
**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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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This fourth edition cancels and replaces the third edition (ISO 6621-5:2013), which has been technically revised.

The main changes compared to the previous edition are as follows:

- changed procedure for counting defects.

A list of all parts in the ISO 6621 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is one of a number of series of International Standards dealing with piston rings for reciprocating internal combustion engines.

The common features and dimensional tables presented in this document 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 should also refer 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 document, 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.

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Internal combustion engines — Piston rings —

Part 5: Quality requirements

1 Scope

This document specifies quality aspects that can be defined but that are 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; and
- 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 some of the limits of acceptance relating to inspection measuring principles (covered by ISO 6621-2), this document also covers those features for which no recognized quantitative measurement procedures exist and which are only checked visually with normal eyesight (glasses 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 document does not establish acceptable quality levels (AQL), it being left to manufacturer and customer to decide the appropriate levels jointly. In this case, the recommendations of ISO 2859-1 are followed.

This document specifies the quality requirements of piston rings for reciprocating internal combustion engines for road vehicles and other applications. It is applicable to all such rings of a nominal diameter from 30 mm up to and including 200 mm.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6621-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

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				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		
$30 \leq d_1 < 60$	0,1	0,3	0,1	0,1	2	4
$60 \leq d_1 < 100$	0,15	0,5	0,1	0,2	4	4
$100 \leq d_1 < 150$	0,2	0,5	0,1	0,3	6	8
$150 \leq d_1 \leq 200$	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 mm.

^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; and
- 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](#); and
- 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 in the base material.

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	
$30 \leq d_1 < 100$	0,3	0,6	10 % of corresponding max. defect size
$100 \leq d_1 \leq 200$	0,5	1	

4.4 Edges

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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:	Cast iron and steel single and 2-piece rings	Maximum size of burr		
		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
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Dimensions in millimetres

Location of edge	Removal of material
On peripheral edges	max. 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 and peripheral edges at the gap.

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 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 PVD (excluding DLC) coated rings;
 - [Table 9](#) for chamfers on all rings.

Typical defects are illustrated in [Figures 1](#) and [2](#).

L_1 is always the length dimension of a defect that intersects with the ring face and measured parallel to the gap edge cut by the defect (axial defect).

L_2 is always the length dimension of a defect that intersects with the ring face and measured parallel to the side edge cut by the defect (circumferential defect).

L_3 is always the length dimensions of a defect that does not intersect with the ring face.

W is always the width dimension of the defect measured perpendicular to the length of the defect.

The limitations for chipping and similar defects on peripheral edges, peripheral edges of the gap and opposite gap corners are given in 4.4.2.1 to 4.4.2.3.

4.4.2.1 Defects that intersect with the peripheral edge in the circumferential direction.

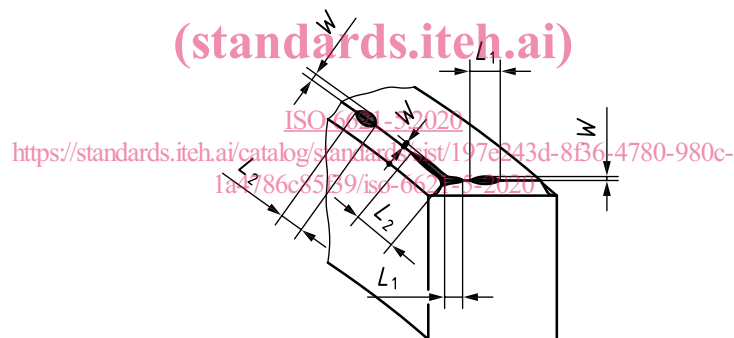
Defects to be included in the assessment of the peripheral edge are all values of L_2 as well as the W , for example the left-hand defect illustrated in Figure 1.

Maximum sizes are given in Tables 5, 6, 7 and 8 (peripheral edge column).

4.4.2.2 Defects that intersect with the peripheral edge along the axial direction of the gap

Defects to be included in the assessment of the peripheral edges of the gap are all values of L_1 as well as the W , for example the right-hand defect illustrated in Figure 1.

Maximum sizes are given in Tables 5, 6, 7 and 8 (peripheral edge of gap column).



Key

- L_1 length dimension of the defect measured parallel to the gap edge cut by the defect
- L_2 length dimension of the defect measured parallel to the side edge cut by the defect
- W width dimension of the defect measured perpendicular to the length of the defect

Figure 1 — Chipping on peripheral edges and peripheral edges of the gap