

JIS

JAPANESE INDUSTRIAL STANDARD

**Testing Methods of Lubricating
Oil for Aircraft**

JIS K 2503—1980

Translated and Published

by

Japanese Standards Association

Printed in Japan

In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

JAPANESE INDUSTRIAL STANDARD

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Testing Methods of Lubricating
Oil for AircraftK 2503-1980
(Reaffirmed: 1985)1. Scope

This Japanese Industrial Standard specifies the testing methods of lubricating oil for aircraft.

Remark: The units and numerical values given in { } in this Standard are in accordance with the International System of Units (SI), and are appended for informative reference.

2. Definitions

The definition of main terms used in this Standard shall be as follows:

- (1) precipitation number The absolute number of the precipitation expressed in ml that is settled when the mixture of the sample and the naphtha for precipitation is centrifugally separated under specified condition.
- (2) saponification value The weight of the potassium hydroxide in mg that is needed to saponify 1 g of the sample.

3. Testing Methods3.1 Testing Method of Precipitation Number

3.1.1 Summary of Testing Method Take 10 ml of the sample and 90 ml of the naphtha for precipitation in a test tube for centrifugal separation, and after separating centrifugally under specified condition, measure the volume of precipitation.

3.1.2 Tester for Precipitation Number The tester for precipitation number shall be in accordance with the following:

- (1) Graduated Test Tube for Centrifugal Separation As shown in Fig. 105 specified in JIS K 2839.
- (2) Centrifugal Separator Holding two or more test tubes containing the sample, the separator shall be able to rotate in order to make the relative centrifugal force at the top end of the tube to be 600 to 700, and such parts as a rotating shaft, an outside cylinder for a test tube, and a shock absorbing rubber shall be made strong enough to endure the maximum centrifugal force.

While the centrifugal separator runs, the outside cylinder and shock absorbing rubber shall firmly hold the test tube. The number of revolution per minute of a rotating shaft shall be calculated from the following formula:

$$n=1335\sqrt{\frac{f}{a}}$$

Applicable Standards: See page 17 and 18.

where n : number of revolution per minute

f : relative centrifugal force

a : distance between two opposite ends of test tubes while rotating, that is, rotation diameter (mm)

3.1.3 Reagent

Naphtha for Precipitation The naphtha for precipitation shall conform to the requirements shown in Table 1.

Table 1. Quality and Characteristic of Naphtha for Precipitation

Item(s)	Quality and characteristic	Applicable testing method
Specific gravity 15/4°C	0.692 to 0.702	JIS K 2249
Aniline point °C	58 to 60	JIS K 2256
Distillation characteristics (including loss)		
Initial boiling point °C	50 min.	
50 % distillation point °C	70 to 80	JIS K 2254
End point °C	130 max.	

3.1.4 Procedures of Test

The procedures of test shall be as follows:

- (1) Take accurately 10 ml of the sample at room temperature into each of two graduated test tubes for centrifugal separation which have been cleaned and dried, and add the naphtha for precipitation up to the graduation of 100 ml. Stopper firmly with a cork stopper (avoid using a rubber stopper), and agitate them vigorously at least 20 times so as to let them mix completely. Next, allow them to standstill in a water bath of 32 to 35°C for 5 min.

Open the cork stopper slightly to let the inside pressure reduce, and after stoppering firmly again, agitate them vigorously 20 times at least until complete mixing will be obtained. In order to confirm the complete mixing of the sample and the naphtha for precipitation, observe whether or not the sample is remained at the bottom end of the test tube after making it upside down.

- (2) Attach two or more test tubes at opposite positions concerning a rotating shaft to get a balance. Then, rotate them for 10 min at the number of revolution under which the relative centrifugal force at the top end of the test tube becomes 600 to 700.

In Table 2, the relation between rotation diameter, the relative centrifugal force and the number of revolution per minute is shown.

Table 2. Number of Revolution Per Minute Related with Rotation Diameter

Rotation diameter mm	r.p.m. when f equals 600	r.p.m. when f equals 700
483	1490	1610
508	1450	1570
533	1420	1530
559	1390	1500

where f : relative centrifugal force

Repeat this procedure until the volume of the precipitation settled in the test tube is measured equally at three successive measurements, and read the volume to the nearest 0.1 ml. When it is impossible to read the volume of precipitation due to the black precipitate or fibrous material deposited at the bottom of the test tube, confirm its existence.

3.1.5 Result When the difference of the readings in volume between the precipitates in two test tubes falls within 0.1 ml, the average of two measurements shall be adopted as the precipitation number in an absolute number. If the difference not less than 0.1 ml, further sample kept in two test tubes shall be retested, and the average of four measurements in absolute number be adopted. When it is impossible to read the volume of precipitate due to the black precipitate or fibrous material deposited at the bottom of the test tube, the condition shall be appended.

3.1.6 Precision Precision shall be judged as follows:

Repeatability When the same person carries out the test two times by changing day or time on the same sample in the same laboratory using the same tester, the discrepancy between two test results shall not exceed 0.1.

3.2 Testing Method of Saponification Value (Titrating Method by Indicator)

3.2.1 Summary of Testing Method Dissolve the sample in methyl ethyl ketone, and add known quantity of potassium hydroxide-ethyl alcohol solution. After saponifying the sample by heating with reflux, titrate it with standard hydrochloric acid solution, and, after finding the quantity of potassium hydroxide consumed, calculate the saponification value of the sample.

3.2.2 Tester for Saponification Value A saponification tester shall be in accordance with the following:

- (1) **Erlenmeyer Flask and Condenser** Those made of hard glass of the Grade 1 hardness (1) in Fig. 103 and Fig. 104 specified in JIS K 2839.

Note (1) A flask must be clean and free from any flaw or cloudiness at its inside.

A new flask gives occasionally so high blank test value, that it is required to confirm whether or not there is difference between values resulted from the simultaneous two blank tests using a new and an old flask.

(2) Buret The buret shown in Fig. 100 of JIS K 2839, which has been been calibrated to the accuracy ± 0.05 ml, or the automatic buret calibrated to the same accuracy.

(3) Heater A water bath or a suitable heater.

3.2.3 Reagents Reagents shall be as follows:

(1) Alcohol The alcohol specified in JIS K 8102.

Remark: Adopt the following way to eliminate aldehyde contained in alcohol.

Dissolve 1.5 g of silver nitrate, specified in JIS K 8550, in about 3 ml of water, and pour this solution in 1 l of alcohol kept in a bottle with ground stopper. Mix sufficiently. Then, dissolve 3 g of potassium hydroxide in 10 to 15 ml of warm alcohol, and after cooling, add this solution in the silver nitrate alcohol solution gently with stirring little by little. Settle down silver nitrate, and after taking out the supernatant solution using a syphon, distill the solution on a steam bath.

(2) N/2 Potassium Hydroxide-Ethyl Alcohol Solution (hereinafter referred to as the "N/2 KOH solution") Prepare in accordance with 2. (11) in JIS K 8006. Providing that no standardization is needed.

(3) N/10 Potassium Hydroxide-Ethyl Alcohol Solution (hereinafter referred to as the "N/10 KOH solution") Prepare similarly to the description in (2).

(4) N/2 Hydrochloric Acid Standard Solution (hereinafter referred to as the "N/2 HCl solution") Prepare by dissolving about 50 ml of hydrochloric acid specified in JIS K 8180 in 1 l of water. Standardize this solution as follows:

Weigh out accurately 0.5 g to 0.8 g of the sodium carbonate, specified in JIS K 8005 to the nearest 0.1 mg, that has been dried for 40 to 50 min in a platinum crucible heated at 500 to 600°C, and dissolve in about 20 ml of water. Titrate this solution with hydrochloric acid solution using bromophenol blue solution prepared according to JIS K 8006 as indicator, and make it the end point when color of the solution turns yellow from blue violet. Calculate the normality of hydrochloric acid standard solution, from the quantity of consumed hydrochloric acid solution, to the fourth decimal place in accordance with the following formula:

$$N = \frac{18.87 B}{A}$$

where N : normality of $N/2$ HCl solution

B : sampled quantity of sodium carbonate (g)

A : consumed quantity of hydrochloric acid solution (ml)

- (5) N/10 Hydrochloric Acid Standard Solution (hereinafter referred to as the "N/10 HCl solution") Prepare similarly to the description in (4), and standardize it.
- (6) Phenolphthalein Indicator Dissolve 1.0 g of phenolphthalein specified in JIS K 8799 in 100 ml of ethyl alcohol. Use this solution after being neutralized with N/10 KOH solution prepared at (3) until it becomes pale pink.
- (7) Methyl Ethyl Ketone The methyl ethyl ketone specified in JIS K 8900.
- (8) Naphtha Naphtha for precipitation specified in 3.1.3 or the naphtha specified in JIS K 8848.

3.2.4 Quantity of Sample The quantity of sample taken shall be such that the volume of hydrochloric acid standard solution needed for sample titration may become from 40 to 80 % volume of the standard solution needed for blank test, providing that it shall not exceed 20 g.

Remark: The quantity of sample to be taken is estimated according to the following formula:

$$C = \frac{560N}{R}$$

where C : quantity of sample taken (g)

N : normality of hydrochloric acid standard solution

R : estimated saponification value (mg KOH/g)

3.2.5 Procedures of Test The procedures of test shall be as follows:

- (1) Weigh out accurately the sample to the nearest 0.01 g into an Erlenmeyer flask. Add 25 ± 1 ml of methyl ethyl ketone, and then add 25 ml of $N/2$ KOH solution ⁽²⁾ by using a transfer pipet.

Note ⁽²⁾ When saponification value is less than 1 mg KOH/g, use N/10 KOH solution.

- (2) After attaching a condenser to the Erlenmeyer flask, heat the flask to saponify the sample solution with refluxing ⁽³⁾ for 30 min.

Note ⁽³⁾ Generally, 30 min is taken for refluxing time, but, according to the sample, 10 min may suffice or 2 h or more be needed.

- (3) When refluxing is completed, add carefully 50 ml of naphtha through the condenser ⁽⁴⁾.