BS 3A 174:2012

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AEROSPACE SERIES

100° Countersunk head, D-slot recess, corrosion-resisting steel bolts (Unified threads), Strength Class 880 MPa, for aircraft

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 16, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 November 2012. It was prepared by Technical Committee ACE/12, *Aerospace fasteners and fastening systems*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 2A 174:1962, which is withdrawn.

Information about this document

This revision of BS A 174 includes the addition of high expansion heat-resisting steel to BS HR 650, BS EN 2398 and BS EN 2399 and changes to take account of the mechanical properties of these steels. In addition, the revision introduces a part number code for bolts made from high expansion heat-resisting steels, to distinguish them from bolts made from the BS S 80 material. This code will also be marked on the bolt surface – see Clause **9**.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This British Standard specifies the materials, dimensions and inspection requirements for D-slot recess, corrosion-resisting steel bolts with 100° countersunk heads and unified threads for aircraft (Strength Class 880 MPa).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS S 80, *High chromium-nickel corrosion resisting steel forging stock, bars, forgings and parts (880 to 1 080 MPa: limiting ruling section 100 mm)*

BS 4A 100:2003, *Specification for general requirements for bolts and free running nuts of tensile strength not exceeding 1 249 MPa*

BS HR 650, *Specification for high expansion heat-resisting steel bar and wire for the manufacture of bolts, studs, set screws and nuts (Ni 25.5, Cr 15, Ti 2, Mn 1.5, Mo 1.25, Si 0.7, V 0.3) (Limiting ruling section 50 mm)*

BS EN 2398, *Aerospace series – Heat resisting steel FE-PA2601 (X6NiCrTiMoV26-15) – Rm ≥ 900 MPa – Bars for machined bolts – D ≤ 25 mm*

BS EN 2399, *Aerospace series – Heat resisting steel FE-PA2601 (X4NiCrTiMoV26-15) – Rm ≥ 900 MPa – Bars for forged bolts – D ≤ 25 mm*

3 General

The bolts shall conform to the relevant requirements of BS 4A 100:2003 in respect of manufacture, screw threads and identification and marking.

4 Material and manufacture

4.1 The bolts shall be manufactured by one of the following methods:

a) machined from bright drawn bars which conform to one of the British Standards specified in Table 1;

b) forged from material which conforms to one of the British Standards specified in Table 1.

4.2 The materials used for the manufacture of forged bolts shall have the following mechanical properties in the finally heat treated condition:

a) 0.2% proof stress (min.): 590 MPa;

b) tensile stress (min.): 880 MPa;

c) elongation (min.): 12%;

d) Izod impact (min.): 55 J (40 ft.lbf). Not applicable to the materials given in BS HR 650, BS EN 2398 and BS EN 2399.

Table 1 **Materials for manufacture of bolts**

BS No.	Material	Application
BS S 80	2½% nickel-chromium-molybdenum steel	For the manufacture of machined bolts
BS HR 650	High expansion heat-resisting steel	For the manufacture of forged bolts
BS EN 2398	High expansion heat-resisting steel	For the manufacture of machined bolts
BS EN 2399	High expansion heat-resisting steel	For the manufacture of forged bolts

5 Dimensions

5.1 All finished bolts shall conform to the dimensions and tolerances given in Figure 1, Figure 2 and Table 2.

5.2 The clamping length of the bolt shall conform to the dimensions and tolerances given in Table 3, and shall be such that, when a standard nut without countersink or a ring gauge without countersink has been screwed on as far as possible by hand, its leading face is within the distance *M* from the upper surface of the bolt head. The runout of thread shall not exceed twice the pitch.

5.3 The nominal length of the bolt shall be the minimum bearing length *L*, which is determined by the minimum clamping length *M*, less two thread pitches. See Figure 3.

6 Screw threads

The bolts shall have unified threads of the form and class of fit specified in the relevant requirements of BS 4A 100:2003, Clause **8**.

7 Protective finish

None.

8 Hardness values

The hardness values of finished bolts shall be as follows:

a) for machined components:

255 min./321 max. HB or 270 min./340 max. HV;

b) for forged components:

248 min./341 max. HB or 260 min./360 max. HV.

9 Identification and marking

9.1 Identification

The British Standard identifier and part number (in accordance with Table 3) shall not be applied to the bolts, but shall be clearly marked on labels of parcels of bolts together with the batch identification code.

NOTE For example, A174-11D is a bolt with thread size 10-32 UNF and bearing length 1.1 inches manufactured in BS S 80 material and A174X11D is a bolt the same size manufactured in BS EN 2398 or BS EN 2399 material.

9.2 Marking

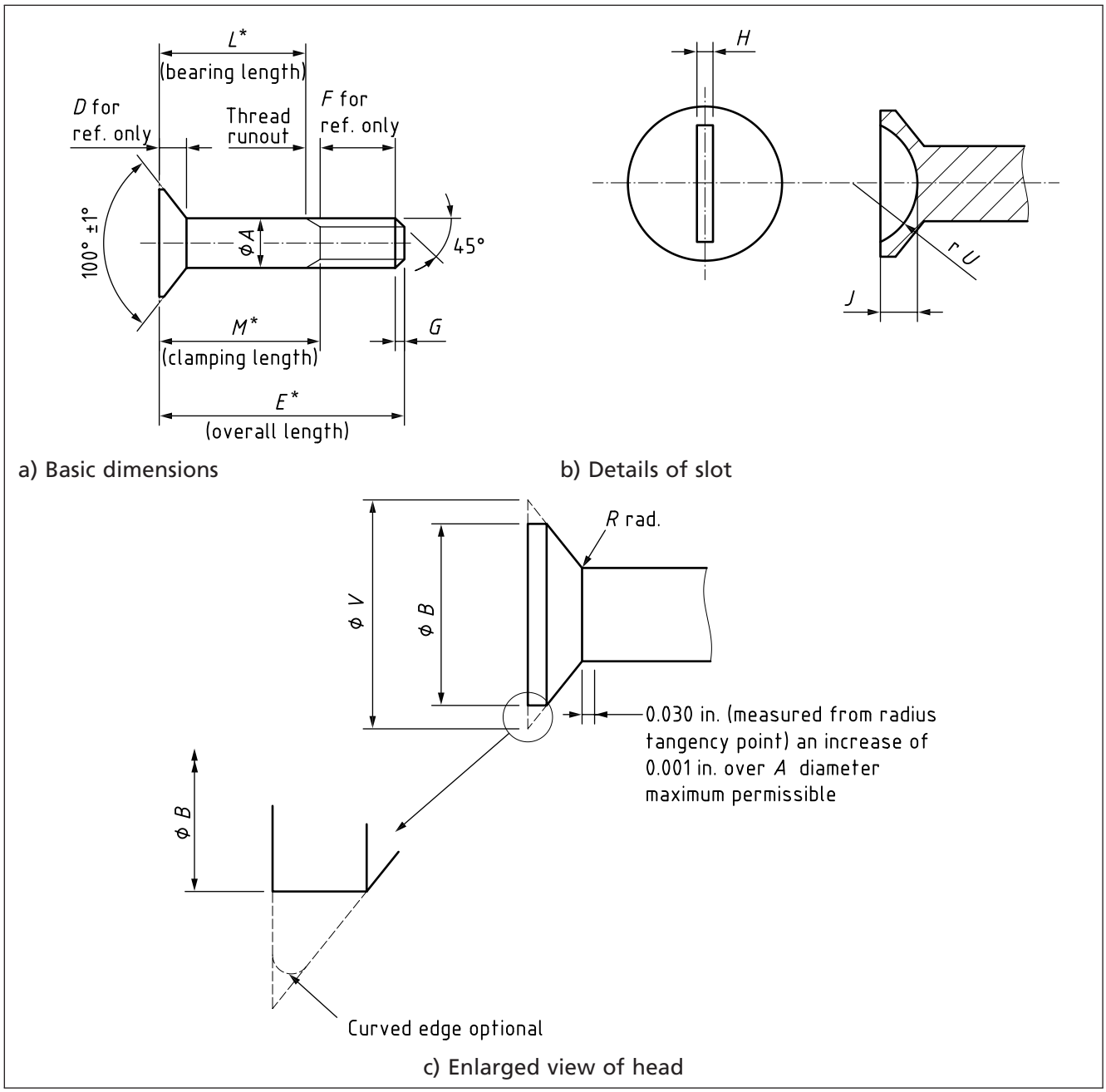
Bolts manufactured in BS HR 650, BS EN 2398 and BS EN 2399 material shall be marked with an "X" in accordance with BS 4A 100:2003, Clause **8**.

10 Inspection procedure

The bolts shall be inspected in accordance with the relevant requirements of BS 4A 100:2003.

*NOTE The requirements for gauging head dimensions are given in **A.8**.*

Figure 1 **Basic dimensions**



a) Basic dimensions

b) Details of slot

c) Enlarged view of head

Table 2 **Dimensions** *(1 of 2)*

1	2	3	4	5	6	7	8	9	10
Decimal equivalent of nominal thread size	**Nominal thread size**	**Diameter of plain portion of shank *A***		**Thread runout (2 × pitch)**	**Min. length of screwed portion of shank [A] *F***	**Diameter of head**			**Nominal head depth *D* [B]** (For reference only)
						To sharp corners *V* (For reference only)		**Absolute minimum *B***	
		max.	min.		min. ref.	max.	min.		
in		in	in	in	in	in	in	in	in
0.164-32 UNC	8-32 UNC	0.163 5	0.160 5	0.063	0.327	0.334	0.323	0.287	0.068
0.190-32 UNF	10-32 UNF	0.189 5	0.186 5	0.063	0.377	0.387	0.375	0.337	0.080
0.250-28 UNF	¼-28 UNF	0.249 5	0.246 5	0.071	0.459	0.510	0.496	0.452	0.106
0.312 5-24 UNF	$^{5}/_{16}$ -24 UNF	0.312 0	0.309 0	0.083	0.497	0.638	0.622	0.572	0.133
0.375-24 UNF	$^{3}/_{8}$ -24 UNF	0.374 5	0.371 5	0.083	0.597	0.766	0.748	0.692	0.159
0.437 5-20 UNF	$^{7}/_{16}$ -20 UNF	0.437 0	0.433 5	0.100	0.670	0.894	0.874	0.812	0.186
0.500-20 UNF	½ -20 UNF	0.499 5	0.496 0	0.100	0.770	1.022	1.000	0.932	0.213

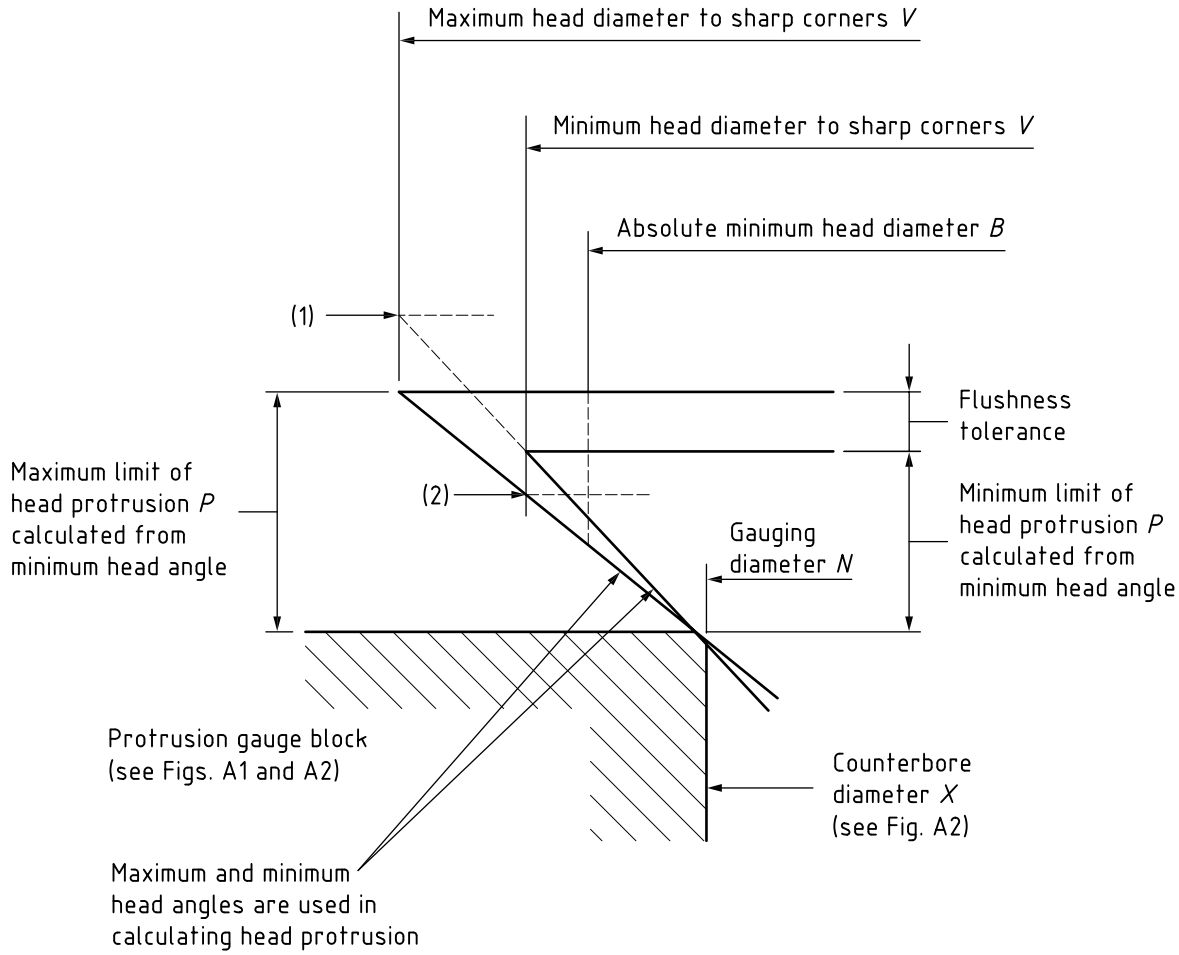
Table 2 **Dimensions** *(2 of 2)*

2	11	12	13	14	15	16	17	18	19	20	21	22
Nominal thread size	**Gauging dia. *N***	**Head protrusion**			**Radius under bolt head *R***		**Depth of chamfer *G***		**Slot**			
		Protrusion above gauging dia. *P*		**Flushness tolerance (*P* max. – *P* min.)**					**Width *H***		**Depth *J***	**Rad. *U***
		max.	min.		max.	min.	max.	min.	min.	max.	0 –0.010	±0.010
	in	in	in	in	in	in	in	in	in	in	in	in
8-32 UNC	0.267 1	0.027 6	0.023 8	0.003 8	0.020	0.010	0.030	0.020	0.045	0.054	0.045	0.219
10-32 UNF	0.314 7	0.029 9	0.025 9	0.004 0	0.020	0.010	0.030	0.020	0.050	0.060	0.060	0.219
¼-28 UNF	0.424 5	0.035 3	0.030 7	0.004 6	0.030	0.015	0.040	0.030	0.050	0.060	0.068	0.300
$^{5}/_{16}$ -24 UNF	0.538 9	0.040 9	0.035 7	0.005 2	0.030	0.015	0.040	0.030	0.050	0.060	0.087	0.300
$^{3}/_{8}$ -24 UNF	0.653 2	0.046 6	0.040 7	0.005 9	0.030	0.015	0.040	0.030	0.070	0.080	0.123	0.375
$^{7}/_{16}$ -20 UNF	0.767 6	0.052 2	0.045 7	0.006 5	0.030	0.015	0.050	0.040	0.070	0.080	0.134	0.375
½-20 UNF	0.882 0	0.057 8	0.050 7	0.007 1	0.030	0.015	0.050	0.040	0.070	0.080	0.134	0.375

[A] This dimension is an absolute minimum associated with maximum length *M* and minimum length *E*. It is not intended that it be used for manufacturing or inspection purposes.

[B] These dimensions 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.

Figure 2 **Diagram (part) showing maximum and minimum head conditions**



NOTE Gauges suitable for controlling flushness are described in Annex A.

The limits on head protrusion do not permit the extreme limits on diameter to sharp corners and on head angle shown by (1) and (2) to occur in one and the same head. This is because the application of these countersunk heads demands a high degree of flushness.

(1) Indicates the maximum head protrusion obtainable with the minimum head angle.

(2) Indicates the minimum head protrusion obtainable with the maximum head angle.

Figure 3 **Bearing length, clamping length and overall length dimensions**

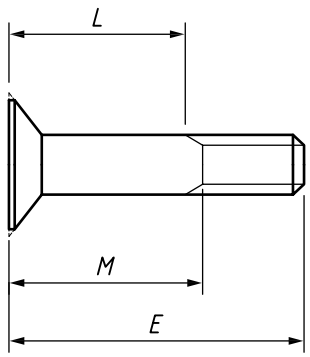


Table 3 **Bearing length *L*, clamping length *M* and overall length *E*** *(1 of 6)*

No. 8-32 UNC				No. 10-32 UNF			
Part No.	***L* min** [A)]	***M*** **0 −0.030**	***E*** **+0.040 0**	**Part No.**	***L* min** [A)]	***M*** **0 −0.030**	***E*** **+0.040 0**
	in	in	in		in	in	in
1C	0.1	0.193	0.55	1D	0.1	0.193	0.60
2C	0.2	0.293	0.65	2D	0.2	0.293	0.70
3C	0.3	0.393	0.75	3D	0.3	0.393	0.80
4C	0.4	0.493	0.85	4D	0.4	0.493	0.90
5C	0.5	0.593	0.95	5D	0.5	0.593	1.00
6C	0.6	0.693	1.05	6D	0.6	0.693	1.10
7C	0.7	0.793	1.15	7D	0.7	0.793	1.20
8C	0.8	0.893	1.25	8D	0.8	0.893	1.30
9C	0.9	0.993	1.35	9D	0.9	0.993	1.40
10C	1.0	1.093	1.45	10D	1.0	1.093	1.50
11C	1.1	1.193	1.55	11D	1.1	1.193	1.60
12C	1.2	1.293	1.65	12D	1.2	1.293	1.70
13C	1.3	1.393	1.75	13D	1.3	1.393	1.80
14C	1.4	1.493	1.85	14D	1.4	1.493	1.90
15C	1.5	1.593	1.95	15D	1.5	1.593	2.00
16C	1.6	1.693	2.05	16D	1.6	1.693	2.10
17C	1.7	1.793	2.15	17D	1.7	1.793	2.20
18C	1.8	1.893	2.25	18D	1.8	1.893	2.30
19C	1.9	1.993	2.35	19D	1.9	1.993	2.40
20C	2.0	2.093	2.45	20D	2.0	2.093	2.50
21C	2.1	2.193	2.55	21D	2.1	2.193	2.60
22C	2.2	2.293	2.65	22D	2.2	2.293	2.70
23C	2.3	2.393	2.75	23D	2.3	2.393	2.80
24C	2.4	2.493	2.85	24D	2.4	2.493	2.90
25C	2.5	2.593	2.95	25D	2.5	2.593	3.00
26C	2.6	2.693	3.05	26D	2.6	2.693	3.10
27C	2.7	2.793	3.15	27D	2.7	2.793	3.20
28C	2.8	2.893	3.25	28D	2.8	2.893	3.30

Table 3 **Bearing length *L*, clamping length *M* and overall length *E*** *(2 of 6)*

No. 8-32 UNC				No. 10-32 UNF			
Part No.	***L* min** [A)]	***M*** **0 −0.030**	***E*** **+0.040 0**	**Part No.**	***L* min** [A)]	***M*** **0 −0.030**	***E*** **+0.040 0**
	in	in	in		in	in	in
29C	2.9	2.993	3.35	29D	2.9	2.993	3.40
30C	3.0	3.093	3.45	30D	3.0	3.093	3.50
31C	3.1	3.193	3.55	31D	3.1	3.193	3.60
32C	3.2	3.293	3.65	32D	3.2	3.293	3.70
33C	3.3	3.393	3.75	33D	3.3	3.393	3.80
34C	3.4	3.493	3.85	34D	3.4	3.493	3.90
35C	3.5	3.593	3.95	35D	3.5	3.593	4.00
36C	3.6	3.693	4.05	36D	3.6	3.693	4.10
37C	3.7	3.793	4.15	37D	3.7	3.793	4.20
38C	3.8	3.893	4.25	38D	3.8	3.893	4.30
39C	3.9	3.993	4.35	39D	3.9	3.993	4.40
40C	4.0	4.093	4.45	40D	4.0	4.093	4.50
41C	4.1	4.193	4.55	41D	4.1	4.193	4.60
42C	4.2	4.293	4.65	42D	4.2	4.293	4.70
43C	4.3	4.393	4.75	43D	4.3	4.393	4.80
44C	4.4	4.493	4.85	44D	4.4	4.493	4.90
45C	4.5	4.593	4.95	45D	4.5	4.593	5.00
46C	4.6	4.693	5.05	46D	4.6	4.693	5.10
47C	4.7	4.793	5.15	47D	4.7	4.793	5.20
48C	4.8	4.893	5.25	48D	4.8	4.893	5.30
49C	4.9	4.993	5.35	49D	4.9	4.993	5.40
50C	5.0	5.093	5.45	50D	5.0	5.093	5.50
51C	5.1	5.193	5.55	51D	5.1	5.193	5.60
52C	5.2	5.293	5.65	52D	5.2	5.293	5.70
53C	5.3	5.393	5.75	53D	5.3	5.393	5.80

Table 3 **Bearing length *L*, clamping length *M* and overall length *E*** *(3 of 6)*

¼ in UNF				5/16 in UNF				3/8 in UNF			
Part No.	*L* min [A)]	*M* 0 −0.030	*E* +0.040 0	Part No.	*L* min [A)]	*M* 0 −0.030	*E* +0.040 0	Part No.	*L* min [A)]	*M* 0 −0.030	*E* +0.040 0
	in	in	in		in	in	in		in	in	in
2E	0.2	0.301	0.80	2G	0.2	0.313	0.85	2J	0.2	0.313	0.95
3E	0.3	0.401	0.90	3G	0.3	0.413	0.95	3J	0.3	0.413	1.05
4E	0.4	0.501	1.00	4G	0.4	0.513	1.05	4J	0.4	0.513	1.15
5E	0.5	0.601	1.10	5G	0.5	0.613	1.15	5J	0.5	0.613	1.25
6E	0.6	0.701	1.20	6G	0.6	0.713	1.25	6J	0.6	0.713	1.35
7E	0.7	0.801	1.30	7G	0.7	0.813	1.35	7J	0.7	0.813	1.45
8E	0.8	0.901	1.40	8G	0.8	0.913	1.45	8J	0.8	0.913	1.55
9E	0.9	1.001	1.50	9G	0.9	1.013	1.55	9J	0.9	1.013	1.65
10E	1.0	1.101	1.60	10G	1.0	1.113	1.65	10J	1.0	1.113	1.75
11E	1.1	1.201	1.70	11G	1.1	1.213	1.75	11J	1.1	1.213	1.85
12E	1.2	1.301	1.80	12G	1.2	1.313	1.85	12J	1.2	1.313	1.95
13E	1.3	1.401	1.90	13G	1.3	1.413	1.95	13J	1.3	1.413	2.05
14E	1.4	1.501	2.00	14G	1.4	1.513	2.05	14J	1.4	1.513	2.15
15E	1.5	1.601	2.10	15G	1.5	1.613	2.15	15J	1.5	1.613	2.25
16E	1.6	1.701	2.20	16G	1.6	1.713	2.25	16J	1.6	1.713	2.35
17E	1.7	1.801	2.30	17G	1.7	1.813	2.35	17J	1.7	1.813	2.45
18E	1.8	1.901	2.40	18G	1.8	1.913	2.45	18J	1.8	1.913	2.55
19E	1.9	2.001	2.50	19G	1.9	2.013	2.55	19J	1.9	2.013	2.65
20E	2.0	2.101	2.60	20G	2.0	2.113	2.65	20J	2.0	2.113	2.75
21E	2.1	2.201	2.70	21G	2.1	2.213	2.75	21J	2.1	2.213	2.85
22E	2.2	2.301	2.80	22G	2.2	2.313	2.85	22J	2.2	2.313	2.95
23E	2.3	2.401	2.90	23G	2.3	2.413	2.95	23J	2.3	2.413	3.05
24E	2.4	2.501	3.00	24G	2.4	2.513	3.05	24J	2.4	2.513	3.15
25E	2.5	2.601	3.10	25G	2.5	2.613	3.15	25J	2.5	2.613	3.25
26E	2.6	2.701	3.20	26G	2.6	2.713	3.25	26J	2.6	2.713	3.35
27E	2.7	2.801	3.30	27G	2.7	2.813	3.35	27J	2.7	2.813	3.45
28E	2.8	2.901	3.40	28G	2.8	2.913	3.45	28J	2.8	2.913	3.55
29E	2.9	3.001	3.50	29G	2.9	3.013	3.55	29J	2.9	3.013	3.65
30E	3.0	3.101	3.60	30G	3.0	3.113	3.65	30J	3.0	3.113	3.75
31E	3.1	3.201	3.70	31G	3.1	3.213	3.75	31J	3.1	3.213	3.85
32E	3.2	3.301	3.80	32G	3.2	3.313	3.85	32J	3.2	3.313	3.95
33E	3.3	3.401	3.90	33G	3.3	3.413	3.95	33J	3.3	3.413	4.05
34E	3.4	3.501	4.00	34G	3.4	3.513	4.05	34J	3.4	3.513	4.15
35E	3.5	3.601	4.10	35G	3.5	3.613	4.15	35J	3.5	3.613	4.25
36E	3.6	3.701	4.20	36G	3.6	3.713	4.25	36J	3.6	3.713	4.35
37E	3.7	3.801	4.30	37G	3.7	3.813	4.35	37J	3.7	3.813	4.45
38E	3.8	3.901	4.40	38G	3.8	3.913	4.45	38J	3.8	3.913	4.55
39E	3.9	4.001	4.50	39G	3.9	4.013	4.55	39J	3.9	4.013	4.65
40E	4.0	4.101	4.60	40G	4.0	4.113	4.65	40J	4.0	4.113	4.75

Table 3 **Bearing length *L*, clamping length *M* and overall length *E*** *(4 of 6)*

¼ in UNF				$^{5}/_{16}$ in UNF				$^{3}/_{8}$ in UNF			
Part No.	***L*** **min** [A)]	***M*** **0 −0.030**	***E*** **+0.040 0**	**Part No.**	***L*** **min** [A)]	***M*** **0 −0.030**	***E*** **+0.040 0**	**Part No.**	***L*** **min** [A)]	***M*** **0 −0.030**	***E*** **+0.040 0**
	in	in	in		in	in	in		in	in	in
41E	4.1	4.201	4.70	41G	4.1	4.213	4.75	41J	4.1	4.213	4.85
42E	4.2	4.301	4.80	42G	4.2	4.313	4.85	42J	4.2	4.313	4.95
43E	4.3	4.401	4.90	43G	4.3	4.413	4.95	43J	4.3	4.413	5.05
44E	4.4	4.501	5.00	44G	4.4	4.513	5.05	44J	4.4	4.513	5.15
45E	4.5	4.601	5.10	45G	4.5	4.613	5.15	45J	4.5	4.613	5.25
46E	4.6	4.701	5.20	46G	4.6	4.713	5.25	46J	4.6	4.713	5.35
47E	4.7	4.801	5.30	47G	4.7	4.813	5.35	47J	4.7	4.813	5.45
48E	4.8	4.901	5.40	48G	4.8	4.913	5.45	48J	4.8	4.913	5.55
49E	4.9	5.001	5.50	49G	4.9	5.013	5.55	49J	4.9	5.013	5.65
50E	5.0	5.101	5.60	50G	5.0	5.113	5.65	50J	5.0	5.113	5.75
51E	5.1	5.201	5.70	51G	5.1	5.213	5.75	51J	5.1	5.213	5.85
52E	5.2	5.301	5.80	52G	5.2	5.313	5.85	52J	5.2	5.313	5.95
53E	5.3	5.401	5.90	53G	5.3	5.413	5.95	53J	5.3	5.413	6.05
54E	5.4	5.501	6.00	54G	5.4	5.513	6.05	54J	5.4	5.513	6.15

Table 3 **Bearing length *L*, clamping length *M* and overall length *E*** *(5 of 6)*

$^{7}/_{16}$ in UNF				½ in UNF			
Part No.	***L* min** [A)]	***M*** **0 −0.030**	***E*** **+0.040 0**	**Part No.**	***L* min** [A)]	***M*** **0 −0.030**	***E*** **+0.040 0**
	in	in	in		in	in	in
2L	0.2	0.330	1.05				
3L	0.3	0.430	1.15	3N	0.3	0.430	1.25
4L	0.4	0.530	1.25	4N	0.4	0.530	1.35
5L	0.5	0.630	1.35	5N	0.5	0.630	1.45
6L	0.6	0.730	1.45	6N	0.6	0.730	1.55
7L	0.7	0.830	1.55	7N	0.7	0.830	1.65
8L	0.8	0.930	1.65	8N	0.8	0.930	1.75
9L	0.9	1.030	1.75	9N	0.9	1.030	1.85
10L	1.0	1.130	1.85	10N	1.0	1.130	1.95
11L	1.1	1.230	1.95	11N	1.1	1.230	2.05
12L	1.2	1.330	2.05	12N	1.2	1.330	2.15
13L	1.3	1.430	2.15	13N	1.3	1.430	2.25
14L	1.4	1.530	2.25	14N	1.4	1.530	2.35
15L	1.5	1.630	2.35	15N	1.5	1.630	2.45
16L	1.6	1.730	2.45	16N	1.6	1.730	2.55
17L	1.7	1.830	2.55	17N	1.7	1.830	2.65
18L	1.8	1.930	2.65	18N	1.8	1.930	2.75
19L	1.9	2.030	2.75	19N	1.9	2.030	2.85
20L	2.0	2.130	2.85	20N	2.0	2.130	2.95
21L	2.1	2.230	2.95	21N	2.1	2.230	3.05
22L	2.2	2.330	3.05	22N	2.2	2.330	3.15
23L	2.3	2.430	3.15	23N	2.3	2.430	3.25
24L	2.4	2.530	3.25	24N	2.4	2.530	3.35
25L	2.5	2.630	3.35	25N	2.5	2.630	3.45
26L	2.6	2.730	3.45	26N	2.6	2.730	3.55
27L	2.7	2.830	3.55	27N	2.7	2.830	3.65
28L	2.8	2.930	3.65	28N	2.8	2.930	3.75
29L	2.9	3.030	3.75	29N	2.9	3.030	3.85
30L	3.0	3.130	3.85	30N	3.0	3.130	3.95

Table 3 **Bearing length *L*, clamping length *M* and overall length *E*** *(6 of 6)*

$^{7}/_{16}$ in UNF				½ in UNF			
Part No.	***L* min** [A)]	***M*** **0 −0.030**	***E*** **+0.040 0**	**Part No.**	***L* min** [A)]	***M*** **0 −0.030**	***E*** **+0.040 0**
	in	in	in		in	in	in
31L	3.1	3.230	3.95	31N	3.1	3.230	4.05
32L	3.2	3.330	4.05	32N	3.2	3.330	4.15
33L	3.3	3.430	4.15	33N	3.3	3.430	4.25
34L	3.4	3.530	4.25	34N	3.4	3.530	4.35
35L	3.5	3.630	4.35	35N	3.5	3.630	4.45
36L	3.6	3.730	4.45	36N	3.6	3.730	4.55
37L	3.7	3.830	4.55	37N	3.7	3.830	4.65
38L	3.8	3.930	4.65	38N	3.8	3.930	4.75
39L	3.9	4.030	4.75	39N	3.9	4.030	4.85
40L	4.0	4.130	4.85	40N	4.0	4.130	4.95
41L	4.1	4.230	4.95	41N	4.1	4.230	5.05
42L	4.2	4.330	5.05	42N	4.2	4.330	5.15
43L	4.3	4.430	5.15	43N	4.3	4.430	5.25
44L	4.4	4.530	5.25	44N	4.4	4.530	5.35
45L	4.5	4.630	5.35	45N	4.5	4.630	5.45
46L	4.6	4.730	5.45	46N	4.6	4.730	5.55
47L	4.7	4.830	5.55	47N	4.7	4.830	5.65
48L	4.8	4.930	5.65	48N	4.8	4.930	5.75
49L	4.9	5.030	5.75	49N	4.9	5.030	5.85
50L	5.0	5.130	5.85	50N	5.0	5.130	5.95
51L	5.1	5.230	5.95	51N	5.1	5.230	6.05
52L	5.2	5.330	6.05	52N	5.2	5.330	6.15
53L	5.3	5.430	6.15	53N	5.3	5.430	6.25
54L	5.4	5.530	6.25	54N	5.4	5.530	6.35

[A)] See **5.3**.

Annex A (informative) Principles of flushness control and recommended gauging practice

A.1 The major requirement of the user of a countersunk head bolt, is that the upper surface of the head should fit with as great a 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 bolt and that on the countersunk hole into which the head is fitted. The method of dimensioning adopted in this British Standard directly controls the flushness accuracy of the bolt in relation to the countersink, the result in an actual assembly being dependent upon the tolerance applied to the countersink, which is outside the scope of this British Standard.

A.2 In the traditional method of dimensioning countersunk head bolts, the limits on the bolt 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 bolt 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 normal to its axis at a specified diameter known as the gauging diameter (see Figure 2). The dimension measured is known as the "head protrusion" and its tolerance as the "flushness tolerance".

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

a) the diameter to sharp corners (the hypothetical intersection of the flat upper surface and the conical under surface of the head); and

b) the included angle of the head.

A.6 The gauging diameter is at approximately one-third of the head depth from the upper surface.

A.7 The elements which define the bolt head and which are required to be controlled by inspection are:

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

b) diameter of head to sharp corners; this is controlled indirectly by the inspection of a) and d);

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

d) included angle of the conical under surface;

e) radius between conical surface and shank.

A.8 It is not a requirement of this British Standard that a particular method of inspection is employed. Head protrusion may be checked by means of a gauge of the type shown in Figure A.1 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.9 Figure A.1 illustrates a type of gauge which has achieved some popularity for use with aircraft countersunk head bolts and rivets in the U.S.A. Details of a suitable gauge block and dimensions are given in Figure A.2 and Table A.1.

A.10 The intersection of the hole *X* with the top surface of the gauge block forms the diameter on which the cone of the bolt 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 hardened steel ball until the dimension *Z* is within the stated limits. The dimension *Z* is calculated from the formula:

$$Z = \tfrac{1}{2}\left(Y + \sqrt{Y^2 - N^2}\right)$$

where *Y* is the ball diameter.

A.11 When the bolt 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 bolt head protrudes above the top surface of the gauge block.

A.12 The method of head dimensioning shown in Figure 1, Figure 2 and Table 2 defines maximum and minimum head envelopes which control flushness.

A.13 The type of gauge shown in Figure A.1 and Figure A.2 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 Figure A.1 and Figure A.2 does not control the head angle, which needs to be checked at intervals during production. An additional gauge is necessary for the absolute minimum head diameter.

Figure A.1 **Method of measurement of head protrusion**

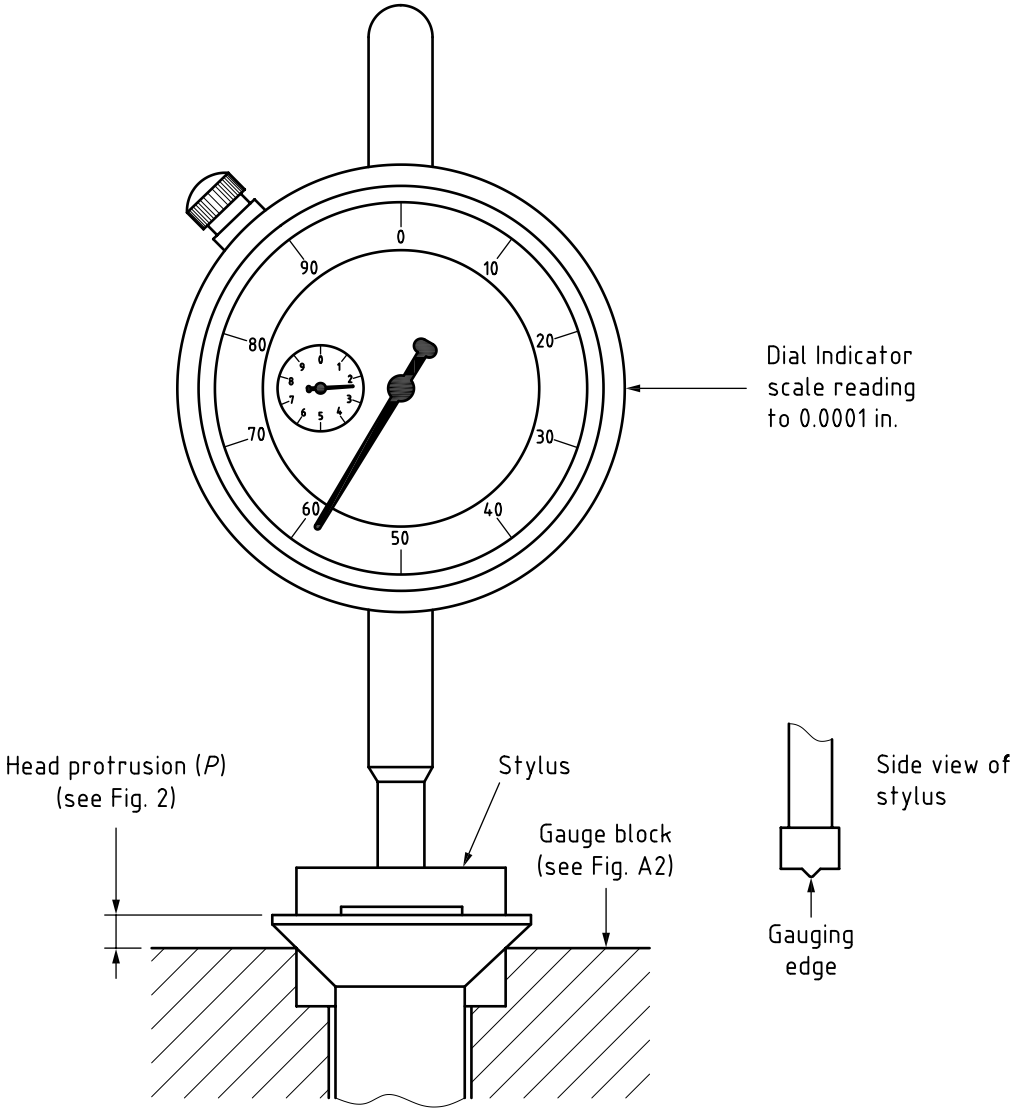


Figure A.2 **Protrusion gauge block (see Figure A.1 and subclause A.9)**

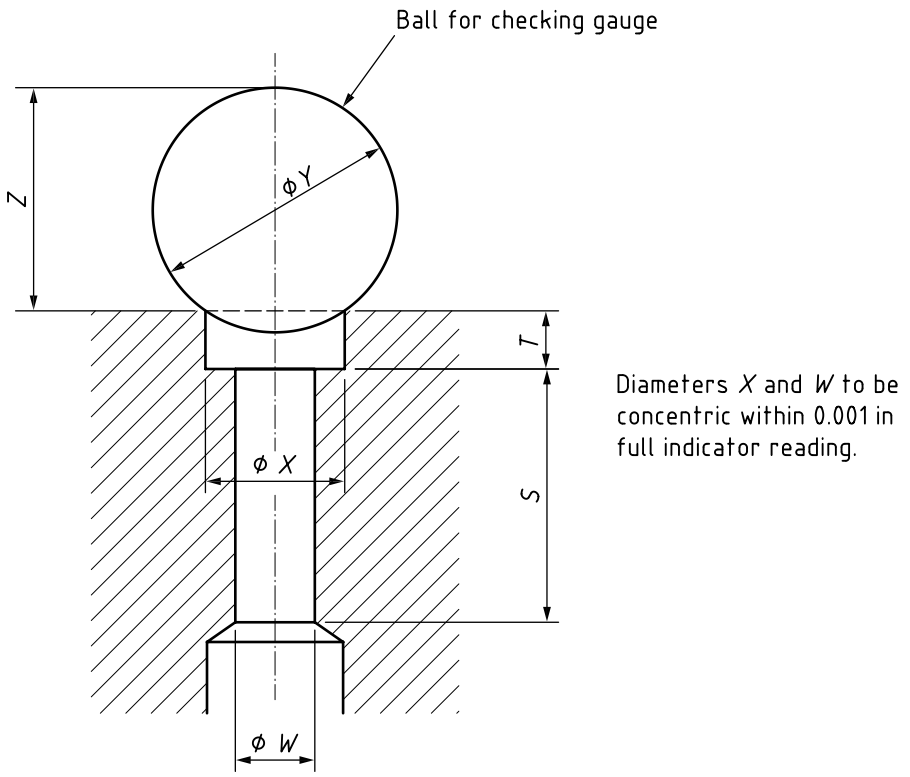


Table A.1 **Protrusion gauge block dimensions**

Nominal size of bolt	Ball dia. *Y*	Counter-bore dia. *X*	Ball protrusion *Z* [A)]	Depth of counterbore *T*	Dia. of guide *W*	Length of guide *S*
	Nominal	0 –0.001	+0.000 2 0	+0.010 0	+0.001 0	+0.010 0
		in	in	in	in	in
8-32 UNC	0.406 25 ($^{13}/_{32}$)	0.263	0.356 2	0.120	0.166 5	0.25
10-32 UNF	0.468 75 ($^{15}/_{32}$)	0.311	0.408 1	0.120	0.193 5	0.30
¼-28 UNF	0.656 25 ($^{21}/_{32}$)	0.420	0.578 3	0.120	0.253 5	0.40
$^{5}/_{16}$-24 UNF	0.812 50 ($^{13}/_{16}$)	0.535	0.710 3	0.150	0.316 0	0.50
$^{3}/_{8}$ -24 UNF	1.000 00 (1)	0.649	0.878 6	0.170	0.378 5	0.60
$^{7}/_{16}$-20 UNF	1.187 50 (1 $^{3}/_{16}$)	0.764	1.046 8	0.200	0.442 0	0.70
½-20 UNF	1.312 50 (1 $^{5}/_{16}$)	0.878	1.142 2	0.230	0.504 5	0.80

[A)] For the basis of calculation of these dimensions, see **A.10**.

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