Bolt Shear Capacity

Table 12

Specification	AS 1111 AS 2451		AS 1110 Prop. Cl. 8.8 AS 2465 Grade 5			AS 1110 Prop. Cl 10.9 AS 2465 Grade 8		
Size	Minimum Breaking Load in Single Shear – kN [1] [2]							
	Shank[3]	Thread	Shank[3]	Thread		Shank[3]	Thread	
				Coarse	Fine		Coarse	Fine
M6	7	4	14	9		18	12	
1/4"	9	5	16	9	11	20	11	14
M8	13	8	25	16		33	21	
5/16"	13	8	26	15	17	32	19	22
3/8"	19	12	37	23	27	46	28	34
M10	20	13	39	26		51	34	
7/16"	26	16	50	31	36	63	39	45
M12	28	19	57	38		74	50	
1/2"	34	21	65	42	50	82	52	62
M16	50	36	101	72		131	94	
5/8"	53	35	102	67	80	128	84	100
3/4"	77	53	147	101	117	184	126	146
M20	79	56	163	117		204	146	
7/8"	105	73	201	140	160	251	175	200
M24	113	81	235	168		294	211	
1"	137	97	262	184	208	327	230	260
1 1/8"	173	121	332	202	237	414	289	338
M30	177	130	368	270		459	337	
M36	254	190	529	395		662	493	
1 1/2"	308	226	589	377	444	736	539	634

NOTES:

1. *Tabulated values are for failure. Refer to applicable Code for permissible Design Stress. Table 13 gives guidance for AS 1250 and AS 4100 values*
2. *The values shown are for a single shear plane and may be compounded for multiple shear planes. Multiple bolt joints are subject to an "unbuttoning effect".*

   AS 1250 states that this should be considered when more than 5 bolts are aligned in the direction of the force.

   AS 1511 reduces design shear capacity, 14% for joints 500-1200mm length, 43% for joints over 1200mm.

   AS 4100 progressively reduces design shear capacity by 25% for joints 300-1300mm length and longer.
3. *Based on nominal diameter of shank.*

Table 13

Bolt Type	Shear Stress at failure[1] (Mpa) Min	Max	Ratio[2]	AS 1250–1981 Maximum Permissible Design Shear Stress (MPa)[4]	AS 4100–1990 Maximum "Design Capacity Shear Stress"[5] (MPa)
AS 1111 Property Class 4.6	248.0	431.5	1.74	79.2	198.4
AS 2451 BSW					
Low Tensile 1/4" – 3/4"	267.8	452.6	1.69	(81.5)[6]	214.3
7/8" – 1"	267.8	452.6	1.69	(76.6)[6]	214.3
AS 1559 Tower Bolt	320.0[7]	–	–	112.2[8]	238.1[9]
AS Property Class 5.8	322.4	431.5	1.34	130.0	257.9
AS 1110 Property Class 8.8					
M1.6 – M16	496.0	636.1	1.28	200.0	396.8
M18 – M36	514.6	654.1	1.27	207.5	411.7
AS 2465 Unified Grade 5					
1/4" – 1"	512.7	654.1	1.28	206.8	410.2
1 1/8" – 1 1/2"	448.9	589.6	1.31	181.0	359.1
AS 2465 Unified Grade 8	641.0	752.1	1.17	258.5	512.9
AS 1110 Property Class 10.9	644.8	752.1	1.17	260.0	515.8

NOTES

1. *Basis is ultimate shear stress equals 62% of ultimate tensile strength. Reference AS 4100-1990. This ratio was established on tension loaded lap joints. Geometric effects on compression loading similar joint configuration can give apparent bolt shear capacity 9% higher.*
2. *For overload protection application, check that both maximum and minimum are suitable. Maximum equals minimum (Table 12) value times ratio.*
3. *Maximum shear stress at failure is based on imputed maximum tensile strength, estimated from specified maximum hardness. Reference SAE J417.*
4. *Maximum Permissible Shear Stress in design is the lesser of $.33F_{yf}$ and $0.25F_{uf}$.*
5. *AS 4100 does not express stress values but extends the data to a "Design Resistance Capacity" taking account of the length of the joint (see Table 12 Note 2), the available bolt shear area (threads or shanks) and a "Capacity Factor" which is 0.8 for the Strength Limit State Criterion. Thus the "Design Capacity Shear Stress" shown here to facilitate comparison with the previous rule is 80% of the minimum shear stress at failure shown in column 2, and represents the stress value which the factored actions (loads) acting on the bolts may not exceed - not the actual shear stress which may not be applied to the bolts. With Load Factors of 1.25 on dead loads and 1.5 on live loads it can be seen that bolt loading is still conservative compared to their ultimate capacity although less so than under AS 1250 rules. Other load factors apply for other actions eg. earthquake, wind etc.*
6. *For mild steel bolts the relevant criterion (see Note 4 above) is generally $.33F_{yf}$. AS 2451 does not specify F_{yf} so the values shown are from Blacks Fasteners Ltd data.*
7. *On the basis of Note 1, the value here would be 297.6 MPa but 320 MPa is shown as it is a specified requirement of AS 1559.*
8. *Some Design Authorities have for over 5 years, used a value 290 MPa (=91% of the specified minimum value) which would be experienced by the fastener under the 80 year mean return wind, in lattice tower design. They previously used the 30 year mean return wind and had some towers blow down.*
9. *Factoring the specification minimum shear stress would give a value of 256 MPa.*
10. *kN x 224.809 = lbf. MPa x 145.038 = lbf/in^2.*