

Specification for

Spring retaining rings —

Part 4: Carbon steel circlips — metric series

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This British Standard, having been prepared under the direction of the Mechanical Engineering Standards Committee, was published under the authority of the Executive Board on 28 February 1977

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The following BSI references relate to the work on this standard:
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Amendments issued since publication

Amd. No.	Date of issue	Comments
2369	October 1977	Title; Table 1 and Table 2

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Foreword

This Part of BS 3673 has been prepared under the authority of the Mechanical Engineering Standards Committee, and is a revision of the metric series given in BS 3673-1:1968. The metric dimensions given in Part 1 are therefore withdrawn. A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 22, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 3673 relates to internal and external metric series circlips manufactured from carbon steel.

Requirements for material, heat treatment, hardness and manufacture are laid down, together with dimensions and tolerances. The requirements for the finish and testing of the circlips are also given.

2 References

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

3 Definitions and nomenclature

For the purposes of this Part of BS 3673 the nomenclature used for Figure 1 to Figure 3 shall apply together with the following definitions.

3.1

nominal size

the nominal size of a circlip is equal to the nominal diameter of shaft or bore for which the circlip is designed

3.2

radial flatness error (dish)

the minimum distance separating two parallel planes which just contain the sectional profile of a circlip, the free ends of which are positioned in a common plane in order to discount any spiral effect which may be present (see Figure 1)

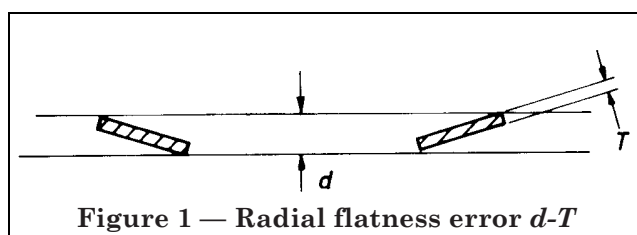


Figure 1 — Radial flatness error $d-T$

3.3

spiral flatness error (helix)

the minimum distance separating two parallel planes, perpendicular to the axis of the circlip, which just contain the circlip, the free ends being mutually displaced by the helix in the circlip (see Figure 2)

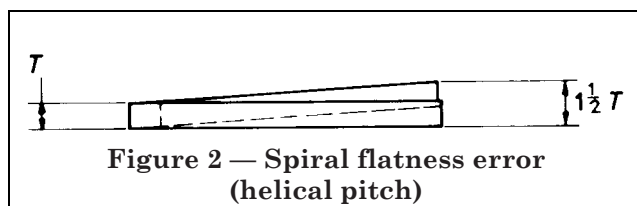


Figure 2 — Spiral flatness error (helical pitch)

3.4

edge margin

the distance from the end of the shaft or bore to the nearest groove wall

3.5

beam

the maximum radial depth of the circlip section

4 Material

Circlips manufactured from cold rolled strip shall be manufactured from strip complying with the requirements of grade 70 or 80 range of BS 1449-1:1972.

Circlips not manufactured from strip should utilize similar material which will ensure that the circlips are capable of satisfying the test requirements of clause 9.

5 Heat treatment and hardness

Circlips shall be austempered or hardened and tempered in accordance with the following hardness ranges.

Size range	Hardness HRC	
	Austempered	Hardened and tempered
mm		
Up to 38	49 to 54	47 to 52
39 to 200	46 to 51	44 to 49
Above 200	42 to 47	40 to 45

When plated finishes are requested by a purchaser the hardness may be modified at the manufacturer's discretion; de-embrittlement treatment shall be given immediately after plating in accordance with BS 1706.

6 Form, dimensions and tolerances

The form, dimensions and tolerances of internal and external circlips shall be as given in Table 1 and Table 2 (see also clause 10).

6.1 Holes (or slots). Each end of each circlip shall have a hole (or, in the case of external circlips, a hole or a slot) in order to facilitate assembly by use of circlip pliers.

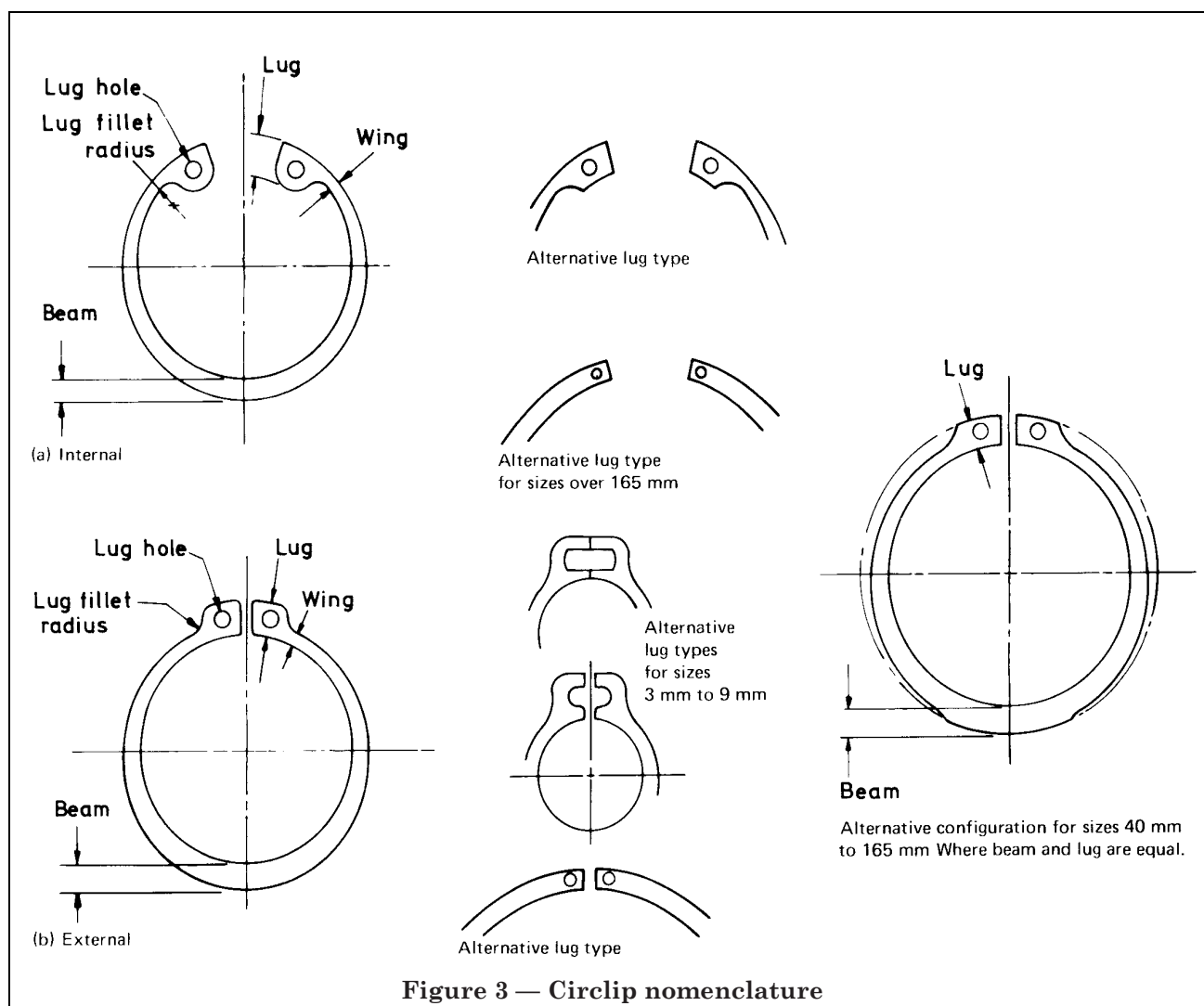


Figure 3 — Circlip nomenclature

The holes (or slots) shall be so positioned that, when the circlip is fitted in a groove of appropriate dimensions, the hole (or slot) shall be clear of the external diameter of the shaft or, in the case of internal circlips, clear of the internal diameter of the bore.

The diameter of the holes (or width of slots) shall be in accordance with Table 1 and Table 2 and sufficient material shall be retained around each hole (or on either side of each slot) to ensure that no permanent distortion of the circlip ends shall result when circlip pliers are applied during assembly of the circlip under normal conditions.

6.2 Lugs. Circlips up to and including 165 mm designating size shall have integrally formed lugs. Above this size, whether or not the circlips have lugs shall be the subject of agreement between the purchaser and the manufacturer. The profile of the lug may vary at the discretion of the manufacturer provided that the following conditions are met.

a) *External circlips.* When passed over a shaft of the maximum diameter as given in Table 1, the circlip shall be capable of passing through the clearance diameter C_1 .

b) *Internal circlips.* When passed through a bore of the minimum diameter as given in Table 2, the circlip shall be capable of passing over the clearance diameter C_1 .

6.3 Lug fillet. A fillet of minimum radius equal to the maximum thickness T of the circlip shall be formed adjacent to each lug. The fillet shall blend smoothly with the lug profile and with the wing depth. At no point around the contour shall the fillet undercut either the lug profile or the wing (see Figure 1).

6.4 Tolerance on radial flatness. Departures from radial flatness (see 3.2) shall be not greater than the values stated in 10.6.

6.5 Tolerance for helix. Departures from spiral flatness (see 3.3) shall be not greater than the values stated in 10.7.

6.6 Tolerance on thickness. Thickness tolerances are inclusive of the thickness of any finish applied. If special finishes are required the overall thickness shall be agreed between the purchaser and the manufacturer.

7 Finish

Sharp edges shall be removed from the circlips. In addition, finishing shall remove all burrs and scale. No cracks, pitting, or other surface defects shall be present.

Unless any alternative finish is specified by the purchaser the circlips shall be phosphated in accordance with BS 3189, chemically or thermally blued or blacked, or self-finished.

Suitable temporary anti-corrosion treatment shall be applied in accordance with BS 1133-6.

8 Marking

Each package of circlips shall be clearly and indelibly marked with the following:

- the number of this British Standard, i.e. BS 3673-4;
- the manufacturer's name or trademark;
- the appropriate size-designating reference number or manufacturer's designation as given in Table 1 and Table 2.

The basis of these numbers is as follows.

The reference number of the circlip shall comply with column 1 of Table 1 and Table 2 adding, if necessary, a cypher or cyphers in order to retain, in all cases, the same number of digits; also adding the appropriate prefix S, (shaft) or B, (bore) and the suffix M (metric) as shown in the following examples

S012 M external circlip to suit 12 mm nominal diameter shaft.

B250 M internal circlip to suit 250 mm nominal diameter bore.

NOTE The mark BS 3673-4 on, or in relation to, the product is a claim by the manufacturer that it complies with the requirements of this standard.

9 Tests

Each circlip shall meet the requirements of the tests described in 9.1 to 9.3.

9.1 Permanent set and grip. Circlips shall grip firmly on the groove diameter given in Table 1 and Table 2 after having been passed three times over a shaft (for the external type) or through a bore (for the internal type) which is of nominal diameter. The circlip shall be relaxed between each phase of the test.

NOTE By "grip firmly" it is meant that with the shaft or bore positioned vertically the circlip will remain correctly in position on the groove diameter, unaided and under its own weight. Provision should be made to ensure that at all times during the test the circlip is normal to the axis of the test shaft or test bore as applicable.

9.2 Bend and fracture test. The circlip shall be positioned so that it is gripped across the beam section, as shown in Figure 4. The circlip shall then be bent through 30° by repeated light hammer blows around a test block of radius equal to the maximum thickness of the circlip, following which there shall be no visible sign of fracture, cracks or similar defects. The circlip shall then be further bent until fracture occurs, following which examination of the fracture shall reveal a uniform grain structure with no sign of laminations or other defects.

9.3 Hardness. Tests shall be carried out in accordance with BS 891-1, using a machine verified in accordance with BS 891-2. The hardness of each circlip shall be within the appropriate range as given in clause 5.

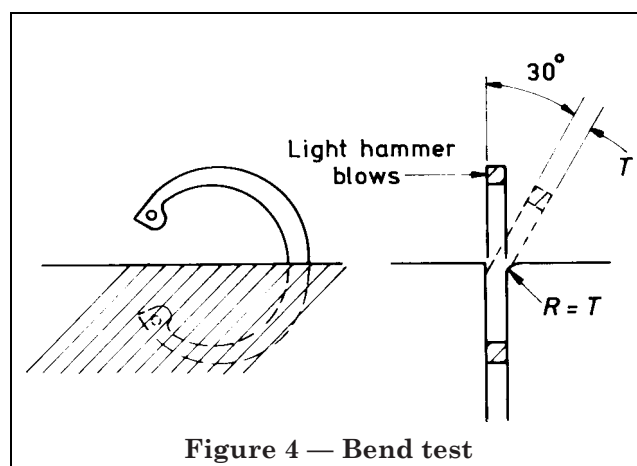


Figure 4 — Bend test

10 Dimensions of circlips and grooves

The basis for determining the dimensions and tolerances of external and internal circlips and their related grooves shall be as given in 10.1 to 10.11.

10.1 Tolerances on thickness T . Tolerances shall be based on $h11$.¹⁾

¹⁾ See BS 4500-1.

10.2 Tolerances on M . The values given in Table 1 and Table 2 are approximate and a range of $\pm 5\%$ of the value given may be applied up to and including 165 mm nominal size. For larger circlips the values given are maxima but a tolerance of 0, – 10 % may be applied to M (max).

10.3 Clearance diameters. Clearance diameters “during fitting” and “fitted” (see Table 1 and Table 2, columns 15 and 16) are maxima for external and minima for internal circlips.

10.4 Lug fillet. Minimum radius = T max.

10.5 Groove diameters. As given in Table 1 and Table 2 subject to the following tolerances.

The bottoms of grooves shall have radii of 10 % maximum of groove depth up to a maximum of 0.25 mm.

10.6 Tolerances on radial flatness. Maximum error (see 3.2):

up to and including 22 mm nominal size of circlip	0.10 mm
23 mm up to and including 39 mm nominal size of circlip	0.15 mm
40 mm up to and including 82 mm nominal size of circlip	0.20 mm
85 mm up to and including 200 mm nominal size of circlip	0.25 mm
above 200 mm	0.40 mm

10.7 Tolerances for spiral flatness. Maximum error (see 3.3): the pitch of the helix shall not exceed $\frac{1}{2} T$, where T is the maximum thickness of the circlip.

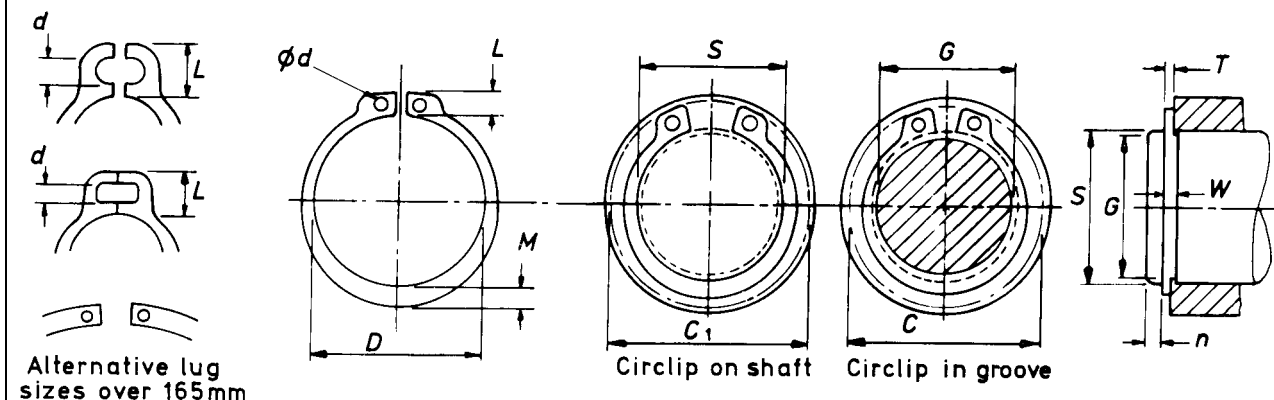
10.8 Groove widths. As given in Table 1 and Table 2, subject to tolerances to H13.¹⁾

10.9 Edge margins. Minimum edge margins are given in Table 1 and Table 2.

10.10 Maximum shaft diameter. S , subject to tolerance Z7, where S is the nominal size of shaft.

10.11 Minimum bore diameter. B , subject to tolerance Z7, where B is the nominal size of bore.

Table 1 — External series

Alternative lug types
 3 mm to 9 mm


All dimensions are in millimetres

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Reference number of circlip	Shaft diameter	Groove details					Circlip details							Minimum external clearance	
		Diameter	Tolerance	Width	Tolerance	Edge margin min.	Diameter	Tolerance	Thickness	Tolerance	Beam approx.	Lug depth max.	Lug hole diameter min.	Fitted	During fitting
	<i>S</i>	<i>G</i>		<i>W</i>		<i>n</i>	<i>D</i>		<i>T</i>		<i>M</i>	<i>L</i>	<i>d</i>	<i>C</i>	<i>C</i> ₁
S003M	3	2.8	0 −0.06	0.5	+0.14 0	0.30	2.66	0.06 − 0.15	0.4	0 −0.04	0.8	1.9	0.8	6.6	7.2
S004M	4	3.8	0 − 0.075	0.5			3.64		0.4		0.9	2.2		8.2	8.8
S005M	5	4.8		0.7			4.64		0.6		1.1	2.5	1.0	9.8	10.6
S006M	6	5.7		0.8			5.54	0.7	1.3	2.7	1.15	11.1	12.1		
S007M	7	6.7		0.9		0.45	6.45	0.8	1.4	3.1		12.9	14.0		
S008M	8	7.6	0 −0.09	0.9		0.60	7.35	+ 0.09 − 0.18	0.8	1.5	3.2	1.2	14.0	15.2	
S009M	9	8.6		1.1		0.75	8.35	+ 0.18 − 0.36	1.0	0 −0.06	1.7	3.3		15.2	16.6
S010M	10	9.6					9.25				1.8	3.3		16.2	17.6
S011M	11	10.5	0 −0.11				10.2				1.8	3.3	1.5	17.1	18.6
S012M	12	11.5					11.0				1.8	3.3	1.7	18.1	19.6