BS EN 15427-2-1:2022



BSI Standards Publication

Railway applications — Wheel/ Rail friction management

Part 2-1: Properties and Characteristics — Flange lubricants

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National foreword

This British Standard is the UK implementation of EN 15427-2-1:2022. It supersedes BS EN 16028:2012, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RAE/3/-/6, Railway applications - Wheel/rail friction management.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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European foreword

This document (EN 15427-2-1:2022) has been prepared by Technical Committee CEN/TC 256 “Railway Applciations”, 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of an identical text or by endorsement, at the latest by November 2022, and conflicting national standards shall be withdrawn at the latest by November 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 16028:2012.

This document is part of the following series:

— EN 15427-1-1, *Railway applications - Wheel/Rail friction management - Part 1-1: Equipment and Application – Flange lubrication*

— CEN/TS 15427-1-2, *Railway applications - Wheel/Rail friction management - Part 1-2: Equipment and Application – Top of Rail materials*

— CEN/TS 15427-1-3, *Railway applications - Wheel/Rail friction management - Part 1-3: Equipment and Application – Adhesion materials*

— EN 15427-2-1, *Railway applications - Wheel/Rail friction management - Part 2-1: Properties and Characteristics – Flange lubricants*

— CEN/TS 15427-2-2, *Railway applications - Wheel/Rail friction management - Part 2-2: Properties and Characteristics – Top of Rail materials*

— CEN/TS 15427-2-3, *Railway applications - Wheel/Rail friction management - Part 2-3: Properties and Characteristics – Adhesion materials*

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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 interface, commonly referred to as “flange or rail lubrication”;

— lubrication of the back of flange/ check rail interface; commonly referred to as “check rail lubrication”;

— altering the level of friction at the interface between the top of rail and the wheel tread, commonly referred to as “top of rail friction management”;

— altering the level of adhesion at the interface between the top of rail and the wheel tread.

This document 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;

— accordance with relevant environmental requirements;

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

— satisfactory and consistent product quality and performance;

— no degradation to the safety of the railway (braking, signalling).

The main purpose of the lubricant is to reduce friction and wear and reduce the risk of flange climb derailment.

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1 Scope

This document specifies the properties and characteristics of lubricants applied to the interface between the wheel flange and the gauge face of the rail, and contact area between the check rail face and the back of the wheel (active interface), either directly or indirectly to the wheel flange or to the rail, and includes both trainborne and trackside solutions.

It outlines the information required for most approval procedures, the method of testing and routine control/monitoring of the lubricant.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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 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 pycnometer method and titration method (ISO 1183-1)*

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

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 7827, *Water quality - Evaluation of the "ready", "ultimate" aerobic biodegradability of organic compounds in an aqueous medium - Method by analysis of dissolved organic carbon (DOC) (ISO 7827)*

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)*

EN ISO 9439, *Water quality - Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium - Carbon dioxide evolution test (ISO 9439)*

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)*

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

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

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

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

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

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

ISO 22285, *Petroleum products and lubricants — Determination of oil separation from grease — Pressure filtration 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 13737, *Petroleum products and lubricants — Determination of low-temperature cone penetration of lubricating greases*

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

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

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
lubricant
substance designed to alter friction at the active interface

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 comprises 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.

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

3.6
active interface
contact area between wheel flange and the gauge face of the rail and contact area between the check rail face and the back of the wheel

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

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
trainborne equipment
system carried on the train that consists of one or more applicators, a storage unit and a means of control

3.10
trackside equipment
system installed on or adjacent to the track that consists of one or more applicators, storage containers and a means of control

3.11
operating temperature
temperature range in which the lubricant can be applied effectively

3.12
creep
slip
measure of the relative displacement or motion of the wheel against the rail, usually caused by imperfect steering of a bogie in a curve

Note 1 to entry: Creep is usually expressed as a percentage of the rolling displacement.

Note 2 to entry: Creep can be longitudinal, lateral or in a spin direction relative to the rail.

3.13
product specification
document prepared by the customer that describes the conditions and requirements for the adhesion material to meet and the tests to validate it

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4 Design requirements

The lubricant shall be designed to meet at least one of the following:

— reduction in noise and vibration;

— reduction in the rate of wear;

When applied within the specified limits, the lubricant shall not compromise the safety of the railway (i.e braking distances, signalling systems, etc.).

NOTE Specified limits are normally understood and agreed between relevant parties before use of lubricant.

5 Technical specification and product approval

5.1 Introduction

This clause outlines the information required to gain product approval on most railway networks. It does not cover its performance on the railway.

5.2 Product specification

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

a) purpose of the lubricant;

b) conformity to the applicable type tests as set out in Tables A.1 to A.3;

c) conformance with other relevant local requirements, (such as environmental, fire, toxicity, etc.);

d) application data:

   1) including equipment with which it can be used, (see Annex G - I);

   2) operating temperatures;

e) additional validation tests, (see Table A.4);

f) any previous relevant experience, (i.e. use in other countries);

g) conditions for packaging and labelling, (see Clause 8);

h) environmental tests, as defined in Tables A.1 to A.3.

NOTE 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.

5.3 Technical 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 provided. A technical datasheet shall also be provided (see Clause 7).

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

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6 Control and monitoring of product

6.1 Manufacturing process

If the manufacturing process is changed in a way that can affect the properties or characteristics of the lubricant, the new process shall be documented and the customer shall be notified.

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

6.2 Composition of lubricant

If the composition of the lubricant is changed in any way that affects its properties or characteristics, it shall be documented and the customer shall be notified.

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

6.3 Routine tests

Routine tests ensure product consistency from batch to batch.

The routine tests are listed in Tables A1 to A3. If additional tests are required, (such as those not included in the tables or a type test), these and their frequency should be agreed between the client and supplier.

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

The results of the routine tests shall be recorded.

6.4 Additional measures

Retention of test records and samples, witnessing of tests, calibration of test equipment shall be considered.

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 subclauses shall also be included.

7.2 Grease-based 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 particulates 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-based lubricant characteristics

The product shall be described by its viscosity, its temperature range and by the type of oil used. Where solid particulates 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-based 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.

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

8 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 will 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.

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Annex A
(normative)

Requirements for lubricants and testing

A.1 Explanation of Tables A.1 to A.4

The tables have two purposes:

1) Tests to show the product can be used in the railway environment;

2) Product consistency.

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 the 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 the performance characteristics of the lubricants and that the lubricant will operate correctly with the equipment with which it is to be used.

A.2 Key to Tables A.1 to A.4, 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 6.1 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:

— '**X**' indicates that the test or piece of information is mandatory;

— '**O**' indicates that the test or piece of information is optional.

A.3 Key to Tables A.1 to A.4, column 'Use'

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

— A = Trainborne, using oil or grease–based lubricants;

— B = Trackside, using grease-based lubricants;

— 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.

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Table A.1 — Requirements for greases

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.1.1	Appearance	A and B	-	Visual	Homogenous	**X**	**X**	**X**	Appearance is a general assessment of the product
A.1.2	Colour	A and B	-	Visual	Homogenous	**X**	**O**	**X**	
A.1.3	Consistency	A	-	ISO 6743-99	Typically 00–000	**X**	**X**	**X**	
		B	-	ISO 6743-99	Typically 1	**X**	**X**	**X**	
A.1.4.1	Un-worked grease penetration at:	A							
a)	25 °C		0,1 mm	ISO 2137	Typically 400 to 475	**X**	**O**		
b)	0 °C		0,1 mm	ISO 13737	≥ 350	**X**	**O**		
c)	−25 °C		0,1 mm	ISO 13737	≥ 300	**X**	**O**		
A.1.4.2	Un-worked grease penetration at:	B							
a)	25 °C		0,1 mm	ISO 2137	Informative – no criteria	**X**	**O**		
b)	0 °C		0,1 mm	ISO 13737	Informative – no criteria	**X**	**O**		
c)	−25 °C		0,1 mm	ISO 13737	Informative – no criteria	**X**	**O**		

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Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.1.6	Drop point	B	°C	ISO 2176	Higher than operating range upper limit	**X**	**X**	**X**	
A.1.7	Flash point	A and B	°C	EN ISO 2592	≥ 200	**X**		**X**	
A.1.8	Water content	A and B	% mass	ISO 760 or ISO 3733	Informative – no criteria	**O**	**O**		
A.1.9	Water resistance at 40 °C	A	Level	DIN 51807-1	1	**O**	**O**	**O**	
		B	Level	DIN 51807-1	1	**X**	**O**	**X**	
A.1.10	Adhesion to sheet steel	A	Stage	Annex D	1	**O**	**O**	**O**	
	(0,05 mm, 24 h at temperature agreed between client and supplier)	B	Stage	Annex D	1	**O**	**O**	**O**	
A.1.11	Volatile components (24 h at 60 °C)	A and B	% mass	Annex E	≤ 10	**O**	**O**	**O**	
A.1.12	Oil separation / “bleeding”								
A.1.12.1	(18 h at 40 °C)	A	% mass	ISO 22285	≤ 5	**X**	**O**		With 100 g weight
A.1.12.2	(168 h [7 days] at 40 °C)	B	% mass	ISO 22285	5 % maximum by weight for NLGI No.2 grease &	**X**	**O**		With 100 g weight

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Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
					7 % maximum by weight for a NLGI No.1 grease				
A.1.13	Corrosion test								
a)	Steel	A	Level	Annex C	1	**O**	**O**	**O**	
		B	Rating	ISO 11007-1 and ISO 11007-2 using water	0; 0	**O**	**O**	**O**	
b)	Copper 24 h at 50 °C	A and B	Grade	DIN 51811	1	**O**	**O**	**O**	
A.1.14	Compatibility with elastomers (60 °C for 168 h)	A and B							Where applicable
a)	Change in volume for NBR1		%	ISO 6072	+15/-0	**O**			Other elastomer types may be tested as necessary
b)	Change in hardness for NBR1		IRHD	ISO 6072	±8	**O**			Other elastomer types may be tested as necessary
A.1.15	Identity testing: Using Infrared, or Xray fluorescence, or Inductively coupled plasma emission spectroscopy	A and B		Standard laboratory method. (See comments for applicable standards)	For routine tests compare with approved batch using same process	**X**	**X**		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							

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Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
a)	25 °C		mPa·s	DIN 51810-1	≥ 150	**O**	**O**	**O**	
b)	0 °C				≥ 400	**O**	**O**	**O**	
c)	−25 °C				≤ 4 000	**O**	**O**	**O**	
A.1.17	Four ball test	A and B							
a)	Wear test rating (300 N, 1 h at 1 500 r/min)		mm	EN ISO 20623	≤ 0,8	**X**		**X**	
b)	Extreme pressure		daN	EN ISO 20623	Weld load not less than 3000 N	**X**			
A.1.18	Effect of water (water wash-off test)	B	visual	Annex B	No corrosion after 72 h	**O**			
			% loss	ASTM D4049 at 83 kPa	Informative – no criteria	**O**			
A.1.19	Low temperature flow pressure (pumpability)	B	mbar	DIN 51805	Less than 500 mbar at −20 °C	**O**	**O**		
A.1.20	Density at 15 °C	A	kg/m^3	EN ISO 12185 EN ISO 3675	Informative value	**X**	**O**	**X**	
A.1.21	Biodegradability	A and B	%	EN ISO 7827 EN ISO 9408 EN ISO 9439 EN ISO 10707 Or equivalent standards	Informative value	**X**		**X**	As defined in product specification. Equivalent standards include OECD 301 suite

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Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.1.22	Fire behaviour a) Smoke b) Spread of flame c) Toxicity	A and B		As defined by the client		**O**		**O**	
A.1.23	Bead size/droop/peaking	B		Example test in Annex F	Sufficient bead size that peaks and does not droop	**O**			
A.1.24	Water pollution	A and B	As required	As defined in the product specification, see comment.	Local conditions may apply	**O**			For example, in Germany: Verwaltungsvorschrift wassergefährdender Stoffe [German Administrative Regulation on Substances Hazardous to Water]

Table A.2 — Requirements of oil

Item	Property	Use	Unit	Test method	Values	Type	Routine	Datasheet	Comments
A.2.1	Appearance	A	-	Visual	Homogenous	**X**	**X**	**O**	Appearance is a holistic assessment of the product
A.2.2	Colour	A	-	Visual	Homogenous	**X**	**O**	**X**	
A.2.3	Flash point	A	°C	EN ISO 2592	≥ 200	**X**		**X**	

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