INTERNATIONAL STANDARD

ISO 6621-3

Second edition
2000-09-01

Internal combustion engines — Piston rings —

Part 3: Material specifications

Moteurs à combustion interne — Segments de piston —
Partie 3: Spécifications des matériaux

Reference number
ISO 6621-3:2000(E)

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Printed 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 3.

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 part of ISO 6621 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 6621-3 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

This second edition cancels and replaces the first edition (ISO 6621-3:1983), which has been technically revised.

ISO 6621 consists of the following parts, under the general title *Internal combustion engines — Piston rings*:

— *Part 1: Vocabulary*

— *Part 2: Inspection measuring principles*

— *Part 3: Material specifications*

— *Part 4: General specifications*

— *Part 5: Quality requirements*

Introduction

ISO 6621 is one of a series of International Standards dealing with piston rings for reciprocating internal combustion engines. Others are ISO 6622-1 [5] and ISO 6622-2 [6], ISO 6623 [7], ISO 6624-1 [8], ISO 6624-2 [9], ISO 6624-3 [10] and ISO 6624-4 [11], ISO 6625 [12], ISO 6626 [13] [14], and ISO 6627 [15].

This part of ISO 6621 provides a user guide to the types of materials available for piston rings.

Many such materials are available, made by different manufacturers using different casting and machining techniques, with each suited to a particular application. In many instances, their chemical compositions differ, but the method of manufacture and the heat treatment, if any, result in materials from different manufacturers with similar mechanical properties. The performance of rings made from two different materials might be very similar; i.e. several subclasses of materials could meet a given requirement.

In ring manufacture it is convenient to group materials into classes according to their moduli, since for a ring of given dimensions, the pressure it exerts on the cylinder wall is determined only by the modulus. The material strength is also generally related to modulus, i.e. the higher the modulus, the greater the strength, although there are exceptions depending on the method of manufacture. Material hardness, on the other hand, is determined by both chemical composition and heat treatment; this is made clear by the division of classes into subclasses. Because of this, the final choice of material and subclass is to be agreed between manufacturer and client.

Internal combustion engines — Piston rings —

Part 3:
Material specifications

1 Scope

This part of ISO 6621 classifies materials intended for the manufacture of piston rings, based on their mechanical properties and the stresses the materials are capable of withstanding.

This part of ISO 6621 is applicable to piston rings for reciprocating internal combustion engines up to and including those of 200 mm in diameter. It is also applicable to piston rings of compressors working under similar conditions.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of ISO 6621. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 6621 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*.

3 Mechanical properties

The choice of material made in accordance with the mechanical strength criteria given in Table 1 shall also take into account the final coating of rings, engine characteristics (rating, liner surface, etc.) and microstructural features such as graphite, cementite and ferrite.

Table 1 — Piston-ring materials and their mechanical properties

Class	Mechanical properties MPa or N/mm²		Material						Typical applications
	Typical modulus of elasticity	Minimum bending strength	Type	Minimum hardness [a] HV30	HRB	HRC	Specific details	Subclass Code	
10	90 000	300	Grey cast iron	200	93	—	Non-heat-treated	MC 11	Compression, scraper and oil control rings
	90 000	350		205	95	—		MC 12	
	100 000	390		205	95	—		MC 13	
20	115 000	450	Grey cast iron	255	—	23	Heat-treated	MC 21	Compression and scraper rings
		450		290	—	28		MC 22	
		450		390	—	40		MC 23	
		500		320	—	32		MC 24	
	130 000	650		365	—	37		MC 25	
30	145 000	550	Carbidic cast iron	265	—	25	Heat-treated pearlitic	MC 31	
		500		300	—	30	Heat-treated martensitic	MC 32	
40	160 000	600	Malleable cast iron	210	95	—	Heat-treated pearlitic	MC 41	Compression rings, scraper rings and narrow-width oil-control rings
		600		250	—	22	Heat-treated martensitic	MC 42	
		600		300	—	30	Heat-treated martensitic	MC 43	
		1000		280	—	27	Heat-treated carbidic	MC 44	
50	160 000	1100	Spheroidal graphite cast iron	255	—	23	Heat-treated martensitic	MC 51	
		1300		255	—	23	Heat-treated martensitic	MC 52	
		1300		290	—	28	Heat-treated martensitic	MC 53	
		1300		210	95	—	Pearlitic	MC 54	
				225	97	—	Ferritic	MC 55	
		1300		345	—	35	Heat-treated martensitic	MC 56	
60	210 000	—	Steel	370	—	38	CrMoV-alloyed	MC 61	Compression rings
				390	—	40	CrSi-alloyed	MC 62	Coil springs and compression rings
				485	—	48	CrSi-alloyed	MC 63	Compression rings
				450	—	45	CrSi-alloyed	MC 64	Compression rings
				270	—	26	Martensitic (11 % Cr min.)	MC 65	Compression, oil-control rings and segments
				270	—	26	Martensitic (17 % Cr min.)	MC 66	Compression rings and segments
				— [b]	—	—	Austenitic (16 % Cr min.)	MC 67	Expanders
				450 [b]	—	—	Unalloyed	MC 68	Expanders/spacers and segments

[a] The hardness values are averages from three measurements on one ring, one being at the gap and the others 90° and 180° around from the gap. HV30 hardness testing is in accordance with ISO 6507-1. HRB and HRC are given for reference only. The application of the hardness measuring methods HRB and HRC is restricted, due to the geometry and the material of piston rings. The hardness values stated are used only for classifying the materials into the individual subclasses. Other hardness-measuring methods and their equivalent values shall be agreed between manufacturer and client.

All hardness figures refer to the finished piston rings and segments. However, in the case of nitrided steel rings the given hardness figures apply to the core hardness only.

[b] Hardness for expanders depends on the manufacturing process. Values for finished parts shall be agreed between manufacturer and client.

Bibliography

[1] ISO 6621-1:—[1], *Internal combustion engines — Piston rings — Part 1: Vocabulary.*

[2] ISO 6621-2:—[2], *Internal combustion engines — Piston rings — Part 2: Inspection measuring principles.*

[3] ISO 6621-4:—[3], *Internal combustion engines — Piston rings — Part 4: General specifications.*

[4] ISO 6621-5:—[4], *Internal combustion engines — Piston rings — Part 5: Quality requirements.*

[5] ISO 6622-1:—[5], *Internal combustion engines — Piston rings — Part 1: Rectangular rings made of cast iron*.

[6] ISO 6622-2:—[6], *Internal combustion engines — Piston rings — Part 2: Rectangular rings with narrow ring width*.

[7] ISO 6623:—[7], *Internal combustion engines — Piston rings — Scraper rings made of cast iron*.

[8] ISO 6624-1:—[8], *Internal combustion engines — Piston rings — Part 1: Keystone rings made of cast iron.*

[9] ISO 6624-2:—[9], *Internal combustion engines — Piston rings — Part 2: Half keystone rings made of cast iron*.

[10] ISO 6624-3:—[10], *Internal combustion engines — Piston rings — Part 3: Keystone rings made of steel*.

[11] ISO 6624-4:—[10], *Internal combustion engines — Piston rings — Part 4: Half keystone rings made of steel*.

[12] ISO 6625:1986, *Internal combustion engines — Piston rings — Oil control rings*.

[13] ISO 6626:1989, *Internal combustion engines — Piston rings — Coil-spring-loaded oil control rings*.

[14] ISO 6626-2:—[10], *Internal combustion engines — Piston rings — Part 2: Coil-spring-loaded oil control rings of narrow width made of cast iron*.

[15] ISO 6627:—[10], *Internal combustion engines — Piston rings — Expander/segment oil-control rings*.

1) To be published. (Revision of ISO 6621-1:1986)

2) To be published. (Revision of ISO 6621-2:1984)

3) To be published. (Revision of ISO 6621-4:1988)

4) To be published. (Revision of ISO 6621-5:1988)

5) To be published. (Revision of ISO 6622-1:1986)

6) To be published. (Revision of ISO 6622-2:1988)

7) To be published. (Revision of ISO 6623:1986)

8) To be published. (Revision of ISO 6624-1:1986)

9) To be published. (Revision of ISO 6624-2:1988)

10) To be published.

ICS 43.060.10

Price based on 3 pages