NUMBER OF FLUTES

Cutting taps (as opposed to forming taps which do not cut metal or produce chips) are manufactured with a number of flutes running the length of their thread sections. These flutes have two functions: ground perpendicular to the tap threads as they are, they provide the teeth which cut into the object being threaded; and they provide channels along which the metal chips produced in thread cutting can escape from the workpiece. Generally speaking, increasing the number of flutes increases the number of cutting faces presented to the work piece, thereby distributing the cutting action over a greater number of teeth and reducing the wear on each tooth.

The basic number of flutes for most standard hand tap sizes from No. 8 through 1" is four, but for applications in which greater land strength or greater chip clearing ability is required (as in the case of tough, stringy metals), two and three fluted taps are available as optional standards. Two and three fluted taps are provided as standard in the spiral pointed and spiral fluted tap lines while standard pipe taps, in the larger sizes, are manufactured with as many as eight flutes.

THREAD PITCH DIAMETER LIMITS

The basic pitch diameter of any given thread size is equivalent to both the maximum pitch diameter of all screws manufactured to that size and to the minimum pitch diameter of any nut of that size. However, since basic pitch diameter is a theoretical figure which cannot be attained under production conditions, it is primarily a control point from which standardized deviations or tolerances are established.

Accordingly, since basic pitch diameter is the same as minimum pitch diameter of internally threaded objects such as nuts, standard taps in a given size are manufactured to various different tolerance levels that produce dimensions greater than that of basic pitch diameter. For instance, the basic pitch diameter of a 1/4-20 screw thread is .2175, but a 1/4-20 tap produced to the tolerances of G H3 limits has a pitch diameter tolerance range of .2185 to .2190. Pitch diameter limits for taps through 1" in diameter follow.

H1 basic to basic plus .0005"
H2 basic plus .0005" to basic plus .0010"
H3 basic plus .0010" to basic plus .0015"
H4 basic plus .0015" to basic plus .0020"
H5 basic plus .0020" to basic plus .0025"
H6 basic plus .0025" to basic plus .0030"

TECHNICAL DATA

Of most importance to successful hole tapping is the information for determining the correct tap/drill sizes given for thread cutting taps on page 165. The same information for forming taps can be found on page 152. In addition, specific recommendations regarding tapping in different types of material can be found on page 162.

SCREW THREAD CLASSES OF FIT

Three classes of fit have been established for screw threads in the unified system which permit the making of standard recommendations that relate screw thread class of fit to specific tap tolerance limits.

The class of fit of two threaded members such as a nut and a bolt is expressed by a symbol containing a number and a letter as part of the thread designation. The number, 1 through 3, expresses the class of fit while the letter "A" or "B" respectively expresses whether external or internal threads are involved. In the example "1/2-13 UNC-2B", 2B expresses the class of fit for an internal thread.

Class 1A External and Class 1B Internal Threads

This class of fit is intended to apply to the manufacture of threaded parts where frequent quick assembly is necessary or desired. A wide allowance, or difference, between basic pitch diameter and maximum pitch diameter, is provided to permit the loose assembly.

Class 2A External and Class 2B Internal Threads

This class of fit is medium loose and is intended to apply to screws, bolts, and nuts for general fastener use. This allowance will permit freedom of fit to prevent seizure in assembly and will allow limited plating and coating.

Class 3A External and Class 3B Internal Threads

This class of fit is intended for thread assembly where closeness of fit and accuracy of thread angle and lead are required. This close fit can be obtained consistently only by use of high quality tooling and equipment and a highly efficient system of gaging and inspection.

Where the letter "U", "A", or "B" do not appear in thread designation (for example, 1/2-13NC-2), gaging and tap pitch diameter would conform to earlier American Standard threads, which include Class 2 and Class 3 only.

Unified threads, American threads, and UNJ threads have the same tap thread form so that Unified and American threaded parts are mechanically interchangeable.

UNJ internal threads are produced with taps with standard thread form. Radius root applies only to the externally threaded member. Special oversize minor diameter (drilled hole) is required in UNJ threads. Refer to MIL-S-8879A which is the industry standard for the UNJ thread.

PITCH DIAMETER LIMIT RECOMMENDATIONS

The chart on the next page lists recommendations of specific taps by pitch diameter limit in each thread size for each class of fit. The recommended tap in each case should provide the required class of fit under good tapping conditions. There are some conditions, however, such as a tendency to oversize tapping, that may necessitate the selection of an alternate pitch diameter limit. Generally, if only the first few holes gage loose and can be tolerated, it is best to use the recommended pitch diameter limit in order to secure maximum tap life.

Pitch diameters shown under "Min/All Classes (Basic)" are those for the thread gage GO member. Pitch diameters shown under the four "Max" classes are those for the HI or NO GO member. If only the class of fit is shown on orders, taps with corresponding limits as shown on this chart will be furnished. If only ground thread is specified, taps with the limit for Class 2B or 3B fit will be furnished.

In very abrasive material, improved tap life can be realized by using taps with one pitch diameter limit higher than recommended in the chart. The first few holes tapped may gage a little loose, but after wear land has developed, good gaging will usually follow.

PITCH DIAMETER LIMIT RECOMMENDATIONS (continued)

There are several factors other than the pitch diameter limit in maintaining good gaging. High flute hook, high chamfer relief, and high thread relief as well as spindle run-out, misalignment, overfeeding, in or out, and incorrect tapping speeds can all cause oversize gaging. On the other hand, some materials tend to expand under comparatively low heat conditions and to close up the tapped hole, which will result in tight gaging.

Some high production tapping machines cause the tap to stop on reversing about one thread from the top of the hole and pull out without turning. This causes distortion of the top thread that may restrict the GO gage. If gaging problems persist, call your Vermont representative or the Technical Service Department at Vermont Tap & Die.

TECHNICAL TABLES

TABLE #1 TAP RECOMMENDATIONS FOR CLASSES 2, 3, 1B, 2B & 3B UNIFIED AND AMERICAN NATIONAL SCREW THREADS

	THREADS PER INCH		RECOMMENDED TAP LIMITS				INTERNAL THREAD PITCH DIAMETER LIMITS				
SIZE	NC UNC	NF UNF	CLASS 2	CLASS 3	CLASS 2B	CLASS 3B	MIN/ALL CLASSES (BASIC)	MAX CLASS 2	MAX CLASS 3	MAX CLASS 2B	MAX CLASS 3B
0		80	G H1	G H1	G H2	G H1	.0519	.0536	.0532	.0542	.0536
1	64		G H1	G H1	G H2	G H1	.0629	.0648	.0643	.0655	.0648
1		72	G H1	G H1	G H2	G H1	.0640	.0658	.0653	.0665	.0659
2	56		G H1	G H1	G H2	G H1	.0744	.0764	.0759	.0772	.0765
2		64	G H1	G H1	G H2	G H1	.0759	.0778	.0773	.0786	.0779
3	48		G H1	G H1	G H2	G H1	.0855	.0877	.0871	.0885	.0877
3		56	G H1	G H1	G H2	G H1	.0874	.0894	.0889	.0902	.0895
4	40		G H2	G H1	G H2	G H2	.0958	.0982	.0975	.0991	.0982
4		48	G H1	G H1	G H2	G H1	.0985	.1007	.1001	.1016	.1008
5	40		G H2	G H1	G H2	G H2	.1088	.1112	.1105	.1121	.1113
5		44	G H1	G H1	G H2	G H1	.1102	.1125	.1118	.1134	.1126
6	32		G H2	G H1	G H3	G H2	.1177	.1204	.1196	.1214	.1204
6		40	G H2	G H1	G H2	G H2	.1218	.1242	.1235	.1252	.1243
8	32		G H2	G H1	G H3	G H2	.1437	.1464	.1456	.1475	.1465
8		36	G H2	G H1	G H2	G H2	.1460	.1485	.1478	.1496	.1487
10	24		G H3	G H1	G H3	G H3	.1629	.1662	.1653	.1672	.1661
10		32	G H2	G H1	G H3	G H2	.1697	.1724	.1716	.1736	.1726
12	24		G H3	G H1	G H3	G H3	.1889	.1922	.1913	.1933	.1922
12		28	G H3	G H1	G H3	G H3	.1928	.1959	.1950	.1970	.1959
1/4	20		G H3	G H2	G H5	G H3	.2175	.2211	.2201	.2223	.2211
1/4		28	G H3	G H1	G H4	G H3	.2268	.2299	.2290	.2311	.2300
5/16	18		G H3	G H2	G H5	G H3	.2764	.2805	.2794	.2817	.2803
5/16		24	G H3	G H1	G H4	G H3	.2854	.2887	.2878	.2902	.2890
3/8	16		G H3	G H2	G H5	G H3	.3344	.3389	.3376	.3401	.3387
3/8		24	G H3	G H1	G H4	G H3	.3479	.3512	.3503	.3528	.3516
7/16	14		G H5	G H3	G H5	G H3	.3911	.3960	.3947	.3972	.3957
7/16		20	G H3	G H1	G H5	G H3	.4050	.4086	.4076	.4104	.4091
1/2	13		G H5	G H3	G H5	G H3	.4500	.4552	.4537	.4565	.4548
1/2		20	G H3	G H1	G H5	G H3	.4675	.4711	.4701	.4731	.4717
9/16	12		G H5	G H3	G H5	G H3	.5084	.5140	.5124	.5152	.5135
9/16		18	G H3	G H2	G H5	G H3	.5264	.5305	.5294	.5323	.5308
5/8	11		G H5	G H3	G H5	G H3	.5660	.5719	.5702	.5732	.5714
5/8		18	G H3	G H2	G H5	G H3	.5889	.5930	.5919	.5949	.5934
3/4	10		G H5	G H3	G H5	G H5	.6850	.6914	.6895	.6927	.6907
3/4		16	G H3	G H2	G H5	G H3	.7094	.7139	.7126	.7159	.7143
7/8	9		G H6	G H4	G H6	G H4	.8028	.8098	.8077	.8110	.8089
7/8		14	G H4	G H2	G H6	G H4	.8286	.8335	.8322	.8356	.8339
1	8		G H6	G H4	G H6	G H4	.9188	.9264	.9242	.9276	.9254
1		12	G H4	G H2	G H6	G H4	.9459	.9515	.9499	.9535	.9516
1		14 NS	G H4	G H2	G H6	G H4	.9536	.9585	.9572	.9609	.9590
1-1/8	7		G H8	G H4	G H8	G H4	1.0322	1.0407	1.0381	1.0416	1.0393
1-1/8		12	G H4	G H4	G H6	G H4	1.0709	1.0765	1.0749	1.0787	1.0768
1-1/4	7		G H8	G H4	G H8	G H4	1.1572	1.1657	1.1631	1.1668	1.1644
1-1/4		12	G H4	G H4	G H6	G H4	1.1959	1.2015	1.1999	1.2039	1.2019
1-3/8	6		G H8	G H4	G H8	G H4	1.2667	1.2768	1.2738	1.2771	1.2745
1-3/8		12	G H4	G H4	G H6	G H4	1.3209	1.3265	1.3249	1.3291	1.3270
1-1/2	6		G H8	G H4	G H8	G H4	1.3917	1.4018	1.3988	1.4022	1.3996
1-1/2		12	G H4	G H4	G H6	G H4	1.4459	1.4515	1.4499	1.4542	1.4522

NOTES: Class 1B tapped holes can be produced with cut thread taps.
Class 2B: Cut thread taps may be used under normal conditions and in average materials for producing tapped holes to this classification.
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.

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