

When bolts are broken in tension, breaking will normally occur in the threaded section, and it might be expected that the breaking load could be calculated on the basis of the material strength and the area at the root of the thread.

Tests have proved, however, that the actual tensile breaking load of a bolt is higher than the figure calculated in this manner, and the most accurate estimate is based on the mean of the pitch and minor

diameters of the thread. This calculation gives a figure which is known as the "Stress Area", and this is now generally accepted as the basis for computing the strength in tension of an externally threaded part. Stress Area is adopted for strength calculations in I.S.O. recommendations and in specifications issued by the Standards Association of Australia, British Standards Institution, American Society of Automotive Engineers (SAE).

Blacks BSW Bolts AS 2451

Table 5

Based on: Tensile Strength = 28 tonf/in² min.
Yield Stress = 16 tonf/in² min. (to 3/4" diameter)
15 tonf/in² min. (over 3/4" diameter)

Size	Area of Root of Thread	Stress Area of Thread*	Yield Load of bolt (min.)			Breaking Load of bolt (min.)		
	Sq. in.	Sq.in.	Tonf	lbf	Kn	Tonf	lbf	Kn
3/16 BSW	0.0141	0.0171	0.27	600	2.73	0.48	1070	4.77
1/4 BSW	0.0272	0.0321	0.51	1140	5.12	0.90	2010	8.96
5/16 BSW	0.0457	0.0527	0.84	1880	8.40	1.47	3290	14.7
3/8 BSW	0.0683	0.0779	1.25	2800	12.4	2.18	4880	21.7
7/16 BSW	0.0941	0.1069	1.71	3830	17.0	2.99	6700	29.8
1/2 BSW	0.1214	0.1385	2.22	4970	22.1	3.88	8690	38.6
5/8 BSW	0.2032	0.227	3.63	8130	36.2	6.35	14220	63.3
3/4 BSW	0.3039	0.336	5.38	12050	53.6	9.41	21080	93.7
7/8 BSW	0.4218	0.464	6.96	15590	69.3	13.00	29120	129
1 BSW	0.5542	0.608	9.12	20420	90.9	17.05	38190	170
1 1/8 BSW	0.6969	0.766	11.50	25760	114	21.42	47980	214
1 1/4 BSW	0.8942	0.980	14.70	32920	146	27.40	61480	273
1 1/2 BSW	1.300	1.410	21.15	47370	211	39.45	88370	393
1 3/4 BSW	1.753	1.907	28.60	64060	285	53.39	119590	532
2 BSW	2.311	2.508	37.60	84220	375	70.21	157270	700

* See introductory paragraph to this section for definition of "Stress Area".

Blacks Cup Head BSW Bolts AS B108

Table 6

Based on: Tensile Strength = 26 tonf/in² min.
 Yield Stress = 13 tonf/in² min.

Size	Area of Root of Thread	Stress Area of Thread*	Yield Load of Bolt (min.)			Breaking Load of Bolt (min.)		
	Sq. in.	Sq.in.	Tonf	lbf	Kn	Tonf	lbf	Kn
³ / ₁₆ BSW	0.0141	0.0171	0.22	500	2.22	0.44 ^{as}	1000	4.43
¹ / ₄ BSW	0.0272	0.0321	0.41	940	4.16	0.84	1880	8.32
⁵ / ₁₆ BSW	0.0457	0.0527	0.69	1540	6.83	1.37	3070	13.7
³ / ₈ BSW	0.0683	0.0779	1.01	2270	10.1	2.03	4540	20.2
⁷ / ₁₆ BSW	0.0941	0.1069	1.39	3110	13.8	2.78	6230	27.7
¹ / ₂ BSW	0.1214	0.1385	1.80	4030	17.9	3.60	8070	35.9
⁵ / ₈ BSW	0.2032	0.227	2.95	6610	29.4	5.90	13220	58.8
³ / ₄ BSW	0.3039	0.336	4.37	9780	43.5	8.74	19570	87.0

* See introductory paragraph to this section for definition of "Stress Area".

Blacks Unified High Tensile Hexagon Head Bolts and Set Screws (AS 2465/SAE Grade 5)

Table 7

Based on: Tensile Strength = 120000 lbf/in² min. (827 MPa) Sizes ¹/₄" - 1" incl.
 = 105000 lbf/in² min. (724 MPa) Sizes ¹/₈" - ¹/₂" incl.
 Yield Stress = 92000 lbf/in² min. (634 MPa) Sizes ¹/₄" - 1" incl.
 81000 lbf/in² min. (558 MPa) Sizes ¹/₈" - ¹/₂" incl.
 Proof Load Stress = 85000 lbf/in² (586 MPa) Sizes ¹/₄" - 1" incl.
 74000 lbf/in² (510 MPa) Sizes ¹/₈" - ¹/₂" incl.

Size		Area of Root of Thread	Stress Area of Thread*	Proof Load of Bolt		Breaking Load of Bolt (Min.)	
		Sq. in.	Sq. in.	lbf	kN	lbf	kN
¹ / ₄	UNF	0.0326	0.0364	3100	13.8	4350	19.3
⁵ / ₁₆	UNF	0.0524	0.0580	4900	21.8	6950	30.9
³ / ₈	UNF	0.0809	0.0878	7450	33.1	10500	46.7
⁷ / ₁₆	UNF	0.1090	0.1187	10100	44.9	14200	63.2
¹ / ₂	UNF	0.1486	0.1599	13600	60.5	19200	85.4
⁵ / ₈	UNF	0.240	0.256	21800	97.0	30700	137
³ / ₄	UNF	0.351	0.373	31700	141	44800	199
⁷ / ₈	UNF	0.480	0.509	43300	193	61100	272
1	UNF	0.625	0.663	56400	251	79600	354
¹ / ₈	UNF	0.812	0.856	63300	282	89900	400
¹ / ₄	UNF	1.024	1.073	79400	353	112700	501
¹ / ₂	UNF	1.521	1.581	117000	520	166000	738

* See introductory paragraph to this section for definition of "Stress Area".
 Blacks stock range shown in bold face. Other sizes to special order.

Blacks Hexagon
Head Bolts and Set Screws
(AS 2465/SAE Grade 5)

Table 8

Based on: Tensile Strength = 120000 lbf/in² min. (827 MPa) Sizes 1/4" - 1" incl.
 = 105000 lbf/in² min. (724 MPa) Sizes 1 1/8" - 1 1/2" incl.
 Yield Stress = 92000 lbf/in² min. (634 MPa) Sizes 1/4" - 1" incl.
 = 81000 lbf/in² min. (558 MPa) Sizes 1 1/8" - 1 1/2" incl.
 Proof Load Stress = 85000 lbf/in² (586 MPa) Sizes 1/4" - 1" incl.
 = 74000 lbf/in² (510 MPa) Sizes 1 1/8" - 1 1/2" incl.

Size		Area of Root of Thread	Stress Area of Thread*	Proof Load of Bolt		Breaking Load of Bolt (Min.)	
		Sq. in.	Sq. in.	lbf	kN	lbf	kN
1/4	UNC	0.0269	0.0318	2700	12.0	3800	16.9
5/16	UNC	0.0454	0.0524	4450	19.8	6300	28.0
3/8	UNC	0.0678	0.0775	6600	29.4	9300	41.4
7/16	UNC	0.0933	0.1063	9050	40.3	12800	56.9
1/2	UNC	0.1257	0.1419	12100	53.8	17000	75.6
5/8	UNC	0.202	0.226	19200	85.4	27100	121
3/4	UNC	0.302	0.334	28400	126	40100	178
7/8	UNC	0.419	0.462	39300	175	55400	246
1	UNC	0.551	0.606	51500	229	72700	323
1 1/8	UNC	0.693	0.763	56500	251	80100	356
1 1/4	UNC	0.890	0.969	71700	319	101700	452
1 1/2	UNC	1.294	1.405	104000	463	147500	656

* See introductory paragraph to this section for definition of "Stress Area".
 Blacks stock range shown in bold face. Other sizes to special order.

Blacks Hexagon
 Head Bolts and Set Screws
 (AS 2465/SAE Grade 8)

Table 9

Based on: Tensile Strength = 150000 lbf/in² min. (1034 MPa) Sizes 1/4" - 1 1/2" incl.
 Yield Stress = 130000 lbf/in² min. (896 MPa)
 Proof Load Stress = 120000 lbf/in² (827 MPa)

Size		Area of Root of Thread	Stress Area of Thread*	Proof Load of Bolt		Breaking Load of Bolt (Min.)	
		Sq. in.	Sq. in.	lbf	kN	lbf	kN
1/4	UNF	0.0326	0.0364	4350	19.3	5450	24.2
5/16	UNF	0.0524	0.0580	6950	30.9	8700	38.7
3/8	UNF	0.0809	0.0878	10500	46.7	13200	58.7
7/16	UNF	0.1090	0.1187	14200	63.2	17800	79.2
1/2	UNF	0.1486	0.1599	19200	85.4	24000	107
5/8	UNF	0.240	0.256	30700	137	38400	171
3/4	UNF	0.351	0.373	44800	199	56000	249
7/8	UNF	0.480	0.509	61100	272	76400	340
1	UNF	0.625	0.663	79600	354	99400	442
1 1/8	UNF	0.812	0.856	102700	457	128400	571
1 1/4	UNF	1.024	1.073	128800	573	161000	716
1 1/2	UNF	1.521	1.581	189700	844	237200	1055
1/4	UNC	0.0269	0.0318	3800	16.9	4750	19.3
5/16	UNC	0.0454	0.0524	6300	28.0	7850	30.9
3/8	UNC	0.0678	0.0775	9300	41.4	11600	46.7
7/16	UNC	0.0933	0.1063	12800	56.9	15900	63.2
1/2	UNC	0.1257	0.1419	17000	75.6	21300	85.4
5/8	UNC	0.202	0.226	27100	121	33900	137
3/4	UNC	0.302	0.334	40100	178	50100	199
7/8	UNC	0.419	0.462	55400	246	69300	272
1	UNC	0.551	0.606	72700	323	90900	354
1 1/8	UNC	0.693	0.763	91600	407	114400	457
1 1/4	UNC	0.890	0.969	116300	517	145400	573
1 1/2	UNC	1.294	1.405	168600	750	210800	844

* See introductory paragraph to this section for definition of "Stress Area".

Blacks Metric Hexagon Commercial
Bolts and Screws
(AS 1111 Property Class 4.6)

Table 10

Based on:

Tensile Strength	=	400 MPa min	(58015 lbf/in ²)
Yield Stress	=	240 MPa min	(34810 lbf/in ²)
Proof Load Stress	=	225 MPa	(32635 lbf/in ²)

Size	Area of Root of Thread	Tensile Stress Area of Thread	Proof Load of Bolt		Breaking Load of Bolt (Min.)	
	mm ²	mm ²	kN	lbf	kN	lbf
M5	12.7	14.2	3.20	719	5.68	1277
M6	17.9	20.1	4.52	1016	8.04	1807
M8	32.8	36.6	8.24	1852	14.6	3282
M10	52.3	58.0	13.0	2923	23.2	5216
M12	76.2	84.3	19.0	4271	33.7	7576
M16	144	157	35.3	7936	62.8	14118
M20	225	245	55.1	12387	98.0	22031
M24	324	353	79.4	17850	141	31698
M30	519	561	126	28326	224	50357
M36	759	817	184	41365	327	73513
M42	1050	1120	252	56652	448	100714
M48	1380	1470	331	74412	588	132188
M56	1910	2030	458	102963	812	182545
M64	2520	2680	605	136009	1072	240995

Blacks Metric Hexagon Precision
 Bolts and Screws
 (AS 1110 Property Class 8.8)

Table 11

Based on:	Tensile Strength	= 800 MPa min	(116030 lbf/in ²)	Sizes M5 - M16 incl.
		= 830 MPa min	(120380 lbf/in ²)	Sizes M20 - M36 incl.
Yield Stress		= 640 MPa min	(92825 lbf/in ²)	Sizes M5 - M16 incl.
		= 660 MPa min	(95725 lbf/in ²)	Sizes M20 - M36 incl.
Proof Load Stress		= 580 MPa	(84120 lbf/in ²)	Sizes M5 - M16 incl.
		= 600 MPa	(87025 lbf/in ²)	Sizes M20 - M36 incl.

Size	Area of Root of Thread	Tensile Stress Area of Thread*	Proof Load of Bolt		Breaking Load of Bolt (Min.)	
	mm ²	mm ²	kN	lbf	kN	lbf
M5	12.7	14.2	8.23	1850	11.35	2552
M6	17.9	20.1	11.6	2608	16.1	3619
M8	32.8	36.6	21.2	4766	29.2	6564
M10	52.3	58.0	33.7	7576	46.4	10431
M12	76.2	84.3	48.9	10993	67.4	15152
M16	144	157	91.0	20458	125	28101
M20	225	245	147	33047	203	45636
M24	324	353	212	47660	293	65869
M30	519	561	337	75760	466	104761
M36	759	817	490	110156	678	152421

* See introductory paragraph to this section for definition of "Stress Area".