2SP 68 to 2SP 71 : October : 1973

(Superseding British Standard SP 68-71)

UDC 629.7.02 : 621.884.3 : 669.71

British Standard : Aerospace Series

Specification for

100° Countersunk precision head aluminium and aluminium alloy rivets*

Foreword

The first issue of these British Standards marked a departure from the traditional method of dimensioning countersunk head rivets by means of toleranced dimensions for the head diameter, head thickness, land and angle. The method now adopted is known as the 'flushness tolerance' method and was first used for countersunk fasteners in BS 1981, Unified machine screws and machine screw nuts. Its basic principles and advantages are outlined in Appendix A to this standard, which also gives details of suggested methods of gauging. The standards include the marking of rivets as agreed by ISO/TC 20—Aircraft and space vehicles, and a method for the identification of undyed versions of the rivets.

Details of rivets with radiused tails for use in auto-riveting machines are given in Appendix B.

1. Scope

These British Standards specify the materials, dimensions, finish, marking and part numbers of 100° countersunk precision head aluminium and aluminium alloy rivets for aerospace use.

NOTE. The figures in inch units are to be regarded as the standard. A table is given in Appendix C to provide a ready means of calculating the approximate metric equivalents of the imperial dimensions. More accurate conversions should be based on the tables in BS 350.

2. Material and manufacture

The rivets shall be manufactured from the appropriate material specified in Table 1 in the condition as supplied.

3. Condition of rivets

3.1 Rivets to British Standard SP 68 require no heat treatment.

3.2 Rivets to British Standard SP 69 require heat treatment in accordance with **10.1** and **10.2** before use.

3.3 Rivets to British Standard SP 70 require no heat treatment.

3.4 Rivets to British Standard SP 71 shall be finally heat treated by the rivet manufacturer in accordance with **10.3.**

4. Dimensions

The rivets shall conform to the dimensions specified in Tables 2 and 3.

***Index form of title:** Rivets, 100° countersunk precision head, in L36, L37, L58 and L86 materials.

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5. Finish

5.1 The rivets shall conform to the finish for the appropriate material specified in Table 1.

5.2 Anodic treatment shall be in accordance with the requirements of the latest issue of Procurement Executive M.O.D. aircraft process specification DEF 151.

5.3 Chemical oxidation shall be in accordance with the requirements of the latest issue of Procurement Executive M.O.D. aircraft process specification DTD 913.

5.4 Colouring shall be in accordance with the requirements of the latest issue of Procurement Executive, M.O.D. aircraft process specification DTD 913, or other approved process e.g. DEF 151.

6. Gauging

The method of head dimensioning shown in Table 2 defines maximum and minimum head envelopes which control flushness in relation to a countersink of nominal dimensions.

The type of gauge in Figs. 5 and 6 is recommended as being suitable for flushness measurement, but the type of gauge to be used is not a mandatory requirement of this standard. The gauge shown in Figs. 5 and 6 does not control the head angle which will require to be checked at intervals during production. An additional gauge will be necessary for the absolute minimum head diameter.

7. Identification and marking

7.1 The marking of the rivets shall be as specified in Table 1, and shall be applied as follows.

(1) Rivets over 3/32 in diameter which do not exceed 8 diameters in length shall be marked on the shank end.

(2) Rivets 1/16 in and 3/32 in diameter in all lengths, and rivets over 3/32 in diameter which exceed 8 diameters in length, may be marked on either the head or the shank end.

The marking, whether indented or embossed, shall be clearly visible and the height or depth shall not exceed the following dimensions.

0.006 in on sizes up to and including 1/8 in diameter;
0.008 in on sizes 5/32 in and 3/16 in diameter;
0.010 in on sizes 7/32 in diameter and over.

7.2 Rivets identified by old-style markings may be supplied until existing stocks are consumed or until the end of 1976, whichever is the sooner. The obsolescent markings are as follows.

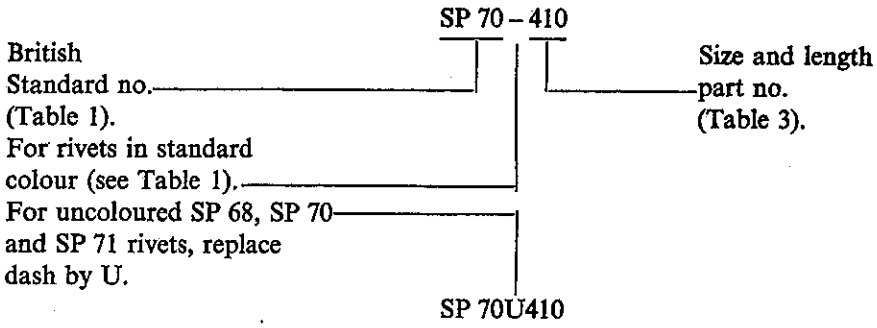
Material	Marking
L 36	1
L 37	7
L 58	8
L 86	0

7.3 The rivets shall be identified for ordering purposes by the relevant British Standard number (see Table 1) and the appropriate part number (see Table 3), e.g. a rivet in L 58 material 3/16 in diameter × 3/8 in length is SP 70-410.

7.4 Undyed versions of rivets shall be identified by their part number with the letter U in place of the dash.

7310-2k
Printed in England by Gaylard & Son Ltd., London, SE14 6TY

7.5 Example of call-up:



8. Inspection

It is recommended that inspection be by quality control methods designed to ensure that the manufacturing process is stable and that the rivets meet the requirements of the specification.

9. Freedom from defects

The rivets shall be free from harmful defects.

The rivets may be rejected at any time for faults in, or revealed by, manufacture, although they have been made from material passed previously for chemical composition and mechanical properties.

10. Heat treatment of rivets

10.1 Immediately before use or before refrigeration as described in **10.2**, rivets to British Standard SP 69 shall be heated uniformly at a temperature of 495 ± 5°C and quenched in water at a temperature not exceeding 40°C.

10.2 Rivets to British Standard SP 69 commence to age harden immediately when kept at atmospheric temperature after quenching. Ageing may be delayed, however, by storing the rivets at low temperatures after quenching, and they may be expected to remain in a condition suitable for closing for a period depending on the storage temperature as shown below:

Temperature	Maximum storage period
0°C to − 5°C	45 hours
−15°C to −20°C	150 hours

The rivets shall be closed within two hours of solution treatment if kept at atmospheric temperature or within two hours of removal from cold storage.

10.3 Rivets to British Standard SP 71 shall be heat treated by the rivet manufacturer as follows.

Solution treat at a temperature of 495 ± 5°C and quench in water at a temperature not exceeding 40°C. Age at room temperature for not less than four days.

11. Packaging

Rivets shall be packaged, bagged or labelled and such packages, bags or labels shall bear the complete appropriate part number, e.g. SP 68–408. See Table 3 for part numbers.

Table 1. British Standard numbers, materials, finish and marking of 100° countersunk precision head aluminium and aluminium alloy rivets

British Standard no.	Material	Finish		Identification mark
	British Standard	Treatment	Colour	
SP 68	L 36*	Anodic or chemical oxidation	Black	'I'
SP 69	L 37*	None	Plain	— o — Embossed
SP 70	L 58*	Anodic or chemical oxidation	Green	+ Embossed
SP 71	L 86*		Violet	o Indented

* Latest issue.

NOTE. Undyed versions of rivets in L 36, L 58 and L 86 are also available. See 7.4.

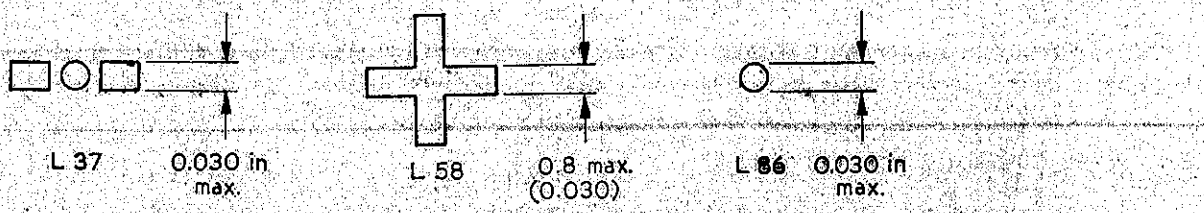


Fig. 1. Dimensions of identification marks

Table 2. Dimensions of 100° countersunk precision head aluminium and aluminium alloy rivets

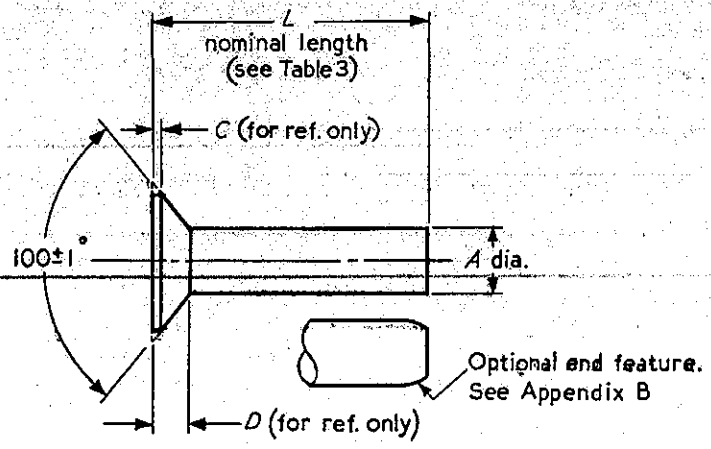


Fig. 2. Rivet dimensions

Conical surface of head to be concentric with rivet shank within 0.005 in (0.010 in full indicator reading). Maximum head cocking angle relative to rivet axis = ½°.

Table 2 (contd.)

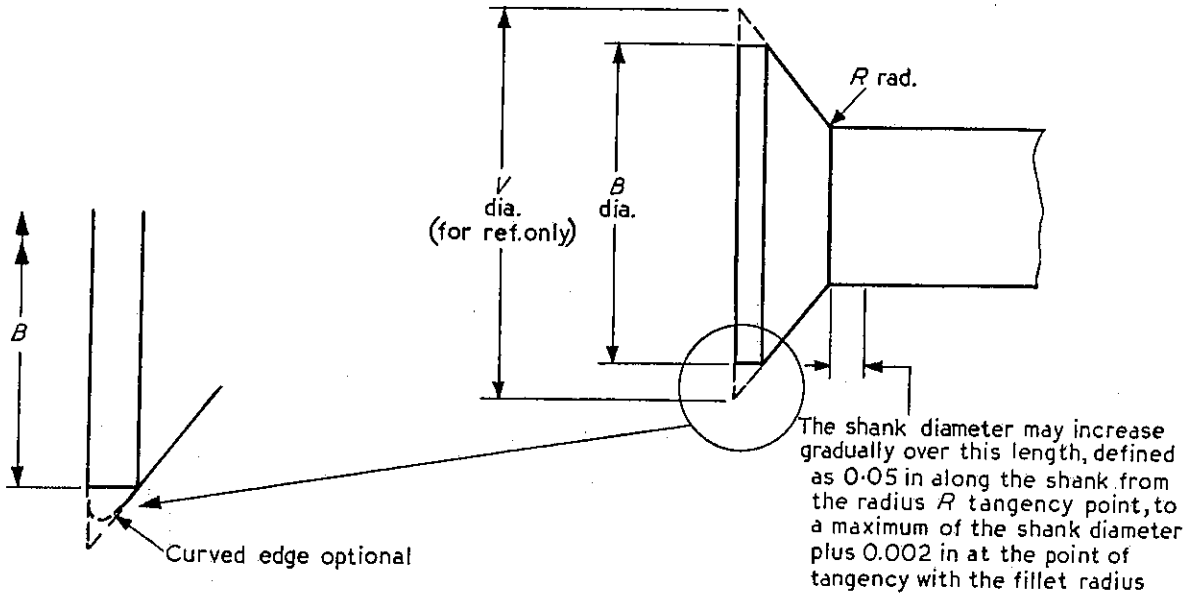


Fig. 2*b*. Enlarged view of head

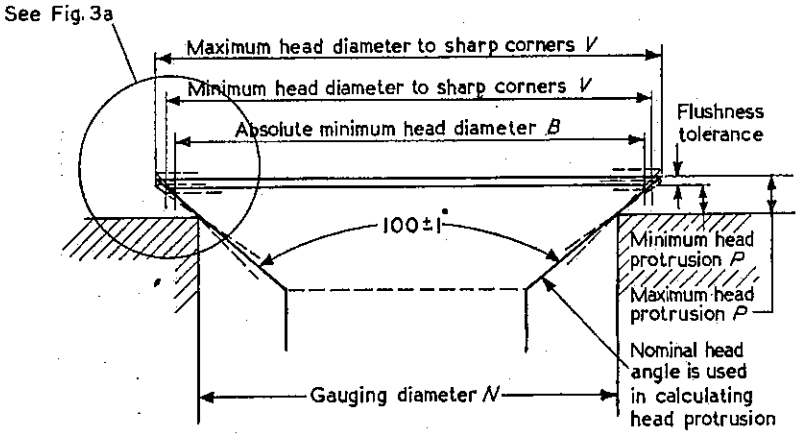


Fig. 3*a*. Diagram showing maximum and minimum head conditions

NOTE. Head angle to be checked at intervals during production. Gauges suitable for controlling flushness are described in Appendix A.

Table 2 (contd.)

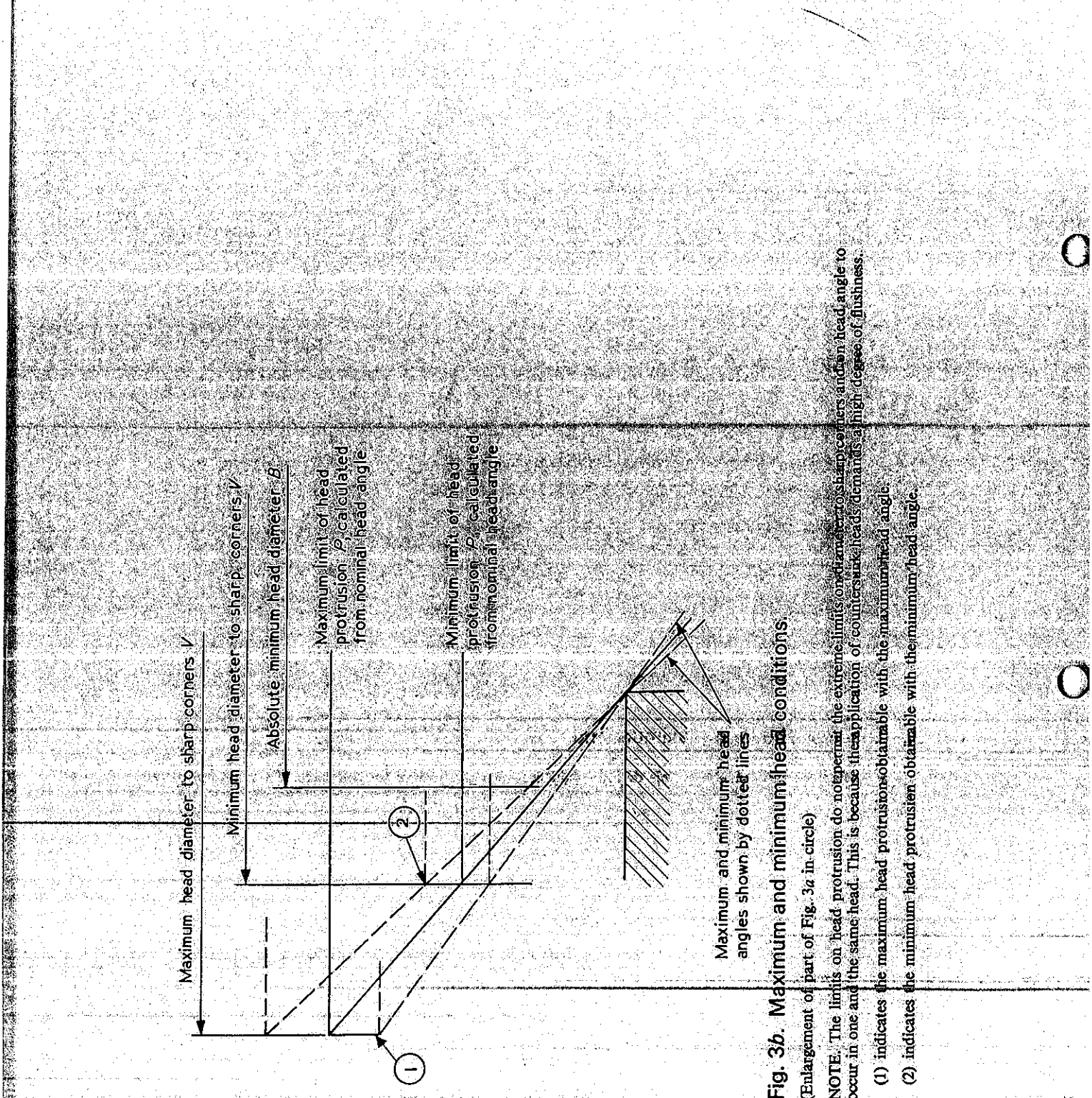


Fig. 3*b*. Maximum and minimum head conditions.

(Enlargement of part of Fig. 3*a* in circle)

NOTE. The limits on head protrusion do not permit the extreme limits on diameters across corners and on head angle to occur in one and the same head. This is because the application of counterSunk heads demands a high degree of flushness.

(1) indicates the maximum head protrusion obtainable with the maximum head angle.

(2) indicates the minimum head protrusion obtainable with the minimum head angle.

Table 2 (contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Nominal size of rivet	Diameter of shank, *A*		Diameter of head			Nominal depth of head, *D*	Depth of land, *C*	Gauging diameter, *N*	Head protrusion				
			To sharp corners, *V* (reference only)		Absolute min., *B*				Protrusion above gauging diameter, *P*		Flushness tolerance, (*P* max.-*P* min.)	Radius under head, *R*	
	max.	min.	max.	min.		(Reference only)	(Reference only)		max.	min.		max.	min.
in	in	in	in	in	in	in	in	in	in	in	in	in	in
1/16 (0.062)	0.065	0.061	0.1170	0.1110	0.104	0.022	0.006	0.097	0.0084	0.0059	0.0025	0.020	0.010
3/32 (0.094)	0.097	0.093	0.1825	0.1755	0.164	0.036	0.008	0.151	0.0132	0.0103	0.0029	0.020	0.010
1/8 (0.125)	0.128	0.124	0.2285	0.2215	0.208	0.042	0.009	0.192	0.0153	0.0124	0.0029	0.020	0.010
5/32 (0.156)	0.159	0.155	0.2900	0.2820	0.267	0.055	0.010	0.243	0.0197	0.0164	0.0033	0.020	0.010
3/16 (0.187)	0.190	0.186	0.3575	0.3485	0.329	0.070	0.012	0.298	0.0250	0.0212	0.0038	0.020	0.010
7/32 (0.219)	0.222	0.218	0.419	0.410	0.386	0.082	0.014	0.350	0.0289	0.0251	0.0038	0.030	0.015
1/4 (0.250)	0.253	0.249	0.4805	0.4715	0.445	0.095	0.015	0.401	0.0334	0.0296	0.0038	0.030	0.015
5/16 (0.312)	0.315	0.311	0.5690	0.5590	0.526	0.106	0.018	0.480	0.0373	0.0331	0.0042	0.030	0.015
3/8 (0.375)	0.378	0.374	0.6995	0.6885	0.650	0.134	0.020	0.588	0.0468	0.0422	0.0046	0.030	0.015

NOTES. The following notes on the dimensions shown in Table 2, with particular reference to their relationship with those shown in the American Standard for rivets MS 20426 are given for information.

1. *Shank diameter.* The maximum dimensions conform to nominal + 0.003 in and the minimum dimensions to nominal — 0.001 in as in MS 20426 to provide for the aircraft constructor's requirements for a close fit between the rivet shank and the drilled hole.

2. *Maximum and minimum head diameter to sharp corners.* The dimensions are based on those of MS 20426 but with slight variations to allow for a progressive tolerance between the maximum and minimum head diameter to sharp corners. The tolerance on the smallest size is 0.006 in and on the largest size 0.011 in. MS 20426 specifies a tolerance of 0.008 in throughout. The dimensions are for reference only.

3. *Absolute minimum head diameter.* This dimension is not specified in MS 20426. The dimensions in column 6 have been calculated from a progressive depth of land which is considered necessary for forging.

4. *Nominal head depth.* The dimensions are for reference only and have been calculated as the mean between maximum and minimum head depth, corresponding to maximum and minimum diameters to sharp corners, the head angle and shank diameter being taken as nominal.

5. *Maximum depth of land* (See Note 3). These dimensions are for reference only.

6. *Gauging diameter.* This is a fundamental dimension and it is essential that it be used in gauging, whether by flushness gauge (Figs. 5 and 6) or by optical projection.

7. *Head protrusion.* Similarly, these dimensions must be used in gauging whether by flushness gauge (Figs. 5 and 6) or by optical projection. The maximum head protrusion has been calculated from the maximum head diameter to sharp corners, the gauging diameter and the nominal head angle, and the minimum head protrusion has been calculated from the minimum head diameter to sharp corners, the gauging diameter and the nominal head angle. The gauging diameter and flushness tolerance have been chosen to give a head of comparable precision to that of MS 20426.

2SP 68 to 2SP 71 : 1973

Table 3. Standard lengths and part numbers of 100° countersunk precision head aluminium and aluminium alloy rivets

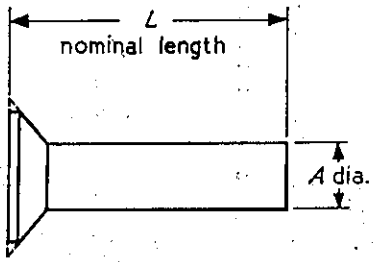


Fig. 4. Rivet dimensions.

Nominal length, L* ±0.010 in	Nominal diameter, A, in inches								
	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8
	Part number The last two figures of the part numbers denote the length in 1/16 in, the remaining figure or figures denoting the diameter in 1/32 in.								
in									
1/8	202	302							
3/16	203	303	403						
1/4	204	304	404	504					
5/16	205	305	405	505	605				
3/8	206	306	406	506	606	706	806		
7/16	207	307	407	507	607	707	807	1007	
1/2	208	308	408	508	608	708	808	1008	1208
9/16	209	309	409	509	609	709	809	1009	1209
5/8	210	310	410	510	610	710	810	1010	1210
*11/16	*211	*311	*411	*511	*611	*711	*811	*1011	*1211
3/4	*212	312	412	512	612	712	812	1012	1212
*13/16	*213	*313	*413	*513	*613	*713	*813	*1013	*1213
7/8	*214	314	414	514	614	714	814	1014	1214
*15/16	*215	*315	*415	*515	*615	*715	*815	*1015	*1215
1	*216	316	416	516	616	716	816	1016	1216
1 1/8		*318	418	518	618	718	818	1018	1218
1 1/4		*320	420	520	620	720	820	1020	1220
1 3/8		*322	422	522	622	722	822	1022	1222
1 1/2		*324	424	524	624	724	824	1024	1224
1 3/4			428	528	628	728	828	1028	1228
2				532	632	732	832	1032	1232
2 1/2					640	740	840	1040	1240
3					648	748	848	1048	1248

* Non-preferred sizes.

NOTE. For details of rivets with radiused tails see Appendix B. The maximum available lengths of radiused tail rivets are indicated in Table 3 by the broken line in each nominal diameter column. The maximum nominal length L available for each nominal diameter A is the length corresponding to the part number immediately above the broken line.

Appendix A
Principles of flushness control and recommended gauging practice

A.1 The major requirement of the user of a countersunk head rivet is that the upper surface of the head should fit with as great degree of flushness as possible with the surface into which it is inserted. This flushness is dependent upon both the tolerance on the head of the rivet and that of the countersink into which the head is fitted. The method of dimensioning adopted in this standard directly controls the flushness accuracy of the rivet in relation to a nominal countersink, the result in an actual assembly being dependent upon the tolerance applied to the countersink, which is outside the scope of this standard.

A.2 In the traditional method of dimensioning countersunk head rivets, the limits on the rivet head thickness are affected by the tolerance on the shank diameter. This however is of no consequence in the matter of flushness and it would be necessary, for any degree of flushness, to exercise a closer control on head thickness and/or shank diameter if the traditional dimensioning methods were used.

A.3 The recommended methods of gauging flushness are simple and do not call for any measurement of difficult or dubious dimensions.

A.4 The most important aspect of the rivet head in the attainment of flushness is the position of the flat upper surface of the head in relation to the conical under surface. The gauging dimension by which this is controlled is that between the flat upper surface and a plane which cuts the conical surface of the head normal to its axis at a specified diameter known as the gauging diameter (see Fig. 3*a*). The dimension gauged is known as head protrusion and its tolerance as the flushness tolerance.

A.5 The variables which affect the flushness tolerance are:

(1) the diameter to sharp corners, formed by the hypothetical intersection of the flat upper surface of the head and the conical under surface;

(2) the included angle of the head;

(3) the concentricity of the head and the shank.

The gauging diameter is at approximately one-third of the head depth from the upper surface.

A.6 The elements which define the rivet head and are required to be controlled by inspection are:

(1) head protrusion, the limits of which define the flushness tolerance;

(2) diameter of head to sharp corners; this is controlled indirectly by the inspection of (1) and (4);

(3) actual diameter of head for which a minimum is specified and which is the diameter at the land;

(4) included angle of the conical under surface;

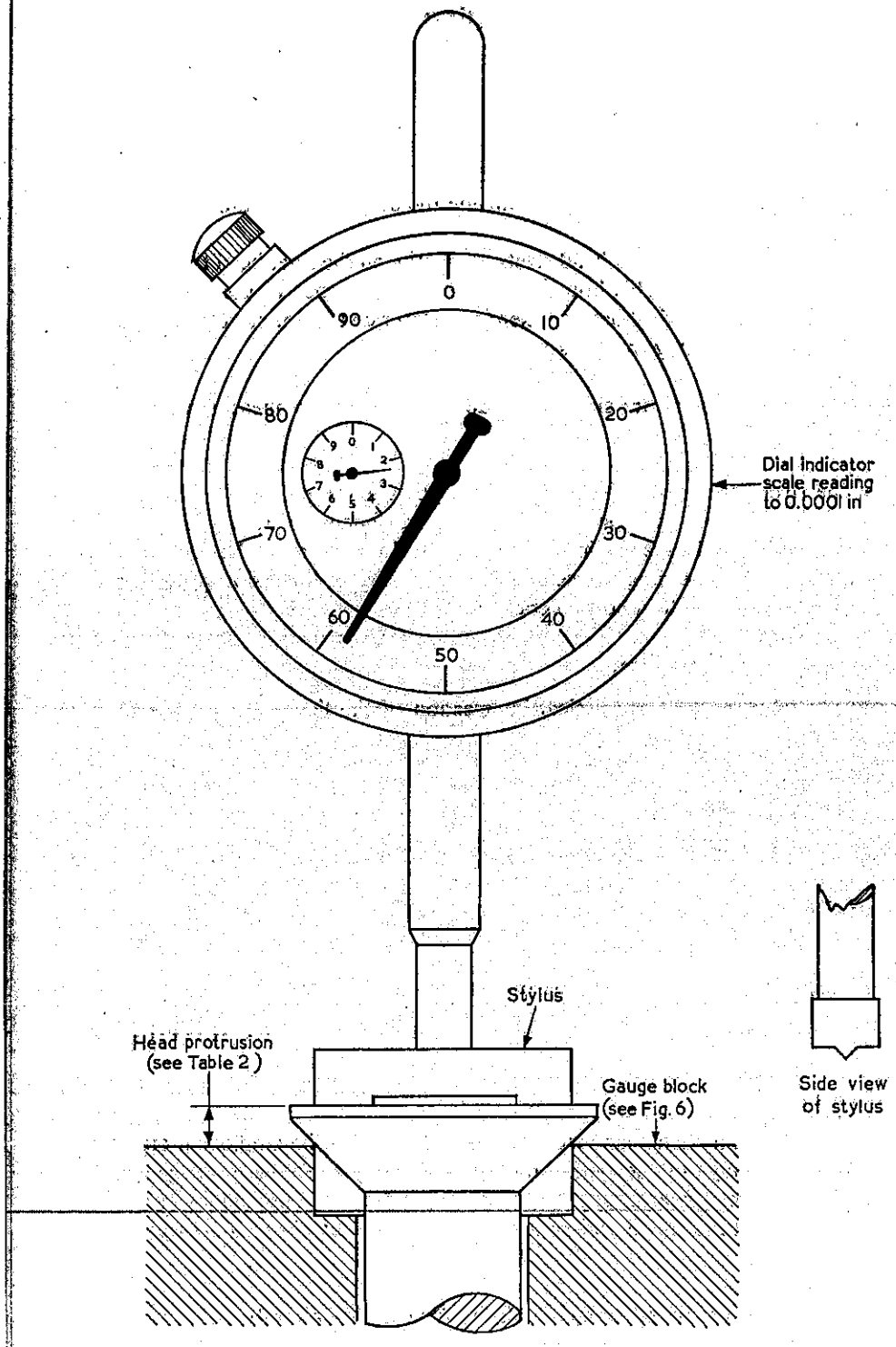
(5) radius between conical surface and shank.

It is not a requirement of this standard that a particular method of inspection shall be employed. Head protrusion may be checked by means of a gauge of the type shown in Fig. 5, by a GO – NOT GO gauge, by optical projection, or by any other suitable means. The actual diameter may be checked by direct measurement or by a GO – NOT GO gauge.The head angle and radius at shank may be checked by optical projection.

A.7 Fig. 5 illustrates a type of gauge which has achieved some popularity for use with aircraft countersunk head bolts and rivets in the USA. Details of a suitable gauge block are given in Fig. 6.

The intersection of the hole 'X' with the top surface of the gauge block forms the diameter on which the cone of the rivet head rests. The diameter of the hole 'X' is slightly less than the gauging diameter N to permit the edge of the hole to be broken to form a land approximately 0.003 in wide by lapping with a hardened steel ball until the dimension Z is within the stated limits. Z is calulated from the formula: $Z = \frac{1}{2}(Y + \sqrt{Y^2 - N^2})$.

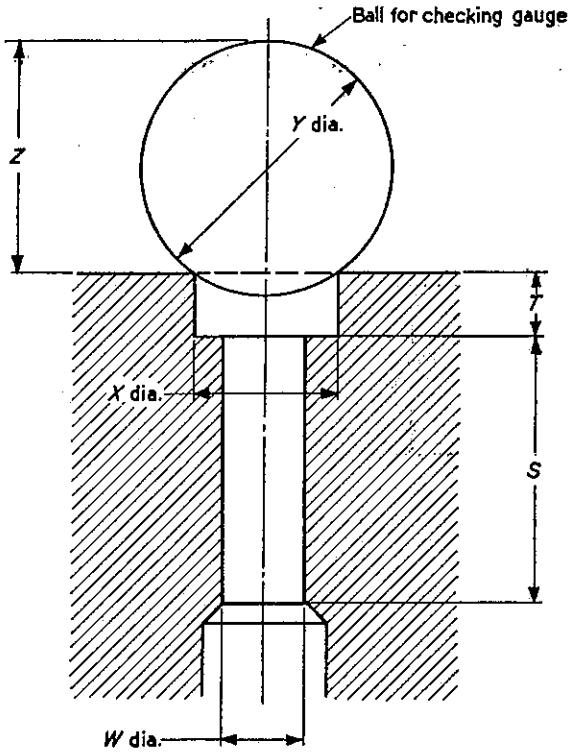
When the rivet is inserted in the block, the dial indicator is used to give a direct reading of head protrusion which is the amount by which the top surface of the rivet protrudes above the top surface of the gauge block.



Stylus and top surface of gauge block to be parallel within 0.0001 in. Indicator to be perpendicular to gauge block.

Fig. 5. Method of measurement of head protrusion

Table 4. Dimensions of gauge blocks



Diameters X and W to be concentric within 0.001 in full indicator reading.

Section through gauge block.

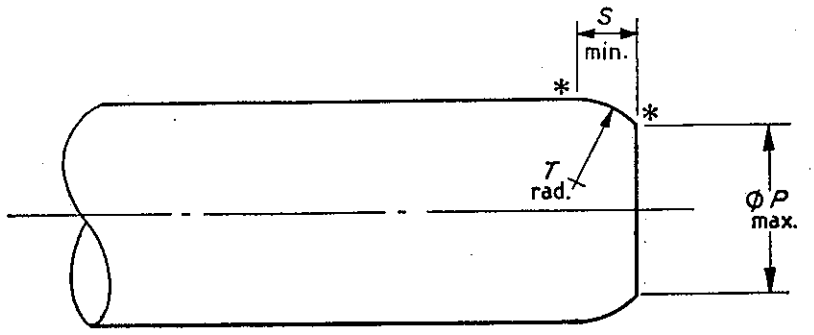
Fig. 6. Protrusion gauge block (see Fig. 5 and A.7.)

Nominal size of rivet	Ball dia., Y	C/bore dia., X	Ball protrusion, Z*	Depth of counterbore, T	Dia. of guide, W	Length of guide, S	Min. depth of gauge block for max. length rivet
	Nominal	+0 −0.001	+0.0002 −0	+0.010 −0	+0.001 −0	±0.010	
in	in	in	in	in	in	in	in
1/16	0.15625 (5/32)	0.093	0.1394	0.125	0.066	0.100	1
3/32	0.2362 (6 mm)	0.147	0.2089	0.140	0.099	0.150	1½
1/8	0.3125 (5/16)	0.188	0.2795	0.150	0.130	0.200	1¾
5/32	0.3750 (3/8)	0.239	0.3303	0.160	0.162	0.250	2
3/16	0.46875 (15/32)	0.294	0.4153	0.175	0.194	0.300	3
7/32	0.5625 (9/16)	0.346	0.5014	0.190	0.226	0.350	3
1/4	0.6250 (5/8)	0.397	0.5522	0.200	0.257	0.400	3
5/16	0.750 (3/4)	0.476	0.6631	0.210	0.319	0.500	3
3/8	0.9375 (15/16)	0.584	0.8338	0.240	0.382	0.600	3

* For the basis of calculation of this dimension see A.7.

Appendix B
Rivets for use in auto-riveting machines

B.1 With the advent of auto-riveting machines, it is necessary to form the rivet tail with a small radius. Conventional methods of riveting are unaffected by this feature.



* Intersection points.

Fig. 7. Detail of radiused tail

Table 5. Dimensions of radiused tails

Nominal diameter	S min.	T rad. ±0.010 in.	Dia. P max.
in	in	in	in
1/16	0.011	0.019	0.053
3/32	0.018	0.029	0.078
1/8	0.026	0.039	0.102
5/32	0.034	0.049	0.128
3/16	0.042	0.059	0.153
7/32	0.049	0.069	0.180
1/4	0.057	0.078	0.202
9/16	0.073	0.098	0.248
5/8	0.089	0.117	0.294

B.2 After 1976, rivets of standard lengths and diameters, up to the maximum available lengths indicated by broken lines shown in Table 3, will only be supplied with radiused tails. Until then, manufacturers are free to supply rivets with either tail form, unless purchasers specifically order rivets with radiused tails.

B.3 Rivets with lengths and diameters outside the range detailed in **A.2** will, normally, only be supplied in the blunt-ended configuration.

Appendix C
Conversion of inches to approximate millimetre equivalents

in	mm	in	mm	in	mm
1/32	0.8	7/16	11.1	1	25.4
1/16	1.6	1/2	12.7	2	50.8
3/32	2.4	9/16	14.3	3	76.2
1/8	3.2	5/8	15.9	4	101.6
5/32	4.0	11/16	17.5	5	127.0
3/16	4.8	3/4	19.1	6	152.4
7/32	5.6	13/16	20.7	7	177.8
1/4	6.4	7/8	22.2	8	203.2
5/16	8.0	15/16	23.9	9	228.6
3/8	9.6			10	254.0

Examples:

1⅜ in = 25.4 + 9.6 = 35.0 mm

0.124 in = 2.54 + 0.508 + 0.1016 = 3.15 mm

This British Standard, having been approved by the Aerospace Industry Standards Committee, was published under the authority of the Executive Board on 31 October, 1973.

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Revision of British Standards
British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. **It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.**

The following BSI references relate to the work on this standard:

Committee reference ACE/14 Draft for approval 72/35871

s 620.1
377

BSI

Amendment Slip No. 2
published and effective from 30 June 1980
to British Standard 2SP 68 to 2SP 71 : 1973
(Aerospace Series)

100° Countersunk precision head aluminium and aluminium alloy rivets

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Revised text

AMD 3263
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Clause 7.2 (as amended by Amendment No. 1)

In the first sentence insert a full stop after 'consumed' and delete 'or until the end of 1978, whichever is the sooner.'.

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ACE/12