TAPS AND THREADING DIES

General dimensions and tap markings given in the ASME/ANSI Standard B94.9-1987 for straight fluted taps, spiral pointed taps, spiral pointed only taps, spiral fluted taps, fast spiral fluted taps, thread forming taps, pulley taps, nut taps, and pipe taps are shown in the tables on the pages that follow. This Standard also gives the thread limits for taps with cut threads and ground threads. The thread limits for cut thread and ground thread taps for screw threads are given in Tables 3 through 7 and Tables 8a and 8b; thread limits for cut thread and ground thread taps for pipe threads are given in Tables 9a through 10c. Taps recommended for various classes of Unified screw threads are given in Tables 11a through 14 in numbered sizes and Table 12 for nuts in fractional sizes.

Types of Taps.—Taps included in ASME/ANSI B94.9-1987 are categorized either by the style of fluting or by the specific application for which the taps are designed. The following types 1 through 6 are generally short in length, and were originally called "Hand Taps" but this design is generally used in machine applications. The remaining types have special lengths, which are detailed in the tables.

The thread size specifications for these types may be fractional or machine screw inch sizes, or metric sizes. The thread form may be ground or cut (unground) as further defined in each table. Additionally, the cutting chamfer on the thread may be Bottoming (B), Plug (P), or Taper (T).

(1) Straight Flute Taps: These taps have straight flutes of a number specified as either standard or optional, and are for general purpose applications.

(2) Spiral Pointed Taps: These taps have straight flutes and the cutting face of the first few threads is ground at an angle to force the chips ahead and prevent clogging in the flutes.

(3) Spiral Pointed Only Taps: These taps are made with the spiral point feature only without longitudinal flutes. These taps are especially suitable for tapping thin materials.

(4) Spiral Fluted Taps: These taps have right-hand helical flutes with a helix angle of 25 to 35 deg. These features are designed to help draw chips from the hole or to bridge a keyway.

(5) Fast Spiral Fluted Taps: These taps are similar to spiral fluted taps, except the helix angle is from 45 to 60 deg.

(6) Thread Forming Taps: These taps are fluteless except as optionally designed with one or more lubricating grooves. The thread form on the tap is lobed, so that there are a finite number of points contacting the work thread form. The tap does not cut, but forms the thread by extrusion.

(7) Pulley Taps: These taps have shanks that are extended in length by a standard amount for use where added reach is required. The shank is the same nominal diameter as the thread.

(8) Nut Taps: These taps are designed for tapping nuts on a low-production basis. Approximately one-half to three-quarters of the threaded portion has a chamfered section, which distributes the cutting over many teeth and facilitates entering the hole to be tapped. The length overall, the length of the thread, and the length of the shank are appreciably longer than on a regular straight fluted tap.

(9) Pipe Taps: These taps are used to produce standard straight or tapered pipe threads.

Definitions of Tap Terms.—The definitions that follow are taken from ANSI/ASME B94.9 but include only the more important terms. Some tap terms are the same as screw thread terms; therefore, see *Definitions of Screw Threads* starting on page 1707.

Back Taper: A gradual decrease in the diameter of the thread form on a tap from the chamfered end of the land toward the back, which creates a slight radial relief in the threads.

Base of Thread: Coincides with the cylindrical or conical surface from which the thread projects.

Chamfer: Tapering of the threads at the front end of each land or chaser of a tap by cutting away and relieving the crest of the first few teeth to distribute the cutting action over several teeth.

Chamfer Angle: Angle formed between the chamfer and the axis of the tap measured in an axial plane at the cutting edge.

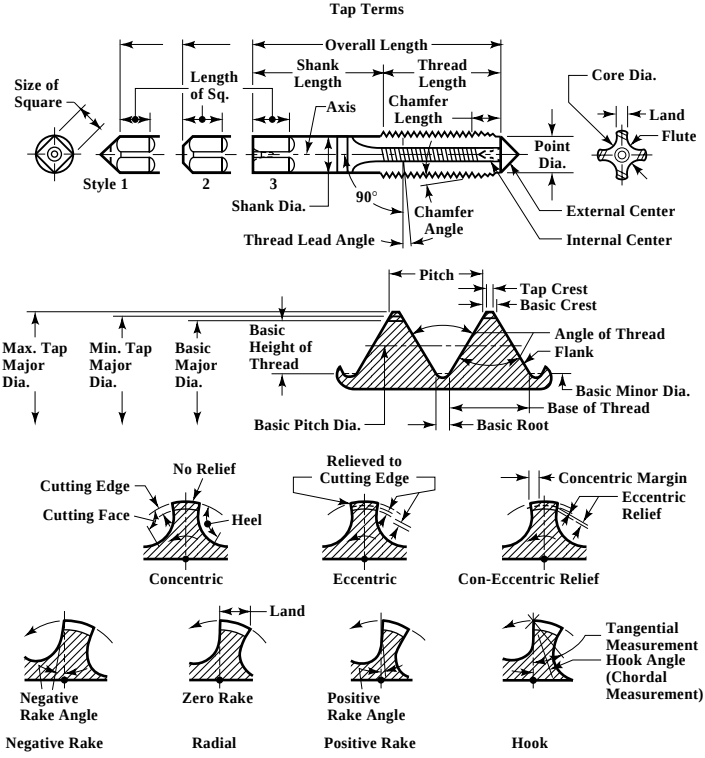
Chamfer Relief Angle: Complement of the angle formed between a tangent to the relieved surface at the cutting edge and a radial line to the same point on the cutting edge.

Core Diameter: Diameter of a circle which is tangent to the bottom of the flutes at a given point on the axis.

First Full Thread: First full thread on the cutting edge back of the chamfer. It is at this point that rake, hook, and thread elements are measured.

Crest Clearance: Radial distance between the root of the internal thread and the crest of the external thread of the coaxially assembled design forms of mating threads.

Class of Thread: Designation of the class that determines the specification of the size, allowance, and tolerance to which a given threaded product is to be manufactured. It is not applicable to the tools used for threading.



Flank Angle: Angle between the individual flank and the perpendicular to the axis of the thread, measured in an axial plane. A flank angle of a symmetrical thread is commonly termed the "half angle of thread."

Flank—Leading: 1) Flank of a thread facing toward the chamfered end of a threading tool; and 2) The leading flank of a thread is the one which, when the thread is about to be assembled with a mating thread, faces the mating thread.

Flank—Trailing: The trailing flank of a thread is the one opposite the leading flank.

Flutes: Longitudinal channels formed in a tap to create cutting edges on the thread profile and to provide chip spaces and cutting fluid passages. On a parallel or straight thread tap they may be straight, angular or helical; on a taper thread tap they may be straight, angular or spiral.

Flute-Angular: A flute lying in a plane intersecting the tool axis at an angle.

Flute-Helical: A flute with uniform axial lead and constant helix in a helical path around the axis of a cylindrical tap.

Flute-Spiral: A flute with uniform axial lead in a spiral path around the axis of a conical tap.

Flute Lead Angle: Angle at which a helical or spiral cutting edge at a given point makes with an axial plane through the same point.

Flute-Straight: A flute which forms a cutting edge lying in an axial plane.

Front Taper: A gradual increase in the diameter of the thread form on a tap from the leading end of the tool toward the back.

Heel: Edge of the land opposite the cutting edge.

Hook Angle: Inclination of a concave cutting face, usually specified either as Chordal Hook or Tangential Hook.

Hook-Chordal Angle: Angle between the chord passing through the root and crest of a thread form at the cutting face, and a radial line through the crest at the cutting edge.

Hook-Tangential Angle: Angle between a line tangent to a hook cutting face at the cutting edge and a radial line to the same point.

Interrupted Thread Tap: A tap having an odd number of lands with alternate teeth in the thread helix removed. In some designs alternate teeth are removed only for a portion of the thread length.

Land: One of the threaded sections between the flutes of a tap.

Lead: Distance a screw thread advances axially in one complete turn.

Lead Error: Deviation from prescribed limits.

Lead Deviation: Deviation from the basic nominal lead.

Progressive Lead Deviation: (1) On a straight thread the deviation from a true helix where the thread helix advances uniformly. (2) On a taper thread the deviation from a true spiral where the thread spiral advances uniformly.

Length of Thread: The length of the thread of the tap includes the chamfered threads and the full threads but does not include an external center. It is indicated by the letter "B" in the illustrations at the heads of the tables.

Limits: The limits of size are the applicable maximum and minimum sizes.

Major Diameter: On a straight thread the major diameter is that of the major cylinder. On a taper thread the major diameter at a given position on the thread axis is that of the major cone at that position.

Minor Diameter: On a straight thread the minor diameter is that of the minor cylinder. On a taper thread the minor diameter at a given position on the thread axis is that of the minor cone at that position.

Pitch Diameter (Simple Effective Diameter: On a straight thread, the pitch diameter is the diameter of the imaginary coaxial cylinder, the surface of which would pass through the thread profiles at such points as to make the width of the groove equal to one-half the basic pitch. On a perfect thread this coincidence occurs at the point where the widths of the thread and groove are equal. On a taper thread, the pitch diameter at a given position on the thread axis is the diameter of the pitch cone at that position.

Point Diameter: Diameter at the cutting edge of the leading end of the chamfered section.

Rake: Angular relationship of the straight cutting face of a tooth with respect to a radial line through the crest of the tooth at the cutting edge. Positive rake means that the crest of the cutting face is angularly ahead of the balance of the cutting face of the tooth. Negative rake means that the crest of the cutting face is angularly behind the balance of the cutting face of the tooth. Zero rake means that the cutting face is directly on a radial line.

Relief: Removal of metal behind the cutting edge to provide clearance between the part being threaded and the threaded land.

Relief-Center: Clearance produced on a portion of the tap land by reducing the diameter of the entire thread form between cutting edge and heel.

Relief-Chamfer: Gradual decrease in land height from cutting edge to heel on the chamfered portion of the land on a tap to provide radial clearance for the cutting edge.

Relief-Con-eccentric Thread: Radial relief in the thread form starting back of a concentric margin.

Relief-Double Eccentric Thread: Combination of a slight radial relief in the thread form starting at the cutting edge and continuing for a portion of the land width, and a greater radial relief for the balance of the land.

Relief-Eccentric Thread: Radial relief in the thread form starting at the cutting edge and continuing to the heel.

Relief-Flatted Land: Clearance produced on a portion of the tap land by truncating the thread between cutting edge and heel.

Relief-Grooved Land: Clearance produced on a tap land by forming a longitudinal groove in the center of the land.

Relief-Radial: Clearance produced by removal of metal from behind the cutting edge. Taps should have the chamfer relieved and should have back taper, but may or may not have relief in the angle and on the major diameter of the threads. When the thread angle is relieved, starting at the cutting edge and continuing to the heel, the tap is said to have "eccentric" relief. If the thread angle is relieved back of a concentric margin (usually one-third of land width), the tap is said to have "con-eccentric" relief.

Size-Actual: Measured size of an element on an individual part.

Size-Basic: That size from which the limits of size are derived by the application of allowances and tolerances.

Size-Functional: The functional diameter of an external or internal thread is the pitch diameter of the enveloping thread of perfect pitch, lead and flank angles, having full depth of engagement but clear at crests and roots, and of a specified length of engagement. It may be derived by adding to the pitch diameter in an external thread, or subtracting from the pitch diameter in an internal thread, the cumulative effects of deviations from specified profile, including variations in lead and flank angle over a specified length of engagement. The effects of taper, out-of-roundness,and surface defects may be positive or negative on either external or internal threads.

Size-Nominal: Designation used for the purpose of general identification.

Spiral Flute: See *Flutes.*

Spiral Point: Angular fluting in the cutting face of the land at the chamfered end. It is formed at an angle with respect to the tap axis of opposite hand to that of rotation. Its length is usually greater than the chamfer length and its angle with respect to the tap axis is usually made great enough to direct the chips ahead of the tap. The tap may or may not have longitudinal flutes.

Thread Lead Angle: On a straight thread, the lead angle is the angle made by the helix of the thread at the pitch line with a plane perpendicular to the axis. On a taper thread, the lead angle at a given axial position is the angle made by the conical spiral of the thread, with the plane perpendicular to the axis, at the pitch line.

Table 3. ANSI Standard Fraction-Size Taps — Cut Thread Limits
ASME/ANSI B94.9-1987

Tap Size	Threads per Inch			Major Diameter			Pitch Diameter		
	NC UNC	NF UNF	NS UNS	Basic	Min.	Max.	Basic	Min.	Max.
1/8	…	…	40	0.1250	0.1266	0.1286	0.1088	0.1090	0.1105
5/32	…	…	32	0.1563	0.1585	0.1605	0.1360	0.1365	0.1380
3/16	…	…	24	0.1875	0.1903	0.1923	0.1604	0.1609	0.1624
3/16	…	…	32	0.1875	0.1897	0.1917	0.1672	0.1677	0.1692
1/4	20	…	…	0.2500	0.2532	0.2557	0.2175	0.2180	0.2200
1/4	…	28	…	0.2500	0.2524	0.2549	0.2268	0.2273	0.2288
5/16	18	…	…	0.3125	0.3160	0.3185	0.2764	0.2769	0.2789
5/16	…	24	…	0.3125	0.3153	0.3178	0.2854	0.2859	0.2874
3/8	16	…	…	0.3750	0.3789	0.3814	0.3344	0.3349	0.3369
3/8	…	24	…	0.3750	0.3778	0.3803	0.3479	0.3484	0.3499
7/16	14	…	…	0.4375	0.4419	0.4449	0.3911	0.3916	0.3941
7/16	…	20	…	0.4375	0.4407	0.4437	0.4050	0.4055	0.4075
1/2	13	…	…	0.5000	0.5047	0.5077	0.4500	0.4505	0.4530
1/2	…	20	…	0.5000	0.5032	0.5062	0.4675	0.4680	0.4700
9/16	12	…	…	0.5625	0.5675	0.5705	0.5084	0.5089	0.5114
9/16	…	18	…	0.5625	0.5660	0.5690	0.5264	0.5269	0.5289
5/8	11	…	…	0.6250	0.6304	0.6334	0.5660	0.5665	0.5690
5/8	…	18	…	0.6250	0.6285	0.6315	0.5889	0.5894	0.5914
3/4	10	…	…	0.7500	0.7559	0.7599	0.6850	0.6855	0.6885
3/4	…	16	…	0.7500	0.7539	0.7579	0.7094	0.7099	0.7124
7/8	9	…	…	0.8750	0.8820	0.8860	0.8028	0.8038	0.8068
7/8	…	14	…	0.8750	0.8799	0.8839	0.8286	0.8296	0.8321
1	8	…	…	1.0000	1.0078	1.0118	0.9188	0.9198	0.9228
1	…	12	…	1.0000	1.0055	1.0095	0.9459	0.9469	0.9494
1	…	…	14	1.0000	1.0049	1.0089	0.9536	0.9546	0.9571
1 1/8	7	…	…	1.1250	1.1337	1.1382	1.0322	1.0332	1.0367
1 1/8	…	12	…	1.1250	1.1305	1.1350	1.0709	1.0719	1.0749
1 1/4	7	…	…	1.2500	1.2587	1.2632	1.1572	1.1582	1.1617
1 1/4	…	12	…	1.2500	1.2555	1.2600	1.1959	1.1969	1.1999
1 3/8	6	…	…	1.3750	1.3850	1.3895	1.2667	1.2677	1.2712
1 3/8	…	12	…	1.3750	1.3805	1.3850	1.3209	1.3219	1.3249
1 1/2	6	…	…	1.5000	1.5100	1.5145	1.3917	1.3927	1.3962
1 1/2	…	12	…	1.5000	1.5055	1.5100	1.4459	1.4469	1.4499
1 3/4	5	…	…	1.7500	1.7602	1.7657	1.6201	1.6216	1.6256
2	4 1/2	…	…	2.0000	2.0111	2.0166	1.8557	1.8572	1.8612

All dimensions are given in inches.

Lead Tolerance: Plus or minus 0.003 inch max. per inch of thread.

Angle Tolerance: Plus or minus 35 min. in half angle or 53 min. in full angle for 4½ to 5½ thds. per in.; 40 min. half angle and 60 min. full angle for 6 to 9 thds.; 45 min. half angle and 68 min. full angle for 10 to 28 thds.; 60 min. half angle and 90 min. full angle for 30 to 64 thds. per in.

Table 4. ANSI Standard Fractional-Size Taps — Ground Thread Limits *ASME/ANSI B94.9-1987*

Size	Threads per Inch			Major Diameter			Pitch Diameter Limits								
	NC UNC	NF UNF	NS UNS	Basic	Min.	Max.	Basic Pitch Dia.	H1 Limit		H2 Limit		H3 & H4[a] Limits		H4,[a] H5[b] & H6[c] Limits	
								Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1/4	20	…	…	0.2500	0.2533	0.2565	0.2175	0.2175	0.2180	0.2180	0.2185	0.2185	0.2190	0.2195[b]	0.2200[b]
1/4	…	28	…	0.2500	0.2523	0.2546	0.2268	0.2268	0.2273	0.2273	0.2278	0.2278	0.2283	0.2283[a]	0.2288[a]
5/16	18	…	…	0.3125	0.3161	0.3197	0.2764	0.2764	0.2769	0.2769	0.2774	0.2774	0.2779	0.2784[b]	0.2789[b]
5/16	…	24	…	0.3125	0.3152	0.3179	0.2854	0.2854	0.2859	0.2859	0.2864	0.2864	0.2869	0.2869[a]	0.2874[a]
3/8	16	…	…	0.3750	0.3790	0.3831	0.3344	0.3344	0.3349	0.3349	0.3354	0.3354	0.3359	0.3364[b]	0.3369[b]
3/8	…	24	…	0.3750	0.3777	0.3804	0.3479	0.3479	0.3484	0.3484	0.3489	0.3489	0.3494	0.3494[a]	0.3499[a]
7/16	14	…	…	0.4375	0.4422	0.4468	0.3911	…	…	0.3916	0.3921	0.3921	0.3926	0.3931[b]	0.3936[b]
7/16	…	20	…	0.4375	0.4408	0.4440	0.4050	…	…	…	…	0.4060	0.4065	0.4070[b]	0.4075[b]
1/2	13	…	…	0.5000	0.5050	0.5100	0.4500	0.4500	0.4505	0.4505	0.4510	0.4510	0.4515	0.4520[b]	0.4525[b]
1/2	…	20	…	0.5000	0.5033	0.5065	0.4675	0.4675	0.4680	0.4680	0.4685	0.4685	0.4690	0.4695[b]	0.4700[b]
9/16	12	…	…	0.5625	0.5679	0.5733	0.5084	…	…	…	…	0.5094	0.5099	0.5104[b]	0.5109[b]
9/16	…	18	…	0.5625	0.5661	0.5697	0.5264	…	…	0.5269	0.5274	0.5274	0.5279	0.5284[b]	0.5289[b]
5/8	11	…	…	0.6250	0.6309	0.6368	0.5660	…	…	0.5665	0.5670	0.5670	0.5675	0.5680[b]	0.5685[b]
5/8	…	18	…	0.6250	0.6286	0.6322	0.5889	…	…	0.5894	0.5899	0.5899	0.5904	0.5909[b]	0.5914[b]
11/16	…	…	11	0.6875	0.6934	0.6993	0.6285	…	…	…	…	0.6295	0.6300	…	…
11/16	…	…	16	0.6875	0.6915	0.6956	0.6469	…	…	…	…	0.6479	0.6484	…	…
3/4	10	…	…	0.7500	0.7565	0.7630	0.6850	…	…	0.6855	0.6860	0.6860	0.6865	0.6870[b]	0.6875[b]
3/4	…	16	…	0.7500	0.7540	0.7581	0.7094	0.7094	0.7099	0.7099	0.7104	0.7104	0.7109	0.7114[b]	0.7119[b]
7/8	9	…	…	0.8750	0.8822	0.8894	0.8028	…	…	…	…	0.8043[a]	0.8048[a]	0.8053[c]	0.8058[c]
7/8	…	14	…	0.8750	0.8797	0.8843	0.8286	…	…	0.8291	0.8296	0.8301[a]	0.8306[a]	…	…
1	8	…	…	1.0000	1.0081	1.0162	0.9188	…	…	…	…	0.9203[a]	0.9208[a]	0.9213[c]	0.9218[c]
1	…	12	…	1.0000	1.0054	1.0108	0.9459	…	…	…	…	0.9474[a]	0.9479[a]	…	…
1	…	…	14	1.0000	1.0047	1.0093	0.9536	…	…	…	…	0.9551[a]	0.9556[a]	…	…

[a] H4 limit value.
[b] H5 limit value.
[c] H6 li.

Table 5. ANSI Standard Fractional –Size Taps—Ground Thread Limits (ASME/ANSI B94.9–1987)

Size	Threads per Inch			Major Diameter			Pitch Diameter Limits		
	NC UNC	NF UNF	NS UNS	Basic	Min.	Max.	Basic Pitch Dia.	H4 Limit	
								Min.	Max.
1⅛	7	…	…	1.1250	1.1343	1.1436	1.0322	1.0332	1.0342
1⅛	…	12	…	1.1250	1.1304	1.1358	1.0709	1.0719	1.0729
1¼	7	…	…	1.2500	1.2593	1.2686	1.1572	1.1582	1.1592
1¼	…	12	…	1.2500	1.2554	1.2608	1.1959	1.1969	1.1979
1⅜	6	…	…	1.3750	1.3859	1.3967	1.2667	1.2677	1.2687
1⅜	…	12	…	1.3750	1.3804	1.3858	1.3209	1.3219	1.3229
1½	6	…	…	1.5000	1.5109	1.5217	1.3917	1.3927	1.3937
1½	…	12	…	1.5000	1.5054	1.5108	1.4459	1.4469	1.4479

All dimensions are given in inches.

Lead Tolerance: Plus or minus 0.0005 inch within any two threads not farther apart than one inch.

Angle Tolerance: Plus or minus 25 min. in half angle for 6 to 9 threads per inch; plus or minus 30 min. in half angle for 10 to 28 threads per inch.

For an explanation of the significance of the H4 limit value range see *Standard System Tap Thread Limits and Identification for Unified Inch Screw Threads, Ground Thread* starting on page 896.

Table 6. ANSI Standard Machine Screw Taps — Ground Thread Limits
ASME/ANSI B94.9-1987

Size	Threads per Inch			Major Diameter			Pitch Diameter Limits[a]						
	NC UNC	NF UNF	NS UNS	Basic	Min.	Max.	Basic Pitch Dia.	H1 Limit		H2 Limit		H3 Limit	
								Min.	Max.	Min.	Max.	Min.	Max.
0	…	80	…	0.0600	0.0605	0.0616	0.0519	0.0519	0.0524	0.0524	0.0529	…	…
1	64	…	…	0.0730	0.0736	0.0750	0.0629	0.0629	0.0634	0.0634	0.0639	…	…
1	…	72	…	0.0730	0.0736	0.0748	0.0640	0.0640	0.0645	0.0645	0.0650	…	…
2	56	…	…	0.0860	0.0867	0.0883	0.0744	0.0744	0.0749	0.0749	0.0754	…	…
2	…	64	…	0.0860	0.0866	0.0880	0.0759	…	…	0.0764	0.0769	…	…
3	48	…	…	0.0990	0.0999	0.1017	0.0855	0.0855	0.0860	0.0860	0.0865	…	…
3	…	56	…	0.0990	0.0997	0.1013	0.0874	0.0874	0.0879	0.0879	0.0884	…	…
4	…	…	36	0.1120	0.1135	0.1156	0.0940	…	…	0.0945	0.0950	…	…
4	40	…	…	0.1120	0.1133	0.1152	0.0958	0.0958	0.0963	0.0963	0.0968	…	…
4	…	48	…	0.1120	0.1129	0.1147	0.0985	0.0985	0.0990	0.0990	0.0995	…	…
5	40	…	…	0.1250	0.1263	0.1282	0.1088	0.1088	0.1093	0.1093	0.1098	…	…
5	…	44	…	0.1250	0.1263	0.1280	0.1102	…	…	0.1107	0.1112	…	…
6	32	…	…	0.1380	0.1401	0.1421	0.1177	0.1177	0.1182	0.1182	0.1187	0.1187	0.1192
6	…	40	…	0.1380	0.1393	0.1412	0.1218	0.1218	0.1223	0.1223	0.1228	…	…
8	32	…	…	0.1640	0.1661	0.1681	0.1437	0.1437	0.1442	0.1442	0.1447	0.1447	0.1452
8	…	36	…	0.1640	0.1655	0.1676	0.1460	…	…	0.1465	0.1470	…	…
10	24	…	…	0.1900	0.1927	0.1954	0.1629	0.1629	0.1634	0.1634	0.1639	0.1639	0.1644
10	…	32	…	0.1900	0.1921	0.1941	0.1697	0.1697	0.1702	0.1702	0.1707	0.1707	0.1712
12	24	…	…	0.2160	0.2187	0.2214	0.1889	…	…	…	…	0.1899	0.1904
12	…	28	…	0.2160	0.2183	0.2206	0.1928	…	…	…	…	0.1938	0.1943

[a] H7 limits (formerly designated as G) apply to same threads as H3 limits with the exception of the 12–24 and 12–28 threads. H7 limits have minimum and maximum major diameters 0.0020 inch larger than shown and minimum and maximum pitch diameters 0.0020 inch larger than shown for H3 limits.

All dimensions are given in inches.

Lead Tolerance: Plus or minus 0.0005 inch within any two threads not farther apart than one inch.

Angle Tolerance: Plus or minus 30 min. in half angle for 20 to 80 threads per inch.

For an explanation of the significance of the limit value ranges see *Standard System Tap Thread Limits and Identification for Unified Inch Screw Threads, Ground Thread* starting on page 896.

Table 7. ANSI Standard Machine Screw Taps — Cut Threads Limits
ASME/ANSI B94.9-1987

Size	Threads per Inch			Major Diameter			Pitch Diameter		
	NC UNC	NF UNF	NS UNS	Basic	Min.	Max.	Basic	Min.	Max.
0	…	80	…	0.0600	0.0609	0.0624	0.0519	0.0521	0.0531
1	64	…	…	0.0730	0.0740	0.0755	0.0629	0.0631	0.0641
1	…	72	…	0.0730	0.0740	0.0755	0.0640	0.0642	0.0652
2	56	…	…	0.0860	0.0872	0.0887	0.0744	0.0746	0.0756
2	…	64	…	0.0860	0.0870	0.0885	0.0759	0.0761	0.0771
3	48	…	…	0.0990	0.1003	0.1018	0.0855	0.0857	0.0867
3	…	56	…	0.0990	0.1002	0.1017	0.0874	0.0876	0.0886
4	…	…	36	0.1120	0.1137	0.1157	0.0940	0.0942	0.0957
4	40	…	…	0.1120	0.1136	0.1156	0.0958	0.0960	0.0975
4	…	48	…	0.1120	0.1133	0.1153	0.0985	0.0987	0.1002
5	40	…	…	0.1250	0.1266	0.1286	0.1088	0.1090	0.1105
6	32	…	…	0.1380	0.1402	0.1422	0.1177	0.1182	0.1197
6	…	…	36	0.1380	0.1397	0.1417	0.1200	0.1202	0.1217
6	…	40	…	0.1380	0.1396	0.1416	0.1218	0.1220	0.1235
8	32	…	…	0.1640	0.1662	0.1682	0.1437	0.1442	0.1457
8	…	36	…	0.1640	0.1657	0.1677	0.1460	0.1462	0.1477
8	…	…	40	0.1640	0.1656	0.1676	0.1478	0.1480	0.1495
10	24	…	…	0.1900	0.1928	0.1948	0.1629	0.1634	0.1649
10	…	32	…	0.1900	0.1922	0.1942	0.1697	0.1702	0.1717
12	24	…	…	0.2160	0.2188	0.2208	0.1889	0.1894	0.1909
12	…	28	…	0.2160	0.2184	0.2204	0.1928	0.1933	0.1948
14	…	…	24	0.2420	0.2448	0.2473	0.2149	0.2154	0.2174

All dimensions are given in inches.

Lead Tolerance: Plus or minus 0.003 inch per inch of thread. *Angle Tolerance:* Plus or minus 45 min. in half angle and 68 min. in full angle for 20 to 28 threads per inch; plus or minus 60 min. in half angle and 90 min. in full angle for 30 or more threads per inch.

Table 8a. ANSI Standard Metric Tap Ground Thread Limits in Inches — M Profile
ASME/ANSI B94.9-1987

Nominal Diam, mm	Pitch, mm	Major Diameter (Inches)			Pitch Diameter (Inches)		
		Basic	Min	Max	Basic	Min	Max
1.6	0.35	0.06299	0.06409	0.06508	0.05406	0.05500	0.05559
2	0.4	0.07874	0.08000	0.08098	0.06850	0.06945	0.07004
2.5	0.45	0.09843	0.09984	0.10083	0.08693	0.08787	0.08846
3	0.5	0.11811	0.11969	0.12067	0.10531	0.10626	0.10685
3.5	0.6	0.13780	0.13969	0.14067	0.12244	0.12370	0.12449
4	0.7	0.15748	0.15969	0.16130	0.13957	0.14083	0.14161
4.5	0.75	0.17717	0.17953	0.18114	0.15799	0.15925	0.16004
5	0.8	0.19685	0.19937	0.20098	0.17638	0.17764	0.17843
6	1	0.23622	0.23937	0.24098	0.21063	0.21220	0.21319
7	1	0.27559	0.27874	0.28035	0.25000	0.25157	0.25256
8	1.25	0.31496	0.31890	0.32142	0.28299	0.28433	0.28555
10	1.5	0.39370	0.39843	0.40094	0.35535	0.35720	0.35843
12	1.75	0.47244	0.47795	0.48047	0.42768	0.42953	0.43075
14	2	0.55118	0.55748	0.56000	0.50004	0.50201	0.50362
16	2	0.62992	0.63622	0.63874	0.57878	0.58075	0.58236
20	2.5	0.78740	0.79538	0.79780	0.72346	0.72543	0.72705
24	3	0.94488	0.95433	0.95827	0.86815	0.87063	0.87224
30	3.5	1.18110	1.19213	1.19606	1.09161	1.09417	1.09622
36	4	1.41732	1.42992	1.43386	1.31504	1.31760	1.31965

Basic pitch diameter is the same as minimum pitch diameter of internal thread, Class 6H as shown in table starting on page 1769.

Pitch diameter limits are designated in the Standard as D3 for 1.6 to 3 mm diameter sizes, incl.: D4 for 3.5 to 5 mm sizes, incl.; D5 for 6 and 8 mm sizes; D6 for 10 and 12 mm sizes; D7 for 14 to 20 mm sizes, incl.; D8 for 24 mm size; and D9 for 30 and 36 mm sizes.

Angle tolerances are plus or minus 30 minutes in half angle for pitches ranging from 0.35 through 2.5 mm, incl. and plus or minus 25 minutes in half angle for pitches ranging from 3 to 4 mm, incl.

A maximum deviation of plus or minus 0.0005 inch within any two threads not farther apart than one inch is permitted.

Table 8b. ANSI Standard Metric Tap Ground Thread Limits in Millimeters—M Profile *ASME/ANSI B94.9-1987*

Nominal Diam, mm	Pitch, mm	Major Diameter (mm)			Pitch Diameter (mm)		
		Basic	Min	Max	Basic	Min	Max
1.6	0.35	1.600	1.628	1.653	1.373	1.397	1.412
2	0.4	2.000	2.032	2.057	1.740	1.764	1.779
2.5	0.45	2.500	2.536	2.561	2.208	2.232	2.247
3	0.5	3.000	3.040	3.065	2.675	2.699	2.714
3.5	0.6	3.500	3.548	3.573	3.110	3.142	3.162
4	0.7	4.000	4.056	4.097	3.545	3.577	3.597
4.5	0.75	4.500	4.560	4.601	4.013	4.045	4.065
5	0.8	5.000	5.064	5.105	4.480	4.512	4.532
6	1	6.000	6.080	6.121	5.350	5.390	5.415
7	1	7.000	7.080	7.121	6.350	6.390	6.415
8	1.25	8.000	8.100	8.164	7.188	7.222	7.253
10	1.5	10.000	10.120	10.184	9.026	9.073	9.104
12	1.75	12.000	12.140	12.204	10.863	10.910	10.941
14	2	14.000	14.160	14.224	12.701	12.751	12.792
16	2	16.000	16.160	16.224	14.701	14.751	14.792
20	2.5	20.000	20.200	20.264	18.376	18.426	18.467
24	3	24.000	24.240	24.340	22.051	22.114	22.155
30	3.5	30.000	30.280	30.380	27.727	27.792	27.844
36	4	36.000	36.320	36.420	33.402	33.467	33.519

Basic pitch diameter is the same as minimum pitch diameter of internal thread, Class 6H as shown in table starting on page 1769.

Pitch diameter limits are designated in the Standard as D3 for 1.6 to 3 mm diameter sizes, incl.: D4 for 3.5 to 5 mm sizes, incl.; D5 for 6 and 8 mm sizes; D6 for 10 and 12 mm sizes; D7 for 14 to 20 mm sizes, incl.; D8 for 24 mm size; and D9 for 30 and 36 mm sizes.

Angle tolerances are plus or minus 30 minutes in half angle for pitches ranging from 0.35 through 2.5 mm, incl. and plus or minus 25 minutes in half angle for pitches ranging from 3 to 4 mm, incl.

A maximum lead deviation of plus or minus 0.013 mm within any two threads not farther apart than 25 mm is permitted.

Table 9a. ANSI Standard Taper Pipe Taps — Cut Thread Tolerances for NPT and Ground Thread Tolerances for NPT, NPTF, and ANPT *ASME/ANSI B94.9-1987*

Nominal Size	Threads per Inch NPT, NPTF, or ANPT	Gage Measurement[a]			Taper per Foot, Inches			
			Tolerance Plus or Minus		Cut Thread		Ground Thread	
		Projection Inches	Cut Thread	Ground Thread	Min.	Max.	Min.	Max.
1/16	27	0.312	1/16	1/16	23/32	27/32	23/32	25/32
1/8	27	0.312	1/16	1/16	23/32	27/32	23/32	25/32
1/4	18	0.459	1/16	1/16	23/32	27/32	23/32	25/32
3/8	18	0.454	1/16	1/16	23/32	27/32	23/32	25/32
1/2	14	0.579	1/16	1/16	23/32	13/16	23/32	25/32
3/4	14	0.565	1/16	1/16	23/32	13/16	23/32	25/32
1	11½	0.678	3/32	3/32	23/32	13/16	23/32	25/32
1¼	11½	0.686	3/32	3/32	23/32	13/16	23/32	25/32
1½	11½	0.699	3/32	3/32	23/32	13/16	23/32	25/32
2	11½	0.667	3/32	3/32	23/32	13/16	23/32	25/32
2½	8	0.925	3/32	3/32	47/64	51/64	47/64	25/32
3	8	0.925	3/32	3/32	47/64	51/64	47/64	25/32
3½	8	0.938	1/8	1/8	47/64	51/64	47/64	25/32
4	8	0.950	1/8	1/8	47/64	51/64	47/64	25/32

[a] Distance that small end of tap projects through L1 taper ring gage (see ANSI B1.20.3).

All dimensions are given in inches.

Lead Tolerance: Plus or minus 0.003 inch per inch of cut thread and plus or minus 0.0005 inch per inch of ground thread.

Angle Tolerance: Plus or minus 40 min. in half angle and 60 min. in full angle for 8 cut threads per inch; plus or minus 45 min. in half angle and 68 min. in full angle for 11½ to 27 cut threads per inch; plus or minus 25 min. in half angle for 8 ground threads per inch; and plus and minus 30 min. in half angle for 11½ to 27 ground threads per inch.

Table 9b. ANSI Standard Taper Pipe Thread — Widths of Flats at Tap Crests and Roots for Cut Thread NPT and Ground Thread NPT, ANPT, and NPTF
ASME/ANSI B94.9-1987

Threads per Inch	Tap Flat Width at	Column I NPT—Cut and Ground Thread ANPT—Ground Thread		Column II NPTF—Cut and Ground Thread	
		Minimum[a]	Maximum	Minimum[a]	Maximum
27	{ Major Diameter	0.0014	0.0041	0.0040	0.0055
	{ Minor Diameter	…	0.0041	…	0.0040
18	{ Major Diameter	0.0021	0.0057	0.0050	0.0065
	{ Minor Diameter	…	0.0057	…	0.0050
14	{ Major Diameter	0.0027	0.0064	0.0050	0.0065
	{ Minor Diameter	…	0.0064	…	0.0050
11½	{ Major Diameter	0.0033	0.0073	0.0060	0.0083
	{ Minor Diameter	…	0.0073	…	0.0060
8	{ Major Diameter	0.0048	0.0090	0.0080	0.0103
	{ Minor Diameter	…	0.0090	…	0.0080

[a] Minimum minor diameter falts are not specified. May be sharp as practicable.

All dimensions are given in inches.

Note: Cut Thread taps made to Column I are marked NPT but are not recommended for ANPT applications. Ground Thread taps made to Column I are marked NPT and may be used for NPT and ANPT applications. Ground Thread taps made to Column II are marked NPTF and used for Dryseal application.

Table 10a. ANSI Standard Straight Pipe Taps (NPSF—Dryseal)—Ground Thread Limits *ASME/ANSI B94.9-1987*

Nominal Size, Inches	Threads per Inch	Major Diameter		Pitch Diameter			
		Min. *G*	Max. *H*	Plug at Gaging Notch *E*	Min. *K*	Max. *L*	Minor[a] Dia. Flat, Max.
1/16	27	0.3008	0.3018	0.2812	0.2772	0.2777	0.004
1/8	27	0.3932	0.3942	0.3736	0.3696	0.3701	0.004
1/4	18	0.5239	0.5249	0.4916	0.4859	0.4864	0.005
3/8	18	0.6593	0.6603	0.6270	0.6213	0.6218	0.005
1/2	14	0.8230	0.8240	0.7784	0.7712	0.7717	0.005
3/4	14	1.0335	1.0345	0.9889	0.9817	0.9822	0.005

[a] As specified or sharper.

Formulas For American Dryseal (NPSF) Ground Thread Taps					
Nominal Size, Inches	Major Diameter		Pitch Diameter		Max. Minor Dia.
	Min. *G*	Max. *H*	Min. *K*	Max. *L*	
1/16	$H - 0.0010$	$K + Q - 0.0005$	$L - 0.0005$	$E - F$	$M - Q$
1/8	$H - 0.0010$	$K + Q - 0.0005$	$L - 0.0005$	$E - F$	$M - Q$
1/4	$H - 0.0010$	$K + Q - 0.0005$	$L - 0.0005$	$E - F$	$M - Q$
3/8	$H - 0.0010$	$K + Q - 0.0005$	$L - 0.0005$	$E - F$	$M - Q$
1/2	$H - 0.0010$	$K + Q - 0.0005$	$L - 0.0005$	$E - F$	$M - Q$
3/4	$H - 0.0010$	$K + Q - 0.0005$	$L - 0.0005$	$E - F$	$M - Q$

Values to Use in Formulas				
Threads per Inch	*E*	*F*	*M*	*Q*
27	Pitch diameter of plug at gaging notch	0.0035	Actual measured pitch diameter	0.0251
18		0.0052		0.0395
14		0.0067		0.0533

All dimensions are given in inches.

Lead Tolerance: Plus or minus 0.0005 inch within any two threads not farther apart than one inch.

Angle Tolerance: Plus or minus 30 min. in half angle for 14 to 27 threads per inch.

Table 10b. ANSI Standard Straight Pipe Taps (NPS)—Cut Thread Limits
ASME/ANSI B94.9-1987

Nominal Size	Threads per Inch, NPS, NPSC	Size at Gaging Notch	Pitch Diameter		Values to Use in Formulas		
			Min.	Max.	*A*	*B*	*C*
1/8	27	0.3736	0.3721	0.3751	0.0267	0.0296	0.0257
1/4	18	0.4916	0.4908	0.4938	} 0.0408	0.0444	0.0401
3/8	18	0.6270	0.6257	0.6292			
1/2	14	0.7784	0.7776	0.7811	} 0.0535	0.0571	0.0525
3/4	14	0.9889	0.9876	0.9916			
1	11 1/2	1.2386	1.2372	1.2412	0.0658	0.0696	0.0647

The following are approximate formulas, in which M = measured pitch diameter in inches:
Major dia., min. = $M + A$
Major dia., max. = $M + B$ Minor dia., max. = $M - C$

All dimensions are given in inches.

Lead Tolerance: Plus or minus 0.003 inch per inch of thread.

Angle Tolerance: All pitches, plus or minus 45 min. in half angle and 68 min. in full angle. Taps made to these specifications are to be marked NPS and used for NPSC thread form.

Table 10c. ANSI Standard Straight Pipe Taps (NPS)—Ground Thread Limits
ASME/ANSI B94.9-1987

Nominal Size, Inches	Threads per Inch, NPS, NPSC, NPSM	Major Diameter			Pitch Diameter		
		Plug at Gaging Notch	Min. *G*	Max. *H*	Plug at Gaging Notch *E*	Min. *K*	Max. *L*
1/8	27	0.3983	0.4022	0.4032	0.3736	0.3746	0.3751
1/4	18	0.5286	0.5347	0.5357	0.4916	0.4933	0.4938
3/8	18	0.6640	0.6701	0.6711	0.6270	0.6287	0.6292
1/2	14	0.8260	0.8347	0.8357	0.7784	0.7806	0.7811
3/4	14	1.0364	1.0447	1.0457	0.9889	0.9906	0.9916
1	11 1/2	1.2966	1.3062	1.3077	1.2386	1.2402	1.2412

Formulas for NPS Ground Thread Taps[a]

Nominal Size	Major Diameter		Minor Dia.	Threads per Inch	*A*	*B*
	Min. *G*	Max. *H*	Max.			
1/8	$H - 0.0010$	$(K + A) - 0.0010$	$M - B$	18	0.0444	0.0401
1/4 to 3/4	$H - 0.0010$	$(K + A) - 0.0020$	$M - B$	14	0.0571	0.0525
1	$H - 0.0015$	$(K + A) - 0.0021$	$M - B$	11 1/2	0.0696	0.0647

The maximum Pitch Diameter of tap is based upon an allowance deducted from the maximum product pitch diameter of NPSC or NPSM, whichever is smaller.
The minimum Pitch Diameter of tap is derived by subtracting the ground thread pitch diameter tolerance for actual equivalent size.

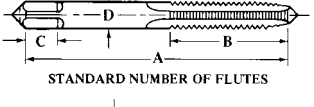
[a] In the formulas, M equals the actual measured pitch diameter.

All dimensions are given in inches.

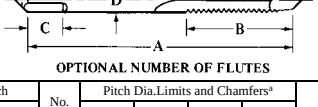
Lead tolerance: Plus or minus 0.0005 inch within any two threads not farther apart than one inch.

Angle Tolerance: All pitches, plus or minus 30 min. in half angle. Taps made to these specifications are to be marked NPS and used for NPSC and NPSM.

Table 11a. ANSI Standard Ground Thread Straight Fluted Taps—Machine Screw Sizes *ASME/ANSI B94.9-1987*



STANDARD NUMBER OF FLUTES



OPTIONAL NUMBER OF FLUTES

Size	Basic Major Diameter	Threads per Inch			No. of Flutes	Pitch Dia.Limits and Chamfers[a]				Length Overall *A*	Length of Thread	Length of Square	Diameter of Shank	*E*
		NC UNC	NF UNF	NS UNS		H1	H2	H3	H7					
0	0.060	…	80	…	2	TPB	PB	…	…	1 5/8	5/16	3/16	0.141	0.110
1	0.073	64	…	…	2	TPB	P	…	…	1 11/16	3/16	3/16	0.141	0.110
1	0.073	…	72	…	2	TPB	PB	…	…	1 11/16	3/8	3/16	0.141	0.110
2	0.086	56	…	…	2[b]	…	PB	…	…	1 3/4	7/16	3/16	0.141	0.110
2	0.086	56	…	…	3	TPB	TPB	…	…	1 3/4	7/16	3/16	0.141	0.110
2	0.086	…	64	…	3	…	TPB	…	…	1 3/4	7/16	3/16	0.141	0.110
3	0.099	48	…	…	2[b]	…	PB	…	…	1 13/16	1/2	3/16	0.141	0.110
3	0.099	48	…	…	3	P	TPB	…	…	1 13/16	1/2	3/16	0.141	0.110
3	0.099	…	56	…	3	…	TPB	…	…	1 13/16	1/2	3/16	0.141	0.110
4	0.112	…	…	36	3	…	TPB	…	…	1 7/8	9/16	3/16	0.141	0.110
4	0.112	40	…	…	2[b]	P	PB	…	…	1 7/8	9/16	3/16	0.141	0.110
4	0.112	40	…	…	3	…	TPB	…	…	1 7/8	9/16	3/16	0.141	0.110
4	0.112	…	48	…	3	…	TPB	…	…	1 7/8	9/16	3/16	0.141	0.110
5	0.125	40	…	…	2[b]	…	PB	…	…	1 15/16	5/8	3/16	0.141	0.110
5	0.125	40	…	…	3	P	TPB	…	…	1 15/16	5/8	3/16	0.141	0.110
5	0.125	…	44	…	3	…	TPB	…	…	1 15/16	5/8	3/16	0.141	0.110
6	0.138	32	…	…	2[b]	P	PB	PB	…	2	11/16	3/16	0.141	0.110
6	0.138	32	…	…	3	TPB	TPB	TPB	PB	2	11/16	3/16	0.141	0.110
6	0.138	…	40	…	2[b]	…	P	…	…	2	11/16	3/16	0.141	0.110
6	0.138	…	40	…	3	P	TPB	…	…	2	11/16	3/16	0.141	0.110
8	0.164	32	…	…	2[b]	P	PB	PB	…	2 1/8	3/4	1/4	0.168	0.131
8	0.164	32	…	…	3[b]	…	PB	PB	PB	2 1/8	3/4	1/4	0.168	0.131
8	0.164	32	…	…	4	TPB	TPB	TPB	PB	2 1/8	3/4	1/4	0.168	0.131
8	0.164	…	36	…	4	…	TPB	…	…	2 1/8	3/4	1/4	0.168	0.131
10	0.190	24	…	…	2*	…	PB	PB	…	2 3/8	7/8	1/4	0.194	0.152
10	0.190	24	…	…	3[b]	…	P	PB	…	2 3/8	7/8	1/4	0.194	0.152
10	0.190	…	32	…	2[b]	P	PB	PB	…	2 3/8	7/8	1/4	0.194	0.152
10	0.190	…	32	…	3[b]	…	PB	PB	PB	2 3/8	7/8	1/4	0.194	0.152
10	0.190	24	32	…	4	TPB	TPB	TPB	PB	2 3/8	7/8	1/4	0.194	0.152
12	0.216	24	…	…	4	…	…	TPB	…	2 3/8	15/16	9/32	0.220	0.165
12	0.216	…	28	…	4	…	…	TPB	…	2 3/8	15/16	9/32	0.220	0.165

[a] Chamfer designations are: T = taper, P = plug, and B = bottoming.

[b] Optional number of flutes.

All dimensions are given in inches.

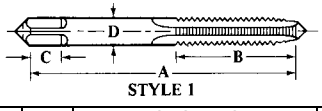
These taps are standard as high-speed steel taps with ground threads, with standard and optional number of flutes and pitch diameter limits and chamfers as given in the table.

These are style 1 taps and have external centers on thread and shank ends (may be removed on thread end of bottoming taps).

For standard thread limits see Table 6. For eccentricity tolerances see Table 25.

Tolerances: Numbers 0 to 12 size range — $A, \pm 1/32$; $B, \pm 3/64$; $C, \pm 1/32$; $D, -0.0015$; $E, -0.004$.

Table 11b. ANSI Standard Cut Thread Straight Fluted Taps — Machine Screw Sizes
ASME/ANSI B94.9-1987



Size	Basic Major Diameter	Threads per Inch: Carbon Steel NC UNC	Carbon Steel NF UNF	Carbon Steel NS UNS	HS Steel NC UNC	HS Steel NF UNF	Number of Flutes	Dimensions: Length Overall, *A*	Length of Thread, *B*	Length of Square, *C*	Diameter of Shank, *D*	Size of Square, *E*
0	0.060	…	80[a]	…	…	…	2	$1\frac{5}{8}$	$\frac{5}{16}$	$\frac{3}{16}$	0.141	0.110
1	0.073	64[a]	72[a]	…	…	…	2	$1\frac{11}{16}$	$\frac{3}{8}$	$\frac{3}{16}$	0.141	0.110
2	0.086	56	64[a]	…	…	…	3	$1\frac{3}{4}$	$\frac{7}{16}$	$\frac{3}{16}$	0.141	0.110
3	0.099	48[a]	56[a]	…	…	…	3	$1\frac{13}{16}$	$\frac{1}{2}$	$\frac{3}{16}$	0.141	0.110
4	0.112	40	48[a]	36[a]	40[a]	…	3	$1\frac{7}{8}$	$\frac{9}{16}$	$\frac{3}{16}$	0.141	0.110
5	0.125	40	…	…	40[a]	…	3	$1\frac{15}{16}$	$\frac{5}{8}$	$\frac{3}{16}$	0.141	0.110
6	0.138	32	40[a]	36[a]	32	…	3	2	$\frac{11}{16}$	$\frac{3}{16}$	0.141	0.110
8	0.164	32	36[a]	40[a]	32	…	4	$2\frac{1}{8}$	$\frac{3}{4}$	$\frac{1}{4}$	0.168	0.131
10	0.190	24	32	…	24	32	4	$2\frac{3}{8}$	$\frac{7}{8}$	$\frac{1}{4}$	0.194	0.152
12	0.216	24	28[a]	…	24	…	4	$2\frac{3}{8}$	$\frac{15}{16}$	$\frac{9}{32}$	0.220	0.165
14	0.242	…	…	24[a]	…	…	4	$2\frac{1}{2}$	1	$\frac{5}{16}$	0.255	0.191

[a] These taps are standard with plug chamfer only. All others are standard with taper, plug or bottoming chamfer.

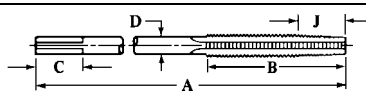
Tolerances for General Dimensions					
Element	Range	Tolerance	Element	Range	Tolerance
Length Overall, *A*	0 to 14 incl	$\pm\frac{1}{32}$	Diameter of Shank, *D*	0 to 12 incl	–0.004
Length of Thread, *B*	0 to 12 incl	$\pm\frac{1}{64}$		14	–0.005
	14	$\pm\frac{1}{16}$	Size of Square, *E*	0 to 14 incl	–0.004
Length of Square, *C*	0 to 14 incl	$\pm\frac{1}{32}$			

All dimensions are given in inches.

Styles 1 and 2 cut thread taps have optional style centers on thread and shank ends.

For standard thread limits see Table 7. For eccentricity tolerances see Table 25.

Table 12. ANSI Standard Nut Taps *ASME/ANSI B94.9-1987*



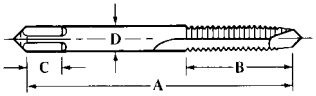
Dia. of Tap	Threads per Inch NC,UNC	Number of Flutes	Length Overall, *A*	Length of Thread, *B*	Length of Square, *C*	Diameter of Shank, *D*	Size of Square, *E*
$\frac{1}{4}$	20	4	5	$1\frac{5}{8}$	$\frac{9}{16}$	0.185	0.139
$\frac{5}{16}$	18	4	$5\frac{1}{2}$	$1\frac{13}{16}$	$\frac{5}{8}$	0.240	0.180
$\frac{3}{8}$	16	4	6	2	$\frac{11}{16}$	0.294	0.220
$\frac{1}{2}$	13	4	7	$2\frac{1}{2}$	$\frac{7}{8}$	0.400	0.300

Tolerances for General Dimensions					
Element	Diameter Range	Tolerance	Element	Diameter Range	Tolerance
Overall Length, *A*	$\frac{1}{4}$ to $\frac{1}{2}$	$\pm\frac{1}{16}$	Shank Diameter,D	$\frac{1}{4}$ to $\frac{1}{2}$	–0.005
Thread Length, *B*	$\frac{1}{4}$ to $\frac{1}{2}$	$\pm\frac{1}{16}$	Size of Square,E	$\frac{1}{4}$ to $\frac{1}{2}$	–0.004
Square Length, *C*	$\frac{1}{4}$ to $\frac{1}{2}$	$\pm\frac{1}{32}$			

All dimensions are given in inches. These ground thread high-speed steel taps are standard in H3 limit only. All taps have an internal center in thread end. For standard limits see Table 4.

Chamfer *J* is made $\frac{1}{2}$ ro $\frac{3}{4}$ the thread length of *B*.

Table 13. ANSI Standard Spiral-Pointed Taps—Machine Screw Sizes
ASME/ANSI B94.9-1987



STYLE 1

High-Speed Steel Taps with Ground Threads

Size	Basic Major Diameter	Threads per Inch NC UNC	Threads per Inch NF UNF	Threads per Inch NS UNS	No. of Flutes	Pitch Dia. Limits and Chamfers† H1	H2	H3	H7	Length Overall *A*	Length of Thread *B*	Length of Square *C*	Diameter of Shank *D*	Size of Square *E*
0	0.060	…	80	…	2	PB	PB	…	…	1 3/8	5/16	3/16	0.141	0.110
1	0.073	64	72	…	2	P	P	…	…	1 11/16	3/8	3/16	0.141	0.110
2	0.086	56	…	…	2	PB	PB	…	…	1 3/4	7/16	3/16	0.141	0.110
2	0.086	…	64	…	2	…	P	…	…	1 3/4	7/16	3/16	0.141	0.110
3	0.099	48	…	…	2	…	PB	…	…	1 13/16	1/2	3/16	0.141	0.110
3	0.099	…	56	…	2	P	P	…	…	1 13/16	1/2	3/16	0.141	0.110
4	0.112	…	…	36	2	…	P	…	…	1 7/8	9/16	3/16	0.141	0.110
4	0.112	40	…	…	2	P	PB	…	…	1 7/8	9/16	3/16	0.141	0.110
4	0.112	…	48	…	2	P	PB	…	…	1 7/8	9/16	3/16	0.141	0.110
5	0.125	40	…	…	2	P	PB	…	…	1 15/16	5/8	3/16	0.141	0.110
5	0.125	…	44	…	2	…	P	…	…	1 15/16	5/8	3/16	0.141	0.110
6	0.138	32	…	…	2	P	PB	PB	PB	2	11/16	3/16	0.141	0.110
6	0.138	…	40	…	2	…	PB	…	…	2	11/16	3/16	0.141	0.110
8	0.164	32	…	…	2	P	PB	PB	PB	2 1/8	3/4	1/4	0.168	0.131
8	0.164	…	36	…	2	…	P	…	…	2 1/8	3/4	1/4	0.168	0.131
10	0.190	24	…	…	2	P	PB	PB	P	2 3/8	7/8	1/4	0.194	0.152
10	0.190	…	32	…	2	PB	PB	PB	P	2 3/8	7/8	1/4	0.194	0.152
12	0.216	24	…	…	2	…	…	PB	…	2 3/8	15/16	9/32	0.220	0.165
12	0.216	…	28	…	2	…	…	P	…	2 3/8	15/16	9/32	0.220	0.165

High-Speed and Carbon Steel Taps with Cut Threads

Size	Basic Major Diameter	Threads per Inch Carbon Steel NC UNC	Threads per Inch Carbon Steel NF UNF	Threads per Inch HS Steel NC UNC	Threads per Inch HS Steel NF UNF	No. of Flutes	Length Overall, *A*	Length of Thread, *B*	Length of Square, *C*	Diameter of Shank, *D*	Size of Square, *E*
4	0.112	…	…	40	…	2	1 7/8	9/16	3/16	0.141	0.110
5	0.125	…	…	40	…	2	1 15/16	5/8	3/16	0.141	0.110
6	0.138	32	…	32	…	2	2	11/16	3/16	0.141	0.110
8	0.164	32	…	32	…	2	2 1/8	3/4	1/4	0.168	0.131
10	0.190	24	32	24	32	2	2 3/8	7/8	1/4	0.194	0.152
12	0.216	…	…	24	…	2	2 3/8	15/16	9/32	0.220	0.165

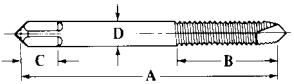
Tolerances for General Dimensions

Element	Size Range	Tolerance Ground Thread	Tolerance Cut Thread	Element	Size Range	Tolerance Ground Thread	Tolerance Cut Thread
Overall Length, *A*	0 to 12	±1/32	±1/32	Shank Diameter, *D*	0 to 12	–0.0015	–0.004
Thread Length, *B*	0 to 12	±3/64	±3/64	Size of Square, *E*	0 to 12	–0.004	–0.004
Square Length, *C*	0 to 12	±1/32	±1/32				

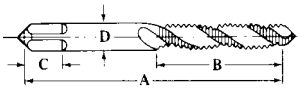
All dimensions are in inches. Chamfer designations are: P = plug and B = bottoming. Cut thread taps are standard with plug chamfer only. Style 1 ground thread taps have external centers on thread and shank ends (may be removed on thread end of bottoming taps). Style 1 cut thread taps have optional style centers on thread and shank ends. Standard thread limits for ground threads are given in Table 6 and for cut threads in Table 7. For eccentricity tolerances see Table 25.

Table 14. ANSI Standard Spiral Pointed Only and Regular and Fast Spiral-Fluted Taps — Machine Screw Sizes *ASME/ANSI B94.9-1987*

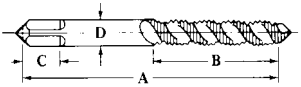
STYLE 1



SPIRAL POINTED ONLY TAPS



REGULAR SPIRAL FLUTED TAPS



FAST SPIRAL FLUTED TAPS

Size	Basic Major Diameter	Threads per Inch NC UNC	Threads per Inch NF UNF	No. of Flutes	Pitch Dia. Limits & Chamfers[a] H2	Pitch Dia. Limits & Chamfers[a] H3	Length Overall, *A*	Length of Thread, *B*	Length of Square, *C*	Diameter of Shank, *D*	Size of Square, *E*
3[b]	0.099	48	…	2	PB	…	1 13/16	1/2	3/16	0.141	0.110
4	0.112	40	…	2	PB	…	1 7/8	9/16	3/16	0.141	0.110
5	0.125	40	…	2	PB	…	1 15/16	5/8	3/16	0.141	0.110
6	0.138	32	…	2	…	PB	2	11/16	3/16	0.141	0.110
8	0.164	32	…	2[c], 3[b]	…	PB	2 1/8	3/4	1/4	0.168	0.131
10	0.190	24	32	2[c], 3[b]	…	PB	2 3/8	7/8	1/4	0.194	0.152
12[d]	0.216	24	…	2[c], 3[b]	…	PB	2 3/8	15/16	9/32	0.220	0.165

[a] Bottom chamfer applies only to regular and fast spiral-fluted machine screw taps.
[b] Applies only to fast spiral-fluted machine screw taps.
[c] Does not apply to fast spiral-fluted machine screw taps.
[d] Does not apply to regular spiral-fluted machine screw taps.

Tolerances for General Dimensions					
Element	Size Range	Tolerance	Element	Size Range	Tolerance
Overall Length, *A*	3 to 12	±1/32	Shank Diameter, *D*	3 to 12	–0.0015
Thread Length, *B*	3 to 12	±3/64			
Square Length, *C*	3 to 12	±1/32	Size of Square, *E*	3 to 12	–0.004

All dimensions are given in inches. These standard taps are made of high-speed steel with ground threads. For standard thread limits see Table 6. For eccentricity tolerances see Table 25.

Spiral Pointed Only Taps: These taps are standard with plug chamfer only. They are provided with a spiral point only; the balance of the threaded section is left unfluted. These Style 1 taps have external centers on thread and shank ends.

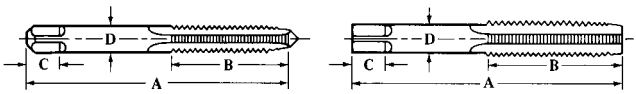
Regular Spiral Fluted Taps: These taps have right-hand spiral flutes with a helix angle of from 25 to 35 degrees.

Fast Spiral Fluted Taps: These taps have right-hand spiral flutes with a helix angle of from 45 to 60 degrees.

Both regular and fast spiral-fluted Style 1 taps have external centers on thread and shank ends (may be removed on thread end of bottoming taps).

Chamfer designations: P = plug and B = bottoming.

Table 15a. ANSI Standard Ground Thread Straight Fluted Taps—Fractional Sizes *ASME/ANSI B94.9-1987*



STYLE 2 **STYLE 3**

Dia. of Tap	Threads per Inch NC UNC	Threads per Inch NF UNF	No. of Flutes	Pitch Diameter Limits and Chamfers H1	H2	H3	H4	H5	Dimensions Length Overall, *A*	Length ofThread, *B*	Length of Square, *C*	Dia.of Shank, *D*	Sizeof Square, *E*
1/4	20	…	4	TPB	TPB	TPB	…	PB	2 1/2	1	5/16	0.255	0.191
1/4	…	28	4	PB	PB	TBP	PB	…	2 1/2	1	5/16	0.255	0.191
5/16	18	…	4	PB	PB	TPB	…	PB	2 23/32	1 1/8	3/8	0.318	0.238
5/16	…	24	4	PB	P	TPB	PB	…	2 23/32	1 1/8	3/8	0.318	0.238
3/8	16	…	4	PB	PB	TPB	…	PB	2 15/16	1 1/4	7/16	0.381	0.286
3/8	…	24	4	PB	PB	TPB	PB	…	2 15/16	1 1/4	7/16	0.381	0.286
7/16	14	20	4	…	…	TPB	…	PB	3 5/32	1 7/16	13/32	0.323	0.242
1/2	13	…	4	P	…	TPB	…	PB	3 3/8	1 21/32	7/16	0.367	0.275
1/2	…	20	4	PB	…	TPB	…	P	3 3/8	1 21/32	7/16	0.367	0.275
9/16	12	…	4	…	…	TPB	…	P	3 19/32	1 21/32	1/2	0.429	0.322
9/16	…	18	4	…	P	TPB	…	P	3 19/32	1 21/32	1/2	0.429	0.322
5/8	11	…	4	…	P	TPB	…	PB	3 13/16	1 13/16	9/16	0.480	0.360
5/8	…	18	4	…	P	TPB	…	PB	3 13/16	1 13/16	9/16	0.480	0.360
11/16 [a]	…	…	4	…	…	TPB	…	…	4 1/32	1 13/16	5/8	0.542	0.406
3/4	10	…	4	…	P	TPB	…	PB	4 1/4	2	11/16	0.590	0.442
3/4	…	16	4	P	P	TPB	…	PB	4 1/4	2	11/16	0.590	0.442
7/8 [b]	9	…	4	…	…	…	TPB	…	4 11/16	2 7/32	3/4	0.697	0.523
7/8	…	14	4	…	P	…	TPB	…	4 11/16	2 7/32	3/4	0.697	0.523
1 [b]	8	…	4	…	…	…	TPB	…	5 1/8	2 1/2	13/16	0.800	0.600
1	…	12	4	…	…	…	TPB	…	5 1/8	2 1/2	13/16	0.800	0.600
1 [c]	…	…	4	…	…	…	TPB	…	5 1/8	2 1/2	13/16	0.800	0.600
1 1/8	7	12	4	…	…	…	TPB	…	5 7/16	2 9/16	7/8	0.896	0.672
1 1/4	7	12 [d]	4	…	…	…	TPB	…	5 3/4	2 9/16	1	1.021	0.766
1 3/8	6	12 [d]	4	…	…	…	TPB	…	6 1/16	3	1 1/16	1.108	0.831
1 1/2	6	12 [d]	4	…	…	…	TPB	…	6 3/8	3	1 1/8	1.233	0.925

[a] This size has 11 or 16 threads per inch NS-UNS.

[b] These sizes are also available with plug chamfer in H6 pitch diameter limits.

[c] This size has 14 threads per inch NS-UNS.

[d] In these sizes NF-UNF thread taps have six flutes.

Tolerances for General Dimensions					
Element	Diameter Range	Tolerance	Element	Diameter Range	Tolerance
Length Overall, *A*	1/4 to 1 incl 1 1/8 to 1 1/2 incl	±1/32 ±1/16	Diameter of Shank, *D*	1/4 to 5/8 incl 11/16 to 1 1/2 incl	–0.0015 –0.002
Length of Thread, *B*	1/4 to 1/2 incl 9/16 to 1 1/2 incl	±1/16 ±3/32	Size of Square, *E*	1/4 to 1/2 incl 9/16 to 1 incl 1 1/16 to 1 1/2 incl	–0.004 –0.006 –0.008
Length of Square, *C*	1/4 to 1 incl 1 1/16 to 1 1/2 incl	±1/32 ±1/16			

All dimensions are given in inches.

These taps are standard in high-speed steel.

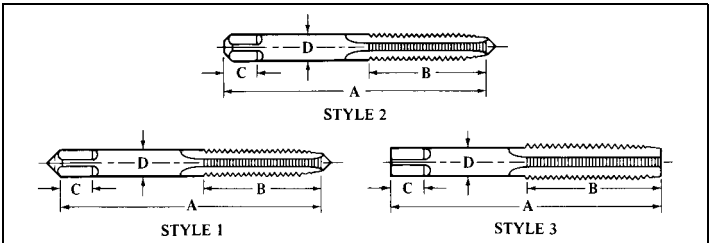
Chamfer designations are: T = taper, P = plug, and B = bottoming.

Style 2 taps, 3/8 inch and smaller, have external center on thread end (may be removed on bottoming taps) and external partial cone center on shank end with length of come approximately one-quarter of diameter of shank.

Style 3 taps, larger than 3/8 inch, have internal center in thread and shank ends.

For standared thread limits see Table 4. For eccentricity tolerances see Table 25.

Table 15b. ANSI Standard Cut Thread Straight Fluted Taps—Fractional Sizes *ASME/ANSI B94.9-1987*



Dia. of Tap	Threads Per Inch: Carbon Steel NC UNC	Carbon Steel NF UNF	Carbon Steel NS UNS	HS Steel NC UNC	HS Steel NF UNF	No. of Flutes	Dimensions: Length Overall, *A*	Length of Thread, *B*	Length of Square, *C*	Dia. of Shank, *D*	Size of Square, *E*
1/8	…	…	40	…	…	3	1 15/16	5/8	3/16	0.141	0.110
5/32	…	…	32	…	…	4	2 1/8	3/4	1/4	0.168	0.131
3/16	…	…	24, 32	…	…	4	2 3/8	7/8	1/4	0.194	0.152
1/4	20	28	…	20	28	4	2 1/2	1	5/16	0.255	0.191
5/16	18	24	…	18	24	4	2 23/32	1 1/8	3/8	0.318	0.238
3/8	16	24	…	16	24	4	2 15/16	1 1/4	7/16	0.381	0.286
7/16	14	20	…	14	20	4	3 3/32	1 7/16	13/32	0.323	0.242
1/2	13	20	…	13	20	4	3 3/8	1 21/32	7/16	0.367	0.275
9/16	12	18	…	12	…	4	3 19/32	1 21/32	1/2	0.429	0.322
5/8	11	18	…	11	18	4	3 13/16	1 13/16	9/16	0.480	0.360
3/4	10	16	…	10	16	4	4 1/4	2	11/16	0.590	0.442
7/8	9	14	…	9	14	4	4 11/16	2 7/32	3/4	0.697	0.523
1	8	…	14[a]	8	…	4	5 1/8	2 1/2	13/16	0.800	0.600
1 1/8	7	12	…	…	…	4	5 7/16	2 9/16	7/8	0.896	0.672
1 1/4	7	12[b]	…	…	…	4	5 3/4	2 9/16	1	1.021	0.766
1 3/8	6[a]	12[ba]	…	…	…	4	6 1/16	3	1 1/16	1.108	0.831
1 1/2	6	12[ba]	…	…	…	4	6 3/8	3	1 1/8	1.233	0.925
1 3/4	5[a]	…	…	…	…	6	7	3 3/16	1 1/4	1.430	1.072
2	4 1/2[a]	…	…	…	…	6	7 5/8	3 9/16	1 3/8	1.644	1.233

[a] Standard in plug chamfer only.

[b] In these sizes NF-UNF thread taps have six flutes.

Tolerances for General Dimensions					
Elements	Range	Tolerance	Elements	Range	Tolerance
Length Overall, *A*	1/16 to 1 1 1/8 to 2	±1/32 ±1/16	Diameter of Shank, *D*	1/16 to 3/16 1/4 to 1 1 1/8 to 2	−0.004 −0.005 −0.007
Length of Thread, *B*	1/16 to 3/16 1/4 to 1/2 9/16 to 1 1/2 1 5/8 to 2	±3/64 ±1/16 ±3/32 ±1/8	Size of Square, *E*	1/16 to 1/2 9/16 to 1 1 1/8 to 2	−0.004 −0.006 −0.008
Length of Square, *C*	1/16 to 1 1 1/8 to 2	±1/32 ±1/16			

All dimensions are given in inches.

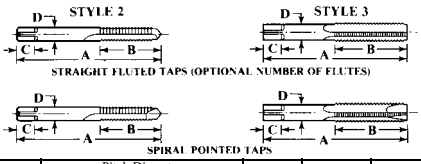
These taps are standard in carbon steel and high-speed steel.

Except where indicated, these taps are standard with taper, plug, or bottoming chamfer.

Cut thread taps, sizes 3/8 inch and smaller have optional style center on thread and shank ends; sizes larger than 3/8 inch have internal centers in thread and shank ends.

For standard thread limits see Table 3. For eccentricity tolerances see Table 25.

Table 16. ANSI Standard Straight Fluted (Optional Number of Flutes) and Spiral Pointed Taps—Fractional Sizes *ASME/ANSI B94.9-1987*



Dia. of Tap	Threads per-Inch NC UNC	Threads per-Inch NF UNF	No. of Flutes	Pitch Diameter Limits and Chamfers[ab] H1	H2	H3	H4	H5	Length Overall, *A*	Length of Thread, *B*	Length of Square, *C*	Dia. of Shank, *D*	Size of Square, *E*
Ground Thread High-Speed-Steel Straight Fluted Taps													
1/4	20	…	2	…	…	PB	…	…	2 1/2	1	5/16	0.255	0.191
1/4	20	…	3	P	P	PB	…	P	2 1/2	1	5/16	0.255	0.191
1/4	…	28	2, 3	…	…	PB	…	…	2 1/2	1	5/16	0.255	0.191
5/16	18	…	2	…	…	PB	…	…	2 23/32	1 1/8	3/8	0.318	0.238
5/16	18	…	3	…	…	PB	…	…	2 23/32	1 1/8	3/8	0.318	0.238
5/16	…	24	3	…	…	PB	…	…	2 23/32	1 1/8	3/8	0.318	0.238
3/8	16	…	3	…	…	PB	…	…	2 15/16	1 1/4	7/16	0.381	0.286
3/8	…	24	3	…	…	PB	…	…	2 15/16	1 1/4	7/16	0.381	0.286
7/16	14	…	3	…	…	P	…	…	3 3/32	1 7/16	13/32	0.323	0.242
7/16	…	20	3	…	…	P	…	…	3 3/32	1 7/16	13/32	0.323	0.242
1/2	13	…	3	…	…	PB	…	…	3 3/8	1 21/32	7/16	0.367	0.275
1/2	…	20	3	…	…	P	…	…	3 3/8	1 21/32	7/16	0.367	0.275
Ground Thread High-Speed-Steel and Cut Thread High-Speed-Steel Spiral Pointed Taps													
1/4	20	…	2	P	P	PB	…	P	2 1/2	1	5/16	0.255	0.191
1/4[a]	20	…	3	…	…	P	…	P	2 1/2	1	5/16	0.255	0.191
1/4	…	28	2	P	P	PB	P	…	2 1/2	1	5/16	0.255	0.191
1/4[a]	…	28	3	…	P	…	P	…	2 1/2	1	5/16	0.255	0.191
5/16	18	…	2	P	P	PB	…	P	2 23/32	1 1/8	3/8	0.318	0.238
5/16[a]	18	…	3	…	…	P	…	P	2 23/32	1 1/8	3/8	0.318	0.238
5/16	…	24	2	P	P	PB	P	…	2 23/32	1 1/8	3/8	0.318	0.238
5/16[a]	…	24	3	…	P	P	P	…	2 23/32	1 1/8	3/8	0.318	0.238
3/8	16	…	3	P	P	P	…	P	2 15/16	1 1/4	7/16	0.381	0.286
3/8	…	24	3	P	P	P	P	…	2 15/16	1 1/4	7/16	0.381	0.286
7/16[a]	14	20	3	…	P[c]	P	…	P	3 3/32	1 7/16	13/32	0.323	0.242
1/2	13	20[a]	3	P	P	P	…	P	3 3/8	1 21/32	7/16	0.367	0.275
5/8[a]	11	18	3	…	…	P	…	P[d]	3 13/16	1 13/16	9/16	0.480	0.360
3/4[a]	10	16	3	…	…	P	…	P[e]	4 1/4	2	11/16	0.590	0.442

[a] Applies only to ground thread high-speed-steel taps.

[b] Cut thread high-speed-steel taps are standard with plug chamfer only.

[c] Applies only to 7/16-14 tap.

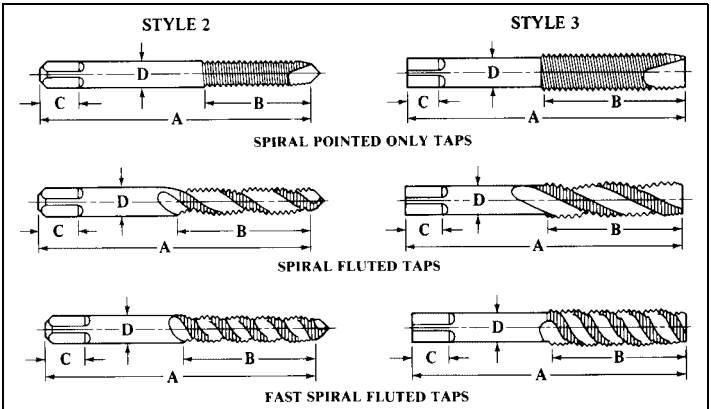
[d] Applies only to 5/8-11 tap.

[e] Applies ony to 3/4-10 tap. For eccentricity tolerances see Table 25.

Tolerances for General Dimensions							
Element	Diameter Range	Tolerance Ground Thread	Tolerance Cut Thread	Element	Diameter Range	Tolerance Ground Thread	Tolerance CutThread
Overall-Length, *A*	1/4 to 3/4	±1/32	±1/32	ShankDiameter,D	1/4 to 5/8 3/4	−0.0015 −0.0020	−0.005 …
Thread-Length, *B*	1/4 to 1/2 5/8 to 3/4	±1/16 ±1/32	±1/16	Size ofSquare,*E*	1/4 to 1/2 5/8 to 3/4	−0.0040 −0.0060	−0.004 …
				Square Length, *C*	1/4 to 3/4	±1/32	

All dimensions are given in inches. P = plug and B = bottoming. Ground thread taps — Style 2, 3/8 inch and smaller, have external center on thread end (may be removed on bottoming taps) and external partial cone center on shank end, with length of cone approximately 1/4 of shank diameter. Ground thread taps—Style 3, larger than 3/8 inch, have internal center in thread and shank ends. Cut thread-taps, 3/8 inch and smaller have optional style center on thread and shank ends; sizes larger than 3/8 inch have internal centers in thread and shank ends. For standard thread limits see Tables 3 and 4.

Table 17. Other Types of ANSI Standard Taps *ASME/ANSI B94.9-198*



Dia. of Tap	Threads per Inch NC UNC	Threads per Inch NF UNF	Number of Flutes	Length Overall, *A*	Length of Thread, *B*	Length of Square, *C*	Dia. of Shank, *D*	Size of Square, *E*
1/4	20	28[a]	2[b], 3[a]	2 1/2	1	5/16	0.255	0.191
5/16	18	24[a]	2[c], 3[a]	2 23/32	1 1/8	3/8	0.318	0.238
3/8	16	24[a]	3	2 15/16	1 1/4	7/16	0.381	0.286
7/16 [d]	14	20	3	3 5/32	1 7/16	13/32	0.323	0.242
1/2	13	20[d]	3	3 3/8	1 21/32	7/16	0.367	0.275

[a] Does not apply to spiral pointed only taps.
[b] Does not apply to spiral fluted taps or to spiral fluted taps with 28 threads per inch.
[c] Applies only to spiral pointed only taps.
[d] Applies only to fast spiral fluted taps.

Tolerances for General Dimensions					
Element	Diameter Range	Tolerance	Element	Diameter Range	Tolerance
Overall Length, *A*	1/4 to 1/2	±1/32	Shank Diameter, *D*	1/4 to 1/2	−0.0015
Thread Length, *B*	1/4 to 1/2	±1/16	Size of Square, *E*	1/4 to 1/2	−0.004
Square Length, *C*	1/4 to 1/2	±1/32			

All dimensions are given in inches. These standard taps are made of high-speed steel with ground threads. For standard thread limits see Table 4.

Spiral Pointed Only Taps: These taps are standard with plulg chamfer only in H3 limit. They are provided with spiral point only. The balance of the threaded section is left unfluted.

Spiral Fluted Taps: These taps are standard with plug or bottoming chamfer in H3 limit and have right-hand spiral flutes with a helix angle of from 25 to 35 degrees.

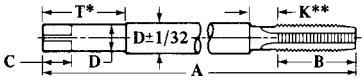
Fast Spiral Fluted Taps: These taps are standard with plug or bottoming chamfer in H3 limit and have right-hand spiral flutes with a helix angle of from 45 to 60 degrees.

Style 2 taps, 3/8 inch and smaller, have external center on thread end (may be removed on bottoming taps) and external partial cone center on shank end with cone length approximately 1/4 shank diameter.

Style 3 taps larger than 3/8 inch have internal center in thread and shank ends.

For standard thread limits see Table 4. For eccentricity tolerances see Table 25.

Table 18. ANSI Standard Pulley Taps *ASME/ANSI B94.9-1987*



Dia. of Tap	Threads per Inch NC UNC	Number of Flutes	Length Overall, *A*	Length of Thread, *B*	Length of Square, *C*	Dia. of Shank, *D*	Length of Close Tolerance, *T*[a]	Size of Square, *E*	Length of Neck, *K*[b]
1/4	20	4	6,8	1	5/16	0.255	1 1/2	0.191	3/8
5/16	18	4	6,8	1 1/8	3/8	0.318	1 9/16	0.238	3/8
3/8	16	4	6,8,10	1 1/4	7/16	0.381	1 5/8	0.286	3/8
7/16	14	4	6	1 7/16	1/2	0.444	1 11/16	0.333	7/16
1/2	13	4	6,8,10,12	1 21/32	9/16	0.507	1 11/16	0.380	1/2
5/8	11	4	6,8,10	1 13/16	11/16	0.633	2	0.475	5/8
3/4	10	4	10	2	3/4	0.759	2 1/4	0.569	3/4

[a] *T* is minimum length of shank which is held to eccentricity tolerances.
[b] *K* neck optional with manufacturer.

Tolerances for General Dimensions					
Element	Diameter Range	Tolerance	Element	Diameter Range	Tolerance
Overall Length, *A*	1/4 to 3/4	±1/16	Shank Diameter, *D*	1/4 to 3/4	–0.005
Thread Length, *B*	1/4 to 3/4	±1/16	Size of Square, *E*	1/4 to 1/2	–0.004
Square Length, *C*	1/4 to 3/4	±1/32		5/8 to 3/4	–0.006

All dimensions are given in inches. These ground thread high-speed steel taps are standard with plug chamfer in H3 limit only. All taps have an internal center in thread end. For standard thread limits see Table 4. For eccentricity tolerances see Table 25.

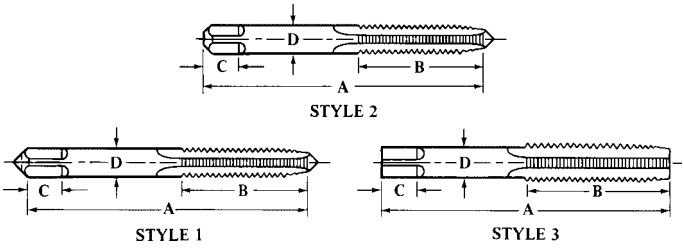
Table 19. ANSI Standard Ground Thread Spark Plug Taps—Metric Sizes
ASME/ANSI B94.9-1987

Tap Diameter, mm	Pitch, mm	Number of Flutes	Overall Length, In. *A*	Thread Length, In. *B*	Square Length, In. *C*	Shank Dia., In. *D*	Square Size, In. *E*
14	1.25	4	3 19/32	1 21/32	1/2	0.429	0.322
18	1.50	4	4 1/32	1 13/16	5/8	0.542	0.406

These are high-speed steel Style 3 taps and have internal center in thread and shank ends. They are standard with plug chamfer only, right-hand threads with 60-degree form of thread.

Tolerances: Overall length, ± 1/32 inch; thread length, ± 3/32 inch; square length, ± 1/32 inch; shank diameter, 14 mm, –0.0015 inch, 18 mm, –0.0020 inch; and size of square, –0.0040 inch.

Table 20a. ANSI Standard Ground Thread Straight Fluted Taps — M Profile — Metric Sizes *ASME/ANSI B94.9-1987*



Nom. Dia. mm.	Pitch mm	No. of Flutes	Pitch Diameter Limits and Chamfers D3	D4	D5	D6	D7	D8	D9	Length Overall *A*	Length of Thread *B*	Length of Square *C*	Dia. of Square *D*	Size of Square *E*
1.6	0.35	2	PB	…	…	…	…	…	…	1 5/8	5/16	3/16	0.141	0.110
2	0.4	3	PB	…	…	…	…	…	…	1 3/4	7/16	3/16	0.141	0.110
2.5	0.45	3	PB	…	…	…	…	…	…	1 13/16	1/2	3/16	0.141	0.110
3	0.5	3	PB	…	…	…	…	…	…	1 15/16	5/8	3/16	0.141	0.110
3.5	0.6	3	…	PB	…	…	…	…	…	2	11/16	3/16	0.141	0.110
4	0.7	4	…	PB	…	…	…	…	…	2 1/8	3/4	1/4	0.168	0.131
4.5	0.75	4	…	PB	…	…	…	…	…	2 3/8	7/8	1/4	0.194	0.152
5	0.8	4	…	PB	…	…	…	…	…	2 3/8	7/8	1/4	0.194	0.152
6	1	4	…	…	PB	…	…	…	…	2 1/2	1	5/16	0.255	0.191
7	1	4	…	…	PB	…	…	…	…	2 23/32	1 1/8	3/8	0.318	0.238
8	1.25	4	…	…	PB	…	…	…	…	2 23/32	1 1/8	3/8	0.318	0.238
10	1.5	4	…	…	…	PB	…	…	…	2 15/16	1 1/4	7/16	0.381	0.286
12	1.75	4	…	…	…	PB	…	…	…	3 3/8	1 21/32	7/16	0.367	0.275
14	2	4	…	…	…	…	PB	…	…	3 19/32	1 21/32	1/2	0.429	0.322
16	2	4	…	…	…	…	PB	…	…	3 13/16	1 13/16	9/16	0.480	0.360
20	2.5	4	…	…	…	…	PB	…	…	4 15/32	2	11/16	0.652	0.489
24	3	4	…	…	…	…	…	PB	…	4 29/32	2 7/32	3/4	0.760	0.570
30	3.5	4	…	…	…	…	…	…	PB	5 7/16	2 9/16	1	1.021	0.766
36	4	4	…	…	…	…	…	…	PB	6 1/16	3	1 1/8	1.233	0.925

Tolerances					
Element	Nom. Dia. Range, mm	Toler., Inch	Element	Nom. Dia. Range, mm	Toler., Inch
Overall Length, *A*	M1.6 to M24, incl.	±1/32	Shank Diameter, *D*	M1.6 to M14, incl.	–0.0015
	M30 and M36	±1/16		M16 to M36	–0.002
Thread Length, *B*	M1.6 to M5, incl.	±3/64	Size of Square, *E*	M1.6 to M12, incl.	–0.004
	M6 to M12 incl.	±1/16		M14 to M24, incl.	–0.006
	M14 to M36	±3/32		M30 and M36	–0.008
Square Length, *C*	M1.6 to M24, incl.	±1/32			
	M30 and M36	±1/16			

All dimensions are in inches except where otherwise stated.

Chamfer Designation: P — Plug, B — Bottoming. These taps are high-speed steel.

Style 1 taps, sizes M1.6 through M5, have external center on thread and shank ends (may be removed on thread end of bottoming taps).

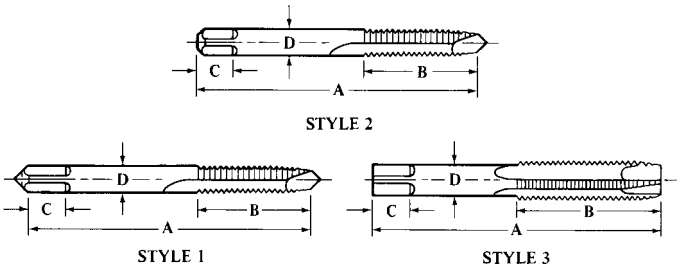
Style 2 taps, sizes M6, M7, M8, and M10, have external center on thread end (may be removed on bottoming taps) and external partial cone center on shank end with length of cone approximately 1/4 of diameter of shank.

Style 3 taps, sizes larger than M10 have external center on thread and shank ends.

For standard thread limits see Tables 8a and 8b.

For eccentricity tolerances of tap elements see Table 25.

Table 20b. ANSI Standard Spiral Pointed Ground Thread Taps — M Profile — Metric Sizes *ASME/ANSI B94.9-1987*



Nom. Dia. mm.	Pitch mm	No. of Flutes	Pitch Diameter Limits and Styles					Length Overall	Length of Thread	Length of Square	Dia. of Square	Size of Square
			D3	D4	D5	D6	D7	*A*	*B*	*C*	*D*	*E*
1.6	0.35	2	P	…	…	…	…	1 5/8	5/16	3/16	0.141	0.110
2	0.4	2	P	…	…	…	…	1 3/4	7/16	3/16	0.141	0.110
2.5	0.45	2	P	…	…	…	…	1 13/16	1/2	3/16	0.141	0.110
3	0.5	2	P	…	…	…	…	1 15/16	5/8	3/16	0.141	0.110
3.5	0.6	2	…	P	…	…	…	2	11/16	3/16	0.141	0.110
4	0.7	2	…	P	…	…	…	2 1/8	3/4	1/4	0.168	0.131
5	0.8	2	…	P	…	…	…	2 3/8	7/8	1/4	0.194	0.152
6	1	2	…	…	P	…	…	2 1/2	1	5/16	0.255	0.191
8	1.25	2	…	…	P	…	…	2 23/32	1 1/8	3/8	0.318	0.238
10	1.5	3	…	…	…	P	…	2 15/16	1 1/4	7/16	0.381	0.286
12	1.75	3	…	…	…	P	…	3 3/8	1 21/32	7/16	0.367	0.275
14	2	3	…	…	…	…	P	3 19/32	1 21/32	1/2	0.429	0.322
16	2	3	…	…	…	…	P	3 13/16	1 13/16	9/16	0.480	0.360
20	2.5	3	…	…	…	…	P	4 15/32	2	11/16	0.652	0.489

Tolerances

Element	Nom. Dia. Range, mm	Toler., Inch
Overall Length, *A*	M1.6 to M20, incl.	±1/32
Thread Length, *B*	M1.6 to M5, incl.	±3/64
	M16 to M12 incl.	±1/16
	M14 to M20	±3/32
Square Length, *C*	M1.6 to M20	±1/32

Element	Nom. Dia. Range, mm	Toler., Inch
Shank Diameter, *D*	M1.6 to M14, incl. M16 to M20	–0.0015 –0.002
Size of Square, *E*	M1.6 to M12, incl. M14 to M20, incl.	–0.004 –0.006

All dimensions are in inches except where otherwise stated.

Chamfer Designation: P — Plug. These taps are high-speed steel.

Style 1 taps, sizes M1.6 through M5, have external center on thread and shank ends.

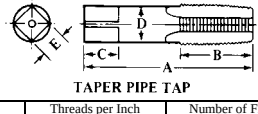
Style 2 taps, sizes M6, M8 and M10, have external center on thread end and external partial cone center on shank end with length of cone approximately 1/4 of diameter of shank.

Style 3 taps, sizes larger than M10 have external center on thread and shank ends.

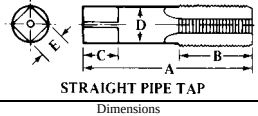
For standards thread limits see Table 8a and 8b.

For eccentricity tolerances of tap elements see Table 25.

Table 21. ANSI Standard Taper and Straight Pipe Taps *ASME/ANSI B94.9-1987*



TAPER PIPE TAP



STRAIGHT PIPE TAP

Nominal Size	Threads per Inch: Carbon Steel	Threads per Inch: High-Speed Steel	Number of Flutes: Regular	Number of Flutes: Interrupted	Dimensions: Length Overall, *A*	Dimensions: Length of Thread, *B*	Dimensions: Length of Square, *C*	Dimensions: Diameter of Shank, *D*	Dimensions: Size of Square, *E*
Taper Pipe Taps									
1/16 [a]	…	27	4	…	2 1/8	11/16	3/8	0.3125	0.234
1/8	27	27	4	5	2 1/8	3/4	3/8	0.3125	0.234
1/8	27	27	4	5	2 1/8	3/4	3/8	0.4375	0.328
1/4	18	18	4	5	2 7/16	1 1/16	7/16	0.5625	0.421
3/8	18	18	4	5	2 9/16	1 1/16	1/2	0.7000	0.531
1/2	14	14	4	5	3 1/8	1 3/8	5/8	0.6875	0.515
3/4	14	14	5	5	3 1/4	1 3/8	11/16	0.9063	0.679
1	11 1/2	11 1/2	5	5	3 3/4	1 3/4	13/16	1.1250	0.843
1 1/4	11 1/2	11 1/2	5	5	4	1 3/4	15/16	1.3125	0.984
1 1/2	11 1/2	11 1/2	7	7 [ba]	4 1/4	1 3/4	1	1.5000	1.125
2	11 1/2	11 1/2	7	7 [ba]	4 1/2	1 3/4	1 1/8	1.8750	1.406
2 1/2 [c]	8	…	8	…	5 1/2	2 9/16	1 1/4	2.2500	1.687
3 [c]	8	…	8	…	6	2 5/8	1 3/8	2.6250	1.968
Straight Pipe Taps									
1/8 [a]	…	27	4	…	2 1/8	3/4	3/8	0.3125	0.234
1/8	…	27	4	…	2 1/8	3/4	3/8	0.4375	0.328
1/4	…	18	4	…	2 7/16	1 1/16	7/16	0.5625	0.421
3/8	…	18	4	…	2 9/16	1 1/16	1/2	0.7000	0.531
1/2	…	14	4	…	3 1/8	1 3/8	5/8	0.6875	0.515
3/4	…	14	5	…	3 1/4	1 3/8	11/16	0.9063	0.679
1	…	11 1/2	5	…	3 3/4	1 3/4	13/16	1.1250	0.843

[a] Ground thread taps only.

[b] Standard in NPT form of thread only.

[c] Cut thread taps only.

Tolerances for General Dimensions							
Element	Diameter Range	Tolerance: Cut Thread	Tolerance: Ground Thread	Element	Diameter Range	Tolerance: Cut Thread	Tolerance: Ground Thread
Overall Length, *A*	1/16 to 3/4	±1/32	±1/32	Shank Diameter, *D*	1/16 to 1/8	…	−0.0015
	1 to 3	±1/16	± 1/16		1/8 to 1/2	−0.007	…
Thread Length, *B*	1/16 to 3/4	±1/16	±1/16		1/4 to 1	…	−0.002
	1 to 1 1/4	±3/32	±3/32		3/4 to 3	−0.009	…
	1 1/2 to 3	±1/8	±1/8		1 1/4 to 2	…	−0.003
Square Length, *C*	1/16 to 3/4	±1/32	±1/32	Size of Square, *E*	1/16 to 1/8	−0.004	−0.004
	1 to 3	±1/16	±1/16		1/4 to 3/4	−0.006	−0.006
					1 to 3	−0.008	−0.008

All dimensions are given in inches. These taps have an internal center in the thread end. *Taper Pipe Threads*: The 1/8-inch pipe tap is furnished with large size shank unless the small shank is specified. These taps have 2 to 3 1/2 threads chamfer. The first few threads on interrupted thread pipe taps are left full. The following styles and sizes are standard: 1/16 to 2 inches regular ground thread, NPT, NPTF, and ANPT: 1/8 to 2 inches interrupted ground thread, NPT, NPTF and ANPT: 1/8 to 3 inches carbon steel regular cut thread, NPT; 1/8 to 2 inches high-speed steel, regular cut thread, NPT; 1/8 to 1 1/4 inches high-speed steel interrupted cut thread, NPT. For standard thread limits see Tables 9a and 9b. *Straight Pipe Threads:* The 1/8-inch pipe tap is furnished with large size shank unless the small size is specified. These taps are standard with plug chamfer only. The following styles and sizes are standard: ground threads — 1/8 to 1 inch, NPSC and NPSM; 1/8 to 3/4 inch, NPSF; cut threads — 1/8 to 1 inch, NPSC and NPSM. For standard thread limits see Tables 10a, 10b, and 10c. For eccentricity tolerances see Table 25.

Table 22. Taps Recommended for Classes 2B and 3B Unified Screw Threads — Numbered and Fractional Sizes *ASME/ANSI B94.9-1987*

Size	Threads per Inch		Recommended Tap For Class of Thread		Pitch Diameter Limits For Class of Thread		
	NC UNC	NF UNF	Class 2B[a]	Class 3B	Min All Classes (Basic)	Max Class 2B	Max Class 3B
Machine Screw Numbered Size Taps							
0	…	80	G H2	G H1	0.0519	0.0542	0.0536
1	64	…	G H2	G H1	0.0629	0.0655	0.0648
1	…	72	G H2	G H1	0.0640	0.0665	0.0659
2	56	…	G H2	G H1	0.0744	0.0772	0.0765
2	…	64	G H2	G H1	0.0759	0.0786	0.0779
3	48	…	G H2	G H1	0.0855	0.0885	0.0877
3	…	56	G H2	G H1	0.0874	0.0902	0.0895
4	40	…	G H2	G H2	0.0958	0.0991	0.0982
4	…	48	G H2	G H1	0.0985	0.1016	0.1008
5	40	…	G H2	G H2	0.1088	0.1121	0.1113
5	…	44	G H2	G H1	0.1102	0.1134	0.1126
6	32	…	G H3	G H2	0.1177	0.1214	0.1204
6	…	40	G H2	G H2	0.1218	0.1252	0.1243
8	32	…	G H3	G H2	0.1437	0.1475	0.1465
8	…	36	G H2	G H2	0.1460	0.1496	0.1487
10	24	…	G H3	G H3	0.1629	0.1672	0.1661
10	…	32	G H3	G H2	0.1697	0.1736	0.1726
12	24	…	G H3	G H3	0.1889	0.1933	0.1922
12	…	28	G H3	G H3	0.1928	0.1970	0.1959
Fractional Size Taps							
1/4	20	…	G H5	G H3	0.2175	0.2224	0.2211
1/4	…	28	G H4	G H3	0.2268	0.2311	0.2300
5/16	18	…	G H5	G H3	0.2764	0.2817	0.2803
5/16	…	24	G H4	G H3	0.2854	0.2902	0.2890
3/8	16	…	G H5	G H3	0.3344	0.3401	0.3387
3/8	…	24	G H4	G H3	0.3479	0.3528	0.3516
7/16	14	…	G H5	G H3	0.3911	0.3972	0.3957
7/16	…	20	G H5	G H3	0.4050	0.4104	0.4091
1/2	13	…	G H5	G H3	0.4500	0.4565	0.4548
1/2	…	20	G H5	G H3	0.4675	0.4731	0.4717
9/16	12	…	G H5	G H3	0.5084	0.5152	0.5135
9/16	…	18	G H5	G H3	0.5264	0.5323	0.5308
5/8	11	…	G H5	G H3	0.5660	0.5732	0.5714
5/8	…	18	G H5	G H3	0.5889	0.5949	0.5934
3/4	10	…	G H5	G H5	0.6850	0.6927	0.6907
3/4	…	16	G H5	G H3	0.7094	0.7159	0.7143
7/8	9	…	G H6[b]	G H4	0.8028	0.8110	0.8089
7/8	…	14	G H6[b]	G H4	0.8286	0.8356	0.8339
1	8	…	G H6[b]	G H4	0.9188	0.9276	0.9254
1	…	12	G H6[b]	G H4	0.9459	0.9535	0.9516
1	14NS		G H6[b]	G H4	0.9536	0.9609	0.9590
1 1/8	7	…	G H8[b]	G H4	1.0322	1.0416	1.0393
1 1/8	…	12	G H6[b]	G H4	1.0709	1.0787	1.0768
1 1/4	7	…	G H8[b]	G H4	1.1572	1.1668	1.1644
1 1/4	…	12	G H6[b]	G H4	1.1959	1.2039	1.2019
1 3/8	6	…	G H8[b]	G H4	1.2667	1.2771	1.2745
1 3/8	…	12	G H6[b]	G H4	1.3209	1.3291	1.3270
1 1/2	6	…	G H8[b]	G H4	1.3917	1.4022	1.3996
1 1/2	…	12	G H6[b]	G H4	1.4459	1.4542	1.4522

[a] Cut thread taps in all fractional sizes and in numbered sizes 3 to 12 NC and NF may be used under normal conditions and in average materials to produce tapped holes in this classification.

[b] Standard G H4 taps are also suitable for this class of thread.

All dimensions are given in inches.

The above recommended taps normally produce the class of thread indicated in average materials when used with reasonable care. However, if the tap specified does not give a satisfactory gage fit in the work, a choice of some other limit tap will be necessary.

Standard System of Tap Marking.—Ground thread taps, inch screw threads, are marked with the nominal size, number of threads per inch, the proper symbol to identify the thread form, "HS" for high-speed steel, "G" for ground thread, and designators for tap pitch diameter and special features, such as left-hand and multi-start threads.

Cut thread taps, inch screw threads, are marked with the nominal size, number of threads per inch, and the proper symbol to identify the thread form. High-speed steel taps are marked "HS," but carbon steel taps need not be marked.

Ground thread taps made with metric screw threads, M profile, are marked with "M," followed by the nominal size and pitch in millimeters, separated by "x." Marking also includes "HS" for high-speed steel, "G" for ground thread, designators for tap pitch diameter and special features, such as left-hand and multi-start threads.

Thread symbol designators are listed in the accompanying table. Tap pitch diameter designators, systems of limits, special features, and examples for ground threads are given in the following section.

Standard System Tap Thread Limits and Identification for Unified Inch Screw Threads, Ground Thread.—*H or L Limits:* For Unified inch screw threads, when the maximum tap pitch diameter is over basic pitch diameter by an even multiple of 0.0005 in. or the minimum tap pitch diameter limit is under basic pitch diameter by an even multiple of 0.0005 in., the taps are marked "H" or "L," respectively, followed by a limit number, determined as follows:

H limit number =Amount maximum tap PD limit is over basic PD divided by 0.0005

L limit number =Amount minimum tap PD limit is under basic PD divided by 0.0005

Table 23. Thread Series Designations

Standard Tap Marking	Product Thread Designation	Third Series
M	M	Metric Screw Threads—M Profile, with basic ISO 68 profile
M	MJ	Metric Screw Threads—M Profile, with rounded root of radius 0.15011*P* to 0.18042*P* Class 5 interference-fit thread
NC	NC_5IF	Entire ferrous material range
NC	NC_5INF	Entire nonferrous material range
NPS	NPSC	American Standard straight pipe threads in pipe couplings
NPSF	NPSF	Dry seal American Standard fuel internal straight pipe threads
NPSH	NPSH	American Standard straight hose coupling threads for joining to American Standard taper pipe threads
NPSI	NPSI	Dryseal American Standard intermediate internal straight pipe threads
NPSL	NPSL	American Standard straight pipe threads for loose-fitting mechanical joints with locknuts
NPS	NPSM	American Standard straight pipe threads for free-fitting mechanical joints for fixtures
NPT	NPT	American Standard taper pipe threads for general use
NPTF	NPTF	Dryseal American Standard taper pipe threads
NPTR	NPTR	American Standard taper pipe threads for railing joints
Unified Inch Screw Thread		
N	UN	Constant-pitch series
NC	UNC	Coarse pitch series
NF	UNF	Fine pitch series
NEF	UNEF	Extra-fine pitch series
N	UNJ	Constant-pitch series, with rounded root of radius 0.15011*P* to 0.18042*P* (ext. thd. only)
NC	UNJC	Coarse pitch series, with rounded root of radius 0.15011*P* to 0.18042 *P* (ext. thd. only)
NF	UNJF	Fine pitch series, with rounded root of radius 0.15011*P* to 0.18042*P* (ext. thd. only)
NEF	UNJEF	Extra-fine pitch series, with rounded root of radius 0.15011*P* to 0.18042*P* (ext. thd. only)
N	UNR	Constant-pitch series, with rounded root of radius not less than 0.108*P* (ext. thd. only)
NC	UNRC	Coarse thread series, with rounded root of radius not less than 0.108*P* (ext. thd. only)
NF	UNRF	Fine pitch series, with rounded root of radius not less than 0.108*P* (ext. thd. only)
NEF	UNREF	Extra-fine pitch series, with rounded root of radius not less than 0.108*P* (ext. thd. only)
NS	UNS	Special diameter pitch, or length of engagement

The PD limits for various H limit numbers are given in Table 4. The PD limits for L limit numbers are determined as follows. The minimum tap PD equals the basic PD minus the number of half-thousandths (0.0005 in.) represented by the limit number. The maximum tap PD equals the minimum PD plus the PD tolerance given in Table 24.

Table 24. PD Tolerance for Unified Inch Screw Threads—Ground Thread *ASME/ANSI B94.9-1987*

Threads per Inch	To 1 in., incl.	Over 1 in. to 1½ in., incl.	Over 1½ to 2½ in., incl.	Over 2 ½ in.
80-28	0.0005	0.0010	0.0010	0.0015
24-18	0.0005	0.0010	0.0015	0.0015
16-18	0.0005	0.0010	0.0015	0.0020
7-6	0.0010	0.0010	0.0020	0.0025
5½-4	0.0010	0.0015	0.0020	0.0025

Examples: ⅜-16 NC HS H1

Max. tap PD = 0.3349

Min. tap PD = 0.3344

⅜-16 NC HS G L2

Min. tap PD = Basic PD – 0.0010 in. = 0.3344 – 0.0010 = 0.3334

Max. tap PD = Min. Tap PD + 0.0005 = 0.3334 + 0.0005 = 0.3339

Oversize or Undersize: When the maximum tap PD over basic PD or the minimum tap PD under basic PD is not an even multiple of 0.0005, the tap PD is usually designated as an amount oversize or undersize. The amount oversize is added to the basic PD to establish the *minimum* tap PD. The amount undersize is subtracted from the basic PD to establish the *minimum* tap PD. The PD tolerance in Table 24 is added to the minimum tap PD to establish the maximum tap PD for both.

Example : 7/16-14 NC plus 0.0017 HS G

Min. tap PD = Basic PD + 0.0017 in.

Max. tap PD = Min. tap PD + 0.0005 in.

Whenever possible for oversize or other special tap PD requirements, the maximum and minimum tap PD requirements should be specified.

Special Tap Pitch Diameter: Taps not made to H or L limit numbers, to Table 25, or to the formula for oversize or undersize taps, may be marked with the letter "S" enclosed by a circle or by some other special identifier. *Example:* ½-16 NC HS G .

Table 25. ANSI Standard Eccentricity Tolerances of Tap Elements When Tested on Dead Centers *ASME/ANSI B94.9-1987*

	Range Sizes are Inclusive			Cut Thread		Ground Thread	
Element	Hand, Mch. Screw	Metric	Pipe	Eccentricity	tiv[a]	Eccentricity	tiv[a]
Square	#0–½″	M1.6–M12	1/16–⅛″	0.0030	0.0060	0.0030	0.0060
(at central point)	17/32–4″	M14–M100	¼–4″	0.0040	0.0080	0.0040	0.0080
Shank	#0–5/16″	M1.6–M8	1/16″	0.0030	0.0060	0.0005	0.0010
	11/32–4″	M10–M100	⅛–4″	0.0040	0.0080	0.0008	0.0016
Major Diameter	#0–5/16″	M1.6–M8	1/16″	0.0025	0.0050	0.0005	0.0010
	11/32–4″	M10–M100	⅛–4″	0.0040	0.0080	0.0008	0.0016
Pitch Diameter	#0–5/16″	M1.6–M8	1/16″	0.0025	0.0050	0.0005	0.0010
(at first full thread)	11/32–4″	M10–M100	⅛–4″	0.0040	0.0080	0.0008	0.0016
Chamfer[b]	#0–½″	M1.6–M12	1/16–⅛″	0.0020	0.0040	0.0010	0.0020
	17/32–4″	M14–M100	¼–4″	0.0030	0.0060	0.0015	0.0030

[a] tiv = total indicator variation. Figures are given for both eccentricity and total indicator variation to avoid misunderstanding.

[b] Chamfer should preferably be inspected by light projection to avoid errors due to indicator contact points dropping into the thread groove.

All dimensions are given in inches.

Left-Hand Taps: Taps with left-hand threads are marked "LEFT HAND" or "LH." *Example:* $\frac{3}{8}$-16 NC LH HS G H3.

Multiple-Start Threads: Taps with multiple-start threads are marked with the lead designated as a fraction, also "Double," "Triple," etc. The Unified Screw Thread form symbol is always designated as "NS" for multiple-start threads. *Example:* $\frac{3}{8}$-16 NS Double $\frac{1}{8}$ Lead HS G H5.

Standard System of Ground Thread Tap Limits and Identification for Metric Screw Threads — M Profile.— All calculations for metric taps use millimeter values. When U.S. customary values are needed, they are translated from the three-place millimeter tap diameters only after the calculations are completed.

Table 26. PD Tolerance for Metric Screw Threads— M Profile—Ground Threads *ASME/ANSI B94.9-1987*

Pitch, *P* (mm)	M1.6 to M6.3, incl.	Over M6.3 to M25, incl.	Over M25 to M90, incl.	Over M90
0.3	0.015	0.015	0.020	0.020
0.35	0.015	0.015	0.020	0.020
0.4	0.015	0.015	0.020	0.025
0.45	0.015	0.020	0.020	0.025
0.5	0.015	0.020	0.025	0.025
0.6	0.020	0.020	0.025	0.025
0.7	0.020	0.020	0.025	0.025
0.75	0.020	0.025	0.025	0.031
0.8	0.020	0.025	0.025	0.031
0.9	0.020	0.025	0.025	0.031
1	0.025	0.025	0.031	0.031
1.25	0.025	0.031	0.031	0.041
1.5	0.025	0.031	0.031	0.041
1.75	…	0.031	0.041	0.041
2	…	0.041	0.041	0.041
2.5	…	0.041	0.041	0.052
3	…	0.041	0.052	0.052
3.5	…	0.041	0.052	0.052
4	…	0.052	0.052	0.064
4.5	…	0.052	0.052	0.064
5	…	…	0.064	0.064
5.5	…	…	0.064	0.064
6	…	…	0.064	0.064

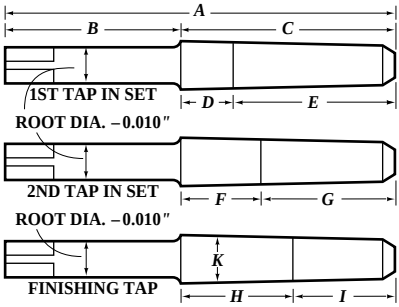
D or DU Limits: When the maximum tap pitch diameter is over basic pitch diameter by an even multiple of 0.013 mm (0.000512 in. reference), or the minimum tap pitch diameter limit is under basic pitch diameter by an even multiple of 0.013 mm, the taps are marked with the letters "D" or "DU," respectively, followed by a limit number. The limit number is determined as follows:

D limit number = Amount maximum tap PD limit is over basic PD divided by 0.013

DU limit number = Amount minimum tap PD limit is under basic PD divided by 0.013

The PD limits for various D limit numbers are given in Table 8b. The PD limits for DU limit numbers are determined as follows. The minimum tap PD equals the basic PD minus the number of millimeters represented by the limit number (multiples of 0.013 mm). The maximum tap PD equals the minimum tap PD plus the PD tolerance given in Table 26. E

Table 27. Dimensions of Acme Threads Taps in Sets of Three Taps



Nominal Dia.	A	B	C	D	E	F	G	H	I	K
1/2	4 1/4	1 7/8	2 3/8	1/2	1 7/8	5/8	1 3/4	7/8	1 1/2	0.520
9/16	4 7/8	2 1/8	2 3/4	9/16	2 3/16	3/4	2	1	1 3/4	0.582
5/8	5 1/2	2 3/8	3 1/8	5/8	2 1/2	7/8	2 1/4	1 1/8	2	0.645
11/16	6	2 1/2	3 1/2	3 13/16	2 13/16	15/16	2 9/16	1 1/4	2 1/4	0.707
3/4	6 1/2	2 11/16	3 13/16	11/16	3 1/8	1	2 13/16	1 3/8	2 7/16	0.770
13/16	6 7/8	2 13/16	4 1/16	3/4	3 5/16	1 1/16	3	1 7/16	2 5/8	0.832
7/8	7 1/4	3	4 1/4	3/4	3 1/2	1 1/8	3 1/8	1 1/2	2 3/4	0.895
15/16	7 9/16	3 1/8	4 7/16	13/16	3 5/8	1 3/16	3 1/4	1 9/16	2 7/8	0.957
1	7 7/8	3 1/4	4 5/8	13/16	3 13/16	1 1/4	3 3/8	1 5/8	3	1.020
1 1/8	8 1/2	3 9/16	4 15/16	7/8	4 1/16	1 5/16	3 5/8	1 3/4	3 3/16	1.145
1 1/4	9	3 3/4	5 1/4	15/16	4 5/16	1 3/8	3 7/8	1 7/8	3 3/8	1.270
1 3/8	9 1/2	4	5 1/2	1	4 1/2	1 7/16	4 1/16	2	3 1/2	1.395
1 1/2	10	4 1/4	5 3/4	1	4 3/4	1 1/2	4 1/4	2 1/8	3 5/8	1.520
1 5/8	10 1/2	4 1/2	6	1	5	1 1/2	4 1/2	2 1/8	3 7/8	1.645
1 3/4	11	4 3/4	6 1/4	1 1/16	5 3/16	1 9/16	4 11/16	2 1/4	4	1.770
1 7/8	11 3/8	4 7/8	6 1/2	1 1/16	5 7/16	1 9/16	4 15/16	2 1/4	4 1/4	1.895
2	11 3/4	5	6 3/4	1 1/8	5 5/8	1 5/8	5 1/8	2 3/8	4 3/8	2.020
2 1/4	12 1/2	5 1/4	7 1/4	1 1/8	6 1/8	1 3/16	5 1/2	2 1/2	4 3/4	2.270
2 1/2	13 1/4	5 1/2	7 3/4	1 3/4	6 9/16	1 7/8	5 7/8	2 5/8	5 1/8	2.520
2 3/4	14	5 3/4	8 1/4	1 1/4	7	2	6 1/4	2 3/4	5 1/2	2.770
3	15	6 1/4	8 3/4	1 1/4	7 1/2	2	6 3/4	3	5 3/4	3.020

Examples:

M1.6 × 0.35 HS G D3

Max. tap PD = 1.412

Min. tap PD = 1.397

M6 × 1 HS G DU4

Min. tap PD = Basic PD – 0.052 mm = 5.350 – 0.052 = 5.298

Max. tap PD = Min. tap PD + 0.025 mm = 5.323

Metric oversize or undersize taps, taps with special pitch diameters, and left-hand taps follow the marking system given for inch taps.
Examples:

M12 × 1.75 + 0.044 HS G

M10 × 1.5 HS G

M10 × 1.5 LH HS G D6

Multiple-Start Threads: Metric taps with multiple-start threads are marked with the lead designated in millimeters preceded by the letter "L," the pitch in millimeters preceded by the letter "P," and the words "(2 starts)," "(3 starts)," etc.

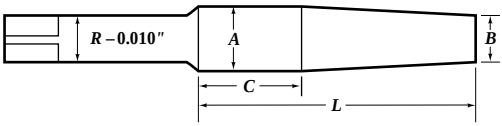
Examples: M16 × L4-P2 (2 starts) HS G D8
M14 × L6-P2 (3 starts) HS G D7

Acme and Square-Threaded Taps.—These taps are usually made in sets, three taps in a set being the most common. For very fine pitches, two taps in a set will be found sufficient, whereas as many as five taps in a set are used for coarse pitches. The table on the next page gives dimensions for proportioning both Acme and square-threaded taps when made in sets. In cutting the threads of square-threaded taps, one leading tap maker uses the following rules: The width of the groove between two threads is made equal to one-half the pitch of the thread, less 0.004 inch, making the width of the thread itself equal to one-half of the pitch, plus 0.004 inch. The depth of the thread is made equal to 0.45 times the pitch, plus 0.0025 inch. This latter rule produces a thread that for all the ordinarily used pitches for square-threaded taps has a depth less than the generally accepted standard depth, this latter depth being equal to one-half the pitch. The object of this shallow thread is to ensure that if the hole to be threaded by the tap is not bored out so as to provide clearance at the bottom of the thread, the tap will cut its own clearance. The hole should, however, always be drilled out large enough so that the cutting of the clearance is not required of the tap.

The table, *Dimensions of Acme Threads Taps in Sets of Three Taps*, may also be used for the length dimensions for Acme taps. The dimensions in this table apply to single-threaded taps. For multiple-threaded taps or taps with very coarse pitch, relative to the diameter, the length of the chamfered part of the thread may be increased. Square-threaded taps are made to the same table as Acme taps, with the exception of the figures in column *K*, which for square-threaded taps should be equal to the nominal diameter of the tap, no oversize allowance being customary in these taps. The first tap in a set of Acme taps (not square-threaded taps) should be turned to a taper at the bottom of the thread for a distance of about one-quarter of the length of the threaded part. The taper should be so selected that the root diameter is about $\frac{1}{32}$ inch smaller at the point than the proper root diameter of the tap. The first tap should preferably be provided with a short pilot at the point. For very coarse pitches, the first tap may be provided with spiral flutes at right angles to the angle of the thread. Acme and square-threaded taps should be relieved or backed off on the top of the thread of the chamfered portion on all the taps in the set. When the taps are used as machine taps, rather than as hand taps, they should be relieved in the angle of the thread, as well as on the top, for the whole length of the chamfered portion. Acme taps should also always be relieved on the front side of the thread to within $\frac{1}{32}$ inch of the cutting edge.

Adjustable Taps: Many adjustable taps are now used, especially for accurate work. Some taps of this class are made of a solid piece of tool steel that is split and provided with means of expanding sufficiently to compensate for wear. Most of the larger adjustable taps have inserted blades or chasers that are held rigidly, but are capable of radial adjustment. The use of taps of this general class enables standard sizes to be maintained readily.

Table 28. Proportions of Acme and Square-Threaded Taps Made in Sets



R = root diameter of thread. ***D*** = full diameter of tap.
T = double depth of full thread.

Kind of Tap	No. of Taps in Set	Order of Tap in Set	*A*	*B*	*C*
Acme Thread Taps	2	1st	$R + 0.65T$	$R + 0.010$	$\frac{1}{6}L$ to $\frac{1}{6}L$
		2d	*D*	*A* on 1st tap − 0.005	$\frac{1}{4}L$ to $\frac{1}{3}L$
	3	1st	$R + 0.45T$	$R + 0.010$	$\frac{1}{8}L$ to $\frac{1}{6}L$
		2d	$R + 0.80T$	*A* on 1st tap − 0.005	$\frac{1}{6}L$ to $\frac{1}{4}L$
		3d	*D*	*A* on 2d tap − 0.005	$\frac{1}{4}L$ to $\frac{1}{3}L$
	4	1st	$R + 0.40T$	$R + 0.010$	$\frac{1}{8}L$
		2d	$R + 0.70T$	*A* on 1st tap − 0.005	$\frac{1}{6}L$
		3d	$R + 0.90T$	*A* on 2d tap − 0.005	$\frac{1}{5}L$
		4th	*D*	*A* on 3d tap − 0.005	$\frac{1}{4}L$ to $\frac{1}{3}L$
	5	1st	$R + 0.37T$	$R + 0.010$	$\frac{1}{8}L$
		2d	$R + 0.63T$	*A* on 1st tap − 0.005	$\frac{1}{6}L$
		3d	$R + 0.82T$	*A* on 2d tap − 0.005	$\frac{1}{5}L$
		4th	$R + 0.94T$	*A* on 3d tap − 0.005	$\frac{1}{5}L$ to $\frac{1}{4}L$
		5th	*D*	*A* on 4th tap − 0.005	$\frac{1}{4}L$ to $\frac{1}{3}L$
Square-Threaded Taps	2	1st	$R + 0.67T$	*R*	$\frac{1}{8}L$ to $\frac{1}{6}L$
		2d	*D*	*A* on 1st tap − 0.005	$\frac{1}{4}L$ to $\frac{1}{3}L$
	3	1st	$R + 0.41T$	*R*	$\frac{1}{8}L$ to $\frac{1}{6}L$
		2d	$R + 0.080T$	*A* on 1st tap − 0.005	$\frac{1}{6}L$ to $\frac{1}{4}L$
		3d	*D*	*A* on 2d tap − 0.005	$\frac{1}{4}L$ to $\frac{1}{3}L$
	4	1st	$R + 0.32T$	*R*	$\frac{1}{8}L$
		2d	$R + 0.62T$	*A* on 1st tap − 0.005	$\frac{1}{6}L$
		3d	$R + 0.90T$	*A* on 2d tap − 0.005	$\frac{1}{5}L$
		4th	*D*	*A* on 3d tap − 0.005	$\frac{1}{4}L$ to $\frac{1}{3}L$
	5	1st	$R + 0.26T$	*R*	$\frac{1}{6}L$
		2d	$R + 0.50T$	*A* on 1st tap − 0.005	$\frac{1}{6}L$
		3d	$R + 0.72T$	*A* on 2d tap − 0.005	$\frac{1}{5}L$
		4th	$R + 0.92T$	*A* on 3d tap − 0.005	$\frac{1}{5}L$ to $\frac{1}{4}L$
		5th	*D*	*A* on 4th tap − 0.005	$\frac{1}{4}L$ to $\frac{1}{3}L$

Drill Hole Sizes for Acme Threads

Many tap and die manufacturers and vendors make available to their customers computer programs designed to calculate drill hole sizes for all the Acme threads in their ranges from the basic dimensions. The large variety and combination of dimensions for such tools prevent inclusion of a complete set of tables of tap drills for Acme taps in this Handbook. The following formulas (dimensions in inches) for calculating drill hole sizes for Acme

threads are derived from the American National Standard, ASME/ANSI B1.5-1988, Acme Screw Threads.

To select a tap drill size for an Acme thread, first calculate the maximum and minimum internal product minor diameters for the thread to be produced. (Dimensions for general purpose, centralizing, and stub Acme screw threads are given in the Threads and Threading section, starting on page 1792.) Then select a drill that will yield a finished hole somewhere between the established maximum and minimum product minor diameters. Consider staying close to the maximum product limit in selecting the hole size, to reduce the amount of material to be removed when cutting the thread. If there is no standard drill size that matches the hole diameter selected, it may be necessary to drill and ream, or bore the hole to size, to achieve the required hole diameter.

Diameters of General-Purpose Acme screw threads of Classes 2G, 3G, and 4G may be calculated from:
minimum diameter = basic major diameter – pitch
maximum diameter = minimum minor diameter + 0.05 × pitch
pitch = 1/number of threads per inch

For example, ½-10 Acme 2G, pitch = 1⁄10 = 0.1
minimum diameter = 0.5 – 0.1 = 0.4
maximum diameter = 0.4 + (0.05 × 0.1) = 0.405
drill selected = letter X or 0.3970 + 0.0046 (probable oversize) = 0.4016

Similarly, diameters of Acme Centralizing screw threads of Classes 2C, 3C, and 4C may be calculated from:
minimum diameter = basic major diameter – 0.9 × pitch
maximum diameter = minimum minor diameter + 0.05 × pitch
pitch = 1/number of threads per inch

For example, ½-10 Acme 2C, pitch = 1⁄10 = 0.1:
minimum diameter = 0.5 – (0.9 × 0.1) = 0.41
maximum diameter = 0.41 + (0.05 × 0.1) = 0.415.drill selected = $^{13}/_{32}$ or 0.4062 + 0.0046 (probable oversize) = 0.4108.

Diameters for Acme Centralizing screw threads of Classes 5C and 6C (not recommended for new designs) may be calculated from:
minimum diameter = [basic major diameter – (0.025 √ basic major diameter)] – 0.9 × pitch;
maximum diameter = minimum minor diameter + 0.05 × pitch
pitch = 1/number of threads per inch.

For example, ½-10 Acme 5C, pitch = 1⁄10 = 0.1
minimum diameter = [0.5 – (0.025 √ 0.5)] – (0.9 × 0.1) = 0.3923
maximum diameter = 0.3923 + (0.05 × 0.1) = 0.3973
drill selected = $^{25}/_{64}$ or 0.3906 + 0.0046 (probable oversize) = 0.3952

British Standard Screwing Taps for ISO Metric Threads.—BS 949: Part 1: 1976 provides dimensions and tolerances for screwing taps for ISO metric coarse-pitch series threads in accordance with BS 3643: Part 2; and for metric fine-pitch series threads in accordance with BS 3643: Part 3.

Table 1 provides dimensional data for the cutting portion of cut-thread taps for coarse-series threads of ISO metric sizes. The sizes shown were selected from the first-choice combinations of diameter and pitch listed in BS 3643:Part 1:1981 (1998). Table 16 provides similar data for ground-thread taps for both coarse- and fine-pitch series threads of ISO metric sizes.

Table 1. British Standard Screwing Taps for ISO Metric Threads; Dimensional Limits for the Threaded Portion of Cut Taps—Coarse Pitch Series *BS 949: Part 1: 1976*

Designation	Pitch	Major Diameter	Pitch Diameter			Tolerance on Thread Angle, Degrees
		Minimum[a]	Basic	Max.	Min.	
M1	0.25	1.030	0.838	0.875	0.848	4.0
M1.2	0.25	1.230	1.038	1.077	1.048	4.0
M1.6	0.35	1.636	1.373	1.417	1.385	3.4
M2	0.40	2.036	1.740	1.786	1.752	3.2
M2.5	0.45	2.539	2.208	2.259	2.221	3.0
M3	0.50	3.042	2.675	2.730	2.689	2.9
M4	0.70	4.051	3.545	3.608	3.562	2.4
M5	0.80	5.054	4.480	4.547	4.498	2.3
M6	1.00	6.060	5.350	5.424	5.370	2.0
M8	1.25	8.066	7.188	7.270	7.210	1.8
M10	1.50	10.072	9.026	9.116	9.050	1.6
M12	1.75	12.078	10.863	10.961	10.889	1.5
M16	2.00	16.084	14.701	14.811	14.729	1.4
M20	2.50	20.093	18.376	18.497	18.407	1.3
M24	3.00	24.102	22.051	22.183	22.085	1.2
M30	3.50	30.111	27.727	27.874	27.764	1.1
M36	4.00	36.117	33.402	33.563	33.441	1.0

[a] See notes under Table 2.

Table 2. British Standard Screwing Taps for ISO Metric Threads; Dimensional Limits for the Threaded Portion of Ground Taps—Coarse-and Fine-Pitch *BS 949: Part 1: 1976*

Thread			All Classes of Taps		Class 1 Taps		Class 2 Taps		Class 3 Taps		Tolerance on ½ Thd Angle
					Pitch Diameter						
Designation	Nominal Major Dia. (basic) d	Pitch p	Min. Major Dia. d_{min}[a]	Basic Pitch Dia. d_2	$d_2$min	$d_2$max	$d_2$min	$d_2$max	$d_2$min	$d_2$max	
COARSE-PITCH THREAD SERIES											
M1	1	0.25	1.022	0.838	0.844	0.855	…	…	…	…	±60′
M1.2	1.2	0.25	1.222	1.038	1.044	1.055	…	…	…	…	±60′
M1.6	1.6	0.35	1.627	1.373	1.380	1.393	1.393	1.407	…	…	±50′
M2	2	0.40	2.028	1.740	1.747	1.761	1.761	1.776	…	…	±40′
M2.5	2.5	0.45	2.530	2.208	2.216	2.231	2.231	2.246	…	…	±38′
M3	3	0.50	3.032	2.675	2.683	2.699	2.699	2.715	2.715	2.731	±36′
M4	4	0.70	4.038	3.545	3.555	3.574	3.574	3.593	3.593	3.612	±30′
M5	5	0.80	5.040	4.480	4.490	4.510	4.510	4.530	4.530	4.550	±26′
M6	6	1.00	6.047	5.350	5.362	5.385	5.385	5.409	5.409	5.433	±24′
M8	8	1.25	8.050	7.188	7.201	7.226	7.226	7.251	7.251	7.276	±22′
M10	10	1.50	10.056	9.026	9.040	9.068	9.068	9.096	9.096	9.124	±20′
M12	12	1.75	12.064	10.863	10.879	10.911	10.911	10.943	10.943	10.975	±19′
M16	16	2.00	16.068	14.701	14.718	14.752	14.752	14.786	14.786	14.820	±18′
M20	20	2.50	20.072	18.376	18.394	18.430	18.430	18.466	18.466	18.502	±16′
M24	24	3.00	24.085	22.051	22.072	22.115	22.115	22.157	22.157	22.199	±14′

Table 2. *(Continued)* **British Standard Screwing Taps for ISO Metric Threads; Dimensional Limits for the Threaded Portion of Ground Taps—Coarse-and Fine-Pitch** *BS 949: Part 1: 1976*

Thread			All Classes of Taps		Class 1 Taps		Class 2 Taps		Class 3 Taps		Tolerance on ½ Thd Angle
					Pitch Diameter						
Designation	Nominal Major Dia. (basic) d	Pitch p	Min. Major Dia. d_{min}[a]	Basic Pitch Dia. d_2	$d_2$min	$d_2$max	$d_2$min	$d_2$max	$d_2$min	$d_2$max	
M30	30	3.50	30.090	27.727	27.749	27.794	27.794	27.839	27.839	27.884	±13′
M36	36	4.00	36.094	33.402	33.426	33.473	33.473	33.520	33.520	33.567	±12′
FINE-PITCH THREAD SIZES											
M1 × 0.2	1	0.20	1.020	0.870	0.875	0.885	…	…	…	…	±70′
M1.2 × 0.2	1.2	0.20	1.220	1.070	1.075	1.085	…	…	…	…	±70′
M1.6 × 0.2	1.6	0.20	1.621	1.470	1.475	1.485	…	…	…	…	±70′
M2 × 0.25	2	0.25	2.024	1.838	1.844	1.856	…	…	…	…	±60′
M2.5 × 0.35	2.5	0.35	2.527	2.273	2.280	2.293	2.293	2.307	…	…	±50′
M3 × 0.35	3	0.35	3.028	2.773	2.780	2.794	2.794	2.809	…	…	±50′
M4 × 0.5	4	0.50	4.032	3.675	3.683	3.699	3.699	3.715	3.715	3.731	±36′
M5 × 0.5	5	0.50	5.032	4.675	4.683	4.699	4.699	4.715	4.715	4.731	±36′
M6 × 0.75	6	0.75	6.042	5.513	5.524	5.545	5.545	5.566	5.566	5.587	±28′
M8 × 1	8	1.00	8.047	7.350	7.362	7.385	7.385	7.409	7.409	7.433	±24′
M10 × 1.25	10	1.25	10.050	9.188	9.201	9.226	9.226	9.251	9.251	9.276	±22′
M12 × 1.25	12	1.25	12.056	11.188	11.202	11.230	11.230	11.258	11.258	11.286	±22′
M16 × 1.5	16	1.50	16.060	15.026	15.041	15.071	15.071	15.101	15.101	15.131	±20′
M20 × 1.5	20	1.50	20.060	19.026	19.041	19.071	19.071	19.101	19.101	19.131	±20′
M24 × 2	24	2.00	24.072	22.701	22.719	22.755	22.755	22.791	22.791	22.827	±18′
M30 × 2	30	2.00	30.072	28.701	28.719	28.755	28.755	28.791	28.791	28.827	±18′

[a] The maximum tap major diameter, *d* max, is not specified and is left to the manufacturer's discretion.

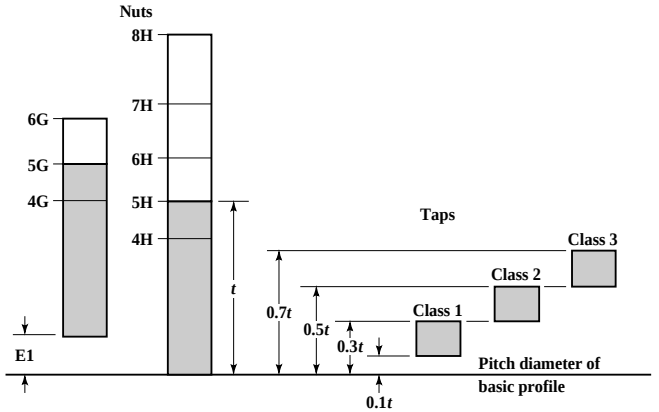
All dimension are in millimeters. The thread sizes in the table have been selected from the preferred series shown in BS 3643:Part 1:1981 (1998). For other sizes, and for second and third choice combinations of diameters and pitches, see the Standard.

Tolerance Classes of Taps: Three tolerance classes (class 1, class 2, and class 3) are used for the designation of taps used for the production of nuts of the following classes:

nut classes 4H, 5H, 6H, 7H, and 8H, all having zero minimum clearance;

nut classes 4G, 5G, and 6G, all having positive minimum clearance.

The tolerances for the three classes of taps are stated in terms of a tolerance unit *t*, the value of which is equal to the pitch diameter tolerance, T_{D2}, grade 5, of the nut. Thus, $t = T_{D2}$, grade 5, of the nut. Taps of the different classes vary in the limits of size of the tap pitch diameter. The tolerance on the tap pitch diameter, T_{d2}, is the same for all three classes of taps (20 percent of *t*), but the position of the tolerance zone with respect to the basic pitch diameter depends upon the lower deviation value *Em* which is: for tap class 1, $Em = +0.1t$; for tap class 2, $Em = +0.3t$; and for tap class 3, $Em = +0.5t$.



The disposition of the tolerances described is shown in the accompanying illustration of nut class tolerances compared against tap class tolerances. The distance *EI* shown in this illustration is the minumum clearance, which is zero for *H* classes and positive for *G* classes of nuts.

Choice of Tap Tolerance Class: Unless otherwise specified, class 1 taps are used for nuts of classes 4H and 5H; class 2 taps for nuts of classes 6H, 4G, and 5G; and class 3 taps for nuts of classes 7H, 8H, and 6G. This relationship of tap and nut classes is a general one, since the accuracy of tapping varies with a number of factors such as the material being tapped, the condition of the machine tool used, the tapping attachment used, the tapping speed, and the lubricant.

Tap Major Diameter: Except when a screwed connection has to be tight against gaseous or liquid pressure, it is undesirable for the mating threads to bear on the roots and crests. By avoiding contact in these regions of the threads, the opposite flanks of the two threads are allowed to make proper load bearing contact when the connection is tightened. In general, the desired clearance between crests and roots of mating threads is obtained by increasing the major and minor diameters of the internal thread. Such an increase in the minor diameter is already provided on threads such as the ISO metric thread, in which there is a basic clearance between the crests of minimum size nuts and the roots of maximum size bolts. For this reason, and the fact that taps are susceptible to wear on the crests of their threads, a minimum size is specified for the major diameter of new taps which provides a reasonable margin for the wear of their crests and at the same time provides the desired clearance at the major diameter of the hole. These minimum major diameters for taps are shown in Tables 1 and 16. The maximum tap major diameter is not specified and is left to the manufacturer to take advantage of this concession to produce taps with as liberal a margin possible for wear on the major diameter.

Tapping Square Threads.—If it is necessary to tap square threads, this should be done by using a set of taps that will form the thread by a progressive cutting action, the taps varying in size in order to distribute the work, especially for threads of comparatively coarse pitch. From three to five taps may be required in a set, depending upon the pitch. Each tap should have a pilot to steady it. The pilot of the first tap has a smooth cylindrical end from 0.003 to 0.005 inch smaller than the hole, and the pilots of following taps should have teeth.