

Note

This leaflet is part of a set which also includes :

- Leaflet 510-1 : Wagons - Running gear - Normalisation.
- Leaflet 515 : Coaches - Running gear.
- Leaflet 813 : Technical specification for the supply of wheelsets for tractive and trailing stock. Tolerances and assembly.
- Leaflet 846 : Technical specification for the supply of roller bearing axle box cases made of spheroidal graphite cast iron.

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0 - General

0.1 - Subject

This specification defines the criteria for selecting greases for railway vehicle roller bearing axleboxes as well as the conditions for the approval, acceptance and use of these greases.

The values quoted relate only to lithium based greases, the use of which is recommended.

Purchasing railways may use greases based on other substances, in which case new values and suitable test methods must be specified. Test methods for greases based on substances other than lithium may to a large extent be derived from the methods described in this specification.

0.2 - Scope

The following provisions are relevant for vehicles used in international traffic.

Depending on the technology, the use of the vehicles and their maintenance regulations the purchasing railways may supplement the obligatory provisions specified for lithium based greases with recommended tests (5.2) to match their requirements or adapt their regulations for other lubricants.

1 - Characteristics of lithium based greases

1.1 - Chemical composition

- Type of soap base : lithium

- Additives : anti-oxidant, anti-corrosive and, if necessary, extreme pressure resistant, etc.

Use of particular greases and additives must not be in contradiction with the laws applicable to the purchasing railway.

1.2 - Application temperature

The lubricating properties of the grease must be guaranteed for temperatures between - 20° C and + 120° C.

1.3 - Conditions

The conditions and the nature and category of the tests (type tests or series tests) for the approval and acceptance of greases are given in paragraph 5.

- Type tests are tests for checking a specific quality level and specifying properties to be met in series tests for the purpose of approval testing,
- Series tests are tests used to check that quality standards are constantly met when an approved grease is supplied.

1.3.1 - Obligatory conditions

Obligatory conditions are given in paragraph 5.1.

1.3.2 - Recommended conditions

Recommended conditions are given in paragraph 5.2.

2 - Approval conditions for greases

2.1 - Manufacture

No special conditions are stipulated for the production of greases, provided the product matches the conditions laid down in paragraph 5 or stipulated by the purchasing railway.

2.2 - Approval of manufacturers

The greases to which this specification applies may only be produced by manufacturers approved by the purchasing railway. The manufacturer must also have installations enabling him to ensure uniform production quality.

2.3 - Approval of greases

2.3.1 - General

The grease samples submitted for approval must be industrially manufactured and not originate in the laboratory. All grease required for approval tests (series tests, type tests and line tests) must be taken from the same production batch and delivered in a single consignment.

The approval applies only to the particular grease submitted to the tests. Any change in the composition of the grease can consequently only be made after prior approval by the purchasing railway.

To obtain such approval the manufacturer is requested to give early notification of any intended change to the purchasing railway to allow sufficient time for carrying out any tests (series tests, type tests or complete approval procedure) required in its view for new approval.

2.3.2 - Approval testing

2.3.2.1 - Type tests

The type tests are shown in paragraph 5.1. If results are satisfactory, the purchasing railway may permit service trials to be held or specify additional tests to be carried out for research purposes (see paragraph 2.3.2.2).

Depending on the intended use of the grease the purchasing railway can choose between 2 tests : DB C1 St V 300, page 15 of this leaflet (Table 1) and the SNCF test ML3 - R2F 1-00, Method 1, page 1, page 17 of this leaflet (Table 1).

2.3.2.2 - Recommended additional tests

These tests are intended to give the purchasing railway additional guarantees, especially for special applications (high speeds, temperature, etc.).

Depending on the intended application the purchasing railway may require one or several of the additional tests given in paragraph 5.2 to be carried out.

2.3.2.3 - Service tests

Service tests shall be made with representative tractive vehicles, coaches and wagons selected by the purchasing railway. If possible, vehicles with a high annual performance and high speed and axle-load for that type of vehicle are selected. The duration of the test depends on the construction type of the test vehicle. Usually it extends over 3 years.

During the test period the purchasing railway assesses the lubricating properties and lubricating abilities of the grease by taking samples and by suitable analysis. The samples must be taken from the rolling area of the axlebox. The amounts of grease taken must be small so as not to endanger the continuation of the service test but large enough to judge whether the test should be continued. Suitable assessment criteria are especially : micro-penetration, drop point, sulphate ash content, iron content, acid number and water content.

A number of test wheelsets must be held in reserve so as to have a sufficient number of roller bearing axleboxes with the grease being tested available throughout the planned test period. In addition, railways are advised to provide a similar number of reference wheelsets with roller bearing grease already approved. The test wheelsets and the reference wheelsets must always be used on the same vehicle. After the end of the service tests, all grease shall be removed from the bearings and the removed grease samples analysed in detail. The roller bearing axleboxes shall be inspected visually.

Approval shall be given when no irregularities ascribable to the grease are found. The purchasing railway shall decide for which type of vehicle, roller bearings, maximum speeds, maximum axle-loads and running distance the grease can be approved.

3 - Acceptance of approved greases

3.1 - Batch formation

Greases produced in the same manufacturing process shall form a batch. Proper homogenisation before drawing off the grease is a pre-condition. The purchasing railway reserves the right to check each batch for homogeneity, at all times.

The minimum batch size shall be specified by the purchasing railway.

3.2 - Test methods

The results of the tests and controls carried out by the manufacturer to ensure the quality of the basic oil must be recorded in writing. The purchasing railway must be allowed to inspect the documentation.

Greases shall be submitted to the obligatory quality control series tests given in Table 1 and, if applicable, to the recommended tests given in Table 2. However, the purchasing railway reserves the right also to check the other properties by random testing.

The series tests are carried out at least once per production batch.

3.3 - Conclusions drawn from the tests

Any test result, or tests, not conforming with the conditions can cause the rejection of the corresponding batch.

4 - Handling of the greases

4.1 - Packing

The greases must be supplied in leakproof packaging.

The packaging unit must be adapted to the site consumption.

4.2 - Labelling

Every package must bear the following :

- Name or brand name of the manufacturer
- Description of the grease
- Net weight
- Manufacturing date and batch number
- Supply number

4.3 - Storage

Greases must be stored under weather protection. If this is impossible, rain protection shall be compulsory.

4.4. - Preservation

After six months storage in the closed original packing, counted from the date of delivery, at temperatures between -5°C and $+30^{\circ}\text{C}$ in the conditions specified in paragraph 4.3, greases must have retained the properties described in this specification.

If changes occur before the end of this period, unused greases may be rejected.

5 - Tabular representation of properties

5.1 - Compulsory properties

The compulsory properties, the method of testing (type or series tests) as well as the standard test methods for lithium based lubricants are shown in Table 1.

Non-standard test methods are the subject of Appendix 1.

Depending on application the purchasing railway may choose between DB test C1 St V 300, page 15 of this leaflet (Table 1) and the SNCF test ML3 - R2F 1-00, Method 1, page 17 of this leaflet (Table 1).

Table 1
Quality control test for greases

Properties	Unit	Regulation	Test category		Test method
			Approval (Type)	Quality (Series)	
Colour and appearance		homogeneous	X	X	
Consistency class		2-3	X		NLGI and ISO 2137
Change in work penetration after 60 cycles from approval specimen	0.1 mm	± 15		X	ISO 2137
Change in work penetration after 60000 cycles in relation to work penetration after 60 cycles	0.1 mm	≤ 60	X		ISO 2137
Drop point	$^{\circ}\text{C}$	$\geq 180^{\circ}\text{C}$	X	X	ISO 2176
Sulphate ash	%	as an indication	X		NF T 60-144 DIN 51 575

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Sulphate ash, relative change compared with approval specimen	%	± 20		X	NF T 60-144 DIN 51 575
Acid number	mg KOH/g	≤ 9.0 alk. ≤ 4.5 acid	X	X	DIN 51 809 Part 2
Water content	%	≤ 0.2	X	X	Karl Fischer ISO 3733
Cold behaviour (penetration with non-worked grease at - 20°C)	0.1mm	> 150	X	X	See Appendix 1
Capability of preventing rust formation EMCOR - SKF		0	X	X	NF T 60-135 DIN 51 802 IP 220

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Resistance to rolling - impression 1/2 cone deviation before and after test - 4 h at 100°C - penetration deviation	0.1 mm	≤ 60	X	X	ASTM D 1831
Infrared spectrum		as an indication in line with approval specimen	X	X	usual laboratory methods
static oil separation 42 h at 40°C	%	between 0.5 and 6	X	X	IP 121
Water behaviour		1	X		DIN 51 807 Part 1
Oxidation behaviour IROX after 700 h at 130°C	cm ⁻¹	≤ 70	X		Appendix 1

Mechanical and dynamic tests					DB C1 V 300 Appendix 1
DB trial run 2 with SKF machine					X
- change in mass of roller bearing sets	mg			≤ 50	X
- change in mass of bearing cages	mg			≤ 100	
- residual grease in bearing	g			≥ 10	
- assessment criterion	index number				
• wetting power T				1	
• oil carbon OK				1	
• consistency change KV				2	
• Sealing A				1	
• oil separation OA				2	
• Gel formation G				1	
• participation in rotation UT				1	
• air emulsion E				1	

- corrosion prevention properties of grease near the rollers EMCOR				0	
- properties of residual grease					
• change in penetration compared with penetration after 60 cycles	0.1 mm			≤ 60	
• drop point	°C			≥ 140	
• acid number	mg KOH/g				
• infrared spectrum				no significant change	

or test with SKF R2F machine SNCF Method 1 (28 days)		X	X	SNCF method ML3-R2F 1-00 Method 1 Appendix 1
• appearance of grease			• no emulsion • no oil carbon formation • no significant variation in consistency • no heavy oil separation	
• inspection of bearings			• no dull areas on the bearings • no brown or glossy streaks amounting to wear	

• loss of mass of bearings				
• cages	mg	≤ 100		
• rollers	mg	≤ 25		
• housing tempera- ture	°C	≤ 75		

5.2 - Recommended properties

The recommended properties as well as the kind of test (type or series test) and all standard test methods are shown in Table 2.

Non-standard test methods are the subject of Appendix 2.

Table 2

Quality control test for greases

Properties	Unit	Regulation	Test category		Test method
			Approval (Type)	Quality (series)	
Lubricating power Test with SKF R2F machine Method 2 (3 months) - appearance of grease		- no emulsion - no oil carbon formation - no oxidation - no significant variation of consistency - no heavy oil separation	X		SNCF method ML3 - R2F 2-00 Method 2 Appendix 2

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- inspection of bearings - loss of mass of bearing - cage - rollers - housing temperature Wear resistance	mg mg °C	- no dull areas on bearings - no brown or glossy streaks amounting to wear ≤ 100 ≤ 25 ≤ 75	X		DB Cf St V 301 Appendix 2

DB running test 1 with SKF machine					
- change of mass of roller sets	mg	≤ 50			
- change of mass of cages	mg	≤ 100			
- assessment criteria	index number				
• Wetting T			1		
• oil carbon OK			1		
• consistency KV			2		
• change A			1		
• Sealing OK			2		
• oil separation G			1		
• Gel formation					
• participation UT			1		
• in rotation E			1		
• air emulsion					

- properties of residual grease - change of penetration compared with penetration after 60 cycles - drop point - acid number - infrared spectrum	0,1 mm °C mg KOH/g	≤60 ≥140 no significant changes			
Endurance test D8 running test 2 with the SKF test machine			X		
- temperature increase above the test temperature of 120°C - change of mass of roller sets - change of mass of cages	°C mg mg	≤20 ≤50 ≤100			

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Friction wear test - specific force N _{max}	N	measured	X	DB C 1 St V 304 Appendix 2
Wear test by friction Reduction of acceptable specific force compared with specimen				
Assessment of particle size of sodium nitrite in the grease - particle size	N 10 ⁻³ mm	≤ 5	X	DB C1 St V 204 Appendix 2
Mechanical strength and oxidation stability (700 hour test) Grease appearance		no change in consistency	X	SNCF method MEV NM 86 022 ROVITS machine Appendix 2
IXOX after 700 hours		≤ 50		

Testing of functional characteristics

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Properties	Unit	Regulation	Test category		Test method
			Approval (Type)	Quality (Series)	
Miscibility with other approved greases of the same railway - mechanical stability of the 1/1 mixture - change of penetration after 24 h at ambient temperature - change of penetration after 24 h at 110°C in relation to worked grease penetration after 60 cycles - maximum penetration after 24 h at 110°C - drop point of 1/1 mixture and roller test 24 h at 110°C	0.1 mm °C	 ≤60 ≤150 ≤400 ≥140	X		DB C1 St V 307 Appendix 2

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Full scale bench tests

Properties	Unit	Regulation	Test category		Test method
			Approval (Type)	Quality (series)	
Fatigue and impact strength - loss of grease	g	≤ 100	X	X	ROPECS Bench (SNCF) MEV NM 86020 Appendix 2
Flow resistance and effectiveness of additives			X		ROPECAUS Bench (SNCF) MEV NM 86021 Appendix 2
High pressure - amount of grease forced out	g	≤ 150			
- functional temperature of rollers	°C	≤ 135			
- consumed power	KW	< 2.0			

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- appearance of rollers - steps		no trace of seizing			
- inner rings		-			
- roller ends		-			
- tracks		no discolouring			
Performance			X		MEB bench (SNCF) MEV NM 86019 Appendix 2
- temperature of rollers in the load zone with an ambient temperature of 20°C	°C	≤ 65 with a measuring tolerance of 1% ≤ 85			
- temperature in hot box detection area (DBC zone) with an ambient temperature of 20°C	°C	≤ 55 with a measuring tolerance of 1% ≤ 75			
- temperature deviation measured in the load zone	°C	≤ 15 with a measuring tolerance of 1% ≤ 25			

- appearance of the rollers	the rollers and the rings must not show any faults such as flaking, seizing, heating. The cages must not show any cracks, incipient cracks, deformation, or abnormal wear			
- increase of Fe content in grease :				
zones 1 and 2	%	≤ 0.5		
zone 3	%	≤ 1		

Compulsory non-standard test methods

French National Railways	Cold temperature behaviour Cold penetration at - 20° C	ML3 PAF 00
1 - TEST PRINCIPLE Determine the unworked penetration at - 20°C using the penetrometer specified in Standard NF T 60-132.		
2 - MATERIAL - a penetrometer, - a mechanically-ventilated thermostatic cell, in which testing is carried out at -20°C with an accuracy of ± 1°C.		
3 - TEST PROCEDURE a) Preparation - fill the oil beaker with grease in accordance with Standard 60-132, - place in the thermostatic cell, which was previously set to - 20°C, and leave in the cell at the test temperature for 4 h ± 5 min. b) Measurements - set up the penetrometer with a measuring cone beside the thermostatic cell - remove the sample from the thermostatic cell - take off the grease and measure the penetration immediately. Less than 1 minute should pass between removal from the thermostatic cell and measurement.		

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- TEST PRINCIPLE

The grease test samples are aged artificially in order to measure oxidation development over time. The oxidation of a reference grease is tested at the same time.

2 - MATERIAL

A motor connected to a gear wheel arrangement, with which stainless steel pots can be rotated at 100 r.p.m.

Each pot contains a stirring system, which revolves in the opposite direction at 135 r.p.m. (see diagram).

The apparatus must contain at least 4 pots (2 for the test grease and 2 for the reference grease).

- stainless steel pots : see drawing
- stainless steel stirrer : see drawing
- 1 thermostatic cell at $130 \pm 0.2^{\circ}\text{C}$
- 1 cover, which closes the test apparatus and keeps the temperature evenly distributed. The cover has 2 diametrically opposed holes each with a 5 mm diameter for better air circulation.

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3-TEST PROCEDURE

- after cleaning, place 40g grease in each pot. 2 pots are used for each grease sample, regardless whether it is the test grease or the reference grease,
- insert the test apparatus, closed with the cover, into the thermostatic cell at $130 \pm 0.2^{\circ}\text{C}$,
- start the drive motor,
- every 100 hours remove a sufficiently large grease sample from each pot so as to be able to measure the "IROX" oxidation, as indicated in Appendix 1, page 33.
- take the "IROX" value, which is the arithmetic mean of 2 measurements.

The last sample shall be removed after 700 hours.