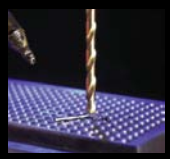
TECHNICAL HELP
Drills



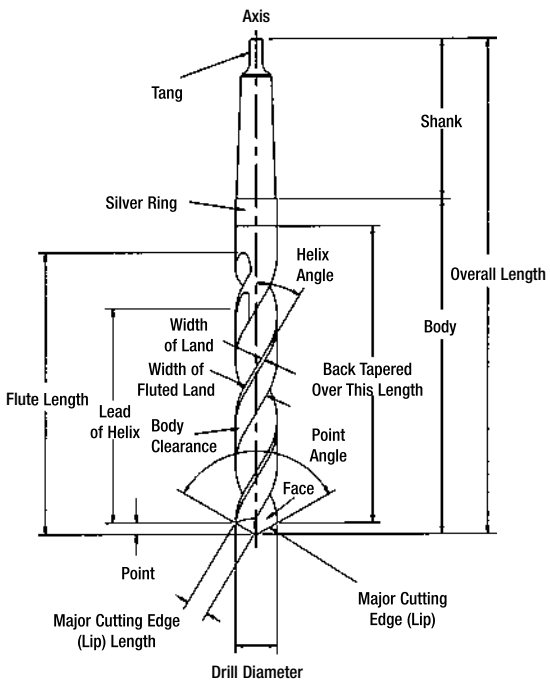
Technical Tips / Drills

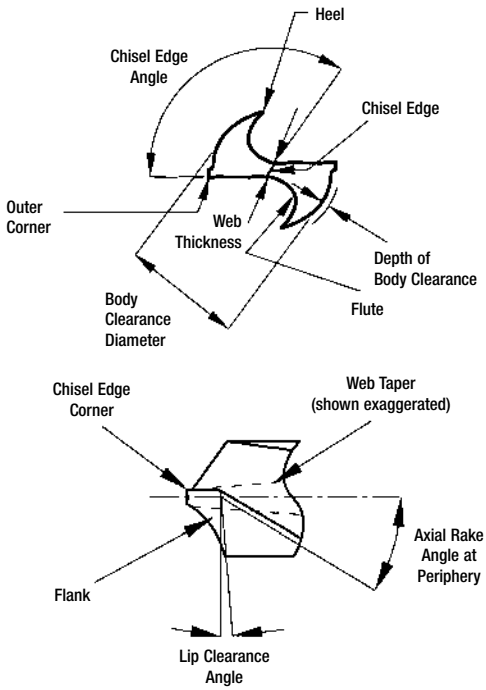
1. The most common mistake when drilling is to over-speed and under feed the tool. This will generate excess heat at the cutting edge, prematurely dulling the drill. Brute drills are designed to be fed heavily. If speed is increased an increase to feed is also appropriate. This will ensure that a “healthy” chip is being formed, and you will achieve good drilling results.
2. The workpiece must be held rigid and the machine spindle should have no play.
3. The chuck in which a straight shank drill is held must be good quality. If the drill slips in the chuck and the feed is automatic, breakage of the drill may occur.
4. Use recommended lubricants to enhance the life of the drill and ensure that the lubricant always reaches the drill point.
5. Do not allow the flutes of a drill to become choked with chips, especially in the holes. When drilling deeper than 4 x diameter, withdrawal of the drill to clear chips may be required.
6. When the drill is reground ensure that all wear is removed and check that the correct point geometry is produced. Always keep drills sharp; frequent regrinding is good economy.

When drilling a particular material at a given speed and feed, the drill’s performance is governed by its quality and the following other important factors:

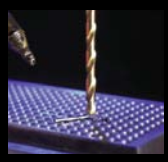
- MATERIAL BEING DRILLED
- DEPTH OF HOLE
- THROUGH OR BLIND HOLE
- COOLANT USED
- CONDITION OF THE MACHINE
- MACHINE POWER CAPACITY
- CHOICE OF TOOL HOLDING
- STABILITY OF WORK HOLDING
- HORIZONTAL OR VERTICAL DRILLING
- STATIONARY OR REVOLVING DRILL
- CHIP CONTROL

Drill Nomenclature





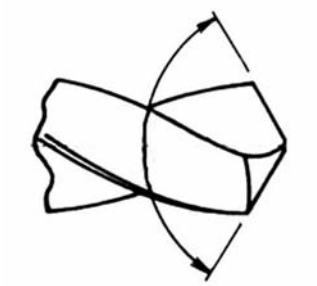
TECHNICAL HELP
Drills



Trouble Shooting / Drills

1. **OUTER CORNERS BREAK DOWN.**
   Cutting Speed too high / Hard spots in material / No cutting fluid at drill point / Flutes clogged with chips / Drill was used to enlarge an existing hole - Reamer should be used to enlarge holes.
2. **CUTTING LIPS CHIPPED**
   Too much feed / Lip relief too great / Drill was used to enlarge an existing hole - Reamer should be used to enlarge holes.
3. **CHECKS OR CRACKS IN CUTTING LIPS**
   Overheated or too quickly cooled while sharpening or drilling.
4. **MARGIN CHIPS**
   Oversize jig bushing
5. **DRILL BREAKS**
   Point improperly ground / Feed too heavy / Spring or back lash in drill press, fixture or work / Drill is dull / Flutes clogged with chips.
6. **TANG BREAKS**
   Imperfect fit between taper shank and socket caused by dirt or chips, or burred or badly worn sockets.
7. **DRILL BREAKS WHEN DRILLING BRASS OR WOOD**
   Flutes clogged with chips / Improper type of drill
8. **DRILL SPLITS UP CENTER**
   Lip relief too small / Too much feed
9. **DRILL WILL NOT ENTER WORK**
   Drill is dull / Lip relief is too small / Too heavy a web
10. **HOLE ROUGH**
    Point improperly ground or dull / No cutting compound at drill point / Improper cutting fluid / Feed too great / Fixture not rigid
11. **HOLE OVERSIZE**
    Unequal angle or length of the cutting edges - or both / Loose spindle
12. **CHIP SHAPE CHANGES WHEN DRILLING**
    Drill becomes dull or cutting lips chipped
13. **LARGE CHIP COMING OUT OF ONE FLUTE, SMALL CHIP OUT OF THE OTHER**
    Point incorrectly ground, one lip is doing all the cutting.

Drill Tip Geometry



118 ° Conventional Point

- General use
- Not self centering
- For stationary drills
- performs better in softer materials than hard metal

135 ° Split Point

- Self centering (won't walk)
- For portable drills
- For harder materials
- Requires less force than 118°

TECHNICAL HELP
Drills

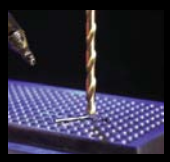
Material Application Chart

Material	Carbon Steel			Alloyed Steels			Steel Drop Forgings Heat Treated			Grey Cast Iron		
Level	Low	Medium	High							Soft	Medium	Hard
Hardness Brinell	85-125	125-175	175-225	<200	200-300	>300	330-370	370-420	>420	85-125	125-175	175-225
Hardness RC	-	1-9	9-22	<16	16-39	>39	35-40	40-44	>44	-	1-9	9-22
SFM	80-95	70-85	45-65	60-90	40-70	20-30	30-40	20-30	10-20	80-95	70-85	45-65

Product Categories - Best / Better / Good Suitability

BRUTE -	Best	XL5	XL5	XL5	XL5	XL5	XL5	XL5	XL5	XL5	XL5	XL5	XL5
	Better												
	Good												
SCREW -	Best	1705	1705	1705C	1705	1705C	1705C	1705	1705C	1705C	1705	1705C	1705C
MACHINE	Better			1705		1705						1705	1705
	Good			2905		2905						2905	2905
JOBBER -	Best	700T	700T	700T	700T	700T	705C	705C	705C	705C	700T	700T	700T
	Better	XG0	XG0	705SP	XG0	705SP					XG0	705SP	705SP
	Good	US5	US5	705P	US5	705P					US5	705P	705P
JOBBER -	Best	708	708	708	708	708					708	XL8	XL8
(METRIC)	Better	XL8	XL8	XL8	XL8	XL8					XL8	708	708
	Good						XL8	XL8	XL8	XL8			
JOBBER -	Best	705LH	705LH	XL5LH	705LH	XL5LH					705LH	XL5LH	XL5LH
(LEFT HAND)	Better	XL5LH	XL5LH	705LH	XL5LH	705LH	XL5LH	XL5LH	XL5LH	XL5LH	XL5LH	705LH	705LH
	Good						705LH	705LH	705LH	705LH			
MECHANICS -	Best	XL28	XL28	XM28	XM28	XM28					XL28	XM28	XM28
	Better						XL28	XL28	XL28	XL28			
	Good						XM28	XM28	XM28	XM28			
3/8 SHANK -	Best	XG38	XG38	XL38	XG38	XL38					XG38	XL38	XL38
	Better	738	738	XG38	738	XG38	738	XL38	XL38	XL38	738	XG38	XG38
	Good			738		738	XG38	XG38	XG38	XG38		738	738
S&D -	Best	XL12	XL12	712CO	XL12	712CO	712CO	712CO	712CO	712CO	XL12	712CO	712CO
	Better	XG12	XG12	XG12	XG12	XG12	XG12	XG12	XG12	XG12	XG12	XG12	XG12
	Good	712	712	US12	712	US12	712	712	712	712	712	US12	US12
TAPER -	Best	704	704	704	704	704	704	704	704	704	704	704	704
LENGTH	Better												
	Good												

TECHNICAL HELP
Drills



Material Application Chart

Material	Titanium			Stainless Steel			Steel		Steel		
Level	T175A	Ti150A-RS120	140A-RC-130B & Ti 6AL 4V	300	400	Matenistic 416, 420, 416 PlusK, 400F, 416SE 440F	Heat Resisting	Nimonic Alloys	Manganese	Spring Steels	Armor Plate
Hardness Brinell	300-440	300-440	300-440	120-220	200-300	135 thru 450	175-225	200-300	125-220	402	200-350
Hardness RC	33-46	33-46	33-46	1-16	16-33	1 thru 47	9-21	16-33	1-21	43	16-37
SFM	50-60	40-50	30-40	20-40	40-70	20 thru 50	10-25	10-20	10-12	15-30	30-40

Product Categories - Best / Better / Good Suitability

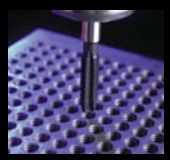
BRUTE -	Best	XL5	XL5	XL5	XL5	XL5	XL5	XL5	XL5	XL5	XL5	XL5
	Better											
	Good											
SCREW -	Best	1705C	1705C	1705C	1705C	1705C	1705C	1705C	1705C	1705C	1705C	1705C
MACHINE	Better									1705		
	Good									2905		
JOBBER -	Best	705C	705C	705C	705C	705C	705C	705C	705C	700T	705C	705C
	Better									705SP		
	Good									705P		
JOBBER -	Best									XL8		
(METRIC)	Better									708		
	Good	XL8	XL8	XL8	XL8	XL8	XL8	XL8	XL8		XL8	XL8
JOBBER -	Best							XL5	XL5	XL5LH		
(LEFT HAND)	Better	XL5LH	XL5LH	XL5LH	XL5LH	XL5LH	XL5LH			705LH	XL5LH	XL5LH
	Good	705LH	705LH	705LH	705LH	705LH	705LH				705LH	705LH
MECHANICS -	Best									XM28		
	Better	XL28	XL28	XL28	XL28	XL28	XL28	XL28	XL28		XL28	XL28
	Good	XM28	XM28	XM28	XM28	XM28	XM28	XM28	XM28		XM28	XM28
3/8 SHANK -	Best									XL38		
	Better	XL38	XL38	XL38	XL38	XL38	XL38	XL38	XM38	XG38	XL38	XL38
	Good	XG38	XG38	XG38	XG38	XG38	XG38	XL38	XM38	738	XG38	XG38
S&D -	Best	712CO	712CO	712CO	712CO	712CO	712CO	712CO	712CO	XL12	712CO	712CO
	Better	XG12	XG12	XG12	XG12	XG12	XG12	XG12	XG12	XG12	XG12	XG12
	Good	712	712	712	712	712	712	712	712	712	712	712
TAPER -	Best	704	704	704	704	704	704	704	704	704	704	704
LENGTH	Better											
	Good											

TECHNICAL HELP
Drills

Decimal Equivalents / Drill Sizes

Drill Size	Decimal Equiv.	Drill Size	Decimal Equiv.	Drill Size	Decimal Equiv.	Drill Size	Decimal Equiv.
80	.0135	36	.1065	D	.2460	13.5mm	.5315
79	.0145	7/64”	.1094	1/4” E	.2500	35/64”	.5469
1/64”	.0156	35	.1100	6.5mm	.2559	14.0mm	.5512
78	.0160	34	.1100	F	.2570	9/16”	.5625
77	.0180	33	.1130	G	.2610	14.5mm	.5709
.5mm	.0197	32	.1160	17/64”	.2656	37/64”	.5781
76	.0200	3.0mm	.1181	H	.2660	15.0mm	.5906
75	.0210	31	.1200	I	.2720	19/32”	.5938
74	.0225	1/8”	.1250	7.0mm	.2756	39/64”	.6094
73	.0240	30	.1285	J	.2770	15.5mm	.6102
72	.0250	29	.1360	K	.2810	5/8”	.6250
71	.0260	3.5mm	.1378	9/32”	.2812	16.0mm	.6299
70	.0280	28	.1405	L	.2900	41/64”	.6406
69	.0292	9/64”	.1406	M	.2950	16.5mm	.6496
68	.0310	27	.1440	7.5mm	.2953	21/32”	.6562
1/32”	.0312	26	.1470	19/64”	.2969	17.0mm	.6693
67	.0320	25	.1495	N	.3020	43/64”	.6719
66	.0330	24	.1520	5/16”	.3125	11/16”	.6875
65	.0350	23	.1540	8.0mm	.3150	17.5mm	.6890
64	.0360	5/32”	.1562	O	.3160	45/64”	.7031
63	.0370	22	.1570	P	.3230	18.0mm	.7067
62	.0380	4.0mm	.1575	21/64”	.3281	23/32”	.7188
61	.0390	21	.1590	Q	.3320	18.5mm	.7283
1.0mm	.0394	20	.1510	8.5mm	.3346	47/64”	.7344
60	.0400	19	.1660	R	.3390	19.0mm	.7480
59	.0410	18	.1695	11/32”	.3438	3/4”	.7500
58	.0420	11/64”	.1719	S	.3480	49/64”	.7656
57	.0430	17	.1730	9.0mm	.3543	19.5mm	.7677
56	.0465	16	.1770	T	.3580	25/32”	.7812
3/64”	.0469	4.5mm	.1772	23/64”	.3594	20.0mm	.7874
55	.0520	15	.1800	U	.3680	51/64”	.7969
54	.0560	14	.1820	9.5mm	.3740	20.5mm	.8071
1.5mm	.0591	13	.1850	3/8”	.3750	13/16”	.8125
53	.0595	3/16”	.1875	V	.3770	21.0mm	.8268
1/16”	.0625	12	.1890	W	.3860	53/64”	.8281
52	.0635	11	.1910	25/64”	.3906	27/32”	.8438
51	.0670	10	.1935	10.0mm	.3937	21.5mm	.8465
50	.0700	9	.1960	X	.3970	55/64”	.8594
49	.0730	5.0mm	.1969	Y	.4040	22.0mm	.8661
48	.0760	8	.1990	13/32”	.4062	7/8”	.8750
5/64”	.0781	7	.2010	Z	.4130	22.5mm	.8858
47	.0785	13/64”	.2031	10.5mm	.4134	57/64”	.8906
2.0mm	.0787	6	.2040	27/64”	.4219	23.0mm	.9055
46	.0810	5	.2055	11.0mm	.4331	29/32”	.9062
45	.0820	4	.2090	7/16”	.4375	59/64”	.9219
44	.0860	3	.2130	11.5mm	.4528	23.5mm	.9252
43	.0890	5.5mm	.2165	29/64”	.4531	15/16”	.9375
42	.0935	7/32”	.2188	15/32”	.4688	24.0mm	.9449
3/32”	.0938	2	.2210	12.0mm	.4724	61/64”	.9531
41	.0960	1	.2280	31/64”	.4844	24.5mm	.9646
40	.0980	A	.2340	12.5mm	.4921	31/32”	.9688
2.5mm	.0984	15/64”	.2344	1/2”	.5000	25.0mm	.9843
39	.0995	6.0mm	.2362	13.0mm	.5118	63/64”	.9844
38	.1015	B	.2380	33/64”	.5156	1”	1.000
37	.1040	C	.2420				

TECHNICAL HELP
Taps



Technical Tips / Taps

Spiral point taps

Spiral point taps have straight, shallow flutes and are often referred to as "gun" taps. The gun nose or spiral point is designed to drive the chips forward. The relatively shallow flutes ensure that the sectional strength is maximized. They also act to allow lubricant to reach the cutting edges. This type of tap is recommended for threading through holes and may be used in blind hole applications where there is sufficient space to accommodate the chips.

General hints on Tapping

1. Select the correct design of tap for the component material and type of hole, i.e. through or blind.

2. Ensure the component is securely clamped, lateral movement may cause tap breakage or poor quality threads.

3. Size matters. For optimal performance it is important to use the right size drill before tapping.
   Please call 800-645-3957 to order a free Champion decimal equivalency card (DC-1) card.

4. Select the correct cutting speed.

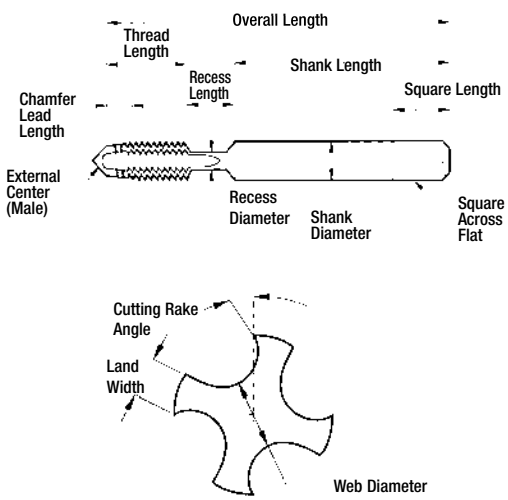
5. Use appropriate cutting fluid for correct application.

6. In CNC applications ensure that the pitch value chosen for the program is correct. When using a tapping attachment, 95% to 97% of the pitch is recommended to allow the tap to generate its own pitch.

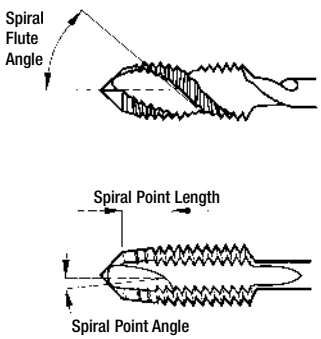
7. Where possible hold the tap in a good quality torque limiting tapping attachment, which ensures free axial movement of the tap and presents it squarely to the hole. It also protects the tap from breakage if accidentally “bottomed” in a blind hole.

8. Ensure smooth entry of the tap into the hole, as an uneven feed may cause “bell mouthing”.

Tap Nomenclature

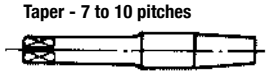


Spiral Tap Nomenclature



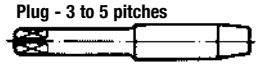
Tap Chamfers

Taper - 7 to 10 pitches



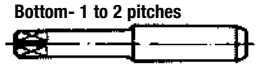
The taper chamfer has the longest standard chamfer ensuring easier starting. It requires less tapping torque because of more working teeth.

Plug - 3 to 5 pitches



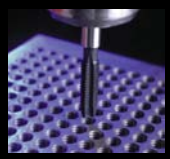
The most common chamfer for use by hand or machine in through or blind holes. This chamfer is more efficient than a bottoming chamfer

Bottom- 1 to 2 pitches



For threading close to the bottom of blind holes, the bottoming chamfer is the least efficient chamfer available.

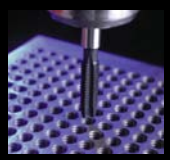
TECHNICAL HELP
Taps



Trouble Shooting / Taps

TROUBLE	PROBABLE CAUSES	REMEDY
Breakage	Hole too small	Use correct drill size Consult Tap Drill Chart
	Tap Hitting Bottom	Correct adjustment Exercise more care Use positive reverse Drill hole deeper
	Misalignment	Make correction
	Tapping too deep	Use spiral point or serial taps
	Dull tap	Sharpen tap
	Cramped condition	Check tap holder and alignment
Chipping	Inadequate lubrication	Consult lubrication chart if lubrication engineer
	Hitting bottom of hole or chips packed in bottom of hole	Check reversing stop Drill hole deeper
	Hard spots in work	Check hole for work hardening
	Loading	Check lubrication / Use surface treated taps
Torn or Rough Threads	Incorrect hook, relief, or chamfer	Grind correctly
	Inadequate lubrication	Increase flow - see that it is getting into the hole
	Dull tap	Resharpen tap
	Loading	Use surface treated taps / check lubrication
Tapping Oversize or Bell-Mouth Holes	Loose spindle or worn holders	Repair machine, tap holders or work holders
	Misalignment	Correct condition
	Excessive thrust	Adjust pressure if air driven / use more care if manual
	Loading	Use surface treated taps
Excessive Wear	Inadequate lubrication	Check lubrication engineer
	Sand in cored holes	Clean hole before tapping
	Abrasive material	If Bakelite, etc : use oversize tap with surface treatment

TECHNICAL HELP
Taps



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	70	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

Metric 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”

TECHNICAL HELP
Carbide Burs
Carbide Tipped Hole Cutters

Carbide Bur Application & Speed Recommendations

SOLID CARBIDE BUR APPLICATION INFORMATION

Material Check List	Suitability: Double Cut	Suitability: Non Ferrous
Aluminum		YES
Brass	YES	YES
Bronze	YES	
Cast Iron	YES	
Copper		YES
Carbon Fiber		YES
Fiberglass	YES	
Inconel	YES	
Magnesium		YES
Plastics	YES	
Hard Rubber	YES	
Steel - 45-55Rc	YES	
Steel - 55-60Rc	YES	
Steel - Carbon	YES	
Steel - Nickel Chrome	YES	
Steel - Stainless	YES	
Steel - Weldments	YES	
Titanium	YES	
Zinc		YES

SOLID CARBIDE BUR SPEED RECOMMENDATIONS

Bur Diameter	Recommended Cutting Speed (RPM)	Maximum Cutting Speed (RPM)
1/16	60,000 - 90,000	100,000
1/8	40,000 - 70,000	90,000
3/16	35,000 - 60,000	80,000
1/4	30,000 - 50,000	70,000
5/16	20,000 - 40,000	68,000
3/8	20,000 - 40,000	66,000
7/16	15,000 - 40,000	58,000
1/2	15,000 - 40,000	50,000
5/8	12,000 - 25,000	40,000
3/4	10,000 - 20,000	33,000
1	7,500 - 20,000	25,000
1-1/8	7,000 - 13,000	20,000
1-1/2	5,000 - 10,000	17,000
1-3/4	4,500 - 9,000	14,000
2	4,000 - 8,000	12,500

General Information on Bur Use

1. Do not use carbide burs in a portable drill motors. Portable Drill motors run at much lower speeds.
2. It may be recommended to adjust the bur speed as shown under maximum recommended operating speeds for optimum performance.

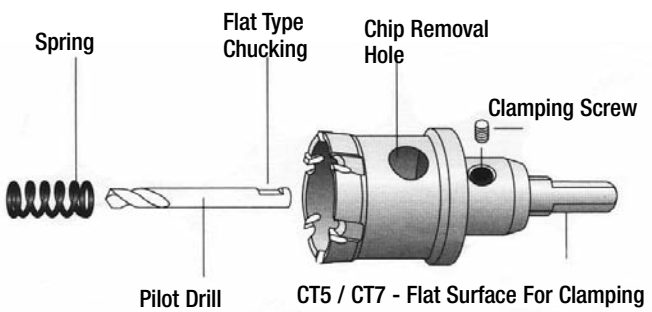
   Use slower speeds for harder materials.
   Use higher speeds when using small burs.
   Use slower speeds when using long series burs.

3. Running burs below recommended speeds may cause chipping.
4. Do not use worn out tools and collets as they will also cause chipping.
5. Running burs too fast will cause teeth to wear prematurely.
6. Apply constant pressure and movements when in use.

Carbide Tipped Hole Cutters - CT3 / CT5 / CT7

SPEED RECOMMENDATIONS

Diameter	Steel	Stainless Steel
9/16 to 13/16	700 - 1000	300 - 700
7/8 to 1-3/16	500 - 800	200 - 450
1-1/4 to 1-9/16	300 - 600	175 - 315
1-5/8 to 2	200 - 500	120 - 225
2-1/16 to 2-3/8	200 - 400	95 - 195
2-7/16 to 3	150 - 300	80 - 150
3-1/16 to 6	100 - 200	60 - 120



CT5 / CT7 - Flat Surface For Clamping
CT3 - Hex Shank to 1/4”

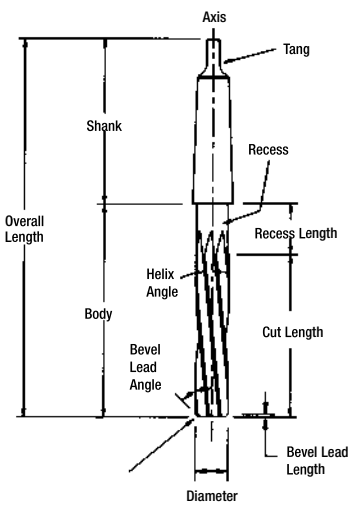
TECHNICAL HELP
Reamers / End Mills

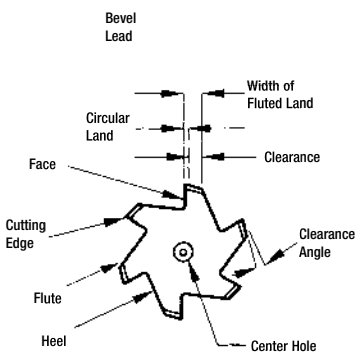
Technical Tips / Reamers

General Hints on Reaming

To obtain the best results when using reamers it is essential to make them “work”. It is a common fault to prepare holes for reaming with too little stock left in. If insufficient stock is left in the hole before reaming then the reamer will rub, quickly show wear and will result in loss of diameter. It is equally important for performance not to leave too much stock in the hole.

1. Select the optimum type of reamer and the optimum speeds and feeds for the application. Ensure that pre-drilled holes are the correct diameter.
2. The workpiece must be held rigid and the machine spindle should have no play.
3. The chuck in which a straight shank reamer is held must be good quality. If the reamer slips in the chuck and the feed is automatic, breakage of the reamer may occur.
4. Keep tool overhang from machine spindle to a minimum.
5. Use recommended lubricants to enhance the life of the reamer and ensure the fluid reaches the cutting edges.
6. Do not allow the flutes of a reamer to become blocked with chips.
7. Keep reamers sharp. Frequent regrinding is good economy, but it is important to understand that reamers cut only on the bevel and taper leads and not on the lands. Consequently only these leads need regrinding. Accuracy of regrinding is important to hole quality and tool life.





Technical Tips / End Mills

General Hints on Milling

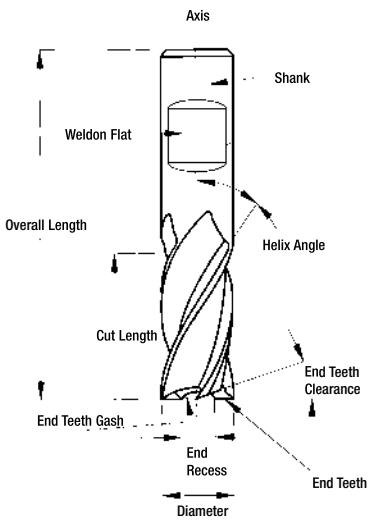
A liberal supply of cutting liquid (emulsion) should be used.

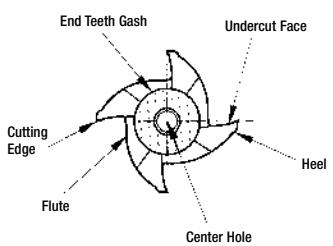
Adaptation to the machine tool

Conventional milling machines usually have a limited number of selectable speed and feed rates.

The recommendations made must therefore be adapted to the values applicable to the machine being used. Adaptation should be done so that the recommended rate of feed per tooth is changed as little as possible.

It is particularly important that the rate of feed per tooth does not increase for diameters < 3/8”.





TECHNICAL HELP
RotoBrute Annular Cutters


Annular Cutter Material and Speed Recommendations

Use the following table when using annular cutters in fixed machine tools.

Type of Material		Brinell Hardness	Cutting Speed (sfm)
Aluminum	Wrought & Cast	*30-150	500-1000
	Die Cast 360.0, 380.0	*40-125	450-600
	383.0, 413.0	*40-125	450-600
	390.0, 392.0	*40-125	75-100
Brass & Bronze		-	300-600
Cast Iron	Soft	120-150	75-125
	Medium	160-220	50-100
	Chilled	230-300	30-50
Malleable Iron	Ferretic	110-160	100-130
	Pearlitic	160-220	75-100
	Temperature Martensite	200-320	30-60
Magnesium		*50-90	8
Nickel Alloys	200-230	80-170	60-80
	Monel 400-404	115-240	35-50
	Monel K500, 502	150-330	20-40
Steel	Resulphurized/Leaded Free Machining	-	105-130
Carbon Steel	10xx, 12xx, xx10, xx20	125-160	90-110
Steel Alloys Soft		170-210	65-90
Steel Alloys Medium		220-250	55-75
Steel Alloys Hard		260-300	35-50
		325-400	30-40
Tool Steel		210-250	35-60
Forgings		-	40-50
Armor Plate		200-250	40-55
		250-300	30-45
Stainless Steel Ferritic	430/405	135-185	90-125
	430F		
Stainless Steel Austenitic	Lower BHN	135-185	55-75
	Higher BHN	225-275	40-70
Stainless Steel Nitonic (Low Alloy)		275-325	25-35
Stainless Steel Matensitic	By Hardness Range	135-185	70-125
	501	185-240	45-110
	416/440F	275-325	35-55
		375-425	30-55
Stainless Steel Precipitation Hardening	By Hardness Range	150-200	45-55
	17-4 PH	275-325	40-50
		325-375	35-45

Cutter Dia. Inches	Surface Feet per Minute									
	10	20	30	40	50	60	70	80	90	100
	Revolutions per minute (RPM)									
.7500	51	102	153	204	255	306	357	407	458	509
.8750	44	87	131	175	218	262	306	349	393	437
1.0000	38	76	115	153	191	229	267	306	344	382
1.1250	34	68	102	136	170	204	238	272	306	340
1.2500	31	61	92	122	153	183	214	244	275	306
1.3750	28	56	83	111	139	167	194	222	250	278
1.5000	25	51	76	102	127	153	178	204	229	255
1.6250	24	47	71	94	118	141	165	188	212	235
1.7500	22	44	65	87	109	131	153	175	196	218
1.8750	20	41	61	81	102	122	143	163	183	204
2.0000	19	38	57	76	95	115	134	153	172	191
2.1250	18	36	54	72	90	108	126	144	162	180
2.2500	17	34	51	68	85	102	119	136	153	170
2.3750	16	32	48	64	80	96	113	129	145	161
2.5000	15	31	46	61	76	92	107	122	138	153
2.6250	15	29	44	58	73	87	102	116	131	146
2.7500	14	28	42	56	69	83	97	111	125	139
2.8750	13	27	40	53	66	80	93	106	120	133
3.0000	13	25	38	51	64	76	89	102	115	127
3.1250	12	24	37	49	61	73	86	98	110	122
3.2500	12	24	35	47	59	71	82	94	106	118
3.3750	11	23	34	45	57	68	79	91	102	113
3.5000	11	22	33	44	55	64	76	87	98	109
3.6250	11	21	32	42	53	63	74	84	95	105
3.7500	10	20	31	41	51	61	71	81	92	102
3.8750	10	20	30	39	49	59	69	79	89	99
4.0000	10	19	29	38	48	57	67	76	86	95

Arbor Preparation

When using a drill press, ensure that a support system is in place for the arbor and that it is not worn out.

Surface Preparation

The material must be at least 3/8" thick. The machine's magnetic base must be clear of chips and debris and must be securely attached to a clean workpiece.

The magnet will be prevented from obtaining optimal holding power if it is used on an uneven surface or there is a large debris buildup. This may cause the drill to shift or lift during operation.

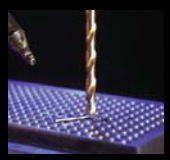
Pipe / Convex Surface Drilling

Champion magnetic drill presses can be used to drill such surfaces, but you need a support system. Champion stocks the RB-Saddle for such circumstances.

Machine Maintenance

For the best performance, always maintain your drill as instructed in your Champion machine operator's manual. Champion magnetic drill presses feature a slide/gibway system that requires periodic adjustments to maintain rigidity and optimal performance. Worn or damaged parts should be replaced to reduce the possibility of injury. Champion stocks a full range of replacement parts.

TECHNICAL HELP
BruteLube



BruteLube Material Data Sheet

IDENTIFICATION
Product Name: BruteLube
Chemical Family: Hydrocarbon Mixture CAS#: Not Applicable to this mixture
Manufacturer: Champion Cutting Tool Corp, 10 Madison Avenue, Rockville Centre, NY 11570 Tel: (516) 536-8200
Emergency Phone Number: (800) 424-9300 CHEMTREC (Transportation Emergencies)

COMPOSITIONAL INFORMATION
Ingredients Exposure Limit
Severely Hydrotreated Naphthenic Distillate. ..... 5 mg/cubic meter (OSHA PEL 8 hour work day)
Paraflinic Distillate ..... 5 mg/cubic meter (OSHA PEL 8 hour work day)
10 mg/cubic meter (ACGIH TLV/STEL)
Chlorinated Paraffin* ..... Not established
Chlorinated Fatty Acid* ..... Not established
*contains corrosion and stain inhibitor

PHYSICAL DATA
Flash Point (PM CC) .....Over 300 degrees Fahrenheit
Density (20 degrees C.) ..... 7.7 pounds per gallon
Vapor Pressure (60 degrees F.) ..... Less than Ether

ROUTE(S) OF EXPOSURE AND EFFECTS
Eye Contact: Contact with the eye may cause moderate irritation.
Skin Contact: Prolonged or repeated exposure may cause defatting of the skin resulting in moderate irritation.
Inhalation: Excessive exposures at elevated temperatures may cause irritation to eyes, nose, mucous membranes and the respiratory system. Excessive exposures may also cause dizziness and other central nervous system effects.
Ingestion: This product has a low order of acute toxicity. Pulmonary aspiration hazard if swallowed and vomiting occurs.

REACTIVITY
Reaction with water ..... Non-reactive
Hazardous Polymerization ..... Non-reactive
Stability ..... Stable
Incompatible Materials ..... Strong oxidizing and reducing agents.
Hazardous Decomposition Products ..... Carbon dioxide, carbon monoxide, hydrogen chloride and oxides of sulfur.

PROTECTION INFORMATION
Respiratory: Use with adequate ventilation. Ventilate as needed to comply with exposure limit. In event of vapor concentrations exceeding the time weighted exposure limit use a NIOSH approved cartridge respirator or gas mask.
Skin: Impervious gloves are optional.
Eyes: Splash proof chemical goggles or face shield is optional.

SPILL OR LEAK PROCEDURES
Prevent ignition, stop leak, ventilate area, contain spill by diking or impounding. Add sand, earth, or other suitable absorbent to spill area. Keep product out of sewers and waterways. Wear respiratory protection for large spill, leak or release. Dispose of according to local, state and federal regulations.

FIRST AID PROCEDURES
Eye Contact: Flush with water for 15 minutes. Obtain medical assistance if irritation persists.
Skin Contact: Wash with soap and water until no odor remains.
Inhalation: Move person to fresh air. If not breathing, give artificial respiration and obtain medical assistance.
Ingestion: Do not induce vomiting. Do not give liquids. Obtain medical assistance. Small amounts entering the mouth should be rinsed out until no taste remains.

FIRE FIGHTING PROCEDURES & EXTINGUISHING MEDIA
Use foam, water spray (fog), dry chemical carbon dioxide or vaporizing liquid for this type of product depending on size or potential size of fire and circumstances related to the situation. Plan fire protection and response strategy through consultation with local fire protection authorities or appropriate specialists. Wear self contained breathing apparatus to protect against decomposition products.

NOTE: CONTENTS OF BRUTELUBE ARE NOT LISTED AS A CARCINOGEN BY NTP OR IARC. CONTENTS ARE NOT OSHA REGULATED.

TECHNICAL HELP
BruteLube Wax

BruteLube Wax Material Data Sheet

I. PRODUCT AND MANUFACTURER INFORMATION

Product name	BruteLube Multi-Purpose Cutting Wax
Chemical name	
Synonyms	
CAS number	NE
Manufacturer	Champion Cutting Tool Corp. 10 Madison Avenue, Rockville Centre, NY 11570
Emergency phone number	516-536-8200
Date of last revision	7/9/03

II. HAZARDOUS INGREDIENTS

HAZARDOUS COMPONENT	CAS NUMBER	% OPTIONAL	OSHA PEL	ACGIH TLV	CHEMICAL AND/OR COMMON NAME(S)
MINERAL OIL	(CAS 64742-52-5)		350 PPM	350 PPM	

III. PHYSICAL AND CHEMICAL CHARACTERISTICS

Boiling point @ 760mm Hg	>700 F
Vapor pressure at 20°C	<1
Vapor density (air = 1)	ND
Solubility in water	NOT SOLUBLE
Appearance and odor	YELLOW OPAQUE SOLID
Specific gravity (H2O = 1.0)	0.85
Melting point	172 F
Evaporation rate (butyl acetate = 1)	<1

IV. FIRE AND EXPLOSION HAZARD DATA

Combustible/Not combustible	NOT COMBUSTIBLE		
Flammable/Not flammable		NOT FLAMMABLE	
Pyrophoric/Not pyrophoric		NOT PYROPHORIC	
Explosive/Not explosive		NOT EXPLOSIVE	
Flash point (test method)		>450 F	
Flammable limits (in Air % by volume)	NA	NA	NA
Extinguishing media	FOAM OR DRY CHEMICAL		
Special fire-fighting procedures or equipment		SAME AS FOR PETROLEUM PRODUCTS	
Unusual fire and explosion hazards		NONE	

V. REACTIVITY DATA

Material is stable/unstable	STABLE
Conditions to avoid	AVOID STRONG ACIDS OR BASES
Incompatibility (materials to avoid)	AVOID STRONG ACIDS OR BASES
Hazardous decomposition or by-products	NONE KNOWN
Hazardous polymerization will/will not occur	WILL NOT OCCUR

VI. HEALTH HAZARD DATA

Threshold limit value	NE
Primary route(s) of entry	
Known Hazards Under 29 CFR 1910.1200	
Mutagenic (genetic defects)	NONE
Reproductive	NONE
Systemic	NONE
Teratogenic (birth defects)	NONE