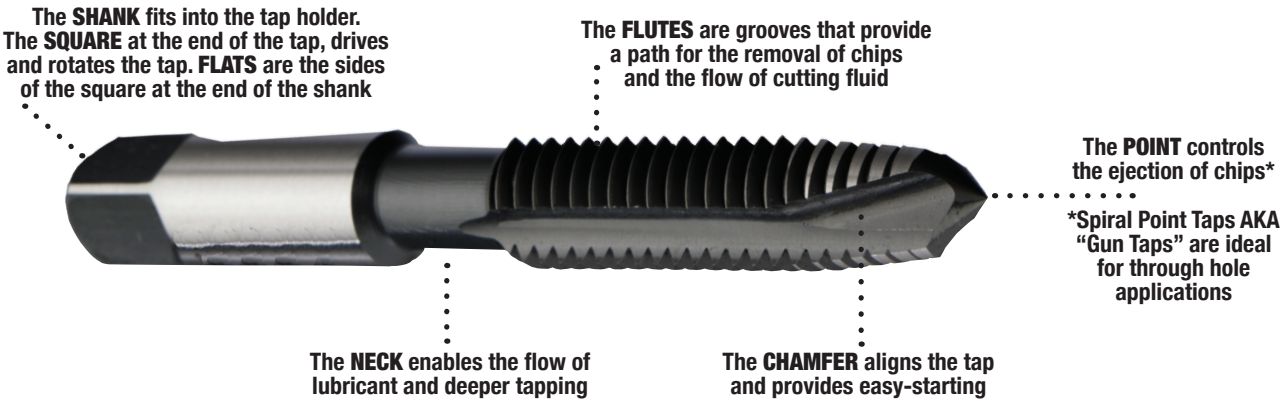
Understanding Taps • Optimize Tap Performance • Prevent Breakage

Taps are rotary cutting tools that cut internal threads in metal. They have cutting teeth and either helical or straight flutes for the passage of chips and the admission of cutting fluid. The purpose of cutting internal threads is so that it can receive a part with an external thread, such as a bolt, rod, or fastener. These two parts can then be joined together. Taps can be made out of different types of steel and can be engineered for different applications (See Champion Tap Guide).

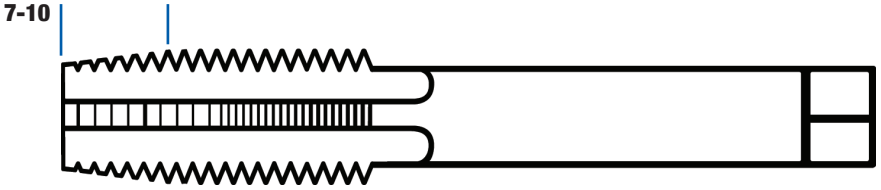
Anatomy & Nomenclature



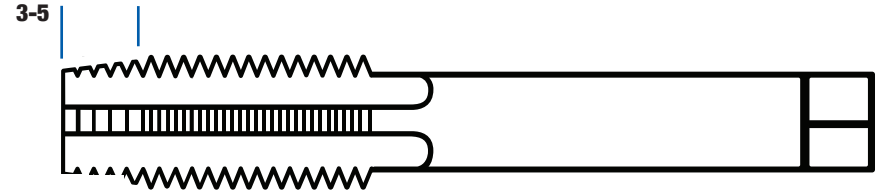
Chamfer Styles

> The chamfer is ground on the front of the tap to help it begin threading and assist with alignment.

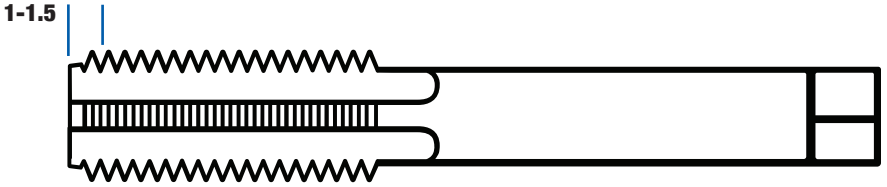
TAPER
- 7 TO 10 THREADS OF CHAMFER
Nickname: "STARTER Taps" - they are easy to align and start threading



PLUG
- 3 TO 5 THREADS OF CHAMFER
Most popular - often used to start and finish threading in a single pass



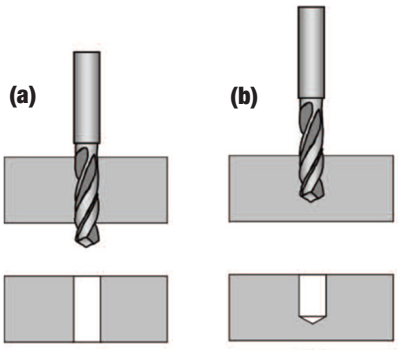
BOTTOM
- 1 TO 1.5 THREADS OF CHAMFER
Nickname: "FINISHING Taps" - can thread to the bottom of a blind hole (packs the chips at the bottom)



Through Holes vs. Blind Holes

(a) Through Hole:
- A hole that passes completely through the work piece

(b) Blind Hole:
- A hole that does not pass completely through the work piece



Reading Tap Sizes

IMPERIAL FRACTIONAL TAPS

Fractional and machine screw taps are measured in terms of "Threads Per Inch" (TPI)

308-¼-20-P

- Champion Series Name
- Nominal Size (inch) (diameter)
- # Threads Per Inch
- Plug Style Chamfer

METRIC TAPS

Metric tap sizes are designated by the pitch (distance between threads)

308M-8x1.25-P

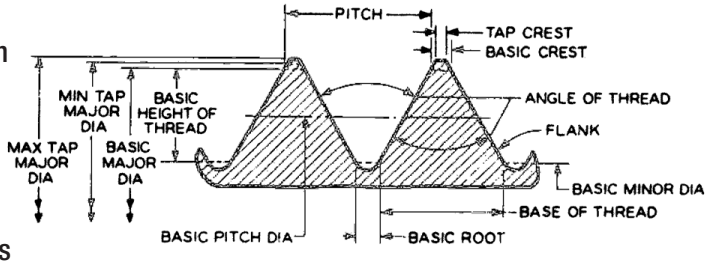
- Champion Series Name
- Nominal Size (mm) (diameter)
- Pitch Between Threads (mm)
- Plug Style Chamfer

Coarse vs. Fine Threads

This information refers to the proximity of threads being cut by the tap.

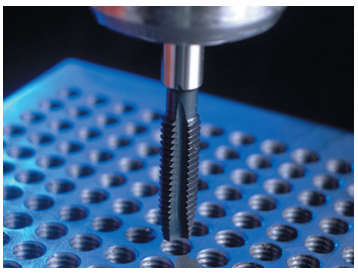
> Imperial Fractional Taps- Defined by the number of threads per inch
- UNC (coarse): 308-1/4-20-P
- UNF (fine): 308-1/4-28-P

> Metric Taps- Defined by the proximity of the threads
- Coarse: 308M-8x1.5-P
- Fine: 308M-8x1.25-P (the pitch is smaller between threads so the tap creates a finer thread when it cuts)



Operating Taps

> Tap Wrench
- For Hand Tapping Applications
- Make sure hole is drilled to correct size
- Align tap properly for precise threading and to prevent tap breakage



> Machining
- High Production CNC Operations
- High performance taps are recommended
- Use proper speeds & feeds

> Brute XLT Tapper
- High Performance Power Tool Engineered Specifically For Tapping
- Ideal for use on jobsites where hundreds of holes are required
- Use in through hole applications with Brute XL22 Spiral Point Taps

Lubrication

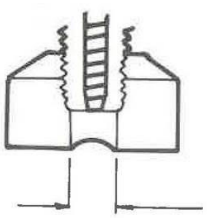
BruteLube Cutting Fluid is ideal to optimize the performance of your tap when creating threads in metal. The purpose is to lubricate the contact surfaces between the tool and the work piece to reduce friction and heat. Lubrication of the chip provides better chip disposal, and reduced heat. It also prevents the chip from welding to the tool, which can cause "build up edge" and shorten cutting tool life dramatically. By enhancing tool heat resistance, operators will experience smoother cuts, longer tool life, and increased production.

Drilling The Right Size Hole

A screw or fastener will only fit properly into a threaded hole if:

> The hole was drilled to the proper diameter and
> The hole was properly tapped

Consult your tap/drill chart to determine the correct diameter drill.



Drill Diameter Options for ¼-20 Thread

¼-20	9	77
	7	70
	13/64"	66

> #7 drill will yield a 70% of thread

> #9 drill (smaller) will yield a smaller hole-tap will work harder. You will achieve a higher % of thread (77%) but tap life will be shortened

> 13/64" drill (larger) will result in less thread engagement (66%)

Tap Drill Sizes

Tap Size	Tap Drill Size	Prob % of Thread	Tap Size	Tap Drill Size	Prob % of Thread
0-80	56	74	3/8-24	Q	75
	3/64	71		8.5mm	70
1-64	54	81	7/16-14	U	75
	53	59	7/16-20	W	75
1-72	1.50mm	68		25/64"	68
	53	67	1/2-13	27/64"	75
2-56	51	74		11.0mm	64
	50	62	1/2-20	11.4mm	74
2-64	50	70		29/64"	67
	49	56	9/16-12	15/32	84
3-48	48	78		31/64"	69
	5/64"	70	9/16-18	1/2"	82
3-56	46	69		33/64"	60
	45	56 5	/8-11	17/32	76
4-40	44	74		35/64"	63
	43	65	5/8-18	9/16	82
4-48	2.35mm	72		37/64	60
	42	61	11/16-11	19/32	75
5-40	39	71	11/16-16	5/8"	75
	38	65	3/4-10	41/64"	81
5-44	38	72		21/32"	69
	37	63	3/14-16	11/16"	72
6-32	36	72		17.5mm	70
	7/64"	64	7/8-9	49/64"	73
6-40	33	69		25/32"	62
	32	60	7/8-14	51/64"	79
8-32	3.40mm	74		13/16"	62
	29	62	1-8	7/8"	74
8-36	29	70		57/64"	64
	9/64"	60	1-12	29/32"	82
10-24	3.70mm	76		59/64"	68
	25	69	1-14	59/64"	79
10-32	5/32"	75		15/16"	62
	21	68	1-1/8-7	63/64"	73
12-24	11/64"	75		1	65
	17	73	1-1/8-12	1-1/32"	82
12-28	16	77		1-3/64"	67
	15	78	1-1/4-7	1-3/32"	81
1/4-20	9	77		1-7/64"	73
	7	70		1-1/8"	64
	13/64"	66	1-1/4-12	1-5/32"	81
1/4-28	3	70		1-11/64	67
	5.50mm	67	1-3/8-6	1-13/64	81
5/16-18	F	72		1-19/64"	66
	G	66	1-3/8-12	1-9/32"	81
5/16-24	6.80mm	78		1-19/64	66
	I	70	1-1/2-6	1-11/32"	69
3/8-16	5/16"	74		1-23/64"	62
	O	69	1-1/2-12	1-13/32"	80
				1-27/64"	66

Tap Drill Sizes

Tap Size	Tap Drill Size	Prob % of Thread	Tap Size	Tap Drill Size	Prob % of Thread
1.6x.35	1.25mm	69	9.0x1.25	7.75mm	73
1.8x.35	1.45mm	69	10x1.5	8.50mm	71
2.0x.4	1.60mm	69		Q	75
	52	66	10x1.25	8.70mm	73
2.2x.45	1.75mm	70		11/32"	71
2.5x.45	2.05mm	69	11x1.5	9.50mm	70
	46	67		3/8"	71
3.0x2.5	2.50mm	68	12x1.75	10.20mm	74
	40	70		Y	71
3.5x6	2.90mm	68	12x1.25	10.80mm	67
	33	72		27/64"	72
4.0x.7	3.30mm	69	14x2.0	12.00mm	72
	30	73		15/32"	76
4.5x.75	3.70mm	74	14x1.5	12.50mm	71
	26	70	16x2.0	14.00mm	72
5.0x.8	4.20mm	69		35/64"	76
	19	68	16x1.5	14.50mm	71
5.5x.9	4.60mm	68	18x2.5	15.50mm	73
	14	67		39/64"	74
6.0x.75	5.30mm	74	18x1.5	16.50mm	70
	4	73	20x2.5	17.50mm	73
6.0x1.0	5.00mm	70		11/16"	74
	9	71	22x2.5	19.50mm	73
7.0x.75	6.30mm	74		49/64"	75
	D	72	24x3.0	21.00mm	73
7.0x1.0	6.00mm	70		53/64"	72
	15/64"	73	27x3.0	24.00mm	73
8.0x1.25	6.70mm	74		15/16"	78
	17/64"	71	30x3.5	26.50mm	74
8.0x1.0	7.00mm	69		1-3/64	73
	J	66	33x3.5	29.50mm	74
				1-11/64"	72

Pipe Tap Drill Sizes

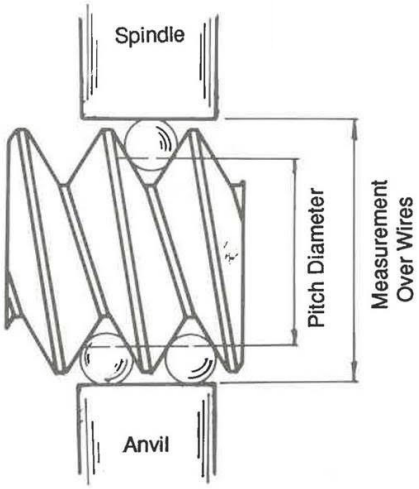
Tap Size	NPT Tap Drill	NPS Tap Drill
1/16-27	D	1/4"
1/8-27	Q	11/32"
1/4-18	7/16"	7/16"
3/8-18	9/16"	37/64"
1/2-14	45/64"	23/32"
3/4-14	29/32"	59/64"
1-11-1/2	1-9/64"	1-5/32"
1-1/4-11-1/2	1-31/64"	1-1/2
1-1/2-11-1/2	1-47/64	1-3/4
2-11-1/2	2-13/64"	2-7/32
2-1/2-8	2-5/8"	2-21/32"

Class of Fit

When threaded parts are mated, the two parts must assemble with a degree of tightness dictated by the use of the fastener.

Class Of Fit System - 3 established Classes of Threads in the UN series

> Designate minimum and maximum pitch diameters for internal and external threads (define tolerance)
> "A" = screws (external threads)
> "B" = nuts or other internal threads



Class 1B Thread: 1A screw will easily and quickly assemble with a 1B hole
- The fit is a 1B thread - large tolerances
- Very rarely used in modern metal working

Class 2B Thread: 2A screw goes into a 2B hole
- Fair tolerance allowances
- Wide applications to accomodate plating, finishing and coatings on screws, bolts and nuts

Class 3B Thread: 3A screw on a 3B nut or internal threaded hole
- Closeness of fit and accuracy are very important
- Tolerance limits are close
- These threads are created only when using high production equipment (CNC Machine)

H Limits

Measures the tolerance variability of the thread cut by the tap in relation to basic pitch diameter.

> 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.

> Ground thread tap limits are designated by the letter H (high) "H Limits" above basic pitch diameter, or L (low) below basic pitch diameter

- Pitch Diameter Limits for taps up to 1" diameter:
  - 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

*Metric threads use a similar D limit system

Tap Troubleshooting

Oversize or Bell Mouthed Holes

> Tap Misalignment: The misalignment of the tap to the drilled hole will cause the tap to be deflected in to the hole on start of tapping. The deflected tap will cut more heavily on one side than the other. Oversize and bell mouthing will result

Remedy - Ensure correct alignment of the tap to the drilled hole

> Excessive feed pressure or a restricted feed pressure when machine tapping will feed the tap "out-of-pitch" with the tap threads, causing the tap to cut on the thread flanks

Remedy - Use a pitch controlled tapping machine or tapping attachment with axial float, free under torsional load

Poor Thread Finish

> Dull or blunt tap: A dull or blunt tap will rub and gall the material being tapping, producing rough torn threads

Remedy - Replace tap

> Incorrect lubricant or lack of lubricant can result in poor thread finish

Remedy - Use proper lubricant

Tap Teeth Chipping

> Incorrect hole size, or tap hitting bottom of hole

Remedy - Consult a tap/drill chart to drill the correct hole size. Reduce the travel of the tap or drill deeper hole to allow clearance in the hole depth

Excessive Rate of Wear

> Incorrect hole size, tapping speed to high or lack of lubricant

Remedy - Consult a tap/drill chart to drill the correct hole size. Select the correct tapping speed for the material and tap type and use proper lubricant

Tap Breakage

> Misalignment or incorrect hole size

Remedy - Align tap with alignment tool or self-guiding tapping machine. Consult a tap/drill chart to drill the correct hole size