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Internal combustion engines — Piston rings —

Part 5: Quality requirements

Moteurs à combustion interne — Segments de piston — Partie 5: Exigences de qualité

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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 6621-5 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

This second edition cancels and replaces the first edition (ISO 6621-5:1988), 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 number of series of International Standards dealing with piston rings for reciprocating internal combustion engines. Others are ISO 6621 [1], ISO 6622, ISO 6623, ISO 6624, ISO 6625, ISO 6626 and ISO 6627 (see Bibliography for details).

The common features and dimensional tables presented in this part of ISO 6621 constitute a broad range of variables, and the designer, in selecting a particular ring type, should bear in mind the conditions under which it will be required to operate. The designer also refers to the specifications and requirements of ISO 6621-3 and ISO 6621-4 before completing his selection.

The difficulty of trying to define in absolute terms the quality attainable in normal commercial manufacture of piston rings is well known. In this part of ISO 6621, the commonly encountered aspects of quality in terms of casting defects and other departures from ideal are quantified. Many minor defects are clearly quite acceptable; other defects because of size or number are inadmissible.

Internal combustion engines — Piston rings —

Part 5: Quality requirements

1 Scope

This part of ISO 6621 specifies those quality aspects that are capable of definition but not normally found on a drawing specification.

It covers the following:

— single-piece piston rings of grey cast iron or steel;

— multi-piece piston rings (oil control rings) consisting of cast iron parts and spring components;

— single-piece and multi-piece oil control rings of steel, i.e. oil control rings in the form of strip steel components or steel segments (rails) with spring expander components.

In addition to specifying certain of the limits of acceptance relating to inspection measuring principles (covered by ISO 6621-2), this part of ISO 6621 also covers those features for which no recognized quantitative measurement procedures exist and which are only checked visually with normal eyesight (spectacles if worn normally) and without magnification. Such features (superficial defects) are additional to the standard tolerances of ring width, radial wall thickness and closed gap.

This part of ISO 6621 does not establish acceptable quality levels (AQL), it being left to manufacturer and client to decide the appropriate levels jointly. In this case, the recommendations of ISO 2859 are followed.

This part of ISO 6621 specifies the quality requirements of piston rings for both reciprocating internal combustion engines and compressors working under analogous conditions. It is applicable to all such rings of a diameter $\leqslant$ 200 mm.

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 6621-1, *Internal combustion engines — Piston rings — Part 1: Vocabulary*

ISO 6621-3, *Internal combustion engines — Piston rings — Part 3: Material specifications*

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

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

ISO 6622-2, *Internal combustion engines — Piston rings — Part 2: Rectangular rings made of steel*

ISO 6623, *Internal combustion engines — Piston rings — Scraper rings made of cast iron*

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

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

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

ISO 6624-4, *Internal combustion engines — Piston rings — Part 4: Half keystone rings made of steel*

ISO 6625, *Internal combustion engines — Piston rings — Oil control rings*

ISO 6626, *Internal combustion engines — Piston rings — Coil-spring-loaded oil control rings*

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

ISO 6627, *Internal combustion engine — Piston rings — Expander/segment oil control rings*

3 Terms and definitions

The terminology used in this part of ISO 6621 is as given in ISO 6621-1.

4 Visible defects

4.1 General

Visible defects are divided into two principle classes as described in 4.2 to 4.5.

The first class covers those defects frequently found in castings and includes such defects as porosity, sand inclusions, cavities, etc.

The second class of defect covers mechanical abrasions which may occur during forming, machining or handling of the rings, and includes scratches, dents, chipping, burrs and cracks.

Inspection of piston rings for such defects is generally carried out visually, without magnification, by inspectors having normal eyesight, corrected if necessary.

It is not intended that every ring be rigorously inspected for size and distribution of defects, but rather that the values given in the tables and text be used as a general guide. However, in case of doubt, the values given should be used as the means of judging the quality of the rings.

4.2 Pores, cavities and sand inclusions

Such defects are permissible on uncoated surfaces and edges provided that the values given in Table 1 for size, number and spacing are not exceeded.

Table 1 — Permissible values of size, number and spacing of pores, cavities and sand inclusions

Dimensions in millimetres

Nominal diameter d_1	Defect size max.				Number of defects per ring max.	Spacing of defects [c] min.
	on peripheral surface [a]	on other surfaces [a]	on peripheral edges	on other edges [b]		
$30 \leqslant d_1 < 60$	0,1	0,3	0,1	0,1	2	4
$60 \leqslant d_1 < 100$	0,15	0,5	0,1	0,2	4	4
$100 \leqslant d_1 < 150$	0,2	0,5	0,1	0,3	6	8
$150 \leqslant d_1 \leqslant 200$	0,2	0,8	0,1	0,4	8	8

[a] The defects should not be closer to an edge than one-half of the maximum permissible size of the defect, with a minimum of 0,2.

[b] Does not apply to inside gap edges of piston rings with internal notch.

[c] Spacing includes defects on adjacent or opposite surfaces.

4.3 Scratches, indentations, depressions and cracks

4.3.1 Scratches

Isolated scratches are permissible provided that:

— no burrs are produced exceeding the permissible values given in 4.4.1.1;

— on turned peripheral surfaces, they are not deeper than the tool marks;

— on non-turned peripheral surfaces, they are not deeper than 0,004 mm;

— on the side faces, they are not deeper than 0,01 mm;

— on other surfaces, they are not deeper than 0,06 mm.

4.3.2 Indentations, depressions

Indentations and depressions are permissible provided that:

— the values given in Table 1 for number and spacing of defects are met;

— no burrs are produced exceeding the permissible values given in 4.4.1.1;

— they do not exceed the values for size and depth given in Table 2.

Rings of a plated/coated/nitrided type shall not have indentations or depressions on the periphery.

NOTE Indentations arising from hardness measurements on the side faces are acceptable provided that they do not exceed the limits given in Tables 2 and 11.

4.3.3 Cracks

No cracks are permissible.

See also 4.5.4 for chromium-plated peripheral surfaces and 4.5.6 for nitrided surfaces.

Table 2 — Permissible size of indentations and depressions

Dimensions in millimetres

Nominal diameter d_1	Defect size max.		Depth max.
	On peripheral surface	On side face	
$30 \leqslant d_1 < 100$	0,3	0,6	10 % of corresponding max. defect size
$100 \leqslant d_1 \leqslant 200$	0,5	1	

4.4 Edges

4.4.1 Edge configuration

All edges of the piston ring shall be sharp; ideally, they should be free from burrs and from ragged edges, whether arising from crumbling of material or from deburring. Such conditions are almost impossible to achieve regularly in volume production and hence both burrs and removal of edge material is permitted up to the maximum sizes given in 4.4.1.1 and 4.4.1.2.

4.4.1.1 Burrs

Burrs are permitted up to the maximum values given in Table 3. The orientation and direction of burrs shall relate to the functional surfaces of the piston ring; any burr present should point in the direction of sliding motion of the ring and not normal to the direction of sliding.

Any burrs remaining on the edges of rings should be firmly attached, forming an integral part of the edge.

Table 3 — Permissible size of burrs for all sizes of ring

Dimensions in millimetres

Burrs on edges adjacent to:	Maximum size of burr			
	Cast iron & steel single & 2 piece rings	Expander/segment oil control rings		
		Expander	Plated segment	Nitrided segment
Peripheral surface	0,006	0,01	0,004	0,004
Side faces	0,006	0,01	0,02	0,01
Butt ends (gap surface)	0,04	0,1	0,1	0,04
The outside groove face (oil rings)	0,2	—	—	—
The inside surface and the ends of the slots (oil rings)	0,5	0,5	0,1	0,1
All other surfaces	0,1	0,1	0,1	0,1

4.4.1.2 Edge material removal

To eliminate protruding burrs in any direction, it is permissible to remove material from the edges to the values given in Table 4.

Table 4 — Edge material removal in deburr operations

Dimensions in millimetres

Location of edge	Removal of material max.
On peripheral edges	0,08
On peripheral edges of the gap [a]	0,15
On inside edges of the gap	0,5 in circumferential direction
	0,25 in radial direction
On other edges	0,25

[a] Does not apply to rings which have specified gap edge chamfers.

4.4.2 Chipping and similar defects on peripheral edges, peripheral edges at the gap, outside gap corners and on peripheral chamfers

Chipping and similar defects are permitted at these points provided that:

— they are free of loosely adhering particles;

— no burrs are produced exceeding the values permitted in 4.4.1.1;

— they do not exceed half the width of any witness land on, for example, taper-faced rings;

— they do not exceed the values given in the following tables:

  — Table 5 for plain rings;

  — Table 6 for chromium plated or nitrided rings;

  — Table 7 for spray coated rings;

  — Table 8 for chamfers on all rings.

Typical defects are illustrated in Figures 1 to 6.

K_1, K_2, K_3 are always the dimensions of the defect measured along the edge cut by the defect.

F_1, F_2, F_3 are always the dimensions of the defect measured from normal to the edge cut by the defect.

However, when chipping or other defects occur on outside gap corners, i.e. when the defect crosses the intersecting edges of the peripheral edge and the peripheral edge of the gap, a convention is required.

The defect is taken as appropriate to the edge that contains the larger amount of the defect. For example, in Figure 3, most of the left side defect is on the peripheral edge and therefore the defect is appropriate to that edge. Hence, the K value lies along the peripheral edge and is denoted K_3 while the F value, although it lies along the peripheral edge of the gap, is taken as the dimension, measured normal to the peripheral edge and is denoted F_3.

In the case of the defect on the right side corner, most of the defect lies along the peripheral edge of the gap and the defect is therefore appropriate to this edge. The measurement K_3 in this case is therefore measured along the peripheral edge of the gap and F_3 is its dimension normal to the edge of the gap.