INTERNATIONAL STANDARD

ISO 24254

First edition
2007-10-15

Lubricants, industrial oils and related products (class L) — Family E (internal combustion engine oils) — Specifications for oils for use in four-stroke cycle motorcycle gasoline engines and associated drivetrains (categories EMA and EMB)

Lubrifiants, huiles industrielles et produits connexes (classe L) — Famille E (huiles pour moteurs à combustion interne) — Spécifications pour les huiles pour moteurs quatre-temps à essence et transmissions associées pour motocyclettes (catégories EMA et EMB)

Reference number
ISO 24254:2007(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 24254 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 4, *Classifications and specifications*.

Introduction

This International Standard aims to specify the minimum performance requirements for four-stroke engine oils and to classify their performance according to their frictional properties. Unique lubricant performance standards have not been in existence for four-stroke engine oils used in motorcycles, motor scooters, all-terrain vehicules (ATVs) and related equipment. As a consequence, manufacturers of these kind of equipment have experienced field-related problems where four-stroke engine oils not meeting the unique frictional requirements of some of these engines have been used. The intent of this International Standard is to enable engine manufacturers to better communicate the lubricant needs of their engines to consumers and, thus, assist the consumer in selecting the proper lubricant from the many available in the marketplace.

Lubricants, industrial oils and related products (class L) — Family E (internal combustion engine oils) — Specifications for oils for use in four-stroke cycle motorcycle gasoline engines and associated drivetrains (categories EMA and EMB)

WARNING — Handling and use of products as specified in this International Standard may be hazardous if suitable precautions are not observed. This International Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard specifies the requirements of lubricating engine oils (hereinafter referred to as "four-stroke engine oils") to be used in four-stroke cycle spark ignition gasoline engines employing a common sump containing the lubricating oil for both the engine and associated drivetrain (transmission, clutch, starter) of motorcycles, motor scooters, all-terrain vehicles (ATVs) and related equipment. Classification of four-stroke engine oils is defined in ISO 6743-15 [1]. Among all of the categories covered by ISO 6743-15, this International Standard includes categories EMA and EMB.

This International Standard specifies the performance classification of four-stroke cycle gasoline engine oils based on physical and chemical properties, and three friction performance indices, which are derived from the frictional properties of the lubricant, according to the JASO T904 test procedure[1)].

NOTE For the purposes of this International Standard, the term "% (m/m)" is used to represent the mass fraction.

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.

ISO 3987, *Petroleum products — Lubricating oils and additives — Determination of sulfated ash*

ISO 6247, *Petroleum products — Determination of foaming characteristics of lubricating oils*

ISO 20844, *Petroleum and related products — Determination of the shear stability of polymer-containing oils using a diesel injector nozzle*

ASTM D4683, *Standard Test Method for Measuring Viscosity at High Shear Rate and High Temperature by Tapered Bearing Simulator*

1) JASO T904:2006 is based upon the test procedures and specifications developed by the Japanese Automobile Standards Organization (JASO) of the Society of Automotive Engineers of Japan, Inc. (JSAE). JASO was joined in this effort by the American Society for Testing and Materials (ASTM) and the Coordinating European Council for the development of performance tests for lubricants and engine fuels (CEC). Lubricants meeting this International Standard can be applied to four-stroke-cycle spark-ignition gasoline engines used in transportation, leisure and utility applications, such as motorcycles, motor scooters, ATVs and related equipment.

ASTM D4741, *Standard Test Method for Measuring Viscosity at High Temperature and High Shear rate by Tapered-Plug Viscosimeter*

ASTM D4951, *Standard Test Method for Determination of Additive Elements in Lubricating Oils by Inductively Coupled Plasma Atomic Emission Spectroscopy*

CEC L40-A93, *Standard test method for evaporation loss of lubricating oils by the Noack method*

JASO T904, *Motorcycles — Four Stroke Cycle Gasoline Engine Oils — Friction Properties Test for the Clutch Systems*

JPI-5S-38, *Lubricating Oils — Determination of Additive Elements — Inductively Coupled Plasma Atomic Emission Spectrometry*

3 Terms and definitions

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

3.1
candidate oil
four-stroke cycle engine oil whose performance is subject to evaluation in this test method

3.2
reference oil
four-stroke cycle engine oil of known performance that is used for comparison to categorize the performance of a candidate oil

NOTE Two standard reference oils are used for comparison purposes in evaluating the performance of a candidate oil: JAFRE-A (Japanese Four-Stroke Cycle Engine Reference Oil-A) with high frictional properties and JAFRE-B (Japanese Four-Stroke Cycle Engine Reference Oil-B) with low frictional properties [2)].

3.3
friction index
relative performance index, which is determined by comparing the test results of the candidate oil with the results of the reference oils

3.4
dynamic friction index
DFI
resultant index determined from the dynamic friction coefficients, μ_d, obtained from the dynamic friction test

3.5
static friction index
SFI
resultant index determined from the static friction coefficients, μ_s, obtained from the static friction test

3.6
stop time index
STI
resultant index determined from the stop time, ST, obtained from the dynamic friction test

2) Reference oils can be ordered from Technical Center, Japan Lubricating Oil Society, 2-16-1, Hinode, Funabashi-shi, Chiba 273-0015, Japan, Tel.: +81 47 433 5181, Fax: +81 47 431 9579. This information is given for the convenience of the users of this International Standard and does not constitute an endorsement of these products by ISO.

4 Four-stroke cycle engine oil requirements

4.1 General performance level

Candidate four-stroke cycle engine oils shall be formulated such that their engine performance be of a quality level at least equivalent to one or more of the performance categories for engine oil specifications given in Table 1.

Table 1 — Engine oil performance categories

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

[a] API performance categories and standards are documented in ASTM D4485[2].

[b] ILSAC standards are documented in the ILSAC GF-1(2, 3) minimum performance standard for passenger car engine oils.

[c] ACEA sequence tests and performance levels are documented in the *ACEA European oil sequence for service fill gasoline engine oils*.

4.2 Physical and chemical property requirements

In addition to prescribed performance requirements, a candidate oil shall also satisfy the physical and chemical property requirements given in Table 2. These physical and chemical properties supersede the general performance level values detailed in the performance classification standards described in Table 1.

Table 2 — Physical and chemical property requirements for four-stroke cycle engine oils

Requirement	Unit	Limit	Test method
Sulfated ash	% (*m*/*m*)	1,2 max.	ISO 3987
Phosphorous content	% (*m*/*m*)	0,08 min. and 0,12 max.	JPI-5S-38 or ASTM D4951
Evaporation loss	% (*m*/*m*)	20 max.	CEC L40-A93
Foaming tendency/stability Sequence I Sequence II Sequence III	ml	 10/0 max. 50/0 max. 10/0 max.	ISO 6247
Shear stability 100 °C kinematic viscosity after test XW-30 XW-40 XW-50 Other grades:	mm^2/s	 9,0 min. 12,0 min. 15,0 min. stay in grade	ISO 20844
Viscosity at high shear rate and high temperature	mPa·s	2,9 min.	ASTM D4683 or ASTM D4741

4.3 Performance requirements

The performance of four-stroke cycle engine oils is classified into one of two grades, as indicated in Table 3, based on the three performance indices derived from the friction indices according to the following:

The friction index, I_F, is calculated in accordance with Equation (1):

$$I_F = 1 + \frac{X_{Cand} - X_{JAFREB}}{X_{JAFREA} - X_{JAFREB}} \quad (1)$$

where

X_{Cand} is the test result of the candidate oil;

X_{JAFREA} is the test result of the reference oil JAFRE-A;

X_{JAFREB} is the test result of the reference oil JAFRE-B.

NOTE The resultant friction indices are calculated such that 2,00 is obtained when the JAFRE-A oil is evaluated as the candidate and 1,00, when the JAFRE-B oil is evaluated as the candidate.

Table 3 — Performance classification

Rated parameter	Performance classification		Test method
	EMA	EMB	
Dynamic friction index (DFI)	⩾ 1,45 and < 2,50	⩾ 0,50 and < 1,45	JASO T904
Static friction index (SFI)	⩾ 1,15 and < 2,50	⩾ 0,50 and < 1,15	
Stop time index (STI)	⩾ 1,55 and < 2,50	⩾ 0,50 and < 1,55	

Regarding the classification of a candidate oil, if any one or more of the three friction indices (DFI, SFI and STI) does not meet the classification of EMA, the candidate four-stroke cycle engine oil shall be classified as EMB.

Given the wide range in allowable EMA indices, further classification can be made into EMA subcategories, EMA2 and EMA1, as detailed in Table 4. Subcategories EMA1 and EMA2 may be used only if all the resultant friction indices for a candidate oil fall within that specific subcategory.

Table 4 — Subcategory classification

Rated parameter	Performance classification		Test method
	EMA		
	EMA1	EMA2	
Dynamic friction index (DFI)	⩾ 1,45 and < 1,80	⩾ 1,80 and < 2,50	JASO T904
Static friction index (SFI)	⩾ 1,15 and < 1,70	⩾ 1,70 and < 2,50	
Stop time index (STI)	⩾ 1,55 and < 1,90	⩾ 1,90 and < 2,50	

Annex A
(informative)

Background and examples of assignment of performance classification

A.1 Background

There are several common performance requirements for the lubrication of motorcycles and automotive engines. For many years, the performance requirements of automotive engine oils have been applied to those of motorcycles, scooters, ATVs and related equipment without modification. The minimum performance requirement for four-stroke engine oils currently recommended by motorcycle and motor scooter manufacturers is defined by the API SG category. (Although some of the API SG performance tests are now obsolete and no longer available, oils equivalent to these specifications are still available in many regions world-wide and are marketed as such at the discretion of the lubricant manufacturer.) However, with the recent trend towards improved fuel economy automotive engine oils (ILSAC GF-3, GF-4), the propensity for misapplication of some of these oils has increased. Unique lubrication demands exist for the transmission gear, starter and clutch assemblies of motorcycles and motor scooters related to its viscosity and frictional characteristics. For low-viscosity engine oils (0W-20), transmission gear durability is known to decrease. In addition, with heavily friction modified engine oils, clutch slippage can result due to the low resultant frictional properties of the lubricant, especially at high temperatures where oils of higher frictional properties are desired.

The intention of specifying minimum performance requirements and establishing appropriate limits for viscosity, volatility and frictional properties, is to minimize the tendency for misapplication and resulting field problems. Four-stroke cycle engine oils, as defined by this International Standard, should be classified according to their frictional properties as either EMA, EMA2, EMA1 (high-friction coefficients) or EMB (low-friction coefficients). Note that there are applications, such as with some ATVs, where oils of lower friction are more desirable than those with higher friction properties, as defined by the JASO T904 test method. Also, for scooters and/or with motorcycles with dry clutches, where clutch slippage is no longer a concern, it can be desirable to use oils with lower friction characteristics for the derived benefits in fuel economy. Classification of a four-stroke cycle engine oil as either EMA, EMA2, EMA1 or EMB should not be interpreted as an indicator of overall perceived quality.

Furthermore, the phosphorus content of automotive engine oils, such as those meeting API SM and GF-4, has decreased to minimize catalyst poisoning; acceptable ranges are between a minimum of 0,06 % (m/m) to a maximum of 0,08 % (m/m). Since current motorcycle design has the transmission lubricated by the engine oil, these low-phosphorous oils can lead to an increased propensity for gear pitting. To minimize these concerns, an acceptable range of phosphorous concentrations was incorporated into the specification. Based on gear durability tests and field experience, the phosphorous limits were set at a minimum of 0,08 % (m/m) and a maximum of 0,12 % (m/m) to ensure a cap to mitigate catalyst poisoning concerns.

A.2 Examples of assignment of performance classification

Table A.1 provides examples of all possible combinations of friction indices and their relative classification assignments. For example, Sample 2 clearly shows all the friction indices, i.e. static friction index (SFI), dynamic friction index (DFI) and stop time index (STI), that fall in the EMA classification. Furthermore, it is clear that all the friction indices can be further classified as meeting subcategory EMA1. As such, either the EMA general classification or the EMA1 subclassification may be applied to this sample lubricant. Samples 4 through 9 provide examples where one or two of the individual indices do not meet either subcategory (EMA1 or EMA2) as represented by the shading, but clearly fall in the EMA category and are classified accordingly. Conversely, Samples 10 through 15 provide examples where one or two of the friction indices fall into the EMB range, and, consequently, these samples can be classified only as EMB. Subcategories EMA1 and EMA2 may be used only if all the resultant friction indices for a candidate oil fall within that specific subcategory.