

# JCMAS

## **Lubricating grease for construction machinery**

**JCMAS P 040: 2004**

Published 2004-05-20  
English translation issued in June 2012

**Japan Construction Machinery and Construction Association**

## **Forward**

This Japan Construction Machinery and Construction Association Standard (hereafter “JCMAS”) was prepared by Domestic Standardization Committee of Japan Construction Machinery and Construction Association (hereafter “JCMA”) and has been published by Chairman of JCMA

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- The draft of this JCMAS was approved on 2004-01-29 at JCMA Domestic Standardization Committee
- Invitation for submission of comments on the draft JCMAS according to WTO/TBT agreement "Code of good practice" was made from 2004-03-15 to 2004-05-15.
- Then this JCMAS was published on 2004-05-20.
- English translation was prepared then it was published in June 2012.

NOTE “Explanatory Note” following the main text describes the purpose, the development history, the rationale (major discussions, etc.) and the lists of drafting committee members of this standard.

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## Lubricating grease for construction machinery

### 1 Scope

This standard specifies general lubricating grease for construction machinery (hereinafter referred to as GK for abbreviation) and biodegradable grease for construction machinery (hereinafter referred to as GKB for abbreviation).

### 2 Normative references

The following referenced documents are indispensable for the application 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.

- JIS K 2220:2003**      *Lubricating grease*
- JIS K 2251**      *Crude petroleum and petroleum products - Sampling*
- JIS K 2283**      *Crude petroleum and petroleum products-Determination of kinematic viscosity and calculation of viscosity index from kinematic viscosity*
- JIS K 6251**      *Rubber, vulcanized or thermoplastics-Determination of tensile stress-strain properties*
- JIS K 6253**      *Rubber, vulcanized or thermoplastic-Determination of hardness*
- JIS K 6258**      *Rubber, vulcanized or thermoplastic-Determination of the effect of liquids*
- ISO 2137**      *Petroleum products and lubricants -- Determination of cone penetration of lubricating greases and petrolatum<sup>1)</sup>*
- ISO 2176**      *Petroleum products-Lubricating grease-Determination of dropping point<sup>1)</sup>*
- ISO 6743-9**      *Lubricants, industrial oils and related products (class L) -- Classification -- Part 9: Family X (Greases)<sup>1)</sup>*
- ISO 11009**      *Petroleum products and lubricants -- Determination of water washout characteristics of lubricating greases<sup>1)</sup>*
- ISO 13226**      *Rubber -- Standard reference elastomers (SREs) for characterizing the effect of liquids on vulcanized rubbers*
- ASTM D 2266**      *Standard Test Method for Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method)*
- ASTM D 2596**      *Standard Test Method for Measurement of Extreme-Pressure Properties of Lubricating Grease (Four-Ball Method)*

### 3 Class

Classes of lubricating grease for construction machinery are as indicated in **Table 1**. Based on **JIS K 2220:2003**, Clause 3, q), Table 1 worked penetration number, general lubricating grease for construction machinery (GK) is classified into No. 1 and No. 2 and biodegradable grease (GKB) is classified into No. 2.

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<sup>1)</sup> Cited as information

**Table 1** Classification of Lubricating grease for construction machinery

Class		Range of operating temperature °C	Suitability for use conditions		Application example
Use	Consistency Grade		Contact with water	Bio-degradability	
General grease (GK)	No. 1	-20~+130	Suited	No	Construction machinery
	No. 2	-20~+130	Suited	No	
Biodegradable grease (GKB)	No. 2	-20~+130	Suited	Yes	Construction machinery to be used at the site requiring environmental protection

#### 4 Quality and performance

##### 4.1 General lubricating grease for construction machinery (GK)

General lubricating grease for construction machinery (GK) shall comply with the criteria as specified in **Table 2** when tested in accordance with the testing methods as specified in **Clause 5**.

In addition, hazardous substance(s) that may cause harmful effect(s) on environment shall not be used in manufacturing processes.

**Table 2** General lubricating grease for construction machinery (GK) performance criteria

Performance criteria			
Item	Test method (subclause no.)	Cone penetration No.	
		No. 1	No. 2
Range of operating temperature (°C)		-20~+130	-20~+130
Thickener type		Report <sup>1)</sup>	Report <sup>1)</sup>
Worked penetration	5.3	310~340	265~295
Unworked penetration	5.3	Report <sup>1)</sup>	Report <sup>1)</sup>
Apparent viscosity (-10°C, shear rate: 10S <sup>-1</sup> ) (Pa * s)	5.3	250 or less	500 or less
Base oil kinematic viscosity (40°C) (mm <sup>2</sup> /s)	5.4	Report <sup>1)</sup>	Report <sup>1)</sup>
<b>Heat resistance</b>			
Dropping point (°C)	5.3	170 or more	170 or more
Oil separation (100°C, 24h) (mass %)	5.3	10 or less	5 or less
Evaporation loss (99°C, 22h) (mass %)	5.3	2.0 or less	2.0 or less
<b>Rust prevention</b>			
Humidity cabinet test (14 days)	5.3	Class A	Class A
Copper corrosion (100°C, 24h)	5.3	Have no color change in green or black on copper plate	
<b>Extreme-pressure/ anti-wear properties</b>			
Four-ball load bearing characteristics (weld load) (N)	5.5	1961 or more	1961 or more
Four-ball wear resistance (wear diameter) (mm)	5.6	0.7 or less	0.7 or less
<b>Mechanical stability</b>			
Worked stability	5.3	400 or less	375 or less
<b>Water washout characteristics</b>			
Loss in mass (%) by water washout (38°C, 1h)	5.3	10 or less	10 or less
<b>Oxidation stability</b>			
Oxidation stability (90°C, 100h) (KPa)	5.3	80 or less	80 or less

**Table 2 General lubricating grease for construction machinery (GK) performance criteria (Continued)**

Performance criteria				
Item	Test method (subclause no.)	Cone penetration No.		
		No. 1	No. 2	
<b>Seal immersion test (100°C, 72h)</b>				
NBR	Hardness change	5.7	-30 or more	-30 or more
	Tensile strength change (%)	5.7	-70 or more	-70 or more
	Elongation change (%)	5.7	-80 or more	-80 or more
	Volume change (%)	5.7	0~40	0~40
AU (urethane)	Hardness change	5.7	-5~+5	-5~+5
	Tensile strength change (%)	5.7	-70 or more	-70 or more
	Elongation change (%)	5.7	-60 or more	-60 or more
	Volume change (%)	5.7	-5~+15	-5~+15
NOTE 1	Apply durometer type A for measuring hardness change in the seal immersion test			
NOTE 2	Apply low nitride rubber material (SRE-NBR/L) defined in <b>ISO 13226</b> as “NBR” for the seal immersion test.			
NOTE 3	The characteristics of the “AU” material to be used in the seal immersion test shall be in accordance with Table 3.			
Table footnote <sup>1)</sup>	Report the test results.			

**Table 3 Seal material characteristics**

Criteria		Unit	AU
	Hardness	Durometer A	88~98
	Tensile strength	MPa	29.4 or more
	Elongation	%	300 or more

#### 4.2 Biodegradable grease for construction machinery (GKB)

Biodegradable grease for construction machinery (GKB) is composed of base oil having biodegradability and additives which give no adverse effect on environment. It shall comply with the criteria as specified in Table 2 when tested in accordance with the testing methods as specified in **Clause 5**.

**Table 4 Biodegradable grease for construction machinery (GKB) performance criteria**

Performance criteria		
Item	Test method	Cone penetration No.
		No. 2
Range of operating temperature (°C)		-20~+130
Thickener type		Report <sup>1)</sup>
Worked penetration	5.3	265~295
Unworked penetration	5.3	Report <sup>1)</sup>
Apparent viscosity (-10°C, shear rate: 10S <sup>-1</sup> ) (Pa·s)	5.3	500 or less
Base oil kinematic viscosity (40°C) (mm <sup>2</sup> /s)	5.4	Report <sup>1)</sup>

**Table 4 Biodegradable grease for construction machinery (GKB) performance criteria (Continued)**

Performance criteria			
Item	Test method	Cone penetration No.	
		No. 2	
<b>Heat resistance</b>			
Dropping point (°C)	5.3	170 or more	
Oil separation (100°C, 24h) (mass %)	5.3	5 or less	
Evaporation loss (99°C, 22h) (mass %)	5.3	2.0 or less	
<b>Rust resistance</b>			
Humidity cabinet test (14 days)	5.3	Class A	
Copper corrosion (100°C, 24h)	5.3	Have no color change in green or black on copper plate	
<b>Performance criteria</b>			
<b>Extreme-pressure/ anti-wear properties</b>			
Four-ball load bearing characteristics (weld load) (N)	5.5	981 or more	
Four-ball wear resistance (wear diameter) (mm)	5.6	0.7 or less	
<b>Mechanical stability</b>			
Worked stability	5.3	375 or less	
<b>Water washout characteristics</b>			
Loss in mass (%) by water washout (38°C, 1h)	5.3	10 or less	
<b>Oxidation stability</b>			
Oxidation stability (99°C, 100h) (kPa)	5.3	80 or less	
<b>Seal immersion test (100°C, 72h)</b>			
NBR (nitride rubber)	Hardness change	5.7	Report <sup>1)</sup>
	Tensile strength change (%)	5.7	Report <sup>1)</sup>
	Elongation change (%)	5.7	Report <sup>1)</sup>
	Volume change (%)	5.7	Report <sup>1)</sup>
AU (urethane)	Hardness change	5.7	Report <sup>1)</sup>
	Tensile strength change (%)	5.7	Report <sup>1)</sup>
	Elongation change (%)	5.7	Report <sup>1)</sup>
	Volume change (%)	5.7	Report <sup>1)</sup>
<b>Standards for environment</b>			
Biodegradability (28 days)	5.8	Standards in section 5.8 are to be met.	
Fish acute toxicity 96h LC <sub>50</sub> value	5.8	Standards in section 5.8 are to be met.	
NOTE 1	Apply durometer type A for measuring hardness change in the seal immersion test.		
NOTE 2	Apply low nitride rubber material (SRE-NBR/L) defined in <b>ISO 13226</b> as “NBR” for seal immersion test.		
NOTE 3	Characteristics of the “AU” material to be used in the seal immersion test shall be in accordance with Table 3.		
Table footnote <sup>1)</sup>	Report the test results.		

## 5 Tests methods

### 5.1 Material sampling method

Material sampling methods shall be in accordance with **JIS K 2251**.

### 5.2 Tests apparatus in general

Tests apparatus shall be, in general, in accordance with **JIS K 2220**.

### **5.3 Basic grease tests**

Basic grease tests shall be in accordance with **JIS K 2220**.

### **5.4 Base oil kinematic viscosity test**

Base oil kinematic viscosity tests shall be in accordance with that specified in **JIS K 2283**.

### **5.5 Four ball extreme-pressure test**

Four ball extreme-pressure test shall be in accordance with **ASTM D 2596**.

### **5.6 Four ball wear resistance test**

Four ball wear resistance test shall be in accordance with **ASTM D 2266**.

### **5.7 Seal immersion test**

Seal immersion tests shall be in accordance with the dip test methods for vulcanized rubber as specified in **JIS K 6258**. Then, for evaluation purpose, tensile test methods for vulcanized rubber as specified in **JIS K 6251** and hardness test methods for vulcanized rubber and thermoplastic rubber as specified in **JIS K 6253** are to be applied.

### **5.8 Environmental criteria**

Environmental criteria shall be in accordance with Japan Environmental Association Eco Mark Product Category No.110 "Biodegradable Lubricating Oil Version2.4", subclause 4.1.

## Explanatory note

### Introduction

This Annex explains the main texts and specified/described as well as referenced matters and also those relating to the aforementioned. Accordingly, this annex does not comprise any provision of this standard.

### 1 Purpose of this standard

There are two methods to classify a grease: one is the method to classify it by its components (base oil, thickener, additives), and another is the method to classify by application as in **JIS K 2220**. And also, in **JIS K 2220:2003** version, grease classification by ISO was added to **Annex 1 (Normative)**. So far, however, each construction machinery manufacturer has recommended its own branded product or those available from the market based on their application. Against this, construction machinery users have needed common grease to satisfy performance requirements by various construction machinery manufacturers under the market trend where they have been using plural number of construction machines, diversified models and designs, and with the development of rental or leasing systems. Taking into account such background, this standard is established to standardize grease for use with construction machinery.

Actual grease performance currently used for construction machinery is employed as the basis of this standard.

This standard for general lubricating grease for construction machinery (GK) gives provisions of lubrication performance and quality of grease for use with hydraulic excavators, bulldozers, wheel loaders and the like that need periodical lubrication service. In addition, this standard provides grease specifications to satisfy construction machinery users in terms of cost, lubrication intervals, availability, handling characteristics, etc., and specifies two classes - cone penetration grades of No. 1 and 2.

The other standard for biodegradable grease for construction machinery (GKB) sets forth specifications of biodegradable grease intended for use with construction machinery, and with a single cone penetration grade of No 2 considering the market circumstances. As to standardizing biodegradability, various standards including ISO, Blue Angel and VAMIL were investigated but in the end it has been decided to specify the minimum requirements in accordance with Japan Environmental Association Eco Mark Product Category No.110 "Biodegradable Lubricating Oil Version2.4", subclause 4.1.

Biodegradable grease can minimize environmental burden by gradual degradation by microorganism in environment even in case of grease spillage and spread through construction machinery operation.

### 2 History of establishment of the Standard

The draft of this standard was prepared by the Equipment Engineering Committee, Fuels & Lubricants Subcommittee of Japan Construction Machinery Association (JCMA), then reviewed and approved by the Domestic Standard Subcommittee and subsequently established as a JCMAS, after posting for comments for a period of 60 days in accordance with WTO Agreement on Technical Barriers to Trade (TBT) "Code of good practice (CGP)".

### 3 Major discussions



### 3.1 Range of operating temperature

**JIS K 2220** specifies grease operating temperature range between - 10°C (for low side) and + 100°C (for high side). Usually, guaranteed temperature range for construction machinery by the manufacturer is –from 20°C up to + 40°C, but while taking high temperature during the machine manufacturing process at the painting line and high temperature around the machine engine, modification of operating temperature range up to + 130°C was proposed. Through certain discussions, eventually, operating temperature range was decided to be from - 20°C and up to 130°C. Also it was decided not to specify but to report the thickener type.

### 3.2 Oil separation

As the oil separation information may be included as one of purchasing conditions at the construction site of major general contractors, this test has been included. Discussions were made around the testing temperature and duration. While this standard specifies grease operating temperature range as + 130°C for high side on the other side there exists no testing method provisions at + 130°C and it will cause confusion for the user of this standard. While the current JIS gives provisions for the test temperature of + 100°C for 24 hours, the testing at + 130°C for 30 hours is not a general practice and is considered rather too severe for lithium-type grease, testing conditions as that in the current JIS are applied.

### 3.3 Lubricating performance

Lubricating performance test is a test to check grease bearing life and was strongly requested by construction machinery manufacturers. However, testing method **ASTM D 1741** has been withdrawn 10 years ago, and **ASTM D 3336: 1997** “Standard test method for life of lubricating grease in ball bearing at elevated temperature” is considered to be the most popular method instead. Therefore, it was once planned to specify the requirements at the highest grease operating temperature of 120°C (based on **ISO 6743-9: 2003**) with the bearing life of minimum  $L_{50} = 500$  h or the results of first 3 tests are 350 h or more . Subsequently, discussions on this consideration were made with the experts from Japan Grease Association. As the result of discussions, it became apparent that characteristics of testing equipment specified in **ASTM D 3336** differ each other and correlation between test results using different test apparatus is not good enough and therefore unreliable. Accordingly, this test item was withdrawn from this standard leaving the responsibility for this test and results is left for machine manufactureres.

### 3.4 Seal immersion test

As to seal material rubber or resin resistance against grease, imersion test method was investigated. At the early stage of developing this standard, test conditions of 70°C with duration of 72h was proposed. However based on current conditions of greased parts of state-of-art construction machinery, test temperature of 100°C with duration of 72 h was specified. Construction machinery manufactureres have evaluated market-proven grease under the above condition and standard values are then decided accordingly. As to biodegradable grease, there is a report that nitrile content has significant impact on hardness and volume shift through the test. However, as construction machinery manufacturers have not enough experiences on this item, specific requirements are not decided for biodegradable grease and it is decided to require report of the results.

## 4 Scope

This standard is applicable to general grease and biodegradable grease for construction machinery.

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**5 Provisions**

Nothing to state in particular..

**6 Possible concerns**

Nothing to state in particular..

**7 Normative references**

Nothing to state in particular..

**8 Patent rights and so on**

Nothing to state in particular..

**9 Others**

Nothing to state in particular..

**10 Composition of the Drafting Committees**

Listed below are members who compose the Drafting Committee and the Reviewing Committee related to this Standard.

**Reviewing Committee (Domestic Standardization Committee)**

Responsibility	Name	Organization (At fiscal 2003 year end)
Chairman	OHHASHI, Hideo, Mr	Academic expert
Observers	FUJIWARA, Tatsuya, Mr	Ministry of Economy, Trade & Industry
(Official	INAGAKI, Takashi, Mr	Ministry of Land, Infrastructure & Transport
Governmental)	YOSHIDA, Tadashi, Mr	Public Works Research Institute
Members	TAKAHASHI, Shoichi, Mr	Ministry of Health, Labor & Welfare
	KOGA, Hidekazu, Mr	Ministry of Economy, Trade & Industry
	WATANABE, Ken-ichi, Mr	Japanese Standards Association
	HIGASHI, Hidehiko, Mr	Academic expert
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	NISHIGAYA, Tadaaki, Mr	Construction Method & Machinery Research Institute
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	SUNAMURA, Kazuhiro, Mr	Hitachi Construction Machinery Co., Ltd.
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for Construction Machinery )**

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