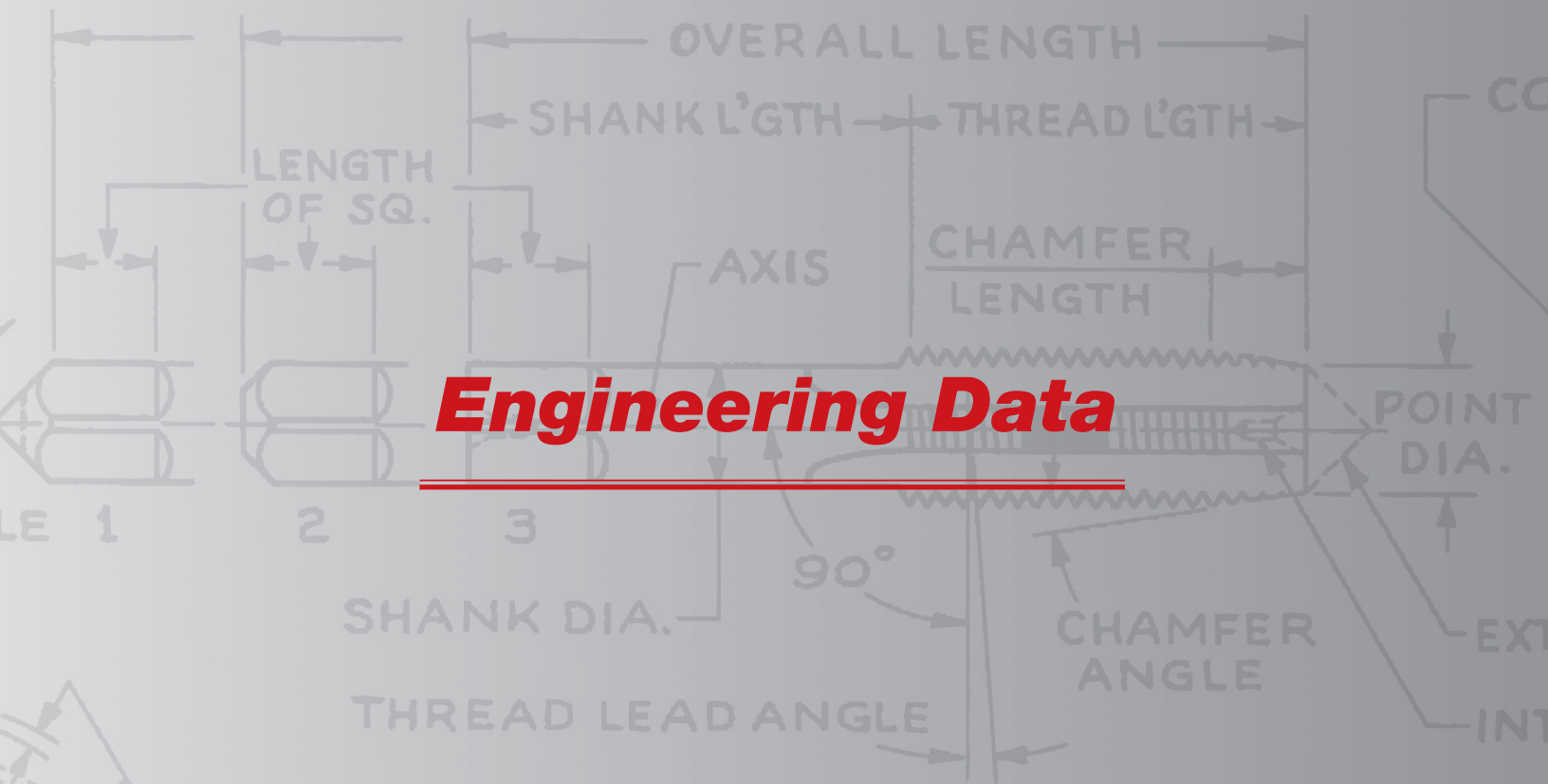
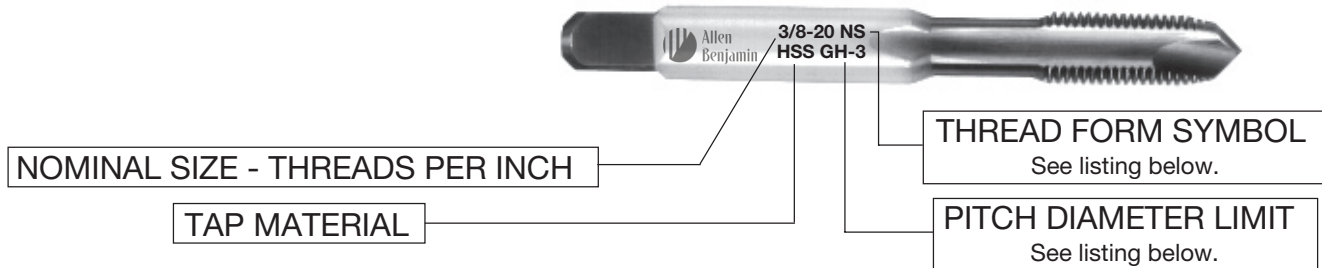


Engineering Data



Taps, dies and other types of threading tools are marked according to the Standard System of Marking Ground Thread Taps. Tools are marked with the nominal size, number of threads per inch (pitch), and the appropriate thread form symbol and pitch diameter symbol. *Symbols typically used are listed.*



PITCH DIAMETER LIMIT SYMBOLS

All standard ground thread taps are marked with the letter “G” to designate Ground Thread. The letter G will be followed by the letter “H” to designate above basic; or the letter “L” to designate below basic. The number following H or L signifies the number of .0005” steps above or below the basic pitch diameter. *For instance, the tap pictured above is a 3/8” dia. tap with 20 threads per inch (pitch), and has a NS (American National Special Thread) thread form. The tap is made from High Speed Steel, and the GH-3 pitch diameter limit symbol indicates a Ground Thread tap with pitch diameter limits .0010 to .0015 over basic.*

Pitch Diameter Limits for taps to 1” diameter inclusive:

- L1 = Basic to Basic minus .0005
- 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

Taps larger than 1” dia. are ground to a .0010” tolerance on the pitch diameter and are, for example,

- H4 (Basic plus .0010” to Basic plus .0020”).

THREAD FORM SYMBOLS

ACME-C	Acme Thread-Centralizing	NPTF	Dryseal American National Standard Taper Pipe Thread
ACME-G	Acme Thread-General Purpose	NPTR	American National Standard Taper Pipe Thread for Railing Joints (Tap marked NPT)
AMO	American Standard Microscope Objective Thread	NS	American National Thread-Special
ANPT	Aeronautical National Form Taper Pipe Thread (Ground thread tap marked NPT)	PG	Panzer Gewinde
BA	British Association Standard Thread	PTF	Dryseal SAE Short Taper Pipe Thread
BSF	British Standard Fine Thread Series	SGT	Special Gas Taper Thread
BSP	British Standard Pipe	SPL-PTF	Dryseal Special Taper Pipe Thread
BSPP	British Standard Pipe (Parallel) Thread	STI	Special Thread for Helical Coil Wire Screw Thread Inserts
BSPT	British Standard Taper Pipe Thread	Stub Acme	Stub Acme Thread
BSW	British Standard Whitworth Coarse Thread Series	*UN	Unified Constant Pitch Thread Series
M	Metric ScrewThread Series	*UNC	Unified Coarse Thread Series
N	American National 8, 12 and 16 Thread Series (8N, 12N, 16N)	*UNEF	Unified Extra Fine Thread Series
N BUTT	American Buttress Screw Thread	*UNF	Unified Fine Thread Series
NC	American National Coarse Thread Series	UNJ**	Unified Thread Series with a 0.15011P to 0.18042P Controlled Root Radius on External Thread only.
NEF	American National Extra Fine Thread Series	UNJC	Unified Coarse Thread Series with a 0.15011P to 0.18042P Controlled Root Radius on External Thread only.
NF	American National Fine Thread Series	UNJF	Unified Fine Thread Series with a 0.15011P to 0.18042P Controlled Root Radius on External Thread only.
NGO	National Gas Outlet Thread	UNM	Unified Miniature Thread Series
NGT	National Gas Taper Thread (see “SGT”)	UNR	Unified Constant Pitch Thread Series with a 0.108P to 0.144P Controlled Root Radius; Ext. thread only.
NH	American National Hose Coupling and Fire Hose Coupling Threads	UNRC	Unified Coarse Thread Series with a 0.108P to 0.144P Controlled Root Radius; Ext. thread only.
NPS	For tap marking only (See NPSC, NPSM)	UNRF	Unified Fine Thread Series with a 0.108P to 0.144P Controlled Root Radius; External thread only.
NPSC	American National Standard Straight Pipe Thread in Pipe Couplings (Tap marked NPS)	*UNS	Unified Thread-Special
NPSF	Dryseal American National Standard Fuel Internal Straight Pipe Thread	V	A 60° “V” thread with Truncated Crest and Root. The theoretical “V” Form is usually flattened to the user’s specifications.
NPSH	American National Standard Straight Pipe Thread for Hose Couplings	WHIT	British Standard Whitworth Special Thread
NPSI	Dryseal American National Standard Intermediate Internal Straight Pipe Thread		
NPSL	American National Standard Straight Pipe Thread for Loose Fitting Mechanical Joints with Locknuts		
NPSM	American National Standard Straight Pipe Threads for Free-Fitting Mechanical Joints for Fixtures (Tap marked NPS)		
NPT	American National Standard Taper Pipe Thread (See ANPT, NPTR)		

*Taps are not marked with “U” but with the symbol for the corresponding American Standard thread form with which it is compatible.

** See next page for additional information on UNJ taps.

INCH SCREW THREADS - UNJ PROFILE

Controlled Root Radius with Increased Minor Diameter

The UNJ thread standard (ASME B1.15) defines a system of threads for highly stressed applications requiring high fatigue strength. It was derived from a military specification (MIL-S-8879). MIL-S-8879 was primarily thought of and used for aerospace fastener and threaded component applications. Due to the increase in both its use and types of applications, the American Society of Mechanical Engineers developed and published ASME B1.15 in 1995.

Form. UNJ screw threads are of the same form as Unified Screw Threads to ASME/ANSI B1.1 except:

External threads: the root has a maximum and minimum prescribed continuous radius, and is not merely rounded due to tool wear.

Internal threads: the minor diameter is increased to accommodate the maximum root radius of the external thread. There is no radius requirement for either the crest or the root of the internal thread.

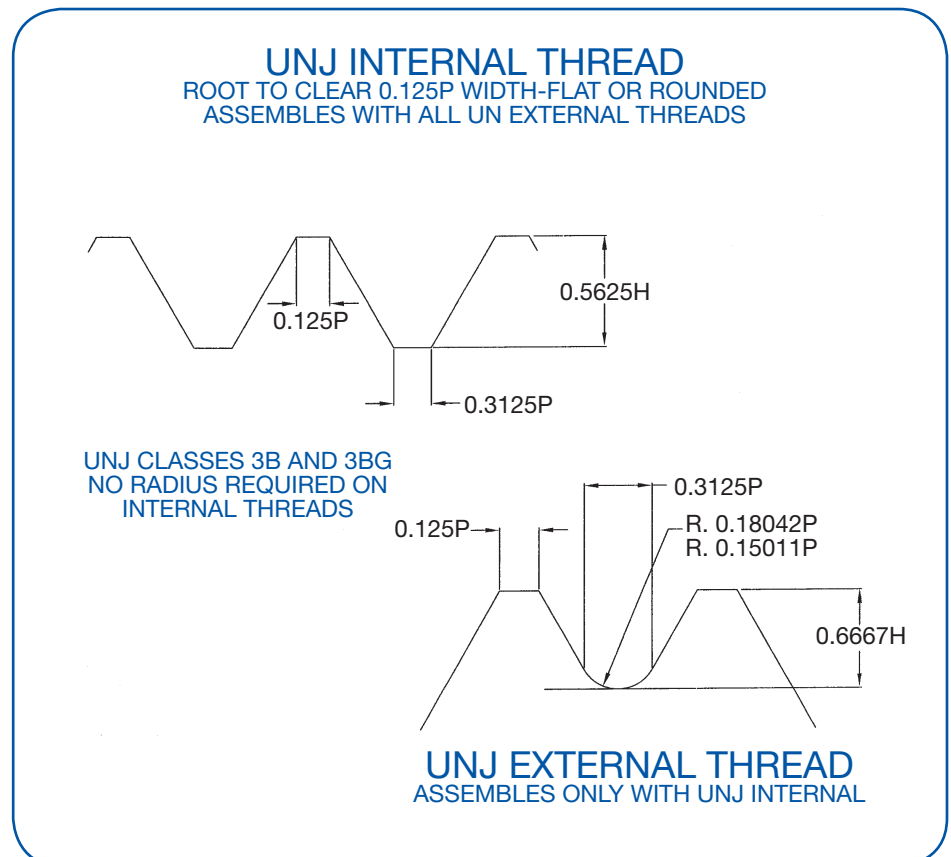
Designation. UNJ product threads are identified by the letter “J” in the thread symbol, and a thread class symbol including an “A” for external threads or a “B” for internal threads.

Use of Unified Tooling. Many of the UNJ thread form characteristics are the same as for UN threads. Therefore, some of the tooling used to produce one form can be used to produce the other.

External UNJ threads must be produced with a prescribed root radius; therefore, standard Unified Screw Thread (UN) tooling may not be used.

Internal UNJ threads are not required to have a root radius; therefore, ground thread taps designed to produce Unified Screw Threads of the proper class of fit may be used. The letter “J” need not be marked on the tap. The larger product minor diameter of the UNJ internal thread requires the use of a larger tap drill than is used when producing Unified Screw Threads.

- UNJ Thread Form: Unified Thread Series with a $0.15011P$ to $0.18042P$ controlled root radius on external thread only. (As defined by MIL-S-8879C)
- UNJ internal threads do not require radius; only external thread requires radius on root.
- UNJ external thread assemblies only with UNJ internal thread.
- UNJ tap is standard 2B or 3B class of fit.

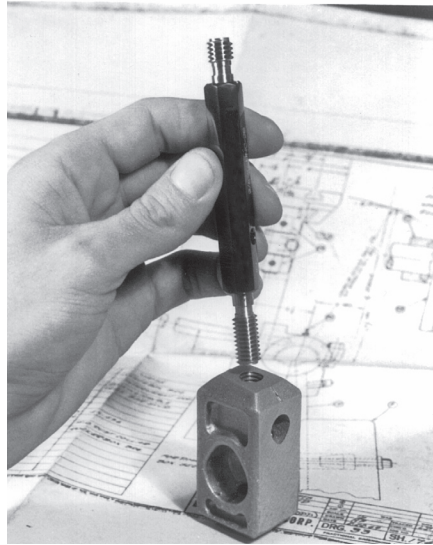


CLASSES OF THREADS AND TAP

SIZE: There is a direct relationship between the size of a tap and the size of the thread that it cuts. Size refers to pitch diameter and its relationship to the class of fit required. If two threaded parts are assembled, the looseness or tightness of the fit is determined by contact on the flanks of the threads only. This contact is controlled by the pitch diameters of each part.

CLASSES OF THREAD: When threaded parts are mated, the two parts must assemble with a degree of tightness dictated by the use of the fastener. In addition, the internal thread must be large enough to allow the external thread to enter it for the required length of engagement. A system of thread classes, each representing a comparative degree of tightness, has been established and universally adopted, to provide manufacturers and users of threaded products with a common language of specification. The thread classes designate minimum and maximum pitch diameters for internal and external threads. It is important to remember that classes of thread actually represents manufacturing tolerances. The closer the tolerance required, the higher the cost involved in producing the parts. Therefore, designers and engineers should always try to select the class of thread with the widest permissible tolerance.

TAP SIZE: Due to material variability and machining conditions, taps rarely cut their own size. The thread size produced is usually larger, but can be smaller due



to shrinkage. Tap manufacturers realized that to tap a specified class of thread, several different ground thread tap limits would be required. These limits represent small, defined variations in tap size. A numbering system was developed to designate each series of limits, but these limit numbers are not to be confused with the classes of threads. Ground thread tap limits are designated by the letter H (high) above basic pitch diameter, or L (low) below basic pitch diameter, and these numbers establish the tolerance range in relation to basic pitch diameter. As an example, in sizes 1" and smaller, an H1 tap has a tolerance range of from basic to .0005" over basic;

an H2 tap from .0005" over basic to .001" over basic, (see Chart 1A on this page). In addition, metric threads are also designated in much the same way. The thread tap limits are designated by the letter D (ground, high) above basic pitch diameter, or U (ground, low) below basic pitch diameter. As an example, in sizes M25 and smaller, a D1 tap has a size of .0005" over basic to tap max. P.D.; a D2 tap has a size of .001" over basic to tap max. P.D., (see Chart 1B). The Tables on pages 57-59 list recommended limit numbers for different classes of thread. Several different limit numbers are available for each diameter and pitch combination. Consequently, it is possible to select the "H" or "L" limit, or the "D" or "U" limit most suitable for the required tapping operation. Please contact Allen Benjamin for questions regarding tap limits and their relation to classes of fit.

CHART 1A

Pitch Diameter Limits for taps to 1" diameter inclusive:

- L1 = Basic to Basic minus .0005
- 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

Taps larger than 1" dia. are ground to a .0010" tolerance on the pitch diameter and are, for example,

H4 (Basic plus .0010" to Basic plus .0020").

CHART 1B

Pitch Diameter Limits for taps to 1" diameter inclusive:

(Metric taps generally have more manufacturing tolerance than .0005 to the minus side.)

- U1 = Basic minus .0005 = min. tap P.D.
- D1 = Basic plus .0005 = max. tap P.D.
- D2 = Basic plus .0010 = max. tap P.D.
- D3 = Basic plus .0015 = max. tap P.D.
- D4 = Basic plus .0020 = max. tap P.D.
- D5 = Basic plus .0025 = max. tap P.D.
- D6 = Basic plus .0030 = max. tap P.D.

On Charts 2A and 2B (below), examples of the relationship of Class of Fit to various tap limit sizes is shown for both Imperial and Metric sizes. In chart 2A, using a 1/4"-20NC or UNC thread size, it is obvious that an H5 limit (+.0025" over basic pitch diameter) can be used to cut the tightest class of thread in most machining

situations, as can the H1 limit (+.0005" over basic P.D.). However, tool wear would force the discarding of the H1 tap long before the H5 would be worn to an undersize condition. **The rule is obvious: always select the largest "H" limit possible to achieve proper class of fit, and maximum tool life.**

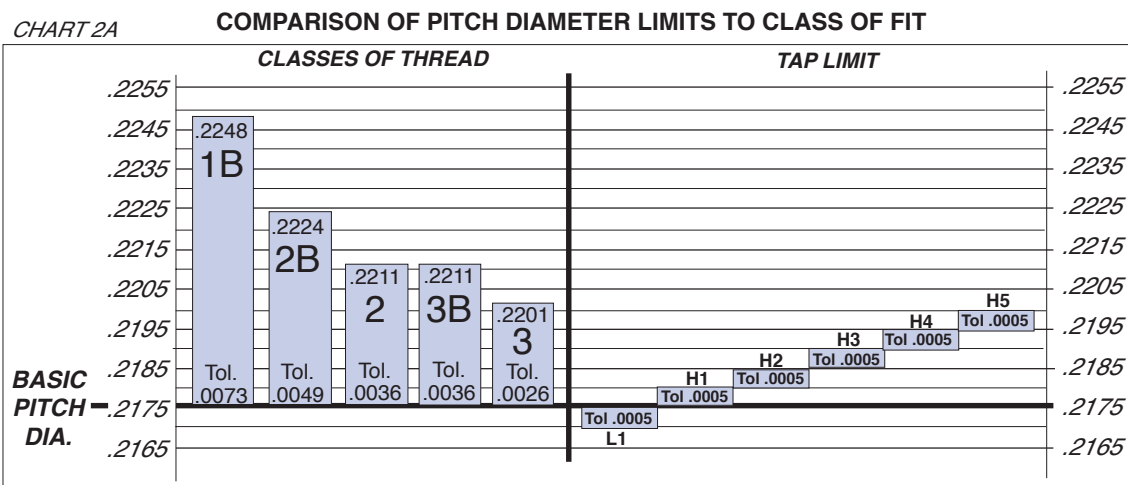
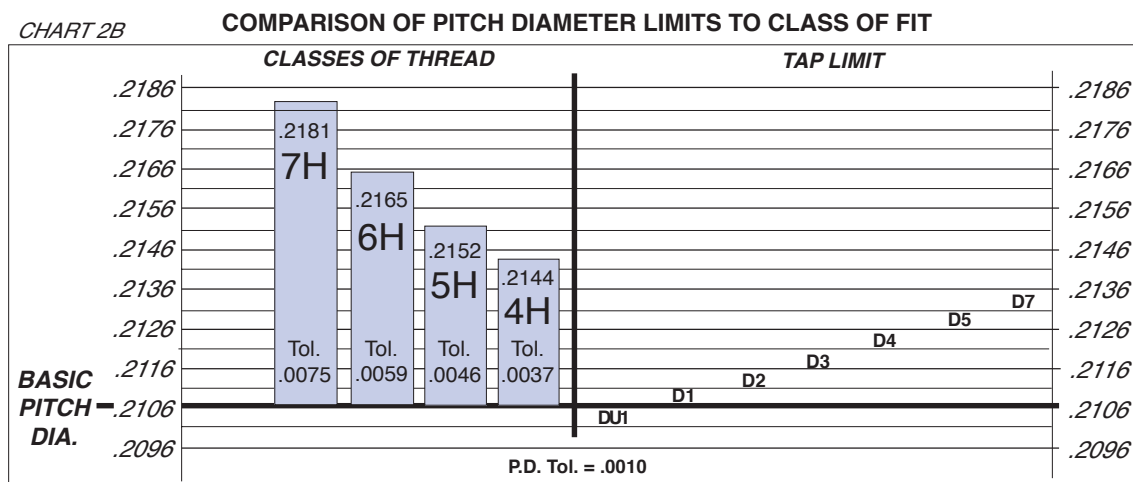


Chart 2B shows the same relationship with a metric thread. Using a M6 X 1.0, it is obvious that a D5 limit (+.0025" over basic pitch diameter) can be used to cut the standard class of thread in most machining situations, as can the D1 limit (+.0005" over basic P.D.).

However, tool wear would force the discarding of the D1 tap long before the D5 would be worn to an undersize condition. **The rule is obvious: always select the largest "D" limit possible to achieve proper class of fit, and maximum tool life.**



SCREW THREAD CLASSES OVERVIEW

Screw thread classes are distinguished from each other by the amount of tolerance and allowance.

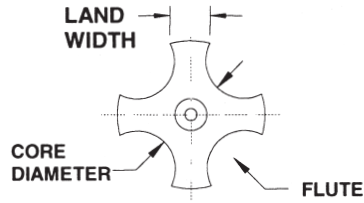
Class 1A and Class 1B: The combination of Class 1A for external threads and Class 1B for internal threads is intended to cover the manufacture of threaded parts where quick and easy assembly is necessary or desired, and an allowance is provided to permit ready assembly.

Class 2A and Class 2B: The combination of Class 2A for external threads and Class 2B for internal threads designed for screws, bolts and nuts, is also suitable for a variety of other applications. A similar allowance is provided which minimizes

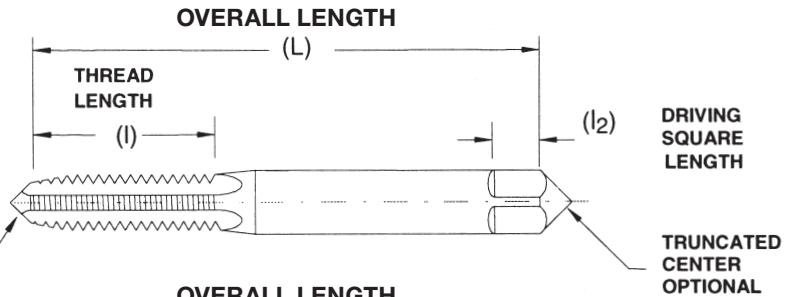
galling and seizure encountered in assembly and use. It also accommodates, to a limited extent, plating, finishes or coatings.

Class 3A and 3B: The combination of Class 3A for external threads and Class 3B for internal threads is provided for those applications where closeness of fit and accuracy of lead and angle of thread are important. These threads are obtained consistently only by use of high quality production equipment supported by a very efficient system of gauging and inspection.

No allowance is provided.

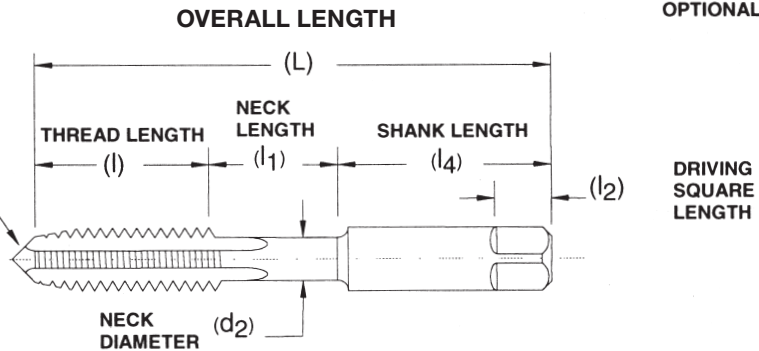


BLANK DESIGN 1

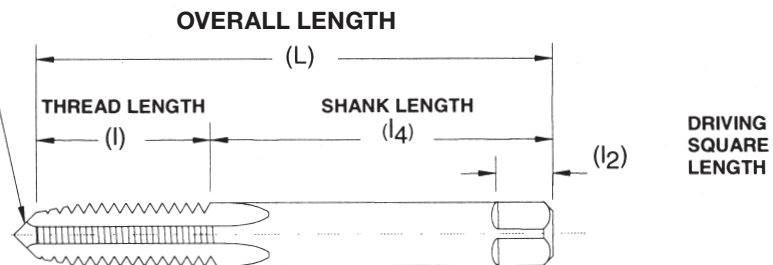


EXTERNAL CENTERS

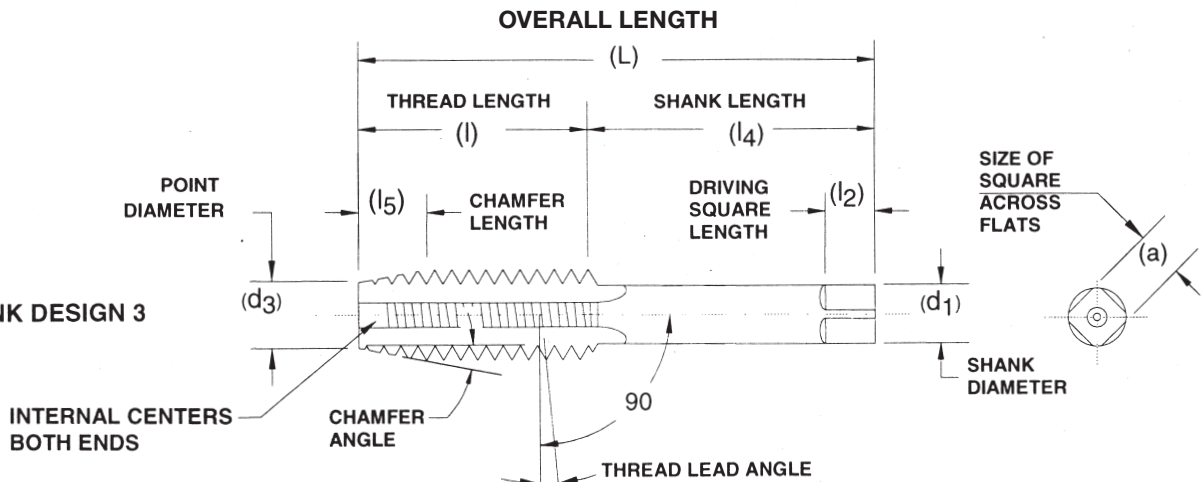
**BLANK DESIGN 2
(WITH OPTIONAL NECK)**

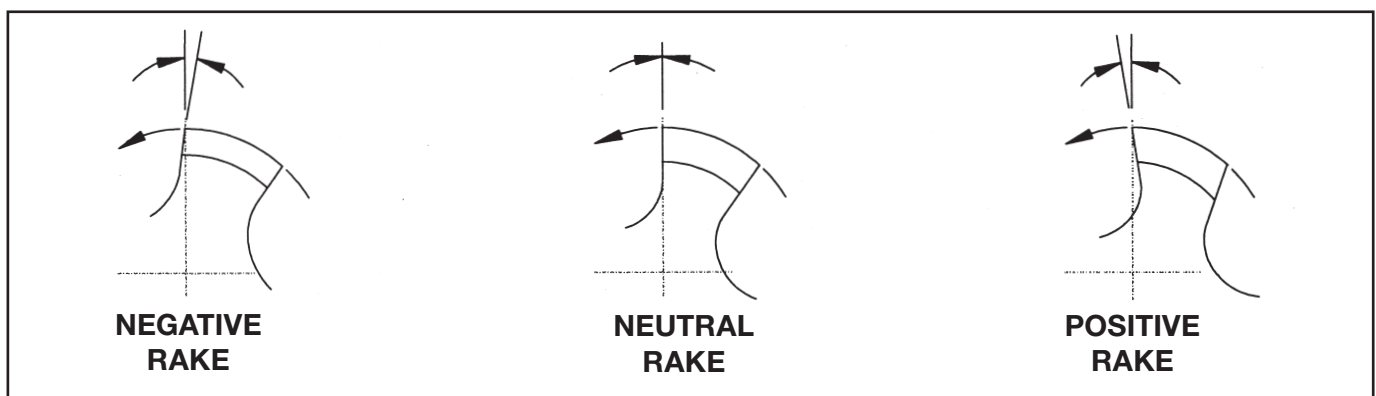
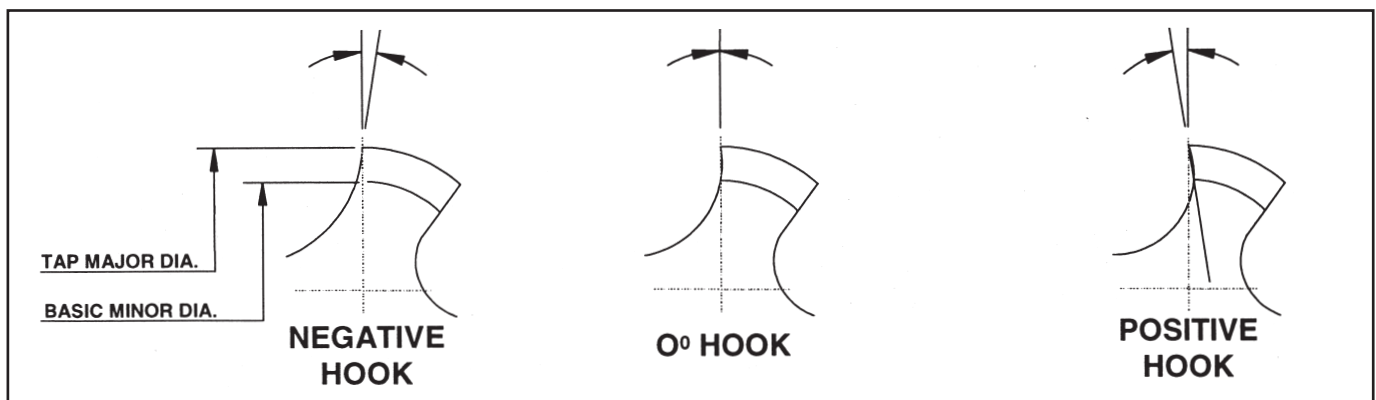
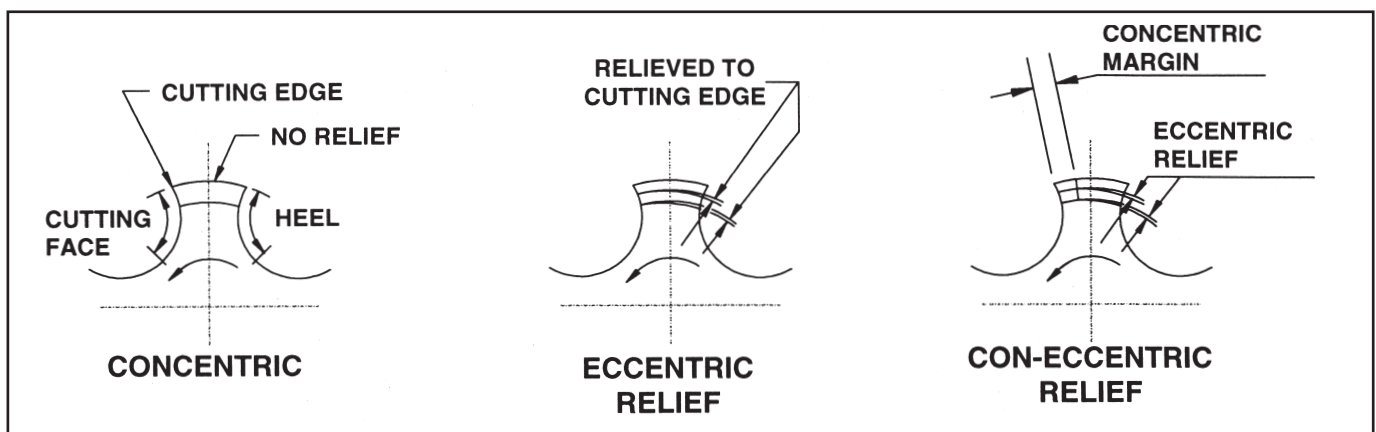
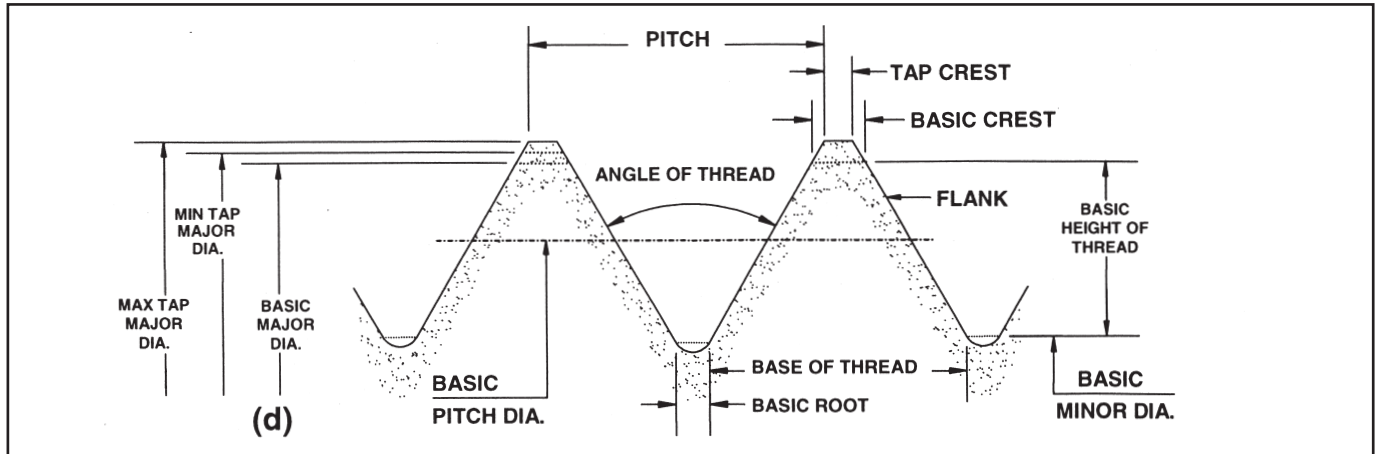


**BLANK DESIGN 2
(WITHOUT OPTIONAL NECK)**



BLANK DESIGN 3





ALLOWANCE

Minimum clearance between two mating parts; the prescribed variations from the basic size.

ANGLE OF THREAD

The angle included between the sides of the thread measured in an axial plane.

AXIS

The imaginary straight line that forms the longitudinal centerline of the tool or threaded part.

BACK TAPER

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

BASE OF THREAD

The bottom section of the thread; the greatest section between the two adjacent roots.

BASIC SIZE

The theoretical or nominal standard size from which all variations are derived by application of allowances and tolerances.

CHAMFER

The tapering of the threads at the front end of each land of a tap by cutting away and relieving the crest of the first few teeth to distribute the cutting action over several teeth; *Taper taps* are chamfered 7-10 threads; *plug taps* are chamfered 3-5 threads; *semi-bottoming (or modified bottoming) taps* are chamfered 2-2.5 threads; *bottoming taps* are chamfered 1-2 threads; *taper pipe taps* are chamfered 2-3.5 threads.

CHAMFER RELIEF

The gradual decrease in land height from cutting edge to heel on the chamfered portion, to provide clearance for the cutting action as the tap advances.

CREST

The top surface joining the two sides or flanks of the thread; the crest of an external thread is at its major diameter, while the crest of an internal thread is at its minor diameter.

CUTTING FACE

The leading side of the land in the direction of cutting rotation on which the chip forms.

FLUTE

The longitudinal channels formed in a tap to create cutting edges on the thread profile, and to provide chip spaces and cutting fluid passages.

HEEL

The edge of the land opposite the cutting edge.

HEIGHT OF THREAD

The distance, measured radially, between the crest and the base of a thread.

HELIX ANGLE

The angle made by the advance of the thread as it wraps around an imaginary cylinder.

HOOK

The undercut on the face of the teeth.

HOOK ANGLE

The inclination of a concave cutting face, usually specified either as Chordal Hook or Tangential Hook.

Chordal Hook Angle: The 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.

Tangential Hook Angle: The 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 along the thread helix removed. In some cases alternate teeth are removed only for a portion of the thread length.

LAND

The part of the tap body which remains after the flutes are cut, and on which the threads are finally ground. The threaded section between the flutes of a tap.

LEAD

The axial distance a tap will advance along its axis in one revolution. On a single start, the lead and the pitch are identical; on a double start, the lead is twice the pitch.

MAJOR DIAMETER

Commonly known as the "outside diameter." It is the largest diameter of the thread.

MINOR DIAMETER

Commonly known as the "root diameter." It is the smallest diameter of the thread.

PERCENT OF THREAD

One-half the difference between the basic major diameter and the actual minor diameter of an internal thread, divided by the basic thread height, expressed as a percentage.

PITCH

The distance from any point on a screw thread to a corresponding point on the next thread, measured parallel to the axis and on the same side of the axis. The pitch equals one divided by the number of threads per inch.

PITCH DIAMETER

On a straight thread, the pitch diameter is the diameter of the imaginary co-axial 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 of the basic pitch. On a perfect thread this 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.

RAKE

The 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 (or Thread Relief)

The removal of metal from behind the cutting edge to provide clearance and reduce friction between the part being threaded and the threaded land.

ROOT

The bottom surface joining the sides of two adjacent threads, and is identical with or immediately adjacent to the cylinder or cone from which the thread projects.

SPIRAL FLUTE

A flute with uniform axial lead in a spiral path around the axis of a tap.

SPIRAL POINT

The angular fluting in the cutting face of the land at the chamfered end; 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 taps cutting action.

STRAIGHT FLUTE

A flute that forms a cutting edge lying in an axial plane.

TOLERANCE

In producing a tap to given specifications, tolerance is: (a.) the total permissible variation of a size; (b.) the difference between the limits of size.

Chamfers for Thread Cutting Taps

The tap chamfer is the tapering of the threads to distribute cutting action over several teeth. The type of hole to be tapped has much to do with the chamfer style of that tap that's best suited. Some holes go all the way through; some, while not through-holes, are relatively deep; some are quite shallow (a little deeper than diameter). Each of these three kinds of holes - through, deep-bottoming blind, and shallow bottoming - has a tap chamfer best suited to threading requirements.



Taper Taps - This style, with a **7-10 thread chamfer**, has the longest chamfer of the three to distribute action over the maximum number of teeth; and the taper also acts as a guide in starting the cutting action in the hole. Taper style taps start the thread square with the workpiece. Taper taps are commonly used in through holes and in materials where a tapered guide is necessary.



Plug Taps - This style, with a **3-5 thread chamfer**, is most widely used in through holes and where there is sufficient room at the bottom in blind holes.

Semi (or Modified) Bottoming Taps - This style, with a **2 to 2.5 thread chamfer**, should be used whenever possible in difficult material applications in blind holes, when threads are not required to the bottom of the hole.



Bottoming Taps - This style, designed with a **1 to 2 thread chamfer**, is made with just enough chamfer for starting in the hole; as the name implies, it is designed to thread blind holes to the bottom.

NOTE: Taper, plug and bottoming taps as a set, in a given size (for example: 1/4-20 NC) are identical as to size, length and vital measurements; the difference is in the chamfered threaded portion at the point. As a rule, such taps when used by hand are furnished in sets of three of a given size...namely, taper, plug and bottoming (and should be used in that order).



HAND TAP

These standard style taps have straight flutes of a number specified as either standard or optional. Hand taps are for general purpose applications such as production tapping or hand tapping operations. Taper, plug and bottoming styles provide versatility in tough materials, blind and through holes.



SPIRAL POINT TAP

As to general physical dimensions, spiral point taps are identical with the standard hand tap. However, the spiral point tap has the cutting face of the first few threads cut at a predetermined angle relative to the tap's axis angle to force the evacuation of chips ahead of the cutting action. This feature, plus the excellent shearing action of the flute, make spiral pointed taps ideal for production tapping of through holes. Typically, this type of tap has a shallower flute passage than conventional taps. This gives the spiral point tap more cross-sectional area, which means greater strength, allows higher tapping speeds, and requires less power to drive.



Regular (or Slow) Spiral Fluted Tap



Fast Spiral Fluted Tap

SPIRAL FLUTED TAP

These taps, as the name implies, are made with spiral flutes instead of straight flutes. This spiral fluting feature aids in drawing chips out of a hole, or serves to bridge a gap inside the hole such as a keyway or cross-hole. Commonly available in *slow spiral* (25-30° helix angle) or *fast spiral* (45-60°).



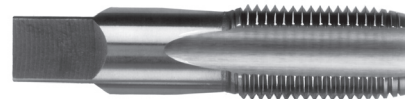
INTERRUPTED THREAD TAP

These taps have an odd number of lands with alternate teeth in the thread helix removed. The removal of every other tooth helps to break the chip and allows a greater supply of lubrication to reach the cutting teeth, reducing the incidence of torn threads. Ideal for tapping non-ferrous metals and low carbon steel; as well as use in titanium and high hardness alloys.



THREAD FORMING (or Roll Form) TAP

These taps are fluteless except as optionally designed with one or more lubrication grooves. The thread form is lobed so there is a finite number of points contacting the work. This tap does not cut, so it is 'chipless', and consequently will not cause a chip problem. The tool forms the thread by extrusion, thus thread size can be closely maintained. The fluteless design allows high quality threads, faster tapping speeds, higher production, and generates no chips which simplifies tapping of blind bottoming holes (threads can be formed the full depth of the hole).



Straight Pipe Tap



Taper Pipe Tap

PIPE TAP

These taps are for producing standard straight or tapered pipe threads in a wide range of pipe connections. Manufactured with the appropriate design variations to cut specified pipe thread forms.



ACME THREAD TAP

Acme screw threads were devised to allow rotary and transversing motion on machines; and are also used in jacks, valves, presses and other mechanisms where heavy loads are encountered. The acme thread is characterized by a 29° included angle. Acme taps typically require specialized engineering and design due to the nature and severity of cut required in producing Acme threads.



EXTENSION TAP

These taps are made to conventional tap dimensions, except that they have an extended shank to reach inaccessible holes. Thread length, shank diameter, and shank square are made to standard specifications listed in Table 302. Extension taps are available in both hand and spiral point styles, and in small shank style.

TAP RECOMMENDATIONS FOR CLASSES OF THREAD

Unified and American National Screw Threads

Nominal Size	T.P.I. NC UNC	T.P.I. NF UNF	RECOMMENDED TAP FOR CLASS OF THREAD				PITCH DIAMETER LIMITS FOR CLASS OF THREAD				
			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	GH1	GH1	GH2	GH1	.0519	.0536	.0532	.0542	.0536
1	64	—	GH1	GH1	GH2	GH1	.0629	.0648	.0643	.0655	.0648
1	—	72	GH1	GH1	GH2	GH1	.0640	.0658	.0653	.0665	.0659
2	56	—	GH1	GH1	GH2	GH1	.0744	.0764	.0759	.0772	.0765
2	—	64	GH1	GH1	GH2	GH1	.0759	.0778	.0773	.0786	.0779
3	48	—	GH1	GH1	GH2	GH1	.0855	.0877	.0871	.0885	.0877
3	—	56	GH1	GH1	GH2	GH1	.0874	.0894	.0889	.0902	.0895
4	40	—	GH2	GH1	GH2	GH2	.0958	.0982	.0975	.0991	.0982
4	—	48	GH1	GH1	GH2	GH1	.0985	.1007	.1001	.1016	.1008
5	40	—	GH2	GH1	GH2	GH2	.1088	.1112	.1105	.1121	.1113
5	—	44	GH1	GH1	GH2	GH1	.1102	.1125	.1118	.1134	.1126
6	32	—	GH2	GH1	GH3	GH2	.1177	.1204	.1196	.1214	.1204
6	—	40	GH2	GH1	GH2	GH2	.1218	.1242	.1235	.1252	.1243
8	32	—	GH2	GH1	GH3	GH2	.1437	.1464	.1456	.1475	.1465
8	—	36	GH2	GH1	GH2	GH2	.1460	.1485	.1478	.1496	.1487
10	24	—	GH3	GH1	GH3	GH3	.1629	.1662	.1653	.1672	.1661
10	—	32	GH2	GH1	GH3	GH2	.1697	.1724	.1716	.1736	.1726
12	24	—	GH3	GH1	GH3	GH3	.1889	.1922	.1913	.1933	.1922
12	—	28	GH3	GH1	GH3	GH3	.1928	.1959	.1950	.1970	.1959
1/4	20	—	GH3	GH2	GH5	GH3	.2175	.2211	.2201	.2224	.2211
1/4	—	28	GH3	GH1	GH4	GH3	.2268	.2299	.2290	.2311	.2300
5/16	18	—	GH3	GH2	GH5	GH3	.2764	.2805	.2794	.2817	.2803
5/16	—	24	GH3	GH1	GH4	GH3	.2854	.2887	.2878	.2902	.2890
3/8	16	—	GH3	GH2	GH5	GH3	.3344	.3389	.3376	.3401	.3387
3/8	—	24	GH3	GH1	GH4	GH3	.3479	.3512	.3503	.3528	.3516
7/16	14	—	GH5	GH3	GH5	GH3	.3911	.3960	.3947	.3972	.3957
7/16	—	20	GH3	GH1	GH5	GH3	.4050	.4086	.4076	.4104	.4091
1/2	13	—	GH5	GH3	GH5	GH3	.4500	.4552	.4537	.4565	.4548
1/2	—	20	GH3	GH1	GH5	GH3	.4675	.4711	.4701	.4731	.4717
9/16	12	—	GH5	GH3	GH5	GH3	.5084	.5140	.5124	.5152	.5135
9/16	—	18	GH3	GH2	GH5	GH3	.5264	.5305	.5294	.5323	.5308
5/8	11	—	GH5	GH3	GH5	GH3	.5660	.5719	.5702	.5732	.5714
5/8	—	18	GH3	GH2	GH5	GH3	.5889	.5930	.5919	.5949	.5934
3/4	10	—	GH5	GH3	GH5	GH3	.6850	.6914	.6895	.6927	.6907
3/4	—	16	GH3	GH2	GH5	GH3	.7094	.7139	.7126	.7159	.7143
7/8	9	—	GH6	GH4	GH6	GH4	.8028	.8098	.8077	.8110	.8089
7/8	—	14	GH4	GH2	GH6	GH4	.8286	.8335	.8322	.8356	.8339
1	8	—	GH6	GH4	GH6	GH4	.9188	.9264	.9242	.9276	.9254
1	—	12	GH4	GH2	GH6	GH4	.9459	.9515	.9499	.9535	.9516
1	—	14*	GH4	GH2	GH6	GH4	.9536	.9585	.9572	.9609	.9590
1 1/8	7	—	GH8	GH4	GH8	GH4	1.0322	1.0407	1.0381	1.0416	1.0393
1 1/8	—	12	GH4	GH4	GH6	GH4	1.0709	1.0765	1.0749	1.0787	1.0768
1 1/4	7	—	GH8	GH4	GH8	GH4	1.1572	1.1657	1.1631	1.1668	1.1644
1 1/4	—	12	GH4	GH4	GH6	GH4	1.1959	1.2015	1.1999	1.2039	1.2019
1 3/8	6	—	GH8	GH4	GH8	GH4	1.2667	1.2768	1.2738	1.2771	1.2745
1 3/8	—	12	GH4	GH4	GH6	GH4	1.3209	1.3265	1.3249	1.3291	1.3270
1 1/2	6	—	GH8	GH4	GH8	GH4	1.3917	1.4018	1.3988	1.4022	1.3996
1 1/2	—	12	GH4	GH4	GH6	GH4	1.4459	1.4515	1.4499	1.4542	1.4522

*UN

These are general tap recommendations to 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, please consult the factory.

METRIC TAP RECOMMENDATIONS FOR CLASSES OF THREAD

(ISO)

SIZE mm	PITCH mm	RECOMMENDED TAP FOR CLASS OF THREAD		PITCH DIAMETER LIMITS FOR CLASS OF THREAD		
		4H	6H	MINIMUM (BASIC)	MAX. 4H	MAX. 6H
M1.5	0.35	D1	D2	1.273	1.326	1.358
M1.6	0.35	D1	D3	1.373	1.426	1.458
M1.8	0.35	D1	D3	1.573	1.626	1.658
M2	0.45	D1	D2	1.708	1.768	1.803
M2	0.40	D1	D3	1.740	1.796	1.830
M2.2	0.45	D1	D3	1.908	1.968	2.003
M2.3	0.40	D1	D2	2.040	2.096	2.130
M2.5	0.45	D1	D3	2.208	2.268	2.303
M2.6	0.45	D1	D2	2.308	2.368	2.403
M3	0.60	D1	D2	2.610	2.681	2.722
M3	0.50	D1	D3	2.675	2.738	2.775
M3.5	0.60	D1	D4	3.110	3.181	3.222
M4	0.75	D2	D3	3.513	3.588	3.631
M4	0.70	D2	D4	3.545	3.620	3.663
M4.5	0.75	D2	D4	4.013	4.088	4.131
M5	1.00	D2	D3	4.350	4.440	4.490
M5	0.90	D2	D3	4.415	4.501	4.549
M5	0.80	D2	D4	4.480	4.560	4.605
M5.5	0.90	D2	D3	4.915	5.002	5.050
M6	1.00	D3	D5	5.350	5.445	5.500
M6	0.75	D3	D4	5.513	5.598	5.645
M7	1.00	D3	D5	6.350	6.445	6.500
M7	0.75	D2	D4	6.513	6.598	6.645
M8	1.25	D3	D5	7.188	7.288	7.348
M8	1.00	D3	D5	7.350	7.445	7.500
M9	1.25	D3	D5	8.188	8.288	8.348
M9	1.00	D3	D5	8.350	8.445	8.500
M10	1.50	D3	D6	9.026	9.138	9.206
M10	1.25	D3	D5	9.188	9.288	9.348
M10	1.00	D3	D5	9.350	9.445	9.500
M11	1.50	D3	D5	10.026	10.138	10.206
M12	1.75	D3	D6	10.863	10.988	11.063
M12	1.50	D3	D6	11.026	11.144	11.216
M12	1.25	D3	D5	11.188	11.300	11.368
M14	2.00	D3	D7	12.701	12.833	12.913
M14	1.50	D3	D6	13.026	13.144	13.216
M14	1.25	D3	D5	13.188	13.300	13.368

cont.

These are general tap recommendations to 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, please consult the factory.

METRIC TAP RECOMMENDATIONS FOR CLASSES OF THREAD

(ISO) cont.

SIZE mm	PITCH mm	RECOMMENDED TAP FOR CLASS OF THREAD		PITCH DIAMETER LIMITS FOR CLASS OF THREAD		
		4H	6H	MINIMUM (BASIC)	MAX. 4H	MAX. 6H
M16	2.00	D4	D7	14.701	14.833	14.913
M16	1.50	D3	D6	15.026	15.144	15.216
M17	1.50	D3	D5	16.026	16.144	16.216
M18	2.50	D4	D7	16.376	16.516	16.600
M18	2.00	D4	D6	16.701	16.833	16.913
M18	1.50	D3	D6	17.026	17.144	17.216
M19	2.50	D4	D6	17.376	17.516	17.600
M20	2.50	D4	D7	18.376	18.516	18.600
M20	2.00	D4	D6	18.701	18.833	18.913
M20	1.50	D3	D6	19.026	19.144	19.216
M22	2.50	D4	D7	20.376	20.516	20.600
M22	2.00	D4	D6	20.701	20.833	20.913
M22	1.50	D3	D6	21.026	21.144	21.216
M24	3.00	D4	D8	22.051	22.221	22.316
M24	2.00	D4	D7	22.701	22.841	22.925
M24	1.50	D3	D5	23.026	23.151	23.226
M25	2.00	D4	D7	23.701	23.841	23.925
M25	1.50	D3	D5	24.026	24.151	24.226
M26	3.00	D5	D8	24.051	24.221	24.316
M27	3.00	D5	D8	25.051	25.221	25.316
M27	2.00	D5	D7	25.701	25.841	25.925
M28	3.00	D5	D8	26.051	26.221	26.316
M28	2.00	D5	D7	26.701	26.841	26.925
M30	3.50	D5	D9	27.727	27.907	28.007
M30	3.00	D5	D8	28.051	28.221	28.316
M30	2.00	D5	D7	28.701	28.841	28.925
M32	3.50	D5	D9	29.727	29.907	30.007
M32	2.00	D5	D7	30.701	30.841	30.925
M33	3.50	D5	D9	30.727	30.907	31.007
M33	3.00	D5	D8	31.051	31.221	31.316
M33	2.00	D5	D7	31.701	31.841	31.925
M34	3.50	D5	D9	31.727	31.907	32.007
M36	4.00	D5	D9	33.402	33.592	33.702
M36	3.00	D5	D8	34.051	34.221	34.316
M36	2.00	D5	D7	34.701	34.841	34.925
M38	4.00	D5	D9	35.402	35.592	35.702
M39	4.00	D6	D9	36.402	36.592	36.702
M39	3.00	D6	D8	37.051	37.221	37.316
M39	2.00	D6	D7	37.701	37.841	37.925

These are general tap recommendations to 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, please consult the factory.

FORMULA FOR TAP/DRILL SIZES (INCH)

METHOD 1

$$\text{Drilled Hole Size (in.)} = \text{Basic Major Dia. of Thread (in.)} - \frac{.013 \times \% \text{ of Full Thread}^*}{\# \text{ of Threads per Inch (T.P.I.)}$$

* Use whole number for % of thread...for 65%, use 65 (not .65).

METHOD 2

$$\text{Nominal O.D.} - (\text{Dbl. Thread Depth} \times \% \text{ of Full Thread}) = \text{Drilled Hole Size}$$

*EXAMPLE: To find the hole size for obtaining 75% of thread in a 1/4-20 tapped hole, follow first column down to 20 threads, then across to 75% of thread. This figure (.0485), when subtracted from the .250 diameter, is .2015, which is the required diameter of hole. See equation:
.250 - .0485 = .2015*

To figure whether or not pitch is too coarse for diameter:
(Double thread depth) X 3 = x
x = the smallest diameter possible for that T.P.I.

Threads per Inch	Double Thread Depth	50% Thread	55% Thread	60% Thread	65% Thread	70% Thread	75% Thread	80% Thread	85% Thread
6	.21651	.1083	.1192	.1300	.1408	.1517	.1625	.1733	.1842
7	.18558	.0929	.1021	.1114	.1207	.1300	.1393	.1486	.1579
8	.16238	.0813	.0894	.0975	.1056	.1138	.1219	.1300	.1381
9	.14434	.0722	.0794	.0866	.0939	.1011	.1083	.1156	.1228
10	.12990	.0649	.0714	.0779	.0844	.0909	.0974	.1039	.1105
11	.11809	.0590	.0649	.0708	.0767	.0826	.0885	.0944	.1005
12	.10825	.0541	.0595	.0649	.0702	.0755	.0808	.0861	.0921
13	.09992	.0499	.0549	.0599	.0649	.0699	.0749	.0799	.0850
14	.09278	.0464	.0510	.0556	.0602	.0648	.0694	.0740	.0789
16	.08119	.0406	.0446	.0486	.0526	.0566	.0606	.0646	.0691
18	.07217	.0361	.0396	.0431	.0466	.0501	.0536	.0571	.0614
20	.06495	.0325	.0357	.0389	.0421	.0453	.0485	.0517	.0553
24	.05412	.0270	.0298	.0326	.0354	.0382	.0410	.0438	.0460
27	.04811	.0240	.0264	.0288	.0312	.0336	.0360	.0384	.0409
28	.04639	.0232	.0254	.0276	.0298	.0324	.0347	.0370	.0395
30	.04330	.0216	.0238	.0260	.0282	.0304	.0326	.0348	.0368
32	.04059	.0203	.0223	.0243	.0263	.0283	.0303	.0323	.0345
36	.03608	.0180	.0198	.0216	.0234	.0252	.0270	.0288	.0307
40	.03247	.0162	.0178	.0194	.0210	.0226	.0242	.0258	.0276
44	.02952	.0147	.0162	.0177	.0192	.0207	.0222	.0237	.0251
48	.02706	.0135	.0148	.0161	.0174	.0187	.0200	.0213	.0230
56	.02319	.0116	.0127	.0138	.0149	.0160	.0171	.0182	.0197
64	.02029	.0101	.0111	.0121	.0131	.0141	.0151	.0161	.0173
72	.01804	.0090	.0099	.0107	.0115	.0123	.0131	.0139	.0153
80	.01623	.0081	.0089	.0097	.0105	.0113	.0121	.0129	.0138

Figures in table show amount to subtract from O.D. of screw to obtain specific percentages of thread.
Select nearest size commercial stock drill.

FORMULA FOR TAP/DRILL SIZES (METRIC)

METHOD 1

$$\text{Drilled Hole Size (mm)} = \text{Basic Major Dia. of Thread (mm)} - \frac{\% \text{ of Full Thread} \times \text{mm Pitch}}{76.98}$$

* Use whole number for % of thread...for 65%, use 65 (not .65).

METHOD 2

$$\text{Nominal O.D.} - (\text{Dbl. Thread Depth} \times \% \text{ of Full Thread}) = \text{Drilled Hole Size}$$

*EXAMPLE: To find the hole size for obtaining 75% of thread in a (M6) 6mm x 1.00 tapped hole, follow first column down to 1.00 threads, then across to 75% of thread. This figure (.9743), when subtracted from 6mm diameter, is 5.0257, which is the required diameter of hole. See equation:
M6 - (1.2990 X 75) = (6 - .9743) = 5.0257mm*

To figure whether or not pitch is too coarse for diameter:
(Double thread depth) X 3 = x
x = the smallest diameter possible for that T.P.I.

NOTE: All numbers are shown in millimeters (mm). To convert metric values to inches, divide by 25.4

mm Pitch	Double Thread Depth	50% Thread	55% Thread	60% Thread	65% Thread	70% Thread	75% Thread	80% Thread	85% Thread
4.0	5.1963	2.5982	2.8580	3.1178	3.3776	3.6374	3.8972	4.1570	4.4169
3.50	4.5466	2.2733	2.5006	2.7280	2.9553	3.1826	3.4100	3.6373	3.8646
3.00	3.8969	1.9485	2.1433	2.3381	2.5330	2.7278	2.9227	3.1175	3.3124
2.50	3.2476	1.6238	1.7862	1.9486	2.1109	2.2733	2.4357	2.5981	2.7605
2.00	2.5979	1.2990	1.4288	1.5587	1.6886	1.8185	1.9484	2.0783	2.2082
1.75	2.2733	1.1367	1.2503	1.3640	1.4776	1.5913	1.7050	1.8186	1.9323
1.50	1.9487	.9744	1.0718	1.1692	1.2667	1.3641	1.4615	1.5590	1.6564
1.25	1.6236	.8118	.8930	.9742	1.0553	1.1365	1.2177	1.2989	1.3801
1.00	1.2990	.6495	.7145	.7794	.8444	.9093	.9743	1.0392	1.1042
.90	1.1687	.5844	.6428	.7012	.7597	.8181	.8765	.9350	.9934
.80	1.0394	.5197	.5717	.6236	.6756	.7276	.7796	.8315	.8835
.75	.9743	.4871	.5359	.5846	.6333	.6820	.7307	.7794	.8282
.70	.9093	.4547	.5001	.5456	.5910	.6365	.6820	.7274	.7729
.60	.7793	.3897	.4286	.4676	.5065	.5455	.5845	.6234	.6624
.50	.6421	.3211	.3532	.3853	.4174	.4495	.4816	.5137	.5458
.45	.5847	.2924	.3216	.3508	.3801	.4093	.4385	.4678	.4970
.40	.5197	.2599	.2858	.3118	.3378	.3638	.3898	.4158	.4417
.35	.4547	.2274	.2501	.2728	.2956	.3183	.3410	.3638	.3865
.30	.3896	.1948	.2143	.2338	.2532	.2727	.2922	.3117	.3312
.25	.3246	.1663	.1785	.1948	.2110	.2272	.2434	.2597	.2759

Figures in table show amount to subtract from O.D. of screw to obtain specific percentages of thread.
Select nearest size commercial stock drill.

• **Materials Listing** • **Suggested Surface Treatments**
Cutting Fluids and Cutting Speeds
(STARTING SFM RECOMMENDATIONS ONLY)

MATERIAL TO BE TAPPED	SUGGESTED SURFACE TREATMENT**	LUBRICANT/COOLANT	HSS SPEED / SFM	CARBIDE SPEED / SFM
ALUMINUM (WROUGHT)	TiN, TiCN	Soluble, Light Base, or Lard Oil	90-150	100-250
ALUMINUM DIE CASTING	TiCN, TiN, CrN, TiAlN+WC/C	Soluble or Lard Oil	65-75	75-100
ALUMINUM BRONZE	N, TiN	Mineral Oil w/Lard, or Light Oil	20-60	40-80
BAKELITE (HARD PLASTIC)	TiCN	Dry or Air Jet	25-40	25-40
BERYLLIUM COPPER	TiAlN+WC/C, CrN, N	Soluble Light Base Oil	50-90	50-90
BRASS	None, TiCN	Soluble Light Base Oil	100-200	100-200
BRONZE (FREE-MACHINE)	None, TiCN, N	Soluble Light Base Oil	80-150	100-200
CAST BRASS	N, TiCN	Soluble Light Base Oil	100-200	125-250
CAST IRON (GRAY)	N, TiCN	Dry or Soluble Oil	20-80	40-100
COPPER	TiAlN+WC/C, CrN	Soluble Light Base Oil	80-150	100-200
COPPER-NICKEL	N, TiCN	Soluble Light Base Oil	10-20	20-50
DELTRIN	TiAlN+WC/C, TiN, N	Dry, Air Jet, or Water Soluble	65-100	65-100
DUCTILE IRON	N+O, TiN, TiCN	Soluble or Sulphur Based Oils	30-50	40-80
DURALUMIN	TiAlN+WC/C, CrN	Soluble or Lard Oil	50-90	50-90
FERRO-TIC	None	Anti-Seize Compound	8-20	8-20
FIBERGLASS	TiCN	Dry or Air Jet	25-40	30-60
HASTELLOY	CrN	Sulphur Based Oils	8-20	8-20
INCONEL	N, CrN	Sulphur Based Oils	8-20	8-20
MAGNESIUM	CrN	Soluble Light Base Oil	100-150	100-150
MALLEABLE IRON	N+O, TiN, TiCN	Soluble or Sulphur Based Oils	30-50	30-50
MANGANESE	TiCN	Sulphur Based Oils	8-20	8-20
MANGANESE BRONZE	N, TiCN	Soluble Light Base Oil	20-60	40-80
MOLYBDENUM	N, TiN, TiCN	Sulphur Based Oils	20-45	30-60
MONEL	N, TiCN	Sulphur Based Oils	8-20	15-40
NAVAL BRASS	N	Soluble Light Base Oil	100-200	100-200
NAVAL BRONZE	None, TiCN	Soluble Light Base Oil	80-150	80-150
NICKEL SILVER	N, TiCN	Sulphur Based Oils	20-60	20-60
NICKEL (PURE)	N, TiCN	Soluble Light Base Oil	5-25	10-40
NITRALLOY	N, TiCN	Sulphur Based Oils	8-20	8-20
NITRONIC (* NO GUARANTEE)	N, TiN, TiCN	Sulphur Based Oils	8-20	8-20
NYLON	N, TiN	Dry, Air Jet or Water Soluble	65-100	65-100
PLASTICS:				
THERMOPLASTIC (SOFT) ABS, DELTRIN, NYLON, PVC, ETC.	N, TiN	Dry, Air Jet or Water Soluble	65-100	65-100
THERMOSETTING (HARD) BAKELITE, LAMINATES, PHENOLIC, POLYESTERS, ETC.	TiCN	Dry or Air Jet	25-40	25-40
POWDERED METAL (Sintered)	TiCN	Soluble Light Based Oil	25-80	25-80
RUBBER, HARD	None	Dry	50-200	50-200
SILICON BRONZE	N, TiCN	Soluble Light Base Oil	20-60	20-60
STEEL:				
CARBON STEEL	O, N, TiN	Sulphur Based Oils	40-90	50-120
COLD-ROLLED STEEL (1018, etc.)	O, N, TiN	Sulphur Based Oils	40-90	50-120
FORGED	O, N, TiN	Sulphur Based Oils	20-50	30-75
LEADED (12L14, etc.)	O, N, TiN	Sulphur Based Oils	40-90	50-125
STAINLESS:				
FREE MACHINING	N, TiN, TiCN	Sulphur Based Oils	20-40	40-80
PRECIP. HARDENING	N, TiN, TiCN	Sulphur Based Oils	8-20	10-30
TOOL STEEL	N, TiN, TiCN	Sulphur Based Oils	20-50	30-65
TITANIUM	O, N, CrN	Sulphur Based Oils	20-50	30-65
TUNGSTEN	TiN	Sulphur Based Oils	8-20	8-20
TURCITE (SOFT PLASTIC)	N, TiN	Dry, Air Jet or Water Soluble	65-100	65-100
ZAMAK (ZINC DIE CAST)	TiCN, TiN, CrN, TiAlN+WC/C	Soluble Light Based Oil	50-200	50-200
ZINC	TiCN, TiN, CrN, TiAlN+WC/C	Soluble Light Based Oil	50-200	50-200

* If problems are encountered when tapping nitronic, or any other material (listed or not), please consult the factory.

** See definitions of surface treatment abbreviations.

Note: The SFM cutting speeds listed are starting SFM recommendations only and depending on specific tapping conditions, may have to be altered. Allen Benjamin assumes no responsibility or liability of any kind as a result of the above listed SFM recommendations.

TABLE OF SPEEDS FOR TAPS

(USE ONLY AS SUGGESTED STARTING R.P.M.)

MACHINE SCREW AND FRACTIONAL SIZES

Tap Size (UNC/UNF)	Taper Pipe Taps (NPT/NPTF)	Surface Feet per Minute (SFM)																	
		5'	10'	15'	20'	25'	30'	40'	50'	60'	70'	80'	90'	100'	110'	120'	130'	140'	150'
Revolutions per Minute (RPM)																			
0 (.060)		318	637	955	1273	1592	1910	2546	3183	3820	4456	5093	5729	6366	7003	7639	8276	8913	9549
1 (.073)		273	546	819	1046	1308	1570	2093	2617	3140	3663	4186	4710	5233	5756	6279	6805	7326	7849
2 (.086)		212	424	637	888	1110	1333	1777	2221	2665	3109	3554	3999	4442	4886	5330	5774	6218	6662
3 (.099)		191	382	573	772	964	1157	1543	1929	2315	2701	3086	3472	3858	4244	4629	5015	5401	5787
4 (.112)		174	347	521	682	853	1023	1364	1705	2046	2387	2728	3069	3411	3751	4092	4434	4775	5116
5 (.125)		147	294	441	611	764	917	1222	1528	1833	2139	2445	2750	3056	3361	3667	3973	4278	4584
6 (.138)		136	273	409	553	691	829	1106	1382	1659	1935	2212	2488	2766	3042	3318	3595	3871	4148
8 (.164)		119	239	358	466	583	699	932	1165	1398	1631	1864	2097	2330	2563	2796	3029	3262	3495
10 (.190)		101	201	302	402	502	603	804	1005	1205	1406	1607	1808	2009	2210	2411	2612	2813	3014
12 (.216)		87	174	260	354	442	531	707	884	1061	1238	1415	1592	1769	1945	2122	2300	2476	2653
14 (.242)		79	158	237	316	395	474	631	789	947	1105	1263	1421	1579	1736	1894	2052	2210	2368
1/4		76	153	229	306	382	458	611	764	917	1070	1222	1375	1528	1681	1833	1986	2139	2292
5/16	1/16	62	123	185	245	306	367	489	611	733	856	978	1100	1222	1345	1467	1589	1711	1833
3/8		50	101	151	204	255	305	407	509	611	713	815	917	1019	1120	1222	1324	1426	1528
7/16	1/8	43	87	130	175	219	262	349	437	524	611	698	786	873	960	1048	1135	1222	1310
1/2		38	76	115	153	191	229	305	382	458	535	611	688	764	840	917	993	1070	1146
9/16	1/4	34	68	102	137	172	206	274	342	410	478	547	616	683	752	820	888	952	1020
5/8		32	64	96	122	153	183	244	306	367	428	489	550	611	672	733	794	856	917
11/16	3/8	28	55	83	111	138	167	222	278	333	389	444	500	556	611	667	722	778	833
3/4		25	51	76	102	128	153	203	255	305	357	407	458	509	560	611	662	713	764
7/8	1/2	22	43	65	87	109	131	175	218	262	306	350	392	437	480	524	568	611	655
1"		19	38	57	76	96	115	153	191	230	268	305	344	382	420	458	497	535	573
1 1/8	3/4	17	34	51	68	84	102	136	170	204	238	272	306	340	373	407	441	475	509
1 1/4		15	31	46	61	76	92	122	153	183	214	244	275	305	336	367	397	428	458
1 3/8	1	14	28	42	56	69	83	111	139	167	194	222	250	278	306	333	361	389	417
1 1/2		13	25	38	51	63	76	102	127	153	178	204	229	255	280	305	331	356	382
1 5/8		12	23	35	47	59	71	94	118	141	165	188	212	235	259	282	306	329	353
1 3/4	1 1/4	11	22	33	44	55	65	87	109	131	153	175	196	218	240	262	284	306	327
1 7/8	1 1/2	10	20	30	41	51	61	81	102	122	143	163	183	204	224	244	265	285	306
2"		9	19	29	38	48	57	76	96	115	134	153	172	191	210	229	248	267	287

METRIC SIZES

Metric Tap Size	Dec. Equiv. Size	Surface Feet per Minute (SFM)																	
		5'	10'	15'	20'	25'	30'	40'	50'	60'	70'	80'	90'	100'	110'	120'	130'	140'	150'
		Revolutions per Minute (RPM)																	
M1	.0394	490	979	1469	1959	2449	2938	3918	4897	5877	6856	7836	8815	9795	10774	11754	12733	13713	14692
M2	.0787	242	484	725	967	1209	1451	1934	2418	2901	3385	3868	4352	4835	5319	5803	6286	6770	7253
M3	.1181	162	324	486	647	809	971	1295	1619	1942	2266	2590	2914	3237	3561	3885	4208	4532	4856
M3.5	.1378	138	277	415	554	692	830	1107	1384	1661	1938	2214	2491	2768	3045	3322	3599	3875	4152
M4	.1575	122	243	365	487	608	730	973	1217	1460	1703	1946	2190	2433	2676	2920	3163	3406	3650
M5	.1969	97	194	291	388	485	582	776	970	1163	1357	1551	1745	1939	2133	2327	2521	2715	2909
M6	.2362	81	162	243	324	405	486	647	809	971	1133	1295	1457	1619	1781	1942	2104	2266	2428
M7	.2756	69	138	208	277	346	415	554	692	830	969	1107	1246	1384	1522	1661	1799	1938	2076
M8	.3150	61	121	182	243	303	364	485	606	728	849	970	1091	1213	1334	1455	1577	1698	1819
M10	.3937	48	97	145	194	242	291	388	485	582	679	776	873	970	1067	1163	1260	1357	1454
M12	.4724	40	81	121	162	202	243	324	405	486	567	647	728	809	890	971	1052	1133	1214
M14	.5512	35	69	104	139	173	208	277	347	416	485	555	624	693	763	832	901	971	1040
M16	.6299	30	61	91	121	152	182	243	303	364	424	485	546	606	667	728	788	849	910
M18	.7087	27	54	81	108	135	162	216	269	323	377	431	485	539	593	647	700	754	808
M20	.7874	24	49	73	97	121	146	194	243	291	340	388	437	485	534	582	631	680	728
M22	.8661	22	44	66	88	110	132	176	221	265	309	353	397	441	485	529	573	618	662
M24	.9449	20	40	61	81	101	121	162	202	243	283	323	364	404	445	485	526	566	606
M27	1.0630	18	36	54	72	90	108	144	180	216	252	287	323	359	395	431	467	503	539
M30	1.1811	16	32	49	65	81	97	129	162	194	226	259	291	323	356	388	420	453	485

Factors to be considered when determining tapping speeds:

- Material to be tapped
- Pitch of thread
- Machine equipment and rigidity
- Depth of hole
- Percentage of full thread to be cut
- Horizontal or vertical tapping
- Length of chamfer on tap
- Lubrication

Speed / Feed Equations:	INCH:	S.F.M. = 0.26 X R.P.M. X TOOL DIA.	R.P.M. = $\frac{3.82 \times \text{S.F.M.}}{\text{TOOL DIA.}}$
	METRIC:	S m/m = $\frac{\pi \times \text{TOOL DIA.} \times \text{R.P.M.}}{1000}$	R.P.M. = $\frac{\text{m/m} \times 1000}{\pi \times \text{TOOL DIA.}}$

ROCKWELL - BRINELL HARDNESS DATA

ROCKWELL C to BRINELL 3000 KG. For Hardened Steel and Alloys

ROCKWELL C 150 Kg. Load "Brale"	BRINELL 3000 Kg. Load 10mm Ball
60	614
59	600
58	587
57	573
56	560
55	547
54	534
53	522
52	509
51	496
50	484
49	472
48	460
47	448
46	437
45	426
44	415
42	393
40	372
38	352
36	332
34	313
32	297
30	283
28	270
26	260
24	250
22	240
20	230

BRINELL 3000 KG. TO ULTIMATE TENSILE STRENGTH FOR STEELS

BRINELL 3000 Kg. Load 10mm Ball	ULTIMATE TENSILE STRENGTH, psi
200	100,000
225	108,000
250	122,000
275	141,000
300	158,000
325	174,000
350	188,000
375	202,000
400	215,000
425	227,000
450	238,000
475	249,000
500	258,000
525	267,000
550	282,000
575	295,000
600	308,000

ROCKWELL B to BRINELL 500 and 3000 KG. For Unhardened Steel, Steel of Soft Temper, Gray and Malleable Cast Iron and Most Nonferrous Metal

ROCKWELL B 100 Kg. Load 1/16" Dia. Ball	BRINELL 500 Kg. Load 10mm Ball	BRINELL 3000 Kg. Load 10mm Ball
100	201	240
99	195	234
98	189	228
97	184	222
96	179	216
95	175	210
94	171	205
93	167	200
92	163	195
91	160	190
90	157	185
89	154	180
88	151	176
87	148	172
86	145	169
85	142	165
84	140	162
83	137	159
82	135	156
81	133	153
80	130	150
79	128	147
78	126	144
77	124	141
76	122	139
75	120	137
74	118	135
72	114	130
70	110	125
68	107	121
66	104	117
64	101	114
62	98	110
60	95	107
58	92	104
56	90	101
54	87	
52	85	
50	83	
48	81	
46	79	
44	78	
42	76	
40	74	
38	73	
36	71	
34	70	
32	68	
30	67	
28	66	
24	64	
20	62	
16	60	
12	58	
8	56	
4	55	
0	53	

THREAD FORMING TAP ENTRY LENGTHS:

Entry taper length is measured on the full diameter of the thread forming lobes and is the axial distance from the entry diameter position to the theoretical intersection of tap major diameter and entry taper angle. Whenever entry taper length is specified in terms of number of threads, this length is measured in number of pitches (p).

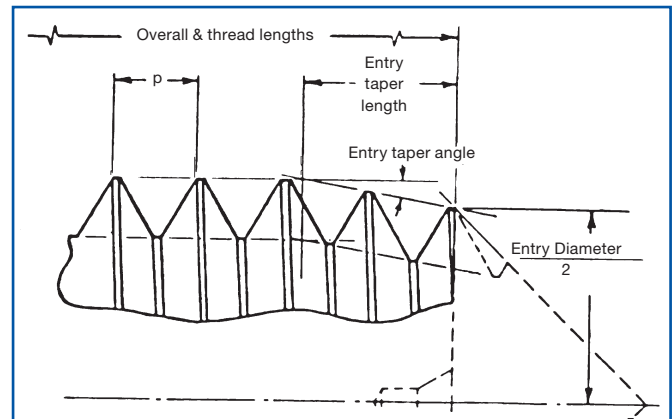
BOTTOMING LENGTH = 1-1/2 to 2-1/2 PITCHES

PLUG LENGTH = 3 to 5 PITCHES

The chamfer on BOTTOM style form taps is approximately 2 threads long and requires a drilled hole depth 3-4 pitches beyond the full thread required. When a controlled maximum chamfer shorter than 2 threads is required, an additional charge will apply. *We will not guarantee the performance of taps with the shorter chamfer.*

Entry diameter, measured at the thread crest nearest the front of the tap, is an appropriate amount smaller than the diameter of the hole drilled for tapping. See below for tap/drill size formulas, and formulas to determine maximum and minimum drill hole sizes for appropriate percent of thread.

TAPPING SPEEDS: Form taps operate most efficiently at spindle speeds 1-1/2 to 2 times faster than those recommended for conventional cutting taps, especially in softer materials and/or with fine pitch forming taps.



As higher speeds are attained, adequate lubrication is essential for prolonged tap life and thread quality.

LUBRICATION: Since it is more important to 'lubricate' the cold-forming tap than to 'cool' the tap, these taps should be used with conventional lubricating cutting oils or EP (extreme pressure) rated oil...soluble oils and similar coolants are not recommended.

PRE-TAPPED HOLE SIZE: Forming taps require a larger pre-tapped hole size than conventional cutting taps. To insure a properly tapped (cold formed) hole, adhere to the following:

FORMULA FOR TAP/DRILL SIZES FOR DECIMAL/INCH FORM TAPS:

$$\text{HOLE SIZE} = \text{Basic Tap O.D.} - \left(\frac{.0068 \times \% \text{ of Thread}^*}{\text{Threads per Inch}} \right)$$

For example:

To determine drill size for a 1/4-20 thread forming tap at 65% of thread: $.250 - \left(\frac{.0068 \times 65}{20} \right) = .2279$

* Use whole number for % of thread...for 65%, use 65 (not .65).

FORMULA FOR TAP/DRILL SIZES FOR METRIC FORM TAPS:

$$\text{HOLE SIZE (mm)} = \text{Basic Tap O.D.(mm)} - \left(\frac{\% \text{ of Thread} \times \text{mm Pitch}}{147.06} \right)$$

* Use whole number for % of thread...for 65%, use 65 (not .65).

There is no true method of predicting percent of thread that will be obtained when tapping with forming taps due to the many variables involved. As a starting point, however, 55% for maximum drill size and 75% for minimum drill size can be used as a guide. Any desired percent of thread can be approximated by using drill sizes in between. To determine theoretical maximum and minimum drill sizes (for average operating conditions), see formulas below.

For UNIFIED INCH Threads:

$$\text{Max. Drill Size} = \text{Basic Major Diameter} - \frac{3}{8N}$$

$$\text{Min. Drill Size} = \text{Basic Major Diameter} - \frac{1}{2N}$$

N = T.P.I. (Threads per Inch)

For 60° Metric Threads:

$$\text{Max. Drill Size} = \text{Basic Major Diameter} - 0.375P$$

$$\text{Min. Drill Size} = \text{Basic Major Diameter} - 0.5P$$

P = Pitch

Note: For Basic Major Diameter and Pitch, use millimeter value to obtain drill size in mm. To convert mm to inch value, divide by 25.4:

$$\frac{\text{mm Value}}{25.4} = \text{Inch Value}$$



Carbide Standard Straight Flute Taps

Straight flute carbide taps are for general purposes and are listed in sub-micron carbide up to and including 5/8 inch diameter. All inserted carbide taps, 3/4 inch and larger, are manufactured by brazing sub-micron carbide onto high speed steel bodies, thus providing the ultimate in strength and wear. Upon ordering any carbide or carbide inserted tap, it is advisable and highly recommended to specify the material to be tapped, and the condition that the material is in at the time of tapping.

Carbide Standard Spiral Point Taps

Spiral point taps, also known as gun taps, are so named because they drive the chip ahead of the tap. These taps are stronger than other straight flute taps and are most efficient when used for tapping through holes.

Spiral point carbide taps are highly recommended for cast iron, ferrous and extremely abrasive applications.

All spiral point taps listed are offered in sub-micron carbide to be used under conditions of high metallurgical strength and hardness. These taps are an economical means of tapping the current high temperature alloy materials. Upon ordering any carbide spiral point tap, it is advisable and highly recommended to specify the material to be tapped, and the condition that the material is in at the time of tapping.

Carbide Standard Screw Thread Insert (S.T.I.) Taps

Screw thread insert taps are primarily used in soft abrasive materials. It is most advisable to use sub-micron carbide taps. Carbide taps generally wear longer and maintain accurate thread forms, which is essential to proper gaging. The taps listed are available as factory standards. When ordering S.T.I. taps, it is highly recommended to specify the material to be tapped, and the condition that the material is in at the time of tapping.

Carbide Standard Metric (ISO) Taps

All carbide metric taps are manufactured the same as the American standard straight flute and spiral point taps. The ISO metric tap is used as commonly as the American standard tap in all threading applications. All sizes larger than M16 are available as carbide inserted specials and are priced upon application.

'PRX' Series Carbide Taps for Stellite, Inconel, etc.

The 'PRX' tap was first developed in 1984 by Allen Benjamin Inc. as a tap for a local aerospace company to tap inconel, and was the first truly high performance carbide tap. This tap has evolved through changes in carbide composition, geometry and surface treatment. As the basis of the Allen Benjamin line of high performance taps, the 'PRX' tap remains basically a tap for inconel and stellite, and is available in many variations. It has been used to chase threads in materials with a high hardness on the Rockwell C scale and has proven successful in tapping pure tungsten and cast aluminum.

'PRX' taps are manufactured from a special grade of sub-micron carbide engineered specifically for tapping high cobalt chrome materials and are widely used in demanding aerospace applications.

'PRC' Series Carbide Taps for Titanium and Beryllium

The 'PRC' tap for titanium is a specialized version of the Allen Benjamin line of high performance carbide taps. The original specialized line was the 'PRX' tap for inconel and stellite introduced in 1984. Allen Benjamin 'PRC' high performance taps are based on the 'PRX' tap design and have benefited from continuing improvements.

The 'PRC' tap, with its unique characteristics and geometry, was engineered for threading titanium, beryllium and related materials in aerospace and medical applications.

Carbide Multi-Flute Taps (for Plastic)

Multi-flute taps, manufactured with thin lands, were developed specifically for the tapping of resins, plastics, fiberglass circuit boards, ceramics, metal

oxides and like materials. The life of the carbide multi-flute tap is remarkable, compared to high speed steel. Carbide tap life, in the above materials, will outperform HSS taps in the majority of applications under favorable tapping conditions. The multi-flute, thin land design permits better chip clearance and less heat generation, thereby reducing tap breakage. Note the larger pitch diameter sizes (H#) that are carried as catalog items. Most of the above materials have memory and tend to close in after tapping, hence the extra size allowance built into the stock taps. These taps are manufactured with the full thread length, as specified in Table 302, instead of the high performance style of our standard line of general purpose taps made to Table 302-A standards.

Carbide Pipe Taps - NPT / NPTF / NPS / NPSF

Carbide pipe taps prove the most profitable when used for threading cast iron, aluminum, bronze, brass or plastic pipe fittings. Tap life is higher than that of high speed steel pipe taps depending upon the application. Contact Allen Benjamin for specific pipe thread forms required.

Carbide Thread Forming Taps

Carbide thread forming taps will outperform HSS thread form taps in most instances by producing a higher number of consistent threaded holes. These taps are fluteless and are typically designed with one or more lubrication grooves. The thread form is lobed so there is a finite number of points contacting the work. The thread forming tap is not a general purpose tool, as threads are formed by displacing the metal without removing it. Therefore, the difficulties of chip removal in blind holes is eliminated. No loading of chips means oversize or damaged threads is not a problem as well. Allen Benjamin form taps are well suited to threading many materials.

Carbide Insert Taps

Carbide insert taps provide an economical approach to carbide taps where only the cutting portion of the tap is comprised of carbide. This tap features a HSS tap body with brazed micrograin carbide cutting faces. The HSS tap body is better suited to absorb vibration and handle lack of rigidity in the cut over conventional solid carbide taps.

METRIC SIZE X .03937 = DECIMAL EQUIVALENT
DECIMAL SIZE X 25.4 = METRIC (mm) EQUIVALENT

FRACTIONAL, DECIMAL AND METRIC EQUIVALENTS

Fraction Of Inch	Decimal Of Inch	Millimeters	Fraction Of Inch	Decimal of Inch	Millimeters
1/64	.015625	0.3969	33/64	.515625	13.0969
1/32	.03125	0.7938	17/32	.53125	13.4938
3/64	.046875	1.1906	35/64	.546875	13.8906
1/16	.0625	1.5875	9/16	.5625	14.2875
5/64	.078125	1.9844	37/64	.578125	14.6844
3/32	.09375	2.3812	19/32	.59375	15.0812
7/64	.109375	2.7781	39/64	.609375	15.4781
1/8	.125	3.1750	5/8	.625	15.8750
9/64	.140625	3.5719	41/64	.640625	16.2719
5/32	.15625	3.9688	21/32	.65625	16.6688
11/64	.171875	4.3656	43/64	.671875	17.0656
3/16	.1875	4.7625	11/16	.6875	17.4625
13/64	.203125	5.1594	45/64	.703125	17.8594
7/32	.21875	5.5562	23/32	.71875	18.2562
15/64	.234375	5.9531	47/64	.734375	18.6531
1/4	.250	6.3500	3/4	.750	19.0500
17/64	.265625	6.7469	49/64	.765625	19.4469
9/32	.28125	7.1438	25/32	.78125	19.8438
19/64	.296875	7.5406	51/64	.796875	20.2406
5/16	.3125	7.9375	13/16	.8125	20.6375
21/64	.328125	8.3344	53/64	.828125	21.0344
11/32	.34375	8.7312	27/32	.843750	21.4312
23/64	.359375	9.1281	55/64	.859375	21.8281
3/8	.375	9.5250	7/8	.875	22.2250
25/64	.390625	9.9219	57/64	.890625	22.6219
13/32	.40625	10.3188	29/32	.90625	23.0188
27/64	.421875	10.7156	59/64	.921875	23.4156
7/16	.4375	11.1125	15/16	.9375	23.8125
29/64	.453125	11.5094	61/64	.953125	24.2094
15/32	.46875	11.9062	31/32	.96875	24.6062
31/64	.484375	12.3031	63/64	.984375	25.0031
1/2	.500	12.7000	1.000	1.0000	25.4000

MILLIMETER PITCH TO THREADS PER INCH METRIC PITCH CONVERSIONS

Pitch In Millimeters	Pitch In Inches	Threads Per In.	Basic Height	Pitch In Millimeters	Pitch In Inches	Threads Per In.	Basic Height
.25	.00984	101.6000	.00639	1.25	.04921	20.3211	.03196
.30	.01181	84.6668	.00767	1.50	.05906	16.9316	.03836
.35	.01378	72.5689	.00895	1.75	.06890	14.5138	.04475
.40	.01575	63.4921	.01023	2.00	.07874	12.7000	.05114
.45	.01772	56.4334	.01151	2.50	.09843	10.1595	.06393
.50	.01969	50.8000	.01279	3.00	.11811	8.4667	.07671
.60	.02362	42.3370	.01534	3.50	.13780	7.2569	.08950
.70	.02756	36.2845	.01790	4.00	.15748	6.3500	.10229
.75	.02953	33.8639	.01918	4.50	.17717	5.6443	.11508
.80	.03150	31.7460	.02046	5.00	.19685	5.0800	.12785
.90	.03543	28.2247	.02301	6.00	.23622	4.2333	.15344
1.00	.03937	25.4000	.02557				

Carbide Tooling
Technical Data

Many cutting tool applications are well suited to the use of carbide tooling to achieve maximum performance and productivity.

Compared to high speed steel, carbide taps can offer the following advantages:

- Higher hardness and wear resistance;
- Greater performance at high temperatures through maximum heat resistance;
- Sharper cutting edges over the life of the tap.

Special taps made to your specifications are available upon request. Inquiries concerning specials and non-standard tools can be directed to our Customer Service Dept.

**TAPPING
RECOMMENDATIONS FOR
CARBIDE TAPS**

- Always follow good tapping procedures.
- If possible, use a torque-limiting tapping head or an axial/radial tension-compression holder unless performing rigid tapping.
- Set torque to minimum to cut full thread with new tap plus 5-8%. When a tap will not cut at this setting, the tap is dull and should be sharpened. Increasing torque will cause the tap to break.
- If horizontal tapping is required, reduce overhang to a minimum and use direct drive rather than a tapping head.
- Use full flood coolant directed into the hole. Flooding the surface is not sufficient in most applications. If possible, use coolant-feeding (coolant-through) taps.
- Contact Customer Service about availability of additional tap geometries.

WARNING**CEMENTED CARBIDE PRODUCT
WITH COBALT BINDER
(ALL CARBIDE GRADES)**

The above grades contain Tungsten Carbide and Cobalt, with some grades containing one or more of the following: Tantalum Carbide, Vanadium Carbide, Molybdenum and Nickel.

Tungsten Carbide products are prone to fracture under some conditions. Because cutting tools may shatter or break, government regulations require the use of safety glasses with side shields and other safety equipment at all times in the vicinity of use. Grinding of solid carbide and brazed carbide tools may produce dust and fumes with potentially hazardous ingredients. To avoid adverse health effects utilize adequate ventilation and dust collection procedures and read the Material Safety Data Sheet for carbides as well as for any cutting fluids and other material coming into contact with this product.

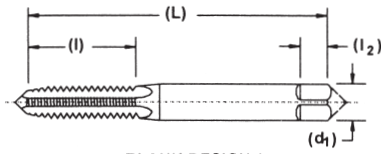
Dust from grinding this product can cause nose, throat, skin and eye irritation and temporary or permanent respiratory disease in a small percentage of exposed individuals. Permanent respiratory disease can lead to disability or death. Coolant mist from wet grinding or machining may contain dust.

- Avoid breathing dust or mist.
- Avoid prolonged skin contact with dust or mist.
- Use adequate ventilation when grinding.
- Maintain dust level below OSHA and ACGIH levels.
- Use protective devices as specified in MSDS for this product.
- Wash hands thoroughly after handling, before eating or smoking.
- Dispose of materials according to local, state and/or federal regulations.

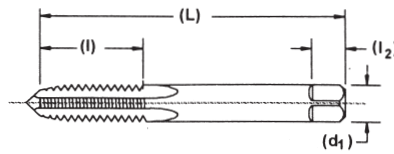
STANDARD TAP DIMENSIONS • GROUND THREAD

(Ref. USCTI Table 302)

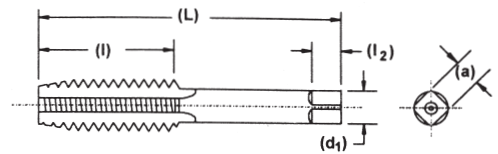
General Dimensions



BLANK DESIGN 1



BLANK DESIGN 2



BLANK DESIGN 3

Nominal Diameter Range - Inches		Machine Screw Size No.	Nominal Fractional Diameter Inches	Nominal Metric Diameter Millimeters, (Inches)	Blank Design No.	Tap Dimensions---Inches				
Over	To (Inc.)					Overall Length L	Thread Length l	Square Length l ₂	Shank Diameter d ₁	Size of Square a
.052	.065	0 (.0600)		M 1.6 (.0630)	1	1.63	.31	.19	.1410	.110
.065	.078	1 (.0730)		M1.8 (.0709)	1	1.69	.38	.19	.1410	.110
.078	.091	2 (.0860)		M2 (.0787), M2.2 (.0866)	1	1.75	.44	.19	.1410	.110
.091	.104	3 (.0990)		M2.5 (.0984)	1	1.81	.50	.19	.1410	.110
.104	.117	4 (.1120)			1	1.88	.56	.19	.1410	.110
.117	.130	5 (.1250)		M3 (.1181)	1	1.94	.63	.19	.1410	.110
.130	.145	6 (.1380)		M3.5 (.1378)	1	2.00	.69	.19	.1410	.110
.145	.171	8 (.1640)		M4 (.1575)	1	2.13	.75	.25	.1680	.131
.171	.197	10 (.1900)		M4.5 (.1772), M5 (.1969)	1	2.38	.88	.25	.1940	.152
.197	.223	12 (.2160)			1	2.38	.94	.28	.2200	.165
.223	.260		1/4 (.2500)	M6 (.2362)	2	2.50	1.00	.31	.2550	.191
.260	.323		5/16 (.3125)	M7 (.2756), M8 (.3150)	2	2.72	1.13	.38	.3180	.238
.323	.395		3/8 (.3750)	M10 (.3937)	2	2.94	1.25	.44	.3810	.286
.395	.448		7/16 (.4375)		3	3.16	1.44	.41	.3230	.242
.448	.510		1/2 (.5000)	M12 (.4724)	3	3.38	1.66	.44	.3670	.275
.510	.573		9/16 (.5625)	M14 (.5512)	3	3.59	1.66	.50	.4290	.322
.573	.635		5/8 (.6250)	M16 (.6299)	3	3.81	1.81	.56	.4800	.360
.635	.709		11/16 (.6875)	M18 (.7087)	3	4.03	1.81	.63	.5420	.406
.709	.760		3/4 (.7500)		3	4.25	2.00	.69	.5900	.442
.760	.823		13/16 (.8125)	M20 (.7874)	3	4.47	2.00	.69	.6520	.489
.823	.885		7/8 (.8750)	M22 (.8661)	3	4.69	2.22	.75	.6970	.523
.885	.948		15/16 (.9375)	M24 (.9449)	3	4.91	2.22	.75	.7600	.570
.948	1.010		1 (1.0000)	M25 (.9843)	3	5.13	2.50	.81	.8000	.600
1.010	1.073		1-1/16 (1.0625)	M27 (1.0630)	3	5.13	2.50	.88	.8960	.672
1.073	1.135		1-1/8 (1.1250)		3	5.44	2.56	.88	.8960	.672
1.135	1.198		1-3/16 (1.1875)	M30 (1.1811)	3	5.44	2.56	1.00	1.0210	.766
1.198	1.260		1-1/4 (1.2500)		3	5.75	2.56	1.00	1.0210	.766
1.260	1.323		1-5/16 (1.3125)	M33 (1.2992)	3	5.75	2.56	1.06	1.1080	.831
1.323	1.385		1-3/8 (1.3750)		3	6.06	3.00	1.06	1.1080	.831
1.385	1.448		1-7/16 (1.4375)	M36 (1.4173)	3	6.06	3.00	1.13	1.2330	.925
1.448	1.510		1-1/2 (1.5000)		3	6.38	3.00	1.13	1.2330	.925
1.510	1.635		1-5/8 (1.6250)	M39 (1.5354)	3	6.69	3.19	1.13	1.3050	.979
1.635	1.760		1-3/4 (1.7500)	M42 (1.6535)	3	7.00	3.19	1.25	1.4300	1.072
1.760	1.885		1-7/8 (1.8750)		3	7.31	3.56	1.25	1.5190	1.139
1.885	2.010		2 (2.0000)	M48 (1.8898)	3	7.63	3.56	1.38	1.6440	1.233

(Continued)

STANDARD TAP DIMENSIONS • GROUND THREAD (cont.)

(Ref. USCTI Table 302)

General Dimensions

Nominal Diameter Range - Inches		Machine Screw Size No.	Nominal Fractional Diameter Inches	Nominal Metric Diameter Millimeters, (Inches)	Blank Design No.	Tap Dimensions---Inches				
						Overall Length L	Thread Length l	Square Length l ₂	Shank Diameter d ₁	Size of Square a
2.010	2.135		2 1/8 (2.1250)		3	8.00	3.56	1.38	1.7690	1.327
2.135	2.260		2 1/4 (2.2500)	M56 (2.2047)	3	8.25	3.56	1.44	1.8940	1.420
2.260	2.385		2 3/8 (2.3750)		3	8.50	4.00	1.44	2.0190	1.514
2.385	2.510		2 1/2 (2.5000)		3	8.75	4.00	1.50	2.1000	1.575
2.510	2.635		2 5/8 (2.6250)	M64 (2.5197)	3	8.75	4.00	1.50	2.2250	1.669
2.635	2.760		2 3/4 (2.7500)		3	9.25	4.00	1.56	2.3500	1.762
2.760	2.885		2 7/8 (2.8750)	M72 (2.8346)	3	9.25	4.00	1.56	2.4750	1.856
2.885	3.010		3 (3.0000)		3	9.75	4.56	1.63	2.5430	1.907
3.010	3.135		3 1/8 (3.1250)		3	9.75	4.56	1.63	2.6680	2.001
3.135	3.260		3 1/4 (3.2500)	M80 (3.1496)	3	10.00	4.56	1.75	2.7930	2.095
3.260	3.385		3 3/8 (3.3750)		3	10.00	4.56	1.75	2.8830	2.162
3.385	3.510		3 1/2 (3.5000)		3	10.25	4.94	2.00	3.0080	2.256
3.510	3.635		3 5/8 (3.6250)	M90 (3.5433)	3	10.25	4.94	2.00	3.1330	2.350
3.635	3.760		3 3/4 (3.7500)		3	10.50	5.31	2.13	3.2170	2.413
3.760	3.885		3 7/8 (3.8750)		3	10.50	5.31	2.13	3.3420	2.506
3.885	4.010		4 (4.0000)	M100 (3.9370)	3	10.75	5.31	2.25	3.4670	2.600

SPECIAL TAPS

Unless otherwise specified:

Special taps over 1.010" to 1.510" diameter inclusive, having 14 or more threads per inch or 1.75 millimeter pitch and finer, and sizes over 1.510" diameter with 10 or more threads per inch or 2.5 millimeter pitch and finer, are made to general dimensions shown in Table 303.

Special tap thread limits are determined by using the formulas shown in Table 331 for Unified Inch Screw Threads and Table 341 for Metric M-Profile Screw Threads.

NOTES

Tap sizes .395" and smaller have an external center on the thread end (may be removed on bottoming taps). Sizes .223" and smaller have an external center on the shank end. Sizes .224" thru .395" have truncated partial cone centers on the shank end (length of cone approx. 1/4 of diameter of shank). Sizes over .395" have internal centers on both the thread and shank ends.

For standard thread limits and tolerances for Unified Inch Screw Threads see table 327 and for Metric Threads see Table 337.

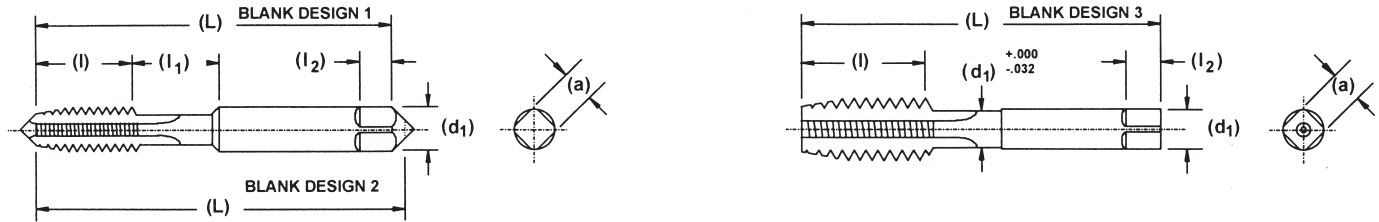
For eccentricity tolerances of tap elements see Table 317.

Tolerances

Element	Nominal Diameter Range in Inches		Direction	Tolerance (Inches)
	Over	To (Inc.)		
Length Overall - L	.0520	1.0100	Plus or Minus	.031
	1.0100	4.0100	Plus or Minus	.063
Length of Thread - l	.0520	.2230	Plus or Minus	.047
	.2230	.5100	Plus or Minus	.063
	.5100	1.5100	Plus or Minus	.094
	1.5100	4.0100	Plus or Minus	.125
Length of square - l ₂	.0520	1.0100	Plus or Minus	.031
	1.0100	4.0100	Plus or Minus	.063
Diameter of shank - d ₁	.0520	.2230	Minus	.0015
	.2230	.6350	Minus	.0015
	.6350	1.0100	Minus	.0020
	1.0100	1.5100	Minus	.0020
	1.5100	2.0100	Minus	.0030
	2.0100	4.0100	Minus	.0030
Size of square - a	.0520	.5100	Minus	.004
	.5100	1.0100	Minus	.006
	1.0100	2.0100	Minus	.008
	2.0100	4.0100	Minus	.010

OPTIONAL NECK AND OPTIONAL SHORTENED THREAD LENGTH TAP DIMENSIONS, GROUND THREAD

(Ref. USCTI Table 302-A)



General Dimensions

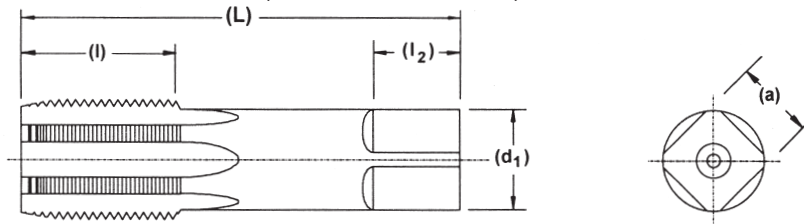
Nominal Diameter Range-Inches		Machine Screw Size No.	Nominal Fractional Diameter Inches	Nominal Metric Diameter Millimeters, (Inches)	Blank Design No.	Tap Dimensions---Inches					
						Overall Length L	Thread Length l	Neck Length l1	Square Length l2	Shank Diameter d1	Size of Square a
.104	.117	4 (.1120)			1	1.88	.31	.25	.19	.1410	.110
.117	.130	5 (.1250)		M3 (.1181)	1	1.94	.31	.31	.19	.1410	.110
.130	.145	6 (.1380)		M3.5 (.1378)	1	2.00	.38	.31	.19	.1410	.110
.145	.171	8 (.1640)		M4 (.1575)	1	2.13	.38	.38	.25	.1680	.131
.171	.197	10 (.1900)		M4.5 (.1772), M5 (.1969)	1	2.38	.50	.38	.25	.1940	.152
.197	.223	12 (.2160)			1	2.38	.50	.44	.28	.2200	.165
.223	.260		1/4 (.2500)	M6 (.2362)	2	2.50	.63	.38	.31	.2550	.191
.260	.323		5/16 (.3125)	M7 (.2756), M8 (.3150)	2	2.72	.69	.44	.38	.3180	.238
.323	.395		3/8 (.3750)	M10 (.3937)	2	2.94	.75	.50	.44	.3810	.286
.395	.448		7/16 (.4375)		3	3.16	.88	-	.41	.3230	.242
.448	.510		1/2 (.5000)	M12 (.4724)	3	3.38	.94	-	.44	.3670	.275
.510	.573		9/16 (.5625)	M14 (.5512)	3	3.59	1.00	-	.50	.4290	.322
.573	.635		5/8 (.6250)	M16 (.6299)	3	3.81	1.09	-	.56	.4800	.360
.635	.709		11/16 (.6875)	M18 (.7087)	3	4.03	1.09	-	.63	.5420	.406
.709	.760		3/4 (.7500)		3	4.25	1.22	-	.69	.5900	.442
.760	.823		13/16 (.8125)	M20 (.7874)	3	4.47	1.22	-	.69	.6520	.489
.823	.885		7/8 (.8750)	M22 (.8661)	3	4.69	1.34	-	.75	.6970	.523
.885	.948		15/16 (.9375)	M24 (.9449)	3	4.91	1.34	-	.75	.7600	.570
.948	1.010		1 (1.0000)	M25 (.9843)	3	5.13	1.50	-	.81	.8000	.600

NOTES

1. Thread Length "l" is based on a length of 12 pitches of the UNC thread series.
2. Thread Length "l" is a minimum value and has no tolerance.
3. When Thread Length "l" is added to Neck Length "l1" the total shall be no less than the minimum Table 302 Thread Length "l".
4. Unless otherwise specified, all tolerances are in accordance with Table 302.
5. For eccentricity tolerances, see Table 317.

SPECIAL FINE PITCH TAPS, SHORT SERIES, GROUND THREAD

(Ref. USCTI Table 303)



Unless otherwise specified, special taps 1.010" to 1.510" diameter inclusive, having 14 or more threads per inch or 1.75 millimeter pitch and finer, and sizes over 1.510" diameter with 10 or more threads per inch, or 2.5 millimeter pitch and finer, will be made to the general dimensions shown below:

General Dimensions

Nominal Diameter Range - Inches		Nominal Fractional Diameter Inches	Nominal Metric Diameter Millimeters	Tap Dimensions - Inches				
Over	To (Incl.)			Overall Length L	Thread Length l	Square Length l ₂	Shank Diameter d ₁	Size of Square a
1.010	1.073	1 1/16	M27	4.00	1.50	.88	.8960	.672
1.073	1.135	1 1/8		4.00	1.50	.88	.8960	.672
1.135	1.198	1 3/16	M30	4.00	1.50	1.00	1.0210	.766
1.198	1.260	1 1/4		4.00	1.50	1.00	1.0210	.766
1.260	1.323	1 5/16	M33	4.00	1.50	1.00	1.1080	.831
1.323	1.385	1 3/8		4.00	1.50	1.00	1.1080	.831
1.385	1.448	1 7/16	M36	4.00	1.50	1.00	1.2330	.925
1.448	1.510	1 1/2		4.00	1.50	1.00	1.2330	.925
1.510	1.635	1 5/8	M39	5.00	2.00	1.13	1.3050	.979
1.635	1.760	1 3/4	M42	5.00	2.00	1.25	1.4300	1.072
1.760	1.885	1 7/8		5.00	2.00	1.25	1.5190	1.139
1.885	2.010	2	M48	5.00	2.00	1.38	1.6440	1.233
2.010	2.135	2 1/8		5.25	2.00	1.38	1.7690	1.327
2.135	2.260	2 1/4	M56	5.25	2.00	1.44	1.8940	1.420
2.260	2.385	2 3/8		5.25	2.00	1.44	2.0190	1.514
2.385	2.510	2 1/2		5.25	2.00	1.50	2.1000	1.575
2.510	2.635	2 5/8	M64	5.50	2.00	1.50	2.1000	1.575
2.635	2.760	2 3/4		5.50	2.00	1.50	2.1000	1.575
2.760	2.885	2 7/8	M72	5.50	2.00	1.50	2.1000	1.575
2.885	3.010	3		5.50	2.00	1.50	2.1000	1.575
3.010	3.135	3 1/8		5.75	2.00	1.50	2.1000	1.575
3.135	3.260	3 1/4	M80	5.75	2.00	1.50	2.1000	1.575
3.260	3.385	3 3/8		5.75	2.00	1.50	2.1000	1.575
3.385	3.510	3 1/2		5.75	2.00	1.50	2.1000	1.575
3.510	3.635	3 5/8	M90	6.00	2.00	1.75	2.1000	1.575
3.635	3.760	3 3/4		6.00	2.00	1.75	2.1000	1.575
3.760	3.885	3 7/8		6.00	2.00	1.75	2.1000	1.575
3.885	4.010	4	M100	6.00	2.00	1.75	2.1000	1.575

NOTES

For tolerances see Table 302.

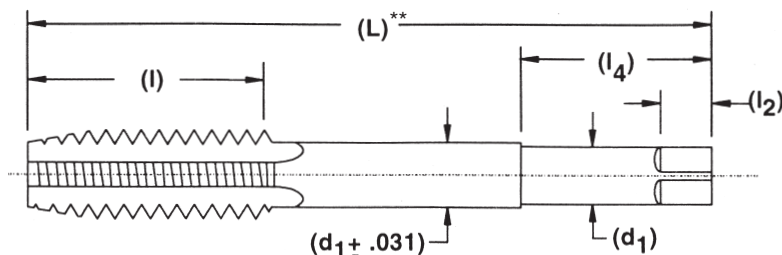
For standard thread limits and tolerances for Unified Inch Screw Threads see Table 327A.

For standard thread limits and tolerances for Metric Threads see Tables 337 and 341.

For eccentricity tolerances of tap elements see Table 317.

SPECIAL EXTENSION TAPS, GROUND THREAD

(Ref. USCTI Table 303-A)



Unless otherwise specified, special extension taps will be furnished with dimensions and tolerances as shown for Machine Screw and Fractional taps in Tables 302 and 303, and for Pipe taps in Table 311.

Exceptions:

1. Types of centers are optional with manufacturer.
2. Tolerances on shank diameter d_1 for l_4 length as shown in the following table.
3. Shank eccentricity tolerance in Table 317 applies only to the l_4 length shown in the following table.
4. Length of Close Tolerance Shank, (l_4) is minimum.

Nominal Tap Size		l Thread Length	d_1 Shank Diameter	l_2 Square Length	Square Size	"l ₄ " Ground Shank Length
Fractional	Machine Screw					
	6	.688	.141	.188	.110	1.13
	8	.750	.168	.250	.131	1.25
	10 - 12	.875	.194	.250	.152	1.38
1/4	14	1.00	.255	.313	.191	1.50
1/4*		1.00	.185	.250	.138	Full Length
5/16		1.13	.318	.375	.238	1.56
5/16*		1.13	.240	.281	.180	Full Length
3/8		1.25	.381	.438	.286	1.63
3/8*		1.25	.275	.375	.206	Full Length
7/16		1.44	.323	.406	.242	1.69
1/2		1.66	.367	.438	.275	1.69
9/16		1.66	.429	.500	.322	1.88
5/8		1.81	.480	.563	.360	2.00
3/4		2.00	.590	.688	.442	2.25
7/8		2.22	.697	.750	.523	2.50
1"		2.50	.800	.813	.600	2.63
1-1/8		2.56	.896	.875	.672	2.75
1-1/4		2.56	1.021	1.00	.766	2.88
1-3/8		3.00	1.108	1.063	.831	3.00
1-1/2		3.00	1.233	1.125	.925	3.00

* Denotes small shank.

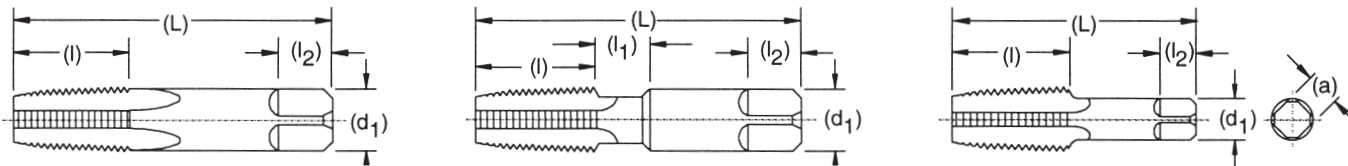
** NOTE: The overall length ('L' Dimension) is determined by customer requirements. Stocked sizes are 4", 6", 8" 10" and 12" OAL depending on diameter.

Tolerances

For Shank Diameter, d_1 and l_4 length

Size Range		Direction	Tolerance
Fractional	Machine Screw		
1/4 to 5/8 incl.	0 - 14 incl.	Minus	.003
11/16 to 1-1/2 incl.		Minus	.004

STANDARD PIPE TAP DIMENSIONS STRAIGHT AND TAPER, GROUND THREAD (Ref. USCTI Table 311)



General Dimensions

Dimensions - Inches						
Nominal Size Inches	Length Overall L	Length of Thread l1	Length of Square l2	Dia. of Shank d1	Size of Square a	Length Optional Neck l1
1/16	2.13	.69	.38	.3125	.234	.375
* 1/8	2.13	.75	.38	.3125	.234	...
1/8	2.13	.75	.38	.4375	.328	.375
1/4	2.44	1.06	.44	.5625	.421	.375
3/8	2.56	1.06	.50	.7000	.531	.375
1/2	3.13	1.38	.63	.6875	.515	...
3/4	3.25	1.38	.69	.9063	.679	...
1"	3.75	1.75	.81	1.1250	.843	...
1-1/4	4.00	1.75	.94	1.3125	.984	...
1-1/2	4.25	1.75	1.00	1.5000	1.125	...
2"	4.50	1.75	1.13	1.8750	1.406	...
2-1/2	5.50	2.56	1.25	2.2500	1.687	...
3"	6.00	2.63	1.38	2.6250	1.968	...
3-1/2	6.50	2.69	1.50	2.8125	2.108	...
4"	6.75	2.75	1.56	3.0000	2.250	...

* Small shank

Tolerances

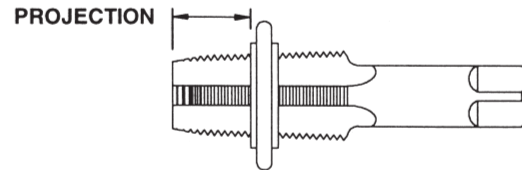
Element	Range	Direction	Tolerance
Length Overall - L	1/16 to 3/4 inc.	Plus or Minus	.031
	1" to 4" inc.	Plus or Minus	.063
Length of Thread - l1	1/16 to 3/4 inc.	Plus or Minus	.063
	1" to 1-1/4 inc.	Plus or Minus	.094
	1-1/2 to 4"	Plus or Minus	.125
Length of Square - l2	1/16 to 3/4 inc.	Plus or Minus	.031
	1" to 4" inc.	Plus or Minus	.063
Diameter of Shank - d1	1/16 to 1/8	Minus	.0015
	1/4 to 1" inc.	Minus	.0020
	1-1/4 to 4" inc.	Minus	.0030
Size of Square - a	1/16 to 1/8	Minus	.004
	1/4 to 3/4 inc.	Minus	.006
	1" to 4" inc.	Minus	.008

NOTE: For thread limits and tolerances see USCTI Tables 335, 335A and 338. For eccentricity tolerances of taps see Table 317.

TAPER PIPE TAP, THREAD LIMITS, GROUND THREAD

(Ref. USCTI Table 338)

- American National Standard Taper Pipe Thread Form (NPT)
- Aeronautical National Taper Pipe Thread Form (ANPT)
- Dryseal American National Standard Taper Pipe Thread Form (NPTF)



Tap Thread Limits						Reference Dimensions	
Nominal Size Inches	Threads per Inch	Projection* Inches	Projection Tolerance + or -	Taper Per Foot Limits		L ₁ Length	Tap Drill Size ** NPT,ANPT,NPTF
				Minimum	Maximum		
1/16	27	.312	.063	.719	.781	.160	C
1/8	27	.312	.063	.719	.781	.1615	Q
1/4	18	.459	.063	.719	.781	.2278	7/16
3/8	18	.454	.063	.719	.781	.240	9/16
1/2	14	.579	.063	.719	.781	.320	45/64
3/4	14	.565	.063	.719	.781	.339	29/32
1"	11-1/2	.678	.094	.719	.781	.400	1-9/64
1-1/4	11-1/2	.686	.094	.719	.781	.420	1-31/64
1-1/2	11-1/2	.699	.094	.719	.781	.420	1-23/32
2"	11-1/2	.667	.094	.719	.781	.436	2-3/16
2-1/2	8	.925	.094	.734	.781	.682	2-39/64
3"	8	.925	.094	.734	.781	.766	3-15/64
3-1/2	8	.938	.125	.734	.781	.821	
4	8	.950	.125	.734	.781	.844	

NOTES

* Distance small end of tap projects through L₁ Taper Thread Ring Gage.

** Recommended size given permit direct tapping without reaming the hole, but only give a full thread for approx. the L₁ length.

LEAD TOLERANCE

A maximum lead deviation of plus or minus .0005" within any two threads not farther than 1" is permitted.

ECCENTRICITY TOLERANCES OF TAP ELEMENTS WHEN TESTED ON DEAD CENTERS

(Ref. USCTI Table 317)

Applicable to Tables 302,303,303A,and 311

Element	Range			Ground Thread	
	Inch & Mach. Screw	Pipe	Metric	Eccentricity	t.i.v.*
Square (at central point)	#0 - 1/2"	1/16 - 1/8"	M1.6 - M12	.0030	.0060
	Over 1/2" thru 4"	1/4 - 4"	Over M12 Thru M100	.0040	.0080
Shank	#0 - 5/16"	1/16"	M1.6 - M8	.0005	.0010
	Over 5/16" thru 4"	1/8 - 4"	Over M8 thru M100	.0008	.0016
Major Diameter	#0 - 5/16"	1/16"	M1.6 - M8	.0005	.0010
	Over 5/16" thru 4"	1/8 - 4"	Over M8 thru M100	.0008	.0016
Pitch Diameter (at first full thread)	#0 - 1/2"	1/16"	M1.6 - M8	.0005	.0010
	Over 1/2" thru 4"	1/8 - 4"	Over M8 thru M100	.0008	.0016
Chamfer**	#0 - 1/2"	1/16 - 1/8"	M1.6 - M12	.0010	.0020
	Over 1/2" thru 4"	1/4 - 4"	Over M12 Thru M100	.0015	.0030

* t.i.v. = Total indicator variation. Figures are given for both eccentricity and total indicator variation to avoid misunderstanding.

**Chamfer should preferably be inspected by light projection to avoid errors due to indicator contact points dropping into the thread grooves.

SURFACE TREATMENT ABBREVIATIONS

AlCrN:	Aluminum Chromium Nitride	TiAlN+WC/C:	'Hardlube' - Titanium Aluminum Nitride
CrC:	Chromium Carbide		
CrN:	Chromium Nitride		
DLC:	Diamond-like Carbon	TiCN:	Titanium Carbonitride
N:	Nitride	TiN:	Titanium Nitride
N + Ox:	Nitride + Oxide*	WC/C:	Tungsten Carbide/Carbon
	*Oxide (Ox) may also be shown as 'O'	WS2:	Tungsten Disulfide
Ox:	Steam Oxide*	ZrN:	Zirconium Nitride
TiAlN:	Titanium Aluminum Nitride		

In many applications, a tap that is properly designed and used under recommended conditions will produce acceptable results without the use of surface treatments. However, under some conditions, such as tapping excessively hard, abrasive or challenging materials, the use of performance enhancing surface treatments will be beneficial to the overall results of your tapping operation in terms of improved tool life and internal thread quality. Coolant-through taps may also be a consideration.

Contact Allen Benjamin for tapping recommendations.

Allen Benjamin Rep. (if applicable): _____
Customer Name: _____ Date: ____ / ____ / ____
City/State/Zip: _____ Distributor: _____
Phone: _____ Fax: _____ E-Mail: _____
Contact: _____ Title: _____ Extn.: _____

GENERAL INFORMATION

(Application) B/P or Job # _____
Tool Description _____
Tap Style _____ Class of Fit _____ H-Limit _____ Thread Form _____
Surface Treatment _____ Cutting/Forming _____ Blind/Thru Hole _____
Hole Depth _____ Thread Length _____ Tap Drill Size _____ % of Thread _____
Machine Tool _____ Condition _____ Horiz./Vert. _____
Coolant _____ Mix _____ Speed (SFM) _____ # Taps/Set-Up _____
Holder: Tension/Compression _____ Rigid Collet _____ Floating _____
Material _____ Hardness _____ Characteristics _____
Feed: ☐ CNC control ☐ NC control ☐ Synchronous Spindle ☐ Manual
☐ Cam Followed ☐ Lead Screw
Unique job details: _____

COMPETITIVE BRAND:

Name _____ Tool Description _____
Current Performance _____ # Holes/Tap _____
Competitive Price (\$) _____ Est. Annual Usage _____
Comments _____

RECOMMENDATIONS:

Tap Style _____ H-Limit _____ Surface Treatment _____ Speed (SFM) _____
Tap/Drill Size _____ Coolant _____ Comments _____

TEST EVALUATION

Allen Benjamin P.O. # _____ Dist. P.O. # _____ # Holes Tapped _____
Quality of Thread _____ Gaging O.K. _____ On-Hand for Test _____
Comments _____

Fill-out and fax to: 480.731.9462 or scan and send to info@allenbenjamin.com
or copy and send to Allen Benjamin, P.O. Box 116, South Beloit, IL 61080-0116
Be sure to include pertinent comments, blueprints or sketches.