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IMPORTANT EUROPEAN SCREW THREAD SYSTEMS AND DIMENSIONS OF BOLT AND SCREW HEADS AND NUTS

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I. INTRODUCTION

This circular is a collection of data appertaining to screw thread systems and standard dimensions for bolt and screw heads and nuts in use in various European countries. It covers, particularly, those standards which originated in Great Britain, France, Switzerland, and Germany, although used by other European nations as well.

So far as practicable the nomenclature in vogue in the United States and sanctioned by the National Screw Thread Commission has been used, in order that information given may be understood and applied with as little difficulty as possible. An effort has been made to give a complete presentation of all essential data.

Since American standards for the dimensions of bolt and screw heads are still in the process of formulation, this collection of data may prove of use in arriving at such standards. These data should also prove useful to those who manufacture machinery for export.

II. BRITISH STANDARD WHITWORTH AND BRITISH STANDARD FINE SCREW THREADS

1. British Standard Whitworth and British Standard Fine Screw Threads

The Whitworth series of screw threads was proposed in 1841 by Joseph Whitworth of Great Britain in a paper read before the Institution of Civil Engineers. The Whitworth thread angle, diameters and pitches were chosen because they represented the average engineering practice at that time. Of thread angle, Mr. Whitworth said: "The mean of the angles in one inch screws was found to be about 55 deg., which was also nearly the mean in screws of different diameters, hence, it is adopted throughout the scale".

The British Engineering Standards Association adopted the British Standard Whitworth Screw Threads (B.S.W.) in 1905 and issued a report giving the essential dimensions of the series. The thread angle in an axial plane is 55 deg.; the threads are rounded equally at crest and root to a radius of 0.137329 times the pitch, and the resulting depth of thread becomes 0.640327

times the pitch. Thus, one-sixth of the depth of the basic triangle is removed from the crest of the thread, and one-sixth of the depth is filled in at the root. This form of thread is designated the "Whitworth" thread form, and is shown in Fig. 1.

The Whitworth form of thread is also used in the British standard Fine Screw Threads (B.S.F.) British Standard Pipe Threads (B.S.P.), and British Standard Conduit Threads.

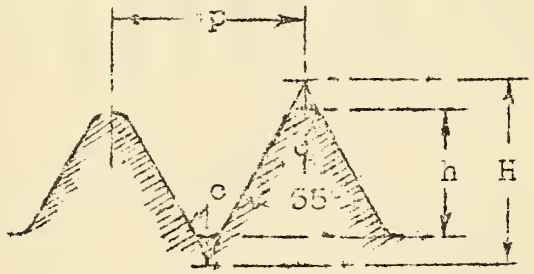


Fig. 1. Whitworth Thread Form.

The British Standard Fine Screw Threads were introduced in 1908 by the British Engineering Standards Association, and are said to be well suited to the purposesfor which they were designated. The pitches are obtained by the formula,

$$p = 0.1\ D^{3/5}$$

for sizes up to and including one inch, and

$$p = 0.1\ D^{5/8}$$

for sizes above one inch. In these formulas,

p = pitch
and D = major diameter.

2. Dimensions, Allowances, and Tolerances

The basic dimensions of British Standard Whitworth and British Standard Fine Screw Threads are given in Tables 1 and 4. In Tables 2, 3, 5, 6, 7, and 8 are given the dimensions and tolerances on bolts and nuts for both series.

The maximum screw is made to the basic size. For example, the maximum major diameter of a 1/4 inch B.S.W. screw is 0.2500 inch, and the minimum major diameter is equal to the maximum major diameter minus the tolerance. The tolerance is given in Table 2 as 0.0018 inch, hence, the maximum major diameter is 0.2482 inch.

All allowances to provide for clearance are in the nut, the minimum diameter of the thread in the nut being above basic size. As shown in Table 3, the minimum major diameter of a 1/4 inch nut is 0.0005 inch above basic size, or 0.2505 inch. The maximum major diameter is 0.2535 inch, being greater than the minimum major diameter by an amount equal to the tolerance, namely, 0.0018 inch.

3. British Standard Automobile Threads

In a report submitted by the Sub-Committee on Automobile Threads, which was adopted by the Section Committee on Screw Threads and Limit Gages, and approved by the British Engineering Standards Association in 1911, the sizes of the British Standard Fine Screw Threads from 1/4 in. to 1 in., inclusive, as given under bolt dimensions in Table 4, were taken as standard for threads used in automobile construction.

4. Interchangeability of United States National Coarse and British Standard Whitworth Threads by Diameter Modification

Table 9 shows that the diameters and pitches of the U.S. National Coarse Thread Series and the British Standard Whitworth Threads, in most cases, correspond. Consequently the question of interchangeability between them has caused considerable discussion, both in this country and in England. A method of securing interchangeability is based on a slight modification of the diameters of either the National or the Whitworth threads, or both, without changing the angle or thread form of either. Table 10 shows the modification of diameters of either of the systems necessary to produce assembly. Since the Whitworth thread angle is 5 deg. less than that of the National Thread, contact occurs near the crest of the Whitworth thread and near the root of the National Thread. Table 10 includes only those threads whose pitches are common to both systems.

Fig. 2 shows the two possible combinations of the Whitworth and National Threads. The conditions of stress developed in the thread would be the same in either system as would ordinarily

occur with a slight difference in angle between bolt and nut. It is desirable that, in such combinations, the bolt thread oe of the National form and the nut thread of the Whitworth form, as in that case the crest of the nut thread will bear near the root of the bolt thread, which is a very favorable condition as to distribution of stresses in the nut. If, however, as in the combination of a Whitworth bolt thread with a National nut thread, the root of the nut thread bears on the crest of the bolt thread, the stresses in the nut will be two or three times as severe as in the first case, which may result in failure of the threads at the bottom of the nut.

References:

Institutionof Civil Engineers, 1841, Vol. 1, page 157.
British Engineering Standard Asscciation Reports Nos.
20 - 1913. - Screw Threads
38 - 1913. - Standard Systems for Limit Gages for Screw Threads
54 - 1911. - British Standard Threads, Nuts, and Bolt Heads for use in Automobile Construction
84 - 1918. - British Standard Fine Screw Threads and their Tolerances.

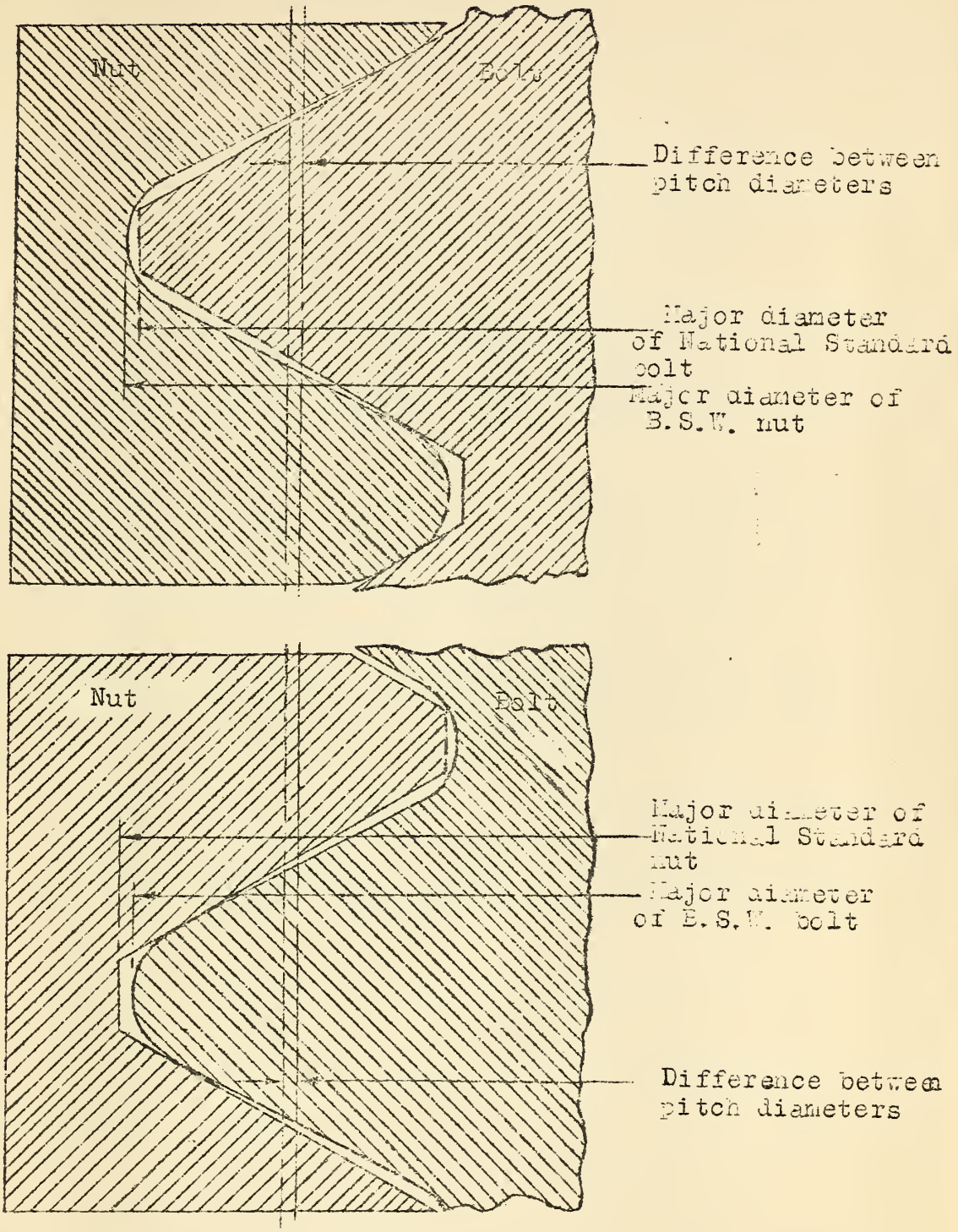

Nut
Bolt
Difference between pitch diameters
Major diameter of National Standard bolt
Major diameter of B.S.W. nut
Nut
Bolt
Major diameter of National Standard nut
Major diameter of B.S.W. bolt
Difference between pitch diameters

Fig. 2.

Table 1.-Basic Dimensions of British Standard Whitworth Screw Threads

1	2	3	4	5	6	7	8	9	10
Nominal dia.	No. of thds. per in.	Pitch	Depth of thd.	Major diameter		Pitch diameter		Minor diameter	
				Bolt	Nut	Bolt	Nut	Bolt	Nut
In.		In.	In.	In.	In.	In.	In.	In.	In.
1/4	20	0.05000	0.03200	0.2500	0.2520	0.2180	0.2200	0.1860	0.1880
5/16	18	.05556	.03555	.3125	.3145	.2709	.2789	.2414	.2434
3/8	16	.06250	.04000	.3750	.3770	.3350	.3370	.2950	.2970
7/16	14	.07143	.04575	.4375	.4395	.3918	.3938	.3460	.3480
1/2	12	.08333	.05335	.5000	.5020	.4466	.4486	.3933	.3953
9/16	12	.08333	.05335	.5625	.5645	.5091	.5111	.4558	.4578
5/8	11	.09091	.05820	.6250	.6270	.5668	.5688	.5086	.5106
3/4	10	.10000	.06405	.7500	.7520	.6860	.6880	.6219	.6239
7/8	9	.11111	.07115	.8750	.8770	.8039	.8059	.7327	.7347
1	8	.12500	.08005	1.0000	1.0020	.9200	.9220	.8339	.8419
1 1/8	7	.14286	.09150	1.1250	1.1270	1.0335	1.0355	.9420	.9440
1 1/4	7	.14286	.09150	1.2500	1.2520	1.1585	1.1605	1.0670	1.0690
1 1/2	6	.16667	.10670	1.5000	1.5020	1.3933	1.3953	1.2866	1.2886
1 3/4	5	.20000	.12805	1.7500	1.7520	1.6219	1.6239	1.4939	1.4959
2	4.5	.22222	.14230	2.0000	2.0020	1.8577	1.8597	1.7154	1.7174
2 1/4	4	.25000	.16010	2.2500	2.2520	2.0899	2.0919	1.9298	1.9318
2 1/2	4	.25000	.16010	2.5000	2.5020	2.3399	2.3419	2.1798	2.1818
2 3/4	3.5	.28571	.18295	2.7500	2.7520	2.5870	2.5890	2.3841	2.3861
3	3.5	.28571	.18295	3.0000	3.0020	2.8170	2.8190	2.6341	2.6361
3 1/4	3.25	.30769	.19700	3.2500	3.2520	3.0530	3.0550	2.8560	2.8580
3 1/2	3.25	.30769	.19700	3.5000	3.5020	3.3030	3.3050	3.1060	3.1080
3 3/4	3	.33333	.21345	3.7500	3.7520	3.5386	3.5386	3.3231	3.3251
4	3	.33333	.21345	4.0000	4.0020	3.7886	3.7886	3.5731	3.5751
4 1/2	2.875	.34783	.22270	4.5000	4.5020	4.2773	4.2793	4.0546	4.0566
5	2.75	.36364	.23285	5.0000	5.0020	4.7672	4.7692	4.5343	4.5363
5 1/2	2.625	.38095	.24395	5.5000	5.5020	5.2561	5.2581	5.0121	5.0141
6	2.5	.40000	.25615	6.0000	6.0020	5.7459	5.7459	5.4877	5.4897

This table is taken from British Engineering Standards Association Interim Report No. C.L.(M.) 7270-1919. Intermediate sizes included therein, which the association recommends be dispensed with, are not included.

Table 3. - Standard Sizes and Tolerances for Threads on Bolts, British Standard Whitworth Screw Threads

1	2	3	4	5	6	7	8	9	10	11	12	13	14
			See note A		Major diameter			Pitch diameter			Minor diameter		
Nominal diameter Inches	Number of threads per inch	Pitch p Inches	Pitch Inches	Angle Degrees	Maximum Inches	Minimum Inches	0.03√p Tolerance Inches	Maximum Inches	Minimum Inches	0.02√p Tolerance Inches	Maximum Inches	Minimum Inches	0.04√p Tolerance Inches
1/4	20	0.05000	0.0012	4.5	0.2500	0.2403	0.0037	0.2190	0.2135	0.0045	0.1880	0.1770	0.0090
5/16	18	.05556	.0012	4.0	.3125	.3054	.0071	.2769	.2722	.0047	.2414	.2320	.0094
3/8	16	.06250	.0013	3.8	.3750	.3675	.0075	.3350	.3300	.0050	.2950	.2850	.0100
7/16	14	.07143	.0014	3.5	.4375	.4295	.0080	.3918	.3865	.0053	.3460	.3353	.0107
1/2	12	.08333	.0015	3.3	.5000	.4913	.0087	.4466	.4408	.0058	.3933	.3818	.0115
9/16	12	.08333	.0015	3.3	.5625	.5538	.0087	.5091	.5033	.0058	.4558	.4443	.0115
5/8	11	.09091	.0016	3.2	.6250	.6160	.0090	.5668	.5608	.0060	.5086	.4965	.0121
3/4	10	.10000	.0016	3.0	.7500	.7405	.0095	.6860	.6797	.0063	.6219	.6093	.0126
7/8	9	.11111	.0017	2.9	.8750	.8650	.0100	.8039	.7972	.0067	.7327	.7194	.0133
1	8	.12500	.0018	2.7	1.0000	.9894	.0106	.9200	.9129	.0071	.8399	.8258	.0141
1-1/8	7	.14286	.0020	2.5	1.1250	1.1137	.0113	1.0335	1.0259	.0076	.9420	.9269	.0151
1-1/4	7	.14286	.0020	2.5	1.2500	1.2387	.0113	1.1585	1.1509	.0076	1.0670	1.0519	.0151
1-1/2	6	.16667	.0021	2.5	1.5000	1.4878	.0122	1.3933	1.3851	.0083	1.2866	1.2703	.0163
1-3/4	5	.20000	.0023	2.1	1.7500	1.7366	.0134	1.6219	1.6130	.0089	1.4939	1.4760	.0179
2	4.5	.22222	.0025	2.0	2.0000	1.9859	.0141	1.8577	1.8483	.0094	1.7154	1.6965	.0189
2-1/4	4	.25000	.0026	1.9	2.2500	2.2350	.0150	2.0899	2.0799	.0100	1.9298	1.9098	.0200
2-1/2	4	.25000	.0026	1.9	2.5000	2.4850	.0150	2.3399	2.3299	.0100	2.1798	2.1598	.0200
2-3/4	3.5	.28571	.0028	1.8	2.7500	2.7340	.0160	2.5870	2.5763	.0107	2.3841	2.3627	.0214
3	3.5	.28571	.0028	1.8	3.0000	2.9840	.0160	2.8170	2.8063	.0107	2.6341	2.6127	.0214
3-1/4	3.25	.30769	.0029	1.7	3.2500	3.2334	.0166	3.0530	3.0419	.0111	2.8560	2.8338	.0222
3-1/2	3.25	.30769	.0029	1.7	3.5000	3.4834	.0166	3.3030	3.2919	.0111	3.1060	3.0838	.0223
3-3/4	3	.33333	.0030	1.6	3.7500	3.7327	.0173	3.5366	3.5251	.0115	3.3231	3.3000	.0231
4	3	.33333	.0030	1.6	4.0000	3.9827	.0173	3.7866	3.7751	.0115	3.5731	3.5500	.0231
4-1/2	2.875	.34783	.0031	1.6	4.5000	4.4823	.0177	4.2773	4.2655	.0118	4.0546	4.0310	.0236
5	2.75	.36364	.0031	1.6	5.0000	4.9819	.0181	4.7672	4.7551	.0121	4.5343	4.5102	.0241
5-1/2	2.625	.38095	.0032	1.5	5.5000	5.4815	.0185	5.2561	5.2438	.0123	5.0121	4.9874	.0247
6	2.5	.40000	.0033	1.5	6.0000	5.9810	.0190	5.7439	5.7313	.0126	5.4877	5.4624	.0253

This table is taken from British Engineering Standards Association Interim Report No. C.L.(M.) 7270-1919. Intermediate sizes included therein, which the Association recommends be dispensed with, are not included.

Note A:- The errors in pitch in the length of thread engaged, and in angle are given, which can each be compensated by one-half of the tolerance on pitch diameter as given. The errors in pitch and angle may exist together, provided that the pitch diameter has the minimum value; also the permissible error in pitch may be increased to twice the value shown, provided that the error in angle is correspondingly reduced, and vice versa.

Table 5. - Standard Sizes and Tolerances for Threads in Nuts.

British Standard Whitworth Screw Threads

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Nominal diameter	Number of threads per inch	Pitch p	See note A		Major diameter			Pitch diameter			Minor diameter		
			Pitch	Angle	Minimum	Maximum	Tolerance 0.64Vp	Minimum	Maximum	Tolerance 0.03Vp	Minimum	Maximum	Tolerance 0.04Vp
Inches		Inches	Inches	Degrees	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
1/4	20	.05000	0.0012	4.3	0.2520	0.2610	0.0090	0.2200	0.2245	0.0045	0.1830	0.1947	0.0067
5/16	18	.05556	.0012	4.0	.3145	.3239	.0094	.2789	.2836	.0047	.2434	.2505	.0071
3/8	16	.06250	.0013	3.8	.3770	.3870	.0100	.3370	.3420	.0050	.2970	.3045	.0075
7/16	14	.07145	.0014	3.5	.4395	.4502	.0107	.3938	.3991	.0053	.3480	.3560	.0080
1/2	12	.08333	.0015	3.3	.5020	.5135	.0115	.4486	.4544	.0058	.3955	.4040	.0087
9/16	12	.08333	.0015	3.3	.5645	.5760	.0115	.5111	.5169	.0058	.4578	.4665	.0087
5/8	11	.09091	.0016	3.2	.6270	.6391	.0121	.5688	.5748	.0060	.5106	.5196	.0090
3/4	10	.10000	.0016	3.0	.7520	.7646	.0126	.6880	.6943	.0063	.6239	.6334	.0095
7/8	9	.11111	.0017	2.9	.8770	.8903	.0133	.8059	.8126	.0067	.7347	.7447	.0100
1	8	.12500	.0018	2.7	1.0020	1.0161	.0141	.9220	.9291	.0071	.8419	.8525	.0106
1-1/8	7	.14286	.0020	2.5	1.1270	1.1421	.0151	1.0355	1.0431	.0076	.9440	.9555	.0115
1-1/4	7	.14286	.0020	2.5	1.2520	1.2671	.0151	1.1605	1.1681	.0076	1.0690	1.0805	.0113
1-1/2	6	.16667	.0021	2.3	1.5020	1.5183	.0163	1.3953	1.4035	.0082	1.2886	1.3008	.0122
1-3/4	5	.20000	.0023	2.1	1.7520	1.7699	.0179	1.6239	1.6328	.0089	1.4959	1.5093	.0134
2	45	.22222	.0025	2.0	2.0020	2.0209	.0189	1.8597	1.8691	.0094	1.7174	1.7315	.0141
2-1/4	4	.25000	.0026	1.9	2.2520	2.2720	.0200	2.0919	2.1019	.0100	1.9318	1.9468	.0150
2-1/2	4	.25000	.0026	1.9	2.5020	2.5220	.0200	2.3419	2.3519	.0100	2.1818	2.1968	.0150
2-3/4	35	.28571	.0028	1.8	2.7520	2.7734	.0214	2.5690	2.5797	.0107	2.3861	2.4021	.0160
3	35	.28571	.0028	1.8	3.0020	3.0234	.0214	2.8190	2.8297	.0107	2.6361	2.6521	.0160
3-1/4	325	.30769	.0029	1.7	3.2520	3.2742	.0222	3.0550	3.0661	.0111	2.8580	2.8746	.0166
3-1/2	325	.30769	.0029	1.7	3.5020	3.5242	.0222	3.3050	3.3161	.0111	3.1080	3.1246	.0166
3-3/4	3	.33333	.0030	1.6	3.7520	3.7751	.0231	3.5386	3.5501	.0115	3.3251	3.3424	.0173
4	3	.33333	.0030	1.6	4.0020	4.0251	.0231	3.7886	3.8001	.0115	3.5751	3.5924	.0173
4-1/2	2875	.34785	.0031	1.6	4.5020	4.5256	.0236	4.2793	4.2911	.0118	4.0566	4.0743	.0177
5	275	.36364	.0031	1.6	5.0020	5.0261	.0241	4.7692	4.7813	.0121	4.5363	4.5544	.0181
5-1/2	2625	.38095	.0032	1.5	5.5020	5.5267	.0247	5.2581	5.2704	.0123	5.0141	5.0326	.0185
6	25	.40000	.0033	1.5	6.0020	6.0273	.0253	5.7459	5.7585	.0126	5.4897	5.5087	.0190

This table is taken from British Engineering Standards Association Interim Report No. C.L.(M.) 7270-1919. Intermediate sizes included therein, which the Association recommends be dispensed with, are not included.

Note A. - The errors in pitch in the length of thread engaged, and in angle are given, which can each be compensated by one-half of the tolerance on pitch diameter as given. The errors in pitch and angle may exist together, provided that the pitch diameter has the maximum value; also, the permissible error in pitch may be increased to twice the value shown, provided that the error in angle is correspondingly reduced, and vice versa.

Table 4. - Basic Dimensions of British Standard Fine Screw Threads

1	2	3	4	5	6	7	8	9	10
Nominal diameter	Number of threads per inch	Pitch	Depth of thread	Major Diameter		Pitch Diameter		Minor Diameter	
				Bolt	Nut	Bolt	Nut	Bolt	Nut
Inches		Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
7/32	28	0.03571	0.02285	0.2188	0.2208	0.1960	0.1980	0.1731	0.1751
1/4	26	.03846	.02465	.2500	.2520	.2254	.2274	.2007	.2027
9/32	26	.03846	.02465	.2813	.2833	.2566	.2586	.2320	.2340
5/16	22	.04545	.02910	.3125	.3145	.2834	.2854	.2543	.2563
5/8	20	.05000	.03200	.3750	.3770	.3430	.3450	.3110	.3130
7/16	18	.05556	.03555	.4375	.4395	.4019	.4039	.3654	.3684
1/2	16	.06250	.04000	.5000	.5020	.4600	.4620	.4200	.4230
9/16	16	.06250	.04000	.5625	.5645	.5225	.5245	.4825	.4845
5/8	14	.07143	.04575	.6250	.6270	.5793	.5813	.5335	.5355
11/16	14	.07143	.04575	.6875	.6895	.6418	.6438	.5960	.5980
3/4	12	.08333	.05335	.7500	.7520	.6966	.6986	.6433	.6453
13/16	12	.08333	.05335	.8125	.8145	.7591	.7611	.7058	.7078
7/8	11	.09091	.05820	.8750	.8770	.8168	.8188	.7586	.7606
1	10	.10000	.06405	1.0000	1.0020	.9360	.9380	.8719	.8739
1-1/8	9	.11111	.07115	1.1250	1.1270	1.0539	1.0559	.9827	.9847
1-1/4	9	.11111	.07115	1.2500	1.2520	1.1789	1.1809	1.1077	1.1097
1-3/8	8	.12500	.08005	1.3750	1.3770	1.2950	1.2970	1.2149	1.2169
1-1/2	8	.12500	.08005	1.5000	1.5020	1.4200	1.4220	1.3399	1.3419
1-5/8	8	.12500	.08005	1.6250	1.6270	1.5450	1.5470	1.4649	1.4669
1-3/4	7	.14286	.09150	1.7500	1.7520	1.6585	1.6605	1.5670	1.5690
2	7	.14286	.09150	2.0000	2.0020	1.9085	1.9105	1.8170	1.8190
2-1/4	6	.16667	.10670	2.2500	2.2520	2.1433	2.1453	2.0366	2.0386
2-1/2	6	.16667	.10670	2.5000	2.5020	2.3933	2.3953	2.2866	2.2886
2-3/4	6	.16667	.10670	2.7500	2.7520	2.6433	2.6453	2.5366	2.5386
3	5	.20000	.12805	3.0000	3.0020	2.8719	2.8739	2.7439	2.7459

This table is taken from British Engineering Standards Association Report No. 84-1918.

Table 5. - Standard Sizes and Tolerances for Threads on Bolts,

British Standard Fine Screw Threads

1	2	3	4	5	6	7	8
Nominal diameter	Number of threads per inch	Pitch	See note A		Major diameter		
			Pitch	Angle	Maximum	Minimum	Tolerance
Inches		Inches	Inches	Degrees	Inches	Inches	Inches
7/32	28	0.03571	0.0010	5.1	0.2188	0.2131	0.0057
1/4	26	.03846	.0010	4.8	.2500	.2441	.0059
9/32	26	.03846	.0010	4.8	.2813	.2754	.0059
5/16	22	.04545	.0011	4.5	.3125	.3061	.0064
3/8	20	.05000	.0012	4.3	.3750	.3683	.0067
7/16	18	.05556	.0012	4.0	.4375	.4304	.0071
1/2	16	.06250	.0013	3.8	.5000	.4925	.0075
9/16	16	.06250	.0013	3.8	.5625	.5550	.0075
5/8	14	.07143	.0014	3.5	.6250	.6170	.0080
11/16	14	.07143	.0014	3.5	.6875	.6795	.0080
3/4	12	.08333	.0015	3.3	.7500	.7413	.0087
13/16	12	.08333	.0015	3.3	.8125	.8038	.0087
7/8	11	.09091	.0016	3.2	.8750	.8660	.0090
1	10	.10000	.0018	3.0	1.0000	.9905	.0095
1 1/8	9	.11111	.0017	2.9	1.1250	1.1150	.0100
1 1/4	9	.11111	.0017	2.9	1.2500	1.2400	.0100
1 3/8	8	.12500	.0018	2.7	1.3750	1.3644	.0106
1 1/2	8	.12500	.0018	2.7	1.5000	1.4894	.0106
1 5/8	8	.12500	.0018	2.7	1.6250	1.6144	.0106
1 3/4	7	.14286	.0020	2.5	1.7500	1.7387	.0113
2	7	.14286	.0020	2.5	2.0000	1.9887	.0113
2 1/4	6	.16667	.0021	2.3	2.2500	2.2378	.0122
2 1/2	6	.16667	.0021	2.3	2.5000	2.4878	.0122
2 3/4	6	.16667	.0021	2.3	2.7500	2.7378	.0122
3	5	.20000	.0023	2.1	3.0000	2.9866	.0134

9	10	11	12	13	14
Pitch diameter			Minor diameter		
Maximum	Minimum	Tolerance	Maximum	Minimum	Tolerance
Inches	Inches	Inches	Inches	Inches	Inches
0.1960	0.1922	0.0038	0.1731	0.1665	0.0076
.2254	.2215	.0039	.2007	.1929	.0078
.2566	.2527	.0039	.2320	.2242	.0078
.2834	.2791	.0043	.2543	.2458	.0085
.3430	.3385	.0045	.3110	.3020	.0090
.4019	.3972	.0047	.3664	.3570	.0094
.4600	.4550	.0050	.4200	.4100	.0100
.5225	.5175	.0050	.4825	.4725	.0100
.5793	.5740	.0053	.5355	.5228	.0107
.6418	.6365	.0053	.5980	.5853	.0107
.6966	.6908	.0058	.6433	.6318	.0115
.7591	.7533	.0058	.7058	.6943	.0115
.8168	.8108	.0060	.7536	.7465	.0121
.9360	.9297	.0063	.8719	.8593	.0126
1.0539	1.0472	.0067	.9827	.9694	.0133
1.1789	1.1722	.0067	1.1077	1.0944	.0133
1.2950	1.2879	.0071	1.2149	1.2008	.0141
1.4200	1.4129	.0071	1.3399	1.3258	.0141
1.5450	1.5379	.0071	1.4649	1.4508	.0141
1.6585	1.6509	.0076	1.5670	1.5519	.0151
1.9085	1.9009	.0076	1.8170	1.8019	.0151
2.1433	2.1351	.0082	2.0366	2.0203	.0163
2.3933	2.3851	.0082	2.2866	2.2703	.0163
2.6433	2.6351	.0082	2.5366	2.5203	.0163
2.8719	2.8630	.0089	2.7439	2.7260	.0179

A. The errors in pitch in the length of thread engaged, and in angle, are given, which can each be compensated by one-half of the tolerance on pitch diameter as given. The errors in pitch and angle may exist together, provided that the pitch diameter has the minimum value; also, the permissible error in pitch may be increased to twice the value shown, provided that the error in angle is correspondingly reduced, and vice versa.

Table 6. - Standard Sizes and Tolerances for Threads in Nuts
British Standard Fine Screw Threads

1	2	3	4	5	6	7	8	9	10	11	12	13	14
			See note A		Major diameter			Pitch diameter			Minor diameter		
Nominal diameter	Number of thds. per inch	Pitch	Pitch	Angle	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance
Inches		Inches	Inches	Degrees	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
7/32	28	0.03571	0.0010	5.1	0.2208	0.2284	0.0076	0.1980	0.2018	0.0038	0.1751	0.1808	0.0057
1/4	28	.03846	.0010	4.8	.2520	.2598	.0078	.2274	.2313	.0039	.2087	.2086	.0059
9/32	26	.03946	.0010	4.8	.2833	.2911	.0078	.2586	.2625	.0039	.2340	.2399	.0059
5/16	22	.04545	.0011	4.5	.3145	.3230	.0085	.2854	.2897	.0043	.2563	.2627	.0064
3/8	20	.05000	.0012	4.3	.3770	.3860	.0090	.3450	.3495	.0045	.3130	.3197	.0067
7/16	18	.05556	.0012	4.0	.4395	.4489	.0094	.4039	.4086	.0047	.3694	.3755	.0071
1/2	16	.06250	.0013	3.8	.5020	.5120	.0100	.4620	.4670	.0050	.4220	.4295	.0075
9/16	16	.06250	.0013	3.8	.5645	.5745	.0100	.5245	.5295	.0050	.4845	.4920	.0075
5/8	14	.07143	.0014	3.5	.6270	.6377	.0107	.5813	.5866	.0053	.5355	.5435	.0080
11/16	14	.07143	.0014	3.5	.6895	.7002	.0107	.6438	.6491	.0053	.5980	.6060	.0080
3/4	12	.08333	.0015	3.3	.7520	.7635	.0115	.6986	.7044	.0058	.6453	.6540	.0087
13/16	12	.08333	.0015	3.3	.8145	.8260	.0115	.7611	.7669	.0058	.7078	.7165	.0087
7/8	11	.09091	.0016	3.2	.8770	.8891	.0121	.8188	.8248	.0060	.7606	.7696	.0090
1	10	.10000	.0016	3.0	1.0020	1.0146	.0126	.9380	.9443	.0063	.8739	.8834	.0095
1 1/8	9	.11111	.0017	2.9	1.1270	1.1403	.0133	1.0559	1.0626	.0067	.9847	.9947	.0100
1 1/4	9	.11111	.0017	2.9	1.2520	1.2653	.0133	1.1809	1.1876	.0067	1.1097	1.1197	.0100
1 3/8	8	.12500	.0018	2.7	1.3770	1.3911	.0141	1.2970	1.3041	.0071	1.2169	1.2275	.0106
1 1/2	8	.12500	.0018	2.7	1.5020	1.5161	.0141	1.4220	1.4291	.0071	1.3419	1.3525	.0106
1 5/8	8	.12500	.0018	2.7	1.6270	1.6411	.0141	1.5470	1.5541	.0071	1.4669	1.4775	.0106
1 3/4	7	.14286	.0020	2.5	1.7520	1.7671	.0151	1.6605	1.6681	.0076	1.5690	1.5803	.0113
2	7	.14286	.0020	2.5	2.0020	2.0171	.0151	1.9105	1.9181	.0076	1.8190	1.8303	.0113
2 1/4	6	.16667	.0021	2.3	2.2520	2.2683	.0163	2.1453	2.1535	.0082	2.0386	2.0508	.0122
2 1/2	6	.16667	.0021	2.3	2.5020	2.5183	.0163	2.3953	2.4035	.0082	2.2886	2.3008	.0122
2 3/4	6	.16667	.0021	2.3	2.7520	2.7683	.0163	2.6453	2.6535	.0082	2.5386	2.5508	.0122
3	5	.20000	.0023	2.1	3.0020	3.0199	.0179	2.8739	2.8828	.0089	2.7459	2.7593	.0134

Note A. The errors in pitch in the length of thread engaged, and in angle, are given, which can each be compensated by one-half of the tolerance on pitch diameter, as given. The errors in pitch and angle may exist together, provided that the pitch diameter has the maximum value; also, the permissible error in pitch may be increased to twice the value shown, provided that the error in angle is correspondingly reduced, and vice versa.

Table 7. - Standard Sizes and Tolerances for Threads on Bolts, British Standard Fine Screw Threads (Close Fits)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
			See note A		Major diameter			Pitch diameter			Minor diameter		
Nominal diameter	Number of thds. per inch	Pitch	Pitch	Angle	Maximum	Minimum	Tolerance	Maximum	Minimum	Tolerance	Maximum	Minimum	Tolerance
Inches		Inches	Inches	Degrees	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
7/32	28	0.03571	0.0005	2.6	0.2188	0.2159	0.0029	0.1960	0.1941	0.0019	0.1731	0.1693	0.0038
1/4	26	.03846	.0005	2.4	.2500	.2470	.0030	.2254	.2234	.0020	.2007	.1968	.0039
9/32	26	.03846	.0005	2.4	.2813	.2783	.0030	.2566	.2546	.0020	.2320	.2281	.0039
5/16	22	.04545	.0006	2.3	.3125	.3093	.0032	.2834	.2812	.0022	.2543	.2500	.0043
3/8	20	.05000	.0006	2.2	.3750	.3716	.0034	.3430	.3407	.0023	.3110	.3065	.0045
7/16	18	.05556	.0006	2.0	.4375	.4339	.0036	.4019	.3995	.0024	.3664	.3617	.0047
1/2	16	.06250	.0007	1.9	.5000	.4962	.0038	.4600	.4575	.0025	.4200	.4150	.0050
9/16	16	.06250	.0007	1.9	.5625	.5587	.0038	.5225	.5200	.0025	.4825	.4775	.0050
5/8	14	.07143	.0007	1.8	.6250	.6210	.0040	.5793	.5766	.0027	.5335	.5281	.0054
11/16	14	.07143	.0007	1.8	.6875	.6835	.0040	.6418	.6391	.0027	.5960	.5906	.0054
3/4	12	.08333	.0008	1.7	.7500	.7456	.0044	.6966	.6937	.0029	.6433	.6375	.0058
13/16	12	.08333	.0008	1.7	.8125	.8081	.0044	.7591	.7562	.0029	.7058	.7000	.0058
7/8	11	.09091	.0008	1.6	.8750	.8705	.0045	.8168	.8138	.0030	.7586	.7525	.0061
1	10	.10000	.0008	1.5	1.0000	.9952	.0048	.9360	.9328	.0032	.8719	.8658	.0063
1 1/8	9	.11111	.0009	1.5	1.1250	1.1200	.0050	1.0539	1.0505	.0034	.9827	.9760	.0067
1 1/4	9	.11111	.0009	1.5	1.2500	1.2450	.0050	1.1789	1.1755	.0034	1.1077	1.1010	.0067
1 3/8	8	.12500	.0009	1.4	1.3750	1.3697	.0053	1.2950	1.2914	.0036	1.2149	1.2078	.0071
1 1/2	8	.12500	.0009	1.4	1.5000	1.4947	.0053	1.4200	1.4164	.0036	1.3399	1.3328	.0071
1 5/8	8	.12500	.0009	1.4	1.6250	1.6197	.0053	1.5450	1.5414	.0036	1.4649	1.4578	.0071
1 3/4	7	.14286	.0010	1.3	1.7500	1.7443	.0057	1.6585	1.6547	.0038	1.5670	1.5594	.0076
2	7	.14286	.0010	1.3	2.0000	1.9943	.0057	1.9085	1.9047	.0038	1.8170	1.8094	.0076
2 1/4	6	.16667	.0011	1.2	2.2500	2.2439	.0061	2.1433	2.1392	.0041	2.0366	2.0284	.0082
2 1/2	6	.16667	.0011	1.2	2.5000	2.4939	.0061	2.3933	2.3892	.0041	2.2806	2.2724	.0082
2 3/4	6	.16667	.0011	1.2	2.7500	2.7439	.0061	2.6433	2.6392	.0041	2.5306	2.5224	.0082
3	5	.20000	.0012	1.1	3.0000	2.9933	.0067	2.8719	2.8674	.0045	2.7459	2.7349	.0090

Note A. The errors in pitch in the length of thread engaged, and in angle, are given, which can each be compensated by one-half of the tolerance on pitch diameter as given. The errors in pitch and angle may exist together, provided that the pitch diameter has the minimum value; also, the permissible error in pitch may be increased to twice the value shown, provided that the error in angle is correspondingly reduced, and vice versa.

Table 8. - Standard Sizes and Tolerances for Threads in Nuts, British Standard Fine Screw Threads (Close Fits)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
			See Note A		Major diameter			Pitch diameter			Minor diameter		
Nominal diameter	Number of thds. per inch	Pitch	Pitch	Angle	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance
Inches		Inches	Inches	Degrees	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
7/32	28	0.03571	0.0005	2.6	0.2208	0.2246	0.0038	0.1980	0.1999	0.0019	0.1751	0.1780	0.0029
1/4	26	.03846	.0005	2.4	.2580	.2559	.0039	.2274	.2294	.0020	.2037	.2057	.0030
9/32	26	.03846	.0005	2.4	.2833	.2872	.0039	.2586	.2606	.0020	.2340	.2370	.0030
5/16	22	.04545	.0006	2.3	.3145	.3188	.0043	.2854	.2876	.0022	.2563	.2595	.0032
3/8	20	.05000	.0006	2.2	.3770	.3815	.0045	.3450	.3473	.0023	.3130	.3164	.0034
7/16	18	.05556	.0006	2.0	.4395	.4442	.0047	.4039	.4063	.0024	.3684	.3720	.0036
1/2	16	.06250	.0007	1.9	.5020	.5070	.0050	.4620	.4645	.0025	.4220	.4258	.0038
9/16	16	.06250	.0007	1.9	.5645	.5695	.0050	.5245	.5270	.0025	.4845	.4883	.0038
5/8	14	.07143	.0007	1.8	.6270	.6324	.0054	.5813	.5840	.0027	.5355	.5395	.0040
11/16	14	.07143	.0007	1.8	.6895	.6949	.0054	.6438	.6465	.0027	.5980	.6020	.0040
3/4	12	.08333	.0008	1.7	.7520	.7578	.0058	.6986	.7015	.0029	.6453	.6497	.0044
13/16	12	.08333	.0008	1.7	.8145	.8203	.0058	.7611	.7640	.0029	.7078	.7122	.0044
7/8	11	.09091	.0008	1.6	.8770	.8831	.0061	.8188	.8218	.0030	.7606	.7651	.0045
1	10	.10000	.0008	1.5	1.0020	1.0083	.0063	.9380	.9412	.0032	.8739	.8787	.0048
1 1/8	9	.11111	.0009	1.5	1.1270	1.1337	.0067	1.0559	1.0593	.0034	.9847	.9897	.0050
1 1/4	9	.11111	.0009	1.5	1.2520	1.2587	.0067	1.1809	1.1843	.0034	1.1097	1.1147	.0050
1 3/8	8	.12500	.0009	1.4	1.3770	1.3841	.0071	1.2970	1.3006	.0036	1.2169	1.2222	.0053
1 1/2	8	.12500	.0009	1.4	1.5020	1.5091	.0071	1.4220	1.4256	.0036	1.3419	1.3472	.0053
1 5/8	8	.12500	.0009	1.4	1.6270	1.6341	.0071	1.5470	1.5506	.0036	1.4669	1.4722	.0053
1 3/4	7	.14286	.0010	1.3	1.7520	1.7596	.0076	1.6605	1.6643	.0038	1.5690	1.5747	.0057
2	7	.14286	.0010	1.3	2.0020	2.0096	.0076	1.9105	1.9143	.0038	1.8190	1.8247	.0057
2 1/4	6	.16667	.0011	1.2	2.2520	2.2602	.0082	2.1453	2.1494	.0041	2.0386	2.0447	.0061
2 1/2	6	.16667	.0011	1.2	2.5020	2.5102	.0082	2.3953	2.3994	.0041	2.2886	2.2947	.0061
2 3/4	6	.16667	.0011	1.2	2.7520	2.7602	.0082	2.6453	2.6494	.0041	2.5386	2.5447	.0061
3	5	.20000	.0012	1.1	3.0020	3.0110	.0090	2.8739	2.8784	.0045	2.7459	2.7526	.0067

Note A. The errors in pitch in the length of thread engaged, and in angle, are given, which can be compensated by one-half of the tolerance on pitch diameter as given. The errors in pitch and angle may exist together, provided that the pitch diameter has the maximum value; also, the permissible error in pitch may be increased to twice the value shown, provided that the error in angle is correspondingly reduced, and vice versa.

Table 9. — Comparison of Threads per Inch of United States National and British Standard Whitworth and Fine Screw Threads

1	2	3	4	5
	Number of threads per inch			
Size	U.S. National Coarse Threads	British Standard Whitworth Threads	U.S. National Fine Threads	British Standard Fine Threads
Inches				
*7/32	24		28	28
1/4	20	20	28	26
5/16	18	18	24	22
3/8	16	16	24	20
7/16	14	14	20	18
1/2	13	12	20	16
9/16	12	12	18	16
5/8	11	11	18	14
3/4	10	10	16	12
7/8	9	9	14	11
1	8	8	14	10
1 1/8	7	7	12	9
1 1/4	7	7	12	9
1 1/2	6	6	12	8
1 3/4	5	5	12	7
2	4 1/2	4 1/2	12	7
2 1/4	4 1/2	4	12	6
2 1/2	4	4	12	6
2 3/4	4	3 1/2	12	6
3	4	3 1/2	10	5

* National size #12, major diameter, 0.216 inches.

Table 10. - Diameter Modification of National or British Standard Whitworth Threads for Interchangeability

1	2	3	4	5
Threads per inch	Pitch	Change in pitch diameter for interchangeability	Difference in major diameter required for assembly	
		Minus on bolts or plus on nuts	U.S.nut B.S.W.bolt	B.S.W.nut U.S.bolt
	Inches	Inches	Inches	Inches
20	0.0500	0.0024	0.0029	0.0019
18	.0556	.0027	.0032	.0022
16	.0625	.0031	.0037	.0025
14	.0714	.0035	.0042	.0028
12	.0833	.0041	.0048	.0034
11	.0909	.0045	.0053	.0035
10	.1000	.0049	.0059	.0039
9	.1111	.0054	.0065	.0043
8	.1250	.0061	.0073	.0049
7	.1429	.0070	.0083	.0057
6	.1667	.0082	.0098	.0066
5	.2000	.0098	.0116	.0080
4½	.2222	.0109	.0129	.0089
4	.2500	.0122	.0145	.0099

III. BRITISH ASSOCIATION SCREW THREADS

In 1878 the Horological Section of the Geneva Society of Arts recommended a system of screw threads designed by Prof. F. Thury. This system was based on the measurement of well proportioned watch and small instrument screws in actual use in European countries. This thread had an angle of 47.5 degrees and was rounded equally at crest and root to a radius of approximately two elevenths of the pitch. The sizes were designated by consecutive numbers (n), the pitch (p) corresponding to any given size being given by the formula:

$$p = 0.9^n,$$

and the major diameter (D), corresponding to any pitch, being given by the formula:

$$D = 6p^{6/5}.$$

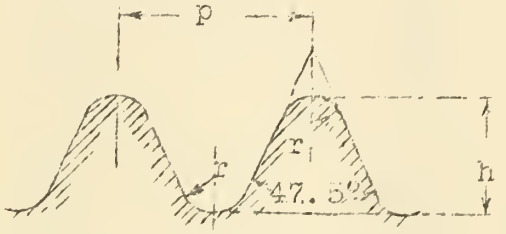


Fig. 5. British Association Thread Form

In 1884 the British Association for the Advancement of Science recommended the use of the Thury system, with modifications, for all screws less than 1/4 inch in diameter. The thread form was modified to give an equal rounding at crest and root of approximately 2/11 p. See Fig. 5. The British Engineering Standards Association, in their Report No. 20 on British Standard Screw Threads, give dimensions of British Association Screw Threads, including recommended clearances between crests and roots of mating threads which are given herein in tables 11 and 12.

References:

Systematique des Vis Horologeries, by F. Thury.
Reports of the British Association for the Advancement of Science, 1884 and 1900.
British Engineering Standards Association Report No. 20-1913. - Screw Threads.

Table 11. -- British Association Screw Threads

1	2	3	4	5	6	7	8
Designating number	Major Diameter	Approximate major diameter	Pitch	Approximate threads per inch	Depth of thread	Pitch diameter	Minor diameter
	mm	Inches	mm		mm	mm	mm
0	6.0	0.236	1.00	25.4	0.60	5.40	4.80
*1	5.3	.209	.90	28.2	.54	4.76	4.22
2	4.7	.185	.81	31.4	.485	4.215	3.73
*3	4.1	.161	.73	34.8	.44	3.66	3.22
4	3.6	.142	.66	38.5	.395	3.205	2.81
*5	3.2	.126	.59	43.1	.355	2.845	2.49
6	2.8	.110	.53	48.0	.32	2.48	2.16
*7	2.5	.098	.48	53.0	.29	2.21	1.92
8	2.2	.087	.43	59.1	.26	1.94	1.68
*9	1.9	.075	.39	65.2	.235	1.665	1.43
10	1.7	.067	.35	72.6	.21	1.49	1.28
*11	1.5	.059	.31	82.0	.185	1.315	1.13
12	1.3	.051	.28	90.7	.17	1.13	.96
*13	1.2	.047	.25	102	.15	1.05	.90
14	1.0	.039	.23	110	.14	.86	.72
*15	.90	.035	.21	121	.125	.775	.65
16	.79	.031	.19	134	.115	.675	.56
17	.70	.028	.17	149	.10	.60	.50
18	.62	.024	.15	169	.09	.53	.44
19	.54	.021	.14	181	.085	.455	.37
20	.48	.019	.12	212	.07	.41	.34
21	.42	.017	.11	231	.065	.355	.29
22	.37	.015	.10	254	.06	.31	.25
23	.33	.013	.09	282	.055	.275	.22
24	.29	.011	.08	318	.05	.24	.19
25	.25	.010	.07	363	.04	.21	.17

The figures in columns 3 and 5 are given for convenience only, and should, in no case, be worked to where satisfactory interchangeability is required.

*The British Engineering Standards Association recommend that for general use these sizes be dispensed with.

Table 12. -- Recommended Crest and Root Clearances, British Association Screw Threads

1	2	3	4	5
Designating number	Minor diameter of screw		Major diameter of tap	
	Maximum	Minimum	Maximum	Minimum
	mm	mm	mm	mm
0	4.74	4.60	6.20	6.06
*1	4.16	4.04	5.48	5.36
2	3.68	3.57	4.86	4.75
*3	3.17	3.07	4.25	4.15
4	2.77	2.68	3.77	3.64
*5	2.45	2.37	3.32	3.24
6	2.13	2.05	2.91	2.83
*7	1.89	1.82	2.60	2.53
8	1.65	1.59	2.29	2.23
*9	1.41	1.35	1.98	1.92
10	1.26	1.21	1.77	1.72
*11	1.11	1.07	1.56	1.52
12	.94	.90	1.36	1.32
*13	.88	.85	1.25	1.22
14	.71	.67	1.05	1.01
*15	.64	.61	.94	.91
16	.55	.52	.83	.80
17	.49	.47	.73	.71
18	.43	.41	.65	.63
19	.36	.34	.57	.55
20	.33	.32	.50	.49
21	.28	.27	.44	.43
22	.24	.23	.39	.38
23	.21	.20	.35	.34
24	.18	.17	.31	.30
25	.16	.15	.27	.26

*The British Engineering Standards Association recommend that for general use these sizes be dispensed with.

IV. BRITISH STANDARD PIPE THREADS

1. British Standard Pipe Thread for Iron and Steel Tubes

The British Standard Pipe Thread for Iron and Steel Tubes (B.S.P.) was adopted in 1905 by the Sectional Committee on Screw Threads and Limit Gages of the British Engineering Standards Association. It was approved by the Association in March 1905.

The Whitworth form of thread was adopted. Two classes of pipe threads were recognized by the Association, and are now in use, namely, -

Class I - the taper thread
Class II - the parallel (straight) thread.

Class I. The thread at the pipe end is tapered 1/16 inch per inch of length, the threads being perpendicular to the surface of the cone and pitch being measured parallel to the axis of the thread. The thread in the coupling may be either straight or tapered; ordinarily, a straight coupling and tapered pipe end are used. Taper couplings are used to secure exceptionally good fits.

Dimensions of Class I, tapered threads, are given in Table 13. All threads for iron and steel pipe and tubing purporting to be of British Standard dimensions shall have the dimensions given in this table.

Class II. Straight pipe threads have the same diameters as the diameters of tapered threads at the gaging notch. (See Column 3, Table 13).

2. British Standard Thread for Steel Conduit

Two classes of steel conduit are recognized as standard:-

Class A - plain,
Class B - threaded.

Class "A" is a light gage conduit. The coupling joining the lengths of tubing is a sleeve and neither the ends of the conduit, nor the coupling joining the lengths are threaded.

Class "B" is a heavy gage conduit. Both ends of the conduit are threaded with the Whitworth form of thread as defined for British Standard Pipe Threads.

The length of thread on the ends of conduits, which shall be the same for binds, tees, junction boxes and other threaded accessories, is given in Table 14, and is deduced by the formula,

$$L = 1/2\ D + 3/8 \text{ inches},$$

in which L = length of thread,
and D = outside diameter.

British Standard Dimensions of both Class "A" and Class "B" steel conduit are given in Table 14.

3. British Standard Dimensions for Copper Tubes and Their Screw Threads.

The report of the Sub-Committee on Metal Tubes and Connections on standard specifications for copper tubes and their screw threads was adopted by the Sectional Committee on Screw Threads and Limit Gages, and was approved by the British Engineering Standards Association, in March 1913. For the heavier gage tubes the British Standard Pipe Threads, as given in Tables 13 and 16, were adopted, and for the lighter gage tubes the dimensions given in Table 15 were adopted, the Whitworth form of thread being used.

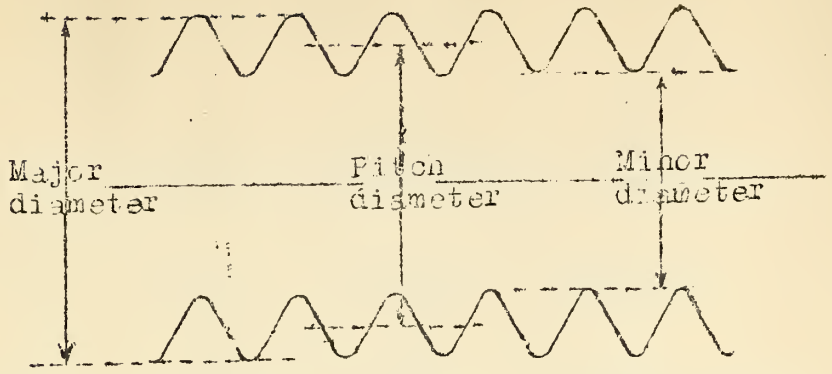
4. Gaging British Standard Pipe Threads

In order to insure correct gaging, it is necessary to define the position of the gage diameter on the pipe end and in the coupling. Fig. 4 is a drawing of plug and ring gages which give satisfactory results. Instead of dimensions being given on the drawing, reference is made to column numbers of Table 13. By referring to the table, dimensions may be found for gaging any size of thread.

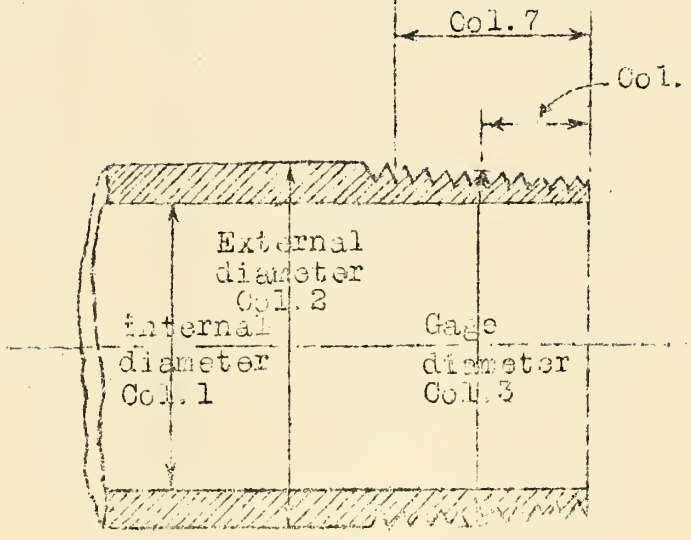
The distances between the surfaces A and B of the ring gages, for any given size, is the difference between values given in columns 10 and 11. The gage having a plain conical surface is slipped over the end of the pipe, and, when pressed on by hand, the pipe end must protrude beyond surface B. On the plug gage, surfaces C and D correspond to surfaces A and B on the ring. The plug must enter beyond C, but surface D must remain outside.

References:

British Engineering Standards Association Reports
Nos. 21-1909.-Pipe Threads for Iron or Steel Pipes and Tubes.
31-1910.-Steel Conduits for Electrical Wiring
61-1913.-Copper Tubes and Their Screw Threads.



Thread form of British Standard Pipe Threads



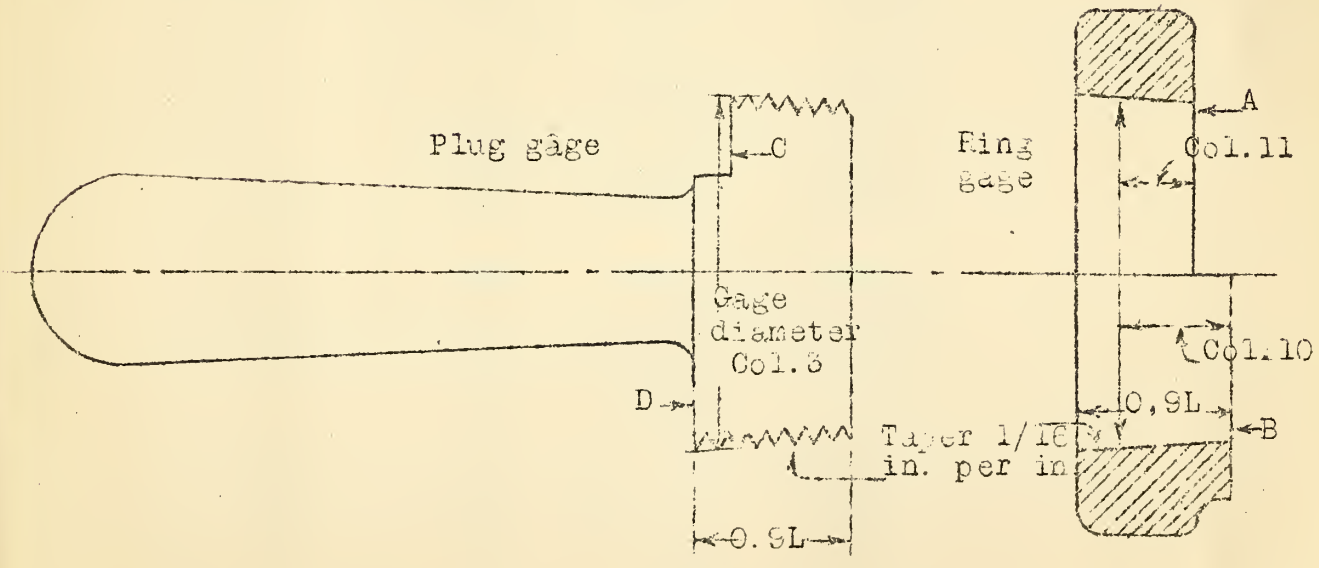


Fig. 4.- Gages for British Standard Pipe Threads

Table 13. - Dimensions of British Standard Pipe Threads

1	2	3	4	5	6	7	8	9	10	11
Nominal size of pipe	Outside diameter of pipe	Gage diameter (basic major diameter)	Number of threads per inch	Depth of thread	Minor diameter corresponding to gage diameter	Minimum length of thread "L" on pipe-end	Minimum length of thread In coupling	Distance of gage diameter from pipe-end (Class I taper screw) Standard	Distance of gage diameter from pipe-end (Class I taper screw) Maximum	Distance of gage diameter from pipe-end (Class I taper screw) Minimum
Inches	Inches	Inches		Inches	Inches	Inches	Inches	Inches	Inches	Inches
1/8	13/32	0.383	28	0.02285	0.3373	3/8	3/4	5/32	0.1883	0.1302
1/4	17/32	.518	19	.03370	.4506	7/16	7/8	3/16	.2188	.1562
3/8	11/16	.656	19	.03370	.5886	1/2	1	1/4	.2917	.2083
1/2	27/32	.825	14	.04575	.7335	5/8	1 1/4	1/4	.2917	.2083
5/8	15/16	.902	14	.04575	.8105	5/8	1 1/4	1/4	.2917	.2083
3/4	1 1/16	1.041	14	.04575	.9495	3/4	1 1/2	3/8	.4375	.3125
7/8	1 7/32	1.189	14	.04575	1.0975	3/4	1 1/2	3/8	.4375	.3125
1	1 11/32	1.309	11	.05820	1.1926	7/8	1 3/4	3/8	.4375	.3125
1 1/4	1 11/16	1.650	11	.05820	1.5336	1	2	1/2	.5833	.4167
1 1/2	1 29/32	1.882	11	.05820	1.7656	1	2	1/2	.5833	.4167
1 3/4	2 5/32	2.116	11	.05820	1.9996	1 1/8	2 1/4	5/8	.7292	.5208
2	2 3/8	2.347	11	.05820	2.2306	1 1/8	2 1/4	5/8	.7292	.5208
2 1/4	2 5/8	2.587	11	.05820	2.4706	1 1/4	2 1/2	11/16	.8021	.5729
2 1/2	3	2.960	11	.05820	2.8436	1 1/4	2 1/2	11/16	.8021	.5729
2 3/4	3 1/4	3.210	11	.05820	3.0936	1 3/8	2 3/4	13/16	.9479	.6771
3	3 1/2	3.460	11	.05820	3.3436	1 3/8	2 3/4	13/16	.9479	.6771
3 1/4	3 3/4	3.700	11	.05820	3.5836	1 1/2	3	7/8	1.0208	.7292
3 1/2	4	3.950	11	.05820	3.8336	1 1/2	3	7/8	1.0208	.7292
3 3/4	4 1/4	4.200	11	.05820	4.0836	1 1/2	3	7/8	1.0208	.7292
4	4 1/2	4.450	11	.05820	4.3336	1 5/8	3 1/4	1	1.1667	.8333
4 1/2	5	4.950	11	.05820	4.8336	1 5/8	3 1/4	1	1.1667	.8333
5	5 1/2	6.450	11	.05820	5.3336	1 3/4	3 1/2	1 1/8	1.3125	.9375
5 1/2	6	5.950	11	.05820	5.8336	1 7/8	3 3/4	1 1/4	1.4583	1.0417
6	6 1/2	6.450	11	.05820	6.3336	2	4	1 3/8	1.6042	1.1458
7	7 1/2	7.450	10	.0640	7.3219	2 1/8	4 1/4	1 3/8	1.6042	1.1458
8	8 1/2	8.450	10	.06405	8.3219	2 1/4	4 1/2	1 1/2	1.7500	1.2500
9	9 1/2	9.450	10	.06405	9.3219	2 1/4	4 1/2	1 1/2	1.7500	1.2500
10	10 1/2	10.450	10	.06405	10.3219	2 3/8	4 3/4	1 5/8	1.8958	1.3542
11	11 1/2	11.450	8	.08005	11.2899	2 1/2	5	1 5/8	1.8958	1.3542
12	12 1/2	12.450	8	.08005	12.2899	2 1/2	5	1 5/8	1.8958	1.3542
13	13 3/4	13.680	8	.08005	13.5199	2 5/8	5 1/4	1 5/8	1.8958	1.3542
14	14 3/4	14.680	8	.08005	14.5199	2 3/4	5 1/2	1 3/4	2.0417	1.4583
15	15 3/4	15.680	8	.08005	15.5199	2 3/4	5 1/2	1 3/4	2.0417	1.4583
16	16 3/4	16.680	8	.08005	16.5199	2 7/8	5 3/4	1 7/8	2.1875	1.5625
17	17 3/4	17.680	8	.08005	17.5199	3	6	2	2.3333	1.6667
18	18 3/4	18.680	8	.08005	18.5199	3	6	2	2.3333	1.6667

Table 14.-British Standard Dimensions of Threaded Steel Conduits, Class "B", and Plain Steel Conduit, Class "A"

			1	2	3	4	5	6
Outside diameter in inches			5/8	3/4	1	1 1/4	1 1/2	2
Threads per inch			18	16	16	16	14	14
Depth of thread in inches			0.0356	0.0400	0.0400	0.0400	0.0457	0.0457
Maximum length of thread on end of conduit in inches			1/2	9/16	11/16	13/16	15/16	1 3/16
Minimum length of thread on end of conduit in inches			7/16	1/2	5/8	3/4	7/8	1 1/8
Nominal thickness	Class A	S.W.G. No.	19	18	18	17	16	16
		Inches	0.040	0.048	0.048	0.056	0.064	0.064
	Class B)	S.W.G.	16	15	15	15	14	13
		Inches	0.064	0.072	0.072	0.072	0.080	0.092
Weight per 100 ft. in lbs.	Class A	Max.	28.9	40.8	55.4	79.9	108.7	146.7
		Min.	23.6	34.4	46.6	68.9	95.4	128.1
	Class B	Max.	42.2	56.9	78.1	99.3	132.1	202.4
		Min.	37.4	51.0	69.8	88.5	119.0	184.7
Combined lengths of recessed portions of plain sockets in inches			2 1/4	2 1/2	3	3 1/2	4	5
Thickness of plain socket in inches			0.060	0.072	0.072	0.084	0.096	0.096
Length of coupling in inches			1 1/8	1 1/4	1 1/2	1 3/4	2	2 1/2
Thickness of coupling in inches before threading			0.128	0.144	0.144	0.144	0.160	0.184
Minimum radius of bends in inches			1 7/8	2	2 1/2	2 3/4	5 1/4	8 1/2

Table 15. - Screw Threads for Low and Medium Pressure Copper Tubes

1	2	3	4	5	6	7
Nominal bore of tube	Outside diameter standard	Cage diameter	No. of threads per in.	Depth of thread	Minor diameter	Length of thread
Inches	Inches	Inches		Inches	Inches	Inches
1/8	0.253	0.248	28	0.0230	0.202	5/16
1/4	.394	.389	20	.0320	.325	3/8
3/8	.519	.514	20	.0320	.450	1/2
1/2	.644	.639	20	.0320	.575	1/2
5/8	.769	.764	20	.0320	.700	5/8
3/4	.894	.889	20	.0320	.825	5/8
7/8	1.019	1.014	20	.0320	.950	3/4
1	1.160	1.155	20	.0320	1.091	3/4
1 1/4	1.410	1.405	20	.0320	1.341	7/8
1 1/2	1.660	1.655	20	.0320	1.591	7/8
1 3/4	1.934	1.929	16	.0400	1.849	1
2	2.184	2.179	16	.0400	2.099	1
2 1/4	2.434	2.429	16	.0400	2 349	1
2 1/2	2.684	2.679	16	.0400	2.599	1
2 3/4	2.934	2.929	16	.0400	2.849	1
3	3.208	3.203	16	.0400	3.125	1 1/8
3 1/4	3.458	3.453	16	.0400	3.373	1 1/8
3 1/2	3.732	3.727	16	.0400	3.647	1 1/8
3 3/4	3.982	3.977	16	.0400	3.897	1 1/8
4	4.256	4.251	16	.0400	4.171	1 1/4

Table 16. - Screw Threads for British Standard High Pressure Copper Tubes

For working pressures up to 200 lbs. per square inch.

1	2	3	4	5	6	7	8	9	10	11
Nominal bore of	Outside diameter	Gage diameter	No. of thds. per inch	Depth of thd.	Minor diameter	Length of thread, Min.		Distance of gage diameter from end of pipe		
						On pipe	In coupling	Std.	Max.	Min.
In.	In.	In.		In.	In.	In.	In.	In.	In.	In.
1/8	0.388	0.383	28	0.0230	0.337	3/8	3/4	5/32	0.18	0.13
1/4	.523	.518	19	.0335	.451	7/16	7/8	3/16	.22	.16
3/8	.661	.656	19	.0335	.589	1/2	1	1/4	.29	.21
1/2	.830	.825	14	.0455	.734	5/8	1 1/4	1/4	.29	.21
5/8	.907	.902	14	.0455	.811	5/8	1 1/4	1/4	.29	.21
3/4	1.046	1.041	14	.0455	.950	3/4	1 1/2	3/8	.44	.31
7/8	1.194	1.189	14	.0455	1.098	3/4	1 1/2	3/8	.44	.31
1	1.314	1.309	11	.0580	1.193	7/8	1 3/4	3/8	.44	.31
1 1/8	1.497	1.492	11	.0580	1.376	7/8	1 3/4	3/8	.44	.31
1 1/4	1.655	1.650	11	.0580	1.534	1	2	1/2	.58	.42
1 3/8	1.750	1.745	11	.0580	1.629	1	2	1/2	.58	.42
1 1/2	1.887	1.882	11	.0580	1.766	1	2	1/2	.58	.42
1 5/8	2.087	2.082	11	.0580	1.966	1 1/8	2 1/4	5/8	.73	.52
1 3/4	2.121	2.116	11	.0580	2.000	1 1/8	2 1/4	5/8	.73	.52
1 7/8	2.249	2.244	11	.0580	2.128	1 1/8	2 1/4	5/8	.73	.52
2	2.352	2.347	11	.0580	2.231	1 1/8	2 1/4	5/8	.73	.53
2 1/4	2.592	2.587	11	.0580	2.471	1 1/4	2 1/2	11/16	.80	.57
2 1/2	2.965	2.960	11	.0580	2.844	1 1/4	2 1/2	11/16	.80	.57
2 3/4	3.215	3.210	11	.0580	3.094	1 3/8	2 3/4	13/16	.95	.68
3	3.465	3.460	11	.0580	3.344	1 3/8	2 3/4	13/16	.95	.68
3 1/4	3.705	3.700	11	.0580	3.584	1 1/2	3	7/8	1.02	.75
3 1/2	3.955	3.950	11	.0580	3.834	1 1/2	3	7/8	1.02	.75
3 3/4	4.205	4.200	11	.0580	4.084	1 1/2	3	7/8	1.02	.75
4	4.455	4.450	11	.0580	4.334	1 5/8	3 1/4	1	1.17	.85

V. BRITISH STANDARD BOLT HEADS, NUTS, AND SCREW HEADS

1. British Standard Bolt Heads and Nuts

Standard dimensions for hexagonal bright nuts and bright bolt heads; black nuts, black lock nuts, and black bolt heads; spanners; and castle nuts, which were adopted by the Sectional Committee on Screw Threads and Limit Gages, and approved by the British Engineering Standards Association in 1906, are given in Tables 17, 18, and 19.

2. British Standard Automobile Bolt Heads and Nuts

Standard dimensions for nuts and bolt heads used in automobile construction as given in Table 20 were submitted by the Sub-Committee on Automobile Threads, adopted by the Sectional Committee on Screw Threads and Limit Gages, and approved by the British Engineering Standards Association in 1911.

3. British Standard Heads for British Association Screws

The proportions of heads for small screws, namely,-countersunk, instrument, round, cheese, filister, capstan, connection, and hexagon, for sizes 0 to 15 ("British Association" designating numbers) were established by the Sectional Committee on Machine Parts, their Gaging and Nomenclature, and approved on behalf of the British Engineering Standards Association in 1920. The sizes standardized range from 6 mm to 0.9 mm (0.236 in. to 0.035 in.). The smaller sizes not being in general use, except in special cases, were not standardized. See Table 21.

References:

British Engineering Standards Association Reports
Nos. 28-1908. Nuts, Bolt Heads, and Spanners.
54-1911. Screw Threads, Nuts, and Bolt Heads for use in Automobile Construction.
57-1920. Heads for British Association Screws.

Table 17. -- British Standard Hexagonal Bright Nuts and Bolt Heads

1	2	3	4	5	6	7	8	9	10
Diameter of bolt	Bright Nuts					Bright lock nuts		Bright bolt heads	
	Width across flats		Width across corners	Thickness		Thickness		Thickness	
	Max.	Min.	Approx. Max.	Max.	Min.	Max.	Min.	Max.	Min.
Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
1/4	0.585	0.580	0.61	0.26	0.25	0.18	0.17	0.23	0.22
5/16	.600	.595	.69	.32	.31	.22	.21	.28	.27
3/8	.710	.705	.82	.39	.38	.26	.25	.34	.33
7/16	.820	.815	.95	.45	.44	.30	.29	.39	.38
1/2	.920	.915	1.06	.51	.50	.34	.33	.45	.44
9/16	1.010	1.002	1.17	.57	.56	.39	.38	.50	.49
5/8	1.100	1.092	1.27	.64	.63	.43	.42	.56	.55
11/16	1.200	1.192	1.39	.70	.69	.47	.46	.61	.60
3/4	1.300	1.292	1.50	.76	.75	.51	.50	.67	.66
13/16	1.390	1.382	1.61	.82	.81	.55	.54	.72	.71
7/8	1.480	1.472	1.71	.89	.88	.59	.58	.78	.77
1	1.670	1.662	1.93	1.01	1.00	.68	.67	.89	.88
1 1/8	1.860	1.850	2.15	1.15	1.13	.77	.75	1.00	.98
1 1/4	2.050	2.040	2.37	1.27	1.25	.85	.83	1.11	1.09
1 3/8	2.220	2.210	2.56	1.40	1.38	.94	.92	1.22	1.20
1 1/2	2.410	2.400	2.78	1.52	1.50	1.02	1.00	1.33	1.31
1 5/8	2.580	2.570	2.98	1.65	1.63	1.10	1.08	1.44	1.42
1 3/4	2.760	2.750	3.19	1.77	1.75	1.19	1.17	1.55	1.53
2	3.150	3.140	3.64	2.02	2.00	1.35	1.33	1.77	1.75
2 1/4	3.550	3.535	4.10	2.27	2.25	1.52	1.50	1.99	1.97
2 1/2	3.890	3.875	4.49	2.52	2.50	1.69	1.67	2.21	2.19
2 3/4	4.180	4.165	4.83	2.77	2.75	1.85	1.83	2.43	2.41
3	4.530	4.515	5.23	3.02	3.00	2.02	2.00	2.65	2.63
3 1/4	4.850	4.830	5.60	3.27	3.25	2.19	2.17	2.86	2.84
3 1/2	5.180	5.160	5.98	3.52	3.50	2.35	2.33	3.08	3.06
3 3/4	5.550	5.530	6.41	3.77	3.75	2.52	2.50	3.30	3.28
4	5.950	5.930	6.87	4.02	4.00	2.69	2.67	3.52	3.50
4 1/2	6.820	6.795	7.88	4.53	4.50	3.03	3.00	3.97	3.94
5	7.800	7.775	9.01	5.03	5.00	3.36	3.33	4.41	4.38
5 1/2	8.850	8.830	10.22	5.53	5.50	3.70	3.67	4.84	4.81
6	10.000	9.970	11.55	6.03	6.00	4.03	4.00	5.28	5.25

Table 18. -- British Standard Black Nuts, Lock Nuts, and Bolt Heads

1	2	3	4	5	6	7	8	9	10
Diameter of Bolt	Black Nuts					Black lock nuts		Black bolt heads	
	Width across flats		Width across corners	Thickness		Thickness		Thickness	
	Max.	Min.	Approx. Max.	Max.	Min	Max.	Min.	Max.	Min.
Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
1/4	0.525	0.505	0.61	0.27	0.25	0.19	0.17	0.24	0.22
5/16	.600	.580	.69	.33	.31	.23	.21	.29	.27
3/8	.710	.690	.82	.40	.38	.27	.25	.35	.33
7/16	.820	.800	.95	.46	.44	.31	.29	.40	.38
1/2	.920	.900	1.06	.52	.50	.35	.33	.46	.44
9/16	1.010	.990	1.17	.58	.56	.40	.38	.51	.49
5/8	1.100	1.080	1.27	.65	.63	.44	.42	.57	.55
11/16	1.200	1.180	1.39	.71	.69	.48	.46	.63	.60
3/4	1.300	1.280	1.50	.77	.75	.52	.50	.68	.66
13/16	1.390	1.370	1.61	.83	.81	.56	.54	.73	.71
7/8	1.480	1.460	1.71	.90	.88	.60	.58	.79	.77
1	1.670	1.650	1.93	1.02	1.00	.69	.67	.90	.88
1 1/8	1.860	1.830	2.15	1.16	1.13	.78	.75	1.01	.98
1 1/4	2.050	2.020	2.37	1.28	1.25	.86	.83	1.12	1.09
1 3/8	2.220	2.190	2.56	1.41	1.38	.95	.92	1.23	1.20
1 1/2	2.410	2.380	2.78	1.53	1.50	1.03	1.00	1.34	1.31
1 5/8	2.580	2.550	2.98	1.66	1.63	1.11	1.08	1.45	1.42
1 3/4	2.760	2.730	3.19	1.78	1.75	1.20	1.17	1.56	1.53
2	3.150	3.120	3.64	2.03	2.00	1.36	1.33	1.78	1.75
2 1/4	3.550	3.510	4.10	2.28	2.25	1.53	1.50	2.00	1.97
2 1/2	3.890	3.850	4.49	2.53	2.50	1.70	1.67	2.22	2.19
2 3/4	4.180	4.140	4.83	2.78	2.75	1.86	1.83	2.44	2.41
3	4.530	4.490	5.23	3.03	3.00	2.03	2.00	2.66	2.63
3 1/4	4.850	4.810	5.60	3.28	3.25	2.20	2.17	2.87	2.84
3 1/2	5.180	5.140	5.98	3.53	3.50	2.36	2.33	3.09	3.06
3 3/4	5.550	5.510	6.41	3.78	3.75	2.53	2.50	3.31	3.28
4	5.950	5.910	6.87	4.03	4.00	2.70	2.67	3.53	3.50
4 1/2	6.820	6.770	7.88	4.54	4.50	3.04	3.00	3.98	3.94
5	7.800	7.750	9.01	5.04	5.00	3.37	3.33	4.42	4.38
5 1/2	8.850	8.800	10.22	5.54	5.50	3.71	3.67	4.85	4.81
6	10.000	9.950	11.55	6.04	6.00	4.04	4.00	5.29	5.25

Table 19.-British Standard Castle Nuts

Diameter of bolt	Dimensions of nut					Dimensions of slot	
	Width across flats		Width across corners	Total thickness	Thickness of hexagonal portion	Width	Depth
	Max.	Min.	Approximate Max.*	D	H	W	S
Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
1/4	0.525	0.520	0.61	0.31	0.19	0.063	0.11
3/8	.710	.705	.82	.47	.28	.094	.16
1/2	.920	.915	1.06	.63	.38	.125	.22
5/8	1.100	1.092	1.27	.78	.47	.156	.27
3/4	1.300	1.292	1.50	.94	.56	.188	.33
7/8	1.480	1.472	1.71	1.09	.66	.219	.38
1	1.670	1.662	1.93	1.25	.75	.250	.44
1 1/8	1.860	1.850	2.15	1.41	.84	.281	.49
1 1/4	2.050	2.040	2.37	1.56	.94	.313	.55
1 1/2	2.410	2.400	2.78	1.88	1.13	.375	.66
1 3/4	2.760	2.750	3.19	2.19	1.31	.438	.77
2	3.150	3.140	3.64	2.50	1.50	.500	.88

D-H	C	R
Inches	Inches	Inches
0.12	0.45	0.03
.19	.64	.05
.25	.85	.06
.31	1.02	.08
.38	1.22	.09
.43	1.400	.11
.50	1.590	.13
.57	1.78	.14
.62	1.97	.16
.75	2.33	.19
.88	2.69	.22
1.00	3.07	.25

*The figures in this column represent the maximum width across the corners correct to two decimal places.

The dimensions given are based on the following proportions, which the committee believe have, by experience, proved themselves to be the most satisfactory:

T = 1.25D
H = 0.75D
S = 0.4375D
C = Width across flats minus 1/16 in.
where D = full diameter of thread on bolt.

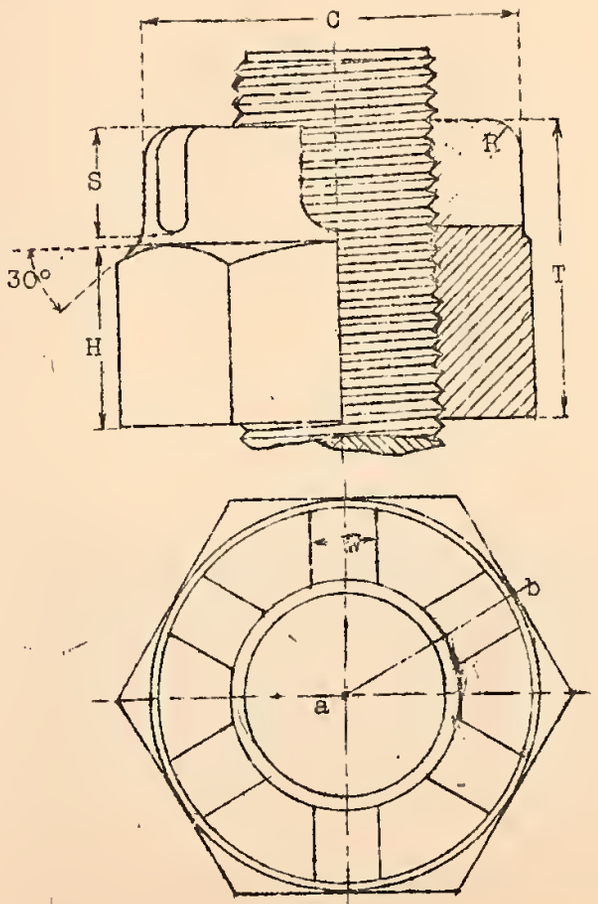


Fig. 5

Table 20. - British Standard Automobile Nuts and Bolt Heads

Diameter of bolt	Nuts and bolt heads			Nuts		Bolt heads	
	Width across flats		Width across corners	Thickness		Thickness	
	Max.	Min.	Approx. Max.	Max.	Min.	Max.	Min.
In.	Inches	Inches	Inches	Inches	Inches	Inches	Inches
1/4	0.445	0.440	0.515	0.21	0.20	0.16	0.15
9/32	.525	.520	.61	.26	.25	.23	.22
5/16	.525	.520	.61	.26	.25	.23	.22
3/8	.600	.595	.69	.32	.31	.28	.27
7/16	.710	.705	.82	.39	.38	.34	.33
1/2	.820	.815	.95	.45	.44	.39	.38
9/16	.920	.915	1.06	.51	.50	.45	.44
5/8	1.010	1.002	1.17	.57	.56	.50	.49
11/16							
3/4	1.200	1.192	1.39	.70	.69	.61	.60
13/16							
7/8	1.390	1.382	1.61	.82	.81	.72	.71
15/16							
1	1.480	1.472	1.71	.89	.88	.78	.77

The above nuts and bolt heads are lighter than the B.S.W. and B.S.F. bright nuts and bolt heads, but the same set of wrenches will fit all sizes with the exception of the 1/4 in. diameter size, since, with this exception, the widths across the flats of the British Standard Nuts and Bolt Heads have been adopted.

Table 21. — BRITISH STANDARD HEADS FOR BRITISH ASSOCIATION SCREWS.

SCHEDULE OF DIMENSIONS.

(All dimensions are given in mils except where otherwise stated.)
One mil = ·001 of an inch.

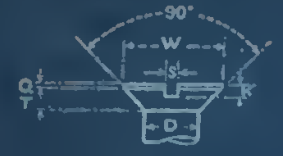


Fig. 6.
COUNTERSUNK

Fig. 7.
INSTRUMENT.

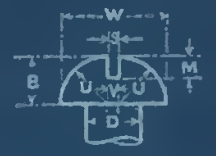


Fig. 8.
ROUND.

Fig. 9.
CHEESE.

Fig. 10.
FILISTER

Fig. 11.
CAPSTAN.

Fig. 12.
CONNECTION.

Fig. 13.
HEXAGON.

Fig. 14.
HEXAGON NUT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
B.A Designating Number.	Diameter of Shank and Full Diameter of Thread.		Diameter of Head.	Tolerances on Dimensions marked W.	Diameter of Head of Connection Screw.	Tolerance on Diameter of Head of Connection Screw Col. 6	Depth of Coned portion of Head.	Part Depth of Head (See Figs. 6 & 7).	Part Depth of Head (See Figs. 7 & 10).	Total Depth of Head. Countersunk.	Total Depth of Head. Instrument.	Tolerance on Cols. 12 & 13.	Total Depth of Head. Hexagon, Cheese, Round, Fillister, Capstan, Connection.				Tolerance on Cols. 14 15, 16, 17.	Width of Saw Cut. See Notes for Tolerances.		Depth of Saw Cut. See Notes for Tolerances.					Radii Round Head.	Distance between Centres.	Instrument and Diameter	Diameter of Spike Holes in Capstan Head.	Hexagon Heads & Nuts. Width across Flats.	Thickness. Ordinary.	Tolerance on Width across Flats of Hexagon Heads and Nuts.	B.A. Designating Number.
	D		W 1·75 D		X	T ·375 D	Q Maximum	·05 D ·0·1 mm. C		T + Q ·425 D + 0·1 mm.	T + Q + C 0·825 D + 0·1 mm.		B 0·8 D	A 0·75 D	A + C 0·95 D	Y 1·4 D			S ·1 D ± 0·1 mm.	K 0·22 D (App)	L 0·31 D (App)	M 0·4 D	N 0·375 D	O 0·475 D	U 0·8 D	V		R 2·0 D	Z	H 1·75 D	E 1·0 D		
	mm.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	S.W.G. No.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	mils.	
0	6·0	236	413	−8	472	−8	89	16	43	105	152	−4	189	177	224	330	−8	18	48	52	76	94	89	112	189	35		472	120	413	236	3	0
1	5·3	209	365	−8	413	−8	78	14	43	92	134	−4	167	156	198	293	−7	18	48	47	68	83	78	99	167	31		417	113	365	209	3	1
2	4·7	185	324	−8	365	8	69	13	37	82	119	−4	148	139	176	259	−7	19	40	43	61	74	69	88	148	28		370	107	324	185	3	2
3	4·1	161	282	−6	324	−8	61	12	34	73	105	−3	129	121	153	225	−6	19	40	36	52	65	61	77	129	24		323	98	282	161	−3	3
4	3·6	143	248	−6	282	−6	53	11	29	64	92	−3	113	106	134	199	−6	21	32	32	47	57	53	67	113	21		283	89	248	142	3	4
5	3·2	126	220	−6	248	−6	47	10	25	57	82	−3	101	94	119	176	−5	21	32	30	42	50	47	60	101	19		252	82	220	126	3	5
6	2·8	110	193	—	220	−6	41	9	22	50	72	−3	88	83	105	154	−5	23	24	25	36	44	41	52	88	17		220	76	193	110	−3	6
7	2·5	98	172	−5	193	−6	37	9	20	46	66	−3	79	74	94	137	−4	23	24	22	32	39	37	47	79	16		173	67	172	98	−2	7
8	2·2	87	152	−5	172	−5	32	8	17	40	57	−3	69	65	82	122	−4	23	24	20	29	35	32	41	69	13		173	59	152	87	2	8
9	1·9	75	131	−4	152	−5	28	8	15	36	51	−2	60	56	71	105	−4	26	18	18	25	30	28	36	60	11		150	52	131	75	−2	9
10	1·7	67	117	−4	131	−4	25	7	13	32	45	−2	54	50	63	94	−4	26	18	16	23	27	25	32	54	10		134	43	117	67	−2	10
11	1·5	59	103	−4	117	−4	22	7	12	29	41	−2	47	44	66	83	−3	26	18	15	21	24	22	28	47	9		118	—	—	59	−2	11
12	1·3	51	90	−4	103	−4	19	6	10	25	35	−2	41	38	48	71	−3	30	12·4	14	19	20	19	24	41	8		102	—	90	51	−2	12
13	1·2	47	83	−3	90	−4	18	6	9	24	33	−2	38	35	44	66	−3	30	12·4	13	18	19	18	22	38	7		94	—	83	47	−2	13
14	1·0	39	69	−3	83	−3	15	6	8	21	29	2	31	30	38	55	−3	30	12·4	11	15	16	15	19	31	6		79	—	69	39	2	14
15	0·9	35	61	−3	69	−3	13	6	7	19	26	−2	28	26	33	49	−3	31	11·6	7	10	14	13	17	28	5		70	—	61	35	−2	15

Notes to Table.—The Tolerances on Diameter and Depths of Head are minus, *i.e.*, the dimensions to which they refer should not exceed the values given in the Table.

The Association recommends that the tolerances on the Widths and Depths of the Saw Cuts (columns 19 to 25 inclusive) be from −7½% to +8% of the dimensions given in the Table, such standard tolerances being determined by the nearest unit above the calculated

VI. International Metric Screw Thread Standard, and Proposed Metric Fine and International Pipe Threads.

The International Screw Thread Standard (S. I.) was adopted by a congress, representing principal continental countries, at Zurich in 1898. The system proposed was based on the French Metric Screw Thread System as adopted by the Société d'Encouragement de l'Industrie Nationale in 1894. The principal difference between the two systems is in the pitch of three screws 8, 9 and 12 mm; the French system specifying 1, 1, and 1.5 mm pitch respectively while the International gives 1.25, 1.25, and 1.75 mm. The International form of thread has a 60° angle and the crest of thread is flattened 1/8th the height of the basic triangle while the root is filled in 1/16 the height, either flat or rounded, as shown in Fig. 15. This gives a definite clearance between the tops and bottoms of the threads of screw and nut. The actual form at the root is left to the choice of the manufacturer.

The dimensions of the International Screw Thread System are given in Table 23. The sizes from 6 mm to 80 mm, inclusive, were standardized at the Congress of Zurich, and those above 80 mm were added by the Société de Encouragement pour l'Industrie Nationale of France. No tables of allowances and toleranoes for this thread series are available. A chart showing a comparison of the pitches and diameters of the International with the U. S. National Coarse and Fine Thread Series is given in Fig. 16.

A series of Metric Fine Threads consisting of 188 sizes ranging from 1 mm to 300 mm has been proposed by the German Industry Committee on Standards, but has not yet been established as a standard.

A series of pipe threads has been proposed as an International Standard, and published (see reference below). It is practically a translation of the British Standard into metric units.

References:

International Metric Screw Threads

Bulletin Soc. d'Encouragement pour l'Industrie Nationale, March 1899 and September-October 1919.
Ptotokoll International Commission, 1898, (Druck von F. Lehbaner).

Proposed Metric Fine Threads

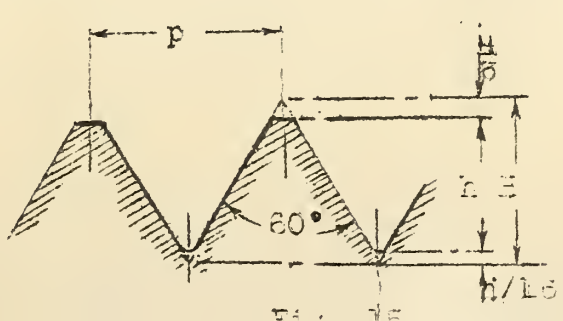
Normenausschuss der Deutschen Industrie, Machinenbau, Vol. 1, No. 7, July 8, 1922, pp. 475-492.

Proposed International pipe Threads

Bulletin Soc. d'Encouragement pour l'Industrie Nationale, May-June, 1916.

Table 22. - International Metric Screw Thread System

1	2	3	4	5	6	7	8
Size	Pitch	Approx. threads per inch	Major diameter		Pitch diameter	Minor diameter	
			Screw	Nut		Screw	Nut
mm	mm		Inches	Inches	Inches	Inches	Inches
6	1.0	25.4	0.2362	0.2405	0.2106	0.1808	0.1851
7	1.0	25.4	.2756	.2799	.2500	.2202	.2244
8	1.25	20.3	.3150	.3203	.2830	.2457	.2510
9	1.25	20.3	.3543	.3597	.3223	.2851	.2904
10	1.5	16.9	.3937	.4001	.3553	.3106	.3170
11	1.5	16.9	.4331	.4395	.3947	.3500	.3564
12	1.75	14.5	.4724	.4799	.4276	.3755	.3829
14	2.0	12.7	.5512	.5597	.5001	.4404	.4489
16	2.0	12.7	.6299	.6384	.5788	.5191	.5276
18	2.5	10.2	.7087	.7193	.6448	.5701	.5808
20	2.5	10.2	.7874	.7981	.7235	.6489	.6595
22	2.5	10.2	.8661	.8768	.8022	.7276	.7383
24	3.0	8.5	.9449	.9577	.8682	.7787	.7915
27	3.0	8.5	1.0630	1.0758	.9863	.8968	.9096
30	3.5	7.3	1.1811	1.1960	1.0916	.9872	1.0021
33	3.5	7.3	1.2992	1.3141	1.2097	1.1053	1.1202
36	4.0	6.3	1.4173	1.4344	1.3150	1.1957	1.2127
39	4.0	6.3	1.5354	1.5525	1.4331	1.3138	1.3308
42	4.5	5.6	1.6535	1.6727	1.5384	1.4042	1.4234
45	4.5	5.6	1.7716	1.7908	1.6565	1.5223	1.5415
48	5.0	5.1	1.8898	1.9111	1.7619	1.6127	1.6340
52	5.0	5.1	2.0472	2.0685	1.9193	1.7702	1.7915
56	5.5	4.6	2.2047	2.2282	2.0640	1.9000	1.9234
60	5.5	4.6	2.3622	2.3856	2.2215	2.0575	2.0809
64	6.0	4.2	2.5197	2.5453	2.3663	2.1872	2.2128
68	6.0	4.2	2.6772	2.7027	2.5238	2.3447	2.3703
72	6.5	3.9	2.8346	2.8623	2.6684	2.4745	2.5022
76	6.5	3.9	2.9921	3.0198	2.8259	2.6320	2.6597
80	7.0	3.6	3.1496	3.1794	2.9706	2.7618	2.7916
84	7.0	3.6	3.3071	3.3389	3.1281	2.9192	2.9491
88	7.5	3.4	3.4646	3.4965	3.2728	3.0490	3.0810
92	7.5	3.4	3.6220	3.6540	3.4303	3.2065	3.2385
96	8.0	3.2	3.7795	3.8136	3.5749	3.3363	3.3704
100	8.0	3.2	3.9370	3.9711	3.7324	3.4938	3.5279



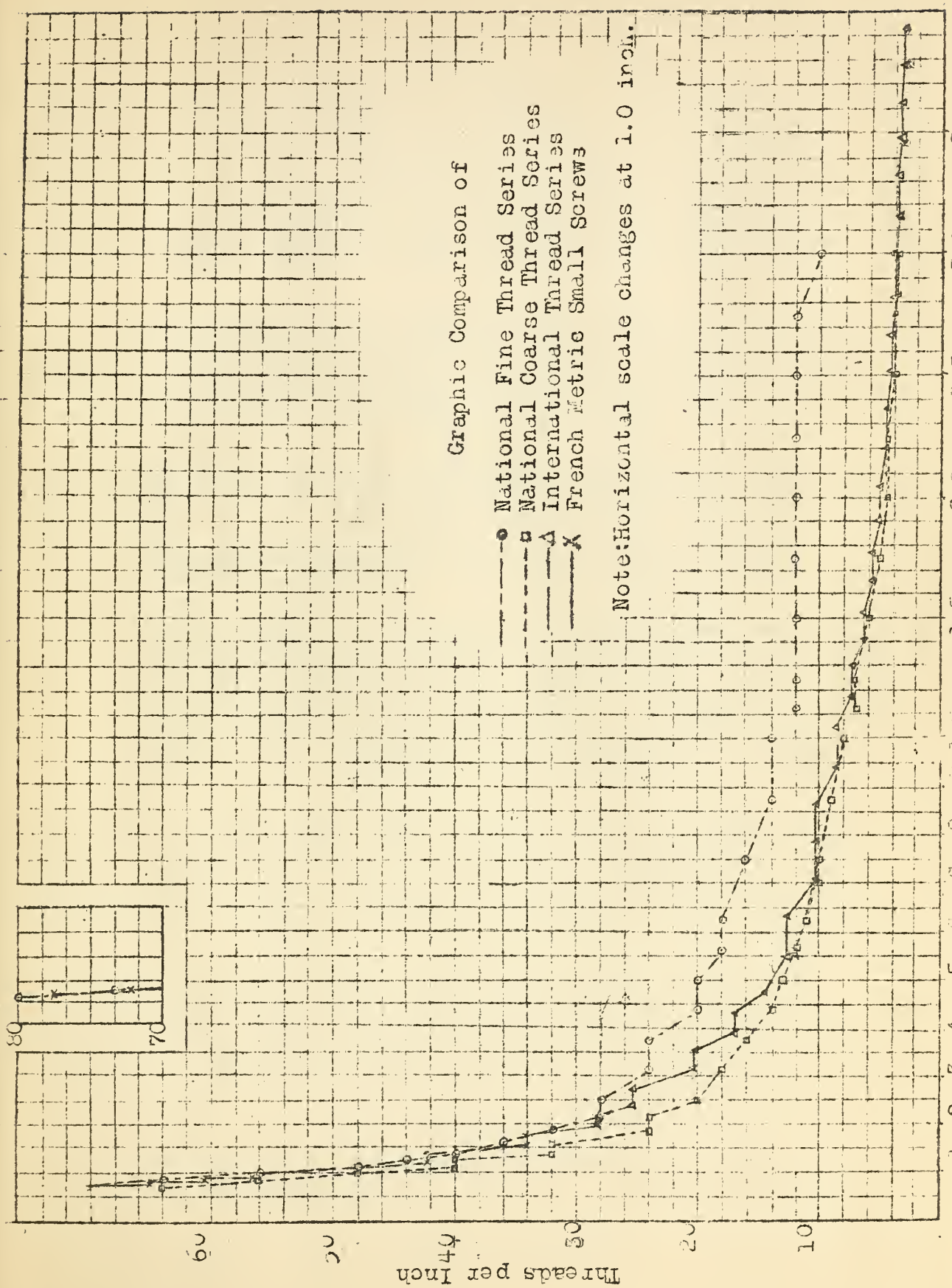

Graphic Comparison of
National Fine Thread Series
National Coarse Thread Series
International Thread Series
French Metric Small Screws
Note:Horizontal scale changes at 1.0 inch.
Threads per Inch
Nominal Diameter - Inches
80
70
60
50
40
30
20
10
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.5
2.0
2.5
3.0
3.5

Fig. 16

VII. SCREW THREAD STANDARDS IN USE IN FRANCE

The International form of thread (Fig. 13) is the standard form for screw threads used in France. The diameters and pitches of the International System are most widely used for those sizes which fall within the range of this series. The Societé d'Encouragement pour l'Industrie Nationale has supplemented the International series by introducing sizes between 12 mm and 40 mm so that the series advances by 1 mm steps throughout this range. The interpolated diameters have, in each case, the same pitch as the next larger diameter in the Congress of Zunich series. See Table 23.

A small machine screw series (Série de la Petite Mécanique) below the International series, from 2.5 to 5.5 mm inclusive, Tables 23 and 24, were added by the Societé d'Encouragement in 1906, and the small watchmakers' screws (Série Horlogère), Table 27, were standardized by the same body in 1909.

The various commercial interests recognize selected sizes, given in Table 23, of the International and Societe d'Encouragement series, with the following exceptions and additions:

1. The Etablissements Schneider et Cie add a size having a diameter of 106 mm and a pitch of 8.5 mm.

2. In the series of the Chambre Syndicale des Constructeurs d'Automobiles, the sizes 0.3 mm and 0.5 mm have the pitches 0.5 mm and 0.75 mm respectively, and are, therefore, not interchangeable with the corresponding sizes of the "Série de la Petite Mécanique". The same is true of the 5 mm size in the series of the Chambre Syndicale des Industries Aéronautiques.

There are also variations in practice as to the form of thread at crest and root. The Societé d'Encouragement does not specify a clearance at the major and minor diameters of screw and nut, and the Syndicale des Constructeurs d'Automobiles does not round the profile at the root. Neither of these modifications, however, prevent interchangeability with S. I. threads.

No tables of allowances and tolerances are available except those for the Aircraft Threads given in Tables 25 and 26. These tolerances were suggested by the British Engineering Standards Association at the request of the Naval and Military Air Service of Great Britain.

References:

Bulletin Soc. d'Encouragement l'Industrie Nationale, Sept.-Oct. 1919.

Table 26. - Standard Screw Threads in Use in France

1	2	3	4	5	6
Diameter					
(International) Congrès de Zurich	Société d'Encouragement pour l'Industrie nationale	Chemins de fer Français (Railroads)	Chambre Syndicale des Constructeurs d'Automobiles (Automobiles)	Chambre Syndicale des Industries Aéronautiques (Aircraft)	Etablissements Schneider et Cie. (Ordnance)
mm	mm	mm	mm	mm	mm
	2.5				
	3		3		
	3.5			3	
	4		4	4	
	4.5				
	5		5	5	
	5.5				
6	6	6	6	6	6
7	7		7		
8	8	8	8	8	8
9	9		9		
10	10	10	10	10	10
11	11			11	
12	12	12	12	12	12
	13				
14	14	14	14		14
	15				
16	16	16	16		16
	17				
18	18	18	18		18
	19				
20	20	20	20		20
	21				
22	22	22	22		22
	23				
24	24	24	24		24
	25				
	26		26		
27	27	27			27
	28		28		
	29				
30	30	30	30		30
	31				

7	1	2	3	6	7
	Diameter				
Pitch	(International) Congrès de Zurich	Société d'Encouragement pour l'Industrie nationale	Chemins de fer Français (Railroads)	Etablissements Schneider et Cie. (Ordnance)	Pitch
mm	mm	mm	mm	mm	mm
0.45		32			3.5
.5	33	33	33	33	3.5
.6		34			3.5
.6		35			3.5
.75	36	36	36	36	4
.75		37			4
.75		38			4
.9	39	39		39	4
.9		40			4
1.0	42	42		42	4.5
1.0	45	45		45	4.5
1.25	48	48		48	5
1.25	52	52		52	5
1.5	56	56		56	5.5
1.5	60	60		60	5.5
1.75	64	64		64	6
1.75	68	68		68	6
2	72	72		72	6.5
2	76	76		76	6.5
2	80	80		80	7
2	84	84		84	7
2.5	88	88		88	7.5
2.5	92	92		92	7.5
2.5	96	96		96	8
2.5	100	100		100	8
2.5				106	8.5
2.5					
3					
3					
3					
3					
3					
3					
3.5					
3.5					

Table 24. - Standard Small Screws in Use in France

1	2	3	4	5
Standard screws in use.			Screws superseded	
Name of series	Diameter	Pitch	Pitch	Remarks
	mm	mm	mm	
Watchmakers' screws	0.40	0.11		
	.45	.11		
	.50	.13		
	.55	.13		
	.60	.15		
	.65	.15		
	.70	.17		
	.75	.17		
	.80	.19		
	.85	.19		
	.90	.21		
	.95	.21		
Watchmakers' screws and small machine screws. Sizes common to both	1.00	.24	0.25	
	1.10	.24		
	1.20	.27		
	1.25		.25	Superseded pitches of small machine screws temporarily maintained for existing machines
	1.30	.27		
	1.40	.30		
	1.50	.30	.35	
	1.60	.33		
	1.70	.33		
	1.75		.35	
	1.80	.36		
	1.90	.36		
	2.00	.39	.45	
	2.10	.39		
	2.20	.42		
	2.30	.42		
	2.40	.45		
	2.50	.45		
Small machine screw. series	3.00	.60		
	3.50	.60		
	4.00	.75		
	4.50	.75		
	5.00	.90		
	5.50	.90		
	6.00	1.00		

This table is taken from the table issued by the Société d'Encouragement pour l'Industrie Nationale in the Bulletin of November-December, 1915.

Table 25. - French Metric Aircraft Threads

Screw Sizes

Nominal size	Major diameter			Pitch	Tolerance on pitch		Pitch diameter			Minor diameter	
	Max.	First grade Min.	Second grade Min.		First grade	Second grade	Max.	First grade Min.	Second grade Min.	1st or 2nd grade Min.	Max.
Mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
3	3.00	2.84	2.78	0.60	0.046	0.092	2.61	2.53	2.45	2.00	2.22
4	4.00	3.84	3.78	.75	.046	.092	3.51	3.43	3.35	2.80	3.02
5	5.00	4.84	4.78	.75	.046	.092	4.51	4.43	4.35	3.80	4.02
6	6.00	5.84	5.74	1.00	.046	.092	5.35	5.27	5.19	4.44	4.70
7	7.00	6.84	6.74	1.00	.046	.092	6.35	6.27	6.19	5.44	5.70
8	8.00	7.80	7.70	1.25	.058	.115	7.19	7.09	6.99	6.06	6.36
9	9.00	8.80	8.70	1.25	.058	.115	8.19	8.09	7.99	7.06	7.36
10	10.00	9.80	9.64	1.50	.058	.115	9.03	8.93	8.83	7.68	8.04
11	11.00	10.80	10.64	1.50	.058	.115	10.03	9.93	9.83	8.68	9.04
12	12.00	11.80	11.60	1.75	.058	.115	10.86	10.76	10.66	9.32	9.72

Tables 25 and 26 were prepared by the British Engineering Standards Committee upon request. The pitch of the 5 mm. screw given in these tables is 0.75 mm., whereas the pitch commonly used in France is 0.80 mm., as shown by Table 23.

Table 26. - French Metric Aircraft Threads

Sizes for Nuts and Tapped Holes

Nominal size	Major diameter		Pitch	Tolerance on pitch		Pitch diameter			Minor diameter		
	Max.	1st or 2nd Gr. Min.		First grade	Second grade	Min.	First grade Max.	Second grade Max.	Min.	First grade Max.	Second grade Max.
mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
3	3.24	3.02	0.60	0.046	0.092	2.63	2.71	2.79	2.24	2.40	2.46
4	4.24	4.02	.75	.046	.092	3.53	3.61	3.69	3.04	3.20	3.26
5	5.24	5.02	.75	.046	.092	4.53	4.61	4.69	4.04	4.20	4.26
6	6.28	6.02	1.00	.046	..092	5.37	5.45	5.53	4.72	4.88	4.98
7	7.28	7.02	1.00	.046	.092	6.37	6.45	6.53	5.72	5.88	5.98
8	8.32	8.02	1.25	.058	.115	7.21	7.31	7.41	6.38	6.58	6.68
9	9.32	9.02	1.25	.058	.115	8.21	8.31	8.41	7.38	7.58	7.68
10	10.38	10.02	1.50	.058	.115	9.05	9.15	9.25	8.06	8.26	8.42
11	11.38	11.02	1.50	.058	.115	10.05	10.15	10.25	9.06	9.26	9.42
12	12.42	12.02	1.75	.058	.115	10.88	10.98	11.08	9.74	9.9[illegible]	[illegible]

VIII. STANDARD DIMENSIONS OF BOLT HEADS, NUTS, AND SCREW HEADS IN USE IN FRANCE

The commercial practice in France as to dimensions of bolt heads, nuts, and screw heads, varies among the various industrial organizations. The standard practice of each organization is given separately for each element in tables, 27.to 32 inclusive. This information was taken from two numbers of the Bulletin of the Société d'Encouragement pour l'Industrie Nationale, September - October 1919, and April 1921. The wrench openings specified by the Congress of Zurich, all dimensions specified by L'Union des Syndicats d'Electricite, the depth of slot of circular heads, and the angle of countersunk heads were copied directly from tables published in the Bulletin. The remainder of the dimensions given in the tables herein were computed from the formulas published in the Bulletin.

1. Width Across Flats or Diameters of Bolt Heads, Nuts, and Screw Heads (Table 27)

Congress of Zurich. The Congress of Zurich did not fix the sizes of heads, as such, but specified a wrench opening for every diameter of the International Standard Series determined by the formula 1.4 D + 4 mm, in which D is the diameter of body in millimeters. These wrench openings thus determine the widths across flats of both hexagon and square heads and nuts.

Société d'Encouragement pour l'Industrie Nationale. For hexagon heads and nuts of the small machine screw series, a diameter across corners of 2 D is recommended, that is, 1.732 D is the width across flats. For circular heads a diameter of 2 D is recommended.

Etablissements Schneider et Cie. The widths across flats of hexagon and square heads, and hexagon nuts are the same as the wrench openings specified by the Congress of Zurich, that is, 1.4 D + 4mm. The diameters of circular heads are the same as the widths across flats of the corresponding hexagon heads.

Chambre Syndicale des Constructeurs d'Automobiles. The widths across flats of square and hexagon heads are determined by the width of a hexagon inscribed in a circle whose diameter is 2 D (that is, 1.732 D), in which D is the diameter of body of the next smaller size in the series. More than half of the sizes thus determined do not fit the wrench sizes specified by the Congress of Zurich.

The diameters of circular heads are not listed in Table 27, since they are permitted to vary from 1.8 D to 2 D for cylindrical and countersunk heads. Round heads are somewhat smaller.

The widths across flats of hexagon nuts is 1.732 D, D being the diameter of the body of the bolt. The nuts are, thus, larger than the corresponding bolt heads.

Union des Syndicats d'Electricite. For sizes from 2.5 to 7 mm the widths across flats for square and hexagon heads and nuts are equal to the diameter d' of the body four steps larger in the series. For sizes from 8 to 12 mm. the widths across flats are 1.4 d" + 4 mm., d" being the diameter of body of two steps smaller in the series. Thus the same widths across flats, or wrench openings are used as those specified by the Congress of Zurich, but are associated with different sizes of bolts or screws.

For circular heads, whether rounded, cylindrical, or countersunk, the diameters are equal to the diameter d' of the bolt four steps larger in the series. The diameters of circular heads agree, therefore, with those of the body diameters of bolts and screws, thus reducing the necessary number of sizes of bar stock.

2. Height of Bolt and Screw Heads and Thickness of Nuts (Tables 28 and 29)

Congress of Zurich. The Congress of Zurich recommended a height of 0.7 D for square and hexagon bolt and screw heads, and a thickness equal to D for nuts, D being the major diameter of the thread.

Société d'Encouragement pour l'Industrie Nationale. The height of heads, whether hexagonal or circular, and also the thickness of nuts, is equal to the diameter of thread, D.

Etablissements Schneider et Cie. The height of hexagonal or cylindrical heads is approximately 0.7 D. Two different thicknesses of nuts are provided, - thick nuts whose thickness is equal to D, and lock nuts of a thickness equal to 0.7 D.

ChambreSyndicale des Constructeurs d'Automobiles. The heights of heads approved by this association vary considerably. For hexagonal or square heads, the height is about 2/3 D. The thicknesses of nuts are equal to D, and of lock-nuts, 2/3 D.

L'Union des Syndicats d'Electricite. The heights of heads for corresponding sizes are the same for hexagonal, cylindrical, and rounded forms, and are equal to 0.7 D. The height of the conical portion of a countersunk head is determined by the cone-angle, 84°, and the diameter of the head. It is equal to 1.555 times the difference between the diameters of the head and body.

A cylindrical portion surmounts the cone, its height being equal to one-half the pitch of the thread. The total height of the flat countersunk head is equal to the sum of the heights of these two portions. If the head is convex, the height of the rounded portion is added to this height.

Two thicknesses of nuts are provided, both of which apply to either square or hexagonal nuts. For thick nuts, the thickness is equal to the diameter of body, D, two steps smaller in the series. The thickness of thin nuts is equal to 2/3 that of the thick nuts.

3. Dimensions of Slots in Screw Heads (Table 30)

Neither the Congress of Zurich nor the Société d'Encouragement have specified the dimensions of slots in circular screw heads.

Etablissements Schneider et Cie. The width of slot is specified for screws from 6 mm to 18 mm in diameter. The depth of slot varies for different types of head between the limits indicated in Table 30.

Chambre Syndicale des Constructeurs d'Automobiles. The width of slot is specified for screws from 3 mm to 30 mm in diameter. The depth of slot varies for different types of head between the limits indicated in Table 30.

Union des Syndicats d'Electricite. The width of slot is the same for corresponding sizes of all forms of heads. The depth of slot is the same for cylindrical and rounded heads, and is equal to 1/3 the height of the head. For countersunk heads the depth of slot is equal to 1/2 the total height of head.

4. Length Below Head and Length of Threaded Portion of Bolts and Screws (Tables 31 and 32)

Etablissements Schneider et Cie. There are twenty-nine lengths of bolts, studs, and screws listed in Column 1 of Table 31, which are obtained by adding to the minimum length of 10 mm the successive increments listed in Column 3, which are also used in determining threaded lengths.

The length of threading is such that if the screw, stud, or bolt were cut down to the next shorter length in the series, the threaded part would still remain long enough to take a nut. The formula applied is

$$F = D + 3R/2,$$

in which F = length of threaded part,
D = diameter of thread,
and R = difference in length between the bolt and the next shorter one in the series.

When the threaded part must also carry a locknut, the threaded length is increased by the thickness of the locknut and becomes,

$$F' = F + 0.7\ D = 1.7\ D + 3R/2.$$

Chambre Syndicale des Constructeurs d'Automobiles. The total lengths below heads are graduated as follows:

by 5 mm steps between 10 mm and 100 mm,
" 10 " " " 100 " " 200 " ,
" 50 " " " 200 " " 300 " .

Thus there are 30 different lengths from 10 mm to 300 mm.

Threads to take nut and locknut have a length equal to 2 d, and for nut and washer equal to 1.5 d, d being the diameter of the next smaller (in diameter) bolt in the series. For sizes up to and including 12 mm this length is increased by 2 mm. This is not sufficient, in all cases, to permit a bolt cut down to the next shorter length to take a nut.

Union des Syndicats d'Electricite. The minimum lengths below head for each diameter of screw are given in Table 32. The series of lengths above these minima corresponds to the series obtained by adding successively and cumulatively to the base 4 mm the natural series of numbers 1, 2, 3, 4, 5, etc. giving the lengths given in Column 7, Table 31. These values serve only as a suggestion and are those recognized by Etablissements Schneider et Cie, and Chemins de fer Francais.

5. Angles of Countersunk Heads.

The Congress of Zurich made no recommendation in regard to the cone angle of countersunk heads. The angles specified by other organizations are as follows:

Société d'Encouragement,	84 degrees,
Schneider et Cie,	84 " ,
Constructeurs d'Automobiles,	90 " ,
Syndicats d'Electricite,	84 " .

References:

Bulletin Société d'Encouragement pour l'Industrie Nationale, September-October 1919, and April 1921.

Table 37. - Widths Across Flats and Diameters of Bolt Heads, Screw Heads, and Nuts in Use in France

1	2	3	4	5	6	7	8	9	10
Diameter of body and major diameter of thread		Congress of Zurich		Societe d'Encouragement pour l'Industrie Nationale				Etablissements Schneider et Cie.	
		Wrench opening		Hexagon heads, width across flats		Circular heads, diameter		Hexagon or circular heads and nuts, width or diameter	
D		1.4D+4mm	1.4D+.157in.	1.732D		2D		1.4D+4mm	1.4D+.157
mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches
2.5	0.098			4	0.157	5	0.197		
3	.118			5	.197	6	.236		
3.5	.138			6	.236	7	.276		
4	.157			7	.276	8	.315		
4.5	.177			8	.315	9	.354		
5	.197			9	.354	10	.394		
5.5	.217			10	.394	11	.433		
6	.236	12	0.472					12	0.472
7	.276	13	.512						
8	.315	15	.591					15	.591
9	.354	16	.630						
10	.394	18	.709					18	.709
11	.433	19	.748						
12	.472	21	.827					21	.827
14	.551	23	.906					23	.906
16	.630	26	1.024					26	1.024
18	.709	29	1.142					29	1.142
20	.787	32	1.260					32	1.260
22	.866	35	1.378					35	1.378
24	.945	38	1.496					38	1.496
26	1.024								
27	1.063	42	1.654						
28	1.102							42	1.654
30	1.181	46	1.811						
33	1.299	50	1.968					46	1.811
36	1.417	54	2.126					50	1.968
39	1.535	58	2.283					54	2.126
42	1.654	63	2.480					58	2.283
45	1.772	67	2.638					63	2.480
48	1.890	71	2.795					67	2.638
52	2.047	77	3.031					71	2.795
56	2.205	82	3.228					77	3.031
60	2.362	88	3.465					82	3.228
64	2.520	94	3.701					88	3.465
68	2.677	100	3.937					94	3.701
72	2.835	105	4.134					100	3.937
76	2.992	110	4.331					105	4.134
80	3.150	116	4.567					110	4.331
84	3.307	122	4.803					116	4.567
88	3.465	127	5.000					122	4.803
								127	5.000
92	3.622	133	5.236					133	5.236
96	3.780	138	5.433					138	5.433
100	3.937	144	5.669					144	5.669
106	4.173							152	5.984

11	12	13	14	15	16	17	18
Chambre Syndicale des Constructeurs d'Automobiles				L'Union des Syndicats d'Electricite			
Square and hexagon heads, widths across flats		Hexagon nuts, width across flats		Square and hexagon heads and nuts, width across flats		Circular heads, diameter	
1.732D*		1.732D					
mm	Inches	mm	Inches	mm	Inches	mm	Inches
				4.5	0.177	4.5	0.177
4	0.157	5	0.197	5	.197	5	.197
				5.5	.217	5.5	.217
5	.197	7	.276	6	.236	6	.236
				7	.276	7	.276
7	.276	9	.354	8	.315	8	.315
				9	.354	9	.354
9	.354	10	.394	10	.394	10	.394
10	.394	12	.472	11	.433	11	.433
12	.472	14	.551	12	.472	12	.472
14	.551	16	.630	13	.512	14	.551
16	.630	17	.669	15	.591	16	.630
				16	.630	18	.709
19	.748	21	.827	18	.709	20	.787
21	.827	24	.945				
24	.945	28	1.102				
28	1.102	31	1.220				
31	1.220	35	1.358				
35	1.358	38	1.496				
38	1.496	42	1.654				
42	1.654	45	1.772				
45	1.772	48	1.890				
48	1.890	52	2.047				
52	2.047	57	2.244				
57	2.244	62	2.441				
62	2.441	68	2.677				
68	2.677	73	2.874				
73	2.874	78	3.071				
78	3.071	83	3.268				
83	3.268	90	3.543				
90	3.543	97	3.819				
97	3.819	104	4.094				
104	4.094	111	4.370				
111	4.370	118	4.646				
118	4.646	125	4.921				
125	4.921	132	5.197				
132	5.197	139	5.472				
139	5.472	145	5.709				
145	5.709	152	5.984				
152	5.984	159	6.260				
159	6.260	166	6.535				
166	6.535	173	6.811				

* D in columns 11 and 12 is the diameter of body of the next smaller size.

Table 28. - Heights of Bolt and Screw Heads in Use in France

D = diameter of body
H = diameter of head
p = pitch of thread.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Diameter of body and major diameter of thread		Congress of Zurich		Société d'Encouragement pour l'Industrie Nationale		Etablissement Schneider et Cie.		Chambre Syndicale des Constructeurs d'Automobiles		L'Union des Syndicats d'Electricité							
		Height of heads								Height of hex-agon, cylindrical, and round heads		Countersunk heads					
												Height of conical part		Height of cylindrical part		Total height	
D		0.7D		D		0.7D		2D/3		0.7D		1.535(H - D)		p/3			
mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches
2.5	0.098			2.5	0.098					2	0.079	1.11	0.044	0.2	0.008	1.31	0.052
3	.118			3	.118			2	0.079	2	.079	1.11	.044	.3	.012	1.41	.056
3.5	.138			3.5	.138					2.5	.098	1.11	.044	.3	.012	1.41	.056
4	.157			4	.157			2.5	.095	3	.118	1.11	.044	.4	.016	1.51	.059
4.5	.177			4.5	.177					3	.118	1.39	.055	.4	.016	1.79	.070
5	.197			5	.197			3.5	.138	3.5	.138	1.65	.065	.5	.020	2.16	.085
5.5	.217			5.5	.217					4	.157	1.94	.078	.5	.020	2.44	.096
6	.236	4	0.157			4	0.157	4	.157	4.5	.177	2.22	.087	.5	.020	2.72	.107
7	.276	5	.197					4.5	.177	5	.197	2.22	.087	.5	.020	2.72	.107
8	.315	5.5	.217			5.5	.217	5.5	.217	5.5	.217	2.22	.087	.6	.024	2.82	.111
9	.354	6.5	.258					6	.236	6.5	.256	2.77	.109	.6	.024	3.37	.133
10	.394	7	.276			7	.276	6.5	.256	7	.276	3.33	.131	.6	.031	4.13	.163
11	.433	7.5	.295							7.5	.295	3.88	.153	.8	.031	4.68	.184
12	.472	8.5	.335			8.5	.335	8	.315	8.5	.335	4.44	.175	.9	.035	5.34	.210
14	.551	10	.394			10	.394	9.5	.374								
16	.630	11	.433			11	.433	10.5	.413								
18	.709	12.5	.492			12.5	.492	12	.472								
20	.787	14	.551			14	.551	13.5	.531								
22	.866	15.5	.610			15.5	.610	14.5	.571								
24	.945	17	.669			17	.669	16	.630								
26	1.024							17.5	.689								
27	1.063	19	.748			19	.748										
28	1.102							18.5	.728								
30	1.181	21	.827			21	.827	20	.787								
33	1.299	23	.906			23	.906	22	.866								
36	1.417	25	.984			25	.984	24	.945								
39	1.535	27.5	1.083			27.5	1.083	26	1.024								
42	1.654	29.5	1.161			29.5	1.161	28	1.102								
45	1.772	31.5	1.240			31.5	1.240	30	1.181								
48	1.890	33.5	1.319			33.5	1.319	32	1.260								
52	2.047	36.5	1.437			36.5	1.437	34.5	1.358								
56	2.205	39	1.555			39	1.555	37.5	1.476								
60	2.362	42	1.673			42	1.673	40	1.575								
64	2.520	45	1.791			45	1.791	42.5	1.673								
68	2.677	47.5	1.870			47.5	1.870	45.5	1.791								
72	2.835	50.5	1.988			50.5	1.988	48	1.890								
76	2.992	53	2.087			53	2.087	50.5	1.988								
80	3.150	56	2.205			56	2.205	53.5	2.106								
84	3.307	59	2.323			59	2.323	56	2.205								
88	3.465	61.5	2.421			61.5	2.421	58.5	2.303								
92	3.622	64.5	2.539			64.5	2.539	61.5	2.421								
96	3.780	67	2.638			67	2.638	64	2.539								
100	3.937	70	2.756			70	2.756	65.5	2.579								
106	4.173					74	2.913										

Table 29. - Thicknesses of Nuts in Use in France

1	2	3	4	5	6	7	8	9	10
Diameter of body and major diameter of thread		Congress of Zurich		Société d'Encouragement pour l'Industrie Nation.		Etablissement Schneider et Cie.			
		Thickness of nuts		Thickness of nuts		Thickness of nuts		Thickness of lock-nuts	
D		D		D		D		0.7D	
mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches
2.5	0.098			2.5	0.098				
3	.118			3	.118				
3.5	.138			3.5	.138				
4	.157			4	.157				
4.5	.177			4.5	.177				
5	.197			5	.197				
5.5	.217			5.5	.217				
6	.236	6	.236			6	0.236	4	0.157
7	.276	7	.276						
8	.315	8	.315			8	.315	5.5	.217
9	.354	9	.354						
10	.394	10	.394			10	.394	7	.276
11	.433	11	.433						
12	.472	12	.472			12	.472	8.5	.335
14	.551	14	.551			14	.551	10	.394
16	.630	16	.630			16	.630	11	.433
18	.709	18	.709			18	.709	12.5	.492
20	.787	20	.787			20	.787	14	.551
22	.866	22	.866			22	.866	15.5	.610
24	.945	24	.945			24	.945	17	.669
26	1.024								
27	1.063	27	1.063			27	1.063	19	.748
28	1.102								
30	1.181	30	1.181			30	1.181	21	.827
33	1.299	33	1.299			33	1.299	23	.906
36	1.417	36	1.417			36	1.417	25	.984
39	1.535	39	1.535			39	1.535	27.5	1.083
42	1.654	42	1.654			42	1.654	29.5	1.161
45	1.772	45	1.772			45	1.772	31.5	1.240
48	1.890	48	1.890			48	1.890	33.5	1.319
52	2.047	52	2.047			52	2.047	36.5	1.437
56	2.205	55	2.205			56	2.205	39	1.555
60	2.362	60	2.362			60	2.362	42	1.673
64	2.520	64	2.520			64	2.520	45	1.791
68	2.677	68	2.677			68	2.677	47.5	1.870
72	2.835	72	2.835			72	2.835	50.5	1.988
76	2.992	76	2.992			76	2.992	53	2.087
80	3.150	80	3.150			80	3.150	56	2.205
84	3.307	84	3.307			84	3.307	59	2.323
88	3.465	88	3.465			88	3.465	61.5	2.421
92	3.622	92	3.622			92	3.622	64.5	2.539
96	3.780	96	3.780			96	3.780	67	2.638
100	3.937	100	3.937			100	3.937	70	2.756
106	4.173					106	4.173	74	2.913

11	12	13	14	15	16	17	18
Chambre Syndicale des Constructeurs d'Automobiles				L'Union des Syndicats d'Electricite			
Thickness of nuts		Thickness of nuts		Thickness of thick nuts		Thickness of thin nuts	
D		2D/3					
mm	Inches	mm	Inches	mm	Inches	mm	Inches
				2	0.079	1	0.039
3	0.118	2	0.079	2	.079	1	.039
				2.5	.098	1.5	.059
4	.157	2.5	.098	3	.118	2	.079
				3.5	.138	2.5	.098
5	.197	3.5	.138	4	.157	2.5	.098
				4.5	.177	3	.118
6	.236	4	.157	5	.197	3.5	.138
7	.276	4.5	.177	5.5	.217	3.5	.138
8	.315	5.5	.217	6	.236	4	.157
9	.354	6	.236	7	.275	4.5	.177
10	.394	6.5	.256	8	.315	5.5	.217
				9	.354	6	.236
12	.472	8	.315	10	.394	6.5	.256
14	.551	9.5	.374				
16	.630	10.5	.413				
18	.709	12	.473				
20	.787	13.5	.531				
22	.866	14.5	.571				
24	.945	16	.630				
26	1.024	17.5	.689				
28	1.102	18.5	.728				
30	1.181	20	.787				
33	1.299	22	.866				
36	1.417	24	.945				
39	1.535	26	1.024				
42	1.654	28	1.102				
45	1.772	30	1.181				
48	1.890	32	1.260				
52	2.047	34.5	1.358				
56	2.205	37.5	1.476				
60	2.362	40	1.575				
64	2.520	42.5	1.673				
68	2.677	45.5	1.791				
72	2.835	48	1.890				
76	2.992	50.5	1.988				
80	3.150	53.5	2.106				
84	3.307	56	2.205				
88	3.465	58.5	2.303				
92	3.622	61.5	2.421				
96	3.780	64	2.539				
100	3.937	65.5	2.579				

Table 30. - Dimensions of Slots in Screw Heads in Use in France

1	2	3	4	5	6	7	8	9	10	11	12
Diameter of body and major diameter of thread		Etablissements Schneider et Cie.		Chambre Syndicale des Constructeurs d'Automobiles		L'Union des Syndicats d'Electricite					
						Width of slot		Depth of slot			
		Width of slot						Cylindrical and rounded heads		Countersunk heads	
mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches
2.5	0.098					0.7	0.028	0.7	0.028	0.7	0.028
3	.118			1	0.039	0.7	.028	.7	.028	.7	.028
3.5	.138					.7	.028	.8	.031	.7	.028
4	.157			1	.039	.7	.028	1.0	.039	.7	.028
4.5	.177					.7	.028	1.0	.039	.9	.035
5	.197			1	.039	1.2	.047	1.2	.047	1.1	.043
5.5	.217					1.2	.047	1.3	.051	1.2	.047
6	.236	2	0.079	1	.039	1.2	.047	1.5	.059	1.4	.055
7	.276			1	.039	1.2	.047	1.7	.067	1.4	.055
8	.315	2.5	.098	1.5	.059	1.2	.047	1.8	.071	1.4	.055
9	.354			2	.079	2	.079	2.2	.087	1.7	.067
10	.394	2.5	.098	2	.079	2	.079	2.3	.091	2	.079
11	.433					2	.079	2.5	.098	2.3	.091
12	.472	2.5	.098	2	.079	2	.079	2.8	.110	2.7	.106
14	.551	2.5	.098	2.5	.098						
16	.630	2.5	.098	3	.118						
18	.709	2.5	.098	3.5	.138						
20	.787			4	.157						
22	.866			4.5	.177						
24	.945			5	.197						
26	1.024			5.5	.217						
28	1.102			5.5	.217						
30	1.181			6	.236						

1	3		4	5	6	7
Shape of head	Etablissements Schneider et Cie.		Chambre Syndicale des Constructeurs d'Automobiles			
	Depth of slot		Major dia. of thread		Depth of slot	
	mm	Inches	mm	Inches	mm	Inches
Cylindrical	2.5to4.0	.10to.16	20to30	.79to1.18	1to2.5	.04to.10
Rounded	2.5to4.0	.10to.16				
Countersunk flat	1.5to4.5	.06to.18	6to30	.24to1.18	1.5to8	.06to.31
" convex	2.5to7.0	.10to.28	20to30	.79to1.18	1to2.5	.04to.10

Table 51. - Lengths below Head of Bolts and Screws in Use in France

1	2	3	4	5	6	7	8
Etablissements Schneider et Cie.				Chambre Syndicale des Constructeurs d'Automobiles		L'Union des Syndicats d'Electricite	
Length below head		Series increments		Length below head		Length below head	
mm	Inches	mm	Inches	mm	Inches	mm	Inches
						4	0.16
						5	.20
						7	.28
10	0.39			10	0.39	10	.39
14	.55	4	0.16	15	.59	14	.55
19	.75	5	.20	20	.79	19	.75
25	.98	6	.24	25	.98	25	.98
32	1.26	7	.28	30	1.18	32	1.26
40	1.57	8	.31	35	1.38	40	1.57
49	1.93	9	.35	40	1.57	49	1.93
59	2.32	10	.39	45	1.77	59	2.32
70	2.76	11	.43	50	1.97	70	2.76
82	3.23	12	.47	55	2.17	82	3.23
95	3.74	13	.51	60	2.36	95	3.74
109	4.29	14	.55	65	2.56	109	4.29
124	4.88	15	.59	70	2.76	124	4.88
140	5.51	16	.63	75	2.95	140	5.51
157	6.18	17	.67	80	3.15	157	6.18
175	6.89	18	.71	85	3.35	175	6.89
194	7.64	19	.75	90	3.54	194	7.64
214	8.43	20	.79	95	3.74	214	8.43
235	9.25	21	.83	100	3.94	235	9.25
257	10.12	22	.87	110	4.33	257	10.12
280	11.02	23	.91	120	4.72	280	11.02
304	11.97	24	.94	130	5.12	304	11.97
329	12.95	25	.98	140	5.51	329	12.95
355	13.98	26	1.02	150	5.91	355	13.98
382	15.04	27	1.06	160	6.30	382	15.04
410	16.14	28	1.10	170	6.70	410	16.14
439	17.28	29	1.14	180	7.09	439	17.28
469	18.46	30	1.18	190	7.48	469	18.46
500	19.68	31	1.22	200	7.87	500	19.68
				250	9.84		
				300	11.81		

Table 32. - Minimum Length Below Head, L'Union des Syndicats d'Electricite

1	2	3	4
Major diameter of thread		Minimum length below head	
mm	Inches	mm	Inches
2.5	0.098	4	0.16
3	.118	4	.16
3.5	.138	4	.16
4	.157	5	.20
4.5	.177	5	.20
5	.197	7	.28
5.5	.217	7	.28
6	.236	10	.39
7	.276	10	.39
8	.315	14	.55
9	.354	14	.55
10	.394	19	.75
11	.433	19	.75
12	.472	19	.75

IX. The Loewenherz Screw Thread System and Standard Instrument and Machine Screws

The Verein Deutscher Ingenieure in 1888 adopted a system of metric screw threads for sizes from 6 mm to 40 mm diameter inclusive. The thread form selected, shown in Fig. 17, has an angle of 53° 8' and is flattened at top and bottom 1/8th the height of the basic triangle. The angle 53° 8' gives a triangle whose height is equal to its base, therefore, the depth of thread is 3/4 of the pitch.

In December 1892 a commission representing German instrument makers, technical socities, and government departments, adopted a system of threads ranging in diameter from 1 mm to 10 mm, and especially intended for use in small machines and instruments. The same form of thread is employed as in the earlier system and the overlapping sizes 6 mm to 10 mm are identical. The system was called the Loewenherz System after Dr. Leopold Loewenherz, at one time Director of the Physicalisch-Technische Reichsanstalt. The dimensions of the Loewenherz Screw Thread System are given in Table 33.

At the same time standard proportions for instrument and machine screws for sizes from 1.0 to 10.0 mm were adopted by the commission, which are given in Table 34.

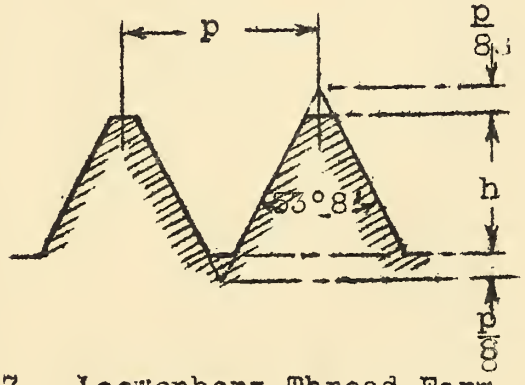


Fig. 17 - Loewenherz Thread Form

References:

Zeitschrift Verein Deutcher Ingeneure, 1888.
Zeitschrift für Instrumentkunde, February 1893, pages 41-58; June 1893, pages 246-249; and August 1894, pages 285-291.

Table 33. - Lowenherz Screw Thread System

Major diameter		Pitch	Approx. threads per inch	Pitch diameter	Minor diameter
mm	Inches	mm		Inches	Inches
1.	0.0394	0.25	102.	0.0320	0.0246
1.2	.0472	.25	102.	.0399	.0325
1.4	.0551	.3	84.6	.0462	.0374
1.7	.0669	.35	72.6	.0566	.0463
2.	.0787	.4	63.5	.0669	.0551
2.3	.0906	.4	63.5	.0787	.0669
2.6	.1024	.45	56.4	.0891	.0758
3.	.1181	.5	50.8	.1033	.0886
3.5	.1378	.6	42.3	.1201	.1024
4.0	.1575	.7	36.3	.1368	.1161
4.5	.1772	.75	33.9	.1550	.1329
5.	.1969	.8	31.7	.1732	.1496
5.5	.2165	.9	28.2	.1900	.1634
6.	.2362	1.0	25.4	.2067	.1772
7.	.2756	1.1	23.1	.2431	.2106
8.	.3150	1.2	21.2	.2795	.2441
9.	.3543	1.3	19.5	.3159	.2776
10.	.3937	1.4	18.1	.3524	.3110
12.	.4724	1.6	15.9	.4251	.3779
14.	.5512	1.8	14.1	.4980	.4449
16.	.6299	2.0	12.7	.5708	.5118
18.	.7087	2.2	11.5	.6437	.5787
20.	.7874	2.4	10.6	.7615	.6457
22.	.8661	2.8	9.1	.7835	.7008
24.	.9449	2.8	9.1	.8622	.7795
26.	1.0236	3.2	7.9	.9291	.8346
28.	1.1024	3.2	7.9	1.0079	.9134
30.	1.1811	3.6	7.1	1.0748	.9685
32.	1.2598	3.6	7.1	1.1535	1.0472
36.	1.4173	4.0	6.3	1.2992	1.1811
40.	1.5748	4.4	5.8	1.4449	1.3150

Table 34. - Loewenherz Standard Instrument and Machine Screws

1	2	3	4	5	6	7	8	9	10	11
Diameter of body		Pitch	Length of threaded portion		Diameter of cylindrical head		Diameter of countersunk head		Height of slotted head	
d		p	$L = 3d + 1$		$D = \frac{5d + 1}{5}$		$D_y = 3d$		$h_s = 0.6D$	
mm	Inches	mm	mm	Inches	mm	Inches	mm	Inches	mm	Inches
1.0	0.039	0.25	4	0.157	2.0	0.079	2.0	0.079	1.2	0.047
1.2	.047	.25	5	.197	2.3	.091	2.4	.094	1.4	.055
1.4	.055	.30	5	.197	2.7	.106	3.8	.110	1.6	.063
1.7	.067	.35	6	.236	3.2	.126	3.4	.134	1.9	.075
2.0	.079	.40	7	.276	3.7	.146	4.0	.157	2.2	.087
2.3	.091	.40	8	.315	4.2	.165	4.6	.181	2.5	.098
2.6	.102	.45	9	.354	4.7	.185	5.2	.205	2.8	.110
3.0	.118	.50	10	.394	5.3	.209	6	.236	3.2	.126
3.5	.138	.60	11	.433	6.0	.236	7	.276	3.7	.146
4.0	.157	.70	13	.512	7.0	.276	8	.315	4.2	.165
4.5	.177	.75	14	.551	8.0	.315	9	.354	4.7	.185
5.0	.197	.8	16	.630	8.5	.335	10	.394	5.2	.205
5.5	.217	.9	17	.669	9.5	.374	11	.433	5.7	.224
6	.236	1.0	19	.748	10.5	.413	12	.472	6.2	.244
7	.276	1.1	22	.866	12.0	.472	14	.551	7.2	.283
8	.315	1.2	25	.984	13.5	.532	16	.630	8.2	.323
9	.354	1.3	28	1.102	15.5	.610	18	.709	9.2	.362
10	.394	1.4	31	1.220	17.0	.669	20	.787	10.2	.402

12	13	14	15	16	17	18	19
Dimensions of slot, slotted head				Capstan head			
Width of slot		Depth of slot		Height of capstan head		Diameter of hole	
$b = 0.1d + 0.2$		$t = 0.5d + 0.3$		$h_c = 0.8D$		$c = 0.85d + 0.4b$	
mm	Inches	mm	Inches	mm	Inches	mm	Inches
0.3	0.012	0.8	0.031	1.6	0.063	0.8	0.031
.3	.012	.9	.036	1.9	.075	.9	.035
.3	.012	1.0	.039	2.2	.087	.9	.035
.4	.016	1.1	.043	2.6	.102	1.0	.039
.4	.016	1.3	.051	3.0	.118	1.1	.043
.4	.016	1.4	.055	3.4	.134	1.3	.051
.5	.020	1.6	.063	3.8	.150	1.4	.055
.5	.020	1.8	.071	4.3	.169	1.5	.059
.6	.024	2.0	.079	5.0	.197	1.7	.067
.6	.024	2.3	.091	5.6	.220	1.8	.071
.7	.028	2.5	.098	6.3	.248	2.0	.079
.7	.028	2.8	.110	7.0	.276	2.2	.087
.8	.031	3.0	.118	7.6	.299	2.4	.094
.8	.031	3.3	.130	8.3	.327	2.5	.098
.9	.035	3.8	.150	9.6	.378	2.9	.114
1.0	.039	4.3	.169	11.0	.433	3.2	.126
1.1	.043	4.8	.189	12.3	.484	3.6	.142
1.2	.047	5.3	.209	13.8	.535	4.0	.157

The diameter of cylindrical head, D, is rounded off to the next half or whole millimeter when d is greater than 3 mm.

Countersunk heads have an included angle of 90° and are finished on the top of the head with a spherical surface of radius 2d, or with a cylindrical projection of height equal to 0.4d.

Length of unthreaded portion varies in all gradations from 0.5d to 1.0d.