

JCMAS

Lubricating grease for construction machinery

JCMAS P 040: 2024
(Second Revised Edition)

(English version of JCMAS P 040:2024 second revised edition)

(English version: Published on Sept.07, 2026)

Japan Construction Machinery and Construction Association

Forward

This Japan Construction Machinery and Construction Association Standard (hereafter “JCMAS”) was prepared by Drafting Committee (Oil Technical Subcommittee) and Domestic Standards Committee of Japan Construction Machinery and Construction Association (hereafter “JCMA”) and has been published by Chairman of JCMA.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. JCMA Chairman, Drafting Committee and/or Domestic Standards Committee shall not be held responsible for identifying any or all such patent rights.

The first edition:

- The draft was approved on 2004-01-29 by JCMA Domestic Standards 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.
- The established date of the first edition: 2004-05-20

The second revision:

- The draft was approved on 2024-06-21 by JCMA Domestic Standards Committee
- Invitation for submission of comments on the draft JCMAS according to WTO/TBT agreement "Code of good practice" was made from 2024-07-05 to 2024-09-02.
- The established date of the second revision : 2024-09-06

NOTE: This English version is a translation of the second revision(2024-09-06), and the corrections of corrigendum(2026-09-07) have been reflected on this English version.

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. The latest edition of the referenced document (including any amendments) applies.

JIS K 2220 *Lubricating grease*

NOTE Relevant International Standard: ISO 2137, 2176, 6743-9, 11009 and 12924 (Modified)

JIS K 2251 *Crude petroleum and petroleum products - Sampling*

NOTE Relevant International Standard: ISO 3170 (Modified)

JIS K 2283 *Crude petroleum and petroleum products - Determination of kinematic viscosity and calculation of viscosity index from kinematic viscosity*

NOTE Relevant International Standard: ISO 2909 and 3104 (Modified)

JIS K 6251 *Rubber, vulcanized or thermoplastics - Determination of tensile stress-strain properties*

NOTE Relevant International Standard: ISO 37 (Modified)

JIS K 6253-3 *Rubber, vulcanized or thermoplastic - Determination of hardness*

NOTE Relevant International Standard: ISO 7619-1 (Modified)

JIS K 6258 *Rubber, vulcanized or thermoplastic - Determination of the effect of liquids*

NOTE Relevant International Standard: ISO 1817 (Modified)

ISO 13226 *Rubber -- Standard reference elastomers (SREs) for characterizing the effect of liquids on vulcanized rubbers*

ASTM D2266 *Standard Test Method for Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method)*

ASTM D2596 *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**, Clause 3.16, 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.

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 ¹⁾	Report ¹⁾
Worked penetration	5.3	310 ~ 340	265 ~ 295
Unworked penetration	5.4	Report ¹⁾	Report ¹⁾
Apparent viscosity (-10°C, shear rate: 10S ⁻¹) (Pa*s)	5.5	250 or less	500 or less
Base oil kinematic viscosity (40°C) (mm ² /s)	5.6	Report ¹⁾	Report ¹⁾
Heat resistance			
Dropping point (°C)	5.7	170 or more	170 or more
Oil separation (100°C, 24 h) (mass %)	5.8	10 or less	5 or less
Evaporation loss (99°C, 22 h) (mass %)	5.9	2.0 or less	2.0 or less
Rust prevention			
Humidity cabinet test (14 days)	5.10	Class A	Class A
Copper corrosion (100°C, 24 h)	5.11	Have no color change into green or black on copper plate	
Extreme-pressure/ anti-wear properties			
Four-ball load bearing characteristics (weld load) (N)	5.12	1961 or more	1961 or more
Four-ball wear resistance (wear scar diameter) (mm)	5.13	0.7 or less	0.7 or less
Mechanical stability			
Worked stability	5.14	400 or less	375 or less
Water washout characteristics			
Loss in mass (%) by water washout (38°C, 1 h)	5.15	10 or less	10 or less
Oxidation stability			
Oxidation stability (90°C,100 h) (KPa)	5.16	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
Seal immesion test (100°C, 72h)				
NBR	Hardness change	5.17	-30 ~ +10	-30 ~ +10
	Tensile strength change (%)	5.17	-70 ~ +50	-70 ~ +50
	Elongation change (%)	5.17	-80 ~ +50	-80 ~ +50
	Volume change (%)	5.17	-5 ~ +40	-5 ~ +40
AU (urethane)	Hardness change	5.17	-5 ~ +5	-5 ~ +5
	Tensile strength change (%)	5.17	-70 ~ +50	-70 ~ +50
	Elongation change (%)	5.17	-60 ~ +50	-60 ~ +50
	Volume change (%)	5.17	-5 ~ +15	-5 ~ +15
NOTE 1	Apply durometer type A for measuring hardness change in the seal immersion test.			
NOTE 2	Apply low nitrile rubber material (SRE-NBR/L) defined in ISO 13226 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 1)	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 4** 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 ¹⁾
Worked penetration	5.3	265 ~ 295
Unworked penetration	5.4	Report ¹⁾
Apparent viscosity (-10°C, shear rate: 10 S ⁻¹) (Pa·s)	5.5	500 or less
Base oil kinematic viscosity (40°C) (mm ² /s)	5.6	Report ¹⁾

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

Performance criteria			
Item		Test method	Cone penetration No.
			No. 2
Heat resistance			
Dropping point (°C)		5.7	170 or more
Oil separation (100°C, 24 h) (mass %)		5.8	5 or less
Evaporation loss (99°C, 22 h) (mass %)		5.9	2.0 or less
Rust resistance			
Humidity cabinet test (14 days)		5.10	Class A
Copper corrosion (100°C, 2 4h)		5.11	Have no color change into green or black on copper plate
Performance criteria			
Extreme-pressure/ anti-wear properties			
Four-ball load bearing characteristics (weld load) (N)		5.12	981 or more
Four-ball wear resistance (wear scar diameter) (mm)		5.13	0.7 or less
Mechanical stability			
Worked stability		5.14	375 or less
Water washout characteristics			
Loss in mass (%) by water washout (38°C, 1 h)		5.15	10 or less
Oxidation stability			
Oxidation stability (99°C, 100 h) (kPa)		5.16	80 or less
Seal immersion test (100°C, 72 h)			
NBR (nitrile rubber)	Hardness change	5.17	Report ¹⁾
	Tensile strength change (%)	5.17	Report ¹⁾
	Elongation change (%)	5.17	Report ¹⁾
	Volume change (%)	5.17	Report ¹⁾
AU (urethane)	Hardness change	5.17	Report ¹⁾
	Tensile strength change (%)	5.17	Report ¹⁾
	Elongation change (%)	5.17	Report ¹⁾
	Volume change (%)	5.17	Report ¹⁾
Criteria for environment			
Biodegradability (28 days)		5.18	Criteria in subclause 5.18 are to be met.
Fish acute toxicity 96h LC ₅₀ value		5.18	Criteria in subclause 5.18 are to be met.
NOTE 1	Apply durometer type A for measuring hardness change in the seal immersion test.		
NOTE 2	Apply low nitrile rubber material (SRE-NBR/L) defined in ISO 13226 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 ¹⁾	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 Worked penetration test

Worked penetration test shall be in accordance with that specified in **JIS K 2220**.

5.4 Unworked penetration test

Unworked penetration test shall be in accordance with that specified in **JIS K 2220**.

5.5 Apparent viscosity test

Apparent viscosity test shall be in accordance with that specified in **JIS K 2220**.

5.6 Base oil kinematic viscosity test

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

5.7 Dropping point test

Dropping point test shall be in accordance with that specified in **JIS K 2220**.

5.8 Oil separation test

Oil separation test shall be in accordance with that specified in **JIS K 2220**.

5.9 Evaporation loss test

Evaporation loss test shall be in accordance with that specified in **JIS K 2220**.

5.10 Humidity cabinet test

Humidity cabinet test shall be in accordance with that specified in **JIS K 2220**.

5.11 Copper corrosion test

Copper corrosion test shall be in accordance with that specified in **JIS K 2220**.

5.12 Four ball extreme-pressure test

Four ball extreme-pressure test shall be in accordance with **ASTM D2596**.

5.13 Four ball wear resistance test

Four ball wear resistance test shall be in accordance with **ASTM D2266**.

5.14 Worked stability test

Worked stability test shall be in accordance with that specified in **JIS K 2220**.

5.15 Water washout test

Water washout test shall be in accordance with that specified in **JIS K 2220**.

5.16 Oxidation stability test

Oxidation stability test shall be in accordance with that specified in **JIS K 2220**.

5.17 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 6253-3** are to be applied.

5.18 Environmental criteria

Environmental criteria shall be in accordance with Japan Environmental Association Eco Mark Product Category No.110 “Biodegradable Lubricating Oil Version2.7”, 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

1.1 Purpose of the first edition

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.

1.2 Purpose of the revised edition

There has been a lot of modifications in the specifications and test methods quoted in this standard during more than 20 years since the first edition was established, therefore, an amendment has been required. Though simple correction of the original edition was considered, a revision is concluded since the number of corrections is huge.

2 History of establishment of the original and revised Standards

The draft of the original and revised standard was prepared by the Equipment Engineering Committee, Oil Technical Subcommittee of Japan Construction Mechanization Association (JCMA, now is Japan Construction Machinery and

Construction Association), 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 $+100^{\circ}\text{C}$ (for high side). Usually, guaranteed temperature range for construction machinery by the manufacturer is from -20°C up to $+40^{\circ}\text{C}$, 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 $+130^{\circ}\text{C}$ was proposed. Through certain discussions, eventually, operating temperature range was decided to be from -20°C and up to $+130^{\circ}\text{C}$. 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 $+130^{\circ}\text{C}$ for high side on the other side there exists no testing method provisions at $+130^{\circ}\text{C}$ and it will cause confusion for the user of this standard. While the current JIS gives provisions for the test temperature of $+100^{\circ}\text{C}$ for 24 hours, the testing at $+130^{\circ}\text{C}$ 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 D1741** has been withdrawn 10 years ago, and **ASTM D3336: 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 $L_{50} = 500$ hours or the results of first 3 tests are 350 hours 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 D3336** 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 **ASTM D3336** differ each other and correlation between test results using different test apparatus is not good enough for this test and results is left for machine manufacturers.

3.4 Seal immersion test

As to seal material rubber or resin resistance against grease, immersion test method was investigated. At the early stage of developing this standard, test conditions of 70°C with duration of 72 hours 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 hours was specified. Construction machinery manufacturers 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.

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 and the Deliberative Committee

The membership lists of the Drafting Committee and the Deliberative Committee are shown below.

Deliberative Committee of the 2nd Revised Edition (Domestic Standards Committee) as of Sept, 2024

Responsibility	Name	Organization
Chairman	Hiroshi Takahashi	Tohoku University
Member	Takuyuki Kawauchi	Ministry of Economy, Trade & Industry
	Rei Fukui	Ministry of Health, Labor & Welfare
	Masatomo Sano	Japan Construction Method and Machinery Research Institute
	Sachiko Motoike	Japanese Standards Association
	Takashi Yamaguchi	Public Works Research Institute
	Yasutaka Omoto	Kobelco Construction Machinery Co., Ltd.
	Shoichiro Kato	Caterpillar Japan LLC
	Yoshinobu Suzuki	Sumitomo Construction Machinery Co., Ltd.
	Masanori Tahara	Hitachi Construction Machinery Co., Ltd.
	Shigehiro Hara	Komatsu Ltd.
	Hideki Oonishi	NIPPO Corporation
	Makoto Sakashita	Maeda Corporation
	Masayuki Shinomiya	Sato Kogyo Co., Ltd.

	Seiichiro Nakamura	AKTIO Corporation
	Shinji Yamashita	Maeda Road Construction Co., Ltd.
Relevant Person	Mikio Nakada	Ministry of Economy, Trade & Industry
Secretariat	Minpei Shoda	Japan Construction Machinery and Construction Association
	Kimihiko Ogura	Japan Construction Machinery and Construction Association
	Keijiro Ohnishi	Japan Construction Machinery and Construction Association

Drafting Committee of the 2nd Revised Edition (Oil Technical Subcommittee)

Responsibility	Name	Organization
Chairman	Takuma Koinuma	Hitachi Construction Machinery Co., Ltd.
Vice-chairman	Hitoshi Hamaguchi	GS Caltex Corp.
Member	Genroku Sugiyama	Japan Construction Machinery and Construction Association
	Shirou Yoshida	Japan Construction Machinery and Construction Association
	Kouji Iijima	Komatsu Ltd.
	Tetsuo Taketa	Idemitsu Kosan Co., Ltd.
	Hisanori Wada	TADANO LTD.
	Masatoshi Nakane	Sumitomo Construction Machinery Co., Ltd.
	Hiroyuki Ueda	Kubota Corp.
	Hidenori Tanaka	Kobelco Construction Machinery Co., Ltd.
	Takumi Yamamoto	ENEOS Corp.
	Izumi Takayanagi	Shell Lubricants Japan K.K.
	Michiya Ito	Shell Lubricants Japan K.K.
	Kazuki Saito	Cosmo Oil Lubricants Co., Ltd.
	Naoki Asami	Cosmo Oil Lubricants Co., Ltd.
	Masahito Mori	Evonik Japan Co., Ltd.
	Kohsuke Tomimatsu	Lubrizol Japan Ltd.
	Shichiro Takahashi	Lubrizol Japan Ltd.
	Tomohiro Takamishi	Afton Chemical Japan Corp.
	Shuichiro Tanaka	Afton Chemical Japan Corp.
	Yusuke Yanagisawa	Chevron Japan Ltd.
	Haruhiko Hishiki	Sumiko Lubricant Co., Ltd.
	Ataru Ariyoshi	Idemitsu NTG Co., Ltd.
	Masayoshi Morimoto	Kyodo Yushi Co., Ltd.
	Masahiro Yoneda	NICHIMOLY Division, DAIZO Corp.
	Nobuo Ushioda	TotalEnergies Lubrifiants S.A.
	Kedar Shrestha	Petronas Lubricants International SDN BHD
	Shinya Yoshida	Okada Corp.
Secretariat	Hideki Watai	Japan Construction Machinery and Construction Association

Deliberative Committee of the First Edition (Domestic Standards Committee)

Responsibility	Name	Organization
Chairman	Hideo Ohhashi	Academic expert
Observers	Tatsuya Fujiwara	Ministry of Economy, Trade & Industry
(Official	Takashi Inagaki	Ministry of Land, Infrastructure & Transport
Governmental)	Tadashi Yoshida	Public Works Research Institute
Members	Shoichi Takahashi	Ministry of Health, Labor & Welfare
	Hidekazu Koga	Ministry of Economy, Trade & Industry
	Ken-ichi Watanabe	Japanese Standards Association
	Hidehiko Higashi	Academic expert
	Yasuo Sugiyama	Academic expert
	Tadaaki Nishigaya	Construction Method & Machinery Research Institute
	Yoshihiro Tonomura	Nishio Rent All Co., Ltd.
	Yoshitaka Kuwabara	Nishimatsu Construction Co., Ltd.
	Toshiyuki Aoyama	NIPPO Corporation
	Yujirou Iwamoto	Kumagai Co., Ltd.
	Ryuji Imamura	SC Machinery Corporation
	Toshio Nakamura	Obayashi Corp.
	Yuichi Kikuchi	Prosta Ltd.
	Kazuo Matsuda	Komatsu Ltd.
	Kazuhiro Sunamura	Hitachi Construction Machinery Co., Ltd.
	Hiroaki Suyama	Shin Caterpillar Mitsubishi Ltd.
	Satoshi Fujimoto	Kobelco Construction Machinery Co., Ltd.
	Yutaka Motohashi	Sumitomo Construction Machinery Co., Ltd.
	Toshihiko Akimoto	Sakai Heavy Industries, Ltd.
	Takayoshi Oomura	Furnace Engineering Inc.
Secretariat	Tadashi Watanabe	Japan Construction Mechanization Association
	Tetsuo Nishikawa	Japan Construction Mechanization Association
	Yutaka Abe	Japan Construction Mechanization Association

Drafting Committee of the First Edition (Oil Technical Subcommittee)

Responsibility	Name	Organization
Chairman	Satoshi Ohkawa	Komatsu Ltd.
Member	Tsunejiryo Senoo	Kubota Corp.
	Takehiko Iizuka	Gikenseisakusho, Co., Ltd.
	Hiroshi Touji	Kobelco Construction Machinery Co., Ltd.
	Kimihiko Ogura	Shin Caterpillar Mitsubishi Ltd.

	Hiroshi Ishiyama	Sumitomo Construction Machinery Co., Ltd.
	Genroku Sugiyama	Hitachi Construction Machinery Co., Ltd.
	Yuuichi Matsuyama	Idemitsu Kosan Co., Ltd.
	Takahiro Ozaki	Showa Shell Sekiyu K.K
	Shin-ichi	Nippon Oil Corporation
	Akihiro Mochizuki	ChevronTexaco Japan Co., Ltd.
Observer	Ryuuzou Satou	Kyodo Yushi Co., Ltd.
	Kiyoshi Takeuchi	Kyodo Yushi Co., Ltd.
	Minoru Nakamura	Nippom Koyu Ltd.
	Hiroshi Nishimura	Nippom Koyu Ltd.
	Hironori Nishina	NOK Corp.
	Hirohito Hasegawa	Lubrizol Japan Ltd
Secretariat	Masao Miyaguchi	Japan Construction Mechanization Association