Motorcycles—Four-stroke cycle gasoline engine oils

1. Scope

This standard applies to engine oils used in four-stroke cycle motorcycle gasoline engines.

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.

JASO M348:2012	Test method for friction properties of automatic transmission fluids for automobiles
JIS K 2272	Testing methods for ash and sulfated ash of crude oil and petroleum products
JIS K 2518	Petroleum products － Lubricating oils － Determination of foaming characteristics
JPI-5S-36	Lubricating oils－Measuring viscosity at high temperature and high shear rate
JPI-5S-38	Lubricating oils－ Additive element test procedures－ Inductively-coupled plasma optical emission spectrometry (ICP-OES)
JPI-5S-41	Test method for evaporation loss of engine oils (NOACK test)
ACEA European Oil Sequences	
ASTM D6278	Standard Test method for Shear Stability of Polymer Containing Fluids Using a European Diesel Injector Apparatus
SAE J183	Engine Oil Performance and Engine Service Classification
SAE J300	Engine Oil Viscosity Classification

3. Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Candidate oil

The four-stroke cycle engine oil to be subjected to the performance evaluation.

3.2 Reference oil

A four-stroke cycle engine oil used for comparison in evaluating the performance of a candidate oil.

There are the following two types of reference oil: **JAFRE-A16** (**Ja**panese **F**our-Stroke Cycle Engine **R**eference Oil**-A**:20**16**) having higher friction properties, and **JAFRE-B16** (**Ja**panese **F**our-Stroke Cycle Engine **R**eference Oil**-B**:20**16**) having lower friction properties.

3.3 Friction properties

A term that is used to express the behavior of the friction element that determines the transfer torque performance of the clutch, using the friction coefficient (μ). There are two types of friction properties: dynamic friction properties and static friction properties.

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3.4 Friction property index

An index that is determined by comparing the candidate oil friction properties with those for **JAFRE-A16** and **JAFRE-B16**. The friction property index is a general term for the following three indices: dynamic friction index, static friction index, and stop time index.

3.4.1 Dynamic friction index (DFI)

An index that is calculated from the dynamic friction coefficient (μ_d) obtained from the dynamic friction test.

3.4.2 Static friction index (SFI)

An index that is calculated from the static friction coefficient (μ_s) obtained from the static friction test.

3.4.3 Stop time index (STI)

An index that is calculated from the stop time (*ST*) obtained from the dynamic friction test.

4. Requirements

4.1 Engine oil quality

The four-stroke cycle motorcycle engine oils subject to this standard shall be of a quality equivalent to any of the engine oil specification categories shown in **Table 1**.

Table 1 Four-stroke cycle gasoline engine oil quality

Specifications	Quality categories
API [a]	SG, SH, SJ, SL, SM [d], SN [e]
ILSAC [b]	GF-1, GF-2, GF-3
ACEA [c]	A1/B1, A3/B3, A3/B4, A5/B5, C2, C3, C4

[a] The performance levels and standards are documented in **SAE J183**, Engine Oil Performance and Engine Service Classification (Other than “Energy Conserving”).
[b] The standards are documented in the Performance Standard for Passenger Car Engine Oils of the International Lubricant Standardization and Approval Committee (ILSAC)
[c] The performance levels are documented in the **ACEA European Oil Sequences**.
[d] Excluding SM/EC.
[e] Excluding SN/RC.

4.2 Physicochemical properties

The properties of four-stroke cycle motorcycle engine oils shall satisfy the physicochemical specifications shown in **Table 2**.

The specified values in **Table 2** supersede the values of the performance categories described in **Table 1**.

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Table 2 Physicochemical properties

Test item			Performance criteria	Test procedure
Sulfated ash		mass%	1.2 max.	**JIS K 2272**
Phosphorous content		mass%	≥0.08 and ≤0.12	**JPI-5S-38**
Evaporative loss		mass%	20 max.	**JPI-5S-41**
Foaming tendency (foaming/settling)	Sequence I Sequence II Sequence III	mL	10/0 max. 50/0 max. 10/0 max.	**JIS K 2518**
Shear stability (Kinematic viscosity (100°C) after the test)		mm^2/s	xW-30: 9.0 min. xW-40: 12.0 min. xW-50: 15.0 min. Other grades: stay in grade [a]	**ASTM D6278** [b]
High temperature high shear viscosity		mPa·s	2.9 min.	**JPI-5S-36**

[a] Refer to **SAE J300** for the viscosity.
[b] The test shall be conducted by the diesel injector method under the standard test conditions (30 cycles).

4.3 Performance classification according to friction property indices

The performance of candidate four-stroke cycle motorcycle engine oils is classified into one of the four grades shown in **Table 3** based on the results of the test carried out in accordance with **Annex A**.

Note that the friction property indices shall be within the range ≥0.40 and <2.50.

Table 3 Performance classifications

Rated parameter	Index performance criteria [a]			
	MA [b]	MA2 [b]	MA1 [b]	MB [c]
Dynamic friction index (DFI)	≥1.35 and <2.50	≥1.50 and <2.50	≥1.35 and <1.50	≥0.40 and <1.35
Static friction index (SFI)	≥1.45 and <2.50	≥1.60 and <2.50	≥1.45 and <1.60	≥0.40 and <1.45
Stop time index (STI)	≥1.40 and <2.50	≥1.60 and <2.50	≥1.40 and <1.60	≥0.40 and <1.40

[a] The friction property indices are set to provide a value of 2.00 when **JAFRE-A16** is evaluated and 1.00 when **JAFRE-B16** is evaluated.
[b] MA, MA2, and MA1 shall be within the respective ranges described in the table above for each of the three indices (DFI, SFI, and STI).
[c] MB shall be within the MB range for each of the three indices (DFI, SFI, and STI), or two indices shall be in the MB range and one index shall be in the MA range, or one index shall be in the MB range and two indices shall be within the MA range.

Related standards:

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

ASTM D4485 *Standard Specification for Performance of Engine Oils*

SAE J300 *Engine Oil Viscosity Classification*

SAE J183 *Engine Oil Performance and Engine Service Classification (Other than "Energy Conserving")*

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Annex A
(normative)

Test procedure for friction properties of clutch system

A.1 General

This annex specifies a test procedure for evaluating clutch friction properties of four-stroke cycle motorcycle engine oils in the case where a common lubricant is used for the engine, built-in clutch system (hereinafter referred to as the "clutch"), and transmission.

A.2 Test evaluation

Friction tests shall be carried out on the candidate oil and two reference oils using the SAE No. 2 clutch friction test machine or an equivalent device. The friction plates shall be frictionally engaged with the steel plates while submerged in the oil at the specified temperature. Measurements shall then be taken for the dynamic friction coefficients (μ_d [1] and μ_0 [2]), stop time (ST [3]), and static friction coefficients (μ_t [4] and μ_s [5]) corresponding to the number of revolutions the plates are subjected to. This gives an evaluation of the friction properties of the candidate oil based on the friction coefficients and stop time of the reference oils.

Note: [1]

μ_d is calculated by the formula shown in **A.7.2** based on the friction torque (T_d) at the time when the revolution speed reaches 1,800 min^{-1} after braking, in the dynamic friction test indicated in **A6.1**.

Note: [2]

μ_0 is calculated by the formula shown in **A.7.2** based on the maximum torque (T_0) when braking is completed at a revolution speed of 200 min^{-1} or less, in the dynamic friction test indicated in **A.6.1**.

Note: [3]

ST is the period of time starting when a pushing pressure of 30% of the set value is applied and ending when the revolution speed is reduced to 60 min^{-1} in the dynamic friction test indicated in **A.6.1**.

Note: [4]

μ_t is calculated by the formula shown in **A.7.2** based on the stable friction torque (T_t) in a period of two seconds after drag is started, in the static friction test indicated in **A.6.2**.

Note: [5]

μ_s is calculated by the formula shown in **A.7.2** based on the maximum torque (T_s) after drag is started, in the static friction test indicated in **A.6.2**.

A.3 Test device

The SAE No. 2 clutch friction test machine or an equivalent device shall be used.

A.4 Test materials

The test materials used in this standard other than candidate oils shall be as follows.

a) Friction plates

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The friction plates used shall have the part number 141-D1G27-00 as described in **Table A.1**.

b) Steel plates

The steel plates used shall have the part number 131-D1G18-00 as described in **Table A.1**.

Table A.1 Clutch parts for test use

Part name	Part number	Thickness (mm)	Remark
Friction plate	**141-D1G27-00**	2.34±0.08	Amount required for 1 test: 3
Steel plate	**131-D1G18-00**	1.80±0.05	Amount required for 1 test: 4
The above part numbers and thicknesses differ from those stated in **JASO M 348**.			

c) Reference oils

The typical properties of the reference oils are shown in **Table A.2**.

Table A.2 Typical properties of reference oils

Measured parameter			**JAFRE-A16**	**JAFRE-B16**
Density	15°C	g/cm^3	0.875	0.857
Viscosity	40°C	mm^2/s	66.9	86.2
	100°C	mm^2/s	10.3	13.5
Viscosity index	-----		140	160
Acid number		mgKOH/g	2.1	2.1
Base number	Perchloric acid	mgKOH/g	6.8	6.8

A.5 Test preparation

The test shall be prepared in accordance with **JASO M 348:**2012, **3.2** Preparation of test.

A.6 Test procedures

The test procedures shall be in accordance with **JASO M 348:**2012, **3.3** Test procedures. Furthermore, it shall be confirmed that the oil temperature reaches the specified temperature that allows the start of measurement for all measurement cycles, and the number of revolutions to raise the temperature shall be 500 min^{-1}.

A.6.1 Dynamic friction test

The dynamic friction test shall be in accordance with **JASO M 348:**2012, **3.3.1** Dynamic friction test, except that the number of test cycles shall be 1,000.

A.6.2 Static friction test

The static friction test shall be in accordance with **JASO M 348**:2012, **3.3.2** Static friction test. Properties shall be measured at test cycle number 10, 50, 100, and every 100 cycles thereafter up to 1,000 cycles in the dynamic friction test.

A.7 Measurement and calculation of friction property indices

A.7.1 Items to be measured

The items to be measured are specified in **Table A.3**.

In order to confirm the test validity, the patterns of torque, revolution speed, and pressure at the test cycle numbers between 100 and 1,000 (every 100 cycles) in the dynamic friction test shall be outputted and recorded continuously in the chart.

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