Carbide Recommended Drilling Data | Metric (mm)

	Material	Hardness (BHN)	Insert Grade	Speed (M/min)	Feed Rate (mm/rev) by Diameter 9.50mm - 12.69mm	12.70mm - 17.64mm	17.65mm - 24.37mm	24.38mm - 35.04mm	35.05mm - 47.80mm
P	**Free-Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	P	145	0.18	0.25	0.33	0.410	0.51
		150 - 200	P	135	0.18	0.25	0.33	0.41	0.51
		200 - 250	P	125	0.15	0.25	0.33	0.41	0.51
	Low-Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	P	130	0.15	0.23	0.30	0.38	0.48
		125 - 175	P	125	0.15	0.23	0.30	0.38	0.48
		175 - 225	P	115	0.13	0.20	0.25	0.36	0.46
		225 - 275	P	110	0.13	0.20	0.25	0.36	0.46
	Medium-Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	P	125	0.15	0.23	0.30	0.38	0.48
		175 - 225	P	115	0.13	0.20	0.25	0.36	0.46
		225 - 275	P	110	0.13	0.20	0.25	0.36	0.46
		275 - 325	P	100	0.10	0.18	0.23	0.30	0.41
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	P	130	0.15	0.23	0.30	0.36	0.43
		175 - 225	P	120	0.13	0.20	0.28	0.36	0.43
		225 - 275	P	110	0.13	0.20	0.28	0.36	0.43
		275 - 325	P	105	0.10	0.18	0.25	0.30	0.38
		325 - 375	P	95	0.08	0.18	0.25	0.30	0.38
	High-Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	P	105	0.10	0.18	0.25	0.33	0.38
		300 - 350	P	100	0.08	0.15	0.23	0.30	0.36
		350 - 400	P	90	0.08	0.15	0.20	0.28	0.33
	Structural Steel A36, A285, A516, etc.	100 - 150	P	120	0.15	0.25	0.30	0.36	0.46
		150 - 250	P	105	0.13	0.23	0.25	0.30	0.41
		250 - 350	P	85	0.10	0.20	0.23	0.25	0.36
	Tool Steel H-13, H-21, A-4, S-3, etc.	150 - 200	P	65	0.10	0.15	0.20	0.25	0.30
		200 - 250	P	55	0.10	0.15	0.20	0.25	0.30
S	**High-Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	M	33	0.05	0.13	0.18	0.20	0.23
		220 - 310	M	26	0.05	0.08	0.13	0.15	0.18
	Titanium Alloy	140 - 220	M	45	0.08	0.10	0.18	0.20	0.23
		220 - 310	M	36	0.08	0.08	0.13	0.15	0.18
	Aerospace Alloy S82	185 - 275	M	45	0.08	0.10	0.18	0.20	0.23
		275 - 350	M	36	0.08	0.08	0.13	0.15	0.18

7xD and 10xD Adjustment Example (0.80 Adjustment)

Data • Adjustment Value	Speed/Feed (7xD)
100 M/min • 0.80	= 80 M/min
0.2 mm/rev • 0.80	= 0.16 mm/rev

12xD and 15xD Adjustment Example (0.70 Adjustment)

Speed • Adjustment Value	Speed/Feed (12xD)
100 M/min • 0.70	= 70 M/min
0.2 mm/rev • 0.70	= 0.14 mm/rev

Coolant Recommendations

Series	STUB, 3xD, 5xD Pressure BAR	STUB, 3xD, 5xD Flow Rate LPM	7xD, 10xD Pressure BAR	7xD, 10xD Flow Rate LPM	12xD, 15xD Pressure BAR	12xD, 15xD Flow Rate LPM
Z	31	15	34	22	45	30
0	24	22	31	34	34	45
1	21	30	27	38	34	45
2	17	38	24	49	31	60
3	14	45	21	53	27	68

⚠ WARNING **Tool failure can cause serious injury. To prevent:**
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IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the coolant recommendation chart for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. For 7xD, 10xD, 12xD, and 15xD holder lengths, see adjustment example above.

Carbide Recommended Drilling Data | Metric (mm)

	Material	Hardness (BHN)	Insert Grade	Speed (M/min)	Feed Rate (mm/rev) by Diameter 9.50mm - 12.69mm	12.70mm - 17.64mm	17.65mm - 24.37mm	24.38mm - 35.04mm	35.05mm - 47.80mm
M	**Stainless Steel 400 Series**	185 - 275	M	85	0.13	0.25	0.28	0.30	0.33
	416, 420, etc.	275 - 350	M	75	0.10	0.23	0.25	0.28	0.30
	Stainless Steel 300 Series	135 - 185	M	85	0.08	0.10	0.13	0.20	0.28
	304, 316, 17-4PH, etc.	185 - 275	M	75	0.05	0.08	0.10	0.18	0.23
	Stainless Steel 300L Series	135 - 185	M	100	0.08	0.10	0.13	0.20	0.28
	304L, 316L etc.	185 - 275	M	85	0.05	0.08	0.10	0.18	0.23
	PH Stainless	275-350	M	85	0.08	0.10	0.13	0.20	0.28
	17-4, 13-8, 15-5	350-425	M	75	0.05	0.08	0.10	0.18	0.23
	Super Duplex Stainless Steel	135 - 185	M	75	0.08	0.10	0.13	0.20	0.28
		185 - 275	M	70	0.05	0.08	0.10	0.18	0.23
H	**Wear Plate**	400	P	20	0.08	0.15	0.20	0.23	0.30
	Hardox, AR400, T-1, etc.	500	P	15	0.05	0.13	0.18	0.20	0.25
		600	N/A	–	–	–	–	–	–
	Hardened Steel	300 - 400	P	30	0.08	0.15	0.20	0.23	0.30
		400 - 500	P	15	0.05	0.13	0.18	0.20	0.25
K	**SG / Nodular Cast Iron**	120 - 150	K	185	0.18	0.30	0.41	0.51	0.61
		150 - 200	K	170	0.15	0.28	0.36	0.46	0.56
		200 - 220	K	150	0.15	0.23	0.30	0.41	0.46
		220 - 260	K	135	0.13	0.18	0.23	0.30	0.36
		260 - 320	K	120	0.10	0.15	0.18	0.23	0.30
N	**Cast Aluminum**	30	N	335	0.20	0.33	0.41	0.51	0.56
		180	N	185	0.20	0.33	0.41	0.46	0.56
	Wrought Aluminum	30	N	335	0.23	0.33	0.43	0.51	0.61
		180	N	185	0.13	0.18	0.25	0.33	0.41
	Aluminum Bronze	100 - 200	N	150	0.15	0.28	0.36	0.46	0.56
		200 - 250	N	90	0.13	0.18	0.23	0.30	0.36
	Brass	100	N	200	0.18	0.30	0.41	0.51	0.61
	Copper	60	N	50	0.05	0.08	0.15	0.20	0.25

7xD and 10xD Adjustment Example (0.80 Adjustment)

Data • Adjustment Value	Speed/Feed (7xD)
100 M/min • 0.80	= 80 M/min
0.2 mm/rev • 0.80	= 0.16 mm/rev

12xD and 15xD Adjustment Example (0.70 Adjustment)

Speed • Adjustment Value	Speed/Feed (12xD)
100 M/min • 0.70	= 70 M/min
0.2 mm/rev • 0.70	= 0.14 mm/rev

Coolant Recommendations

Series	STUB, 3xD, 5xD Pressure BAR	STUB, 3xD, 5xD Flow Rate LPM	7xD, 10xD Pressure BAR	7xD, 10xD Flow Rate LPM	12xD, 15xD Pressure BAR	12xD, 15xD Flow Rate LPM
Z	31	15	34	22	45	30
0	24	22	31	34	34	45
1	21	30	27	38	34	45
2	17	38	24	49	31	60
3	14	45	21	53	27	68

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High-Speed Steel Recommended Drilling Data | Metric (mm)

	Material	Hardness (BHN)	Insert Grade	Speed (M/min)	Feed Rate (mm/rev) by Diameter 9.50mm - 12.69mm	12.70mm - 17.64mm	17.65mm - 24.37mm	24.38mm - 35.04mm	35.05mm - 47.80mm
P	**Free-Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	X	105	0.18	0.25	0.33	0.41	0.51
		150 - 200	X	100	0.18	0.25	0.33	0.41	0.51
		200 - 250	X	90	0.15	0.25	0.33	0.41	0.51
	Low-Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	X	95	0.15	0.23	0.30	0.38	0.48
		125 - 175	X	90	0.15	0.23	0.30	0.38	0.48
		175 - 225	X	85	0.13	0.20	0.25	0.36	0.46
		225 - 275	X	80	0.13	0.20	0.25	0.36	0.46
	Medium-Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	X	90	0.15	0.23	0.30	0.38	0.48
		175 - 225	X	85	0.13	0.20	0.25	0.36	0.46
		225 - 275	X	80	0.13	0.20	0.25	0.36	0.46
		275 - 325	X	70	0.10	0.18	0.23	0.30	0.41
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	X	75	0.15	0.23	0.30	0.36	0.43
		175 - 225	X	70	0.13	0.20	0.28	0.36	0.43
		225 - 275	X	65	0.13	0.20	0.28	0.36	0.43
		275 - 325	X	60	0.10	0.18	0.25	0.30	0.38
		325 - 375	X	60	0.08	0.18	0.25	0.30	0.38
	High-Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	X	40	0.10	0.18	0.25	0.33	0.38
		300 - 350	X	35	0.08	0.15	0.23	0.30	0.36
		350 - 400	X	25	0.08	0.15	0.20	0.28	0.33
	Structural Steel A36, A285, A516, etc.	100 - 150	X	75	0.15	0.25	0.30	0.36	0.46
		150 - 250	X	65	0.13	0.23	0.25	0.30	0.41
		250 - 350	X	55	0.10	0.20	0.23	0.25	0.36
	Tool Steel H-13, H-21, A-4, S-3, etc.	150 - 200	X	45	0.10	0.15	0.20	0.25	0.30
		200 - 250	X	35	0.10	0.15	0.20	0.25	0.30
S	**High-Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	X	15	0.08	0.18	0.20	0.25	0.30
		220 - 310	X	10	0.08	0.15	0.18	0.20	0.25
	Titanium Alloy	140 - 220	X	20	0.08	0.18	0.20	0.25	0.30
		220 - 310	X	15	0.08	0.15	0.18	0.20	0.25
	Aerospace Alloy S82	185 - 275	X	40	0.13	0.20	0.23	0.25	0.36
		275 - 350	X	35	0.10	0.18	0.20	0.20	0.30

7xD and 10xD Adjustment Example (0.80 Adjustment)

Data • Adjustment Value	Speed/Feed (7xD)
100 M/min • 0.80	= 80 M/min
0.2 mm/rev • 0.80	= 0.16 mm/rev

12xD and 15xD Adjustment Example (0.70 Adjustment)

Speed • Adjustment Value	Speed/Feed (12xD)
100 M/min • 0.70	= 70 M/min
0.2 mm/rev • 0.70	= 0.14 mm/rev

Coolant Recommendations

Series	STUB, 3xD, 5xD Pressure BAR	STUB, 3xD, 5xD Flow Rate LPM	7xD, 10xD Pressure BAR	7xD, 10xD Flow Rate LPM	12xD, 15xD Pressure BAR	12xD, 15xD Flow Rate LPM
Z	31	15	34	22	45	30
0	24	22	31	34	34	45
1	21	30	27	38	34	45
2	17	38	24	49	31	60
3	14	45	21	53	27	68

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High-Speed Steel Recommended Drilling Data | Metric (mm)

	Material	Hardness (BHN)	Insert Grade	Speed (M/min)	Feed Rate (mm/rev) by Diameter 9.50mm - 12.69mm	12.70mm - 17.64mm	17.65mm - 24.37mm	24.38mm - 35.04mm	35.05mm - 47.80mm
M	**Stainless Steel 400 Series**	185 - 275	X	40	0.13	0.25	0.28	0.30	0.33
	416, 420, etc.	275 - 350	X	35	0.10	0.23	0.25	0.28	0.30
	Stainless Steel 300 Series	135 - 185	X	40	0.13	0.18	0.20	0.23	0.30
	304, 316, 17-4PH, etc.	185 - 275	X	35	0.10	0.15	0.18	0.20	0.28
	PH Stainless	275-350	X	30	0.08	0.10	0.15	0.20	0.25
	17-4, 13-8, 15-5	350-425	X	25	0.08	0.10	0.15	0.20	0.25
	Super Duplex Stainless Steel	135 - 185	X	40	0.13	0.13	0.15	0.15	0.18
		185 - 275	X	35	0.10	0.13	0.13	0.15	0.15
H	**Wear Plate**	400	X	20	0.08	0.15	0.20	0.23	0.30
	Hardox, AR400, T-1, etc.	500	X	15	0.05	0.13	0.18	0.20	0.25
		600	X	–	–	–	–	–	–
	Hardened Steel	300 - 400	X	30	0.08	0.15	0.20	0.23	0.30
		400 - 500	X	15	0.05	0.13	0.18	0.20	0.25
K	**SG / Nodular Cast Iron**	120 - 150	X	90	0.18	0.30	0.41	0.51	0.61
		150 - 200	X	85	0.15	0.28	0.36	0.46	0.56
		200 - 220	X	75	0.15	0.23	0.30	0.41	0.46
		220 - 260	X	65	0.13	0.18	0.23	0.30	0.36
		260 - 320	X	55	0.10	0.15	0.18	0.23	0.30
N	**Cast Aluminum**	30	X	185	0.20	0.33	0.41	0.51	0.56
		180	X	90	0.20	0.33	0.41	0.46	0.56
	Wrought Aluminum	30	X	275	0.23	0.33	0.43	0.51	0.61
		180	X	185	0.13	0.18	0.25	0.33	0.41
	Aluminum Bronze	100 - 200	X	90	0.15	0.28	0.36	0.46	0.56
		200 - 250	X	75	0.13	0.18	0.23	0.30	0.36
	Brass	100	X	150	0.18	0.30	0.41	0.51	0.61
	Copper	60	X	100	0.05	0.08	0.15	0.20	0.25

7xD and 10xD Adjustment Example (0.80 Adjustment)

Data • Adjustment Value	Speed/Feed (7xD)
100 M/min • 0.80	= 80 M/min
0.2 mm/rev • 0.80	= 0.16 mm/rev

12xD and 15xD Adjustment Example (0.70 Adjustment)

Speed • Adjustment Value	Speed/Feed (12xD)
100 M/min • 0.70	= 70 M/min
0.2 mm/rev • 0.70	= 0.14 mm/rev

Coolant Recommendations

Series	STUB, 3xD, 5xD Pressure BAR	STUB, 3xD, 5xD Flow Rate LPM	7xD, 10xD Pressure BAR	7xD, 10xD Flow Rate LPM	12xD, 15xD Pressure BAR	12xD, 15xD Flow Rate LPM
Z	31	15	34	22	45	30
0	24	22	31	34	34	45
1	21	30	27	38	34	45
2	17	38	24	49	31	60
3	14	45	21	53	27	68

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Carbide Recommended Drilling Data | Imperial (inch)

	Material	Hardness (BHN)	Insert Grade	Speed (SFM)	Feed Rate (IPR) by Diameter 3/8" - 33/64"	1/2" - 11/16"	45/64" - 15/16"	31/32" - 1-3/8"	1-13/32" - 1-7/8"
P	**Free-Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	P	475	0.007	0.010	0.013	0.016	0.020
		150 - 200	P	440	0.007	0.010	0.013	0.016	0.020
		200 - 250	P	410	0.006	0.010	0.013	0.016	0.020
	Low-Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	P	425	0.006	0.009	0.012	0.015	0.019
		125 - 175	P	410	0.006	0.009	0.012	0.015	0.019
		175 - 225	P	385	0.005	0.008	0.010	0.014	0.018
		225 - 275	P	355	0.005	0.008	0.010	0.014	0.018
	Medium-Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	P	410	0.006	0.009	0.012	0.015	0.019
		175 - 225	P	385	0.005	0.008	0.010	0.014	0.018
		225 - 275	P	355	0.005	0.008	0.010	0.014	0.018
		275 - 325	P	330	0.004	0.007	0.009	0.012	0.016
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	P	420	0.006	0.009	0.012	0.014	0.017
		175 - 225	P	390	0.005	0.008	0.011	0.014	0.017
		225 - 275	P	360	0.005	0.008	0.011	0.014	0.017
		275 - 325	P	340	0.004	0.007	0.010	0.012	0.015
		325 - 375	P	310	0.003	0.007	0.010	0.012	0.015
	High-Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	P	350	0.004	0.007	0.010	0.013	0.015
		300 - 350	P	325	0.003	0.006	0.009	0.012	0.014
		350 - 400	P	300	0.003	0.006	0.008	0.011	0.013
	Structural Steel A36, A285, A516, etc.	100 - 150	P	400	0.006	0.010	0.012	0.014	0.018
		150 - 250	P	340	0.005	0.009	0.010	0.012	0.016
		250 - 350	P	280	0.004	0.008	0.009	0.010	0.014
	Tool Steel H-13, H-21, A-4, S-3, etc.	150 - 200	P	220	0.004	0.006	0.008	0.010	0.012
		200 - 250	P	180	0.004	0.006	0.008	0.010	0.012
S	**High-Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	M	110	0.002	0.005	0.007	0.008	0.009
		220 - 310	M	85	0.002	0.003	0.005	0.006	0.007
	Titanium Alloy	140 - 220	M	150	0.003	0.004	0.007	0.008	0.009
		220 - 310	M	120	0.003	0.003	0.005	0.006	0.007
	Aerospace Alloy S82	185 - 275	M	150	0.003	0.004	0.007	0.008	0.009
		275 - 350	M	120	0.003	0.003	0.005	0.006	0.007

7xD and 10xD Adjustment Example (0.80 Adjustment)

Data • Adjustment Value	Speed/Feed (7xD)
200 SFM • 0.80	= 160 SFM
0.008 IPR • 0.80	= 0.0064 IPR

12xD and 15xD Adjustment Example (0.70 Adjustment)

Speed • Adjustment Value	Speed/Feed (12xD)
200 SFM • 0.70	= 140 SFM
0.008 IPR • 0.70	= 0.0056 IPR

Coolant Recommendations

Series	STUB, 3xD, 5xD Pressure PSI	STUB, 3xD, 5xD Flow Rate GPM	7xD, 10xD Pressure PSI	7xD, 10xD Flow Rate GPM	12xD, 15xD Pressure PSI	12xD, 15xD Flow Rate GPM
Z	450	4	550	6	650	8
0	350	6	450	9	550	12
1	300	8	400	10	500	12
2	250	10	350	13	450	16
3	200	12	300	14	400	18

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Carbide Recommended Drilling Data | Imperial (inch)

	Material	Hardness (BHN)	Insert Grade	Speed (SFM)	Feed Rate (IPR) by Diameter 3/8" - 33/64"	1/2" - 11/16"	45/64" - 15/16"	31/32" - 1-3/8"	1-13/32" - 1-7/8"
M	**Stainless Steel 400 Series**	185 - 275	M	280	0.005	0.010	0.011	0.012	0.013
	416, 420, etc.	275 - 350	M	230	0.004	0.009	0.010	0.011	0.012
	Stainless Steel 300 Series	135 - 185	M	280	0.003	0.004	0.005	0.008	0.011
	304, 316, 17-4PH, etc.	185 - 275	M	250	0.002	0.003	0.004	0.007	0.009
	Stainless Steel 300L Series	135 - 185	M	325	0.003	0.004	0.005	0.008	0.011
	304L, 316L, etc.	185 - 275	M	280	0.002	0.003	0.004	0.007	0.009
	PH Stainless	275-350	M	280	0.003	0.004	0.005	0.008	0.011
	17-4, 13-8, 15-5	350-425	M	250	0.002	0.003	0.004	0.007	0.009
	Super Duplex Stainless Steel	135 - 185	M	250	0.003	0.004	0.005	0.008	0.011
		185 - 275	M	230	0.002	0.003	0.004	0.007	0.009
H	**Wear Plate**	400	P	70	0.003	0.006	0.008	0.009	0.012
	Hardox, AR400, T-1, etc.	500	P	45	0.002	0.005	0.007	0.008	0.010
		600	N/A	–	–	–	–	–	–
	Hardened Steel	300 - 400	P	95	0.003	0.006	0.008	0.009	0.012
		400 - 500	P	45	0.002	0.005	0.007	0.008	0.010
K	**SG / Nodular Cast Iron**	120 - 150	K	600	0.007	0.012	0.016	0.020	0.024
		150 - 200	K	550	0.006	0.011	0.014	0.018	0.022
		200 - 220	K	500	0.006	0.009	0.012	0.016	0.018
		220 - 260	K	450	0.005	0.007	0.009	0.012	0.014
		260 - 320	K	400	0.004	0.006	0.007	0.009	0.012
N	**Cast Aluminum**	30	N	1100	0.008	0.013	0.016	0.020	0.022
		180	N	600	0.008	0.013	0.016	0.018	0.022
	Wrought Aluminum	30	N	1100	0.009	0.013	0.017	0.020	0.024
		180	N	600	0.005	0.007	0.010	0.013	0.016
	Aluminum Bronze	100 - 200	N	500	0.006	0.011	0.014	0.018	0.022
		200 - 250	N	300	0.005	0.007	0.009	0.012	0.014
	Brass	100	N	650	0.007	0.012	0.016	0.020	0.024
	Copper	60	N	430	0.002	0.003	0.006	0.008	0.010

7xD and 10xD Adjustment Example (0.80 Adjustment)

Data • Adjustment Value	Speed/Feed (7xD)
200 SFM • 0.80	= 160 SFM
0.008 IPR • 0.80	= 0.0064 IPR

12xD and 15xD Adjustment Example (0.70 Adjustment)

Speed • Adjustment Value	Speed/Feed (12xD)
200 SFM • 0.70	= 140 SFM
0.008 IPR • 0.70	= 0.0056 IPR

Coolant Recommendations

Series	STUB, 3xD, 5xD Pressure PSI	STUB, 3xD, 5xD Flow Rate GPM	7xD, 10xD Pressure PSI	7xD, 10xD Flow Rate GPM	12xD, 15xD Pressure PSI	12xD, 15xD Flow Rate GPM
Z	450	4	550	6	650	8
0	350	6	450	9	550	12
1	300	8	400	10	500	12
2	250	10	350	13	450	16
3	200	12	300	14	400	18

⚠ WARNING **Tool failure can cause serious injury. To prevent:**
- When using holders without support bushing, use a short T-A Pro holder to establish an initial hole that is a minimum of 2 diameters deep.
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High-Speed Steel Recommended Drilling Data | Imperial (inch)

	Material	Hardness (BHN)	Insert Grade	Speed (SFM)	Feed Rate (IPR) by Diameter 3/8" - 33/64"	1/2" - 11/16"	45/64" - 15/16"	31/32" - 1-3/8"	1-13/32" - 1-7/8"
P	**Free-Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	X	350	0.007	0.010	0.013	0.016	0.020
		150 - 200	X	325	0.007	0.010	0.013	0.016	0.020
		200 - 250	X	300	0.006	0.010	0.013	0.016	0.020
	Low-Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	X	315	0.006	0.009	0.012	0.015	0.019
		125 - 175	X	300	0.006	0.009	0.012	0.015	0.019
		175 - 225	X	285	0.005	0.008	0.010	0.014	0.018
		225 - 275	X	265	0.005	0.008	0.010	0.014	0.018
	Medium-Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	X	300	0.006	0.009	0.012	0.015	0.019
		175 - 225	X	285	0.005	0.008	0.010	0.014	0.018
		225 - 275	X	265	0.005	0.008	0.010	0.014	0.018
		275 - 325	X	235	0.004	0.007	0.009	0.012	0.016
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	X	250	0.006	0.009	0.012	0.014	0.017
		175 - 225	X	235	0.005	0.008	0.011	0.014	0.017
		225 - 275	X	220	0.005	0.008	0.011	0.014	0.017
		275 - 325	X	205	0.004	0.007	0.010	0.012	0.015
		325 - 375	X	190	0.003	0.007	0.010	0.012	0.015
	High-Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	X	135	0.004	0.007	0.010	0.013	0.015
		300 - 350	X	110	0.003	0.006	0.009	0.012	0.014
		350 - 400	X	90	0.003	0.006	0.008	0.011	0.013
	Structural Steel A36, A285, A516, etc.	100 - 150	X	250	0.006	0.010	0.012	0.014	0.018
		150 - 250	X	210	0.005	0.009	0.010	0.012	0.016
		250 - 350	X	175	0.004	0.008	0.009	0.010	0.014
	Tool Steel H-13, H-21, A-4, S-3, etc.	150 - 200	X	145	0.004	0.006	0.008	0.010	0.012
		200 - 250	X	120	0.004	0.006	0.008	0.010	0.012
S	**High-Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	X	45	0.003	0.007	0.008	0.010	0.012
		220 - 310	X	40	0.003	0.006	0.007	0.008	0.010
	Titanium Alloy	140 - 220	X	60	0.003	0.007	0.008	0.010	0.012
		220 - 310	X	50	0.003	0.006	0.007	0.008	0.010
	Aerospace Alloy S82	185 - 275	X	125	0.005	0.008	0.009	0.010	0.014
		275 - 350	X	110	0.004	0.007	0.008	0.008	0.012

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Data • Adjustment Value	Speed/Feed (7xD)
200 SFM • 0.80	= 160 SFM
0.008 IPR • 0.80	= 0.0064 IPR

12xD and 15xD Adjustment Example (0.70 Adjustment)

Speed • Adjustment Value	Speed/Feed (12xD)
200 SFM • 0.70	= 140 SFM
0.008 IPR • 0.70	= 0.0056 IPR

Coolant Recommendations

Series	STUB, 3xD, 5xD Pressure PSI	STUB, 3xD, 5xD Flow Rate GPM	7xD, 10xD Pressure PSI	7xD, 10xD Flow Rate GPM	12xD, 15xD Pressure PSI	12xD, 15xD Flow Rate GPM
Z	450	4	550	6	650	8
0	350	6	450	9	550	12
1	300	8	400	10	500	12
2	250	10	350	13	450	16
3	200	12	300	14	400	18

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High-Speed Steel Recommended Drilling Data | Imperial (inch)

	Material	Hardness (BHN)	Insert Grade	Speed (SFM)	Feed Rate (IPR) by Diameter 3/8" - 33/64"	1/2" - 11/16"	45/64" - 15/16"	31/32" - 1-3/8"	1-13/32" - 1-7/8"
M	**Stainless Steel 400 Series**	185 - 275	X	125	0.005	0.010	0.011	0.012	0.013
	416, 420, etc.	275 - 350	X	110	0.004	0.009	0.010	0.011	0.012
	Stainless Steel 300 Series	135 - 185	X	125	0.005	0.007	0.008	0.009	0.012
	304, 316, 17-4PH, etc.	185 - 275	X	110	0.004	0.006	0.007	0.008	0.011
	PH Stainless	275-350	X	95	0.003	0.004	0.006	0.008	0.010
	17-4, 13-8, 15-5	350-425	X	75	0.003	0.004	0.006	0.008	0.010
	Super Duplex Stainless Steel	135 - 185	X	125	0.005	0.005	0.006	0.006	0.007
		185 - 275	X	110	0.004	0.005	0.005	0.006	0.006
H	**Wear Plate**	400	X	60	0.003	0.006	0.008	0.009	0.012
	Hardox, AR400, T-1, etc.	500	X	45	0.002	0.005	0.007	0.008	0.010
		600	X	–	–	–	–	–	–
	Hardened Steel	300 - 400	X	75	0.003	0.006	0.008	0.009	0.012
		400 - 500	X	45	0.002	0.005	0.007	0.008	0.010
K	**SG / Nodular Cast Iron**	120 - 150	X	300	0.007	0.012	0.016	0.020	0.024
		150 - 200	X	275	0.006	0.011	0.014	0.018	0.022
		200 - 220	X	240	0.006	0.009	0.012	0.016	0.018
		220 - 260	X	215	0.005	0.007	0.009	0.012	0.014
		260 - 320	X	175	0.004	0.006	0.007	0.009	0.012
N	**Cast Aluminum**	30	X	600	0.008	0.013	0.016	0.020	0.022
		180	X	300	0.008	0.013	0.016	0.018	0.022
	Wrought Aluminum	30	X	900	0.009	0.013	0.017	0.020	0.024
		180	X	600	0.005	0.007	0.010	0.013	0.016
	Aluminum Bronze	100 - 200	X	300	0.006	0.011	0.014	0.018	0.022
		200 - 250	X	250	0.005	0.007	0.009	0.012	0.014
	Brass	100	X	485	0.007	0.012	0.016	0.020	0.024
	Copper	60	X	320	0.002	0.003	0.006	0.008	0.010

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0.008 IPR • 0.80	= 0.0064 IPR

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Speed • Adjustment Value	Speed/Feed (12xD)
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Series	STUB, 3xD, 5xD Pressure PSI	STUB, 3xD, 5xD Flow Rate GPM	7xD, 10xD Pressure PSI	7xD, 10xD Flow Rate GPM	12xD, 15xD Pressure PSI	12xD, 15xD Flow Rate GPM
Z	450	4	550	6	650	8
0	350	6	450	9	550	12
1	300	8	400	10	500	12
2	250	10	350	13	450	16
3	200	12	300	14	400	18

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Tap Drill Information and Formulas | Metric (mm)

Tap Size	Tap Drill Size	Decimal Equivalent (inch)	* Theo % Thread	Probable Mean Oversize	Probable Hole Size	** Probable % Thread
12 X 1.25	27/64	0.4219	79%	0.075mm	10.79mm	74%
	10.8mm	0.4252	74%	0.075mm	10.88mm	69%
14 X 2.0	15/32	0.4688	81%	0.075mm	11.98mm	78%
	12.0mm	0.4724	77%	0.075mm	12.08mm	74%
14 X 1.5	12.5mm	0.4921	77%	0.075mm	12.58mm	73%
16 X 2.0	14.0mm	0.5512	77%	0.075mm	14.08mm	74%
16 X 1.5	14.5mm	0.5709	77%	0.075mm	14.58mm	73%
	37/64	0.5781	68%	0.075mm	14.76mm	64%
18 X 2.5	15.5 mm	0.6102	77%	0.075mm	15.58mm	75%
18 X 1.5	16.5mm	0.6496	77%	0.075mm	16.58mm	73%
	21/32	0.6563	68%	0.075mm	16.75mm	64%
20 X 2.5	11/16	0.6875	78%	0.075mm	17.54mm	76%
	17.5 mm	0.6890	77%	0.075mm	17.58mm	74%
20 X 1.5	18.5mm	0.7283	77%	0.075mm	18.58mm	73%
	47/64	0.7344	69%	0.075mm	18.66mm	65%
22 X 2.5	49/64	0.7656	79%	0.075mm	19.52mm	76%
	19.5 mm	0.7677	77%	0.075mm	19.58mm	75%
22 X 1.5	20.5mm	0.8071	77%	0.075mm	20.58mm	73%
	13/16	0.8125	70%	0.075mm	20.71mm	66%
24 X 3	13/16	0.8125	86%	0.075mm	20.71mm	84%
	21.0 mm	0.8268	76%	0.075mm	21.08mm	75%
24 X 2	22.0mm	0.8661	77%	0.075mm	22.08mm	74%
	7/8	0.8750	68%	0.075mm	22.30mm	65%
27 X 3	24.0mm	0.9449	77%	0.075mm	24.08mm	75%

Formulas

1.	**RPM**	**= (318.47 • M/min) / DIA**
	where:	
	RPM	= revolutions per minute (rev/min)
	M/min	= speed (M/min)
	DIA	= diameter of drill (mm)
2.	**mm/min**	**= RPM • mm/rev**
	where:	
	mm/min	= mm per minute (mm/min)
	RPM	= revolutions per minute (rev/min)
	mm/rev	= feed rate (mm/rev)
3.	**M/min**	**= RPM • 0.003 • DIA**
	where:	
	M/min	= speed (M/min)
	RPM	= revolutions per minute (rev/min)
	DIA	= diameter of drill (mm)
4.	**Thrust**	**= 154 • (mm/rev) • DIA • K_m**
	where:	
	Thrust	= axial thrust (N)
	mm/rev	= feed rate (mm/rev)
	DIA	= diameter of drill (mm)
	K_m	= specific cutting energy (kPa)
5.	**Tool Power**	**= ((mm/rev) • RPM • K_m • DIA^2) / 218604.8**
	where:	
	Tool Power	= tool power (HP)
	mm/rev	= feed rate (mm/rev)
	RPM	= revolutions per minute (rev/min)
	K_m	= specific cutting energy (kPa)
	DIA	= diameter of drill (mm)

BSP and ISO 7-1

Tap Size	Tap Drill Size	Decimal Equivalent	* Theo % Thread	Probable Mean Oversize	Probable Hole Size	** Probable % Thread
1/4-19	7/16	0.4375	–	0.075mm	11.19 mm	–
3/8-19	37/64	0.5781	–	0.075mm	14.76 mm	–
1/2-14	23/32	0.7188	–	0.075mm	18.33 mm	–
3/4-14	15/16	0.9375	–	0.075mm	23.89 mm	–

* Based on nominal tap drill diameter
** Based on 0.075mm probable mean oversize

To calculate the percent of full thread for a given hole diameter:

% Thread = $\frac{76.93}{\text{Pitch (mm)}}$ • (Basic major diameter - Drill hole size)

Material Constants

Type of Material	Hardness	Km (kPa)
Plain Carbon and Alloy Steel	85 - 200 BHN	5.45
	200 - 275 BHN	6.48
	275 - 375 BHN	6.89
	375 - 425 BHN	7.93
High-Temperature Alloys	–	9.93
Titanium Alloy	–	4.96
Stainless Steels	135 - 275 BHN	6.48
	30 - 45 RC	7.45
Cast Iron	100 - 200 BHN	3.45
	200 - 300 BHN	7.45
Copper Alloy	20 - 80 RB	2.96
	80 - 100 RB	4.96
Aluminum Alloy	–	1.52
Magnesium Alloy	–	1.10

Notes

- The above tap drill information represents probable thread percentages for the standard tap drills stocked at Allied Machine. Special insert diameters may be required in order to meet a user specific percentage of thread requirement.
- The .075mm probable mean oversize hole condition is based on optimum cutting conditions. Probable percent of full thread may vary based on less ideal cutting conditions.
- The table and equations on this page are found in the *Machinery's Handbook*. Permission to simplify and print the equations is granted by the editor of the *Machinery's Handbook*.

Tap Drill Information and Formulas | Imperial (inch)

American - Unified Inch Screw Thread

Tap Size	Tap Drill Size	Decimal Equivalent	* Theo % Thread	Probable Mean Oversize	Probable Hole Size	** Probable % Thread
1/2 - 20	29/64	0.4531	72%	0.003	0.4561	68%
9/16 - 12	12.0mm	0.4724	72%	0.003	0.4754	69%
	31/64	0.4844	83%	0.003	0.4874	80%
9/16 - 18	1/2	0.5000	87%	0.003	0.5030	82%
	13.0mm	0.5118	70%	0.003	0.5148	66%
	31/64	0.5156	65%	0.003	0.5186	61%
5/8 - 11	17/32	0.5313	79%	0.003	0.5343	77%
5/8 - 12	35/64	0.5469	72%	0.003	0.5499	69%
5/8 - 18	9/16	0.5625	87%	0.003	0.5655	82%
	14.5mm	0.5709	75%	0.003	0.5739	71%
	37/64	0.5781	65%	0.003	0.5811	61%
11/16 - 12	39/64	0.6094	72%	0.003	0.6124	69%
3/4 - 10	41/64	0.6406	84%	0.003	0.6436	82%
	16.5mm	0.6496	77%	0.003	0.6526	75%
	21/32	0.6563	72%	0.003	0.6593	70%
3/4 - 12	43/64	0.6719	72%	0.003	0.6749	69%
3/4 - 16	11/16	0.6875	77%	0.003	0.6905	73%
	17.5mm	0.6890	75%	0.003	0.6920	71%
7/8 - 9	49/64	0.7656	76%	0.003	0.7686	74%
	25/32	0.7813	65%	0.003	0.7843	63%
7/8 - 14	51/64	0.7969	84%	0.003	0.7999	81%
	13/16	0.8125	67%	0.003	0.8155	64%
15/16 - 12	55/64	0.8594	72%	0.003	0.8624	69%
15/16 - 20	57/64	0.8906	72%	0.003	0.8936	68%
1 - 8	22.0mm	0.8661	82%	0.003	0.8691	81%
	7/8	0.8750	77%	0.003	0.8780	75%
	57/64	0.8906	67%	0.003	0.8936	65%
1 - 12	29/32	0.9063	87%	0.003	0.9093	84%
	59/64	0.9219	72%	0.003	0.9249	69%
1 - 14	15/16	0.9375	67%	0.003	0.9405	64%
1-1/8 - 12	1-1/32	1.0313	87%	0.003	1.0343	84%
	1-3/64	1.0469	72%	0.003	1.0499	69%
1-1/4 - 7	1-7/64	1.1094	76%	0.003	1.1124	74%

Formulas

1. **RPM = (3.82 • SFM) / DIA**

where:

RPM = revolutions per minute (rev/min)
SFM = speed (ft/min)
DIA = diameter of drill (inch)

2. **IPM = RPM • IPR**

where:

IPM = inches per minute (in/min)
RPM = revolutions per minute (rev/min)
IPR = feed rate (in/rev)

3. **SFM = RPM • 0.262 • DIA**

where:

SFM = speed (ft/min)
RPM = revolutions per minute (rev/min)
DIA = diameter of drill (inch)

4. **Thrust = 153,700 • IPR • DIA • Km**

where:

Thrust = axial thrust (lbs)
IPR = feed rate (in/rev)
DIA = diameter of drill (inch)
Km = specific cutting energy (lbs/in^2)

5. **Tool Power = .6991 • IPR • RPM • Km • DIA^2**

where:

Tool Power = tool power (HP)
IPR = feed rate (in/rev)
RPM = revolutions per minute (rev/min)
Km = specific cutting energy (lbs/in^2)
DIA = diameter of drill (inch)

Taper Pipe Thread (NPT)

Tap Size	Tap Drill Size	Decimal Equivalent	* Theo % Thread	Probable Mean Oversize	Probable Hole Size	** Probable % Thread
1/4 - 18	7/16	0.4375	–	0.003	0.4405	–
3/8 - 18	9/16	0.5625	–	0.003	0.5655	–
1/2 - 14	45/64	0.7031	–	0.003	0.7061	–
3/4 - 14	29/32	0.9063	–	0.003	0.9093	–

* Based on nominal tap drill diameter
** Based on .003" probable mean oversize

To calculate the percent of full thread for a given hole diameter:

$$\text{\% Thread} = \text{\# of threads per inch} \bullet \frac{\text{(Basic major diameter of thread - Drill hole size)}}{.0130}$$

Material Constants

Type of Material	Hardness	Km (lbs/in^2)
Plain Carbon and Alloy Steel	85 - 200 BHN	0.79
	200 - 275 BHN	0.94
	275 - 375 BHN	1.00
	375 - 425 BHN	1.15
High-Temperature Alloys	–	1.44
Titanium Alloy	–	0.72
Stainless Steels	135 - 275 BHN	0.94
	30 - 45 RC	1.08
Cast Iron	100 - 200 BHN	0.50
	200 - 300 BHN	1.08
Copper Alloy	20 - 80 RB	0.43
	80 - 100 RB	0.72
Aluminum Alloy	–	0.22
Magnesium Alloy	–	0.16

Notes

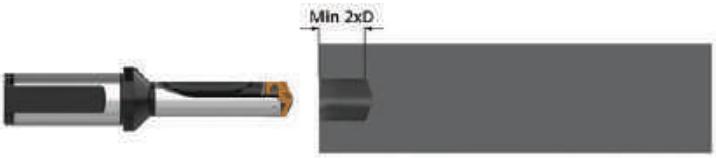
- The above tap drill information represents probable thread percentages for the standard tap drills stocked at Allied Machine. Special insert diameters may be required in order to meet a user specific percentage of thread requirement.
- The .003 probable mean oversize hole condition is based on optimum cutting conditions. Probable percent of full thread may vary based on less ideal cutting conditions.
- The table and equations on this page are found in the *Machinery's Handbook*. Permission to simplify and print the equations is granted by the editor of the *Machinery's Handbook*.

Deep Hole Drilling Guidelines

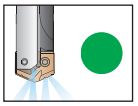
T-A Pro | 10xD, 12xD, and 15xD Holders

1. Pilot Hole
100 % RPM
100% mm/rev (IPR)

Establish the pilot hole using the same diameter short drill to a depth of 2xD minimum.
Utilize a pilot drill with the same or larger included point angle.



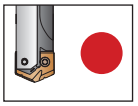
Coolant ON



2. Feed-in
50 RPM max
300 mm/min (12 IPM)

Feed the longer drill within 1.5mm (1/16") short of the established pilot hole bottom at a **maximum of 50 RPM** and 300 mm/min (12 IPM) feed rate.

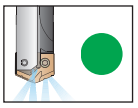
Coolant OFF



3. Deep Hole Transition Drilling
50 % RPM
75% mm/rev (IPR)

Drill additional 1xD past the bottom of the pilot hole at 50% reduction of recommended speed and 25% reduction of recommended feed.
Minimum of one second dwell is required to meet full speed before feeding.

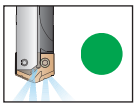
Coolant ON



4. Deep Hole Drilling - Blind
100% RPM
100% IPR (mm/rev)

Drill to full depth at recommended speed and feed for longer drill according to Allied speed and feed charts.
No peck cycle recommended.

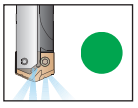
Coolant ON



5. Deep Hole Drilling - at Breakout
50% RPM
75% mm/rev (IPR)

For through holes only:
Reduce speed by 50% and feed by 25% prior to breakout.
Do not break out more than 3mm (1/8") past the full diameter of the drill.

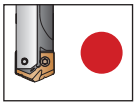
Coolant ON



6. Drill Retract
50 RPM max

Reduce speed to a **maximum of 50 RPM** before retracting from the hole.

Coolant OFF



⚠ WARNING **Tool failure can cause serious injury. To prevent:**
- When using holders without support bushing, use a short T-A Pro holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holders more than 50 RPM unless it is engaged with the workpiece or fixture.

Visit **www.alliedmachine.com/DeepHoleGuidelines** for the most up-to-date information and procedures.
Factory technical assistance is available for your specific applications through our Application Engineering department. *email*: **en**gineer*ing.eu*@a**lliedmachine.com**

Troubleshooting Guide

	Potential Problem																				
	Accelerated corner wear	Barber pole	Bell-mouth hole	Insert chipping	Blue chips	Built-Up Edge (BUE)	Chatter	Chip packing	Chipping of point	Damaged or broken tools	Excessive margin wear	High flank wear	Hole lead off	Hole out of position	Hole out of round	Oversize hole	Poor hole finish	Poor tool life	Power spikes - Load meter	Retract spiral	
Setup Condition	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	**Possible Solutions**
Worn or misaligned spindle (lathe, screw machine, chucker)	**1**		**3**				**7**		**9**	**10**	**11**		**13**			**16**	**17**			**20**	• Align spindle and turret or tailstock. • Repair spindle.
Use of low rigidity machine tools		**2**	**3**	**4**			**7**		**9**	**10**			**13**	**14**						**20**	• Reduce penetration rate to fall within the physical limits of the machine or setup (**NOTICE:** Do not reduce feed below threshold of good chip formation).
Poor work piece support		**2**		**4**			**7**			**10**	**11**				**15**		**17**			**20**	• Provide additional support for the work piece. • Reduce penetration rate to fall within the physical limits of the machine or setup (**NOTICE:** Do not reduce feed below threshold of good chip formation).
Flood coolant, low coolant pressure, or low coolant volume	**1**				**5**	**6**		**8**		**10**		**12**				**16**	**17**	**18**	**19**		• Run coolant through tool holder when drilling greater than 1xD. • Increase coolant pressure and volume through the tool holder. • Reduce penetration rate to fall within the coolant limitations (**NOTICE:** Do not reduce feed below threshold of good chip formation). • Add a peck cycle to help clear chips.
Interrupted cuts. Entry or exit surfaces that are not perpendicular to the spindle (draft angles, parting lines, curved or stepped surfaces, cross holes, and cast or forged surfaces)				**4**			**7**		**9**	**10**	**11**		**13**	**14**	**15**	**16**	**17**	**18**			• Pre-mill (spot face) entry or exit surface to remove interruption. • Decrease feed as much as 50% through entry or exit interruption. • Use short holders in low impact entry cuts.
Material harder than expected or running tools beyond recommended speed	**1**				**5**	**6**				**10**		**12**						**18**			• Reduce speed. • Increase coolant pressure and volume. • Improve coolant condition by use of quality products and regular maintenance.
Poor material micro-structure or foreign particles (forgings and castings that have not been normalized or annealed, poorly prepared steel, flame cut parts, and sand casting)				**4**		**6**				**10**		**12**	**13**					**18**			• Compare performance of other tools for similar wear problems, which may indicate poor micro-structure. Anneal or normalize parts to improve micro-structure for machining. • Reduce feeds (**NOTICE:** Do not reduce feed below threshold of good chip formation).
Poor chip control								**8**		**10**	**11**		**13**			**16**	**17**	**18**	**19**		• Increase feed to recommended levels. Contact Allied's Application Engineering group for technical recommendations. • Increase coolant pressure and volume. • Improve coolant condition by use of quality products and regular maintenance.
Spot drilled holes with included angle less than that matching T-A Pro or cored holes	**1**			**4**			**7**						**13**					**18**			• Spot hole with short tool of same or greater included angle as T-A Pro drill insert. • Reduce feed (**NOTICE:** Do not reduce feed below threshold of good chip formation). If possible, drill from solid.