INTERNATIONAL STANDARD

ISO 3448

Second edition
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Industrial liquid lubricants — ISO viscosity classification

Lubrifiants liquides industriels — Classification ISO selon la viscosité

Reference number
ISO 3448:1992(E)

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.

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.

International Standard ISO 3448 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*.

This second edition cancels and replaces the first edition (ISO 3448:1975), of which it constitutes a technical revision.

Annex A of this International Standard is for information only.

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Introduction

This International Standard has been prepared to meet the immediate needs of those ISO Technical Committees that promulgate International Standards for equipment and need to refer to lubricants, i.e. TC 39, *Machines tools*; TC 123, *Plain bearings*; TC 131, *Fluid power systems*; and others, by providing a classification of liquid lubricants according to viscosity grades. The purpose of this classification system is to establish a series of definite kinematic-viscosity levels so that lubricant suppliers, lubricant users and equipment designers will have a uniform and common basis for designating or selecting industrial liquid lubricants according to the kinematic viscosity required in a particular application.

When the first edition of this International Standard was being prepared, systems for classifying the viscosity characteristics of industrial liquid lubricants were simultaneously under study by the American Society for Testing and Materials (ASTM) in collaboration with the Society of Tribologists and Lubrication Engineers (STLE) (ASTM D 2422-68), by the British Standards Institution (BSI) (BS 4231) and by the Deutsches Institut für Normung (DIN). The cooperative effort first resulted in this ISO classification in 1975.

It is desirable that any such classification system should cover the entire range of kinematic viscosities of liquid lubricants normally used; at the same time, the number of kinematic-viscosity grades within the classification should be limited. A continuous system, in which any lubricant within the viscosity range could be given a grade number, was first considered, but it was recognized that this would involve either an unduly large number of grades or an unduly wide range of permitted kinematic viscosities for each grade.

For the classification to be of direct use in engineering design calculations, in which the kinematic viscosity of the lubricant is only one of the parameters, it is desirable that the viscosity grade width be not more than 10 % on either side of the nominal value. This would reflect an order of uncertainty in calculation similar to that imposed by dimensional manufacturing tolerances. This limitation, coupled with the requirement that the number of viscosity grades should not be too large, has led to the adoption of a discontinuous system with gaps between the viscosity grades.

The reference temperature for the classification should be selected to be reasonably close to average service experience. It should also closely relate to other selected temperatures used to define properties such as viscosity index which can aid in defining a lubricant. A study of a series of possible temperatures indicates that 40 °C is particularly suitable for the purposes of industrial-lubricant classification as well as for the lubricant-definition properties mentioned above. This viscosity classification is consequently based on kinematic viscosity at 40 °C.

The viscosity designations are identical to those in the well-known ASTM/STLE and BSI classifications previously mentioned.

Although this ISO classification is bound to lead to a number of existing lubricants (possibly including some at present widely used) not being accommodated within the classification, there is nothing to prevent the continued use of such products by agreement between supplier and consumer. The kinematic viscosities of such out-of-classification oils should, however, be determined at 40 °C. It is expected, however, that lubricant producers will move towards the adjustment of their products so that each product will fall within one of the viscosity grade designations; that users will, in the interests of rationalization and the reduction of the number of oils which they use, call increasingly for lubricants covered by the classification; and that machine and equipment manufacturers and their component suppliers will take due note of the classification in the design stages and in their lubricant viscosity recommendations.

It is not expected that liquid lubricants of every quality, or those designed for very specific purposes, will be, or will need to be, available within every viscosity grade of this International Standard.

NOTE 1 The Society of Automative Engineers (USA) established many years ago standards for identifying and/or classifying the viscosity characteristics of lubricants used in automotive engines or gears. Their systems, which are widely known and used in most countries of the world, are based on the measurement of kinematic viscosity at temperatures that are considered to represent the normal operating range; the nomenclature used is for example SAE 10W, 20W and 20, 30, etc., for engine oils (SAE J 300) and SAE 75W, 80W, 90, 140, etc., for gear oils (SAE J 306). It should be noted that this ISO classification for industrial liquid lubricants is not intended to replace either of the SAE systems; on the other hand, the latter systems, while they have desirable features for automotive lubricants, are not suitable for extension to industrial lubricants in general.

Industrial liquid lubricants — ISO viscosity classification

1 Scope

This International Standard establishes a system of viscosity classification for industrial liquid lubricants and related fluids. This includes mineral oils used as lubricants, hydraulic fluids, electrical oils and for other applications. The usual method for kinematic-viscosity determination is that specified in ISO 3104, but this may give anomalous results when used with non-Newtonian fluids (i.e. those whose coefficient of viscosity varies significantly with rate of shear). For such fluids, it is therefore important to state the particular method by which viscosity has been determined.

It is also recognized that there may be some pure chemicals and naturally occurring products, used as lubricants, which will not fall within this classification.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3104:1976, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity.*

3 Classification

3.1 The classification defines 20 viscosity grades in the range 2 mm^2/s to 3 200 mm^2/s at 40 °C. This covers, as far as petroleum-based liquids are concerned, approximately the range from kerosine to cylinder oils.

3.2 Each viscosity grade is designated by the nearest whole number to its mid-point kinematic viscosity in square millimetres per second (mm^2/s) at 40 °C, and a kinematic-viscosity range of ± 10 % of this value is permitted. The 20 viscosity grades with the limits appropriate to each are given in table 1.

3.3 The classification is based on the principle that the mid-point kinematic viscosity of each grade should be approximately 50 % greater than that of the preceding one. The division of each decade into six equal logarithmic steps provides such a system and permits a uniform progression from decade to decade, but in order to provide simple numbers the logarithmic series has been rounded off. The maximum deviation of the mid-point viscosities from the logarithmic series is 2,2 %.

3.4 The classification implies no quality evaluation, and provides information only on the kinematic viscosity at the defining temperature of 40 °C. The kinematic viscosities at other temperatures will depend on the viscosity/temperature characteristics of the lubricants, which are usually reported as viscosity/temperature curves or stated in terms of a viscosity index (VI).

3.5 The kinematic viscosities of the same lubricants defined by this International Standard, but identified at other temperatures customarily used in some countries, are shown in annex A. Three values of the viscosity index have been used. These data are given only for the purpose of general guidance in understanding or adoption of this International Standard.

4 Designation

The following wording shall be used to designate a particular viscosity grade:

ISO viscosity grade ... (ISO 3448)

which may be abbreviated to:

ISO VG...

Table 1 — ISO viscosity classification

ISO viscosity grade	Mid-point kinematic viscosity mm²/s at 40 °C	Kinematic-viscosity limits mm²/s at 40 °C	
		min.	max.
ISO VG 2	2,2	1,98	2,42
ISO VG 3	3,2	2,88	3,52
ISO VG 5	4,6	4,14	5,06
ISO VG 7	6,8	6,12	7,48
ISO VG 10	10	9,00	11,0
ISO VG 15	15	13,5	16,5
ISO VG 22	22	19,8	24,2
ISO VG 32	32	28,8	35,2
ISO VG 46	46	41,4	50,6
ISO VG 68	68	61,2	74,8
ISO VG 100	100	90,0	110
ISO VG 150	150	135	165
ISO VG 220	220	198	242
ISO VG 320	320	288	352
ISO VG 460	460	414	506
ISO VG 680	680	612	748
ISO VG 1 000	1 000	900	1 100
ISO VG 1 500	1 500	1 350	1 650
ISO VG 2 200	2 200	1 980	2 420
ISO VG 3 200	3 200	2 880	3 520

Annex A
(informative)

ISO viscosity classification with corresponding kinematic viscosities at various temperatures for differing viscosity indices

Table A.1

ISO viscosity grade	Kinematic-viscosity range	Approximate kinematic viscosity at other temperatures for different values of viscosity index								
		Viscosity index = 0			Viscosity index = 50			Viscosity index = 95		
	mm²/s at 40 °C	mm²/s at 20 °C	mm²/s at 37,8 °C	mm²/s at 50 °C	mm²/s at 20 °C	mm²/s at 37,8 °C	mm²/s at 50 °C	mm²/s at 20 °C	mm²/s at 37,8 °C	mm²/s at 50 °C
ISO VG 2	1,98 to 2,42	(2,82 to 3,67)	(2,05 to 2,52)	(1,69 to 2,03)	(2,87 to 3,69)	(2,05 to 2,52)	(1,69 to 2,03)	(2,92 to 3,71)	(2,06 to 2,52)	(1,69 to 2,03)
ISO VG 3	2,88 to 3,52	(4,60 to 5,99)	(3,02 to 3,71)	(2,37 to 2,83)	(4,59 to 5,92)	(3,02 to 3,70)	(2,38 to 2,84)	(4,58 to 5,83)	(3,01 to 3,69)	(2,39 to 2,86)
ISO VG 5	4,14 to 5,06	(7,39 to 9,60)	(4,38 to 5,38)	(3,27 to 3,91)	(7,25 to 9,35)	(4,37 to 5,37)	(3,29 to 3,95)	(7,09 to 9,03)	(4,36 to 5,35)	(3,32 to 3,99)
ISO VG 7	6,12 to 7,48	(12,3 to 16,0)	(6,55 to 8,05)	(4,63 to 5,52)	(11,9 to 15,3)	(6,52 to 8,01)	(4,68 to 5,61)	(11,4 to 14,4)	(6,50 to 7,98)	(4,76 to 5,72)
ISO VG 10	9,00 to 11,0	20,2 to 25,9	9,73 to 12,0	6,53 to 7,83	19,1 to 24,3	9,68 to 11,9	6,65 to 7,99	18,1 to 23,1	9,64 to 11,8	6,78 to 8,14
ISO VG 15	13,5 to 16,5	33,5 to 43,0	14,7 to 18,1	9,43 to 11,3	31,6 to 40,6	14,7 to 18,0	9,62 to 11,5	29,8 to 38,3	14,6 to 17,9	9,80 to 11,8
ISO VG 22	19,8 to 24,2	54,2 to 69,8	21,8 to 26,8	13,3 to 16,0	51,0 to 65,8	21,7 to 26,6	13,6 to 16,3	48,0 to 61,7	21,6 to 26,5	13,9 to 16,6
ISO VG 32	28,8 to 35,2	87,7 to 115	32,0 to 39,4	18,6 to 22,2	82,6 to 108	31,9 to 39,2	19,0 to 22,6	76,9 to 98,7	31,7 to 38,9	19,4 to 23,3
ISO VG 46	41,4 to 50,6	144 to 189	46,6 to 57,4	25,5 to 30,3	133 to 172	46,3 to 56,9	26,1 to 31,3	120 to 153	45,9 to 56,3	27,0 to 32,5
ISO VG 68	61,2 to 74,8	242 to 315	69,8 to 85,8	35,9 to 42,8	219 to 283	69,2 to 85,0	37,1 to 44,4	193 to 244	68,4 to 83,9	38,7 to 46,6
ISO VG 100	90,0 to 110	402 to 520	104 to 127	50,4 to 60,3	356 to 454	103 to 126	52,4 to 63,0	303 to 383	101 to 124	55,3 to 66,6
ISO VG 150	135 to 165	672 to 862	157 to 194	72,5 to 86,9	583 to 743	155 to 191	75,9 to 91,2	486 to 614	153 to 188	80,6 to 97,1
ISO VG 220	198 to 242	1 080 to 1 390	233 to 286	102 to 123	927 to 1 180	230 to 282	108 to 129	761 to 964	226 to 277	115 to 138
ISO VG 320	288 to 352	1 720 to 2 210	341 to 419	144 to 172	1 460 to 1 870	337 to 414	151 to 182	1 180 to 1 500	331 to 406	163 to 196
ISO VG 460	414 to 506	2 700 to 3 480	495 to 608	199 to 239	2 290 to 2 930	488 to 599	210 to 252	1 810 to 2 300	478 to 587	228 to 274
ISO VG 680	612 to 748	4 420 to 5 680	739 to 908	283 to 339	3 700 to 4 740	728 to 894	300 to 360	2 880 to 3 650	712 to 874	326 to 393
ISO VG 1 000	900 to 1 100	7 170 to 9 230	1 100 to 1 350	400 to 479	5 960 to 7 640	1 080 to 1 330	425 to 509	4 550 to 5 780	1 050 to 1 290	466 to 560
ISO VG 1 500	1 350 to 1 650	11 900 to 15 400	1 600 to 2 040	575 to 688	9 850 to 12 600	1 640 to 2 010	613 to 734	7 390 to 9 400	1 590 to 1 960	676 to 812
ISO VG 2 200	1 980 to 2 420	19 400 to 25 200	2 460 to 3 020	810 to 970	15 900 to 20 400	2 420 to 2 970	865 to 1 040	11 710 to 15 300	2 350 to 2 890	950 to 1 150
ISO VG 3 200	2 880 to 3 520	31 180 to 40 300	3 610 to 4 435	1 130 to 1 355	25 360 to 32 600	3 350 to 4 360	1 210 to 1 450	18 450 to 24 500	3 450 to 4 260	1 350 to 1 620

NOTE — Values in parentheses have been derived by extrapolation and are approximate.

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