INTERNATIONAL STANDARD

ISO 6621-2

Third edition
2020-03

Internal combustion engines — Piston rings —

Part 2: Inspection measuring principles

Moteurs à combustion interne — Segments de piston —

Partie 2: Principes de mesure pour inspection

Reference number
ISO 6621-2:2020(E)

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Published in Switzerland

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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).

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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.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 34, *Propulsion, powertrain and powertrain fluids*.

This third edition cancels and replaces the second edition (ISO 6621-2:2003), which has been technically revised.

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

— Oil ring diameter range for ring widths 3,0 mm and 3,5 mm increased up to 160 mm.

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 International Standards dealing with piston rings for reciprocating internal combustion engines. Others are ISO 6621-1, ISO 6621-3, ISO 6621-4, ISO 6621-5, 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 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.

It is also essential that the designer refer to the specifications and requirements of ISO 6621-3 and ISO 6621-4 before completing their selection.

Internal combustion engines — Piston rings —

Part 2: Inspection measuring principles

1 Scope

This document defines the measuring principles to be used for measuring piston rings; it applies to piston rings up to and including 200 mm diameter for reciprocating internal combustion engines.

This document can be used for piston rings for compressors working under analogous conditions.

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 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

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

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*

3 Terms and definitions

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

3.1
h_1
distance between the sides, at any particular point perpendicular to the reference plane measured in millimetres

Note 1 to entry: See Figures 1 and 2.

3.2
***h*$_3$**
distance between the sides at a specified distance a_6 from the peripheral surface.

Note 1 to entry: See Figure 4.

Note 2 to entry: Alternatively, the ring width is controlled by a_6 at a specified width h_3 (see Figure 6).

3.3
radial wall thickness
a_1
radial distance between the peripheral surface and the inside surface of the ring measured in millimetres

Note 1 to entry: See Figure 7.

3.4
total free gap
m
p
chordal distance between the gap ends of the ring in a free unstressed state, measured at the centre line of the *radial wall thickness* (3.3)

Note 1 to entry: See Figure 10.

Note 2 to entry: For rings with an internal notch for a peg, the total free gap is defined by the chordal distance marked as *p* in Figure 11.

Note 3 to entry: The total free gap is measured in millimetres.

3.5
closed gap
s_1

distance between the gap ends of the ring measured at the narrowest point, which the ring would have when fitted in a gauge of nominal cylinder bore size

Note 1 to entry: See Figure 12.

Note 2 to entry: The closed gap s_1 is related to the nominal diameter d_1.

3.6
tangential force
F_t
force necessary to maintain the ring at the *closed gap* (3.5) condition by means of a tangential pull on the ends of a circumferential metal tape or hoop

Note 1 to entry: See Figures 13 to15.

Note 2 to entry: Tangential force is measured in Newtons.

Note 3 to entry: For single-piece rings, it is not recommended for rings $d_1 < 50$mm; for these rings, see 4.2.6.

Note 4 to entry: For multi-piece rings, vibration is used to reduce friction during or prior to measurement.

3.7
diametral force
F_d
force, acting diametrically at 90° to the gap, necessary to maintain the ring at the nominal diameter condition measured in the direction of the force

Note 1 to entry: See Figure 20.

Note 2 to entry: This method is only applicable to single-piece rings.

Note 3 to entry: Diametral force is measured in Newtons.

3.8
ovality
U
difference between the mutually perpendicular diameters d_3 and d_4 when the ring is drawn to a *closed gap* (3.5) within a flexible tape

Note 1 to entry: It can be either positive ($d_3 > d_4$) or negative ($d_3 < d_4$) (see Figure 21).

Note 2 to entry: This method is only applicable to single-piece rings.

Note 3 to entry: Ovality is measured in millimetres.

3.9
point deflection
W
deviation of the butt ends from the true circle when restrained in a gauge of nominal cylinder bore diameter

Note 1 to entry: See Figure 22.

Note 2 to entry: Point deflection is measured in millimetres.

3.10
light tightness
ability of the peripheral surface of a ring when mounted in a gauge of nominal cylinder bore diameter to exclude the passage of light

Note 1 to entry: See Figure 23.

Note 2 to entry: Areas of the ring showing pinpoint, burry or fuzzy light shall be considered as light tight.

Note 3 to entry: Light tightness is measured in percentage of ring circumference.

3.11
taper on peripheral surface
intentional angular deviation of the peripheral surface from a line perpendicular to the reference plane

Note 1 to entry: See Figure 24.

Note 2 to entry: In the case of the taper faced peripheral surface with partly cylindrical area both measuring points shall be placed on the taper area.

Note 3 to entry: Taper on peripheral surface is measured in micrometres or degrees.

3.12
barrel on peripheral surface
intentional convex deviation of the peripheral surface from a line perpendicular to the reference plane

Note 1 to entry: See Figure 26 for a symmetrical barrel and Figure 28 for an asymmetrical barrel.

Note 2 to entry: t_2 is used for lower barrel face and t_3 for upper barrel face.

Note 3 to entry: Barrel on a peripheral surface is measured in millimetres.

3.13
land width
h_4
h_5
width of the land which theoretically should be in contact with the cylinder bore

Note 1 to entry: See Figure 29.

Note 2 to entry: Land width is measured in millimetres.

3.14
land offset
displacement of the two peripheral surfaces of a slotted or drilled oil control ring in relation to each other in a radial direction

Note 1 to entry: See Figure 31.

Note 2 to entry: Land offset is measured in millimetres.

3.15
plating/coating thickness
distance between the outer surface of the plating/coating and the surface of the base ring material connected with the different configurations of platings/coatings

Note 1 to entry: See Figure 33.

Note 2 to entry: Plating/coating thickness is measured in millimetres.

3.16
nitrided case depth
thickness of the surface layer with a hardness value ≥700 HV 0,1 measured perpendicular to the ring peripheral surface or side faces.

Note 1 to entry: See Figures 34 and 35.

Note 2 to entry: Nitrided case depth is measured in millimetres.

3.17
keystone angle
angle enclosed by the two sides of the ring or alternatively, the sum of both side face angles, i.e. included angle

Note 1 to entry: See Figure 36.

Note 2 to entry: Keystone angle is measured in degrees.

3.18
obliqueness
unintentional deviation of the bisector of the keystone included angle from parallelism with the reference plane

Note 1 to entry: Not applicable to rings with designed *twist* (3.19).

Note 2 to entry: See Figure 42.

Note 3 to entry: Obliqueness is measured in degrees.

3.19
twist
intentional torsional deviation of the section of the ring from the reference plane when the ring is restricted to nominal diameter, as in the case of asymmetrical rings such as those internally or externally stepped or bevelled

Note 1 to entry: See Figure 43.

Note 2 to entry: Twist is measured in millimetres.

3.20
unevenness
Te
unintentional deviation of the sides of the ring from parallelism to the reference plane, i.e. twisted or dished rings

Note 1 to entry: See Figures 46 and 48.

Note 2 to entry: Not applicable to rings with designed *twist* (3.19), as covered by 4.2.18.

3.21
helix
displacement of the gap ends perpendicular to the reference plane

Note 1 to entry: See Figure 51.

Note 2 to entry: Helix is measured in millimetres.

3.22
free flatness
relationship between the ring in the free state and a plane parallel to its reference plane

Note 1 to entry: Free flatness is measured in millimetres.

3.23
circumferential waviness
three or more lobes showing a continuous pattern of peaks and valleys spaced at a set frequency circumferentially around the bottom side face of the ring

Note 1 to entry: Circumferential waviness is measured in micrometres.

4 Measuring principles

4.1 General measuring conditions

The following general requirements are applicable to all measuring principles unless otherwise specified:

a) the ring shall rest on the reference plane in the free or open condition. No additional force shall be applied to load the ring on the reference plane; except when measuring "unevenness" in accordance with 4.2.19 or "helix" in accordance with 4.2.20;

b) certain measurements are made with the ring in the closed condition in a gauge of nominal cylinder bore diameter. When orientated rings are measured in this way, they shall be so placed that the top side of the ring is towards the reference plane;

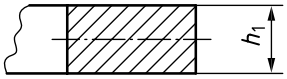
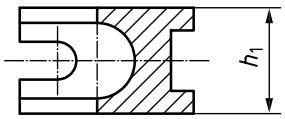
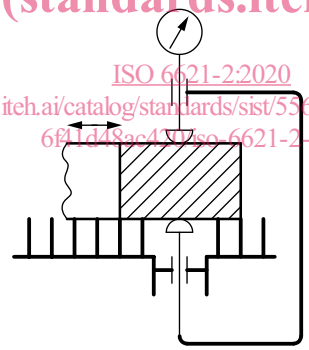
c) measurements shall be made using instruments with a resolution not to exceed 10 % of the tolerance of the dimension being measured.

For further terms and definitions see ISO 6621-1.

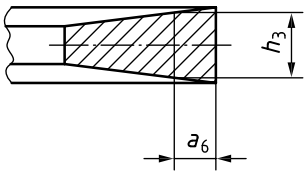
4.2 Characteristics and measuring principles

4.2.1 Ring width

4.2.1.1 Parallel sided rings, h_1 (in millimetres)

Measuring principle
Measure with spherical measuring probes each of radius 1,5 mm ± 0,05 mm, exerting a measuring force of approximately 1 N (see Figure 3). In the case of slotted oil rings, the measurement shall be made between the slots and not across them (see Figure 2).  **Key** h_1 ring width **Figure 1**
 **Key** h_1 ring width **Figure 2**
 **Figure 3**

4.2.1.2 Keystone rings, half keystone rings, h_3

Measuring principle
Method A This method determines h_3 for a specified value of a_6 (see Figure 4).  **Key** h_3 keystone ring width a_6 keystone ring depth **Figure 4**