HYDRAULIC FLUIDS FOR CONSTRUCTION MACHINERY
(JCMAS P 041:2004, JCMAS P 042:2004)

IMPLEMENTATION MANUAL

June 2007
(Revised March 2024)

JCMA Lubricants Standards Implementation Panel

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NOTICE:

The quality, performance and product class marking of the hydraulic fluid for construction machinery that has been reported for on-filing and on-file submitted under this JCMA Hydraulic Fluid Standards Implementation System (the “System”) are classified and guaranteed solely on the basis of individual judgment and responsibility of the party who submitted the specified reporting documents for filing, whereby the party shall assume all resultant liabilities.

When this System, the JCMA Lubricants Standards Implementation Panel (the "Panel") does not guarantee the quality or performance of the products on file, nor does the Panel assume any responsibility whatsoever with regard to such matters.

Should there arise any problem related to the quality, performance, or product class marking on hydraulic fluids filed under this System, the user of this System and the related standards shall be solely responsible for resolving the problem.

In order to facilitate proper implementation of the Standard for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004) and the Standard for Biodegradable Hydraulic Fluids for Construction Machinery (JCMAS P 042:2004), users of this System and/or the related standards are requested to fully understand the content of this manual prior to utilization of the System.

Any changes made to the content of this manual will be announced through the website of the JCMA Lubricants Standards Implementation Panel (http://www.jalos.or.jp/onfile/) or other appropriate means. Users of the System are strongly encouraged to confirm the latest information before their on-file reporting actions.

1. Introduction

This manual has been prepared as a part of the activities of the Hydraulic Fluid Standards Implementation Panel of the Japan Construction Machinery and Construction Association (the “JCMA”), which panel is a voluntary organization comprising various industry associations and academic societies in Japan involved in the field of hydraulic fluids for construction machinery established with the aim to promote proper implementation of the JCMAS Standards for Hydraulic Fluids for Construction Machinery in Japan as well as in the international markets. The objective of this manual is to describe the procedures and other related matters for lubricant suppliers or marketers to notify and on-file submitter with said Panel applicable products conforming to the Standards for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004 and JCMAS P 042:2004) established by JCMA.

In this manual, the term "hydraulic fluids for construction machinery" means hydraulic fluids used in high-pressure hydraulic systems installed on construction machinery such as hydraulic excavators, mini-diggers, bulldozers, wheel loaders and other types of construction machinery.

The system of the reporting for on-filing (“on-file reporting”) and on-file submitting described in this manual has been drafted by the Special Committee on the JCMA Hydraulic Fluid

Standards Implementation, which is a subordinate organization of the Equipment Engineering Committee - Fuels and Lubricants Subcommittee of the JCMA, and subsequently established by the JCMA Lubricants Standards Implementation Panel after obtaining support of related industry associations.

2. Objective and Working Organization of the JCMA Hydraulic Fluid Standards Implementation System

2.1 Objective

The system described in this manual has been developed with the objective of promoting the Standards for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004 and JCMAS P 042:2004), established by JCMA, for conformity to construction machinery. Effective utilization of this System by marketers of hydraulic fluids for construction machinery will provide consumers with clear guidance in selecting the optimum grades when procuring hydraulic fluids, along with improved reliability of performance by the hydraulic systems operating in construction machinery.

2.2 Working Organizations

Upon utilization of the Standards for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004 and JCMAS P 042:2004), the JCMA Lubricants Standards Implementation Panel has been organized with the participation of several related industry associations. Additionally, a Hydraulic Fluid Steering Committee has been organized under the said Panel. Figure 1 illustrates the relationships among these organizations together with related associations.

The JCMA Lubricants Standards Implementation Panel is an organ for decision making relating to the implementation of the standards, with secretariat offices set up at the JCMA for the Panel's main activities, and the Petroleum Association of Japan ("PAJ") available for supporting functions.

The Hydraulic Fluid Steering Committee as a subordinate organ under the Panel is charged with developing and drafting of new provisions of or revisions to this manual and the related standards, together with planning and recommendation to the panel of activities for promotion and promulgation of the standards. The constituent members of the Hydraulic Fluid Steering Committee consist mainly of personnel nominated by construction machinery manufacturers, lubricant suppliers, and additive suppliers, which are the member corporations of industry associations participating in the JCMA Lubricants Standards Implementation Panel, with additional participants to be invited from other industries as and when needed.

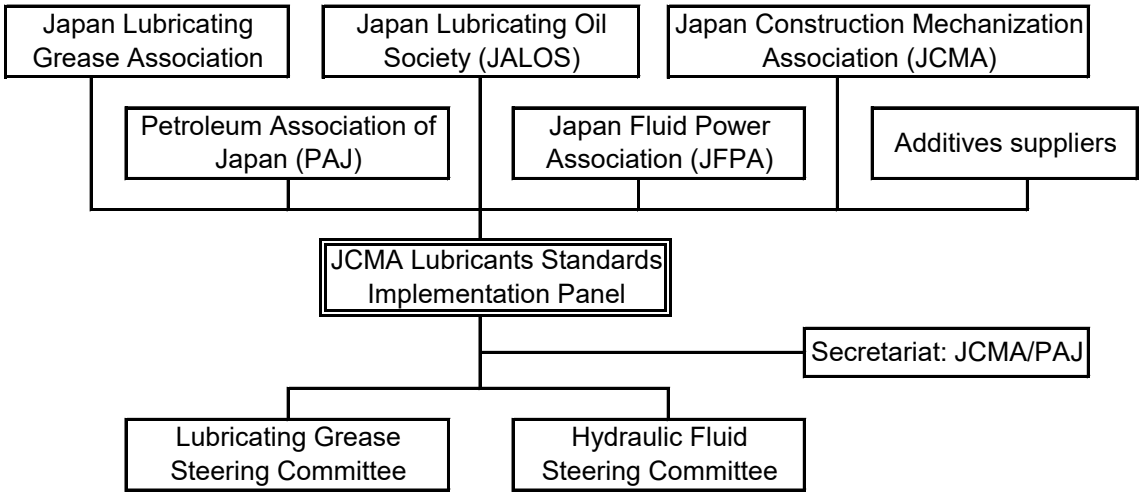


Figure 1 Working Organizations for JCMA Lubricants Standards Implementation

3. Standard for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004)

3.1 Background of Establishment of the Standard

The oil recommendations for hydraulic fluids for use in construction machinery have so far been provided by individual construction machinery manufacturers based on specifications established separately by each manufacturer, because of the lack of an adequate industry standard that addresses the trends in recent years where operating pressures of hydraulic equipment are increasing. Against this situation, there has been strong demand from equipment users including the equipment rental industry for a common industry standard that will enable simplified inventory management as well as improved availability in procurement.

In the area of generic hydraulic fluids, the International Organization for Standardization (ISO) has established a definition of hydraulic fluid classification under ISO 6743-4, and under such definition a quality standard for a range of mineral-based hydraulic fluids have been established under ISO 11158. However, said standard has no provisions for high-pressure pump test and as a result is unable to govern hydraulic fluids for construction machinery for which an operating pressure of 34.3MPa is quite common. Furthermore, although a requirement for friction characteristics is also important in the specification for hydraulic fluids for construction machinery wherein the wet parking brakes are commonly employed, the ISO 11158 does not include such a requirement.

Meanwhile, lubricant suppliers have also been suffering from an increase in the cost of product development resulting from the need to deal with numerous specifications varying from manufacturer to manufacturer. The voices calling for establishment of an industry standard

covering hydraulic fluids for construction machinery have thus been raised from each of the construction machinery manufacturers, machinery users, and lubricant suppliers.

On the basis of the above-mentioned situation and requirements, the Equipment Engineering Committee - Fuels and Lubricants Subcommittee of the JCMA initiated a discussion about establishing an industry standard for hydraulic fluids most suitable for use in construction machinery. In developing a draft for the standard, the Committee set forth the following objectives:

(1) To establish a quality standard conforming to the operating conditions of construction machinery and leading to an extended service life of hydraulic equipment.
(2) To develop a performance standard that can be commonly applicable to all construction machinery under a hydraulic pressure of 34.3 MPa and an operating temperature of 100 °C.
(3) To develop, to the extent possible, a standard which is consistent with the existing ISO standards with a view toward incorporating the standard into the ISO standardization system in the future.

Based on the above objectives and after about five years of study, in 2004 the JCMAS P 041 was developed as the main standard along with four related test method standards.

3.2 Outline of the Standard

The hydraulic fluid with a designation JCMAS HK, which shall conform to the Standard for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004), is intended for application in hydraulic equipment employed in construction machinery.

The JCMAS HK specification sets forth provisions for physical and chemical properties, oxidation stability, seal compatibility, rust-preventing characteristics, and anti-wear properties required for a hydraulic fluid for construction machinery, as well as requirements for a high-pressure piston pump test and a vane pump test to evaluate lubrication property of a hydraulic fluid in actual pump units, and tests to evaluate friction characteristics.

The JCMAS HK specification covers two viscosity grades of VG32 and VG46 used in construction machinery. Further, in addition to specifications for a low temperature application, specifications for a normal temperature application have been included to cover less stringent requirements for low temperature performance in certain milder operating regions, from the viewpoint of facilitating wider implementation of the standard (see Table 1). The specifications for low temperature application and normal temperature application differ only with respect to low temperature viscometrics and pour point requirements, with all other specifications being common. Concerning specifications for various physical and chemical properties, the ISO 11158 Category HV (high VI hydraulic fluids), which is comparatively close to the hydraulic fluid for

construction machinery application, has been referenced, from which items essential for application in construction machinery have been adopted while unnecessary items have been discarded.

The most significant feature of the JCMAS HK specification is that it has a requirement for high-pressure piston pump tests which are not included in the ISO specifications. Since no publicly recognized test method existed ever under ASTM for evaluating piston pump performance of a hydraulic fluid at an operating pressure of 34.3 MPa, much effort has been undertaken in order to develop the test method. After extensive discussions within the Fuels and Lubricants Subcommittee as well as consultation with the Japan Fluid Power Association, an industry group of hydraulic pump manufacturers, it was decided that users would be permitted to evaluate the pump performance with either one of the two test methods proposed. However, in order to deal with the differences in performance requirements between the two tests, high-speed four-ball tests and the FZG gear test have been added as supplementary measures to ensure the load carrying capacity and anti-wear property of the test fluid are adequately evaluated. For testing the performance with vane pumps, the specification also allows users a choice between the two most popular models in the market, i.e. the Models 104C and 35VQ25, taking the dissemination in the market into account.

While friction property is considered to be one of the critical tests for characterizing performance of a hydraulic fluid for construction machinery, the ISO 11158 does not address this point at all. As a method for evaluating the friction property, although the micro clutch test is rather popular in the Japanese industry, in consideration of the future promotion of the JCMAS HK specifications for currency in the global markets, the SAE No.2 friction machine test has been studied instead, as it is presently the most common method for evaluating friction property worldwide. However, since the conditions in the standard SAE No.2 machine test specified for automatic transmission fluids turned out to be excessively severe to evaluate and differentiate the hydraulic fluids, a modified version of the test has been developed and adopted as a new test method under the JCMAS system.

3.3 Test Items and Acceptance Criteria

Table 2 presents the performance requirements and acceptance criteria specified in the Standard for Hydraulic Fluids for Construction Machinery, JCMAS HK (JCMAS P 041:2004).

Since the physical/chemical properties and test results to be reported at the time of the on-file submitting include certain items other than those specified in the Standard for Hydraulic Fluids for Construction Machinery, JCMAS HK (JCMAS P 041:2004), please refer to Appendix 3 of this manual for guidance.

Further, in conducting various test items given in Table 2, use of alternative test methods as provided in Appendix 2 “Cross-reference Table of Test Methods” is permitted. In the event that an

alternative test method has been employed, the on-file submitting documents must clearly indicate which method has been used for acquiring the test data submitted.

In the event that the Standard for Hydraulic Fluids for Construction Machinery, JCMAS HK (JCMAS P 041:2004) has been revised, users must use the latest version. Similarly, as for the test methods stipulated in the Standard for Hydraulic Fluids for Construction Machinery, JCMAS HK (JCMAS P 041:2004), the latest version of the test standards must be used unless the year of establishment for a particular test item is specified. However, for the test method standards JCMAS P 043:2004, JCMAS P 044:2004, JCMAS P 045:2004, and JCMAS P 047:2004 as well as standards quoted in these test methods, the latest versions available at the time of the testing may be used.

Table 1 Classification of hydraulic fluids for construction machinery

Type	Symbol	Uses
Normal temperature use	VG32	For construction machinery operating under ambient temperatures of -5°C or higher
	VG46	
Low temperature use	VG32W	For construction machinery operating under ambient temperatures of -25°C or higher
	VG46W	For construction machinery operating under ambient temperatures of -20°C or higher

Table 2 Quality/performance requirements and acceptance criteria specified for JCMAS HK (JCMAS P 041:2004) Hydraulic Fluids for Construction Machinery

Test Items \ Type		Types and grades			
		Normal temperature use		Low temperature use	
		VG32	VG46	VG32W	VG46W
Viscosity Classification		ISO VG32	ISO VG46	ISO VG32	ISO VG46
Flash Point, °C		Report[1)]			
Kinematic Viscosity, mm^2/s [2)]	(40°C)	28.8 min. 35.2 max.	41.4 min. 50.6 max.	28.8 min. 35.2 max.	41.4 min. 50.6 max.
	(100°C)	5.0 min.	6.1 min.	5.3 min.	6.8 min.
Viscosity Index		90 min.	90 min.	120 min.	120 min.
Pour Point, °C		-17.5 max.	-15 max.	-40 max.	-30 max.
Low Temperature Viscosity, mPa·s	(-20°C)	-	-	-	5,000 max.
	(-25°C)			5,000 max.	-
Foaming, ml	(24°C)	50 max./0 max.			
	(93.5°C)	50 max./0 max.			
	(24°C after 93.5°C)	50 max./0 max.			
Shear Stability, Viscosity Loss (100°C), %		-		10 max.	
Oxidation Stability (95°C, 1,000 hrs), TAN Increase, mgKOH/g		1.0 max.			
Rust-preventing characteristics (synthetic sea water, 24 hrs)		No rust to be identified			
Seal Compatibility (NBR[4)], 100°C, 240 hrs)	Hardness change[3)]	-25 max.			
	Change in Tensile strength, %	-50 max.			
	Change in Elongation, %	-50 max.			
	Change in Volume, %	0 - +30			
Seal Compatibility (AU[5)], 120°C, 240 hrs)	Hardness change[3)]	-5 - +5			
	Change in Tensile strength, %	-30 max.			
	Change in Elongation, %	-30 max.			
	Change in Volume, %	-5 - +5			
Aniline Point, °C		90 min.			
Filterability Test, min.	1st run	25 max.			
	2nd run	30 max.			
Copper Corrosion (100°C, 3 hrs)		1 max.			
Load-carrying Capacity (Shell 4 Ball), Weld-point, N		1,235 min.			
Anti-wear Test (Shell 4 Ball), (294 N, 1,200 min^{-1}, 60 min., 75°C), Wear Scar Diameter, mm		0.6 max.			
FZG Gear Test, Failure Load Stage		8 min.			

High-pressure Piston Pump Test[6)]	Lubricity Evaluation with Model HPV35+35 Pump (34.3 MPa, 2,100 min^{-1}, 95°C, 500 hrs)	For all evaluation items on changes in the discharge flow rates, components wear, and changes in the hydraulic fluid characteristics, the test results shall be within the specified criteria.	
	Service Life Evaluation with Model A2F Pump (35 MPa, 1,500 min^{-1}, 80°C, 500 hrs)	Viscosity Change (40 °C), %	+10 max.
		TAN Increase, mgKOH/g	2.0 max.
		Contaminants (0.8μm), mg/100 ml	10 max.
Vane Pump Test[7)]	Lubricity Evaluation with Model 35VQ25 Pump (20.79 MPa, 2400 min^{-1}, 93°C, 150 hrs), mg	Ring: 75 max. Vane: 15 max	
	Lubricity Evaluation with Model 104C Pump (13.8 MPa, 1,200 min^{-1}, 66°C, 100 hrs), mg	Ring and vane total: 50 max.	
Friction Characteristics[8)]	Micro-clutch Test, μ	0.08 min.	
	SAE No.2 Friction Test Machine, (1,000 cycles), μs	0.07 min.	

Remarks:

[1)] Report the test results.

[2)] A value expressed in mm^2/s is numerically equal to that in cSt.

[3)] Use Type-A Durometer.

[4)] Use low-acrylonitrile elastomer SRE-NBR/L per ISO 13226 for specimen.

[5)] For the specimen polyester urethane, use the AU described in Table 3 below or equivalent.

Table 3 Elastomer Characteristics

	Items	Unit	AU (U801)
Requirements	Hardness rating	Type-A Durometer	88 - 98
	Tensile strength	MPa	29.4 min.
	Elongation	%	300 min.

[6)] Evaluation with a high-pressure piston pump shall be conducted by either one of the Model HPV35+35 Pump Test according to JCMAS P044, or the Model A2F Pump Test in accordance with JCMAS P045. In the case of JCMAS P045, results of all evaluation items from every interim inspection until 500 hours shall be within the acceptance criteria.

[7)] Evaluation with a vane pump shall be conducted by either one of the Model 104C Pump Test in accordance with ASTM D7043, or the Model 35VQ25 Pump Test in accordance with ASTM D6973. Either 7.1) or 7.2) procedures below are acceptable for the 35VQ25 Pump Test.

7.1) Continuous 150 hours test run with single test pump cartridge and pass the acceptance criteria.

7.2) Three of 50 hours tests run on the same candidate oil but with three test pump cartridges. Each test has to pass the acceptance criteria.

[8] Evaluation for the friction characteristics shall be conducted by either one of the Micro-clutch Test in accordance with JCMAS P047, or a test using the SAE No.2 Friction Test Machine (at 800 rpm). In addition, the test fluid is required to exhibit adequate anti-squeak function for the hydraulic cylinder operation regardless of the provisions for frictional characteristics.

3.4 Information on New Filing, Effective Period of On-filing, and Classification Indication for a Fluid Conforming to the Standards

The first date as of which the product class marking under this System can be displayed on a product conforming to the Standard for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004), shall be as follows:

- The first date as of which a product class mark can be displayed on a product qualifying for JCMAS HK (JCMAS P 041:2004) shall be November 1, 2007.

For indication of the relevant product classification, the year of issuance of the applicable standards shall be omitted and a marking such as “JCMAS HK VG32W”, for instance, shall be indicated.

4. Standard for Biodegradable Hydraulic Fluids for Construction Machinery (JCMAS P 042:2004)

4.1 Background of Establishment of the Standard

Although a number of biodegradable hydraulic fluids have been developed and marketed in response to an increasing demand for hydraulic fluids that may present less environmental risk in the event of spillage into the natural environment, in line with heightened awareness for environmental protection, no industry standard so far has been developed to define and specify such products in an integrated manner.

When used in places where attention to environmental impact is required for reasons such as preservation of biodiversity, since biodegradable hydraulic fluids could be gradually decomposed by microorganisms existing naturally in the environment, they can help minimize the environmental burden due to oil contamination in the event of accidental leakage or spillage of hydraulic fluid into the environment during work involving construction machinery.

While various performance standards specifying hydraulic fluids for a general range of hydraulic equipment have been developed by international organizations such as ISO, and widely implemented as generic hydraulic fluids, it is well known that the hydraulic systems employed in construction machinery tend to expose hydraulic fluids to much more severe load than other, general type hydraulic equipment, as exemplified in hydraulic excavators where the frequent intermittent operations in addition to high operating pressures and temperatures are

causing moisture in the air to condense inside the reservoir and increasing the risk of water ingress into hydraulic fluids. The JCMAS P042: 2004 Standard has been developed in response to concerns raised by the above-mentioned circumstances calling for a performance standard defining and specifying biodegradable hydraulic fluids for construction machinery.

This Standard was developed based on the framework of ISO 15380 which had already been in place to govern biodegradable hydraulic fluids for industrial use, while paying attention to maintaining consistency with standards specifying mineral-based hydraulic fluids for construction machinery. Further, quality levels of commercially available biodegradable hydraulic fluids with proven performance in construction machinery have also been referenced.

Since the performance requirements for construction machinery vary widely by type and design of the machinery, as well as by operating conditions, the application of this Standard to individual construction machinery should be discussed between the respective hydraulic fluid supplier and the machinery manufacturer or, if necessary, the supplier of the hydraulic equipment.

On the basis of the above-mentioned situation and requirements, the Equipment Engineering Committee - Fuels and Lubricants Subcommittee of the JCMA initiated a discussion about establishing an industry standard for biodegradable hydraulic fluids most suitable for use in construction machinery. In developing a draft for the standard, the Committee set itself the following objectives:

(1) To establish a quality standard conforming to the operating conditions of construction machinery and leading to an extended service life for hydraulic equipment.

(2) To develop a performance standard that can be commonly applicable to all construction machinery under a hydraulic pressure of 34.3 MPa and an operating temperature of 100 °C.

(3) To develop, to the extent possible, a standard which is consistent with the existing ISO standards with a view toward incorporating the standard into the ISO standardization system in the future.

Based on the above objectives and after about three years of study, in 2004 the JCMAS P 042 was developed as the main standard along with four related test method standards.

4.2 Outline of the Standard

The hydraulic fluid with a designation JCMAS HKB which shall conform to the Standard for Biodegradable Hydraulic Fluids for Construction Machinery (JCMAS P 042:2004) is intended for application in hydraulic equipment employed in construction machinery.

The JCMAS HKB specification meets the environmental criteria set forth under Section 4-1 of the Eco Mark Product Category No.110 “Biodegradable Lubricating Oil” (Version 2.0)

established by the Japan Environment Association – Eco Mark Office. In addition, the JCMAS HKB specification sets forth to provisions for physical and chemical properties, oxidation stability, seal compatibility, rust-preventing characteristics, and anti-wear properties required for a hydraulic fluid for construction machinery, as well as requirements for a high-pressure piston pump test and a vane pump test to evaluate lubrication property of a hydraulic fluid in actual pump units, and tests to evaluate friction characteristics.

While friction property is considered to be one of the critical tests to characterize performance of a hydraulic fluid for construction machinery, the ISO 15380 does not address this point at all. As a method for evaluating the friction property, although the micro clutch test is rather popular in the Japanese industry, in consideration of the future promotion of the JCMAS specifications for currency in the global markets, the SAE No.2 friction machine test has been studied as it is presently the most common method for evaluating friction property worldwide. However, since the conditions in the standard SAE No.2 machine test specified for automatic transmission fluids turned out to be excessively severe to evaluate and differentiate the hydraulic fluids, a modified version of the test has been developed and adopted as a new test method under the JCMAS system.

The JCMAS HKB specification covers two viscosity grades of VG32 and VG46 commonly used in construction machinery operating under normal temperatures as well as another two grades of VG32L and VG46L for use under low temperatures. In other words, from the viewpoint of facilitating wider implementation of the standard, in addition to specifications for a low temperature application, specifications for a normal temperature application have been included to cover less stringent requirements for low temperature performance in certain milder operating regions (see Table 4). The specifications for the two categories differ only with respect to low temperature viscometrics and pour point requirements, with all other specifications being common. Concerning specifications for various physical and chemical properties, the ISO 15380 mentioned above has been referenced, from which items essential for application in construction machinery have been picked up while unnecessary items have been discarded.

4.3 Test Items and Acceptance Criteria

Table 5 presents the performance requirements and acceptance criteria specified in the Standard for Biodegradable Hydraulic Fluids for Construction Machinery, JCMAS HKB (JCMAS P 042:2004).

Since the physical/chemical properties and test results to be reported at the time of the on-file submitting include certain items other than those specified in the Standard for Biodegradable Hydraulic Fluids for Construction Machinery, JCMAS HKB (JCMAS P 042:2004), please refer to Appendix 3 of this manual for guidance.

Further, in conducting various test items given in Table 5, use of alternative test methods as

provided in Appendix 2 Cross-reference Table of Test Methods is permitted. In the event that an alternative test method has been employed, the on-file submitting documents must clearly indicate which method was used for acquiring the test data submitted.

In the event that the Standard for Biodegradable Hydraulic Fluids for Construction Machinery, JCMAS HKB (JCMAS P 042:2004) has been revised, users must use the latest version. Similarly, as for the test methods stipulated in the Standard for Biodegradable Hydraulic Fluids for Construction Machinery, JCMAS HKB (JCMAS P 042:2004), the latest version test standards must be used unless the year of establishment for a particular test item is specified. However, for the test method standards JCMAS P 043:2004, JCMAS P 044:2004, JCMAS P 045:2004, and JCMAS P 047:2004 as well as standards quoted in these test methods, the latest versions available at the time of the testing may be used.

Table 4 Classification of biodegradable hydraulic fluids for construction machinery

Type	Symbol	Application
Normal temperature use	VG32 VG46	For use in construction machinery mainly operating under ambient temperatures of -5°C or higher
Low temperature use	VG32L VG46L	For use in construction machinery mainly operating under ambient temperatures of -25°C or higher for VG32L, and -20°C or higher for VG46L

Table 5 Quality/performance requirements and acceptance criteria specified for JCMAS HKB (JCMAS P 042:2004) Biodegradable Hydraulic Fluids for Construction Machinery

Test Items \ Type		Normal temperature use		Low temperature use	
		VG32	VG46	VG32L	VG46L
Viscosity Classification		ISO VG32	ISO VG46	ISO VG32	ISO VG46
Density (15 °C), kg/m^3		Report[1)]			
Color, ASTM		Report[1)]			
Flash Point, °C		Report[1)]			
Kinematic Viscosity, mm^2/s	(40°C)	28.8 min. 35.2 max.	41.4 min. 50.6 max.	28.8 min. 35.2 max.	41.4 min. 50.6 max.
	(100°C)	5.3 min.	6.8 min.	5.3 min.	6.8 min.
Low Temperature Viscosity, mPa･s	(-10°C)	Report[1)]		-	
	(-25°C)	-		5,000 max.	-
	(-20°C)			-	5,000 max.
Pour Point, °C		-17.5 max.		-35 max.	-30 max.
TAN, mgKOH/g		Report[1)]			
Water Content, mg/kg		1,000 max. (before breaking the container seal)			
Copper Corrosion (100°C, 3 hrs)		1 max.			
Rust-preventing property (Distilled water)		No rust to be identified			
Foaming, ml	(24°C)	50 max./0 max.			
	(93.5°C)	50 max./0 max.			
	(24°C after 93.5°C)	50 max./0 max.			
Seal Compatibility Test (NBR[3)], 100°C, 240 hrs)	Hardness change[2)]	-40 - +10			
	Change in Volume, %	-5 - +70.			
	Change in Elongation, %	-60 - +20			
	Change in Tensile strength, %	-65 - +20			
Seal Compatibility Test (HNBR[4)], 100°C, 240 hrs)	Hardness Change[2)]	-8 - +8			
	Change in Volume, %	-5 - +15.			
	Change in Elongation, %	-15 - +20			
	Change in Tensile strength, %	-15 - +20			
Seal Compatibility Test (AU[5)], 100°C, 240 hrs)	Hardness Change[2)]	Report[1)]			
	Change in Volume, %	Report[1)]			
	Change in Elongation, %	Report[1)]			
	Change in Tensile strength, %	Report[1)]			
FZG Gear Test, Failure Load Stage		8 min.			

Vane Pump Test (Model 104C, 250 hrs)	Ring wear, mg	120 max.
	Vane wear, mg	30 max.
Service Life Evaluation with Model A2F10 Pump (500 hrs)	Viscosity change (40°C), % [7)]	+10 max.
	TAN increase, mgKOH/g	2.0 max.
	Contaminants (0.8μm), mg/100 ml	10 max.
	Cu-content increase in Oil-layer, mass ppm	Report[1)]
Hydrolytic Stability	Copper weight loss, mg/cm^2	Report[1)]
	Copper Appearance	Report[1)]
	TAN increase in oil layer, mgKOH/g	Report[1)]
Load-carrying Capacity (Shell 4 Ball), Weld-point, N		1,235 min.
Anti-wear Test (Shell 4 Ball) (294 N, 1,200 min^{-1}, 60 min., 75°C), Wear Scar Diameter, mm		0.6 max.
Friction Characteristics[6)]	Micro-clutch test, μ	0.05 min.
	SAE No.2 Friction Test Machine, (1,000 cycles), μs	0.07 min.
Environmental Criteria	Biodegradability (28 Days)	Must meet the criteria specified in Section 4-1 of the Eco Mark Product Category No.110 “Biodegradable Lubricating Oil” (Version 2.0)
	Acute Toxicity (96 hrs, LC_{50} Value)	Must meet the criteria specified in Section 4-1 of the Eco Mark Product Category No.110 “Biodegradable Lubricating Oil” (Version 2.0)

Remarks:

[1)] Report the test results.

[2)] Use Type-A Durometer.

[3)] For the specimen NBR, use low-acrylonitrile SRE-NBR/L per ISO 13226.

[4)] For the specimen HNBR, use the material described in Table 6 below.

[5)] For the specimen AU, use the material described in Table 6 below.

[6)] Evaluation for the friction characteristics shall be conducted by either one of the Micro-clutch Test in accordance with JCMAS P047, or a test using the SAE No.2 Friction Test Machine (at 800 rpm).

[7)] In the case of JCMAS P045, results of all evaluation items from every interim inspection until 500 hours shall be within the acceptance criteria.

Table 6 Elastomer Characteristics

	Items	Unit	HNBR (G361)	AU (U801)
Requirements	Hardness rating	Type-A Durometer	75 - 85	88 - 98
	Tensile strength	MPa	28.3 min.	29.4 min.
	Elongation	%	260 min.	300 min.

4.4 Information on New Filing, Effective Period of On-filing, and Classification Indication for a Fluid Conforming to the Standards

The first date as of which the product class marking under the System can be displayed on a product conforming to the Standard for Biodegradable Hydraulic Fluids for Construction Machinery (JCMAS P 042:2004) shall be as follows:

- The first date as of which a product class mark can be displayed on a product qualifying for JCMAS HKB (JCMAS P 042:2004) shall be November 1, 2007.

For indication of the relevant product classification, the year of issuance of the applicable standards shall be omitted and a marking such as “JCMAS HKB VG32L”, for instance, shall be indicated.

5. Selection of Test Organizations

5.1 General Rules

While various pump tests, friction characteristics tests, and bench tests as well as physical/chemical properties are specified in the Standards for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004 and JCMAS P 042:2004), for the purpose of the reporting and on-file submitting in accordance with the procedures to be described below, data from test results are considered valid only if the tests have been conducted at test organizations that can satisfy the requirements given in the following sections for each test item.

5.2 Pump Tests (JCMAS P 044:2004, JCMAS P 045:2004, and ASTM D 6973 and D 7043)

For JCMAS P 044 (Evaluation method for indicating lubrication property in high pressure piston pump) and JCMAS P 045 (Test method for indicating oxidation stability in high pressure piston pump), the party attempting the on-file submitting is required to submit data from test results that have been obtained at a test organization which owns test equipment completely satisfying the test conditions specified in respective testing standards.

Additionally, it is also required that the results data for either of the pump tests mentioned above accompany as an attachment the results of a test conducted on a standard Reference Fluid and carried out by the same test organization employed for obtaining the respective pump test data. For this purpose, the standard Reference Fluid data being attached should preferably be obtained within a period of one year prior to the testing start date for the candidate fluid being reported for the on-file submitting.

For ASTM D 6973 (Standard test method for indicating wear characteristics of petroleum hydraulic fluids in a high pressure constant volume vane pump) and ASTM D 7043 (Standard

test method for indicating wear characteristics of petroleum and non-petroleum hydraulic fluids in a constant volume vane pump), the party filing the on-file submitting is required to submit results obtained at a test organization satisfying the testing precision specified in respective testing standards.

5.3 Friction Characteristics Tests (JCMAS P 047:2004)

For JCMAS P 047 (Test method for friction characteristics of hydraulic fluids for construction machinery), the party attempting the on-file submitting is required to submit test result data obtained from a test organization which owns testing equipment completely satisfying the test conditions provided in the above testing standards.

Additionally, it is also required that the results data for this test accompany as an attachment the results of a test conducted on a standard Reference Fluid and carried out by the same test organization employed for obtaining the test data on the fluid being reported for the on-file submitting. For this purpose, the Reference Fluid data being attached should preferably be obtained within a period of one year prior to the testing start date for the candidate fluid.

5.4 Bench Tests and Physical/Chemical Property Tests

For JPI-5S-32 (Testing Method for Anti-Wear Properties of Lubricating Fluid), JPI-5S-40 (Testing Method for Extreme-Pressure Properties of Lubricating Fluids), ASTM D 5182 (Standard test method for evaluating the scuffing load capacity of oils [FZG gear test]), JPI-5S-29 (Test Methods for Shear Stability of Polymer-Containing Oils), ISO 13226 (Rubber – Standard reference elastomers for characterizing the effect of liquids on vulcanized rubbers), JCMAS P 043 (Test method for filterability), and physical/chemical property tests such as tests on anti-foaming property, low-temperature fluidity, oxidation stability, rust preventing characteristics, aniline point, as well as other physical/chemical properties submitted for the on-file submitting, test result data may be obtained at any test organization satisfying the testing precision specified in respective testing standards.

5.5 Public Information on Test Organizations

Test organizations that are able to conduct pump tests and friction characteristics tests in accordance with the JCMAS standards and are willing to accept requests for testing from outside parties are publicized, if such publication is desired by the test organization, at the website of the JCMA Lubricants Standards Implementation Panel (http://www.jalos.or.jp/onfile/). Test organizations that wish to publicize the availability of such testing services are required to complete a form for Application for Contract Test Laboratory (Appendix 1) and submit it to the JCMA Lubricants Standards Implementation Panel. Any inquiries or requests on the related testing are to be made directly by the user of this manual to the publicized test organizations, as

the JCMA Lubricants Standards Implementation Panel will not act as an intermediary between the user and the publicized test organizations.

5.6 Reference Fluids

The standard Reference Fluids to be used in obtaining the reference test data to accompany the main data on pump tests and friction characteristics tests are two types listed below. Availability information concerning these Reference Fluids is given in section 10.3 of this manual.

Standard Reference Fluids

Reference Fluid Code	Applicable JCMA Test Method
JCMA-R1	JCMAS P 044 JCMAS P 045 JCMAS P 047 (For SAE No.2 Machine only)
JCMA-R2	JCMAS P 047 (For Micro-clutch test only)

6. Procedures for the On-file Reporting and Submitting

6.1 Outline of procedures

Oil marketers or suppliers who wish to use the On-file System described herein based on the Standards for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004) and Standard for Biodegradable Hydraulic Fluids for Construction Machinery (JCMAS P 042:2004) are required to verify, in accordance with the requirements given in this manual, that the product being submitted “on-file” conforms to the required performance and other criteria set forth in the above standards through evaluation tests conducted at test organizations that satisfy the conditions specified in this manual, and complete the procedures based on the steps described in the sections titled “On-file Reporting and submitting Procedures”, “Retention and Submission of Test Data”, and other relevant paragraphs appearing in later sections, such steps being required individually for each product brand as well as for each product formulation being filed.

The core of this System is for each user of said standards to make it publicly known that the product conforms to the above-mentioned standards, based on the user’s own judgment and responsibility and by way of on-file submitting. Accordingly, it is not intended for this System or the Panel to certify or authenticate the conformity of any product with a JCMA Standard against which the product is filed in the above process. Each user of this System must therefore fully understand such nature and pay attention not to cause any misunderstanding on the part of end users including consumers, and make a conscientious effort to maintain the conformity with the relevant standards for the product placed in the market.

6.2 Reporting Procedure Flow

An outline of the on-file reporting and submitting procedure is shown in Figure 2.

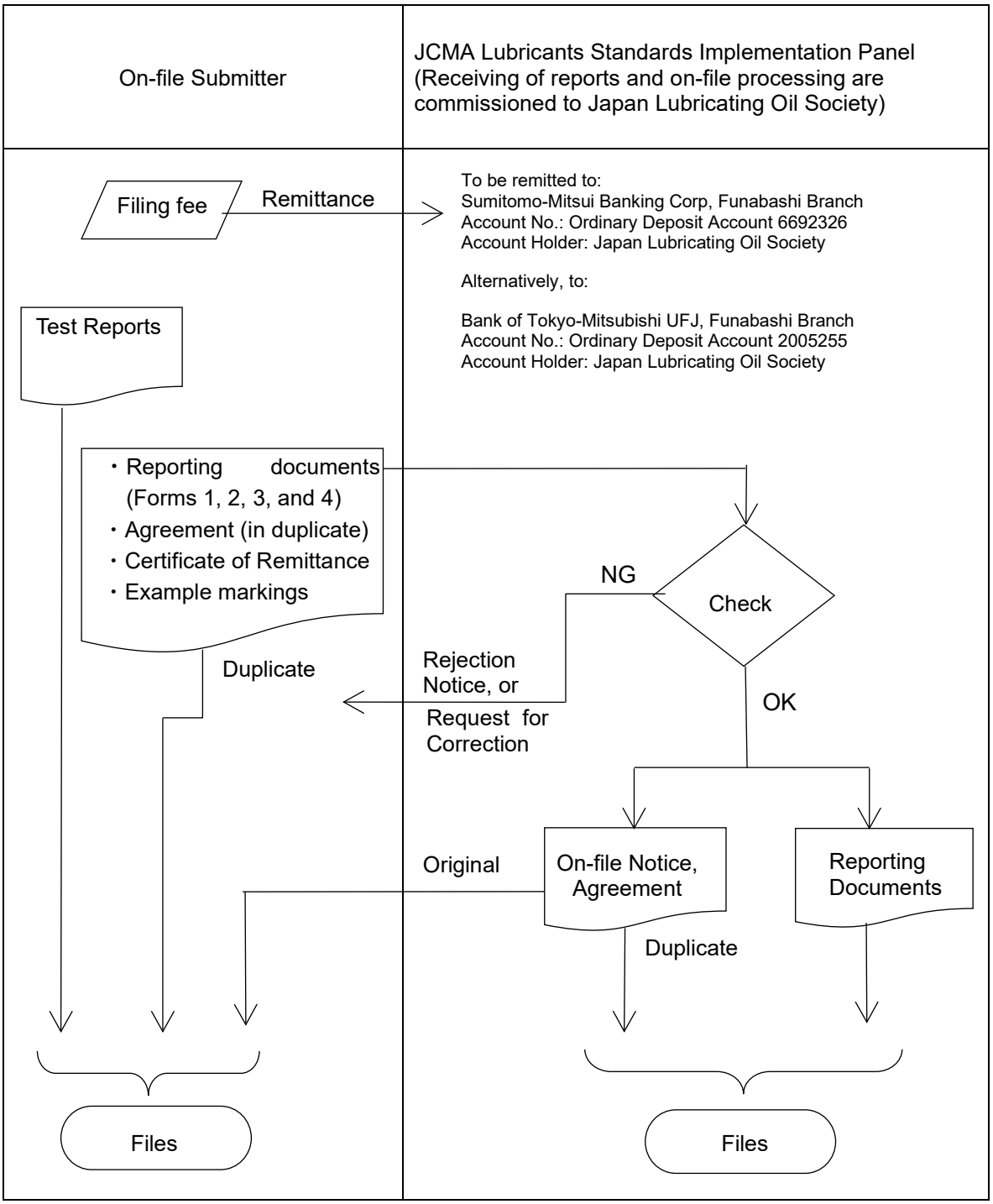


Figure 2 Notification and On-file Submitting Flow

6.3 On-file Reporting and Submitting Procedure

The party who wishes to initiate the process of on-file reporting and submitting (hereinafter referred to as the “submitter”) must first remit a filing fee as indicated in Appendix 3 to a bank account designated by the JCMA Lubricants Standards Implementation Panel. Thereafter, the submitter is to prepare a set of requisite reporting documents (see Forms 1, 2, 3 and 4 in Appendix 3), and an original and a duplicate of the On-file Notice/Agreement Form (see Appendix 4) by filling out Part B of the form. The submitter shall then forward the package of the reporting documents, the On-file Notice/Agreement Form, and a bank certificate of the filing fee transfer to the attention of the JCMA Lubricants Standards Implementation Panel. Note here that, since paperwork for receiving and processing on-filing documents is commissioned to the Japan Lubricating Oil Society (JALOS), the package of the reporting documents shall be sent to the address given below:

Japan Lubricating Oil Society
c/o Business Department
JCMA Lubricants Standards Implementation Panel
No. 2-16-1, Hinode, Funabashi-shi, Chiba
273-0015 Japan

Any expenses incidental to remitting the filing fee to the designated bank account shall be borne by the submitter. The reporting documents and the filing fee will not be returned to the submitter. In the event of a change in the filing fee schedule, the JCMA Lubricants Standards Implementation Panel will announce such change through its associated organizations.

In addition to the above-mentioned documents, at the time of the on-file reporting and submitting, the submitter must submit to the JCMA Lubricants Standards Implementation Panel a representative example of product class marking to be displayed on the product container and an entire product label design or its artwork. (see Section 7: Marking)

6.4 Retention and Submission of Test Data

The hydraulic fluid test reports, as the basic data for the on-file reporting and submitting, must be prepared in a format specified in the relevant JCMA Standards, and the submitter bears responsibility for safeguarding the test reports. Further, other related test reports shall also be prepared in accordance with the respective testing standards and retained by the submitter. The test reports must be retained until the submitter withdraws the product concerned from the on-file listing. The submitter must submit the original test reports promptly whenever the submitter has received a request for them from the JCMA Lubricants Standards Implementation Panel.

6.5 Examination of Documents

Upon receipt of the on-file reporting documents, the JCMA Lubricants Standards Implementation Panel will examine them as to:

(1) whether all the necessary items have been entered;
(2) whether infrared absorption spectrum chart has been attached in the specified format;
(3) whether hydraulic fluid performance data have been prepared as specified; and
(4) test results values for bench test items for which acceptance values have been specified.

Further, the Panel will examine the proposed product class marking format and the product labels for any inadequacy and/or potentially misleading expressions.

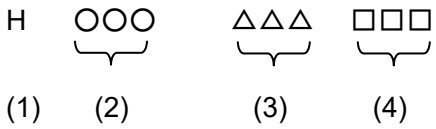
If any one of the above items has been found inadequate or unsatisfactory, the Panel will issue the submitter a notice of on-file rejection (with reasoning for the rejection) or a request for necessary correction.

If all the documents are found to be in order and satisfactory, the JCMA Lubricants Standards Implementation Panel will forward an On-file Notice to the submitter and put its duplicate copy into a file together with the related reporting documents.

6.6 Oil Code

Oil code to be set forth upon on-file notification shall be set forth in accordance with the following guidelines. Such oil code is set with the aim to make it easier for users of hydraulic fluid to identify whether such hydraulic fluid has been on-file or not, since an oil code will be clearly described in the logo mark indicated on the product package (see Appendix 7), and at the same time will be made public indicated together with the product name at the webpage of the JCMA Lubricants Standards Implementation Panel.

An oil code shall be determined by the submitter and recorded by the JCMA Lubricants Standards Implementation Panel. Each oil code shall be established in the format shown below:



Where:

(1) Category code (an alphabetic capital letter): An “H” is assigned to hydraulic fluids.
(2) Country code (a three digit numeral): An international telephone country code of the nation where the submitter is domiciled. (Example: Japan: 081, USA: 001, England (UK): 044, etc.)
(3) Marketer code (three alphabetic capital letters): Any three alphabetic capital letters desired by the submitter (e.g., Komatsu Ltd.: KMT, JX Nippon Oil & Energy

Corporation: JXE, etc.). Note that a submitter is not allowed to use more than one marketer code. If a submitter is already using a marketer code in the JASO on-filing system for automotive products such as two cycle gasoline engine oils, four-cycle engine oils for motorcycles, and diesel engine oils, the same marketer code shall be used. If a marketer code desired by a submitter has already been used by another submitter, the JCMA Lubricants Standards Implementation Panel may request a change of the code to avoid duplication.

(4) Control code (a three digit numeral): An arbitrary number to be assigned by a submitter for its own control purposes. A submitter is not allowed to assign one and the same control code to different products or different trial products.

For guidance, examples of oil code assignment are shown in Appendix 6.

6.7 Publication of On-File Information

For promotion of the Standard for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004) and the Standard for Biodegradable Hydraulic Fluids for Construction Machinery (JCMAS P 042:2004) and improved understanding and recognition among the users of hydraulic fluids for construction machinery, the JCMA Lubricants Standards Implementation Panel will publish product names, submitter names, viscosity grades, oil code, and product class (JCMA HK or HKB) of hydraulic fluid products on-filed through media such as an Internet website.

Prior to publication, the JCMA Lubricants Standards Implementation Panel will advise the submitter of the information being posted. In case any information so posted or a part thereof is found to be incorrect, the submitter must promptly notify the Panel of necessary correction in writing.

The JCMA Lubricants Standards Implementation Panel will not assume any responsibility for loss or damage incurred by a submitter due to the published information which has been confirmed beforehand by the submitter.

6.8 On-File Maintenance

The JCMA Lubricants Standards Implementation Panel will send a letter of inquiry to each submitter by the end of each year to confirm whether the submitter wishes to continue the submitted status of its products on file from January 1 onward of the year subsequent, along with an inquiry on sales volume of the products concerned.

(1) If continuation of on-filing of the products concerned is desired, the submitter intending continuation of on-filing (hereinafter, the “renewing submitter”) must notify the JCMA Lubricants Standards Implementation Panel of the desire and the amount due on the on-file maintenance fee by the end of February of the subsequent year, such amount being

calculated according to the sales quantity (for the period from January to December of the preceding year) and the method as specified in Appendix 3. Upon notification from the renewing submitter, the JCMA Lubricants Standards Implementation Panel will examine the request and issue an invoice to the renewing submitter in April. Upon receiving the invoice, the renewing submitter shall promptly remit the on-file maintenance fee to a bank account designated by the JCMA Lubricants Standards Implementation Panel. Any expenses incidental to the remittance of the on-file maintenance fee shall be borne by the renewing submitter. The on-file maintenance fee will not be returned once received by the Panel.

If the renewing submitter fails to remit the on-file maintenance fee on time, the JCMA Lubricants Standards Implementation Panel will assume that the product concerned has been discontinued, and will eliminate the on-file submitting for the product.

(2) If the submitter does not intend to continue on-filing of the product concerned, the submitter must promptly notify the JCMA Lubricants Standards Implementation Panel of its intention, and stop displaying oil code and product class on the product package. The JCMA Lubricants Standards Implementation Panel shall immediately eliminate the on-file submitting for the product upon receiving the notice not to intend to continue on-filing.

In the event of a change in the on-file maintenance fee or its calculation method, the JCMA Lubricants Standards Implementation Panel will announce such charge through the associated organizations.

Figure 3 shows a general flow of on-file maintenance procedure.

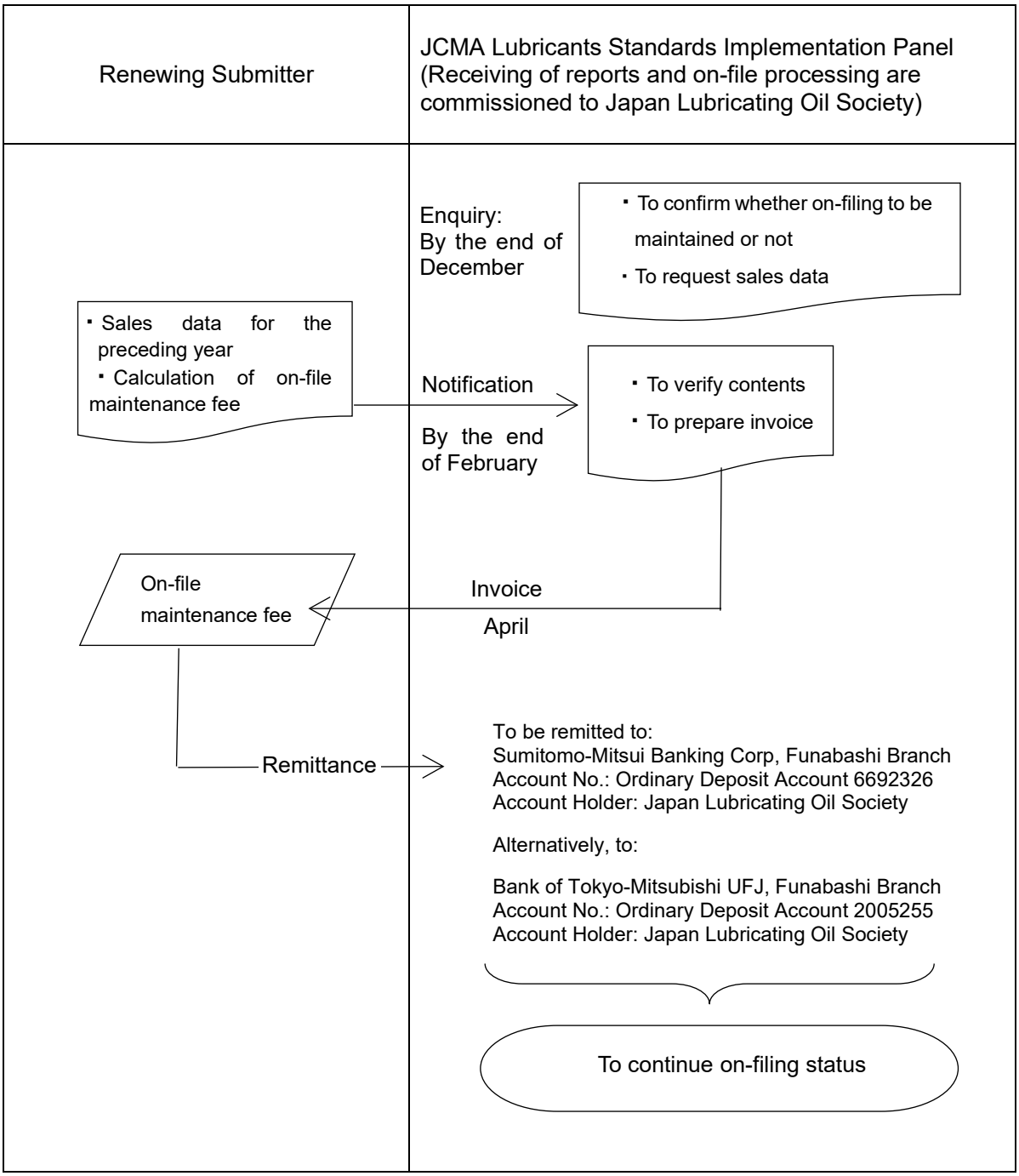


Figure 3 Flow of On-file Maintenance Procedure

6.9 Liability for Product Quality

The quality and performance of the hydraulic fluids for construction machinery on-filed under this System, as classified and guaranteed by the submitter, are the sole responsibility of the submitter, whereby the submitter (the marketer) shall assume all resultant liabilities.

Under this System, the JCMA Lubricants Standards Implementation Panel does not guarantee the quality or performance of the products on file, nor does the Panel assume any responsibility whatsoever with regard to any loss or damage arising from the use of this System.

Should there arise any problems concerning quality or performance of a product filed under this System, the submitter is solely responsible for resolving the issues.

In case this System is in contravention of any laws or regulations of a country, nation, or government (including local administrative organs), such laws or regulations take precedence over this System. Accordingly, the JCMA Lubricants Standards Implementation Panel will not assume any responsibility whatsoever with regard to any loss or damage arising from the use of this System without regard to its nonconformity with certain laws or regulations.

6.10 Information Security

Except for the contents described in Section 6.7 - Publication of On-File Information, the JCMA Lubricants Standards Implementation Panel will not disclose on-file information to a third party without written permission of the submitter concerned; provided, however, that disclosure of on-file information is allowed if the disclosure is required as a legislative action by public authorities. Even if information reported or filed should be inadvertently made known to a third party, the JCMA Lubricants Standards Implementation Panel will not assume any responsibility for compensation as to any loss or damage due to such disclosure of the information.

If the JCMA Lubricants Standards Implementation Panel has received a written inquiry from a third party with respect to a problem or a dispute in the market, the Panel is allowed to inform the inquirer of the on-filing status and the name of the marketer corresponding to the hydraulic fluid product having the oil code concerned. Further, if the inquirer desires to communicate with the submitter concerned, the JCMA Lubricants Standards Implementation Panel will notify the submitter and leave any responses with the submitter, without taking any further actions of its own.

6.11 Changes in Filed Data

In cases where any of the following changes is to be made to the on-file data, the submitter concerned must notify the JCMA Lubricants Standards Implementation Panel of the details in advance. In any of these cases, the submitter is required to pay for the filing fees as specified in Section 6.3, and renew the respective Oil Code:

(1) Any changes in the corporate name or the marketer code of the submitter;
(2) Any changes in the product name;
(3) Any additions or changes in viscosity grades (notification is required even if the changes are within the allowable read-across range specified in Appendix 5.); and
(4) Any changes in the product class marking format.

In any of the following cases, the submitter concerned is required to promptly notify the JCMA Lubricants Standards Implementation Panel of the detail; provided, however, that the submitter is not required to pay for the filing fee as specified in Section 6.3 nor update the oil code concerned:

(1) Changes in the contact address of the submitter such as postal address, telephone number, etc.; In this case, the submitter is required to submit documents in Forms 5 and 6 included in Appendix 3.
(2) Changes in any conditions other than the viscosity grade and within the allowable read-across range specified in Appendix 5; In this case, the submitter is required to submit documents in Forms 5, 6, 7 and 8 included in Appendix 3.

If a change is being made by another submitter concerning a product already on file and within the allowable read-across range specified in Appendix 5, the submitter is required to complete a new on-file reporting according to Section 6.3.

However, if the above submitter makes changes in the newly filed product with respect to any conditions other than the viscosity grade and within the allowable read-across range specified in Appendix 5, the submitter is only required to notify the JCMA Lubricants Standards Implementation Panel of the details of such changes in due course.

Appendix 6 presents case examples of reporting and/or notification for changes.

6.12 Precautions by the Submitter

In displaying the oil code and the product class marking on a product container based on this System, the submitter concerned is required to pay careful attention to the following conditions:

(1) The quality, performance and product class marking of a product to be marketed are identical to those described in the on-file documents for the product;
(2) In the event of any problem arising with respect to the quality, performance or product class marking of a product, the submitter is responsible for resolving or redressing the issue, with expenses incurred in settling the issue also being borne by the submitter.
(3) The Submitter must publicize and make it widely known to general consumers through the sales channels of the submitter that the quality, performance and product class

marking of the hydraulic fluids for construction machinery on-filed under this System, as classified and guaranteed by the submitter, are the sole responsibility of the submitter.

If a submitter discontinues marketing of a hydraulic fluid product listed on-file, the submitter shall promptly notify the JCMA Lubricants Standards Implementation Panel of the cancellation of on-file status for the product.

7. Marking

When displaying an oil code on a product container after receiving the On-file Notice letter from the Panel, the submitter concerned must make clear that it is solely responsible for the oil code and must use the format exemplified in Appendix 7.

Users of this System must not use, either in advertisements or otherwise, an expression which might lead to a misunderstanding that the quality or performance of the hydraulic fluid products concerned has been certified or authenticated by the JCMA Lubricants Standards Implementation Panel.

As specified in Section 6.3, users of this System must submit by mail representative examples of product class marking to be displayed on the product container and an entire product label design or its artwork to the JCMA Lubricants Standards Implementation Panel.

8. Market Monitoring

For protecting legitimate interests of consumers and on-file submitters, the JCMA Lubricants Standards Implementation Panel may conduct market monitoring regarding the hydraulic fluids for construction machinery on-filed so that the Panel can verify that the Standard for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004) and the Standard for Biodegradable Hydraulic Fluids for Construction Machinery (JCMAS P 042:2004) are adequately implemented in the marketplace.

For this purpose the Panel may randomly collect samples of products from the marketplace, examine the product class marking and inspect their quality and performance against the requirements specified in the above-mentioned Standards, and check the information against the respective on-file report documents. In the event that any clear discrepancy with the relevant on-file document is found in such market sampling, the JCMA Lubricants Standards Implementation Panel may ask the on-file submitter in writing for explanation or make a request for remedy.

The JCMA Lubricants Standards Implementation Panel may publish the results of market sampling in a manner such that specific names of submitters or products are unidentifiable.

9. Use of the Standards by Construction Machinery Manufacturers or Marketers

Manufacturers or marketers of construction machinery or related equipment may use the Standard for Hydraulic Fluids for Construction Machinery (JCMAS P 041:2004) and the Standard for Biodegradable Hydraulic Fluids for Construction Machinery (JCMAS P 042:2004), on the basis of individual judgment and responsibility of such parties, by referring to the Standards in the Owner's Manual or any other documents to make recommendations on proper grades of hydraulic fluids to be used by the machinery operators.

The party making an oil recommendation based on the above-mentioned Standards must not use in advertisements or other materials any expression which could lead to a misunderstanding that the quality or performance of the hydraulic fluid products concerned has been certified or authenticated by the JCMA Lubricants Standards Implementation Panel (for example, by stating a “hydraulic fluid certified or approved by the JCMA Lubricants Standards Implementation Panel”).

The party who intends to make an oil recommendation based on these Standards is required to mail a representative example of the Owner's Manual concerned to the JCMA Lubricants Standards Implementation Panel.

10. List of References

Listed below are contact addresses from which detailed information or requisite materials regarding this System could be found or obtained:

10.1 For obtaining and forwarding On-File Reporting forms and On-File documents:

The JCMA Lubricants Standards Implementation Panel
c/o Business Department
Japan Lubricating Oil Society
No. 2-16-1 Hinode, Funabashi-shi, Chiba
273-0015 Japan
Tel: 81-47-433-5181
Fax: 81-47-431-9579
URL: http://www.jalos.or.jp/jcmaonfile/

10.2 For obtaining the JCMA Standards and Testing Methods:

Secretariat - Standards Department
Japan Construction Machinery and Construction Association
No. 3-5-8, Shiba Park
Minato-ku, Tokyo
105-0011 Japan
Tel: 81-3-5776-7858

Fax: 81-3-3432-0289

10.3 For obtaining the Standard Reference Fluids:

Technical Center
Japan Lubricating Oil Society
No. 2-16-1 Hinode, Funabashi-shi, Chiba
273-0015 Japan
Tel: 81-47-433-5181
Fax: 81-47-431-9579

10.4 For obtaining test pumps, parts and materials:

10.4.1 Pumps and parts for JCMAS P 044 (Model HPV35+35):

Komatsu Ltd.
Oyama Plant Planning & Coordination Department
Instrumentation System Division
400 Yokokura shinden, Oyama-shi, Tochigi
323-8558 Japan
Tel: 81-285-28-8261
Fax: 81-285-27-3642

10.4.2 Pumps and parts for ASTM D 6973 (Model 35VQ) and ASTM D 7043 (Model 104C):

Control Division 2 - Fluid Power Dept.
TOKYO KEIKI INC.
No. 2-46-46 Minamikamata, Ohta-ku, Tokyo
144-8551 Japan
Tel: 81-3-3737-8619
Fax: 81-3-3737-8667

10.4.3 Pumps and parts for JCMAS P 045 (Model A2F-10):

Marketing Division – Construction Machinery Engineering Dept.
Bosch Rexroth, Japan
No. 5-1 Higashi Nakanuki-cho, Tsuchiura-shi, Ibaragi
300-8588 Japan
Tel: 81-29-834-0831
Fax: 81-29-834-0832

10.4.4 Elastomer specimens U801 (AU) and G361 (HNBR):

Marketing Division – Kanto Branch
NOK Corporation.
No. 1-12-15 Shiba-daimon, Minato-ku, Tokyo
105-8585 Japan
Tel: 81-3-3432-6472
Fax: 81-3-3432-2831

10.4.5 Elastomer specimen SRE-NBR/L (NBR):
Polymer Technology Division
Chemicals Evaluation and Research Institute, Japan
No. 1600 Shimotakano, Sugito-cho, Kitakatsusika
Saitama, 345-0043 Japan
Tel: 81-480-37-2601
Fax: 81-480-37-2521
URL: http://www.ceri.or.jp/

10.4.6 Micro-clutch test specimens &maintenance
Nikko Create Co., Ltd.
NINAGAWA FACTRY Industrial Equipment Department
188 Onoguchi-machi, Tochigi-shi
Tochigi, 323-0065, Japan
Tel: 81-282-20-1170
Fax: 81-282-20-1157

10.5 Related foreign test standards:
10.5.1 For obtaining ASTM test standards and inquiring about testing facilities:
ASTM International
100 Barr Harbor Drive
P.O. Box C700
West Conshohocken, PA 19428-2959 U.S.A.
Tel: 1-610-832-9585
Fax: 1-610-832-9555
URL: http://www.astm.org/ e-mail: service@astm.org

Appendix 1

Application for Contract Test Laboratory on JCMAS Pump and Friction Characteristics Tests

To: Messrs: JCMA Lubricants Standards Implementation Panel

Date of Application : (Year) (Month) (Day)		
Applicant Name	Corporate Seal	Name of Test Organization: Contact Address: Name:
Person in Charge: Name: Seal Position/Title: Signature:		Position/Title: Postal Address: Tel Fax

Acceptable Test Items (Tick desired test items)		
JCMAS Filterability Test (JCMAS P 043)		Result data of the latest test on standard reference fluid preformed within one year must be attached using relevant report format included in Form-3.
JCMAS High-pressure Piston Pump Test (JCMAS P 044)		
JCMAS High-pressure Piston Pump Test (JCMAS P 045)		
JCMAS Friction Characteristics Test (JCMAS P 047)		

NOTES:

1. Names and addresses of the authorized test organizations are publicized in the Panel website.
2. For cancellation of the contract test laboratory submitting, notify the Panel of the desire.

For Use by JCMA Lubricants Standards Implementation Panel
Received by : Signature/Seal
Date of Receipt : (Year) (Month) (Day)
Receipt No. :
Remarks :

Appendix 2

Cross-reference Table of Test Methods: JIS/JPI, etc. vs. ISO/ASTM, etc.

Test Item	Test Description	ISO/ASTM+T.M.No.	JIS/JPI+ T.M. No.
ISO viscosity classification	Industrial liquid lubricants -- ISO viscosity classification	ISO3448:92 ASTM D 2422:97(02)	JIS K 2001-93
Color	Testing Methods for Color of Petroleum Products	ISO 2049:96 ASTM D 1500:02	JIS K 2580-03
Density	Crude petroleum and petroleum products - Determination of density and petroleum measurement tables based on a reference temperature (15℃)	ISO 91-1:92 ASTM D 1298:99	JIS K 2249-95
Pour point	Testing Methods for Pour Point and Cloud Point of Crude Oil and Petroleum Products	ISO 3016:88 ISO 3015 :88 ASDM D 97:02 ASTM D 2500:02	JIS K 2269-03
Aniline point	Petroleum products – Determination of aniline point and mixed aniline point	ISO 2977:97 ASTM D 611:01b	JIS K 2256-98
Water	Testing Methods for Water Content of Crude Oil and Petroleum Products.	ISO 9029:90 ASTM D 4006:81	JIS K 2275-96
Flash point (COC)	Crude oil and petroleum products - Determination of flash point	ISO 2592:00 ASTM D 92:02b	JIS K 2265-96
Kinematic viscosity	Crude petroleum and petroleum products -- Determination of kinematic viscosity and calculation of viscosity index from kinematic viscosity	ISO 3104:93 ASTM D 445:03	JIS K 2283-00
Viscosity index		ISO 2909:81 ASTM D 2270:93(98)	JIS K 2283-00
Brookfield viscosity	Testing Methods for Low-Temperature Viscosity of Gear Oils (Brookfield)	ASTM D 2983:87(93) ASTM D 6080:92(02)	JPI - 5S - 26-99
TAN	Petroleum Products and Lubricants - Determination of Neutralization Number	ISO 6618:97 ASTMD974:02	JIS K 2501-03
Rust prevention	Lubricants -- Determination of rust-preventing characteristics	ISO 7120:87 ASTM D 665:02	JIS K 2510-98
Copper corrosion	Petroleum Products - Corrosiveness to copper - Copper strip test	ISO 2160:98 ASTM D 130:94(00)	JIS K 2513-00
Oxidation stability	Testing Methods for Oxidation Stability of Lubricating Oils.	ISO 4263:86 ASTM D 943:02	JIS K 2514-96
Foaming	Petroleum Products - Lubricating Oils - Determination of Foaming Characteristics.	ISO 6247:98 ASTM D 892:03	JIS K 2518-03
Elastomer tensile strength	Tensile testing methods for vulcanized rubber	ISO 37:94	JIS K 6251-04
Elastomer hardness	Hardness testing methods for rubber, vulcanized or thermoplastic	ISO 7619 : 97	JIS K 6253-97
Elastomer compatibility	Testing methods of the effect of liquids for vulcanized rubber.	ISO 1817:99	JIS K 6258-03
Shear stability	Test Methods for Shear Stability of Polymer-Containing Oils	ASTM D 5621:01	JPI - 5S -29-88
Anti-wear property	Testing Method for Anti-Wear Properties of Lubricating Fluid (Shell Four-Ball Method)	ASTM D 4172:94	JPI - 5S -32-90
E.P. property	Testing Method for Extreme-Pressure Properties of Lubricating Fluids (Shell Four-Ball Method)	ASTM D 2783:88	JPI- 5S -40-93
Filterability	Hydraulic Fluids for Construction Machinery – Filterability Test Method	—	JCMAS P 043
Hydrolytic stability	Standard test method for hydrolytic stability of hydraulic fluids (Beverage bottle method)	ASTM D 2619:95	—

FZG gear test	Standard test method for evaluating the scuffing load capacity of oils (FZG visual method)	ASTM D 5182:97 DIN 51354- 2: 90	—
Vane pump test	Standard test method for indicating wear characteristics of petroleum and non-petroleum hydraulic fluids in a constant volume vane pump (Model 104C)	ASTM D 7043:05 IP281(BSI2000)	—
	Test method for indicating wear characteristics of petroleum hydraulic fluids in a high pressure constant volume vane pump (Model 35VQ)	ASTM D 6973:03	—
High-pressure piston pump test	Hydraulic fluid for construction machinery - Evaluation method for indicating lubrication property in high pressure piston pump	—	JCMAS P 044
	Hydraulic fluid for construction machinery - Test method for indicating oxidation stability in high pressure piston pump	—	JCMAS P 045
Friction characteristics	Hydraulic fluid for construction machinery - Test method for friction characteristics	—	JCMAS P 047
Biodegradability	Water quality -- Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium -- Method by analysis of inorganic carbon in sealed vessels (CO2 headspace test)	OECD 301B OECD 301C OECD 301F ASTM D 5864 ASTM D 6731	—
Fish toxicity	Testing method for industrial waste water - Acute toxicity test for fish	OECD 203	JIS K 0102-98 JIS K 0420-71-00

Appendix 3

On-File Reporting and Maintenance of Hydraulic Fluids for Construction Machinery

Table of Contents

Reporting Document Forms

1. Reminders on Completing Report Forms

(1) When completing the on-file reporting forms, refer to relevant sections of the System Implementation Manual.
(2) In case any test method is referenced in the reporting forms without indication of the year of issuance, use the latest version available at the time of reporting.
(3) Product marking and sales based on false declarations may be punishable under the Act Against Unjustifiable Premiums and Misleading Representation (Article 4, Clause 1, Item 1) or the Unfair Competition Prevention Law (Article 2, Clause 1, Item 13).

2. On-File Reporting Procedure

2.1 Filing Fee

The filing fee required for a new on-file submitting shall be ¥40,000 for each product being filed.

2.2 On-File Reporting and Remittance of Filing Fee

Prior to initiating a new on-file reporting and submitting, a filing fee specified in 2.1 for each product being filed must be remitted to one of the bank accounts shown below. To initiate the reporting and submitting process, a bank certificate of the fee remittance and other necessary documents listed below are to be prepared and submitted to the Panel at the address given in the System Implementation Manual.

The bank names and account numbers for filing fee remittance:

Sumitomo-Mitsui Banking Corporation, Funabashi Branch
Account No.: Ordinary Deposit Account 6692326
Account Holder: Japan Lubricating Oil Society

Or:

Bank of Tokyo-Mitsubishi UFJ, Funabashi Branch
Account No.: Ordinary Deposit Account 1036018
Account Holder: Japan Lubricating Oil Society

For obtaining and forwarding On-File forms and On-File documents:

The JCMA Lubricants Standards Implementation Panel
c/o Business Department
Japan Lubricating Oil Society
No. 2-16-1 Hinode, Funabashi-shi, Chiba
273-0015 Japan
Tel: 81-47-433-5181
Fax: 81-47-431-9579

Documents required for filing:

- A bank certificate of filing fee remittance
- Form-1: Cover Sheet of Reporting Form
- Form-2: Test Results Data
- Form-3: Reference Fluid Test Data
- Form-4: Report on Use of Modified Formulations
- A representative example of marking to be displayed on the product container and an entire product label design or its artwork.
- On-file Notice and Agreement Form (Appendix 4; Part B to be filled) in duplicate

3. On-File Maintenance Fee

(1) Those who has done on-file reporting shall bear, in addition to the filing fee to be paid upon the reporting, on-file maintenance fee in accordance with the sales quantity during the period from January 1 to December 31 of the current year (the “Maintenance Fee Calculation Period”).
(2) The on-file maintenance fee shall be calculated for each submitter, and if a submitter has more than one on-file products, then the sales quantity shall be the total of the sales quantities of all products submitted by that submitter, and shall be calculated in a manner as shown below:

Total Quantity of Sales of submitted Product(s) for the Previous Year	On-File Maintenance Fee
Less than 1,000 Kl	¥30,000
1,000 Kl or more	To be calculated at a rate of ¥30 per Kl, up to a maximum of ¥300,000

(3) Each on-file submitter shall, by the end of February each year, report the sales quantity to the JCMA Lubricants Standards Implementation Panel in accordance with the form sent to it in advance and remit on-file maintenance fee as calculated based on the reported sales quantity in accordance with the above-mentioned calculation method to the same bank account (account name: Japan Lubricating Oil Society) as designated under 2.2 of this Appendix 3 for remittance of filing fee.
(4) If an on-file submitter fails to complete reporting of the sales quantity and remittance of the on-file maintenance fee within the time period set forth under the preceding paragraph, the JCMA Lubricants Standards Implementation Panel shall eliminate all the on-file submittings of the submitter concerned.

[Calculation Example–1]

In the case where on-file submitting was completed as of November 1, 2007 and 1,250 Kl of the product was sold by December 31, 2007:

The first year term in this case is the period between November 1, 2007 and December 31,

2007, with the second year term being the period between January 1, 2008 and December 31, 2008. Accordingly, the on-file maintenance fee to be paid in the second year is calculated on the basis of the sales quantity in the previous year. In this case, it is determined according to the declared sales quantity during the period of November 1, 2007 to December 31, 2007, hence;

1,250 Kl × □¥30/Kl = ¥37,500

[Calculation Example–2]

In the case where Product A was first on-filed effective November 15, 2007, and a total of 500 Kl was sold by December 31, 2007, followed by a 2,000 Kl sale in the year 2008; whereas the on-file submitting for Product B was completed as of May 1, 2008, and 1,000 Kl of Product B was sold by December 31, 2008: (See Fig. 3.1.)

Since the total sales quantity of Product A in the year 2007 is 500 Kl, an on-file maintenance fee to be paid in the year 2008 is ¥30,000. The total sales quantity of the two products in the year 2008 is 3,000 Kl, i.e., 2,000 Kl of Product A plus 1,000 Kl of Product B. Hence, an on-file maintenance fee to be paid in the year 2009 is calculated as indicated below.

3,000 Kl × □¥30/Kl = ¥90,000

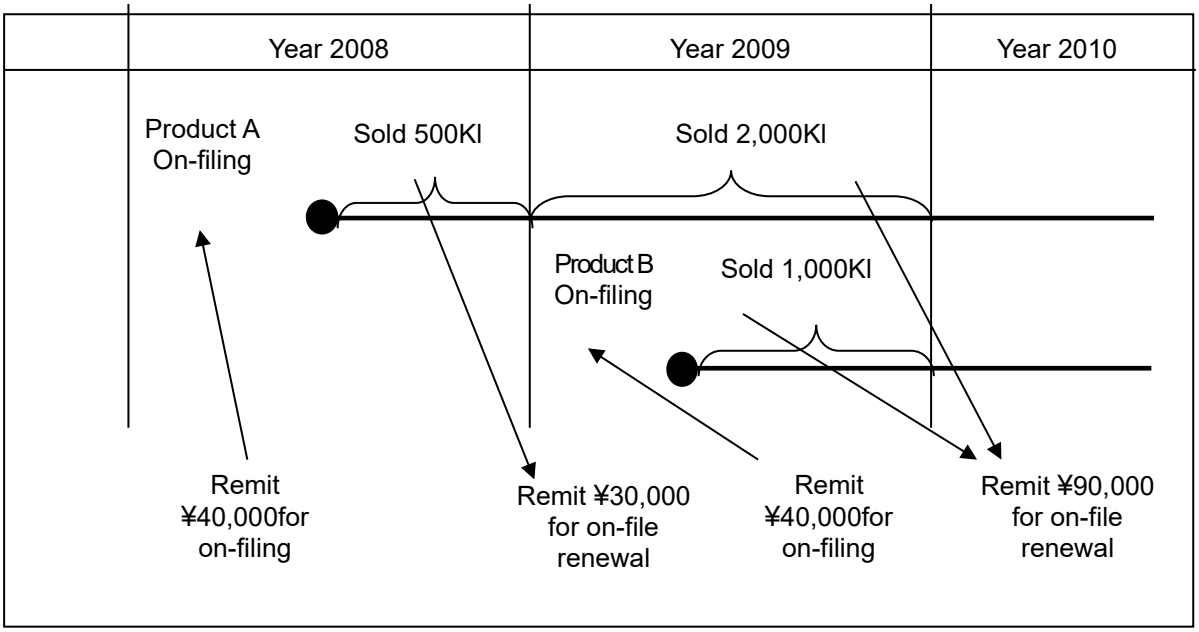


Figure 3.1 Calculation Example of On-File Maintenance Fee

4. On-File Change Notification Procedure

In the case where the submitter wishes to change any subject described in the on-file report, the following documents must be prepared regardless of the need for renewal of the oil code, and then be submitted to the JCMA Lubricants Standards Implementation Panel. For details, refer to

Section 6.11 of the System Implementation Manual:

(1) Documents required when changing contact address of the submitter:

Form-5: Change Notice
Form-6: Cover Sheet for Change Notice

(2) Documents required when changing any conditions other than viscosity grades and within the allowable read-across range specified in Appendix 5:

Form-5: Change Notice
Form-6: Cover Sheet for Change Notice
Form-7: Test Results Data for Change Notice
Form-8: Use of Modified Formulations for Change Notice

Form-1 Cover Sheet for Reporting Documents

Report for Filing Hydraulic Fluid for Construction Machinery

To: Messrs. JCMA Lubricants Standards Implementation Panel

Date of Reporting : (Year) (Month) (Day)		
Submitter Name	Corporate Seal	Contact Address: Name:
Person in Charge: Name: Seal Position/Title: Signature:		Position/Title: Postal Address: Tel Fax

Product for On-file submitting		
In-house Product ID or Code		
Commercial Name		
Product Class (Tick one)	☐ HK	☐ HKB
Hydraulic Fluid Classification (Tick one)	VG32,VG46,VG32W,VG46W	VG32,VG46,VG32W,VG46W
Oil Code		

Form-2: Test Results Data

Form-2a-1: Test Results Data for JCMAS HK – Low temperature use

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32W	VG46W	VG32W	VG46W
ISO Viscosity Classification		JIS K 2001-1993			ISOVG32	ISOVG46
Flash Point, °C		JIS K 2265-1996			Report[1)]	
Kinematic Viscosity (40°C), mm^2/s [2)]		JIS K 2283-1993			28.8 min. 35.2 max.	41.4 min. 50.6 max
Kinematic Viscosity (100°C), mm^2/s [2)]		JIS K 2283-1993			5.3 min.	6.8 min.
Viscosity Index		JIS K 2283-1993			120 min.	120 min.
Pour Point, °C		JIS K 2269-1987			-40.0 max.	-30.0 max.
Low Temp. Viscosity (-20°C), mPa・s		JPI-5S-26-	—		—	5,000 max.
(-25°C), mPa・s				—	5,000 max.	—
Foaming, ml	(24°C)	JIS K 2518-1991.			50 max./ 0 max.	
	(93.5°C)				50 max./ 0 max.	
	(24°C after 93.5°C)				50 max./ 0 max.	
Shear Stability Viscosity Loss (100°C), %		JPI-5S-29			10 max.	
Oxidation Stability (95°C, 1,000h) TAN Increase, mgKOH/g		JIS K 2514-1996			1.0 max.	
Rust Preventing Characteristics (synthetic sea water, 24h)		JIS K 2510-1987			No rust	
Seal Compatibility Tests						
NBR [4)] (100°C 240h)	Hardness Change [3)] Change in tensile strength, % Change in elongation, % Change in volume, %	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-25 max. -50 max. -50 max. +30 max.	
AU [5)] (120°C 240h)	Hardness Change [3)] Change in tensile strength, % Change in elongation, % Change in volume, %				-30 max. -50 max. -50 max. -5～+5	
Aniline Point , °C		JIS K 2556-1985			90 min.	
Filterability, min.	Run 1	JCMAS P 043			25 max.	
	Run 2				30 max.	
Copper Corrosion (100°C, 3h)		JIS K 2513-1991			1 max.	
Load-carrying Capacity (Shell 4-ball) Weld point , N		JPI-5S-40			1,235 min.	
Anti-wear Property (Shell 4-ball) (294N, 1200rpm, 60min, @75°C), mm		JPI-5S-32			0.60 max.	
FZG Gear Failure load stage		ASTM D 5182 DIN 51534-2			8 min..	

Form-2a-2: Test Results Data for JCMAS HK – Low temperature use (continued)

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32W	VG46W	VG32W	VG46W
High-pressure Piston Pump Test [6]	□ Lubricity Evaluation [9] (HPV35+35)	JCMAS P 044			Per separate criteria	
	□ Service Life (A2F)	JCMAS P 045			(500h)	
	Vis.Change (40°C), %				+10 max.	
	TAN Increase, mgKOH/g				2.0 max.	
	Contaminants (0.8μm), mg/100ml				10 max.	
Vane Pump Tests [7]	□ Lubricity Evaluation (35VQ25)	ASTM D 6973			(150h)	
	Ring Wear, mg				75 max.	
	Vane Wear, mg				15 max.	
	□ Lubricity Evaluation (104C)	ASTM D 7043			(100h)	
	Ring and vane wear, mg				50 max.	
Friction Characteristics [8]	□ Micro-clutch Test (μ)	JCMAS P 047			0.08 min.	
	□ SAENo.2 Machine (1000cycles), (μs)				0.07 min.	
Infrared absorption spectrum analysis 0.1mm (KBr) sealed absorption cell			A4 size IR chart to be attached		Report[1]	

Form-2a-3: Test Results Data for JCMAS HK – Low temperature use; JCMAS P 044 Results

	Evaluation items		Test Results	Pass/Fail Criteria (based on highest measurements)
1	Change in flow rate			Decrease in flow rate: 3% max. (at 19.6 MPa)
2	[Parts wear] Cylinder block, Bore diameter, mm			0.050 max.
	Piston, Outer diameter, mm			0.030 max.
	Piston shoe, Thickness, mm			0.050 max.
	Piston shoe, Looseness, mm			0.20 max.
	Cylinder block, Spherical portion, mm			0.015 max.
	Valve plate, Spherical portion, mm			0.015 max.
	Locker cam, Shoe sliding surface, mm			0.015 max.
	Locker cam, Cylindrical surface, mm			0.020 max.
	Cradle, Cylindrical surface, mm			0.010 max.
	Servo piston, mm			0.010 max.[9)]
	Oil seal, Wear width on the main lip, mm			0.80 max.
3	Parts condition, Visual inspection on all pump parts			Should be free of any signs of seizure, scoring, erosion, surface roughness, significant deposit, lacquer and precipitate. (See JCMAS P 044 Appendix Figures 1 to7) Further, the area ratio of seizure, scoring, and/or adhesive wear damage between locker cam and cradle should be 10% or less of the cylindrical surface.
4	Filter			Should be free of abnormal plugging
5	[Change in fluid characteristics] Kinematic viscosity (40°C), %			±5
	TAN increase, mgKOH/g			0.8 max.
	Water content, mg/kg			1,000 max.
	Pentane insolubles, %			0.1 max.
	Metals in fluid, Mass ppm	Fe		Report[1)]
		Cu		Report[1)]
		Pb		Report[1)]
		Zn		Report[1)]
		Si		Report[1)]
		Al		Report[1)]
	Contaminants; (Particle count) (NAS Cleanliness Class)	For 5 - 15 µm		Report[1)]
		15 - 25 µm		Report[1)]
		25 - 50 µm		Report[1)]
		50 - 100 µm		Report[1)]
		>100 µm		Report[1)]

Remarks:

[1)] Report the test results.

[2)] A value expressed in mm^2/s is numerically equal to that in cSt.

[3)] Use Type-A Durometer.

[4)] Use low-acrylonitrile elastomer SRE-NBR/L specified in ISO 13226 for specimen.

[5)] For the specimen polyester urethane, use the AU described in Table 1 below or equivalent.

Table 1 Elastomer Characteristics

	Items	Unit	AU (U801)
Requirements	Hardness rating,	Type-A Durometer	88 - 98
	Tensile strength,	MPa	29.4 min.
	Elongation,	%	300 min.

[6] Evaluation with a high-pressure piston pump shall be conducted by either one of the Model HPV35+35 Pump Test according to JCMAS P 044, or the Model A2F Pump Test in accordance with JCMAS P 045. In the case of JCMAS P045, results of all evaluation items from every interim inspection until 500 hours shall be within the acceptance criteria.

[7] Evaluation with a vane pump shall be conducted by either one of the Model 104C Pump Test in accordance with ASTM D 7043 (or ISO 20763), or the Model 35VQ25 Pump Test in accordance with ASTM D 6973. Either 7.1) or 7.2) procedures below are acceptable for the 35VQ25 Pump Test.

7.1) Continuous 150 hours test run with single test pump cartridge and pass the acceptance criteria.

7.2) Three of 50 hours tests run on the same candidate oil but with three test pump cartridges. Each test has to pass the acceptance criteria.

[8] Evaluation for the friction characteristics shall be conducted by either one of the Micro-clutch Test in accordance with JCMAS P 047, or a test using the SAE No.2 Friction Test Machine (at 800 rpm). In addition, the test fluid is required to exhibit adequate anti-squeak function for the hydraulic cylinder operation regardless of the provisions for frictional characteristics.

[9] Wear measurement with the profilometer may be omitted if no irregularity such as scoring or seizure is visually identifiable.

When more than one test method are specified for a test item, enter a test result with one of the methods specified, and tick the check box corresponding to the method used.

Form-2: Test Results Data

Form-2b-1: Test Results Data for JCMAS HK – Normal temperature use

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32	VG46	VG32	VG46
ISO Viscosity Classification		JIS K 2001-1993			ISOVG32	ISOVG46
Flash Point, °C		JIS K 2265-1996			Report[1)]	
Kinematic Viscosity (40°C), mm^2/s [2)]		JIS K 2283-1993			28.8 min. 35.2 max.	41.4 min. 50.6 max
Kinematic Viscosity (100°C), mm^2/s [2)]		JIS K 2283-1993			5.0 min.	6.1 min.
Viscosity Index		JIS K 2283-1993			90 min.	90 min.
Pour Point, °C		JIS K 2269-1987			-17.5 max.	-15.0 max.
Foaming, ml	(24°C)	JIS K 2518-1991.			50 max./ 0 max.	
	(93.5°C)				50 max./ 0 max.	
	(24°C after 93.5°C)				50 max./ 0 max.	
Oxidation Stability (95°C, 1,000h) TAN Increase, mgKOH/g		JIS K 2514-1996			1.0 max.	
Rust Preventing Characteristics (synthetic sea water, 24h)		JIS K 2510-1987			No rust	
Seal Compatibility Tests						
NBR [4)] 100°C 240h	Hardness Change [3)] Change in tensile strength, % Change in elongation, % Change in volume, %	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-25 max. -50 max. -50 max. +30 max.	
AU [5)] 120°C 240h	Hardness Change [3)] Change in tensile strength, % Change in elongation, % Change in volume, %				-30 max. -50 max. -50 max. -5～+5	
Aniline Point, °C		JIS K 2556-1985			90 min.	
Filterability, min.	Run 1	JCMAS P 043			25 max.	
	Run 2				30 max.	
Copper Corrosion (100°C, 3h)		JIS K 2513-1991			1 max.	
Load-carrying Capacity (Shell 4-ball) Weld Point, N		JPI-5S-40			1,235 min.	
Anti-wear Property (Shell 4-ball) (294N, 1200rpm, 60min, @75°C) , mm		JPI-5S-32			0.60 max.	
FZG Gear Failure load stage		ASTM D 5182 DIN 51534-2			8 min..	

Form-2b-2: Test Results Data for JCMAS HK – Normal temperature use (continued)

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32	VG46	VG32	VG46
	□ Lubricity Evaluation (HPV35+35 [9)]	JCMAS P 044			Per separate criteria	
High-pressure Piston Pump Test [6)]	□ Service Life (A2F)	JCMAS P 045			(500h)	
	Vis.Change (40°C), %				+10 max.	
	TAN Increase, mgKOH/g				2.0 max.	
	Contaminants, (0.8μm), mg/100ml				10 max.	
Vane Pump Tests [7)]	□ Lubricity Evaluation (35VQ25)	ASTM D 6973			(150h)	
	Ring Wear, mg				75 max.	
	Vane Wear, mg				15 max.	
	□ Lubricity Evaluation (104C)	ASTM D 7043			(100h)	
	Ring and vane wear, mg				50 max.	
Friction Characteristics [8)]	□ Micro-clutch Test (μ)	JCMAS P 047			0.08 min.	
	□ SAENo.2 Machine (1000cycles)、(μs)				0.07 min.	
Infrared absorption spectrum analysis 0.1mm (KBr) sealed absorption cell			A4 size IR chart to be attached		Report[1)]	

Form-2b-3: Test Results Data for JCMAS HK – Normal temperature use; JCMAS P 044 Results

	Evaluation items		Test Results	Pass/Fail Criteria (based on highest measurements)
1	Change in flow rate			Decrease in flow rate: 3% max. (at 19.6 MPa)
2	[Parts wear] Cylinder block, Bore diameter, mm			0.050 max.
	Piston, Outer diameter, mm			0.030 max.
	Piston shoe, Thickness, mm			0.050 max.
	Piston shoe, Looseness, mm			0.20 max.
	Cylinder block, Spherical portion, mm			0.015 max.
	Valve plate, Spherical portion, mm			0.015 max.
	Locker cam, Shoe sliding surface, mm			0.015 max.
	Locker cam, Cylindrical surface, mm			0.020 max.
	Cradle, Cylindrical surface, mm			0.010 max.
	Servo piston, mm			0.010 max.[9)]
	Oil seal, Wear width on the main lip, mm			0.80 max.
3	Parts condition, Visual inspection on all pump parts			Should be free of any signs of seizure, scoring, erosion, surface roughness, significant deposit, lacquer and precipitate. (See JCMAS P 044 Appendix Fig. 1 to 7) Further, the area ratio of seizure, scoring, and/or adhesive wear damage between locker cam and cradle should be 10% or less of the cylindrical surface.
4	Filter			Should be free of abnormal plugging
5	[Change in fluid characteristics] Kinematic viscosity (40°C), %			±5
	TAN increase, mgKOH/g			0.8 max.
	Water content, mg/kg			1,000 max.
	Pentane insolubles, %			0.1 max.
	Metals in fluid, Mass ppm	Fe		Report[1)]
		Cu		Report[1)]
		Pb		Report[1)]
		Zn		Report[1)]
		Si		Report[1)]
		Al		Report[1)]
	Contaminants; (Particle count) (NAS Cleanliness Class)	For 5 - 15 µm		Report[1)]
		15 - 25 µm		Report[1)]
		25 - 50 µm		Report[1)]
		50 - 100 µm		Report[1)]
		>100 µm		Report[1)]

Remarks:

[1)] Report the test results.

[2)] A value expressed in mm^2/s is numerically equal to that in cSt.

[3)] Use Type-A Durometer.

[4)] Use low-acrylonitrile elastomer SRE-NBR/L specified in ISO 13226 for specimen.

[5)] For the specimen polyester urethane, use the AU described in Table 1 below or equivalent.

Table 1 Elastomer Characteristics

	Items	Unit	AU (U801)
Requirements	Hardness rating,	Type-A Durometer	88 - 98
	Tensile strength,	MPa	29.4 min.
	Elongation,	%	300 min.

[6] Evaluation with a high-pressure piston pump shall be conducted by either one of the Model HPV35+35 Pump Test according to JCMAS P 044, or the Model A2F Pump Test in accordance with JCMAS P 045. [7] In the case of JCMAS P045, results of all evaluation items from every interim inspection until 500 hours shall be within the acceptance criteria.

[7] Evaluation with a vane pump shall be conducted by either one of the Model 104C Pump Test in accordance with ASTM D 7043 (or ISO 20763), or the Model 35VQ25 Pump Test in accordance with ASTM D 6973. Either 7.1) or 7.2) procedures below are acceptable for the 35VQ25 Pump Test.

7.1) Continuous 150 hours test run with single test pump cartridge and pass the acceptance criteria.

7.2) Three of 50 hours tests run on the same candidate oil but with three test pump cartridges. Each test has to pass the acceptance criteria.

[8] Evaluation for the friction characteristics shall be conducted by either one of the Micro-clutch Test in accordance with JCMAS P 047, or a test using the SAE No.2 Friction Test Machine (at 800 rpm). In addition, the test fluid is required to exhibit adequate anti-squeak function for the hydraulic cylinder operation regardless of the provisions for frictional characteristics.

[9] Wear measurement with the profilometer may be omitted if no irregularity such as scoring or seizure is visually identifiable.

When more than one test method are specified for a test item, enter a test result with one of the methods specified, and tick the check box corresponding to the method used.

Form-2c-1: Test Results Data for JCMAS HKB – Low temperature use

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32L	VG46L	VG32L	VG46L
ISO Viscosity Classification		JIS K 2001-1993			ISO VG32	ISO VG46
Density (15°C), kg/m^3		JIS K 2249-1995			Report[1)]	
Color, ASTM		JIS K 2580-2003			Report[1)]	
Flash Point, °C		JIS K 2265-1996			Report[1)]	
Kinematic Viscosity (40°C), mm^2/s		JIS K 2283-1993			28.8 min. 35.2 max.	41.4 min. 50.6 max
Kinematic Viscosity (100°C), mm^2/s		JIS K 2283-1993			5.3 min.	6.8 min.
Low Temp. Viscosity (-20°C), mPa・s		JPI-5S-26-90	—		—	5,000 max.
(-25°C), mPa・s				—	5,000 max	—
Pour Point, °C		JIS K 2269-1987			-35.0 max.	-30.0 max.
TAN, mgKOH/g		JIS K 2501-2003			Report[1)]	
Water Content, mg/kg		JIS K 2275-1996			1,000 max. (before breaking container seal)	
Copper Corrosion (100°C, 3h)		JIS K 2513-1991			1max.	
Rust Preventing Characteristics (Distilled water)		JIS K 2510-1987			No rust	
Foaming, ml	(24°C)	JIS K 2518-1991.			50 max./0 max.	
	(93.5°C)				50 max./0 max.	
	(24°C after 93.5°C)				50 max./0 max.	
Seal Compatibility Tests						
NBR[3)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-40~+10	
	Change in volume, %				-5~+70	
	Change in elongation, %				-60~+20	
	Change in tensile strength, %				-65~+20	
HNBR[4)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-8~+8	
	Change in volume, %				-5~+15	
	Change in elongation, %				-15~+20	
	Change in tensile strength, %				-15~+20	
AU[5)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			Report[1)]	
	Change in volume, %				Report[1)]	
	Change in elongation, %				Report[1)]	
	Change in tensile strength, %				Report[1)]	
FZG Gear Test Failure Load Stage		□ASTM D 5182:1997 □ DIN 51534-2:1990			8 min.	
Vane Pump Test (104C) (250h)	Ring Wear, mg	ASTM D 7043:2005			120 max.	
	Vane Wear, mg				30 max.	

Form-2c-2: Test Results Data for JCMAS HKB – Low temperature use (continued)

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32L	VG46L	VG32L	VG46L
High-pressure Pump Test (A2F10) 500h	Vis. Change (40°C), %[7]	JCMAS P 045			+10 max.	
	TAN Increase, mgKOH/g				2.0 max.	
	Contaminants (0.8μm), mg/100ml				10 max.	
	Cu-content Increase in oil layer, mass ppm				Report[1]	
Hydrolytic Stability	Copper weight loss, mg/cm^2	ASTM D 2619:1995			Report[1]	
	Copper Appearance				Report[1]	
	TAN Increase in oil layer, mgKOH/g				Report[1]	
Load-carrying Capacity (Shell 4-Ball), Weld Load, N		JPI-5S-40			1,235 min.	
Anti-wear Property (Shell 4-Ball) (294N, 1,200rpm, 60min., @75°C) , mm		JPI-5S-32			0.60 max.	
Friction Characteristics[6]	□ Micro-clutch Test (μ)	JCMAS P 047			0.05 min.	
	□ SAENo.2 Machine (1000cycles)、(μs)				0.07 min.	
Environmental Criteria	Biodegradability (28 Days)	ISO 14593:99 ISO 9434:99 ASTM D 5864:95 ASTM D 6731:			Must meet the criteria specified in Section 4-1 of the Eco Mark Product Category No.110 “Bio-degradable Lubricating Oil” (Version 2.0)	
	Acute Toxicity (96 hrs, LC_{50} Value)	ISO 7346-2:96			Must meet the criteria specified in Section 4-1 of the Eco Mark Product Category No.110 “Bio-degradable Lubricating Oil” (Version 2.0)	

Remarks:

[1] Report the test results.

[2] Use Type-A Durometer.

[3] For the specimen NBR, use low-acrylonitrile SRE-NBR/L specified in ISO 13226.

[4] For the specimen HNBR, use the material described in Table 1 below.

[5] For the specimen AU, use the material described in Table 1 below.

[6] Evaluation for the friction characteristics shall be conducted by either Micro-clutch Test in accordance with JCMAS P 047, or SAE No.2 Friction Test Machine (at 800 rpm).

[7] In the case of JCMAS P045, results of all evaluation items from every interim inspection until 500 hours shall be within the acceptance criteria.

When more than one test method are specified for a test item, enter a test result with one of the methods specified, and tick the check box corresponding to the method used.

Table 1 Elastomer Characteristics

	Items	Unit	HNBR (G361)	AU (U801)
Requirements	Hardness rating	Type-A Durometer	75 ~ 85	88 ~ 98
	Tensile strength	MPa	28.3 min.	29.4 min.
	Elongation	%	260 min.	300 min.

Form-2d-1: Test Results Data for JCMAS HKB – Normal temperature use

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32	VG46	VG32	VG46
ISO Viscosity Classification		JIS K 2001-1993			ISO VG32	ISO VG46
Density (15°C), kg/m^3		JIS K 2249-1995			Report[1)]	
Color, ASTM		JIS K 2580-2003			Report[1)]	
Flash Point, °C		JIS K 2265-1996			Report[1)]	
Kinematic Viscosity (40°C), mm^2/s		JIS K 2283-1993			28.8 min. 35.2 max.	41.4 min. 50.6 max
Kinematic Viscosity (100°C), mm^2/s		JIS K 2283-1993			5.3 min.	6.8 min.
Low Temp. Viscosity (-10°C), mPa・s		JPI-5S-26-90	—		Report[1)]	
Pour Point, °C		JIS K 2269-1987			-17.5 max.	
TAN, mgKOH/g		JIS K 2501-2003			Report[1)]	
Water Content, mg/kg		JIS K 2275-1996			1,000 max. (before breaking container seal)	
Copper Corrosion (100°C, 3h)		JIS K 2513-1991			1max.	
Rust Preventing Characteristics (Distilled water)		JIS K 2510-1987			No rust	
Foaming, ml	(24°C)	JIS K 2518-1991.			50 max./0 max.	
	(93.5°C)				50 max./0 max.	
	(24°C after 93.5°C)				50 max./0 max.	
Seal Compatibility Tests						
NBR[3)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-40~+10	
	Change in volume, %				-5~+70	
	Change in elongation, %				-60~+20	
	Change in tensile strength, %				-65~+20	
HNBR[4)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-8~+8	
	Change in volume, %				-5~+15	
	Change in elongation, %				-15~+20	
	Change in tensile strength, %				-15~+20	
AU[5)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			Report[1)]	
	Change in volume, %				Report[1)]	
	Change in elongation, %				Report[1)]	
	Change in tensile strength, %				Report[1)]	
FZG Gear Test Failure Load Stage		□ ASTM D 5182:1997 □ DIN 51534-2:1990			8 min.	
Vane Pump Test (104C) (250h)	Ring Wear, mg	ASTM D 7043:2005			120 max.	
	Vane Wear, mg				30 max.	

Form-2d-2: Test Results Data for JCMAS HKB – Normal temperature use (continued)

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32	VG46	VG32	VG46
High-pressure Pump Test (A2F10) 500h	Vis. Change, (40°C) %[7]	JCMAS P 045			+10 max.	
	TAN Increase, mgKOH/g				2.0 max.	
	Contaminants (0.8μm) , mg/100ml				10 max.	
	Cu-content Increase in oil layer, mass ppm				Report[1]	
Hydrolytic Stability	Copper weight loss, mg/cm^2	ASTM D 2619:1995			Report[1]	
	Copper Appearance				Report[1]	
	TAN Increase in oil layer, mgKOH/g				Report[1]	
Load-carrying Capacity (Shell 4-Ball), Weld Load, N		JPI-5S-40			1,235 min.	
Anti-wear Property (Shell 4-Ball) (294N, 1,200rpm, 60min., @75°C) , mm		JPI-5S-32			0.60 max.	
Friction Characteristics[6]	□ Micro-clutch Test (μ)	JCMAS P 047			0.05 min.	
	□ SAENo.2 Machine (1000cycles)、(μs)				0.07 min.	
Environmental Criteria	Biodegradability (28 Days)	ISO 14593:99 ISO 9434:99 ASTM D 5864:95 ASTM D 6731:			Must meet the criteria specified in Section 4-1 of the Eco Mark Product Category No.110 “Bio-degradable Lubricating Oil” (Version 2.0)	
	Acute Toxicity (96 hrs, LC_{50} Value)	ISO 7346-2:96			Must meet the criteria specified in Section 4-1 of the Eco Mark Product Category No.110 “Bio-degradable Lubricating Oil” (Version 2.0)	

Remarks:

[1] Report the test results.

[2] Use Type-A Durometer.

[3] For the specimen NBR, use low-acrylonitrile SRE-NBR/L specified in ISO 13226.

[4] For the specimen HNBR, use the material described in Table 1 below.

[5] For the specimen AU, use the material described in Table 1 below.

[6] Evaluation for the friction characteristics shall be conducted by either Micro-clutch Test in accordance with JCMAS P 047, or SAE No.2 Friction Test Machine (at 800 rpm).

[7] In the case of JCMAS P045, results of all evaluation items from every interim inspection until 500 hours shall be within the acceptance criteria.

When more than one test method are specified for a test item, enter a test result with one of the methods specified, and tick the check box corresponding to the method used.

Table 1 Elastomer Characteristics

	Items	Unit	HNBR (G361)	AU (U801)
Requirements	Hardness rating	Type-A Durometer	75 ~ 85	88 ~ 98
	Tensile strength	MPa	28.3 min.	29.4 min.
	Elongation	%	260 min.	300 min.

For Use by JCMA Lubricants Standards Implementation Panel				
Received by	:		Signature/Seal	
Date of Receipt	:	(Year)	(Month)	(Day)
Receipt No.	:			
Remarks :				

Form-3 Reference Fluid Test Data

Form-3.1 JCMAS Reference Fluid Test Results

[Reference Fluid: JCMA-R1]

Test Item		Test Method	Results	Precision Criteria
Friction Characteristics	□ SAENo.2 Machine 1000cycles, (μs)	JCMAS P 047		0.10~0.15
High-pressure Pump Test	□ Lubricity Evaluation （HPV35+35）	JCMAS P 044	See Exhibit 1	Per criteria in Exhibit 1
	□ Service Life (A2F）	JCMAS P 045		(500h)
	Vis. Change (40℃), %			10 max.
	TAN Increase, mgKOH/g			2.0 max.
	Contaminants, mg/100ml			10 max.

[Reference Fluid: JCMA-R2 (Micro-clutch test reference)]

Test Item		Test Method	Results	Precision Criteria
Friction Characteristics	□ Micro-clutch Test (μ)	JCMAS P 047	See Exhibit 2	Per criteria in Exhibit 2

Form-3.2 Exhibit 1: JCMA-R1 JCMAS P 044 Reference Test Results Data

	Evaluation items		Results	Precision Criteria (based on highest measurements)
1	Change in flow rate			Decrease in flow rate: 3% max. (at 19.6 MPa)
2	[Parts wear] Cylinder block, Bore diameter, mm			0.050 max.
	Piston, Outer diameter, mm			0.030 max.
	Piston shoe, Thickness, mm			0.050 max.
	Piston shoe, Looseness, mm			0.20 max.
	Cylinder block, Spherical portion, mm			0.015 max.
	Valve plate, Spherical portion, mm			0.015 max.
	Locker cam, Shoe sliding surface, mm			0.015 max.
	Locker cam, Cylindrical surface, mm			0.020 max.
	Cradle, Cylindrical surface, mm			0.010 max.
	Servo piston, mm			0.010 max.[1)]
	Oil seal, Wear width on the main lip, mm			0.80 max.
3	Parts condition, Visual inspection on all pump parts			Should be free of any signs of seizure, scoring, erosion, surface roughness, significant deposit, lacquer and precipitate. (See JCMAS P 044 Appendix Fig. 1 to7) Further, the area ratio of seizure, scoring, and/or adhesive wear damage between locker cam and cradle should be 10% or less of the cylindrical surface.
4	Filter			Should be free of abnormal plugging
5	[Change in fluid characteristics] Kinematic viscosity (40°C), %			±5
	TAN increase, mgKOH/g			0.8 max.
	Water content, mg/kg			1,000 max.
	Pentane insolubles, %			0.1 max.
	Metals in fluid, Mass ppm	Fe		Report[2)]
		Cu		Report[2)]
		Pb		Report[2)]
		Zn		Report[2)]
		Si		Report[2)]
		Al		Report[2)]
	Contaminants; (Particle count) (NAS Cleanliness Class)	For 5 – 15 µm		Report[2)]
		15 - 25 µm		Report[2)]
		25 - 50 µm		Report[2)]
		50 - 100 µm		Report[2)]
		>100 µm		Report[2)]

Remarks: [1)] Wear measurement with the profilometer may be omitted if no irregularity such as scoring or seizure is visually identifiable.

[2)] Report the test results.

When more than one test method is specified for a test item, enter a test result with one of the methods specified, and tick the check box corresponding to the method used.

Form-3.3
Exhibit 2: JCMA-R2 JCMAS P 047 (Micro-clutch Test) Reference Test Results Data

Temperature, ℃	Measurements	Precision Criteria
40		-
60		0.147~0.185
80		0.141~0.171
100		0.134~0.158
120		0.127~0.150
140		0.123~0.140

Form-4: Report on Use of Modified Formulations

In the case where the product being submitted is different from the one which has been used to obtain pump test result data in the on-file reporting (i.e. an alteration is made in the product formulation), report the nature of such alteration with this Form, entering a check mark in the following table for each test item and at each of the corresponding rules applied for the formulation alteration. For application of the alteration rules, follow the guidelines provided in Appendix 5.

Item	High-pressure Piston Pump Test (HPV35+35)	High-pressure Piston Pump Test (A2F-10)	Vane Pump Test (35VQ25)
Test Method	JCMAS P 044: 2004	JCMAS P 045: 2004	ASTM D 6973 2003
Minor change in additive formulation			
Change in base oil			
Read-across for viscosity grade			

Form-5: Change Notice

Hydraulic Fluid for Construction Machinery: Notice of Change in On-file Data

To: Messrs. JCMA Lubricants Standards Implementation Panel

In accordance with the provisions in Section 6.11 of the System Implementation Manual, we hereby notify the Panel that we wish to make the following change(s) in the data on-filed for the hydraulic fluid product with the Reception Number indicated below:

Hydraulic Fluid for Construction Machinery for Change(s) of On-file Data:

Reception No.	:	
In-house Product ID/Code	:	
Product Name	:	
Product Class (Tick one)	:	☐HK ☐HKB
Viscosity Grade	:	
Oil Code	:	

Description of Change(s) of On-file Data:

*	Description	Attached Documents
	Change(s) in submitter's contact address	Form-5 Form-6
	Change(s) in conditions other than viscosity grades and within the allowable read-across range specified in Appendix 5	Form-5 Form-6 Form-7 Form-8

* Enter a check mark for the applicable change type.

Notification Date	:	(Year) (Month) (Day)
Submitter Name	:	Corporate Seal
Person in Charge	:	
Position/Title	:	
Signature	:	

For Use by JCMA Lubricants Standards Implementation Panel				
Received by	:	Signature/Seal		
Date of Receipt	:	(Year)	(Month)	(Day)
Receipt No.	:			
Remarks :				

Form-6 Cover Sheet for Reporting Documents (For Change Notice)

Report for Filing Hydraulic Fluid for Construction Machinery (For Change Notice)

To: Messrs. JCMA Lubricants Standards Implementation Panel

Date of Reporting : (Year) (Month) (Day)		
Submitter Name	Corporate Seal	Contact Address: Name:
Person in Charge: Name: Seal Position/Title: Signature:		Position/Title: Postal Address: Tel Fax

Product for On-file submitting	
In-house Product ID or Code	
Commercial Name	
Product Class (Tick one)	☐ HK ☐ HKB
Viscosity Grade	
Oil Code	

Form-7: Test Results Data for Change Notice

Form-7a-1: Test Results Data for JCMAS HK – Low temperature use

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32W	VG46W	VG32W	VG46W
ISO Viscosity Classification		JIS K 2001-1993			ISOVG32	ISOVG46
Flash Point, °C		JIS K 2265-1996			Report[1)]	
Kinematic Viscosity (40°C), mm^2/s [2)]		JIS K 2283-1993			28.8 min. 35.2 max.	41.4 min. 50.6 max
Kinematic Viscosity (100°C), mm^2/s [2)]		JIS K 2283-1993			5.3 min.	6.8 min.
Viscosity Index		JIS K 2283-1993			120 min.	120 min.
Pour Point, °C		JIS K 2269-1987			-40.0 max.	-30.0 max.
Low Temp. Viscosity (-20°C), mPa・s		JPI-5S-26-	—		—	5,000 max.
(-25°C), mPa・s				—	5,000 max.	—
Foaming, ml	(24°C)	JIS K 2518-1991.			50 max./ 0 max.	
	(93.5°C)				50 max./ 0 max.	
	(24°C after 93.5°C)				50 max./ 0 max.	
Shear Stability Viscosity Loss (100°C), %		JPI-5S-29			10 max.	
Oxidation Stability (95°C, 1,000h) TAN Increase, mgKOH/g		JIS K 2514-1996			1.0 max.	
Rust Preventing Characteristics (synthetic sea water, 24h)		JIS K 2510-1987			No rust	
Seal Compatibility Tests						
NBR [4)] (100°C 240h)	Hardness Change [3)] Change in tensile strength, % Change in elongation, % Change in volume, %	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-25 max. -50 max. -50 max. +30 max.	
AU [5)] (120°C 240h)	Hardness Change [3)] Change in tensile strength, % Change in elongation, % Change in volume, %				-30 max. -50 max. -50 max. -5～+5	
Aniline Point , °C		JIS K 2556-1985			90 min.	
Filterability, min.	Run 1	JCMAS P 043			25 max.	
	Run 2				30 max.	
Copper Corrosion (100°C, 3h)		JIS K 2513-1991			1 max.	
Load-carrying Capacity (Shell 4-ball) Weld point , N		JPI-5S-40			1,235 min.	
Anti-wear Property (Shell 4-ball) (294N, 1200rpm, 60min, @75°C) , mm		JPI-5S-32			0.60 max.	
FZG Gear Failure load stage		ASTM D 5182 DIN 51534-2			8 min..	

Form-7a-2: Test Results Data for JCMAS HK – Low temperature use (continued)

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32W	VG46W	VG32W	VG46W
High-pressure Piston Pump Test [6]	□ Lubricity Evaluation [9] (HPV35+35)	JCMAS P 044			Per separate criteria	
	□ Service Life (A2F)	JCMAS P 045			(500h)	
	Vis.Change (40°C) , %				+10 max.	
	TAN Increase, mgKOH/g				2.0 max.	
	Contaminants (0.8μm), mg/100ml				10 max.	
Vane Pump Tests [7]	□ Lubricity Evaluation (35VQ25)	ASTM D 6973			(150h)	
	Ring Wear, mg				75 max.	
	Vane Wear, mg				15 max.	
	□ Lubricity Evaluation (104C)	ASTM D 7043			(100h)	
	Ring and vane wear, mg				50 max.	
Friction Characteristics [8]	□ Micro-clutch Test (μ)	JCMAS P 047			0.08 min.	
	□ SAENo.2 Machine (1000cycles), (μs)				0.07 min.	
Infrared absorption spectrum analysis 0.1mm (KBr) sealed absorption cell			A4 size IR chart to be attached		Report[1]	

Form-7a-3: Test Results Data for JCMAS HK – Low temperature use; JCMAS P 044 Results

	Evaluation items		Test Results	Pass/Fail Criteria (based on highest measurements)
1	Change in flow rate			Decrease in flow rate: 3% max. (at 19.6 MPa)
2	[Parts wear] Cylinder block, Bore diameter, mm			0.050 max.
	Piston, Outer diameter, mm			0.030 max.
	Piston shoe, Thickness, mm			0.050 max.
	Piston shoe, Looseness, mm			0.20 max.
	Cylinder block, Spherical portion, mm			0.015 max.
	Valve plate, Spherical portion, mm			0.015 max.
	Locker cam, Shoe sliding surface, mm			0.015 max.
	Locker cam, Cylindrical surface, mm			0.020 max.
	Cradle, Cylindrical surface, mm			0.010 max.
	Servo piston, mm			0.010 max.[9)]
	Oil seal, Wear width on the main lip, mm			0.80 max.
3	Parts condition, Visual inspection on all pump parts			Should be free of any signs of seizure, scoring, erosion, surface roughness, significant deposit, lacquer and precipitate. (See JCMAS P 044 Appendix Figures 1 to7) Further, the area ratio of seizure, scoring, and/or adhesive wear damage between locker cam and cradle should be 10% or less of the cylindrical surface.
4	Filter			Should be free of abnormal plugging
5	[Change in fluid characteristics] Kinematic viscosity (40°C), %			±5
	TAN increase, mgKOH/g			0.8 max.
	Water content, mg/kg			1,000 max.
	Pentane insolubles, %			0.1 max.
	Metals in fluid, Mass ppm	Fe		Report[1)]
		Cu		Report[1)]
		Pb		Report[1)]
		Zn		Report[1)]
		Si		Report[1)]
		Al		Report[1)]
	Contaminants; (Particle count) (NAS Cleanliness Class)	For 5 – 15 µm		Report[1)]
		15 - 25 µm		Report[1)]
		25 - 50 µm		Report[1)]
		50 - 100 µm		Report[1)]
		>100 µm		Report[1)]

Remarks:

[1)] Report the test results.

[2)] A value expressed in mm^2/s is numerically equal to that in cSt.

[3)] Use Type-A Durometer.

[4)] Use low-acrylonitrile elastomer SRE-NBR/L specified in ISO 13226 for specimen.

[5)] For the specimen polyester urethane, use the AU described in Table 1 below or equivalent.

Table 1 Elastomer Characteristics

	Items	Unit	AU (U801)
Requirements	Hardness rating,	Type-A Durometer	88 - 98
	Tensile strength,	MPa	29.4 min.
	Elongation,	%	300 min.

[6] Evaluation with a high-pressure piston pump shall be conducted by either one of the Model HPV35+35 Pump Test according to JCMAS P 044, or the Model A2F Pump Test in accordance with JCMAS P 045. In the case of JCMAS P045, results of all evaluation items from every interim inspection until 500 hours shall be within the acceptance criteria.

[7] Evaluation with a vane pump shall be conducted by either one of the Model 104C Pump Test in accordance with ASTM D 7043 (or ISO 20763), or the Model 35VQ25 Pump Test in accordance with ASTM D 6973. Either 7.1) or 7.2) procedures below are acceptable for the 35VQ25 Pump Test.

7.1) Continuous 150 hours test run with single test pump cartridge and pass the acceptance criteria.

7.2) Three of 50 hours tests run on the same candidate oil but with three test pump cartridges. Each test has to pass the acceptance criteria.

[8] Evaluation for the friction characteristics shall be conducted by either one of the Micro-clutch Test in accordance with JCMAS P 047, or a test using the SAE No.2 Friction Test Machine (at 800 rpm). In addition, the test fluid is required to exhibit adequate anti-squeak function for the hydraulic cylinder operation regardless of the provisions for frictional characteristics.

[9] Wear measurement with the profilometer may be omitted if no irregularity such as scoring or seizure is visually identifiable.

When more than one test method are specified for a test item, enter a test result with one of the methods specified, and tick the check box corresponding to the method used.

Form-7: Test Results Data

Form-7b-1: Test Results Data for JCMAS HK – Normal temperature use

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32	VG46	VG32	VG46
ISO Viscosity Classification		JIS K 2001-1993			ISOVG32	ISOVG46
Flash Point, °C		JIS K 2265-1996			Report[1)]	
Kinematic Viscosity (40°C), mm^2/s [2)]		JIS K 2283-1993			28.8 min. 35.2 max.	41.4 min. 50.6 max
Kinematic Viscosity (100°C), mm^2/s [2)]		JIS K 2283-1993			5.0 min.	6.1 min.
Viscosity Index		JIS K 2283-1993			90 min.	90 min.
Pour Point, °C		JIS K 2269-1987			-17.5 max.	-15.0 max.
Foaming, ml	(24°C)	JIS K 2518-1991.			50 max./ 0 max.	
	(93.5°C)				50 max./ 0 max.	
	(24°C after 93.5°C)				50 max./ 0 max.	
Oxidation Stability (95°C, 1,000h) TAN Increase, mgKOH/g		JIS K 2514-1996			1.0 max.	
Rust Preventing Characteristics (synthetic sea water, 24h)		JIS K 2510-1987			No rust	
Seal Compatibility Tests						
NBR [4)] 100°C 240h	Hardness Change [3)] Change in tensile strength, % Change in elongation, % Change in volume, %	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-25 max. -50 max. -50 max. +30 max.	
AU [5)] 120°C 240h	Hardness Change [3)] Change in tensile strength, % Change in elongation, % Change in volume, %				-30 max. -50 max. -50 max. -5～+5	
Aniline Point, °C		JIS K 2556-1985			90 min.	
Filterability, min.	Run 1	JCMAS P 043			25 max.	
	Run 2				30 max.	
Copper Corrosion (100°C, 3h)		JIS K 2513-1991			1 max.	
Load-carrying Capacity (Shell 4-ball) Weld Point, N		JPI-5S-40			1,235 min.	
Anti-wear Property (Shell 4-ball) (294N, 1200rpm, 60min, @75°C) , mm		JPI-5S-32			0.60 max.	
FZG Gear Failure load stage		ASTM D 5182 DIN 51534-2			8 min..	

Form-7b-2: Test Results Data for JCMAS HK – Normal temperature use (continued)

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32	VG46	VG32	VG46
	□ Lubricity Evaluation (HPV35+35 [9)]	JCMAS P 044			Per separate criteria	
High-pressure Piston Pump Test [6)]	□ Service Life (A2F)	JCMAS P 045			(500h)	
	Vis.Change (40°C) , %				+10 max.	
	TAN Increase, mgKOH/g				2.0 max.	
	Contaminants (0.8μm), mg/100ml				10 max.	
Vane Pump Tests [7)]	□ Lubricity Evaluation (35VQ25)	ASTM D 6973			(150h)	
	Ring Wear, mg				75 max.	
	Vane Wear, mg				15 max.	
	□ Lubricity Evaluation (104C)	ASTM D 7043			(100h)	
	Ring and vane wear, mg				50 max.	
Friction Characteristics [8)]	□ Micro-clutch Test (μ)	JCMAS P 047			0.08 min.	
	□ SAENo.2 Machine (1000cycles)、(μs)				0.07 min.	
Infrared absorption spectrum analysis 0.1mm (KBr) sealed absorption cell			A4 size IR chart to be attached		Report[1)]	

Form-7b-3: Test Results Data for JCMAS HK – Normal temperature use; JCMAS P 044 Results

	Evaluation items		Test Results	Pass/Fail Criteria (based on highest measurements)
1	Change in flow rate			Decrease in flow rate: 3% max. (at 19.6 MPa)
2	[Parts wear] Cylinder block, Bore diameter, mm			0.050 max.
	Piston, Outer diameter, mm			0.030 max.
	Piston shoe, Thickness, mm			0.050 max.
	Piston shoe, Looseness, mm			0.20 max.
	Cylinder block, Spherical portion, mm			0.015 max.
	Valve plate, Spherical portion, mm			0.015 max.
	Locker cam, Shoe sliding surface, mm			0.015 max.
	Locker cam, Cylindrical surface, mm			0.020 max.
	Cradle, Cylindrical surface, mm			0.010 max.
	Servo piston, mm			0.010 max.[9)]
	Oil seal, Wear width on the main lip, mm			0.80 max.
3	Parts condition, Visual inspection on all pump parts			Should be free of any signs of seizure, scoring, erosion, surface roughness, significant deposit, lacquer and precipitate. (See JCMAS P 044 Appendix Fig. 1 to 7) Further, the area ratio of seizure, scoring, and/or adhesive wear damage between locker cam and cradle should be 10% or less of the cylindrical surface.
4	Filter			Should be free of abnormal plugging
5	[Change in fluid characteristics] Kinematic viscosity (40°C), %			±5
	TAN increase, mgKOH/g			0.8 max.
	Water content, mg/kg			1,000 max.
	Pentane insolubles, %			0.1 max.
	Metals in fluid, Mass ppm	Fe		Report[1)]
		Cu		Report[1)]
		Pb		Report[1)]
		Zn		Report[1)]
		Si		Report[1)]
		Al		Report[1)]
	Contaminants; (Particle count) (NAS Cleanliness Class)	For 5 – 15 µm		Report[1)]
		15 - 25 µm		Report[1)]
		25 - 50 µm		Report[1)]
		50 - 100 µm		Report[1)]
		>100 µm		Report[1)]

Remarks:

[1)] Report the test results.

[2)] A value expressed in mm^2/s is numerically equal to that in cSt.

[3)] Use Type-A Durometer.

[4)] Use low-acrylonitrile elastomer SRE-NBR/L specified in ISO 13226 for specimen.

[5)] For the specimen polyester urethane, use the AU described in Table 1 below or equivalent.

Table 1 Elastomer Characteristics

	Items	Unit	AU (U801)
Requirements	Hardness rating,	Type-A Durometer	88 - 98
	Tensile strength,	MPa	29.4 min.
	Elongation,	%	300 min.

[6] Evaluation with a high-pressure piston pump shall be conducted by either one of the Model HPV35+35 Pump Test according to JCMAS P 044, or the Model A2F Pump Test in accordance with JCMAS P 045. In the case of JCMAS P045, results of all evaluation items from every interim inspection until 500 hours shall be within the acceptance criteria.

[7] Evaluation with a vane pump shall be conducted by either one of the Model 104C Pump Test in accordance with ASTM D 7043 (or ISO 20763), or the Model 35VQ25 Pump Test in accordance with ASTM D 6973. Either 7.1) or 7.2) procedures below are acceptable for the 35VQ25 Pump Test.

7.1) Continuous 150 hours test run with single test pump cartridge and pass the acceptance criteria.

7.2) Three of 50 hours tests run on the same candidate oil but with three test pump cartridges. Each test has to pass the acceptance criteria.

[8] Evaluation for the friction characteristics shall be conducted by either one of the Micro-clutch Test in accordance with JCMAS P 047, or a test using the SAE No.2 Friction Test Machine (at 800 rpm). In addition, the test fluid is required to exhibit adequate anti-squeak function for the hydraulic cylinder operation regardless of the provisions for frictional characteristics.

[9] Wear measurement with the profilometer may be omitted if no irregularity such as scoring or seizure is visually identifiable.

When more than one test method are specified for a test item, enter a test result with one of the methods specified, and tick the check box corresponding to the method used.

Form-7c-1: Test Results Data for JCMAS HKB – Low temperature use

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32L	VG46L	VG32L	VG46L
ISO Viscosity Classification		JIS K 2001-1993			ISO VG32	ISO VG46
Density (15°C), kg/m^3		JIS K 2249-1995			Report[1)]	
Color, ASTM		JIS K 2580-2003			Report[1)]	
Flash Point, °C		JIS K 2265-1996			Report[1)]	
Kinematic Viscosity (40°C), mm^2/s		JIS K 2283-1993			28.8 min. 35.2 max.	41.4 min. 50.6 max
Kinematic Viscosity (100°C), mm^2/s		JIS K 2283-1993			5.3 min.	6.8 min.
Low Temp. Viscosity (-20°C), mPa・s		JPI-5S-26-90	—		—	5,000 max.
(-25°C), mPa・s				—	5,000 max	—
Pour Point, °C		JIS K 2269-1987			-35.0 max.	-30.0 max.
TAN, mgKOH/g		JIS K 2501-2003			Report[1)]	
Water Content, mg/kg		JIS K 2275-1996			1,000 max. (before breaking container seal)	
Copper Corrosion (100°C, 3h)		JIS K 2513-1991			1max.	
Rust Preventing Characteristics (Distilled water)		JIS K 2510-1987			No rust	
Foaming, ml	(24°C)	JIS K 2518-1991.			50 max./0 max.	
	(93.5°C)				50 max./0 max.	
	(24°C after 93.5°C)				50 max./0 max.	
Seal Compatibility Tests						
NBR[3)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-40~+10	
	Change in volume, %				-5~+70	
	Change in elongation, %				-60~+20	
	Change in tensile strength, %				-65~+20	
HNBR[4)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-8~+8	
	Change in volume, %				-5~+15	
	Change in elongation, %				-15~+20	
	Change in tensile strength, %				-15~+20	
AU[5)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			Report[1)]	
	Change in volume, %				Report[1)]	
	Change in elongation, %				Report[1)]	
	Change in tensile strength, %				Report[1)]	
FZG Gear Test Failure Load Stage		□ASTM D 5182:1997 □ DIN 51534-2:1990			8 min.	
Vane Pump Test (104C) (250h)	Ring Wear, mg	ASTM D 7043:2005			120 max.	
	Vane Wear, mg				30 max.	

Form-7c-2: Test Results Data for JCMAS HKB – Low temperature use (continued)

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32L	VG46L	VG32L	VG46L
High-pressure Pump Test (A2F10) 500h	Vis. Change (40°C), %[7)]	JCMAS P 045			+10 max.	
	TAN Increase, mgKOH/g				2.0 max.	
	Contaminants (0.8μm), mg/100ml				+10 max.	
	Cu-content Increase in oil layer, mass ppm				Report[1)]	
Hydrolytic Stability	Copper weight loss, mg/cm^2	ASTM D 2619:1995			Report[1)]	
	Copper Appearance				Report[1)]	
	TAN Increase in oil layer, mgKOH/g				Report[1)]	
Load-carrying Capacity (Shell 4-Ball), Weld Load, N		JPI-5S-40			1,235 min.	
Anti-wear Property (Shell 4-Ball) (294N, 1,200rpm, 60min., @75°C) , mm		JPI-5S-32			0.60 max.	
Friction Characteristics[6)]	□ Micro-clutch Test (μ)	JCMAS P 047			0.05 min.	
	□ SAENo.2 Machine (1000cycles)、(μs)				0.07 min.	
Environmental Criteria	Biodegradability (28 Days)	ISO 14593:99 ISO 9434:99 ASTM D 5864:95 ASTM D 6731:			Must meet the criteria specified in Section 4-1 of the Eco Mark Product Category No.110 "Bio-degradable Lubricating Oil" (Version 2.0)	
	Acute Toxicity (96 hrs, LC_{50} Value)	ISO 7346-2:96			Must meet the criteria specified in Section 4-1 of the Eco Mark Product Category No.110 "Bio-degradable Lubricating Oil" (Version 2.0)	

Remarks:

1) Report the test results.

2) Use Type-A Durometer.

3) For the specimen NBR, use low-acrylonitrile SRE-NBR/L specified in ISO 13226.

4) For the specimen HNBR, use the material described in Table 1 below.

5) For the specimen AU, use the material described in Table 1 below.

6) Evaluation for the friction characteristics shall be conducted by either Micro-clutch Test in accordance with JCMAS P 047, or SAE No.2 Friction Test Machine (at 800 rpm).

7) In the case of JCMAS P045, results of all evaluation items from every interim inspection until 500 hours shall be within the acceptance criteria.

When more than one test method are specified for a test item, enter a test result with one of the methods specified, and tick the check box corresponding to the method used.

Table 1 Elastomer Characteristics

	Items	Unit	HNBR (G361)	AU (U801)
Requirements	Hardness rating	Type-A Durometer	75 ~ 85	88 ~ 98
	Tensile strength	MPa	28.3 min.	29.4 min.
	Elongation	%	260 min.	300 min.

Form-7d-1: Test Results Data for JCMAS HKB – Normal temperature use

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32	VG46	VG32	VG46
ISO Viscosity Classification		JIS K 2001-1993			ISO VG32	ISO VG46
Density (15°C), kg/m^3		JIS K 2249-1995			Report[1)]	
Color, ASTM		JIS K 2580-2003			Report[1)]	
Flash Point, °C		JIS K 2265-1996			Report[1)]	
Kinematic Viscosity (40°C), mm^2/s		JIS K 2283-1993			28.8 min. 35.2 max.	41.4 min. 50.6 max
Kinematic Viscosity (100°C), mm^2/s		JIS K 2283-1993			5.3 min.	6.8 min.
Low Temp. Viscosity (-10°C), mPa・s		JPI-5S-26-90	—		Report[1)]	
Pour Point, °C		JIS K 2269-1987			-17.5 max.	
TAN, mgKOH/g		JIS K 2501-2003			Report[1)]	
Water Content, mg/kg		JIS K 2275-1996			1,000 max. (before breaking container seal)	
Copper Corrosion (100°C, 3h)		JIS K 2513-1991			1max.	
Rust Preventing Characteristics (Distilled water)		JIS K 2510-1987			No rust	
Foaming, ml	(24°C)	JIS K 2518-1991.			50 max./0 max.	
	(93.5°C)				50 max./0 max.	
	(24°C after 93.5°C)				50 max./0 max.	
Seal Compatibility Tests						
NBR[3)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-40~+10	
	Change in volume, %				-5~+70	
	Change in elongation, %				-60~+20	
	Change in tensile strength, %				-65~+20	
HNBR[4)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			-8~+8	
	Change in volume, %				-5~+15	
	Change in elongation, %				-15~+20	
	Change in tensile strength, %				-15~+20	
AU[5)] (100°C 240h)	Hardness Change[2)]	JIS K 6251-2004 JIS K 6253-1997 JIS K 6258-2003			Report[1)]	
	Change in volume, %				Report[1)]	
	Change in elongation, %				Report[1)]	
	Change in tensile strength, %				Report[1)]	
FZG Gear Test Failure Load Stage		□ ASTM D 5182:1997 □ DIN 51534-2:1990			8 min.	
Vane Pump Test (104C) (250h)	Ring Wear, mg	ASTM D 7043:2005			120 max.	
	Vane Wear, mg				30 max.	

Form-7d-2: Test Results Data for JCMAS HKB – Normal temperature use (continued)

Test Item		Test Method	Test Results		Specifications	
Hydraulic Fluid Classification			VG32	VG46	VG32	VG46
High-pressure Pump Test (A2F10) 500h	Vis. Change (40°C), %[7]	JCMAS P 045			+10 max.	
	TAN Increase, mgKOH/g				2.0 max.	
	Contaminants (0.8μm), mg/100ml				10 max.	
	Cu-content Increase in oil layer, mass ppm				Report[1]	
Hydrolytic Stability	Copper weight loss, mg/cm^2	ASTM D 2619:1995			Report[1]	
	Copper Appearance				Report[1]	
	TAN Increase in oil Layer, mgKOH/g				Report[1]	
Load-carrying Capacity (Shell 4-Ball), Weld Load, N		JPI-5S-40			1,235 min.	
Anti-wear Property (Shell 4-Ball) (294N, 1,200rpm, 60min., @75°C) , mm		JPI-5S-32			0.60 max.	
Friction Characteristics[6]	□ Micro-clutch Test (μ)	JCMAS P 047			0.05 min.	
	□ SAENo.2 Machine (1000cycles)、(μs)				0.07 min.	
Environmental Criteria	Biodegradability (28 Days)	ISO 14593:99 ISO 9434:99 ASTM D 5864:95 ASTM D 6731:			Must meet the criteria specified in Section 4-1 of the Eco Mark Product Category No.110 "Bio-degradable Lubricating Oil" (Version 2.0)	
	Acute Toxicity (96 hrs, LC_{50} Value)	ISO 7346-2:96			Must meet the criteria specified in Section 4-1 of the Eco Mark Product Category No.110 "Bio-degradable Lubricating Oil" (Version 2.0)	

Remarks:

[1] Report the test results.

[2] Use Type-A Durometer.

[3] For the specimen NBR, use low-acrylonitrile SRE-NBR/L specified in ISO 13226.

[4] For the specimen HNBR, use the material described in Table 1 below.

[5] For the specimen AU, use the material described in Table 1 below.

[6] Evaluation for the friction characteristics shall be conducted by either Micro-clutch Test in accordance with JCMAS P 047, or SAE No.2 Friction Test Machine (at 800 rpm).

[7] In the case of JCMAS P045, results of all evaluation items from every interim inspection until 500 hours shall be within the acceptance criteria.

When more than one test method are specified for a test item, enter a test result with one of the methods specified, and tick the check box corresponding to the method used.

Table 1 Elastomer Characteristics

	Items	Unit	HNBR (G361)	AU (U801)
Requirements	Hardness rating	Type-A Durometer	75 ~ 85	88 ~ 98
	Tensile strength	MPa	28.3 min.	29.4 min.
	Elongation	%	260 min.	300 min.

Form-8: Report on Use of Modified Formulations

In the case where the product being submitted is different from the one which has been used to obtain pump test result data in the on-file reporting (i.e. an alteration was made in the product formulation), report the nature of such alteration with this Form, by entering a check mark in the following table for each test item and at each of the corresponding rules applied for the formulation alteration. For application of the alteration rules, follow the guidelines provided in Appendix 5.

Item	High-pressure Piston Pump Test (HPV35+35)	High-pressure Piston Pump Test (A2F-10)	Vane Pump Test (35VQ25)
Test Method	JCMAS P 044: 2004	JCMAS P 045: 2004	ASTM D 6973: 2003
Minor change in additive formulation			
Change in base oil			
Read-across for viscosity grade			

Appendix 4

On-file Notice for Hydraulic Fluid for Construction Machinery (Original)

Date:

To:

The JCMA Lubricants Standards Implementation Panel is pleased to advise you that the hydraulic fluid for construction machinery with the Reception No. indicated below has been filed in the on-file system for the Oil Code and the Product Class as indicated below:

Reception No.	:	
In-house Product ID/Code	:	
Product Name	:	
Product Class (Tick one)	:	□HK □HKB
Viscosity Grade	:	
Oil Code	:	

Agreement Concerning Hydraulic Fluid On-Filing (Original)

To: Messrs. JCMA Lubricants Standards Implementation Panel

We as the Submitter hereby agree to the following terms and conditions in marketing the above hydraulic fluid for construction machinery listed in the on-file system:

1. The submitter acknowledges that the quality and performance of hydraulic fluid product as well as the labeling thereof for the product and other purposes, shall be made under the responsibility of the submitter, and the relevant information to that effect as well as the fact that the JCMA Lubricants Standards Implementation Panel (the "Panel") will not make any guaranty about the quality or performance of the product, shall be publicized to end users and general consumers of such hydraulic fluid product through the sales channels of the submitter.
2. In the event of any problem in the market arising from the use of the said hydraulic fluid product, the submitter shall solve it on its own responsibility, recognizing that no responsibility whatsoever shall be assumed by the Panel, and the submitter shall give utmost consideration so that the Panel will not undergo any inconvenience or damage whatever.
3. The submitter guarantees that the quality/performance (including the data) and the product labeling example described in the report document represent the said hydraulic fluid product to be actually placed in the market.
4. In accordance with the purpose of 1. above, the submitter must not use in sales (including wholesale and retail sale) or advertisements/commercial messages an expression which might lead to a misunderstanding that the quality/performance of the said hydraulic fluid product has been guaranteed or authenticated by the Panel.
5. In the event that the Panel requests the submitter to report the JCMA pump test results data for the said hydraulic fluid product, the submitter shall promptly comply with such a request. The submitter will follow the Panel's instructions with respect to the format of the data, form and media of such report.
6. The submitter accepts that the Panel may publish through Internet webpage and other media such product name, submitter, viscosity grades, and product class as described in this Notice with respect to the said hydraulic fluid product on-filed. Further, the submitter has no objection that, when market monitoring is conducted by the Panel, the results of the market monitoring may be published by the Panel in a manner where specific names of submitter or products are unidentifiable.
7. The submitter shall pay the on-file maintenance fees as specified in the System Implementation Manual by due date each year. If the submitter fails to make payment of the on-file maintenance fees in accordance with such Manual, the submitter will not raise any objection even if the on-file submitting is deleted.
8. In the event that the marketing of the any hydraulic fluid product is discontinued, the submitter shall promptly inform the Panel of the discontinued product. In such a case, the Panel will cancel the on-file status for such product.
9. For provisions other than mentioned in the above, the submitter undertakes to accept all conditions and/or requirements contained in the System Implementation Manual with clear understanding thereof; The submitter further undertakes to abide by the newest Implementation Manual in the case of any amendment thereof.

Report Date	:	(Year) (Month) (Day)
Submitter Name	:	Corporate Seal
Person in Charge	:	
Position/Title	:	
Signature/Seal	:	

Appendix 4

On-file Notice for Hydraulic Fluid for Construction Machinery (Duplicate)

Date:

To:

The JCMA Lubricants Standards Implementation Panel is pleased to advise you that the hydraulic fluid for construction machinery with the Reception No. indicated below has been filed in the on-file system for the Oil Code and the Product Class as indicated below:

Reception No.	:	
In-house Product ID/Code	:	
Product Name	:	
Product Class (Tick one)	:	□HK □HKB
Viscosity Grade	:	
Oil Code	:	

Agreement Concerning Hydraulic Fluid On-Filing (Duplicate)

To: Messrs. JCMA Lubricants Standards Implementation Panel

We as the submitter hereby agree to the following terms and conditions in marketing the above hydraulic fluid for construction machinery listed in the on-file system:

1. The submitter acknowledges that the quality and performance of hydraulic fluid product as well as the labeling thereof for the product and other purposes, shall be made under the responsibility of the submitter, and the relevant information to that effect as well as the fact that the JCMA Lubricants Standards Implementation Panel (the "Panel") will not make any guaranty about the quality or performance of the product, shall be publicized to end users and general consumers of such hydraulic fluid product through the sales channels of the submitter.
2. In the event of any problem in the market arising from the use of the said hydraulic fluid product, the submitter shall solve it on its own responsibility, recognizing that no responsibility whatsoever shall be assumed by the Panel, and the submitter shall give utmost consideration so that the Panel will not undergo any inconvenience or damage whatever.
3. The submitter guarantees that the quality/performance (including the data) and the product labeling example described in the report document represent the said hydraulic fluid product to be actually placed in the market.
4. In accordance with the purpose of 1. above, the submitter must not use in sales (including wholesale and retail sale) or advertisements/commercial messages an expression which might lead to a misunderstanding that the quality/performance of the said hydraulic fluid product has been guaranteed or authenticated by the Panel.
5. In the event that the Panel requests the submitter to report the JCMA pump test results data for the said hydraulic fluid product, the submitter shall promptly comply with such a request. The submitter will follow the Panel's instructions with respect to the format of the data, form and media of such report.
6. The submitter accepts that the Panel may publish through Internet webpage and other media such product name, submitter, viscosity grades, and product class as described in this Notice with respect to the said hydraulic fluid product on-filed. Further, the submitter has no objection that, when market monitoring is conducted by the Panel, the results of the market monitoring may be published by the Panel in a manner where specific names of submitter or products are unidentifiable.
7. The submitter shall pay the on-file maintenance fees as specified in the System Implementation Manual by due date each year. If the submitter fails to make payment of the on-file maintenance fees in accordance with such Manual, the submitter will not raise any objection even if the on-file submitting is deleted.
8. In the event that the marketing of the any hydraulic fluid product is discontinued, the submitter shall promptly inform the Panel of the discontinued product. In such a case, the Panel will cancel the on-file status for such product.
9. For provisions other than mentioned in the above, the submitter undertakes to accept all conditions and/or requirements contained in the System Implementation Manual with clear understanding thereof; The submitter further undertakes to abide by the newest Implementation Manual in the case of any amendment thereof.

Report Date	:	(Year) (Month) (Day)
submitter Name	:	Corporate Seal
Person in Charge	:	
Position/Title	:	
Signature/Seal	:	

Appendix 5

Formulation Read-Across Guidelines for Hydraulic Fluids for Construction Machinery

A change in base oils or various types of additives that make up a hydraulic fluid could give significant effects on the performance level of the hydraulic fluid. For this reason, if a change has been made to any of the viscosity grade, components selection or additives treat rate for a hydraulic fluid product filed in the on-file system, the submitter is required in principle to redo all the tests specified in the System Implementation Manual for the product concerned, as the performance level of the product is deemed to have been altered.

However, with respect to the high-pressure pump tests (i.e. JCMAS P 044:2004, JCMAS P 045:2004 and ASTM D 6973), if a change in a product formulation remains within the scope and range provided in the following sections, the resulting formulation is deemed to be in the equivalent performance level. In this case, the product concerned is exempted from the JCMA pump test requirements mentioned above (such a concept being hereinafter referred to as “read-across” or “interchangeability”).

Tables A to D give the read-across criteria and guidelines for respective pump tests.

Table A: Allowable Read-across Ranges and Application

Item	Changes during product development		On-file reporting and submission (Base formulation)	Changes after on-filing	
	High-pressure pump tests(1)	Other tests		High-pressure pump tests(1)	Other tests
1. Change in base oils	Read-across is allowed within the range given in Table B	Required at each change		Read-across allowed within the range given in Table B	Required at each change
2. Changes in main performance additives	Read-across is allowed within the range given in Table C	Required at each change		Read-across allowed for original submitter only and within the range given in Table C	Required at each change
3. Changes in pour point depressants or foam inhibitors	Read-across is allowed	Required only for pour point and foaming tests		Read-across allowed	Required only for pour point and foaming tests
4. Changes in viscosity grade	Read-across is allowed within the range given in Table D	Required at each change		Read-across allowed for original submitter only and within the range given in Table D	Required at each change

(Note 1) Pump tests applicable for the formulation read-across:

- Model HPV35+35 High-pressure Pump Test（JCMAS P 044:2004）
- Model A2F High-pressure Pump Test（JCMAS P 045:2004）
- Model 35VQ25Vane Pump Test（ASTM D 6972:2003）

(Note 2) For a formulation change after the on-file submitting, more than one change concerning the item 1, 2, and 4 above are not allowed for a product.

[Definition of terminology]

(1) Base oil: Main component base material of a hydraulic fluid, including mineral oils, synthetic lubricants, or mixtures thereof but not including the following components (2)、(3) and (4).

(2) Main performance additives: Substance being blended with base oil for enhancing hydraulic fluid performance, e.g. anti-wear agents, anti-oxidants, friction modifiers, etc.

(3) Viscosity index (VI) improvers: Substance being blended with base oil for improving viscosity characteristics of a hydraulic fluid.

(4) Pour point depressant, foam inhibitor: Substance added to base oil for improving low-temperature fluidity and foaming characteristic of a hydraulic fluid.

Table B: Guideline for Base Oil Interchange in Pump Tests

Base oil category in original formulation	Base oil type after substitution		
	Group I	Group II	Group III
Group I	△	○	○
Group II	×	○	○
Group III	×	×	○

(Note 3) Symbols in the table denote the following read-across availability:

○: Read-across is allowed.

△: Read-across is allowed only if oxidation stability test result is equivalent or better.

×: Read-across is not allowed.

(Note 4) Pump tests applicable for the formulation read-across:

- Model HPV35+35 High-pressure Pump Test（JCMAS P 044:2004）
- Model A2F High-pressure Pump Test（JCMAS P 045:2004）
- Model 35VQ25 Vane Pump Test（ASTM D 6972:2003）

(Note 5) Definition of base oil category Groups I ~ III is according to the relevant API documents.

(Note 6) Base oil read-across is not permitted for other base oil categories, i.e. Groups IV and V.

Table C: Guideline for Additive Formulation Read-across in Pump Tests

Type of Formulation Changes	Allowable Read-across Range
Treat rate changes for a performance additive package	Allowed within a range of 0% to +20% of original treat rate.
Change in VI Improvers	Allowed within a range of -15% to +15% of original treat rate for viscometrics adjustment within the same viscosity grade, or treat rate change needed in a viscosity grade change; read-across for changes in polymer type or molecular weight is not allowed.
Changes in pour point depressants, defoamers	Allowable for any changes (pour point and foaming only to be tested to confirm results.)
Changes in friction modifiers	Allowed within a range of -30% to +30% of original treat rate, but not for different chemistry.
Changes in treat rate or chemistry of other additive components	Read-across is not allowed for any change.

(Note 7) Pump tests applicable for the formulation read-across:

- Model HPV35+35 High-pressure Pump Test（JCMAS P 044:2004）
- Model A2F High-pressure Pump Test（JCMAS P 045:2004）
- Model 35VQ25Vane Pump Test（ASTM D 6972:2003）

Table D: Guideline for Viscosity Grade Read-across in Pump Tests

Original Viscosity Grade	New Viscosity Grade			
	VG32	VG46	VG32W	VG46W
VG32		○	×	○
VG46	×		×	×
VG32W	○	○		○
VG46W	×	○	×	

(Note 8) Symbols in the table denote the following read-across availability:

○: Read-across is allowed.

×: Read-across is not allowed.

(Note 9) Pump tests applicable for the formulation read-across:

- Model HPV35+35 High-pressure Pump Test（JCMAS P 044:2004）
- Model A2F High-pressure Pump Test（JCMAS P 045:2004）
- Model 35VQ25Vane Pump Test（ASTM D 6972:2003）

Appendix 6

Examples of Oil Code Setting and Reporting/Notification Requirements on Changes in On-file Data or Product Formulation

Details of oil code assignments and reporting or notification requirements on changes in on-file data or formulations are described in Sections 6.6 and 6.11 of the System Implementation Manual.

For reference purposes, specific examples are shown in the following tables, with Variation Case 1 being the base on-file product newly submitted.

Variation case	Description	Actions required	Product		Submitter (Marketer, etc.)			Viscosity		Formulation										Oil code examples	Requirement for JCMA Pump test
			Product name	Marketing region	Company name	Marketer code	Country	Viscosity grade	Viscosity grade read-across (VGRA) (1)	Base oil group	Base oil interchange(BOI) (2)	Performance additive package	Minor change in package treat rate (3)	VII Improver (VII) name	Change in VII formulation (3)	PPD, foam inhibitor names	Change in PPD/FI formulation (3)	Friction modifier (FM) name	Change in FM formulation (3)		
1	Base on-file product	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	-	H081ABC001	Yes
2	Product name change	Change notice	BBB	U	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	-	H081ABC002	No
3	Change in submitter (marketer) name or code	Change notice	AAA	Japan	B	XYZ	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	-	H081XYZ001	No
4	Change in submitter (marketer) contact address	Notify	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	-	H081ABC001	No
5	Change in marketing region	(None)	AAA	V	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	-	H081ABC001	No
6	Change to Case 1 in viscosity within VGRA	Change notice	AAA	Japan	A	ABC	Japan	46	Allowed	II	-	ad	-	pm	Allowed	pp	-	fm	-	H081ABC010	No
7	Change to Case 1 in viscosity outside VGRA	New On-filing	AAA	Japan	A	ABC	Japan	32W	Denied	II	-	ad	-	pm	Allowed	pp	-	fm	-	H081ABC003	Yes

[Acronyms] VGRA: Viscosity grade read-across, BOI: Base oil interchange, VII: Viscosity index improver, PPD: Pour point depressant, FI: Foam inhibitor, FM: Friction modifier

Notes: (1), (2), and (3): See Tables-D, -B, and -C respectively of Appendix 5.

Examples of Oil Code Setting and Reporting or Notification Requirements on Changes in On-file Data or Formulations (cont-2)

Variation case	Description	Actions required	Product		Submitter (Marketer, etc.)			Viscosity		Formulation										Oil code examples	Requirement for JCMA Pump test
			Product name	Marketing region	Company name	Marketer code	Country	Viscosity grade	Viscosity grade read-across (VGRA) (1)	Base oil group	Base oil interchange(BOI) (2)	Performance additive package	Minor change in package treat rate (3)	VII Improver (VII) name	Change in VII formulation (3)	PPD, foam inhibitor names	Change in PPD/FI formulation (3)	Friction modifier (FM) name	Change in FM formulation (3)		
1	Base on-file product	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	-	H081ABC001	Yes
8	Base oil change to Case 1 within BOI criteria	Notify	AAA	Japan	A	ABC	Japan	46W	-	III	Allowed	ad	-	pm	-	pp	-	fm	-	H081ABC001	No
9	Base oil change to Case 1 outside BOI criteria	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	I	Denied	ad	-	pm	-	pp	-	fm	-	H081ABC101	Yes
10	Additive package treat rate change to Case 1, within 0%~+20% range	Notify	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	Allowed	pm	-	pp	-	fm	-	H081ABC001	No
11	Additive package treat rate change to Case 1, outside 0%~+20% range	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	Denied	pm	-	pp	-	fm	-	H081ABC201	Yes
12	VII treat rate change to Case 1, within -15%~+15% range	Notify	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	Allowed	pp	-	fm	-	H081ABC001	No
13	VII treat rate change to Case 1, outside -15%~+15% range	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	Denied	pp	-	fm	-	H081ABC301	Yes

[Acronyms] VGRA: Viscosity grade read-across, BOI: Base oil interchange, VII: Viscosity index improver, PPD: Pour point depressant, FI: Foam inhibitor, FM: Friction modifier

Notes: (1), (2), and (3): See Tables D, B, and C respectively of Appendix 5.

Examples of Oil Code Setting and Reporting or Notification Requirements on Changes in On-file Data or Formulations (cont-3)

Variation case	Description	Actions required	Product		Submitter (Marketer, etc.)			Viscosity		Formulation										Oil code examples	Requirement for JCMA Pump test
			Product name	Marketing region	Company name	Marketer code	Country	Viscosity grade	Viscosity grade read-across (VGRA) (1)	Base oil group	Base oil interchange(BOI) (2)	Performance additive package	Minor change in package treat rate (3)	VII Improver (VII) name	Change in VII formulation (3)	PPD, foam inhibitor names	Change in PPD/FI formulation (3)	Friction modifier (FM) name	Change in FM formulation (3)		
1	Base on-file product	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	-	H081ABC001	Yes
14	VII molecular weight change to Case 1	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	Pm1	Denied	pp	-	fm	-	H081ABC401	Yes
15	VII polymer type change to Case 1	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	ocp	Denied	pp	-	fm	-	H081ABC501	Yes
16	PPD/FI change to Case 1	Notify	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	FI	Allowed	fm	-	H081ABC001	No
17	FM treat rate change to Case 1, within -30%~+30% range	Notify	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	Allowed	H081ABC001	No
18	FM treat rate change to Case 1, outside of -30%~+30% range	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	Denied	H081ABC601	Yes
19	FM type change to Case 1	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	ep	Denied	H081ABC701	Yes
20	Additive component treat rate change to Case 1	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	-	H081ABC801	Yes
21	Additive component type change to Case 1	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	-	H081ABC901	Yes

[Acronyms] VGRA: Viscosity grade read-across, BOI: Base oil interchange, VII: Viscosity index improver, PPD: Pour point depressant, FI: Foam inhibitor, FM: Friction modifier

Notes: (1), (2), and (3): See Tables D, B, and C respectively of Appendix 5.

Examples of Oil Code Setting and Reporting or Notification Requirements on Changes in On-file Data or Formulations (cont-4)

Variation case	Description	Actions required	Product		Submitter (Marketer, etc.)			Viscosity		Formulation										Oil code examples	Requirement for JCMA Pump test
			Product name	Marketing region	Company name	Marketer code	Country	Viscosity grade	Viscosity grade read-across (VGRA) (1)	Base oil group	Base oil interchange(BOI) (2)	Performance additive package	Minor change in package treat rate (3)	VII Improver (VII) name	Change in VII formulation (3)	PPD, foam inhibitor names	Change in PPD/FI formulation (3)	Friction modifier (FM) name	Change in FM formulation (3)		
1	Base on-file product	New On-filing	AAA	Japan	A	ABC	Japan	46W	-	II	-	ad	-	pm	-	pp	-	fm	-	H081ABC001	Yes
22	Base oil change to Case 1 within BOI criteria, filed by another submitter based on original on-filing data	New On-filing	CCC	Singapore	C	DEF	Singapore	46W	-	II	Allowed	ad	-	pm	-	pp	-	fm	-	H065DEF001	No
23	Base oil change to Case 1 outside BOI criteria, filed by another submitter based on original on-filing data	New On-filing	CCC	Singapore	C	DEF	Singapore	46W	-	I	Denied	ad	-	pm	-	pp	-	fm	-	H065DEF002	Yes
24	Viscosity grade change to Case 1 within VGRA, filed by another submitter based on original on-filing data	New On-filing	CCC	Singapore	C	DEF	Singapore	46	Allowed	II	Allowed	ad	-	pm	-	pp	-	fm	-	H065DEF010	Yes
25	Viscosity grade change to Case 1 outside VGRA, filed by another submitter based on original on-filing data	New On-filing	CCC	Singapore	C	DEF	Singapore	32W	Denied	II	Allowed	ad	-	pm	-	pp	-	fm	-	H065DEF101	Yes
26	PPD type change only to Case 1, filed by another submitter based on original on-filing data	New On-filing	CCC	Singapore	C	DEF	Singapore	46W	-	II	-	ad	-	pm	-	FI	-	fm	-	H065DEF001	No
27	Performance additive package change meeting guidelines to Case 1, filed by another submitter based on original on-filing data	New On-filing	CCC	Singapore	C	DEF	Singapore	46W	-	II	-	ad	Allowed	pm	-	pp	-	fm	-	H065DEF001	No

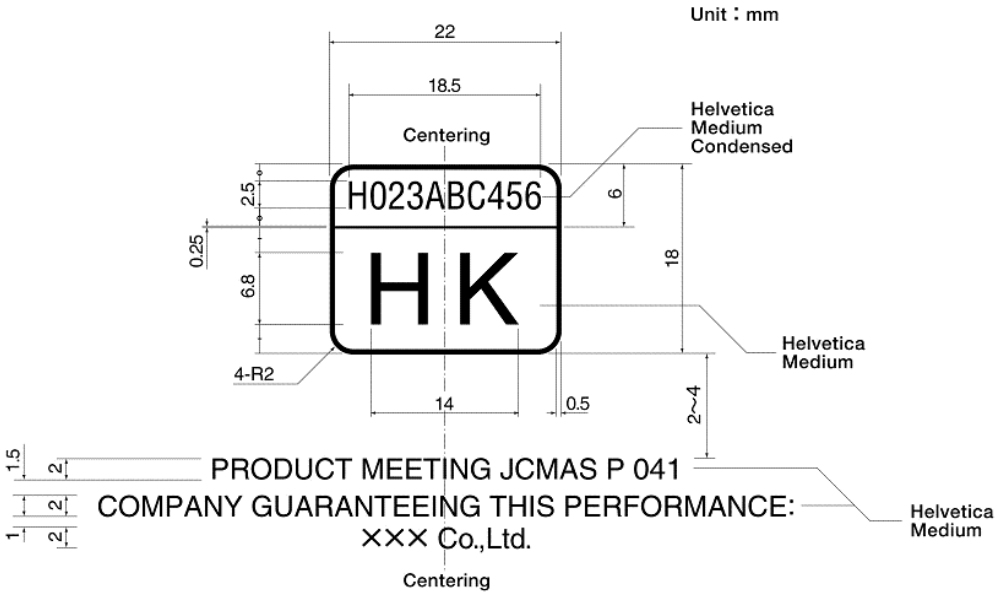
[Acronyms] VGRA: Viscosity grade read-across, BOI: Base oil interchange, VII: Viscosity index improver, PPD: Pour point depressant, FI: Foam inhibitor, FM: Friction modifier

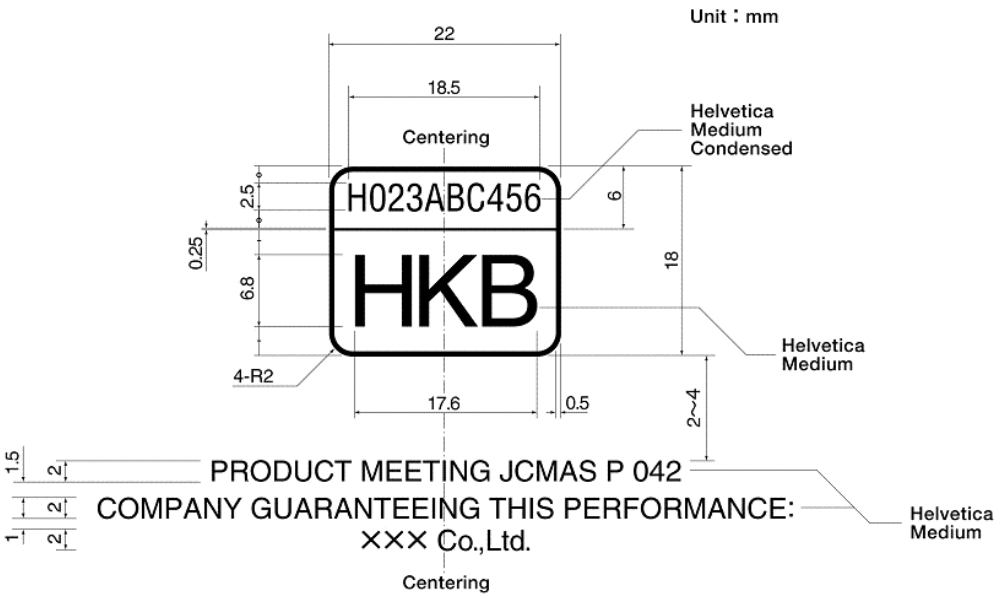
Notes: (1), (2), and (3): See Tables D, B, and C respectively of Appendix 5.

Appendix 7
Oil Code and Product Class Marking Display

When displaying the Oil Code and Product Class marking on the container of an on-file product, the marker is required to follow general rules as illustrated in the examples below:

1. Examples of Marking Display
1.1 Dimensions and lettering fonts





1.2 Notes on the examples:

(1) In the above illustration, the part showing “H023ABC456” is for displaying the Oil Code. For the lettering fonts for this part, use Helvetica Medium Condensed or Arial Narrow. The characters must be designed so that their sizes can fit in the specified dimensions for the frame.

(2) For the characters indicating the Product Class, i.e. “HK” or “HKB” in the above examples, use Helvetica Medium or Arial fonts. The characters must be designed so that their size can fit in the specified dimensions for the frame.

(3) For the alphanumeric display of the performance level, i.e. “PRODUCT MEETING JCMAS P 041” appearing under the Oil Code and Product Class marking in the above examples, use Helvetica Medium or Arial fonts, with a character size corresponding to the specified dimensions, and arranged in a single line. Likewise, for the display of the quality assurance statement, i.e. “HK PERFORMANCE GUARANTED BY: (Company name)” in the above examples, use Helvetica Medium or Arial fonts, with a character size corresponding to the specified dimensions, and arranged in two or three lines.

(4) The color of the characters and frame lines must be in sharp contrast with the background color.

2. Display method

(1) The dimensions shown in the above marking examples are minimum required sizes. Enlarged designs may be used according to the size of the product container as long as like figures are maintained.

(2) The marking may be displayed at any conspicuous location on the container.

3. Examples of Marking

Figure dimensions not enlarged

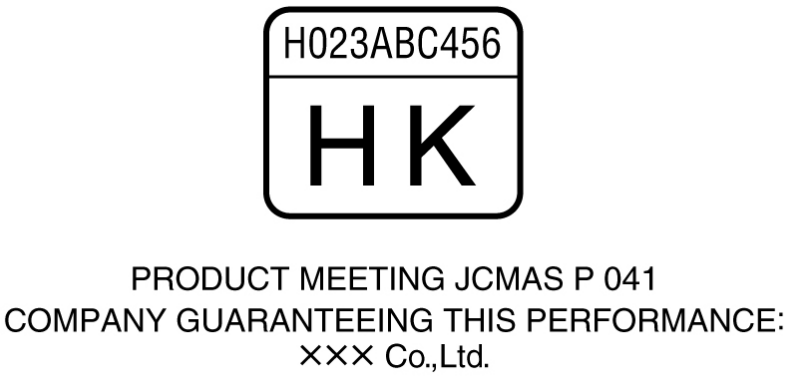


Figure dimension enlarged 1.5 times

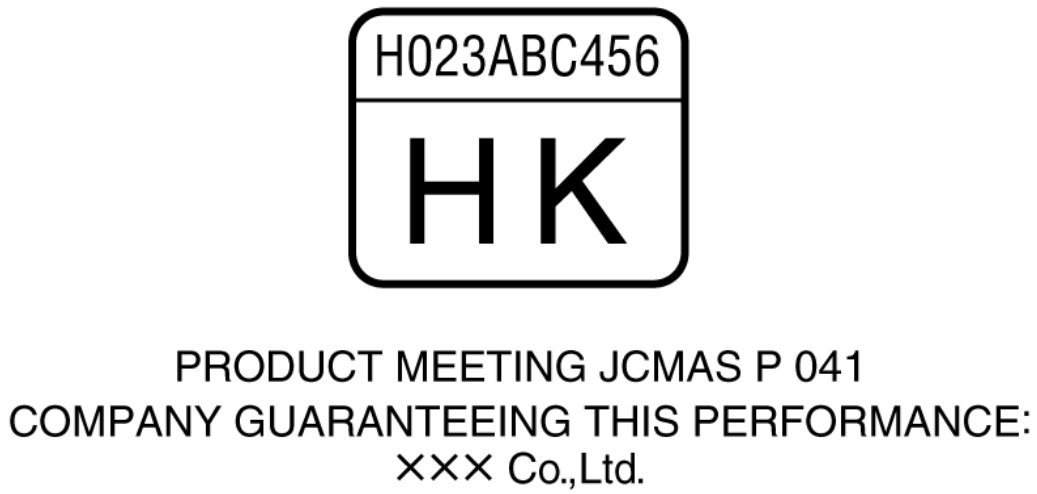


Figure dimension enlarged 2 times

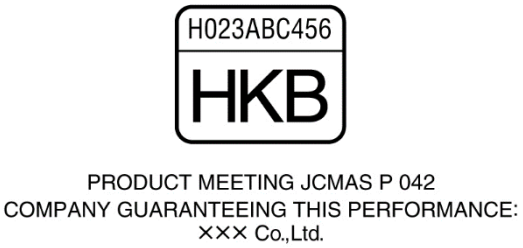


Figure dimensions not enlarged

Figure dimension enlarged 1.5 times

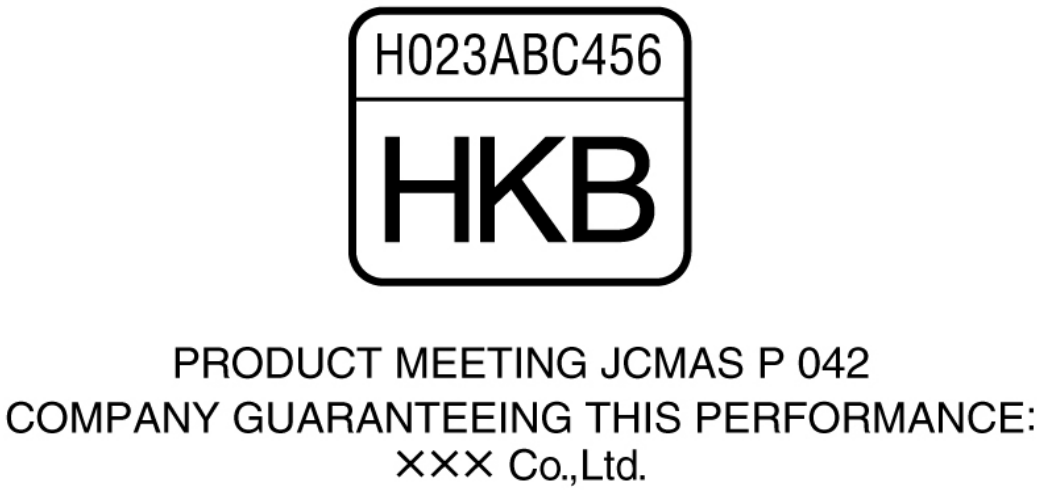


Figure dimension enlarged 2 times