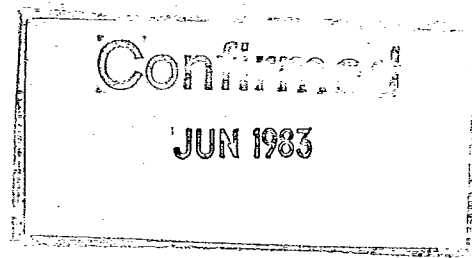




BS 5341 : Part 4 : 1976

UDC 621.431.3 - 242.3 : 531.7



Specification for
**Piston rings up to 200 mm diameter for
reciprocating internal combustion engines**

Part 4. Measuring and testing procedures

Segments de pistons jusqu'à 200 mm de diamètre
pour moteurs alternatifs à combustion interne
Partie 4. Procédés de mesure et d'essai

Kolbenringe mit Durchmesser bis 200 mm für Kolbenmotoren
Teil 4. Mess-und Prüfverfahren

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Foreword

This British Standard was prepared under the authority of the Mechanical Engineering Standards Committee and specifies, in metric units, the data for a complete range of rationalized sizes for standard types of piston rings for reciprocating internal combustion engines.

It has been prepared primarily to provide a basis for rationalization of sizes, materials and other characteristics of piston rings and incorporates current good practice used within the internal combustion engines industry. This standard supersedes BS 3627 'Dimensions of compression and oil control rings and piston ring grooves for i.c. engines' (in imperial units) which, however, will be retained until such time as it is no longer required by industry.

In the preparation of this standard consideration was given to the equivalent German DIN Standards for piston rings for automotive engineering.

The standard is prepared in five Parts. Other Parts of the standard are:

- Part 1 Designs, dimensions, materials and designations for single piece rings;
- Part 2 Designs, dimensions, materials and designations for multi-piece oil control rings*;
- Part 3 Quality requirements*;
- Part 5 Ring grooves.*

* In course of preparation.

British Standard Specification for Piston rings up to 200 mm diameter for reciprocating internal combustion engines

Part 4. Measuring and testing procedures

1. Scope

This Part of BS 5341 defines all the attributes of piston rings, and specifies the basic methods used for measuring piston rings.

NOTE. Other reference methods may be used in production.

2. References

The titles of the standards publications referred to in this standard are given on the inside back cover.

3. Definitions

For the purposes of this Part of BS 5341 the following definitions apply. Nomenclature for piston ring types and for piston and ring details are given in figures 1 and 2.

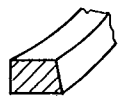
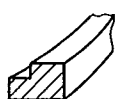
- 3.1 single piece ring.** A ring comprising only one part which is intended for assembly in a single ring groove.
- 3.2 multi-piece ring.** A ring comprising two or more component parts which are intended for assembly in a single ring groove.
- 3.3 ring groove.** The groove into which the piston ring is fitted.
- 3.4 compression ring.** A ring intended primarily to prevent the leakage of gas past the piston in either direction.
- 3.5 oil control ring.** A ring having oil return slots or equivalent and intended for scraping splashed oil from the cylinder wall and returning it to the sump.
- 3.6 scraper ring.** A ring which does not have slots but which is intended primarily to scrape oil from the cylinder wall. It can also act as a lower compression ring.
- 3.7 nominal cylinder bore and ring diameter (symbol d_1).** The minimum cylinder bore diameter.
- 3.8 bore gauge.** A ring gauge having an inside diameter of nominal (minimum) cylinder bore diameter.
- 3.9 modulus of elasticity. (E_n value)** The nominal calculated value based on a ring test.
- 3.10 closed gap (symbol s_1).** The gap at the butt ends of the ring, measured at standard temperature at the narrowest point of the gap, which the ring would have when fitted into a bore gauge of nominal (minimum) cylinder bore diameter, to allow for thermal circumferential expansion in service.
- 3.11 butting.** That which occurs when the ends of the ring touch.
- 3.12 total free gap (symbol p).** The distance between the butt ends of the ring in a free unstressed state measured at the inner edges of the butt ends.
- 3.13 effective free gap (symbol g_f).** The total free gap minus the mean closed gap s_1 . It is the free gap used in the formulae for the calculations of E_n value, tangential and diametral forces and closing stress.
- 3.14 joint.** The joint at the butt ends of the ring.
- 3.15 negative point deflection (toe-in) (symbol W).** The deviation of the butt ends inside a true circle when the ring is restrained to the nominal diameter and is unsupported near the butt ends within a specified arc.
- 3.16 positive ovality (high points) (symbol V).** The difference by which the diameter, measured at the gap, is greater than the diameter measured at 90° to the gap with the ring compressed to closed gap within a tape.
- 3.17 negative ovality (low points) (symbol Y).** The difference by which the diameter, measured at the gap, is less than the diameter measured at 90° to the gap with the ring compressed to closed gap within a tape.
- 3.18 pressure pattern.** The polar diagram of the radial pressure distribution around the circumference of the ring when closed in its nominal cylinder bore.
- 3.19 pin point or burry light.** Intermittent pin points of bright light or hazy light, and not bright direct light.
- 3.20 datum surface.** The plane on which the unloaded ring lies in its free state for measurements, except where otherwise specified.
- 3.21 twist (dish).** The deviation of the section of ring from the datum surface when ring is restrained to nominal diameter. It can be intentional (as in the case of asymmetrical rings, such as those internally stepped) or unintentional (as in the case of symmetrical rings, such as plain compression).
- 3.22 wind.** Circumferential twist or relative displacement of butt ends in the axial direction.
- 3.23 witness land.** A small land of approximately 0.25 mm, lapped on the periphery of a taper faced ring or twist type ring, which can be just seen or witnessed around the circumference with normal vision.
- 3.24 sticking.** The filling of the ring side clearance, resulting in the loss of free movement of the ring in its groove.
- 3.25 scuffing.** The partial welding and tearing of the ring periphery and the cylinder bore resulting from breakdown of the oil film. Scuffed peripheries have a torn or smeared appearance, usually accompanied by a discolouration of the lacerated portions.
- 3.26 blowby.** The escape of gas from the combustion chamber, past the rings and into the crankcase.
- 3.27 tangential and diametral force.** See 4.9 to 4.12.

NOTE. Other terms which are not defined in clause 3 are, together with their symbols, given in clause 4.

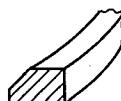


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(a) Compression rings

Plain
(parallel faced)Tapered
(taper faced)Keystone (wedge)
(taper sided)

Internally stepped



Internally bevelled

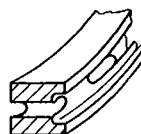
Barrelled
(barrel faced)Barrelled chromium
(barrel faced chromium)Coated
(chromium coated and
molybdenum coated)Inlaid
(chromium inlaid and
molybdenum inlaid)

(b) Scraper rings

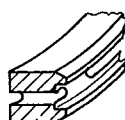
Napier
(undercut step)

Stepped

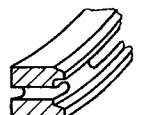
(c) Oil Control rings



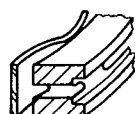
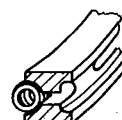
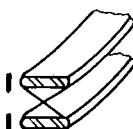
Slotted



Bevelled edge



Double bevelled

Expander spring loaded
(multi-piece, cast iron
part and spring) (see Part 2)Coil spring loaded
(multi-piece, cast iron
part and spring)

Multi-piece steel rail ring

NOTE. Dimensions of single piece and multi-piece rings are given in Parts 1 and 2 respectively

Figure 1. Nomenclature for piston ring types

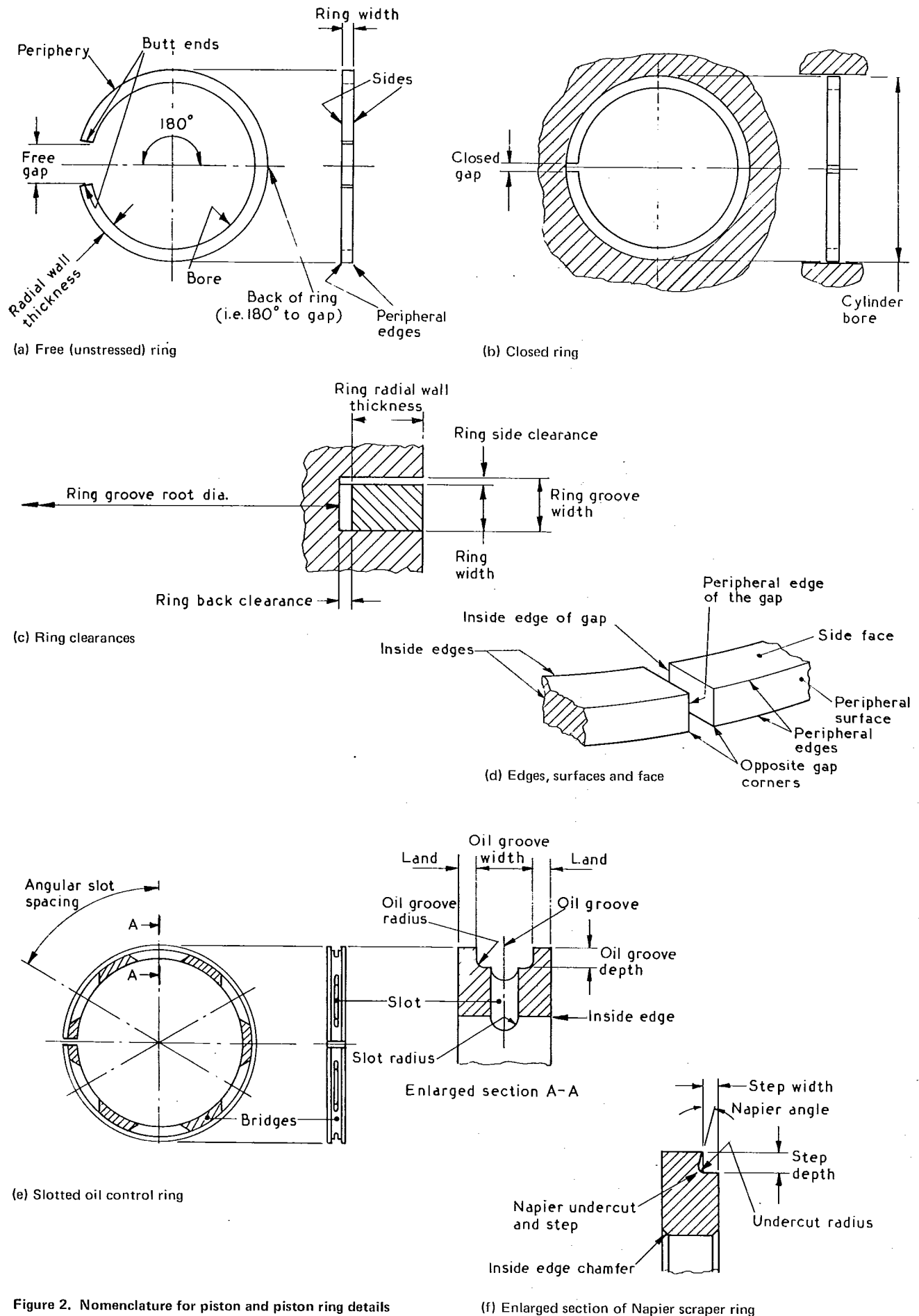


Figure 2. Nomenclature for piston and piston ring details

(f) Enlarged section of Napier scraper ring

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4. Quality characteristics

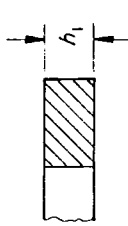
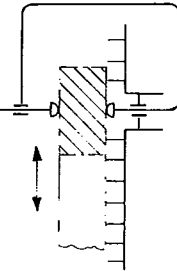
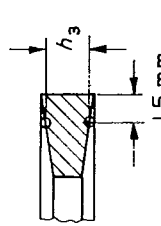
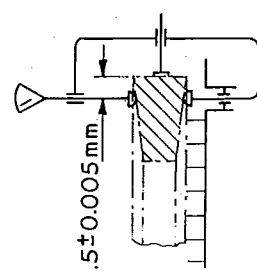
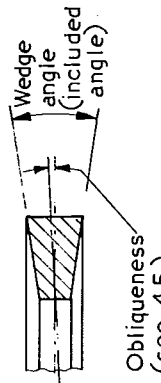
4.1 The piston ring dimensional and physical characteristics listed below shall be determined by the appropriate method specified in 4.2 to 4.27.

Ring characteristic	Symbol	Relevant clause(s)
Nominal diameter*	d_i	4.6 and 4.15
Ring width	h_1	4.2
Keystone (wedge) section width	h_3	4.3
Keystone (wedge) section angle	—	4.4
Obliqueness	—	4.5
Closed gap	s_1	4.6
Radial wall thickness	a_1	4.7
Land widths	h_4 and h_5	4.8
Tangential force	F_t	4.9 and 4.10
Diametral force at diameter	F_d	4.11
Diametral force at gap	F_{ds}	4.12
Ovality	d_3 and d_4	4.13
Point deflection	W	4.14
Light tightness	—	4.15
Coating/inlay thickness	—	4.16
Taper	—	4.17
Radial land offset	—	4.18
Barrel form	t_2 and t_3	4.19
Unevenness of side faces in radial direction	Te_r	4.20
Unevenness of side faces in circumferential direction	Te_u	4.21
Wind or flatness (i.e. axial displacement of butt ends)	—	4.22
Free gap (total)	ρ	4.23
Peripheral contact	—	4.24
Modulus of elasticity	En	4.25
Bending strength	—	4.26
Skin stress	R	4.27

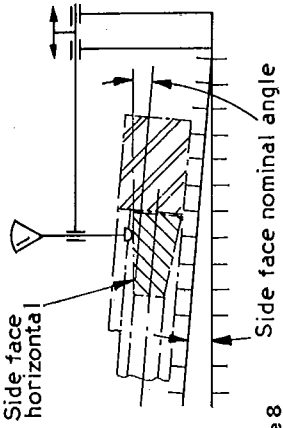
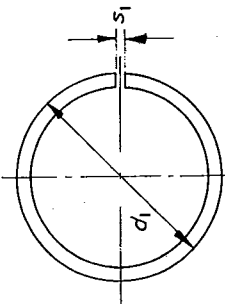
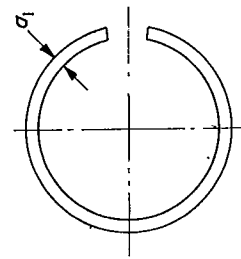
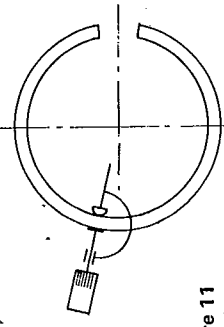
NOTE. It is recommended that inspection procedures should be based on BS 6000.

* Measured when measuring closed gap and light tightness.

4. Quality characteristics (continued)

Term	Definition	Measuring procedure	Figure
4.2 Ring width h_1 (in mm)	The distance between the sides, at any point around the circumference, parallel to the axis of the ring (see figure 3).	Measure with spherical measuring probes each of spherical radius 1.5 mm (see figure 4). In the case of slotted oil control rings, the measurements shall be made between and not across the slots. (See Part 3 of this standard for quality requirements)	 Figure 3  Figure 4
4.3 Keystone (wedge) ring width h_3 (in mm)	The wedge section width (see figure 5) is the axial width of the wedge section ring and is the distance, parallel to the axis of the ring, between two points on the side faces lying at a distance of 1.5 mm from the ring periphery in the axial section.	Measure in the axial section with spherical measuring probes each of spherical radius 1.5 mm (see figure 6). The error occurring when using spherical measuring probes instead of perfectly sharp points is as follows: for 6° wedge angle: $+0.004$ mm for 15° wedge angle: $+0.026$ mm The respective amount is to be added to the h_3 mean width value (obtained from the appropriate dimensional tables in Part 1 of this standard) and included in the width of the parallel slip gauge on which spherical probe dial indicators are set to zero on scale, so that no subsequent deductions will then be necessary on the indicator deviations recorded (i.e. these then being the deviations from the mean h_3 value).	 Figure 5  Figure 6
4.4 Keystone (wedge) section angle (in degrees, minutes)	The wedge angle is the angle between the two sides of the ring (see figure 7), or alternatively, is the sum of both side face angles (i.e. the included angle).	Measure with ring located in a bore gauge of its nominal diameter, and in an angle fixture inclined at the nominal angle between the plane of the ring and its side face, so that at the lowest point the side face is horizontal (see figure 8). By placing this fixture on a surface plate a measuring probe can then be traversed across the ring side face to record any deviation of this and its nominal angle of inclination. Obliqueness is found by checking the angle on both sides of the ring and taking the mean (see 4.5).	 Figure 7

4. Quality characteristics (*continued*)

Term	Definition	Measuring procedure	Figure
4.5 Obliqueness (in minutes)	The deviation of the bisector of the wedge angle from parallelism to the datum surface in the axial section with the ring restrained in a bore gauge of nominal cylinder bore diameter (see figure 7).	Measure in the axial section at the back of the ring (see figure 2(a)) as half the difference between the two side face angles (see figure 8). For rings with a fixed fitting position (e.g. with internal bevel), the following designation is used: descending from the outside to the inside: positive (+); ascending from the outside to the inside: negative (—). The obliqueness for all rings not requiring a particular fitting position i.e. rings not having a mark indicating the top side, shall be stated without sign.	 Figure 8
4.6 Closed gap s_1 (in mm)	The gap at the butt ends of the ring, measured at the narrowest point of the gap, which the ring would have when fitted in a bore gauge of nominal (minimum) cylinder bore size (see figure 9). The closed gap s_1 is related to the nominal diameter d_1 .	Measure in a bore gauge of nominal diameter with feeler gauges. (See Part 3 of this standard for quality requirements.)	 Figure 9
4.7 Radial wall thickness a_1 (in mm)	The radial distance between periphery and internal surface or bore of the ring (see figure 10).	Measure radially to the periphery of the ring between a flat measuring surface outside and a spherical measuring probe inside (see figure 11).	 Figure 10  Figure 11