BRITISH STANDARD AEROSPACE SERIES

BS 2SP 96: 1982

CONFIRMED
APRIL 1998

Specification for

Internal retaining rings (imperial sizes)

UDC 629.7:621.887:669.14.018.27

Foreword

This revision of BS SP 96 specifies a range of internal retaining rings in imperial sizes only, suitable for aerospace applications and is based on BS 3673-1. The range of metric sizes is now contained in BS SP 166:1982. BS SP 96:1968 is now withdrawn.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 5 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.

This British Standard, having been prepared under the direction of the Aerospace Standards Committee, was published under the authority of the Board of BSI and comes into effect on 30 September 1982

The following BSI references relate to the work on this standard:
Committee reference ACE/14
Draft for comment 81/73435 DC

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Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

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1 Scope

This British Standard relates to internal retaining rings in inch dimensional ranges, manufactured from spring steel.

Requirements for material, heat treatment, hardness and manufacture are stated, together with dimensions and tolerances. The requirements for the finish and testing of the retaining rings are also given.

2 References

This standard makes reference to the following publications:

British Standards

BS 427, *Method for Vickers hardness test — Part 1: Testing of metals — Part 2: Verification of hardness scales.*

BS 860, *Tables for comparison of hardness scales.*

BS 1133, *Packaging code — Section 6: Temporary protection of metal surfaces against corrosion (during transport and storage).*

BS 1134, *Method for the assessment of surface texture.*

BS 1449, *Steel plate, sheet and strip.*

BS 1916, *Limits and fits for engineering.*

BS 3673, *Spring retaining rings — Part 1: Carbon steel circlips.*

BS S 513, *Spring steel strips.*

BS SP 166, *Specification for spring retaining rings for aerospace application: carbon steel circlips (metric series).*

Ministry of Defence Standards[1)]

DEF STAN 03-11, *Phosphate treatment of iron and steel.*

3 Definitions and nomenclature

For the purposes of this British Standard, the nomenclature given in Figure 1 applies together with the following definitions:

3.1
designating size

the designating size of a retaining ring is equal to the nominal bore diameter for which the retaining ring is designed

3.2
radial flatness error (dish)

on a nominally flat retaining ring, the amount by which the actual thickness is exceeded by the distance separating two parallel planes which just contain the sectional profile of the ring, the free ends of which are positioned in a common plane in order to discount any spiral effect which may be present (see Figure 2)

4 Material

Retaining rings shall be manufactured from spring steel complying with BS S 513, or grade 70 or 80 of BS 1449-1.

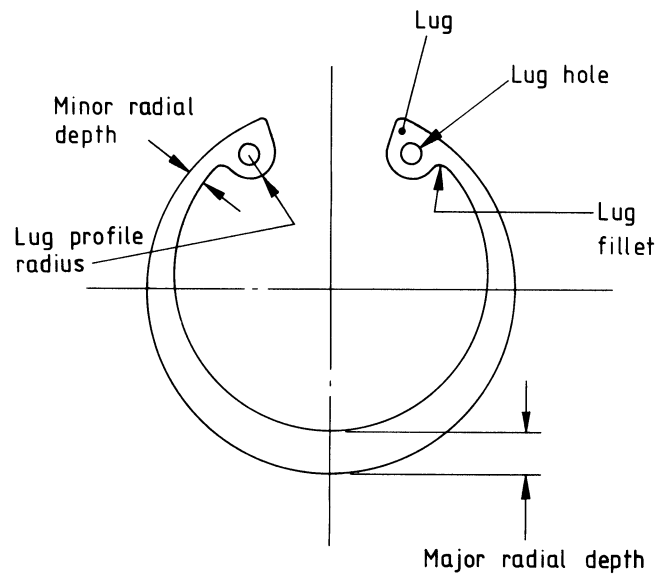


Figure 1 — Nomenclature of internal retaining ring

[1)] Obtainable from HMSO.

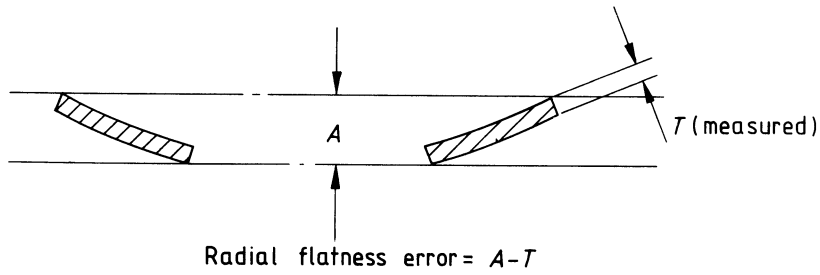


Figure 2 — Radial flatness error

5 Heat treatment and hardness

5.1 Retaining rings shall be hardened and tempered so that the minimum hardness after tempering shall be as follows:

up to and including 3.0 in designating size	480 HV
above 3.0 in designating size	460 HV

5.2 The test load shall be appropriate to the thickness of the retaining ring and applied in accordance with BS 427-1.

5.3 Equivalent hardness values on other approved hardness scales may be used in accordance with BS 860.

6 Form, dimensions and tolerances

6.1 General. The form, dimensions and tolerances of retaining rings shall be as given in Table 1, and in accordance with **6.2** to **6.6**.

6.2 Holes. Each end of each retaining ring shall have a hole in order to facilitate assembly by use of retaining ring pliers. The holes shall be so positioned that when the retaining ring is fitted in a groove of appropriate dimensions, the hole shall be clear of the internal diameter of the bore. The diameter of the holes shall be in accordance with Table 1 and sufficient material shall be retained around each hole to ensure that no permanent distortion of the retaining ring ends shall result when retaining ring pliers are applied during assembly of the retaining rings under normal conditions.

6.3 Lugs. Retaining rings shall have integrally formed lugs.

The profile of the lug may vary at the discretion of the manufacturer provided that when passed through a bore of the minimum diameter as given in Table 1, the retaining ring shall be capable of passing over clearance diameter *C*.

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

6.5 Minor radial depth. The minor radial depth (see Figure 1) shall be not less than the maximum thickness *T* of the retaining ring.

6.6 Tolerance on radial flatness. The maximum error on radial flatness shall be as follows:

up to and including B0075 designating size of retaining ring	0.0025 in;
B0081 up to and including B0150 designating size of retaining ring	0.004 in;
B0156 up to and including B0400 designating size of retaining ring	0.006 in.

7 Finish

7.1 Sharp edges shall be removed from the retaining rings, which shall be free from burrs, cracks, laminations and other deleterious defects. The bearing faces and outer edges shall be in accordance with section X-X of Figure 5.

7.2 The retaining rings shall be phosphated in accordance with DEF STAN 03-11.

7.3 Suitable temporary anti-corrosion treatment shall be applied to the retaining rings in accordance with BS 1133:Section 6.

8 Tests

8.1 General. Retaining rings shall be tested, after heat treatment, as given in **8.2** to **8.4**.

8.2 Hardness. A minimum of three retaining rings shall be selected at random from each heat treatment batch or, in the case of continuous heat treatment, at hourly intervals, and hardness tested in accordance with BS 427-1. The hardness of each retaining ring tested shall be within the appropriate range as given in clause **5**.

8.3 Bend and fracture test. The retaining rings selected in **8.2** shall be bent through 30° by repeated light hammer blows around a test block or radius equal to the maximum thickness of the retaining rings (see Figure 3) following which there shall be no visible sign of fracture cracks or similar defects. The retaining rings shall then be further bent until fracture occurs following which a metallurgical examination of the structure shall reveal a uniform grain structure with no signs of laminations or other defects.

8.4 Permanent set and grip test

8.4.1 Retaining rings shall be tested for permanent set and grip either as given in **8.4.2**, or by some other means of testing, including automatic devices, that may be employed subject to the approval of the inspecting authority.

8.4.2 A minimum of 2 %, selected at random, from each heat treatment batch or, in the case of continuous heat treatment at 2 % of each hour's production, shall be subjected to a permanent set and grip test. For this test, a multi-stepped cylinder in accordance with Figure 4 shall be used. Each retaining ring, selected as above, shall be mounted within bore *Y* of the cylinder and then caused to follow and maintain contact with the contours of each step in turn until the retaining ring reaches bore *X*. The retaining ring shall firmly grip within the bore *X* and, on removal, shall show no visible defect. Provision shall be made to ensure that at all times during the test the retaining ring is normal to the axis of the cylinder.

NOTE By "firmly grip" it is meant that with the multi-stepped test cylinder positioned vertically, the retaining ring will remain correctly in position on the *X* diameter unaided and under its own weight.

8.5 Acceptance. Failure of the selected retaining rings to pass the tests laid down in **8.2** to **8.4** shall be cause for rejection of the entire batch.

NOTE Reheat treatment may only be resorted to with the approval of the inspecting authority.

9 Marking

Each package or lot of retaining rings shall bear the manufacturer's name or trademark and the number of this British Standard i.e. BS SP 96[2)], followed by the appropriate size-designating reference number. The reference numbers shall be as given in column 1 of Table 1.

Example

BS SP 96 B0125 is a retaining ring to suit 1.250 in nominal diameter bore.

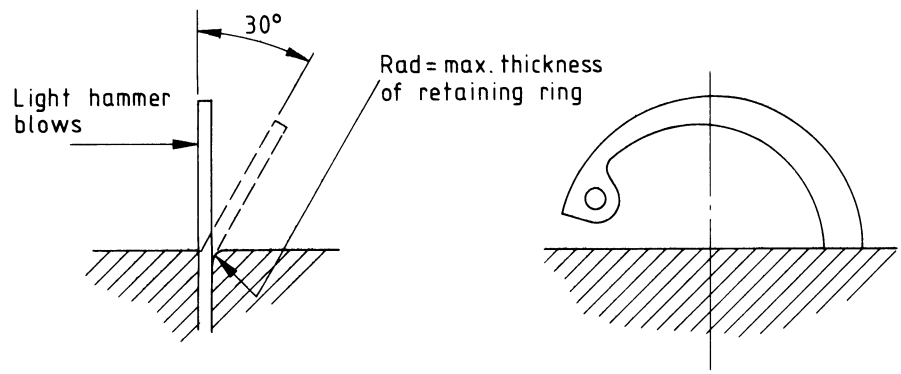
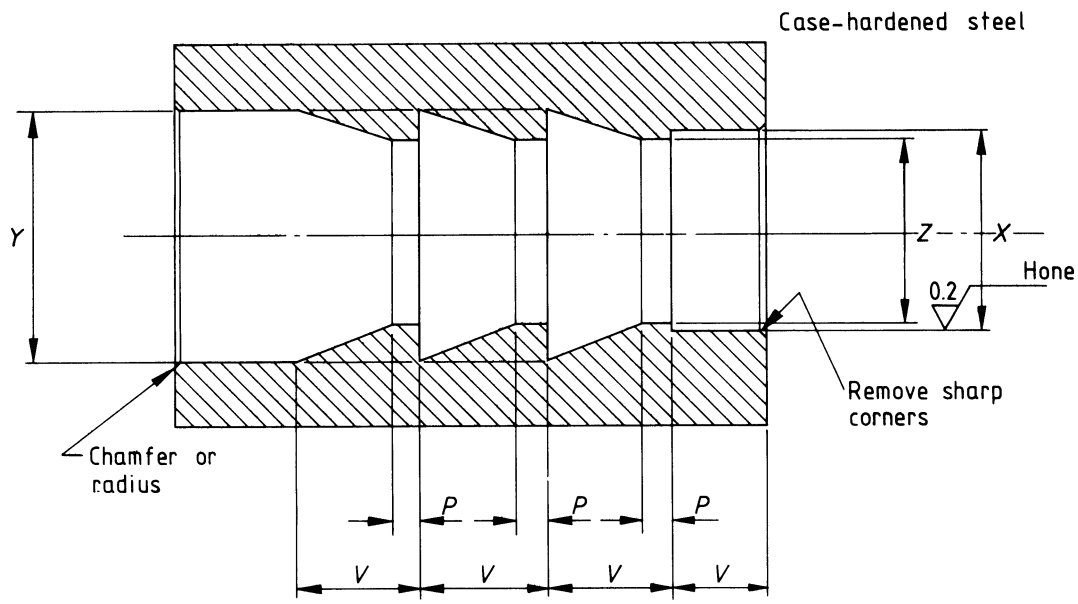


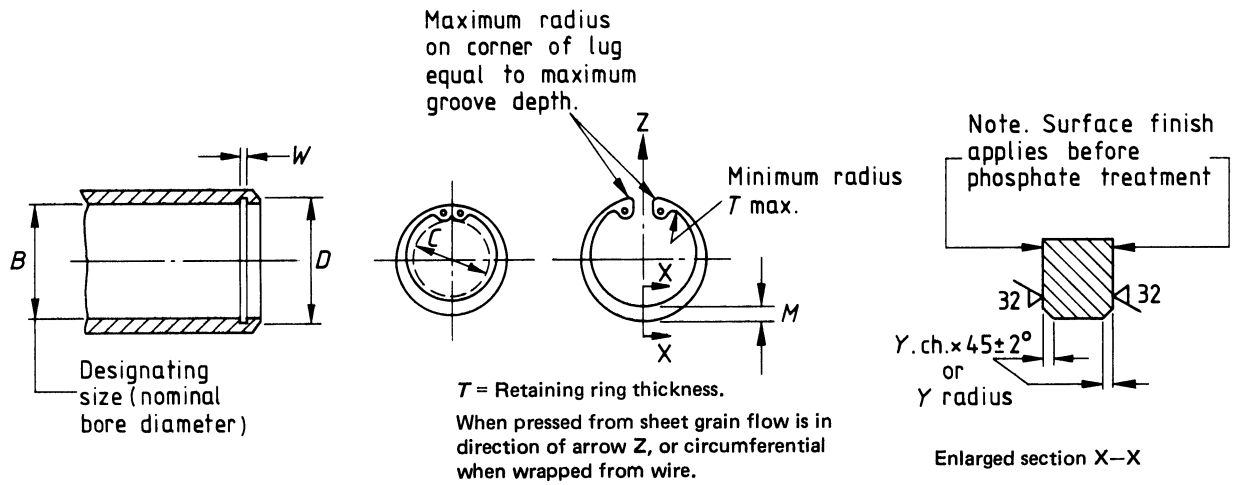
Figure 3 — Bend and fracture test

[2)] Marking BS SP 96 on or in relation to a product is a claim by the manufacturer that the product has been manufactured in accordance with the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification to support such claims should be addressed to the Director, Quality Assurance Division, British Standards Institution, Maylands Avenue, Hemel Hempstead, Herts HP2 4SQ in the case of certification marks administered by BSI or to the appropriate authority for other certification marks.



Dimension in inches.
X is D max. (see Table 1) subject to tolerance H6 (see BS 1916).
Y is 1.2 × nominal bore diameter.
Z is the minimum bore diameter subject to tolerance K6 (see BS 1916).
P is 0.125 × nominal bore diameter.
V is 0.5 × nominal bore diameter.

Figure 4 — Bore for permanent set and grip test for internal retaining rings



NOTE Bottom of grooves to have radii R.

Figure 5 — Internal retaining rings

Table 1 — Dimensions of internal retaining rings and recommended groove dimensions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Reference number of retaining ring	Designating size (nominal bore diameter) *B*		Bore diameter	Thickness of retaining ring *T*		Major radial depth *M*		Chamfer or radius *Y*		Internal clearance diameter during assembly *C*	Lug hole diameter	Groove dimensions					
												Diameter *D*		Width *W*		Radius *R*	
			min.	min.	max.	min.	max.	min.	max.	max.	min.	min.	max.	min.	max.	min.	max.
	in		in	in	in	in	in	in	in	in	in	in	in	in	in	in	in
B0037	0.375	—	0.373	0.037	0.040	0.045	0.055	0.004	0.008	0.035	0.039	0.393	0.397	0.043	0.047	—	0.004
B0043	0.438	—	0.436	0.037	0.040	0.050	0.060	0.004	0.008	0.098	0.039	0.459	0.463	0.043	0.047	—	0.004
B0050	0.500	—	0.498	0.037	0.040	0.054	0.066	0.006	0.010	0.160	0.045	0.524	0.528	0.043	0.047	0.003	0.006
B0056	0.562	—	0.559	0.037	0.040	0.059	0.071	0.006	0.010	0.222	0.045	0.589	0.593	0.043	0.047	0.003	0.006
B0062	0.625	—	0.622	0.037	0.040	0.063	0.077	0.006	0.010	0.285	0.060	0.655	0.659	0.043	0.047	0.003	0.006
B0068	0.688	—	0.685	0.037	0.040	0.068	0.082	0.006	0.010	0.348	0.060	0.721	0.726	0.043	0.047	0.003	0.006
B0075	0.750	—	0.747	0.037	0.040	0.073	0.087	0.006	0.010	0.410	0.060	0.786	0.791	0.043	0.047	0.003	0.006
B0081	0.812	—	0.809	0.037	0.040	0.077	0.093	0.006	0.010	0.472	0.060	0.851	0.856	0.043	0.047	0.003	0.006
B0087	0.875	—	0.872	0.037	0.040	0.082	0.098	0.006	0.010	0.535	0.060	0.917	0.922	0.043	0.047	0.003	0.006
B0093	0.938	—	0.935	0.0445	0.0475	0.087	0.103	0.008	0.012	0.534	0.060	0.983	0.988	0.051	0.055	0.004	0.008
B0100	1.000	—	0.996	0.0445	0.0475	0.091	0.109	0.008	0.012	0.596	0.060	1.048	1.053	0.051	0.055	0.004	0.008
B0112	1.125	—	1.122	0.0445	0.0475	0.101	0.120	0.008	0.012	0.721	0.076	1.178	1.183	0.051	0.055	0.004	0.008
B0118	1.188	—	1.184	0.0445	0.0475	0.106	0.126	0.008	0.012	0.784	0.076	1.244	1.250	0.051	0.055	0.004	0.008
B0125	1.250	—	1.245	0.0445	0.0475	0.111	0.131	0.008	0.012	0.846	0.076	1.309	1.315	0.051	0.055	0.004	0.008
B0131	1.312	—	1.307	0.0445	0.0475	0.116	0.137	0.008	0.012	0.908	0.076	1.373	1.379	0.051	0.055	0.004	0.008
B0137	1.375	—	1.370	0.056	0.060	0.121	0.142	0.008	0.012	0.865	0.076	1.439	1.445	0.064	0.068	0.004	0.008
B0143	1.438	—	1.433	0.056	0.060	0.126	0.148	0.008	0.012	0.928	0.076	1.505	1.511	0.064	0.068	0.004	0.008
B0150	1.500	—	1.495	0.056	0.060	0.131	0.154	0.008	0.012	0.990	0.076	1.569	1.575	0.064	0.068	0.004	0.008
B0156	1.562	—	1.557	0.066	0.070	0.136	0.159	0.008	0.012	0.967	0.076	1.634	1.640	0.074	0.078	0.004	0.008
B0162	1.625	—	1.619	0.066	0.070	0.142	0.165	0.008	0.012	0.030	0.076	1.700	1.706	0.074	0.078	0.004	0.008
B0168	1.687	—	1.681	0.066	0.070	0.147	0.170	0.008	0.012	1.092	0.076	1.764	1.770	0.074	0.078	0.004	0.008
B0175	1.740	—	1.744	0.066	0.070	0.152	0.176	0.008	0.012	1.155	0.076	1.830	1.836	0.074	0.078	0.004	0.008
B0187	1.875	—	1.869	0.066	0.070	0.162	0.187	0.008	0.012	1.280	0.091	1.960	1.966	0.074	0.078	0.004	0.008
B0200	2.000	—	1.992	0.076	0.080	0.172	0.198	—	0.015	1.320	0.091	2.090	2.097	0.084	0.088	0.005	0.010
B0212	2.125	—	2.117	0.076	0.080	0.182	0.209	0.010	0.015	1.445	0.091	2.220	2.227	0.084	0.088	0.005	0.010
B0225	2.250	—	2.242	0.076	0.080	0.192	0.221	0.010	0.015	1.570	0.091	2.350	2.357	0.084	0.088	0.005	0.010
B0237	2.375	—	2.367	0.076	0.080	0.202	0.232	0.010	0.015	1.695	0.091	2.480	2.487	0.084	0.088	0.005	0.010
B0250	2.500	—	2.492	0.076	0.080	0.212	0.243	0.010	0.015	1.820	0.098	2.609	2.616	0.084	0.088	0.005	0.010
B0262	2.625	—	2.616	0.095	0.099	0.223	0.254	0.015	0.020	1.784	0.098	2.739	2.746	0.103	0.107	0.010	0.015
B0275	2.750	—	2.741	0.095	0.099	0.233	0.265	0.015	0.020	1.909	0.098	2.869	2.876	0.103	0.107	0.010	0.015
B0287	2.875	—	2.866	0.095	0.099	0.243	0.276	0.015	0.020	2.034	0.098	2.998	3.005	0.103	0.107	0.010	0.015
B0300	3.000	—	2.991	0.095	0.099	0.253	0.287	0.015	0.020	2.159	0.098	3.128	3.135	0.103	0.107	0.010	0.015
B0312	3.125	—	3.116	0.095	0.099	0.263	0.298	0.015	0.020	2.284	0.098	3.257	3.266	0.103	0.107	0.010	0.015
B0325	3.250	—	3.239	0.095	0.099	0.274	0.309	0.015	0.020	2.409	0.118	3.386	3.395	0.103	0.107	0.010	0.015
B0337	3.375	—	3.364	0.115	0.119	0.284	0.320	0.020	0.025	2.364	0.118	3.515	3.524	0.123	0.128	0.015	0.020
B0350	3.500	—	3.489	0.115	0.119	0.294	0.331	0.020	0.025	2.489	0.118	3.644	3.653	0.123	0.128	0.015	0.020
B0362	3.625	—	3.614	0.115	0.119	0.304	0.342	0.020	0.025	2.614	0.118	3.773	3.782	0.123	0.128	0.015	0.020
B0375	3.750	—	3.739	0.115	0.119	0.315	0.353	0.020	0.025	2.749	0.118	3.902	3.911	0.123	0.128	0.015	0.020
B0387	3.875	—	3.864	0.115	0.119	0.323	0.362	0.020	0.025	2.874	0.118	4.031	4.040	0.123	0.128	0.015	0.020
B0400	4.000	—	3.987	0.115	0.119	0.328	0.368	0.020	0.025	2.989	0.118	4.160	4.169	0.123	0.128	0.015	0.020

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