

~~ISO/DIS~~ **FDIS 18669-2:2024(E)**

~~ISO/TC.22/SC.34/WG.9~~

~~Date: 2022-01-25~~

Secretariat: ANSI

Date: 2024-09-25

**Internal combustion engines — Piston pins — 2**

**Part 2:  
Inspection measuring principles**

*Moteurs à combustion interne — Axes de pistons —*

*Partie 2: Principes de mesure pour le contrôle*

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Published in Switzerland

iTeh Standards  
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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](http://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](http://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](http://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 18669-2:2020), which has been technically revised.

The main changes are as follows:

- ~~Updated~~ the reference for material defects by eddy current inspection ~~to match changes to part has been updated to align with ISO 18669-1 of the standard.~~

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](http://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~~ 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 agree, 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 ~~4287~~21920-1, *Geometrical Product Specifications (GPS) — Surface texture: Profile ~~method~~ — Part 1: Indication of surface texture*

ISO 21920-2, *Geometrical Product Specifications (GPS) — Surface texture: Profile — Terms, definitions and surface texture parameters*

ISO ~~4289~~21920-3, *Geometrical Product Specifications (GPS) — Surface texture: Profile ~~method~~ — Rules and procedures for the assessment of surface texture — Part 3: Specification operators*

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 ~~12181~~12180-2, *Geometrical product specifications (GPS) — ~~Cylindricity~~ — Part*

*ISO 12181-2, Geometrical product specifications (GPS) — Roundness — Part*

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

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

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

ISO 18669-1:2021, *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 terminology databases for use in standardization at the following addresses:

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

#### 3.1 outside diameter

**OD**

$d_1$   
diameter of the outer surface measured at any point excluding areas of *edge drop-off* (b) ~~(3.5)~~(3.5)

Note 1-to-entry: See ISO 18669-1:2021, 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)~~(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

**RQNs**

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**

ID

$d_2$

$d_4$

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**

$s$

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 around the axis 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**

$\alpha$   
angle of inclination measured from the peripheral surface

**3.16 runout tapered bore**

$e$   
concentricity of the tapered bore (3.26) to the outside diameter (~~3.1~~)(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,  $H_s$ , 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 within the whole volume and on surfaces of the pin-

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~~marks on bore surface of cold-~~formed~~ end-web pins

3.26

**tapered bore**

pin with conical-shaped inside diameter near the ends that reduces the weight of the piston pin

[SOURCE: ISO 18669-1:2021, 3.2.1.3]

**4 Measurement principles**

**4.1 General measuring conditions**

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

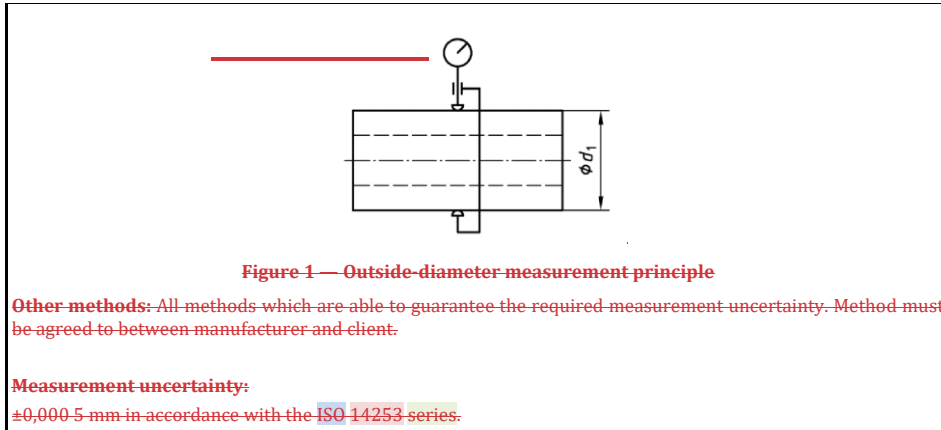
- a) ~~a)~~ Measurements shall be made using instruments with a resolution not exceeding 10 % of the tolerance of the dimension being measured.
- b) ~~b)~~ "Measurement uncertainty" according to the ISO 14253 series shall apply.
- c) ~~c)~~ "Measurement systems analysis" reference AIAG IATF 16949 applies.
- d) ~~d)~~ The reference temperature for outside-~~diameter~~ measurements shall be 20 °C ± 1 °C.
- e) ~~e)~~ The "principle of independence" according to ISO 8015 shall apply.
- f) ~~f)~~ Other methods ~~which are able to~~that can guarantee the required measurement accuracy are allowed with prior agreement between manufacturer and customer.

**4.2 Characteristics and measurement principles**

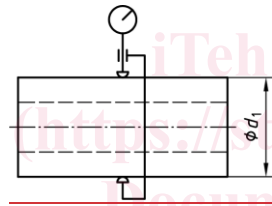
**4.2.1 Outside diameter,  $d_1$**

ISO/FDIS 18669-2

Measurement principle
<del>Reference method:</del>  Measure with a precision calliper having spherical measuring probes each of radius 1.0 mm min. exerting a measuring force of approximately 1 N (see Figure 1).



Reference method: Measure with a precision calliper having spherical measuring probes each of radius 1,0 mm min. exerting a measuring force of approximately 1 N (see Figure 1).



**Figure 1 — Outside-diameter measurement principle**

Other methods: Any method that can guarantee the required measurement uncertainty. The manufacturer and the client shall agree on the method.

The measurement uncertainty is  $\pm 0,000\ 5$  mm according to the ISO 14253 series.

#### 4.2.2 Cylindricity of the outside diameter ( $d_1$ )

Measurement 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 to 50

Record and evaluate multiple polar diagrams (measuring in a minimum of three planes, centre of pin and near each end avoiding edge features), in accordance with ISO 12180-2.

This method has the following parameters: