INTERNATIONAL STANDARD

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Second edition
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Internal combustion engines — Piston pins —

Part 2: Inspection measuring principles

Moteurs à combustion interne — Axes de pistons —

Partie 2: Principes de mesure pour le contrôle

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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).

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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 second edition cancels and replaces the first edition (ISO 18669-2:2004), which has been technically revised.

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

— the scope has been defined more in detail; and

— references have been updated.

A list of all parts in the ISO 18669 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.

Internal combustion engines — Piston pins —

Part 2: Inspection measuring principles

1 Scope

This document defines the measuring principles used for measuring piston pins; it applies to piston pins with a nominal outer diameter from 8 mm up to and including 100 mm, for reciprocating internal combustion engines for road vehicles and other applications.

In certain applications, except road vehicles, and provided that mutual agreement is made between the purchaser and the manufacturer, this document can be used with suitable modifications.

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 1302, *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation*

ISO 18203, *Steel — Determination of the thickness of surface-hardened layers*

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 9934 (all parts), *Non-destructive testing — Magnetic particle testing*

ISO 6506 (all parts), *Metallic materials — Brinell hardness test*

ISO 6507 (all parts), *Metallic materials — Vickers hardness test*

ISO 6508 (all parts), *Metallic materials — Rockwell hardness test*

ISO 8015, *Geometrical product specifications (GPS) — Fundamentals — Concepts, principles and rules*

ISO 14104:2017, *Gears — Surface temper etch inspection after grinding, chemical method*

ISO 14253 (all parts), *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment*

ISO 15548 (all parts), *Non-destructive testing — Equipment for eddy current examination*

ISO 16810, *Non-destructive testing — Ultrasonic testing — General principles*

ISO 18265, *Metallic materials — Conversion of hardness values*

ISO 18669-1:2013, *Internal combustion engines — Piston pins — Part 1: General specifications*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
outside diameter
d_1
diameter of the outer surface measured at any point excluding areas of *edge drop-off (b)* (3.5)

Note 1 to entry: See ISO 18669-1:2013, Figure 12.

3.2
cylindricity of the outside diameter
CYLt
peak-to-valley cylindricity deviation; geometric form of the peripheral surface excluding areas of *edge drop-off (b)* (3.5)

Note 1 to entry: Characteristics measured in the axial direction are taper, convexity, concavity and waviness.

Note 2 to entry: See ISO 1101.

3.3
circularity of the outside diameter
RONt
peak-to-valley roundness deviation; deviations of the peripheral surface from circularity such as waviness, ovality and spherical-triangular forms

Note 1 to entry: See ISO 1101.

3.4
circumferential waviness
undulations of the peripheral surface from circularity in a waveform

3.5
edge drop-off
b
c
geometric form of the peripheral surface at the outside edges

3.6
inside diameter
d_2
d_4
diameter of the bore measured at any point

3.7
concentricity of inside diameter relative to outside diameter
difference between the maximum and minimum dimensions of the wall thickness (*a*) as measured in a plane perpendicular to the peripheral surface

Note 1 to entry: See ISO 1101.

3.8
length
l_1
Maximum dimension measured between two planes perpendicular to the peripheral surface.

3.9
gauge length
l_5
dimension between the gauge points measured perpendicular to the peripheral surface

3.10
runout of the end faces
axial distance between two circles located concentrically to the axis of the piston pin

Note 1 to entry: All points of the end face of the piston pin must lie during rotation around the axis.

3.11
end face diameter
d_6
maximum diameter of end face concavity or end face step

3.12
outside-edge profile
transition from the peripheral surface to the end face of piston pin

3.13
inside chamfer
t_1
transition from the inside cylindrical surface to the end face

3.14
tapered bore diameter
d_3
diameter of the taper at the end face

3.15
tapered bore angle
α
angle of inclination measured from the peripheral surface

3.16
runout tapered bore
e
concentricity of the tapered bore to the *outside diameter* (3.1)

3.17
carburised and nitrided case depth
thickness of the surface layer with a hardness value which is greater than the limit hardness *Hs*, measured perpendicular to the piston pin peripheral surface or bore surface on the finish-machined piston pin

3.18
core hardness
hardness in the core zone that is not affected by the case-hardened or the nitrided layer

3.19
peripheral surface hardness
hardness measured on the peripheral surface of the carburised or nitrided layer

3.20
volume change
change in volume detected as a permanent outside-diameter dimensional deviation at reference temperature after being heated to a test temperature for a specified period of time

3.21
material defect
defects occurring on the peripheral surface, bore surface and core zone

EXAMPLE Grinding cracks, hardening cracks, stress cracks, inclusions, slag lines and seams.

3.22
residual magnetism
remaining magnetism after demagnetisation

3.23
visual defect
visible defects detected without magnification, by inspectors having normal eyesight (corrected if necessary) or detected automatically with opto-electronic systems

3.24
grinder burn
localised over- heating on ground surfaces, resulting in surface tempering and/or reheating with measurable changes in surface hardness

3.25
streaks on bore surface
forming streaks on bore surface of cold-formed end-web pins

4 Measuring principles

4.1 General measuring conditions

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

a) Measurements shall be made using instruments with a resolution not exceeding 10 % of the tolerance of the dimension being measured.

b) “Measuring uncertainty” according to the ISO 14253 series shall apply.

c) “Measurement systems analysis” reference AIAG IATF 16949 applies.

d) The reference temperature for outside-diameter measurements shall be 20 °C ± 1 °C.

e) The "principle of independence" according to ISO 8015 shall apply.

f) **Other methods** which are able to guarantee the required measurement accuracy are allowed with prior agreement between manufacturer and customer.

4.2 Characteristics and measuring principles

4.2.1 Outside diameter, d_1

Measuring principle
— Reference method: Measure with a precision calliper having spherical measuring probes each of radius 1,5 mm min. exerting a measuring force of approximately 1 N (see Figure 1).

Measuring principle

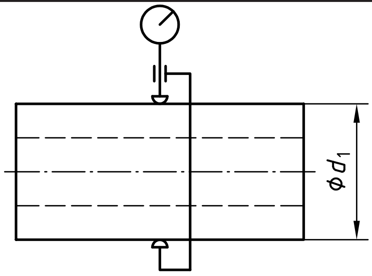



Figure 1 — Outside-diameter measuring principle
Measurement uncertainty:
±0,000 5 mm in accordance with the ISO 14253 series.

4.2.2 Cylindricity of the outside diameter (d_1)

Measuring principle
Record and evaluate multiple polar diagrams (measuring in a minimum of 3 planes, centre of pin and near each end avoiding edge features), in accordance with ISO 12180.
Reference cylinder: Least squares (LSCY)
Filter: Gaussian (G)
Stylus tip radius: 1,0 mm
Undulations per revolution (UPR): 1 - 50

4.2.3 Circularity of the outside diameter (d_1)

Measuring principle
Recording and evaluation of a macro-form diagram in the circumferential direction avoiding edge features (polar diagram), in accordance with ISO 12181.
Reference circle: Least squares (LSCI)
Filter: Gaussian (G)
Stylus tip radius: 1,0 mm
Undulations per revolution (UPR): 1 – 50

4.2.4 Circumferential waviness

Measuring principle
Recording circumferential undulations on the OD surface.
Reference circle: Least squares (LSCI)
Filter: Gaussian (G)
Stylus tip radius: 1,0 mm
Undulations per revolution (UPR): 1 – 50
Analysis method A: Sector roundness
Departure from true circle (DFTC) within a defined angular window (example: 15° or 30° DFTC window).
Analysis method B: Filtered bandwidth
Peak-to-valley roundness deviation (RONt) with defined band pass filtering (example: 10 – 50 UPR or 15 – 50 UPR).
Analysis method C: Dominant roundness waviness
Dominant roundness waviness (RONWDt) with defined band pass filtering (example: 10-50 UPR or 15-50 UPR).

4.2.5 Edge drop-off, *b, c*

Measuring principle
Record and evaluate a macro-form diagram on both ends in the axial direction (profile lines), (see ISO 18669-1:2013, Figure 12).

4.2.6 Inside diameter, d_2, d_4

Measuring principle
Measured with inside measuring devices.

4.2.7 Concentricity of inside diameter (ID) relative to outside diameter (OD)

Measuring principle
Method A:
Measured with a thickness gauge (e.g. dial calliper or comparable gauges) (see Figure 2).

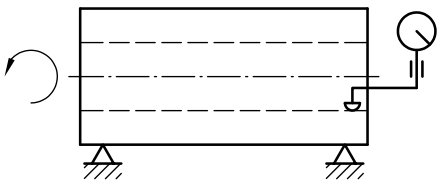


Figure 2 — Inside-diameter concentricity (Radial runout)

Method B:
Measured with a calliper or probe-indicator by 360° rotation in a V-block (see Figure 3).

Measuring principle

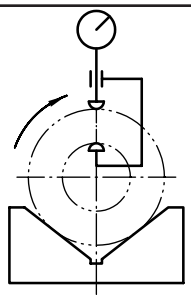
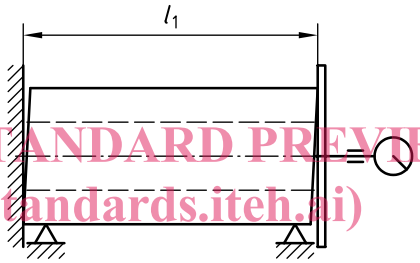
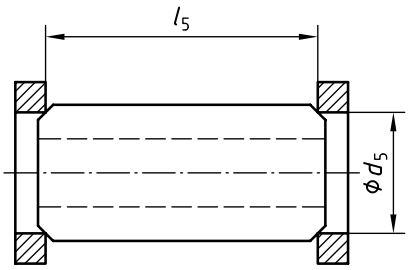



Figure 3 — Wall-thickness measuring principle

4.2.8 Length, l_1

Measuring principle
Reference method: Measured between two planes parallel to each other and perpendicular to the outside surface (see Figure 4). The envelope principle according to ISO 14405-1 (see Bibliography) does not apply.
   **Figure 4 — Length measuring principle**
When using other methods, the runout shall be considered to determine the total length of the pin.

4.2.9 Gauge length, l_5

Measuring principle
The pin is put between two ring gauges perpendicular to the outside surface, with inside diameters d_5. The sharp edges of these gauges measure from contact point to contact point. This “assembly” of pin and two rings is put in a height gauge and measured. A known standard is used to set the gauge at “0” (see Figure 5).
 **Figure 5 — Gauge-length measuring principle**
NOTE Other lengths: all methods which are able to measure the characteristics according to specification.