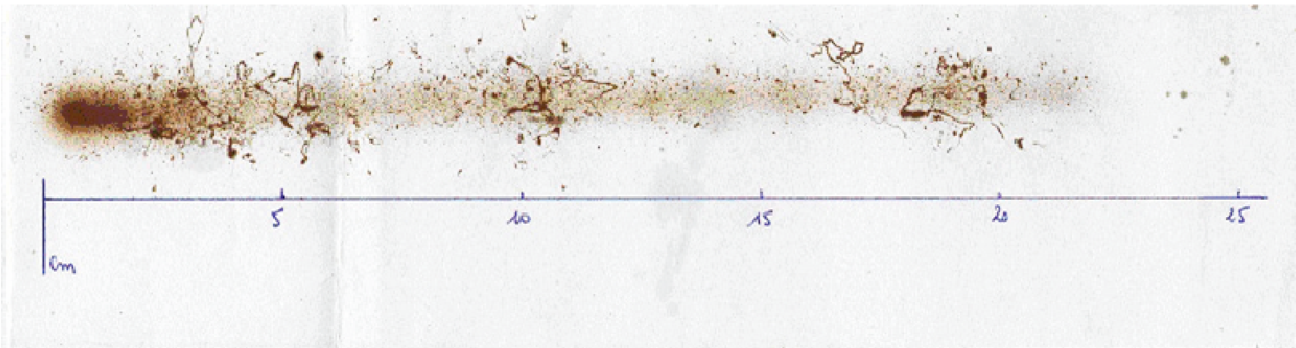


Figure K.4 — Test with the moving strip - Satisfactory result

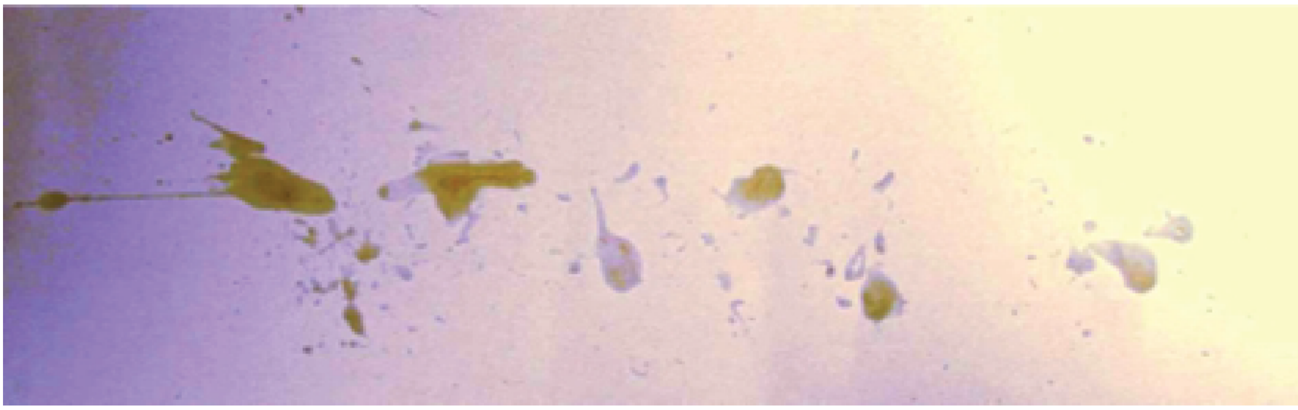


Figure K.5 — Test with the moving strip - Unsatisfactory result

Annex L
(informative)

Solid stick testing on twin-disc machine

L.1 Purpose

The purpose of this annex is to provide basic guidelines for conducting comparative testing using a twin disc machine for solid stick products with respect to quantifying the following key performance criteria:

a) The ability to reduce and control the coefficient of friction (CoF) when the solid stick product is applied to the wheel flange;

b) The durability of the applied film once the solid stick product is removed. This provides an indication of how long the applied film will last when being transferred between the wheel flange and rail gauge side face.

This methodology can be used to assess performance from different stick suppliers or to compare batch to batch variability from a single supplier.

As there are different designs of twin disc test machines, the proposed methodology discusses how to compare results of different product compositions using the **same** twin disc apparatus. The method does not describe how to compare results from different twin disc apparatus.

L.2 Short description

A twin disc machine is a twin-roller tribometer that runs two cylindrical discs against each other under a preset applied pressure and slip between the two discs. One disc represents the wheel and the other the rail. The machine usually operates under ambient laboratory conditions. In most machines, the amount of pressure and slip can be varied; usually, a coefficient of friction is derived from the measured torque. An example of a twin disc test machine is shown in the following Figures L.1 and L.2.

L.3 Conditions for test

L.3.1 Test conditions

Testing is usually conducted in the ambient temperature and relative humidity conditions found in laboratories. These conditions should be recorded for each test.

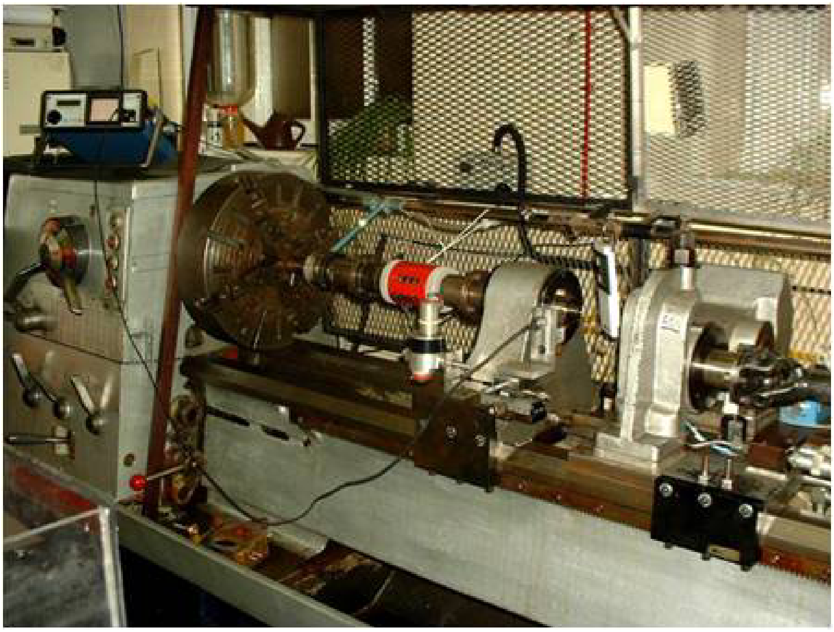


Figure L.1 — Example of laboratory twin disc test machine

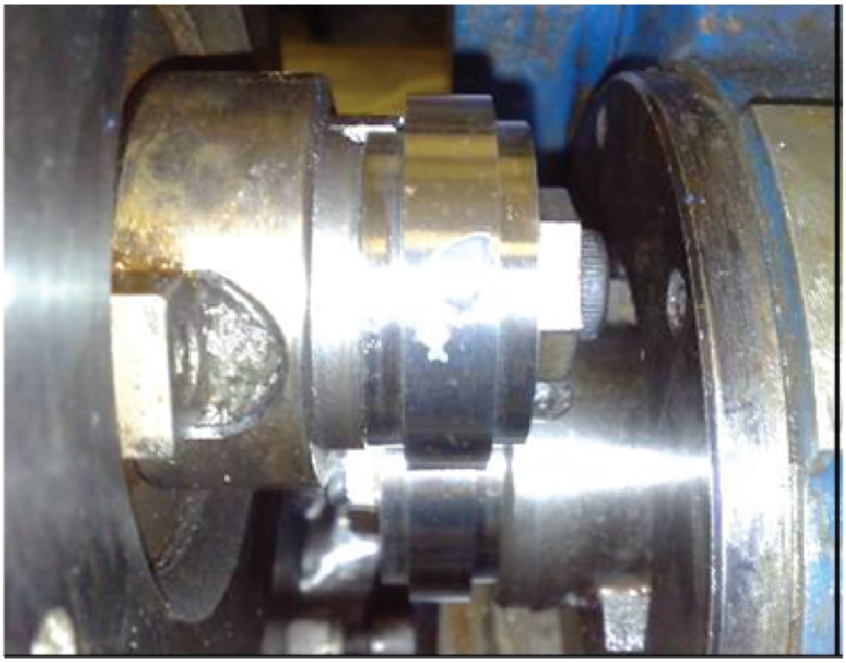


Figure L.2 — Simulated wheel/rail contact using a wheel and rail disc(s)

L.3.2 Required testing and measuring equipment

L.3.2.1 Twin discs

Ideally, the “wheel” and “rail” discs are manufactured from actual sections of wheel and rail sources in order to match their typical characteristics (metallurgy, hardness, etc.). The discs themselves should generally be free from corrosion and contaminants. The discs may vary in diameter depending on the test apparatus employed to generate the slip/creepage. For example, a twin disc machine may employ wheel and rail discs of the same diameter and use independent motors to generate the required slip/creepage. Other test machines may use a single motor but will utilize wheel and rail discs of different diameters in order to generate the required slip/creepage. The discs may or may not be profiled in order to generate the required Hertzian Pressure.

L.3.2.2 Solid stick applicator

To apply the solid stick sample to the “wheel” disc, a stick applicator is required. The basic constraints of the design are as follows:

a) It is possible to utilize a sample cut from a solid stick product (i.e. rectangular shape).

b) It is possible to simulate the same applied (spring) pressure as utilized in the actual field application.

c) It is possible to have some adjustment to ensure the solid stick is applied correctly onto the rotating disc surface.

An example of a solid stick applicator for a twin disc machine is shown in Figure L.3 below.

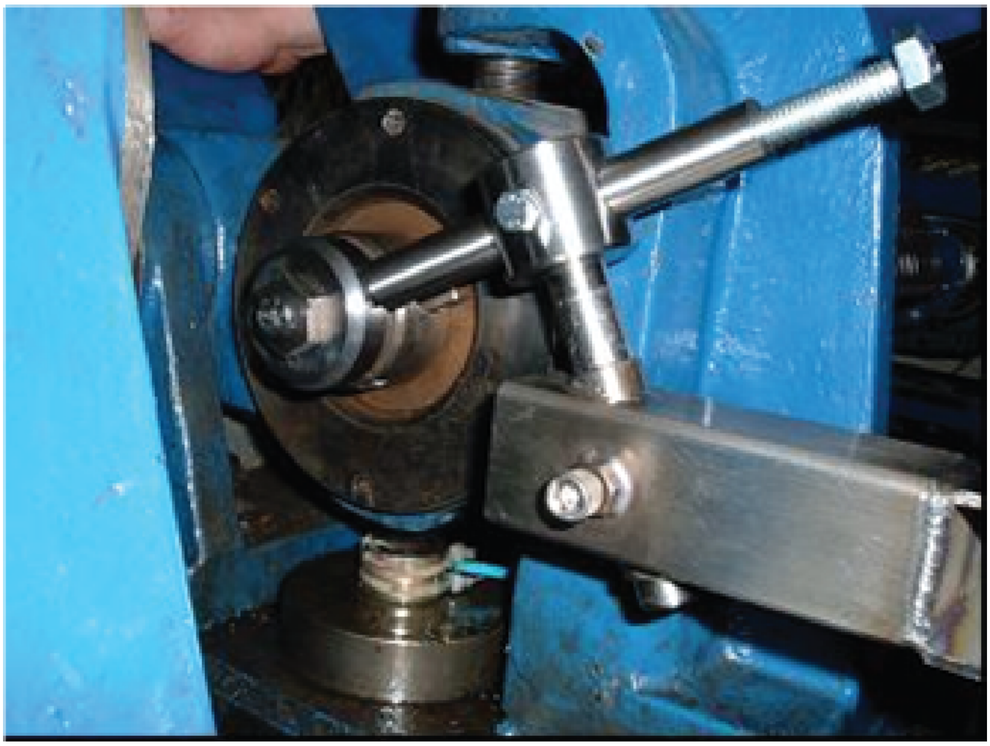


Figure L.3 — Example of solid stick applicator for twin disc machine

L.4 Test process

L.4.1 Sample collection and test preparation

It is recommended that samples of the solid stick products for twin disc testing are collected from existing inventory/stock. Sample preparation should involve cutting a smaller sample from the solid stick to perform the twin disc test. It is important to know the cross sectional area of the stick to be applied against the wheel disc in order to calculate the required spring force.

Prior to commencing a test, it is recommended that the solid stick sample be allowed to form a profile to the wheel disc by rubbing it against the disc. This means that the stick profile conforms with the disc ensuring optimum and accurate results. Depending on test conditions, this can take several hours.

L.4.2 Test settings

The following conditions are recommended for twin disc testing:

Slip/creepage : 10 % to 20 %;

Speed (revs per min) : 230 to 400 (depends on type of twin disc machine);

Pressure : 800 MPa to 1 000 MPa.

L.4.3 Performance of test

Weigh the solid stick sample before the test commences. This should be after it has been conditioned against the disc to optimize its shape.

If conditioning of the stick sample took place, remove any product from the disc before continuing. Commence testing with dry discs and allow the measured coefficient of friction to increase to 0,4. This represents a “dry” baseline.

Once the dry baseline has been achieved, apply the solid stick to the wheel disc at the specified pressure for 200 s. Record the measured coefficient of friction.

Remove the solid stick from the disc surface and allow the discs to continue to be rotated until the dry baseline coefficient of friction level is reached. Record the time to achieve this.

Weigh the solid stick sample after the test is completed. Determine the percentage of product consumed during testing.

Testing should be repeated at least three times.

L.4.4 Evaluation

An example of data generated from a twin disc test machine is shown in Figure L.4. The graph compares the performance from two different solid stick products.

L.5 Test results

Key performance attributes to qualitatively assess the test results include the following:

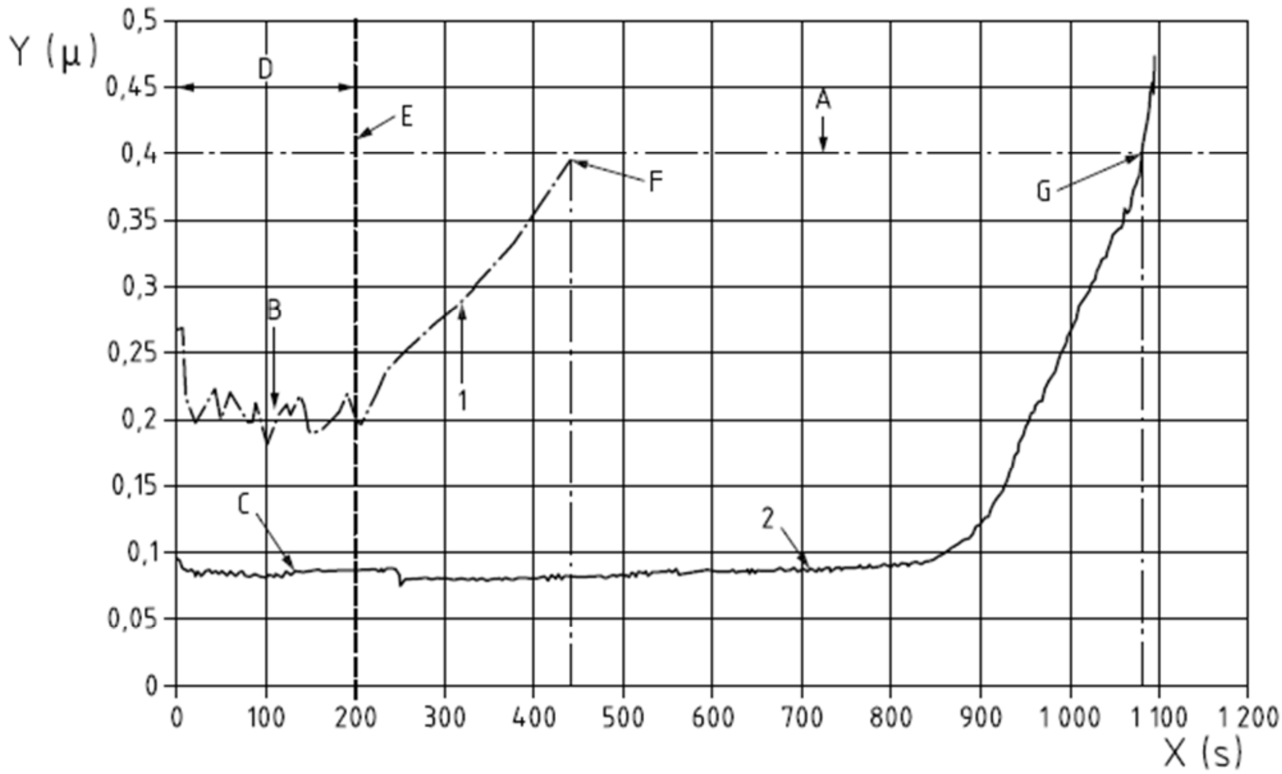
1) How quickly does the CoF reduce once the solid stick is applied to the wheel disc? Ideally, a rapid reduction in CoF indicates a superior transfer of the solid lubricant to the twin disc interface.

2) What value does the CoF stabilize at when the solid stick is continuously applied? A lower CoF is more desirable in order to minimize wear.

3) How long does it take to re-achieve the “baseline” CoF once the stick is removed? Ideally, a long lasting film is desired especially as it is expected that the product will withstand multiple wheel/rail transfers.

4) Referring to the measured stick weights, what is the comparative stick consumption rate?

In the example in Figure L.4, sample “B” provides superior performance compared to sample “A”.



Key

1 sample A
2 sample B
A “Dry” baseline CoF of 0,4
B CoF value of approximately 0,08 for Sample A
C CoF value of approximately 0,2 for Sample B
D stick continuously applied onto disc surface for 200 s
E stick removed from disc surface
F sample A reaches baseline CoF approximately 250 s after stick is removed
G sample B reaches baseline CoF approximately 875 s after stick is removed
X time (s)
Y coefficient of friction

Figure L.4 — Comparative CoF performance of two different solid stick products on a twin disc test machine

Annex M
(informative)

Lubricant product performance - Field assessment

M.1 General

This annex provides basic guidelines on setting up controlled field trials for assessing lubricant product performance. The annex is written specifically for assessing trainborne systems for reducing wheel flange wear.

M.2 Product performance assessment

The typical steps in assessing lubricant performance are as follows:

a) Select at least one train set (or vehicle) which can be used for the duration of the test; note that these tests can run for three to twelve months. Preferably, the wheel sets should have been recently turned (but worn in). The basic wheel flange dimensions should be recorded and the profile shape traced.

b) Review the track routes and select a route which generates high flange wear (i.e. high proportion of curves); ensure that the test train can be dedicated to this specific route for the extended period of time. Note however that other trains using the route can influence the results.

c) If desired, a baseline phase can be conducted in order to establish an existing flange wear rate (in the absence of train-mounted lubrication). In some cases, this data may already be available in historical maintenance records.

d) If a baseline field test is to be conducted, the following general best practices should be applied:

   1) A schedule for measurements should be established based on distance travelled for the test train. The length of the test should be sufficient to generate statistically valid wear rates.

   2) A measurement plan should be established which includes multiple measurements on each wheel as well as multiple wheel sets (on the test train/vehicle).

   3) General environmental conditions should be noted during the course of the test phase.

   4) Wear data analysis should follow industry accepted practices and should be presented as a function of distance travelled.

   5) The measurement instrument should be calibrated on a regular basis.

e) In the next phase of the trial, the trainborne lubricant system can be installed or activated.

f) The lubricant test phase follows the same best practices as explained in section (d). It should be noted the distances travelled for both baseline and lubricant test phases should be similar.

g) Compare baseline and lubricated wear rates, ascertain savings and compare to projected costs.

h) Finalize results in a report.

Bibliography

[1] ISO 6743-1, *Lubricants, industrial oils and related products (class L) Classification — Part 1: Family A (Total loss systems)*

[2] ASTM D2596, *Standard Test Method for Measurement of Extreme-Pressure Properties of Lubricating Grease (Four-Balls Method)*

[3] STM-S-801, *Spécification SNCF — Matériel roulant ferroviaire — Huiles pour graisseurs de boudins,* Indice C, Janvier 2004 (STM-S-801, *SNCF Specification — Rolling Stock — Oils for flange lubricators*, Issue C, January 2004)

[4] *Specifiche Techniche di Fornitura – Dispsitivi per la Lubrificazione delle rotataie e relative lubrificanti* Issue A 28-7-2006 RFI

[5] NR/PS/XXX/yyyy — *Business Process Document — Permanent Way Lubricants*, Draft 1, 2005 — Network Rail

[6] BR672 *Flange Lubrication Greases*, March 1992, BR Research

[7] *Lubricants: Rapidly biodegradable wheel flange grease, Technical delivery terms and conditions,* DB Data Sheet 517 718 (30.05.2008)

[8] *Lubricants: Rapidly biodegradable wheel flange grease for trackside application, Technical delivery terms and conditions*, DB Data Sheet 783 667 (30.05.2008)

[9] I J McEwen, *Selection of the optimum flange lubricant for use on JNP lines*, *4 — Rail Services Limited*. Infraco JNP, July 2002

[10] Fiche de donnée techniques de l'huile SHELL EP 460 — *Lubrifiant pour graisseurs de boudins de roues* (Datasheet for oil SHELL EP 460 — *Lubricant for wheel flange lubricators*)

[11] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006, concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC

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