JCMAS

Hydraulic Fluids for Construction Machinery -- Test Method for Indicating Oxidation Stability in High Pressure Piston Pump

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Forward

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Japan Construction Mechanization
Association Standard
JCMAS
P 045 : 2004

Hydraulic Fluids for Construction Machinery -- Test Method for Indicating Oxidation Stability in High Pressure Piston Pump

1 Scope

This standard specifies a test method for indicating oxidation stability of hydraulic fluids for construction machinery. It also specifies a method for indicating the degree of hydraulic fluid deterioration based on this test method.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies

JIS B 9931, *Fluid contamination —Determination of contaminants by the gravimetric methods*

NOTE Relevant International Standard: **ISO 4405** (Modified)

JIS K 0116, *General rules for atomic emission spectrometry*

JIS K 2251, *Crude Petroleum and Petroleum Products -- Sampling*

NOTE Relevant International Standard: **ISO 3170** (Modified)

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

NOTE Relevant International Standards: **ISO 2909**, **ISO 3104** (Modified)

JIS K 2501, *Petroleum products and lubricants -- Determination of neutralization number*

NOTE Relevant International Standards: **ISO 3771**, **ISO 6618, ISO 6619**, **ISO 7537** (Modified)

JIS K 2518, *Petroleum products - Lubricating oils - Determination of foaming characteristics*

NOTE Relevant International Standards: **ISO 6247** (Modified)

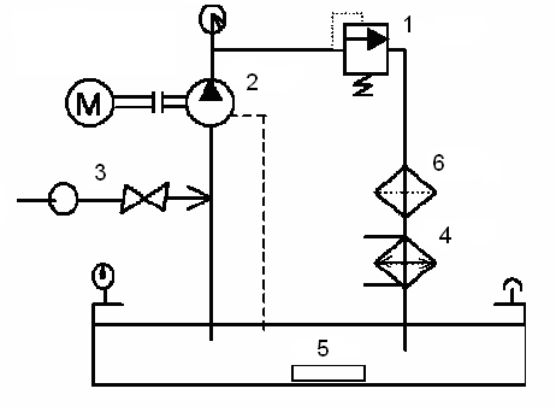
JIS K 2580, *Petroleum product -- Determination of colour*

NOTE Relevant International Standards: **ISO 2049** (Modified)

3 Test method

3.1 Outline of the test apparatus:

Figure 1 as folows gives a schematic diagram of the hydraulic circuit for the test equipment.



Key

1	Relief valve
2	Piston pump
3	Air regulator
4	Oil cooler
5	Copper catalyst
6	Oil filter

Figure 1 Hydraulic circuit for the test equipment

3.2 Test conditions

Table 1 as follows gives particulars of the test equipment and test conditions:

Table 1 Test equipment set-up and test conditions:

Items	Units	Description
Air-supply temperature	℃	20
Suction pipe nominal diameter	mm	12.7 (internal)
Location (L) of air-supply confluence	mm	700 (to pump inlet)
Air-supply pipe diameter	mm	4
Air-supply humidity	%	40-80
Air-supply rate	L/hr	1.0
Copper catalyst form	-	ϕ 1.6 mm×60 m (Remove oxide layer before testing)
Copper catalyst material	-	JIS C 3102
High-pressure pipe diameter	mm	12.7 (internal)
Pump model	-	Bent-axis type axial piston pump[1)]
Pump speed	min^{-1}	1,500
Pump displacement	cm^3/rev	10.3
Oil cooler material	-	SUS304
Oil tank material	-	SUS304
Oil temperature in oil tank	℃	80±5
Initial fluid quantity in oil tank	L	13
Relief valve model	-	Direct-acting type[2)]
Relief pressure setting	MPa	35

NOTE: [1)] Reference model: A2F10

[2)] Reference model: DBDH10 KAO/400

3.3 Flushing

Prior to the test run, flushing procedures shall be performed as described as follows:

- Primary flushing: Three times with base stock using 13 L each
- Secondary flushing: Once with 13 L of the test fluid

3.4 Sampling

Sampling of the test fluid for interim inspections shall be performed in accordance with the timing and quantities as specified in Table 2:

Table 2 Timing and quantities of sampling

Timing of sampling, hrs.	Units	Quantity
1	mL	300
100	mL	300
200	mL	300
300	mL	300
400	mL	300
500	mL	300

3.5 Fluid property examination:

The samples collected as above shall be tested for determination of physical and chemical properties given in Table 3 below:

Table 3 Fluid property test items

Test items		Units	Test methods
Kinematic viscosity (40°C)		mm^2/s	JIS K 2283
Kinematic viscosity (100°C)		mm^2/s	JIS K 2283
Viscosity index		-	JIS K 2283
Acid number (Indicator method)		mgKOH/g	JIS K 2501
Base number		mgKOH/g	JIS K 2501
Foaming (24°C)		mL	JIS K 2518
Color, ASTM		-	JIS K 2580
Contaminants, 0.8μm		mg/100 mL	JIS B 9931
Metal content	Copper (Cu)	mass ppm	JIS K 0116
	Zinc (Zn)	mass ppm	JIS K 0116

4 Hydraulic fluid deterioration criteria

Criteria for determining the degree of hydraulic fluid deterioration shall be established based on the fluid property tests listed in Table 3, while taking operating conditions for each individual fluid into consideration.

For reference purposes, an example of condemnation criteria for a typical hydraulic fluid is given in the following:

NOTE A generic type, mineral oil-based hydraulic fluid shall be considered to have reached its limit of service life when any one of the limits specified in Table 4 has been exceeded. For a hydraulic fluid to function satisfactorily in construction machinery under a maximum fluid temperature of 100 °C, a maximum operating pressure of 34.3 MPa, and for a fluid change interval of 2 000 hours, it is desired that the fluid clear the criteria given in Table 4 at the inspection conducted after 500 hours in accordance with this Standard.

Table 4　Deterioration criteria for typical hydraulic fluid

Items	Units	Criteria
Viscosity change (40°C)	%	+ 10 max.
Acid number increase	mgKOH/g	2.0 max.
Contaminants (0.8μm)	mg/ 100mL	10 max.

Note that the above criteria are established for a targeted fluid change interval of 2 000 hours, and other criteria based on a longer test duration aiming at an extended fluid change interval are conceivable. It should be kept in mind, however, that the reservoir capacity of construction machinery varies widely with machinery types, whereby the smaller the reservoir size becomes, the shorter the fluid change interval tends to become. Therefore, the final judgment on the service life of a hydraulic fluid should desirably be made in consultation between the manufacturer of the construction machinery and the supplier of the hydraulic fluid.

Annex (informative)
Explanatory Note on JCMAS P045
Hydraulic Fluids for Construction Machinery -- Test Method for Indicating Oxidation Stability in High Pressure Piston Pump

This explanatory note, which does not form a part of this Standard, elaborates on the main body of the Standard and matters specified or described therein, as well as items of reference and other matters related thereto.

1 Purpose of establishing the Standard

In developing a quality standard for hydraulic fluids for construction machinery, adoption of a test method for indicating service life of conventional hydraulic fluids has been considered. However, it has been empirically known that service life as indicated by test methods for examining the degree of oxidative deterioration, such as ISOT (Indiana Stirring Oxidation Test) which is employed in quality standards for engine oils, does not necessarily agree with the deteriorating trends observed with hydraulic fluids used in actual construction machinery. As a result of the above, it has been concluded that a new method for indicating service life is required.

As a result of intensive investigation and research conducted under the forum of the Japan Construction Mechanization Association (JCMA), Fuels & Lubricants Subcommittee – Task Force on Biodegradable Hydraulic Fluids for Construction Machinery, with the participation of hydraulic fluid suppliers, manufacturers of construction machinery, and lubricant additives suppliers, it has been established that a good correlation exists between the indications obtained with the method for determining service life described hereunder and the deteriorating trends observed with hydraulic fluids used in actual construction machinery. Consequently, this Standard has been established as the test method for indicating service life of hydraulic fluids for construction machinery.

It should be noted here that, although this Standard is a test method using a piston pump operating under a high pressure, its sole objective is to indicate the service life for a hydraulic fluid and not the evaluation of suitability of such a fluid for use with the test pump.

2 History of establishment of the Standard

The draft for this Standard was prepared by the Equipment Engineering Committee - Fuels and Lubricants Subcommittee of the JCMA, and after the review and approval by the Standard Committee - Domestic Standard Subcommittee, was posted for comment according to WTO Agreement on Technical Barriers to Trade (TBT) “Code of good practice (CGP)” prior to publication as a JCMAS.

3 Issues discussed during the deliberation

Nothing to state in particular.

4 Scope

This Standard applies to hydraulic fluids for construction machinery.

5 Supplementary notes on items specified in this Standard

Nothing to state in particular.

6 Issues at hand

Nothing to state in particular.

7 Issues concerning the normative references

Nothing to state in particular.

8 Issues concerning patent and intellectual properties

Nothing to state in particular.

9 Other issues

Nothing to state in particular.

10 Composition of the Drafting Committees

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

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