STANDARD SYSTEM OF TAP MARKING

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.



Nominal Size – Threads Per Inch
Tap Material
Thread Form Symbol (See listing below)
Pitch Diameter Limit (See listing below)

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

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

** See page 100 for additional information on UNJ taps.

SPECIAL 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 accomodate 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.

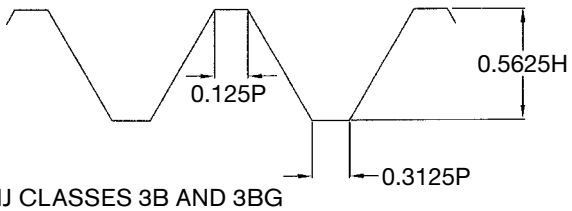
External UNJ threads must be produced with a prescribed root radius; therefore, standard Unified Screw Thread (UN) tooling may not be used.

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.

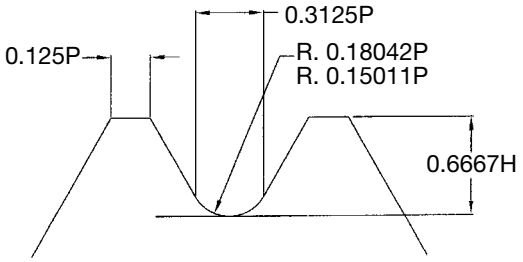
- UNJ Thread Form: Unified Thread Series with a 0.15011P to 0.18042P controlled root radius on external thread only. (As defined by MIL-S-8879C)
- UNJ internal threads do not require radius; only external thread requires radius on root.
- UNJ external thread assembles only with UNJ internal thread.
-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

UNJ INTERNAL THREAD

Root to Clear 0.125P Width-Flat or Rounded
Assembles With All UN External Threads



UNJ CLASSES 3B AND 3BG
NO RADIUS REQUIRED ON
INTERNAL THREADS



UNJ EXTERNAL THREAD

Assembles Only With UNJ Internal



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 115-117 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 our Customer Service Dept. 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").

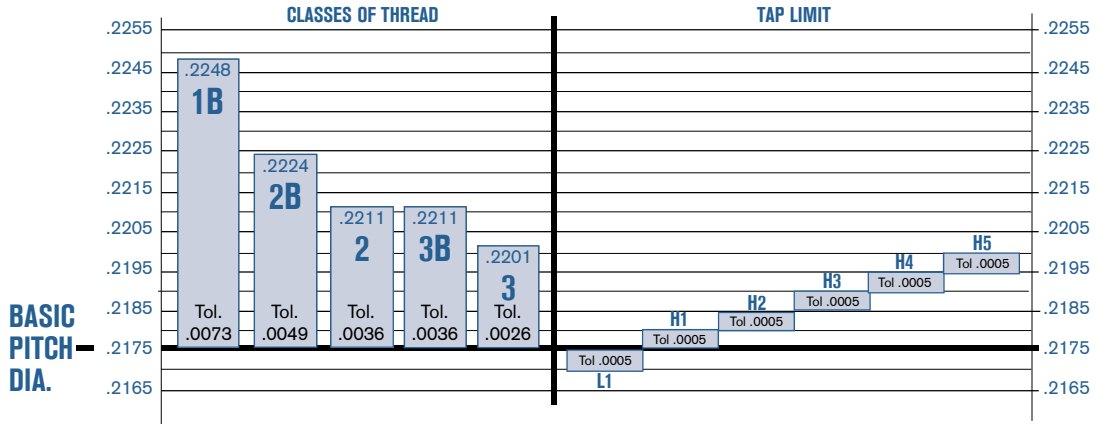
CHART 1B

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.

SPECIAL TAPS & GAGES

CHART 2A COMPARISON OF PITCH DIAMETER LIMITS TO CLASS OF FIT



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 COMPARISON OF PITCH DIAMETER LIMITS TO CLASS OF FIT

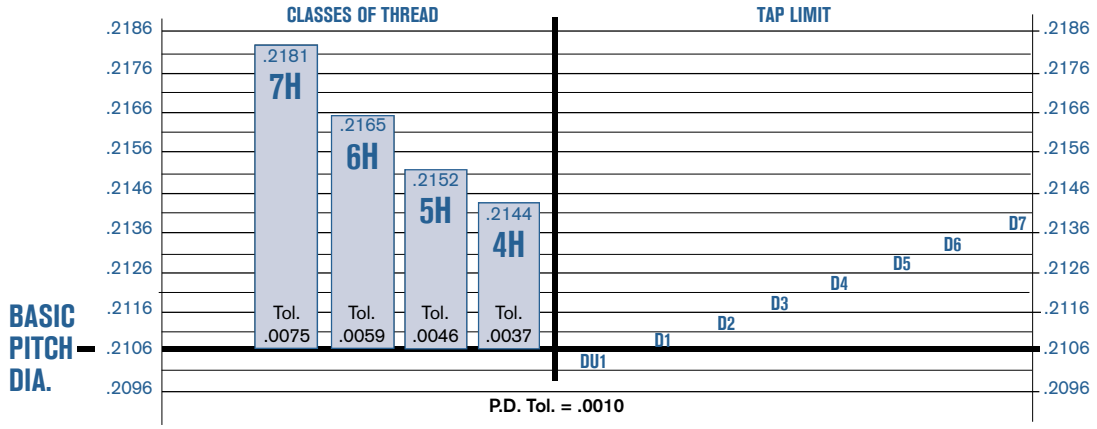


Chart 2B shows the same relationship with a metric thread. Using a M6 X 1.0, it is obvious that a D5 limit (+.0025" over basic pitch diameter) can be used to cut the standard class of thread in most machining situations, as can the D1 limit (+.0005" over basic P.D.). However, tool wear would force the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

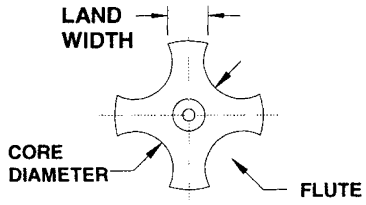
Class 1A and Class 1B: The combination of Class 1A for external threads and Class 1B for internal threads is intended to cover the manufacture of threaded parts where quick and easy assembly is necessary or desired, and an allowance is provided to permit ready assembly.

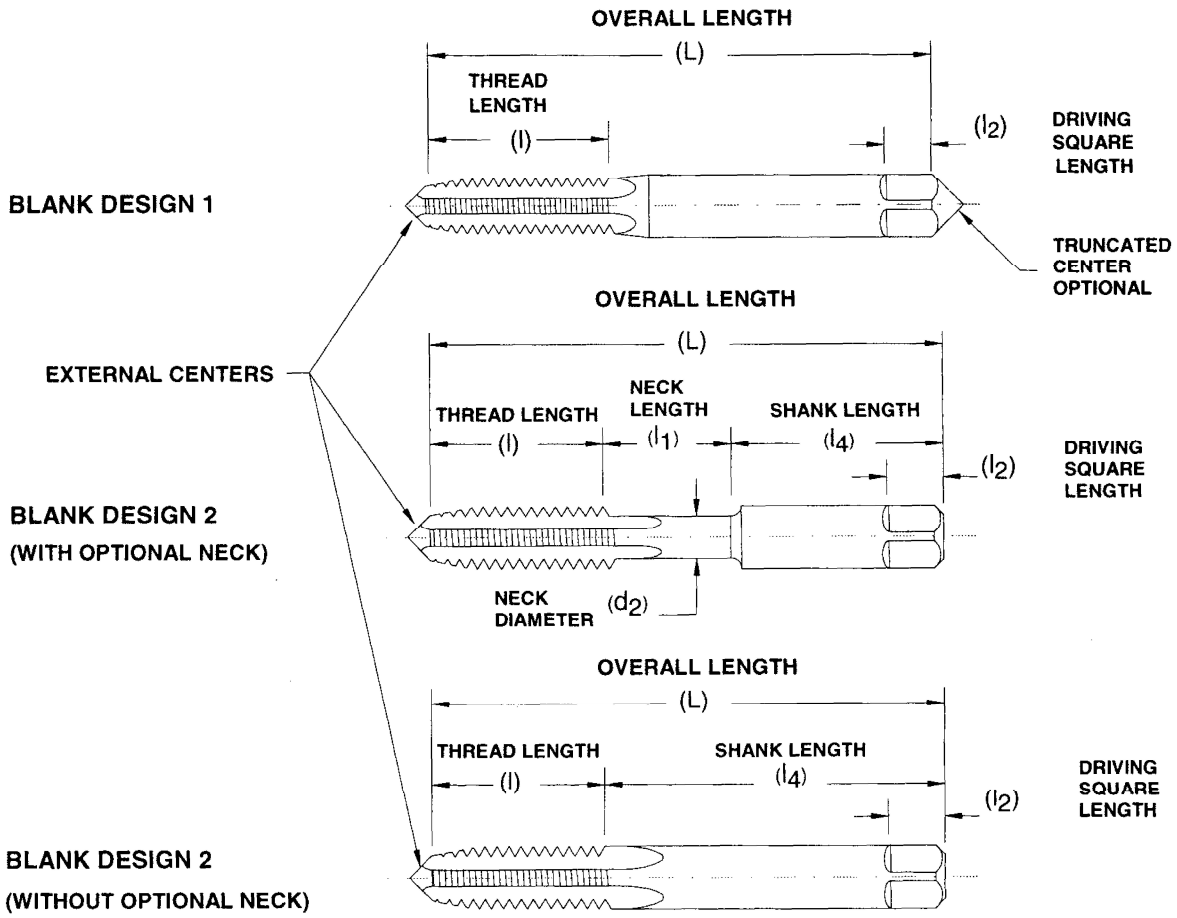
Class 2A and Class 2B: The combination of Class 2A for external threads and Class 2B for internal threads designed for screws, bolts and nuts, is also suitable for a variety of other applications. A similar allowance is provided which minimizes galling and seizure encountered in assembly and use. It also accomodates, 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.

ILLUSTRATION OF TERMS APPLYING TO TAPS





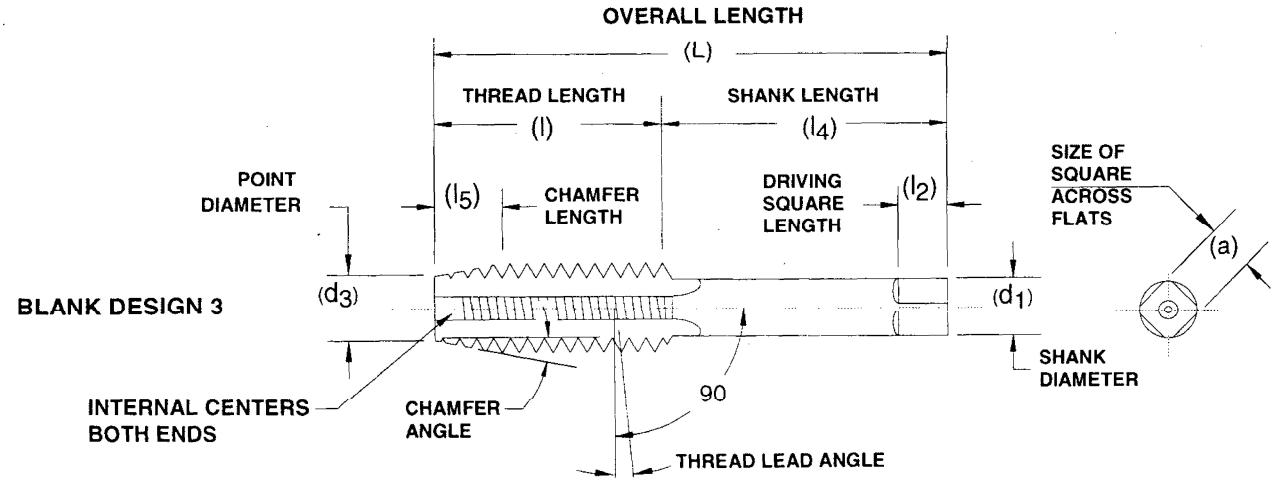
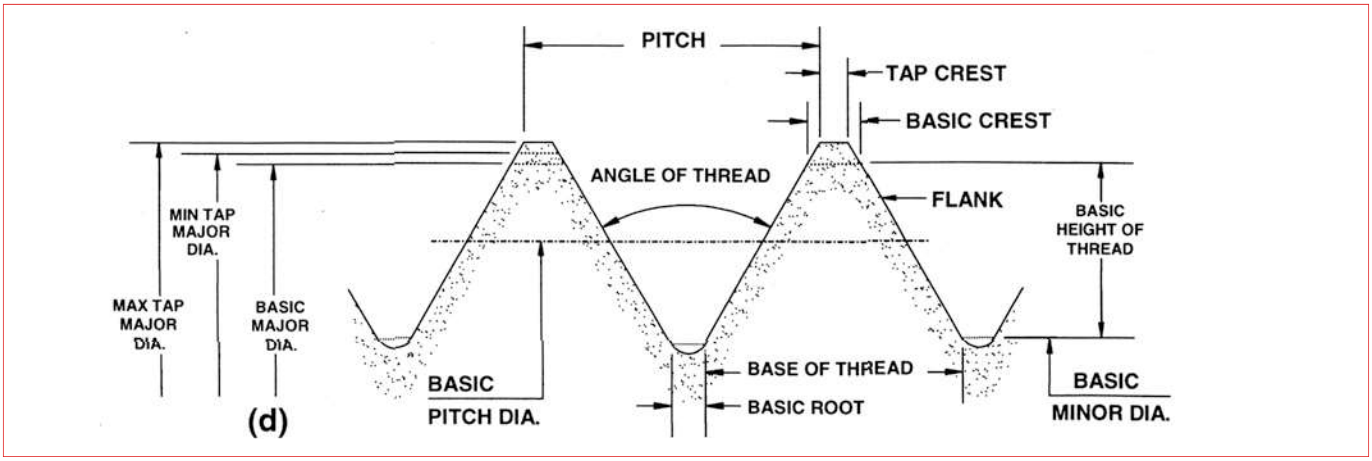
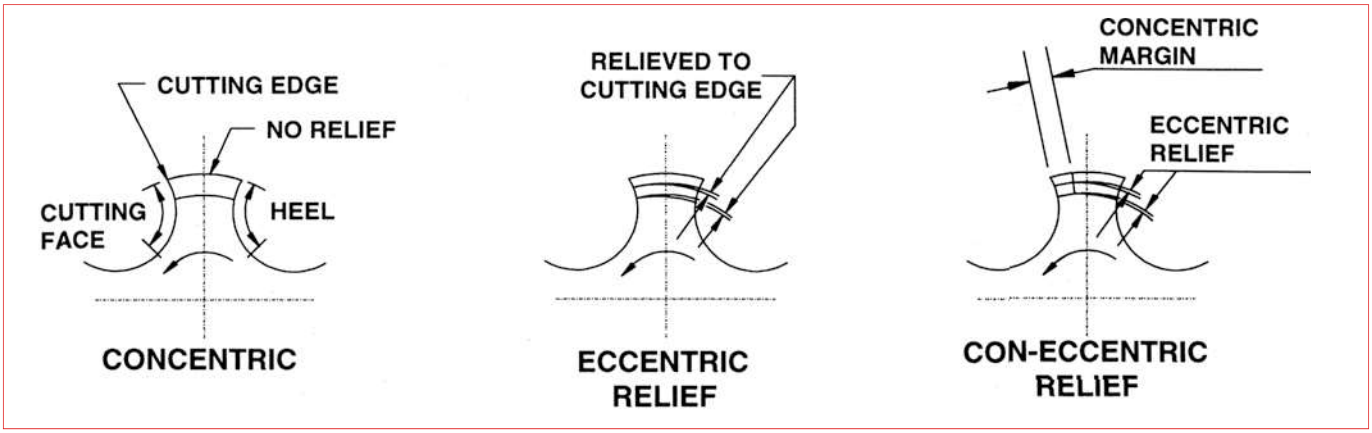
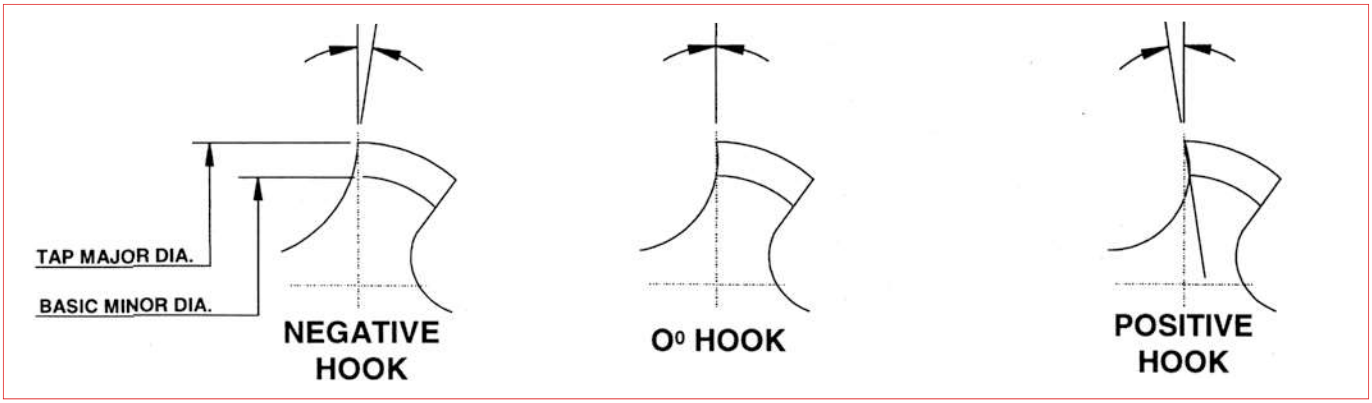
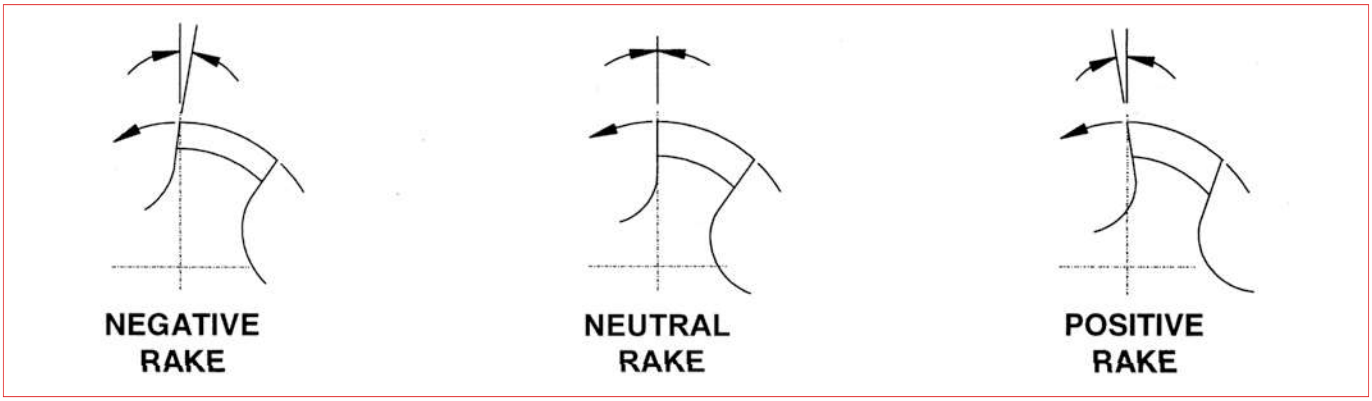


ILLUSTRATION OF TERMS APPLYING TO TAPS









DEFINITION OF TERMS APPLYING TO TAPS

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 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 complete turn. 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.

DEFINITION OF TERMS APPLYING TO TAPS

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-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).

TAP STYLE GUIDE

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.

SPIRAL FLUTED TAP



Regular (or Slow) Spiral



Fast Spiral

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 (18-30° helix angle) or fast spiral (45-52°). Spiral flute taps are available in left hand style.

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 TAP (TRU-FLO™)



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).

PIPE TAP



Straight Pipe Tap



Taper 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.

COMBINED DRILL & TAP (COST CUTTER™)



This high production tool is specially designed to drill and tap in one pass only. By design, this value-added tool reduces machining operations and subsequent parts handling. The drill end features a split point, and the tool shank and square fit standard tap holders.

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.

TAP STYLE GUIDE

TANDEM ACME TAP



These taps combine the initial roughing cut with the final finishing cut, in one pass, to achieve an acme screw thread. These taps are economical and enhance production levels by saving on the operation of two tools. Since acme thread pitches are generally coarse relative to diameters, these taps are subjected to heavy chip loads. To achieve a high quality acme thread in a cost-effective manner, roughing and finishing operations are recommended.

EXTENSION TAPS (incl. Nut & Pulley Taps)



Extension Tap - These taps are made to conventional tap dimensions, except that they have an extended shank in order to tap hard to reach 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.



Pulley Tap - The hub portion of pulley parts contain oil cups and set screw holes, most of which cannot be reached with ordinary hand taps. Pulley taps have the same basic thread dimensions as hand taps, but pulley taps differ in that they have a longer shank which is of the same basic major diameter as the threaded portion. When tapping pulley hub holes, the taps are inserted through holes in the rims which are slightly larger than the shanks of the taps. These holes serve as guides or bushings for the taps to assure proper alignment when tapping. Pulley taps can also be used for general tapping in parts where an extra long length is required to reach the holes being tapped.



Nut Tap - Nut taps feature a long chamfer which assists in entering the drilled hole, and distributes the cutting action over several teeth. These taps were initially designed for tapping nuts and have a long thread length. The shank diameter is smaller than the tap's minor diameter to allow the accumulation of several nuts after tapping. Nut taps also feature an extended square length.

THREAD PLUG & RING GAGES

- Thread Plug Gages - UNC, UNF & UNEF
  Class 2B - 3B, Taperlock & Reversible,
  + Metric Sizes - Class 6H

- Thread Ring Gages - UNC, UNF, UNEF
  Class 2A-3A
  + Metric Sizes - Class 6g

- Truncated Thread Setting Plug Gages
  Class 2A-3A
  + Metric Sizes - Class 6g

- Thread Plug Gages - STI
  Screw Thread Insert

- BSP Plug Gages
  (BSPT, BSPP)

- Taper Pipe Gages - Plugs & Rings
  NPT-L1, L1 & L2 Rings,
  NPTF L1 & L3 Plugs,
  NPTF Crest Check Plugs & Rings

... contact North American Tool for your special gaging requirements.



Thread Plug Gage



Reversible Thread Plug Gage



Thread Ring Gage

TRU-FLO® THREAD FORMING TAPS

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).

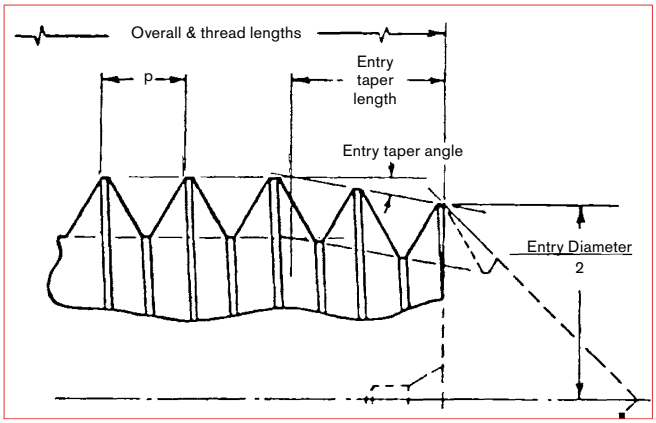
BOTTOMING LENGTH = 1-1/2 to 2-1/2 PITCHES

PLUG LENGTH = 3 to 5 PITCHES

The chamfer on Tru-Flo BOTTOM 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: TRU-FLO 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 TRU-FLO 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, TRU-FLO 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: TRU-FLO cold 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 TRU-FLO 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: $.250 - \left(\frac{.0068 \times 65}{20} \right) = .2279$

FORMULA FOR TAP/DRILL SIZES FOR METRIC TRU-FLO 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:

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

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

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

For 60° Metric Threads:

Max. Drill Size = Basic Major Diameter - 0.375P
Min. Drill Size = 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: $\frac{\text{mm Value}}{25.4}$ = Inch Value

SPECIAL TAPS

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	.3401	.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.

SPECIAL TAPS

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	27.727	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.

TAP/DRILL SIZES

TAP SIZE		CUTTING TAPS		TRU-FLO ™ FORMING TAPS	
INCH	METRIC	DRILL SIZE	DECIMAL EQUIVALENT	DRILL SIZE	DECIMAL EQUIVALENT
0-80		3/64	.0469	54	.0550
	M1.6 X 0.35	1.25mm	.0492	1.45mm	.0571
	M1.8 X 0.35	1.45mm	.0571	1.65mm	.0650
1-64		53	.0595	51	.0650
1-72		53	.0595	51	.0650
	M2 X 0.40	1.60mm	.0630	1.80mm	.0709
2-56		50	.0700	5/64	.0781
2-64		50	.0700	47	.0785
	M2.2 X 0.45	1.75mm	.0689	2.00mm	.0787
	M2.5 X 0.45	2.05mm	.0807	2.30mm	.0906
3-48		47	.0785	43	.0890
3-56		46	.0810	2.30mm	.0905
4-40		43	.0890	38	.1015
4-48		42	.0935	2.60mm	.1024
	M3 X 0.50	2.50mm	.0984	7/64	.1094
5-40		38	.1015	33	.1130
5-44		37	.1040	2.90mm	.1142
	M3.5 X 0.60	2.90mm	.1142	3.20mm	.1260
6-32		36	.1065	1/8	.1250
6-40		33	.1130	3.25mm	.1280
	M4 X 0.70	3.30mm	.1299	3.70mm	.1457
8-32		29	.1360	25	.1495
8-36		29	.1360	24	.1520
	M4.5 X 0.75	3.70mm	.1476	4.10mm	.1614
10-24		26	.1470	11/64	.1719
10-32		21	.1590	16	.1770
	M5 X 0.80	4.20mm	.1654	14	.1820
12-24		16	.1770	5mm	.1969
12-28		15	.1800	7	.2010
	M6 X 1.00	5.00mm	.1969	7/32	.2188
1/4-20		7	.2010	1	.2280
1/4-28		3	.2130	15/64	.2340
	M7 X 1.00	6.00mm	.2362	F	.2570
5/16-18		F	.2570	L	.2900
5/16-24		I	.2720	M	.2950
	M8 X 1.25	6.70mm	.2638	7.40mm	.2913
	M8 X 1.0	7.00mm	.2756	19/64	.2969
3/8-16		5/16	.3125	S	.3480
3/8-24		Q	.3320	T	.3580
	M10 X 1.50	8.50mm	.3346	U	.3680
	M10 X 1.25	8.70mm	.3425	9.40mm	.3701
7/16-14		U	.3680	Y	.4040
7/16-20		25/64	.3906	Z	.4130
	M12 X 1.75	10.20mm	.4016	11.20mm	.4409
	M12 X 1.25	10.80mm	.4252	11.50mm	.4528
1/2-13		27/64	.4219	15/32	.4682
1/2-20		29/64	.4531	12.25mm	.4823
	M14 X 2.00	12.00mm	.4224	33/64	.5156
9/16-12		31/64	.4844	17/32	.5312
9/16-18		33/64	.5156	13.50mm	.5315
5/8-11		17/32	.5312	14.75mm	.5807
5/8-18		37/64	.5781	15.25mm	.6004
	M16 X 2.00	14.00mm	.5512	19/32	.5938
	M16 X 1.50	14.50mm	.5906	15.25mm	.6004
	M18 X 2.50	15.50mm	.6102	39/64	.6094
	M18 X 1.50	16.50mm	.6496	17.25mm	.6791

Drill sizes given are the 'closest' drill size.

SPECIAL TAPS

TAP/DRILL SIZES cont.

TAP SIZE		CUTTING TAPS		TRU-FLO ™ FORMING TAPS	
INCH	METRIC	DRILL SIZE	DECIMAL EQUIVALENT	DRILL SIZE	DECIMAL EQUIVALENT
3/4-10		21/32	.6562	45/64	.7031
3/4-16		11/16	.6875	23/32	.7188
	M20 X 2.50	17.50mm	.6890		
	M20 X 1.50	18.50mm	.7283		
	M22 X 2.50	19.50mm	.7677		
	M22 X 1.50	20.50mm	.8071		
7/8-9		49/64	.7656		
7/8-14		13/16	.8125		
	M24 X 3.00	21.00mm	.8268		
	M24 X 2.00	22.00mm	.8661		
1-8		7/8	.8750		
1-12		59/64	.9219		
	M27 X 3.00	24.00mm	.9449		
	M27 X 2.00	25.00mm	.9843		
1-1/8-7		63/64	.9844		
1-1/8-12		1-3/64	1.0469		
	M30 X 3.50	26.50mm	1.0433		
	M30 X 2.00	28.00mm	1.1024		
1-1/4-7		1-7/64	1.1094		
1-1/4-12		1-11/64	1.1719		
	M33 X 3.50	29.50mm	1.1614		
	M33 X 2.00	31.00mm	1.2205		
1-3/8-6		1-7/32	1.2188		
1-3/8-12		1-19/64	1.2969		
	M36 X 4.00	32.00mm	1.2598		
	M36 X 3.00	33.00mm	1.2992		
1-1/2-6		1-11/32	1.3438		
1-1/2-12		1-27/64	1.4219		
	M39 X 4.00	35.00mm	1.3780		
	M39 X 3.00	36.00mm	1.4173		

PIPE THREAD DRILLED HOLE SIZES

NOMINAL SIZE	NPT	NPTF	NPSC	NPSM	NPSF	NPSI	BSPT	BSPP
1/16 - 27	D (0.246)	D (0.246)	.250		.250	.250		
1/8 - 27	Q (0.332)	Q (0.332)	.3437	.3593	.3437	.3437		
1/8 - 28							.3281	.3437
1/4 - 18	.4375	.4375	.4375	.4687	.4375	.4375		
1/4 - 19							.4375	.4531
3/8 - 18	.5625	.5781	.5781	.6093	.5781	.5781		
3/8 - 19							.5781	.5937
1/2 - 14	.7031	.7031	.7187	.750	.7187	.7187	.7187	.7343
5/8 - 14								.8125
3/4 - 14	.9062	.9218	.9218	.9646			.9380	.9650
7/8 - 14								1.1093
1 - 11							1.1718	1.1875
1 - 11-1/2	1.1406	1.1562	1.1562	1.2031				
1-1/4 - 11							1.500	1.5468
1-1/4 - 11-1/2	1.4843	1.500	1.500	1.5468				
1-1/2 - 11							1.750	1.7656
1-1/2 - 11-1/2	1.7343	1.7343	1.750	1.7913				
1-3/4 - 11								2.000
2 - 11							2.2187	2.250
2 - 11-1/2	2.2031	2.2187	2.2187	2.2638				

Drill sizes given are the 'closest' drill size.

FORMULA FOR TAP/DRILL SIZES (INCH)

METHOD 1:

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

*Use whole numbers for % of thread…for 65% (not .65).

METHOD 2:

Nominal O.D. - (Dbl. Thread Depth X % of Full Thread) = 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	RECOMMENDED RANGE			80% THREAD	85% THREAD
					65% THREAD	70% THREAD	75% 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.

SPECIAL TAPS

FORMULA FOR TAP/DRILL SIZES (METRIC)

METHOD 1:

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

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

METHOD 2:

Nominal O.D. - (Dbl. Thread Depth X % of Full Thread) = 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.

mm PITCH	DOUBLE THREAD DEPTH	50% THREAD	55% THREAD	60% THREAD	RECOMMENDED RANGE 65% THREAD	RECOMMENDED RANGE 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	.2137	.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.

MATERIAL HOOK OR RAKE ANGLES • SUGGESTED SURFACE TREATMENTS • CUTTING FLUIDS AND CUTTING SPEEDS
(INITIAL RECOMMENDATIONS ONLY)

MATERIAL TO BE TAPPED	HOOK OR RAKE ANGLE	SUGGESTED SURFACE TREATMENT **	LUBRICANT/ COOLANT	HSS SPEED=SFM	CARBIDE SPEED=SFM
ALUMINUM (WROUGHT)	12° - 15° HOOK	TiN, TiCN	Soluble or Light Based	90 - 150 SFM	100 - 250 SFM
ALUMINUM DIE CASTING	8° - 10° RAKE	TiCN, TiN, CrN, TiALN+WC/ C	Soluble Or Lard Oil	65 - 75 SFM	75 - 100 SFM
ALUMINUM BRONZE	0° - 3° RAKE	N, TiN	Mineral Oil W/ Light Oil	20 - 60 SFM	40 - 80 SFM
BAKELITE (HARD PLASTIC)	0° - 3° RAKE	TiCN	Dry Or Air Jet	25 - 40 SFM	25 - 40 SFM
BERYLLIUM COPPER	12° - 14° HOOK	TiAlN+WC/C, CrN, N	Soluble Light Base Oil	50 - 90 SFM	50 - 90 SFM
BRASS	0° - 3 ° RAKE	None, TiCN	Soluble Light Base Oil	100 - 200 SFM	100 - 200 SFM
BRONZE (FREE-MACHINING)	2° - 6° HOOK	None, TiCN, N	Soluble Light Base Oil	80 - 150 SFM	100 - 200 SFM
CAST BRASS	2° - 5 ° RAKE	N, TiCN	Soluble Light Base Oil	100 - 200 SFM	125 - 250 SFM
CAST IRON (GRAY)	0° - 3 ° RAKE	N, TiCN	Dry Or Soluble Oil	20 - 80 SFM	40 - 100 SFM
COPPER	18° HOOK	TiAlN+WC/C, CrN	Soluble Light Base Oil	80 - 150 SFM	100 - 200 SFM
COPPER - NICKEL	12° HOOK	N, TiCN	Soluble Light Base Oil	10 - 20 SFM	20 - 50 SFM
DELRIN	5° - 8° HOOK	TiAlN+WC/C, TiN, N	Dry, Air Jet, Or Water Soluble	65 - 100 SFM	65 - 100 SFM
DUCTILE IRON	3° - 6° HOOK	N+O, TiN, TiCN	Soluble Or Sulphur Based Oils	30 - 50 SFM	40 - 80 SFM
DURALUMIN	12° - 14° HOOK	TiAlN+WC/C, CrN	Soluble Oil	50 - 90 SFM	50 - 90 SFM
FERRO-TIC	0° - 3° NEG RAKE	None	Anti-Seize Compound	8 - 20 SFM	8 - 20 SFM
FIBERGLASS	0° - 3 ° RAKE	TiCN	Dry Or Air Jet	25 - 40 SFM	30 - 60 SFM
HASTELLOY	12° - 15° HOOK	CrN	Sulphur Based Oils	8 - 20 SFM	8 - 20 SFM
INCONEL	12° - 15° HOOK	N, CrN	Sulphur Based Oils	8 - 20 SFM	8 - 20 SFM
MAGNESIUM	18° - 20° HOOK (MUST)	CrN	Soluble Light Base Oil	100 - 150 SFM	100 - 150 SFM
MALLEABLE IRON	3° RAKE	N+O, TiN, TiCN	Soluble Or Sulphur Based Oils	30 - 50 SFM	30 - 50 SFM
MANGANESE	0° - 3° RAKE	TiCN	Sulphur Based Oils	8 - 20 SFM	8 - 20 SFM
MANGANESE BRONZE	0° - 3° RAKE	N, TiCN	Soluble Light Base Oil	20 - 60 SFM	40 - 80 SFM
MOLYBDENUM	12° - 14° HOOK	N, TiN, TiCN	Sulphur Based Oils	20 - 45 SFM	30 - 60 SFM
MONEL	12° - 15° HOOK	N, TiCN	Sulphur Based Oils	8 - 20 SFM	15 - 40 SFM
NAVAL BRASS	0° - 3° RAKE	N	Soluble Light Base Oil	100 - 200 SFM	100 - 200 SFM
NAVAL BRONZE	2° - 6° HOOK	None, TiCN	Soluble Light Base Oil	80 - 150 SFM	80 - 150 SFM
NICKEL SILVER	0° - 3° RAKE	N, TiCN	Sulphur Based Oils	20 - 60 SFM	20 - 60 SFM
NICKEL (PURE)	12° - 15° HOOK	N, TiCN	Soluble Light Base Oil	5 - 25 SFM	10 - 40 SFM
NITRALLOY	0° RAKE	N, TiCN	Sulphur Based Oils	8 - 20 SFM	8 - 20 SFM
NITRONIC (*NO GUARANTEE)	12° - 14° POS. RAKE	N, TiN, TiCN	Sulphur Based Oils	8 - 20 SFM	8 - 20 SFM
NYLON	5° - 8° HOOK	N, TiN	Dry, Air Jet Or Water Soluble	65 - 100 SFM	65 - 100 SFM
PLASTICS :					
THERMOPLASTIC (SOFT)	5° - 8° HOOK	N, TiN	Dry, Air Jet Or Water Soluble	65 - 100 SFM	65 - 100 SFM
ABS, DELRIN, NYLON, PVC, ETC .					
THERMOSETTING (HARD)	0° - 3° RAKE	TiCN	Dry Or Air Jet	25 - 40 SFM	25 - 40 SFM
BAKELITE, LAMINATES,					
PHENOLIC, POLYESTERS, ETC .					
POWDERED METAL (Sintered)	0° RAKE	TiCN	Soluble Light Based Oil	25 - 80 SFM	25 - 80 SFM
RUBBER, HARD	0° - 3° RAKE	None	Dry	50 - 200 SFM	50 - 200 SFM
SILICON BRONZE	0° - 3° RAKE	N, TiCN	Soluble Light Base Oil	20 - 60 SFM	20 - 60 SFM
STEEL:					
CARBON STEEL	10° - 12° HOOK	O, N, TiN	Sulphur Based Oil	40 - 90 SFM	50 - 120 SFM
COLD-ROLLED STEEL (1018, ETC.)	10° - 12° HOOK	O, N, TiN, TiAlN	Sulphur Based Oil	40 - 90 SFM	50 - 120 SFM
FORGE D	10° - 12° HOOK	O, N, TiN	Sulphur Based Oil	20 - 50 SFM	30 - 75 SFM
LEADED (12L14, ETC.)	12° HOOK	O, N, TiN	Sulphur Based Oil	40 - 90 SFM	50 - 125 SFM
STAINLESS					
FREE MACHINING	12° - 14° HOOK	N, TiN, TiCN	Sulphur Based Oil	20 - 40 SFM	40 - 180 SFM
PRECIP. HARDENING	12° - 14° HOOK	N, TiN, TiCN	Sulphur Based Oil	8 - 20 SFM	10 - 30 SFM
TOOL	12° - 14° HOOK	N, TiN, TiCN	Sulphur Based Oil	20 - 50 SFM	30 - 65 SFM
TITANIUM	15° - 20° HOOK	O, N, CrN	Sulphur Based Oil	20 - 50 SFM	30 - 65 SFM
TUNGSTEN	5° RAKE	TiN	Sulphur Based Oil	8 - 20 SFM	8 - 20 SFM
TURCITE (SOFT PLASTIC)	5° - 8° HOOK	N, TiN	Dry, Air Jet Or Water Soluble	65 - 100 SFM	65 - 100 SFM
ZAMAK (ZINK DIE CAST)	10° - 12° RAKE	TiCN, TiN, CrN, TiAlN+WC/C	Soluble Light B Ased Oil	50 - 200 SFM	50 - 200 SFM
ZINC	10° - 12° RAKE	TiCN, TiN, CrN, TiAlN+WC/C	Soluble Light B Ased Oil	50 - 200 SFM	50 - 200 SFM

* If problems are encountered when tapping nitronic (or anyother material), please consult North American Tool's Tool Designers.
** See page 127 for definitions of tool coating abbreviations.

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

SPECIAL TAPS

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	2536	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		35	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
- Depth of hole
- Length of chamfer on tap
- Pitch of thread
- Percentage of full thread to be cut
- Lubrication
- Machine equipment and rigidity
- Horizontal or vertical tapping

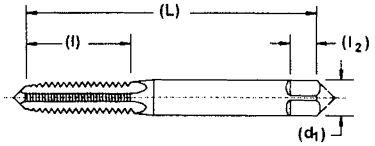
S.F.M./R.P.M. EQUATIONS:

S.F.M. = 0.26 x R.P.M. x Tool Diameter

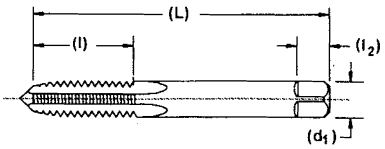
$$\text{R.P.M.} = \frac{3.82 \times \text{S.F.M.}}{\text{TOOL DIAMETER}}$$

STANDARD TAP DIMENSIONS • GROUND THREAD (Ref. USCTI Table 302)

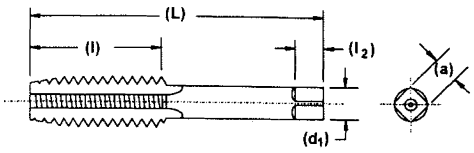
GENERAL DIMENSIONS



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)		M1.6 (.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

cont.

STANDARD TAP DIMENSIONS • GROUND THREAD (Ref. USCTI Table 302) cont.

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				
OVER	TO (INC.)					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 threadend (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.

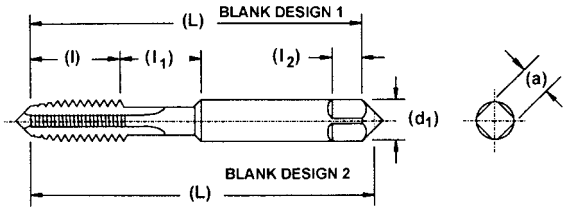
For eccentricity tolerances of tap elements see Table 317.

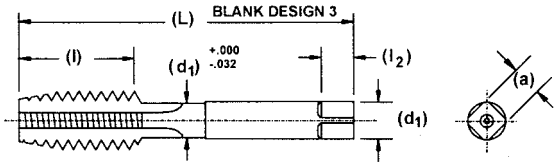
TOLERANCES

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





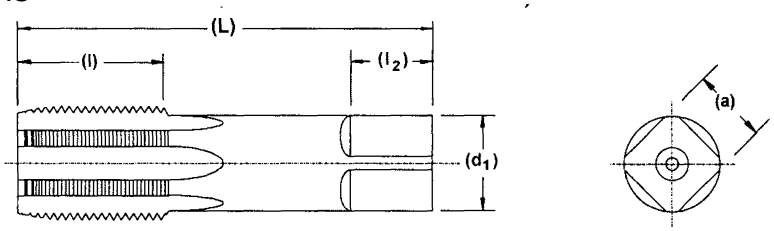
NOMINAL DIAMETER RANGE - INCHES		MACHINE SCREW SIZE NO.	NOMINAL FRACTIONAL DIAMETER INCHES	NOMINAL METRIC DIAMETER MILLIMETERS, (INCHES)	BLANK DESIGN NO.	TAP DIMENSIONS – INCHES					
OVER	TO (INCL.)					OVERALL LENGTH L	THREAD LENGTH l	NECK LENGTH l_1	SQUARE LENGTH l_2	SHANK DIAMETER d_1	SIZE OF SQUARE 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 “l_1” 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)

GENERAL DIMENSIONS



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:

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

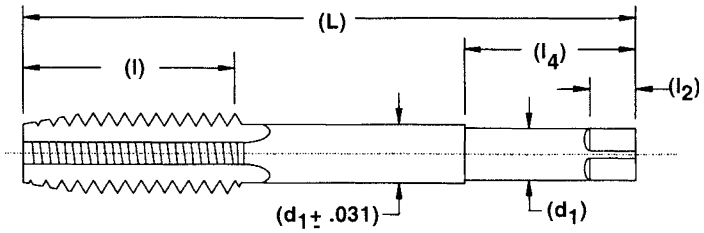
For tolerances see Table 302.

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 lengh 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	0.69	0.1410	0.19	.110	1.13
	8	0.75	0.1680	0.25	.131	1.25
	10 - 12	0.88	0.1940	0.25	.152	1.38
1/4	14	1.00	0.2550	0.31	.191	1.50
1/4*		1.00	0.1850	0.25	.138	Full Length
5/16		1.13	0.3180	0.38	.238	1.56
5/16*		1.13	0.2400	0.28	.180	Full Length
3/8		1.25	0.3810	0.44	.286	1.63
3/8*		1.25	0.2750	0.38	.206	Full Length
7/16		1.44	0.3230	0.41	.242	1.69
1/2		1.66	0.3670	0.44	.275	1.69
9/16		1.66	0.4290	0.50	.322	1.88
5/8		1.81	0.4800	0.56	.360	2.00
3/4		2.00	0.5900	0.69	.442	2.25
7/8		2.22	0.6970	0.75	.523	2.50
1"		2.50	0.8000	0.81	.600	2.63
1-1/8		2.56	0.8960	0.88	.672	2.75
1-1/4		2.56	1.0210	1.00	.766	2.88
1-3/8		3.00	1.1080	1.06	.831	3.00
1-1/2		3.00	1.2330	1.13	.925	3.00

* Small Shank

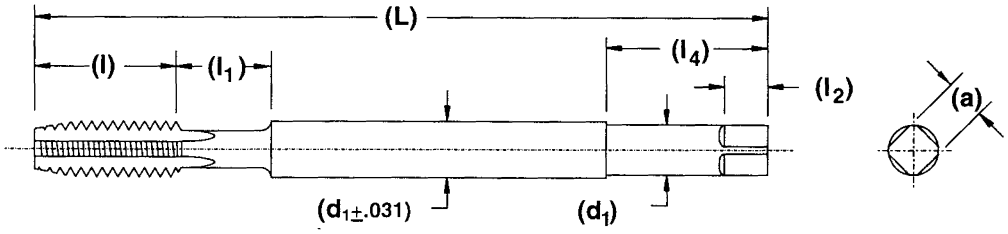
TOLERANCES FOR SHANK DIAMETER, d_1 AND l_4 LENGTH

SIZE RANGE		DIRECTION	TOLERANCES
FRACTIONAL	MACHINE SCREW		
1/4 to 5/8 incl.	0 -14 incl.	Minus	.003
11/16 to 1-1/2 incl.		Minus	.004

TAP DIMENSIONS

PULLEY TAP DIMENSIONS • GROUND THREAD (REF. USCTI TABLE 310)

GENERAL DIMENSIONS



NOMINAL FRACTION DIAMETER INCHES	TAP DIMENSIONS – INCHES						
	OVERALL LENGTH L	THREAD LENGTH l	NECK LENGTH l_1	SQUARE LENGTH l_2	LENGTH OF SHANK CLOSE TOL. SECTION l_4	SHANK DIAMETER d_1	SIZE OF SQUARE a
1/4 (.2500)	6,8	1.00	.38	.31	1.50	.2550	.191
5/16 (.3125)	6,8	1.13	.38	.38	1.56	.3180	.238
3/8 (.3750)	6,8,10	1.25	.38	.44	1.63	.3810	.286
7/16 (.4375)	6,8	1.44	.44	.50	1.69	.4440	.333
1/2 (.5000)	6,8,10,12	1.66	.50	.56	1.69	.5070	.380
5/8 (.6250)	6,8,10,12	1.81	.63	.69	2.00	.6330	.475
3/4 (.7500)	10,12	2.00	.75	.75	2.25	.7590	.569

TOLERANCES

ELEMENT	SIZE RANGE	DIRECTION	TOLERANCE
Overall Length - L	1/4 to 3/4 included	Plus or Minus	.063
Thread Length - l	1/4 to 3/4 included	Plus or Minus	.063
Neck Length - l_1	1/4 to 3/4 included	See Note - 1	See Note - 1
Square Length - l_2	1/4 to 3/4 included	Plus or Minus	.031
Length of Shank (close tol.) l_4	1/4 to 3/4 included	See Note - 2	See Note - 2
Size of Diameter - d_1	1/4 to 3/4 included	Minus	.0050
Size of Square - a	1/4 to 1/2 included	Minus	.004
	5/8 to 3/4 included	Minus	.006

NOTES

1. l_1, (Neck Length); neck and its length is optional with manufacturer.
2. l_4, (Length of Close Tolerance Shank) is minimum length which is held to eccentricity tolerances per Table 317.

GENERAL NOTES

a. These taps have an internal center in the thread end.

b. These taps are made to the H3 limits shown in Table 327.

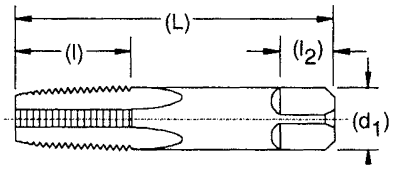
c. For eccentricity tolerances of taps elements see Table 317.

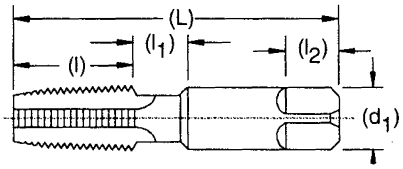
d. d_1, (Shank diameter) is approximately the same as the maximum major diameter for that size.

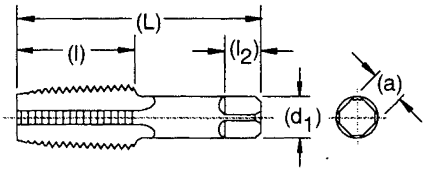
e. a, (Size of Square) is equal to .75 X d_1 to the nearest .001 inch.

STANDARD PIPE TAP DIMENSIONS • STRAIGHT AND TAPER, GROUND THREAD (REF. USCTI TABLE 311)

GENERAL DIMENSIONS







NOMINAL SIZE INCHES	LENGTH OVERALL L	LENGTH OF THREAD l	LENGTH OF SQUARE l_2	DIA. OF SHANK d_1	SIZE OF SQUARE a	LENGTH OPTIONAL NECK l_1
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

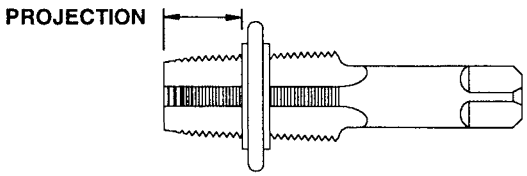
ELEMENT	RANGE	DIRECTION	TOLERANCE
Length Overall - L	1/16 to 3/4 inc.	Plus or Minus	.031
	1" to 4" inc.	Plus or Minus	.063
Length of Thread - l	1/16 to 3/4 inc.	Plus or Minus	.063
	1" to 1 -1/4 inc.	Plus or Minus	.094
	1- 1/2 to 4"	Plus or Minus	.125
Length of Square - l_2	1/16 to 3/4 inc.	Plus or Minus	.031
	1" to 4" inc.	Plus or Minus	.063
Diameter of Shank - d_1	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.

TAP DIMENSIONS

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 From (NPTF)

THREAD TAP LIMITS						L_1 LENGTH
NOMINAL SIZE INCHES	THREADS PER INCH	PROJECTION* INCHES	PROJECTION TOLERANCE + OR -	TAPER PER FOOT LIMITS		
				MINIMUM	MAXIMUM	
1/16	27	.312	.063	.719	.781	.160
1/8	27	.312	.063	.719	.781	.1615
1/4	18	.459	.063	.719	.781	.2278
3/8	18	.454	.063	.719	.781	.240
1/2	14	.579	.063	.719	.781	.320
3/4	14	.565	.063	.719	.781	.339
1"	11-1/2	.678	.094	.719	.781	.400
1-1/4	11-1/2	.686	.094	.719	.781	.420
1-1/2	11-1/2	.699	.094	.719	.781	.420
2"	11-1/2	.667	.094	.719	.781	.436
2-1/2	8	.925	.094	.734	.781	.682
3"	8	.925	.094	.734	.781	.766
3-1/2	8	.938	.125	.734	.781	.821
4	8	.950	.125	.734	.781	.844

NOTES

* Distance small end of tap projects throught L_1 Taper Thread Ring Gage.

See page 114 for pipe tap drill sizes.

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

SEE PAGE 117 FOR SURFACE TREATMENT RECOMMENDATIONS

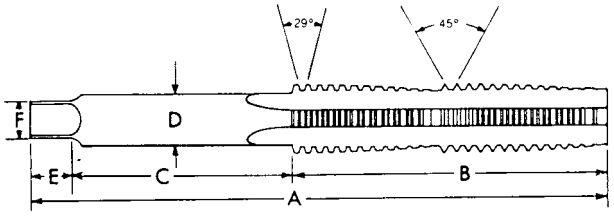
CrN:	Chromium Nitride	TiAlN:	Titanium Aluminum Nitride
N:	Nitride	TiCN:	Titanium Carbonitride
N + O:	Nitride + Oxide	TiN:	Titanium Nitride
O:	Steam Oxide	Amphorex™ DLC:	Diamond-like Carbon
AlCrN:	Aluminum Chromium Nitride	TiAlN + Amphorex™ DLC:	Titanium Aluminum Nitride + Diamond-like Carbon
ZrN:	Zirconium Nitride		



Surface treatments and coatings allow improved tooling performance. For more information on surface treatments, contact Customer Service.

TAP DIMENSIONS

TANDEM ACME TAP DIMENSIONS

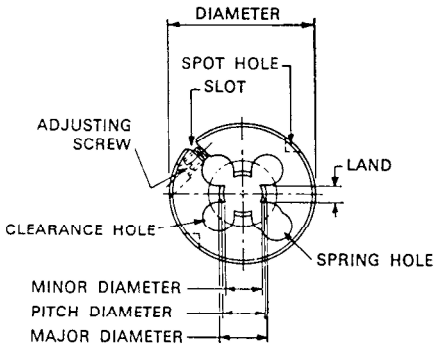


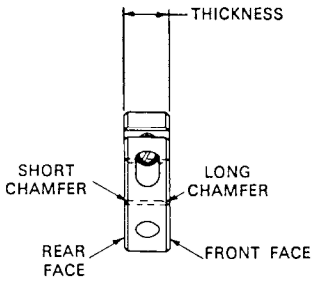
SIZE & PITCH	A OVERALL LENGTH	B LENGTH THREAD END	ROUND SHANK		SQUARE		MAXIMUM DEPTH OF NUT	
			C LENGTH	D DIA.	E LENGTH	F ACROSS FLATS	BRONZE & STEEL	BRASS & CAST IRON
1/4 -16	3"	1 3/4	1"	.185	1/4	.138	1/2	3/4
5/16 -14	3 13/32	1 7/8	1 1/4	.220	9/32	.165	5/8	7/8
3/8 -12	4 1/16	2 1/8	1 5/8	.255	5/16	.191	5/8	1"
1/2-10	5"	2 9/16	2"	.367	7/16	.275	1"	1 1/2
5/8-8	6 1/4	3 3/16	2 1/2	.480	9/16	.360	1 1/4	1 7/8
3/4-6	7 15/16	4 5/16	3"	.542	5/8	.406	1 1/2	2 1/4
3/4-8	7 15/16	4 5/16	3"	.542	5/8	.406	1 1/2	2 1/4
7/8-6	8 5/8	4 3/8	3 1/2	.697	3/4	.523	1 3/4	2 5/8
1" -5	10 1/8	5 1/4	4"	.697	3/4	.523	2"	3"
1 1/8-5	10 3/4	5 1/4	4 1/2	.800	13/16	.600	2 1/4	3 3/8
1 1/4-5	11 1/8	5 1/4	4 3/4	.896	7/8	.672	2 1/2	3 3/4
1 3/8-4	12 1/4	5 7/8	5 1/8	1.108	1 1/4	.831	2 3/4	4 1/8
1 1/2-4	12 5/8	5 7/8	5 1/2	1.233	1 1/4	.925	3"	4 1/2
1 3/4-4	13 3/8	5 7/8	6 1/4	1.430	1 1/4	1.072	3 1/2	5"
2" -4	14 7/8	6 1/2	7	1.644	1 3/8	1.233	4"	6"

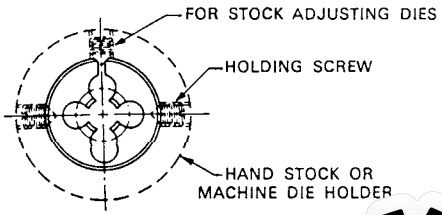
ROUND ADJUSTABLE DIES TECHNICAL DATA

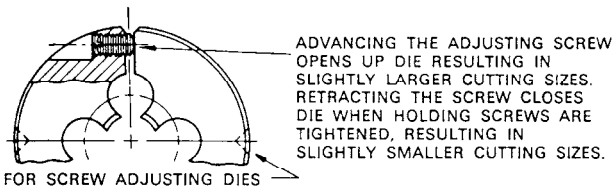
DIE THICKNESS CHART

O.D.(INCH)	O.D.(MM)	THICKNESS
13/16	20.6 mm	1/4
1"	25.4 mm	3/8
1-1/2	38.1 mm	1/2
2"	50.8 mm	5/8
2-1/2	63.5 mm	3/4
3" (10 pitch & coarser)	76.2 mm	1"
3" (11 pitch & finer)	76.2 mm	3/4









SPT SUNCOAST INC. PRECISION TOOLS ESTABLISHED 1963