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Nominal Size & Threads In.	Series ¹ Designation	External ⁴									Internal ⁴							
		Class	Allowance	Major Diameter			Pitch Diameter			UN ² Minor Diam Max (Ref)	UNR Minor Diam Max (Ref)	Class	Minor Diameter		Pitch Diameter			Major Diameter Min
				Max ³	Min	Min ⁵	Max ³	Min	Tolerance				Min	Max	Min	Max	Tolerance	
0-80 or 0.060-80	UNF	2A	0.0005	0.0595	0.0563	---	0.0514	0.0496	0.0018	0.0460	0.0446	2B	0.0465	0.0514	0.0519	0.0542	0.0023	0.0600
		3A	0.0000	0.0600	0.0568	---	0.0519	0.0506	0.0013	0.0465	0.0451	3B	0.0465	0.0514	0.0519	0.0536	0.0017	0.0600
1.64 or 0.073-64	UNC	2A	0.0006	0.0724	0.0686	---	0.0623	0.0603	0.0020	0.0555	0.0538	2B	0.0561	0.0623	0.0629	0.0655	0.0026	0.0730
		3A	0.0000	0.0730	0.0692	---	0.0629	0.0614	0.0015	0.0561	0.0544	3B	0.0561	0.0623	0.0629	0.0648	0.0019	0.0730
1-72 or 0.073-72	UNF	2A	0.0006	0.0724	0.0689	---	0.0634	0.0615	0.0019	0.0574	0.0559	2B	0.0580	0.0635	0.0640	0.0665	0.0025	0.0730
		3A	0.0000	0.0730	0.0695	---	0.0640	0.0626	0.0014	0.0580	0.0565	3B	0.0580	0.0635	0.0640	0.0659	0.0019	0.0730
2-56 or 0.086-56	UNC	2A	0.0006	0.0854	0.0813	---	0.0738	0.0717	0.0021	0.0661	0.0642	2B	0.0667	0.0737	0.0744	0.0772	0.0028	0.0860
		3A	0.0000	0.0860	0.0819	---	0.0744	0.0728	0.0016	0.0667	0.0648	3B	0.0667	0.0737	0.0744	0.0765	0.0021	0.0860
2-64 or 0.086-64	UNF	2A	0.0006	0.0854	0.0816	---	0.0753	0.0733	0.0020	0.0685	0.0668	2B	0.0691	0.0753	0.0759	0.0786	0.0027	0.0860
		3A	0.0000	0.0860	0.0822	---	0.0759	0.0744	0.0015	0.0691	0.0674	3B	0.0691	0.0753	0.0759	0.0779	0.0020	0.0860
3-48 or 0.099-48	UNC	2A	0.0007	0.0983	0.0938	---	0.0848	0.0825	0.0023	0.0757	0.0734	2B	0.0764	0.0845	0.0855	0.0885	0.0030	0.0990
		3A	0.0000	0.0990	0.0945	---	0.0855	0.0838	0.0017	0.0764	0.0741	3B	0.0764	0.0845	0.0855	0.0877	0.0022	0.0990
3-56 or 0.099-56	UNF	2A	0.0007	0.0983	0.0942	---	0.0867	0.0845	0.0022	0.0790	0.0771	2B	0.0797	0.0865	0.0874	0.0902	0.0028	0.0990
		3A	0.0000	0.0990	0.0949	---	0.0874	0.0858	0.0016	0.0797	0.0778	3B	0.0797	0.0865	0.0874	0.0895	0.0021	0.0990
4-40 or 0.112-40	UNC	2A	0.0008	0.1112	0.1061	---	0.0950	0.0925	0.0025	0.0841	0.0814	2B	0.0849	0.0939	0.0958	0.0991	0.0033	0.1120
		3A	0.0000	0.1120	0.1069	---	0.0958	0.0939	0.0019	0.0849	0.0822	3B	0.0849	0.0939	0.0958	0.0982	0.0024	0.1120
4-48 or 0.112-48	UNF	2A	0.0007	0.1113	0.1068	---	0.0978	0.0954	0.0024	0.0887	0.0864	2B	0.0894	0.0968	0.0985	0.1016	0.0031	0.1120
		3A	0.0000	0.1120	0.1075	---	0.0985	0.0967	0.0018	0.0894	0.0871	3B	0.0894	0.0968	0.0985	0.1008	0.0023	0.1120
5-40 or 0.125-40	UNC	2A	0.0008	0.1242	0.1191	---	0.1080	0.1054	0.0026	0.0971	0.0944	2B	0.0979	0.1062	0.1088	0.1121	0.0033	0.1250
		3A	0.0000	0.1250	0.1199	---	0.1088	0.1069	0.0019	0.0979	0.0952	3B	0.0979	0.1062	0.1088	0.1113	0.0025	0.1250
5-44 or 0.125-44	UNF	2A	0.0007	0.1243	0.1195	---	0.1095	0.1070	0.0025	0.0997	0.0972	2B	0.1004	0.1079	0.1102	0.1134	0.0032	0.1250
		3A	0.0000	0.1250	0.1202	---	0.1102	0.1083	0.0019	0.1044	0.0979	3B	0.1004	0.1079	0.1102	0.1126	0.0024	0.1250
6-32 or 0.138-32	UNC	2A	0.0008	0.1372	0.1312	---	0.1169	0.1141	0.0028	0.1034	0.1000	2B	0.104	0.114	0.1177	0.1214	0.0037	0.1380
		3A	0.0000	0.1380	0.1320	---	0.1177	0.1156	0.0021	0.1042	0.1008	3B	0.1040	0.1140	0.1177	0.1204	0.0027	0.1380
6-40 or 0.138-40	UNF	2A	0.0008	0.1372	0.1321	---	0.1210	0.1184	0.0026	0.1101	0.1074	2B	0.111	0.119	0.1218	0.1252	0.0034	0.1380
		3A	0.0000	0.1380	0.1329	---	0.1218	0.1198	0.0020	0.1109	0.1082	3B	0.1110	0.1186	0.1218	0.1243	0.0025	0.1380
8-32 or 0.164-32	UNC	2A	0.0009	0.1631	0.1571	---	0.1428	0.1399	0.0029	0.1293	0.0259	2B	0.130	0.139	0.1437	0.1475	0.0038	0.1640
		3A	0.0000	0.1640	0.1580	---	0.1437	0.1415	0.0022	0.1302	0.1268	3B	0.1300	0.1389	0.1437	0.1465	0.0028	0.1640
8-36 or 0.164-36	UNF	2A	0.0008	0.1632	0.1577	---	0.1452	0.1424	0.0028	0.1331	0.1301	2B	0.134	0.142	0.1460	0.1496	0.0036	0.1640
		3A	0.0000	0.1640	0.1585	---	0.1460	0.1439	0.0021	0.1339	0.1309	3B	0.1340	0.1416	0.1460	0.1487	0.0027	0.1640
10-24 or 0.190-24	UNC	2A	0.0010	0.1890	0.1818	---	0.1619	0.1586	0.0033	0.1439	0.1394	2B	0.145	0.156	0.1629	0.1672	0.0043	0.1900
		3A	0.0000	0.1900	0.1828	---	0.1629	0.1604	0.0025	0.1449	0.1404	3B	0.1450	0.1555	0.1629	0.1661	0.0032	0.1900
10-32 or 0.190-32	UNF	2A	0.0009	0.1891	0.1831	---	0.1688	0.1658	0.0030	0.1553	0.1519	2B	0.156	0.164	0.1697	0.1736	0.0039	0.1900
		3A	0.0000	0.1900	0.1840	---	0.1697	0.1674	0.0023	0.1562	0.1528	3B	0.1560	0.1641	0.1697	0.1726	0.0029	0.1900
12-24 or 0.216-24	UNC	2A	0.0010	0.2150	0.2078	---	0.1879	0.1845	0.0034	0.1699	0.1654	2B	0.171	0.181	0.1889	0.1933	0.0044	0.2160
		3A	0.0000	0.2160	0.2088	---	0.1889	0.1863	0.0026	0.1709	0.1664	3B	0.1710	0.1807	0.1889	0.1922	0.0033	0.2160
12-28 or 0.216-28	UNF	2A	0.0010	0.2150	0.2085	---	0.1918	0.1886	0.0032	0.1763	0.1724	2B	0.177	0.186	0.1928	0.1970	0.0042	0.2160
		3A	0.0000	0.2160	0.2095	---	0.1928	0.1904	0.0024	0.1773	0.1734	3B	0.1770	0.1857	0.1928	0.1959	0.0031	0.2160
1/4-20 or 0.250-20	UNC	1A	0.0011	0.2489	0.2367	---	0.2164	0.2108	0.0056	0.1948	0.1894	1B	0.196	0.207	0.2175	0.2248	0.0073	0.2500
		2A	0.0011	0.2489	0.2408	0.2367	0.2164	0.2127	0.0037	0.1948	0.1894	2B	0.196	0.207	0.2175	0.2224	0.0049	0.2500
		3A	0.0000	0.2500	0.2419	---	0.2175	0.2147	0.0028	0.1959	0.1905	3B	0.1960	0.2067	0.2175	0.2211	0.0036	0.2500
1/4-28 or 0.250-28	UNF	1A	0.0010	0.2490	0.2392	---	0.2258	0.2208	0.0050	0.2103	0.2064	1B	0.211	0.220	0.2268	0.2333	0.0065	0.2500
		2A	0.0010	0.2490	0.2425	---	0.2258	0.2225	0.0033	0.2103	0.2064	2B	0.211	0.220	0.2268	0.2311	0.0043	0.2500
		3A	0.0000	0.2500	0.2435	---	0.2268	0.2243	0.0025	0.2113	0.2074	3B	0.2110	0.2190	0.2268	0.2300	0.0032	0.2500
5/16-18 or 0.312-18	UNC	1A	0.0012	0.3113	0.2982	---	0.2752	0.2691	0.0061	0.2512	0.2452	1B	0.252	0.265	0.2764	0.2843	0.0079	0.3125
		2A	0.0012	0.3113	0.3026	0.2982	0.2752	0.2712	0.0040	0.2512	0.2452	2B	0.252	0.265	0.2764	0.2817	0.0053	0.3125
		3A	0.0000	0.3125	0.3038	---	0.2764	0.2734	0.0030	0.2524	0.2464	3B	0.2520	0.2630	0.2764	0.2803	0.0039	0.3125



Nominal Size & Threads In.	Series ¹ Designation	External ⁴									Internal ⁴							
		Class	Allowance	Major Diameter			Pitch Diameter			UN ² Minor Diam Max (Ref)	UNR Minor Diam Max (Ref)	Class	Minor Diameter		Pitch Diameter			Major Diameter Min
				Max ³	Min	Min ⁵	Max ³	Min	Tolerance				Min	Max	Min	Max	Tolerance	
5/16-24 or 0.3125-24	UNF	1A	0.0011	0.3114	0.3006	---	0.2743	0.2788	0.0055	0.2663	0.2618	1B	0.267	0.277	0.2854	0.2925	0.0071	0.3125
		2A	0.0011	0.3114	0.3042	---	0.2843	0.2866	0.0037	0.2663	0.2618	2B	0.267	0.277	0.2854	0.2902	0.0048	0.3125
		3A	0.0000	0.3125	0.3053	---	0.2854	0.2827	0.0027	0.2674	0.2629	3B	0.2670	0.2754	0.2854	0.2890	0.0036	0.3125
3/8-16 or .0375-16	UNC	1A	0.0013	0.3737	0.3595	---	0.3331	0.3266	0.0065	0.3060	0.2992	1B	0.307	0.321	0.3344	0.3429	0.0085	0.3750
		2A	0.0013	0.3737	0.3643	0.3595	0.3331	0.3287	0.0044	0.3060	0.2992	2B	0.307	0.321	0.3344	0.3401	0.0057	0.3750
		3A	0.0000	0.3750	0.3656	---	0.3344	0.3331	0.0033	0.3073	0.3005	3B	0.3070	0.3182	0.3344	0.3387	0.0043	0.3750
3/8-24 or 0.375-24	UNF	1A	0.0011	0.3739	0.3631	---	0.3468	0.3411	0.0057	0.3288	0.3243	1B	0.330	0.340	0.3479	0.3553	0.0074	0.3750
		2A	0.0011	0.3739	0.3667	---	0.3468	0.3430	0.0038	0.3288	0.3243	2B	0.330	0.340	0.3479	0.3528	0.0049	0.3750
		3A	0.0000	0.3750	0.3678	---	0.3479	0.3450	0.0029	0.3299	0.3254	3B	0.3300	0.3372	0.3479	0.3516	0.0037	0.3750
7/16-14 or 0.4375-14	UNC	1A	0.0014	0.4361	0.4206	---	0.3897	0.3826	0.0071	0.3588	0.3511	1B	0.360	0.376	0.3911	0.4003	0.0092	0.4375
		2A	0.0014	0.4361	0.4258	0.4206	0.3897	0.3850	0.0047	0.3588	0.3511	2B	0.360	0.376	0.3911	0.3972	0.0061	0.4375
		3A	0.0000	0.4375	0.4272	---	0.3911	0.3876	0.0035	0.3602	0.3525	3B	0.3600	0.3717	0.3911	0.3957	0.0046	0.4375
7/16-20 or 0.4375-20	UNF	1A	0.0013	0.4362	0.4240	---	0.4037	0.3975	0.0062	0.3821	0.3767	1B	0.383	0.395	0.4050	0.4131	0.0081	0.4375
		2A	0.0013	0.4362	0.4281	---	0.4037	0.3995	0.0042	0.3821	0.3767	2B	0.383	0.395	0.4050	0.4104	0.0054	0.4375
		3A	0.0000	0.4375	0.4294	---	0.4050	0.4019	0.0031	0.3834	0.3780	3B	0.3830	0.3916	0.4050	0.4091	0.0041	0.4375
1/2-13 or 0.500-13	UNC	1A	0.0015	0.4985	0.4822	---	0.4485	0.4411	0.0074	0.4152	0.4069	1B	0.417	0.434	0.4500	0.4597	0.0097	0.5000
		2A	0.0015	0.4985	0.4876	---	0.4485	0.4435	0.0050	0.4152	0.4069	2B	0.417	0.434	0.4500	0.4565	0.0065	0.5000
		3A	0.0000	0.5000	0.4891	---	0.4500	0.4463	0.0037	0.4167	0.4084	3B	0.4170	0.4284	0.4500	0.4548	0.0048	0.5000
1/2-20 or 0.500-20	UNF	1A	0.0013	0.4987	0.4865	---	0.4662	0.4598	0.0064	0.4446	0.4392	1B	0.446	0.457	0.4675	0.4759	0.0084	0.5000
		2A	0.0013	0.4987	0.4906	---	0.4662	0.4619	0.0043	0.4446	0.4392	2B	0.446	0.457	0.4675	0.4731	0.0056	0.5000
		3A	0.0000	0.5000	0.4919	---	0.4675	0.4643	0.0032	0.4459	0.4405	3B	0.4460	0.4537	0.4675	0.4717	0.0042	0.5000
9/16-12 or 0.5625-12	UNC	1A	0.0016	0.5609	0.5437	---	0.5068	0.4990	0.0078	0.4707	0.4617	1B	0.472	0.490	0.5084	0.5186	0.0102	0.5625
		2A	0.0016	0.5609	0.5495	0.5437	0.5068	0.5016	0.0054	0.4707	0.4617	2B	0.472	0.490	0.5084	0.5152	0.0068	0.5625
		3A	0.0000	0.5625	0.5511	---	0.5084	0.5045	0.0039	0.4723	0.4633	3B	0.4720	0.4843	0.5084	0.5135	0.0051	0.5625
9/16-18 or 0.5625-18	UNF	1A	0.0014	0.5611	0.5480	---	0.5250	0.5182	0.0068	0.5010	0.4950	1B	0.502	0.515	0.5264	0.5353	0.0089	0.5625
		2A	0.0014	0.5611	0.5524	---	0.5250	0.5205	0.0045	0.5010	0.4950	2B	0.502	0.515	0.5264	0.5323	0.0059	0.5625
		3A	0.0000	0.5625	0.5538	---	0.5264	0.5230	0.0034	0.5024	0.4964	3B	0.5020	0.5106	0.5264	0.5308	0.0044	0.5625
5/8-11 or 0.625-11	UNC	1A	0.0016	0.6234	0.6052	---	0.5644	0.5561	0.0083	0.5250	0.5152	1B	0.527	0.546	0.5660	0.5767	0.0107	0.6250
		2A	0.0016	0.6234	0.6113	0.6052	0.5589	0.5589	0.0055	0.5250	0.5152	2B	0.527	0.546	0.5660	0.5732	0.0072	0.6250
		3A	0.0000	0.6250	0.6129	---	0.5619	0.5619	0.0041	0.5266	0.5168	3B	0.5270	0.5391	0.5660	0.5714	0.0054	0.6250
5/8-18 or .0625-18	UNF	1A	0.0014	0.6236	0.6105	---	0.5875	0.5805	0.0070	0.5635	0.5575	1B	0.565	0.578	0.5889	0.5980	0.0091	0.6250
		2A	0.0014	0.6236	0.6149	---	0.5875	0.5828	0.0047	0.5635	0.5575	2B	0.565	0.578	0.5889	0.5949	0.0060	0.6250
		3A	0.0000	0.6250	0.6163	---	0.5889	0.5854	0.0035	0.5649	0.5589	3B	0.5650	0.5730	0.5889	0.5934	0.0045	0.6250
3/4-10 or 0.750-10	UNC	1A	0.0018	0.7482	0.7288	---	0.6832	0.6744	0.0088	0.6399	0.6291	1B	0.642	0.663	0.6850	0.6965	0.0115	0.7500
		2A	0.0018	0.7482	0.7353	0.7288	0.6832	0.6773	0.0059	0.6399	0.6291	2B	0.642	0.663	0.6850	0.6927	0.0077	0.7500
		3A	0.0000	0.7500	0.7371	---	0.6850	0.6806	0.0044	0.6417	0.6309	3B	0.6420	0.6545	0.6850	0.6907	0.0057	0.7500
3/4-16 or 0.750-16	UNF	1A	0.0015	0.7485	0.7343	---	0.7079	0.7004	0.0075	0.6808	0.6740	1B	0.682	0.696	0.7094	0.7192	0.0098	0.7500
		2A	0.0015	0.7485	0.7391	---	0.7079	0.7029	0.0050	0.6808	0.6740	2B	0.682	0.696	0.7094	0.7159	0.0065	0.7500
		3A	0.0000	0.7500	0.7406	---	0.7094	0.7056	0.0038	0.6823	0.6755	3B	0.6820	0.6908	0.7094	0.7143	0.0049	0.7500
7/8-9 or 0.875-9	UNC	1A	0.0019	0.8731	0.8523	---	0.8009	0.7914	0.0095	0.7528	0.7408	1B	0.755	0.778	0.8028	0.8151	0.0123	0.8750
		2A	0.0019	0.8731	0.8592	0.8523	0.8009	0.7946	0.0063	0.7528	0.7408	2B	0.755	0.778	0.8028	0.8110	0.0082	0.8750
		3A	0.0000	0.8750	0.8611	---	0.8028	0.7981	0.0047	0.7547	0.7427	3B	0.7550	0.7681	0.8028	0.8089	0.0061	0.8750
7/8-14 or 0.875-14	UNF	1A	0.0016	0.8734	0.8579	---	0.8270	0.8189	0.0081	0.7961	0.7884	1B	0.798	0.814	0.8286	0.8392	0.0106	0.8750
		2A	0.0016	0.8734	0.8631	---	0.8270	0.8216	0.0054	0.7961	0.7884	2B	0.798	0.814	0.8286	0.8356	0.0070	0.8750
		3A	0.0000	0.8750	0.8647	---	0.8286	0.8245	0.0041	0.7977	0.7900	3B	0.7980	0.8068	0.8286	0.8339	0.0053	0.8750
1-8 or 1.000-8	UNC	1A	0.0020	0.9980	0.9755	---	0.9168	0.9067	0.0101	0.8627	0.8492	1B	0.865	0.890	0.9188	0.9320	0.0132	1.0000
		2A	0.0020	0.9980	0.9830	0.9755	0.9168	0.9100	0.0068	0.8627	0.8492	2B	0.865	0.890	0.9188	0.9276	0.0088	1.0000
		3A	0.0000	1.0000	0.9850	---	0.9188	0.9137	0.0051	0.8647	0.8512	3B	0.8650	0.8797	0.9188	0.9254	0.0066	1.0000











Nominal Size & Threads In.	Series ¹ Designation	External ⁴									Internal ⁴							
		Class	Allowance	Major Diameter			Pitch Diameter			UN ² Minor Diam Max (Ref)	UNR Minor Diam Max (Ref)	Class	Minor Diameter		Pitch Diameter			Major Diameter Min
				Max ³	Min	Min ⁵	Max ³	Min	Tolerance				Min	Max	Min	Max	Tolerance	
1-12 or 1.000-12	UNF	1A	0.0018	0.9982	0.9810	---	0.9441	0.9353	0.0088	0.09080	0.8990	1B	0.910	0.928	0.9459	0.9573	0.0114	1.0000
		2A	0.0018	0.9982	0.9868	---	0.9441	0.9382	0.0059	0.9080	0.8990	2B	0.910	0.928	0.9459	0.9535	0.0076	1.0000
		3A	0.0000	1.0000	0.9886	---	0.9459	0.9415	0.0044	0.9098	0.9008	3B	0.9100	0.9198	0.9459	0.9516	0.0057	1.0000
1-14 or 1.000-14	UNS	1A	0.0017	0.9983	0.9828	---	0.9519	0.9435	0.0084	0.9210	0.9132	1B	0.923	0.938	0.9536	0.9645	0.0109	1.0000
		2A	0.0017	0.9983	0.9880	---	0.9519	0.9463	0.0056	0.9210	0.9132	2B	0.923	0.938	0.9536	0.9609	0.0073	1.0000
		3A	0.0000	1.0000	0.9897	---	0.9536	0.9494	0.0042	0.9227	0.9150	3B	0.9230	0.9315	0.9536	0.9590	0.0054	1.0000
1-1/8-7 or 1.125-7	UNC	1A	0.0022	1.1228	1.0982	---	1.0300	1.0191	0.0109	0.9682	0.9527	1B	0.970	0.998	1.0322	1.0463	0.0141	1.1250
		2A	0.0022	1.1228	1.1064	1.0982	1.0300	1.0228	0.0072	0.9682	0.9527	2B	0.970	0.998	1.0322	1.0416	0.0094	1.1250
		3A	0.0000	1.1250	1.1086	---	1.0322	1.0268	0.0054	0.97049	0.9549	3B	0.9700	0.9875	1.0322	1.0393	0.0071	1.1250
1-1/8-8 or 1.125-8	UN	2A	0.0021	1.1229	1.1079	1.1004	1.0417	1.0348	0.0069	0.9876	0.9741	2B	0.990	1.015	1.0438	1.0528	0.0090	1.1250
		3A	0.0000	1.1250	1.1100	---	1.0438	1.0386	0.0052	0.9897	0.9762	3B	0.9900	1.0047	1.0438	1.0505	0.0067	1.1250
1-1/4-7 or 1.250-7	UNC	1A	0.0022	1.2478	1.2232	---	1.1550	1.1439	0.0111	1.0932	1.0777	1B	1.095	1.123	1.1572	1.1668	0.0144	1.2500
		2A	0.0022	1.2478	1.2314	1.2232	1.1550	1.1476	0.0074	1.0932	1.0777	2B	1.095	1.123	1.1572	1.1668	0.0096	1.2500
		3A	0.0000	1.2500	1.2336	---	1.1572	1.1517	0.0055	1.0954	1.0799	3B	1.0950	1.1125	1.1572	1.1644	0.0072	1.2500
1-1/4-8 or 1.250-8	UN	2A	0.0021	1.2479	1.2329	1.2254	1.1667	1.1597	0.0070	1.1126	1.0991	2B	1.115	1.140	1.1688	1.1780	0.0092	1.2500
		3A	0.0000	1.2500	1.2350	---	1.1688	1.635	0.0053	1.1147	1.1012	3B	1.1150	1.1297	1.1688	1.1757	0.0069	1.2500
1-1/4-12 or 1.250-12	UNF	1A	0.0018	1.2482	1.2310	---	1.1941	1.1849	0.0092	1.1580	1.1490	1B	1.160	1.178	1.1959	1.2079	0.0120	1.2500
		2A	0.0018	1.2482	1.2368	---	1.1941	1.1879	0.0062	1.1580	1.1490	2B	1.160	1.178	1.1959	1.2039	0.0080	1.2500
		3A	0.0000	1.2500	1.2386	---	1.1959	1.1913	0.0046	1.1598	1.1508	3B	1.1600	1.1698	1.1959	1.2019	0.0060	1.2500
1-3/8-6 or 1.375-6	UNC	1A	0.0024	1.3726	1.3453	---	1.2643	1.2523	0.0120	1.1922	1.1742	1B	1.195	1.225	1.2667	1.2822	0.0155	1.3750
		2A	0.0024	1.3726	1.3544	1.3453	1.2643	1.2563	0.0080	1.1922	1.1742	2B	1.195	1.225	1.2667	1.2771	0.0104	1.3750
		3A	0.0000	1.3750	1.3568	---	1.2667	1.2607	0.0060	1.0946	1.1766	3B	1.1950	1.2146	1.2667	1.2745	0.0078	1.3750
1-3/8-8 or 1.375-8	UN	2A	0.0022	0.3728	1.3578	1.3503	1.2916	1.2844	0.0072	1.2375	0.2240	2B	1.240	1.265	1.2938	1.3031	0.0093	1.3750
		3A	0.0000	1.3750	1.3600	---	1.2938	1.2884	0.0054	1.2397	1.2262	3B	1.2400	1.2547	1.2938	1.3008	0.0070	1.3750
		1A	0.0024	1.4976	1.4703	---	1.3893	1.3772	0.0121	1.3172	1.2992	1B	1.320	1.350	1.3917	1.4075	0.0158	1.5000
1-1/2-6 or 1.500-6	UNC	2A	0.0024	1.4976	1.4794	1.4703	1.3893	1.3812	0.0081	1.3172	1.2992	2B	1.320	1.350	1.3917	1.4022	0.0105	1.5000
		3A	0.0000	1.5000	1.4818	---	1.3917	1.3856	0.0061	1.3196	1.3016	3B	1.3200	1.3396	1.3917	1.3996	0.0079	1.5000
		1A	0.0022	1.4978	1.4828	1.4753	1.4166	1.4093	0.0073	1.3625	1.3490	2B	1.365	1.390	1.4188	1.4283	0.0095	1.5000
1-1/2-8 or 1.500-8	UN	3A	0.0000	1.5000	1.4850	---	1.4188	1.4133	0.0055	1.3647	1.3512	3B	1.3650	1.3797	1.4188	1.4259	0.0071	1.5000
		1A	0.0019	1.4981	1.4809	---	1.4440	1.4344	0.0096	1.4079	1.3989	1B	1.410	1.428	1.4459	1.4584	0.0125	1.5000
		2A	0.0019	1.4981	1.4867	---	1.4440	1.4376	0.0064	1.4079	1.3989	2B	1.410	1.428	1.4459	1.4542	0.0083	1.5000
1-1/2-12 or 1.625-12	UNF	3A	0.0000	1.5000	1.4886	---	1.4459	1.4411	0.0048	1.4098	1.4008	3B	1.4100	1.4198	1.4459	1.4522	0.0063	1.5000
		1A	0.0027	1.7473	1.7165	---	1.6174	1.6040	0.0134	1.5308	1.5092	1B	1.534	1.568	1.6201	1.6375	0.0174	1.7500
		2A	0.0027	1.7473	1.7268	1.7165	1.6174	1.6085	0.0089	1.5308	1.5092	2B	1.534	1.568	1.6201	1.6317	0.0116	1.7500
1-5/8-8 or 1.625-8	UNC	3A	0.0000	1.7500	1.7295	---	1.6201	1.6134	0.0067	1.5335	1.5119	3B	1.5340	1.5575	1.6201	1.6288	0.0087	1.7500
		1A	0.0023	1.7477	1.7327	1.752	1.6665	1.6590	0.0075	1.6124	1.5989	2B	1.615	1.640	1.6688	1.6786	0.0098	1.7500
		3A	0.0000	1.7500	1.7350	---	1.6688	1.6632	0.0056	1.6147	1.6012	3B	1.6150	1.6297	1.6688	1.6762	0.0074	1.7500
1-7/8-8 or 1.875-8	UN	2A	0.0023	1.8727	1.8577	1.8502	1.7915	1.7838	0.0077	1.7374	1.7239	2B	1.740	1.765	1.7938	1.8038	0.100	1.8750
		3A	0.0000	1.8750	1.8600	---	1.7938	1.7881	0.0057	1.7397	1.7262	3B	1.7400	1.7547	1.7938	1.8013	0.0075	1.8750
		1A	0.0029	1.9971	1.9641	---	1.8528	1.8385	0.0143	1.7565	1.7324	1B	1.759	1.795	1.8557	1.8743	0.0186	2.0000
2-4-1/2 or 2.000-4.5	UNC	2A	0.0029	1.9971	1.9751	1.9641	1.8528	1.8433	0.0095	1.7565	1.7324	2B	1.759	1.795	1.8557	1.8681	0.0124	2.0000
		3A	0.0000	2.0000	1.9780	---	1.8557	1.8486	0.0071	1.7594	1.7353	3B	1.7590	1.7861	1.8557	1.8650	0.0093	2.0000
		2A	0.0023	1.9977	1.9827	1.9752	1.9155	1.9087	0.0078	1.8624	1.8489	2B	1.865	1.890	1.9188	1.9289	0.0101	2.0000
2-8 or 2.000-8	UN	3A	0.0000	2.0000	1.9850	---	1.9188	1.9030	0.0058	1.8647	1.8512	3B	1.8650	1.8797	1.9188	1.9264	0.0076	2.0000
		1A	0.0029	2.2471	2.2141	---	2.1028	2.0882	0.0146	2.0065	1.9824	1B	2.009	2.045	2.1057	2.1247	0.0190	2.2500



Nominal Size & Threads In.	Series ¹ Designation	External ⁴									Internal ⁴							
		Class	Allowance	Major Diameter			Pitch Diameter			UN ² Minor Diam Max (Ref)	UNR Minor Diam Max (Ref)	Class	Minor Diameter		Pitch Diameter			Major Diameter Min
				Max ³	Min	Min ⁵	Max ³	Min	Tolerance				Min	Max	Min	Max	Tolerance	
or 2.250-4.5		2A	0.0029	2.2471	2.2251	2.2141	2.1028	2.0931	0.0097	2.0065	1.39824	2B	2.009	2.045	2.1057	2.1183	0.0126	2.2500
		3A	0.000	2.2500	2.2280	---	2.1057	2.0984	0.0073	2.0094	1.9853	3B	2.0090	2.0361	2.1057	2.1152	0.0095	2.2500
2-1/4-8 or 2.250-8	UN	2A	0.0024	2.2476	2.2326	2.2251	2.1664	2.1584	0.0080	2.1123	2.0988	2B	2.115	2.140	2.1688	2.1792	0.0104	2.2500
		3A	0.0000	2.250	2.2350	---	2.1688	2.1628	0.0060	2.1147	2.1012	3B	2.1150	2.1297	2.1688	2.1766	0.0078	2.2500
2-1/2-4 or 2.500-4	UNC	1A	0.0031	2.4969	2.4612	---	2.3345	2.3190	0.0155	2.2263	2.1992	1B	2.229	2.267	2.3376	2.3578	0.0202	2.5000
		2A	0.0031	2.4969	2.4731	2.4612	2.3345	2.3241	0.0104	2.2263	2.1992	2B	2.229	2.267	2.3376	2.3511	0.0135	2.5000
		3A	0.0000	2.5000	2.4762	---	2.3376	2.3298	0.0078	2.2294	2.2023	3B	2.2290	2.294	2.3376	2.3477	0.0101	2.5000
2-1/2-8 or 2.500-8	UN	2A	0.0024	2.4976	2.4826	2.4751	2.4164	2.4082	0.0082	2.3623	2.3488	2B	2.365	2.390	2.4188	2.4294	0.0106	2.2500
		3A	0.0000	2.5000	2.4850	---	2.4188	2.4127	0.0061	2.3647	2.3512	3B	2.3650	2.3797	2.4188	2.4268	0.0080	2.2500
2-3/4-4 or 2.750-4	UNC	1A	0.0032	2.7468	2.7111	---	2.5844	2.5686	0.0158	2.4762	2.4491	1B	2.479	2.517	2.5876	2.6082	0.0206	2.7500
		2A	0.0032	2.7468	2.7230	2.7111	2.5844	2.5739	0.0105	2.4762	2.4491	2B	2.479	2.517	2.5876	2.6013	0.0137	2.7500
		3A	0.0000	2.7500	2.7262	---	2.5876	2.5797	0.0079	2.4794	2.4523	3B	2.4790	2.5094	2.5876	2.5979	0.0103	2.7500
2-3/4-8 or 2.750-8	UN	2A	0.0025	2.7475	2.7325	2.7250	2.6663	2.6580	0.0083	2.6122	2.5987	2B	2.615	2.640	2.6688	2.6796	0.0108	2.7500
		3A	0.0000	2.7500	2.7350	---	2.6688	2.6625	0.0063	2.6147	2.6012	3B	2.6150	2.6297	2.6688	2.6769	0.0081	2.7500
3-4 or 3.000-4	UNC	1A	0.0032	2.9968	2.9611	---	2.8344	2.8183	0.0161	2.7262	2.6991	1B	2.729	2.767	2.8376	2.8585	0.0209	3.0000
		2A	0.0032	2.9968	2.9730	2.9611	2.8344	2.8237	0.0107	2.7262	2.6991	2B	2.729	2.767	2.8376	2.8515	0.0139	3.0000
		3A	0.0000	3.0000	2.9762	---	2.8296	2.8376	0.0080	2.7294	2.7023	3B	2.7290	2.7594	2.8376	2.8480	0.0104	3.0000
3-8 or 3.000-8	UN	2A	0.0026	2.9974	2.9824	2.9749	2.9162	2.9077	0.0085	2.8621	2.8486	2B	2.865	2.890	2.9188	2.9299	0.0111	3.0000
		3A	0.0000	3.0000	2.9850	---	2.9188	2.9124	0.0064	2.8647	2.8512	3B	2.8650	2.8797	2.9188	2.9271	0.0081	3.0000
3-1/4-4 or 3.250-4	UNC	1A	0.0033	3.2467	3.2110	---	3.0843	3.0680	0.0163	2.9761	2.9490	1B	2.979	3.017	3.0876	3.1088	0.0212	3.2500
		2A	0.0033	3.2467	3.2229	3.2110	3.0843	3.0734	0.0109	2.9761	2.9490	2B	2.979	3.017	3.0876	3.1017	0.0141	3.2500
		3A	0.0000	3.2500	3.2262	---	3.0876	3.0794	0.0084	2.9794	2.9523	3B	2.9790	3.0094	3.0876	3.0982	0.0106	3.2500
3-1/4-8 or 3.250-8	UN	2A	0.0026	3.2474	3.2324	3.2249	3.1662	3.1575	0.0087	3.1121	3.0986	2B	3.115	3.140	3.1688	3.1801	0.0113	3.2500
		3A	0.0000	3.2500	3.2350	---	3.1688	3.1623	0.0065	3.1147	3.1012	3B	3.1150	3.1297	3.1688	3.1773	0.0085	3.2500
3-1/2-4 or 3.500-4	UNC	1A	0.0033	3.4967	3.4610	---	3.3343	3.3177	0.0166	3.2261	3.1990	1B	3.229	3.267	3.3376	3.3591	0.0215	3.5000
		2A	0.0033	3.4967	3.4729	3.4610	3.3343	3.3233	0.0110	3.2261	3.1990	2B	3.229	3.267	3.3376	3.3519	0.0143	3.5000
		3A	0.0000	3.5000	3.4762	---	3.3376	3.3293	0.0083	3.2294	3.2023	3B	3.2290	3.2594	3.3376	3.3484	0.0108	3.5000
3-1/2-8 or 3.500-8	UN	2A	0.0026	3.4974	3.4824	3.4749	3.4162	3.4074	0.0088	3.3621	3.3621	2B	3.365	3.390	3.4188	3.4303	0.0115	3.5000
		3A	0.0000	3.5000	3.4850	---	3.4188	3.4122	0.0066	3.3647	3.3647	3B	3.3650	3.3797	3.4188	3.4274	0.0086	3.5000
3-3/4-4 or 3.750-4	UNC	1A	0.0034	3.7466	3.7109	---	3.5842	3.5674	0.0168	3.4760	3.4489	1B	3.479	3.517	3.5876	3.6094	0.0218	3.7500
		2A	0.0034	3.7466	3.7228	3.7109	3.5842	3.5730	0.0112	3.4760	3.4489	2B	3.479	3.517	3.5876	3.6021	0.0145	3.7500
		3A	0.0000	3.7500	3.7262	---	3.5876	3.5792	0.0084	3.4794	3.4523	3B	3.4790	3.5094	3.5876	3.5985	0.0109	3.7500
3-3/4-8 or 3.750-8	UN	2A	0.0027	3.7473	3.7323	3.7248	3.6661	3.6571	0.0090	3.6120	3.5985	2B	3.615	3.640	3.6688	3.6805	0.0117	3.7500
		3A	0.0000	3.7500	3.7350	---	3.6688	3.6621	0.0067	3.6147	3.6012	3B	3.6150	3.6297	3.6688	3.6776	0.0088	3.7500
4-4 or 4.000-4	UNC	1A	0.0034	3.9966	3.9609	---	3.8342	3.8172	0.0170	3.7260	3.6989	1B	3.729	3.767	3.8376	3.8597	0.0221	4.0000
		2A	0.0034	3.9966	3.9728	3.9609	3.8342	3.8229	0.0113	3.7260	3.6989	2B	3.729	3.767	3.8376	3.8523	0.0147	4.0000
		3A	0.0000	4.0000	3.9762	---	3.8376	3.8291	0.0085	3.7294	3.7023	3B	3.7290	3.7594	3.8376	3.8487	0.0111	4.0000
4-8 or 4.000-8	UN	2A	0.0027	3.973	3.9823	3.9748	3.9161	3.9070	0.0091	3.8620	3.8485	2B	3.865	3.890	3.9188	3.9307	0.0119	4.0000
		3A	0.0000	4.0000	3.9850	---	3.9188	3.9120	0.0068	3.8647	3.8512	3B	3.8650	3.8797	3.9188	3.9277	0.0089	4.0000



ASTM AND SAE GRADE MARKINGS FOR STEEL BOLTS AND SCREWS

Grade Marking	Specification	Material	Bolt & Screw Size (In.)	Yield PSI	Ult. Tensile Strength Min PSI
	SAE-Grade 1	Low Carbon Steel 1018-1022 Steel	1/4 thru 1-1/2	33,000	60,000
	Grade A ASTM-A307		1/4 thru 1-1/2 over 1-1/2 thru 4	33,000 ----	60,000 55,000
	SAE-Grade 2		1/4 thru 3/4 over 3/4 thru 1-1/2	55,000 33,000	74,000 60,000
	SAE-Grade 5	Medium Carbon Steel Quenched & Tempered 1038 Steel	1/4 thru 1-1/2 over 1-1/2 thru 4	85,000 74,000	120,000 105,000
	ASTM-A449		1/4 thru 1 over 1 thru 1-1/2 over 1-1/2 thru 3	85,000 74,000 55,000	120,000 105,000 90,000
	ASTM-A325	Medium Carbon Steel Quenched & Tempered 1038 Steel	1/2, 5/8, 3/4 7/8, 1 1-1/8 thru 1-1/2	85,000 78,000 74,000	120,000 115,000 105,000
	ASTM-A354 Grade BD	Alloy Steel, Quenched & Tempered 4140/4340 Alloy Steel	1/4 thru 2-1/2 over 2-1/2 thru 4	130,000 115,000	150,000 140,000
	ASTM-A354 Grade BC	Alloy Steel, Quenched & Tempered 4140/4145 Alloy Steel	1/4 thru 2-1/2 over 2-1/2	109,000 99,000	125,000 115,000
	ASTM-A193 Grade B7	Alloy Steel, Quenched & Tempered	2-1/2 & under 2-1/2 thru 4	105,000 95,000	125,000 115,000
	SAE-Grade 8	Medium Carbon Alloy Steel Quenched & Tempered	1/4 thru 1-1/2	120,000	150,000
	ASTM-A490	Alloy Steel, Quenched & Tempered	1/2 thru 2-1/2 over 2-1/2 thru 4	120,000 105,000	150,000 140,000



PLATINGS AND COATINGS FOR FASTENERS

Cadmium Plating (ASTM B766)

An electrolytically deposited, silver-gray plating which provides exceptionally good protection against corrosion, particularly in a salt atmosphere. Chromate Clear Dip is a protective film dip applied after electroplating, and gives additional corrosion protection and a bright, shiny appearance which resists staining and finger marks. Cadmium is a known carcinogen, and has been banned in many countries. Commercial grades of cadmium plating are typically applied a minimum of 5 microns thick (.0002"). Cadmium plating with a chromate dip must not show white corrosion products at 96 hours of salt spray testing per ASTM B117.

Zinc Electroplating (ASTM B633)

Zinc electroplating is also a protective coating against corrosion, blue gray in color, non-toxic, and can be used around food. Zinc plating performs better than cadmium in an industrial atmosphere, but not in a salt atmosphere. A clear Chromate dip is a protective film applied after electroplating, adding corrosion protection. At Sigma, we also use a "silicon dip," to aid in assembly. Commercial grades of zinc electroplating are typically applied a minimum of 5 microns thick (.0002"). Zinc electroplating with a chromate dip must not show base metal corrosion products at 96 hours of salt spray testing per ASTM B117, but may show white corrosion at the edges.

Thickness conversion factors: microns x .0394=mils, mils x 25.4=microns, mils x .0254=millimeters, mils x .001=inches

Chromate Dips

Clear chromate dip as used by Sigma is applied to all zinc plated parts unless otherwise requested. We use an excellent product produced by MacDermid, which contains no hexavalent chrome.

Olive Drab Dichromate- Electroplated work is dipped in solution of chrome, nitric and acetic acids and a dye. This produces additional corrosion resistance, and is thicker than standard chromate dips.

Yellow Iridescent Dichromate – Electroplated work is dipped in solution of sodium dichromate, takes on surface film of basic chromium chromate which resists corrosion. Finish is yellow to brown in color.

Baking

Parts to be electroplated that are RC38 or higher in hardness, should be further processed to relieve hydrogen embrittlement. This process should include baking at 375 deg. F for 8 hours or more within 4 hours of the plating process. If the parts are over 40 RC, the baking should be for 24 hours minimum. The baking should be done before the chromate treatment. The parts are re-dipped in acid very briefly to reactivate the surface prior to chromating.

Phosphating

Supplementary Phosphate – Zinc-plated parts are dipped in a solution of acid phosphates, and catalytic agents at 200 degrees F. Adherent, porous coating makes an excellent bond for paint or oil, and is performed on all Sigma parts to be coated.

Several types of phosphate coatings are available: manganese, zinc, and iron. At Sigma, we prefer zinc phosphate as the best preparation for coating.

Black Oxide

Black oxide is a thin film of iron oxide formed on the metal. It will not chip, peel, crack, or crumble. The pleasing finish provides only mild rust protection.



Passivation

Passivation gives stainless steels added resistance to corrosion. The nitric acid or sodium dichromate dip removes any imbedded metal particles on the surface, and leaves a protective film of stainless only, to prevent rusting.

Hot Dip Galvanizing (ASTM A153):

Hot dip zinc galvanizing is available for many fasteners. Threads in the nuts must be tapped oversized after galvanizing, or the parts will not assemble. This coating is very effective in salt atmosphere because it is applied approximately 2 mils thick. Because of the need to tap the nuts after galvanizing, the inside of the nut forms corrosion that will not allow disassembly after a period of time.

Sigma does not recommend Hot Dip Galvanizing for medium to high strength alloy parts used in the production of oil and gas, because of the chance of hydrogen embrittlement, and the tendency for the thickness to vary, causing uneven torque readings upon application.

Molybdenum Disulfide

"Moly" coating is typically used as a bonded lubricant, and has some corrosion resistance. It is spray coated to a dry film thickness of .4 to .7 mil, and cured in ovens.

Sermagard 1105 (ASTM F1428)

Sigma Fasteners is a licensed applicator for Sermagard products. 1105 is a ceramic-metallic sprayed basecoat that at 1 mil of thickness or more affords 3000-4000 hours of ASTM B117 salt spray resistance, with an appropriate topcoat. It can be used at high temperatures. It is extremely effective in salt atmospheres. The Sermagard 1105 process involves curing at high temperatures (Minimum of 750 deg. F) and subsequent burnishing with appropriate blast media to achieve conductivity. Sermagard 1105 contains aluminum flake.

Sermagard 1280

Sermagard 1280 is a fluorocarbon topcoat, which when applied to Sermagard 1105 basecoat gives superior corrosion resistance and UV protection.

Xylan 1000 Series

Xylan is a fluoropolymer topcoat manufactured by Whitford Corporation, which in the 1014 and 1070 coatings afford high lubricity (co-efficient of friction as low as .02), and corrosion resistance of approximately 1000 hours (ASTM B117) when applied over phosphate, and up to 2000 hours when applied over electroplating. These are solvent based thin film topcoats. These Xylan products have a maximum operating temperature ranging up to 500 deg. F.

Xylan 1000 and 1400 series may also be applied over other basecoats, for added corrosion protection.

Xylan 1400 series:

The 1400 series coatings by Whitford (typically 1424), are low voc coatings. They have a coefficient of friction of .05 to .10, and a maximum constant operating temperature of 400 deg. F. The corrosion resistance of the 1400 series is approximately 1500 hours, when applied over a suitable basecoat such as zinc electroplating.

Sigma also applies coatings from other manufacturers, per customer specifications. Examples of other coating products we apply:

Everslik by EM Coatings
Inorganic Zinc
Magnigard



Other ASTM Specifications commonly used for fasteners

- A 307 – Low Carbon Steel Externally and Internally Threaded Standard Fasteners
- A 325 – High Strength Steel Bolts for Structural Steel Joints, including Suitable Nuts and Plain Hardened Washers
- A 449 – Quenched and Tempered Steel Bolts and Studs, Grade 5
- A 453 – High Temperature Bolting Materials, Age hardened
- A 354 – Quenched and Tempered Alloy Steel Bolts and Studs with Suitable Nuts Grades BC and BD
- A 490 – High Strength Alloy Steel Bolts for Structural Steel Joints, including Suitable Nuts and Plain Hardened Washers
- A 540 – Alloy Bolting Material for Special Applications
- A 563 -- Nuts of Carbon and Alloy Steel
- A 564 – Age Hardening stainless steel (17-4, etc)
- A 574 – Alloy Steel Socket Head Cap Screws
- F 593 – Stainless Steel Bolts, Hex Cap Screws and Studs



SAE Specifications

J 429c – Mechanical and Quality Requirements for Threaded Fasteners

HEX CAP SCREWS – SAE J429

Mechanical & Quality Requirements for Externally Threaded Fasteners

Proof Load & Tensile Requirements ^a							
Nominal Diam of Product & Threads per In.	Stress Area Sq. In.	Grade 2		Grade 5		Grade 8	
		Proof Load Lb.	Tensile Strength Min Lb.	Proof Load Lb	Tensile Strength Min Lb.	Proof Load Lb	Tensile Strength Min Lb.

Coarse Thread Series -- UNRC

No. 1/4-20	0.0318	1.750	2.350	2.700	3.800	3.800	4.750
5/16-18	0.0524	2.900	3.900	4.450	6.300	6.300	7.850
3/8-16	0.0775	4.250	5.750	6.600	9.300	9.300	11.600
7/16-14	0.1063	5.850	7.850	9.050	12.800	12.800	15.900
1/2-13	0.1419	7.800	10.500	12.100	17.000	17.000	21.300
9/16-12	0.182	10.000	13.500	15.500	21.800	21.800	27.300
5/8-11	1.226	12.400	16.700	19.200	27.100	27.100	33.900
3/4-10	0.334	18.400	24.700	28.400	40.100	40.100	50.100
7/8-9	0.462	15.200	27.700	39.300	55.400	55.400	69.300
1-8	0.606	20.000	36.400	51.500	72.700	72.700	90.900
1-1/8-7	0.763	25.200	45.800	56.500	81.100	91.600	114.400
1-1/4-7	0.969	32.000	58.100	71.700	101.700	116.300	145.400
1-3/8-6	1.155	38.100	69.300	85.500	121.300	138.600	173.200
1-1/2-6	1.405	46.40	84.300	104.000	147.500	168.600	210.800

Fine Thread Series – UNRF

No. 1/4-28	0.0364	2.000	2.700	3.100	4.350	4.350	5.450
5/16-24	0.0580	3.200	4.300	4.900	6.950	6.950	8.700
3/8-24	0.0878	4.800	6.500	7.450	10.500	10.500	13.200
7/16-20	0.1187	6.550	8.800	10.100	14.200	14.200	17.800
1/2-20	0.1599	8.800	11.800	13.600	19.200	19.200	24.000
9/16-18	0.203	11.200	15.000	17.300	24.400	24.400	30.400
5/8-19	0.256	14.100	18.900	21.800	30.700	30.700	38.400
3/4-16	0.373	20.500	27.600	31.700	44.800	44.800	56.000
7/8-14	0.509	16.800	30.500	43.300	61.100	61.100	76.400
1-12	0.663	21.900	39.800	56.400	79.600	79.600	99.400
1-14 uns	0.679	22.400	40.700	57.700	81.500	81.500	101.900
1-1/8-12	0.856	28.200	51.400	63.300	89.900	102.700	128.400
1-1/4-12	1.073	35.400	64.400	79.400	112.700	128.800	161.000
1-3/8-12	1.315	43.400	78.900	97.300	138.100	157.800	197.200
1-1/2-12	1.581	52.200	94.900	117.000	166.000	189.700	237.200



Suggested assembly torques for hex cap screws per SAE J429
notes below

CAUTION -- See

Cap Screw Diam	Grade 2			Grade 5			Grade 8		
	Minimum Yield Strength	Torque (ft-lb)		Minimum Yield Strength	Torque (ft-lb)		Minimum Yield Strength	Torque (ft-lb)	
		UNRC	UNRF		UNRC	UNRF		UNRC	UNRF
1/4	57,000	6	7	92,000	10	11	130,000	14	15
5/16	57,000	12	14	92,000	20	22	130,000	28	31
3/8	57,000	22	25	92,000	36	40	130,000	50	60
7/16	57,000	35	39	92,000	57	64	130,000	80	90
1/2	57,000	54	61	92,000	90	100	130,000	125	140
9/16	57,000	77	87	92,000	125	140	130,000	180	200
5/8	57,000	107	122	92,000	175	200	130,000	240	280
3/4	57,000	190	212	92,000	310	340	130,000	430	480
7/8	36,000	193	216	92,000	500	550	130,000	700	770
1	36,000	290	320	92,000	740	810	130,000	1050	1150
1-1/8	36,000	410	470	81,000	930	1040	---	---	---
1-1/4	36,000	580	645	81,000	1300	1440	---	---	---
1-3/8	36,000	760	870	81,000	1700	1900	---	---	---
1-1/2	36,000	1010	1115	81,000	2270	2550	---	---	---

General formula for calculating torque. Torque (in.-lb) = 0.2 x nominal diameter meter of screw x load (b) where load is 80% of yield strength expressed in pounds. not psi. Torque for bolts with nuts may be slightly higher. Tension induced in a cap screw may be checked by measuring overall length before torquing and then under torque load. The crew stretches 0.001 in. per in. of screw length for each 30,000 psi. induced tension. Applies only to loads below the yield point. Torque suggestions in the above table are calculated in accordance with a standard formula for cap screws. It is based on the assumption that the screws and the internal threads into which they are rotated are free of excessive rust, dirt or lubricant. and that the threads have been properly formed within standard tolerances. Galvanizing or plating will upset the relationship between torque and tension upon which the table is based. Such variations of thread condition can cause the suggested torque values to vary by as much as 25%. Hot-galvanized zinc coatings may loosen and pack into the thread clearances causing galling of threads and the possibility of broken bolts. CAUTION: The information in this table is offered due to repeated requests by customers for such data. We suggest, in order to achieve adequate tightening and safe results, that personnel using the torque control technique should be carefully trained in the theory and methods of tightening. Bolts that have been overloaded too far beyond their proof load -- or if threads have been seriously distorted during tightening -- should be replaced.



STEEL BAR WEIGHTS

DIA	NOMINAL RD BAR		THREADED BAR		HEX BAR	
	INCH	FOOT	INCH	FOOT	INCH	FOOT
1/8"	0.0035	0.0420			0.0038	0.0456
3/16"	0.0078	0.0936			0.0087	0.1044
1/4"	0.0139	0.1668			0.0453	0.5436
5/16"	0.0218	0.2616			0.0240	0.2880
3/8"	0.0313	0.3756			0.0345	0.4140
7/16"	0.0425	0.5100			0.0470	0.5640
1/2"	0.0557	0.6684	0.0438	0.525	0.0613	0.7356
9/16"	0.0704	0.8448			0.0777	0.9324
5/8"	0.0869	1.0428	0.0695	0.834	0.0958	1.1496
11/16"	0.1052	1.2624			0.1161	1.3932
3/4"	0.1252	1.5024	0.0991	1.189	0.1380	1.6560
13/16"	0.1469	1.7628			0.1620	1.9440
7/8"	0.1703	2.0436	0.1405	1.686	0.1878	2.2536
15/16"	0.1956	2.3472			0.2157	2.5884
1"	0.2225	2.6700	0.1843	2.211	0.2454	2.9448
1 1/8"	0.2817	3.3804	0.2354	2.825	0.3106	3.7272
1 1/4"	0.3477	4.1724	0.2993	3.591	0.3834	4.6008
1 3/8"	0.4208	5.0496	0.3671	4.405	0.4639	5.5668
1 1/2"	0.5007	6.0084	0.4419	5.303	0.5521	6.6252
1 5/8"	0.5876	7.0512	0.5238	6.285	0.6479	7.7748
1 3/4"	0.6815	8.1780	0.6124	7.349	0.7515	9.0180
1 7/8"	0.7823	9.3876	0.7080	8.496	0.8627	10.3524
2"	0.8901	10.6812	0.8106	9.727	0.9815	11.7780
2 1/4"	1.1266	13.5192	1.0367	12.44	1.2422	14.9064
2 1/2"	1.3908	16.6896	1.2900	15.48	1.5336	18.4032
2 3/4"	1.6829	20.1948	1.5867	19.04	1.8557	22.2684
3"	2.0028	24.0336	1.8867	22.64	2.2084	26.5008
3 1/4"	2.3508	28.2096	2.2308	26.77	2.5918	31.1016
3 1/2"	2.7251	32.7012	2.5967	31.16	3.0058	36.0696
3 3/4"	3.1292	37.5504			3.4506	41.4072
4"	3.5608	42.7296			3.9260	47.1120



WEIGHT MULTIPLIERS:

BRASS	0.364
HASTELLOY "B"	1.085
HASTELLOY "C"	1.187
HASTELLOY "G/G3"	1.139
HASTELLOY "X"	1.058
INCOLOY 800/800H	1.058
INCOLOY 825	1.012
INCONEL 600	1.037
INCONEL 625	1.074
INCONEL 718	1.082
INCONEL X-750	1.029
MONEL 400/405	1.053
MONEL K-500	1.078
NAVAL BRASS	1.074
NICKEL 200/201	1.134
SILICON BRONZE	1.110
TANTALUM	2.142
TITANIUM	0.582
TOOL STEEL	1.000
WASPALLOY	1.057
ZIRCONIUM	0.835
300 SERIES S/S	1.011
410 S/S	0.989
660 S/S	1.070
904-L	1.026



MATERIALS SELECTION

Suggested materials for use in various temperatures and atmospheres typically encountered in the energy industry

ASTM Designation	Grade	Service Temperature Range	Strength and Ductility					Alloy Type	AISI	Suitable Nuts (ASTM/Grade)
			Tensile Min. psi	Yield	Reduction of Area R/A	Elongation EL				
ASTM A-193	B7	High Temp. from 0 – 480°C	125,000	100,000	50	16	Cr-Mo	(4140)	A194 Gr 2H	
ASTM A-193	B16	High Temp. from 0 – 550°C	125,000	105,000	50	18	Cr-Mo V	(4140M)	A194 Gr 4	
ASTM A-193	B7M	High Temp. from 0 – 450°C	100,000	80,000	50	18	Cr-Mo	(4140)	A194 Gr 2HM	
ASTM A-320	L7	Low Temp. -100°C	125,000	105,000	50	16	Cr-Mo	(4140)	A194 Gr 4 or A194 Gr 7	
ASTM A-193	B5	Up to 815°C	100,000	80,000	50	16	5% Cr	(501)	A194 Gr 3	
ASTM A-193	B6	Up to 450°C	110,000	85,000	50	16	13% Cr	(410)	A194 Gr 6	
ASTM A-193	B8	Low Temp. -200 – 650°C	75,000	30,000	50	30	18% CR – 8% Ni	(304)	A194 B8	
ASTM A-193	B8M	Low Temp. -200 – 750°C	75,000	30,000	50	30	16%Cr – 10% Ni	(316)	A194 B8M	
ASTM A-320	B8	Low Temp. -200 – 650°C	75,000	30,000	50	30	18% Cr – 8% Ni	(304)	A194 B8	
ASTM A-320	B8M	Low Temp. -200 – 750°C	75,000	30,000	50	30	16% Cr – 10% Ni	(316)	A194 B8M	
ASTM A-320	B8T	Low Temp. -200 – 650°C	75,000	30,000	50	30	13% Cr	(321)	A194 B8T6	
ASTM A-320	B8C	Low Temp. -200 – 650°C	75,000	30,000	50	30	18% CR – 8% Ni	(347)	A194 B8C	
ASTM A-193	B8M class 2	Low Temp. -200 – 650°C	125,000	100,000	35	12	16% Cr – 10% Ni	(304)	A194 B8C	
ASTM A-453	660	High Temp. up to 750°C	130,000	85,000	18	15	High Iron Superalloy	660 (A286)	A453 600	
ASTM A-564 (cond. 900) (cond. 1100)	630	Med Temp. up to 316°C	190,000 140,000	170,000 115,000	40 45	10 14	Precipitation Hardening STST	630 (17-4)	A564 630	
ASTM B-408	800 – 800H	High Temp. 540°C – 815°C	80,000	35,000		25	Incoloy	---	ASTM B408	
ASTM B-164	405	High Temp. to 815°C	85,000	50,000		15	Monel	---	---	
ASTM B-164	K500	High Temp. 650°C - 423°C Low Temp. 650 °C – 253°C	100,000	70,000		35	Monel	---	---	
600, 625, 718, x750	ASTM B446, B637	High Temp. from 850°C – 1090°C	100,000	80,000		30	Nickel Superalloy (Inconel)	---	---	
B, C, X		High Temp. to 850°C	170,000	115,000		30	Nickel Superalloy (Hastalloy)	---	---	
Incoloy	925	High Temp. to - 1000°C	176,000	120,000	40	24	Nickel Iron Chrome	---	---	